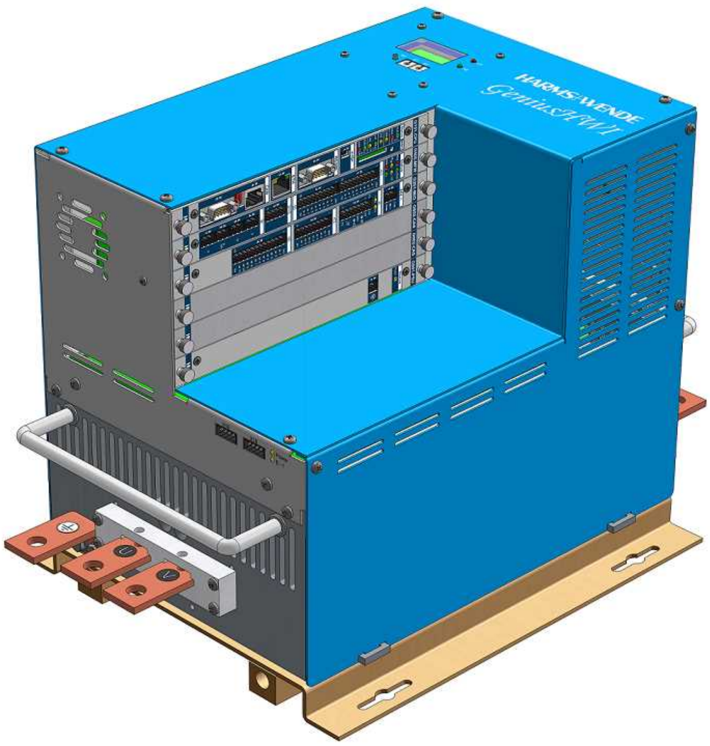
Medium-frequency inverter

GeniusHWI

GeniusHWI

Operating instructions

35031-08en



Imprint

Harms & Wende GmbH & Co. KG

Grossmoorkehre 9

D-21079 Hamburg

Germany

Tel.: +49 40 766 904-0

Fax.: +49 40 766 904-88

E-mail: hwh@harms-wende.de

Internet: www.harms-wende.de

Representative managing directors:

Ralf Bothfeld, Horst-Uwe Siemßen

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Liability exclusion

All data refer to systems and machines with average utilisation. In case of doubt, contact our HWH Service department, tel.: +49 40 766 904-84.

Harms & Wende accepts no liability for damage caused through the installation and operation of other software applications.

Contents

1 Introduction

1.1 About this documentation

This documentation is part of the delivery scope of GeniusHWI.

This documentation must always be available at the module's operating location. Store for future use.

Complete documentation

The complete documentation (depending on equipment) is comprised as follows:

- Operating instructions
- "Pin assignments" document
- Control cabinet connection
- IQR operating instructions
- User interface online help
- System messages
- Quick guide

The complete documentation is available in the download area at www.harms-wende.de or will be provided upon request. One-off registration is required to use the download area.

Target group

This documentation is aimed at trained personnel – specialist electricians or persons with electrical engineering training as per DIN VDE 1000-10 – with knowledge of handling welding system control systems. This documentation is not a substitute for training.

Standards

Harms & Wende does not undertake to provide any guarantee for the completeness or correctness of laws, standards and guidelines which are mentioned or cited in this documentation. Obtaining the complete, relevant, valid version of the laws, standards and guidelines is recommended.

Service

If you have any further questions on the content of this documentation or the operation of your module, please contact Harms & Wende GmbH & Co. KG.

HWH Service, tel.: +49 40 766 904-84.

1.2 Typographical conventions

Safety instructions

In this documentation, four signal words indicate different degrees of hazard.

DANGER

Hazard source

Non-observance will result in death or serious injury.

- Avoidance measure

WARNING

Hazard source

Non-observance may possibly result in death or serious injury.

- Avoidance measure

CAUTION

Hazard source

Non-observance may lead to moderate to slight physical injury.

- Avoidance measure

NOTICE

Hazard source

Improper handling or non-observance may lead to material damage.

- Avoidance measure

Other instructions

Certain points of this documentation provide separate information indicated by the following symbol:

Note

Indicates additional important information.

Danger symbols

The following symbols can be found in this documentation:

	Danger point
	Hazardous electrical voltage
	Explosive substances
	Warning regarding magnetic fields

Emphasised text sections

To emphasise them, I/O signals, parameters and process variables are shown within angled brackets:

<Input signal>

Operating controls are shown in square brackets:

[Operating control]

The path with which a specific menu item can be selected in the operating unit/user interface is shown as follows:

Menu level > Sub-menu level > Program level > Value level

Designation of Harms & Wende products

All Harms & Wende products are referred to generically as "modules". If reference is made to specific products, these are designated corresponding to their function, e.g. as "welding control system" or "welding inverter".

2 Device description

GeniusHWI integrates a control system and power unit for operating a medium-frequency welding transformer. The inverter is intended for operation in control cabinets and is available with different components depending on the required power and supply voltage, see *Appendix*, p. 293.

Functional principle

GeniusHWI operates with an electronic control system. The inverter transforms the incoming mains voltage into a single-phase square-wave signal. This square-wave signal is used to actuate a welding transformer.

Technical data see *Technical data*, p. 245

2.1 Proper use

The module controls welding tasks in the field of resistance welding.

This includes:

- Spot welding on one and two sides
- Projection welding on one and two sides
- Flash butt welding
- Upset welding
- Heating.

The module is intended to be used as a component in industrial systems and machines which are in technically flawless condition.

The limit values specified in the technical data may not be exceeded at any time.

Any other use is not intended and is improper.

Improper use, unauthorised conversion and spare part procurement

Improper use of and/or modifications to the hardware or software of the module, which have not been verified and approved by Harms & Wende, may result in unforeseeable damage.

Risks which arise in the event of improper use are the responsibility of the owner.

2.2 Structure

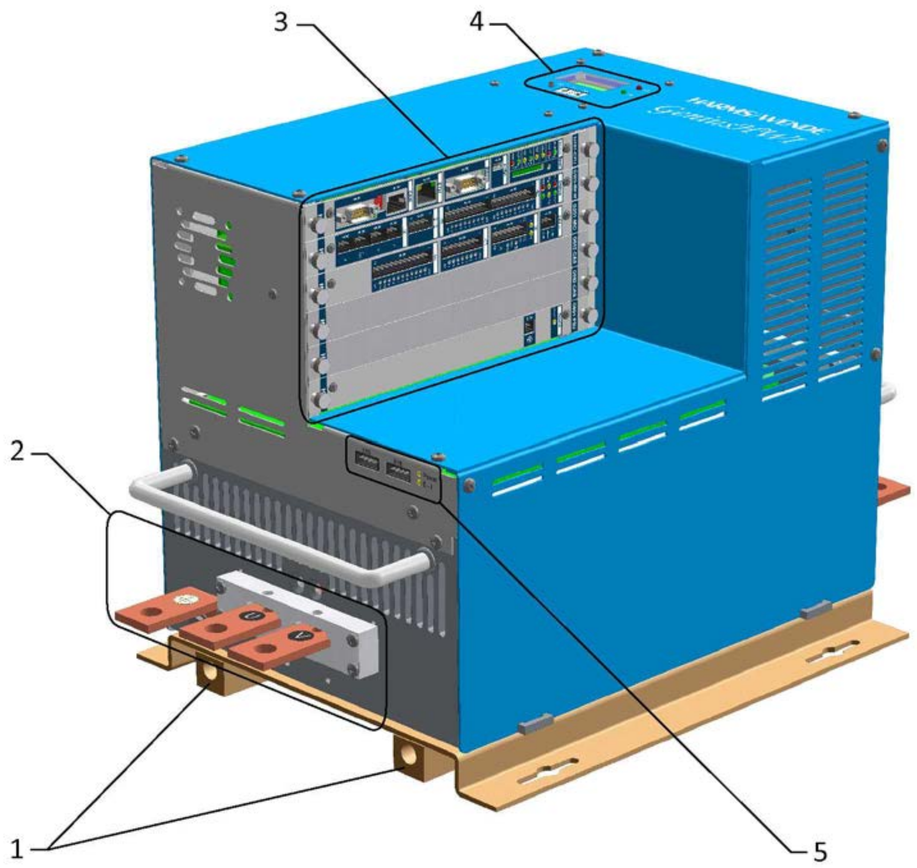


Fig. 2-1: GeniusHWI device overview, view from the side

1	Water connections
2	Power output connections
3	Slots for the plug-in modules
4	Display unit (IGBT error)
5	Status display

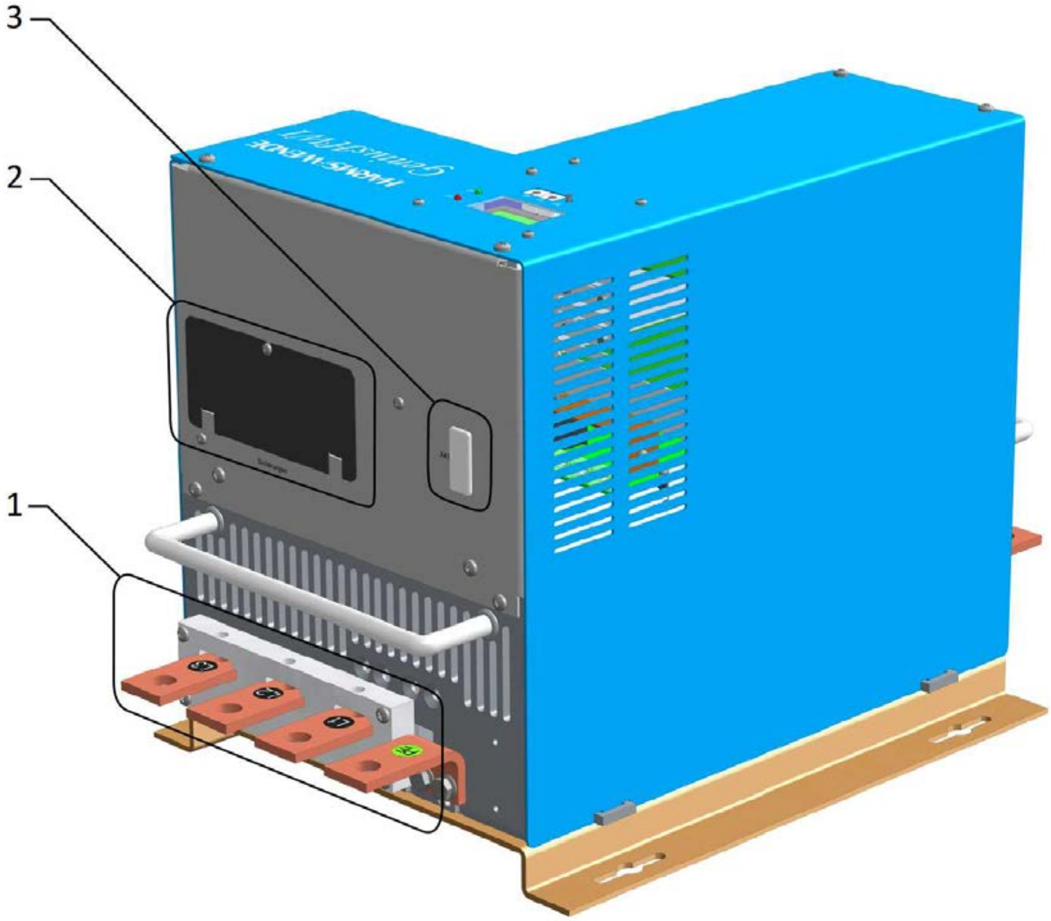


Fig. 2-2: GeniusHWI device overview, view from the top

1	Power input connections
2	Fuse cover
3	Slave connection (x41)

2.3 Display unit

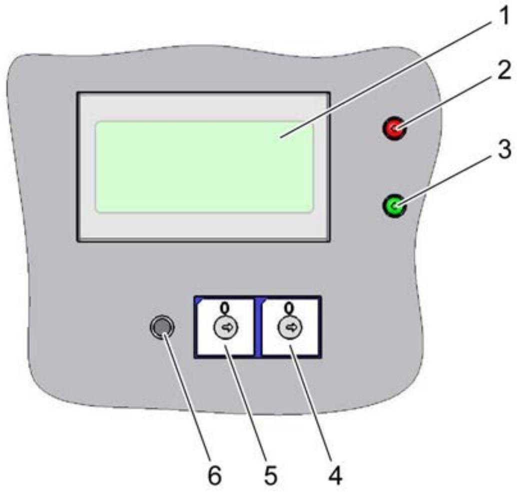


Fig. 2-3: Display unit

1	Display
2	Red LED display (status)
3	Green LED display (status)
4	Coding switch S2, currently without function
5	Coding switch S1, currently without function
6	Button S3

Display

After starting the system, the display shows the CPU's firmware version.

The status of the welding process is shown on the display using welding codes (wld). See *Welding process: status display on the display*, p. 76.

Red and green LED display

Red	=	fault/alarm
Green	=	ready

Button S3

When the device is switched on, one of the following values is always shown on the display:

- Processor capacity utilisation in percent
- Current messages as continuous text
- IP address as continuous text
- Loaded firmware version.
  At the same time, this is also the display after starting the system, see Display.

Pressing the button switches the display to the next value in the list. If the loaded firmware version is displayed at the end of the list, the display switches back to the first value in the list when the button is next pressed, see above.

Warm start

If button S3 is pressed for more than 5 s, the control system performs a warm start.

- The text "reset" is shown in the display.
  A warm start is performed.

2.4 Labelling

On the rear of the module a type plate is mounted:

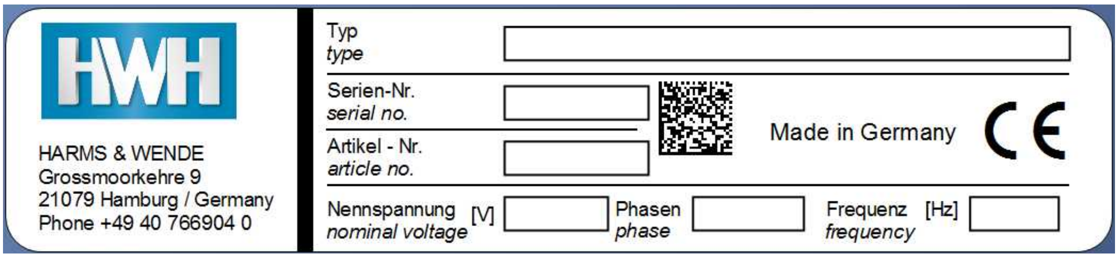


Fig. 2-4: Type plate

This specifies the name, serial number and article number of the module plus the address and telephone number of Harms & Wende GmbH & Co. KG.

2.5 Inverter equipment

The equipment may vary depending on the functions. Not all of the functions listed in these operating instructions are part of the module supplied.

XPegasus and XComand user interface

The XPegasus and XComand software, with which the modules are parameterised for the respective welding processes, is available as a user interface. The welding processes are visualised using the user interface. At Harms & Wende, the XPegasus and XComand user interfaces are separately available in different versions and can be connected to the modules using the system's EtherNet bus system.

Note

Information on using the user interface is available in the accompanying online help.

2.6 Operating conditions

The module may only be operated in dry, dust-free rooms.

The ambient temperature must lie between 5 °C and 55 °C. The relative humidity must be max. 90%, non-condensing.

The module must not be exposed to severe vibrations.

3 Safety

Read the safety instructions prior to installation and commissioning under all circumstances. The operating instructions must be read and understood. Inadequately informed operators my endanger themselves and other persons.

Note

The system's internal working, operating and safety regulations must also be observed.

3.1 Basic notes

Operator

The operator is responsible for adhering to the safety regulations. The operator is any natural or legal person who uses the system or on whose behalf the system is used. The operator may appoint an officer to assert his rights and perform his duties as his representative.

National safety regulations

In Germany, the requirements for persons employed in the field of electrical engineering as per DIN VDE 1000-10 and the accident prevention regulations for electrical systems and operating equipment (DGUV regulation 3) must be observed.
National safety regulations, e.g. from professional associations, social insurance companies, authorities for occupational safety and others must also be heeded.

Electrical safety

Work on the module may only be carried out by specialist electricians or persons with electrical engineering training.
The work that may be performed by persons who are neither specialist electricians nor persons with electrical engineering training must be decided by a responsible, specialist electrician.

Specialist electrician

A specialist electrician is a person who, due to his specialist training, knowledge and experience, can assess the work given to him and recognise possible dangers.

Person with electrical engineering training

A person with electrical engineering training has been instructed by a specialist electrician on the tasks given to him and the possible dangers of improper behaviour and, if necessary, trained as well as instructed as regards the necessary safety devices and protective measures.

Dangers resulting from disregarding safety instructions

Failure to follow the safety instructions may pose a danger to persons as well as result in damage to the module and/or system. Failure to follow the safety instructions renders any claims for damages null and void.

Operation in residential environments

Note

The module (class A) is not intended for operation in residential environments in which current is supplied via a public, low-voltage grid. Due to both line-bound and radiated interference, it may possibly be difficult to guarantee electromagnetic compatibility in these environments.

If the module is connected to a public, low-voltage grid, the operator is responsible for guaranteeing that the module may be connected, after consulting the operator of the power supply grid if necessary.

3.2 Personal protection

All persons who install, operate or maintain the module or control cabinet must observe the safety instructions contained in this documentation. Work on the module or control cabinet may only be performed by specialist electricians.

Danger due to contact with electrical parts

The contact guard for live parts must not be removed.

DANGER

Hazardous voltage at the connection terminals, at supply L1, L2, L3 and at transformer connections U, V

Electric shock resulting in death.

- Maintain a safety distance.
- Apply the five safety rules prior to service work.
- Residual current protective devices must be sensitive to all currents (RCD type B).

If the module is used in an environment which requires increased protection against direct contact with the power supply and power output terminals (see EN 60204-1), an optional finger guard is available. The finger guard is already included in the delivery scope of certain modules.

If necessary, contact HWH Service, tel.: +49 40 766 904-84.

Magnetic fields

Strong magnetic fields occur in the area of the module.

WARNING

Strong magnetic fields

Cardiac dysrhythmia may occur in persons with pacemakers. The risk of cardiac damage with potentially fatal results exists.

- Adhere to a safety distance of at least 3 m.

Discharge time

The inverter is not immediately de-energised after being switching off. The 2-minute discharge time must be adhered to before opening the inverter.

DANGER

Hazardous voltage at the inverter

Electric shock with potentially fatal results on opening the inverter

- Before opening, wait for 2 minutes until the residual energy stored in the inverter has dissipated.

3.3 Warning signs

The warning signs mounted on the inverter must be observed and must be kept complete and in legible condition.

The following warning signs are mounted on the inverter:

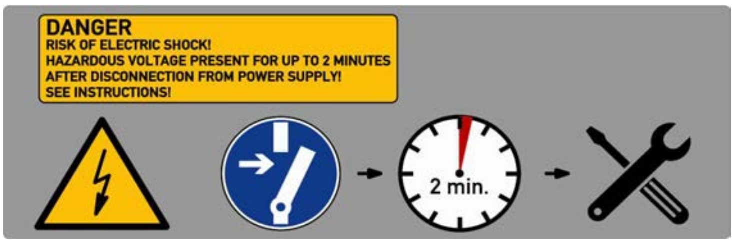


Fig. 3-1: Discharge time warning sign

Caution: high voltage! Before opening the housing and when replacing fuses, switch off the main switch! Discharge time 2 minutes.

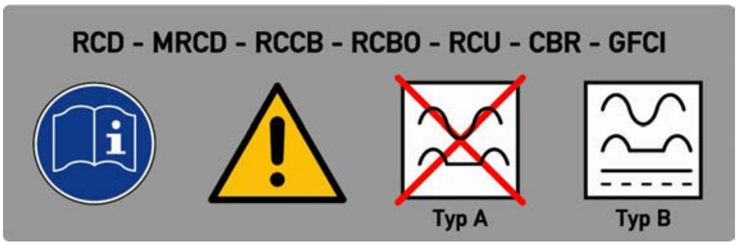


Fig. 3-2: Type of fault current circuit breaker information sign

Residual current protective devices for protection against contact must be sensitive to all currents (RCD type B). Make sure that the system is de-energised prior to maintenance work. Heed the safety information.

3.4 Safety instructions for service and maintenance work.

Service and maintenance work may only be performed by authorised and qualified specialist electricians.

Work on the system and its components may only ever be performed when they are switched off and thus de-energised.

DANGER

Hazardous voltage at the connection terminals, at supply L1, L2, L3 and at transformer connections U, V

Electric shock resulting in death.

- Maintain a safety distance.
- Apply the five safety rules prior to service work.
- Residual current protective devices must be sensitive to all currents (RCD type B).

Prior to the start of service work on electrical systems, observe the following 5 safety rules under all circumstances:

- Power down
- Secure to prevent unintentional reactivation
- Ensure that the system is de-energised
- Earth and short-circuit (at U >1000 V)
- Cover or cordon off any adjacent live parts

3.5 Device protection

Incorrect connection

The module may be damaged due to incorrect connection.

Only connect inputs to voltage corresponding to the technical data.

NOTICE

Module incorrectly connected

Damage to the module

- Only connect inputs to voltage corresponding to the technical data.
- Do not connect outputs to external voltages.
- Mains, intermediate circuit and transformer cables must not be connected to the +24 V low voltage. Ensure adequate insulation.

High-voltage or insulation test

If the system's electrical equipment is subjected to a high-voltage or insulation test, all module connections must be disconnected.

NOTICE

System high-voltage or insulation test

Damage to the module's electronic components.

- Disconnect or remove the module's connections.

Electrostatic charging

Electrostatic discharging (ESD) may cause damage to the modules, especially the plug-in modules.

ESD protection is required for electrostatic sensitive components (EGB)

- During packaging, transport and storage
- During work with personnel, workplaces, devices and tools coming into contact with electrostatically sensitive components.

NOTICE

Electrostatic charging

Damage to the module's electronic components.

- Discharge persons and objects which come into contact with module components through earthing (e.g. with ESD shoes) or they must have the same voltage potential.

Emergency stop

Ensure the possibility of emergency stop to avoid damage to the system and the module, e.g. through integration into the emergency stop chain.

See *Emergency stop input*, p. 36.

Water-cooled inverter

When using water-cooled inverters, observe the following notes to avoid damaging the device:

NOTICE

Frost damage

Cracks in the heat sink may occur.

- Drain the heat sinks completely prior to transport, storage or temporary decommissioning.
- Do not store below the freezing point.

NOTICE

Leaky cooling water lines and hose connections

Escaping cooling water may cause damage to the module and surrounding parts of the system.

- Before switching on the supply voltage, check the cooling water supply lines and connections for leaks.
- Protect devices in the immediate vicinity against escaping cooling water.

4 Delivery

The module should remain in the original packaging until final installation. As a result, it is optimally protected against mechanical damage and harmful electrostatic voltages (ESD).

4.1 Scope of delivery

The delivery scope includes:

- GeniusHWI
- Operating instructions
- One set of plugs, matching plug-in modules.
- Optionally available: finger guard for connection terminals.

4.2 Delivery

The module is delivered in a reinforced box with double base and interior foam lining. The box may have to be secured on a pallet.

Note

On delivery, please check the following points:

- Immediately after receipt, check the delivery against the delivery note to determine completeness and any transport damage.
- Notify the transport company and the Harms & Wende GmbH & Co. KG Service department immediately of any damaged parts.
- The system may not be commissioned until the damaged parts have been repaired or replaced.

5 Transport

5.1 Internal

After checking the delivery condition, transport the module to the installation location.

NOTICE

Transport damage to the module

Parts of the housing and power connections may be damaged due to improper transport.

- Do **not** use electrical power connections as carrying handles.
- Use a suitable means of conveyance.

5.2 Return transport/shipping

If it is necessary to return/ship the module, it must be packaged properly and securely.

NOTICE

Improper packaging

Parts of the housing and power connections may be damaged or destroyed during shipping.

- Always package the module in a reinforced box with a double base.
- Line the interior of the box with foam.
- Do **not** use power connections as carrying handles.
- Seal the box securely and secure to a pallet, if necessary.

6 Assembly

Data on the dimensioning of the inverter, installation in a control cabinet and recommendations for lead cross-sections can be found in the technical data chapter.

See *Fuses and leads*, p. 263.

Inverter installation

If the inverter is installed in a control cabinet, a sufficient distance from all sides of the control cabinet must be maintained to avoid heat build-up in the control cabinet. We additionally recommend the installation of an air circulation system in difficult temperature conditions.

Also, when installing inverters one on top of the other, enough space should be maintained to allow the warm exhaust air from being sucked in by the next inverter below it.

If more than one inverter is to be installed in the control cabinet, installing an air circulation facility is urgently required.

Control cabinet

On installation of a control cabinet containing an integrated inverter, a distance must be maintained between the heat sink at the rear and the wall.

If several control cabinets are to be installed next to each other, we also recommend maintaining sufficient distance between the control cabinets and the additional installation of an air circulation system.

Cooling losses

Cooling losses of the inverter depend on the supply voltage, inverter capacity and inverter load. A minimum of approx. 20 W and an average load of approx. 60 W can be assumed.

Cooling losses from the control cabinet depend on the type of the cabinet, the components installed in it as well as their number and layout. No general information about this can be given here.

6.1 Electrical installation

The system must be powered down before installing the inverter.

DANGER

Hazardous voltage at the connection terminals, at supply L1, L2, L3 and at transformer connections U, V

Electric shock resulting in death.

- Maintain a safety distance.
- Apply the five safety rules prior to service work.
- Residual current protective devices must be sensitive to all currents (RCD type B).

Prior to the start of service work on electrical systems, observe the following 5 safety rules under all circumstances:

- Power down
- Secure to prevent unintentional reactivation
- Ensure that the system is de-energised
- Earth and short-circuit (at U >1000 V)
- Cover or cordon off any adjacent live parts

Note

If the module is used in an environment which requires increased protection against direct contact with the power supply and power output terminals (see EN 60204-1), an optional finger guard is available. The finger guard is already included in the delivery scope of certain modules.

If necessary, contact HWH Service, tel.: +49 40 766 904-84.

Connection terminals 400 – 440 V, 480 V

Fig. 6-1: Power input 400 – 440 V, 480 V

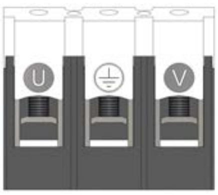


Fig. 6-2: Power output 400 – 440 V, 480 V

Connection terminals 690 V

Fig. 6-3: Power input 690 V

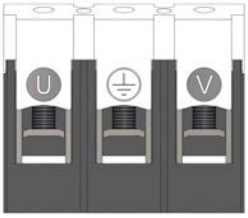


Fig. 6-4: Power output 690 V

Connection terminals for bigger power classes 400 - 480 V

Fig. 6-5: Power input 400 - 480 V

Fig. 6-6: Power output 400 - 480 V

Note under all circumstances prior to installation:

- Avoid ground loops in the connections.
- When installing the inverter in the system, check whether interference suppression measures have to be implemented. See *Interference suppression*, p. 34.
- Use highly-flexible, shielded and twisted cables when connecting the measuring sensors. See *Connecting measuring sensors*, p. 32.
- Only apply the shielding on one side of shielded cables.

6.2 Connecting measuring sensors

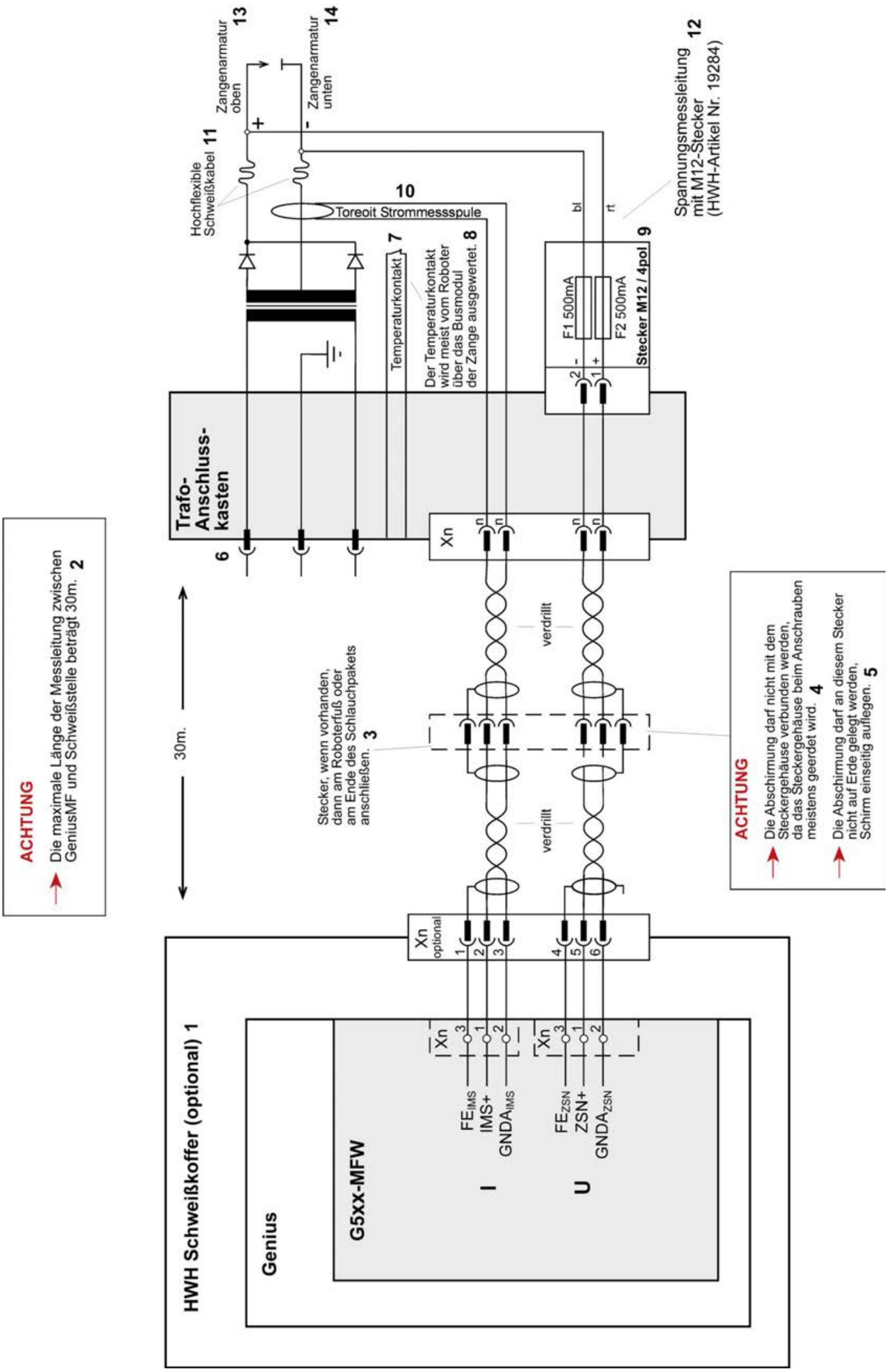


Fig. 6-7: Measuring sensor wiring diagram (legend on next page)

1 HWH welding case (optional)
2 Attention! The maximum length of the measurement lead between the inverter and the welding point is 30 m.
3 If available, connect the plug at the base of the robot or the end of the hose package.
4 Attention! The shielding must not be connected to the plug housing, as the plug housing is usually earthed on screwing on.
5 The shielding on this plug must not be connected to earth.
6 Transformer connection box
7 Thermal contact
8 The temperature contact is usually evaluated by the robot via the electrode holder's bus module.
9 Plug M12 / 4-pin
10 Measuring coil
11 Highly-flexible welding cables
12 Voltage measurement lead with M12 plug, (HWH article No. 19284)
13 Upper electrode holder fitting
14 Lower electrode holder fitting

Cable specifications

The measurement leads to be used should meet the following specifications:

- Cross-section > 0.25 mm^2
- Highly-flexible
- Wires shielded and twisted for current and voltage measurement.
- Current and voltage measurement leads can be routed in one cable.
- The maximum lead length is 30 m.
- Do not route over long distances parallel with power cables.

Note

On retrofitting a Rogowski belt for the current, it must be mounted protected against welding spatter. Welding spatter deposits on the Rogowski belt may distort the measurement signal.

As voltage pick-up is to be carried out at the electrode holder fitting and this may consist of copper, brass or aluminium, the procedure varies accordingly.

- With copper and brass, the measurement lead must be fastened with a suitably sized cable lug to the electrode holder arms according to DIN 46237.
- With aluminium, the clamping point must first be cleaned and protected with acid-free grease to avoid corrosion.

Connecting the voltage measurement device

The welding voltage corresponds to the voltage between the upper and lower electrode cap. It is practically impossible to attach measurement leads to the caps. As a result, the voltage is picked up at the electrode holder fitting, where the current straps are also connected. One side of the measurement lead shield is connected to earth on the control system side. It is not necessary to generally fuse these cables. If fuses are still installed, we recommend the use of measurement cables with integrated fuses.

We recommend fastening the voltage measurement device to the electrode holder fitting, as the moving parts (welding cables) are subject to heating and wear. If fastening here is not possible, the voltage must be measured upstream of the current straps if possible.

Connecting a current measurement device to the secondary circuit

A measuring coil or a Rogowski belt with a sensitivity of 150 mV = 1 kA is used as a current sensor. In the majority of medium-frequency welding transformers, the current sensor is already integrated into the welding transformer. Such welding transformers must be used if possible.

