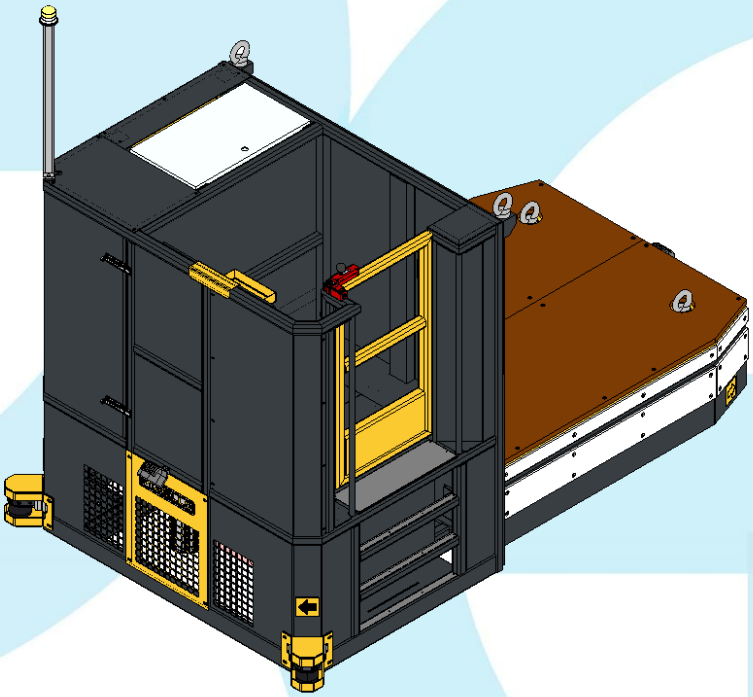
TRANSLATION OF
“ISTRUZIONI ORIGINALI”

MORELLO
SHAPING INTRALOGISTICS

SELF-PROPELLED ELECTRONIC TROLLEY WITH TYRES



MANUAL USER AND MAINTENANCE

Model:	**SGAE-E ±90° P 38/3 - TRANSPALLET**	Revision:	**00**
Serial number:	**2750 / 1 and 2750 / 2**	Working load limit (WLL):	**38 t**
Version:	**GROUND OPERATOR**	Construction year:	**2026**

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REVISION

REVISION				
MODEL	**LANGUAGE**	**DATE**	**VERSION**	**NOTES**
SGAE-E ±90° P 38/3 TRANSPALLET	English	05/2026	00	First issue

The information contained in this handbook is the property of **Morello S.r.l.**

Drawings and other documents that accompany the machine are property of **Morello S.r.l.**

It is forbidden to distribute and/or duplicate, under any form or by any means, this handbook, even partially, without written authorization from **Morello S.r.l.**

The company **Morello S.r.l.** reserves the right to change, without prior warning, the characteristics of the product described in this manual.

In case of doubts or difficulties in understanding or interpretation of the manual, the original/official version referred to as “ISTRUZIONI ORIGINALI” on the cover, must be considered as the valid version.

Some of the images included in this manual should be considered as examples only, as some details may have changed over time.

ADDITIONAL INFORMATION

The **self-propelled electronic trolley with tyres**, described, hereinafter will be called “**machine**”.

HANDBOOK STRUCTURE

The manual is divided into 9 chapters.

CHAPTER 1 – GENERAL INFORMATION

This chapter contains general information about the machine and the Manufacturer's data.

CHAPTER 2 – SAFETY

This chapter contains a description regarding the standards, the type of certification applied, working environment conditions, accident prevention devices used, residual risks, warning plates applied to the machine.

CHAPTER 3 – GENERAL DESCRIPTION

This chapter contains the description of the machine functioning principles and of the controls available for the operator, the general technical data and the description of the groups that constitute the same.

CHAPTER 4 – TRANSPORT AND STORAGE

This chapter contains instructions on how to use the proper packing, handling, transport and unloading at the user's plant.

CHAPTER 5 – INSTALLATION

This chapter contains the instructions to carry out any assembly, checking, inspection and adjustment operations to be performed before start-up.

CHAPTER 6 – USE

his chapter contains the instructions for machine start-up, use, with description of the more important operating sequences and use of the diagnostics system.

CHAPTER 7 – MAINTENANCE

This chapter contains the machine maintenance schedule. It contains the warnings, precautions and instructions to correctly carry out the maintenance operations on the machine.

CHAPTER 8 – DISMANTLING

This chapter contains information and warnings to properly decommission and dismantle the machine at end-of life.

CHAPTER 9 – ATTACHMENTS

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GENERAL INFORMATION

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1. GENERAL INFORMATION

1.1 INTRODUCTION

ADDITIONAL INFORMATION



MORELLO S.r.l. the machine manufacturing company, is indicated in the handbook with the name: **Manufacturer**.

ADDITIONAL INFORMATION



The Company purchasing the machine is indicated in the handbook with the name: **Customer**.

The manufacturer recommends a training course for personnel responsible for operating and maintaining the machine to increase familiarity and know-how of the various procedures.

This manual contains the features, performances, instructions for use and the references to the preventive and remedial operations of the machine.

The manufacturer compels the personnel in charge of operating and maintaining the machine, as well as the personnel in charge of transport and possible assembly operations, to read this document.

This document is the Use and Maintenance handbook for the:

ELECTRONIC SELF-PROPELLED INDUSTRIAL TROLLEY WITH TYRES MODEL SGAE-E ±90° P 38/3 TRANSPALLET SERIAL NUMBERS 2750/1 E 2570/2

and has been drawn up in compliance with machines directive 2006/42/CE.

The Use and Maintenance Manual is to be considered an integral part of the machine and must be kept until final disposal or transfer of ownership, at which time the manual must be handed over to the new owner. It must be kept by the person in charge who is entrusted with the machine.

1.2 SERVICE DEPARTMENT

For technical assistance, contact the manufacturer:

Morello S.r.l.

Head Office and Factory:

Lungo Dora Colletta 85/A

10153 – Torino (Italy)

TEL. 011.248.05.69

TEL. / FAX. 011.85.00.85

E-mail: info@morellogiovanni.it

Website: www.morello.eu.com

1.3 GLOSSARY

Emergency stop – to stop in an emergency; the purpose of this function is:

- to avoid or reduce hazards that exist for persons, damage to the machinery or to the work in progress and
- to be initiated by a single human action.

Machinery Directive: the DIRECTIVE 2006/42/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL on the approximation of the laws of the Member States relating to machinery.

Command device: device inserted in a command circuit for use of the machine.

Supplier: entity (Manufacturer, installer, system integrator) that provides equipment or services associated with the machine (the user can also act as a manufacturer for himself).

Safety function: machine function, the failure of which could cause an immediate increase of risks.

Failure: terms of the capacity of an element to perform a required function.

Machine:

- an assembly equipped or to be equipped with a drive system different from direct human or animal force, composed of parts or components, at least one of which is mobile, integrally connected together for a well determined application;
- an assembly as per the first section, lacks only the elements of connection to the site of use or connection to the sources of energy and movement;
- an assembly as per the first and second sections, ready for installation and that can only function after assembly on a means of transport or installed in a building or in a construction;
- a group of machines, as per the first, the second and the third section, or partly completed machines, that to attain the same result are arranged and controlled in a manner to have an integral functioning;
- a group of parts or components, one of which is mobile, integrally connected together for the lifting of weights, and having direct human forces as the only source of energy;

Malfunctioning: inability of a machine to perform the foreseen function.

Marking: symbol and wording for the identification of the machine, which is affixed by the Manufacturer.

Safety measure: means that eliminate or reduce a hazard.

Operator: person in charge of running the machine.

Hazard: Potential source of harm.

Qualified technician or skilled maintenance technician: the persons who have attended specialisation courses, vocational training, etc. and have experience regarding installation, putting into service and maintenance operations, repairs, transport, and handling of the machine.

PLC: Programmable Logic Controller can manage and control all movements of the machine. It's equipped with electronic cards designed to control the various devices and to receive the associated control signals.

Protection: measure using means to prevent hazards that cannot be reasonably eliminated or risks that cannot be sufficiently reduced by design-integrated protective measures.

Safety protection: Shelter or protective device used as a safety measure for the protection of persons from a present or latent danger.

Guard: physical barrier, designed as part of the machine, to provide protection.

Fixed guard: fixed protection (for example: by screws, nuts, welding) so that it can only be opened or removed using tools or by removal of the means of anchorage.

Risk: combination of the probability of occurrence of harm and the severity of that damage.

Residual risk: risk that remains after the protective measures have been applied.

Transport: a set of operations designed to transfer equipment from the manufacturer to the final work position at the Customer's.

Foreseen use: use of the machine in conformity with the information provided in the instructions for use.

User: entity using the machine and the associated electrical equipment.

Danger zone: all spaces, area within or near the machine in which the presence of an exposed person constitutes a risk to his health and / or safety.

1.4 SYMBOLS

The manual uses a number of symbols that are meant to draw the reader's attention and highlight some aspects that are particularly important.

An explanation of each indication is given below.

DANGER



Indicates a situation where there is an immediate danger which, if not avoided, will result in serious injury or death to the operator.

Identifies absolutely forbidden operations and procedures that must be adopted in order to avoid serious injury or death to the operator.

WARNING



Indicates a situation where a potential hazard is present which, if not avoided, could result in serious injury or death to the operator.

Describes operations that require special attention in order to avoid serious injury or death to the operator.

CAUTION



Indicates a situation where a non-immediate or potential hazard is present which, if not avoided, could result in medium or low-level injury or health damage to the operator.

Describes operations that require special attention in order to avoid injury to the operator.

NOTE



Indicates important information and/or describes those procedures, the non-observance or partial observance of which may result in damage to the machine or equipment connected to it.

ADDITIONAL INFORMATION



It provides useful information and/or indicates references to other supplementary documentation, such as accompanying instruction manuals, technical documents or other sections of this manual.

1.5 MANUFACTURER'S ADDRESS

For any kind of information or clarifications regarding the use, maintenance, etc., the Technical Office of the Manufacturer is always available to the customer requirements.

It is appropriate that the latter puts the questions in clear, with references to this manual, always indicating the data shown on the identification plate of the machine in question.

Any request for assistance, service at the Customer, or clarification regarding the technical aspects of this document should be addressed to:

MORELLO S.r.l.

Lungo Dora Colletta 85/A 10153 – TORINO (TO) – ITALIA

TEL. 011.248.05.69 – TEL./FAX 011.85.00.85

E-mail: info@morellogiovanni.it

Website: www.morello.eu.com

1.6 SAFETY STANDARDS

Prescriptions, instructions, regulations and related safety notes described in the various chapters of the manual are intended to define a set of behaviours and rules to be observed when performing the various activities that constitute the mode of intended use of the machine in order to operate in conditions of safety for personnel, for the equipment and the surrounding environment.

The safety instructions are addressed to all authorized personnel, trained and authorized to perform the various activities and operations:

- Transport.
- Installation.
- Use.
- Management.
- Maintenance.
- Cleaning.
- Decommissioning and dismantling.

1.7 RESPONSIBILITY OF THE MANUFACTURER

The manufacturer declines any liability arising from the incorrect use or misuse of the machine in question and from damage caused by the use of non-original and non-prescribed spare parts, by maintenance not carried out properly and by tampering with circuits, components, and system software.

The responsibility for the application of the safety requirements, as set out below, lies with the technical personnel of the Customer responsible for the planned activities on the machine.

They must ensure that the operators authorised to carry out the required activities are qualified, comply with and are aware of the requirements contained in this document and the general safety regulations applied to the machine itself.

Failure to follow the safety instructions can cause injury to persons and damage to equipment.

1.8 MANAGEMENT OF THE MACHINE

The machine control is allowed only to authorized and properly trained persons, or at least with adequate technical expertise.

Operators responsible for running and maintenance operations should be aware that the knowledge and application of safety standards is an integral part of their work.

Operators not authorised to work on the machine are not to have access to the pushbuttons.

Before starting the machine, do the following:

- Read this manual carefully.
- Know what protections and emergency stop devices are present on the machine, where they are located and how they work.

Do not remove, even partially, the protections, safety devices and/or warning signs applied to the machine. In the event of malfunction or failure of such devices, they should be immediately repaired or replaced.

1.9 WARRANTY

The manufacturer guarantees that its machines are free of manufacturing flaws for the period specified in the relevant terms of the contract.

The buyer is only entitled to the replacement of parts acknowledged to be defective, excluding parts subject to wear and tear (such as gaskets, seals and electrical and electronic components). The costs of packaging and transport, as well as any installation, shall be borne by him. In such cases, the Buyer shall specify in writing:

- Date and number of the purchase document.
- Machine model.
- Serial number.
- Defective part, if known.

Will not be recognized claims for damages for loss of production caused by any periods of inactivity of the machine.

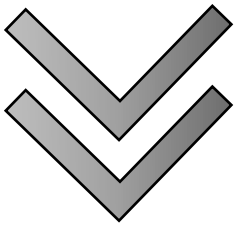
Damages are excluded caused by improper use to the contents of this “Use Manual and Maintenance” which is an integral part of the machine, including the maintenance, if not conforming to the instructions provided.

The warranty will not be recognized for the machines on which were performed unauthorized modifications. Modifications or tampering of safety devices are in every way strictly prohibited.

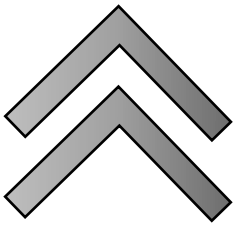
If damages occur during warranty period, the warranty is valid only using original spare parts.

Repair work may only be performed by skilled operators, who are familiar with the machine.

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SAFETY



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2. SAFETY

2.1 GENERAL INFORMATION

The Customer must provide instructions for the operators about the risks of injury, safety devices installed on the machine and the general rules regarding accident prevention as specified by the Community directives and the law of the country where the machine is used.

The operators must know the location and operation of all the controls of the machine and its characteristics.

Tampering, or unauthorized replacement of one or more components of the machine, the adoption of accessories and the use of particular parts different from the originals may cause injury risks.

WARNING



It is absolutely forbidden to exclude/tamper with the safety devices on the machine. The Manufacturer declines all responsibility for the safety of the machine in case of failure to comply with this prohibition.

CAUTION



It is the responsibility of the operator who uses the machine to check that during movement there are no objects or persons in the area.

2.1.1 Certification of the machine

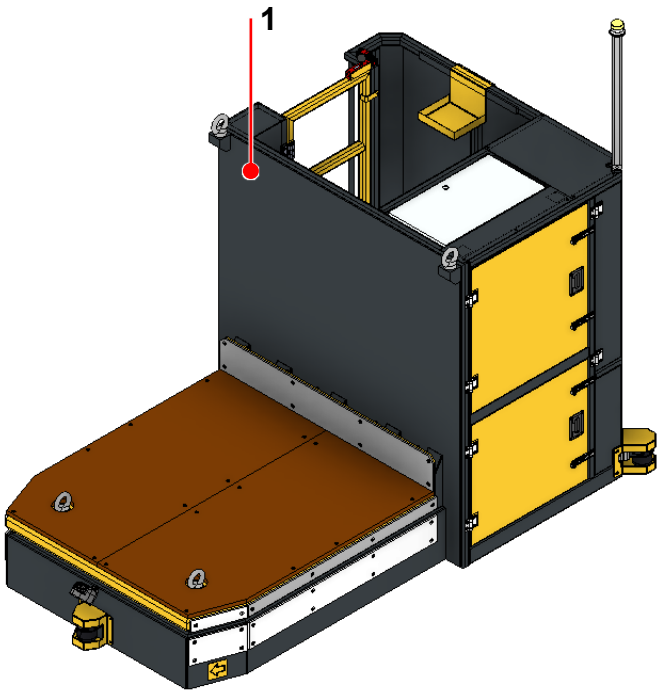
The Machine is provided with the EC declaration of conformity to the essential safety requirements in accordance with Directive 2006/42/EC (annex II A) and EMC Directive 2014/30/UE.

ADDITIONAL INFORMATION

Any changes made to the machine immediately invalidate the EC certification issued by the manufacturer.

ADDITIONAL INFORMATION

The picture shown below is for the sole purpose of indicating the position of the EC **(1)** with the main machine identification data.



1

MORELLO
Lungo Dora Colletta, 85 / A
10153 TORINO - ITALY

CE

MODEL		SGAE-E ±90° P 38/3
DEAD LOAD	Kg	3.800
PAYLOAD	Kg	38.000
SERIAL NUMBER		2750_1
YEAR OF CONSTRUCTION		2026

1

MORELLO
Lungo Dora Colletta, 85 / A
10153 TORINO - ITALY

CE

MODEL		SGAE-E ±90° P 38/3
DEAD LOAD	Kg	3.800
PAYLOAD	Kg	38.000
SERIAL NUMBER		2750_2
YEAR OF CONSTRUCTION		2026

2.1.2 Foreseen and unforeseen uses

The machine has been designed and manufactured to lift and handle heavy loads, in accordance with the technical specifications set out in this manual. The load must be placed on a suitable pallet (not supplied). It can be used both indoors on a concrete floor (flat, smooth and level).

The machine is not to be used on roads (road traffic).

Use is not possible of the machine for purposes other than those planned.

DANGER



The use of the machine for processing purposes not described in this manual is **IMPROPER USE**. In that case the Manufacturer declines all responsibility for any damage caused to property and/or persons and considers annulled every kind of guarantee of the machinery. The manufacturer declines all responsibility in the event of tampering with the machine, unauthorised modifications or maintenance operations carried out by unskilled operators.

CAUTION



The use of the machine is allowed only to the experienced and qualified operator, who has taken full vision and awareness of this document.

CAUTION



Never transport persons on the machine.

CAUTION



Only one operator is required to manage the machine, who is to position as indicated in the paragraph “Operator workstation” and to follow the instructions as described in the chapter “Use”.

NOTE



In the event of abnormal behaviour of the machine, or lack of power, it is forbidden to carry out any movement because specific competence of maintenance personnel.

2.2 OPERATING ENVIRONMENTAL CONDITIONS

The machine is to be placed in an environment equipped with all safety requirements specified by the laws in the user country, and with adequate ventilation.

Operating environment conditions:

- Environment temperature ranging between 0°C and + 30°C.
- Humidity: <80% (with no condensation).

2.2.1 Installation of fire protection

The machine is not equipped with its own sprinkler system.

2.2.2 Explosive atmosphere

The machine has not been designed and built to operate in zones with explosive atmosphere or partially explosive atmosphere.

2.2.3 Lighting

The machine does not have its own lighting system.

NOTE

It is the task of the Customer to provide correct lighting in the working area.

2.2.4 Vibrations

The machine does not produce hazardous vibration to the health of the operators who work there.

NOTE

The operator's workstation is, however, fitted with a non-slip, vibration-damping mat.

NOTE

Excessive vibration can only be caused by a mechanical failure, that is to be immediately reported and eliminated.

2.2.5 Noise

Noise measurement has been carried out in conformity with the specifications of acoustic standards. The typical sound data are filed by the manufacturer.

The machine operating features are such that, with no load, the overall noise generated is less than 75 dB (A), measured in the workstation of the relevant operators.

NOTE



The sound pressure level in the actual working conditions depends on the characteristics and the capacity of the load.

NOTE



The measurement of exposure to noise levels of workers should be carried out by the user, in compliance with the legislation in force in your country.

2.2.6 Electromagnetic emissions

The machine contains electronic components subject to the directive on Electromagnetic Compatibility, affected by radiated and conducted emissions.

Emission values are in accordance with regulations thanks to the use of EMC compatible components, suitable connections and installation of filters where necessary.

NOTE



Any maintenance on electrical equipment made in a non-compliant manner, or wrong replacement of components, can impair the effectiveness of the equipment.

2.3 DISPOSAL OF EXHAUSTED MATERIALS

The machine produces exhausted materials (reducers oil, hydraulic power unit oil and filters).

In every country there are specific regulations for disposal to safeguard the environment.

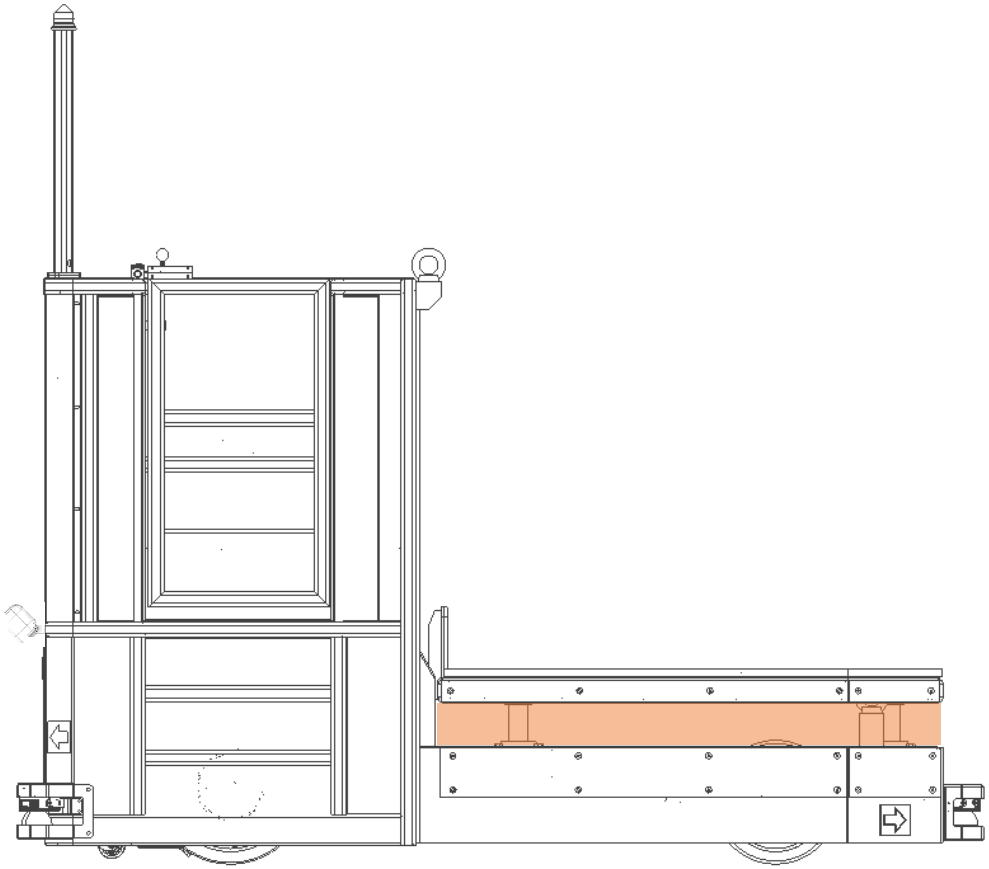
The customer must be aware of these standards and work in such a manner to respect them.

In particular, see chapter 8 for disposal of the materials that the machine is composed of.

2.4 DANGEROUS ZONES

The machine's hazardous areas are demarcated by fixed or movable guards and protected by laser scanners (with the exception of the loading platform handling area). Access to these areas, subject only to maintenance operations, must be carried out as indicated in this manual.

The following image shows the danger zone of the machine.

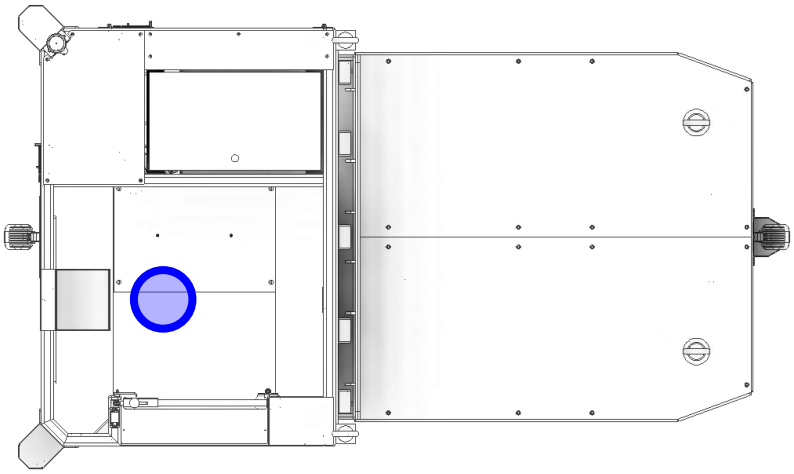


Dangerous zone

2.5 OPERATOR WORKSTATION

The machine is designed to be operated by a single operator, who must stand at the designated operating position on the machine.

Operator workstation



2.6 SAFETY DEVICES

The machine is equipped with the following safety devices:

DEVICE TYPE	FUNCTION
Power-on key selector switch	To prevent machine movement.
Emergency button/s	Emergency stop of the machine.
Retained action movement system	Stops machine movements if the control is released.
Fixed and movable guards	Demarcation of hazardous areas of the machine.
Visual and acoustic signalling systems	It indicates when the machine is in motion.
Laser scanner	Slowing down and stopping the machine in the event of an interception of the intervention areas.
Parapets	Prevent the operator from falling from the driver's seat.
Safety switch	Prevent the machine from moving whilst the gate is open.
Pilot-operated shut-off valves	Prevent the loading platform from descending in the event of a fault or emergency.
Safety circuits	Cuts-out the electric power supply in the case of overload or short circuit.

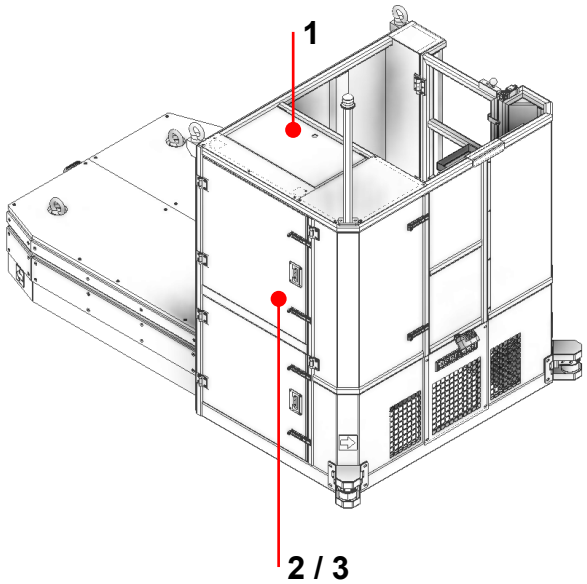
2.6.1 Power-on key selector switch

Function:	To prevent machine movement.
Characteristics and methods:	The machine electric power is disconnected by turning the “power-on key selector”, on the electric panel to position (0), and removing the key. Subsequently disconnect the machine plug from the battery socket to cut out the power supply.

WARNING

For maintenance, disconnect the battery, removing the machine power supply plug from the battery socket.

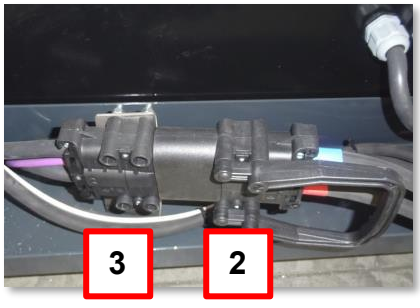
1. Power-on key selector switch
2. Machine power plug
3. Battery socket



1



2 / 3



Example images for only illustrative purposes

2.6.2 Emergency button/s

Function: Immediate machine stoppage.

Characteristics and methods: Press this button in a hazardous situation to safeguard the operators and/or the machine.

Pressing this button **(1)** causes the power supply to the motors, and the hydraulic power unit, to be cut off, thus stopping the machine's movements. The locking valves hold the loading platform in its current position.

If pressed, the emergency button remains in low position. To reset, turn it clockwise.

The emergency button is located on the control panel.

CAUTION

The emergency button requires regular checks to ensure its correct operation.

NOTE

In case of maintenance is not enough to intervene on emergency buttons for cutting energy of the machine.



Wired control panel / Radio-control

2.6.3 Retained action movement system

Function:	Machine movement, with presence of operator.
Characteristics and methods:	To carry out all movements, there are momentary-action controls **(1)** on the wired control panel and on the remote control. If the control is released, the movement currently in progress is stopped.

CAUTION

For correct use of the radio-control / wired control panel the operator is to remain in position as indicated in paragraph “Operator workstation”.



Wired control panel / Radio-control

2.6.4 Fixed and movable guards

Function: Demarcation of hazardous areas of the machine.

Characteristics and methods:

Fixed guards

The fixed guards (casings) are firmly secured to the structure by screws that require a specific tool for removal. They are not monitored, and their removal is permitted only as part of maintenance work, with the machine's power supply switched off.

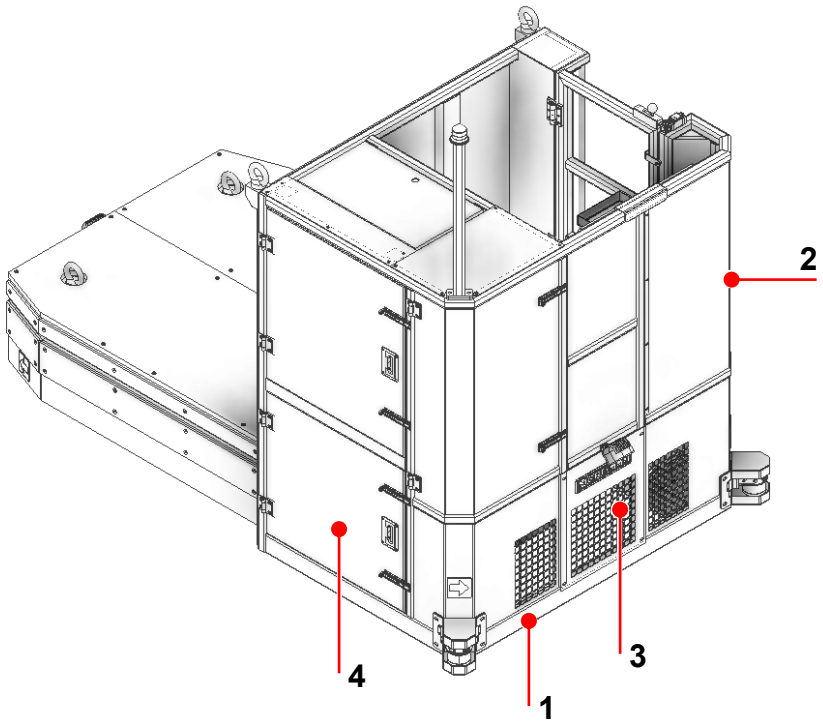
Movables guards

There are three uncontrolled movable guards at the front of the machine (battery compartment, hydraulic control unit compartment and electrical control panel compartment). These may only be opened for maintenance purposes, with the machine's power supply switched off.

WARNING

The manufacturer accepts no liability should the machine be operated without safety guards or with the movable guards open.

1. Machine frame
2. Protective cover made from smooth sheet steel (example)
3. Protective grating cover (example)
4. Mobile guard made of smooth sheet steel (example)

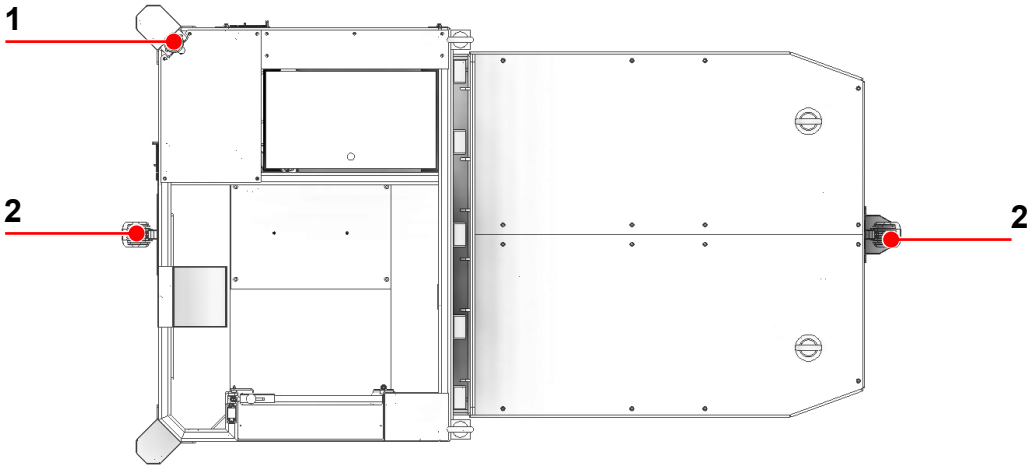


2.6.5 Visual and acoustic signalling systems

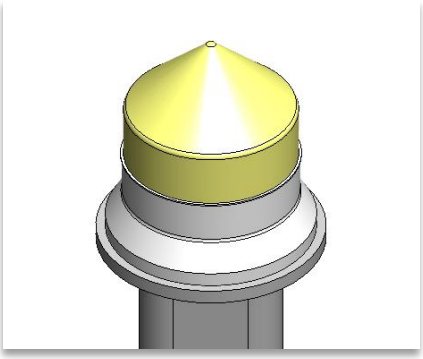
Function: Visual and acoustic signalling of moving machine.

Characteristics and methods: The machine is fitted with a buzzer and an indicator light **(1).** These devices are activated when the machine is in motion.

There are also two BLUESPOT spotlights **(2)** which project a blue beam of light onto the ground in the direction of travel.



1



2



2.6.6 Laser scanner

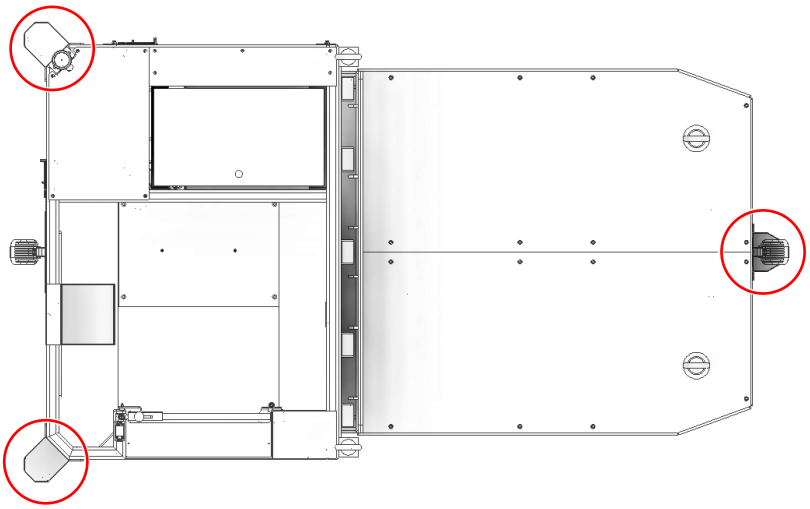
Function: Slowing down and stopping the machine in the event of an interception of the intervention areas.

Characteristics and methods: Three laser scanners **(1)** are fitted to the machine, each fitted with impact protection.

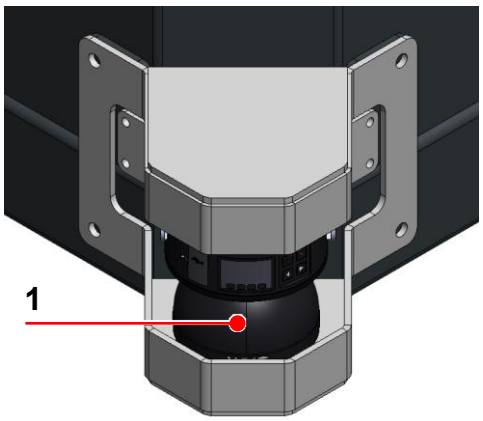
Each of these devices is programmed with two intervention areas:

- Slowdown area (GREEN): the machine slows down.
- Stop area (RED): the machine stops immediately.

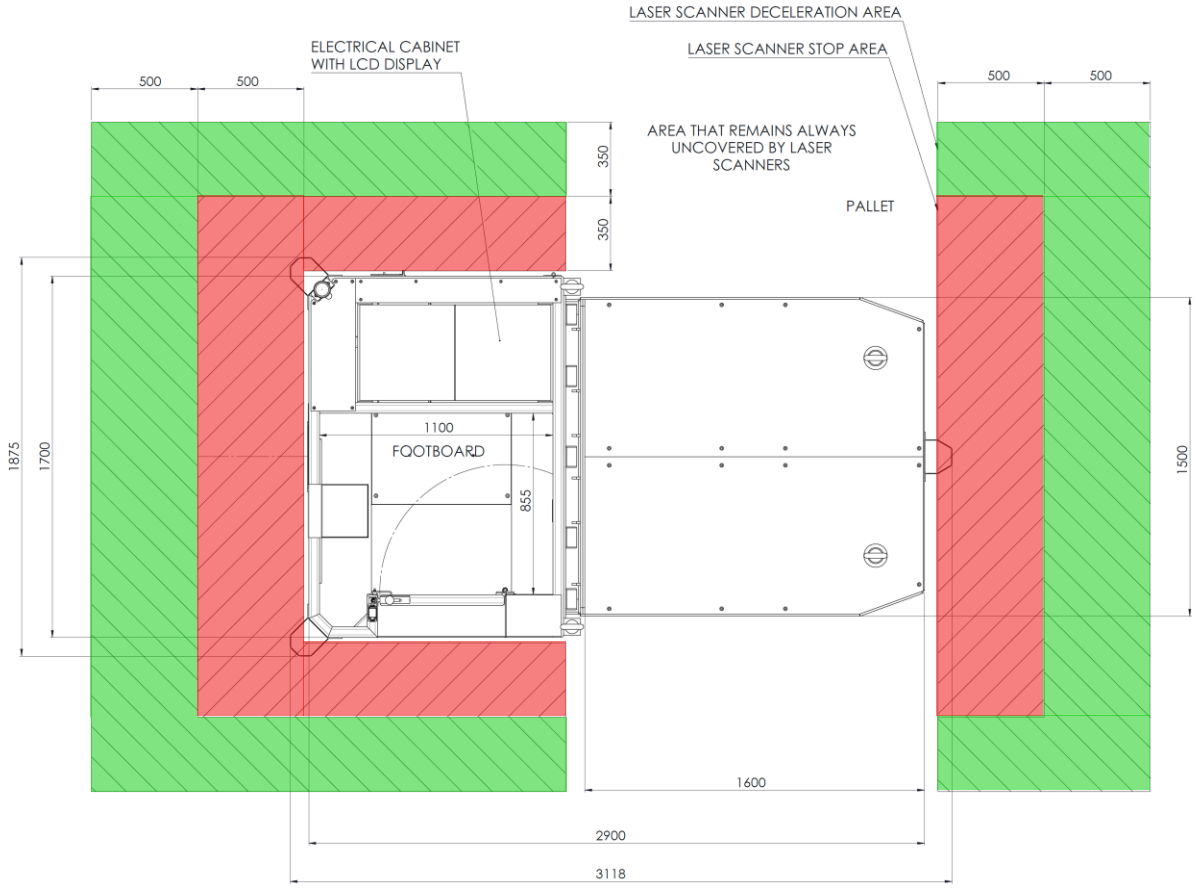
Only the areas in the direction of travel are active.



Position of the laser scanners



The following image shows the scanning areas of the laser scanners (dimensions in mm).



CAUTION

The beam interceptor must not be used to lock the machine for maintenance. Any tampering with the devices poses a possible risk.

CAUTION

Setting the selector switch to SAFETY OFF (and keeping it in that position) disables the laser scanners. In this state (with the safety function disabled), it is the operator's responsibility to ensure that the area is clear of objects and people during operation.

CAUTION

It is possible to disable the laser scanners until the machine is switched off, using the RFID reader located on the control panel, which is fitted with a numeric keypad for entering the PIN.

In this state (with the safety function disabled), it is the operator's responsibility to ensure that the area is clear of objects and people during operation.

NOTE

The protection of personnel operating and maintaining the machine is not guaranteed if laser scanners are not used in accordance with the relevant manual.

NOTE

Direct sunlight on the laser scanner lens causes a false positive (i.e. the presence of an obstacle) to be detected.

ADDITIONAL INFORMATION

For more information, please refer to the attached laser scanners manual.

2.6.7 Parapets

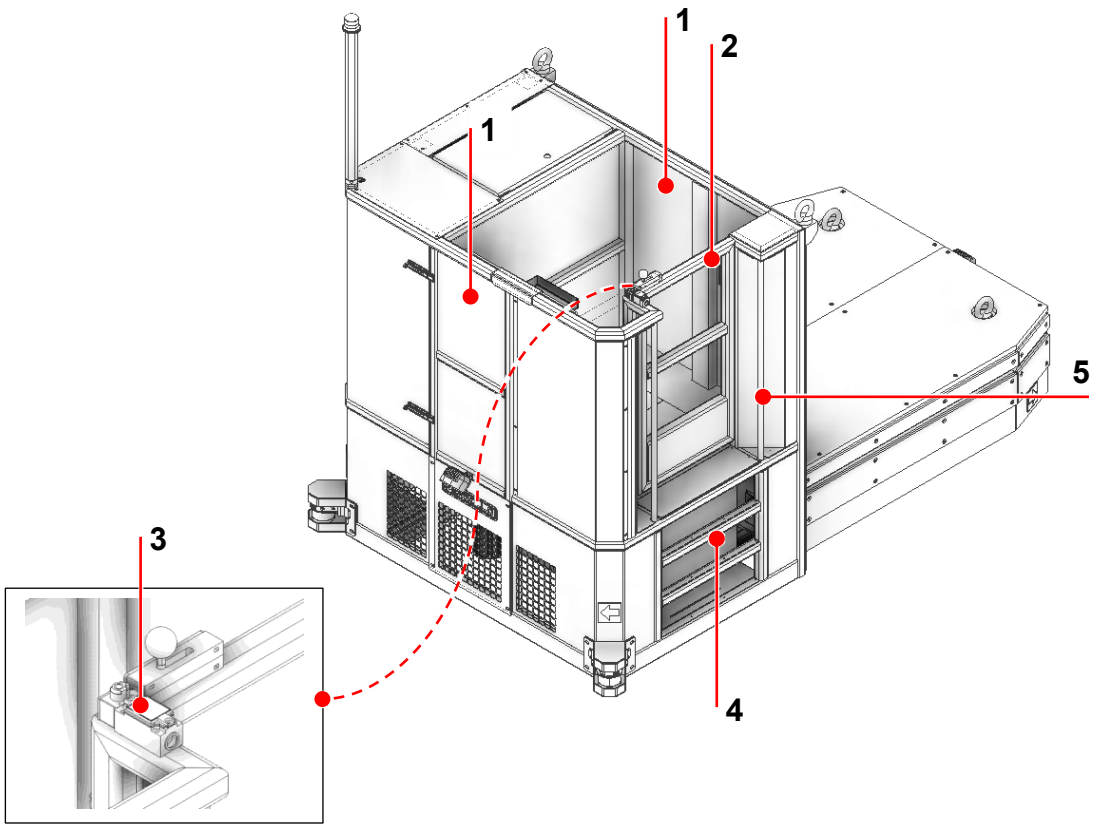
Function: Prevent the operator from falling from the driver's seat.

Characteristics and methods: The perimeter of the operator's station is enclosed by guardrails **(1)** 1,100 mm high.

Access to the driver's station is via a gate **(2),** fitted with a footrest and a crossbar, operated by a switch **(3).**

This safety system helps to prevent accidental falls.

There is a ladder **(4)** and handrails **(5)** on either side of the gate.



2.6.8 Safety switch

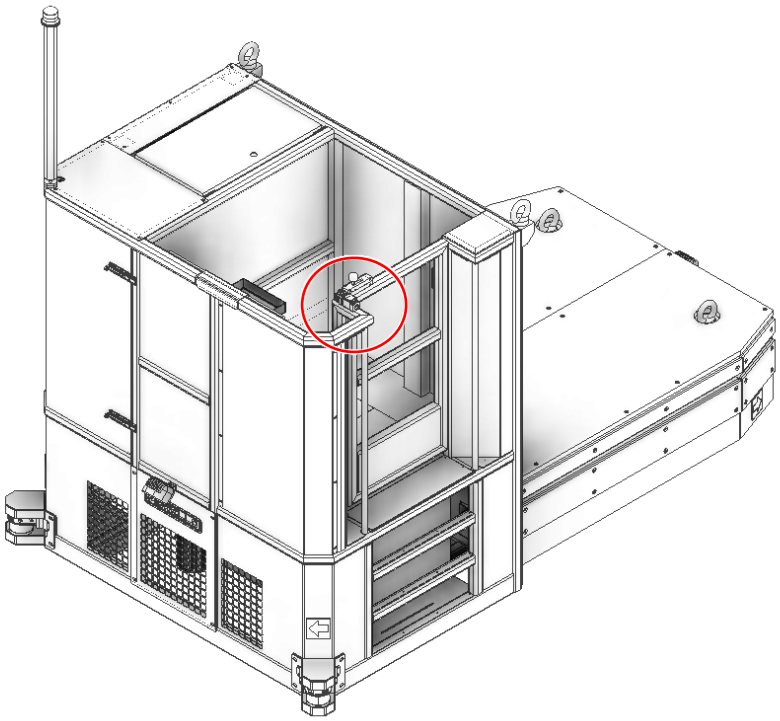
Function: Prevent the machine from moving whilst the gate is open.

Characteristics and methods: The access gate to the operator's station is controlled by a safety switch.

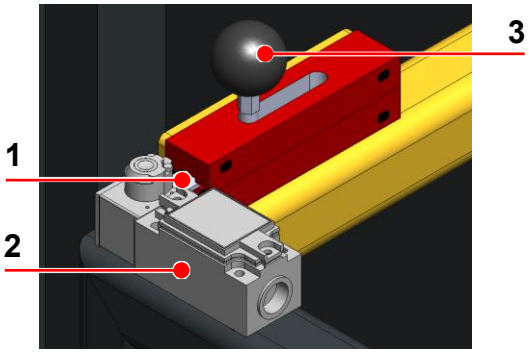
After closing the gate, you must manually engage the actuator **(1)** in the switch **(2)** by operating the knobbed lever **(3)** to enable the machine to move.

CAUTION

The switch requires regular checks to ensure it is working properly.



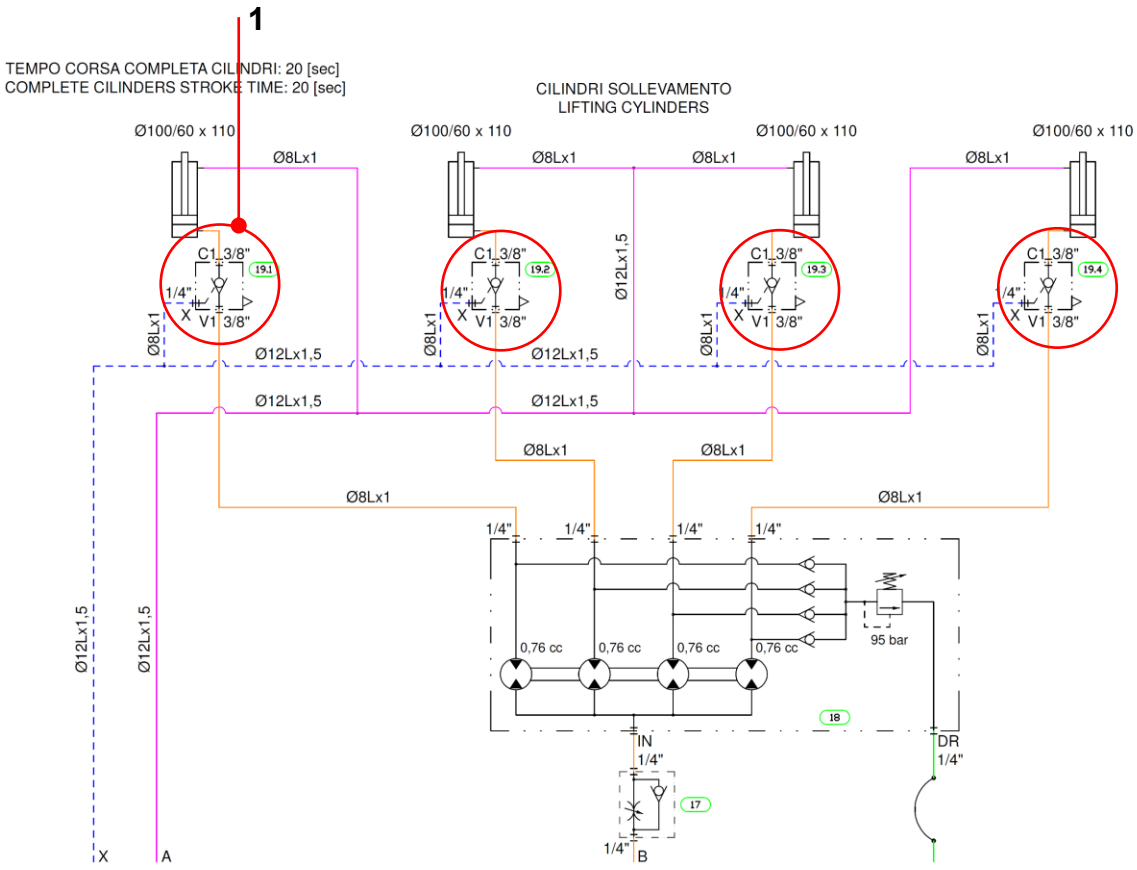
Switch position



2.6.9 Pilot-operated shut-off valves

Function: Prevent the loading platform from descending in the event of a fault or emergency.

Characteristics and methods: On the discharge line of the lower chamber of each lifting cylinder, there is a shut-off valve **(1)** designed to prevent the platform from descending in the event of an emergency.



Extract from the hydraulic diagram

2.6.10 Safety circuits

Function:	To control electric circuits and interrupt electric supply before hazardous overloads/short circuits are generated.
Characteristics and methods:	If an overload or short circuit occurs, the fuses installed inside the electric panel cut out the power supply to the circuits and immediately stop the machine.

ADDITIONAL INFORMATION

For information on the location of the fuses refer to the electrical diagram with its bill.

2.7 PERSONAL PROTECTIVE EQUIPMENT

The machine operator is to use the personal protection devices to reduce the possibility of risks to a minimum.

CAUTION



The clothing of those who work or perform maintenance on the system must comply with the essential safety requirements set by EU Directives and laws in the country where the machine is used.

NOTE



During the operations of management and maintenance, personnel should wear appropriate work clothing so as to prevent the occurrence of accidents.

To avoid mechanical risks, such as dragging, entrapment, etc, keep hair gathered up and do not wear bracelets, wrist-watches, rings or chains.

2.8 RESIDUAL RISKS

2.8.1 General information

In the design phase have been assessed all zones or high-risk parts and were taken as a result all necessary precautions to avoid risks to persons and damage to machine components.

WARNING



Periodically check the operation of all safety devices.

Do not dismantle the guards on the machine.

Do not insert foreign objects in the machine movement area.

2.8.2 Residual risks

After carefully examining all possible machine risks, all the necessary solutions have been applied to eliminate the risks and limit hazards for exposed persons.

Despite the necessary precautions taken, some risks remain on the machine that cannot be eliminated. For these, appropriate monitoring plates have been provided in the area concerned.

- **Risk of crushing of the lower/upper limbs**

  This hazard is present beneath the loading platform during the lowering phase. It is the operator's responsibility to ensure that no one is present whilst the platform is being lowered.

2.8.3 Plates on the machine

The manufacturer has affixed to the machine a set of monitoring plates defined in accordance with the European regulations on the graphic symbols to be used. These plates are located in a highly visible position.

The maintenance service is required to immediately replace all the plates which, due to wear, they should become illegible.

CAUTION



It is absolutely forbidden to remove the warning notices on the machine.

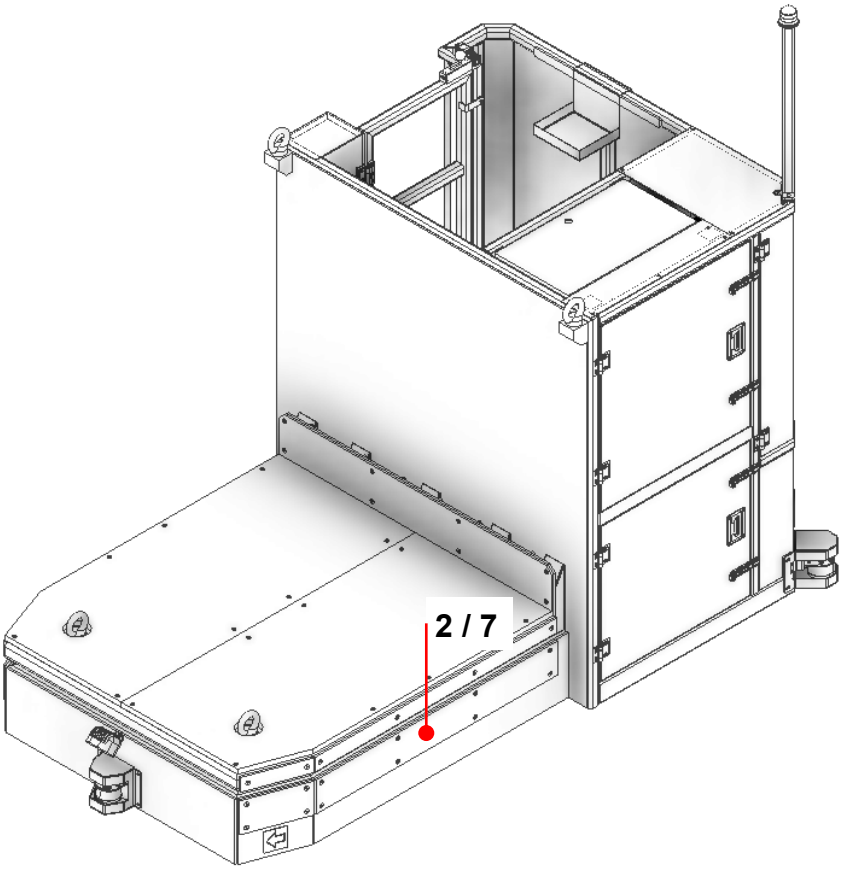
The manufacturer declines all responsibility for the safety of the machine in case of failure to comply with this prohibition.

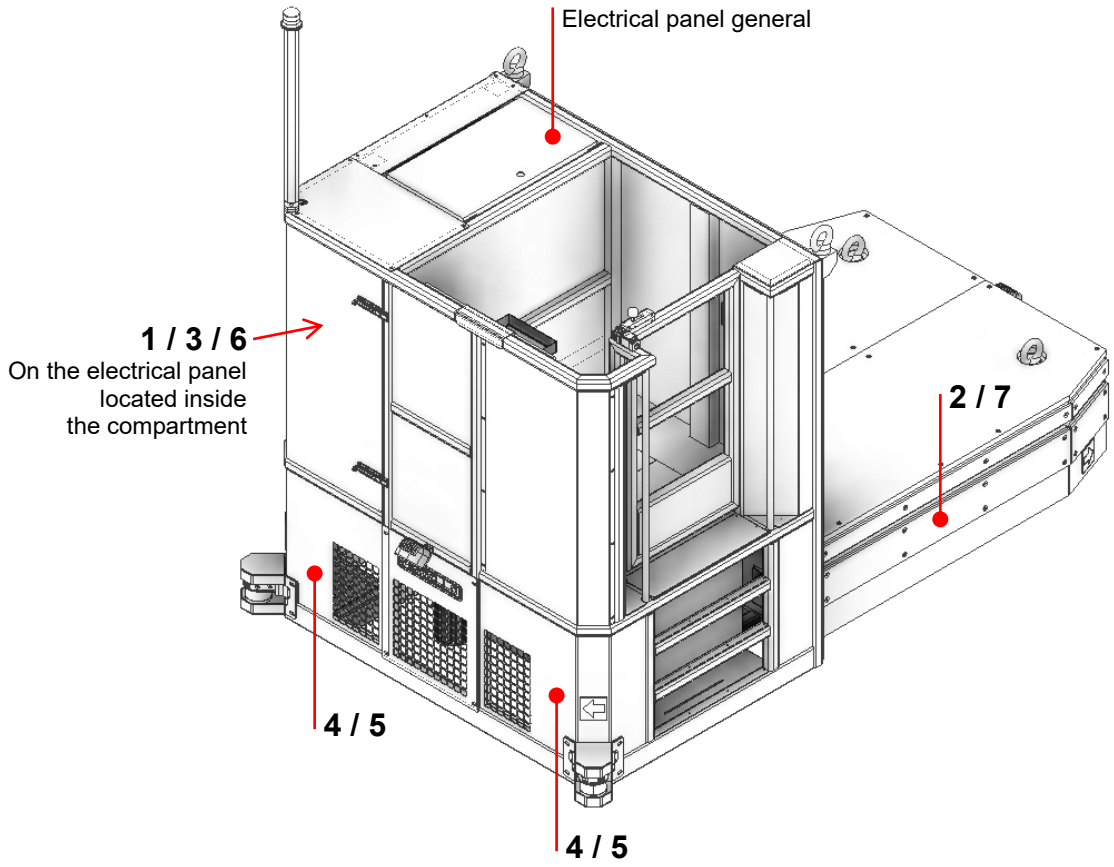
ADDITIONAL INFORMATION



For information on the warning plates installed on the incorporated parts of the machine, consult the specific manuals.

PLATES ON THE MACHINE		
Plate 1		Hazardous electric voltage.
Plate 2		Danger of crushing lower and upper limbs.
Plate 3		Do not carry out maintenance with equipment powered.
Plate 4		Do not clean, oil, grease, repair or adjust moving parts by hand.
Plate 5		Do not remove safety devices.
Plate 6		Do not extinguish fires with water.
Plate 7		Do not climb on the machine.
Plate 8		It is compulsory to wear protective gloves.
Plate 9		Obligation to read the user and maintenance manual.


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1 / 3 / 6 / 8 / 9
Electrical panel general
1 / 3 / 6
On the electrical panel located inside the compartment
2 / 7
4 / 5
4 / 5

GENERAL DESCRIPTION

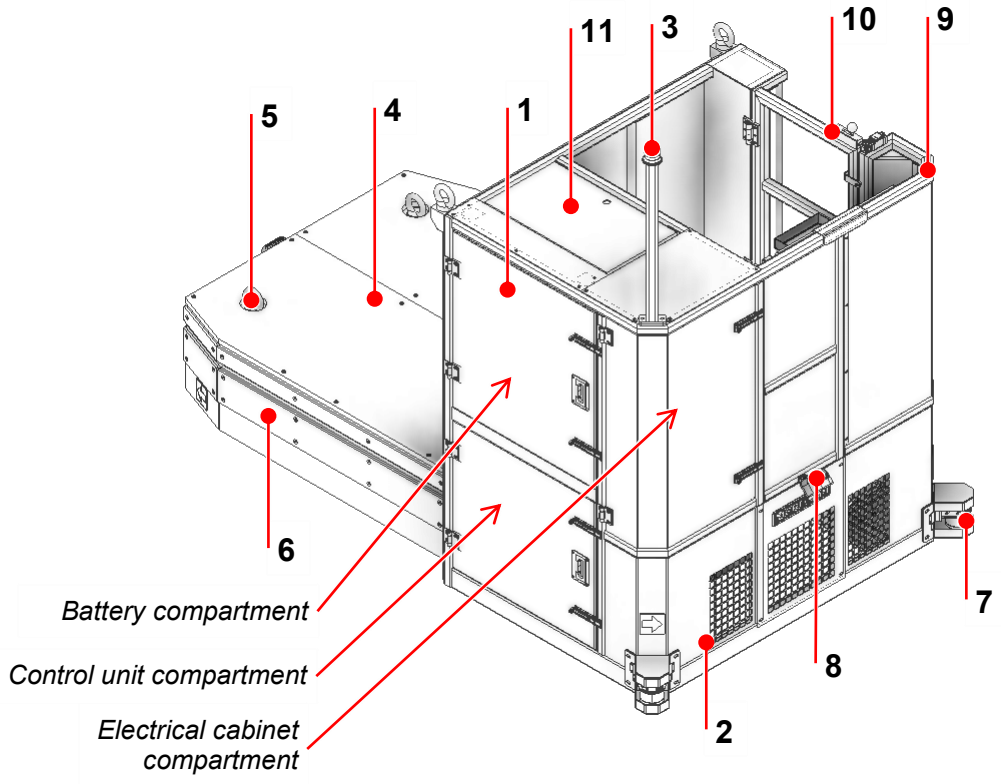
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3. GENERAL DESCRIPTION

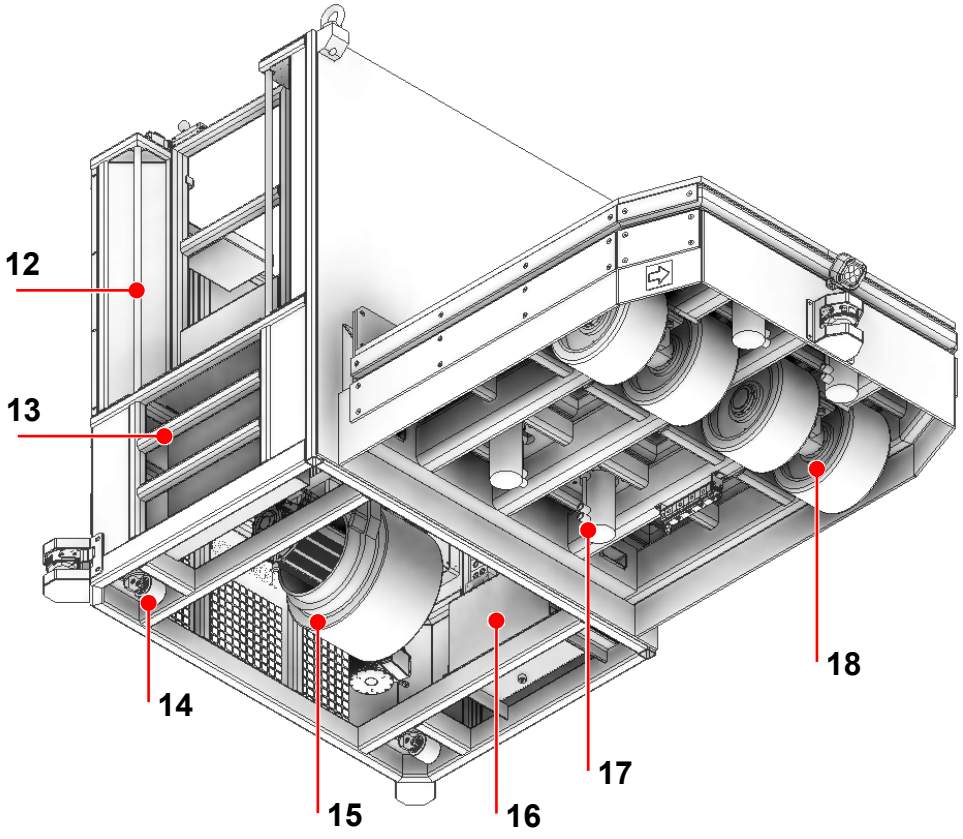
The machine has been designed and manufactured to lift and handle heavy loads, in accordance with the technical specifications set out in this manual. The load must be placed on a suitable pallet (not supplied). It can be used both indoors on a concrete floor (flat, smooth and level). The working area must be clear and large enough for machine movement.

3.1 LAYOUT

N.	DESCRIPTION
1	Movable guard
2	Fixe guard
3	Signal lamp
4	Loading surface
5	Lifting point on the machine
6	Scratch-resistant side protection
7	Laser scanner
8	Spotlight BLUEPOINT
9	Parapet
10	Gate with a switch
11	Electrical switchboard with HMI panel



N.	DESCRIPTION
12	Handrail
13	Ladder
14	Stability wheel
15	Front motorbike
16	Hydraulic unit
17	Hydraulic lifting cylinder
18	Idler wheel
19	Wired control panel / Radio-control





3.2 TECHNICAL DATA

The following table contains the main machine data.

MACHINE	
Weight	Approx. 3.800 kg
Maximum working load (WLL)	38 t evenly distributed, with the centre of gravity aligned with the Client's pallet
Loading surface dimensions	Approx. 1.500 mm x 1.600 mm
Height loading surface	Approx. 520 mm from the ground ± 110 mm (lifting stroke)
Movement indicators	Acoustic and luminous
Machine lifting points	4
Fixed guard	Steel
Frame	Steel
Loading surface	Smooth steel sheet + non-slip coating
Transmission	Electro-mechanical
Translation	Adjustable electronics
Steering	Electrical
Type of steering	Simple front flip
Steering angle	± 90°
Motorised steering wheels	1 (front)
Idler wheels	4 (rear)
Stability wheels	2
Type of wheels	Polyurethane coating
Dimensions of the motorised wheel	Ø 500 x 300 mm
Idler wheel dimensions	Ø 400 x 200 mm
Maximum slope that can be overcome	0,5 %
Traction motor	1 electric motor 80 V 12 kW
Steering motor	1 electric motor 80 V 3 kW
Travel speed	Quick mode: 0 ÷ 45 m / min Slow mode: 0 ÷ 25 m / min
Service brake	Electric negative
Parking brakes	Electromagnetic negatives

MACHINE	
Control device	Wired control panel / Radio-control
Lifting cylinders	4
Hydraulic power unit motor	1 electric motor 80 V 2,2 kW
Oil tank capacity	30 litres

POWER SUPPLY	
Power supply voltage	80 V
Type of power supply	LITHIUM battery
Nominal capacity	220 Ah
Battery weight	Approx. 170 kg
Autonomy	Approx. 3 h
Recharging method	Rectifier
Rectifier supply voltage	480 V 60 Hz
Recharging time (full)	Approx. 2 h

ADDITIONAL INFORMATION

The data contained in the tables above may vary, therefore, for more precision or verifications of the machine data, see the attached diagrams.

3.3 GROUPS DESCRIPTION

ADDITIONAL INFORMATION

For more information on the commercial components that make up the groups, please refer to the accompanying documentation.

3.3.1 Machine structure

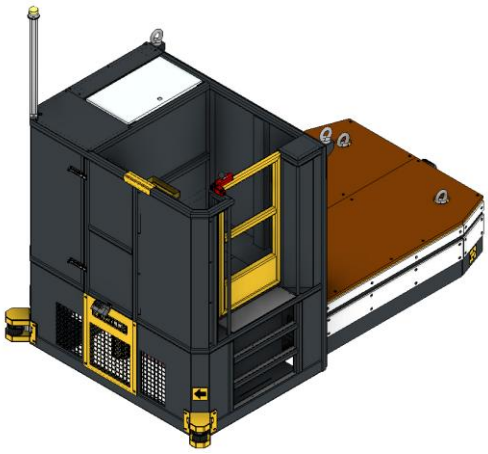
The machine is constructed with a frame **(1)** made of sheet and profile steel and a protection casing made of smooth **(2)** and grated sheet steel **(3)**.

At the front of the machine there are three hatches **(4)** providing access to the battery, the electrical panel and the hydraulic control unit (for maintenance work).

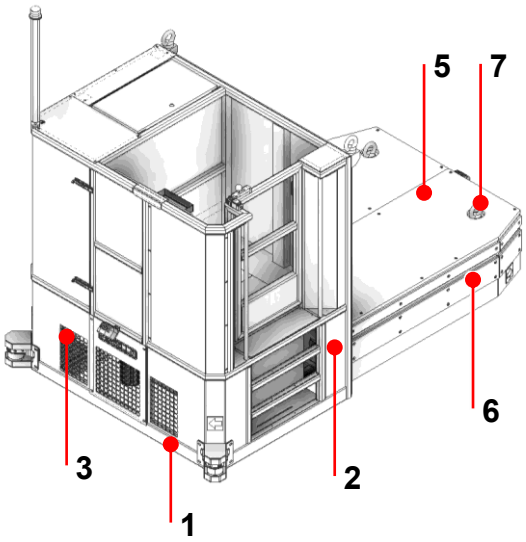
The machine is fitted with a lifting platform **(5)** on which the load is placed. The perimeter of the loading platform is lined with polyethylene protective panels **(6),** whilst the top is lined with wooden panels.

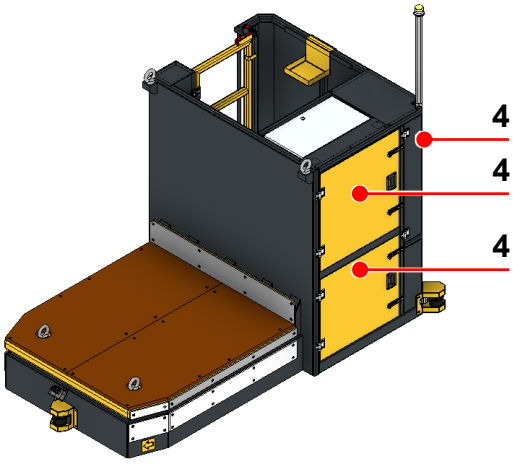
The paintwork is finished in anthracite grey (RAL 7016) and yellow (RAL 1018).

There are four threaded holes for fitting four eye bolts **(7)** for lifting the machine.



Front





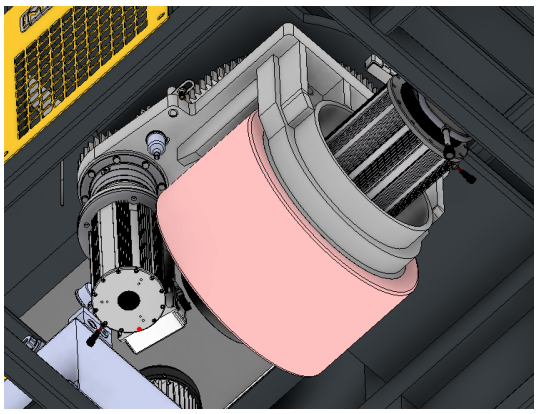
Rear

3.3.2 Wheels group

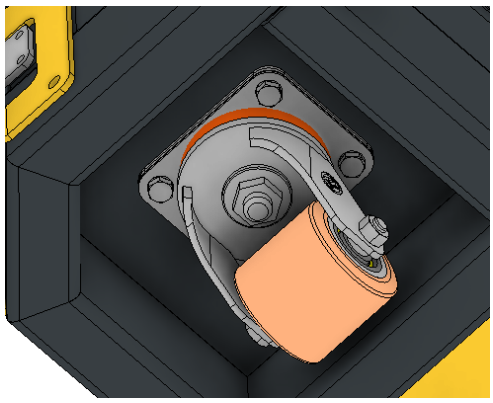
The machine is manoeuvred by five wheels, comprising one motorised front wheel **(1)** and four non-driven rear wheels **(2).** The non-driven wheels are mounted in pairs on rockers **(3).**

Two pivoting non-driven wheels **(4)** are fitted at the front to ensure stability.

Each wheel is constructed with a steel core and a polyurethane coating.



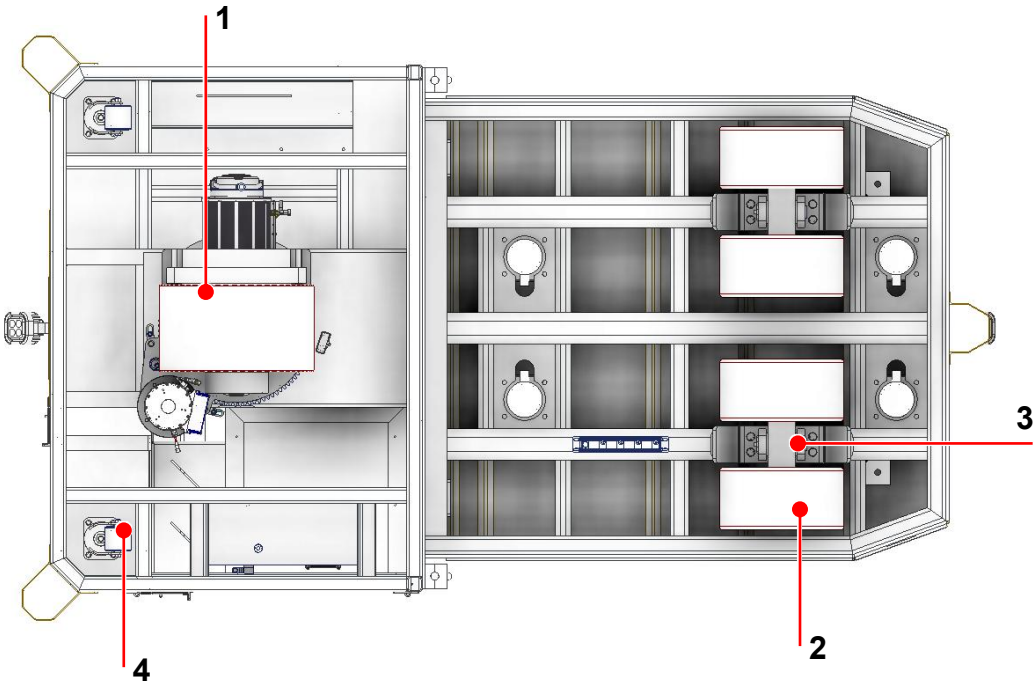
Motorised front wheel (1)



Front stabiliser wheel (4)



Idler rear wheels (2) on the rocker arm (3)

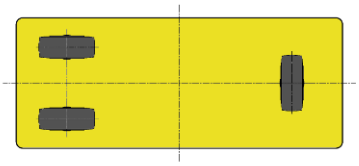


3.3.3 Steering

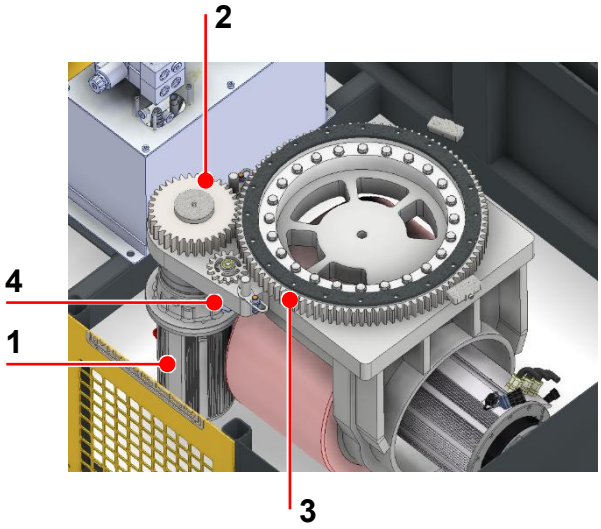
Steering is controlled by an electric gear motor **(1)**, which transmits motion via a pinion **(2)** to the rack **(3)** of the front motorised wheel. It can steer through ± 90°.

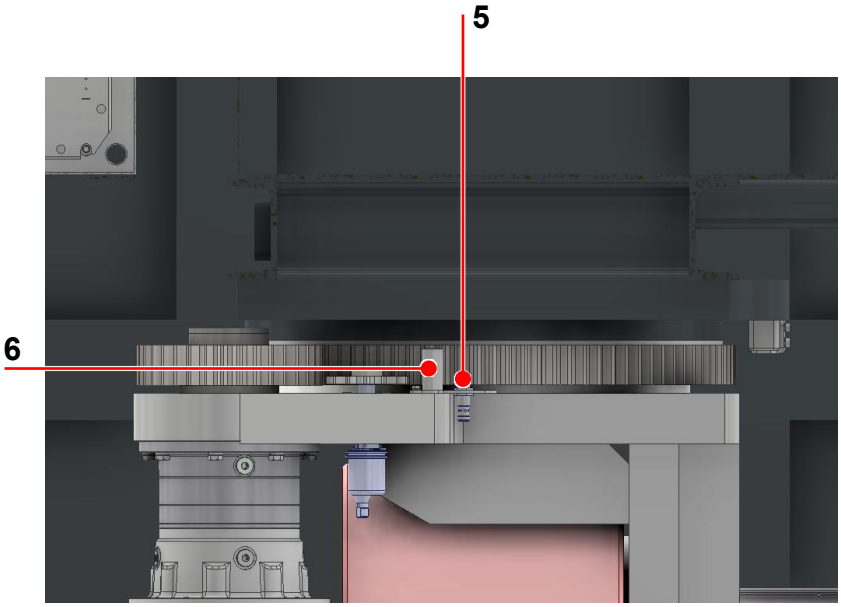
The steering angle is read from an encoder **(4)**.

In order to guarantee machine safety, in the event of an encoder failure, there are two types of limit switches (the first electrical type **(5)** and the second mechanical type **(6)**).



Front single-curve steering





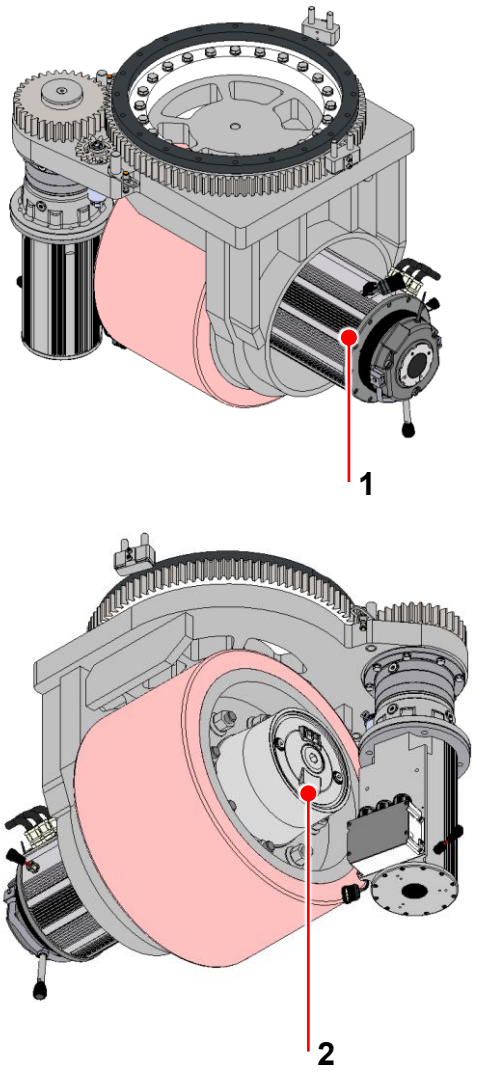
3.3.4 Traction and braking

Power is transmitted to the front motor wheel via an electric motor **(1)**. The power is transmitted via a gearbox **(2).**

The translation, which is electronic, allows gradual acceleration and deceleration ramps, millimetre shifts and uniform speed variations.

Operating braking is achieved by negative torque on the traction motor.

Parking braking is achieved via negative electromagnetic brakes mounted on the motors.

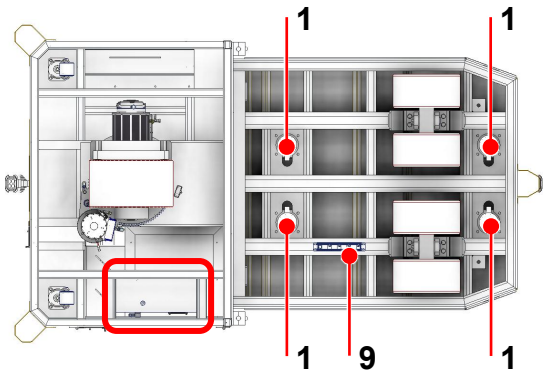


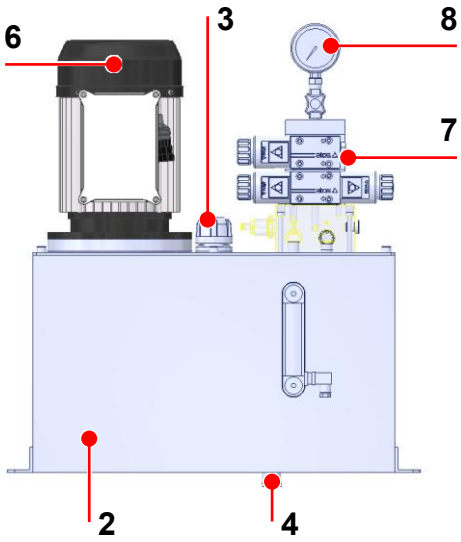
3.3.5 Hydraulic unit

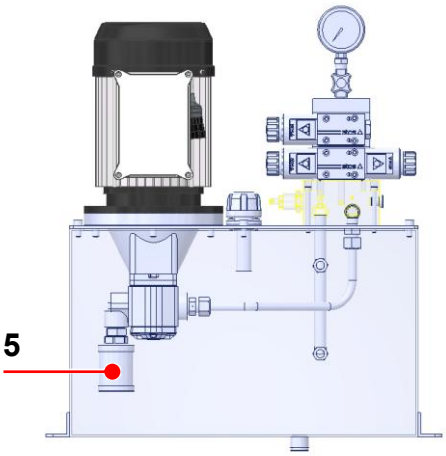
The unit enables the loading platform to be raised by means of four hydraulic cylinders **(1).**

It consists mainly of:

- Oil tank **(2)** with level indicator.
- Tank top-up point (3).
- Tank drain point (4).
- Filter **(5)**.
- Pump **(6)** with electric motor.
- Solenoid valves **(7)**.
- Pressure gauge **(8)** with excluder
- Shut-off valves.
- Pressure relief valve.
- Flow divider **(9)**.





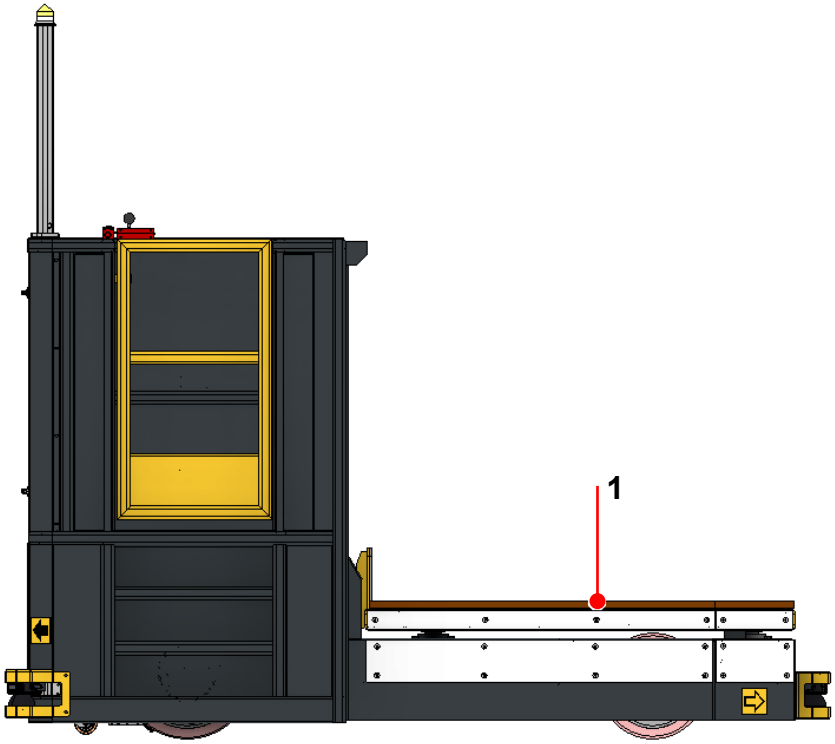


ADDITIONAL INFORMATION

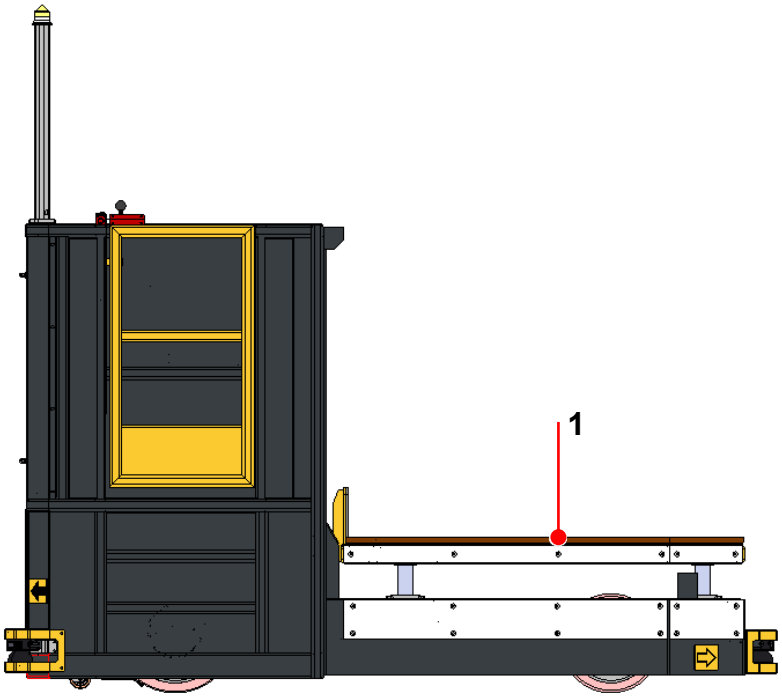
For further information on the hydraulic system, please refer to the relevant diagram and the hydraulic control unit manual provided in the appendix.

3.3.6 Liftable loading platform

The loading platform **(1),** consisting of a sub-frame supported by four hydraulic cylinders, can be raised evenly over a stroke of 110 mm.



Low-level floor



Upper level floor

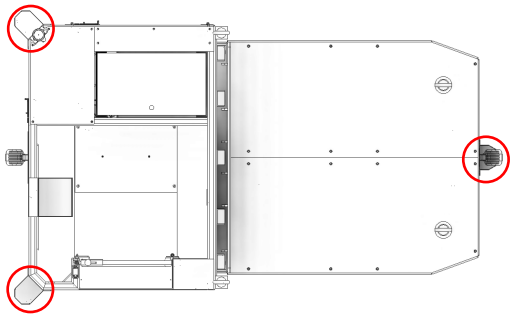
3.3.7 Laser scanner

Three laser scanners **(1)** are fitted around the perimeter of the machine to slow it down and bring it to a halt in the event of obstacles.

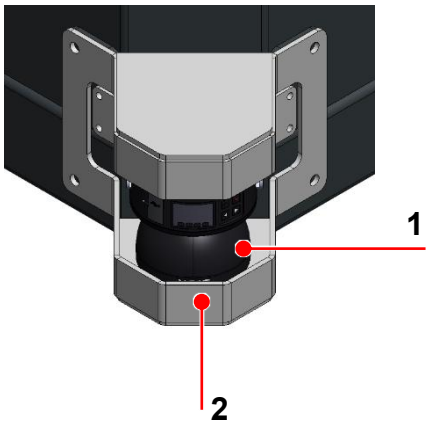
The devices are protected by steel sheet guards **(2).**

There are two areas of operation:

- Slowdown: if an obstacle is intercepted in this area, there is a slowdown of the machine.
- Stop: if an obstacle is intercepted in this area, the machine stops immediately.



Laser scanner 1 position



3.3.8 Control devices

Machine movements are controlled via the control panel (radio-control or wired control panel).

The operator can execute all commands via a single connected device.

There is a socket on the machine for connecting the control panel.



Wired control panel



Radio-control

3.3.9 Driver's seat

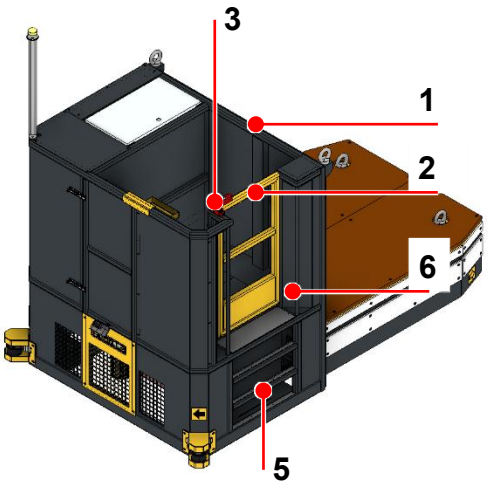
The machine is fitted with an on-board operator's station for operating it.

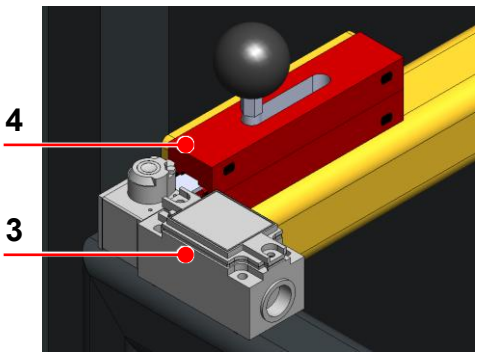
The perimeter of the operator's station is enclosed by guardrails **(1)** 1,100 mm high. Access is via a gate **(2),** fitted with a footrest and an intermediate rail, controlled by a switch **(3).** After closing the gate, the actuator **(4)** must be manually inserted into the switch **(3)** by operating the knobbed lever to enable the machine's movements.

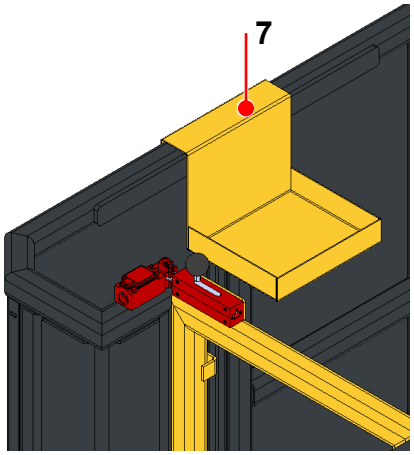
This safety system helps to prevent accidental falls.

There is a small ladder **(5)** at the gate, with handrails **(6)** on either side.

The station is fitted with a non-slip, vibration-damping mat and a movable stand **(7)** on which to place the control panel.





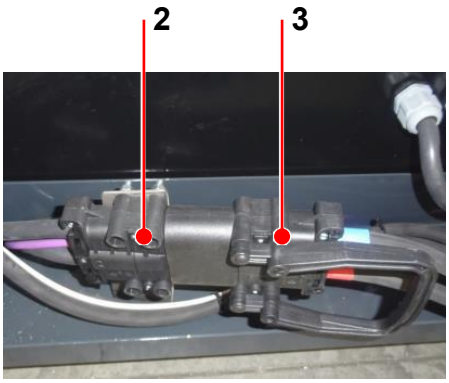


3.3.10 Power supply

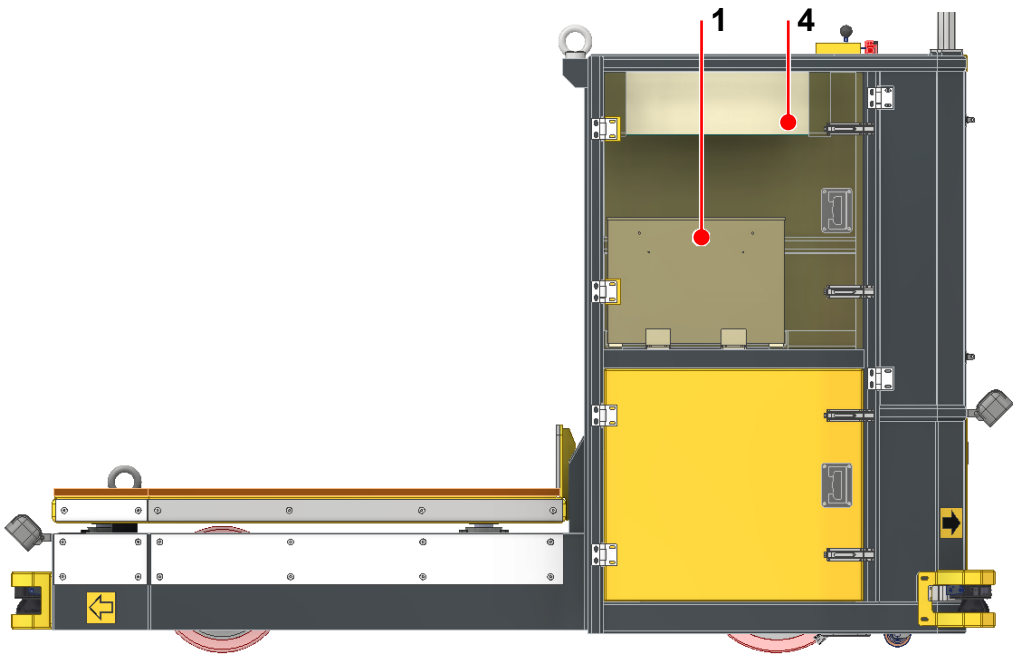
The machine is powered by a lithium battery **(1)** inserted in a special compartment.

The battery socket **(2)**, located near the battery, can be connected to the machine's plug to supply power, or to the rectifier's plug **(3)** for recharging.

The connectors and the battery are accessible via the movable cover **(4)**.



Example image



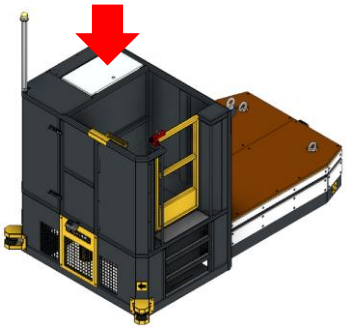
3.3.11 Accessories

The Manufacturer in addition to the delivery of the machine provides:

- N.1 Rectifier for battery recharging of the machine.
- N.1 Radio-control battery charger.

3.4 PUSHBUTTONS

3.4.1 Pushbutton on electric panel



Position



Image of the pushbutton panel

IMAGE	DESCRITPION
	**Power-on key selector switch** Turn to position (1) to switch on the machine. Turn to position (0) to switch off the machine
	**Insertion services white luminous button** Press to insert the auxiliary services.
	**Voltage inserted on white led** When alight, it indicates the machine is powered.
	**Yellow illuminated button for additional time** This switches on to indicate that the battery has reached approx. 30% autonomy. Pressing restores power to the machine for another 15 minutes, to be able to reach the recharging station.

IMAGE	DESCRITPION
	**Red luminous generic fault button** When alight it indicates there is a fault/emergency. Check the cause of the fault/emergency on the display.
	**Red light on intercepted scanners** When this light comes on, it indicates that the laser scanner's stop area has been detected.
	CAN network programming port connector.
	**Orange lamp: SCANNER BY-PASSED** If lit, this indicates that the timed bypass for the laser scanners has been activated, which deactivates the devices until the machine is switched off.
	**Battery display** This tool allows you to view information about the battery (remaining charge, voltage, current, etc.). For further information, please refer to the battery manual, which is attached.

3.4.2 RFID reader with numeric keypad



An RFID card reader with a numeric keypad for entering the PIN code is fitted to the machine's control panel.

This device allows the laser scanners to be deactivated until the machine is switched off. When this happens, the flashing orange 'SCANNERS BYPASSED' indicator light on the control panel comes on.

To activate the bypass, you must:

1. Hold the card close to the RFID reader.
2. Enter the relevant PIN.

To reactivate the laser scanners, you need to switch the machine off and on again.

NOTE

RFID cards (and their corresponding PINs) must be kept in a secure place by the person in charge of the machine.

CAUTION

When the bypass is active (i.e. the safety function is disabled), it is the operator's responsibility to ensure that the area is clear of people and objects during operation.

3.4.3 Control panel (wired control panel / radio-control)



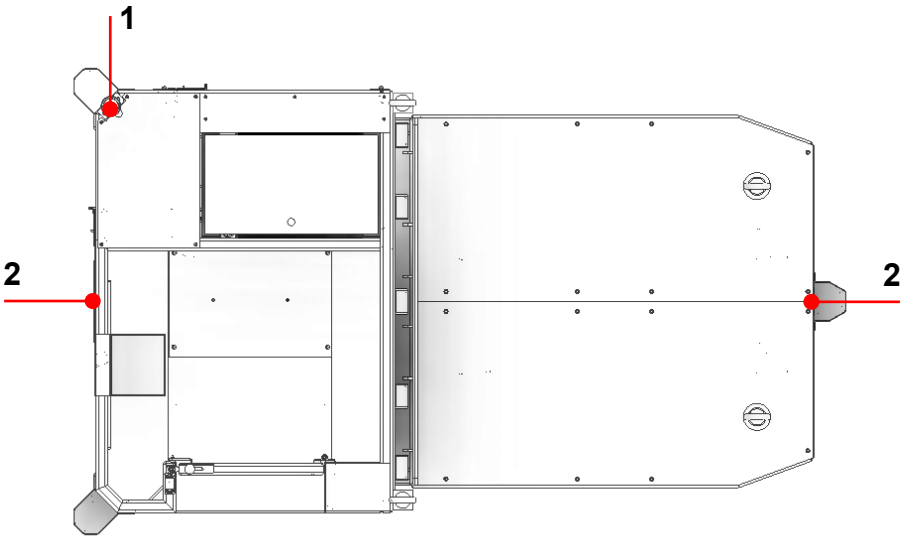
IMAGE	DESCRIPTION
	**Key switch for the control panel (SIDE)** Turn the switch to the (I) position to switch the pushbutton panel on. Turn the switch to the (O) position to switch the pushbutton panel off.
	**Green button START / HORN (SIDE)** Press to activate the wired control panel / connect the remote control after switching it on. Press to operate the horn while the car is in use.
	**Button 0° (SIDE)** Press to straighten the steering wheel.
	**Green ON indicator light** When lit, this indicates that the pushbutton panel is switched on.
	**RESET / SAFETY OFF lever** Push the lever to RESET to activate the auxiliary circuits. If you move the lever to SAFETY OFF (and hold it in this position), the laser scanners are disabled. If you hold it down for more than 60 seconds, an alarm is triggered.

IMAGE	DESCRIPTION
	**Lever for selecting the maximum travel speed** Push on “HARE” to set maximum speed of 45 m/min. Push on “SNAIL” to set maximum speed of 25 m/min.
	**Lever for raising and lowering the loading platform** Move the lever to raise or lower the loading platform. The lever is a hold-to-operate type.
	**Emergency button** Press in the event of danger to bring the machine to an immediate stop. To reset it, turn it clockwise.
	**Steering lever LEFT / RIGHT** Operate the lever to steer to the left or right. The lever is maintained action.
	**Movement lever FORWARD / REVERSE** Act on the lever to move the machine forwards or backwards. The lever has a maintained action. The travel speed is proportional to the pressure exerted.
	Pushbutton panel cable connector.

3.5 VISUAL AND ACOUSTIC INDICATIONS

The following visual and acoustic indication devices are installed on the machine:

- Lamp **(1)**
- Buzzer
- Spotlight BLUEPOINT **(2)**



1



2

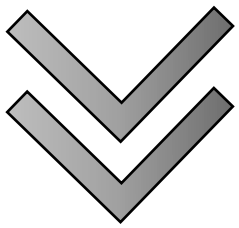


SIGNALLING	DESCRIPTION
YELLOW FLASHING LIGHT + BUZZER	They are activated during machine movement and deactivated when the machine is completely stationary.
BLUE LIGHT (2)	A beam of blue light on the road surface in the direction of travel.

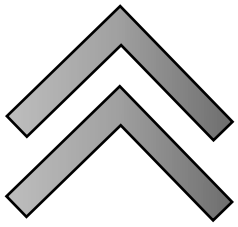
ADDITIONAL INFORMATION

There is a horn that the operator can use to warn of the passage of the machine.

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TRANSPORT AND STORAGE



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4. TRANSPORT AND STORAGE

4.1 STORAGE

The machine is shipped by the Manufacturer already assembled and with the battery charged inside it.

The packaging does not protect the machine against external weather conditions, such as rain, snow, hail, etc even if it is transported in wooden cases. Therefore, if it remains exposed to weather conditions it is indispensable that it remains in the closed container until the final storage.

The storage site is to be appropriate for use as a machine warehouse: closed, protected against weather conditions, clean and ventilated. The floor is to be able to sustain the weight of the machine. Environment temperature is to be between 0 ° C and + 30 ° C.

The Manufacturer shall not be held liable for damage caused by long periods of storage or under conditions that differ from those indicated.

4.1.1 Storage of battery/batteries

When not used, the battery is to be kept in a covered area that is protected against weather conditions, dry, free of dust and protected against frost. Inspect and recharge at regular intervals on a weekly basis. Run complete recharging cycles before periods of long inactivity.

ADDITIONAL INFORMATION

For any other information regarding the battery, see the relevant manual attached.

4.2 TRANSPORT

The machine may be shipped, according to the destination, in the following ways:

- BY SEA → the machine is enclosed in a caisson with a flat bottom and anchored with tie rods. The caisson is lined with tar paper and contains bags with drying salts against moisture and salt.
- BY AIR → the machine is enclosed in a flat-bottomed box and anchored with tie rods.
- BY LAND→ land transport can be divided into two categories:
  - LONG-DISTANCE TRANSPORT the machine is covered with protective tarpaulins, enclosed in a wooden cage with a flat bottom and anchored with tie rods on the loading surface of the articulated truck.

    The instructions printed on the outside of the packaging must be strictly adhered to when lifting the container. Packages may be recovered for eventual re-use; it is good practice to try to keep them in a protected place to avoid damaging them and making them unreliable. If, on the other hand, they are disposed of, it is the Customer's responsibility to dispose of them in accordance with the regulations in force in their own country.
  - MEDIUM AND SHORT-DISTANCE TRANSPORT the machine is secured to a flatbed and covered with protective sheets.

The anchorage points for lifting are indicated on the shipped packages.

Furthermore, externally on the packages there are all the indications to identify the contents and for the safe handling:

- Address of the receiver and the sender.
- Dimensions (length, width, height).
- Gross, net weight and tare.
- Centre of gravity.
- Notes and symbols (e.g. fragile, this way up, etc.).
- Packing list holder label (to be contained inside each package).

4.3 LIFTING

Before any handling and/or lifting operations, it is important to know the weight.

NOTE

All handling and lifting operations are to be carried out by qualified operators, who know the standards regarding lifting and handling of loads, so that it can act in full respect of them.

NOTE

Use suitable lifting equipment, appropriate for the weight and overall dimensions of the load to be handled.

NOTE

Always check the correct balancing of the load. If it is unbalanced, immediately rest it on the ground and rearrange the slings appropriately.

CAUTION

When the load is lifted by more than 50 cm from the ground, the operators are to remain at a safe distance of more than 2 m from the perimeter.

Breakage of a chain or an uncontrolled movement of the load is, in fact, a serious hazard for the safety of the operators.

4.3.1 Weight/s

DESCRIPTION	WEIGHT
Machine	Approx. 3.800 kg

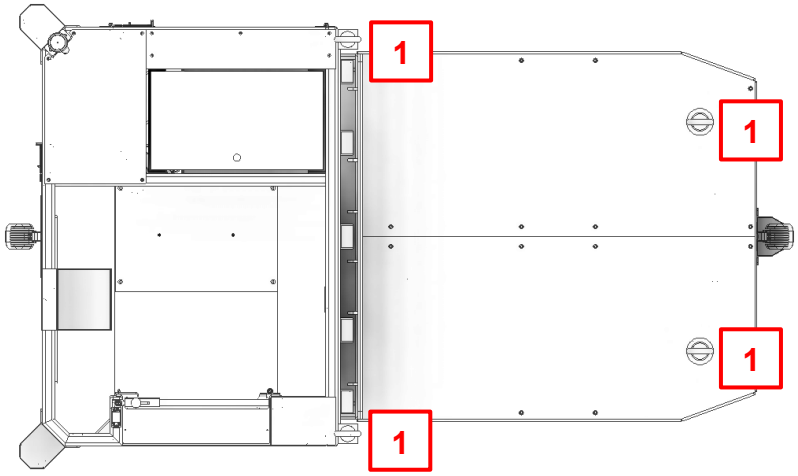
4.3.2 Complementary to the machine

The manufacturer, in addition to the delivery of the machine, provides n.4 fixed M30 eyebolts for lifting the machine.

4.3.3 Machine lifting

To lift the machine, proceed as follows:

- Make sure there is nothing on the loading platform.
- Make sure the loading platform is fully lowered.
- Insert a fixed M30 eyebolt into each of the four points **(1)** provided on the machine.



NOTE

Before using the eyebolt, check the integrity and cleanliness of the thread.

To orientate the eyebolts correctly, insert suitable washers.



Images for illustrative purposes

- Insert appropriate hooks with chains in the four eyebolts.
- Secure the chains to the hooks of an appropriate lifting.
- Slowly lift the machine taking care to balance it correctly.
- Transport it is avoiding abrupt movements and keeping it as close to the ground as possible.
- Upon arrival at destination, slowly and gradually rest it on the ground.
- Only release the chains after the machine is resting perfectly on the ground.
- Remove the eyebolts.

LIFTING DIAGRAM

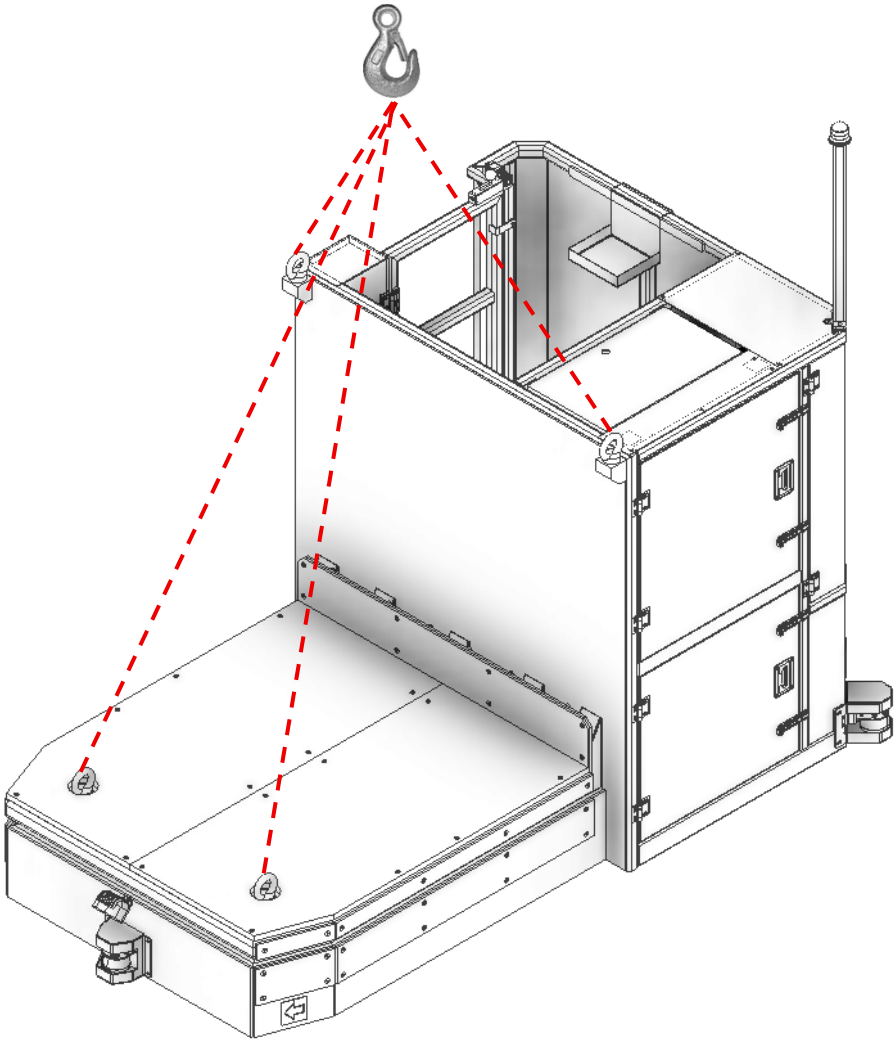
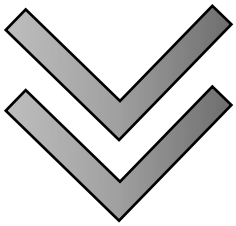
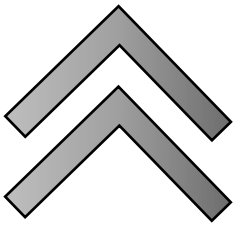


Image for illustrative purposes

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INSTALLATION



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5. INSTALLATION

Before using the machine, the following have to be removed:

- Any fastening restraints used for transport.
- Protective packaging.

5.1 INTACTNESS CHECK

The machine has to be checked to ensure that no damage has occurred during transport. Therefore, in the case of accidents or if visible damage is seen (signs or traces of impact), please notify in this manner:

- With a written notification on the Shipping Document.
- Informing the carrier and the Manufacturer of the damage found by means of registered letter (or PEC) attaching photos of the damage, within 48 hours of the machine delivery.

5.2 INSTALLATION OF THE MACHINE

NOTE

The machine is shipped from the manufacturer already assembled and with a charged battery inside.

5.2.1 General safety precautions

The operations described in this chapter must be performed by authorized personnel.

NOTE

Personnel in charge of all operations described in this chapter must be trained, to avoid incorrect operations that could damage the machine.

CAUTION

Make sure there is nothing around the machine that can cause interference or danger to operators.

ADDITIONAL INFORMATION

Refer to specific manuals for information regarding embedded devices.

5.2.2 Choice of place of use and check on requirements

The Customer **MUST** provide:

- A sufficiently large environment, free of obstacles, equipped according to the safety standards in force in the user country.
- Correct ventilation and lighting.
- Appropriate lifting devices.
- Operational spaces.
- Passageways.
- Escape routes.
- A flat, level and smooth surface capable of supporting the weight of the machine and its load.
- A power supply that meets the required specifications and tolerances.
- Pallets of a suitable size.

5.3 FILLING THE TANK

The machine is supplied with the hydraulic unit tank empty.

Upon installation, it is necessary to first fill with oil using a special filter to avoid contamination.

NOTE



It is recommended never to mix oils of different types and/or manufacturer. Used oil, as special waste, is subject to disposal through authorized consortia.

NOTE



Using a type of oil that is not equivalent to that specified will void the warranty in case of failure and/or breakage.

ADDITIONAL INFORMATION



The machine is supplied with the control unit already connected.

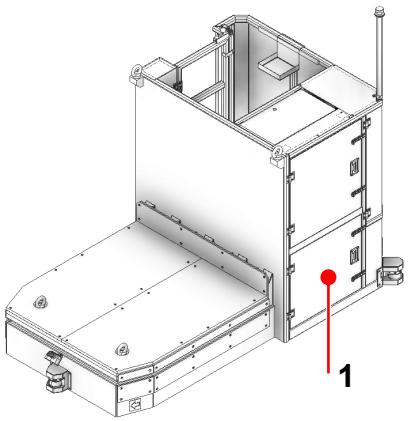
5.3.1 Hydraulic power unit tank filling

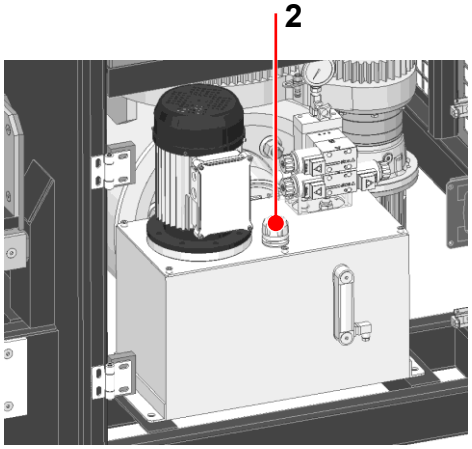
WARNING

This operation must be carried out whilst the machine is at a standstill and the power supply is switched off and disconnected.

For filling, proceed as follows:

- Access the tank by opening the flap **(1).**
- Check that all the pipe connections to the tank are securely tightened.
- Turn and remove the tank cap **(2)** to fill the tank.
- Fill the reservoir with IP HYDRUS 46 oil or an equivalent product until the level reaches the midpoint between the minimum and maximum marks on the reservoir's gauge.
- Securely close the cap **(2).**
- Close the door **(1).**





NOTE

The fluid level decreases when the system is put into operation as the fluid fills the pipes and actuators, which is why the fluid level must be checked regularly.

ADDITIONAL INFORMATION

For more information on the hydraulic unit, please refer to the accompanying manual and hydraulic diagram.

5.4 CHECKS AND INSPECTIONS

Before starting the machine, some general controls and checks have to be carried out to avoid risks or problems during machine operation.

CAUTION



These checks and preparation for the first start-up are to be carried out by a specialised technician of the Manufacturer or by a specialised technician who has been specifically trained.

NOTE



Before starting any movement, make sure there are no anomalies to avoid damage to the machine. Before deleting any fault, check the cause and remove it.

ADDITIONAL INFORMATION



The checks and inspections that follow are to be considered as routine maintenance operations.

ADDITIONAL INFORMATION



Refer to specific manuals for information on built-in devices.

5.4.1 Overall checks on mechanical units

WARNING



This operation must be carried out with the machine at standstill and with the power source switched off and disconnected. Ensure the working area is clear and free of obstructions.

- Visually check the wheel groups, checking there are no mechanical faults (ovalizing, crushing, warping due to loads and/or foreign objects).
- Perform a general visual inspection of the various groups that make up the machine, verifying that there are no particular mechanical anomalies or foreign bodies.
- Check that all the guards are mounted correctly.
- Check that moving parts are correctly lubricated.
- Check for correct tightness of all nuts and bolts.

ADDITIONAL INFORMATION



To check the tightness, see the tables in the paragraph “Tightening torques” in the chapter “Maintenance”.

NOTE



If problems arise, contact the Manufacturer immediately.

5.4.2 Electrical system check

Proceed with a general check on the electrical system and in particular check that all the junction boxes are closed and all the conductors are connected.

Main switch

- Rotate the voltage input selector on (1) and verify the presence of voltage, by turning on the appropriate lamp.

Motor/s

- Check correct connection of the motor/s.

Pushbutton panels

- Check correct functioning of the buttons and selectors with consequent switching on of the luminous indicators.
- Check that the machine movement corresponds to the relevant control.

Indicators and sensors

- Check correct connection and functioning of the buzzer and the horn.
- Check that the lamp and spotlights are correctly connected and working properly.
- Check the correct connection and function of the limit switches and encoder.
- Check the correct connection and function of the laser scanner.

ADDITIONAL INFORMATION

For further information and details, see the wiring diagram.

5.4.3 Checks on safety devices

Check that the guards and the safety devices are correctly assembled and functioning.

WARNING



Machine safety cannot be ensured if safety devices are removed or tampered with.

CAUTION



Carry out the functional, tightness and positioning checks of the safety systems as indicated in chapter 2.

NOTE



These control procedures are to be applied as normal maintenance procedures.

5.4.4 Hydraulic system checks

Carry out a general check of the hydraulic system, and in particular:

- Check the oil level in the tank via the gauge on the tank.
- Check that the pressure matches that shown in the relevant diagram.
- Check that there are no hydraulic leaks from pipes or cylinders.
- Check the correct tightening of pipe connections.
- Check the hoses for tight bends, crushing or abrasion.

ADDITIONAL INFORMATION



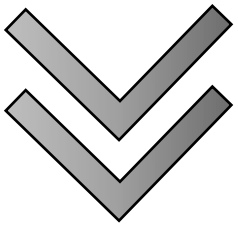
For further information and clarification, please refer to the hydraulic diagram and the hydraulic control unit manual.

5.5 UNIVERSAL INTERNATIONAL RECYCLING CODES

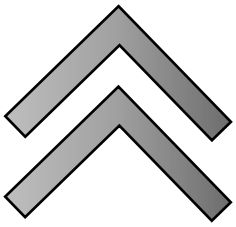
Symbol	Code	Description
Plastics		
	#1 PET o PETE	Polyethylene terephthalate or arnite: water bottles, soft drink bottles, shampoo bottles
	#2 HDPE	High-density polyethylene: containers of yogurt, detergent bottles
	#3 PVC o V	Polyvinyl chloride: food containers
	#4 LDPE	Low Density Polyethylene: frozen food bags, squeezable bottles
	#5 PP	Polypropylene or MOPLEN: bottles
	#6 PS	Polystyrene or Styrofoam: disposable glasses
	#7-#19 O	Any other plastics
Paper		
	#20 PAP	Corrugated Cardboard: boxes of furniture to assemble
	#21 PAP	Paperboard, not corrugated: packaging of sandwiches in fast-food
	#22 PAP	Paper: pack of fries in fast-food, newsprint, paper bags
	#23-#39	Other types of paper
Metals		
	#40 FE	Steel
	#41 ALU	Aluminium: cans
	#42-#49	Other types of metal
Wooden materials		
	#50 FOR	Wood

Symbol	Code	Description
	#51 FOR	Cork
	#52-#59	Other types
Textiles		
	#60 TEX	Cotton
	#61 TEX	Jute
	#60-69	Other textile materials.
Glass		
	#70	Transparent / colourless glass: water bottles
	#71	Green glass: wine bottles
	#72	Brown glass: bottles of beer
	#73-79	Other materials in glass and cans
Composite materials		
	#80	Paper and cardboard / various metals
	#81	Paper and cardboard / plastic
	#82	Paper and cardboard / aluminium: bag of packed biscuits
	#83	Paper and cardboard / tin
	#84	Paper and cardboard / plastic / aluminium
	#85	Paper and cardboard / plastic / aluminium / tin
	#86-#89	Other composed materials
	#90	Plastic / aluminium
	#91	Plastic / tin
	#92	Plastic / various metals
	#93-#94	Other composed materials
	#95	Glass / plastic
	#96	Glass / aluminium
	#97	Glass / tin
	#98	Glass / various metals
	#99	Other composed materials

SELF-PROPELLED ELECTRONIC TROLLEY WITH TYRES
Serial numbers 2750/1 - 2750/2



USE



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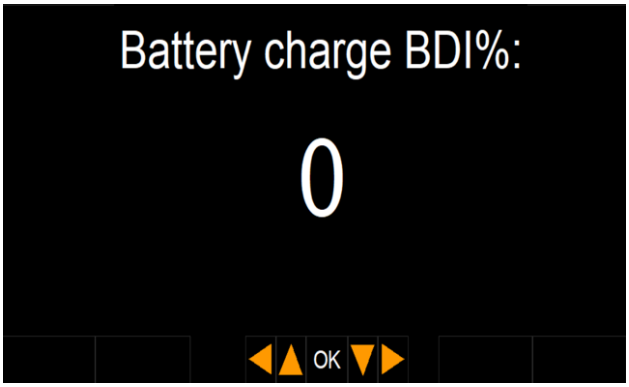
6. USE

6.1 VIDEO PAGES

There is an LCD display on the electrical panel that allows you to view information about the machine.

The screens that can be displayed on the screen are shown below. You can scroll through the screens using the arrows.

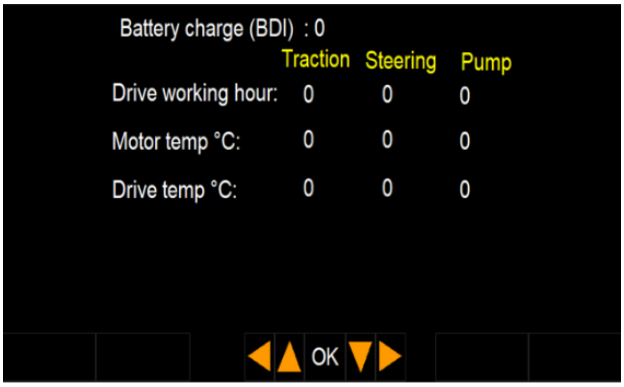
6.1.1 Screen 1: battery remaining charge



This page indicates:

- Battery remaining charge level.
- Any faults / emergency present.

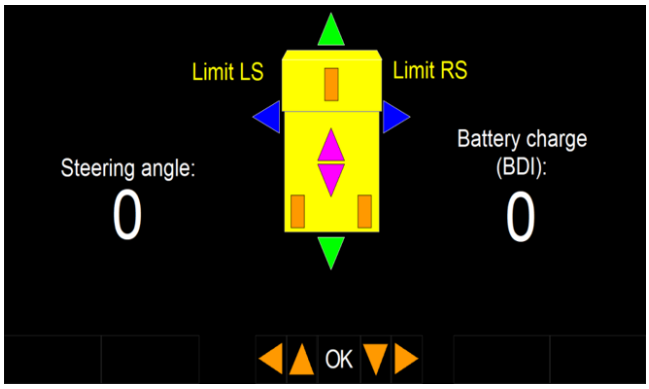
6.1.2 Screen 2: trolley data



This page displays the data regarding:

- Battery remaining charge level.
- Working hours of motor drives.
- Motors temperature in degrees Celsius (°C).
- Temperature of motor drives in degrees Celsius (°C).
- Any faults / emergency present.

6.1.3 Screen 3: movements



This page displays the data regarding:

- Battery remaining charge level.
- Position of the steering wheel.
- Steering angle of the wheel.
- Steering direction (blue arrow).
- Direction of travel (green arrow).
- Upward or downward movement of the load platform (purple arrow).
- Indicator showing that the maximum steering angle has been reached.

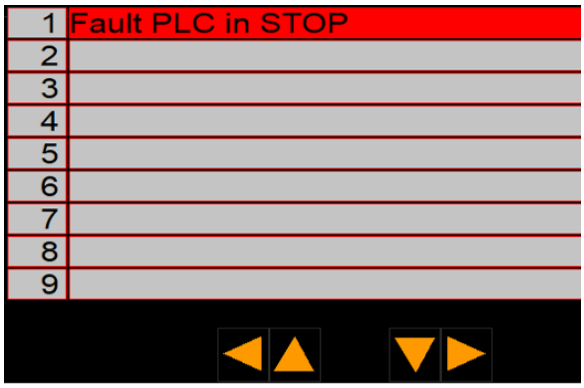
NOTE

In the event of an overtravel limit switch tripping, the red general fault lamp on the electrical panel lights up.

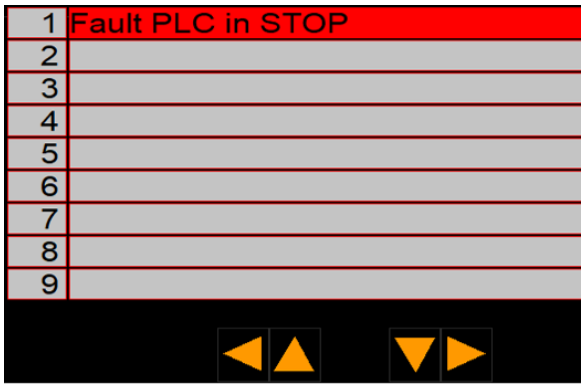
- Any faults / emergency present.

6.1.4 Screen 4 and 5: alarms

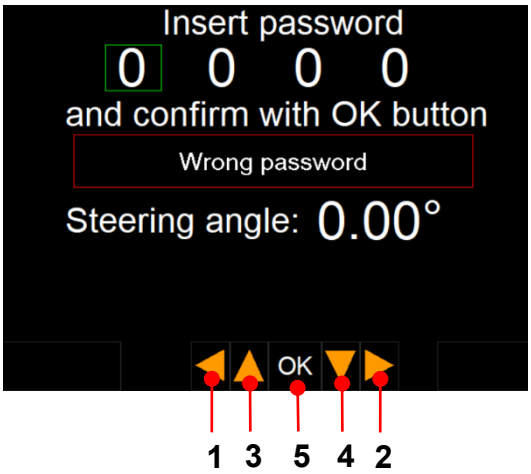
The following screen allows you to view the active alarms. You can scroll through the list / pages using the arrows.



On the following screen it is possible to view a history of the alarms in chronological order. Red highlighted lines show active alarms, while grey lines show reset alarms.



6.1.5 Screen 6: reset encoder



Using this screen, the steering encoder can be reset after entering the access password.

NOTE

Please contact the manufacturer for the password.

Use the physical buttons below the indicators **(1)** / **(2)** to move between the four digits and the physical buttons below the indicators **(3)** / **(4)** to select the digit. Press the OK button **(5)** to confirm.

To perform the reset, once you have positioned the steering wheel correctly, press the button below the indicator **(3)** and hold it down for 5 seconds.

6.2 ALARMS

A list follows of possible alarms that may be shown on the display.

NOTE



All the operations to be carried out to reset the fault are to be carried out by a specialised technician.

NOTE



For further information and details regarding how to solve faults that could occur, contact the Manufacturer.

ALARM DISPLAYED	CAUSE	ACTION
Emergency not OK	Emergency circuit has activated.	Remove the cause of the error or the hazard and reset the emergency. SPECIALISED TECHNICIAN: Check electrical continuity of the emergency circuit and correct functioning of the emergency devices.
Steering motor drive alarm: cod.[xxxx] **Traction motor drive alarm: cod.[xxxx]** **Pump motor drive alarm: cod. xx**	Inverter fault.	SPECIALISED TECHNICIAN: Make sure the battery is charged. Check that the inverter protection fuses are intact. Check that the relevant motor is not blocked or impeded. Check that there is voltage on the auxiliary circuits (24 Vdc). Check drive alarms through the control desk or the configuration software.
Steering motor or drive temp. alarm: cod.[xxxx] **Traction motor or drive temp. alarm: cod.[xxxx]**	Motor overload, motor blocked, battery flat, interruption of a phase or temperature sensor failure.	SPECIALISED TECHNICIAN: Make sure the battery is charged. Check that the motor is not impeded or blocked. Check continuity of the drive and the motor power circuits. Check continuity of the temperature sensor.
Battery low	Battery flat.	Recharge the battery.

ALARM DISPLAYED	CAUSE	ACTION
Right steering overrun LS **Left steering overrun LS**	Position does not correct by software, of the steering wheel due to possible encoder failure or encoder slippage.	SPECIALISED TECHNICIAN: Reset the steering encoder if it is not aligned with the mechanical zero position. After the reset, move the wheel several times and check there is no discrepancy between the mechanical zero position and the zero shown on the display. Check that the encoder is secured correctly with no mechanical slipping. Check cables and wiring of the encoder. Check that the encoder functions correctly, watching the position on the display during the steering. If necessary, replace.
	Overrun limit switch fault.	SPECIALIST TECHNICIAN: If the wheel has not reached the overtravel limit switch, check that the limit switch is working correctly, as well as the limit switch power cable and the wiring.
Encoder not OK: frozen data	Encoder fault.	SPECIALISED TECHNICIAN: Check the electrical connection. If connected correctly, contact the Manufacturer.
CAN Cumulative Fault	CAN communication with errors.	SPECIALISED TECHNICIAN: Check the electrical connection. If connected correctly, contact the Manufacturer.
CAN Encoder Fault	No CAN communication between encoder and PLC.	SPECIALISED TECHNICIAN: Check the electrical connection. If connected correctly, contact the Manufacturer.
CAN Remote control Fault	No CAN communication between control pushbutton panel and PLC.	SPECIALISED TECHNICIAN: Check the electrical connection. If connected correctly, contact the Manufacturer.
CAN Steering motor Driver Fault **CAN Traction motor Driver Fault** **CAN Pump motor Driver Fault**	No CAN communication between motor control driver and PLC.	SPECIALISED TECHNICIAN: Check the electrical connection. If connected correctly, contact the Manufacturer.
CAN Lithium Battery Fault	No CAN communication between battery and PLC.	SPECIALISED TECHNICIAN: Check the electrical connection. If connected correctly, contact the Manufacturer.

ALARM DISPLAYED	CAUSE	ACTION
Steering offset is ZERO	No ZERO offset setting.	Contact the Manufacturer.
Fault PLC in STOP	PLC hardware or power supply fault.	SPECIALISED TECHNICIAN: Check the status of the PLC via the diagnostic LED. Check the electrical connection. Contact the Manufacturer for more information.
Lithium battery: voltage or current too high **Lithium battery: cell temperature out of range** **Lithium battery: out current too high** **Lithium battery: cell voltage too low: recharge** **Lithium battery: battery voltage too low: recharge** **Lithium battery: generic fault: see battery display**	Lithium battery fault.	See the battery manual.
Front laser area switching: feedback missing **Rear laser area switching: feedback missing**	Faulty relay or disconnected wire.	Contact the Manufacturer.
Laser scanner intercepted	The laser scanner's stop area has been detected.	Clear the area by removing the obstacle and reset the alarm.
Laser scanner Safety Off active	The SAFETY OFF function is active and the laser scanners are disabled.	Take care when moving the machine. Release the control to reactivate the laser scanners.
Safety Off time limit exceeded	The time limit for the activated function has been reached.	Release the SAFETY OFF control.
Laser scanner bypass activated	The laser scanner bypass has been activated (the laser scanners are disabled until the machine is switched off).	Take care when moving the machine. Switch the machine off and on again to reactivate the laser scanners.

ALARM DISPLAYED	CAUSE	ACTION
Lifting timeout: Check load position	Lifting timeout.	Check the position of the load, as its centre of gravity may not be centred. SPECIALISED TECHNICIAN: Check that the hydraulic pump and proportional valves are working properly.
Gate Open	The gate is open.	Close the gate and plug the motor into the switch.

6.3 PRELIMINARY PROCEDURES FOR MACHINE MOVEMENT

Before starting to move the machine, the operator shall:

- Check that there are no foreign objects attached to the wheels and that they are not deformed.
- Check the correct operation and positioning of the safety devices present.
- Check that the machine is not in a maintenance/cleaning state.
- Verify that all guards are properly mounted.
- Verify the correct operation of the limit switches.
- Verify the correct operation of the control devices.
- Check the correct insertion of the machine's power plug into the battery socket.
- Check the correct insertion of the wired hand control plug into the socket on the machine (if used).
- Check that the battery of the radio-control is charged (if used).
- Check that the battery charge level of the machine is sufficient.
- Check that there are no fault signals.
- Check that the electrical panel doors are properly closed and locked and that there are no damaged or loose components on the control panels.
- Check that the movable guards are closed.
- Check that there is sufficient oil in the tank.

6.4 MACHINE OPERATION

The machine can only be operated using one of the radio-control supplied.

WARNING



Before carrying out handling operations, ensure that no obstacles or persons are in the vicinity of the machine.

CAUTION



It is forbidden to have the machine operated by unqualified and authorised personnel.

NOTE



Before switching on the machine, make sure that there are no leaks from the hydraulic circuit.

6.4.1 Battery connection

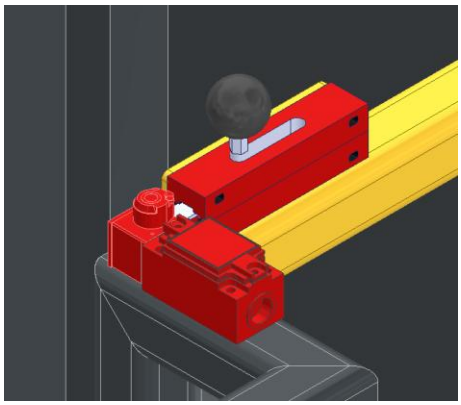
Before starting the machine:

- Open the battery compartment door.
- Plug the machine’s power plug (coming from the electrical panel) into the battery socket.
- Close the panel.

6.4.2 Machine start-up with wired control panel

To start-up the machine, proceed as follows:

- Go to the control panel and close the gate. Plug the actuator into the gate switch.



- Place the control panel in the designated holder.
- Connect the wired hand control connector to the socket on the machine.

NOTE

The wired control panel is enabled by connecting the connector to the socket on the machine. Inserting the connector disables the radio-control, so only one device can be used at a time.

- **Electrical panel:**
  - Insert the key in the power-on selector and turn it to position (1).
  - The voltage inserted led switches on.
- **Wired control panel:**
  - Switch on the control panel by inserting the appropriate key and turning the selector to position (I).
  - The ON indicator light comes on.
  - If pressed, release the emergency button.
  - Press the green START button
- **Electrical panel:**
  - Press the illuminated white service button (Alternatively, press the RESET button on the wall-mounted control panel.)
  - The internal LED of the service button lights up.

You are ready to move the machine.

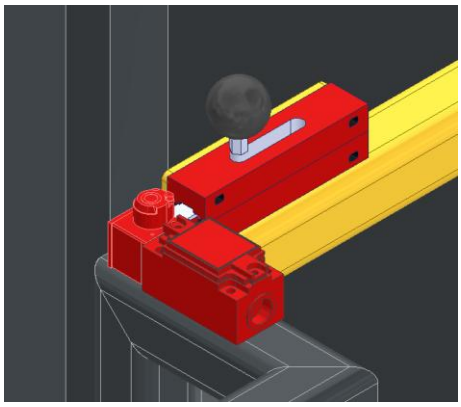
NOTE

Do not disconnect or connect the shoulder strap pushbutton panel before the voltage to the machine has been switched off (voltage selector in position 0).

6.4.3 Machine start-up with radio-control

To start the machine, proceed as follows:

- Go to the control panel and close the gate. Plug the actuator into the gate switch.



- Place the remote control in the designated holder.
- **Radio-control:**
  - Switch on the remote control by inserting the key and turning the selector switch to position (I).
  - The ON indicator light comes on.
  - If pressed, release the emergency button.
- **Electrical panel:**
  - Insert the key into the voltage on selector switch and turn it to position (1).
  - The voltage on LED lights up.
- **Radio-control:** Press the green START button.
- **Electrical panel:**
  - Press the illuminated white service button (Alternatively, press the RESET button on the remote control.)
  - The internal LED of the service button lights up.

You are ready to move the machine.

NOTE

Before changing the control panel (from wired control panel to radio-control panel and vice versa), switch off the control panel and the machine using the appropriate selectors.

6.4.4 Machine movement (translation and steering)

To move the machine, after start-up, proceed as follows:

Via the control panel in use (radio control or wired control panel):

- Set the maximum travel speed by means of the travel speed selector switch.
- Exert pressure on the FORWARD / BACKWARD movement lever to move the machine. The travel speed is proportional to the pressure exerted. Release the lever to stop the machine.
- In order for the machine to perform the required wheel angle change, exert pressure on the steering lever LEFT/RIGHT. The maximum steering angle of the wheel is ± 90°. Releasing the lever stops the steering movement.

CAUTION



It is the responsibility of the operator who uses the machine to check that during movement there are no objects or persons in the area.

CAUTION



Only one operator is required to manage the machine, who is to position as indicated in the paragraph “Operator workstation”.

NOTE



During movement, pay attention, and if necessary, signal the passage of the machine with the horn.

NOTE



Before starting any movement, make sure there are no anomalies to avoid damage to the machine. Before deleting any fault, check the cause and remove it.

Pay attention to the lighting up of the general fault indication lamp and the indications shown on the display.

6.4.5 Direction indicators

On the machine there are visual indications regarding the directions.

PLATE	DESCRIPTION
	FORWARD
	BACKWARD
	LEFT
	RIGHT

6.4.6 Raising / lowering the loading platform

The machine can raise the loading platform to a level position, thanks to four hydraulic cylinders operated by an electro-hydraulic power unit.

Using the control panel:

- Push the lever ⇧/⇩ upwards to raise the top. Keep pressing until it reaches the end of its travel.
- Push the lever ⇧/⇩ down to lower the table. Keep pressing until it reaches the end of its travel.

NOTE



Lower the loading platform before switching off the machine to prevent damage.

6.4.7 Start-up after an emergency stop

If the movement is interrupted by an EMERGENCY STOP, proceed as follows:

- Remove cause of the error or the hazard.
- Reset by turning the EMERGENCY STOP button clockwise, if pressed.
- Wired control panel / radio-control: press the START button.
- Electrical panel: press the white luminous service button and check that the internal LED lights up.

The machine is ready to move.

6.4.8 Laser scanner operation

If there is an obstacle in the stop zone, the machine comes to a halt. On the control panel, the ‘scanners detected’ LED lights up steadily and the ‘services enabled’ LED flashes.

To reset the laser scanners, you must:

- Remove the obstacle.

CAUTION



If it is not possible to remove the obstruction, use the “SAFETY OFF” button on the control panel to deactivate the laser scanners, and move the machine until the work areas are clear.

It is the responsibility of the operator using the machine to ensure that the area is clear of objects and people during operation

- Press the service reset button on the electrical panel to reset the safety functions (or, alternatively, operate the RESET lever on the control panel).

6.4.9 Parking brakes

The machine is equipped with electromagnetic parking brakes that disengage when the movement command is given and engage when the machine stops.

NOTE



It is not possible to tow the machine because the negative brakes of the electric motors prevent wheel movement. If it is necessary to release the motor brakes, contact the Manufacturer.

6.4.10 Shutting down the machine

NOTE



Do not leave the load on the machine. Set the loading platform to the 'fully lowered' position before switching off the machine, to prevent damage.

To shut down the machine, proceed as follows:

- Stop the machine on a flat floor.
- Switch off the control pushbutton panel (wired control panel or radio-control).

NOTE



Do not disconnect the shoulder strap pushbutton panel if no tension has been removed to the machine before (voltage selector switch in '0' position).

- Switch off the machine, turning the power-on selector on the electric panel to (0) and take out the key.
- If used, disconnect the wired shoulder strap pushbutton panel from the machine.

NOTE



In the case of long periods of disuse, or for maintenance operations, disconnect the machine plug from the battery socket to cut out the electrical supply.

6.5 LOAD POSITIONING

NOTE

The machine is capable of lifting and transporting a pallet of suitable dimensions, which is not supplied by the manufacturer.

The load to be transported must be placed on the pallet's loading surface, taking care to distribute it evenly. The load's centre of gravity must be at the centre of the pallet.

NOTE

It is the operator's responsibility to position the load correctly on the pallet and to comply with the machine's maximum load capacity specifications.

WARNING

It is the operator's responsibility to secure the load to the pallet using suitable slinging systems appropriate to the dimensions of the load.

The machine can slide under the pallet (with the platform in the 'fully lowered' position) and lift it for handling (with the platform in the 'fully raised' position).

It is recommended that the pallet be lifted slowly, without any jolts that might cause additional stress within the load-bearing structure and the machine's mechanical components.

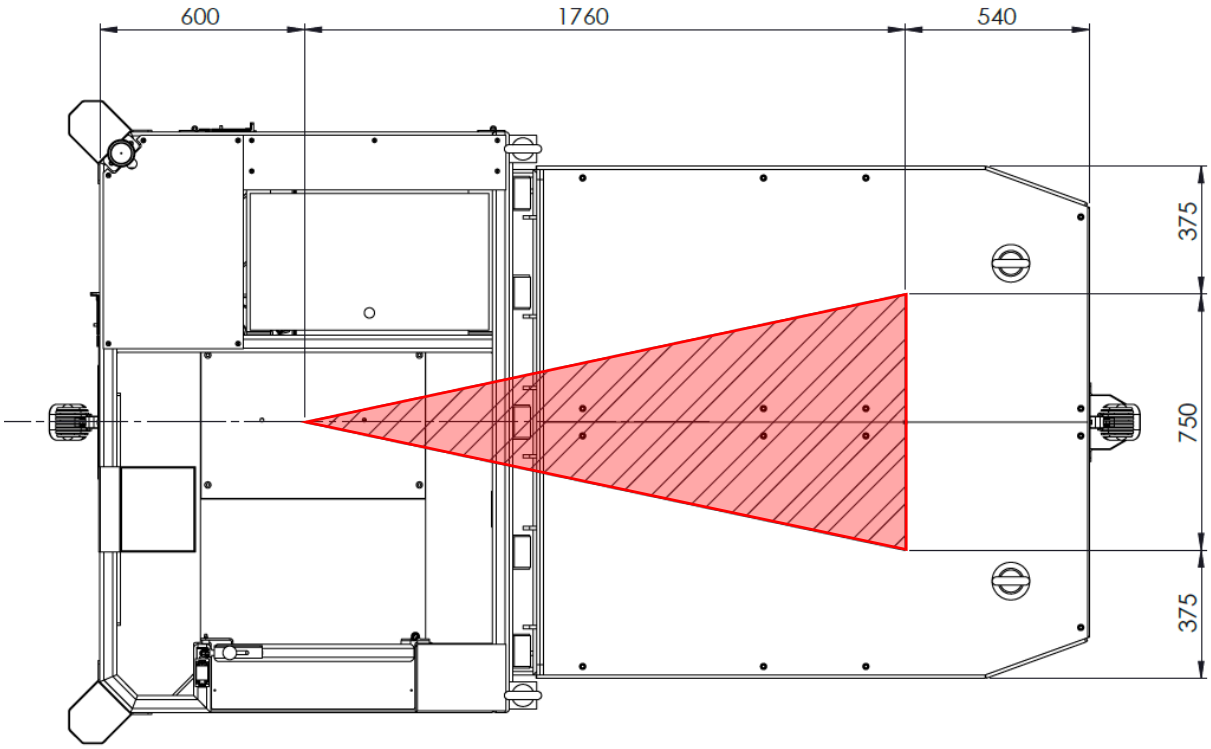
CAUTION

It is the operator's responsibility to align the machine correctly with the pallet (it is strictly forbidden to lift or move the pallet if this requirement is not met) and to lift it with care.

Whilst picking up and setting down the pallet, the operator must ensure that the area is clear of objects and people.

6.5.1 Stability area

There are three points that allow the frame to discharge the weight of the load to the ground, as shown in the following image. There is therefore ‘an area of stability’ given by the junction of these points.



Stability zone highlighted in red

WARNING

To avoid tipping hazards, the centre of gravity of the load must always be positioned within the above area.

6.6 BATTERY

For the first use of the machine nothing is required, since the battery inside is already charged 100%.

6.6.1 Flat battery and extra time

The autonomy of the battery at 100 % charge, indicated in the table of technical characteristics, is calculated on the basis of actual flat use (50 % full load and 50 % empty).

When a residual charge of about 30 per cent is reached, the machine stops and the yellow extra time button on the electrical panel lights up. To move the machine again, this button must be pressed. This gives an autonomy of about 15 minutes to reach the charging station.

Once the extra time has elapsed, it is mandatory to recharge the battery.

NOTE

It is not possible to tow the machine as the negative brakes of the electric motors prevent wheel movement. Therefore, the only way to move it is to recharge/replace the battery or lift it. For possible release of the brakes contact the Manufacturer.

6.6.2 Maintaining the Lithium Battery

ADDITIONAL INFORMATION

For all information regarding the battery (charging frequency, operating and storage conditions and temperatures, maintenance, etc.), please refer to the battery manual provided in the appendix.

For the battery maintenance, it is recommended:

- Do not go below 20% residual charge.

NOTE

Drastic discharge can irreparably damage the lithium cells. The warranty does not cover replacement of cells that are totally discharged.

- When not in use, store the fully charged battery in a dry place where it will not be exposed to frost.

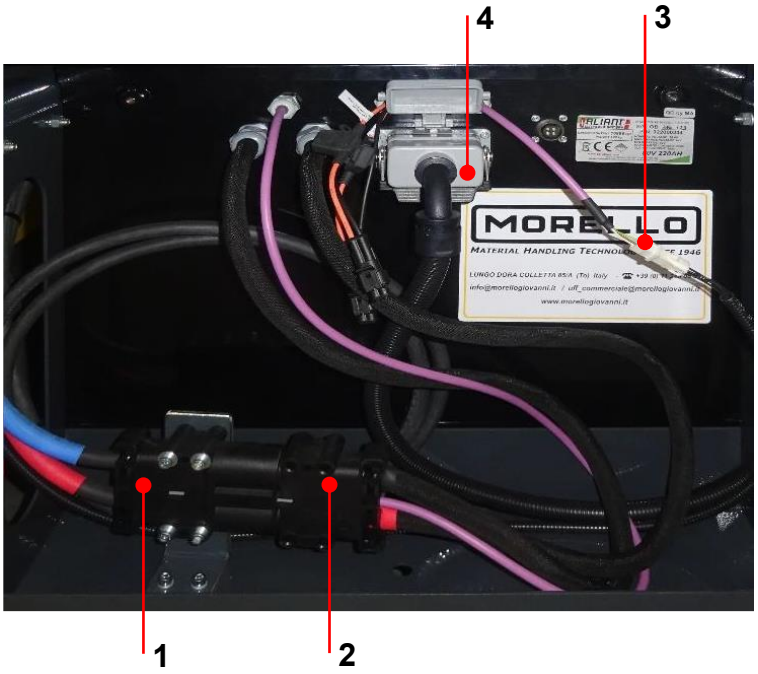
NOTE

The battery charge level decreases even if not used. Therefore, also in the case of no use, recharge the battery periodically (at least once a week), to avoid slowly dropping under the indicated threshold.

6.6.3 Battery removal

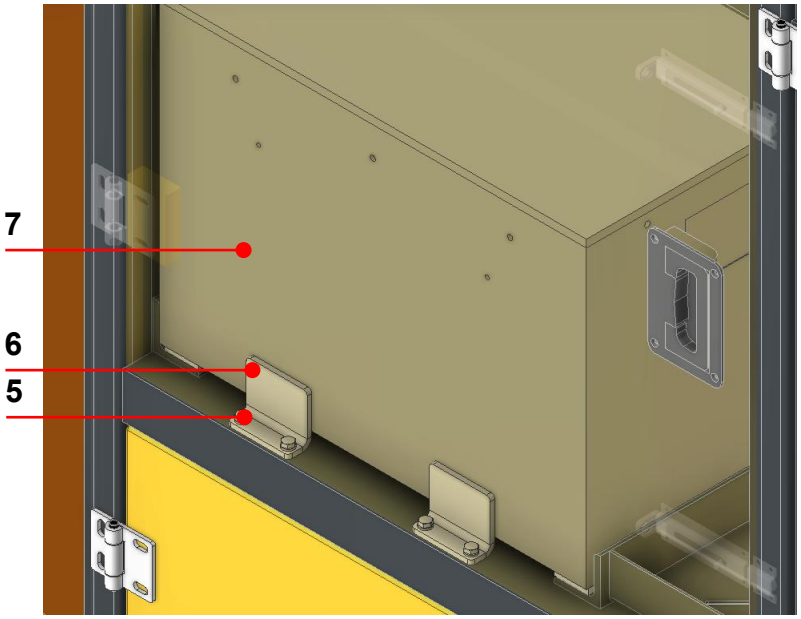
To remove the battery, proceed as follows:

- Interrupt the power supply to the machine by turning the voltage cut-off key switch, located on the control panel, to position (0). Remove the key.
- Open the battery compartment access door.
- Disconnect the machine's power plug **(1)** from the battery socket **(2)**.
- Disconnect the battery display cable **(3)** and the PLC connector **(4)** (connected to the battery).



Exampe image for only illustrative purposes

- Unscrew the four screws **(5)** with washers and remove the two clips **(6).**
- Position the forks of a suitable lifting device at the height of the battery **(7).**



- Manually remove the battery **(7)** by moving it onto the lifting equipment. The battery is fitted with sliding runners on the underside.
- Slowly lower the forks and transport the battery **(7),** taking care to avoid any sudden movements.

To reposition the battery, proceed in reverse order.

ADDITIONAL INFORMATION



For further information on battery handling, please refer to the accompanying manual.

6.6.4 Recharge of the battery

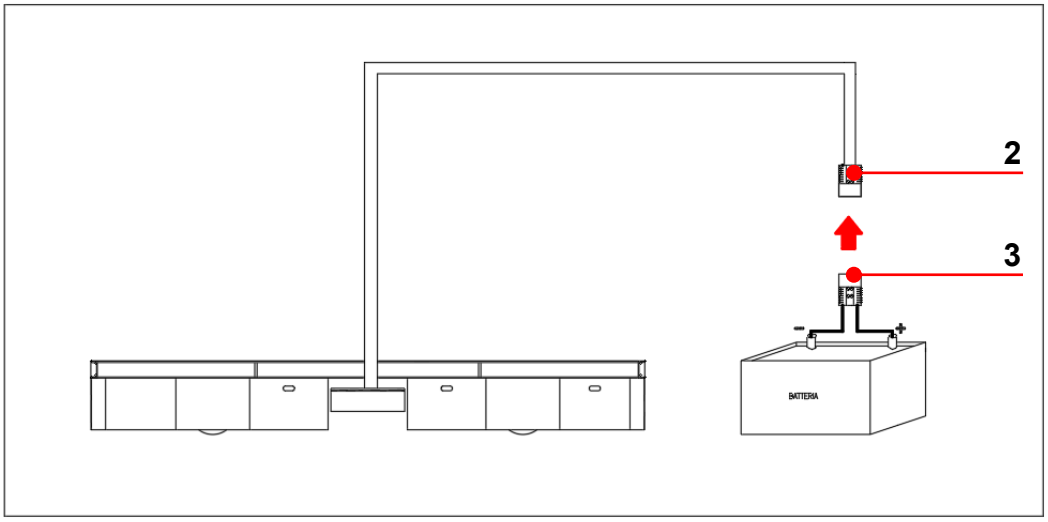
To recharge the battery, proceed as follows:

- Bring the machine to the charging area, observing the appropriate safety distances.
- Switch off the power supply to the machine by turning the key switch **(1)**, located on the electrical panel, to position (0). Remove the key.

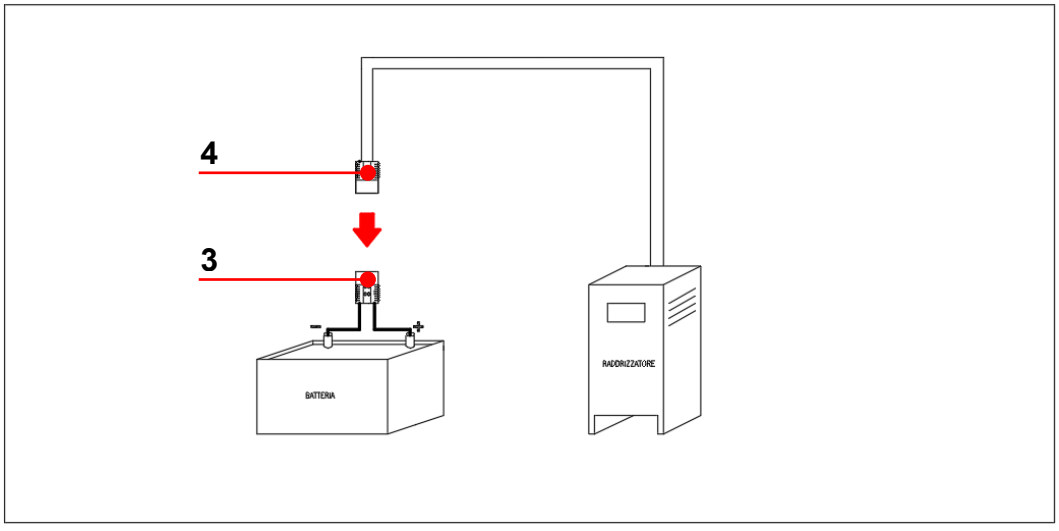


Key selector switch (1)

- Disconnect the power plug **(2)** of the machine from the socket **(3)** of the battery.

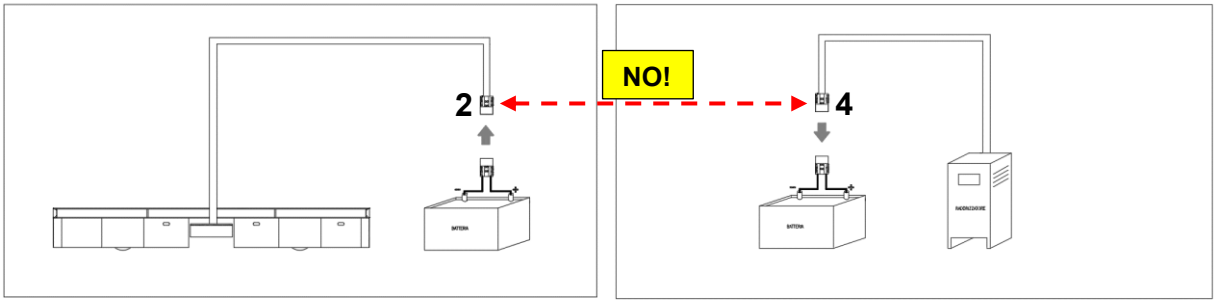


- Connect the plug **(4)** of the rectifier to the socket **(3)** of the battery.

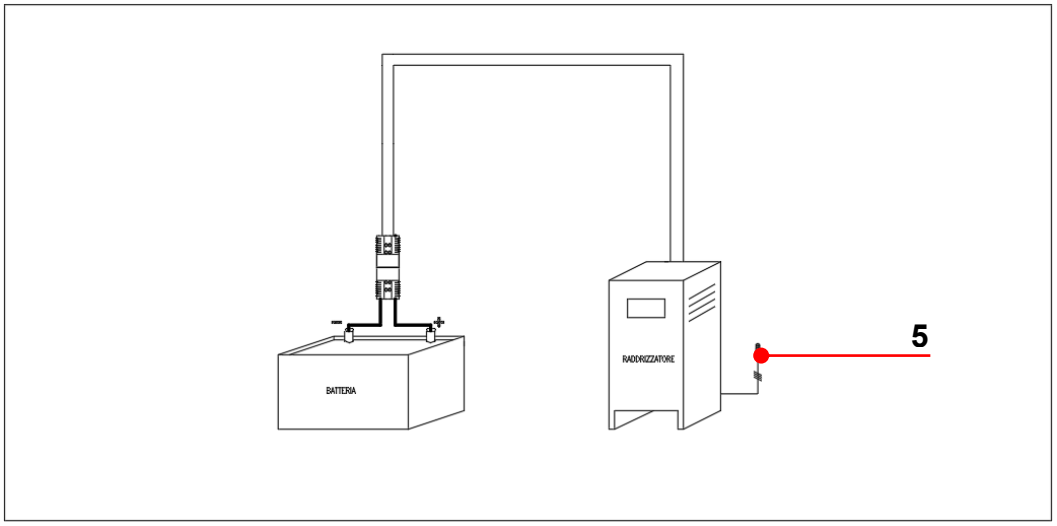


NOTE

It is forbidden to connect the plug **(4)** of the rectifier to the plug **(2)** of the machine's power supply (coming out of the on-board electrical panel).



- Connect the plug **(5)** of the rectifier to the electric mains.



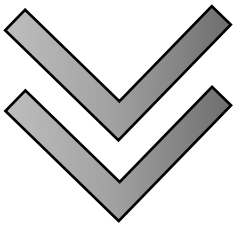
- Operate the battery charging rectifier by turning the switch to ON.
- Wait for the battery to recharge.

When recharging is complete, proceed backwards.

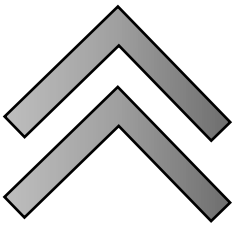
ADDITIONAL INFORMATION

For more information on recharging the battery through the rectifier, please refer to the accompanying manual.

SELF-PROPELLED ELECTRONIC TROLLEY WITH TYRES
Serial numbers 2750/1 - 2750/2



MAINTENANCE



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7. MAINTENANCE

7.1 GENERAL SAFETY PRECAUTIONS

Maintenance, troubleshooting and repairs are only to be carried out by the authorised technicians.

The persons assigned to use and maintenance of the machine are to be well trained and have in-depth knowledge of accident-prevention standards. Unauthorized personnel must remain outside of the work area during operations.

The safety precautions contained in this paragraph shall always be strictly observed, during the conduct and maintenance of the machine, in order to avoid damage to personnel and equipment.

At the end of each maintenance operation is required to restore the protections, verifying the correct functioning.

7.1.1 General hazards

- High voltages can cause death upon contact. Always operate with extreme caution and following the accident-prevention standards in force in the country.
- When the machine is functioning there are moving parts that can cause serious harm to persons. Therefore, the cleaning and specialised maintenance operations regarding disassembly or replacement of components on the machine and on the control unit, are to be carried out with the system off.
- Place specific warning notices (“MACHINE BEING SERVICED – DO NOT POWER-ON”) near the electric panel/s.
- Do not used inflammable or harmful solvents.
- Always wear protective goggles and gloves when carrying out maintenance on the equipment.
- Make sure that the tools to be used are in perfect condition and have insulated grips, where required.
- Check that the isolation of cables and conductors of testing equipment has no signs of breakage or damage.
- Lack of equipment connection to ground can cause serious harm to persons. Always make sure the ground is connected and that it complies to the standards.
- Long overloads or failures can cause overheating of electric motors and electrical equipment developing harmful fumes; immediately cut-out the power supply for safety and do not approach the equipment before dispersing the fumes by means of appropriate ventilation. Do not inhale residual fumes inside the equipment during the repair operations.
- In the event of fire, never spray water on the equipment; cut-out all power supplies and use CO_2 extinguishers.
- Avoid prolonged, excessive or repeated contact of the skin with lubrication products and change clothes immediately if they become impregnated, because lubricants are very hazardous for the skin.
- Do not handle lubricants (such as oils, greases, etc) where there are electric sparks and/or naked flames.

WARNING



Lubricants are inflammable products; follow the indications on the containers

- Before making connections, carefully inspect all fittings and ensure that there is no dirt or defects on the threads.
- Before pressurizing systems following repair work, check that fittings and joints are tightened correctly.
- Always make sure, before setting the machine in operation, that no tools or materials have been left near the equipment.
- Do not wear items that could become entangled in the equipment, or act as conductors (chains, bracelets, etc.).
- Maintenance, repair and troubleshooting operations are to terminate with verification of correct machine functioning and restoration of all safety devices.

7.1.2 General warnings

- Machine maximum reliability and minimum maintenance costs are the result of planned maintenance and inspection schedules, scrupulously followed during the entire machine life. Scrupulously observe the set maintenance time intervals and program the operations according to the specific requirements.
- It is advised, should major operations be necessary, to contact the Manufacturer for any explanations regarding the project or for technical assistance.
- Before starting to check and maintenance operations, remove any dirt from the machine.
- Always use perfectly dry air for cleaning and with a pressure not over 0.2 Mpa.
- Always use tools in perfect condition and that are specifically for the operation to be performed; use of inappropriate and/or inefficient equipment can cause serious damage.
- During disassembly, mark the separate parts with an identity tag to ensure the correct reassembly.
- After every maintenance operation that requires disconnection of cables and/or fixed and mobile parts, check that the number/tag on the fixed and on the mobile part coincide.
- Before resetting the equipment in operation after a failure, it is to be carefully inspected and checked to highlight any damage.
- Never act, unless following a failure, on adjustments and position of limit switch microswitches, where installed: tampering with them can cause serious damage.
- Always take utmost care when checking lubrication on machine components, because insufficient or defective greasing can jeopardise correct functioning.
- For lubrication, use only the recommended lubricants, or those with equivalent properties and of a known and proven quality.
- The lubricants used are to have a good emulsion stability and be unalterable with age.
- It is absolutely necessary to continue to use the same lubricants as used for the first filling.
- Upon completion of the normal maintenance activities, the maintenance technicians are to carry out, when foreseen, also predictive instrumental maintenance operations consisting in analysis and specialistic controls to predict, over time, breakdowns that can occur in certain machine components.

7.2 QUALIFICATION OF MAINTENANCE TECHNICIANS

CAUTION



The Security Officer will ensure that all persons operating on the machine have received all their instructions contained in this manual.

7.2.1 General skills

To be up to the ever-increasing qualifications needed in the field of maintenance, the maintenance technicians must have the following requisites:

- be aware of the standards in force regarding prevention of accidents, and be able to apply them,
- have read and understood the “Safety” chapter,
- know the basic structure and functions of the machine,
- know how to use and refer to the manufacturing papers and machine documentation,
- assume the responsibility to make autonomous decisions regarding interventions on the machine,
- be willing to adapt to technological changes on the machine,
- note irregularities and, where appropriate, take the necessary measures.

7.3 PROCEDURE TO STOP MACHINE

WARNING

Maintenance work must be carried out with the load removed and the platform in the fully lowered position.

Before starting maintenance operations, the operator is to stop the machine and set it in maintenance state following this procedure:

- Cut-out the machine power supply sources, if required by the maintenance operation to be carried out. Otherwise, this is not necessary.

NOTE

To deactivate and cut-out the electrical supply:

- Switch off the machine following the indications contained in the paragraph “Shutting-down the machine”.
- Disconnect the machine power supply plug from the battery socket.

- Place the notice “DO NOT EXECUTE MOVEMENTS – MACHINE BEING SERVICED” on the electric panel near the power-on selector.



After the maintenance operations, restore the previously deactivated electrical supply.

Before resuming normal machine functioning, check the entire system again following the start-up procedure indicated in this manual.

NOTE

After every maintenance operation check correct machine functioning.

7.4 MACHINE PROCEDURE FOR MAINTENANCE POSITIONING

The following paragraph provides indications for the positioning of the machine on appropriate resting supports (maintenance-aid devices) for the maintenance operations where they are required.

Before lifting the machine, the Customer is to procure two suitable maintenance-aid devices, to place the machine.

WARNING



The Manufacturer shall not be held in any way liable if unsuitable devices are used.

The main purpose of the maintenance-aid devices is to stabilize the suspended trolley; therefore, the lifting device and the chains are to remain tensioned.

To position the machine on the devices, three operators are necessary:

- One operator in charge of the lifting device;
- One operator in charge of the maintenance-aid devices;
- One operator to ensure correct positioning of the machine on the maintenance-aid devices.

WARNING



Before lifting the machine, place the two maintenance-aid devices in an appropriate and segregated area, to which unauthorized persons are not permitted access.

NOTE



Before starting the lifting, operations check that the lifting devices have an adequate grip and that all the operators are equipped with personal protection devices (DPI).

To prepare the machine for maintenance proceed as follows:

- Stop the machine and cut-out the power supply, following the procedure indicated in **paragraph 7.3** “Procedure to stop machine”.
- If necessary, remove the protective perimeter casing using the specific wrench.
- Lift the machine, following the procedure indicated in **paragraph 4.3.3** “Machine lifting”.

NOTE



Always check correct machine balancing. If it is unbalanced, rest it on the ground immediately and correctly reposition the chains.

- Transfer it, avoiding abrupt movements.
- Visually check that the machine resting points are aligned with the maintenance-aid devices.
- If necessary, correct the position of the devices.
- Rest the machine on these devices, avoiding abrupt movements, and check they are perfectly in contact with the frame.

CAUTION

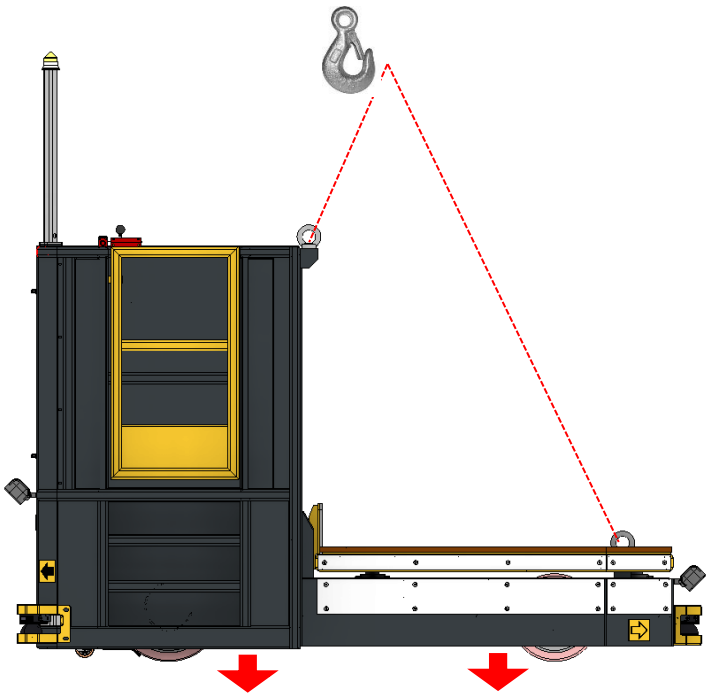


The lifting equipment operator is to pay careful attention to avoid collisions against the devices when positioning the machine.

- Keep the lifting chains tensioned during the entire maintenance operations.

After the maintenance has been completed, slowly lift the machine, place it on the ground (following the indications contained in the paragraph regarding lifting) and refit any casings that were previously removed.

POSITIONING OF THE MACHINE ON SERVICE DEVICES





Example image of an assistive device

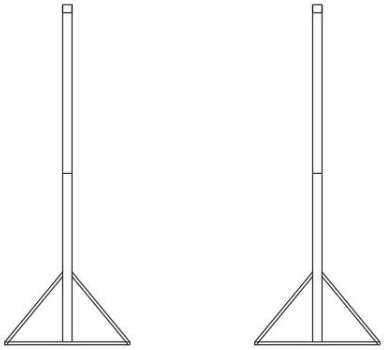


Image for illustration purposes only

7.5 CONTROL PLAN ON SAFETY

WARNING



It is strictly forbidden to electrically or mechanically bridge the safety switches of the safety circuits or tamper with them in any way.

CAUTION



Periodically check the efficiency of security systems on the machine. This procedure must be repeated as normal maintenance practices.

7.5.1 Checks and functional tests on safety devices

The maintenance technicians have the obligation to periodically check the functioning of the safety devices.

The operation is to be carried out by skilled technicians who have specific knowledge regarding the uses of the safety devices.

CAUTION



Carry out the functional, tightness and positioning checks of the safety systems as indicated in chapter 2.

7.6 MAINTENANCE FREQUENCY

To ensure machine reliability, regular and efficient maintenance is necessary and a constant control of the indicator instrument parameters. Maintenance, troubleshooting and repairs are only to be carried out by the authorised technicians.

FREQUENCY	DESCRIPTION
Every week	Full battery charge cycle.
Every week	Check that the horn, the warning buzzer, the indicator light and the spotlights are working properly.
Every week	Check the correct functioning of the hold-to-run levers.
Every week	Visually check that there are no hydraulic leaks from the pipes or cylinders.
Every week	Check that the laser scanners are correctly connected, securely fastened and functioning properly. Clean the laser scanner sensor with a suitable cloth. For further information, please refer to the relevant manual.
Every month	Clean the wheels, the load floor, the spotlights and the lamp.
Every month	Clean the pushbutton panel on the electrical panel, the radio-control and the wired control panel.
Every month	Check that the encoder, limit switches, spotlights and lamp are correctly connected and tightened.
Every month	Check the correct functioning of the limit switches.
Every month	Check that the turntable moves smoothly. In the event of anomalies, contact the manufacturer.
Every month	Check that the discharge chain is correctly attached to the ground.
Every month	Check that the pressure in the hydraulic circuit corresponds to that shown in the relevant diagram.
Every three months	Check that the hydraulic fittings are properly tightened. Check that the hoses do not have any excessively tight bends, kinks or abrasions.
Every three months	Check that the cylinders are securely fastened and undamaged.
Every three months	Check that there are no signs of wear or damage to the polyethylene and wooden protective covers.
Every six months	Perform a general visual check of the various groups that make up the machine, verifying that there are no mechanical anomalies.

FREQUENCY	DESCRIPTION
Annual	Check tightness of all nuts and bolts.
Annual	Check there are no signs of wear, damage or mechanical faults on the wheels. If necessary, contact the Manufacturer for the replacement.

ADDITIONAL INFORMATION



For information regarding maintenance of commercial devices incorporated, see the relevant manuals.

ADDITIONAL INFORMATION



For information on maintaining the filters in the hydraulic power unit, please refer to the relevant manual.

NOTE



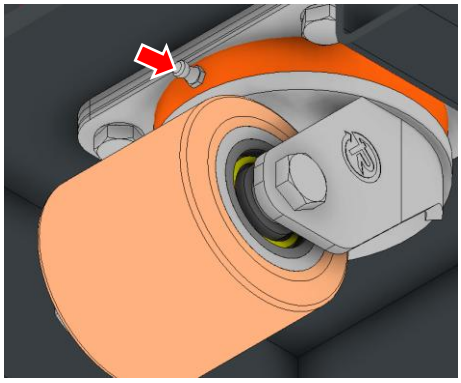
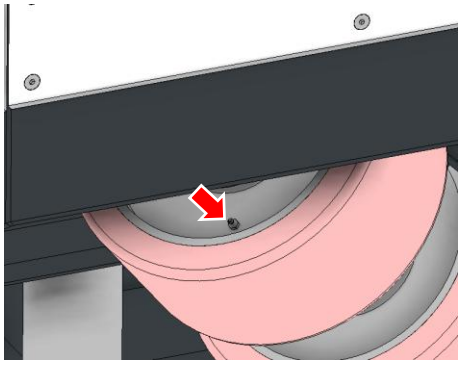
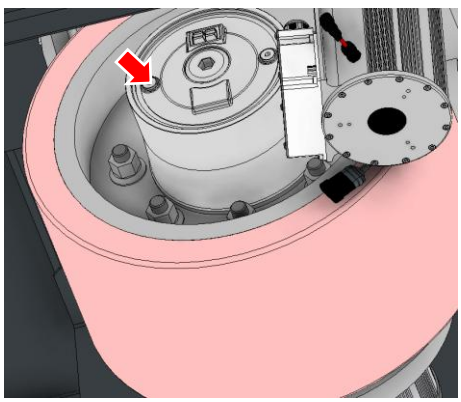
For information regarding replacement procedures, contact the Manufacturer.

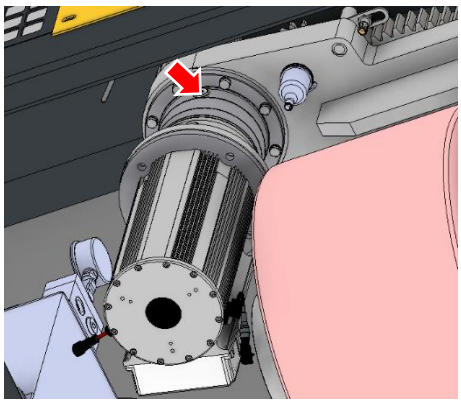
7.7 LUBRICATION

Before carrying out lubrication operations, stop the machine, cut-out the power supply and prepare it for maintenance as indicated in **paragraph 7.3** “Procedure to stop the machine”. If necessary, remove the outer casings (and reassemble them at the end of operations).

Where necessary, prepare the machine for maintenance as described in **paragraph 7.4** "Machine procedure for maintenance positioning”.

The following table indicates the machine points to be lubricated.

FREQUENCY	COMPONENT	IMAGE	METHOD
Every three months for the first year, then every six months	Pivoting idler wheel bearings		Insert grease into the nozzles with a grease gun. Use TRIBOL GR 4020/220-2 PD grease or equivalent
Every three months for the first year, then every six months	Idler wheel bearings		Insert grease into the nozzles with a grease gun. Use TRIBOL GR 4020/220-2 PD grease or equivalent
-	Drive reduction gearbox		For information on lubrication of the gearbox, refer to the accompanying manual and the nameplate affixed to the gearbox. Use the oil specified in the relevant manual.

FREQUENCY	COMPONENT	IMAGE	METHOD
-	Steering gearbox		For information on lubrication of the gearbox, refer to the accompanying manual and the nameplate affixed to the gearbox. Use the oil specified in the relevant manual.

NOTE

Never mix oils/greases of different types and/or brands.

Waste oil is a special waste and has to be disposed of by authorised consortiums.

NOTE

Use of a type of oil/grease that is not equivalent to that indicated annuls the warranty in the case of failures and/or breakdowns.

7.8 TIGHTNESS CHECK

The following table indicates the tightening torques for each screw dimension. Table A relates to the tightening of wheel nuts, whilst Table B applies to the remaining screws on the machine.

ADDITIONAL INFORMATION



To tighten, use a torque wrench.

NOTE



Carry out a check after the first month of machine use and annually thereafter.

NOTE



When tightening the wheel nuts, work diagonally.

Table A

Ø Screw	Fine-grained	Cross-section	Coefficient of friction	Classes of fine-pitch fasteners											
				4.8		5.8		6.8		8.8		10.9		12.9	
				preload	Tightening torque	preload	Tightening torque	preload	Tightening torque	preload	Tightening torque	preload	Tightening torque	preload	Tightening torque
	mm	mm²		N	Nm	N	Nm	N	Nm	N	Nm	N	Nm	N	Nm
M8	1	39,2	0,10	9758,1	**10,87**	12247,6	**13,59**	14697,1	**16,31**	19596,1	**21,75**	27557,1	**30,58**	33068,5	**36,70**
			0,14	9079,5	**13,53**	11349,4	**16,91**	13619,3	**20,29**	18159,1	**27,05**	25536,2	**38,04**	30643,4	**45,65**
M10	1,25	61,2	0,10	15296,9	**21,13**	19121,1	**26,41**	22945,3	**31,69**	30593,8	**42,25**	43022,5	**59,42**	31627,0	**71,30**
			0,14	14175,0	**25,27**	17718,8	**32,84**	21262,6	**39,41**	28350,1	**52,55**	39867,3	**73,89**	47840,8	**88,67**
M10	1	64,5	0,10	16383,6	**22,12**	20479,5	**27,66**	24575,4	**33,19**	32767,2	**44,25**	46078,8	**62,23**	55294,6	**74,67**
			0,14	15221,6	**27,80**	19027,0	**34,75**	22832,5	**41,70**	30443,3	**55,61**	42810,8	**78,20**	51373,0	**93,84**
M12	1,50	88,1	0,10	22020,7	**35,83**	27525,9	**44,79**	33031,0	**53,75**	44041,4	**74,51**	65626,1	**104,78**	78751,3	**125,74**
			0,14	20405,8	**44,53**	25507,2	**55,66**	30608,7	**68,79**	40811,6	**93,41**	60944,6	**131,36**	73133,5	**157,63**
M12	1,25	92,1	0,10	23333,7	**37,26**	29167,1	**55,88**	35000,6	**74,51**	78751,3	**104,78**	78751,3	**104,70**	78751,3	**125,74**
			0,14	21669,2	**45,70**	27086,5	**70,06**	32503,8	**93,41**	73133,5	**131,36**	73133,5	**121,36**	73133,5	**157,83**
M14	1,50	125	0,10	31610,0	**59,04**	39512,5	**73,80**	47415,0	**88,57**	63220,0	**118,09**	88903,1	**166,06**	106683,7	**199,27**
			0,14	29345,9	**73,92**	36682,4	**92,40**	44018,9	**110,89**	58691,9	**147,85**	82535,4	**207,91**	99042,5	**249,49**
M16	1,50	167	0,10	42581,3	**89,78**	53226,6	**112,33**	63871,9	**134,67**	85162,5	**179,56**	119759,8	**252,51**	143711,8	**303,02**
			0,14	39587,8	**113,06**	49484,7	**141,32**	59381,6	**169,59**	79175,5	**226,12**	111340,6	**317,98**	133608,7	**381,57**
M18	2	204	0,10	51457,2	**124,03**	64321,5	**155,03**	77185,8	**186,04**	102914,4	**248,06**	144723,3	**343,83**	173568,0	**418,59**
			0,14	47751,7	**155,02**	59689,6	**193,78**	71627,5	**232,53**	95503,3	**310,05**	134301,6	**436,00**	161161,9	**523,20**
M18	1,50	216	0,10	55415,1	**130,17**	69268,9	**162,72**	83122,7	**195,26**	110830,3	**260,35**	155855,1	**366,12**	187026,1	**439,34**
			0,14	51577,6	**164,67**	64472,0	**205,84**	77356,4	**247,01**	103155,2	**329,35**	145062,1	**463,15**	174074,5	**555,77**
M20	2	258	0,10	65534,1	**173,72**	81917,7	**217,16**	98301,2	**260,59**	131068,3	**347,45**	184314,8	**488,60**	221177,8	**586,32**
			0,14	60886,2	**218,17**	76107,8	**272,71**	91329,3	**327,26**	121772,4	**436,34**	171242,5	**613,61**	205491,0	**736,33**
M20	1,50	272	0,10	70114,7	**181,58**	87643,3	**226,97**	105172,0	**272,36**	140229,3	**363,15**	197197,5	**510,68**	236637,0	**612,82**
			0,14	65319,1	**230,55**	81648,4	**288,19**	97978,6	**345,82**	130638,1	**461,10**	183709,9	**648,42**	220451,9	**778,10**
M22	2	318	0,10	81220,8	**236,88**	101526,0	**296,10**	121831,2	**355,32**	162441,5	**473,76**	228433,4	**666,23**	274120,1	**799,48**
			0,14	75533,9	**298,75**	94417,4	**373,43**	113300,9	**448,12**	151067,8	**597,49**	212439,1	**880,22**	254927,0	**1001,27**
M22	1,50	333	0,10	86164,2	**246,02**	107705,3	**307,53**	129246,4	**359,04**	172328,5	**492,05**	242337,0	**691,94**	290804,3	**830,33**
			0,14	80331,8	**313,41**	100414,7	**391,76**	120497,7	**470,11**	160663,6	**626,82**	225933,2	**881,46**	271119,8	**1057,75**
M24	2	384	0,10	98515,6	**308,56**	123144,5	**385,70**	147773,4	**462,84**	197031,1	**617,12**	277075,0	**867,83**	332490,0	**1041,40**
			0,14	91693,3	**390,33**	114616,6	**487,92**	137539,9	**585,50**	183386,5	**780,67**	257887,3	**1097,82**	309464,8	**1371,38**
M24	1,50	401	0,10	104079,4	**316,62**	130099,2	**399,52**	156119,0	**479,43**	208158,7	**639,23**	292723,2	**898,92**	351267,9	**1078,71**
			0,14	97096,0	**408,12**	121370,1	**510,15**	145644,1	**612,18**	194192,1	**816,24**	273082,6	**1147,84**	327699,1	**1377,41**
M27	2	496	0,10	127922,3	**448,43**	159902,9	**560,54**	191883,5	**672,65**	255844,7	**896,37**	359781,6	**1251,22**	431737,9	**1513,46**
			0,14	119185,0	**569,67**	148981,3	**712,09**	178777,5	**854,51**	238370,1	**1139,34**	335207,9	**1602,20**	402249,5	**1922,64**
M30	2	621	0,10	160817,5	**623,80**	201021,8	**779,75**	241226,2	**935,70**	321635,0	**1247,60**	452299,2	**1754,43**	572759,0	**2105,32**
			0,14	149957,0	**795,14**	187445,3	**993,03**	224935,5	**1192,72**	299914,0	**1590,29**	421754,2	**2236,34**	506105,0	**2683,61**
M33	2	761	0,10	197716,9	**835,81**	247145,1	**1044,76**	296575,4	**1253,72**	395433,8	**1671,62**	556078,8	**2350,72**	667294,5	**2820,57**
			0,14	184490,1	**1058,24**	230512,6	**1335,30**	226735,1	**1602,36**	368980,2	**2135,49**	518878,4	**3004,43**	622654,0	**3505,32**
M36	3	865	0,10	221916,8	**1048,15**	277395,0	**1310,18**	332875,1	**1572,22**	443833,5	**2096,29**	624140,9	**2947,91**	748969,0	**3537,49**
			0,14	206548,9	**1326,13**	258186,2	**1657,66**	309823,4	**1989,19**	413097,9	**2652,26**	580918,9	**3729,74**	697102,7	**4475,68**

Ø Screw	Fine-grained	Cross-section	Coefficient of friction	Classes of fine-pitch fasteners											
				4.8		5.8		6.8		8.8		10.9		12.9	
				preload	Tightening torque	preload	Tightening torque	preload	Tightening torque	preload	Tightening torque	preload	Tightening torque	preload	Tightening torque
	mm	mm²		N	Nm	N	Nm	N	Nm	N	Nm	N	Nm	N	Nm
M39	3	1030	0,10	265219,6	**1351,70**	331524,5	**1689,63**	397829,5	**2027,56**	530439,3	**2703,41**	745930,2	**3801,67**	895116,2	**4562,00**
			0,14	247027,0	**1715,15**	308783,8	**2143,94**	370540,5	**2572,72**	494051,1	**3430,30**	694763,5	**4823,86**	833716,1	**5783,63**
M42	3	1210	0,10	312529,3	**1709,52**	390561,6	**2136,90**	468793,9	**2564,28**	625058,5	**3418,04**	878988,6	**4808,02**	1054786,0	**5769,62**
			0,14	291268,7	**2174,59**	364085,9	**2718,24**	436903,1	**3251,89**	582537,4	**4349,18**	819193,3	**6116,04**	983031,9	**7339,24**
M45	3	1400	0,10	36551,7	**2118,52**	453189,7	**2648,14**	543827,6	**3177,77**	725103,5	**4237,03**	1019677,0	**5958,33**	1223612,0	**7149,99**
			0,14	338057,8	**2700,72**	422584,7	**3375,90**	507101,7	**4051,08**	676135,5	**5401,43**	950815,6	**7595,77**	1140979,0	**9114,92**
M48	3	1600	0,10	415279,0	**2581,68**	519098,7	**3227,11**	622918,5	**3872,53**	830558,0	**5163,37**	1167972,0	**7260,99**	1401567,0	**8713,18**
			0,14	387415,3	**3297,46**	484269,2	**4121,83**	581123,0	**4946,20**	774830,6	**6594,93**	1089606,0	**9274,12**	1307527,0	**11128,94**
M52	3	1900	0,10	494405,2	**3299,14**	618005,5	**4123,92**	741607,8	**4948,71**	988810,4	**6598,28**	1390515,5	**9278,83**	1668618,0	**11134,60**
			0,14	461482,7	**4222,62**	576853,3	**5278,28**	692224,0	**6333,94**	922965,3	**8445,25**	1297920,0	**11876,13**	1557504,0	**14251,36**
M56	4	2140	0,10	552738,4	**4008,26**	690923,0	**5010,32**	829107,5	**6012,39**	1105477,0	**8016,51**	1554577,0	**11273,22**	1865492,0	**13527,87**
			0,14	515137,2	**5097,95**	643921,5	**6372,43**	772705,8	**7646,92**	1030274,0	**10195,89**	1448823,0	**14337,98**	1738588,0	**17205,57**
M60	4	2480	0,10	642235,1	**4950,24**	802793,9	**6187,80**	863352,7	**7425,36**	1284470,0	**9800,49**	1806286,0	**13922,56**	2167544,0	**16707,07**
			0,14	598863,8	**6309,01**	748579,8	**7886,27**	898295,7	**9463,52**	1197728,0	**12618,02**	1684304,0	**17744,10**	2021165,0	**21292,92**
M64	4	2850	0,10	739716,3	**6039,07**	924545,4	**7548,84**	1109574,0	**9058,60**	1479433,0	**12078,14**	2080452,0	**16934,88**	2496543,0	**20381,86**
			0,14	690084,3	**7710,76**	862605,3	**9638,45**	1035126,0	**11566,14**	1380169,0	**15421,52**	1940852,0	**21686,51**	2329034,0	**25023,81**
M68	4	3240	0,10	842588,5	**7253,31**	1063236,0	**9079,14**	1263883,0	**10894,97**	1685177,0	**14526,52**	2369780,0	**20428,06**	2843735,0	**24513,58**
			0,14	786380,1	**9288,98**	982975,1	**11611,23**	1179570,0	**13933,47**	1572760,0	**18577,96**	2211694,0	**26125,26**	2654033,0	**21350,31**

Table B

Ø Screw	Screw pitch	Pre-tightening torque [kgm]	Tightening torque [kgm]
M6	1	0,75	1
M8	1,25	1,8	2,4
M10	1,5	3,6	4,8
M12	1,75	6,5	8,5
M14	2	10	13
M16	2	15	20,5
M18	2,5	22	29
M20	2,5	30	40
M22	2,5	42	56
M24	3	50	70
M27	3	80	105
M30	3,5	95	130

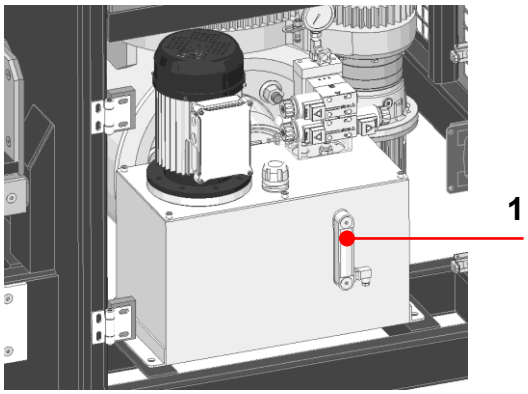
7.9 HYDRAULIC UNIT

WARNING

Before performing maintenance operations, stop the machine and cut off the power supply, as described in **paragraph 7.3** "Procedure to stop the machine".

If necessary, prepare the machine for maintenance as described in **paragraph 7.4** 'Preparing the machine for maintenance'".

Check the oil level regularly via the oil level gauge **(1)** on the tank. For the procedure for topping up the oil, see section 'Filling the hydraulic pump tank".



NOTE

Do not start the machine if the oil is below the minimum level.

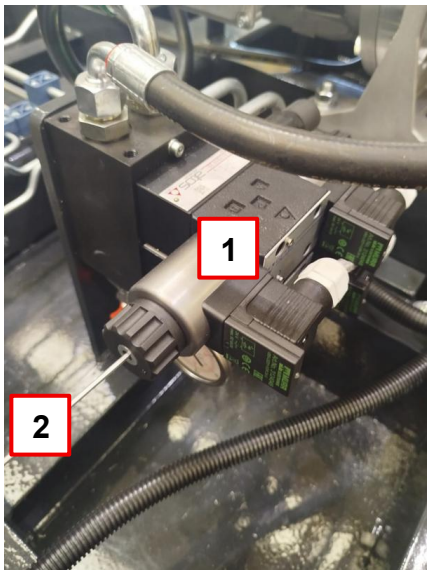
ADDITIONAL INFORMATION

For further information on hydraulic system maintenance, please refer to the hydraulic control unit manual attached.

7.9.1 Oil cleaning procedure

If necessary, change the hydraulic oil as follows:

- Stop the machine and switch off the power supply.
- Access the oil reservoir.
- Remove the fuel tank filler cap and its filter.
- Connect a suitable transfer pump (fitted with filters) to the tank, at the point where the cap has been removed, to allow the oil to be drawn out of the circuit.
- Connect the pump to an oil collection drum.
- Start drawing oil from the machine's hydraulic circuit.
- Run the cycle in reverse to refill the machine's circuit.
- Circulate the oil for about two hours.
- Move the steering cylinder periodically to change the oil in the pipes. To move the cylinder, you need to mechanically actuate the relevant solenoid valve **(1)** by moving the spool with a screwdriver **(2).**



Example image

When you have finished, disconnect the pump and replace the cap with the filter.

NOTE

If the problem persists, you should clean any dirt build-up from the solenoid valve housing that controls the steering cylinder.

7.9.2 Oil change procedure

To change the hydraulic oil, proceed as follows:

- Stop the machine and switch off the power supply.
- Access the oil reservoir.
- Remove the fuel tank filler cap and its filter.
- Connect a suitable transfer pump to the tank, at the point where the cap has been removed, to allow the oil to be drawn out of the circuit.
- Connect the pump to an oil collection drum.
- Connect the pump to an oil collection drum.
- Move the steering cylinder periodically to drain the pipes. To move the cylinder, you must mechanically actuate the relevant solenoid valve **(1)** by moving the spool with a screwdriver **(2)**.

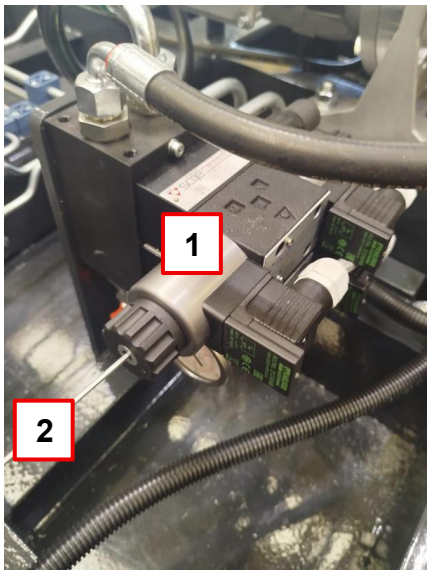


Image example

- After draining the system, connect the pump to the drum containing the new oil and to the tank, and proceed with the transfer.

When you have finished, disconnect the pump and replace the cap with the filter.

7.10 MAINTENANCE SHEET

Record all the maintenance operations in a specific logbook, for which an example follows.

DATE	OPERATOR	DESCRIPTION OF OPERATION

7.11 SPARE PARTS

A spare parts list follows. The letter “U” indicates parts subject to wear that it is recommended to keep in stock, whereas the letter “R” indicates those which could break (for which it is necessary to contact the Manufacturer).

NOTE



Use only original spare parts. Replacement with parts that are not originals could jeopardise machine functioning.

NOTE



The spare parts are to be kept clean, lubricated and stored in appropriate containers to preserve the integrity over time.

7.11.1 Mechanical spare parts

U / R	Description	Manufacturer	Quantity installed	Quantity recommended
U	Motorised polyurethane wheel Ø 500 x 280 mm code M_RTE_PLM_0043	MORELLO	1	1
U	Idler wheel made of polyurethane Ø 400 x 200 mm code M_RTE_PLF_0033	MORELLO	4	1
U	Polyurethane swivel castor Ø 85 x 80 mm code TPAC 85.80 P4	OMG	2	1
R	Ring nut KM16	SKF	4	-
R	Washer MB16	SKF	4	-
R	Dust cover 80x125x3	MORELLO	8	-
R	Steering gear motor AC 80V 3.000W 2.800rpm code AGX135.150.004	CFR	1	-
R	Traction motor AC 80V 12.000W 1.600rpm code AMX200.190.022	CFR	1	-
R	Reduction unit (traction) code RRWDB800D/53,00 LC-KC (DG-3731-C)	REGGIANA	1	-
R	Shaft for engine coupling (AMX200.190.022) code 90.X0142	CFR	1	-
R	Fifth wheel code M_CSC_RLM_0114	MORELLO	1	-
R	Pinion m=5 Z=35 code M_MTR_PRT_0346	MORELLO	1	-
R	Toothed wheel encoder m=5 Z=15 km=0,5	MORELLO	1	-

U / R	Description	Manufacturer	Quantity installed	Quantity recommended
R	Internal clamping device code TLK350 10X20	TOLLOK	1	-
U	Rigid ball bearing code 6201-2RSL (12x32x10)	SKF	2	1
U	Taper roller bearing 32016X code (80x125x29)	SKF	8	2
U	Bushing DU 45x50x40 type GLY.PG 455040 F	FEDERAL MOGUL	4	1
U	Bushing DU 45x50x50 type GLY.PG 455050 F	FEDERAL MOGUL	4	1
U	Polizene panel code 2750_A2A_GN002	MORELLO	2	1
U	Polizene panel code 2750_A2A_GN004	MORELLO	2	1
U	Polizene panel code 2750_A2A_GN005	MORELLO	1	1
U	Polizene panel code 2750_A1A_GN019	MORELLO	2	1
U	Polizene panel code 2750_A1A_GN016	MORELLO	2	1
U	Polizene panel code 2750_A1A_GN009	MORELLO	2	1
U	Wooden panel CARPLY code 2750_A2A_GN006	MORELLO	1	1
U	Wooden panel CARPLY code 2750_A2A_GN007	MORELLO	1	1
R	Double-acting cylinder – BORE 100 mm STEM Ø 60 mm STROKE 110 mm code M_CIL_IDR_0232	MORELLO	4	-

7.11.2 Electrical spare parts

U / R	Description	Manufacturer	Quantity installed	Quantity recommended
R	LITHIUM battery 80 V 220 Ah	ALIANT	1	-
R	Rectifier code CB80100 G6 UL	ALIANT	1	-
R	Inductive sensor code IFS340	IFM	2	-
R	Hollow-shaft multi-turn absolute encoder code RM8004	IFM	1	-
R	Laser scanner I/O field 4m code MICS3-AAAZ40AZ1P01	SICK	3	-
R	Flashing yellow code CTL600	SIRENA	1	-

U / R	Description	Manufacturer	Quantity installed	Quantity recommended
R	Actuator code XCSZ05	SCHNEIDER ELECTRIC	1	-
R	Safety switch code XCSB702	SCHNEIDER ELECTRIC	1	-
R	Traction motor controller 1236SE-6521 48-80V 450A	CURTIS	1	-
R	Steering motor controller 1232E-6221 48-80V 175A	CURTIS	1	-
R	Pump motor controller 1232E-6221 48-80V 175A	CURTIS	1	-

7.11.3 Hydraulic spare parts

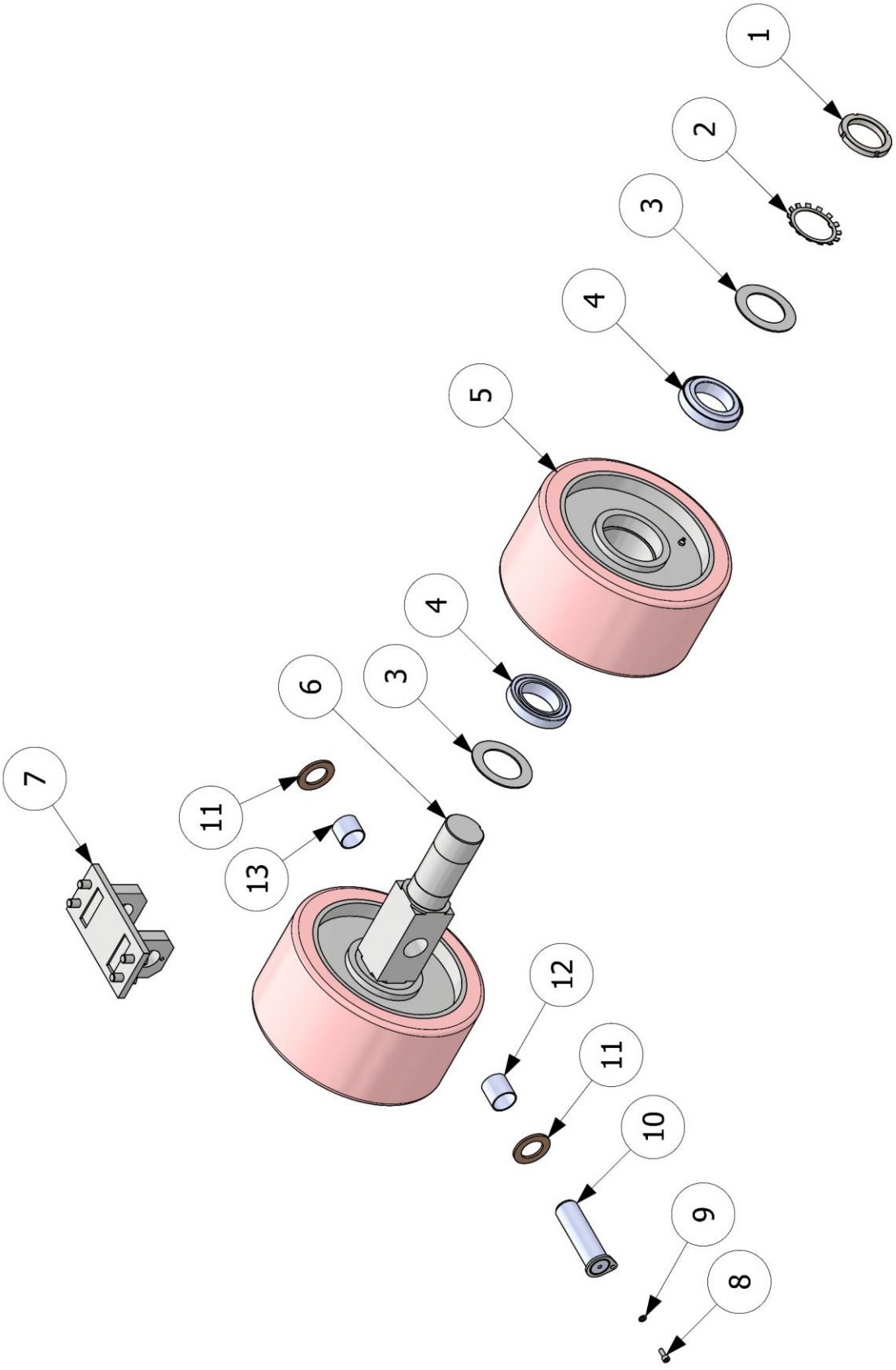
ADDITIONAL INFORMATION

For a list of hydraulic spare parts, please refer to the enclosed group manual.

7.12 EXPLODED DRAWINGS

7.12.1 Idler wheel assembly

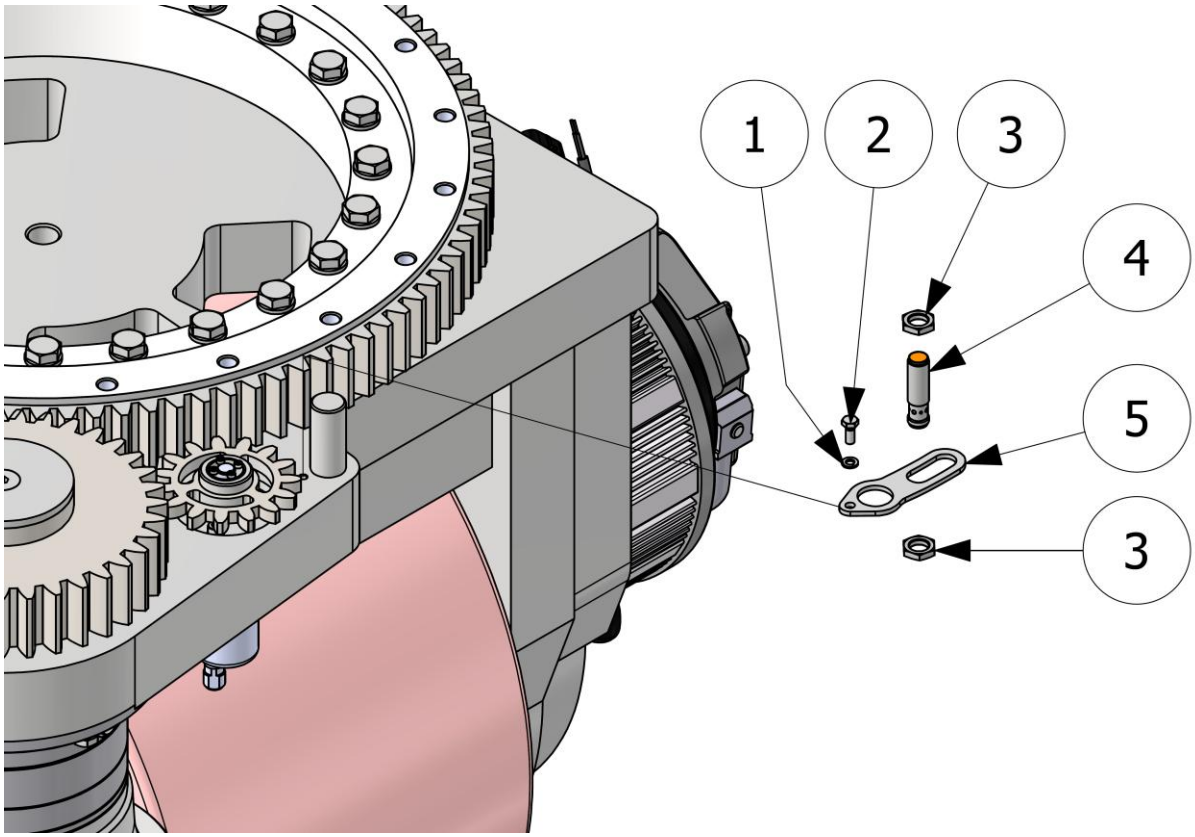
Pos.	Description	Quantity
1	Ring nut KM16	2
2	Washer MB16	2
3	Dust cover 80x125x3	4
4	Taper roller bearing 32016X code (80x125x29)	4
5	Idler wheel made of polyurethane Ø 400 x 200 mm code M_RTE_PLF_0033	2
6	Axle	1
7	Axle-end mounting bracket	1
8	Cylinder head screws M8x20	2
9	Open spring washer M8	2
10	Pin	2
11	Shim 45 75 5	4
12	Bushing DU 45x50x50 type GLY.PG 455050 F	2
13	Bushing DU 45x50x40 type GLY.PG 455040 F	2


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7.12.2 Motor wheel assembly

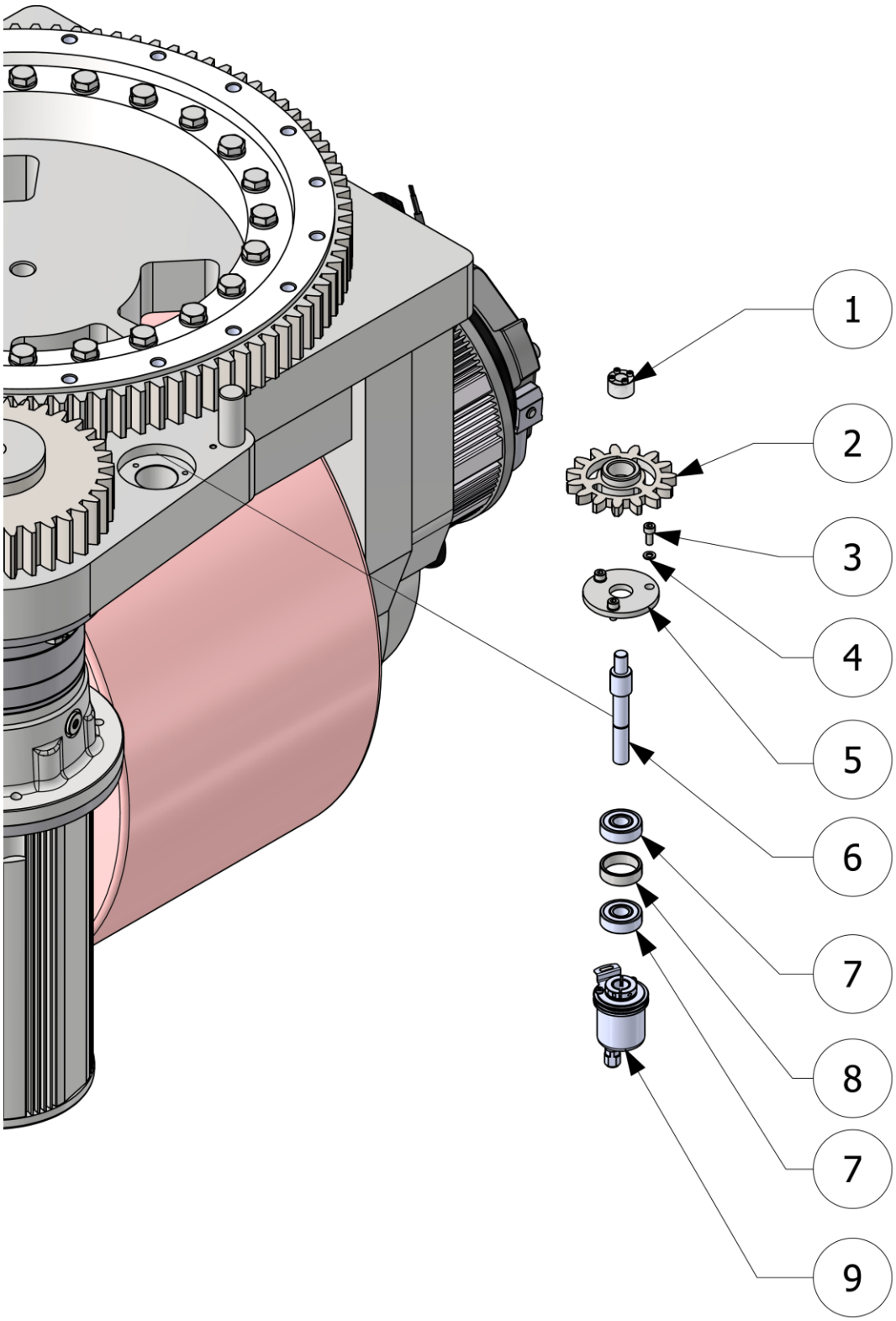
LIMIT SWITCH

Pos.	Description	Quantity
1	Open spring washer M5	2
2	Hex head screw M5x12	2
3	Nut M12	4
4	Inductive sensor code IFS340	2
5	Fastening plate	2


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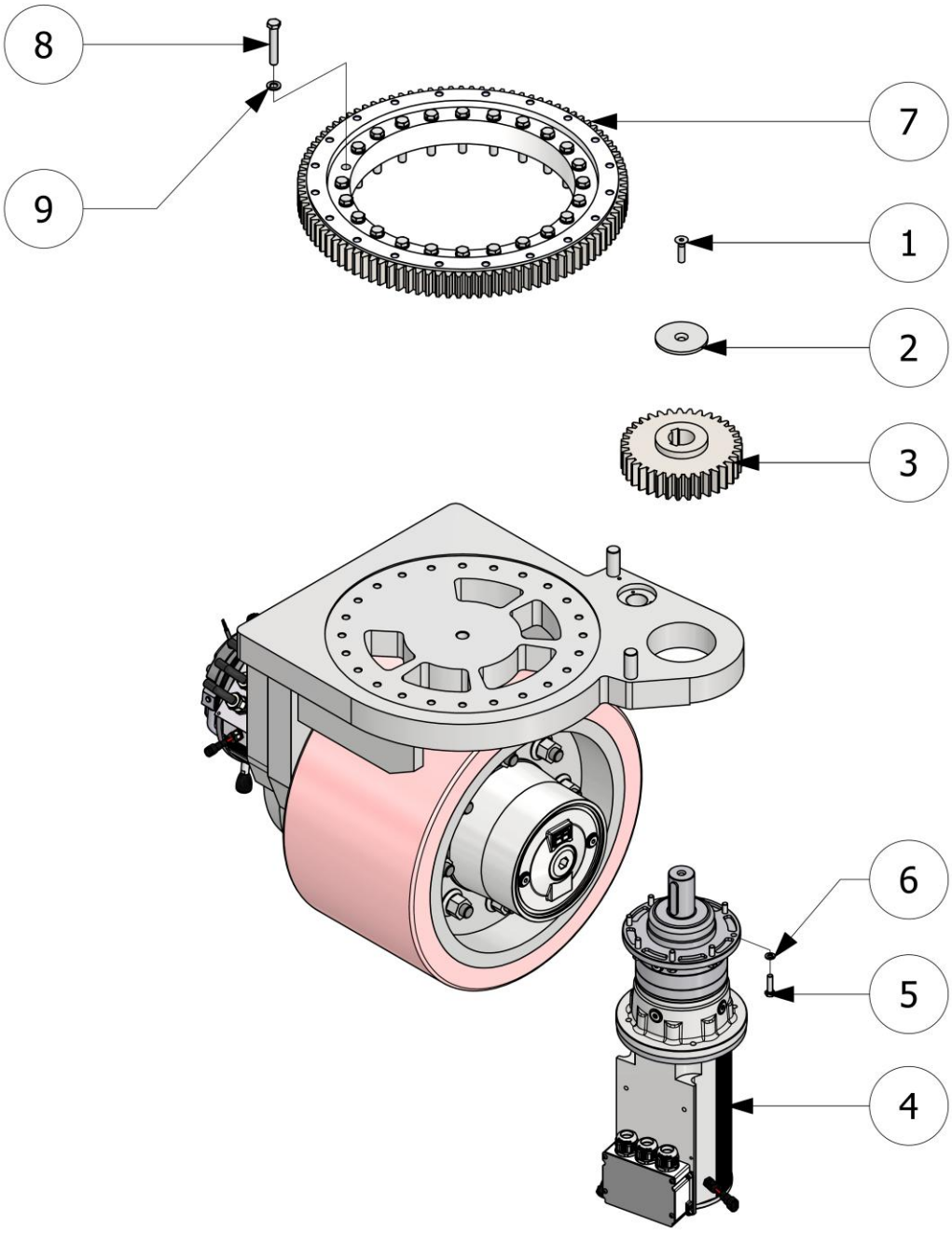
ENCODER

Pos.	Description	Quantity
1	Internal clamping device code TLK350 10X20	1
2	Toothed wheel encoder m=5 Z=15 km=0,5	1
3	Cylinder head screws M5x12	3
4	Open spring washer M5	3
5	Plate	1
6	Shaft	1
7	Rigid ball bearing code 6201-2RSL (12x32x10)	2
8	Spacer	1
9	Multi-turn absolute encoder RM8004	1


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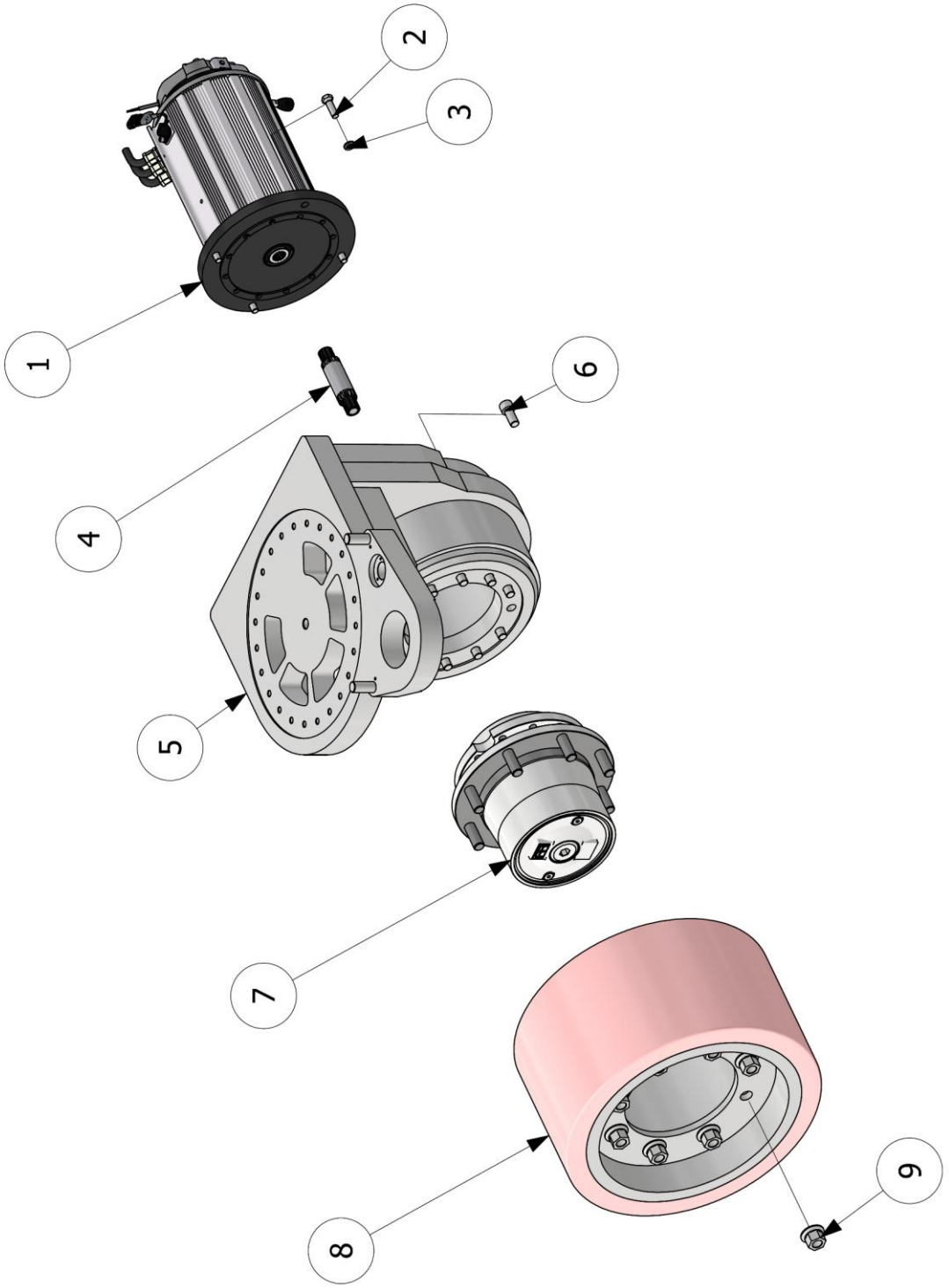
STEERING GEAR MOTOR

Pos.	Description	Quantity
1	Countersunk screw M10x40	1
2	Cap	1
3	Pinion m=5 Z=35 code M_MTR_PRT_0346	1
4	Steering gear motor AC 80V 3.000W 2.800rpm code AGX135.150.004	1
5	Hex head screw M8x30	8
6	Open spring washer M8	8
7	Fifth wheel code M_CSC_RLM_0114	1
8	Hex head screw M12x70	24
9	Open spring washer M12	24

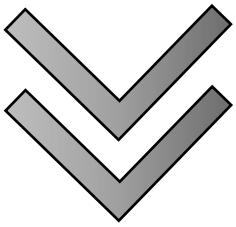

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TRACTION GEAR MOTOR

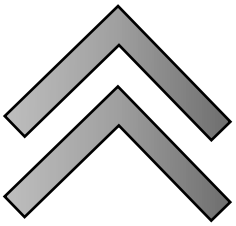
Pos.	Description	Quantity
1	Traction motor AC 80V 12.000W 1.600rpm code AMX200.190.022	1
2	Hex head screw M12x40	4
3	Open spring washer M12	4
4	Shaft for engine coupling (AMX200.190.022) code 90.X0142	1
5	Wheel frame	1
6	Cylinder head screws M16x35	12
7	Reduction unit (traction) code RRWDB800D/53,00 LC-KC (DG-3731-C)	1
8	Motorised polyurethane wheel Ø 500 x 280 mm code M_RTE_PLM_0043	1
9	Nut with washer M20x1,5	8


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DISPOSAL



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8. DISPOSAL

The following paragraph contains some suggestions and indications to correctly carry out the operations for putting out of service, dismantling and removal of the machine at the end of its operating life.

CAUTION



The following operations are the responsibility of authorized personnel.

- Make sure that, around the machine, there is sufficient space to enable staff to perform all the necessary movements without risk.
- Disconnect the electrical energy devices.
- Disconnect and remove the battery.

ADDITIONAL INFORMATION



For disposal of the battery, see the relevant manual attached.

- Unload, disconnect and remove the oil tank from the machine.
- Remove the lubricants.
- Disassemble the machine by taking, for each group.

WARNING



Pay close attention to possible falling machine parts or components during removal. This could cause serious danger to operators.

- Remove the moving parts and separate, as far as possible, the various components for the type of materials (plastic, metal, etc.), in order to be able to be disposed of through a separate collection.
- Remove and move the machine parts from the work area by taking all the necessary precautions.
- Before lifting components of considerable size/weight, check the correct attachment of lifting devices and only use appropriate slings and equipment.

ADDITIONAL INFORMATION



Disposal operations must be carried out in accordance with the provisions of the regulations in force in the country where the machine is used.

NOTE



In case of difficulty in dismantling, demolition of the machine, or for added security, please contact the Manufacturer and indicate cause of the removal and serial number of the machine.

- The machine is built with various materials, recyclable and not. For this reason, its removal involves adequate separation of the materials: steel, aluminium, copper, bronze, special alloys, plastic, etc.
- The manufacturer assumes no liability for any damage caused by any use of the individual components other than the one prescribed.

NOTE



Demolition is to be carried out in compliance with the laws in force.

8.1 RECYCLING

Part of the dismantled materials can be recycled. For the relevant indications, see the table in Chapter 5 “INTERNATIONAL RECYCLING CODES”.

8.2 DISPOSAL

During the machine working life, waste materials are produced (lubricants, hydraulic oil and filters).

To dispose of some of these materials, specific standards are in place to safeguard the environment.

For the disposal of waste lubricants/oils, it is necessary to observe the following environment protection regulations:

- The lubricants/oils risk contaminating water and the soil, therefore never pour the products on the ground, in the water, or the sewage drain. Each breach of these rules can be prosecuted by law. When using lubricants, keep a container for oil within hand's reach.
- Carefully recover all lubricants/oils, by separating the mineral based products with those with a synthetic base. On disposal, comply with the regulations in force on disposal of exhausted oil.

It is compulsory for the client to know the legislation in force in his country and work to ensure this legislation is enforced.

ATTACHED DOCUMENTATION

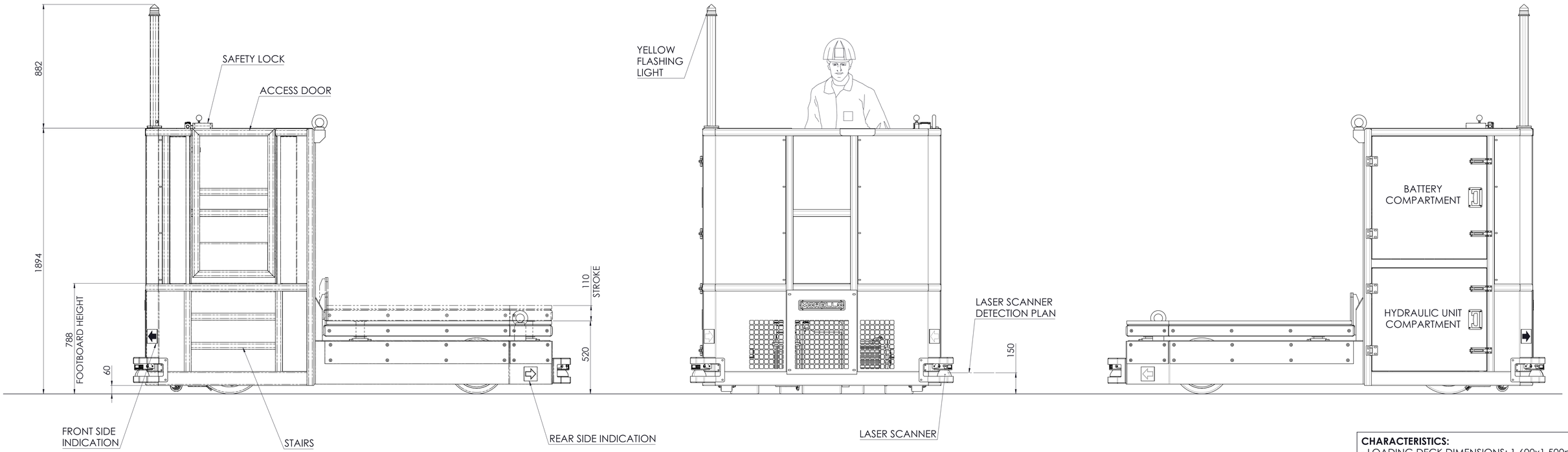
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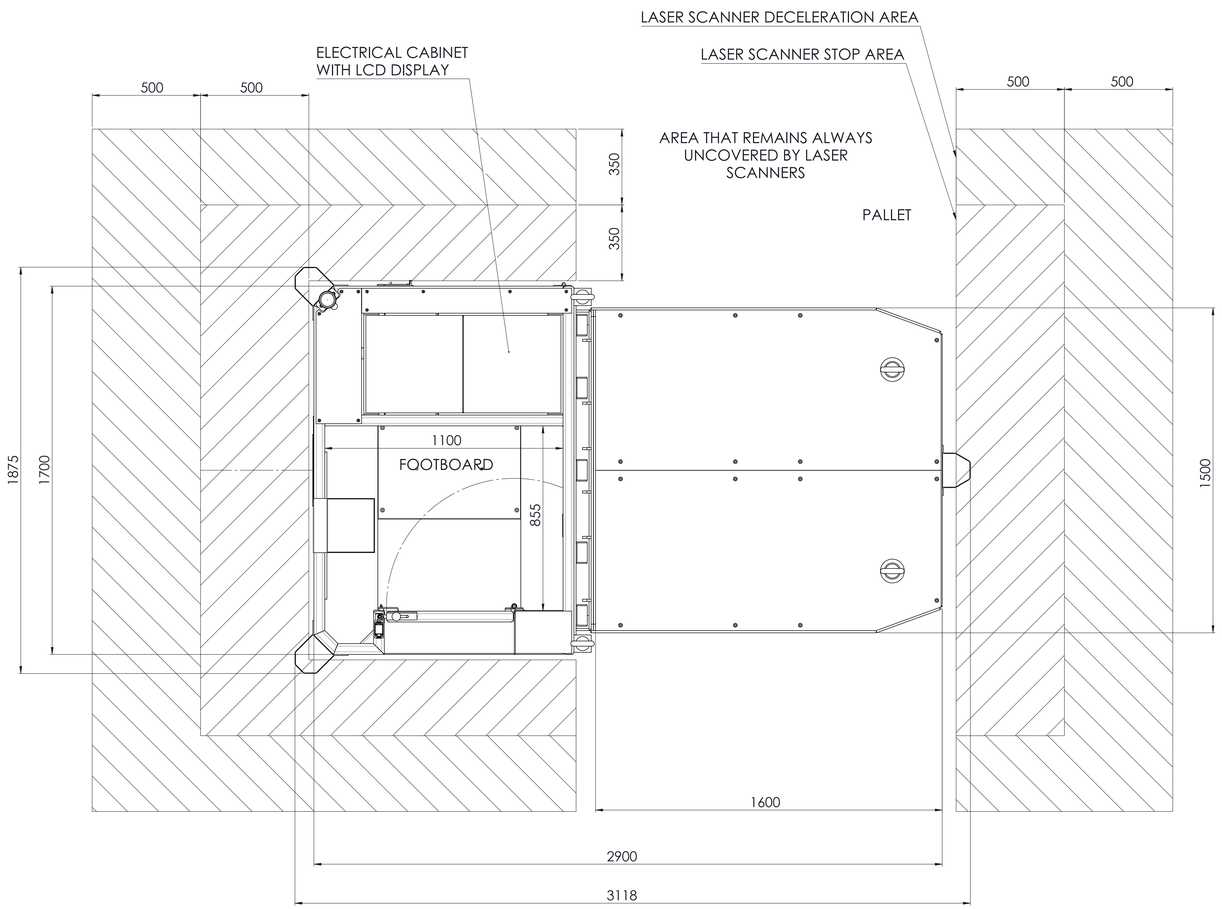
9. ATTACHED DOCUMENTATION

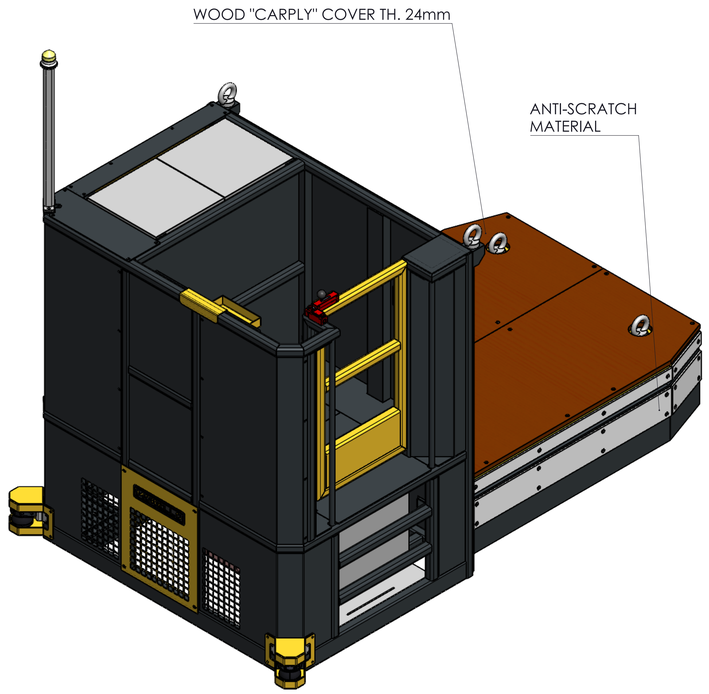
The documents below will be inserted at the end of this manual.

	DESCRIPTION
1	Machine layout
2	Wiring diagram
3	Hydraulic diagram
4	Hydraulic control unit manual
5	Battery manual
6	Rectifier manual
7	Motors manual
8	Gearboxes manual
9	Inverter manual
10	Laser scanner manual

Morello S.r.l.
Head Office and Factory:
Lungo Dora Colletta 85/A
10153 – Torino (Italy)
TEL. 011.248.05.69
TEL. / FAX. 011.85.00.85
E-mail: info@morellogiovanni.it
Website: www.morello.eu.com







CHARACTERISTICS:
- LOADING DECK DIMENSIONS: 1.600x1.500mm
- LOADING DECK HEIGHT: 520mm
- ELEVATION STROKE: 110mm
- PAYLOAD: 38.000kg
- LOAD TYPE: uniformly distributed
- SPEED: 45-25m/min
- SLOPE: 0,5% max
- DEAD LOAD: 3.800kg
- PAINTING: GREY RAL7016 + YELLOW RAL1018

MAIN MECHANICAL COMPONENTS
-N. 1 MOTORIZED POLYURETHANE WHEEL Ø500x300mm
-N. 1 AC MOTOR 80V 12.000W 2.000rpm
-N. 4 IDLE POLYURETHANE WHEELS Ø400x200mm
-N. 4 HYDRAULIC CYLINDERS

MAIN ELECTRICAL COMPONENTS
-N. 1 LITHIUM BATTERY 80V 220Ah
-N. 1 BATTERY CHARGER 480V 60Hz 3p+E
-N. 3 SAFETY LASER SCANNERS
-N. 1 WIRED CONTROLLER
-N. 1 WIRELESS REMOTE CONTROLLER
-N. 1 YELLOW FLASHING LIGHT
-N. 1 ACOUSTIC SIGNAL SIGNALLING TRAILER OPERATING

MORELLO
MATERIAL HANDLING TECHNOLOGY SINCE 1946
L.go Dora Colletta 85/A
10153 Torino (Italy)
Tel. 011/2480569 - Fax 850085
e-mail: info@morellogiovanni.it
http:\\ www.morellogiovanni.it

PROJECT:
SGAE-E ±90° P 38/3
TRANSPALLET

PAYLOAD 38t

DESCRIPTION:
GENERAL ASSEMBLY DRAWING

CUSTOMER:	ORDER:	OFFER REFERENCE:
	2750	*2024-OC-031400*
DRW BY: D.Semilia	DATE: 23/09/2025	**2750_A1A_AA000**
CHK BY:	SCALE: 1:20	ITEM NUMBER

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\t1.15; wiring diagram:

Self-propelled

eries: SGAE-E ±90° P 38

trolley 3 - Pallet truck

MORELLO

MORELLO GIOVANNI S.R.L.

MATERIAL HANDLING TECHNOLOGY SINCE 1946

customer:
YAMAHA MOTOR MANUFACTURING

n. order:
2750(1-2)

specifications:

USA

Certification:	UL
Feeding:	80V
Control voltage:	24V
Operating Temperature:	0°C...+40°C
Scope:	38t
Axles and wheels:	1 assi / 1 asse sterzante / 1 ruota motrice + 4 ruote folli
Securities:	1 Lampeggiatore giallo e 1 segnalatore acustico 1 Clacson 2 Sensori sterzatura + 1 Encoder sterzatura 2 Freni negativi nei motori trazione 1 Serratura sicurezza



REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA 24-02-2026

DOC.Nr. M2750(1-2)_0

FILE M2750(1-2)_REV2_EN

DISEGN. R.G.

APPR.

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

TITOLO

title

SCALA

Fogli Totali 49

Foglio 1

Foglio Seguente 1A

STANDARD

CE STANDARD

Conductor color

Nero (BK) :	*Main current circuits for direct and alternating voltage*
Light Blue (LBU):	*Neutral conductor for alternating voltage*
Red (RD) :	*AC voltage control circuits*
Blue (bu):	*Control circuits for DC voltage*
Orange (OG) :	*External ring/voltage wires before main switch*
green-yellow (gnye):	*Protective conductor*

Leading cross-section

All conductors not marked for 24V DC: *0.5 mm² / blue*

Color

Nero:	(BK)
Marrone:	(BN)
Red:	(RD)
Orange:	(OG)
Yellow:	(YE)
Green:	(GN)
Blue:	(BU)
light blue:	(LBU)
purple:	(VT)
Grey:	(GY)
White:	(WH)
Rosa:	(PK)
Gold:	(GD)
Turquoise:	(TQ)
Silver:	(SR)
light blue:	(PB)
Transparency:	(TR)
Green/Yellow:	(GN/YE)
Screen:	(SH)

UL/CSA STANDARD

Conductor color

Nero (BK) :	*Main current circuits for direct and alternating voltage operating at the supply voltage*
Red (RD) :	*control system for ungrounded sieved current operating at a voltage lower than the supply voltage*
White (wh):	*grounded flood current control circuit, regardless of voltage*
Blue (bu):	*Control circuits protected for DC voltage*
White/Blue (Wh/Bu):	*Common grounded DC current*
Orange (OG) :	*Ungrounded AC or DC power cords that remain energized when the main disconnector is turned off*
White/Orange (Wh/Og):	*grounded AC or DC power wires that provide power when the main disconnector is disconnected*
Green/Yellow (GN/YE):	*Protective conductor*

Leading cross-section

All conductors not marked for 24V DC: 20AWG

REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA 24-02-2026
DOC.Nr. M2750(1-2)_0
FILE M2750(1-2)_REV2_ENG
DISEGN. R.G.
APPR.

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

NORMATIVE COLORAZIONI CONDUTTORI

Guide Staining Regulations

SCALA

Fogli Totali 49

Foglio 1A

Foglio Seguente 1B

REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA	24-02-2026
DOC.Nr.	M2750(1-2)_0
FILE	M2750(1-2)_REV2_EN
DISEGN.	R.G.
APPR.	

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

REVISIONI

Revisions

SCALA	
	Fogli Totali: 49
Foglio: 1B	Foglio Seguente: 2

LISTA FOGLI \ INDEX

Foglio Sheet	Descrizione Description	Revisioni Revisions 1	2	3	4	5	6	7	8	9
1	*title*	X								
1A	*Guide Staining Regulations*									
1B	*Revisions*									
2	*index*	X								
4	*battery*									
5	*Traction Motor Controller*									
6	*Steering Motor Controller*									
7	*Pump Motor Controller*									
10	*AUXILIARY CIRCUIT POWER SUPPLY*									
11	*Cart Reports*									
12	*Control panels*									
14	*BM Emergencies and Reset*									
15	*Scanner bypass keypad*									
16	*emergency*									
17	*emergency*									
18	*emergency*									
19	*PLC Power Supply and Canbus*									
20	PLC INPUT									
21	PLC INPUT									
22	PLC INPUT									
23	PLC OUTPUT									
24	PLC OUTPUT									
25	PLC OUTPUT									
27	*Laser Scanner*									
28	*Solenoid valves*									
31	CAN BUS									
33	*Panel terminal block EP1*	X								
34	*EP2 square terminal block*	X								

Foglio Sheet	Descrizione Description	Revisioni Revisions 1	2	3	4	5	6	7	8	9
35	*Connectors*	X								
37	*Quadro EP1 front panel layout*	X								
38	*EP1 Panel Layout*	X								
39	*EP1 Panel Layout*	X								
40	*EP1 Panel Layout*	X								
41	*EP2 Panel Layout*	X								
42	*Bill of Materials*	X								
43	*Bill of Materials*	X								
44	*Bill of Materials*	X								
45	*Bill of Materials*	X								
46	*Bill of Materials*	X								
47	*Bill of Materials*	X								
48	*Bill of Materials*	X								
49	*Bill of Materials*	X								

REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA 24-02-2026

DOC.Nr. M2750(1-2)_0

FILE M2750(1-2)_REV2_EN

DISEGN. R.G.

APPR.

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

INDICE

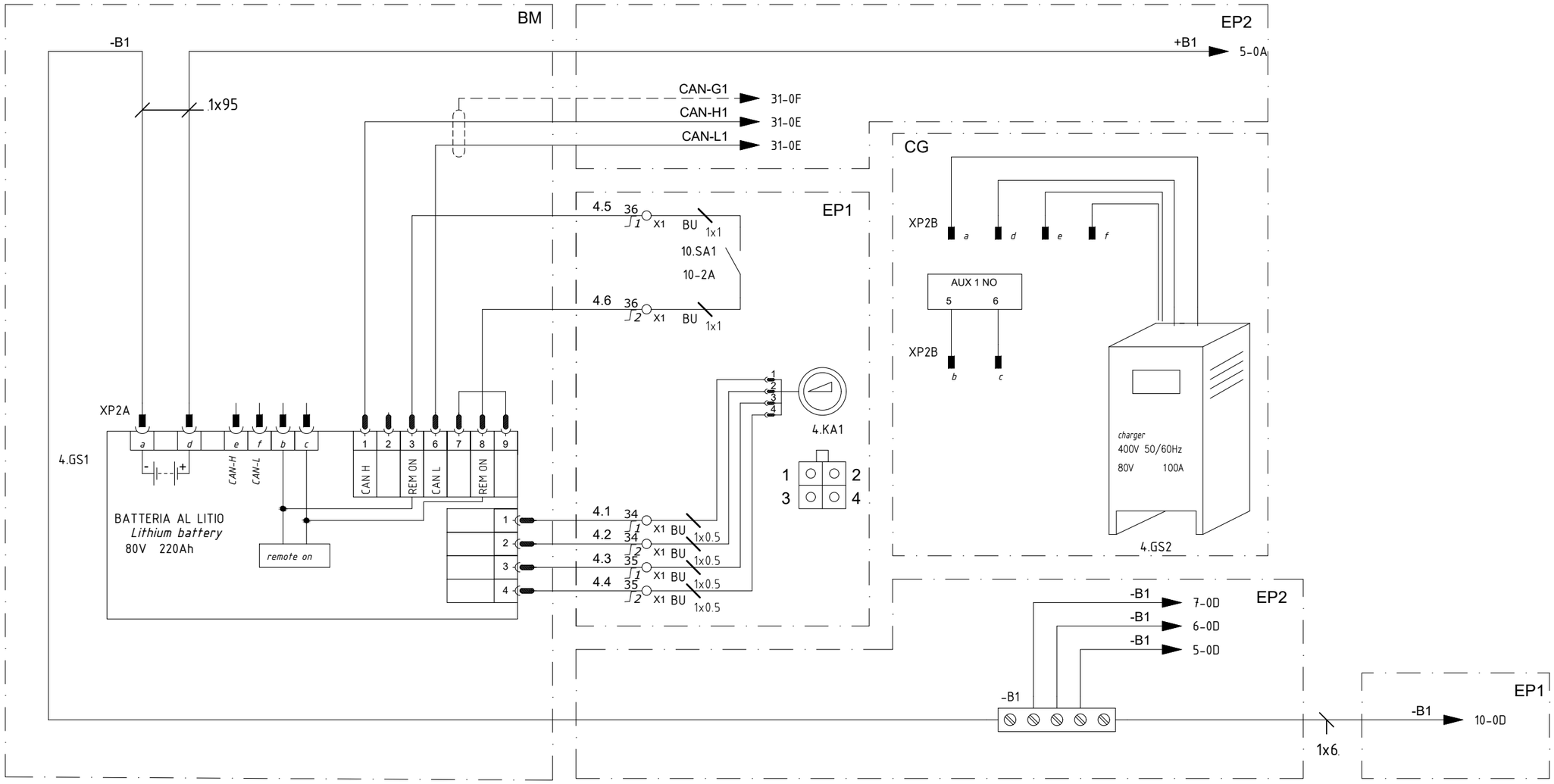
index

SCALA

Fogli Totali 49

Foglio 2

Foglio Seguente 4



REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA 24-02-2026
DOC.Nr. M2750(1-2)_0
FILE M2750(1-2)_REV2_EN
DISEGN. R.G.
APPR.

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

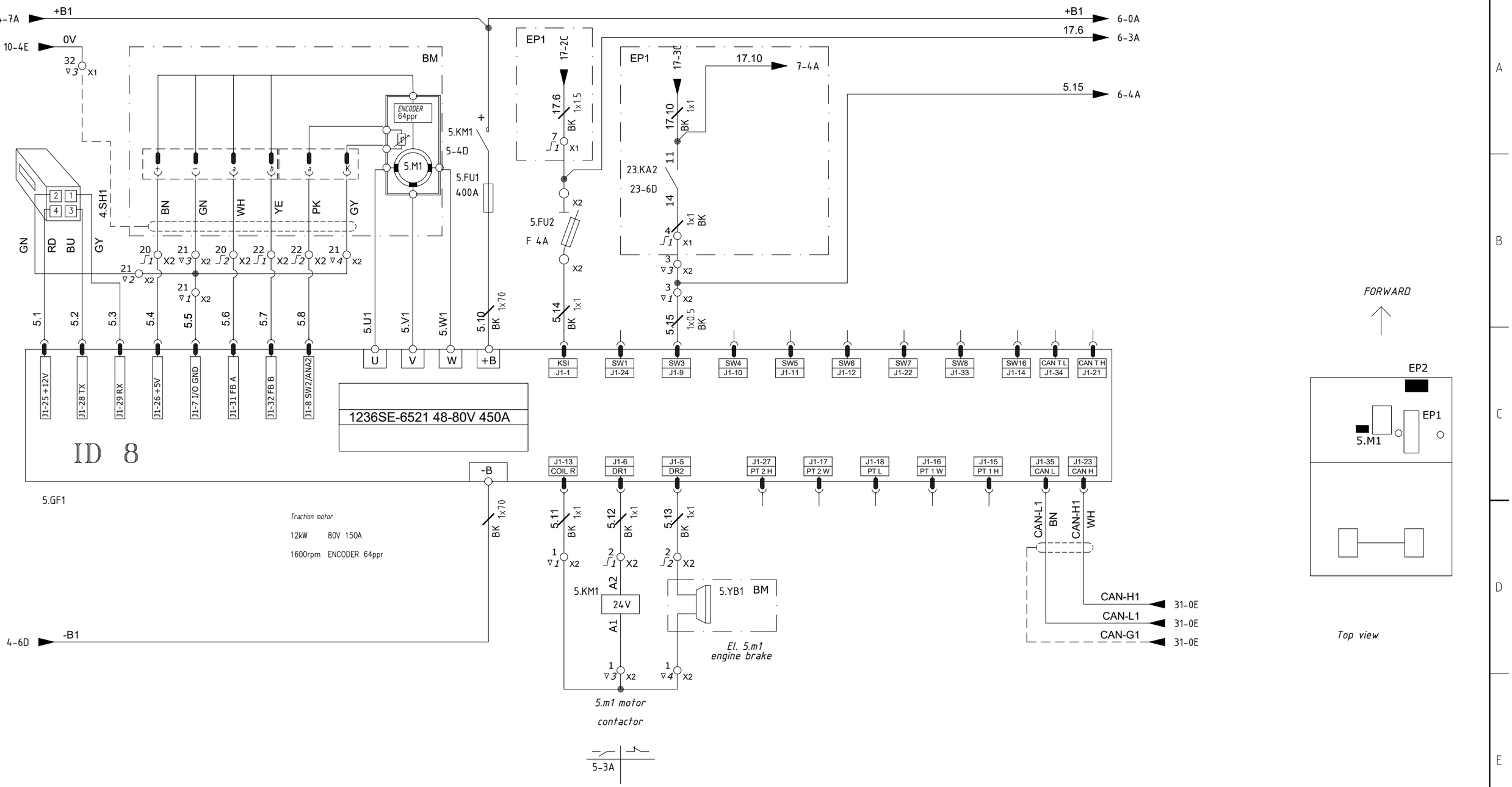
BATTERIA
battery

SCALA

Fogli Totali 49

Foglio 4

Foglio Seguente 5



REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

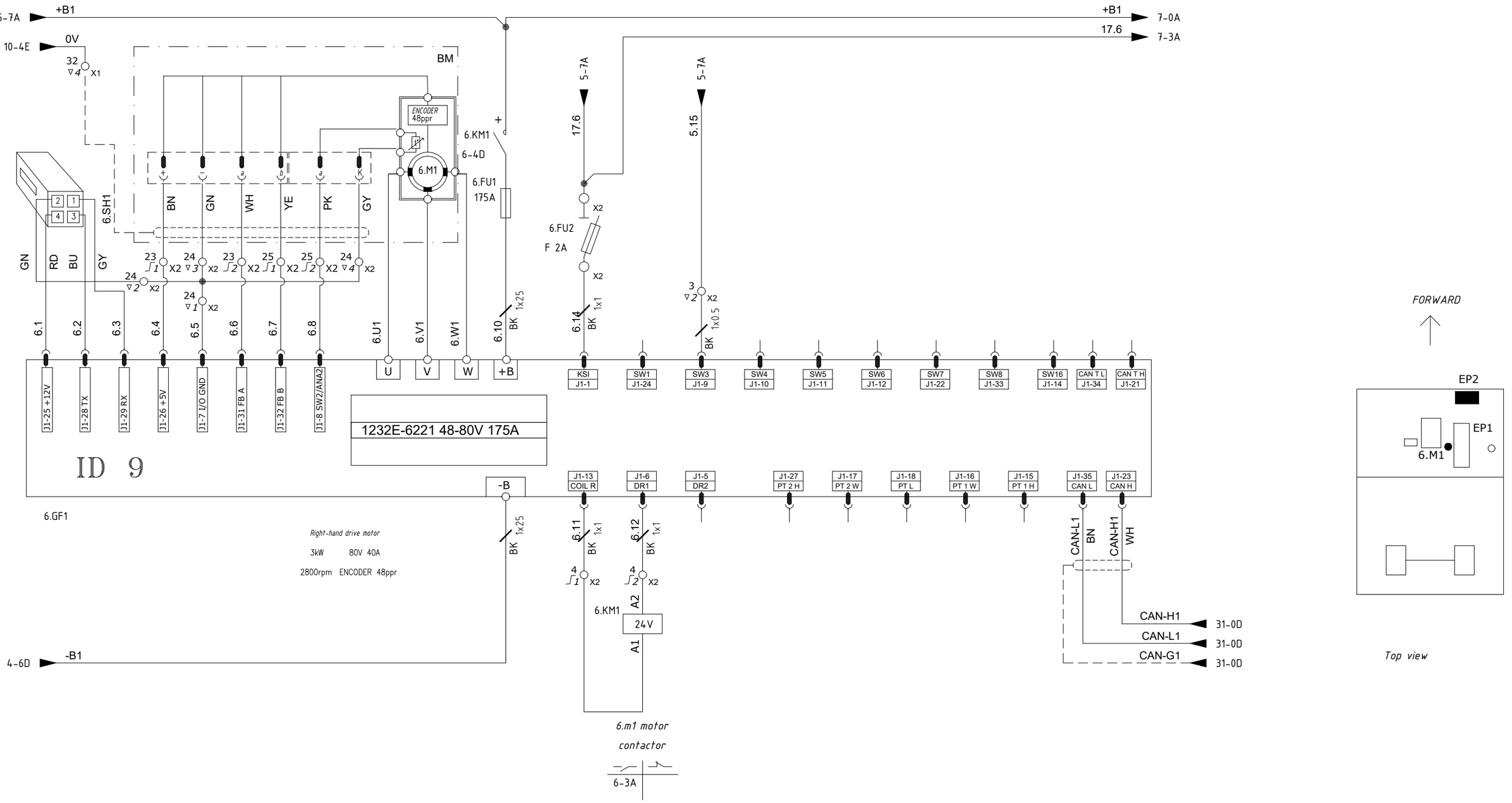
DATA	24-02-2026
DOC.Nr.	M2750(1-2)_0
FILE	M2750(1-2)_REV2_EN
DISEGN.	R.G.
APPR.	

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

CONTROLLORE MOTORE TRAZIONE

Traction Motor Controller

SCALA	Fogli Totali
	49
Foglio	Foglio Seguente
5	6



REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA 24-02-2026
DOC.Nr. M2750(1-2)_0
FILE M2750(1-2)_REV2_EN
DISEGN. R.G.
APPR.

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

CONTROLLORE MOTORE STERZATURA

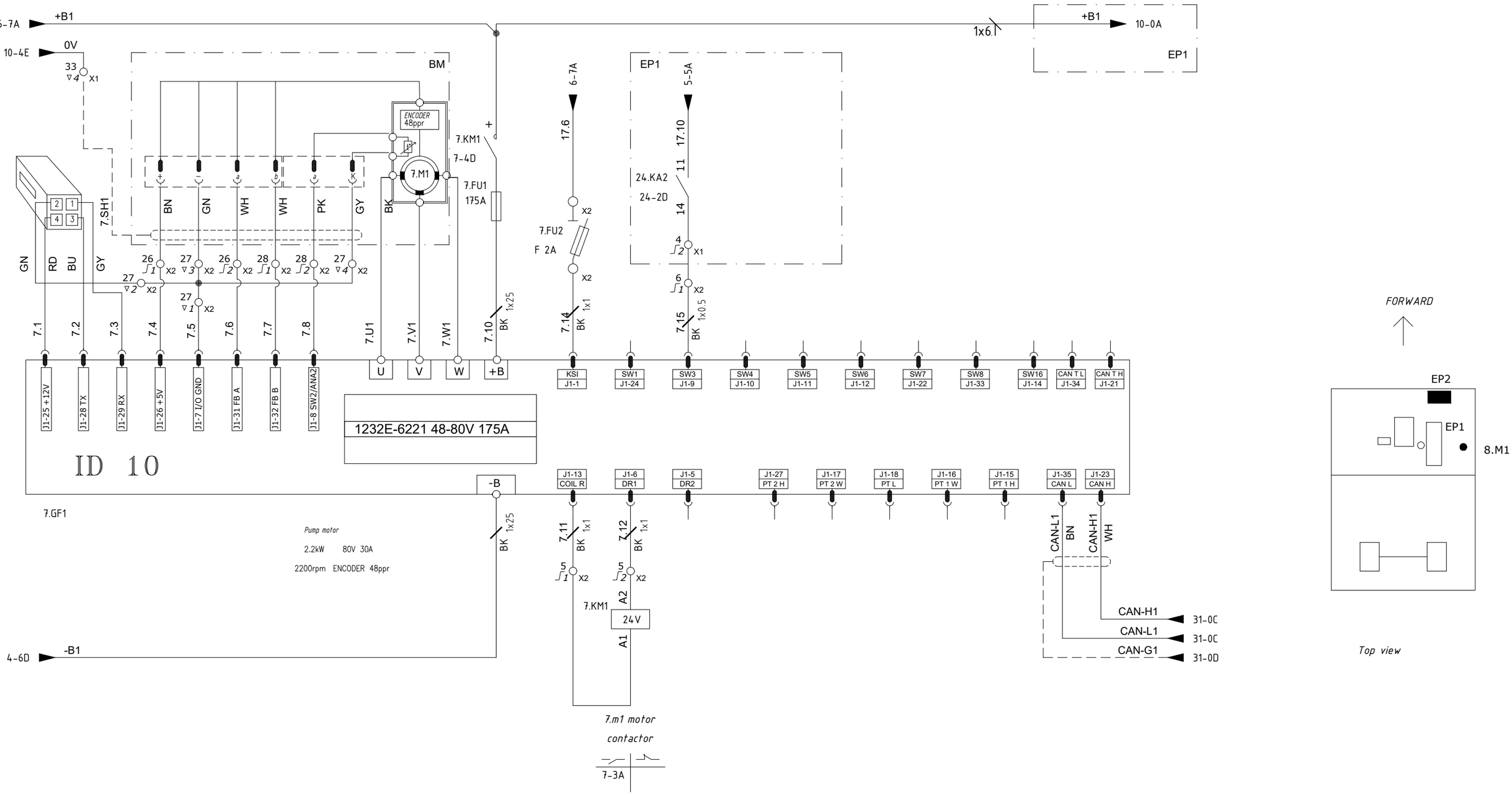
Steering Motor Controller

SCALA

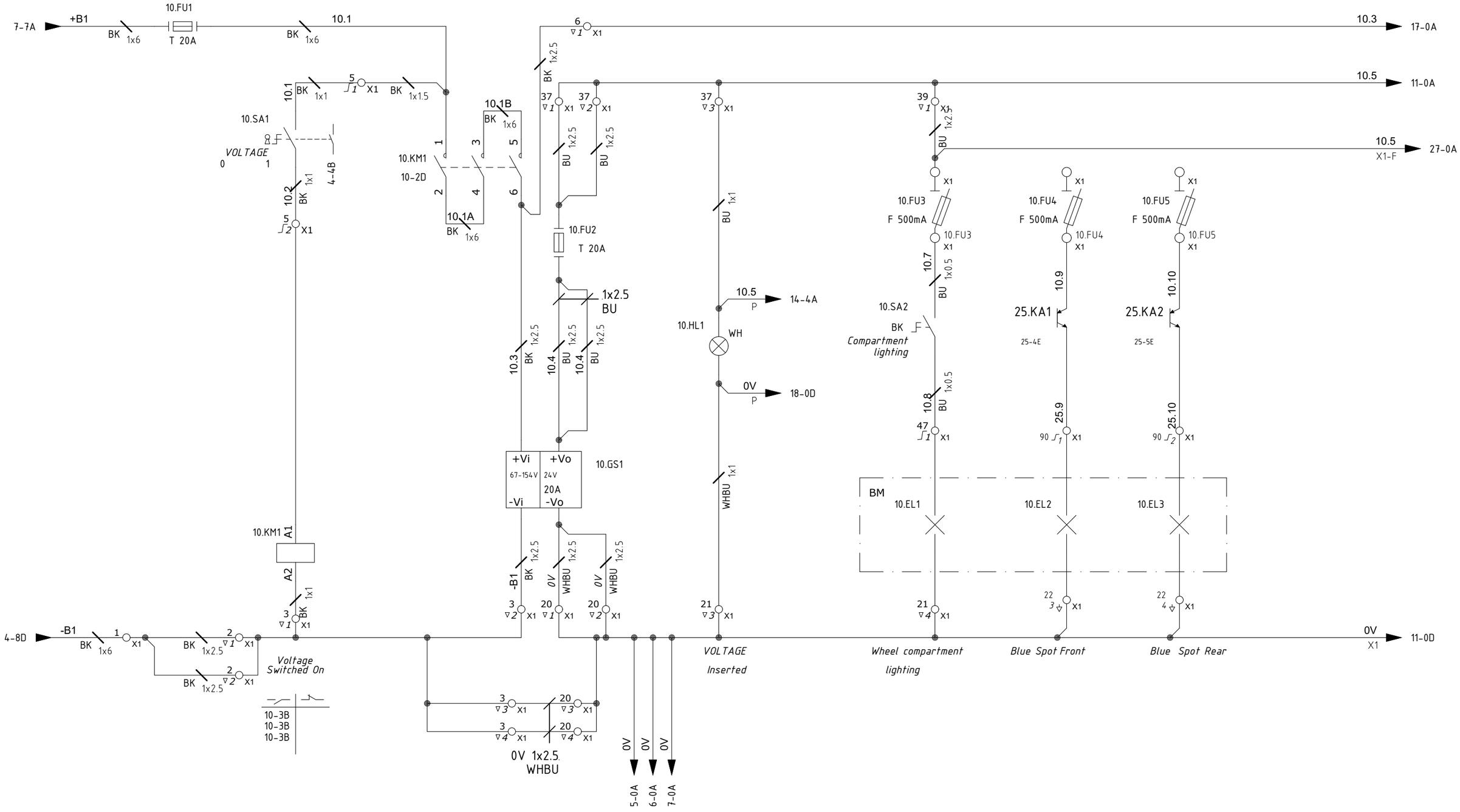
Fogli Totali 49

Foglio 6

Foglio Seguente 7



				COMMESSA M2750(1-2)	DATA 24-02-2026	DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET	SCALA
				YAMAHA MOTOR MANUFACTURING	DOC.Nr. M2750(1-2)_0	CONTROLLORE MOTORE POMPA	Fogli Totali 49
				MORELLO GIOVANNI S.R.L.	FILE M2750(1-2)_REV2_EN	*Pump Motor Controller*	Foglio 7 / Foglio Seguente 10
REV.	MODIFICA	DATA	FIRMA		DISEGN. R.G.		
					APPR.		



REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA 24-02-2026
DOC.Nr. M2750(1-2)_0
FILE M2750(1-2)_REV2_EN
DISEGN. R.G.
APPR.

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

ALIMENTAZIONE AUSILIARI

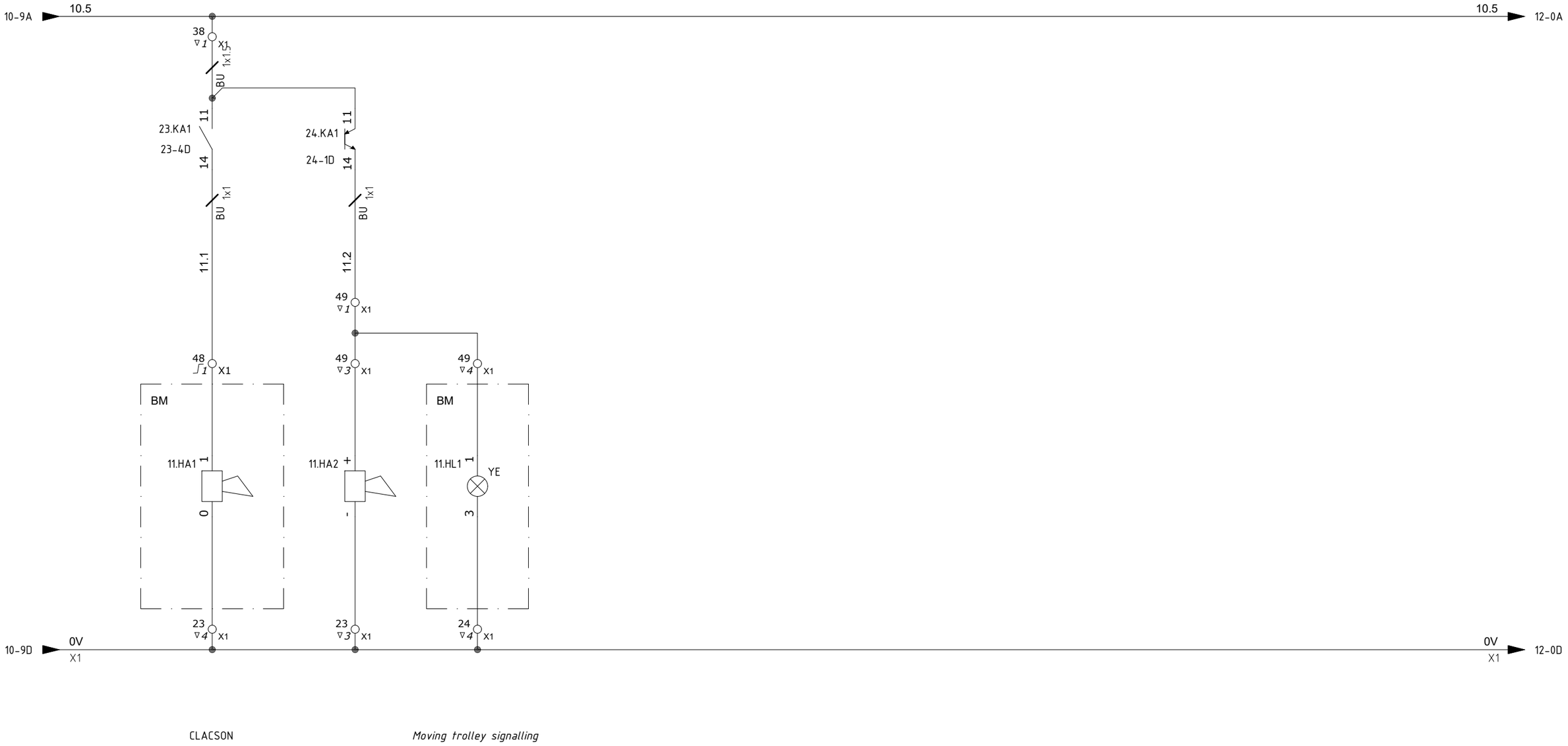
AUXILIARY CIRCUIT POWER SUPPLY

SCALA

Fogli Totali 49

Foglio 10

Foglio Seguente 11



REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA 24-02-2026
DOC.Nr. M2750(1-2)_0
FILE M2750(1-2)_REV2_EN
DISEGN. R.G.
APPR.

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

SEGNALAZIONI CARRELLO

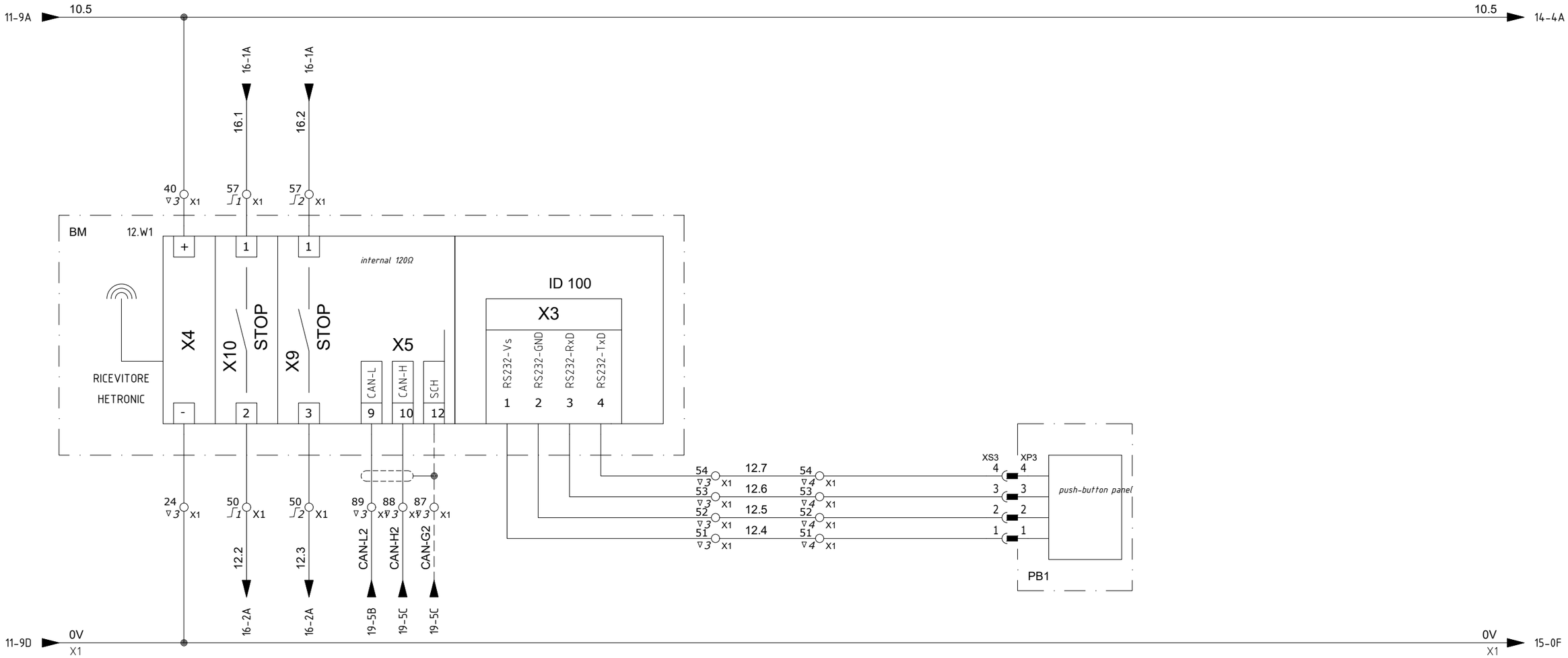
Cart Reports

SCALA

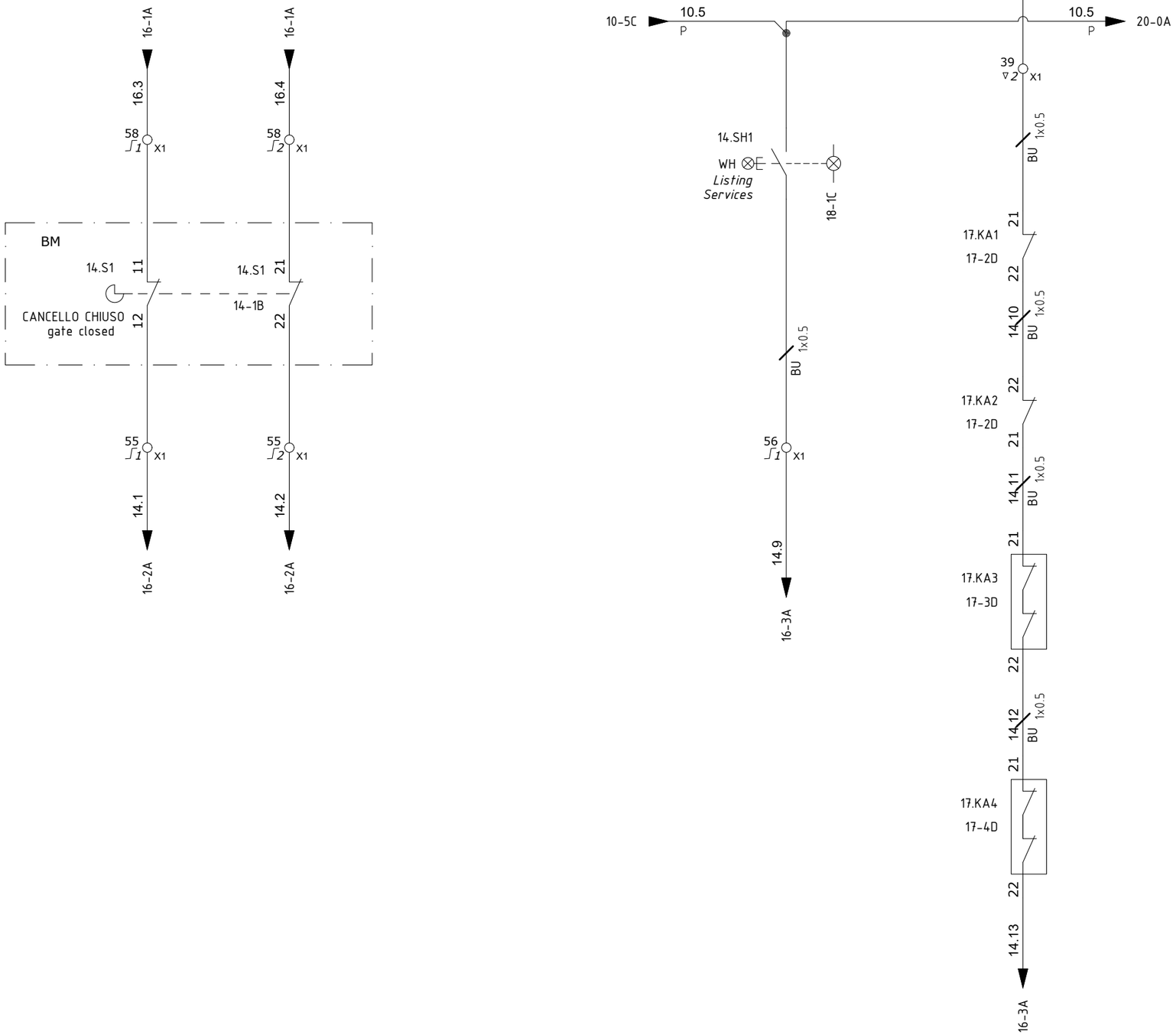
Fogli Totali 49

Foglio 11

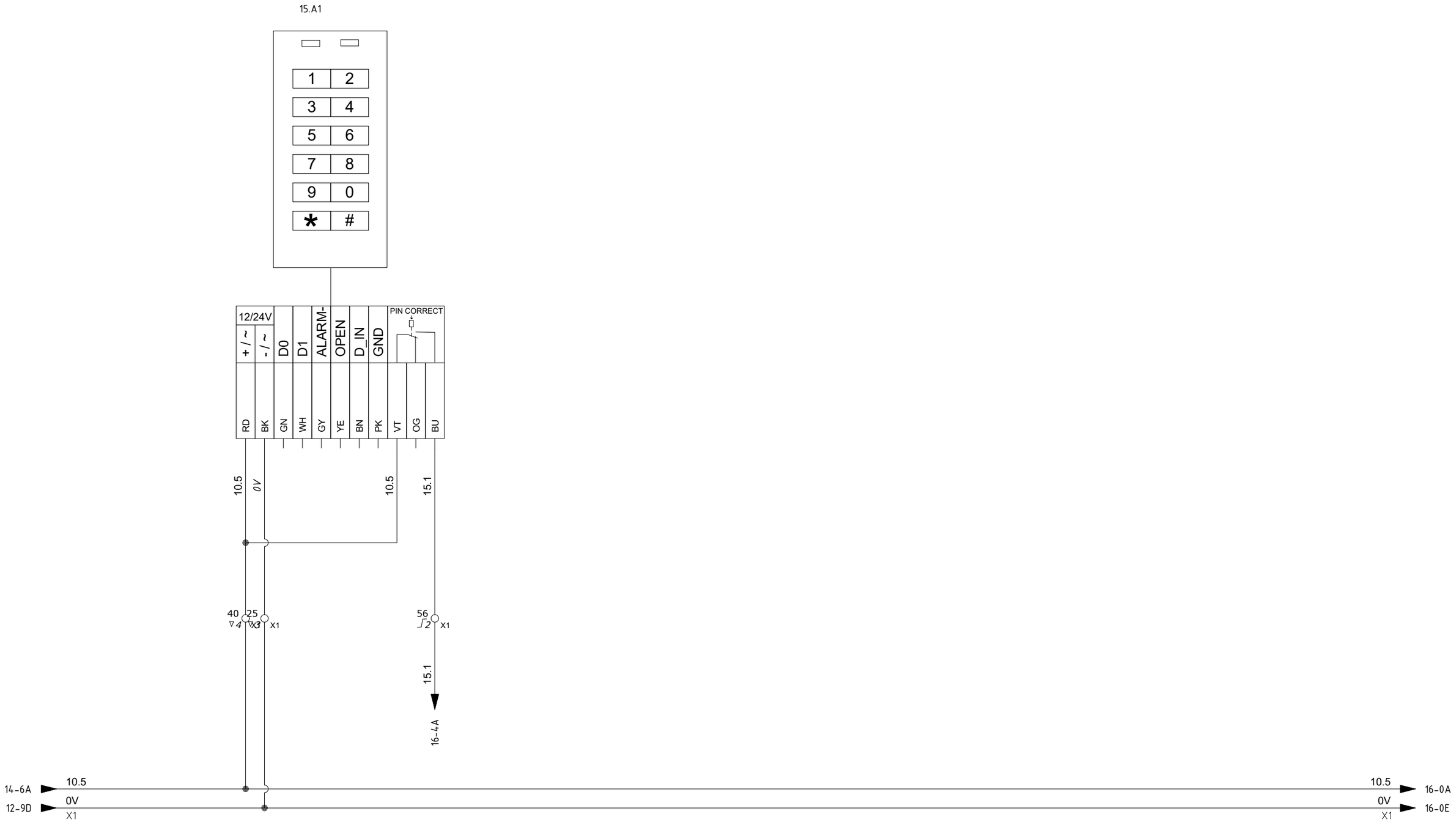
Foglio Seguente 12



REV.	MODIFICA	DATA	FIRMA	COMMESSA M2750(1-2)		DATA 24-02-2026	DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET	SCALA	
				YAMAHA MOTOR MANUFACTURING	MORELLO GIOVANNI S.R.L.	DOC.Nr. M2750(1-2)_0	PULSANTIERE DI COMANDO		Fogli Totali 49
						FILE M2750(1-2)_REV2_EN	*Control panels*	Foglio 12	Foglio Seguente 14
						DISEGN. R.G.			
						APPR.			



				COMMESSA M2750(1-2)	DATA 24-02-2026	DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET	SCALA
					DOC.Nr. M2750(1-2)_0		Fogli Totali 49
				YAMAHA MOTOR MANUFACTURING	FILE M2750(1-2)_REV2_ENG	EMERGENZE BM E RESET	
				MORELLO GIOVANNI S.R.L.	DISEGN. R.G.	*BM Emergencies and Reset*	Foglio 14 / Foglio Seguente 15
REV.	MODIFICA	DATA	FIRMA		APPR.		



REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA 24-02-2026

DOC.Nr. M2750(1-2)_0

FILE M2750(1-2)_REV2_EN

DISEGN. R.G.

APPR.

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

CASTIERINO BYPASS SCANNER

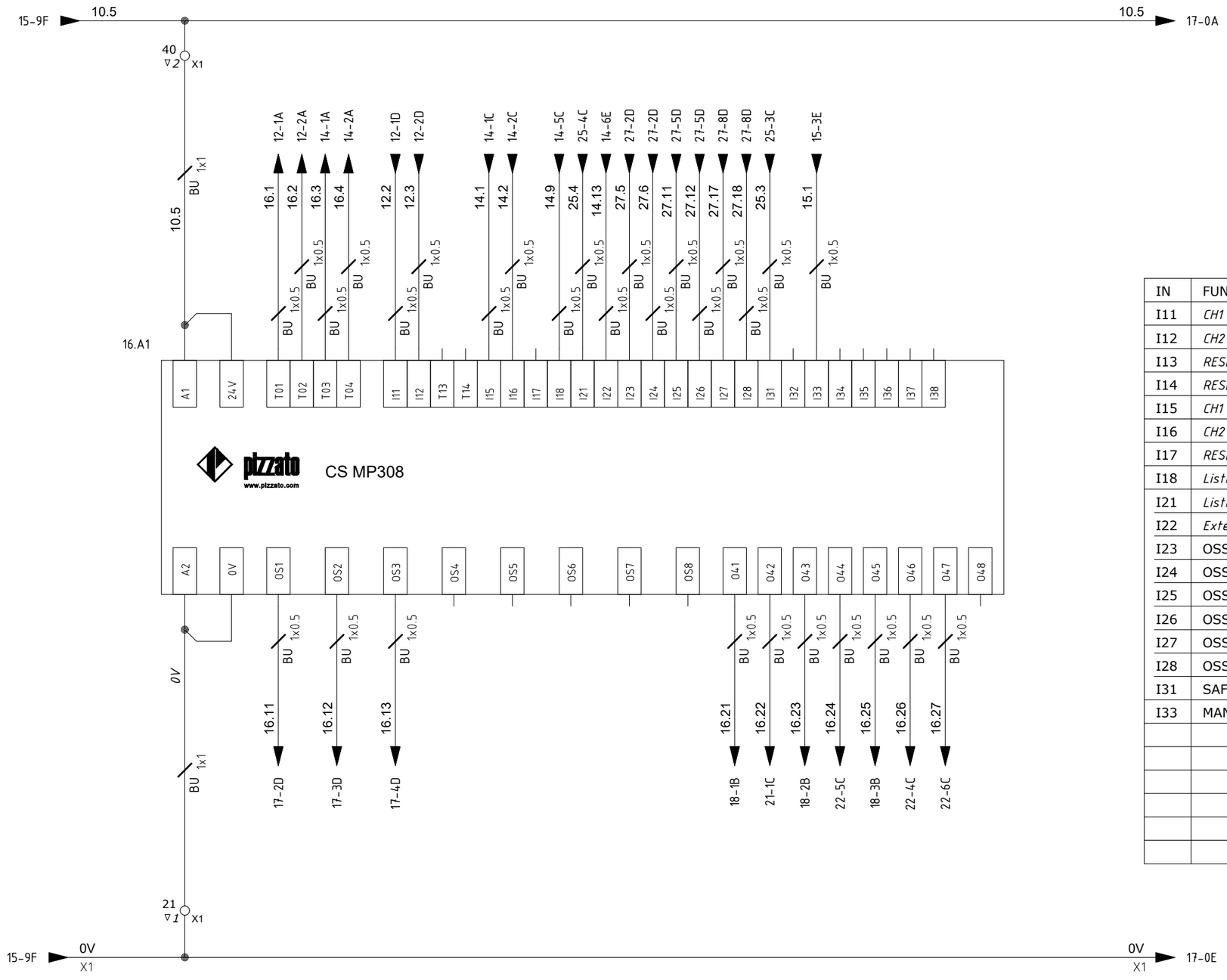
Scanner bypass keypad

SCALA

Fogli Totali 49

Foglio 15

Foglio Seguente 16



IN	FUNCTION	OUT	FUNCTION
I11	*CH1 Emergency Radio Remote Control*	OS1	*Emergency Key Controller*
I12	*CH2 Emergency Radio Control*	OS2	*Emergency Interlock Security*
I13	*RESERVE*	OS3	*Emergency solenoid valves*
I14	*RESERVE*	OS4	*RESERVE*
I15	*CH1 Gate*		
I16	*CH2 Gate*		
I17	*RESERVE*		
I18	*Listing Services*		
I21	*Listing services from PLC*	O41	*Services Included*
I22	*External Relay Feedback*	O42	*Emergency OK*
I23	OSSD1 27SQ1	O43	SCANNER INTERCEPTED
I24	OSSD2 27SQ1	O44	*Scanner Intercepted PLC*
I25	OSSD1 27SQ2	O45	*bypassed scanner*
I26	OSSD2 27SQ2	O46	*Bypassed PLC scanner*
I27	OSSD1 27SQ3	O47	*PLC Closed Gate*
I28	OSSD2 27SQ3		
I31	SAFETY OFF		
I33	MANUAL BYPASS		

REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA 24-02-2026
DOC.Nr. M2750(1-2)_0
FILE M2750(1-2)_REV2_ENG
DISEGN. R.G.
APPR.

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

EMERGENZA

emergency

SCALA

Fogli Totali 49

Foglio 16

Foglio Seguente 17

16-6A 10.5

10-9A 10.3

10.5 19-0E

6 ▽3 X1 — BK 1x1.5 — 1 — 17.KA1 17-2D — 2 — 17.5 BK 1x1.5 — 1 — 17.KA2 17-2D — 2 — 17.6 BK 1x1.5 — 5-3A — 16-1D

6 ▽4 X1 — BK 1x1 — 13 — 17.KA3 17-3D — 14 — 17.10 BK 1x1 — 5-4A — 16-1D

40 ▽1 X1 — BU 1x1.5 — 13 — 17.KA4 17-4D — 14 — 17.11 BU 1x1.5 — 28-0A — 16-2D

16-1D: 16.11 BU 1x0.5 — 17.KA1 A1 / 17.KA2 A1 — A2 — 17.KA2 A2 — 17.KA1 A2 — 1x0.75 WHBU — 21 ▽2 X1

16-2D: 16.12 BU 1x0.5 — 17.KA3 A1 — A2 — 17.KA3 A2

16-2D: 16.13 BU 1x0.5 — 17.KA4 A1 — A2 — 17.KA4 A2

16-6E 0V X1 — 0V X1 19-0F

Emergency Key Controller

Emergency Interlock Traction Safety

Emergency solenoid valves

17-2A | 14-6B

17-2B | 14-6C

17-3B | 14-6C

17-4B | 14-6D

REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA 24-02-2026

DOC.Nr. M2750(1-2)_0

FILE M2750(1-2)_REV2_ENG

DISEGN. R.G.

APPR.

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

EMERGENZA

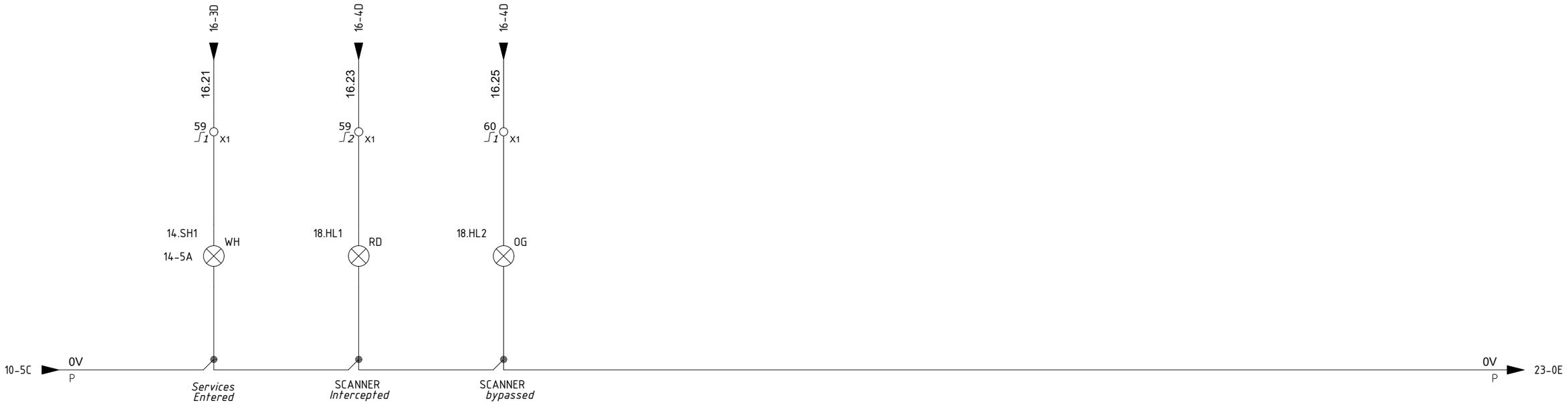
emergency

SCALA

Fogli Totali 49

Foglio 17

Foglio Seguente 18



REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA 24-02-2026
DOC.Nr. M2750(1-2)_0
FILE M2750(1-2)_REV2_ENG
DISEGN. R.G.
APPR.

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

EMERGENZA

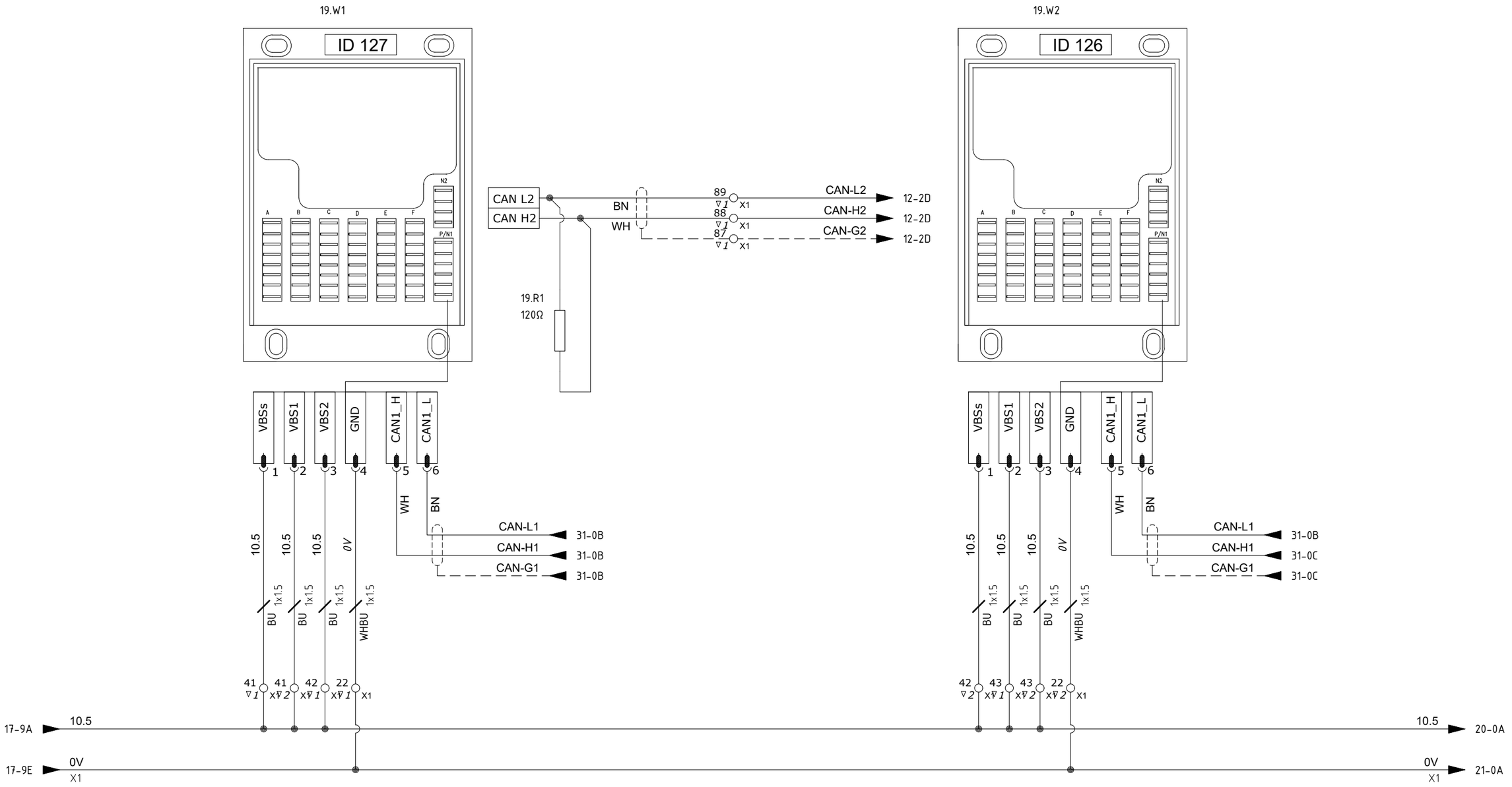
emergency

SCALA

Fogli Totali 49

Foglio 18

Foglio Seguente 19



				COMMESSA M2750(1-2)	DATA 24-02-2026	DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET	SCALA
				YAMAHA MOTOR MANUFACTURING	DOC.Nr. M2750(1-2)_0	PLC ALIMENTAZIONE E CANBUS	Fogli Totali 49
				MORELLO GIOVANNI S.R.L.	FILE M2750(1-2)_REV2_EN	*PLC Power Supply and Canbus*	Foglio 19 / Foglio Seguente 20
					DISEGN. R.G.		
					APPR.		
REV.	MODIFICA	DATA	FIRMA				

19-9E 10.5 X1

14-6A 10.5 P

10.5 X1 21-0A

41 ▽3 X1

41 ▽4 X1

20.SH1

YE

Overtime

23-5D

BM

20.SL1

20.4 BU 1x0.5

61 ∫1 X1 — 20.1 BU 1x0.5 — 2

61 ∫2 X1 — 20.2 BU 1x0.5 — 3

62 ∫1 X1 — 20.3 BU 1x0.5 — 6

62 ∫2 X1 — BU 1x0.5 — 7

63 ∫1 X1 — 20.5 BU 1x0.5 — 2

63 ∫2 X1 — 20.6 BU 1x0.5 — 3

64 ∫1 X1 — 20.7 BU 1x0.5 — 6

64 ∫2 X1 — 20.8 BU 1x0.5 — 7

IN0	IN1	IN2	IN3	IN4	IN5	IN6	IN7
A	A	A	A	B	B	B	B
RISERVA *RESERVE*	RISERVA *RESERVE*	RISERVA *RESERVE*	TEMPO SUPPLEMENTARE *Overtime*	RISERVA *RESERVE*	RISERVA *RESERVE*	LIVELLO MINIMO OLIO *Minimum oil level*	RISERVA *RESERVE*

CPU: 1 — TYPE: CR0403 — MOD. : 19.W1

CPU: 1 — TYPE: CR0403 — MOD. : 19.W1

REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA 24-02-2026

DOC.Nr. M2750(1-2)_0

FILE M2750(1-2)_REV2_ENG

DISEGN. R.G.

APPR.

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

PLC INPUT

SCALA

Fogli Totali 49

Foglio 20

Foglio Seguente 21

20-9A 10.5
19-9F 0V
X1

10.5 31-0A
0V 23-0E
X1

42 ▽3 X1 — 26 ▽3 X1 — 42 ▽4 X1 — 26 ▽4 X1

BM

21.SQ1 (BN / BU) — 21.SQ2 (BN / BU)

WH — WH

16-4D

	65 ⎍1 X1	65 ⎍2 X1	66 ⎍1 X1
16.22	21.2	21.3	21.4
BU 1x0.5	BU 1x0.5	BU 1x0.5	BU 1x0.5
2	3	6	7
IN8 C	IN9 C	IN10 C	IN11 C
ENERGENZA RIPRISTINATA *energy restored*	RISERVA *RESERVE*	*Stop Right Rotation*	*Stop Left Rotation*

CPU: 1
TYPE: CR0403 MOD. : 19.W1

27-3C 27-6C 27-9C

			66 ⎍2 X1
27.4	27.10	27.16	21.8
BU 1x0.5	BU 1x0.5	BU 1x0.5	BU 1x0.5
2	3	6	7
IN0 A	IN1 A	IN2 A	IN3 A
Feedback change area front right laser scanner	*Feedback change area front left laser scanner*	*Rear Laser Scanner Area Change Feedback*	RISERVA *RESERVE*

CPU: 2
TYPE: CR0403 MOD. : 19.W2

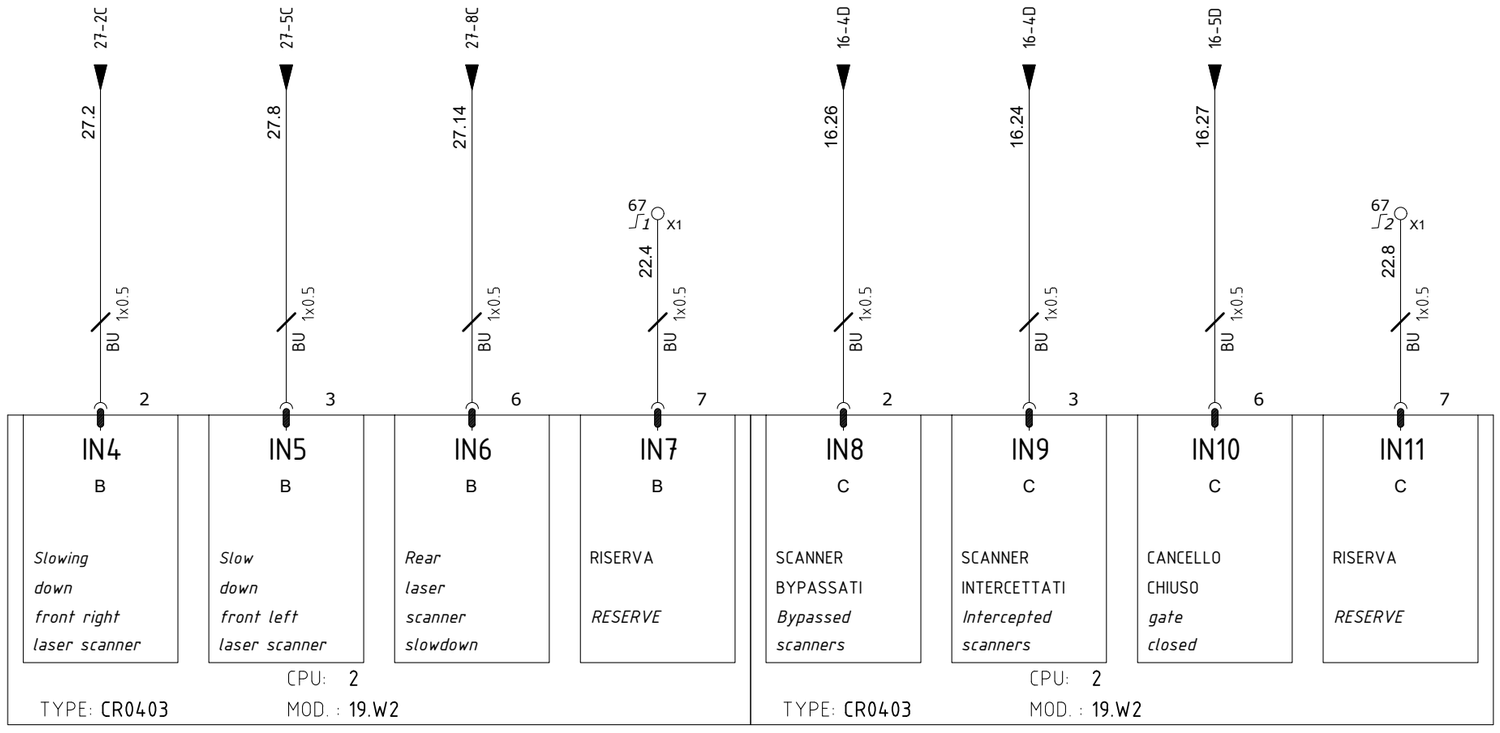
REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)
YAMAHA MOTOR MANUFACTURING
MORELLO GIOVANNI S.R.L.

DATA 24-02-2026
DOC.Nr. M2750(1-2)_0
FILE M2750(1-2)_REV2_ENG
DISEGN. R.G.
APPR.

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET
PLC INPUT

SCALA
Fogli Totali 49
Foglio 21
Foglio Seguente 22



REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA 24-02-2026
DOC.Nr. M2750(1-2)_0
FILE M2750(1-2)_REV2_ENG
DISEGN. R.G.
APPR.

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

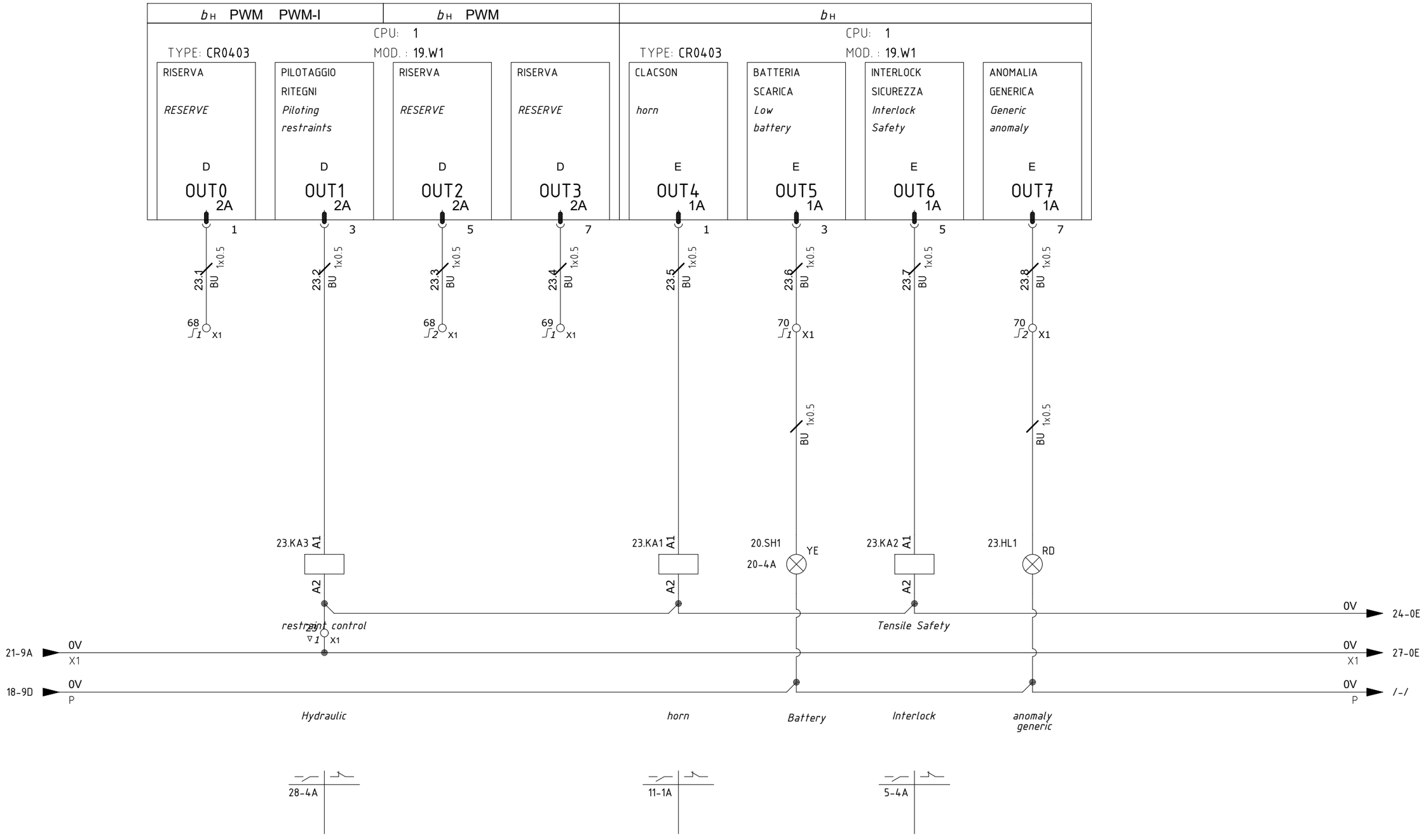
PLC INPUT

SCALA

Fogli Totali 49

Foglio 22

Foglio Seguente 23



REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA 24-02-2026
DOC.Nr. M2750(1-2)_0
FILE M2750(1-2)_REV2_EN
DISEGN. R.G.
APPR.

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

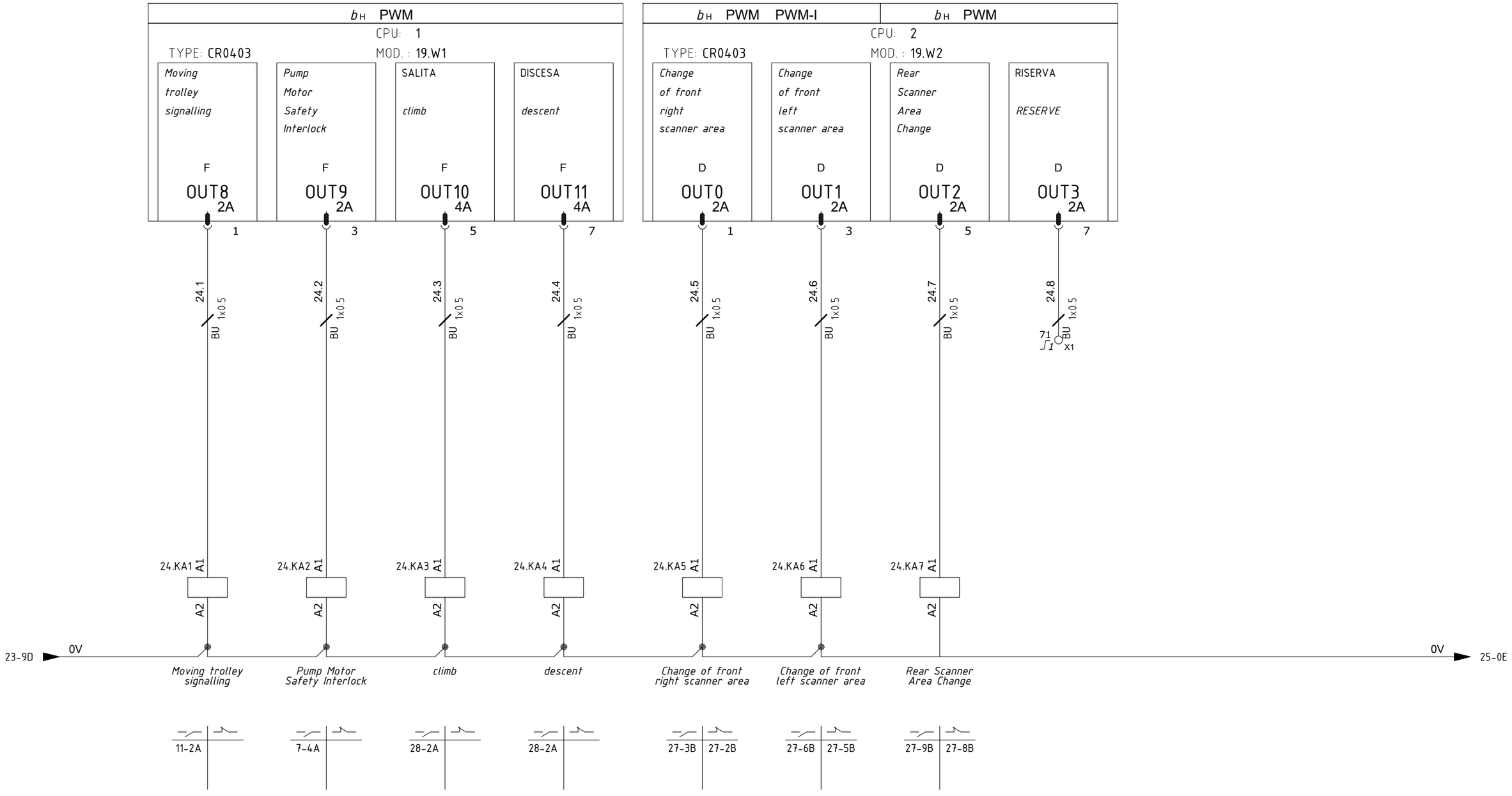
PLC OUTPUT

SCALA

Fogli Totali 49

Foglio 23

Foglio Seguente 24



REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA 24-02-2026
DOC.Nr. M2750(1-2)_0
FILE M2750(1-2)_REV2_EN
DISEGN. R.G.
APPR.

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

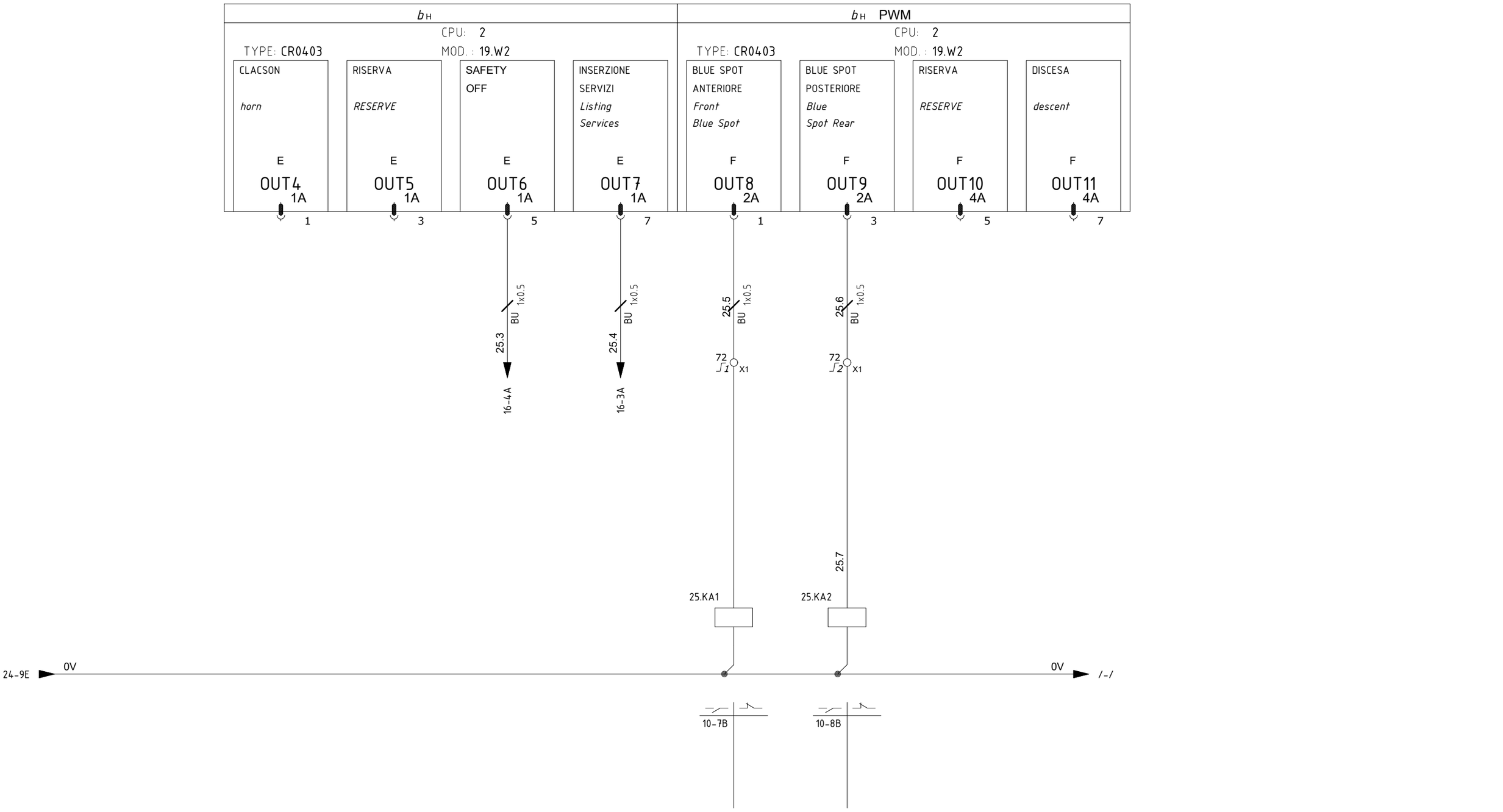
PLC OUTPUT

SCALA

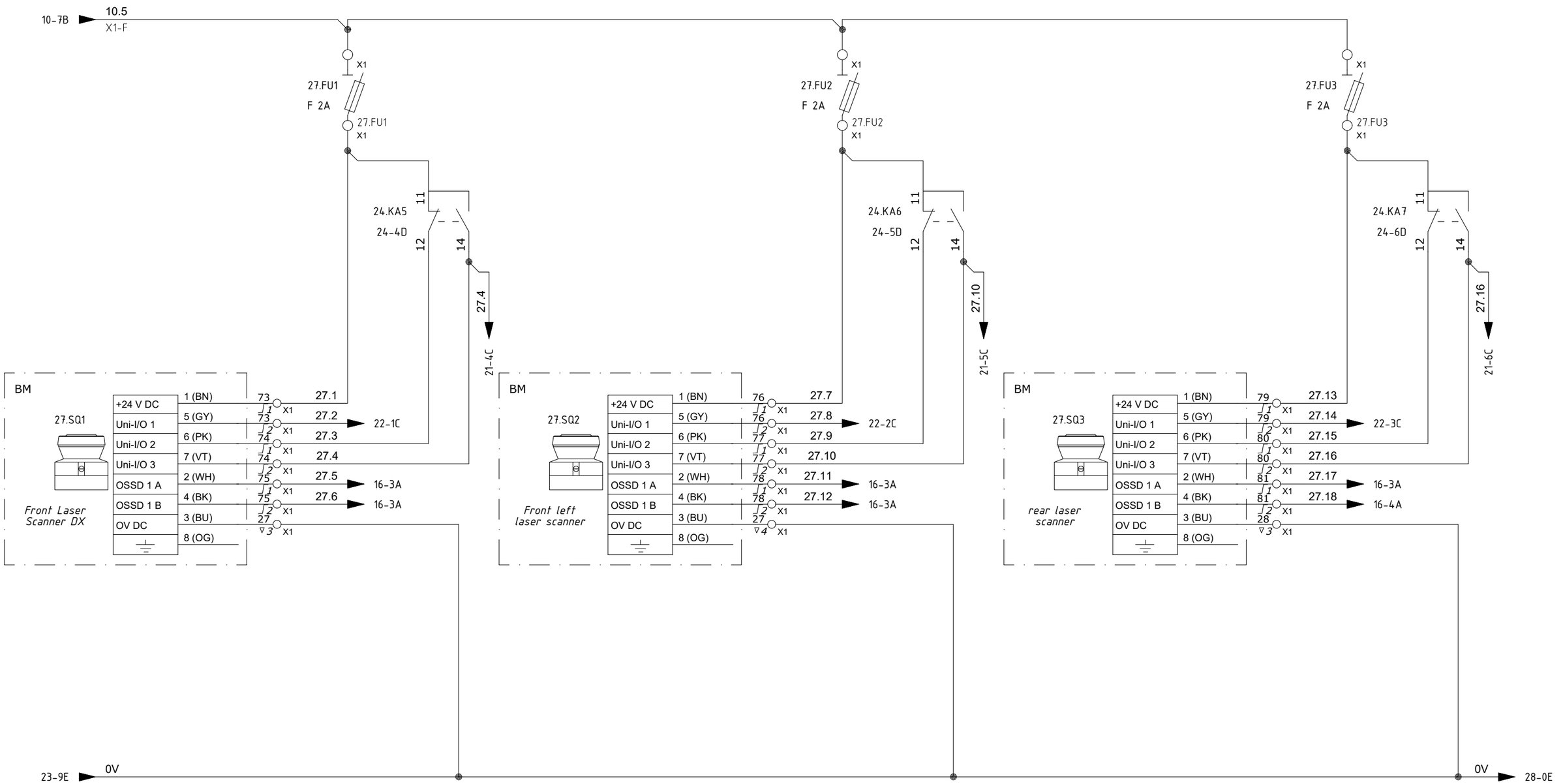
Fogli Totali 49

Foglio 24

Foglio Seguente 25



				COMMESSA M2750(1-2)	DATA 24-02-2026	DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET	SCALA
					DOC.Nr. M2750(1-2)_0		Fogli Totali 49
				YAMAHA MOTOR MANUFACTURING	FILE M2750(1-2)_REV2_EN	PLC OUTPUT	Foglio 25 / Foglio Seguente 27
				MORELLO GIOVANNI S.R.L.	DISEGN. R.G.		
REV.	MODIFICA	DATA	FIRMA		APPR.		



REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA 24-02-2026
DOC.Nr. M2750(1-2)_0
FILE M2750(1-2)_REV2_ENG
DISEGN. R.G.
APPR.

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

LASER SCANNER

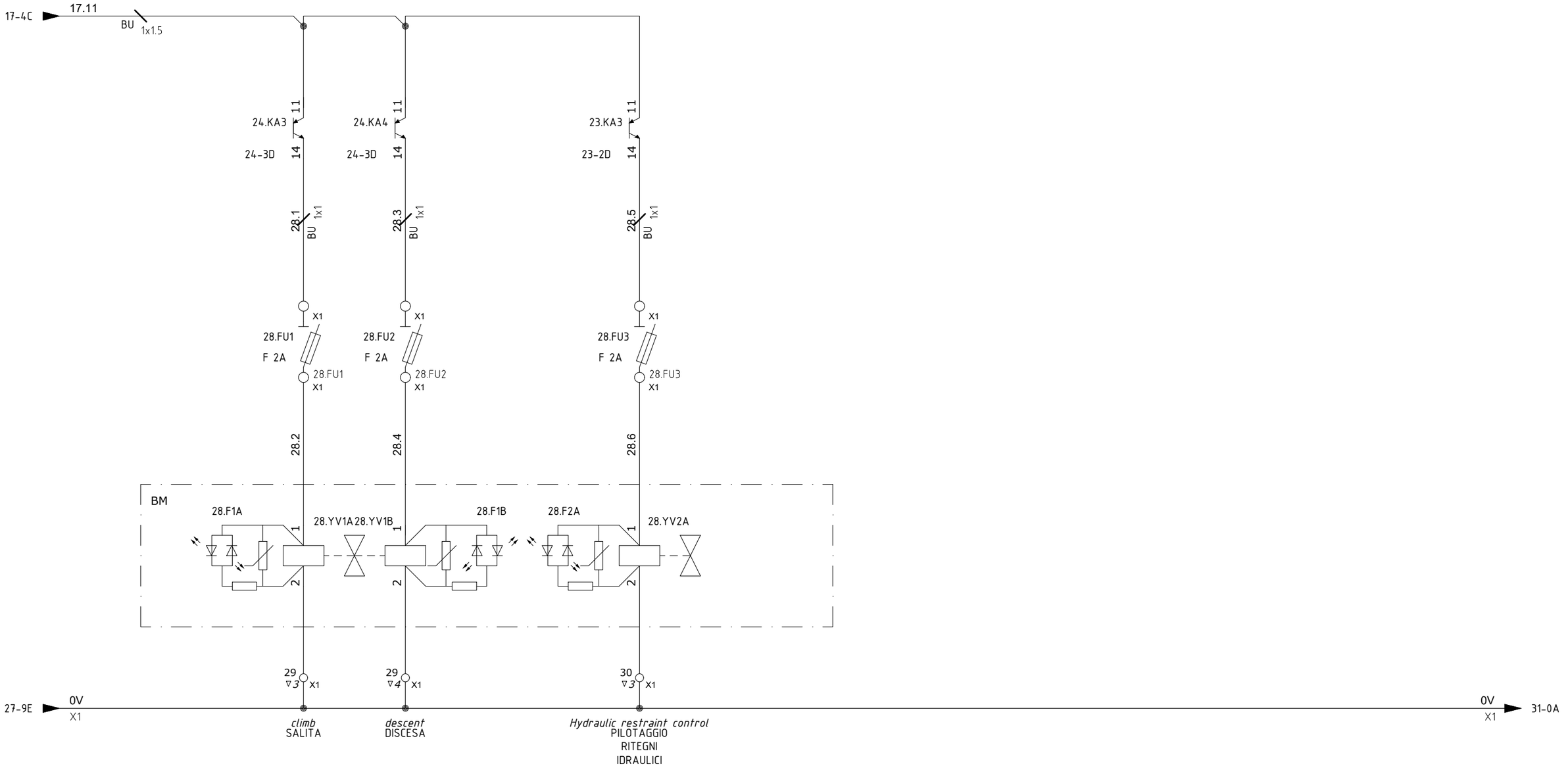
Laser Scanner

SCALA

Fogli Totali 49

Foglio 27

Foglio Seguente 28



REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA 24-02-2026
DOC.Nr. M2750(1-2)_0
FILE M2750(1-2)_REV2_ENG
DISEGN. R.G.
APPR.

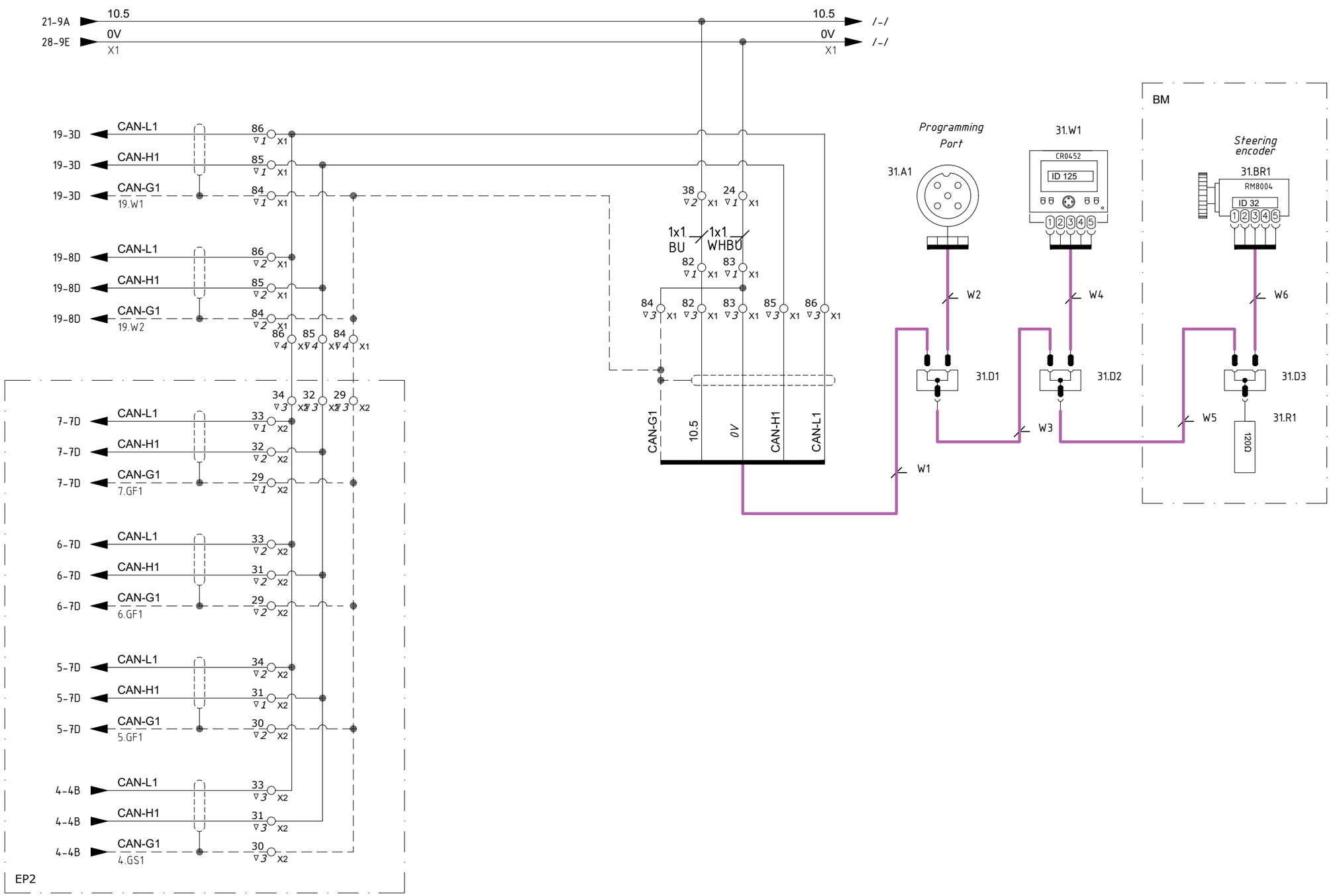
DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET ELETTROVALVOLE
Solenoid valves

SCALA

Fogli Totali 49

Foglio 28

Foglio Seguente 31



REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA 24-02-2026
DOC.Nr. M2750(1-2)_0
FILE M2750(1-2)_REV2_EN
DISEGN. R.G.
APPR.

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET CAN BUS

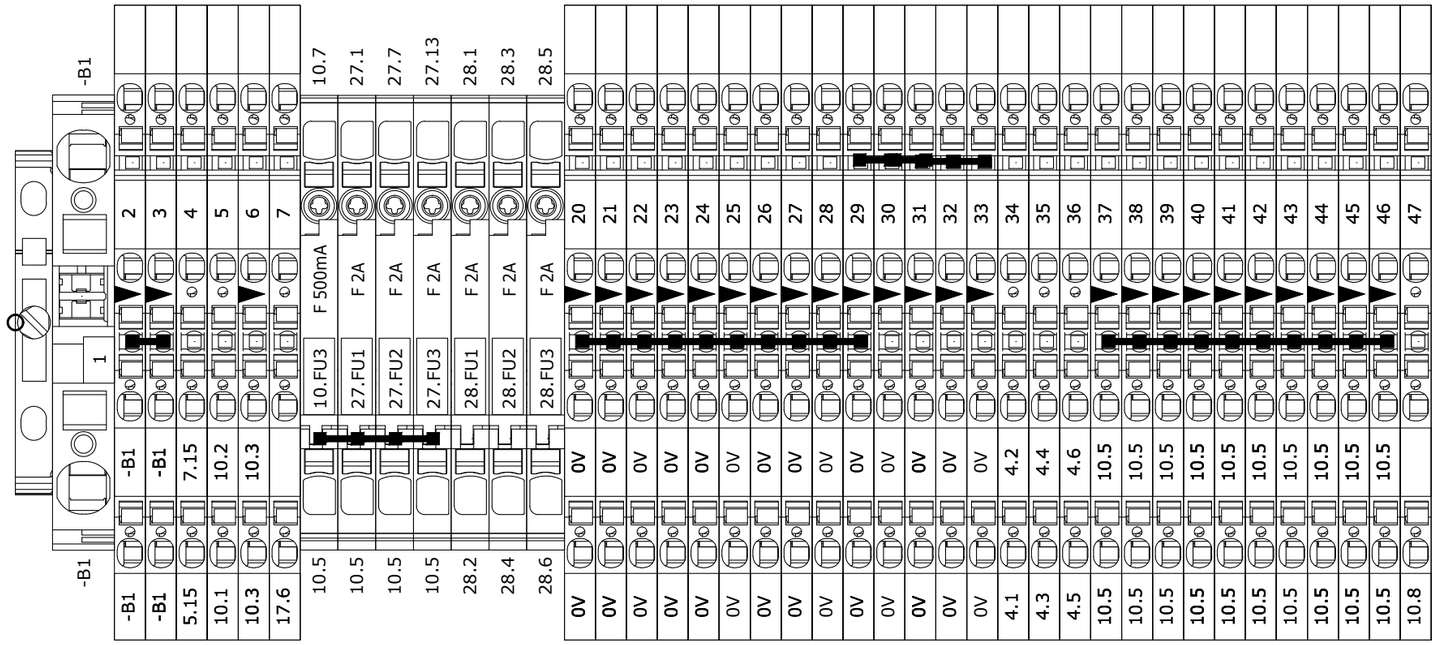
SCALA

Fogli Totali 49

Foglio 31

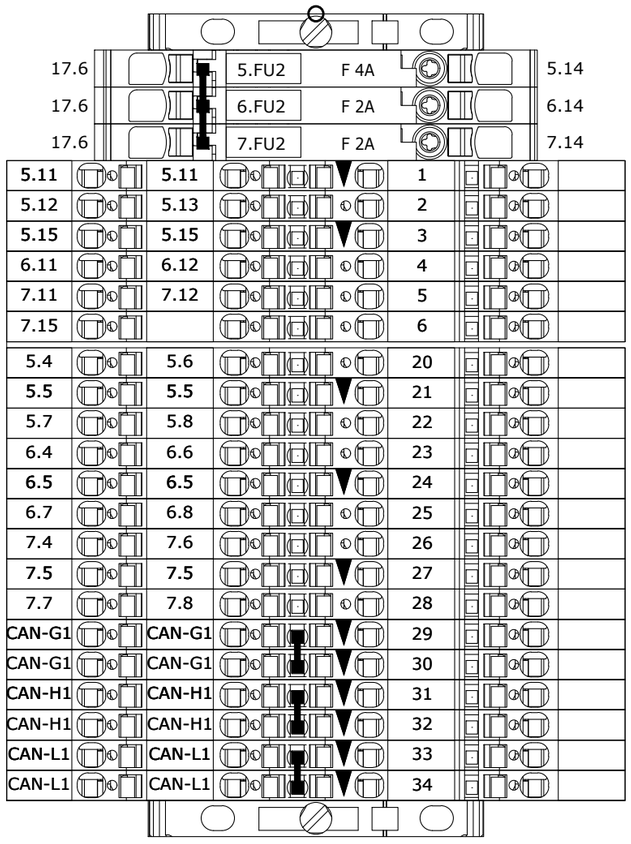
Foglio Seguente 33

EP1 X1
Quadro generale


-B1
1
2 3 4 5 6 7
10.7 27.1 27.7 27.13 28.1 28.3 28.5
F 500mA F 2A F 2A F 2A F 2A F 2A F 2A
10.FU3 27.FU1 27.FU2 27.FU3 28.FU1 28.FU2 28.FU3
-B1 -B1 7.15 10.2 10.3
0V 0V 0V

EP2 X2

Quadro di potenza



REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA 24-02-2026
DOC.Nr. M2750(1-2)_0
FILE M2750(1-2)_REV2_EN
DISEGN. R.G.
APPR.

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

MORSETTIERA QUADRO EP2

EP2 square terminal block

SCALA

Fogli Totali 49

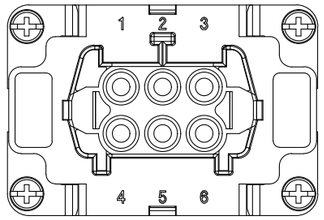
Foglio 34

Foglio Seguente 35

EP1
XS3
Hand control socket

TYPE	*constructor*	ID FILO	NumI	Pin
CSHF 06	Ilme			
		EP1 X1 OVERVIEW	12.4	1
		EP1 X1 OVERVIEW	12.5	2
		EP1 X1 OVERVIEW	12.6	3
		EP1 X1 OVERVIEW	12.7	4
				5
				6
				PE
CHI 16 LS	Ilme			

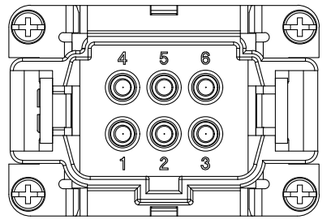
F



PB1
XP3
push-button plug with cable

TYPE	*constructor*	ID FILO	NumI	Pin
CSHM 06	Ilme			
			12.4	1
			12.5	2
			12.6	3
			12.7	4
				5
				6
				PE
CHV 16 L	Ilme			

M



REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA 24-02-2026
DOC.Nr. M2750(1-2)_0
FILE M2750(1-2)_REV2_ENG
DISEGN. R.G.
APPR.

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

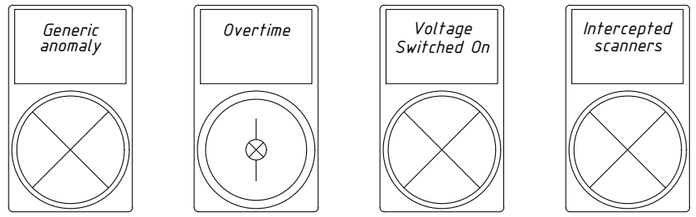
CONNETTORI
Connectors

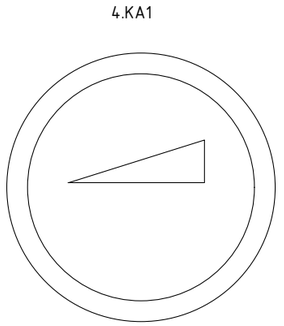
SCALA

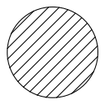
Fogli Totali 49

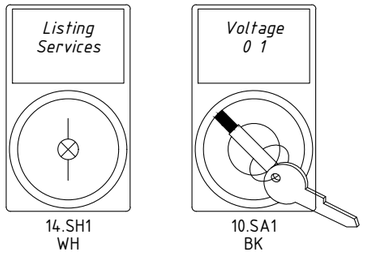
Foglio 35

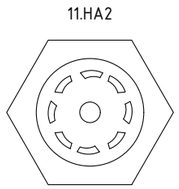
Foglio Seguente 37











REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA 24-02-2026
DOC.Nr. M2750(1-2)_0
FILE M2750(1-2)_REV2_ENG
DISEGN. R.G.
APPR.

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

LAYOUT PANNELLO FRONTALE QUADRO EP1

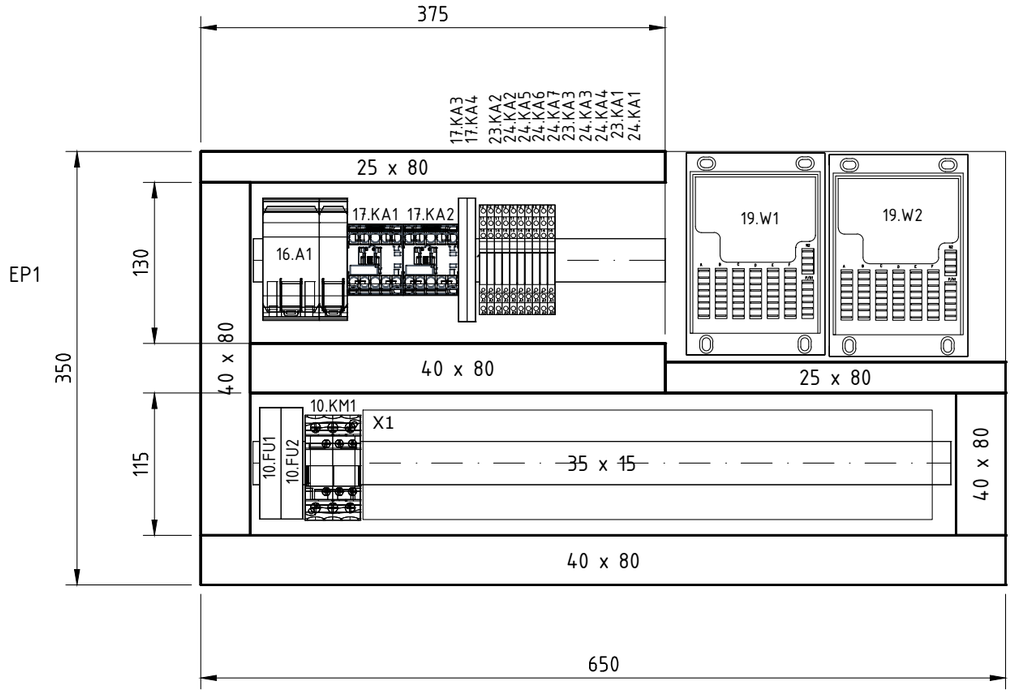
Quadro EP1 front panel layout

SCALA

Fogli Totali 49

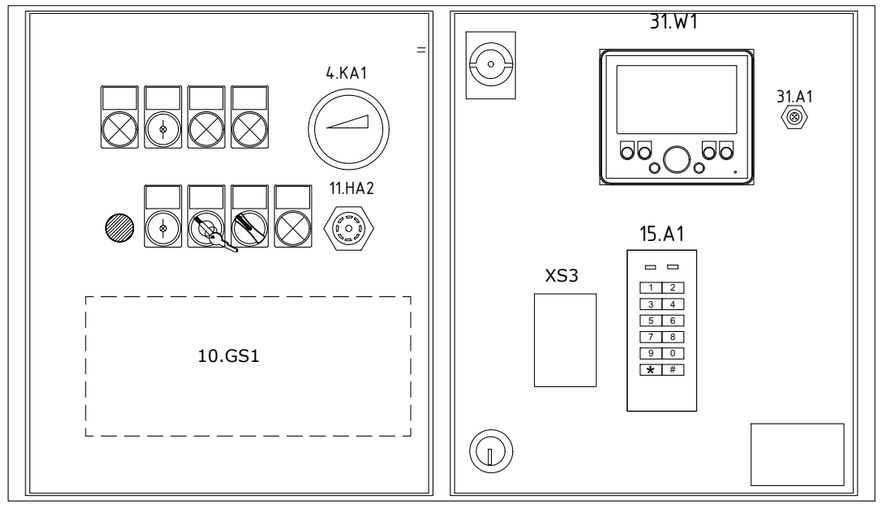
Foglio 37

Foglio Seguente 38

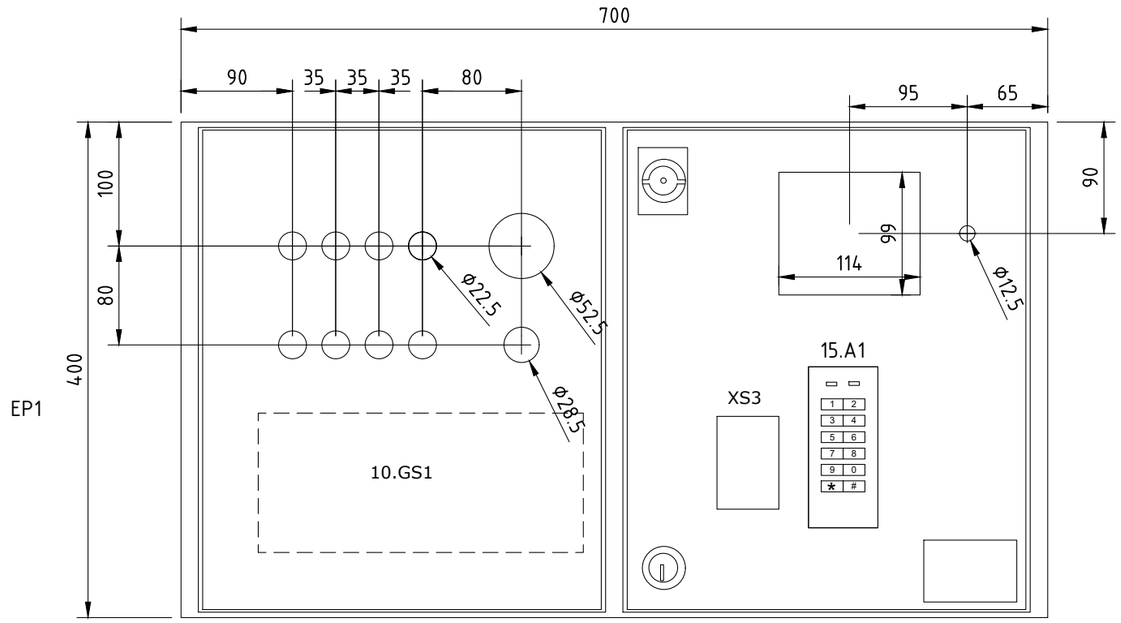


				COMMESSA M2750(1-2)	DATA 24-02-2026	DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET	SCALA
					DOC.Nr. M2750(1-2)_0		Fogli Totali 49
				YAMAHA MOTOR MANUFACTURING	FILE M2750(1-2)_REV2_ENG	LAYOUT QUADRO EP1	
				MORELLO GIOVANNI S.R.L.	DISEGN. R.G.	*EP1 Panel Layout*	Foglio 38 / Foglio Seguente 39
REV.	MODIFICA	DATA	FIRMA		APPR.		

EP1



				COMMESSA M2750(1-2)	DATA 24-02-2026	DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET	SCALA	
					DOC.Nr. M2750(1-2)_0			Fogli Totali 49
				YAMAHA MOTOR MANUFACTURING	FILE M2750(1-2)_REV2_ENG	LAYOUT QUADRO EP1		
				MORELLO GIOVANNI S.R.L.	DISEGN. R.G.	*EP1 Panel Layout*	Foglio 39	Foglio Seguente 40
REV.	MODIFICA	DATA	FIRMA		APPR.			



REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA 24-02-2026

DOC.Nr. M2750(1-2)_0

FILE M2750(1-2)_REV2_ENG

DISEGN. R.G.

APPR.

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

LAYOUT QUADRO EP1

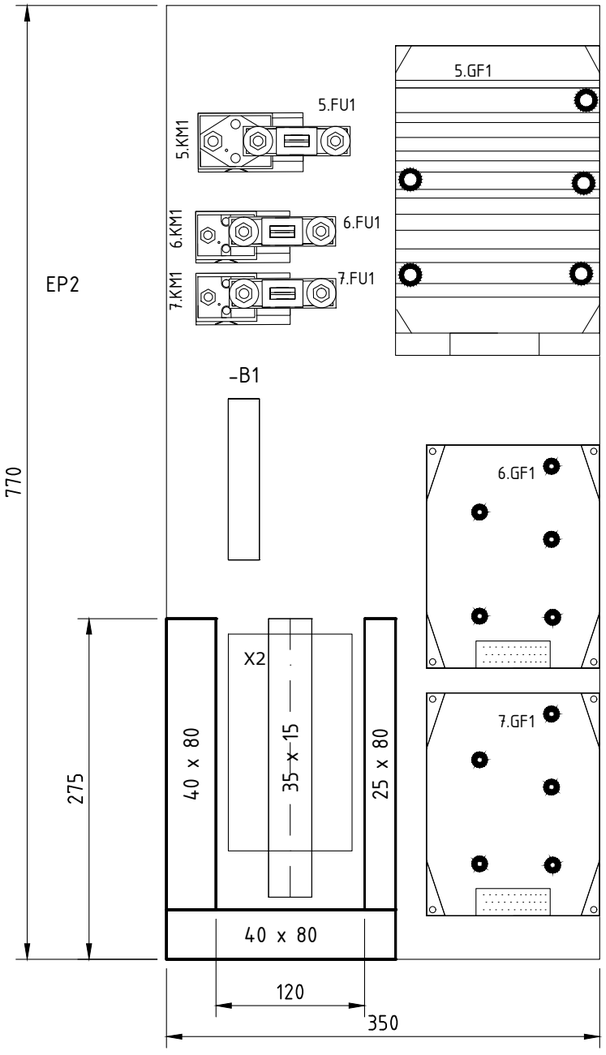
EP1 Panel Layout

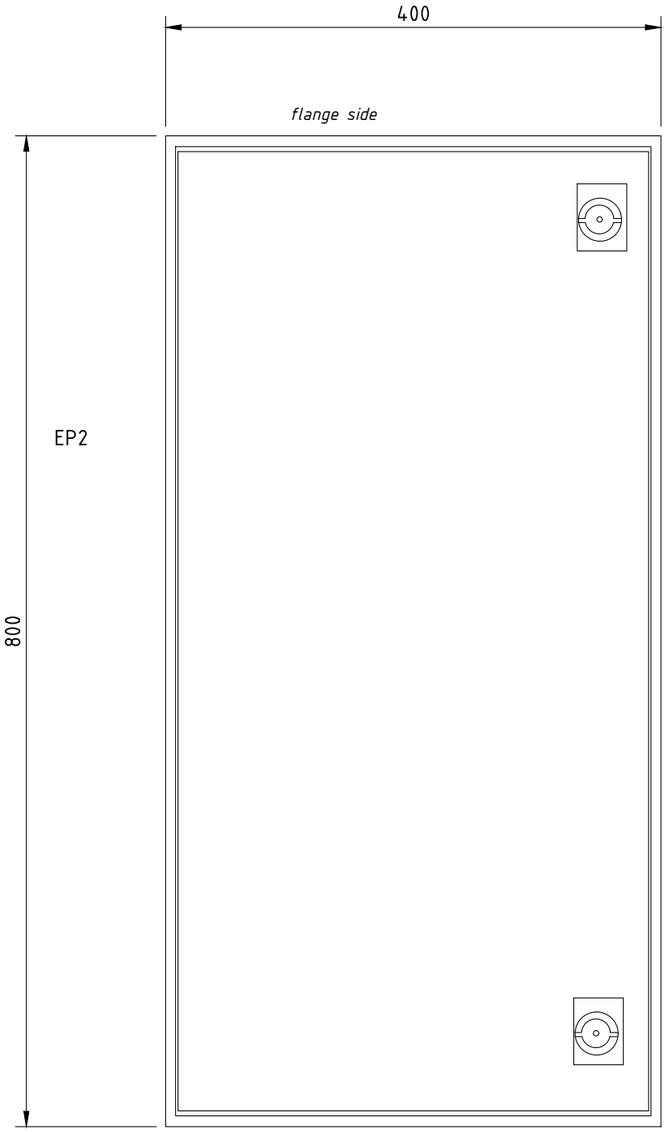
SCALA

Fogli Totali 49

Foglio 40

Foglio Seguente 41





REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA 24-02-2026
DOC.Nr. M2750(1-2)_0
FILE M2750(1-2)_REV2_ENG
DISEGN. R.G.
APPR.

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

LAYOUT QUADRO EP2

EP2 Panel Layout

SCALA

Fogli Totali 49

Foglio 41

Foglio Seguente 42

Name/Item	type/type	Descrizione/Description	Manufacturer/Marke	Quadro/Board	Q.ta/Q.ty	Internal code
4.GS1	322000434	*80v 220ah lithium battery*	ALIANT	BM	1	M_BAT_80V_0079
5.M1	AMX200.190.022	*AC Motor 80V 12.000W 1.600RPM*	CFR	BM	1	M_MAC_80V_0039
6.M1	AGX135.150.004	*Steering gear motor - AC 80V 3.000W 2.800rpm*	CFR	BM	1	M_MTZ_GRP_0077
7.M1	AMP135.100.B006	*AC Pump Motor 80V 2.200W 2.200RPM*	CFR	BM	1	H_MOT_EAC_0034
10.EL1	050PEL3C-24	*LED Linear Ceiling Light, 24V AC/DC, 50/60Hz, 600 LM, L 368mm, with Connector*	New Elfin	BM	1	E_CCS_LED_0098
11.HA1	171287 171449	*SL7-AP24-M Signal. Acus. 24V Multisound* *SL7-CB-EMH Base with external fixing holes*	Eaton Eaton	BM	1 1	E_CCS_ACU_0001 E_ACC_CCS_0008
11.HL1	38665	*Flashing CTL 600 yellow*	Sirena	BM	1	M_LMP_MNC_0003
12.W1	4C0459-01857.A-AZA	*Wire Radio System CAN Europe SGAE/I Standard Lifting Code: 4C0459-01857.A-AZA*	Hetronic	BM	1	E_CMD_RDC_0077
14.S1	XCSB702 XCSZ05	*SAVETY SWITCH* *Bolt Actuator*	Telemecanique Telemecanique	BM	1 1	M_SSR_ELS_0001 E_CCS_KEY_0014
21.SQ1	IFS340 EVC006	*Inductive Sensor Reading: 6mm - Digital - M12x1 L=45mm* *Cable with M12 4-pin angled connector 10m*	Ifm Ifm	BM	1 1	M_SSR_FPX_0076 E_CAV_CON_0029
21.SQ2	IFS340 EVC006	*Inductive Sensor Reading: 6mm - Digital - M12x1 L=45mm* *Cable with M12 4-pin angled connector 10m*	Ifm Ifm	BM	1 1	M_SSR_FPX_0076 E_CAV_CON_0029
27.SQ1	1075842 2073851 2079316	*Micro Scan 3 Core I/O 4M Laser Scanner* *Mounting bracket* *M12 8-pin extension connector 10m*	Sick Sick Sick	BM	1 1 1	 M_SSR_LSC_0014
27.SQ2	1075842 2073851 2079316	*Micro Scan 3 Core I/O 4M Laser Scanner* *Mounting bracket* *M12 8-pin extension connector 10m*	Sick Sick Sick	BM	1 1 1	 M_SSR_LSC_0014
27.SQ3	1075842 2073851 2079316	*Micro Scan 3 Core I/O 4M Laser Scanner* *Mounting bracket* *M12 8-pin extension connector 10m*	Sick Sick Sick	BM	1 1 1	 M_SSR_LSC_0014
28.F1A	3124048	*varistor surge suppressor*	MURR ELEKTRONIK	BM	1	E_CQD_BRD_0001
28.F1B	3124048	*varistor surge suppressor*	MURR ELEKTRONIK	BM	1	E_CQD_BRD_0001
28.F2A	3124048	*varistor surge suppressor*	MURR ELEKTRONIK	BM	1	E_CQD_BRD_0001
31.BR1	RM8004	*Absolute multi-turn encoders, absolute Ø 36.5 / L = 74 mm Hollow shaft open on one side, 12 mm*	Ifm	BM	1	M_TRD_ENC_0003
31.D3	EBC116	*Shunt M12 2F 1M*	Ifm	BM	1	E_CON_MAS_0004
31.R1	E11589	*Terminal Resistor F*	Ifm	BM	1	E_CQD_CON_0009
W5	E11594	*Canopen M12 M-F 5m Cable*	Ifm	BM	1	E_CAV_CON_0009
W6	7000-40542-8030030	*Canopen cable M12 M-F 90° 0.30m*	MURR ELEKTRONIK	BM	1	E_CAV_CON_0048

REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA 24-02-2026
DOC.Nr. M2750(1-2)_0
FILE M2750(1-2)_REV2_EN
DISEGN. R.G.
APPR.

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

DISTINTA MATERIALI
Bill of Materials

SCALA

Fogli Totali 49

Foglio 42

Foglio Seguente 43

Name/Item	*type/type*	Descrizione/Description	*Manufacturer/Marke*	Quadro/Board	Q.ta/Q.ty	*Internal code*
4.GS2	329000953	*Rectifier Green 6 80V 100A 460/480V*	ELSA	CG	1	

REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA 24-02-2026

DOC.Nr. M2750(1-2)_0

FILE M2750(1-2)_REV2_ENG

DISEGN. R.G.

APPR.

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

DISTINTA MATERIALI

Bill of Materials

SCALA

Fogli Totali 49

Foglio 43

Foglio Seguente 44

Name/Item	type/type	Descrizione/Description	Manufacturer/Marke	Quadro/Board	Q.ta/Q.ty	Internal code
4.KA1	324000019	BMS SMART GAUGE CANbus	ALIANT	EP1	1	E_CQD_BRD_0057
10.FU1	DF101	Fuse holder 32A 10x38 1P	Schneider Electric	EP1	1	E_CQD_FUS_0024
	FNQ-20	FNQ-20 BUSS MIDGET Fusibile	Eaton		1	
10.FU2	DF101	Fuse holder 32A 10x38 1P	Schneider Electric	EP1	1	E_CQD_FUS_0024
	FNQ-20	FNQ-20 BUSS MIDGET Fusibile	Eaton		1	
10.FU3	0100500	5x20F STD 500mA 250V Fuse	Italweber	EP1	1	E_CQD_FUS_0028
10.GS1	RSD-500D-24	DC/DC converter 67-154/24V 20A	Mean Well	EP1	1	E_ALM_DTD_0008
10.HL1	ZB4BV013	White pilot light head for ø22 units with smooth lens	Schneider Electric	EP1	1	E_CCS_LED_0012
	ZB4BZ009	Fixing base for electrical elements - for units Ø 22 mm XB4-A - 10/pack	Schneider Electric		1	E_ACC_CCS_0007
	ZBVB1	White light element for Ø22 24V head	Schneider Electric		1	E_CCS_LED_0039
10.KM1	LC1D38EHE	Tesys D Contactor - 3P(3 NO) 1 NO 1 NC - AC-3 - <= 440 V 38 A - 48-130 V AC/DC Coil - Screw terminals	Schneider Electric	EP1	1	E_CQD_RLY_0051
10.SA1	ZB4BG4	Keyed selector switch	Schneider Electric	EP1	1	E_CCS_KEY_0001
	ZB4BZ009	Fixing base for electrical elements - for units Ø 22 mm XB4-A - 10/pack	Schneider Electric		1	E_ACC_CCS_0007
	ZBE101	Single contact block for circular pushbutton Ø 22 mm - 1NO with silver alloy screw terminals	Schneider Electric		2	E_CCS_CNT_0007
10.SA2	ZB4BD2	Black selector head for ø22 units with 2 fixed positions	Schneider Electric	EP1	1	E_CCS_SEL_0001
	ZB4BZ009	Fixing base for electrical elements - for units Ø 22 mm XB4-A - 10/pack	Schneider Electric		1	E_ACC_CCS_0007
	ZBE101	Single contact block for circular pushbutton Ø 22 mm - 1NO with silver alloy screw terminals	Schneider Electric		1	E_CCS_CNT_0007
11.HA2	23265800000	IP65 sounder with volume control	Pfannenberg	EP1	1	E_CQD_VEN_0013
	28300000011	Gasket for sounder P28 DMX	Pfannenberg		1	E_CQD_VEN_0014
14.SH1	ZB4BW313	White luminous wire pushbutton head for Ø22 units with spring return	Schneider Electric	EP1	1	E_CCS_PLS_0005
	ZB4BZ009	Fixing base for electrical elements - for units Ø 22 mm XB4-A - 10/pack	Schneider Electric		1	E_ACC_CCS_0007
	ZBE101	Single contact block for circular pushbutton Ø 22 mm - 1NO with silver alloy screw terminals	Schneider Electric		1	E_CCS_CNT_0007
	ZBVB1	White light element for Ø22 24V head	Schneider Electric		1	E_CCS_LED_0039
15.A1	GSK4-W	Access control reader with PIN or RFID 24VDC, IP66 relay output	G.OSTI	EP1	1	
16.A1	CS MP308M0	CS MP308M0 Programmable Multifunction Safety Module	Pizzato Elettrica	EP1	1	E_CQD_BRD_0061

REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA 24-02-2026
DOC.Nr. M2750(1-2)_0
FILE M2750(1-2)_REV2_EN
DISEGN. R.G.
APPR.

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

DISTINTA MATERIALI

Bill of Materials

SCALA

Fogli Totali 49

Foglio 44

Foglio Seguente 45

Name/Item	type/type	Descrizione/Description	Manufacturer/Marke	Quadro/Board	Q.ta/Q.ty	Internal code
17.KA1	3RT2018-1BB42	Power Contactor, AC-3 16 A, 7.5 kW / 400 V 1 NC, 24 V DC 3 Poles, Size S00 Screw Terminals	Siemens	EP1	1	E_CQD_RLY_0026
	3RT2916-1LM00	LED diode,DC 24-70V,S00,	Siemens		1	E_CCS_DID_0002
17.KA2	3RT2018-1BB42	Power Contactor, AC-3 16 A, 7.5 kW / 400 V 1 NC, 24 V DC 3 Poles, Size S00 Screw Terminals	Siemens	EP1	1	E_CQD_RLY_0026
	3RT2916-1LM00	LED diode,DC 24-70V,S00,	Siemens		1	E_CCS_DID_0002
17.KA3	2702663	Relé SLIM SIL3 1NO+1NC 24VDC	Phoenix Contact	EP1	1	E_CQD_RLY_0046
17.KA4	2702663	Relé SLIM SIL3 1NO+1NC 24VDC	Phoenix Contact	EP1	1	E_CQD_RLY_0046
18.HL1	ZB4BV043	Red pilot light head for ø22 units with flat lens	Schneider Electric	EP1	1	E_CCS_LED_0014
	ZB4BZ009	Fixing base for electrical elements - for units Ø 22 mm XB4-A - 10/pack	Schneider Electric		1	E_ACC_CCS_0007
	ZBVB1	White light element for Ø22 24V head	Schneider Electric		1	E_CCS_LED_0039
18.HL2	ZB4BV053	Orange pilot light head for Ø22 units with flat lens	Schneider Electric	EP1	1	E_CCS_LED_0011
	ZB4BZ009	Fixing base for electrical elements - for units Ø 22 mm XB4-A - 10/pack	Schneider Electric		1	E_ACC_CCS_0007
	ZBVB1	White light element for Ø22 24V head	Schneider Electric		1	E_CCS_LED_0039
19.R1	R120Ω	Resistance 120Ω	Various	EP1	1	E_CQD_RES_0003
19.W1	CR0403	PLC 12 inputs and 12 outputs	ifm	EP1	1	E_CQD_PLC_0001
	EC0456	Contact Kit	Ifm		1	E_CQD_TER_0003
19.W2	CR0403	PLC 12 inputs and 12 outputs	ifm	EP1	1	E_CQD_PLC_0001
	EC0456	Contact Kit	ifm		1	E_CQD_TER_0003
20.SH1	ZB4BW383	Yellow luminous wire pushbutton head for Ø22 units with spring return	Schneider Electric	EP1	1	E_CCS_PLS_0001
	ZB4BZ009	Fixing base for electrical elements - for units Ø 22 mm XB4-A - 10/pack	Schneider Electric		1	E_ACC_CCS_0007
	ZBVB1	White light element for Ø22 24V head	Schneider Electric		1	E_CCS_LED_0039
	ZBE101	Single contact block for circular pushbutton Ø 22 mm - 1NO with silver alloy screw terminals	Schneider Electric		1	E_CCS_CNT_0007
23.HL1	ZB4BV043	Red pilot light head for ø22 units with flat lens	Schneider Electric	EP1	1	E_CCS_LED_0014
	ZB4BZ009	Fixing base for electrical elements - for units Ø 22 mm XB4-A - 10/pack	Schneider Electric		1	E_ACC_CCS_0007
	ZBVB1	White light element for Ø22 24V head	Schneider Electric		1	E_CCS_LED_0039
23.KA1	34.51.7.024.0010	Mini Relay for EMR 1CO 24VDC 6A DC	Finder	EP1	1	E_CQD_RLY_0028
	93.61.7.024	socket with socket clamps Masterbasic	Finder		1	E_ACC_RLY_0007
23.KA2	34.51.7.024.0010	Mini Relay for EMR 1CO 24VDC 6A DC	Finder	EP1	1	E_CQD_RLY_0028
	93.61.7.024	socket with socket clamps Masterbasic	Finder		1	E_ACC_RLY_0007
23.KA3	34.81.7.024.9024	Mini Relay for SSR 1No 24VDC 6A	Finder	EP1	1	E_CQD_RLY_0029
	93.61.7.024	socket with socket clamps Masterbasic	Finder		1	E_ACC_RLY_0007
24.KA1	34.81.7.024.9024	Mini Relay for SSR 1No 24VDC 6A	Finder	EP1	1	E_CQD_RLY_0029

REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA 24-02-2026
DOC.Nr. M2750(1-2)_0
FILE M2750(1-2)_REV2_EN
DISEGN. R.G.
APPR.

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

DISTINTA MATERIALI
Bill of Materials

SCALA

Fogli Totali 49

Foglio 45

Foglio Seguente 46

Name/Item	type/type	Descrizione/Description	Manufacturer/Marke	Quadro/Board	Q.ta/Q.ty	Internal code
24.KA1	93.61.7.024	socket with socket clamps Masterbasic	Finder	EP1	1	E_ACC_RLY_0007
24.KA2	34.51.7.024.0010	Mini Relay for EMR 1CO 24VDC 6A DC	Finder	EP1	1	E_CQD_RLY_0028
	93.61.7.024	socket with socket clamps Masterbasic	Finder		1	E_ACC_RLY_0007
24.KA3	34.81.7.024.9024	Mini Relay for SSR 1No 24VDC 6A	Finder	EP1	1	E_CQD_RLY_0029
	93.61.7.024	socket with socket clamps Masterbasic	Finder		1	E_ACC_RLY_0007
24.KA4	34.81.7.024.9024	Mini Relay for SSR 1No 24VDC 6A	Finder	EP1	1	E_CQD_RLY_0029
	93.61.7.024	socket with socket clamps Masterbasic	Finder		1	E_ACC_RLY_0007
24.KA5	34.51.7.024.0010	Mini Relay for EMR 1CO 24VDC 6A DC	Finder	EP1	1	E_CQD_RLY_0028
	93.61.7.024	socket with socket clamps Masterbasic	Finder		1	E_ACC_RLY_0007
24.KA6	34.51.7.024.0010	Mini Relay for EMR 1CO 24VDC 6A DC	Finder	EP1	1	E_CQD_RLY_0028
	93.61.7.024	socket with socket clamps Masterbasic	Finder		1	E_ACC_RLY_0007
24.KA7	34.51.7.024.0010	Mini Relay for EMR 1CO 24VDC 6A DC	Finder	EP1	1	E_CQD_RLY_0028
	93.61.7.024	socket with socket clamps Masterbasic	Finder		1	E_ACC_RLY_0007
25 x 80	02578	T1-EN 25X80 G CAN. CABL.	Bocchiotti	EP1	0.58	E_CNL_PLA_0003
27.FU1	0102002	Fuse 5x20F STD 2A 250V	Italweber	EP1	1	E_CQD_FUS_0016
27.FU2	0102002	Fuse 5x20F STD 2A 250V	Italweber	EP1	1	E_CQD_FUS_0016
27.FU3	0102002	Fuse 5x20F STD 2A 250V	Italweber	EP1	1	E_CQD_FUS_0016
28.FU1	0102002	Fuse 5x20F STD 2A 250V	Italweber	EP1	1	E_CQD_FUS_0016
28.FU2	0102002	Fuse 5x20F STD 2A 250V	Italweber	EP1	1	E_CQD_FUS_0016
28.FU3	0102002	Fuse 5x20F STD 2A 250V	Italweber	EP1	1	E_CQD_FUS_0016
31.A1	E73008	M12 5pin A Panel Connector	Ifm	EP1	1	E_CQD_CON_0012
	1456200	M12 dust cap	Phoenix Contact		1	E_ACC_CON_0012
31.D1	EBC116	Shunt M12 2F 1M	Ifm	EP1	1	E_CON_MAS_0004
31.D2	EBC116	Shunt M12 2F 1M	Ifm	EP1	1	E_CON_MAS_0004
31.W1	CR0452	Display LCD	Ifm	EP1	1	E_CQD_HMI_0002
	EC0404	Mounting bracket	Ifm		1	E_ACC_HMI_0002
35 x 15	023650 b=Ø5,5	TS 35x15 b=Ø5,5	Weidmuller	EP1	0.9	E_GUI_DIN_0001
40 x 80	02581	T1-EN 40X80 G CAN. CABL.	Bocchiotti	EP1	1.39	E_CNL_PLA_0002
EP1	BIE/118	700x400x250 2-door switchboard	Zanardo	EP1	1	E_QDR_STD_0033
	8004	Yale Key Lock	Zanardo		1	E_ACC_QDR_0010
	DRC928	Door Lock Rod	Zanardo		2	E_ACC_QDR_0005
	Electrical voltage sticker 140x140x140	Electrical voltage sticker 140x140x140	Various		1	G_TAR_ADS_0007
	80v 140x30 sticker	Adhesive plate 80V 140x30	Various		1	G_TAR_ADS_0017
	24v 140x30 sticker	Adhesive plate 24V 140x30	Various		1	G_TAR_ADS_0001
	268000-GB	Red Sticker Plate in English DPR	Cembre		1	G_TAR_ADS_0015
	ZB5SZ3	Black Circular Shutter Cap Ø22	Schneider Electric		2	E_ACC_CCS_0004
EP1	RRPTAL65035010	Piastra alluminio 650x350x10	REAR	EP1	1	E_ACC_QDR_0017
W1	E11598	Canopen M12 M-Cable 2m	Ifm	EP1	1	E_CAV_CON_0016
W2	7000-40542-8030110	Canopen cable M12 M-F 90° 1.10m	MURR ELEKTRONIK	EP1	1	E_CAV_CON_0061
W3	E11591	Canopen cable M12 M-F 0.30m	Ifm	EP1	1	E_CAV_CON_0005
W4	7000-40542-8030110	Canopen cable M12 M-F 90° 1.10m	MURR ELEKTRONIK	EP1	1	E_CAV_CON_0061
X1	1674300000	Double clamp ZDK 2.5/1.5	Weidmuller	EP1	36	E_CQD_TER_0010
	1689990000	ZDK 2.5/1.5V Dual Clamp	Weidmuller		40	E_CQD_TER_0011

REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

MORELLO GIOVANNI S.R.L.

DATA 24-02-2026
DOC.Nr. M2750(1-2)_0
FILE M2750(1-2)_REV2_EN
DISEGN. R.G.
APPR.

DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

DISTINTA MATERIALI

Bill of Materials

SCALA

Fogli Totali 49

Foglio 46

Foglio Seguente 47

Name/Item	*type/type*	Descrizione/Description	*Manufacturer/Marke*	Quadro/Board	Q.ta/Q.ty	*Internal code*
X1	2429860000	*AFS 4 2C BK Fuse terminal block, push in, 4 mm², 500 V, 6.3 A, black*	Weidmuller	EP1	7	E_CQD_TER_0019
	1746750000	*Modular passage terminal ZDU 10*	Weidmuller		1	E_CQD_TER_0032
	9540000000	*Fixing terminal for TS 35 ZEW 35 /6mm*	Weidmuller		2	E_CQD_TER_0018
XS3	CSHF 06	*Socket socket, 6-pin PE, Connection with Squich spring clamp, 16A max, 500 V, 6kV, 3, with sockets, silver-plated, size 44.27, Sockets Class Tecnica series*	Ilme	EP1	1	E_CON_FEM_0008
	CHI 16 LS	*Recessed enclosure single lock with lever and door*	Ilme		1	E_ACC_CON_0014

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DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

DISTINTA MATERIALI

Bill of Materials

SCALA

Fogli Totali 49

Foglio 47

Foglio Seguente 48

Name/Item	*type/type*	Descrizione/Description	*Manufacturer/Marke*	Quadro/Board	Q.ta/Q.ty	*Internal code*
5.FU1	CNL400DIN	*Traction fuse 400A*	MERSEN	EP2	1	
5.FU2	0104004	*Fuse 5x20F STD 4A 250V*	Italweber	EP2	1	E_CQD_FUS_0017
5.GF1	470396521	1236SE-6521 48-80V 450A	Curtis	EP2	1	E_CQD_AZN_0010
5.KM1	C29986	*Contactor SU280B-1004 24V CO 250A(Interrupted)/350A(Uninterrupted)*	ZTP	EP2	1	E_CQD_TEL_0001
6.FU1	CNL175DIN	*Traction fuse 175A*	MERSEN	EP2	1	E_CQD_FUS_0064
6.FU2	0102002	*Fuse 5x20F STD 2A 250V*	Italweber	EP2	1	E_CQD_FUS_0016
6.GF1	389216221	1232E-6221 48-80V 175A	Curtis	EP2	1	E_CQD_AZN_0002
6.KM1	C29556	*Contactor SW80B/6 24V CO 100A(Interrupted)/125A(Uninterrupted)*	ZTP	EP2	1	E_CQD_TEL_0007
7.FU1	CNL175DIN	*Traction fuse 175A*	MERSEN	EP2	1	E_CQD_FUS_0064
7.FU2	0102002	*Fuse 5x20F STD 2A 250V*	Italweber	EP2	1	E_CQD_FUS_0016
7.GF1	389216221	1232E-6221 48-80V 175A	Curtis	EP2	1	E_CQD_AZN_0002
7.KM1	C29556	*Contactor SW80B/6 24V CO 100A(Interrupted)/125A(Uninterrupted)*	ZTP	EP2	1	E_CQD_TEL_0007
25 x 80	02578	T1-EN 25X80 G CAN. CABL.	Bocchiotti	EP2	0.23	E_CNL_PLA_0003
35 x 15	023650 b=Ø5,5	TS 35x15 b=Ø5,5	Weidmuller	EP2	0.23	E_GUI_DIN_0001
40 x 80	02581	T1-EN 40X80 G CAN. CABL.	Bocchiotti	EP2	0.42	E_CNL_PLA_0002
-B1	ISO2190	*PA insulating pedestal M8 H35*	Teknomega	EP2	2	E_CQD_ISO_0002
EP2	MAS0804030R5	*electrical panel 800x400x300, 1 door*	nVent HOFFMAN	EP2	1	
EP2	RRPTAL77035010	Piastra alluminio 770x350x10	REAR	EP2	1	
X2	2429860000	*AFS 4 2C BK Fuse terminal block, push in, 4 mm², 500 V, 6.3 A, black*	Weidmuller	EP2	3	E_CQD_TER_0019
	1674300000	*Double clamp ZDK 2.5/1.5*	Weidmuller		10	E_CQD_TER_0010
	1689990000	*ZDK 2.5/1.5V Dual Clamp*	Weidmuller		11	E_CQD_TER_0011
	9540000000	*Fixing terminal for TS 35 ZEW 35 /6mm*	Weidmuller		2	E_CQD_TER_0018

REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

YAMAHA MOTOR MANUFACTURING

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DISTINTA MATERIALI
Bill of Materials

SCALA

Fogli Totali 49

Foglio 48

Foglio Seguente 49

Name/Item	*type/type*	Descrizione/Description	*Manufacturer/Marke*	Quadro/Board	Q.ta/Q.ty	*Internal code*
XP3	CSHM 06	*Plug Socket, 6 PE Poles, Squich Spring Clamp Connection, 16A Max, 500 V, 6KV, 3, with Plugs, Silver-Plated, Size 44.27, Sockets Class Technical Series*	Ilme	PB1	1	E_CON_MAS_0016
	CHV 16 L	*Mobile enclosure with single lock with pegs, vertical outlet PG 21*	Ilme		1	E_ACC_CON_0002

REV.	MODIFICA	DATA	FIRMA

COMMESSA M2750(1-2)

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DOCUMENTO SGAE-E ±90° P 38/3 - TRANSPALLET

DISTINTA MATERIALI

Bill of Materials

SCALA

Fogli Totali 49

Foglio 49

Foglio Seguente /

User manual and maintenance
HYDRAULIC POWER UNIT

SUMMARY

Sez. A - Technical data
Sez. B - Intended use, General warnings
Sez. C - Existing risks and Residual risks
Sez. D - Handling and Demolition
Sez. E - Installation and Connection
Sez. F - Plant startup
Sez. G - Maintenance
Sez. H - Troubleshooting

ANNEXES

"HS" Hydraulic diagram
"PL" Part list
"TA" Layout drawing
"DI" Declaration of incorporation

WARNING

DO NOT START THE POWER UNIT AND DO NOT MAKE ANY INTERVENTION, IF FIRST DOES NOT BE ACCURATE READ AND INTEGRALLY UNDERSTAND THIS MANUAL IN ALL OF THEIR PARTS.

The assembly in object is destined to be incorporated inside a machine to which the Machinery Directive 2006/42/CE applies, therefore its starting-up is prohibited before the machine, where it will be incorporated, has been declared in accordance with all provisions of the Directive

In case of alterations or improper use of the power unit, MORELLO s.r.l. will not be held responsible for the basic safety and health requirements related to the supply described in this manual.

The technical data and drawings contained in these assembly instructions may have been revised and modified. Reference should therefore be made to the latest update of the technical drawings or diagrams related to assemblies or systems.

Please contact our technical office if you have any questions about the interpretation of the manual.

Constructor:

TECNICAL DATA

Serial number and year :	3123/2026
Customer reference:	2750
Date and document review:	01/2016 R0
Flow and pressure pump/s :	9 Lt/1' 100 bar
Motor/s :	2,2 KW 80V AC 4Pole
Solenoid valve tension:	24 VDC
Net tank capacity :	30 Litre
Accumulator/s capacity:	(Not Present)
Net weight :	39 Kg
Measures WxDxH :	570x250x597

INTENDED USE, GENERAL WARNINGS AND SAFETY

DESCRIPTION OF POWER UNIT, INTENDED USE AND OPERATION LIMITS

The hydraulic unit described in this manual is to be used for hydraulic automation, as a control component, and was designed for use with hydraulic oil of group II art. 13 directive 2014/68/EU which, in addition to transferring power, guarantees the lubrication and protection of the equipment making up the unit.

By means of one or more motor pump units, the hydraulic unit can draw the oil at ambient pressure contained in a tank and pressurise it to a determined pressure.

The flow and regulation of pressurised fluid by means of special valves, allows the movement of linear or rotary actuators situated on the machine that the unit will be assembled to. The unit can be fitted with a number of accessories such as filters, heat exchangers, level sensors and accumulators, required for a correct and lasting operation, according to the application of the machine.

The control unit is designed to be used within these parameters:

Hydraulic oils are according to DIN 51524 ... 535, ISO6743-4 norms
Oil viscosity at working temperature (40°C) between 35 and 68 mm2/S (ISO VG 35 / 68)
Maximum oil viscosity for cold start of 400 mm2/S
Ambient temperatures allowed -10°C +60°C
Optimal oil temperature between +40°C a +50°C
Maximum oil temperature +60°C
Pressure according to attachment “HS” (Hydraulic diagram)

For applications other than those listed, if not agreed at the time of the order, the performance and safety features may be different from those designed.

Consult the Annexes:

“HS” (hydraulic diagram) for the logic of operation and adjustment.
“PL” (part list) for the list of installed components.
“TA” (layout drawing) for the layout of the components and for the overall dimensions.

GENERAL WARNINGS

All activities of installation of the assembly must be conducted by competent and qualified staff.

The assembly instructions for the partly complete machine must be considered as an integrant part of the partly complete machine and must be kept for future reference until final demolition of the machine.

The content of this manual is exclusively referred to the assembly made by MORELLO srl and it does not provide for eventual risks which can be derived after the incorporation into the machine. It is the machine manufacturer’s responsibility to provide for suitable guards in the vicinity of flexible and rigid pipes, accumulators and parts of the plant under particularly high pressure, or wherever a risk of explosion exists.

These instructions represent the intended directions for use, in order to operate the machine in safe conditions for the personnel, for the equipment and for the environment.

Before leaving the factory, the assembly has been carefully checked and tested in all its functions. The only allowed operations are the settings described in the “Plant start-up” and “Maintenance” sections.

The partly complete machine has been designed to operate in automatic mode only after it has been connected to another machine. In manual mode, the safety instructions included in this manual must be strictly followed.

The hydraulic unit can NEVER be used:

- For applications other than those described in annex “HS” (Hydraulic diagram).
- With operating limits different from those described above.
- In environments with potentially explosive, aggressive atmosphere or high concentration of dust or oily substances suspended in the air.
- If the pipes or other components have not be correctly connected.
- Changing the pressures indicated in annex *HS* (Hydraulic diagram).
- With unplanned oils by type and density.
- With temperature of the fluid exceed 60 ° C inside the tank.
- Before checking the correct fluid level into the tank with proper visual indicator.

SAFETY

If access to the working area of the unit is required, the operators must wear suitable protective equipment for the operations to be carried out.

Clothes must be tight-fitting.

Avoid wearing ties, necklaces or belts that may get tangled or caught in moving parts.

Approved individual protection devices required: **Goggles, Mask, Shoes, Gloves.**

Main safety regulations

- Protective goggles must be worn whenever compressed air must be used (not recommended) during the cleaning operation.
- During maintenance operations, the areas being worked on must be cleaned. Never use flammable and toxic solvents: Gasoline, Benzene, Ether, Alcohol, Turpentine, Ammonia or other similar products. Use exclusively authorised substances.
- Protective goggles and gloves must be worn at all time. No not dispose of rags or paper used for cleaning in the environment but throw them in the designated containers distributed in the plant.
- In case of fire, never direct water jets to the equipment. Switch off all power supplies and use suitable CO_2 fire extinguishers.
- Do not work on energised electric equipment. Start working only after the safety measures have been implemented.
- It is forbidden to unscrew screws and fittings with the pressurized system.
- Any operation carried out incorrectly will void the warranty and exclude any safety liability as per the declaration of incorporation related to Machinery Directive 2006/42/EC.

EXISTING RISKS AND RESIDUAL RISKS

EXISTING RISKS

During the designing stage have been evaluated all the components' compatibility with the pressure and consequently all necessary precautions have been taken to avoid risks to the persons and damage to the plant components, including the scrapping operation.
The evaluation also took into account the fact that the safety devices used in the system have all the quality and safety certifications, and their failure is therefore highly improbable.
Other factors have not been taken into account, such as the work organisation, the operators' capacities and, consequently, their tendency not to comply with the normal safety requirements.

Summary of the main existing risks:

Hydraulic	Pressurised accumulator (if present)
Electric	400V voltage
Thermal	High temperature of metallic parts
Substances used	Contact with hydraulic oil
Power supply	Pressurised elements
Mechanical	Crushing, impact (during transport and assembly)

RESIDUAL RISKS

After a careful evaluation of all possible risks related to the use and maintenance of the unit and after implementing all the solutions required to remove the risks and limit possible hazards to exposed persons, the following residual risks remain, and can be removed or reduced with the corresponding measures.
Any non authorised modification could compromise the operator's safety during the machine operation, with serious risks for the operator.

Residual risks mainly concern:

- The presence of a pressurised oil accumulator (if present), the pressure is not automatically released when the machine is switched off, since the accumulator is used as a power reserve in lack of power supply; if necessary, release the pressure by operating the appropriate manual valve.
- the presence of energised electric equipment – RISK OF ELECTRIC SHOCK
- the obligation to wear eye protection in case of compressed air cleaning – RISK OF DUST AND/OIL PROJECTION.

Hydraulic oil is used during the authorised operation of the machine. This hydraulic oil is not classified as dangerous, including for the environment, according to the criteria established by the European Union, however, care is recommended as a minor risk of explosion exists.
It may form flammable mixtures or burn only if heated at temperatures higher than the flash point. Repeated and lasting contact, if combined with poor personal hygiene, may cause reddening of the skin, irritations and contact dermatitis by degreasing effect.
Accidental ingestion of small quantities may cause nausea, indisposition and gastric disorders.
Considering the product organoleptic properties, ingestion of large quantities is deemed improbable.



WARNING – In case of incidents with pressurised pipe work or similar, any substance may be accidentally injected in the subcutaneous tissues, with no apparent external lesion. In this case, the injured person must be immediately taken to hospital for the necessary treatment.

Summary of residual risks

Mechanical/ Hydraulic	(impacts / pressurised accumulator)
Materials/Substances	(hydraulic oil used)
Electric	(400V voltage)

Risks resulting from forbidden operations

- All the planned and programmed operations of the partly complete machine must be performed only with the safety protections activated.
- The utmost care is recommended when operating pressure accumulation devices: they must be pre-charged exclusively with **nitrogen**, under no circumstances should oxygen be used as it may cause violent explosions if it comes in contact with hydraulic oil.
- It is strictly forbidden to carry out the working cycle with personnel or foreign objects in the vicinity of the unit,
- Under no circumstances should the partly complete machine be operated with the guards removed, opened or tampered.
- Do not operate the energised electric panel.
- During adjustment and/or maintenance operations, the operator must not get his face too close to the components on which he is working.
- It is strictly forbidden to carry out maintenance, cleaning and lubrication operations on moving parts.
- Do not smoke and do not approach flames during the fluid filling, replacement or top-up operations.
- Do not weld with the assembly full of fluid.
- Strictly follow all the recommendations of the chosen hydraulic fluid contained in the relevant security schedule.
- Use proper containers for the exhaust fluid.
- After the maintenance operations or in case of fluid leakages, immediately remove the fluid stains from the surfaces on which people walk.



WARNING – Systems that require one or more accumulators must be de-pressurized prior to maintenance even if the control unit is inactive.
- With automatic drain systems, check the pressure gauges, if necessary open the pressure gauge, that the pressure is actually zero.
- With systems without automatic drain system, de-pressurize through the manual drain valve.

HANDLING AND DISPOSAL

TRANSPORT

The machine must be transported on a truck suited to the weight of the machine, and wooden boards must be interposed between the truck platform and the unit to avoid sliding. The machine must be securely anchored to the truck with cables of suitable strength.
The edges and parts on which the cables are resting must be protected with suitable guards to avoid damage to the machine due to dragging or sudden impacts.
It is forbidden to superimpose any other object above the present packaging.
On receipt, make sure there is no visible damage.

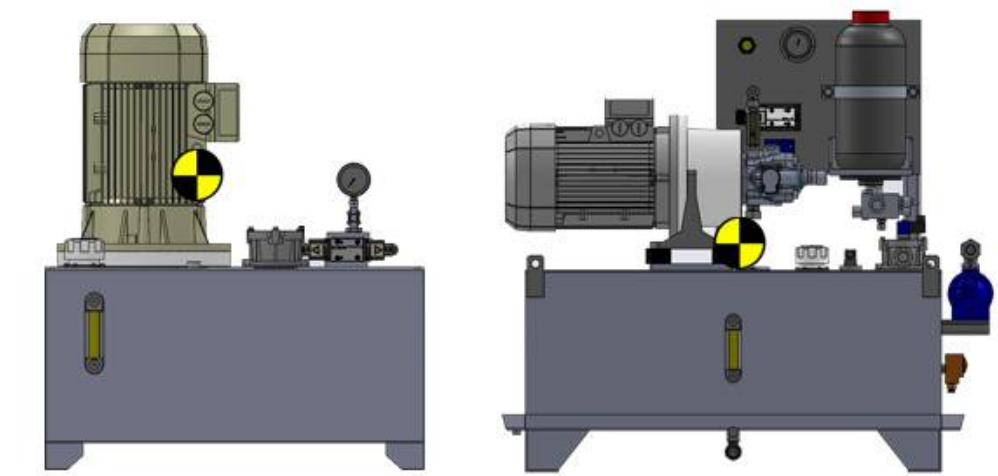
LIFTING

If the weight of the unit is not significant, therefore the lifting operation can be carried out with a standard forklift truck but a cable harness may be needed, if are present lifting eye bolt connect them to the lifting ones.

WARNING – During the handling and lifting operations, make sure nobody crosses or stands within the operating range of the lifting equipment.
-The indications about the operations to be performed must be only given by the person responsible for the lifting.

WARNING – The overturning of the unit may cause severe injury or death. The center of gravity of a empty power unit is positioned much higher than it looks, very often placed above the level of the lid, paying particular attention to the presence of large engines, accumulators and valves.

Generic examples for locating the center of gravity:



PACKAGING

Before packing the power unit for transport empty the tank and, if necessary, all interlocking power sources (electric current, hydraulic power) must be disconnected. Unprotected openings of hydraulic systems/components must be sealed and tapped threads must be protected during transport. These seals must be removed only when the machine is reassembled.

It is important that this operation is controlled/directed by qualified personnel.

The parts of the machine and/or aggregates that are likely to move when handled with lifting equipment, should be secured in the position offering the smallest dimensions, and the most vulnerable parts should be suitably protected against possible impacts.

Cable channels, flexible and rigid pipes, and electric cables must be marked before being disconnected, then suitably codified to be reassembled and gathered around the machine or aggregate, included in the package or packed separately according to the dimensions.

The type of packaging, if necessary, must be compliant with the regulations set by the legislation and/or by the specific standards of the country where the machine will be shipped.

STORAGE

The storage of the partly complete machine and its components can take place in packaging conditions, for short periods of time (3 to 4 weeks), always in a covered area, even if packed.

The stocking must be provided into a room without humidity and dust. The ambient temperature must be within -10° to +70°C and the relative humidity must be lower than 65%.

DISPOSAL AND DEMOLITION

General precautionary measures:
-The machine, systems and aggregates consist of metal, plastic and rubber material.
-For a safe demolition process, electric cables, rubber pipes and plastic and polymer components must be carefully separated from metal components.

Remember that the disposal of any substance must be carried out in compliance with D.P.R. 691/82 and D.L. 95 - 27/01/1992.

Taking out of service and scrapping of the hydraulic unit must be carried out by technical personnel suitably instructed, informed and trained on the residual risks existing on the machine, even after it has been disabled.

At the end of the unit operating life, the components of the hydraulic unit must not be disposed of as common waste but must be scrapped in special containers for proper recycling.

INSTALLATION AND CONNECTION

INSTALLATION

WARNING – All activities of installation of the asembly must be conducted by competent and qualified staff.

The positioning of the machine does not require any special foundation, however the installation must be carried out on a smooth, compact, level ground and can support the sum of the weight of the control unit and the oil it may contain.
For a correct and safe operation, the hydraulic unit must always be anchored to the ground; avoid locations exposed to impacts; avoid locations that may generate vibrations and do not expose the unit to severe weather conditions.
Position the unit in such a way as to facilitate the installation and maintenance operations, allowing easy access to all controls and/or devices.

If mobile parts of the machine are present close to the assembly, suitable protections (carters) must be provided to avoid dangerous situations for the maintenance operators.

The machine is supplied without any start, stop, operating and emergency stop device, therefore the machine manufacturer must insert them, positioning them in an accessible and safe position without compromising their operation.
The machine must be designed and manufactured in such a way that the shutdown controls, including the emergency stop devices, can shut down not only the machine but also the unit and the components supplied by MORELLO s.r.l.

If not otherwise indicated, the following conditions must be respected:
- altitude within 0 to 1000 m sea level;
- relative humidity lower than 65%;
- electrical voltage supply tolerance Vnom +/- 10%;
- ambient temperature between 0° to 40°C;

ELECTRICAL CONNECTION

WARNING – The terminal box contains metallic connectors which can be under voltage, after carried out the connections always close the terminal box.
The electrical installation and connection must be performed by qualified personnel.

The electric connection of all the required components (electric motor, pressure switches, level gauges, etc.) is the machine manufacturer's responsibility, refer to A*nnex* "HS" (Hydraulic diagram) and the data sheet of the electrical component manufacturer, in case of any doubt contact our technical service.
Verify that the power unit source of potentially dangerous electrostatic charges, has been correctly connected to the ground circuit.
The electrical power supply must be the same as specified on the motor nameplate data.

HYDRAULIC CONNECTION

WARNING – Carefully observe the connection shown in the "HS" (Hydraulic diagram), paying attention not to invert P and T and to comply with the connection of the A and B uses with the respective cylinder bottom and bottom sides.

Hydraulic connections must be made with appropriate fittings and pipes of good quality, make sure that the pressure range are higher than those indicated in the Annex "HS" (Hydraulic diagram) , suitably dimensioned to avoid pressure loss or obstructions.
Before assembly, the pipes must be carefully cleaned from the dirties and burrs, the pipes with welded end must be pickled.

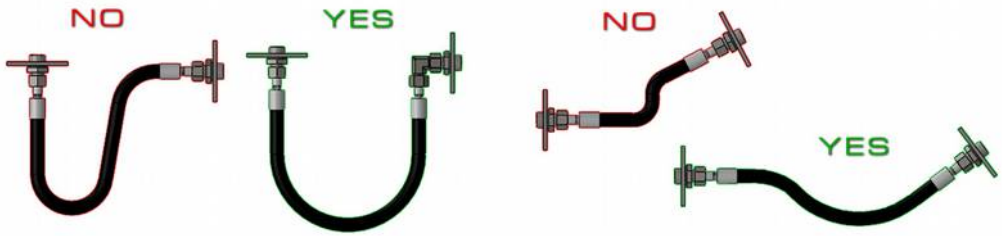
Sealing materials (i.e. hemp) are not allowed because they can produce impurities causing functional problems. The steel pipes have to be held with proper supports, equally distanced; they never have to be forced or modified after their installation. The use of steel pipes without welding, according to EN 10305-4, DIN 2391 is recommended. The fittings must be assembled according to the manufacturer recommendations.

The flexible pipes must be assembled according to the manufacturer recommendations, pay attention to their length because if too short, mechanical stress may occur at the pipe ends, they have to be locked and protect with a suitable carter depending to their dangerous level for the operators.

For the hydraulic connections between the assembly and the machine it is preferable that a section is made with flexible pipes to reduce transmitted vibrations and noise. Keep user connection closed with suitable plugs in order to avoid the entry of dust and dirties.

In the case of pipes longer than 5 meters, we recommend using pipes with a one size larger and two size for length over 20 meters.

Examples of bad/proper mounting of flexible hoses



WARNING – When supplying a separate tank and motopump, provide a suction hose of generous size and length not more than one meter, do not use elbow joint or curves too tightly, place the pump unit under oil level.

PLANT STARTUP

WARNING – All activities of plant startup must be conducted by competent and qualified staff.

PRELIMINARY OPERATIONS

Before proceeding with the startup, do the following:

-Check that all the components of the hydraulic circuit are correctly installed and ready for use.

-Check that all pipes are correctly connected and the fittings are correctly locked.

-Check the accumulator pre-charge pressure. For the charge only NITROGEN must be used.

-Before proceeding to the tank filling, ensure that the tank has not been contaminated by external particles or dirties. In this case a new internal cleaning has to be performed.

-Fill the tank with good quality oil in according to the table below, preferably using a filtration and filling unit with an in-line filter with a filtration degree of at least 25 microns or 10 microns in the presence of proportional valves.

T°environment	**<20 °C avg.**	**>20 °C avg.**	**>40 °C avg.**
DIN51524/Part.2	**H-LP 32**	**H-LP 46**	**H-LP 68**
ISO VG ref	32	46	68
AGIP	OSO 32	OSO 46	OSO 68
IP	Hydrus 32	Hydrus 46	Hydrus 68
BP	Energol HPL32	Energol HPL46	Energol HPL68
CASTROL	Hyspin AWS 32	Hyspin AWS 46	Hyspin AWS 68
ESSO	Nuto H 32	Nuto H 46	Nuto H 68
MOBIL	DTE 24	DTE 25	DTE 26
SHELL	Tellus 32	Tellus 46	Tellus 68
CHEVRON	EP Hydraulic Oil 32	EP Hydraulic Oil 46	EP Hydraulic Oil 68

-In the case of pumps outside the tank, fill in the suction hose and the pump body with the fluid used in the circuit through the outlet pipe and in the pumps that provide it from the drain hose, tighten the fittings again after filling.

-If large cylinders have been provided in the circuit, manually provide their first filling.

-Temporarily loosen the pressure regulating valve to prevent the initial start from taking place under high load.

-Make sure the rotation direction of the electric motor is "CLOCKWISE" looking at the motor fan, while it is powered for a short time, never remove the fan protection from the electrical motor and do not introduce objects in contact with the fan.

WARNING – Do not start the unit before the fluid inlet and outlet pipes have been correctly connected, as these conditions could cause risks for the operator and for the environment.

FIRST START

WARNING – The unit startup and the oil pressure involves the movement of the interlocked moving parts. It is the machine manufacturer's responsibility to implement all necessary measures to avoid damage to persons and objects.

During the first startup, the pump must start in neutral, without pressure generation, with flow free in delivery, so that it can be triggered correctly.

-For fixed-flow pumps, such as gear pumps, simply start the engine by leaving the solenoid valve de-energized.

- In the case of variable flow pumps such as piston or vane pumps, it is necessary temporarily to short-circuit the "P" output pipe to the "T" return pipe, after a few seconds of flushing turn off the electric motor and reset the circuit. If present high/low pressure solenoid it must be kept de-energized.
Refer to the annex "HS" e "PL" to identify the type.

During the start-up and adjustment phases completely open the pressure gauge shut-off to correctly display the pressure of the system, utilities and accumulators if present.

WARNING – After the end of the adjustment phase close the pressure gauge shut-off, a pressure gauge breakage may cause the entire system fluid to leak, with relative fire risk in hot working environments.

The control valves and utilities must be operated at reduced pressure and, whenever possible, also at reduced capacity, to prevent damages due to errors made during the hydraulic and electric connection of the unit.

start the electric motor with intermittent pulses in order to facilitate the pump suction.
During the filling phase of the circuit, provide air purge by temporarily loosening the fittings of the higher parts of the circuit. Take several cycles back and forth on each cylinder until the bottom of the stroke to remove air bags. At this initial stage, it is likely that an air / oil emulsion will be formed, it is recommended to turn off the system and leave the oil to decant for several hours.

After performing the filling and the air bleeding operations, check the fluid level into the tank and eventually re-fill it.

then progressively pressurize the circuit and proceed with the setting of the pressure relief valves according to the values shown in the hydraulic scheme. Complete the valves settings and lock their regulations
Check the eventual presence of foam in the tank, this would witnesses the presence of air income into the pump suction line.
The calibration and adjustment phase of the valves should be carried out at a temperature of between 40° and 50°.

MAINTENANCE

ORDINARY MAINTENANCE OPERATIONS

The hydraulic system requires periodic preventive maintenance. It is therefore very important that all the check-up operations, even if simple, are programmed and reported on specific maintenance program schedules (maintenance handbook).

WARNING – Do not perform maintenance with the power unit functioning. In case of maintenance and/or adjustment, make sure the power supply has been switched off and the residual pressure has been released.

WARNING – Systems that require one or more accumulators must be de-pressurized prior to maintenance even if the control unit is inactive.
- With automatic drain systems, check the pressure gauges, if necessary open the pressure gauge, that the pressure is actually zero.
- With systems without automatic drain system, de-pressurize through the manual drain valve.

Filling level and Fluid replacing

Every time the fluid level falls below the minimum it is necessary to refill the fluid of the same type only, the oil level must neither exceed the upper mark.
Fluid replacing has to be performed in as average every 2000-3000 working hours or, in case of seldom using, once a year, if a high degree of pollution is detected, it must be accompanied by a flush of the whole plant.

Replacing filters

Check the clogging indicators on the return and pressure filters (if any), if they are clogged to replace them.
Check the air filter, normally placed inside the filling port, and replace if dirty or clogged, pay particular attention to very dusty environments.
Annually check and clean, replace if necessary, the suction filter inside the tank in the power units that provide it.
A clogged filter, in addition to creating anomalies, may collapse and damage the whole system.

External cleaning

Check that there are no deposits of foreign bodies, workpieces or dust that may hinder the cooling of the electric motor or the air vent of the tank through the filler cap. Good cleaning allows easy localization of any leaks and immediate intervention.

Pressure check

Check the pressure values on the pressure gauges and close the shut-off valves to prevent their continuous stress with possible breakage.

Accumulator check

The preload pressure Po must match the design pressure, improper preload means premature rupture of the bag, use the dedicated control device.
Accumulator must be preloaded solely with nitrogen.

Fluid temperature check

The fluid deterioration due to the temperature is one of the causes of the system degradation.
The formation of deterioration products is influenced by the temperature.
The oxidation rate can be considered constant up to 60°C; starting from this point it doubles for each 10°C of temperature increment.

Piping check and Leakages removing

A six-monthly check on fittings, piping, flow regulators and all secondary components ensures it's efficiency and durability while safeguarding the original safety conditions.
The leakages from pipes are usually removed by tightening the fittings that could self-unlock due to the vibrations and/or system temperatures. In case of leakages from the mounting surfaces, the relevant seals must be replaced with new ones.
Check the integrity of the hoses if they are cracks, bulges and/or leaks near the rubber/fitting junction replaced immediately.

Heat exchanger check

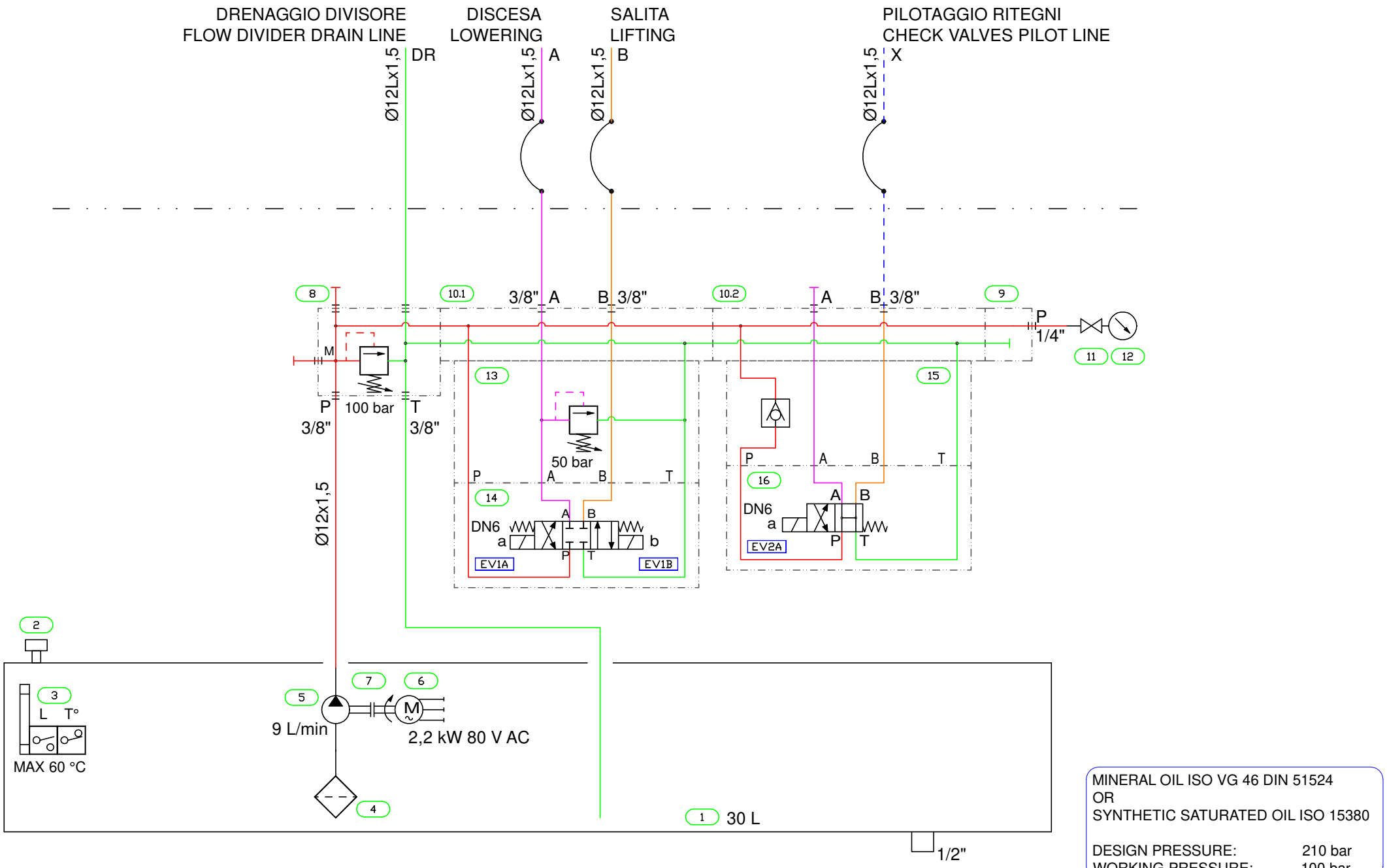
The heat exchangers have to be cleaned about every six months, the maintenance frequency depends from the quality of the used water in case of water/fluid exchangers and to the environmental conditions (high density of dust) in case of the air/fluid exchangers.
The daily check of the fluid temperature is useful to put in evidence the progressive deterioration of the thermal exchange and the consequent necessity of maintenance.

PREVENTIVE MAINTENANCE PROGRAM (working cycles 24 hours a day)

Intervention for control / replacement	Daily	Weekly	Monthly	Semiannual	Yearly
Fluid level	Check				
Fluid temperature		Check			
Fluid Contamination			Check		
Clogging indicators		Check			
Suction filters					Replace
Pressure Filter’s cartridges					Replace
Return Filter’s cartridges					Replace
Air Filters			Check		Replace
Calibration of working pressures			Check		
Calibration of pump’s flow					Check
Accumulators Pre-Charge pressure (if present)			Check		
Pipes (Leakage or damage)				Check	
Flexible Pipes (Leakage or damage)				Check	
Elastic insert junction motor/pump				Check	Replace

TROUBLESHOOTING

MALFUNCTION	POSSIBLE CAUSES	REMEDY
PRESSURE TOO LOW	1) pressure relief valve half open	a) setting pressure too low b) wear of sealing seats c) contaminant matter under seats d) spring broken
	2) pump faulty	see point 5 to 11
	3) excessive internal leak	a) worn seals in cylinders or in hydraulic motors b) wear of valves and distributors c) too low oil viscosity
	4) excessive pressure drop	a) too high oil viscosity b) poor sizing of oil paths c) oil paths partially stopped
PUMP FAULTY	5) intake throttled	a) intake filter too little or clogged b) intake pipe stopped c) intake pipe too small or wound
	6) air inlet	a) at intake port in the reservoi b) at the seal on the pump shaft c) for intake of oil with foam
	7) reservoir sealproof	air bleed in the reservoir clogged
	8) drive faulty	a) check the coupling b) too high or too low speed
	9) too high oil viscosity	see pump prescriptions
	10) fault inside the pump	a) internal seals broken b) seized vanes, cheekplates or pistons c) pump head not tightened
	11) pump worn out	pump to be replaced
PUMP NOISY	12) cavitation	a) intake throttled: see point 5 b) high viscosity: see point 9
	13) air inlet	see point 6
	14) internal wear	too high backlash in the supports and cheekplates
WARMING OVER 50/60 °	15) maximum pressure too high	valve setting too high
	16) useless engaged power	a) cutoff valve operation faulty b) shuting at cycle end not operating c) hydraulic circuit to be modified
	17) excessive internal leak	see point 3
	18) excessive pressure drop	see point 4
	19) oil capacity not enough	make oil capacity bigger
	20) cooling not enough	a) add more cooling b) cooling media not efficient
	21) excessive friction	a) faulty internal assembly of the pump b) lack of lubricating where required c) poorly lubricating oil
WRONG MOVEMENTS	22) air in the circuit	a) vent air bubbles in higher located parts b) eliminate air inlet see point 6
	23) valves blocked	a) valves blocked at closing by rubbers or other matter b) valves halfopen due to contaminant matter
	24) cylinders blocked	a) cylinders internal assembly faulty b) loads perpendicular to the axis not allowed c) seizing of connecting pivots
	25) pressure drops too high	see point 4
	26) variable pressure in the accumulators	a) accumulators capacity poor b) higher request by the circuit owing to internal leakage
EXCESSIVE WEAR IN RELATION TO USE	27) oil containing wear agents	a) oil too old b) filters not efficient
	28) poor lubrication	a) oil of poor quality b) oil too fluid at the operation temperature
	29) high operation pressure	in relation to the maximum permissible for the pumps and valves
	30) faulty couplings	unnormal loads on shafts or on rods



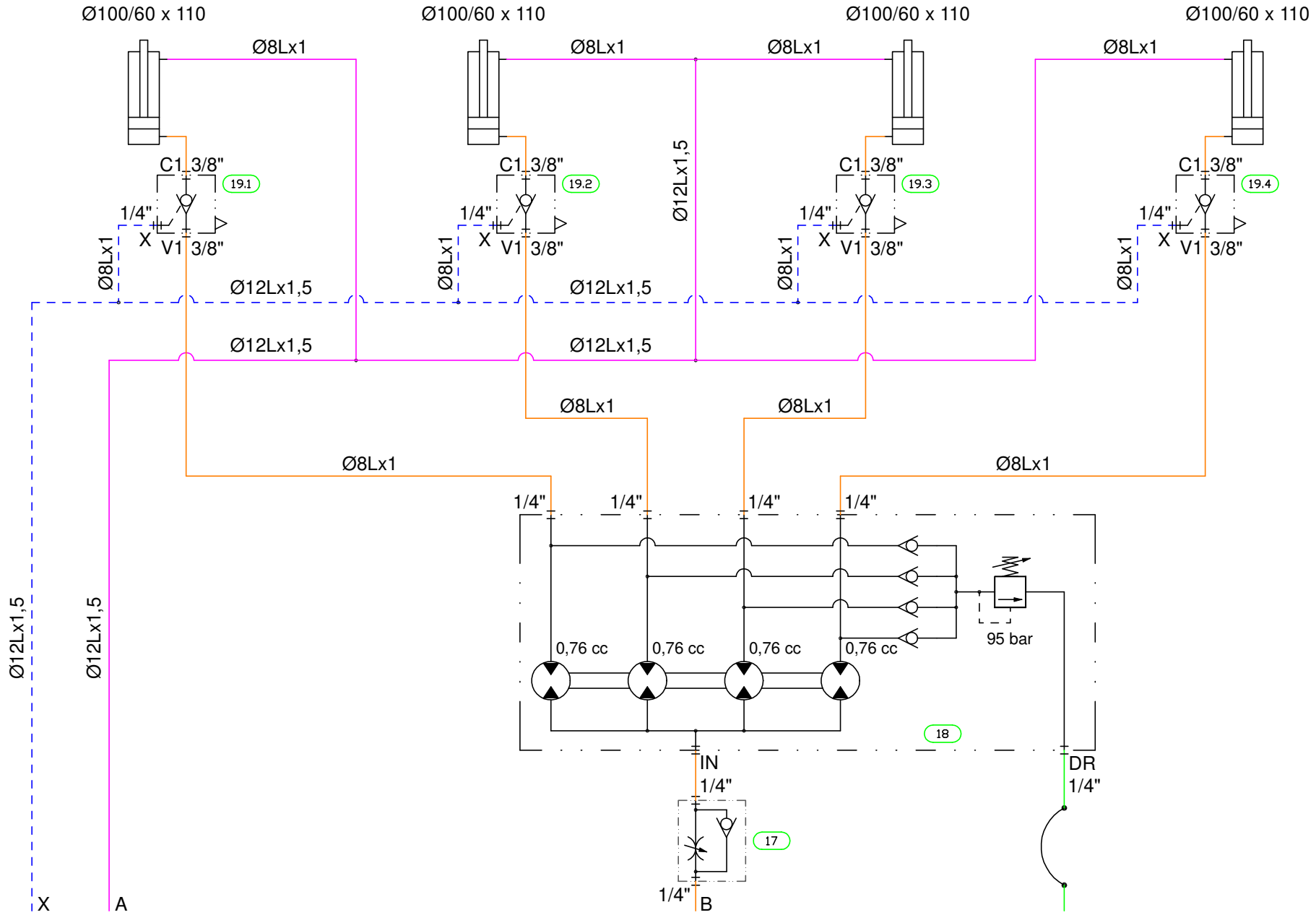
MINERAL OIL ISO VG 46 DIN 51524
OR
SYNTHETIC SATURATED OIL ISO 15380

DESIGN PRESSURE: 210 bar
WORKING PRESSURE: 100 bar

DIS./DES.: VAYR DATA/DATE: 04/11/2025	DISEGNO N. DRAWING N. 3123HS01	MACCHINA/MACHINE: IMPIANTO OLEODINAMICO DI SOLLEVAMENTO LIFTING HYDRAULIC SYSTEM	COMMESSA N./SERIAL N. 2750 CLIENTE/CUSTOMER: MORELLO	FG/SHEET N. 1 DI/OF: 2

TEMPO CORSA COMPLETA CILINDRI: 20 [sec]
COMPLETE CILINDERS STROKE TIME: 20 [sec]

CILINDRI SOLLEVAMENTO
LIFTING CYLINDERS



	DIS./DES.: VAYR DATA/DATE: 04/11/2025	DISEGNO N. DRAWING N. 3123HS01	MACCHINA/MACHINE: IMPIANTO OLEODINAMICO DI SOLLEVAMENTO LIFTING HYDRAULIC SYSTEM	COMMESSA N./SERIAL N. 2750 CLIENTE/CUSTOMER: MORELLO	FG/SHEET N. 2 DI/OF: 2

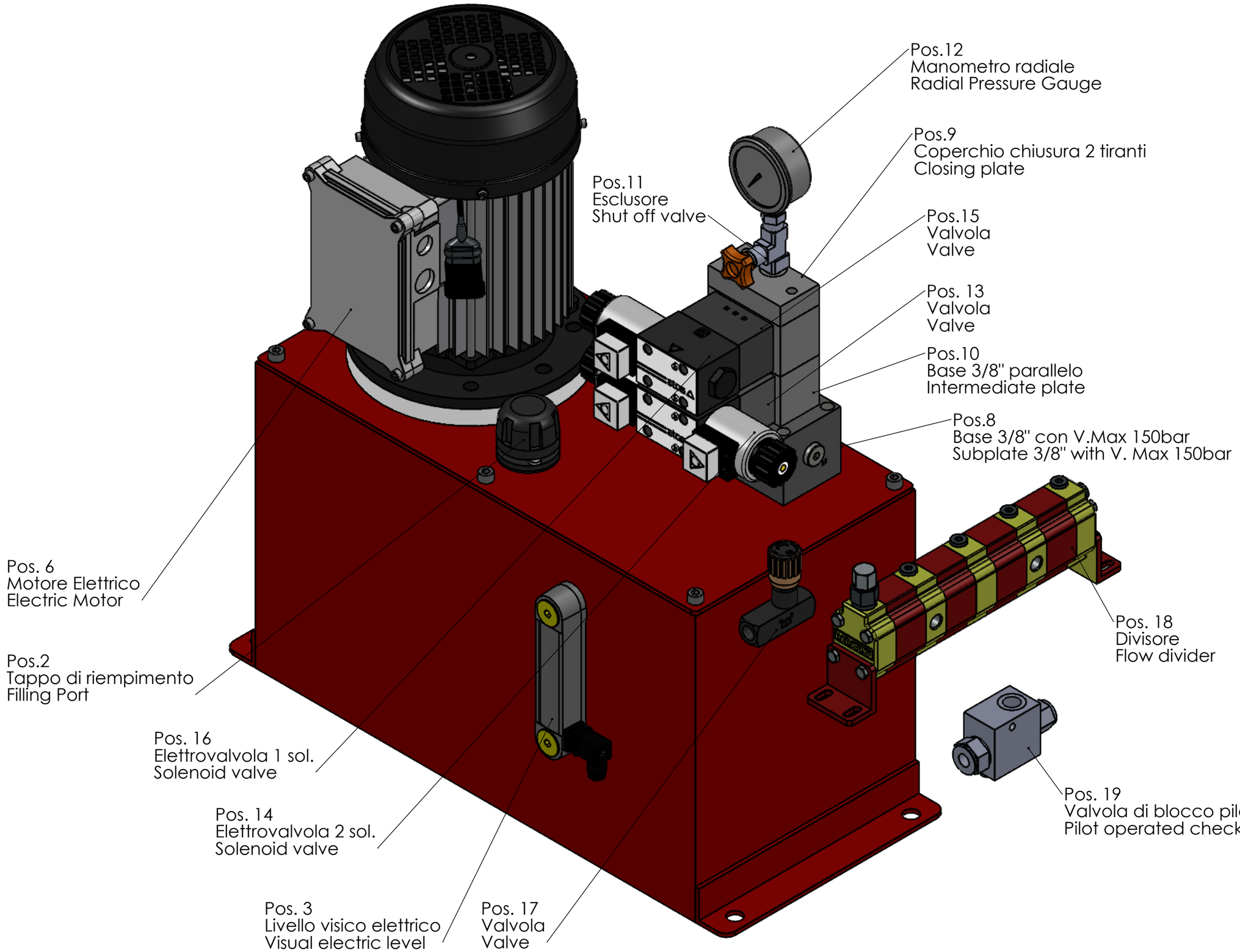
HYDRAULIC PLANT BILL OF MATERIALS

DWG N. 3123HS01 + 3123TA01

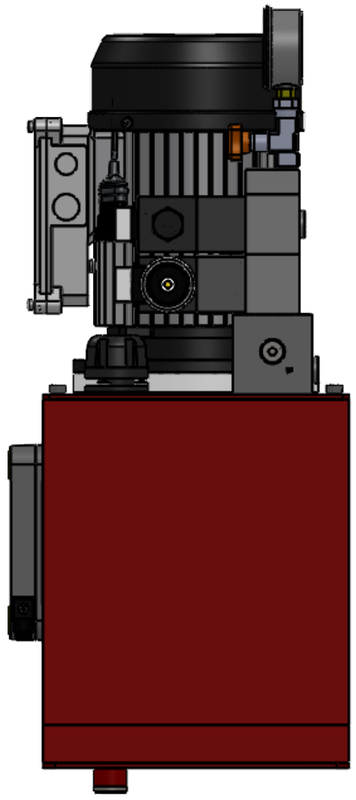
CUSTOMER: MORELLO SRL **JOB N.** 2750

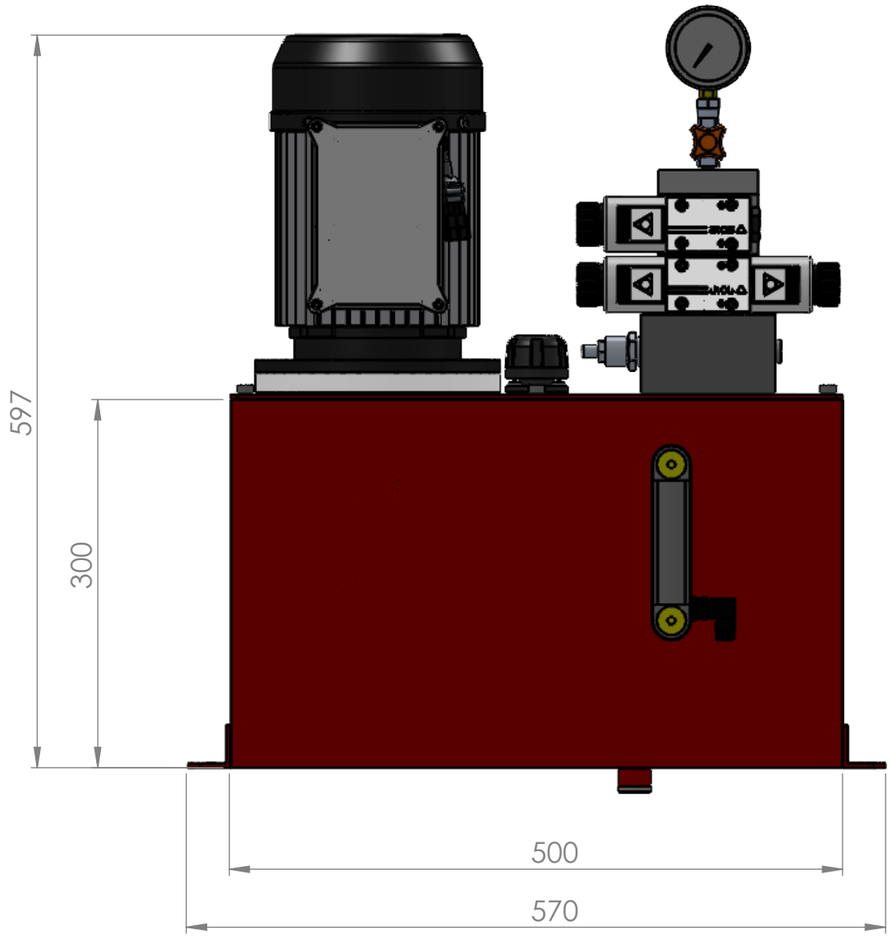
Item	Code	Description	Quantity	Supplier
1	3123TA02	RESEVOIR 30L	1	CPAFLUID
2	TAP50B10A01P01	FILLING PORT	1	MP
3	TL/E-127-B3B0A102	VISUAL-ELECTRIC LEVEL INDICATOR WITH THERMOSTA	1	GIACOMELL
4	STR0502SG1M250P01	SUCTION FILTER	1	MP
5	ALP1-D-9	PUMP	1	MARZOCCHI
5	RP1-038-M	FITTING 3/8"X30	1	OMT
5	RP1-012-M	FITTING 1/2"X30	1	OMT
6	2,2KW-80VAC-B5/90	ELECTRIC MOTOR 2,2 kW 2000 rpm	1	CFR
7	SGE-A01-FS1M0	HALF COUPLING	1	MP
7	LMG200MFS1M04E	BELL HOUSING 30 ex LMC200M-FS1M0-4E	1	MP
7	SGE-A01-M04-048-FG	HALF COUPLING 24-8	1	MP
7	EGE0	ELASTIC COUPLING SPIDER	1	MP
8	EC2AH3X2F	SUBPLATE	1	EUROFLUID
9	EC2A33	CLOSING PLATE	1	EUROFLUID
10	EC2A1338	INTERMEDIATE PLATE	2	EUROFLUID
11	FT-290-14	SHUT OFF VALVE	1	TOGNELLA
12	MGR-63-250	RADIAL PRESSURE GAUGE	1	NUOVA FIMA
13	HMP-013/210	VALVE	1	ATOS
14	SDHE-0711-X-24DC	SOLENOID VALVE 2 SOL.	1	ATOS
15	HR-011	VALVE	1	ATOS
16	SDHE-0610-X-24DC	SOLENOID VALVE	1	ATOS
17	FT-257/5-14	VALVE	1	TOGNELLA
18	RV-0S-0,76X4	FLOW DIVIDER (single valve) 9RS04E06	1	VIVOIL

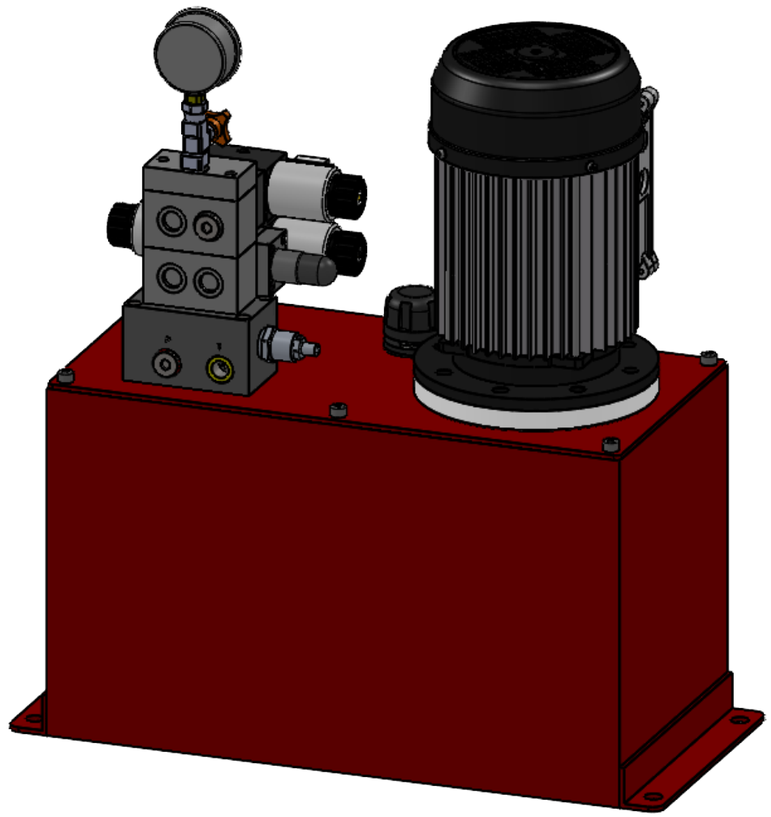
Item	Code	Description	Quantity	Supplier
19	VBS-L-PS-38	PILOT OPERATED CHECK VALVE	4	CBF
20	G1NU2000	CONNECTOR PG9/PG11, black, 2 pole+earth	3	HTP

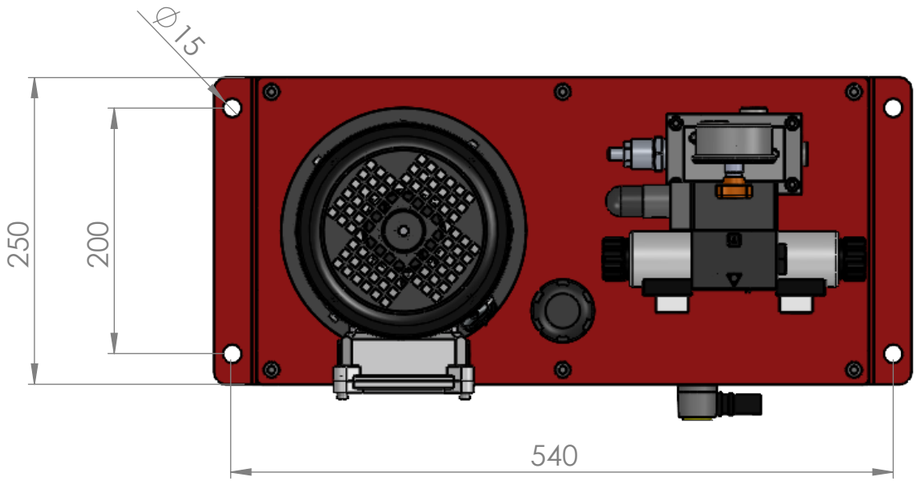


Componente: 3123TA01			
Disegnatore: VAYR			
Scala 1:3	Non ridimensionare	Data: 05/11/2025	Foglio A3 : 1/2









Componente: 3123TA01			
Disegnatore: VAYR			
Scala 1:5	Non ridimensionare	Data: 05/11/2025	Foglio A3 : 2/2

MANUALE USO E MANUTENZIONE - SISTEMI LIFEPO4 ALIANT EK

MAINTENANCE MANUAL – SYSTEM LIFEPO4 ALIANT EK

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BATTERIA LITIO ALIANT

Destinazione di uso

I sistemi di accumulo al litio ferro fosfato Aliant Serie EK, sono ***batterie per trazione elettrica, destinate a veicoli per sollevamento e movimentazione.***

I sistemi Aliant EK sono stati progettati per poter soddisfare ad hoc le richieste del cliente nei sopracitati veicoli. Grazie all'elettronica di ultima generazione integrata, è possibile configurare tale sistema per operare con inverter, driver, carica batterie e pressoché qualunque altro dispositivo elettronico.

E' fondamentale che le specifiche comunicate dal cliente siano corrette per evitare problemi tecnici e possibili danneggiamenti all'impianto elettrico all'interno del quale viene collegato; i rischi legati ad un uso improprio sono l'esplosione, l'incendio e il danno al sistema stesso o a componenti dell'impianto elettrico collegato.

Rispettare le avvertenze del costruttore durante l'installazione.

Assicurarsi di utilizzare la strumentazione elettronica e meccanica opportuna.

Tale sistema NON è adatto per l'utilizzo su aerei ultraleggeri, su autoveicoli o per applicazioni marine.

Il modello è specificatamente prodotto per MORELLO e per utilizzo come batteria di trazione su carrelli trasportatori.



ALIANT LITHIUM BATTERY

Proper Use

Aliant Lithium Iron Phosphate storage system are ***batteries developed for traction application in electric and hybrid vehicles.***

Aliant EK systems have been designed to meet ad hoc requests of the client in the above vehicles.

Thanks to latest generation embedded electronics, you can configure the system to operate with inverter, driver, battery charger, and almost any other electronic device.

It's important that the specifications given by the customer are correct to avoid technical problems and possible damage to the electrical system within which it is connected; risks related to improper use are the explosion, fire and damage to the system or electrical system components connected.

Please observe the instructions of the manufacturer of the battery during installation.

Be sure to use the appropriate mechanical and electronic instrumentation.

This system is NOT suitable for use on ultralight aircraft, on vehicles or marine applications.

Model is specifically produced for MORELLO and to be used as traction battery of transporter carts.

INSTALLAZIONE

L'installazione è effettuata dal costruttore del macchinario, in accordo con le istruzioni concordate con il supporto tecnico Aliant.

INSTALLATION

The installation is carried out by the manufacturer of the machinery, in accordance with the instructions received from the Aliant technical support

ACCENSIONE E SPEGNIMENTO

Gestito tramite pulsante "ON/OFF". Non sono previste procedure o dispositivi di autospegnimento della batteria e, in caso di dimenticanza dell'operatore, la batteria può pertanto scaricarsi completamente.

START UP

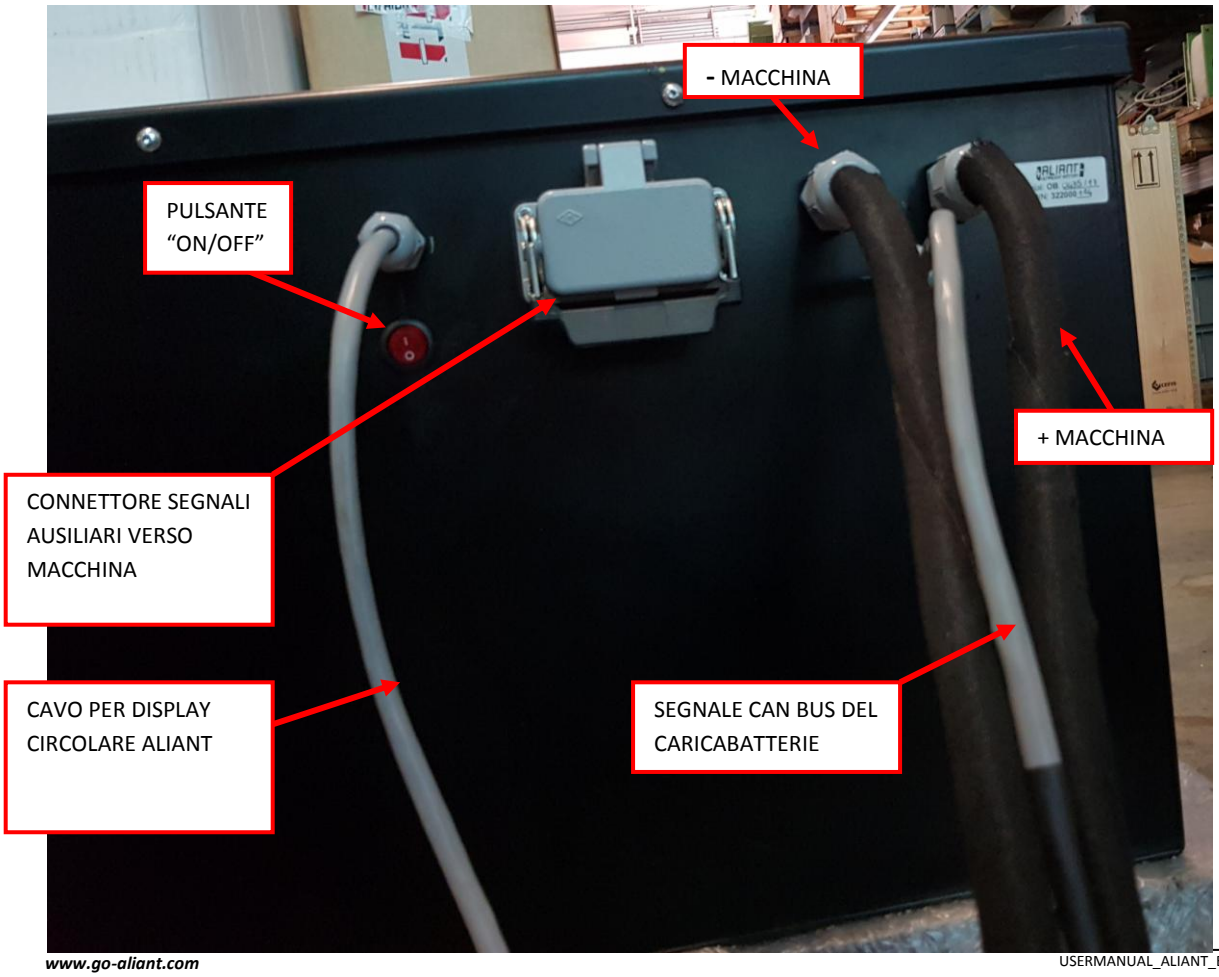
Managed through "ON/OFF" button. There are not auto-off procedures or devices of the battery and, in case of operator's forgetfulness, the battery can therefore be discharged completely.

LAYOUT GENERALE E COMPONENTI INTERNI

La batteria si presenta come da foto sotto riportata.
E' costituita da una custodia di acciaio, avente rinforzi nella zona inferiore. NON sono presenti ventole di aerazione .

GENERAL LAYOUT AND INTERNAL COMPONENTS

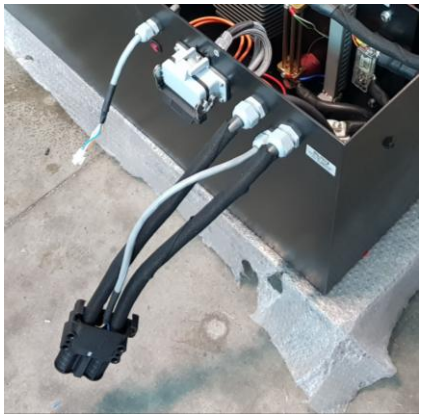
The battery looks like the photo below.
It's composed by a steel case, having reinforcements in the lower zone.



CONNETTORE DI POTENZA

Marca: REMA

Modello: DIN 320

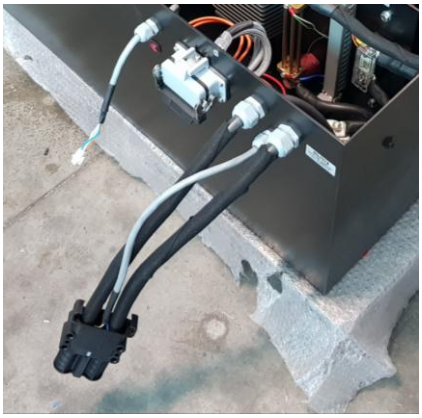


Permette il collegamento della batteria con la macchina oppure con il caricabatterie.

POWER CONNECTOR

Brand: REMA

Model: DIN320



It allows to discharge or charge the machine.

MANUTENZIONE

Le batterie Aliant richiedono una manutenzione limitata. Mantenere le batterie cariche, se possibile, al 100%. Inoltre, eseguire questa semplice serie di operazioni periodicamente:

Controllare i cavi, i morsetti, e se vi sono evidenti danni o collegamenti allentati

Pulire i morsetti e connettori se necessario

Ricaricare il sistema ogni 3-4 settimane se il veicolo viene lasciato fermo per lunghi periodi senza scollegare i cavi dell'impianto elettrico. Se si scollega la batteria dall'impianto elettrico del veicolo, occorre comunque fare una ricarica periodica ogni 3-4 mesi, e soprattutto ricaricare completamente la batteria prima di riavviare in moto il veicolo

Indossare sempre una visiera o occhiali di sicurezza quando si operi sulla batteria.
Indossare guanti di plastica , un grembiule o camice per proteggere i vostri vestiti; rimuovere braccialetti, anelli o altri oggetti metallici che potrebbero causare corti circuiti involontari.

In caso di dubbi contattare l'assistenza tecnica ALIANT tramite sito internet.

Spegnere la batteria con apposito pulsante in caso di fermi prolungati oltre le 8 ore in assenza di caricabatterie collegato a rete. La scarica profonda può danneggiare IRREPARABILMENTE le celle litio presenti. Se la batteria viene lasciata accesa ma non in carica, è normale che il consumo elettronico e dei piccoli carichi interni possa scaricare completamente la batterie ANCHE SOLO in 8 ore. Le celle SCARICATE PROFONDAMENTE non sono sostiuite in garanzia.

MAINTENANCE

Aliant battery only requires a little maintenance to perform perfectly. Keep the battery charged to 100%, if that is possible. Other than that, follow this simple check list periodically (3-4 months typically) :

Check cables, clamps, and case for obvious damage or loose connections

Clean terminals and connectors as necessary

Finish up by testing the battery with a voltmeter. To extend the service life of your battery, make periodical battery maintenance part of your routine.

Always wear safety glasses before working on the battery. Wear gloves and apron to protect dress; remove bracelets, rings and others metallic object that may cause short circuit in the battery.

In case of any doubt, contact ALIANT technical assistance.

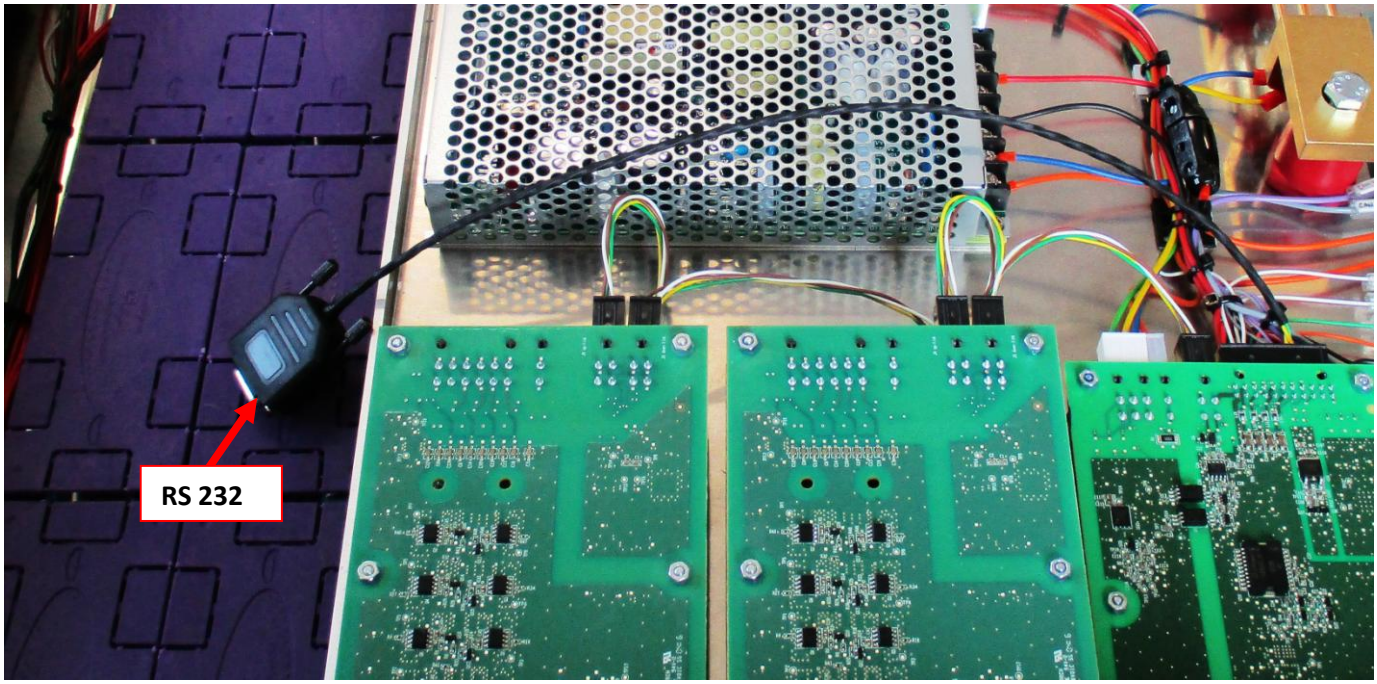
TURN OFF the battery with the dedicated button in case of stops longer than 8 hours without charging the battery. DEEP DISCHARGE of the battery can damage the cells irreparably. If the battery is left ON without being under charge, it is normal to have dee discharge of the battery even in less than 8 hours, due to internal electronic consumption. DEEP DISCHARGE cells are not covered by warranty.

MANUTENZIONE STRAORDINARIA

Eseguire questa operazione solo in caso di problemi del costruttore del macchinario.
In tale caso, eventualmente potrà essere richiesto di aprire il coperchio della batteria ed accedere al connettore RS232 per diagnostica avanzata e connessione PC ALIANT di accesso remoto.
Qualora venga richiesto, procedere come da foto allegata: ogni batteria è equipaggiata con connettore RS232 presente all'interno del vano batteria ed ancorato lateralmente.

EXTRAORDINARY MAINTENANCE

This operation must be done only in case of problem.
It is possible that technical support ask user to use RS232 port with technical support PC. In this case, follow the picture to access the RS232 port and connect to PC.



CONSERVAZIONE DELLA BATTERIA

Se il veicolo è utilizzato raramente, si suggerisce di scollegare i cavi della batteria per eliminare la scarica dovuta all'assorbimento elettrico. Ogni veicolo, anche se spento e privo della chiave, infatti, consuma energia a causa della presenza dell'impianto elettrico e di sistemi ausiliari (allarmi, strumentazione, orologio, etc.) **Ricaricare la batteria ogni tre/quattro mesi.**
In caso di stoccaggio prolungato (otto/dieci mesi) caricare al 100% prima del rimessaggio e prima del successivo riutilizzo.
Questa ricarica può durare anche 16-20 ore a causa del lungo periodo di fermo.
Accertarsi che le batterie siano riposte in zone fuori dalla portata dei bambini.

Non utilizzare mantenitori di carica, battery tender, fast charger o altri dispositivi similari con batterie Aliant. Utilizzare esclusivamente il carica batteria in dotazione.

Non caricare la batteria oltre il valore di tensione massima indicato.

Controllare lo stato esterno dei terminali e dell'involucro metallico, eventuali segni di danneggiamento o usura anomala possono essersi verificati durante il servizio. Se avete dei dubbi sulla condizione della batteria, raccomandiamo di chiedere al costruttore del macchinario.

Non rimuovere il coperchio della batteria, non forare né tagliare il contenitore metallico esterno: rischio di corto circuito.

Non lavare né immergere in acqua o altro liquido la batteria: rischio di corto circuito.

BATTERY STORAGE

If the vehicle is in storage or used infrequently, disconnect the battery cable to eliminate drain from electrical equipment. Every vehicle has a current consumption even when the key is turned off. Charge the battery every three/four months.
For extended storage (eight / ten months) charge to 100% before reuse. This charging can last for 16-20 hours due to the long period of detention.
Make sure batteries are stored out of reach of children.

Do not use battery mantainer, battery tender, fast charger or other similar devices with Aliant batteries. Use only the battery charger supplied.

Do not overcharge the battery. Respect Maximum charging voltage.

Check the status of the external terminals and the metal case, any signs of damage or abnormal wear may have occurred during the service. If you have any doubts about the condition of the battery, it is recommended to ask the manufacturer.

Never remove battery cap nor cut or drill battery case. It is extremely dangerous and may cause short.

Do not wash nor put into water or other conductive liquid: it is extremely dangerous and may cause short.

SICUREZZA

Abbigliamento

Indossare sempre una visiera o occhiali di sicurezza quando si operi sulla batteria.
Indossare guanti di plastica , un grembiule o camice per proteggere i vostri vestiti; rimuovere braccialetti, anelli o altri oggetti metallici che potrebbero causare corti circuiti involontari.

RICARICA DELLA BATTERIA

Assolutamente non fumare, creare scintille o fiamme in prossimità delle batterie e del carica batterie: rischio esplosione.

Non caricare le batterie Aliant con valori di corrente superiori a quelli indicati nelle specifiche tecniche e raccomandati nelle istruzioni: potrebbe causare pericolosi surriscaldamenti. UTILIZZARE SOLO IL CARICABATTERIE con cui la batteria è stata collaudata.

Non collegare piu' di una batteria all'impianto elettrico del veicolo. Non COLLEGARE MAI più batterie ALIANT in serie o parallelo tra loro.

SAFETY

Proper Clothing

Always wear a face shield or safety goggles. Remove bracelets, rings or necklaces that might accidentally short the battery.

BATTERY RECHARGE

When charging Lithium Ion batteries, Only use manufacturer recommended Lithium Ion Battery Charger. Different procedure may cause explosion.
If the battery feels hot to the touch during charging, STOP. Allow the battery to cool before charging again. Properly connect the charger to the battery: positive charger lead to positive battery post and negative charger lead to negative battery post.

Do not smoke, cause sparks or flames in proximity with battery or battery chargers: this may cause explosion.

Do not charge Aliant batteries at current value higher then the ones recommended by User Manual in the SPECIFICATIONS section: this may damage batteries, cause explosions and fire. Turn off the charger before removing charger clamp from the battery, in order to avoid any sparks.

Do not connect more than one battery to the electric plant of the vehicle. Never connect Aliant batteries in series or parallel between eachother.

AVVERTENZE SPECIALI

Leggere attentamente le istruzioni di uso e manutenzione prima di eseguire qualsiasi operazione con la batteria.

Contattare un installatore professionale oppure il numero verde in caso di difficoltà o dubbi.

Le batterie al litio hanno elevatissime prestazioni. La tecnologia di celle litio ferro fosfato utilizzate nelle batterie Aliant è intrinsecamente più "sicura", ma ciò non impedisce che un uso improprio della batteria, oppure corto circuito tra i poli, surriscaldamento, vicinanza a fiamme libere o scintille, oppure ricarica con caricabatterie diversi da quelli forniti da ELSA Solutions possano causare pericoli seri.

Non esporre la batteria al calore o al fuoco o a microonde. Non esporre a temperatura maggiore di 60°C: pericolo di esplosione. Non inserite alcun oggetto metallico nel vano porta batteria. Non depositate la batteria assieme ad alti oggetti metallici (come la cassetta attrezzi) o assieme ad altre batterie. Pericolo di generare un corto circuito elettrico.

Mettere le batterie e gli apparecchi elettrici fuori dalla portata dei bambini.

SPECIAL WARNINGS

Aliant batteries have been developed in order to be completely interchangeable with traditional lead acid batteries. Integrated electronics inside Aliant batteries allow the user to replace traditional batteries without any further addo: neither to change the vehicle electric system nor the alternator. It is extremely easy to use Aliant and replace traditional lead acid.

Read carefully installation and maintenance instructions before starting the operations with Aliant battery.

Contact a professional installer or toll free number in case of any doubt or problem.

Lithium batteries feature very high performance. Aliant LIFEPO4 batteries use top tecnology cells, which are intrinsecally safer, this by the way does not mean that an improper use could not lead to troubles, such as fires and explosions. Do not underestimate the danger associated with misuse of lithium batteries and possible side effects.

Do not expose the battery to heat or fire or microwave. Do not expose to direct sunlight. Do not expose to direct sunlight when ambient temperature is higher than 60°C – risk of explosion. Do not keep any metallic object inside the battery trunk of your vehicle. Do not store the battery together with other metallic object or with other batteries – this may cause short circuit.

Always keep the battery away from children.

SPECIFICHE TECNICHE BATTERIA
Allegato 1

SCHEMA ELETTRICO
Allegato 2

~~DIMENSIONI~~
~~Allegato 3~~

PROTOCOLLO CAN
Allegato 4

PINNATURA CONNETTORI
Allegato 5

SPECIFICATIONS
Attachment 1

ELECTRICAL CONNECTION
Attachment 2

~~DIMENSION~~
~~Attachment 3~~

CAN PROTOCOL
Attachment 4

PIN OUT
Attachment 5

APPLICAZIONI TIPICHE

Le applicazioni consigliate per l'utilizzo della Serie EK, sono:

1) Sistemi di trazione elettrica
2) Mezzi elettrici ed ibridi
3) Sistemi di alimentazione e trazione per veicoli sollevamento e movimentazione
4) Emergency Storage per automazione industriale
5) Sistemi di Accumulo per Energie Rinnovabili

In particolare il modello è specificatamente prodotto per MORELLO e per utilizzo come batteria di trazione su carrelli trasportatori.

TYPICAL APPLICATIONS

The recommended applications for the use of the EK series are:

1) Systems of electric traction
2) Electric and Hybrid Vehicles
3) Systems of power and traction for vehicles lifting and handling equipment
4) Emergency Storage for industrial automation
5) Systems for Renewable Energy Storage

Model is specifically produced for MORELLO and to be used as traction battery of transporter carts.

Aliant is a registered trademark by **Elsa Solutions**

Designed, Engineered and Assembled by
ELSA Solutions srl
Via Patarini 15
40026 IMOLA (BO) – ITALY

Assemblato in Italia

Mail:
info@go-aliant.com

Web:
www.go-aliant.com

Numero Verde 800 132 166

RoHS

lead-free

-

Grazie per aver acquistato Aliant!

Thank you for purchasing Aliant!

ALIANT ULTRALIGHT BATTERY www.go-aliant.com CE

DICHIARAZIONE DI CONFORMITA' CE

Elsa Solutions s.r.l.
Via Einaudi, 9
40026 Imola (Bo)
Italia

dichiara la conformità

alla Direttiva 2004/108/EMC relativa alle normative applicabili

prodotto: Batterie ALIANT Serie EK

famiglia: **tutte le batterie appartenente alla serie EK**

Dal 3220000071	Al 322000079
Dal 322000101	Al 322000199

tipo: **Batterie trazione litio**

Norme armonizzate applicate:

- **EN 55022:2010(Class B)**
- **EN 61000-3-2:2006+A1:2009+A2:2009**
- **EN 61000-3-3:2008**
- **EN 55024:2010**
- **IEC 61000-4-2:2008**
- **IEC 61000-4-3:2006+A1:2007+A2:2010**
- **IEC 61000-4-4:2004+A1:2010**
- **IEC 61000-4-5:2005**
- **IEC 61000-4-6:2008**
- **IEC 61000-4-8:2009**
- **IEC 61000-4-11:2004**

Imola, 30 / 06 / 2013

Enzo Dal Pozzo
ELSA SOLUTIONS srl
Il Presidente
(Enzo Dal Pozzo)
Legale Rappresentante Elsa Solutions s.r.l.

ALIANT ULTRALIGHT BATTERY E' UN PRODOTTO BY ELSA SOLUTIONS srl – VIA EINAUDI, 9 - 40026 IMOLA (BO) – ITALY
Ph..+39 800 132 166 Cap. Soc. € 26.000 - Cod. Fisc. 02335150377 - P.IVA 00571441203 - Iscr. Trib. n.33973 - C.C.I.A.A n.272440

ALIANT ULTRALIGHT BATTERY www.go-aliant.com

CE

CE CONFORMITY DECLARATION

Elsa Solutions s.r.l.
Via Einaudi, 9
40026 Imola (Bo)
Italia

Hereby declares the conformity

To the applicable CE directive and to 2004/108/EMC

product: Batteries ALIANT Series EK

family: **all batteries of the EK series**

Code from 3220000071	To 322000079
Code from 322000101	To 322000199

type: **lithium traction batteries**

Armonized standards:

- **EN 55022:2010(Class B)**
- **EN 61000-3-2:2006+A1:2009+A2:2009**
- **EN 61000-3-3:2008**
- **EN 55024:2010**
- **IEC 61000-4-2:2008**
- **IEC 61000-4-3:2006+A1:2007+A2:2010**
- **IEC 61000-4-4:2004+A1:2010**
- **IEC 61000-4-5:2005**
- **IEC 61000-4-6:2008**
- **IEC 61000-4-8:2009**
- **IEC 61000-4-11:2004**

Imola, 30 / 06 / 2013

Enzo Dal Pozzo

Presidente Elsa Solutions s.r.l.