6.3 Fault current protection

The inverter is intended to be used without a fault current circuit breaker (RCD). If the system's safety concept provides for the use of fault current circuit breakers, use a type class B fault current circuit breaker for the inverter.

6.4 Interference suppression

Interference suppression measures are required to suppress interference from external sources.

Modern inverter and welding control systems are built using highly integrated components packed tightly together. Due to undesired heat development, these modules work at a low level of performance and high clock frequency. For this reason, if no suitable countermeasures are taken, they can be affected by magnetic and/or electrical interference originating from sources of interference such as voltage peaks and conducted via connection leads.

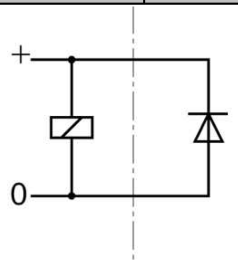
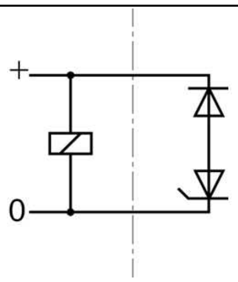
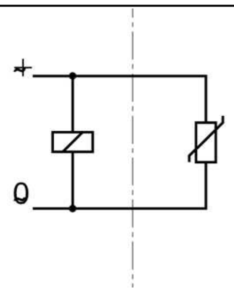
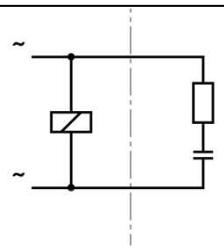
As a general rule, anything producing interference (relay coils, other inductive switching elements, etc.) must be suppressed at the source.

The suppression element must be mounted directly at the source of the interference. If this is not possible, it must be mounted in a terminal box as close as possible to the interference suppression device. The connection leads must be twisted tightly.

The suppression elements (resistors, capacitors and diodes) must be securely mounted using mechanical means in order to prevent breakage due to vibration.

Examples of interference suppression

The following table shows examples of interference suppression measures. In addition, the industry offers a range of components for interference suppression; these are tailored specifically to your products and are also usually easy to install.

Source of interference: Contactor, relay, solenoid valve	Additional wiring	Component types	Remarks
		**Diode** Type 1N4005 or 1N5060 to 60 V =	**Advantages:** Uncritical dimensioning Lowest possible induction voltage **Disadvantages:** Very high release delay **Application**: Small DC voltage relays
		**Diode** Type 1N4005 or 1N5060 **Zener Diode** ZL22 up to 48 V = or ZL66 to 60 V =	**Advantages:** Uncritical dimensioning Lowest possible induction voltage **Disadvantages:** No suppression below Zener voltage U_{ZD} **Application**: Large DC contactors
		**VDR** Varistor e.g. SIOV S14 K25 for 24 V = or SIOV S14 K230 for 230 V =	**Advantages:** Uncritical dimensioning High energy absorption **Disadvantages:** No suppression below U_{UDR} VDR voltage > peak U **Application:** alternative to diode or RC
		**RC wiring** Resistance; 220Ω/5W Capacitor: 0.1 µF 1000 V at 230 V~ to 440 V~ or 0.5µF 1000 V at 110 V~ or ready to install interference protection	**Advantages:** Good high-frequency damping **Disadvantages:** Requires precise dimensioning High inrush current **Application**: AC relays and motors

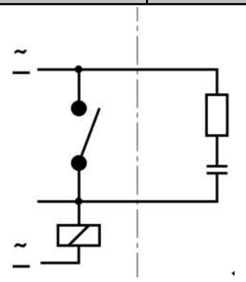
Source of interference: Contactor, relay, solenoid valve	Additional wiring	Component types	Remarks
		**RC wiring** Resistance: load-dependent capacitor: 0.01 µF to 0.1µF 1000 V	**Advantages:** Good high-frequency damping Contact protection against spark erosion **Disadvantages:** Requires precise dimensioning Greater relay release delay **Application:** Surge voltage suppressor for inductive load

Fig. 6-8: Examples of interference suppression

6.5 Protective earthing conductor PE

Establish a protective earthing conductor connection to earth the inverter. Information on the lead cross-section and the lead length can be found in the technical data.

See *Technical data*, p. 245.

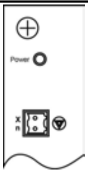
6.6 Emergency stop input

The <emergency stop> input enables the inverter's power output to be shut off. When the power output is shut off, the inverter remains connected to the grid; no physical disconnection from the grid takes place.

The <emergency stop> input can be integrated into the system's emergency stop chain if certain conditions are observed.

- The <emergency stop> input and the outputs switched with it do not meet the safety specifications (redundancy) of an emergency stop or emergency stop function in the sense of machine and system safety.
- The switch for the <emergency stop> input must not therefore be marked in red.
- If the safety specifications are met, the outputs influenced by our <emergency stop> input must additionally be shut off with a contact section of the system's emergency stop function.

When using an external voltage supply for emergency-stop supply, the 0 volt lead must always be connected.

Figure	Designation	LED / pin	Status		
	Power LED	On	Operational		
		Off	Not operational		
	Emergency stop	X	Emergency stop	E*	24 V
		N	GND with reference to emergency stop	E*	0 V

Wiring examples for the emergency stop input <X> without external voltage supply

In the following figures, the designations have the following meanings:

- ☑ identifies recommended wiring examples. These can be used without problems.
- ☒ identifies wiring examples which must not be used. In certain situations, these may result in errors or damage to the components.
- XN designates the connections for emergency stop.
- X1/X2 designates 24 V inputs and outputs which are present at the plug-in modules' connections (G500-MFW, G501-MFW), see *Plug-in modules*, p. 143

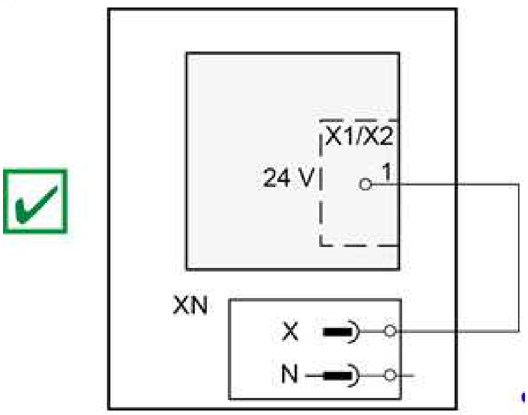


Fig. 6-9: Operation without emergency stop

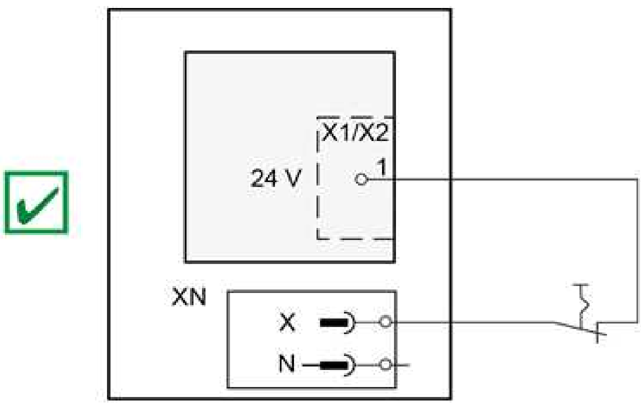


Fig. 6-10: XN supplied via a plug-in module's 24 V connection

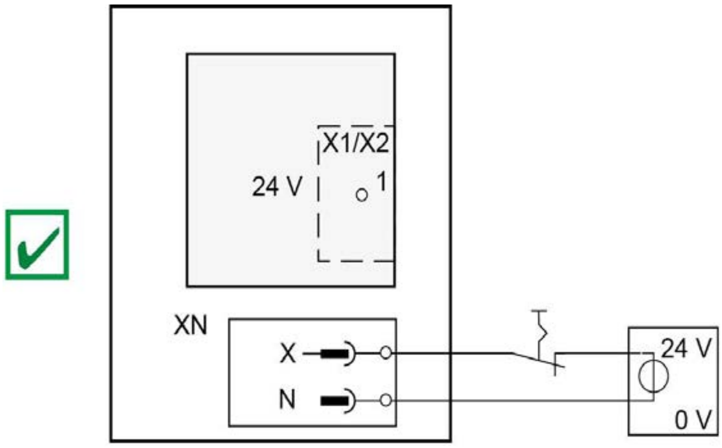


Fig. 6-11: XN supplied via a separate, external power unit, two-pin connection

Note

The external power supply's 0 V must be connected to XN.

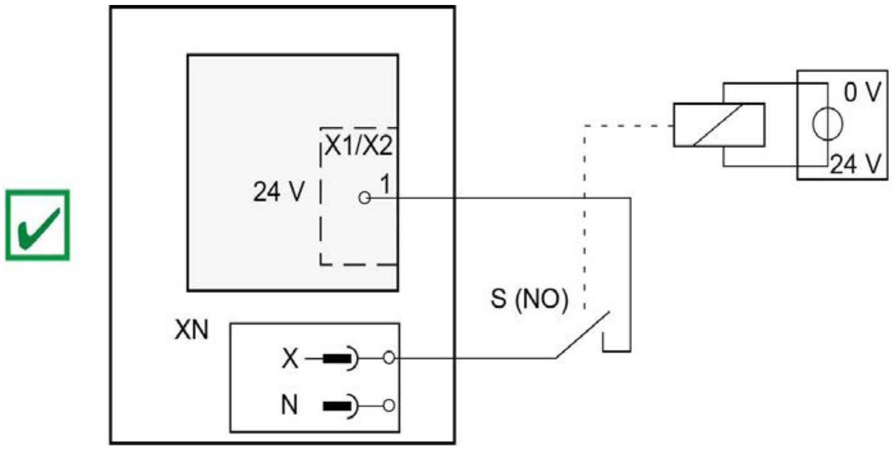


Fig. 6-12: XN supplied via a relay contact (NO)

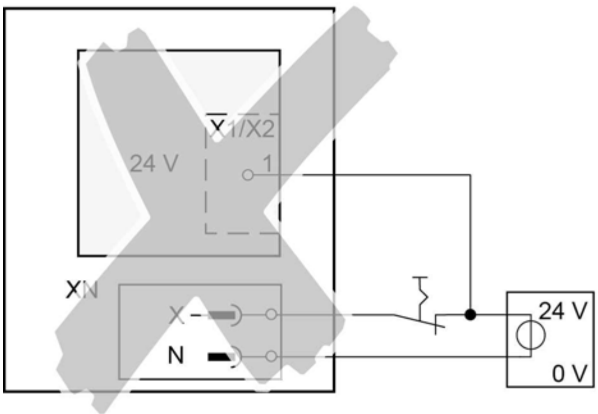


Fig. 6-13: Prohibited wiring, see above

6.7 Connecting the water cooling

To guarantee reliable cooling, the cooling water connection must be designed according to DIN EN 560.

Cooling water quality

As regards its content of soluble chemicals and insoluble substances, the cooling water must meet the following conditions:

Hydrogen ion concentration	pH 7 – 9
Chlorides	Max. 20 mg/l
Nitrates	Max. 10 mg/l
Sulphates	Max. 100 mg/l
Insoluble substances	Max. 250 mg/l
Particle size	Max. 0.8 mm
Total hardness D	Max. 10 German degrees (1 German degree = 1.25 English degrees = 1.05 US degrees = 1.8 French degrees)

Tap water will usually meet these conditions. If the available tap water does not meet these conditions, however, a closed-loop cooling system must be used. The cooling water should then be checked constantly.

Note

Malfunctions and other damage caused by impermissible cooling water quality or condensed water are not covered by the warranty.

Connection

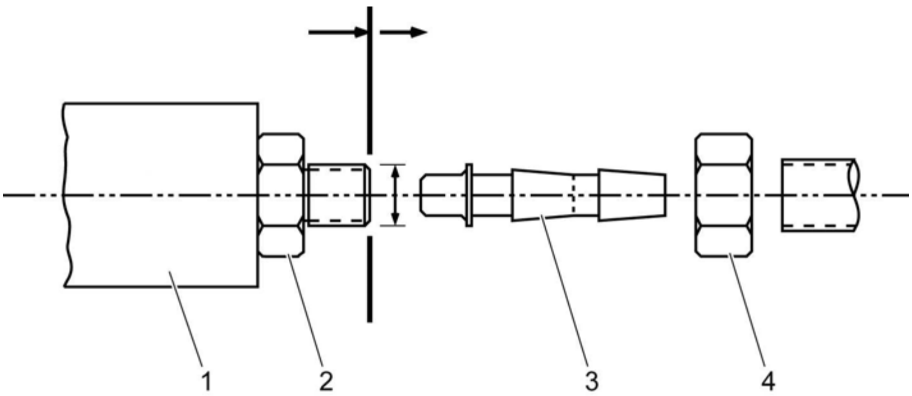


Fig. 6-14: Water cooling connection

1	Heat sink
2	Hose grommet
3	Nipple with inner cone
4	Union nut, e.g. G1/4"

NOTICE

Condensation on operation of the water cooling system

Water damage to the module

- Maintain a minimum temperature of 20°C.

NOTICE

Leaky cooling water lines and hose connections

Escaping cooling water may cause damage to the module and surrounding parts of the system.

- Before switching on the supply voltage, check the cooling water supply lines and connections for leaks.
- Protect devices in the immediate vicinity against escaping cooling water.

Note during installation under all circumstances:

- Adhere to the flow volume (dependent on inverter data)
- Connect the inverter in parallel to the cooling water circuit.
- Take the flow direction specified on the components into consideration.
- Use only suitable coolant or clean water.
- Deposits in the installed cooling water line must be removed in time by cleaning or exchanging the cooling water line.
- Condensation formation on the components conducting the water must be avoided. The cooling water temperature at the cooling water inlet must not exceed 30°C.

For further information on cooling water, see *Cooling water data*, p. 266.

To guarantee reliable cooling, the installation of fflow monitors is recommended, e.g. for 4 litre (HWH 15192) or 6 litre (HWH 14141). For flow monitors with other flow rates, contact HWH Service, Phone: +49 40 766 904-84.

6.8 Air cooling

In an air-cooled module, the power electronics are cooled via a heat sink on the rear side by means of an air flow.

The module must be mounted in the control cabinet so that the heat sink projects out of the control cabinet. It must be ensured that no heat build-up occurs at the heat sink.

7 Commissioning

NOTICE

Module incorrectly connected or parameterised with incorrect settings

The module may be damaged or destroyed.

- Only authorised, specialist personnel may perform commissioning.

The connection diagrams always apply to connection, see separate "Pin assignments" document.

Prior to the first welding process:

Prerequisites

- The set supply voltage matches the voltage provided by the power stage.
- The solenoid valve voltage has been checked.
- The functional earth is connected.
- The grounds are connected correctly.
- Power stage plug connectors and input and output plug connectors are connected.
- The welding control system is connected to the external sensor system.
- The supply voltage is switched on.
- The welding control system is ready for operation and the parameters have been input.
- The first weld must be performed in the mode set (current input in SKT).

The welding inverter is properly connected and ready for the first welding process.

After connecting and activating the supply voltage, the inverter is in stand-by mode. Welding cannot be performed, as the programs are locked. To unlock the programs, see *Program selection*, p. 48.

8 Module configuration

Prior to the first welding operation, basic module configurations for different functional relationships must be defined. Some configurations are thus described in the context of the associated functions. The descriptions are available by clicking the appropriate link.

The available configurations include:

- Message management, see *Message management*, p. 43.
- First milling, see *Initial milling*, p. 61.
- Automatic spot repetition, see *Automatic spot repetition*, p. 105.
- Start interlock, see *Start interlock*, p. 44.
- Internal or external program selection, see *Program selection*, p. 48.
- Electrode management output relations, see *Electrode management: output relations*, p. 45.
- Pressure increase, see *Pressure increase*, p. 56

8.1 Message management

The MODULE CONFIGURATION > MESSAGES menu item on the user interface can be used to control the behaviour of the module as regards the relevant messages.

Note

Information on using the user interface is available in the accompanying online help.

The module behaviour can be pre-configured in various ways:

- Grey check box with tick: pre-configured.
- Black check box: configuration by the operator.

Settings for the behaviour of the servo electrode holder and the welding process in the event of certain messages are defined within the MOVEMENT and WELDING sections.

The module behaviour on acknowledging a message can be controlled in the ACKNOWLEDGEMENT section.

The AUTOMATIC SPOT REPETITION section defines whether the spot is to be repeated automatically after the message has been output, see *Automatic spot repetition*, p. 105.

Movement

Cancel	Settings for the HWH servo gun. Tool movement is aborted immediately.
Prohibited	Settings for the HWH servo gun. Further movement is prohibited/not possible.

Welding

Abort	The welding process is immediately aborted.
Prohibited	No further welding process can be started.
Stop	The welding process is stopped before outputting the end of sequence. Spot repetition is possible.

Acknowledgement

Acknowledgement	Acknowledging the message is possible.
Process	The message is acknowledged automatically on starting the next welding process.
Restart	The module is automatically restarted after acknowledging the message.

Automatic spot repetition

Automatic spot repetition is performed when this message is output. Condition:

- The start signal is still set.
- Automatic spot repetition is activated (module configuration).
- The number of automatic spot repetitions is >0.

Note

Information about the causes and remedies for system messages are available separately in the document "System messages - description and troubleshooting".

This is available in the download area at www.harms-wende.de or will be provided by our Service department on request. Registration is required to use the download area.

8.2 Start interlock

The start interlock can be used to configure whether the welding process may still be aborted in the current-free squeeze time.

In most cases, this is wise in order to be able to perform corrections if necessary. The <With current time> start interlock setting must therefore typically be selected for both automatic and manual systems.

Configuration is performed using the user interface.

MODULE > MODULE CONFIGURATIONS > I/O OPTIONS > START INTERLOCK

Parameters	With current time/immediate
Inputs	Start
Outputs	-
System messages	-

Module behaviour with <With current time> start interlock

The present <Start> signal can still be withdrawn during the current-free squeeze time. The welding process is only locked when the main current time starts.

Procedure:

- The welding process begins with the present <Start> signal.
- The welding unit is closed.
- Hold time without current begins.
- By cancelling the start, the welding process can be aborted at this point if required.

Module behaviour with <Immediate> start interlock

The welding process is immediately locked with the present <Start> signal. This setting should only be used in exceptional cases, because in case of error (e.g. missing pressure contact, component fault) the start can no longer be aborted. The welding process can then only be interrupted by activating the emergency stop or switching the module off.

Procedure:

- The welding process begins with the present <Start> signal.
- The welding unit is closed.
- The welding process runs without stopping until the end of sequence.

8.3 Electrode management: output relations

The desired output relations must be defined for electrode management.

See *Electrode management*, p. 59.

The basis on which the spot counter, see *Spot counter*, p. 60, is evaluated is defined for the following functions:

- Pre-warning
- Electrode exchange
- Rework/milling (milling cycles)

Defining an output relation

MODULE > MODULE CONFIGURATIONS > I/O OPTIONS

- Program-related
  The evaluation is dependent on the program that is selected. The spot counter assigned to the program or the gun belonging to the program is used for evaluation.
- Module-related
  Each program in the module is evaluated, i.e. all spot counters. It is irrelevant which program is currently active. When one of the spot counters has reached the corresponding value, the appropriate output signal is output.

9 Functions

The inverters functions are described in this chapter.

9.1 Selection functions

A desired welding program may alternatively be selected via program selection or spot selection.

Program selection	The desired program is selected directly via the inputs or via the user interface. See *Program selection*, p. 48.
Spot selection	The desired program is indirectly selected via a spot table. The corresponding table entry is selected via the inputs. See *Spot selection*, p. 49. ATTENTION: This selection function is only possible for modules with field bus connection.

Note

When using spot selection, the <Program selection active> input must be **inactive**. Only then is spot selection enabled.

This input is not used in all I/O programs. Refer to the diagnostics page for the inputs and inputs that are used. MODULE > DIAGNOSTICS.

9.1.1 Gun selection/gun assignment

A gun is usually selected via the program selection. See *Program selection*, p. 48.

A gun number/counter number is always assigned to a welding program. Assignment is carried out via the user interface, pull-down menu: MODULE > ELECTRODE HOLDER CONFIGURATION > GUN ASSIGNMENT.

Please note: a welding program can only be assigned to **one** gun, but a gun can be assigned to several welding programs.

If a gun is selected via the program number, the outputs indicate this gun's wear status.

See *Electrode management*, p. 59.

See *Electrode management I/O signals*, p. 140.

Gun selection via <Electrode status> or <Gun selection active>

With field bus applications only. The input may only be set outside of the welding process.

When this input signal is set, the spot number is interpreted as the gun number (counter number). The wear status of each electrode can therefore be polled if several guns are used.

If a gun number has been detected, the selected gun's <Request initial milling>, <Request milling>, <Pre-warning> and <Request electrode exchange> outputs are output accordingly.

See *Electrode management output signals*, p. 140.

9.1.2 Program selection

The program selection defines which previously parameterised welding process is performed. The number of available programs depends on the inverter's equipment. Depending on configuration, there can be up to 1024 programs. Programs are locked or released via the user interface.

There are various options for selecting a welding program:

Internal program selection via the user interface

Software prerequisites:
XPegasus: version 4.1 and higher
Firmware: version 2.50 and higher

Prerequisite

- The program selection must be set accordingly via the user interface:

MODULE > MODULE CONFIGURATIONS > I/O OPTIONS > PROGRAM SELECTION: EXTERNAL OR INTERNAL

Procedure

- Select program:

MODULE > PROCESS VIEW > PROGRAM SELECTION

Note:

Internal (manual) program selection is **exclusively** possible using this menu item. The PROGRAM SELECTION in other user interface dialogues is only used for editing programs.

The currently selected program can be seen in the diagnostics window. MODULE > DIAGNOSTICS.

External program selection via the inputs

Binary-coded program selection is carried out via the <Spot number bit 1> to <Spot number bit n> inputs.

Program selection becomes clear when <Start> is active. The selected program starts when <Start> is active and the module signals <Ready>.

Program selection calculation using an example:

Input	Active/inactive	Bit valency
Spot number bit 1	Active	1
Spot number bit 2	Inactive	0
Spot number bit 3	Active	4
Spot number bit 4	Active	8
Program selection (=sum of bit valency)		13

Program selection via spot number

See *Spot selection*, p. 49.

Program selection overview

Parameters	-
Inputs	Spot number bit 1 to bit n Start
Outputs	Ready
System messages	286 Program <No.> blocked
	290 Cancel start
	459 Program selection unsuccessful

9.1.3 Spot selection

Spot selection enables you to assign a program to each welding spot with which this spot is to be welded.

Prerequisite

- This selection function is only possible for modules with field bus connection.
- In order to use spot selection, the <Program selection active> bit must not be set.

Functional principle

A welding program is always selected via TYPE ID and SPOT NUMBER, which together result in a unique spot designation.

The type ID normally refers to the corresponding product group/production line; the spot number specifies the spot to be welded.

A distinction is made between two cases:

- A program number is assigned to the type ID and spot number combination via a **spot table**. See *Spot assignment*, p. 50.
  The desired table entry is indirectly selected via the corresponding inputs.

TYPE ID + spot number →	Spot table (implementation table) →	Program number

- Depending on version,[1] low spot numbers (less than the maximum program number) are used as **direct** program selection in combination with the type ID=0. This bypasses the spot table, and the spot number is interpreted as the program number.

Basic: (TYPE ID=0) + (spot number < 256) →	Spot number = program number
Pro: (TYPE ID=0) + (spot number <512) →	Spot number = program number

[1] If necessary, contact HWH Service, tel.: +49 40 766 904-84, if you are uncertain about the version.

Spot selection overview

Parameters	Type ID Spot number Spot designation Program number Module name
Inputs	Spot number Type ID Program selection active[2]
Outputs	Program number Program selection OK[3] Program selection error[4]
System messages	-

9.1.4 Spot assignment

In a spot table, a program number is assigned to each combination of spot number and type ID = spot designation. Spot assignment is required to be able to use spot selection, see *Spot selection*, p. 49

The spot table is edited via the user interface and transferred to the inverter: SYSTEM > SPOT ASSIGNMENT.

Alternatively, it is possible to import the spot assignment into the user interface via a previously created CSV file: SYSTEM > SPOT ASSIGNMENT.

Note

Further information on the topic of spot assignment is available in the "HWH welding systems spot assignment" quick guide. This is available in the download area at www.harms-wende.de or will be provided by our Service department on request. Registration is required to use the download area.

Invalid spot number

Spot numbers are invalid if:

- No spot table is available in the control system.
- The selected spot number is not entered in the spot table.

In these cases, the <Spot selection OK> output is not set, or <Spot selection error> is output.[5]

2 Depending on I/O program version.
3 Depending on I/O program version.
4 Depending on I/O program version.
5 Depending on I/O program version.

Spot table

The spot table can be both transferred to the inverter and read out from there via the user interface:

SYSTEM > SPOT ASSIGNMENT.

Depending on configuration, the type ID / spot number can be up to 64 bits in size.

Example for the structure of a spot table:

	Type ID	Spot number	Program number	Spot designation
Value range	0 to 255	0 to 65,535	0 to 255	Max. 32 alphanumerical characters

9.2 Gun maintenance management (mechanical)

Gun maintenance management can be used to check the mechanical loads on the gun, current strap and milling blades.

The function is parameterised via the user interface:
MODULE > ELECTRODE HOLDER CONFIGURATION > MAINTENANCE.

GUN MAINTENANCE MANAGEMENT includes three wear counters:

- For guns,
- For current strap,
- For milling blade.

The movements of a gun or the milling processes are counted. Closing and opening once increments the counters by one, including closing and opening without current.

Pre-warning values and limit values, which indicate maintenance or necessary gun or current strap exchange, can be configured for this function. If the parameterised limit values are reached, a message is output. The messages do not cause the process to stop.

Parameters	Stroke counter Milling counter Preheat value Current strap exchange at Electrode holder exchange at Milling blade exchange at	
Inputs	Milling blade exchanged	
Outputs	Milling blade exchanged active Milling blade exchange pre-warning Request milling blade exchange	
System messages	366	Pre-warning value for milling blade exchange reached
	367	Milling blade exchange required
	368	Pre-warning value for electrode holder exchange reached
	369	Electrode holder exchange required
	370	Pre-warning value for current strap exchange reached
	371	Current strap exchange necessary

Milling blade wear counter

As well as the messages, signals can be output to a milling facility for milling blade exchange via the above outputs. Depending on the configured counter statuses, milling blade reworking or exchange can therefore be requested and arranged.

Software prerequisites:
XPegasus
Firmware: version 1.68 and higher

9.3 Combination of multiple power units (master-slave)

The inverter, consisting of a control unit and power unit, can be operated with up to four additional identical power units. The first control unit and power unit combination is referred to as the "master" below, each additional power unit is the "slave".

Software prerequisites:
XPegasus
Firmware: version 2.20 and higher

input <Slave ready> is connected with up to four power units in series. Via its input, each slave is signaled via the <Ready> signal that the system is ready for the next welding operation.

Welding does not take place...

- If the control unit is not ready
- If a slave power unit reports an error
- A power unit is overloaded

A message is output as soon as an error is present at the master's input. By default, the welding process is not aborted, but stops before <End of sequence>. Stopping before <End of sequence> can be deactivated via the configuration.

If a power unit is overloaded, this results in an external alarm (IGBT error) and the welding process is aborted.

For details on the messages, refer to the documentation about Genius messages.

Parameters	-	
Inputs – Master	External alarm Slave not ready	
Outputs – Master	Ready	
System messages	456	Water flow not OK
	457	Slave not ready
	310	Power unit: IGBT temperature error <nn>°C

9.4 Manual electrode holder mode

Manual electrode holder mode enables welding using two different guns. Each gun has its own dedicated programs, counters and signals.

Parameters	-	
Inputs	Program number (n) 1: Start 2: Start 1: External alarm 2: External alarm 1: Transformer temperature 2: Transformer temperature 1: Counter reset 2: Counter reset 1: Milling completed 2: Milling completed 1: Initial milling completed 2: Initial milling completed	
Outputs	1: Working stroke 2: Working stroke 1: Request electrode exchange 2: Request electrode exchange 1: Pre-warning 2: Pre-warning 1: Request milling 2: Request milling 1: Request initial milling 2: Request initial milling	
System messages	-	

The electrode holders' welding processes are independent of each other; however, welding can only be performed with one electrode holder. Welding with both electrode holders at the same time is not possible. If one electrode holder has a fault, welding can be performed using the other electrode holder.

Each gun has its own parameter set and its own signals. The number of programs is configured by default:

- Gun 1: program 10 – 19
- Gun 2: program 20 – 29

9.5 Cache

If the user interface is connected to the module over a network it will fetch the archived data of the welding processes in real time.

If the user interface is switched off or there are network problems, the module will cache the archived data. Switching off the module during this time will result in loss of the cached archived data.

The cache is limited to:

Welding time	No. of welding processes
100 ms	500
500 ms	300
1000 ms	160

If memory is exceeded by up to 80%, the following message is output:

- 264- XPegasus server: <nn> data records were not fetched from the control system's archive memory.

If memory is full and data is lost, the following message is output:

- 265- XPegasus server: the control system's archive memory cannot accommodate any further data records.

On the PQS system, the message are:

- 266 - PQS server: <nn> data records were not fetched from the control system's archive memory.
- 267 - PQS server: the control system's archive memory cannot accommodate any further data records.

9.6 Component trace

Component-related parameters can be determined, saved and and archived with this function. This function is optional, and can be parameterised via the XPegasus user interface.

Software prerequisites:

XPegasus: version 4.1.16 or higher

Firmware: version 2.03 or higher

Genius with component trace

Note

Information on using the user interface is available in the accompanying online help.

9.7 PQS – process and quality management system

PQS is an intelligent monitoring system for monitoring the quality of different welding processes.

This software from HWH subsidiary QST can be used for detailed statistics and complex process analyses of process stability. It provides custom solutions in the monitoring and analysis of voltage, current and travel.

Licensing and activation

When a PQS software package is purchased, the corresponding number of licence cards and the instructions for licensing are included.

Activation is done using the licence card (SD card). The licence card must be inserted into the MMC slot of the G101-CPU plug-in module.

Further information and the operating instructions are available by request from:

HARMS+WENDE QST GmbH
QualitätsSicherungsTechnologien
Gewerbegebiet Chemnitzpark
Nordstraße 25
D-09247 Chemnitz-Röhrsdorf

Tel.: +49(0)3722-89081-0
Fax: +49(0)3722-89081-299
info@hwh-qst.de

http://www.hwh-qst.de

9.8 Pressure increase

The <Pressure increase> function enables the electrode pressure to be increased in a defined time period after closing the electrodes.

Two options are available for this:

- With an additional solenoid valve output for actuating bypass valves,
- With the operation of a proportional valve via an analogue output.

Software prerequisites:

XPegasus: version 5.1 and higher
Firmware: version 2.80 and higher

The <Pressure increase> function must be activated via the user interface:

MODULE > MODULE CONFIGURATIONS > OPTIONS > WELDING WITH PRESSURE PROGRAM

The pressure increase is controlledusing six parameters that are also specified via the user interface:

MODULE > EDIT WELDING PARAMETERS > FORCE >

After calibrating the gun (electrode), the pressure is displayed in daN and can be used instead of pressure specified as a percentage. This calibration can be carried out via the user interface.

MODULE > ELECTRODE HOLDER CONFIGURATION > CALIBRATION > GUN FORCE

Notes on the program sequence

The pressure increase program starts at the beginning of the <Squeeze time>.

If the <Squeeze time> is extended by the <Pressure contact> input or <NBS enable>, the currently active program time is extended by the same value.

<Nominal values> and <Increased nominal values> are assigned to the welding programs. If the program selection is changed outside of the welding process, the <Nominal value> of the selected program is output immediately.

The <Increased nominal value> takes effect in <On time 1> and <On time 2>.

The <Pressure increase> output is a 24 V output, i.e. it actuates a valve so that either the full operating pressure or no pressure acts.

Conversely, the analogue <Proportional valve> output is used to actuate a proportional valve so that the acting pressure lies between zero and the full operating pressure. Input is carried out as a percentage of the operating pressure.

The pressure program sequence always ends on expiry of the <Hold time>.

Start	**VHZ** **1st VHZ** (with single spot mode only)

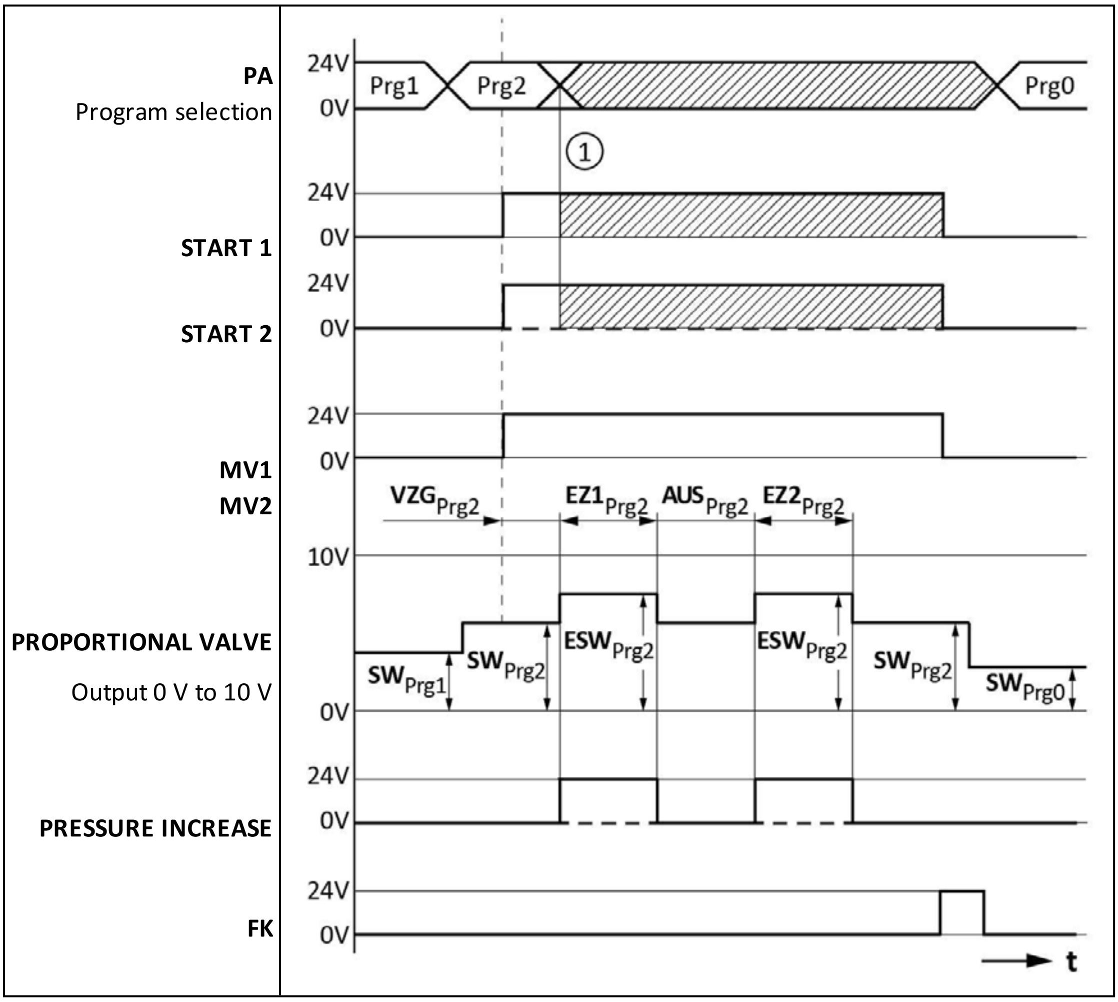


Fig. 9-1: Pressure increase, sequences

1	Start interlock is active Signals can be changed
Prg	Selected/started program
VHZ	Squeeze time
VZG	Delay time
EZ	On time
OFF	Off time
SW	Nominal value
ESW	Increased nominal value
t	Time

10 Electrode management

The gun's electrodes are subject to extreme wear. Regular reworking by milling or cleaning and exchange of the electrodes is therefore necessary. Electrode management can be used to indicate electrode wear, control maintenance and adapt the welding current to the status of the electrodes.

The <Spot counter> function counts each welding process during which current has flowed. See *Spot counter*, p. 60.

Following a parameterisable number of welding processes, electrode milling or exchange is requested. Before reaching this value, a pre-warning can be output.

A safety limit exists in the form of the spot counter overflow. This parameter can be used to ensure that component welding can still be completed before electrode milling or exchange becomes urgently necessary.

The following functions are responsible for electrode maintenance:

Spot counter	See *Spot counter*, p. 60.
Initial milling	See *Initial milling*, p. 61.
Electrode milling	See *Electrode milling (subsequent milling)*, p. 62.
Electrode exchange	See *Electrode exchange*, p. 65.
Start current increasing	See *Start current increasing*, p. 68.
Current stepper Compensates the increased transition resistance due to electrode abrasion.	See *Current stepper*, p. 68.
Tip monitor(optional) Checks whether electrode milling was successful.	See *Tip monitor*, p. 70.
Milling unit interface(optional) For integrating milling facilities.	See *Milling unit interface*, p. 72.

With regard to the signals, see *Electrode management I/O signals*, p. 140.

10.1 Electrode management I/O signals

Note:

In the case of manual electrode holders, the signal assignment is firmly defined, and refers to the spot counter for gun 1 or gun 2 in each case. See *Manual electrode holder mode*, p. 54.

Electrode management signal level

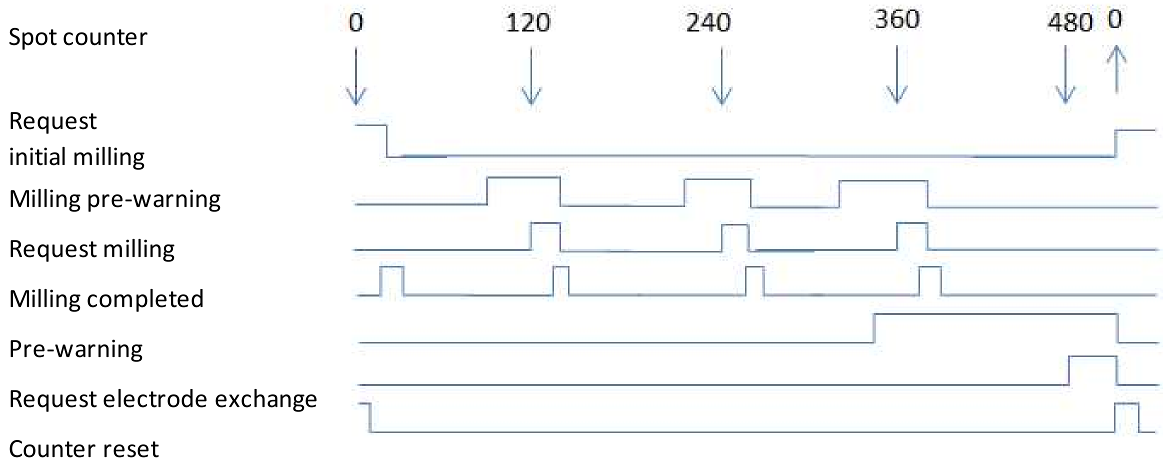


Fig. 10-1: Electrode management signal level

10.2 Spot counter

The spot counter counts the welding processes during which current has flowed. Each gun has its own spot counter.

The spot counter influences the following signals and functions:

- Electrode exchange, see *Electrode exchange*, p. 65
- Electrode milling, see *Electrode milling (subsequent milling)*, p. 62
- Stepper, see *Current stepper*, p. 68.
- Start current increasing, see *Start current increasing*, p. 68

Please note:
If no counting function is desired for one or more guns, the counting function can be switched off. To do this, set the <Electrode exchange at> parameter to 0. MODULE > ELECTRODE HOLDER CONFIGURATION > ELECTRODE.

Resetting the spot counter

After maintenance or exchanging the electrodes, reset the responsible spot counter to 0 so that wear cycle counting starts at 0 again.

Note:

In the case of manual electrode holders, the signal assignment is firmly defined, and refers to the spot counter for gun 1 or gun 2 in each case. See *Manual electrode holder mode*, p. 54.

The spot counter can be reset using one of the following methods:

- Manual reset via the user interface by overwriting the value.
- Selection of gun 1 or 2 via the <n: Reset gun spot counter> input.
- Selection of the <Program number (n)> and <Counter reset> inputs.
  The counter assigned to the program with the number (n) is reset.

- Selection of the <Counter reset>, <Electrode status / Gun selection active> and <Spot number (n)> inputs (with field bus applications only):
  -The spot number is interpreted as the counter number
  - The counter assigned to the spot with the number n is reset for n > 0.
  - The counters of **all** of the module's guns are reset for n = 0.

10.3 Initial milling

Please note:

When the <Initial milling> function is active, no welding process is possible until initial milling has been performed.

As new electrodes do not always have the shape required for the welding task, they can be milled into the required shape using the <Initial milling> function prior to initial welding.

Activating the function

The <Initial milling> function is available depending on the module configuration. It is activated via the user interface:
MODULE > MODULE CONFIGURATION > OPTIONS > INITIAL MILLING ON/OFF.

Process

After electrode exchange, the <Request initial milling> output signal is set and must be acknowledged with <Milling completed>. The initial milling request is acknowledged with the same signal as subsequent milling.

See *Acknowledging electrode milling*, p. 65.

If the <Initial milling> function is activated, but not executed, and a welding process is to be performed <With current>, the following message is output:

System message	223 - No initial milling for gun

The module is not ready to weld again until initial milling has been performed.

10.4 Electrode milling (subsequent milling)

The <Electrode milling> function controls the time point for electrode milling. Milling ensures that the electrode caps remain in the same shape over the entire life of the electrode and therefore have the same contact surface. Milling extends the service life of an electrode.

Electrode milling is used mainly in spot welding, and is optimised for it.

The tip monitor can be used to check whether milling was successful. See *Tip monitor*, p. 70.

The function can be activated and parameterised via the user interface.

MODULE > ELECTRODE HOLDER CONFIGURATION > ELECTRODE.

Parameters	Spot counter Electrode exchange	
Inputs	Milling completed	
Outputs	Request milling Request electrode exchange	
System messages	222	Electrode exchange urgently required for gun <No.>
	224	Milling required for gun <No.>
	225	Milling urgently required for gun <No.>
	288	Electrode exchange required for gun <No.>
	294	Pre-warning value of gun <No.> reached
	377	Pre-warning value for milling gun <No.> reached

Prerequisite

- The milling function must be activated: MODULE > ELECTRODE HOLDER CONFIGURATION > ELECTRODE > MILLING ACTIVE.
- If <Initial milling> is activated, initial milling must have been performed and acknowledged. See *Initial milling*, p. 61.
- The electrode management output relations must be configured. See *Electrode management: output relations*, p. 45.

<Milling at>

The number of welding processes after which the electrodes should be milled again is entered here. If the milling spot counter reaches this value, the <Request milling> output signal is set. The following message is output:

System message	224 -Milling required for gun n

After milling, see *Acknowledging electrode milling*, p. 65.

<Spot counter overflow>

The spot counter overflow can be used to ensure that component welding can be completed before milling becomes urgently necessary.

If the electrodes are not milled despite a milling request (message 224), only the number of spots entered in the <Spot counter overflow> can still be welded.

If no milling takes place, the following message is output:

System message	225 -Milling urgently required for gun n

No further welding is possible until the milling request has been acknowledged.

See *Acknowledging electrode milling*, p. 65.

<Milling pre-warning value>

Please note:
This parameter and the respective output are not available in every system configuration.

A configurable pre-warning value can be assigned to the limit value for electrode milling via the user interface. The pre-warning value specifies the number of welding processes still possible up to milling.

Milling cycles and <Maximum rework>

The maximum permissible number of milling cycles is input here. When this value is reached, electrode exchange becomes necessary. See *Electrode exchange*, p. 65.

The number of possible milling cycles is dependent on the electrodes that are used and the components to be welded.

The following message is output:

System message	288 -Electrode exchange required for gun n

When the milling function is active, the value leading to the electrode exchange request is calculated from the following parameter settings:

Milling at (n spots)	x	Milling cycles (n cycles)	+	Milling at (n spots)	=	Request electrode exchange

Process diagram: electrode milling with electrode exchange

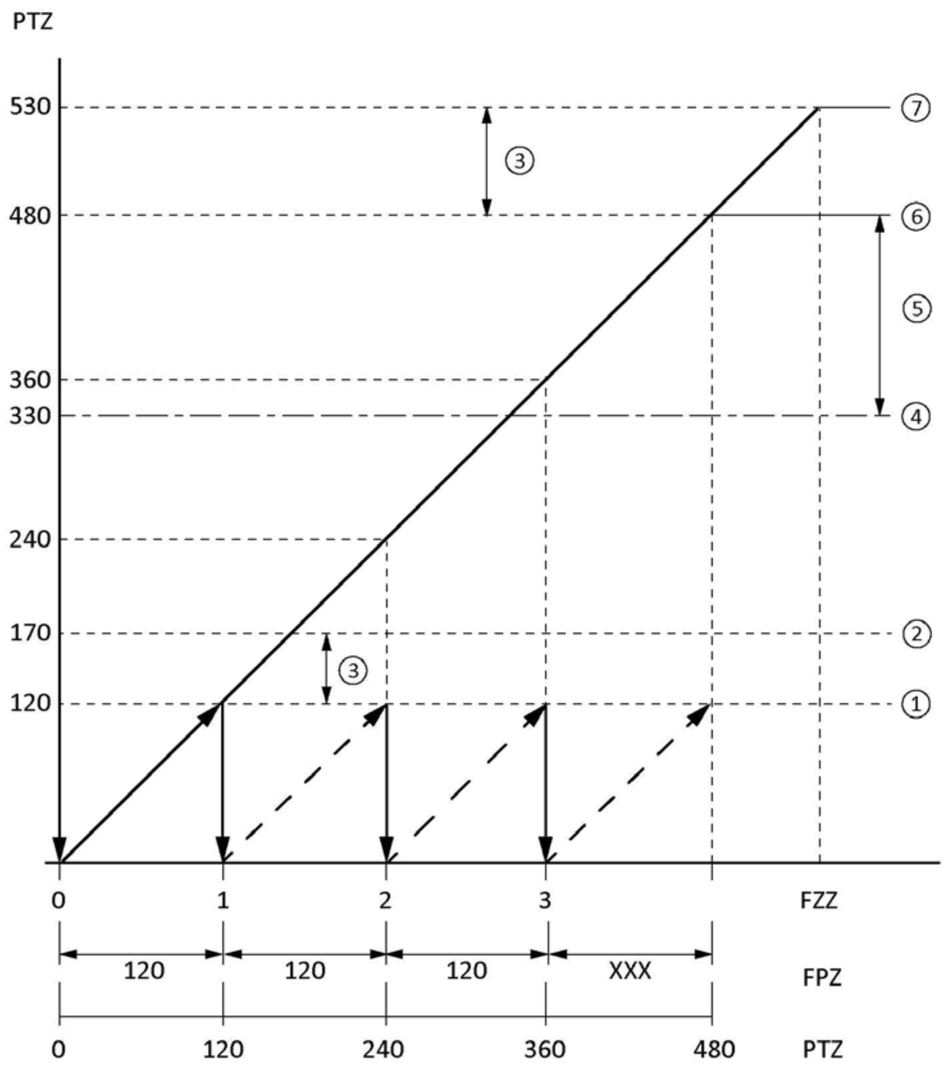


Fig. 10-2: Electrode milling with electrode exchange

SFR	Initial milling
PTZ	Spot counter
FPZ	Milling spot counter
FZZ	Milling cycle counter
1	Module message: milling required for gun n
2	Module message: milling urgently required for gun n
3	Spot counter overflow
4	Module message: pre-warning value for electrode exchange reached
5	Electrode exchange pre-warning value
6	Module message: electrode exchange required for gun n
7	Module message: electrode exchange urgently required for gun n

10.4.1 Acknowledging electrode milling

After milling, the milling request must be withdrawn by setting the input signal <Milling completed>. The module must not be in the welding process in this case. This has the following effects:

- The milling spot counter is reset to 0.
- The milling cycle counter is incremented by 1.

The welding processes defined under <Milling at> can then be performed again. This corresponds to one milling cycle.

When the maximum number of milling cycles is reached, electrode exchange becomes necessary. See *Electrode exchange*, p. 65.

> **Please note:**
>
> Soiled electrodes can be milled at any time even without a milling request. A new milling cycle begins after final acknowledgement.

10.5 Electrode exchange

The electrode exchange function enables the time point of electrode exchange to be defined. The function is activated and parameterised via the user interface:

MODULE > ELECTRODE HOLDER CONFIGURATION > ELECTRODE

Parameters	Spot counter	
Inputs	-	
Outputs	Electrode exchange required Pre-warning	
System messages	294	Pre-warning value of gun <No.> reached
	288	Electrode exchange required for gun <No.>
	222	Electrode exchange urgently required for gun <No.>

Prerequisite

- The electrode management output relations must be configured.
  See *Electrode management: output relations*, p. 45.

Note under all circumstances:

- No further welding is performed when the maximum permissible number of welding processes has been reached (<Electrode exchange at> plus <Spot counter overflow>).
- Following electrode exchange, the spot counter must be reset. See *Spot counter*, p. 60.

<Electrode exchange at>

The number of welding processes after which electrode exchange is required is entered here. If the spot counter reaches this value, the <Request electrode exchange> output signal is set. The following message is output:

System message	288 Electrode exchange reached for gun n

The function is deactivated with the value 0.

Please note: if the milling function is activated at the same time, this value is calculated:

Milling at (n spots)	x	Milling cycles (n cycles)	+	Milling at (n spots)	=	Request electrode exchange

See *Electrode milling (subsequent milling)*, p. 62.

<Spot counter overflow>

To be able to finish welding a part without having to perform electrode exchange beforehand, a corresponding value can be entered for the <Spot counter overflow> parameter.

If the <Electrode exchange at> plus <Spot counter overflow> value is reached, electrode exchange becomes urgently necessary.

No further welding process is possible; the control system is no longer ready. The following message is output:

System message	222 Electrode exchange urgently required for gun n

<Pre-warning value>

A pre-warning value for electrode exchange can be entered here. The pre-warning is output when the spot counter reaches the value <Electrode exchange> minus <Pre-warning value>. Only n welding processes (=pre-warning value) are still possible up to electrode exchange.

The following message is output:

System message	294 Pre-warning value for gun n reached

The control system remains in ready status; welding is still possible.

Electrode exchange process diagram

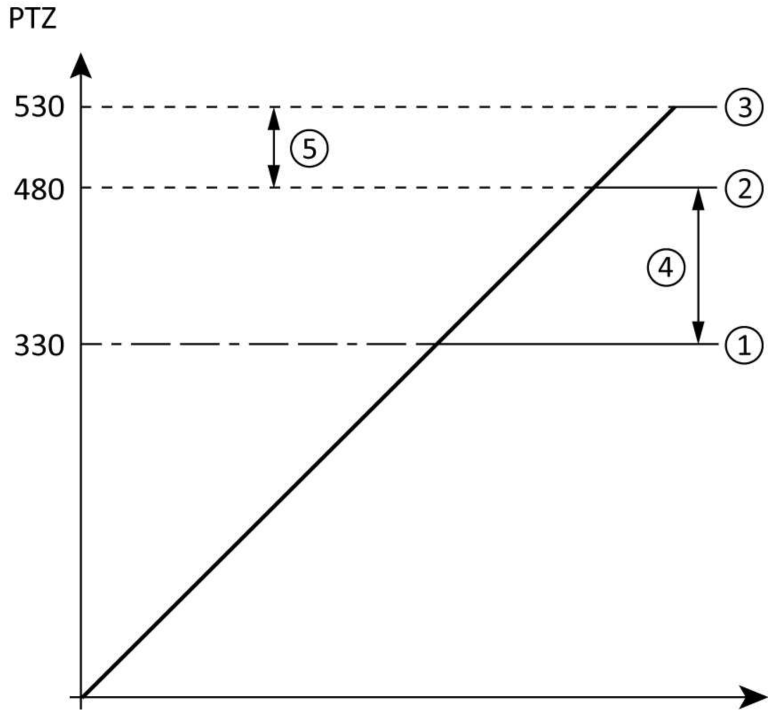


Fig. 10-3: Electrode exchange

1	Module message: electrode exchange pre-warning value
2	Module message: electrode exchange required for gun n
3	Module message: electrode exchange urgently required for gun n
4	Electrode exchange pre-warning value
5	Spot counter overflow

10.5.1 Acknowledging electrode exchange

An electrode exchange is acknowledged by resetting the spot counter. See *Spot counter*, p. 60.

It must be ensured that the correct gun/counter is selected.

Please note:

If the initial milling function is activated, initial milling is triggered immediately after counter reset. The module is only ready to weld again when initial milling has been acknowledged. See *Initial milling*, p. 61.

10.6 Start current increasing

The use of start current increasing is recommended when the milling function is active, see *Electrode milling (subsequent milling)*, p. 62.

Often, the welding results with a freshly milled electrode cap do not correspond to those of a welded-in electrode cap. This can be compensated with start current increasing.

Start current increasing is switched on and configured via the user interface.

MODULE > ELECTRODE HOLDER CONFIGURATION > MAINTENANCE > START CURRENT INCREASING.

Please note:

Start current increasing is always assigned to the selected gun and the respective spot counter, see *Spot counter*, p. 60, and acts on all welding programs assigned to this gun.

The increase is specified in percent.

Parameters	Increase Spot counter

As a result, the current is increased by the specified percentage, and then decreases again in linear form to the kA value specified in the welding program.

10.7 Current stepper

The electrodes wear as the number of welding processes increases. This reduces the current density and increases the transition resistance. This results in reduced welding quality.

The current stepper can be used to continuously increase the welding current as the electrode electrode condition decreases. Use with the milling function switched off is recommended. See *Electrode milling (subsequent milling)*, p. 62.

Software prerequisites:
XPegasus
Firmware: version 2.00 and higher

The function is activated and parameterised via the user interface:

MODULE > EDIT WELDING PARAMETERS > I STEPPER

Parameters	Spot counter	
Inputs	-	
Outputs	-	
System messages	-	

The settings for the current stepper are always assigned to the selected welding program. A percentage current increase on reaching a defined spot counter status can be defined.

When the milling function is active, the milling spot counter is used as the basis.

When the milling function is deactivated, the weld spot counter is used as the basis.

Note under all circumstances:

- The current stepper improves the welding quality of the electrodes during their service life.
- The electrodes' service life is not extended by the stepper.

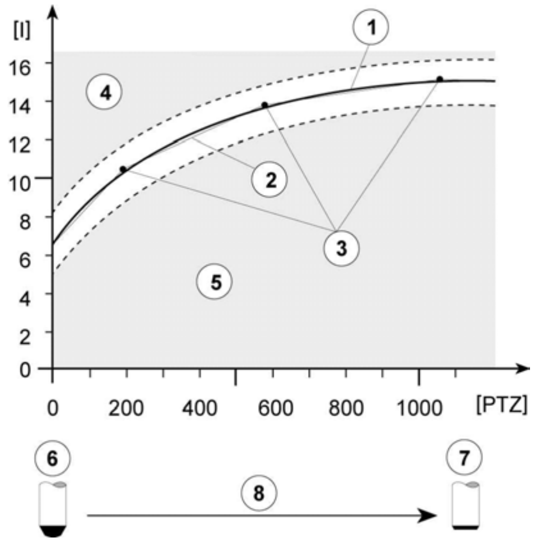


Fig. 10-4: Current stepper function

1	Ideal welding setting
2	Current specification
3	Increase value
4	Spatter range
5	Bonding range
6	Electrode status at start
7	Electrode status at end
8	Electrode status decrease
[I]	Current
[PTZ]	Spot counter

10.8 Milling stepper

The milling stepper can be used to increase the current each time after milling to compensate the higher transition resistance after milling the electrodes.

The milling stepper is switched on and configured via the user interface.

MODULE > ELECTRODE HOLDER CONFIGURATION > MAINTENANCE > MILLING STEPPER.

The increase is specified in percent.

The milling stepper always refers to the selected gun.

10.9 Tip monitor

This function is optionally available.

The tip monitor is used to check whether electrode milling was successful.

Software prerequisites:
Software: XPegasus
Firmware: version 1.68 and higher

Parameters	Tolerance Delay Record reference curve	
Inputs	Perform reference welding Perform control welding	
Outputs	Control welding OK Control welding not OK	
System messages	372	Comparison of welding processes before and after milling incorrect
	373	Error on recording the reference curve
	374	Reference curve has been deleted

To do this, a reference weld with worn electrodes which measures the electrode voltage is performed prior to scheduled milling. An envelope is created as the result. After milling, a control weld is performed and compared against the reference weld.

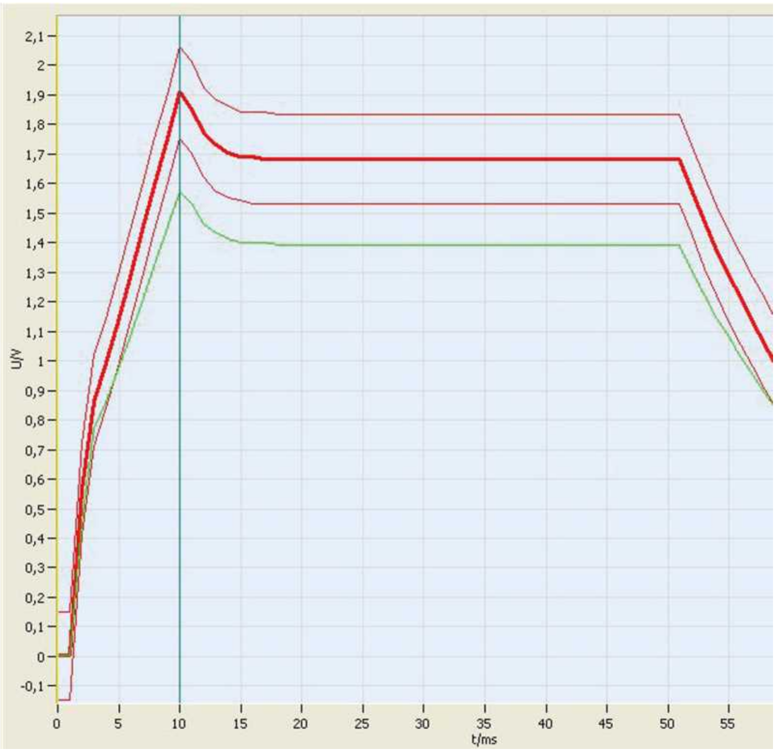


Fig. 10-5: Milling successful

The control weld curve (green) must lie outside of the envelope for milling to be judged successful. A time parameter is used to define the maximum length of time for which the curves may correspond.

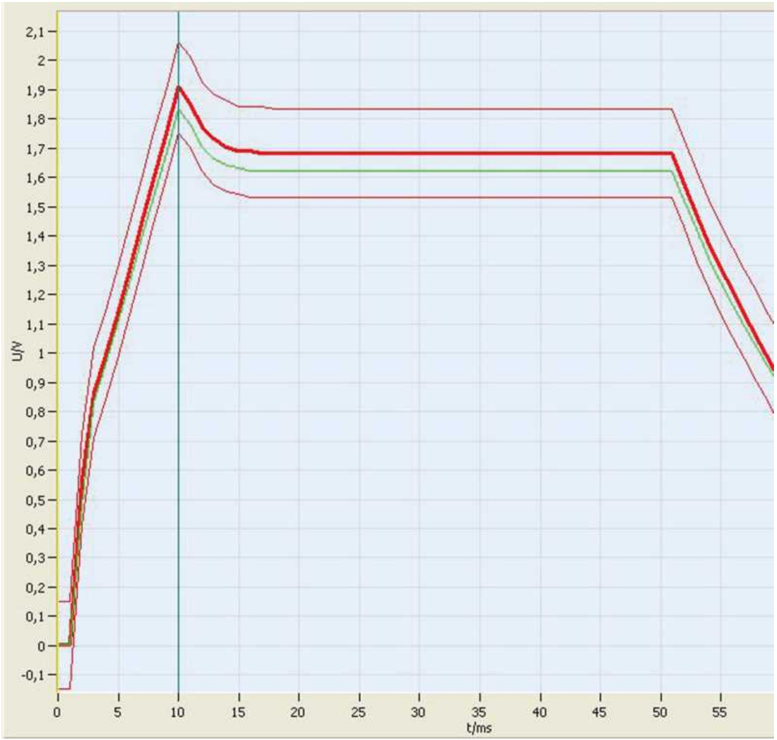


Fig. 10-6: Milling unsuccessful

If the control weld curve (green) still lies within the envelope, milling was unsuccessful and message 372 (comparison of welding before and after milling incorrect) is output.

The function is activated and parameterised using the user interface.

10.10 Milling unit interface

If this function is part of the delivery scope, non-integrated milling units can be used. The module then controls the milling facility/ies. The function provides the signals required for both initial and subsequent milling. The success of milling can be checked with the corresponding monitor, see *Tip monitor*, p. 70.

Software prerequisites:
XPegasus
Firmware: version 1.69 and higher

Parameters	Milling time Milling blade revolutions Mode Type
Inputs	Initial milling Standard milling Electrode holder closed Motor protection contact Motor temperature
Outputs	Milling running Milling finished Milling error Milling unit number
System messages	-

Process

How the process is implemented depends on the parameter settings. The robot positions the electrode holder in front of the milling station so that it can be completely closed or the milling unit is slewed into a stationary electrode holder.

The <Initial milling> or <Standard milling> start signal activates the signal for the milling motor. After the milling motor has started and corresponding rotation pulses, the <Milling running> signal is activated. The robot then closes the gun and signals this with the <Gun closed> signal.

Depending on mode, the <Milling finished> signal is activated after the specified milling time or the number of rotation pulses. The robot opens the gun. Finally, the start signal has to be deactivated again to stop the motor.

Error during process

If an error occurs during cap milling, the process is aborted. Causes of the error may be:

- Protective functions of the milling motor,
  signals at the <Motor protection contact> or <Motor temperature> inputs,
- Lack of motor rotation pulses,

- Premature electrode holder opening,
- Exceeding the maximum milling unit operating time.

If an error condition occurs, the milling motor is shut off, the <Milling running> signal is deactivated and the <Milling error> signal is activated.

Operation with multiple milling stations

The function can also use multiple milling units, but not at the same time. The <Milling unit number> signal is provided for this. This signal specifies which milling unit is to be addressed. There is no fixed electrode holder/milling station assignment. Selection is merely performed by the number set in the start signal. When at rest, the signal is 0, no milling unit is selected.

If the number of the milling unit greater than 0 is written as the <Initial milling> start signal or the <Standard milling> signal, this number appears as the <Milling unit number> signal. The start signal can then also contain other values as long as no 0 is written, which would result in the abortion of milling. The <Milling unit number> signal is no longer changed until milling is completed. At the end of milling, the signal is set to 0 again and other milling units can be set. The <Milling unit number> signal is set 50 ms prior to the start of the milling process and remains set until 50 ms after the end of the process before being reset to 0.

11 Parameterising the welding process

11.1 Welding process

The welding process describes the course of the welding current over time. A program's welding process is defined through a variety of parameters. The parameters for a welding process are stored as a program. The parameters are input via the user interface.

NOTICE

Improper parameterisation of the module

Material damage to the system and/or component

- Make sure the module is correctly parameterised.

Welding process overview

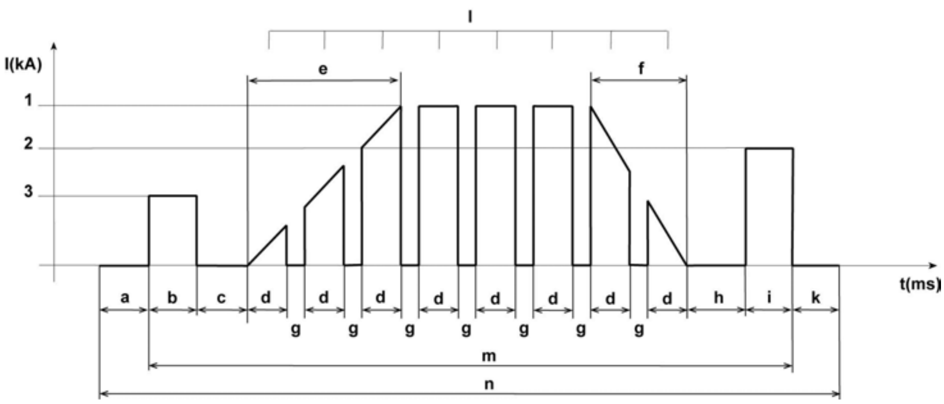


Fig. 11-1: Welding process

1	Strength of the main current (kA)
2	Strength of the post-heating current (kA)
3	Strength of the pre-heating current (kA)
a	Squeeze time
b	Pre-heating time
c	Heat compensation time
d	Main current time (main current)
e	Current increase time
f	Current decrease time
g	Pause time
h	Recooling time
i	Post-heating time
k	Hold time
l	Number of pulses
m	Welding time
n	Welding process

The welding process is initiated by program selection and the presence of the start signal; it ends with the end of sequence.

The welding unit is closed at the beginning of the welding process and welding force builds up. Closing and the build-up of force take place in the squeeze time, or in the first extended squeeze time.

See *First extended squeeze time*, p. 86.

See *Squeeze time*, p. 86.

After the welding facility has been closed and the desired nominal force value achieved, the input of heat into the workpiece begins with welding time (see Fig. 11-1).

To achieve an optimal welding result, it may be necessary to not introduce heat uniformly but in the form of current profiles. Current profiles individually tailored to the welding job can be parameterised using the <Pre-heating>, <Main current> and <Post-heating> parameters.

See *Pre-heating*, p. 87.

See *Main current*, p. 89.

See *Post-heating*, p. 92.

Current increase and decrease, pulse and pause times can also be configured.

See *Current increase time*, p. 88.

See *Current decrease time*, p. 90.

See *Pulses*, p. 89.

See *Pause time*, p. 90.

The current-conducting times are followed by the hold time. During hold time the welding spot cools down and is mechanically resilient afterwards. The end of sequence is set when hold time ends; the welding process is completed.

See *Hold time*, p. 93.

11.1.1 Welding process: status display on the display

The status of the welding process is shown on the module's display using welding codes (wld). The numbers have the following meanings:

wld 00	No process.
wld 01	Process is in the first extended squeeze time.
wld 02	Process is in the squeeze time.
wld 03	Process is in the hold time.
wld 04	Process is in the open time.
wld 05	Process is finished.
wld 06	Emergency stop detected.
wld 07	Process has been started.
wld 16	Process is in the pre-heating current.
wld 17	Process is in the main current.
wld 18	Process is in the post-heating current.

11.2 Operating modes

You can choose between single spot and series spot mode.