Il Presidente
(Enzo Dal Pozzo)

ALIANT ULTRALIGHT BATTERY E' UN PRODOTTO BY ELSA SOLUTIONS srl – VIA EINAUDI, 9 - 40026 IMOLA (BO) – ITALY
Ph..+39 800 132 166 Cap. Soc. € 26.000 - Cod. Fisc. 02335150377 - P.IVA 00571441203 - Iscr. Trib. n.33973 - C.C.I.A.A n.272440

GREEN6 – GREEN8 - GREENX

USER MANUAL
BEDIENUNGSANLEITUNGEN
MANUALE DI ISTRUZIONI
MODE D'EMPLOI
MANUAL DEL USUARIO
GEBRUIKERSHANDLEIDING
INSTRUKCJA OBSŁUGI
كتيب التعليمات
사용 설명서
取扱説明書

Before connecting the battery charger to the mains and to the battery, **READ THE FOLLOWING INSTRUCTIONS CAREFULLY.**

Vor dem Anschließen des Batterieladegeräts an das Stromnetz und an die Batterie **UNBEDINGT AUFMERKSAM NACHSTEHENDE ANLEITUNGEN LESEN.**

Prima di connettere il caricabatterie alla rete ed alla batteria, **VI PREGHIAMO DI LEGGERE ATTENTAMENTE LE SEGUENTI ISTRUZIONI.**

Avant de connecter le chargeur de batterie au secteur et à la batterie, **NOUS VOUS PRIONS DE LIRE ATTENTIVEMENT LES INSTRUCTIONS SUIVANTES.**

Antes de conectar el cargador a la red eléctrica y a la batería, **LEER CUIDADOSAMENTE LAS SIGUIENTES INSTRUCCIONES.**

Alvorens de acculader aan te sluiten op het elektriciteitsnet en op de accu, **DEZE AANWIJZINGEN AANDACHTIG LEZEN.**

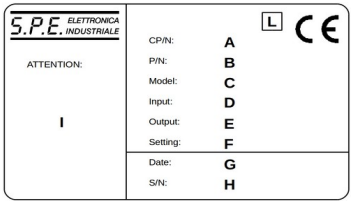
Przed podłączeniem ładowarki do sieci lub baterii, **PROSIMY O DOKŁADNE PRZECZYTANIE NINIEJSZYCH INSTRUKCJI.**

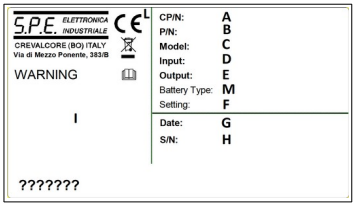
يُرجى قراءة التعليمات التالية بعناية قبل توصيل شاحن البطاريات بشبكة الكهرباء. والبطارية

배터리 충전기를 주 전원과 배터리에 연결하기 전에 **다음 지시사항을 상세히 읽으십시오.**

バッテリー充電器を電源につなぐ前に、**以下の指示を注意してお読みください。**

BATTERY CHARGER IDENTIFICATION LABEL
TYPENSCHILD DES BATTERIE-LADEGERÄTES
ETICHETTA IDENTIFICATIVA DEL CARICABATTERIA
ÉTIQUETTE D'IDENTIFICATION DU CHARGEUR DE BATTERIE
ETIQUETA DE IDENTIFICACIÓN DEL CARGADOR DE BATERÍA





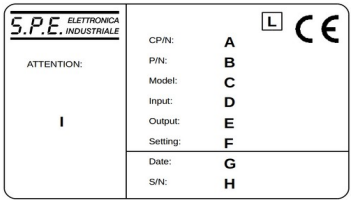
A	CUTOMER PART NUMBER	KUNDEN-SERIENNUMMER	CODICE DEL CLIENTE	NUMÉRO DE RÉFÉRENCE CLIENT	NÚMERO DE SERIE CLIENTE
B	PART NUMBER	SERIENNUMMER	CODICE	NUMÉRO DE RÉFÉRENCE	NÚMERO DE SERIE
C	MODEL	MODELL	MODELLO	MODÈLE	MODELO
D	INPUT VOLTAGE AND MAINS ABSORPTION	VERSORGUNGSSPANNUNG UND NETZENTNAHME	TENSIONE DI ALIMENTAZIONE ED ASSORBIMENTO DI RETE	TENSION D'ENTRÉE ET ABSORPTION RÉSEAU ÉLECTRIQUE	TENSIÓN ALIMENTACIÓN Y ABSORBCIÓN DE RED
E	OUTPUT VOLTAGE AND CURRENT	AUSGANGSSPANNUNG UND STROM	TENSIONE E CORRENTE DI USCITA	TENSION ET COURANT DE SORTIE	TENSIÓN DE SALIDA Y CORRIENTE
F	SETTING	EINSTELLUNGEN	RÉGLAGE	RÉGLAGE	AJUSTES
G	BATTERY CHARGER MANUFACURE DATE	HERSTELLUNGSDATUM DES BATTERIELADEGERÄTS	DATA DI FABBRICAZIONE DEL CARICABATTERIA	DATE DE FABRICATION DU CHARGEUR	FECHA FABRICACIÓN DEL CARGADOR
H	BATTERY CHARGER SERIAL NUMBER	SERIENNUMMER BATTERIELADEGERÄT	NUMERO DI SERIE DEL CARICABATTERIA	NUMÉRO DE SÉRIE DU CHARGEUR DE BATTERIE	NÚMERO DE SERIE DEL CARGADOR
I	ATTENTION	HINWEISE	AVVERTENZE	AVERTISSEMENT	ADVERTENCIAS
L	PRODUCT CERTIFICATIONS STAMP	MARKEN PRODUKTZERTIFIZIERUNG	MARCHI DI CERTIFICAZIONE DI PRODOTTO	ESTAMPILLES CERTIFICATION PRODUIT	MARCAS CERTIFICACIÓN DEL PRODUCTO
M	BATTERY TYPE	BATTERIETYP	TIPO DI BATTERIA	TYPE DE BATTERIE	TIPO DE BATERÍA

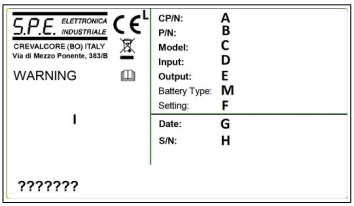
Storage temperature: from -20°C to +50°C;
Lagertemperatur: von -20°C bis +50°C;
Temperatura di immagazzinamento: da -20°C a +50°C;
Température de stockage: de -20°C à +50°C;
Temperatura de almacenamiento: de -20°C a +50°C;

Relative humidity: 0 – 80% up to 50°C;
Relative Feuchtigkeit: 0 – 80% bis 50°C;
Umidità relativa: 0 – 80% fino a 50°C;
Humidité relative: 0 – 80% jusqu'à 50°C;
Humedad relativa: 0 – 80% hasta 50°C;

Operating temperature: from 0°C to 40°C;
Betriebstemperatur: von 0°C bis 40°C;
Temperatura operativa: da 0°C a 40°C;
Température d'exploitation: de 0°C à 40°C;
Temperatura operativa: de 0°C a 40°C;

IDENTIFICATIELABEL ACCULADER
ETYKIETA IDENTYFIKACYJNA ŁADOWARKI
ملصق تعريف شاحن البطارية
배터리 충전기 식별 라벨
バッテリー充電器の定格銘板





A	KLANTONDERDEEL-NUMMER	KOD KLIENTA	كود العميل	고객 부품 번호	先方品番
B	ONDERDEELNUM-MER	KOD	الكود	부품 번호	品番
C	MODEL	MODEL	الموديل	모델	型番
D	INGANGSSPAN-NING ABSORPTIE NETSPANNING	NAPIĘCIE ZASILANIA I POBÓR SIECI	جهد التغذية واستهلاك الشبكة	입력 전압 및 주 전원 흡수	入力電圧と消費電流
E	UITGANGSSPANNING EN STROOM	NAPIĘCIE I PRĄD WYJŚCIOWY	جهد وتيار المخرج	출력 전압 및 전류	出力電圧と出力電流
F	INSTELLING	USTAWIENIE	الإعداد	설정	設定
G	FABRICAGEDATUM ACCULADER	DATA PRODUKCJI ŁADOWARKI	تاريخ صُنع الشاحن	배터리 충전기 제조일	バッテリー充電器の製造日
H	SERIENUMMER AC-CULADER	NUMER SERYJNY ŁADOWARKI	الرقم التسلسلي لشاحن البطارية	배터리 충전기 제품 번호	バッテリー充電器のシリアルナンバー
I	LET OP	OSTRZEŻENIA	تحذيرات	주의	警告
L	PRODUCTCERTIFI-CERING	ZNAKI CERTYFIKUJĄCE PRODUKTU	علامات اعتماد المنتج	제품 인증 스탬프	製品の認証マーク
M	TYPE ACCU	RODZAJ BATERII	نوع البطارية	배터리 유형	バッテリーのタイプ

Opslagtemperatuur: van -20°C tot +50°C;
Temperatura magazynowania: od -20°C do +50°C;
درجة حرارة التخزين: من -20 درجة مئوية إلى + 50 درجة مئوية؛
보관 온도: -20°C ~ +50°C;
保管温度:-20°C ~ +50°C

Relatieve luchtvochtigheid: 0 – 80% tot max. 50°C;
Wilgotność względna: 0 – 80% aż do 50°C;
الرطوبة النسبية: 0 -80 % إلى 50 درجة مئوية؛
상대 습도: 0 ~ 80% 최대 50°C;
相对湿度:0 ~ 80%(50°C 以下)

Bedrijfstemperatuur: van 0°C tot 40°C;
Temperatura robocza: od 0°C do 40°C;
درجة حرارة التشغيل: من 0 درجة مئوية إلى 40 درجة مئوية.
작동 온도: 0°C ~ 40°C;
使用温度:0°C ~ 40°C

Battery Chargers **nnnVac** three phases mains (also available for Lithium Battery Packs)
Batterieladegerät **nnnVac** Dreiphasen Netz (auch für Lithium Batteriepack)
Caricabatterie **nnnVac** rete trifase (disponibile anche per baterie al Litio)
Chargeur de batterie **nnnVac** triphasé (également disponible pour batteries au Lithium)
Cargador de batería **nnnVac** trifásico de red (disponible para batería de Litio)
nnnVac Driefasennet Acculader (ook beschikbaar voor Lithiumbatterijen)
Ładowarka **nnnVac** sieć trójfazowa (dostępne również dla zestawów baterii Litowych)
شاحن بطاريات **nnnVac** فولت من تيار متردد ثالثي الطور
배터리 충전기 **nnnVac** 3 상 주 전원
三相交流 **nnnVac** 電源バッテリー充電器

M	Model	Modell	Modello	Modèle	Modelo	Model	Model
BV	Battery Voltage	Batterie Strospannung	Tensione Batteria	Batterie Tension	Batería voltaje	Spanning Accu	Napięcie baterii
CC	Charging Current	Aufladen Aktell	Corrente Carica	Charge Courant	Corriente de carga	Lead-Stroom	Prąd ładowania
MIC	Max Input Current	Max Eingangsstrom	Max Corrente Ingresso	Max Courant d'entrèe	Corriente de entrada máxima	Maximale Ingangs-stroom	Maksymalny prąd wejściowy
BC	Battery Capacity	Batteriekatät	Capacità Batteria	Capacitè de la batterie	Capacidad de la entrada batería	Accucapaciteit	Zdolność baterii
AC MCD	AC Mains Cabel Description	Kabel Beschreibung	Descrizione cavo AC	Description du câble	Cable Descripción	Beschrijving Bedrading	Opis okablowania

M	الموديل	모델	型番
BV	الجهد الكهربائي للبطارية (فولت)	배터리 전압	バッテリー の電圧
CC	تيار الشحن (أمبير)	충전 전류	充電電流
MIC	أقصى تيار في المدخل (أمبير)	최대 입력 전류	最大 入力電流
BC	قدرة البطارية أمبير ساعة	배터리 용량	バッテリー容量
AC MCD	وصف توصيل الكابالت	케이블 설명	使用ケーブル

Battery Chargers 380 - 415Vac three phases mains
(also available for Lithium Battery Packs)

M	BV [V]	CC [A]	MIC [A]	BC [Ah C5]	AC MCD
GREEN6 24-50	24	50	3	350 – 420	4 x 2.5mm² / 4 x 12AWG (O.D. Ø12,7mm) 450 / 750V
GREEN6 24-60	24	60	4	420 – 510	
GREEN6 24-70	24	70	4.5	480 – 590	
GREEN6 24-80	24	80	5	550 – 680	
GREEN6 24-100	24	100	6	690 – 850	
GREEN6 24-120	24	120	8	830 – 1020	4 x 4mm² / 4 x 10AWG (O.D. Ø14,6mm) 450 / 750V
GREEN6 24-150	24	150	10	1040 – 1270	
GREEN8 24-160	24	160	10	1110 – 1350	4 x 6mm² / 4 x 10AWG (O.D. Ø16,4mm) 450 / 750V
GREEN8 24-180	24	180	12	1250 – 1520	
GREEN8 24-200	24	200	13	1380 – 1690	
GREENX 24-250	24	250	16	1730 – 2120	
GREENX 24-300	24	300	19	2080 – 2540	
GREEN6 36-80	36	80	8	550 – 680	4 x 2.5mm² / 4 x 12AWG (O.D. Ø12,7mm) 450 / 750V
GREEN6 36-100	36	100	10	690 – 850	
GREEN6 36-120	36	120	12	830 – 1020	4 x 4mm² / 4 x 10AWG (O.D. Ø14,6mm) 450 / 750V
GREEN6 36-150	36	150	14	1040 – 1270	
GREEN8 36-180	36	180	17	1250 – 1520	4 x 6mm² / 4 x 10AWG (O.D. Ø16,4mm) 450 / 750V
GREEN8 36-200	36	200	19	1380 – 1690	
GREENX 36-250	36	250	20	1730 – 2120	
GREENX 36-300	36	300	21	2080 – 2540	
GREEN6 48-25	48	25	3	170 – 210	4 x 2.5mm² / 4 x 12AWG (O.D. Ø12,7mm) 450 / 750V
GREEN6 48-30	48	30	2.8	210 – 255	
GREEN6 48-40	48	40	5	280 – 340	
GREEN6 48-50	48	50	6	350 – 420	
GREEN6 48-60	48	60	8	420 – 510	
GREEN6 48-70	48	70	9	480 – 590	
GREEN6 48-80	48	80	10	550 – 680	
GREEN6 48-90	48	90	12	620 – 760	
GREEN6 48-100	48	100	13	690 – 850	

GREEN6 48-120	48	120	15	830 – 1020	4 x 4mm² / 4 x 10AWG (O.D. Ø14,6mm) 450 / 750V
GREEN6 48-130	48	130	17	900 – 1100	
GREEN6 48 150	48	150	19	1040 – 1270	
GREEN8 48-160	48	160	21	1110 – 1350	4 x 6mm² / 4 x 10AWG (O.D. Ø16,4mm) 450 / 750V
GREEN8 48-180	48	180	23	1250 – 1520	
GREEN8 48-200	48	200	26	1380 – 1690	
GREENX 48-250	48	250	32	1730 – 2120	
GREENX 48-300	48	300	38	2070 – 2540	
GREEN6 72-30	72	30	6	210 – 255	4 x 2.5mm² / 4 x 12AWG (O.D. Ø12,7mm) 450 / 750V
GREEN6 72-40	72	40	7.5	275 – 340	
GREEN6 72-50	72	50	10	350 – 420	
GREEN6 72-60	72	60	12	420 – 510	
GREEN6 72-80	72	80	15	550 – 680	4 x 4mm² / 4 x 10AWG (O.D. Ø14,6mm) 450 / 750V
GREEN6 72-100	72	100	19	690 – 850	
GREEN8 72-130	72	130	25	900 – 1100	4 x 6mm² / 4 x 10AWG (O.D. Ø16,4mm) 450 / 750V
GREEN6 80-30	80	30	6.5	210 – 255	4 x 2.5mm² / 4 x 12AWG (O.D. Ø12,7mm) 450 / 750V
GREEN6 80-40	80	40	8.5	275 – 340	
GREEN6 80-50	80	50	11	350 – 420	
GREEN6 80-60	80	60	13	420 – 510	
GREEN6 80-80	80	80	17	550 – 680	4 x 4mm² / 4 x 10AWG (O.D. Ø14,6mm) 450 / 750V
GREEN6 80-100	80	100	21	690 – 850	
GREEN8 80-110	80	110	23	760 – 930	4 x 6mm² / 4 x 10AWG (O.D. Ø16,4mm) 450 / 750V
GREEN8 80-120	80	120	26	830 – 1020	
GREEN8 80-130	80	130	28	900 – 1100	
GREENX 80-150	80	150	32	1040 – 1270	
GREENX 80-160	80	160	34	1110 – 1350	
GREENX 80-200	80	200	43	1380 – 1690	
GREEN6 96-20	96	20	5	140 – 170	4 x 2.5mm² / 4 x 12AWG (O.D. Ø12,7mm) 450 / 750V
GREEN6 96-25	96	25	6	170 – 210	
GREEN6 96-30	96	30	8	210 – 255	
GREEN6 96-40	96	40	10	280 – 340	
GREEN6 96-50	96	50	13	350 – 420	
GREEN6 96-60	96	60	15	420 – 510	4 x 4mm² / 4 x 10AWG

GREEN6 96-65	96	65	17	450 – 550	(O.D. Ø14,6mm) 450 / 750V
GREEN6 96-60	96	70	18	480 – 590	
GREEN6 96-75	96	75	19	520 – 630	
GREEN8 96-80	96	80	21	550 – 680	4 x 6mm² / 4 x 10AWG (O.D. Ø16,4mm) 450 / 750V
GREEN8 96-100	96	100	26	690 – 850	
GREENX 96-125	96	125	32	870 – 1060	
GREENX 96-150	96	150	38	1040 – 1270	

Battery Chargers 200Vac three phases mains (also available for Lithium Battery Packs)

M	BV [V]	CC [A]	MIC [A]	BC [Ah C5]	AC MCD
GREEN6 36-100	36	100	20	690 – 850	4 x 4mm² / 4 x 10AWG (O.D. Ø14,6mm) 450 / 750V
GREEN6 48-100	48	100	26	690 – 850	4 x 6mm² / 4 x 10AWG (O.D. Ø16,4mm) 450 / 750V
GREEN6 48-150	48	150	38	1040 – 1270	
GREEN8 48-200	48	200	43	1380 – 1690	
GREEN8 80-30	80	30	13	210 – 255	4 x 2.5mm² / 4 x 12AWG (O.D. Ø12,7mm) 450 / 750V
GREEN8 80-130	80	130	46.5	900 – 1100	4 x 6mm² / 4 x 10AWG (O.D. Ø16,4mm) 450 / 750V

Battery Chargers 220Vac three phases mains (also available for Lithium Battery Packs)

M	BV [V]	CC [A]	MIC [A]	BC [Ah C5]	AC MCD
GREEN6 24-50	24	50	5	350 – 420	4 x 4mm² / 4 x 10AWG (O.D. Ø14,6mm) 450 / 750V
GREEN6 24-80	24	80	8	550 – 680	
GREEN6 24-100	24	100	10.5	690 – 850	
GREEN6 24-120	24	120	12	830 – 1020	4 x 6mm² / 4 x 10AWG (O.D. Ø16,4mm) 450 / 750V
GREEN6 24-150	24	150	15	1040 – 1270	
GREEN6 36-100	36	100	15.5	690 – 850	4 x 4mm² / 4 x 10AWG (O.D. Ø14,6mm) 450 / 750V

GREEN6 36-120	36	120	18	830 – 1020	4 x 6mm² / 4 x 10AWG (O.D. Ø16,4mm) 450 / 750V
GREEN6 36-150	36	150	23	1041 – 1270	
GREEN8 36-160	36	160	24	1110 – 1350	
GREEN8 36-200	36	200	30.5	1380 – 1690	
GREEN6 48-100	48	100	21	690 – 850	4 x 4mm² / 4 x 10AWG (O.D. Ø14,6mm) 450 / 750V
GREEN6 48-120	48	120	24	830 – 1020	4 x 6mm² / 4 x 10AWG (O.D. Ø16,4mm) 450 / 750V
GREEN6 48-130	48	130	26.5	900 – 1100	
GREEN6 36-150	48	150	31	1040 – 1270	
GREEN8 48-200	48	200	41	1380 – 1690	
GREEN6 72-100	72	100	31	690 – 850	4 x 6mm² / 4 x 10AWG (O.D. Ø16,4mm) 450 / 750V
GREEN6 80-80	80	80	27	550 – 680	
GREEN6 80-100	80	100	34	690 – 850	
GREEN8 80-120	80	120	41	830 – 1020	
GREEN8 80-130	80	130	44	900 – 1100	

Battery Chargers 440Vac three phases mains (also available for Lithium Battery Packs)

M	BV [V]	CC [A]	MIC [A]	BC [Ah C5]	AC MCD
GREEN6 24-80	24	80	5	550 – 680	4 x 2.5mm² / 4 x 12AWG (O.D. Ø12,7mm) 450 / 750V
GREEN6 24-100	24	100	6	690 – 850	
GREEN6 24-120	24	120	7	830 – 1020	4 x 4mm² / 4 x 10AWG (O.D. Ø14,6mm) 450 / 750V
GREEN8 24-200	24	200	12	1380 – 1690	4 x 6mm² / 4 x 10AWG (O.D. Ø16,4mm) 450 / 750V
GREEN8 36-200	36	200	17	1380 – 1690	
GREEN6 48-150	48	150	17	1040 – 1270	4 x 4mm² / 4 x 10AWG (O.D. Ø14,6mm) 450 / 750V
GREEN8 48-200	48	200	23	1380 – 1690	4 x 6mm² / 4 x 10AWG (O.D. Ø16,4mm) 450 / 750V

Battery Chargers 208Vac three phases mains (also available for Lithium Battery Packs)

M	BV [V]	CC [A]	MIC [A]	BC [Ah C5]	AC MCD
GREEN6 24-100	24	100	10.6	690 – 850	4 x 2.5mm² / 4 x 12AWG (O.D. Ø12,7mm) 450 / 750V
GREEN6 24-120	24	120	12.8	830 – 1020	4 x 4mm² / 4 x 10AWG (O.D. Ø14,6mm) 450 / 750V
GREEN6 36-80	36	80	15	550 – 680	4 x 2.5mm² / 4 x 12AWG (O.D. Ø12,7mm) 450 / 750V
GREEN6 36-150	36	150	23.9	1040 – 1270	4 x 4mm² / 4 x 10AWG (O.D. Ø14,6mm) 450 / 750V
GREEN6 48-100	48	100	21.3	690 – 850	4 x 2.5mm² / 4 x 12AWG (O.D. Ø12,7mm) 450 / 750V
GREEN6 48-150	48	150	31.9	1040 – 1270	4 x 4mm² / 4 x 10AWG (O.D. Ø14,6mm) 450 / 750V
GREEN8 48-200	48	200	42.6	1380 – 1690	4 x 6mm² / 4 x 10AWG (O.D. Ø16,4mm) 450 / 750V

Battery Chargers 480Vac three phases mains (also available for Lithium Battery Packs)

M	BV [V]	CC [A]	MIC [A]	BC [Ah C5]	AC MCD
GREEN6 24-50	24	50	2.3	350 – 420	4 x 2.5mm² / 4 x 12AWG (O.D. Ø12,7mm) 450 / 750V
GREEN6 24-60	24	60	2.8	420 – 510	
GREEN6 24-70	24	70	3.2	480 – 590	
GREEN6 24-80	24	80	3.7	550 – 680	
GREEN6 24-90	24	90	4.1	620 – 760	
GREEN6 24-100	24	100	4.6	690 – 850	
GREEN6 24-110	24	110	5.1	760 – 930	4 x 4mm² / 4 x 10AWG (O.D. Ø14,6mm) 450 / 750V
GREEN6 24-120	24	120	5.5	830 – 1020	
GREEN6 24-130	24	130	6.0	900 – 1100	
GREEN6 24-140	24	140	6.5	970 – 1180	
GREEN6 24-150	24	150	6.9	1040 – 1270	

GREEN8 24-160	24	160	7.4	1110 – 1350	4 x 4mm² / 4 x 10AWG (O.D. Ø16,4mm) 450 / 750V
GREEN8 24-170	24	170	7.8	1180 – 1440	
GREEN8 24-180	24	180	8.3	1250 – 1520	
GREEN8 24-190	24	190	8.8	1320 – 1610	
GREEN8 24-200	24	200	9.2	1380 – 1690	
GREENX 24-210	24	210	9.7	1450 – 1780	4 x 6mm² / 4 x 10AWG (O.D. Ø16,4mm) 450 / 750V
GREENX 24-220	24	220	10.1	1520 – 1860	
GREENX 24-230	24	230	10.6	1590 – 1950	
GREENX 24-240	24	240	11.1	1660 – 2030	
GREENX 24-250	24	250	11.5	1730 – 2120	
GREENX 24-260	24	260	12.0	1800 – 2200	
GREENX 24-270	24	270	12.4	1870 – 2280	
GREENX 24-280	24	280	12.9	1940 – 2370	
GREENX 24-290	24	290	13.4	2010 – 2450	
GREENX 24-300	24	300	13.8	2080 – 2540	
GREEN6 36-50	36	50	3.5	350 – 420	4 x 2.5mm² / 4 x 12AWG (O.D. Ø12,7mm) 450 / 750V
GREEN6 36-60	36	60	4.1	420 – 510	
GREEN6 36-70	36	70	4.8	480 – 590	
GREEN6 36-80	36	80	5.5	550 – 680	
GREEN6 36-90	36	90	6.2	620 – 760	
GREEN6 36-100	36	100	6.9	690 – 850	
GREEN6 36-110	36	110	7.6	760 – 930	4 x 4mm² / 4 x 10AWG (O.D. Ø14,6mm) 450 / 750V
GREEN6 36-120	36	120	8.3	830 – 1020	
GREEN6 36-130	36	130	9.0	900 – 1100	
GREEN6 36-140	36	140	9.7	970 – 1180	
GREEN6 36-150	36	150	10.4	1040 – 1270	
GREEN8 36-160	36	160	11.1	1110 – 1350	4 x 6mm² / 4 x 10AWG (O.D. Ø16,4mm) 450 / 750V
GREEN8 36-170	36	170	11.8	1180 – 1440	
GREEN8 36-180	36	180	12.4	1250 – 1520	
GREEN8 36-190	36	190	13.1	1320 – 1610	
GREEN8 36-200	36	200	13.8	1380 – 1690	
GREENX 36-210	36	210	14.5	1450 – 1780	
GREENX 36-220	36	220	15.2	1520 – 1860	
GREENX 36-230	36	230	15.9	1590 – 1950	
GREENX 36-240	36	240	16.6	1660 – 2030	
GREENX 36-250	36	250	17.3	1730 – 2120	

GREENX 36-260	36	260	18.0	1800 – 2200	4 x 6mm² / 4 x 10AWG (O.D. Ø16,4mm) 450 / 750V
GREENX 36-270	36	270	18.7	1870 – 2280	
GREENX 36-280	36	280	19.4	1940 – 2370	
GREENX 36-290	36	290	20.1	2010 – 2450	
GREENX 36-300	36	300	20.7	2080 – 2540	
GREEN6 48-50	48	50	4.6	350 – 420	4 x 2.5mm² / 4 x 12AWG (O.D. Ø12,7mm) 450 / 750V
GREEN6 48-60	48	60	5.5	420 – 510	
GREEN6 48-70	48	70	6.5	480 – 590	
GREEN6 48-80	48	80	7.4	550 – 680	
GREEN6 48-90	48	90	8.3	620 – 760	
GREEN6 48-100	48	100	9.2	690 – 850	
GREEN6 48-110	48	110	10.1	760 – 930	4 x 4mm² / 4 x 10AWG (O.D. Ø14,6mm) 450 / 750V
GREEN6 48-120	48	120	11.1	830 – 1020	
GREEN6 48-130	48	130	12.0	900 – 1100	
GREEN6 48-140	48	140	12.9	970 – 1180	
GREEN6 48 150	48	150	13.8	1040 – 1270	
GREEN8 48-160	48	160	14.8	1110 – 1350	4 x 4mm² / 4 x 10AWG (O.D. Ø16,4mm) 450 / 750V
GREEN8 48-170	48	170	15.7	1180 – 1440	
GREEN8 48-180	48	180	16.6	1250 – 1520	
GREEN8 48-190	48	190	17.5	1320 – 1610	
GREEN8 48-200	48	200	18.4	1380 – 1690	
GREENX 48-210	48	210	19.4	1450 – 1780	4 x 6mm² / 4 x 10AWG (O.D. Ø16,4mm) 450 / 750V
GREENX 48-220	48	220	20.3	1520 – 1860	
GREENX 48-230	48	230	21.2	1590 – 1950	
GREENX 48-240	48	240	22.1	1660 – 2030	
GREENX 48-250	48	250	23.1	1730 – 2120	
GREENX 48-260	48	260	24.0	1800 – 2200	
GREENX 48-270	48	270	24.9	1870 – 2280	
GREENX 48-280	48	280	25.8	1940 – 2370	
GREENX 48-290	48	290	26.7	2010 – 2450	
GREENX 48-300	48	300	27.7	2080 – 2540	

Important safety instructions. Keep these instructions. This manual contains important instructions for the safety of the user and operation of the device.

GENERAL WARNINGS

1) Before each use of the battery charger the instructions set out below must be carefully read and abided by.
2) The failure to follow these instructions and /or errors in installing or using the battery charger could lead to endangering the operator and /or damaging the device, voiding the manufacturer's guarantee.
3) The battery charger cannot be used as a component in systems which provide life support and/or medical devices.
4) The battery charger must not be used by persons with reduced physical, sensory and mental capabilities or with lack of experience and/or knowledge, unless they are properly supervised and instructed by a person responsible for their safety.
5) The rating label must be visible after installation.

CHILDREN

6) This appliance can be used by children aged from 8 years and above and persons with reduced physical, sensory or mental capabilities or lack of experience and knowledge if they have been given supervision or instruction concerning use of the appliance in a safe way and understand the hazards involved. Children being supervised not to play with the appliance. Cleaning and user maintenance shall not be made by children without supervision.

WHERE TO INSTALL

7) Never place the battery charger in the immediate vicinity of the battery in order to prevent gases produced and/or emitted by the actual battery during charging corroding and/or damaging the battery charger. Place the battery charger as far away from the battery as the length of cables permits.
8) Do not install the battery charger in a closed space or in such a way as to somehow prevent ventilation. For units equipped with fans, at least 30 mm clearance must be left around the vents. In

order to facilitate the heat exchange of the battery charger it must be positioned vertically, exploiting the fixture holes (where provided).
9) Do not use the battery charger outdoors.
10) Do not expose the battery charger to rain, water splashes or steam.
11) Do not install the battery charger in caravans and / or similar vehicles.
12) Do not install the battery charger near any heat sources or in areas with high concentrations of dust.
13) Do not install the battery charger near any potential sources of flammable material, for example methane gas pipes or fuel depots (petrol, kerosene, ...).
14) Do not place and/or fit the battery charger onto surfaces manufactured out of combustible materials, like wooden shelves or walls.

BATTERIES

15) Follow the specific safety instructions provided by the battery manufacturer carefully, for example, whether or not to remove cell caps during charging and the recommended charge rates.
16) Working in the vicinity of a lead-acid battery is dangerous, as batteries generate explosives gases during charging. Therefore smoking and/or generating open flames and/or sparks must be avoided.
17) Never charge a frozen battery.
18) Batteries must be charged in specific, well-ventilated areas.
19) In order to reduce risk of injury only charge Lead–Acid, GEL or AGM type, Lithium Polymer or Lithium Ion batteries. Do not charge other types of rechargeable or non-rechargeable batteries as they could explode causing damage and/or injury.

FURTHER SPECIFICATIONS FOR LITHIUM BATTERIES

20) In order to charge Lithium Polymer and Lithium Ion batteries, a BMS (Battery Management System) must always be used, comprising an active and passive safety system, in compliance with safety regulations in force.

21) The possibility of the BMS acting directly on the battery charger operation during cell balancing phases rules out, for any reason whatsoever, that the battery charger is held directly responsible should damage caused to the battery, or even a fire or an explosion, be due to an error in the BMS software.
22) The faculty offered by the materials produced by S.P.E. ELETTRONICA INDUSTRIALE to select different levels of voltage for charging, is entrusted to the control and supervision of the end user and S.P.E. ELETTRONICA INDUSTRIALE is not liable for any consequences resulting from the selection of the incorrect level of voltage. If in doubt, the user should ask a qualified professional for clarification.
23) The battery charger tolerance thresholds, as far as levels of over-voltage and overcharging are concerned, are used only for the safeguarding of the systems of the same and have no safety functions for the battery itself, the safety of which depends solely on the BMS, even when the battery charger is connected to the battery, whether the latter is being charged or not.
24) Should the client want to use the battery charger on a specific on-board system and in general in any cases of special usage, it is the client's responsibility to inform S.P.E. ELETTRONICA INDUSTRIALE, so that the latter can draw up any necessary recommendations. In this case, the client must provide S.P.E. ELETTRONICA INDUSTRIALE with all designs, diagrams and descriptive material necessary. S.P.E. ELETTRONICA INDUSTRIALE cannot be held responsible for any damage resulting from the use of the battery charger after opening it and/or modifying it and/or inserting it into other systems.
25) Under no circumstances can S.P.E. ELETTRONICA INDUSTRIALE be held responsible for the malfunctioning of the batteries or the incineration/explosion of these, in so much as the safety of the battery is the task of the BMS and not of the battery charger.

CHECKING CABLES, GRID, EARTHING

26) Do not transport the battery charger by pulling on the cables as they could be damaged. Use the handles on the battery charger, if provided.

27) Before using the battery charger, check that the sleeving on the mains cable and battery cables is in good condition. Should one of the cables be damaged, have it replaced by a S.P.E. ELETTRONICA INDUSTRIALE qualified technician.

28) Check that the input voltage of the battery charger given on the data plate is in line with the voltage available.

29) Check the compatibility of the mains plug supplied with the battery charger: the use of adaptors is not recommended (in Canada it is against the law). If the input plug does not fit the power outlet, contact SPE ELETTRONICA INDUSTRIALE for the proper cord set terminating in an attachment plug of the proper configuration for the power outlet. If the supply cord is damaged, it must be replaced by the manufacturer, its service agent or similarly qualified persons in order to avoid a hazard.

30) The battery charger must be plugged into a socket fitted with an earth wire. Should the socket not be equipped with an earth connection, do not use the device before having a suitable socket installed by a qualified technician.

31) The power socket to which the battery charger is to be connected must be protected by an electrical device by law (fuse and/or automatic cut-out), capable of absorbing an electrical current equalling the absorption of current stated on the matriculation number of the battery charger, increased by 10%.

32) Do not open the battery charger as there are no parts which can be serviced and/or replaced by the user. Only specialized personnel, authorized by S.P.E. ELETTRONICA INDUSTRIALE may carry out servicing which involves opening the actual device. Electrical/electronic components inside may cause electric shocks even if the device is not plugged in.

CHECKING BATTERY CHARGER OPERATION AND CURVE

33) Before charging, make sure that the battery charger is in line with the voltage of the battery, that the charging current suits the capacity of the battery and that the selected charging curve (for lead-acid batteries, or for airtight GEL or AGM type batteries, Lithium Polymer or Lithium Ion batteries) is correct for the type of battery to be charged. In case of recharging floor treatment machine, ensure the machine is switched off and not used.

34) We recommend fitting a fuse between battery charger and battery. The fuse must be installed along the connection to the positive terminal of the battery. The rating of the fuse must be proportionate to the nominal output current of the battery charger, the diameter of cable used and the environment in which it is to be installed.

35) We recommend unplugging it from the mains supply before connecting and disconnecting batteries.

36) During normal operation of the battery charger, the external surface may become hot and may remain so for a certain period of time after it has been switched off.

37) The battery charger needs no special maintenance, only regular cleaning procedures, to be carried out according to the type of working environment. Cleaning procedures should only be carried out on the external surface of the battery charger. Before starting any cleaning procedures, the mains supply cable and battery cables must be unplugged. Do NOT use water and/or detergents in general and/or pressure washers of any kind when carrying out cleaning.

NOT IN USE

38) If safe operation of the battery charger can no longer be ensured, stop the device and ensure that it cannot be put back into operation.

Battery type LEAD-ACID, GEL, AGM, LITHIUM
Number of cells = 6 – 12 – 18 – 24 – 36 – 40 – 48

CAUTION: Risk of Fire. Charge LEAD-Acid, Gel, AGM and Lithium batteries. For Lithium: Use only battery packs that include BMS and all necessary protection for the battery pack integral to the pack.

DANGER: Risk of electric shock. Do not touch uninsulated portion of output connector or uninsulated battery terminal.

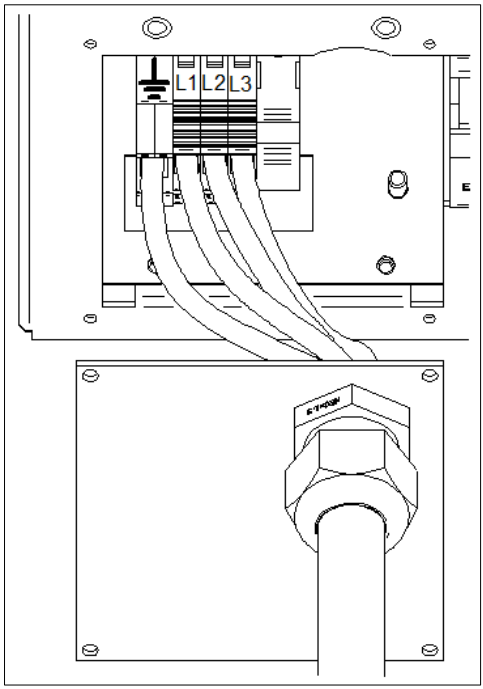
CAUTION: Risk of Fire. Use only on circuits provided with _____ amperes branch circuit protection in accordance with the National Electrical Code, NFPA 70."

Note: The specifications set out in this manual are subject to change without any notice. This publication replaces any previously supplied information.

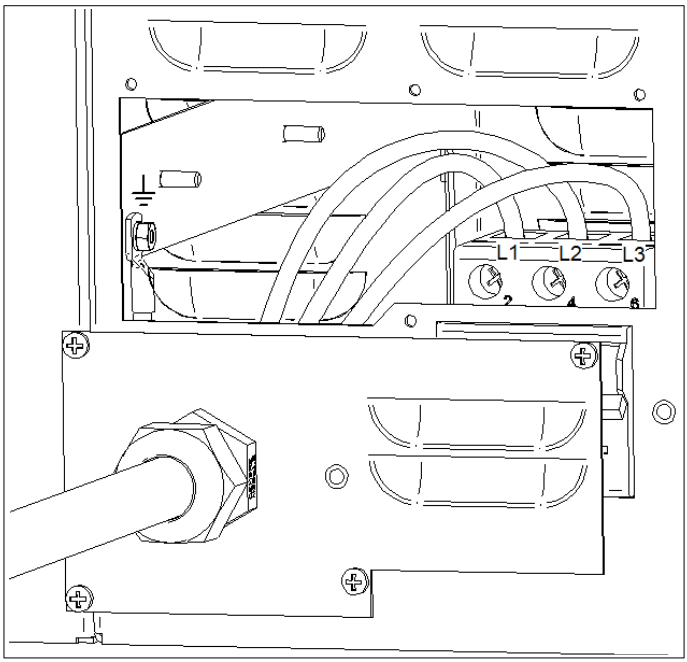
GREEN6 – GREEN8 – GREENX
High Frequency Battery Charger

MAINS CONNECTION

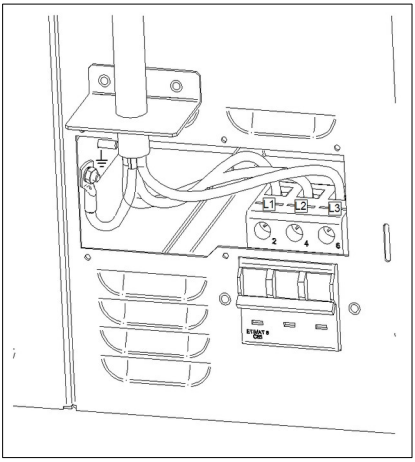
The battery charger must be connected to a socket proportionate in power to the charger. Check it on the rating label positioned on the side of the charger:

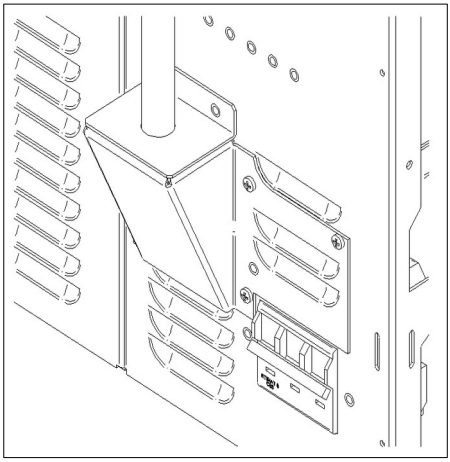


Standard mains connection



Alternative mains connection





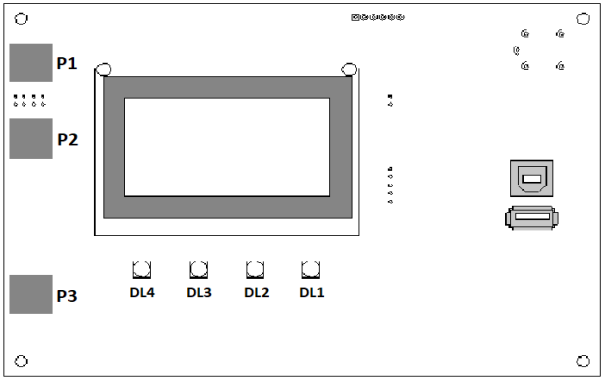
Cable conduit wiring connection

BATTERY CONNECTION

The battery charger is already provided of battery connector. In any case, we recommend using appropriate compliant bipolar connectors which do not allow polarity reverse. Ensure the battery leads are correctly crimped to the connector's contacts and themselves are well inserted into the battery connector.
Only specialized personnel should carry out this procedure.

VISUAL SIGNALS

This paragraph describes the displays of the 4 status LEDs during the different operational phases of the battery charger.



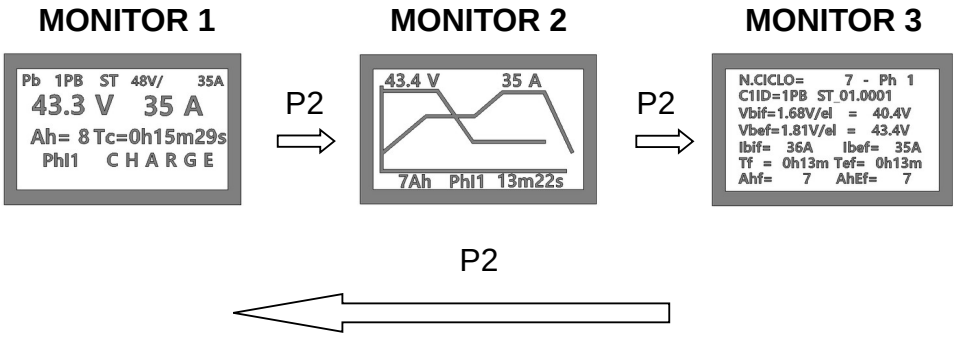
REF	DESCRIPTION	DL4 LED (green)	DL3 LED (yellow)	DL2 LED (green)	DL1 LED (red)	DISPLAY
S1	Only battery power supply	OFF	OFF	OFF	OFF	OFF
S2	Only mains power supply	OFF	OFF	OFF	OFF	ON
S3	Both mains and battery power supply	ON	OFF	OFF	OFF	ON
S4	Perform Autostart	BL	BL	BL	BL	ON
F1	Phase 1 – Initial charge CI	BL	OFF	OFF	OFF	ON
F2-F7	Phase 2 – Phase 7	BL	ON	OFF	OFF	ON
F8	Equalisation period	ON	ON	ON	OFF	ON
EQU ON	Equalisation charge ON (in progress)	BL	BL	ON	OFF	ON
					OFF	ON
EQU OFF	Equalisation charge OFF (paused)	ON	ON	ON	OFF	ON

M	Maintenance	BL	BL	ON	OFF	ON
END	Charge Finished	ON	ON	ON	OFF	ON

Where:
OFF = the led is off
ON = the led is constant
BL = the led is blinking (Blink, T=1 second)
- - = the led can be in any condition

LCD DISPLAY

During charging, the battery charger offers 3 monitor menus, which you can move between by pressing the P2 button, and whose detailed meaning was previously illustrated

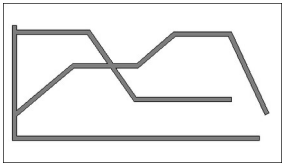


Below is a summary of the information given respectively on the 3 MONITOR displays.

MONITOR 1

LINE	EXAMPLE	DESCRIPTION
(1)	Pb 1Pb ST 48V / 35A	Battery Technology, Type of Curve, Battery Charger Rating
(2)	43,3 V 35A	Battery voltage and current
(3)	Ah= 8 Tc= 0h 15m 29s	Ah charged, Charging Time in hours, min, sec
(4)	Phl1 CHARGE	Current charging phase, battery charger STATUS
(5)	-- Messages	(e.g. phase = auto start A0, Status= BATTERY NOT CONNECTED)

MONITOR 2

LINE	EXAMPLE	DESCRIPTION
(1)	43,3V 35A	Battery Voltage and Current Supplied
(2)		Active charge profile with indication: • Phases complete (thick line) • Phase in progress (flashing line) • Phases to execute (thin line)
(3)	7Ah PhI1 13m22s	Ah charged, Charging time in hours, min, sec
(4)	-- Message	Possible fault or status messages

MONITOR 3

LINE	EXAMPLE	DESCRIPTION
(1)	N.CYCLE= 7 – Ph 1	Number of charge cycle and current charge phase E.g. : charge cycle 5 and Phase 3
(2)	C1ID=1PB ST_01.0001	Charging curve unique identification
(3)	Vbif=1.68V/el = 40.4V	Battery voltage at start of phase (Vbif) expressed first as element voltage (V/el), then as absolute voltage (V)
(4)	Vbef=1.81V/el = 43.4V	Battery voltage at end of phase (current) (Vbef) expressed first as element voltage (V/el), then as absolute voltage (V)
(5)	Ibif= 36A Ibef= 35A	Current at start of phase (Ibif) and current at end of phase (Ibef)
(6)	Tf =0h13m Tef=0h13m	Single phase time (Tf) and Overall charge time at end of phase (Tef)
(7)	Ahf= 7 AhEf= 7	Ah supplied in the selected phase (Ahf) and overall charge Ah (AhEf)
(8)	-- Message	Indicates any faults occurring during the charge cycle

GUARANTEE

- The machine is guaranteed 12 months from the date of installation.
- The guarantee covers parts found to be defective in manufacturing or assembly.
- The guarantee does NOT cover damage caused by incorrect usage and/or installation.
- The guarantee lapses if any tampering is discovered.
- For any problems, please refer to an AUTHORISED RETAILER or directly to S.P.E. Elettronica Industriale

DECLARATION OF CONFORMITY

We

S.P.E. ELETTRONICA INDUSTRIALE di Poletti Sergio
Via di Mezzo Ponente, 383 – 40014 Crevalcore (Bologna) ITALY

Declare under our sole responsibility that the product:

ELECTRONIC AUTOMATIC BATTERY CHARGER MODEL:

GREEN6 24-50, GREEN6 24-60, GREEN6 24-70, GREEN6 24-80, GREEN6 24-100, GREEN6 24-120, GREEN6 24-150, GREEN8 24-160, GREEN8 24-180, GREEN8 24-200, GREENX 24-250, GREENX 24-300, GREEN6 36-80, GREEN6 36-100, GREEN6 36-120, GREEN6 36-150, GREEN6 36-180, GREEN8 36-200, GREENX 36-250, GREENX 36-300, GREEN6 48-25, GREEN6 48-30, GREEN6 48-40, GREEN6 48-50, GREEN6 48-60, GREEN6 48-70, GREEN6 48-80, GREEN6 48-90, GREEN6 48-100, GREEN6 48-120, GREEN6 48-130, GREEN6 48-150, GREEN8 48-160, GREEN8 48-180, GREEN8 48-200, GREENX 48-250, GREENX 48-300, GREEN6 72-30, GREEN6 72-40, GREEN6 72-50, GREEN6 72-60, GREEN6 72-80, GREEN6 72-100, GREEN8 72-130, GREEN6 80-30, GREEN6 80-40, GREEN6 80-50, GREEN6 80-60, GREEN6 80-80, GREEN6 80-100, GREEN8 80-110, GREEN8 80-120, GREEN8 80-130, GREENX 80-150, GREENX 80-160, GREENX 80-200, GREEN6 96-20, GREEN6 96-25, GREEN6 96-30, GREEN6 96-40, GREEN6 96-50, GREEN 96-60, GREEN6 96-65, GREEN6 96-70, GREEN6 96-75, GREEN8 96-80, GREEN8 96-100, GREENX 96-125, GREENX 96-150

to which this declaration applies, complies with the provisions of the Directives of the Council of the European Union on the approximation of the laws of the members states:

Relating to Electromagnetic Compatibility (EMC) Directive 2014/30/EU of the European Parliament and of the council of 26 February 2014 on the approximation of the laws of the member states relating to electromagnetic compatibility and repealing directive 89/336/EEC, conformity is proven by compliance with the following standard:

- EN IEC 61000-6-2: 2019 - *Part 6-2: Generic standards - Immunity standard for industrial environments (Emission)*
- EN 61000-6-4: 2007 + A1:2011 - *Part 6-4: Generic standards - Emission standard for industrial environments (Immunity – Category II)*

Relating to Extra Low Voltage (LVD) Directive 2014/35/EU of the European parliament and of the council of 26 February 2014 on the harmonisation of the laws of member states relating to electrical equipment designed for use within certain voltage limits, conformity is proven by compliance with the following standard:

- EN 60335-1:2012 + A11:2014 + A13:2017 - *"Safety of household and similar electric appliance – Part 1:General requirements"*
- EN 62233:2008 - *"Measurement methods for electromagnetic fields of household appliances and similar apparatus with regard to human exposure"*

Crevalcore 16 – 06 - 2021

Sergio Poletti
President

S.P.E. ELETTRONICA INDUSTRIALE di Poletti Sergio
Via di Mezzo Ponente n. 383/B
40014 CREVALCORE (Bologna)

Wichtige Sicherheitsanleitungen. Diese Anleitungen aufbewahren. Das vorliegende Handbuch enthält wichtige Anleitungen für die Sicherheit des Anwenders und den Betrieb des Gerätes.

ALLGEMEINE HINWEISE

1) Vor jedem Einsatz des Batterie-Ladegeräts müssen die folgenden Anleitungen gelesen und sorgfältig eingehalten werden.
2) Eine Nichtbeachtung der folgenden Anleitungen bzw. Fehler bei der Installation oder dem Einsatz des Batterie-Ladegeräts können den Anwender gefährden bzw. Schäden am Gerät verursachen und führen zum Verfall der Hersteller-Garantie.
3). Das Ladegerät kann nicht als Komponente für Geräte mit lebenserhaltenden Funktionen oder in medizinischen Geräten verwendet werden.
4) Personen mit eingeschränkten psychologischen – physischen – sensorischen Fähigkeiten oder mit unzureichender Erfahrung bzw. Kenntnis ist die Verwendung des Batterie-Ladegerätes verboten, es sei denn, dass sie von jemandem, der für ihre Unversehrtheit verantwortlich ist, aufmerksam überwacht und unterrichtet werden.
5) Das Typenschild muss nach der Installation sichtbar sein.

KINDER

6). Dieses Gerät kann von Kindern ab 8 Jahren und von Personen mit eingeschränkten körperlichen, sensorischen oder geistigen Fähigkeiten oder mangelnder Erfahrung und mangelndem Wissen verwendet werden, wenn sie über die sichere Verwendung des Geräts unterwiesen wurden und die Gefahren kennen beteiligt. Kinder werden beaufsichtigt, nicht mit dem Gerät zu spielen. Reinigung und Benutzerwartung dürfen nicht von Kindern ohne Aufsicht durchgeführt werden.

INSTALLATIONSORT

7) Absolut vermeiden, das Batterie-Ladegerät in unmittelbarer Nähe der Batterie aufzustellen, um zu verhindern, dass die während des Ladevorgangs in der Batterie entstehenden bzw. austretenden

Gase das Batterie-Ladegerät angreifen bzw. beschädigen können. Das Batterie-Ladegerät, soweit es die Kabellänge zulässt, möglichst weit von der Batterie entfernt aufstellen.
8) Das Batterie-Ladegerät nicht in geschlossenen Bereichen oder so aufstellen, dass die Lüftung behindert werden könnte. Für die mit Gebläse ausgestatteten Geräte muss um die Lüftungsöffnungen ein Freiraum von mindestens 30 mm gelassen werden. Um den Wärmeaustausch des Batterie-Ladegeräts zu erleichtern, muss es senkrecht an den Befestigungsbohrungen (falls vorhanden) installiert werden.
9) Das Batterie-Ladegerät nicht im Freien benutzen.
10) Das Batterie-Ladegerät nicht dem Regen, Wasserstrahlen, Dampfquellen aussetzen.
11) Das Batterie-Ladegerät nicht in Wohnmobilen oder ähnlichen Fahrzeugen installieren
12) Das Batterie-Ladegerät nicht in der Nähe von Hitzequellen oder in stark staubbelasteten Räumen installieren.
13) Das Batterie-Ladegerät nicht in der Nähe von potentiell entzündbarem Material installieren, wie z. B. Erdgasleitungen, Brennstofflager (Benzin, Kerosin, ...).
14) Das Batterie-Ladegerät nicht auf Ablagen aus brennbarem Material abstellen bzw. befestigen, wie Holz-Regale bzw. Wände.

BATTERIEN

15) Die spezifischen Anweisungen des Batterie-Herstellers sorgfältig einhalten, z. B., ob die Verschlüsse von den Batterieelementen während des Ladevorgangs abgenommen werden müssen oder nicht, sowie die empfohlenen Lademodalitäten.
16) Das Arbeiten in der Nähe von Blei-Säure-Batterien während des Ladevorgangs ist gefährlich, weil die Batterien explosive Gase erzeugen. Aus diesem Grund ist das Rauchen und die Benutzung offener Flammen verboten, eine Funkenbildung ist zu vermeiden.
17) Keine eingefrorenen Batterie aufladen.
18) Die Batterien müssen in dafür vorgesehenen und gut gelüfteten Räumen geladen werden.

19) Um Unfallgefahren zu reduzieren, ausschließlich Blei-Säure-, GEL oder AGM, Lithium-Polymer- oder Lithium-Ionen-Batterien aufladen. Keine anderen Arten von aufladbaren oder nicht-aufladbaren Batterien laden, da diese explodieren und Sach- bzw. Personenschäden verursachen könnten.

WEITERE SPEZIFIKATIONEN FÜR LITHIUM-BATTERIEN

20) Für das Aufladen von Lithium-Polymer- oder Lithium-Ionen-Batterien muss immer ein BMS (Battery Management System) mit aktivem oder passivem Sicherheitssystem vorhanden sein, das den geltenden Sicherheitsnormen entsprechen muss.

21) Die Möglichkeit des BMS beim Abgleich der Zellen direkt auf den Betrieb des Batterie-Ladegerätes zuzugreifen, schließt eine direkte Verantwortung des Batterie-Ladegerätes aus, wenn die Schäden an der Batterie, oder sogar Brand oder Explosion, durch einen Softwarefehler im BMS verursacht wurden.

22) Die von der S.P.E. ELETTRONICA INDUSTRIALE hergestellten Produkte bieten die Möglichkeiten unterschiedliche Spannungsstufen für den Ladevorgang auszuwählen. Die Auswahl der Spannungsstufe nimmt der Endanwender vor. S.P.E. ELETTRONICA INDUSTRIALE haftet nicht für Schäden, die durch die Auswahl einer falschen Spannung verursacht werden. Im Zweifelsfall muss der Anwender einen Fachtechniker um Erläuterungen bitten.

23) Die Toleranzschwellen des Batterie-Ladegerätes in Bezug auf Überspannung und Überlast beziehen sich ausschließlich auf den Schutz der Systeme im Batterie-Ladegerät und nicht auf die Batterie. Die Batterie wird ausschließlich durch das BMS geschützt, auch wenn das Batterie-Ladegerät an die Batterie angeschlossen ist, unabhängig davon, ob geladen wird oder nicht.

24) Beabsichtigt der Kunde das Batterie-Ladegerät an einem spezifischen, eingebauten System zu benutzen, und allgemein bei allen Fällen von besonderem Einsatz, muss der Kunde die S.P.E. ELETTRONICA INDUSTRIALE benachrichtigen, damit gegebenenfalls entsprechende Empfehlungen gegeben werden können. In diesem Fall muss der Kunde der S.P.E. ELETTRONICA

INDUSTRIALE alle Entwürfe, Schaltpläne und Beschreibungen zur Verfügung stellen. S.P.E. ELETTRONICA INDUSTRIALE haftet nicht für Schäden, die aus einem Einsatz des Batterie-Ladegeräts entstehen, nachdem dieses geöffnet bzw. geändert oder in ein anderes System eingebaut wurden ist.
25) S.P.E. ELETTRONICA INDUSTRIALE haftet auf keinen Fall für Schäden an der Batterie bzw. Brand/ Explosion der Batterien, da die Absicherung der Batterien durch das BMS und nicht durch das Batterie-Ladegerät erfolgt.

KONTROLLE KABEL, NETZ, ERDUNG

26) Das Batterie-Ladegerät nie zum Transport an den Kabeln greifen, da sich diese beschädigen können. Soweit vorhanden, die entsprechenden Transportgriffe verwenden.
27) Vorm Einsatz des Batterie-Ladegeräts den guten Zustand der Kabelisolierungen am Anschlusskabel für das Stromnetz und der Batteriekabel überprüfen. Ist auch nur ein Kabel beschädigt, muss es durch einen Fachtechniker der S.P.E. ELETTRONICA INDUSTRIALE ausgewechselt werden.
28) Kontrollieren, dass die auf dem Typenschild angegebene Eingangsspannung für das Batterie-Ladegerät der zur Verfügung stehenden Versorgungsspannung entspricht.
29) Die Kompatibilität des mit dem Batterie-Ladegerät mitgelieferten Netzsteckers kontrollieren: von einem Einsatz von Adaptern wird abgeraten (in Kanada verboten).
30) Das Batterie-Ladegerät muss an eine Steckdose mit Erdungsleitung angeschlossen werden. Besitzt die Steckdose keine Erdungsleitung, darf das Batterie-Ladegerät nicht benutzt werden, bevor ein Fachtechniker eine geeignete Steckdose installiert hat.
31) Die Steckdose, an die das Batterie-Ladegerät angeschlossen wird, muss mit einer gesetzlich vorgeschriebenen, elektrischen Vorrichtung abgesichert sein (Sicherung bzw. automatischer Schalter), die für einen Strom bemessen sein muss, der der Angabe für die Stromaufnahme auf dem Typenschild plus 10% entspricht.
32) Das Batterie-Ladegerät nicht öffnen, da sich in seinem Inneren keine Bauteile befinden, die vom Anwender repariert bzw.

ausgewechselt werden können. Nur von der S.P.E. ELETTRONICA INDUSTRIALE autorisiertes Fachpersonal darf Arbeiten vornehmen, bei denen das Gerät geöffnet werden muss. Im Gerät befinden sich elektrische/ elektronische Bauteile, die einen Stromschlag verursachen können, auch wenn das Gerät nicht an der Steckdose angeschlossen ist.

KONTROLLE DER FUNKTIONEN DES BATTERIE-LADEGERÄTS UND KURVE

33) Vorm Aufladen sicherstellen, dass das Batterie-Ladegerät für die Batteriespannung geeignet ist, dass der Ladestrom für die Batterieleistung geeignet ist, und dass die ausgewählte Lade-Dynamik (für Blei-Säure-Batterien, wartungsfreie GEL- oder AGM-Batterien, Lithium-Polymer- oder Lithium-Ionen-Batterien) für die Art der zu ladenden Batterie richtig ist.
34) Es wird empfohlen eine Sicherung zwischen Batterie-Ladegerät und Batterie zwischenzuschalten. Die Sicherung muss am Anschluss zum Pluspol installiert werden. Der Wert für die Sicherung muss abhängig vom Nennstrom am Ausgang des Batterie-Ladegeräts, dem Kabelquerschnitt und der Installations-Umgebung bemessen werden.
35) Es wird empfohlen die Stromversorgung vorm Anschließen oder Trennen der Batterie auszuschalten.
36) Während des Normalbetriebs des Batterie-Ladegeräts kann sich die Außenfläche erhitzen und auch nach Abschalten des Batterie-Ladegeräts einige Zeit heiß bleiben.
37) Das Batterie-Ladegerät benötigt keine besondere Wartung, sondern muss nur, abhängig von der Betriebsumgebung, regelmäßig gereinigt werden. Die Reinigung darf nur außen am Batterie-Ladegerät vorgenommen werden. Vor der Reinigung muss das Speisekabel vom Stromnetz sowie die Anschlusskabel zur Batterie getrennt werden. Für die Reinigung wird empfohlen allgemein KEIN Wasser bzw. Reinigungsmittel und keine Hochdruckreiniger zu verwenden

NICHTBENUTZUNG

38) Kann ein sicherer Betrieb des Batterie-Ladegeräts nicht garantiert werden, das Gerät abschalten und sicherstellen, dass es nicht wieder in Betrieb genommen werden kann.

Batterietyp BLEISÄURE, GEL, AGM, LITHIUM
Anzahl der Zellen = 6 – 12 – 18 – 24 – 36 – 40 – 48

VORSICHT: Brandgefahr. Ladung Blei-Säure, Gel, AGM und Lithium Batterien. Bzgl. Lithium: Laden Sie nur Batterien, welche über ein BMS und alle notwendigen Schutzvorrichtungen innerhalb der Batterie (bzw. Batteriepacks) verfügen.

GEFAHR: Risiko eines elektrischen Schlages. Berühren Sie nicht den nicht isolierten Teil des Ausgangsanschlusses oder den nicht isolierten Batteriepol.

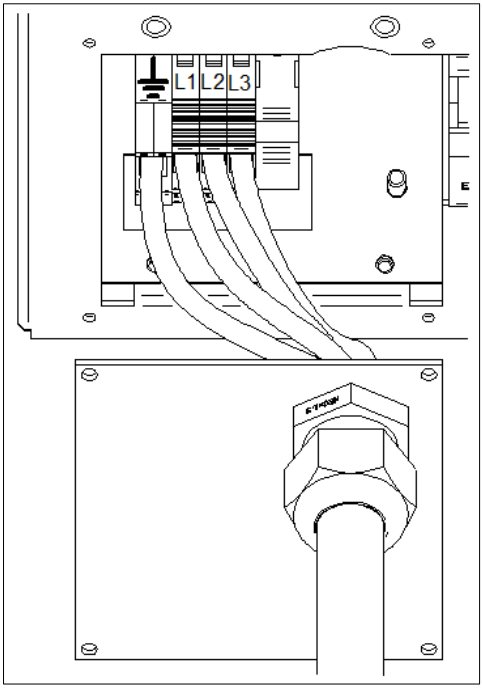
VORSICHT: Brandgefahr. Nur für Stromkreise verwenden, die mit einem Stromkreisschutz von _____ Ampere gemäß dem National Electrical Code, NFPA 70, ausgestattet sind.

Note: Die Angaben in diesem Handbuch können jederzeit ohne Vorankündigung geändert werden. Diese Ausgabe ersetzt alle früher gelieferten Informationen.

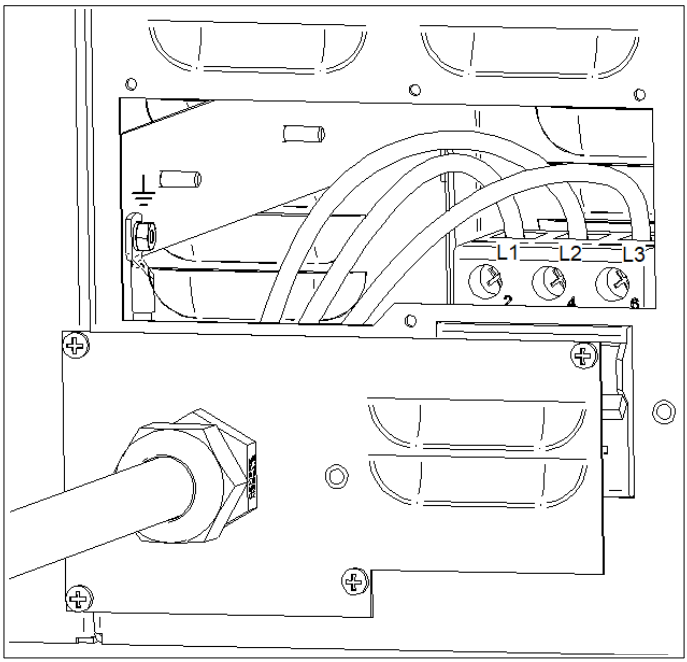
GREEN6 - GREEN8 - GREENX
HochFrequenzBatterieLadegerät

STROMNETZANSCHLUSS

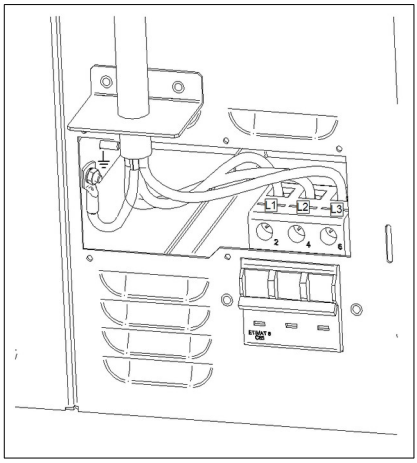
Das installierte Ladegerät muss an eine Steckdose mit einer dem Ladegerät entsprechenden Leistung angeschlossen werden. Prüfen Sie die Daten auf dem Typenschild:

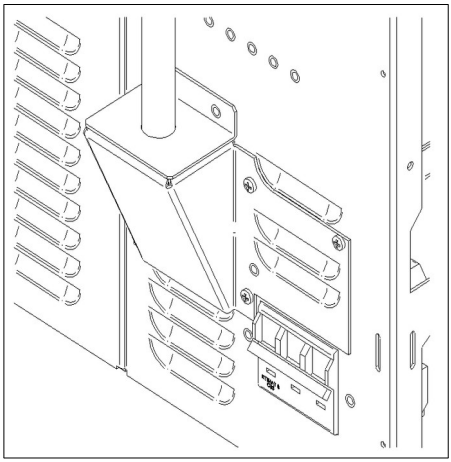


Standard Netzanschluss



Alternativer Netzanschluss





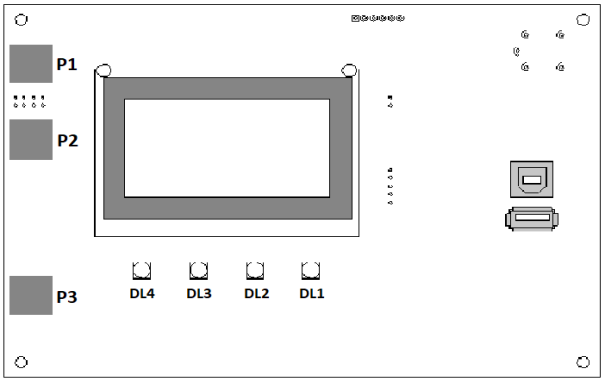
Kabelkanal / Kabelverbindung

ANSCHLUSS AN DIE BATTERIE

Wir empfehlen zur verwendung der eigenen normengerechten zweipoligen stecker, die kein vertauschen der batteriepolarität ermöglichen. Stellen sie auch sicher, dass die kabel richtig an die verbinderkontakte angeschlossen sind. Dieser vorgang muss ausschließlich fachpersonal überlassen werden.

SICHTSIGNALE

Vorliegender absatz beschreibt die anzeigen der 4 zustand-leds im zuge der verschiedenen betriebsphasen des batterieladegeräts.



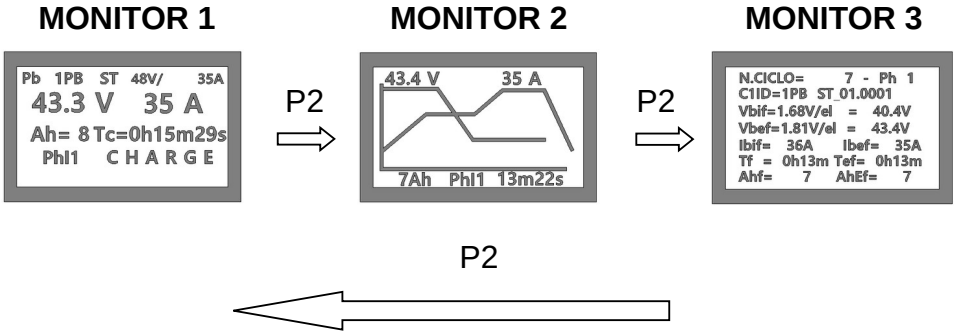
BEZ	BESCHREIBUNG	LED DL4 (grün)	LED DL3 (gelb)	LED DL2 (grün)	LED DL1 (rot)	DISPLAY
S1	Nur batterieversorgung	OFF	OFF	OFF	OFF	OFF
S2	Nur Netzversorgung	OFF	OFF	OFF	OFF	ON
S3	Batterie und netzversorgung	ON	OFF	OFF	OFF	ON
S4	Autostart vornehmen	BL	BL	BL	BL	ON
F1	Phase 1 – Erstladung CI	BL	OFF	OFF	OFF	ON
F2-F7	Phase 2 – Phase 7	BL	ON	OFF	OFF	ON
F8	Entzerrungszeit	ON	ON	ON	OFF	ON
EQU ON	Ausgleichsladung ON (im gange)	BL	BL	ON	OFF	ON
					OFF	ON
EQU OFF	Ausgleichsladung OFF (auf pause)	ON	ON	ON	OFF	ON

M	Wartung	BL	BL	ON	OFF	ON
ENDE	Ladung beendet	ON	ON	ON	OFF	ON

Wo:
OFF = LED aus
ON = LED fix an
BL = LED blinkt (Intervall, T=1 Sekunde)
- - = LED in jedem Zustand

LCD-DISPLAY

Beim Aufladen bietet das Batterieladegerät 3 Bildschirmmenüs, durch die Sie durch Betätigen des vorab ausführlich beschriebenen Druckknopfs P2 surfen können.

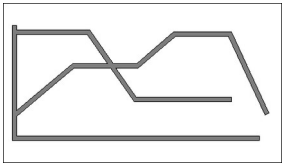


Nachstehend eine Zusammenfassung der mit den 3 Bildschirmanzeigen gelieferten Informationen.

MONITOR 1

ZEILE	BEISPIEL	BESCHREIBUNG
(1)	Pb 1Pb ST 48V / 35A	Technologie der batterie, kurvenart, rating batterieladegerät
(2)	43,3 V 35A	Spannung und strom der batterie
(3)	Ah= 8 Tc= 0h 15m 29s	Stromstärke der ladung, ladezeit in h, min, s
(4)	PhI1 CHARGE	Ladung im gange, ZUSTAND des batterieladegeräts
(5)	-- Aussage	(Beisp. Phase = Autostart A0, Zustand= BATTERIE NICHT ANGESCHLOSSEN)

MONITOR 2

ZEILE	BEISPIEL	BESCHREIBUNG
(1)	43,3V 35A	Spannung und strom der gelieferten batterie
(2)		Batterieladeprofil mit angabe von: • Komplette Phasen (dicke Zeile) • Laufende Phase (blinkende Zeile) • Auszuführende Phasen (dünne Zeile)
(3)	7Ah PhI1 13m22s	Stromstärke der Ladung, Ladezeit in h, min, s
(4)	-- Aussage	Eventuelle Schadens - oder Zustandsmeldungen

MONITOR 3

ZEILE	BEISPIEL	BESCHREIBUNG
(1)	N.CYCLE= 7 – Ph 1	Nummer der ladezyklen und laufende ladephase Beisp. : Ladezyklus 5 und Phase 3
(2)	C1ID=1PB ST_01.0001	Eindeutiger identifikator der ladekurve
(3)	Vbif=1.68V/el = 40.4V	Batteriespannung zu phasenbeginn (Vbif), anfangs als elementspannung (V/el), sodann als absolute spannung (V) ausgedrückt
(4)	Vbef=1.81V/el = 43.4V	Batterie spannung am phasenende (Spannung) (Vbif), anfangs als elementspannung (V/el), sodann als absolute spannung (V) ausgedrückt
(5)	Ibif= 36A Ibef= 35A	Spannung zu phasenbeginn (Ibif) und spannung am phasenende (Ibef)
(6)	Tf =0h13m Tef=0h13m	Dauer der einzelnen phase (Ibif) und gesamtdauer am phasenende (Ibef)
(7)	Ahf= 7 AhEf= 7	in der gewählten phase gelieferte Ah (Ahf) und Ah der Ladung insgesamt (AhEf)
(8)	-- Aussage	Zeigt eventuelle störungen während des ladezyklus an

GARANTIE

- Die Maschine ist für eine Dauer von 12 Monate ab Installationsdatum garantiert.
- Die Garantie deckt nur nachgewiesene Bau- oder Montagefehler.
- Die Garantie deckt KEINESFALLS auf unsachgemäße Bedienung und/oder Installation zurückzuführende Schäden.
- Die Garantie verfällt bei eventuell aufgedeckten Änderungen.
- Bei Problemen wenden Sie sich bitte an einen VERTRAGSHÄNDLER oder direkt an die S.P.E. Elettronica Industriale.

KONFORMITÄTSERKLÄRUNG

Die unterzeichnende firma:

S.P.E. ELETTRONICA INDUSTRIALE di Poletti Sergio
Via di Mezzo Ponente, 383 – 40014 Crevalcore (Bologna) ITALIA

erklärt eigenverantwortlich, dass das Produkt:

AUTOMATISCHES ELEKTRONISCHES BATTERIELADEGERÄT MODELL:

GREEN6 24-50, GREEN6 24-60, GREEN6 24-70, GREEN6 24-80, GREEN6 24-100, GREEN6 24-120, GREEN6 24-150, GREEN8 24-160, GREEN8 24-180, GREEN8 24-200, GREENX 24-250, GREENX 24-300, GREEN6 36-80, GREEN6 36-100, GREEN6 36-120, GREEN6 36-150, GREEN6 36-180, GREEN8 36-200, GREENX 36-250, GREENX 36-300, GREEN6 48-25, GREEN6 48-30, GREEN6 48-40, GREEN6 48-50, GREEN6 48-60, GREEN6 48-70, GREEN6 48-80, GREEN6 48-90, GREEN6 48-100, GREEN6 48-120, GREEN6 48-130, GREEN6 48-150, GREEN8 48-160, GREEN8 48-180, GREEN8 48-200, GREENX 48-250, GREENX 48-300, GREEN6 72-30, GREEN6 72-40, GREEN6 72-50, GREEN6 72-60, GREEN6 72-80, GREEN6 72-100, GREEN8 72-130, GREEN6 80-30, GREEN6 80-40, GREEN6 80-50, GREEN6 80-60, GREEN6 80-80, GREEN6 80-100, GREEN8 80-110, GREEN8 80-120, GREEN8 80-130, GREENX 80-150, GREENX 80-160, GREENX 80-200, GREEN6 96-20, GREEN6 96-25, GREEN6 96-30, GREEN6 96-40, GREEN6 96-50, GREEN 96-60, GREEN6 96-65, GREEN6 96-70, GREEN6 96-75, GREEN8 96-80, GREEN8 96-100, GREENX 96-125, GREENX 96-150

auf das sich vorliegende Erklärung bezieht, den Richtlinien des Rats der Europäischen Union betreffend die Annäherung der Bestimmungen der Mitgliedsstaaten entspricht:

Im Hinblick auf die Richtlinie zur elektromagnetischen Verträglichkeit (EMV) 2014/30/EG des Europäischen Parlaments und Rats vom 26. Februar 2014 betreffend die Annäherung der Gesetzgebungen der Mitgliedsstaaten über die elektromagnetische Verträglichkeit und unter Aufhebung der Richtlinie 89/336/EWG ist die Konformität nachgewiesen, wenn nachstehende Normen beachtet sind:

- Elektromagnetische Verträglichkeit (EMV) - Teil 6-2: Fachgrundnormen - Störfestigkeit für Industriebereiche (EN IEC 61000-6-2:2019);
- Elektromagnetische Verträglichkeit (EMV) - Teil 6-4: Fachgrundnormen - Störaussendung für Industriebereiche (EN 61000-6-4:2007 + A1:2011);

Im Hinblick auf die Niederspannungsrichtlinie 2014/35/EG des Europäischen Parlaments und Rats vom 26. Februar 2014 betreffend die Annäherung der Gesetzgebungen der Mitgliedsstaaten für Elektrogeräte innerhalb bestimmter Spannungsgrenzen, ist die Konformität nachgewiesen, wenn nachstehende Normen beachtet werden.

- EN 60335-1:2012 + A11:2014 + A13:2017 *"Sicherheit elektrischer geräte für den hausgebrauch und ähnliche zwecke - Teil 1: Allgemeine anforderungen"*
- EN 62233:2008 *"Verfahren zur messung der elektromagnetischen felder von haushaltsgeräten und ähnlichen elektrogeräten im hinblick auf die sicherheit von personen"*

Crevalcore, den 16 – 06 - 2021

Sergio Poletti
Präsident

S.P.E. ELETTRONICA INDUSTRIALE di Poletti Sergio
Via di Mezzo Ponente n. 383/B
40014 CREVALCORE (Bologna)
Partita IVA
Codice Fiscale

Istruzioni importanti per la sicurezza. Conservare queste istruzioni. Il presente manuale contiene importanti istruzioni per la sicurezza dell'utente ed il funzionamento dell'apparecchio.

AVVERTENZE GENERALI

1) Prima di ogni utilizzo del caricabatteria è necessario leggere ed osservare attentamente le istruzioni fornite di seguito.
2) La mancata osservanza delle seguenti istruzioni e/o errori in fase di installazione od utilizzo del caricabatteria, può determinare pericoli per l'operatore e/o danni all'apparecchio invalidando la garanzia del fabbricante.
3) Il caricabatteria non può essere utilizzato come componente in dispositivi per il supporto di funzioni vitali e/o apparecchiature mediche.
4) Il caricabatteria non deve essere utilizzato da persone con ridotte capacità fisiche, sensoriali e mentali o con mancanza di esperienza e / o conoscenza, a meno che non siano adeguatamente sorvegliate e istruite da una persona responsabile della loro sicurezza.
5) I dati di targa devono essere visibili dopo l'installazione.

BAMBINI

6) Questo dispositivo può essere utilizzato da bambini di età superiore a 8 anni e da persone con ridotte capacità psico-fisico-sensoriali o con esperienza e/o conoscenza insufficienti, posto che siano attentamente sorvegliate o istruite sull'utilizzo in sicurezza del dispositivo e siano consapevoli dei possibili rischi.Il caricabatteria non è un giocattolo e non deve essere trattato come tale.
Le operazioni di pulizia e manutenzione non devono essere effettuate da bambini se non sorvegliati.

LUOGO DI INSTALLAZIONE

7) Evitare assolutamente di posizionare il caricabatteria nelle immediate vicinanze della batteria in modo da evitare che i gas prodotti e/o emessi dalla batteria stessa durante la ricarica

corrodano e/o danneggino il caricabatteria. Posizionare il caricabatteria il più lontano possibile dalla batteria per quanto consentito dalla lunghezza dei cavi.
8) Non installare il caricabatteria in un'area chiusa o tale da impedire in qualche modo la ventilazione. Per gli apparecchi dotati di ventole occorre lasciare uno spazio libero di almeno 30mm attorno alle prese d'aria.
9) Non utilizzare il caricabatteria in ambiente esterno.
10) Non esporre il caricabatteria a pioggia, getti d'acqua, fonti di vapore.
11) Non installare il caricabatteria su caravans e/o veicoli similari.
12) Non installare il caricabatteria vicino a fonti di calore o in locali densi di polveri.
13) Non installare il caricabatteria vicino a potenziali fonti di materiale infiammabile come ad esempio condotte di gas metano o depositi di carburanti (benzina, kerosene, ...).
14) Non posizionare e/o fissare il caricabatteria su piani di appoggio prodotti con materiali combustibili come mensole e/o pareti di legno.

BATTERIE

15) Seguire attentamente le specifiche istruzioni di sicurezza fornite dal produttore della batteria, ad esempio se rimuovere o meno i tappi degli elementi durante la carica e le modalità di carica consigliate.
16) E' pericoloso lavorare in prossimità di una batteria al piombo acido in quanto, durante il ciclo di ricarica, le batterie generano gas esplosivi. Occorre pertanto evitare di fumare e/o generare fiamme libere e/o scintille.
17) Non caricare una batteria congelata.
18) La ricarica delle batterie deve essere effettuata in locali dedicati e ben aerati e/o ventilati.
19) Al fine di ridurre i rischi di incidenti, caricare solo batterie al Piombo – Acido, GEL o AGM, Polimeri di Litio o Ioni di Litio. Non ricaricare altri tipi di batterie ricaricabili o non ricaricabili in quanto potrebbero esplodere causando danni ad oggetti e/o persone.

ULTERIORI SPECIFICHE PER BATTERIE LITIO

20) Per effettuare la ricarica di batterie in Polimeri di Litio o Ioni di Litio, deve essere sempre presente un BMS (Battery Management System) comprendente un sistema di sicurezza attiva e passiva, in conformità alle norme di sicurezza vigenti.

21) La possibilità, da parte del BMS, di agire direttamente sulle funzionalità del caricabatteria durante la fase di equilibratura delle cellule esclude ad ogni titolo il sussistere di una responsabilità diretta del caricabatteria nel caso in cui i danni causati alla batteria, o addirittura un incendio o un esplosione, siano dovuti ad un errore del software del BMS.

22) La possibilità offerta dai materiali prodotti dalla S.P.E. ELETTRONICA INDUSTRIALE di selezionare differenti livelli di tensione della carica, è affidata al controllo ed alla direzione dell'utilizzatore finale e la S.P.E. ELETTRONICA INDUSTRIALE non risponde in alcun caso delle conseguenze scaturenti dalla scelta di un livello di tensione errato. In caso di dubbio, l'utilizzatore dovrà chiedere chiarimenti ad un professionista qualificato.

23) Le soglie di tolleranza del caricabatteria, per quanto riguarda i livelli di sovratensione e di sovraccarico, sono unicamente funzionali alla salvaguardia dei sistemi dello stesso e non hanno alcuna funzione di sicurezza per la batteria in sé considerata, la sicurezza della quale dipende unicamente dal BMS anche quando il caricatore è connesso alla batteria, sia quest'ultima in fase di ricarica o meno.

24) Nel caso in cui il cliente voglia utilizzare il caricabatteria su un sistema imbarcato specifico, o in generale in tutti i casi di particolare utilizzo, spetta al cliente avvisare S.P.E. ELETTRONICA INDUSTRIALE, affinché quest'ultima possa formulare, all'occorrenza, delle raccomandazioni. In questo caso il cliente dovrà fornire a S.P.E. ELETTRONICA INDUSTRIALE ogni progetto, schema ed elemento descrittivo necessario. S.P.E. ELETTRONICA INDUSTRIALE non potrà essere ritenuta responsabile per qualsiasi danno scaturente dall'utilizzo del caricabatteria in seguito alla sua apertura e/o modifica e/o inclusione in altro sistema.

25) In nessun caso S.P.E. ELETTRONICA INDUSTRIALE potrà essere ritenuta responsabile del guasto delle batterie o dell'incendio/esplosione di queste ultime, in quanto la sicurezza delle batterie è funzione del BMS e non del caricabatteria.

CONTROLLO CAVI, RETE, PRESE DI TERRA

26) Non trasportare il caricabatteria prendendolo per i cavi in quanto potrebbero danneggiarsi. Utilizzare le maniglie predisposte qualora presenti.
27) Prima dell'utilizzo del caricabatteria occorre verificare il buono stato delle guaine di isolamento del cavo di collegamento alla rete di alimentazione e dei cavi batteria. Qualora uno dei cavi fosse danneggiato, farlo sostituire da un tecnico qualificato da S.P.E. ELETTRONICA INDUSTRIALE.
28) Verificare che la tensione di ingresso del caricabatteria indicata sui dati di targa soddisfi la tensione di alimentazione disponibile.
29) Verificare la compatibilità della spina di rete in dotazione al caricabatteria: è sconsigliato (in Canada proibito) l'utilizzo di adattatori. Se la spina non combacia con la presa di corrente, contattare SPE ELETTRONICA INDUSTRIALE per richiedere un cavo con spina appropriata alla presa.
30) Il caricabatteria deve essere collegato ad una presa di corrente dotata di conduttore di terra. Qualora la presa non fosse provvista di messa a terra, non utilizzare l'apparecchio prima di avere fatto installare una presa adatta da un tecnico qualificato.
31) La presa di corrente a cui si collega il caricabatteria deve essere protetta da un'apparecchiatura elettrica a norma di legge (fusibile e/o interruttore automatico) dimensionata per una corrente elettrica pari all'assorbimento di corrente dichiarato sulla matricola del caricabatteria maggiorata del 10%.
32) Non aprire il caricabatteria in quanto all'interno non vi sono componenti che possono essere riparati e/o sostituiti dall'utente. Solo personale specializzato ed autorizzato da S.P.E. ELETTRONICA INDUSTRIALE può eseguire interventi che richiedono l'apertura dell'apparecchio stesso. All'interno sono presenti componenti elettrici/elettronici che possono provocare

scariche elettriche anche se l'apparecchio non è collegato alla presa di corrente.

CONTROLLO FUNZIONI CARICABATTERIA e CURVA

33) Prima di effettuare una ricarica, assicurarsi che il caricabatteria soddisfi la tensione della batteria, che la corrente di carica sia appropriata alla capacità della batteria, e che la dinamica di ricarica selezionata (per batterie al piombo acido, o per batterie ermetiche al GEL o AGM, Polimeri di Litio o Ioni di Litio) sia corretta per il tipo di batteria da ricaricare.
34) Si raccomanda di interporre un fusibile tra caricabatteria e batteria. Il fusibile deve essere installato lungo il collegamento al polo positivo della batteria. Il valore del fusibile deve essere dimensionato in funzione della corrente nominale di uscita del caricabatteria, della sezione del cavo utilizzato e dell'ambiente ove viene installato.
35) Si raccomanda di scollegare l'alimentazione dalla rete elettrica prima di effettuare il collegamento o il distacco dalle batterie.
36) Durante il normale funzionamento del caricabatteria, la superficie esterna può surriscaldarsi e può rimanere tale per un certo periodo di tempo anche dopo lo spegnimento dello stesso.
37) Il caricabatteria non necessita di alcuna manutenzione particolare ma solo di normali operazioni di pulizia da effettuarsi periodicamente in base alla tipologia dell'ambiente di lavoro. Le operazioni di pulizia sono da effettuarsi solo nella superficie esterna del caricabatteria. Prima di iniziare le operazioni di pulizia, occorre scollegare il cavo di alimentazione dalla rete elettrica ed i cavi di collegamento alle batterie. Per eseguire la pulizia si raccomanda di NON utilizzare acqua e/o detergenti in generali e/o idropulitrici di alcun genere.

NON in USO

38) Qualora non fosse possibile garantire il funzionamento in sicurezza del caricabatteria, arrestare il dispositivo e assicurarsi che non venga messo nuovamente in funzione.

Modello batteria = Piombo – Acido, GEL, AGM, Litio
Numero di celle = 6 – 12 – 18 – 24 – 36 – 40 – 48

ATTENZIONE: Rischio di incendio. Caricare LEAD-Acid, Gel, AGM e batterie al litio. Per Litio: Usare solo pacchetti batteria che includono BMS e tutte le protezioni necessarie incluse nel pacco batteria.

PERICOLO: Rischio di shock elettrico. Non toccare le porzioni non isolate dei connettori di uscita o dei terminali di batteria.

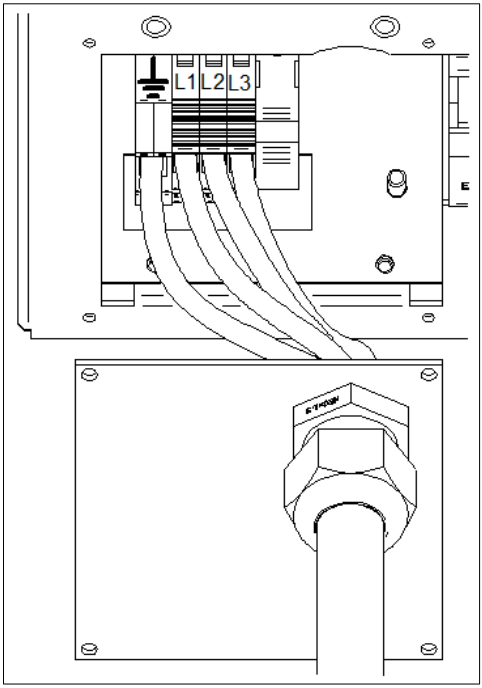
ATTENZIONE: Rischio di incendio. Usare solo circuiti forniti con _____ ampere. Protezione dei circuiti in accordo con il codice elettrico nazionale, NFPA 70".

Note: Le specifiche indicate in questo manuale sono soggette a modifiche senza preavviso. Questa pubblicazione sostituisce ogni informazione precedentemente fornita.

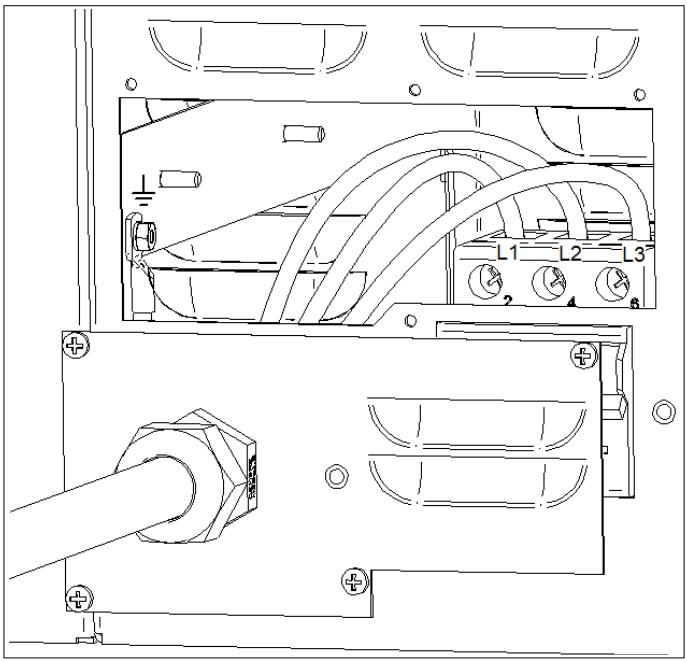
GREEN 6 - GREEN8 - GREENX
Caricabatteria ad Alta Frequenza

CONNESSIONE ALLA RETE

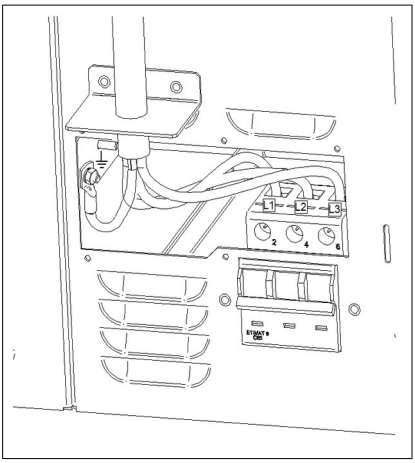
Il caricabatterie installato dovrà essere connesso ad una presa con potenza adeguata al caricabatterie, verificare i dati indicati sull'etichetta del numero di serie:

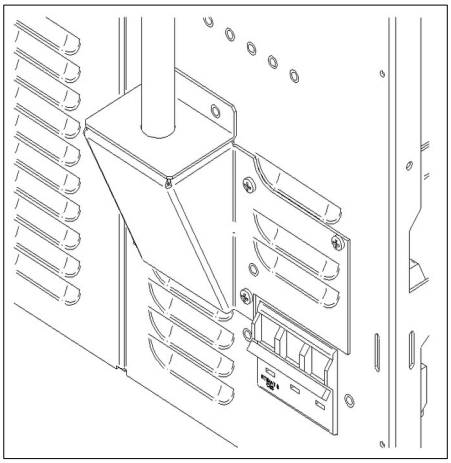


Connessione principale



Connessione alternativa





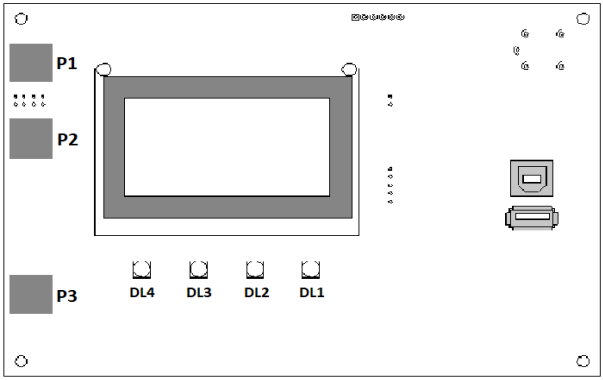
Collegamento dei cablaggi alla conduttura elettrica

CONNESSIONE ALLA BATTERIA

Raccomandiamo l'utilizzo degli appositi connettori bipolari a norma che non permettano lo scambio di polarità della batteria; assicurarsi anche che i cavi siano correttamente connessi ai contatti dei connettori.
Questa procedura dovrà essere eseguita esclusivamente da personale specializzato.

SEGNALI VISIVI

Il presente paragrafo descrive le visualizzazioni dei 4 LED di stato nel corso delle diverse fasi di funzionamento del caricabatterie.



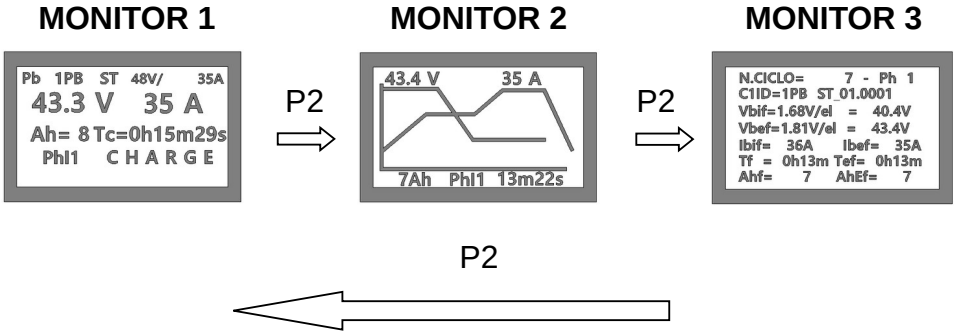
RIF	DESCRIZIONE	LED DL4 (verde)	LED DL3 (giallo)	LED DL2 (verde)	LED DL1 (rosso)	DISPLAY
S1	Solo alimentazione batteria	OFF	OFF	OFF	OFF	OFF
S2	Solo alimentazione da rete	OFF	OFF	OFF	OFF	ON
S3	Alimentazione sia batteria sia rete	ON	OFF	OFF	OFF	ON
S4	Eseguire Autostart	BL	BL	BL	BL	ON
F1	Fase 1 - Carica Iniziale CI	BL	OFF	OFF	OFF	ON
F2-F7	Fase 2 - Fase 7	BL	ON	OFF	OFF	ON
F8	Periodo di equalizzazione	ON	ON	ON	OFF	ON
EQU ON	Carica di Equalizzazione ON (in corso)	BL	BL	ON	OFF	ON
					OFF	ON
EQU OFF	Carica di Equalizzazione OFF (in pausa)	ON	ON	ON	OFF	ON

M	Manutenzione	BL	BL	ON	OFF	ON
FINE	Carica Terminata	ON	ON	ON	OFF	ON

Dove:
OFF = il LED è spento
ON = il LED è acceso con luce costante
BL = il LED lampeggia (intervallo, T=1 secondo)
- - = il LED è in qualunque condizione

DISPLAY LCD

Durante la carica, il caricabatterie offre 3 menu del monitor, tra cui potrete navigare premendo il bottone P2, il cui significato è stato precedentemente illustrato in dettaglio

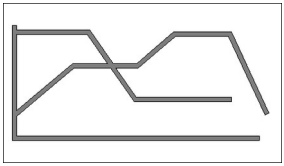


Di seguito il riassunto delle informazioni rispettivamente fornite nelle 3 visualizzazioni del monitor.

MONITOR 1

RIGA	ESEMPIO	DESCRIZIONE
(1)	Pb 1Pb ST 48V / 35A	Tecnologia della Batteria, Tipo di Curva, Rating Caricabatteria
(2)	43,3 V 35A	Voltaggio e tensione della batteria
(3)	Ah= 8 Tc= 0h 15m 29s	Amperaggio carica, Tempo Carica in ore, min, sec
(4)	PhI1 CHARGE	Fase di Carica in corso, STATO del caricabatteria
(5)	-- Messages	(es. fase = auto start A0, Stato= BATTERIA NON CONNESSA)

MONITOR 2

RIGA	ESEMPIO	DESCRIZIONE
(1)	43,3V 35A	Voltaggio e tensione della batteria fornita
(2)		Profilo carica batteria con indicazione • Fasi Complete (riga spessa) • Fase in corso (riga lampeggiante) • Fasi da eseguire (riga sottile)
(3)	7Ah PhI1 13m22s	Amperaggio carica, Tempo Carica in ore, min, sec
(4)	-- Messages	Eventuali messaggi di avaria o di stato

MONITOR 3

RIGA	ESEMPIO	DESCRIZIONE
(1)	N.CYCLE= 7 – Ph 1	Numero di cicli di carica e fase di carica in corso Es. : ciclo carica 5 e Fase 3
(2)	C1ID=1PB ST_01.0001	Identificatore univoco curva di carica
(3)	Vbif=1.68V/el = 40.4V	Voltaggio batteria all'inizio della fase (Vbif) espresso inizialmente come voltaggio elemento (V/el), quindi come voltaggio assoluto (V)
(4)	Vbef=1.81V/el = 43.4V	Voltaggio batteria al termine della fase (tensione) (Vbif) espresso inizialmente come voltaggio elemento (V/el), quindi come voltaggio assoluto (V)
(5)	Ibif= 36A Ibef= 35A	Tensione all'inizio della fase (Ibif) e tensione al termine della fase (Ibef)
(6)	Tf =0h13m Tef=0h13m	Tempo della singola fase (Ibif) e Tempo complessivo di carica al termine della fase (Ibef)
(7)	Ahf= 7 AhEf= 7	Ah forniti nella fase selezionata (Ahf) e Ah complessivi di carica (AhEf)
(8)	-- MessageS	Indica eventuali avarie durante il ciclo di ricarica

GARANZIA

- La macchina è garantita per 12 mesi dalla data di installazione.
- La garanzia copre difetti accertati di componenti o errori di assemblaggio.
- La garanzia NON coprirà nessun danno cagionato da utilizzo e/o installazione impropri.
- La garanzia decadrà nel caso in cui siano scoperte eventuali manomissioni.
- In caso di eventuali problemi, vi preghiamo di rivolgervi ad un RIVENDITORE AUTORIZZATO o, direttamente alla S.P.E. Elettronica Industriale.

S.P.E. ELETTRONICA INDUSTRIALE

DICHIARAZIONE DI CONFORMITA' CE

La sottoscritta

S.P.E. ELETTRONICA INDUSTRIALE di Poletti Sergio
Via di Mezzo Ponente, 383 – 40014 Crevalcore (Bologna) ITALIA

Dichiara sotto la propria esclusiva responsabilità che il prodotto:

CARICABATTERIA ELETTRONICO AUTOMATICO MODELLO:

GREEN6 24-50, GREEN6 24-60, GREEN6 24-70, GREEN6 24-80, GREEN6 24-100, GREEN6 24-120, GREEN6 24-150, GREEN8 24-160, GREEN8 24-180, GREEN8 24-200, GREENX 24-250, GREENX 24-300, GREEN6 36-80, GREEN6 36-100, GREEN6 36-120, GREEN6 36-150, GREEN6 36-180, GREEN8 36-200, GREENX 36-250, GREENX 36-300, GREEN6 48-25, GREEN6 48-30, GREEN6 48-40, GREEN6 48-50, GREEN6 48-60, GREEN6 48-70, GREEN6 48-80, GREEN6 48-90, GREEN6 48-100, GREEN6 48-120, GREEN6 48-130, GREEN6 48-150, GREEN8 48-160, GREEN8 48-180, GREEN8 48-200, GREENX 48-250, GREENX 48-300, GREEN6 72-30, GREEN6 72-40, GREEN6 72-50, GREEN6 72-60, GREEN6 72-80, GREEN6 72-100, GREEN8 72-130, GREEN6 80-30, GREEN6 80-40, GREEN6 80-50, GREEN6 80-60, GREEN6 80-80, GREEN6 80-100, GREEN8 80-110, GREEN8 80-120, GREEN8 80-130, GREENX 80-150, GREENX 80-160, GREENX 80-200, GREEN6 96-20, GREEN6 96-25, GREEN6 96-30, GREEN6 96-40, GREEN6 96-50, GREEN 96-60, GREEN6 96-65, GREEN6 96-70, GREEN6 96-75, GREEN8 96-80, GREEN8 96-100, GREENX 96-125, GREENX 96-150

cui si riferisce la presente dichiarazione, è conforme alle disposizioni di cui alle Direttive del Consiglio dell'Unione Europea concernenti il ravvicinamento delle normative degli stati membri:

Con riguardo alla Direttiva sulla Compatibilità Elettromagnetica (EMC) 2014/30/CE del Parlamento e del Consiglio Europei datata 26 Febbraio 2014 sul ravvicinamento delle legislazioni degli Stati Membri sulla compatibilità elettromagnetica e in abrogazione della Direttiva 89/336/CEE, la conformità è provata qualora i seguenti standard siano rispettati:

- EN IEC 61000-6-2: 2019 - *Parte 6-2: Norme generiche – Immunità per l'ambiente industriale*
- EN 61000-6-4: 2007 + A1:2011 - *Parte 6-4: Norme generiche – Emissioni per l'ambiente industriale (Immunità – Categoria II)*

Con riguardo alla Direttiva Bassa Tensione 2014/35/CE del Parlamento e del Consiglio Europei datata 26 Febbraio 2014 sul ravvicinamento delle legislazioni degli Stati Membri sugli apparati elettrici progettati per essere utilizzati entro determinati limiti di tensione, la conformità è provata qualora i seguenti standard siano rispettati:

- EN 60335-1:2012 + A11:2014 + A13:2017 *"Sicurezza degli apparecchi elettrici d'uso domestico e similare - Parte 1: Norme generali"*
- EN 62233: 2008 *"Metodi di misura per campi elettromagnetici degli apparecchi elettrici di uso domestico e similari con riferimento all'esposizione umana"*

Crevalcore 16 – 06 - 2021

Sergio Poletti
Presidente

S.P.E. ELETTRONICA INDUSTRIALE di Poletti Sergio
Via di Mezzo Ponente n. 383/B
40014 CREVALCORE (Bologna)
Partita IVA
Codice Fiscale

Instructions importantes pour la sécurité. Conserver ces instructions. Ce manuel contient des instructions importantes pour la sécurité de l'utilisateur et le fonctionnement de l'appareil.

PRÉCAUTIONS GÉNÉRALES

1) Avant chaque utilisation du chargeur, vous devez lire et suivre attentivement les instructions fournies ci-dessous.
2) L'inobservance des instructions suivantes et/ ou des erreurs en phase d'installation ou emploi du chargeur, peuvent causer des risques à l'opérateur et/ou des dommages à l'appareil rendant nulle la garantie du fabricant.
3) Le chargeur de batterie ne peut pas utilisé comme composant pour les dispositifs à l'appui des fonctions vitales et/ou d'appareils médicaux.
4) Les personnes avec des capacités réduites psychophysiques – sensorielles ou expérimentés et/ou avec des connaissances insuffisantes ne peuvent pas utiliser le chargeur de batterie, à moins qu'elles sont étroitement surveillées et mises en état pour leur sécurité.
5) Les données de la plaque signalétique doivent être visibles après l'installation.

ENFANTS

6) Les enfants ne peuvent pas utiliser le chargeur. Ce n'est pas un jouet et il ne doit pas être considéré comme tel.

LIEU INSTALLATION

7) Éviter absolument de positionner le chargeur près de la batterie pour éviter que les gaz produits et/ou émis par la batterie pendant le chargement corrodent et/ou endommagent le chargeur. Positionner le chargeur le plus loin possible de la batterie selon la mesure permise par la longueur des câbles.
8) Ne pas installer le chargeur dans une zone fermée ou qui puisse empêcher d'une quelconque manière la ventilation. Pour les appareils avec des hélices, il faut laisser un espace libre d'au moins

30 mm autour de l'aération. Afin de faciliter l'échange de chargeur, il faut l'installer en position verticale profitant des trous de fixation (où présents).
9) Ne pas utiliser le chargeur dans un environnement externe.
10) Ne pas exposer le chargeur de batterie à la pluie, aux jets d'eau, aux sources de vapeur.
11) Ne pas installer le chargeur de batteries sur les roulottes et/ou les véhicules similaires
12) Ne pas installer le chargeur près d'une source de chaleur ou dans des locaux denses de poussières.
13) Ne pas installer le chargeur près des sources potentielles de matériels inflammables, comme par exemple les pipelines de gaz naturel ou les dépôts de carburant (essence, kérosène,...).
14) Ne pas positionner et/ou fixer le chargeur sur les plans d'appui des produits combustibles tels que les étagères et/ou les murs en bois.

BATTERIES

15) Suivre soigneusement les instructions de sécurité fournies par le fabricant de la batterie, par exemple si enlever ou non les bouchons des éléments au cours de la charge et les modalités de chargement conseillés.
16) Il est dangereux de travailler près d'une batterie au plomb acide, parce que, au cours du cycle de la recharge, les batteries produisent des gaz explosifs. Par conséquent, éviter de fumer et/ou générer des flammes libres et/ou des étincelles.
17) Ne pas charger de batterie congelée.
18) La recharge des batteries doit être effectuée dans des locaux dédiés et bien aérés et/ou ventilés.
19) Afin de réduire les risques d'accidents, charger seulement les batteries au Plomb- Acide, GEL ou AGM, Polymères au lithium ou Ions au lithium. Ne pas recharger autres types de batteries rechargeables ou non rechargeables parce qu'elles pourraient exploser causant des dommages aux objets et/ou personnes.

DES AUTRES DÉTAILS POUR LES BATTERIES AU LITHIUM

20) Pour effectuer la recharge de batteries en polymères de lithium ou Ions de Lithium, un BMS (système de gestion de batterie) doit être toujours présent, y compris un système de sécurité active et passive, conformément aux normes de sécurité en vigueur.
21) La possibilité de la part de BMS, d'agir directement sur les fonctionnalités du chargeur pendant la phase d'équilibrage des cellules exclut à chaque titre l'existence d'une responsabilité directe du chargeur, si les dommages causés à la batterie, ou même un incendie ou une explosion, sont dus à une erreur du logiciel du BMS.
22) La possibilité offerte par les matériels produits par la « S.P.E. ELETTRONICA INDUSTRIALE » de sélectionner les différents niveaux de chargement de tension, est confiée au contrôle et à la direction de l'utilisateur final et de la « S.P.E. ELETTRONICA INDUSTRIALE » ne répond en aucun cas des conséquences qui dérivent du choix d'un niveau de tension erroné. En cas de doute, l'utilisateur devra demander des éclaircissements à un professionnel qualifié.
23) Les seuils de tolérance du chargeur, en ce qui concerne les niveaux de surtension et de
surcharge, sont uniquement fonctionnels à la sauvegarde de leurs systèmes et ils n'ont aucune fonction de sécurité pour la batterie considérée, sa sécurité qui dépend uniquement du BMS également lorsque le chargeur est connecté à la batterie et si cette dernière est en phase de recharge ou non.
24) Si le client souhaite utiliser le chargeur sur un système lancé spécifique et, généralement, dans tous les cas d'emploi particulier pour que cette dernière puisse formuler des recommandations. Dans ce cas, le client doit fournir à la S.P.E. ELETTRONICA INDUSTRIALE, chaque projet, schéma et élément descriptif requis. S.P.E. ELETTRONICA INDUSTRIALE ne sera pas responsable des dommages dérivant de l'emploi du chargeur à la suite de son ouverture et/ou modification et/ou inclusion dans un autre système.
25) En aucun cas la S.P.E. ELETTRONICA INDUSTRIALE ne pourra être tenue responsable du dommage des batteries ou de

l'incendie /explosion de ces dernières, parce que la sécurité des batteries est une fonction du BMS et non pas du chargeur.

CONTRÔLES DES CÂBLES, DES RÉSEAUX, DES PRISES DE TERRE

26) Ne pas transporter le chargeur en le prenant par les câbles parce qu'ils pourraient s'endommager. Utilisez les poignées prédisposées si présentes.
27) Avant d'utiliser le chargeur, il est nécessaire de vérifier le bon état des revêtements d'isolation du câble de connexion au réseau d'alimentation et des câbles batterie. Si un des câbles était endommagé, le remplacer par un technicien qualifié de la S.P.E. ELETTRONICA INDUSTRIALE.
28) Vérifier que la tension d'entrée du chargeur indiquée sur les données de plaque satisfait la tension d'alimentation disponible.
29) Vérifier la compatibilité de la prise de réseau en dotation au chargeur : on ne recommande pas (au Canada interdit) l'utilisation d'adaptateurs.
30) Le chargeur doit être connecté à une prise de courant équipée de conducteur de terre. Si la prise n'était pas complète de mise à terre, ne pas utiliser l'appareil avant d'installer une prise adapte par un technicien qualifié.
31) La prise de courant à laquelle se connecte le chargeur doit être protégée par un équipement électrique conformément à la loi (fusible ou disjoncteur) dimensionnée pour un courant électrique égal à l'absorption de courant déclaré sur la matricule du chargeur majorée du 10 %.
32) Ne pas ouvrir le chargeur parce qu'il n'y a pas à l'intérieur de composants qui peuvent être réparés ou remplacés par l'utilisateur. Seulement le personnel spécialisé et autorisé par la S.P.E. ELETTRONICA INDUSTRIALE peut effectuer des actions qui nécessitent l'ouverture de l'appareil.
Des composants électriques et électroniques sont présents à l'intérieur et ils peuvent causer des chocs électriques, même si l'appareil n'est pas branché à la prise de courant.

CONTRÔLE DES FONCTIONS CHARGEUR ET COURBE

33) Avant d'effectuer une recharge, s'assurer que le chargeur satisfait la tension de la batterie que la charge de courant soit approprié à la capacité de la batterie, et que la dynamique de recharge sélectionnée (pour les batteries au plomb acide, ou pour les batteries hermétiques au GEL ou AGM, Polymères de lithium ou Ions de lithium) est correcte pour le type de batterie qu'il faut recharger.

34) On recommande d'utiliser un fusible entre la batterie et le chargeur. Le fusible doit être installé le long de la liaison vers le pôle positif de la batterie. La valeur du fusible doit être dimensionnée selon le courant nominal de sortie du chargeur, de la section du câble utilisé et du milieu où il est installé.

35) On recommande de débrancher l'alimentation du réseau électrique avant d'effectuer la connexion ou le détachement des batteries.

36) Pendant le fonctionnement normal du chargeur, la surface externe peut se surchauffer et peut rester ainsi pendant un certain temps, même après son éteignement.

37) Le chargeur n'a besoin d'aucune manutention spéciale, mais seulement d'opérations normales de nettoyage qu'il fau effectuer périodiquement selon la nature de l'environnement de travail. Les opérations de nettoyage doivent être effectuées uniquement sur la surface externe du chargeur. Avant de commencer à nettoyer, débrancher le câble d'alimentation et les câbles aux batteries. Pour le nettoyage NE PAS utiliser l'eau et/ou les détergents en général ou le nettoyage d'aucune sorte.

INUTILISATION

38) Si le fonctionnement en sécurité du chargeur ne peut pas être garanti, arrêter la machine et s'assurer qu'il ne peut pas être remis en service.

Battery type LEAD-ACID, GEL, AGM, LITHIUM
Number of cells = 6 – 12 – 18 – 24 – 36 – 40 – 48

AVERTISSEMENT: Risque d'incendie. Chargez les batteries LEAD-Acid, Gel, AGM et Lithium. Pour le lithium: Utilisez uniquement des blocs-batteries comprenant du BMS et toutes les protections nécessaires incluses dans le bloc-batterie.

DANGER: Risque de choc électrique. Ne touchez pas la partie non isolée du connecteur de sortie ou la borne de batterie non isolée.

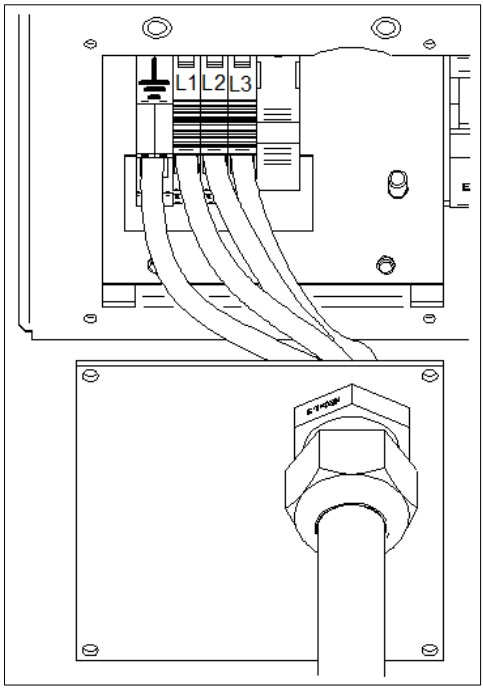
AVERTISSEMENT: Risque d'incendie. Utilisez uniquement des circuits fournis avec _____ ampères. Protection des circuits conformément au code électrique national, NFPA 70."

Notes: Les spécifications indiquées dans ce manuel sont soumises à changement sans préavis. Cette publication remplace toute information fournie précédemment.

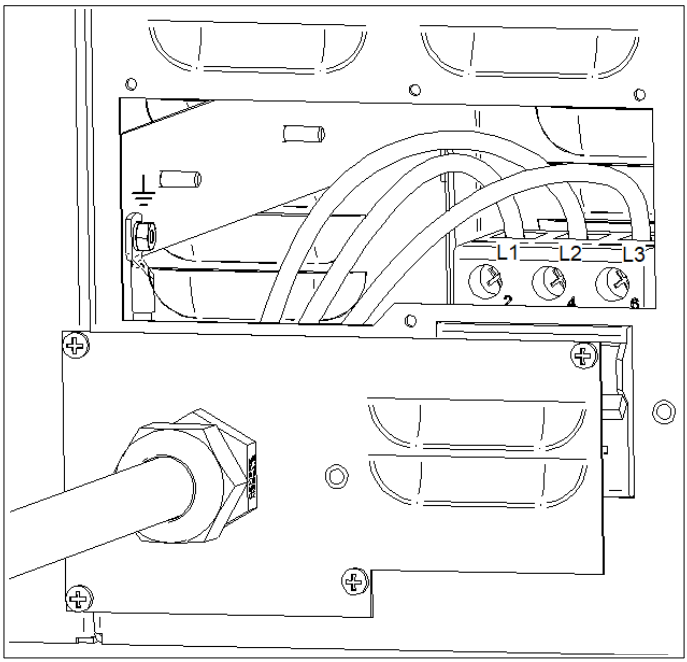
GREEN 6 - GREEN8 - GREENX
Chargeur de batterie à haute fréquence

CONNEXION AU SECTEUR

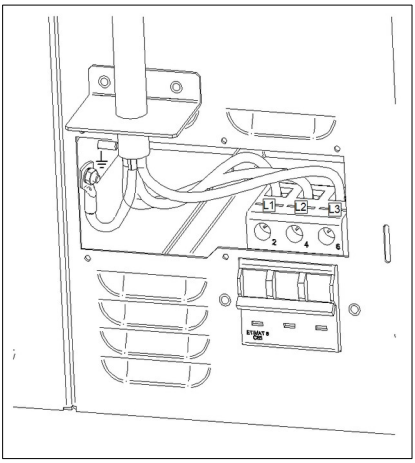
Le chargeur de batterie installé devra être connecté à une prise ayant une puissance adéquate au chargeur; à cet effet, vérifier les données indiquées sur l'étiquette du numéro de série:

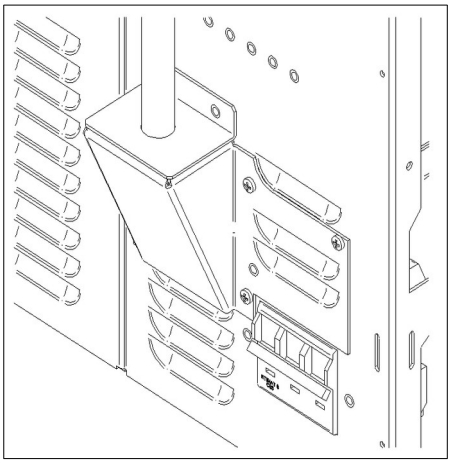


Connexion secteur standard



Connexion alternative au réseau





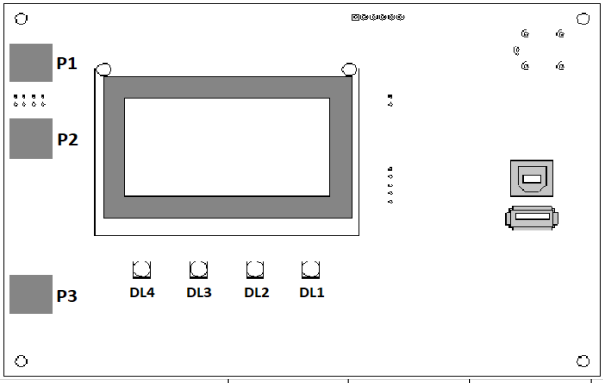
Connexion du câblage au conduit électrique.

CONNEXION À LA BATTERIE

Nous recommandons l'utilisation des connecteurs bipolaires spécifiques conformes aux normes ne permettant pas l'échange de polarité de la Batterie; s'assurer également que les câbles sont correctement branchés aux contacts des connecteurs.
Cette procédure doit être exécutée exclusivement par un personnel spécialisé.

SIGNALISATIONS VISUELLES

Ce paragraphe décrit les signalisations visuelles des 4 voyants lumineux (LEDs) d'état au cours des différentes phases de fonctionnement du chargeur.



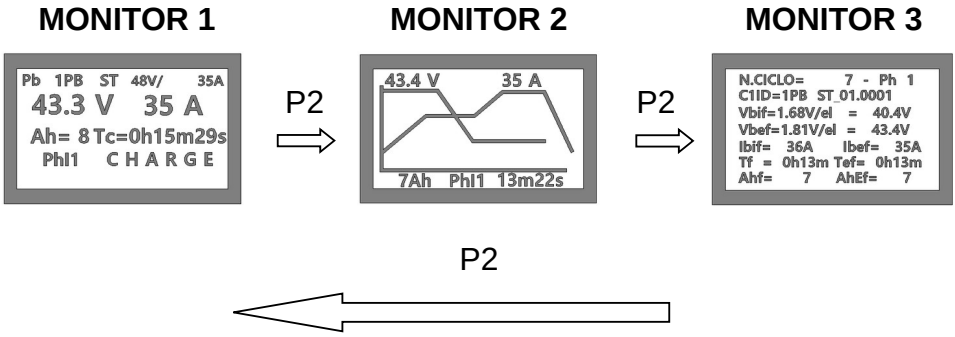
REF	DESCRIPTION	VOYANT DL4 (vert)	VOYANT DL3 (jaune)	VOYANT DL2 (vert)	VOYANT DL1 (rouge)	ÉCRAN
S1	Uniquement alimentation batterie	OFF	OFF	OFF	OFF	OFF
S2	Uniquement alimentation secteur	OFF	OFF	OFF	OFF	ON
S3	Alimentation batterie et secteur	ON	OFF	OFF	OFF	ON
S4	Exécuter Autostart	BL	BL	BL	BL	ON
F1	Phase 1 - Charge initiale CI	BL	OFF	OFF	OFF	ON
F2-F7	Phase 2 - Phase 7	BL	ON	OFF	OFF	ON
F8	Période d'égalisation	ON	ON	ON	OFF	ON
EQU ON	Charge d'égalisation ON (en cours)	BL	BL	ON	OFF	ON
					OFF	ON
EQU OFF	Charge d'égalisation OFF (en pause)	ON	ON	ON	OFF	ON
M	Entretien	BL	BL	ON	OFF	ON

FINE	Charge terminée	ON	ON	ON	OFF	ON

Où:
OFF = le voyant lumineux est éteint
ON = le voyant lumineux est allumé avec lumière constante
BL = le voyant lumineux clignote (intervalle, T=1 seconde)
- - = le voyant lumineux peut être dans n'importe quelle condition

ÉCRAN ACL

Pendant la charge, le chargeur offre 3 menus d'écran, parmi lesquels vous pourrez naviguer en appuyant sur le bouton P2, dont la signification a été précédemment illustrée en détail.



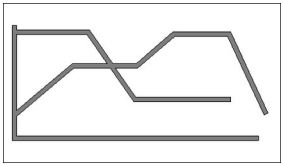
Un résumé est fourni ci-après des informations respectivement fournies dans les 3 visualisations de l'écran.

MONITOR 1

LIGNE	EXEMPLE	DESCRIPTION
(1)	Pb 1Pb ST 48V / 35A	Technologie de la batterie, type de courbe, valeurs du chargeur de batterie
(2)	43,3 V 35A	Voltage et tension de la batterie
(3)	Ah= 8 Tc= 0h 15m 29s	Ampérage charge, durée de charge en heures, minutes, secondes
(4)	PhI1 CHARGE	Phase de charge en cours, ÉTAT du chargeur de batterie
(5)	-- Messages	(par ex. phase = autostart A0, État= BATTERIE NON CONNECTÉE)

MONITOR 2

LIGNE	EXEMPLE	DESCRIPTION

(1)	43,3V 35A	Voltage et tension de la batterie fournie
(2)		Profil chargeur de batterie avec indication • Phases complètes (ligne épaisse) • Phase en cours (ligne clignotante) • Phases à exécuter (fine ligne)
(3)	7Ah PhI1 13m22s	Ampérage charge, durée de charge en heures, minutes, secondes
(4)	-- Message	Éventuels messages d'anomalie ou d'état

MONITOR 3

LIGNE	EXEMPLE	DESCRIPTION
(1)	N.CYCLE= 7 – Ph 1	Nombre de cycles de charge et phase de charge en cours. Par ex. : cycle charge 5 et phase 3
(2)	C1ID=1PB ST_01.0001	Identificateur univoque courbe de charge
(3)	Vbif=1.68V/el = 40.4V	Voltage batterie au début de la phase (Vbif) exprimé initialement comme voltage élément (V/el), puis comme voltage absolu (V)
(4)	Vbef=1.81V/el = 43.4V	Voltage batterie à la fin de la phase (tension) (Vbif) exprimé initialement comme voltage élément (V/el), puis comme voltage absolu (V)
(5)	Ibif= 36A Ibef= 35A	Tension au début de la phase (Ibif) et tension à la fin de la phase (Ibef)
(6)	Tf =0h13m Tef=0h13m	Durée de la phase individuelle (Ibif) et Durée globale de charge à la fin de la phase (Ibef)
(7)	Ahf= 7 AhEf= 7	Ah fournis dans la phase sélectionnée (Ahf) et Ah globaux de charge (AhEf)
(8)	-- Message	Indique les anomalies éventuelles pendant le cycle de charge

GARANTIE

- La machine est garantie pendant une période de 12 mois à compter de la date d'installation.
- La garantie couvre tous vices constatés de construction ou de montage.
- La garantie NE COUVRE AUCUN dommage provoqué par une utilisation et/ou installation incorrecte.
- La garantie est invalidée si des manipulations sont constatées.
- Pour tous problèmes, nous vous prions de vous adresser à un DÉTAILLANT AGRÉÉ ou, directement à la société S.P.E. ELETTRONICA INDUSTRIALE

DÉCLARATION DE CONFORMITÉ CE

La soussignée

S.P.E. ELETTRONICA INDUSTRIALE di Poletti Sergio
Via di Mezzo Ponente, 383 – 40014 Crevalcore (Bologne) ITALIE

Déclare sous sa propre et exclusive responsabilité que le produit:

CHARGEUR DE BATTERIE ÉLECTRONIQUE AUTOMATIQUE MODÈLE:

GREEN6 24-50, GREEN6 24-60, GREEN6 24-70, GREEN6 24-80, GREEN6 24-100, GREEN6 24-120, GREEN6 24-150, GREEN8 24-160, GREEN8 24-180, GREEN8 24-200, GREENX 24-250, GREENX 24-300, GREEN6 36-80, GREEN6 36-100, GREEN6 36-120, GREEN6 36-150, GREEN6 36-180, GREEN8 36-200, GREENX 36-250, GREENX 36-300, GREEN6 48-25, GREEN6 48-30, GREEN6 48-40, GREEN6 48-50, GREEN6 48-60, GREEN6 48-70, GREEN6 48-80, GREEN6 48-90, GREEN6 48-100, GREEN6 48-120, GREEN6 48-130, GREEN6 48-150, GREEN8 48-160, GREEN8 48-180, GREEN8 48-200, GREENX 48-250, GREENX 48-300, GREEN6 72-30, GREEN6 72-40, GREEN6 72-50, GREEN6 72-60, GREEN6 72-80, GREEN6 72-100, GREEN8 72-130, GREEN6 80-30, GREEN6 80-40, GREEN6 80-50, GREEN6 80-60, GREEN6 80-80, GREEN6 80-100, GREEN8 80-110, GREEN8 80-120, GREEN8 80-130, GREENX 80-150, GREENX 80-160, GREENX 80-200, GREEN6 96-20, GREEN6 96-25, GREEN6 96-30, GREEN6 96-40, GREEN6 96-50, GREEN 96-60, GREEN6 96-65, GREEN6 96-70, GREEN6 96-75, GREEN8 96-80, GREEN8 96-100, GREENX 96-125, GREENX 96-150

auquel cette déclaration se rapporte, est conforme aux dispositions des Directives du Conseil de l'Union Européenne concernant le rapprochement des législations des États membres:

En matière de compatibilité électromagnétique (EMC), Directive 2014/30/CE du Parlement et du Conseil Européens du 26 Février 2014 concernant le rapprochement des législations des États membres en matière de compatibilité électromagnétique abrogeant la directive 89/336/CEE, la conformité est démontrée par le respect des normes suivantes:

- EN IEC 61000-6-2: 2019 - *Partie 6-2: Normes génériques - Norme d'immunité pour les environnements industriels (émission)*
- EN 61000-6-4: 2007 + A1:2011 - *Partie 6-4: Normes génériques – Norme d'émission pour les environnements industriels (Immunité – Catégorie II)*

En matière de Basse Tension, Directive 2014/35/CE du Parlement et du Conseil Européens du 26 Février 2014 concernant le rapprochement des législations des États membres sur les appareils électriques destinés à être utilisés dans certaines limites de tension, la conformité est démontrée par le respect des normes suivantes :

- EN 60335-1:2012 + A11:2014 + A13:2017 - *"Sécurité des appareils électriques d'usage domestique et similaire - Partie 1: Normes générales"*
- EN 62233:2008 - *"Méthodes de mesure pour champs électromagnétiques des appareils électriques d'usage domestique et similaires en relation avec l'exposition humaine"*

Crevalcore 16 – 06 - 2021

Sergio Poletti
President

S.P.E. ELETTRONICA INDUSTRIALE di Poletti Sergio
Via di Mezzo Ponente, 383/B
40014 CREVALCORE (Bologna)
Partita IVA
Codice Fisc.

Importantes instrucciones de seguridad. Conservar estas instrucciones. El presente manual contiene importantes instrucciones para la seguridad del usuario y el funcionamiento del aparato.

ADVERTENCIAS GENERALES

1) Antes de cada utilización del cargador es necesario leer y seguir atentamente las siguientes instrucciones.
2) El incumplimiento de las siguientes instrucciones y/o errores en la fase de instalación o utilización del cargador pueden poner en peligro al operador y/o dañar el aparato anulando la garantía del fabricante.
3) El cargador no puede utilizarse como parte de los dispositivos de soporte de las funciones vitales y/o aparatos médicos
4) El uso del cargador no está permitido a personas con discapacidades mentales, físicas o sensoriales o con experiencia y/o conocimientos insuficientes, a menos que estén bajo vigilancia y reciban instrucciones de una persona responsable de su incolumnidad.
5) Los datos de la placa de identificación deben estar visibles después de la instalación.

NIÑOS

6) No está permitido que los niños utilicen del cargador. No se trata de un juguete y por lo tanto no debe ser utilizado para jugar.

LUGAR DE INSTALACIÓN

7) Evitar la colocación del cargador cerca de la batería para evitar que los gases producidos y/o emitidos por la misma durante la recarga corroan y/o dañen el cargador. Colocar el cargador lo más lejos posible de la batería, todo lo que la longitud de los cables permita.
8) No instalar el cargador en un área cerrada o con poca ventilación. Para los aparatos con ventilador en dotación es necesario dejar un espacio libre de al menos 30 mm alrededor de las tomas de aire. Para facilitar el intercambio térmico del cargador

es necesario instalarlo en posición vertical utilizando los orificios de fijación (si los hay).
9) No utilizar el cargador en ambientes exteriores.
10) No exponer el cargador a la lluvia, chorros de agua o fuentes de vapor.
11) No instalar el cargador de baterías en furgonetas o vehículos similares.
12) No instalar el cargador cerca de fuentes de calor o en sitios llenos de polvo.
13) No instalar el cargador cerca de materiales potencialmente inflamables como por ejemplo tuberías de gas metano o depósitos de carburantes (gasolina, queroseno...).
14) No colocar y/o fijar el cargador sobre superficies de apoyo realizadas con materiales combustibles como repisas y/o paredes de madera.

BATERÍAS

15) Seguir atentamente las instrucciones de seguridad específicas que proporciona el productor de la batería, por ejemplo, para saber las modalidades de carga recomendadas y si es mejor quitar o dejar las tapas de los componentes durante la recarga.
16) Es peligroso trabajar cerca de una batería con plomo ácido ya que durante el ciclo de carga estas baterías producen gases explosivos. Por lo tanto, es indispensable no fumar y/o generar llamas abiertas y/o chispas.
17) No recargar una batería congelada.
18) La recarga de baterías debe llevarse a cabo en lugares específicos para ello, bien aireados y/o ventilados.
19) Con el fin de reducir los riesgos de accidentes, recargar solamente baterías de Plomo –Ácido, GEL o AGM, Polímeros de litio o Iones de litio. No recargar otros tipo de baterías recargables o no recargables ya que podrían explotar causando daños a personas y/u objetos.

ESPECIFICACIONES PARA BATERÍAS DE LITIO

20) Para efectuar la recarga de baterías con Polímeros de litio o Iones de litio, siempre debe estar presente una BMS (Battery Management System) con un sistema de seguridad activo y pasivo, de conformidad con las normas de seguridad vigentes.
21) La posibilidad de que una BMS actúe directamente sobre la funcionalidad del cargador de baterías durante la fase de equilibrado de las celdas, excluye completamente cualquier responsabilidad directa del cargador, en caso de que los daños causados a la batería o incluso un incendio o explosión sean ocasionados por un error del software del BMS.
22) La posibilidad que ofrecen los materiales producidos por S.P.E. ELETTRONICA INDUSTRIALE de seleccionar diferentes niveles de tensión de la carga, es responsabilidad del usuario final y S.P.E. ELETTRONICA INDUSTRIALE no responderá en ningún caso por las consecuencias que deriven de la elección equivocada de un nivel de tensión. Si surgen dudas, el usuario tendrá que pedir aclaraciones a un profesional cualificado.
23)Los márgenes de tolerancia de los niveles de sobretensión y sobrecarga del cargador son funcionales únicamente para la salvaguardia de los sistemas del mismo y no tienen ninguna función de seguridad para la batería, cuya seguridad depende únicamente del BMS, aún cuando el cargador esté conectado a la batería, ya sea que ésta se encuentre en fase de carga o no.
24) En caso que el cliente quiera utilizar el cargador en un sistema embarcado específico y en general en cualquier caso de uso especial, le corresponde al cliente avisar a S.P.E. ELETTRONICA INDUSTRIALE, para que ésta pueda formular, si es necesario, algunas recomendaciones. En este caso, el cliente tendrá que proporcionar a S.P.E. ELETTRONICA INDUSTRIALE los proyectos, esquemas y elementos descriptivos necesarios. No se podrá considerar responsable a S.P.E. ELETTRONICA INDUSTRIALE por daños derivados de la utilización del cargador después de haber sido abierto y/o modificado e/o instalado en otro sistema.
25) S.P.E. ELETTRONICA INDUSTRIALE declina cualquier responsabilidad en caso de fallo de las baterías o

incendio/explosión de éstas, ya que la seguridad de las baterías depende del BMS y no del cargador.

REVISIÓN DE CABLES, RED, Y TOMAS DE TIERRA

26) No transportar el cargador tomándolo por los cables ya que pueden dañarse. Utilizar las empuñaduras predispuestas (si las hay).

27) Antes de utilizar el cargador es necesario verificar que los recubrimientos aislantes del cable de conexión a la red de alimentación y los cables de la batería se encuentren en buen estado. Si uno de los cables se encuentra dañado, debe ser sustituido por un técnico cualificado de S.P.E. ELETTRONICA INDUSTRIALE.

28) Verificar que la tensión de entrada del cargador, indicada en la chapa de características sea adecuada para la tensión de alimentación disponible.

29) Verificar la compatibilidad de la clavija de red proporcionado con el cargador. No se recomienda (en Canadá está prohibido) la utilización de adaptadores.

30) El cargador debe conectarse a una toma de corriente con conductor de tierra. En caso que la clavija no esté provista de puesta a tierra, no utilizar el aparato antes de que un técnico cualificado haya instalado una clavija adapta.

31) La toma de corriente en la cual será conectado el cargador debe estar protegida por un aparato eléctrico conforme a la ley (fusible e/o interruptor automático) para una corriente eléctrica igual a la absorción de corriente declarada en la matrícula del cargador aumentada un 10%.

32) No abrir el cargador ya que en su interior no hay componentes que puedan ser reparados y/o sustituidos por el usuario. Sólo personal especializado y autorizado por S.P.E. ELETTRONICA INDUSTRIALE puede llevar a cabo intervenciones que requieran abrir el aparato.

Al interno hay componentes eléctricos/electrónicos que pueden provocar descargas eléctricas aunque el aparato no esté conectado a la toma de corriente.

REVISIÓN FUNCIONES DEL CARGADOR Y CURVA

33) Antes de efectuar una recarga, es preciso asegurarse que el cargador proporcione la tensión correcta para la batería, que la corriente sea apropiada a la capacidad de la batería y que el tipo de recarga seleccionado (para baterías de plomo ácido, o para baterías herméticas de GEL o AGM, Polímeros de litio o Iones de litio) sea correcto para el tipo de batería que se va recargar.
34) Es aconsejable intercalar un fusible entre el cargador y la batería. El fusible debe instalarse a lo largo de la conexión en el polo positivo de la batería. El valor del fusible debe ajustarse según la corriente nominal de salida del cargador, la sección del cable utilizado y el sitio donde se va a instalar.
35) Es aconsejable desconectar la alimentación de la red eléctrica antes de efectuar la conexión o desconexión de las baterías.
36) Durante el funcionamiento normal del cargador, la superficie externa se puede sobrecalentar y permanecer caliente por un lapso de tiempo aún después de que el cargador ha sido apagado.
37) El cargador no necesita ningún tipo de mantenimiento especial, sólo operaciones de limpieza que se realizarán periódicamente de acuerdo al tipo de ambiente de trabajo. Las operaciones de limpieza deberán realizarse únicamente en la superficie externa del cargador. Antes de iniciar las operaciones de limpieza, es necesario desconectar de la red eléctrica el cable de alimentación y los cables de conexión con las baterías. Para efectuar la limpieza se recomienda NO utilizar agua y/o detergentes en general y/o máquinas hidrolimpiadoras de ningún tipo.

NO UTILIZACIÓN

38) Si el funcionamiento seguro del cargador no està garantizado, detener el aparato y asegurarse de que no se pueda volver a poner en marcha.

Tipo de batería ÁCIDO DE PLOMO, GEL, AGM, LITIO
Número de celdas = 6 – 12 – 18 – 24 – 36 – 40 – 48

ADVERTENCIA: Riesgo de incendio. Cargue baterías de Plomo LEAD-Acid, Gel, AGM y Litio. Para Litio: Use solo paquetes de baterías que incluyan BMS y todas las protecciones necesarias incluidas en el paquete de baterías.

PELIGRO: Riesgo de descarga eléctrica. No toque la parte sin aislamiento del conector de salida o del terminal de la batería.

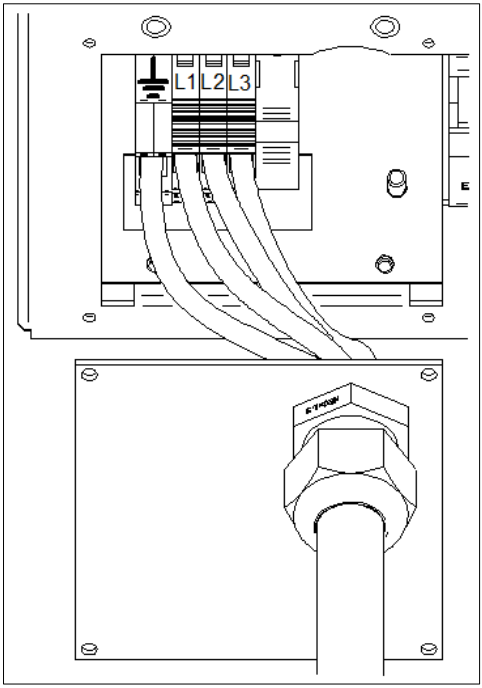
ADVERTENCIA: Riesgo de incendio. Use solo circuitos suministrados con _____ amperios. Protección del circuito de acuerdo con el código eléctrico nacional, NFPA 70."

Notas: Las especificaciones establecidas en este manual están sujetas a cambios sin previo aviso. Esta publicación reemplaza cualquier información suministrada previamente.

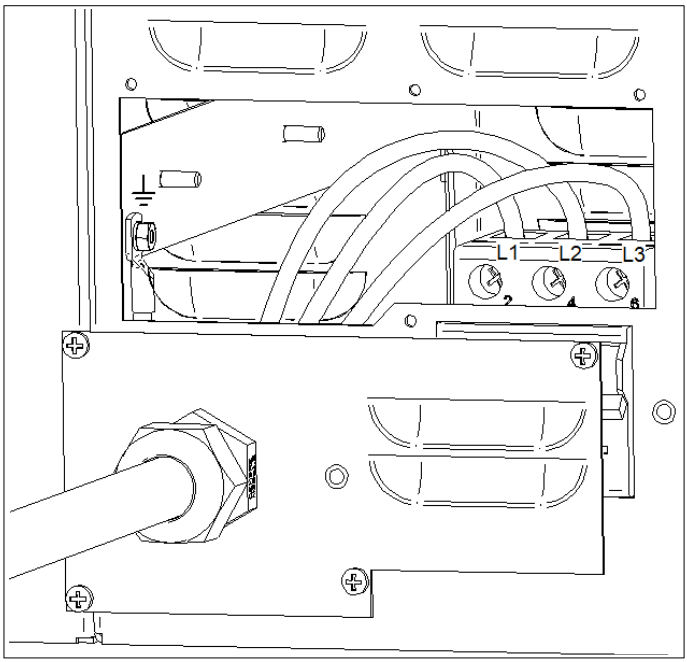
GREEN 6 - GREEN8 - GREENX
Cargadores de Batería de Alta Frecuencia

CONEXIÓN A LA RED ELÉCTRICA

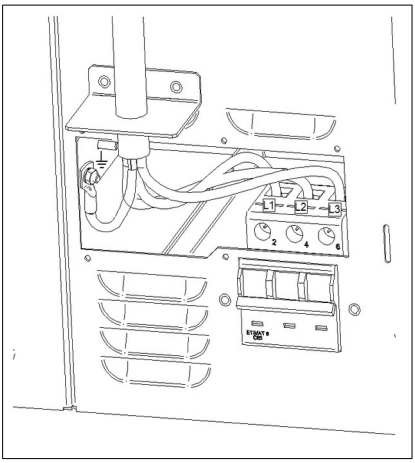
Una vez instalado el cargador de baterías deberá conectarse a un enchufe que proporcione la energía que requiere el cargador, verificar los datos de la etiqueta del numero de serie.

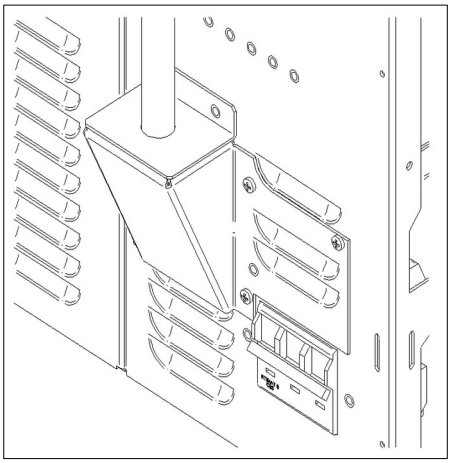


Conexión a la red alternativa



Conexión a la red estándard





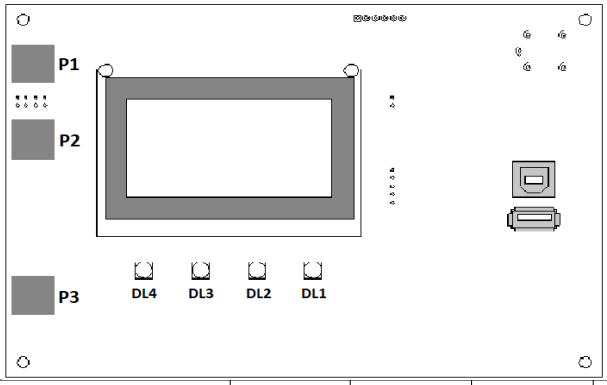
Conexión del cableado al conducto eléctrico

CONEXIÓN A LA BATERÍA

Se recomienda utilizar conectores bipolares apropiados y conformes, que previenen la inversión de polaridad en la batería. Cerciorarse de que también los cables estén conectados correctamente a los contactos de los conectores. Únicamente personal especializado puede llevar a cabo esta operación.

SEÑALES VISUALES

Este párrafo describe los mensajes que aparecen en los 4 Leds durante las diferentes fases de operación del cargador.



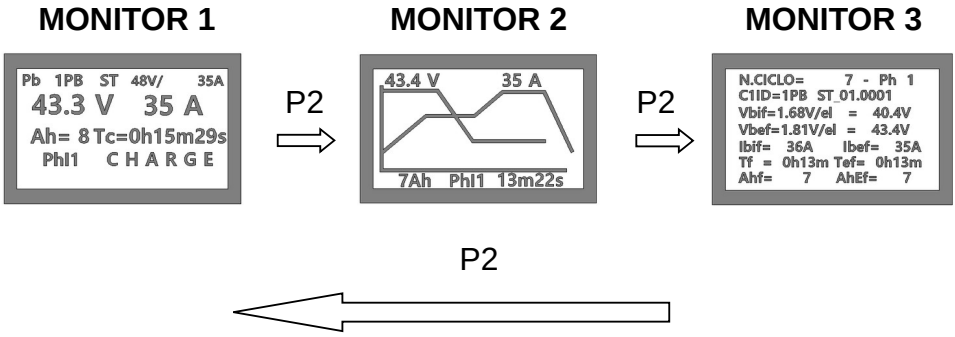
RÉF	DESCRIPCIÓN	LED DL4 (verde)	LED DL3 (amarillo)	LED DL2 (verde)	LED DL1 (rojo)	PANTALLA
S1	Solo suministro de energía de la batería	OFF	OFF	OFF	OFF	OFF
S2	Solo suministro de red eléctrica	OFF	OFF	OFF	OFF	ON
S3	Suministro de red y de energía de la batería	ON	OFF	OFF	OFF	ON
S4	Realizar Autostart	BL	BL	BL	BL	ON
F1	Fase 1 – Carga Inicial CI	BL	OFF	OFF	OFF	ON
F2-F7	Fase 2 – Fase 7	BL	ON	OFF	OFF	ON
F8	Periodo de Ecualización	ON	ON	ON	OFF	ON
EQU ON	Ecualización de carga ON (en curso)	BL	BL	ON	OFF	ON
					OFF	ON
EQU OFF	Ecualización de carga OFF (pausa)	ON	ON	ON	OFF	ON
M	Mantenimiento	BL	BL	ON	OFF	ON
FINE	Carga Terminada	ON	ON	ON	OFF	ON

Significa que :

OFF = el led está apagado
ON = el led está encendido con luz constante
BL = el led está parpadeando (intervalo, T=1 segundo)
- - = el led está en cualquier condición

PANTALLA LCD

Durante la carga, el cargador muestra 3 menús en los monitores, entre los cuales el usuario puede moverse presionando el botón P2; el significado de éstos ha sido previamente ilustrado.

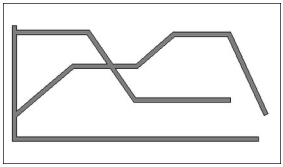


MONITOR 1

LÍNEA	EJEMPLO	DESCRIPCIÓN
(1)	Pb 1Pb ST 48V / 35A	Tecnología de la Batería, Tipo de Curva, Valores Cargador de Baterías
(2)	43,3 V 35A	Voltaje y tensión de la Batería
(3)	Ah= 8 Tc= 0h 15m 29s	Amperaje cargado, Tiempo de carga en horas, minutos, segundos
(4)	PhI1 CHARGE	Fase actual de carga, STATUS del cargador
(5)	-- Messages	(ej. fase = auto start A0, Status= BATERIA NO CONECTADA)

MONITOR 2

LÍNEA	EJEMPLO	DESCRIPCIÓN
(1)	43,3V 35A	Voltaje Batería y Corriente suministradas

(2)		Perfil de carga activa con indicación : • Fases completas (línea gruesa) • Fase en curso (línea parpadeante) • Fases a ejecutar (línea delgada)
(3)	7Ah PhI1 13m22s	Amperaje cargado, tiempo de carga en horas, minutos, segundos
(4)	-- Message	Posible mensaje o status de fallo

MONITOR 3

LÍNEA	EJEMPLO	DESCRIPCIÓN
(1)	N.CYCLE= 7 – Ph 1	Número de ciclo de carga y fase de carga actual Ej. : ciclo de carga 5 y fase 3
(2)	C1ID=1PB ST_01.0001	Identificador unívoco de curva de carga
(3)	Vbif=1.68V/el = 40.4V	Voltaje de la batería al inicio de la fase (Vbif) primero como voltaje del elemento (V/el), luego como voltaje absoluto (V)
(4)	Vbef=1.81V/el = 43.4V	Voltaje de la batería al final de la fase (corriente) (Vbef) primero como voltaje del elemento (V/el), luego como voltaje absoluto (V)
(5)	Ibif= 36A Ibef= 35A	Tensión al inicio de la fase (Ibif) y la tension al final de la fase (Ibef)
(6)	Tf =0h13m Tef=0h13m	Tiempo de fase única (Tf) y tiempo de carga total al final de la fase (Tef)
(7)	Ahf= 7 AhEf= 7	Ah suministrado en la fase seleccionada (Ahf) y carga total Ah (AhEf)
(8)	-- Message	Indica cualquier fallo que pueda ocurrir durante el ciclo de carga

GARANTÍA

- El equipo tiene garantía de 12 meses a partir de la fecha de instalación.
- La garantía cubre las partes defectuosas generadas durante la fabricación o montaje.
- La garantía NO cubre daños ocasionados por uso y/o instalación incorrectos.
- La garantía queda anulada si se descubre que el equipo ha sido manipulado.
- Para cualquier problema, contacte con un DISTRIBUIDOR AUTORIZADO o directamente con S.P.E. Elettronica Industriale.

DECLARATION OF CONFORMITY

We

S.P.E. ELETTRONICA INDUSTRIALE de Poletti Sergio
Via di Mezzo Ponente, 383 – 40014 Crevalcore (Bolonia) ITALIA

Declara bajo su responsabilidad que el producto:

MODELO CARGADOR DE BATERÍAS AUTOMÁTICO ELECTRÓNICO:

GREEN6 24-50, GREEN6 24-60, GREEN6 24-70, GREEN6 24-80, GREEN6 24-100, GREEN6 24-120, GREEN6 24-150, GREEN8 24-160, GREEN8 24-180, GREEN8 24-200, GREENX 24-250, GREENX 24-300, GREEN6 36-80, GREEN6 36-100, GREEN6 36-120, GREEN6 36-150, GREEN6 36-180, GREEN8 36-200, GREENX 36-250, GREENX 36-300, GREEN6 48-25, GREEN6 48-30, GREEN6 48-40, GREEN6 48-50, GREEN6 48-60, GREEN6 48-70, GREEN6 48-80, GREEN6 48-90, GREEN6 48-100, GREEN6 48-120, GREEN6 48-130, GREEN6 48-150, GREEN8 48-160, GREEN8 48-180, GREEN8 48-200, GREENX 48-250, GREENX 48-300, GREEN6 72-30, GREEN6 72-40, GREEN6 72-50, GREEN6 72-60, GREEN6 72-80, GREEN6 72-100, GREEN8 72-130, GREEN6 80-30, GREEN6 80-40, GREEN6 80-50, GREEN6 80-60, GREEN6 80-80, GREEN6 80-100, GREEN8 80-110, GREEN8 80-120, GREEN8 80-130, GREENX 80-150, GREENX 80-160, GREENX 80-200, GREEN6 96-20, GREEN6 96-25, GREEN6 96-30, GREEN6 96-40, GREEN6 96-50, GREEN 96-60, GREEN6 96-65, GREEN6 96-70, GREEN6 96-75, GREEN8 96-80, GREEN8 96-100, GREENX 96-125, GREENX 96-150

Al que se refiere la presente declaración, cumple con las disposiciones de las Directivas del Consejo de la Unión Europa con respecto a la aproximación de las legislaciones de los estados miembros:

Relativas a la Compatibilidad Electromagnética (EMC) Directiva 2014/30/EC del Parlamento Europeo y del consejo del 26 de Febrero de 2014 sobre a la aproximación de las legislaciones de los estados miembros con respecto a la compatibilidad electromagnética y que deroga la directiva 89/336/EEC, la conformidad queda demostrada en el cumplimiento de los siguientes estándares:

- EN IEC 61000-6-2:2019 - *Parte 6-2: Normas genéricas – Norma de inmunidad para entornos industriales (Emisión)*
- EN 61000-6-4:2007 + A1:2011 - *Parte 6-4: Normas genéricas – Norma de emisión para entornos industriales (Inmunidad – Categoría II)*

Relativas a la tensión extra-baja (por sus siglas en inglés: LVD) Directiva 2014/35/EC del Parlamento Europeo y el consejo del 26 de Febrero de 2014 que concierne a la armonización de las legislaciones de los estados miembros relativas al equipo eléctrico destinado a utilizarse bajo ciertos limites de tensión, la conformidad queda demostrada en el cumplimiento de los siguientes estándares:

- EN 60335-1:2012 + A11:2014 + A13:2017 *"Seguridad de los aparatos eléctricos de uso doméstico y similares - Parte 1: Normas generales"*
- EN 62233:2008 *"Métodos de medida para campos electromagnéticos de los aparatos eléctricos de uso doméstico y aparatos similares con referencia a la exposición humana"*

Crevalcore 16 – 06 - 2021

Sergio Poletti
President

S.P.E. ELETTRONICA INDUSTRIALE di Poletti Sergio
Via di Mezzo Ponente n.383/B
40014 Crevalcore (Bologna)
Partita IVA
Codice Fisc.

Belangrijke veiligheidsinstructies. Bewaar deze instructies. Deze handleiding bevat belangrijke instructies voor de veiligheid van de gebruiker en de werking van het apparaat.

ALGEMENE WAARSCHUWINGEN

1) Vóór elk gebruik van de acculader, moeten onderstaande aanwijzingen zorgvuldig gelezen en in acht genomen worden.
2) Het niet opvolgen van deze aanwijzingen en/of fouten bij de installatie of het gebruik van de acculader, zouden de bediener in gevaar kunnen brengen en/of het apparaat kunnen beschadigen, waardoor de garantie van de fabrikant komt te vervallen.
3) De acculader mag niet gebruikt worden als onderdeel in systemen die zorgen voor ondersteuning van de levensfuncties en/of medische apparatuur.
4) De acculader mag niet worden gebruikt door personen met verminderde fysieke, sensorische en mentale capaciteiten of met een gebrek aan ervaring en / of kennis, tenzij ze goed onder toezicht staan en geïnstrueerd worden door een persoon die verantwoordelijk is voor hun veiligheid.
5) Het typeplaatje moet na de installatie zichtbaar zijn.

KINDEREN

6) Dit apparaat mag worden gebruikt door kinderen ouder dan 8 jaar en door personen met verminderde psychofysische zintuiglijke vermogens of onvoldoende ervaring en/of kennis, op voorwaarde dat zij worden begeleid of geïnstrueerd over het veilige gebruik van het apparaat en zich bewust zijn van de mogelijke risico's. De oplader is geen speelgoed en mag niet als zodanig worden behandeld.
Reinigings- en onderhoudswerkzaamheden mogen niet door kinderen worden uitgevoerd, tenzij onder toezicht.

PLAATS VAN INSTALLATIE

7) Zet de acculader nooit in de onmiddellijke omgeving van de accu om te voorkomen dat door de betreffende accugeproduceerde en/of uitgestoten gassen de acculader tijdens het opladen corroderen of

beschadigen. Zet de acculader zo ver mogelijk uit de buurt van de accu als de lengte van de kabels mogelijk maakt.
8) Installeer de acculader niet in een afgesloten ruimte of zodanig dat de ventilatie op één of andere manier wordt verhinderd. Voor eenheden uitgerust met ventilatoren, moet minstens 30 mm ruimte rond de ventilatieopeningen vrij worden gehouden.
9) Gebruik de acculader niet in een buitenomgeving.
10) Stel de acculader niet bloot aan regen, waterspatten of stoom.
11) Installeer de acculader niet in caravans en/of soortgelijke voertuigen.
12) Installeer de acculader niet in de buurt van warmtebronnen of in stoffige ruimtes.
13) Installeer de acculader niet in de buurt van mogelijke bronnen van ontvlambaar materiaal, bijvoorbeeld aardgasleidingen of brandstofdepots (benzine, kerosine, ...).
14) Zet en/of monteer de acculader niet op oppervlakken die gemaakt zijn van brandbare materialen, zoals houten planken of wanden.

ACCU'S

15) Volg de specifieke veiligheidsinstructies die geleverd zijn door de fabrikant van de accu zorgvuldig op, bijvoorbeeld, of u de doppen van de cellen tijdens het opladen al dan niet moet verwijderen en de aanbevolen laadsnelheid.
16) Werken in de buurt van loodzuuraccu's is gevaarlijk, aangezien accu's explosieve gassen genereren tijdens het opladen. Daarom moet roken en/of het genereren van open vuur en/of vonken vermeden worden.
17) Laad nooit een bevroren accu op.
18) Accu's moeten opgeladen worden in geschikte en goed geventileerde ruimtes.
19) Om het risico op ongevallen te verminderen, mogen alleen loodzuur-, GEL- of AGM-accu's, lithium-polymeer of lithium-ion accu's worden opgeladen. Laad geen andere soorten oplaadbare of niet-oplaadbare accu's op, omdat deze kunnen exploderen en schade aan voorwerpen en/of personen kunnen veroorzaken.

OVERIGE SPECIFICATIES VOOR LITHIUM ACCU'S

20) Om lithium-polymeer en lithium-ion accu's op te laden, moet er altijd een BMS (Battery Management System – Accubeheerssysteem) met een actief en passief veiligheidssysteem gebruikt worden, in overeenstemming met de geldende veiligheidsvoorschriften.
21) Doordat het BMS tijdens het balanceren van de cellen de werking van de acculader rechtstreeks kan beïnvloeden, wordt elke directe aansprakelijkheid van de acculader uitgesloten indien de schade aan de accu, of zelfs een brand of explosie, het gevolg is van een fout in de BMS-software.
22) De mogelijkheid die geboden worden door de door S.P.E. ELETTRONICA INDUSTRIALE geproduceerde materialen, om verschillende spanningsniveaus te selecteren voor het opladen, is toevertrouwd aan de controle en supervisie van de eindgebruiker en S.P.E. ELETTRONICA INDUSTRIALE is in geen geval verantwoordelijk voor de gevolgen die voortvloeien uit de keuze van een verkeerd spanningsniveau. Bij twijfel dient de gebruiker een gekwalificeerde deskundige om verduidelijking te vragen.
23) De tolerantiedrempels van de acculader, voor wat betreft te hoge spanningsniveaus en overbelasting, worden alleen gebruikt voor de bescherming van de systemen van de lader en hebben geen veiligheidsfunctie voor de accu zelf, waarvan de veiligheid uitsluitend afhankelijk is van het BMS, zelfs wanneer de lader op de accu is aangesloten, ongeacht of deze wordt opgeladen of niet.
24) Als de klant de acculader wil gebruiken op een specifiek boordsysteem en in het algemeen in alle gevallen van speciaal gebruik, is het de verantwoordelijkheid van de klant op S.P.E. ELETTRONICA INDUSTRIALE hierover te informeren, zodat deze laatste eventuele noodzakelijke aanbevelingen kan opstellen. In dat geval moet de klant S.P.E. ELETTRONICA INDUSTRIALE voorzien van alle noodzakelijke tekeningen, schema's en beschrijvend materiaal. S.P.E. ELETTRONICA INDUSTRIALE kan niet aansprakelijk gesteld worden voor eventuele schade veroorzaakt

door het gebruik van de acculader na het openen en/of wijzigen ervan of na plaatsing ervan in andere systemen.
25) In geen geval kan S.P.E. ELETTRONICA INDUSTRIALE aansprakelijk gesteld worden voor de slechte werking van de accu's of voor brand/explosie ervan, aangezien de veiligheid van de accu een functie is van het BMS en niet van de acculader.

CONTROLE VAN KABELS, ELEKTRICITEITSNET, AARDING

26) Verplaats de acculader niet door aan de kabels te trekken, deze zouden beschadigd kunnen raken. Gebruik hiervoor de handgrepen, indien aanwezig.
27) Controleer, alvorens de acculader te gebruiken, of de hulzen rond de aansluit- en accukabels in goede staat zijn. Als één van de kabels beschadigd is, laat deze dan vervangen door een gekwalificeerde technicus van S.P.E. ELETTRONICA INDUSTRIALE.
28) Controleer of de ingangsspanning van de acculader op het typeplaatje overeenkomt met de beschikbare voedingsspanning.
29) Controleer de compatibiliteit van de netstekker die bij de acculader geleverd is, het gebruik van adapters is niet aanbevolen (in Canada is het wettelijk verboden). Als de stekker niet in het stopcontact past, neem dan contact op met SPE ELECTRONICS INDUSTRIAL om een kabel met een geschikte stekker voor het stopcontact aan te vragen.
30) De stekker van de acculader moet worden aangesloten op een geaard stopcontact. Als het stopcontact niet geaard is, mag u het apparaat niet gebruiken voordat er een geschikt stopcontact geïnstalleerd is door een gekwalificeerde technicus.
31) Het stopcontact waarop de acculader wordt aangesloten, moet beveiligd zijn met een elektrische voorziening die voldoet aan de wet (zekering en/of installatieautomaat) en waarvan de grootte gelijk is aan het stroomverbruik dat is aangegeven op het typeplaatje van de lader plus 10%.
32) Maak de acculader niet open aangezien er geen onderdelen in zitten die door de gebruiker kunnen worden gerepareerd en/of vervangen. Alleen gespecialiseerd personeel dat door S.P.E.

ELETTRONICA INDUSTRIALE is geautoriseerd, mag werkzaamheden verrichten waarvoor het apparaat geopend moet worden. Elektrische/elektronische onderdelen in het apparaat kunnen leiden tot elektrische schokken, ook als de stekker van het apparaat uit het stopcontact is gehaald

CONTROLE VAN DE WERKING EN LAADCURVE VAN DE ACCULADER

33) Controleer voor het laden of de acculader voldoet aan de accuspanning, of de laadstroom geschikt is voor de accucapaciteit en of de gekozen laadmodus (voor loodzuuraccu's, of voor hermetische GEL- of AGM-accu's, lithium-polymeer of lithium-ion accu's) geschikt is voor het type accu dat moet worden geladen.
34) Het wordt aanbevolen om een zekering te plaatsen tussen de acculader en de accu. De zekering moet op de verbinding met de pluspool van de accu worden aangebracht. De waarde van de zekering moet afgestemd zijn op de nominale uitgangsstroom van de acculader, de doorsnede van de gebruikte kabel en de omgeving waarin deze is geïnstalleerd.
35) Het wordt aanbevolen om de stroomtoevoer van het stroomnet te onderbreken alvorens de accu's aan te sluiten of af te koppelen.
36) Tijdens de normale werking van de acculader kan het buitenoppervlak heet worden en nog enige tijd heet blijven, zelfs nadat de acculader is uitgeschakeld.
37) De acculader heeft geen bijzonder onderhoud nodig, alleen normale reiniging die periodiek moeten worden uitgevoerd, afhankelijk van het type werkomgeving. Reiniging mag alleen aan de buitenkant van de acculader worden uitgevoerd. Alvorens te beginnen met de reiniging moet het netsnoer van het stroomnet en de accukabels worden losgekoppeld. Gebruik GEEN water en / of reinigingsmiddelen in het algemeen en/of hogedrukreinigers, van welk type ook, bij het reinigen.

WANNEER HET APPARAAT NIET TE GEBRUIKEN

38) Als de veilige werking van de acculader niet kan worden gegarandeerd, zet het apparaat dan uit en zorg ervoor dat het niet weer in gebruik genomen kan worden.

Accutype = loodzuur, GEL, AGM, lithium
Aantal cellen = 6 – 12 – 18 – 24 – 36 – 40 – 48

OPGELET: Brandgevaar. Laad alleen loodzuur (LEAD- Acid), Gel-, AGM-accu's en lithium accu's op. Voor lithium: Gebruik alleen accupacks die voorzien zijn van BMS en alle noodzakelijke bescherming die in de accupacks is opgenomen.

GEVAAR: Elektrisch gevaar. Raak de niet-geïsoleerde delen van de uitgangsstekkers of de accupolen niet aan.

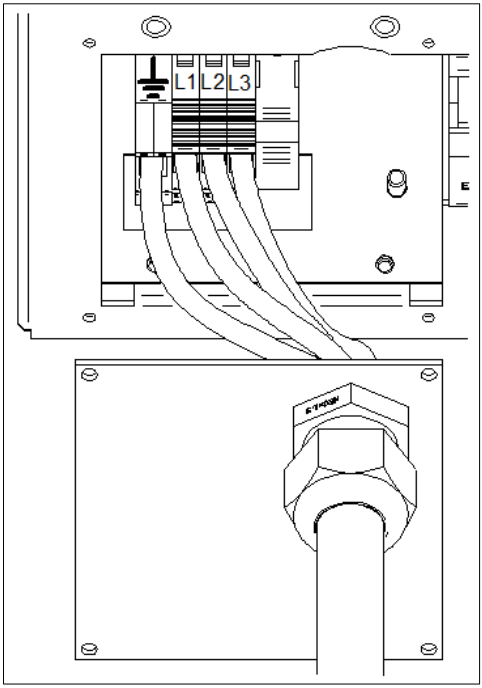
OPGELET: Brandgevaar. Gebruik alleen circuits die worden geleverd met _____ ampère. Circuitbeveiliging volgens het Amerikaanse National Fire Protection Association (NFPA), NFPA 70".

Opmerking: De specificaties in deze handleiding kunnen zonder voorafgaande kennisgeving worden gewijzigd. Deze publicatie vervangt alle eerder verstrekte informatie.

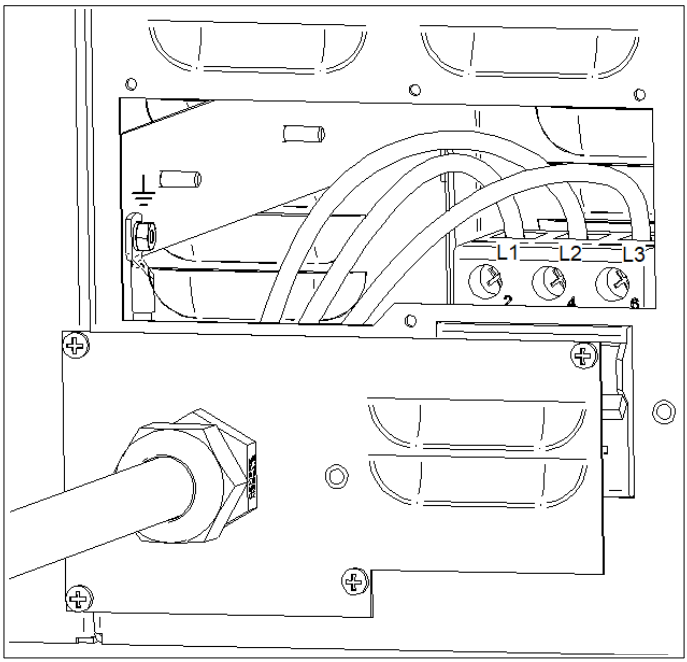
GREEN 6 - GREEN8 - GREENX
Hoogfrequent acculader

AANSLUIITING OP HET NET

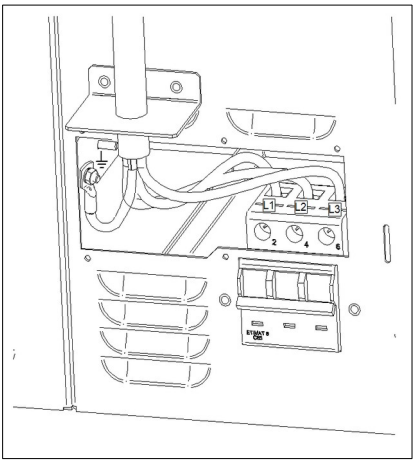
De geïnstalleerde acculader moet worden aangesloten op een stopcontact met voldoende stroom voor de lader, controleer de gegevens vermeld op het serienummerlabel:

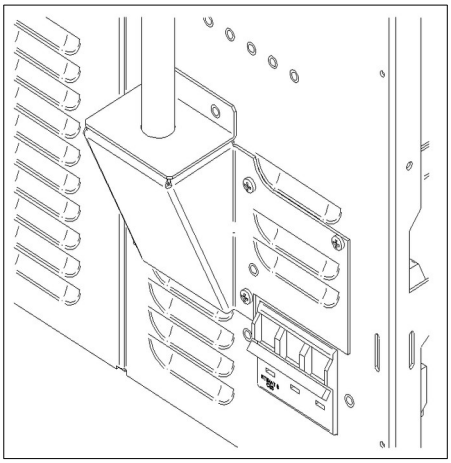


Hoofdaansluiting



Secundaire aansluiting





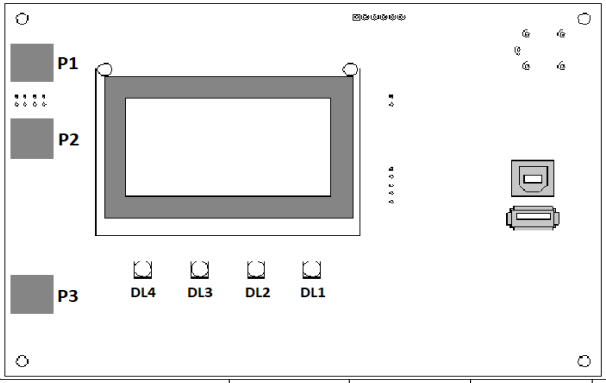
Aansluiting van de bedrading op de stroomtoevoer

AANSLUITING OP DE ACCU

Wij adviseren het gebruik van geschikte conforme tweepolige stekkers die omkering van de polariteit van de accu onmogelijk maken en tevens garanderen dat de kabels correct worden aangesloten op de contacten van de stekkers.
Uitsluitend gespecialiseerd personeel mag deze procedure uitvoeren.

VISUELE SIGNALEN

Deze paragraaf beschrijft de weergave van de 4 statusleds tijdens de verschillende fasen van de werking van de acculader.

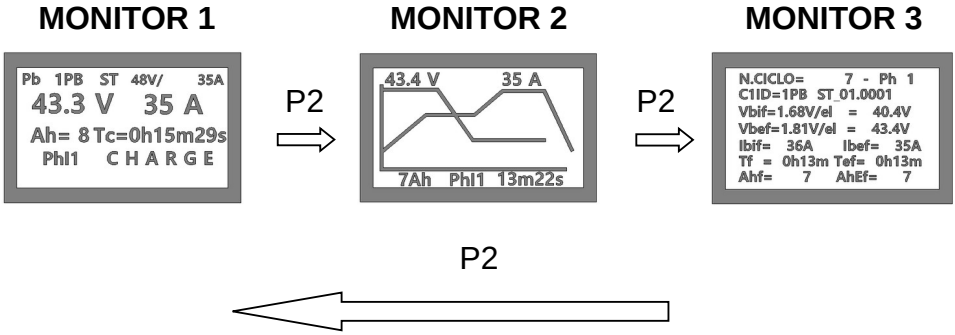


REF	BESCHRIJVING	LED DL4 (groen)	LED DL3 (geel)	LED DL2 (groen)	LED DL1 (rood)	DISPLAY
S1	Alleen accuvoeding	OFF	OFF	OFF	OFF	OFF
S2	Alleen netvoeding	OFF	OFF	OFF	OFF	ON
S3	Zowel accu- als netvoeding	ON	OFF	OFF	OFF	ON
S4	Automatische start uitvoeren	BL	BL	BL	BL	ON
F1	Fase 1 - Eerste lading CI	BL	OFF	OFF	OFF	ON
F2-F7	Fase 2 – Fase 7	BL	ON	OFF	OFF	ON
F8	Egalisatiefase	ON	ON	ON	OFF	ON
EQU ON	Egalisatielading ON (in uitvoering)	BL	BL	ON	OFF	ON
					OFF	ON
EQU OFF	Egalisatielading OFF (gepauzeerd)	ON	ON	ON	OFF	ON
M	Onderhoud	BL	BL	ON	OFF	ON
END	Laden voltooid	ON	ON	ON	OFF	ON

Legenda:
OFF = LED is uit
ON = LED brandt constant
BL = LED knippert (interval, T=1 seconde)
– – = LED in willekeurige toestand

LCD-DISPLAY

Tijdens het opladen biedt de lader 3 monitormenu's, waartussen u kunt omschakelen door op knop P2 te drukken, en waarvan de betekenis eerder werd toegelicht

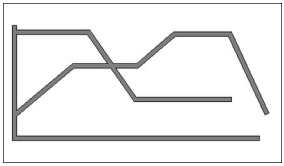


Hieronder vindt u een samenvatting van de informatie die respectievelijk in de 3 beeldschermen wordt gegeven.

MONITOR 1

REGEL	VOORBEELD	BESCHRIJVING
(1)	Pb 1Pb ST 48V / 35A	Accutype, type curve, rating acculader
(2)	43,3 V 35A	Accuspanning en stroom
(3)	Ah= 8 Tc= 0h 15m 29s	Laadstroom, laadtijd in uren, min, sec.
(4)	PhI1 CHARGE	Huidige laadfase, STATUS acculader
(5)	-- Messages	(bv. fase = automatische start A0, status= ACCU NIET AANGESLOTEN)

MONITOR 2

REGEL	VOORBEELD	BESCHRIJVING
(1)	43,3V 35A	Geleverde accuspanning en stroom
(2)		Laadprofiel accu met indicatie: • Voltooide fases (dikke lijn) • Fase in uitvoering (knipperende lijn) • Fases die uitgevoerd moet worden (dunne lijn)
(3)	7Ah PhI1 13m22s	Laadstroom, laadtijd in uren, min, sec.
(4)	-- Message	Eventuele storingen of statusmeldingen

MONITOR 3

REGEL	VOORBEELD	BESCHRIJVING
(1)	N.CYCLE= 7 – Ph 1	Aantal laadcycli en laadfase in uitvoering Bv. : laadcyclus 5 en fase 3
(2)	C1ID=1PB ST_01.0001	Unieke identificatiecode laadcurve
(3)	Vbif=1.68V/el = 40.4V	Accuspanning aan het begin van de fase (Vbif) in eerste instantie uitgedrukt als celspanning (V/el), daarna als absolute spanning (V)
(4)	Vbef=1.81V/el = 43.4V	Accuspanning aan het einde van de fase (Vbif) in eerste instantie uitgedrukt als celspanning (V/el), daarna als absolute spanning (V)
(5)	Ibif= 36A Ibef= 35A	Spanning aan het begin van de fase (Ibif) en spanning aan het einde van de fase (Ibef)
(6)	Tf =0h13m Tef=0h13m	Tijdsduur enkele fase (Ibif) en totale laadtijd aan het einde van de fase (Ibef)
(7)	Ahf= 7 AhEf= 7	Ah afgegeven in de geselecteerde fase (Ahf) en Ah totale lading (AhEf)
(8)	-- Message	Geeft eventuele storingen tijdens de laadcyclus aan

GARANTIE

- De machine heeft een garantie van 12 maanden vanaf de datum van installatie.
- De garantie dekt gebreken in de constructie of de montage.
- De garantie dekt GEEN schade die wordt veroorzaakt door onjuist gebruik en/of onjuiste installatie.
- De garantie vervalt als er geknoei wordt vastgesteld.
- Neem in geval van problemen contact op met een GEAUTORISEERDE DEALER of rechtstreeks met S.P.E. Elettronica Industriale.

EG-VERKLARING VAN OVEREENSTEMMING

Ondergetekende

S.P.E. ELETTRONICA INDUSTRIALE di Poletti Sergio
Via di Mezzo Ponente, 383 – 40014 Crevalcore (Bologna) ITALY

Verklaart onder eigen verantwoordelijkheid dat het product:

ELEKTRONISCHE AUTOMATISCHE ACCULADER MODEL:

GREEN6 24-50, GREEN6 24-60, GREEN6 24-70, GREEN6 24-80, GREEN6 24-100, GREEN6 24-120, GREEN6 24-150, GREEN8 24-160, GREEN8 24-180, GREEN8 24-200, GREENX 24-250, GREENX 24-300, GREEN6 36-80, GREEN6 36-100, GREEN6 36-120, GREEN6 36-150, GREEN6 36-180, GREEN8 36-200, GREENX 36-250, GREENX 36-300, GREEN6 48-25, GREEN6 48-30, GREEN6 48-40, GREEN6 48-50, GREEN6 48-60, GREEN6 48-70, GREEN6 48-80, GREEN6 48-90, GREEN6 48-100, GREEN6 48-120, GREEN6 48-130, GREEN6 48-150, GREEN8 48-160, GREEN8 48-180, GREEN8 48-200, GREENX 48-250, GREENX 48-300, GREEN6 72-30, GREEN6 72-40, GREEN6 72-50, GREEN6 72-60, GREEN6 72-80, GREEN6 72-100, GREEN8 72-130, GREEN6 80-30, GREEN6 80-40, GREEN6 80-50, GREEN6 80-60, GREEN6 80-80, GREEN6 80-100, GREEN8 80-110, GREEN8 80-120, GREEN8 80-130, GREENX 80-150, GREENX 80-160, GREENX 80-200, GREEN6 96-20, GREEN6 96-25, GREEN6 96-30, GREEN6 96-40, GREEN6 96-50, GREEN 96-60, GREEN6 96-65, GREEN6 96-70, GREEN6 96-75, GREEN8 96-80, GREEN8 96-100, GREENX 96-125, GREENX 96-150

waarop deze verklaring betrekking heeft, voldoet aan de bepalingen van de richtlijnen van de Raad van de Europese Unie betreffende de onderlinge aanpassing van de wetgevingen van de lidstaten:

Met betrekking tot elektromagnetische compatibiliteit (EMC) richtlijn 2014/30/EG van het Europese Parlement en van de Raad van 26 februari 2014 inzake de onderlinge aanpassing van de wetten van de lidstaten inzake elektromagnetische compatibiliteit en tot intrekking van de richtlijn 89/336/EEG, is conformiteit bewezen door overeenstemming met de volgende normen:

- EN 61000-6-2: 2019 - *6-2: Generieke normen - Immuniteit voor de industriële omgeving*
- EN 61000-6-4: 2007 + A1:2011 - *6-4: Generieke normen - Emissies voor de industriële omgeving (Immuniteit – Categorie II)*

Met betrekking tot de laagspanningsrichtlijn 2014/35/EG van het Europees Parlement en de Raad van 26 februari 2014 betreffende de onderlinge aanpassing van de wettelijke voorschriften der lidstaten inzake elektrisch materiaal bestemd voor gebruik binnen bepaalde spanningsgrenzen, is conformiteit bewezen door overeenstemming met de volgende normen:

- EN IEC 60335-1:2012 + A11:2014 + A13:2017 *"Veiligheid van huishoudelijke en soortgelijke elektrische toestellen – Deel 1: Algemene eisen"*
- EN 62233: 2008-04 *"Meetmethode voor elektromagnetische velden van huishoudelijke toestellen en soortgelijke apparaten met betrekking tot menselijke blootstelling"*

Crevalcore 16 – 06 - 2021

Sergio Poletti
Directeur

S.P.E. ELETTRONICA INDUSTRIALE di Poletti Sergio
Via di Mezzo Ponente n.383/B
40014 CREVALCORE (Bologna)
Partita IVA
Codice Fisc.

Ważne instrukcje dla zachowania bezpieczeństwa. Zachować niniejsze wskazówki. Niniejsza instrukcja zawiera ważne wskazówki dotyczące bezpieczeństwa użytkownika i działania urządzenia.

OGÓLNE ŚRODKI OSTROŻNOŚCI

1) Przed jakimkolwiek użyciem ładowarki należy dokładnie przeczytać i przestrzegać instrukcji poniżej opisanych.
2) Nieprzestrzeganie poniższych instrukcji i/lub błędów w fazie instalacji lub użytkowania ładowarki może być przyczyną zagrożeń dla operatora i/lub może wywołać szkody na urządzeniu unieważniając gwarancję fabryczną.
3) Ładowarka nie może być zastosowana jako element w urządzeniach do monitorowania funkcji życiowych i/lub wsparcia urządzeń medycznych.
4) Ładowarka nie może być używana przez osoby o ograniczonych zdolnościach fizycznych, sensorycznych i umysłowych lub bez doświadczenia i / lub wiedzy, chyba że są one odpowiednio nadzorowane i poinstruowane przez osobę odpowiedzialną za ich bezpieczeństwo.
5) Dane na tabliczce muszą być widoczne po instalacji.

DZIECI

6) Urządzenie może być używane przez dzieci powyżej 8-go roku życia i przez osoby o ograniczonych zdolnościach fizycznych, czuciowych i umysłowych, a także przez osoby nie posiadające wiedzy i doświadczenia chyba, że będą one nadzorowane lub zostaną poinformowane na temat bezpiecznego korzystania z urządzenia i na temat zagrożeń związanych z jego nieprawidłowym użytkowaniem. Ładowarka nie jest zabawką i nie może być traktowana jako taka.
Czynności czyszczenie i konserwacji nie mogą być wykonane przez dzieci jeśli nie są one nadzorowane.

MIEJSCE INSTALACJI

7) Absolutnie unikać umieszczania ładowarki w pobliżu baterii, aby nie dopuścić, by wytworzone i/lub wydostające się gazy z tejże baterii podczas ładowania spowodowały korozję i/lub uszkodziły ładowarkę. Umieścić ładowarkę jak najdalej od baterii, jak tylko umożliwia to długość kabli.
8) Nie instalować ładowarki w zamkniętej strefie lub takiej, która ogranicza wentylację. W urządzeniach wyposażonych w wentylatory należy pozostawić miejsce wolne na co najmniej 30 mm wokół wlotów powietrza.
9) Nie używać ładowarki na zewnątrz.
10) Nie wystawić ładowarki na deszcz, nie narażać na działanie strumieni wody, źródeł pary.
11) Nie instalować ładowarki w przyczepach kempingowych i/lub podobnych pojazdach.
12) Nie instalować ładowarki w pobliżu źródeł ciepła lub w pomieszczeniach z dużą ilością pyłów.
13) Nie instalować ładowarki w pobliżu możliwych źródeł materiałów łatwopalnych jak na przykład przewody gazowe lub depozyty paliwowe (benzyna, kerosen, ...).
14) Nie umieszczać i/lub mocować ładowarki na płaszczyznach wykonanych z materiałów łatwopalnych takich jak półki i/lub ściany z drewna.

BATERIE

15) Postępować zgodnie z wytycznymi instrukcji dostarczonymi przez producenta baterii, na przykład, czy zdjąć lub nie osłony elementów podczas ładowania i postępować zgodnie z zalecanymi sposobami ładowania.
16) Niebezpiecznie jest pracować w pobliżu baterii ołowiowo-kwasowych jako, że podczas cyklu ładowania baterie generują gaz wybuchowy. Unikać więc palenia i/lub generowania wolnego ognia i/lub iskier.
17) Nie ładować zamarzniętej baterii.
18) Ładowanie baterii musi być wykonane w odpowiednich pomieszczeniach i dobrze przewietrzonych i/lub wietrzonych.

19) W ramach ograniczenia ryzyka pożaru ładować tylko baterie ołowiowe-kwasowe, GEL lub AGM, baterie z polimerów litowych lub jonowo-litowych. Nie ładować innego rodzaju baterii ładowalnych i niełądowalnych jako, że mogą wywołać wybuch powodując szkody na rzeczach i/lub osobach.

DODATKOWE SPECYFIKACJE DLA BATERII LITOWYCH

20) W celu naładowania baterii z polimerów litowych lub jonowo-litowych musi być zawsze do dyspozycji BMS (Battery Management System) zawierający system bezpieczeństwa aktywny i pasywny, zgodnie z obowiązującymi przepisami bezpieczeństwa.
21) Możliwość, ze strony BMS, bezpośredniego zadziałania na funkcje ładowarki, podczas faz równoważenia cząstek wyklucza całkowicie zaistnienie odpowiedzialności ładowarki w przypadku, gdy szkody wywołane na baterii, lub wręcz pożar lub wybuch są spowodowane przez błąd oprogramowania BMS.
22) Gwarancja oferowana przez produkty wyprodukowane przez S.P.E. ELETTRONICA INDUSTRIALE w ramach selekcjonowania różnych poziomów napięcia, zależy od procesów kontrolnych i działania końcowego użytkownika i firma S.P.E. ELETTRONICA INDUSTRIALE nie odpowiada za żaden przypadek w konsekwencji wywołany błędnym wyborem poziomu napięcia. W razie jakiejkolwiek wątpliwości użytkownik powinien poprosić o pomoc wykwalifikowanego technika.
23) Progi tolerancji ładowarki, jeżeli chodzi o poziomy przepięcia i przeładowania, są jedynie wykorzystywane do zabezpieczenia systemu jej samej i nie posiadają żadnej funkcji zabezpieczającej baterię, bezpieczeństwo jej zależy tylko i wyłącznie od BMS, także gdy ładowarka jest podłączona do baterii, tak w fazie ładowania jak i nie.
24) W przypadku, gdy klient będzie chciał użyć ładowarkę na szczególnym systemie on-board lub we wszystkich innych przypadkach szczególnego zastosowania powinien poinformować S.P.E. ELETTRONICA INDUSTRIALE, aby mogła ona wydać odpowiednie instrukcje. W tym przypadku klient będzie musiał dostarczyć S.P.E. ELETTRONICA INDUSTRIALE wszystkie

projekty, schematy i konieczne elementy opisowe. S.P.E. ELETTRONICA INDUSTRIALE nie ponosi żadnej odpowiedzialności za wynikłe szkody wywołane użytkowaniem ładowarki z powodu jej otwarcie i/ lub modyfikacji i/lub wprowadzenia innego systemu.
25) W żadnym wypadku S.P.E. ELETTRONICA INDUSTRIALE nie ponosi odpowiedzialności za uszkodzenie baterii lub pożaru/ wybuchu tychże baterii jako, że bezpieczeństwo baterii ściśle zależy od działania BMS, a nie od ładowarki.

KONTROLA KABLI, SIECI, WTYCZKI UZIEMIAJĄCEJ
26) Nie transportować ładowarki ciągnąc ją za kable jako, że może się uszkodzić. Używać odpowiednich rączek, jeśli obecne.
27) Przed użyciem ładowarki należy sprawdzić uszczelnienia izolacji kabla łączącego z siecią zasilania i kabli baterii, czy są w dobrym stanie. Jeśli choć jeden z kabli jest uszkodzony należy go wymienić przez wykwalifikowanego technika S.P.E. ELETTRONICA INDUSTRIALE.
28) Sprawdzić, czy napięcie wejściowe ładowarki wskazane na tabliczce odpowiada dostępnemu napięciu zasilania.
29) Sprawdzić kompatybilność wtyczki sieci na wyposażeniu z ładowarką: zaleca się użycie adapterów (w Kanadzie zakazane). Jeżeli wtyczka nie wchodzi do gniazdka poprosić S.P.E. ELETTRONICA INDUSTRIALE o kabel wyposażony w odpowiednią wtyczkę.
30) Ładowarka musi być podłączona do gniazda prądu wyposażonego w przewód uziemiający. Jeżeli takowe gniazdo z uziemieniem nie jest przewidziane nie używać urządzenia i zainstalować odpowiednie gniazdo przez wykwalifikowanego technika.
31) Gniazdo prądu, do którego należy podłączyć ładowarkę musi być zabezpieczone przez urządzenie elektryczne zgodne z prawem (bezpieczniki topikowe i/lub wyłącznik automatyczny) dostosowane do prądu elektrycznego równego absorpcji prądu zdeklarowanego w oznaczeniu ładowarki powiększonego o 10%.

32) Nie otwierać ładowarki jako, że wewnątrz nie ma elementów, które mogą zostać naprawione i/lub wymienione przez użytkownika. Tylko osoby wyspecjalizowane i upoważnione przez S.P.E. ELETTRONICA INDUSTRIALE mogą wykonać prace, które wymagają otwarcia urządzenia. Wewnątrz znajdują się elementy elektryczne/elektroniczne które mogą spowodować wyładowania elektryczne, nawet jeśli urządzenie nie jest podłączone do prądu.

KONTROLA FUNKCJI ŁADOWARKI I KRZYWA

33) Przed wykonaniem naładowania upewnić się, czy wartości ładowarki odpowiada napięciu baterii, czy wartość prądu jest odpowiednia co do zdolności baterii, i czy wybrana dynamika ładowania (dla baterii ołowiowo-kwasowych, baterii hermetycznych GEL lub AGM, baterii z polimerów litowych lub jonowo-litowych) jest prawidłowa dla każdego rodzaju baterii do ładowania.
34) Zaleca się wprowadzić bezpiecznik pomiędzy ładowarkę, a baterię. Bezpiecznik powinien być zainstalowany wzdłuż połączenia do bieguna dodatniego baterii. Wartość bezpiecznika musi być odpowiednia do działania prądu znamionowego na wyjściu ładowarki, do przekroju używanego kabla i do środowiska, w którym zostanie zainstalowany.
35) Zaleca się odłączyć zasilanie od sieci prądu przed wykonaniem podłączenia lub odłączenia baterii.
36) Podczas normalnego działania ładowarki zewnętrzna powierzchnia może się ogrzać i może taką pozostać przez pewien okres czasu, także po jej wyłączeniu.
37) Ładowarka nie wymaga szczególnych czynności konserwacyjnych, ale tylko normalnych czynności czyszczenia do wykonania okresowo w zależności od rodzaju środowiska pracy. Czynności czyszczenia są do wykonania tylko na zewnętrznej powierzchni ładowarki. Przed rozpoczęciem czynności czyszczenia należy odłączyć kabel zasilania od sieci elektrycznej i kable łączące z baterią. W ramach wykonania czyszczenia zaleca się NIE używać wody i/lub detergentów, ani jakiegokolwiek rodzaju myjek wodnych.

NIEUŻYTKOWANIE

38) Jeżeli nie może być zapewnione bezpieczne działanie ładowarki wyłączyć urządzenie i upewnić się, aby nie mogło zostać przywrócone do funkcjonowania.

Model baterii = Ołowiowo – Kwasowe, GEL, AGM, Litowe
Ilość ogniw = 6 – 12 – 18 – 24 – 36 – 40 – 48

UWAGA: Ryzyko pożaru. Ładować LEAD-Acid, Gel, AGM i baterie litowe. Dla baterii litowych: Używać tylko pakietów baterii, które zawierają BMS i wszystkie konieczne zabezpieczenia znajdujące się w opakowaniu baterii.

ZAGROŻENIE: Ryzyko szoku elektrycznego. Nie dotykać nieizolowanych części złącz wyjściowych lub terminali baterii.

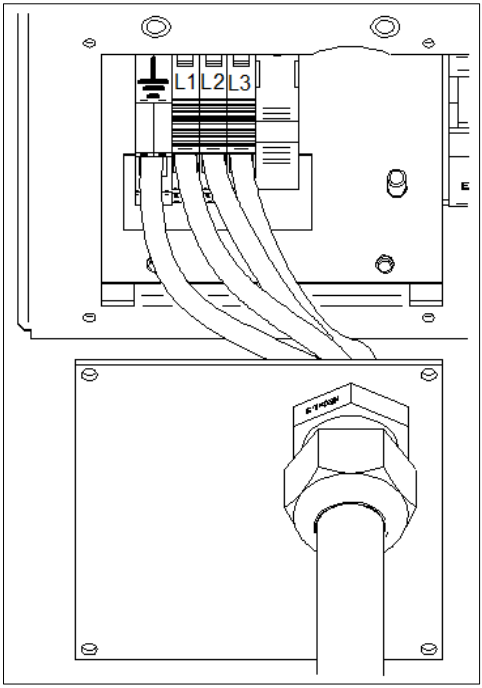
UWAGA: Ryzyko pożarowe. Używać tylko układów dostarczonych z _____ amperów. Ochrona układów zgodnie z krajowym kodem elektrycznym NFPA 70“.

N.B: Wskazane właściwości w niniejszej instrukcji są przedmiotem modyfikacji przez uprzedzenia. Niniejsza publikacja zastępuje każdą informację uprzednio dostarczoną.

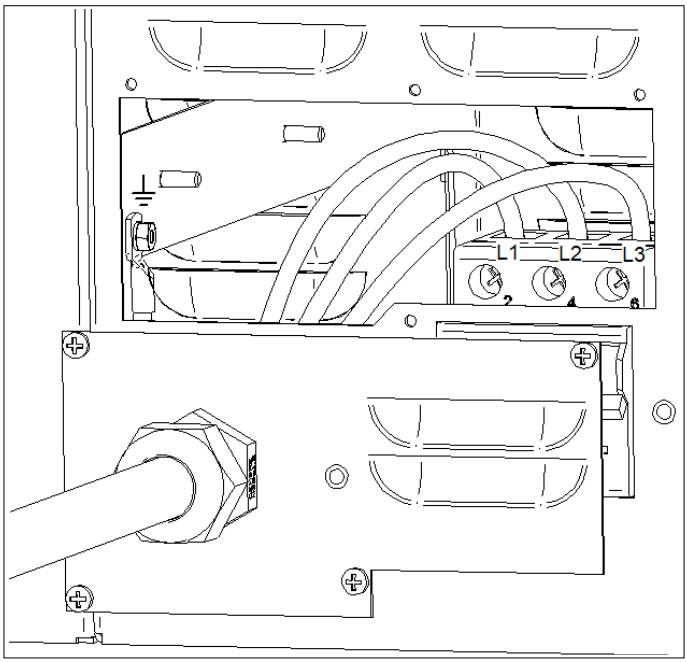
GREEN 6 - GREEN8 - GREENX
Ładowarka wysokiej częstotliwości

PODŁĄCZENIE DO SIECI

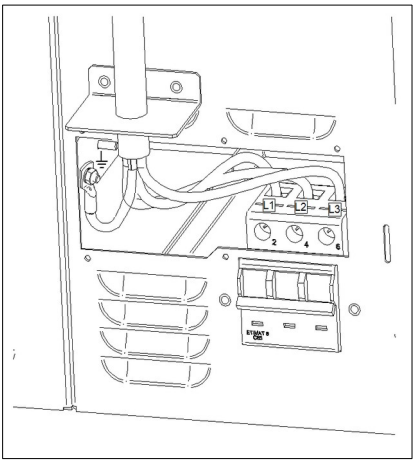
Zainstalowana ładowarka musi zostać podłączona do gniazda z mocą odpowiednią dla ładowarek, sprawdzić dane znajdujące się na etykiecie numeru seryjnego:

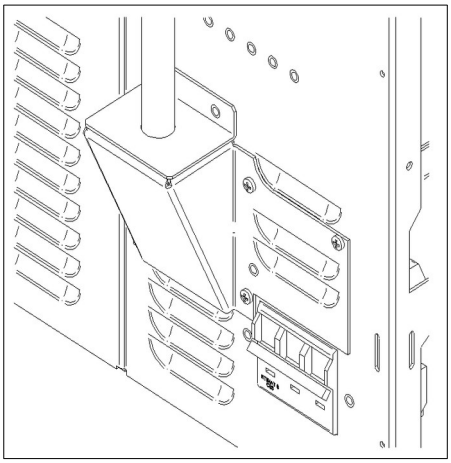


Podłączenie główne



Podłączenie alternatywne





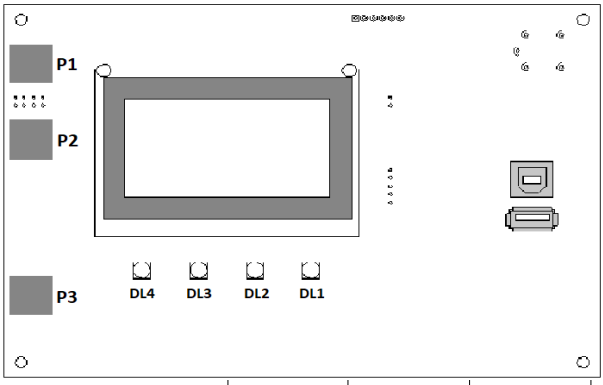
Podłączenie kabli do sieci elektrycznej

PODŁĄCZENIE DO BATERII

Zalecamy użycie odpowiednich złącz dwubiegunowych, które nie dopuszczą do zamiany biegunowości baterii, upewnić się czy kable są prawidłowo podłączone do styków złącz. Niniejsza procedura powinna zostać wykonana tylko i wyłącznie przez wykwalifikowany personel.

KOMUNIKATY WIZUALNE

Niniejszy paragraf opisuje różne komunikaty 4 LED-ów stanu różnych faz działania ładowarki.

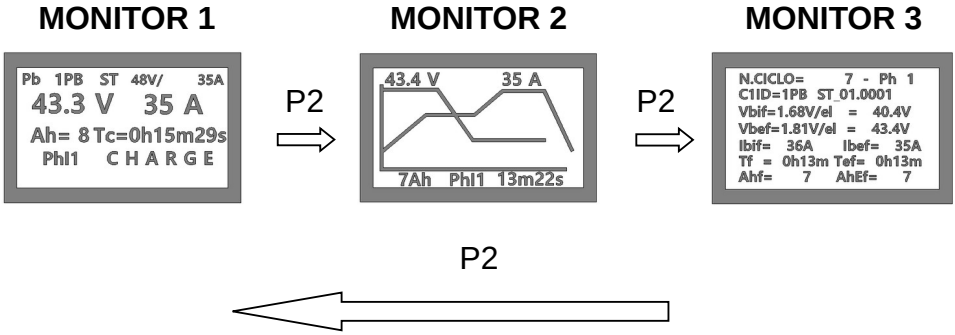


SYMBOL	OPIS	LED DL4 (zielony)	LED DL3 (żółty)	LED DL2 (zielony)	LED DL1 (czerwony)	WYŚWIET LACZ
S1	Tylko zasilanie z baterii	OFF	OFF	OFF	OFF	OFF
S2	Tylko zasilanie z sieci	OFF	OFF	OFF	OFF	ON
S3	Zasilania tak z baterii jak i sieci	ON	OFF	OFF	OFF	ON
S4	Autostart	BL	BL	BL	BL	ON
F1	Faza 1 – Ładowanie rozpoczęte CI	BL	OFF	OFF	OFF	ON
F2-F7	Faza 2 – Faza 7	BL	ON	OFF	OFF	ON
F8	Okres wyrównawczy	ON	ON	ON	OFF	ON
EQU ON	Ładowanie wyrównawcze ON (w toku)	BL	BL	ON	OFF	ON
					OFF	ON
EQU OFF	Ładowanie wyrównawcze OFF (przerwa)	ON	ON	ON	OFF	ON
M	Konserwacja	BL	BL	ON	OFF	ON
END	Ładowanie zakończone	ON	ON	ON	OFF	ON

Gdzie:
OFF = LED jest wyłączony
ON = LED jest włączony, światło stałe
BL = LED migający (przerwa, T=1 sekunda)
- - = LED jest w jakimkolwiek trybie

WYŚWIETLACZ LCD

Podczas ładowania, ładowarka wyświetla 3 menu na monitorze, które można przeglądać wciskając przycisk P2, którego znaczenie zostało powyżej dokładnie zilustrowane.



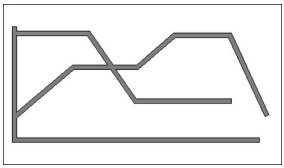
Poniżej opis informacji zebranych w 3 komunikatach przedstawionych na monitorze.

MONITOR 1

WIERSZ	PRZYKŁAD	OPIS
(1)	Pb 1Pb ST 48V / 35A	Technologia baterii, Rodzaj krzywej, Parametry ładowarki
(2)	43,3 V 35A	Napięcie i prąd baterii
(3)	Ah= 8 Tc= 0h 15m 29s	Pojemność naładowana, czas ładowania w godz., min., sek.
(4)	PhI1 CHARGE	Faza ładowania w toku, STAN ładowarki
(5)	-- Messages	(przykład faza = auto start A0, Stan= BATERIA NIEPODŁĄCZONA)

MONITOR 2

WIERSZ	PRZYKŁAD	OPIS
(1)	43,3V 35A	Napięcie i prąd baterii

(2)		Profil ładowania baterii z oznaczeniami • Fazy całkowite (wiersz tekstowy pogrubiony) • Faza w toku (wiersz tekstowy migający) • Fazy do wykonania (wiersz tekstowy cienki)
(3)	7Ah PhI1 13m22s	Pojemność naładowana, czas ładowania w godz., min, sek.
(4)	-- Messages	Ewentualne komunikaty awarii lub stanu

MONITOR 3

WIERSZ	PRZYKŁAD	OPIS
(1)	N.CYCLE= 7 – Ph 1	Ilość cykli ładowania i fazy ładowania w toku Przykład. : cykl ładowania 5 i Faza 3
(2)	C1ID=1PB ST_01.0001	Jednoznaczny identyfikator krzywej ładowania
(3)	Vbif=1.68V/el = 40.4V	Napięcie baterii na początku fazy (Vbif) wyrażone na początku jako napięcie ogniwa (V/el), po czym jako napięcie całkowite (V)
(4)	Vbef=1.81V/el = 43.4V	Napięcie baterii na końcu fazy (napięcie) (Vbif) wyrażone na początku jako napięcie ogniwa (V/el), po czym jako napięcie całkowite (V)
(5)	Ibif= 36A Ibef= 35A	Napięcie na początku fazy (Ibif) i napięcie na koniec fazy (Ibef)
(6)	Tf =0h13m Tef=0h13m	Czas pojedynczej fazy (Ibif) i całkowity czas ładowania na koniec fazy (Ibef)
(7)	Ahf= 7 AhEf= 7	Ah dostarczone w fazie selekcji (Ahf) i Ah całkowite ładowania (AhEf)
(8)	-- Message	Wskazuje ewentualne awarie podczas cyklu ładowania

GWARANCJA

- Urządzenie posiada 12 miesięczny okres gwarancji od daty instalacji.
- Gwarancja pokrywa stwierdzone wady konstrukcyjne lub montażowe.
- Gwarancja NIE obejmuje żadnych uszkodzeń spowodowanych niewłaściwym użytkowaniem i/lub nieprawidłową instalacją.
- Gwarancja wygasa w przypadku wykrycia jakichkolwiek manipulacji.
- W razie jakichkolwiek problemów prosimy o kontakt z AUTORYZOWANYM DEALEREM lub bezpośrednio z S.P.E. Elettronica Industriale.

DEKLARACJA ZGODNOŚCI CE

Niżej podpisana

S.P.E. ELETTRONICA INDUSTRIALE DI POLETTI SERGIO
Via di Mezzo Ponente, 383 – 40014 Crevalcore (Bologna) ITALIA

Oświadcza na własną odpowiedzialność, że produkt:

AUTOMATYCZNA ŁADOWARKA ELEKTRONICZNA MODEL:

GREEN6 24-50, GREEN6 24-60, GREEN6 24-70, GREEN6 24-80, GREEN6 24-100, GREEN6 24-120, GREEN6 24-150, GREEN8 24-160, GREEN8 24-180, GREEN8 24-200, GREENX 24-250, GREENX 24-300, GREEN6 36-80, GREEN6 36-100, GREEN6 36-120, GREEN6 36-150, GREEN6 36-180, GREEN8 36-200, GREENX 36-250, GREENX 36-300, GREEN6 48-25, GREEN6 48-30, GREEN6 48-40, GREEN6 48-50, GREEN6 48-60, GREEN6 48-70, GREEN6 48-80, GREEN6 48-90, GREEN6 48-100, GREEN6 48-120, GREEN6 48-130, GREEN6 48-150, GREEN8 48-160, GREEN8 48-180, GREEN8 48-200, GREENX 48-250, GREENX 48-300, GREEN6 72-30, GREEN6 72-40, GREEN6 72-50, GREEN6 72-60, GREEN6 72-80, GREEN6 72-100, GREEN8 72-130, GREEN6 80-30, GREEN6 80-40, GREEN6 80-50, GREEN6 80-60, GREEN6 80-80, GREEN6 80-100, GREEN8 80-110, GREEN8 80-120, GREEN8 80-130, GREENX 80-150, GREENX 80-160, GREENX 80-200, GREEN6 96-20, GREEN6 96-25, GREEN6 96-30, GREEN6 96-40, GREEN6 96-50, GREEN 96-60, GREEN6 96-65, GREEN6 96-70, GREEN6 96-75, GREEN8 96-80, GREEN8 96-100, GREENX 96-125, GREENX 96-150

do której to oświadczenie się odnosi jest zgodna z wytycznymi Dyrektywy Rady Unii Europejskiej w sprawie zbliżenia ustawodawstw Państw Członkowskich:

co do Dyrektywy Kompatybilności Elektromagnetycznej (EMC), 2014/30/WE Parlamentu Europejskiego i Rady z 26 lutego 2014 w sprawie zbliżenia ustawodawstw Państw Członkowskich dotyczących kompatybilności elektromagnetycznej i uchylającej Dyrektywy 89/336/EWG, zgodność jest zachowana przestrzegając poniższych norm:

- EN IEC 61000-6-2: 2019 - *Część 6-2: Normy ogólne – Odporność w środowiskach przemysłowych*
- EN 61000-6-4: 2007 + A1:2011 - *Część 6-4: Normy ogólne – Emisyjność w środowiskach przemysłowych (Odporność – Kategoria II)*

co do Dyrektywy Niskiego Napięcia 2014/35/WE Parlamentu Europejskiego i Rady z 26 lutego 2014 w sprawie zbliżenia ustawodawstw Państw Członkowskich dotyczących materiału elektrycznego przeznaczonego do obróbki w wyznaczonych granicach napięcia, zgodność jest zachowana przestrzegając poniższych norm:

- EN 60335-1:2012 + A11:2014 + A13:2017 „ *Elektryczny sprzęt do użytku domowego i podobnego Bezpieczeństwo użytkowania - Część 1: Normy ogólne"*
- EN 62233: 2008 *„ Metody pomiaru pól elektromagnetycznych elektrycznego sprzętu do użytku domowego i podobnego z uwzględnieniem narażania człowieka"*

Crevalcore 16 – 06 - 2021

Sergio Poletti
Prezes

S.P.E. ELETTRONICA INDUSTRIALE di Poletti Sergio
Via di Mezzo Ponente n.383/B
40014 Crevalcore (Bologna)
Partita IVA
Codice Fiscale

تعليمات هامة للسلامة. احتفظ بهذه التعليمات. يحتوي هذا الدليل على تعليمات هامة لسلامة المُستخدم ولتشغيل الجهاز.

تحذيرات عامة

1) من الضروري قراءة واتباع التعليمات المُقدمة فيما يلي بعناية قبل كل استخدام لشاحن البطارية.
2) قد يؤدي عدم مراعاة التعليمات التالية وارتكاب أخطاء في مرحلة التركيب وعند استخدام شاحن البطارية أو أي من تلك الأمور إلى تعريض المُشغِّل إلى مخاطر ووقوع أضرار بالجهاز أو أيهما مما يبطل ضمان الشركة المُصنِّعة.
3) لا يجوز استخدام شاحن البطارية كمكون في أجهزة دعم الحياة والأجهزة الطبية أو أيهما.
4) يجب أن تكون لوحة البيانات مرئية بعد التركيب.

الأطفال

5) يُمكن استخدام هذا الجهاز من قِبل الأطفال الذين تتجاوز أعمارهم 8 أعوام، ومن قِبل الأشخاص ذوي الاحتياجات النفسية أو الجسدية أو الحسية أو دون الخبرة أو الدراية الكافية إذا تم الإشراف عليهم عن كثب أو منحهم تعليمات استخدام الجهاز بشكل آمن وكانوا مدركين للأخطار المحتملة. الشاحن ليس لعبة ولا يجب التعامل معه على هذا النحو.
يجب ألا تتم عمليات التنظيف من قِبل أطفال دون إشراف عليهم.

مكان التركيب

6) تجنَّب تمامًا وضع الشاحن في المنطقة المجاورة مباشرة للبطارية، وذلك لتجنب أن تؤدي الغازات المُنتَجة و \ أو المنبعثة من البطارية إلى تآكل و \ أو تلف الشاحن. ضع الشاحن بعيدًا قدر الإمكان عن البطارية إلى الحد الذي يسمح به طول الكابلات.
7) لا تركب الشاحن في منطقة مغلقة أو تمنع التهوية بطريقة أو بأُخرى. بالنسبة للأجهزة المزودة بمراوح، يجب ترك مساحة فارغة تبلغ على الأقل 03 ملم حول مداخل الهواء. بالنسبة للتركيب في وضع عمودي، انظر التعليمات الواردة في الصفحة 01.
8) لا تستخدم الشاحن في الهواء الطلق.
9) لا تُعرِّض الشاحن إلى المطر أو دفعات المياه أو مصادر البخار.
10) لا تركب الشاحن على كرفانات ومركبات مماثلة أو أيهما.
11) لا تركب الشاحن بالقرب من مصادر الحرارة أو أماكن كثيفة الأتربة.
12) لا تركب الشاحن بالقرب من مصادر محتملة لمادة قابلة للاشتعال مثل أنابيب الغاز الطبيعي أو مستودعات الوقود (البنزين والكيروسين وغير ذلك).

13) لا تضع الشاحن وتثبته أو أي منهما على أسطح دعم مصنوعة من مواد قابلة للاشتعال مثل الأرفف والجدران الخشبية أو أيهما.

البطاريات

14) اتبع بعناية تعليمات السلامة الخاصة التي تقدمها الشركة المُصنِّعة للبطارية، على سبيل المثال ما إذا كان عليك إزالة أو عدم إزالة أغطية الخلايا أثناء الشحن وطرق الشحن الموصي بها.
15) العمل على مقربة من بطارية رصاص حمضية أمر خطير حيث تولِّد البطاريات غازات متفجرة أثناء دورة إعادة الشحن. لذا يلزم تجنُّب التدخين وتوليد لهب مكشوف وشرر أو أي من تلك الأمور.
16) لا تشحن بطارية مُجمَّدة.
17) يجب أن تتم إعادة شحن البطاريات في أماكن مُخصصة جيدة التهوية.
18) للحدّ من أخطار الحوادث، لا تشحن إلا بطاريات رصاص حمضية، أو جل «GEL»، أو حصير الامتصاص الزجاجي «AGM»، أو ليثيوم بوليمر أو ليثيوم أيون. لا تعد شحن أي أنواع أُخرى من البطاريات القابلة أو غير القابلة للشحن لأنها قد تنفجر مما يتسبب في أضرار بالممتلكات وإصابة الأشخاص أو أيهما.

مواصفات إضافية لبطاريات الليثيوم

19) لإعادة شحن بطاريات ليثيوم بوليمر أو ليثيوم أيون، يجب أن يتواجد دائمًا «BMS» (نظام إدارة البطارية) يشتمل على نظام أمان إيجابي وسلبي وفقًا لقواعد السلامة المعمول بها.
20) إمكانية عمل نظام الـ «BMS» مباشرة على وظائف الشاحن أثناء مرحلة موازنة الخلايا تستبعد في جميع الأحوال وجود مسؤولية مباشرة للشاحن إذا كانت الأضرار التي لحقت بالبطارية، أو حتى الحريق أو الانفجار، ترجع إلى خطأ في برنامج الـ «BMS».
21) تخضع الإمكانيات التي توفرها المواد التي تنتجها شركة « S.P.E ELETTRONICA INDUSTRIALE» لاختيار مستويات مختلفة من جهد الشحن، إلى فحص وإدارة المُستخدم النهائي، ولا تتحمل شركة «S.P.E ELETTRONICA INDUSTRIALE» أي مسئولية عن أي عواقب ناجمة عن اختيار مستوى جهد خاطئ. في حالة الشك، يتعين على المُستخدم أن يطلب توضيحات من مهني مؤهل.
22) تعد حدود تحمل الشاحن فيما يتعلق بمستويات الجهد الزائد والحمولة الزائدة عملية فقط لحماية أنظمته، وليس لديها أي وظيفة أمان للبطارية المتعلقة بها، وتعتمد سلامتها على نظام الـ «BMS" فحسب وأيضًا عندما يكون الشاحن متصلاً بالبطارية سواء كانت الأخيرة في مرحلة إعادة الشحن أم لا.

23) في حالة ما إذا أراد العميل استخدام شاحن البطارية في نظام مدمج خاص أو بشكل عام في جميع حالات الاستخدام الخاص، يتعين على العميل إبلاغ شركة «S.P.E. Elettronica Industriale» حتى تتمكن الشركة من وضع التوصيات عند الاقتضاء. في هذه الحالة، يجب على العميل أن يقدم لشركة «S.P.E. Elettronica Industriale» أي مشروع ومخطط وعنصر وصفي ضروري. لا يجوز اعتبار شركة «S.P.E. Elettronica Industriale» مسؤولة عن أي ضرر ناجم عن استخدام الشاحن بعد فتحه وتعديله ودمجه في نظام آخر أو أي من تلك الأمور.
24) لا يجوز اعتبار شركة «S.P.E. Elettronica Industriale»، في أي حال من الأحوال، مسؤولة عن تلف البطاريات أو نشوب حريق بها \ انفجارها بما أن أمان البطاريات
هو وظيفة نظام الـ «BMS» وليس الشاحن.

فحص الكابلات والشبكة والمآخذ الأرضية

25) لا تنقل الشاحن بتحريكه من الكابلات لأنها قد تتلف. استخدم المقابض المُخصصة إذا وجدت.
26) قبل استخدام الشاحن، من الضروري التحقق من سلامة أغلفة عزل كابل التوصيل بشبكة التغذية وكابلات البطارية. في حالة تلف أحد الكابلات، يجب أن يستبدله فني مؤهل من شركة «SPE ELETTRONICA INDUSTRIALE».
27) تحقق من أن جهد مدخل الشاحن المُشار إليه على لوحة البيانات يوافق جهد التغذية المتاح.
28) تأكد من توافق قابس الشبكة المرفق بالشاحن: لا ننصح باستخدام محولات (يُمنع استخدامها في كندا). هذا الشاحن مزود بمجموعة من الكابلات للتوصيل بمأخذ تيار 120 فولت اسمي (أو 240 فولت). إذا كان القابس غير متوافق مع مأخذ التيار، اتصل بشركة «SPE ELETTRONICA INDUSTRIALE» لطلب كابل بقابس مناسب للمأخذ.
29) يجب توصيل الشاحن بمأخذ تيار مزود بموصل أرضي. في حالة ما إذا كان المأخذ غير مُخصص للتأريض، لا تستخدم الجهاز قبل أن يركب فني مؤهل مأخذ مناسب.
30) يجب أن يكون مأخذ التيار الذي يتصل به الشاحن محميًا بواسطة جهاز كهربائي وفقًا للقانون (منصهر وقاطع تلقائي أو أيهما) مُصمم لتيار كهربائي مساوي لاستهلاك التيار الموضح على الرقم التسلسلي لشاحن البطارية بزيادة 10%.
31) لا تفتح الشاحن حيث لا يوجد داخله أي مكونات يُمكن للمستخدم إصلاحها أو استبدالها أو كلاهما. يُمكن فقط لأفراد مُتخصصون ومُصرح لهم من شركة «S.P.E. Elettronica Industriale» أن يقوموا بتدخلات تتطلب فتح الجهاز نفسه. يوجد بالداخل مكونات كهربائية / إلكترونية قد تتسبب في تفريغ كهربائي حتى لو لم يكن الجهاز متصلا مأخذ التيار.

فحص وظائف الشاحن والمنحنى

32) قبل الشحن، تأكد من أن الشاحن يوافق جهد البطارية، وأن تيار الشحن مناسب لقدرة البطارية، وأن ديناميكية الشحن المُختارة (لبطاريات الرصاص الحمضية أو البطاريات المختومة «GEL» أو «AGM» أو بوليمرات الليثيوم أو أيون الليثيوم) صحيحة لنوع البطارية المُراد شحنها.

33) نوصي بأن يتوسط مُنصهر بين الشاحن والبطارية. يجب أن يتم تركيب المنصهر على امتداد التوصيل بالطرف الموجب للبطارية. يجب أن تكون قيمة المنصهر مضبوطة وفقًا للتيار الاسمي لمخرج البطارية ومقطع الكابل المُستخدم والبيئة التي تم التركيب فيها.

34) نوصي بفصل التغذية عن الشبكة الكهربائية قبل القيام بالتوصيل أو الفصل عن البطاريات.

35) أثناء التشغيل العادي للشاحن، يُمكن أن ترتفع درجة حرارة السطح الخارجي، وقد تظل على هذا الحال لفترة زمنية معينة أيضًا بعد إيقاف تشغيله.

36) لا يحتاج الشاحن إلى أي عمليات صيانة خاصة، بل فقط عملية تنظيف عادية يتعين القيام بها بشكل دوري على أساس نوع بيئة العمل. يجب ألا تتم عمليات التنظيف إلا على السطح الخارجي للشاحن. قبل البدء في عمليات التنظيف، يلزم فصل كابل التغذية عن الشبكة الكهربائية وكابلات التوصيل بالبطاريات. للقيام بالتنظيف، نوصي بعدم استخدام المياه و \ أو المنظفات بشكل عام و \ أو منظفات الضغط العالي من أي نوع.

في حالة عدم الاستخدام

37) في حالة عدم إمكانية ضمان تشغيل الشاحن في ظروف آمنة، قم بإيقاف الجهاز وتأكد من ألا يتم تشغيله مجددًا.

موديل البطارية = حمض الرصاص، الجل، "AGM»، الليثيوم
عدد الخلايا = 12-18-24-36-48

تنبيـه: خطر اندلاع حريق. قم بشحن بطاريات «LEAD-Acid» والجل و«AGM» والليثيوم. بالنسبة لبطاريات الليثيوم: استخدم فقط مجموعات البطارية التي تتضمن نظام «BMS» وجميع أشكال الحماية الضرورية المضمنة في مجموعة البطارية.

خطر: خطر الصدمة الكهربائية. لا تلمس الأجزاء غير المعزولة من موصلات المخرج أو أطراف البطارية.

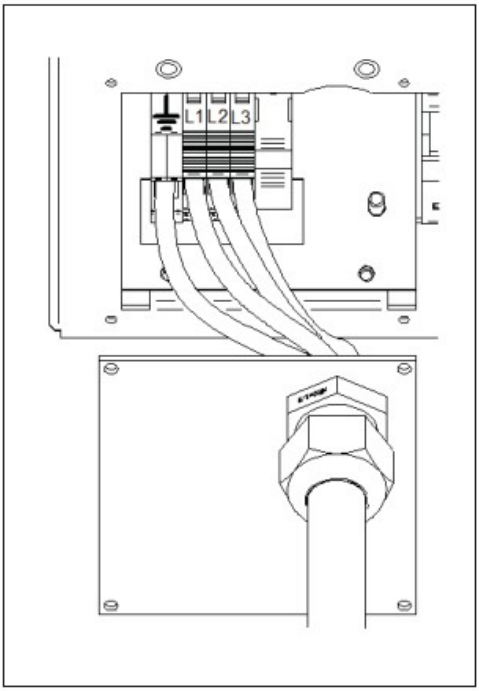
تنبيه: خطر اندلاع حريق. استخدم فقط الدوائر المرفقة بقدرة _____ أمبير. حماية الدائرة وفقًا للقانون الوطني للكهرباء، NFPA 70».

ملاحظات: تخضع المواصفات الواردة في هذا الكتيب إلى تعديلات دون إشعار مُسبق. هذا المنشور يحل محل أي معلومات سبق تقديمها.

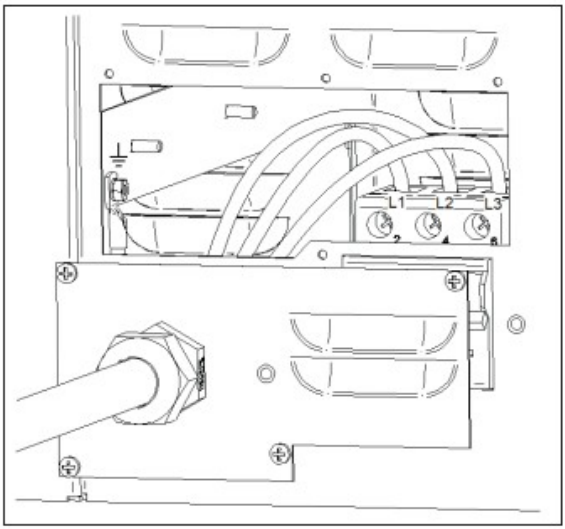
GREEN 6 - GREEN8 - GREENX
شاحن عالي التردد

التوصيل بالشبكة

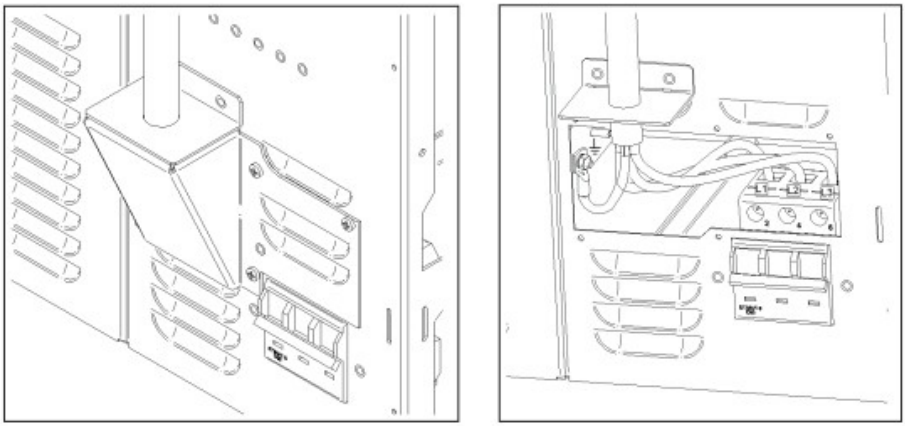
يجب أن يتصل الشاحن المُركَّب بمأخذ ذي قدرة مناسبة له؛ وأن يتم التحقق من البيانات المُشار إليها على ملصق الرقم التسلسلي:



التوصيل الرئيسي



التوصيل البديل



توصيل الكابلات بالقناة الكهربائية

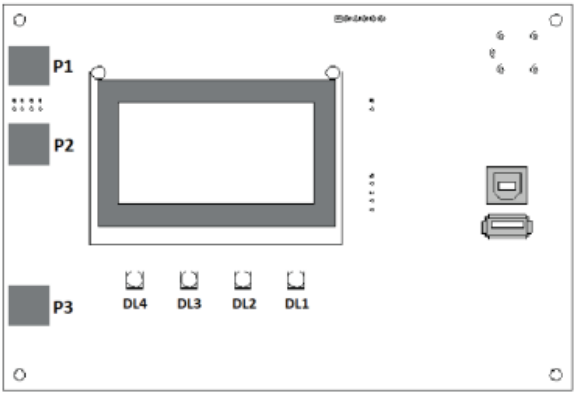
التوصيل بالبطارية

نوصي باستخدام الموصلات ثنائية الأقطاب المناسبة شريطة ألا تسمح بتبادل قطبية البطارية؛ وتأكد من التوصيل الصحيح للكابلات بعناصر اتصال الموصلات.

يجب أن يتم هذا الإجراء من قبل موظفين مُتخصصين.

الإشارات المرئية

تصف هذه الفقرة مشاهدة 4 مؤشرات ضوئية ليد خاصة بالحالة على مدار مراحل التشغيل المختلفة للشاحن.



المرجع	الوصف	المؤشر الضوئي الليد «DL4» (أخضر)	المؤشر الضوئي الليد «DL3» (أصفر)	المؤشر الضوئي الليد «DL2» (أخضر)	المؤشر الضوئي الليد «DL1» (أحمر)	الشاشة
S1	تغذية البطارية فقط	OFF	OFF	OFF	OFF	OFF
S2	تغذية الشبكة فقط	OFF	OFF	OFF	OFF	ON
S3	تغذية سواء البطارية أو الشبكة	ON	OFF	OFF	OFF	ON
S4	إجراء تشغيل تلقائي	BL	BL	BL	BL	ON
F1	المرحلة 1 -الشحن الأولي C1	BL	OFF	OFF	OFF	ON
F2-F7	المرحلة 2 -المرحلة 7	BL	ON	OFF	OFF	ON
F8	فترة المعادلة	ON	ON	ON	OFF	ON
EQU ON	شحن المعادلة عامل. (جاري)	BL	BL	ON	OFF	ON
					OFF	ON
EQU OFF	شحن المعادلة لا يعمل. (متوقف مؤقتًا)	ON	ON	ON	OFF	ON
M	الصيانة	BL	BL	ON	OFF	ON
FINE	انتهاء الشحن	ON	ON	ON	OFF	ON

حيث أن:

OFF = المؤشر الضوئي لليد مطفأ.

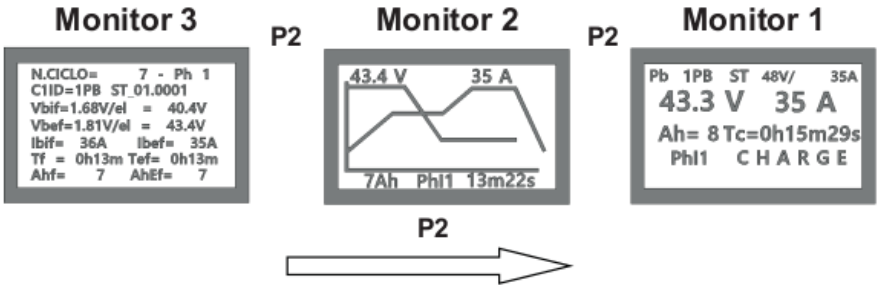
ON = المؤشر الضوئي لليد يعمل بضوء ثابت

BL = المؤشر الضوئي لليد يومض (الفترة الفاصلة، 1 = T ثانية).

-- = المؤشر الضوئي لليد في أي حالة.

شاشة «LCD»

أثناء الشحن، يقدم الشاحن 3 قوائم للشاشة يُمكنك أن تتنقل خلالها بالضغط على الزر «P2» الذي سبق توضيح معناه بالتفصيل.



فيما يلي نذكر ملخص للمعلومات المُقدمة على التوالي في 3 عروض للشاشة.

MONITOR 1

RIGA	المثل	الوصف
(1)	Pb 1Pb ST 48V / 35A	تقنية البطارية، نوع المنحني، تقييم الشاحن
(2)	43,3 فولت 35 أمبير	فولطية وجهد البطارية
(3)	Ah= 8 Tc= 0h 15m 29s	أمبيرية الشحن، زمن الشحن بالساعات والدقائق والثواني
(4)	Ph1 CHARGE	مرحلة الشحن الجارية، حالة الشاحن
(5)	- Messages	(على سبيل المثال المرحلة = التشغيل التلقائي A0، الحالة = البطارية غير متصلة)

MONITOR 2

RIGA	المثل	الوصف
(1)	43,3 فولت 35 أمبير	فولطية وجهد البطارية الموردة
(2)		بيئات شحن بالبطارية مع الإرشادات • المراحل المنتهية (خط سميك) • المراحل الجارية (خط وامض) • المراحل التي يتعين القيام بها (خط رفيع)
(3)	7Ah Ph1 13m22s	أمبيرية الشحن، زمن الشحن بالساعات والدقائق والثواني
(4)	Message --	أي رسائل أعطال أو حالة

MONITOR 3

RIGA	المثل	الوصف
(1)	N.CYCLE= 7 – Ph 1	عدد دورات الشحن ومرحلة الشحن الجارية على سبيل المثال: دورة الشحن 5 والمرحلة 3
(2)	C1ID=1PB ST_01.0001	المعرّف الأوحد لمنحنى الشحن
(3)	Vbif=1.68V/el = 40.4V	فولطية البطارية في بداية المرحلة (Vbif) موضحة في البداية كفولطية الخلية (V/el) وبالتالي كالفولطية المطلقة (V).
(4)	Vbef=1.81V/el = 43.4V	فولطية البطارية في نهاية المرحلة (الجهد) (Vbif) موضحة في البداية كفولطية الخلية (V/el) ثم كالفولطية المطلقة (V).
(5)	Ibif= 36A Ibef= 35A	الجهد في بداية المرحلة (Ibif) والجهد في نهايتها (Ibef).
(6)	Tf =0h13m Tef=0h13m	زمن المرحلة الواحدة (Ibif) وزمن الشحن الإجمالي في نهاية المرحلة (Ibef).
(7)	Ahf= 7 AhEf= 7	الأمبيرية في الساعة المقدمة في المرحلة المختارة (Ahf) والأمبيرية في الساعة الإجمالية الخاصة بالشحن (AhEf).
(8)	Message --	تشير إلى أي خلل أثناء دورة الشحن.

الضمان

- يمتد ضمان الماكينة 12 شهرًا من تاريخ التركيب.
- يغطي الضمان التلف الناجم عن عيوب تصنيع أو تجميع مؤكدة.
- لا يشمل الضمان أي ضرر ناتج عن الاستخدام و \ أو التركيب غير الصحيح.
- يسقط الضمان في حالة اكتشاف أي عمليات عبث بالجهاز.
- في حالة وجود أي مشاكل، يُرجى التوجه إلى بائع معتمد أو مباشرة إلى شركة «S.P.E. Elettronica Industriale».

CE S.P.E. ELETTRONICA INDUSTRIALE

إعلان مطابقة الاتحاد الأوروبي «CE»

بموجب التوجيهات UNI CEI EN ISO/IEC 17050-1:2010

تعلن الموقعة أدناه شركة

«S.P.E ELETTRONICA INDUSTRIALE» لصاحبها بوليتي سيرجو «POLETTI SERGIO»

الكائنة في «Via di Mezzo Ponente, 383 -40014 Crevalcore"، بولونيا، إيطاليا

تحت مسؤوليتها الخاصة أن المنتج:

الشاحن الإلكتروني التلقائي موديل:

GREEN6 24 50, GREEN6 24 60, GREEN6 24 70, GREEN6 24 80, GREEN6 24 100, GREEN6 24 120, GREEN6 24 150, GREEN8 24 160, GREEN8 24 180, GREEN8 24 200, GREENX 24 300, GREEN6 36 80, GREEN6 36 100, GREEN6 36 120, GREEN6 36 150, GREEN8 36 200, GREEN6 48 25, GREEN6 48 40, GREEN6 48 50, GREEN6 48 60, GREEN6 48 70, GREEN6 48 80, GREEN6 48 90, GREEN6 48 100, GREEN6 48 120, GREEN6 48 130, GREEN6 48 150, GREEN8 48 160, GREEN8 48 180, GREEN8 48 200, GREENX 48 250, GREENX 48 300, GREEN6 72 30, GREEN6 72 50, GREEN6 72 60, GREEN6 72 80, GREEN6 72 100, GREEN8 72 130, GREEN6 80 30, GREEN6 80 40, GREEN6 80 50, GREEN6 80 60, GREEN6 80 80, GREEN6 80 100, GREEN8 80 110, GREEN8 80 120, GREEN8 80 130, GREENX 80 150, GREENX 80 160, GREENX 80 200, GREEN6 96 30, GREEN6 96 50, GREEN 96 60, GREEN6 96 65, GREEN6 96 75, GREENX 96 125, GREENX 96 150

الذي يشير إليه هذا الإعلان، مطابق لأحكام توجيهات الاتحاد الأوروبي المتعلقة بتقريب لوائح الدول الأعضاء:

فيما يتعلق بتوجيه التوافق الكهرومغناطيسي (EMC) -رقم 2014 / 30 / CE للبرلمان والمجلس الأوروبيين المؤرخ 26 فبراير \ شباط 2014 بشأن تقريب تشريعات الدول الأعضاء حول التوافق الكهرومغناطيسي وإلغاء التوجيه 89 / 336 / CEE، التوافق مثبت عند استيفاء المعايير التالية:

EN 61000-6-2:2019) - الجزء 6-2: المعايير العامة - الحصانة للبيئة الصناعية) 6102IEC 61000-6-2:

EN 61000-6-4:2007/A1:2011) + A1:2010 - الجزء 6-4: المعايير العامة - الانبعاثات للبيئة الصناعية (الحصانة - الفئة الثانية) 6002IEC 61000-6-4 +

فيما يتعلق بتوجيه الجهد المنخفض رقم 2014 / 35 / CE للبرلمان والمجلس الأوروبيين المؤرخ 26 فبراير \ شباط 2014 بشأن تقريب تشريعات الدول الأعضاء حول المعدات الكهربائية المُصممة للاستخدام في إطار حدود معينة للجهد، التوافق مثبت عند استيفاء المعايير التالية:

EN 60335-1:2012 + AC:2014 + A11:2014 + A13:2017
«سلامة الأجهزة الكهربائية ذات الاستخدام المنزلي أو ما شابه ذلك - الجزء 1: قواعد عامة»
IEC 60335-2-29:2016
«سلامة الأجهزة الكهربائية ذات الاستخدام المنزلي أو ما شابه ذلك - الجزء 2: المعايير الخاصة لشواحن البطاريات»
EN 62233:2008
«طرق قياس المجالات المغنطيسية للأجهزة الكهربائية ذات الاستخدام المنزلي وما شابه ذلك من ناحية تعرض الإنسان لها»

Crevalcore 21-02-2020

سيرجو بوليتي «Sergio Poletti»
الرئيس

중요 안전 지침. 이 설명서를 보관해 두십시오. 이 설명서에는 사용자의 안전과 장치 조작에 관한 중요한 지침이 포함되어 있습니다.

일반적인 경고

1) 배터리 충전기를 사용하기 전에 아래 나와 있는 지침을 주의 깊게 읽고 숙지해야 합니다.
2) 배터리 충전기를 설치하거나 사용할 때 이 지침 또는 오류를 따르지 않을 경우, 사용자가 위험하거나 장치가 손상되어 제조업체의 보증이 무효화될 수 있습니다.
3) 본 배터리 충전기는 생명 유지 장치 또는 의료 기기를 제공하는 시스템의 구성 요소로 사용할 수 없습니다.
4) 신체적, 감각적, 정신적 능력이 저하된 사람이나 기기에 대한 경험 또는 지식이 부족한 사람은 안전을 책임지는 사람의 감독 하에만 이 배터리 충전기를 사용해야 합니다.
5) 설치한 후에 등급 라벨이 잘 보이는 위치에 있어야 합니다

어린이

6) 이 기기를 사용할 수 있는 연령은 8 세 이상입니다. 신체적, 감각적 또는 정신적 능력이 저하되었거나 경험과 지식이 부족한 사람의 경우, 안전을 책임지는 사람의 감독 하에 사용하거나 안전한 기기 사용법에 관한 지시를 받아서 기기 사용과 관련된 위험을 숙지했을 때만 사용해야 합니다. 어린이가 이 기기를 가지고 놀지 않도록 감독해야 합니다. 어린이가 어른의 감독 없이 청소 및 사용자 유지보수 작업을 수행해서는 안 됩니다.