11.2.1 Single spot

<Single spot> mode is typically used for automated systems.

In single spot mode, a welding process is performed when a start signal is detected. The welding process is completed with the end of sequence, see *Welding process output signals*, p. 138. **One** welded joint is produced.

- After starting, a welding process runs as programmed.
- The welding process is repeated after opening the start contact and closing it again.
- A start signal activated prior to the end of sequence does not result in a renewed welding process. It can only be started after the completion of the previous welding process.

11.2.2 Series spot

<Series spot> operating mode is typically used for manual electrode holders.

The continuous sequence of welding processes for the duration of the applied start is called series spot mode. A start thus results in a series of welding processes, i.e. **multiple** welded joints.
In serial spot mode, a welding process is repeated following the output of the end of sequence signal and expiry of open time for as long as the <Start> signal is also present.

In series spot mode, the welding process normally begins with the first extended squeeze time, see *First extended squeeze time*, p. 86.

This is required because more time is needed to close the electrode holder and for power to build up during the first welding process.

Note

In serial spot welding, the <Start interlock with current time> configuration is recommended. This enables the welding process to still be aborted during the squeeze time without current if necessary.

If the welding process is not cancelled, it runs as programmed to the end of hold time.

See *Hold time*, p. 93..

At this point, a check is made as to whether the <Start> input continues to be active. In this case, the programmed <Open time> is executed. A new welding process then begins with the <Squeeze time>.
During open time, the welding unit opens slightly and can be positioned to the next welding spot. When open time expires, the next welding process begins with the closing of the welding unit and hold time. The first prolonged squeeze time no longer occurs.

See *First extended squeeze time*, p. 86..

This process is repeated as long as start signal is still being applied. Series spot mode is normally ended in open time by cancelling the start signal. See *Open time*, p. 93..

11.3 Regulation modes

The control mode is used to set whether and how the current is regulated during the welding process. The following control modes are available:

SKT	Set mode
KSR	Constant current regulation
IQR	Adaptive regulation
AMC	AluModeClassic
AMF	AluModeForce

11.3.1 SKT set mode

SKT is an unregulated mode for setting the welding current in scale divisions (SKT). This is also referred to as "set mode".

Value range

The value range lies between 1 SKT and 999 SKT.

The lowest welding current is achieved with 1 SKT. However, this value is always adjusted, in order for to exceed the diode voltage of the welding transformer. The actual values show then lie at a minimum of between 40 and 160 SKT, depending on the transformer current set.

When operating in SKT control mode, lead voltage compensation is always switched on up to the maximum settings of 999 SKT. This also has an effect on the actual values that are shown.

The highest welding current is achieved at 999 SKT, but only when the power unit is not overloaded. In this case a message to this effect is output. When operating at 999 SKT, all reducing functions are switched off and actual values up to 1001 SKT can be shown.

The following figure shows the course of a welding current set in SKT. It clearly shows that the scale divisions remain unchanged. The curve shows the course of the welding current.

Fig. 11-2: SKT set operation

11.3.2 KSR constant current regulation

Constant current regulation (KSR) is used to keep the welding current constant.

Prerequisite

- To achieve good control behaviour, constant current regulation must be adapted to the conditions of the system, this is achieved with the set-up welding processes, see *Set-up welding processes*, p. 80.

Only after performing the set-up welding processes is constant current regulation ready for operation.

Functional principle

Using constant current regulation (KSR), the welding current (nominal value) set in kA should be reached as quickly as possible and kept at the set value. Current ramps can also be set.

In order to keep the value set, welding current is measured in millisecond intervals and compared with the nominal value. Adjustment is carried out with scale divisions (SKT) in the event of deviations. The prerequisite of this is that the measuring sensors are correctly connected. See *Connecting measuring sensors*, p. 32.

The function is parameterised via the user interface under the pull-down menu MODULE > EDIT WELDING PARAMETERS. The desired control mode can be selected and set there.

The values are entered in kA.

Note

Further information on the topic is available in "HWH welding systems initial commissioning" quick guide. This is available in the download area at www.harms-wende.de or will be provided by our Service department on request. Registration is required to use the download area.

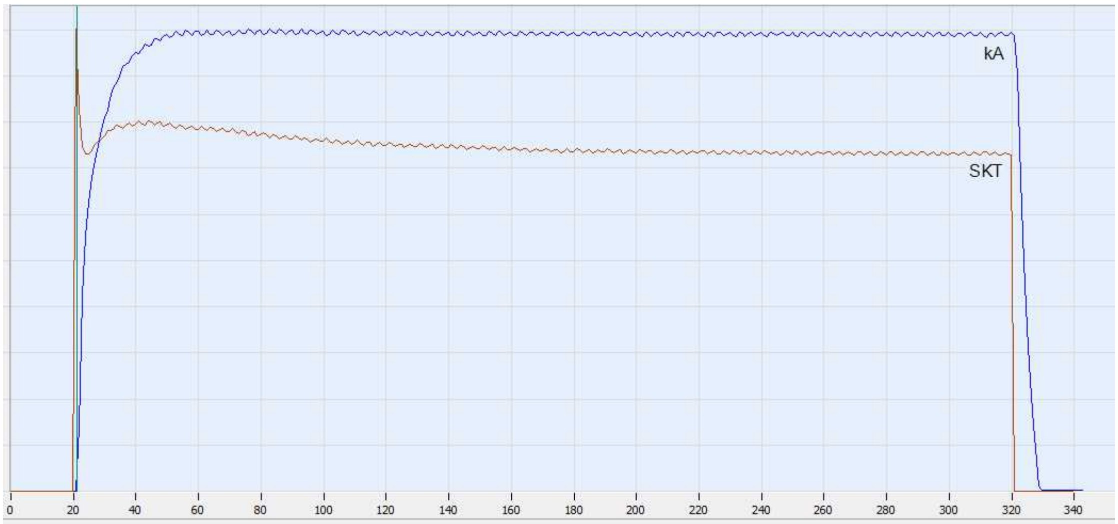


Fig. 11-3: Constant current regulation (KSR), set up

Controller optimisation

Controller optimisation can be used to vary the aggressiveness of the current increase. The settings are dependent on the specific welding task.

The function is set via the user interface: ELECTRODE HOLDER > CALIBRATE > CONSTANT CURRENT CONTROLLER.

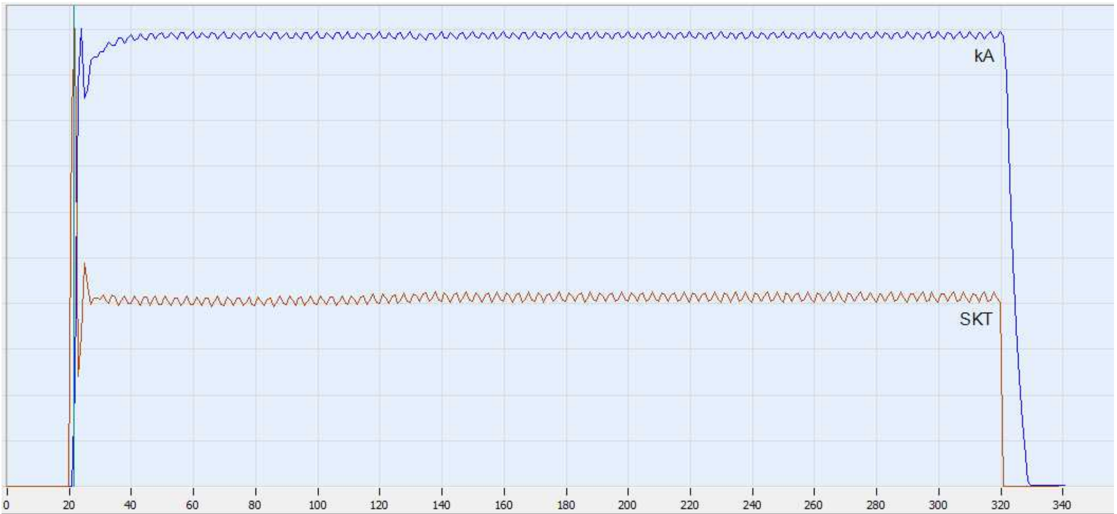


Fig. 11-4: Constant current regulation (KSR) with controller optimisation

Set-up welding processes

The adaptation of constant current regulation to the system is performed with the help of five set-up welding processes.

The set-up welding processes must be performed separately for each electrode holder.

Note

Before beginning set-up welding, make sure that the welding current is being measured correctly. To check current measurement, perform one welding operation in SKT mode.

Then carry out five consecutive welding processes without a message. This concludes the set-up welding processes.

The following points must be noted for these five welding processes:

- Switch off monitoring (inspectors), as it can cause messages.
- Carry out the welding processes <With current>.
- Use only the <Main current> and <Main current time> parameters; do not parameterise current increase and
  decrease. Do not use pulses.
- Use the current values typical for the system. The time set is not as critical as selecting current that is too low.

The set-up can be deleted from the user interface at any time.

When the set-up has been deleted, the subsequent five welding processes in KSR or IQR control mode are always performed as set-up welding processes.

Note

If the gun is replaced following set-up welding, set-up welding may have to be repeated.

Note

Further information on the topic is available in "HWH welding systems initial commissioning" quick guide. This is available in the download area at www.harms-wende.de or will be provided by our Service department on request. Registration is required to use the download area.

11.3.3 IQR adaptive regulation

The IQR control mode is adaptive regulation for resistance spot welding.

Prerequisites

- For the operation of IQR, the electrode voltage measurement leads must be wired correctly. See *Connecting measuring sensors*, p. 32..

This is required, because electrode voltage must also be measured to calculated the resistance. Resistance is calculated from the amperage and voltage.

Functional principle

IQR controls the welding current based on the course of the resistance of the workpiece. The process utilises the thermal course of a welding operation through the resistance, compensating for disturbances. This is not possible with constant current regulation.

Note

Further information on the topic of IQR adaptive regulation is available in the detailed IQR documentation. This is available in the download area at www.harms-wende.de or will be provided by our Service department on request. Registration is required to use the download area.

11.3.4 AMC – AluMode Classic

AluMode Classic is a control mode tailored specifically to joining aluminium.

Software prerequisites:
XPegasus: version 3.2.10 and higher
Firmware: version 2.02 and higher

Parameters		
Squeeze time	Data in ms	
Pre-heating current	0-100 000 A	
Pre-heating time	0-200 ms	
Heat compensation time	0-2000 ms	
Conditioning current	0-100 000 A	
Conditioning time	20-500 ms	
Conditioning threshold	0-15 000 µΩ	
Pause time	0-250 ms	
Current increase time	0-250 ms	
Main current	0-200 000 A	
Current time	0-2000 ms	
Recooling time	0-2000 ms	
Post-heating current	0-200 000 A	
Post-heating time	0-2000 ms	
Post-heating drop out time	0-2000 ms	
Hold time	Data in ms	
Force before	0-15 000 daN	
Force current phase	0-15 000 daN	
Force after	0-15 000 daN	
Force adaptation time	0-2000 ms	
Bring forward nominal force	0-2000 ms	
Continue when time exceeded	yes/no	
Inputs	Nominal force reached	
Outputs	Aluminium conditioning too long Pressure increase Aluminium adaptation time exceeded	
System messages	346	Conditioning: time exceeded.
	363	Nominal force not reached after <n> ms

Due to the low resistance and good electrical and thermal conductivity, aluminium requires short and high amperage. Due to its tendency to oxidise, the extensively varying transfer and contact resistance also presents a challenge to the welding process.

AluMode Classic is configured via the user interface.

It is possible to use both pneumatic proportional valves and electrode holders driven by an electric motor.

Prerequisites

- Set-up welding with constant current regulation has been performed.
- The gun's force is calibrated.

Functional principle

AluMode Classic forwards a force profile nominal value to the tool. The current profile is controlled in parallel. Two temporal phases are used for this. In the first phase the resistance is evaluated in a preconditioning current. This is followed by aluminium main current time in the second phase.

Preconditioning makes it possible to create uniform initial starting conditions related to the material or the electrical resistance of the material. The resistance to be achieved is defined via the <Conditioning threshold> parameter. Aluminium current time starts only after this conditioning threshold is reached.

The maximum time permitted for this adaptation process is defined using the <Conditioning time> parameter. If this time is exceeded, a corresponding system message is output. The behaviour of the module when the time is exceeded can be configured

The actual main current time is defined by the temporally fixed aluminium current time (<Main current>) in the aluminium current profile. The aluminium current time can also include an increase and a decrease in current.

Specific force profiles are available for the pre and post-heating time. The <Force before> parameter applies to the squeeze time and the pre-heating time; the <Force after> parameter accordingly applies to the post-heating time and hold time.

The maximum time permitted for this adaptation process is defined via the <Force adaptation time> parameter. Only when the force current phase is reached does the conditioning time begin.

The following graphic shows the welding process with AluMode Classic.

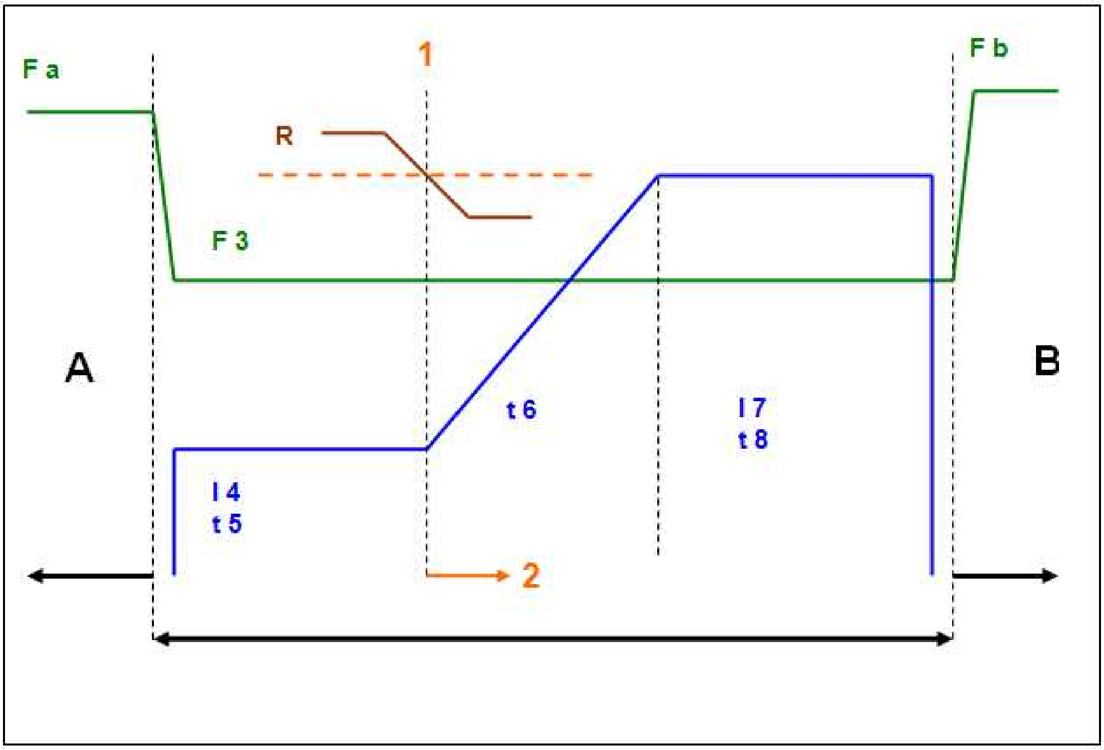


Fig. 11-5: AluMode Classic, process

A	Pre-heating
B	Post-heating
R	Electric resistance
Fa	Force before
Fb	Force after
1	Conditioning threshold
2	Indexing
F3	Force current phase
I4	Conditioning current
t5	Conditioning time
t6	Current increase time
I7	Main current aluminium
t8	Current time aluminium

11.3.5 AMF - AluMode Force

AluMode Force (AMF) is a control mode tailored specifically to the process of joining aluminium.

In addition to AluMode Classic, see *AMC – AluMode Classic*, p. 82, AMF offers the following functions:

- Welding spot quality monitoring
- Adaptive control for the welding process
- Controller activity monitoring

Note

Further information on the topic of AMF (Aluminium Mode Force) is available in the detailed AMF documentation. This will be available shortly in the download area at www.harms-wende.de or will be provided by our Service department on request. Registration is required to use the download area.

11.4 Parameters

11.4.1 First extended squeeze time

The <First extended squeeze time> is used primarily in series spot mode.

See *Series spot*, p. 77..

It begins with the input signal <Start> and ends with the beginning of squeeze time. During the first extended squeeze time, the welding unit closes and permits safe pressure build-up when pressing the electrode onto the workpiece.

In series spot mode, use of the first extended squeeze time permits a more efficient welding process, because the welding unit needs more time to close during the first welding spot than with subsequent spots. This time can be parameterised beyond the first extended squeeze time.

The fist extended squeeze time is always the first time expiring in the welding process; it can also have the value 0.

11.4.2 Squeeze time

The squeeze time is a current-free time after starting or after the first extended squeeze time, see *First extended squeeze time*, p. 86. The squeeze time is used to bridge the gun closing time and for the safe build-up of force when the welding facility is closed; however, no current flows yet.

Squeeze time must be set so long that the desired pressure can build up over the workpiece. If this time is set too short, this may result in initial spatter.

The pressure contact indicates whether the nominal force value is reached. Accordingly, squeeze time only ends when the pressure contact is closed. If the pressure contact is missing, squeeze time is prolonged, and this message appears:

- 358 - Waiting for input pressure contact

Note

If the <Pressure contact> input is not used, this input must have a fixed 24 V connection.

Note

With immediate start interlock and a missing pressure input signal, the welding process will pause. It can then only be cancelled through external status changes such as <EMERGENCY STOP>.

11.4.3 Pre-heating

In order to execute the welding task with the best quality possible, it may be necessary to pre-heat the material.

Pre-heating determines how long the component is heated by the <Pre-heating current> prior to the welding process. Pre-heating can, for example, be used to join the material (poor fit), overcome transition resistances in coated materials.

The duration and strength of current are always dependent on the welding task.

The following parameters are available:

- Pre-heating time
- Pre-heating current
- Heat compensation time

The pre-heating time can be switched off (= 0 ms). If pre-heating time = 0 is set, no pre-heating occurs. In this case, the nominal pre-heating current value has no effect on the initial value of the current increase in the main current time. The heat compensation time is not then carried out either.

The nominal value settings of all current values can be specified from the operating unit in SKT for SKT mode or kA for KSR mode.

Pre-heating current

The parameter determines the value of the current which heats the component during the <Pre-heating time>.

Pre-heating current is output with no current increase or decrease.

Depending on control mode, the values are specified in kA or SKT, see the user interface for the possible value ranges.

Pre-heating time

The parameter determines the length of time for which the component is heated by the <Pre-heating current> prior to welding.

Pre-heating time is a current conducting time, it can be switched off (= 0).

The value is input in ms, refer to the user interface for possible value ranges.

Heat compensation time

To avoid excessive heating, heat compensation time can be parameterised after pre-heating time. During this time, cooling at the welding spot takes place through the electrodes which are applied.

The parameter determines the duration between the end of <Pre-heating time> and the start of <Current time>. No current flows during this period of time.

The value is input in ms, refer to the user interface for the possible value ranges.

11.4.4 Main current time

In order to execute the welding task with the best possible quality, it may be necessary to not continuously input heat into the material. Main current time is a parameter that can be used to customise heat input for each welding task. It is possible to parameterise current increase and decrease, pulses and current pauses. Initial values are available from the spot tables.

See *Spot table*, p. 51..

Main current time has the following parameters:

- Current increase time (up slope time)
- Main current
- Main current time
- Recooling time
- Pause time
- Number of pulses
- Current decrease time (down slope time)

Current increase time

The <Current increase time> parameter is used at the start of the main current time to set a continuous nominal current amplitude value change in the input current increase time from the initial value to the nominal current value.

The value is input in ms, refer to the user interface for the possible value ranges. The current increase always starts with the value that the pre-heating current ends with, if it has been parameterised; see *Pre-heating*, p. 87.Otherwise, the current increase starts at 0.

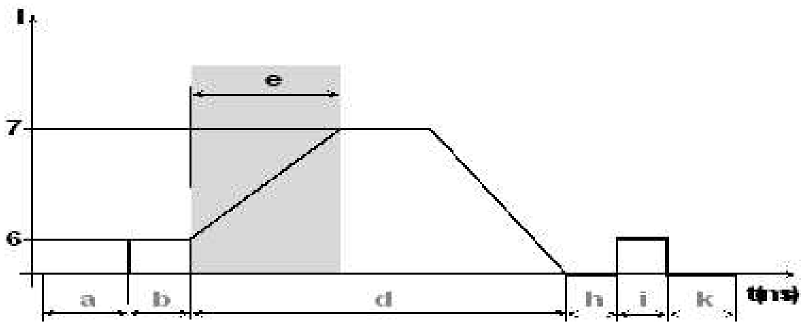


Fig. 11-6: Current increase time

6	Pre-heating current
7	Main current
a	Squeeze time
b	Pre-heating time
d	Main current time
e	Current increase time
h	Recooling time
i	Post-heating time
k	Hold time

The slope of current increase is calculated as follows:

$$\text{Slope} = \frac{\text{Main current pre-heating current}}{\text{Current increase time}}$$

If current increase time is longer than current time, the main current set will not be reached.

Main current

The parameter specifies the current value which flows during the <Main current time>.

The main current is greater than the post-heating current or hold time.

Depending on control mode, the values are specified in kA or SKT, see the user interface for the possible value ranges.

Pulses

The parameter enables the <Current time> to be broken down into individual pulses with intermediate pauses. During the pause time, heat compensation takes place at the welding spot between the pulses.

See *Pause time*, p. 90..

The minimum setting is 1. If more than one pulse is programmed, the main current time is repeated according to the set value after a possible pause time.

Main current time is over when the set number of impulses has been carried out to completion.

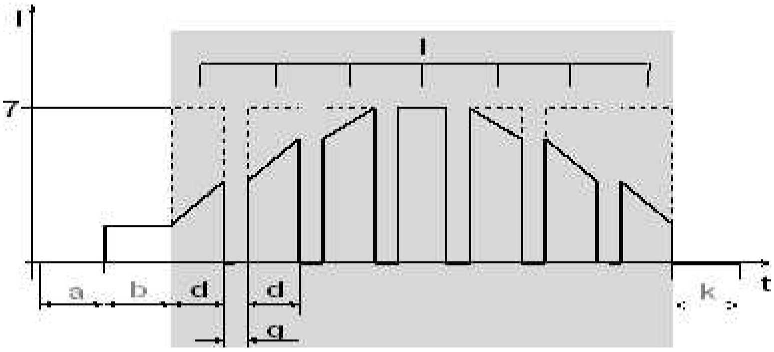


Fig. 11-7: Main current with pulses

7	Main current
a	Squeeze time
b	Pre-heating time
d	Main current time
g	Pause time
k	Hold time
l	Number of pulses

Main current time

The parameter determines the length of time for which <Main current> flows during the welding process.

The value is input in ms, refer to the user interface for the possible value ranges.

Pause time

The parameter enables current pauses to be inserted during the <Main current time>. Pause time is not a current-conducting time. During <Pause time>, heat compensation takes place.

The <Pause time> is only taken into account in welding processes with two or more pulses, see *Pulses*, p. 89. The <Main current time> ends once the <Number of pulses> has been processed.

Current decrease time

At the end of welding time, the <Current decrease time> parameter is used to set a continuous nominal current amplitude value change in the input current decrease time from the nominal current value to the end value.

The parameter thus determines the duration of the current decrease. The temperature of the component decreases during this period of time.

The initial value corresponds to the <Main current>; the final value is 0 or corresponds to the value of the <Post-heating current>, if it has been parameterised.

The value is input in ms, refer to the user interface for the possible value ranges.

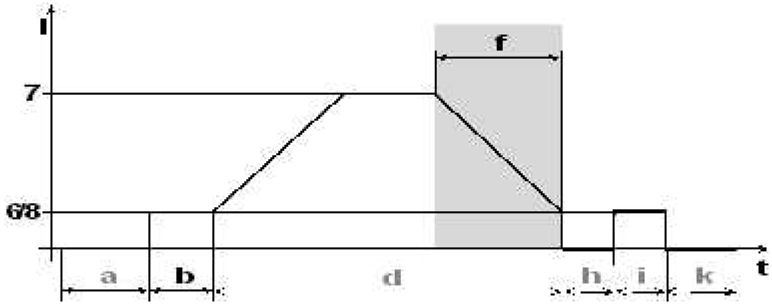


Fig. 11-8: Current decrease time

6/8	Pre-heating current/post-heating current
7	Main current
a	Squeeze time
b	Pre-heating time
d	Main current time
f	Current decrease time
h	Recooling time
i	Post-heating time
k	Hold time

The slope of current decrease is calculated as follows:

$$\text{Slope} = \frac{\text{Post-heating main current}}{\text{Current decrease time}}$$

If current decrease time is longer than main current time, the end value will not be reached.

11.4.5 Post-heating

In order to execute the welding job with the best possible quality, it may be necessary to not continuously input heat into the material. The parameters for post-heating can be used to further adjust heat input to the welding job; post-heating can thus be used to temper the material.

The following parameters are available:

- Post-heating time
- Post-heating current

The initial value of <Post-heating current> is the final value of the amplitude for the current decrease, if this was parameterised.

See *Current decrease time*, p. 90..

Setting the current nominal value settings can be specified in SKT for SKT mode or kA for KSR mode.

Recooling time

The parameter determines the period of time between the end of <Current time> and the start of <Post-heating time>. No current flows during this period of time. Cooling from the electrode still attached takes place on the welding spot.

The value is input in ms, refer to the user interface for the possible value ranges.

Post-heating current

The parameter determines the value of the current which heats the component during the <Post-heating time>.

The initial value of the <Post-heating current> is the final value of the amplitude for current decrease see *Current decrease time*, p. 90, if it was parameterised.

Depending on the control mode, the values are specified in kA or SKT; refer to the user interface for the possible value ranges.

Post-heating time

Certain welding jobs require post-heating of the material, e.g. to avoid stress cracks.

The parameter determines the length of time for which the component is heated by the <Post-heating current> after the main current.

The value is input in ms, refer to the user interface for the possible value ranges.

11.4.6 Hold time

The hold time, also called the post-pressing time, starts after the last time in which current flows (main current or post-heating current). During the hold time, the electrodes remain pressed together to allow the welding spot to recool so that the spot solidifies and is then mechanically resilient.

The parameter determines the length of time for which the electrodes apply pressure on the component after welding. No current flows during this period of time.

Successful welding and faulty welding in the hold time

During the hold time, the calculations for all monitoring functions and inspectors are completed. If the hold time to too short for the calculations, the hold time is extended.

If welding is successful, the system is opened at the end of hold time and the end of sequence is output; the welding process is ended. At the same time, start interlock is released.

When welds are faulty, the end of sequence is not output, the hold time is prolonged, the welding unit remains closed. The corresponding messages are output.

The hold time can still be ended by acknowledging the <With FK> message; the system is opened and the end of sequence is output. The welding process is complete. This ensures that workpieces with faulty welds do not go unnoticed for further processing. The behaviour of the module after outputting the message can be configured.

See *Message management*, p. 43.

11.4.7 Open time

The open time is used exclusively in series spot mode. It begins at the end of hold time.

See *Series spot*, p. 77..

Open time enables material transport or tool positioning. The <Solenoid valve> signal is shuts off for this purpose so that the welding unit can open. The welding unit can be moved to the next welding spot in short opening phases. When the open time ends the next welding process begins with the squeeze time. The welding unit closes again.

This parameter thus determines the period of time between the end of the <Hold time> and the start of <Squeeze time> for the next welding process.

Note

Cancelling the triggering start signal leads to the immediate end of open time and thus the end of the serial spot process.

11.4.8 Nominal force value

The gun force is entered using the <Nominal force> parameter.

The following value entries are possible:

- In percent
  When entering in %, 1% = 0.01 V at the output of the proportional valve. 99% correspond to 9.96 V. The gun force this value results in depends on the welding facility.
- In daN
  This requires that the gun has been calibrated.

Note

Further information on the topic is available in "HWH welding systems initial commissioning" quick guide. This is available in the download area at www.harms-wende.de or will be provided by our Service department on request. Registration is required to use the download area.

Output can can come from different channels:

- the analogue output of the proportional valve and the output of the field bus.
- output of the field bus.

The channels are output in parallel.

The parameters take effect immediately after selecting the welding program.

12 Inspectors

The inspectors are functions that enable various welding process parameters to be monitored. The inspectors' monitoring functions help to assure the quality of welding processes. This chapter explains the most important parameters, the monitoring methods and the way in which the inspectors function.

The inspectors are independent of each other. Depending on the choice of inspector, current, voltage, electrode force, control stroke, process stability, the component size and electrode travel plus the occurrence of spatter can be monitored:

- Current: I inspector and limit value monitoring
- Voltage: U inspector
- Force: F inspector
- Control stroke: H inspector
- Process stability: Q inspector
- Component control and travel measurement: S inspector
- Spatter: SP inspector

Note

A maximum of three inspectors can be operated simultaneously.

The monitoring functions compare the data of a completed welding process with previously defined nominal and reference values. Deviations from the desired result are detected and displayed in a system message. The system message can be acknowledged manually. If an automated process after a system message is desired, automatic spot repetition is configured, for instance. The individual setting options for the further process after a system message can be found in the documentation on Genius messages.

12.1 Explanation of the most important parameter terms

The following parameters are important to the use of the inspectors. The parameters are input via the user interface.

12.1.1 Delay

The <Delay> parameter can be used to delay the start of the <Measuring time>. The <Measuring time> starts with the first current.

At the start of a welding process, the current curve increases after a delay (the cause is the inductivity of the welding circuit). The required delay is specified to remove the delayed increase of the current curve from the measurement. The aim is that the values from the delayed current increase are not included in the comparison of the nominal and actual values.

Note

If an excessive delay is specified, no current is measured. Example: the specified delay is greater than the welding time.

Note

When monitoring voltage and control stroke, the actual values may temporarily noticeably increase at the start of a welding process, e.g. as higher voltage or a higher control stroke is initially required depending on the coating or waviness of the material being welded. The values can be removed from the measurement by inputting a start delay time.

The inductivity of the welding circuit also results in a delayed decrease in the actual current curve. The delayed current decrease occurs after the current time. As the measuring time ends with the current time, no delay is required for the delayed current decrease. The current decrease is disregarded in the measurement.

The following illustration shows the measuring time. The duration of the measuring time with and without the specified delay is shown.

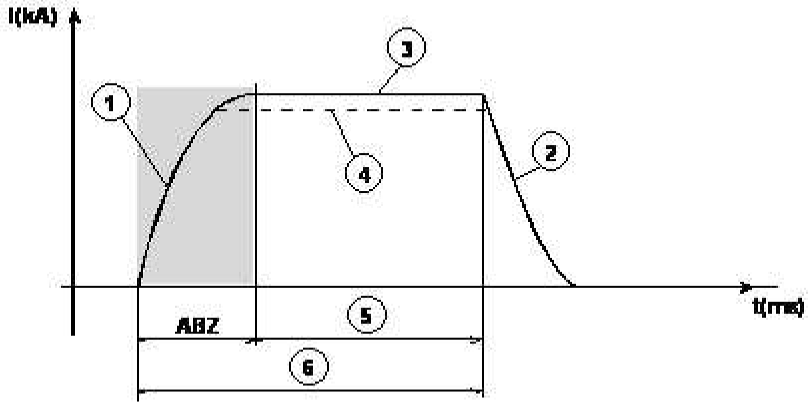


Fig. 12-1: Measuring time with and without delay

ABZ	Delay
1	Delayed current increase
2	Delayed current decrease
3	Mean actual current value with delay
4	Mean actual current value with delay
5	Measuring time with specified delay
6	Measuring time without delay

Note

The following applies on use of external measuring devices:

It must be ensured that external measuring devices (sensors) determine the current in the same manner as the Harms & Wende module. To achieve comparable results, the measuring time and the delay of the module and external measuring devices must match. Otherwise, significant deviations may occur on comparison of the nominal value determined by the module with the actual value determined by the external measurement.

Different measuring device tolerances may also result in deviations: e.g. current measurement sensors which operate according to the Rogowski principle may exhibit high tolerances. Here, the position of the Rogowski belt versus the current-carrying conductor affects the measurement result.

12.1.2 Measuring time

The <Measuring time> begins with the first current after the <Delay>.
<Delay> excludes the delayed current increase at the start of a welding process from the measurement, see Fig. 12-1.

12.1.3 Tolerances

The use of inspectors requires the selection of a monitoring method. Positive and negative tolerances can be specified for the monitoring methods. The tolerances are the permissible deviations from nominal and reference values. If positive or negative deviation from tolerances occurs, a system message displays the deviation.

12.1.4 Deviation window

A deviation window can be used to define a limited scope for deviations outside of the tolerance range. Temporary outliers in the deviation window section are not judged errors. Only several deviations in close succession, the sum of which lies outside of the window in the longer-term, results in a system message.

12.2 Monitoring methods

This chapter offers an overview of the monitoring methods provided by the inspectors.

The following table provides an overview of the inspectors and the relevant monitoring methods:

To evaluate a completed welding process, a nominal value or a reference value is required as a comparative value source. Both terms are explained in the following.
The I inspector, F inspector, U inspector and H inspector offer the mean value, envelope and envelope absolute monitoring methods. There is a further option for monitoring the current: the I inspector function and the limit value monitoring function offer the mean nominal current value monitoring method.

	Reference curve record	Mean value	Envelope	Envelope absolute	Nominal value	Reference value
Limit value monitoring Current					x	
I-Inspector	x	x	x	x	x	x
H-Inspector	x	x	x	x	x	x
F inspector	x		x	x		x
U Inspector	x	x	x	x	x	x
Q-Inspector	x					x
S-Inspector						x
SP-Inspector	Function, see *SP inspector*, p. 131					

12.2.1 Reference curve

Recording reference curves enables the specification of reference values for welding tasks.

Note

If the S inspector is used, the <Profile indexing> function must under all circumstances be activated each time a reference curve is recorded. This also applies if the reference curve is recorded using another inspector.

Record reference curve

To record a reference curve for a welding program, the relevant inspector's <Record reference curve> parameter must be activated. A welding process is then performed. If the recording lies within tolerances, the control system automatically deactivates the respective inspector's parameter <Record reference curve> again after welding. If the recording lies outside of the tolerances and the inspector remains active, this does not happen. The measured values are used as the reference curve and are available as reference values.

If a welding program is now started, the curves of various process parameters such as welding current and control stroke, etc. can be determined and compared with the stored reference curve. If the comparison is to be based on a mean value, the mean value is calculated from the reference curve.

Reference value

The reference value comparative value source designates:

- The mean value from which the curve is calculated (in combination with the mean value monitoring method).
- The entire curve as a reference (in combination with the envelope and envelope absolute monitoring methods).

Note

If the parameters for the temporal sequence of a welding process are changed, the following options exist for the available reference curve:

- Delete the existing reference curve
- Record the existing reference curve again
- Retain the existing reference curve

Note

The component welded to record a reference curve must be checked after the welding process under all circumstances. Only this ensures that the reference value specifies the desired result.

Save reference curve

Saving reference curves can result in significant data volumes. The reference curves are therefore stored in the reference curve memory in pre-configured memory blocks.

The capacity of the entire memory for all reference curves is 500 kBytes. The total time for all reference curves is 240 s. The pre-configured memory blocks are available in three, or from firmware 2.04 four, different block sizes. The block sizes determine the maximum time up to which a reference curve is saved.

Block size	Max. reference curve duration
I	350 ms
II	700 ms
III	1000 ms
IC (from firmware 2.04)	2000 ms

The most appropriate memory block is always used to save a reference curve. If no appropriate memory blocks are available, the next block size is used until the entire memory is used. If the entire memory space is already used, a corresponding message appears.

Note

An individual memory block is always required to save a reference curve. No memory blocks are attached to each other.

Reference curves can only be saved up to a maximum length of 2000 ms.

Memory usage can be structured as follows e.g.:

- 570 reference curves, each with a length of ≤ 350 ms or
- 300 reference curves, each with a length of ≤ 700 ms or
- 230 reference curves, each with a length of ≤ 1000 ms
- 115 reference curves, each with a length of ≤ 2000 ms

Automatic referencing

Basically, references curves do not change. Automatic referencing can be used for the envelope and envelope absolute reference curves. If automatic referencing is switched on on the user interface, the system automatically creates new reference curves for the corresponding inspectors at specific intervals, e.g. after n welding processes. At the same time for inspectors that are active, and subsequently for those that are switched on later.

Automatic referencing is carried out for all programs assigned to an gun, here also for each active program, for the programs when next used.

Parameters	
Monitoring method	Off/mean value/envelope/envelope absolute
Comparative value source	Nominal value/reference value
Measurement time setting	Automatic
Record reference curve	Activates reference curve recording, deletes the existing reference curve for the program

System messages	408	New reference curve is recorded
	407	New reference curve saved
	409	Automatic referencing is completed

If the new reference curve does not lie within the specified tolerance range, a corresponding system message is output:

System message	E.g 253	Envelope: current for program too low by ‰

The new curve is saved, but automatic referencing remains active. Another reference curve is recorded and set in relation to this last one. Only when two consecutive reference curves lie within the tolerances is <Record reference curve> switched off.

12.2.2 Nominal value, mean value, envelope and envelope absolute

Only the I inspector, U inspector, F inspector and H inspector offer the mean value, envelope and envelope absolute monitoring methods. The nominal value and reference value are available as comparative value sources.
For information on reference value see *Reference curve*, p. 98.

Nominal value

The nominal value for a welding process parameter is stored in the program and is used for comparison with the actual values of a completed welding process.

Note

Delimitation of nominal value and reference value: only the reference value is based on a curve.

As a comparative value source, the nominal value is only useful in combination with the mean value monitoring method.

Mean value

In the mean value monitoring method, the nominal value or reference value are available as comparative value sources. The mean value of the actual values of a welding process is evaluated based on the comparative value source.

Depending on the inspector and the welding process parameter to be monitored, the mean value of the completed welding process is calculated from:

- the actual current values (I inspector)
- the actual voltage values (U inspector)
- the actual control stroke values (H inspector)

All current-conducting times of a completed welding process lying within the measuring time are taken into consideration.

On positive or negative deviation from the mean value, the control system outputs a message.

Envelope

The envelope monitoring method is only combined with the reference value comparative value source.

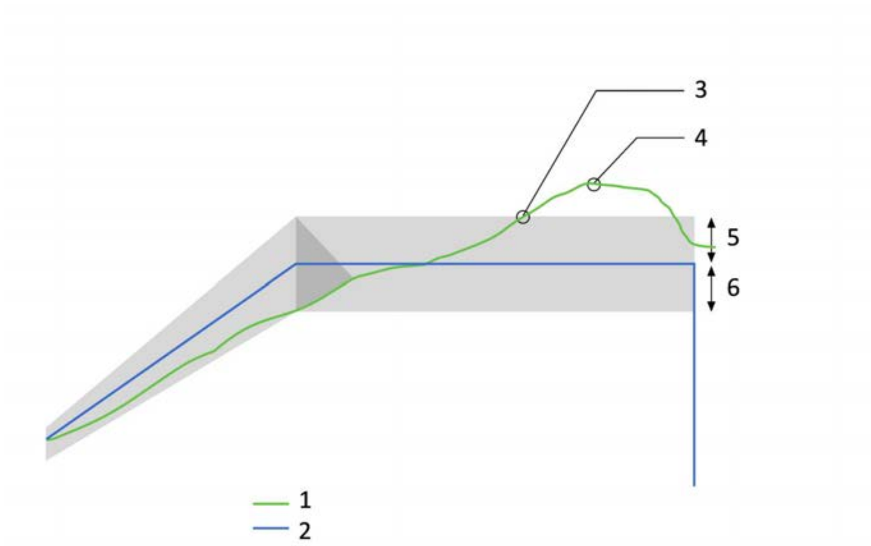


Fig. 12-2: Envelope

1	Actual value
2	Nominal value
3	Start of impermissible deviation
4	Error is determined
5	Tolerance+
6	Tolerance-

The term envelope designates a reference curve plus the tolerances defined for positive and negative deviation from the reference values. In envelope monitoring, a tolerance range surrounds the reference curve including all fluctuations. When monitoring current, voltage and control stroke, the envelope is compared against the actual values recorded during the welding process over the entire curve.

In the figure see Fig. 12-2 it can be seen that the distance between the tolerance range and reference curve varies. As the tolerance range for the envelope is specified in percent, the tolerance behaves proportionate to the individual value of the reference curve. As a result, the distance between the represented tolerance range and the reference curve may decrease or increase.

For information about recording a reference curve see *Reference curve*, p. 98.

On positive or negative deviation from the envelope, a message is output.

Envelope absolute

The envelope absolute monitoring method is only combined with the reference value comparative value.

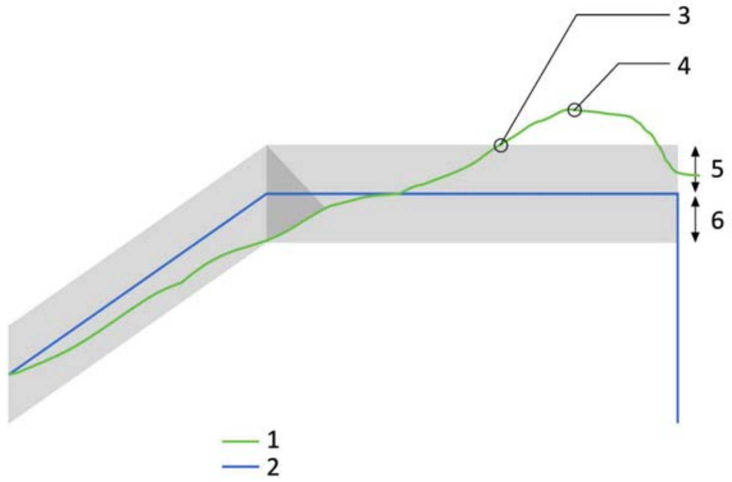


Fig. 12-3: Envelope absolute

1 Actual value
2 Nominal value
3 Start of impermissible deviation
4 Error is determined
5 Tolerance+
6 Tolerance-

The envelope absolute monitoring method differs from the envelope monitoring method: the tolerance range is independent from the individual curve values and thus has a constant value. In the figure, see Fig. 12-3, the distance between the tolerance range and the reference curve always remains the same. The tolerance is input in the relevant basic unit.

12.2.3 Mean nominal current value

Only the I inspector and limit value monitoring offer the <Meannominal current value> monitoring method.

The reference value for the mean nominal current value is calculated from all currents entered as parameters under the welding parameters menu item. If e.g. values for pre-heating current, main current and post-heating current are input, the values are integrated into the calculation.

Background information

The mean nominal current value is calculated by dividing all current time areas by the <Measuring time>.

$$\text{Mean nominal value} = \frac{\text{All current time areas}}{\text{Measuring time}}$$

Measuring time consists of the total current time minus the delay.

$$\text{Measuring time} = \text{total current time} - \text{delay}$$

Total current time consists of all current times and current values from the start of pre-heating time to the end of post-heating time. All pauses plus current increases and decreases are integrated.

$$\text{Total current time} = \text{pre-heating time} + (\text{current time} \times \text{pulses}) + (\text{all pauses}) + \text{post-heating time}$$

The mean nominal current value is compared against the flowed actual current value. If the actual current value lies outside of the defined tolerance, a system message displays the deviation in thousandths.

12.3 Further process after a deviation message

If the inspectors ascertain a deviation outside of the specified tolerances and the specified deviation window, the corresponding system message appears on the user interface. The system message must be acknowledged.

The <End of sequence> signal is required to move to the next welding process. The <End of sequence> indicates the end of a welding process. If the <End of sequence> signal is not output, the welding process initially comes to a halt until the errors are deleted by an error reset. The <End of sequence> signal is output after deleting the errors.

A system message can be acknowledged in various ways:

- Acknowledge message(s) without end of sequence
- Acknowledge message(s) with end of sequence
- Acknowledge message(s) with spot repetition

The system message can be acknowledged manually. see *Message management*, p. 43 for the setting options for the automated process after a system message.

12.4 Repeating the welding process

If an inspector detects a deviation outside of the specified tolerances, it may be necessary to repeat the welding process. The following options are available for automatically repeating the welding process:

- Repetition of the welding process is initialised by a connected programmable logic controller (PLC).
- To weld a welding spot again, the welding control system's <Automatic spot repetition> (PWH) parameter is activated. Application case: negative deviation from the mean current value occurred on setting a welding spot.

12.4.1 Process repetition with PLC support

If the module is connected to a PLC, repetition of the welding process can be initiated by the PLC.

If a welding error occurs, the module outputs a corresponding system message and stops without outputting the <end of sequence> output signal. The PLC causes the welding process to be repeated.

Parameters		
Inputs	Reset error with process repetition	
Outputs	Request for error reset with process repetition	
System messages	-	

Process

- A welding error occurs.
- The module control system forwards the system message to the PLC and stops.
- The <End of sequence> signal is not output.
- The PLC causes the robot to reset the <Start welding> signal and to open the gun slightly.
- The PLC again selects the same spot and causes the robot to repeat the welding process.

12.4.2 Automatic spot repetition

Note

Automatic spot repetition is a special case. Automatic spot repetition is only sensible if negative deviation from the mean current value has taken place. If negative deviation from the mean current value occurs, no or no stable connection between the materials to be welded occurs.

To automatically repeat a welding process, automatic spot repetition (PWH) must first be switched on. To do this, the <With automatic PWH> parameter is activated via the user interface. The user interface is also used to define the possible number of automatic spot repetitions and the waiting time between the individual repetitions.

There is an upper limit for the PWH number and waiting time:

- Automatic PWH can have a maximum number of 9.
- The waiting time can be a maximum of 10000 ms.

The welding process is repeated until one of the following results has occurred:

- The specified parameters have been adhered to.
- The maximum number of spot repeats has been reached.

If required, automatic spot repetition can be activated individually for each system message. This defines whether automatic spot repetition takes place when a specific message occurs. See *Message management*, p. 43..

Parameters		
No. of automatic PWH	Input of the number of PWH (0-9)	
Automatic PWH waiting time	Input of the waiting time between PWHs (0-10,000 ms)	
With automatic PWH	Switch on/switch off	
Inputs	Start	
Outputs	-	
System messages	344	Spot repetition for program (n) has been aborted

12.5 Current limit value monitoring

The limit value monitoring function monitors the welding current using the <Mean nominal current value> monitoring method.

The function monitors the welding current based on the mean nominal current value plus tolerances. The mean actual current calue is calculated from the measured actual values of a welding process and compared against the mean nominal current value. The difference is assessed based on the specified tolerances. If the mean actual current value of the completed welding process is higher or lower than the permissible tolerance, a system message is output. The system message must be acknowledged. The further procedure after system message output can be configured in advance.

The following table provides an overview of the limit value monitoring parameters. The parameters are input via the user interface.

Parameters		
Limit value monitoring	Switch on/switch off	
Tolerance+	Positive current tolerance in %	
Tolerance-	Negative current tolerance in %	
Current delay	Duration of the delay (0.00 – 65535 ms)	
Measuring time	Limit value monitoring duration	
Nominal welding time	Welding time duration (0.00 – 65535 ms)	
Inputs	Current measurement	
Outputs	Current error	
	Without monitoring	
System messages	242	The welding current is above the tolerance
	243	The welding current is below the tolerance

12.6 I inspector

The I inspector function monitors the current welding process parameter. The mean nominal current value, mean value, envelope and envelope absolute methods are available for monitoring. The function requires the specification of positive and negative tolerances. For an explanation of the individual methods and the sensible combination of the monitoring method and comparative value source, see *Monitoring methods*, p. 97.

The function is activated and parameterised using the user interface. Measurement is performed using externally connected measuring sensors.

The nominal value is either specified by the selected program or a reference value is determined on the basis of previously recorded reference curves. Depending on the monitoring method which is selected, either mean values or curves are monitored. For information on recording reference curvessee *Reference curve*, p. 98.

The I inspector compares the nominal value or the reference value with the actual current value of a completed welding process. The difference is assessed based on the specified tolerances. If the deviation lies outside of the specified tolerances, a system message reports the extent of the deviation in thousandths for the program concerned. The system message must be acknowledged. The further procedure after system message output can be configured in advance.

Defining the measuring time

The measuring time is defined automatically or manually via the <Measuring time setting> parameter.

- Automatic: Delays and measuring time are calculated automatically. It is ensured that only the current flow time important to the welding quality is measured.
- Manual: Delays and measuring time are freely selectable. In the manual method, only selecting the current flow time important to the welding quality as the measuring time is recommended, see Fig. 12-1.

Deviation window

A deviation window can be input via the user interface. Within the deviation window, no system message is output yet for deviations outside of the tolerance range. For an explanation of deviation window see *Deviation window*, p. 97.

Parameters		
Monitoring method	Off/mean value/envelope/envelope absolute	
Comparative value source	Nominal value/reference value	
Measurement time setting	Automatic/manual	
Record reference curve	Activates reference curve recording, deletes the existing reference curve for the program	
Tolerance+	Positive current tolerance (0-100% or 0.00-100.00 kA)	
Tolerance-	Negative current tolerance (0-100% or 0.00-100.00 kA)	
Delay	Current delay (0-65,535 ms)	
Measuring time	Current measuring time (0-65,535 ms)	
Deviation window	Current deviation window (0-65,535 ms)	
Inputs	Current measurement	
Outputs	Welding error	
System messages	242	Current for program <No.> <nn>‰ too high
	243	Current for program <No.> <nn>‰ too low
	252	Envelope: current for program <No.> <nn>‰ too high
	253	Envelope: current for program <No.> <nn>‰ too low

12.7 U-Inspector

The U inspector function monitors the voltage process variable. The mean value, envelope and envelope absolute methods are available for monitoring. The function requires the specification of positive and negative tolerances. For an explanation of the individual methods and the sensible combination of the monitoring method and comparative value source, see *Monitoring methods*, p. 97.

The function is activated and parameterised using the user interface. Measurement is performed using externally connected measuring sensors.

The nominal value is either specified by the selected program or a reference value is determined on the basis of previously recorded reference curves. Depending on the monitoring method which is selected, either mean values or curves are monitored. For information on recording reference curves see *Reference curve*, p. 98.

The U inspector compares the nominal value or the reference value with the actual electrode voltage value of a completed welding process. The resulting difference is evaluated based on the specified tolerances. If the deviation lies outside of the specified tolerances, a system message reports positive or negative deviation from the specified electrode voltage for the program concerned. The system message must be acknowledged. The further procedure after system message output can be configured in advance.

Defining the measuring time

The measuring time is defined automatically or manually via the <Measuring time setting> parameter.

- Automatic: Delays and measuring time are calculated automatically. It is ensured that only the current flow time important to the welding quality is measured.
- Manual: Delays and measuring time are freely selectable. In the manual method, only selecting the current flow time important to the welding quality as the measuring time is recommended see Fig. 12-1.

Deviation window

A deviation window can be input via the user interface. Within the deviation window, no system message is output yet for deviations outside of the tolerance range. For an explanation of deviation window, see *Deviation window*, p. 97.

Parameters		
Monitoring method	Off/mean value/envelope/envelope absolute	
Comparative value source	Reference value	
Measurement time setting	Automatic/manual	
Record reference curve	Activates reference curve recording, deletes the existing reference curve for the program	
Tolerance+	Positive tolerance (0.0-100.0% or 0.00-10.00 V)	
Tolerance-	Negative tolerance (0.0-100.0% or 0.00-10.00 V)	
Delay	Voltage delay (0-65,535 ms)	
Measuring time	Voltage measuring time (0-65,535 ms)	
Deviation window	Voltage deviation window (0-65,535 ms)	
Inputs	Electrode voltage measurement	
Outputs	Welding NOK	
System messages	254	The mean electrode voltage value lies above the tolerance
	255	The mean electrode voltage value lies below the tolerance
	258	The electrode voltage has exceeded the envelope
	259	The electrode voltage has fallen below the envelope

12.8 R inspector

The R inspector function monitors the resistance welding process parameter. The mean value, envelope and envelope absolute methods are available for monitoring. The function requires the specification of positive and negative tolerances. For an explanation of the individual methods and the sensible combination of the monitoring method and comparative value source, see *Monitoring methods*, p. 97.

The function is activated and parameterised using the user interface. Measurement is performed using externally connected measuring sensors.

The nominal value is either specified by the selected program or a reference value is determined on the basis of previously recorded reference curves. Depending on the monitoring method which is selected, either mean values or curves are monitored. For information on recording reference curves see *Reference curve*, p. 98.

The R inspector compares the nominal value or the reference value with the actual resistance value of a completed welding process. The resulting difference is evaluated based on the specified tolerances. If the deviation lies outside of the specified tolerances, a system message indicates positive or negative deviation from the specified resistance for the program concerned. The system message must be acknowledged. The further procedure after system message output can be configured in advance.

Defining the measuring time

The measuring time is defined automatically or manually via the <Measuring time setting> parameter.

- Automatic: Delays and measuring time are calculated automatically. It is ensured that only the current flow time important to the welding quality is measured.
- Manual: Delays and measuring time are freely selectable. In the manual method, only selecting the current flow time important to the welding quality as the measuring time is recommended see Fig. 12-1.

Deviation window

A deviation window can be input via the user interface. Within the deviation window, no system message is output yet for deviations outside of the tolerance range, see *Deviation window*, p. 97.

R inspector overview

Parameters	
Monitoring method	Off/mean value/envelope/envelope absolute
Comparative value source	Reference value
Measurement time setting	Automatic/manual
Record reference curve	Activates reference curve recording, deletes the existing reference curve for the program
Tolerance+	Positive tolerance (0.0-100.0% or 0.00-10.00 V)

Tolerance-	Negative tolerance (0.0-100.0% or 0.00-10.00 V)	
Delay	Resistance delay (0-65,535 ms)	
Measuring time	Resistance measuring time (0-65,535 ms)	
Deviation window	Resistance deviation window (0-65,535 ms)	
Inputs	Electrode voltage measurement + electrode current measurement	
Outputs	Welding NOK	
System messages	450	The mean resistance value lies above the tolerance
	451	The mean resistance value lies below the tolerance
	454	The resistance has exceeded the envelope
	455	The resistance has fallen below the envelope

12.9 F inspector

The F inspector function monitors the force welding process parameter. The mean value, envelope and envelope absolute methods are available for monitoring. The function requires the specification of positive and negative tolerances. For an explanation of the individual methods and the sensible combination of the monitoring method and comparative value source, see *Monitoring methods*, p. 97.

The function is activated and parameterised via the user interface: INSPECTORS > F INSPECTOR.

Measurement is performed using externally connected measuring sensors.

The force sensors must be calibrated. See *Force sensor calibration*, p. 115.

Comparative value source

The nominal value is either specified by the selected program or a reference value is determined on the basis of previously recorded reference curves. Depending on the monitoring method which is selected, either mean values or curves are monitored. For information on recording reference curves, see *Reference curve*, p. 98.

The F inspector compares the reference value with the actual force value of a completed welding process. The difference is assessed based on the specified tolerances. If the deviation lies outside of the specified tolerances, a system message reports the extent of the deviation in thousandths for the program concerned. The system message must be acknowledged. The further procedure after system message output can be configured in advance, see *Message management*, p. 43

Measuring / delay

The <Delay> and <Measuring time> can be used to precisely define which part of the welding process is monitored. For instance, the force increase or decrease can be hidden.

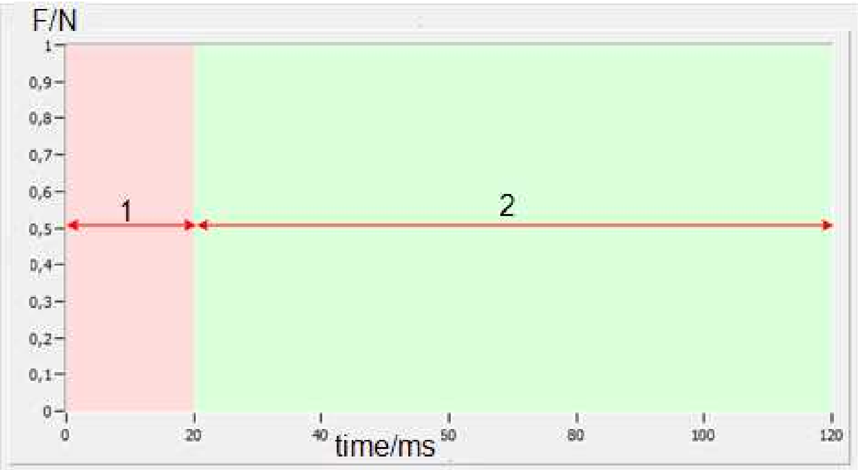


Fig. 12-4: Example of configuration of the measuring time

1	Delay
2	measuring time

see Fig. 12-4, it shows an example with a delay (ABZ) of 20 ms and a measuring time (MZ) of 100 ms.

Defining the measuring time

The measuring time is defined automatically or manually via the <Measuring time setting> parameter.

- Automatic: Delays and measuring time are calculated automatically. It is ensured that only the current flow time important to the welding quality is measured.
- Manual: Delays and measuring time are freely selectable. In the manual method, only selecting the current flow time important to the welding quality as the measuring time is recommended see Fig. 12-1.

Deviation window

A deviation window can be input via the user interface. Within the deviation window, no system message is output yet for deviations outside of the tolerance range.See *Deviation window*, p. 97..

F inspector overview

Parameters		
Monitoring method	Off/mean value/envelope/envelope absolute	
Comparative value source	Reference value	
Measurement time setting	Automatic/manual	
Record reference curve	Activates reference curve recording, deletes the existing reference curve for the program	
Tolerance+	Positive force	
Tolerance-	Negative force	
Delay	Delay force	
Measuring time	Measuring time force	
Deviation window	Deviation window force	
Inputs		
Outputs	welding NOK	
System messages	271	Reference curves for program <PrgNo> have been deleted
	323	Reference curve <No.> for program <No.> was not stored
	324	Record <Welding process parameter> reference curve for program <PrgNo>
	323	<Welding process parameter> reference curve for program <PrgNo> was not saved
	444	Force 1 for program <No.> <n>% too high
	445	Force 1 for program <No.> <n>% too low
	446	Profile: Force 1 for program <No.> <n>% too high

	447	Profile: Force 1 for program <No.> <n>% too low
	448	Envelope: Force 1 for program <No.> <n>% too high
	449	Envelope: Force 1 for program <No.> <n>% too low
	460	Force 2 for program <No.> <n>% too high
	461	Force 2 for program <No.> <n>% too low
	462	Profile: Force 2 for program <No.> <n>% too high
	463	Profile: Force 2 for program <No.> <n>% too low
	464	Envelope: Force 2 for program <No.> <n>% too high
	465	Envelope: Force 2 for program <No.> <n>% too low

12.9.1 Force sensor calibration

The force sensors are calibrated via the user interface: ELECTRODE HOLDER > CALIBRATION > FORCE SENSOR CALIBRATION.

The values for force monitoring 1 and 2 are entered separately.

Force at 0 V	Value supplied by the force sensor at 0 V.
Force at 10 V	Value supplied by the force sensor at 10 V.

12.10 H inspector

The H inspector function monitors the control stroke welding process parameter. The mean value, envelope and envelope absolute methods are available for monitoring. The function requires the specification of positive and negative tolerances. The function is activated and parameterised using the user interface. For an explanation of the individual methods and the sensible combination of the monitoring method and comparative value source, see *Monitoring methods*, p. 97.

The nominal value is either specified by the selected program or a reference value is determined on the basis of previously recorded reference curves. Depending on the monitoring method which is selected, either mean values or curves are monitored. For information on recording reference curvessee *Reference curve*, p. 98.

The H inspector compares the nominal value or the reference value with the actual control stroke value of a completed welding process. The difference is assessed based on the specified tolerances. If the deviation lies outside of the specified tolerances, a system message reports the extent of the deviation in thousandths for the program concerned. The system message must be acknowledged. The further procedure after system message output can be configured in advance.

Note

Use of the H inspector is only sensible with active regulation, e.g. in KSR mode (constant current regulation) or IQR mode (integrated quality control).

The H inspector is meaningless in SKT mode (scale divisions).

Defining the measuring time

The measuring time is defined automatically or manually via the <Measuring time setting> parameter.

- Automatic: Delays and measuring time are calculated automatically. It is ensured that only the current flow time important to the welding quality is measured.
- Manual: Delays and measuring time are freely selectable. In the manual method, only selecting the current flow time important to the welding quality as the measuring time is recommended, see Fig. 3-1.

Deviation window

A deviation window can be input via the user interface. Within the deviation window, no system message is output yet for deviations outside of the tolerance range. For an explanation of deviation window see *Deviation window*, p. 97.

Parameters		
Monitoring method	Off/mean value/envelope/envelope absolute	
Comparative value source	Nominal value/reference value	
Measurement time setting	Automatic/manual	
Record reference curve	Activates reference curve recording, deletes the existing reference curve for the program	
Tolerance+	Positive tolerance (0.0-100.0% or 0-1000 Skt)	
Tolerance-	Negative tolerance (0.0-100.0% or 0-1000 Skt)	
Delay	Control stroke delay (0-65,535 ms)	
Measuring time	Control stroke measuring time (0-65,535 ms)	
Deviation window	Deviation window (0-65,535 ms)	
Inputs	Current control regulation values (internal process, without the option of direct, external access)	
Outputs	Welding error	
System messages	328	Control stroke for program <No.> <nn>‰ too high
	329	Control stroke for program <No.> <nn>‰ too low
	332	Envelope: control stroke for program <No.> <nn>‰ too high
	333	Envelope: control stroke for program <No.> <nn>‰ too small

12.11 Q inspector

The Q inspector monitors process stability.

Application areas

The Q inspector's evaluation algorithm is designed for steel sheets. Projection welding applications must be separately validated in advance by the application technology department. Adaptations may be necessary under certain circumstances. As the Q inspector evaluates the resistance curve, it is only suitable for aluminium.

Software prerequisites:
XPegasus Gold version with archive function: version 3.2.10 and higher

Further information on parameterising and configuring the Q inspector can be found in the XPegasus online help.

Basic principle

The Q inspector function monitors the spot value welding process parameter. The spot value is calculated as follows: the current welding process is compared with a reference with the aid of an internal algorithm and is evaluated as regards its similarity. The spot value is a value that enables process stability to be assessed.

To check the spot value, a welding program or a gun is monitored over several welding processes. The Q inspector can e.g. display the last 100 welding processes for a program or a gun. If the display reveals undesired deviations, a process change is present.

The function is activated and parameterised using the user interface.

The process in detail

The Q inspector is activated and parameterised via the user interface.

- The simplest way to use the archive function is to activate the <Recording> control field. The connection to the archive is thus established. The second method is via the [System] menu item. Refer to the online help for the precise procedure using [System].
- At least one completed welding process from the archive is selected as a reference. If several archived welding processes are selected, the mean value curve is determined from the curves. Accordingly, the mean value curve serves as a reference.

Note

All completed welding processes are stored in the archive and are thus available for selection as reference curves.

The Q inspector enables reference curve administration. Individual curves can be recorded again or deleted. Comments can be added.

- The current welding process is compared with the reference with the aid of an internal algorithm and is evaluated as regards its similarity. This value is called the spot value.
- 1 is defined as a value for a good welding process. 0 represents a poor welding process. If the spot value moves towards 1, this means extensive correspondence with the reference. If the spot value moves towards 0, this means little correspondence with the reference. If the spot value for a welding spot changes from welding process to welding process, a process change is present.
- The Q inspector enables a limit value for an acceptable process change to be defined. This limit value is the spot value threshold. If the spot value threshold is not reached, a system message is triggered. The spot value threshold can be input individually for each welding spot.
- The system message interrupts the welding process and has to be acknowledged.

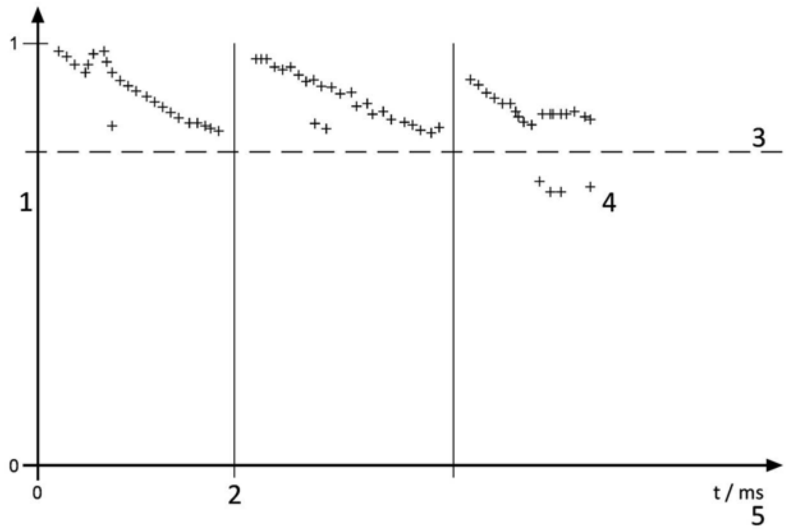


Fig. 12-5: System message on negative deviation from the spot value threshold

1	Spot value
2	Electrode milled
3	Spot value threshold
4	Error is triggered (system message 327)
5	n welding processes

The spot value curve can be monitored for either a welding program or an electrode holder. This enables the user to determine whether errors are attributable to the individual welding spot or the electrode holder. In addition to the spot value curve, electrode exchange, milling cycles and spatter are also displayed on the user interface.

The determined <Spot values> can be displayed from the archive by date. E.g. a time period can be selected to obtain an overview of the day's production. The data for individual spot values can be called up as a table.

Parameters		
Q inspector	Off/on	
Spot value threshold	Message threshold for spot value	
Spot value Q logic	Message threshold for Q logic	
Reference curve from archive	New reference curve/delete/load/administer/recording	
Inputs	-	
Outputs	Without monitoring	
	welding NOK	
System messages	327	Spot value for program <No.> <nn>% too high

Note

The delay is automatically defined by the Q inspector. Manual setting is not necessary.

The delay can be set manually for special cases. E.g. for welding processes with two pulses. The first pulse is hidden, the second pulse is integrated into the evaluation.

12.12 S-Inspector

The S inspector function monitors the component size and the electrodes' travel.

Electrode travel is determined using travel sensors. The welding control system can also administer two travel sensors depending on equipment. The electrodes' travel provides information on the size of the component before and after the welding process and the extent to which the electrodes have sunk in during the welding process.