설치 위치

7) 충전 중에 실제 배터리에서 생성 또는 방출되는 가스로 인해 배터리 충전기가 부식 또는 손상되지 않도록 하려면, 배터리 충전기를 절대로 배터리 근처에 두지 마십시오. 최대한 케이블 길이만큼 배터리 충전기를 배터리에서 멀리 떨어뜨려 놓으십시오.
8) 밀폐된 공간이나 통풍을 막을 수도 있는 방식으로 배터리 충전기를 설치하지 마십시오. 팬이 장착된 장치의 경우 통풍구 주위에 30mm 이상의 여유 공간을 남겨 두어야 합니다. 배터리 충전기의 열 교환을 용이하게 하려면 고정 구멍(제공된 경우)을 이용하여 수직으로 배치해야 합니다.
9) 배터리 충전기를 옥외에서 사용하지 마십시오.

10) 배터리 충전기를 비나 증기에 노출시키거나 물이 튀지 않도록 하십시오.
11) 캠핑카 또는 이와 유사한 유형의 차량에 배터리 충전기를 설치하지 마십시오.
12) 열원 근처나 먼지가 많은 곳에 배터리 충전기를 설치하지 마십시오.
13) 예를 들어 메탄 가스 파이프나 연료 저장소(석유, 등유 등)와 같은 잠재적 인화성 물질 근처에 배터리 충전기를 설치하지 마십시오.
14) 나무 선반이나 벽과 같은 가연성 물질로 건축된 표면에 배터리 충전기를 놓거나 장착하지 마십시오.

배터리

15) 예를 들어 충전 중에 셀 캡을 벗길지 여부나 권장 충전율과 같이 배터리 제조업체가 제공한 특정 안전 지침을 주의해서 따르십시오.
16) 충전 중에는 배터리에서 폭발성 가스를 생성되므로 납산 밀폐형 배터리 근처에서 작업하는 것은 위험합니다. 따라서 흡연 또는 화염 또는 스파크 발생을 피해야 합니다.
17) 절대로 얼어 있는 배터리를 충전하지 마십시오.
18) 통풍이 잘 되는 특정 구역에서 배터리를 충전해야 합니다.
19) 부상의 위험을 줄이려면 납산 밀폐형, 젤이나 AGM 유형, 리튬 폴리머 또는 리튬 이온 배터리만 충전하십시오. 다른 유형의 충전식 배터리나 비충전식 배터리를 충전할 경우 폭발로 인해 기기 손상 또는 부상을 초래할 수 있습니다.

리튬 배터리에 대한 추가 사양

20) 리튬 폴리머 배터리나 리튬 이온 배터리를 충전하기 위해서는 항상 액티브 및 패시브 안전 시스템으로 구성된 BMS(배터리 관리 시스템)를 사용하여 시행 중인 안전 규정을 준수해야 합니다.
21) 셀 밸런싱 단계에서 배터리 관리 시스템이 배터리 충전기 작동에 직접 작용할 가능성은 배터리에 발생한 손상이나 화재나 폭발로 인한 손상, 배터리 관리 시스템 소프트웨어의 오류로 인한 손상 등 이유가 무엇이든 배터리 충전기에 대한 직접적인 책임에서 배제됩니다.
22) 충전할 때 다양한 레벨의 전압 중에서 선택할 수 있도록 한, S.P.E. ELETTRONICA INDUSTRIALE 에서 생산한 재료가 제공하는 기능을 제어하고 감독할 책임은 최종 사용자에게 있으며, S.P.E. ELETTRONICA INDUSTRIALE 은 잘못된 전압 레벨을 선택함으로써 발생하는 결과에 대해

책임지지 않습니다. 의심스러운 경우 자격을 갖춘 전문가에게 설명을 요청해야 합니다.

23) 과전압이나 과충전 레벨에 관한 한, 배터리 충전기 허용 오차 임계값은 임계값이 동일한 시스템을 보호하는 데만 사용될 뿐이며 배터리 자체를 위한 안전 기능은 없습니다. 배터리 충전기가 배터리에 연결되어 있더라도 배터리가 충전 중인지 여부와 관계없이 배터리의 안전은 배터리 관리 시스템이 단독으로 처리합니다.

24) 고객이 특정 온보드 시스템 및 일반적으로 특별한 용도로 배터리 충전기를 사용하려는 어떠한 경우라도 S.P.E. ELETTRONICA INDUSTRIALE 에 통보하는 것은 고객의 책임입니다. 그렇게 해야 S.P.E. ELETTRONICA INDUSTRIALE 이 필요한 권장 사항을 작성할 수 있습니다. 이때 고객은 필요한 모든 설계와 다이어그램 및 설명 자료를 S.P.E. ELETTRONICA INDUSTRIALE 에게 제공해야 합니다. S.P.E. ELETTRONICA INDUSTRIALE 은 배터리 충전기를 개봉, 개조 또는 다른 시스템에 삽입한 후 배터리 충전기를 사용함으로써 발생한 손상에 대해 책임지지 않습니다.

25) 어떠한 경우에도 S.P.E. ELETTRONICA INDUSTRIALE 은 배터리의 안전을 배터리 충전기가 아닌 배터리 관리 시스템이 담당하는 한에 있어서는 배터리의 오작동 또는 소각/폭발에 대해 책임지지 않습니다.

케이블, 그리드, 접지 확인하기

26) 케이블을 당겨서 배터리 충전기를 옮기지 마십시오. 케이블이 손상될 수 있습니다. 배터리 충전기에 핸들이 부착되어 있는 경우, 핸들을 잡아서 옮기십시오.

27) 배터리 충전기를 사용하기 전에 주 전원 케이블의 슬리빙과 배터리 케이블의 상태가 양호한지 확인하십시오. 케이블 중 한 개가 손상된 경우에는 S.P.E. ELETTRONICA INDUSTRIALE 전문 기술자에게 의뢰해 케이블을 교체해야 합니다.

28) 데이터 플레이트에 지정되어 있는 배터리 충전기 입력 전압이 사용 가능한 전압과 일치하는지 확인하십시오.

29) 배터리 충전기와 함께 제공된 주 전원 플러그의 호환성 여부를 확인하십시오. 어댑터는 사용하지 않는 것이 좋습니다(캐나다의 경우 법에 위배됨). 이 충전기에는 공칭 전압 120V(또는 240V) 로 작동하는 콘센트에 연결할 수 있는 코드 세트가 함께 제공됩니다. 입력 플러그가 전원 콘센트에 맞지 않을 경우, SPE ELETTRONICA INDUSTRIALE 에 전원 콘센트에 맞는 연결 플러그로 말단을

처리한 적합한 코드 세트가 있는지 문의하십시오. 전원 공급장치의 코드가 손상된 경우, 위험을 방지하려면 반드시 제조업체 기술자나 해당 제조업체의 서비스 대행업체 직원 또는 이와 동등한 자격을 갖춘 기술자가 교체 작업을 수행해야 합니다.
30) 배터리 충전기는 접지선이 달려 있는 소켓에 끼워야 합니다. 소켓에 접지 연결이 되어 있지 않은 경우, 자격을 갖춘 기술자가 적절한 소켓을 설치하기 전까지는 장치를 사용하지 마십시오.
31) 배터리 충전기가 연결되는 전원 소켓은 관련 법에 따라 전기 장치(퓨즈 또는 자동 안정기)에 의해 보호되어야 하며, 배터리 충전기의 허가 번호에 명시된 전류의 흡수량와 동일한 전류를 흡수할 수 있어야 하고 증분 단위는 10%입니다.
32) 이 배터리 충전기에는 사용자가 수리 또는 교체할 수 있는 부품이 없으므로 배터리 충전기를 열지 마십시오. 실제 장치를 열어야 하는 수리 작업은 반드시 S.P.E. ELETTRONICA INDUSTRIALE 로부터 승인받은 전문 기술자가 담당해야 합니다. 장치가 연결되어 있지 않았더라도 내부의 전기/전자 부품에 감전될 수 있습니다.

배터리 충전기 작동 및 충전 곡선 확인하기

33) 충전하기 전에 배터리 충전기가 배터리 전압과 일치하는지, 충전 전류가 배터리 용량에 맞는지, 선택한 충전 곡선(납산 밀폐형 배터리 또는 밀폐된 젤 또는 AGM 유형 배터리, 리튬 폴리머 또는 리튬 이온 배터리)이 충전할 배터리 유형에 맞는지 여부를 확인하십시오. 바닥 처리용 기계를 충전하는 경우 기계가 꺼져 있고 사용하지 않는 상태이어야 합니다.
34) 배터리 충전기와 배터리 사이에 퓨즈를 끼우는 것이 좋습니다. 퓨즈는 배터리의 양극 단자에 연결하여 설치해야 합니다. 퓨즈의 정격은 배터리 충전기의 정격 출력 전류, 사용하는 케이블 직경 및 설치할 환경에 비례해야 합니다.
35) 배터리를 연결하거나 분리하기 전에 주 전원에서 플러그를 뽑는 것이 바람직합니다.
36) 배터리 충전기가 정상적으로 작동하는 동안에는 외부 표면이 뜨거워져 전원이 꺼진 후에도 일정 시간 동안 열기가 남아 있을 수 있습니다.
37) 본 배터리 충전기는 작업 환경의 유형에 따라 특별한 유지보수를 수행할 필요가 없으며 정기적으로 청소만 하면 됩니다. 청소는 배터리 충전기의 외부 표면에서만 수행해야 합니다. 청소 절차를 시작하기 전에 주 전원 공급 케이블과 배터리 케이블을 분리해야 합니다. 일반 물, 세제 또는 어떠한 종류의 고압 세척기도 청소 작업에 사용하지 마십시오.

사용하지 않을 때

38) 배터리 충전기의 안전한 작동을 더 이상 보장 할 수 없을 경우 장치 사용을 중지하고 다시 작동하지 못하도록 하십시오.

배터리 유형 = 납산 밀폐형, 젤, AGM, 리튬
셀 번호 = 12-18-24-36-40-48

주의: 화재의 위험. 납산 밀폐형, 젤, AGM, 리튬 배터리를 충전하십시오. 리튬 배터리의 경우: 반드시 배터리 관리 시스템이 있는 배터리 팩과 배터리 팩에 필요하고 팩에 통합되어 있는 모든 보호 기능을 사용하십시오.

위험: 감전의 위험. 출력 커넥터의 비절연 부분이나 비절연 배터리 단자를 만지지 마십시오.

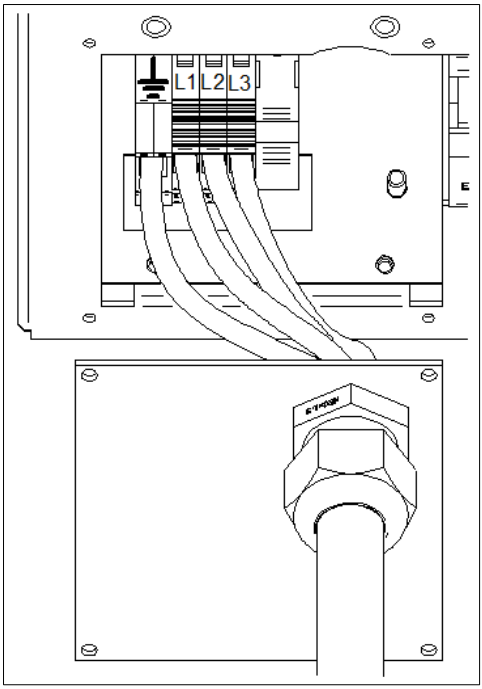
주의: 화재의 위험. 미국 국가 전기 코드(National Electrical Code), NFPA 70에 따라 _____ 암페어 분기 회로 보호 기능이 있는 회로에서만 사용하십시오.

참고: 이 설명서에 나와 있는 사양은 사전 통지 없이 변경될 수 있습니다. 이 발행물은 이전에 제공된 정보를 대체합니다.

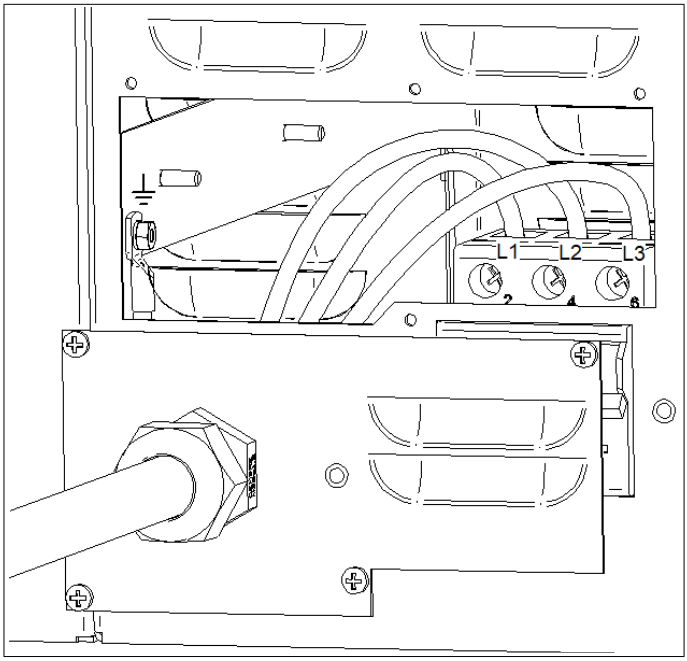
GREEN6 - GREEN8 - GREENX
고주파수 배터리 충전기

주 전원 연결

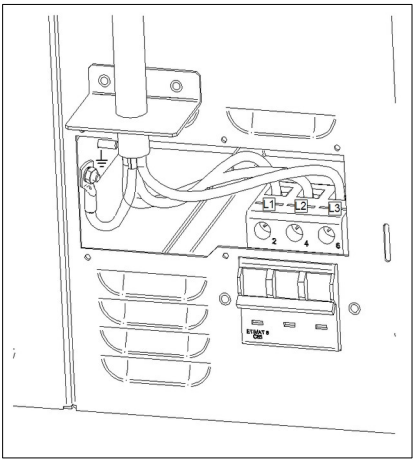
배터리 충전기는 충전기 전원에 비례하는 소켓에 연결해야 합니다. 정확한 내용은 충전기 측면에 있는 등급

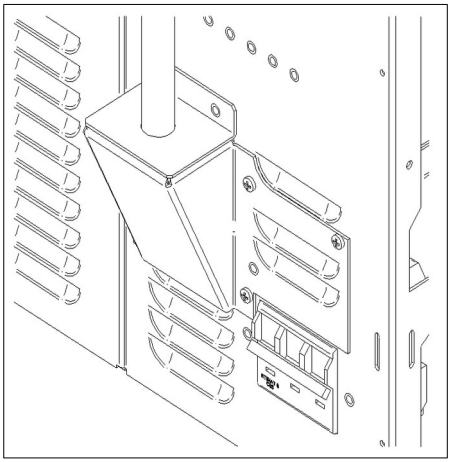


표준 주 전원 연결



대체 주 전원 연결





케이블 도관 배선 연결

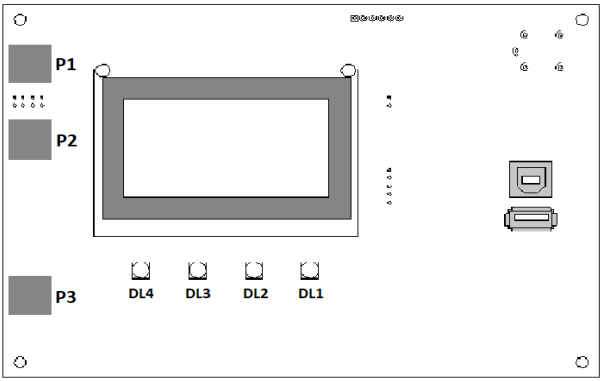
배터리 연결

이 배터리 충전기에는 배터리 커넥터가 함께 제공됩니다. 어쨌든 극성이 뒤바뀔 수 없는 적합한 규격 준수 양극 커넥터를 사용하는 것이 좋습니다. 배터리 리드가 커넥터 접점에 올바르게 압착되어 있고 배터리 커넥터에 제대로 삽입되어 있는지 확인하십시오.

이 절차는 반드시 전문 기술자가 수행해야 합니다.

육안 신호

이 단락에는 배터리 충전기의 각기 다른 작동 단계에서 표시되는 4 개의 상태 LED 표시에 대한 설명이 나와 있습니다.



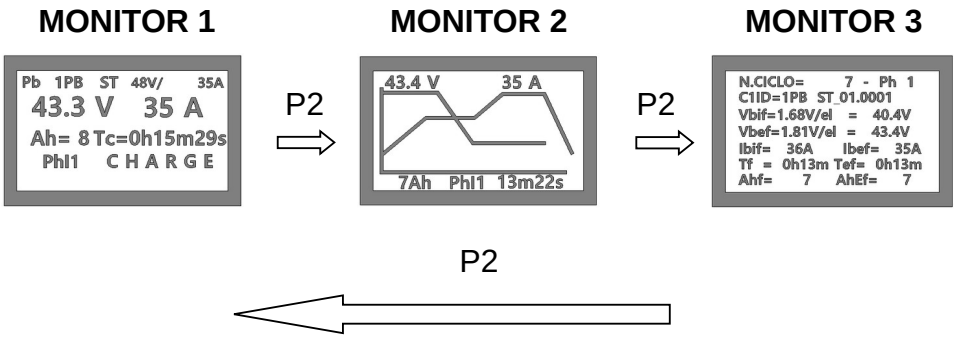
참조	설명	DL4 LED (녹색)	DL3 LED (노란색)	DL2 LED (녹색)	DL1 LED (빨간색)	디스플레이
S1	배터리 전원만 사용할 경우	OFF	OFF	OFF	OFF	OFF
S2	주 전원만 사용할 경우	OFF	OFF	OFF	OFF	ON
S3	주 전원과 배터리 전원 둘 모두 사용할 경우	ON	OFF	OFF	OFF	ON
S4	자동 시작(Autostart) 수행	BL	BL	BL	BL	ON
F1	단계 1 - 초기 충전 CI	BL	OFF	OFF	OFF	ON
F2-F7	단계 2 ~ 단계 7	BL	ON	OFF	OFF	ON
F8	이퀄라이제이션 기간	ON	ON	ON	OFF	ON
EQU ON	이퀄라이제이션 충전 켜짐 (진행 중)	BL	BL	ON	OFF	ON
					OFF	ON
EQU OFF	이퀄라이제이션 충전 꺼짐 (일시중지됨)	ON	ON	ON	OFF	ON

M	유지보수	BL	BL	ON	OFF	ON
END	충전 완료	ON	ON	ON	OFF	ON

위치:
OFF(꺼짐) = LED 꺼짐
ON(꺼짐) = LED 켜짐
BL(깜박거림) = LED 깜박거림(깜박거림, T=1 초)
- - = LED 가 아무 조건에나 있을 수 있음

LCD 디스플레이

충전이 진행되는 동안 배터리 충전기는 3 개의 모니터 메뉴를 제공하며, P2 버튼을 눌러서 메뉴 간에 이동할 수 있고 해당 메뉴의 자세한 의미는 이전에 설명되어 있습니다.

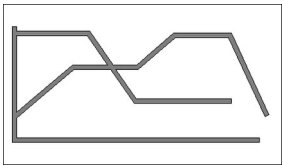


다음은 3 개의 모니터에 각각 제공된 정보 요약입니다.

MONITOR 1

행	예	설명
(1)	Pb 1Pb ST 48V / 35A	배터리 기술, 충전 곡선 유형, 배터리 충전기 등급
(2)	43,3 V 35A	배터리 전압 및 전류
(3)	Ah= 8 Tc= 0h 15m 29s	Ah 충전, 시/분/초 순서의 충전 시간 표시
(4)	Phl1 CHARGE	현재 충전 단계, 배터리 충전기 상태
(5)	-- 메시지	(예: 단계 = 자동 시작 A0, 상태= 배터리가 연결되지 않음)

MONITOR 2

행	예	설명
(1)	43,3V 35A	공급되는 배터리 전압 및 전류
(2)		표시가 있는 활성 충전 프로필: • 단계 완료(두꺼운 선으로 표시됨) • 단계 진행 중(선이 깜박거림) • 실행할 단계(가는 선으로 표시됨)
(3)	7Ah Phl1 13m22s	Ah 충전, 시/분/초 순서의 충전 시간 표시
(4)	-- 메시지	가능한 결함 또는 상태 메시지

MONITOR 3

행	예	설명
(1)	N.CYCLE= 7 – Ph 1	충전 사이클 수 및 현재 충전 단계 예: 충전 사이클 5 와 단계 3
(2)	C1ID=1PB ST_01.0001	충전 곡선 고유 식별
(3)	Vbif=1.68V/el = 40.4V	단계가 시작될 때의 배터리 전압(Vbif)은 처음에는 요소 전압(V/ el)으로 표시되고 나중에는 절대 전압(V)으로 표시됨
(4)	Vbef=1.81V/el = 43.4V	단계가 끝날 때의 배터리 전압(전류) (Vbef)은 처음에는 요소 전압(V/el)으로 표시되고 나중에는 절대 전압(V)으로 표시됨
(5)	Ibif= 36A Ibef= 35A	단계가 시작될 때의 전류(Ibif)와 단계가 끝날 때의 전류(Ibef)
(6)	Tf =0h13m Tef=0h13m	단일 단계에 걸리는 시간(Tf) 및 단계 종료 시에는 전체 충전 시간(Tef)
(7)	Ahf= 7 AhEf= 7	선택한 단계(Ahf)에 공급되는 Ah 및 전체 충전 Ah(AhEf)
(8)	-- 메시지	충전 사이클이 진행되는 중에 발생한 결함을 보여줍니다.

보증

- 이 기기의 보증 기간은 설치일로부터 12 개월입니다.
- 보증에는 제조 또는 조립 과정에서 결함이 발견된 부품이 포함됩니다.
- 잘못된 사용 또는 설치로 인한 손상에는 보증이 적용되지 않습니다.
- 훼손 부위가 발견될 경우 보증이 만료됩니다.
- 문제가 있을 경우 공인 대리점이나 S.P.E. Elettronica Industriale 로 직접 문의하십시오.

적합성 선언

당사, 즉

S.P.E. ELETTRONICA INDUSTRIALE DI POLETTI SERGIO
Via di Mezzo Ponente, 383 – 40014 Crevalcore (Bologna) ITALY

는 당사의 단독 책임 하에 이 선언이 적용되는 제품:

전자동 배터리 충전기 모델:

GREEN6 24-50, GREEN6 24-60, GREEN6 24-70, GREEN6 24-80, GREEN6 24-100, GREEN6 24-120, GREEN6 24-150, GREEN8 24-160, GREEN8 24-180, GREEN8 24-200, GREENX 24-250, GREENX 24-300, GREEN6 36-80, GREEN6 36-100, GREEN6 36-120, GREEN6 36-150, GREEN6 36-180, GREEN8 36-200, GREENX 36-250, GREENX 36-300, GREEN6 48-25, GREEN6 48-30, GREEN6 48-40, GREEN6 48-50, GREEN6 48-60, GREEN6 48-70, GREEN6 48-80, GREEN6 48-90, GREEN6 48-100, GREEN6 48-120, GREEN6 48-130, GREEN6 48-150, GREEN8 48-160, GREEN8 48-180, GREEN8 48-200, GREENX 48-250, GREENX 48-300, GREEN6 72-30, GREEN6 72-40, GREEN6 72-50, GREEN6 72-60, GREEN6 72-80, GREEN6 72-100, GREEN8 72-130, GREEN6 80-30, GREEN6 80-40, GREEN6 80-50, GREEN6 80-60, GREEN6 80-80, GREEN6 80-100, GREEN8 80-110, GREEN8 80-120, GREEN8 80-130, GREENX 80-150, GREENX 80-160, GREENX 80-200, GREEN6 96-20, GREEN6 96-25, GREEN6 96-30, GREEN6 96-40, GREEN6 96-50, GREEN 96-60, GREEN6 96-65, GREEN6 96-70, GREEN6 96-75, GREEN8 96-80, GREEN8 96-100, GREENX 96-125, GREENX 96-150

이 회원국 법률간의 조화에 관한 다음과 같은 유럽 연합 이사회 지침의 조항을 준수함을 선언합니다.

전자파 적합성 및 폐기 지침 89/336/EEC 에 관한 회원국 법률간의 조화에 관한 2014 년 2 월 26 일자 유럽 의회 및 이사회의 전자파 적합성(EMC) 지침 2014/30/EU 와 관련하여 다음 표준을 준수함으로써 적합성이 입증되었습니다.

- EN IEC 61000-6-2: 2019 – Part 6-2 부: 일반 표준 - 산업 환경에 대한 내성 표준 (방출)
- EN 61000-6-4: 2007 + A1:2011 - Part 6-4: 일반 표준 - 산업 환경에 대한 방출 표준 (내성 – 카테고리 II)

특정 전압 한도 내에서 사용하도록 설계된 전기 장비와 관련된 회원국 법률의 조화에 관한 2014 년 2 월 26 일자 유럽 의회 및 이사회의 초저전압(LVD) 지침 2014/35/EU 와 관련하여 다음 표준을 준수함으로써 그 적합성이 입증되었습니다.

- EN 60335-1:2012 + A11:2014 + A13:2017 "가전 기기 및 이와 유사한 전기 제품의 안전 – 1 부: 일반 요구사항"
- EN 62233: 2008 "인체 노출과 관련해서 가전 기기 및 이와 유사한 장치에서의 전자기장 측정 방법"

Crevalcore 16 – 06 - 2021

회장
세르지오 폴레티
Sergio Poletti

S.P.E. ELETTRONICA INDUSTRIALE di Poletti Sergio
Via di Mezzo Ponente n.383/B
40014 CREVALCORE (Bologna)
Partita IVA
Codice Fisc.

安全のための重要な指示。この説明書は大切に保管してください。この取扱説明書には、使用者の安全のための重要な指示と機器のしくみが説明されています。

一般的な注意

1) バッテリー充電器の毎回の使用前に、以下に説明されている指 示を注意して読み、守るようにしてください。
2) 本書に記載されている指示を守らない場合、 またはバッテリー充 電器の設置または使用に誤りがあった場合、操作する人に危険 を及ぼしたり、機器に損害を与えたりする可能性があるだけでな く、製造者による保証が無効になります。
3) バッテリー充電器は、生命維持装置や医療機器のコンポーネント として使用することはできません。
4) 身体、知覚あるいは精神障害をお持ちの方、権限および知識のな い方は、安全責任を持つ人による補佐や指導がない取り、本バッ テリー充電器を使用しないでください。
5) 定格銘板が見えるように設置してください。

子供

6) 本機器の安全な使用のしかたや危険について教えられ、注意深 く監視されているならば、8 歳以上の子供や心理•身体•感覚能力 の低い人や十分な知識•経験がない人も本機器を使用すること ができます。バッテリー充電器は玩具ではありませんので、玩具の ように扱ってはいけません。 清掃とメンテナンスは監視されていない状況で子供が実施して はなりません。

設置場所

7) 充電中にバッテリー自体から発生する気体がバッテリー充電器 を腐食させたり、損傷させたりしないように、 バッテリー充電器を バッテリーのすぐそばに置くことを避けてください。 バッテリー充 電器はケーブルの長さが許す限り、 バッテリーからできるだけ遠く に置くようにしてください。
8) バッテリー充電器は、閉めきった場所や風通しの良くない場所に 設置してはいけません。ファンが付いているバッテリー充電器に ついては、空気の取入れ口の周囲に少なくとも 30 mm の距離ま ではさえぎるものがないように

しなければなりません。垂直に設 置する場合は 10 ページに記載された指示を参照してください。
9) バッテリー充電器を屋外で使用してはいけません。
10) バッテリー充電器には、雨、水しぶき、蒸気がかかってはなりませ ん。
11) バッテリー充電器をキャンピングトレーラーやそれに類した車両 に設置してはいけません。
12) バッテリー充電器を熱源の近くやホコリの多い場所に設置しては いけません。
13) バッテリー充電器を、 メタンガス導管や燃料(ガソリン、石油など)の 置き場所など、引火性のある物質の近くに設置してはいけません。
14) バッテリー充電器を、棚や木製壁などの可燃性素材で作られた 板や台に置いたり、固定したりしてはいけません。

バッテリー
15) 充電中にキャップを取り外すべきかどうかや、推奨する充電の方 法など、バッテリーの製造者が出した安全のための指示を注意し て守るようにしてください。
16) バッテリーは爆発性の気体を発生させますので、鉛バッテリーの 充電中に近くで作業をすることは危険です。 したがって、喫煙や、 裸火や火花を生じることは避けてください。
17) 凍結したバッテリーを充電してはいけません。
18) バッテリーの充電は、風通しの良い、または、換気がある所定の 部屋でおこなう必要があります。
19) 事故の危険を減少させるために、鉛バッテリー、ゲルバッテリ ー、AGM バッテリー、 リチウムポリマーバッテリー、 リチウムイオン バッテリーのみを充電するようにしてください。他のタイプの電 池•バッテリーは、充電可能、不可能なものを問わず、物や人身に 損害を引き起こす可能性がありますので、充電しないでください。

リチウムバッテリーに関する追加の指示
20) リチウムポリマーバッテリーやリチウムイオンバッテリーを充電す るには、現行の安全に関する法規制に適合する、 アクティブ/パッ シブな安全シ

ステムを含めた BMS(バッテリーマネージメントシ ステム)が備えられている必要があります。

21) セルのバランス調整の段階で BMS が直接にバッテリー充電器を 動かすことができることは、 バッテリーによって引き起こされる損 害、火事や爆発のようなものまでが BMS のソフトウェアのエラー が原因である場合、バッテリー充電器に一切の直接的責任がな いことを意味します。
22) S.P.E. ELETTRONICA INDUSTRIALE はさまざまな充電の電 圧のレベルを持つ製品を提供していますが、どの製品を選択 するべきかは最終使用者が確認•監視するものであり、S.P.E. ELETTRONICA INDUSTRIALE は、誤った電圧レベルを選択する ことによって引き起こされた結果に対して、一切の責任を負いま せん。疑問がある場合は、使用者は専門家に説明を求める義務 があります。
23) バッテリー充電器の過電圧と過負荷のレベルに関する許容範囲 のしきい値は、 バッテリー充電器システム自体を保護するもので あり、
バッテリー自体の安全には関係していません。 バッテリーの 安全は、充電器がバッテリーに接続されている場合でも、 バッテリ ーが充電中であるかどうかに関係なく、BMS のみにかかっていま す。
24) お客様がバッテリー充電器を、特別なオンボード装置上でご使 用になられたい場合、あるいは一般的に特殊な使用のしかた をご希望の場合は、お客様の責任で、必要な指示を得るため に、S.P.E. ELETTRONICA INDUSTRIALE に前もって問い合わせ なければなりません。 この場合、
お客様は、 S.P.E. ELETTRONICA INDUSTRIALE に対して、 すべての設計書、図面、必要な説明を与 える必要があります。 S.P.E. ELETTRONICA INDUSTRIALE は、 バッテリー充電器の開封、変更、他のシステムへの組み込みによっ て引き起こされた一切の損害に対して責任を負うものではあり ません。
25) バッテリーの安全性はバッテリー充電器ではなく BMS にかか わるものである以上、バッテリーの故障、火事、爆発について は、S.P.E. ELETTRONICA INDUSTRIALE は、 いかなる場合にお いても責任を負うものではありません。

ケーブル、配線網、アースの点検

26) バッテリー充電器のケーブルをつかんで運搬することは、ケーブ ルを傷める原因となりますので、禁止されています。 取っ手がある 場合は、取っ手を使用して運搬してください。

27) バッテリー充電器を使用する前に、電源に接続するケーブルやバ ッテリーのケーブルの絶縁用がい装が良好な状態にあるかどう かを点検する必要があります。ケーブルに損傷が見られる場合 は、 S.P.E. ELETTRONICA INDUSTRIALE が許可した技術員に 交換させてください。

28) 定格銘板に示されているバッテリー充電器の入力電圧が、利用 する電源の電圧に対応するかどうかを確認してください。

29) バッテリー充電器に付属しているケーブルのプラグが使用できる かを確認してください。 アダプターの使用は推奨できません(カナ ダでは禁止されています)。 本充電器には、定格電圧 120 V(また は 240 V)の電源コンセントにつなぐためのケーブルのセットが付 属しています。 プラグが電源コンセントに適していない場合は、 お 使いの電源コンセントに適したプラグが付いたケーブルを請求 するために、SPE ELETTRONICA INDUSTRIALE にご連絡くださ い。

30) バッテリー充電器は、 アースが接続されている電源コンセントに 接続される必要があります。 コンセントにアースがない場合は、 有資格技術者が適切なコンセントを取り付けるまで、 バッテリー 充電器を使用してはなりません。

31) バッテリー充電器をつなぐ電源コンセントは、バッテリー充電器 の銘板に書かれている最大入力電流の 10%増の電流の消費の 規模に適した、法律で定められている電気機器(ヒューズまたは ブレーカー)によって保護されている必要があります。

32) 充電器の内部には使用者によって修理•交換ができるパーツ は存在しない以上、バッテリー充電器を開封してはいけません。 S.P.E. ELETTRONICA INDUSTRIALE が許可した専門員の みが、充電器の開封を必要とする修理等をおこなうことができま す。充電器の内部には、電源コンセントにつないでいない場合で も放電する可能性がある電気•電子パーツが存在します。

バッテリー充電器の機能と曲線の点検

33) 充電をする前に、バッテリー充電器がバッテリーの電圧に適して いるかどうか、充電電流がバッテリーの容量に適しているかどう か、選択した充電方式が充電するバッテリーのタイプ(鉛バッテリ ー、密封型ゲルバッテリー、AGM バッテリー、 リチウムポリマーバッ テリー、 リチウムイオンバッテリー)に適しているかどうかを確認 してください。
34) バッテリー充電器とバッテリーの間にはヒューズを取り付けるこ とを推奨します。 ヒューズは、 バッテリーの陽極側の接続部に沿っ て取り付けられる必要があります。 ヒューズの値は、 バッテリー充 電器の定格出力電流、使用するケーブルの断面の大きさ、取り付 けられる部屋によって左右されます。
35) バッテリーの接続または接続解除をおこなう前に、電源を切るこ とを推奨します。
36) バッテリー充電器が正常に機能している間に、外部表面が熱くな り、充電器を消した後もしばらくの間、熱いままにとどまる可能性 があります。
37) バッテリー充電器は特別なメンテナンスを必要としませんが、仕 事場のタイプに応じて定期的に通常の清掃作業をするようにして ください。
清掃作業はバッテリー充電器の外部表面のみに実施し てください。 清掃作業を実施する前には、電源ケーブルとバッテリ ー接続ケーブルを外してください。 清掃には、水、洗剤、 ウォーター ジェットクリーナーを一切使用してはなりません。 使用停止
38) バッテリー充電器が安全に機能することが保証されない場合は、 充電器を停止するとともに再び使用されないための処置をして ください。

バッテリーのタイプ = 鉛/ジェル/AGM/リチウムバッテリー
セルの数 = 6 – 12 – 18 – 24 – 36 – 40 – 48

注意: 火災の危険。 鉛/ジェル/AGM/リチウムバッテリーを充電し てください。 リチウムバッテリーについては、BMS と必要な安全装置 が備わっているバッテリーパックのみを使用してください。

危険: 感電の危険。 バッテリーの出力地点や端子周辺にある絶縁され ていない部分を触ってはいけません。

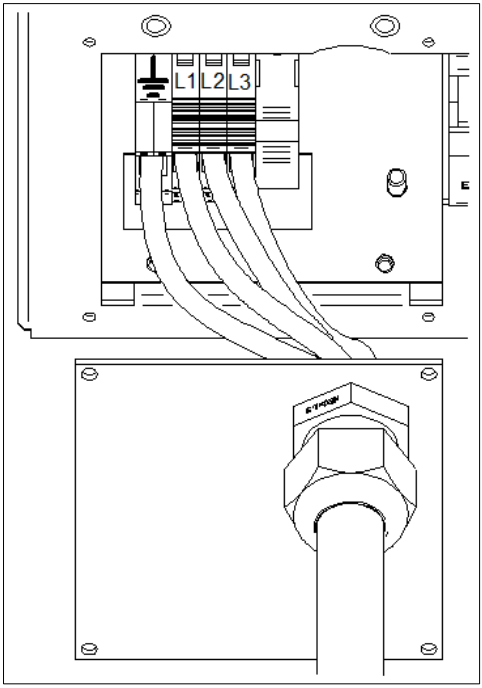
注意: 火災の危険。 _____アンペアの回路のみを使用してください。 全米防火協会による米国電気工事基準 NFPA70 に準拠する回路の プロテクション。

注記: 本取扱説明書に記載されている仕様は、予告なしに変更され ることがあります。本書は、 これまでに与えられた情報のすべてに取 って替わるものです。

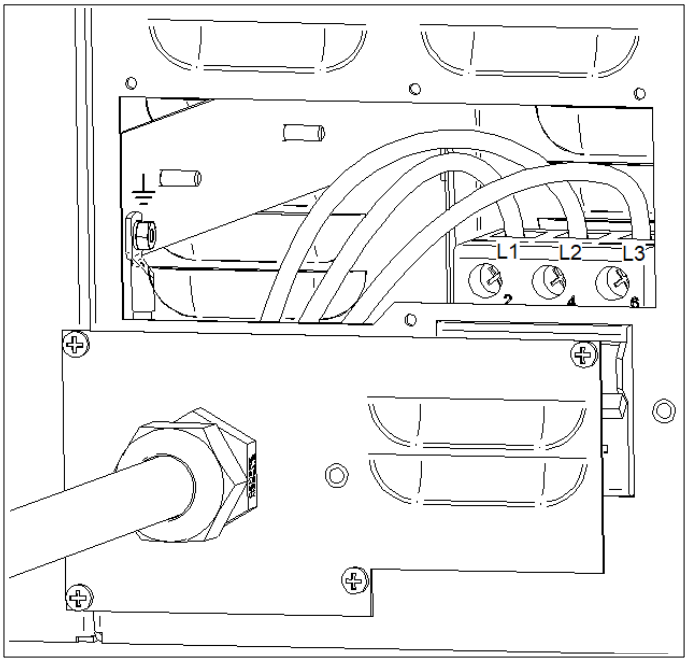
GREEN 6 - GREEN8 - GREENX
高周波バッテリー充電器

電源への接続

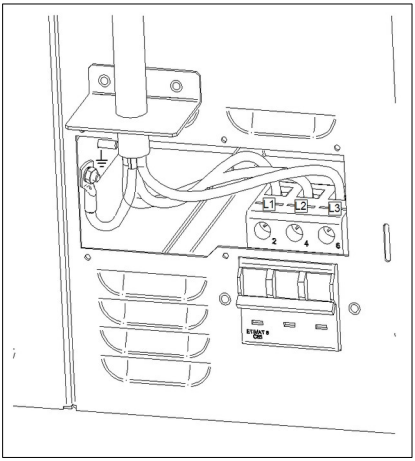
設置を終えたバッテリー充電器はバッテリー充電器に適した電力を持つコンセントにつない でください。 シリアルナンバーのラベルに記載されているデータを確認してください。

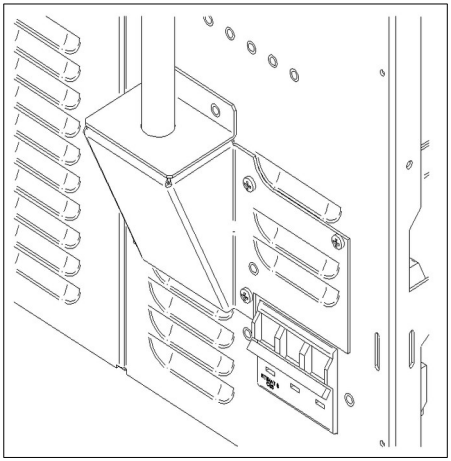


電源への標準のつなぎかた



電源への別のつなぎかた





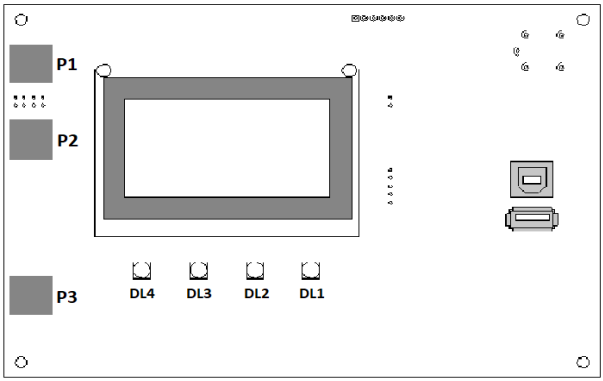
配線ダクトへのワイヤーのつなぎかた

バッテリーへのつなぎかた

バッテリーの転極を防ぐ、規格に準拠している所定の双極コネクターを使用してください。 ケ ーブル類がコネクターの接点に正しくつながれていることを確認してください。
この手順の実施は専門作業員のみに任せる必要があります。

視覚表示

この節では、 バッテリー充電器の各動作フェーズにおけるステータスを示す 4 つの LED ラン プの表示内容について説明します。



フェーズ	内容	LED DL4 (緑色)	LED DL3 (黄色)	LED DL2 (緑色)	LED DL1 (赤色)	ディスプレイ
S1	バッテリー電源のみ給電	OFF	OFF	OFF	OFF	OFF
S2	主電源のみ給電	OFF	OFF	OFF	OFF	ON
S3	バッテリー電源、主電源の両 方に給電	ON	OFF	OFF	OFF	ON
S4	オートスタートの実施	BL	BL	BL	BL	ON
F1	第 1 フェーズ – 初期充電(CI)	BL	OFF	OFF	OFF	ON
F2-F7	第 2 フェーズ – 第 7 フェーズ	BL	ON	OFF	OFF	ON
F8	均等化期間	ON	ON	ON	OFF	ON
EQU ON	均等充電 オン (進行中)	BL	BL	ON	OFF	ON
					OFF	ON
EQU OFF	均等充電 オフ (休止)	ON	ON	ON	OFF	ON
M	メンテナンス	BL	BL	ON	OFF	ON

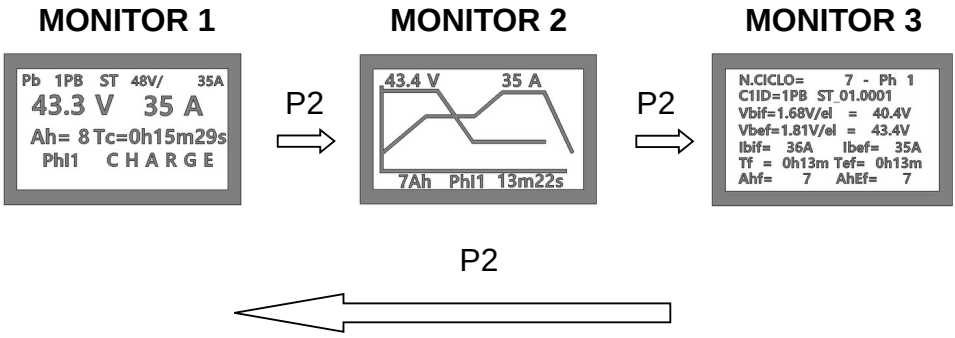
END	充電終了	ON	ON	ON	OFF	ON

読み方:

OFF = LED ランプは消灯
ON = LED ランプは点灯
BL = LED ランプは点滅(T = 1 秒の間隔)
- - = LED ランプの表示指定なし

液晶ディスプレイ

充電中は、 バッテリー充電器のディスプレイには 3 種類の画面が表示されます。 先に詳しく説 明した P2 ボタンを押すと画面が切り替わります。

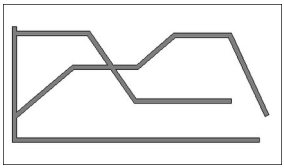


3 つの画面のそれぞれでは以下のようなデータが表示されます。

画面 1

行	例	内容
(1)	Pb 1Pb ST 48V / 35A	バッテリーの技術的な種類、曲線の種類、 バッテリー充電器の定格
(2)	43,3 V 35A	バッテリーの電圧と電流の値
(3)	Ah= 8 Tc= 0h 15m 29s	充電済みのアンペアアワー(Ah)、充電時間(時間、分、秒)
(4)	Phl1 CHARGE	現在の充電フェーズ、 バッテリー充電器のステータス
(5)	-- Messages	(例えば、 フェーズ = オートスタート A0、 ステータス= バッテリーが未 接続)

画面 2

行	例	内容
(1)	43,3V 35A	与えられたバッテリーの電圧と電流の値
(2)		バッテリー充電のプロファイル • 完了済みフェーズ (太線) • 進行中(点滅する線) • 実施待ちのフェーズ (細い線)
(3)	7Ah PhI1 13m22s	充電済みのアンペアアワー(Ah)、充電時間(時間、分、秒)
(4)	-- メッセージ	故障またはステータスを示すメッセージ

画面 3

行	例	内容
(1)	N.CYCLE= 7 – Ph 1	充電サイクルの番号と進行中の充電フェーズ 例:充電サイクルの番号 5、 フェーズ 3
(2)	C1ID=1PB ST_01.0001	一意性を持つ充電カーブのコード
(3)	Vbif=1.68V/el = 40.4V	フェーズ開始時の電圧 (Vbif) が、最初はエレメントの電圧 (V/el)、続 いて絶対電圧 (V) の形で表示されます
(4)	Vbef=1.81V/el = 43.4V	フェーズ終了時の電圧 (Vbif) が、最初はエレメントの電圧 (V/el)、続 いて絶対電圧 (V) の形で表示されます
(5)	Ibif= 36A Ibef= 35A	フェーズ開始時の電流 (Ibif) とフェーズ終了時の電流 (Ibef)
(6)	Tf =0h13m Tef=0h13m	個々のフェーズの時間 (Ibif) とフェーズ終了時の充電時間合計 (Ibef)
(7)	Ahf= 7 AhEf= 7	選択したフェーズで得た Ah (Ahf) と充電した Ah の合計 (AhEf)
(8)	-- メッセージ	充電サイクル中の故障を示します

保証

- 製品の保証期間は設置日から 12 か月です。
- 保証は発見された製造および組み立ての瑕疵に適用されます。
- 不適切な使用や設置が原因で引き起こされた損害には保証は適用されません。
- 製品の改ざんが発見された場合、保証は無効になります。

- 問題が生じましたら、 正規販売店または S.P.E. Elettronica Industriale まで直 接にお問い合わせください。

EC 適合
宣言書

以下に署名する

セルジョ•ポレッティの S.P.E. ELETTRONICA INDUSTRIALE
所在地 Via di Mezzo Ponente, 383 – 40014 Crevalcore (Bologna), Italy

は、弊社の単独責任のもとに、以下の製品:

以下の電子式自動バッテリー充電器のモデル:

GREEN6 24-50, GREEN6 24-60, GREEN6 24-70, GREEN6 24-80, GREEN6 24-100, GREEN6 24-120, GREEN6 24-150, GREEN8 24-160, GREEN8 24-180, GREEN8 24-200, GREENX 24-250, GREENX 24-300, GREEN6 36-80, GREEN6 36-100, GREEN6 36-120, GREEN6 36-150, GREEN6 36-180, GREEN8 36-200, GREENX 36-250, GREENX 36-300, GREEN6 48-25, GREEN6 48-30, GREEN6 48-40, GREEN6 48-50, GREEN6 48-60, GREEN6 48-70, GREEN6 48-80, GREEN6 48-90, GREEN6 48-100, GREEN6 48-120, GREEN6 48-130, GREEN6 48-150, GREEN8 48-160, GREEN8 48-180, GREEN8 48-200, GREENX 48-250, GREENX 48-300, GREEN6 72-30, GREEN6 72-40, GREEN6 72-50, GREEN6 72-60, GREEN6 72-80, GREEN6 72-100, GREEN8 72-130, GREEN6 80-30, GREEN6 80-40, GREEN6 80-50, GREEN6 80-60, GREEN6 80-80, GREEN6 80-100, GREEN8 80-110, GREEN8 80-120, GREEN8 80-130, GREENX 80-150, GREENX 80-160, GREENX 80-200, GREEN6 96-20, GREEN6 96-25, GREEN6 96-30, GREEN6 96-40, GREEN6 96-50, GREEN 96-60, GREEN6 96-65, GREEN6 96-70, GREEN6 96-75, GREEN8 96-80, GREEN8 96-100, GREENX 96-125, GREENX 96-150

という本宣言書の対象が、加盟諸国の法規の近似化に関する欧州連合理事会の指令にある以下の規定に適合することを宣言するものである:

89/336/EEC 指令を廃止する、2014 年 2 月 26 日の電磁両立性に関する加盟国の法律の近似化のための欧州議会並びに欧州閣僚理事会指令 2014/30/EU (EMC 指令)については、以下の規格が遵守された場合は適合性が証明されたことになる:

- EN IEC 61000-6-2: 2019 - 第 6-2 部: 一般規格 – 工業環境のイミュニティ規格
- EN 61000-6-4: 2007 + A1:2011 - 第 6-4 部: 一般規格 – 工業環境のイミ ュニティ規格 (イミュニティ – カテゴリー II)

2014 年 2 月 26 日の特定の電圧限度内での使用のために設計された電気機器に関する加盟国の法律の近似化のための欧州議会並びに欧州閣僚理事会指令 2014/35/EU (低電圧指令)については、以下の規格が遵守された場合は適合性が証明されたことになる:

- EN 60335-1:2012 + A11:2014 + A13:2017 「家庭用及び類似用途の電気機器-安全性-第 1 部: 一 般要求事項」
- EN 62233: 2008-04 「人の暴露に関連する家庭用及び類似用途の電気機器の電磁場の測定方法」

2021 年 06 月 16 日、
クレヴァルコレ市にて

Sergio Poletti
会長



S.P.E. ELETTRONICA INDUSTRIALE

600-006

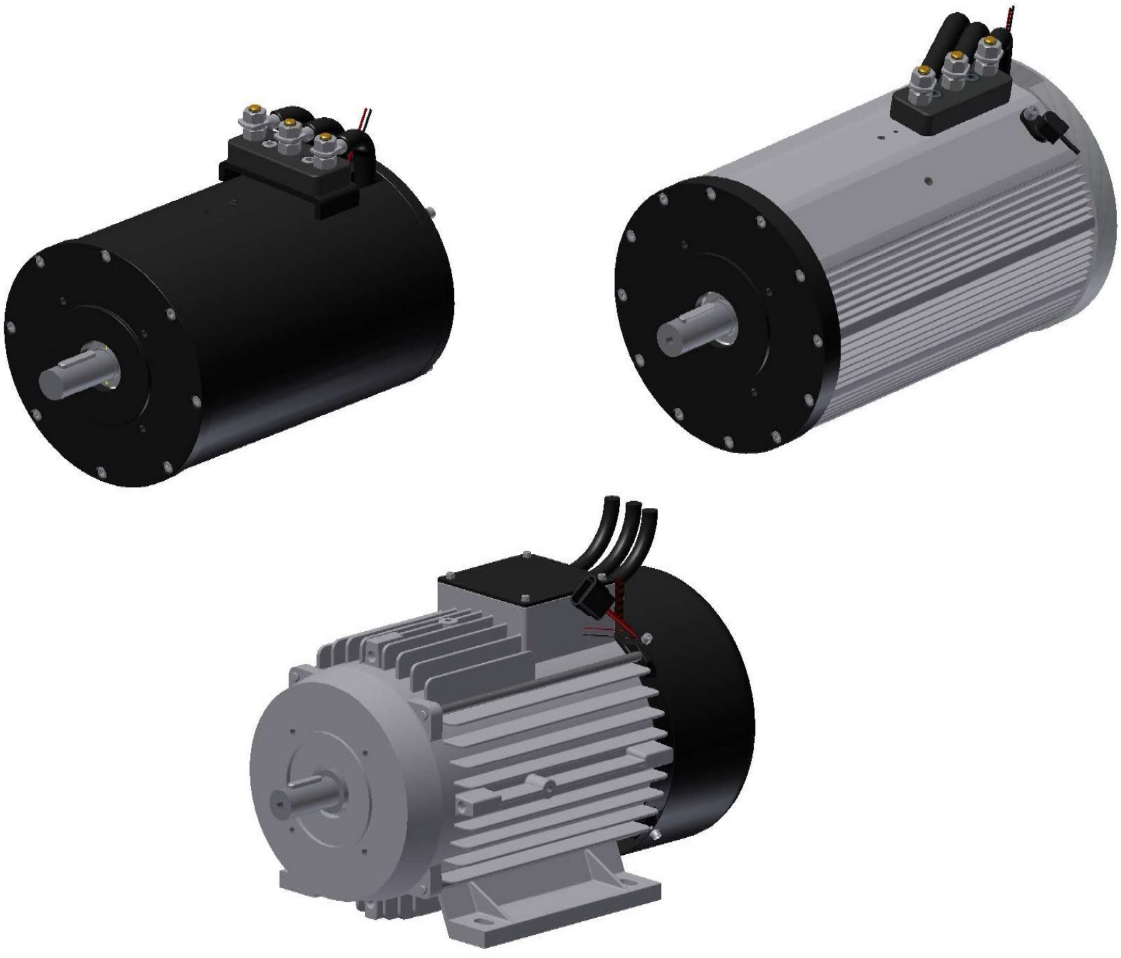
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TECHNICAL MANUAL

Asynchronous three-phase electric motors 24V to 144V type AM, AME, AMP



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1 INTRODUCTION

1.1 SYMBOLS ADOPTED



IMPORTANT:
Read the highlighted information with care, and follow instructions to the letter.



CAUTION
This symbol warns the reader to pay maximum attention to the highlighted information. Failure to follow instructions can result in serious damage to persons or to the product.



FORBIDDEN
Pay careful attention to the highlighted instructions.

1.2 GENERAL INFORMATION

It is important that all the precautions indicated in the manual are strictly observed. In the event that the expected conditions of use or technical data are not covered by this document, contact C.F.R. so that the application can be evaluated.
The purpose of this document is to provide the user with all the information needed to ensure correct selection and proper use of the products described.

	**Products must be used according to the methods described in this document, by persons who are properly trained for the purpose.**
	**Customers are responsible for ensuring correct selection and use of the product on the basis of their industrial and/or business needs.** **With the state of the art constantly evolving, C.F.R. reserves the right to update and improve the content of this literature at any time, making changes which however cannot be regarded as binding.** **Responsibility for the selection of the product lies ultimately with the Customer, unless otherwise agreed in writing between the parties.**

1.3 GENERAL SAFETY WARNINGS

	Asynchronous three-phase electric motors contain dangerous parts and carry various types of risk; consequently, it is essential to observe all the safety warnings indicated. The electric motor must be used only after proper training has been given and the following instructions have been read. Technicians entrusted with installation, commissioning, inspection, maintenance and repair operations must be suitably qualified and familiar with general safety regulations both in the country of origin and in the country where the product will be installed. They must also have received specific technical training that will enable them to identify and avoid every potential danger. In particular, maximum caution must be exercised in respect of live components, rotating parts and hot surfaces. The electric motor must not be operated in hostile environmental conditions. Be certain to abide by the parameters indicated in this manual. Important: • do not deactivate or tamper with protection devices; if safety systems are tampered with or by-passed, C.F.R. will acknowledge no liability for any damage that could occur as a result; • if an electric motor develops a fault and/or is not running smoothly, withdraw it from use and label it officially out of service. If repairs are required, contact C.F.R. Technical Assistance.
	An electric motor must not be installed in areas where potentially explosive atmospheres can be created or where there is a high fire risk. Commissioning of the motor must not proceed if the driven machine is found to be at variance with the pertinent directive.
	Always use appropriate items of personal protective equipment, e.g. gloves, safety eyewear, etc...
	Do not run the motor if it has become damaged during transport or assembly; in this instance contact C.F.R. for instructions on how to proceed. Use only original replacement parts or accessories, or in any event those authorized by C.F.R srl. If this condition is ignored, claims for repairs or damages will not be recognized. Avoid swallowing oil, grease or other material from the electric motor, and do not dispose of these items irresponsibly. Do not clean or wash the motor with solvents or pressurized water jets. These are actions that could damage the product. Do not clean the electric motor using flammable substances, and never use cleaning compounds that are corrosive or harmful to health. Do not apply paint to the electric motor. If in doubt on any point, contact CFR.

1.4 RESIDUAL RISKS

 	**Danger from moving parts** Take particular care to avoid any kind of physical contact with moving parts. Install control components that will allow the motor to be started and stopped both under normal operating conditions and in an emergency. Be careful to stop the motor and wait a few minutes before commencing maintenance operations, making certain that all moving parts have slowed to a complete standstill.
	**Danger from explosion and fire** Do not install the motor outdoors or in hostile environments without first checking the level of protection specified. An asynchronous motor can continue to carry voltage even after the stop control has been operated: after testing the earth system, for example, certain parts may present residual risks of explosion. Make certain live parts are completely safe before working on the motor.
	**Waterless fire extinguishers only** In the event of fire, put out flames only with extinguishers using powder or CO_2.
	**Danger of burns through contact with motor surfaces** Remember always to wait a few minutes after shutting down the machine before working on the motor, as some hot parts may not cool down immediately. Before starting up the motor, ensure that parts made of plastic or temperature-sensitive materials are shielded from sources of excessive heat.

1.5 INTENDED USE

C.F.R. electric motors are intended for incorporation into machines, generally for professional use, secured to fixed mountings such as the machine frame or baseplate and designed to cover the widest imaginable range of applications.

Electric motors are not normally designed for use in conditions exposed directly to the elements. If electric motors are to operate in hostile environments with notable levels of dirt, water splash, heat or humidity, they must be equipped with special guards. For applications requiring electric motors equipped with special protective enclosures, contact the C.F.R. sales office to ensure these are ordered correctly.

1.6 PROHIBITED USES

The intended use for C.F.R. electric motors is as described above. Any other uses not specifically indicated are prohibited.

The following are severely prohibited:

- Tampering with parts of the motor or fitting replacements not supplied by C.F.R.
- Use in environments where potentially explosive atmospheres can be expected.
- Connection to power sources and use in conditions other than those described in the technical specifications.

	The electric motor must absolutely not be used in an improper manner and/or operated before it has been definitively installed in and interfaced with the driven machine. Where electric motors are used for unsuitable or unspecified applications, warranty is automatically invalidated and C.F.R. will decline liability for any damage that may be caused to persons or property.

1.7 IDENTIFICATION OF OPERATORS

Given that certain activities essential to the use of electric motors involve the exposure of operators to specific risks (e.g. connections at installation), persons entrusted with the operations described in this document, from installation through to maintenance, must be properly trained in accordance with current statutory regulations.

1.8 WARRANTY CONDITIONS

The motors referred to in these instructions are guaranteed for 12 months from the date of consignment by C.F.R. Any warranty arrangements of a different nature or duration must be negotiated with C.F.R. and included in the agreed contractual conditions.

The warranty cover is limited strictly to cases of malfunction deriving from defects of manufacture, in accordance with the indications given in this document. C.F.R. acknowledges no liability for damage caused to machinery or systems in which the motor is installed. Warranty covers the repair or replacement only of defective motor parts. Warranty does not cover any defect attributable to installation, maintenance, cleaning or parts replacement procedures that have been performed incorrectly or ineffectively.

If a claim under warranty is acknowledged by C.F.R., the defective component will be replaced or repaired by the company's own staff. Warranty does not cover parts subject to normal wear and tear. Warranty claims will not be acknowledged in cases of incorrect installation or maintenance, tampering with the product, improper use, or damage sustained during transport, handling and storage. All transport costs incurred in returning the product to C.F.R. and restoring it subsequently to the customer are excluded from the warranty.

1.9 DECLARATION OF CONFORMITY AND INCORPORATION

The manufacturer:
C.F.R. srl, with registered office at Via Raimondo dalla Costa, 625, 41122 – Modena (MO) – Italy, in the person of its Legal Representative Mr Luciano Cottafavi

Declares under its own responsibility that products manufactured by the company under the name:

Asynchronous three-phase electric motors - type AM, AME, AMP.

to which this declaration relates, are in conformity where applicable with the following directives:

- 2014 / 35 / UE (low voltage),
- 2014 / 30 / UE (electromagnetic compatibility),
- 2006/42/CE (machinery), insofar as they meet applicable safety requirements and are capable of being incorporated into a machine

The electric motors are also in conformity with the following technical standards:

EN 60034-1
EN 60034-5
EN 60034-7

Furthermore:

- The technical file is held by C.F.R. srl with registered office at Via Raimondo dalla Costa 625, 41122 – Modena (MO) – Italy, in the person of its legal representative,
- C.F.R. undertakes to transmit information regarding its products, in response to any reasonable request from the national authorities. This undertaking is given in respect of the method of transmission and without prejudice to the intellectual property rights retained by the manufacturer of the product,
- **Electric motors must not be commissioned until the system or the machine into which they will be incorporated have been declared as being in conformity with the requirements of applicable directives.**

Modena, 05/05/2014

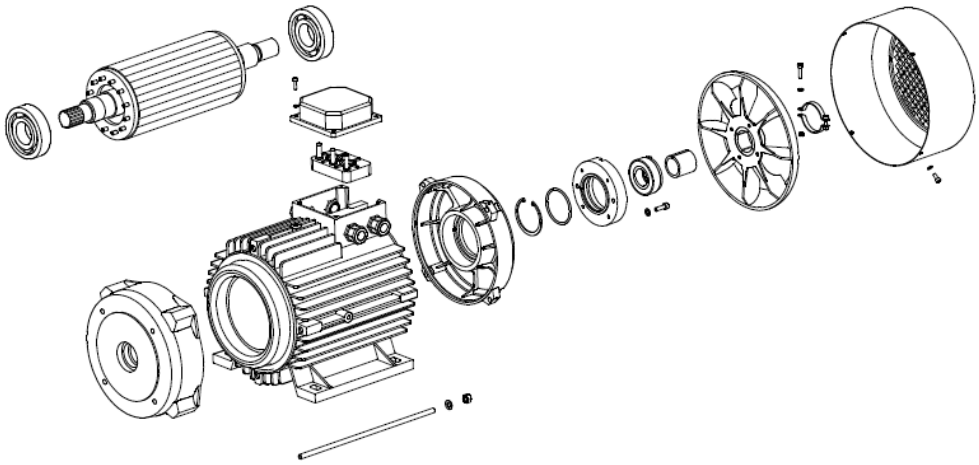
Signed

.....
Luciano Cottafavi
(Legal Representative of C.F.R. srl)

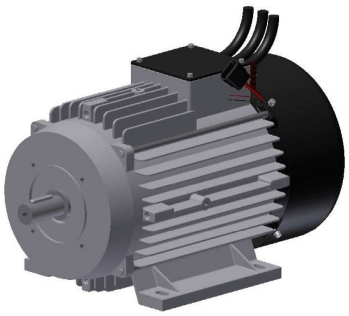
2 ASYNCHRONOUS MOTORS

2.1 DESIGN

These are asynchronous three-phase electric motors operating off a low voltage a.c. power supply, designed for general use in industrial applications.



Main parts of the motor:

		
Type AM: Steel case	**Type AME**: Extruded aluminium case	**Type AMP**: Pressure diecast aluminium case

- **Case:** can be made of aluminium, steel or cast iron**.**
- **Flanges and end covers**: can be made of aluminium, cast iron or steel.
- **Motor shaft**: always steel, with both male and female output configurations at the coupling end and at the end opposite. Special shafts can be supplied if requested by the customer.

- **Bearings**: these are double-shielded, grease lubricated radial ball bearings designed specifically for electric motors. Efficient lubrication is guaranteed at operating temperatures up to 100 °C maximum.

- **Stator winding**: the material used for all our motors is double-enamelled copper wire, insulation class H. Careful separation of phase windings (slots and end rings), safe insulation of “braid” (phase lead wires).

- **Rotor**: pressure diecast aluminium squirrel cage type; all rotors are balanced to eliminate vibration and noise.

- **Motor enclosure rating**: ingress protection from IP 00 to IP 66, on request.

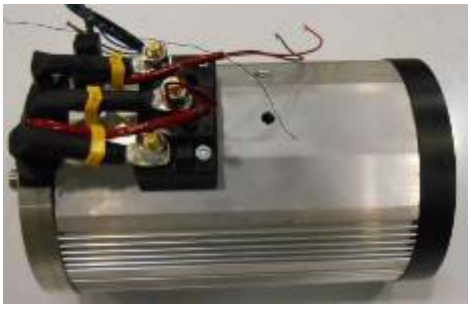


- **Terminal box enclosure rating**: motors can be supplied with terminal box or exit cables having ingress protection from IP 00 to IP 66





- **Ventilation**: motors can be supplied in non-ventilated (totally enclosed or with a few cooling holes) and self-ventilated versions.



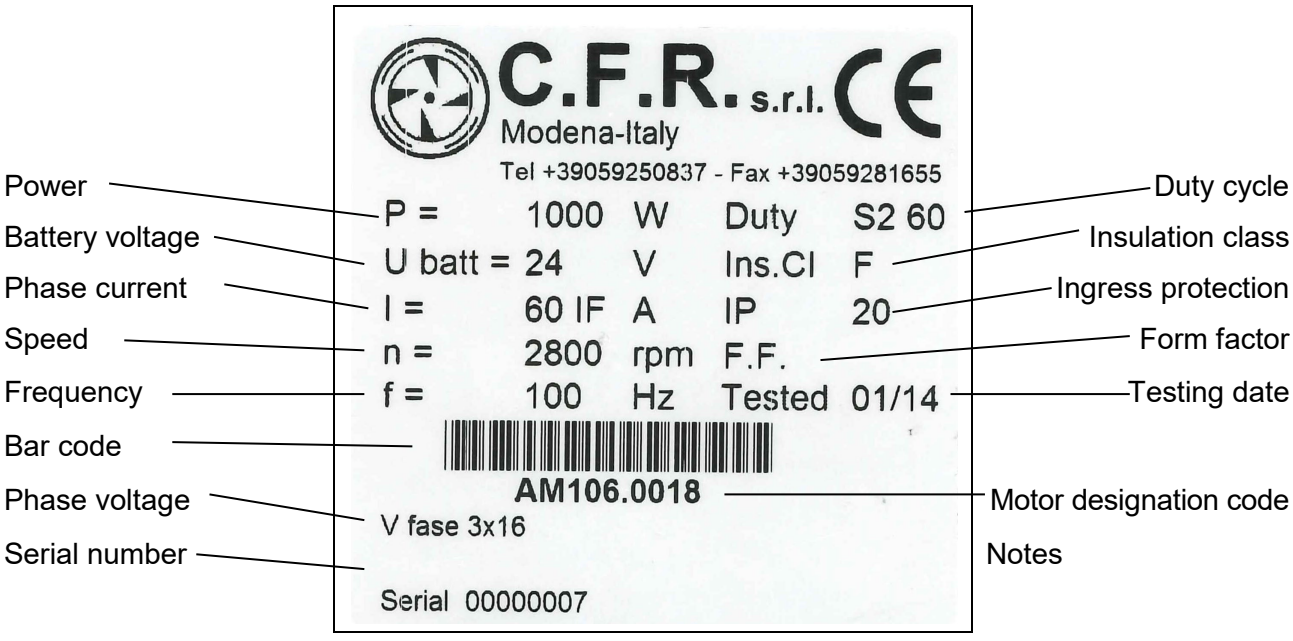


In addition, if requested, C.F.R. can supply:

- **Electromagnetic brakes:** The electromagnetic brakes supplied are generally negative acting: when the circuit is powered up, the brake releases; when powered off, the brake is applied**.**
- **Encoders:** 3 types of encoder are available currently, connectorized to customer specification if requested.
- **Bimetal thermal sensors:** normally closed or normally open, with temperature thresholds of 90 °C, 110 °C, 140 °C. Used to protect the motor from excessively high temperatures. Items supplied on request when ordering.
- **Mounting feet**: fixing feet can be supplied for certain types of motor.
- **Painting**: motors can be supplied with special paint finishes, if requested.
- **Operation**: C.F.R. motors operate generally with electronic control systems, which signifies almost invariably that the motor will be fitted with an encoder, and with a specific thermal sensor for monitoring the temperature level. The thermal sensor must be of a type compatible with the electronic controller.

2.2 MOTOR IDENTIFICATION AND DATA PLATE

All motors made by the company are identified by a data plate, as illustrated below:



	Many items of technical data on the plate are self-explanatory. For further information, refer to drawings supplied with the accompanying documentation, or contact C.F.R. direct.

2.3 NOMINAL OPERATING CHARACTERISTICS

Unless otherwise indicated, the operating characteristics refer to:

- Duty cycle (see indication on the motor data plate).
- ambient temperature: 0 °C ... + 40 °C.
- maximum altitude 1000 m above sea level.
- power input at nominal voltage and frequency; maximum permissible voltage fluctuation ±5%. For maximum and minimum power input values, assume a further ±5% (e.g. a motor rated 48 V is suitable for nominal mains voltages from 45 V to 50 V).

	The efficiency of a motor can be reduced if the voltage and/or frequency of the power input deviate from the nominal rated values.

2.4 TYPES OF DUTY

Duty cycles are explained in the following summary of the reference standards and the definitions adopted.

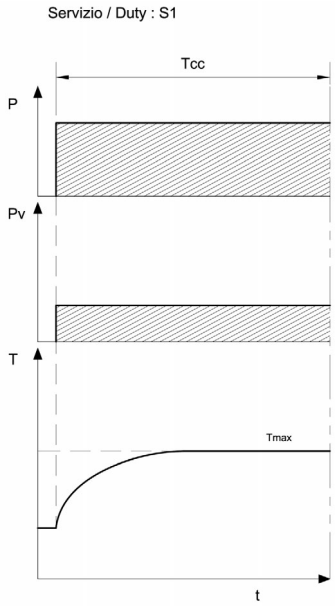
- **Load:** the combined values of electrical and mechanical quantities that characterize the requirements placed on a rotating machine by an electrical circuit or by a mechanical device, at a given moment.
- **Duty:** the definition of the load, or loads, to which the machine is subject, which include (if applicable) starting, electric braking, no-load and idle periods, as well as their duration and their sequence over time.

EN 60034-1 standards define different types of duty. Those of interest for C.F.R. products are:

Continuous Duty – S1

Operation at constant load for a duration sufficient to reach thermal equilibrium.

Conditions of continuous duty, equating to maximum performance.



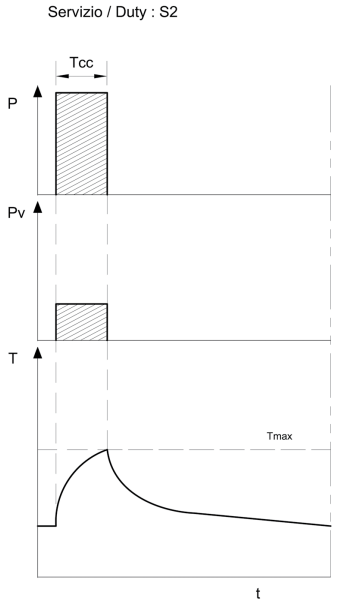
P = Load
Pv = Electric losses
T = Temperature
t = Time
Tcc = Time period of operation at constant load
Tmax = Maximum temperature recorded

Short time duty – S2

Operation at constant load for a given period of time less than that required to reach thermal equilibrium, followed by an idle period of duration sufficient to re-establish equality between the temperature of the machine and the temperature of the cooling fluid, with a tolerance of 2°K.

Example: S2-60 min

The motor operates continuously under nominal rated conditions for 60 min, then remains idle for a duration sufficient to return to ambient temperature.



P = Load

Pv = Electric losses

T = Temperature

t = Time

Tcc = Time period of operation at constant load

Tmax = Maximum temperature recorded

Intermittent periodic duty – S3

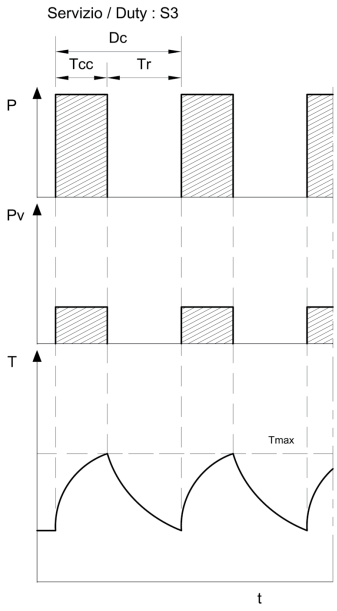
Sequence of identical operating cycles, each comprising a period of operation at constant load and an idle period.

Duration of cycle 10 minutes.

In this duty cycle, the sequence is such that the starting current has no significant effect on temperature rise. The nature of periodic duty dictates that thermal equilibrium is never reached during the on-load period.

Example: S3-70%

The motor runs for 7 minutes and remains idle for 3 minutes



P = Load

Pv = Electric losses

T = Temperature

t = Time

Dc = Duration of single cycle (10 min)

Tcc = Time period of operation at constant load

Tr = Idle period

Tmax = Maximum temperature recorded

Intermittent ratio = Tcc / (Tcc+Tr)

* 100%

3 HANDLING AND TRANSPORT

3.1 PRELIMINARY WARNINGS

All C.F.R. products are prepared for shipment packed in wooden crates or steel containers, or boxed on pallets, as appropriate for the weight and dimensions of the particular item. Special packing can be provided on request; in this instance, contact the sales department when placing the order.

	In the case of models that cannot be handled manually, the choice of suitable lifting gear (straps, slings, chains, eyebolts) will depend primarily on the weight of the electric motor. Handling, transport and installation procedures must be carried out by persons properly trained and instructed for the purpose, in accordance with current regulations on health and safety in the workplace.
	If any pack received from a carrier has been seriously damaged, the best policy is to indicate PROVISIONAL ACCEPTANCE, check immediately that the actual product has not been damaged, photographing it if necessary, then provide a written account of the situation and the condition of the product. The product must not be used until written authorization is received from C.F.R. If any parts or components are found to be defective or damaged, contact the Engineering - Sales Department. Should the data plate be damaged, a duplicate must be requested in writing from the Engineering department. Make certain that there are no parts of the packing such as fragments of cardboard, staples etc., occluding or obstructing motor ventilation holes. If electric motors are not going to be used immediately, they must be stored in clean, dry, temperate surroundings, protected from vibration, sheltered from the weather, and preferably covered in such a way that the case cannot be penetrated by dust and debris. Before using a motor, check that all parts are in serviceable condition, especially the shaft, bearings and flanges, and all electrical contacts. Test the insulation of the winding, or windings, using the appropriate instrument. Do not touch the terminals either during tests or immediately afterwards, as they can remain live for a certain duration.
	The materials in which electric motors and relative components are packed must be suitably disposed of at authorized collection sites.

3.2 HANDLING OF MOTORS

Small motors can be handled manually, without lifting gear. Motors that cannot be man-handled are provided with a threaded hole into which an eyebolt of suitable capacity can be screwed.



If necessary, the motor can be cradled using straps or slings of suitable capacity looped around the case at the appropriate points; in any event, be sure to observe current accident prevention regulations.



	Do not added further loads to the motor when lifting. Do not lift a motor by its output shaft or fan cowl, or by plastic parts, terminals or power cables.

4 INSTALLATION AND COMMISSIONING

4.1 ACCEPTANCE AND STORAGE

	Check that the motor is exactly as ordered, and has not been damaged during transport. Eyebolts that may already be fitted to the case must be used only for lifting the motor itself. If the required operating parameters are different to those indicated in the technical specifications, contact the C.F.R. engineering department before proceeding.

4.2 INSTALLATION AND COMMISSIONING

4.2.1 PRELIMINARY WARNINGS

	When installing the motor, the machine must be at a standstill, and disconnected from the electrical power supply.

Motors can be installed in any of the mounting positions covered by EN/IEC 60034-7.

The mounting position of the motor must be selected in such a way that:

- The motor can be properly secured, with all threaded fasteners properly tightened.
- In the case of a ventilated motor, there is sufficient clearance between the fan and the frame of the machine to allow a free flow of air.
- All power cables for encoders, thermal sensors, electromagnetic brakes and any other components (accessories) supplied with the motor can be fastened securely between nuts and lock nuts or with connectors. In addition, power cables must not be pressed or pinched against other parts (machine frame, flanges, etc...) and must be long enough to ensure they can be connected without difficulty, in other words free of any tensile stress that could place strain on terminals and connections.

When tightening cables to the relative terminals, always use two wrenches as illustrated. Hold the bottom nut stationary to prevent the terminal from turning, then, with the cable termination lug in position on the post, tighten the top nut to obtain a secure and durable contact.



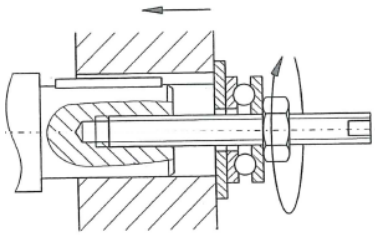
	During the installation procedure, ensure that fixing screws or bolts do not penetrate internally of the motor, as these could damage the electrical windings.
	Do not install near heat sources. Bearing in mind the required ingress protection, install the motor in such a way that foreign matter cannot penetrate the frame, or obstruct the ventilation holes if any. Make certain that water or other liquids cannot infiltrate the motor. Make sure the motor cannot be damaged when the machine is moved for whatever reason. Check that the data plate remains clearly visible once the motor is installed. If the case includes drain holes, check that these are correctly positioned in such a way that condensate can run off freely.

Once in position on the driven machine, all motors must be connected mechanically to the machine pivot so that rotation can be transmitted.
The connections most frequently used are:

- Direct coupling to another component (gear unit, differential, pump...);
- Indirect coupling, by way of pulleys, drive couplings or pinions.

Before coupling the motor, clean and lubricate contact surfaces to prevent any risk of seizing.

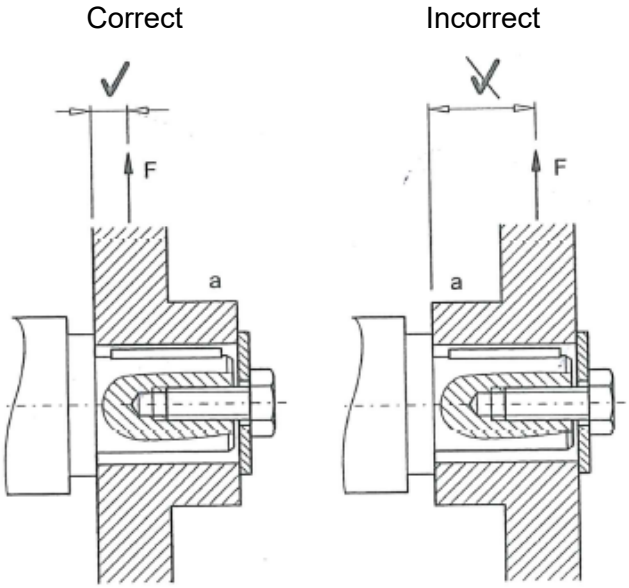
If the motor is bolted to a bed or baseplate, ensure that the mounting surface is sufficiently thick, with a flatness tolerance of less than 0.03 mm.

	It is always important to check that the fit tolerances of coupled components are correct and compatible with those of the motor components. In particular, for both direct and indirect coupling arrangements, the rectangularity tolerance between the motor shaft and output flange and the components to be coupled must be less than 0.03 mm. When making the connection, avoid axial or radial loads that could damage the bearings and other components of the motor.
	Use the appropriate special tools for assembly purposes. 
	To find out the permissible axial or radial loads, always ask for and refer to literature originated by C.F.R.

Avoid mounting components in such a way as to create overhung loads, and ensure that chains or belts are not tensioned to the point of affecting bearing life, or even causing failure of the motor shaft (see illustration alongside).

a: hub

F: Force



	Make certain there is no way that elements coupled to the motor can cause damage to parts of the machine or injury to persons. Ensure that parts of the motor likely to reach high temperatures are suitably protected against possible bodily contact. The coupling component and the type of transmission are selected and designed to suit the particular operating conditions. Selection and design are the responsibility of the customer: the responsibility of C.F.R. srl is limited to the reliability of such technical data as the company can be expected to provide to the customer, on request.

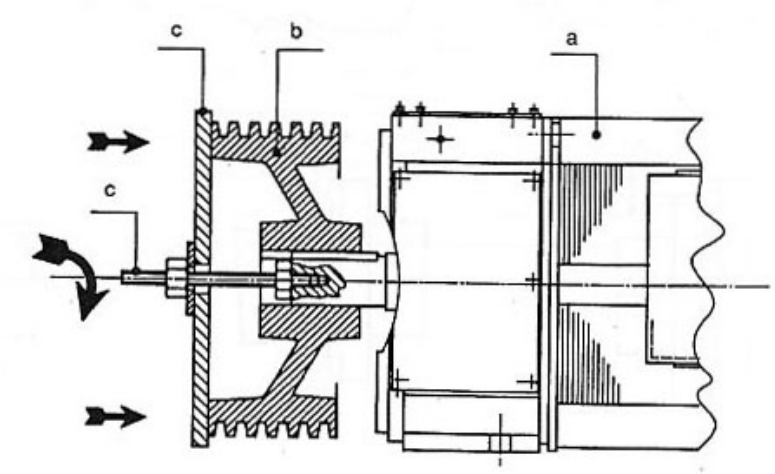
The recommended tightening torques for threaded fasteners are:

Bolt size	**Tightening torque for typical rated strengths**		
	8.8	**10.9**	**12.9**
	[Nm]	**[Nm]**	**[Nm]**
M4	3	4	5
M5	6	9	10
M6	10	15	18
M8	25	35	41
M10	50	70	85
M12	90	120	145
M16	210	295	355
M20	450	580	690
M24	750	1,000	1,200

A tolerance of +/- 8% is permissible on the above values

4.2.2 KEYING

C.F.R. motors are always balanced with a half-key fitted to the shaft (unless specified otherwise when ordering). Accordingly, transmission components must also be balanced using a half-key. For special keying requirements, refer to the detailed instructions provided by the supplier of the component and by C.F.R.



Example of transmission component keyed cold to the motor, using the threaded hole in the end of the shaft.

a) Motor

b) Transmission component

c) Assembly tool

	If the end face of the shaft end and/or the hole in the hub are damaged, the defect must be rectified BEFORE proceeding with assembly.

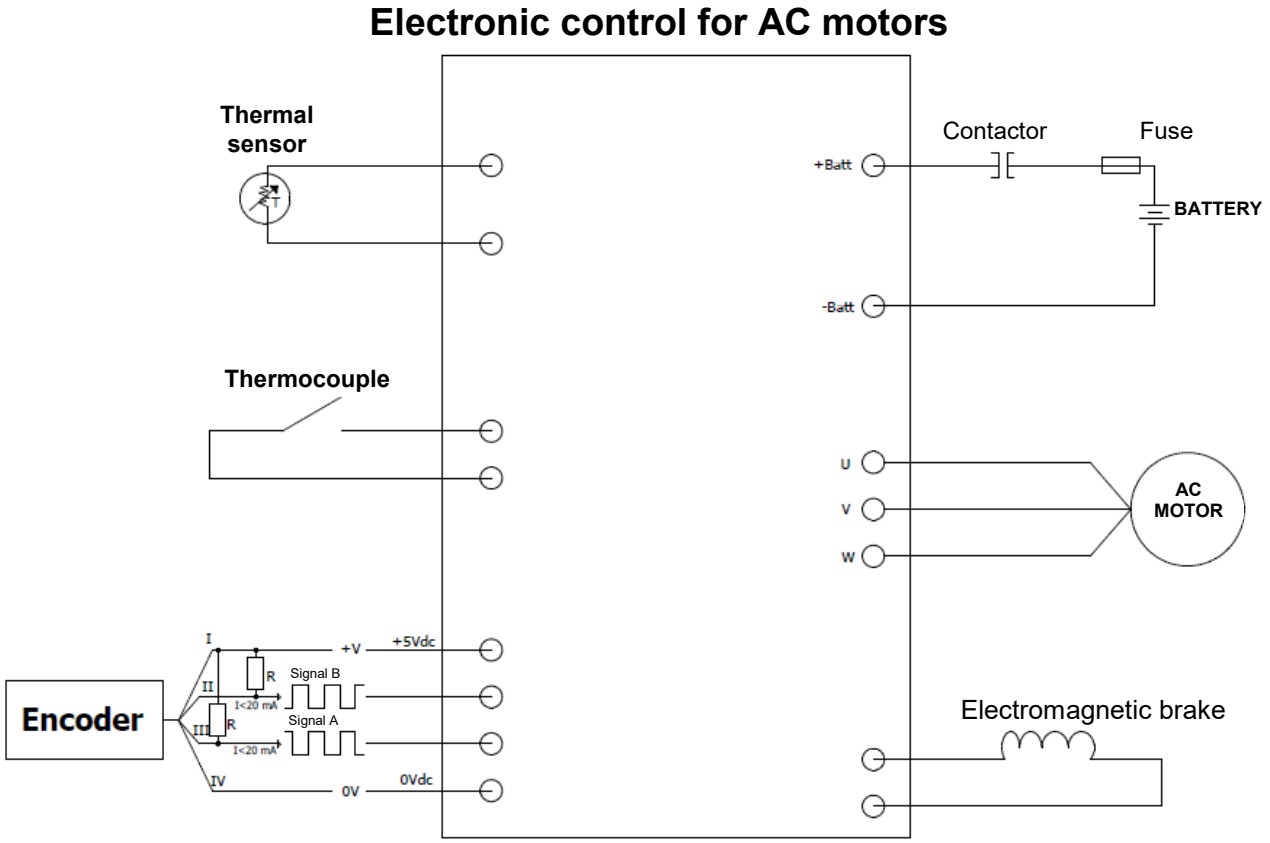
4.2.3 ELECTRICAL CONNECTIONS

C.F.R. srl can supply different types of motors, consequently it is important that each one should be wired according to the instructions provided. If the motor is operated by an electronic control or other device, compatibility between the motor winding and the control must be verified.

	Before making the electrical connection, make certain that the power supply matches the values indicated on the data plate. Make the electrical connections to the motor and to auxiliary items when the machine is idle, with the motor isolated from the mains power supply.
	Use cables of section large enough to prevent overheating and/or excessive voltage drop at the motor terminals. Remove the key from the keyway before starting the motor with the shaft uncoupled, otherwise it could be flung out with considerable force.
	Generally speaking, all C.F.R. asynchronous three-phase motors have windings with 1 or 2 coils per slot; the phases can be wired internally adopting star or delta configuration, but in either case there are 3 terminals or 3 cables, and the connection can be made using either of the 2 methods indicated below.

	Motors can rotate in either direction, left or right: if the direction of rotation is not as required, invert the connections of the two outer phases U and V, leaving the central phase (V) in place.
	Before disconnecting the cables to invert the direction of rotation, make certain that the motor is isolated from the power supply.

Example of connection between asynchronous motor with accessories, and electronic control

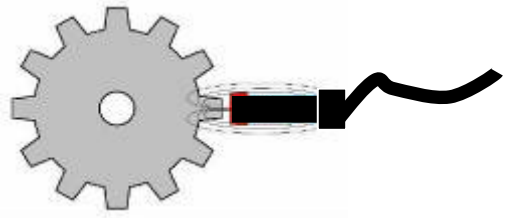


4.2.4 CONNECTION OF ENCODERS

Electronic control systems require a variety of feedback devices to ensure the correct operation of asynchronous three-phase motors; these include encoders.
C.F.R. can supply three types of encoder: RT, ES or CU: the technical specifications of the encoders available are indicated below.

Type RT: This type of encoder has two main components: a toothed wheel having a suitably sized module, mounted internally of the motor, and a Hall effect sensor inserted through the case from the outside.

The sensor generates two square wave signals — designated A and B — phase shifted by 90°. The number of pulses per revolution (generally 48,64,80 pulse/rev) is determined by the encoder wheel and can vary with the size of the motor. The sensor is readily accessible and easy to replace; the cable can be connectorized if requested.



	It is advisable that the speed should not exceed 6000 rpm. In the event of the RT encoder being replaced, re-utilize the metal shims of the discarded encoder so as to guarantee the same distance (gap) between the sensor and the toothed wheel.

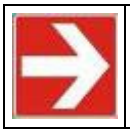


Technical data:	
• Input voltage:	5 – 24 V_{DC}
• Frequency range:	0.1 – 20 kHz
• Operating temperature:	-10 – +120 °C
• IP ingress protection	IP 65
• Current	5 V 7.6 mA ... 17 mA
	12 V 7.8 mA ... 17 mA
	24 V ... 8 mA.. 18 mA
• Cable diameter (4 wires)	0.34 mm^2
• Red	+5V ... +24V
• Black	Negative
• White	Channel A
• Blue	Channel B

Type ES: This encoder, which is mounted entirely on the outside of the motor and therefore easily replaced, operates on the same principle as the RT model described previously: a small toothed wheel is mounted to the shaft of the rotor (generally at the rear end of the motor), and covered by a sensor of circular shape.

This sensor, like that of the RT, generates two square waves phase shifted by 90°.

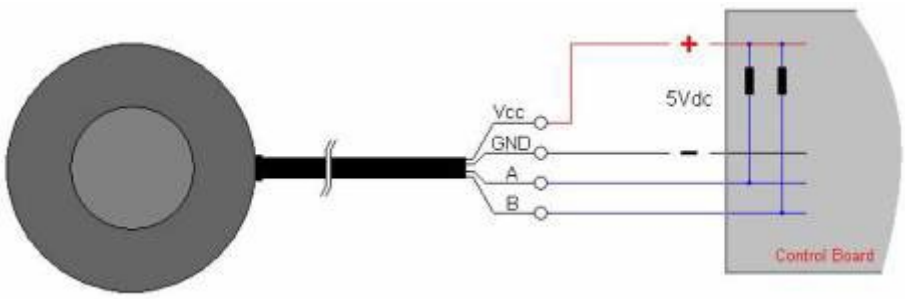
The cable is supplied with AMP superseal 282106-1 connectorization, and the number of pulses per revolution is 64.

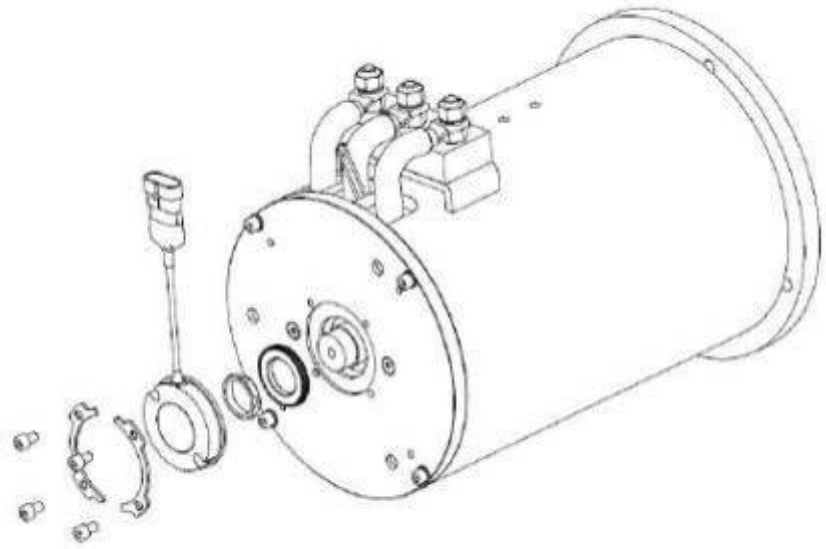
	It is advisable that the speed should not exceed 6500 rpm.

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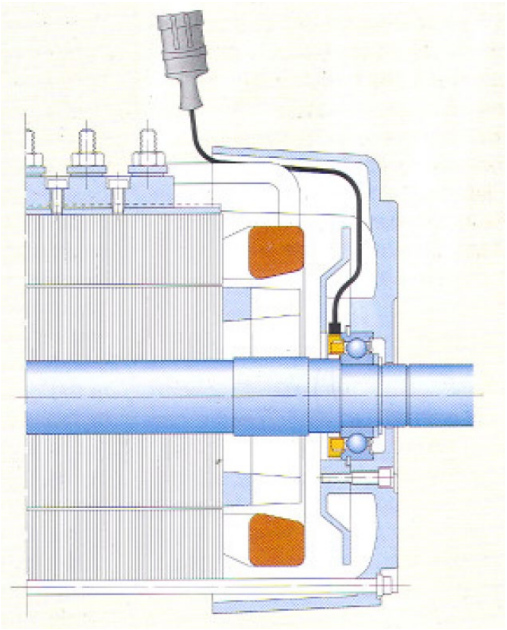


Technical data:	
• Input voltage:	5 – 24 V_{DC}
• Frequency range:	8 Hz … 10 kHz
• Operating temperature:	-10 – +120 °C
• Current	5 V - 270 ohm
	12 V - 680 ohm
	24 V - 1500 ohm
• Insulation	1000 V_{DC}





Type CU: This type of encoder is also known as a sensor bearing, given that it consists effectively of a bearing that incorporates the necessary electronics. The great advantage of this component is that it requires no additional space, but is installed in the same way as a standard bearing carrying the rotor. On the down-side, the motor must be opened up if the encoder needs replacing, and this operation must be entrusted to C.F.R. approved technicians.



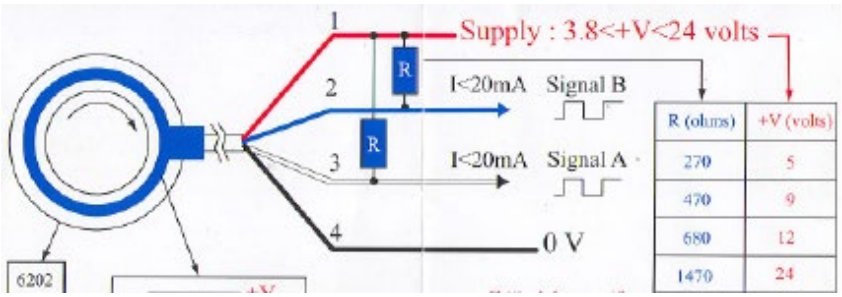
Likewise in this instance, the encoder generates two square wave signals (channel A and channel B) phase shifted by 90°.

The number of pulses generated will depend on the size of the bearing.

	Extreme care must be taken over the installation of this encoder. When fitted onto a shaft or in the recess of a flange, special tools must be used, and every precaution taken to avoid damaging the electronics. If force is required for installation purposes, this can be applied only to the inner ring of the encoder bearing. The sensor bearing can be seriously damaged if exposed to: • an input voltage higher than 24 V;

	• incorrect installation; • excessive overheating; • short circuit between power cables; • electrostatic charges: the sensor is highly sensitive and must be handled with care; • Avoid contact between power conductors and signal wires. The output cable can be connectorized if requested. Fitting this type of encoder is always a highly delicate operation, which must be entrusted to an expert technician and performed using the proper equipment.

Technical data:	
Input voltage:	5 – 24 Vdc
Operating temperature	-10 – +90 °C
Current	5 V - 270 ohm
	12 V - 680 ohm
	24 V - 1470 ohm
Frequency range	0.1 Hz … 9 kHz
ESD - IEC61000-4-2	contact 4 KV - air 8 KV
ETF - IEC61000-4-4	4000 V
Cable diameter (4 wires)	0.32 mm2
Red	5 … 24 Vdc
Black	Negative
White	Channel B
Blue	Channel A



4.2.5 CONNECTION OF THERMAL SENSOR

Asynchronous motors generally need to be equipped with a temperature detection device; C.F.R. motors are fitted with Philips KTY84-130 sensors, but can be supplied with other types if requested. The sensor serves to indicate the temperature of the winding (range -40 °C up to +300°C), and is connected to the electronic control circuit. The two electrical terminals emerge from the motor case on the exit side of the terminal box; see the "maintenance" heading for replacement instructions.

	Failure to connect the thermal sensor (when installed) will automatically invalidate the motor warranty.

The encoder and thermal sensor can be supplied already connectorized



4.2.6 ACCESSORIES

Various accessories requiring an electrical connection can be installed on the motor, if requested.

Thermal overload protections

Motors used for heavy duty applications can be protected against excessive overheating by means of a bimetal thermal sensor. This protection device must be specified when ordering the motor. C.F.R. supplies 3 different thermal overload sensors with temperature thresholds of: 90 °C, 110 °C and 140 °C (+/- 8 °C); different thresholds are available on request.

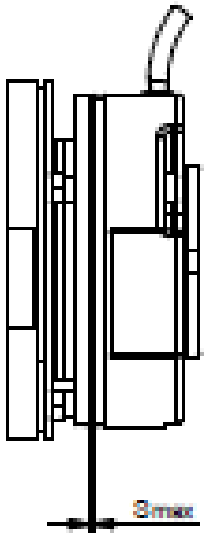
The thermal sensor is generally embedded in the winding, with two relative wires emerging from the motor; these must be connected as indicated in the wiring diagram.

THERMOCOUPLE TYPE S 01 WITH AUTOMATIC RESET AND CONNECTING CABLE	
Switching method	breaker contact
Switching temperature threshold	90 °C, 110 °C, 140 °C
Tolerance	+/- 5 °K
Measurement current / n° cycles	2.5 A / 10 000, 5 A / 3000
Standard connection	Cable of 0.25 mm2 section





Connection of electromagnetic brake



If the motor is equipped with an electromagnetic brake, this must also be connected to the electrical circuit.

The electromagnetic brakes we supply are generally negative acting: when the circuit is powered up, the brake releases; when powered off, the brake is applied.

All brakes are supplied calibrated and mounted with 3 screws, normally at the rear end of the motor.

The middle screw can provide a torque rise of ±10%.

Torque, power requirement and maximum air gap values are indicated in the following table:

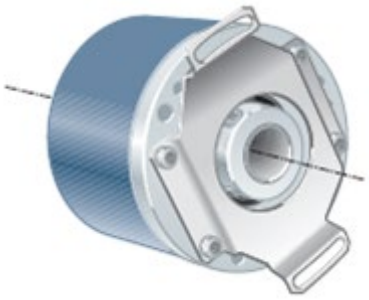
Size	Nominal braking torque	Power at 20 °C	Smax
	[Nm]	[W]	[mm]
06	4	20	0.3
08	8	25	0.3
10	16	30	0.3
12	32	40	0.5
14	60	50	0.5
16	80	60	0.5

	Smax indicates the maximum permissible air gap, beyond which the brake must be recalibrated and, if necessary, the brake disc replaced.

4.2.7 CONNECTION OF AN EXTERNAL ENCODER

Connection of an external encoder

An external encoder can be fitted to the motor, if requested by the customer.



The external encoder is not essential for control of the actual motor, but will be used to increase the resolution of speed and position signals utilized in monitoring the performance of the driven machine.

If requested by the customer, C.F.R. will prepare the motor shaft to accept the installation of any encoder selected and installed subsequently by the customer.

	An external encoder must not be connected to the electronic control governing the motor, but to the electronic control governing the driven machine as a whole.
	All wiring of encoders, thermal sensors and accessories must be entrusted to an expert installation/service technician and undertaken with maximum care. C.F.R. recommends users to procure the proper connectorization tools for the various cables.
	For further information on encoders, contact the engineering department at C.F.R. srl.

4.3 REMINDERS ON INCORPORATION PROCEDURES

During the process of installing the motor in the driven machine, all of the various controls must be included: start, stop, emergency stop devices if applicable, and machine safety devices. The motor must be protected permanently against unacceptable power input or loading situations, and against malfunction or breakdown. C.F.R. srl can assist in identifying the most suitable protection systems for particular cases. Where the requisite protection systems are omitted or incorrectly calibrated or found to be ineffective, C.F.R. srl will decline all liability in respect of faults or failures.

<table>
<tr><td>  </td><td><u>Electrical protections</u>
Motors are not supplied with any kind of electrical protection installed (e.g. fuses, thermal-magnetic breakers...); it is the responsibility of the user to ensure that protections against short-circuit and overvoltage are provided.</td></tr>
<tr><td>  </td><td><u>Mechanical protections</u>
Before machines are commissioned, the user must make certain that all moving parts are suitably protected; in particular, the machine must not be commissioned if:
• The motor has not been suitably fixed.
• The cover of the terminal box, if specified, has not been properly fitted and secured with its screws, to prevent accidental contact with live parts.
• Power cables have not been suitably connected and protected against accidental contact with live parts.
• The cowl of the cooling fan, if specified, has not been correctly fitted.
• Motors presenting accessible moving parts have not been properly protected.
In addition to mechanical protections associated specifically with motors, the user must also make certain that all components connected to the driven machine and set in motion (couplings, pulleys, driver belts, etc.) are suitably protected against accidental contact.</td></tr>
<tr><td>  </td><td><u>Protections against thermal risk</u>
The outer surfaces of motors can reach particularly high temperatures.
The user must deploy suitable guards that will prevent operators from coming into contact with hot parts, whether intentionally or unintentionally.</td></tr>
</table>

If necessary, C.F.R. can provide special protection systems for the correct isolation of connection terminals.





5 MAINTENANCE

	All maintenance operations must be carried out by skilled service technicians. **If in doubt, or in need of any information on the use of electric motors, always contact C.F.R. technical assistance.**
	Any maintenance operation on the motor must be carried out with the machine at standstill and disconnected from the power supply (including auxiliary circuits). Irregularities or abnormalities discovered during an inspection must be remedied without delay. Do not carry out maintenance work when the electric motor is running or connected to the power supply. Make certain that the motor has been disconnected from the power supply and always wait a few minutes after it has been shut down, as there are parts that may still be hot. When work is completed, replace guards and protections that have been removed. Take every precaution during maintenance operations to ensure that the motor cannot be started up by unauthorized persons.
	If the electric motor needs to be painted, contact C.F.R. srl for instructions. **To ensure maintenance is performed correctly, it is always advisable that the electric motor should be removed from the machine in which it is installed.**
	During maintenance work, wear suitable items of personal protective equipment; wait for a few minutes until the electric motor has cooled down sufficiently and come to a complete standstill.
	Do not release or dispose of residual matter into the surrounding environment when carrying out maintenance. Always observe statutory regulations on waste disposal.

The frequency of inspections will depend mainly on the number of hours the motor has been running and on ambient conditions; in any event, current regulations on the servicing of machinery must be observed.

5.1 GENERAL MAINTENANCE

Asynchronous motors do not have parts in direct or sliding contact; nonetheless, inspection and maintenance are importance for the smooth running and durability both of the motor and of the driven machine.

Checks to be carried out at installation and at least once a year

- Check that there are no traces of debris, oil or water on the motor, and that these have caused no damage to any parts of the motor, especially wiring components. Clean all components if necessary, and before reassembly, test the insulation of the stator.
- Check that the entire cooling circuit (case, fan cowl air inlet vents, motorized fan unit if any) is free of dust, oil and any process waste, in order to ensure that the motor will not overheat due to the normal flow of cooling air being impeded.
- Check that all connections — whether cables secured to terminals or connectorized cables — are clean, neatly arranged and properly tightened. If connections are damaged, they must be renewed or replaced.
- Check that the motor runs free of vibration and without abnormal noise. If vibrations are detected, check that the motor is fastened securely and that the driven machine is properly balanced.
- Where drive belts are in use, check that these are correctly tensioned, as a belt that is too tight can significantly reduce the life of motor bearings and even cause failure of the shaft extension.
- Where O-rings, seals and other protection devices are installed, check their condition and replace if necessary with identical components.
- Check that any additional components fitted to the motor, such as contactors, thermal sensors or external fan units, are operating as they should and calibrated as per specification.

Inspection of bearings: at least once a year

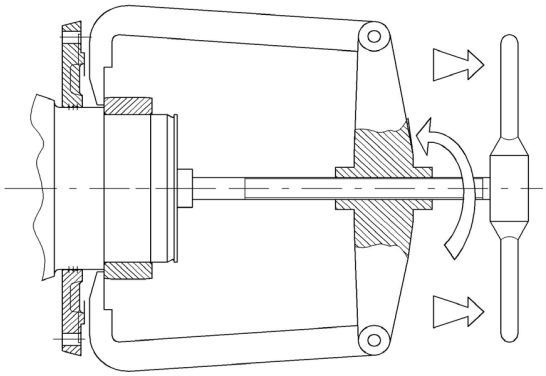
All bearings used by C.F.R. are designed specifically for electric motors, with double seals and grease lubrication, and do not require any special maintenance; all the same, it is good policy to check on a regular basis that they are functioning correctly when in operation.
Bearing life can vary to a considerable extent depending on the nature of the loads applied to the motor and the starting cycles adopted, also on temperature and humidity levels in the operating environment. Excessive bearing noise will generally indicate the need for replacement.

If the motor has been commissioned only recently, the first area to check is the coupling (rectify any possible misalignment or check the tension of drive belts, if in use; see also heading 4.2). If bearing noise persists after remedial action has been taken, this means the bearings are already impaired and must be replaced.

5.2 MAJOR SERVICING

Replacement of bearings

Always remove bearings with the aid of a puller, taking care not to deface or damage the motor shaft.



Removal of bearing
turning
the handle
of the puller

Before bearings are fitted, make certain the relative seats have been thoroughly cleaned. Bearings should be fitted using a press, taking care not to damage the ball races. Check that the bearing rings are correctly abutted against the shoulders of the shaft and of the relative flanges, also that the replacement bearings are of the same type as the original components, or equivalent. Where shaft seals are fitted, these should always be renewed throughout.

	When replacing an encoder bearing, refit the new bearing with maximum care and observing the position of the wiring components. Take particular care to ensure that no stresses are applied to the electrical cable. When removing and replacing motor components installed with protective mastic and/or silicone sealant, make certain that the same level of protection is reinstated following reassembly.

Replacement of motor:

	All operations must be entrusted to expert service technicians and carried out in accordance with current regulations, using the requisite items of Personal Protective Equipment. Before commencing any removal steps, the motor and any accessories installed should be disconnected completely from the power supply.

It is always preferable, where possible, to remove the motor from the machine and position it on a work bench.

Proceed to strip down the motor, following the steps described:

- If the motor has a fan, remove the fan cowl, and the propeller.
- Disconnect the cables from the terminals.
- The motor shaft (rotor) is always retained at one of the two flanges by a circlip preventing axial movement; remove the circlip, proceed to remove the two flanges, and the rotor can then be separated from the case.

	Take care not to damage the rotor or the stator winding when separating one from the other.

- Proceed to remove the bearings, which may be force fitted to the motor shaft or to the flanges; in either case, use the appropriate pulling tools or drivers, being careful not to damage the seats.

C.F.R. will undertake the overhaul and repair of motors at its own premises. In any event, the work must be entrusted only to expert service technicians who are able to guarantee that the motor will be returned to its faultless original condition.

When carrying out an overhaul or repair, always use original replacement parts, or at least parts approved in writing by C.F.R.

To obtain correct information on the product, indicate:

- Motor designation code
- serial number
- date of manufacture

In the case of maintenance, it always advisable that bearings and shaft seals should all be replaced.

Following the removal steps, conduct a visual inspection to verify the mechanical integrity and functional efficiency of all components, replacing any that are found to be defective or worn (e.g. shaft). Measure the insulation resistance of the stator applying a test voltage of at least 1000 V, and if correct, the serviced or repaired motor can be reassembled.

	Before installing the reassembled motor on the machine; - test the insulation again between phase and earth; - secure the motor to the bench and, before connecting to the power supply, check that there are no parts incorrectly or insufficiently tightened, liable to injure the operator or damage the motor, or parts connected to the motor; - connect the motor and any accessories (e.g. electromagnetic brake) to the power supply, following the relative instructions; - supply the correct voltage to the motor and to components (e.g. brake), checking that the shaft rotates in the required direction and there is no vibration or noise; - check that the current draw is correct, on the basis of data plate values. This done, the motor can be installed on the machine.

5.3 DECOMMISSIONING

	With regard to the correct handling of Waste Electrical and Electronic Equipment, remember that: 1. waste electrical material must not be disposed of as household refuse, but properly sorted in accordance with local regulations; 2. this item of equipment may contain hazardous substances: improper use or incorrect disposal could have negative effects on human health and on the environment. Incorrect disposal of WEEE materials is punishable by law.

6 TROUBLESHOOTING

The following table shows a list of abnormal situations that could arise, together with possible remedies and an indication of the person authorized to remedy them.

If a given problem does not appear in the table, contact the C.F.R. engineering department.

Problem	Causes	Remedy	Competency
Electric motor does not start.	No electrical power reaching the motor	Check that the power supply is correct and reaching the contactor or the electronic control (if installed) and that voltage is registering at the motor	Routine maintenance technician
	Incorrect electrical connection	Restore the correct connection	Routine maintenance technician
	Electronic control (if installed)	Check that the control is working and correctly configured Check whether or not there are alarms tripped; if so, remove the cause to restore normal operation of the electronic control	Routine maintenance technician
	Electromagnetic brake (if installed) not releasing	Check that the electronic control or the dedicated brake control device are working correctly and able to release the brake	Routine maintenance technician
	Motor damaged	Contact the C.F.R. srl engineering department	C.F.R. approved service technician
	Mains voltage too high or too low	Check the a.c. mains power supply	Routine maintenance technician
	Resisting torque too high	Disconnect the drive coupling and test the motor under no-load conditions	Routine maintenance technician

Problem	Causes	Remedy	Competency
Motor emits vibration or noise when tested under no-load conditions.	motor malfunctioning	Check that there is no foreign matter inside the motor Check that the motor shaft bearings are not damaged	Routine maintenance technician
	Misalignment and/or incorrect assembly	Check that all components are securely and firmly fastened and there are no bolts loose	Routine maintenance technician
	Rotor and stator touching	Contact C.F.R.	C.F.R. approved service technician
	Damaged, defective or worn bearings	Replace the bearings	Routine maintenance technician
	Fan touching the cowl or other fixed parts of the motor	Locate the point of contact and eliminate	Routine maintenance technician
Excessive power consumption	Possible motor fault	Check that the motor is not damaged Check that the brake (if installed) is fully released Check that there is no mechanical component of the motor seized or damaged, or that there is no misalignment	Routine maintenance technician
	Workload too high	Check that the load factor for the machine is the same as used for selection of the motor size	Routine maintenance technician
Motor overheating	Fan cowl or ventilation holes occluded or obstructed	Clean thoroughly to restore cooling air flow	Routine maintenance technician
	Input voltage too high or too low	Check the voltage against the data plate	Routine maintenance technician

	The manual cannot possibly inform the user as to every potential danger situation that might arise during the operation or maintenance of these asynchronous electric motors. Accordingly, a sound technical knowledge of the product and of the precautions indicated in this manual — and careful observance of the basic rules regarding safety — can certainly help in anticipating and resolving many danger situations. Our aim is to help the user adopt and develop safe working procedures, and put them into practice. Remember: safety is in your interests, and is your responsibility.



REGGIANA RIDUTTORI
PLANETARY REDUCTION GEARS

MANUALE TECNICO

RUOTE MOTRICI

RRTD100 ÷ RRTD5000T
RRWD200 ÷ RRWD1700T

TECHNICAL MANUAL
WHEEL GEARS

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1 INTRODUZIONE

1.1 Scopo del documento

Il presente manuale tecnico fornisce tutte le indicazioni necessarie per il trasporto, lo stoccaggio, la movimentazione, l'installazione, l'uso e la manutenzione delle ruote, nel rispetto dell'integrità del prodotto e delle vigenti norme di sicurezza.

1.2 Avvertenze generali

La mancata osservanza delle indicazioni contenute nel presente manuale, oltre a compromettere il buon funzionamento della ruota, può essere fonte di pericolo per la sicurezza delle persone e dell'ambiente.

Reggiana Riduttori s.r.l. declina ogni responsabilità in caso di:

- Utilizzo della ruota in maniera non conforme a quanto previsto in sede di progetto e non esplicitamente riportato nel presente manuale;
- Installazione della ruota errata o non conforme a quanto riportato nel presente manuale;
- Modifiche o sostituzioni di parti della ruota non espressamente autorizzate;
- Interventi effettuati da parte di personale non autorizzato.

1.3 Condizioni di garanzia

Reggiana Riduttori s.r.l. garantisce i suoi prodotti per una durata di tempo pari a 24 mesi dalla data di spedizione. Gli oneri e i costi connessi all'accertamento del difetto e alla sostituzione dei pezzi sono a carico del Cliente.
Gli interventi non autorizzati o effettuati da personale non autorizzato comportano l'annullamento della garanzia.

1.4 Ubicazioni delle istruzioni

Il presente manuale va conservato in prossimità dell'impianto dove è installata la ruota e deve essere messo a disposizione degli operatori addetti al funzionamento e alla manutenzione.

1.5 Copyright

È vietata la riproduzione, parziale o totale, del presente manuale, senza la specifica autorizzazione scritta di ***Reggiana Riduttori s.r.l.***

1.6 Revisioni

Reggiana Riduttori s.r.l. si riserva il diritto di revisionare il presente manuale, apportando modifiche o integrazioni, senza preavviso.

2 DEFINIZIONI E SIMBOLOGIA

Di seguito sono riportate alcune definizioni e simbologie di uso corrente e all'interno del presente manuale:

Operatore:
persona addestrata per l'installazione, il funzionamento, la regolazione, la pulizia e la manutenzione ordinaria della ruota.

Manutentore esperto:
persona scelta ed addestrata, tra coloro che possiedono le conoscenze di natura meccanica ed elettrica e le competenze in materia di sicurezza, per effettuare interventi di riparazione e di manutenzione straordinaria sulla ruota.

Manutenzione ordinaria:
insieme delle operazioni programmate aventi lo scopo di garantire il buon funzionamento della ruota.

Manutenzione straordinaria:
operazioni non programmate che richiedono l'intervento di un manutentore esperto.

⚠ *ATTENZIONE*

Questo segnale indica situazioni di pericolo grave, che possono mettere a rischio la salute e la sicurezza delle persone. Adottare tutte le misure previste dalle normative antinfortunistiche.

⚠ *IMPORTANTE*

Questo segnale indica informazioni tecniche di particolare importanza, la cui inosservanza può causare danni alla ruota ed essere fonte di pericolo per la salute e la sicurezza delle persone.

3 IDENTIFICAZIONE DEL PRODOTTO

Le ruote vengono identificate mediante una sigla composta nel seguente modo:

RR TD 1700 T B / 64.20 RF27 OMSS

PREFISSO INVARIABILE / INVARIABLE PREFIX
REGGIANA RIDUTTORI

TIPO RIDUTTORE RUOTA / WHEEL GEAR TYPE
WD = Riduttore ruota per gommato / Wheel gear for tyred vehicles
TD = Riduttore ruota per cingolato / Wheel gear for tracked vehicles

GRANDEZZA / SIZE
da 100 a 5000

NUMERO DI STADI / NUMBER OF STAGES
- = Singolo stadio / Single stage
D = Doppio stadio / Double stage
T = Triplo stadio / Triple stage

CONFIGURAZIONE FRENO SERIE RRTD-RRWD / BRAKE CONFIGURATION RRTD/RRWD SERIES
- = Senza freno negativo / Without negative brake
B = Con freno negativo / With negative brake

RAPPORTO DI RIDUZIONE / RATIO

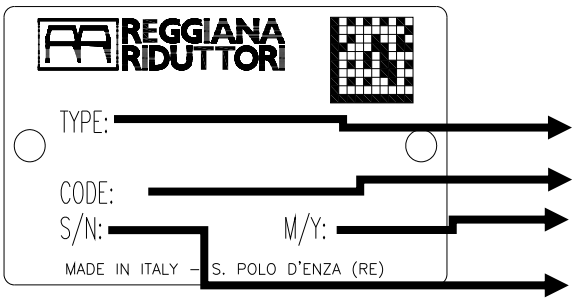
PRESTAZIONI FRENO NEGATIVO / NEGATIVE BRAKE PERFORMANCES
- = Senza freno negativo / Without negative brake
RF27 = Coppia statica nominale in ingresso [daNm]
Nominal static torque in input [daNm]

CONFIGURAZIONE IN INGRESSO / INPUT CONFIGURATION
OMSS = Predisposizione accoppiamento motore
Motor coupling configuration type

3.1 Marcatura del prodotto e disegnazione del tipo

Tutti i prodotti ***Reggiana Riduttori*** sono dotati di targhetta di identificazione, posizionata in modo da risultare facilmente leggibile, anche dopo l'installazione.

La seguente figura mostra un esempio di targhetta.



Legenda

Tipo di ruota e rapporto
Codice identificativo di ordinazione
Anno di produzione
N° progressivo di matricola

3.2 Leggibilità della targhetta

L'utilizzatore è tenuto a verificare l'integrità della targhetta e la leggibilità di tutti I dati presenti su di essa, provvedendo periodicamente alla pulizia. In caso di danneggiamento o smarrimento della targhetta l'utilizzatore è tenuto a richiederne un duplicato.

In caso di verniciatura supplementare proteggere la targhetta e, successivamente, verificarne la leggibilità.

3.3 Dichiarazione CE di conformità alle Direttive di regolamentazione tecnica

Tutti i prodotti ***Reggiana Riduttori*** sono progettati nel rispetto dei Requisiti Essenziali di Sicurezza contenuti nella Direttiva Macchine 98/37/CE.

4 SPECIFICA DEL PRODOTTO

4.1 Funzioni generali e gamma di applicazioni, utilizzo previsto

Utilizzare la ruota soltanto per gli usi previsti in fase di progetto. L'impiego per usi impropri può essere causa di pericolo per la sicurezza e la salute delle persone.

Gli usi previsti sono quelli industriali e mobili per i quali sono state sviluppate e costruite le ruote.

4.2 Utilizzo non previsto

Non è consentito l'impiego della ruota in maniera non conforme a quanto stabilito in fase di progetto.
In particolare è vietato:

- L'utilizzo della ruota da parte di personale non qualificato;
- L'installazione in maniera non conforme alla posizione di montaggio concordata in fase d'ordine;
- Immergere la ruota in acqua o altri liquidi, se non espressamente concordato in fase di progetto;
- La modifica o sostituzione di parti della ruota non espressamente autorizzata da ***Reggiana Riduttori***;
- Effettuare saldature sulla superficie della ruota;
- Utilizzare la ruota, se non esplicitamente previsto allo scopo, in atmosfera potenzialmente esplosiva.

4.3 Dimensioni e massa

Per conoscere le dimensioni e la massa della ruota e degli accessori fare riferimento alla più recente versione del catalogo generale Ruote ***Reggiana Riduttori***.

4.4 Condizioni di fornitura

Salvo diversi accordi con il Cliente, i prodotti ***Reggiana Riduttori*** vengono forniti in assenza di lubrificante, come indicato da un apposito adesivo presente sulla superficie esterna della ruota. Il riempimento della ruota deve essere effettuato dall'utilizzatore prima dell'avviamento.

Le parti esterne, ad eccezione delle superfici di accoppiamento e salvo prescrizioni particolari, sono oliate o verniciate con vernice rossa sintetica antiossidante e sopra-verniciabile; la verniciatura finale è affidata al Cliente.

In caso di verniciatura supplementare attenersi alle seguenti indicazioni:
- proteggere gli anelli di tenuta, la targhetta di identificazione, i tappi
- non verniciare per immersione

Le parti esterne destinate ad accoppiamento (alberi, centraggi, superfici d'appoggio, etc.) sono protette con un film di olio antiossidante. Le parti interne delle carcasse ed i cinematismi sono protetti con olio antiossidante.

4.5 Dati di alimentazione dei freni negativi

Nel caso in cui la ruota venga fornita in abbinamento ad un freno negativo occorre accertarsi che la pressione di alimentazione del circuito di apertura del freno sia maggiore della minima pressione di apertura. Per i valori di pressione da adottare, riferirsi al catalogo Ruote ***Reggiana Riduttori***.

I freni sono lubrificati ad olio ed espressamente disegnati per utilizzo statico e/o parcheggio.

⚠ *ATTENZIONE*

È vietato l'utilizzo in modo dinamico.

4.6 Condizioni ambientali e limiti di impiego e funzionamento

La temperatura di esercizio raccomandata per i prodotti ***Reggiana Riduttori*** è compresa tra -20°C e +40°C.

Condizioni differenti di impiego sono, tuttavia, possibili, utilizzando particolari accorgimenti progettuali da concordare in modo specifico insieme al servizio tecnico ***Reggiana Riduttori***.

4.7 Informazioni relative alla sicurezza antinfortunistica

Prima di effettuare qualunque operazione sulla ruota, leggere attentamente le istruzioni riportate nel presente manuale. Il personale addetto al funzionamento e alla manutenzione della ruota deve:

- Possedere adeguate competenze tecniche ed esperienza nel settore specifico;
- Essere messo a conoscenza delle condizioni di pericolo e dei derivanti rischi di infortunio;
- Conoscere ed adoperare i dispositivi di protezione individuali DPI previsti dalla normativa vigente (D-Lgs. 626/94);
- Agire sempre prestando la massima attenzione e nel rispetto delle norme di sicurezza previste dalle direttive internazionali e dalla legislazione del Paese in cui viene impiegata la ruota.

5 IMBALLO, MOVIMENTAZIONE E STOCCAGGIO

I prodotti ***Reggiana Riduttori*** vengono imballati e spediti in casse o su pallets. L'imballo è realizzato in maniera da resistere alle condizioni dei normali ambienti industriali. In caso di ambienti particolarmente ostili occorre predisporre opportune misure di protezione.

Le ruote vengono avvolte in sacchi di plastica e, nel caso di imballaggio in casse, viene introdotto del polistirolo o altro materiale per attutire gli urti.

5.1 Movimentazione

Eseguire la movimentazione dei colli con attrezzature e mezzi di sollevamento idonei al tipo di imballo.

Tenere conto della massa, dell'ingombro, dei punti di presa e della posizione del baricentro; questi dati, se necessari, sono indicati esternamente al collo.

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La movimentazione deve essere affidata a personale esperto, che operi nel rispetto delle norme antinfortunistica, per garantire la propria sicurezza e quella delle persone presenti nelle vicinanze.

Per la movimentazione attenersi alle seguenti disposizioni:

- Individuare un'area con superficie possibilmente piana e sufficientemente grande per contenere i colli, sulla quale effettuare lo scarico;
- Non inclinare o capovolgere i colli durante il sollevamento e lo spostamento;
- Procedere con cautela durante il posizionamento dei colli, evitando movimenti bruschi ed impatti violenti.

Per la rimozione delle ruote dal loro imballo, utilizzare accessori idonei (catene, fasce, funi, golfari, ganci, etc.) e fare in modo da avere il carico sempre bilanciato.

5.2 Stoccaggio

Evitare lo stoccaggio delle ruote in ambienti aperti o soggetti a eccessiva umidità; non lasciare mai le ruote a contatto diretto con il suolo.

Per periodi di stoccaggio superiori a 2 mesi attenersi alle seguenti indicazioni:

- Effettuare il riempimento della ruota con olio lubrificante del tipo previsto;
- Proteggere le superfici esterne di accoppiamento con grasso o con apposito prodotto antiossidante;
- Effettuare lo stoccaggio in luogo asciutto e pulito, con temperature comprese tra -15°C e +50°C con umidità relativa non superiore al 80%.
  Per condizioni ambientali diverse da quelle sopra elencate, predisporre imballo specifico.

5.3 Disimballaggio

Al ricevimento della merce occorre verificare la corrispondenza tra quanto indicato sulla targhetta e le specifiche dell'ordine; verificare, inoltre, che il contenuto dell'imballo non abbia subito danneggiamenti durante il trasporto.

5.4 Smaltimento in sicurezza dei materiali di imballaggio

I materiali che costituiscono l'imballo vanno smaltiti secondo le vigenti norme in materia di ambiente.

6 INSTALLAZIONE

6.1 Norme generali

L'installazione della ruota deve essere eseguita con estrema attenzione.

Nella verniciatura delle ruote usare vernici anticorrosive, proteggendo le varie tenute e le superfici di accoppiamento con maschere o grasso.

Si consiglia di effettuare il riempimento ed il controllo del livello dell'olio, possibilmente dopo l'installazione sulla macchina. Nel caso ci sia la necessità di effettuare il riempimento della ruota prima dell'installazione, verificarne il livello una volta terminato il montaggio.



Rispettare le norme di sicurezza durante la procedura di messa in servizio.



L'installazione deve essere affidata a personale esperto, che operi nel rispetto delle norme antinfortunistica, per garantire la propria sicurezza e quella delle persone presenti nelle vicinanze.

6.2 Norme di installazione

La struttura a cui va fissata la ruota deve essere rigida, con la superficie di accoppiamento pulita ed ortogonale all'asse azionato. In fase di installazione assicurarsi sempre della corretta esecuzione delle sedi e delle calettature. Le superfici di accoppiamento devono essere, inoltre, prive di ammaccature, onde garantire la perfetta ortogonalità dell'accoppiamento ruota/struttura.

Per le tolleranze sui centraggi della macchina si consiglia di rispettare quanto indicato a tabella:

		CENTRAGGIO LATO USCITA			CENTRAGGIO LATO ENTRATA		
		Diametro	**Tolleranza sulla Ruota**	**Tolleranza sulla macchina**	**Diametro**	**Tolleranza sulla Ruota**	**Tolleranza sulla macchina**
RRTD	**100**	144	h8	**F8**	144	h8	**F8**
RRTD	**300**	190	h8	**F8**	180	h8	**F8**
RRTD	**800D**	220	h7	**F8**	190	f7	**H8**
RRTD	**1000D**	220	h7	**F8**	190	f7	**H8**
RRTD	**1700T**	280	h7	**F8**	270	f7	**H8**
RRTD	**1701T**	270	h7	**F8**	240	f7	**H8**
RRTD	**2400T**	300	h7	**F8**	240	f7	**H8**
RRTD	**3600T**	320	h8	**F8**	270	f7	**H8**
RRTD	**5000T**	350	h8	**F8**	280	h8	**F8**
RRWD	**200**	110	h8	**F8**	180	h8	**F8**
RRWD	**270**	152.4	h8	**F8**	200	h8	**F8**
RRWD	**300**	110	h8	**F8**	160	h8	**F8**
RRWD	**500D-10”**	110	h8	**F8**	190	f7	**H8**
RRWD	**500D-12”**	160	h8	**F8**	190	f7	**H8**
RRWD	**600D**	200	h7	**F8**	177.8	h8	**F8**
RRWD	**800D**	220	h7	**F8**	190	f7	**H8**
RRWD	**1700T**	280	h7	**F8**	270	f7	**H8**

Per il fissaggio della ruota alla struttura della macchina, si consiglia l’utilizzo di viti in classe 10.9 dove l’applicazione comporta forti sollecitazioni.

Serrare le viti alla coppia consigliata dalla normativa vigente, in funzione della dimensione e del tipo di materiale.

La tabella seguente indica il precarico e il momento di serraggio per viti con filettatura ISO e UNC.

Il precarico è stato calcolato pari al 70% del carico di snervamento minimo del materiale della vite ed attribuendo al coefficiente d'attrito il valore medio di 0.14.

Diametro vite ***Screw diameter***	Precarico max [N] **Max. preload [N]**			Coppia max [Nm] **Max. torque [Nm]**		
	8.8	10.9	12.9	8.8	10.9	12.9
	8G	10K	12K	8G	10K	12K
M4x0.7	3940	5540	6650	3.1	4.3	5.2
M5x0.8	6350	8950	10700	6	8.4	10.1
M6x1	9020	12700	15200	10.3	14.6	17.5
M7x1	13000	18200	21800	16.9	23.6	28.3
M8x1.25	16400	23100	27700	24.8	34.9	41.9
M9x1.25	21600	30500	36300	36.7	51.8	61.7
M10x1.5	26000	36600	43800	49.7	70	83.7
M12x1.75	37800	53200	63800	84.6	119	143
M14x2	51600	72500	87000	134.6	189.2	227
5/8"-11 UNC	66100	93000	111600	199	280	337
M16x1.5	75000	105000	126000	215	300	360
M16x2	70200	99000	119000	204	288	346
M18x2.5	86000	121000	145000	284	400	480
M20x2.5	110000	155400	185000	396	556	666
M22x2.5	136000	191000	229000	530	745	900
M24x3	159000	223000	267000	700	980	1170
M27x3	206000	289000	347000	1010	1420	1700
M30x3.5	280000	399000	467000	1500	2130	2500

E per i tappi olio:

Diametro tappo Plug diameter	Coppia Torque [Nm]
G1/8	**8**
G1/4	**11**
G3/8	**15**
G1/2	**19**
G3/4	**25**
G1	**33**
G1 1/8	**40**
G1 1/4	**47**
G 1 1/2	**57**
G2	**79**

Nell'installazione del motore, lubrificare opportunamente le superfici di accoppiamento con un leggero film di lubrificante. Fare attenzione a non danneggiare gli eventuali anelli O-ring.

Assicurarsi, prima di serrare le viti di fissaggio, del corretto allineamento.

Prevedere protezioni per motori e collegamenti, ove esposti a eventuali ostacoli o asperità del terreno.

Nel montaggio del cerchione sulla ruota, prestare la massima attenzione ad imboccare correttamente i fori di fissaggio del cerchione con le colonnette della ruota, per non danneggiare la filettatura.

Per il serraggio dei cerchi delle ruote si consigliano dadi DIN74361-H-10.

Applicare una coppia di serraggio ai dadi del valore indicato in tabella:

M14x1.5	**140 Nm**
5/8"-18 UNF	**225 Nm**
M18x1.5	**300 Nm**
M20x1.5	**450 Nm**
M22x1.5	**550 Nm**

Verificare il serraggio delle viti dopo un breve utilizzo del veicolo.

Le ruote ***Reggiana Riduttori*** possono essere fornite con o senza freni. Di seguito sono riportate le indicazioni per una corretta messa in funzione dei freni.

6.3 Messa in funzione dei freni di tipo negativo a dischi multipli

La procedura per mettere in funzione il freno negativo è la seguente:

- Collegare i raccordi del circuito idraulico al foro di comando freno presente su ogni ruota.
- Dare pressione al circuito idraulico.
- Svitare leggermente il raccordo in ingresso olio ed attendere la fuoriuscita dell'aria.
- Richiudere il raccordo quando esce solo olio.

Verificare che la pressione di sblocco del freno negativo sia sufficiente a garantirne la completa apertura e che sia in linea con quella riportata sulle schede del catalogo Ruote o relativi disegni.
Verificare che la pressione nel circuito del freno negativo vada completamente a zero quando il veicolo deve essere frenato. Un'eventuale pressione residua nel circuito riduce le prestazioni del freno.

7 LUBRIFICAZIONE

Salvo diverse indicazioni, tutte le ruote sono fornite prive di olio lubrificante; è compito dell'utilizzatore effettuare il riempimento prima della messa in servizio e controllarne poi in seguito il livello dell'olio.
Le quantità d'olio, puramente indicative, necessarie al riempimento sono riportate nelle schede tecniche delle ruote (catalogo Ruote) o relativi disegni.

L'olio lubrificante all'interno di una ruota ha il compito di:

- ridurre l'attrito tra gli organi di trasmissione, aumentandone il rendimento;
- contribuire allo smaltimento del calore, trasferendolo dagli organi in movimento alla carcassa;
- proteggere le superfici dalla formazione di ruggine;
- ridurre la rumorosità.



Una corretta lubrificazione assicura un buon funzionamento ed una lunga durata della ruota

7.1 Viscosità

La viscosità cinematica del lubrificante deve essere scelta in funzione della temperatura di esercizio e della velocità di rotazione.
Poiché la viscosità diminuisce al crescere della temperatura, per temperature di funzionamento elevate è opportuno scegliere un olio con classe di viscosità maggiore.
Nel caso di riduzioni molto lente (velocità in uscita n_2 inferiore a 5 min^{-1}) si consiglia di utilizzare un olio con classe di viscosità elevata; viceversa, nel caso di ruota con elevata velocità di rotazione si consiglia di impiegare un olio con classe di viscosità bassa.

7.2 Additivi

L'uso di additivi di tipo EP (Extreme Pressure) serve a diminuire l'usura superficiale di ingranaggi e cuscinetti. Questi additivi, infatti, sotto l'effetto del calore e della pressione tra le superfici sottoposte a carico, reagiscono chimicamente con le superfici stesse, formando un rivestimento protettivo che impedisce la formazione di micro-saldature ed il conseguente grippaggio.

7.3 Contaminazione

Durante le prime ore di funzionamento delle ruote, a causa del contatto tra le superfici non rodate, si verifica una diffusione di particelle metalliche nell'olio.

La presenza di queste particelle ha un effetto certamente negativo sulla durata di vita di ingranaggi e cuscinetti.

Per ridurre la presenza di particelle metalliche nell'olio si consiglia di effettuare la sostituzione dell'olio, come spiegato più avanti nel capitolo dedicato alla manutenzione.

I tipi di lubrificante consigliati sono indicati nelle tabelle seguenti:

Lubrificanti per uso generale

	Oli Minerali			Oli Sintetici Polialfaolefine (PAO)			Oli Sintetici Poliglicoli (PG)		
Produttore	**ISO VG 150**	**ISO VG 220**	**ISO VG 320**	**ISO VG 150**	**ISO VG 220**	**ISO VG 320**	**ISO VG 150**	**ISO VG 220**	**ISO VG 320**
BP	Energol GR-XP 150	Energol GR-XP 220	Energol GR-XP 320	Enersyn EPX 150	Enersyn EPX 220	Enersyn EPX 320	Enersyn SG 150	Enersyn SG-XP 220	Enersyn SG-XP 320
BELLINI	RED R/ 4 150	RED R/ 4 220	RED R/ 4 320	-	SYNT RED R/4 PAO 220 ST	SYNT RED R/4 PAO 320 ST	SRG 150	SRG 220	SRG 320
CASTROL	Alpha SP 150	Alpha SP 220	AlphaSP 320	Alphasyn EP 150	Alphasyn EP 220	Alphasyn EP 320	Alphasyn PG 150	Alphasyn PG 220	Alphasyn PG 320
CHEVRON	Ultra Gear 150	Ultra Gear 220	Ultra Gear 320	Tegra Synthetic Gear 150	Tegra Synthetic Gear 220	Tegra Synthetic Gear 320	HiPerSYN 150	HiPerSYN 220	HiPerSYN 320
ENI	Blasia 150	Blasia 220	Blasia 320	Blasia SX 150	Blasia SX 220	Blasia SX 320	Blasia S 150	Blasia S 220	Blasia S 320
KLüBER	Klüberoil GEM 1-150 N	Klüberoil GEM 1-220 N	Klüberoil GEM 1-320 N	Klübersynth EG 4-150 N	Klübersynth EG 4-220 N	Klübersynth EG 4-320 N	Klübersynth GH 6-150	Klübersynth GH 6-220	Klübersynth GH 6-320
MOBIL	Mobilgear XMP 150	Mobilgear XMP 220	Mobilgear XMP 320	Mobilgear SHC Gear 150	Mobilgear SHC Gear 220	Mobilgear SHC Gear 320	Glygoyle 150	Glygoyle 220	Glygoyle 320
MOLIKOTE	L-0115	L-0122	L-0132	L-1115	L-1122	L-1132	-	-	-
NILS	Ripress EP 150	Ripress EP 220	Ripress EP 320	Atoil Synt PAO 150	Atoil Synt PAO 220	Atoil Synt PAO 320	Ripress Synt 150	Ripress Synt 220	Ripress Synt 320
Q8	Goya 150	Goya 220	Goya 320	El Greco 150	El Greco 220	El Greco 320	Gade 150	Gade 220	Gade 320
REPSOL	Super Tauro 150	Super Tauro 220	Super Tauro 320	Super Tauro Sintetico 150	Super Tauro Sintetico 220	Super Tauro Sintetico 320	Super Tauro PAG 150	Super Tauro PAG 220	Super Tauro PAG 320
SHELL	Omala S2 GX 150	Omala S2 GX 220	Omala S2 GX 320	Omala S4 GXV 150	Omala S4 GXV 220	Omala S4 GXV 320	Omala S4 WE 150	Omala S4 WE 220	Omala S4 WE 320
TEXACO	Meropa 150	Meropa 220	Meropa 320	Pinnacle EP 150	Pinnacle EP 220	Pinnacle EP 320	-	Synlube CLP 220	Synlube CLP 320
TOTAL	Carter EP 150	Carter EP 220	Carter EP 320	Carter SH 150	Carter SH 220	Carter SH 320	Carter SY 150	Carter SY 220	Carter SY 320
TRIBOL	1100/150	1100/220	1100/320	1510/150	1510/220	1510/320	800\150	800\220	800\320

Lubrificanti per uso alimentare

	Oli Idraulici			Oli per ingranaggi		
Produttore	**ISO VG 32**	**ISO VG 46**	**ISO VG 68**	**ISO VG 150**	**ISO VG 220**	**ISO VG 320**
BELLINI	-	-	-	SYNT RED HC LE 150	-	-
BP	Enerpar M 32	Enerpar M 46	Enerpar M 68	-	-	-
ENI	-	-	-	RIBES SX150	-	-
KLÜBER	Klüberfood 4 NH1-32	Klüberfood 4 NH1-46	Klüberfood 4 NH1-68	Klüberoil 4 UH1-150 N	Klüberoil 4 UH1-220 N	Klüberoil 4 UH1-320 N
MOBIL	DTE FM 32	DTE FM 46	DTE FM 68	DTE FM 150	DTE FM 220	DTE FM 320
NILS	Mizart Synt 32	Mizart Synt 46	Mizart Synt 68	Ripress Synt Food 150	Ripress Synt Food 220	Ripress Synt Food 320
REPSOL	FG Hydraulic 32	FG Hydraulic 46	FG Hydraulic 68	FG Gear Synth 150	FG Gear Synth 220	FG Gear Synth 320
FUCHS	Cassida Fluid HF 32	Cassida Fluid HF 46	Cassida Fluid HF 68	Cassida Fluid GL 150	Cassida Fluid GL 220	Cassida Fluid GL 320
TEXACO	Cygnus Hydraulic Oil 32	Cygnus Hydraulic Oil 46	Cygnus Hydraulic Oil 68	Cygnus Gear PAO 150	Cygnus Gear PAO 220	-
TOTAL	Nevastane AW 32	Nevastane AW 46	Nevastane AW 68	Nevastane SL 150	Nevastane SL 220	Nevastane SL 320
TRIBOL	Food Proof 1840/32	Food Proof 1840/ 46	Food Proof 1840/68	-	Food Proof 1810/220	Food Proof 1810/320

Nel caso di impiego di altri lubrificanti sintetici, verificarne la compatibilità con le tenute paraolio in NBR presenti nella ruota.

Non mescolare lubrificanti sintetici di tipo differente

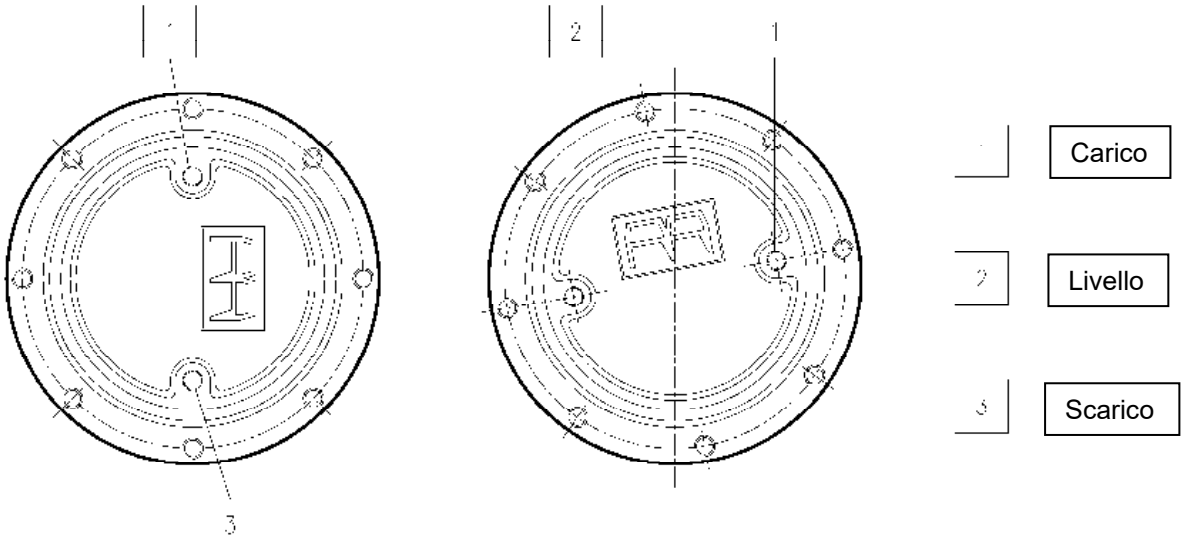
Se le condizioni di esercizio della ruota prevedono prolungati periodi di funzionamento tali da produrre una elevata temperatura dell'olio (>60°C) si consiglia l'utilizzo di olio sintetico, per garantire una minore usura dei componenti ed aumentare gli intervalli di sostituzione.

La temperatura massima del lubrificante all'interno della ruota non deve oltrepassare i 90°C.

7.4 Riempimento

Effettuare il cambio dell'olio lubrificante secondo gli intervalli descritti nel capitolo Manutenzione utilizzando la seguente procedura:

- Orientare la ruota come in figura A.
- Svitare, quindi rimuovere i tappi, sia di carico che di scarico, per facilitare la fuoriuscita dell'olio.
- Lavare l'interno della ruota con apposito detergente.
- Orientare la ruota come in figura B.
- Caricare l'olio fino a quando il livello raggiunge il foro di scarico.
- Chiudere i tappi cambiando ogni volta le guarnizioni di tenuta.



A: Posizione di scarico olio

B: Posizione di carico olio

8 MESSA IN SERVIZIO

8.1 Controlli al primo avviamento

Prima di effettuare l'avviamento della macchina occorre verificare i seguenti punti:

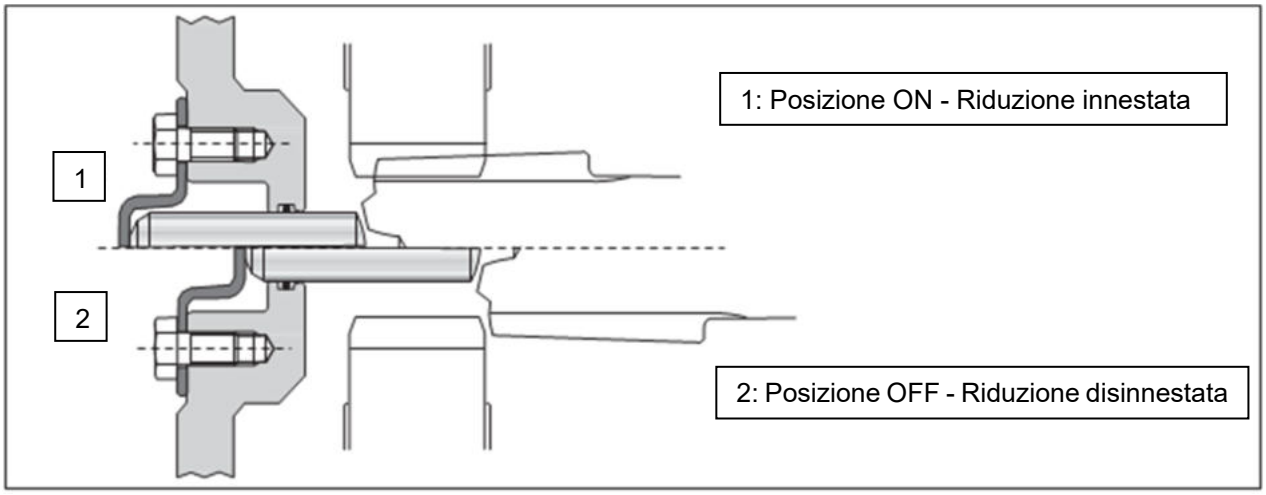
- Controllo livello olio.
- Controllo pressione del circuito frenante (ove presente).
  La pressione del circuito idraulico di frenatura deve essere sufficiente per l'apertura del freno negativo a dischi multipli. La pressione di esercizio non deve mai scendere al di sotto della pressione minima di apertura del freno negativo. Questo serve per evitare un surriscaldamento, una rapida usura dei dischi e un'azione frenante non voluta.
- Controllo del serraggio viti che fissano il cerchione alla ruota e di quelle che fissano la ruota alla macchina.

8.2 Prova a vuoto senza carichi

Dopo un breve periodo di funzionamento del veicolo con carichi limitati, ripetere i controlli del punto 8.1.

9 DISINNESTO

Le ruote della gamma RRTD non sono fornite di serie del dispositivo di disinnesto.
Le ruote della gamma RRWD hanno tutti il dispositivo di disinnesto
Schema standard di azionamento disinnesto:



10 MANUTENZIONE

La manutenzione ordinaria deve essere eseguita da personale qualificato nei modi e tempi previsti dal costruttore.
Il montaggio e smontaggio dei componenti deve essere effettuato utilizzando attrezzature idonee.
Utilizzare sempre e solo ricambi originali ***Reggiana Riduttori***, a garanzia della totale affidabilità e sicurezza.

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Rispettare tutte le condizioni di sicurezza durante le operazioni di manutenzione.

10.1 Manutenzione ordinaria

È richiesto solamente il controllo periodico del livello olio e dello stato delle tenute.

Per la manutenzione o sostituzione dei freni negativi a dischi multipli contattare il centro assistenza ***Reggiana Riduttori***.

La manutenzione deve essere eseguita da un operatore che intervenga nel rispetto delle norme antinfortunistica, per garantire la propria sicurezza e quella delle persone presenti nelle vicinanze.
Prima di eseguire qualsiasi intervento, assicurarsi che la macchina alla quale è collegata la ruota sia spenta e ne sia impedito l'avviamento accidentale.
Pericolo ustioni: non toccare la ruota durante l'esercizio e la fase di raffreddamento dopo la disinserzione.
Per lo smontaggio e il montaggio dei componenti utilizzare attrezzature idonee e in buono stato.

Dopo le prime 100 ore di funzionamento:

- effettuare la sostituzione dell'olio;
- controllare il serraggio di tutte le viti.

Per la sostituzione dell'olio posizionare un recipiente adeguato per raccogliere l'olio esausto e svitare i tappi di carico e scarico. Attendere qualche minuto per permettere la completa fuoriuscita dell'olio, quindi riavvitare il tappo di scarico sostituendone la guarnizione. Introdurre l'olio (facendo attenzione a non mescolare oli di marche e caratteristiche diverse) fino al raggiungimento del livello previsto e infine avvitare il tappo di carico sostituendo la guarnizione.
Eseguire il cambio dell'olio con ruota ancora calda per facilitare un completo svuotamento ed evitare la formazione di morchie.

Ogni 500 ore di funzionamento:

- controllare lo stato delle tenute esterne, ed accertarsi di eventuali perdite. In tal caso provvedere alla sostituzione delle tenute, utilizzando ricambi originali;
- controllare il serraggio di tutte le viti.

Per gli intervalli di sostituzione dell'olio riferirsi alla seguente tabella:

Temperatura olio	**Olio minerale**	**Olio sintetico**		
	-	**PAO**	**PG**	
Prima sostituzione olio	100			[h]
≤ 65°C	8000	20000	20000	[h]
65°C ÷ 80°C	4000	15000	15000	[h]
80°C ÷ 90°C	2000	10000	10000	[h]
Sostituzioni olio	12	24	24	[mesi]

Qualora su una ruota con freno negativo e motore idraulico si dovesse riscontrare un aumento del livello del lubrificante, potrebbe essersi verificato un trafilamento d'olio dalle tenute del freno oppure dalla tenuta rotante del motore; in tal caso contattare il Servizio assistenza **Reggiana Riduttori**.

10.2 Manutenzione straordinaria

La manutenzione straordinaria è di norma di pertinenza del Servizio assistenza **Reggiana Riduttori**, pertanto è vietata l'apertura della ruota per qualsiasi tipo di operazione che non rientri tra quelle definite "ordinarie".
Nel caso in cui venga concordata una riparazione da parte dell'utente finale, questa deve essere eseguita da un Manutentore esperto.

Reggiana Riduttori non si assume nessuna responsabilità per tutte quelle operazioni effettuate non comprese nella manutenzione ordinaria o non concordate preliminarmente con il Cliente, che abbiano arrecato danni a cose o a persone.

10.3 Reimballaggio

Nel caso in cui si renda necessaria una riparazione e la ruota debba essere spedita presso il Servizio assistenza, predisporre un imballo analogo a quello in cui è stato fornita la ruota.

11 MESSA FUORI SERVIZIO DEL PRODOTTO

Le operazioni per la messa fuori servizio della ruota vanno effettuate da personale esperto, nel rispetto delle vigenti norme in materia di sicurezza sul lavoro.

Si consiglia di procedere nel seguente modo:

- Svuotare completamente la ruota dagli oli presenti all'interno;
- Disconnettere l'eventuale motorizzazione;
- Smontare i componenti.

Si raccomanda di effettuare le suddette operazioni nel rispetto delle vigenti norme in materia di ambiente, evitando la contaminazione di suolo, acqua o aria con prodotti non biodegradabili.

Tutti i componenti provenienti dalla messa fuori servizio della ruota vanno consegnati presso centri di raccolta autorizzati per il trattamento, il riciclaggio e lo smaltimento dei rifiuti non biodegradabili.

12 ANOMALIE E RIMEDI

In caso di funzionamento anomalo consultare la seguente tabella; se l'anomalia dovesse persistere, contattare il Centro Assistenza ***Reggiana Riduttori*** più vicino.

ANOMALIA	POSSIBILE CAUSA	RIMEDIO
Trafilamento olio dalle tenute	Irrigidimento tenute per prolungato stoccaggio	Pulire la zona e verificare dopo pochi giorni
	Danneggiamento o usura tenute	Rivolgersi ad un Centro Assistenza
	Quantità eccessiva di lubrificante	Controllo del livello dell'olio
Vibrazioni e/o rumorosità eccessiva	Riduttore ruota non installato correttamente	Verificare i fissaggi
	Anomalia interna	Rivolgersi ad un Centro Assistenza
	Cuscinetti mal lubrificati o difettosi	
	Denti con ammaccature o sbeccature	
Freno a dischi multipli di stazionamento non si sblocca	Mancanza di pressione nel circuito frenante	Verificare il collegamento al freno
	Incollaggio dei dischi dovuto al periodo di stazionamento	Applicare pressione al freno e far girare la ruota azionando il motore
	Tenute del freno difettose	Rivolgersi ad un Centro Assistenza
Freno a dischi multipli di stazionamento non blocca	Pressione residua nel circuito	Verificare il circuito idraulico
	Dischi usurati	Rivolgersi ad un Centro Assistenza
Con motore in funzione il riduttore ruota non gira	Errata installazione motore	Verificare l'accoppiamento tra motore e riduttore ruota
	Freni bloccati	Verificare l'impianto frenante
	Anomalia interna	Rivolgersi ad un Centro Assistenza
	Riduttore ruota disinnestato	Vedere il capitolo DISINNESTO
Riscaldamento eccessivo	Olio in quantità eccessiva o insufficiente	Controllare il livello dell'olio
	Lubrificante inadatto	Controllare il tipo e lo stato del lubrificante
	Cuscinetti mal lubrificati o difettosi	Rivolgersi ad un Centro Assistenza
	Freno a dischi multipli non apre completamente	Verificare la pressione di apertura del freno
	Potenze termiche elevate	Rivolgersi ad un Centro Assistenza

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13 INTRODUCTION

13.1 Purpose of the document

This technical manual gives all the indications necessary for transporting, storing, handling, installing, using and servicing wheel gears, guaranteeing product integrity and compliance with current safety rules and regulations.

13.2 General warnings

Failure to abide by the indications given in this manual could be a hazard source for the safety of people and the environment besides impairing operation of the wheel gear.

Reggiana Riduttori s.r.l. declines all liabilities in the case of:

- using the wheel gear in a way that does not comply with what was established at the designing stage and not explicitly specified herein;
- incorrect installation of the wheel gear or in a way that does not conform to what is specified herein;
- alterations made or parts changed that were not expressly authorised;
- work done on the gear by unauthorised people.

13.3 Guarantee conditions

Reggiana Riduttori s.r.l. guarantees its products for 24 months from the date of shipment. Charges and costs connected to assessing a fault and replacing pieces shall be borne by the Customer.
Unauthorised work or work carried out by unauthorised people will invalidate the guarantee.

13.4 Keeping the instructions

This manual must be kept near where the wheel gear is installed and made available to the operating and maintenance personnel.

13.5 Copyright

Total or even partial reproduction of this manual is forbidden unless written authorisation is given by ***Reggiana Riduttori s.r.l.***

13.6 Revisions

Reggiana Riduttori s.r.l. reserves the right to revise this manual, altering or integrating it without notice.

14 DEFINITIONS AND SYMBOLS

Some of the definitions and symbols used often in this manual are:

Operator: person trained to install, work, adjust, clean and carry out routine maintenance on the wheel gear.

Expert maintenance engineer: person chosen and trained out of all those who have mechanical and electrical expertise with knowledge of the safety rules, to repair and carry out extraordinary maintenance on the wheel gear.

Routine maintenance: programmed operations that have the purpose of guaranteeing the proper working order of the wheel gear.

Extraordinary maintenance: these operations are not programmed and require the skill of an expert maintenance engineer.

ATTENTION

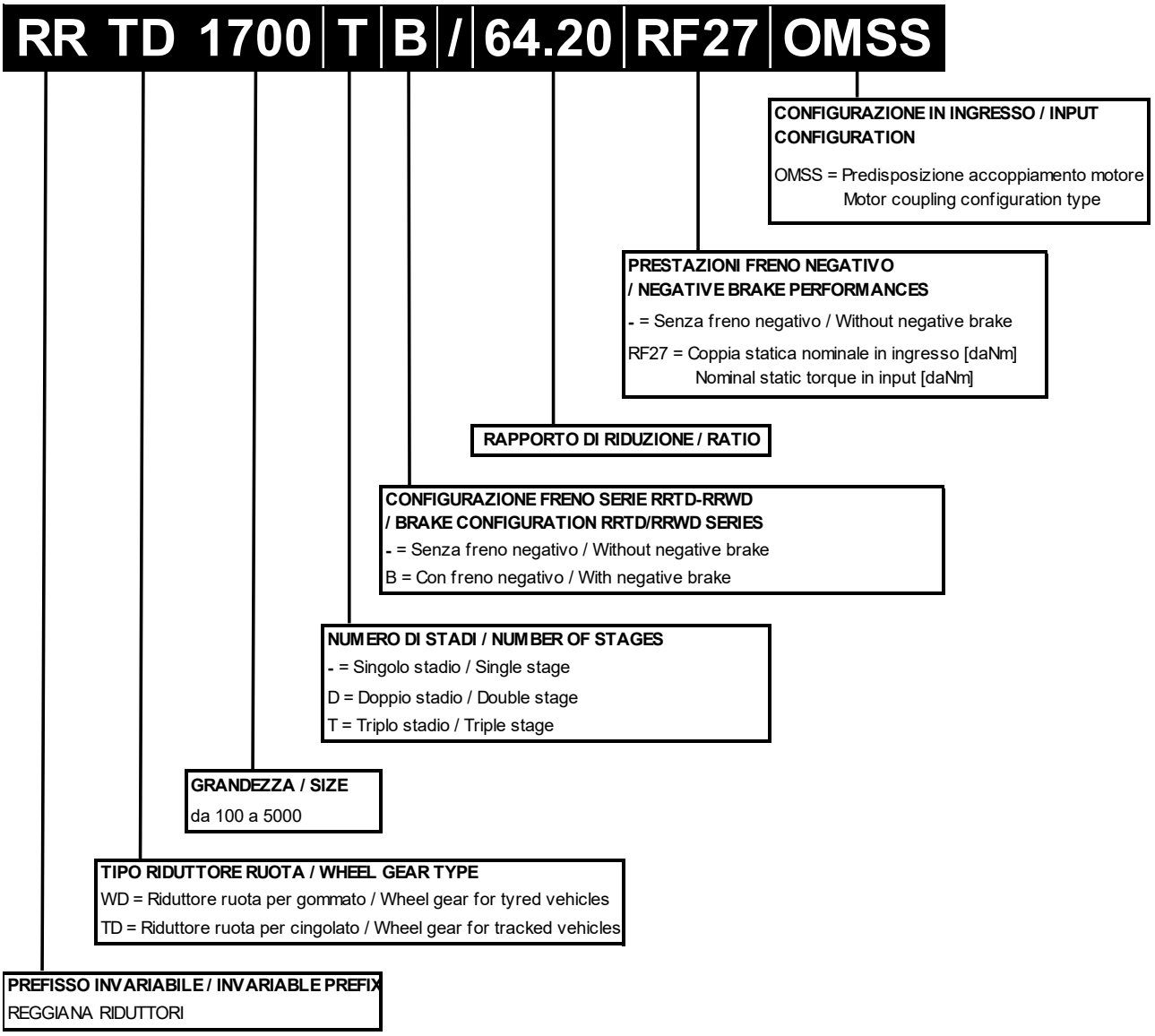
This indicates situations of serious danger that could put the health and safety of people at risk. Take all the necessary precautions established by the accident prevention laws.

IMPORTANT

This indicates technical information of a particularly important nature and which, if disregarded, could cause damage to the wheel gear and be a hazard source for the health and safety of people.

15 PRODUCT IDENTIFICATION

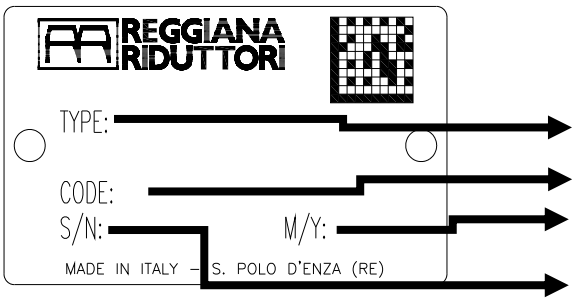
The ***Reggiana Riduttori*** wheel gears are identified by codes created in the following way:



15.1 Product marking and type designation

All ***Reggiana Riduttori*** products have a metal id plate positioned so as to be easily readable also after installation.

The following figure shows an example of a plate.



Legend

Wheel gear type and ratio
ID code for ordering
Year of production
Progressive serial number

15.2 Plate legibility

It is the user's responsibility to make sure the plate is in excellent condition and that all the data on it can be read easily, and it must be cleaned regularly. If it is damaged or lost, the user must ask for a duplicate.

In the case of additional painting, protect the plate, checking its legibility after.

15.3 CE Declaration of Conformity to the Technical Regulation Directives

All ***Reggiana Riduttori*** products are designed in compliance with the Essential Safety Requirements laid down in the Machine Directive 98/37/CE.

16 PRODUCT SPECIFICATIONS

16.1 General functions and range of applications, intended use

The wheel gear must be used only for what it has been designed. If it is put to other uses it could be hazardous for the health and safety of people.

The wheel gears' intended uses are industrial and mobile, for which they have been specifically designed and made.

16.2 Not intended use

It is forbidden to use the wheel gear in a way that does not conform to what was established at the designing stage. More specifically it is forbidden:

- for unqualified personnel to use the wheel gear;
- to install it in a way that fails to conform to the assembly position agreed when the order was placed;
- to dip the wheel gear in water or other liquids unless expressly agreed otherwise at the designing stage;
- to alter or replace parts of the wheel gear unless expressly authorised by ***Reggiana Riduttori***;
- to do any welding on the surface of the wheel gear;
- to use the wheel gear in a potentially explosive atmosphere unless explicitly intended for such a purpose.

16.3 Dimensions and mass

To know the dimensions and mass of the wheel gears and accessories, refer to the most recent version of the ***Reggiana Riduttori*** wheel gear catalogue.

16.4 Supply conditions

Unless agreed otherwise with the Customer, the ***Reggiana Riduttori*** products are supplied without lubricant, as indicated on a sticker on the outside of the wheel gear. The user must fill the wheel gear before using it.

The outside parts, except for the coupling surfaces and any specific requirements, are oiled or painted in a red, rustproof synthetic paint that can be painted over; the top coat is up to Customer.

If there is going to be a top coat of paint, follow these instructions:
- protect the O-rings, ID plate and plugs
- do not paint by dipping

The outside parts used for coupling (shafts, centrings, supporting surfaces, etc.) are protected with a film of rustproof oil. The parts inside the casings and kinematics are protected with rustproof oil.

16.5 Negative brake powering data

If the wheel gear is supplied together with a negative brake, make sure the brake's opening circuit supply pressure is higher than the minimum opening pressure. For the pressures to work with, please see ***Reggiana Riduttori*** wheel gear catalogue.
Brakes are oil lubricated and on purpose drawn for static and/or parking use.

⚠ *ATTENTION*

Dynamic use is prohibited.

16.6 Environment conditions and use/operating limits

The operating temperature recommended for ***Reggiana Riduttori*** products ranges between -20°C and +40°C.
Different conditions of use are however possible, taking certain designing measures which have to be agreed specifically with ***Reggiana Riduttori*** technical service.

16.7 Information about accident prevention

Before doing anything on the wheel gear read carefully all the instructions given in this manual.
The person who sees to operating and servicing the wheel gear must:

- be adequately skilled technically and experienced in the specific sector;
- be informed about the conditions of danger and the resulting risks of injury;
- know and use the IPG established by current legislation (Italian Law Decree 626/94);
- act always paying maximum attention and in compliance with the safety rules and regulations laid down by international directives and by the laws in the country where the wheel gear is used.

17 PACKING, HANDLING AND STORING

Reggiana Riduttori products are packed and shipped in crates or on pallets. Packaging is made to withstand the conditions of normal industrial environments. However, suitable protection measures must be taken if environmental conditions are particularly bad.
The wheel gears are wrapped in plastic bags and, if they are being packed in crates, polystyrene or other similar material is put inside to soften knocks.

17.1 Handling

Handle the packs with equipment and lifting means that are suitable for this type of packaging.
Take into account the mass, dimensions, points for lifting and the barycentre (which, if necessary, you will find on the outside of the pack).

⚠

Handling must be entrusted to expert personnel who must work in compliance with the accident prevention rules and regulations so as to guarantee their own safety and that of others in the vicinity.

Follow these instructions for handling:

- find an area where the surface is flat and possibly big enough for unloading and depositing the packs;
- do not tilt or turn the packs upside down when lifting and moving;
- proceed with caution when positioning the packs, avoiding sudden movements and violent knocks.

Use suitable tools to take the wheel gears out of their packaging (chains, straps, ropes, eyebolts, hooks, etc.) and make sure the load is always balanced.

17.2 Storing

Do not store the wheel gears in the open or where they would be subject to excessive dampness; never leave the wheel gears in direct contact with the ground.
If storing for more than 2 months, proceed as follows:

- Fill the wheel gear with lubricant oil of the type foreseen;
- protect the outside coupling surfaces with grease or a rustproof product;
- store in a dry, clean place, where temperature is between -15°C and +50°C with relative humidity not exceeding 80%. All other conditions require specific packaging.

17.3 Unpacking

When the goods are received they must be checked to see that they correspond to what is specified on the plate and in the order; also check that the contents of the pack have not been damaged during transport.

17.4 Disposing of the packaging materials safely

The packaging materials must be disposed of in accordance with the current environmental protection laws.

18 INSTALLATION

18.1 General rules

The wheel gears should be installed very carefully. When painting the wheel gears use anti-corrosion paints, protecting the various seals and coupling surfaces with masks or grease.
We advise filling up and checking the level of the oil, if possible after installation on the machine. If it is necessary to fill the wheel gear before installation, check the level after it has been mounted.



Observe all the safety conditions during commissioning.



Installation is to be entrusted to expert personnel working in compliance with the accident prevention rules and regulations so as to guarantee their own safety and that of others in the vicinity.

18.2 Installation instructions

The structure that the wheel gear is connected to has to be rigid with clean coupling surfaces at right angles to the activated axis. During the installation phase always make sure that the housing and the splining are carried out correctly. Moreover, the coupling surfaces should be free of dents, to guarantee perfect squareness of the wheel gear/structure coupling

On the machine centrings we suggest the following tolerances:

		CENTRING OUTPUT SIDE			CENTRING INPUT SIDE		
		Diameter	**Tolerance wheel gear**	**Tolerance machine**	**Diameter**	**Tolerance wheel gear**	**Tolerance machine**
RRTD	**100**	144	h8	**F8**	144	h8	**F8**
RRTD	**300**	190	h8	**F8**	180	h8	**F8**
RRTD	**800D**	220	h7	**F8**	190	f7	**H8**
RRTD	**1000D**	220	h7	**F8**	190	f7	**H8**
RRTD	**1700T**	280	h7	**F8**	270	f7	**H8**
RRTD	**1701T**	270	h7	**F8**	240	f7	**H8**
RRTD	**2400T**	300	h7	**F8**	240	f7	**H8**
RRTD	**3600T**	320	h8	**F8**	270	f7	**H8**
RRTD	**5000T**	350	h8	**F8**	280	h8	**F8**
RRWD	**200**	110	h8	**F8**	180	h8	**F8**
RRWD	**270**	152.4	h8	**F8**	200	h8	**F8**
RRWD	**300**	110	h8	**F8**	160	h8	**F8**
RRWD	**500D-10”**	110	h8	**F8**	190	f7	**H8**
RRWD	**500D-12”**	160	h8	**F8**	190	f7	**H8**
RRWD	**600D**	200	h7	**F8**	177.8	h8	**F8**
RRWD	**800D**	220	h7	**F8**	190	f7	**H8**
RRWD	**1700T**	280	h7	**F8**	270	f7	**H8**

Where the application entails heavy strain, use screws class 10.9 for fastening the wheel gear to the machine structure.
Tighten the screws at the torque advised by the current norms, in accordance with the dimension and the type of material.

The following table gives the preload and tightening moment for screws with ISO and UNC threads.

Preload has been calculated as being equal to 70% of the minimum yield strength of screw material and attributing an average value of 0.14 to the friction coefficient.

Diametro vite ***Screw diameter***	Precarico max [N] **Max. preload [N]**			Coppia max [Nm] **Max. torque [Nm]**		
	8.8	10.9	12.9	8.8	10.9	12.9
	8G	10K	12K	8G	10K	12K
M4x0.7	3940	5540	6650	3.1	4.3	5.2
M5x0.8	6350	8950	10700	6	8.4	10.1
M6x1	9020	12700	15200	10.3	14.6	17.5
M7x1	13000	18200	21800	16.9	23.6	28.3
M8x1.25	16400	23100	27700	24.8	34.9	41.9
M9x1.25	21600	30500	36300	36.7	51.8	61.7
M10x1.5	26000	36600	43800	49.7	70	83.7
M12x1.75	37800	53200	63800	84.6	119	143
M14x2	51600	72500	87000	134.6	189.2	227
5/8"-11 UNC	66100	93000	111600	199	280	337
M16x1.5	75000	105000	126000	215	300	360
M16x2	70200	99000	119000	204	288	346
M18x2.5	86000	121000	145000	284	400	480
M20x2.5	110000	155400	185000	396	556	666
M22x2.5	136000	191000	229000	530	745	900
M24x3	159000	223000	267000	700	980	1170
M27x3	206000	289000	347000	1010	1420	1700
M30x3.5	280000	399000	467000	1500	2130	2500

And for the oil plugs:

Diametro tappo Plug diameter	Coppia Torque [Nm]
G1/8	**8**
G1/4	**11**
G3/8	**15**
G1/2	**19**
G3/4	**25**
G1	**33**
G1 1/8	**40**
G1 1/4	**47**
G 1 1/2	**57**
G2	**79**

During the installation of the motor, suitably lubricate the coupling surfaces with a light film of lubricant.
Be careful not to damage the O-rings, if they are present.
Before tightening the screws make sure that the alignment is correct.
Provide protections for motors and connections, where they are exposed to obstacles or irregularity of the ground.
When mounting the rims on the wheel gears, make sure that the rim fastening holes fit correctly onto the wheel gear pins so as not to damage the threading.

For tightening the wheel rims we recommend DIN74361-H-10 nuts.

Apply a tightening torque to the nuts of the value indicated in the table:

M14x1.5	**140 Nm**
5/8"-18 UNF	**225 Nm**
M18x1.5	**300 Nm**
M20x1.5	**450 Nm**
M22x1.5	**550 Nm**

Check tightness of the screws after the vehicle has been used a short while.

The ***Reggiana Riduttori*** wheel gears can be supplied with or without brakes. Below are the indications for correct brake commissioning.

18.3 Commissioning the negative multiple-disc brakes

The commissioning procedure for the negative brake is the following:

- Connect the couplings of the hydraulic circuit to the brake control hole on each wheel gear.
- Pressurize the hydraulic circuit.
- Slightly loosen the oil input fitting and wait for the air to come out.
- Reclose the fitting when only oil is coming out.

Check that the release pressure of the negative brake is sufficient to guarantee full opening and is in line with what is specified on the technical data sheets of each wheel gear in the catalogue.
Check that the pressure in the negative brake circuit goes right down to zero when the vehicle has to be braked. If there is any residual pressure left in the circuit it reduces brake performances.

19 LUBRICATION

Unless specified otherwise, all wheel gears are supplied without lubricant and inspected with a leak test as specified by a sticker; the user has to add the oil before start-up.
The quantities of oil, purely indicative, necessary for filling up are shown in the technical data sheets of the wheel gear catalogue or relative drawings.

The lubricant oil inside a wheel gear has the job of:

- Reducing friction between the transmission parts, increasing their performances;
- Helping to get rid of heat, transferring it from the moving parts to the casing;
- Protecting surfaces from going rusty;
- Reducing noise.

Correct lubrication ensures good operation and a long life of the wheel gear.

19.1 Viscosity

The lubricant's kinematic viscosity must be chosen in accordance with both the operating temperature and rotation speed.
Since viscosity diminishes as the temperature rises, for high operating temperatures it is advisable to choose a higher viscosity class oil.
In the case of very slow reductions (output speed n_2 below 5 min^{-1}) we recommend using a high viscosity class oil or, vice versa, in the case of wheel gears with high rotation speed, we recommend using a low viscosity class oil.

19.2 Additives

The use of EP type additives (Extreme Pressure) helps reduce surface wear of the gears and bearings. As a matter of fact, these additives, under the effect of the heat and pressure between surfaces subject to load, react chemically with these same surfaces, forming a protective coating that prevents the formation of micro-weldings and consequent seizure.

19.3 Contamination

During the first hours of operation of the wheel gears, due to the contact between surfaces that have not been run-in, you will find metallic particles in the oil.
Undoubtedly these particles have a negative effect on the life of gears and bearings.

To reduce the number of metallic particles in the oil we recommend changing the oil, as explained further on in the Maintenance chapter.

The recommended lubricants are listed in the following tables:

General purpose lubricant

	Mineral oils			Poly-Alpha-Olefin synthetic oils (PAO)			Polyglycol synthetic oils (PG)		
Manufacturer	**ISO VG 150**	**ISO VG 220**	**ISO VG 320**	**ISO VG 150**	**ISO VG 220**	**ISO VG 320**	**ISO VG 150**	**ISO VG 220**	**ISO VG 320**
BP	Energol GR-XP 150	Energol GR-XP 220	Energol GR-XP 320	Enersyn EPX 150	Enersyn EPX 220	Enersyn EPX 320	Enersyn SG 150	Enersyn SG-XP 220	Enersyn SG-XP 320
BELLINI	RED R/ 4 150	RED R/ 4 220	RED R/ 4 320	-	SYNT RED R/4 PAO 220 ST	SYNT RED R/4 PAO 320 ST	SRG 150	SRG 220	SRG 320
CASTROL	Alpha SP 150	Alpha SP 220	AlphaSP 320	Alphasyn EP 150	Alphasyn EP 220	Alphasyn EP 320	Alphasyn PG 150	Alphasyn PG 220	Alphasyn PG 320
CHEVRON	Ultra Gear 150	Ultra Gear 220	Ultra Gear 320	Tegra Synthetic Gear 150	Tegra Synthetic Gear 220	Tegra Synthetic Gear 320	HiPerSYN 150	HiPerSYN 220	HiPerSYN 320
ENI	Blasia 150	Blasia 220	Blasia 320	Blasia SX 150	Blasia SX 220	Blasia SX 320	Blasia S 150	Blasia S 220	Blasia S 320
KLüBER	Klüberoil GEM 1-150 N	Klüberoil GEM 1-220 N	Klüberoil GEM 1-320 N	Klübersynth EG 4-150 N	Klübersynth EG 4-220 N	Klübersynth EG 4-320 N	Klübersynth GH 6-150	Klübersynth GH 6-220	Klübersynth GH 6-320
MOBIL	Mobilgear XMP 150	Mobilgear XMP 220	Mobilgear XMP 320	Mobilgear SHC Gear 150	Mobilgear SHC Gear 220	Mobilgear SHC Gear 320	Glygoyle 150	Glygoyle 220	Glygoyle 320
MOLIKOTE	L-0115	L-0122	L-0132	L-1115	L-1122	L-1132	-	-	-
NILS	Ripress EP 150	Ripress EP 220	Ripress EP 320	Atoil Synt PAO 150	Atoil Synt PAO 220	Atoil Synt PAO 320	Ripress Synt 150	Ripress Synt 220	Ripress Synt 320
Q8	Goya 150	Goya 220	Goya 320	El Greco 150	El Greco 220	El Greco 320	Gade 150	Gade 220	Gade 320
REPSOL	Super Tauro 150	Super Tauro 220	Super Tauro 320	Super Tauro Sintetico 150	Super Tauro Sintetico 220	Super Tauro Sintetico 320	Super Tauro PAG 150	Super Tauro PAG 220	Super Tauro PAG 320
SHELL	Omala S2 GX 150	Omala S2 GX 220	Omala S2 GX 320	Omala S4 GXV 150	Omala S4 GXV 220	Omala S4 GXV 320	Omala S4 WE 150	Omala S4 WE 220	Omala S4 WE 320
TEXACO	Meropa 150	Meropa 220	Meropa 320	Pinnacle EP 150	Pinnacle EP 220	Pinnacle EP 320	-	Synlube CLP 220	Synlube CLP 320
TOTAL	Carter EP 150	Carter EP 220	Carter EP 320	Carter SH 150	Carter SH 220	Carter SH 320	Carter SY 150	Carter SY 220	Carter SY 320
TRIBOL	1100/150	1100/220	1100/320	1510/150	1510/220	1510/320	800\150	800\220	800\320

Food grade lubricants

	Hydraulic oils			Gear oils		
Manufacturer	**ISO VG 32**	**ISO VG 46**	**ISO VG 68**	**ISO VG 150**	**ISO VG 220**	**ISO VG 320**
BELLINI	-	-	-	SYNT RED HC LE 150	-	-
BP	Enerpar M 32	Enerpar M 46	Enerpar M 68	-	-	-
ENI	-	-	-	RIBES SX150	-	-
KLÜBER	Klüberfood 4 NH1-32	Klüberfood 4 NH1-46	Klüberfood 4 NH1-68	Klüberoil 4 UH1-150 N	Klüberoil 4 UH1-220 N	Klüberoil 4 UH1-320 N
MOBIL	DTE FM 32	DTE FM 46	DTE FM 68	DTE FM 150	DTE FM 220	DTE FM 320
NILS	Mizart Synt 32	Mizart Synt 46	Mizart Synt 68	Ripress Synt Food 150	Ripress Synt Food 220	Ripress Synt Food 320
REPSOL	FG Hydraulic 32	FG Hydraulic 46	FG Hydraulic 68	FG Gear Synth 150	FG Gear Synth 220	FG Gear Synth 320
FUCHS	Cassida Fluid HF 32	Cassida Fluid HF 46	Cassida Fluid HF 68	Cassida Fluid GL 150	Cassida Fluid GL 220	Cassida Fluid GL 320
TEXACO	Cygnus Hydraulic Oil 32	Cygnus Hydraulic Oil 46	Cygnus Hydraulic Oil 68	Cygnus Gear PAO 150	Cygnus Gear PAO 220	-
TOTAL	Nevastane AW 32	Nevastane AW 46	Nevastane AW 68	Nevastane SL 150	Nevastane SL 220	Nevastane SL 320
TRIBOL	Food Proof 1840/32	Food Proof 1840/ 46	Food Proof 1840/68	-	Food Proof 1810/220	Food Proof 1810/320

If other lubricants are used always check their compatibility with the NBR oil seals used in the wheel gear.

Do not mix different kinds of synthetic lubricant together

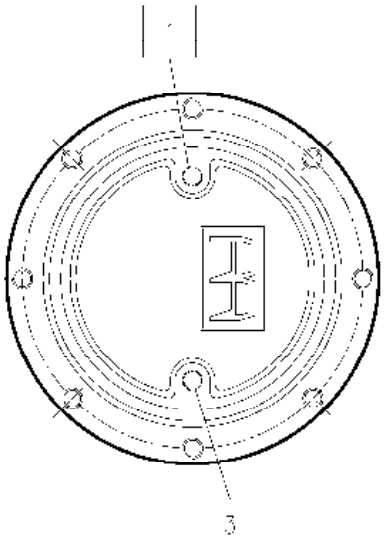
If the working conditions of the wheel gears entail prolonged working periods such that the oil gets very hot (>60°C) we recommend using synthetic oil to guarantee less wear of the components and also for longer intervals between changing it.

The maximum temperature of the lubricant inside the wheel gear should not exceed 90°C.

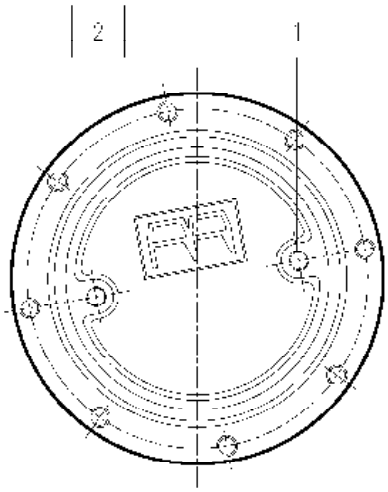
19.4 Filling up

Change the lubricated oil at the frequencies given in the Maintenance chapter in the following way:

- Position the wheel gear as shown in figure A.
- Loosen and remove the plugs, both the filling up and draining ones, so the oil can drain away easily.
- Wash the inside of the wheel gear with specific detergent.
- Position the wheel gear as shown in figure B.
- Fill with oil until the level reaches the drain hole.
- Close the plugs, changing the seals each time.



A: Oil drainage position



B: Oil filling up position

1 Filling up

2 Level

3 Draining

20 COMMISSIONING

20.1 First start-up checks

Before starting up the machine verify the following:

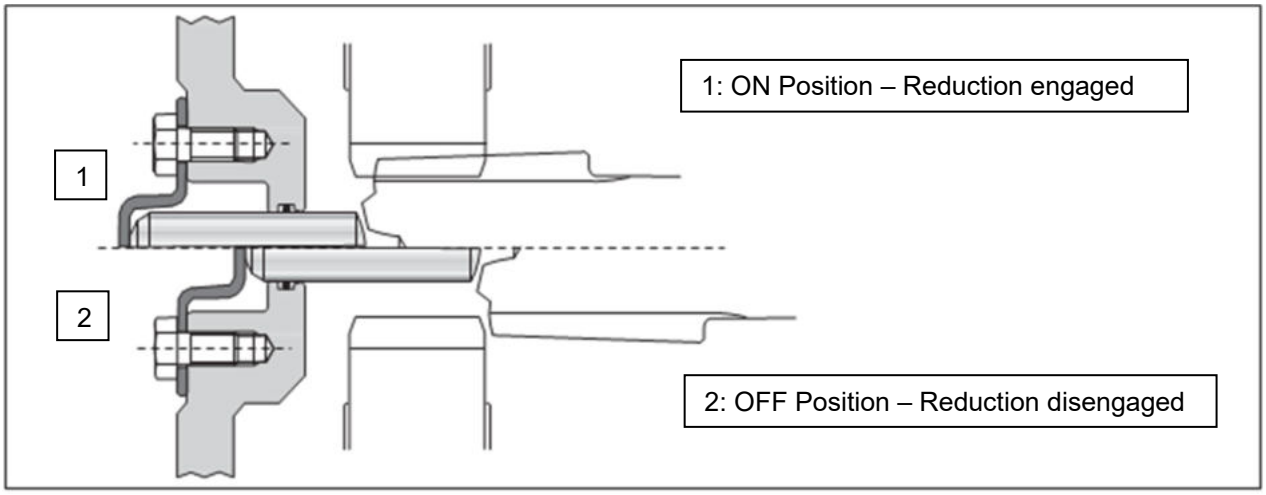
- Check the oil level.
- Check the pressure of the braking circuit (if any).
  The pressure in the hydraulic braking circuit must be enough to open the negative multiple-disc brake. Working pressure must never drop below the minimum negative brake opening pressure. This is to prevent overheating, quick wearing of the discs and unwanted braking action.
- Check tightness of the screws securing the rim to the wheel and those securing the wheel to the machine.

20.2 Idle test without load

After a brief period of operating the vehicle with limited loads, repeat the checks in point 20.1.

21 DISENGAGEMENT

The RRTD range of wheel gears does not have the disengagement device fitted as a standard feature.
All the RRWD range of wheel gears are fitted with the disengagement device.
Standard disengagement activation diagram:



22 MAINTENANCE

Routine maintenance should be carried out by qualified personnel in accordance with the methods and times programmed by the manufacturer.
The components should be mounted and dismounted only with suitable equipment.
Always and only use genuine ***Reggiana Riduttori*** spare parts, to guarantee total reliability and safety.

Observe all the safety conditions during maintenance jobs.

22.1 Routine maintenance

Only a periodical check of the oil level and the state of the seals is necessary.

For servicing or changing the negative multiple-disc brakes, contact the ***Reggiana Riduttori*** assistance centre.

Maintenance must be carried out by a person working in compliance with the accident prevention rules so as to guarantee his safety and that of the other people in the vicinity.
Before starting any maintenance work, make certain the machine the wheel gear is connected to is off and it is impossible for it to be switched back on accidentally.
Danger burns: do not touch the gear unit during operation and cooling down phase after switching off.
Use suitable tools, in good condition, to remove and mount the components.

After the first 100 hours of operation:

- Change the oil;
- Check tightness of all the screws.

To change the oil, place a tray underneath in which to collect the waste oil and unscrew the filling up and draining plugs. Wait a few minutes until all the oils has drained off and then screw the drain plug back on, replacing the seal. Put the new oil in (do not mix oils of different brands or properties) up to the level foreseen and then screw the filling up plug back on, replacing the seal.
Change the oil when the wheel gear is still hot as this makes it easier to empty the oil completely, avoiding the formation of oil foots.

Every 500 hours of operation:

- Check the condition of the external seals and make sure there are no leaks. If there are, replace the seals, using original spare parts;
- Check tightness of all the screws.

For the oil change refers to the following table of maintenance:

Oil temperature	**Mineral oils**	**Synthetic oils**		
	-	**PAO**	**PG**	
First oil change	100			[h]
≤ 65°C	8000	20000	20000	[h]
65°C ÷ 80°C	4000	15000	15000	[h]
80°C ÷ 90°C	2000	10000	10000	[h]
Oil changes	12	24	24	[months]

If you should find the level of the lubricant increases on a wheel gear with a negative brake and hydraulic motor, oil could be leaking from the brake seals or from the motor's rotating seal; in such an event, contact the ***Reggiana Riduttori*** Assistance service.

22.2 Extraordinary maintenance

Extraordinary maintenance is the competence of the ***Reggiana Riduttori*** Assistance service, therefore it is prohibited to open the wheel gear for any type of operation that does not fall within the category of those defined as “routine maintenance”.
If repairs by the end user are agreed, such repairs must be done by an expert Maintenance Engineer.

Reggiana Riduttori cannot be held liable for any operations carried out, that are not part of routine maintenance or not agreed upon beforehand with the Customer, that have caused injury to people or damage to things.

22.3 Repacking

If the wheel gear needs repairing and has to be shipped to the Assistance service the packaging used must be similar to the one it was delivered in.

23 DECOMMISSIONING THE PRODUCT

Expert personnel must see to the decommissioning operations in compliance with current rules and regulations on safety at the work place.

We suggest proceeding in the following way:

- drain off all oil from inside the wheel gear;
- disconnect the motor, if any;
- remove the components.

The above operations must be done observing the current laws concerning the environment, doing everything possible not to contaminate the ground, water or air with non-biodegradable products.

All the components removed when decommissioning the wheel gear must be handed over to authorised collection centres for treatment, recycling and disposal of non-biodegradable waste.

24 TROUBLESHOOTING

Should an anomaly occur during operation consult the following table. If the problem persists, contact the closest ***Reggiana Riduttori*** Assistance service.

ANOMALY	POSSIBLE CAUSE	SOLUTION
Oil leakage from the seals	Hardening of the seals due to prolonged storing	Clean the area and check for leakage after a few days
	Seals damaged or worn	Contact an Assistance Centre
	Too much lubricant	Check oil level
Vibrations and/or excessive noise	Wheel gear not installed correctly	Check the fixings
	Internal anomaly	Contact an Assistance Centre
	Bearings badly lubricated or faulty	
	Dented or chipped teeth	
The parking disc brake fails to disengage	Lack of pressure in the braking circuit	Check the brake connection
	Discs stuck due to the parking period	Apply pressure to the brake and turn the wheel gear by turning the motor on
	Brake seals are faulty	Contact an Assistance Centre
The parking disc brake does not block	Residual pressure in the circuit	Check hydraulic circuit
	Discs worn	Contact an Assistance Centre
With the motor activated the wheel gear does not rotate	Incorrect mounting of motor	Check coupling between motor and wheel gear
	Brakes blocked	Check the braking system
	Internal anomaly	Contact an Assistance Centre
	Wheel gear disengaged	See DISENGAGEMENT chapter
Over-heating	Either too much or too little oil	Check the oil level
	Unsuitable lubricant	Check the type and condition of the lubricant
	Bearings badly lubricated or faulty	Contact an Assistance Centre
	Multiple-disc brake not opening completely	Check brake opening pressure
	High thermal power	Contact an Assistance Centre

M100-2201-20

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INTERPUMP GROUP POWER TRANSMISSIONS DIVISION

CURTIS

Manual

Models **1232E / 34E / 36E / 38E** and **1232SE / 34SE / 36SE / 38SE**

Enhanced AC Controllers
for PMAC and Induction Motors

» Software Version OS 37.0* «



* 53096 Manual Rev C August 2021 includes updates to os37.49

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Mt. Kisco, NY 10549
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Read Instructions Carefully!

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53096, Rev D Oct. 2021

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1 — INTRODUCTION

Curtis 1232E/SE, 1234E/SE, 1236E/SE, and 1238E/SE AC motor controllers provide accurate, dependable, and highly efficient control of speed and torque of AC induction motors (ACIM) and permanent magnet AC motors (PMAC).

These AC controllers contain two microprocessors to provide exceptional capability and functional safety. The primary microprocessor runs an advanced field-oriented AC motor control while simultaneously running VCL software in an embedded logic controller. The second microprocessor continuously monitors the operation of the system, redundantly measuring inputs, crosschecking results, and verifying critical timing and operations.

VCL (Vehicle Control Language) is an innovative software programming language developed by Curtis. Many electric vehicle functions are uniquely built into the VCL code, and additional functions can be created by OEMs as required. VCL opens new avenues of customization, allowing specific vehicle application functions to be created quickly and easily within the motor controller itself, often eliminating the need to use separate vehicle manager modules.

The CANbus communications included within these controllers allow them to function as either the system CAN manager or as a CAN ancillary device. Inputs and outputs can be optimally shared throughout the system, minimizing wiring and creating integrated functions that often reduce the cost of the system.

These controllers are the ideal solution for traction, hoist, dual drive, and other motor drive and vehicle control needs.

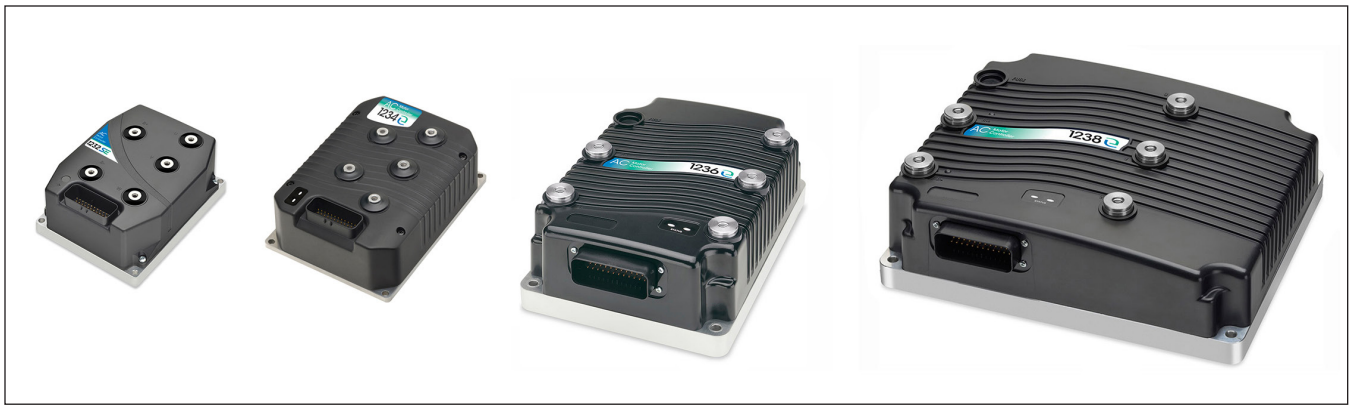


Figure 1

Curtis AC induction motor controllers:
from left to right, models 1232SE, 1234E, 1236E, and 1238E.
The E and SE models look similar, and share the same standard features.

Like all Curtis controllers, the E and SE models offer superior operator control of motor drive performance. Features include:

- Closed-loop speed and torque control for induction (ACIM) motors.
- Full field-weakening capability with ACIM motors.
- Built-in auto-characterization routines for effective in-vehicle optimization of motor performance and efficiency.
- Powerful operating system allows parallel processing of vehicle control tasks, motor control tasks, and user configurable programmable logic (VCL).
- Built-in Dual Drive software allows easy setup and control of typical dual-drive vehicles, without VCL.
- CANopen compatible CANbus connection; other CANbus protocols are configurable through VCL.
- Easily programmable through the Curtis 1313 handheld programmer and 1314 PC Programming Station.
- Rugged sealed housing and connectors meet IP65 environmental sealing standards for use in harsh environments.
- Compliance with Machinery Directives 2006/42/EC and EN13849-1.

What is New in os37.49

OS37.49 updates the available ACIM Motor Types to 536. It updates the PMAC Motor Types to 127. This Revision D clarifies the fact that the 1232E/1232/SE controllers do have the analog output.

os37.49 includes the updates for os37.0:

The Digital Out 6 Open/Short and Digital Out 7 Open/Short were updated to Digital Out 6 Overcurrent and Digital Out 7 Overcurrent to more accurately describe the feature as the open driver checks were not performed. The current limit remains at 1 Amp. This name change also applies to the VCL_BIT definitions,

- DIGITAL_OUT_6_OPEN_SHORT_FAULT = DIGITAL_OUT_6_OVERCURRENT_FAULT.
- DIGITAL_OUT_7_OPEN_SHORT_FAULT = DIGITAL_OUT_7_OVERCURRENT_FAULT.

The VCL_CONST definitions were also updated,

- DIGITAL_OUT_6_OPEN_SHORT = DIGITAL_OUT_6_OVERCURRENT.
- DIGITAL_OUT_7_OPEN_SHORT = DIGITAL_OUT_7_OVERCURRENT.

Getting the most out of the Curtis controller

Thoroughly read and refer to this manual to apply and configure the controller. Understanding the installation & wiring guidelines, the parameter settings, the VCL functions, the initial setup & commissioning, and using the diagnostic and troubleshooting guide are critical to a successful application.

This manual describes the typical usage of the controller. If the intended application is not illustrated or discussed within this manual, contact the Curtis distributor or the regional Curtis sales-support office for additional technical support. The Curtis sales and support office-contact information is available from the Curtis Instruments website under the International tab: https://www.curtisinstruments.com/international/

2 — INSTALLATION AND WIRING

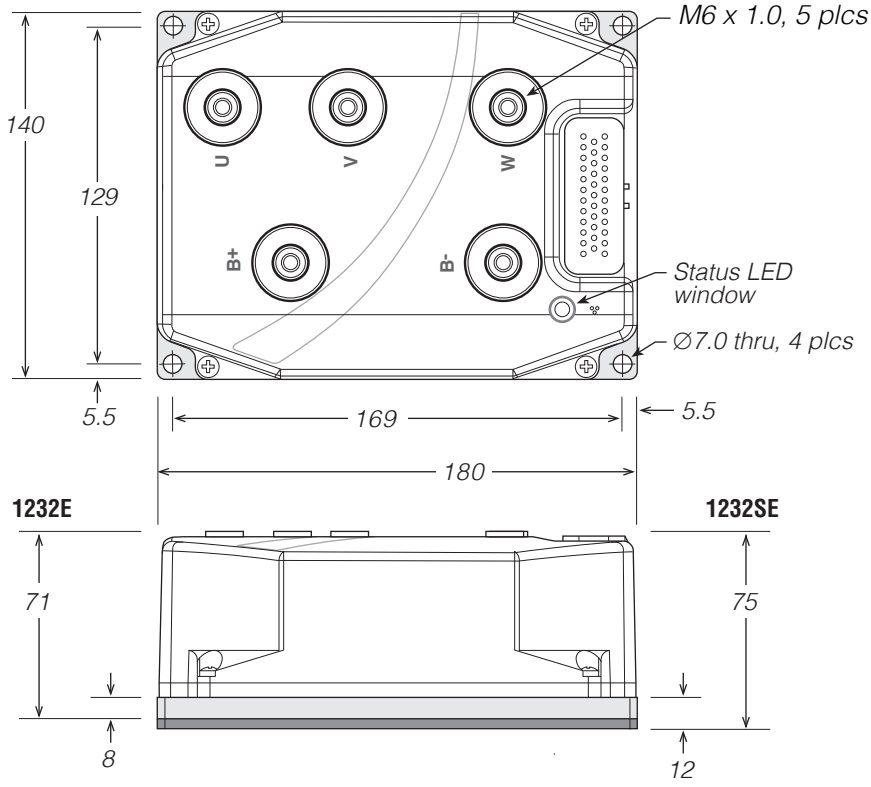
MOUNTING THE CONTROLLER

The outline and mounting hole dimensions for the 1232E/SE controller are shown in Figure 2a, for the 1234E/SE controller in Figure 2b, and for the 1236E/SE and 1238E/SE controllers in Figure 2c. When an Ampseal plug housing is mated with the 35-pin logic receptacle, these controllers meet the IP65 requirements for environmental protection against dust and water. Nevertheless, in order to prevent external corrosion and leakage paths from developing, **the mounting location should be carefully chosen to keep the controller as clean and dry as possible.**

Mount the controller to a flat surface devoid of protrusions, ridges, or a curvature that can cause damage or distortion to its heatsink (the base plate). Secure the controller using four 6 mm (1/4") diameter bolts evenly torqued to the vehicle's mounting surface. These controller's heatsink (bottom surface) have a typical roughness grade of N8 (ISO 1302), with a flatness tolerance of < 5 mm (0.13 per 25 mm). A thermal joint compound is recommended to improve heat conduction from the controller heatsink to the vehicle's mounting surface. Typically, when properly mounted to a larger metal surface, additional heat-sinking or fan-cooling is not necessary to meet the application's peak and continuous current ratings.

Figure 2a

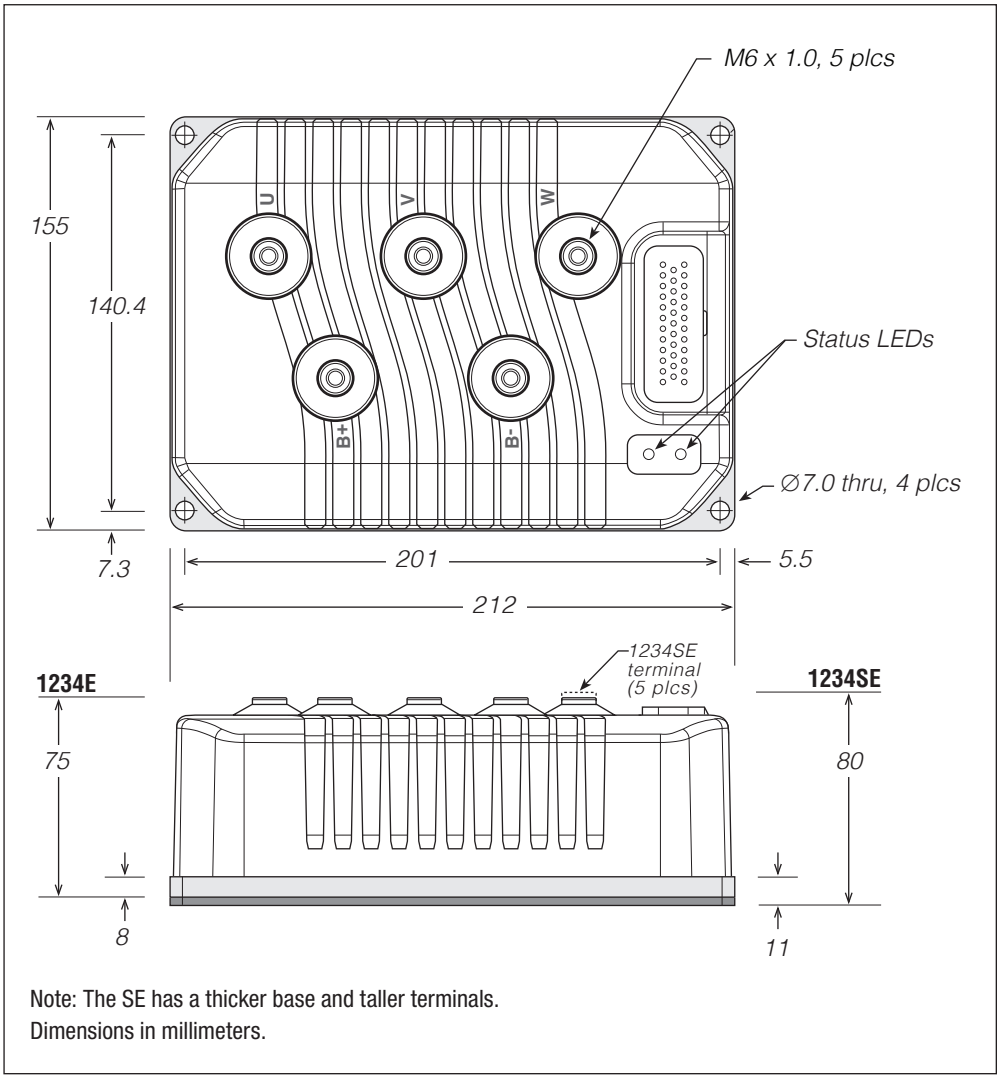
Mounting dimensions, Curtis 1232E and 1232SE motor controllers.



Note: The SE has a thicker base.
Dimensions in millimeters.

Figure 2b

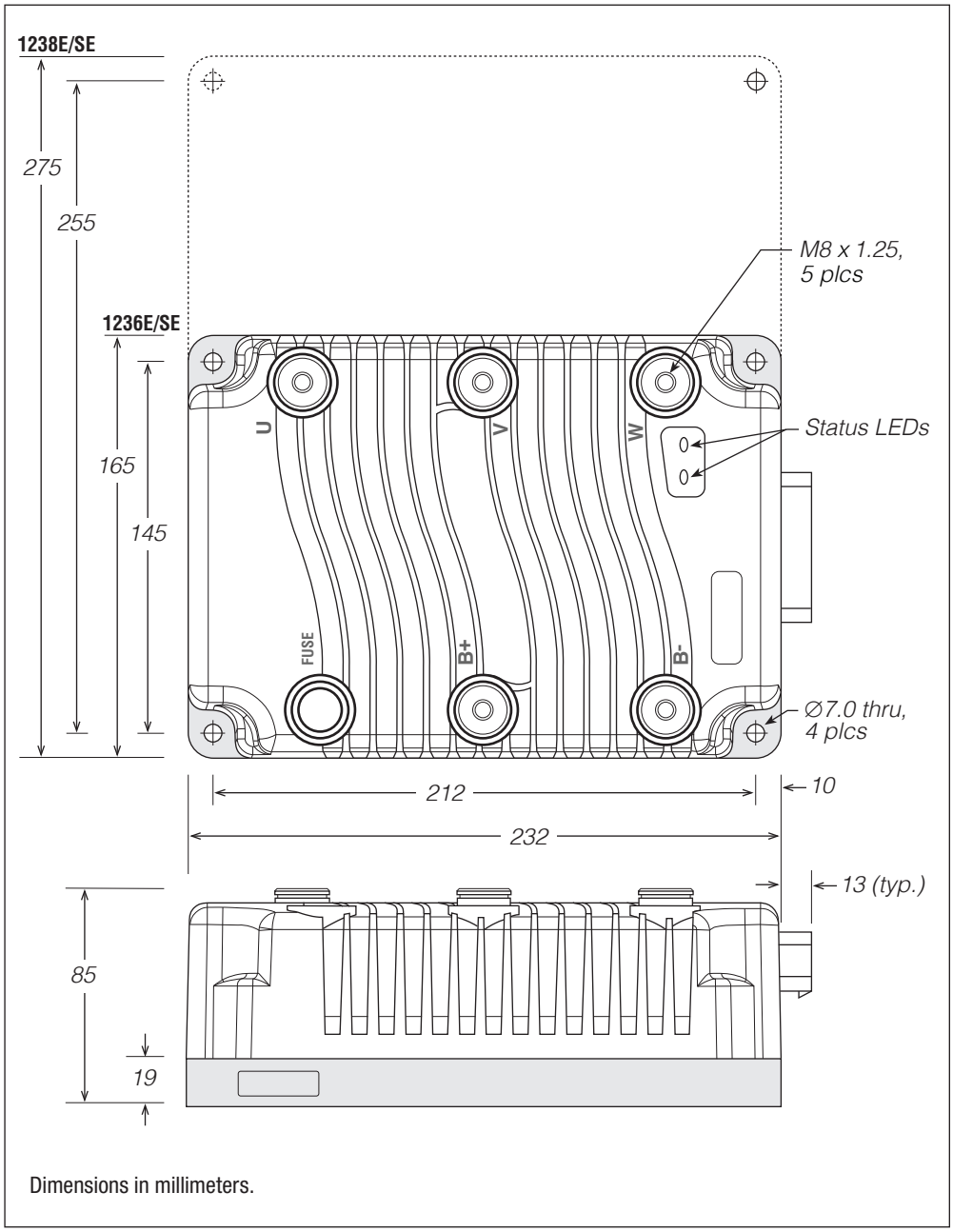
Mounting dimensions, Curtis 1234E and 1234SE motor controllers.



Note: The SE has a thicker base and taller terminals.
Dimensions in millimeters.

Figure 2c

Mounting dimensions, Curtis 1236E/SE and 1238E/SE motor controllers.



Dimensions in millimeters.

⚠ WARNING

Working on electrical systems is potentially dangerous. Protect all personnel against uncontrolled operation, high current arcs, and outgassing from lead-acid batteries:

UNCONTROLLED OPERATION — Some conditions could cause the motor to run out of control. Disconnect the motor or jack up the vehicle and get the drive wheels off the ground before attempting any work on the motor control circuitry.

HIGH CURRENT ARCS — Batteries can supply very high power, and arcing can occur if they are short circuited. Always open the battery circuit before working on the motor control circuit. Wear safety glasses, and use properly insulated tools to prevent shorts.

LEAD-ACID BATTERIES — Charging or discharging generates hydrogen gas, which can build up in and around the batteries. Follow the battery manufacturer's safety recommendations. Wear safety glasses.

Take the required steps during the design and development of the end product to ensure that its EMC performance complies with applicable regulations; suggestions are presented in Appendix A.



These controllers contain **ESD-sensitive components**. Use appropriate precautions in connecting, disconnecting, and handling the controller. See installation suggestions in Appendix A for protecting the controller from ESD damage.

HIGH POWER CONNECTIONS

There are five high power terminals, identified on the controller housing as **B+**, **B–**, **U**, **V**, and **W**.

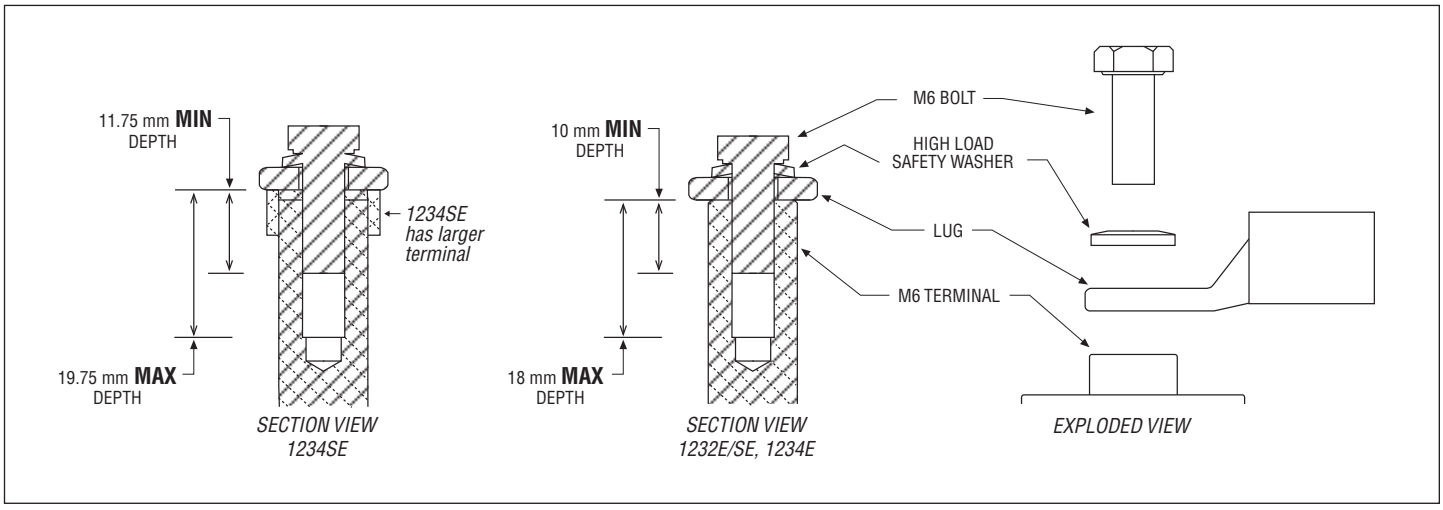
Table 1 High Powered Connections

Terminal	Function
B+	Positive battery to controller
B–	Negative battery to controller
U	Motor phase U
V	Motor phase V
W	Motor phase W

Lug Assembly: 1232E/SE and 1234E/SE models

Five aluminum M6 terminals are provided. Lugs should be installed as follows, using M6 bolts sized to provide proper engagement (see diagram):

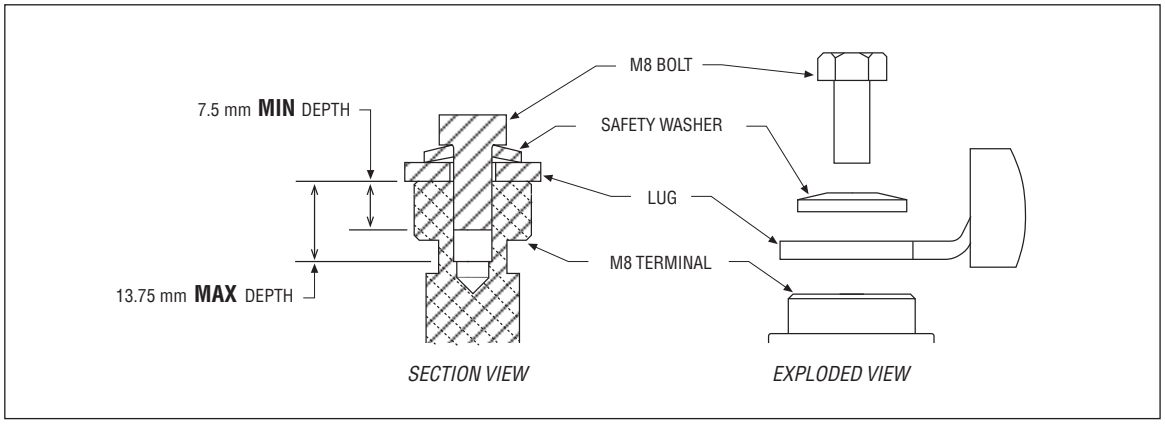
- Place the lug on top of the aluminum terminal, followed by a high-load safety washer with its convex side on top. The washer should be a SCHNORR 416320, or equivalent.
- If two lugs are used on the same terminal, stack them so the lug carrying the least current is on top.
- Tighten the assembly to 10.2 ±1.1 N·m (90 ±10 in-lbs).



Lug assembly: 1236E/SE and 1238E/SE models

Five M8 terminals are provided. Lugs should be installed as follows, using M8 bolts sized to provide proper engagement (see diagram):

- Place the lug on top of the terminal, followed by a safety washer with its convex side on top. The washer should be a SCHNORR 700800, or equivalent.
- If two lugs are used on the same terminal, stack them so the lug carrying the least current is on top.
- Tighten the assembly to 9.6 ±0.9 N·m (85 ±8 in-lbs).



High Power Wiring Guidelines: All Models

Battery cables (B+, B–)

These two cables should be run close to each other between the controller and the battery. Use high quality copper lugs and observe the recommended torque ratings. For best noise immunity the cables should not run across the center section of the controller. With multiple high current controllers, use a star ground from the battery **B–** terminal.

Motor wiring (U, V, W)

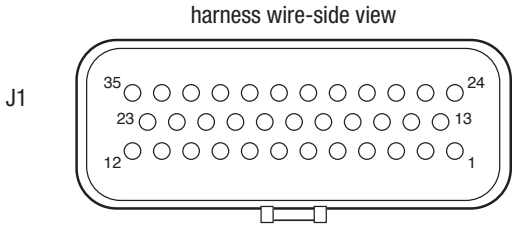
The three phase wires should be close to the same length and bundled together as they run between the controller and the motor. The cable lengths should be kept as short as possible. Use high quality copper lugs and observe the recommended torque ratings.

For optimum noise immunity, the motor cables should not run across the center section of the controller. In applications that seek the lowest possible emissions, a shield can be placed around the bundled motor cables and connected to the B– terminal at the controller. Typical installations will readily pass the emissions standards without a shield. Low current signal wires should not be run parallel to the motor cables. When necessary they should cross the motor cables at a right angle to minimize noise coupling. Refer to Appendix A for further information about Electromagnetic Compatibility (EMC).

LOW POWER 35-PIN CONNECTIONS

All low power connections are made through a single 35-pin AMPSEAL connector. The mating plug housing is AMP p/n 776164-1 and the gold-plated socket terminals are AMP p/n 770520-3 (Strip form) and 770854-3 (loose piece). The connector will accept 0.5 – 1.25 mm (20 – 16 AWG) wire with a 1.7 – 2.7 mm diameter (thin-wall insulation). Seal any non-used connector positions that have the silo-diaphragm pierced with seal plug 770678-1.

The 35 individual pins are characterized in Table 2.



Low Power Wiring Guidelines

Position feedback (Pins 7, 26, 31, 32)

All four wires (+5V, Feedback A, Feedback B, and I/O ground) should be bundled together as they run between the motor and controller logic connector. These can often be run with the rest of the low current wiring harness. The encoder cables should not be run near the motor cables. In applications where this is necessary, shielded cable should be used with the ground shield connected to the I/O ground (pin 7) at only the controller side. In extreme applications, common mode filters (e.g. ferrite beads) could be used.

CANbus (Pins 21, 23, 34, 35)

It is recommended that the CAN wires be run as a twisted pair. However, many successful applications at 125 kbit/s are run without twisting, simply using two lines bundled in with the rest of the low current wiring. The CANbus wiring should be kept away from the high current cables and cross them at right angles when necessary.

All other low power wiring

The remaining low power wiring should be run according to standard practices. When designing the vehicle's wiring and routing, keep the input lines such as throttle, brake, temperature, and the above mentioned encoder signals separate from controller's output lines such as the coil driver outputs. Avoid routing the low-power wiring parallel to the high power (and current) battery and motor cables.

Table 2 Low Power Connections

Pin	Name	Description	Related VCL*	
			Function	References
1	KSI	Keyswitch input. Provides logic power for the controller and power for the coil drivers.		Keyswitch_Voltage
2	Prop. Driver	Proportional driver. This is a coil driver with current control capability typically used for a proportional valve on a hydraulic manifold. Can also be used as a digital input.	Automate_PWM() Put_PWM() Automate_ Frequency_ Output() Frequency_ Output_Duty_ Cycle()	Sw_13 PWM5 PD_Current PD_Output PD_Throttle VCL_PD_Throttle
3	Driver 4	Generic driver #4; can also be used as a digital input. Has low frequency PWM capabilities.	Automate_PWM() Put_PWM()	Sw_12 PWM4 PWM4_Output
4	Driver 3	Generic driver #3; can also be used as a digital input. Has low frequency PWM capabilities. Typically used for pump contactor.	Automate_PWM() Put_PWM()	Sw_11 PWM3 PWM3_Output
5	Driver 2	Generic driver #2; can also be used as a digital input. Has low frequency PWM capabilities and a slightly higher current rating. Typically used for electromagnetic brake.	Automate_PWM() Put_PWM()	Sw_10 PWM2 PWM2_Output
6	Driver 1	Generic driver #1; can also be used as a digital input. Has low frequency PWM capabilities. Typically used for main contactor.	Automate_PWM() Put_PWM() Set_Interlock() Clear_Interlock()	Sw_9 PWM1 PWM1_Output Interlock_State Main_State
7	I/O Ground	Input and output ground reference.		
8	Switch 2 Analog 2	Can be used as generic switch input #2 or as generic analog input #2. Typically used as the motor temperature analog input.		Sw_2 Analog2_Input Motor_Temperature
9	Switch 3	Generic switch input #3. Typically used as the interlock switch.		Sw_3
10	Switch 4	Generic switch input #4.		Sw_4
11	Switch 5	Generic switch input #5.		Sw_5
12	Switch 6	Generic switch input #6.		Sw_6
13	Coil Return	This is the coil return pin (at B+ potential) for all the contactor coils.		
14	Switch 16	Generic switch input #16.		Sw_16
15	Throttle Pot High	Pot high connection for a 3-wire throttle pot.		
16	Throttle Pot Wiper	Pot wiper connection for the throttle pot.	Setup_Pot() Setup_Pot_Faults()	Throttle_Pot Throttle_Pot_Output
17	Pot2 Wiper	Pot wiper connection for the brake pot.	Setup_Pot() Setup_Pot_Faults()	Brake_Pot Brake_Pot_Output

** The related VCL columns are vital when writing VCL code (see Chapter 10). VCL "functions" are used to access the various I/Os; VCL "references" are predefined names for specific pins. Refer to the OS SysInfo file for specific VCL functions, controller system variables, usage, and CAN Object IDs.*

Table 2 Low Power Connections, cont'd

Pin	Name	Description	Related VCL*	
			Function	References
18	Pot Low	Common pot low connection for the throttle and brake pots.		Pot_Low_Output
19	Digital Out 6	An On/Off output driver. Can also be used as a digital input.	Set_DigOut() Clear_DigOut()	Sw_14 DigOut6 Dig6_Output
20	Digital Out 7	An On/Off output driver. Can also be used as a digital input.	Set_DigOut() Clear_DigOut()	Sw_15 DigOut7 Dig7_Output
21	CAN Term H	High connection for the CAN termination jumper.		
22	Switch 7	Generic switch input #7. Typically used as the Forward switch.		Sw_7
23	CAN H	CANbus high.	Setup_CAN() Setup_Mailbox() Send_Mailbox() etc.	
24	Switch 1 Analog 1	Can be used as generic switch input #1 or as generic analog input #1. Typically used for emergency reverse switch (if applicable).		Sw_1 Analog1_Input
25	+12V Out	Unregulated low power +12V output.		Ext_Supply_Current
26	+5V Out	Regulated low power +5V output.		5_Volts_Output Ext_Supply_Current
27	Pot2 High	Pot high connection for a 3-wire brake pot.		
28	Serial TX	Serial transmit line for display or flash update.	Setup_Serial()	
29	Serial RX	Serial receive line for flash update.	Setup_Serial()	
30	Analog Output	Low power, low frequency 0V to 10V analog output.	Automate_PWM() Put_PWM()	PWM6 Analog_Output
31	Position Feedback A	Quadrature encoder input phase A (ACIM motors).		Motor_RPM MotorspeedA Encoder_Sin_Input_Compensated
32	Position Feedback B	Quadrature encoder input phase B (ACIM motors).		Motor_RPM MotorspeedB Encoder_Cos_Input_Compensated
33	Switch 8	Generic switch input #8. Typically used as the Reverse switch.		Sw_8
34	CAN Term L	Low connection for the CANbus termination jumper.		
35	CAN L	CANbus low.	Setup_CAN() Setup_Mailbox() Send_Mailbox() etc.	

** The related VCL columns are vital when writing VCL code (see Chapter 10). VCL "functions" are used to access the various I/Os; VCL "references" are predefined names for specific pins. Refer to the OS SysInfo file for specific VCL functions, controller system variables, usage, and CAN Object IDs.*

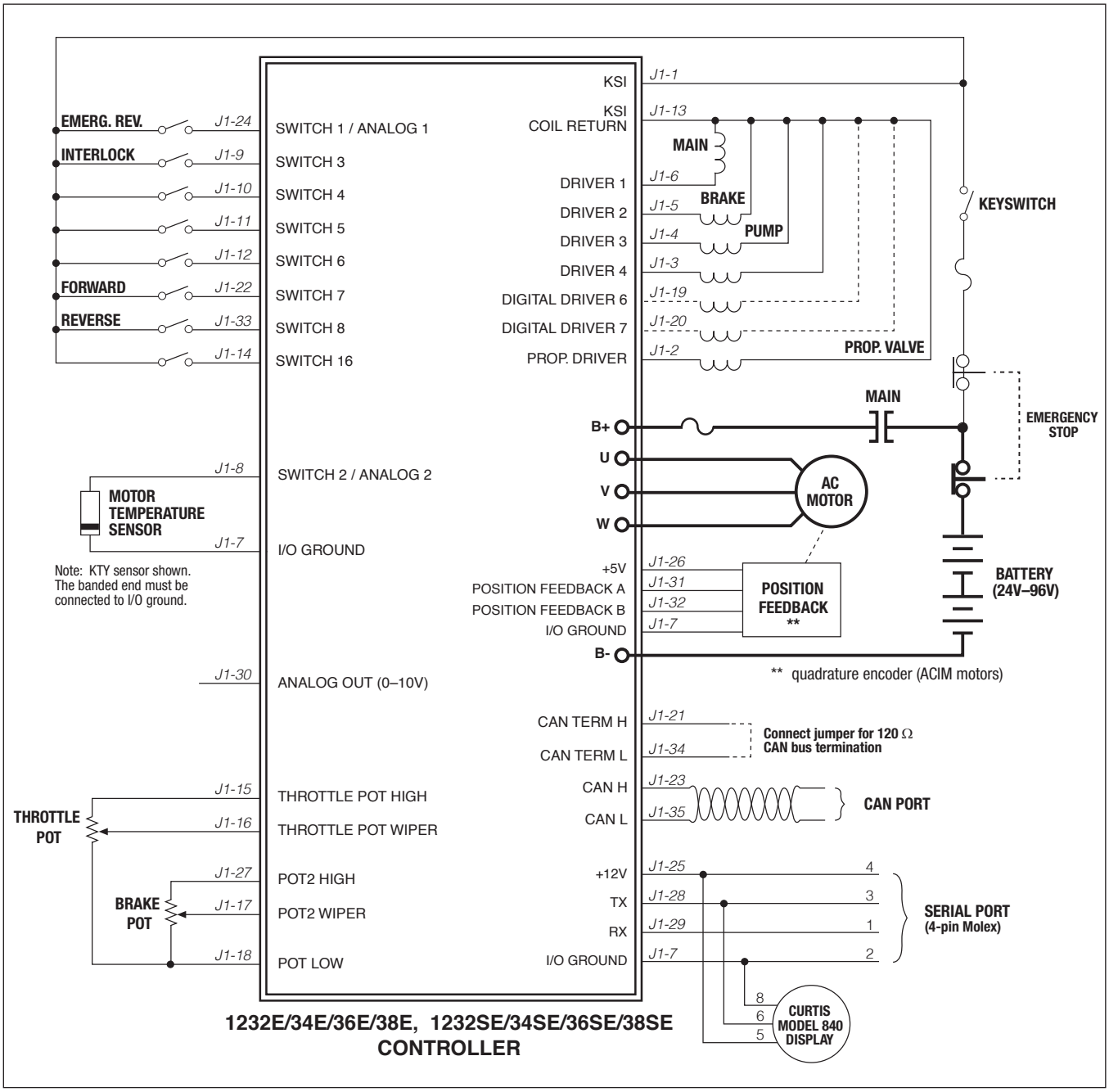
CONTROLLER WIRING: BASIC CONFIGURATION

A basic wiring diagram is shown in Figure 3. Throttle and brake are shown in the diagram as 3-wire potentiometers; other types of throttle and brake inputs are easily accommodated, and are discussed in the following throttle wiring section.

The main contactor coil must be wired directly to the controller as shown in Figure 3 to meet EEC safety requirements. The controller can be programmed to check for welded or missing contactor faults and uses the main contactor coil driver output to remove power from the controller and motor in the event of various other faults. **If the main contactor coil is not wired to Pin 6 of the 35-pin**

Figure 3

Basic wiring diagram, Curtis 1232E/SE, 34E/SE, 36E/SE, and 38E/SE motor controllers.



connector as shown, the controller will not be able to open the main contactor in serious fault conditions and the system will therefore not meet EEC safety requirements.

Note that the basic wiring diagram is designed for generic applications and may not fully meet the requirements of every vehicle system. These controllers have very flexible I/O and wiring configurations; Please contact the Curtis distributor or support engineer to discuss a particular application.

SWITCH INPUT WIRING

The following inputs are dedicated to specific functions when the parameter settings are as shown:

Switch 1: Emergency Reverse input if the EMR Enable = On and EMR Type = 0 or 2.

Switch 3: Interlock input if Interlock Type = 0.

Switch 5: Lift input (depends on VCL program).

Switch 6: Lower input (depends on VCL program).

Switch 7: Forward input if Throttle Type = 1–3.

Switch 8: Reverse input if Throttle Type = 1–3.

LOW POWER CIRCUIT SPECIFICATIONS

The input/output circuits wired to the 35-pin connector can be grouped by type as follows; their electrical characteristics are discussed below.

- Digital Inputs.
- Digital and PWM Outputs.
- Analog Inputs.
- Analog Output.
- Power Supply Outputs.
- KSI and Coil Return Inputs.
- Throttle and Brake Inputs.
- Communications Ports I/O.
- Position Feedback Inputs.

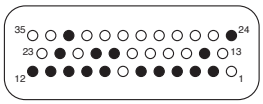
Digital Inputs

These control lines can be used as digital (on/off) inputs. Normal “on” connection is direct to B+; “off” is direct to B–. Input will pull low (off) if no connection is made. All digital inputs are protected against shorts to B+ or B–.

Nine of these lines (Switches 1–8, 16) are designed to pull current to keep switch contacts clean and prevent leakage paths from causing false signals.

The remaining lines are digital inputs associated with driver outputs; note that they have much higher input impedances. The two digital output lines, Digital Out 6 and 7, can also be read as inputs, and are therefore included in this group.

The digital inputs at pins 24 and 8 can also be used as analog inputs, and are included in that group as well.



DIGITAL INPUT SPECIFICATIONS

Name	Pin	Logic Thresholds	Input impedance*	Voltage range†	ESD Tolerance
Switch 1	24	Rising edge = 4.4V max Falling edge = 1.5V min	*24-36V models:* 7.0 kΩ, 7.2 kΩ *36-48V models:* 10.8 kΩ, 11.2 kΩ *48-80V models:* 25.2 kΩ, 27.3 kΩ *72-96V models:* n/a, 29.4 kΩ	–10V to (MaxV + 10V)	± 8 kV (direct strike)
Switch 2	8				
Switch 3	9				
Switch 4	10				
Switch 5	11				
Switch 6	12				
Switch 7	22				
Switch 8	33				
Switch 16	14				
Digital Out 6	19	Rising edge = 4.4V max — = 10V on the 48-80V and 72-96V models Falling edge = 1.5V min	See the Driver Circuit diagrams, below	–5V to (MaxV + 10V)	
Digital Out 7	20				
Driver 1	6				
Driver 2	5				
Driver 3	4				
Driver 4	3				
Prop Driver	2				

Quick Link:
Figure 3 wiring diagram p.12

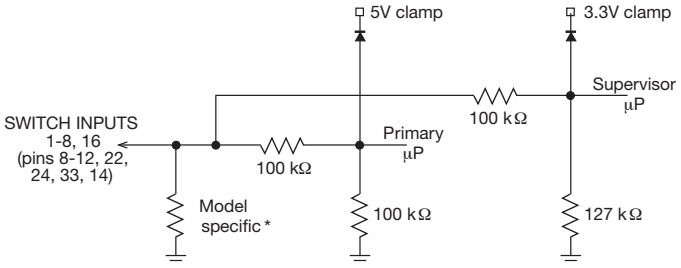
**The first value is for 1232E/SE and 1234E/SE controllers, and the second value is for 1236E/SE and 1238E/SE controllers.*

† "MaxV" in this and the following tables is the controller's maximum voltage; see Table D-1 for the maximum voltage of each model.

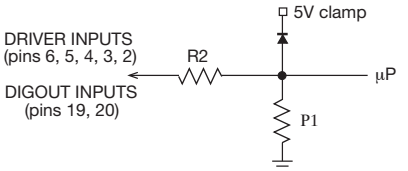
***NOTE:** The voltage at the switch inputs 3–8 and 16 must be above the high threshold or below the low threshold for proper operation. Allowing these inputs to fall between these thresholds for more than 100 milliseconds could result in a Supervisor Fault (fault code 77).*

DIGITAL INPUT IMPEDANCE CIRCUITS

1232E/SE and 1234E/SE controllers

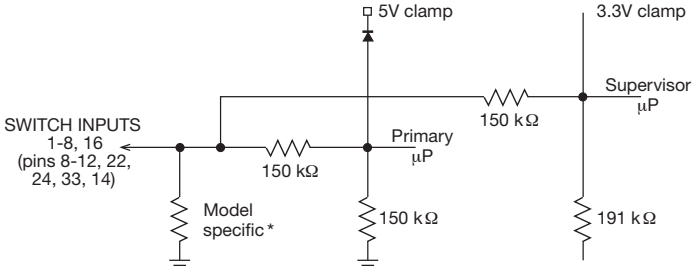


* 24-36V models = 7.5k Ω, 36-48V = 12k Ω, 48-80V = 33k Ω, 72-96V = 36k Ω

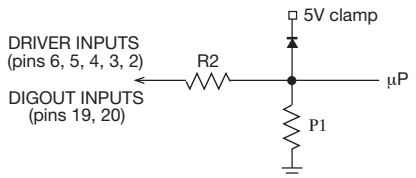


Model Voltage Specific	R1 Ω	R2 Ω
24V (also all 1239E models)	100k	100k
24-36V	100k	100k
36-48V	100k	100k
48-80V	49.9k	150k
72-96V	49.9k	150k

1236E/SE and 1238E/SE controllers



* 24-36V models = 7.5k Ω, 36-48V = 12k Ω, 48-80V = 33k Ω, 72-96V = 36k Ω



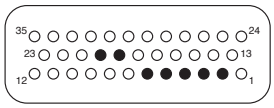
Model Voltage Specific	R1 Ω	R2 Ω
24V (also all 1239E models)	100k	100k
24-36V	100k	100k
36-48V	100k	100k
48-80V	49.9k	150k
72-96V	49.9k	150k

Digital and PWM Outputs

Seven digital (on/off) and PWM output drivers are available. One of these, the proportional driver, can be operated in a current control mode for driving a proportional valve or similar load. The frequency of this driver is normally 18 kHz, but this output can also serve to drive an electronic speedometer or tachometer using the VCL function Automate_Frequency_Output().

Each output can be independently turned on continuously (low level) or pulse width modulated to set the average output voltage. These outputs are intended to drive inductive loads such as contactors and electromagnetic brakes but could also be used to drive resistive loads if peak current ratings are not exceeded. All these outputs are protected against shorts to B+ or B–. All inductive loads should be connected to the coil return (pin 13), which provides flyback diode protection.

These lines can also be used as digital inputs, and are included in that group as well.



DIGITAL and PWM OUTPUT SPECIFICATIONS

Name	Pin	PWM	PV Current	Frequency	Output Current	Protected Voltage	ESD Tolerance
Driver 1	6	0 to 100% Duty Cycle	N/A	120 to 1000 Hz *	2A Max	–0.5V to (MaxV + 10V)	± 8 kV (direct strike)
Driver 2	5				3A Max		
Driver 3	4				2A Max		
Driver 4	3						
Prop Driver	2		0 to 2A in 607 nominal steps	18 kHz			
Digital Out 6	19	On / Off	N/A	N/A	1A Max		
Digital Out 7	20						

**Drivers 1–4 Frequency is set by the PWM Frequency parameter.*

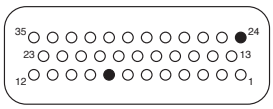
Analog Inputs

Quick Links:
Figure 3 wiring diagram p.12
Motor Temp Sensor p.67

Two control lines can be used as analog inputs. Both inputs are protected against shorts to B+ or B–.

Typically Analog 2 is used as the input for the motor temperature sensor. This input provides a constant current appropriate for a thermistor sensor. Some standard predefined motor temperature sensors are supported in software (see the motor's Sensor Type parameter). Note: The industry standard KTY temperature sensors are silicon temperature sensors with a polarity band; the polarity band of a KTY sensor must be the end connected to I/O Ground (pin 7).

These lines can also be used as digital inputs, and are included in that group as well.



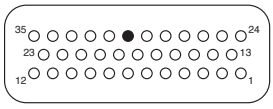
ANALOG INPUT SPECIFICATIONS

Signal Name	Pin	Operating Voltage	Input impedance*	Protected Voltage	ESD Tolerance
Analog 1	24	0 to 10V in 1024 steps	*24-36 V models:* 6.9 kΩ, 7.1 kΩ *36-48 V models:* 10.5 kΩ, 11.0 kΩ *48-80 V models:* 23.8 kΩ, 28.1 kΩ *72-96 V models:* n/a, 28.1 kΩ	–10V to (MaxV + 10V)	± 8 kV (direct strike)
Analog 2	8				

** The first value is for 1232E/SE and 1234E/SE controllers, and the second value is for 1236E/SE and 1238E/SE controllers.*

Analog Outputs

A single line is available as a low power analog output and is intended to drive instrumentation such as a battery discharge indicator. This output is generated from a filtered PWM signal and has about 1% ripple. The 2% settling time is <25 ms for a 0–5V step and <30 ms for a 0–10V step. This output line is protected against shorts to B+ or B–.



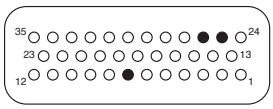
ANALOG OUTPUT SPECIFICATIONS

Signal Name	Pin	Output Voltage	Output Current	Protected Voltage	ESD Tolerance
Analog Out	30	0 to 10V	10 mA	–1V to (MaxV + 10V)	± 8 kV (direct strike)

Power Supply Outputs

Quick Link:
Figure 3 wiring diagram p.12

Two lines provide auxiliary output power for low power circuits such as electronic throttles, LED indicators, displays, position encoder, and remote I/O boards. I/O Ground (at pin 7) is the return line for these low power devices. Both power supply outputs are protected against shorts to B+ or B–.



POWER SUPPLY OUTPUT SPECIFICATIONS

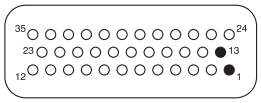
Signal Name	Pin	Output Voltage	Output Current	Protected Voltage	ESD Tolerance
+12V Out	25	11.5 to 14.5V	100 mA max for +12 Out 100 mA max for +5 Out 200 mA max (combined total)	–1V to (MaxV + 10V)	± 8 kV (direct strike)
+5V Out	26	5V ±10%			
I/O Ground	7	n/a	500 mA max	not protected	

KSI and Coil Return

The KSI input provides power for all low power control circuits. This includes the microprocessors, power supply outputs, power for the digital and PWM driver outputs, the power-capacitor precharge (before main contactor closure). Battery voltage is sensed on the input for the VCL battery discharge function.

Coil Return (pin 13) should be wired to the positive battery side of the contactors being driven so that switching noise associated with PWM operation of the contactors is localized to the contactor wiring only.

It is important to maintain the division between KSI and coil return in order to ensure reverse polarity protection (e.g., vehicle wiring correct, battery terminals reversed).



KSI and COIL RETURN INPUT SPECIFICATIONS

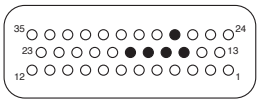
Signal Name	Pin	Operating Voltage	Input Current	Protected Voltage	ESD Tolerance
KSI	1	Between under- and overvoltage cutbacks	13A max * continuous	± (MaxV + 10V)	± 8 kV (direct strike)
Coil Return	13		10A or 12A max **	(KSI – 0.3V) to (MaxV + 10V)	

** Including current from the coil return (pin 13).*
*** 12 A for 1236E/SE and 1238E/SE; 10 A for 1232E/SE and 1234E/SE.*

Throttle and Brake Inputs

The two pot inputs are independently programmable to allow use of a voltage throttle or a 2-wire or 3-wire resistance throttle. Voltage throttles require only the Pot Wiper input (with I/O Ground for the return line). Resistance throttles require Pot Wiper and Pot Low (2-wire) or Pot High, Pot Wiper, and Pot Low (3-wire). All throttle I/O is protected against shorts to B+ or B–.

Alternatively, these two inputs can be used for analog signals other than the throttle and brake pot inputs. Configuring the inputs for use with other signals requires VCL programming; see Chapter 10.



Quick Links:
Figure 3 wiring diagram p.12
Throttle & Brake Types p.20–23

THROTTLE INPUT SPECIFICATIONS

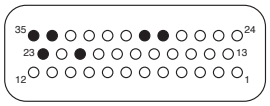
Signal Name	Pin	Operating Voltage	Input Impedance	S/Sink Current	Protected Voltage	ESD Tolerance
Throttle Pot High	15	0V (shorted to Pot Low) 5V (open circuit)	N/A	1 mA nominal (source)	–0.5V to (MaxV + 10V)	± 8 kV (direct strike)
Pot2 High	27					
Throttle Pot Wiper	16	0 to 6.25V	100 kΩ min	0.76 mA nominal (source, 2-wire)		
Pot2 Wiper	17					
Pot Low	18	0 to 0.25V	20 Ω nom.	Faults if above 15 mA (sink)	–1V to (MaxV + 10V)	

Communications Ports

Separate CAN and serial ports provide complete communications and programming capability for all user available controller information.

The Curtis 1313 handheld programmer and 1314 PC programmer's 1309-serial-interface-device plug into a connector* wired to pins 28 and 29, along with ground (pin 7) and the +12 V power supply (pin 25); see wiring diagram, Figure 3. The Curtis "Spy" Model 840 display will connect the serial-port pins as shown in Figure 3.

Wiring the CAN Term H and CAN Term L pins together provides a local CAN termination of 120 Ω, 0.5 W; keep the length of these wires short. CAN Term H and CAN Term L should never be connected to any external wiring.



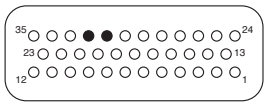
COMMUNICATIONS PORT SPECIFICATIONS

Signal Name	Pin	Supported Protocol / Devices	Data Range	Protected Voltage	ESD Tolerance
CAN H	23	CANopen, other 11-bit or 29-bit identifier protocols	up to 1 Mbit/s	–0.5V to (MaxV + 10V)	± 8 kV (direct strike)
CAN L	35				
CAN Term H	21			(no connection to external wiring)	
CAN Term L	34				
Serial TX	28	Curtis 840 Display, 1313 Handheld Programmer, 1314 PC Programming Station	as required, 9.6 kbit/s to 56 kbit/s	–0.3V to 12V	
Serial RX	29				

** Molex Mini-Fit Jr. dual-row, 4 circuits, vehicle harness plug (e.g., p/n 39-01-2046)*

Position Feedback Input: Quadrature Encoder

Two control lines are internally configured to read a quadrature type position encoder. The encoder is typically powered from the 5V supply (pin 26) or 12V supply (pin 25), but can be powered from any external supply (from 5V up to B+) as long as the logic threshold requirements are met. The quadrature encoder is used in ACIM applications.



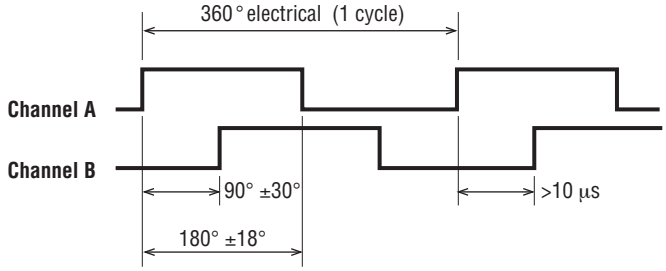
QUADRATURE ENCODER INPUT SPECIFICATIONS

Signal Name	Pin	Logic Threshold	Input Impedance	Max. Frequency	Protected Voltage	ESD Tolerance
Position Feedback A	31	Rising edge= 2.9V max Falling edge= 2.0V min	2 kΩ (internal pull-up to to +4.5V)	10 kHz	–5V to (MaxV + 10V)	± 8 kV (direct strike)
Position Feedback B	32					

Phase Shift 90° ±30, Duty Cycle 50% ±10%; no signal edge can be closer than 10 µs to an adjacent edge.

Quick Link:
Figure 3 wiring diagram p.12

These signal tolerances must be maintained throughout the application's operating conditions, including voltage, temperature, speed and torque ranges.



Position Feedback Input: Sin/Cos Sensor (encoder)

Use a Sin/Cos sensor in PMAC applications.

A Sine/Cosine encoder is an absolute position sensor that produces two sinusoidal signals, set 90° out of phase. Measurement and comparison of the two signals at any point can determine the absolute position of the sensor. One motor (rotor) mechanical revolution per 360° sin/cos sensor rotation (sweep).

The physical waveforms are not bipolar, but center around an offset voltage (Voff), typically around 2.5 volts. The Peak-Peak voltage (VPP) swing may be as small as 2V or up to 4V, the bigger the range the better the performance for motor control. Both parameters require configuration for the sensor to operate properly.

Configure the *Sin Min*, *Sin Max*, *Cos Min* and *Cos Max* parameters during commissioning. These normalize the incoming sin/cos signals.

Sine/Cosine Signal Tracking

The values of the inputs are tracked to ensure an accurate position can be obtained if the signal amplitude changes during operation. The amplitude of the signal may alter due to mechanical tolerances, thermal expansion, magnetic field strength changes in the actuator magnet etc.

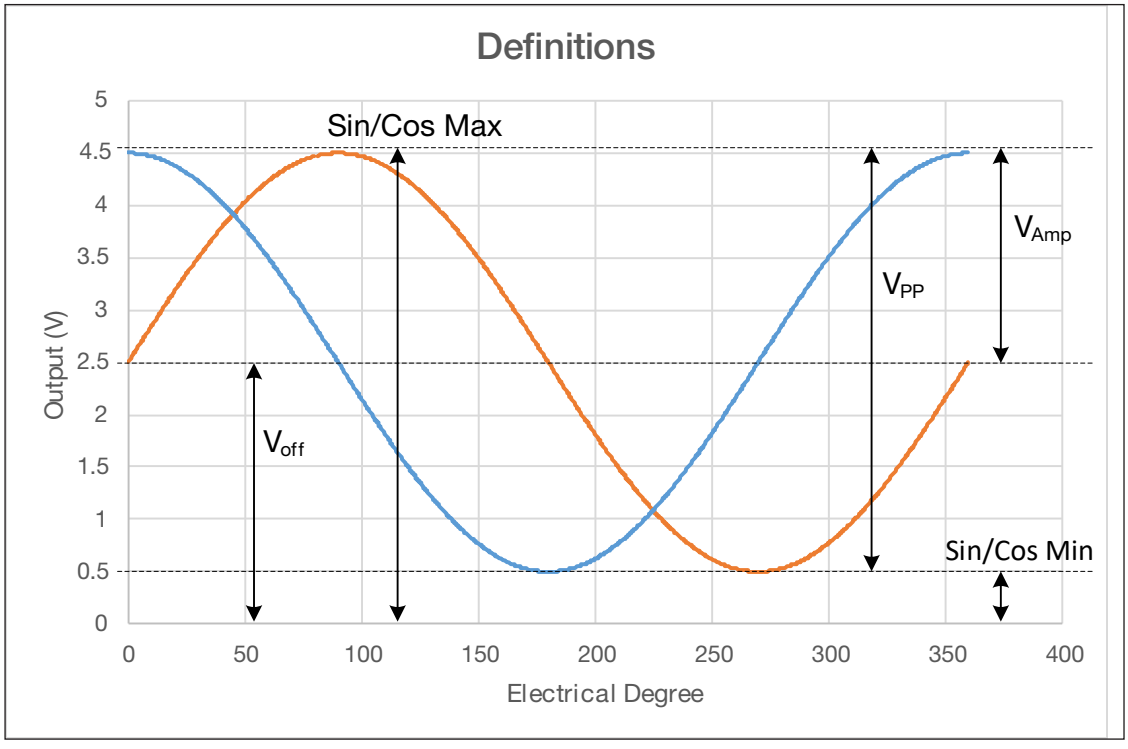
These signal tolerances must be maintained throughout the application's operating conditions, including voltage, temperature, speed and torque ranges.

Sin/Cos Sensor Device Electrical Specifications

Signal Name	Pin	Operating Voltage / Signal Range	Max Input Frequency[1]	Phase Lag[2]	Input Impedance	ESD Tolerance
Position Feedback A	31	0.5-4.5V (+10% / –0%) / Optimum: Multiturn sensor. 4Vpp with the signal centered at 2.5V.	500 Hz Sinewave	≤6.1° at 800Hz ±0.5° Max difference between Sine/Cosine inputs	> 50k Ω	± 8 kV (direct strike)
Position Feedback B	32					

[1] Max input frequency may not exceed max controller electrical fundamental frequency.

[2] Maximum phase lag between sensor and actual rotor position. This is required to maintain proper PMAC rotor alignment at high speed.



3 — APPLICATION-SPECIFIC FEATURES

Some features of the 1232E/SE – 1238E/SE controllers affect how the specific controller is wired or parameter settings. This chapter provides background information on application-specific features, to assist the vehicle designer in the design process.

THROTTLE WIRING

In this manual, the term *throttle* is used in two senses: (1) as another name for the drive throttle, and (2) as a generic term covering both the drive throttle and the brake throttle. Wiring is the same, whether the throttle in question is used for acceleration or (regen) braking.

Various throttles can be used with these controllers. They are characterized as one of five types in the programming menu of the 1313/1314 programmer.

Type 1: 2-wire 5kΩ–0 potentiometers.

Type 2: single-ended 0–5V throttles, current source throttles, 3-wire potentiometers, and electronic throttles.

Type 3: 2-wire 0–5kΩ potentiometers.

Type 4: wigwag 0–5V throttles and 3-wire potentiometers.

Type 5: VCL input (VCL_Throttle or VCL_Brake).

The two throttle inputs (drive throttle and brake throttle) are programmed independently.

For potentiometers, the controller provides complete throttle fault protection that meets all applicable EEC regulations. **For voltage throttles,** the controller protects against out-of-range wiper values, but does not detect wiring faults; it is therefore the responsibility of the OEM to provide full throttle fault protection in vehicles using voltage throttles.

Quick Link:
Figure 15 p.114

Throttle types 1–3 use the forward and reverse inputs (switches 7 and 8) in addition to the throttle pot input to define the throttle command (see Figure 15). Throttle types 4 and 5 do not use the forward and reverse inputs.

Wiring for the most common throttles is described in the following three pages and shown in the accompanying illustrations. If a throttle the application will use is not covered, contact the Curtis distributor or support engineer.

Throttle Type 1

For these 2-wire resistive potentiometers, shown in Figure 4, full throttle request corresponds to 0 Ω measured between the pot wiper pin and the Pot Low pin. A Type 1 throttle requires the Forward & Reverse Deadbands parameters settings be towards the higher voltage (e.g., 4.50 V) and the Forward & Reverse Max parameters set to the lower voltage (e.g., 0.5 V). Note, this is the opposite of these parameters' default setting. With the 2-wire rheostat in place, the throttle-wiper voltage can be check using the Monitor » Inputs variable Throttle Pot (or Pot2Raw for the brake pot).

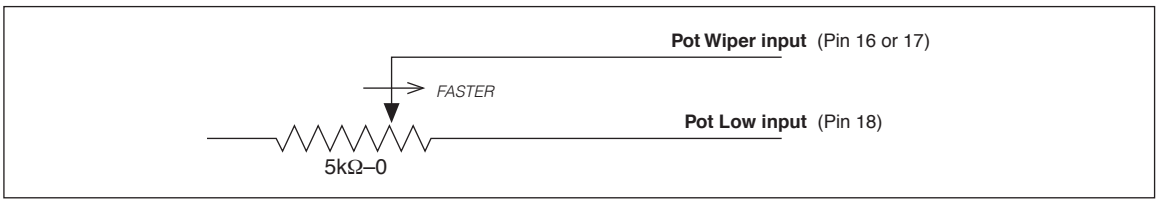


Figure 4
Wiring for Type 1 throttles.

Broken wire protection is provided by the controller sensing the current flow from the pot wiper input (pin 16 or 17) through the potentiometer and into Pot Low (pin 18). For Type 1 throttles, if the Pot Low input current falls below 0.65 mA, a throttle fault is generated and the throttle request is zeroed. Note: Pot Low (pin 18) must not be tied to ground (pin 7 or B–).

Throttle Type 2

With these throttles, the controller looks for a voltage signal at the wiper input. Zero throttle request corresponds to 0V and full throttle request to 5V.

A variety of devices can be used with this throttle input type, including voltage sources, current sources, 3-wire pots, and electronic throttles. The wiring for each is slightly different, as shown in Figure 5, and they have varying levels of throttle fault protection.

When a **voltage source** is used as a throttle, it is the responsibility of the OEM to provide appropriate throttle fault detection. For ground-referenced 0–5V throttles, the controller will detect open breaks in the wiper input but cannot provide full throttle fault protection.

To use a **current source** as a throttle, a resistor must be added to the circuit to convert the current source value to a voltage; the resistor should be sized to provide a 0–5V signal variation over the full current range. It is the responsibility of the OEM to provide appropriate throttle fault detection.

When a **3-wire potentiometer** is used, the controller provides full fault protection in accordance with EEC requirements. The pot is used in its voltage divider mode, with the controller providing the voltage source and return. Throttle Pot High (pin 15) provides a current limited 5V source to the 3-wire potentiometer, and Pot Low (pin 18) provides the return path. This is the throttle shown in the basic wiring diagram (Figure 3) for the drive throttle and for the brake throttle.

Complementing the controllers, Curtis offers both Hall-effect and 3-wire potentiometer throttles which are easily integrated into vehicles.

Hall-effect voltage throttles:

The Curtis FP Series of throttles offers multiple pedal angles and mounting configurations (floor, suspended, flush) with 0–5 volt operation with a Idle Validation Switch (IVS).



Curtis FP-SCV-0022 Hall-effect throttle

The ET-XXX electronic throttle is typically used only as a drive throttle (illustrated in Fig. 5).

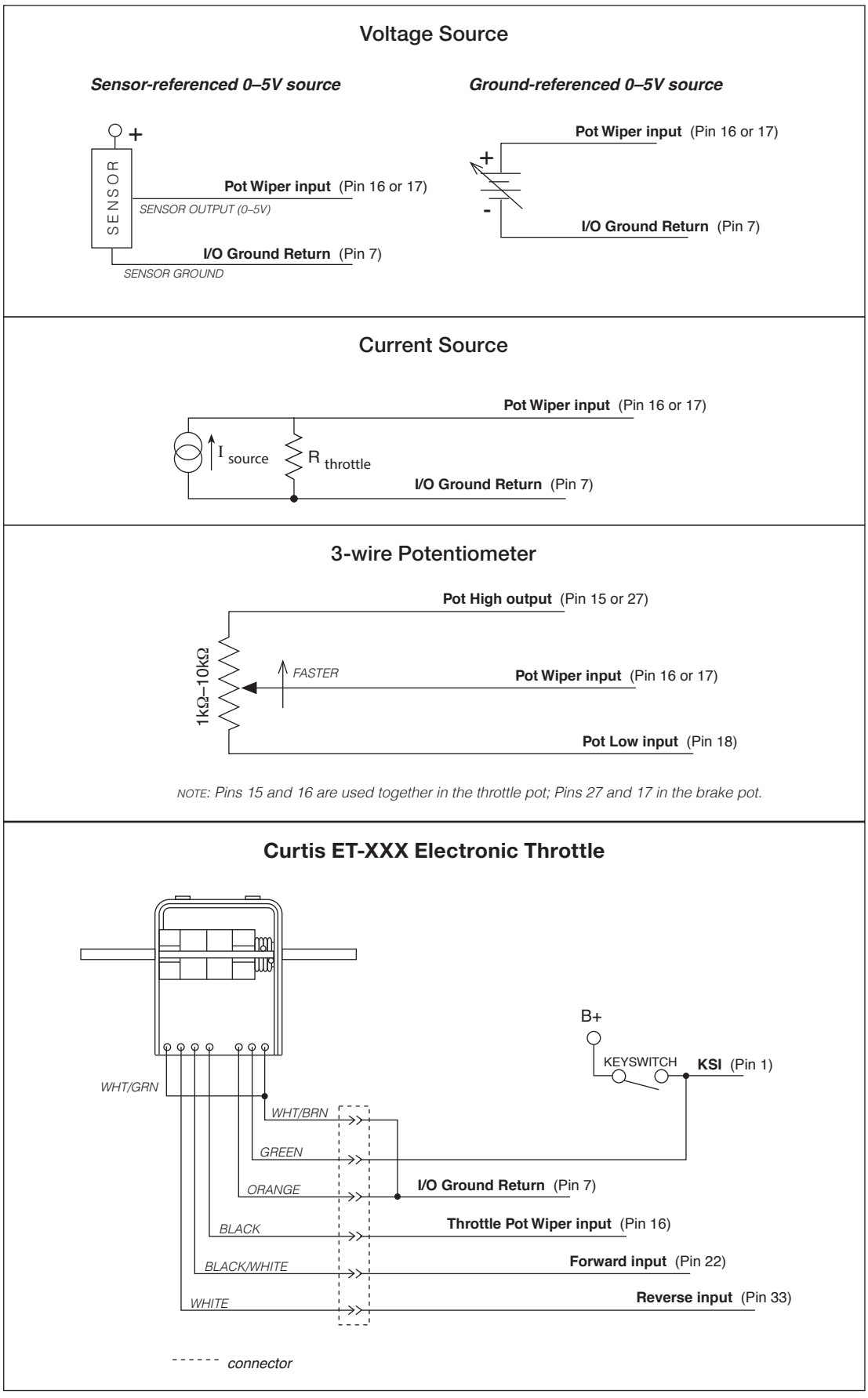
These voltage throttles contains no built-in fault detection, and the controller will detect only open wiper faults. It is the responsibility of the OEM to provide any additional throttle fault detection necessary.

3-wire potentiometer throttle:

The FP-10 model offers, besides the controller's 3-wire fault detection, two throttle spring detection switches and two micro-switches to indicate idle validation and full throttle circuits. This throttle can also be configured from 0-5k (Type 3) or 5k-0 (Type 1) throttles while retaining the detection circuits.

For help with a throttle selection, contact the Curtis distributor or support engineer to discuss the particular throttle requirements and the application of Curtis throttles.

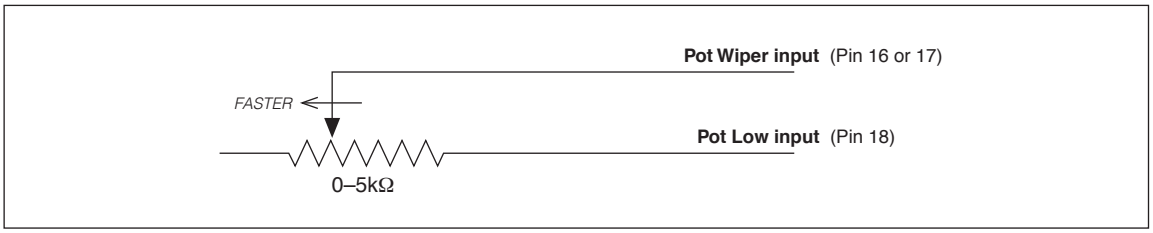
Figure 5
Wiring for Type 2 throttles.



Throttle Type 3

For these 2-wire resistive potentiometers, shown in Figure 6, full throttle request corresponds to 5 kΩ measured between the pot wiper pin and the Pot Low pin.

Figure 6
Wiring for Type 3 throttles.



Broken wire protection is provided by the controller sensing the current flow from the wiper input (pin 16 or 17) through the potentiometer and into Pot Low (pin 18). For Type 3 throttles, if the Pot Low input current falls below 0.65 mA, a throttle fault is generated and the throttle request is zeroed. Note: Pot Low (pin 18) must not be tied to ground (pin 7 or B–).

Throttle Type 4

Type 4 throttles operate in wigwag style. No signals to the controller's forward and reverse inputs are required; the direction is determined by the wiper input value. Only 0–5V voltage sources and 3-wire potentiometers can be used as Type 4 throttles. The controller interface for Type 4 throttles is the same as for the corresponding Type 2 throttles; see Figure 5.

In a Type 4 throttle, the neutral point must be set up somewhere in the center of the throw, with increasing voltage beyond this point providing increasing forward command and voltages below this point providing increasing reverse command. For example, to set the Forward Deadband at 2.6V with Forward Max at 4 V, and Reverse Deadband at 2.4V with Reverse Max at 1V.

When a 3-wire pot is used, the controller provides full fault protection. When a voltage throttle is used, the controller will detect open breaks in the wiper input but cannot provide full throttle fault protection.

Throttle Type 5

Throttle Type 5 provides a different way of sending the throttle command to the controller. This throttle type uses VCL to define the throttle signal that will be "input" into the throttle signal chain as VCL_Throttle (see Figure 15).

Quick Links:
Figure 15 p.114
Throttle Type parameter p.47
Brake Type parameter p.49

This throttle type can be used for either the drive throttle or the brake throttle by using the VCL variables VCL_Throttle or VCL_Brake (see Brake menu). How the VCL program is written will determine the source of the throttle signal, making this a very flexible throttle input method. VCL can be written to use the throttle or brake pot inputs, switch inputs, or CAN communication messages as the source of the throttle signals.

Setting the Throttle Type to Type 5 also allows the throttle pot input (Pin 16) to be redefined by a VCL program for uses other than throttle input.

Note: The option also applies to the Brake Type, which when set to Type 5 uses VCL_Brake as signal chain for the Brake_Command (see the Brake parameter menu and Figure 15).

For questions regarding this throttle type, contact the Curtis distributor or support engineer.

MOTOR SPEED CONSTRAINTS

The maximum motor speed is a programmable parameter in each control mode. Regardless of which control mode is used, the maximum motor speed the controller will allow is constrained by the number of motor poles, the encoder pulses per motor revolution, and the maximum speed constraint imposed by the firmware.

NOTE: The overall maximum motor speed* allowed is the least of the following three constraints:

1. Electrical Frequency Constraint

The controller is designed to output fundamental electrical frequencies up to 450 Hz. It accomplishes this by clamping the Max Speed allowed, using the equation:

Max Speed Frequency Limit = 54000 / Number of Motor Poles

Thus, for example, an 8-pole motor running synchronously at 450 Hz would rotate at 54000/8 = 6730 rpm (max). Therefore the internal control software will limit the max speed to 6750 rpm for an 8-pole motor. Limited over-speed is allowed, for example if the motor were to go over this speed going down a hill, the controller will still attempt to produce the correct frequency for maximized torque and proper control; it will not simply clamp to 450 Hz.

2. Encoder Pulses/Revolution Constraint (quadrature encoder)

The maximum encoder frequency the controller will accept is 10 kHz. To determine how fast this constraint will allow the motor to spin, use the equation

Max Speed Encoder Limit = 600000 / Encoder Size

(e.g., a motor with a 128-pulse encoder can run up to 4687 rpm).

Quick Link:
Max Speed Controller Limit p.80

3. Firmware Max Speed Constraint

The maximum motor speed the controller will allow is 10,000 rpm.

Max Speed RPM Limit = 10,000*

** This maximum allowed speed is displayed in the Monitor » Motor » Max Speed Controller Limit variable.*

Note: In the case where the Max Speed parameter is the prevailing constraint, greater RPM may be possible. Contact the Curtis distributor or support engineer to discuss the application.

VOLTAGE LIMITS

The controller establishes both hardware-based voltage limits and parameter-based user defined limits. Overvoltage protection cuts back regen braking to prevent damage to batteries and other electrical system components due to overvoltage. Undervoltage protection prevents systems from operating at voltages below their design thresholds.

The four threshold points are calculated from the Nominal Voltage, Undervoltage Kp and Ki, User Overvoltage, and User Undervoltage parameter settings and the controller's minimum voltage and maximum voltage ratings. Note that both the KSI (pin 1) and the B+ terminal (when the main is closed) are at battery voltage, and the capacitor bank is precharged via KSI prior to the main closure.

Overvoltage = Either Max Voltage (see Table D-1)
or *User Overvoltage* × *Nominal Voltage,* whichever is lower.

Severe Overvoltage = Overvoltage (see previous item) + 10V.

Undervoltage = Either Min Voltage (see Table D-1)
or *User Undervoltage* × *Nominal Voltage,* whichever is higher.

Severe Undervoltage = Either drive current cut back to 0% for 64 ms or Brownout Voltage * (see Table D-1) is reached, whichever comes first.

Quick Links:
Controller voltage ratings p.160
User/parameter voltage limits p.68

* The Brownout Voltage is determined by the controller base type and cannot be changed. When the controller's capacitor voltage falls below the Brownout voltage the bridge is switched off (i.e., motor current is switched off). If the capacitor voltage stays below the Brownout voltage for > 64 milliseconds the controller will reset (equivalent to cycling the keyswitch). If the capacitor voltage rises above the Brownout voltage before 64 ms have passed the bridge will be re-enabled. The Severe Undervoltage point cannot be set lower than the Brownout voltage.

BATTERY DISCHARGE INDICATOR

The lead-acid battery discharge indicator (BDI) algorithm continuously calculates the battery state-of-charge from the KSI voltage. The result of the BDI algorithm is the variable BDI Percentage, which is viewable in the 1313/1314 menu Monitor » Battery. When KSI is turned off, the present BDI Percentage is stored in nonvolatile memory.

The standard values for volts per cell are as follows, for flooded lead-acid batteries and sealed maintenance-free lead-acid batteries.

	Battery Type	
	Flooded	**Sealed**
Reset Volts Per Cell	2.09	2.09
Full Volts Per Cell	2.04	2.04
Empty Volts Per Cell	1.73	1.90

Use the standard values for the application's type of batteries as the starting point in setting the reset, full, and empty volts-per-cell parameters. Note: For non lead-acid batteries, including Lithium-Ion battery packs, use the pack's or cell manufacturer's approved Battery Management System (BMS) for determining BDI.

4 — PROGRAMMABLE PARAMETERS

These controllers have a number of parameters that can be programmed using a Curtis 1313 handheld programmer or 1314 PC Programming Station. The programmable parameters allow the vehicle's performance to be customized to fit the needs of specific applications.

PROGRAMMING MENUS

The programmable parameters are grouped into nested hierarchical menus, as shown in Table 3.

Motor response tuning

Motor response characteristics can be tuned through speed control or through torque control, depending on the application. Use the Control Mode Select parameter (page 32) to select which tuning mode to use:

- Speed Mode Express.
- Speed Mode.
- Torque Mode.

Speed Mode Express is a simplified version of Speed Mode with a reduced set of parameters that is adequate for most speed-controlled applications.

Use *Speed Mode* or *Speed Mode Express* for applications where throttle input corresponds to motor speed output.

Use *Torque Mode* for applications where throttle input corresponds to motor torque output.

Note: Tune using torque control or speed control, but not both. For example, if adjusting a torque control parameter while Speed Mode or Speed Mode Express has been selected as the tuning mode, the programmer will show the new setting but it will have no effect.

We strongly urge reading Chapter 7, Initial Setup, before adjusting any of the parameters.

NOTICE

Even if opting to leave most of the parameters at their default settings, it is imperative that the procedures outlined in Chapter 7 are performed (completed), which sets up the basic system characteristics for an application.

Parameter change faults

Parameters marked **[PCF]** in the menu charts will set a Parameter Change Fault (code 49) if they are changed while the motor bridge is enabled (interlock = On). Although the parameter will be changed, the fault will prevent motor control functions until the fault is cleared by cycling the keyswitch. If the motor bridge is disabled (interlock = Off), changing these parameters will not cause a fault and the changes will take effect immediately.

Table 3 Programmable Parameters Menus: 1313/1314 Programmer

- CONTROL MODE SELECT..... p. 32
- 0 - SPEED MODE EXPRESS..... p. 33
  - Max Speed
  - Kp
  - Ki
  - Accel Rate
  - Decel Rate
  - Brake Rate
  - Pump Enable
  - Regen Lower Enable
- 1 - SPEED MODE MENU..... p. 34
  - SPEED CONTROLLER..... p. 34
    - Max Speed
    - Kp
    - Ki LS
    - Ki HS
    - VEL FEEDFORWARD..... p. 34
      - Kvff
      - Build Rate
      - Release Rate
    - ACC FEEDFORWARD .... p. 35
      - Kaff
      - Kbff
      - Build Rate
      - Release Rate
  - RESPONSE..... p. 36
    - Full Accel Rate HS
    - Full Accel Rate LS
    - Low Accel Rate
    - Neutral Decel Rate HS
    - Neutral Decel Rate LS
    - Full Brake Rate HS
    - Full Brake Rate LS
    - Low Brake Rate
    - FINE TUNING..... p. 37
      - Partial Decel Rate
      - HS (High Speed)
      - LS (Low Speed)
      - Reversal Soften
      - Max Speed Accel
      - Max Speed Decel
      - Creep Speed
  - RESTRAINT..... p. 38
    - Restraint Forward
    - Restraint Back
    - Soft Stop Speed
    - POSITION HOLD..... p. 39
      - Position Hold Enable
      - Position Hold Timeout Time
      - Kp
      - Kd
      - Zero Speed Threshold
      - Zero Speed Threshold Time
      - Position Hold Settling Time
      - Entry Rate
      - Exit Rollback Reduction
    - Pump Enable..... p. 40
    - Regen Lower Enable..... p. 40
- 2 - TORQUE MODE MENU..... p. 40
  - SPEED LIMITER..... p. 40
    - Max Speed
    - Kp
    - Ki
    - Kd
  - RESPONSE..... p. 41
    - Accel Rate
    - Accel Release Rate
    - Brake Rate
    - Brake Release Rate
    - Neutral Braking
    - Neutral Taper Speed
    - Forward Full Restraint Speed
    - Back Full Restraint Speed
    - FINE TUNING..... p. 42
      - Creep Torque
      - Brake Full Creep Cancel
      - Creep Build Rate
      - Creep Release Rate
      - Gear Soften
      - Brake Taper Speed
      - Reversal Soften
      - Max Speed Decel
- CURRENT LIMITS MENU..... p. 44
  - Drive Current Limit
  - Regen Current Limit
  - Brake Current Limit
  - EMR Current Limit
  - Interlock Brake Current Limit
  - POWER LIMITING MAP..... p. 44
    - PL Nominal Speed
    - Delta Speed
    - DRIVE LIMITING MAP..... p. 45
      - Nominal
      - Plus Delta
      - Plus 2x Delta
      - Plus 4x Delta
      - Plus 8x Delta
    - REGEN LIMITING MAP... p. 46
      - Nominal
      - Plus Delta
      - Plus 2x Delta
      - Plus 4x Delta
      - Plus 8x Delta
- THROTTLE MENU..... p. 47
  - Throttle Type
  - Forward Deadband
  - Forward Map
  - Forward Max
  - Forward Offset
  - Reverse Deadband
  - Reverse Map
  - Reverse Max
  - Reverse Offset
  - Throttle Filter
  - HPD SRO Type
  - Sequencing Delay
  - VCL Throttle Enable
- BRAKE MENU..... p. 49
  - Brake Pedal Enable
  - Brake Type
  - Brake Deadband
  - Brake Map
  - Brake Max
  - Brake Offset
  - Brake Filter
  - VCL Brake Enable

Table 3 Programmable Parameters Menus: 1313/1314 Programmer, cont'd

- **EM BRAKE CONTROL MENU..... p. 50**
  - — Brake Type
  - — Pull In Voltage
  - — Holding Voltage
  - — Battery Voltage Comp.
  - — Set EM Brake On Fault
  - — Zero Speed Threshold
  - — Zero Speed Threshold Time
  - — Position Hold Settling Time
  - — Brake Set Time
  - — Torque Release Time
  - — Brake Release Time
  - — Torque Preload Time
  - — Torque Preload Enable
  - — Save Torque Preload
  - — Torque Preload Cancel Delay
  - — EM Brake Fault Motor Revs
- — EM BRAKE TEST MENU..... p. 52
  - — Mode
  - — Direction
  - — Current
  - — Ramp Time
  - — Test Threshold
  - — Hold Time
  - — Max Speed Limit
  - — Hill Compensation Enable
- **DRIVERS MENU..... p. 52**
- — MAIN CONTACTOR..... p. 52
  - — Main Enable
  - — Main Interlock Type
  - — Pull In Voltage
  - — Holding Voltage
  - — Battery Voltage Comp.
  - — Interlock Type
  - — Open Delay
  - — Weld Check Enable
  - — Main DNC Check Enable
  - — Weld Check On Open Enable
  - — Main DNC Check Threshold
  - — Precharge Enable
- — PROPORTIONAL DRIVER..... p. 54
  - — PD Enable
  - — Hyd Lower Enable
  - — PD Max Current
  - — PD Min Current
  - — PD Dither %
  - — PD Dither Period
  - — PD Kp
  - — PD Ki
- — DRIVER 3..... p. 54
  - — Contactor Enable
  - — Pull In Voltage
  - — Holding Voltage
- — FAULT CHECKING..... p. 55
  - — Driver1 Checks Enable
  - — Driver2 Checks Enable
  - — Driver3 Checks Enable
  - — Driver4 Checks Enable
  - — PD Checks Enable
  - — External Supply Max
  - — External Supply Min
- — PWM FREQUENCY..... p.55
- **MOTOR MENU..... p. 56**
- — Typical Max Speed
- — Motor Technology
- — 0 - INDUCTION MOTOR (ACIM) ..... p. 57
- — CHARACTERIZATION TESTS ..... p. 57
  - — Test Enable
  - — Test Throttle
  - — Motor Poles
  - — Max Test Speed
  - — Max Text Current
  - — SlipGain
  - — Current Reg Tuning Test Enable
- — FIELD WEAKENING CONTROL... p. 58
  - — FW Base Speed
  - — Field Weakening Drive
  - — Weakening Rate Drive
  - — Min Field Current
- — Swap Two Phases
- — Swap Feedback Direction
- — Motor Type
  - — LOS (LIMITED OPERATING STRATEGY)..... p. 60
    - — LOS Upon Encoder Fault
    - — LOS Max Speed
    - — LOS Max Current
    - — LOS Max Mod Depth
    - — LOS Accel Rate
    - — LOS Decel Rate
  - — 1 - PMAC (PERMANENT MAGNET MOTOR)..... p. 61
- — COMMISSIONING TESTS..... p. 61
  - — Typical Max Speed
  - — Max Test Speed
  - — Motor Type
  - — Test Enable
  - — Test Throttle
  - — Swap Direction
  - — Max Test Current
- — FIELD WEAKENING CONTROL.... p. 62
  - — Field Weakening Rate
  - — FW Current Limit (Apk)
- — Motor Type
- — Restricted Operation
- — COMMISSIONING RESULTS..... p. 63
  - — Tuning Voltage
  - — Short Circuit Current (RMS)
  - — Phasing Mode
  - — Sensor Position Offset
  - — Sensor Compensation Factor
  - — Kp d Axis Current
  - — Ki d Axis Current
  - — Kp q Axis Current
  - — Ki q Axis Current
  - — Sin Min
  - — Sin Max
  - — Cos Min
  - — Cos Max
  - — Rsys
  - — Commissioning Needed
- — FEEDBACK OPTIONS..... p. 64
  - — Feedback Type

Table 3 Programmable Parameters Menus: 1313/1314 Programmer, cont'd

- 1 - QUADRATURE ENCODER..... p. 64
  - Encoder Steps
  - SPEED FILTERS..... p. 64
    - Speed Filter
    - Speed Filter Zero Speed
- 2 - SIN/COS..... p. 65
  - Enable Multiturn Sensor
  - Sin Cos Fault Threshold
  - Sin Cos fault Threshold High
  - Sin Cos Fault Time
  - Sin Cos Startup Time
  - Sin Min
  - Sin Max
  - Cos Min
  - Cos Max
  - SPEED FILTERS..... p. 65
    - Speed Filter
    - Speed Filter Zero Speed
- FEEDBACK FAULT SETUP..... p. 66
  - Fault Detection Enable
  - Fault Max Speed
  - Fault Min Speed
  - Pulse Fault Detact Time
  - Fault Stall Speed
  - Fault Stall Time
- TEMPERATURE CONTROL..... p. 67
  - Sensor Enable
  - Sensor Type
  - Sensor Offset
  - Braking Thermal Cutback Enable
  - Temperature Hot
  - Temperature Max
  - MotorTemp LOS Max Speed

BATTERY MENU..... p. 68
- Nominal Voltage
- Kp UV
- Ki UV
- User Overvoltage
- User Undervoltage
- Reset Volts Per Cell
- Full Volts Per Cell
- Empty Volts Per Cell
- Discharge Time
- BDI Reset Percent

- BATTERY CURRENT LIMITING MENU..... p. 69
  - Battery Current Limiter Enable
  - Drive Battery Current Limit
  - Regen Battery Current Limit
  - Kp
  - Kp HS
  - Ki
  - Ki HS
  - Kd
  - Kd HS
  - Limit Ramp Rate

BATTERY POWER LIMITING MENU..... p. 70
- Drive Power Limit
- Regen Power Limit
- Voltage Filter

DUAL DRIVE MENU ..... *see Dual Drive addendum, Document number: 53097 DUAL-DRIVE SUPPLEMENT_os37*

VEHICLE MENU..... p. 71
- Metric Units
- Speed to RPM
- Capture Speed 1
- Capture Speed 2
- Capture Distance 1
- Capture Distance 2
- Capture Distance 3

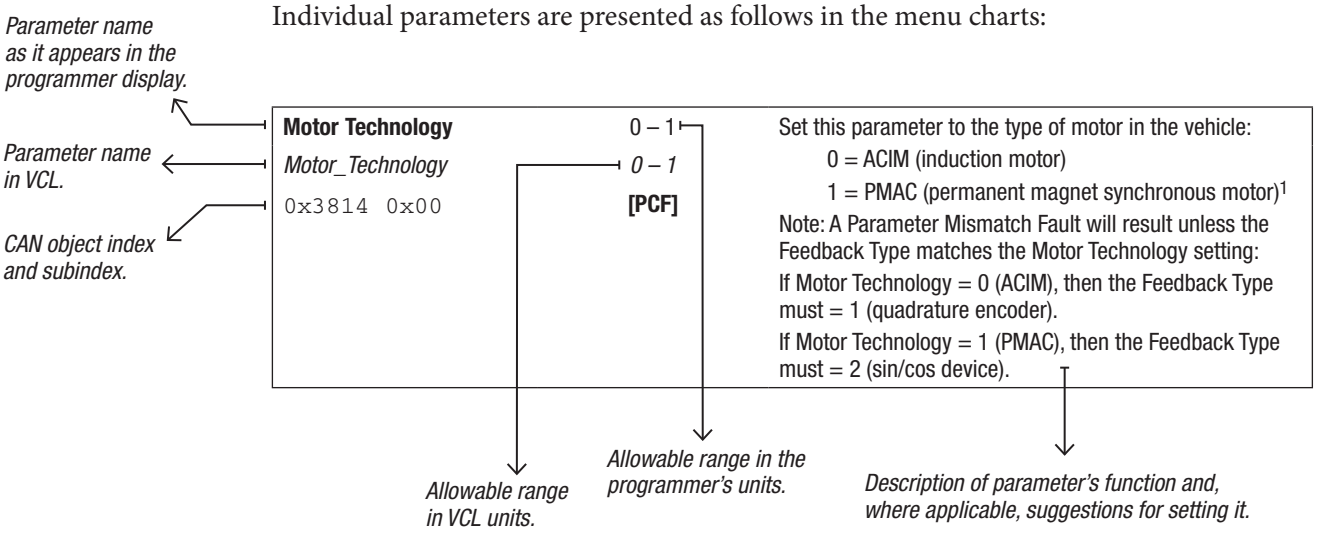
EMERGENCY REVERSE MENU ..... p. 72
- EMR Enable
- EMR Type
- EMR Dir Interlock
- EMR Time Limit
- EMR Speed
- EMR Accel Rate
- EMR Decel Rate

INTERLOCK BRAKING MENU..... p. 73
- Enable
- Decel Rate HS
- Decel Rate LS
- Interlock Brake Timeout
- Settling Time

CAN INTERFACE MENU..... p. 74
- CANopen Interlock
- CAN Node ID 1
- CAN Node ID 2
- CAN Node ID 3
- CAN Node ID 4
- Supervisor Node ID
- Baud Rate
- Heartbeat Rate
- PDO1 Timeout Period
- PDO2 Timeout Period
- Emergency Message Rate
- Suppress CANopen Init

RESET CONTROLLER..... p. 75

Individual parameters are presented as follows in the menu charts:



Note: All bit variables have two VCL parameter names. The first is the name of the bit, and the second is the name of the byte containing the bit. The bit position within the byte is indicated in brackets after the byte name.

Examples:

BIT NAME: **Metric_Units**

BYTE NAME: *OptionBits3* [Bit 5]

BIT NAME: **EMR_Dir_Interlock**

BYTE NAME: *EMR_DIR_INTERLOCK_BIT0* [Bit 0]

In the second example, "_Bit0" is part of the byte name, and does not indicate the bit position; this byte, like all bytes, has 8 available bits.

Within the menu charts, each pair of bit variable names is shown as a grouped set, with the bit name appearing first and then the byte name:

Metric Units	**On/Off**
Metric_Units	*On/Off*
OptionBits3	[Bit 5]

SDO Write Message

To retain parameter values changed via CANopen SDO write messages following a key-cycle, write a non-zero value to CAN_EE_Writes_Enabled (object index 0x332F, subindex 0x00) before changing parameter values. This will cause changes to be written to non-volatile memory immediately. After completing the changes, write the value zero to CAN_EE_Writes_Enabled.

CAUTION

Do not leave CAN_EE_Writes_Enabled at a non-zero value during normal operation, because damage to the controller's EEPROM may occur.

CAN SDO and PDO message transmission nomenclature:

With regard to SDO messages, the terms “Client”, “Server”, “Request”, and “Response” are used. For SDOs, the Client /Server are:

- Used in SDO transfers, including data uploads and downloads.
- The Client device (controller) initiates the communications, whether it is a read, write, upload or download.
- The Sever must respond to the Client request with data and confirm or issue an abort.
- Uploads are data from the device (controller).
- Downloads are data sent to the device (controller).
- SDO_RX (Receive), or SDO_REQ.
- SDO_TX (Transmit), or SDO_RESP.

PDOs messages are always from the perspective of the ancillary device (controller).

- Transmit PDOs (TPDO) are messages that are sent by the ancillary device (controller).
- Receive PDOs (RPDO) are messages that are received by the ancillary device (controller).

CONTROL MODE SELECT

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Control Mode Select *Control_Mode_Select* 0x3010 0x00	0 – 2 *0 – 2* **[PCF]**	This parameter determines which control method will be in effect when programming motor response: **0 = SPEED MODE EXPRESS.** **1 = SPEED MODE.** **2 = TORQUE MODE.** Contact the Curtis distributor or support engineer if there is interest in a non-generic control method. NOTE: Such a case will almost always require time, which may delay any immediate project's time-frame over the standard options. NOTE: Do not change this parameter while the controller is powering the motor. Any time this parameter is changed a Parameter Change Fault (fault code 49) is set and must be cleared by cycling power; this protects the controller and the operator.

0 - SPEED MODE EXPRESS — SPEED MODE EXPRESS MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Max Speed *Max_Speed_SpdMx* 0x3840 0x00	100 – 10000 rpm *100 – 10000*	Defines the maximum requested motor rpm at full throttle. Partially-applied throttle is scaled proportionately; e.g., 40% applied throttle corresponds to a request for 40% of the set Max Speed Value. If Max_Speed_SpdMx is set <10 rpm (through VCL or CAN), the throttle request is zeroed. NOTE: The maximum motor rpm is subject to the constraints on page 24.
Kp *Kp_SpdMx* 0x3841 0x00	0 – 100% *0 – 8192*	Determines how aggressively the speed controller attempts to match the speed of the motor to the commanded speed. Larger values provide tighter control. If the gain is set too high, the application may experience oscillations as the controller tries to control speed. If it is set too low, the motor may behave sluggishly and be difficult to control.
Ki *Ki_SpdMx* 0x3842 0x00	5 – 100% *50 – 1000*	The integral term (Ki) forces zero steady state error, so the motor will run at exactly the commanded speed. Larger values provide tighter control. If the gain is set too high, the application may experience oscillations as the controller tries to control speed. If it is set too low, the motor may take a long time to approach the exact commanded speed.
Accel Rate *Accel_Rate_SpdMx* 0x3843 0x00	0.1 – 30.0 s *100 – 30000*	Sets the rate (in seconds) at which the speed command increases when throttle is applied. Larger values represent slower response.
Decel Rate *Decel_Rate_SpdMx* 0x3847 0x00	0.1 – 30.0 s *100 – 30000*	Sets the rate (in seconds) that is used to slow down the vehicle when the throttle is reduced. Larger values represent slower response.
Brake Rate *Brake_Rate_SpdMx* 0x3848 0x00	0.1 – 30.0 s *100 – 30000*	Sets the rate (in seconds) at which the vehicle slows down when brake is applied or when throttle is applied in the opposite direction. Larger values represent slower response.
Pump Enable* *|AC_Pump_Enable_SpdM* *|AC_Pump_Enable_SpdM_Bit0* **[Bit 0]** 0x3896 0x00	On / Off *On / Off*	This parameter should be programmed On to operate a pump motor rather than a vehicle drive motor. The speed-controller responsiveness and stability are enhanced for pump-motor applications.
Regen Lower Enable* *Regen_Lower_Enable_SpdM* *Regen_Lower_Enable_SpdM_Bit0* **[Bit 0]** 0x3877 0x00	On / Off *On / Off*	This parameter works together with Pump Enable as follows: 1) When Pump Enable = On and Regen Lower Enable = On, the pump motor can turn in both the forward and the reverse direction. In this case, the pump can be used as the Lower function (reverse). The pump motor, when "driven in reverse by a load" will also regen current in a similar fashion to a drive-motor regenerative braking. 2) When Pump Enable = On and Regen Lower Enable = Off, the pump motor can turn only in the forward direction. In this case, a hydraulic valve is typically used for the Lower function. 3) When Pump Enable = Off, the Regen Lower Enable parameter has no effect on the control system.

** This parameter appears twice in the parameter menu structure. Changing the value of this parameter affects the same parameter in Speed Mode.*

Quick Link:
Motor Speed
Constraints p.24

1- SPEED MODE — SPEED CONTROLLER MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Max Speed *Max_Speed_SpdM* 0x3011 0x00	100 – 10000 rpm *100 – 10000*	Defines the maximum requested motor rpm at full throttle. Partially-applied throttle is scaled proportionately; e.g., 40% applied throttle corresponds to a request for 40% of the set Max Speed Value. If Max_Speed_SpdM is set <10 rpm (through VCL or CAN), the throttle request is zeroed. NOTE: The maximum motor rpm is subject to the constraints on page 24.
Kp *Kp_SpdM* 0x3012 0x00	0 – 100% *0 – 8192*	Determines how aggressively the speed controller attempts to match the speed of the motor to the commanded speed. Larger values provide tighter control. If the gain is set too high, the application may experience oscillations as the controller tries to control speed. If it is set too low, the motor may behave sluggishly and be difficult to control.
Ki LS *Ki_SpdM* 0x3015 0x00	5 – 100% *50 – 1000*	The Ki LS parameter sets the Ki for low vehicle speeds. The integral term (Ki) forces zero steady state error, so the motor will run at exactly the commanded speed. Larger values provide tighter control. If the gain is set too high, the application may experience oscillations as the controller tries to control speed. If it is set too low, the motor may take a long time to approach the exact commanded speed.
Ki HS *Ki_HS_SpdM* 0x301D 0x00	5 – 100% *50 – 1000*	The Ki HS parameter sets the integral term (Ki) for high vehicle speeds; see description of Ki LS.

Quick Link:
Motor Speed
Constraints p.24

1- SPEED MODE — VELOCITY FEEDFORWARD MENU [OPTIONAL]

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Kvff *Kvff_SpdM* 0x3014 0x00	0 – 500 A *0 – 5000*	This velocity feedforward term is designed to improve throttle responsiveness and speed controller performance, especially at low speeds. For traction systems, set it to 50–70% of the current needed to maintain a very low speed, unloaded, on flat ground. For a pump system, set it to the lowest load current (i.e., the current running at the minimum load). Alternatively, the responsiveness of a pump speed control loop can be significantly enhanced by using a VCL program to continuously update this parameter to the appropriate value as each pump load is requested.
Build Rate *Vel_FF_Build_Rate_SpdM* 0x3093 0x00	0.1 – 5.0 s *100 – 5000*	Determines how fast the Kvff term builds up. For traction systems, if the mechanical gear-backlash is abruptly felt or heard when moving the throttle from neutral to a very small value, slowing the build rate (i.e., setting it to a higher value) will soften the feel. For a pump system, start with this parameter at the minimum setting. Slowing it down (i.e., setting it to a higher value) will reduce speed overshoot if too much feedforward has been commanded.
Release Rate *Vel_FF_Release_Rate_SpdM* 0x3094 0x00	0.1 – 5.0 s *100 – 5000*	Determines how fast the Kvff term releases. If the release seems too abrupt, slowing the release rate (i.e., setting it to a higher value) will soften the feel. It should be set fast enough (i.e., at a low enough value) to prevent the vehicle from running on after throttle release.

1- SPEED MODE — ACCELERATION FEEDFORWARD MENU [OPTIONAL]

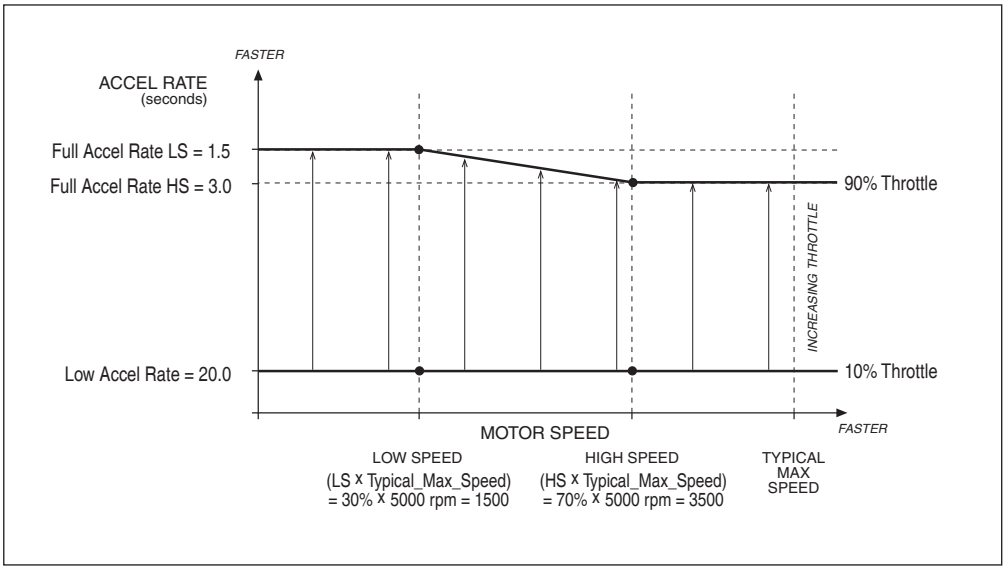
PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Kaff *Kaff_SpdM* 0x3013 0x00	0 – 500 A *0 – 5000*	This acceleration feedforward term is designed to improve throttle responsiveness and speed controller performance at all speeds. It can be thought of as a "quick start" function which can enhance responsiveness at all speeds. Using the present accel and decel rates, observe the average current while running at full throttle at low speeds when accelerating without load on flat ground, and set Kaff to 50–70% of that value. **NOTE: If any accel rate parameters get changed, this parameter will need to be changed also.**
Kbff *Kbff_SpdM* 0x3019 0x00	0 – 500 A *0 – 5000*	This braking feedforward term is designed to improve braking responsiveness at all speeds. Using the present decel rates, observe the average current while running at full throttle braking, and set Kbff to that value.
Build Rate *Acc_FF_Build_Rate_SpdM* 0x3095 0x00	0.1 – 5.0 s *100 – 5000*	Determines how fast the Kaff and Kbff terms build up. For traction systems, if the mechanical gear-backlash is abruptly felt or heard when moving the throttle from neutral to a very small value, slowing the build rate (i.e., setting it to a higher value) will soften the feel. For a pump system, start with this parameter at the minimum setting. Slowing it down (i.e., setting it to a higher value) will reduce over-shoot if too much feedforward has been commanded.
Release Rate *Acc_FF_Release_Rate_SpdM* 0x3096 0x00	0.1 – 5.0 s *100 – 5000*	Determines how fast the Kaff and Kbff terms release. It should be set fast enough (i.e., at a low enough value) to prevent the vehicle from running on after throttle release.

1- SPEED MODE —RESPONSE MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Full Accel Rate HS *Full_Accel_Rate_HS_SpdM* 0x307F 0x00	0.1 – 30.0 s *100 – 30000*	Sets the rate (in seconds) at which the speed command increases when full throttle is applied at high vehicle speeds. Larger values represent slower response. See Figure 7 for relationship between Full Accel Rate HS, Full Accel Rate LS, and Low Accel Rate.
Full Accel Rate LS *Full_Accel_Rate_LS_SpdM* 0x3016 0x00	0.1 – 30.0 s *100 – 30000*	Sets the rate (in seconds) at which the speed command increases when full throttle is applied at low vehicle speeds.
Low Accel Rate *Low_Accel_Rate_SpdM* 0x3081 0x00	0.1 – 30.0 s *100 – 30000*	Sets the rate (in seconds) at which the speed command increases when a small amount of throttle is applied. This rate is typically adjusted to affect low speed maneuverability.
Neutral Decel Rate HS *Neutral_Decel_Rate_HS_SpdM* 0x3018 0x00	0.1 – 30.0 s *100 – 30000*	Sets the rate (in seconds) that is used to slow down the vehicle when the throttle is released to neutral at high vehicle speeds.
Neutral Decel Rate LS *Neutral_Decel_Rate_LS_SpdM* 0x3070 0x00	0.1 – 30.0 s *100 – 30000*	Sets the rate (in seconds) that is used to slow down the vehicle when the throttle is released to neutral at slow vehicle speeds.
Full Brake Rate HS *Full_Brake_Rate_HS_SpdM* 0x301B 0x00	0.1 – 30.0 s *100 – 30000*	Sets the rate (in seconds) at which the vehicle slows down from high speeds when full brake is applied or when full throttle is applied in the opposite direction. See Figure 8 for relationship between Full Brake Rate HS, Full Brake Rate LS, and Low Brake Rate.
Full Brake Rate LS *Full_Brake_Rate_LS_SpdM* 0x3077 0x00	0.1 – 30.0 s *100 – 30000*	Sets the rate (in seconds) at which the vehicle slows down from low speeds when full brake is applied or when full throttle is applied in the opposite direction.
Low Brake Rate *Low_Brake_Rate_SpdM* 0x301A 0x00	0.1 – 30.0 s *100 – 30000*	Sets the rate (in seconds) at which the vehicle slows down at all speeds when a small amount of brake is applied or when a small amount of throttle is applied in the opposite direction. The Low Brake Rate parameter should always be set less than or equal to the Neutral Decel Rate LS, Neutral Decel Rate HS, Full Brake Rate LS and Full Brake Rate HS.

Figure 7

Acceleration response rate diagram. In this example,
HS = 70%,
LS = 30%,
Typ Max Spd = 5000 rpm.

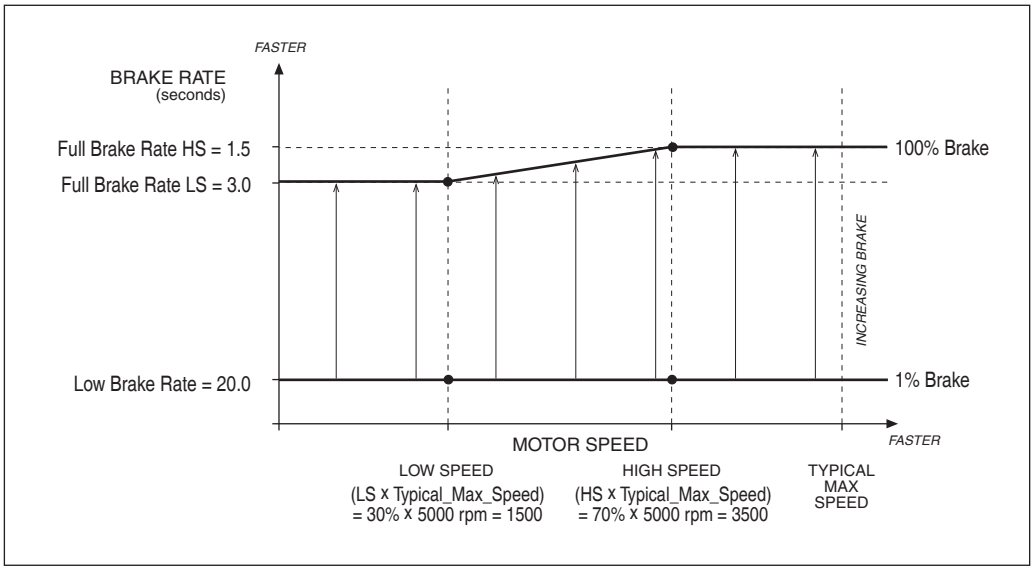


1- SPEED MODE — FINE TUNING MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Partial Decel Rate *Partial_Decel_Rate_SpdM* 0x3082 0x00	0.1 – 30.0 s *100 – 30000*	Sets the rate (in seconds) that is used to slow down the vehicle when the throttle is reduced without being released to neutral. Larger values represent slower response.
HS (High Speed) *HS* 0x3076 0x00	0 – 100% *0 – 32767*	Sets the percentage of the Typical Max Speed above which the "HS" parameters will be used.
LS (Low Speed) *LS* 0x3075 0x00	0 – 100% *0 – 32767*	Sets the percentage of the Typical Max Speed below which the "LS" parameters will be used.
Reversal Soften *Reversal_Soften* 0x3074 0x00	0 – 100% *0 – 30000*	Larger values create a softer reversal from regen braking to drive when near zero speed. This helps soften the transition when the regen and drive current limits are set to different values. Note: This parameter is not mode-specific and appears in two places. Changing the value of this speed-mode parameter affects the parameter listed in: Program » Torque Mode » Response » Fine Tuning » Reversal Soften.
Max Speed Accel *Max_Speed_Accel_SpdM* 0x384A 0x00	0.1 – 30.0 s *100 – 30000*	In some applications, the Max Speed value is changed frequently, through VCL or over the CANbus. The Max Speed Accel parameter controls the rate at which the maximum speed setpoint is allowed to change when the value of Max Speed is raised. The rate set by this parameter is the time to ramp from 0 rpm to Typical Max Speed rpm. For example, suppose Max Speed is raised from 1000 rpm to 4000 rpm. If Typical Max Speed is 5000 rpm and the rate is 10.0 seconds, it will take 10.0 X (4000–1000) ÷ 5000 = 6.0 seconds to ramp from 1000 rpm to 4000 rpm.
Max Speed Decel *Max_Speed_Decel_SpdM* 0x3846 0x00	0.1 – 30.0 s *100 – 30000*	This parameter works like the Max Speed Accel parameter, except that it controls the rate at which the maximum speed setpoint is allowed to change when the value of Max Speed is lowered. For example, suppose the Max Speed is changed from 4500 rpm to 2500 rpm. If Typical Max Speed is 5000 rpm, and the rate is 5.0 seconds, it will take 5.0 X (4500–2500) ÷ 5000 = 2.0 seconds to ramp from 4500 rpm to 2500 rpm.
Creep Speed *Creep_Speed_SpdM* 0x3852 0x00	0 – 1000 rpm *0 – 1000*	Sets a minimum speed for steady state operation. The programmed accel and decel rates will still be in affect as the speed slews through the region between this value and zero. A larger value of this parameter will provide a smoother feel, but my impact (increase) brake distance.

Quick Link:
Typical Max Speed p.56

Figure 8
Braking response rate diagram. In this example, HS = 70%, LS = 30%, Typ Max Spd = 5000 rpm.



1- SPEED MODE — RESTRAINT MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Restraint Forward *Restraint_Forward_SpdM* 0x3020 0x00	0 – 100% *0 – 32767*	Increases torque when on a steep hill in order to limit roll-forward speed. Setting this parameter too high may cause oscillations in the motor as it attempts to limit the roll-forward speed.
Restraint Back *Restraint_Back_SpdM* 0x301F 0x00	0 – 100% *0 – 32767*	Increases torque when on a steep hill in order to limit roll-back speed. Setting this parameter too high may cause oscillations in the motor as it attempts to limit the roll-back speed.
Soft Stop Speed *Soft_Stop_Speed* 0x3027 0x00	0 – 500 rpm *0 – 500*	Defines the speed below which a much slower decel rate is used. A setting of zero disables the function. NOTE: This parameter works only in Speed Mode and Speed Mode Express. Soft Stop Speed is useful for vehicles that have fast deceleration and vehicles operating on ramps using the Position Hold function. With vehicles that have fast deceleration, the driver may find the final speed reduction to zero rpm uncomfortable; the vehicle may even rock back as a result of tire wind-up. Soft Stop Speed allows the vehicle to slow at the same fast rate until it reaches the set threshold, at which point it changes to a slower (softer) deceleration rate. However, if the threshold is set too high, the vehicle will feel like it is “running on.” When throttle is released on a ramp, the vehicle may roll back before Position Hold (see below) takes control. Soft Speed Stop can be used to reduce the amount of rollback, but shouldn’t be set so high the vehicle drives up the ramp after the throttle is released.

1- SPEED MODE — POSITION HOLD MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Position Hold Enable *Position_Hold_Enable* *Position_Hold_Enable_Bit0* [Bit 0] 0x3893 0x00	On / Off *On / Off* **[PCF]**	Allows the Position Hold mode to be entered at zero throttle when the vehicle comes to a stop. NOTE: EM Brake Type = 2 also enables the Position Hold function.
Position Hold Timeout Time *Position_Hold_Timeout_Time* 0x388C 0x00	0.0 – 20.0 s *0 – 625*	This parameter plus the **Position Hold Settling Time** parameter sets the maximum time the vehicle will stay in Position Hold before releasing the hold and going into Restraint mode. Setting the parameter to zero disables this timeout function, which means the Position Hold will be held. Activating the interlock resets the timer.
Kp *Kp_Position_Hold* 0x388A 0x00	2 – 100% *82 – 2048*	Determines the stiffness with which position is regulated when in Position Hold mode. High Kp will produce less rollback on a ramp, but more bouncing; see Kd below. Too much Kp will cause instability.
Kd *Kd_Position_Hold* 0x388D 0x00	0 – 100% *0 – 8192*	Determines the damping in Position Hold mode. Some damping must be present in the control system to keep the vehicle from oscillating slowly ("bouncing"). High Kd will improve the dynamic response of the Position Hold controller, but too much Kd will cause fast instability.
Zero Speed Threshold *Zero_Speed_Threshold* 0x306F 0x00	5 – 100 rpm *5 – 100*	Determines the speed below which the EM brake will be commanded to set. Setting this speed too high may cause a jerky stop when the EM brake sets and stops the motor. This parameter appears twice in the menu structure. Changing the value of this parameter affects this (same) parameter in the EM Brake Control menu.
Zero Speed Threshold Time *Zero_Speed_Threshold_Time* 0x30DA 0x00	0 – 480 ms *0 – 60*	Determines how long motor speed must be below Zero_Speed_Threshold to declare zero speed. This parameter appears twice in the menu structure. Changing the value of this parameter affects this (same) parameter in the EM Brake Control menu.
Position Hold Settling Time *Position_Hold_Settling_Time* 0x3024 0x00	0 – 5000 ms *0 – 156*	Determines how long the position hold function is allowed to operate before the EM brake is set. This time should be set long enough for the position hold to settle. This parameter appears twice in the menu structure. Changing the value of this parameter affects this (same) parameter in the EM Brake Control menu.
Entry Rate *Entry_Rate_Position_Hold* 0x383B 0x00	5 – 100% *50 – 1000*	When the vehicle transitions from forward speed to reverse speed or from reverse speed to forward speed (for example when coming to a stop going up a steep ramp) Position Hold is automatically entered immediately at zero speed regardless of this parameter. This parameter applies when the vehicle needs to be brought to a stop without the assistance of gravity (for example when moving forward down a ramp). This rate determines how quickly zero speed is attained after the ramped speed request reaches zero. Setting this parameter too high will make the stop seem very abrupt and may even cause the vehicle to roll back slightly. When the parameter is set lower the vehicle take longer to come to a stop and enter Position Hold mode.
Exit Rollback Reduction *Exit_Rollback_Reduction* 0x3844 0x00	0 – 100% *0 – 2048*	This function is applicable when the Torque Preload Enable function has been Disabled (Off) or the Torque Preload Cancel Delay timer has expired (see EM Brake menu). Exit Rollback Reduction is only intended for use with EM Brake Type = 2, for EM Brake Type = 1 (or 0) set Exit Rollback Reduction = 0. Exit Rollback Reduction introduces an additional control function for the speed controller to reduce rollback on a ramp after a throttle command is applied from a stop. For example, suppose the vehicle is on a ramp facing upwards and, after a forward throttle request, the vehicle rolls back slightly before climbing the ramp (again, assuming the torque preload function is inactive). As the vehicle rolls back, this additional term will be added to the torque request until forward speed is sensed, to attempt to minimize rollback. The effect increases with percentage, and is disabled when = 0%. Setting the value too high may introduce temporary oscillations. If the Torque Preload Cancel Delay parameter expires before the throttle is re-engaged, the torque preload [Position Hold] memory will be cleared. In such a case, setting Exit Rollback Reduction to > 0% will reduce unintended roll.

Quick Links:
EM Brake Type p.50
Torque Preload Enable p.51
Torque Preload Cancel Delay p.51

1- SPEED MODE — PUMP PARAMETERS

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Pump Enable* *AC_Pump_Enable_SpdM* *AC_Pump_Enable_SpdM_Bit0* **[Bit 0]** 0x3896 0x00	On / Off *On / Off*	This parameter should be programmed On to operate a pump motor rather than a vehicle drive motor. Speed controller responsiveness and stability are enhanced.
Regen Lower Enable* *Regen_Lower_Enable_SpdM* *Regen_Lower_Enable_SpdM_Bit0* **[Bit 0]** 0x3877 0x00	On / Off *On / Off*	This parameter works together with Pump Enable as follows: 1) When Pump Enable = On and Regen Lower Enable = On, the pump motor can turn in both the forward and the reverse direction. In this case, the pump can be used as the Lower function (reverse). The pump motor, when "driven in reverse by a load" will also regen current in a similar fashion to a drive-motor regenerative braking. 2) When Pump Enable = On and Regen Lower Enable = Off, the pump motor can turn only in the forward direction. In this case, a hydraulic valve is typically used for the Lower function. 3) When Pump Enable = Off, the Regen Lower Enable parameter has no effect on the control system.

** This parameter appears twice in the parameter menu structure. Changing the value of this parameter affects the same parameter in Speed Mode Express.*

2 – TORQUE MODE — SPEED LIMITER MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Max Speed *Max_Speed_TrqM* 0x3021 0x00	500 – 10000 rpm *500 – 10000*	Defines the maximum allowed motor rpm for torque control mode (independent of throttle position). In torque control mode, full throttle requests 100% of the available torque. Partially-applied throttle is scaled proportionately; e.g., 40% applied throttle corresponds to a request for 40% of the available torque. NOTE: The maximum motor rpm is subject to the constraints.
Kp *Kp_TrqM* 0x3023 0x00	0 – 100% *0 – 8192*	Determines how aggressively the speed controller attempts to limit the speed of the motor to Max Speed. Larger values provide tighter control. If Kp is set too high, the application may experience oscillations as the controller tries to control speed. Setting Kp too low may result in a top speed much higher than Max Speed.
Ki *Ki_TrqM* 0x3025 0x00	5 – 100% *50 – 1000*	The integral term (Ki) forces zero steady state error, so the motor speed will be limited to Max Speed. Larger values provide faster control. If the gain is set too high, application may experience oscillations as the controller tries to limit speed. If it is set too low, it may take a long time for the motor to approach Max Speed from overspeed.
Kd *Kd_TrqM* 0x3836 0x00	0 – 100% *0 – 8192*	Provides damping as the vehicle approaches top speed, thereby reducing overshoot. If Kd is set too high, the vehicle may take too long to reach top speed. If Kd is set too low, the vehicle may overshoot top speed, especially when traveling downhill.

Quick Link:
Motor Speed Constraints p.24

2 - TORQUE MODE — RESPONSE MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Accel Rate *Accel_Rate_TrqM* 0x3026 0x00	0.1 – 30.0 s *100 – 30000*	Sets the rate (in seconds) at which the motor torque increases to full when full throttle is applied. Larger values represent slower response.
Accel Release Rate *Accel_Release_Rate_TrqM* 0x3028 0x00	0.1 – 2.0 s *100 – 2000*	Determines how quickly deceleration will be initiated when the throttle is released while the vehicle is still accelerating. If the release rate is fast (i.e., set to a low value), the transition is initiated abruptly. The transition is smoother if the release rate is set to a higher value (slower transition); however, setting the rate too high can cause the vehicle to feel uncontrollable when the throttle is released, as it will continue to drive for a short time.
Brake Rate *Brake_Rate_TrqM* 0x3029 0x00	0.1 – 5.0 s *100 – 5000*	Adjusts the rate (in seconds) at which braking torque builds as the vehicle transitions from drive to braking when direction is reversed, the brake pedal is applied, or neutral braking begins. Lower values represent faster times and therefore faster braking; gentler braking is achieved by setting the braking rate to a higher value.
Brake Release Rate *Brake_Release_Rate_TrqM* 0x3831 0x00	0.1 – 2.0 s *100 – 2000*	Adjusts the rate (in seconds) at which braking torque releases as the vehicle transitions from braking to drive.
Neutral Braking *Neutral_Braking_TrqM* 0x302E 0x00	0 – 100% *0 – 32767*	Neutral braking occurs progressively when the throttle is reduced toward the neutral position or when no direction is selected. The neutral braking parameter is adjustable from 0 to 100% of the regen current limit.
Neutral Taper Speed *Neutral_Taper_Speed_TrqM* 0x302F 0x00	200 – 6000 rpm *200 – 6000*	Determines the motor speed below which neutral braking current is adjusted when throttle is reduced; see Figure 9. The neutral braking current is linearly reduced by the product of the parameters, Neutral Braking x Regen Current Limit, at the Neutral Taper Speed to the Creep Torque current at zero rpm motor speed. NOTE: Setting the taper speed too low may cause oscillations in the motor.
Forward Full Restraint Speed *Forward_Full_Restraint_Speed _TrqM* 0x386D 0x00	100 – 32000 rpm *100 – 32000*	Sets the speed point at which the full regen current will be applied to restrain the vehicle from rolling forward. Although this speed is never actually reached, it does set the slope of the restraint strength and can be thought of as a gain; see Figure 9. Setting this parameter too low can cause oscillations.
Back Full Restraint Speed *Back_Full_Restraint_Speed_TrqM _TrqM* 0x386E 0x00	100 – 32000 rpm *100 – 32000*	Sets the speed point at which the full regen current will be applied to restrain the vehicle from rolling in reverse (backward). Although this speed is never actually reached, it does set the slope of the restraint strength and can be thought of as a gain; see Figure 9. Setting this parameter too low can cause oscillations.

Quick Link:
Current Limits menu p.44

2 - TORQUE MODE — FINE TUNING MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Creep Torque *Creep_Torque_TrqM* 0x3071 0x00	0 – 100% *0 – 32767*	Determines the amount of torque applied to the vehicle at a stop with no throttle input, to emulate the feel of an automatic transmission automobile; see Fig. 9. ***WARNING!*** When interlock is engaged, creep torque allows vehicle propulsion if a direction is selected even though no throttle is applied. Care should be taken when setting up this parameter. If pedal braking is enabled, creep torque is progressively disabled as brake is applied so as to prevent the motor from driving into the brakes and thus wasting energy. Creep Torque and Neutral Taper Speed interact to create the slope of the torque response as the vehicle approaches zero speed; see Figure 9. If the vehicle oscillates as it coasts down toward zero speed, try lowering Creep Torque or increasing Neutral Taper Speed.
Brake Full Creep Cancel *Brake_Full_Creep_Cancel_TrqM* 0x3837 0x00	25 – 100% *8192 – 32767*	Determines the amount of brake pedal input that will fully cancel the creep torque. Amount of cancellation is proportional to the brake input.
Creep Build Rate *Creep_Build_Rate_TrqM* 0x3832 0x00	0.1 – 5.0 s *100 – 5000*	Determines how fast the programmed creep torque builds when a direction is selected.
Creep Release Rate *Creep_Release_Rate_TrqM* 0x3833 0x00	0.1 – 5.0 s *100 – 5000*	Determines how fast the programmed creep torque releases when the brake is cancelling the creep torque or when the direction switches are cleared (neutral).
Gear Soften *Gear_Soften_TrqM* 0x302A 0x00	0 – 100% *0 – 5000*	Adjusts the throttle take-up from linear (0% setting) to an S curve. Larger values create softer throttle take-up, in forward and reverse. Softening is progressively reduced at higher speeds; see Figure 10.
Brake Taper Speed *Brake_Taper_Speed_TrqM* 0x300F 0x00	200 – 6000 rpm *200 – 6000*	Determines the motor speed below which the maximum braking current is linearly reduced from 100% to 0% at zero speed; see Figure 11. Setting the taper speed too low for the braking current will cause oscillations in the motor as it attempts to brake the vehicle to a stop on very steep slopes. Taper speed is applicable only in response to brake pedal input; it does not affect direction reversal braking or neutral braking. If the vehicle is in restraint when the brake is pressed, the applied braking torque is affected by both Brake Taper Speed and Forward (or Back) Full Restraint Speed. If the vehicle oscillates in this mode, it may be necessary to increase one or more of these parameters.
Reversal Soften *Reversal_Soften* 0x3074 0x00	0 – 100% *0 – 3000*	Larger values create a softer reversal from regen braking to drive when near zero speed. This helps soften the transition when the regen and drive current limits are set to different values. Note: This parameter is not mode-specific and appears in two places. Changing the value of this torque-mode parameter affects the parameter listed in: Program » Speed Mode » Response » Fine Tuning » Reversal Soften.
Max Speed Decel *Max_Speed_Decel_TrqM* 0x3835 0x00	0.1 – 30.0 s *100 – 30000*	In some applications, the Max Speed value is changed frequently, through VCL or over the CANbus. The Max Speed Decel parameter controls the rate at which the maximum speed setpoint is allowed to change when the value of Max Speed is lowered. The rate set by this parameter is the time to ramp from Typical Max Speed rpm to 0 rpm. For example, suppose the Max Speed is changed from 3000 rpm to 1000 rpm. If Typical Max Speed is 5000 rpm, and the rate is 5.0 seconds, it will take 5.0 X (3000–1000) ÷ 5000 = 2.0 seconds to ramp from 3000 rpm to 1000 rpm.

Quick Link:
Brake Pedal Enable p.49

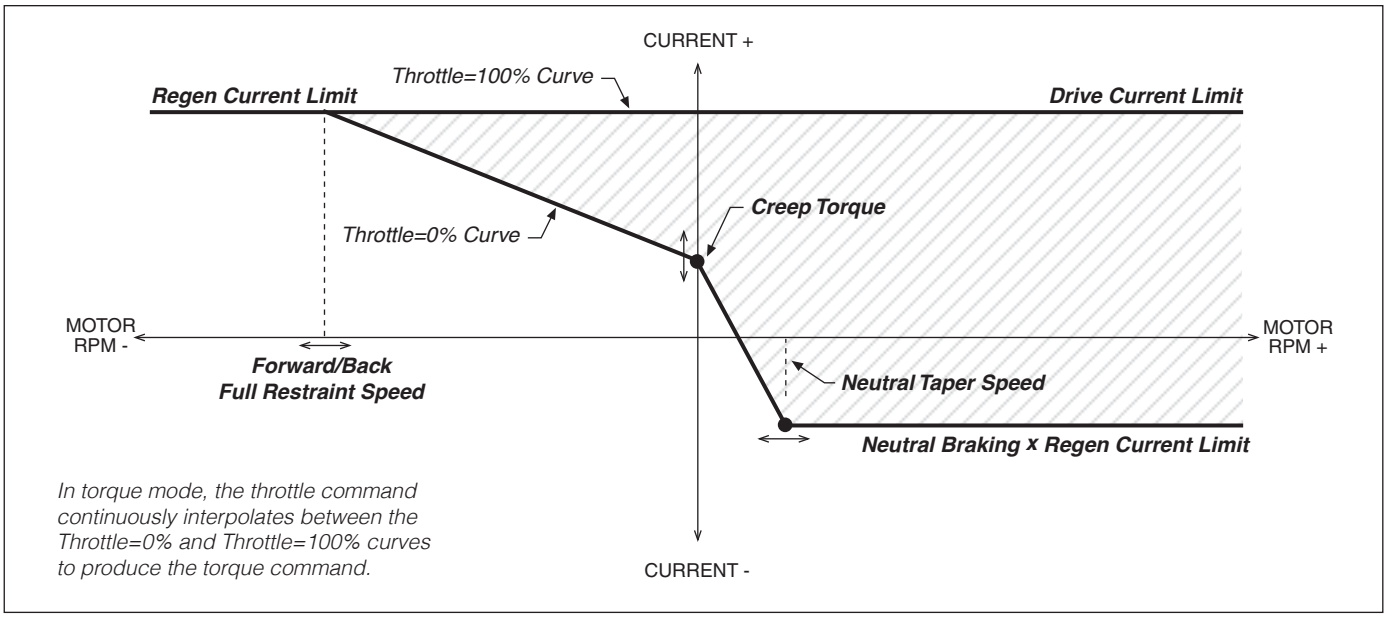


Figure 9

Throttle mapping (torque control mode).

Figure 10

Effect of Gear Soften parameter (torque control mode).

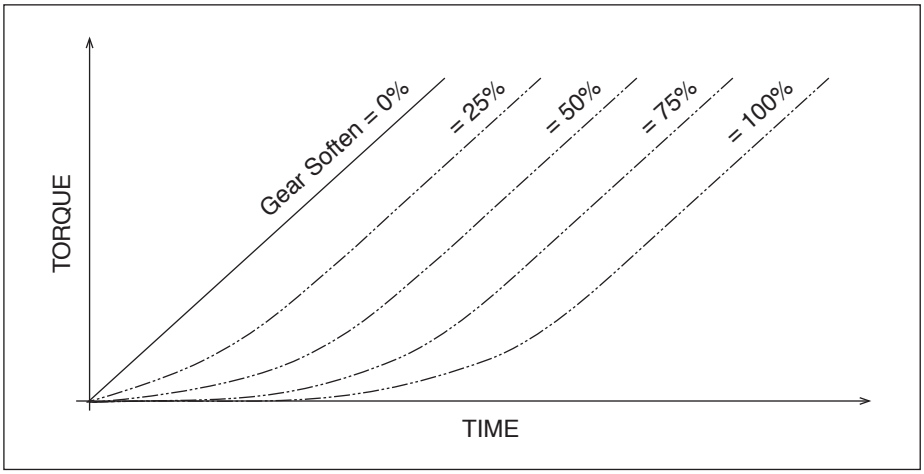
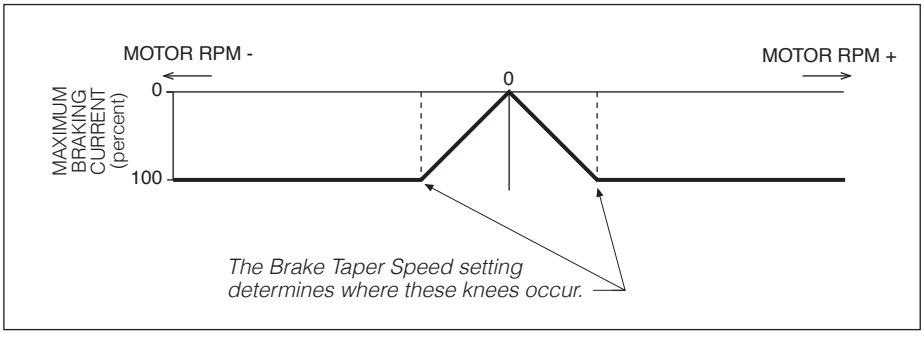


Figure 11

Effect of Brake Taper Speed parameter (torque control mode).



CURRENT LIMITS MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Drive Current Limit *Drive_Current_Limit* 0x305B 0x00	5 – 100% *1638 – 32767*	Sets the maximum RMS current the controller will supply to the motor during drive operation, as a percentage of the controller's full rated current.* Reducing this value will reduce the maximum drive torque. **NOTE: Changing this parameter requires the re-setting of the ACIM FW Base Speed parameter.**
Regen Current Limit *Regen_Current_Limit* 0x305C 0x00	5 – 100% *1638 – 32767*	Sets the maximum RMS regen current, as a percentage of the controller's full rated current.* The regen current limit applies during neutral braking, direction reversal braking, and speed limiting when traveling downhill.
Brake Current Limit *Brake_Current_Limit* 0x305D 0x00	5 – 100% *1638 – 32767*	Sets the maximum RMS regen current during braking when a brake command is given, as a percentage of the controller's full rated current.* Typically the brake current limit is set equal to the regen current limit. The brake current limit overrides the regen current limit when the brake input is active.
EMR Current Limit *EMR_Current_Limit* 0x3037 0x00	5 – 100% *1638 – 32767*	Sets the maximum RMS current allowed for braking and drive when in emergency reverse. The emergency reverse current limit is a percentage of the controller's full rated current.*
Interlock Brake Current Limit *Interlock_Brake_Current_Limit* 0x309D 0x00	5 – 100% *1638 – 32767*	Sets the maximum RMS regen current during interlock braking, as a percentage of the controller's full rated current.*

** The full rated current depends on the controller model;*
see specifications in Table D-1 for the rated current of the controller model number.

POWER LIMITING MAP MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
PL Nominal Speed *PL_Nominal_Speed* 0x305E 0x00	100 – 8000 rpm *100 – 8000*	Sets the base speed that will be used in the drive limiting map and regen limiting map. **NOTE: Changing this parameter requires the re-setting of the ACIM FW Base Speed parameter.**
Delta Speed *PL_Delta_Speed* 0x305F 0x00	50 – 1000 rpm *50 – 1000*	Sets the width of the delta increment that will be used in the drive limiting map and regen limiting map.

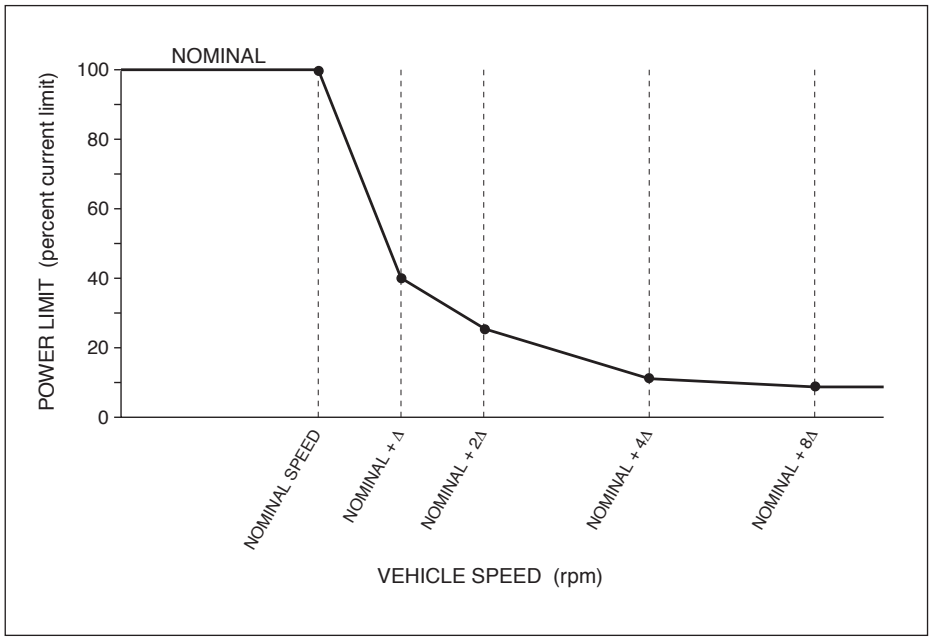
Quick Link:
Base Speed p.58

DRIVE LIMITING MAP MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Nominal *PL_Drive_Nominal* 0x3060 0x00	0 – 100% *0 – 32767*	These parameters define the percentage of drive current limit that will be applied at the speeds defined by the nominal speed and delta speed parameters. The resulting map allows the controller to reduce the drive current as a function of speed. Reducing the power requirements at certain speeds restricts performance. This can be useful for reducing motor heating. It can also be used to keep consistent vehicle power with changing battery state-of-charge. Figure 12 illustrates these parameters' typical usage.
Plus Delta *PL_Drive_Nominal_Plus_Delta* 0x3061 0x00	0 – 100% *0 – 32767*	
Plus 2xDelta *PL_Drive_Nominal_Plus_2xDelta* 0x3062 0x00	0 – 100% *0 – 32767*	
Plus 4xDelta *PL_Drive_Nominal_Plus_4xDelta* 0x3063 0x00	0 – 100% *0 – 32767*	
Plus 8xDelta *PL_Drive_Nominal_Plus_8xDelta* 0x3064 0x00	0 – 100% *0 – 32767*	

Figure 12

Drive current limiting map (typical example).



REGEN LIMITING MAP MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Nominal *PL_Regen_Nominal* 0x3065 0x00	0 – 100% *0 – 32767*	These parameters define the percentage of regen current limit or braking current limit that will be applied at the speeds defined by the nominal speed and delta speed parameters. The curve can be shaped to limit the available torque at various speeds. One possible use is to compensate for the torque-speed characteristic of the motor. Figure 13 illustrates two typical usages of these parameters.
Plus Delta *PL_Regen_Nominal_Plus_Delta* 0x3066 0x00	0 – 100% *0 – 32767*	
Plus 2xDelta *PL_Regen_Nominal_Plus_2xDelta* 0x3067 0x00	0 – 100% *0 – 32767*	
Plus 4xDelta *PL_Regen_Nominal_Plus_4xDelta* 0x3068 0x00	0 – 100% *0 – 32767*	
Plus 8xDelta *PL_Regen_Nominal_Plus_8xDelta* 0x3069 0x00	0 – 100% 0 – 32767	

Figure 13

Regen current limiting map (two examples).

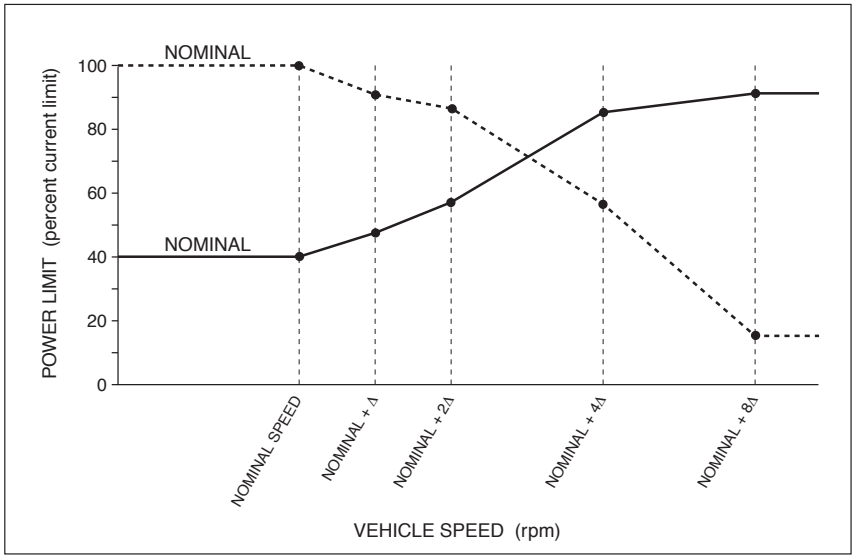


Figure 14

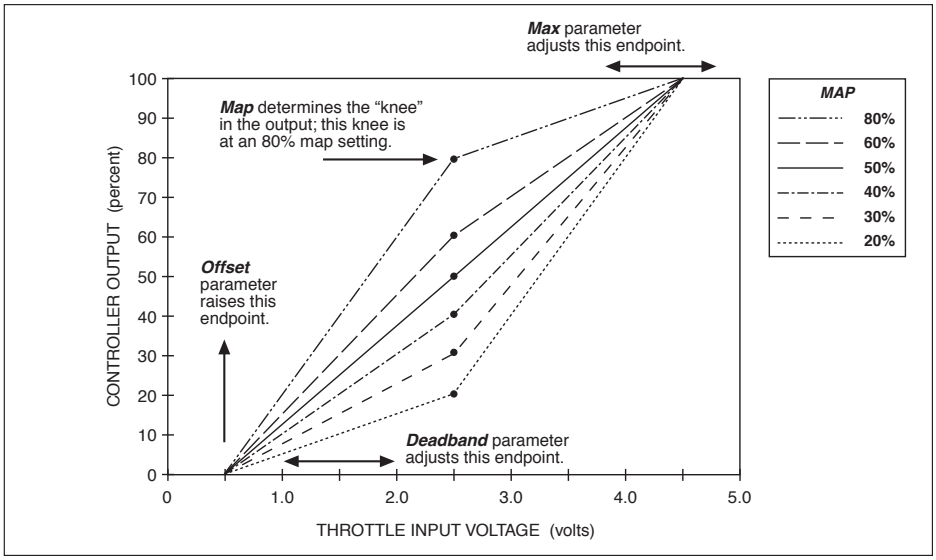
Effect of throttle adjustment parameters. Together these four generic parameters determine the controller's response to throttle demand (in forward or reverse) and to brake demand.

In the examples shown in this figure,

Deadband = 0.5V

Max = 4.5V

Offset = 0.



THROTTLE MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Throttle Type *Throttle_Type* 0x3000 0x00	1 – 5 *1 – 5* **[PCF]**	These E and SE controllers accept a variety of throttle inputs. The throttle type parameter can be programmed as follows: 1. 2-wire rheostat, 5 kΩ–0 input. 2. Single-ended 3-wire 1 kΩ–10 kΩ potentiometer, or 0–5 V voltage source. 3. 2-wire rheostat, 0–5 kΩ input. 4. Wigwag 3-wire 1 kΩ–10 kΩ potentiometer, or 0–5 V voltage source. 5. VCL input (*VCL_Throttle*). **NOTE:** Do not change this parameter while the controller is powering the motor. Any time this parameter is changed a Parameter Change Fault (fault code 49) is set and must be cleared by cycling power; this protects the controller and the operator.
Forward Deadband *Forward_Deadband* 0x3001 0x00	0.00 – 5.00V *0 – 32767*	Defines the wiper voltage at the throttle deadband threshold. Increasing the throttle deadband setting will increase the neutral range. This parameter is especially useful with throttle assemblies that do not reliably return to a well-defined neutral point, because it allows the deadband to be defined wide enough to ensure that the controller goes into neutral when the throttle mechanism is released.
Forward Map *Forward_Map* 0x3002 0x00	0 – 100% *0 – 32767*	Modifies the vehicle's response to the throttle input. Setting the throttle map at 50% provides a linear output response to throttle position. Values below 50% reduce the controller output at low throttle settings, providing enhanced slow speed maneuverability. Values above 50% give the vehicle a faster, more responsive feel at low throttle settings. The map value is the percentage of controller output at half throttle [(deadband + max)/2].
Forward Max *Forward_Max* 0x3003 0x00	0.00 – 5.00V *0 – 32767*	Defines the wiper voltage required to produce 100% controller output. Decreasing the throttle max setting reduces the wiper voltage and therefore the full stroke necessary to produce full controller output. This parameter allows reduced-range throttle assemblies to be accommodated.
Forward Offset *Forward_Offset* 0x3004 0x00	0 – 100% *0 – 32767*	Defines the initial controller output generated when the throttle is first rotated out of the neutral deadband. For most vehicles, a setting of 0 is appropriate. For heavy vehicles, however, increasing the offset may improve controllability by reducing the amount of throttle required to start the vehicle moving.
Reverse Deadband *Reverse_Deadband* 0x3005 0x00	0.00 – 5.00V *0 – 32767*	The four Throttle Reverse parameters are the same as their Throttle Forward counterparts, and apply when the throttle direction is reversed.
Reverse Map *Reverse_Map* 0x3006 0x00	0 – 100% *0 – 32767*	
Reverse Max *Reverse_Max* 0x3007 0x00	0.00 – 5.00V *0 – 32767*	
Reverse Offset *Reverse_Offset* 0x3008 0x00	0 – 100% *0 – 32767*	
Throttle Filter *Throttle_Filter* 0x3030 0x00	0.5 – 125.0 Hz 131 – 32767	Sets the low pass filter cutoff frequency for the throttle pot wiper input. Higher values will make the throttle more responsive to quick changes. Lower values will make the throttle less responsive to electrical noise.

NOTE: All four throttle adjustment parameters — Deadband, Map, Max, Offset — condition the raw throttle voltage into a single % throttle command, as shown in Figure 14 on the previous page.

THROTTLE MENU, cont'd

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
HPD SRO Type *HPD_SRO_Type* 0x30CF 0x00	0 – 3 *0 – 3* **[PCF]**	Determines the type of HPD (High Pedal Disable) / SRO (Static Return to Off) protection. One type of checks is available for material-handling vehicles, and two types for golf-style vehicles. If any of the HPD/SRO checks finds an input sequencing problem, an HPD/Sequencing Fault (flash code 47) is set. 0. HPD/SRO feature is disabled. 1. HPD/SRO enabled for material-handling vehicles. ***HPD:*** If throttle input is received before interlock input. ***SRO:*** If direction input is received before interlock input. The HPD/SRO check is made when the interlock input changes from Off to On. If the throttle input >25% or a direction input is On, an HPD/Sequencing Fault is set. The HPD/Sequencing Fault is cleared by returning the throttle input to <25% or the direction inputs to Off. 2. Golf-style HPD that allows direction reversal while driving. ***HPD:*** Throttle input received before interlock, or throttle input received before direction input while vehicle is stationary. ***SRO:*** None. The HPD check is made when the interlock input or direction inputs are Off and the vehicle is stationary. If the throttle input >25%, an HPD/Sequencing Fault is set. No SRO check is made with this type, so the order of the interlock and direction inputs does not matter. The HPD/Sequencing Fault is cleared by returning the throttle input to <25% or the direction inputs to Off. 3. Golf-style HPD that prevents direction reversal while driving. ***HPD:*** If throttle input is received before interlock or direction input. ***SRO:*** None. HPD check is made when the interlock input or direction inputs are Off. If the throttle input >25%, an HPD/Sequencing Fault is set. The check is done regardless of vehicle speed, so reversing direction with throttle input >25% will result in a fault. No SRO check is made with this type, so the order of the interlock and direction inputs does not matter. The HPD/Sequencing Fault is cleared by returning the throttle input to <25% or the direction inputs to Off.
Sequencing Delay *Sequencing_Delay* 0x3009 0x00	0.0 – 5.0 s *0 – 1250*	Typically the sequencing delay feature allows the interlock switch to be cycled within a set time (the defined sequencing delay), thus preventing inadvertent activation of HPD/SRO. This feature is especially useful in applications where the interlock switch may bounce or be momentarily cycled during operation.
VCL Throttle Enable *VCL_Throttle_Enable* *VCL_Throttle_Enable_Bit0* **[Bit 0]** 0x3099 0x00	On / Off *On / Off*	When programmed On, the throttle processing with fault detection will operate normally; however, the throttle command will require VCL to define the connection between the OS_Throttle and VCL_Throttle variables. This allows VCL flexibility and customization of throttle processing, while still allowing Throttle_Type 1–4 with throttle fault detection. Figure 15 illustrates these throttle chains.

Quick Link:
Figure 15 p.114

BRAKE MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Brake Pedal Enable *Brake_Pedal_Enable* *OptionBits1* **[Bit 3]** 0x306A 0x00	On / Off *On / Off*	Determines whether the brake input and algorithm are enabled, making the brake throttle part of the motor control command.
Brake Type *Brake_Type* 0x300A 0x00	1 – 5 *1 – 5* **[PCF]**	These E and SE controllers accept a variety of brake inputs. The brake type parameter can be programmed as follows: 1. 2-wire rheostat, 5 kΩ–0 input. 2. Single-ended 3-wire 1 kΩ–10 kΩ potentiometer, 0–5 V voltage source. 3. 2-wire rheostat, 0–5 kΩ input. 4. (Not applicable). 5. VCL input (*VCL_Brake*). NOTE: Do not change this parameter while the controller is powering the motor. Any time this parameter is changed a Parameter Change Fault (fault code 49) is set and must be cleared by cycling power; this protects the controller and the operator.
Brake Deadband *Brake_Deadband* 0x300B 0x00	0.00 – 5.00 V *0 – 32767*	The four Brake throttle adjustment parameters are the same as their Drive throttle counterparts; see descriptions and Figure 14.
Brake Map *Brake_Map* 0x300C 0x00	0 – 100% *0 – 32767*	
Brake Max *Brake_Max* 0x300D 0x00	0.00 – 5.00 V *0 – 32767*	
Brake Offset *Brake_Offset* 0x300E 0x00	0 – 100% *0 – 32767*	
Brake Filter *Brake_Filter* 0x3031 0x00	0.5 – 125.0 Hz *131 – 32767*	Sets the low pass filter cutoff frequency for the pot2 wiper input. Higher values will make the brake more responsive to quick changes. Lower values will make the brake less responsive to electrical noise.
VCL Brake Enable *VCL_Brake_Enable* *VCL_Brake_Enable_Bit0* **[Bit 0]** 0x301E 0x00	On / Off *On / Off*	When programmed On, the brake processing with fault detection will operate normally; however, the brake command will require VCL to define the connection between the OS_Brake and VCL_Brake variables. This allows VCL flexibility and customization of throttle processing, while still allowing Brake_Type 1–3 with brake fault detection. Figure 15 illustrates these brake chains.

Quick Link:
Figure 15 p.114

EM BRAKE CONTROL MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Brake Type *EM_Brake_Type* 0x3097 0x00	0 – 2 *0 – 2* **[PCF]**	This brake type parameter determines how the EM brake responds to the interlock input, throttle, and vehicle motor speed. 0. EM brake function disabled. The EM brake driver (PWM2) is released to general I/O use with VCL. 1. EM brake controlled by interlock. The controller will command the EM brake to release whenever the interlock is closed (Interlock = On). If interlock braking is enabled and the interlock opens when the vehicle is moving at motor speed greater than Zero_Speed_Threshold, the controller will brake the vehicle to a stop (with interlock braking) and then command the EM brake to set. If the vehicle motor speed is less than this threshold, the EM brake will engage after the Sequencing_Delay has expired. If interlock braking is disabled, the EM brake will engage after the Sequencing_Delay has expired. 2. EM brake controlled by interlock and neutral. The controller will command the EM brake to set whenever the throttle command is zero and motor speed is less than Zero_Speed_Threshold. Position Hold will be enabled automatically.
Pull In Voltage *EM_Brake_Pull_In_Voltage* 0x3072 0x00	0 – 100% *0 – 32767*	The EM brake pull-in voltage allows a high initial voltage when the EM brake first turns on, to ensure brake release. After 1 second, this peak voltage drops to the EM brake holding voltage. Note: The Battery Voltage Compensated parameter controls whether the pull-in and holding voltages are battery voltage compensated.
Holding Voltage *EM_Brake_Holding_Voltage* 0x3098 0x00	0 – 100% *0 – 32767*	The EM brake holding voltage allows a reduced average voltage to be applied to the brake coil once the brake has been released. This parameter must be set high enough to hold the brake released under all shock and vibration conditions the vehicle will be subjected to. Note: The Battery Voltage Compensated parameter controls whether the pull-in and holding voltages are battery voltage compensated.
Battery Voltage Compensated *EM_Brake_Battery_Voltage_Compensated* *EM_Brake_Battery_Voltage_Compensated_Bit0* **[Bit 0]** 0x302D 0x00	On / Off *On / Off*	This parameter determines whether the EM brake pull-in and holding voltages are battery voltage compensated. When set On, the pull-in and holding voltages are compensated relative to the set Nominal Voltage. In other words, the output voltage is adjusted to compensate for swings in battery voltage, so the percentage is relative to the set Nominal Voltage—not to the actual voltage. For example, suppose Nominal Voltage is set to 48V and Holding Voltage is set to 75% (36V) to the output driver. Now suppose the bus voltage dips to 40V. If Battery Voltage Compensated = On, the output will still be 36V (Nominal Voltage × Holding Voltage) to the coil. If Battery Voltage Compensated = Off, the output will be 30V (Actual Voltage × Holding Voltage) to the coil.
Set EM Brake On Fault *EM_Brake_Set_Upon_Fault* *EM_Brake_Set_Upon_Fault_Bit0* **[Bit 0]** 0x309B 0x00	On / Off *On / Off*	When programmed On, the controller's operating system will set the electromagnetic brake when a fault occurs that has a fault action of ShutdownEMBrake. See the Troubleshooting Chart, Chapter 10, for a list of all the faults that have a fault action of ShutdownEMBrake.
Zero Speed Threshold *Zero_Speed_Threshold* 0x306F 0x00	5 – 100 rpm *5 – 100*	Determines the speed below which the EM brake will be commanded to set. Setting this speed too high may cause a jerky stop when the EM brake sets and stops the motor. This parameter appears twice in the menu structure. Changing the value of this parameter affects this (same) parameter in the Position Hold menu.
Zero Speed Threshold Time *Zero_Speed_Threshold_Time* 0x30DA 0x00	0 – 480 ms *0 – 60*	Determines how long motor speed must be below Zero_Speed_ Threshold to declare zero speed. This parameter appears twice in the menu structure. Changing the value of this parameter affects this (same) parameter in the Position Hold menu.

Quick Links:
Battery Menu p.68
Position Hold menu p.39

EM BRAKE CONTROL MENU, cont'd

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Position Hold Settling Time *Position_Hold_Settling_Time* 0x3024 0x00	0 – 5000 ms *0 – 156*	Determines how long the position hold function is allowed to operate before the EM brake is set. This time should be set long enough for the position hold to settle. This parameter appears twice in the menu structure. Changing the value of this parameter affects this (same) parameter in the Position Hold menu. NOTE *
Brake Set Time *EM_Brake_Set_Time* 0x30DB 0x00	40 – 2000 ms *5 – 250*	Estimated time for the EM brake to physically set after the holding voltage is released. This determines how long the controller waits, after removing voltage from the brake, before released the torque. This should be set longer than the actual brake setting time to ensure the vehicle doesn't move before the brake fully engages.
Torque Release Time *EM_Brake_Torque_Release_Time* 0x30DC 0x00	40 – 2000 ms *5 – 250*	Time to release torque after EM Brake has set and motor has stopped (EMBrakeEngagedAndStopped state).
Brake Release Time *EM_Brake_Release_Time* 0x3073 0x00	40 – 2000 ms *5 – 250*	Estimated time for the EM brake to physically release after the pull-in voltage is applied. This is used to ensure the position hold torque buildup is complete before the brake releases. When set too low, the vehicle may experience rollback on EM brake release.
Torque Preload Time *EM_Brake_Torque_Preload_Time* 0x3090 0x00	0 – 800 ms *0 – 100*	Estimated worst-case time to build up the torque required to hold the vehicle stationary on a hill prior to EM brake release. This is used in conjunction with Release Delay to determine when to release the brake and allow the speed request to slew away from zero. NOTE *
Torque Preload Enable *EM_Brake_Torque_Preload_Enable* *EM_Brake_Torque_Preload_Enable_Bit0* **[Bit 0]** 0x389D 0x00	On / Off *On / Off*	When enabled, this function eliminates rollback when the throttle is re-engaged on a ramp by forcing the vehicle to first enter position-hold before setting the EM brake, and then "remembering" the amount of torque that was necessary to hold it on the ramp. When throttle is re-engaged, this value is loaded in the motor before the EM brake is released. The torque value is cleared automatically when KSI power is cycled. Off = When a valid throttle input is received, the speed controller will start with no torque preload as soon as the Release Delay expires. This will allow some rollback when the EM brake releases. This rollback can be reduced by raising the Exit Rollback Reduction parameter in the Position Hold Menu. On = When a valid throttle input is received, the speed controller will start with a pre-set torque as measured by position-hold when the vehicle came to a stop. NOTE *
Save Torque Preload *Save_Torque_Preload* *Save_Torque_Preload_Bit0* **[Bit 0]** 0x38C9 0x00	On/Off *On/Off*	This parameter controls whether the EM Brake torque preload is saved over a keyswitch cycle. If Torque_Preload_Cancel_Delay is nonzero and this parameter = On, the timer starts again upon startup (KSI cycle) such that the countdown is from the full value of the Torque_Preload_Cancel_Delay parameter.
Torque Preload Cancel Delay *EM_Brake_Torque_Preload_ Cancel_Delay* 0x3091 0x00	0 – 120 s *0 – 15000*	The timer starts after the EM brake is set. If the timer expires before the throttle is re-engaged, the torque preload memory will be cleared. Setting this parameter to zero disables the timer, i.e., the preload is never cancelled. The purpose of this delay is to prevent the vehicle from lunging forward if it is unloaded on a hill such that the torque measured by position-hold is no longer valid. NOTE: This parameter is applicable only when Torque Preload Enable = On (see parameter, previous page).
EM Brake Fault Motor Revs *EM_Brake_Fault_Motor_Revs* 0x3894 0x00	1.0 – 20.0 *10 – 200*	Defines the allowable number of motor revolutions after the EM brake is set before an EM Brake Failed to Set fault is issued (fault code 92).

NOTE: **This parameter is applicable only when Speed Mode or Speed Mode Express is selected and either Position Hold Enable = On or EM Brake Type = 2.*

Quick Link:
Position Hold menu p.39

EM BRAKE CONTROL MENU: EM BRAKE TEST

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Mode *EM_Brake_Test_Mode* 0x30E1 0x00	0 – 1 0 – 1	Controls the test mode for the EM brake. 0 = VCL 1 = Startup
Direction *EM_Brake_Test_Direction* 0x30E2 0x00	0 – 2 0 – 2	Controls which direction torque is applied during the EM brake test. 0 = FWD 1 = REV 2 = Both
Current *EM_Brake_Test_Current* 0x30E3 0x00	10.0 – 100.0 % 3277 – 32767	The current as a percentage of base current applied during the EM brake test.
Ramp Time *EM_Brake_Test_Current_Ramp_Time* 0x30E4 0x00	10 – 1000 ms 10 – 1000	The time taken to ramp the current to the maximum EM_Brake_Test_ Current value. The same time is used to ramp it down again.
Test Threshold *EM_Brake_Test_Threshold* 0x30E5 0x00	0.1 – 2.0 revs 10 – 200	The number of motor revolutions the motor can move during the EM brake test before a fault is declared.
Hold Time *EM_Brake_Test_Hold_Time* 0x30E6 0x00	0.1 – 1.0 seconds 12 – 125	The amount of time the torque is held between ramp up and ramp down times.
Max Speed Limit *Max_Speed_EM_Brake_Fault* 0x30E9 0x00	100 – 10000 RPM 100 – 10000	This parameter determines the max speed of the controller when an EM Brake Failed to Set fault is present.
Hill Compensation Enable *EM_Brake_Test_Hill_Compensation_Enable* 0x30E7 0x00	0 – 1 0 – 1	Enables or disables modifying the torque applied during the EM brake test while the vehicle is on a hill. If turned on, The Torque Preload Memory is added to the request to avoid overstressing the brake in 1 direction and not sufficiently testing it in the other.

DRIVERS: MAIN CONTACTOR MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Main Enable *Main_Enable OptionBits1* **[Bit 0]** 0x306A 0x00	On / Off *On / Off*	When programmed On, the controller's native software controls the main contactor when the interlock is enabled; when programmed Off, the contactor is controlled by VCL. **NOTE: With Main Enable programmed Off, the controller will not be able to open the main contactor in serious fault conditions and the system will therefore not meet EEC safety requirements.**
Main Interlock Type *Main_Interlock_Type* 0x386F 0x00	0 – 1 *0 – 1*	When set to 0, the main contactor and interlock each work as determined by their respective parameters. When set to 1, the main contactor will pull in with KSI (like a Type 2 interlock) but the interlock input (pin 9, Switch 3) enables/disables drive and engages interlock braking (like a Type 0 or Type 1 interlock).
Pull In Voltage *Main_Pull_In_Voltage* 0x303C 0x00	0 – 100% *0 – 32767*	The main contactor pull-in voltage parameter allows a high initial voltage when the main contactor driver first turns on, to ensure contactor closure. After 1 second, this peak voltage drops to the contactor holding voltage. NOTE: The Battery Voltage Compensated parameter (below) controls whether the pull-in and holding voltages are battery voltage compensated.
Holding Voltage *Main_Holding_Voltage* 0x303D 0x00	0 – 100% *0 – 32767*	The main contactor holding voltage parameter allows a reduced average voltage to be applied to the contactor coil once it has closed. This parameter must be set high enough to hold the contactor closed under all shock and vibration conditions the vehicle will be subjected to. NOTE: The Battery Voltage Compensated parameter (below) controls whether the pull-in and holding voltages are battery voltage compensated.

DRIVERS: MAIN CONTACTOR MENU, cont'd

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Battery Voltage Compensated *Main_Driver_Battery_Voltage_Compensated* *Main_Driver_Battery_Voltage_Compensated_Bit0* **[Bit 0]** 0x302C 0x00	On / Off *On / Off*	This parameter determines whether the main pull-in and holding voltages are battery voltage compensated. When set On, the pull-in and holding voltages are set relative to the set Nominal Voltage (see Battery Menu, page 68). In other words, the output voltage is adjusted to compensate for swings in battery voltage, so the percentage is relative to the set Nominal Voltage—not to the actual voltage. For example, suppose Nominal Voltage is set to 48V and Holding Voltage is set to 75% (36V) to the output driver. Now suppose the bus voltage dips to 40V. If Battery Voltage Compensated = On, the output will still be 36V (Nominal Voltage x Holding Voltage) to the coil. If Battery Volt- age Compensated = Off, the output will be 30V (Actual Voltage × Holding Voltage) to the coil.
Interlock Type *Interlock_Type* 0x303E 0x00	0 – 2 *0 – 2*	Three interlock options are available: 0 = interlock turns on with switch 3. 1 = interlock controlled by VCL functions. 2 = interlock turns on with KSI.
Open Delay *Open_Delay* 0x303F 0x00	0.0 – 40.0 s *0 – 10000*	Applicable only when Interlock Type = 0 or 1. The delay can be set to allow the contactor to remain closed for a period of time (the delay) after the interlock switch is opened. The delay is useful for preventing unnecessary cycling of the contactor and for maintaining power to auxiliary functions that may be used for a short time after the interlock switch has opened.
Weld Check Enable *Weld_Check_Enable* *OptionBits1* **[Bit 2]** 0x306A 0x00	On / Off *On / Off*	When programmed On, the controller performs a test to make sure the main contactor is open (not welded shut) before it is commanded to close. This test is not performed if this parameter is Off. The main contactor driver, however, is always protected from short circuits.
Weld Check On Open Enable *Weld_Check_On_Open_Enable_Bit0* **[Bit 0]** 0x30E0 0x00	Off / *On* Off / *On*	When programmed On, the controller performs a test to make sure the main contactor is open (not welded shut) after it is commanded to open. This test is not performed if this parameter is Off.
Main DNC Check Enable *Main_DNC_Check_Enable* *OptionBits4* **[Bit 7]** 0x306D 0x00	On / Off *On / Off*	When programmed On, the controller performs a test immediately after the main contactor is commanded to close, to make sure the contactor has in fact closed. The test is not performed if this parameter is programmed Off. The main contactor driver, however, is always protected from short circuits.
Main DNC Runtime Threshold *Main_DNC_Runtime_Threshold* 0x3032 0x00	0.0 – 200.0 V *0 – 12800*	Sets the threshold used for the ongoing check that ensures the main contactor remains closed while in operation. The Main DNC Runtime Threshold is the maximum voltage difference between the Keyswitch and Capacitor voltages. When the voltage difference is above this threshold, and the battery current is low, a Main Did Not Close fault will be set. Setting this parameter lower will increase the sensitivity of the fault detection. Setting this parameter too low may cause false fault trips due to normal voltage drops between the keyswitch and capacitor voltages. Setting this parameter = 0V will disable the Main Did Not Close fault check.
Precharge Enable *Precharge_Enable* *OptionBits2* **[Bit 6]** 0x306B 0x00	On / Off *On / Off*	Turns the precharge feature on and off. Precharge provides a limited current charge of the controller's internal capacitor bank before the main contactor is closed. This decreases the arcing that would otherwise occur when the contactor is closed with the capacitor bank discharged.

Quick Link:
Battery menu p.68

DRIVERS: PROPORTIONAL DRIVER MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
PD Enable *PD_Enable* *OptionBits1* **[Bit 6]** 0x306A 0x00	On / Off *On / Off* **[PCF]**	Determines how the PWM of the proportional driver is controlled. When programmed On, it is controlled by the controller's PD current control software. When programmed Off, it is controlled by the VCL function *Put_PWM* (PWM5, value); see Figure 17, page 118.
Hyd Lower Enable *Hyd_Lower_Enable* *OptionBits1* **[Bit 7]** 0x306A 0x00	On / Off *On / Off*	When programmed On, lowering is controlled by throttle position. When programmed Off, lowering is controlled by the VCL variable *VCL_PD_Throttle*; see Figure 17, page 118.
PD Max Current *PD_Max_Current* 0x3040 0x00	0.00 – 2.00 A *0 – 607*	*The lift-lowering speed is determined by the aperture of the proportional valve. This parameter sets the maximum allowed current through the valve, which in turn defines its aperture.
PD Min Current *PD_Min_Current* 0x3041 0x00	0.00 – 2.00 A *0 – 607*	*Sets the minimum allowed current through the proportional valve. Most proportional valves need a non-zero closed current in order to start opening immediately when Lower is requested.
PD Dither % *PD_Dither_Percent* 0x3042 0x00	0 – 100 % *0 – 32767*	*Dither provides a constantly changing current in the coil to produce a rapid back-and-forth motion of the valve; this keeps the valve lubricated and allows low-friction, precise movement. The PD Dither % parameter specifies the amount of dither as a percentage of the PD max current, and is applied in a continuous cycle of add%-subtract%.
PD Dither Period *PD_Dither_Period* 0x3043 0x00	16 – 112 ms *1 – 7*	*Sets the period for proportional valve dither.
PD Kp *PD_Kp* 0x3044 0x00	1 – 100 % *82 – 8192*	*Sets the proportional gain of the current feedback controller. Higher gains force the control loop to respond quickly but may cause oscillations.
PD Ki *PD_Ki* 0x3045 0x00	1 – 100 % *327 – 32767*	*Sets the integral gain of the current feedback controller. Integral gain tries to force the error to zero. Higher gains force the control loop to respond quickly but may cause oscillations.

**These parameter descriptions assume the proportional driver is being used to drive a proportional valve, and that the PD current control software is active (PD_Enable = On).*

Quick Link:
Fig 17 p.118

DRIVERS: DRIVER 3 MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Contactor Enable *Hydraulic_Contactor_Enable* *OptionBits4* **[Bit 1]** 0x306D 0x00	On / Off *On / Off*	When programmed On, VCL functions control Driver 3 as the hydraulic pump contactor. On: The VCL function Start_Pump() will close the pump contactor according to the defined pull-in and holding voltages. The VCL function Stop_Pump() will open the pump contactor. Off: Driver 3 will be available for general VCL usage. Start_Pump() and Stop_Pump() will not have any effect.
Pull In Voltage *Driver3_Pull_In_Voltage* 0x3864 0x00	0 – 100% *0 – 32767*	The pull-in voltage parameter allows a high initial voltage when the contactor driver first turns on, to ensure contactor closure. After 1 second, this peak voltage drops to the contactor holding voltage. NOTE: This voltage will be battery voltage compensated.
Holding Voltage *Driver3_Holding_Voltage* 0x3865 0x00	0 – 100% *0 – 32767*	The holding voltage parameter allows a reduced average voltage to be applied to the contactor coil once it has closed. This parameter must be set high enough to hold the contactor closed under all shock and vibration conditions the vehicle will be subjected to. NOTE: This voltage will be battery voltage compensated.

DRIVERS: FAULT CHECKING MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Driver1 Checks Enable *Driver1_Checks_Enable* *OptionBits2* **[Bit 1]** 0x306B 0x00	On / Off *On / Off*	The five Checks Enable parameters are used to enable driver and coil fault detection at the five individual drivers (at Pins J1-6, J1-5, J1-4, J1-3, and J1-2). When a Driver Checks parameter is enabled, the associated driver, driver wiring, and driver load are checked to verify that the driver correctly drives the load both high and low. The checks will occur regardless of the PWM output of the driver. The checks will detect both open and shorted conditions. When a fault is detected, the controller opens the driver and issues a fault code. If nothing is connected to a driver, its Checks Enable parameter should be set Off. NOTE: Short circuit protection is always active at these five drivers, regardless of how Checks Enable is set.
Driver2 Checks Enable *Driver2_Checks_Enable* *OptionBits2* **[Bit 2]** 0x306B 0x00	On / Off *On / Off*	
Driver3 Checks Enable *Driver3_Checks_Enable* *OptionBits2* **[Bit 3]** 0x306B 0x00	On / Off *On / Off*	
Driver4 Checks Enable *Driver4_Checks_Enable* *OptionBits2* **[Bit 4]** 0x306B 0x00	On / Off *On / Off*	
PD Checks Enable *PD_Checks_Enable* *OptionBits2* **[Bit 5]** 0x306B 0x00	On / Off *On / Off*	
External Supply Max *External_Supply_Max* 0x3046 0x00	0 – 200 mA *0 – 800*	Sets the upper threshold of the combined current of the 5V and 12V external supplies. At or above this threshold a fault will be created that can be read by VCL.
External Supply Min *External_Supply_Min* 0x3047 0x00	0 – 200 mA *0 – 800*	Sets the lower threshold of the combined current of the 5V and 12V external supplies. At or below this threshold a fault will be created that can be read by VCL.

DRIVERS: PWM FREQUENCY PARAMETER

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
PWM Frequency *PWM_Frequency* 0x3938 0x00	100 – 1000 Hz *100 – 1000*	This single parameter defines the frequency of Drivers 1 through 4.

MOTOR MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Typical Max Speed *Typical_Max_Speed* 0x304D 0x00	500 – 10000 rpm *500 – 10000*	Set this parameter to the typical maximum motor speed of the vehicle. This value does not need to be set precisely; an estimate will do. All of the vehicle response rates are normalized to Typical Max Speed. For example, suppose Typical_Max_Speed is fixed at 6000 rpm, and Full_Accel_Rate_LS_SpdM = 3.0 seconds: If Max_Speed_SpdM = 6000 rpm, it will take 3.0 seconds to accelerate from zero to top speed (6000 rpm). If Max_Speed_SpdM = 3000 rpm, it will take 1.5 seconds to accelerate from zero to top speed (3000 rpm). If Max_Speed_SpdM = 1000 rpm, it will take 0.5 seconds to accelerate to accelerate from zero to top speed (1000 rpm). Note: This parameter appears in multiple places. Changing the value of this parameter affects all parameters listed below: *Program » Motor » 1 – PMAC (permanent Magnet Motor) » Commissioning Tests » Typical Max Speed.*
Motor Technology *Motor_Technology* 0x3814 0x00	0 – 1 *0 – 1* **[PCF]**	Set this parameter to the type of motor in the vehicle: 0 = ACIM (induction motor). 1 = PMAC (permanent magnet synchronous motor).* Note: A Parameter Mismatch Fault will result unless the Feedback Type matches the Motor Technology setting: If Motor Technology = 0 (ACIM), then the Feedback Type must = 1 (quadrature encoder). If Motor Technology = 1 (PMAC), then the Feedback Type must = 2 (sin/cos device).

*For PMAC applications, step through all the PMAC related parameters and considerations in these motor menus and NOTICE. See Chapters 7 and 8B for further PMAC related procedures.

PMAC Support and Considerations

NOTICE

PMAC applications are only compatible with controllers that are manufactured with a cross-connect diode. These controllers are models 123XE-xx7x and 123XSE-xx7x. All the 1239E models are PMAC compatible when operated as described below. The cross-connect diode allows the logic section of the controller to power up if the capacitor voltage is above the brownout voltage regardless of whether the KSI pin is powered. Since a field weakened IPM motor can generate voltages significantly above the ratings of the motor, the controller must be able to control the main power bridge if the motor is generating significant voltages in order to protect itself from these damaging voltages. If a controller without a cross connect diode is configured for PMAC operation, a non-clearable Parameter Mismatch Fault will be declared.

Supported 1232E, 1232SE, 1234SE, 1236SE and 1238SE models

The following newly introduced 123X-xx7x models are manufactured with a cross-connect diode and calibrated for operation with OS34+:

- 1232E-2171, 1232E-2371, 1232E-5171, 1232E-5271, 1232E-6271, 1232E-7271.
- 1232SE-2471, 1232SE-5371, 1232SE-6371.
- 1234SE-4571, 1234SE-5471, 1234SE-6371.
- 1236SE-4671, 1236SE-5671, 1236SE-6571.
- 1238SE-4971, 1238SE-5971, 1238SE-6971, 1238SE-7971.

The 1234E, 1236E and 1238E controllers are not available with cross-connect diodes.

1239E PMAC Support (See manual 53095)

All existing 1239E models and the 1269E support PMAC operation with OS 37.0, but the OEM must insure that KSI power is active any time the motor is moving. Removal of KSI power when the motor is spinning past the base speed may result in immediate controller damage.

0 – INDUCTION MOTOR (ACIM): CHARACTERIZATION TESTS

See Chapter 8A for the complete description of the ACIM motor characterization procedure.

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Test Enable *IM_AutoChar_Test_Enable* 0x3800 0x00	0 – 1 *0 – 1*	Enables ACIM (induction motor) characterization with quadrature encoder to begin once Test Throttle is asserted.
Test Throtte *IM_Test_Throttle* 0x3034 0x00	–1 – 1 *–1 – 1*	Begins ACIM characterization if the Test Enable is asserted. This parameter is also used to change the direction of the motor to the forward direction during ACIM motor characterization. **Important:** If the motor starts to turn in the **positive-rpm** vehicle (**forward**) direction, set **Test Throttle = 1**. If it turns in the **negative-rpm** vehicle (**reverse**) direction, set Test **Throttle = –1**.
Motor Poles *IM_MotorData6* 0x3805 0x00	2 – 12 *1 – 6*	Use this parameter to select the number of induction motor poles before beginning the ACIM motor characterization procedure. Induction motor "poles" are always in "pairs" and are part of the motor's specifications from the manufacturer. Use the number of "poles" ... not "pole pairs" for this parameter value. Note that the VCL variable, *IM_MotorData6* is in "pole pairs" (1/2 the 1314/1313 display value).
Max Test Speed *IM_AutoChar_Max_Test_Speed* 0x38A0 0x00	500 – 10000 rpm *500 – 10000*	This parameter sets the maximum motor speed allowed during ACIM motor characterization.
Max Test Current *IM_AutoChar_Max_Test_Current* 0x38A1 0x00	10 – 100% *3277 – 32767*	This parameter sets the maximum motor current allowed during ACIM motor characterization.
SlipGain *IM_MotorData8* 0x3819 0x00	0.00 – 200.00 *0 – 20000*	Adjust this parameter during ACIM motor characterization procedure to tune the motor to deliver the maximum torque per amp. Always tune this parameter.
Current Reg Tuning Test Enable *IM_CR_Tuning_Test_Enable* 0x388B 0x00	0 – 1 *0 – 1*	Performs only the current-regulator tuning portion of the autocharacterization test. To begin, clear any existing faults, then set the Interlock = On and this parameter = 1. Similar to the auto-characterization routine steps in Chapter 8A, then set Test Enable = 1 followed by setting Test Throttle = 1. The controller will run the tuning test and issue a Parameter Change Fault when finished. If a new (or existing Type 0) motor is auto-characterized following the steps in Chapter 8A, do not use this parameter, as it is automatically included in the full auto-characterization routine. Consult the Curtis distributor or support engineer for further assistance based on the motor and its application.

Quick Link:
Chapter 8A (ACIM motor characterization) p.93

MOTOR: FIELD WEAKENING CONTROL MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
FW Base Speed *FW_Base_Speed* 0x3857 0x00	200 – 12000 rpm *200 – 12000*	Sets the speed at which modulation depth has reached 100% (all available voltage is used) and where field weakening begins. This parameter is scaled by an internal motor characterization parameter, so the setting of FW Base Speed should always be done using the tuning test, which will take into account the scaling factor. Entering a speed observed from a torque vs. speed plot should not be done, as this number fails to take into account the internal scaling factor. **This parameter needs to be set during initial setup (Chapter 7) and reset each time the Motor Type or the low speed current limit is changed.** For example, if the Drive_Current_Limit or PL_Drive_Nominal parameters are lowered, reset this FW Base Speed parameter. To determine the correct value, perform this "base speed" tuning test. Run this test with batteries that have a reasonable charge. In either Speed Mode or Torque Mode, set the accel rates to be fast—so the motor will be accelerating at full current during the test. Next, set this FW Base Speed parameter to 6000 rpm (i.e., at a high-enough speed that its value will not interfere with the test result). From a stop, apply full throttle and accelerate to a high-speed beyond the expected base speed. After the motor settles at this speed for a moment, release the throttle to stop the test. Note the value displayed in *Monitor » Controller » Motor Tuning » Base Speed Captured*, and enter the value for this FW Base Speed parameter setting. For traction motors, the test restarts each time the vehicle comes to a stop and the throttle is released, so be sure to note the Base Speed Captured value before driving away. For pump motors, follow the instructions in Chapter 8A, Part 2b.
Field Weakening Drive *Field_Weakening_Drive* 0x3033 0x00	0 – 100% *0 – 1024*	Sets the amount of field weakening allowed while driving the motor. Field Weakening Drive will affect efficiency and torque only at speeds above the programmed FW Base Speed. Low settings will result in better efficiency but less torque; higher settings will result in more torque and less efficiency. A setting of zero will disable field weakening, thus resulting in the highest efficiency and lowest torque above base speed. To keep motor and controller heating to a minimum (high efficiency), Field Weakening Drive should be set just high enough to meet the high speed performance specifications. (Typical high speed performance specifications are maximum drive speed with full load, or maximum lift speed with full load.) The drive current limiting map can also be used to restrict performance at all speeds. The maximum setting of the Field Weakening Drive parameter depends on the type of motor characterization that was used. If the ACIM motor was dyno characterized (i.e., sent to the Curtis factory for characterization on the motor dyno), Field Weakening Drive can be set anywhere in the range of 0% (lowest torque, highest efficiency) to 100% (highest torque, lowest efficiency). If the ACIM motor was auto characterized (i.e., characterized using the ACIM motor characterization procedure in Chapter 8A), the range is restricted by the results of the Field Weakening Test. For these motors, Field Weakening Drive can be set anywhere in the range of 0% (lowest torque, highest efficiency) to Max Field Weakening Drive (highest torque, lowest efficiency) result. For auto characterized motors, setting Field Weakening Drive greater than the maximum setting found in the Field Weakening Test will result in poorer efficiency and less torque as the motor will be operating "over the slip curve." NOTE: The Field Weakening Drive setting will have no effect at motor speeds below FW Base Speed.

Quick Links:
Drive Current Limit p.44
PL Drive Nominal p.45
Base Speed Captured p.83
Figure 12 p.45

MOTOR: FIELD WEAKENING CONTROL MENU, cont'd

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Weakening Rate Drive *Field_Weakening_Rate_Drive* 0x383C 0x00	0 – 100% *0 – 500*	Sets the control loop gains for field weakening. Setting the rate too low may create surging in the vehicle as it accelerates at mid to high speeds. Setting the rate too high may create high frequency oscillations (usually audible) when the vehicle accelerates at mid to high speeds.
Min Field Current *Min_Field_Current* 0x3821 0x00	0 – 800 A *0 – 8000*	Sets the field current when no torque is requested from the motor. This current pre-fluxes the motor and can improve initial take-off at the expense of some battery consumption.
Swap Two Phases *Swap_Two_Phases_OptionBits3* **[Bit 3]** 0x306C 0x00 **⚠ WARNING**	On / Off *On / Off* **[PCF]**	If, after Swap Encoder Direction has been set correctly, the vehicle drives in the wrong direction (i.e., drives forward when in reverse, and vice versa), try changing the setting of the Swap Two Phases parameter. This parameter has the same effect as physically swapping the cables on any two of the three motor phase connections. **Positive motor speed must be in the forward direction in order for the emergency reverse feature to operate properly.** NOTE: Do not change this parameter while the controller is powering the motor. Any time this parameter is changed a Parameter Change Fault (fault code 49) is set and must be cleared by cycling power; this protects the controller and the operator. **Adjusting this parameter can be hazardous. For instructions, see Chapter 7, Step 12.**
Swap Feedback Direction *Swap_Feedback_Direction OptionBits3* **[Bit 0]** 0x306C 0x00 **⚠ WARNING**	On / Off *On / Off* **[PCF]**	Changes the motor encoder's effective direction of rotation. The encoder provides data used to calculate motor position and speed. This parameter must be set such that when the motor is turning forward, the controller reports back a positive motor speed. **Positive motor speed must be in the forward direction in order for the emergency reverse feature to operate properly.** Note: Do not change this parameter while the controller is powering the motor. Any time this parameter is changed a Parameter Change Fault (fault code 49) is set and must be cleared by cycling power; this protects the controller and the operator. Adjusting this parameter can be hazardous. For instructions, see Chapter 7, Step 10.
Motor Type *IM_Motor_Type* 0x3809 0x00	0 – 536* *0 – 536* **[PCF]**	This parameter references a predefined table of motor parameters for many AC induction motors. Motor Type 0 is reserved for using the auto-characterization procedure in Chapter 8A. **NOTE: Changing this parameter requires the re-setting of the FW Base Speed parameter. Other parameters may also need to be reset or evaluated by following the Initial Setup and Tuning Guide chapters instructions.** Consult the Curtis distributor or support engineer for information how to set this parameter based on the application and motor.

*536 = os37.49

528 = os37.34

504 = os37.0

MOTOR: LOS (Limited Operating Strategy) MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
LOS Upon Encoder Fault *LOS_Upon_Encoder_Fault* *LOS_Upon_Encoder_Fault_Bit0* **[Bit 0]** 0x308F 0x00	On / Off *On / Off*	Limited Operating Strategy (LOS) is typically used to drive the vehicle back to a repair center at very low speeds in the event the motor encoder fails. Following an encoder failure ((either Encoder Fault (fault code 36) or Stall Detected (fault code 73)), and after the Interlock is cycled, the vehicle enters LOS mode thus allowing drive without motor encoder feedback. In LOS mode, the ability to achieve maximum torque—even for a very short time—is considered more important than smoothness. When LOS mode is entered, the Encoder LOS fault (fault code 93) becomes active and the encoder fault ((either Encoder Fault (fault code 36) or Stall Detected (fault code 73)) is cleared. When this parameter is programmed On, LOS mode will be entered in the event of an encoder fault followed by an Interlock cycle. When programmed Off, in the event of an encoder fault the encoder fault remains and drive is disabled.
LOS Max Speed *Enc_LOS_Max_Speed* 0x3083 0x00	100 – 2000 rpm *100 – 2000*	This parameter indirectly defines the maximum speed for LOS mode by setting the maximum frequency that corresponds to LOS Max Speed. In LOS mode the throttle commands a frequency that is interpolated linearly between zero (at Throttle Command = 0%) and the programmed LOS Max Speed (at Throttle Command = 100%).
LOS Max Current *Enc_LOS_Max_Current* 0x3085 0x00	50 – 1000 A *500 – 10000*	In LOS mode, a partial or full throttle command will result in the maximum current set by this parameter. This current setting is clamped by the controller's rated current.
LOS Max Mod Depth *Enc_LOS_Max_Mod_Depth* 0x3084 0x00	15 – 100% *177 – 1182*	In LOS mode, the maximum modulation depth acts to limit the current at higher speeds. This parameter should be set such that the modulation depth limit is reached prior to the LOS Max Speed limit, so that the motor current will fall off from LOS Max Current at higher speeds. This may allow the vehicle to drive longer in LOS mode, as it lessens the chance of the motor or controller overheating.
LOS Accel Rate *Enc_LOS_Accel_Rate* 0x3086 0x00	2.0 – 15.0 s *2000 – 15000*	Defines the rate (in seconds) at which the frequency increases when full throttle is applied, while operating in LOS mode. This parameter should be set to a slow rate (high parameter value) so the frequency command has a very slow slew rate to ensure that the max torque point is hit for a reasonable period of time; this decreases the probability of going over the slip curve, and allows ramps or obstacles to be overcome.
LOS Decel Rate *Enc_LOS_Decel_Rate* 0x3087 0x00	2.0 – 15.0 s *2000 – 15000*	Defines the rate (in seconds) at which the frequency decreases when throttle is released, while operating in LOS mode.

MOTOR: 1 – PMAC (PERMANENT MAGENT MOTOR): COMMISSIONING TESTS MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Typical Max Speed *Typical_Max_Speed* 0x304D 0x00	500 – 10000 RPM *500 – 10000*	Set this parameter to the typical maximum motor speed of the vehicle. This value does not need to be set precisely; an estimate will do. All of the vehicle response rates are normalized to Typical Max Speed. For example, suppose Typical_Max_Speed is fixed at 6000 rpm, and Full_Accel_Rate_LS_SpdM = 3.0 seconds: If Max_Speed_SpdM = 6000 rpm, it will take 3.0 seconds to accelerate from zero to top speed (6000 rpm). If Max_Speed_SpdM = 3000 rpm, it will take 1.5 seconds to accelerate from zero to top speed (3000 rpm). If Max_Speed_SpdM = 1000 rpm, it will take 0.5 seconds to accelerate to accelerate from zero to top speed (1000 rpm).
Max Test Speed *PMAC_Commissioning_Max_Test_Speed* 0x38C1 0x00	1000 – 10000 RPM *1000 – 10000*	This parameter is used to set the maximum motor speed allowed during PMAC motor commissioning.
Motor Type *PMAC_Motor_Type* 0x3854 0x00	1 – 127* *1 – 127* **[PCF]**	This parameter references a predefined table of motor parameters for many PMAC motors. **This parameter appears in multiple places. Changing the value of this parameter affects the parameter in:** *Program » Motor » 1-PMAC (Permanent Magnet Motor) » Motor Type.*
Test Enable *PMAC_Commissioning_Test_Enable* 0x3862 0x00	0 – 1 *0 – 1*	This parameter is used to start the PMAC motor commissioning procedure. If the motor type is known, enter it first. Manually close the Interlock switch after this has been set, then set the Test Throttle to start the test.
Test Throttle *PMAC_Test_Throttle* 0x30D1 0x00	–1 – 1 *–1 – 1*	Begins commissioning if a Test Enable asserted. **IMPORTANT:** If motor starts to turn in **positive** (forward) vehicle speed direction, set the Test Throttle to **1**. If the motor turns in the **negative** (reverse) direction, set the Test Throttle to **–1**.
Swap Direction *OptionBits3 [Bit 0]* 0x306C 0x00	On/Off *On/Off* **[PCF]**	Changes the physical direction of rotation of a PMAC motor relative to the throttle command. Change the state of this parameter if the motor turns in the incorrect direction with a positive throttle after the commissioning procedure is complete. Positive motor speed must be in the forward direction in order for the emergency reverse feature to operate properly. Note: Do not change this parameter while the controller is powering the motor. Any time this parameter is changed a Parameter Change Fault (fault code 49) is set and must be cleared by cycling power; this protects the controller and the operator. **Adjusting this parameter can be hazardous. If in doubt, consult the revised PMAC commissioning procedure Chapter 8B in this document, reference step 14.**
Max Test Current *PMAC_Commissioning_Max_Test_Current* 0x38C2 0x00	2 – 30% *655 – 9831*	This parameter is used to set the maximum motor current allowed during PMAC motor commissioning.

***127 = os37.49**

114 = os37.34

89 = os37.0

MOTOR: 1 – PMAC (PERMANENT MAGENT MOTOR): FIELD WEAKENING CONTROL MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Field Weakening Rate *PMAC_Field_Weakening_Rate* 0x3875 0x00	0 – 100 % 0 – 100	Sets the control loop gains for field weakening. Setting the rate too low may create surging in the vehicle as it accelerates at mid to high speeds. Setting the rate too high may create high frequency oscillations (usually audible) when the vehicle accelerates at mid to high speeds.
FW Current Limit (Apk) *PMAC_Field_Weakening_Min_Id* 0x355C 0x00	*–3200 – 0 A* *–32000 – 0*	Sets the minimum negative Id Current allowed in field weakening.

MOTOR: 1 – PMAC (PERMANENT MAGENT MOTOR) MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Motor Type *PMAC_Motor_Type* 0x3854 0x00	1 – 127* *1 – 127* **[PCF]**	This parameter references a predefined table of motor parameters for many PMAC motors. **This parameter appears in multiple places. Changing the value of this parameter affects the parameter in:** *Program » Motor » 1-PMAC (Permanent Magnet Motor) » Commissioning Tests » Motor Type.*
Restricted Operation *PMAC_Restricted_Operation* 0x351A 0x00	0 – 1 *0 – 1*	Limits motor to a safe range and stops regen to allow the controller to never short the motor. This allows the controller to operate with a current rating less than the motor short circuit current.

* 127 = os37.49

114 = os37.34

89 = os37.0

MOTOR: 1 – PMAC (PERMANENT MAGENT MOTOR): COMMISSIONING RESULTS MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Tuning Voltage *PMAC_Tuning_Nominal_Pack_Voltage* 0x3856 0x00	22.0 – 200.0V *1408 – 12800*	This value is set by the commissioning process and indicates the capacitor voltage at the time the commissioning process was run.
Short Circuit Current (RMS) *PMAC_Short_Circuit_Current* 0x351B 0x00	0 – 1000 A *0 – 10000*	This value should be measured on the motor by shorting the three phases together, external spinning up to high speed, and then measuring any of the three phase currents.
Phasing Mode *PMAC_Phasing_Mode_Bit0* **[Bit 0]** 0x3874 0x00	On/Off *On/Off*	Set by the commissioning process– **do not change manually**.
Sensor Position Offset *PMAC_Encoder_Position_Offset* 0x351C 0x00	0 – 4095 *0 – 4095*	The electrical offset to the position sensor for magnet alignment in PMAC applications (4096 = 1 Mechanical Rev).
Sensor Compensation Factor *PMAC_Sensor_Compensation_Factor* 0x351D 0x00	0 – 4095 *0 – 4095*	Compensation of the delay in motor PWM and Sin/Cos sensor filtering.
Kp d Axis Current *PMAC_Kp_d_Axis_Current* 0x3859 0x00	50 – 32767 *50 – 32767*	Determines how aggressively the d axis current regulator attempts to match the current command. Larger values provide tighter control but may cause oscillation. This parameter is set automatically by the commissioning process and should not be adjusted manually.
Ki d Axis Current *PMAC_Ki_d_Axis_Current* 0x385A 0x00	0 – 5000 *0 – 5000*	The integral term (Ki) forces zero steady state error, so the d axis current regulator will run at exactly the commanded current. Larger values provide tighter control but may cause oscillation. This parameter is set automatically by the commissioning process and should not be adjusted manually.
Kp q Axis Current *PMAC_Kp_q_Axis_Current* 0x351E 0x00	50 – 32767 *50 – 32767*	Determines how aggressively the q axis current regulator attempts to match the current command. Larger values provide tighter control but may cause oscillation. This parameter is set automatically by the commissioning process and should not be adjusted manually.
Ki q Axis Current *PMAC_Ki_q_Axis_Current* 0x351F 0x00	0 – 5000 *0 – 5000*	The integral term (Ki) forces zero steady state error, so the q axis current regulator will run at exactly the commanded current. Larger values provide tighter control but may cause oscillation. This parameter is set automatically by the commissioning process and should not be adjusted manually.
Sin Min *Feedback_Sin_Min* 0x3863 0x00	0 – 1023 *0 – 1023*	Minimum output by the Sin/Cos sensor on the Sin channel. Input detected at Position Feedback A (pin 31). The value is set during the PMAC motor commissioning procedure.
Sin Max *Feedback_Sin_Max* 0x385C 0x00	0 – 1023 *0 – 1023*	Maximum output by the Sin/Cos sensor on the Sin channel. Input detected at Position Feedback A (pin 31). The value is set during the PMAC motor commissioning procedure.
Cos Min *Feedback_Cos_Min* 0x385F 0x00	0 – 1023 *0 – 1023*	Minimum output by the Sin/Cos sensor on the Cos channel. Input detected at Position Feedback B (pin 32). The value is set during the PMAC motor commissioning procedure.
Cos Max *Feedback_Cos_Max* 0x382F 0x00	0 – 1023 *0 – 1023*	Maximum output by the Sin/Cos sensor on the Cos channel. Input detected at Position Feedback B (pin 32). The value is set during the PMAC motor commissioning procedure.
Rsys *PMAC_Rsys* 0x3530 0x00	0.0 – 100.0 mOhm *0 – 1000*	This is the measured stator resistance of the motor including the wiring between the motor and controller. The value is set during the PMAC motor commissioning procedure.
Commissioning Needed *PMAC_Commissioning_Needed* 0x3515 0x00	0 – 1 *0 – 1*	This parameter is set on defaults refresh, including a new OS download. Running a successful autocharacterization clears it, or it can be cleared manually if the user is certain the rest of the parameters are setup correctly.

MOTOR: FEEDBACK OPTIONS MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Feedback Type *Feedback_Type* 0x382E 0x00	1 – 2 *1 – 2* **[PCF]**	Set this parameter to the type of position feedback device in the vehicle: 1 = quadrature encoder. 2 = Sin/Cos sensor. Note: A Parameter Mismatch Fault will result unless the Feedback Type matches the Motor Technology setting: If Motor Technology = 0 (ACIM), then the Feedback Type must = 1 (quadrature encoder). If Motor Technology = 1 (PMAC), then the Feedback Type must = 2 (Sin/Cos sensor).

MOTOR: FEEDBACK OPTIONS – 1 – QUADRATURE ENCODER MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Encoder Steps *Encoder_Steps* 0x304B 0x00 **⚠ WARNING**	32 – 256 *32 – 256* **[PCF]**	Sets the number of encoder pulses per revolution. This must be set to match the encoder; see motor nameplate or its technical data for this information. NOTE: Do not change this parameter while the controller is powering the motor. Any time this parameter is changed a Parameter Change Fault (fault code 49) is set and must be cleared by cycling power; this protects the controller and the operator. **Adjusting this parameter can be hazardous; setting it improperly may cause vehicle malfunction, including uncommanded drive. For instructions, see Chapter 7, Step 8.**

MOTOR: FEEDBACK OPTIONS – 1 - QUADRATURE ENCODER: SPEED FILTERS MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Speed Filter *Speed_Filter* 0x3869 0x00	5.0 – 250.0 *660 – 32767*	Units are in rad/sec. Divide by 2*pi to get equivalent value in Hz.
Speed Filter Zero Speed *Speed_Filter_Zero_Speed* 0x3885 0x00	0.5 – 250.0 *64 – 32767*	Units are in rad/sec. Divide by 2*pi to get equivalent value in Hz.

MOTOR: FEEDBACK OPTIONS – 2 – SIN/COS MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Enable Multiturn Sensor *Feedback_Multiturn* 0x3531 0x00	0 – 1 *0 – 1* **[PCF]**	Enable Multiturn Sensor = 0 (Off): One sensor cycle per mechanical revolution. (Not using a multiturn encoder). Enable Multiturn Sensor = 1 (On): One sensor cycle per electrical cycle. (Using a multiturn encoder).
Sin Cos Fault Threshold *Sin_Cos_Fault_Threshold* 0x3878 0x00	5.0 – 20.0 % *51 – 205*	Defines the % allowable change in the SIN or COS feedback. A SinCos Fault is generated if this threshold is exceeded 10 times sequentially.
Sin Cos fault Threshold High *Sin_Cos_Fault_Threshold_High* 0x38CD 0x00	20.0 – 100.0 % *205 – 1024*	Defines the % allowable change in the SIN or COS feedback (high value used for first 30 seconds after interlock. This will allow the controller to adjust for slight variances if the sensor was changed.
Sin Cos Fault Time *Sin_Cos_Fault_Time* 0x38CE 0x00	10 – 1000 ms 10 – 1000	A sin cos fault will be generated if the sensor is outside the tolerance for 10ms during this amount of time.
Sin Cos Startup Time *Sin_Cos_Startup_Time* 0x3532 0x00	0 – 2000 ms *0 – 2000*	Time at startup for the sin/cos sensor to start producing valid data. No sin/cos faults will be declared during this time but the power section will not enable.
Sin Min *Feedback_Sin_Min* 0x3863 0x00	0 – 1023 *0 – 1023*	Minimum output by the Sin/Cos sensor on the Sin channel. Input detected at Position Feedback A (pin 31). The value is set during the PMAC motor commissioning procedure.
Sin Max *Feedback_Sin_Max* 0x385C 0x00	0 – 1023 *0 – 1023*	Maximum output by the Sin/Cos sensor on the Sin channel. Input detected at Position Feedback A (pin 31). The value is set during the PMAC motor commissioning procedure.
Cos Min *Feedback_Cos_Min* 0x385F 0x00	0 – 1023 *0 – 1023*	Minimum output by the Sin/Cos sensor on the Cos channel. Input detected at Position Feedback B (pin 32). The value is set during the PMAC motor commissioning procedure.
Cos Max *Feedback_Cos_Max* 0x382F 0x00	0 – 1023 *0 – 1023*	Maximum output by the Sin/Cos sensor on the Cos channel. Input detected at Position Feedback B (pin 32). The value is set during the PMAC motor commissioning procedure.

MOTOR: FEEDBACK OPTIONS – 2 – SIN/COS: SPEED FILTERS MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Speed Filter *Speed_Filter_Sin_Cos* 0x3534 0x00	5.0 – 250.0 *660 – 32767*	Units are in rad/sec. Divide by 2*pi to get equivalent value in Hz.
Speed Filter Zero Speed *Speed_Filter_Zero_Speed_Sin_Cos* 0x3535 0x00	0.5 – 250.0 *64 – 32767*	Units are in rad/sec. Divide by 2*pi to get equivalent value in Hz.

MOTOR: FEEDBACK OPTIONS – FEEDBACK FAULT SETUP

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Fault Detection Enable *Encoder_Fault_Detection_Enable* *Encoder_Fault_Detection_Enable_Bit0* **[Bit 0]** 0x389C 0x00	On/Off *On/Off*	When programmed On, encoder fault checking is enabled. Three fault conditions are checked: Encoder Fault (fault code 36, Stall Detected (fault code 73), and Encoder Pulse Error (fault code 88).
Fault Max Speed *Encoder_Fault_Max_Speed* No CAN Object	0 – 2000 RPM *0 – 2000*	If the controller transitions from above this speed to below minimum speed in 8ms an encoder fault will be declared.
Fault Min Speed *Encoder_Fault_Min_Speed* 0x308B 0x00	0 – 2000 RPM *0 – 2000*	Speed determined to be 0 speed when using a sin/cos feedback sensor. Has no effect using a quadrature encoder, that value is calculated based on the speed for a single pulse.
Pulse Fault Detect Time *Encoder_Pulse_Fault_Detect_Time* 0x393E 0x00	0.0 – 3.0 S *0 – 94*	Defines the minimum time it takes for the controller, while the vehicle is in motion, to detect that the encoder and the Encoder Steps parameter do not match. When the Encoder Steps setup is incorrect, the motor controller cannot properly calculate AC motor field orientation. The loss of field orientation can cause the motor to spin up toward full speed once any throttle is applied. This parameter sets a timer that starts once the throttle has been moved and then released, the drive current is significant, and the motor is still accelerating. Note that the motor can spin at high rpm for several seconds before conditions allow the controller to properly detect a fault. An Encoder Pulse Error (fault code 88) is declared when this fault is detected. Setting the parameter to zero will disable this fault detection.
Fault Stall Speed *Enc_Fault_Stall_Speed* No CAN Object	0 – 100 RPM *0 – 100*	Sets the threshold below which the stall timer may count. If Motor Speed is less than Fault Stall Speed for Fault Stall Time, a Stall Detected fault (fault code 73) may be issued.
Fault Stall Time *Enc_Fault_Stall_Time* 0x3089 0x00	0 – 10 s *0 – 5000*	Sets a timer when no motor encoder movement is detected. In Speed Modes: If no motor encoder movement is detected for the programmed Fault Stall Time, a Stall Detected fault (fault code 73) is issued. In Torque Mode: If no motor encoder movement is detected for the programmed Fault Stall Time, with maximum throttle applied, a Stall Detected fault (fault code 73) is issued.

MOTOR: TEMPERATURE CONTROL MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Sensor Enable *MotorTemp_Sensor_Enable* *OptionBits3* **[Bit 1]** 0x306C 0x00	On / Off *On / Off*	When programmed On, the motor temperature cutback and the motor temperature compensation features are enabled. This parameter can be used only if a temperature sensor has been properly configured. The motor temperature cutback feature will linearly cut back the current from 100% to 0% between the Temperature Hot and Temperature Max temperatures. The motor temperature compensation feature will adapt the motor control algorithms to varying motor temperatures, for improved efficiency and more consistant performance.
Sensor Type *MotorTemp_Sensor_Type* 0x307B 0x00 **NOTICE**	0 – 9 *0 – 9*	Nine sensor types are predefined in the software: Type 1 KTY83–122. Type 2 2× Type 1, in series. Type 3 KTY84–130 or KTY84–150. Type 4 2× Type 3, in series. Type 5 PT1000. Type 6 SDN16_FKFN_X. Type 7 KTY84_150. Type 8 Omega 44004. Type 9 KTY81_110. Custom sensor types can be set up using VCL, if the predefined types are not appropriate for the application. Please contact the Curtis distributor or support engineer. NOTE: The industry standard KTY temperature sensors are silicon temperature sensors with a polarity band; **the polarity band of a KTY sensor must be the end connected to I/O Ground** (pin 7).
Sensor Offset *MotorTemp_Sensor_Offset* 0x305A 0x00	–20 – 20°C *–200 – 200*	Often the sensor is placed in the motor at a location with a known offset to the critical temperature; the offset can be corrected with this parameter. The parameter can also be used to correct a known offset in the sensor itself.
Braking Thermal Cutback Enable *MotorBrakingThermalCutback_Enable* *MotorBrakingThermalCutback_Enable_Bit0* **[Bit0]** 0x386C 0x00	On / Off *On / Off*	When programmed On, drive current and regen braking current will be cut back based on motor temperature. All forms of regen braking current (Regen_Current_Limit, Brake_Current_Limit, EMR_Current_Limit, Interlock_Brake_Current_Limit) includes emergency reverse braking, interlock braking, brake input braking, direction reversal braking, neutral braking, and speed limit braking. When programmed Off, only drive current (and not regen braking current) will be cut back based on motor temperature. If the vehicle has mechanical brakes, setting this parameter to On may help reduce motor heating.
Temperature Hot *MotorTemp_Hot* 0x304E 0x00	0 – 250°C *0 – 2500*	Defines the temperature at which current cutback begins.
Temperature Max *MotorTemp_Max* 0x304F 0x00	0 – 250°C *0 – 2500*	Defines the temperature at which current is cut back to zero.
MotorTemp LOS Max Speed *MotorTemp_LOS_Max_Speed* 0x308A 0x00	100 – 3000 rpm *100 – 3000*	When a Motor Temp Sensor Fault (fault code 29) is set, a LOS (Limited Operating Strategy) mode is engaged. The maximum speed is reduced to the programmed Max Speed in the operating mode (Max_Speed_SpdMx, Max_Speed_SpdM, Max_Speed_TrqM) or to \the MotorTemp_LOS_Max_Speed, whichever is lower.

BATTERY MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Nominal Voltage *Nominal_Voltage* 0x3048 0x00	24 – 96V *1536 – 6144*	Must be set to the vehicle's nominal battery pack voltage. This parameter is used in determining the overvoltage and undervoltage protection thresholds for the electronic system. See the Voltage Limits section for Over, Under, and Brownout voltage definitions and constraints. NOTE: In all cases the OS default Nominal Voltage is the highest value in the controller's range (See Table D-1). Always check and adjust this parameter whenever using a lower nominal voltage. Scaling is 64 counts per volt. For example, controller 1238E-65XX has a 48–80 voltage range. Therefore, when using a 48 volt battery, the *Nominal_Voltage* parameter will be 3072 (64 × 48 = 3072) in the application's VCL program, or as the raw (decimal) value in TACT.
Kp UV *Batt_Kp_UV* 0x380E 0x00	0.0 – 100.0% / V *0 – 1024*	When the battery voltage goes below the undervoltage threshold, a closed loop PI (Proportional/Integral) controller is enabled in an attempt to keep the battery voltage from drooping. It accomplishes this by cutting back the drive current, thereby reducing the load on the battery. The Kp term is the proportional gain and is set in units of % cutback per volt; for example, a setting of 25 would provide full current cutback with 4 V of droop. The Ki term is the integral gain. Integral gain will accumulate the voltage droop and attempt to bring the battery droop back to 0 V. Higher gains will react more strongly and quickly. Typically, Kp UV and Ki UV are used together to provide the best response. If the linear response of the previous AC controllers is preferred, set Ki UV = 0.
Ki UV *Batt_Ki_UV* 0x380F 0x00	0 – 100% *0 – 16384*	
User Overvoltage *User_Overvoltage* 0x3049 0x00	105 – 200% *269 – 512*	The value of this parameter is a percentage of the Nominal Voltage setting. The User Overvoltage parameter can be used to adjust the overvoltage threshold, which is the voltage at which the controller will cut back regen braking to prevent damage to the electrical system. Typically this parameter is changed only when the controller is being used in an application at the low end of the controller's range: such as a 48–80V controller being used in a system with a 48 V battery pack. In this case, the overvoltage threshold can be raised by setting the User Overvoltage to a higher value. The overvoltage threshold can never be raised above the controller's power base maximum voltage rating.
User Undervoltage *User_Undervoltage* 0x304A 0x00	0 – 95% *0 – 242*	The value of this parameter is a percentage of the Nominal Voltage setting. The User Undervoltage parameter can be used to adjust the undervoltage threshold, which is the voltage at which the controller will cut back drive current to prevent damage to the electrical system. Typically this parameter is changed only when the controller is being used in an application at the high end of the controller's range: such as a 24–36V controller being used in a system with a 36V battery pack. In this case, the undervoltage threshold can be lowered by setting the User Undervoltage to a lower value. The undervoltage threshold can never be lowered below the controller's power base minimum voltage rating.
Reset Volts Per Cell *BDI_Reset_Volts_Per_Cell* 0x3170 0x00	0.900 – 3.000V *900 – 3000*	The reset voltage level is checked only once, when the main contactor first closes. Note that the BDI Reset Percent parameter also influences the algorithm that determines whether BDI Percentage is reset to 100%. Reset Volts Per Cell should always be set higher than Full Volts Per Cell. Reset Voltage Level = Reset Volts Per Cell × number of cells in the battery pack.*

** To determine the number of cells in the battery pack, divide the Nominal Voltage setting by the battery chemistry's nominal volts-per-cell. Lead-acid: 2.0 V/cell, nominal.*

Note: For non lead-acid batteries, including Lithium-Ion battery packs, use the pack's or cell manufacturer's approved Battery Management System (BMS) for determining BDI.

Quick Link:
Voltage Limits p.25

BATTERY MENU, cont'd

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Full Volts Per Cell *BDI_Full_Volts_Per_Cell* 0x3171 0x00	0.900 – 3.000V *900 – 3000*	The full voltage level sets the B+ (capacitor voltage) that is considered to be 100% state-of-charge; when a loaded battery drops below this voltage, it begins to lose charge. Capacitor Voltage is viewable in the programmer's Monitor » Battery menu. Full Voltage Level = Full Volts Per Cell × number of cells in the battery pack.*
Empty Volts Per Cell *BDI_Empty_Volts_Per_Cell* 0x3172 0x00	0.900 – 3.000V *900 – 3000*	The empty voltage level sets the Capacitor Voltage that is considered to be 0% state-of-charge. Empty Voltage Level = Empty Volts Per Cell × number of cells in the battery pack.*
Discharge Time *BDI_Discharge_Time* 0x3173 0x00	0 – 600 minutes *0 – 600*	Sets the minimum time for the BDI algorithm to count down the BDI Percentage from 100% to 0%. The BDI algorithm integrates the time the filtered capacitor voltage is below the state of charge voltage level. When that cumulative time exceeds the Discharge Time / 100, the BDI Percentage is decremented by one percentage point and a new state of charge voltage level is calculated. State of Charge Level = [(Full Voltage Level - Empty Voltage Level) x BDI Percentage / 100] + Empty Voltage Level.
BDI Reset Percent *BDI_Reset_Percent* 0x3174 0x00	0 – 100% *0 – 100*	When a battery has a high BDI percentage, its float voltage at KSI On can sometimes cause false resets. The BDI Reset Percent parameter addresses this problem by allowing the user to define a BDI Percentage value above which the BDI Percentage variable will not reset. When KSI is first powered on, the BDI Percentage variable will reset to 100% only if ((Keyswitch Voltage > Reset Voltage Level) and (BDI Percentage < BDI Reset Percent)).

** To determine the number of cells in the battery pack, divide the Nominal Voltage setting by the battery chemistry's nominal volts-per-cell. Lead-acid: 2.0 V/cell, nominal.*

Note: For non lead-acid batteries, including Lithium-Ion battery packs, use the pack's or cell manufacturer's approved Battery Management System (BMS) for determining BDI.

BATTERY MENU: BATTERY CURRENT LIMITING

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Battery Current Limiter Enable *Battery_Current_Limiter_Enable* 0x31E1 0x00	0 – 1 0 – 1	Setting this parameter to 1 enables drive and regen battery current limits. This is particularly useful when interfacing to Lithium Batteries with defined current limits.
Drive Battery Current Limit *Drive_Battery_Current_Limit* 0x31E2 0x00	0 – 1000 A 0 – 10000	Sets a limit on the DC current that the controller may draw out of the battery.
Regen Battery Current Limit *Regen_Battery_Current_Limit* 0x31E3 0x00	0 – 1000 A 0 – 10000	Sets a limit on the DC current that the controller may put into the battery from regenerative braking.
Kp *Battery_Current_Kp* 0x31E4 0x00	0 – 100.0 % 0 – 1000	Determines how aggressively the battery current limiter attempts to match the Drive Battery Current Limit or the Regen Battery Current Limit. This parameter is active when the motor is spinning at low motor speeds. Larger values provide tighter control but may cause oscillation.
Kp HS *Battery_Current_Kp_HS* 0x31E5 0x00	0 – 100.0 % 0 – 1000	Sets the proportional gain (Kp) for high motor speeds; see description of Kp.

BATTERY MENU: BATTERY CURRENT LIMITING, cont'd

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Ki *Battery_Current_Ki* 0x31E6 0x00	0 – 100.0 % 0 – 1000	The integral gain (Ki) forces zero steady state error, so the battery current regulator will limit to exactly the current limit set by the Drive Battery Current Limit or Regen Battery Current Limit. This parameter is active when the motor is spinning at low speeds. Larger values provide tighter control but may cause oscillation.
Ki HS *Battery_Current_Ki_HS* 0x31E7 0x00	0 – 100.0 % 0 – 1000	Sets the integral gain (Ki) for high motor speeds; see description of Ki.
Kd *Battery_Current_Kd* 0x31E8 0x00	0 – 100.0 % 0 – 1000	The derivative gain (Kd) provides damping as the battery current approaches the programmed limit, thereby reducing overshoot. This parameter is active when the motor is spinning at lower speeds. If Kd is set too high, the current may cut back before the limit and may take too long to reach the limit. If Kd is set too low, the current may overshoot the limit.
Kd HS *Battery_Current_Kd_Hs* 0x31E9 0x00	0 – 400.0 % 0 – 4000	Sets the derivative gain (Kd) for high motor speeds; see description of Kd.
Limit Ramp Rate *Battery_Current_Limit_Ramp_Rate* 0x31EA 0x00	0 – 30.0 Seconds 0 – 30000	This parameter limits how fast the actual Battery Current Limit can change when the Drive or Regen battery current limit parameters are changed during controller operation. A setting of 30.0 seconds means that the limit will take 30.0 seconds to ramp from the full current limit of the controller to zero or vice versa. A setting of zero means that the ramp rate will not be limited.

BATTERY MENU: BATTERY POWER LIMITING

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Drive Power Limit *Battery_Drive_Power_Limit* 0x31EB 0x00	0.00 – 300.00 kW 0 – 30000	Sets a limit on the DC power that the controller will draw out of the battery during drive. Battery Current Limiting must be enabled for Battery Power Limiting to function. The controller will use more restrictive of this or battery current limit.
Regen Power Limit *Battery_Regen_Power_Limit* 0x31EC 0x00	0.00 – 300.00 kW 0 – 30000	Sets a limit on the DC power that the controller will put into the battery during regen. Battery Current Limiting must be enabled for Battery Power Limiting to function. The controller will use more restrictive of this or battery current limit.
Voltage Filter *Battery_Power_Limit_Voltage_Filter* 0x31ED 0x00	0.02 – 99.5 Hz 66 – 32767	Sets the low pass filter cutoff frequency for the battery voltage measurement used in the battery power calculation. Lower values will filter the voltage signal more.

DUAL DRIVE MENU: See the Dual Drive Supplement, document # 53097

VEHICLE MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Metric Units *Metric_Units* *OptionBits3* **[Bit 5]** 0x306C 0x00	On / Off *On / Off*	When this parameter is programmed On, the distance variables (Vehicle Odometer, Braking Distance Captured, Distance Since Stop, Distance Fine, and the Capture Distance variables) will accumulate and display in metric units (km, meters, or decimeters). When programmed Off, the distance variables will accumulate and display in English units (miles, feet, or inches). Distance variables are displayed in the Monitor » Vehicle menu.
Speed to RPM *Speed_to_RPM* 0x304C 0x00	10.0 – 3000.0 *100 – 30000*	This parameter affects the vehicle speed displayed in the Monitor » Motor menu, and also modifies the VCL variable Vehicle_Speed; it does not affect actual vehicle performance. The value entered for Speed to RPM is a conversion factor that scales motor speed to vehicle speed. KPH to RPM: (G/d)*5305, where G = gear ratio, d = tire diameter [mm]. MPH to RPM: (G/d)*336.1, where G = gear ratio, d = tire diameter [in].
Capture Speed 1 *Capture_Speed_1* 0x3079 0x00	0 – 10000 rpm *0 – 10000*	The controller captures the time it takes the motor to go from 0 rpm to the programmed Capture Speed. The result is stored as “Time to Speed 1” in the Monitor » Vehicle menu. This timer starts every time the motor accelerates from zero speed.
Capture Speed 2 *Capture_Speed_2* 0x3886 0x00	0 – 10000 rpm *0 – 10000*	This parameter allows a second capture speed to be defined, and works identically to Capture Speed 1. The result is stored as “Time to Speed 2” in the Monitor » Vehicle menu.
Capture Distance 1 *Capture_Distance_1* 0x307A 0x00	1 – 1320 *1 – 1320*	The controller captures the time it takes the vehicle to travel from 0 rpm to the programmed Capture Distance. The result is stored as “Time to Dist 1” in the Monitor » Vehicle menu. This timer starts every time the vehicle accelerates from zero speed. Note: For accurate distance measuring, the Speed to RPM parameter must be set correctly. With the Metric Units parameter programmed Off, distance is in units of feet. With Metric Units programmed On, distance is in units of meters.
Capture Distance 2 *Capture_Distance_2* 0x3883 0x00	1 – 1320 *1 – 1320*	This parameter allows a second capture distance to be defined, and works identically to Capture Distance 1. The result is stored as “Time to Dist 2” in the Monitor » Vehicle menu.
Capture Distance 3 *Capture_Distance_3* 0x3884 0x00	1 – 1320 *1 – 1320*	This parameter allows a third capture distance to be defined, and works identically to Capture Distance 1. The result is stored as “Time to Dist 3”in the Monitor » Vehicle menu.

Quick Links:

Monitor » Vehicle Menu p.84
- *Vehicle Speed*
- *Vehicle Odometer*
- *Time to Speed 1*
- *Time to Speed 2*
- *Time to Distance 1*
- *Time to Distance 2*
- *Time to Distance 3*

EMERGENCY REVERSE MENU [SPEED MODE & SPEED MODE EXPRESS only]

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
EMR Enable *EMR_Enable* *OptionBits1* **[Bit 1]** 0x306A 0x00	On / Off *On / Off*	Determines whether the emergency reverse function is active. On = emergency reverse is enabled. Off = emergency reverse is disabled.
EMR Type *EMR_Type* 0x3036 0x00	0 – 3 *0 – 3*	Determines where the input comes from for emergency reverse. 0 = emergency reverse activated by switch 1 (pin 24). 1 = emergency reverse is activated by VCL functions \Enable_Emer_Rev() and Disable_Emer_Rev(). 2 = emergency reverse activated by switch 1 (pin 24), but only if the vehicle is moving forward (forks trailing) when emergency reverse is activated. 3 = emergency reverse is activated by VCL functions Enable_Emer_Rev() and Disable_Emer_Rev(), but only if the vehicle is moving forward (forks trailing) when emergency reverse is activated.
EMR Dir Interlock *EMR_Dir_Interlock* *EMR_Dir_Interlock_Bit0* **[Bit 0]** 0x389F 0x00	On / Off *On / Off*	Determines whether the interlock switch must be turned off after emergency reverse before the vehicle can be driven again. On = interlock and throttle and direction must all be cleared. Off = only throttle and direction must be cleared.
EMR Time Limit *EMR_Time_Limit* 0x303B 0x00	0.0 – 30.0 s *0 – 3750*	Defines how long emergency reverse is allowed to be active after the vehicle is moving in the reverse direction. This timer will restart if the vehicle ever goes forward while emergency reverse is still active. The allowable range is 0–30 seconds, where 30 seconds is a special case of no time out. When emergency reverse times out, the Emer Rev Timeout fault is set. Cycling the emergency reverse input will clear the Emer Rev Timeout fault. To stop the vehicle after an EMR event (not move in reverse direction), set this parameter to 0.
EMR Speed *EMR_Speed* 0x3038 0x00	50 – 6000 rpm *50 – 6000*	Defines the maximum reverse speed of the motor (in motor rpm), when emergency reverse is active. The motor speed in reverse during an emergency reverse event will be the lesser of EMR_Speed and either Max_Speed_SpdMx (for Speed Mode Express) or Max_Speed_SpdM (for Speed Mode). Emergency Reverse is not valid for Torque Mode. See Fig.16, Control Mode Processing.
EMR Accel Rate *EMR_Accel_Rate* 0x3039 0x00	0.1 – 3.0 s *100 – 3000*	Sets the rate (in seconds) at which the vehicle accelerates in the opposite direction after it has been brought to a stop. If the vehicle is already traveling in the reverse direction below the EMR Speed, the EMR Accel Rate will bring the vehicle to the EMR Speed.
EMR Decel Rate *EMR_Decel_Rate* 0x303A 0x00	0.1 – 3.0 s *100 – 3000*	Sets the rate (in seconds) at which the vehicle brakes to a stop when emergency reverse is activated and the vehicle is moving forward. If the vehicle is already traveling in the reverse direction above the EMR Speed, the EMR Decel Rate will bring the vehicle down to the EMR Speed.

Quick Link:
Fig 16 p.117

INTERLOCK BRAKING MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Enable *Interlock_Brake_Enable* *OptionBits3* **[Bit 7]** 0x306C 0x00	On / Off *On / Off*	Determines whether the interlock braking function is active. On = The controller will attempt to bring the vehicle to a stop using regen braking when the interlock signal is removed. Off = The controller will disable the bridge after Sequencing Delay expires and allow the vehicle to roll freely when the interlock signal is removed. This option is typically used only when there is a user controlled mechanical or hydraulic brake system.
Decel Rate HS *Interlock_Brake_Decel_ Rate_HS* 0x309F 0x00	0.1 – 30.0 s *100 – 30000*	Sets the rate (in seconds) that is used to slow down the vehicle when the interlock is released at high vehicle speeds (speeds > HS setting). Larger values represent slower response.
Decel Rate LS *Interlock_Brake_Decel_ Rate_LS* 0x309E 0x00	0.1 – 30.0 s *100 – 30000*	Sets the rate (in seconds) that is used to slow down the vehicle when the interlock is released at low vehicle speeds (speeds < LS setting). Larger values represent slower response.
Interlock Brake Timeout *Interlock_Brake_Timeout* 0x309C 0x00	0.0 – 8.0 s *0 – 1000*	Controls the maximum allowable duration of an interlock braking event. The timer starts as soon as the interlock signal is removed. If the time expires before the vehicle has slowed below the Zero_Speed_Threshold, the EM brake will engage automatically. This timeout allows parallel usage of regen braking and the EM brake to reduce stopping distance. If Interlock Brake Timeout expires and the motor is still moving, regen braking will continue to retard vehicle motion in conjunction with the EM brake. NOTE: This parameter is only applicable when EM_Brake_Type = 1 or 2.
Settling Time *Interlock_Brake_Settling_Time* No CAN Object Index	0 – 8.0 Seconds *0 – 8000*	Time after Zero Speed Threshold is reached that interlock braking is active and slowing the vehicle. Once this timer expires, the bridge will be disabled, and torque will be released. WARNING: This parameter should be set longer than Position Hold Settling Time if Torque Preload is enabled in EM Brake Control to make sure that the EM Brake sets before the torque is released.

Quick Links:
Speed Mode — Fine Tuning Menu p.37
HS (High Speed)
LS (Low Speed)
EM_Brake_Type p.50

CAN INTERFACE MENU

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
CANopen Interlock *CANopen_Interlock_Enable* *OptionBits3* **[Bit 2]** 0x306C 0x00	On / Off *On / Off*	When programmed On, CAN NMT State must = 5 (operational state) in order for the interlock to be set; see Monitor » CAN Status menu.
CAN Node ID 1 *CAN_Node_ID_1* 0x3140 0x00	1 – 127 *1 – 127*	The Node ID for the primary microprocessor is determined by the state of switches 5 and 6 at KSI turn on: Node_ID_1 is selected when Sw 6 = Off and Sw 5 = Off. Node_ID_2 is selected when Sw 6 = Off and Sw 5 = On. Node_ID_3 is selected when Sw 6 = On and Sw 5 = Off. Node_ID_4 is selected when Sw 6 = On and Sw 5 = On. If the selected parameter has a Node ID of zero, the Node_ID_1 parameter is used. If the Node_ID_1 parameter is also zero, a default ID of 38 is used. Note, to disable the CAN Node ID switch arbitration (the parameter Node ID 1-4 swapping with switches), set all the Node IDs to the same value.
CAN Node ID 2 *CAN_Node_ID_2* 0x3141 0x00	1 – 127 *1 – 127*	See description of Node ID 1.
CAN Node ID 3 *CAN_Node_ID_3* 0x3146 0x00	1 – 127 *1 – 127*	See description of Node ID 1.
CAN Node ID 4 *CAN_Node_ID_4* 0x3147 0x00	1 – 127 *1 – 127*	See description of Node ID 1.
Supervisor Node ID *Supervisor_Node_ID* 0x3872 0x00	1 – 127 *1 – 127*	Sets the Node ID for the supervisor microprocessor. The Node ID is the first 7 bits of the 11-bit identifier (the COB ID).
Baud Rate *CAN_Baud_Rate* 0x3142 0x00	– 3 – 4 *– 3 – 4*	Sets the CAN baud rate for the CANopen system for this controller: – 3 = 20 kbit/s, – 2 = 50 kbit/s, – 1 = 100 kbit/s, 0 = 125 kbit/s, 1 = 250 kbit/s, 2 = 500 kbit/s, 3 = 800 kbit/s, 4 = 1000 kbit/s.
Heartbeat Rate *CANopen_Heart_Beat_Rate* 0x1017 0x00	16 – 200 ms *4 – 50*	Sets the rate at which the CAN heartbeat messages are sent from this CANopen controller.
PDO1 Timeout Period *CAN_PDO_Timeout_Period_1* 0x3149 0x00	0 – 200 ms *0 – 50*	Sets the PDO timeout period for the CANopen Ancillary system. After the ancillary controller has sent a PDO-TX, it will declare a PDO Timeout Fault if the manager controller has not sent a reply PDO-RX message within the set time. Either PDO1 RX or PDO2 RX will reset the timer. Setting the PDO Timeout Period = 0 will disable this fault check. ***This parameter previously applied to both PDO1 and PDO2. In previous OS's Both PDO RX messages needed to stop before a PDO timeout was declared.***
PDO2 Timeout Period *CAN_PDO_Timeout_Period_2* 0x314B 0x00	0 – 200 ms *0 – 50*	Sets the PDO timeout period for the CANopen Ancillary system. After the ancillary controller has sent a PDO-TX, it will declare a PDO Timeout Fault if the manager controller has not sent a reply PDO-RX message within the set time. Either PDO1 RX or PDO2 RX will reset the timer. Setting the PDO Timeout Period = 0 will disable this fault check.
Emergency Message Rate *CANopen_Emergency_Rate* 0x3148 0x00	16 – 200 ms *4 – 50*	Sets the minimum rate between CAN emergency messages from this CANopen ancillary controller. This prevents quickly changing fault states from generating so many emergency messages that they flood the CANbus.
Suppress CANopen Init *Suppress_CANopen_Init* 0x3143 0x00	0 – 1 *0 – 1*	When Suppress CANopen Init is set = 1, at KSI On the initialization of the CANopen system is suppressed. Typically this is done so that the VCL program can make changes to the CANopen system before enabling it (by setting the variable Suppress_CANopen_Init = 0 and running the Setup_CAN( ) function).

Quick Link:
CAN Status p.85

Beginning with OS 32.0, eight new CAN mailboxes were added for use by VCL. The total is now 32.

See the System Information file (available from within the Curtis WinVCL program, Info tab).

RESET CONTROLLER PARAMETER

PARAMETER	ALLOWABLE RANGE	DESCRIPTION
Reset Controller *ResetController* 0x3B00 0x00	0 – 1 *0 – 1*	Setting this parameter = 1 will reset the controller. This reset is similar to resetting by cycling the keyswitch. Reset Controller has the advantage of resetting without causing the parameter block to be reloaded into the 1313/1314 programmer.

CLONING CONTROLLERS

(for copying parameter settings to multiple controllers)

Once a controller has been programmed to the desired settings, these settings can be transferred as a group to other controllers, thus creating a family of "clone" controllers with identical settings.

Cloning only works between controllers with the same model number and software version. For example, the 1313/1314 programmer can read all the information from a 1236E-5421 controller and write it to other 1236E-5421 controllers; however, it cannot write that same information to 1236E-5521 or 1236SE-5621 controllers.

To perform cloning, plug the programmer (1313 or 1314) into the controller that has the desired settings. While the steps using the 1313 versus the 1314 are slightly different in terms of screen images, the basic concept is the same: Save the parameters from the controller to clone, which is the act of saving a ".CPF" file (Curtis Program File) using the Save/Save As . . . operations. When saving the CPF file, chose a file name with meaning as this CPF file is used to write (clone) its data to subsequent controllers.

For example, using the 1314 PC Programming Station, with the controller to be updated connected, select "open" in the File menu, then navigate to the above mentioned (saved) CPF file, which will be loaded (indicated) below the menus bar. In the Communication menu, select the "Save file to connected system (F6)" icon, and follow the prompts to copy the settings into the controller being cloned (i.e., the "connected System" or controller). The 1313 is slightly different, working off the SD card where the CPF file was saved versus the PC's hard drive, and then using the "Restore" feature to download the settings into the controller being cloned.

For cloning Dual Drive controllers, the Manager controller parameters will also be loaded into Ancillary controller, then the parameters for the Ancillary-vs-Manager must be adjusted using the 1313/1314, as corresponds to the differences between the manager and ancillary dual-drive controllers. See the separate Dual Drive manual, p/n 53097-DD, for the specific steps to perform for cloning/setup of the Manager and Ancillary Dual-Drive controllers.

Note: Using either programmer (1313/1314), the prompts will offer "Advanced Cloning" . . . . Advanced Cloning is advisable because it restores all parameters, including those at a higher (hidden level). Yet, due to possible conflicts in a non-standard application or OS version, select "No" in the 1313 prompt, or do not "check" the box in the 1314 if there are any questions. Please contact the Curtis distributor or support engineer if there are any question on cloning controllers.

5 — MONITOR MENU

Through its Monitor menu, the 1313 handheld and 1314 PC programmers provide access to real-time data during vehicle operation. This information is helpful during diagnostics and troubleshooting, and also while adjusting programmable parameters and the vehicle's initial setup.

Table 4 Monitor Menu: 1313/1314 Programmer

- **INPUTS MENU** ..... p. 77
  - — Throttle Command
  - — Throttle Multiplier
  - — Mapped Throttle
  - — Throttle Pot
  - — Brake Command
  - — Mapped Brake
  - — Pot2 Raw
  - — PD Throttle
  - — Steer Pot
  - — Steer Angle (deg)
  - — Interlock
  - — Emer Rev
  - — Analog 1
  - — Analog 2
  - — Switch 1
  - — Switch 2
  - — Switch 3
  - — Switch 4
  - — Switch 5
  - — Switch 6
  - — Switch 7
  - — Switch 8
  - — Driver 1 Input
  - — Driver 2 Input
  - — Driver 3 Input
  - — Driver 4 Input
  - — PD Input
  - — DigOut6 Input
  - — DigOut7 Input
  - — Switch 16
- **OUTPUTS MENU** ..... p. 79
  - — Analog Out
  - — Digital Out 6
  - — Digital Out 7
  - — Driver 1 PWM
  - — Driver 2 PWM
  - — Driver 3 PWM
  - — Driver 4 PWM
  - — PD PWM
  - — PD Current
  - — 5 Volts
  - — 12 Volts
  - — Ext Supply Current
  - — Pot Low
- **BATTERY MENU** ..... p. 80
  - — BDI
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- **MOTOR MENU** ..... p. 80
  - — Motor RPM
  - — Max Speed Controller Limit
  - — Temperature
  - — MotorSpeed A
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  - — Sin Input A
  - — Cos Input B
  - — Rotor Position
- **CONTROLLER MENU** ..... p. 81
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  - — Frequency
  - — Temperature
  - — Main State
  - — EMBrake State
  - — EMBrake Test State
  - — Regen
  - — KSI Hour Meter
  - — VCL Error Module
  - — VCL Error
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  - — Motor Characterization Error
  - — Parameter Mismatch Error
  - — Supervision Error
  - — CUTBACKS ..... p. 83
    - — Motor Temp Cutback
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    - — Undervoltage Cutback
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  - — MOTOR TUNING ..... p. 83
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    - — Test Field Current
  - — FOLLOWING ERROR -SPEED MODE ..... p. 83
    - — Following Error
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- **VEHICLE MENU** ..... p. 84
  - — Vehicle Speed
  - — Vehicle Odometer
  - — Vehicle Acceleration
  - — Time to Speed 1
  - — Time to Speed 2
  - — Time Between Speeds
  - — Time to Dist 1
  - — Time to Dist 2
  - — Time to Dist 3
  - — Braking Distance Captured
  - — Distance Since Stop
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- **CAN STATUS MENU** ..... p. 85
  - — CAN Node ID
  - — CAN NMT State
  - — PDO1 RX Byte Map
  - — PDO1 TX Byte Map
  - — PDO2 RX Byte Map
  - — PDO2 TX Byte Map

Monitor Menu: INPUTS

VARIABLE	DISPLAY RANGE	DESCRIPTION
Throttle Command *Throttle_Command* 0x3216 0x00	–100.0 – 100.0% *–32767 – 32767*	Throttle request to slew rate block.
Throttle Multiplier *Throttle_Multiplier* 0x3213 0x00	–200.0 – 200.0% *–256 – 256*	Multiplies or divides the throttle signal; useful in VCL throttle processing (see Throttle Processing and Figure 15).
Mapped Throttle *Mapped_Throttle* 0x3211 0x00	–100.0 – 100.0% *–32767 – 32767*	Mapped throttle request. (see Throttle Processing and Figure 15).
Throttle Pot *Throttle_Pot_Raw* 0x3215 0x00	0.00 – 5.50 V *0 – 36044*	Voltage at throttle pot wiper (pin 16).
Brake Command *Brake_Command* 0x321A 0x00	0.0 – 100.0% *0 – 32767*	Brake request to slew rate block. (see Brake Processing and Figure 15).
Mapped Brake *Mapped_Brake* 0x3212 0x00	0.0 – 100.0% *0 – 32767*	Mapped brake request. (see Brake Processing and Figure 15).
Pot2 Raw *Pot2_Raw* 0x3217 0x00	0.00 – 5.50 V *0 – 36044*	Voltage at pot2 wiper (pin 17).
PD Throttle *PD_Throttle* 0x3210 0x00	0.00 – 100.00 % *0 – 32766*	Proportional driver current request. (see Interfacing the Proportional Current Driver and Figure 17).
Steer Pot *Steer_Pot_Raw* 0x38BB 0x00	0.00 – 6.25 V *0 – 32767*	Voltage at steer pot wiper (pin 17) on Dual Drive traction ancillary controller. (reference the Dual Drive supplement manual: 53097_E&SEDD_os37).
Steer Angle (deg) *Steer_Angle* 0x38BA 0x00	–90 – 90 *–90 – 90*	Steer angle degrees calculated in Dual Drive traction manager.
Interlock *Interlock_State* *System_Flags1* **[Bit 0]** 0x322B 0x00	On / Off *On / Off*	Interlock input on or off. The source of the interlock input is determined by the Interlock Type parameter. from Switch 3 (pin 9) if Interlock Type = 0. from VCL function if Interlock Type = 1. from KSI (pin 1) if Interlock Type = 2.
Emer Rev *EMR_State* *System_Flags1* **[Bit 1]** 0x322B 0x00	On / Off *On / Off*	Emergency reverse input on or off. The source of the emergency reverse input is determined by the EMR Type parameter: from Switch 1 (pin 24) if EMR Type = 0, or 2. from VCL function if EMR Type = 1.
Analog 1 *Analog1_Input* 0x3204 0x00	0.00 – 10.00 V *0 – 1023*	Voltage at analog 1 (pin 24).
Analog 2 *Analog2_Input* 0x3205 0x00	0.00 – 10.00 V *0 – 1023*	Voltage at analog 2 (pin 8).
Switch 1 *Sw_1* *Switches* **[Bit 0]** 0x3226 0x00	On / Off *On / Off*	Switch 1 on or off (pin 24).
Switch 2 *Sw_2* *Switches* **[Bit 1]** 0x3226 0x00	On / Off *On / Off*	Switch 2 on or off (pin 8).

Quick Links:

Throttle Processing p.113 *Figure 15* p.114 *Figure 17* p.118
Brake Processing p.115 *Prop Driver* p.118

Monitor Menu: INPUTS, cont'd

VARIABLE	DISPLAY RANGE	DESCRIPTION
Switch 3 |*Sw_3* |*Switches* **[Bit 2]** 0x3226 0x00	On / Off *On / Off*	Switch 3 on or off (pin 9).
Switch 4 |*Sw_4* |*Switches* **[Bit 3]** 0x3226 0x00	On / Off *On / Off*	Switch 4 on or off (pin 10).
Switch 5 |*Sw_5* |*Switches* **[Bit 4]** 0x3226 0x00	On / Off *On / Off*	Switch 5 on or off (pin 11).
Switch 6 |*Sw_6* |*Switches* **[Bit 5]** 0x3226 0x00	On / Off *On / Off*	Switch 6 on or off (pin 12).
Switch 7 |*Sw_7* |*Switches* **[Bit 6]** 0x3226 0x00	On / Off *On / Off*	Switch 7 on or off (pin 22).
Switch 8 |*Sw_8* |*Switches* **[Bit 7]** 0x3226 0x00	On / Off *On / Off*	Switch 8 on or off (pin 33).
Driver 1 Input |*Sw_9* |*Switches* **[Bit 8]** 0x3226 0x00	On / Off *On / Off*	Driver 1 input on or off (pin 6).
Driver 2 Input |*Sw_10* |*Switches* **[Bit 9]** 0x3226 0x00	On / Off *On / Off*	Driver 2 input on or off (pin 5).
Driver 3 Input |*Sw_11* |*Switches* **[Bit 10]** 0x3226 0x00	On / Off *On / Off*	Driver 3 input on or off (pin 4).
Driver 4 Input |*Sw_12* |*Switches* **[Bit 11]** 0x3226 0x00	On / Off *On / Off*	Driver 4 input on or off (pin 3).
PD Input |*Sw_13* |*Switches* **[Bit 12]** 0x3226 0x00	On / Off *On / Off*	Proportional driver on or off (pin 2).
DigOut6 Input |*Sw_14* |*Switches* **[Bit 13]** 0x3226 0x00	On / Off *On / Off*	Digital Out 6 input on or off (pin 19).
DigOut7 Input |*Sw_15* |*Switches* **[Bit 14]** 0x3226 0x00	On / Off *On / Off*	Digital Out 7 input on or off (pin 20).
Switch 16 |*Sw_16* |*Switches* **[Bit 15]** 0x3226 0x00	On / Off *On / Off*	Switch 16 on or off (pin 14).

Monitor Menu: OUTPUTS

VARIABLE	DISPLAY RANGE	DESCRIPTION
Analog Out *Analog_Output* 0x321D 0x00	0.00 – 10.00V *0 – 32767*	Voltage at Analog output (pin 30).
Digital Out 6 |*Dig6_Output* |*System_Flags1* **[Bit 3]** 0x322B 0x00	On / Off *On / Off*	Digital Out 6 output on or off (pin 19).
Digital Out 7 |*Dig7_Output* |*System_Flags1* **[Bit 4]** 0x322B 0x00	On / Off *On / Off*	Digital Out 7 output on or off (pin 20).
Driver 1 PWM *PWM1_Output* 0x321F 0x00	0 – 100% *0 – 32767*	Driver 1 PWM output (pin 6).
Driver 2 PWM *PWM2_Output* 0x3220 0x00	0 – 100% *0 – 32767*	Driver 2 PWM output (pin 5).
Driver 3 PWM *PWM3_Output* 0x3221 0x00	0 – 100% *0 – 32767*	Driver 3 PWM output (pin 4).
Driver 4 PWM *PWM4_Output* 0x3222 0x00	0 – 100% *0 – 32767*	Driver 4 PWM output (pin 3).
PD PWM *PD_Output* 0x321E 0x00	0 – 100% *0 – 32767*	Proportional driver PWM output (pin 2).
PD Current *PD_Current* 0x321C 0x00	0.00 – 2.00A *0 – 607*	Current at proportional driver (pin 2).
5 Volts *Five_Volts_Output* 0x3202 0x00	0.00 – 6.25V *0 – 1023*	Voltage at +5V output (pin 26).
12 Volts *Twelve_Volts_Output* 0x3522 0x00	0.00 – 12.00V *0 – 768*	Voltage at +12V output (pin 25).
Ext Supply Current *Ext_Supply_Current* 0x3229 0x00	0 – 200 mA *0 – 800*	Combined current of the external +12V and +5V voltage supplies (pins 25 and 26).
Pot Low *Pot_Low_Output* 0x3203 0x00	0.00 – 6.25V *0 – 1023*	Voltage at pot low (pin 18).

Monitor Menu: BATTERY

VARIABLE	DISPLAY RANGE	DESCRIPTION
BDI *BDI_Percentage* 0x3308 0x00	0 – 100% *0 – 100*	Lead-acid battery discharge indicator (BDI). Effectively the battery's remaining state-of-charge. NOTE: For non lead-acid batteries, including Lithium-Ion battery packs, use the pack's or cell manufacturer's approved Battery Management System (BMS) for determining the BDI.
Capacitor Voltage *Capacitor_Voltage* 0x324C 0x00	0.0 – 200.0V *0 – 12800*	Voltage of controller's internal capacitor bank at B+ terminal.
Keyswitch Voltage *Keyswitch_Voltage* 0x324D 0x00	0.0 – 105.0V *0 – 10500*	Voltage at KSI (pin 1).

Monitor Menu: MOTOR

VARIABLE	DISPLAY RANGE	DESCRIPTION
Motor RPM *Motor_RPM_Display*	–12000 – 12000 rpm *–12000 – 12000*	Motor speed in revolutions per minute. Filtered for display on the 1313/1314. No CAN Index is assigned to this monitor variable. Possible usage for a tachometer, due to the filtered (smoothing) nature of this VCL variable over the Motor_RPM variable (see Motor RPM in monitor Controller » Motor Tuning » Motor_RPM).
Max Speed Controller Limit *Max_Speed_Controller_Limit* 0x3559 0x00	0 – 12000 rpm *0 – 12000*	Displays the maximum allowed speed, which clamps the upper limit of the Max Speed parameters. It is the least of the three motor-speed constraints described in Chapter 3.
Temperature *Motor_Temperature* 0x320B 0x00	–100 – 300°C *–1000 – 3000*	Temperature sensor readout.
MotorSpeed A *MotorspeedA* 0x35D1 0x00	–12000 – 12000 rpm *–12000 – 12000*	Motor encoder phase A speed in revolutions per minute. This can be used to verify that phase A of the encoder is operating correctly. MotorSpeed A should equal MotorSpeed B in a properly operating motor encoder. MotorSpeed A does not indicate direction.
MotorSpeed B *MotorspeedB* 0x35D2 0x00	–12000 – 12000 rpm *–12000 – 12000*	Motor encoder phase A speed in revolutions per minute. This can be used to verify that phase B of the encoder is operating correctly. MotorSpeed B should equal MotorSpeed A in a properly operating motor encoder. MotorSpeed B does not indicate direction.
Sin Input A *encoder_sin_calibrated* 0x38C5 0x00	–1023 – 1023 *–1023 – 1023*	Input at Position Feedback A (pin 31). **This parameter has scaling changes and a variable name change.**
Cos Input A *encoder_cos_calibrated* 0x38C6 0x00	–1023 – 1023 *–1023 – 1023*	Input at Position Feedback B (pin 32). **This parameter has scaling changes and a variable name change.**
Rotor Position *rotor_position_raw* 0x38C7 0x00	–32768 – 32767 *–32768 – 32767*	The displayed value will never exceed 4095. 0 – 4095 maps to mechanical 0°– 360°.

Quick Link:
Motor Speed Constraints p.24

Monitor Menu: CONTROLLER

VARIABLE	DISPLAY RANGE	DESCRIPTION
Current (RMS) *Current_RMS* 0x3209 0x00	0.0 – 1000.0 A *0 – 10000*	RMS current of the controller, taking all three phases into account.
Modulation Depth *Modulation_Depth* 0x3208 0x00	0.0 – 100.0% *0 – 1182*	Percentage of available voltage being used.
Frequency *Frequency* 0x3206 0x00	–1000.0 – 1000.0 Hz *–3000 – 3000*	Controller electrical frequency. This parameter has scaling changes to support higher frequencies.
Temperature *Controller_Temperature* 0x322A 0x00	–100 – 300°C *–1000 – 3000*	Controller internal temperature.
Main State *Main_State* 0x3223 0x00	0 – 10 *0 – 10*	Main contactor state: 0 = Open. 1 = Precharge. 2 = Weld check. 3 = Closing delay. 4 = Missing check. 5 = Closed (when Main Enable = On). 6 = Delay. 7 = Arc check. 8 = Open delay. 9 = Fault. 10 = Closed (when Main Enable = Off).
EMBrake State *EMBrakeState* 0x3892 0x00	0 – 4 *0 – 4*	EM brake state: 0 = Engaged. 1 = Releasing. 2 = Released. 3 = Engaging. 4 = Engaged and vehicle stopped.
EMBrake Test State *EM_Brake_Test_State* 0x30E8 0x00	0 – 4 *0 – 4*	The current state of the EM brake test. Can be stop (0), starting (1), running (2), done (3), or failed (4).
Regen *Regen_State* *System_Flags1* **[Bit 2]** 0x322B 0x00	On / Off *On / Off*	On when regen braking is taking place; Off when it is not.
KSI Hour Meter *KSI_Hour_Meter* 0x3160 0x00	0 – 429496729.5 s *0 – 4294967295*	This is the total hours the controller has been powered (keyswitch hours). The timer is controlled by the OS software and cannot be reset.
VCL Error Module *Last_VCL_Error_Module* 0x3473 0x00	0 – 65535 *0 – 65535*	A VCL Runtime Error (fault code 68) will store additional information about the cause of a VCL runtime error in the VCL Error Module and VCL Error variables. The resulting non-zero values can be compared to the runtime VCL module ID and error code definitions listed in the controller's OS SysInfo file, which should help pinpoint the VCL error that caused the runtime error.
VCL Error *Last_VCL_Error* 0x3472 0x00	0 – 65535 *0 – 65535*	

Monitor Menu: CONTROLLER, cont'd

VARIABLE	DISPLAY RANGE	DESCRIPTION
PMAC Commissioning Status *PMAC_Commissioning_State_Display* 0x3879 0x00	0 – 8 *0 – 8*	0 - Motor Needs Commissioning. 1 - Commissioning Not Started. 2 - Align Rotor to Field. 3 - Current Regulator Tuning. 4 - Sin/Cos Peak Voltage Detection. 5 - Determine Phasing. 6 - Determine Sin/Cos Compensation. 7 - Commissioning Complete. 8 - Commissioning Error.
Motor Characterization Error *Motor_Characterization_Error* 0x3899 0x00 Notes: Errors 1 and 8 apply to ACIM motors only. Errors 10, 20, 21, and 23 apply to PMAC motors only. Errors indicate the motor characterization data is invalid, except in the case of Error 1.	0 – 24 *0 – 24*	A Motor Characterization Fault (fault code 87) will store additional information in the Motor Characterization Error variable: 0 = Sequencing error. Normally caused by turning off Motor Characterization Test Enable before running the test. 1 = Encoder signal seen but step size not auto-detected; set up Encoder Steps manually. 2 = Motor temp sensor fault. 3 = Motor temp hot cutback fault. 4 = Controller overtemp cutback fault. 5 = Reserved. 6 = Undervoltage cutback fault. 7 = Severe overvoltage fault. 8 = Encoder signal not seen, or one or both channels missing. 9 = Motor parameters out of characterization range. 20 = Sin/Cos sensor not found. 21 = Phasing not detected. 22 = Sin/Cos sensor characterization failure. 23 = Started characterization procedure while motor rotating. 24 = Sin/Cos signal too noisy for characterization.
Parameter Mismatch Error *Parameter_Mismatch_Error* 0x388F 0x00	0 – 10 *0 – 10*	A Parameter Mismatch Fault (fault code 99) will store additional information in the Parameter Mismatch Error variable: 0 = No Parameter Mismatch Error Present. 1 = Dual Motor Enable = On, and Control Mode Select is not set to either 0-Speed Mode Express or 1-Speed Mode. 2 = Feedback Type is incompatible with Motor Technology setting. 3 = Save Torque Preload = On and Torque Preload Enable = Off. 4 = Speed Filter Mapping Incorrect. 5 = This Control Mode does not support EM Brake Control. 6 = This Control Mode does not support Interlock Braking. 7 = Unused. 8 = Controller not compatible with motor, short circuit current too high. 9 = Single voltage models require cross connect. 10 = Cannot run restricted operation without back emf data. 11 = Mode not yet intended for production use. 12 = This Motor Type not compatible with Direct Torque Mode. 13 = This Motor Type not compatible with Released OS. 14 = Last Step of PMAC Commissioning Skipped. 15 = PMAC Motor Type 0 disabled. 16 = This Throttle Type not compatible with Direct Torque Mode.

Monitor Menu: CONTROLLER, cont'd

VARIABLE	DISPLAY RANGE	DESCRIPTION
Supervision Error *Supervision_Error* 0x3897 0x00	0 – 4 *0 – 4*	A Supervision Fault (fault code 77) will store additional information in the Supervision Error variable: 0 = None. 1 = Watchdog timeout comms. 2 = Power supply fault detected. 3 = Queue fault detected. 4 = ALU fault detected. The Supervisor Fault (flash code 77) has several causes. The most common cause is when one of the digital inputs is stuck in the range between the guaranteed high threshold and the guaranteed low threshold for more than 100 milliseconds.

Monitor Menu: CUTBACKS

VARIABLE	DISPLAY RANGE	DESCRIPTION
Motor Temp Cutback *MotorTempCutback* 0x3581 0x00	0 – 100% *0 – 4096*	Displays the current available as a result of \the motor temperature cutback function. A value of 100% indicates no cutback in current.
Controller Temp Cutback *ControllerTempCutback* 0x35F3 0x00	0 – 100% *0 – 4096*	Displays the current available as a result of the controller temperature cutback function. A value of 100% indicates no cutback in current.
Undervoltage Cutback *UndervoltageCutback* 0x3605 0x00	0 – 100% *0 – 4096*	Displays the current available as a result of the undervoltage cutback function. A value of 100% indicates no cutback in current.
Overvoltage Cutback *OvervoltageCutback* 0x3604 0x00	0 – 100% *0 – 4096*	Displays the current available as a result of the overvoltage cutback function. A value of 100% indicates no cutback in current.
Battery Current Cutback *BatteryCurrentCutback* No CAN Object	0 – 100% *0 – 4096*	Displays the current available as a result of the battery current cutback function. A value of 100% indicates no cutback in the battery current.

Monitor Menu: MOTOR TUNING

VARIABLE	DISPLAY RANGE	DESCRIPTION
Motor RPM *Motor_RPM* 0x3207 0x00	–32768 – 32767 rpm *–32768 – 32767*	Motor speed in revolutions per minute. This is the raw value (compare to the filtered value under the Motor menu). Use Motor_RPM for VCL and CAN applications.
Base Speed Captured *Base_Speed_Captured* 0x35BE 0x00	0 – 65535 rpm *0 – 65535*	Displays the value of the motor base speed captured in the most recent acceleration. This value is used to set the FW Base Speed parameter, using the FW Base Speed set procedure or using the ACIM motor characterization procedure (Chapter 8A).
Test Field Current *Test_Field_Current* 0x3873 0x00	0 – 800 A *0 – 800*	Field test current reading to be used during the ACIM motor characterization procedure (Chapter 8A).

Monitor Menu: FOLLOWING ERROR – SPEED MODE

VARIABLE	DISPLAY RANGE	DESCRIPTION
Following Error *Following_Error* 0x3555 0x00	–1200 – 1200 rpm *–1200 – 1200*	The signal error between the commanded motor speed trajectory and the actual motor RPM.
Following Error Timer *Following_Error_Timer* 0x38CA 0x00	0 – 5.000 S *0 – 2.500*	The time that the following error exceeded the parameterized limit. If this time exceeds the parameterized time limit, the system will set a flowing error fault.

Monitor Menu: VEHICLE

VARIABLE	DISPLAY RANGE	DESCRIPTION
Vehicle Speed *Vehicle_Speed* 0x320A 0x00	–3276.8 – 3276.7 *–32768 – 32767*	Vehicle speed, in units of MPH or KPH, depending on the setting of the Metric Units parameter (see Program » Vehicle menu). For accurate speed estimates, the Speed to RPM parameter must be set correctly.
Vehicle Odometer *Vehicle_Odometer* 0x3200 0x00	0.0 – 10000000.0 *0 – 100000000*	Vehicle distance traveled, in units of miles or km, depending on the setting of the Metric Units parameter in the Vehicle parameters menu. For accurate distance measurements, the Speed to RPM parameter must be set correctly.
Vehicle Acceleration *Vehicle_Acceleration* 0x35C1 0x00	0.000 – 10.000 g *0 – 10000*	Vehicle acceleration. This is a calculated value. The Speed to RPM parameter must be set correctly for an accurate measurement.
Time to Speed 1 *Time_to_Capture_Speed_1* 0x35BF 0x00	0.00 – 128.00 s *0 – 32000*	Time taken for the vehicle to go from zero rpm to the programmed Capture Speed 1 (see Program » Vehicle menu) during its most recent such acceleration.
Time to Speed 2 *Time_to_Capture_Speed_2* 0x35BB 0x00	0.00 – 128.00 s *0 – 32000*	Time taken for the vehicle to go from zero rpm to the programmed Capture Speed 2 (see Program » Vehicle menu) during its most recent such acceleration.
Time Between Speeds *Time_Between_Capture_ Speeds* 0x35C4 0x00	0.00 – 128.00 s *0 – 32000*	Time taken for the vehicle to go from programmed Capture Speed 1 to programmed Capture Speed 2 (see Program » Vehicle menu) during its most recent such acceleration.
Time to Dist 1 *Time_to_Capture_Distance_1* 0x3612 0x00	0.00 – 128.00 s *0 – 32000*	Time taken for the vehicle to travel from zero rpm to the programmed Capture Distance 1 (see Program » Vehicle menu) during its most recent such trip. For accurate distance measurements, the Speed to RPM parameter must be set correctly.
Time to Dist 2 *Time_to_Capture_Distance_2* 0x3613 0x00	0.00 – 128.00 s *0 – 32000*	Time taken for the vehicle to travel from zero rpm to the programmed Capture Distance 2 (see Program » Vehicle menu) during its most recent such trip. For accurate distance measurements, the Speed to RPM parameter must be set correctly.
Time to Dist 3 *Time_to_Capture_Distance_3* 0x3614 0x00	0.00 – 128.00 s *0 – 32000*	Time taken for the vehicle to travel from zero rpm to the programmed Capture Distance 3 (see Program » Vehicle menu) during its most recent such trip. For accurate distance measurements, the Speed to RPM parameter must be set correctly.
Braking Distance Captured *Braking_Distance_Captured* 0x3201 0x00	0.0 – 1000000.0 *0 – 40000000*	Distance traveled by the vehicle starting with vehicle braking (initiated by throttle reversal, brake pot, VCL_Brake, or interlock braking) and ending when Motor_RPM = 0. Units are meters or feet, depending on the setting of the Metric Units parameter. For accurate distance measurements, the Speed to RPM parameter must be set correctly.
Distance Since Stop *Distance_Since_Stop* 0x324E 0x00	0.0 – 1000000.0 *0 – 40000000*	Distance traveled by the vehicle starting from a stop. In effect, the vehicle is used as a tape measure. (In other words, if the vehicle travels 300 feet forward and then 300 feet in reverse, the distance would be 600.) The distance is continuously updated and will stop (and restart) when Motor_RPM = 0. For accurate distance measurements, the Speed to RPM parameter must be set correctly. Units are meters or feet, depending on the setting of the Metric Units parameter.
Distance Fine *Distance_Fine_Long* 0x3616 0x00	–214748364.8 – 214748364.7 *–2147483648 – 2147483647*	Position measurement. Net distance in both the forward and reverse directions. (In other words, if the vehicle travels 20 inches forward and then 20 inches in reverse, the distance would be zero.) The distance is continuously updated and will roll over when the variable goes over the limits. Resets to zero on key cycle. Units are decimeters or inches, depending on the setting of the Metric Units parameter. For accurate distance measurements, the Speed to RPM parameter must be set correctly.

NOTE: All vehicle calculations assume no tire slippage.

Quick Links:
Vehicle Menu parameters p.71
Metric Units
Speed to RPM
Capture Speed 1, 2
Capture Distance 1, 2, 3

Monitor Menu: CAN STATUS

VARIABLE	DISPLAY RANGE	DESCRIPTION
CAN Node ID *CAN_Node_ID* 0x3145 0x00	0 – 127 *0 – 127*	Displays the controller's Node ID.
CAN NMT State *CAN_NMT_State* 0x3328 0x00	0 – 127 *0 – 127*	Controller CAN NMT state: 0=initialization, 4=stopped, 5=operational, 127=pre-operational.
PDO1 RX Byte Map*	0 – 2^{32}	Mapping objects for RPDO1 RX (receive) eight bytes.
PDO1 TX Byte Map*	0 – 2^{32}	Mapping objects for TPDO1 TX (transmit) eight bytes.
PDO2 RX Byte Map*	0 – 2^{32}	Mapping objects for RPDO2 RX (receive) eight bytes.
PDO2 TX Byte Map*	0 – 2^{32}	Mapping objects for TPDO2 TX (transmit) eight bytes.

** Each of these byte maps is a submenu containing 8 variables, one for each byte. Each variable is 32 bits.*

RPDO1 RX Byte Map

CAN_PDO1_RX_MAP_1	0x1600 0x01
CAN_PDO1_RX_MAP_2	0x1600 0x02
CAN_PDO1_RX_MAP_3	0x1600 0x03
CAN_PDO1_RX_MAP_4	0x1600 0x04
CAN_PDO1_RX_MAP_5	0x1600 0x05
CAN_PDO1_RX_MAP_6	0x1600 0x06
CAN_PDO1_RX_MAP_7	0x1600 0x07
CAN_PDO1_RX_MAP_8	0x1600 0x08

RPDO2 RX Byte Map

CAN_PDO2_RX_MAP_1	0x1601 0x01
CAN_PDO2_RX_MAP_2	0x1601 0x02
CAN_PDO2_RX_MAP_3	0x1601 0x03
CAN_PDO2_RX_MAP_4	0x1601 0x04
CAN_PDO2_RX_MAP_5	0x1601 0x05
CAN_PDO2_RX_MAP_6	0x1601 0x06
CAN_PDO2_RX_MAP_7	0x1601 0x07
CAN_PDO2_RX_MAP_8	0x1601 0x08

TPDO1 TX Byte Map

CAN_PDO1_TX_MAP_1	0x1A00 0x01
CAN_PDO1_TX_MAP_2	0x1A00 0x02
CAN_PDO1_TX_MAP_3	0x1A00 0x03
CAN_PDO1_TX_MAP_4	0x1A00 0x04
CAN_PDO1_TX_MAP_5	0x1A00 0x05
CAN_PDO1_TX_MAP_6	0x1A00 0x06
CAN_PDO1_TX_MAP_7	0x1A00 0x07
CAN_PDO1_TX_MAP_8	0x1A00 0x08

TPDO2 TX Byte Map

CAN_PDO2_TX_MAP_1	0x1A01 0x01
CAN_PDO2_TX_MAP_2	0x1A01 0x02
CAN_PDO2_TX_MAP_3	0x1A01 0x03
CAN_PDO2_TX_MAP_4	0x1A01 0x04
CAN_PDO2_TX_MAP_5	0x1A01 0x05
CAN_PDO2_TX_MAP_6	0x1A01 0x06
CAN_PDO2_TX_MAP_7	0x1A01 0x07
CAN_PDO2_TX_MAP_8	0x1A01 0x08

NOTE: RX (PDO request from the manager)
TX (PDO response from the ancillary)

6 — CONTROLLER INFORMATION MENU

This menu provides ID and version numbers for the connected controller's hardware and software.

CONTROLLER INFORMATION MENU

VARIABLE	DISPLAY RANGE	DESCRIPTION
Serial Number *Serial_Number* 0x1018 0x04	0 – 4294967295 *0 – 4294967295*	Serial number. For example, if the serial number printed on the controller is 15045L.11493, the Serial Number variable will have the value of 11493.
Model Number *Model Number* 0x3464 0x00	0 – 4294967295 *0 – 4294967295*	Model number. For example, for a 1236E controller with the model number 1236E-4521, the Model Number variable will have a value of 12364521.
Mfg Date Code *Manuf_Date* 0x3466 0x00	0 – 32767 *0 – 32767*	Controller date of manufacture, with the first two digits indicating the year and the last three indicating the day. For example, if the serial number printed on the controller is 15045L.11493, the Mfg Date Code variable will have the value of 15045 (45th day of 2015).
Hardware Version *Hardware_Ver* 0x3467 0x00	0 – 32.767 *0 – 32767*	The hardware version number uniquely describes the combination of power base assembly and the logic, cap, and IMS board assemblies used in the controller.
OS Version *OS_Ver* 0x346A 0x00	0 – 65535 *0 – 65535*	Version number of the operating system software that is loaded into the controller This variable specifies the major version number of the controller's operating system.
Build Number *TBuild_Number* 0x346B 0x00	0 – 65535 *0 – 65535*	Build number of the operating system software that is loaded into the controller. This variable specifies the minor version number of the controller's operating system.
SM Version *SM_Ver* 0x332B 0x00	0 – 327.67 *0 – 32767*	Version number of the Start Manager software that is loaded into the controller.
Param Blk Version *Param_Blk_Ver* 0x3468 0x00	0 – 327.67 *0 – 32767*	Version number of the parameter block that is loaded into the controller.
VCL App Version *VCL_App_Ver* 0x3463 0x00	0 – 327.67 *0 – 32767*	Version number of the VCL application software that is loaded into the controller. This value is set in the VCL program by assigning a value to the VCL_App_Ver variable.
Vehicle Serial Number *Vehicle_Serial_Number* 0x393D 0x00	0 – 4294967295 *0 – 4294967295*	Provided for OEM use and definition.