The S inspector offers the following monitoring functions:

- Component control
- Travel measurement function:
  - Sink-in travel monitoring
  - Final dimension monitoring
  - Profile indexing

The following diagram provides an overview of the measurement time points during the welding process:

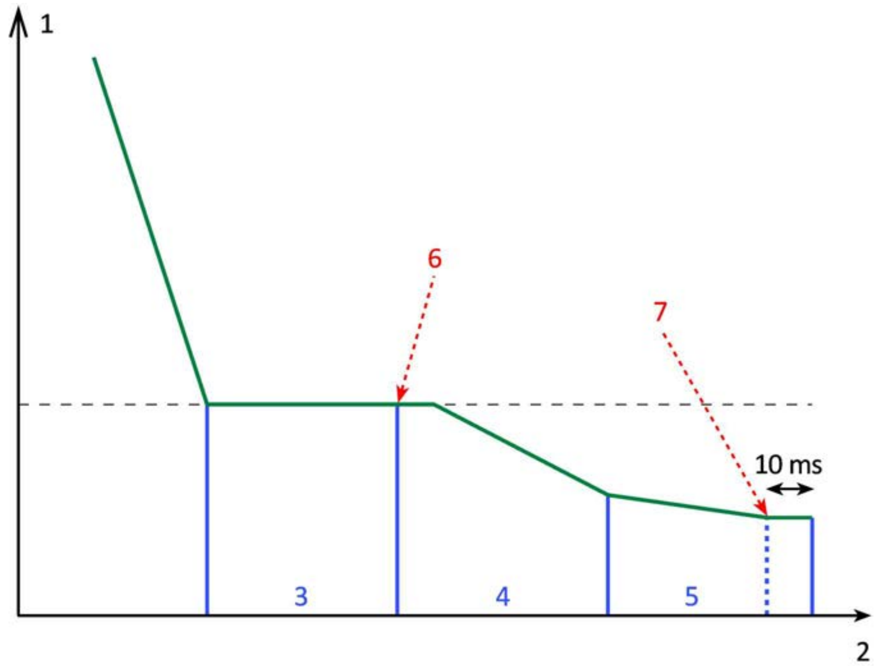


Fig. 12-6: Process diagram, actual output time point values

1	Travel
2	Time in ms
3	Squeeze time
4	Main current time
5	Hold time
6+7	Measuring points

Component control is performed prior to the start of the main current time. Either sink-in travel monitoring or final dimension monitoring is selected for travel measurement: measurement is carried out
10 ms prior to the end of the hold time. If hold time is less than 10 ms, measurement is performed at the start of hold time.

The S inspector is activated and parameterised using the user interface. The monitoring functions are switched on and off individually via the user interface and are independent of each other.

Depending on equipment, two travel sensors can be administered. This dual travel measurement (travel measurement 1 and 2) is a special function for gap welding, in which two spot welds are performed at the same time.

Software prerequisites for 2-fold travel measurement:
XPegasus Silver: version 1.6.2.2218 or higher
XPegasus Gold: version 1.6.2.2319 or higher

Firmware: version 1.46R0 or higher

12.12.1 Prerequisite: suitable travel sensors

Travel measurements are performed with one or two travel sensors. The selection of a suitable travel sensor is also crucial to the quality of the measurement. Travel sensors with a maximum length of 600 mm can be used. Shorter sensors offer a higher resolution. Travel sensors with a length of 25 mm to 120 mm are therefore recommended.

Simple travel measurement offers a resolution of 11 bits.

Dual travel measurement offers a resolution of 15 bits.

Accuracy according to resolution and sensor lengths:

Accuracy			Accuracy			Sensor length	
15-bit	11-bit	Unit	15-bit	11-bit	Unit	Unit	
0.001	0.012	mm/bit	0.763	12.213	µm/bit	25	mm
0.002	0.024	mm/bit	1.526	24.426	µm/bit	50	mm
0.002	0.037	mm/bit	2.289	36.639	µm/bit	75	mm
0.003	0.049	mm/bit	3.052	48.852	µm/bit	100	mm
0.004	0.059	mm/bit	3.662	58.622	µm/bit	120	mm

Incremental travel sensors

Separate quick guides (German) are available for travel measurement with Heidenhain type ST1278 and LS3228C incremental travel sensors.

These are available in the download area at www.harms-wende.de or will be provided by our Service department on request. Registration is required to use the download area.

Measuring transducer

A measuring transducer is required if travel sensors that need a stabilised supply voltage are used. This is the case e.g. with potentiometric travel sensors.

HWH recommends using the MPS100 (fixed measuring range) or MPX101 (variable measuring range) measuring transducers. Other measuring transducers are possible.

Note

Further information on this topic is available in the corresponding quick guide. This is available in the download area at www.harms-wende.de or will be provided by our Service department on request. Registration is required to use the download area.

12.12.2 Default settings

Sensor length input

Before the S inspector is started for the first time, the length of the travel sensor must be input (for both travel sensors in the case of dual travel measurement).

Input is performed via the user interface: MODULE > ELECTRODE HOLDER CONFIGURATION > CALIBRATION > TRAVEL MEASUREMENT.

Inputs for travel measurement

The following inputs are used for travel measurement:

- 0...10 V input for travel measurement
- Input via an external CAN bus module for dual travel measurement

12.12.3 Zero point for travel measurement

To be able to carry out travel measurement from a zero point, the zero point must be determined before first starting a welding program. Either the position of the closed electrodes or the position of the fully open electrodes is selected as the zero point. If the zero point is determined with the electrodes closed, zeroing must be performed without a component. If no zero point is entered, the covered travel is measured with an offset. The values are not usually very clear for users.

Note

Before determining the zero point, it must be noted how the travel sensor was installed.

The distance travelled by the electrodes is less on closing and greater on opening. On closing the electrodes the <Actual travel value> displayed may become larger. The cause of this is the position of the travel sensor. To obtain meaningful values, <Reverse actual travel value display> must be enabled on the user interface.

The zero point can be determined manually or automatically via the user interface.

- Manual: the electrodes are closed. The actual travel value is displayed on the user interface under the <S inspector> menu item. The actual travel value is entered in the <Zero point sensor> parameter under the <Electrode holder> menu item.

- Automatic: the <Zeroing during process> input signal is set. A welding process must then be performed. The welding process is performed automatically without current (depending on the I/O program). Zeroing takes place at the start of the main current time.

Parameters		
Zero point sensor	Position with closed electrodes (0.00-600.00 mm)	
Reverse actual travel value display	Activate if the displayed actual travel value increases on closing the electrodes	
Inputs	Zeroing during process	
Outputs	-	
System messages	-	

Note

The zero point has to be determined anew each time after milling the electrodes or inserting new ones.

12.12.4 Component control

Component control recognises whether a component has been inserted or not, and monitors the component size at the start of the welding process.

Component control is performed after the squeeze time has expired. The travel sensor determines the distance covered by the electrode and outputs it as the actual component value. The S inspector compares the actual component value with the nominal component value of the active welding program (specified component size).

If the actual component value lies within the tolerance range, the welding process is released. The welding process is aborted in the case of values measured outside of the defined tolerances. A system message reports the extent of the deviation in micrometres (µm) for the program concerned.

Parameters		
Actual component value	Travel monitoring (-600.00 - 600.00 mm)	
Actual travel value	Current actual travel value (-600.00 - 600.00 mm)	
Component control active	Off/on	
Record reference value	Activates recording of the reference value (actual component value, actual sink-in travel value and actual final dimension value), deletes the existing reference value.	
Nominal component value	Nominal component value (-600.00 - 600.00 mm)	
Tolerance+	Positive component tolerance (0.00 - 10.00 mm)	
Tolerance-	Negative component tolerance (0.00 - 10.00 mm)	
Inputs	0...10 V travel sensor Zeroing during process	
Outputs	S inspector component control error	
System messages	334	Component error during travel measurement 1: deviation by <nn> µm with program (n)
	355	Component error during travel measurement 2: deviation by <nn> µm with program (n)

The following illustration shows:

- The position of the electrodes with an inserted component prior to the start of the main current time → determination of the <Actual component value>
- The position of the electrodes in the <Hold time> → determination of the <Actual sink-in travel value> or the <Actual final dimension value>

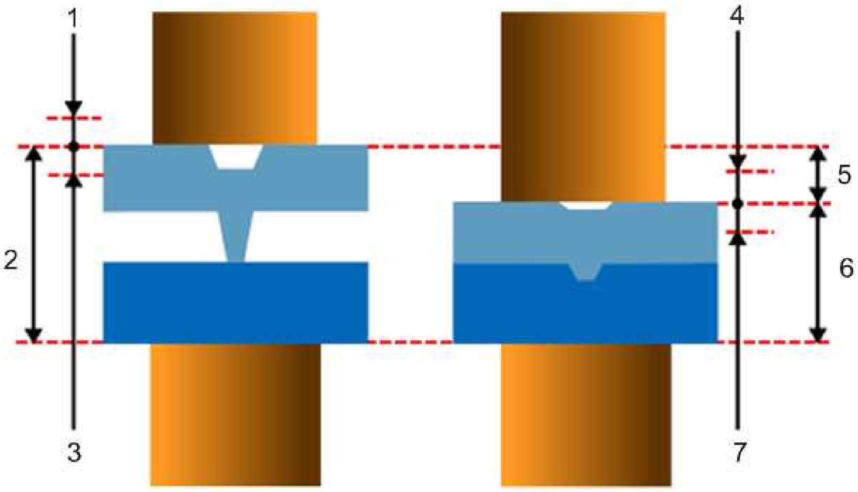


Fig. 12-7: Component control and travel measurement functions

1	Tolerance+
2	Actual component value
3	Tolerance-
4	Tolerance+/-
5	Actual sink-in travel value
6	Actual final dimension value
7	Tolerance+/-

12.12.5 Sink-in travel monitoring

Note

Sink-in travel monitoring is recommended as the default setting for travel measurement.

This function is used to monitor the electrode's sink-in travel during the welding process. Sink-in travel is specified by the nominal value stored in the program. If necessary, a reference value can be recorded and used for comparison with the actual value. The reference value can be changed manually.

The function determines the position of the electrodes before welding and the position of the electrodes after welding. The difference is the sink-in travel. After welding, travel measurement takes place 10 ms prior to the end of the dwell time. If dwell time is less than 10 ms, measurement is performed at the start of dwell time. The determined sink-in travel is compared with the sink-in travel nominal value plus tolerances.

If the sink-in travel lies outside of the defined tolerance, a system message reports the extent of the deviation in micrometres (µm).

Parameters		
Actual travel value	Current actual travel value (-600.00 - 600.00 mm)	
Actual sink-in value	Actual sink-in travel value (-600.00 - 600.00 mm)	
Monitoring	Off/on	
Monitoring type	Sink-in travel	
Record reference value	Activates recording of the reference value (actual component value, actual sink-in travel value and actual final dimension value), deletes the existing reference value	
Tolerance-	Negative sink-in travel tolerance (0.00 - 10.00 mm)	
Tolerance+	Positive sink-in travel tolerance (0.00 - 10.00 mm)	
Nominal sink-in travel value	Nominal sink-in travel value (-600.00 - 600.00 mm)	
Inputs	0...10 V travel sensor	
Outputs	S inspector sink-in travel/final dimension error	
System messages	335	Sink-in travel error during travel measurement 1: deviation by <nn> µm with program (n)
	353	Sink-in travel error during travel measurement 2: deviation by <nn> µm with program (n)

12.12.6 Final dimension monitoring

Note

Final dimension monitoring determines absolute values and is only recommended if determination of the final component dimension after the welding process is important to the production process.

Final dimension monitoring requires determining the zero point.

Final dimension monitoring is used to check whether the component has reached the specified final dimension at the end of the welding process. The final dimension is specified by the nominal value stored in the program. If necessary, a reference value can be recorded and used for comparison with the actual value.

The travel sensor determines the position of the electrode 10 ms before the end of dwell time (actual final dimension value). If dwell time is less than 10 ms, measurement is performed at the start of dwell time. The determined actual final dimension value is compared with the nominal final dimension value plus tolerances.

If the actual final dimension value lies outside of the defined tolerance, a system message reports the extent of the deviation in micrometres (µm).

Parameters		
Actual travel value	Current actual travel value (-600.00 - 600.00 mm)	
Actual final dimension value	Actual final dimension value (-600.00 - 600.00 mm)	
Monitoring	Off/on	
Monitoring type	Final dimension	
Record reference value	Activates recording of the reference value (actual component value, actual sink-in travel value and actual final dimension value), deletes the existing reference value	
Tolerance+	Positive final dimension tolerance (0.00 - 10.00 mm)	
Tolerance-	Negative final dimension tolerance (0.00 - 10.00 mm)	
Nominal final dimension value	Nominal final dimension value (-600.00 - 600.00 mm)	
Inputs	0...10 V travel sensor	
Outputs	S inspector sink-in travel/final dimension error	
System messages	351	Final dimension error during travel measurement 1: deviation by <nn> µm with program (n)
	352	Final dimension error during travel measurement 2: deviation by <nn> µm with program (n)

12.12.7 Profile indexing/travel shut-off

The profile indexing function shuts off the current on reaching the nominal value for the <Profile indexing> parameter.

The next current occurs if a further current has been parameterised.

Parameterisation is performed via the user interface:
INSPECTORS > S INSPECTOR > PROFILE INDEXING

Parameters		
Index profile	Off/on	
Profile indexing at	Index profile when nominal value is reached (-600.00 - 600.00 mm)	
Inputs	-	
Outputs	Current profile has been indexed	
System messages	354	Profile indexing travel 1 with: <n> µm for program <No.>
	356	Profile indexing travel 2 with: <n> µm for program <No.>

Note:

The nominal value of the set monitoring function is crucial to profile indexing. <Sink-in travel> or <Final dimension> are available as monitoring functions.

Profile indexing/travel shut-off are also carried out when monitoring is switched off.

Example

If <Pre-heating current>, <Main current> and <Post-heating current> have been parameterised for a welding program, profile indexing/travel shut-off switches to the next current when travel measurement reaches the specified value. Indexing takes place depending on the selected monitoring type (sink-in travel or final dimension).

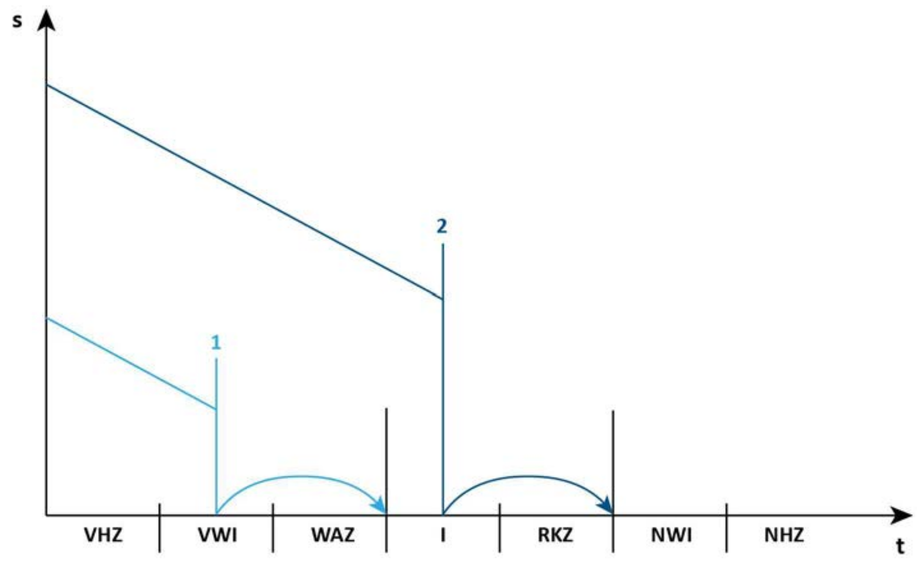


Fig. 12-8: Profile indexing/travel shut-off; process

1	Sink-in travel/final dimension reached in the pre-heating current. Indexing to the next parameterised current profile, e.g. the main current, takes place.
2	Sink-in travel/final dimension reached in the main current. Indexing to the next parameterised current profile, e.g. the post-heating current, takes place.

Consideration of heat compensation time (WAZ) and recooling time (RKZ)

- The heat compensation time is not executed – depending on the parameterised final dimension/sink-in travel – when switching from pre-heating current to main current takes place.
- The recooling time is not executed – depending on the parameterised final dimension/sink-in travel – when switching from main current to post-heating current takes place.

12.13 SP inspector

The SP inspector function monitors the occurrence of spatter.

Software prerequisites:
XPegasus Gold version with archive function: version 3.2.10 and higher

The spatter rate of a welding program provides information on process quality: if spatter occurs early on in the welding process, the welding spot may possibly not hold. Spatter may generally result in less stable welding spots.

The occurrence of spatter can be determined based on the voltage curve of the welding process. The SP inspector represents the voltage curve in a graph. If the voltage dips significantly in the displayed curve, this is an indication of spatter.

Note

It must be noted that the sensitivity of spatter detection is oriented towards the voltage decrease specified by the program. The voltage decrease value is set as default. Depending on the material to be welded, however, it may be necessary to manually change the voltage decrease value.

The SP inspector functions largely automatically and only requires a few settings. The SP inspector is activated and parameterised using the user interface. When the function is activated, each welding process with current flow is evaluated. The function shows the number of welding processes evaluated for each program. The point in time at which spatter occurs is displayed in milliseconds (ms). If no spatter occurs, the text "None" is shown. The spatter rate is calculated continuously after each welding process for the selected program and is specified in percent.

Spatter overview

The <spatter overview> menu item can be used to call up a table with the spatter rates of the various welding programs. The table shows which program has the highest spatter rate. The results can be filtered by entering a percentage. E.g. all programs with a spatter rate of over 30% can be displayed. The spatter rate can be used to determine problems with the electrode holder or individual welding programs.

The <Spatter rate depth> parameter specifies the number of welding processes used to calculate the spatter rate. E.g. the spatter rate depth can be set to the typical number of welding processes of a day's production.

Example

- Spatter rate depth: 100
- Number of welding processes: is incremented until the specified spatter rate depth of 100 welding processes is reached.
- Spatter rate: reveals the spatter rate with reference to the counted number of welding processes. Nn% spatter have occurred in 100 welding processes. If the

number of welding processes is only 19, the spatter rate percentage refers to the 19 welding processes.

Delay

The <Delay> is set to 0 as default. A value of 0 switches to automatic start delay. Nothing else has to be entered. If necessary, the delay can be changed manually.

Switch off / pause

Switching off the SP inspector resets the spatter rate to 0. If the system is switched to Pause, spatter monitoring is shut off for the duration of the pause. After deactivating Pause, counting continues from the last ascertained value.

Parameters	
Spatter time point	Specifies the spatter time point (0 - 7000 ms)
Spatter rate	Spatter rate with reference to the number of completed welding processes (0.0 – 100.0%)
SP-Inspector	Off/on/pause
No. of welding processes	Number of completed welding processes (0 - 65535)
Delay	Delay 0 = automatic start delay (0 - 7000 ms)
Voltage decrease	
Spatter rate depth	Number of welding processes across which the spatter rate is calculated
Inputs	-
Outputs	-
System messages	-

Note

The spatter rate is determined by the module. An archiving function is not necessary.

Note

When using integrated quality control (IQR), the <Start delay time> must under all circumstances be set to 0.

12.14 Q logic

The Q logic function designates the function of three general error counters that can be configured in the control system.

Software prerequisites:
XPegasus Gold version with archive function
Firmware: version 1.69 and higher

These error counters are set by the relevant, activated monitoring functions. The user interface can be used to parameterise individual pre-warning values and limit values for the three error counters, <Program spot error>, <Component spot error> and <Spot error in series>. If the parameterised limit value is reached, a message is output on the user interface. This message does not result in process stoppage.

Parameters	Q logic Error counter Limit value error counter Delete program counter	
Inputs	Q logic: start evaluation	
Outputs	Q logic stop	
System messages	397	Too many welding errors in succession in program <No.>
	398	Too many welding errors on this component
	399	Too many welding errors in sequence

Note

If the same faulty welding spot is detected simultaneously by several monitoring functions, it is only assessed as one error.

Monitoring functions

The error counters are notified by the following monitoring functions. The prerequisite is that the relevant monitoring function is activated.

- I inspector
- U Inspector
- F inspector
- IQR error
- AluMode Classic (AMC)/AluMode Force (AMF) monitoring
- SP inspector
- S inspector
- Internal module intermediate circuit voltage monitoring

Program spot error

This counter counts the welding errors separately for each program. The corresponding counter is incremented with each faulty welding spot and decremented again with each perfect spot. A problem with an individual program can thus be ascertained.

All programs' counters can be reset simultaneously via the user interface. The counters can also be reset individually.

Component spot error

This counter counts each defective welding spot. The presence of too many faulty welding spots in an individual component can thus be ascertained. The <UeberwPunktfehlerReset> signal resets the counter to 0.

Spot error in series

This counter is incremented with each faulty welding spot and decremented again with each perfect spot. This allows the determination as to whether a single component has too many faulty welding spots in series. The <UeberwPunktfehlerReset> signal resets the counter to 0.

Counter statuses

If a counter reaches the set limit value, a message and a signal are generated. The corresponding counter is not incremented any further in the case of further errors. As a result, the corresponding counter is removed from the error zone again with the next fault-free welding spot (also with decrementing counters). The status of all counters is always ≥ 0. There are no negative counter statuses.

The current error counter status can be reset via the user interface or a signal.

13 Input/output signals

The assignments and presence of the signals on the plugs depend on the configuration of each device.

The names of the signals may vary depending on customer requirement.

Note

An overview of input and output signals for your individual configuration can be found in the separate document "Pin assignments". This is provided at the end of these operating instructions or under www.harms-wende.de in the download area. Registration is required to use the download area.

13.1 Welding process I/O signals

Prerequisites for the welding process

- The <Ready> output signal signals the corresponding module status.
- When the <Pre-stroke> function is active, the pre-stroke must be closed.

Start and end of the welding process

The welding process is initiated by selecting the welding program and then setting the <Start> signal. Program selection must take place at least 2 ms prior to the start.

See *Program selection*, p. 48.

The end of the welding process is set with the <End of sequence> signal. The signal remains set for 100 ms, and is extended if the <Start> signal is still present. The welding process is ended when <End of sequence> and <Start> are withdrawn.

Interruption of the welding process with emergency stop

The <Emergency stop> input signal is low-active.

If the <Emergency stop> is withdrawn during the welding process, the welding current is shut off immediately.

See *Welding process input signals*, p. 139.

Welding can be missed out or performed twice due to interruption of the welding process.

Please note: The <Emergency stop> input and the outputs switched with it do not meet the safety specifications (redundancy) of an emergency stop or emergency stop function in the sense of machine and system safety.
The <Emergency stop> input can be integrated into the system's emergency stop chain if certain conditions are observed.
See *Emergency stop input*, p. 36.

Signal level during the welding process (single spot operating mode)

During the welding process (single spot operating mode), at least the following signals are available at the inputs and outputs:

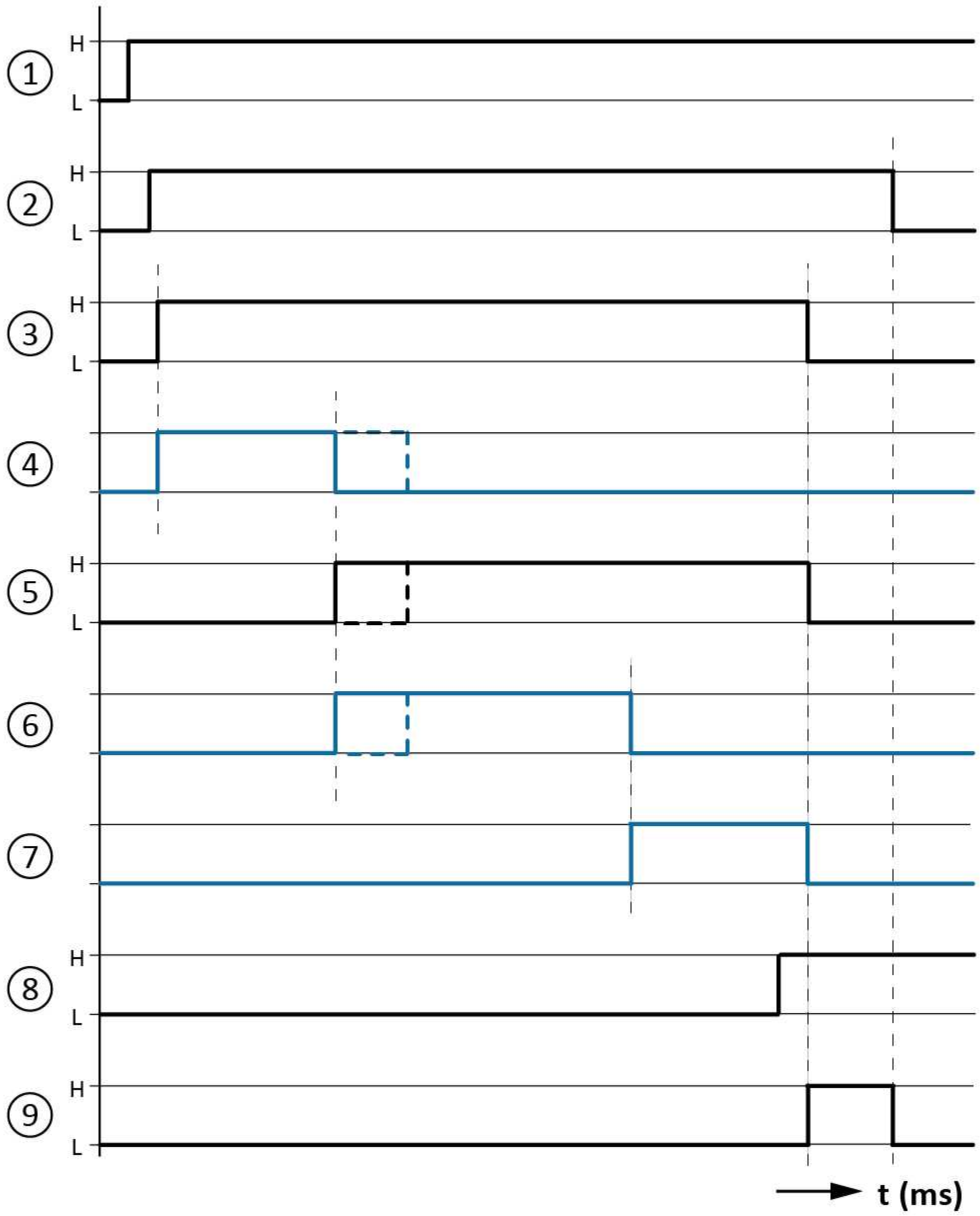


Fig. 13-1: Welding process signal level in connection with the welding times (blue)

1	Selection of the welding program
2	Start
3	Working stroke (solenoid valve)
4	Squeeze time (marked in blue)
5	Pressure OK
6	Welding time (marked in blue)
7	Hold time (marked in blue)
8	Welding OK/NOK
9	End of sequence (FK)

Re. 1

The welding process is initiated by selecting the welding program. Program selection must take place at least 2 ms prior to the start. See *Program selection*, p. 48.

Re. 2:

The <Start> input signal is set by the higher-level control system or the <Start> button on the welding facility. The welding process starts.

Re. 3, 4:

The parameterised welding process usually starts with the squeeze time.

See *Welding process*, p. 75.

At the start of the squeeze time, the <Working stroke> or <Solenoid valve> output signal becomes active if available. The welding facility closes and the gun force is built up.

Re. 5:

At the end of the squeeze time, the module signals that the set welding force has been reached with the <Pressure OK> input signal. If <Pressure OK> is not set, the squeeze time is extended accordingly. As of firware version 2.50, the following system message is output if the gun force has not (yet) been achieved:

System messages	358	Waiting for pressure OK input

Re. 6, 7:

When the squeeze time ends, heat application into the workpiece begins with the welding time. The parameterised welding times and currents are processed, see *Parameters*, p. 86. The welding process can now no longer be aborted.

The hold time begins after the last main current time, see *Hold time*, p. 93. Within the hold time, all monitoring functions (if used) are reviewed; the <Welding OK/NOK> output signals are set.

Re. 8, 9:

<Welding OK>

If welding has been evaluated as OK (good), the welding process is ended by setting the <End of sequence (FK)> output signal.

<Welding NOK>

If welding has been evaluated as NOK, (poor), a system message is output; the hold time is extended according to the module configuration. See *Message management*, p. 43. Only when the system message has been acknowledged with the end of sequence is the welding process ended by setting the <End of sequence (FK)> output signal.

Re. 9:

The <End of sequence (FK)> signal remains set for 100 ms, and is extended if the <Start> signal is still present. The welding process is ended when <End of sequence> and <Start> are withdrawn.

Welding process output signals

<Ready>

The <Ready> signal is an output signal. The signal indicates that an active <Start> leads to a welding process.

Due to present system messages or errors, the <Ready> signal may be inactive, e.g. if the <Emergency stop> input is not set.

See *Welding process input signals*, p. 139.

<Working stroke> or <Solenoid valve>

At the start of the squeeze time, the <Working stroke> or <Solenoid valve> output signal becomes active if available. The signal controls the valve for closing the gun and for building-up the electrode pressure.

The signal is active when <Start> is active and becomes inactive when <End of sequence> is set.

If an error occurs during the welding process, <Working stroke> or <Solenoid valve> remains active. The exception is low-active <Emergency stop> input; this inactivates the signal.

See *Welding process I/O signals*, p. 135.

<Welding OK or NOK>

At the start of the welding process, the <Welding OK or NOK> output signals are inactive. Within the hold time, all monitoring functions (if used) are reviewed; the <Welding OK/NOK> output signals are set.

If no monitoring function is used, the <Welding NOK> signal is also set.

<Welding OK>: If welding has been evaluated as OK (good), the welding process is ended by setting the <End of sequence (FK)> output signal.

<Welding NOK>: If welding has been evaluated as NOK (poor), a system message is output; the hold time is extended according to the module configuration. See *Message management*, p. 43. Only when the system message has been acknowledged with the end of sequence is the welding process ended by setting the <End of sequence (FK)> output signal.

<End of sequence (FK)>

The < End of sequence> (FK) signal is an output signal. This output signal indicates the end of a welding process.

The function of the <End of sequence> (FK) is dependent on its configuration.

By default, the <FK> signal is output at the end of <Hold time>. If the <Start> signal is present for longer than the welding cycle takes, the <FK> signal remains active until the <Start> signal becomes inactive.

If no further <Start> signal is present, <FK> is output as a 100-ms pulse as standard.

After a system message, the <FK> signal is only output after being acknowledged. This can be delayed, with <Hold time> being extended internally.

See *Welding process I/O signals*, p. 135.

See *Message management*, p. 43.

Welding process input signals

<Start>

When the <Start> input signal becomes active, the welding process starts. Depending on the configuration of the start interlock, a pulse or a continuous signal is required for this. Leaving <Start> set up to the end of the welding process is recommended.

See *Start interlock*, p. 44.

See *Welding process I/O signals*, p. 135.

With hand guns, the <Start 1> signal is clearly assigned to gun 1; <Start 2> is clearly assigned to gun 2.

<With current>

The input signal enables a welding process without welding current output.

When the <With current> input is active, the welding process is performed with current, or without current when the input is inactive. The <With current> output also becomes inactive when the <With current> input is inactive. If <With current> becomes inactive during a welding process, the welding process is continued without current.

<Pressure OK> (pressure contact)

At the end of the squeeze time, the module signals that the set welding force has been reached with the <Pressure OK> input signal. If <Pressure OK> is not set, the squeeze time is extended accordingly.

See *Welding process I/O signals*, p. 135.

Please note: If no pressure switch or suitable facility is available, the input must be connected to 24 V.

<Emergency stop>

The <emergency stop> input signal enables the inverter's power output to be shut off. When the power output is shut off, the inverter remains connected to the grid; no physical disconnection from the grid takes place.

<Emergency stop> is low-active. If the emergency stop is activated, the following processes are stopped:

- The <Ready> output signal becomes inactive. The module no longer indicates welding readiness.
- The welding process is aborted.
- The welding current is switched off.
- The <End of sequence> and <Welding OK/NOK> signals are not output.

Please note: The <Emergency stop> input and the outputs switched with it do not meet the safety specifications (redundancy) of an emergency stop or emergency stop function in the sense of machine and system safety.
The <Emergency stop> input can be integrated into the system's emergency stop chain if certain conditions are observed.
See *Emergency stop input*, p. 36.

13.2 Electrode management I/O signals

Note:

In the case of manual electrode holders, the signal assignment is firmly defined, and refers to the spot counter for gun 1 or gun 2 in each case. See *Manual electrode holder mode*, p. 54.

Electrode management signal level

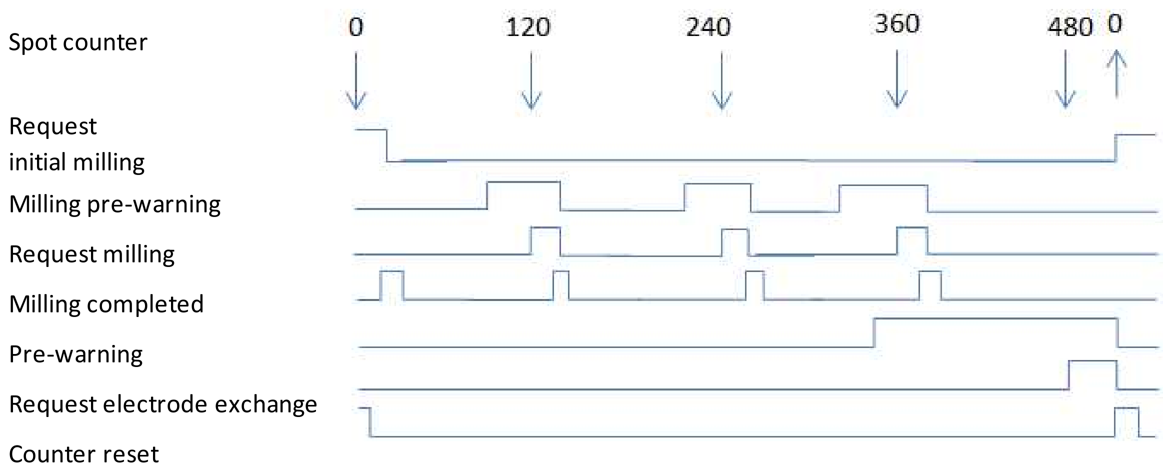


Fig. 13-2: Electrode management signal level

Electrode management output signals

<Request initial milling>

After electrode exchange, the <Request initial milling> output signal is set and must be acknowledged with <Milling completed>. (With initial milling function activated only).