7 — INITIAL SETUP

The 1232E/SE, 1234E/SE, 1236E/SE, and 1238E/SE controllers can be used in a variety of vehicles, which differ widely in characteristics. Before driving the vehicle, it is imperative that these initial setup procedures be carefully followed to ensure that the controller is set up to be compatible with the application.

BEFORE BEGINING

Correct values for the motor parameters (Motor Type, FW Base Speed, and Field Weakening) must be determined individually for each motor.

For ACIM motors, use one of these three options to obtain ACIM motor data:

- Contact the Curtis distributor or support engineer with the manufacturer's part number for the motor. Curtis has a database of many motors for which the motor data has already been determined. Motors in the Curtis database are assigned a number, which is the number used for the ACIM Motor Type parameter.
- Send the ACIM motor to Curtis for testing on the factory motor dyno. The motor's data will be entered into the Curtis database and issue updated software (OS) with the appropriate parameter values set to match the motor. Contact the Curtis distributor or support engineer before shipping the motor.
- Use the ACIM Motor Characterization Procedure (Chapter 8A), which has the controller "learn" the motor parameter data. The procedure should take about half an hour and can be done on the vehicle. Go ahead and complete setup steps 1 through 10 of the Initial Setup before conducting the ACIM characterization procedure.

For PMAC motors, use the PMAC Motor Commissioning Procedure (Chapter 8B). This PMAC motor commissioning has the controller "learn" the motor parameter data. The procedure should take about 10 minutes and can be completed on the vehicle (with the drive wheels off the ground- free to rotate). First complete these Initial Setup steps 1 through 9 before conducting the PMAC commissioning. For PMAC motor data,

- Contact Curtis for the motor number that matches the application's motor.
- Send the PMAC motor to Curtis for testing on the Curtis motor dynamometer (dyno) located in California. Once characterized, the motor's data goes into the Curtis database. Contact the Curtis distributor or support engineer before shipping the motor. Shipping and characterizing a motor required extra time. This process can take weeks to months, plus shipping.

ACIM:

If Curtis has provided the values for Motor Type, FW Base Speed, and Field Weakening and they are "programmed" into the controller (see ACIM Field Weakening Control menu and the 1313/1314 Parameters), complete the these initial setup procedures prior to fine-tuning the motor. If using the automated Motor Characterization Procedure, that will come later—after completing steps 1 through 9. Following the motor characterization, then finish this Chapter's Initial Steps prior to completing the fine-tuning in Chapter 9.

PMAC:

For PMAC motor applications, start these initial setup procedures now. The PMAC motor commissioning will be performed after completing steps 1 through 9. Then finish this Chapter's Initial Steps prior to completing the fine-tuning in Chapter 9.

⚠ WARNING

Before beginning the setup procedures, jack the vehicle drive wheels up off the ground so that they spin freely and the vehicle is stable. Double-check all wiring to ensure it is consistent with the wiring guidelines presented in Chapter 2. Make sure all electrical and mechanical connections are tight.

Turn on the controller and plug in the 1313 handheld or 1314 PC programmer.

Step 1: Motor Temperature Sensor

Set the Sensor Type parameter to the predefined type (1–9) that corresponds to the motor's temperature sensor. Typically, the motor temperature sensor will be a thermistor that is connected from Analog 2 (pin 8) to I/O Ground (pin 7) as shown in Figure 3.

Quick Links:
Monitor/Inputs Menu p.77
Monitor/Motor Menu p.80
Temperature Control Menu p.67

To check whether the Sensor Type and Sensor Offset parameter settings and the motor-thermistor connections yield the correct motor temperature, ensure the motor's Sensor Enable parameter is set to On, then read the Temperature value displayed in the programmer's Monitor » Motor menu.

If the 1313/1314 programmer does not display the correct motor temperature, double-check the motor temperature control parameters Sensor Enable, Sensor Type, and Sensor Offset. Ensure that the thermistor's wiring orientation is as shown in Figure 3.

To setup a custom sensor type, VCL and an OS parameter-block change for a Sensor Type "Type 0" is required by the Curtis distributor or support engineer.

To proceed if the correct motor temperature is not displayed, if there is no motor temperature sensor, or while awaiting a custom sensor os/VCL, the initial setup procedure can continue only if the Sensor Enable parameter is set to Off.

If the 1313/1314 displays the correct motor temperature, complete this step by setting the remaining motor temperature control parameters: Sensor Offset (if not already completed, above), Braking Thermal Cutback Enable, Temperature Hot, Temperature Max, and MotorTemp LOS Max Speed.

Step 2: Current Limits

The Drive, Regen, Brake, EMR, and Interlock Current Limit parameters are a percentage of the controller's full rated current. The controller's full rated current is printed on the label of the controller. Set the five current limit parameters to the application's desired values.

Quick Links:
Drivers/Main Contactor menu
Main Interlock Type p.52
Interlock Type p.53
Current Limits Menu p.44
Battery Menu p.68-69
Main Contactor Menu p. 52-53
EM Brake Control Menu p.50-51

Step 3: Battery

Set the Nominal Voltage parameter to match the nominal battery pack voltage. For Li-ion batteries, follow the manufacturer's settings and the Li-ion BMS recommendations. The controller's BDI is only applicable for lead-acid batteries.

Step 4: Main Contactor

Set up the parameters in the Drivers » Main Contactor Menu.

Step 5: EM Brake

Set up the parameters in the EM Brake Control Menu.

Step 6: Throttle

Before the throttle can be setup, the interlock must be verified as Off. Read the Interlock value displayed in the Monitor » Inputs menu. If the 1313/1314 programmer indicates the interlock is On, review the Interlock Type parameter setting (Drivers » Main Contactor Menu) and turn the interlock off. Verify that the programmer displays that the interlock is now Off.

Contact the Curtis distributor or support engineer to resolve any issues about the interlock before continuing with these initial setup procedures.

Once the interlock has been verified Off, proceed to the throttle input setup. First set the Throttle Type parameter to match the type of throttle (1–5) and wiring used as described in Chapter 3, Throttle section. Then adjust the Forward Deadband, Forward Max, Reverse Deadband and Reverse Max parameters to match the range of the throttle. The Throttle Pot value displayed on the Monitor » Inputs menu is useful when setting up these parameters.

For the forward and reverse directions, read the displayed Throttle Pot voltage at the point when the throttle moves out of neutral and at the point just before full throttle and enter these values for the deadband and max settings for that direction. Set up the remaining parameters in the Throttle Menu as required by the application.

Verify that the throttle settings are correct by checking the Mapped Throttle value displayed in the Monitor » Inputs menu over the entire range of throttle pot movement. The value displayed for Mapped Throttle should be = 0% through the range of throttle motion that is considered neutral. The displayed Mapped Throttle should be = 100% through the range of motion that is considered maximum forward throttle and it is = –100% through the range considered maximum reverse throttle.

Contact the Curtis distributor or support engineer to resolve any issues about the throttle setup before continuing with the initial setup procedures.

Step 7: Brake

If the application does not use the brake function, set the Brake Pedal Enable parameter = Off and Brake Type = 5. Otherwise, configure the Brake parameters.

Before setting the brake parameters, verify that the interlock is Off. Read the Interlock value displayed in the Monitor » Inputs menu. If the 1313/1314 programmer indicates the interlock is On, review the Interlock Type parameter setting (Drivers » Main Contactor Menu) and turn the interlock off.

The Brake Type parameter must be set to match the type of brake throttle (1, 2, 3, 5) and wiring. Next, adjust the Brake Deadband and Brake Max parameters to match the range of the brake pot. The Brake Pot value (Pot2 Raw) displayed in the Monitor » Inputs menu is useful when setting up these parameters. Read the displayed brake pot voltage at the point when the brake moves out of neutral and at the point just before full brake. Enter in these values for the deadband and max parameter settings. Then set up the other parameters in the Brake Menu as required by the applications.

Verify that the brake settings are correct by checking the Mapped Brake value displayed in the Monitor » Inputs menu over the entire range of brake pot movement. The value displayed for Mapped Brake should be = 0% through the range of brake pot motion that is considered neutral. The displayed Mapped Brake should be = 100% through the range of motion that is considered maximum brake.

Contact the Curtis distributor or support engineer to resolve any issues about the brake setup before continuing with the setup procedure.

Step 8: Motor Technology & Feedback Type

Quick Links:
Motor Technology p.56
Motor Feedback p.64

Set the Motor Technology parameter to match the motor used in the application (0 = ACIM, 1 = PMAC).

Set the Motor Feedback Type parameter based on the Motor Technology setting:

Feedback Type = 1 (quadrature position sensor {encoder}) for ACIM,
Feedback Type = 2 (Sin/Cos sensor) for PMAC.

Make sure that the Feedback Type matches the feedback device used on the motor, and the right type of device for the motor. If there is not a match, stop the setup procedure until a compatible motor and feedback device are obtained and installed.

The ACIM motors use a quadrature encoder. Program the Encoder Steps parameter to the correct setting. This information is typically available from the motor manufacturer. In the ACIM Characterization Procedure (Chapter 8A), it can determine the encoder steps, but only for encoders with 32, 48, 64, or 80 pulses per revolution (ppr).

⚠ WARNING **Setting the Encoder Steps parameter improperly may cause vehicle malfunction, including uncommanded drive.**

If the application uses a PMAC motor (which must use a Sin/Cos sensor), the Sin/Cos min and max voltages will be learned during the PMAC Commissioning Procedure (Chapter 8B).

Step 9: Faults (see Chapter 11)

Cycle KSI (to clear any parameter change faults) and use the programmer to check for faults in the controller. All faults and errors (including those in the History file) must be cleared before continuing with the initial setup. Use Chapter 10 for help in troubleshooting. Contact the Curtis customer support engineer to resolve any fault issues before continuing with the setup procedure.

Step 10: Setting Feedback Direction

Quick Links:
Monitor/Inputs Menu p.77
Monitor/Motor Menu p.80
Swap Feedback Direction p.59

ACIM:

Check the encoder while the vehicle drive wheels remain off the ground, no faults present in the controller, the interlock Off (as verified in the Monitor » Inputs menu), and both the throttle and brake in neutral (Mapped Throttle = 0% and Mapped Brake = 0% in the Monitor » Inputs menu).

Use the Monitor » Motor menu to view the Motor RPM display. Turn the motor by hand and observe the sign of Motor RPM. Positive is forward and negative is reverse. If there is a positive Motor RPM when rotating the motor in the forward direction, and a negative Motor RPM when rotating the motor in the reverse direction, the *Swap Feedback Direction* parameter is correct and should not be changed. If the Motor RPM value is negative when rotating the motor forward, the *Swap Feedback Direction* parameter must be changed. Cycle KSI power and repeat the procedure until the *Swap Feedback Direction* setting is correct. If the vehicle will use the emergency reverse feature, the reverse direction (negative Motor RPM) must be correctly selected so that when the Emergency reverse input is active the motor will rotate in the reverse direction.

Contact the Curtis distributor or support engineer to resolve any issues about encoder direction or emergency reverse before continuing with the setup procedure.

PMAC:

Step 10 is not applicable to PMAC motors. Go to the next step for PMAC motor in-vehicle commissioning (Chapter 8B).

Step 11: Motor Characterization

Quick Link:
ACIM characterization p.93–98

For an ACIM motor, use either:

(a) Already have software with the motor data programmed to match the motor. The pre-set motor data software is usually the result of contacting the Curtis distributor or support engineer and getting a match between the motor and the Curtis ACIM motor database, or by shipping a motor to Curtis for dyno characterization.

or (b) Use the in-vehicle ACIM Motor Characterization Procedure (Chapter 8A). This procedure will set the direction, may set the Encoder Steps, learn ACIM motor data, and set the FW Base Speed and Field Weakening Drive. Be sure to complete the SlipGain setting for maximum torque and efficiency.

After ensuring that the controller has the motor data values that match the system, complete Steps 12 through 15 of the initial setup.

⚠ WARNING

NOTE: Do not take the vehicle down off the blocks if re-running the Motor Characterization procedure.

Step 12: Checking Direction of Rotation

Do not take the vehicle down off the blocks until the motor is responding properly.

Only after the motor is responding properly is it safe to lower the vehicle and place the drive wheels on the ground.

Once the encoder direction set correctly, this step tests to see whether the motor rotation is correct. Begin by cycling KSI off and on (to clear any parameter change faults), then use the 1313/1314 programmer to check for faults in the controller. All faults must be cleared before continuing with the setup procedure. Apply the interlock input and verify that Interlock = On (as verified in the Monitor » Inputs menu). Then, while keeping the brake in neutral*, select a direction and apply throttle. The motor should begin to turn.

For an ACIM motor, observe the motor rotation and if the motor appears to be "fighting itself " (struggling at full current while jerkily turning at very low speed), change the setting of the *Swap Two Phases* parameter.

Contact the Curtis distributor or support engineer if the proper motor direction cannot be resolved.

Step 13: Emergency reverse

Set up the parameters in the Emergency Reverse Menu. Note: Emergency Reverse is active only if using Speed Mode Express or Speed Mode as the motor tuning mode.

Step 14: Interlock Braking

Set up the parameters in the Interlock Braking Menu.

Step 15: As Applicable

If not already completed, within the Speed Controller menu,

15.1 Set the Response Restraint parameters.

15.2 Set the Position Hold parameters.

Set the parameters in the EM Brake Control menu.

15.3 New since os32.0 is the EM Brake Test menu

CAUTION

Note that the interactions of the Position Hold and the EM Brake Control can be complex. Be sure to test all operational modes, including uphill (ramp) and downhill (ramp) stops and starts (re-starts) going in both directions (forward and reverse). Test both loaded and unloaded vehicles, and whether a load is removed or added to a vehicle when stopped on a hill (ramp). Protect personnel and property when testing on a hill (ramp) from unintended (or expected) vehicle movement or roll-away conditions.

Quick Link:
Fig 16 p.117

**Note: The Throttle Command is zeroed if the Brake Command is > 0 for Control Modes 0 and 1. See Figure 16.*

8A — AUTOMATED ACIM MOTOR CHARACTERIZATION PROCEDURE

⚠ WARNING **Motor will rotate during this procedure. Do not take the vehicle down off the blocks.**

This procedure is only for applications using an ACIM motor and quadrature encoder.

The procedure is performed in two parts. Both parts must be completed for proper controller setup. The first part applies to all systems, and the second part is different for traction systems and hydraulic systems. It is assumed that Initial Setup steps 1 through 10 have been completed.

The procedure assumes the motor is approximately room temperature (20–25°C); do not characterize a hot motor without a temperature sensor.

If characterizing a traction system, the vehicle should have its drive wheels clearly off ground, and the vehicle should be safely blocked from accidental movement. The drive wheels should be freely spinning—any dragging brake or excessive friction may invalidate this test, or cause it to fail.

If characterizing a hydraulic system, the motor must be unbolted from the hydraulic pump and allowed to spin freely. The test will not work properly if the motor is left connected to the pump. Note: The motor may spin to high speed in either direction.

Hint: The procedure is easier to conduct if the various motor Parameter (Program) and Monitor variables are added to the 1313's Favorites folder. The PC based 1314 programmer can also be used, although it does not offer the convenience of the Favorites folder.

PART 1: TRACTION AND HYDRAULIC SYSTEMS

1. Verify that Motor Technology = 0-ACIM and Feedback Type = 1-encoder. This configuration, and these settings, are required to run this procedure.

   Motor » Control Algorithms » 0-ACIM.
   Motor » Feedback Options » Feedback Type » 1-Encoder.

2. Enter the number of motor poles in the Motor Poles parameter. The vast majority of induction motors will have 4 poles.

   Motor » Control Algorithms » 0-ACIM » Characterization Tests » Motor Poles.

3. Enter the Max Test Speed for the characterization test. Note that this speed might not be achieved, depending on system characteristics; this is normal.

   Set this to the application's corresponding Max Speed value (Max_Speed_SpdMx, Max_Speed_SpdM, or Max_Speed_Trq).

   Motor » Control Algorithms » 0-ACIM » Characterization Tests » Max Test Speed.

4. Enter the desired Max Test Current for the characterization test. A typical setting is 70% (70% of the maximum motor or controller rating, whichever is higher). Generally this is only reduced if motor heating during the test is a problem, or resonance in the motor occurs at high currents.

   Motor » Control Algorithms » 0-ACIM » Characterization Tests » Max Test Current.

5. Using the 1313/1314, clear the Fault History (Faults » Clear Fault History).

6. Ensure that Interlock is enabled (Monitor » Inputs » Interlock).

7. Set Test Enable = 1.

   Motor » Control Algorithms » 0-ACIM » Characterization Tests » Test Enable.

8. If any faults are present, stop and resolve the issue before continuing.

9. Note that no cutbacks should be in effect (thermal, voltage, etc.) when these tests are run. Also, the power limiting maps should not cut back current over the characterization speed

range. Check and verify that the power limiting map parameters are set to 100% over the characterization speed range.

Current Limits » Power Limiting Map.

⚠ WARNING **Motor will start to rotate after next step.**

10. Set Test Throttle = +1.

    Motor » Control Algorithms » 0-ACIM » Characterization Tests » Test Throttle.

11. After approximately 30 or more seconds the motor will begin to rotate. It is critical to verify the motor is turning in the FORWARD vehicle direction. If it is not, set Test Throttle = 0, wait for the motor to come to a stop, then set Test Throttle = –1.

    Notes: (1) This step runs faster if TACT is not running. (2) If the motor starts to accelerate then slows down again, increase **Max Test Current** (IM_AutoChar_Max_Test_Current). See step 4 above.

12. The automated test may take several minutes. When it is complete, the controller will have a Parameter Change Fault. This is normal. Check whether other faults are present. If there is a Characterization Error fault, read the number at Monitor » Controller » Motor Characterization Error and reference the following table. All errors except "1" indicate the motor characterization data is invalid. For error "1," the data is valid but Encoder Steps must be set manually. Contact the Curtis distributor or support engineer if the Motor Characterization Errors indicated cannot be resolved.

Motor Characterization Errors	
0	Sequencing error. Normally caused by turning off Motor Characterization Test. Enable before running test.
1	Encoder signal seen but step size could not be auto-detected; set up Encoder Steps manually. (Only encoder steps of 32, 48, 64, and 80 will be identified automatically.) *Program » Motor » Encoder Steps.*
2	Motor temperature sensor fault.
3	Motor temperature > MotorTemp_Hot (150°C is the typical default). This is active only when the motor temp sensor is present and enabled.
4	Controller overtemperature.
5	Controller undertemperature.
6	Battery undervoltage.
7	Battery severe overvoltage.
8	Encoder signal not seen, or one or both channels missing.
9	Motor parameter out of characterization range; check to be sure motor has no load.

13. Cycle KSI power. The motor control should now be operational, though likely poorly optimized. The Slip Gain test is very important to ensure the optimum torque and motor efficiency. The following steps will complete the optimization process.

PART 2A: TRACTION SYSTEMS ONLY

14. Run the **SlipGain** test.

    Adjust the SlipGain parameter to provide maximum torque at stall (0 rpm motor speed). Note: The present SlipGain value was determined by the auto-characterization procedure, and is not the default value.

    Motor » Control Algorithms » 0-ACIM » Characterization Tests » SlipGain.

    To determine the SlipGain setting, use either of the following two methods, with (a) being the most accurate:

14.1 Configure the vehicle to measure stall torque, by using a load cell / draw bar test. Note: Perform this test quickly to avoid excessive motor heating and provide the most accurate results.

Turn off encoder fault detection (Motor » Encoder Fault Setup » Fault Detection Enable).

While applying and holding full throttle, adjust SlipGain until the peak torque is measured.

To have the encoder fault detection active (recommended), turn it back on (now).

14.2 Alternately, the vehicle can be used as the "draw bar test" by accelerating the motor to a predetermined speed (rpm)—with the quickest time corresponding to the optimum SlipGain. This method uses the controller's time-to-speed function. The test-acceleration will be at full controller current.

Begin by setting the corresponding Accel Rates to very fast values, based upon the application's Control Mode.

Speed Mode Express: Accel Rate.

Speed Mode: Full Accel LS, Full Accel HS, Low Accel.

Torque Mode: Accel Rate.

On the 1313 programmer, add these items to the Favorites shortcut, to easily toggle between them:

Monitor » Vehicle » Capture Speed 1.
Monitor » Vehicle » Time to Speed 1.
Parameters (Program) » Motor Control Tuning » 0-ACIM » Characterization Tests » SlipGain.

Next, set the **Capture Speed 1** parameter to an rpm enveloping the motor's desired maximum torque range. The monitor item, **Time to Speed 1**, will record the time taken for the vehicle (motor) to go from zero rpm to the programed Capture Speed 1 during its most recent acceleration.

To perform the test, from a stop, accelerate the vehicle through the predetermined speed. The timer starts counting when full throttle is applied, and stops counting when the speed is reached. A built-in trigger will allow the test to begin again once the vehicle comes to a stop and the throttle is re-engaged, so be sure to note the value of the test first before accelerating-away in subsequent runs. Each time, adjust the SlipGain value until the Time to Speed 1 is minimized.

This test should be run repeatedly over the same stretch of flat or uphill ground. Loading the vehicle will improve results, the idea being to have the motor produce maximum torque as in the draw-bar method. Work quickly, to avoid excessive motor heating, to obtain the most accurate results.

15. Run the **FW Base Speed** test.

Set the FW Base Speed to 6000 rpm. The test should be run with batteries that have a reasonable charge.

Motor » Control Algorithms » 0-ACIM » Field Weakening Control » FW Base Speed.

Set the Accel Rates to be very fast, so that the vehicle will be accelerating at full current during the test. From a stop, quickly apply full throttle to accelerate to a high speed. After the motor settles at a speed for a moment, release the throttle to stop the test run. Note the value of the Base Speed Captured (Monitor » Controller » Motor Tuning » Base Speed Captured), and enter this value for the FW Base Speed setting.

Note:

- The base speed capture test restarts each time the vehicle comes to a stop and the throttle is released, so be sure to note the value before driving (accelerating) away.
- **This FW Base Speed parameter not only needs to be set during initial setup, yet reset each time the Motor Type or the low speed current limit is changed.** For example, if the *Drive_Current_Limit* or *PL_Drive_Nominal* parameters are lowered (changed), retest and reset this parameter.

16. Run the **Field Weakening** test.

    This test will enable the choice between a more efficient (less torque) or more torque (less efficient) operation above the base speed, by adjusting the **Field Weakening Drive** parameter.

    Note: the present Field Weakening Drive value (0%) was determined by the above auto-characterization routine, and is not the default value (100%) in the native OS intended for the Curtis dynamometer characterized motors when a motor type (number) is utilized. The differences are:

    Auto Characterized: Field Weakening Drive is adjusted UP from 0% to the max Field Weakening Drive determined in this text.

    Dyno Characterized: Field Weakening Drive is adjusted DOWN from 100% (can be set from 0–100%)

    Increasing this parameter toward 100% will progressively allow more torque (along with more current) at high motor speeds, but increasing it too much will actually reduce torque while still driving a great deal of current. The auto-characterization value of 0% will give the most efficient motor operation, but will not give the highest torque at high speeds.

    If more torque is required at high speeds, run this Field Weakening Drive test.

    On the 1313 programmer, add these two items to the Favorites shortcut, along with Field Weakening Drive parameter, to easily toggle between them:

    Parameters (Program) » Motor » Control Algorithms » 0-ACIM » Field Weakening Control » Field Weakening Drive.

    Parameters (Program) » Vehicle » Capture Speed 1, 2.

    Monitor » Vehicle » Time Between Speeds.

    Set **Capture Speed 1 and 2** to values that are close to the Max Speed setting. The Capture Speed 1 and 2 values MUST be set higher than the measured FW Base Speed in step 15 (because Field Weakening only affects performance at speeds above the "base speed"). Ideally the Capture Speed 1, 2 values should be above the second corner point of the motor torque – speed curve. For example, if the Max Speed is set to 4000 rpm, set Capture Speed 1 = 3500 rpm and Capture Speed 2 = 3800 rpm:

    Parameters (Program) » Speed Mode Express » Max Speed.

    Parameters (Program) » Speed Mode » Speed Controller » Max Speed.

    Parameters (Program) » Torque Mode » Speed Limiter » Max Speed.

    From a stop, apply full throttle to accelerate to a speed greater than Capture Speed 2. Note the value displayed in Monitor » Vehicle » Time Between Speeds.

    Now increase the Field Weakening Drive setting and repeat the acceleration in the same direction, with the same load, and with the same full throttle and again note the Time Between Speeds value.

    Keep adjusting the Field Weakening Drive value and repeating the test until finding the Field Weakening Drive value that results in the smallest Time Between Speeds. This Field Weakening Drive value should be used for applications that require the most torque at high speeds.

    Some Field Weakening Drive settings may result in a test acceleration run where Capture Speed 2 cannot be obtained. These Field Weakening Drive settings cannot provide enough torque to get the vehicle past Capture Speed 2, and thus can be ignored.

    Use the Field Weakening Drive setting that best matches the application. It will be somewhere between 0% (most efficient, least motor heating) and the setting found in this test (highest torque at high speeds).

    NOTE: The Field Weakening Drive setting will have no effect at motor speeds below the FW Base Speed.

17. Return to Chapter 6 and complete Initial Setup Steps 12 through 15.

Quick Links:
Max Speed
Express Mode p.33
Speed Mode p.34
Torque Mode p.40
Capture Speed 1,2 p.71
Field Weakening Drive p.58
Time Between Speeds p.84

PART 2B: HYDRAULIC SYSTEMS ONLY

Quick Links:
SlipGain p.57

Max Speed
Express Mode p.33
Speed Mode p.34

Current (RMS) p.81

14. Run the **SlipGain** test.

    Adjust the **SlipGain** parameter to provide maximum torque at low speeds. Note: The present SlipGain value was determined by the auto-characterization procedure, and is not the default value.

    On the 1313 programmer, add the motor current to the items in the Favorites shortcut, to easily toggle between them:

    Monitor » Controller » Current (RMS).

    Parameters (Program) » Motor Control Tuning » 0-ACIM » Characterization Tests » SlipGain.

    Set Max Speed to a fairly low speed (but high enough to be able to lift a heavy load on the forks), typically 800 rpm. The Max Speed setting must be below the motor base speed, which is measured in the next step.

    Put a very heavy load on the forks, preferable a max load.

    Apply full throttle, and adjust the SlipGain parameter until the motor current is minimized. If the vehicle has a multistage mast, work in the first stage only so that the load is consistent.

    This will be the SlipGain parameter value, unless following step 15, the base speed used here (e.g., 800 rpm) was too high.

Quick Links:
FW Base Speed p.58
Express Mode p.33
Accel Rate
Speed Mode p.36
Full Accel HS
Full Accel LS
Low Accel Rate
Test Field Current p.83
Min Field Current p.59
Base Speed Captured p.83

15. Run the **FW Base Speed** test.

    Note: For this test, because the hydraulic motor (disconnected from the pump) can quickly accelerate past the "Base Speed", it will be necessary to pre-flux the motor current prior to running this test to get an accurate measure of base speed. Since the controller will be running current with no throttle, ensure this test's 1313 Favorites items are loaded so the test continues without delay to prevent motor and controller heating. Then, be sure to re-set the controller to cancel the pre-flux following the test. This test is for hydraulic (pump) motor working in Speed Mode only. Run this test with batteries that have a reasonable charge.

    Set in the 1313 Favorites

    Parameters (program) » Motor » Control Algorithms » 0-ACIM » Field Weakening Control » FW Base Speed.

    Parameters (Program) » Motor » Control Algorithms » 0-ACIM » Field Weakening Control » Min Field Current.

    Monitor » Controller » Motor Tuning » Test Field Current.

    Monitor » Controller » Motor Tuning » Base Speed Captured.

    Set the Max Speed to 6000 rpm (i.e., beyond the maximum desired pump speed).

    Set the Accel rates to be very fast, so the motor will be accelerating at full current during the test.

    Record the value of the Test Field Current (Monitor) and enter this value for the Min Field Current parameter.

⚠ CAUTION

The controller is now running current with no throttle, so continue this test without delay to prevent motor and controller heating.

From a stop, quickly apply full throttle to accelerate to a high speed. After the motor settles at a speed for a moment, release the throttle to stop the test. Note the value of the Base Speed Captured and enter this value for the FW Base Speed parameter setting.

⚠ WARNING

When this test is finished, re-set the parameter Min Field Current = 0 Amps to cancel the pre-flux current. Verify that the pre-flux current is canceled before continuing.

16. Run the Field Weakening test.

    This test will enable the choice between a more efficient (less torque) or more torque (less efficient) operation at high speeds, by adjusting the hydraulic motor's Field Weakening Drive parameter. While the most efficient operation will occur with field weakening at the 0% auto-characterization value, more torque at high speeds may be required, necessitating adjusting the field weakening. Field Weakening Drive should be set just high enough to meet the high speed performance specifications, typically maximum lift speed with full load.

    Note: the present Field Weakening Drive value (0%) was determined by the above auto-characterization routine, and is not the default value (100%) in the native OS intended for the Curtis dynamometer characterized motors when a motor type (number) is utilized. The differences are:

    Auto Characterized: Field Weakening Drive is adjusted UP from 0% to the max Field Weakening Drive determined in this test.

    Dyno Characterized: Field Weakening Drive is adjusted DOWN from 100% (can be set from 0–100%).

Quick Links:
Motor RPM p.83
Field Weakening Drive p.58
Max Speed
Express Mode p.33
Speed Mode p.34

    Increasing the Field Weakening Drive parameter toward 100% will progressively allow more torque (along with more current) at high motor speeds, but increasing it too much will actually reduce performance while still driving a great deal of current.

    On the 1313 programmer, add these two items to the Favorites shortcut to easily toggle between them:

    Monitor » Controller » Motor Tuning » Motor RPM.

    Parameter (Program) » Motor » Control Algorithms » 0-ACIM » Field Weakening Control » Field Weakening Drive.

    Run this test with no load on the forks. Work with only the first stage of a multistage mast. Work quickly to avoid overheating the controller or motor.

    Using the application's Speed (control) Mode, set the Max Speed parameter to a high speed that likely cannot be achieved by the hydraulic system.

    Set Field Weakening Drive = 100% (note: this test work works DOWN from 100% to find the actual maximum value).

    Apply full throttle, running the motor towards the maximum speed. Record the maximum (achieved) Motor RPM.

    Repeat the acceleration runs while continuing to lower the Field Weakening Drive value before on each run until the achievable maximum motor speed fall off significantly (20–30 rpm). This number represents the **maximum** Field Weakening Drive value (%) to achieve the maximum torque/speed envelope of the hydraulic motor (do not use a higher percentage). The Field Weakening Drive percentage can always be lowered to reduce energy consumption and improve efficiency (but reducing torque output) at high speeds.

    NOTE: The Field Weakening Drive setting will have no effect at motor speeds below FW Base Speed.

17. Return to Chapter 6 and complete Initial Setup steps 12 through 15.

8B — AUTOMATED PMAC MOTOR COMMISSIONING PROCEDURE

PMAC CONSIDERATIONS

NOTICE

PMAC applications are only compatible with controllers that are manufactured with a cross-connect diode. These controllers are models 123XE-xx7x and 123XSE-xx7x. All the 1239E models are PMAC compatible when operated as described below. The cross-connect diode allows the logic section of the controller to power up if the capacitor voltage is above the brownout voltage regardless of whether the KSI pin is powered. Since a field weakened IPM motor can generate voltages significantly above the ratings of the motor, the controller must be able to control the main power bridge if the motor is generating significant voltages in order to protect itself from these damaging voltages. If a controller without a cross connect diode is configured for PMAC operation, a non-clearable Parameter Mismatch Fault will be declared.

Supported 1232E, 1232SE, 1234SE, 1236SE and 1238SE models

The following newly introduced 123X-xx7x models are manufactured with a cross-connect diode and calibrated for operation with OS34+:

- 1232E-2171, 1232E-2371, 1232E-5171, 1232E-5271, 1232E-6271, 1232E-7271.
- 1232SE-2471, 1232SE-5371, 1232SE-6371.
- 1234SE-4571, 1234SE-5471, 1234SE-6371.
- 1236SE-4671, 1236SE-5671, 1236SE-6571.
- 1238SE-4971, 1238SE-5971, 1238SE-6971, 1238SE-7971.

The 1234E, 1236E and 1238E controllers are not available with cross-connect diodes.

1239E PMAC Support (See manual 53095)

All existing 1239E models and the 1269E support PMAC operation with OS 37.0, but the OEM must insure that KSI power is active any time the motor is moving. Removal of KSI power when the motor is spinning past the base speed may result in immediate controller damage.

Use this Chapter when commissioning a PMAC application after first completing the initial setup steps.

⚠ WARNING

The PMAC motor will rotate during this procedure. Do not take the vehicle down off the blocks. This procedure is only for applications using a PMAC motor and Sin/Cos sensor.

Perform this procedure is in one stage. It takes approximately 5–10 minutes. It can only be used on a sinusoidal wound PMAC motor with a Sin/Cos absolute position sensor (e.g, RLS RM22, SKF BX-BMB-7050, etc.) set up with one sensor revolution per mechanical revolution.

This procedure's assumption is that Initial Setup steps 1 through 9 have been completed and that the motor is approximately room temperature (20–25°C); **do not characterize a hot motor without a temperature sensor.**

If commissioning a traction system, the vehicle should have its drive wheels clearly off ground, and the vehicle should be safely blocked from accidental movement. The drive wheels should be freely spinning—any dragging brake or excessive friction may invalidate this test, or cause it to fail.

If commissioning a hydraulic system, the motor must be unbolted from the hydraulic pump and allowed to spin freely. The test will not work properly if the motor is left connected to the pump. Note: The motor may spin to Max Test Speed in both directions.

If using the 1314, enable Include monitor values for logging:

Options » Settings » Include monitor values.

1. Verify that Motor Technology = 1-PMAC and Feedback Type = 2-Sin/Cos sensor. This configuration, and these settings, are required to run this procedure.

   Motor » Motor Technology » 1-PMAC.

   Motor » Feedback Options » Feedback Type » 2-Sin/Cos.

2. Enter the maximum speed the motor is intended to turn in the application as Typical Max Speed.

   Motor » 1-PMAC » Commissioning Tests » Typical Max Speed.

3. Enter the maximum speed the motor is intended to turn as the Max Test Speed for the commissioning test. Note this speed might not be achieved, depending on system characteristics; this is normal. A typical setting is 5000 rpm, but clearly the Max Test Speed should not be set to a higher speed than safe for the mechanical configuration.

   Motor » 1-PMAC » Commissioning Tests » Max Test Speed.

4. Enter the correct PMAC Motor Type before beginning commissioning test. Contact Curtis if there is a question as to the application's motor type.

   Motor » 1-PMAC » Commissioning Tests » Motor Type.

   Motor » 1-PMAC » Commissioning Tests » Motor Poles.

5. Enter the desired Max Test Current for the commissioning test. A typical setting is 20% (note this is 20% of the maximum controller rating). Generally this is only reduced if motor heating during the test is a problem. Generally, this is only increased if the motor fails to rotate during commissioning.

   Motor » 1-PMAC » Commissioning Tests » Max Test Current.

6. Using the 1313/1314, clear Fault History (*Faults » Clear Fault History*).

7. Turn on (enable) Interlock (Monitor » Inputs » Interlock).

8. Enable the PMAC Commissioning by setting **Test Enable = 1**.

   Motor » 1-PMAC » Commissioning Tests » Test Enable.

9. If any faults are present, except *PMAC Commissioning Needed*, stop and resolve the issue before continuing.

10. Set **Test Throttle = +1**.

    Motor » 1-PMAC » Commissioning Tests » Test Throttle.

⚠ WARNING **WARNING - Motor will start to rotate in step 11 and faster in step 12.**

11. The controller will start to inject test pulses. After a few minutes (when pulsing stops), the motor will begin to rotate very slowly. It is critical to verify the motor is turning in the FORWARD vehicle direction. If it is not, set Test Throttle = 0, wait for the motor to come to a stop, then set Test Throttle = –1. The motor will start again in the same direction. The controller will properly set the direction at the end of commissioning process. (Note: This is a different operation than that in the ACIM characterization procedure, which does turn the motor in the other direction when Test Throttle is set negative).

12. After about a minute, the motor will spin up to a moderate speed, then to high speed (limited by Max Test Speed) in each direction.

13. When the automated test is complete, the controller will have a Parameter Change Fault. This is normal. Check whether other faults are present. If there is a Characterization Error fault, read the number at Monitor » Controller » Motor Characterization Error and reference the following table. An error during the PMAC commissioning test indicates the motor commissioning data is invalid; contact the Curtis distributor or support engineer for assistance if the indicated error cannot be resolved.

Motor Characterization Errors	
0	Sequencing error. Normally caused by turning off Motor Commissioning Test. Enable before running test.
2	Motor temperature sensor fault.
3	Motor overtemperature > Motor Temperature Hot parameter (active only when temp sensor is present).
4	Controller overtemperature.
5	Controller undertemperature.
6	Battery overvoltage.
7	Battery severe overvoltage.
9	Motor parameter out of range; check to be sure motor has no load.
10	Motor Poles not set (set the correct PMAC Motor Type).
20	Sin/Cos sensor not found.
21	Phasing not detected (check to be sure the motor has no load, and Motor Type is setup first, as this sets Motor Poles automatically).
22	Sin/Cos sensor characterization failure. (as above, check Motor Type is setup first, as this sets Motor Poles automatically).
23	Started motor commissioning while motor rotating.
24	Sin/Cos signal too noisy for characterization.

14. When the test is complete, cycle KSI to clear the Parameter Change fault. Then attempt to drive the motor in the forward direction. If the motor turns in the reverse direction, invert the Swap Direction parameter in the Commissioning Tests menu (there is no swap two phases parameter like the induction motor control – swap direction takes care of both).

    Motor » 1-PMAC » Commissioning Tests » Swap Direction.

15. Return to Chapter 7 and complete Initial Setup Steps 12 through 15.

9 — TUNING GUIDE

Many aspects of vehicle performance can be optimized, using the wide variety of adjustable parameters available to these E and SE controllers. Once a vehicle/motor/controller combination has been tuned, the parameter values can be made standard for the system or vehicle model. Any changes in the motor, the vehicle drive system, or the controller will require that the system be tuned again to provide optimum performance.

Selecting the Control Mode

Before starting to tune the vehicle's performance, select which control mode to use. Set the Control Mode Select parameter = 0 (Speed Mode Express for either traction or pump motors), = 1 (Speed Mode, for either traction or pump motors) or = 2 (Torque Mode, for traction motors). Cycle KSI input Off and then On (to clear any parameter change faults) and use the 1313 handheld or 1314 PC programmer to check for faults in the controller. Then proceed to the tuning steps for the control mode selected.

Conduct the steps in the sequence given, because successive steps build upon the ones before. It is important that the effect of these programmable parameters be understood in order to take full advantage of the controller's powerful features. Please refer to the descriptions of the applicable parameters in Chapter 4 if there is any question about what any of them do.

0 – Speed Mode Express Tuning

Quick Links:
Control Mode select p.32
Speed Mode Express menu p.33
Max Speed
Kp
Ki
Accel Rate
Decel Rate
Brake Rate
Typical Max Speed p.56

Speed Mode Express is the same as Speed Mode with the exception that it has fewer parameters and is therefore simpler to use. Most vehicle applications will find success with Speed Mode Express; however, for some applications vehicle performance cannot be satisfactorily fine-tuned in Speed Mode Express. In this case, change the control mode to Speed Mode (i.e., set Control Mode Select =1).

0.1 For traction applications, set Pump Enable to Off. For AC pump applications, set this parameter On.

0.2 Adjust Max Speed to the maximum speed the motor should turn in the vehicle application; this speed setting corresponds to an input of full throttle.

0.3 Adjust Typical Max Speed to the approximate maximum speed that the motor will spin. This is usually the same value as the setting for Max Speed, but some applications have a Max_Speed_SpdMx that changes (in the VCL software). If the Max_Speed_SpdMx changes, set Typical Max Speed to the highest speed the motor is expected to reach. This value does not need to be set precisely since it will not change motor performance. Typical Max Speed sets a reference point for the "rate" parameters (accel, decel, brake rates), so that applications that have a changing Max_Speed_SpdMx will not experience changes in the rates (because the rates are referenced to the unchanging Typical Max Speed value). Once the Typical Max Speed parameter is set, do not readjust it without adjusting all the rate parameters as well.

0.4 Kp and Ki typically do not need to be changed as the default values will work well in most applications. If choosing to adjust Kp (for looser or tighter following of the speed trajectory set by the accel, decel, and brake rates), follow the procedure in step "d" in the Speed Mode tuning section.

0.5 Adjust the Accel Rate and Decel Rate as necessary while moving the throttle to different positions (i.e., neutral to full throttle, half throttle to full throttle, full throttle to half throttle, full throttle to neutral, neutral to low throttle, etc.). For AC pump applications, typically the Accel Rate and Decel Rate are set very fast for quick response to hydraulic inputs.

0.6 Adjust the Brake Rate as necessary while reversing the throttle input (i.e., full throttle forward to low throttle reverse, full throttle forward to full throttle reverse, full throttle reverse to low throttle forward, etc.). If a brake input is present in the application (Brake Pedal Enable = On) continue adjusting Brake Rate by applying different amounts of brake throttle (i.e., full throttle forward, then apply full brake or full throttle forward, then apply low brake, etc.). For AC pump applications the Brake Rate has no effect on performance since the AC pump will not run in reverse nor with a brake input.

⚠ WARNING

AC pump motor applications, which in step "a" had the Pump Enable parameter set to On, may also be controlling hydraulic valves (load hold valve, proportional valve). The Proportional Driver parameters and some VCL will typically be used to set up the control of these valve driver outputs. Consult with the Curtis distributor or support engineer regarding hydraulic valve control.

1 – Speed Mode Tuning

1.1 For traction applications, set Pump Enable to Off. For AC pump applications set this parameter On.

1.2 Adjust Max Speed to the maximum speed the motor should turn in the vehicle application; this speed setting corresponds to an input of full throttle.

1.3 Adjust the Typical Max Speed to the approximate maximum speed that the motor will spin. This is usually the same value as the setting for Max Speed, but some applications have a Max_Speed_SpdM that changes (in the VCL software). If the Max_Speed_SpdM changes, set the Typical Max Speed to the highest speed the motor is expected to reach. This value does not need to be set precisely since it will not change motor performance. Typical Max Speed sets a reference point for the "rate" parameters (accel, decel, brake rates), so that applications that have a changing Max_Speed_SpdM will not experience changes in the rates (because the rates are referenced to the unchanging Typical Max Speed value). Once the Typical Max Speed parameter is set, do not readjust it without adjusting all the rate parameters as well.

Quick Links:
Control Mode select p.32
Speed Mode menu p.34
Speed Controller menu p.34
Max Speed
Kp
Ki (LS/HS)
Response menu p.36
Accel Rate
Decel Rate
Brake Rate
Restraint menu p.38
Soft Stop Speed
Position Hold menu p.39
EM Brake Control menu p.50
Typical Max Speed p.56

1.4 Kp and Ki (LS & HS) typically do not need to be changed as the default values work well in most applications. These parameters control how tightly the actual motor speed will track the requested speed trajectory (speed trajectory is set by the Accel, Decel, and Brake rates).

To adjust the Kp (for looser or tighter following of the speed trajectory), follow these guidelines.

- Set the following parameters. Before setting them, make a note of their present (default) settings so they can be returned to the original values at the end of this procedure.
  - In the Speed Mode » Speed Controller menu, set the **Max Speed** to low value (≈1000 rpm), as high speed operation is not needed to observe system response.
  - In the Speed Mode » Response menu, set all the **Accel and Decel** rates to their fastest values (0.1 seconds); this allows better observation of the system response.
  - In the Speed Mode » Restraint menu, set the **Soft Stop Speed** parameter = 0 rpm to disable the soft stop speed function.
  - In Speed Mode » Restraint » Position Hold Menu, set **Position Hold Enable** = Off such that the position hold function will not interfere with the speed control gain setup procedure.
  - *If the vehicle has an EM Brake*, in the EM Brake menu, set the **EM Brake Type** = 1. This setting will release the EM Brake as soon as interlock is asserted.

- Cycle KSI to clear any faults. Then, assert (close) the Interlock.
- Using very quick, pulsing throttle movements, increase the throttle and then release it to 0%. The intent is to give the speed controller torque impulses.
- Increase Kp and repeat the throttle tests. Increase Kp until noticing marginal stability (normally motor bouncing, or continuous oscillation in the gears, is heard). Note: It is possible that very heavy vehicles will not experience marginal stability even at the highest setting of Kp.
- Once the Kp setting for marginal stability is found, reduce the Kp value by about one third (i.e., final Kp = marginal stability Kp * 2/3).
- If using Speed Mode Express, enter this Kp value for the Kp parameter in the Speed Mode Express menu.
- Set the Max Speed, Accel/Decel, Soft Stop Speed, Position Hold, and Brake Type parameters back to their original values.

Quick Links:
Speed Controller menu p.34
Max Speed
Kp
Ki (LS/HS)
Response menu p.36
Accel Rate
Decel Rate
Brake Rate
Restraint menu p.38
Soft Stop Speed
Position Hold menu p.39

1.5 In the Speed Mode » Response menu, adjust the five Accel and Decel Rate parameters as necessary while moving the throttle to different positions (i.e., neutral to full throttle, half throttle to full throttle, full throttle to half throttle, full throttle to neutral, neutral to low throttle, etc.). For AC pump applications, these parameters are typically set very fast for quick response to hydraulic inputs.

1.6 In the Speed Mode » Response menu, adjust the remaining three brake rate parameters as necessary while reversing the throttle input (i.e., full throttle forward to low throttle reverse, full throttle forward to full throttle reverse, full throttle reverse to low throttle forward, etc.).

If a brake input is present in the application (Brake Pedal Enable = On) continue adjusting these three brake rates by applying different amounts of brake throttle (i.e., full throttle forward, then apply full brake or full throttle forward, then apply low brake, etc.).

For AC pump applications these parameters have no effect on performance since the AC pump will not run in reverse nor with a brake input.

1.7 The parameters in the Speed Mode » Response » Fine Tuning menu typically do not need to be changed as the default values work well in most applications.

⚠ WARNING

AC pump motor applications, which in step "1.1" had the Pump Enable parameter set to On, may also be controlling hydraulic valves (load hold valve, proportional valve). The Proportional Driver parameters and some VCL will typically be used to set up the control of these valve driver outputs. Consult with the Curtis distributor or support engineer regarding hydraulic valve control.

2 – Torque Mode Tuning

2.1 Set Max Speed to the application's maximum motor speed (rpm).

2.2 Kp, Ki, and Kd typically do not need to be changed as the default values will work well in most applications. These parameters control how tightly the controller limits the speed of the motor to the programmed Max Speed.

2.3 Set Typical Max Speed to the expected maximum speed of the motor.

2.4 Adjust the parameters shown in Figure 9 to set up the throttle mapping:

- Drive Current Limit (Current Limits menu).
- Regen Current Limit (Current Limits menu).
- Forward/Back Full Restraint Speed (Torque Mode » Response menu).
- Brake Taper Speed (Torque Mode » Response » Fine Tuning menu).
- Neutral Braking (Torque Mode » Response menu).
- Neutral Taper Speed (Torque Mode » Response menu).
- Creep Torque (Torque Mode » Response » Fine Tuning menu).

2.5 In the Torque Mode » Response menu, adjust the four accel, decel, and release rate parameters as necessary while moving the throttle to different positions (i.e., neutral to full throttle, half throttle to full throttle, full throttle to half throttle, full throttle to neutral, neutral to low throttle, etc.).

2.6 The other parameters in the Torque Mode » Response » Fine Tuning menu typically may need to be changed for some applications. Read the parameter descriptions and adjust as necessary.

Quick Links:
Torque Mode/Speed Limiter p.40
Kp
Ki
Kd
Response menu p.41
Fine Tuning p.42
Figure 9 p.43
Current Limits menu p.44
Typical Max Speed p.56

10 — VEHICLE CONTROL LANGUAGE (VCL)

Curtis 1232E/34E/36E/38E and 1232SE/34SE/36SE/38SE controllers have a built-in programmable logic controller with application-specific functions. VCL (Vehicle Control Language) software provides a way to implement unique and complex vehicle control functions.

VCL is a simple programming language that will feel very familiar to anyone who has worked with BASIC, Pascal, or C. Working with VCL requires the installation of the WinVCL program onto a PC. WinVCL will compile VCL programs and flash download the software into the controller through the computer's serial port. The install process for WinVCL will also install three important manuals on the PC: the WinVCL User's Guide, VCL Programmer's Guide, and VCL Common Functions Manual. These manuals, which are in PDF format, include more detailed information about VCL than is included here.

This chapter of the manual summarizes VCL and also describes aspects and functions of VCL that are specific to these E and SE controllers. For a more complete understanding of the functions and capabilities of VCL, see the WinVCL User's Guide, VCL Programmer's Guide, and VCL Common Functions Manual.

Summary of VCL Basics

- VCL is not case-sensitive:
  put_pwm(), Put_PWM(), and PUT_PWM() are identical.
- Spaces in variable names are not allowed in VCL; use underscores in place of spaces.
  Example: Forward_Offset is the VCL name for the 1313/1314 parameter Forward Offset.
- Functions are followed by parentheses; for example:
  Reset_Controller() is a function.
  Reset_Voltage is a variable.
- Logical statements must be inside parentheses; examples:
  IF (setpoint >50)
  ELSE IF ((setpoint <20) & (temperature >100)).
- Comments are preceded by semicolons.

The VCL functions described in the VCL Common Functions Manual are available to all 1232E/SE, 1234E/SE, 1236E/SE, and 1238E/SE controllers. These controllers have these additional specific functions, listed below. All VCL functions, common and specific, are also available in the controller's os37 SysInfo file.

ENABLE_PRECHARGE() p. 126
DISABLE_PRECHARGE() p. 127
SET_DIGOUT() p. 128
CLEAR_DIGOUT() p. 128
ENABLE_EMER_REV() p. 129
DISABLE_EMER_REV() p. 129
SET_INTERLOCK() p. 130
CLEAR_INTERLOCK() p. 130
SETUP_POT() p. 131
GET_POT() p. 131
SETUP_POT_FAULTS() p. 132
START_PUMP() p. 133
STOP_PUMP() p. 133
AUTOMATE_FREQUENCY_OUTPUT() p. 134
OVERRIDE_EM_BRAKE_PWM() p. 135
RESTORE_EM_BRAKE_PWM() p. 135
MAP_TWO_POINTS() p. 136
BATTERY_COMPENSATE() p. 137
PUT_MESSAGE_TO_STRING() p. 137
AUTOMATE_PWM_INPUT() p. 139
SETUP_TIMER_LONG() p. 139
SETUP_MAILBOX_MASK() p. 140
SETUP_MAILBOX_EXTENDED_MASK() p. 140
AUTOMATE_ENCODER() p. 141

VARIABLE TYPES

VCL provides dedicated space in which to store custom variables. There are four types of variables, based on their type of storage: volatile storage (RAM) and three types of non-volatile storage (EEPROM) are available.

RAM variables are stored only while power is on; they are lost at power-down. They must be initialized on power-up by explicit VCL assignments (i.e., User1 = 12).

NVUser1–15 EEPROM variables are 15 variables automatically saved at power-down and restored at power-on. During power-down or a power-failure (brownout), these variables are saved to NVM1. During operation, these variables are also periodically saved (every 6 minutes) to NVM2, thus two locations are used to preserve the data. At power-up, the data in NVM1 is read first, yet if it is corrupted, the data from NVM2 is restored. See the section on non-volatile memory access in the VCL Common Functions manual for more information, including caution to changing the NVM2 save rate, and rational of the save/restore strategy.

Block EEPROM are 38 blocks of 15 variables (total of 570 variables), which are stored and recalled using the functions NVM_Block_Read and NVM_Block_ Write. The 38 blocks are called NVM3–NVM40. The read and write functions must point to the RAM variables that the EEPROM blocks should be written from or read to. For example, NVM_Block_Read(NVM10,0,15,User20) will read the 15 variables stored in EEPROM block NVM10 and restore those variables to the 15 variables starting with RAM variable User20 (so the 15 EEPROM variables would be restored to User20–34). See the section on non-volatile memory access in the VCL Common Functions manual for more information.

Parameters EEPROM variables are a special type of EEPROM variable that is intended to be used to create OEM defined 1313/1314 programmer parameters. These parameters can be defined as 16-bit by using the P_User variables or they can be defined as bit (On/Off) by using the P_User_Bit variables. These variables are typically written to EEPROM through the 1313 handheld or 1314 PC programmer interface (i.e., when a user changes a parameter setting using the 1313). They can be used in the VCL code, but changing a P_User (or P_User_Bit) value with VCL will only change the variable value in RAM and will not change the value in EEPROM. Thus, these variables are intended for creating and defining 1313/1314 programmable parameters only.

VCL can modify the control mode parameters in RAM by using the VCL variable name for the programmable parameter. For example,

```
Brake_Rate_SpdMx = 3000 ;Change Brake Rate to 3.0sec
```

will change the RAM value of the Speed Mode Express's Brake Rate; the new value will be used in determining the braking rate. However, the value of the parameter's stored EE value remains unchanged; when the controller is turned off, the RAM value will be lost. The next time the controller is powered back on, the "old" value of Brake Rate will be restored from EE memory. To save this RAM value in VCL, use the NVM_Write_Parameter function ((i.e., NVM_Write_Parameter(Brake_Rate_SpdMx)).

Parameter values that are changed by using the 1313 handheld or 1314 PC programmer are saved directly to EE memory. The 1313/1314 changes will be retained and restored the next time the controller is powered back on.

The table below summaries the available VCL variables.

Type	Quantity	Range
RAM	516 variables	User1 – User200 User_Long1 – User_Long16 AutoUser1 – AutoUser300
NVUser EEPROM	15 variables	NVUser1 – NVUser15
Block EEPROM	38 blocks (15 variable each)	NVM3 – NVM40
Parameters EEPROM	150 variables and 10 variables of 8 bits each (80 bits)	P_User1 – P_User150 P_User_Bit1 – P_User_Bit10

VCL RUNTIME RATES

VCL is an interpreted language. Each line of VCL code is converted (compiled) into a set of codes and then flash loaded into the controller. The controller interprets these codes one line at a time while the system is powered up. Here are the processing rates of the various functions:

Item	Function/Item Description	Quantity	Service Rate
ABS	Absolute Value	2	4 ms
ADC	Analog to Digital Converter Input (Analog1 and Analog2)	2	1 ms
CAN	CAN Communications	24	4 ms
CPY	Copy	8	4 ms
DLY	Delay	32	1 ms
FLT	Filter	4	1 ms
LIM	Limit	4	4 ms
MAP	Map	8	4 ms
MTD	Multiply then Divide	4	4 ms
NVM	Non-Volatile Memory block (NVM3-40)	38	2 ms
PID	Proportional Integral Derivative	2	4 ms
POT	Potentiometer Input	2	8 ms
PWM	Pulse Width Modulated output	6	4 ms
RMP	Ramp	4	1 ms
SCL	Scaling	8	4 ms
SEL	Selector, 2-position switch	8	4 ms
SEL_4P	Selector, 4-position switch	8	32 ms
SW	Switch Input	1*	4 ms
TMR	Timers (hourmeters)	3	1 ms

** There is only one Switch variable; it has 16 associated bit-variables.*

OS 36.0 includes 32 CAN Communications mailboxes running at a 4 ms service rate where OS 31.0 included 24 mailboxes.

I/O CONTROL WITH VCL

Digital Inputs

Quick Link:
Fig 3 p.12

The controllers each have 16 digital inputs. Nine are switch inputs (Sw_1 through Sw_8, and Sw_16. These switch inputs are shown on the standard wiring diagram (Figure 3). The remaining seven digital inputs are less obvious: one on each driver and digital output (Sw_9 through Sw_15). These can be used as digital inputs or to sense the state of the output or its wiring (e.g., open coil check).

To address a digital input in a VCL program, use the desired input label (Sw_1 through Sw_16). Use On or Off in the code when determining a switch state; using true/false or 1/0 will give erroneous results.

```
if (Sw_1 = ON)
{
;put code here to run when switch 1 is On
}
if (Sw_16 = OFF)
{
;put code here to run when switch 16 is Off
}
```

All switch inputs are automatically debounced by the VCL operating system. This prevents noisy contacts or contact bounce from causing erroneous events in the application's VCL code. The debounce time can be varied from 0 to 32 ms in 4 ms steps, using this function:

```
Setup_Switches(5); 20 milliseconds
```

If this line is not in the VCL code, the debounce time is set at 16 ms.

The VCL function *Automate_PWM_Input()* can measure the duty cycle of a PWM signal applied to the switch (SW1 – SW16) inputs.

Driver and Digital Outputs

Quick Link:
Digital and PWM Outputs p.15

There are five driver outputs (PWM1 through PWM5) and two digital outputs (DigOut6 and DigOut7). These outputs have variations in current and frequency range. For their specifications, see Digital and PWM Outputs in Chapter 2.

Driver outputs have high current FET output stages and can be pulse width modulated (PWM) to vary the average output to inductive loads such as contactors and relays. This is useful when the battery voltage needs to be brought down for lower voltage coils. The two digital outputs are 1 A drivers that are only On or Off.

Drivers use a special VCL function to set their PWM level. This PWM level can be set up in a signal chain to update automatically or can be set directly in the main loop. PWM can be set from 0–100% using the digital range of 0 to 32767.

```
Put_PWM(PWM2,16384)
```

will output a 50% waveform on Driver 2.

```
Automate_PWM(PWM2,@user1)
```

will continually update the Driver 2 output with the present value of variable User1. This automate statement needs only to be run once, usually in the initialization section of the VCL program. VCL can monitor the present value of a PWM driver: the variable PWMx_Output (where "x" is the PWM channel number) is automatically filled with the present value of the driver output.

The proportional driver (Driver 5 , Pin 2) is different from Drivers 1–4. It can be controlled in two ways: with the proportional driver processing function (see Figure 17) or with the VCL Put_PWM() function. The VCL statement Put_PWM(PWM5, 16383) will result in a 50% PWM output on pin 2 only if the parameter PD Enable is set to Off. For more information about the proportional driver, see the section entitled "INTERFACING THE PROPORTIONAL CURRENT DRIVER" later in this Chapter.

Control of the two digital outputs (Digital Outputs 6 and 7) is done using the VCL functions Set_Digout() and Clear_Digout().

```
Set_DigOut(DigOut6)
```

will set Digital Output 6 On (active). VCL can monitor the present value of a digital output driver: the bit variable Digx_Output (where "x" is the digital output channel number) is automatically filled with the present value of the driver output (On or Off).

It is important to note that all outputs are active Low. With 100% PWM or an output of "On," the FET or transistor will be pulling hard to ground. A DVM on the output will measure near 0 volts.

Potentiometer Inputs

These controllers have two potentiometer inputs, which are typically used for throttle and brake. Many features (mapping, acceleration rates, etc.) are built in as 1313/1314 programmer parameters. Still, there are times that these potentiometer inputs may be needed for other functions such as steering angle or height sensing, or simply as data inputs. The standard way to input pot information is to set the parameter Throttle Type (or Brake Type) to an appropriate value of 1–4 as described in the Throttle Type pages, and the Throttle and Brake parameter menus. When set to a value of 1–4, the resulting signal chain can operate without the use of any VCL.

Quick Links:
Throttle Type Selection p.20–23
Three-Wire/Type 1 p.20
Two-Wire/Type 2 p.21
One-Wire/Voltage p.21-22
Figure 15 p.114
Figure 17 p.118
Throttle menu p.47
Brake menu p.49
Setup_Pot ( ) p.131

However, if an OEM wishes to control the throttle (or brake) signal chain in VCL or use the throttle (or brake) inputs for signals that are not throttle (or brake) signals, then the parameter Throttle Type (or Brake Type) should be set to a value of 5. Setting the parameter Throttle Type (or Brake Type) to a value of 5 changes the routing of the appropriate signal chain (either throttle or brake) and allows the VCL programmer access to the Throttle Pot (or Brake Pot) output variables; see Figure 15.

Using the Setup_Pot() function, executed at the beginning of a VCL program, will define the potentiometer input connection(s) as THREE_WIRE (uses Pot High and Pot Low connections), TWO_ WIRE (variable resistor, or rheostat, uses Pot Low but no connection to Pot High), or ONE_ WIRE (a voltage input, no connection to either Pot High or Pot Low).

THREE_WIRE potentiometer connections are the same as the 3-wire potentiometer connections shown in Figure 5 for Throttle Type 2.

TWO_WIRE potentiometer connections are the same as the 2-wire potentiometer connections shown in Figure 4 for Throttle Type 1.

ONE_WIRE potentiometer connections are the same as the Voltage Source or Current Source connections shown in Figure 5 for Throttle Type 2.

Note that the Setup_Pot() function will only work (and is only needed) if the corresponding Type is set to 5 (Throttle Type = 5 or Brake Type = 5).

```
Setup_Pot(THROTTLE_POT,THREE_WIRE)
```

will set up the throttle pot input for wiring using all three connections (pins 15, 16, 18).

To set up the brake pot input for use in VCL, use the Brake_Pot constant in place of the Thottle_Pot constant in the Setup_Pot function.

```
Setup_Pot(BRAKE_POT,TWO_WIRE)
```

will set up the brake pot input for wiring using two connections (pins 17, 18).

The 0–100% position of the potentiometer is represented by a value from 0–32767 in VCL, and is set up through the VCL Setup_Pot() function. It is important to use the correct setup (ONE_WIRE, TWO_WIRE, or THREE_WIRE) since the input is automatically re-scaled for 0–100% based on the wiring used; for example, the voltage at the Pot Low pin is automatically subtracted and re-scaled on a THREE_WIRE pot.

Another effect of setting the Throttle Type = 5 is that the signal chain for the throttle now gets its input from a different source. The input to the throttle chain is now a VCL variable called VCL_Throttle instead of the throttle pot. Similarly, Brake Type = 5 means the brake signal chain will get its input from a VCL variable called VCL_Brake rather than from the brake pot. The VCL_Throttle and VCL_Brake variables will need to be controlled in the VCL program.

One of the unique features of the potentiometer inputs (as opposed to the analog inputs) is that they have automatic pot fault detection functions running in the motor controller OS. The VCL programmer has access to the pot detection functions with the Setup_Pot_Faults() function. With this function, VCL can re-set the high and low thresholds at which a fault occurs. This function also forces the pot value to a definable level if a fault occurs. Note that the Setup_Pot_Faults() function will work for all throttle Types (1–5). Reference this VCL function for more details, and the **Interfacing the Throttle and Brake Commands** (below), for further information on both the Throttle and Brake processing.

Quick Link:
Setup_Pot_faults ( ) p.132

Analog Inputs

These controllers have two generic analog inputs (pins 24 and 8). These are shared as switch inputs 1 and 2 (Sw_1, Sw_2). The values of the analog inputs are automatically placed in VCL variables Analog1_Input and Analog2_Input every 1 millisecond. Scaling is 0–10V = 0–1023.

```
User2 = Analog2_Input
```

will fill the User2 RAM variable with the value of the voltage at pin 8.

The filtered values of the analog inputs are also available and are automatically placed in VCL variables Analog1_Filtered and Analog2_Filtered. Scaling is 0–10V = 0–1023. The default filter value is 328 (10 Hz) and can be changed in VCL by changing the Analog1_Filter and Analog2_Filter values. Scaling is 0–999 Hz = 0–32767.

Analog Output

The controllers have one analog output (pin 30). This output is a special driver output. The switching stage is filtered to provide a smooth average voltage, instead of the actual PWM waveform seen on Drivers 1–5. However, AnalogOut uses the same VCL functions Put_PWM() and Automate_PWM() used by these other drivers. The scaling is 0–10 V = 0–32767.

```
Put_PWM(PWM6,6553)
```

will generate 2.0 volts at the analog output. VCL can monitor this output using the variable Analog_Output.

INTERFACING THE THROTTLE AND BRAKE COMMANDS

VCL can interface and modify the throttle and brake signals at several points, from the potentiometer to the final motor controller command. VCL can be used to create a completely unique command, adjust parameters to provide MultiMode, or modify the throttle command based on steering angle, height, etc.

The throttle and brake signal chains within the controller are sophisticated and flexible. Before applying VCL to modify these chains, it is important to fully understand the ramifications of implementing changes. The motor and brake command signal chains are illustrated in Figure 15 and discussed below.

Throttle Processing

The top section of Figure 15 shows the throttle processing. The throttle signal chain flows left to right starting with the throttle pot (wiper). The voltage on the throttle wiper input (pin 16) is processed by the controller and has the VCL variable name *Throttle_Pot_Raw*. This variable is displayed as **Throttle Pot** (voltage) in the Monitor » Inputs menu of the 1313/1314 programmer. This throttle signal is then modified by the Throttle Type Processing and Throttle Mapping blocks.

The Throttle Type Processing block combines the Throttle_Type parameter and the throttle potentiometer input (Throttle_Pot_Raw) to create a 16-bit variable containing the magnitude of the raw command. This raw command passes to the Throttle Mapping block, which re-shapes the throttle signal magnitude and direction based on the various Throttle Menu parameters and the direction inputs.

Quick Links:
Figure 15 p.114
Throttle_Type parameter p.47
Throttle menu p.47
Pump parameter menu
Speed Mode = 0 p.33
Speed Mode = 1 p.34–40
Monitor Inputs p.77

Following the Throttle Mapping block are two switches whose purpose is to give the throttle signal a small value (1 for the forward switch, and –1 for the reverse switch) to indicate that a direction switch is On—but only if the throttle signal output from the Throttle Mapping block = 0.

The signal then passes through a selector switch. If the Throttle_Type parameter is set to 5 the Throttle Mapping block output signal is ignored and the command comes from the VCL variable VCL_Throttle. The VCL program manipulates the VCL_Throttle variable to get a throttle command. When the Throttle Type is set to 1–4, the variable VCL_Throttle does nothing, and the Throttle Mapping block output signal passes through.

After the "Throttle Type = 5" switch, the throttle signal is modified by the multiplying and summing nodes. These nodes can be adjusted by VCL through the variables Throttle_Multiplier and Throttle_Offset. This is the basic input point for creating functions like MultiMode, dual drive algorithms, and height vs. speed control. Note that the throttle multiplier has a built-in "divide by 128." This allows the VCL to either multiply (Throttle_Multiplier > 128) or divide (Throttle_Multiplier <128) the nominal throttle value. Typically the default multiplier is set to 128, thus having no net effect. Both Throttle_Multiplier and Throttle_Offset can be positive or negative.

The throttle signal next passes through a limiter that is active only if a pump motor is being operated (Pump Enable = On, and optionally if Regen Lower Enable = On, the pump motor can operate in reverse). This limiter acts to constrain the pump's throttle signal to 100% (positive for forward motion, or negative when Regen_Lower_Enable is On), which is appropriate for controlling a hydraulic pump motor in speed mode.

The output of the multiplying, summing and (pump) limiter nodes is the VCL variable called Mapped_Throttle, which is displayed as Mapped Throttle (percent) in the Monitor » Inputs menu of the 1313 handheld or 1314 PC programmers. A VCL program can control this throttle signal by changing the three variables VCL_Throttle (only if Throttle Type = 5), Throttle_Multiplier, and Throttle_Offset. The effect of these variables can be observed as in the 1313/1314's Mapped Throttle or the VCL Mapped_Throttle variables. Checking the value of Mapped Throttle (Mapped_Throttle) is a good way to see if the Throttle Menu parameters are set correctly.

Monitor menu
Inputs » Interlock State p.77
Controller » Main State p.81
Troubleshooting Chart p.146–153

Prior to passing to the final selector switch, the throttle signal passes through a selector which validates for forward pump operation in speed modes. It will set the pump throttle signal = 0% when, in either speed mode, Pump Enable = On and the Mapped_Throttle is < 0 (negative). This will prevent a pump operating in reverse when Regen Lower Enable = Off, or if the controller is in Torque Mode.

The throttle signal continues to a selector switch that will set the throttle signal = 0% if any of the following conditions are present: Interlock_State = Off, a fault has set throttle request = 0% (Fault action = ShutdownThrottle), or if Main_State ≠ 5 or 10, or an invalid throttle. An invalid throttle is when both the Forward and Reverse switches are On, for example.

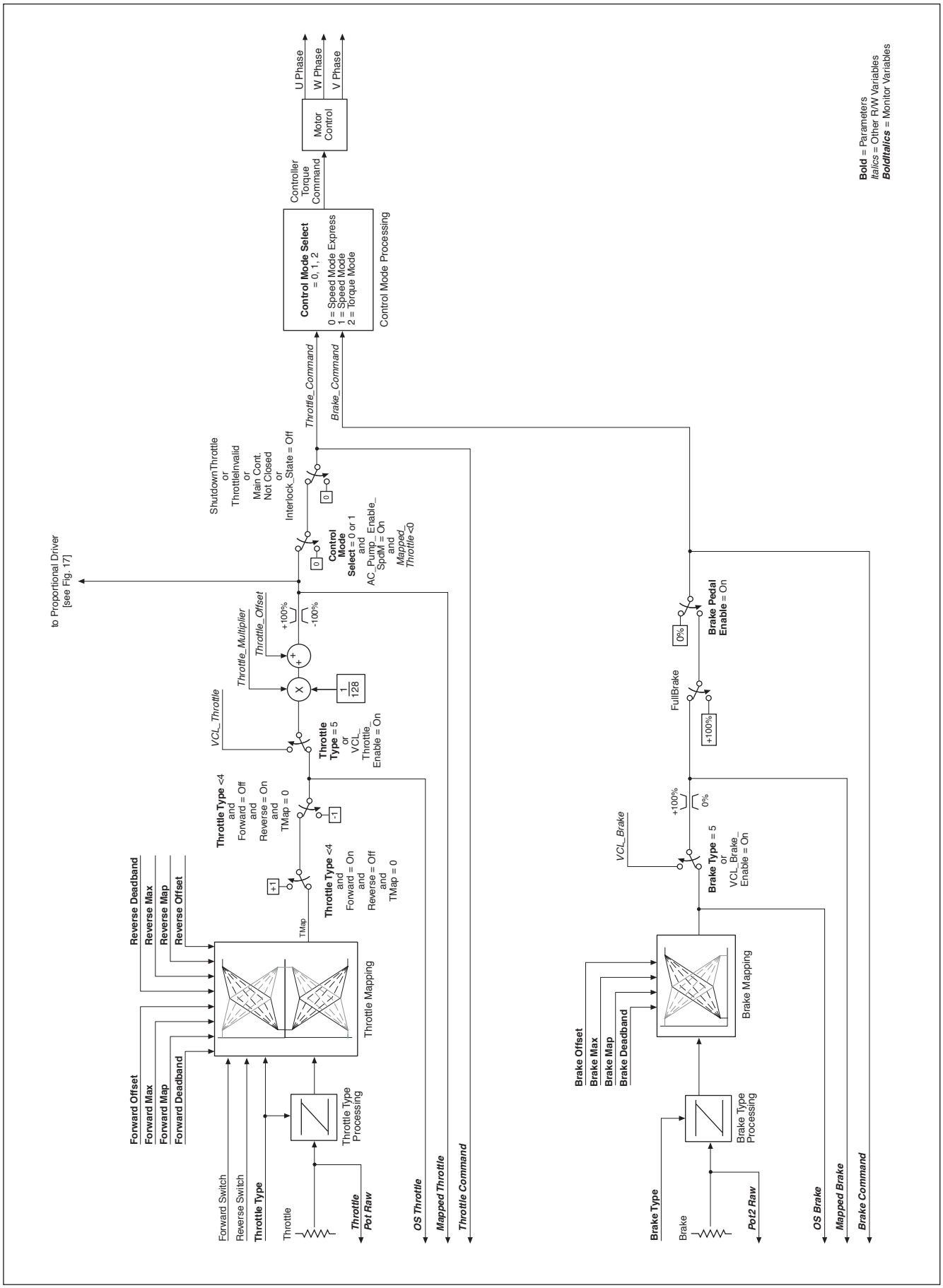


Figure 15
Motor command diagram.

After this final selector switch the throttle signal is the VCL variable called Throttle_Command, which is displayed as Throttle Command in the 1313/1314 Monitor » Inputs menu. Throttle_Command is the final value of the throttle signal chain that is input to the Control Mode Processing block; see Figure 16. Checking the value of Throttle Command using the 1313/1314 is a good way to see the final throttle signal.

If ABS (Throttle_Command) > 1 count, the motor controller will output signals to the motor to make it spin.

For investigating why a motor is not spinning, it is useful to use the 1313/1314 programmer to check the state of the throttle signal from beginning to end: using Throttle_Pot_Raw, Mapped_Throttle, and Throttle_Command. Once these values are known, the Motor Command Diagram (Figure 15) can be used to find how that signal progressed from input to final value.

The following throttle processing variables are accessible by VCL:

VCL Variable *CAN Object Index*	**Access**	**Description**
Throttle_Pot_Raw 0x3215 0x00	Read Only	Voltage measurement at pin 16, scaled for the proper wiring.
OS_Throttle 0x3518 0x00	Read Only	Throttle pot value after mapping, to be used in VCL when VCL Throttle Enable = On and Throttle Type = 1 – 4. Scale: 0 – 100%, 0 – 32,767.
Mapped_Throttle 0x3211 0x00	Read Only	Throttle pot value after mapping.
VCL_Throttle 0x3218 0x00	Read/Write	VCL-accessible throttle command.
Throttle_Multiplier 0x3213 0x00	Read/Write	Multiplies or divides the throttle signal.
Throttle_Offset 0x3214 0x00	Read/Write	Provides a ± offset to the throttle signal.
Throttle_Command 0x3216 0x00	Read Only	Command resulting from throttle processing.

Brake Processing

Quick Links:
Brake Menu
Brake Pedal Enable p.49
Current Limits Menu
Brake Current Limit p.44
Brake Taper Speed p.42
Monitor
Inputs » Pot2 Raw p.77
Figure 15 p.114
Figure 16 p.117

Brake processing is optional as it can be turned Off by setting Brake_Pedal_Enable = Off. If turned On, brake processing can be done with or without VCL. When the controller is in Speed Mode, any non-zero brake command will then override the throttle signal and the motor controller will brake to a stop as determined by the Brake Current Limit and Brake Taper Speed parameters. When the controller is in Torque Mode, the brake command is multiplied by 2 and subtracted from the throttle command to produce the final command; thus a 50% brake command will cancel a 100% throttle command.

The lower part of Figure 15 shows the brake signal processing section. The brake signal chain flows from left to right starting with the physical brake pot. The voltage on the brake wiper input (pin 17) is processed by the controller and has the VCL variable name Pot2_Raw which is displayed as Pot2 Raw in the programmer's Monitor » Inputs menu. This brake signal is then modified by the Brake Type Processing and Brake Mapping blocks.

The Brake Type Processing block uses the Brake_Type parameter and the brake potentiometer input (Pot2_Raw) to create a signed 16-bit variable. This brake signal then passes to the Brake Mapping block, which re-shapes the brake signal according to the various Brake Menu parameters.

The brake signal next passes through a selector switch. If the Brake_Type parameter is set to 5 (Brake Type = VCL input), the Brake Mapping block output signal is ignored and the command comes from the VCL variable VCL_Brake. The VCL program manipulates the VCL_Brake variable to get a brake command. Custom braking functions can be set up in this fashion; e.g., braking based on a switch

position or an internal fault. The brake potentiometer can still be used, but must be set up using the Setup_Pot() function. When the Brake Type is set to 1–4, the variable VCL_Brake does nothing and the Brake Mapping block output signal passes through.

After the "Brake Type = 5" switch, the brake signal passes through a limiter which limits the brake signal to a range of 0–100% (0–32767). After the limiter the brake signal is a VCL variable called Mapped_Brake, which is displayed as Mapped Brake in the Monitor » Inputs menu. Checking the value of Mapped_Brake is a good way to see if the Brake Menu parameters are set correctly. A VCL program can control the brake by changing the variable VCL_Brake (only if Brake Type = 5).

Quick Links:
Brake Menu
Brake parameters p.49
Monitor Inputs
Brake Command p.77
Figure 15 p.114
Figure 16 p.117

The brake signal then goes through a selector which will change it to 100% if the fault-action FullBrake is active. (see Troubleshooting Chart).

The brake signal then goes through a third selector switch that will set the brake signal = 0% if the Brake Pedal Enable parameter is set Off. If set On, then the brake signal will pass through to the Control Mode Processing block. The brake signal after this third selector switch is the VCL variable called Brake_Command and Brake Command in the Monitor » Inputs menu.

Brake_Command is the final value of the brake signal chain that is input to the Control Mode Processing block; see Figure 16. Checking the value of Brake_Command using the 1313 is a good way to see the final brake signal. Note: If Brake_Command is non-zero in Speed Mode Express or Speed Mode, the Throttle_Command will be set to 0% (see Fig. 16).

The following brake processing variables are accessible by VCL:

VCL Variable *CAN Object Index*	**Access**	**Description**
Pot2_Raw 0x3217 0x00	Read Only	Voltage measurement at pin 17.
OS_Brake 0x3519 0x00	Read Only	Brake pot value after mapping, to be used in VCL when VCL Brake Enable = On and Brake Type = 1–3.
VCL_Brake 0x3219 0x00	Read/Write	VCL-accessible brake command.
Mapped_Brake 0x3212 0x00	Read Only	Brake pot value after mapping.
Brake_Command 0x321A 0x00	Read Only	Command resulting from brake processing.

Control Mode and Motor Control Processing

Figure 16 begins with the Throttle_Command and Brake_Command inputs and routes the signals according to the selected control mode. For the speed modes, a switch will zero the Throttle_Command if the Brake_Command is any value but 0%. The signal chains are then directed to Speed Mode Express, Speed Mode, or Torque Mode based on Control Mode Select. Note that in Torque Mode there is no emergency reverse.

Quick Links:
Figure 15 p.114
Figure 16 p.117
Motor Type p.59
Automated Characterization
AC Induction motors p.93

The control mode function uses algorithms to convert the incoming throttle and brake signals, the motor rpm, and associated parameter settings into a Controller Torque Command.

Based upon the control mode selected, the desired Controller Torque Command is calculated, which is passed to the Motor Control block (see Figure 15). The Motor Control block uses its mathematical model of the specific motor & technology to generate the high efficiency three-phase outputs that drive the AC motor via the cables connected to the U, V, and W terminals. For AC Induction motors, 504 motor characterizations are available using the Motor Type parameter, or a motor can be user characterized (Motor Type 0) following the procedures in Chapter 8A.

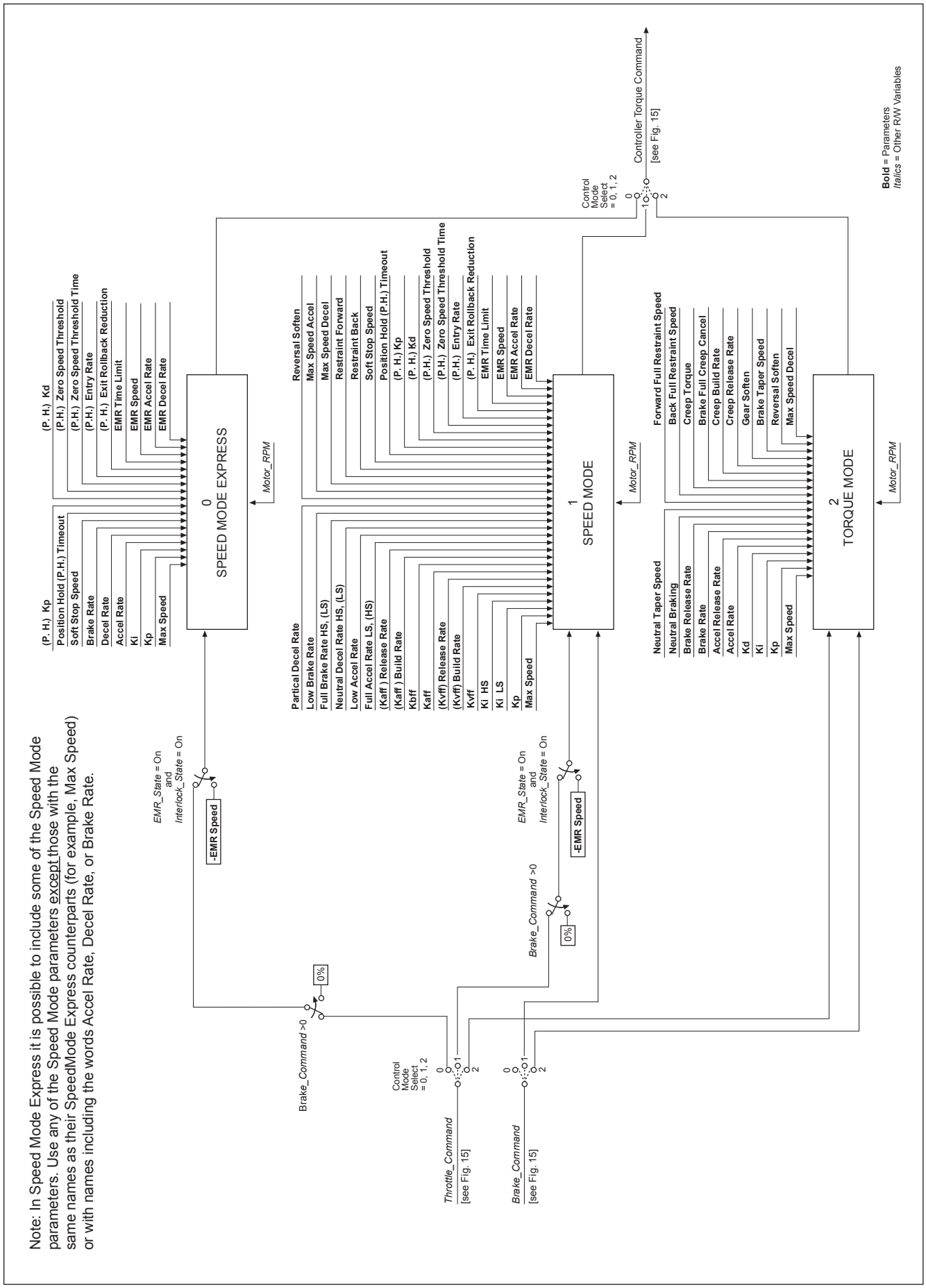


Figure 16
Control Mode processing.

INTERFACING THE PROPORTIONAL CURRENT DRIVER

VCL code can directly interface the proportional current driver (PD), as shown in Figure 17. VCL can change the working parameters of the PD and can provide the command.

Quick Links (for PD text):
Proportional Driver parameters p.54
Monitor
PD Input p.78
PD PWM p.79
PD Current p.79

Depending on how the PD system is to be used, certain parameters need to be set; they can be set via the 1313/1314 programmer or via VCL.

1. **PD_Enable** must be set On for current control, otherwise the PD_Output will be controlled by the VCL function Put_PWM(PWM5,xxxx), which is voltage control.
2. **Hyd_Lower_Enable** must be set On to use the throttle input to control lowering in a hydraulic lift/lower system.
3. **Hyd_Lower_Enable** must be set Off to allow using a VCL variable (VCL_PD_Throttle) as the PD command.

Once the PD parameters are set, the PD_Throttle variable will be mapped between PD_Min_Current and PD_Max_Current and sent to the dither function. Note that Mapped_Throttle is inverted; lowering its value (making it more negative) increases the PD_Throttle value.

The Dither function adds and subtracts from the current command to the PD based on PD_Dither_Percent, at a rate set by PD_Dither_Period.

The dithered current command is compared to the present PD_Current and the error is fed into a PI controller. The feedback gains are set by the parameters PD Kp (proportional gain) and PD Ki (integral gain). The final output is the VCL variable PD_Output, which is displayed in the 1313/1314 programmer's Monitor » Outputs menu as PD PWM.

The following PD processing variables are accessible by VCL:

VCL Variable *CAN Object Index*	**Access**	**Description**
Mapped_Throttle 0x3211 0x00	Read Only	Command from throttle section.
VCL_PD_Throttle 0x320E 0x00	Read/Write	VCL-accessible PD command.
PD_Throttle 0x3210 0x00	Read Only	Resultant command to the PD.
PD_Current 0x321C 0x00	Read Only	Average current flowing in the PD.
PD_Output 0x321E 0x00	Read Only	Resultant PWM at PD output.

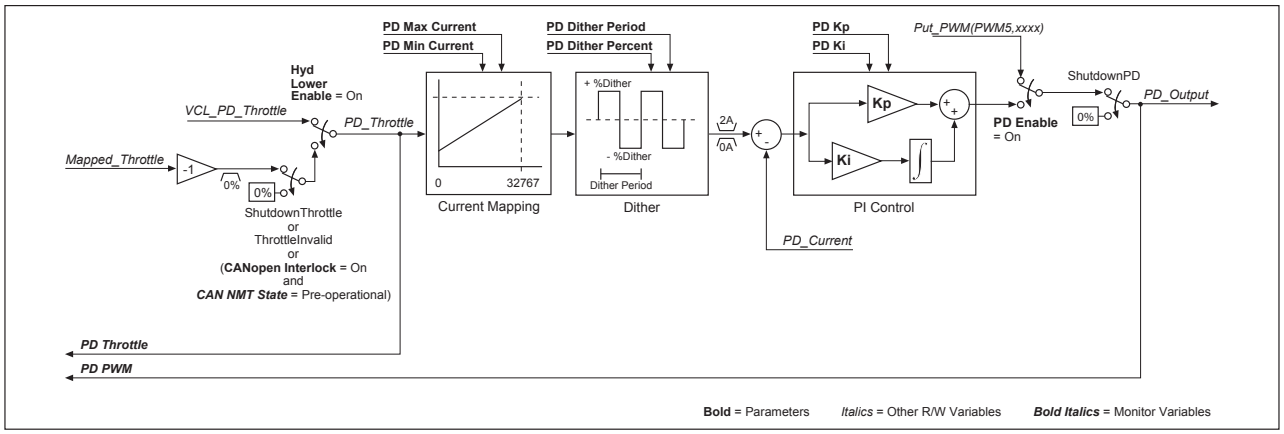


Figure 17
Proportional driver processing.

USING THE FAULT HANDLER IN VCL

The controller's operating system detects various faults and takes appropriate fault actions to protect the controller. These faults have fault codes that are flashed on the controller status LEDs. The fault text is displayed in the System Faults and Fault History menus of the 1313 handheld and 1314 PC programmers. These operating system faults are covered in more detail in Chapter 10's Troubleshooting Chart.

Additionally, the operating system makes the status of the operating system faults available for use in VCL programs in the form of nine variables called Status1, Status2, Status3, Status4, Status5, Status6, Status7, Status8, and Status9. Each of these 16-bit variables contains the status of 8 faults in the lower byte (the upper byte is always set to 0). These Status1–9 variables are read only (RO) and can be used in a VCL program to trigger additional fault actions such as sending fault text messages to a display or blinking a dashboard LED.

Listed below are the bit locations of each of the operating system faults in the Status 1–9 variables, applicable to the default 1232E/SE - 1238E/SE controllers:

```
Status1

      Bit0 = Main Contactor Welded (Code 38)
      Bit1 = Main Contactor Did Not Close (Code 39)
      Bit2 = Pot Low OverCurrent (Code 45)
      Bit3 = Throttle Wiper Low (Code 42)
      Bit4 = Throttle Wiper High (Code 41)
      Bit5 = Pot2 Wiper Low (Code 44)
      Bit6 = Pot2 Wiper High (Code 43)
      Bit7 = EEPROM Failure (Code 46)

Status2

      Bit0 = HPD/Sequencing Fault (Code 47)
      Bit1 = Severe B+ Undervoltage (Code 17)
      Bit2 = Severe B+ Overvoltage (Code 18)
      Bit3 = B+ Undervoltage Cutback (Code 23)
      Bit4 = B+ Overvoltage Cutback (Code 24)
      Bit5 = Sin/Cos Sensor Fault (Code 36)
      Bit6 = Controller Overtemp Cutback (Code 22)
      Bit7 = Controller Severe Undertemp (Code 15)

Status3

      Bit0 = Controller Severe Overtemp (Code 16)
      Bit1 = Coill Driver Open/Short (Code 31)
      Bit2 = Coi12 Driver Open/Short (Code 32)
      Bit3 = Coil3 Driver Open/Short (Code 33)
      Bit4 = Coi14 Driver Open/Short (Code 34)
      Bit5 = PD Open/Short (Code 35)
      Bit6 = Main Open/Short (Code 31)
      Bit7 = EMBrake Open/Short (Code 32)

Status4

      Bit0 = Precharge Failed (Code 14)
      Bit1 = Digital Out 6 Overcurrent (Code 26)
      Bit2 = Digital Out 7 Overcurrent (Code 27)
      Bit3 = Controller Overcurrent (Code 12)
      Bit4 = Current Sensor Fault (Code 13)
      Bit5 = Motor Temp Hot Cutback (Code 28)
      Bit6 = Parameter Change Fault (Code 49)
      Bit7 = Motor Open (Code 37)
```

```
Status5

      Bit0 = External Supply Out of Range (Code 69)
      Bit1 = Motor Temp Sensor Fault (Code 29)
      Bit2 = VCL Run Time Error (Code 68)
      Bit3 = +5V Supply Failure (Code 25)
      Bit4 = OS General (Code 71)
      Bit5 = PDO Timeout (Code 72)
      Bit6 = Encoder Fault (Code 36)
      Bit7 = Stall Detected (Code 73)

Status6

      Bit0 = Bad_Calibrations_Fault (Code 82)
      Bit1 = [Not Used]
      Bit2 = Emer Rev HPD (Code 47)
      Bit3 = [Not Used]
      Bit4 = Motor Type Fault (Code 89)
      Bit5 = Supervisor Fault (Code 77)
      Bit6 = Motor Characterization Fault (Code 87)
      Bit7 = [Not Used]

Status7

      Bit0 = [Not Used]
      Bit1 = VCL/OS Mismatch (Code 91)
      Bit2 = EM Brake Failed to Set (Code 92)
      Bit3 = Encoder LOS (Limited Operating Strategy) (Code 93)
      Bit4 = Emer Rev Timeout (code 94)
      Bit5 = Dual Severe Fault (Code 75)
      Bit6 = Fault On Other Traction Controller (Code 74)
      Bit7 = Illegal Model Number (Code 98)

Status8

      Bit0 = [Not Used]
      Bit1 = [Not Used]
      Bit2 = [Not Used]
      Bit3 = Parameter Mismatch (Code 99)
      Bit4 = Severe KSI Undervoltage (Code 17)
      Bit5 = [Not Used]
      Bit6 = Insulation Resistance Low (Code 76)
      Bit7 = Encoder Pulse Count Fault (Code 88)

Status9

      Bit0 = Supervisor Incompatible (Code 78)
      Bit1 = [Not Used]
      Bit2 = [Not Used]
      Bit3 = PMAC Commissioning Needed (Code 19)
      Bit4 = [Not Used]
      Bit5 = [Not Used]
      Bit6 = Driver Supply (Code 83)
      Bit7 = [Not Used]
```

CANbus Emergency Messages

The Status1–9 faults form CAN emergency message using little-endian byte ordering, where: Byte1&2 is the Error Category, Byte3 is the error register which is "set" (01) if there is an active fault, and Bytes 4–8 map into the Status 1–9 faults as per the error category.

```
Error category = 0x1000 (for Status1 – Status5)
       Byte4 = Status1
       Byte5 = Status2
       Byte6 = Status3
       Byte7 = Status4
       Byte8 = Status5
Error category = 0x1001 (for Status6 – Status 10)
       Byte4 = Status6
       Byte5 = Status7
       Byte6 = Status8
       Byte7 = Status9
       Byte8 = Status … n/a (Status 10 is not utilized)
Example
CANbus error 00 10 01 00 00 00 08 00 equates to Status4, Bit3, Controller
Overcurrent (Code 12)
```

The OEM-defined user faults, described next, are also accessible in a CANbus emergency message.

```
Error category = 0x6200 (for UserFault1 and UserFault2, OEM Defined, implemented
in VCL)
       Byte4 = UserFault1
       Byte5 = UserFault2
       Byte6 = Not applicable
       Byte7 = Not applicable
       Byte8 = Not applicable
Example
CANbus error 00 62 01 02 00 00 00 equates to VCLfault1, Bit 1 (Code 52)
```

OEM-defined User Faults

The operating system provides the capability to create OEM-defined custom faults using VCL. Just as with system faults, the VCL fault codes are flashed on the controller Status LEDs and fault text is displayed on the System Faults and Fault History menus of the 1313/1314 programmer. Optionally, the VCL can assign fault actions to occur automatically when the associated fault is set. Sixteen VCL faults are available, stored in the VCL variables UserFault1 and UserFault2. The UserFault1,2 variables are Read/Write (R/W) and the 16 faults are mapped & stored in the lower byte of each variable as shown below:

```
UserFaultl
       Bit0 = VCLfault1 (Code 51)
       Bit1 = VCLfault2 (Code 52)
       Bit2 = VCLfault3 (Code 53)
       Bit3 = VCLfault4 (Code 54)
       Bit4 = VCLfault5 (Code 55)
       Bit5 = VCLfault6 (Code 56)
       Bit6 = VCLfault7 (Code 57)
       Bit7 = VCLfault8 (Code 58)

UserFault2
       Bit0 = VCLfault9 (Code 59)
       Bit1 = VCLfault10 (Code 61)
       Bit2 = VCLfault11 (Code 62)
       Bit3 = VCLfault12 (Code 63)
       Bit4 = VCLfault13 (Code 64)
       Bit5 = VCLfault14 (Code 65)
       Bit6 = VCLfault15 (Code 66)
       Bit7 = VCLfault16 (Code 67)
```

The “Code” numbers result in the flashing of the controller status LEDs that help identify the fault without use of a 1313/1314 programmer. Setting the fault in VCL is done by setting the associated fault bit in the UserFault1 and 2 variables. Clearing the fault must also be handled by VCL and is done by clearing the associated fault bit. For example:

```
if (BDI_Percentage < 10)
{
UserFault1.2 = ON ;        Set VCL Fault bit
}
else
{
UserFault1.2 = OFF ;       Clear VCL Fault bit
}
```

This VCL will check to see if the Battery Discharge Indicator is less than 10%. If it is, UserFault1 Bit1 (Code 52) is set. If the BDI is not less than 10%, the fault is cleared. Using just the VCL above in a program will only result in the flashing of a code 52 on controller status LEDs and no fault actions will result nor will the 1313/1314 programmer display any text about the fault.

To add automatic fault actions to the VCL faults, the VCL programmer must define the desired fault actions by using the sixteen VCL variables: User_Fault_Action_01 through User_Fault_Action_16. Each of the UserFault bits has a corresponding User_Fault_Action_xx variable (where "xx" is the number of the VCL fault bit). When a VCL fault bit is set, the actions defined in the corresponding User_Fault_Action_xx variable will be automatically executed by the operating system. For any user fault, single or multiple actions can be specified. The available fault actions in the User_Fault_Actions_xx variables are listed below:

Variable	Fault Action
Bit0 = ShutdownMotor	Disable the motor.
Bit1 = ShutdownMainContactor	Shut down the main contactor (only if Main Enable = On).
Bit2 = ShutdownEMBrake	Shut down the EM brake (only if EM Brake Disable Upon Fault = On).
Bit3 = ShutdownThrottle	Set the Throttle_Command = 0%.
Bit4 = ShutdownInterlock	Set the Interlock_State = Off.
Bit5 = ShutdownDriver1	Shut down Driver1.
Bit6 = ShutdownDriver2	Shut down Driver2.
Bit7 = ShutdownDriver3	Shut down Driver3.
Bit8 = ShutdownDriver4	Shut down Driver4.
Bit9 = ShutdownPD	Shut down Proportional Driver.
Bit10 = FullBrake	Set the Brake_Command = 100%.
Bit11 = [Reserved]	N/A.
Bit12 = TrimDisable	Disable Dual Drive trim calculation.
Bit13 = SevereDual	For Dual Drive system, one controller has a severe fault but the main contactor must stay closed so the other controller can continue to operate.
Bit14 = ShutdownSteer	Steer angle = 0°.
Bit15 = LOSDual	For Dual Drive system, set the max speed to Dual_LOS_Max_Speed parameter for operation in Limited Operating Strategy.

The User_Fault_Action_xx variables should be set up at the beginning of a VCL program (before the main loop) as these fault actions should be defined only once in a program. Here is another example:

```
User_Fault_Action_02 = 24 ;Set fault action to ShutdownInterlock
;and ShutdownThrottle
MainLoop:
if (BDI_Percentage < 10)
{
UserFault1.2 = ON ;        Set User Fault bit
Put_Spy_Text("BDI Low") ;  Send message to Model 840 display
}
else
{
UserFault1.2 = OFF ;       Clear User Fault bit
}
goto MainLoop
```

This time when UserFault1.2 is set, the operating system will ShutdownInterlock and ShutdownThrottle (which will result in a Throttle_Command = 0%) in addition to flashing the code 52 on the controller status LEDs. An additional VCL line was added (Put_Spy_Text ("BDI Low")) to show how additional actions beyond those provided in the User_Fault_Action_xx can be programmed using VCL. In this example the Put_Spy_Text("BDI Low") will result in the message "BDI Low" appearing on the model 840 display (presumably as a message to the vehicle operator). This example will still not result in any display on the 1313/1314 programmer System Faults and Fault History menus.

To add the fault text on the System Faults and Fault History menus it is necessary to create a Fault Definition. Creating 1313/1314 fault definitions is a subject that is covered in detail in the VCL Programmer's Guide (Section 5, Support for the 1313/1314 Handheld Programmer). Here is an example of a fault definition:

```
User_Fault_Action_02 = 24 ;       Set fault action to ShutdownInterlock
                                  ;and ShutdownThrottle

MainLoop:
if (BDI_Percentage < 10)
{
UserFault1.2 = ON                 ;Set User fault bit
Put_Spy_Text("BDI Low")           ;Send message to Model 840 display
}
else
{
UserFault1.2 = OFF                ;Clear User fault bit
}
goto MainLoop

; PARAMETER_ENTRY    "BDI Low Fault"
; TYPE               FAULTS
; WIDTH              8BIT
; ALT_ADDRESS        Hist_UserFault1
; ADDRESS            UserFault1
; BITSELECT          1
; BITACTIVELOW       NO
; END
```

This example will result in the exact same actions as the last example, except now the fault will be displayed in the programmer's System Faults menu (only while the fault is set) and this fault will be logged into the Fault History menu after being set. The text displayed in either of these menus will be the text defined in the fault definition (in this example "BDI Low Fault" will be displayed). The variable Hist_UserFault1 is listed as an ALT_ADDRESS. This line controls whether the fault gets logged into fault history (and thus appears in the programmer's Fault History menu). The two variables that can be used in the fault definitions for ALT_ADDRESS are Hist_UserFault1 and Hist_UserFault2; these should be used in the fault definitions with the corresponding UserFault1 and UserFault2 variables. To use VCL to clear fault history, use the VCL function Clear_Diaghist(). Also note that this example fault definition was for bit 1 of UserFault1. The VCL example set and cleared this bit by using the UserFault1.2 notation (".2" being the mask that defines bit 1).

CAN Indexes for the User Fault Variables

The CAN indexes for the various OEM-defined VCL user fault variables are shown below.

```
0x3238 0x00 UserFault1
0x389A 0x00 UserFault1_History
0x3231 0x00 Hist_UserFault1
0x3239 0x00 UserFault2
0x389B 0x00 UserFault2_History
0x3232 0x00 Hist_UserFault2
0x323B 0x00 User_Fault_Action_01
0x323C 0x00 User_Fault_Action_02
0x323D 0x00 User_Fault_Action_03
0x323E 0x00 User_Fault_Action_04
0x323F 0x00 User_Fault_Action_05
0x3240 0x00 User_Fault_Action_06
0x3241 0x00 User_Fault_Action_07
0x3242 0x00 User_Fault_Action_08
0x3243 0x00 User_Fault_Action_09
0x3244 0x00 User_Fault_Action_10
0x3245 0x00 User_Fault_Action_11
0x3246 0x00 User_Fault_Action_12
0x3247 0x00 User_Fault_Action_13
0x3248 0x00 User_Fault_Action_14
0x3249 0x00 User_Fault_Action_15
0x324A 0x00  User_Fault_Action_16
```

VCL FUNCTIONS SPECIFIC TO 1232E/SE, 1234E/SE, 1236E/SE, AND 1238E/SE CONTROLLERS

Function descriptions are provided here for the functions that are unique to these controllers. They are presented in the same format that is used in the VCL Common Functions Manual for the common functions.

ENABLE_PRECHARGE( )

This function is designed to precharge the capacitor bank before engaging a main contactor thereby preventing current surges and to protect controller internal components and main contactor tips. This function turns on the request for precharge of the capacitor bank from KSI.

When the precharge function is enabled, power will be supplied to the capacitor bank until the voltage is within the factory-set range of KSI, or the precharge time limit has expired, or the precharge resistor energy range has been exceeded. The current state of precharge is shown by the precharge variable (Precharge_State), which has the following values:

0 – Precharge has not yet been done.

1 – Precharge is in progress.

2 – Precharge has passed.

3 – Precharge has been aborted by the Disable_Precharge() function.

4 – Precharge has exceeded the precharge resistor energy limit.

5 – Precharge has exceeded the one-second time limit.

Syntax: **`Enable_Precharge()`**

Parameters: None.

Returns:

0 – Precharge not enabled.

1 – Precharge successfully enabled.

Error Codes: None.

Example: `Enable_Precharge()`

This will attempt to precharge the capacitor bank.

Note: Use this function only when the precharge is under VCL control.

DISABLE_PRECHARGE( )

This function is designed to abort the precharge function and clear any precharge fault. This function aborts the request for precharge of the capacitor bank from KSI. The resultant state of the precharge variable (Precharge_State) will be set to = 3 (for precharge aborted). The precharge states are:

0 – Precharge has not yet been done.

1 – Precharge is in progress.

2 – Precharge has passed.

3 – Precharge has been aborted by the Disable_Precharge() function.

4 – Precharge has exceeded the precharge resistor energy limit.

5 – Precharge has exceeded the one-second time limit.

Syntax: **`Disable_Precharge()`**

Parameters: None.

Returns:

0 – Precharge not enabled.

1 – Precharge successfully enabled.

Error Codes: None.

Example:
```
Disable_Precharge()
```
This will attempt to abort the precharge of the capacitor bank and will clear any precharge fault.

SET_DIGOUT( )

This function turns on the selected digital output. The digital outputs are active low (On = driver on and pulled to ground, Off = open circuit at the pin).

Syntax: **`Set_Digout(DigOut_ID)`**

Parameters: DigOut_ID is the digital output identification.
DigOut6 = Digital Output 6 (pin 19).
DigOut7 = Digital Output 7 (pin 20).

Returns:

0 – Selected digital output not set.

1 – Selected digital output successfully set.

Error Codes: Bad_ID is returned when DigOut_ID is not in the range of DigOut6 to DigOut7.

Example:
```
Set_Digout(DigOut6)
```
This example will set Digital Output 6 (pin 19) On (active low, pulled to ground).

CLEAR_DIGOUT( )

This function turns off the selected digital output. The digital outputs are active low (On = driver on and pulled to ground, Off = open circuit at the pin).

Syntax: **`Clear_Digout(DigOut_ID)`**

Parameters: DigOut_ID is the digital output identification.
DigOut6 = Digital Output 6 (pin 19).
DigOut7 = Digital Output 7 (pin 20).

Returns:

0 – Selected digital output not cleared.

1 – Selected digital output successfully cleared.

Error Codes: Bad_ID is returned when DigOut_ID is not in the range of DigOut6 to DigOut7.

Example:
```
Clear_Digout(DigOut6)
```
This example will set Digital Output 6 (pin 19) Off (open circuit).

ENABLE_EMER_REV( )

This function is used to engage emergency reverse using VCL. The EMR Type parameter must be set to = 1 in order for the Enable_Emer_Rev() function to operate. If the system emergency reverse state is enabled (EMR_State bit variable = On), the emergency reverse function will operate according to the Emergency Reverse parameter settings. To view the current emergency reverse state, see Monitor » Inputs: Emer Rev on the 1313/1314 programmer.

When the EMR_Type is set to = 1 and neither the Enable_Emer_Rev() nor the Disable_Emer_Rev() function has been called, the state for emergency reverse is Off (EMR_State bit variable = Off).

Syntax: **`Enable_Emer_Rev()`**

Parameters: None.

Returns:

0 – Emergency reverse not enabled.

1 – Emergency reverse successfully enabled.

Error Codes: None.

Example:
```
Enable_Emer_Rev()
```
This will enable the emergency reverse function.

DISABLE_EMER_REV( )

This function is used to disengage emergency reverse using VCL. The EMR Type parameter must be set to = 1 in order for the Disable_Emer_Rev() function to operate. If the system emergency reverse state is disabled (EMR_State bit variable = Off), the emergency reverse function will stop operating and normal motor control function will resume (including an HPD/SRO check if the HPD/SRO Enable parameter is set to On). To view the current emergency reverse state, see Monitor » Inputs: Emer Rev on the 1313/1314 programmer.

When the EMR_Type is set to = 1 and neither the Enable_Emer_Rev() nor the Disable_Emer_Rev() function has been called, the state for emergency reverse is Off (EMR_State bit variable = Off).

Syntax: **`Disable_Emer_Rev()`**

Parameters: None.

Returns:

0 – Emergency reverse not disabled.

1 – Emergency reverse successfully disabled.

Error Codes: None.

Example:
```
Disable_Emer_Rev()
```
This will disable the emergency reverse function.

SET_INTERLOCK( )

This function is used to engage the system interlock using VCL. The Interlock Type parameter must be set to = 1 in order for the Set_Interlock() function to operate. If the system interlock is set (Interlock_State bit variable = On), the throttle input signal is allowed to pass along the throttle chain; see Figure 15. Additionally, if the main contactor is used (Main Enable parameter = On), setting the interlock will request the main closed state from the main contactor state machine. To view the current interlock state, see the Monitor » Inputs: Interlock. To view the current main contactor state, see Monitor » Controller: Main State.

When the Interlock_Type is set to = 1 and neither the Set_Interlock() nor the Clear_Interlock() function has been called, the state for the interlock is Off (Interlock_State bit variable = Off).

Syntax: **`Set_Interlock()`**

Parameters: None.

Returns:

0 – Interlock not set.

1 – Interlock successfully set.

Error Codes: None.

Example: `Set_Interlock()`

This will engage the system interlock.

CLEAR_INTERLOCK( )

This function is used to disengage the system interlock using VCL. The Interlock Type parameter must be set to = 1 in order for the Set_Interlock() function to operate. If the system interlock is cleared (Interlock_State bit variable = Off), the throttle input signal is not allowed to pass along the throttle chain; see Figure 15. Additionally, if the main contactor is used (Main Enable parameter = On), clearing the interlock will request the main open state from the main contactor state machine. To view the current interlock state, see Monitor » Inputs: Interlock. To view the current main contactor state, see Monitor » Controller: Main State.

When the Interlock_Type is set to = 1 and neither the Set_Interlock() nor Clear_Interlock() function has been called, the default state for the interlock is Off (Interlock_State bit variable = Off).

Syntax: **`Clear_Interlock()`**

Parameters: None.

Returns:

0 – Interlock not cleared.

1 – Interlock successfully cleared.

Error Codes: None.

Example: `Clear_Interlock()`

This will disengage the system interlock.

SETUP_POT( )

This function determines the type of electrical connection of the Throttle Wiper (J1-16) and Pot2 High (J1-27) potentiometers (pot inputs).

One wire pots are a 0 – 5 V input.

Two wire pots are rheostats.

Three wire pots use the pot-high and pot-low as their high and low references.

Syntax:	**`Setup_Pot(Pot_ID, Type)`**
Parameters:	
POT_ID	Pot (ID) Selector (THROTTLE_POT,or BRAKE_POT)
Type	Pot type (ONE_WIRE, TWO_WIRE, or THREE_WIRE)
Returns:	
0	Setup not successful.
1	Setup successful.
Errors	
BAD_ID	POT_ID out of Range.
BAD_P_TYPE	Pot Type out of Range.

GET_POT( )

This function returns the value of the selected pot; 0 – 32767 equating to 0 – 100% over the 0 – 5.00V input range.

Syntax:	**`Get_Pot(POT_ID)`**
Parameters:	
POT_ID	Pot Selector (THROTTLE_POT,or BRAKE_POT)
Returns:	
0	Pot = 0 or error.
n	Pot value.
Errors	
BAD_ID	POT_ID out of Range.

SETUP_POT_FAULTS( )

This function re-sets the upper and lower wiper fault voltages for the specified pot-input that will be used to activate a pot-wiper voltage fault. The valid range for the function parameters are 0 – 6.25 V (0 – 400 counts). If this function is not run, the default thresholds depend on the Throttle Type (or Brake Type) parameter setting; see table below. If the Throttle Type = 5 (or Brake Type = 5), the VCL function Setup_Pot will determine what fault thresholds are used.

Throttle Type	Low Fault Threshold	High Fault Threshold
1	0.1V	5.5V
2	NONE	5.5V
3	0.1V	5.5V
4	0.1V	5.5V
5 (ONE_WIRE)	NONE	5.5V
5 (TWO_WIRE)	0.1V	5.5V
5 (THREE_WIRE)	0.1V	5.5V

Syntax: **`Setup_Pot_Faults(Pot_ID, Low_Fault, High_Fault, Fault_Value)`**

Parameters: `Pot_ID` identifies the throttle whose fault limits are being set:

`Throttle_Pot`

`Brake_Pot`

`Low_Fault:` Specifies the lower threshold voltage limit.

Scaling: 1V = 64 counts.

`High_Fault:` Specifies the upper threshold voltage limit.

Scaling: 1V = 64 counts.

`Fault_Value:` The value that is used for the pot input when there is a fault (0–32767).

Scaling: ± 32767 = ± 100%.

Returns:

0 – Setup did not execute.

1 – Setup successful.

Error Codes: Bad_ID is returned when an incorrect pot ID is used.

Param_Range is returned when the voltage value is not within range.

Example: `Setup_Pot_Faults(THROTTLE_POT,19,320,4000)`

For the throttle pot, this will set the lower pot voltage to 0.3V (19/64) and the upper pot voltage to 5.0V (320/64). When there is a pot fault, the value of 4000 will be used. That is 4000/32767 of the full output, or roughly 12%.

START_PUMP( )

This function is used to turn on the pump lift contactor (pin 4). If the parameter Drivers » Driver3 » Contactor Enable = On (VCL HydraulicContactorEnable bit variable = On), the VCL function Start_Pump() will turn on the pump lift contactor (Driver 3).

When HydraulicContactorEnable = On and neither Start_Pump() nor Stop_ Pump() has been called, the pump lift contactor is Off.

Syntax: **`Start_Pump()`**

Parameters: None.

Returns:

0 – Pump start function not enabled.

1 – Pump start function successfully enabled.

Error Codes: None.

Example:
```
Start_Pump()
```
This will turn on the pump lift contactor.

STOP_PUMP( )

This function is used to turn off the pump lift contactor (pin 4). If the parameter Drivers » Driver3 » Contactor Enable = On (VCL HydraulicContactorEnable bit variable = On), the VCL function Start_Pump() will turn off the pump lift contactor (Driver 3).

When HydraulicContactorEnable = On and neither Start_Pump() nor Stop_ Pump() has been called, the pump lift contactor is Off.

Syntax: **`Stop_Pump()`**

Parameters: None.

Returns:

0 – Pump stop function not enabled.

1 – Pump stop function successfully enabled.

Error Codes: None.

Example:
```
Stop_Pump()
```
This will turn off the pump lift contactor.

AUTOMATE_FREQUENCY_OUTPUT( )

This function sets up the PD Driver (pin 2) PWM output to yield a frequency proportional to the input variable at an execution rate of 16 ms. This output can be used to drive an electronic speedometer or tachometer.

An additional VCL variable called Frequency_Output_Duty_Cycle works in conjunction with the Automate_Frequency_Output() function to modify the duty cycle of the output. The default value of Frequency_Output_Duty_Cycle is 50% (or

Syntax: **`Automate_Frequency_Output()`**

Parameters:

`@Source` Index of source value to be the input.

`MinInput` Holds the minimum value for the input.

`MaxInput` Holds the maximum value for the input.

`MinOutput` Holds the minimum value for the output in Hz.

`MaxOutput` Holds the maximum value for the output in Hz.

NOTE: The frequency range is 0–4000 Hz, with 4 Hz being the minimum active frequency, and 0–3 Hz = Off.

Returns:

0 – PWM not automated.

1 – PWM automated.

Error Codes: Param_Range is returned when a parameter is out of range.

PT_Range is returned when the Parameter Table Index is out of range.

Example: To set up the PD Driver to output 500 Hz to 1500 Hz (at duty cycle = 25%) for motor speed in the range 100 rpm to 4000 rpm:

```
Frequency_Output_Duty_Cycle = 8192 ;set duty cycle = 25%
Automate_Frequency_Output(@ABS_Motor_Speed,100,4000,500,1500)
```

OVERRIDE_EM_BRAKE_PWM( )

This function is designed to override EM Brake. When this function is enabled, it resets the hill hold memory value.

Syntax: **`Override_EM_Brake_PWM(Kill_Hill_Hold)`**

Parameters: Kill_Hill_Hold

0 – Retain hill hold memory.

1 – Reset hill hold memory.

Returns:

0 – Failed to override EM brake.

1 – Succeeded in overriding EM brake.

Error Codes: None.

RESTORE_EM_BRAKE_PWM( )

This function returns control of the EM brake PWM to the EM brake state machine.

Syntax: **`Restore_EM_Brake_PWM()`**

Parameters: None.

Returns:

0 – Failed.

1 – Success.

Error Codes: None.

MAP_TWO_POINTS( )

This function interpolates values between two points, Y1 and Y2; based upon an X input parameter. Interpolating based on X1 and X2.

Typical Usage:

1. Calculate a value framed between two X-axis points projected across two Y points, where the functions' output is the value of the Y-axis intersection.
2. Extend the 7 pair limitation of the Setup_Map function by the use of multiple If, If Else statements on segments of an XY array.

Syntax: **`Map_Two_Points(X,X1,X2,Y1,Y2)`**

Parameters:

`X` Input.

`X1` Input point X1.

`X2` Input point X2.

`Y1` Output point Y1.

`Y2` Output point Y2.

Returns:

n Mapped value.

Error Codes: None.

Example: Convert a controller value, such as Steer_Angle, to a voltage. The input (X) is the Steer_Angle variable, where X1-X2 is an angle between 0 and 90 Degrees. The output is the interpolated value across Y-axis points in Volts.

Enable the expansion of the Setup_Map(16) function beyond the seven (7) point-pair by the use of multiple If, If Else statements on segments of a two point XY array. For Example:

```
If(X < 1)
      {
      Y = Map_2_Points(X, X1, X2, Y1, Y2)
      }
Else If(0<= X <= 1)
      {
      Y = Map_two_Points(X, X1, X2, Y1, Y2)
      }
Else If(1< X <= 2)
      {
      Y = Map_Two_Points(X, X1, X2, Y1, Y2)
      }
Else If(2< X <= 3)
      {
      Y = Map_Two_Points(X, X1, X2, Y1, Y2)
      }
Etc.
```

BATTERY_COMPENSATE( )

This function is used to compensate a variable with battery voltage using the nominal battery setting.

Syntax: **`Battery_Compensate(Input)`**

Parameters:

Input Variable to be compensated.

Returns:

n Output.

Error Codes: None.

Updated since os32.0, a string length argument has been added to the *Put_Message_To_String()* function. This allows the function to create strings up to 64 characters (the previous limit was 12).

PUT_MESSAGE_TO_STRING( )

Use this function to construct a message and parse it into a list of ASCII character equivalents. The output formats an ASCII message with pre-text on the left, a variable's value in the middle, and post-text on the right.

The variable's value can have a decimal place added using the NFormat specifier.

If the resulting message is longer than 64 characters, truncation occurs,

- The variable's value is truncated.
- The post-text is truncated second.
- The pre-text is truncated last.
- All truncation occurs on the right of a section.
- All unused array positions will be filled with a space (ASCII 32).

Syntax: **`Put_Message_To_String(PreText, Variable, PostText, NFormat, @ArrayStart, MsgLength)`**

Parameters:

Pretext String to concatenate on the left.

Variable Numeric value to convert to ASCII and concatenate in the middle.

PostText String to concatenate on the right.

NFormat Numerical format specifier (see NFormat specifiers, below and in Sys Info).

@ArrayStart Pointer to the User or Autouser variable that is the start of the output array.

Msglength Number of characters in the string (up to 64). This is a new argument.

Set this to 12 to maintain backwards compatibility with VCL written for previous OS's.

Returns:

–1 Invalid string format.

0 If message NOT output.

1 If the message was generated successfully.

2 If the message was generated successfully, but the numeric value was truncated.

Error Codes: None.

Example:

```
LEFT-MOTOR 1234.5 RPM    [Msglengh = 21]
```

If the variable = 12345, the pre-text is “LEFT-MOTOR”, the post-text is “RPM”, the decimal format is PSM_DECIMAL_1 and the ArrayStart is User101.

Then set User101 = 76 “L” User102 = 69 “E” User103 = 70 “F” User104 = 84 “T” User105 = 45 “-” User106 = 77 “M” User107 = 79 “0” User108 = 84 “T” User109 = 79 “O” User110 = 82 “R” User111 = 32 “ ”(space) User112 = 49 “1” User113 = 50 “2” User114 = 51 “3” User115 = 52 “4” User116 = 46 “.” User117 = 53 “5” User118 = 32 “ ”(space) User119 = 82 “R” User120 = 80 “P” User121 = 77 “M”

NFormat Numerical format specifier

PSM_DECIMAL = Decimal, no decimal point.

PSM_DECIMAL_0 = Decimal, decimal point at far right.

PSM_DECIMAL_1 = Decimal, decimal point 1st digit from far right.

PSM_DECIMAL_2 = Decimal, decimal point 2nd digit from far right.

PSM_DECIMAL_3 = Decimal, decimal point 3rd digit from far right.

PSM_BINARY, = Binary.

PSM_HEX, = Hexadecimal.

PSM_TEXT_ONLY = Do not use the value of the variable in the message.

AUTOMATE_PWM_INPUT( )

Configures a switch input to measure the duty cycle of a PWM signal applied to the input.

Syntax: **`Automate_PWM_Input(sw#, Period_Ticks)`**

Parameters:

SW# A number 1 – 16 indicating which switch input of SW_1 to SW_16 to measure the duty cycle.

Period_Ticks The *Automate_PWM_Input* function runs at a maximum 8ms rate in the OS. This value is the expected period of the input wavefore/8ms per measurement.

For example, if the PWM signal to be measured has a period of 200ms, the set the *Period_Ticks* to 200/8 = 25.

Set to 0 to disable the *Automate_PWM_Input* function.

Returns:

0 Function did not successfully execute.

1 Function successfully executed.

Error Codes:

BAD_ID `Switch # out of range.`

The outputs of these functions are as follows:

Pwm_Input – The duty cycle of the PWM input. (0-32767 = 0-100% PWM).

SETUP_TIMER_LONG( )

Allows a 32-bit variable to be used to set the value of a timer with a single function call.

Syntax: **`Setup_Timer_Long(TMR#, TIME)`**

Parameters:

TMR# ID of Timer to initialize (TMR1, TMR2, or TMR3).

TIME Reference to 32bit number, time in 0.1hr increments.

Returns:

0 Function did not successfully execute.

1 Function successfully executed.

Error Codes:

BAD_ID `TMR# out of range.`

PARAM_RANGE Parameter is out of range.

SETUP_MAILBOX_MASK( )

Sets up a mask to allow messages with multiple COB ID's to be received by the same mailbox. For each bit in the mask, a "1" indicates that the bit in the incoming message must match the bit in the COB ID setup in the corresponding *Setup_Mailbox()* call. A "0" means that messages will be received into the mailbox regardless of the state of the bit in the COB ID of messages on the bus. This function must be called before *Setup_Mailbox()*.

Syntax: **`Setup_Mailbox_Mask(CAN#, Mask)`**

Parameters:

CAN# The mailbox ID (e.g., CAN3).

Mask 11 bits for mask.

Returns:

0 Mask not setup.

1 Mask setup.

Error Codes:

BAD_ID `CAN# out of range.`

SETUP_MAILBOX_EXTENDED_MASK( )

Sets up a mask to allow messages with multiple 29-bit COB ID's to be received by the same mailbox. For each bit in the mask, a "1" indicates that the bit in the incoming message must match the bit in the COB ID setup in the corresponding Setup_Mailbox_Extended_ID() call. A "0" means that messages will be received into the mailbox regardless of the state of the bit in the COB ID of messages on the bus. This function must be called before *Setup_Mailbox_Extended_ID()*.

Syntax: **`Setup_Mailbox_Extended_Mask(CAN#, Mask_High, Mask_Low)`**

Parameters:

CAN# The mailbox ID (e.g., CAN3).

Mask-High High 13 bits of mask.

Mask_Low Low 16 bits of mask.

Returns:

0 Mask not setup.

1 Mask setup.

Error Codes:

BAD_ID `CAN# out of range.`

AUTOMATE_ENCODER( )

Automate_Encoder() allows processing of low bandwidth Sin/Cos signals for use in VCL. This function runs in the 4 ms queue.

Syntax: **`Automate_Encoder(ENC#, @ChannelA, @ChannelB, V_Min_A, V_Max_A, V_Min_B, V_Max_B, Encoder_Type)`**

Parameters:

ENC#	ENC1 or ENC2 (Holds the ID of the desired encoder block).
@ChannelA	Pointer to source variable 1 (-32767 - 32767).
@ChannelB	Pointer to source variable 2 (-32767 - 32767).
V_Min_A	Minimum Voltage of encoder channel A (–32767 - 32767).
V_Max_A	Maximum Voltage of encoder channel A (–32767 - 32767).
V_Min_B	Minimum Voltage of encoder channel B (–32767 - 32767).
V_Max_B	Maximum Voltage of encoder channel B (–32767 - 32767).
Encoder_Type	Only Sin/Cos encoders are supported, this should be set to 0.

Returns:

0	Function did not successfully execute.
1	Function successfully executed.

Error Codes:

BAD_ID	`ENC# out of Range.`
PT_RANGE	`Invalid source or destination parameter.`

The outputs of these functions are as follows:

`ENC1_rev_output` – ENC1's output in revolutions (–32767 - 32767)

`ENC1_Angle` – ENC1's output angle in degrees (0 - 4096 = 0 - 360 degrees)

`ENC2_rev_output` – ENC2's output in revolutions (–32767 - 32767)

`ENC2_Angle` – ENC2's output angle in degrees (0 - 4096 = 0 - 360 degrees)

Example:

```
Return = Automate_Encoder(ENC#, @ChannelA, @ChannelB, V_Min_A, V_Max_A, V_Min_B, V_Max_B, Encoder_Type)
```

11 — DIAGNOSTICS AND TROUBLESHOOTING

These controllers detect a wide variety of faults or error conditions. Faults can be detected by the operating system or by the VCL code. This chapter describes the faults detected by the operating system.

Faults detected by VCL code (faults 51–67 in Table 6) cannot be defined here as they will vary from application to application. Refer to the appropriate OEM documentation for information on these faults.

DIAGNOSTICS

Diagnostics information can be obtained in either of two ways: (1) by reading the display on a 1313 handheld or 1314 PC programmer or (2) by observing the fault codes issued by the Status LEDs. See Table 5 for a summary of LED display formats.

The 1313 /1314 programmer will display all faults that are currently set as well as a history of the faults that have been set since the history log was last cleared. The 1313/1314 displays the faults by name.

The pair of LEDs built into the controller (one red, one yellow) produce flash codes displaying all the currently set faults in a repeating cycle. Each code consists of two digits. The red LED flashes once to indicate that the first digit of the code will follow; the yellow LED then flashes the appropriate number of times for the first digit. The red LED flashes twice to indicate that the second digit of the code will follow; the yellow LED flashes the appropriate number of times for the second digit.

Example:

B+ Undervoltage Cutback (code 23).

In the Fault menu of the 1313/1314 programmer, the words B+ Undervoltage Cutback will be displayed; the real-time battery voltage is displayed in the Monitor menu (“Capacitor Voltage”).

The controller’s two LEDs will display this repeating pattern:

Red	Yellow	Red	Yellow
✱	✲ ✲	✱ ✱	✲ ✲ ✲
(first digit)	(2)	(second digit)	(3)

The numerical codes used by the yellow LED are listed in the troubleshooting chart (Table 6), which also lists possible fault causes and describes the conditions that set and clear each fault.

Identifying Prototype Software

In recent years, many global functional safety standards have changed to include requirements for formal verification/validation of software for production vehicles. Curtis has included a feature in the software to allow both Curtis internal software development teams and **OEM development engineers** to make it clear to someone working with a prototype vehicle that the software is not fully verified. If a prototype OS coming from Curtis is not fully verified, the LED blink pattern when no faults are present will change to a fast flashing red LED rather than the standard slow yellow flashing LED.

In addition, there is now a VCL variable called *VCL_Prototype_Software*. Setting this variable to a non-zero value in the initialization section of a VCL program will cause the same fast flashing red LED

blink pattern as a prototype OS. This will allow a VCL developer to indicate to someone working with a prototype vehicle that the VCL software has not been fully verified.

Curtis recommends that OEM engineers, or anyone modifying the VCL, whether on a new/development vehicle or an existing vehicle, implement this fast flashing red LED until the VCL code and the vehicle is fully tested and verified.

Summary of LED Display Formats

The two LEDs have four different display modes, indicating the type of information they are providing.

Table 5 Types of LED Display

Display	Status
Neither LED illuminated	Controller is not powered on; or vehicle has dead battery; or severe damage.
Yellow LED flashing	Controller is operating normally.
Yellow and red LEDs both on solid	Controller is in Flash program mode.
Red LED on solid	Internal hardware fault detected by the Supervisor or Primary microprocessor. Missing or corrupt software. Interrupting a software download may cause corruption of the software. Cycle KSI to clear. Reload software or replace controller if necessary.
Red LED and yellow LED flashing alternately	Controller has detected a fault. 2-digit code flashed by yellow LED identifies the specific fault; one or two flashes by red LED indicate whether first or second code digit will follow.

TROUBLESHOOTING

The troubleshooting chart, Table 6, provides the following information on all the controller faults:

- fault code.
- fault name as displayed on the programmer's LCD.
- the effect of the fault.
- possible causes of the fault.
- fault set conditions.
- fault clear conditions.

Whenever a fault is encountered and no wiring or vehicle fault can be found, shut off KSI and turn it back on to see if the fault clears. If it does not, shut off KSI and remove the 35-pin connector. Check the connector for corrosion or damage, clean it if necessary, and re-insert it.

The fault actions (effect of fault) in Table 6 use the same bit-structure as the User_Fault_Action_xx listed in the OEM-defined User Faults. The variable System_Action (available in WinVCL Monitor or TACT) returns the decimal number corresponding to the active fault action bit(s). The Dual Drive fault actions, Bits 12–15, are listed in the supplemental Dual Drive Operation manual.

System_Action Bit	Action
No defined System_Action	Effect of fault as noted in Table 6.
Bit0 = ShutdownMotor	Disable the motor.
Bit1 = ShutdownMainContactor	Shut down the main contactor (only if Main Enable = On).
Bit2 = ShutdownEMBrake	Shut down the EM brake (only if EM Brake Disable Upon Fault = On).
Bit3 = ShutdownThrottle	Set the Throttle_Command = 0%.
Bit4 = ShutdownInterlock	Set the Interlock_State = Off.
Bit5 = ShutdownDriver1	Shut down Driver1.
Bit6 = ShutdownDriver2	Shut down Driver2.
Bit7 = ShutdownDriver3	Shut down Driver3.
Bit8 = ShutdownDriver4	Shut down Driver4.
Bit9 = ShutdownPD	Shut down Proportional Driver.
Bit10 = FullBrake	Set the Brake_Command = 100%.
Bit11 = [Reserved]	N/A (for 1232–1238E/SE, and 1239E controllers).
Bit12 = TrimDisable	Disable Dual Drive trim calculation.
Bit13 = SevereDual	For Dual Drive system, one controller has a severe fault but the main contactor must stay closed so the other controller can continue to operate.
Bit14 = ShutdownSteer	Steer angle = 0° (DD applicable).
Bit15 = LOSDual	For Dual Drive system, set the max speed to Dual_LOS_Max_Speed parameter for operation in Limited Operating Strategy.

Example:

```
HPD/Sequencing Fault, Flash Code 47.
Effect of fault = Shutdown Throttle.
System_Action = 8 (equates to Bit3 set: 0000 0000 0000 1000).
```

Changes to the fault handler and main bridge operation with PMAC motors

In non-1239E models the controller will activate the main power bridge automatically when the overvoltage point is reached, the controller will then command zero torque producing current, and command only enough negative flux producing current to keep the capacitor voltage below the overvoltage threshold. This will occur even if there is no power applied to KSI.

The Shutdown motor fault action has been modified for safe operation with a PMAC motor. If one of the following faults is declared, the bridge will open unless the Severe Overvoltage threshold is exceeded at which time the bridge will short the motor until the capacitor voltage falls below the undervoltage threshold:

- Controller Overcurrent (fault code 12).
- Current Sensor Fault (fault code 13).
- Severe KSI Undervoltage (fault code 17).
- Severe B+ Overvoltage (fault code 18).
- Sin/Cos Sensor Fault (fault code 36).
- Motor Open (fault code 37).
- OS General (fault code 71).
- Stall Detected (fault code 73).
- Supervisor Fault (fault code 77).
- Driver Supply (fault code 83).
- Sin/Cos Misalignment Fault (fault code 88).

For any other fault with a ShutdownMotor fault action, the controller will command zero torque producing current, and command only enough negative flux producing current to keep the capacitor voltage below the overvoltage threshold. If no flux producing current is necessary for 64 ms, the bridge will be disabled.

Table 6 TROUBLESHOOTING CHART

CODE (status#,bit	PROGRAMMER LCD DISPLAY *EFFECT OF FAULT*	POSSIBLE CAUSE	SET / CLEAR CONDITIONS
12 (Status4,3)	**Controller Overcurrent** *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake.*	1. External short of phase U,V, or W motor connections. 2. Motor parameters are mistuned. 3. Controller defective. 4. Speed encoder noise problems.	*Set:* Phase current exceeded the current measurement limit. *Clear:* Cycle KSI or perform a VCL reset.
13 (Status4,4)	**Current Sensor Fault** *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake.*	1. Leakage to vehicle frame from phase U, V, or W (short in motor stator). 2. Controller defective.	*Set:* Controller current sensors have invalid offset reading. *Clear:* Cycle KSI or perform a VCL reset.
14 (Status4,0)	**Precharge Failed** *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake.*	1. See Monitor menu » Battery: Capacitor Voltage. 2. External load on capacitor bank (B+ connection terminal) that prevents the capacitor bank from charging.	*Set:* The precharge failed to charge the capacitor bank. *Clear:* Cycle Interlock input or use VCL function *Enable_Precharge().*
15 (Status2,7)	**Controller Severe Undertemp** *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake.*	1. See Monitor menu » Controller: Temperature. 2. Controller is operating in an extreme environment.	*Set:* Heatsink temperature below -40°C. *Clear:* Bring heatsink temperature above -40°C, and cycle interlock or KSI.
16 (Status3,0)	**Controller Severe Overtemp** *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake.*	1. See Monitor menu » Controller: Temperature. 2. Controller is operating in an extreme environment. 3. Excessive load on vehicle. 4. Improper mounting of controller.	*Set:* Heatsink temperature above +95°C. *Clear:* Bring heatsink temperature below +95°C, and cycle interlock or KSI.
17 (Status2,1)	**Severe B+ Undervoltage** *No drive torque.*	1. Battery parameters are misadjusted. 2. Non-controller system drain on battery. 3. Battery resistance too high. 4. Battery disconnected while driving. 5. See Monitor menu » Battery: Capacitor Voltage. 6. Blown B+ fuse or main contactor did not close.	*Set:* Capacitor bank voltage dropped below the Severe Undervoltage limit (see page 25) with FET bridge enabled. *Clear:* Bring capacitor voltage above Severe Undervoltage limit.
17 (Status8,4)	**Severe KSI Undervoltage** *No action.*	1. See Monitor menu » Battery: Keyswitch Voltage. 2. Non-controller system drain on battery/ KSI circuit wiring. 3. KSI disconnected while driving. 4. Blown KSI fuse.	*Set:* When below Brownout Voltage for 2 seconds (see Table D-1). *Clear:* Bring KSI voltage above Brownout Voltage.
18 (Status2,2)	**Severe B+ Overvoltage** *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake.*	1. See Monitor menu » Battery: Capacitor Voltage. 2. Battery parameters are misadjusted. 3. Battery resistance too high for given regen current. 4. Battery disconnected while regen braking.	*Set:* Capacitor bank voltage exceeded the Severe Overvoltage limit (see page 25) with FET bridge enabled. *Clear:* Bring capacitor voltage below Severe Overvoltage limit, and then cycle KSI.

Table 6 TROUBLESHOOTING CHART, cont'd

CODE (status#,bit	PROGRAMMER LCD DISPLAY *EFFECT OF FAULT*	POSSIBLE CAUSE	SET / CLEAR CONDITIONS
19 (Status9, bit3)	**PMAC Commissioning Needed** Hold all three phases at 50% PWM and disables main weld and DNC faults.	The PMAC Commissioning Procedure has not yet been performed to set up the controller for a new PMAC motor.	*Set:* PMAC Commissioning Needed parameter set to 1. *Clear:* PMAC Commissioning Needed parameter set to 0.
22 (Status2,6)	**Controller Overtemp Cutback** *Reduced drive and brake torque.*	1. See Monitor menu » Controller: Temperature. 2. Controller is performance-limited at this temperature. 3. Controller is operating in an extreme environment. 4. Excessive load on vehicle. 5. Improper mounting of controller.	*Set:* Heatsink temperature exceeded 85°C. *Clear:* Bring heatsink temperature below 85°C.
23 (Status2,3)	**B+ Undervoltage Cutback** *Reduced drive torque.*	1. Normal operation. Fault indicates the batteries need recharging. Controller is performance limited at this voltage. 2. Battery parameters are misadjusted. 3. Non-controller system drain on battery. 4. Battery resistance too high. 5. Battery disconnected while driving. 6. See Monitor menu » Battery: Capacitor Voltage. 7. Blown B+ fuse or main contactor did not close.	*Set:* Capacitor bank voltage dropped below the Undervoltage limit (see page 25) with the FET bridge enabled. *Clear:* Bring capacitor voltage above the Undervoltage limit.
24 (Status2,4)	**B+ Overvoltage Cutback** *Reduced brake torque. Note: This fault is declared only when the controller is running in regen.*	1. Normal operation. Fault shows that regen braking currents elevated the battery voltage during regen braking. Controller is performance limited at this voltage. 2. Battery parameters are misadjusted. 3. Battery resistance too high for given regen current. 4. Battery disconnected while regen braking. 5. See Monitor menu » Battery: Capacitor Voltage.	*Set:* Capacitor bank voltage exceeded the Overvoltage limit (see page 25) with the FET bridge enabled. *Clear:* Bring capacitor voltage below the Overvoltage limit.
25 (Status5,3)	**+5V Supply Failure** *None, unless a fault action is programmed in VCL.*	1. External load impedance on the +5V supply (pin 26) is too low. 2. See Monitor menu » outputs: 5 volts and Ext Supply Current.	*Set:* +5V supply (pin 26) outside the 5V±10% range. *Clear:* Bring voltage within range.
26 (Status4,1)	**Digital Out 6 Overcurrent** *Digital Output 6 driver will not turn on.*	1. External load impedance on Digital Output 6 driver (pin 19) is too low.	*Set:* Digital Output 6 (pin 19) current exceeded 1 Amp. *Clear:* Remedy the overcurrent cause and use the VCL function *Set_DigOut()* to turn the driver on again.
27 (Status4,2)	**Digital Out 7 Overcurrent** *Digital Output 7 driver will not turn on.*	1. External load impedance on Digital Output 7 driver (pin 20) is too low.	*Set:* Digital Output 7 (pin 20) current exceeded 1 Amp. *Clear:* Remedy the overcurrent cause and use the VCL function *Set_DigOut()* to turn the driver on again.

Table 6 TROUBLESHOOTING CHART, cont'd

CODE (status#,bit	PROGRAMMER LCD DISPLAY *EFFECT OF FAULT*	POSSIBLE CAUSE	SET / CLEAR CONDITIONS
28 (Status4,5)	**Motor Temp Hot Cutback** *Reduced drive torque.*	1. Motor temperature is at or above the programmed Temperature Hot setting, and the current is being cut back. 2. Motor Temperature Control Menu parameters are mistuned. 3. See Monitor menu » Motor: Temperature and » Inputs: Analog2. 4. If the application doesn't use a motor thermistor, Temp Compensation and Temp Cutback should be programmed Off.	*Set:* Motor temperature is at or above the Temperature Hot parameter setting. *Clear:* Bring the motor temperature within range.
29 (Status5,1)	**Motor Temp Sensor Fault** *MaxSpeed reduced (LOS, Limited Operating Strategy), and motor temperature cutback disabled.*	1. Motor thermistor is not connected properly. 2. If the application doesn't use a motor thermistor, Motor Temp Sensor Enable should be programmed Off. 3. See Monitor menu » Motor: Temperature and » Inputs: Analog2.	*Set:* Motor thermistor input (pin 8) is at the voltage rail (0V or 10V). *Clear:* Bring the motor thermistor input voltage within range.
31 (Status3,1)	**Coil1 Driver Open/Short** *ShutdownDriver1.*	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	*Set:* Driver 1 (pin 6) is either open or shorted. This fault can be set only when Main Enable = Off. *Clear:* Correct open or short, and cycle driver.
31 (Status3,6)	**Main Open/Short** *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake.*	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	*Set:* Main contactor driver (pin 6) is either open or shorted. This fault can be set only when Main Enable = On. *Clear:* Correct open or short, and cycle driver.
32 (Status3,2)	**Coil2 Driver Open/Short** *ShutdownDriver2.*	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	*Set:* Driver 2 (pin 5) is either open or shorted. This fault can be set only when EM Brake Type = 0. *Clear:* Correct open or short, and cycle driver.
32 (Status3,7)	**EMBrake Open/Short** *ShutdownEMBrake; ShutdownThrottle; FullBrake.*	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	*Set:* Electromagnetic brake driver (pin 5) is either open or shorted. This fault can be set only when EM Brake Type >0. *Clear:* Correct open or short, and cycle driver.
33 (Status3,3)	**Coil3 Driver Open/Short** *ShutdownDriver3.*	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	*Set:* Driver 3 (pin 4) is either open or shorted. *Clear:* Correct open or short, and cycle driver.
34 (Status3,4)	**Coil4 Driver Open/Short** *ShutdownDriver4.*	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	*Set:* Driver 4 (pin 3) is either open or shorted. *Clear:* Correct open or short, and cycle driver.
35 (Status3,5)	**PD Open/Short** *ShutdownPD.*	1. Open or short on driver load. 2. Dirty connector pins. 3. Bad crimps or faulty wiring.	*Set:* Proportional driver (pin 2) is either open or shorted. *Clear:* Correct open or short, and cycle driver.
36 (Status5,6)	**Encoder Fault** *ShutdownEMBrake;* Motor disabled.	1. Motor encoder failure. One or both inputs. 2. Bad crimps or faulty wiring. 3. See Monitor menu » Motor: Motor RPM.	*Set:* Motor encoder phase failure detected. *Clear:* Either cycle KSI, or if parameter LOS Upon Encoder Fault= On and Interlock has been cycled, then the Encoder Fault is cleared and Encoder LOS fault (code 93) is set, allowing limited motor control.

Table 6 TROUBLESHOOTING CHART, cont'd

CODE (status#,bit	PROGRAMMER LCD DISPLAY *EFFECT OF FAULT*	POSSIBLE CAUSE	SET / CLEAR CONDITIONS
37 (Status4,7)	**Motor Open** *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake.*	1. Motor phase is open. 2. Bad crimps or faulty wiring.	*Set:* Motor phase U, V, or W detected open. *Clear:* Cycle KSI.
38 (Status1,0)	**Main Contactor Welded** *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake.*	1. Main contactor tips are welded closed. 2. Motor phase U or V is disconnected or open. 3. An alternate voltage path (such as an external precharge resistor) is providing a current to the capacitor bank (B+ connection terminal).	*Set:* Just prior to the main contactor closing, the capacitor bank voltage (B+ connection terminal) was loaded for a short time and the voltage did not discharge. *Clear:* Cycle KSI.
39 (Status1,1)	**Main Contactor Did Not Close** *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake.*	1. Main contactor did not close. 2. Main contactor tips are oxidized, burned, or not making good contact.* 3. External load on capacitor bank (B+ connection terminal) that prevents capacitor bank from charging. 4. Blown B+ fuse.	*Set:* With the main contactor commanded closed, the capacitor bank voltage (B+ connection terminal) did not charge to B+. *Clear:* Cycle KSI. *New contactors may need to be cycled electrically & mechanically to remove any non-conductive material on the tips. Use reduced voltage (e.g., 12V) to prevent tip damage through excessive arcing.
41 (Status1,4)	**Throttle Wiper High** *ShutdownThrottle.*	1. See Monitor menu » Inputs: Throttle Pot. 2. Throttle pot wiper voltage too high.	*Set:* Throttle pot wiper (pin 16) voltage is higher than the high fault threshold (can be changed with the VCL function *Setup_Pot_Faults()*). *Clear:* Bring throttle pot wiper voltage below the fault threshold.
42 (Status1,3)	**Throttle Wiper Low** *ShutdownThrottle.*	1. See Monitor menu » Inputs: Throttle Pot. 2. Throttle pot wiper voltage too low.	*Set:* Throttle pot wiper (pin 16) voltage is lower than the low fault threshold (can be changed with the VCL function *Setup_Pot_Faults()*). *Clear:* Bring throttle pot wiper voltage above the fault threshold.
43 (Status1,6)	**Pot2 Wiper High** *No Action*	1. See Monitor menu » Inputs: Pot2 Raw. 2. Pot2 wiper voltage too high.	*Set:* Pot2 wiper (pin 17) voltage is higher than the high fault threshold (can be changed with the VCL function *Setup_Pot_Faults()*). *Clear:* Bring Pot2 wiper voltage below the fault threshold.
44 (Status1,5)	**Pot2 Wiper Low** *No Action*	1. See Monitor menu » Inputs: Pot2 Raw. 2. Pot2 wiper voltage too low.	*Set:* Pot2 wiper (pin 17) voltage is lower than the low fault threshold (can be changed with the VCL function *Setup_Pot_Faults()*). *Clear:* Bring Pot2 wiper voltage above the fault threshold.
45 (Status1,2)	**Pot Low OverCurrent** *No Action.* (Does not shut down the pot's low-current source.)	1. See Monitor menu » Outputs: Pot Low. 2. Combined pot resistance connected to pot low is too low.	*Set:* Pot low (pin 18) current exceeds 10 mA. *Clear:* Clear pot low overcurrent condition and/ or cycle KSI.
46 (Status1,7)	**EEPROM Failure** *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; ShutdownInterlock; ShutdownDriver1; ShutdownDriver2; ShutdownDriver3; ShutdownDriver4; ShutdownPD; FullBrake.*	1. Failure to write to EEPROM memory. This can be caused by EEPROM memory writes initiated by VCL, by the CAN bus, by adjusting parameters with the programmer, or by loading new software into the controller.	*Set:* Controller operating system tried to write to EEPROM memory and failed. *Clear:* Download the correct software (OS) and matching parameter default settings into the controller and cycle KSI.

Table 6 TROUBLESHOOTING CHART, cont'd

CODE (status#,bit	PROGRAMMER LCD DISPLAY *EFFECT OF FAULT*	POSSIBLE CAUSE	SET / CLEAR CONDITIONS
47 (Status2,0)	**HPD/Sequencing Fault** *ShutdownThrottle.*	1. KSI, interlock, direction, and throttle inputs applied in incorrect sequence. 2. Faulty wiring, crimps, or switches at KSI, interlock, direction, or throttle inputs. 3. See Monitor menu » Inputs.	*Set:* HPD (High Pedal Disable) or sequencing fault caused by incorrect sequence of KSI, interlock, direction, and throttle inputs. *Clear:* Reapply inputs in correct sequence.
47 (Status6,2)	**Emer Rev HPD** *ShutdownThrottle; ShutdownEMBrake.*	4. Emergency Reverse operation has concluded, but the throttle, forward and reverse inputs, and interlock have not been returned to neutral.	*Set:* At the conclusion of Emergency Reverse, the fault was set because various inputs were not returned to neutral. *Clear:* If EMR_Interlock = On, clear the interlock, throttle, and direction inputs. If EMR_Interlock = Off, clear the throttle and direction inputs.
49 (Status4,6)	**Parameter Change Fault** *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake.*	1. This is a safety fault caused by a change in certain parameter settings so that the vehicle will not operate until KSI is cycled. For example, if a user changes the Throttle Type this fault will appear and require cycling KSI before the vehicle can operate.	*Set:* Adjustment of a parameter setting that requires cycling of KSI. *Clear:* Cycle KSI.
51-67	**OEM Faults** *(See OEM documentation.)*	1. These faults can be defined by the OEM and are implemented in the application-specific VCL code. See OEM documentation.	*Set:* See OEM documentation. *Clear:* See OEM documentation.
68 (Status5,2)	**VCL Run Time Error** *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; ShutdownInterlock; ShutdownDriver1; ShutdownDriver2; ShutdownDriver3; ShutdownDriver4; ShutdownPD; FullBrake.*	1. VCL code encountered a runtime VCL error. 2. See Monitor menu » Controller: VCL Error Module and VCL Error. This error can then be compared to the runtime VCL module ID and error code definitions found in the specific OS system information file.	*Set:* Runtime VCL code error condition. *Clear:* Edit VCL application software to fix this error condition; flash the new compiled software and matching parameter defaults; cycle KSI.
69 (Status5,0)	**External Supply Out of Range** *None, unless a fault action is programmed in VCL.*	1. External load on the 5V and 12V supplies draws either too much or too little current. 2. Fault Checking Menu parameters Ext Supply Max and Ext Supply Min are mistuned. 3. See Monitor menu » Outputs: Ext Supply Current.	*Set:* The external supply current (combined current used by the 5V supply [pin 26] and 12V supply [pin 25]) is either greater than the upper current threshold or lower than the lower current threshold. The two thresholds are defined by the External Supply Max and External Supply Min parameter settings (page 55). *Clear:* Bring the external supply current within range.
71 (Status5,4)	**OS General** *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; ShutdownInterlock; ShutdownDriver1; ShutdownDriver2; ShutdownDriver3; ShutdownDriver4; ShutdownPD; FullBrake.*	1. Internal controller fault.	*Set:* Internal controller fault detected. *Clear:* Cycle KSI.
72 (Status5,5)	**PDO Timeout** *ShutdownThrottle;* CAN NMT State set to Pre-operational.	1. Time between CAN PDO messages received exceeded the PDO Timeout Period.	*Set:* Time between CAN PDO messages received exceeded the PDO Timeout Period. *Clear:* Cycle KSI or receive CAN NMT message.

Table 6 TROUBLESHOOTING CHART, cont'd

CODE (status#,bit	PROGRAMMER LCD DISPLAY *EFFECT OF FAULT*	POSSIBLE CAUSE	SET / CLEAR CONDITIONS
73 (Status5,7)	**Stall Detected** *ShutdownEMBrake;* Motor disabled; Control Mode changed to LOS (Limited Operating Strategy).	1. Stalled motor (motor current insufficient to move the vehicle, for example up a steep hill or over-loaded). 2. Motor encoder failure (no feedback received at the controller). 3. Bad crimps or faulty wiring. 4. Problems with power supply for the motor encoder. 5. See Monitor menu » Motor: Motor RPM.	*Set:* No motor encoder movement detected (no motor speed), yet controller is requesting current (throttle command). *Clear:* Either cycle KSI, or if parameter LOS Upon Encoder Fault = On and Interlock has been cycled, then the Stall Detected fault is cleared and Encoder LOS fault (code 93) is set, allowing limited motor control.
74 (Status7,6)	**Fault On Other Traction Controller**	1. Dual Drive fault: see Dual Drive manual.	
75 (Status7,5)	**Dual Severe Fault**	1. Dual Drive fault: see Dual Drive manual.	
77 (Status6,5)	**Supervisor Fault** *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; ShutdownInterlock; ShutdownDriver1; ShutdownDriver2; ShutdownDriver3; ShutdownDriver4; ShutdownPD; FullBrake.*	1. The Supervisor has detected a mismatch in redundant readings. 2. Internal damage to Supervisor microprocessor. 3. Switch inputs allowed to be within upper and lower thresholds for over 100 milliseconds (for recurring errors, check the switches for moisture).	*Set:* Mismatched redundant readings; damaged Supervisor; illegal switch inputs. *Clear:* Check for noise or voltage drift in all switch inputs; check connections; Cycle KSI or VCL reset.
78 (Status9,0)	**Supervisor Incompatible** *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; ShutdownInterlock; ShutdownDriver1; ShutdownDriver2; ShutdownDriver3; ShutdownDriver4; ShutdownPD; FullBrake.*	1. The main OS is not compatible with the Supervisor OS.	*Set:* Incompatible software. *Clear:* Load properly matched OS code or update the Supervisor code; cycle KSI.
82 (Status6,0)	**Bad Calibrations** *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake.*	1. Internal controller fault.	*Set:* Internal controller fault detection. *Clear:* Cycle KSI or perform a VCL reset.
83 (Status9,6)	**Driver Supply** *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake.*	1. Internal controller fault in the voltage supply for the driver circuits.	*Set:* Internal controller fault detection. *Clear:* Cycle KSI or perform a VCL reset.

Table 6 TROUBLESHOOTING CHART, cont'd

CODE (status#,bit	PROGRAMMER LCD DISPLAY *EFFECT OF FAULT*	POSSIBLE CAUSE	SET / CLEAR CONDITIONS
87 (Status6,6)	**Motor Characterization Fault** *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake.*	1. Motor characterization failed during characterization process. See Monitor menu » Controller: Motor Characterization Error for cause: 0 = Sequencing error. Normally caused by turning off Motor Characterization Test Enable before running the test. 1 = Encoder signal seen but step size not auto-detected; set up Encoder Steps manually. 2 = Motor temp sensor fault. 3 = Motor temp hot cutback fault. 4 = Controller overtemp cutback fault. 5 = Controller undertemp cutback fault. 6 = Undervoltage cutback fault. 7 = Severe overvoltage fault. 8 = Encoder signal not seen, or one or both channels missing. 9 = Motor parameters out of characterization range. 20 = Sin/Cos sensor not found. 21 = Phasing not detected. 22 = Sin/Cos sensor characterization failure. 23 = Started characterization procedure while motor rotating.	*Set:* Motor characterization failed during the motor characterization process. Normally caused by turning off Motor_Characterization_Test_Enable before running test. Needs controller reset. *Clear:* Correct fault; Cycle KSI or perform a VCL reset.
88 (Status8,7)	**Encoder Pulse Count Fault** *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; ShutdownInterlock; ShutdownDriver1; ShutdownDriver2; ShutdownDriver3; ShutdownDriver4; ShutdownPD; FullBrake.*	1. Encoder Steps parameter does not match the actual motor encoder.	*Set:* Detected wrong setting of the Encoder Steps parameter. *Clear:* Ensure the Encoder Steps parameter matches the actual encoder; cycle KSI.
88 (Status2, bit5)	**Sin/Cos Sensor Fault** *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake.* — SinCos Sensor Misaligned Sin_Cos_Motor_Feedback_Fault	The relationship between the rotor magnets in a PMAC motor and the Sin/Cos sensor has shifted away from the value determined by the Commissioning process.	*Set:* The battery current significantly disagrees with the commanded torque and speed. *Clear: Cycle KSI and* Repeat the PMAC commissioning process or repair the Sin/Cos sensor.
89 (Status6,4)	**Motor Type Fault** *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake.*	2. The *Motor_Type* parameter value is out of range for the loaded OS (e.g., os37.0).	*Set: Motor_Type* parameter is set to an incorrect (for the loaded OS) value. *Clear:* Set *Motor_Type* to correct value and cycle KSI.

Table 6 TROUBLESHOOTING CHART, cont'd

CODE (status#,bit	PROGRAMMER LCD DISPLAY *EFFECT OF FAULT*	POSSIBLE CAUSE	SET / CLEAR CONDITIONS
91 (Status7,1)	**VCL/OS Mismatch** *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; ShutdownInterlock; ShutdownDriver1; ShutdownDriver2; ShutdownDriver3; ShutdownDriver4; ShutdownPD; FullBrake.*	1. The VCL software in the controller does not match the OS software in the controller.	*Set:* VCL and OS software do not match; when KSI cycles, a check is made to verify that they match and a fault is issued when they do not. *Clear:* Download the correct VCL and OS software into the controller.
92 (Status7,2)	**EM Brake Failed to Set** Position Hold is engaged when Interlock = On. Follows the Position Hold parameter settings, including the Position Hold Timeout Time.	1. Vehicle movement sensed after the EM Brake has been commanded to set. 2. EM Brake will not hold the motor from rotating.	*Set:* After the EM Brake was commanded to set and time has elapsed to allow the brake to fully engage, vehicle movement has been sensed. *Clear:* 1. Activate the Throttle (EM Brake type 2). 2. Activate the Interlock (EM Brake type 1).
93 (Status7,3)	**Encoder LOS (Limited Operating Strategy)** Enter LOS control mode. NO_ACTION, in LOS mode.	1. Limited Operating Strategy (LOS) control mode has been activated, as a result of either an Encoder Fault (Code 36) or a Stall Detected fault (Code 73). 2. Motor encoder failure. 3. Bad crimps or faulty wiring. 4. Vehicle has stalled.	*Set:* Encoder Fault (code 36) or Stall Detected (code 73) was activated, if parameter LOS Upon Encoder Fault = On and Interlock has been cycled, then the Encoder LOS (code 93) control mode is activated, allowing limited motor control. *Clear:* Cycle KSI or, if LOS mode was activated by the Stall Detected fault, clear by ensuring encoder senses proper operation, Motor RPM = 0, and Throttle Command = 0.
94 (Status7,4)	**Emer Rev Timeout** *ShutdownEMBrake; ShutdownThrottle.*	1. Emergency Reverse was activated and concluded because the EMR Timeout timer has expired. 2. The emergency reverse input is stuck On.	*Set:* Emergency Reverse was activated and ran until the EMR Timeout timer expired. *Clear:* Turn the emergency reverse input Off.
98 (Status7,7)	**Illegal Model Number** *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake.*	1. The model number (*Model_Number*) must be 1232, 1234, 1236, 1238, 1239 or 1298 or E or SE variant. See model list in Appendix D, Table D-1. 2. Software and hardware do not match. 3. Controller defective.	*Set:* Illegal Model_Number variable; when KSI cycles, a check is made to confirm a legal Model_ Number, and a fault is issued if one is not found. *Clear:* Download the appropriate software for the controller model (may require a newer version of the OS, beyond this manual's OS version).
99 (Status8,3)	**Parameter Mismatch** *ShutdownMotor; ShutdownMainContactor; ShutdownEMBrake; ShutdownThrottle; FullBrake.*	1. Dual drive enabled on only one controller. 2. Incorrect position feedback type chosen for motor technology in use. 3. Dual drive is enabled in torque mode. 4. Controller hardware incompatible with PMAC operation or with the selected PMAC motor. 5. This Control Mode does not support EM Brake Control. 6. This Control Mode does not support Interlock Braking. 7. Reserved. 8. Controller/motor incompatibility. PMAC motor short circuit current too high for controller. 9. This controller not compatible with released IPM PMAC software (no xconnect, and not a 1239E). 10. Can't run Restricted Operation Mode on this motor (incomplete Motor Type).	*Set:* Multiple set conditions, see: *Monitor » Controller » Parameter Mismatch Error.* *Clear*: Adjust parameters to appropriate values and cycle KSI.

12 — MAINTENANCE

There are no user serviceable parts in Curtis E/SE controllers. No attempt should be made to open, repair, or otherwise modify the controller. Doing so may damage the controller and will void the warranty.

It is recommended that the controller and connections be kept clean and dry and that the controller's fault history file be checked and cleared periodically.

CLEANING

Periodically cleaning the controller exterior will help protect it against corrosion and possible electrical control problems created by dirt, grime, and chemicals that are part of the operating environment and that normally exist in battery powered systems.

⚠ CAUTION

When working around any battery powered system, proper safety precautions should be taken. These include, but are not limited to: proper training, wearing eye protection, and avoiding loose clothing and jewelry.

Use the following cleaning procedure for routine maintenance. Never use a high pressure washer to clean the controller.

1. Remove power by disconnecting the battery.
2. Discharge the capacitors in the controller by connecting a load (such as a contactor coil) across the controller's B+ and B– terminals.
3. Remove any dirt or corrosion from the power and signal connector areas. The controller should be wiped clean with a moist rag. Dry it before reconnecting the battery.
4. Make sure the connections are tight. Refer to Chapter 2 for maximum tightening torque specifications for the battery and motor connections.

FAULT HISTORY

The 1313 handheld or 1314 PC programmer can be used to access the controller's fault history file. The programmer will read out all the faults the controller has experienced since the last time the fault history file was cleared. Faults such as contactor faults may be the result of loose wires; contactor wiring should be carefully checked. Faults such as overtemperature may be caused by operator habits or by overloading.

After a problem has been diagnosed and corrected, it is a good idea to clear the fault history file. This allows the controller to accumulate a new file of faults. By checking the new fault history file at a later date, a technician can readily determine whether the problem was indeed fixed.

APPENDIX A

VEHICLE DESIGN CONSIDERATIONS

ELECTROMAGNETIC COMPATIBILITY (EMC)

Electromagnetic Compatibility (EMC) encompasses two areas: emissions and immunity. Emissions are radio frequency (RF) energy generated by a product. This energy has the potential to interfere with communications systems such as radio, television, cellular phones, dispatching, aircraft, etc. Immunity is the ability of a product to operate as intended in the presence of RF energy generated by other sources as well as itself. EN12895 is the relevant EMC standard for the CE marking of industrial trucks intended for sale in Europe and some other countries.

EMC Compliance is ultimately a system requirement. Part of the EMC performance is designed into or inherent in each component of a system; another part is designed into or inherent in end product/system characteristics such as shielding, wire routing, individual component layout and a portion is a function of the interactions between all these parts. The techniques presented below can help reduce the risk of EMC problems in products that incorporate Curtis motor controllers.

Emissions

High frequency signals can produce RF emissions that are measurable during Radiated Emissions testing. Long cable and wire harness runs essentially become antennas for the emissions to travel. Therefore, emission reduction techniques include making the battery and motor cables as short as possible. Minimize the lengths of the AMPseal connector's wire harness runs and the formation of wire loops. Further emission decreases may include using shielded cables or ferrites on the control wires and twisting the motor and battery cables. Route the battery and AC motor cables separate from the control wires. When separating control wires and the battery/motor cable routing is not possible, cross them at right angles.

RF Immunity

Radiated immunity problems may occur when the controller is located close to other devices generating high RF energy. Possible ways to help prevent other devices from interfering with a Curtis controller include:

- Placing the controller as far as possible from such noise sources.
- Shield the controller from the noise.
- Enclose the controller in a metal box and add proper ferrites to all cabling entering and leaving it.
- Other possible solutions include the use of ferrite beads at the RF noise source(s) to prevent the noise from traveling along the wiring harness and cross conducting onto sensitive wires and common connections.

ELECTROSTATIC DISCHARGE (ESD) IMMUNITY

Curtis motor controllers contain ESD-sensitive components. It is therefore necessary to protect them from ESD damage. See Table 4 for the controller ESD ratings.

Improve ESD immunity by either providing sufficient distance or isolation between conductors and the ESD source so that a discharge will not occur.

DECOMMISSIONING AND RECYCLING THE CONTROLLER

The controller is for installation into an Original Equipment Manufacturer (OEM) vehicle. As a component, it has no function unless installed as part of a vehicle's electrical or electro-hydraulic control system.

For controller decommissioning and recycling:

1. Follow the OEM's vehicle decommissioning instructions.
2. Follow all applicable landfill directives or regulations for Electrical and Electronic Equipment (EEE) waste.

APPENDIX B

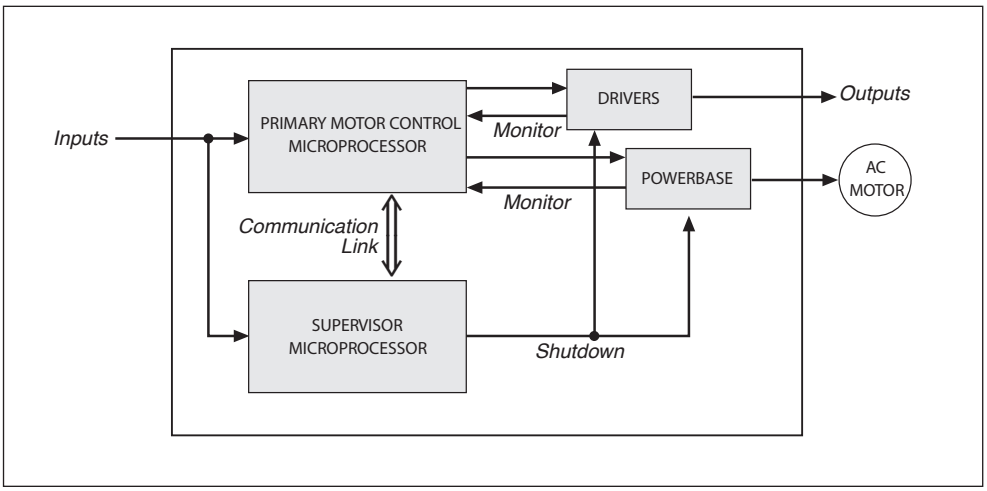
EN13849 COMPLIANCE

Since January 1, 2012, conformance to the European Machinery Directive has required that the Safety Related Parts of the Control System (SRPCS) be designed and verified upon the general principles outlined in EN13849. EN13849 supersedes the EN954 standard and expands upon it by requiring the determination of the safety Performance Level (PL) as a function of Designated Architecture plus Mean Time To Dangerous Failure (MTTFd), Common Cause Faults (CCF), and Diagnostic Coverage (DC). These figures are used by the OEM to calculate the overall PL for each of the safety functions of their vehicle or machine.

The OEM must determine the hazards that are applicable to their vehicle design, operation, and environment. Standards such as EN13849-1 provide guidelines that must be followed in order to achieve compliance. Some industries have developed further standards (called type-C standards) that refer to EN13849 and specifically outline the path to regulatory compliance. EN1175-1 is a type-C standard for battery-powered industrial trucks. Following a type-C standard provides a presumption of conformity to the Machinery Directive.

Curtis Enhanced AC Motor Controllers comply with these directives using advanced active supervisory techniques. The basic "watchdog" test circuits have been replaced with a Supervisor microcontroller that continuously tests the safety related parts of the control system; see the simplified block diagram in Figure B-1.

Figure B-1
Supervisory system in Curtis enhanced AC motor controllers.



The Supervisor and Primary motor control processors run diagnostic checks at startup and continuously during operation. At startup, the integrity of the code and EEPROM are ensured through CRC checksum calculations. RAM is pattern checked for proper read, write, and addressing. During operation, the arithmetic and logic processing unit of each micro is cyclically tested through dynamic stimulus and response. The operating system timing and task sequencing are continuously verified. Redundant input measurements are crosschecked over 30 times per second, and operational status information is passed between microprocessors to keep the system synchronized. Any faults in these startup tests, communication timing, crosschecks, or responses will command a safe shutdown of the controller, disabling the driver outputs and motor drive within 200 ms.

To mitigate the hazards typically found in machine operations, EN13849 requires that safety functions be defined; these must include all the input, logic, outputs, and power circuits that are involved in any potentially hazardous operation. Two safety functions are defined for Curtis Enhanced AC Motor Controllers: Uncommanded Powered Motion and Motor Braking Torque.

The Uncommanded Powered Motion safety function provides detection and safe shutdown in the following circumstances: faulted throttle; improper sequence of forward/reverse switches, throttle, and interlock; incorrect direction of travel; loss of speed control or limiting; uncommanded movement; or movement at start-up. The Braking Torque safety function provides detection and safe shutdown in the event of the loss of braking torque, position/hill hold, or emergency reverse.

Curtis has analyzed each safety function and calculated its Mean Time To Dangerous Failure (MTTFd) and Diagnostic Coverage (DC), and designed them against Common Cause Faults (CCF). The safety-related performance of the 1232E controller is summarized as follows:

Safety Function	Designated Architecture	MTTFd	DC	CCF	PL
Uncommanded Powered Motion	2	>40 yrs	>90%	Pass	d
Motor Braking Torque	2	>16 yrs	>90%	Pass	c

EN1175 specifies that traction and hydraulic electronic control systems must use **Designated Architecture 2** or greater. This design employs input, logic, and output circuits that are monitored and tested by independent circuits and software to ensure a high level of safety performance (up to PL=d).

Mean Time To Dangerous Failure (MTTFd) is related to the expected reliability of the safety related parts used in the controller. Only failures that can result in a dangerous situation are included in the calculation.

Diagnostic Coverage (DC) is a measure of the effectiveness of the control system's self-test and monitoring measures to detect failures and provide a safe shutdown.

Common Cause Faults (CCF) are so named because some faults within a controller can affect several systems. EN13849 provides a checklist of design techniques that should be followed to achieve sufficient mitigation of CCFs. The CCF value is a pass/fail criterion.

Performance Level (PL) categorizes the quality or effectiveness of a safety channel to reduce the potential risk caused by dangerous faults within the system with "a" being the lowest and "e" being the highest achievable performance.

APPENDIX C

PROGRAMMING DEVICES

Curtis programmers provide programming, diagnostic, and test capabilities for the controller. The power for operating the programmer is supplied by the host controller via a 4-pin connector. When the programmer powers up, it gathers information from the controller.

Two types of programming devices are available: the 1314 PC Programming Station and the 1313 handheld programmer. The Programming Station has the advantage of a large, easily read screen; on the other hand, the handheld programmer (with its 45×60mm screen) has the advantage of being more portable and hence convenient for making adjustments in the field.

Both programmers are available in User, Service, Dealer, and OEM versions. Each programmer can perform the actions available at its own level and the levels below that—a User-access programmer can operate at only the User level, whereas an OEM programmer has full access.

PC PROGRAMMING STATION (1314)

The Programming Station is an MS-Windows 32-bit application that runs on a standard Windows PC. Instructions for using the Programming Station are included with the software. In addition, the Curtis 1309 Interface box with a computer-side USB and controller-side 4-pin serial Molex connection is required for the 1314 PC Programmer.

HANDHELD PROGRAMMER (1313)

The 1313 handheld programmer is functionally equivalent to the PC Programming Station; operating instructions are provided in the 1313 manual. This programmer replaces the 1311, an earlier model with fewer functions.

PROGRAMMER FUNCTIONS

Programmer functions include:

Parameter adjustment — provides access to the individual programmable parameters.

Monitoring — presents real-time values during vehicle operation; these include all inputs and outputs.

Diagnostics and troubleshooting — presents diagnostic information, and also a means to clear the fault history file.

Programming — allows the user to save/restore custom parameter settings.

Favorites — allows the user to create shortcuts to the frequently-used adjustable parameters and monitor variables (1313 only).

APPENDIX D

CONTROLLER SPECIFICATIONS

Table D-1 SPECIFICATIONS: 1232E/SE, 1234E/SE, 1236E/SE, 1238E/SE CONTROLLERS[1]

Nominal input voltage: 24 V, 24–36 V, 36–48 V, 48–80 V, 72–96 V

NOMINAL VOLTAGE	MINIMUM VOLTAGE	MAXIMUM VOLTAGE	BROWNOUT VOLTAGE
24 V	14 V	30 V	12 V
24–36 V	16.8 V	50 V	15 V
36–48 V	22.2 V	60 V	20 V
48–80 V	33.6 V	105 V	20 V
72–96 V	50.4 V	120 V	30 V

PWM operating frequency: 10 kHz

Maximum encoder frequency: 10 kHz

Maximum controller output frequency: 450 Hz

Electrical isolation to heatsink: 500 V ac (minimum)

Storage ambient temperature range: –40°C to 95°C (–40°F to 203°F)

Operating ambient temperature range: –40°C to 50°C (–40°F to 122°F)

Thermal cutback: Controller linearly reduces maximum current limit with an internal heatsink temperature from 85°C (185°F) to 95°C (203°F); complete cutoff occurs above 95°C (203°F) and below –40°C (–40°F).

Design life: *1238E-75XX, 1238E-76XX, and 1238SE-79XX:* 5,000 hours
All other models: 20,000 hours.

Operating duration at maximum current: 2 minutes minimum (unless otherwise noted), with initial temperature of 25°C and no additional external heatsink.

Package environmental rating: IP65 per IEC529; compliance requires AMPSEAL 35-pin connector header.

Weight:
1232E: 1.70 kg *1232SE*: 1.92 kg
1234E: 2.84 kg *1234SE*: 3.12 kg
1236E: 4.12 kg *1236SE*: 3.79 kg
1238E: 6.82 kg *1238SE*: 6.00 kg

Dimensions, W×L×H:
1232E: 140 × 180 × 71 mm *1232SE*: 140 × 180 × 74 mm
1234E: 155 × 212 × 75 mm *1234SE*: 155 × 212 × 79 mm
1236E: 165 × 232 × 85 mm *1236SE*: 165 × 232 × 85 mm
1238E: 275 × 232 × 85 mm *1238SE*: 275 × 232 × 85 mm

EMC: Designed to the requirements of EN 12895:2000.

Safety: Designed to the requirements of EN 1175-1:1998 + A1:2010 and EN 13849-1:2008 Category 2.

UL: UL recognized component per UL583.

Note: Regulatory compliance of the complete vehicle system with the controller installed is the responsibility of the OEM.

[1] Controller models 123X/SE -xx7x are the only controllers compatible for PMAC applications. Reference the PMAC motor parameter and commissioning sections for further information. These models are not specifically listed in Table D-1.

Table D-1 SPECIFICATIONS: 1232E/SE, 1234E/SE, 1236E/SE, 1238E/SE CONTROLLERS, cont'd

MODEL CHART				
MODEL NUMBER	NOMINAL BATTERY VOLTAGE (V)	MAXIMUM CURRENT (A)	S2–60 MINUTE CONTINUOUS CURRENT (A)	CONTINUOUS CURRENT FOR DESIGN LIFE (A)
1232E-21XX	24	180	90	80
1232E-23XX	24	250	125	100
1232E-41XX	24-36	150	75	79
1232E-51XX	36–48	150	75	79
1232E-52XX	36–48	200	100	90
1232E-62XX	48–80	175	80	45
1232E-72XX	72–96	175	80	50
1234E-23XX	24	350	175	160
1234E-52XX	36–48	275	135	90
1234E-53XX	36–48	350	175	90
1234E-62XX	48–80	250	110	60
1236E-44XX	24–36	400	175	175
1236E-45XX	24–36	500	240	210
1236E-54XX	36–48	450	205	210
1236E-55XX	36–48	550	250	140
1236E-64XX	48–80	350 (1 min)	100	100
1238E-46XX	24–36	650	300	325
1238E-48XX	24–36	800	355	365
1238E-56XX	36–48	650	295	325
1238E-64XX	48–80	450	155	175
1238E-65XX	48–80	550	190	175
1238E-66XX	48–80	650 (1 min)	195	175
1238E-75XX	72–96	550	175	175
1238E-76XX	72–96	650	200	175
1232SE-24XX	24	375	185	160
1232SE-53XX	36–48	350	175	160
1232SE-63XX	48-80	250	144	125
1234SE-45XX	24–36	500	235	210
1234SE-54XX	36–48	450	215	210
1234SE-63XX	48–80	350	149	175
1236SE-46XX	24–36	650	285	220
1236SE-56XX	36–48	600	260	210
1236SE-65XX	48–80	450	185	175
1238SE-49XX	24–36	1000*	425	376
1238SE-59XX	36–48	900	395	350
1238SE-6971	48–80	900	305	300
1238SE-7971	72–96	900	305	305

Notes: All current ratings are rms values per motor phase.

***S2–60 minute current** is the typical current achievable before thermal cutback occurs, with an ambient temperature of 25°C and the controller mounted to a 6 mm thick vertical steel plate with 6 km/h (1.7 m/s) airflow perpendicular to the plate.*

***Continuous current for design life** is the maximum long-term current, at an internal heatsink long-term temperature of 70°C (158°F), at which the controller will achieve its design life. These numbers are often calculated for a given application by determining an rms duty cycle current and heatsink temperature. For applications that exceed this, please contact the Curtis distributor or support engineer.*

**1238SE-49XX. Please contact the Curtis distributor or support engineer regarding the duty-cycle of this controller.*

OPERATING INSTRUCTIONS

microScan3 Core I/O

Safety laser scanners

SICK
Sensor Intelligence.



Described product

microScan3 Core I/O

Manufacturer

SICK AG
Erwin-Sick-Str. 1
79183 Waldkirch
Germany

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Original document

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1 About this document

1.1 Function of this document

These operating instructions contain the information needed during the life cycle of the safety laser scanner.

Operating instructions of the safety laser scanner must be made available to all people who work with the device.

Read the operating instructions carefully and ensure that you have understood the contents completely before you work with the safety laser scanner.

1.2 Scope

Product

This document applies to the following products:

- Product code: microScan3 Core I/O
- “Operating instructions” type label entry: 8016344

Document identification

Document part number:

- This document: 8016346
- Available language versions of this document: 8016344

You can find the current version of all documents at www.sick.com.

1.3 Target groups of these operating instructions

Some sections of these operating instructions are intended for certain target groups. However, the entire operating instructions are relevant for intended use of the product.

Table 1: Target groups and selected sections of these operating instructions

Target group	Sections of these operating instructions
Project developers (planners, developers, designers)	"Project planning", page 24 "Configuration", page 72 "Technical data", page 141 "Accessories", page 162
Installers	"Mounting", page 66
Electricians	"Electrical installation", page 69
Safety experts (such as CE authorized representatives, compliance officers, people who test and approve the application)	"Project planning", page 24 "Configuration", page 72 "Commissioning", page 118 "Technical data", page 141 "Checklist for initial commissioning and commissioning", page 169
Operators	"Operation", page 121 "Troubleshooting", page 130
Maintenance personnel	"Maintenance", page 125 "Troubleshooting", page 130

1.4 Further information

www.sick.com

The following information is available via the Internet:

- Data sheets and application examples
- CAD files and dimensional drawings
- Certificates (such as the EU declaration of conformity)
- Guide for Safe Machinery. Six steps to a safe machine
- Safety Designer (software for configuring safety solutions made by SICK AG)

1.5 Symbols and document conventions

The following symbols and conventions are used in this document:

Warnings and other notes

DANGER
Indicates a situation presenting imminent danger, which will lead to death or serious injuries if not prevented.

WARNING
Indicates a situation presenting possible danger, which may lead to death or serious injuries if not prevented.

CAUTION
Indicates a situation presenting possible danger, which may lead to moderate or minor injuries if not prevented.

NOTICE
Indicates a situation presenting possible danger, which may lead to property damage if not prevented.

NOTE
Highlights useful tips and recommendations as well as information for efficient and trouble-free operation.

Instructions to action

► The arrow denotes instructions to action.

1. The sequence of instructions for action is numbered.
2. Follow the order in which the numbered instructions are given.

✓ The check mark denotes the result of an instruction.

LED symbols

These symbols indicate the status of an LED:

○ The LED is off.
☼ The LED is flashing.
● The LED is illuminated continuously.

2 Safety information

2.1 General safety notes

Integrating the product

DANGER
The product can not offer the expected protection if it is integrated incorrectly.

- ► Plan the integration of the product in accordance with the machine requirements (project planning).
- ► Implement the integration of the product in accordance with the project planning.

Laser notes

CAUTION
Optical radiation: Class 1 Laser Product

Caution - if any operating or calibrating equipment other than those specified here are used or other methods are employed, this can lead to dangerous exposure to radiation.

- ► Use only the tools and auxiliary equipment specified in this documentation.
- ► Only carry out the procedures specified in this documentation.
- ► Do not open the housing unless carrying out the mounting and maintenance operations provided in this documentation.

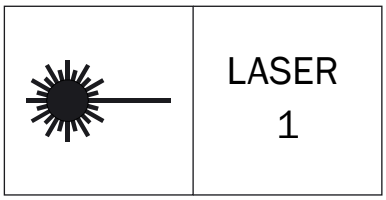


Figure 1: Laser class 1

This device complies with the following standards:

- EN 60825-1:2014 + A11:2021
- IEC 60825-1:2014
- 21 CFR 1040.10 and 1040.11, except compliance with IEC 60825-1:2014, as described in Laser Notice No. 56 dated 08.05.2019

The laser is eye-safe.

The laser marking is located on the underside of the safety laser scanner.

Mounting and electrical installation

DANGER
Death or severe injury due to electrical voltage and/or an unexpected startup of the machine

- ► Make sure that the machine is (and remains) disconnected from the voltage supply during mounting and electrical installation.
- ► Make sure that the dangerous state of the machine is and remains switched off.

Repairs and modifications

DANGER
Improper work on the product

A modified product may not offer the expected protection if it is integrated incorrectly.

► Apart from the procedures described in this document, do not repair, open, manipulate or otherwise modify the product.

2.2 Intended use

The safety laser scanner is an electro-sensitive protective device (ESPE) and is suitable for the following applications:

- Hazardous area protection
- Hazardous point protection
- Access protection
- Mobile hazardous area protection (e.g. protection from automated guided vehicles)

The product may be used in safety functions.

The safety laser scanner must only be used within the limits of the prescribed and specified technical data and operating conditions at all times.

Incorrect use, improper modification or manipulation of the safety laser scanner will invalidate any warranty from SICK; in addition, any responsibility and liability of SICK for damage and secondary damage caused by this is excluded.

2.3 Inappropriate use

DANGER
Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

The safety laser scanner works as an indirect protective measure and cannot provide protection from pieces thrown from the application nor from emitted radiation. Transparent objects are not detected.

► You must only use the safety laser scanner as an indirect protective measure.

The safety laser scanner is not suitable for the following applications, among others:

- Outdoors
- Underwater
- In explosion-hazardous areas

2.4 Cybersecurity

Overview

To protect against cybersecurity threats, the operator must have a comprehensive cybersecurity concept, which must be continuously monitored and maintained. A suitable concept consists of organizational, technical, procedural, electronic, and physical levels of defense and considers suitable measures for different types of risks. The measures implemented in this product can only support protection against cybersecurity threats if the product is used as part of such a concept.

You will find further information at www.sick.com/psirt, e.g.:

- General information on cybersecurity
- Contact option for reporting vulnerabilities
- Information on known vulnerabilities (security advisories)

Communication interfaces

- USB
- Display and pushbuttons

Further topics

- "Managing passwords", page 114
- "Access management", page 115

2.5 Requirements for the qualification of personnel

The product must be configured, installed, connected, commissioned, and serviced by qualified safety personnel only.

Project planning

You need safety expertise to implement safety functions and select suitable products for that purpose. You need expert knowledge of the applicable standards and regulations.

Mounting, electrical installation and commissioning

You need suitable expertise and experience. You must be able to assess if the machine is operating safely.

Configuration

You need suitable expertise and experience. You must be able to assess if the machine is operating safely.

Operation and maintenance

You need suitable expertise and experience. You must be instructed in machine operation by the machine operator. For maintenance, you must be able to assess if the machine is operating safely.

3 Product description

3.1 Product identification via the SICK product ID

SICK product ID

The SICK product ID uniquely identifies the product. It also serves as the address of the web page with information on the product.

The SICK product ID comprises the host name pid.sick.com, the part number (P/N), and the serial number (S/N), each separated by a forward slash.

For newer products, the SICK product ID is displayed as text and QR code on the type label and/or on the packaging.



Figure 2: SICK product ID

3.2 Device overview

Overview

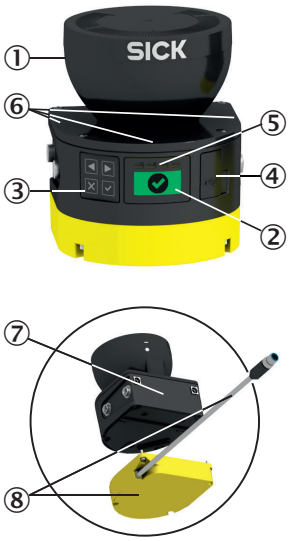


Figure 3: Device overview

① Optics cover
② Display
③ Keypad
④ USB connection
⑤ Status LEDs
⑥ Additional LEDs for ON state and OFF state
⑦ Safety laser scanner without system plug
⑧ System plug

Complementary information

The safety laser scanner can be mounted and operated in any orientation.

Position and direction information in this document:

- The top is the side of the safety laser scanner on which the optics cover is located.
- The bottom is the side of the safety laser scanner opposite the optics cover.
- The front is the side of the safety laser scanner on which the display is located. The 90° angle of the sector of a circle scanned by the safety laser scanner points in this direction.
- The back is the side of the safety laser scanner opposite the display. The sector of a circle not scanned by the safety laser scanner lies in this direction.

Further topics

- "Connections", page 16
- "Status indicators", page 121

3.3 Setup and function

The safety laser scanner is an electro-sensitive protective device (ESPE) which scans its surroundings two-dimensionally using infrared laser beams.

The safety laser scanner forms a protective field using the invisible laser beams. This protective field protects the hazardous area and enables hazardous point protection, access protection or hazardous area protection. As soon as an object is situated in the protective field, the safety laser scanner signals the detection by means of a signal change at the safety output (OSSD for example). The machine or its control must safely analyze the signals (for example using a safe control or safety relays) and stop the dangerous state.

The safety laser scanner operates on the principle of optical time-of-flight measurement. It emits light pulses in regular, very short intervals. If the light strikes an object, it is reflected. The safety laser scanner receives the reflected light. The safety laser scanner calculates the distance to the object based on the time interval between the moment of transmission and moment of receipt (Δt).

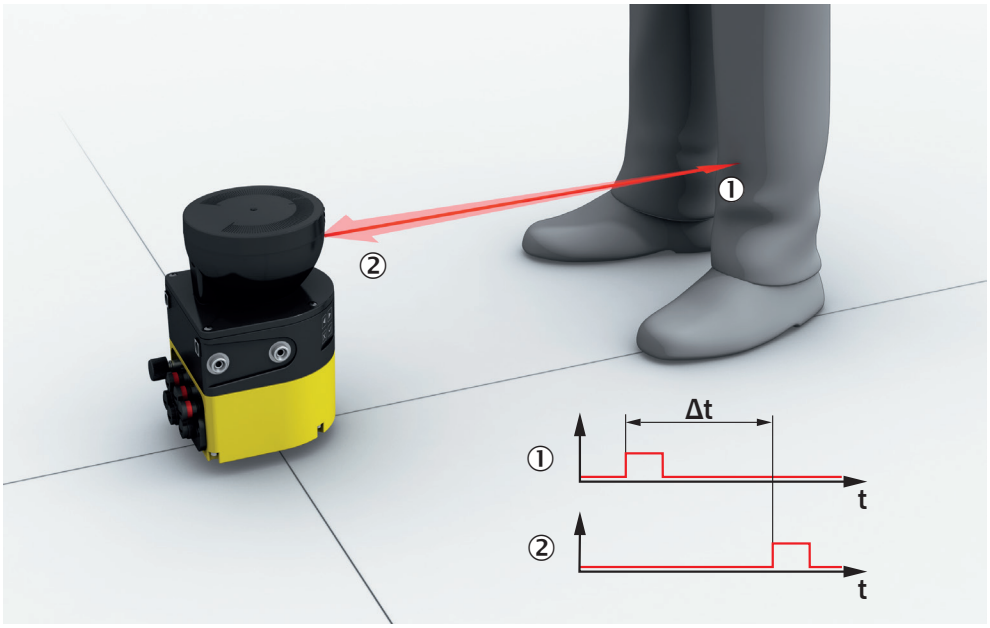


Figure 4: Principle of time-of-flight measurement

① Transmitted light pulse

② Reflected light pulse

A rotating mirror is situated in the safety laser scanner. The mirror deflects the light pulses so that they scan a fan-shaped area.

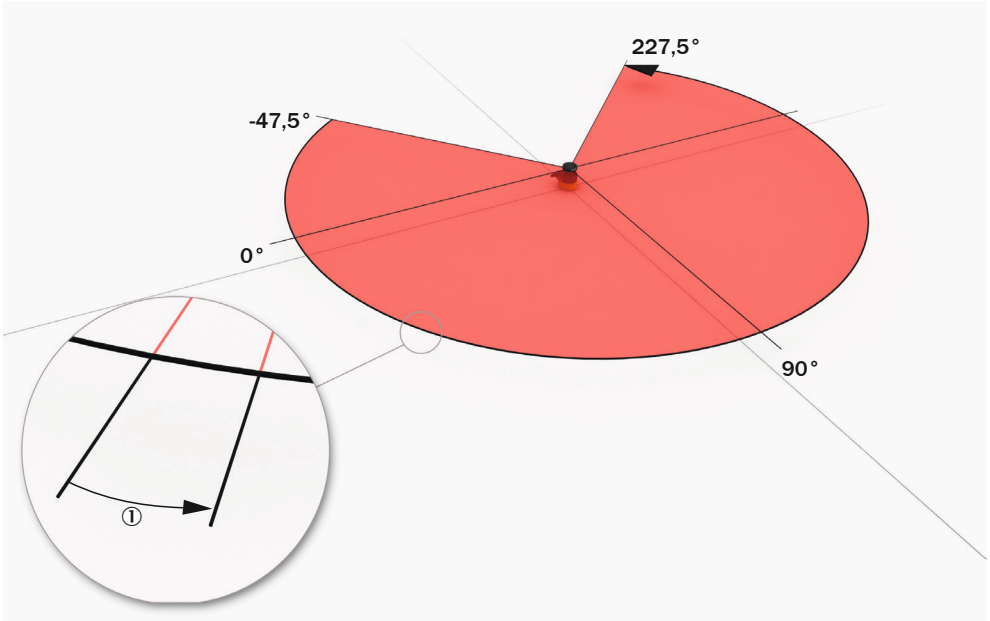


Figure 5: Light pulses scan an area

① Angular resolution: the angular distance (in degrees) between 2 distance measurements

Scan cycle time and resolution

The time that the mirror requires for one rotation is called the scan cycle time. The number of light pulses per unit of time is constant. The scan cycle time and the number of light pulses per unit of time determine the angular resolution. The scanning range for a given object resolution depends on the angular resolution. The object resolution indicates the minimum size that an object must be to allow it to be detected safely. The scan cycle time also influences the response time.

Slightly different scan cycle times can be used to minimize mutual interference in neighboring safety laser scanners.

The resolution in protective fields can be set to various values according to the intended purpose.

Geometry of the scan plane

The laser beams emitted cover a sector of a circle, so an object can be detected in an area of up to 275°.

The sector of a circle covered ranges from –47.5° to 227.5°, where 90° denotes the axis of the safety laser scanner from the back to the front. When viewing the safety laser scanner from above, the direction of rotation of the mirror and the deflected light pulses is counterclockwise, see figure 5.

3.4 Product characteristics

3.4.1 Variants

The safety laser scanner is delivered in different variants. You will find an overview of important distinguishing features of the variants in the following.

Integration in the control

The safety laser scanner communicates with the machine controller as follows:

- I/O: local inputs and outputs (incl. OSSDs)

Protective field range

The safety laser scanner is available in variants with the following maximum protective field range:

- 4.0 m
- 5.5 m
- 9.0 m

Further topics

- "Variant overview", page 141

3.4.2 Connections

Overview

- 1 × connecting cable with male connector, M12, A-coded for voltage supply, OSSDs and universal I/Os (can be used as universal input, universal output or in pairs as static control input)
- 1 × female connector, USB 2.0 Mini-B for configuration and diagnosis [1)]

OSSD

An OSSD is a safety switching output. The functionality of each OSSD is tested periodically. OSSDs are always connected in pairs and must undergo dual-channel analysis for safety reasons. An OSSD pair is formed from 2 OSSDs that are connected and analyzed together.

Control input

A control input receives signals, e.g. from the machine or from the control. Use of control inputs is how the protective device receives information about the conditions at the machine, e.g., if there is a change of operating mode. If the protective device is configured appropriately, it will activate a different monitoring case after receiving a new control input.

The control input information must be transmitted reliably. Generally, at least 2 separate channels are used to do this.

A static control input is a dual-channel control input, which evaluates the status of every channel as the value 0 or 1. The signal states of one or more static control inputs give a unique signal pattern. This signal pattern activates a monitoring case.

Universal I/O

Universal I/O can be configured as universal input or as universal output.

Universal input

Depending on the device, a universal input can be used for resetting, external device monitoring (EDM), sleep mode, or restarting the protective device, for example. If sleep mode is activated by a universal input, the sleep mode must not be used for safety applications. Certain universal inputs can also be used in pairs as a static control input.

Universal output

The function of a universal output is configurable. Which functions are available depends on the device. Possible signals are, for example: reset required, contamination warning.

A universal output must not be used for safety functions.

1) The USB connection may only be used temporarily and only for configuration and diagnostics.

Further topics

- "Connection overview", page 70

3.4.3 System plug

A system plug is required to operate the safety laser scanner.

The base plate is the system plug (see figure 3, page 13).

The safety laser scanner's internal configuration memory is integrated in the system plug. The system plug and all connecting cables can remain at the installation site when the safety laser scanner is replaced. The system plug is detached from the defective safety laser scanner and connected to the new safety laser scanner. The new safety laser scanner reads the configuration from the configuration memory when switched on.

3.4.4 Field types

During operation, the safety laser scanner uses its laser beams to continuously check whether people or objects are present in one or more areas. The areas to be checked are called fields. A distinction is made between the following field types, depending on the application type:

- Protective field
- Reference contour field
- Contour detection field
- Warning field

Table 2: Field types and their function

	Protective field	Reference contour field	Contour detection field	Warning field
Safe switch off (according to ISO 13849-1)	Yes (PL d)	Yes (PL d)	Yes (PL d)	No
Max. scanning range of the safety laser scanner	Variant-dependent: 4.0 m 5.5 m 9.0 m	Variant-dependent: 4.0 m 5.5 m 9.0 m	Variant-dependent: 4.0 m 5.5 m 9.0 m	Variant-dependent: 40 m 64 m
Purpose	Detection and protection of people	Tamper protection	e.g. door monitoring	Functional use (no safety-relevant use)

Protective field

The protective field is the area in which the test object specified by the manufacturer is detected by the electro-sensitive protective equipment (ESPE). As soon as the electro-sensitive protective device detects an object in the protective field, it switches the associated safety outputs to the OFF state. This signal can be passed to controllers resulting in the dangerous state coming to an end, e.g. to stop the machine or the vehicle.

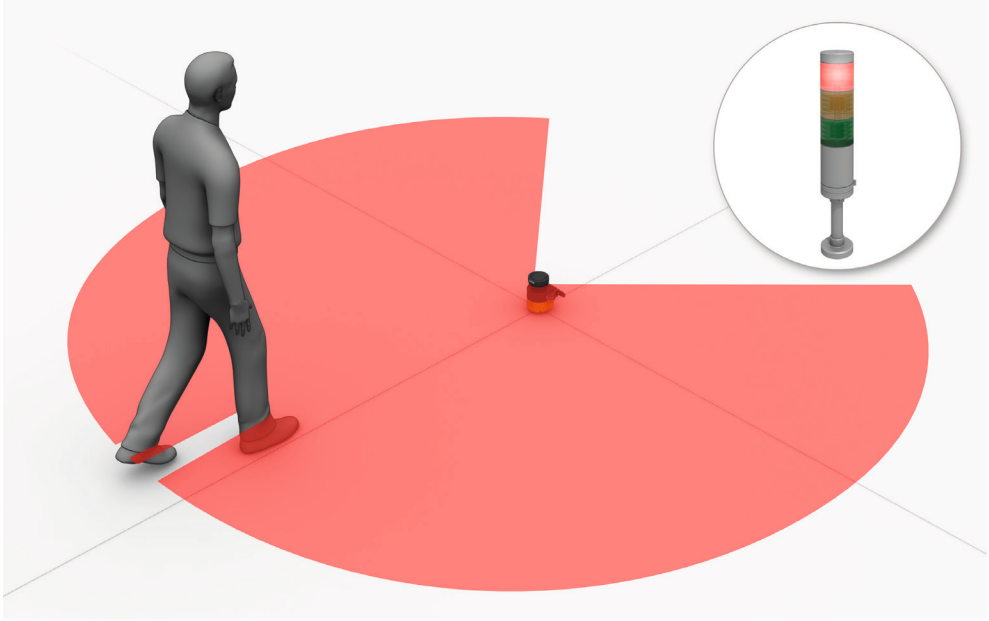


Figure 6: Protective field, shown in red in this document

Reference contour field

The contour as reference field monitors a contour of the environment. The safety laser scanner switches all safety outputs to the OFF state if a contour does not match the set parameters, because, for example, the mounting of the safety laser scanner has been changed.

National and international standards require or recommend that a reference contour is monitored, if the safety laser scanner is used in vertical operation for hazardous point protection or for access protection.

The reference contour field detects unintentional and intentional changes to the position or alignment of the safety laser scanner. Unintentional changes may be caused by vibrations for example. An example of an intentional change is deliberate tampering to disable the functionality of the safety laser scanner.

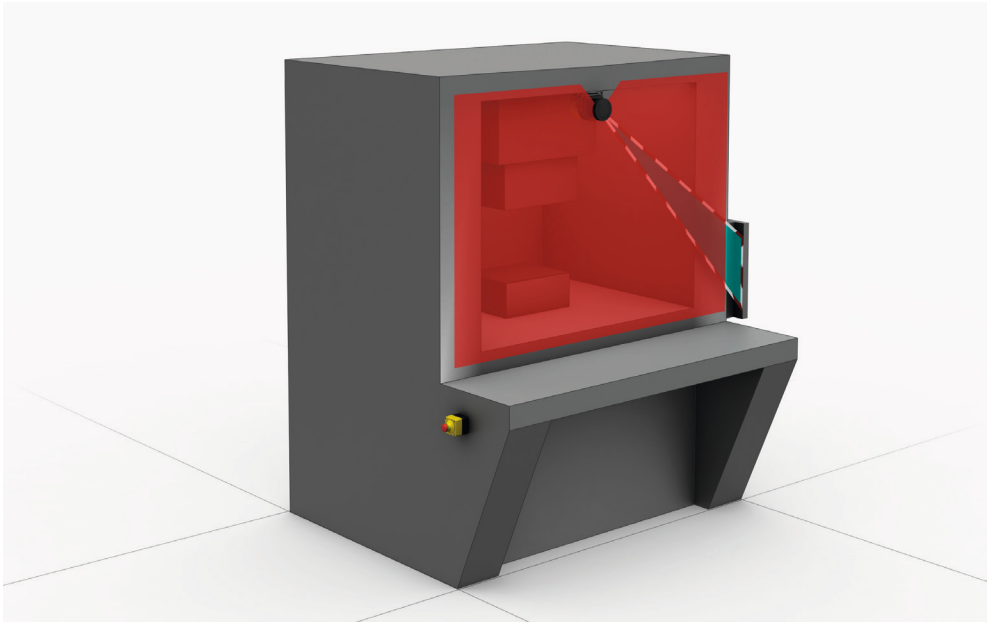


Figure 7: Reference contour field, shown in blue-green in this document

Contour detection field

The contour detection field monitors a contour of the environment. The electro-sensitive protective device switches the associated safety outputs to the OFF state if a contour does not correspond to the set specifications, e.g. because a door or flap is open.

The contour detection field is used for detecting changes in the environment and only switches the outputs in the current monitoring case. By contrast, the reference contour field is used for detecting changes at the safety laser scanner and switches all safety outputs.

Warning field

The warning field monitors larger areas than the protective field. Simple switching functions can be triggered with the warning field, e.g. a warning light or an acoustic signal can be triggered if a person approaches, even before the person enters the protective field.

The warning field must not be used for safety applications.

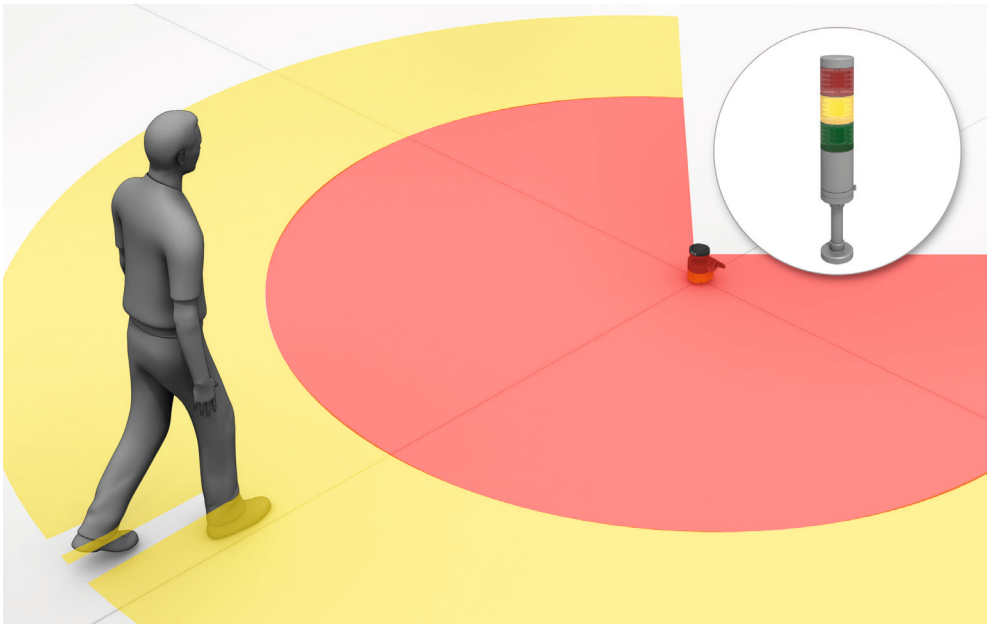


Figure 8: Warning field, shown in yellow or orange in this document

3.4.5 Field set

A field set consists of one or more fields. The fields in a field set are monitored simultaneously.

A field set can contain different field types, e.g., a protective field and a warning field.

A typical application is the use of a protective field with one or more warning fields: if a vehicle approaches a person, a warning field triggers an optical or acoustic signal. If the person does not react to this and the vehicle continues to approach, the safety laser scanner detects an object in the protective field and switches the associated safety outputs to the OFF state. The vehicle stops before it reaches the person.

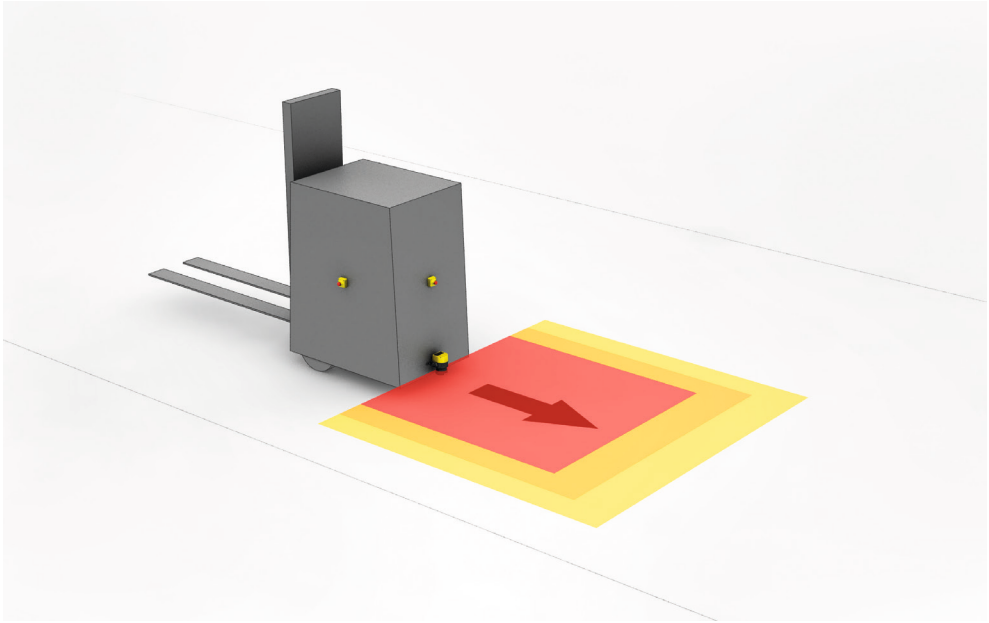


Figure 9: Field set, consisting of one protective field (red) and 2 warning fields (orange and yellow)

3.4.6 Monitoring case

A monitoring case signals the machine status to the safety laser scanner. The safety laser scanner activates the field set, which is assigned to the monitoring case and therefore a particular machine status.

If a machine, e.g., has various operational statuses, a monitoring case can be assigned to each operational status. The safety laser scanner receives a defined signal for the current operational status via the control inputs. If there is a change of signal, the safety laser scanner switches from one monitoring case to the monitoring case that is assigned to the new signal (as well as the new operational status). Generally, one field set is assigned to each monitoring case.

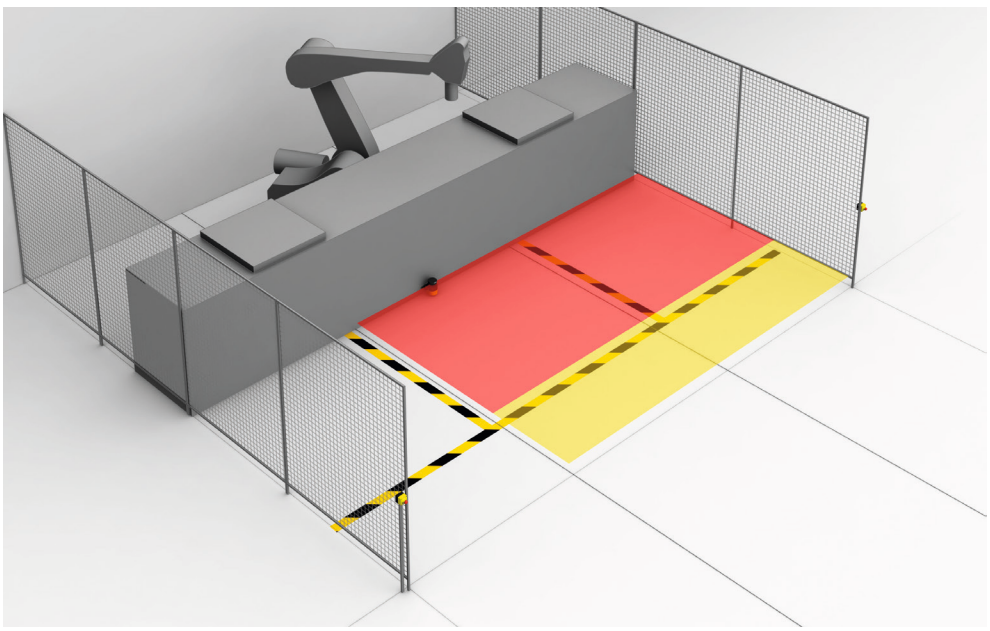


Figure 10: Monitoring case 1 with field set 1

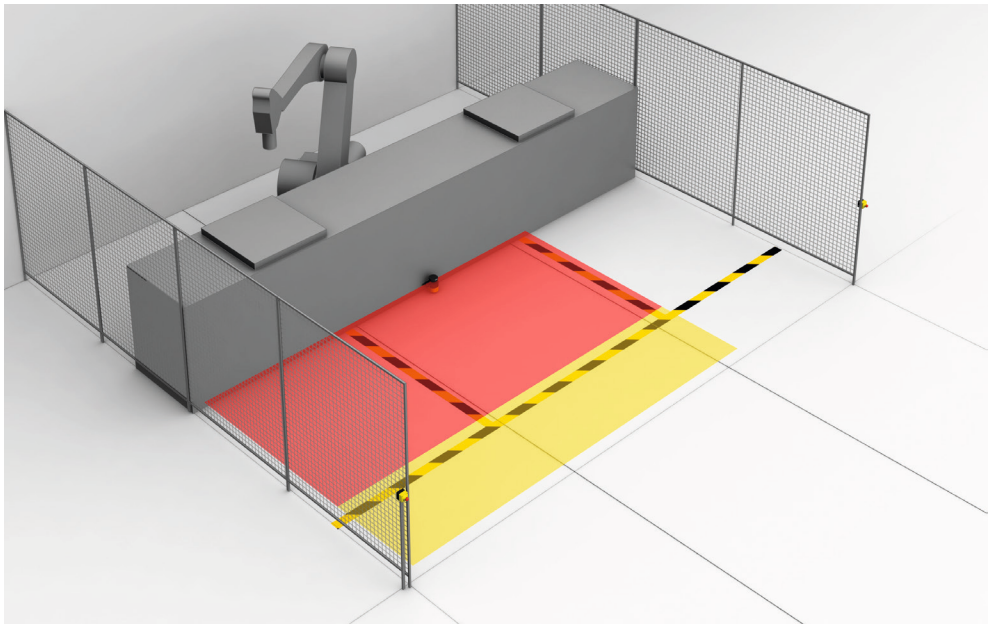


Figure 11: Monitoring case 2 with field set 2

3.5 Example applications

Hazardous area protection

In hazardous area protection, people are detected if they stay in a defined area.

This type of protective device is suitable for machines, where it is possible to see a hazardous area completely from the reset pushbutton. When the hazardous area is entered, a stop signal is triggered and starting is prevented.

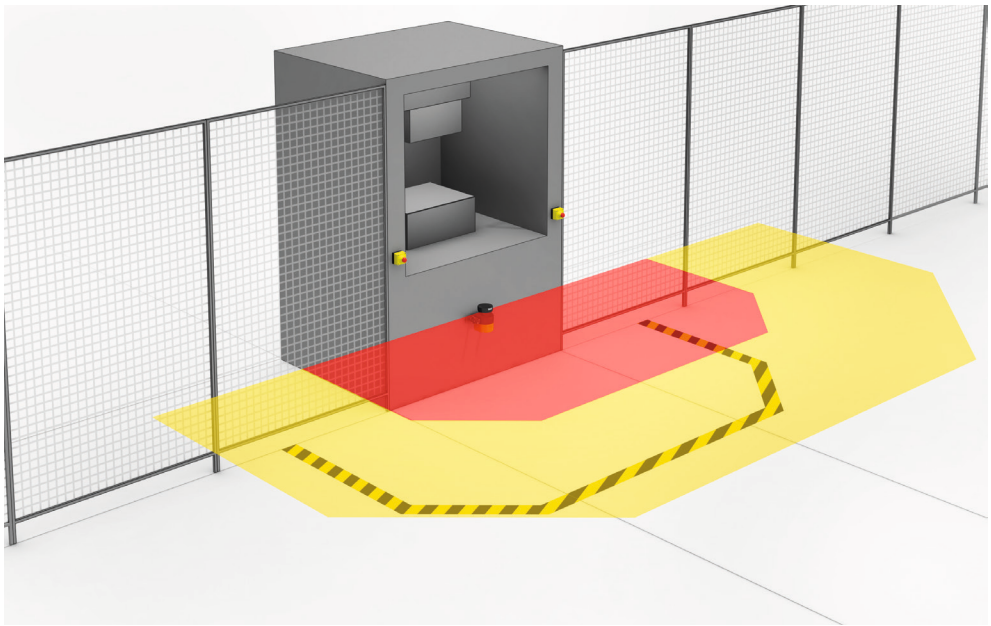


Figure 12: Hazardous area protection: detection of the presence of a person in the hazardous area

Hazardous point protection

In hazardous point protection, the approach is detected very close to the hazardous point.

The advantage of this type of protective device is that it is possible to have a short minimum distance and the operator can work more ergonomically.

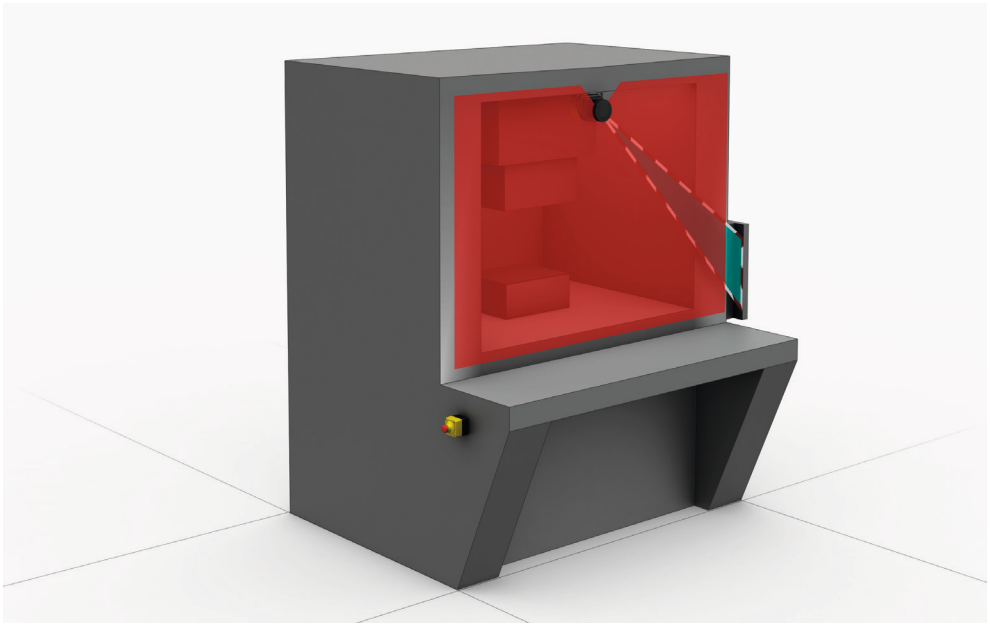


Figure 13: Hazardous point protection: Hand detection

Access protection

In access protection, people are detected if their whole body passes through the protective field.

This type of protective device is used for the protection of access to hazardous areas. When the hazardous area is entered, a stop signal is triggered. A person standing behind the protective device will not be detected by the ESPE.

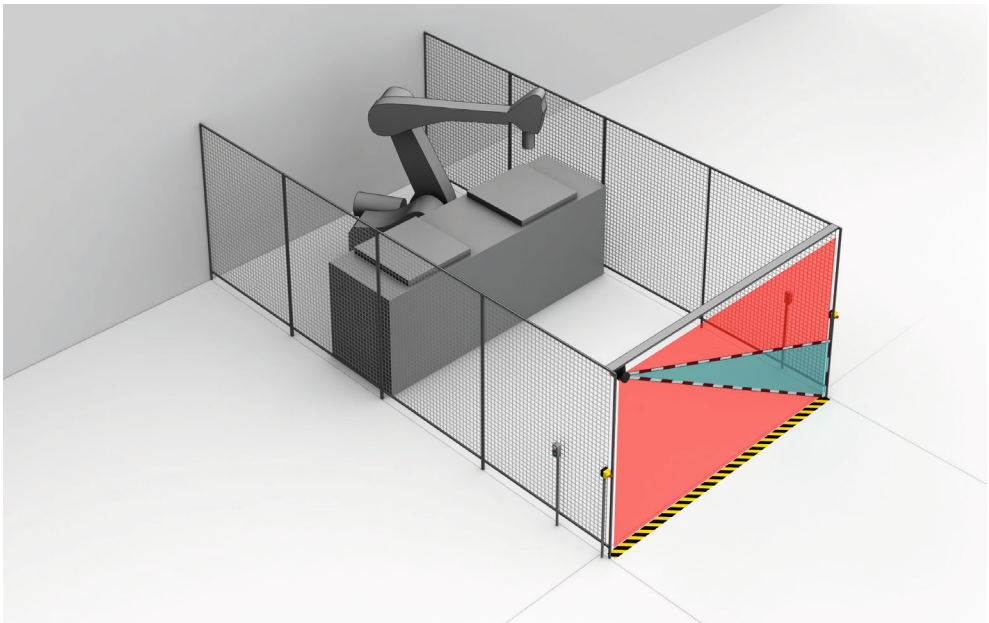


Figure 14: Access protection: detection of a person when accessing a hazardous area

Mobile hazardous area protection

Mobile hazardous area protection is suitable for AGVs (automated guided vehicles), cranes, and forklift trucks to protect people when vehicles are moving or docking at a fixed station.

The safety laser scanner monitors the area in the direction of travel and stops the vehicle as soon as an object is located in the protective field.

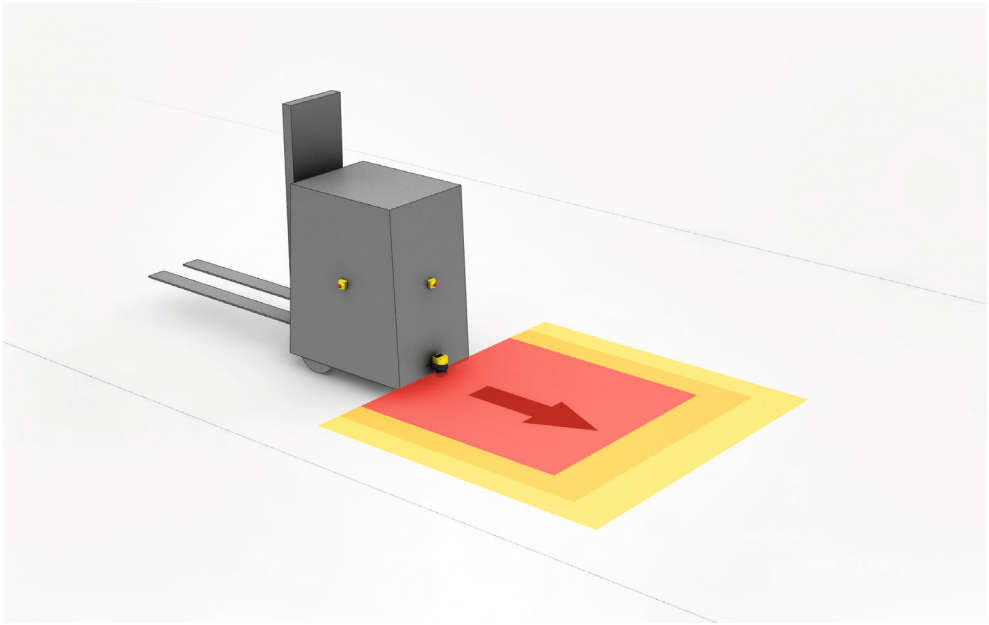


Figure 15: Mobile hazardous area protection: detection of a person when a vehicle approaches

4 Project planning

4.1 Manufacturer of the machine

DANGER
Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

- Use of the safety laser scanner requires a risk assessment. Check whether additional protective measures are required.
- Comply with the applicable national regulations derived from the application (e.g., work safety regulations, safety rules, or other relevant safety guidelines).
- Apart from the procedures described in this document, the components of the safety laser scanner must not be opened.
- The safety laser scanner must not be tampered with or changed.
- Improper repair of the protective device can lead to a loss of the protective function. The protective device must only be repaired by the manufacturer or by someone authorized by the manufacturer.

4.2 Operator of the machine

DANGER
Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

- Changes to the electrical integration of the safety laser scanner in the machine control and changes to the mechanical mounting of the safety laser scanner necessitate a new risk assessment. The results of this risk assessment may require the entity operating the machine to meet the obligations of a manufacturer.
- Changes to the device's configuration may impair the protective function. The effectiveness of the protective device must be checked after any change to the configuration. The person carrying out the change is also responsible for maintaining the protective function of the device.
- Apart from the procedures described in this document, the components of the safety laser scanner must not be opened.
- The safety laser scanner must not be tampered with or changed.
- Improper repair of the protective device can lead to a loss of the protective function. The protective device must only be repaired by the manufacturer or by someone authorized by the manufacturer.

4.3 Assembly

Important information

DANGER
Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

The optical beam path must not be disrupted, e.g. if the system is incorporated into paneling.

- ► Do not apply an additional front screen.
- ► If a viewing slit is required, make sure that it is adequately dimensioned, see "Dimensional drawings", page 157.

NOTE
If you are not integrating the product in accordance with ISO 13855:2010, you must carry out an individual impact analysis.

NOTE
Certain optical and electromagnetic ambient conditions can affect the safety laser scanner. This may have a negative impact on the availability of the machine. That is to say, the safety laser scanner switches off the machine even though there are no people in the protective field.

For high availability:

- ► Avoid having strong electric fields in the vicinity of the safety laser scanner. These may be caused by nearby welding or induction cables, for example.
- ► Avoid condensation on the optics cover.

Prerequisites

- The safety laser scanner must be affixed so that people or parts of the body are reliably detected upon entry into the hazardous area.
- The safety laser scanner must be affixed so that no mirrors or other exceedingly reflective objects are in the protective field.
- The safety laser scanner must be affixed so that no small objects (e.g. cables) are in the protective field, even if the safety outputs do not switch to the OFF state as a result.
- The safety laser scanner must be affixed so that no obstacles disrupt the field of view of the safety laser scanner. Take additional protective measures if a risk arises due to unavoidable obstacles.
- If people can stay between the protective device and the hazardous point without being detected, check if additional protective measures (e.g. restart interlock) are required.
- Reaching under, over and around, crawling beneath and stepping over the safety laser scanner, as well as moving it, must be prevented.

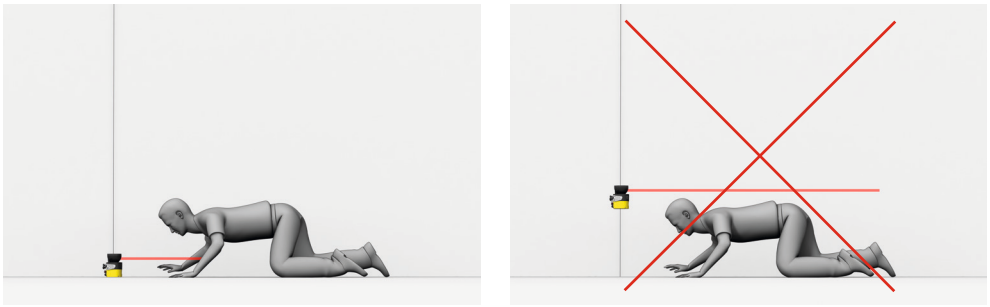


Figure 16: Prevent crawling beneath

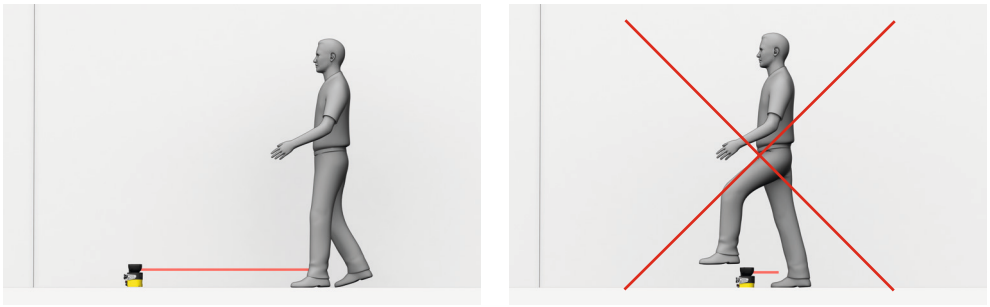


Figure 17: Prevent stepping over

Further topics

- "Mounting", page 66

4.3.1 Protection from influences

A safety laser scanner can be influenced by the beams from a different laser source in close proximity to it, e.g. by another laser scanner. This may impair the machine's availability. That is to say, the affected safety laser scanner switches the machine off, although no people are situated in the protective field.

A safety laser scanner may be dazzled by a strong external light source in the scan plane. This may have a negative impact on the availability of the machine. That is to say, the safety laser scanner switches off the machine even though there are no people in the protective field.

You can use the following measures to increase the availability:

- The safety laser scanner has a function for interference protection. The scan cycle time is adjusted in small increments. You can increase the availability by choosing different modes for interference protection in adjacent safety laser scanners, see "Additional interference protection", page 88.
- Higher multiple sampling reduces the likelihood of a laser source influencing the safety laser scanner. You can increase the availability by setting multiple sampling to the highest value permitted in your application, while taking minimum distances into account, see "Multiple sampling", page 86.
- You can further increase the availability by choosing a suitable mounting method, see "Mounting methods for protection from interference from systems in close proximity", page 170.
- Avoid external light sources in the scan plane. Mount the safety laser scanner so that it cannot be dazzled by incoming sunlight. Do not position halogen lights, infrared light sources or stroboscopes directly on the scan plane.

NOTE
You must comply with the standard ISO 13855:2010 when choosing the mounting method.

4.3.2 Preventing unprotected areas

DANGER
Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

The safety laser scanner must be mounted in such a way that people cannot enter unsecured areas without being detected.

- ► Attach deflector plates to prevent anyone standing behind.
- ► Mount the safety laser scanner in an undercut.
- ► Mount the safety laser scanner in the paneling of the machine or vehicle.
- ► Mount a frame to prevent access to the area.

Unsecured areas behind the safety laser scanner

Depending on the mounting situation, areas may result, which cannot be detected by the safety laser scanner.

The undetected areas become larger if the safety laser scanner is mounted using a mounting kit.

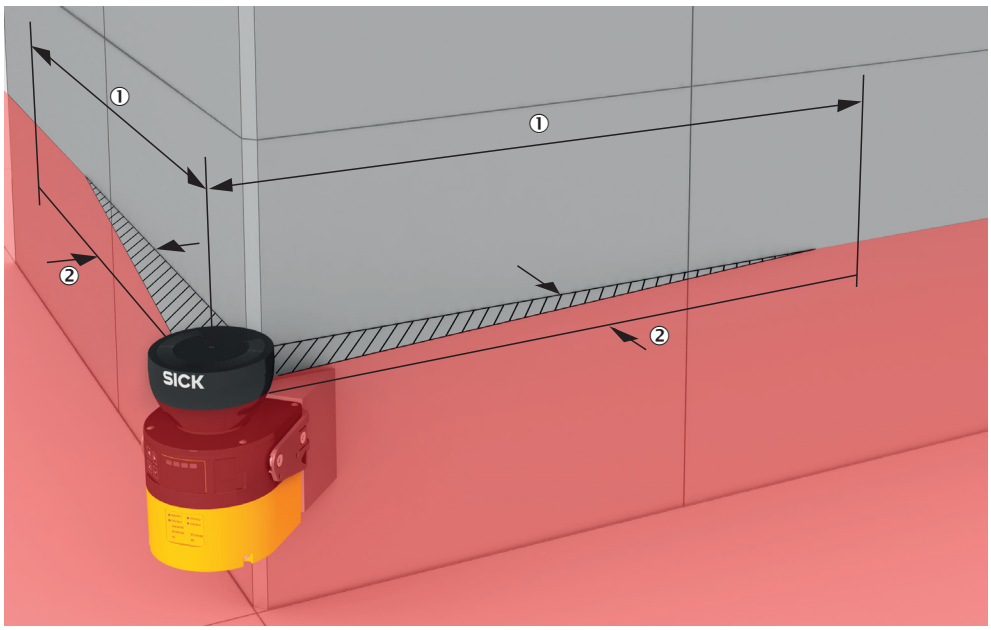


Figure 18: Unsecured areas

① Length of the unsecured area
② Width of the unsecured area

Area where detection capability is restricted

In close proximity (50 mm-wide area in front of the optics cover), the detection capability of the safety laser scanner may be restricted. If required, this area must be secured using an undercut or frame, for example.

Mounting with deflector plates

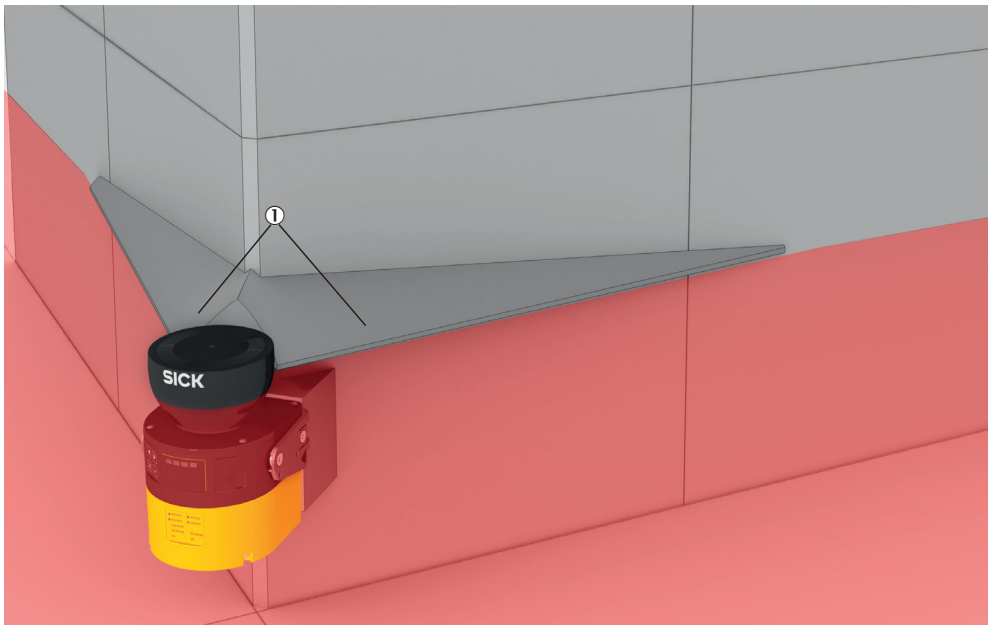


Figure 19: Mounting with deflector plates (example)

- ► Attach the deflector plates ① so that it is not possible to step into unsecured areas.
- ► Attach the deflector plates so that they lie outside the scan plane.

Mounting in an undercut



Figure 20: Mounting in an undercut (example)

- ► Mount the safety laser scanner in an undercut so that no-one can enter the unsecured areas.
- ► Make the undercut at least deep enough ①, that it covers the unsecured areas completely and no one can enter the unsecured areas.
- ► Prevent crawling beneath the undercut. Design the undercut to be so low ②, that no one can crawl into it.

Mounting in the machine or vehicle's paneling

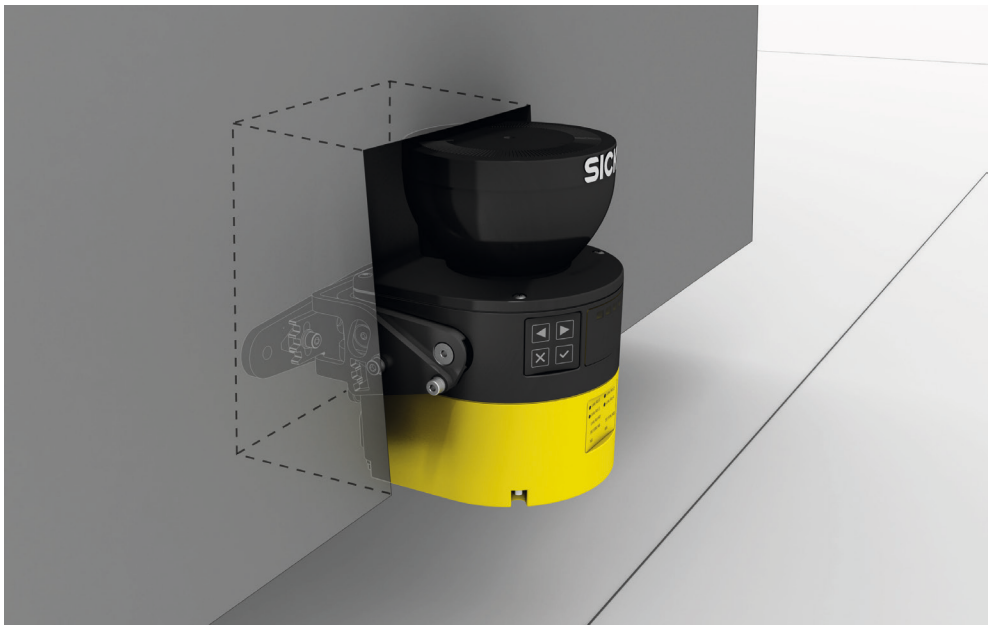


Figure 21: Mounting in vehicle paneling (example)

► If a viewing slit is required, make sure that its size is sufficient, see "Dimensional drawings", page 157.

4.3.3 Response time of the safety laser scanner

The safety laser scanner's response time must be taken into account, among other things, so that the safety laser scanner can be positioned in a suitable location and the protective fields can be sized correctly.

The response times are specified in the technical data, see "Response times", page 148.

The response time of the safety laser scanner resulting from current settings is shown in Safety Designer.

4.3.4 Reference contour monitoring

Vertical operation

National and international standards require or recommend that a reference contour is monitored if the angle between access direction and scan plane exceeds 30°. With the reference contour field, the safety laser scanner monitors the distance to a contour of the environment (e.g. a wall) in order to detect inadvertent adjustment or manipulation.

Configuring the reference contour field during vertical operation

- In many cases, it makes sense to use the floor and lateral vertical passage boundaries (e.g. door frames) as a reference contour.
- The resolution of the reference contour field specifies how large a gap in the contour or an object in the reference contour field must be for the reference contour field to detect the gap or object in any case. Smaller gaps or objects can also trigger detection in some cases.
- The length of the monitored contour must be greater than the set resolution of the reference contour field.
- The reference contour field has an adjustable tolerance band. If the safety laser scanner does not detect the reference contour within the tolerance band, all

safety outputs switch to the OFF state. In Safety Designer, you can define the tolerance band around the reference contour in both directions (near and far).

- For high availability, setting both the positive tolerance band (far) and the negative tolerance band (near) to the TZ value is recommended. (TZ = tolerance zone of the safety laser scanner, see "Data sheet", page 142.)
- The tolerance band must not be too wide. The reference contour field must detect a deviation from the reference contour before access to the hazardous point occurs next to the protective field. Deviations may occur due to changes in position or orientation.
- If the reference contour represents the edge of the protected opening, the sum of the negative and positive tolerance bands must not be greater than the resolution of the protective field.
- If the reference contour does not represent the edge of the protected opening, the sum of the negative and positive tolerance bands must not be greater than the projection.

- You can define a number of contours in the reference contour field and therefore monitor various areas in the environment.

Protective field and reference contour field for hazardous point protection

The protective field must be larger than the protected opening. The required overrun (o) is calculated using the following formula:

$o \geq (2 \times TZ) - d$

Where:

- o = overrun of the protective field over the opening
- TZ = tolerance zone of the safety laser scanner, see "Data sheet", page 142
- d = set resolution

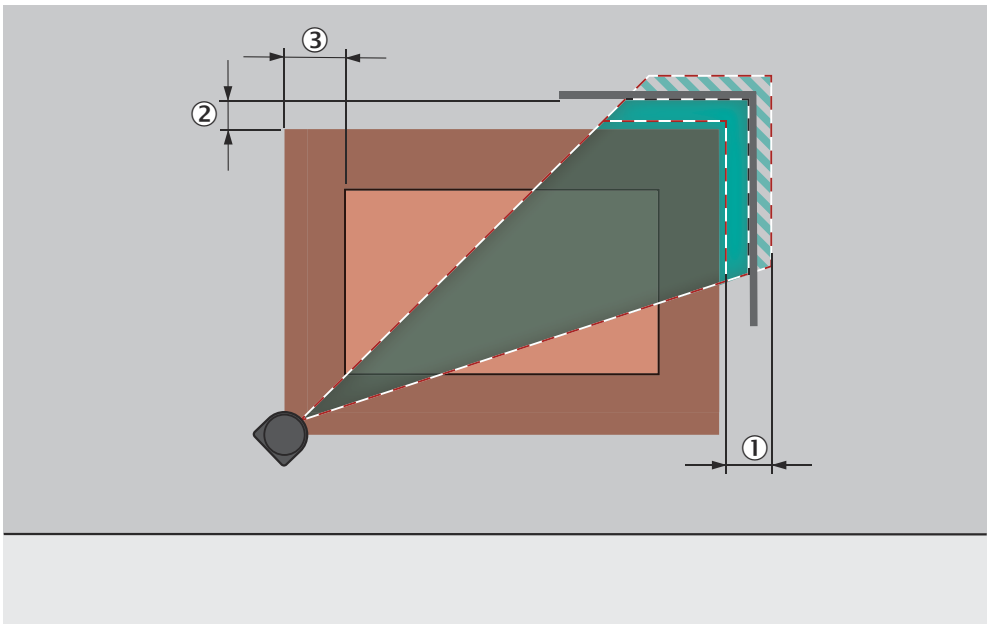


Figure 22: Overrun of the protective field in front of an opening

① Tolerance band of the reference contour field
② Distance of the protective field from the contour, to ensure availability
③ o = overrun of the protective field over the opening

Protective field and reference contour field for access protection

- If the reference contour represents the edge of the protected opening, its distance from the protective field must not exceed 100 mm. A distance equal to the TZ value is recommended for high availability and sufficient protection. (TZ = tolerance zone of the safety laser scanner, see "Data sheet", page 142.)
- If the reference contour does not represent the edge of the protected opening, the protective field must be larger than the protected opening. The required overrun (o) is calculated using the same formula as for hazardous point protection.

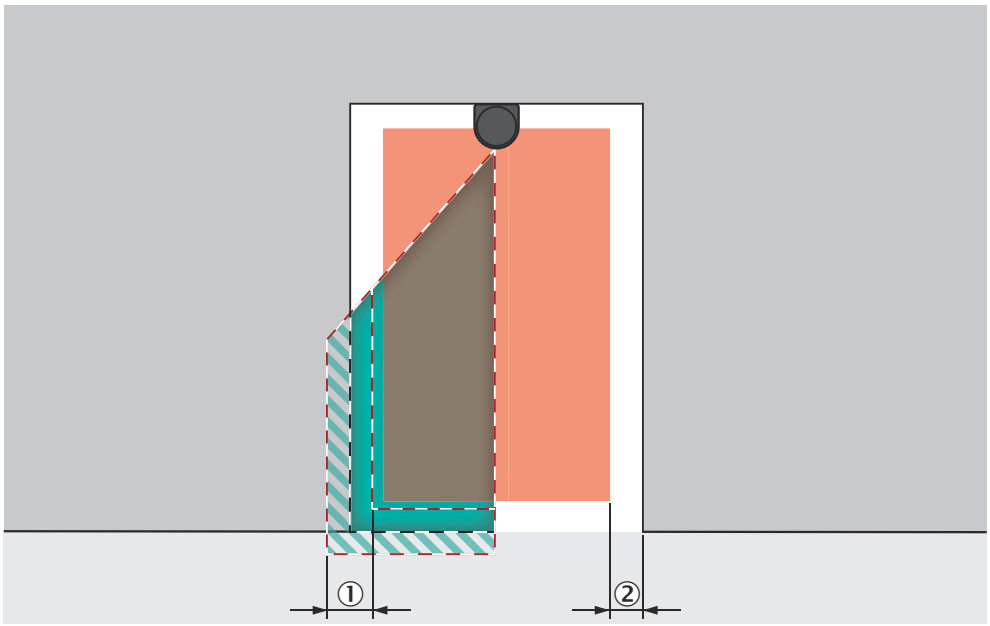


Figure 23: Tolerance band of the contour as reference field (protective field within the protected opening, edge of the protected opening = reference contour)

① Tolerance band of the reference contour field

② Distance of the protective field from the reference contour, to ensure availability

4.3.5 Monitoring case switching time

When switching between monitoring cases, it is possible that a person may already be in the newly activated protective field when switching takes place. Only switching in time (namely before the danger arises for the person at this location) ensures protection.

DANGER
Hazard due to lack of effectiveness of the protective device

► Switching of the monitoring case should be timed so that the safety laser scanner detects a person in the protective field with a sufficient minimum distance, before the dangerous state occurs.

DANGER
Hazard due to lack of effectiveness of the protective device

Persons or parts of the body to be protected may not be recognized or not recognized in time in case of non-observance.

In addition to the parameters considered below, the switching signal's propagation delay time up to the protective device also influences the switching duration. This includes the controls processing time, for example.

► Take account of the switching signal's propagation delay time up to the protective device.

In some cases, the process of switching between monitoring cases takes so long that the new monitoring case is not available inside the response time provided. This means that it may not be possible to detect a person in the protective field in time. In cases like this, you must start switching between monitoring cases earlier.

The following parameters influence the duration of the process:

- The set switch-on delay (see "Input delay", page 106).
- The processing time for the chosen input.

You calculate when to switch between monitoring cases as follows

1. First calculate how long it takes to switch between monitoring cases:
   $t_{CSR} = t_{ID} + t_I$
   where:
   - t_{CSR} = time required for switching between monitoring cases in milliseconds (ms)
   - t_{ID} = input delay for the control inputs in milliseconds (ms)
   - t_I = processing time for the selected switching type in milliseconds (ms)
     - Local control input: t_I = 12 ms
2. Then calculate how much time is available in the response time for switching between monitoring cases:
   $t_{CSA} = (n - n_{CS}) \times t_S$
   where:
   - t_{CSA} = time available for switching between monitoring cases in milliseconds (ms)
   - n = set multiple sampling (default: n = 2)
   - n_{CS} = multiple sampling after switching between monitoring cases (with setting **Fast** (default): $n_{CS} = 1$, with setting **Reliable**: $n_{CS} = n - 1$, with setting **User-defined**: $n_{CS} \leq n - 1$)
   - t_S = scan cycle time (poss. incl. supplement due to interference protection) in milliseconds (ms)
3. Then check whether there is enough time available for switching between monitoring cases:
   - If $t_{CSA} \geq t_{CSR}$: earlier start is not necessary.
   - If $t_{CSA} < t_{CSR}$: you must start switching between monitoring cases earlier. The time advance t_{CSP} required is: $t_{CSP} = t_{CSR} - t_{CSA}$

NOTE
In some cases, it is not possible to define when to switch (for example because processing times of the machine vary) or the time advance means that the monitoring of an area finishes too early. Follow one of the following recommendations in these cases:

► Allow the two protective fields to partially overlap.

4.3.6 Hazardous area protection

The safety laser scanner is mounted with a horizontal scan plane in a stationary application. This is, for example, on a machine where the hazardous area is not completely surrounded by a physical guard. During hazardous area protection, the safety laser scanner detects a person's legs. The protective field is parallel to the person's direction of approach.

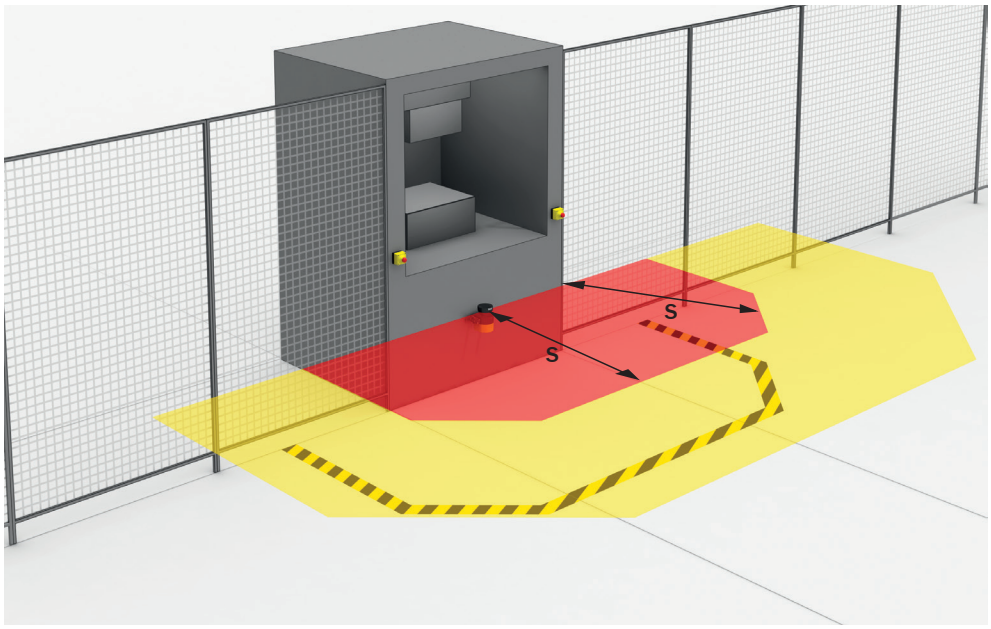


Figure 24: Stationary application with horizontal scan plane for hazardous area protection

NOTE

Mark the outline of the protective field boundaries on the floor after you have worked out the protective field size. By doing this, you allow machine operators to see the protective field boundaries and make it easier to thoroughly check the protective function at a later date.

4.3.6.1 Protective field

Overview

The protective field must be designed so that it detects a person at a minimum distance from the hazardous point. This distance is required to prevent a person or part of their body from reaching the hazardous area before the end of the machine's dangerous state.

In hazardous area protection, the minimum distance typically defines the protective field size required.

If you define a number of monitoring cases with different protective fields, you must calculate the protective field size separately for each protective field used.

In many cases, a resolution of 50 mm to 70 mm is suitable for hazardous area protection.

Important information

DANGER
Hazard due to lack of effectiveness of the protective device

In the case of non-compliance, it is possible that the dangerous state of the machine may not be stopped or not stopped in a timely manner.

1. Calculate the required minimum distance for your machine using the following formulas and examples.
2. Take this calculation and the specifications in these instructions into account when mounting the safety laser scanner.
3. Take this calculation and the specifications in these instructions into account when configuring the safety laser scanner.

DANGER
Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

Body parts to be protected may not be detected under coarse resolution.

- ► Use a resolution of 70 mm or finer for hazardous area protection.
- ► For hazardous area protection with a resolution of 70 mm: make sure that it is possible to detect a human leg.
- ► For hazardous area protection with a resolution of 70 mm: mount the safety laser scanner at a height of at least 300 mm (height of the scan plane).
- ► If it is not possible to mount the safety laser scanner at a height of at least 300 mm, use a finer resolution, see "Calculating required resolution", page 38.

NOTE
If the protective field needs to be as small as possible, you may have to calculate the minimum distance multiple times with different scan cycle times (iterative calculation) because of various dependencies. [2)]

Always take the actual response time into account when calculating the minimum distance, see "Response times", page 148.

1. First calculate the minimum distance on the basis of the response time for a small scan cycle time.
2. If the calculated minimum distance is larger than the resulting protective field range (see "Protective field range", page 150), recalculate the minimum distance on the basis of the response time for a large scan cycle time.

4.3.6.2 Calculating minimum distance

Overview

The calculation of the minimum distance is based on international or national standards and statutory requirements applicable at the place of installation of the machine.

If the minimum distance is calculated according to ISO 13855:2010, then it depends on the following points:

- Machine stopping time (time interval between triggering the sensor function and the end of the machine's dangerous state)
- Response time of the protective device, see "Response times", page 148
- Reach or approach speed of the person
- Resolution (detection capability) of the safety laser scanner

2) The required minimum distance depends on the response time, among other things, and therefore on the scan cycle time. The protective field range likewise depends on the scan cycle time: the protective field range is shorter for a faster scan cycle time.

- Type of approach: parallel
- Parameters specified based on the application
- Supplements for general and, possibly, reflection-based measurement errors
- Supplement to protect against reaching over
- Height of the scan plane
- Switching time between monitoring cases

Important information

NOTE
Additional information is available in the ISO 13855:2010 standard and in the Guide for Safe Machinery.

NOTE
SICK offers a stopping/run-down time measurement service in many countries.

Example calculation of the minimum distance S according to ISO 13855:2010

The example shows the calculation of the minimum distance for parallel approach to the protective field. Depending on the application and the ambient conditions a different calculation may be required. (e.g., a protective field or at an arbitrary angle to the direction of approach or an indirect approach)

► Calculate S using the following formula:
$S = 1{,}600\ mm/s \times T + TZ + Z_R + C_{RO}$
where:
  - S = minimum distance in millimeters (mm)
  - T = stopping/run-down time for the entire system in seconds (s) (Response time of the safety laser scanner + machine stopping time, incl. response time of the machine control system and signal propagation time)
  - TZ = tolerance zone of the safety laser scanner, see "Data sheet", page 142
  - Z_R = supplement for reflection-based measurement errors in millimeters (mm)
  - C_{RO} = supplement to protect against reaching over, in millimeters (mm)

  The reach/approach speed is already included in the formula.

Supplement Z_R for reflection-based measurement errors

All devices: If there is a retroreflector in the vicinity of the protective device (distance of the retroreflector from protective field ≤ 6 m), you must take the supplement Z_R = 350 mm into account.

Devices with max. protective field range of 9 m for stationary applications: Strongly reflective surfaces (e.g. shiny metal, tile) with a distance from the protective field ≤ 6 m can behave similarly to a retroreflector if the laser beam hits the surface vertically. If the protective field in the direction of the vertically impinging laser beam is greater than 50 % of the protective field range, you must take into account the supplement Z_R = 350 mm in this direction[3)] Supplement Z_R must be upheld at least at a width of 3 × d (d = set object resolution) around the laser beam which hits the surface vertically.

Supplement C_{RO} to protect against reaching over

Under certain circumstances, a person can reach the hazardous area by reaching over, before the protective device stops the dangerous state. Supplement C_{RO} prevents this.

3) . The protective field range depends on the set scan cycle time and resolution.

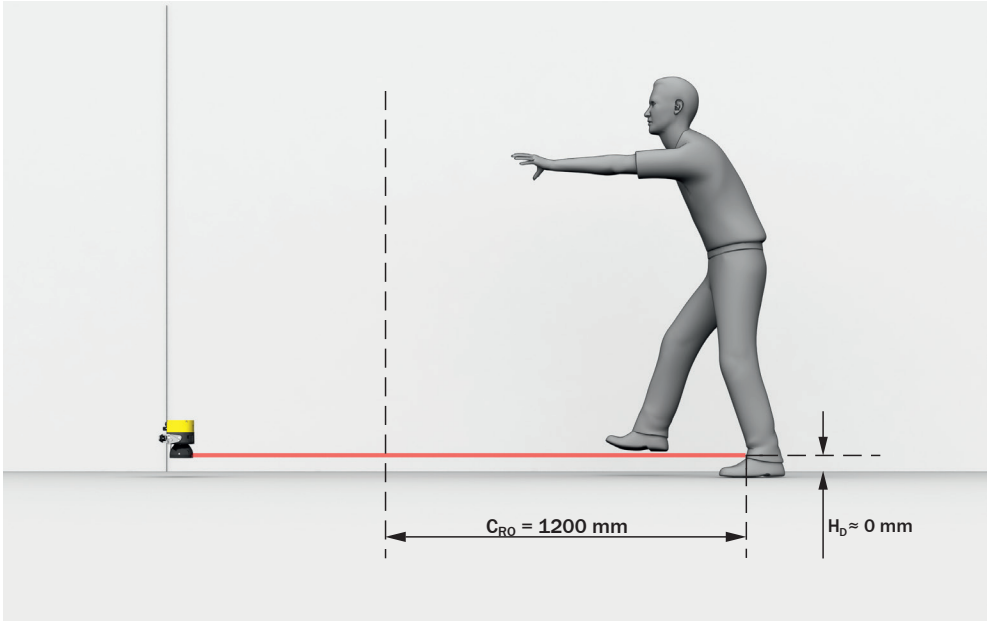


Figure 25: Protection against reaching over when mounted low (dimensions in mm)

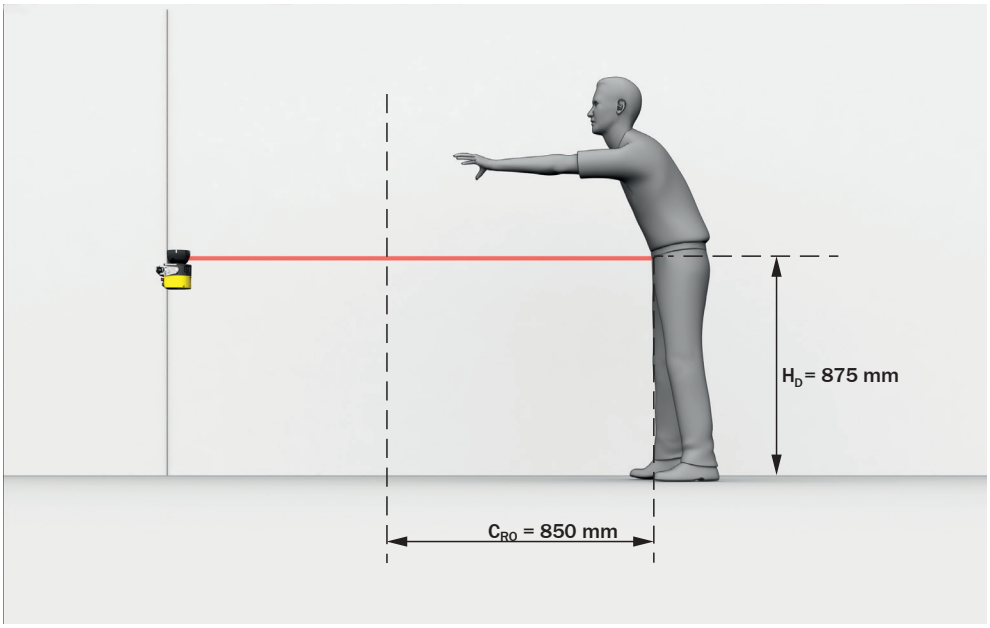


Figure 26: Protection against reaching over when mounted high (dimensions in mm)

The necessary supplement to the minimum distance depends on the height of the protective field's scan plane. The supplement is larger if the safety laser scanner is affixed low-down than if it is affixed high-up.

Calculating the supplement C_{RO}

- If you have sufficient free space in front of your machine, use value 1,200 mm as the supplement C_{RO}.
- If you want to keep the minimum distance as low as possible, use the following formula to calculate C_{RO}:
  C_{RO} = 1,200 mm – (0.4 × H_D)
  where:
  - H_D = height of the protective field above the floor in millimeters (mm).

✓ If the result is $C_{RO} \geq 850$ mm, then use the calculated value as supplement C_{RO}.
✓ If the result is $C_{RO} < 850$ mm, then use $C_{RO} = 850$ mm (this value corresponds to an arm's length and is valid as a minimum supplement to protect against reaching over).

4.3.6.3 Height of the scan plane

Overview

If you choose a resolution of 70 mm for hazardous area protection, it is not possible to detect a human leg under certain circumstances. This is because a beam does not hit the leg. Rather, the beams pass by the sides of the ankle (see figure 27, page 37). If you mount the safety laser scanner at a height of at least 300 mm (height of the scan plane), the scan plane is at calf height and the leg is detected even at a resolution of 70 mm (see figure 28, page 38).

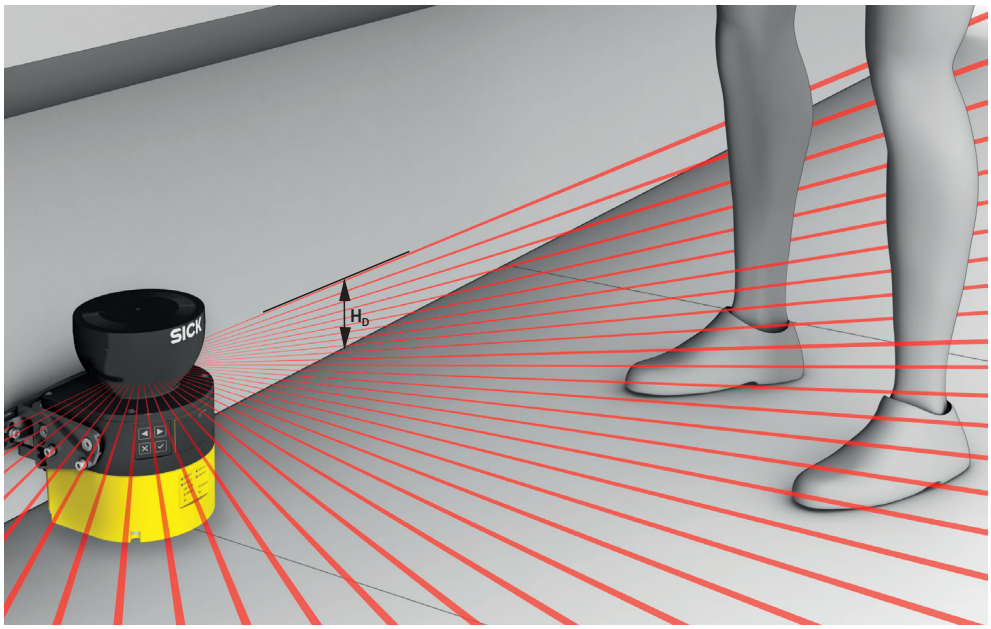


Figure 27: Scan plane at ankle height

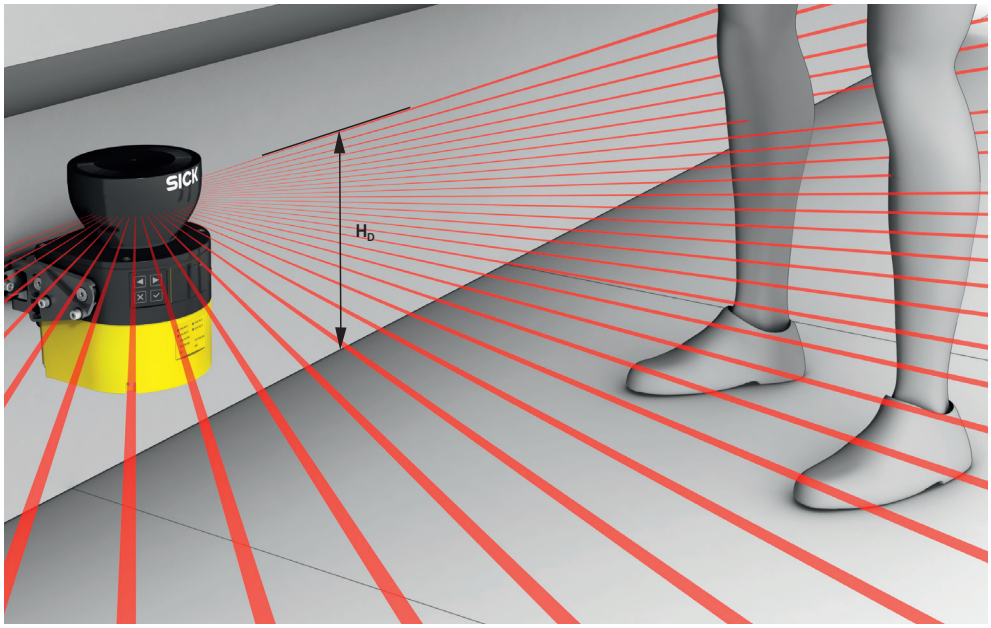


Figure 28: Scan plane at calf height

Important information

DANGER
Hazard due to lack of effectiveness of the protective device

It is possible to get around the protective device by crawling beneath.

- ► Prevent people from being able to crawl beneath the protective field by mounting the safety laser scanner appropriately.
- ► If you mount the protective device higher than 300 mm, you must use additional measures to prevent people crawling underneath.

DANGER
Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

Body parts to be protected may not be detected under coarse resolution.

- ► Use a resolution of 70 mm or finer for hazardous area protection.
- ► For hazardous area protection with a resolution of 70 mm: make sure that it is possible to detect a human leg.
- ► For hazardous area protection with a resolution of 70 mm: mount the safety laser scanner at a height of at least 300 mm (height of the scan plane).
- ► If it is not possible to mount the safety laser scanner at a height of at least 300 mm, use a finer resolution, see "Calculating required resolution", page 38.

Calculating required resolution

If the height of the protective field (scan plane) is predefined and is less than 300 mm, you can calculate the required resolution using the following formula:

$d_r = H_D/15 + 50$ mm

where:

- d_r = coarsest permissible resolution of the safety laser scanner in millimeters (mm)
- H_D = height of the protective field above the floor in millimeters (mm)

► The safety laser scanner's resolution can be set to the predefined value d. If the result d_r does not match any of these values, choose a finer resolution ($d \leq d_r$).

4.3.6.4 Distance from walls

Overview

The availability may be impaired if the protective field stretches as far as a wall or a different object. So, plan to have a space between the protective field and the object. A distance of the TZ value is recommended to ensure availability. (TZ = tolerance zone of the safety laser scanner, see "Data sheet", page 142.)

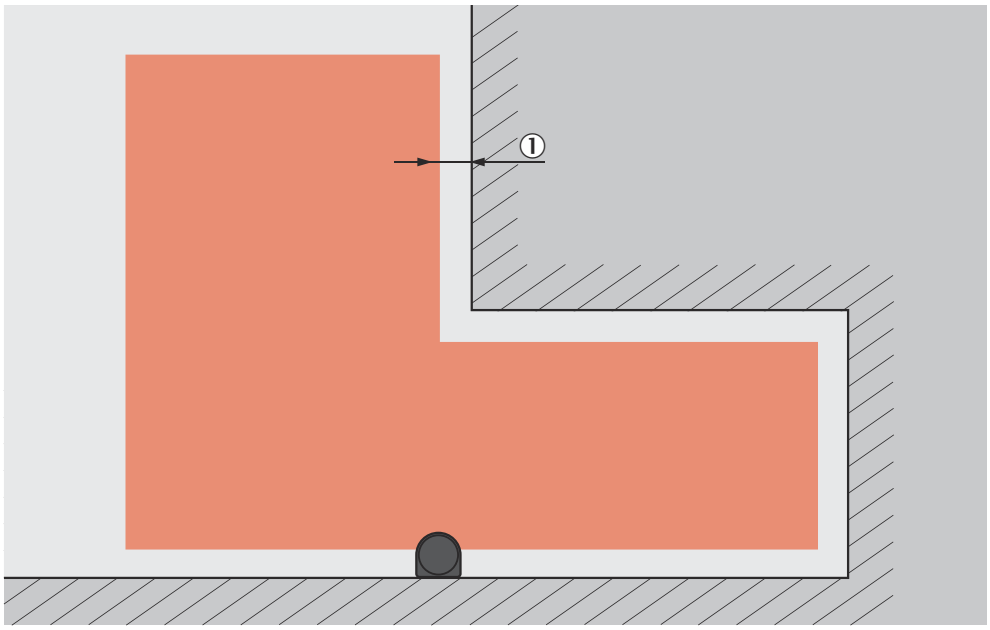


Figure 29: Distance of the protective field from the wall

① Recommended distance of the protective field from the wall.

Important information

DANGER
Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

If the distance between the protective field and the wall is so large that a person can stand in it, this person might not be detected. If needed, take suitable measures to prevent this such as:

► Attaching deflector plates
► Attaching fence

4.3.7 Hazardous point protection

Overview

The safety laser scanner is mounted with a vertical scan plane in a stationary application. This is, for example, on a machine where the operator must stay close to the hazardous point. A fixed barrier with a height of at least 1,200 mm is located in front of the hazardous point. The operator can reach over the barrier and through the scan plane into the hazardous point. But the operator cannot climb over the barrier. If there is no such barrier available, access protection may be required.

During hazardous point protection, the safety laser scanner detects a person's hand or other part of their body. The protective field is orthogonal to the direction of approach of the body part. A resolution of 40 mm or finer is required to ensure detection of the hand during hazardous point protection.

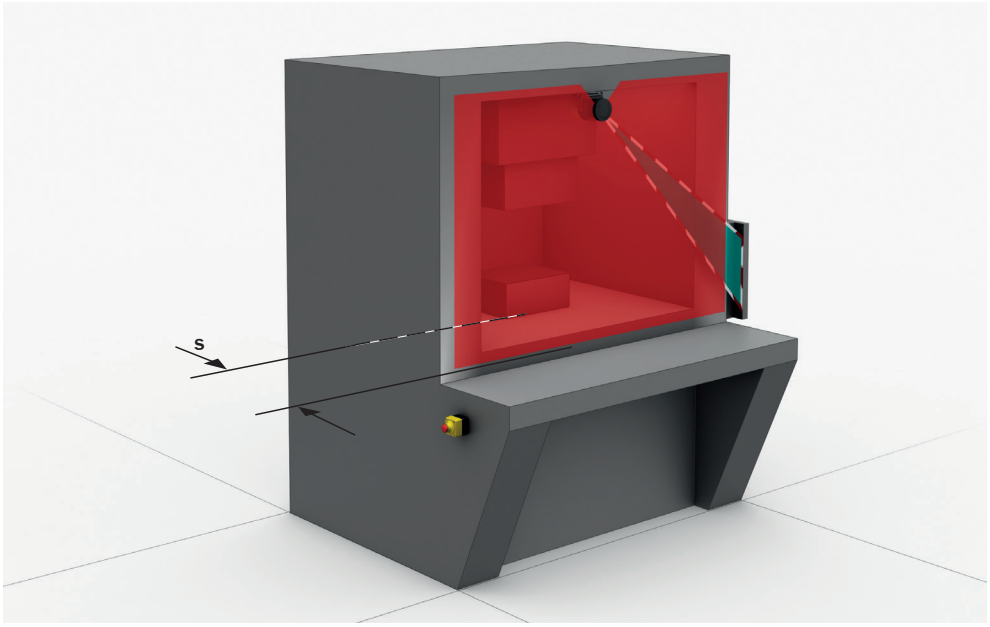


Figure 30: Stationary application in vertical operation for hazardous point protection

Important information

DANGER
Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

The safety laser scanner is not suitable for finger detection, because the finest resolution is 30 mm.

- ► Never use the safety laser scanner for applications in which finger detection has to be realized.
- ► Use the contour of the environment as a reference to protect the protective device from inadvertent adjustment or tampering (see "Reference contour monitoring", page 29).

DANGER
Hazard due to lack of effectiveness of the protective device

If there is a retroreflector in the protective field level (distance of the retroreflector from protective field ≤ 6 m), it may not be possible detect people and parts of the body that are to be protected, or it may not be possible to detect them on time.

- ► Avoid retroreflectors in the protective field level if possible.
- ► With retroreflectors at the protective field level: Increase overrun of the protective field over the opening to be protected by supplement Z_R = 350 mm.

DANGER
Hazard due to lack of effectiveness of the protective device

Devices with max. protective field range of 9 m: Strongly reflective surfaces (e.g. shiny metal, tile) with a distance from the protective field ≤ 6 m can behave similarly to a retroreflector if the laser beam hits the surface vertically. If the protective field is larger than 50% of the effective protective field range in the direction of the laser beam which is hitting the surface vertically, it is possible that persons and parts of the body that are to be protected will not be detected or not be detected on time.

- ► Avoid strongly reflective surfaces in the protective field level if possible.
- ► With strongly reflective surfaces in the protective field level: Increase overrun of the protective field over the opening to be protected by supplement Z_R = 350 mm.

Protective field

The protective field must be designed so that it detects access by a person at a minimum distance from the hazardous point. This distance is required to prevent a person or part of their body from reaching the hazardous area before the end of the machine's dangerous state.

In hazardous area protection, the minimum distance typically defines the position at which the safety laser scanner is mounted.

In many cases, a resolution of 30 mm or 40 mm is suitable for hazardous point protection.

DANGER
Hazard due to lack of effectiveness of the protective device

In the case of non-compliance, it is possible that the dangerous state of the machine may not be stopped or not stopped in a timely manner.

1. Calculate the required minimum distance for your machine using the following formulas and examples.
2. Take this calculation and the specifications in these instructions into account when mounting the safety laser scanner.
3. Take this calculation and the specifications in these instructions into account when configuring the safety laser scanner.

DANGER
Hazard due to lack of effectiveness of the protective device

Persons or parts of the body to be protected may not be recognized or not recognized in time in case of non-observance.

- ► Always mount the safety laser scanner so that it is impossible to reach around or behind.
- ► Provide suitable additional measures if necessary.

NOTE
The required minimum distance depends on the safety laser scanner's set resolution. Take account of the following notes when choosing the resolution:

- If you choose a fine resolution, the protective field range is smaller and the protective field is only suitable for smaller hazardous points. But the required minimum distance is smaller, you can mount the safety laser scanner closer to the hazardous point.
- If you choose a coarser resolution, the protective field range is larger and the protective field is also suitable for larger hazardous points. But the required minimum distance is larger, you must mount the safety laser scanner further away from the hazardous point.

Calculating minimum distance

The calculation of the minimum distance is based on international or national standards and statutory requirements applicable at the place of installation of the machine.

If the minimum distance is calculated according to ISO 13855:2010, then it depends on the following points:

- Machine stopping time (time interval between triggering the sensor function and the end of the machine's dangerous state)
- Response time of the protective device, see "Response times", page 148
- Reach or approach speed of the person
- Resolution (detection capability) of the safety laser scanner
- Type of approach: orthogonal
- Parameters specified based on the application

NOTE
Additional information is available in the ISO 13855:2010 standard and in the Guide for Safe Machinery.

NOTE
SICK offers a stopping/run-down time measurement service in many countries.

Example calculation of the minimum distance S according to ISO 13855:2010

The example shows the calculation of the minimum distance for an orthogonal approach to the protective field. A different calculation may be required depending on the application and the ambient conditions (for example, for a protective field parallel to or at any angle to the direction of approach or an indirect approach).

► First, calculate S using the following formula:
S = 2000 mm/s × T + 8 × (d – 14 mm)
where:
  - S = minimum distance in millimeters (mm)
  - T=stopping/run-down time for the entire system in seconds (s)
(Response time of the safety laser scanner + machine stopping time, incl. response time of the machine control system and signal propagation time)
  - d = resolution of the safety laser scanner in millimeters (mm)

The reach/approach speed is already included in the formula.

✓ If the result S is ≤ 100 mm, use S = 100 mm.

✓ If the result 100 mm < S ≤ 500 mm, use the calculated value as the minimum distance.

► If the result is S > 500 mm, you may be able to reduce the minimum distance using the following calculation:
S = 1600 mm/s × T + 8 ×(d – 14 mm)

✓ If the new value is S > 500 mm, use the newly calculated value as the minimum distance.
✓ If the new value S is ≤ 500 mm, then use 500 mm as the minimum distance.

4.3.8 Access protection

Overview

In a stationary application, for example on a machine where the point of access to the hazardous area can be physically defined, the safety laser scanner is mounted with a vertical scan plane. For access protection, the safety laser scanner detects an intrusion by a whole body. The protective field is orthogonal to the person's direction of approach.

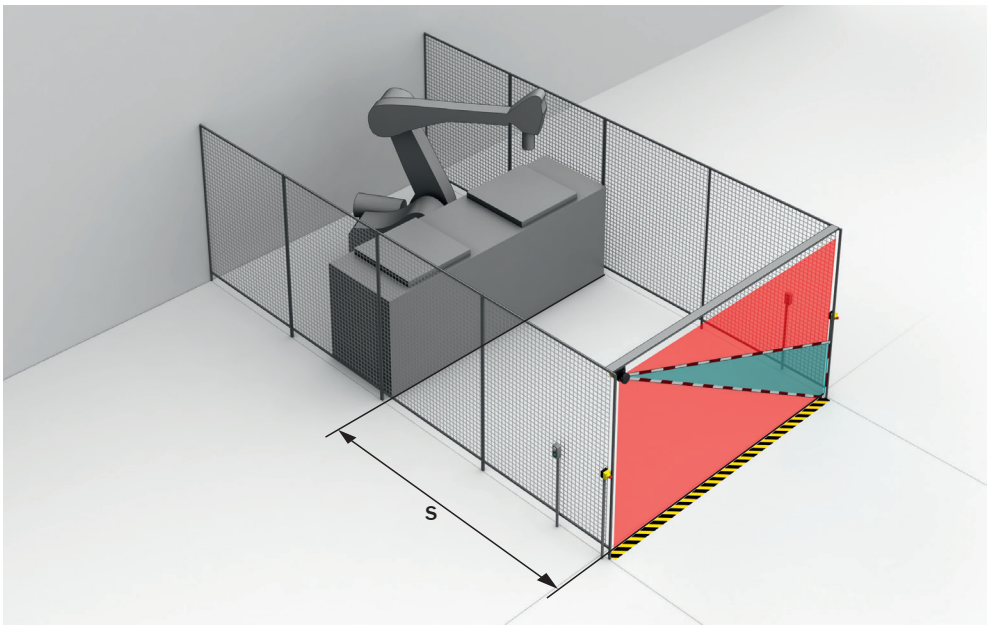


Figure 31: Stationary application in vertical operation for access protection

Important information

DANGER
Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

► Use a resolution of 200 mm or finer. Otherwise, protection will not be ensured during access protection.
► Use double sampling during access protection. Under certain circumstances, a person could pass through the protective field without being detected when using higher multiple sampling.
► Use the contour of the environment as a reference to protect the protective device from inadvertent adjustment or tampering (see "Reference contour monitoring", page 29).

DANGER
Hazard due to lack of effectiveness of the protective device

If there is a retroreflector in the protective field level (distance of the retroreflector from protective field ≤ 6 m), it may not be possible detect people and parts of the body that are to be protected, or it may not be possible to detect them on time.

- ► Avoid retroreflectors in the protective field level if possible.
- ► With retroreflectors at the protective field level: Increase overrun of the protective field over the opening to be protected by supplement Z_R = 350 mm.

DANGER
Hazard due to lack of effectiveness of the protective device

Devices with max. protective field range of 9 m: Strongly reflective surfaces (e.g. shiny metal, tile) with a distance from the protective field ≤ 6 m can behave similarly to a retroreflector if the laser beam hits the surface vertically. If the protective field is larger than 50% of the effective protective field range in the direction of the laser beam which is hitting the surface vertically, it is possible that persons and parts of the body that are to be protected will not be detected or not be detected on time.

- ► Avoid strongly reflective surfaces in the protective field level if possible.
- ► With strongly reflective surfaces in the protective field level: Increase overrun of the protective field over the opening to be protected by supplement Z_R = 350 mm.

4.3.8.1 Protective field

Overview

The protective field must be designed so that it detects a person at a minimum distance from the hazardous point. This distance is required to prevent a person or part of their body from reaching the hazardous area before the end of the machine's dangerous state.

In access protection, the minimum distance typically defines the position at which the safety laser scanner is mounted.

The protective field must cover a minimum area so that the safety laser scanner reliably detects a moving person:

- The lower edge of the protective field must not be more than 300 mm above the floor/ground according to ISO 13855:2010.
- Resolution < 150 mm: The top edge of the protective field must be at least 900 mm above the floor/ground according to ISO 13855:2010.
- Resolution 150 mm: The top edge of the protective field must be at least 1,100 mm above the floor/ground.
- Resolution 200 mm: The top edge of the protective field must be at least 1,400 mm above the floor/ground.
- Devices with a max. protective field range of 9 m: The top edge of the protective field must be at least 1,400 mm above the floor/ground.

Important information

DANGER
Hazard due to lack of effectiveness of the protective device

In the case of non-compliance, it is possible that the dangerous state of the machine may not be stopped or not stopped in a timely manner.

1. Calculate the required minimum distance for your machine using the following formulas and examples.
2. Take this calculation and the specifications in these instructions into account when mounting the safety laser scanner.
3. Take this calculation and the specifications in these instructions into account when configuring the safety laser scanner.

4.3.8.2 Calculating minimum distance

Overview

The calculation of the minimum distance is based on international or national standards and statutory requirements applicable at the place of installation of the machine.

If the minimum distance is calculated in accordance with ISO 13855:2010, then it depends on the following points:

- Machine stopping time (time interval between triggering the sensor function and the end of the machine's dangerous state)
- Response time of the protective device, see "Response times", page 148
- Reach or approach speed of the person
- Resolution (detection capability) of the safety laser scanner
- Type of approach: orthogonal
- Parameters specified based on the application
- Supplement to prevent reaching through

Important information

NOTE
Additional information is available in the ISO 13855:2010 standard and in the Guide for Safe Machinery.

NOTE
SICK offers a stopping/run-down time measurement service in many countries.

Example calculation of the minimum distance S according to ISO 13855:2010

The example shows the calculation of the minimum distance for an orthogonal approach to the protective field. A different calculation may be required depending on the application and the ambient conditions (for example, for a protective field parallel to or at any angle to the direction of approach or an indirect approach).

► Calculate S using the following formula:
S = 1600 mm/s × T + 850 mm
where:
  - S = minimum distance in millimeters (mm)
  - T=stopping/run-down time for the entire system in seconds (s)
    (Response time of the safety laser scanner + machine stopping time, incl. response time of the machine control system and signal propagation time)

The approach speed is already included in the formula.

4.3.9 Mobile hazardous area protection

The safety laser scanner is mounted with a horizontal scan plane in a mobile application, like on an automated guided vehicle. In mobile hazardous area protection, the safety laser scanner protects the hazardous area created by the vehicle's movement. The safety laser scanner detects a person's legs. The protective field is parallel to the direction of approach.

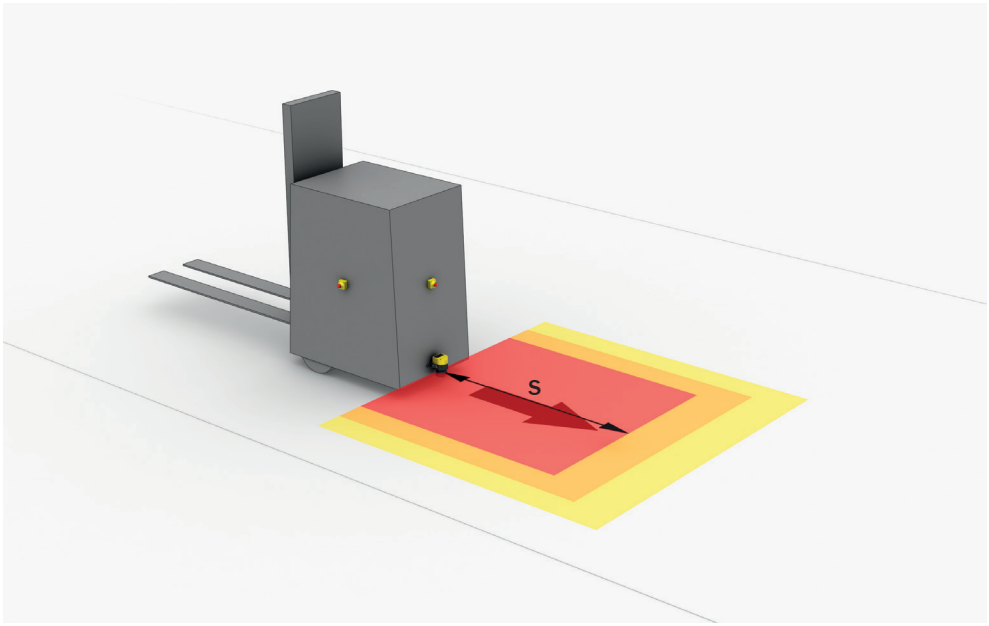


Figure 32: Mobile application in horizontal operation for hazardous area protection

DANGER

Hazard due to lack of effectiveness of the protective device

In the case of non-compliance, it is possible that the dangerous state of the machine may not be stopped or not stopped in a timely manner.

1. Calculate the minimum dimensions required for the protective field taking into account the supplements described in the following text along with the specific requirements imposed by your application.
2. Take this calculation and the specifications in these instructions into account when mounting the safety laser scanner.
3. Take this calculation and the specifications in these instructions into account when configuring the safety laser scanner.

NOTE

- In a mobile application, a resolution of 70 mm (leg detection) is sufficient for detecting people. By contrast with stationary hazardous point protection, this is also true for a low mounting height, as the safety laser scanner moves together with the vehicle.
- In the following calculation examples, only the vehicle speed is taken into account, not the speed of a walking person. This is based on the assumption that the person recognizes the danger and stands still.

4.3.9.1 Protective field length

The protective field must be designed so that it detects a person at a minimum distance from the hazardous point. This distance is required to ensure that the vehicle comes to a stop before it reaches a person or an object.

In mobile hazardous area protection, the minimum distance typically defines the protective field length required. When calculating the protective field length, the impact of turning must be considered separately.

If you define a number of monitoring cases with different protective fields, you must calculate the protective field size separately for each protective field used.

Supplement Z_R for reflection-based measurement errors

All devices: If there is a retroreflector in the vicinity of the protective device (distance of the retroreflector from protective field ≤ 6 m), you must take the supplement Z_R = 350 mm into account.

Supplement Z_F for lack of ground clearance

This supplement is necessary, because, generally, a person is detected above the foot and so the braking process cannot take account of the length of the foot in front of the point of detection. A person's foot could be injured if a vehicle has no ground clearance.

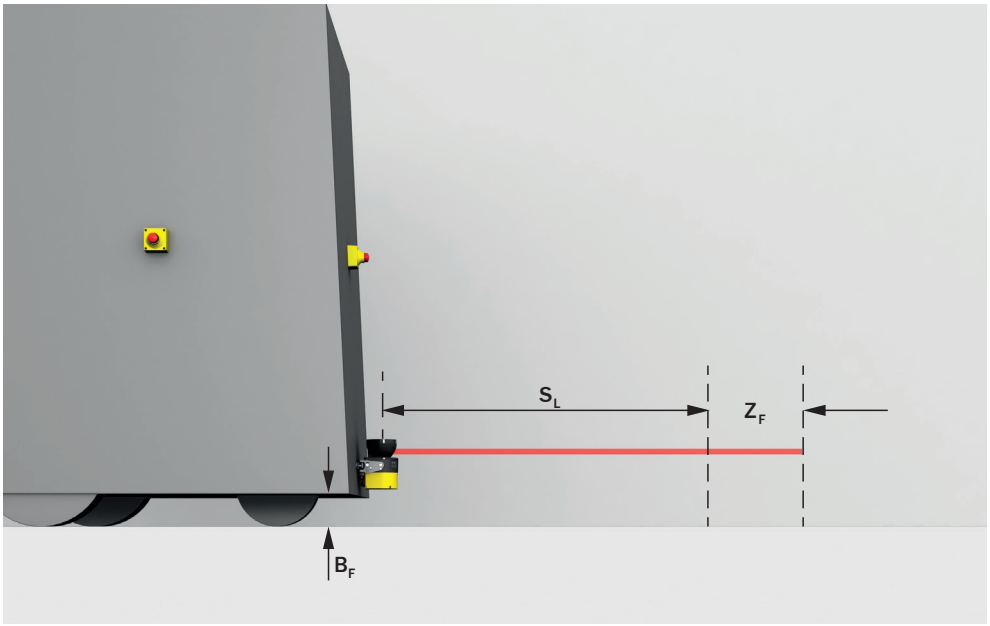


Figure 33: flat-rate supplement ZF for lack of ground clearance

B_F ground clearance

S_L protective field length without a supplement for lack of ground clearance

Z_F supplement for lack of ground clearance

The lump supplement for ground clearance under 120 mm is 150 mm. This supplement may be reduced further in individual cases. Read the supplement actually required for your vehicle's ground clearance from the following graph.

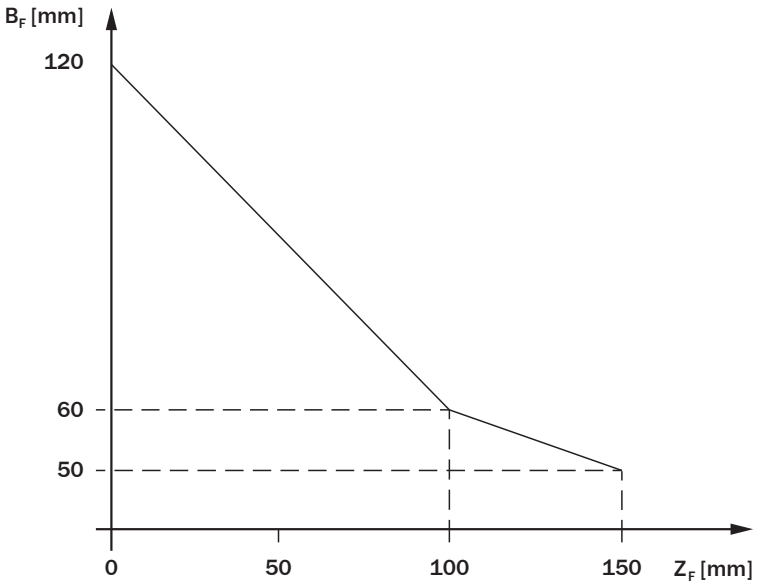


Figure 34: Minimum supplement for lack of ground clearance

B_F ground clearance in mm

Z_F supplement for lack of ground clearance in mm

Calculation example for the protective field length S_L

$S_L = S_A + TZ + Z_R + Z_F + Z_B$

where:

- S_L = protective field length in millimeters (mm)
- S_A = stopping distance in millimeters (mm)
- TZ = tolerance zone of the safety laser scanner, see "Data sheet", page 142
- Z_R = supplement for reflection-based measurement errors in millimeters (mm)
- Z_F = supplement for lack of ground clearance of the vehicle in millimeters (mm)
- Z_B = supplement for the decreasing braking force of the vehicle, from the vehicle documentation, in millimeters (mm)

Stopping distance S_A

The stopping distance comprises the vehicle's braking distance and the distance covered during the safety laser scanner's response time and the vehicle control's response time (including signal propagation time).

NOTE

A vehicle's braking distance does not increase linearly with increasing speed, but rather in a squared relationship.

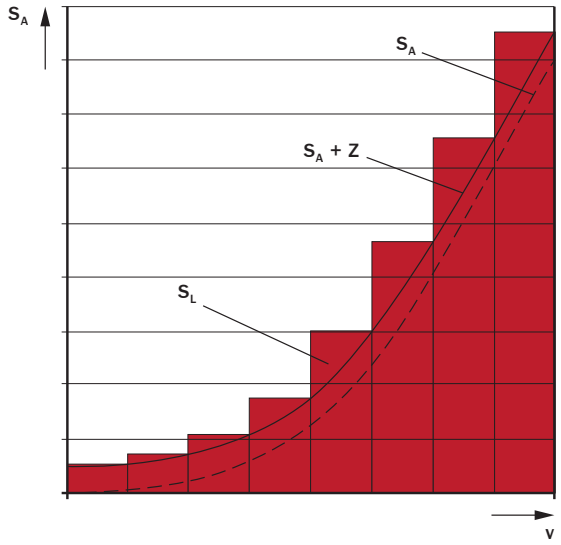


Figure 35: Stopping distance as a function of the vehicle's speed

v speed
S_A stopping distance
Z supplements
S_L protective field length for the relevant range of speeds

$S_A = S_{Br} + S_{AnF} + S_{AnS}$

where:

- S_A = stopping distance in millimeters (mm)
- S_{Br} = braking distance, from the vehicle documentation, in millimeters (mm)
- S_{AnF} = distance covered during the vehicle control's response time (including signal propagation time), from the vehicle documentation, in millimeters (mm)
- S_{AnS} = distance covered during the safety laser scanner's response time in millimeters (mm)
  The distance S_{AnS} depends on the safety laser scanner's response time and the vehicle's speed. The distance S_{AnS} is calculated using the following formula:
  $S_{AnS} = t_R \times V_{max}$
  where:
  - t_R = safety laser scanner's response time in seconds (s) (see "Response times", page 148)
  - V_{max} = maximum speed of the vehicle, from the vehicle documentation, in millimeters per second (mm/s) (If you define a number of monitoring cases with different protective fields: V_{max} = maximum speed of the vehicle in the current monitoring case)

4.3.9.2 Protective field width

The protective field must be wide enough to cover the width of the loaded vehicle with supplements for measurement error and the lack of ground clearance. When calculating the protective field width, the impact of turning must be considered separately.

Supplement Z_R for reflection-based measurement errors

All devices: If there is a retroreflector in the vicinity of the protective device (distance of the retroreflector from protective field ≤ 6 m), you must take the supplement Z_R = 350 mm into account.

Supplement Z_F for lack of ground clearance

This supplement is necessary, because, generally, a person is detected above the foot and so the braking process cannot take account of the length of the foot in front of the point of detection. A person's foot could be injured if a vehicle has no ground clearance, see "Supplement Z_F for lack of ground clearance", page 47.

Calculation example for the protective field width S_B

$S_B = F_B + 2 \times (TZ + Z_R + Z_F)$

where:

- S_B = protective field width in millimeters (mm)
- F_B = vehicle width in millimeters (mm)
- TZ = tolerance zone of the safety laser scanner, see "Data sheet", page 142
- Z_R = supplement for reflection-based measurement errors in millimeters (mm)
- Z_F = supplement for lack of ground clearance of the vehicle in millimeters (mm)

NOTE

In many cases, the safety laser scanner is mounted in the center of the vehicle. If this is not the case, you must define the protective field asymmetrically. Make sure that the supplements are located on the right and left of the vehicle.

4.3.9.3 Height of the scan plane

DANGER

Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

► Mount the safety laser scanner so that the maximum scan plane height is 200 mm.

People who are lying down are reliably detected if the scan plane is at a height of no more than 200 mm.

In many cases, a mounting height of 150 mm above the floor (height of the scan plane) is suitable.

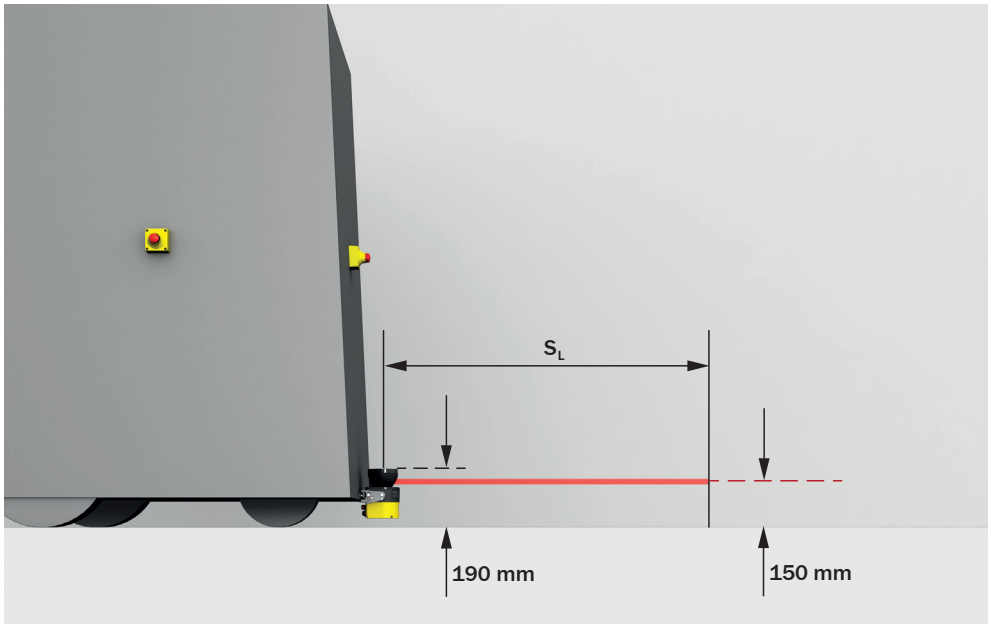


Figure 36: Recommended fitting height

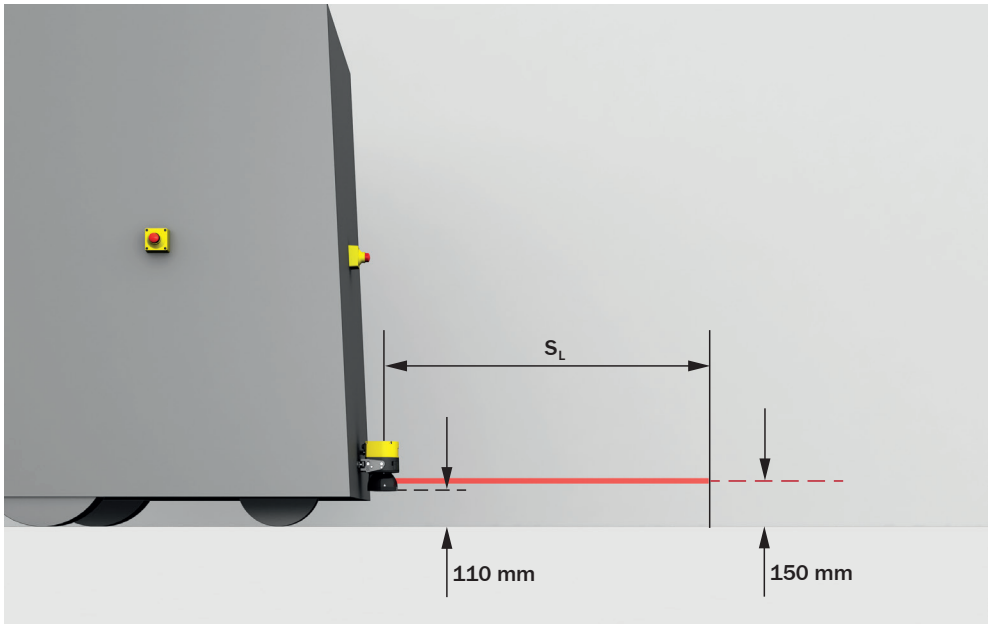


Figure 37: Recommended fitting height for inverted mounting

Further topics

- "Scan plane", page 154

4.4 Integration in the electrical control system

This section contains important information about integration into the electrical control system. Information about the individual steps for the electrical installation of the device: see "Electrical installation", page 69.

Information about pin assignment: see "Pin assignment", page 71.

Requirements for use

The output signals of the protective device must be analyzed by downstream controllers in such a way that the dangerous state of the machine is ended safely. Depending on the safety concept, the signal is analyzed by safety relays or a safety controller, for example.

DANGER
Hazard due to lack of effectiveness of the protective device

In the case of non-compliance, it is possible that the dangerous state of the machine may not be stopped or not stopped in a timely manner.

► Make sure that the following control and electrical requirements are met so the safety laser scanner can fulfill its protective function.

- It must be possible to electrically influence the control of the machine.
- Use the same earthing method for all devices that are electrically connected to the safety laser scanner.
- All earthing points must be connected with the same ground potential.
- Voltage must be supplied in accordance with SELV/PELV (IEC 60204-1) for all devices that are electrically connected to the safety laser scanner.
- All devices connected to a local input or output of the safety laser scanner must be in the same SELV/PELV circuit as the safety laser scanner.
- The control that is connected and all devices responsible for safety must comply with the required performance level and the required category (for example according to ISO 13849-1).
- When using a safety controller, different signal levels of both OSSDs in an OSSD pair must be detected depending on applicable national regulations or required reliability of the safety function. The maximum discrepancy time tolerated by the control must be selected according to the application.
- A restart interlock must be implemented depending on applicable national regulations or required reliability of the safety function. Each OSSD pair in the safety laser scanner is equipped with a configurable internal restart interlock. For safety laser scanners which do not have OSSDs, if a restart interlock is required, it must be provided in the external controller.

DANGER
Hazard due to lack of effectiveness of the protective device

In the case of non-compliance, it is possible that the dangerous state of the machine may not be stopped or not stopped in a timely manner.

Downstream contactors must be positively guided and monitored depending on applicable national regulations or required reliability of the safety function.

► Make sure that downstream contactors are monitored (external device monitoring, EDM).

- Each OSSD pair in the safety laser scanner is equipped with a configurable internal EDM.

The safety laser scanner complies with the regulations for electromagnetic compatibility (EMC) for the industrial sector (Radio Safety Class A).

4.4.1 Electromagnetic compatibility

Overview

Safety components switch all safety outputs to the OFF state in the event of errors in order to rule out potentially dangerous situations. For example, faulty data transmission must lead to a shutdown for safety-related devices, even if it can be tolerated for non-safety-related devices.

To avoid electromagnetic interference as much as possible, a consistent earthing method is required for the entire system. In particular, the functional earth must be connected using suitable conductors. Cables susceptible to interference and sources of interference should be routed separately.

Electromagnetic interference depends on the environment in which the product is used. The product is tested and certified according to common standards. It is therefore reliable when used in industrial environments.

Shielded cables

For shielded cables, the shielding should be applied on both sides and over a large area. Deviations are only permitted in exceptional and justified cases. Especially when using motors or other inductive consumers, one-sided support of the shielding is not sufficient because it does not act against inductive interferers.

Functional earth

The functional earth must be connected. The connection must be made in accordance with the earthing method of the system.

Options for connecting the functional earth:

- Pin or thread on M12 plug connector
- M5 threaded holes on the rear or side of the housing

The functional earth must be connected with low inductance, i.e. with a sufficient wire cross-section and the shortest possible length of cable.

Complementary information

For more information, see the “Background knowledge on EMC” technical information (part number 8027030).

4.4.2 Voltage supply

DANGER
Hazard due to lack of effectiveness of the protective device

In the case of non-compliance, it is possible that the dangerous state of the machine may not be stopped or not stopped in a timely manner.

► Make sure that the following control and electrical requirements are met so the safety laser scanner can fulfill its protective function.

- The power supply unit must be able to jumper a brief power failure of 20 ms as specified in IEC 60204-1.
- The safety laser scanner requires a supply voltage of 24 V. For details about tolerances and further connected loads, see "Data sheet", page 142.
- The power supply unit must provide safe isolation according to IEC 61140 (SELV/PELV as per IEC 60204-1). [4)]
- Make sure that the safety laser scanner is provided with an appropriate electrical fuse protection. Electrical data for calculating what fuse is required, see "Data sheet", page 142.

4) The voltage supply according to SELV has proven to be more reliable in demanding environments.

- Use the same earthing method for all devices that are electrically connected to the safety laser scanner.
- Voltage must be supplied in accordance with SELV/PELV (IEC 60204-1) for all devices that are electrically connected to the safety laser scanner.
- All devices connected to a local input or output of the safety laser scanner must be in the same SELV/PELV circuit as the safety laser scanner.

4.4.3 USB connection

The safety laser scanner has a USB connection for configuration and diagnostics. The USB connection complies with the USB 2.0 mini-B standard (female connector). The USB connection may only be used temporarily and only for configuration and diagnostics. More information: see "Configuration", page 72 and see "Troubleshooting", page 130.

4.4.4 OSSDs

Safety laser scanners with local outputs can be directly integrated into the machine controller.

DANGER
Hazard due to lack of effectiveness of the protective device

In the case of non-compliance, it is possible that the dangerous state of the machine may not be stopped or not stopped in a timely manner.

► Make sure that the following control and electrical requirements are met so the safety laser scanner can fulfill its protective function.

- A restart interlock must be implemented depending on applicable national regulations or required reliability of the safety function. Each OSSD pair in the safety laser scanner is equipped with an internal restart interlock.
- When using a safety controller, different signal levels of both OSSDs in an OSSD pair must be detected depending on applicable national regulations or required reliability of the safety function. The maximum discrepancy time tolerated by the control must be selected according to the application.
- The output signals from an OSSD pair must not be connected to each other.
- In the machine controller, both signals from an OSSD pair must be processed separately.

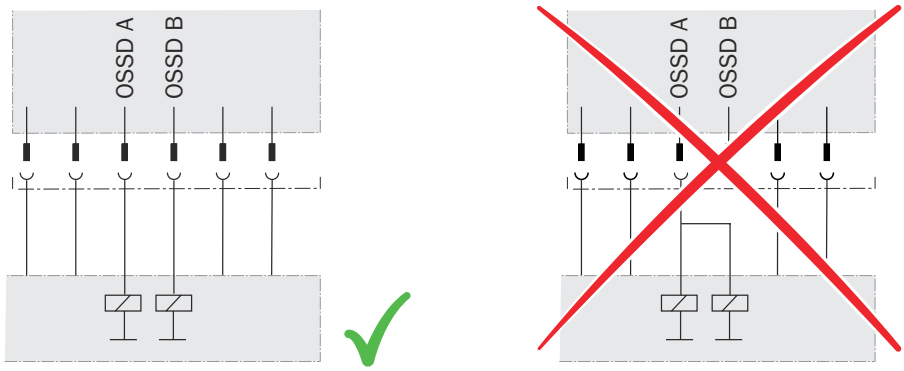


Figure 38: Dual-channel and separate connection of the OSSDs of an OSSD pair

- The machine must switch to the safe state if, at any time, at least one OSSD in an OSSD pair switches to the OFF state.

- Prevent the formation of a potential difference between the load and the protective device. If you connect loads to the OSSDs (safety outputs) that then also switch if controlled with negative voltage (e.g., electro-mechanical contactor without reverse polarity protection diode), you must connect the 0 V connections of these loads and those of the corresponding protective device individually and directly to the same 0 V terminal strip. In the event of an error, this is the only way to ensure that there can be no potential difference between the 0 V connections of the loads and those of the corresponding protective device.

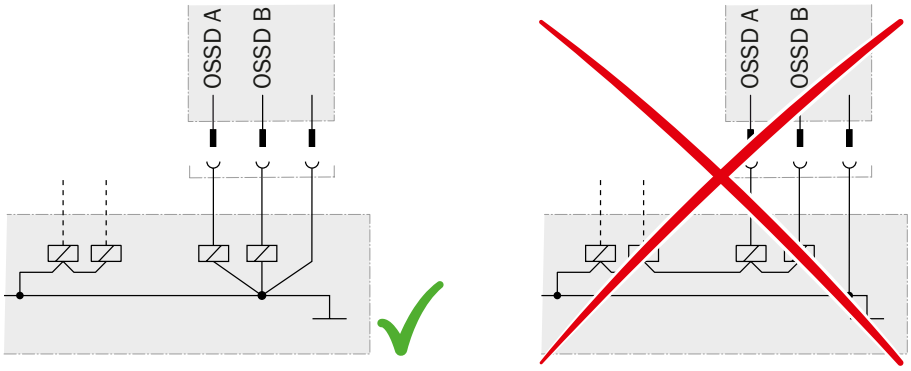


Figure 39: No potential difference between load and protective device

DANGER

Hazard due to lack of effectiveness of the protective device

In the case of non-compliance, it is possible that the dangerous state of the machine may not be stopped or not stopped in a timely manner.

Downstream contactors must be positively guided and monitored depending on applicable national regulations or required reliability of the safety function.

► Make sure that downstream contactors are monitored (external device monitoring, EDM).

- Each OSSD pair in the safety laser scanner is equipped with an internal EDM.

Requirements for the electrical control of the machine

The OSSDs are short-circuit protected to 24 V DC and 0 V. When the protective field is clear, the OSSDs signal the ON state with the HIGH signal level (non-isolated). If there are objects in the protective field or there is a device error, the OSSDs signal the OFF state with the LOW signal level.

4.4.5 Control inputs

Overview

The safety laser scanner is equipped with control inputs:

- The control inputs accept signals for switching between different monitoring cases.
- Static control inputs are used for information about machine status.

When switching between monitoring cases, bear in mind that a person may already be in the protective field when switching takes place. So, you must make sure that the monitoring case is switched at the right time. Only switching in time (namely before the danger arises for the person at this location) ensures protection, see "Monitoring case switching time", page 31.

Important information

DANGER
Hazard due to lack of effectiveness of the protective device

The dangerous state may not be stopped in the event of non-compliance.

The same safety level is required for the safety-related parts of the control which switch the active protective field as for the safety function. In many cases, this is PL d as per ISO 13849-1 or SIL 2 as per IEC 62061.

- Use the same earthing method for all devices that are electrically connected to the safety laser scanner.
- Voltage must be supplied in accordance with SELV/PELV (IEC 60204-1) for all devices that are electrically connected to the safety laser scanner.
- All devices connected to a local input or output of the safety laser scanner must be in the same SELV/PELV circuit as the safety laser scanner.

Prerequisites

- Position-dependent switching is carried out by 2 independently wired signal sources, such as 2 independent position switches.
- Manual switching that depends on the operating mode is carried out using a suitable manual control switch.

Further topics

- "Data sheet", page 142
- "Electrical installation", page 69
- "Inputs and outputs, local", page 101

4.4.5.1 Static control inputs

Overview

The static control inputs support the following evaluation methods:

- Complementary analysis

You can define the switching criteria for the monitoring cases (see "Monitoring cases", page 105).

Complementary analysis

A static control input consists of 2 channels. To switch correctly, one channel must be switched inversely to the other. The following table shows which status the static control input's channels must have to define logical input condition 1 and 0 at the relevant control input.

Table 3: Status of the channels of the control inputs with complementary evaluation

A1	A2	Logical input status (input A)
1	0	0
0	1	1
1	1	Error
0	0	Error

In antivalent evaluation, the 2 channels of each static control input must always be inverted, even if the status of a control input in a monitoring case is random. If it is not inverted, all safety outputs switch to the OFF state and the device displays an error.

Complementary information

- When the input signal is changed, the previous monitoring case remains active for the duration of the set switch-on delay. If no valid input signal is present after the switch-on delay has elapsed, the behavior depends on the sequence monitoring:
  - If monitoring of the switching sequence (sequence monitoring) is not activated, the OSSDs switch to the OFF state after the switch-on delay has elapsed. If a valid input signal is present within another second, the safety laser scanner activates the new monitoring case. If no valid input signal is present within this time, the OSSDs remain in the OFF state and the safety laser scanner displays an error and must be restarted.
  - If monitoring of the switching sequence (sequence monitoring) is activated, the OSSDs switch to the OFF state after the switch-on delay has elapsed and the safety laser scanner displays an error and must be restarted.
- A short-circuit or cross-circuit on one or more channels of the static control inputs can cause the wrong monitoring case to be activated.
  - Some safety controllers detect the short-circuit or cross-circuit and switch off the outputs concerned or all their outputs.
  - Due to the short-circuit or cross-circuit, one or more input channels of the safety laser scanner can still deliver the HIGH signal level. This may result in a valid input signal so that a monitoring case is activated.
  - For this reason, laying the cables for the input signals in a protected manner is recommended. Otherwise, setting the switch-on delay to 0 s and activating sequence monitoring is recommended. Carrying out regular thorough checks at short intervals is also recommended.

Further topics

- "Settings for monitoring case tables", page 105

4.4.6 Universal inputs, universal outputs, universal I/Os

The safety laser scanner is equipped with universal I/Os.

Universal I/O can be configured as universal input or as universal output.

Depending on the device, a universal input can be used for resetting, external device monitoring (EDM), sleep mode, or restarting the protective device, for example. If sleep mode is activated by a universal input, the sleep mode must not be used for safety applications. Certain universal inputs can also be used in pairs as a static control input.

The function of a universal output is configurable. Which functions are available depends on the device. Possible signals are, for example: reset required, contamination warning.

A universal output must not be used for safety functions.

► Use the same earthing method for all devices that are electrically connected to the safety laser scanner.
► Voltage must be supplied in accordance with SELV/PELV (IEC 60204-1) for all devices that are electrically connected to the safety laser scanner.
► All devices connected to a local input or output of the safety laser scanner must be in the same SELV/PELV circuit as the safety laser scanner.

Information about electrical properties: see "Technical data", page 141

Information on pin assignment: see "Electrical installation", page 69

4.4.7 Restart interlock

Depending on the regulations which apply at the place of installation, a restart interlock may be required.

The restart interlock prevents the machine from automatically starting up, for example after a protective device has responded while the machine is operating or after changing the machine's operating mode.

First, the operator must press a reset pushbutton to return the protective device to monitoring status. Then, in a second step, the operator can restart the machine.

Depending on applicable national regulations, a restart interlock must be available if it is possible to stand behind the protective field.

Reset

The reset brings the protective device back to the monitoring state after it has sent a stop command. The reset also quits the start-up or restart interlock of a protective device, so that the machine can be restarted in a second step.

The reset must only be possible, when all safety functions and protective devices are functional.

The reset of the protective device must not introduce any movement or dangerous situations itself. The machine is only permitted to start after the reset once a separate start command has been sent.

- Manual resets are performed using a separate, manually operated device, such as a reset pushbutton.
- Automatic resets by the protective device are only permitted in special cases, if one of the following conditions is met:
  - It must not be possible for people to be in the hazardous area without triggering the protective device.
  - It must be ensured that no people are in the hazardous area during or after the reset.

Internal restart interlock

Each safety output of the safety laser scanner is equipped with a configurable internal restart interlock.

A reset pushbutton can be connected for each OSSD pair.

When the internal restart interlock is used, the following sequence is the result for the machine operator:

1 A safety output of the safety laser scanner switches to the OFF state, if there is an interruption in the protective field.
2 The safety output remains in the OFF state when there is no longer an object in the protective field.
3 The safety output only switches back to the ON state when the operator presses the reset pushbutton, which is outside the hazardous area. If there is an object in the protective field when the reset pushbutton is pressed, the safety output stays in the OFF state.
4 After the reset, the operator can restart the machine in a second step.

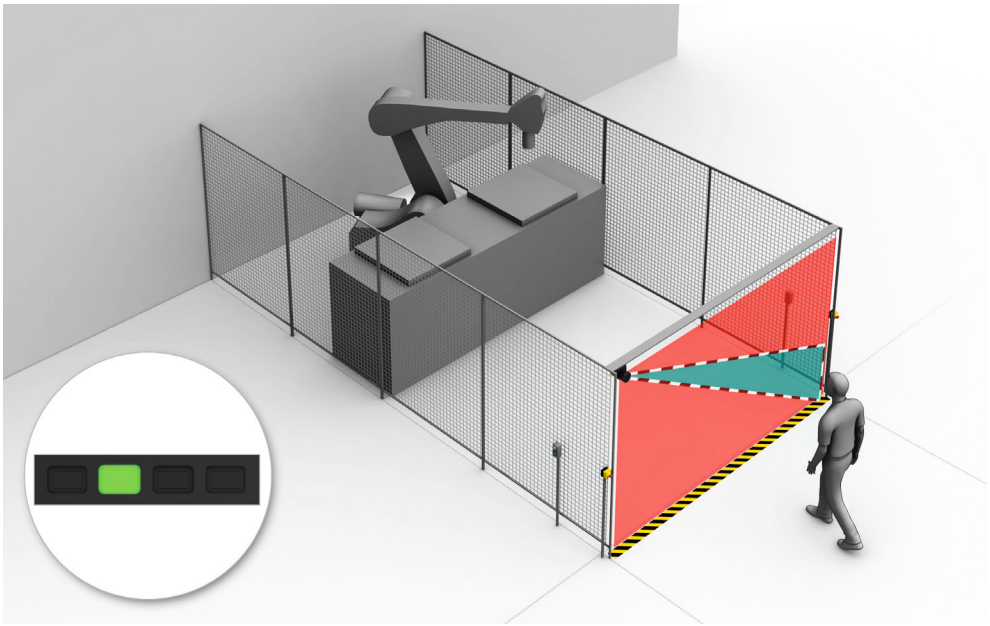


Figure 40: How the restart interlock works (1): no one in protective field, machine operates

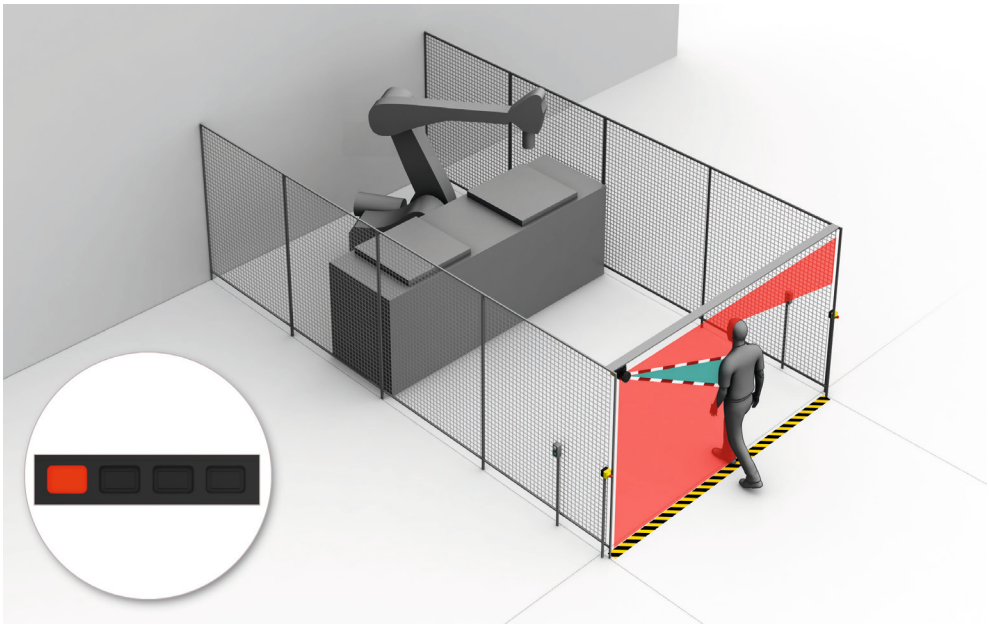


Figure 41: How the restart interlock works (2): person detected in protective field, safety output in OFF state

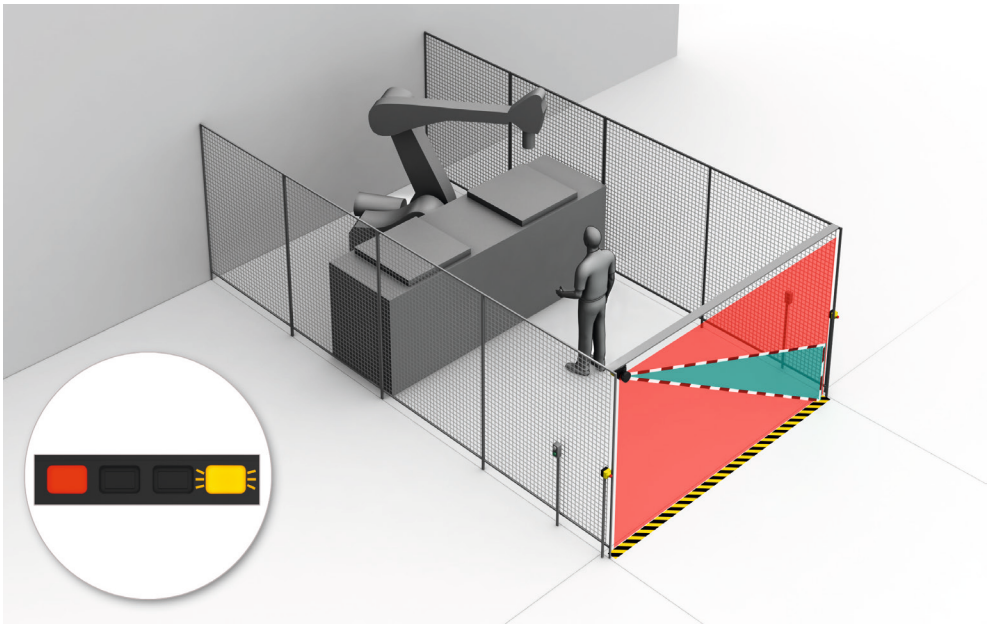


Figure 42: How the restart interlock works (3): person in hazardous area, no detection in protective field, safety output still in OFF state

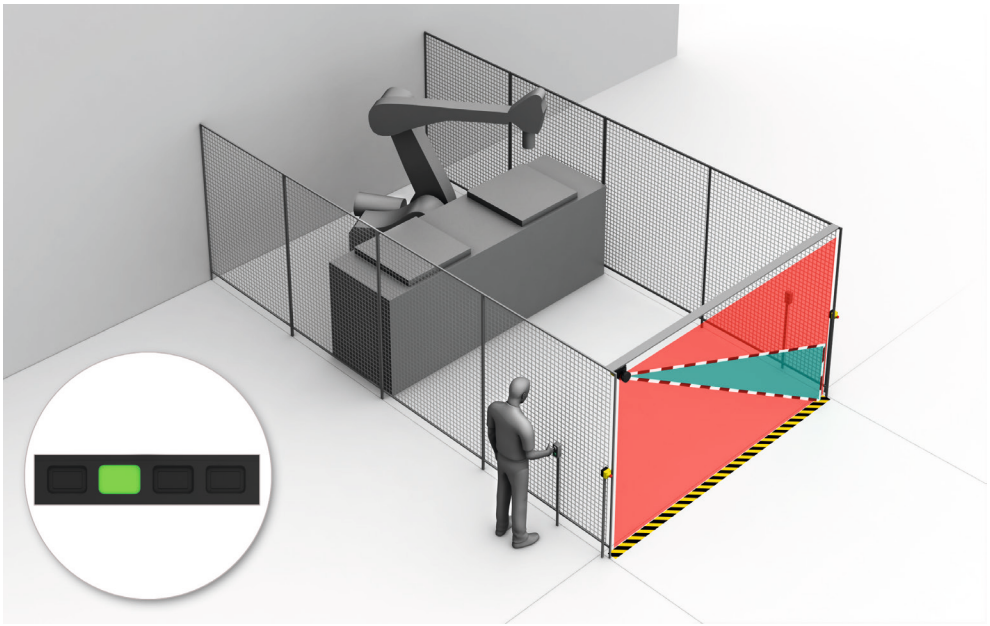


Figure 43: How the restart interlock works (4): the reset pushbutton must be pressed before restarting the machine.

DANGER
Hazard due to unexpected starting of the machine

- ► Affix the control switch for resetting the restart interlock outside the hazardous area.
- ► Make sure that the control switch cannot be activated by a person who is in the hazardous area.
- ► Also make sure that the person activating the control switch has a complete view of the hazardous area.

4.4.8 External device monitoring (EDM)

Overview

The external switching elements (external device monitoring, EDM) must be inspected in line with the regulations which apply at the place of installation or the required reliability of the safety function.

External device monitoring (EDM) monitors the status of downstream contactors.

Prerequisites

- Positively guided contactors are used for shutting down the machine.

Functionality

If you configure external device monitoring, then the safety laser scanner checks the contactors before each time an OSSD pair is switched on. External device monitoring is then able to detect if one of the contactor contacts is welded, for instance. In this case, the OSSDs remain in the OFF state.

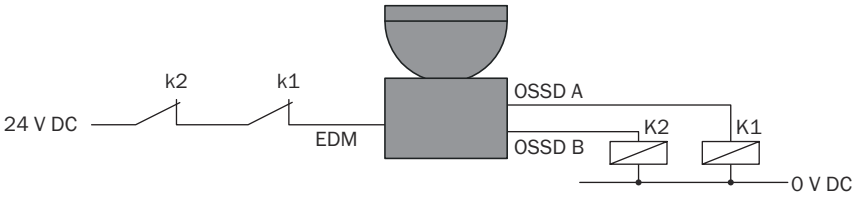


Figure 44: Electrical diagram of external device monitoring (EDM)

When the contactors (K1, K2) reach their rest position after the protective device has tripped, the two N/C contacts (k1, k2) close in a positively guided manner. 24 V is then present at the input of external device monitoring. If 24 V is not present before the OSSD pair is switched on, then one of the contactors is faulty and external device monitoring is preventing the OSSD pair from switching to the ON state.

In addition, external device monitoring checks the contactors after the OSSD pair is switched on. If both N/C contacts (k1, k2) remain closed after the OSSD pair is switched on, the OSSD pair switches back to the OFF state.

Complementary information

Each OSSD pair in the safety laser scanner is equipped with a configurable internal EDM.

4.4.9 Connection diagrams

You can find the connection diagrams at www.sick.com. To do so, enter the product part number in the search field (part number: see the entry in the “P/N” or “Ident. no.” field on the type label).

4.5 Testing plan

The protective device must be tested by appropriately qualified safety personnel when commissioning, after modifications and at regular intervals.

The manufacturer and user must define the type and frequency of the thorough checks of the machine on the basis of the application conditions and the risk assessment. Determination of the thorough checks must be documented in a traceable manner.

The following tests must be planned:

- Before commissioning the machine and after making changes, you must check whether the safety functions are fulfilling their planned purpose and whether persons are being adequately protected.
- The regular tests of the safety laser scanner must fulfill certain minimum requirements.

A test object is required for some thorough checks. An optically opaque cylinder with a black surface can be used as a suitable test object. The diameter must match the configured resolution.

4.5.1 Planning the thorough check during commissioning and in certain situations

Minimum requirements

The protective device and its application must be thoroughly checked in the following situations:

- Before commissioning
- After changes to the configuration or the safety function
- After changes to the mounting, the alignment or the electrical connection
- After exceptional events, such as after manipulation has been detected, after modification of the machine, or after replacing components

The thorough check ensures the following:

- Compliance with all relevant regulations and effectiveness of the protective device for all of the machine's operating modes. This includes the following points:
  - compliance with standards
  - correct use of the protective device
  - suitable configuration and safety function
  - correct alignment
- The documentation matches the state of the machine, incl. the protective device
- The verified configuration report corresponds to the desired project planning (see "Verifying configuration", page 111)

The thorough checks must be carried out by qualified safety personnel or specially qualified and authorized personnel and must be documented in a traceable manner.

In many cases, other data must be documented, see "Reports", page 112.

Recommended thorough checks

In many cases, it makes sense to carry out the following thorough checks during commissioning and in certain situations:

- Thorough check of the relevant points on the checklist, see "Checklist for initial commissioning and commissioning", page 169
- "Thorough visual check of the machine and the protective device", page 65
- "Thorough check of the principal function of the protective device", page 63
- "Thorough check of the area to be protected", page 64
- "Test of the contour detection field", page 65
- Make sure that the operating personnel has been instructed in the protective device's function before starting work on the machine. The instruction is the responsibility of the machine operator and must be carried out by qualified personnel.

4.5.2 Planning the regular thorough check

Overview

The purpose of regular tests is to detect defects due to changes or external influences (e.g. damage or manipulation) and to ensure that the protective measure provides the necessary protection.

Important information

DANGER
Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

- ► Carry out tests at least once a year.
- ► Assign qualified safety personnel to carry out the tests or persons specifically authorized for this purpose.
- ► Document tests in a traceable manner.

Minimum requirements

The following thorough checks must be carried out at least once a year:

- "Thorough check of the principal function of the protective device", page 63
- Testing of the detection capability (resolution) in the context of the "Thorough check of the area to be protected", page 64

Recommendations for further thorough checks

In many cases, depending on the application conditions, the risk assessment of the machine determines that further thorough checks are required or that some thorough checks must take place more frequently.

In many cases, it makes sense to carry out the following thorough checks together with the regular thorough check:

- "Thorough visual check of the machine and the protective device", page 65
- "Test of the contour detection field", page 65
- Test of the relevant points on the checklist, see "Checklist for initial commissioning and commissioning", page 169

In many cases, it makes sense to carry out the following thorough checks daily:

- "Thorough visual check of the machine and the protective device", page 65
- "Thorough check of the principal function of the protective device", page 63

Complementary information

If a thorough check reveals an error, the machine should be shut down immediately. In this case, the mounting and electrical installation of the safety laser scanner must be checked by appropriately qualified safety personnel.

4.5.3 Notes on the tests

Thorough check of the principal function of the protective device

SICK recommends the following procedure:

- ► Watch the display and the status LEDs above the safety laser scanner's display. If, when the machine is switched on, at least one LED above the safety laser scanner's display does not light up permanently, you must assume that there is an error.
- ► Test the function of the protective device by triggering the protective function once and observing the safety output's reaction using the reaction of the machine, for example.
  - All applications: during the thorough check, observe whether the safety laser scanner displays the interruption of the protective field using the LEDs and/or the display.
  - Stationary application (hazardous area protection, access protection, hazardous point protection):

- Interrupt the protective field using the supplied test object and observe whether the machine stops.

- Mobile application (mobile hazardous area protection):
  - Place the supplied test object in the path of the vehicle and observe whether the vehicle stops.
    OR
  - Activate a protective field, which is interrupted by at least one test object and check the expected reaction (for example by an automatic thorough check in the safety controller).

If the thorough check reveals an error, the machine should be shut down immediately. In this case, the mounting and electrical installation of the safety laser scanner must be checked by appropriately qualified safety personnel.

Thorough check of the area to be protected

The area to be protected and the detection capability are examined during this thorough check.

The thorough check covers the following points:

- Changes in the detection capability (thorough check of all configured fields)
- Modifications, tampering and damage to the protective device or the machine, which lead to changes in the area to be protected or the position of the protective field

SICK recommends the following procedure:

Hazardous area protection

► Position the supplied test object at a number of points at the edges of the area to be protected. The safety laser scanner must detect the test object at each position and indicate the detection. How it is indicated depends on the configuration. The number and position of sites where the thorough check is carried out must be chosen so that undetected access to the hazardous area is impossible.
► If a number of protective fields are used (in different monitoring cases for example), check the edges of all protective fields.

Access protection and hazardous point protection

► Move the supplied test object along the edges of the area to be protected. The safety laser scanner must detect the test object at each position and indicate the detection. How it is indicated depends on the configuration. The protective field must be dimensioned such that reaching around or going around it is impossible.
► If a number of protective fields are used (in different monitoring cases for example), check the edges of all protective fields.
► If the reference contour monitoring feature is used, check the areas with the reference contour:
  - Move the test object along the inner edge of the tolerance band of the reference contour. The safety laser scanner must detect the test object at each position and indicate the detection.
  - If a number of reference contours are used, check all reference contours.

Mobile hazardous area protection

► Place the supplied test object in the path of the vehicle and check whether the vehicle comes to a stop in time.
► If a number of protective fields are used (in different monitoring cases for example), check whether the vehicle comes to a stop in time in all of the protective fields.

- ► If necessary, change the position of the test object so that a thorough check is carried out for each monitoring case to determine whether the protective field is active over the whole of the required width.
- ► Check the height of the scan plane. The scan plane must be at a height of at least 200 mm so that people lying down can be reliably detected. For this purpose, position the supplied test object at a number of points at the edges of the area largest protective field. The safety laser scanner must detect the test object at each position and indicate the detection. How it is indicated depends on the configuration.

If the thorough check reveals an error, the machine should be shut down immediately. In this case, the mounting and electrical installation of the safety laser scanner must be checked by appropriately qualified safety personnel.

Test of the contour detection field

If you use contour detection fields, you must test whether each contour detection field fulfills the intended function.

Notes on planning the test

- Which contour should be detected at which position? What is the desired result?
- What is the desired result if the contour is not at the position?
- What is the desired result if only one part of the contour is at the position?
- Is it possible for there to be another object at the intended position instead of the expected object, so that the device still recognizes the contour? What is the desired result?

If the thorough check reveals an error, the machine should be shut down immediately. In this case, the mounting and electrical installation of the device must be checked by appropriately qualified safety personnel.

Thorough visual check of the machine and the protective device

SICK recommends the following procedure:

- ► Check whether the machine or the protective device has been modified or manipulated so that the effectiveness of the protective device may be impaired.
- ► Check the following points in particular.
  - Has the machine been retrofitted?
  - Have machine parts been removed?
  - Have modifications been made to the machine's surroundings?
  - Are there any defective cables or open cable ends?
  - Have the protective device or its parts been dismantled?
  - Is the protective device damaged?
  - Is the protective device severely contaminated?
  - Is the optics cover contaminated, scratched or destructed?
  - Has the protective device's alignment been changed?
  - Are there any objects (e.g. cables, reflective surfaces) in the protective field?

If one of the points applies, the machine should be shut down immediately. In this case, the machine and the protective device must be checked by appropriately qualified safety personnel.

5 Mounting

5.1 Safety

For information about the requirements for properly mounting the safety laser scanner, see "Assembly", page 25.

DANGER
Death or severe injury due to electrical voltage and/or an unexpected startup of the machine

- ► Make sure that the machine is (and remains) disconnected from the voltage supply during mounting and electrical installation.
- ► Make sure that the dangerous state of the machine is and remains switched off.

DANGER
Hazard due to lack of effectiveness of the protective device

If unsuitable brackets are used or if subjected to excessive vibrations, the device may become detached or damaged.

Persons or parts of the body to be protected may not be recognized or not recognized in time in case of non-observance.

- ► Only use SICK-approved brackets for mounting.
- ► Take appropriate measures for vibration damping if vibration and shock specifications exceed the values and test conditions specified in the data sheet, see "Data sheet", page 142.

DANGER
Improper work on the product

A modified product may not offer the expected protection if it is integrated incorrectly.

- ► Apart from the procedures described in this document, do not repair, open, manipulate or otherwise modify the product.

NOTICE
The optics cover of the safety laser scanner is an optical component.

- ► Do not contaminate or scratch the optics cover during unpacking and mounting.
- ► Prevent fingerprints on the optics cover.

NOTE
Mount the device in the following order.

5.2 Unpacking

Procedure

- ► Check the components for completeness and the integrity of all parts.
- ► In the event of complaints, contact the responsible SICK subsidiary.

Further topics

- "Ordering information", page 159

5.3 Mounting procedure

The following options for mounting the safety laser scanner are available:

- mounting directly without a mounting kit
- mounting using mounting kit 1
- mounting using mounting kits 1 and 2

The mounting kits 1 and 2 are built upon one another. This means that for mounting using mounting kit 2, you also need mounting kit 1.

Each mounting kit consists of a bracket, and the screws needed to mount the safety laser scanner on the bracket.

DANGER

Hazard due to lack of effectiveness of the protective device

Persons or parts of the body to be protected may not be recognized or not recognized in time in case of non-observance.

► You must take account of the minimum distances calculated for your machine, see "Assembly", page 25.

► Mount the safety laser scanner so that crawling beneath, climbing over and standing behind the protective fields is impossible.

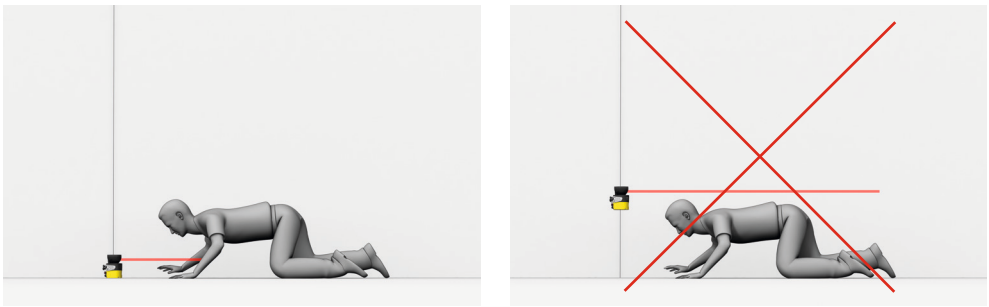


Figure 45: Prevent crawling beneath



Figure 46: Prevent stepping over

NOTE

► Read this section completely before mounting the safety laser scanner.

Mounting instructions

► The optics cover of the safety laser scanner is an optical component. Make sure that the optics cover does not become dirty or scratched during unpacking and mounting. Prevent fingerprints on the optics cover.

► Mount the safety laser scanner so that it is protected from moisture, dirt and damage.

- Make sure that the safety laser scanner's field of view is not restricted.
- Make sure that there are not mirrors or other very reflective objects in the protective field.
- Make sure that no small objects (e.g. cables) are in the protective field, even if the safety outputs do not switch to the OFF state as a result.
- Mount the safety laser scanner so that the status indicators are clearly visible.
- Mount the safety laser scanner so that you can plug in and pull out the system plug.
- Take appropriate measures for vibration damping if vibration and shock specifications exceed the values and test conditions specified in the data sheet, see "Data sheet", page 142.
- For machines that vibrate heavily, use thread-locking compounds to prevent the possibility of fixing screws coming loose unintentionally.
- Make sure that the safety laser scanner is aligned correctly, even during mounting: if the safety laser scanner is intended to monitor an area of 270° on a corner, the safety laser scanner may be mounted rotated by a maximum of 2.5° about the vertical axis.
- Location of the scan plane: see "Dimensional drawings", page 157.
- Take account of the tightening torque for the fixing screws:
  - M5 at rear/at side = 4.5 Nm ... 5.0 Nm
  - M4 at rear/at side = 2.2 Nm ... 2.5 Nm

  Higher tightening torques may damage the thread. Lower tightening torques do not offer sufficient protection against slipping of the safety laser scanner due to vibrations, for example.

5.3.1 Direct mounting

The safety laser scanner has 4 M5 threaded holes on the back. If you are able to drill through the mounting surface from the rear, you can mount the safety laser scanner directly using these threaded holes.

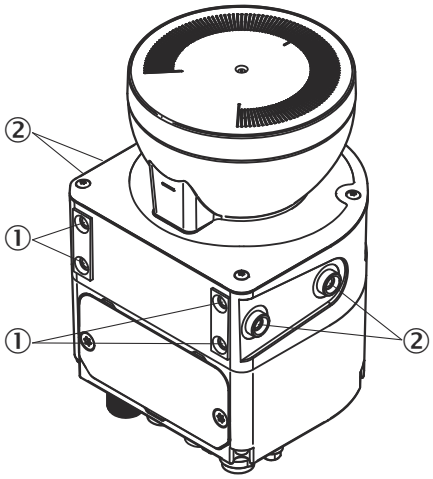


Figure 47: Mounting the safety laser scanner directly

① Rear M5 threaded hole
② Side M5 threaded hole

- Use either the rear or the side M5 threaded holes for direct mounting, see figure 47, page 68.
- Use all four rear or all 4 side M5 threaded holes for direct mounting, so that the values given in the data sheet for vibration and shock resistance are achieved.
- Maximum depth of thread engagement: 7.5 mm (see "Dimensional drawings", page 157).
- Tightening torque: 4.5 Nm to 5.0 Nm.

6 Electrical installation

6.1 Safety

For information on the requirements that must be met for safe integration of the safety laser scanner into the controller and electronics of the machine: see "Integration in the electrical control system", page 51.

Mounting should be completed before electrical installation.

DANGER
Death or severe injury due to electrical voltage and/or an unexpected startup of the machine

- ► Make sure that the machine is (and remains) disconnected from the voltage supply during mounting and electrical installation.
- ► Make sure that the dangerous state of the machine is and remains switched off.

DANGER
Hazard due to lack of effectiveness of the protective device

In the case of non-compliance, it is possible that the dangerous state of the machine may not be stopped or not stopped in a timely manner.

- ► Make sure that the following control and electrical requirements are met so the safety laser scanner can fulfill its protective function.

- ► Use suitable power supply.
- ► Use the same earthing method for all devices that are electrically connected to the safety laser scanner.
- ► Check that all earthing points are connected with the same ground potential.
- ► Voltage must be supplied in accordance with SELV/PELV (IEC 60204-1) for all devices that are electrically connected to the safety laser scanner.
- ► All devices connected to a local input or output of the safety laser scanner must be in the same SELV/PELV circuit as the safety laser scanner.
- ► Connect functional earth correctly.

DANGER
Hazard due to lack of effectiveness of the protective device

The dangerous state may not be stopped in the event of non-compliance.

- ► Always connect the two OSSDs in an OSSD pair separately from one another. The two OSSDs must not be connected to each other.
- ► Connect the OSSDs such that the machine controller processes both signals separately.

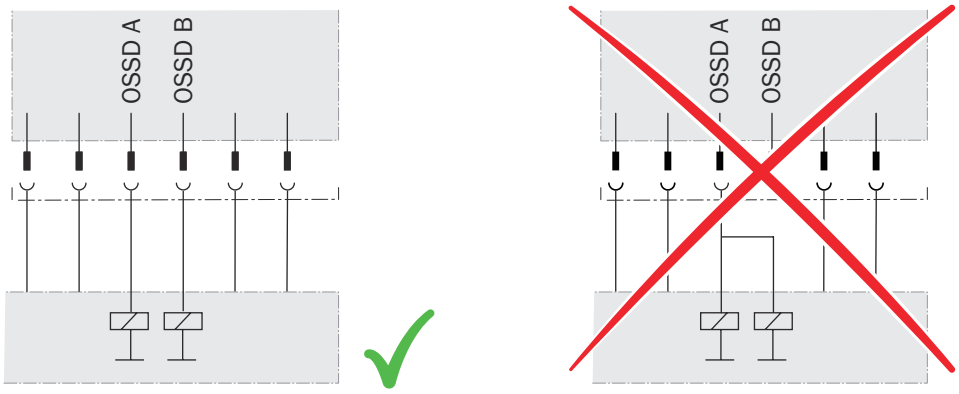


Figure 48: Connection of the OSSDs of an OSSD pair

DANGER
Hazard due to lack of effectiveness of the protective device
The dangerous state may not be stopped in the event of non-compliance.

- ► Prevent the formation of a potential difference between the load and the protective device.

- ► If you connect loads to the OSSDs (safety outputs) that then also switch if controlled with negative voltage (e.g., electro-mechanical contactor without reverse polarity protection diode), you must connect the 0 V connections of these loads and those of the corresponding protective device individually and directly to the same 0 V terminal strip. In the event of an error, this is the only way to ensure that there can be no potential difference between the 0 V connections of the loads and those of the corresponding protective device.

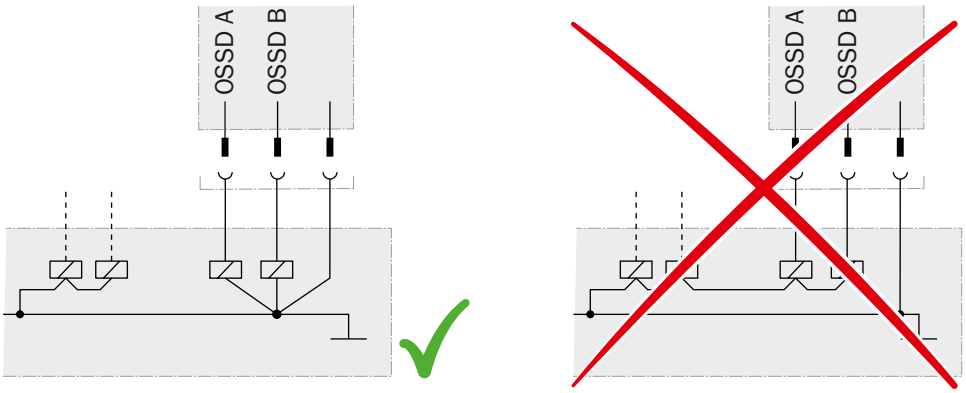


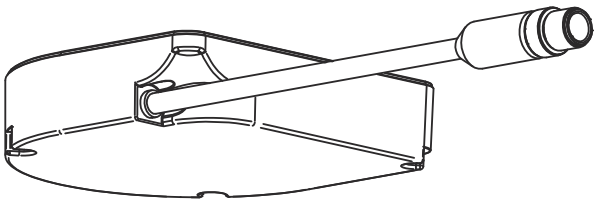
Figure 49: No potential difference between load and protective device

6.2 Connection overview

NOTE
The USB connection may only be used temporarily and only for configuration and diagnostics.

6.2.1 microScan3 Core

Table 4: System plug and connections: microScan3 Core

Safety laser scanner	Suitable system plug	Plug connector
microScan3 Core I/O	 MICSX-ABIZZZZZ1 (part number: 2073156)	• Connecting cable with M12 plug connector, see page 71

6.3 Pin assignment

You will find the pin assignment for the individual plug connectors in the following.

6.3.1 Connecting cable with M12 plug connector

Voltage is supplied and local inputs and outputs are connected via the connecting cable with an 8-pin, A-coded M12 male connector.

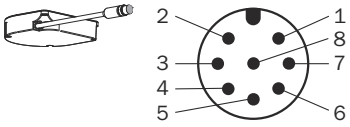


Figure 50: Pin assignment of the connecting cable (male connector, M12, 8-pin, A-coded)

Table 5: Pin assignment of the connecting cable with M12 plug connector

Pin	Marking	Function
1	+24 V DC	Supply voltage (+24 V DC)
2	OSSD 1.A	OSSD pair 1, OSSD A
3	0 V DC	Supply voltage (0 V DC)
4	OSSD 1.B	OSSD pair 1, OSSD B
5	Uni-I/O 01	Universal I/O 1, configurable: • Universal input: resetting, EDM (external device monitoring), sleep mode, restarting the device • Universal output: contamination, error, reset required, monitoring result (warning field)
6	Uni-I/O 02	Universal I/O 2, configurable: • Control input A1 (together with pin 7) • Universal input: resetting, EDM (external device monitoring), sleep mode, restarting the device • Universal output: contamination, error, reset required, monitoring result (warning field)
7	Uni-I/O 03	Universal I/O 3, configurable: • Control input A2 (together with pin 6) • Universal input: resetting, EDM (external device monitoring), sleep mode, restarting the device • Universal output: contamination, error, reset required, monitoring result (warning field)
8	FE	Functional earth/shield

7 Configuration

7.1 Delivery state

The device is not configured in the delivery state.

7.2 Safety Designer configuration software

The safety laser scanner is configured using the Safety Designer.

For information on the Safety Designer, see the operating instructions for the Safety Designer item no. 8018178.

7.2.1 Installing Safety Designer

Prerequisites

- Your Windows user account has rights for installing software.

Procedure

1. Call up the download web page and enter **Safety Designer** in the search field on www.sick.com.
2. Take note of the system requirements on the download page.
3. Download the installation file from the download page. Extract it and run it.
4. Follow the notes from the setup assistant.

7.2.2 Projects

Using Safety Designer, you can configure one or more devices in a project. You can save the configuration data in a project file on the computer.

Creating a project

► Click on **Create new project**.
✓ This creates and opens an empty project.

Configuring a device online (device connected to computer)

The following interfaces are suitable for configuration:

- USB [5)]

If a device is connected to the computer, Safety Designer can establish a connection to the device.

You will then configure the device online. In this case, you can transfer the configuration to the devices directly and use diagnostic functions.

► Click on **Search**.
✓ Safety Designer searches for connected devices, with which it can establish a connection.

Configuring a device offline (device not connected to computer)

If the device is not connected to the computer, select it from the device catalog.

You will then configure the device offline. Diagnostics functions are not available.

You can connect the computer to the device later, assign a device to the device tile, and transfer the configuration to the device.

5) The USB connection may only be used temporarily and only for configuration and diagnostics.

7.2.2.1 Saving verified configuration

When you save a project, information is saved for each device as to whether the configuration is verified. When you open a project file, each device tile and the **Overview** dialog box of the device window show whether the configuration is verified.

You can transfer a verified configuration to the same or an identical device again.

7.2.3 User interface

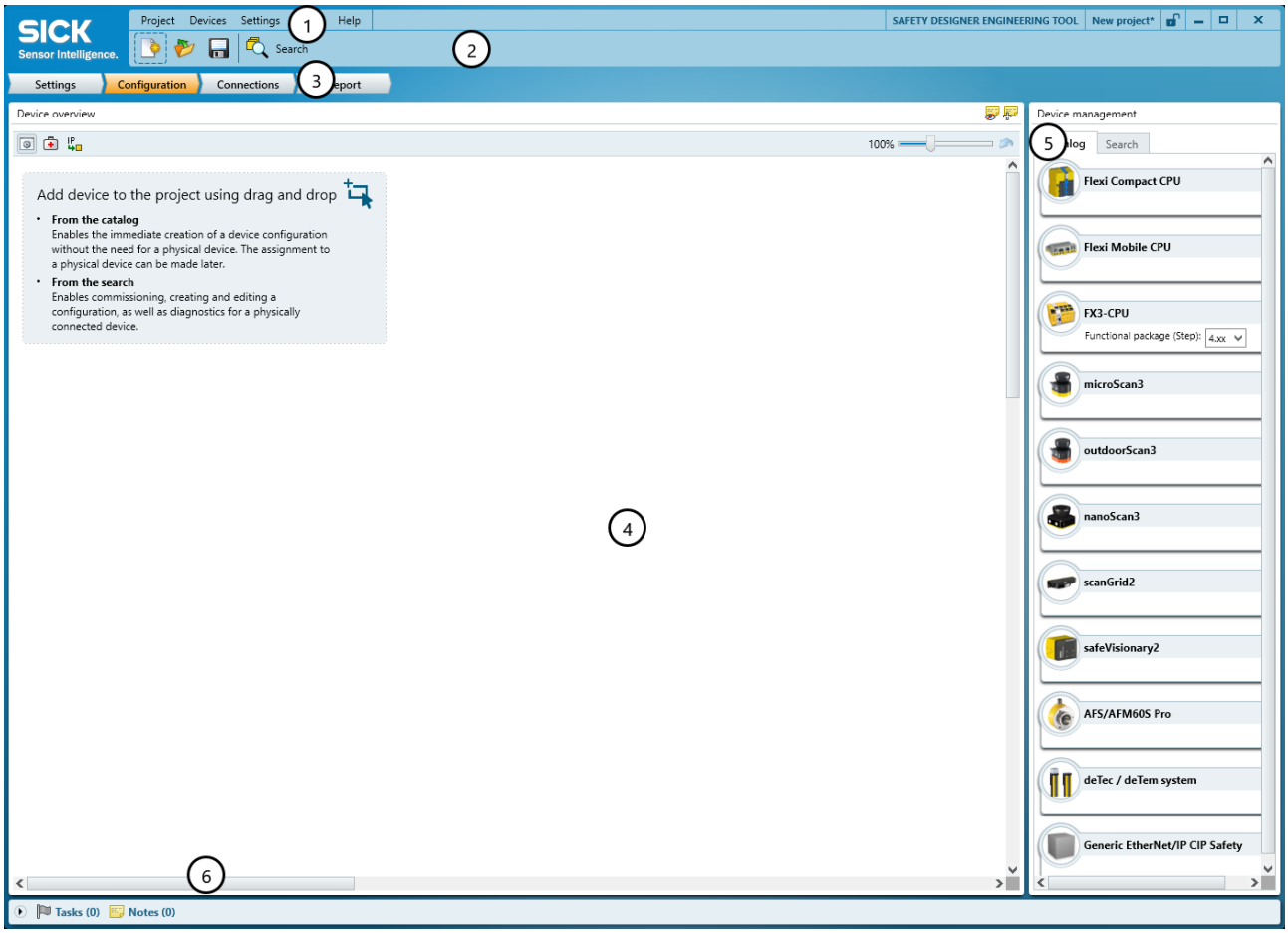


Figure 51: Software controls

① Menu bar
② Toolbar
③ Main navigation
④ Working range
⑤ Device catalog
⑥ Task list and notes

7.2.4 User groups

Overview

The devices contain a hierarchy of user groups that regulate access to the devices.

For certain actions (e.g., transferring a configuration to the device), you are requested to log onto the device with the respective user group.

Depending on the device, 3 or 4 user groups are available.

Important information

NOTICE

When you log into a device, the configuration software stores the password so that you do not need to re-enter it for other configuration steps.

If you do not change any other settings in the login dialog, the password is deleted as soon as you exit the configuration software, or log out in the main window or Device window.

If you enable the **Temporarily store password for login on additional devices.** function, the password will be retained even if you log out in the device window only.

If you leave the computer unattended, you must log off to prevent unwanted access to the device.

Device with 3 user groups

Table 6: User groups

User group		Password	Authorization
	Operator	Does not need a password (anyone can log in as a machine operator).	• May read configuration from the device (if not blocked).
	Maintenance personnel	Does not have a factory-set password. The password is created by the authorized client (namely, it is not possible initially to log in as a maintenance technician).	• May read configuration from the device. • May transfer verified configuration to the device.
	Authorized client	The password SICKSAFE is created at the factory. Change this password to protect the device against unauthorized access.	• May read configuration from the device. • May transfer verified and unverified configuration to the device. • May verify configuration. • Can set a password for maintenance technicians.

Device with 4 user groups

Table 7: User groups

User group		Password	Authorization
	Operator	No password required. Anyone can log on as a machine operator.	• May read configuration from the device.
	Maintenance personnel	Deactivated ex-works, i.e. it is not initially possible to log on as a maintenance technician. The user group can be activated by the user group administrator and provided with a password.	• May read configuration from the device. • May transmit verified configuration to the device. • Change own password allowed.

User group		Password	Authorization
	Authorized client	Deactivated ex-works, i.e. it is not initially possible to log on as an authorized customer. The user group can be activated by the user group administrator and provided with a password.	• May read configuration from the device. • May transmit verified and unverified configuration to the device. • May verify configuration. • Resetting the safety function and communication settings to factory defaults is allowed. • Change own password allowed. • Changing the password of the **Maintenance personnel** user group is allowed.
	Administrator	The password SICKSAFE is created at the factory. ► Change this password to protect the device against unauthorized access.	• May read configuration from the device. • May transmit verified and unverified configuration to the device. • May verify configuration. • Resetting whole device to factory settings allowed. • Activating and deactivating device functions is allowed. • Activating and deactivating the **Maintenance personnel** and **Authorized client** user groups is allowed. • Change own password allowed. • Changing the passwords of the **Maintenance personnel** and **Authorized client** user groups is allowed.

Complementary information

The maintenance engineer is permitted to reset the safety function to factory settings.

The configuration of the device is saved in the system plug. Therefore, the passwords are retained when the device is replaced if the system plug is still used.

Further topics

- "Version numbers and functional scope", page 141

7.2.5 Settings

Information on the functionality and basic operation of the software and on the settings in the main window can be found in the operating instructions of the Safety Designer (part number 8018178).

7.2.6 Configuration

You collect the devices of a project in the **Configuration** area. The available devices can be found in the Device Catalog. The devices are displayed as Device tiles in the working range.

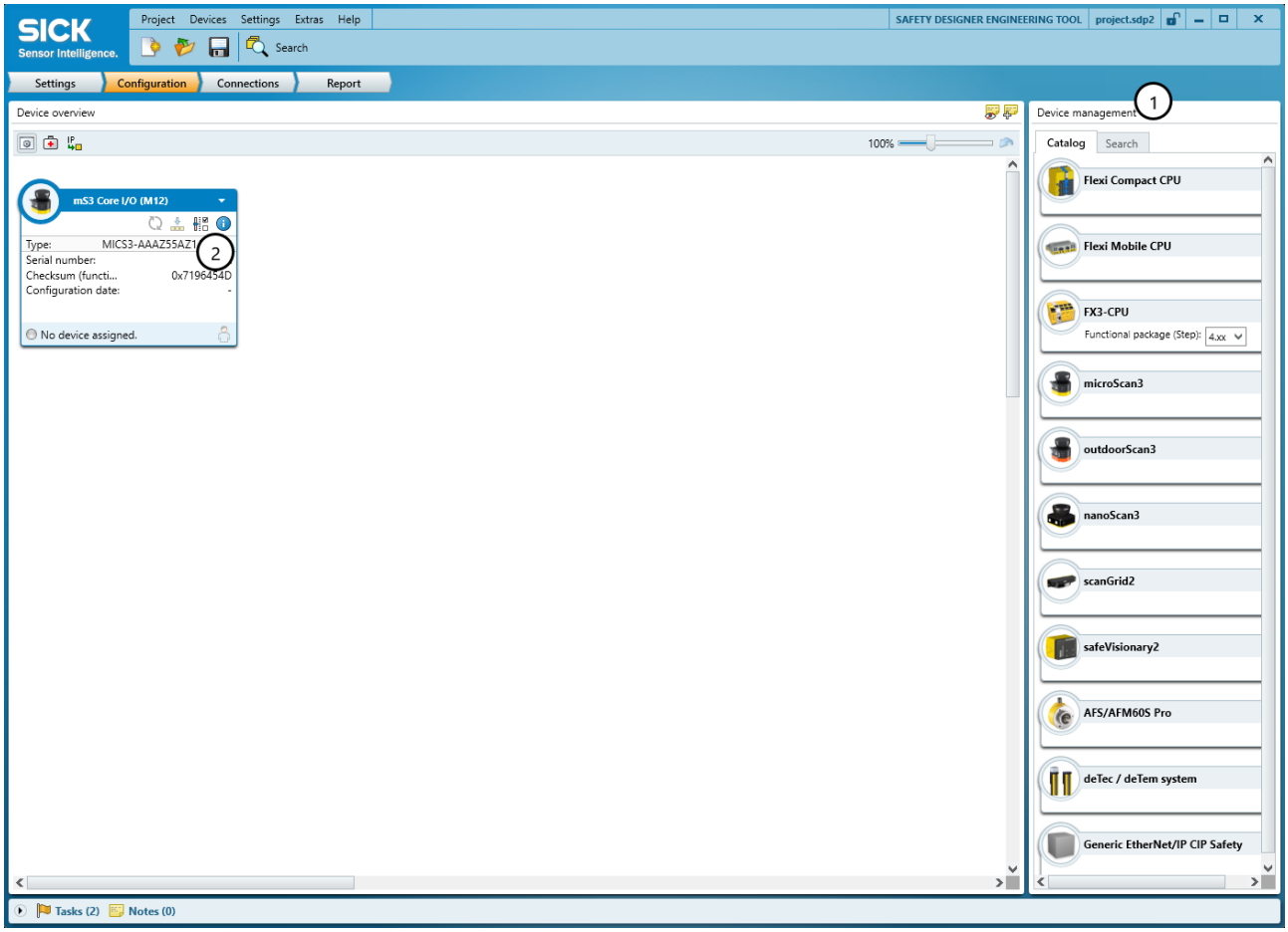


Figure 52: Configuration

① Device management

② Device tile

7.2.6.1 Device Catalog

Overview

Device Management contains all available devices:

- The **Catalog** tab contains the devices installed in Safety Designer.
- The **Search** tab contains the devices found during a search.

Procedure

The devices from the device catalog can be added to a project in the workspace:

► Drag a device into the working area using drag and drop.
Or:
► Double-click on a device in the device catalog.
✓ The device is shown as a tile in the working area.

Complementary information

When a device is configured offline for the first time, the device selection wizard opens for devices with multiple variants (device types). This is where you select the exact type of device to be configured.

7.2.6.2 Open the device window – configure devices

Overview

To configure the device, perform diagnostics or create reports, open a device window.

Procedure

You have the following options:

► Double-click on the Device tile.
Or:
► Open the tile menu and choose **Configure**.
✓ The device window opens.

Complementary information

When a device is configured offline for the first time, the device selection wizard opens for devices with multiple variants (device types). This is where you select the exact type of device to be configured.

7.2.7 Networking

Information on the functionality and basic operation of the software and on the settings in the main window can be found in the operating instructions of the Safety Designer (part number 8018178).

7.3 Overview

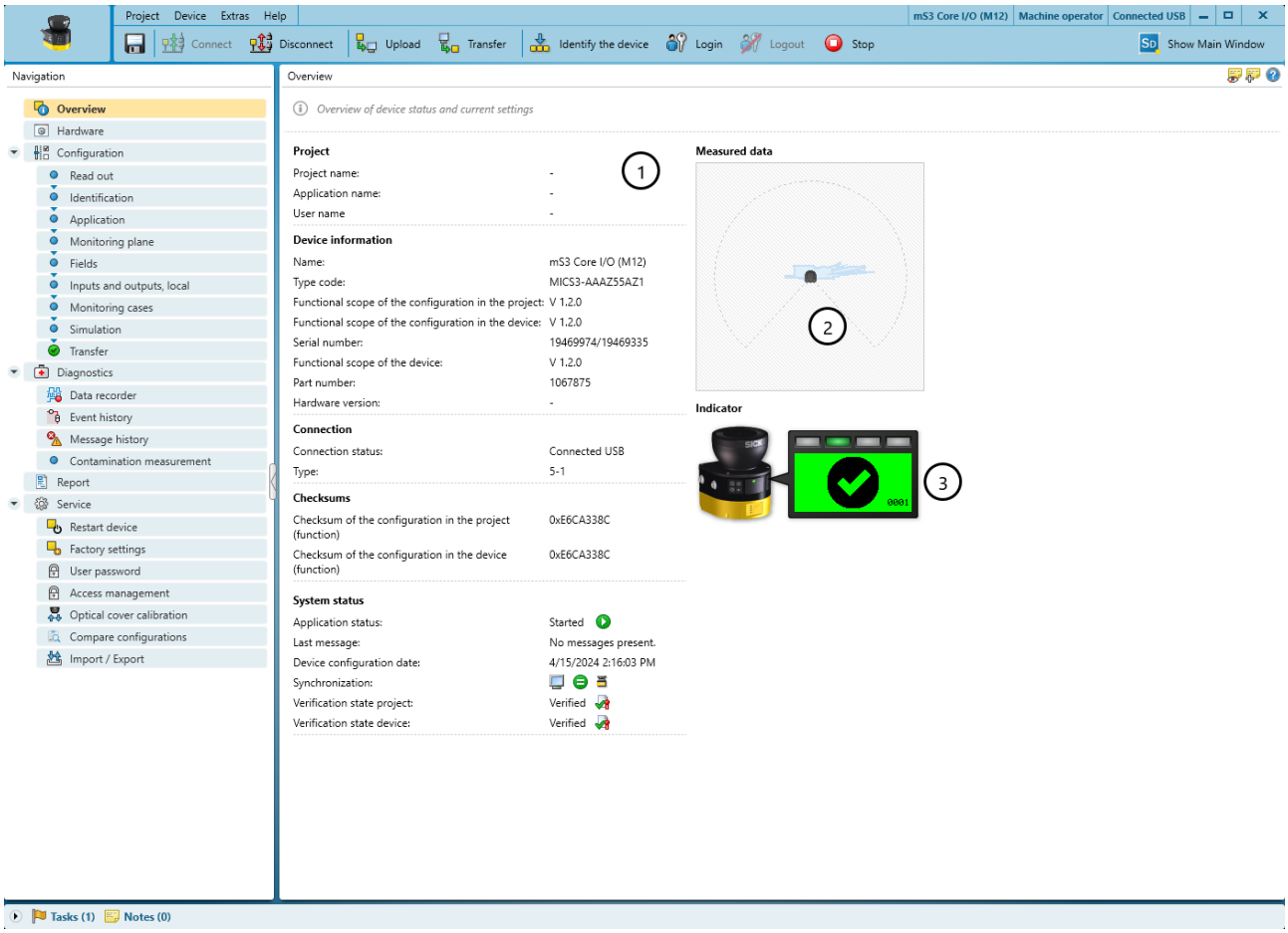


Figure 53: Overview

① Device information
② Current measurement data
③ Display with device status

The **Overview** dialog box contains information about the safety laser scanner.

Project

- Project name: the same name should be chosen for all devices in the project
- Application name: this name can be the same for a number of devices in the project. It highlights that these devices realize an application together, by responding to one another for example.

Device information

- Name, identifies the specific device
- Type code of the safety laser scanner
- Functional scope of the configuration in the project
- Functional scope of the configuration in the device
- Serial number of the safety laser scanner
- Functionality of the device
- Part number
- Revision

Connection

- Connection status
- Type of connection

Checksums

A checksum is used as a unique identification for a configuration. Using the checksum, it is possible to work out whether a setup was changed or whether two devices have the same configuration.

The checksum of the configuration in the project may not match the checksum in the device, for example if a field geometry has been modified, but not yet transmitted to the device.

System status

- Application status
- Current notification of the safety laser scanner
- Configuration date for the configuration in the device
- Synchronization: shows whether the configuration in Safety Designer and the configuration in the device are identical
- Verification status of the configuration in the project
- Verification status of the configuration in the device

Measurement data

Shows the measurement data when a device is connected.

Display

Shows the status of the display and LEDs when a device is connected.

Establishing connection

1. Check whether the safety laser scanner is connected correctly.
2. Click on **Connect** in the toolbar.

✓ Safety Designer establishes the connection to the safety laser scanner.

7.3.1 Functional scope

Older versions of the Safety Designer potentially do not support the full functionality of the latest devices. Vice versa, older devices might not support the full functionality of the latest Safety Designer.

To identify the different levels of the functionality, we use a 3-digit version number. The version number is marked with the letter V on the device.

A configuration in the Safety Designer or in a system connector must match the device for which it is to be used. If the configuration fits, it can be transferred from the Safety Designer to the device and the system connector with the configuration can be used for the device.

The configuration matches the device if the following points apply:

- The 1st digit of the two version numbers must be identical.
- The 2nd digit of the version numbers on the device must be at least as large as that of the configuration in Safety Designer or in the system plug.
- The 3rd digit is not relevant for compatibility.

The functional scope of the device can be read at the following locations:

- Label on the device
- Display, entry in **Device info** menu at **Hardware**
- Safety Designer, **Overview** dialog (only with connected device)
- Safety Designer, report



Figure 54: Functional scope

① Functional scope of the device

If you configure a device offline, you must define the functional scope of the configuration when adding the device in the device selection wizard in the Safety Designer.

If you add a device to the project via the device search, the functionality of the device will be carried over. If the device has already been configured, the functional scope of the configuration is adopted in the device.

Further topics

- "Version numbers and functional scope", page 141

7.4 Hardware

Overview

On the **Hardware** page, you can view details of the safety laser scanner and the system plug.

If several functionally identical products with different part numbers exist, you can select your product. The selected product is shown in the report under **Bill of materials**. The selection does not affect anything else.

7.5 Reading configuration

Overview

At the left, you see the values configured in the project for the device. If the device is connected, you see the values saved in the device at the right.

If the values in the project and the values in the device differ, you can read the values out from the device and adopt them in the project.

Procedure

1. Click on **Read from device**.

✓ The values are read from the device and adopted in the project.

Complementary information

Configuration:

- Name
  If a number of devices are used in an application or in a project, a unique device name helps to tell the individual devices apart.
- Checksums
  A checksum is used as a unique identification for a configuration. Using the checksum, it is possible to work out whether a setup was changed or whether two devices have the same configuration.

The checksum of the configuration in the project may not match the checksum in the device, for example if a field geometry has been modified, but not yet transmitted to the device.

7.6 Identification

Overview

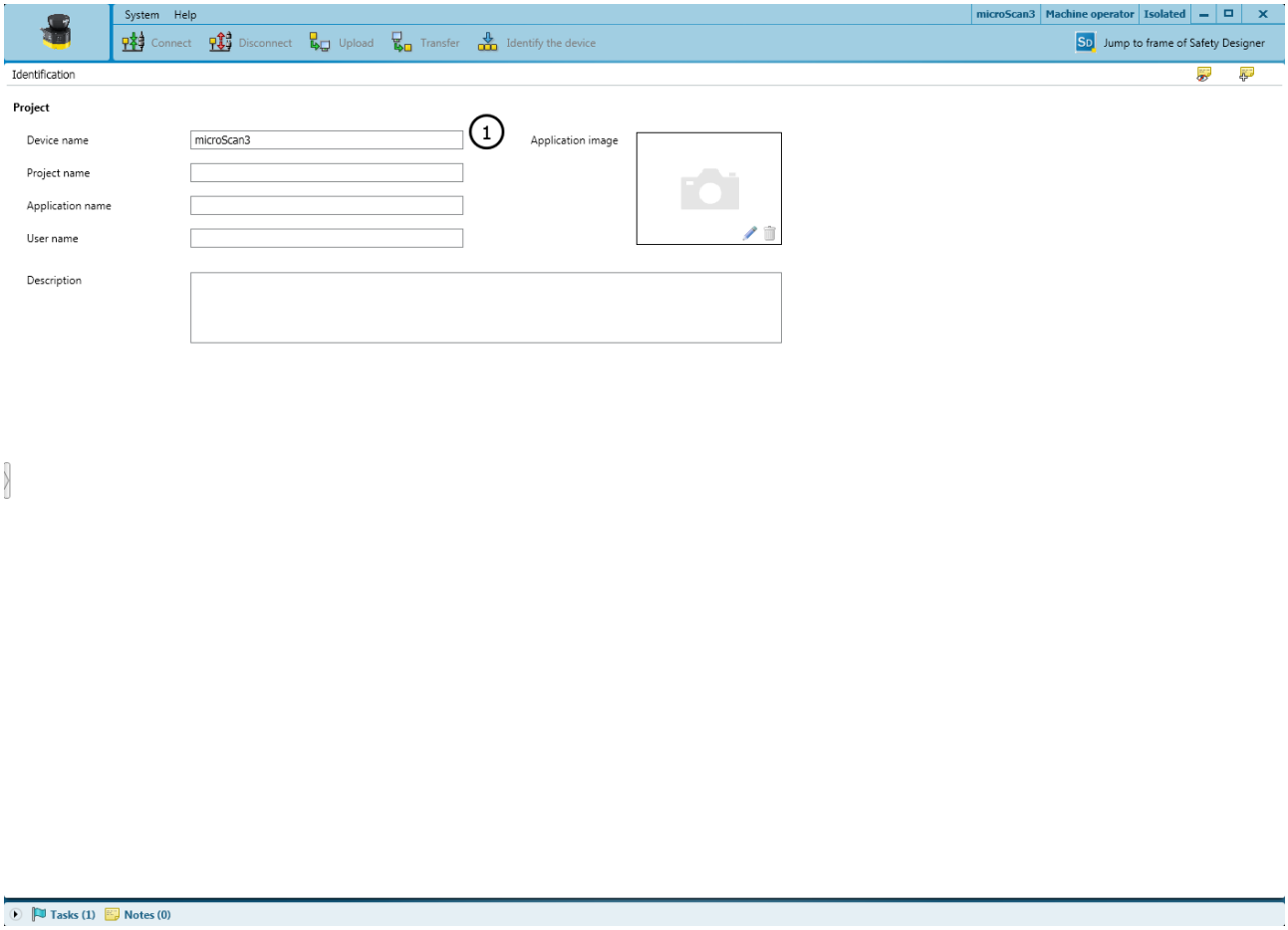


Figure 55: Identification

① Parameters for the project and the device

In the **Identification** dialog box, you can optionally enter names and information to uniquely identify the application, project, and devices.

Device name

If a number of safety laser scanners are used in an application or in a project, a unique device name helps to tell the individual devices apart.

► Give each device a unique device name.

Project name

The project name is used to identify an entire project. The same project name should be chosen for all devices in the project.

► Enter a project name.

Application name

The application name can be the same for a number of devices in the project. It highlights that these devices realize an application together, by responding to one another for example.

► Enter an application name.

User name

The optional user name helps later users to find a contact for the application.

► Enter a user name.

Application image

An image helps to identify the application more quickly. The application image is saved in the project file on the PC and transmitted to the device. The Safety Designer supports the following file formats: BMP, GIF, JPG, PNG, TIF.

1. Click on the pencil icon.
2. Select an image file for the application.

✓ The image is incorporated as a thumbnail.

Description

A description makes it easier to understand an application's context more quickly.

► Enter a description with a maximum of 1000 characters.

7.7 Application

Overview

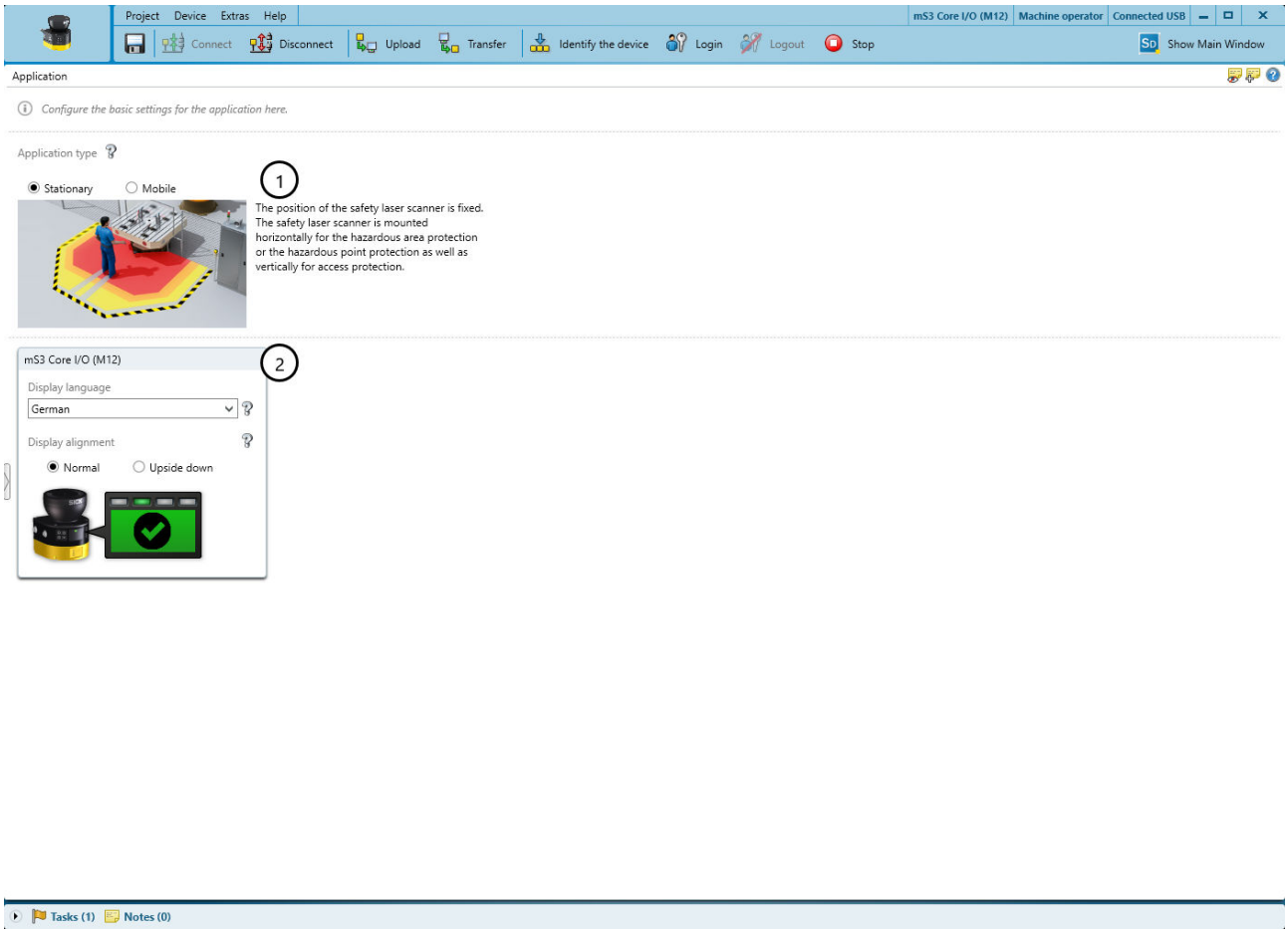


Figure 56: Application

① Basic settings for the application

② Settings for the display

Application type

The type of application depends on the application of the safety laser scanner:

► Select application type.

✓ **Mobile**
Mobile hazardous area protection is suitable for AGVs (automated guided vehicles), cranes, and forklifts to protect people when vehicles are moving or docking. The safety laser scanner monitors the area in the direction of travel and stops the vehicle as soon as an object is located in the protective field.

✓ **Stationary**
The position of the safety laser scanner is fixed. The safety laser scanner is mounted horizontally (for hazardous area protection) or vertically (for hazardous point protection and access protection).

Display language

The display of the safety laser scanner outputs notifications and states. Multiple languages are available for the display.

► Select a language that the operator understands.

✓ The safety laser scanner outputs the notifications in the set language.

Display alignment

If you mount the safety laser scanner with the optics cover downward, you can rotate the orientation of the display through 180°. The preview shows the selected orientation of the display.

► Choose the **Normal** or **Upside down** option to specify the display orientation.
✓ The preview shows the display's orientation.

7.8 Monitoring plane

Overview

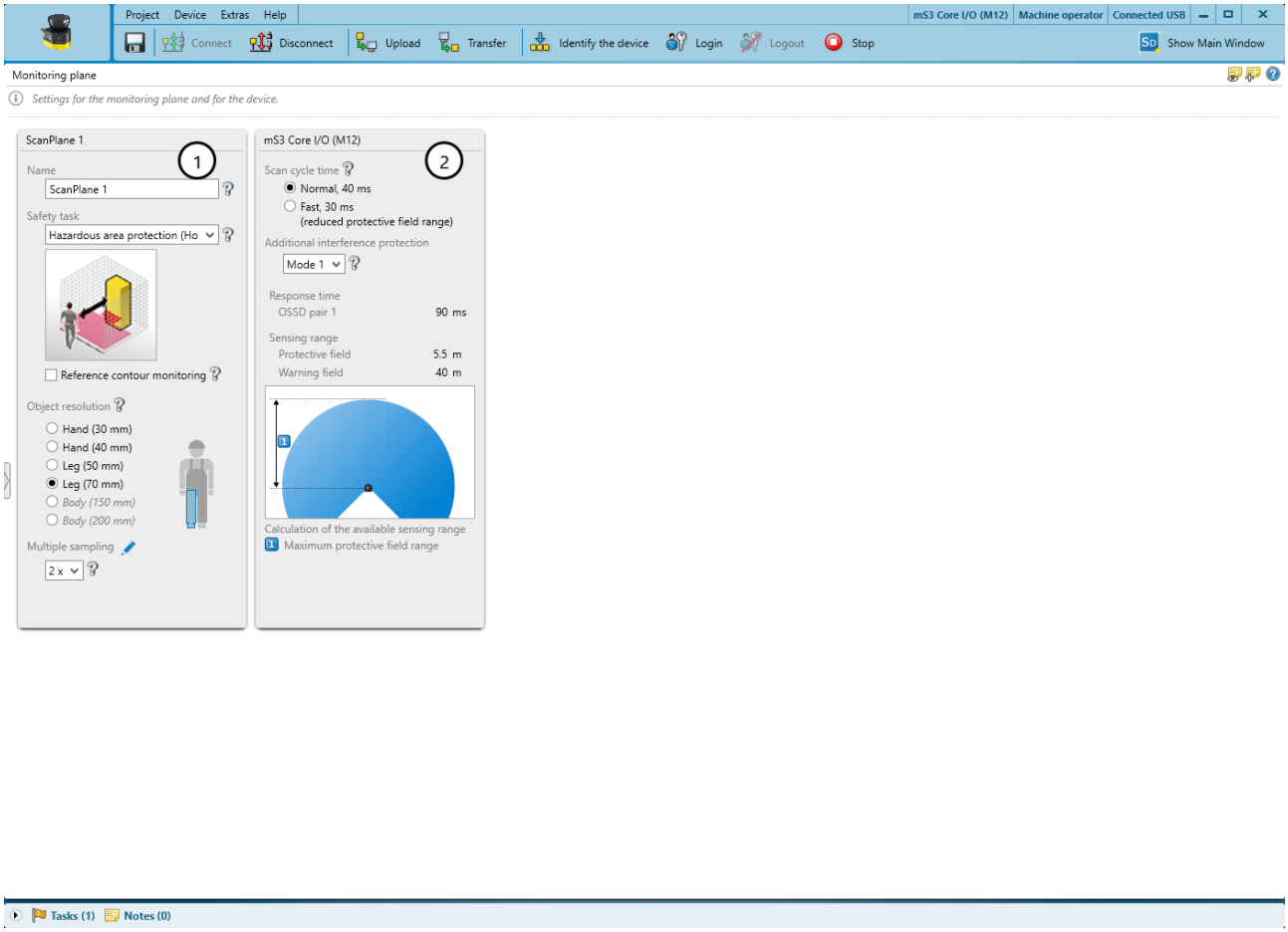


Figure 57: Monitoring plane

① Parameters for the monitoring plane
② Parameters for the safety laser scanner

The scan plane of a safety laser scanner forms its monitoring plane.

This dialog is used to define the following parameters:

- Parameters for the monitoring plane
- Parameters for the safety laser scanner

7.8.1 Parameters for the monitoring plane

Overview

Configure a name, the protection task, object resolution, and multiple sampling setting for the monitoring plane.

At first, the object resolution and multiple sampling configured for the monitoring plane apply for all fields. If necessary, make changes to each individually at a later date. If you do this, Safety Designer will indicate this in the settings for the monitoring plane.

Name

You can use the name to identify monitoring planes when creating fields and monitoring cases and also in reports.

► Enter a descriptive name for the monitoring plane (e.g., “Hazardous area on the right hand side”).
✓ The name is used to identify the monitoring planes.

Safety task

People approach the monitoring plane parallel or orthogonally, depending on the orientation of the protective field in your application (see "Project planning", page 24).

- **Hazardous area protection (Horizontal)**
  Typically, for a horizontal approach, the requirement is to detect the leg. The typical object resolution is leg (70 mm).
- **Access protection (Vertical)**
  Typically, for access protection, the requirement is to detect a person. The typical object resolution is body (200 mm).
- **Hazardous point protection (Vertical)**
  Typically, for hazardous point protection, the requirement is to detect a hand. The typical object resolution is hand (40 mm).

Reference contour monitoring

NOTE
If the monitoring plane has a vertical alignment, a contour (such as the floor, a part of the machine bed, or an access threshold) must typically be defined and monitored as a reference contour. A reference contour field is used for this, see "Reference contour field", page 89.

► Activate the **Reference contour monitoring** option.
✓ The **Reference contour field** item is shown in the navigation. Here you can configure the reference contour field required for your application.

Object resolution

The object resolution defines the size that an object must be to allow it to be reliably detected. The following object resolutions are available:

- 30 mm = hand detection
- 40 mm = hand detection
- 50 mm = leg detection/arm detection
- 60 mm = leg detection/arm detection (depends on variant)
- 70 mm = leg detection/arm detection
- 150 mm = body detection
- 200 mm = body detection

► Choose the object resolution.
✓ Objects the same size as or larger than the chosen object resolution are reliably detected.

NOTE
The configurable object resolution has an influence on the protective field range available. The finer the object resolution configured for the safety laser scanner, the shorter the available protective field range.

The protective field range is shown to you, see "Parameters for the safety laser scanner", page 87.

Multiple sampling

DANGER
Hazard due to lack of effectiveness of the protective device

Persons or parts of the body to be protected may not be recognized or not recognized in time in case of non-observance.

A higher multiple sampling increases the response time.

- ► Make a note of the new response time of the safety laser scanner in Safety Designer.
- ► Adjust the minimum distance from the hazardous point to the new response time.

Multiple sampling indicates how often an object has to be scanned before the safety laser scanner responds. A higher multiple sampling reduces the possibility that insects, weld sparks or other particles cause the machine to be shut down. You will increase the machine's availability.

A multiple sampling of 2 is the minimum setting.

- ► Increase the multiple sampling up to 16.
- ✓ An object must be this many times.

Table 8: Recommended multiple sampling

Application	Recommended multiple sampling
Stationary application: such as horizontal hazardous area protection or vertical hazardous point protection under clean ambient conditions	2×
Stationary application: such as vertical access protection Only 2-time multiple sampling may be used for vertical access protection.	2×
Mobile application	4×
Stationary application: such as horizontal hazardous area protection under dusty ambient conditions	8×

Multiple sampling after monitoring case switching

DANGER
Hazard due to lack of effectiveness of the protective device

If combined with very short switchover times, higher multiple sampling after switching between monitoring cases can result in a person or part of their body not being detected.

- ► Make sure that every monitoring case is active for at least the amount of time required for detection by the safety laser scanner (setting for multiple sampling after monitoring case switching multiplied by the configured scan cycle time including the supplement due to interference protection).

When switching between monitoring cases, it is possible that a person may already be in the newly activated protective field when switching takes place. In order to ensure that the person is detected quickly and the dangerous state is brought to an end swiftly, you can adjust the settings for multiple sampling immediately after switching between monitoring cases – regardless of any other multiple sampling in place.

- **Fast (1 scan)** (default setting): Multiple sampling after monitoring case switching n_{CS} = 1. An object needs to be scanned once before the safety laser scanner responds. Fastest response and safest behavior of the safety laser scanner.
- **Robust (multiple sampling - 1)**: Multiple sampling after monitoring case switching n_{CS} = n – 1. Multiple sampling after switching between monitoring cases is one scan fewer than any other multiple sampling in place. This reduces the possibility that insects, weld sparks, or other particles cause the machine to be switched off. This increases machine availability. The standard response time applies from the outset in the new field.
- **User-defined (please consult manual)**: You can adjust the settings for multiple sampling after monitoring case switching in line with your requirements on response time and reliability. Regardless of the exact settings here, multiple sampling after switching between monitoring cases is always at least one scan fewer than any other multiple sampling in place: $n_{CS} \leq n - 1$

Multiple sampling after object detection

The set multiple sampling also applies by default if a field becomes free again after an object detection. That means, when the field is free again, the free field is scanned the same number of times until the safety outputs switch back to the ON state.

If you activate the **Activate different multiple sampling rate after object detection** option, you can specify deviating values for the monitoring level or for individual fields. This may cause the outputs to switch back to the ON state faster or slower after a field has become free again.

The following case is only relevant if multiple sampling or different multiple sampling rate after object detection is set to a value n < 6: Regardless of whether a different multiple sampling rate after object detection is set, the multiple sampling after object detection will in some circumstances be increased to a value up to n = 6. This case arises if an object detection lasts for a longer period, i.e. if it takes a long time until the field is clear again.

7.8.2 Parameters for the safety laser scanner

Overview

This is where you configure the parameters for the safety laser scanner.

Scan cycle time

You can configure the scan cycle time. The scan cycle time of the safety laser scanner affects the response time and the protective field range.

Devices with a max. protective field range of 4.0 m and devices with max. protective field range of 5.5 m:

- 40 ms: Full protective field range, increased availability in dusty conditions, for example
- 30 ms: Smaller protective field range with shorter response time

Devices with a max. protective field range of 9.0 m:

- 50 ms: Full protective field range, increased availability in dusty conditions, for example
- 40 ms: Smaller protective field range with shorter response time

► Select scan cycle time.
✓ The resulting response time and the range of the fields are shown.

Additional interference protection

If you mount several safety laser scanners in close proximity to each other, this can lead to mutual interference. You will prevent mutual interference in neighboring safety laser scanners if you choose different settings for interference protection.

Modes 1 to 4 are available. Interference protection influences the scan cycle time and therefore the response time.

- Mode 1 = + 0 ms per scan cycle
- Mode 2 = + 1 ms per scan cycle
- Mode 3 = + 2 ms per scan cycle
- Mode 4 = + 3 ms per scan cycle

► Configure a different mode for each safety laser scanner that is mounted in close proximity.
✓ The resulting response time is shown.

Complementary information

NOTE
The response time of the safety laser scanner depends on the scan cycle time, interference protection, and multiple sampling, see "Response times", page 148. In addition to the response time of the safety laser scanner, further signal transmission and processing also influence the time until the end of the dangerous state.

A graphic shows how the configuration affects the available ranges.

7.9 Reference contour field

Overview

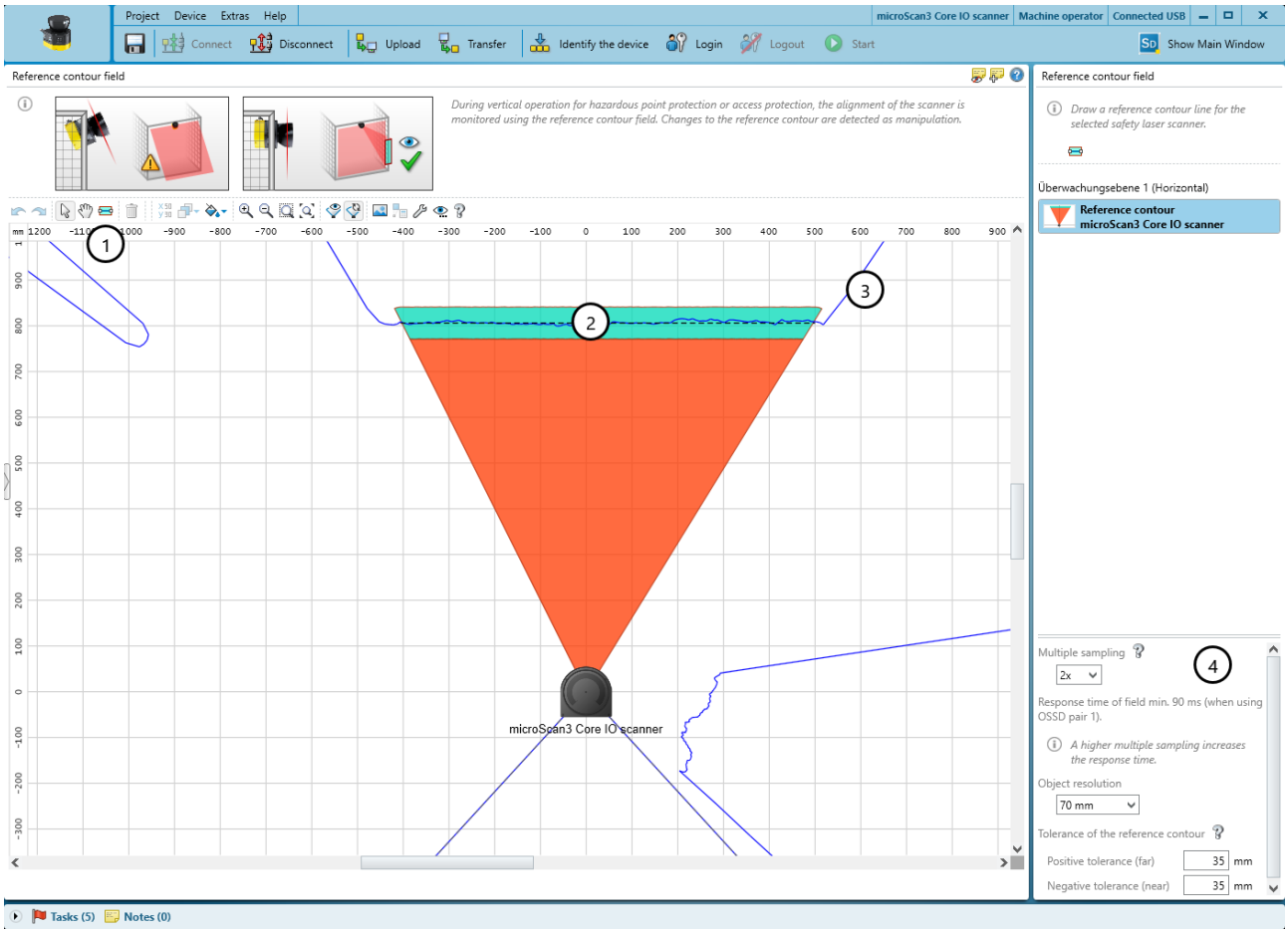


Figure 58: Reference contour field

① Tool for drawing reference contour fields
② Drawn contour with tolerance band
③ Visible spatial contour
④ Configure the field

If you have activated the **Reference contour monitoring** option for a monitoring plane, the **Reference contour field** dialog box is displayed. Draw the reference contour field based on the values determined during project planning (see "Reference contour monitoring", page 29).

The contour as reference field monitors a contour of the environment. The safety laser scanner switches all safety outputs to the OFF state if a contour does not match the set parameters, because, for example, the mounting of the safety laser scanner has been changed.

Drawing a reference contour field

1. Select the tool for drawing reference contour fields.
2. Draw a line along the spatial contour as a reference.
   - ► First, use the mouse to click the desired contour.
   - ► Click to add the corners of the contour.
   - ► Finally, double-click the contour.

✓ The reference contour field is displayed.

Multiple sampling and Object resolution

DANGER
Hazard due to lack of effectiveness of the protective device

Persons or parts of the body to be protected may not be recognized or not recognized in time in case of non-observance.

A higher multiple sampling increases the response time.

- ► Make a note of the new response time of the safety laser scanner in Safety Designer.
- ► Adjust the minimum distance from the hazardous point to the new response time.

At first, the object resolution and multiple sampling configured for the monitoring plane apply for all fields. If necessary, you can change these settings for each individual field.

Tolerance band

A contour has a positive and a negative tolerance band. If the safety laser scanner does not detect the contour within the tolerance band, the field switches to the OFF state.

- **Positive tolerance (far)**: The tolerance away from the safety laser scanner
- **Negative tolerance (near)**: The tolerance toward the safety laser scanner

7.10 Fields

Overview

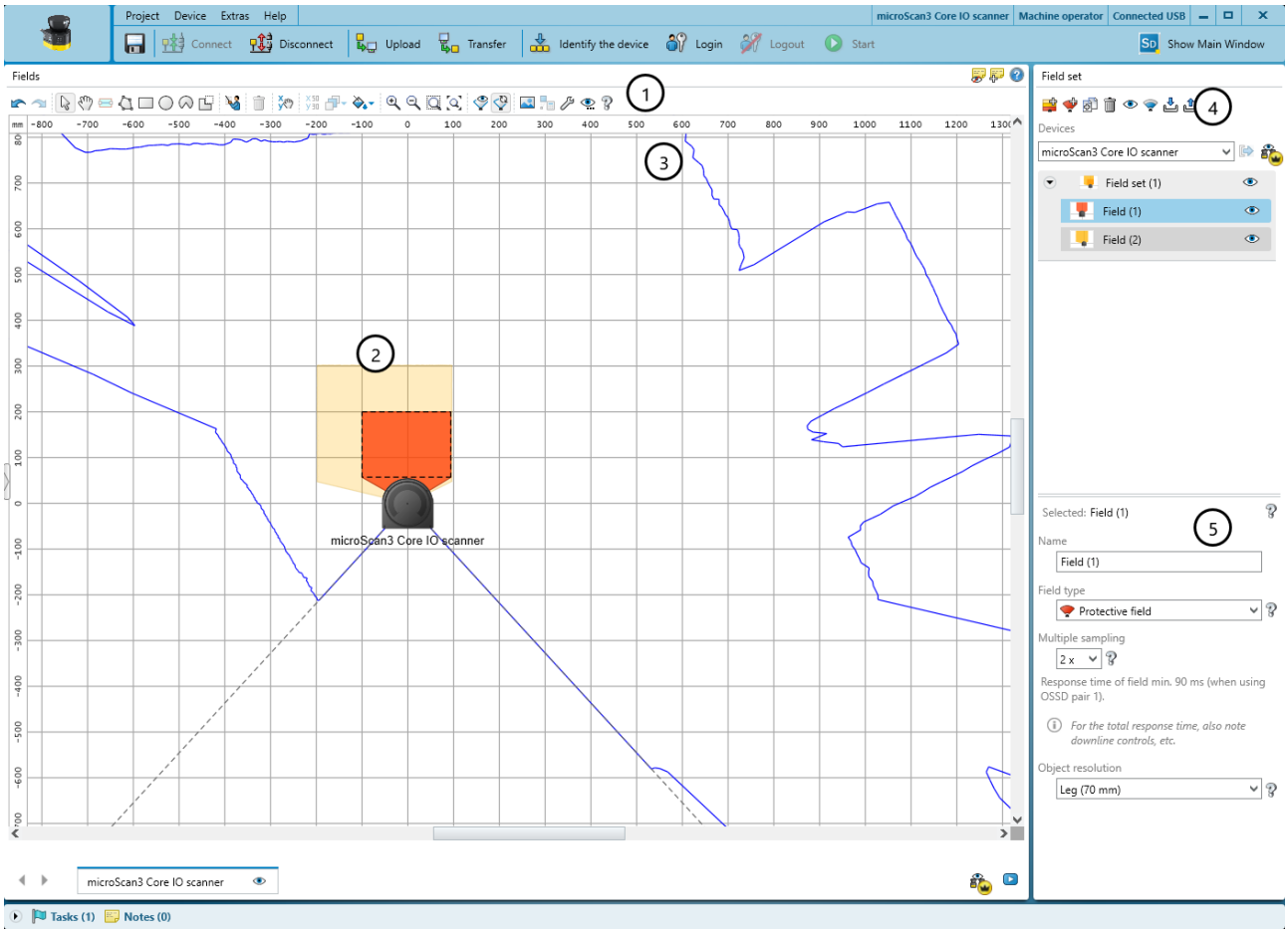


Figure 59: Field editor

① Toolbar
② Protective field (red) and warning field (yellow) created
③ Visible spatial contour
④ Create, duplicate, delete field set and fields
⑤ Define field type, name field, configure field

Using the field editor, you can configure the field sets of the safety laser scanner. The number of configurable fields depends on the safety laser scanner variant.

In the **Fields** area, you draw the fields in a field set using the tools in the toolbar. In the **Field set** area, you create the field sets and fields. In the area below, you configure details for the selected field set or field.

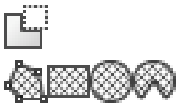
The edge length or the diameter of each field must be at least as large as the selected object resolution.

You can change the sequence of the fields in the **Field set** area using drag and drop. The fields of a field set are displayed in the monitoring case table in the same sequence in which you create them here.

Toolbar

Using the tools in the field editor, you can draw the fields in a field set or masked areas inside the fields.

Table 9: Buttons on the toolbar

	Arrow tool, for marking objects
	Hand tool, for moving the work space
	Measuring tool for measuring distances in the **Fields** area
	Draw reference contour field or contour detection field
	Draw field using points
	Draw rectangle
	Draw circle
	Draw circle segment
	Mask areas. Clicking this button shows the buttons for drawing fields with a hatched display. You can then draw in areas that cannot be monitored.
	Enable propose field
	Delete selected object
	Object transformation. Move, rotate or mirror one or more objects in the **Fields** area.
	Editing a field using coordinates
	Push the object into the foreground or background
	Selecting the color scheme for fields If a device is selected in the field editor: Select pattern for fields
	Zoom in
	Zoom out
	Zoom to area
	Zoom to work space
	Show snapshot of the spatial contour. Clicking again clears the spatial contour shown. For a virtual group, individual devices or all devices can be selected.
	Show live spatial contour For a virtual group, individual devices or all devices can be selected.
	Selecting a color for the displayed room contour For a virtual group, the color can be selected individually for each device.
	Insert background image
	Calculate field
	Open the device settings
	Editing grid settings

Field display

Safety Designer displays the field types in different colors.

Table 10: Colors of the field types

Protective field	Warning field	Reference contour field and contour detection field
		
Red	Yellow	Turquoise

Create fields and field sets

Table 11: Buttons for field sets

	Add field set
	Add field to field set
	Duplicate field set
	Delete field or field set
	Hide or show field sets and fields
	Manage field set templates
	Importing field sets and fields
	Exporting field sets and fields
	Synchronize selection and visibility If a field or a field set is selected or hidden or shown for the current device and a field set of the same name exists in another device of the virtual group, the status is transferred to the other device.

Name

You can assign a unique name for each field set.

Name and Field type

You can assign a unique name and select a field type for each field.

Multiple sampling and Object resolution

DANGER

Hazard due to lack of effectiveness of the protective device

Persons or parts of the body to be protected may not be recognized or not recognized in time in case of non-observance.

A higher multiple sampling increases the response time.

- ► Make a note of the new response time of the safety laser scanner in Safety Designer.
- ► Adjust the minimum distance from the hazardous point to the new response time.

At first, the object resolution and multiple sampling configured for the monitoring plane apply for all fields. If necessary, you can change these settings for each individual field.

Tolerance band

A contour has a positive and a negative tolerance band. If the safety laser scanner does not detect the contour within the tolerance band, the field switches to the OFF state.

- **Positive tolerance (far)**: The tolerance away from the safety laser scanner
- **Negative tolerance (near)**: The tolerance toward the safety laser scanner

7.10.1 Drawing in points that cannot be monitored

Overview

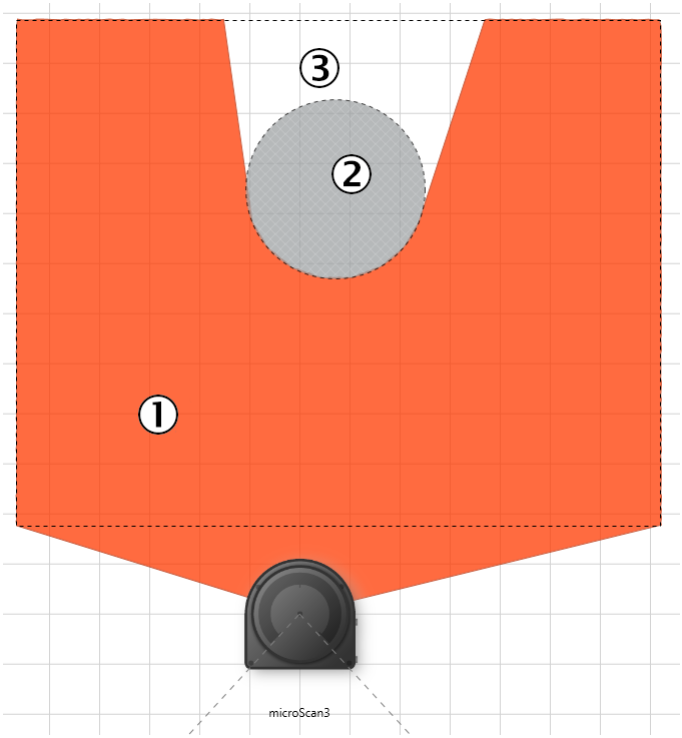


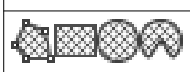
Figure 60: Area that cannot be monitored

① Protective field
② Marked column
③ Area that cannot be monitored

The area to be monitored is scanned radially ①. For this reason, shadows ③ are formed by objects in the room ② (support columns, separator grids, etc.). The safety laser scanner cannot monitor these areas.

You draw objects that limit the field of view of the safety laser scanner as masked areas.

Table 12: Mask areas

	Mask areas
	Hatched drawing tools

Procedure

1. Click on the **Mask areas** tool.

✓ The tools you can use to draw fields are shown crosshatched.
2. Choose a drawing tool.
3. Draw the masked area.
✓ The masked area is shown in gray.
✓ The field editor shows the shadowing of the masked area.

7.10.2 Enable propose field

Overview

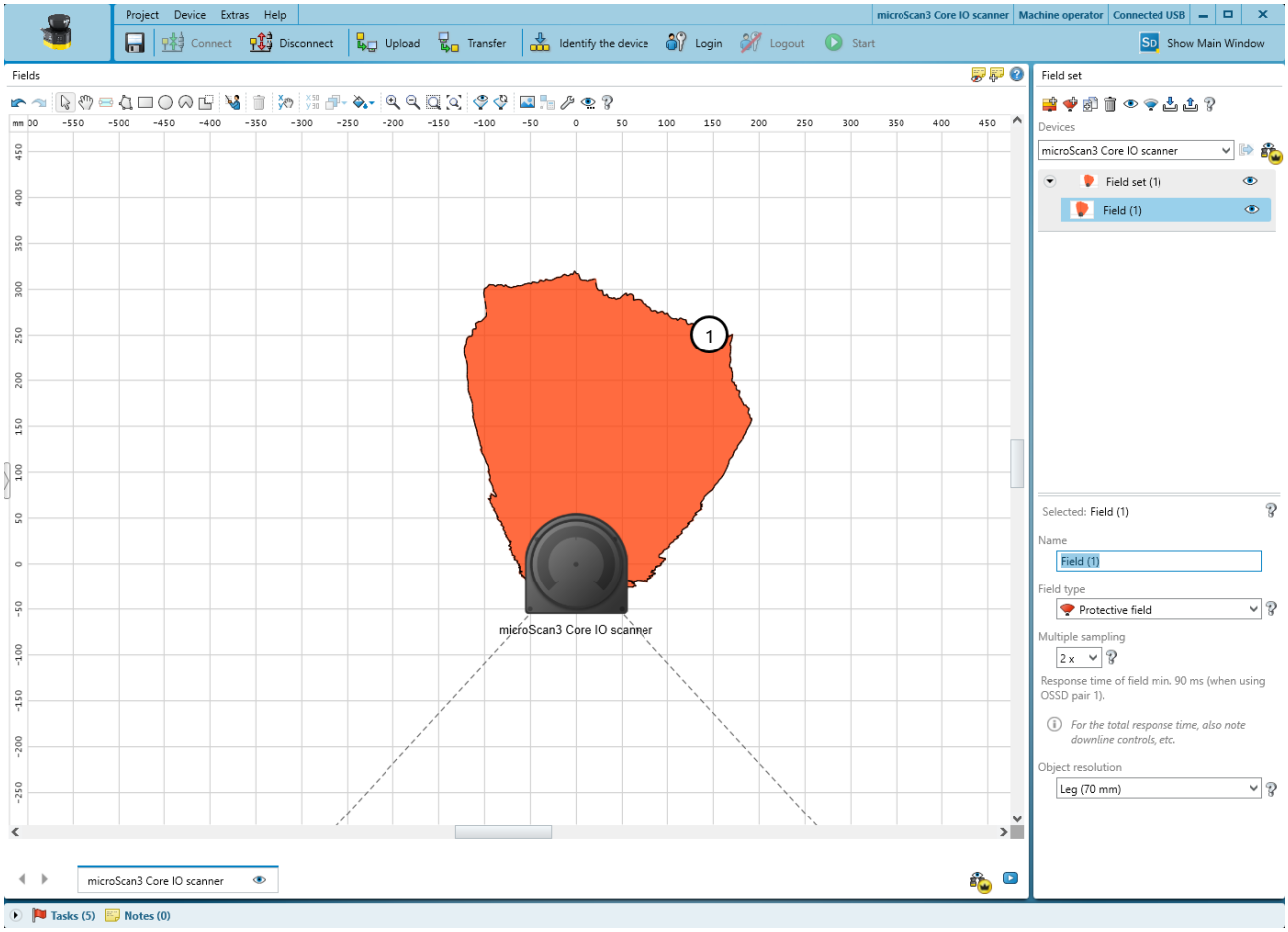


Figure 61: Enable propose field

① Proposal for a protective field

You can have a protective field or warning field suggested by Safety Designer.

For this purpose, the safety laser scanner scans the visible surrounding contour several times. Based on the data obtained, the Safety Designer suggests the contour and size of the field.



You can use the **Suggest field** tool to create a field.

Important information

NOTE

If you propose a protective field, the proposal does not replace calculation of the minimum distance. You must calculate the minimum distance and check whether the size of the proposed protective field is sufficient. You must also take into account the measurement tolerances of the safety laser scanner.

Existing field geometries

- **Delete existing shapes:** The field is redrawn according to the surrounding contour.
- **Refine existing shapes:** The existing field is adapted to the surrounding contour.

Measurement method

- **Use every single distance value:** Each scan of the surrounding contour is used individually to draw the field.
- **Use median of distance values:** The median of the last 25 scans is used to draw the field.

Type of teach-in

- **Only allow reduction:** The shortest measured distance is used at each angle. If you walk along the borders of the imaginary field and, e.g., hold a board or cardboard into the laser beam, this restricts the surrounding contour.
- **Allow expansion:** The surrounding contour is used as it is measured.

Automatic reduction

You can specify that the proposed field is drawn smaller than the measured surrounding contour so that the field will be at a distance from walls. The default value corresponds to the TZ value (tolerance zone of the safety laser scanner).

Smoothing by point reduction

The proposed contour may initially be uneven and consist of very many points. With the **Smoothing by point reduction** option, you can reduce the number of points and simplify the lines.

7.10.3 Object transformation

Overview

Table 13: Object transformation

	**Object transformation**

Procedure

1. In the area on the left, select the objects to be transformed.
2. In the area on the right, select the transformation to be performed (**Shifting** , **Rotation** or **Mirroring**) and enter values for the transformation.
3. In the area on the right, click on **Apply to selected objects** .

✓ The configured transformation is performed in the **Fields** area.

7.10.4 Editing fields using coordinates

You can use coordinates to edit fields. Depending on the form on which a field is based, the appropriate input fields are displayed. The example shows a dialog box for a rectangle.

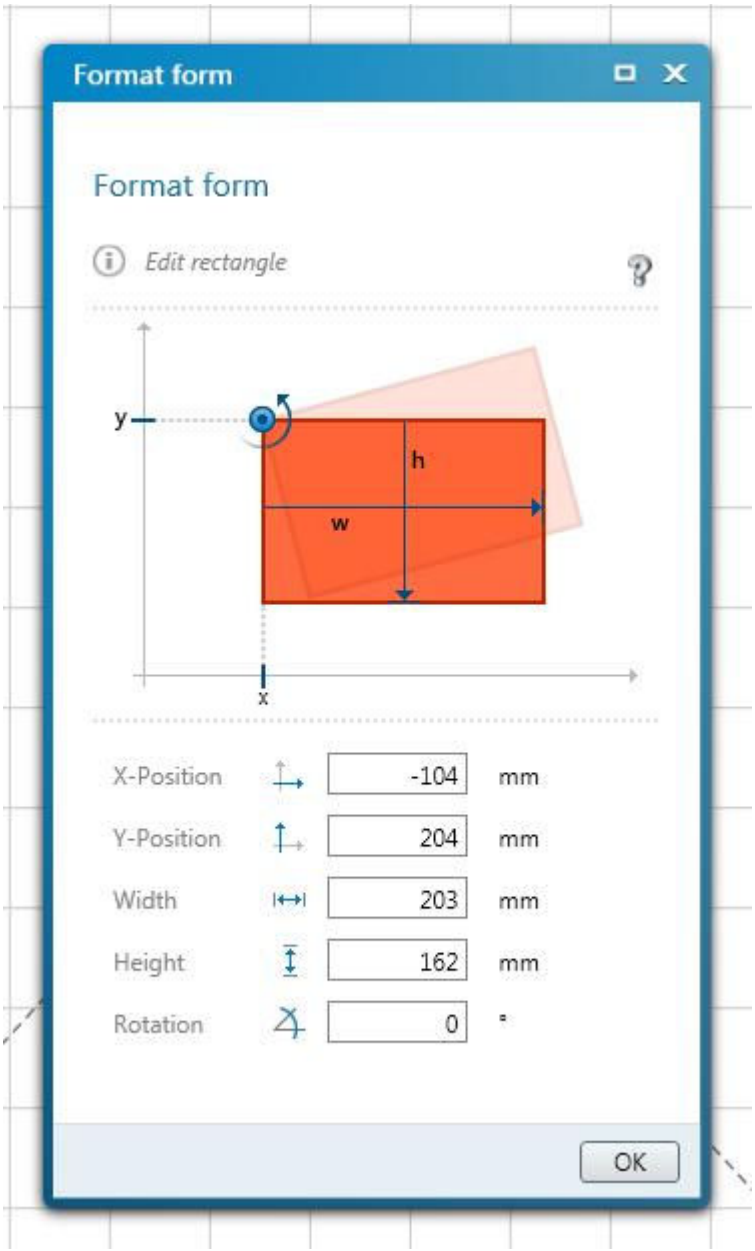


Figure 62: Editing fields using coordinates

The reference points for the X and Y values are as follows:

- Rectangle: top left corner
- Circle: center point
- Circle sector: center point
- Polygon: each point individually
- Contour line: each point individually

7.10.5 Background image

Overview

You can select a background image for the field editor. For example, the plan view of the machine to be protected can be used as a sample.

The background image is saved in the project file on the computer. It is not transmitted to the device.

Table 14: Background image

	**Edit background image**

The Safety Designer supports the following file formats: BMP, JPG, PNG.

Procedure

1. Click on **Edit background image** in the toolbar.
✓ The **Background image** dialog box opens.
2. Click on **Browse ...**.
3. Select the file for the background image.
✓ Safety Designer displays the background image.
4. If necessary, use the pipette icon to select a color of the image to make this color transparent.
5. Adjust the size of the image with the scaling tool or by directly entering the dimensions. Use the scaling tool to move the tips of the blue arrow to two known points and then enter the distance between the points in the field.
6. Enter **X-Position**, **Y-Position** and **Rotation** in the coordinate system of the field editor. You can then freely move or rotate the background image in the field editor.
7. If necessary, click on the **Lock position of the image** option.
✓ It is no longer possible to change the background image in the field editor.

7.10.6 Device Settings

Overview

Table 15: Device Settings

	**Device Settings**

Field calculation

You specify whether the fields are calculated manually or automatically after drawing.

If you select the **Manual** option, first draw the areas to be monitored. Then click on **Calculate field sets** so that the Safety Designer calculates the field that the safety laser scanner actually monitors.

If you select the **Automatic** option, the drawn areas are immediately converted into fields.

Use global geometry

You specify whether global geometries are used.

Display reference contour field

You determine whether the reference contour field is displayed.

7.10.7 Defining global geometry

Overview

You draw field geometries and non-monitored areas as global geometry. The global geometry affects all protective fields and warning fields.

Procedure

1. Click on the **Device Settings** tool.
2. Activate the **Use global geometry** checkbox.
3. In the **Field set** area, select > **Global Geometry**.

4. Draw a global field geometry.
5. If applicable, draw non-monitored areas with the **Mask areas** tool.

7.10.8 Grid Settings

Overview

Table 16: Settings for the field editor

	**Grid Settings**

Drawing surface

You can use a Cartesian or a polar coordinates system and select the colors for the grid, the labels, and the drawing area.

7.10.9 Creating field set templates

If you require the same combination of fields a number of times, you can create a field set template.

 You can edit field set templates using the **Manage field set templates** tool.

Example: you define a field set template with protective field, warning field1 and warning field2.

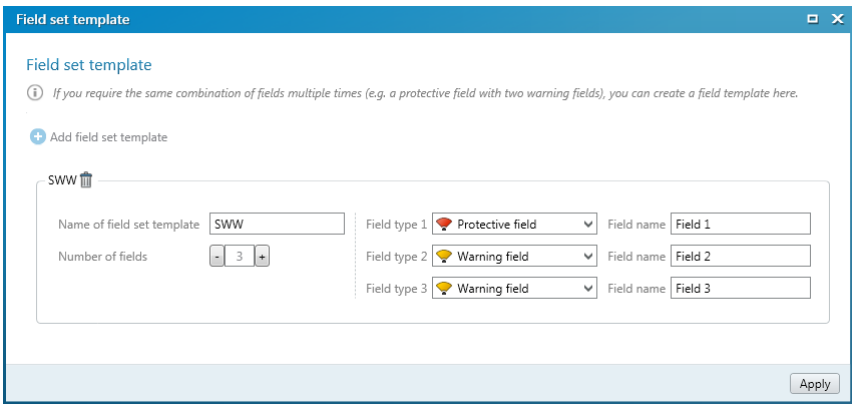


Figure 63: Field set template

Procedure

1. Click on **Add field set template** .
2. Enter the name for the template.
3. Define the number of fields.

✓ A selection field is shown for each field.

4. Select the Field types for the fields.
5. Enter the Field names.
6. Click on **Apply**.

✓ The field set template is saved.

7.10.10 Importing and exporting field sets and fields

Overview

If you need identical field sets or fields across different projects, you can export entire field sets or individual fields out of one project and import them into another project.

Importing field sets and fields

1. Click on **Import fields and field sets**.
2. Select exported file with field set information.
✓ A preview of the field sets and fields saved in the file will be shown.
3. Select the required field sets and fields.
4. Start the import.
✓ The field sets and fields will be imported.

Exporting field sets and fields

1. Click on **Export fields and field sets**.
2. Select the relevant folder and enter a file name for storing the field set information.
3. Select the required field sets and fields.
4. Start the export.
✓ The field sets and fields will be exported.

7.10.11 Virtual group

Overview

If you are configuring several safety laser scanners in a project, you can combine these safety laser scanners into a virtual group. You can then edit the fields for these safety laser scanners in a single field editor. A virtual group can be useful if the safety laser scanners have been mounted on the same level and are arranged in a common world coordinate system.

You need a license to use this function.

Table 17: Virtual group

	Manage devices
	Show/hide device and field decomposition
	Change to device window

Creating a virtual group

1. Click on **Manage devices**.
2. Activate the devices to be included in the virtual group.
3. Click **OK** to confirm.
✓ The devices in the virtual group are displayed at the bottom of the field editor.

Editing devices and associated fields in the field editor

1. Click on the desired device at the bottom of the field editor.
2. Edit the device and the associated fields in the field editor as usual.

Hiding or showing devices and associated fields in the field editor

1. Click on **Show/hide device and field decomposition** next to the desired device.
✓ If the device was previously visible in the field editor, it will be hidden.
✓ If the device was previously hidden in the field editor, it will now be shown.

Switching to another device window in the virtual group

1. Click on **Change to device window** next to the desired device.
✓ The device window of the desired device opens in the foreground.

Complementary information

For information on licenses, see the Safety Designer operating instructions.

7.11 Inputs and outputs, local

Overview

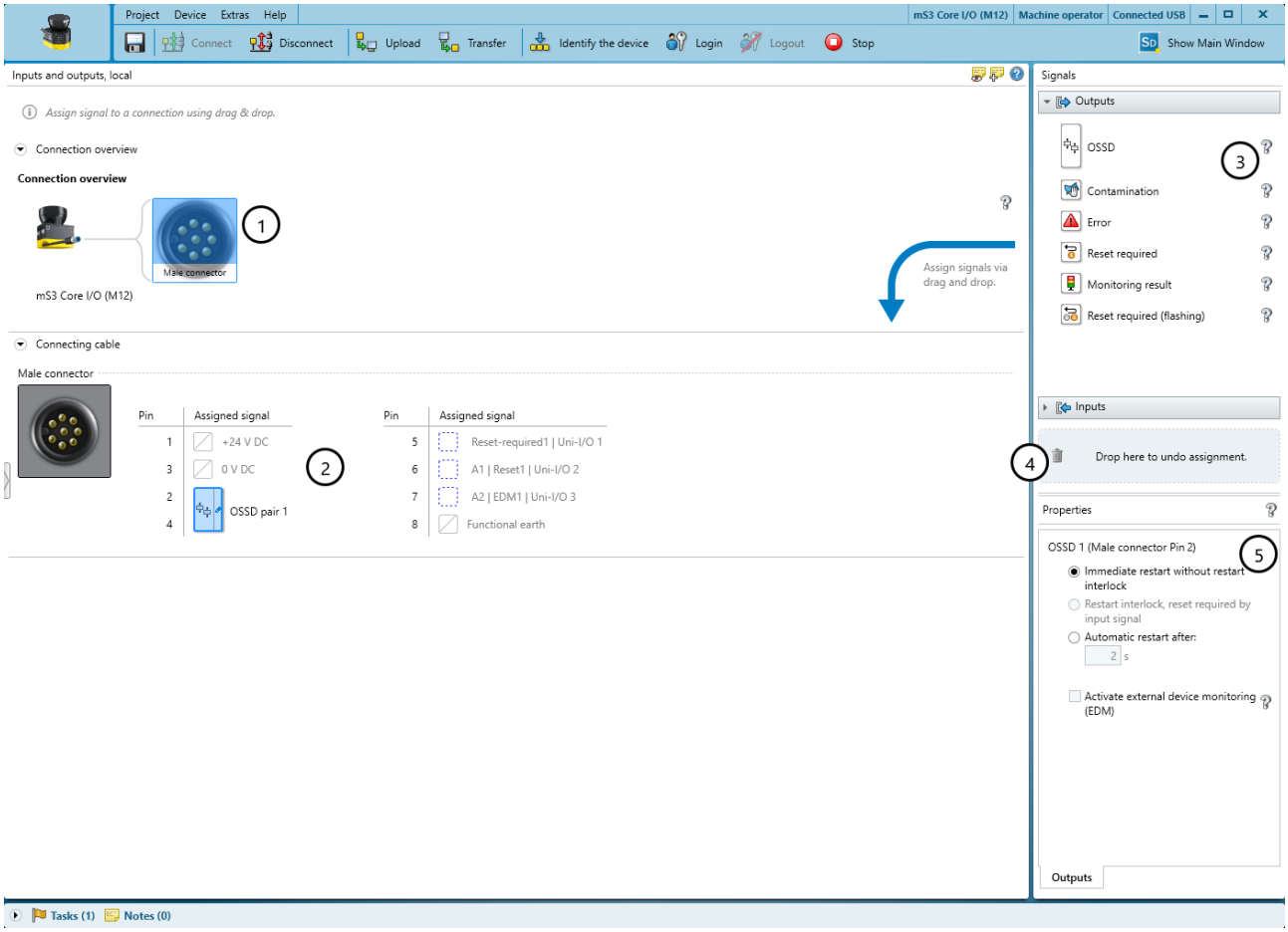


Figure 64: Inputs and outputs, local

① Overview: Plug connectors of the safety laser scanner
② Pin assignment
③ Available signals
④ Remove signal from connection
⑤ Further settings for some signals

Assign the required signals to the safety laser scanner connection in the **Inputs and outputs, local** dialog box.

Connection overview

Safety Designer shows the plug connector of the safety laser scanner.

Pin assignment

Safety Designer displays the plug connector with its individual pins.

Assigning signals to the pins

Safety Designer shows the available signals on the right under **Signals**.

► Click on the desired signal type (e.g., on **Inputs**).
✓ The menu shows the possible inputs.
► Drag the signal towards the pins.
✓ Possible pins for the connection are highlighted.
Safety Designer checks for any restrictions that may apply. For example, an OSSD cannot be placed on an input.
► Drop the signal on the pin.
✓ The signal name is shown on the right next to the pins.

Removing signals

► Click on the signal.
► Drag the signal on to the trash-can symbol.
✓ The pins are free again.

7.11.1 Outputs

OSSD

Dual-channel, safety switching output which is used to switch off the dangerous state.

Contamination

Signals that the optics cover is contaminated.

Error

Signals an error.

Reset required

Signals that a reset is possible. A connected lamp lights up if the restart interlock has been triggered and the protective field is then clear again.

Monitoring result

Indicates the status of the active field. A connected lamp lights up if an object is detected in the field.

Reset required (flashing)

Signals that a reset is possible. A connected lamp flashes if the restart interlock has been triggered and the protective field is then clear again.

7.11.2 Inputs

Static control input

Signal of the machine controller for switching between monitoring cases.

External device monitoring (EDM)

Signal from the auxiliary contacts of the positively guided contactors for external device monitoring (EDM).

Reset

Signal from the reset pushbutton to manually reset the internal restart interlock.

Sleep mode

Signal from a pushbutton to activate sleep mode.

Restart device

Signal from a pushbutton to completely restart the device.

Pause event recording

Signal of a pushbutton to stop the event history.

Further topics

- "External device monitoring (EDM)", page 61
- "Restart interlock", page 57
- "Device restart", page 113

7.11.3 Further settings for some signals

Overview

Safety Designer shows the setting options for some signals under **Properties** at the bottom right.

Important information

DANGER
Hazard due to lack of effectiveness of the protective device
Hazard due to unexpected starting of the machine
By configuring the restart interlock for an OSSD pair, you can influence the restart interlock behavior for the application.

► Take account of the notes in the project planning chapter.

Restart interlock for the OSSD pair

The safety laser scanner has the following options for the restart interlock behavior for the OSSDs:

- **Immediate restart without restart interlock**: If there is no longer an object in the protective field, the safety laser scanner switches the OSSDs to the ON state.
- **Restart interlock, reset required by input signal**: If the operator activates the restart or reset control switch, the safety laser scanner switches the OSSDs to the ON state.
- **Automatic restart after:**: If there is no longer an object in the protective field, the safety laser scanner switches the OSSDs to the ON state after the configured delay.

Activate external device monitoring (EDM)

An input must be configured for external device monitoring (EDM). This input must be correctly connected to the electric control (see "External device monitoring (EDM)", page 61).

If external device monitoring is activated, the safety laser scanner checks whether voltage is applied at the external device monitoring (EDM) input after the OSSDs have been switched off.

If no voltage is applied at the input after the OSSDs have been switched off, the safety laser scanner changes to the locking state and does not switch the OSSDs back to the ON state.

Signal level

For some non-safe output signals, you can select whether the signal is output with HIGH or with LOW:

- Setting **Hi**: The output is normally in LOW state. If the signal is active, the output switches to HIGH state.
- Setting **Lo**: The output is normally in HIGH state. If the signal is active, the output switches to LOW state.

Error

- **Device error** setting: Device errors are serious errors where all safety outputs switch to the OFF state and the device switches to the locking state. Once the cause of the error has been rectified, the device must be completely restarted.
- **Application error** setting: In the event of an application error, all safety outputs switch to the OFF state. Once the cause of the error has been rectified, the safety function must be restarted.

Contamination

- **Switch when Contamination Warning is present. Device is in ON state, but partial contamination on the optics cover is detected.** setting: The optics cover should be cleaned soon.
- **Switch when Contamination Error is present. Device is in OFF state due to contamination of the optics cover.** setting: All safety outputs in the OFF state. The optics cover is severely contaminated and must be cleaned immediately.

Further topics

- "Restart interlock", page 57

7.12 Monitoring cases

Overview

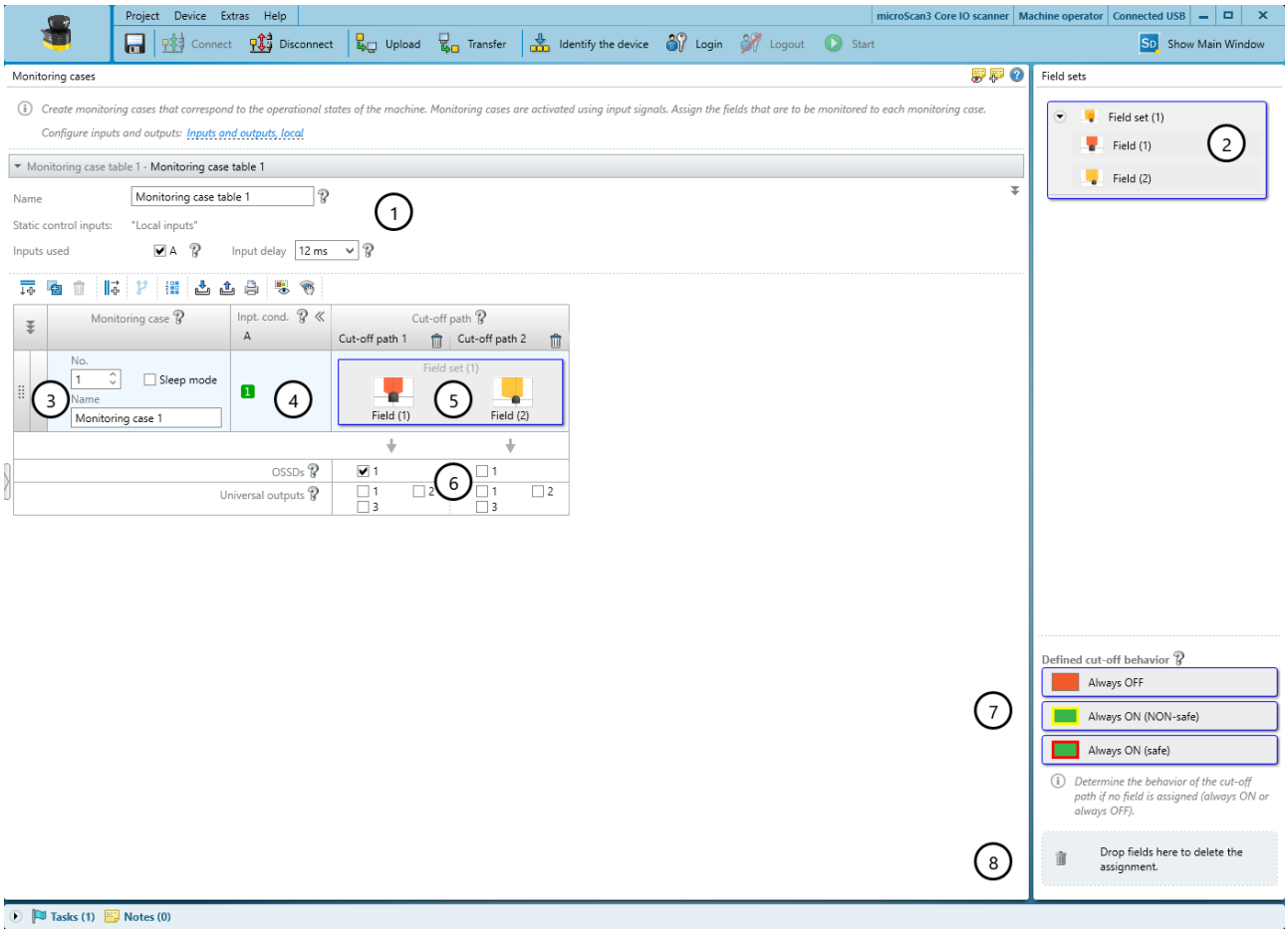


Figure 65: Monitoring cases

① Settings for the whole monitoring case table
② Configured field sets
③ Settings for the individual monitoring case
④ Input conditions for a monitoring case
⑤ Field set in the monitoring case and in the cut-off path
⑥ Cut-off paths
⑦ Areas for defined cut-off behavior
⑧ Remove field set from a monitoring case

In the monitoring case editor, you can also define the monitoring cases with input conditions and assign the field sets.

Further topics

- "Monitoring case", page 20

7.12.1 Settings for monitoring case tables

Name

In the **Name** field, enter a name for the monitoring case table that is as descriptive as possible.

Inputs used

If you want to use static control inputs for monitoring case switching, then select the inputs here.

In antivalent evaluation, the 2 channels of each static control input must always be inverted, even if the status of a control input in a monitoring case is random. If it is not inverted, all safety outputs switch to the OFF state and the device displays an error.

Input delay

If you use static control inputs for monitoring case switching, you can select a delay for the inputs.

If your control device, which you use to switch the static control inputs, cannot switch to the appropriate input condition within 12 ms (for example because of the switch's bounce times), you must configure an input delay. For the input delay, select a time in which your control device can switch in a defined way to a corresponding input condition. You can increase the delay time incrementally.

The following empirical values exist for the switching time using various methods:

Table 18: Empirical values for the required input delay

Switching method	Required input delay
Electronic switching via control, complementary electronic outputs with 0 ms to 12 ms bounce time	12 ms
Tactile controls (relays)	30 ms to 150 ms
Control via independent sensors	130 ms to 480 ms

Also, take account of the notes relating to when to switch between monitoring cases (see "Monitoring case switching time", page 31).

Further topics

- "Static control inputs", page 56

7.12.2 Settings for monitoring cases

Name

Enter a name which is as descriptive as possible for the monitoring case in the **Name** field. If you create a lot of monitoring cases, you should consider a naming concept that makes it possible to identify the monitoring cases easily (for example right cornering, left cornering).

Sleep mode

If you activate this option, the safety laser scanner changes to the sleep mode as soon as the input conditions for this monitoring case exist.

7.12.3 Input condition

For each monitoring case, choose the input conditions for which the monitoring case will be activated.

► Activate the combination of inputs for each monitoring case.
✓ The relevant monitoring case is activated for exactly this combination.
✓ Combinations which are invalid or already assigned are marked.

Complementary information

The **Generate input conditions from case numbers** function allows you to automatically assign input conditions to monitoring cases.

7.12.4 Cut-off paths

Overview

You can create cut-off paths and define the outputs switched by the cut-off paths.

You need a cut-off path for every field in a field set. If the field sets have different sizes, use the field set with the most fields as a guide.

Cut-off path

You can enter a meaningful name for each shutdown path.

Outputs

A cut-off path can switch safety outputs and non-safety outputs.

Warning fields only affect non-safety outputs. If a warning field is within the active monitoring case of a cut-off path, the assigned safety outputs are always in the OFF state even if the warning field is clear.

You select the outputs that the cut-off path should switch:

- **OSSDs**
- **Universal outputs**

7.12.5 Assigning field sets

Overview

The field sets that have been created are listed in the **Field sets** area.

Procedure

Assign a field set to a monitoring case

► Assign a field set to a monitoring case using drag and drop.
✓ The fields in a field set are arranged as they were drawn in the field editor.

Splitting a field set into a monitoring case

1. Assign a field set to a monitoring case using drag and drop.
2. Right click on the assigned field set and select **Split fieldset**.
3. Assign the individual fields to one or various monitoring cases.

Assigning a field to a monitoring case

1. Click on **De-/activate single-drag of fields** in the toolbar.
✓ Every field in the field sets is highlighted with a frame.
2. Click on either a field set or an individual field and assign it to a monitoring case using drag and drop.

Removing assignment

► Drag a field set or field from a monitoring case onto the trash can icon.

7.12.6 Assigning a defined cut-off behavior

Overview

In a monitoring case, you can assign a defined cut-off behavior to a cut-off path instead of a field:

- **Always OFF**: If the monitoring case becomes active, the cut-off path is in the OFF state.
- **Always ON (NON-safe)**: If the monitoring case becomes active, a safety output in the cut-off path is always in the OFF state. A non-safety output is always in the ON state.
- **Always ON (safe)**: If the monitoring case becomes active, the cut-off path is in the ON state.

Important information

DANGER
Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

The **Always ON (safe)** function has the same effect as a field which is always clear. In a monitoring case with the **Always ON (safe)** function, the cut-off path containing this function is permanently in the ON state.

Procedure

Assigning a defined cut-off behavior

► Assign a cut-off behavior to a cut-off path in a monitoring case using drag-and-drop.

Complementary information

If you have not assigned fields to certain cells in a monitoring case table, Safety Designer automatically assigns the **Always OFF** function to these cells.

7.12.6.1 Configuring the default settings for defined cut-off behavior

Overview

With this function, you can define specified cut-off behaviors per cut-off path as default settings for monitoring cases.

Table 19: Show/hide preset for specified cutoff behavior

	Show/hide preset for specified cutoff behavior

Procedure

1. Select **Show/hide preset for specified cutoff behavior**.
✓ Safety Designer displays an additional line in the monitoring case table.
2. Assign a cut-off behavior to a cut-off path in the **Preset for specified cutoff behavior** cell using drag and drop.
✓ Safety Designer applies the default settings when you add a new monitoring case.

7.12.7 Importing and exporting monitoring case tables

Overview

If you need identical monitoring case tables for different projects, you can export entire monitoring case tables out of one project and import them into another project.

Prerequisites

- The inputs used are the same for the target project as for the source project.
- The number of field records and fields created is the same for the target project as for the source project.
- The names of the field sets and fields is the same for the target project as for the source project.

Importing monitoring case tables

1. Click on **Importing from .xml...**.
2. Select exported file with monitoring case table.
3. Start the import.
✓ The monitoring case table is imported.

Exporting monitoring case tables

1. Click on **Exporting to .xml...**.
2. Select desired folder and enter file name under which the monitoring case table will be saved.
3. Start the export.

✓ The monitoring case table is exported.

Complementary information

In many cases, it makes sense to first export the field records from the source project and import them into the target project, see "Importing and exporting field sets and fields", page 99.

7.13 Simulation

Overview

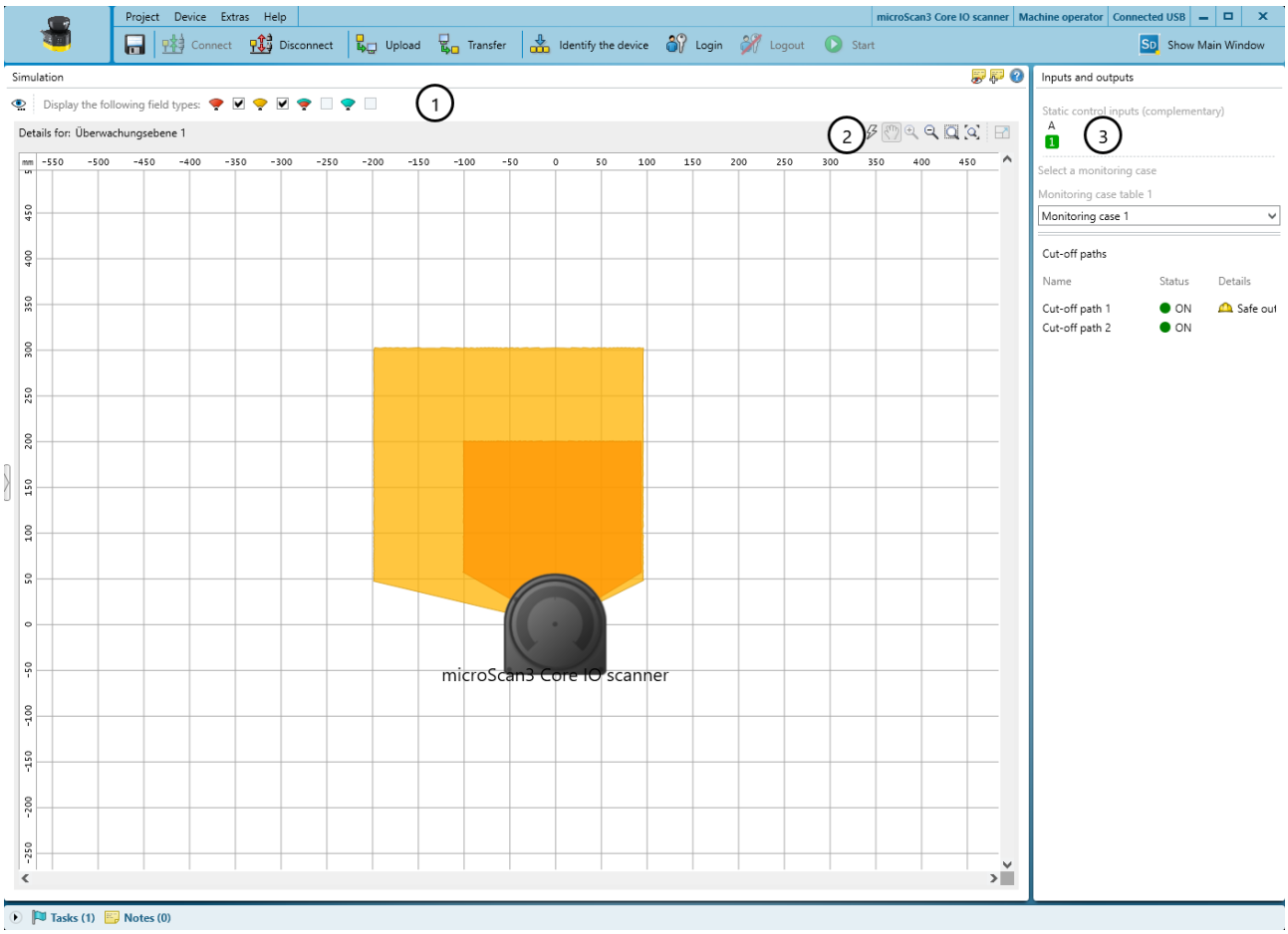


Figure 66: Simulation

① Show or hide field types
② Simulation tools
③ Select input conditions
④ Display the cut-off paths

You can visualize the result of the set configuration in the simulation.

Simulation components and options

- Display the status of the OSSD pairs
- Display the status of the cut-off paths
- Get feedback about which monitoring case is active for the selected input sample (default: monitoring case 1 is active)
- You can switch inputs, monitoring cases, etc. virtually using symbols and observe the result
- You can simulate an object detection in a field and check the result.
- You can move fields to the foreground or to the background using the context menu (right mouse button)

7.14 Transfer

Transferring configuration

DANGER
Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

When transferring the configuration, the protective device's existing configuration may be overwritten.

► Check the configuration carefully before transfer.
► Make sure that the desired device is connected during transfer.

At first, the configuration only exists as a project, namely as a configuration file. The configuration must be transferred to the device.

At the left, you see the values configured in the project for the device. If the device is connected, you see the values saved in the device at the right.

The compatibility of the configuration is checked during transfer.

Checking the configuration

DANGER
Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

If the configuration is verified, the device automatically starts the safety function after switching on the voltage supply.

If the configuration is not verified, the safety laser scanner may not be operated as a protective device. You can start the safety function manually to test the safety laser scanner and the configuration. The test operation has a time limit.

► Only operate the safety laser scanner as a protective device if the configuration is verified.

You can start the safety function manually to test the safety laser scanner with the new configuration, see "Starting and stopping safety function", page 111.

Verifying configuration

DANGER
Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

By verifying the configuration, you can confirm that the configuration complies with the planned safety function and fulfills the requirements in the risk assessment.

- ► Check the verification report carefully before confirming verification.
- ► If the configuration deviates from the planned safety function or does not fulfill the requirements in the risk assessment, verification must not be confirmed.

The configuration must be verified to ensure that the safety function is implemented correctly.

During verification, Safety Designer reads back the transmitted configuration from the safety laser scanner. It compares the configuration with the configuration saved in Safety Designer. If both configurations are identical, Safety Designer displays the verification report. If the user confirms that this is correct, the system is considered to be verified.

Transmitting and verifying the configuration of an individual safety laser scanner

1. Click on **Identify the device** to ensure that the desired device is connected.
✓ The display of the connected device flashes blue.
2. If the checksums on the computer and the device differ, click on **Transfer to device**.
✓ The transfer process is shown in Safety Designer and on the device.
✓ Safety Designer will notify you as soon as the transfer process is complete.
3. Next click on **Verify**.
✓ Safety Designer displays the verification report.
4. Check the verification report and, if necessary, click on **OK**.
✓ Device configuration is shown as verified.

Transferring a verified configuration

No additional verification in Safety Designer is required after transferring a verified configuration. The thorough check during commissioning, however, still needs to be performed as in all other cases.

1. Click on **Identify the device** to ensure that the desired device is connected.
✓ The display of the connected device flashes blue.
2. If the checksums on the computer and the device differ, click on **Transfer to device**.
✓ The transmission process is shown in Safety Designer and on the device.
✓ Safety Designer displays the verification report.
3. Click on **OK**.
✓ Device configuration is shown as verified.

7.15 Starting and stopping safety function

In some situations, it is possible to start or stop the safety function manually.

Table 20: Starting and stopping safety function

	Start	starts the safety function.
	Stop	stops the safety function.

DANGER

Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

If the configuration is verified, the device automatically starts the safety function after switching on the voltage supply.

If the configuration is not verified, the safety laser scanner may not be operated as a protective device. You can start the safety function manually to test the safety laser scanner and the configuration. The test operation has a time limit.

► Only operate the safety laser scanner as a protective device if the configuration is verified.

7.16 Reports

Overview

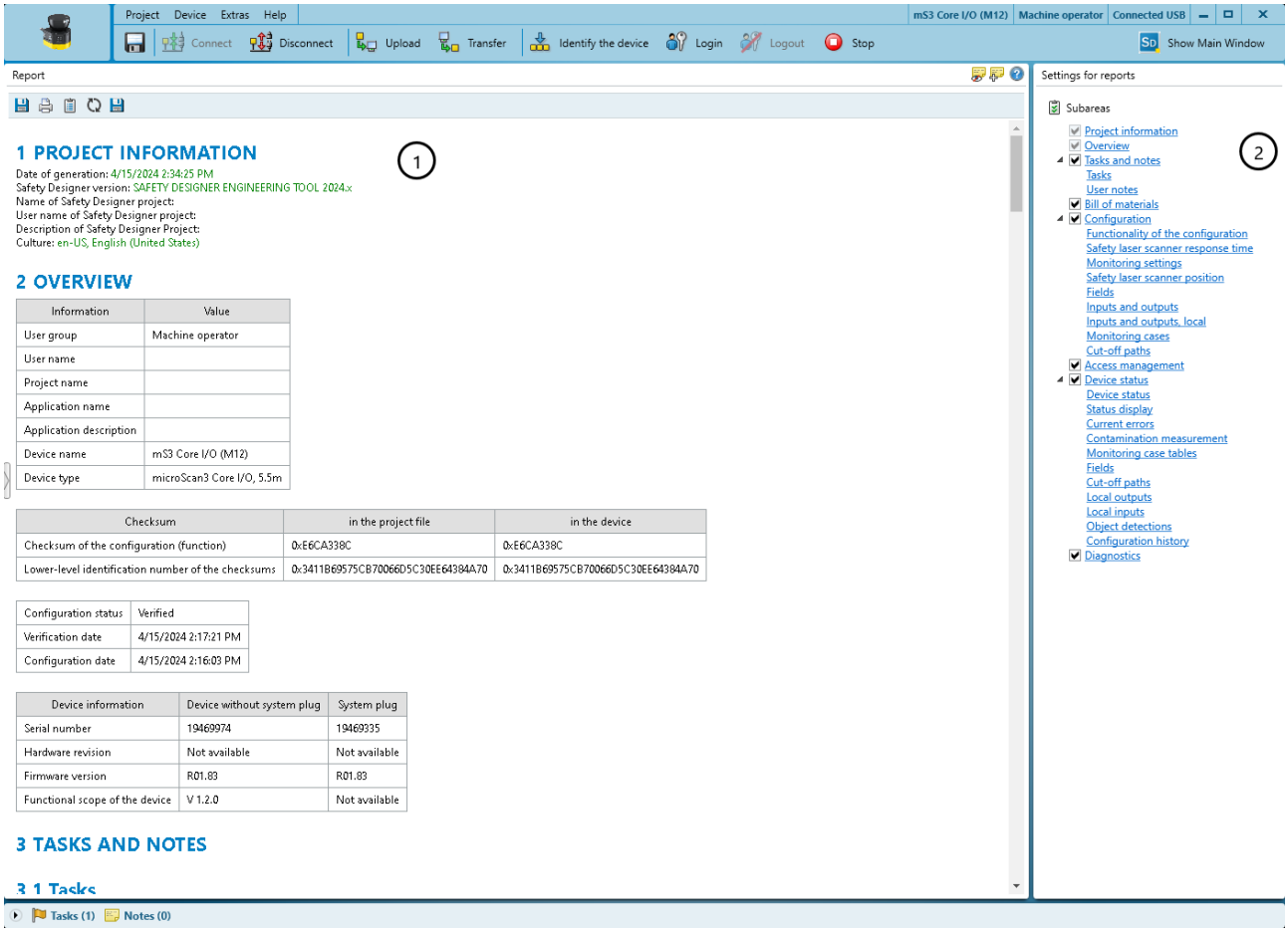


Figure 67: Report

① Contents of the report

② Composition of the report

A report shows the settings and data of a device. You have the option of saving and archiving these data as a PDF.

Report

When you open the **Report** dialog box, the Safety Designer creates a report. If you click on **Update** after making changes to the configuration, you will receive an updated report.

Compiling a report

You compose the contents of a report individually:

1. Select the contents of the report under **Settings for reports**.

✓ Safety Designer creates a report with the selected contents.

Complementary information

National and international standards promote or recommend specific data and the person responsible for it. The required data are included in the report.

1. Print the report.
2. Write down the responsible person on the report.
3. Archive the report.

7.17 Service

7.17.1 Device restart

If you have problems with the device, you can restart the device or subsections of the device (safety function, connections, additional functions).

Restarting safety function

- The fastest type of restart
- Serious errors remain, even if the cause has been rectified (for example a locking state because of a supply voltage which is too low).
- Communication with the device remains intact (connections for configuration, safety function and data not relating to safety).
- Communication beyond the device is not impaired.

Restarting safety function and connections

- The device's function is also re-established after serious errors if the cause has been rectified.
- Communication with the device is interrupted (connections for configuration, safety function and data not relating to safety). The device sets up communication again automatically after restarting.
- Communication beyond the device is not impaired.

Restarting device completely

- The device behaves exactly as it does when the voltage supply is switched off and back on again.
- The device's function is also re-established after serious errors if the cause has been rectified.
- Communication with the device is interrupted (connections for configuration, safety function and data not relating to safety).
- Communication beyond the device is interrupted. This may also affect devices which communicate beyond the device.

7.17.2 Factory settings

Overview

Before reconfiguring the device, you can reset all settings to factory settings.

Depending on the device, 2 or 3 options are available.

Devices with 2 options for resetting to factory settings

Resetting safety function to factory settings
- The configuration for the safety function is reset to factory settings.
- Communication beyond the device is not impaired.

Resetting complete settings to factory settings
- The configuration for the safety function is reset to factory settings.
- The configuration of device communication is reset to factory settings (connections for configuration, safety function and data not relating to safety).

Devices with 3 options for resetting to factory settings

Resetting safety function to factory settings
- The configuration for the safety function is reset to factory settings.
- Communication beyond the device is not impaired.

Resetting safety function and communication settings to factory settings
- The configuration for the safety function is reset to factory settings.
- The configuration of device communication is reset to factory settings (connections for configuration, safety function and data not relating to safety).

Resetting complete settings to factory settings
- The configuration for the safety function is reset to factory settings.
- The configuration of device communication is reset to factory settings (connections for configuration, safety function and data not relating to safety).
- The **Maintenance personnel** and **Authorized client** user groups are deactivated.
- The password of the **Administrator** user group is reset to the factory settings.

7.17.3 Managing passwords

Assigning or changing passwords

1. Establish a connection to the device.
2. In the device window under **Service**, select the **User password** entry.
3. In the **User password** dialog, select the user group.
4. Enter the new password twice and confirm with **Transfer to device**.
5. When you are prompted to log on, select your user group and enter the corresponding password.

✓ The new password is valid for the user group immediately.

Resetting a password

If you have forgotten the password of the privileged user group, you can reset it.

For devices with 3 user groups, user group **Authorized client** is the privileged user group. For devices with new rights management (4 user groups, newer range of functions), user group **Administrator** is the privileged user group.

Reset user group password Authorized client:

1. Request the form for resetting your password from SICK support.
2. Connect to the device in Safety Designer.
3. In the device window under **Service**, select the **User password** entry.
4. In the **User password** dialog, select the **Reset Password** option.
5. Transmit the serial number shown and the device counter together with the product number and the type code on the form to SICK support.

✓ You will then receive a reset code.

6. Enter the reset key under **Reset Password** and confirm with **Apply**.

✓ The passwords are reset to factory settings (SICKSAFE for **Authorized client**, no password for **Operator**, no login possible for **Maintenance personnel**). The configuration is

not changed.

Reset user group password Administrator:

1. Request the form for resetting your password from SICK support.
2. Connect to the device in Safety Designer.
3. In the device window under **Service**, select the **User password** entry.
4. In the **User password** dialog, select the **Start process for resetting the password** option.
5. Send the information displayed on the form to SICK support.

✓ You will then receive an activation code.

6. Enter and confirm the activation code in the field provided in Safety Designer.

✓ The password of the **Administrator** user group is reset to factory settings (SICKSAFE). The **Maintenance personnel** and **Authorized client** user groups are deactivated. The configuration is not changed.

Further topics

- "Version numbers and functional scope", page 141

7.17.4 Access management

Overview

You can activate or deactivate interfaces and selected functions as needed.

In the **Projected device** area, you can see the settings in the project.

When a device is connected, you can see in the **Physical device** area the configuration in the device and the status describing the actual behavior of the device.

Older devices may not support all settings.

Functions and settings

You can activate, deactivate or select the default setting for each function displayed. The default setting depends on the device and its range of functions.

Safety Designer displays the minimum functionality that the device must have to support the setting.

Behavior if the "deactivated" setting is not supported by the device or replacement device:

It may happen that settings are stored in the system connector that the device cannot evaluate, e.g. because a device has been replaced by an older device. You can set how the device should behave in this case.

Older devices ignore all settings in this window. Safety Designer shows up to which functional range the settings are ignored.

7.17.4.1 Functions and settings

Device restart (without network) via device display

You can specify whether the device can be restarted using the pushbuttons on the display.

7.17.5 Optics cover calibration

Overview

After replacing an optics cover, the measurement system of the safety laser scanner must be calibrated to the new optics cover. During optics cover calibration, the reference for the contamination measurement of the optics cover is defined (status = not contaminated).

Important information

WARNING
Poor calibration of the measurement system for the optical properties of the optics cover

The measurement system of the safety laser scanner must be calibrated for the specific optics cover. If optics cover calibration is not done correctly, persons and parts of the body to be protected may not be detected.

- ► Carry out an optics cover calibration with the Safety Designer every time the optics cover is replaced.
- ► Carry out the optics cover calibration at room temperature (10 °C to 30 °C).
- ► Only carry out the optics cover calibration using a new optics cover.
- ► Before the optics cover calibration switch on the device for a few minutes to warm up the internal components.
- ► Make sure that the entire system is clear of contamination when the adjustment is carried out.

Procedure

1. Before the optics cover calibration, switch on the device for a few minutes to warm up the internal components.
2. In the **Exchange** column, click on **Yes**.
3. Check that the optics cover is clean.
4. In the **Check cleanliness** column, click on **OK**.
5. In the **Optical cover calibration** column, click on **Start**.

✓ The calibration process starts. Typically, this process can take up to a minute. A progress bar shows the progress.

6. Do not switch off the safety laser scanner and do not disrupt the connection between the computer and the safety laser scanner during the adjustment.

✓ The end of the calibration is shown.

7.17.6 Compare configuration

Overview

You can use this function to compare the current configuration in the project with a previously exported configuration or the configuration in the device.

Exported configurations are stored in their own format: ".sdsc". You can export a configuration under **Service** > **Compare configurations** in the **Current configuration of project** area in the project.