See *Initial milling*, p. 61.

<Milling pre-warning>

This output signal is only available depending on the system configuration.

See *Electrode milling (subsequent milling)*, p. 62.

This indicates electrode milling that is due soon.

<Request milling> (1 and 2)

Electrode milling is requested with this output signal.

See *Electrode milling (subsequent milling)*, p. 62.

After milling, the milling request must be withdrawn by setting the input signal <Milling completed>.

See *Electrode management input signals*, p. 141.

<Electrode exchange pre-warning> (1 and 2)

This output signal indicates an electrode exchange that is due soon.

See *Electrode exchange*, p. 65.

<Request electrode exchange> (1 and 2)

Electrode exchange is requested with this output signal.

See *Electrode exchange*, p. 65.

Electrode management input signals

<Milling completed> (1 and 2)

The <Request milling> or <Request initial milling> output signal is acknowledged with the <Milling completed> input signal.

See *Electrode milling (subsequent milling)*, p. 62.

See *Electrode management output signals*, p. 140.

<Counter reset>

The <Counter reset> input signal resets the weld spot counter of the selected gun to 0. See *Spot counter*, p. 60.

The function of the <Counter reset> signal is identical to that of the <Acknowledgement, electrode exchange> signal.

Resetting the weld spot counter withdraws the <Pre-warning> and <Request electrode exchange> outputs. See *Electrode management output signals*, p. 140.

If the <Initial milling> function is activated, counter reset triggers the <Request initial milling> output signal. See *Initial milling*, p. 61.

Counter reset can be carried out at any time when the weld spot counter is greater than 0.

<Electrode status / electrode holder selection active>

With field bus applications only. The input may only be set outside of the welding process.

When this input signal is set, the spot number is interpreted as the gun number (counter number). The wear status of each electrode can therefore be polled if several guns are used.

If a gun number has been detected, the selected gun's <Request initial milling>, <Request milling>, <Pre-warning> and <Request electrode exchange> outputs are output accordingly.

See *Electrode management output signals*, p. 140.

14 Plug-in modules

All available plug-in modules are described in this chapter.

Note

An overview of input and output signals for your individual configuration can be found in the separate document "Pin assignments". This is provided at the end of these operating instructions or under www.harms-wende.de in the download area. Registration is required to use the download area.

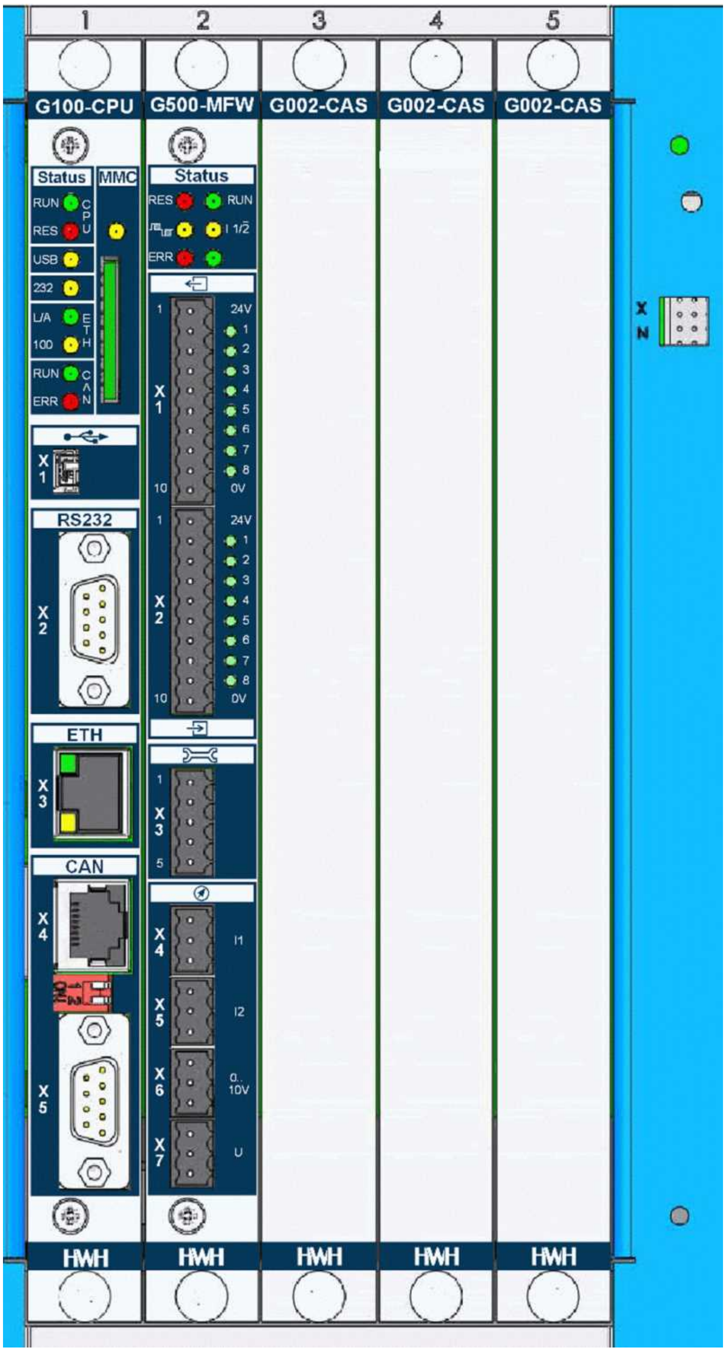


Fig. 14-1: Example of installed plug-in modules

Electrostatic discharge

When plug-in modules are being installed and removed, it must be ensured that people or objects coming into contact with the plug-in modules or other electrostatically sensitive components are discharged through earthing (e.g. with ESD shoes) or they must have the same voltage potential.

Note

CPU plug-in modules contain firmware, programs, parameters, customer-specific configurations and equipment features. These are retained when switching to another power unit.

- Label the CPU plug-in modules with the device type when changing them.
- Swapping CPU plug-in modules is only possible within identical device types (manual system or robot system).

Plug-in modules with Ethernet connection

Plug-in modules with an Ethernet connection (-PNR, _PNI, -EIP extensions), depending on firmware version, can establish communication with a user interface, e.g. XPegasus.

If you have any questions, please contact HWH Service, tel.: +49 40 766 904-84.

Device description files (GSD files) for field bus connection (plug-in modules G4xx-xxx and G6xx-MIO-xxx)

The device description files required for the field bus connection are provided in the download area at www.harms-wende.de (GENIUS > GENERAL STATION DESCRIPTION) or are available from our Service department on request.

Registration is required to use the download area.

14.1 G101-CPU with memory card slot

Plug-in module for the inverter's central logic. We always recommend inserting this type of plug-in module in the first slot.

LED display

LED	Display	Module status	function
CPU			
RUN	On	In operation	Operating status
	Off	Not in operation	
	Flashing	Initialise	
RES	On	CPU stopped, currently restarting	Module reset
	Off	CPU not stopped	
USB, currently without function			
232	Flashing	Data transmission	RS232 interface
ETH			
L/A	Flashing	Data transmission	Ethernet link and activity
100	Flashing	Transmission speed 100 Mbit/s	
	Off	Transmission speed 10 Mbit/s	
CAN			
RUN	On	Network started, CANopen: operational	CANopen operating status
	Off	Network not in operation; devices not initialised	
	Flashing	Network not yet started or stopped again	
ERR	On	Transmission error, disconnection from the network, CAN: status bus off	CANopen error status

	LED	Display	Module status	function
		Flashing	Warning threshold for transmission errors or error monitoring inactive, CAN: status error warning or error passive	
		Double flashing	Incorrect feedback from at least one device, CANopen: node guarding error	
	MMC	Off	Memory card not inserted	MMC operating status
		Flashing	Memory card inserted, preparing	
		Flashing 2.5 Hz	Memory card not known or unusable	
		On	Memory card operational	
		Irregular flickering, temporarily off	Memory card is being accessed. The memory card must not now be removed, as data and file loss may occur!	
		Double flashing	Memory card deactivated	

Connection	I/O	Name	function
X2 RS232			
X2.1		N.c.	RS232 interface
X2.2	E*	RxD input	
X2.3	A	TxD output	
X2.4	A	RTS output (internally connected to DTR)	
X2.5		GND	
X2.6		N.c.	
X2.7	A	DTR output	
X2.8	E*	CTS input	
X2.9		N.c.	
X3 Ethernet			
X3.1	A	TD+	Ethernet interface
X3.2	A	TD-	
X3.3	E*	RD+	
X3.4		RC combination T	
X3.5		RC combination T	
X3.6	E*	RD-	
X3.7		RC combination R	
X3.8		RC combination R	
X4 CAN			

Connection	I/O	Name	function
X4.1	I/O	CAN_H	CAN interface
X4.2	I/O	CAN_L	
X4.3		CAN_GND	
X4.4		N.c.	
X4.5		N.c.	
X4.6		N.c.	
X4.7		CAN_GND	
X4.8	A	CAN_5V	
X5 CAN			
X5.1		N.c.	CAN interface
X5.2	I/O	CAN_L	
X5.3		CAN_GND	
X5.4		N.c.	
X5.5		N.c.	
X5.6		CAN_GND	
X5.7	I/O	CAN_H	
X5.8		N.c.	
X5.9	A	CAN_5V	

Memory card

Parameters	Value	Remark
Supported card types	MMC SD (acc. to spec. 1.0, 1.1, 2.0)	High-capacity SD cards are not supported.
Memory size	≤ 2 GB	
File system	FAT16, FAT32	

DIP switch for CAN line termination

The DIP switch is located between X4 and X5.

Note

If the plug-in module is connected at the end of the CAN bus, line termination must be activated; otherwise, it must be inactive.

DIP switch	Status	function
1	ON	Line termination active
2	ON	
1	OFF	Line termination inactive
2	OFF	

14.2 G102-CPU

Plug-in module for the inverter's central logic. We always recommend inserting this type of plug-in module in the first slot.

LED display

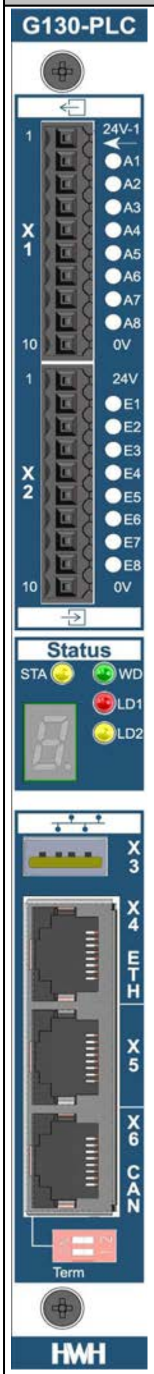
LED	Display	Module status	function
CPU			
RUN	On	In operation	Operating status
	Off	Not in operation	
	Flashing	Initialise	
RES	On	CPU stopped, currently restarting	Module reset
	Off	CPU not stopped	
232	Flashing	Data transmission	RS232 interface
ETH			
L/A	Flashing	Data transmission	Ethernet link and activity
100	Flashing	Transmission speed 100 Mbit/s	
	Off	Transmission speed 10 Mbit/s	

Connection	I/O	Name	function
X2 RS232			
X2.1		N.c.	RS232 interface
X2.2	E*	RxD input	
X2.3	A	TxD output	
X2.4	A	RTS output (internally connected to DTR)	
X2.5		GND	
X2.6		N.c.	
X2.7	A	DTR output	
X2.8	E*	CTS input	
X2.9		N.c.	
X3 Ethernet			
X3.1	A	TD+	Ethernet interface
X3.2	A	TD-	
X3.3	E*	RD+	
X3.4		RC combination T	
X3.5		RC combination T	
X3.6	E*	RD-	
X3.7		RC combination R	
X3.8		RC combination R	

14.3 G130-PLC

The plug-in module provides an internal PLC.

LED display



LED	Display	Module status	function
STA	Flashing	Initialisation	Buffer capacitor[2] is charged
	Flashing, 1 Hz	No data exchange with PLC	
	On[1]	Data exchange with PLC	
	Flashing	Initialisation	Buffer capacitor[2] is not yet charged
	Flashing	No data exchange with PLC yet	
	Flickering	Data exchange with PLC	
	On, dark	Switched off, PLC power-down	
WD	On	PLC firmware loaded, process monitoring has not ascertained any errors.	Watchdog, internal PLC monitoring
	Off	Process monitoring has ascertained errors or no PLC firmware loaded.	
LD1 and LD2	Flickering[1]	PLC is receiving data	Status of data exchange with the PLC via internal CAN[3]
	Flashing, 2 Hz	First warning threshold for number of reception errors exceeded.	
	Flickering[1]	PLC is transmitting data	
	Flashing, 2 Hz	First warning threshold for number of transmission errors exceeded.	
	Flashing, 1 Hz	Second warning threshold for number of transmission errors exceeded. LD1 lights synchronously with LD2	
	Flashing, 0.5 Hz	Abortion of data transmission due to excessive number of transmission errors. PLC has disconnected. LD1 lights synchronously with LD2	

	LED	Display	Module status	function
	7-segment display[3]			
	8	0...7	Start-up phase: initialisation step	Initialisation, task status, error
		Individual segments flicker	Operation: processing load of individual tasks	
		Continuously Exxx or Fxxx	Start-up phase: error number xxx	
	X4 ETH[3]			
		Yellow on	Transmission running	Ethernet link and activity
		Yellow off	No transmission	
		Green on	Ethernet connection established	
		Green off	Ethernet connection not established	
	X6 CAN[3]			
		Yellow flickering[1]	Data are being transmitted	CANopen operating status
		Yellow flashing, 2 Hz	First warning threshold for number of transmission errors exceeded CAN: status error warning	
		Green flickering[1]	Data are being received	
		Green flashing, 2 Hz	First warning threshold for number of reception errors exceeded. CAN: status error warning	
		Flashing, 1 Hz	Second warning threshold for number of transmission errors exceeded, yellow and green flash synchronously CAN: status error passive	
		Flashing, 0.5 Hz	Due to the high number of transmission errors, the PLC has disconnected from the CAN network; yellow and green flash synchronously. CAN: status bus off	

1) Normal status

2) Plug-in module G130-PLC is equipped with a buffer capacitor to buffer the supply voltage. After switching off the device, the PLC is therefore in operation for longer, for a power-down time of > 1 s. After switching on the device, the buffer capacitor first has to be charged completely so that the max. power-down time is available. During the charging time, the LED <STA> flashes, lighting briefly.

[3] More information is available in the separate documentation for the PLC assembly contained in this plug-in module.

Connection	I/O	Name	function
X1 digital outputs			
X1.1	A	24 V	Voltage supply from central supply
X1.2	A	A1	Digital outputs 1...8 The assignment of digital outputs A1 to A8 is not defined and depends on the program running on the PLC.
X1.3	A	A2	
X1.4	A	A3	
X1.5	A	A4	
X1.6	A	A5	
X1.7	A	A6	
X1.8	A	A7	
X1.9	A	A8	
X1.10		0 V	Reference potential for digital I/O
X2 digital inputs			
X2.1	A	24 V	Voltage supply from central supply
X2.2	E*	E1	Digital inputs 1...8 The assignment of digital inputs E1 to E8 is not defined and depends on the program running on the PLC.
X2.3	E*	E2	
X2.4	E*	E3	
X2.5	E*	E4	
X2.6	E*	E5	
X2.7	E*	E6	
X2.8	E*	E7	
X2.9	E*	E8	
X2.10		0 V	Reference potential for digital I/O
X3 USB			
X3.1	A	VCC	+5 V
X3.2	I/O	D-	Transmission/reception data -
X3.3	I/O	D+	Transmission/reception data +
X3.4		GND	Reference potential
X4 Ethernet			
X4.1	A	TX+	Transmission data +
X4.2	A	TX-	Transmission data -
X4.3	E*	RX+	Reception data +
X4.4		N.c.	Not assigned
X4.5		N.c.	Not assigned
X4.6	E*	RX-	Reception data -
X4.7		N.c.	Not assigned
X4.8		N.c.	Not assigned
X5			
X5		Not usable	RS232 interface
X6 CAN			
X6.1	I/O	CAN_H	Data (dominant high)
X6.2	I/O	CAN_L	Data (dominant low)

Connection	I/O	Name	function
X6.3		CAN_ GND	Reference potential for CAN_H/L/5 V
X6.4		N.c.	Not assigned
X6.5		N.c.	Not assigned
X6.6		N.c.	Not assigned
X6.7		CAN_ GND	Reference potential for CAN_H/L/5 V
X6.8		N.c.	Not assigned

DIP switch for CAN line termination

The DIP switch is located beneath CAN interface X6.

DIP switch	Status	function
1	ON	Line termination active
2	ON	
1	OFF	Line termination inactive
2	OFF	

Technical data

Digital inputs

Parameters	Value	Remark
Input type		As per EN 61131-2, type 1
Rated voltage (U_e)	24 V DC (-15/+20%)	
Input current, typical at U_e	5 mA	
Switching delay 0 to 1	≤ 100 µs + input filter	
Switching delay 1 to 0	≤ 100 µs + input filter	
Signal flank gradient	≥ 24 V/ms	
Insulation voltage inputs/logic	≥ 500 V_{eff}	
Input filter	0.2 ms	
Status display	LED lights: input active	
Permissible input voltage	-30 to +30 V	
Working ranges:		As per EN 61131-2, type 1
Signal voltage 0-status (UL)	-30 to +5 V (+15 V)	
Signal voltage 1-status (UH)	+15 to +30 V	

Note

Further information on this plug-in module can be found in the supplier documentation. This is available in the download area at www.harms-wende.de or will be provided by our Service department on request. Registration is required to use the download area.

Digital outputs

Parameters	Value	Remark
Output type	Semiconductor	As per EN 61131-2

Parameters	Value	Remark
Rated voltage (U_e)	24 V DC (-15/+20%)	
Rated current 1-status (I_e)	5 mA	
Voltage drop	≤ 1 V	
Output voltage 0-status	≤ 2 V	
Leak current 0-status	≤ 2 mA	
Insulation voltage outputs/logic	≥ 500 V_{eff}	
Type of protection	Protected output with automatic restart	As per EN 61131-2
Rated load	48 Ohm / 12 W 12 W 12 VA	Ohmic Lamps Inductivities
Switching delay 0 to 1	≤ 500 µs (rated ohmic load) ≤ 100 ms (rated bulb load) ≤ 100 ms (rated inductivity load)	Delay time + current increase time
Switching delay 1 to 0	≤ 1 ms (rated ohmic load) ≤ 1 ms (rated bulb load) ≤ 50 ms (rated inductivity load)	Delay time + current decrease time
Absorbable energy	Max. 0.4 J	
Inductive shut-off voltage limitation	-15 V ≤ U_{demag} ≤ 45 V	
Reverse voltage resistance	Reverse voltage-resistant	Max. permissible current 2 A
Status display	1-status, yellow	Lights up yellow

USB interface

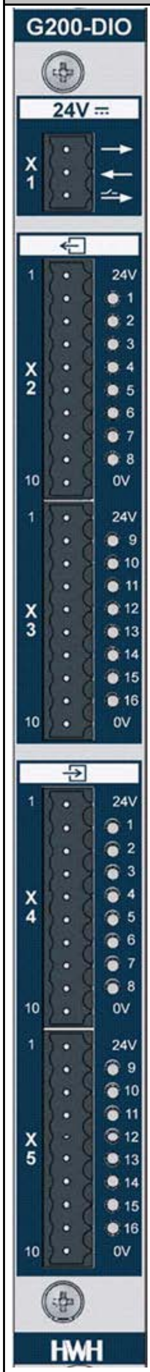
Parameters	Value	Remark
USB specifications	2.0	
Transmission rate	1.5...12 Mbit/s	
Medium	Memory sticks	USB bulk mode, FAT16 or FAT32
Connection technology	Socket type A	

CAN interface

Parameters	Value	Remark
Transmission speed	125...1000 kbit/s	
Line termination	120 Ω	
Insulation voltage CAN/logic	≥ 500 V_{eff}	
Connection technology	RJ45	

14.4 G200-DIO

Plug-in module for digital 24 V inputs and outputs.



Connection	I/O	Name	function
X1.1	A	24 V	From the central supply, non-switched
X1.2	E*	24 V	Supply for this module
X1.3	A	24 V	From the central supply, switched with emergency stop
X2.1	A	24 V	see separate "Pin assignments" document
X2.2	A	A1	
X2.3	A	A2	
X2.4	A	A3	
X2.5	A	A4	
X2.6	A	A5	
X2.7	A	A6	
X2.8	A	A7	
X2.9	A	A8	
X2.10		0 V	
X3.1	A	24 V	see separate "Pin assignments" document
X3.2	A	A9	
X3.3	A	A10	
X3.4	A	A11	
X3.5	A	A12	
X3.6	A	A13	
X3.7	A	A14	
X3.8	A	A15	
X3.9	A	A16	
X3.10		0 V	
X4.1	A	24 V	see separate "Pin assignments" document
X4.2	E*	E1	
X4.3	E*	E2	
X4.4	E*	E3	
X4.5	E*	E4	
X4.6	E*	E5	
X4.7	E*	E6	
X4.8	E*	E7	
X4.9	E*	E8	
X4.10		0 V	
X5.1	A	24 V	see separate "Pin assignments" document

	Connection	I/O	Name	function
	X5.2	E*	E9	
	X5.3	E*	E10	
	X5.4	E*	E11	
	X5.5	E*	E12	
	X5.6	E*	E13	
	X5.7	E*	E14	
	X5.8	E*	E15	
	X5.9	E*	E16	
	X5.10		0 V	

Technical data

Supply

Parameters	Value	Remark
Supply voltage dig. I/O	+18 – +30 V	With external supply
24 V supply voltage fusing	2 A	With external supply
Max. current output of all 24 V pins	1.3 A	Self-healing fuse
Current consumption of all outputs	≤ 80 mA	All outputs 0-status and without load

Digital inputs

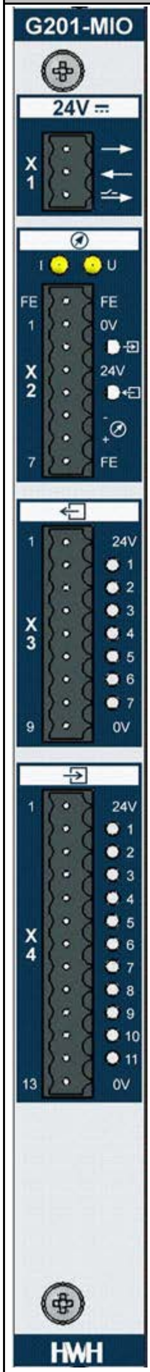
Parameters	Value	Remark
Input type		As per EN 61131-2, type 1
Rated voltage (U_e)	24 V DC (-15/+20%)	
Input current, typical at U_e	5 mA	
Switching delay 0 to 1	≤ 100 µs + input filter	
Switching delay 1 to 0	≤ 100 µs + input filter	
Signal flank gradient	≥ 24 V/ms	
Insulation voltage inputs/logic	≥ 500 V_{eff}	
Input filter	0.2 ms	
Status display	LED lights: input active	
Permissible input voltage	-30 to +30 V	
Working ranges:		As per EN 61131-2, type 1
Signal voltage 0-status (UL)	-30 to +5 V (+15 V)	
Signal voltage 1-status (UH)	+15 to +30 V	

Digital outputs

Parameters	Value	Remark
Output type	Semiconductor	As per EN 61131-2
Rated voltage (U_e)	24 V DC (-15/+20%)	
Rated current 1-status (I_e)	0.5 A	
Insulation voltage outputs/logic	≥ 500 V_{eff}	
Protection type	Protected output with automatic restart	As per EN 61131-2
Rated load	48 Ohm / 12 W 12 W 12 VA (1.2 H, 50 Ohm)	Ohmic Lamps Inductivities
Max. total current output of all outputs	0.7 A	Self-healing fuse

14.5 G201-MIO

Plug-in module with digital 24 V inputs and outputs and one output for controlling a proportional valve.

	Connection	I/O	Name	function
	X1.1	A	24 V	From the central supply, non-switched
	X1.2	E*	24 V	Supply for this module
	X1.3	A	24 V	From the central supply, switched with emergency stop
	FE		FE	Screen
	X2.1		0 V	see separate "Pin assignments" document
	X2.2	E*	E12	
	X2.3	A	24 V /max. 200 mA	
	X2.4	A	Enable	
	X2.5	A	Analogue output -	0 – 10 V, optionally 0 – 20 mA, 4 – 20 mA, see separate "Pin assignments" document
	X2.6	A	Analogue output +	
	X2.7	FE	FE	
	X3.1	A	24 V	see separate "Pin assignments" document
	X3.2	A	A1	
	X3.3	A	A2	
	X3.4	A	A3	
	X3.5	A	A4	
	X3.6	A	A5	
	X3.7	A	A6	
	X3.8	A	A7	
	X3.9		0 V	
	X4.1	A	24 V	see separate "Pin assignments" document
	X4.2	E*	E1	
	X4.3	E*	E2	
	X4.4	E*	E3	
	X4.5	E*	E4	
	X4.6	E*	E5	
	X4.7	E*	E6	
	X4.8	E*	E7	
	X4.9	E*	E8	
	X4.10	E*	E9	
	X4.11	E*	E10	
	X4.12	E*	E11	
	X4.13		0 V	

LED display

LED	Display	Module status	function
I	On	Current	Nominal pressure
	Off	No current	
U	On	Voltage	
	Off	No voltage	

DIP switch for the proportional valve value range

The value range for X2.5 and X2.6 is set to 0 – 10 V as default.

The value range can be changed using a DIP switch.

The DIP switch can only be set when the plug-in module is removed.

The following settings are possible:

S1	S2	S3	S4	Setting
1	1	0	1	0 – 20 mA
1	0	1	0	4 – 20 mA
0	X	X	X	0 – 10 V

Technical data

Supply

Parameters	Value	Remark
Supply voltage dig. I/O	+18 – +30 V	With external supply
24 V supply voltage fusing	2 A	With external supply
Max. current output of all 24 V pins	1.3 A	Self-healing fuse
Current consumption of all outputs	≤ 80 mA	All outputs 0-status and without load

Digital inputs

Parameters	Value	Remark
Input type		As per EN 61131-2, type 1
Rated voltage (U_e)	24 V DC (-15/+20%)	
Input current, typical at U_e	5 mA	
Switching delay 0 to 1	≤ 100 µs + input filter	
Switching delay 1 to 0	≤ 100 µs + input filter	
Signal flank gradient	≥ 24 V/ms	
Insulation voltage inputs/logic	≥ 500 V_{eff}	
Input filter	0.2 ms	
Status display	LED lights: input active	
Permissible input voltage	-30 to +30 V	
Working ranges:		As per EN 61131-2, type 1
Signal voltage 0-status (UL)	-30 to +5 V (+15 V)	
Signal voltage 1-status (UH)	+15 to +30 V	

Digital outputs

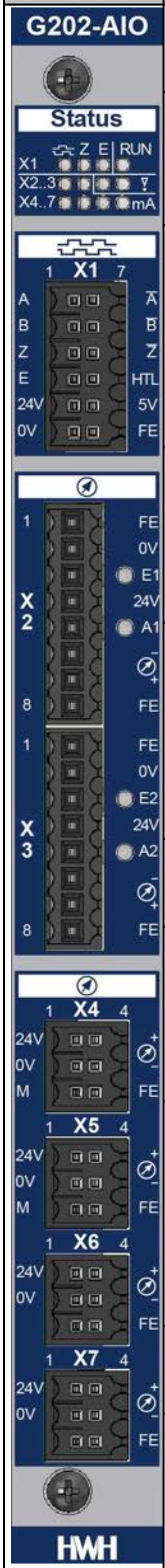
Parameters	Value	Remark
Output type	Semiconductor	As per EN 61131-2
Rated voltage (U_e)	24 V DC (-15/+20%)	
Rated current 1-status (I_e)	0.5 A	
Insulation voltage outputs/logic	≥ 500 V_{eff}	
Protection type	Protected output with automatic restart	As per EN 61131-2
Rated load	48 Ohm / 12 W 12 W 12 VA (1.2 H, 50 Ohm)	Ohmic Lamps Inductivities
Max. total current output of all outputs	0.7 A	Self-healing fuse

Analogue outputs

Parameters	Value	Remark
Output type	Current/voltage	Optionally switchable (S1 – S4)
Voltage	0 – 10 V 2% R_L ≥ 24 Ohm, I max. 5 mA	10-bit
Current 1	0 – 20 mA 2% R_L ≥ 600 Ohm, max. 800 Ohm	10-bit
Current 2	4 – 20 mA 2% R_L ≥ 600 Ohm, max. 800 Ohm	10-bit

14.6 G202-AIO

Plug-in module with analogue 24 V inputs and outputs and one output for controlling a proportional valve.



LED	Display	Module status	function
Incremental encoder			
X1	On	Constant: upwards movement Flickering: downwards movement	
	Off	Shutdown	
X1 Z	On	Position is at reference mark	
	Off		
X1 E	On	E has 1 status	
	Off	E has Ø status	
X1 RUN	On	Operation	
	Off	Module not running	
Analogue outputs			
X2..3 mA	On	Is current output	
	Off	Is voltage output	
X2..3 !	On	With current output: without load With voltage output: overload	
	Off	OK	
Analogue inputs			
X4..7 mA	On	Is current input	
	Off	Is voltage input	

Connection	I/O	Name	function
Incremental encoder input			
X1.1	E	Track A	Incremental value encoder input track A
X1.2	E	Track B	Incremental value encoder input track B
X1.3	E	Track Z	Incremental value encoder input track Z (reference mark)
X1.4	E*	E	Control input for referencing (digital input 3)
X1.5	A	24 V	For encoder supply (24 V from central supply)
X1.6		0 V	Reference potential for encoder signals and supply
X1.7	E	$\overline{A}$	Incremental value encoder input track A inverted
X1.8	E	$\overline{B}$	Incremental value encoder input track B inverted
X1.9	E	$\overline{Z}$	Incremental value encoder input track Z inverted
X1.10	E	HTL	Definition of type of incremental value encoder inputs: bridged to 5 V: HTL (24 V level) Open: RS422 (5 V level)
X1.11	A	5 V	For encoder supply (as alternative to 24 V)
X1.12		FE	Functional earth, connection for shielding
Analogue output 1			
X2.1		FE	Functional earth, connection for shielding
X2.2	E*	0 V	Reference potential for digital I/O
X2.3	A	E1	Digital input 1
X2.4	A	24 V	From central supply
X2.5	A	A1	Digital output 1
X2.6	A	-	Analogue output 1 - or reference
X2.7		+	Analogue output 1 +
X2.8		FE	Functional earth, connection for shielding
Analogue output 2			
X3.1		FE	Functional earth, connection for shielding
X3.2		0 V	Reference potential for digital I/O
X3.3	E*	E2	Digital input 2
X3.4	A	24 V	From central supply
X3.5	A	A2	Digital output 2
X3.6	A	-	Analogue output 2 - or reference
X3.7	A	+	Analogue output 2 +
X3.8		FE	Functional earth, connection for shielding
Analogue input 1			
X4.1	A	24 V	For sensor supply (24 V from central supply)
X4.2		0 V	Reference potential for sensor supply
X4.3	A	m	Measurement enable (digital output 4)
X4.4	E	-	Differential analogue input 1 (10 V / 20 mA) - or refe-rence
X4.5	E	+	Differential analogue input 1 (10 V / 20 mA) +
X4.6		FE	Functional earth, connection for shielding
Analogue input 2			
X5.1	A	24 V	For sensor supply (24 V from central supply)

Connection	I/O	Name	function
X5.2		0 V	Reference potential for sensor supply
X5.3	A	m	Measurement enable (digital output 5)
X5.4	E	-	Differential analogue input 2 (10 V / 20 mA) - or refe-rence
X5.5	E	+	Differential analogue input 2 (10 V / 20 mA) +
X5.6		FE	Functional earth, connection for shielding
Analogue input 3			
X6.1	A	24 V	For sensor supply (24 V from central supply)
X6.2		0 V	Reference potential for sensor supply
X6.3			Not assigned
X6.4	E	-	Differential analogue input 3 (10 V / 20 mA) - or refe-rence
X6.5	E	+	Differential analogue input 3 (10 V / 20 mA) +
X6.6		FE	Functional earth, connection for shielding
Analogue input 4			
X7.1	A	24 V	For sensor supply (24 V from central supply)
X7.2		0 V	Reference potential for sensor supply
X7.3			Not assigned
X7.4	E	-	Differential analogue input 4 (10 V / 20 mA) - or refe-rence
X7.5	E	+	Differential analogue input 4 (10 V / 20 mA) +
X7.6		FE	Functional earth, connection for shielding

DIP switch for the proportional valve value range

The value range for X2.5 and X2.6 is set to 0 – 10 V as default.