Table 21: Buttons

Button	Description
	**Current configuration of project** area: Exports the current configuration in the ".sdsc" format for another comparison
	Comparison data area: Exports the comparison configuration in the ".sdsc" format
	Via the comparison table: Exports the comparison result
	Imports the configuration file in the ".sdsc" format
	Identifying the device
	Reads the configuration from the device

Button	Description
	Updates the configuration comparison

Prerequisites

- The configuration export contains only one device.
- Type code of the device is identical in both configurations.
- Version number of the range of functions in the project is equal to or higher than the configuration to be compared with.

Procedure

1. In the navigation menu of the device window, navigate to **Service** > **Compare configurations**.

✓ The Safety Designer shows the current device configuration at the top left of the workspace.

2. Reading in comparison data:
   - Reading a configuration from the device: Open the drop-down menu next to the device symbol and select **Read from Device**.
   - Importing a configuration file: Select and import a previously exported configuration file using **Import data**.
   - Use the current configuration in the project: Select **Use comparison data**.

✓ The Safety Designer starts the configuration comparison and displays the results in a table in the workspace.

3. If necessary, export the comparison result as a .csv file using **Export result** via the comparison table.

Importing comparison data

You can use the **Import** button to apply all settings of the comparison data to the current configuration if the version number of the range of functions is identical in both configurations.

You need a license to use this function.

For information on licenses, see the Safety Designer operating instructions.

7.17.7 Import / Export

Overview

You can use this function to export the current configuration in the project or import a previously exported configuration.

Exported configurations are stored in their own format: “.sgexml”.

When importing using **Import**, you can select in detail which parts of the configuration to import.

When exporting using **Export**, you can select in detail which parts of the configuration to export.

8 Commissioning

8.1 Safety

WARNING
Hazard due to lack of effectiveness of the protective device

- ► Before commissioning the machine, make sure that the machine is first checked and released by qualified safety personnel.
- ► Only operate the machine with a perfectly functioning protective device.

DANGER
Dangerous state of the machine

During commissioning, the machine or the protective device may not yet behave as you have planned.

- ► Make sure that there is no-one in the hazardous area during commissioning.

DANGER
Hazard due to lack of effectiveness of the protective device

When changes are made to the machine, the effectiveness of the protective device may be affected unintentionally.

- ► After every change to the machine and changes to the integration or operational and secondary conditions of the safety laser scanner, check the protective device for effectiveness and recommission as specified in this section.

Before initial commissioning, project planning, mounting, electrical installation and configuration must be completed in accordance with the following chapters:

- "Project planning", page 24
- "Mounting", page 66
- "Electrical installation", page 69
- "Configuration", page 72

8.2 Alignment

The following options are available to you for precisely aligning the safety laser scanner using mounting kit 2:

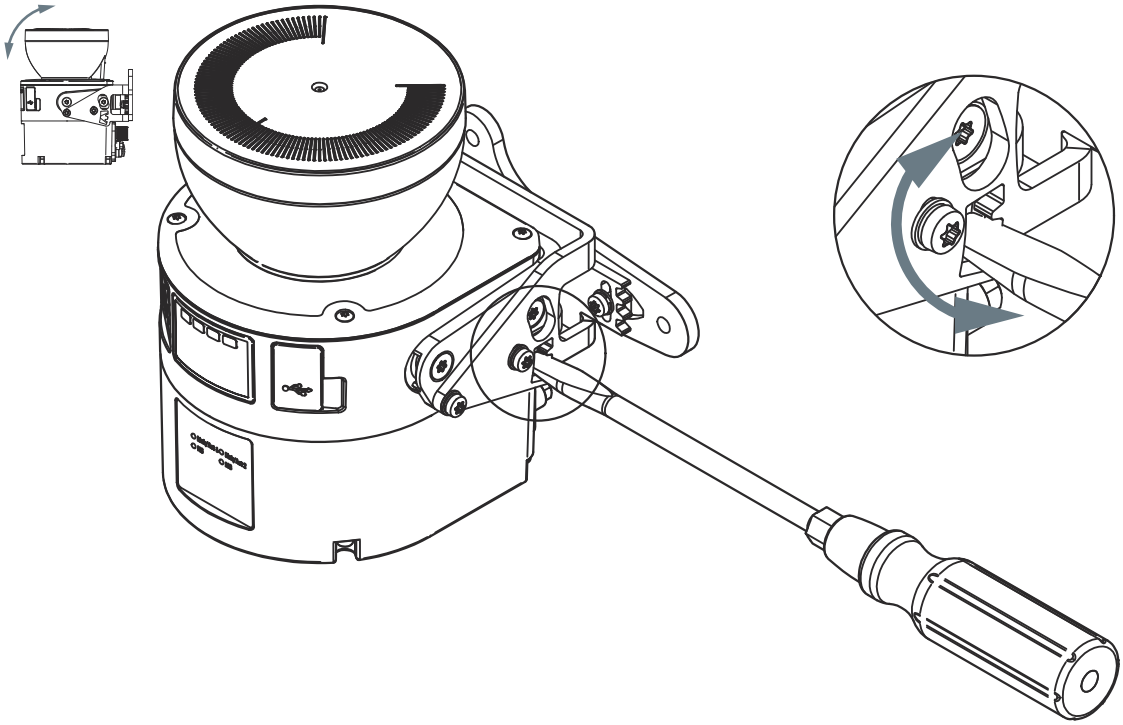


Figure 68: Alignment about the transverse axis

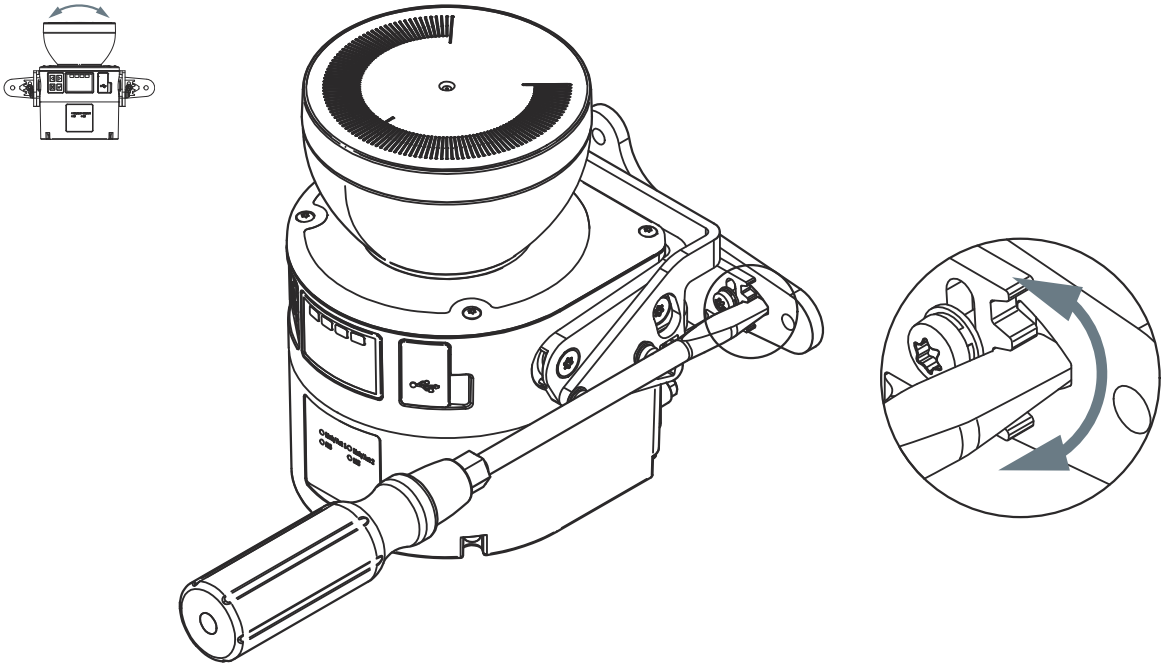


Figure 69: Alignment about the depth axis

► After alignment, tighten the screws with the specified tightening torque.

8.3 Switching on

After switching on, the device performs various internal tests. The OFF LED illuminates continually. The ON LED is off.

The start procedure lasts approx. 10 seconds.

When the startup process is finished, the status LEDs and the display show the current operational status.

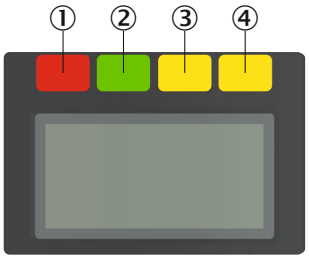


Figure 70: Status LEDs

Table 22: Status LEDs

Number	Function	Color	Meaning
①	OFF state	Red	Lights up red when the OSSD pair is in the OFF state.
②	ON state	Green	Lights up green when the OSSD pair is in the ON state.
③	Warning field	Yellow	Lights up yellow if an object is detected in at least one warning field.
④	Restart interlock	Yellow	Setup with reset: Flashes if the restart interlock has been triggered. Configuration with automated restart after a time: Lights up while the configured time to restart expires.

The OFF state and ON state light emitting diodes can be found in multiple locations on the device. 3 additional sets are arranged in pairs on the base of the optics cover. So the LEDs can also be seen in many cases when it is not possible to see the display, e.g. due to the mounting situation or because it is hidden from the operator's position.

More information about what the LEDs mean and the symbols and information shown on the display: see "Troubleshooting", page 130.

8.4 Check during commissioning and modifications

The thorough check is intended to ensure that the safety functions are fulfilling their planned purpose and whether persons are being adequately protected.

► Carry out the checks specified in the test plan of the manufacturer of the machine and the operating entity.

9 Operation

9.1 Safety

DANGER
Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

- ► Maintenance work, alignment work, error analyses, and any changes to the integration of the protective device in the machine must only be carried out by qualified personnel.
- ► The effectiveness of the protective device must be checked following such work.

NOTE
This document does not provide instructions for operating the machine in which the safety laser scanner is integrated.

9.2 Regular thorough check

The thorough check is intended to ensure that the safety functions are fulfilling their planned purpose and whether persons are being adequately protected.

- ► Carry out the checks specified in the test plan of the manufacturer of the machine and the operating entity.

9.3 Status indicators

Overview



Figure 71: LEDs

① Status LEDs
② Additional LEDs for ON state and OFF state
③ Display

Further topics

- "Detailed diagnostics using the display", page 130
- "Error indication on the display", page 132

9.3.1 Status LEDs

4 status LEDs are located directly above the display.

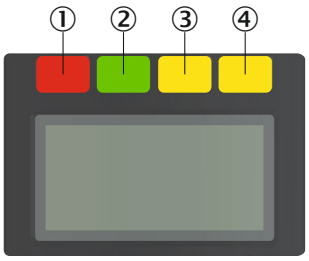


Figure 72: Status LEDs

Table 23: Status LEDs

Number	Function	Color	Meaning
①	OFF state	Red	Lights up red when the OSSD pair is in the OFF state.
②	ON state	Green	Lights up green when the OSSD pair is in the ON state.
③	Warning field	Yellow	Lights up yellow if an object is detected in at least one warning field.
④	Restart interlock	Yellow	Setup with reset: Flashes if the restart interlock has been triggered. Configuration with automated restart after a time: Lights up while the configured time to restart expires.

The OFF state and ON state light emitting diodes can be found in multiple locations on the device. 3 additional sets are arranged in pairs on the base of the optics cover. So the LEDs can also be seen in many cases when it is not possible to see the display, e.g. due to the mounting situation or because it is hidden from the operator's position.

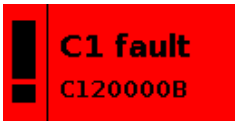
9.3.2 Status indicator with the display

The display shows current information about the status of the safety laser scanner. The display switches off after approx. 60 s if all fields are clear and no other notification is displayed.

- ► If the display is switched off, press any pushbutton to activate the display.
- ► Press any pushbutton to obtain more details about the displayed status information.
- ► If there are a number of pages with detailed information, this is shown in the top right of the display.
- ► Press the arrow buttons to change between a number of pages with detailed information.

Table 24: Overview of status information

Display	Device or configuration	Meaning
	All devices and configurations	All fields clear, OSSD pair in ON state. The number at bottom right indicates the active monitoring case.
	Devices with an OSSD pair	OSSD pair in OFF state.

Display	Device or configuration	Meaning
	Configuration with restart interlock	Protective field is clear, reset can take place.
	Configuration with restart interlock	Reset button pressed Safety output in the OFF state.
	Configuration with restart interlock	Reset button pressed Safety output in the ON state.
	Configuration with automated restart after a time	Protective field is clear, configured time to restart expires.
	Configuration with at least one warning field	Detection in the warning field (left column: number of warning fields with detection, right column: number of warning fields in the current monitoring case).
 Display flashes	All devices and configurations	Error. All safety outputs in the OFF state. Additional information: see "Error indication on the display", page 132.
 Display flashes	All devices and configurations	Contamination warning. Check the optics cover for damage. Clean the optics cover.
 Display flashes	All devices and configurations	Contamination error. All safety outputs in the OFF state. Check the optics cover for damage. Clean the optics cover.
 Display flashes	All devices and configurations	Dazzle warning. Check whether the safety laser scanner is being dazzled by an external light source in the scan plane, e.g., sun, halogen light, infrared light source. Remove or cover the light source.
 Display flashes	All devices and configurations	Dazzle error. The associated safety outputs are in the OFF state. Check whether the safety laser scanner is being dazzled by an external light source in the scan plane, e.g., sun, halogen light, infrared light source. Remove or cover the light source.

Display	Device or configuration	Meaning
 Display flashes	Configuration with external device monitoring (EDM)	Error in the external device monitoring (EDM). OSSD pair in OFF state.
 Display flashes	Configuration with reference contour field	Tamper protection. The safety laser scanner does not detect any contour within the configured tolerance band of the reference contour field. All safety outputs in the OFF state.
 Display flashes	All devices and configurations	Tamper protection. The safety laser scanner measures no values within the distance measurement range in an area of at least 90°. All safety outputs in the OFF state.
	All devices and configurations	Safety function stopped. All safety outputs in the OFF state. Restart the device using the keypad or Safety Designer.
	All devices and configurations	A valid input signal is not yet applied at the control inputs. All safety outputs in the OFF state. After switching on, the safety laser scanner waits for a valid input signal. During this time, an invalid input signal does not result in a error.
	All devices	The device is not configured. The device is in the as-delivered state or has been reset to factory settings. All safety outputs in the OFF state.
	All devices and configurations	Sleep mode. All safety outputs in the OFF state. Press any pushbutton to obtain more information.

10 Maintenance

10.1 Safety

DANGER
Improper work on the product

A modified product may not offer the expected protection if it is integrated incorrectly.

- ► Apart from the procedures described in this document, do not repair, open, manipulate or otherwise modify the product.

10.2 Regular cleaning

Overview

Depending on the ambient conditions, the optics cover must be cleaned regularly and in the event of contamination. For example, static charges can cause dust particles to be attracted to the optics cover.

Important information

DANGER
Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

- ► Regularly check the degree of contamination on all components based on the application conditions.

DANGER
Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

- ► Make sure that the optical properties of the optics cover are not changed by:
  - beading water, mist, frost, or ice formation. If necessary, remove any residues of this type or any other form of contamination and restart the safety laser scanner.
  - Damage. Replace damaged optics covers.
  - Substances containing oil or fat. Substances like this may impair the detection capability of the safety laser scanner. Therefore keep the optics cover free from substances containing oil or fat.

DANGER
Hazard due to unexpected starting of the machine

- ► Make sure that the dangerous state of the machine is and remains switched off during cleaning.
- ► Make sure that the safety laser scanner's outputs do not affect the machine during cleaning.

NOTICE

- ► Do not use aggressive or abrasive cleaning agents.
- ► Recommendation: Use lens cleaner and lens cloths from SICK.

Procedure

Cleaning the optics cover

1. Remove dust from the optics cover using a soft, clean brush.
2. Moisten a clean, soft cloth with lens cleaner and use it to wipe the optics cover.
3. Check the effectiveness of the protective device, see "Thorough check of the principal function of the protective device", page 63.

Complementary information

NOTE
The display shows a contamination warning if the optics cover is contaminated and needs to be cleaned soon. If it is not cleaned and the contamination continues to increase, the safety laser scanner switches to the OFF state for safety reasons and the display shows a contamination error.

- ► Check the optics cover for damage.
- ► Clean the optics cover in a timely manner.

Further topics

- "Spare parts", page 161

10.3 Replacing the optics cover

Overview

If the optics cover is scratched or damaged, it must be replaced.

You can order the replacement optics cover from SICK.

Important information

NOTICE
SICK offers a variety of optics covers as a spare part.

- ► Only use, as a spare part, the optics cover that is suitable for the product, if applicable with mounted accessories.

Complementary information

For instructions on replacing the optics cover and additional information, see the mounting instructions for the respective optics cover.

Further topics

- "Spare parts", page 161

10.4 Replacing the safety laser scanner

If the safety laser scanner is damaged or defective, you must replace it.

DANGER
Hazard due to lack of effectiveness of the protective device
If an unsuitable configuration is saved in the system plug, it may cause the dangerous state to not end in time.

- ► After replacement, make sure the same system plug is used or the configuration is restored.
- ► Make sure that the safety laser scanner is aligned correctly after the replacement.

NOTICE
Enclosure rating IP65 only applies if the safety laser scanner is closed and the system plug is mounted.

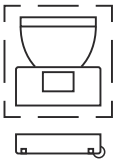
NOTICE
If the system plug is mounted with excessive force, the contacts can break or bend.

- ► Plug in the system plug carefully.
- ► Do not force it.

Tool required:
- TX10 Torx wrench
- TX20 Torx wrench

10.4.1 Replacing the safety laser scanner without system plug

Overview



In many cases, you can reuse the existing bracket and the existing system plug. Detach the defective safety laser scanner from the bracket and the system plug. Then, mount the new safety laser scanner on the bracket and the system plug. When the new safety laser scanner is switched on for the first time, it reads the configuration from the system plug and can be used without having to be reconfigured.

Procedure

1. Make sure that the environment is clean and clear of fog, moisture, and dust.
2. Unscrew screws in the system plug and remove the system plug from the defective safety laser scanner.
3. Unscrew the fixing screws and remove the defective safety laser scanner.
4. Mount the system plug on the new safety laser scanner, see "Replacing the system plug", page 128.
5. Mount the new safety laser scanner, see "Mounting", page 66.
6. Perform commissioning again, taking particular care to conduct all of the thorough checks described, see "Commissioning", page 118.

Complementary information

In certain cases, you can no longer log into the device with Safety Designer after device exchange. [6] If you would like to log into the device, e.g. to change the configuration, you have to reset the password with help from SICK. The device works with the existing configuration even without changing the password.

In certain cases (in the event of dust, high air humidity), it may make sense not to disconnect the system plug and the safety laser scanner at first. In these cases, proceed as follows:

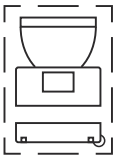
1. Disconnect the connecting cables to the system plug.
2. Unscrew screws from the bracket and remove the defective safety laser scanner from the bracket.
3. Move the safety laser scanner with the system plug to a clean location (e.g., office, maintenance areas).
4. Unscrew screws in the system plug and remove the system plug from the defective safety laser scanner.
5. See above for further steps.

6) This case can only occur if you replace a device with old rights management with a device with new rights management or vice versa. Devices with newer functional scope use the new rights management.

Further topics

- "Managing passwords", page 114
- "Version numbers and functional scope", page 141

10.4.2 Replacing the safety laser scanner completely



1. Disconnect the connecting cables the system plug.
2. Unscrew the fixing screws and remove the defective safety laser scanner.
3. Mount the new safety laser scanner, see "Mounting", page 66.
4. Reconnect the connecting cables to the system plug.
5. Configure the safety laser scanner, see "Configuration", page 72.
6. Perform commissioning again, taking particular care to conduct all of the thorough checks described, see "Commissioning", page 118.

10.5 Replacing the system plug

If the system plug is damaged or defective, you must replace it.

NOTICE
Enclosure rating IP65 only applies if the safety laser scanner is closed and the system plug is mounted.

NOTICE
If the system plug is mounted with excessive force, the contacts can break or bend.

- ► Plug in the system plug carefully.
- ► Do not force it.

Tool required:

- TX10 Torx wrench

Procedure



1. Make sure that the environment is clean and clear of fog, moisture, and dust.
2. Disconnect the connecting cables from the system plug.
3. If necessary: move the safety laser scanner to a clean location.
4. Unscrew the screws in the defective system plug and remove the system plug from the safety laser scanner.
5. Make sure that the seal is seated correctly (①).
6. Carefully place the new system plug onto the safety laser scanner at the back (②).
7. Carefully fold the system plug onto the safety laser scanner (③).
8. Screw in the system plug using the captive screws. Tightening torque: 1.6 Nm ... 1.9 Nm.
9. Reconnect the connecting cables to the system plug.
10. Configure the safety laser scanner, see "Configuration", page 72.
11. Perform commissioning again, taking particular care to conduct all of the thorough checks described, see "Commissioning", page 118.

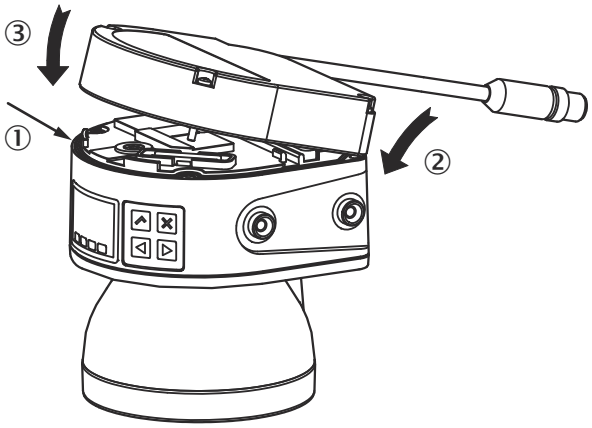


Figure 73: Installing the system plug on the safety laser scanner

10.6 Regular thorough check

The thorough check is intended to ensure that the safety functions are fulfilling their planned purpose and whether persons are being adequately protected.

► Carry out the checks specified in the test plan of the manufacturer of the machine and the operating entity.

11 Troubleshooting

11.1 Safety

DANGER
Hazard due to lack of effectiveness of the protective device

Persons and parts of the body to be protected may not be recognized in case of non-observance.

- ► Immediately shut the machine down if the behavior of the machine cannot be clearly identified.
- ► Immediately put the machine out of operation if you cannot clearly identify or allocate the error and if you cannot safely remedy the error.
- ► Secure the machine so that it cannot switch on unintentionally.

DANGER
Hazard due to unexpected starting of the machine

- ► When any work is taking place, use the protective device to secure the machine or to ensure that the machine is not switched on unintentionally.

NOTE
Additional information on troubleshooting is available from your SICK subsidiary.

11.2 Detailed diagnostics using the display

Overview

You can open the menu using the pushbuttons.

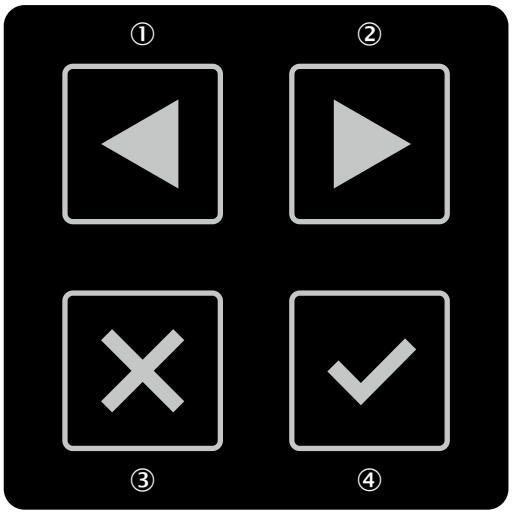


Figure 74: Pushbuttons on the device

① Left arrow button
② Right arrow button
③ Back pushbutton
④ OK pushbutton

If you do not press any pushbuttons for a time, the display changes back to the status display.

Menu

The menu provides access to the following areas:

- **Device info**
- **Diagnostics**
- **Device restart**
- **Settings**

Procedure

► Press the OK pushbutton ④ twice in succession to call up the menu.
► Use the arrow buttons ①, ② to change to the desired menu item.
► Confirm the desired menu item using the OK pushbutton ④.
► Use the same pushbuttons to navigate through the submenus.
► Press the Back pushbutton ③ to return to the higher-level menu item.
► Press the Back pushbutton ③ multiple times to return to the status display.
► Do not press any pushbutton for some time so that the display returns to the status display.

Device info

You will find information about the following topics in the Device info area:

- **Hardware**: For example type code, part numbers, serial numbers, firmware versions, functional scope of device
- **Configuration**: For example device name, application name, checksum, date of last configuration, functional scope of configuration
- **Service interfaces**: Information on whether access to individual interfaces and services is activated or deactivated

The **Functionality of the device** and **Functionality of the configuration** show whether a configuration is compatible with the firmware version of a device. This can be important when exchanging a device, for example.

Configuration and firmware version of a device are compatible if the following conditions are met:

- The 1st place of both numbers must be identical
- The 2nd place for the device must be at least as large as that for the configuration
- The 3rd place does not have an effect on the compatibility

Diagnostics

Check whether the safety laser scanner is being dazzled by an external light source in the scan plane, e.g., sun, halogen light, infrared light source.

- **Intrusions**: Position and time of the last 10 objects in a protective field that have led to a safety output switching to the OFF state.
- **Messages**: Error code and error type of the last 10 error messages.
- **Service**: Currently measured contamination of the optics cover, operating hours, number of power-up processes.

Device restart

You have the following options in the Device restart area:

- Restart the safety laser scanner.

Settings

You have the following options in the Settings area:

- Set the display brightness and contrast.

Complementary information

The display language is set using Safety Designer during configuration. The display language and the configuration cannot be changed using the pushbuttons on the display.

11.3 Error indication on the display

Overview

If there is an error, the display shows a warning symbol, a type of error and an error code on a red flashing background.

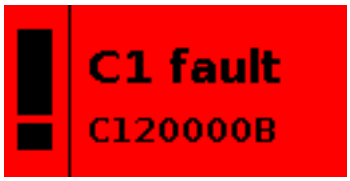


Figure 75: Error display

- The two-character error type will help you during troubleshooting.
- The eight-character error code in the bottom line helps SICK support during the detailed error analysis.
- By pressing any pushbutton, you will obtain more information about the error and for troubleshooting. You can use the arrow buttons to change to further pages with additional information.
- You will find detailed information in Safety Designer's message history about the individual errors and information about events not shown by the display.

Error indication on the display

Table 25: Error types

Error type	Brief description	Cause	Troubleshooting
C1	Faulty configuration	The configuration is faulty.	► Reconfigure the device.
C2	Incompatible configuration	The configuration in the system plug does not match the device's functionality.	► Check device variant. ► Replace or reconfigure the device.
C3	Incompatible firmware	The configuration in the system plug does not match the device's firmware version.	► Check the firmware version of the device. ► Replace or reconfigure the device.
E1	Error in the safety laser scanner	The safety laser scanner has an internal error.	► Perform a device restart using the display or Safety Designer or interrupt the voltage supply for at least two seconds. ► Replace the safety laser scanner and send it to the manufacturer for repair.
E2	Error in the system plug	The system plug has an internal error.	► Perform a device restart using the display or Safety Designer or interrupt the voltage supply for at least two seconds. ► Replace the system plug.
E3	Error in the system plug	The system plug has an internal error.	► Perform a device restart using the display or Safety Designer or interrupt the voltage supply for at least two seconds. ► Replace the system plug.

Error type	Brief description	Cause	Troubleshooting
E4	Incompatible system plug	The system plug is unsuitable for the safety laser scanner.	► Check part number or type code. ► Replace the system plug.
E5	Dazzle error	Strong external light source, e.g., sun, halogen headlamps, infrared light source, stroboscope.	► Remove or cover the light source. ► Perform a device restart using the display or Safety Designer or interrupt the voltage supply for at least two seconds.
F1	Current too high at an OSSD	The current is too high at an OSSD. The limit has been exceeded for current allowed short-term or permanently.	► Check the connected switching element.
F2	OSSD short-circuit to 24 V	There is a short-circuit to 24 V at an OSSD.	► Check wiring.
F3	OSSD short-circuit to 0 V	There is a short-circuit to 0 V at an OSSD.	► Check the wiring.
F4	Short-circuit between 2 OSSDs	There is a short-circuit between two OSSDs.	► Check the wiring.
F5	Short-circuit between OSSD and universal input or universal I/O	There is a short-circuit between an OSSD and a universal input or between an OSSD and a universal I/O.	► Check wiring.
F9	General OSSD error	At least one OSSD is showing unexpected behavior.	► Check the wiring of the OSSDs.
L2	Invalid configuration of the external device monitoring (EDM)	The configuration of the external device monitoring (EDM) is invalid. The configuration is unsuitable for the wiring.	► Check whether the external device monitoring is connected correctly. ► Use Safety Designer to check the configuration.
L3	Error in the external device monitoring (EDM)	A faulty signal is applied at the external device monitoring (EDM). The allowed tolerance time has been exceeded.	► Check whether the connectors are wired correctly and operating correctly.
L8	Error in the reset input	An invalid signal is applied at a reset input. The reset signal is applied for too long.	► Check the reset pushbutton, the wiring, and any other components affected.
L9	Short-circuit at the reset input	Exactly the same signal is applied at a reset input as at another input, an OSSD or an output. There is possibly a short-circuit.	► Check the wiring for cross-circuits.
N1	Invalid input signal	The signal applied at the control inputs is not assigned to a monitoring case. The signal is applied for longer than the set input delay +1 s.	► Check the configuration with Safety Designer. ► Check the working process of the machine.
N2	Incorrect switching sequence	The configured switching sequence was interrupted by the new monitoring case.	► Check the machine's work process. ► Change the configured switching sequence monitoring.
N3	Invalid input signal	The signal applied at the static control inputs does not match the complementary condition. The signal is applied for longer than 1 s.	► Check the control of the control inputs.
T1	Temperature error	The operating temperature of the safety laser scanner has exceeded or fallen below the permitted range.	► Check whether the safety laser scanner is being operated in accordance with the permissible ambient conditions.

Error type	Brief description	Cause	Troubleshooting
W1	Warnings exceed tolerance time	The combination of multiple warnings has resulted in an error. The tolerance time of 1 s has been exceeded as there are multiple warnings.	► Use Safety Designer to check what warnings exist.

11.4 Diagnostics using Safety Designer

Diagnostic tools

The following diagnostics tools are available in the device window:

- Data recorder
- Event history
- Message history
- Contamination measurement

Interfaces

The following interfaces are suitable for diagnostics:

- USB 2.0 mini-B (female connector) [7)]

11.4.1 Data recorder

Overview

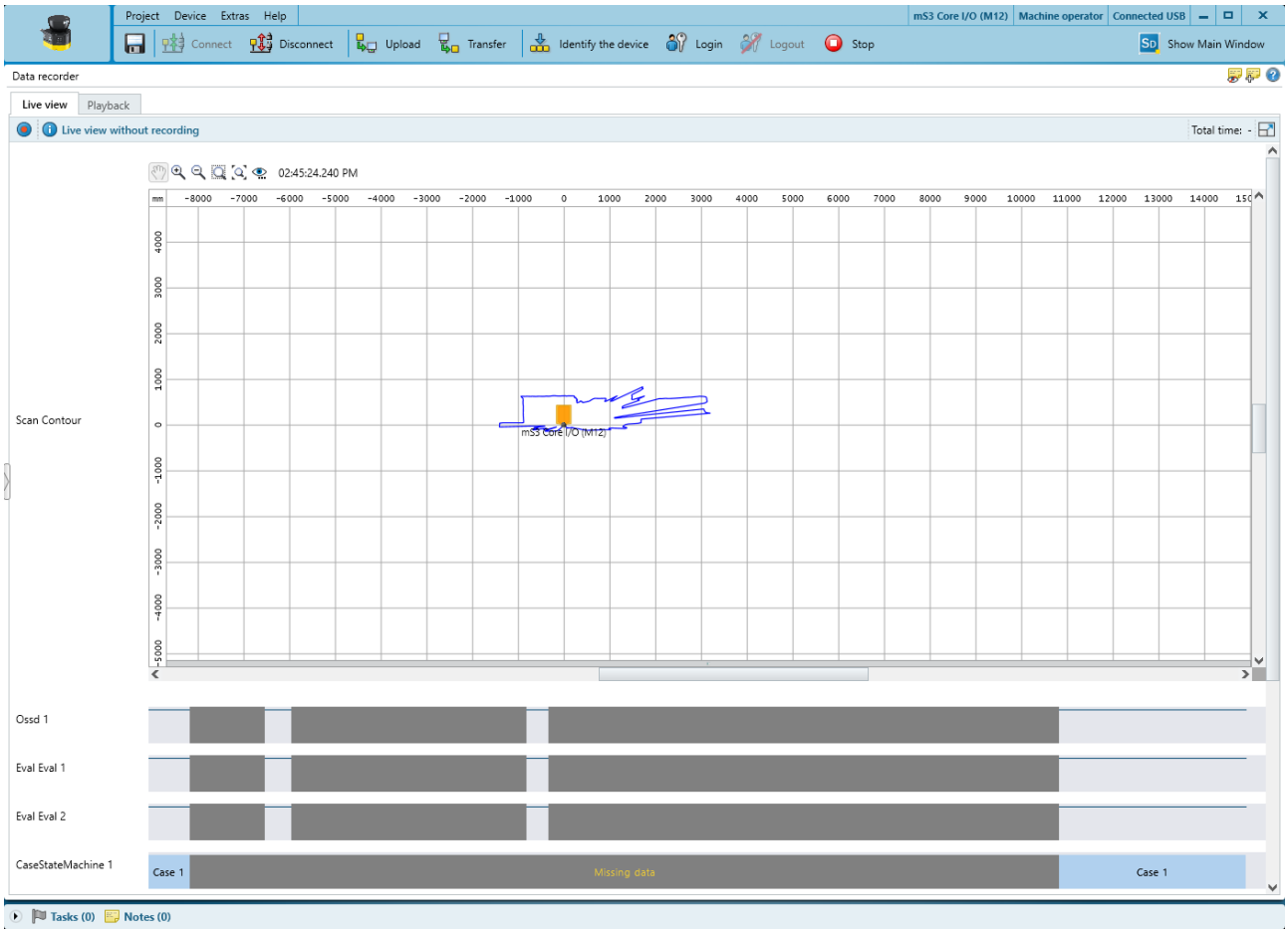


Figure 76: Data recorder

7) The USB connection may only be used temporarily and only for configuration and diagnostics.

You can use the data recorder to record the device's signals. Depending on the interface and the load on the interface, the measurement data may not be transmitted and shown for every scan cycle.

The data is saved in a data recorder diagnostics file.

You can play the data recorder diagnostic file in the data recorder.

You can adjust the settings in the Safety Designer main window.

Table 26: Data recorder

	Start recording
	Stop recording
	Selecting the displayed data and setting the display sequence
	Full screen mode

Typical applications

- Check spatial geometry
- Check where a person can stay or when a person is detected
- Check input information about the current monitoring case
- Check why safety outputs have switched

Prerequisites

- Existing connection between Safety Designer and device
- Configuration in the project and configuration in the device are synchronized

Procedure

1. Import configuration from the device.
2. Take an image.

Complementary information

Reflectors are displayed in turquoise if they are detected at a distance of more than approx. 0.5 m.

11.4.2 Event history

Overview

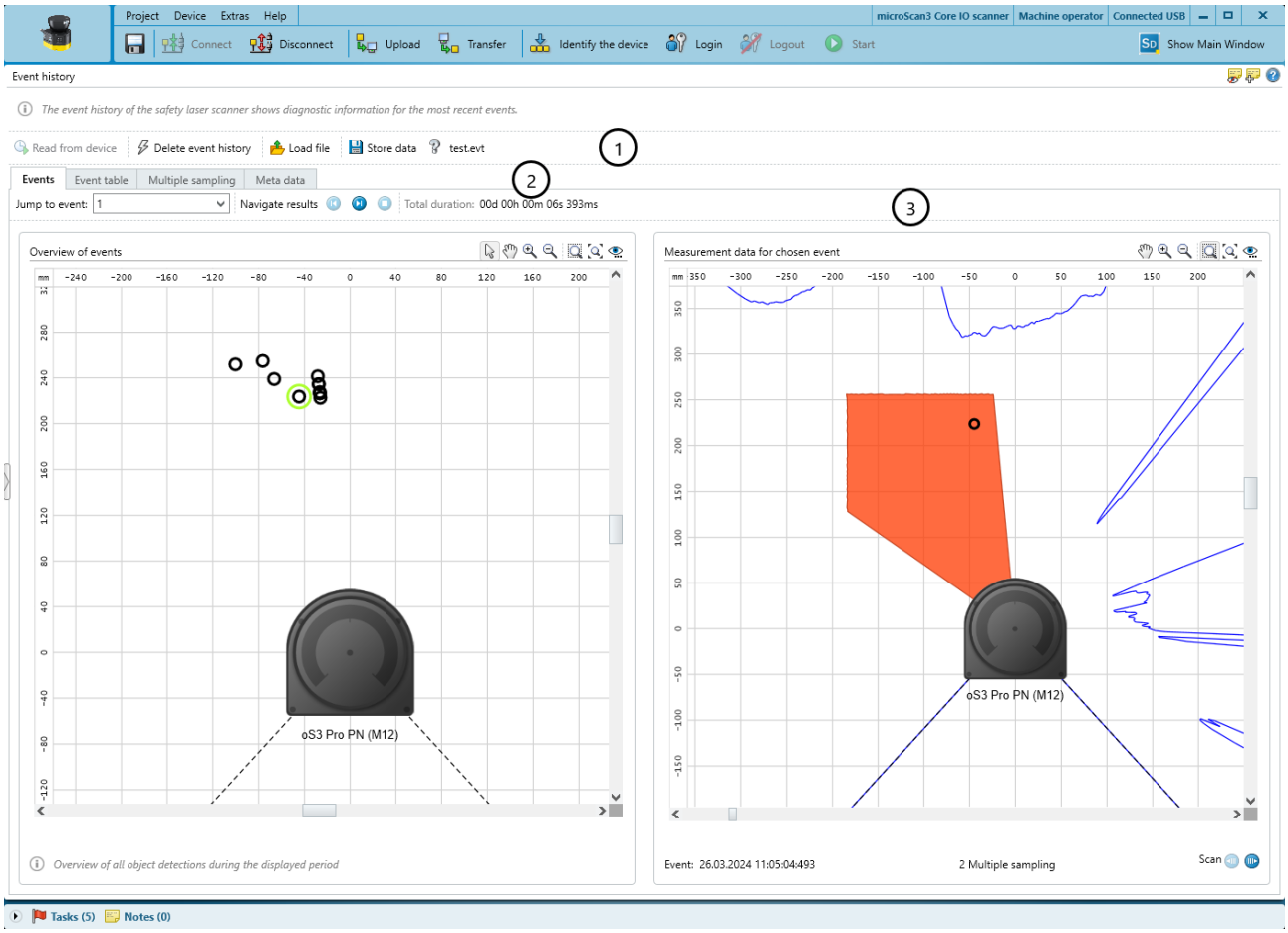


Figure 77: Event history

① Data source
② Available views
③ Navigation

The safety laser scanner stores data on important events. The event history displays information about the most recently stored events.

Event memory in the safety laser scanner

The safety laser scanner stores data on the following events:

- Safety output switches to the OFF state.
- An object is detected in a safety-related field.

For each object detection where a safety output switches to the OFF state, the safety laser scanner stores the data from 10 scans. When the internal memory of the safety laser scanner is full, the scan data of the oldest object detection is overwritten to store a new object detection. The position and time of the object detection are retained.

The internal memory of the safety laser scanner is cleared during a restart and when transferring a configuration.

Data source

- **Read from device**: Only available when a device is connected. The data stored in the device will be read.
- **Load file**: You can open a file that stores events that were previously read from a device.
- **Store data**: You can save the events read from a device to a file for later analysis.

Events

The **Events** view shows a graphical overview of the object detections in safety-related fields that have led to a safety output switching to the OFF state.

- Navigation: You can select the event whose measurement data is displayed in the right area.
- Overview of events: The position of each recorded object detection relative to the safety laser scanner is displayed. If you hold the mouse pointer on a position, the set multiple sampling is displayed. When you click on a position, the corresponding measurement data is displayed in the right-hand area.
- Measurement data for the selected event: The measurement data of the selected object detection is displayed. If multiple scans are stored for the selected object detection, you can view the individual scans one by one by clicking on the icons next to **Scan**.

Event table

The event table shows detailed information about the events which have led to a safety output switching to the OFF state.

Based on the measurement data, a probable cause is assigned to each event:

- **Object**: An object was probably detected in the protective field.
- **Contour**: A reference contour field or a contour identification field detects a deviation of the monitored contour.
- **Contamination**: The shutdown was triggered by a contamination of the optics cover in the area of the protective field. The displayed distance relates to an object that was detected despite the contamination. This value is not reliable due to the contamination.
- **Dazzle**: The shutdown was triggered by an external light source in the scan plane in the area of the protective field, e.g., sun, halogen light, infrared light source, stroboscope.
- **Close to field edge or particle in field**: Object detection in the protective field was probably triggered at the edge or by particles.

Multiple sampling

The **Multiple sampling** view shows how often object detections with different durations occurred. All object detections in safety-related fields are taken into account. Therefore, the number of entries in this view may deviate from the other views.

The duration is specified as the number of consecutive scans in which an object is detected in the field. For each duration, the diagram shows the corresponding number of object detections.

Meta data

The **Meta data** view shows additional information.

You can add to a comment. When you save the event history, the comment is saved as well.

11.4.3 Message history

Overview

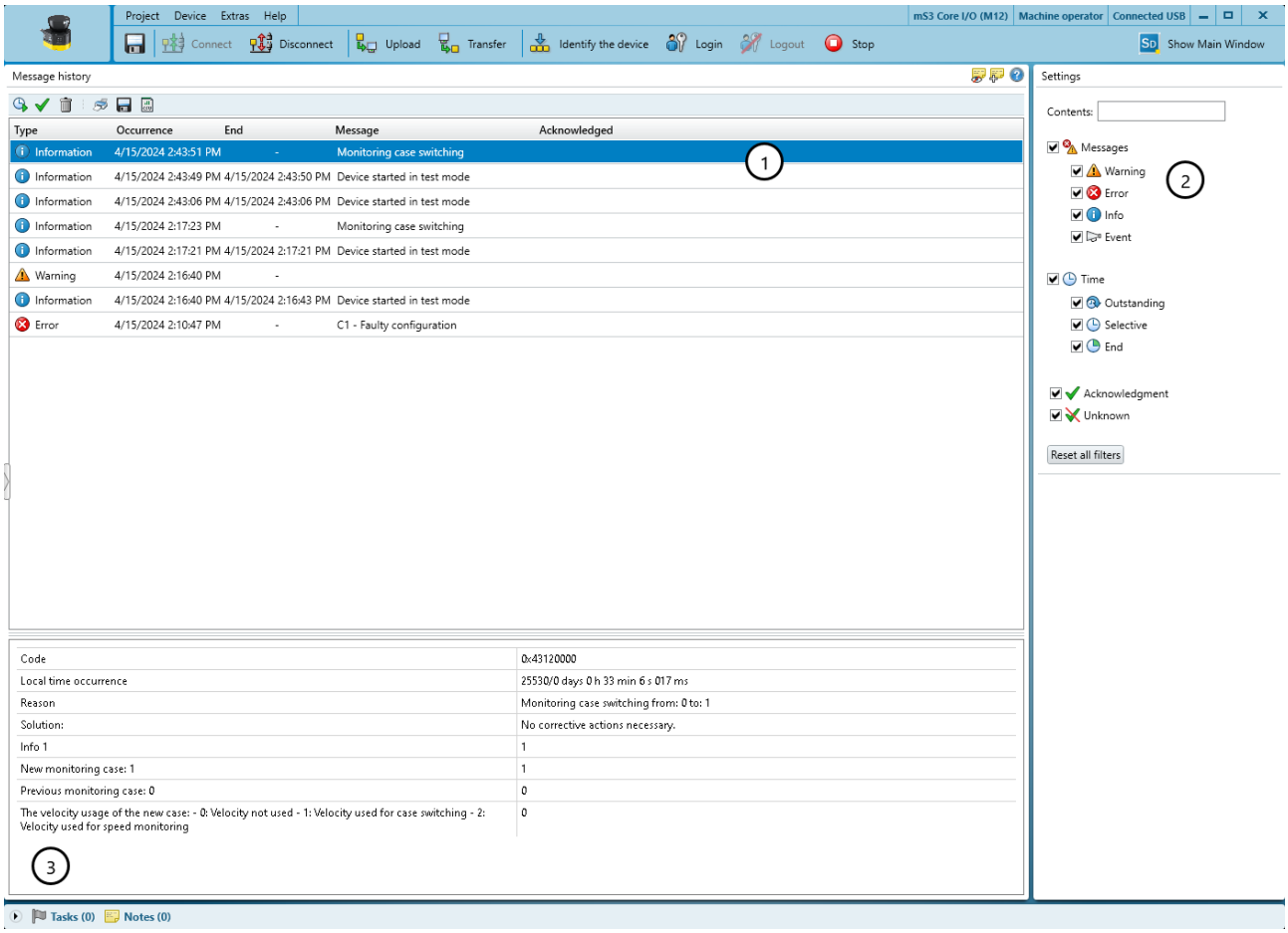


Figure 78: Message history

① Message history

② Display filter

③ Details about the selected message

Events such as errors, warnings and information are stored in the message history.

By right-clicking on the table header, you can select the columns displayed in the message history.

Safety Designer shows details about the events in the bottom part of the window, ways to solve them are also shown.

Table 27: Message history

	Start automatic update
	Stop automatic update
	Mark all entries as viewed
	Delete all entries Deleted entries are hidden for the current user group and for user groups with lower permissions. They are still visible to user groups with higher permissions.

	Print message history
	Save message history as a PDF
	Save message history as CSV

11.4.4 Contamination measurement

Safety Designer displays information on the measured contamination of the optics cover.

A contamination of 100% means that the safety laser scanner is reporting a contamination error and is switching all safety outputs to the OFF state.

12 Decommissioning

12.1 Disposal

Procedure

► Always dispose of unusable devices in accordance with national waste disposal regulations.



Complementary information

SICK will be glad to help you dispose of these devices on request.

13 Technical data

13.1 Variant overview

Ordering information: see "Ordering information", page 160.

Table 28: Devices and type codes

• **Performance package** • **Integration into the controller**	**Protective field range**	**Device without system plug**	**System plug**	**Device with system plug**
• Core • I/O	≤ 4.0 m	MICS3-AAAZ40AZ1	MICSX-ABIZZZZZ1	MICS3-AAAZ40AZ1P01
	≤ 5.5 m	MICS3-AAAZ55AZ1		MICS3-AAAZ55AZ1P01
	≤ 9.0 m	MICS3-AAAZ90AZ1		MICS3-AAAZ90AZ1P01
• Core, PS • I/O	≤ 9.0 m	MICS3-AAAC90AZ1	MICSX-ABIZZZZZ1	MICS3-AAAC90AZ1P01

13.2 Version numbers and functional scope

Functional scope

Older devices might not support the full functional scope of the latest Safety Designer.

To identify the different levels of the functionality, we use a 3-digit version number. The version number is marked with the letter V on the device.

The functional scope of the device can be read at the following locations:

- Label on the device
- Display, entry in **Device info** menu at **Hardware**
- Safety Designer, **Overview** dialog (only with connected device)
- Safety Designer, report

Table 29: Functional scope of the microScan3 Core I/O (devices with a max. protective field range of 4.0 m and devices with max. protective field range of 5.5 m)

Version number	**Amendments and new functions**
V 1.0.0	• First released version
V 1.1.0	• Improved separation of the checksum from the Safety Designer version
V 1.2.0	• Option to adjust the settings for multiple sampling after switching between monitoring cases • New rights management using user group **Administrator** (now 4 user groups) • Additional third option for resetting to factory settings • Modified process for resetting the password • Deviating multiple sampling after object detection can be configured • Interfaces and selected functions can be activated or deactivated • New **Always ON (NON-safe)** function in monitoring case tables

Table 30: Functional scope of the microScan3 Core I/O (devices with a max. protective field range of 9.0 m)

Version number	**Amendments and new functions**
V 1.0.0	• First published version (including improved separation of the checksum from the Safety Designer version)

Version number	Amendments and new functions
V 1.1.0	• Option to adjust the settings for multiple sampling after switching between monitoring cases • New rights management using user group **Administrator** (now 4 user groups) • Additional third option for resetting to factory settings • Modified process for resetting the password • Deviating multiple sampling after object detection can be configured • Interfaces and selected functions can be activated or deactivated • New **Always ON (NON-safe)** function in monitoring case tables

Revision

The different revision statuses of the devices are identified by “Rev” followed by a three-digit version number. New devices have a label which indicates the revision status.

Table 31: Revision

Version number	Amendments and new functions
Rev 1.0.0	• First released version
Rev 1.1.0	• Internal change to components, no change in function
Rev 1.2.0	• Internal change to components, no change in function
Rev 1.3.0	• Adaptation of detection behavior for optimized safety and availability
Rev 1.4.0	• Improved compatibility with old system plugs
Rev 1.4.1	• Improved measurement accuracy
Rev 1.5.0	• Internal change to components, no change in function
Rev 1.6.0	• Internal change to components, no change in function
Rev 1.7.0	• Improved measurement accuracy

In some cases, new system plugs are not suitable for older devices.

New system plugs have a label which indicates the devices for which they are suitable.

Table 32: Compatibility

Label on the device	Label on the system plug	Compatible
–	–	Yes
–	Only compatible with Rev ≥ 1.1.0	Information is available from your SICK subsidiary.
Rev 1.1.0 (or higher)	–	Yes
Rev 1.1.0 (or higher)	Only compatible with Rev ≥ 1.1.0	Yes

13.3 Data sheet

13.3.1 microScan3 Core I/O

Features

Table 33: Features

	microScan3 Core I/O
Protective field range	
Devices with a max. protective field range of 4.0 m	≤ 4.0 m, details: see "Sensing range", page 150

	microScan3 Core I/O
Devices with a max. protective field range of 5.5 m	≤ 5.5 m, details: see "Sensing range", page 150
Devices with a max. protective field range of 9.0 m	≤ 9.0 m, details: see "Sensing range", page 150
Scanning range of the reference contour field	Same as protective field range, see "Sensing range", page 150
Scanning range of the contour detection field	Same as protective field range, see "Sensing range", page 150
Warning field range	
Devices with a max. protective field range of 4.0 m	≤ 40 m
Devices with a max. protective field range of 5.5 m	≤ 40 m
Devices with a max. protective field range of 9.0 m	≤ 64 m
Fields	≤ 8
Simultaneously monitored fields	≤ 4
Field sets	≤ 8
Monitoring cases	≤ 2
Scanning angle	275° (–47.5° ... 227.5°)
Protective field resolution	30 mm, 40 mm, 50 mm, 60 mm, 70 mm, 150 mm, 200 mm [1)]
Response time	
Devices with a max. protective field range of 4.0 m	≥ 70 ms, details: see "Response times", page 148
Devices with a max. protective field range of 5.5 m	≥ 70 ms, details: see "Response times", page 148
Devices with a max. protective field range of 9.0 m	≥ 90 ms, details: see "Response times", page 148
Scan cycle time	
Devices with a max. protective field range of 4.0 m	30 ms or 40 ms (adjustable)
Devices with a max. protective field range of 5.5 m	30 ms or 40 ms (adjustable)
Devices with a max. protective field range of 9.0 m	40 ms or 50 ms (adjustable)
Generally necessary protective field supplement (TZ = tolerance zone of the safety laser scanner)	
Devices with a max. protective field range of 4.0 m	65 mm
Devices with a max. protective field range of 5.5 m	65 mm
Devices with a max. protective field range of 9.0 m	100 mm
Additional supplement Z_R for reflection-based measurement errors	350 mm

	microScan3 Core I/O
Distance of mirror rotational axis (zero point of x and y axis) to mounting surface on rear side of device	56 mm
Distance between center point of scan plane and top edge of the housing	40,1 mm
Multiple sampling	2 ... 16

1) Protective field resolution 60 mm only available for devices with max. protective field range of 9.0 m.

Safety technology parameters

Table 34: Safety-related parameters

	microScan3 Core I/O
Type (IEC 61496)	Type 3
Safety integrity level (IEC 61508)	SIL 2
Safety integrity level (IEC 62061)	SIL 2
Category (ISO 13849)	Category 3
Performance level (ISO 13849)	PL d
PFH (average frequency of a dangerous failure)	$8 \times 10^{-8}\ h^{-1}$
T_M (mission time) (ISO 13849)	20 years
Safe status when an error occurs	At least one OSSD is in the OFF state.

Interfaces

Table 35: Interfaces

	microScan3 Core I/O
OSSD pairs	1
Automated restart of OSSDs after	2 s ... 60 s (configurable)
Voltage supply	
Connection type	Male connector, M12, 8 pin, A-coding (collective male connector for voltage supply and inputs and outputs)
Length of cable (power supply unit tolerance ± 5%)	
Length of cable with 0.25 mm^2 conductor cross section	≤ 35 m
Local inputs and outputs	
Connection type	Male connector, M12, 8 pin, A-coding (collective male connector for voltage supply and inputs and outputs)
Length of cable with wire cross-section 0.25 mm^2	≤ 35 m
USB	
Connection type	USB 2.0 mini-B (female connector)
Transmission rate	≤ 12 Mbit/s

	microScan3 Core I/O
Length of cable	≤ 5 m

Electrical data

Table 36: Electrical data

	microScan3 Core I/O
Operating data	
Protection class	III (IEC 61140)
Supply voltage V_S	24 V DC (16.8 V ... 30 V DC) (SELV/PELV) [1]
Residual ripple	±5% [2]
Start-up current at 24 V	≤ 3 A
Current consumption at 24 V	
No output load	Typ. 0.3 A
With maximum output load	Typ. 1.4 A
In sleep mode, no output load	Typ. 0.27 A
Power consumption	
No output load	Typ. 7 W
With maximum output load	Typ. 34 W
In sleep mode, no output load	Typ. 6.5 W
Power-up delay	≤ 12 s
Safety outputs (OSSD)	
Type of output	2 PNP semiconductors for each OSSD pair, short-circuit protected, cross-circuit monitored
Output voltage for ON state (HIGH)	(U_V –2.7 V) ... U_V
Output voltage for OFF state (LOW)	0 V ... 2 V
Output current for ON state (HIGH)	≤ 250 mA per OSSD
Leakage current [3]	≤ 250 µA
Load inductance	≤ 2.2 H
Load capacity	≤ 2.2 µF in series with 50 Ω
Permissible resistivity between load and device	≤ 2.5 Ω
Test pulse width	≤ 300 µs (typ. 230 µs)
Test pulse interval	
Scan cycle time 30 ms	240 ms ... 264 ms (typ. 240 ms)
Scan cycle time 40 ms	320 ms ... 344 ms (typ. 320 ms)
Scan cycle time 50 ms	400 ms
Duration of OFF state	≥ 80 ms
Discrepancy time (time offset between switching OSSDs of an OSSD pair)	≤ 1 ms (typ. 25 µs)
Universal output, universal I/O (configured as output)	
Output voltage HIGH	(U_V –3.7 V) ... U_V

	microScan3 Core I/O
Output voltage LOW	0 V ... 2 V
Output current HIGH	≤ 200 mA
Leakage current	≤ 0.5 mA
Switch-on delay time	40 ms
Switch off delay	40 ms
Static control input, universal input, universal I/O (configured as input)	
Input voltage HIGH	24 V (13 V ... 30 V)
Input voltage LOW	0 V (–30 V ... 5 V)
Input current HIGH	3 mA ... 6 mA
Input current LOW	0 mA ... 2 mA
Input resistance at HIGH	Typ. 5 kΩ
Input capacitance	10 nF
Input frequency (max. switching sequence when used as control input)	≤ 20 Hz
Sampling time	4 ms
Response time at EDM after switching on OSSDs (when used as EDM input)	300 ms
Actuating duration of control switch for reset (when used as reset input)	60 ms ... 30 s
Actuating duration of switch for sleep mode (when used as sleep mode input)	≥ 120 ms

1) The supply voltage must be within the specified range at all times. It must not fall below the lower limit, even for a brief period.
The power supply unit must be able to bridge a brief power failure of 20 ms as specified in IEC 60204-1. Suitable power supply units are available as accessories from SICK.
2) The voltage level must not fall below the specified minimum voltage.
3) In the event of an error (interruption of the 0 V cable), the specified leak current at most flows in the OSSD cable. The downstream control element must detect this state as the OFF state.

Mechanical data

Table 37: Mechanical data

	microScan3 Core I/O
Dimensions (W × H × D)	112 mm × 135.1 mm × 111.1 mm
Weight (including system plug)	1.15 kg
Housing material	Aluminum
Housing color	RAL 9005 (black) and RAL 1021 (colza yellow)
Optics cover material	Polycarbonate
Optics cover surface	Outside has a scratch-resistant coating

Ambient data

Table 38: Ambient data

	microScan3 Core I/O
Enclosure rating [1]	IP65 (IEC 60529)
Ambient light immunity	≤ 40 klx [2]

	microScan3 Core I/O
Ambient operating temperature	–10 °C ... 50 °C
Storage temperature	–25 °C ... 70 °C
Air humidity	≤ 95%, non-condensing [3]
Height above sea level during operation	≤ 2300 m
Vibration resistance [4]	
Standards	• IEC 60068-2-6 • IEC 60068-2-64 • IEC 60721-3-5 • IEC TR 60721-4-3 • IEC 61496-1 • IEC 61496-3
Class	• 5M1 (IEC 60721-3-5) • 3M4 (IEC TR 60721-4-3)
Sinusoidal vibrations	• 50 m/s^2, 0.35 mm, 10 Hz ... 150 Hz • 5 m/s^2, 1.5 mm, 5 Hz ... 200 Hz • 10 m/s^2, 3.5 mm, 5 Hz ... 150 Hz
Noise vibrations	• 0.5 m^2/s^3, 5 Hz ... 200 Hz • 0.1 m^2/s^3, 200 Hz ... 500 Hz
Shock resistance [4]	
Standards	• IEC 60068-2-27 • IEC 60721-3-5 • IEC TR 60721-4-3 • IEC 61496-1 • IEC 61496-3
Class	• 5M1 (IEC 60721-3-5) • 3M4 (IEC TR 60721-4-3)
Single shock	50 m/s^2, 11 ms
Continuous shock	• 100 m/s^2, 16 ms • 150 m/s^2, 6 ms
EMC	In accordance with IEC 61496-1, IEC 61000-6-2, and IEC 61000-6-4

1) The specified enclosure rating is only valid if the safety laser scanner is closed, the system plug is mounted, and all of the M12 plug connectors of the safety laser scanner have been closed using a cable plug connector or using a protective cap.
2) For ambient light sources directly in the scan plane in accordance with IEC 61496-3: ≤ 3 klx.
3) IEC 61496-1, no. 4.3.1 and no. 5.4.2, IEC 61496-3, no. 4.3.1 and no. 5.4.2. Condensation has an influence on normal operation.
4) In direct mounting.

Miscellaneous data

Table 39: Miscellaneous data

	microScan3 Core I/O
Wavelength	845 nm
Detectable remission	1.8% ... several 1000%
Maximum uniform contamination of the optics cover without reducing the detection capability [1]	30%

	microScan3 Core I/O
Area where detection capability is restricted	≤ 50 mm [2]
Receiving angle	0.75°
Pulse duration	Typ. 4 ns
Average output power	9.2 mW
Laser class	1 [3]

1) In the event of heavy contamination, the safety laser scanner displays a contamination error and switches all safety outputs to the OFF state. This status is displayed in Safety Designer as 100% contamination.
2) In close proximity (50 mm-wide area in front of the optics cover), the detection capability of the safety laser scanner may be restricted. If required, this area must be secured using an undercut or frame, for example.
3) This laser product has laser class 1 according to IEC 60825-1:2014. In some cases, evaluation is required according to the older IEC 60825-1:2007 standard, e.g. by employers in the EU according to Directive 2006/25 / EC. According to the older IEC 60825-1:2007 standard, laser class 1M must be used as the basis.

13.4 Response times

The protective device's response time is the maximum time between the occurrence of the event leading to the sensor's response and supply of the switch-off signal to the protective device's interface (for example OFF state of the OSSD pair).

DANGER
Hazard due to lack of effectiveness of the protective device
In the case of non-compliance, it is possible that the dangerous state of the machine may not be stopped or not stopped in a timely manner.
In addition to the protective device's response time, further signal transmission and processing also influence the time up until the end of the dangerous state. This includes a control's processing time and the response times of downstream contactors, for example.

► Take the time for further signal transmission and processing into account.

Response time

The safety laser scanner's response time depends on the following parameters:

- Scan cycle time
- Set interference protection
- Set multiple sampling

You can calculate the response time using the following formula:

$t_R = (t_S + t_I) \times n + t_O$

The following rules apply:

- t_R = response time
- t_S = scan cycle time
  - Setting "30 ms": t_S = 30 ms
  - Setting "40 ms": t_S = 40 ms
  - Setting "50 ms": t_S = 50 ms
- t_I = time for interference protection
  - Mode 1 (default): t_I = 0 ms
  - Mode 2: t_I = 1 ms
  - Mode 3: t_I = 2 ms
  - Mode 4: t_I = 3 ms

- n = set multiple sampling
  Preset to n = 2.
  Multiple sampling can be changed for the safety laser scanner or for each individual field (2 ≤ n ≤ 16).
- t_0 = time for processing and output
  Dependent on output used:
  - OSSD pair 1: t_0 = 10 ms

Table 40: Response time of an individual safety laser scanner

Scan cycle time (t_S)	Interference protection (t_I)		Output (t_O)	t_R = response time for multiple sampling n
30 ms	Mode 1	0 ms	OSSD pair 1	n × 30 ms + 10 ms
	Mode 2	1 ms	OSSD pair 1	n × 31 ms + 10 ms
	Mode 3	2 ms	OSSD pair 1	n × 32 ms + 10 ms
	Mode 4	3 ms	OSSD pair 1	n × 33 ms + 10 ms
40 ms	Mode 1	0 ms	OSSD pair 1	n × 40 ms + 10 ms
	Mode 2	1 ms	OSSD pair 1	n × 41 ms + 10 ms
	Mode 3	2 ms	OSSD pair 1	n × 42 ms + 10 ms
	Mode 4	3 ms	OSSD pair 1	n × 43 ms + 10 ms
50 ms	Mode 1	0 ms	OSSD pair 1	n × 50 ms + 10 ms

13.5 Course of the OSSD test over time

The safety laser scanner tests the OSSDs at regular intervals. To do this, the safety laser scanner switches each active OSSD briefly (for max. 300 µs) to the OFF state and checks whether this channel is voltage-free during this time.

Make sure that the machine's control does not react to these test pulses and the machine does not switch off.

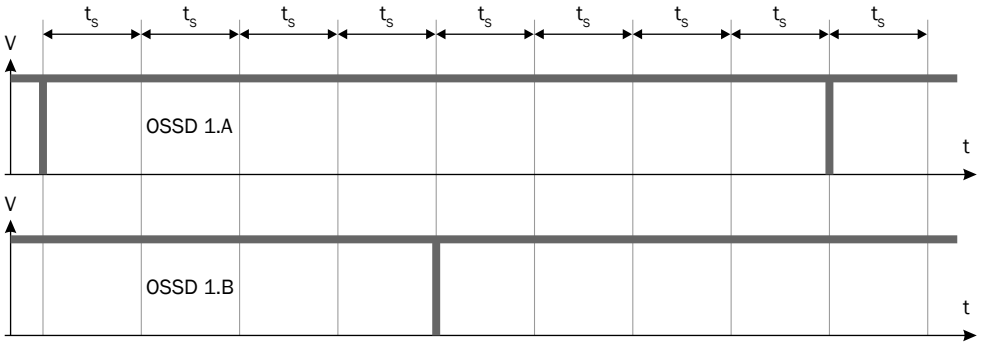


Figure 79: Switch-off tests

t_S Scan cycle time

- Setting "30 ms": t_S = 30 ms
- Setting "40 ms": t_S = 40 ms
- Setting "50 ms": t_S = 50 ms

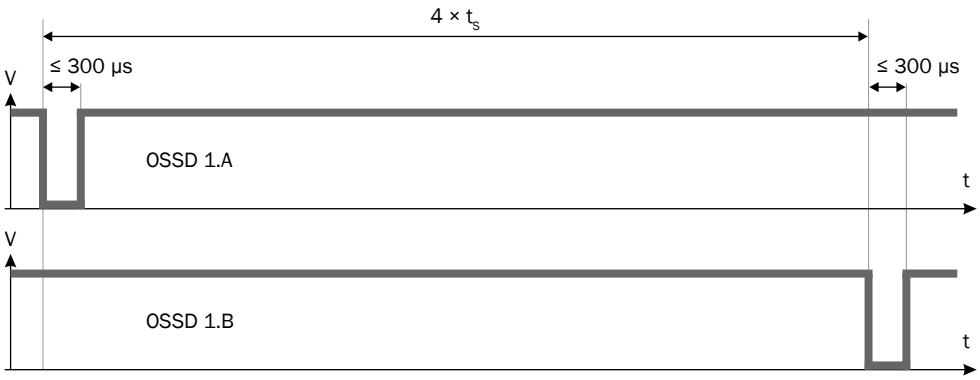


Figure 80: Duration and time offset for the switch-off tests in an OSSD pair

t_S Scan cycle time

- Setting “30 ms”: t_S = 30 ms
- Setting “40 ms”: t_S = 40 ms
- Setting “50 ms”: t_S = 50 ms

13.6 Sensing range

Protective field range

The effective protective field range depends on the variant, on the set scan cycle time and on the set object resolution.

Table 41: Protective field range (devices with a max. protective field range of 4.0 m)

Resolution	Scan cycle time 40 ms	Scan cycle time 30 ms
≥ 70 mm	4.00 m	4.00 m
50 mm	3.50 m	3.00 m
40 mm	3.00 m	2.30 m
30 mm	2.30 m	1.70 m

Table 42: Protective field range (devices with a max. protective field range of 5.5 m)

Resolution	Scan cycle time 40 ms	Scan cycle time 30 ms
≥ 70 mm	5.50 m	4.00 m
50 mm	3.50 m	3.00 m
40 mm	3.00 m	2.30 m
30 mm	2.30 m	1.70 m

Table 43: Protective field range (devices with a max. protective field range of 9.0 m)

Resolution	50 ms scan cycle time	40 ms scan cycle time
≥ 150 mm	9.00 m	9.00 m
70 mm	9.00 m	7.00 m
60 mm	8.00 m	6.00 m
50 mm	7.00 m	5.00 m
40 mm	5.00 m	4.00 m
30 mm	4.50 m	3.00 m

Scanning range of the reference contour field

The effective scanning range of the reference contour field is the same as the protective field range.

Scanning range of the contour detection field

The effective scanning range of the contour detection field is the same as the protective field range.

Range for warning fields

For non-safety applications (warning fields), the safety laser scanner has a larger scanning range than the maximum protective field range. The requirements for size and remission factor of objects to be detected are illustrated in the following graphs as a function of the desired scanning range.

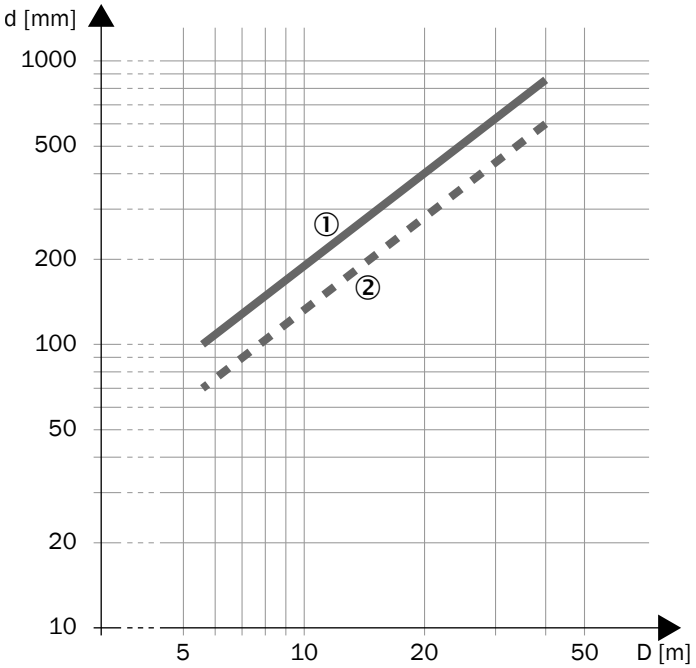


Figure 81: Scanning range and object size for warning fields (devices with a max. protective field range of 4.0 m and devices with max. protective field range of 5.5 m)

d Required minimum size of the object in mm
D Range in m
① Scan cycle time = 30 ms
② Scan cycle time = 40 ms

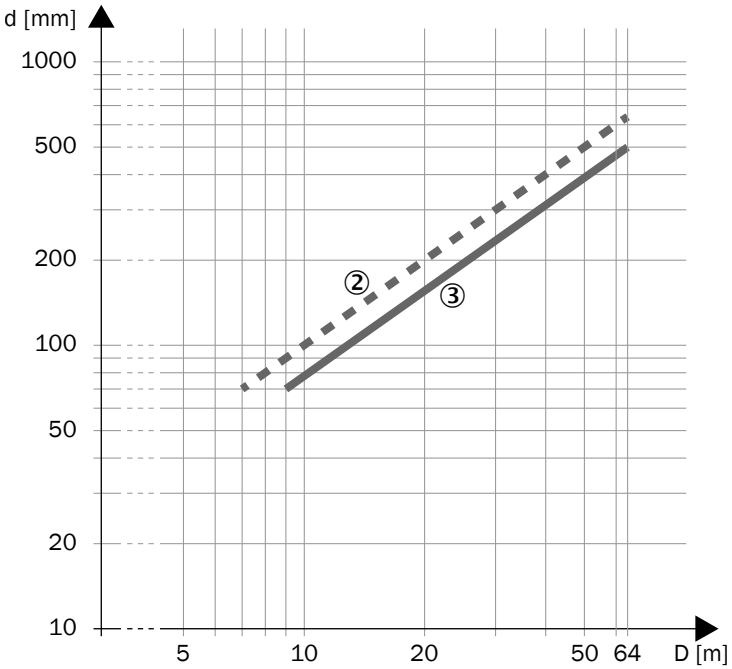


Figure 82: Scanning range and object size for warning fields (devices with a max. protective field range of 9.0 m)

d Required minimum size of the object in mm
D Scanning range in m
② Scan cycle time = 40 ms
③ Scan cycle time = 50 ms

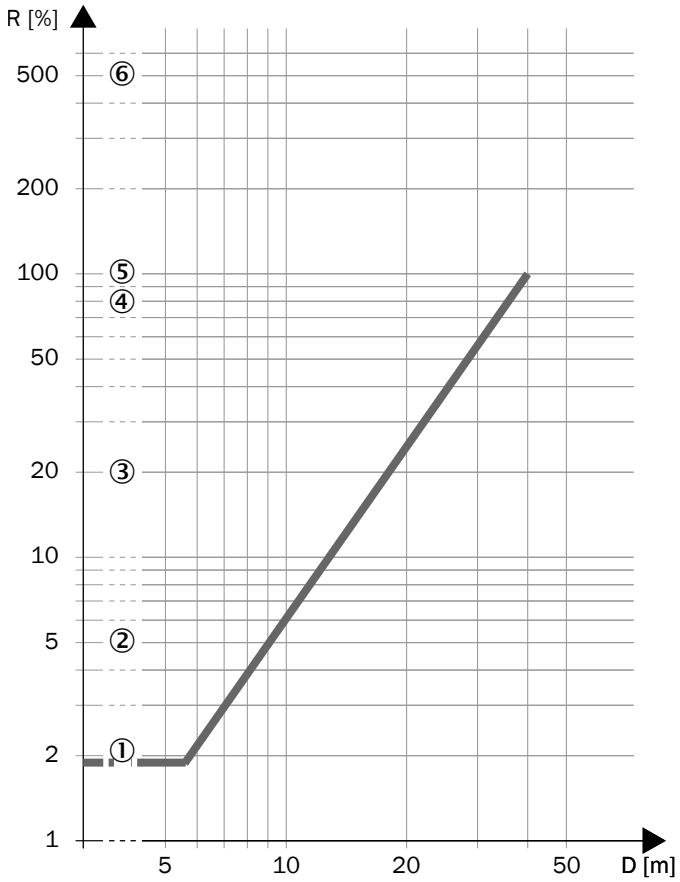


Figure 83: Scanning range and required remission for warning fields (devices with a max. protective field range of 4.0 m and devices with max. protective field range of 5.5 m)

R Required minimum remission in %
D Range in m
① Black shoe leather
② Matt black paint
③ Gray cardboard
④ Writing paper
⑤ White plaster
⑥ Reflectors > 2,000%, reflective tapes > 300% [8)]

8) The measured values are less accurate for reflectors or reflective surfaces because the distance measurement is designed for lower remission values.

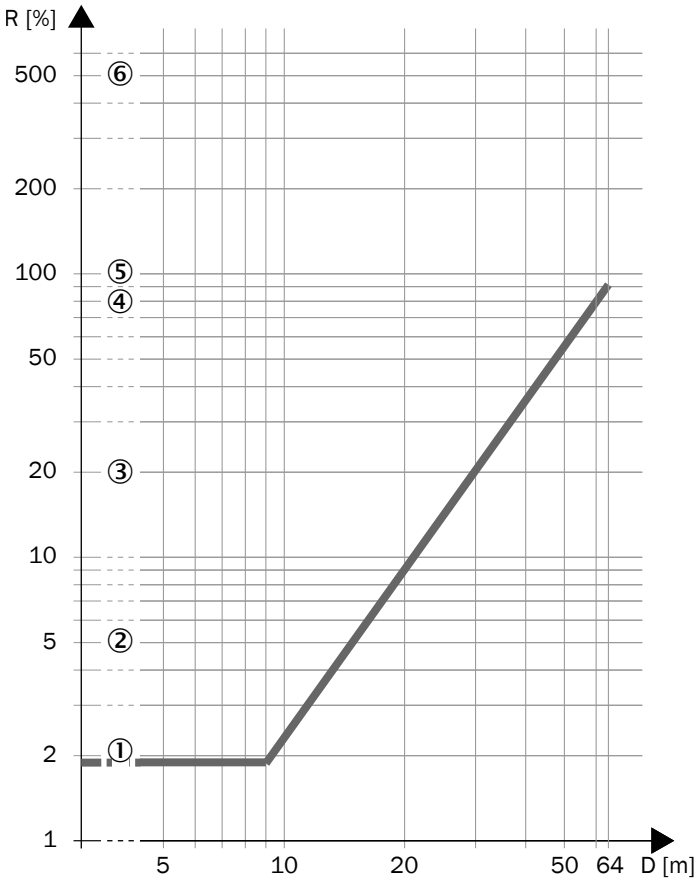


Figure 84: Scanning range and required remission for warning fields (devices with a max. protective field range of 9.0 m)

R Required minimum remission in %
D Scanning range in m
① Black shoe leather
② Matt black paint
③ Gray cardboard
④ Writing paper
⑤ White plaster
⑥ Reflectors > 2,000%, reflective tapes > 300% [9)]

13.7 Scan plane

Overview

In practice, the scan plane is slightly conical and tilted.

For the devices with the name suffix “PS”, the tolerances are smaller than for devices without the name suffix.

9) The measured values are less accurate for reflectors or reflective surfaces because the distance measurement is designed for lower remission values.

Scan plane

Table 44: Scan plane

	microScan3		microScan3 PS	
	Maximum protective field range 4.0 m or 5.5 m	**Maximum protective field range 9.0 m**	**Maximum protective field range 4.0 m or 5.5 m**	**Maximum protective field range 9.0 m**
Conical error [1) 2)]	• ≤ ± 100 mm at a distance of 5.5 m • ≤ ± 364 mm at a distance of 20 m	• ≤ ± 100 mm at a distance of 9 m • ≤ ± 222 mm at a distance of 20 m	• ≤ ± 17 mm at a distance of 5.5 m • ≤ ± 62 mm at a distance of 20 m	• ≤ ± 27 mm at a distance of 9 m • ≤ ± 62 mm at a distance of 20 m
Tilt error [1) 3)]	• ≤ 3° • ≤ ± 288 mm at a distance of 5.5 m • ≤ ± 1048 mm at a distance of 20 m	• ≤ 3° • ≤ ± 472 mm at a distance of 9 m • ≤ ± 1048 mm at a distance of 20 m	• ≤ 0.401° • ≤ ± 39 mm at a distance of 5.5 m • ≤ ± 140 mm at a distance of 20 m	• ≤ 0.401° • ≤ ± 63 mm at a distance of 9 m • ≤ ± 140 mm at a distance of 20 m
Deviation from the ideal scan plane taking into account the conical error and the tilt error [1)]	• ≤ ± 388 mm at a distance of 5.5 m • ≤ ± 1,412 mm at a distance of 20 m	• ≤ ± 572 mm at a distance of 9 m • ≤ ± 1,270 mm at a distance of 20 m	• ≤ ± 39 mm at a distance of 5.5 m • ≤ ± 140 mm at a distance of 20 m	• ≤ ± 63 mm at a distance of 9 m • ≤ ± 140 mm at a distance of 20 m

1) The specified values are valid at an ambient temperature of 20 °C. Deviations can occur at other temperatures.
2) The conical error was described in earlier operating instructions as the deviation from the ideal scan field flatness, or a similar description.
3) The values for tilt error apply for the M5 threaded holes on the sides.
Additional deviations can arise, for example, due to brackets.

Complementary information

The scan plane details are relative to the midpoint of the light spot. Depending on the specific application, it may also be necessary to consider the light spot size.

Further topics

- "Dimensional drawings", page 157
- "Light spot size", page 155

13.8 Light spot size

Overview

The light spot has an elongated shape. The orientation of the light spot varies with the angle at which the light beam exists the device.

The light spot has at its edges a transition area in which significantly less light hits the object than in the central area. In the following, the light spot size is specified as the area of the light spot that triggers a detection under normal conditions.

Light spot size

Table 45: Light spot size [1)]

	Devices with a max. protective field range of 4.0 m Devices with max. protective field range 5.5 m	**Devices with a max. protective field range of 9.0 m**
At a distance of 4.0 m	5.5 mm × 13.8 mm	9.8 mm × 13.1 mm
At a distance of 5.5 m	5.1 mm × 18.4 mm	8.0 mm × 18.2 mm
At a distance of 9.0 m	12.3 mm × 31.3 mm	6.1 mm × 30.1 mm
At a distance of 10.0 m	14.5 mm × 34.6 mm	6.3 mm × 33.6 mm
At a distance of 15.0 m	24.6 mm × 52.8 mm	10.0 mm × 51.4 mm

	Devices with a max. protective field range of 4.0 m Devices with max. protective field range 5.5 m	Devices with a max. protective field range of 9.0 m
At a distance of 20.0 m	37.1 mm × 75.5 mm	15.8 mm × 71.9 mm

1) Effective light spot size (W × H) when the light beam exits the device at a 90° forward angle.

13.9 Measurement data details

Table 46: Measurement data

	Devices with a max. protective field range of 4.0 m Devices with max. protective field range 5.5 m	Devices with a max. protective field range of 9.0 m
Data output channels	Not available	
Distance measurement range [1]		
For remission factor = 10%	≤ 12 m	≤ 22 m
For remission factor = 100%	≤ 40 m	≤ 64 m
Scan rate		
Scan cycle time 30 ms	33 Hz	–
Scan cycle time 40 ms	25 Hz	25 Hz
Scan cycle time 50 ms	–	20 Hz
Angular resolution (physical) [2]		
Scan cycle time 30 ms	< 0.01°	–
Scan cycle time 40 ms	< 0.01°	< 0.01°
Scan cycle time 50 ms	–	< 0.01°
Angular resolution (safeHDDM®) [2]		
Scan cycle time 30 ms	0.51° (537 safeHDDM® measured values)	–
Scan cycle time 40 ms	0.39° (715 safeHDDM® measured values)	0.125° (2,201 safeHDDM® measured values)
Scan cycle time 50 ms	–	0.1° (2,751 safeHDDM® measured values)
Measurement uncertainty [3]		
Systematic error	± 10 mm	
Total measurement error (statistical and systematic)		
At 1 σ	± 13 mm	± 18 mm
At 2 σ	± 16 mm	± 26 mm
At 3 σ	± 19 mm	± 34 mm
At 4 σ	± 22 mm	± 42 mm
At 5 σ	± 25 mm	± 50 mm

1) Warm-up time ≥ 30 min. Light spot fully on the target object.
2) safeHDDM® filters the physical measured values and provides very precise and reproducible measured values. Only safeHDDM® measured values are available via data output.
3) Typical values at 20 °C and remission factor - 1.8%, distance = protective field range.
The measured values are less accurate for reflectors or reflective surfaces because the distance measurement is designed for lower remission values.

13.10 Dimensional drawings

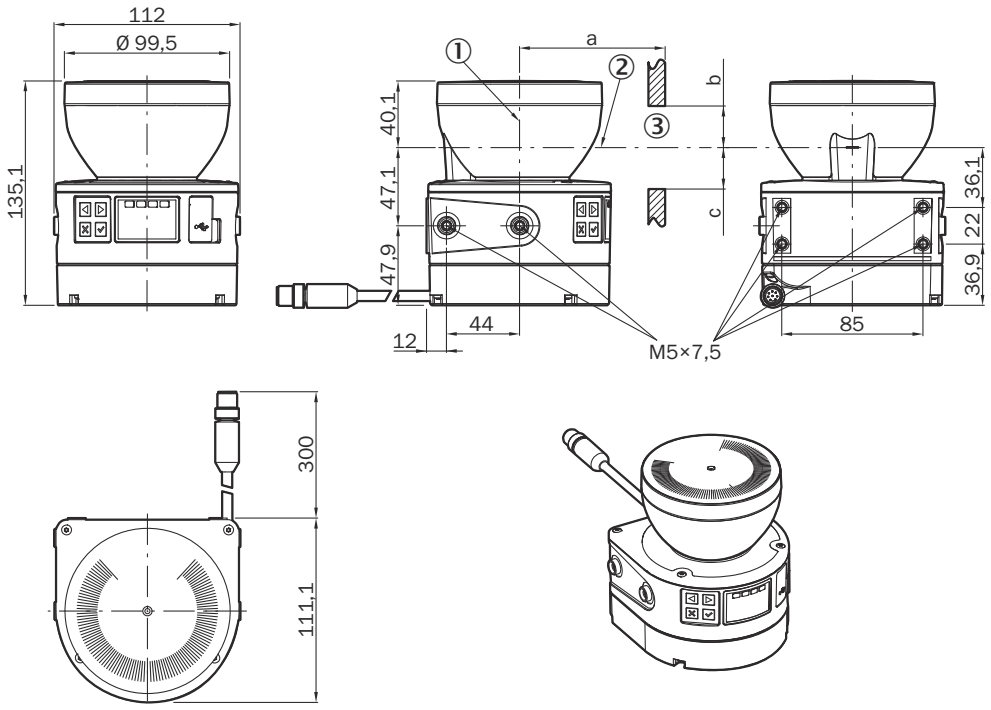


Figure 85: Dimensional drawing

All dimensions in mm.

① Mirror rotational axis

② Scan plane

③ Required viewing slit

- a: Length of the viewing slit
- b: Minimum height above the scan plane
- c: Minimum height below the scan plane

Required viewing slit

If the device is installed in paneling, for example, you must ensure that the laser beam can exit unhindered. The reflected laser beam must also reach the device unhindered. That means the viewing slit must be large enough.

The required minimum height and width of the viewing slit depends on the following parameters, among others:

- Conical error
- Alignment of the safety laser scanner (with compensation of the tilt error)
- Light spot size at the end of the viewing slit. The reflected light beam has a significantly larger light spot. This size must be taken into account.
- Vibrations that affect the scan plane or the geometry of the viewing slit

The following information applies at an ambient temperature of 20 °C. Deviations may occur at other temperatures.

Dimensioning of a viewing slit with length a ≤ 200 mm

- **microScan3**
  - b, c ≥ 25 mm
  - d ≥ 23 mm
- **microScan3 PS**
  Maximum protective field range 4.0 m or 5.5 m

- b, c ≥ 20 mm
- d ≥ 23 mm

Maximum protective field range 9.0 m

- b, c ≥ 18 mm
- d ≥ 23 mm

Dimensioning of a viewing slit with length a > 200 mm

- **microScan3**
  The individual tilt error of the safety laser scanner must be compensated for by suitable alignment during mounting. The cone error cannot be compensated and is taken into account in the formula.
  Maximum protective field range 4.0 m or 5.5 m
  - b, c ≥ 0.01956 × a + 19.1 mm, additional condition: b, c ≥ 25 mm
  - d ≥ 0.00166 × a + 18.2 mm, additional condition: d ≥ 23 mm

  Maximum protective field range 9.0 m
  - b, c ≥ 0.01404 × a + 19.0 mm, additional condition: b, c ≥ 25 mm
  - d ≥ 0.00344 × a + 17.8 mm, additional condition: d ≥ 23 mm
- **microScan3 PS**
  The inclination error and the cone error of the safety laser scanner are taken into account in the formula and do not need to be compensated.
  Maximum protective field range 4.0 m or 5.5 m
  - b, c ≥ 0.00834 × a + 19.5 mm, additional condition: b, c ≥ 20 mm
  - d ≥ 0.00166 × a + 18.2 mm, additional condition: d ≥ 23 mm

  Maximum protective field range 9.0 m
  - b, c ≥ 0.01064 × a + 17.8 mm, additional condition: b, c ≥ 18 mm
  - d ≥ 0.00334 × a + 17.8 mm, additional condition: d ≥ 23 mm

Where:

- a = length of the viewing slit from the mirror rotation axis
- b = minimum height above the scan plane
- c = minimum height below the scan plane
- d = minimum lateral distance between the protective field and the boundary of the viewing slit

14 Ordering information

14.1 Scope of delivery

- Safety laser scanner with system plug
- Safety note
- Mounting Instructions
- Operating instructions for download: www.sick.com

14.2 Ordering information

Table 47: Ordering information for safety laser scanner with system plug

Part	Integration in the control	Protective field range	Type code	Part number
microScan3 Core I/O	I/O	≤ 4.0 m	MICS3-AAAZ40AZ1P01	1075842
microScan3 Core I/O	I/O	≤ 5.5 m	MICS3-AAAZ55AZ1P01	1075843
microScan3 Core I/O	I/O	≤ 9.0 m	MICS3-AAAZ90AZ1P01	1089492
microScan3 Core I/O PS	I/O	≤ 9.0 m	MICS3-AAAC90AZ1P01	1138033

15 Spare parts

15.1 Safety laser scanner without system plug

Table 48: Safety laser scanner without system plug

Product for which the spare part is suitable			Safety laser scanner without system plug	
Part	**Part number**	**Protective field range**	**Type code**	**Part number**
microScan3 Core I/O	1075842	≤ 4.0 m	MICS3-AAAZ40AZ1	1067360
microScan3 Core I/O	1075843	≤ 5.5 m	MICS3-AAAZ55AZ1	1067875
microScan3 Core I/O	1089492	≤ 9.0 m	MICS3-AAAZ90AZ1	1089325
microScan3 Core I/O PS	1138033	≤ 9.0 m	MICS3-AAAC90AZ1	1138032

15.2 System plug

Table 49: System plug

Product for which the spare part is suitable			System plug	
Part	**Part number**	**Connection type**	**Type code**	**Part number**
microScan3 Core I/O	1067360, 1067875, 1075842, 1075843, 1089325, 1089492, 1138032, 1138033	Cable with plug connector	MICSX-ABIZZZZZ1	2073156

15.3 Additional spare parts

Table 50: Additional spare parts

Part	Part number
microScan3 optics cover with screws for use without the airWiper accessory	2073673
microScan3 optics cover with screws for use with the airWiper accessory	2145592

16 Accessories

16.1 Additional accessories

Suitable accessories are available at www.sick.com. Enter the product part number in the search field (part number: see the type label entry in the “Ident. no.” field or in the “P/N” field). All suitable accessories are listed on the Accessories tab of the product page.

17 Glossary

AGV	Automatic Guided Vehicle: driverless vehicle used for transport.
Conical error	In practice, the area scanned by a scan plane is not precisely flat but rather slightly conical. The conical error indicates how pronounced the conicity is, i.e. how strongly the scanned area deviates from the ideal plane. The conical error of a particular device is invariable. It can only be compensated for by measures during mounting.
Contour detection field	The contour detection field monitors a contour of the environment. The electro-sensitive protective device switches the associated safety outputs to the OFF state if a contour does not correspond to the set specifications, e.g. because a door or flap is open.
Control input	A control input receives signals, e.g. from the machine or from the control. Use of control inputs is how the protective device receives information about the conditions at the machine, e.g., if there is a change of operating mode. If the protective device is configured appropriately, it will activate a different monitoring case after receiving a new control input. The control input information must be transmitted reliably. Generally, at least 2 separate channels are used to do this. Depending on the device, a control input can be realized as a static control input or a dynamic control input.
Dangerous state	A dangerous state is a status of the machine or facility, where people may be injured. Protective devices prevent this risk if the machine is operated within its intended use. The figures in this document always show the dangerous state of the machine as movement of a machine part. In practice, there are different dangerous states, such as: • Machine movements • Electrical parts • Visible and invisible beam • A combination of multiple hazards
EDM	External device monitoring
Electro-sensitive protective device	An electro-sensitive protective device is a device or system of devices for safety-related detection of people or parts of the body. It is used to protect people from machines and facilities that pose a risk of injury. It triggers the machine or facility to adopt a safe state before a person is exposed to a hazardous situation. Examples: Safety light curtain, safety laser scanner.
ESPE	Electro-sensitive protective device
External device monitoring	The external device monitoring (EDM) monitors the status of downstream contactors. In order to use external device monitoring, positively guided contactors must be used to switch off the machine. If the auxiliary contacts of the positively guided contactors are connected to the external device monitoring, the external device monitoring checks whether the contactors switch correctly when the OSSDs are switched off.
Field set	A field set consists of one or more fields. The fields in a field set are monitored simultaneously. A field set can contain different field types, e.g., a protective field and a warning field.

Hazardous area	Hazardous area is any space within and/or around machinery in which a person can be exposed to a hazard. (ISO 12100)
Light spot	The light spot is the projection of the light beam on a plane perpendicular to the light beam. The light beam size depends on the distance between the light source and the surface on which the light beam strikes.
Localization	Position determination or localization is the determination of the position of an object. For vehicles, localization is a prerequisite for navigation.
Monitoring case	A monitoring case indicates the machine status to the sensor. Generally, one field set is assigned to each monitoring case. The sensor receives a defined signal for the current machine status. When a signal change occurs, the sensor activates the monitoring case and thereby the field set that is associated with the new machine status.
Navigation	Navigation is the determination and continuous adaptation of the route of a vehicle. This requires precise knowledge of the position of the vehicle and the nature of the environment in which the vehicle is moving.
Navigation	Navigation is a central element of a website or software interface that enables the user to always have an overview of the structure of the website or software and to navigate as directly as possible to any page of the website or software that is considered important.
OFF state	The OFF state is the status of the outputs of the protective device, where the controlled machine is triggered to quit its dangerous state and the start-up of the machine is prevented (e.g., the voltage at the OSSDs is LOW, so that the machine is switched off and remains still).
ON state	The ON state is the status of the outputs of the ESPE, where the controlled machine is permitted to operate (e.g., the voltage at the OSSDs is HIGH so that the machine can run).
OSSD	Output signal switching device: signal output for the protective device, which is used for stopping the dangerous movement. An OSSD is a safety switching output. The functionality of each OSSD is tested periodically. OSSDs are always connected in pairs and must undergo dual-channel analysis for safety reasons. An OSSD pair is formed from 2 OSSDs that are connected and analyzed together.
PFH	Average frequency of a dangerous failure per hour. More information: IEC 61508, IEC 62061, ISO 13849.
PL	Performance level (ISO 13849)
Position determination	Position determination or localization is the determination of the position of an object. For vehicles, localization is a prerequisite for navigation.
PROFINET	PROFINET (Process Field Protocol) is an Ethernet-based network used in industrial automation. With PROFIsafe , PROFINET is also suitable for safety-oriented data communication.

Protective field	The protective field is the area in which the test object specified by the manufacturer is detected by the electro-sensitive protective equipment (ESPE). As soon as the electro-sensitive protective device detects an object in the protective field, it switches the associated safety outputs to the OFF state. This signal can be passed to controllers resulting in the dangerous state coming to an end, e.g. to stop the machine or the vehicle.
Reference contour field	The contour as reference field monitors a contour of the environment. The safety laser scanner switches all safety outputs to the OFF state if a contour does not match the set parameters, because, for example, the mounting of the safety laser scanner has been changed. National and international standards require or recommend that a reference contour is monitored, if the safety laser scanner is used in vertical operation for hazardous point protection or for access protection.

Reset	When a protective device has sent a stop command, the stopped state must be maintained until a reset device is activated and the machine can be restarted in a second step.
	
	The reset brings the protective device back to the monitoring state after it has sent a stop command. The reset also quits the start-up or restart interlock of a protective device, so that the machine can be restarted in a second step.
	
	The reset must only be possible, when all safety functions and protective devices are functional.
	
	The reset of the protective device must not introduce any movement or dangerous situations itself. The machine is only permitted to start after the reset once a separate start command has been sent.
	
	• Manual resets are performed using a separate, manually operated device, such as a reset pushbutton.
	• Automatic resets by the protective device are only permitted in special cases, if one of the following conditions is met:
	  ○ It must not be possible for people to be in the hazardous area without triggering the protective device.
	  ○ It must be ensured that no people are in the hazardous area during or after the reset.

Resolution	The resolution of an active opto-electronic protective device (also known as the sensor detection capability) is the minimum size of an object for it to be reliably detected.
Response time	The protective device's response time is the maximum time between the occurrence of the event leading to the sensor's response and supply of the switch-off signal to the protective device's interface (for example OFF state of the OSSD pair).
Restart interlock	The restart interlock prevents the machine from automatically starting up, for example after a protective device has responded while the machine is operating or after changing the machine's operating mode. The restart interlock can be implemented in the protective device or in the safety controller. A command to reset the protective device must be given, for example using a reset pushbutton, before the machine can be restarted.
Retroreflector	A retroreflector reflects light back toward the light source largely independently of the alignment of the retroreflector.

Safety function	Function of a machine whose failure can result in an immediate increase of the risk(s). (ISO 12100)
Safety output	A safety output provides safety-related information. Safety outputs are OSSDs, for example, or safety-related information on a safety-related network.
Scan cycle time	The scan cycle time is the time the sensor needs for a complete scan of its detection area. Example: Time required by the mirror of a safety laser scanner for one rotation.
Scan plane	The scan plane is the geometric plane in which the 2D laser scanner captures its environment. A scan layer is created by deflecting a laser beam using a rotating mirror. In practice, the area scanned is not precisely flat. Deviations from the ideal plane are specified as a conical error. Deviations from the ideal alignment are specified as a tilt error.
SIL	Safety integrity level
Static control input	A static control input is a dual-channel control input, which evaluates the status of every channel as the value 0 or 1. The signal states of one or more static control inputs give a unique signal pattern. This signal pattern activates a monitoring case.
Tilt error	The tilt error indicates how strongly tilted the scan plane is to the ideal alignment within the specific device. The tilt error can be compensated for in many cases by mounting the sensor at a compensating inclination.
Universal I/O	Universal I/O can be configured as universal input or as universal output.
Universal input	Depending on the device, a universal input can be used for resetting, external device monitoring (EDM), sleep mode, or restarting the protective device, for example. If sleep mode is activated by a universal input, the sleep mode must not be used for safety applications. Certain universal inputs can also be used in pairs as a static control input.
Universal output	The function of a universal output is configurable. Which functions are available depends on the device. Possible signals are, for example: reset required, contamination warning.
Warning field	The warning field monitors larger areas than the protective field. Simple switching functions can be triggered with the warning field, e.g. a warning light or an acoustic signal can be triggered if a person approaches, even before the person enters the protective field. The warning field must not be used for safety applications.

18 Annex

18.1 Conformities and certificates

You can obtain declarations of conformity, certificates, and the current operating instructions for the product at www.sick.com. To do so, enter the product part number in the search field (part number: see the entry in the “P/N” or “Ident. no.” field on the type label).

18.1.1 EU declaration of conformity

Excerpt

The undersigned, representing the manufacturer, herewith declares that the product is in conformity with the provisions of the following EU directive(s) (including all applicable amendments), and that the standards and/or technical specifications stated in the EU declaration of conformity have been used as a basis for this.

- ROHS DIRECTIVE 2011/65/EU
- EMC DIRECTIVE 2014/30/EU
- MACHINERY DIRECTIVE 2006/42/EC

18.1.2 UK declaration of conformity

Excerpt

The undersigned, representing the following manufacturer herewith declares that this declaration of conformity is issued under the sole responsibility of the manufacturer. The product of this declaration is in conformity with the provisions of the following relevant UK Statutory Instruments (including all applicable amendments), and the respective standards and/or technical specifications have been used as a basis.

- Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment Regulations 2012
- Electromagnetic Compatibility Regulations 2016
- Supply of Machinery (Safety) Regulations 2008

18.2 Note on standards

Standards are specified in the information provided by SICK. The table shows regional standards with similar or identical contents. Not every standard applies to all products.

Table 51: Note on standards

Standard	Standard (regional)
	China
IEC 60068-2-6	GB/T 2423.10
IEC 60068-2-27	GB/T 2423.5
IEC 60204-1	GB/T 5226.1
IEC 60529	GB/T 4208
IEC 60825-1	GB 7247.1
IEC 61131-2	GB/T 15969.2
IEC 61140	GB/T 17045
IEC 61496-1	GB/T 19436.1
IEC 61496-2	GB/T 19436.2
IEC 61496-3	GB 19436.3
IEC 61508	GB/T 20438

Standard	Standard (regional)
	China
IEC 62061	GB 28526
ISO 13849-1	GB/T 16855.1
ISO 13855	GB/T 19876

18.3 Checklist for initial commissioning and commissioning

Checklist for manufacturers or installers for installing electro-sensitive protective device (ESPE)

The details relating to the items listed below must be available no later than when the system is commissioned for the first time. However, these depend on the specific application (the requirements of which must be reviewed by the manufacturer or installer).

This checklist should be retained and kept with the machine documentation to serve as reference during recurring tests.

This checklist does not replace the initial commissioning, nor the regular inspection by qualified safety personnel.

Have the safety rules and regulations been observed in compliance with the directives and standards applicable to the machine?	Yes ☐ No ☐
Are the applied directives and standards listed in the declaration of conformity?	Yes ☐ No ☐
Does the protective device correspond to the required PL/SIL and PFH in accordance with ISO 13849-1/IEC 62061 and the required type in accordance with IEC 61496-1?	Yes ☐ No ☐
Is access to the hazardous area or hazardous point only possible through the protective field of the ESPE?	Yes ☐ No ☐
Have appropriate measures been taken to protect (mechanical protection) or monitor (protective devices) any persons or objects in the hazardous area when protecting a hazardous area or hazardous point, and have these devices been secured or locked to prevent their removal?	Yes ☐ No ☐
Are additional mechanical protective measures fitted and secured against manipulation which prevent reaching below, above or around the ESPE?	Yes ☐ No ☐
Has the maximum shutdown and/or stopping time of the machine been measured, specified and documented (at the machine and/or in the machine documentation)?	Yes ☐ No ☐
Has the ESPE been mounted such that the required minimum distance from the nearest hazardous point has been achieved?	Yes ☐ No ☐
Are the ESPE devices properly mounted and secured against manipulation after alignment?	Yes ☐ No ☐
Are the required protective measures against electric shock in effect (protection class)?	Yes ☐ No ☐
Is the control switch for resetting the protective devices (ESPE) or restarting the machine present and correctly installed?	Yes ☐ No ☐
Are the outputs of the ESPE (OSSDs or safety outputs via the network) integrated according to the required PL/SIL in accordance with ISO 13849-1 / IEC 62061 and does the integration correspond to the circuit diagrams?	Yes ☐ No ☐
Has the protective function been checked in compliance with the test notes of this documentation?	Yes ☐ No ☐
Are the specified protective functions effective at every operating mode that can be set?	Yes ☐ No ☐
Are the switching elements activated by the ESPE, e.g. contactors, valves, monitored?	Yes ☐ No ☐
Is the ESPE effective over the entire period of the dangerous state?	Yes ☐ No ☐
Once initiated, will a dangerous state be stopped when switching the ESPE on or off and when changing the operating mode, or when switching to another protective device?	Yes ☐ No ☐

18.4 Mounting methods for protection from interference from systems in close proximity

Due to the safeHDDM® scanning technology, mutual interference of multiple safety laser scanners is unlikely. If many safety laser scanners are operated at the same level in a stationary application, they may nevertheless interfere with one another. We recommend selecting a suitable mounting method to avoid mutual interference. In many cases, you can use the following examples as a guide.

NOTE
You must comply with the standard ISO 13855:2010 when choosing the mounting method.

Mounting multiple safety laser scanners slightly offset and in parallel

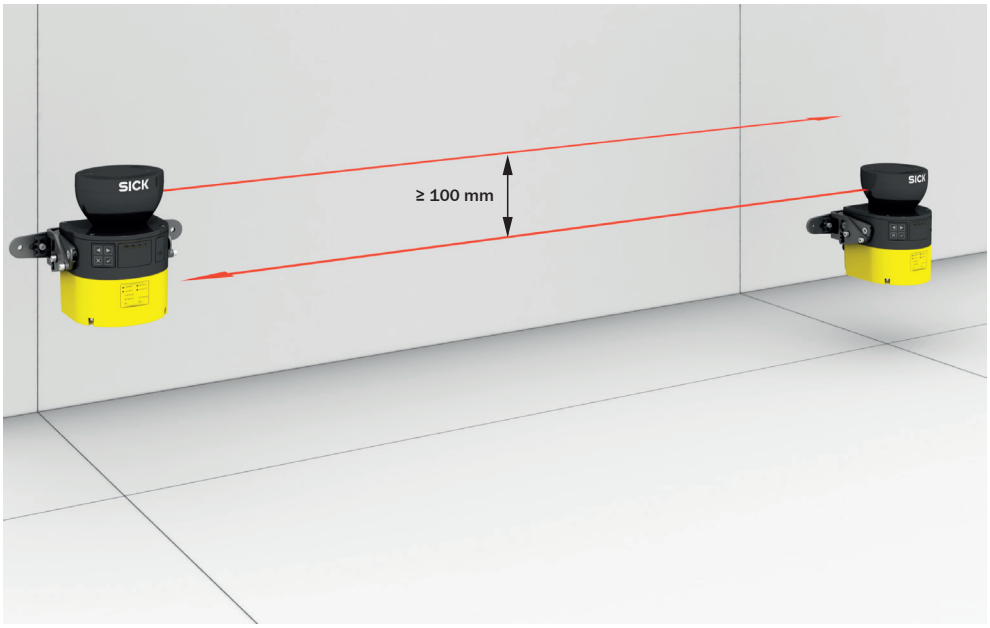


Figure 86: Mounting 2 safety laser scanners with the optics cover facing upward

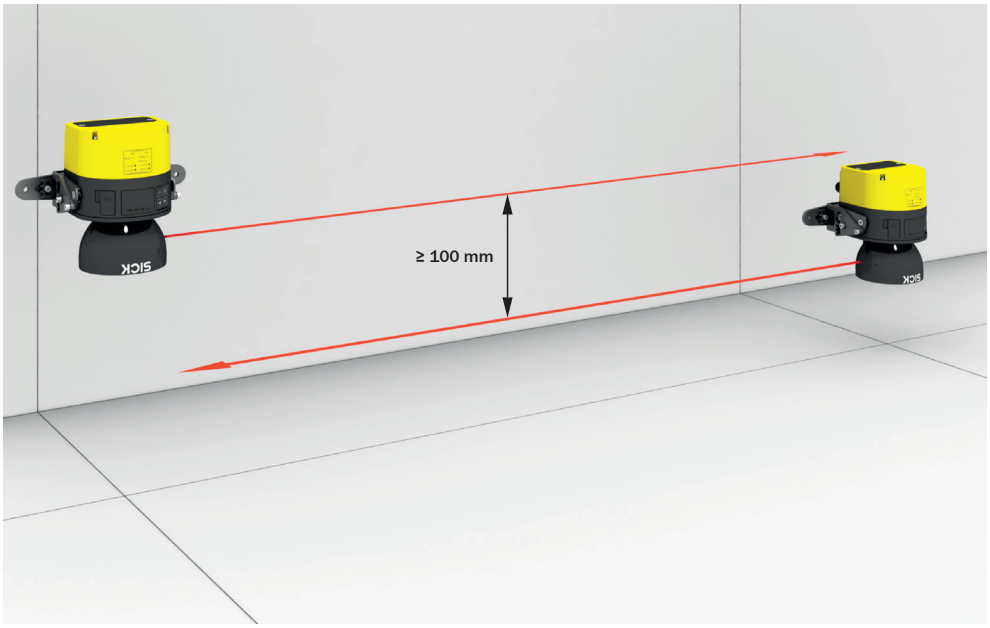


Figure 87: Mounting 2 safety laser scanners with the optics cover facing downward

The following mounting method has the advantage that both safety laser scanners can be mounted at a similar height. Nonetheless, there is enough space between the scan planes.

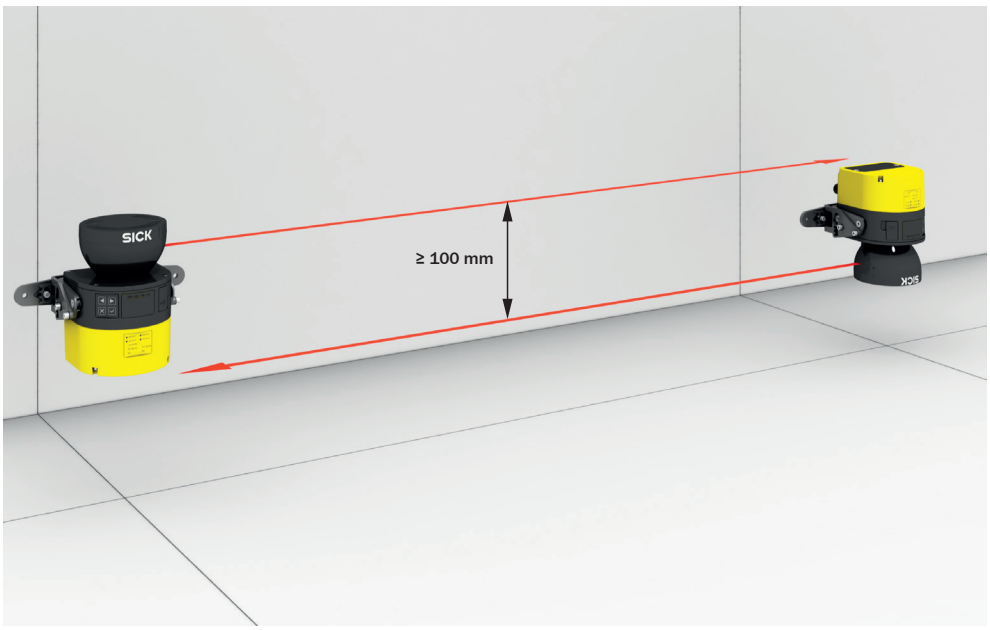


Figure 88: Mounting the upper safety laser scanner with the optics cover facing upward and mounting the lower safety laser scanner with the optics cover facing downward

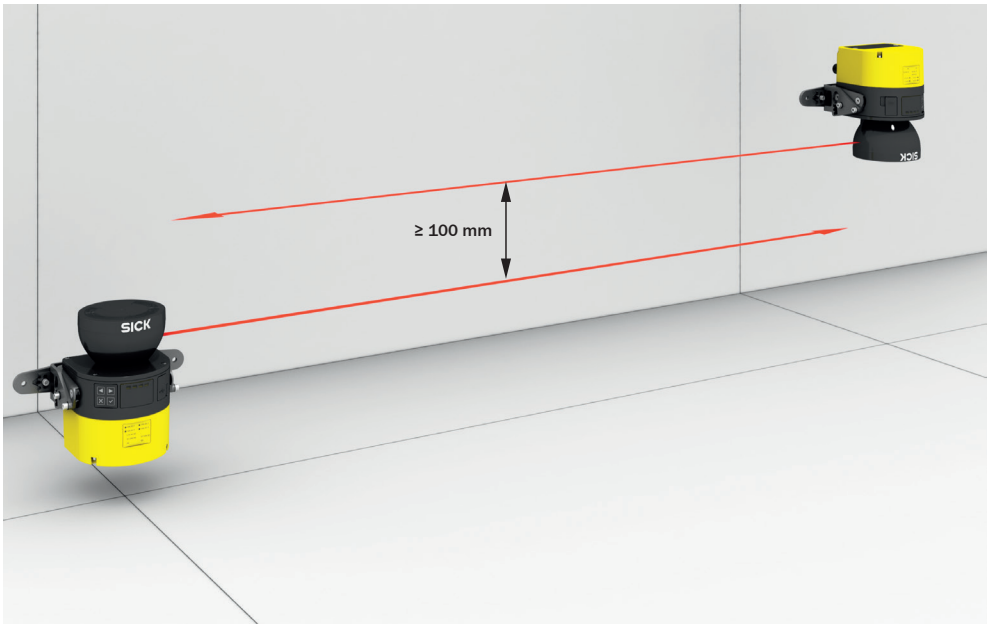


Figure 89: Mounting the upper safety laser scanner with the optics cover facing downward and mounting the lower safety laser scanner with the optics cover facing upward

Mount several safety laser scanners crosswise

If you tilt opposite safety laser scanners with respect to one another, both safety laser scanners must be tilted upward. (If mounted upside down, both safety laser scanners must be tilted downward.)

In any event, ensure that the protective field is at the right height so that crawling beneath and climbing over are prevented and so that the set resolution matches the mounting height.

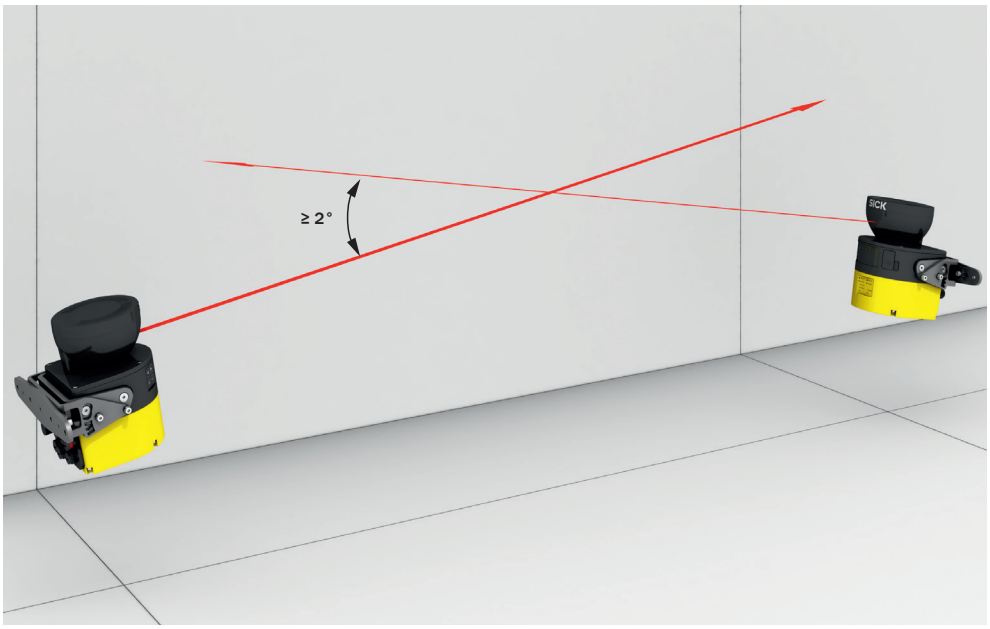


Figure 90: Mounting 2 safety laser scanners opposite one another

If you tilt neighboring safety laser scanners toward one another, the safety laser scanners can be tilted upward or downward.

In any event, ensure that the protective field is at the right height so that crawling beneath and climbing over are prevented and so that the set resolution matches the mounting height.

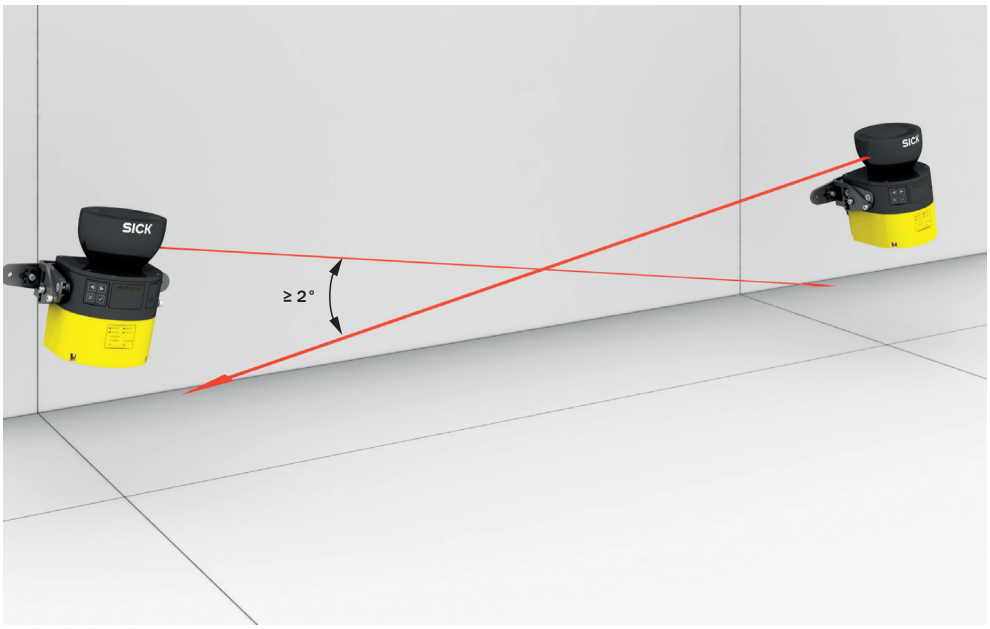


Figure 91: Mounting 2 safety laser scanners next to one another

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USER MANUAL

NOVA Transmitters

USER MANUAL

09/2019

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HETRONIC
A METHODE ELECTRONICS COMPANY

User Manual

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1. Safety

1.1 Intended Use

Your radio remote control is designed for remote operation of machines and systems using safe wireless communications technology. Any modification, reconstruction or extension of the systems without a written agreement of Hetronic may lead to the loss of your warranty and guarantee claims.

Hetronic assumes no liability for damages resulting out of the non-observance of this operating manual. All persons, working with this radio remote control must

- Be suitably trained and qualified as required by the safety regulations.
- Strictly comply with the contents of this operating manual.

Before starting the radio remote control you must have read and fully understood this operating manual. The Safety Checklist in Appendix B is intended to be followed before each time the transmitter is powered up for operation.

1.2 Symbol Notation

The following symbols are used in this operating manual. The safety alert symbol is used in decals on the unit and with proper operation procedures in this manual.

Understand the safety message. It contains important information about personal safety on or near the unit.

	**STOP!** This symbol gives you warning of imminent danger of life, risk of accident and risk of injury, as well as damage to property in case of non-observance of the working instructions.
	**ATTENTION!** This symbol advises against a possible damage to the system in case of non-observance of the working instructions.
	**TIP!** This symbol points to features and information which allow for an easier handling or operation.

1.3 Practices and Laws

Practice safe working precautions for the benefit of yourself and others.

Be alert to unsafe conditions and the possibility of minor, moderate, or serious injury or death. Learn applicable rules and laws in your area.

1.4 Required Operator Training

The original purchaser of this unit was instructed by the seller on safe and proper operation. If unit is to be used by someone other than original purchaser; loaned, rented or sold, ALWAYS provide this manual and any needed safety training before operation. ALWAYS read and understand the documentation for any machine to be controlled by radio remote control.

1.5 Possible Sources of Danger

This device is part of a system that makes remote control via wireless radio signals possible. The transmission of control commands can take place around obstacles and out of the operator's direct line of sight. Take the following precautions to prevent accidental start-up and possible injury or damage:



Switch "OFF" the transmitter when it is not in use. Unless the transmitter has user access control password configured, remove the battery if unit is placed away from the operator.



Disconnect the power supply from the receiver before any assembly, maintenance or repair work is done.



AVOID SYSTEM DAMAGE - ALWAYS disconnect receiver power supply and control wiring before welding on any part of the machine.



NEVER remove or alter any of the safety features.



ALWAYS confirm that the machine and radio remote control Stop functions work properly **BEFORE** beginning any machine operation.

1.6 Protective Features

This transmitter is equipped with electronic and mechanical safety features. Control signals from other transmitters cannot be processed because transmission coding is unique to each system.

1.7 STOP in case of EMERGENCY

Push the emergency stop on the machine.

1.8 Caring for your NOVA Transmitter

The enclosure materials employed on the NOVA transmitter have been carefully selected to minimise maintenance requirements.



Always use genuine chargers and accessories. Cheaper ones that are not compatible or made for going with your NOVA can harm the unit or shorten its lifespan.

Do not keep your NOVA transmitter stored in a closed container for extended periods of time unless it is powered off and the battery is removed from the unit. Charging the battery in a closed container is a potential fire hazard and may shorten its lifespan. Batteries give off heat when charging and when discharging. Keep your battery percentage between 40%-80% for longer battery life.



Clean your transmitter regularly. Use damp cloth or alcohol wipes to clean the unit's exterior surfaces. Do not use aggressive cleaning agents that may inadvertently damage the unit.

2. Introduction and Functional Description

We congratulate you on the purchase of your new Hetronic NOVA transmitter. You have chosen a high quality product. Familiarise yourself with the unit before using it for the first time. In addition please carefully refer to the operating instructions and the safety advise given in this manual. Only use the product as instructed and only for the intended field of application. Keep these instructions in a safe place. If you pass the product on to anyone else, please ensure that you also pass on all the documentation with it.

NOTE: This manual does not cover the EX versions of NOVA transmitters.

2.1 Production and System Numbers

Before contacting your dealer or Hetronic about service, repair or replacement parts, note the equipment Production and System numbers. These numbers are located on the silver label affixed to the unit.

2.2 Before Operating Your Wireless Control Unit

Confirm that installation of all your system components has been properly completed. Before start up, **ALWAYS** confirm that the machine and radio remote control Stop functions work properly.

Understand all Safety Precautions provided in the manuals and review control functions and operation of the machine and this radio remote control system. When not in use, turn the transmitter off and store in a safe place to prevent unauthorized use. Ensure that the USB Dongle (which acts as a security key to program the transmitter) is kept in a separate but safe and secure place. If the machine does not respond properly, immediately stop operation. Turn off the transmitter and report the condition to your supervisor.

Turn off the transmitter before any maintenance work is done. Always have fresh batteries on hand or an optional rechargeable battery pack in the battery charger to ensure the availability of a fully charged battery. Installation, setup and service must be performed by authorized and qualified personnel only.

2.3 Unit Labels

2.3.1 Blank Rating Plate

1. Specific approvals, such as CE, FCC, IC, etc.
2. Type of NOVA transmitter
3. Eleven-digit Production Number
4. Eleven-digit System Number
5. Ingress Protection Rating
6. Frequency information
7. Supply voltage
8. Current rating

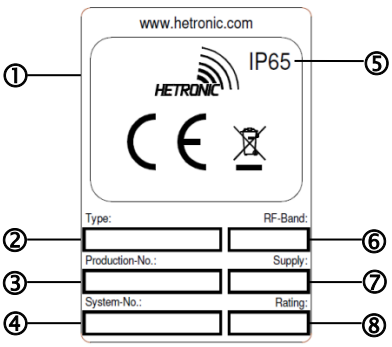


Figure 1. *Blank Rating Plate*

2.3.2 Read User Manual



The “Read User Manual” symbol on the transmitter acts as a reminder for the user to thoroughly read through the manual before attempting to operate the system. This manual must always be placed in a safe and easily accessible place when not being used for when there is the need to refer to it.

3. Your NOVA Transmitter

3.1 General Description

The NOVA family consists of a variety of transmitter sizes offering the user an endless array of possibilities from the most basic to the most complex requirements to satisfy most applications. All transmitters are ergonomically designed, programmable wireless units capable of transmitting a wide variety of functions to remotely control a machine or equipment.

Your transmitter is encased in a rugged minimum IP65 rated housing, is battery-powered, and comes equipped with built-in low battery detection. Standard equipment includes two sets of rechargeable batteries and a battery charger.

3.2 NOVA Basic Features

• Fully programmable via Hetronic PC-Link (depends on type of coder)

• Push buttons with up to two detents

• Single detent Start button/switch

• Joysticks (cross or lever, optional)

• Minimum 150 m (492 ft.) range using CS4XX and CS8xx modules (Line-of-Sight)

• Minimum 70 m (150 ft.) range using CS2400 RF module (Line-of-Sight)

• Internal Antenna (can also be external)

• Auto power off feature (configurable)

• Programming mode

• Low Battery detection

• Status bi-colour LED Red/Green

• Multi-Address Mode

• Belt/shoulder strap/harness/shoulder bar

• Buzzer (configurable)

• Rechargeable battery pack

Additional NOVA Options

• Feedback LEDs

• Display (depends on type of transmitter, can be monochrome or colour)

• Tilt Sensor

• Cable Control (RS232, CAN)

• Palm Sensor (only available on Nova M, Nova L, Nova XL, Nova XL 2.8, Nova XXL 4.3)

3.3 Standard NOVA Configurations

The NOVA-Series transmitters are available either in the following standard configurations or else in highly customizable variants:

Nova-S



➢Digital functionality

➢Any combination of toggle switches, push-button controls, rotary switches and key switches with removable key caps

➢Status LED for operation and low battery indication

➢Operating frequencies: 4xxMHz, 8xxMHz, 9xxMHz

➢Minimum operating range: 150m (Line-of-Sight)

➢Dimensions: H125mm x W160mm x D70mm

➢Weight: 369g

➢Carry options: Belly Belt

➢Battery: 3.6V NiMH rechargeable battery pack

➢Cable back up: Serial through battery enclosure. Custom cable lengths on request

Nova-M



➢Digital or Proportional functionality

➢Up to two dual-axis joysticks

➢Any combination of toggle switches, push-button controls, rotary switches and key switches with removable key caps

➢Status LED for operation and low battery indication

➢Operating Frequencies: 4xxMhz, 8xxMHz, 9xxMHz, 1.2GHz, 2.4GHz

➢Minimum operating range: 150m (Line-of-Sight)

➢Dimensions: H150mm x W180mm x D110mm

➢Weight: 910g

➢Carry options: Neck or belly belt

➢Battery: 3.6V NiMH rechargeable battery pack

➢Cable back up: Serial (RS232/CAN) through battery enclosure or connector plug. Custom cable lengths on request

Nova-L



➢Digital and/or Proportional functionality

➢Up to either two dual-axis joysticks or six paddle levers

➢Any combination of toggle switches, push-button controls, rotary switches and key switches with removable key caps

➢Status LED for operation and standard/advanced low battery indication

➢Optional Feedback LEDs

➢Half or full duplex

➢ Operating Frequencies: 4xxMhz, 8xxMHz, 9xxMHz, 1.2GHz, 2.4GHz

➢Minimum operating range: 150m (492ft) for ≤ 1GHz 10mW module (Line-of-Sight), 70m (150ft) for 2.4GHz 10mW module

➢Dimensions: H235mm x W160mm x D95mm

➢Weight: 1kg

➢Carry options: Belly belt, neck belt, chest belt or shoulder bar

➢Battery: 3.6V NiMH rechargeable battery pack

➢Cable back-up: Serial (RS232/CAN) through battery enclosure or connector plug. Custom cable lengths on request

Nova L 2.4



➢Digital and/or Proportional functionality

➢Up to two dual-axis joysticks

➢Any combination of toggle switches, push-button controls, rotary switches and key switches with removable key caps

➢Status LED for operation and standard/advanced low battery indication

➢Optional Feedback LEDs

➢Half or full duplex

➢High resolution colour TFT 2.4” 240x320, 262K colours with backlight

➢Operating Frequencies: 4xxMhz, 8xxMHz, 9xxMHz, 1.2GHz, 2.4GHz

Minimum operating range: 150m (492ft) for ≤ 1GHz 10mW module (Line-of-Sight), 70m (150ft) for 2.4GHz 10mW module

➢Dimensions: H264mmxW151mmxD213mm

➢Weight: 1.8kg

➢Carry options: Belly belt, neck belt, chest belt or shoulder bar

➢Battery: 3.6V NiMH rechargeable battery pack

➢Cable back-up: Serial (RS232/CAN) through battery enclosure or connector plug. Custom cable lengths on request

Nova-XL





➢Digital and/or Proportional functionality

➢Up to either four dual-axis joysticks or eight paddle levers

➢Any combination of toggle switches, push-button controls, rotary switches and key switches with removable key caps

➢Status LED for operation and standard/advanced low battery

➢Optional Feedback LEDs

➢Half or full duplex

➢Optional monochrome LCD 120x320

➢Operating Frequencies: 4xxMhz, 8xxMHz, 9xxMHz, 1.2GHz, 2.4GHz

➢Minimum operating range: 150m (492ft) for ≤ 1GHz 10mW module (Line-of-Sight), 70m (150ft) for 2.4GHz 10mW module

➢Dimensions: H165mm x W312mm x D170mm

➢Weight: 1.9kg

➢Carry options: Belly belt, neck belt or shoulder bar

➢Battery: 3.6V NiMH rechargeable battery

➢Cable back-up: Serial (RS232/CAN) through battery enclosure or connector plug. Custom cable lengths on request

Nova XL 2.8





➢Digital and/or Proportional functionality

➢Up to four multi-axis joysticks or eight linear paddle levers

➢Any combination of toggle switches, push-button controls, rotary switches and key switches with removable key caps

➢Status LED for operation and standard/advanced low battery

➢Optional Feedback LEDs

➢Half of full duplex

➢High resolution colour TFT 2.8” with backlight

➢Operating Frequencies: 4xxMhz, 8xxMHz, 9xxMHz, 1.2GHz, 2.4GHz

Minimum operating range: 150m (492ft) for ≤ 1GHz 10mW module (Line-of-Sight), 70m (150ft) for 2.4GHz 10mW module

➢Dimensions: H334mm x W216mm x D160mm

➢Weight: 1.8kg

➢Carry options: Belly belt, neck belt or shoulder bar

➢Battery: 3.6V NiMH rechargeable battery

➢Cable back-up: Serial (RS232/CAN) through battery enclosure or connector plug. Custom cable lengths on request

Nova XL 4.3



➢Digital and/or Proportional functionality

➢Up to four multi-axis joysticks or eight linear paddle levers

➢Any combination of toggle switches, push-button controls, rotary switches and key switches with removable key caps

➢Status LED for operation and standard/advanced low battery

➢Optional Feedback LEDs

➢Half of full duplex

➢High resolution colour TFT 4.3” with backlight

➢Operating Frequencies: 4xxMhz, 8xxMHz, 9xxMHz, 1.2GHz, 2.4GHz

Minimum operating range: 150m (492ft) for ≤ 1GHz 10mW module (Line-of-Sight), 70m (150ft) for 2.4GHz 10mW module

➢Dimensions: H210mm x W335mm x D220mm

➢Weight: 2.3kg

➢Carry options: Belly belt, neck belt or shoulder bar

➢Battery: 3.6V NiMH rechargeable battery pack or 3.7V Li-Ion rechargeable battery

➢Cable back-up: Serial (RS232/CAN) through battery enclosure or connector plug. Custom cable lengths on request

Nova XXL 4.3



➢Digital and/or Proportional functionality

➢Up to four multi-axis joysticks or eight linear paddle levers or a combination of both

➢Any combination of toggle switches, push-button controls, rotary switches and key switches with removable key caps

➢Status LED for operation and standard/advanced low battery

➢Optional Feedback LEDs

➢Half or full duplex

➢High resolution colour TFT 4.3” 480x272, 262K colours with backlight

➢Real time data access, feedback and optional real-time video capability with up to 4 simultaneous camera streams

➢8Gb on-board memory by default

➢Operating Frequencies: 4xxMhz, 8xxMHz, 9xxMHz, 1.2GHz, 2.4GHz

➢Video Frequency 2.4GHz or 5GHz

➢Minimum operating range: 150m (492ft) for ≤ 1GHz 10mW module (Line-of-Sight), 70m (150ft) for 2.4GHz 10mW module

➢Dimensions: L367mm x W229mm x D174mm

➢Weight: 2.4kg

➢Carry options: belly, neck, shoulder or chest belt

➢Battery: 3.7V Li-Ion rechargeable battery packs

➢Cable back-up: Serial (RS232/CAN) through battery enclosure or connector plug. Custom cable lengths on request

4. Product Description

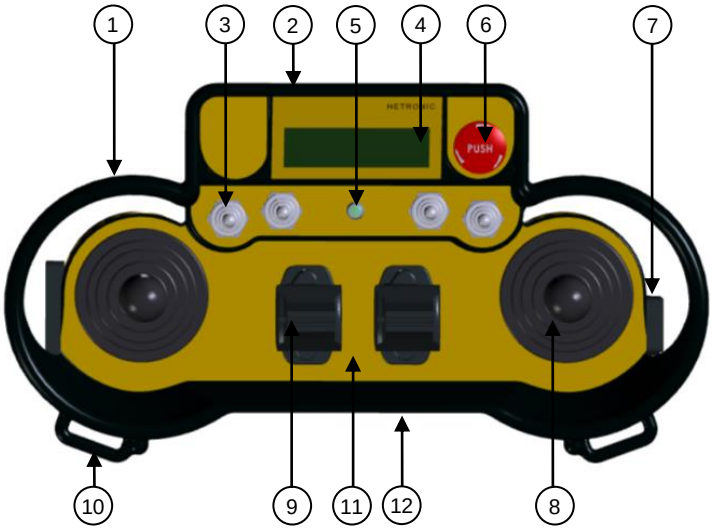


Figure 2. *Generic Transmitter Front view*

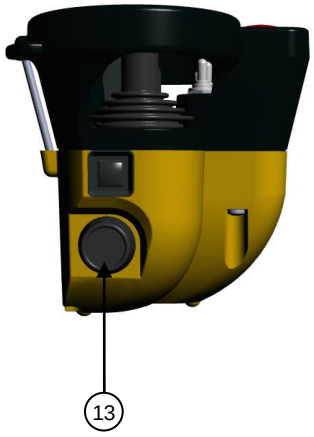


Figure 3. *Generic Transmitter Side View*

1	Transmitter Handlebar
2	Customizable Logo
3	Toggle Switch
4	TFT/LCD
5	Status bi-colour LED
6	STOP Pushbutton
7	Start Push button
8	Cross Joystick
9	Paddle Lever
10	Gripping handles for belt clips
11	Customisable labels
12	Battery Compartment (located in the bottom)
13	Key switch with Key Cap

Table 1. *Nova Transmitter Generic features*

Some basic features of a standard Nova Transmitter are toggle switches, pushbutton controls, rotary switches, key switches, STOP button, LED status indicator, dual-axis joysticks (digital or proportional) or proportional paddle levers, optional graphical display (size dependant on the transmitter size), optional half or full duplex, cable back up, LEDs for feedback.

The optional graphic display provides real-time visual information during operation of the Nova transmitter. It can be used to change configuration settings, provide two-way feedback and display transmitter diagnostic information such as battery life, signal strength and button status. The status LED is normally a bi-colour (green/red) LED and feedback LEDs can be white, yellow, blue, green or red (and these can also be of the high brightness type).

5. Operating Your Transmitter

5.1 Holding Your Transmitter

Hold the transmitter upright with the front facing you. Confirm that you are able to easily read and understand any operation text or symbols. Complete the following procedures once a day, before the start of an operation and at all shift changes.

5.2 Visually Checking Your Transmitter



Always check the transmitter, batteries and accessories for any physical damage before any operation. Check equipment for wear or damage and confirm that you can read and understand all of the safety labels. Never operate a transmitter with worn out or damaged parts.

5.3 Powering ON and Starting Your Transmitter

NOTE: When the transmitter is not being used by the operator, it must be stored in a safe place.

1. Confirm that all safety measures required by the equipment manufacturer have been followed.

2. Insert a battery adapter with fresh batteries into the battery compartment of the transmitter.

3. Make sure that the **STOP** switch (#6) is not pressed and that no other switch is in the operational position.

3. Insert the black key cap supplied with the transmitter in the key switch and turn it to the ON (I) position.

4. Turn ON the receiver.

5. Press **START** (#7). The transmitter will perform a routine initialization upon start up.

Note: The Start button is usually on the right hand side of the transmitter as indicated above, however, it can also take the form of a momentary toggle switch or round push button anywhere on the top face with the symbol ■. This can and is usually paired with the horn function ◂.

Note: For the powering up and starting procedure for the standard Nova-S transmitter refer to the respective section in the Nova S appendix.

5.4 Transmitter Initialization with Standard Status LED Indicator

Upon turning the transmitter ON, all the LEDs light up as solid colours, the buzzer beeps twice (approximately two seconds apart) and then the LEDs switch off before the unit performs the routine initialization.

During initialization, if the coder finds an error in the radio module, address, configuration or feedback, the transmitter will boot up and the failure will be displayed as a blinking RED status LED at the baud rate. The transmitter (all Nova L, Nova XL and Nova XXL variants) may then be connected to Hetronic PC-Link (refer to Programming and Servicing Manual for instructions) for the Error to be corrected.

Note: If the buzzer output remains continuously ON, this shows that the Address module is not present, not plugged in correctly or in error state.

After a successful initialization, the transmitter will enter Normal Operation Mode. The Green LED will blink at the baud rate i.e. the LED toggles on with every transmitted telegram frame. All other LEDs switch off. Test all machine functions. Refer to your machine, transmitter and receiver documentation as needed.

5.5 Transmitter Initialization with Graphic User Interface (TFT) and Standard Status LED Indicator

Upon turning the transmitter ON, the TFT screen turns ON and the LEDs light up as solid colours and then switch off before the unit performs the routine initialization.

During initialization, if the coder finds an error in the radio module, address, configuration or feedback, the transmitter will boot up and the failure will be displayed as a blinking RED status LED at the baud rate. The transmitter (all Nova L, Nova XL and Nova XXL variants) may then be connected to Hetronic PC-Link (refer to instructions in Programming and Service Manual) for the Error to be corrected.

Note: If the buzzer output remains continuously ON, this shows that the Address module is not present, not plugged in correctly or in error state.

After a successful initialization, the NOVA transmitter will enter Normal Operation Mode and display the software version and the splash screen (if present).

The basic home screen will then be displayed and the Green LED will also blink at the baud rate i.e. the LED toggles on with every transmitted telegram frame. All other LEDs switch off. Test all machine functions. Refer to your machine, transmitter and receiver documentation as needed.

5.6 Stopping the Radio Remote Control

In order to completely stop the transmission of data manually, the user must press the **STOP** button (#6).

Then the text **STOP** appears on the display (if present), the RED status LED blinks at a fast rate and the transmitter sends a Stop telegram to the receiver. Upon receiving the Stop telegram, the receiver goes into Safe Mode and turns OFF all receiver outputs.



If the user wishes to resume operation, this is possible by deactivating the STOP switch and pressing the Start switch (#7) again.

Note: For the stopping procedure for the standard Nova-S transmitter refer to the respective section in the Nova S appendix.



WARNING: Holding the transmitter improperly while operating your machine could result in unexpected machine response.



WARNING: Test the stop function as described in the machine manufacturer's operator manual before beginning any operation.



WARNING: To avoid accidental start-up, always press STOP when not in use.

Turn OFF your machine if there is a fault or problem with the safety check.



NEVER operate the machine if the STOP function does not work properly.

WARNING: Improper operation, maintenance or adjustment may cause serious injury or damage to equipment and may void the warranty.

5.7 Battery 'State of Charge' Indication

Unless the transmitter is equipped with a TFT screen, in which case the Battery Level is also displayed on the status bar, the transmitter uses two different warning signs to show the user that the battery needs replacement.

When the Low Battery level warning has been triggered, the RED status LED will blink at a slow rate. The GREEN status LED will still blink at the same rate as the baud rate. The Low Battery detection threshold can be configured through the 'Low Batt Warning' field in the 'RF' tab on Hetronic PC-Link (refer to Service and Programming Manual for instructions).

In addition to low battery warning, a fixed critical battery level is also monitored. When critical battery level is reached, the RED Status LED will blink faster. The coder will automatically trigger the Stop telegram for about 5 seconds until it shuts off.

5.8 LED Behaviour and Meanings

All transmitting units are equipped with LED lights that signal operating status, battery level and fault messages.

GRN LED Behaviour	RED LED Behaviour	Buzzer	Meaning
Off	Off	Off	Power OFF
Off	On	Off	Power ON initialization
On	Off	On	Startup process ~1.5s
On	Off	Off	Startup process ~ 1.5-2.8s
On	Off	On	Startup process ~ 2.8-3.5s
Blinking	Off	Off	Start of Normal Operation GRN LED is toggled every telegram frame transmitted
Blinking	Slow Blinking	-	Low Battery Warning
Blinking	Fast Blinking	-	Critical Battery Warning
Blinking	Blinking Randomly	-	Hetronic PC-Link communication
Blinking	-	On/Off	Buzzer output is activated

Table 2. *LED and Buzzer Outputs Description*

Note: For LED Behaviour on Nova-S Transmitters refer to respective Appendix

5.9 Powering OFF the Transmitter

To turn off the transmitter, the operator must turn the key switch clockwise to the “0” position. It is suggested that the battery is removed from the transmitter when not in use and stored in a safe place so as to avoid accidental operation.

Note: For the powering off procedure for the standard Nova-S transmitter refer to the respective section in the Nova S appendix.

The coder can also be switched off through either one of the following:

1) through the manual activation (Active Stop) of the Stop switch (#6) which will in turn, open the ‘Machine Stop’ relay in the receiver

2) when the Stop function is automatically triggered (Passive Stop) due to an error, such as, transmitter out of range

3) when the duration of the Auto-OFF timer has elapsed during which no operational activity has been detected.

4) when the battery has been discharged to 3.4V and the critical battery duration has elapsed.

5.10 Belts

The practical belt hangers on the Nova transmitter housings allow the user to clip on the appropriate belt for ease of access and operator safety during operation. Each type of transmitter has its own set of belts which are adequately and ergonomically designed to offer the least strain possible on the operator.

6. Generic Radio Remote System functionalities

6.1 "Start" Function

Start switch (#7), generally in green and very close to the key switch, is required to initialize radio remote control. For safety reasons, the "Start" command must be given to give the receiver control every time there is an interruption in the control signals. This switch is in many cases paired with the Horn function ■/🔈.

In order to start up the radio remote control system from the transmitter one has to make sure the stop button (#6) must be released and all control levers must be in neutral position. The key switch must be turned to the "ON" position (I) on the transmitter and the "Start' button (#7) pressed.

6.2 Stop Switch

The most important feature of the radio remote control system is the Stop function. The transmitter sends the Stop status signal along with the rest of the commands through the telegram. This method confirms that ongoing operations are safe. If the Stop pushbutton is pressed (Active STOP), the Stop relay in the receiver causes all functions/motions to stop and the receiver goes into Safe mode.
To restart the system, the Stop button (#6) must be disengaged and the Start/Horn button (#7) is to be pressed again to close the relays in the receiver and resume function.
The Stop functionality responds faster than any other command. When Stop is engaged, the system ignores any other signal that is transmitted. The problem must be corrected before the system will respond to any other signal.
The Stop functionality is self-monitoring and redundant in the transmitter and receiver. The system performs a self-test to ensure the Stop circuit is working properly. If an error is detected, the system automatically goes into Safe mode.
When the transmitter is turned on, it performs a self-test to be sure that communications are within designated parameters. If an error is detected, the transmitter will not transmit any signals.

Whenever Safe mode is active without having the STOP button pressed, the system is said to be in Passive STOP. This means that the Stop button (#6) is still disengaged however the relays in the receiver are open so as not to allow any operation.
Possible triggers for Passive STOP (Safe Mode) are:

1. Transmitter Auto shutdown after period of inactivity
2. Radio signal interference
3. Transmitter out of operating range
4. Low battery sends Stop signal after time out elapses

While it is perfectly protected against unintentional collisions, the STOP button is easily accessible and can be quickly operated with priority.

The STOP button on the transmitter is only a remote stop and will operate only when the transmitter is powered up.



Pressing the STOP pushbutton does not ensure the machine will come to a complete stop. STOP button functionality is subject to the wiring of receiver STOP relays to machine emergency stop circuit and controlled machine logic where applicable.

ALWAYS test the STOP function at the beginning of every operation session or when there is change of operator/shift.

6.3 Digital and Proportional Functions

There are two possible types of electronic control that can be operated from the Radio Remote Control; the digital and the proportional functions.

Digital control (ON-OFF) determines either the opening or closing of a potential-free relay or solid-state switches within the receiver when the transmitter activates this control. These commands are normally sent from push buttons, toggle switches, selector switches or digital joysticks.

Proportional control is a function determining a variable output in either current or voltage in a directly proportional way to the varying of the position of an analogical actuator on the transmitter. This can be a joystick or a simple potentiometer. Cross joysticks operate on either one, two or three axes (X, Y and Z respectively) depending on the application, with the X and Y axes having up to 4 mechanical detents in each direction and the Z axis being the rotation the joystick lever on its own axis. When stepless proportional control is required, the initial movement of the joystick will activate the safety channel before any output can be obtained. The standard paddle joysticks use the same principle as the cross joysticks, however they operate on one axis.

Note: In all cases, all joysticks/levers must be in the neutral position for the system to be able to start.

6.4 Quickset/Programming mode

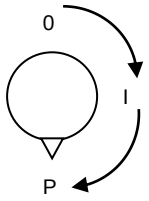
In most cases, the snail-rabbit toggle switch is present so as to change between slow and fast speed levels of the joystick. However when the transmitting unit has another toggle switch/push buttons with "+" and "-" labels, it is possible to manually change the slow speed levels for each joystick in real time, so as to adapt the application's response to the load and precision needs required at that point in time.

In order to activate this functionality, the user has to:

1. Switch OFF transmitter and remove black key cap.

2. Insert red key cap and turn the key to "I" position to switch on the transmitter. An acoustic signal is heard.





3. Turn the key to 'P' position to activate 'Programming' mode and keep holding the "Start" button down for 2 seconds.

4. In order to set the minimum speed for a function, slowly move the joystick until it reaches the point when the safety DK is activated. Hold the joystick in this position and press the '-' or '+' buttons to reduce or increase the speed, respectively.

5. In order to set the maximum speed, move the joystick until its maximum position is reached and press the '-' or '+' buttons to reduce or increase speed.

N.B. Ensure that the speed of only one function is programmed at one go. Whenever a speed setting is completed, wait for approx 10 seconds before disconnecting the transmitter so as to make sure that the correct values are stored in the system.

N.B. The "Snail" and "Hare" functions are independent to each other, thus if the speed of the function "Snail" is to be set, this has to be selected beforehand.

6. When all required joysticks speeds have been set, switch off transmitter by turning the red key cap to the '0' position.

7. Replace red key cap with black key cap and switch on transmitter to resume operation.

7. Setting up your Nova Transmitter for Operation

7.1 Coder

7.1.1 Address

The coder address with which the NOVA transmitter has been programmed from the factory can be found listed on the datasheet. This can be updated via Hetronic PC-Link in the 'RF' tab and any number between 1 and 999999 can be used (refer to Service and Programming Manual for instructions).

7.2 Communication

7.2.1 Radio Settings

The NOVA coder is designed with the possibility to connect two on board RF modules either operating in the sub 1GHz range as well as 2.4GHz. When the RF module is plugged directly on to the coder (onboard), the user may select the frequency channel or group to use for communication. If the RF module is connected to the coder externally (through a cable set inside the transmitter) the channel will depend on the SIP switch settings as outlined in the RF module and Frequency Bands charts. The RF module is used for either transmitting only the control telegram or else operating in half duplex mode. For the coder to operate in full duplex mode then a second RF module has to be connected and configured using Hetronic PC-Link (refer to Service and Programming Manual for instructions).

7.2.2 Auto-OFF

A transmitter Auto-OFF timer can also be set which powers down the coder if it remains idle for a configured period of time. The Auto-OFF timer can also be disabled so that the coder remains always ON until either switched OFF manually or else when the critical battery voltage level is reached and thus the transmitter switches off automatically (refer to Service and Programming Manual for instructions).

Note: In the case of Nova-S transmitters, a jumper setting on the coder determines whether the transmitter switches off or not after 10 minutes of inactivity.

7.2.3 Radio Mode vs Cable Control Mode

Detection of the presence of Cable Control supply can be set automatically to switch to Cable Control mode. In Cable Control mode, the telegram will be sent through the cable RS232/CAN and the Radio mode will be OFF.

Cable Control detection can also be disabled. In this case, the Radio mode will always be used. This is useful whenever the remote control is required to work in Radio mode and the available voltage supply is between 5 and 30V, thus must be supplied via the cable control connector.

The presence of Cable Control supply can also be used as signal to activate a C12HL output.

7.3 DK Configuration

There are 32DK switch assignments on the coder board and an additional 48DK switches can be used when an optional expansion board is added to the system. The 80DK switches have fixed assignments corresponding to DK1 to DK80 and cannot be modified. The final status of the telegram DKs is dependent on the Hetronic PC-Link configuration which is a logic combination of Input Signal/s and its corresponding DK switch for telegram DK1-DK32 and selected Input Signal or DK switch for telegram DK33-DK80.

7.4 AK Configuration

There are 16 configurable AK channels (AK1 to AK16). Each AK channel can be independently assigned to a particular Signal. When no Signal is configured to the AK, the corresponding AK channel will remain in neutral position. The neutral position can be 0x7F or 0x00 hex value corresponding to the Type selected which is Uref/2 or 0-Uref respectively. The AK Channel signals can be either set as Analog Inputs or Gray Code or ADC configurations, in which the analog inputs are used to generate digital step or gray code signals that can be used to trigger telegram DKs. Refer to Service and Programming Manual for instructions.

7.5 Digital Outputs

The coder has 25 configurable outputs which include the Buzzer, two open collector outputs, six push pull digital outputs (TTL1 to TTL6) and 16 optional outputs (LED1 to LED16) when an additional expansion board is used. All the outputs can be assigned with DK signals, feedback bits, logic gates and any coder status signals available. The output active state can be set as either continuous or pulsing with adjustable On/Off durations.

All outputs can be configured latching, thus it will remain active once the signal is activated and remains active even after the signal is deactivated. The latched output turns OFF after the signal is reactivated. The latching function can also be set to switch OFF once the Stop function is activated. Refer to Service and Programming Manual for instructions.

7.6 Inactivity Warning

This feature is mainly used in applications which require one or more functions to be continuously ON and thus, the switch operations are monitored for abnormal conditions. The 14 Timer Triggers can be assigned different trigger signals and timer durations.

When any of these 14 timers is triggered they will in turn trigger a Level 1 Warning signal which will be used to trigger an output. The Level 1 Warning signal is reset when the input trigger is disabled. When the Level 1 Warning signal is activated this automatically triggers a second independent timer which will be used to monitor the presence of the Level 1 Warning signal. If the Level 1 Warning signal remains active all throughout the second timer duration, the Level 2 Warning signal will become active if this is configured. The Level 2 Warning signal can also be used to trigger an output. The Level 2 Warning signal will remain ON once it is activated until the next system power OFF and ON. When a logic output signal is used as a trigger, the corresponding timer will be reset every time one of the inputs of the logic signal changes state.

7.7 Multi-Address Mode

This function provides the possibility to have the transmitter control a number of receivers, one at a time, depending on the address selected. The user can set the addresses to be used by an offset value configurable from 1 to 999 relative to the base address.

Incrementing or decrementing address offset is only possible whenever the assigned “Enable/Select DK Switch” is active. This DK can be assigned from DK11 to DK80 and is outlined on the main drawing of the transmitter.

Increment DK switch and Decrement DK switch are the configured DKs which will be used to change the current address of the coder with the corresponding offset value. The possible DKs are DK11 to DK80 and these can also be configured to offset change the address digits by 10s or 100s for faster operation. The configured DK switches are also outlined on the main drawing of the transmitter.

Confirm DK switch is used to confirm the change in address offset and can also be assigned from DK11 to DK80. The user is also made aware as to which switch is responsible for this functionality through the transmitter drawing.

7.8 Optional Add-Ons

7.8.1 Tilt Sensor

The tilt sensor is a module attached to the inside of the transmitter which is used to trigger an output whenever the transmitter is tilted further than the preset angle. The module supports two independently monitored axis and the corresponding maximum and minimum tilt angle for each. The switched output time delay can also be adjusted from 1 to 60 seconds and the angle detection can be up to 90° in both the X and the Y axis.

7.8.2 Palm Sensor

The palm/touch sensor is used on Nova enclosures to act as a “man-down” safety feature. Its purpose is to detect the presence of a hand through the plastic handle of the housing, even if wearing leather or rubber gloves. The Palm sensor can be used on the Nova M, Nova L, Nova XL, Nova XL 2.8, Nova XL 4.3 and Nova XXL 4.3 variants.

7.8.3 Proximity Detection Sensor

This module operates in the 2.4GHz band to measure the distance between two nodes contained within a specific range and communicate between them. By using a Proximity Detection Module in a paired transmitter and receiver, the location from where the operator can stand to operate the system can be chosen. The user can choose to either operate the system from within the configured distance to the receiving PDM node or else from outside the configured range.

7.9 Cable Control (optional)

Cable control is also possible on NOVA Transmitters and this allows for the operation of the transmitter with no wireless radio transmission, e.g in cases where radio transmission is not permissible or when the batteries are exhausted and the transmitter must be kept on for continual crane operation. This feature requires an additional cable and this can be either plugged in the battery compartment in place of the battery or connected directly to a plug on the side of the transmitter. In either case, both the transmitter and receiver must be configured for CAN or RS232 communication. The CAN communication supports both CANopen and J1939 while RS232 communication is by default set to full duplex communication (refer to Service and Programming Manual for instructions).

The standard cable length is 10m. When the control cable is used all the pre-set adjustments and other optional functions do not change. When not in use, the cable should be stored in a safe compartment inside the truck cabin. The cable with the battery enclosure must not be stored in an area subject to magnetic fields as this could damage it.

7.9.1 Installation of Cable Control Cable

1. Switch off the receiver and NOVA transmitter and remove the battery.
2. Plug in the cable/battery enclosure for cable control in the transmitter and the other end in the receiver, making sure they are securely fastened.
3. Switch on the receiver and the transmitter and press ‘Start’ to enable communication.

Note: The cable connection point is located on the lower side of the installed receiver unit.

Types of Cable Control:

Sure Seal to Sure Seal connector





Amphenol to Amphenol connector





Battery to Amphenol connector





7.9.2 Operation of NOVA in Cable Control Mode

With cable control cable attached, switch on transmitter following the start up sequence as outlined in Section 4. During start up, the transmitter will automatically recognize that the cable is attached and communicating and thus will switch into cable control mode. This will turn off all wireless transmission and send/receive all command and feedback signals through the cable.



All controls on the transmitter will function the same regardless of whether the transmitter is in cable control mode or wireless mode.

7.9.3 Decoder Address Learning (CC interface)

The coder address can be configured by a decoder (ex. BMS2, Rx14HL, DC Mobile) through its cable control (RS232) interface whenever the same coder is powered directly by the decoder. This is possible on all transmitters with a colour display. To put the coder in address learn mode, it must be powered ON with DK1 switch (#7) ON and not in STOP condition. During this stage the red status LED (with the symbol ) starts blinking confirming the coder is in address learn mode. Once the coder is in address learn mode DK1 must be turned OFF and ON again to send address learn command to the decoder. In this mode, it will wait for receiver address information which will be provided by the decoder. Once the address information is being retrieved from the receiver, the green LED will turn ON. The coder will receive the address sent from the decoder and validates the address. The address will be saved into the ADMO if the received address is valid and the green LED turns OFF. If the address received is not valid or if there is any error in the communication while receiving the address, the green LED will remain continuously ON. If there is an error then the coder must be turned OFF and the address learning procedure outlined above must be performed again.

7.9.4 Returning Transmitter to Wireless Mode

To return to wireless mode, the transmitter must be powered off and the cable disconnected. Following the start up sequence from Section 4, restart the transmitter. This will automatically detect that it is no longer in cable control mode and will start the unit in its normal wireless mode.

8. Theory of Operation

Your NOVA transmitter works with a receiving device to transfer machine control commands via radio frequency to your machine. The transmitter electronically generates a carrier frequency that allows it to communicate with the receiver without the use of cables or wires. The receiver then converts the carrier frequency information into discrete machine control outputs that interface with your machine's controls. Each transmitter and receiver that comprises a system is programmed with a unique address code. The receiver only accepts commands from the transmitter with the same address code. This code ensures that machine operations are safe, and that other remote control equipment cannot unintentionally control your machine. The receiver and transmitter have the unique address code set at the factory.

9. Installing the Radio Remote Control

The following instructions are recommended so as to set up a properly operating radio remote control system. The radio remote control must be installed by qualified personnel only.

Install the receiving unit's antenna in the line of sight of the transmitting unit, with no electromagnetic shielding, and if possible, not on metal surfaces so as to improve the operating range.

Do not bypass the safety instructions outlined by the equipment's manufacturer.

Do not install the receiver unit too high above the ground as the unit may receive local radio signals that could disturb transceiving operations.

To prevent water infiltrations, install the receiving unit vertically, with any cable clamps and any other connections at the bottom.

In case of strong mechanical vibrations, rubber shock-absorbing buffers may be installed between the machine and the receiver.

10. Troubleshooting

If your NOVA transmitter does not operate after normal start-up, follow the recommended troubleshooting sequence below to help isolate the cause and determine corrective action. If you need more information, contact your nearest Hetronic dealer.

PROBLEM	PROBABLE CAUSE	CORRECTION
Transmitter won't start	Incorrect Access code(if enabled)	Enter correct access code
	Battery fully discharged	Replace with fully charged battery if needed
The transmitter is turned on, but does not transmit (Power LED not flashing)	Battery is discharged	Replace battery with a fully charged battery
	Component failure	Contact your supervisor or nearest Hetronic Service Centre
Transmitter is transmitting (Power LED flashing), but machine will not respond	No power to the receiver	Check the diagnostic LEDs in the receiver to be sure power is applied. Ensure that the system is properly grounded
	Transmitter/receiver frequency channels do not match	Follow instructions under "Setting Frequency and channels" or contact your supervisor
	Transmitter out of range	Take the transmitter back into the range of the receiver, press START
	Receiver powered off	Turn on power to receiver
	Blown fuse in receiver	Check all fuses and replace if needed
	STOP failure in receiver. Red STOP LED on PC board is illuminated	Contact your supervisor
Battery Status is not displayed	I2C connector inside transmitter is loose	Check all connectors, reseat if needed
All machine motions operate intermittently	Receiver antenna connection is loose or missing	Tighten or replace antenna
	External antenna (if used) has loose connection, poor grounding or interference	Tighten antenna and ground connection. Contact Hetronic or your Dealer for more information
	Connector inside receiver is loose	Check all connectors, reseat if needed
	Another frequency may be interfering with the system	Contact your supervisor

Table 3. *Troubleshooting tips*

11. Warranty, Service, Repairs and Maintenance

Before any service or maintenance intervention on remote controlled equipment always:

- Remove all electrical power from the equipment
- Follow lock out procedures

Hetronic products are covered by a guarantee/warranty against material, construction and manufacturing faults. During the guarantee/warranty period, Hetronic may replace the product or faulty parts. Work under guarantee/warranty must be carried out by Hetronic, or by an authorized service centre specified by Hetronic. Any modification, reconstruction or extension of the systems without a written agreement of Hetronic may lead to the loss of your warranty and guarantee claims.

The following are **not** covered by the guarantee/warranty:

- Faults resulting from normal wear and tear
- Consumables e.g. batteries
- Products that have been subject to unauthorized modifications
- Faults resulting from incorrect installation and use

Maintenance and Preventive Care

- Repairs and maintenance must be carried out by qualified personnel
- Only use original Hetronic spare parts
- Contact your representative for service or any other assistance
- Keep the product in a clean, dry place
- Keep battery contacts clean
- Wipe off dust using a slightly damp, clean cloth
- Remove dust from inside gaps, docking recesses and battery contacts using a vacuum. Special care must be taken when cleaning the battery compartment of the transmitter as detachment of the pressure balance element may lead to ingress protection problems

NEVER USE:

- Abrasive cleaning solutions or high-pressure water jets.
- Sharp, pointed objects or any hard items as these may tear the rubber parts.
- Compressed air as this may lead to ingress protection issues.
- Petroleum based solvents including Diesel and Gasoline to clean the unit as these may react with the silicone rubber of the joystick gaiter.

Note: Refer to web shop for items available as spare parts.

12. Regulatory Information

12.1 Europe

CE Marking

Transmitters - Hetronic hereby declares that the safety component “Radio Remote Control Transmitter Type NOVA” types listed in this manual are in compliance with Directive 2006/42/EU article 2(c) and are designed for installation on machinery or other devices. Furthermore, the listed safety component meets the following relevant directives at the time of delivery from the Hetronic manufacturing facilities:

Machinery Directive	2006/42/EU
RED Directive	2014/53/EU

Batteries - Hetronic declares that the components listed as “Rechargeable Battery Type MINI NiMH” are in accordance with all provisions of Annex I of the EU Council Directive 2014/30/EU referred to as EMC Directive.

Chargers - Hetronic declares that the safety components listed as “Battery Charger UCH 2” and “Battery Charger UCH 3”, in accordance with 2006/42/EU article 2(c), are designed for installation on machinery or other devices. Further, the above listed safety components meet the following directives at the time of delivery from the Hetronic manufacturing facilities:

Machinery Directive	2006/42/EU

The latest version of the complete EU Declarations of Conformity for the NOVA Transmitter, MINI Battery and UCH-2 and UCH-3 chargers are available on the Hetronic website www.hetronic.com.

WEEE Directive



This symbol means that inoperative electrical and electronic products must not be mixed with household waste. The European Union has implemented collection and recycling system for which producers are responsible. For proper treatment, recovery and recycling, please dispose of the product in a designated collection point.

REACH Compliance

Hetronic confirms that, to the best of its knowledge and continual communication with its respective suppliers, chemical Substances of Very High Concern (SVHC) are not included in our products. Based on the response statements of our suppliers no materials from the ECHA are included on Hetronic products. For the latest version of the complete Declaration of Conformity please visit the Hetronic website www.hetronic.com.

RoHS Compliance

As a designer and manufacturer of electrical and electronic products covered by RoHS, RoHS2 and RoHS3, Hetronic confirms that to the best of its knowledge at the date of this statement, none of the products supplied by it contain any of the hazardous substances in excess of permitted levels referred to in the Directive 2002/95/EC. The latest version of the complete Declaration of Conformity is available on the Hetronic website www.hetronic.com

12.2 North America

California Proposition 65

As a designer and manufacturer of electrical and electronic products, Hetronic confirms that to the best of its knowledge at the date of this statement, none of the products supplied by it contain any of the hazardous chemicals listed on California’s Safe Drinking Water & Toxic Enforcement Act of 1986 (commonly known as California Proposition 65).

FCC Recommendations:

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

To comply with FCC RF exposure compliance requirements, this device and its antenna must not be co-located with, or operating in conjunction with, any other antenna or transmitter.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a residential environment.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

• Reorient or relocate the receiving antenna

• Increase the separation between the equipment and receiver

• Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.

• Consult the dealer or an experienced radio/TV technician for help.

12.3 Industry Canada (IC/ISED) Statement

IC RF Exposure Statement

This device meets the IC requirements for RF exposure in public or uncontrolled environments.

IC Warning

This product complies with Industry Canada's licence-exempt RSS standards. Operation is subject to the following two conditions:

1. This device may not cause interference, and
2. This device must accept any interference, including interference that may cause undesired operation of the device.

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Appendix A

Definition of terms

The following terms are used throughout the NOVA User Manual and may be unfamiliar to some operators.

Term	Definition
baud rate	The transmitting speed measured in bits per second.
hamming distance	A measurement of data transmission safety. The amount of failures in the data stream which has to occur during the transmission in order to create a wrong signal.
base address	The base address is the Hetronic PC-Link assigned address of the coder

Appendix B

B.1 Operator Safety Basics

Before starting your shift, you should make sure that the equipment has a current inspection certificate and that the necessary inspections and risk assessment checks have been carried out and are up to date. Also, the equipment must be operated in accordance with the manufacturer's instructions.

Furthermore, it is of utmost importance that you know that **YOU are primarily responsible for YOUR OWN health and safety**. Wear appropriate Personal Protective Equipment and make sure that you have had all the necessary training to operate the equipment. The following basic safety precautions must be adhered to at all times:

1. Transmitter switches must never be mechanically blocked ON or OFF for any motion. When not in use the transmitter must be turned off. A safe and secure storage space should be provided for the transmitter unit and the unit should always be placed there when not in use. This precaution will prevent unauthorized people from operating the crane. Receivers must be removed from the equipment when it is unlikely that it will be used for a period of time, and properly stored.

2. All defective or missing safety equipment, mechanical or electrical defects must be reported to the supervisor without delay. Operation must not continue until all required repairs are completed. Any changes to the condition of the remote or equipment must be recorded and communicated to or made accessible by the following operators on shift.

3. Ensure that there is nobody in the path of the travel of the equipment. If there is, stop and sound the alarm before proceeding.

4. When leaving the equipment area for any reason, switch off the transmitter, remove the key cap and store it in a safe and secure place to prevent unauthorized operation.

5. Do not allow any unauthorized person to operate the transmitter at any point.

6. Do not operate the transmitter at a distance where the equipment and all surrounding objects are not visible. Make sure that your view is not obstructed.

7. Do not attempt to override any of the safety features built into the Radio Remote Control.

8. Put rechargeable batteries on charge at the end of each shift. Chargers are not intended for outdoor use. Use only indoors.

9. Non-rechargeable batteries must NOT be used to power the transmitters. Use ONLY Hetronic rechargeable batteries.

10. Use protective gloves when surface temperature of unit exceeds 58°C (136°F) as per IEC 62368-1:2014.

B.2 Safety Checklist

The following checklist provides general safety guidelines for radio control operation of equipment by fully qualified and trained operators. These recommendations do not take precedence over any of the following requirements relating to cranes, hoists, lifting devices or other equipment which use or include Hetronic products:

- Instructions, manuals, and safety warnings of the manufacturers of the equipment where Hetronic products are used,
- Plant safety rules and procedures of the employers and the owners of the facilities where the Hetronic products are being used,
- Occupational Health and Safety Administration (OSHA) regulations,
- Safety standards and practices for the industries in which Hetronic products are used.

Transmitter Start-up and Safety Checklist		
1	Are batteries fully charged?	
2	Are all switch labels clear and legible?	
3	Is the transmitter free from cracks and damages?	
4	Are the battery enclosures free from cracks and damages?	
5	Is the STOP function working as it should be?	
6	Is the correct key cap being used?	
7	Has each function of the transmitter been tested independently to ensure the equipment is responding correctly?	
8	Is the TFT (where applicable) free from cracks, deep scratches and damages?	
9	Are the switches/rubber caps free from damages/tears?	
10	Are the LEDs on the transmitter clearly visible?	
11	Are the charger and plug in good working condition?	
12	Is the cable control cable (where applicable) free from kinks and damages?	

B.3 Nova Variants and Current Rating

71ABCDEF.A

A		B		C		D	E	F
0	Dig	0	Nova S	0	No Display	Spare / Undefined	System Reference	Spare / Undefined
1	Prop	1	Nova M	1	2.8in TFT			
		2	Nova L	4	4.3in TFT			
		3	Nova XL					
		4	Nova XXL					

The table on the following page shows how the item number of a Nova unit is broken down and explains what each digit refers to with regards to different features available on the transmitter. The suffix, e.g. '.A' denotes the version number of the system as a whole.

Item number	Description	Type	Item number breakdown							Current Rating (mA)
			71	A	B	C	D	E	F	
71000020.B	Dig V2 R2CON	Nova S	71	0	0	0	0	2	0	150
71010003.A	DIG-IND-3	Nova M	71	0	1	0	0	0	3	72
71010040.D	DIG-V04	Nova M	71	0	1	0	0	4	0	72
71010050.E	DIG V5	Nova M	71	0	1	0	0	5	0	72
71110140.C	PROP-4K	Nova M	71	1	1	0	1	4	0	150
71110200.A	PROP-4L	Nova M	71	1	1	0	2	0	0	150
71020010.D	DIG-V01	Nova L	71	0	2	0	0	1	0	50
71020020.D	DIG V02	Nova L	71	0	2	0	0	2	0	50
71020100.C	DIG-V10	Nova L	71	0	2	0	1	0	0	50
71020110.D	DIG-V11	Nova L	71	0	2	0	1	1	0	50
71020200.D	DIG-IND-1V2	Nova L	71	0	2	0	2	0	0	50
71020205.C	DIG-IND-2	Nova L	71	0	2	0	2	0	5	50
71110130.C	PROP-4K W. SURE SEAL	Nova L	71	1	1	0	1	3	0	50
71120040.B	PROP-4L	Nova L	71	1	2	0	0	4	0	50
71120050.A	PROP-4L W. INDIV. SK	Nova L	71	1	2	0	0	5	0	50
71120060.B	PROP-6L	Nova L	71	1	2	0	0	6	0	50
71120070.A	PROP-6L W. INDIV. SK	Nova L	71	1	2	0	0	7	0	50
71120080.A	PROP-6L W. SURE SEAL	Nova L	71	1	2	0	0	8	0	50
71120140.D	PROP-4K	Nova L	71	1	2	0	1	4	0	50
71030200.B	DIG-IND-1V2	Nova XL	71	0	3	0	2	0	0	50
71120150.B	PROP-4K / 2L	Nova XL	71	1	2	0	1	5	0	50
71130060.A	PROP-6L	Nova XL	71	1	3	0	0	6	0	50
71130080.C	PROP-8L	Nova XL	71	1	3	0	0	8	0	50
71130160.C	PROP-6K	Nova XL	71	1	3	0	1	6	0	50
71130165.B	PROP 6K	Nova XL	71	1	3	0	1	6	5	50
71131080.A	PROP-8L	Nova XL 2.8	71	1	3	1	0	8	0	200
71131160.A	PROP-6K	Nova XL 2.8	71	1	3	1	1	6	0	200
71144140.A	PROP-4K	Nova L 2.4	71	1	4	4	1	4	0	190
71144080.A	PROP-8L	Nova XXL 4.3	71	1	4	4	0	8	0	550
71144160.A	PROP-6K	Nova XXL 4.3	71	1	4	4	1	6	0	550

Appendix C

C.1 TFT Protection Film Replacement

The following instructions apply for Protection Film replacement for both the 2.4" TFT on the Nova L and the 4.3" TFT on Nova XXL transmitters. The steps are to be followed cautiously so as not to incur any scratches/damage to the TFT screen or transmitter.

Items required:

- New protection film depending on the TFT screen size
- Flat smooth-edged tool to remove air bubbles
- Lint-free cloth

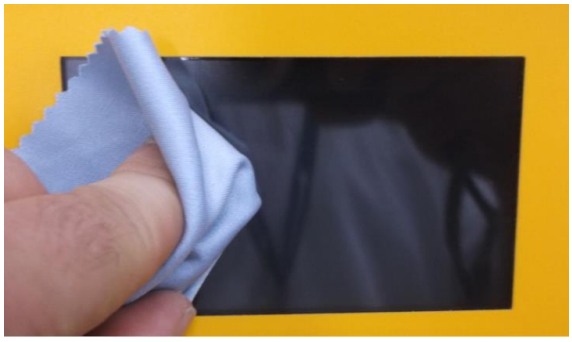
Instructions:

1. Remove the protection film to be replaced.

2. Check that the display is free from scratches and dents before the new protective film is to be applied.



3. Use the lint-free cloth to clean the surface of the display from any dust, grease or particles.



4. Peel the protective blue tab backing and position the screen protector to centre it on the display.



5. Use the smoothing tool to remove any bubbles trapped under the film by pushing them towards the nearest edge. Care must be taken so as not to scratch the upper protecting film.





Protective Film on 2.4” TFT



Protective Film on 4.3” TFT

6. Remove the protective red tab cover.

Transmitter Nova S

Layout Options





Powering ON the Nova S Transmitter

Unlike the other Nova transmitters, the Nova-S does not have a key switch for switching on. Instead, the standard Nova-S versions power up either via a push button on the side or top of the transmitter (normally, this will be green in colour) or with the operation of a toggle switch. In many cases, the 'ON' switch will also activate 'Start' function, if these are on the same control switch. The specific button/switch will be indicated by the standard ON (**I**) and Start (■) symbols. If these are on separate switches then the 'Start' operation must always be carried out after switching the transmitter ON, so as to enable communication with the receiver.

Note: In some cases, the Start Function is also combined with the Horn function (🔈).

Stopping your Transmitter

Press the STOP button (#6). This will automatically make the system ignore any other signal that is transmitted and switch OFF the transmitter.

Powering OFF your Transmitter

Since the standard versions of the Nova S transmitter have no key switch, the coder can be switched off through any one of the following:

1) either through the manual activation (Active Stop) of the Stop switch (#6) which will in turn, open the 'Machine Stop' relay in the receiver

2) or when the Stop function is automatically triggered (Passive Stop) due to an error, such as, transmitter out of range

3) or when the duration of the Auto-OFF timer has elapsed during which no operational activity has been detected.

4) or when the battery has been discharged to 3.4V.

Auto-Off Timer

The coder can be set with a 10-minute timer which will switch off the transmitter when no activity is detected.

Battery State-of-Charge Signals

The onboard buzzer starts beeping fast when the battery reaches 3.4V and the LED starts blinking fast indicating that the coder will soon switch off.

Transmitter Specifications

Transmitter NOVA S	
Housing	Ergonomically designed Impact Resistant Polymer Composite
Environmental Protection	IP 65 (Exceeds Nema 12/13)
Weight	~0.37kg (13oz) depending on configuration
Dimensions	Height: 125 mm
	Width: 160 mm
	Depth: 70 mm
Antenna	Internal as default, external via TNC connector
Power Supply	3.6V NiMH rechargeable MINI battery
Diagnostics	Status LED for operation and standard low battery detection
Battery Operation Time	Min 12 hrs continuous transmission*
Typical Control Configuration (max 24 digital inputs)	Momentary push button for Start-Horn
	3-position maintained toggle switch
	3-position maintained-off-momentary toggle switch
	Push-Pull mushroom head STOP switch
	12-position rotary switch
	Key switch with removable key cap
Frequency Range	4xxMHz or 8xxMhz or 9xxMHz**
Power (RF Output)	Typically ≤ 10mW E.I.R.P
Typical Operating Range	Minimum 150 m. (492ft.) for ≤ 1GHz (Line-of-Sight)
Safety	20-bit programmable address concept with up to 1,000,000 combinations
	Active & Passive Stop Function
	Parity and Checksum
Operating Temperature Range	-25℃ . . . 70℃ (-13℉ . . . 158℉)
Humidity Range	0 - 97% maximum non-condensing
Response Time	Less than 100 msec.
Accessories	Serial cable control through battery enclosure

Technical Specification Transmitter Nova S

*varies by transmitter configuration

** for full Channel Lists refer to Frequency Bands Radio Modules Charts

Battery & Charger

You may power your Nova S transmitter with a Hetronic rechargeable NiMH 3.6V Grey MINI battery inserted in the battery compartment in the bottom side of the transmitter.

Follow the instructions below to ensure best performance of your transmitter and prolonged battery lifetime.

1. Confirm that your batteries are fully-charged. See “Recharging Your Batteries” section in the UCH 2 Charger section.

2. Slide the recharged battery into the battery compartment at the bottom of the transmitter as shown, and snap it into place.

Cable back-up

Cable control on Nova-S transmitters is only possible through the battery compartment due to the space restrictions inside the transmitter. For the control cable to be connected, the battery will have to be removed, and once supply is restored to the transmitter via the control cable, all radio transmissions are cut off automatically.

Accessories and Spare Parts

The Nova-S transmitter comes with a standard belt clip which can be attached to the belly belt specifically designed for the transmitter.

Refer to the online web shop for respective part numbers of any other parts that may need replacement:
https://shop.hetronic.com.mt/en/home

NOTE: Any service/maintenance work and replacement of parts must be carried out by an authorized dealer or service centre specified by Hetronic.

Transmitter Nova M

Layout Options



Powering ON your Transmitter

To switch on the Nova-M transmitter, the standard procedure outlined in section 4.3 is to be followed.

Stopping your Transmitter

Refer to Section 4.6.

Powering OFF your Transmitter

Refer to Section 4.7.

Auto-Off Timer

The coder can be set with a 10-minute timer which will switch off the transmitter when no activity is detected.

Battery State-of-Charge Signals

The onboard buzzer starts beeping fast when the battery reaches 3.4V and the status LED starts blinking red at the same rate indicating that the coder will soon switch off.

Transmitter Specifications

Transmitter NOVA M	
Housing	Ergonomically designed Impact Resistant Polymer Composite
Environmental Protection	IP 65 (Exceeds Nema 12/13)
Weight	~0.91kg (2.1lbs) depending on configuration
Dimensions	Height: 150 mm
	Width: 180 mm
	Depth: 110 mm
Antenna	Internal as default, external via TNC connector
Power Supply	3.6V NiMH rechargeable battery 5 to 30V for cable control
Diagnostics	Status LED for operation and std/adv low battery detection
Battery Operation Time	Min 12hrs continuous transmission*
Control Configuration	Up to 2x Single/Dual/Triple axis cross joysticks or 4x paddle levers
	Digital or Proportional functionality
	Combination of key switches, toggle switches, push buttons, rotary switches, potentiometers and stop switches
	Customized switches available upon request
	Half or Full duplex feedback
Frequency Range	4xxMHz or 8xxMhz or 9xxMHz or 1.216GHz or 2.4GHz**
Power (RF Output)	Typically ≤ 10mW E.I.R.P
Typical Operating Range	Minimum 150 m. (492 ft.) for ≤ 1GHz (Line-of-Sight)
Safety	20-bit programmable address concept with up to 1,000,000 combinations
	Active & Passive Stop Function
	Parity and Checksum
Operating Temperature Range	-25℃ . . . 70℃ (-13℉ . . . 158℉)
Humidity Range	0 - 97% maximum non-condensing
Response Time	Less than 100 msec.
Accessories and options	Cushion and customer logo option
	Optional Custom housing colour
	RS232/CAN Cable control

Technical Specification Transmitter Nova M

*varies by transmitter configuration

** for full Channel Lists refer to Frequency Bands Radio Modules Charts

The Nova-M transmitter can use either an analogue or a digital coder board, depending on the required configuration. The analogue version can hold up to 6 analogue channels and 16 digital channel inputs whilst the digital coder board can hold up to 24 digital channel inputs. Either coder board has an onboard horn which can be used separately or together with an additional optional horn.

Battery & Charger

You may power your Nova M transmitter with a Hetronic rechargeable NiMH 3.6V Grey MINI battery inserted in the battery compartment in the bottom side of the transmitter.

Follow the instructions below to ensure best performance of your transmitter and prolonged battery lifetime.

1. Confirm that your batteries are fully-charged. See “Recharging Your Batteries” section in the UCH 2 Charger section.

2. Slide the recharged battery into the battery compartment at the bottom of the transmitter as shown, and snap it into place.

Cable back-up

Cable control on Nova-M transmitters is possible through either the battery compartment or from a connector plug installed on the side of the transmitter. For back up/control via the battery compartment, the battery will have to be removed. For back up/control via the connector plug, the battery may be left inside the battery compartment as the coder will automatically detect the presence of the cable and disable all wireless activity.

Accessories and Spare Parts

The standard belts for the NOVA M transmitter are the neck and belly belt and these can be obtained with or without the cushion and with or without the logo.

Refer to the online web shop for respective part numbers of any other parts that may need replacement:
https://shop.hetronic.com.mt/en/home

NOTE: Any service/maintenance work and replacement of parts must be carried out by an authorized dealer or service centre specified by Hetronic.

NOTE: Keep the safety instructions for future reference. Always download the User Manual instructions from our website for the latest version available.

Transmitter Nova L

Layout Options



Powering ON your Transmitter

Refer to Section 4.3.

Stopping your Transmitter

Refer to Section 4.6.

Powering OFF your Transmitter

Refer to Section 4.7.

Auto-Off Timer

The coder can be set with a 10-minute timer which will switch off the transmitter when no activity is detected.

Battery State-of-Charge Signals

The onboard buzzer starts beeping fast when the battery reaches 3.4V and the status LED starts blinking red at the same rate indicating that the coder will soon switch off.

Transmitter Specifications

Transmitter NOVA L	
Housing	Ergonomically designed Impact Resistant Polymer Composite
Environmental Protection	IP 65 (Exceeds Nema 12/13)
Weight	~0.745kg (1.6lbs) depending on configuration
Dimensions	Height: 235 mm
	Width: 160 mm
	Depth: 95 mm
Antenna	Internal as default, external via TNC connector
Power Supply	3.6V NiMH rechargeable battery 5 to 30V for cable control
Diagnostics	Status LED for operation and standard/advanced low battery detection
Battery Operation Time	Min 12 hrs continuous transmission*
Control Configuration	2x Single/Dual/Triple axis cross joysticks
	6x Single axis paddle levers
	Combination of key switches, toggle switches, push buttons, rotary switches, potentiometers and stop switches
	Customized switches available upon request
	Half or Full duplex feedback
Frequency Range	4xxMHz or 8xxMhz or 9xxMHz or 1.216GHz or 2.4GHz**
Power (RF Output)	Typically ≤ 10mW E.I.R.P
Typical Operating Range	150m (492ft) for ≤ 1GHz 10mW module (Line-of-Sight) 70m (150ft) for 2.4GHz 10mW module
Safety	20-bit programmable address concept with up to 1,000,000 combinations
	Active & Passive Stop Function
	Parity and Checksum
Operating Temperature Range	-25℃ . . . 70℃ (-13℉ . . . 158℉)
Humidity Range	0 - 97% maximum non-condensing
Response Time	Less than 100 msec.
Accessories and options	Belly belt, neck belt, chest belt or shoulder bar
	Cushion and customer logo option
	Optional Custom housing colour
	RS232/CAN Cable control
TFT	Back-lit monochrome TFT 120x32

Technical Specification Transmitter Nova L

*varies by transmitter configuration

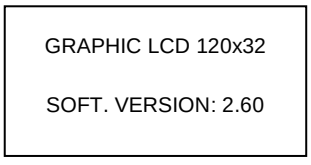
** for full Channel Lists refer to Frequency Bands Radio Modules Charts

Monochrome LCD Display (optional)

There are several standard screens that are displayed on the LCD:

1. Software version

As soon as the display turns on the LCD type and software version installed in the controller are displayed.



2. Welcome screen



The standard Hetronic welcome screen is displayed as soon as the LCD display turns ON after Start Up. The user can opt to choose a different welcome screen by defining the requirements with an authorized Hetronic dealer who can then implement this via a specific graphics programming tool or else choose from the available options when placing the order.

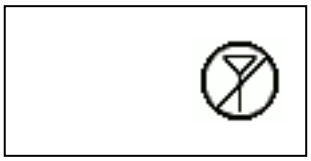
3. Feedback

The feedback function is used to transmit information from the machine or receiver to the transmitter in half or full duplex operation. A number of graphic modes (with different positions and sizes of graphic icons) or up to four lines of text may be used to display the feedback information on the LCD, the format being dependent on the type of message received from the machine. Up to four other on/off digital outputs can also be designated through LCD Feedback.

Contact a Hetronic dealer for information on how to display feedback accordingly.

4. Feedback Error

If the antenna symbol flashes, this means that there is feedback failure i.e. the transmitter has not received a valid telegram for 5 seconds. When this happens there is an imminent risk of losing radio connection thus it is important to check that there are no obstacles blocking the connection and that the units are within the range of the radio system.



5. STOP

The STOP screen is displayed whenever the Transmitter is in STOP mode. This can be achieved when in Active (User manually activates the Stop button #6) or Passive Stop (Transmitter is outside the Antenna reception range or an error occurs).



Battery & Charger

You may power your Nova L transmitter with a Hetronic rechargeable NiMH 3.6V Grey MINI battery inserted in the battery compartment in the bottom side of the transmitter.

Follow the instructions below to ensure best performance of your transmitter and prolonged battery lifetime.

1. Confirm that your batteries are fully-charged. See “Recharging Your Batteries” section in the UCH 2 Charger section.

2. Slide the recharged battery into the battery compartment at the bottom of the transmitter as shown, and snap it into place.

Cable back-up

Cable control on Nova-L transmitters is possible through either the battery compartment or from a connector plug installed on the side of the transmitter. For back up/control via the battery compartment, the battery will have to be removed. For back up/control via the connector plug, the battery may be left inside the battery compartment as the coder will automatically detect the presence of the cable and disable all wireless activity.

Note: When the transmitter is in cable control, the coder offers the possibility to recharge the battery if this is left inside the battery compartment in the transmitter.

Refer to Section 6.9 for more details.

Accessories and Spare Parts

The standard belts for the NOVA L transmitter are the neck, belly and chest belt and these can be obtained with or without the cushion and with or without the logo.

Refer to the online web shop for respective part numbers of any other parts that may need replacement:
https://shop.hetronic.com.mt/en/home

NOTE: Any service/maintenance work and replacement of parts must be carried out by an authorized dealer or service centre specified by Hetronic.

NOTE: Keep the safety instructions for future reference. Always download the User Manual instructions from our website for the latest version available.

Transmitter Nova L 2.4

Layout Options





Powering ON your Transmitter

Refer to Section 4.3.

Stopping your Transmitter

Refer to Section 4.6.

Powering OFF your Transmitter

Refer to Section 4.7.

Auto-Off Timer

The coder can be set with a 10-minute timer which will switch off the transmitter when no activity is detected.

Battery State-of-Charge Signals

The onboard buzzer starts beeping fast when the battery reaches 3.4V and the status LED starts blinking red at the same rate indicating that the coder will soon switch off.

The battery level indicator on the TFT also alerts the user that the battery is being depleted.

TFT Display

The TFT screen layout can be modified according to the user's preferences using the Hetronic Graphics Programming tool.

NOTE: The Protective film covering the TFT can be replaced if scratched or broken. Refer to the instructions in Appendix C.

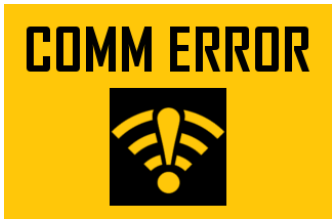
The default TFT display is divided into several segments:



1. The Field Strength (only for systems with feedback)

The field strength indication provides information about the quality of the radio connection. The field strength indication is always visible when the transmitter is switched on. With a perfect connection quality, all 4 bars of the indication are displayed. As the quality of the connection weakens, the reception signal shows less bars depending on how low the quality of the connection is.

If the 'COM error" page is displayed, this means that there is feedback failure i.e. the transmitter is not receiving signals from the receiver. When this happens there is an imminent risk of losing radio connection thus it is important to check that there are no obstacles blocking the connection and that the units are within the range of the radio system.

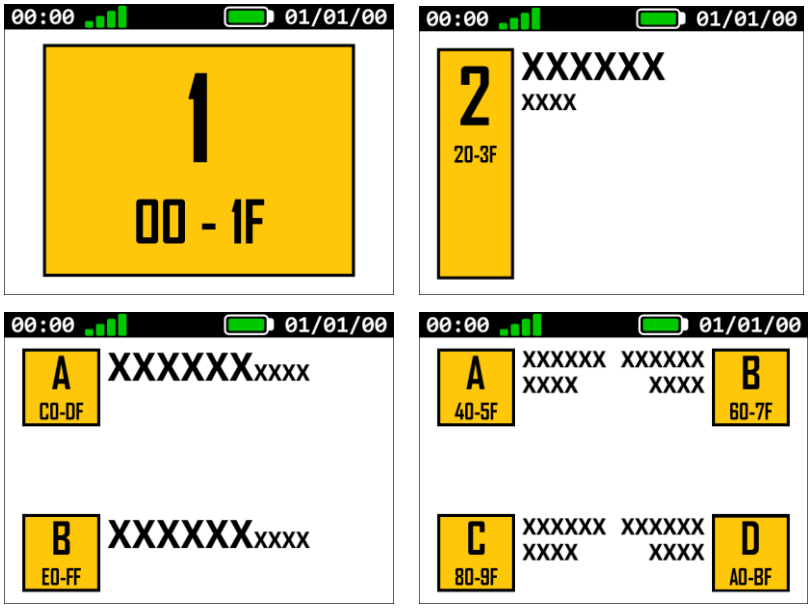


2. Battery Level

The battery level indicator provides information about the current condition of the battery. It is always visible when the transmitter is switched on. As the battery status weakens, the battery level indicator is displayed as a depleting battery until it starts flickering which indicates that it needs to be charged and replaced.

3. Feedback

The feedback function is used to transmit information from the machine or receiver to the transmitter. A number of symbols/graphics or a combination with lines of text are available for displaying feedback information. Contact a Hetronic dealer for information on how to display feedback accordingly.



4. STOP

The STOP screen is displayed whenever the Transmitter is in STOP mode. This can be achieved when in Active (User manually activates the Stop button #6) or Passive Stop (Transmitter is outside the Antenna reception range or an error occurs).



Transmitter Specifications

Transmitter NOVA L 2.4	
Housing	Ergonomically designed Impact Resistant Polymer Composite
Environmental Protection	IP 65 (Exceeds Nema 12/13)
Weight	~1.8kg (3.96lbs) depending on configuration
Dimensions	Height: 264 mm
	Width: 151 mm
	Depth: 213 mm
Antenna	Internal as default, external via TNC connector
Power Supply	3.6V NiMH rechargeable battery pack or 5V to 30V via cable control
Diagnostics	Status LED for operation and standard/advanced low battery detection
Battery Operation Time	Min 12 hrs continuous transmission*
Control Configuration	2x Single/Dual/Triple axis cross joysticks
	Any combination of toggle switches, push-button controls, rotary switches and key switches with removable key caps
	Customized switches available upon request
	Half duplex or Full duplex feedback
Frequency Range	4xxMHz or 8xxMhz or 9xxMHz or 1.216GHz or 2.4GHz**
Power (RF Output)	Typically ≤ 10mW E.I.R.P
Typical Operating Range	150m (492ft) for ≤ 1GHz 10mW module (Line-of-Sight) 70m (150ft) for 2.4GHz 10mW module
Safety	20-bit programmable address concept with up to 1,000,000 combinations
Operating Temperature Range	Active & Passive Stop Function
	Parity and Checksum
	-25℃ . . . 70℃ (-13℉ . . . 158℉)
Humidity Range	0 - 97% maximum non-condensing
Response Time	Less than 100 msec.
Accessories and options	32Mb TFT driver memory
	Cushion and customer logo option
	Optional Custom housing colour
	Belly belt, neck belt, chest belt and shoulder bar
	RS232/CAN Cable control
TFT	2.4'' full colour 240x360 back-lit TFT

Technical Specification Transmitter Nova L 2.4

*varies by transmitter configuration

** for full Channel Lists refer to Frequency Bands Radio Modules Charts

Battery & Charger

You may power your Nova L 2.4 transmitter with a Hetronic rechargeable NiMH 3.6V Grey MINI battery inserted in the battery compartment in the bottom side of the transmitter.

Follow the instructions below to ensure best performance of your transmitter and prolonged battery lifetime.

1. Confirm that your batteries are fully-charged. See “Recharging Your Batteries” section in the UCH 2 Charger section.

2. Slide the recharged battery into the battery compartment at the bottom of the transmitter as shown, and snap it into place.

Cable Back-up

Cable control on Nova L 2.4 transmitters is possible through a connector plug installed on the side of the transmitter. The battery may be left inside the battery compartment as the coder will automatically detect the presence of the cable, thus disable all wireless activity, and recharge the battery if this is left inside the battery compartment in the transmitter. Refer to Section 6.9 for more details.

Accessories and Spare Parts

The standard belts for the NOVA L 2.4 transmitter are the chest, neck and belly belt and these can be obtained with or without the cushion and with or without the logo.
Refer to the online web shop for respective part numbers of any other parts that may need replacement:
https://shop.hetronic.com.mt/en/home

NOTE: Any maintenance work or replacement of parts must be carried out by an authorized dealer or service centre specified by Hetronic.

Transmitter Nova XL

Layout Options



Powering ON your Transmitter

Refer to Section 4.3.

Stopping your Transmitter

Refer to Section 4.6.

Powering OFF your Transmitter

Refer to Section 4.7.

Auto-Off Timer

The coder can be set with a 10-minute timer which will switch off the transmitter when no activity is detected.

Battery State-of-Charge Signals

The onboard buzzer starts beeping fast when the battery reaches 3.4V and the status LED starts blinking RED at the same rate indicating that the coder will soon switch off.

Transmitter Specifications

Transmitter NOVA XL	
Housing	Ergonomically designed Impact Resistant Polymer Composite
Environmental Protection	IP 65 (Exceeds Nema 12/13)
Weight	~1.9kg (4.1lbs) depending on configuration
Dimensions	Height: 165 mm
	Width: 312 mm
	Depth: 170 mm
Antenna	Internal as default, external via TNC connector
Power Supply	3.6V NiMH rechargeable battery pack or 5V to 30V via cable control
Diagnostics	Status LED for operation and standard/advanced low battery detection
Battery Operation Time	Min 12 hrs continuous transmission* for NiMH Min 20 hrs continuous transmission* for Li-Ion
Control Configuration	4x Single/Dual/Triple axis cross joysticks
	8x Single axis paddle levers
	Any combination of key switches, toggle switches, push buttons, rotary switches, potentiometers and stop switches
	Customized switches available upon request
	Half or Full duplex feedback
Frequency Range	4xxMHz or 8xxMhz or 9xxMHz or 1.216GHz or 2.4GHz**
Power (RF Output)	Typically ≤ 10mW E.I.R.P
Typical Operating Range	150m (492ft) for ≤ 1GHz 10mW module (Line-of-Sight) 70m (150ft) for 2.4GHz 10mW module
Safety	20-bit programmable address concept with up to 1,000,000 combinations
Operating Temperature Range	Active & Passive Stop Function
	Parity and Checksum
	-25℃ . . . 70℃ (-13℉ . . . 158℉)
Humidity Range	0 - 97% maximum non-condensing
Response Time	Less than 100 msec.
Accessories and options	Belly belt, neck belt or shoulder bar
	Cushion and customer logo option
	Optional Custom housing colour
	RS232/CAN Cable control
	LCD Display
LCD	Monochrome LCD 120x320

Technical Specification Transmitter Nova XL

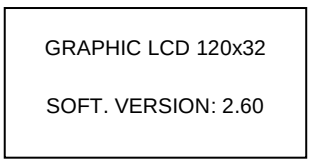
*varies by transmitter configuration and battery type

** for full Channel Lists refer to Frequency Bands Radio Modules Charts

Monochrome LCD Display (optional)

There are several standard screens that are displayed on the LCD:

1. Software version



As soon as the display turns on the LCD type and software version installed in the controller are displayed.

2. Welcome screen



The standard Hetronic welcome screen is displayed as soon as the LCD display turns ON after Start Up. The user can opt to choose a different welcome screen by defining the requirements with an authorized Hetronic dealer who can then implement this via a specific graphics programming tool or else choose from the available options when placing the order.

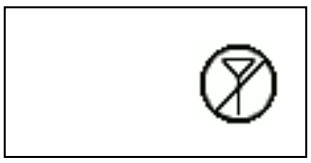
3. Feedback

The feedback function is used to transmit information from the machine or receiver to the transmitter in half or full duplex operation. A number of graphic modes (with different positions and sizes of graphic icons) or up to four lines of text may be used to display the feedback information on the LCD, the format being dependent on the type of message received from the machine. Up to four other on/off digital outputs can also be designated through LCD Feedback.

Contact a Hetronic dealer for information on how to display feedback accordingly.

4. Feedback Error

If the antenna symbol flashes, this means that there is feedback failure i.e. the transmitter has not received a valid telegram for 5 seconds. When this happens there is an imminent risk of losing radio connection thus it is important to check that there are no obstacles blocking the connection and that the units are within the range of the radio system.



5. STOP

The STOP screen is displayed whenever the Transmitter is in STOP mode. This can be achieved when in Active (User manually activates the Stop button #6) or Passive Stop (Transmitter is outside the Antenna reception range or an error occurs).



Battery & Charger

You may power your Nova XL transmitter with a Hetronic rechargeable NiMH 3.6V Grey MINI battery inserted in the battery compartment in the bottom side of the transmitter.

Follow the instructions below to ensure best performance of your transmitter and prolonged battery lifetime.

1. Confirm that your batteries are fully-charged. See “Recharging Your Batteries” section in the UCH 2 Charger section.

2. Slide the recharged battery into the battery compartment at the bottom of the transmitter as shown, and snap it into place.

Cable Back-up

Cable control on Nova-XL transmitters is possible through either the battery compartment or from a connector plug installed on the side of the transmitter. For back up/control via the battery compartment, the battery will have to be removed. For back up/control via the connector plug, the battery may be left inside the battery compartment as the coder will automatically detect the presence of the cable and disable all wireless activity.

Note: When the transmitter is in cable control, the coder offers the possibility to recharge the battery if this is left inside the battery compartment in the transmitter.

Refer to Section 6.9 for more details.

Accessories and Spare Parts

The standard belts for the NOVA XL transmitter are the neck and belly belt and these can be obtained with or without the cushion and with or without the logo.

Refer to the online web shop for respective part numbers of any other parts that may need replacement:
https://shop.hetronic.com.mt/en/home

NOTE: Any service/maintenance work and replacement of parts must be carried out by an authorized dealer or service centre specified by Hetronic.

Transmitter Nova XL 2.8

Layout Options



Powering ON your Transmitter

Refer to Section 4.3.

Stopping your Transmitter

Refer to Section 4.6.

Powering OFF your Transmitter

Refer to Section 4.7.

Auto-Off Timer

The coder can be set with a 10-minute timer which will switch off the transmitter when no activity is detected.

Battery State-of-Charge Signals

The onboard buzzer starts beeping fast when the battery reaches 3.4V and the LED starts blinking RED at the same rate indicating that the coder will soon switch off.

The battery level indicator on the TFT also alerts the user that the battery is being depleted.

TFT Display

The TFT screen layout can be modified according to the user's preferences using the Hetronic Graphics Programming tool.

NOTE: The Protective film covering the TFT can be replaced if scratched or broken. Refer to the instructions in Appendix C.

The default TFT display is divided into several segments:



1. The Field Strength (only for systems with feedback)

The field strength indication provides information about the quality of the radio connection. The field strength indication is always visible when the transmitter is switched on. With a perfect connection quality, all 4 bars of the indication are displayed. As the quality of the connection weakens, the reception signal shows less bars depending on how low the quality of the connection is.

If the 'COM error" page is displayed, this means that there is feedback failure i.e. the transmitter is not receiving signals from the receiver. When this happens there is an imminent risk of losing radio connection thus it is important to check that there are no obstacles blocking the connection and that the units are within the range of the radio system.

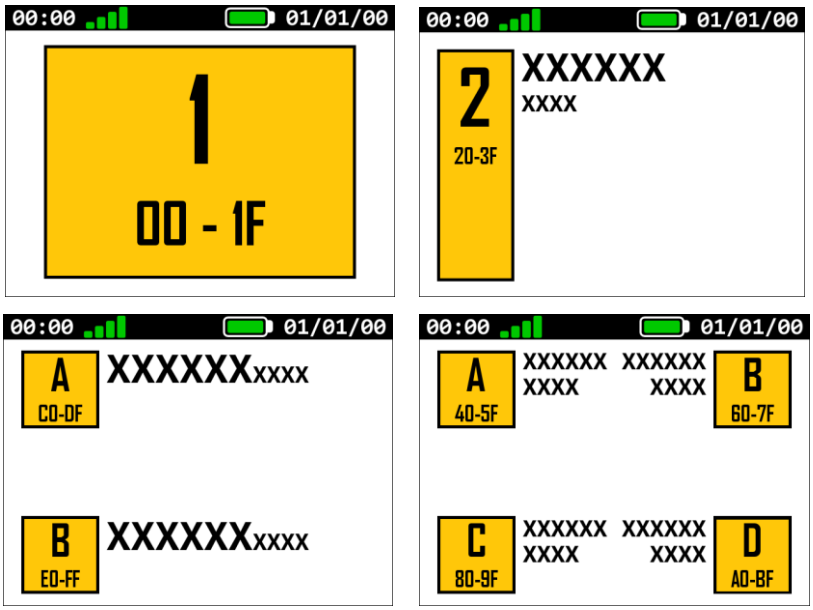


2. Battery Level

The battery level indicator provides information about the current condition of the battery. It is always visible when the transmitter is switched on. As the battery status weakens, the battery level indicator is displayed as a depleting battery until it starts flickering which indicates that it needs to be charged and replaced.

3. Feedback

The feedback function is used to transmit information from the machine or receiver to the transmitter. A number of symbols/graphics or a combination with lines of text are available for displaying feedback information. Contact a Hetronic dealer for information on how to display feedback accordingly.



4. STOP

The STOP screen is displayed whenever the Transmitter is in STOP mode. This can be achieved when in Active (User manually activates the Stop button #6) or Passive Stop (Transmitter is outside the Antenna reception range or an error occurs).



Transmitter Specifications

Transmitter NOVA XL 2.8	
Housing	Ergonomically designed Impact Resistant Polymer Composite
Environmental Protection	IP 65 (Exceeds Nema 12/13)
Weight	~1.9kg (4.1lbs) depending on configuration
Dimensions	Height: 334 mm
	Width: 216 mm
	Depth: 160 mm
Antenna	Internal as default, external via TNC connector
Power Supply	3.6V NiMH rechargeable battery pack 5V-30V via cable control
Diagnostics	Status LED for operation and standard/advanced low battery detection
Battery Operation Time	Min 12 hrs continuous transmission* for NiMH Min 20 hrs continuous transmission* for Li-Ion
Control Configuration	4x Single/Dual/Triple axis cross joysticks
	8x Single axis paddle levers
	Any combination of key switches, toggle switches, push buttons, rotary switches, potentiometers and stop switches
	Customized switches available upon request
	Half or Full duplex feedback
Frequency Range	4xxMHz or 8xxMhz or 9xxMHz or 1.216GHz or 2.4GHz**
Power (RF Output)	Typically ≤ 10mW E.I.R.P
Typical Operating Range	150m (492ft) for ≤ 1GHz 10mW module (Line-of-Sight) 70m (150ft) for 2.4GHz 10mW module
Safety	20-bit programmable address concept with up to 1,000,000 combinations
Operating Temperature Range	Active & Passive Stop Function
	Parity and Checksum
	-25℃ . . . 70℃ (-13℉ . . . 158℉)
Humidity Range	0 - 97% maximum non-condensing
Response Time	Less than 100 msec.
Accessories and options	Belly belt, neck belt or shoulder bar
	Cushion and customer logo option
	Optional Custom housing colour
	RS232/CAN Cable control
	TFT Display
LCD	2.8” 240x320 back-lit TFT, 262K colours

Technical Specification Transmitter Nova XL 2.8

*varies by transmitter configuration and battery type

** for full Channel Lists refer to Frequency Bands Radio Modules Charts

Battery & Charger

You may power your Nova XL 2.8 transmitter with a Hetronic rechargeable NiMH 3.6V Grey MINI battery inserted in the battery compartment in the bottom side of the transmitter.

Follow the instructions below to ensure best performance of your transmitter and prolonged battery lifetime.

1. Confirm that your batteries are fully-charged. See “Recharging Your Batteries” section in the UCH 2 Charger section.

2. Slide the recharged battery into the battery compartment at the bottom of the transmitter as shown, and snap it into place.

Cable Back-up

Cable control on Nova-XL 2.8 transmitters is possible through a connector plug installed on the side of the transmitter. The battery may be left inside the battery compartment as the coder will automatically detect the presence of the cable, thus disable all wireless activity, and recharge the battery if this is left inside the battery compartment in the transmitter.

Refer to Section 6.9 for more details.

Accessories and Spare Parts

The standard belts for the NOVA XL 2.8 transmitter are the neck and belly belt and these can be obtained with or without the cushion and with or without the logo.

Refer to the online web shop for respective part numbers of any other parts that may need replacement:
https://shop.hetronic.com.mt/en/home

NOTE: Any service/maintenance work and replacement of parts must be carried out by an authorized dealer or service centre specified by Hetronic.

Transmitter Nova XL 4.3

Layout Options



Powering ON your Transmitter

Refer to Section 4.3.

Stopping your Transmitter

Refer to Section 4.6.

Powering OFF your Transmitter

Refer to Section 4.7.

Auto-Off Timer

The coder can be set with a 10-minute timer which will switch off the transmitter when no activity is detected.

Battery State-of-Charge Signals

The onboard buzzer starts beeping fast when the battery reaches 3.4V and the LED starts blinking RED at the same rate indicating that the coder will soon switch off.

The battery level indicator on the TFT also alerts the user that the battery is being depleted.

TFT Display

The TFT screen layout can be modified according to the user's preferences using the Hetronic Graphics Programming tool.

NOTE: The Protective film covering the TFT can be replaced if scratched or broken. Refer to the instructions in Appendix C.

The default TFT display is divided into several segments:



1. The Field Strength (only for systems with feedback)

The field strength indication provides information about the quality of the radio connection. The field strength indication is always visible when the transmitter is switched on. With a perfect connection quality, all 4 bars of the indication are displayed. As the quality of the connection weakens, the reception signal shows less bars depending on how low the quality of the connection is.

If the 'COM error" page is displayed, this means that there is feedback failure i.e. the transmitter is not receiving signals from the receiver. When this happens there is an imminent risk of losing radio connection thus it is important to check that there are no obstacles blocking the connection and that the units are within the range of the radio system.

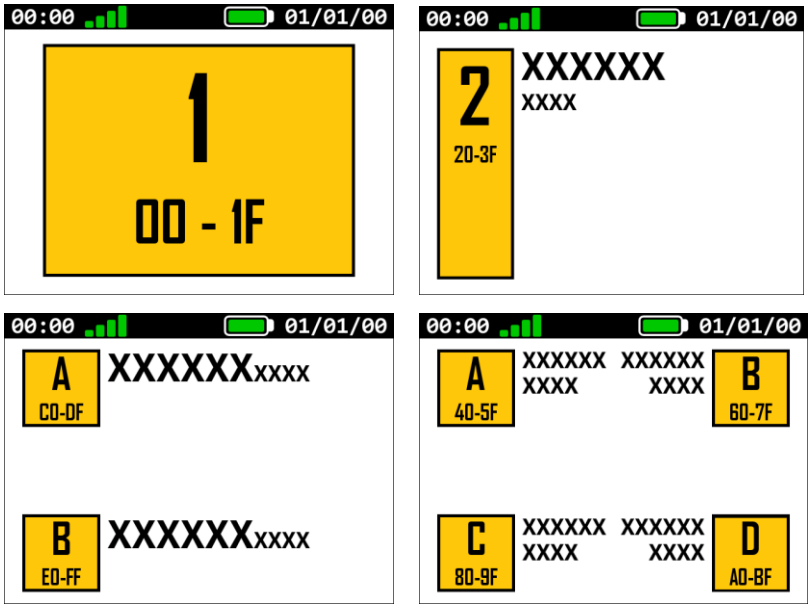


2. Battery Level

The battery level indicator provides information about the current condition of the battery. It is always visible when the transmitter is switched on. As the battery status weakens, the battery level indicator is displayed as a depleting battery until it starts flickering which indicates that it needs to be charged and replaced.

3. Feedback

The feedback function is used to transmit information from the machine or receiver to the transmitter. A number of symbols/graphics or a combination with lines of text are available for displaying feedback information. Contact a Hetronic dealer for information on how to display feedback accordingly.



4. STOP

The STOP screen is displayed whenever the Transmitter is in STOP mode. This can be achieved when in Active (User manually activates the Stop button #6) or Passive Stop (Transmitter is outside the Antenna reception range or an error occurs).



Transmitter Specifications

Transmitter NOVA XL 4.3	
Housing	Ergonomically designed Impact Resistant Polymer Composite
Environmental Protection	IP 65 (Exceeds Nema 12/13)
Weight	~2.3kgs (5lbs.) depending on configuration
Dimensions	Height: 210mm
	Width: 335mm
	Depth: 220mm
Antenna	Internal as default, external via TNC connector
Power Supply	3.7V Li-Ion rechargeable battery 3.6V NiMH rechargeable battery 5V to 30V via cable control
Diagnostics	Status LED for operation and standard/advanced low battery detection
Operation Time	Minimum 20 hrs continuous transmission*
Control Configuration	Up to 4x Single/Dual/Triple axis cross joysticks
	Up to 8x Single axis paddle levers
	Any combination of key switches, toggle switches, push buttons, rotary switches, potentiometers and stop switches
	Customized switches available upon request
	Half or Full duplex
Frequency Range	4xxMHz or 8xxMhz or 9xxMHz or 1.216GHz or 2.4GHz** Video frequency is 2.4GHz or 5 GHz
Power (RF Output)	Typically ≤ 10 mW E.I.R.P
Typical Operating Range	150m (492ft) for ≤ 1GHz 10mW module (Line-of-Sight) 70m (150ft) for 2.4GHz 10mW module
Operating Range for Video Feedback	Near Real-Time Video Feedback 1 to 4 camera capability 100'~300' w/o booster; extended range with boosters up to 2 miles
Safety	20-bit programmable address concept with up to 1,000,000 combinations
	Active & Passive Stop Function
	Parity and Checksum
	Hamming Distance 4
Operating Temperature Range	-20℃ . . . 70℃ (-4℉ . . . 158℉)
Storage Temperature Range	-40℃ . . . 85℃ (-40℉ . . . 185℉)
Humidity Range	0 - 97% maximum non-condensing
Response Time	Less than 100 msec.
Standard Features	8GB on-board memory (by default)
	Linux operating system for advanced graphics management
Accessories	Belly, neck, chest or shoulder belt
	Cushion and customer logo option
	Optional Custom housing colour
TFT	4.3in 480x272 back-lit TFT 262K colours User-replaceable protection cover

Technical Specification Transmitter Nova XL 4.3

*varies by transmitter configuration, GUI and/or Video option

** for full Channel Lists refer to Frequency Bands Radio Modules Charts

Video Feedback (Optional)

The Nova XL 4.3VF option can be used with up to four cameras to provide improved safety and productivity. Video Streaming operates at 2.4GHz.

Battery & Charger

You may power your Nova XL 4.3 transmitter with a Hetronic rechargeable Battery MINI 3.6V Grey NiMH inserted in the battery compartment in the bottom side of the transmitter.

Follow the instructions below to ensure best performance of your transmitter and prolonged battery lifetime.

1. Confirm that your batteries are fully-charged. See "Recharging Your Batteries" section in the UCH 2 Charger section.

2. Slide the recharged battery into the battery compartment at the bottom of the transmitter as shown, and snap it into place.

Cable Back-up

Cable control on Nova-XL 2.8 transmitters is possible through a connector plug installed on the side of the transmitter. The battery may be left inside the battery compartment as the coder will automatically detect the presence of the cable, thus disable all wireless activity, and recharge the battery if this is left inside the battery compartment in the transmitter.

Refer to Section 6.9 for more details.

Accessories and Spare Parts

The standard belts for the NOVA XL 2.8 transmitter are the neck and belly belt and these can be obtained with or without the cushion and with or without the logo.

Refer to the online web shop for respective part numbers of any other parts that may need replacement:
https://shop.hetronic.com.mt/en/home

NOTE: Any service/maintenance work and replacement of parts must be carried out by an authorized dealer or service centre specified by Hetronic.

Transmitter Nova XXL 4.3

Layout Options





Almost any configuration imaginable can be applied on this Nova version, from 4 cross joysticks to 8 paddle levers, together with any combination of push buttons, toggle switches, rotary switches, potentiometers, LEDs, key switches, stop switches. All these can be combined with customizable labels and artwork to meet any customer-specific requirements.

Powering ON your Transmitter

Refer to Section 4.3.

Stopping your Transmitter

Refer to Section 4.6.

Powering OFF your Transmitter

Refer to Section 4.7.

Auto-Off Timer

The coder can be set with a 10-minute timer which will switch off the transmitter when no activity is detected.

Battery State-of-Charge Signals

The onboard buzzer starts beeping fast when the battery reaches 3.4V and the status LED starts blinking RED at the same rate indicating that the coder will soon switch off.

The battery level indicator on the TFT also alerts the user that the battery is being depleted.

TFT Display

The TFT screen layout can be modified according to the user's preferences using the Hetronic Graphics Programming tool.

NOTE: The Protective film covering the TFT can be replaced if scratched or broken. Refer to the instructions in Appendix C.

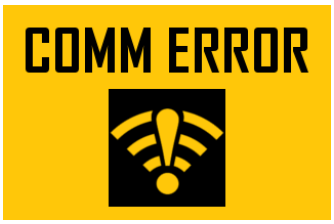
The default TFT display is divided into several segments:



1. The Field Strength (only for systems with feedback)

The field strength indication provides information about the quality of the radio connection. The field strength indication is always visible when the transmitter is switched on. With a perfect connection quality, all 4 bars of the indication are displayed. As the quality of the connection weakens, the reception signal shows less bars depending on how low the quality of the connection is.

If the 'COM error" page is displayed, this means that there is feedback failure i.e. the transmitter is not receiving signals from the receiver. When this happens there is an imminent risk of losing radio connection thus it is important to check that there are no obstacles blocking the connection and that the units are within the range of the radio system.

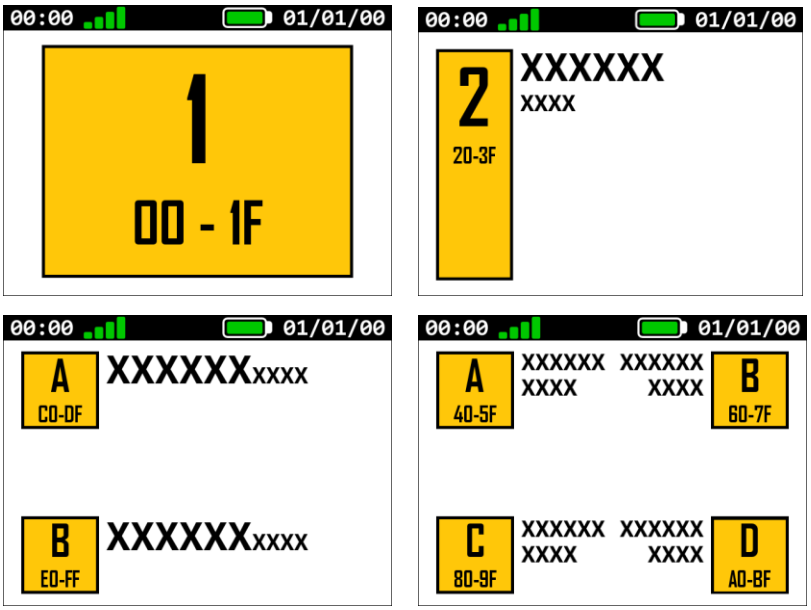


2. Battery Level

The battery level indicator provides information about the current condition of the battery. It is always visible when the transmitter is switched on. As the battery status weakens, the battery level indicator is displayed as a depleting battery until it starts flickering which indicates that it needs to be charged and replaced.

3. Feedback

The feedback function is used to transmit information from the machine or receiver to the transmitter. A number of symbols/graphics or a combination with lines of text are available for displaying feedback information. Contact a Hetronic dealer for information on how to display feedback accordingly.



4. STOP

The STOP screen is displayed whenever the Transmitter is in STOP mode. This can be achieved when in Active (User manually activates the Stop button #6) or Passive Stop (Transmitter is outside the Antenna reception range or an error occurs).



Transmitter Specifications

Transmitter NOVA XXL 4.3	
Housing	Ergonomically designed Impact Resistant Polymer Composite
Environmental Protection	IP 65 (Exceeds Nema 12/13)
Weight	~1.8kg (3.97lbs) to 3.5kgs (8lbs.) depending on configuration
Dimensions	Height: 367 mm
	Width: 229 mm
	Depth: 174 mm
Antenna	Internal as default, external via TNC connector
Power Supply	3.7V Li-Ion rechargeable or 5V to 30V via cable control
Diagnostics	Status LED for operation and standard/advanced low battery detection
Operation Time	Minimum 20 hrs continuous transmission*
Control Configuration	Up to 4x Single/Dual/Triple axis cross joysticks
	Up to 8x Single axis paddle levers
	Any combination of key switches, toggle switches, push buttons, rotary switches, potentiometers and stop switches
	Customized switches available upon request
	Half or Full duplex
Frequency Range	4xxMHz or 8xxMhz or 9xxMHz or 1.216GHz or 2.4GHz** Video frequency is 2.4GHz or 5 GHz
Power (RF Output)	Typically ≤ 10 mW E.I.R.P
Typical Operating Range	150m (492ft) for ≤ 1GHz 10mW module (Line-of-Sight) 70m (150ft) for 2.4GHz 10mW module
Operating Range for Video Feedback	Near Real-Time Video Feedback 1 to 4 camera capability 100'~300' w/o booster; extended range with boosters up to 2 miles
Safety	20-bit programmable address concept with up to 1,000,000 combinations
	Active & Passive Stop Function
	Parity and Checksum
	Hamming Distance 4
Operating Temperature Range	-20℃ . . . 70℃ (-4℉ . . . 158℉)
Storage Temperature Range	-40℃ . . . 85℃ (-40℉ . . . 185℉)
Humidity Range	0 - 97% maximum non-condensing
Response Time	Less than 100 msec.
Standard Features	8GB on-board memory (by default)
	Linux operating system for advanced graphics management
Accessories	Belly, neck, chest or shoulder belt
	Cushion and customer logo option
	Optional Custom housing colour
TFT	4.3in 480x272 back-lit TFT 262K colours User-replaceable protection cover

Technical Specification Transmitter Nova XXL 4.3

*varies by transmitter configuration, GUI and/or Video option

** for full Channel Lists refer to Frequency Bands Radio Modules Charts

Video Feedback (Optional)

The NOVA XXL4.3VF option can be used with from one to four cameras to provide improved safety and productivity. Video streaming operates at 2.4GHz.

Battery & Charger

You may power your Nova XXL 4.3 transmitter with a Hetronic rechargeable 3.7V/9Ah Black Li-Ion Battery inserted in the battery compartment in the bottom side of the transmitter.

Follow the instructions below to ensure best performance of your transmitter and prolonged battery lifetime.

1. Confirm that your batteries are fully-charged. See "Recharging Your Batteries" section in the UCH 3 Charger section.

2. Slide the recharged battery into the battery compartment at the bottom of the transmitter as shown, and snap it into place.

Cable Back up

Cable control on Nova-XXL 4.3 transmitters is possible through a connector plug installed on the side of the transmitter. The battery may be left inside the battery compartment as the coder will automatically detect the presence of the cable, thus disable all wireless activity, and recharge the battery if this is left inside the battery compartment in the transmitter.

Refer to Section 6.9 for more details.

Accessories and Spare Parts

The standard belts for the NOVA XXL 4.3 transmitter are the neck, chest and belly and the shoulder belt and these can be obtained with or without the cushion and with or without the logo.

Refer to the online web shop for respective part numbers of any other parts that may need replacement:
https://shop.hetronic.com.mt/en/home

NOTE: Any service/maintenance work and replacement of parts must be carried out by an authorized dealer or service centre specified by Hetronic.

Battery Types and Specifications

Battery MINI 3.6V/2.75Ah Grey NiMH

Item No. 68301000

Battery MINI 3.6V 2.75Ah	
Rated Capacity	3.6V 2.75Ah NiMH rechargeable battery pack
Storage Environment Conditions	-20°C . . . 40°C, 85%RH max (for short periods less than 1 month) -20°C . . . 30°C, 85%RH max (for periods less than 3 months) -20°C . . . 20°C, 85%RH max (for long term storage, max 1 year)
Charging Temperature Range	0℃ . . . 40℃ (32℉ . . . 104℉), max 85%RH
Discharging Temperature Range	-10℃ . . . 55℃ (14℉ . . . 131℉) , max 85%RH
Charging Time (hrs)	14 (0.1 CmA)

3.6V 2.75Ah MINI Battery Technical Specification



Battery 3.7V/9.75Ah Black Li-Ion

Item No. 68303607.A

Battery Li-Ion 3.7V 9.75Ah	
Rated Capacity	3.7V Li-Ion rechargeable battery pack, 9.75Ah
Storage Environment Conditions	-20°C . . . 50°C, 85%RH max (for periods less than 1 month) -20°C . . . 45°C, 85%RH max (for periods less than 3 months) -20°C . . . 20°C, 85%RH max (for long term storage, max 1 year)
Charging Temperature Range	0℃ . . . 45℃ (32℉ . . . 113℉), max 85%RH (for standard charge)
Discharging Temperature Range	-20℃ . . . 50℃ (-4℉ . . . 122℉) , max 85%RH
Charging Time (hrs)	6 (0.3C)

3.7V 9.75Ah Li-Ion Battery Technical Specification



Battery Disposal

AVOID ENVIRONMENTAL POLLUTION. Recycle your rechargeable batteries according to local recycling rules and regulations. If you have questions or problems operating your battery charger, please contact your nearest Hetronic dealer or service center.

Standard Hetronic rechargeable batteries are the Lithium–Ion type. These batteries have no “memory effect” when charging a battery that is not fully discharged.

Prolonged Battery Life

Avoid battery misuse, over charging, overheating or regular dropping. This can cause permanent damage to the cells.

It is recommended that the battery is not used at temperatures exceeding 60°C for a prolonged time since this will shorten the battery lifetime by approximately 15%.



Never keep a fully charged battery at elevated temperatures. Battery pack does not die suddenly but the runtime gradually shortens as the capacity fades.



Keeping the charge in the 40% to 80% range will prolong battery life.

Unfortunately there is no avoiding fact that battery has a finite life, after which they will certainly degrade. Following these basic tips can help delay the inevitable.

MINI UCH 2 Battery Charger

Recharging your Batteries

To charge the MINI battery, it must be removed from the transmitter by lifting it up and sliding it out of the battery compartment. Slide the battery in the charging unit until it clips in place and the yellow 'CHARGE" LED flashes for two seconds. The yellow LED will remain ON for the whole charging process. When the battery is fully charged, the "READY" green LED lights up and the "CHARGE" yellow LED goes off.

NOTE: If the yellow LED continues to blink after 2 seconds of inserting the battery in the charger, then the battery is defective and must be replaced.

A switch on the indicator panel initiates fast charging of the battery. When "Fast Charge" is in progress a red LED turns on together with the yellow "CHARGE" LED. When fast charging is complete, the green "READY" LED lights up and the red LED switches off.



Charging the MINI Battery

Leave the battery in the charger until it is needed. The charger supplies a "trickle" charge but it will not over-charge the battery.

The charger power cable is supplied with different plugging options: EU plug, cigarette lighter plug, US plug, etc. Below is the list of the variants available.



Charger plug variations

Reference ID	Item Number	Description
A	68108570.A	Charger Mini 90-270VAC 300/780mA Euro-Plug with Fast Charge
B	68108690.A	Charger Mini 10-30VDC 300/780mA Plug Cigarette Lighter with Fast Charge
C	68108580.A	Charger MINI 90-270VAC 300/780mA UL-Plug with Fast Charge
D	68108595.A	Charger Mini 90-270VAC 300/780mA Australia/N.Z. Plug with Fast Charge
E	68108670.A	Charger Mini 10-30VDC 300/780mA Sliding Socket with Fast Charge
F	68108560	Charger Mini 90-270VAC 300/780mA UK-Plug with Fast Charge

List of UCH 2 Charger Variants



EXPLOSIVE GASES AND FLYING DEBRIS can cause death or serious injury. Use only Hetronic replacement rechargeable batteries. Use of unauthorized replacement batteries could cause a battery explosion resulting in injury or death of the operator or other people in the work area.

UCH 3 Battery Charger

Follow the instructions below to ensure best performance of your transmitter and prolonged battery lifetime.

Recharging your Batteries

To charge the 3.7V Li-Ion Battery pack, it must be removed from the transmitter by lifting it up and sliding it out of the battery compartment. Slide the battery pack in the charging unit until it clips in place and make sure that at least one of the four red LEDs switches on. The red LEDs will switch ON sequentially as charging progresses and during the whole charging process. When the battery is fully charged, the red LEDs switch off and the three green LEDs switch on instead.

Leave the battery in the charger until it is needed. The charger supplies a “trickle” charge but it will not over-charge the battery.

The charger power cable is supplied with different plugging options: EU plug, cigarette lighter plug, US plug, etc.



Charger plug variations

Reference ID	Item Number	Description
A	68108870	Charger UCH-3 9-30VDC 1A Sliding Socket
B	68108875	Charger UCH-3 9-30VDC 1A Plug Cigarette Lighter
C	68108880	Charger UCH-3 9-30VDC 1A AC Adapter

List of UCH 3 Charger Variants

EXPLOSIVE GASES AND FLYING DEBRIS can cause death or serious injury. Use only Hetronic replacement rechargeable batteries. Use of unauthorized replacement batteries could cause a battery explosion resulting in injury or death of the operator or other people in the work area.