The value range can be changed using a DIP switch.

The DIP switch can only be set when the plug-in module is removed.

The following settings are possible:

Channel/plug			X2		X3		X4	X5	X6	X7
		Switch position								
	Setting	1	2	3	4	5	6	7	8	9
Analogue output	0 – 10 V	0	0	0	0	0				
	4 – 20 mA	0	0	1	0	1				
	0 – 20 mA	0	1	0	1	0				
	+/- 10 V	0	1	1	1	1				
Analogue input	+/- 10 V	0					0	0	0	0
	+/- 20 mA	0					1	1	1	1

Technical data

Supply (X1..X7)

Parameters	Value	Remark
Supply voltage dig. I/O		With external supply

Parameters	Value	Remark
24 V supply voltage fusing		With external supply
Max. current output of all 24 V pins	0.7 A	Self-healing fuse
Current consumption of all outputs	≤ 6 mA	All outputs 0-status and without load

Digital inputs (X2, X3)

Parameters	Value	Remark
Input type		As per EN 61131-2, type 1
Rated voltage (U_e)	24 V DC (-15/+20%)	
Input current, typical at U_e	5 mA	
Switching delay 0 to 1	≤ 100 µs + input filter	
Switching delay 1 to 0	≤ 100 µs + input filter	
Signal flank gradient	≥ 24 V/ms	
Insulation voltage inputs/logic	≥ 500 V_{eff}	
Input filter	0.2 ms	
Status display	LED lights: input active	
Permissible input voltage	-30 to +30 V	
Working ranges:		As per EN 61131-2, type 1
Signal voltage 0-status (UL)	-30 to +5 V (+15 V)	
Signal voltage 1-status (UH)	+15 to +30 V	

Digital outputs (X2..X5)

Parameters	Value	Remark
Output type	Semiconductor	As per EN 61131-2
- Special outputs M (X4, X5)	Switching to positive (high side) Switching to negative (low side) Switching bilaterally (push-pull)	Adjustable
Rated voltage (U_e)	24 VDC	
Rated current 1-status (I_e)	150 mA	
Voltage drop	≤ 2 V	
Output voltage 0-status	≤ 2 V	
Leak current 0-status	≤ 100 µA	
Insulation voltage outputs/logic	≥ 500 V_{eff}	
Protection type	Protected output with auto-matic restart	As per EN 61131-2
Rated load	160 Ohm / 3.6 W 3.6 VA	Ohmic Inductivities
Inductive shut-off voltage limitation	-12 V ≤ U_{demag} ≤ 36 V	
Reverse voltage resistance	Reverse voltage-resistant	
Status display (with X2, X3 only)	LED lights: active	

Analogue inputs (X4..x7)

Parameters	Value	Remark
Input type	Differential voltage/current input	Can be internally selected using switch/ parameterisation
Permissible input voltage	-17 V to +17 V -30 V to +30 V	Earthed Earth-free
Working range – Voltage – Current	 -10 V to +10 V -20 mA to +20 mA	 One measuring range One measuring range
Internal resistance – Voltage input – Current input	 19 kOhm 500 Ohm	
Accuracy – Voltage – Current	 0.25% 0.5%	 Of the range end value Of the range end value
Quantisation	16-bit	
Limit frequency	5 kHz	
Insulation voltage outputs/logic	Not insulated	

Analogue outputs (X2, X3)

Parameters	Value	Remark
Output type	Voltage/current output	Can be internally selected using switch/ parameterisation
Working range – Voltage – Current	 0 to 10 V / -10 V to +10 V 0 to 20 mA / 4 to 20 mA	
Output load – Voltage output – Current output	 ≥ 1 , < = 20 nF, ≤ 10 mA ≤ 550 Ohm	
Accuracy	0.5%	Of the range end value
Quantisation	12-bit	
Type of protection	Short-circuit protection	
Insulation voltage outputs/logic	≥ 500 V_{eff}	

Incremental value encoder input (X1)

Encoder supply (24 V, 5 V, 0 V)

Parameters	Value	Remark
24 V supply – Rated voltage – Max. current output – Short-circuit protection	 24 V DC Electronic and thermal	 From central supply Self-healing fuse
5 V supply – Rated voltage		

Parameters	Value	Remark
– Max. current output – Short-circuit protection	5 VDC (+/- 5%) 300 mA Electronic and thermal	
Insulation voltage supply/logic	≥ 500 V_{eff}	

Incremental value inputs (A, $\overline{A}$, B, $\overline{B}$, Z, $\overline{Z}$):

Parameters	Value	Remark
Input type	HTL symmetrical, HTL asymmetrical, RS422 symmetrical	Can be set via HTL input
HTL		
Activation	Bridge HTL input at 5 V	
Transducer supply	24 V	
Connection type	A, $\overline{A}$, B, $\overline{B}$, Z, $\overline{Z}$ A, B, Z	With symmetrical use With asymmetrical use
Rated voltage (U_e)	24 VDC	
Permissible input voltage	-8 V to +32 V	
Signal voltage 0-status (UL)	-8 V to +10 V	
Signal voltage 1-status (UH)	+12 V to +32 V	
Input current, typical at U_e	4 mA	
Max. input frequency	250 kHz	
RS422		
Activation	Leave HTL input open	
Transducer supply	24 V or 5 V	
Signal connection type	A, $\overline{A}$, B, $\overline{B}$, Z, $\overline{Z}$	
Permissible input voltage	-8 V to +32 V	
Signal voltage	Differential signal ±0.2 V...±5 V	
Common-mode range	-8 V to +15 V	
Input resistance	120 Ohm	
Max. input frequency	2 MHz	
Insulation voltage outputs/logic	≥ 500 V_{eff}	

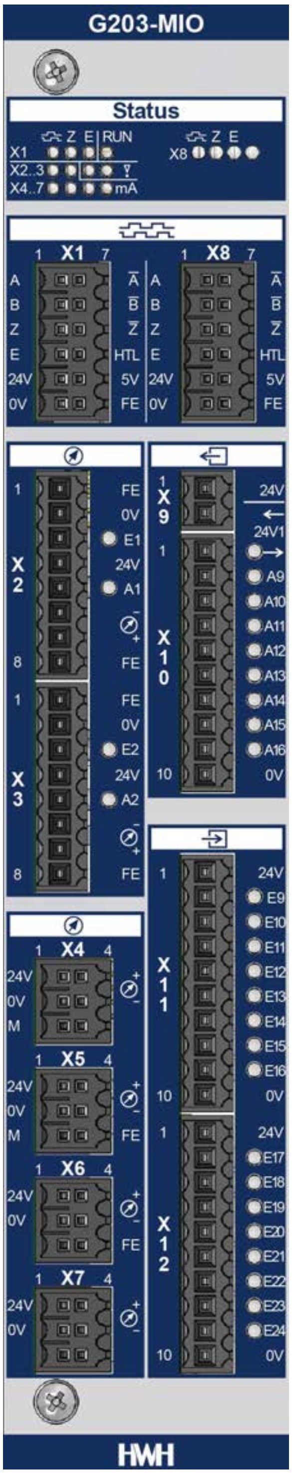
Digital input (E)

Parameters	Value	Remark
Permissible input voltage	-8 V...+15 V	
Input current, typical	5.5 mA	Constant as of input voltage ≥5 V
Switching delay 0 to 1	≤ 15 µs	
Switching delay 1 to 0	≤ 25 µs	
Signal flank gradient	≥ 24 V/ms	
Insulation voltage inputs/logic	≥ 500 V_{eff}	
Input filter	0.01 ms	
Status display	None	
Working ranges:		As per EN 61131-2, type 1

Parameters	Value	Remark
Signal voltage 0-status (UL)	-8 V…+2.6 V	
Signal voltage 1-status (UH)	+3.3 V…+30 V	

14.7 G203-MIO

Plug-in module with digital 24 V inputs and outputs and one output for controlling a proportional valve.



LED	Display	Module status	function
Incremental encoder			
X1	On	Constant: upwards movement Flickering: downwards movement	
	Off	Shutdown	
X1 Z	On	Position is at reference mark	
	Off		
X1 E	On	E has 1 status	
	Off	E has Ø status	
X1 RUN	On	Operation	
	Off	Module not running	
Analogue outputs			
X2..3 mA	On	Is current output	
	Off	Is voltage output	
X2..3 !	On	With current output: without load With voltage output: overload	
	Off	OK	
Analogue inputs			
X4..7 mA	On	Is current input	
	Off	Is voltage input	
Incremental encoder			
X8	On	Constant: upwards movement Flickering: downwards movement	
	Off	Shutdown	
X8 Z	On	Position is at reference mark	
	Off		
X8 E	On	E has 1 status	
	Off	E has Ø status	

Connection	I/O	Name	function
Incremental value encoder input 1			
X1.1	E	A	Incremental value encoder input track A
X1.2	E	B	Incremental value encoder input track B
X1.3	E	Z	Incremental value encoder input track Z (reference mark)
X1.4	E*	E	Control input for referencing (digital input 3)
X1.5	A	24 V	For encoder supply (24 V from central supply)
X1.6		0 V	Reference potential for encoder signals and supply
X1.7	E	$\overline{A}$	Incremental value encoder input track A inverted
X1.8	E	$\overline{B}$	Incremental value encoder input track B inverted
X1.9	E	$\overline{Z}$	Incremental value encoder input track Z inverted
X1.10	E	HTL	Definition of type of incremental value encoder inputs: bridged to 5 V: HTL (24 V level) Open: RS422 (5 V level)
X1.11	A	5 V	For encoder supply (as alternative to 24 V)
X1.12		FE	Functional earth, connection for shielding
Analogue output 1			
X2.1		FE	Functional earth, connection for shielding
X2.2	E*	0 V	Reference potential for digital I/O
X2.3	A	E1	Digital input 1
X2.4	A	24 V	From central supply
X2.5	A	A1	Digital output 1
X2.6	A	-	Analogue output 1 - or reference
X2.7		+	Analogue output 1 +
X2.8		FE	Functional earth, connection for shielding
Analogue output 2			
X3.1		FE	Functional earth, connection for shielding
X3.2		0 V	Reference potential for digital I/O
X3.3	E*	E2	Digital input 2
X3.4	A	24 V	From central supply
X3.5	A	A2	Digital output 2
X3.6	A	-	Analogue output 2 - or reference
X3.7	A	+	Analogue output 2 +
X3.8		FE	Functional earth, connection for shielding
Analogue input 1			
X4.1	A	24 V	For sensor supply (24 V from central supply)
X4.2		0 V	Reference potential for sensor supply
X4.3	A	m	Measurement enable (digital output 4)
X4.4	E	+	Differential analogue input 1 (10 V / 20 mA) +
X4.5	E	-	Differential analogue input 1 (10 V / 20 mA) - or reference
X4.6		FE	Functional earth, connection for shielding
Analogue input 2			
X5.1	A	24 V	For sensor supply (24 V from central supply)
X5.2		0 V	Reference potential for sensor supply
X5.3	A	m	Measurement enable (digital output 5)
X5.4	E	+	Differential analogue input 2 (10 V / 20 mA) +

Connection	I/O	Name	function
X5.5	E	-	Differential analogue input 2 (10 V / 20 mA) - or reference
X5.6		FE	Functional earth, connection for shielding
Analogue input 3			
X6.1	A	24 V	For sensor supply (24 V from central supply)
X6.2		0 V	Reference potential for sensor supply
X6.3			Not assigned
X6.4	E	+	Differential analogue input 3 (10 V / 20 mA) +
X6.5	E	-	Differential analogue input 3 (10 V / 20 mA) - or reference
X6.6		FE	Functional earth, connection for shielding
Analogue input 4			
X7.1	A	24 V	For sensor supply (24 V from central supply)
X7.2		0 V	Reference potential for sensor supply
X7.3			Not assigned
X7.4	E	+	Differential analogue input 4 (10 V / 20 mA) +
X7.5	E	-	Differential analogue input 4 (10 V / 20 mA) - or reference
X7.6		FE	Functional earth, connection for shielding
Incremental value encoder input 2			
X8.1	E	A	Incremental value encoder input 2 track A
X8.2	E	B	Incremental value encoder input 2 track B
X8.3	E	Z	Incremental value encoder input 2 track Z (reference mark)
X8.4	E*	E	Control input for referencing (digital input 8)
X8.5	A	24 V	For encoder supply (24 V from central supply)
X8.6		0 V	Reference potential for encoder signals and supply
X8.7	E	$\overline{A}$	Incremental value encoder input 2 track A inverted
X8.8	E	$\overline{B}$	Incremental value encoder input 2 track B inverted
X8.9	E	$\overline{Z}$	Incremental value encoder input 2 track Z inverted
X8.10	E	HTL	Definition of type of incremental value encoder inputs: bridged to 5 V: HTL (24 V level) Open: RS422 (5 V level)
X8.11	A	5 V	For encoder supply (as alternative to 24 V)
X8.12		FE	Functional earth, connection for shielding
Supply for digital outputs 9..16			
X9.1	A	24 V	From central supply
X9.2	E	24 V 1 ←	Supply for digital outputs 9..16, can be switched separately
Digital outputs 9..16			
X10.1	A	24 V 1 →	Supply for digital outputs, can be switched separately
X10.2	A	A9	Digital output 9
X10.3	A	A10	Digital output 10
X10.4	A	A11	Digital output 11
X10.5	A	A12	Digital output 12
X10.6	A	A13	Digital output 13
X2.7	A	A14	Digital output 14
X10.8	A	A15	Digital output 15
X10.9	A	A16	Digital output 16

Connection	I/O	Name	function
X10.10		0 V	Reference potential for digital I/O
Digital inputs 9..16			
X11.1	A	24 V	From central supply
X11.2	E*	E9	Digital input 9
X11.3	E*	E10	Digital input 10
X11.4	E*	E11	Digital input 11
X11.5	E*	E12	Digital input 12
X11.6	E*	E13	Digital input 13
X11.7	E*	E14	Digital input 14
X11.8	E*	E15	Digital input 15
X11.9	E*	E16	Digital input 16
X11.10		0 V	Reference potential for digital I/O
Digital inputs 17..24			
X12.1	A	24 V	From central supply
X12.2	E*	E17	Digital input 9
X12.3	E*	E18	Digital input 10
X12.4	E*	E19	Digital input 11
X12.5	E*	E20	Digital input 12
X12.6	E*	E21	Digital input 13
X12.7	E*	E22	Digital input 14
X12.8	E*	E23	Digital input 15
X12.9	E*	E24	Digital input 16
X12.10		0 V	Reference potential for digital I/O

DIP switch for the proportional valve value range

The value range for X2.5 and X2.6 is set to 0 – 10 V as default.

The value range can be changed using a DIP switch.

The DIP switch can only be set when the plug-in module is removed.

The following settings are possible:

Channel/plug			X2		X3		X4	X5	X6	X7
		Switch position								
	Setting	1	2	3	4	5	6	7	8	9
Analogue output	0 – 10 V	0	0	0	0	0				
	4 – 20 mA	0	0	1	0	1				
	0 – 20 mA	0	1	0	1	0				
	+/- 10 V	0	1	1	1	1				
Analogue input	+/- 10 V	0					0	0	0	0
	+/- 20 mA	0					1	1	1	1

Technical data

Supply

Parameters	Value	Remark
Supply for digital outputs X10		Supply for X9, 24 V 1
Permissible supply voltage	+18 V to +30 V	
Fusing	None	
Max. current output of all 24 V pins and 24 V outputs		
X1..X7	0.7 A	Self-healing fuse
X8	0.7 A	Self-healing fuse
X9 .. X12	0.7 A	Self-healing fuse
Current consumption of all outputs	≤46 mA	All outputs 0-status and without load

Digital inputs (X2, X3)

Parameters	Value	Remark
Input type		As per EN 61131-2, type 1
Rated voltage (U_e)	24 V DC (-15/+20%)	
Input current, typical at U_e	5 mA	
Switching delay 0 to 1	≤ 100 µs + input filter	
Switching delay 1 to 0	≤ 100 µs + input filter	
Signal flank gradient	≥ 24 V/ms	
Insulation voltage inputs/logic	≥ 500 V_{eff}	
Input filter	0.2 ms	
Status display	LED lights: input active	
Permissible input voltage	-30 to +30 V	
Working ranges:		As per EN 61131-2, type 1
Signal voltage 0-status (UL)	-30 to +5 V (+15 V)	
Signal voltage 1-status (UH)	+15 to +30 V	

Digital inputs (X11, X12)

Parameters	Value	Remark
Input type		As per EN 61131-2, type 1
Rated voltage (U_e)	24 V DC (-15/+20%)	
Input current, typical at U_e	5 mA	
Switching delay 0 to 1	≤ 5 µs + input filter	
Switching delay 1 to 0	≤ 5 µs + input filter	
Signal flank gradient	≥ 24 V/ms	
Insulation voltage inputs/logic	≥ 500 V_{eff}	
Input filter	0.5 ms	
Status display	LED lights: input active	
Permissible input voltage	0 to +34 V	
Working ranges:		As per EN 61131-2, type 1
Signal voltage 0-status (UL)	0 to +5 V (+15 V)	
Signal voltage 1-status (UH)	+15 to +30 V	

Digital outputs (X2 .. X5)

Parameters	Value	Remark
Output type	Semiconductor	As per EN 61131-2
- Special outputs M (X4, X5)	Switching to positive (high side) Switching to negative (low side) Switching bilaterally (push-pull)	Adjustable
Rated voltage (U_e)	24 VDC	
Rated current 1-status (I_e)	150 mA	
Voltage drop	≤ 2 V	
Output voltage 0-status	≤ 2 V	
Leak current 0-status	≤ 100 µA	
Insulation voltage outputs/logic	≥ 500 V_{eff}	
Protection type	Protected output with auto-matic restart	As per EN 61131-2
Rated load	160 Ohm / 3.6 W 3.6 VA	Ohmic Inductivities
Inductive shut-off voltage limitation	-12 V ≤ U_{demag} ≤ 36 V	
Reverse voltage resistance	Reverse voltage-resistant	
Status display (with X2, X3 only)	LED lights: active	

Digital outputs (X10)

Parameters	Value	Remark
Output type	Semiconductor	As per EN 61131-2
Rated voltage (U_e)	24 VDC (-15 V/+20%)	
Rated current 1-status (I_e)	0.7 A	
Voltage drop	≤ 1 V	
Output voltage 0-status	≤ 1 V	
Leak current 0-status	≤ 5 µA	
Insulation voltage outputs/logic	≥ 500 V_{eff}	
Protection type	Protected output with auto-matic restart	Electronic and thermal
Rated load	48 ohm / 12 W 12 VA	Ohmic Inductivities
Switching delay 0 to 1	≤ 50 µs (rated ohmic load)	Delay time + increase time
Switching delay 1 to 0	≤ 50 µs (rated ohmic load)	Delay time + increase time
Absorbable energy	Max. 0.9 J / 0.2 J	One output / all outputs
Inductive shut-off voltage limitation	-15 V ≤ U_{demag} ≤ 45 V	

Parameters	**Value**	**Remark**
Reverse voltage resistance	Reverse voltage-resistant	Max. permissible current 5 A
Status display (with X2, X3 only)	LED lights: active	
Max. current output of all outputs together	0.7 A	With 24 V supply from X9

Analogue inputs (X4 .. X7)

Parameters	**Value**	**Remark**
Input type	Differential vol- tage/current input	Can be internally selected using switch/ parameterisation
Permissible input voltage	-17 V to +17 V -30 V to +30 V	Earthed Earth-free
Working range – Voltage – Current	 -10 V to +10 V -20 mA to +20 mA	 One measuring range One measuring range
Internal resistance – Voltage input – Current input	 19 kOhm 500 Ohm	
Accuracy – Voltage – Current	 0.25% 0.5%	 Of the range end value Of the range end value
Quantisation	16-bit	
Limit frequency	5 kHz	
Insulation voltage outputs/logic	Not insulated	

Analogue outputs (X2, X3)

Parameters	**Value**	**Remark**
Output type	Voltage/current output	Can be internally selected using switch/ parameterisation
Working range – Voltage – Current	 0 to 10 V / -10 V to +10 V 0 to 20 mA / 4 to 20 mA	
Output load – Voltage output – Current output	 ≥ 1 , < = 20 nF, ≤ 10 mA ≤ 550 Ohm	
Accuracy	0.5%	Of the range end value
Quantisation	12-bit	
Type of protection	Short-circuit protection	
Insulation voltage outputs/logic	$\geq 500\ V_{eff}$	

Incremental value encoder inputs (X1, X8)

Parameters	Value	Remark
24 V supply – Rated voltage – Max. current output – Short-circuit protection	 24 V DC 0.7 A Electronic and thermal	 From central supply Self-healing fuse
5 V supply – Rated voltage – Max. current output – Short-circuit protection	 5 VDC (+/- 5%) 300 mA Electronic and thermal	
Insulation voltage supply/logic	≥ 500 V_{eff}	

Incremental value inputs (A, $\overline{A}$, B, $\overline{B}$, Z, $\overline{Z}$):

Parameters	Value	Remark
Input type	HTL symmetrical, HTL asymmetrical, RS422 symmetrical	Can be set via HTL input
HTL		
Activation	Bridge HTL input at 5 V	
Transducer supply	24 V	
Connection type	A, $\overline{A}$, B, $\overline{B}$, Z, $\overline{Z}$ A, B, Z	With symmetrical use With asymmetrical use
Rated voltage (U_e)	24 VDC	
Permissible input voltage	-8 V to +32 V	
Signal voltage 0-status (UL)	-8 V to +10 V	
Signal voltage 1-status (UH)	+12 V to +32 V	
Input current, typical at U_e	4 mA	
Max. input frequency	250 kHz	
RS422		
Activation	Leave HTL input open	
Transducer supply	24 V or 5 V	
Signal connection type	A, $\overline{A}$, B, $\overline{B}$, Z, $\overline{Z}$	
Permissible input voltage	-8 V to +32 V	
Signal voltage	Differential signal ±0.2 V…±5 V	
Common-mode range	-8 V to +15 V	
Input resistance	120 Ohm	
Max. input frequency	2 MHz	
Insulation voltage outputs/logic	≥ 500 V_{eff}	

14.8 G400-IBS

The plug-in module enables connection to the Interbus field bus system with optical fibre. The Interbus specifications can be found in the applicable documents from the INTERBUS Club and from Phoenix Contact.

LED display

LED	Display	Module status	function
RUN	On	Module is operational	Module status
	Off	Not operational	
UL	On	Supply voltage is in the permissible tole-rance range	Voltage monitoring
	Off	No supply voltage available	
RC	On	Incoming connection established	Incoming connection moni-toring
	Off	Incoming connection faulty	
BA	On	Data exchange	Bus activity monitoring
	Off	No data exchange	
2M	On	2 MBit/s	Transmission rate
	Off	500 kBit/s	
RD	On	Forwarding remote bus switched off	Status of the forwarding remote bus
	Off	Forwarding remote bus activated	
FO1	On	Initialisation failed or MAU warning active	Status of the incoming connection
	Off	Initialisation successful, no MAU warning	
FO2	On	Initialisation failed or MAU warning active	Status of the forwarding connection
	Off	Initialisation successful, no MAU warning	

Following correct initialisation, RC and BA light up.

Connection	I/O	Name	function
X3.1		FE	Interbus voltage supply
X3.2		FE	
X3.3	E*	0 V	
X3.4	E*	24 V	

Optical fibre inputs and outputs

Remote	Transmitter/receiver	function
IN ←	Recipient	Incoming interface
IN →	Transmitter	Incoming interface
OUT ←	Recipient	Forwarding interface
OUT →	Transmitter	Forwarding interface

Setting the transmission rate

Jumper X19 on the plug-in module PCB can be used to set the transmission rate of the bus interface. The transmission rate must be set appropriate to the other field bus subscribers and is dependent on the individual configuration of the system.

Possible settings

- Jumper set: 500 kbit/s
- Jumper open: 2 Mbit/s

Technical data

Supply

Parameters	Value	Remark
Bus interface supply voltage	24 VDC (18 – 30 V)	
Bus interface current consumption	≤ 150 mA	
Transmission rate	500 kbit/sBaud, 2 Mbit/s	
Number of data words	1 – 6	
Connection technology	F-SMA Phoenix Contact	

14.9 G401-IBS

The plug-in module enables connection to the Interbus field bus system with electrical interface.

LED display

	LED	Display	Module status	function
	RUN	On	Module is operational	Module status
		Off	Not operational	
	UL	On	Supply voltage is in the permissible tolerance range	Voltage monitoring
		Off	No supply voltage available	
	RC	On	Incoming connection established	Incoming connection monitoring
		Off	Incoming connection faulty	
	BA	On	Data exchange	Bus activity monitoring
		Off	No data exchange	
	2M	On	2000 Mbit/s	Transmission rate
		Off	500 kbit/s	
	RD	On	Forwarding remote bus switched off	Status of the forwarding remote bus
		Off	Forwarding remote bus activated	
	AP1	On	Warning active	Application warning 1
		Off	Warning not active	
	AP2	On	Warning active	Application warning 2
		Off	Warning not active	

Connection	I/O	Name	function
X1.1	A	DO1	
X1.2	E*	DI1	
X1.3		GND1	
X1.4		N.c.	
X1.5		N.c.	
X1.6	A	/DO1	
X1.7	E*	/DI1	
X1.8		N.c.	
X1.9		N.c.	
Housing		FE	
X2.1	A	DO2	
X2.2	E*	DI2	
X2.3		GND	
X2.4		N.c.	
X2.5		+5 V	
X2.6	A	/DO2	
X2.7	E*	/DI2	
X2.8		N.c.	
X2.9		N.c.	
Housing		FE	
X3.1		FE	Interbus voltage supply
X3.2		FE	
X3.3	E*	0 V24	
X3.4	E*	24 V	

Setting the transmission rate

Jumper X19 on the plug-in module PCB can be used to set the transmission rate of the bus interface. The transmission rate must be set appropriate to the other field bus subscribers and is dependent on the individual configuration of the system.

Possible settings

- Jumper set: 500 kbit/s
- Jumper open: 2 Mbit/s

Technical data

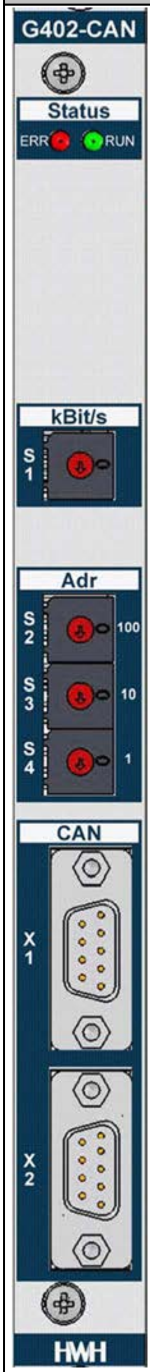
Supply

Parameters	Value	Remark
Bus interface supply voltage	24 VDC (18 – 30 V)	
Bus interface current consumption	≤ 150 mA	
Transmission rate	500 kBit/s, 2 MBit/s	
Number of data words	1 – 6	

14.10 G402-CAN

The plug-in module enables connection to the CANopen field bus system. Further information on the standard is available in the EN50325-4 standard and in CIA DR-301-1.

LED display

	LED	Display	Module status	function
	RUN	On	Network started, CANopen: operational	Operating status
		Off	Network not in operation; devices not initialised	
		Flashing	Network not yet started or stopped again	
	ERR	On	Transmission error, disconnection from the network, CANopen: bus off	Error status
		■–■–■	Warning threshold for transmission errors or error monitoring inactive, CANopen: error warning or error passive	
		■■–■■	Incorrect feedback from at least one device, CANopen: node guarding error	

Connection	I/O	Name	function
X1.1		N.c.	Not assigned
X1.2	I/O	CAN_L	Dominant low data
X1.3		CAN_GND	Ground
X1.4		N.c.	Not assigned
X1.5		N.c.	Not assigned
X1.6		CAN_GND	Ground
X1.7	I/O	CAN_H	Dominant high data
X1.8		N.c.	Not assigned
X1.9	A	CAN_5V	Supply voltage
X2.1		N.c.	Not assigned
X2.2		CAN_L	Dominant low data
X2.3		CAN_GND	Ground
X2.4		N.c.	Not assigned
X2.5		N.c.	Not assigned
X2.6		CAN_GND	Ground
X2.7		CAN_H	Dominant high data
X2.8		N.c.	Not assigned
X2.9		CAN_5V	Supply voltage

Rotary switch S1

The data transmission speed can be set as follows using rotary switch S1:

Switch position	Transmission speed	Maximum bus length
0	10 kbit/s	6700 m
1	20 kbit/s	
2	50 kbit/s	
3	125 kbit/s	500 m
4	250 kbit/s	250 m
5	500 kbit/s	100 m
6	800 kbit/s	
7	1000 kbit/s	20 m
8	Currently without function	
9	Currently without function	

Rotary switches S2, S3 and S4

Rotary switches S2, S3 and S4 define the device address within the CANopen network.

- S2: 100 digit
- S3: 10 digit
- S4: 1 digit

Technical data

Parameters	Value	Remark
Terminating resistors	120 ohm	
Cable type	Shielded TP cable with max. 70 ohm	
Data transmission	CAN-H and CAN-L with GND as reference potential	
Maximum number of subscribers	127	
Transmission speed	10 kbit/s – 1000 kbit/s	

14.11 G410-PBS

The plug-in module enables connection to the profibus field bus system. Profibus specifications can be found in the IEC61158 and IEC61784 standards.

LED display

	LED	Display	Module status	function
	RUN	On	Module is operational	Module status
		Off	Module not in operation	
	ERR	On	Data exchange not possible Module not operational	Error
		Off	No error	
	FB DIAG	Flashing	Diagnosis	Fieldbus diagnosis
		1 Hz	Configuration error	
		2 Hz	Parameter data fields	
		4 Hz	Initialisation error	

Connection	I/O	Name	function
X1.1			
X1.2			
X1.3	E*	0 V	External Profibus plug-in module voltage supply
X1.4	E*	24 V	
X2.1		N.c.	
X2.2		N.c.	
X2.3	I/O	RxD/TxD-P B line	
X2.4		N.c.	
X2.5		GND_{BUS}	
X2.6	E*	+5 V BUS	
X2.7		N.c.	
X2.8	I/O	RxD/TxD-P A line	
X2.9		N.c.	

Profibus line termination DIP switch

The switch for line termination is located beneath the X2 interface.

The following settings are possible:

- ON = line termination on
- OFF = line termination off

Rotary switches NA

The rotary switches NA can be used to manually set the subscriber address for the Profibus.

The two rotary switches are located beneath the DIP switch for line termination.

The default subscriber address is 77.

Rotary switch x10 sets the 10 digit.

Rotary switch x1 sets the 1 digit.

Technical data

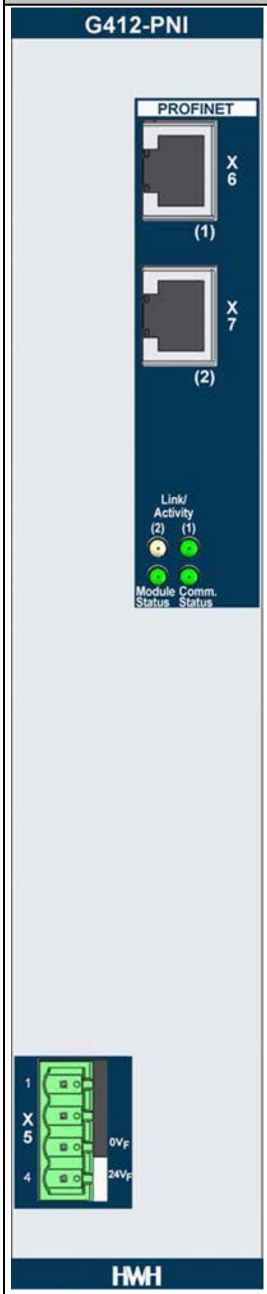
Parameters	Value	Remark
HWH GSD file		Request from info@harms-wende.de
Maximum number of subscribers	32	
Transmission speed	9.6 kbit/s – 12000 kbit/s	
Transmission technology	RS485	

14.12 G412-PNI

The plug-in module enables connection to the Profinet field bus system The specifications for Profinet are included in the IEC 61158 and 61784 standards.

This plug-in module permits data exchange in isochrone mode, also referred to as "IRT" (Isochronous Real Time, with I ≤ 1 ms); however, all other plug-in modules must also have IRT functionality, as the system will otherwise only operate with RT (Real Time, without isochrone mode) functionality.

LED display



	LED	Display	Module status	function
	LA1	On	Data exchange	Connection status X6
		Off	No connection	
	LA2	On	Data exchange	Connection status X7
		Off	No connection	
	Comm. Status	On	Operational	Communication status
		Off	Not operational	
		Flashing	Operational but no data exchange	
	Module status	Green on	Initialised	Module status
		Green flashing 1 Hz	Diagnosis data	
		Green flashing 2 Hz	Module identification	
		Red flashing 1 Hz	Configuration error	
		Red flashing 3 Hz	No station name or no IP address assigned	
		Red flashing 4 Hz	Internal error	
		Off	No supply voltage or not initialised	

Connection	I/O	Module status	function
X5.1			
X5.2			
X5.3	E*	0 V	External voltage supply
X5.4	E*	24 V	
X6.1		TxD +	see separate "Pin assignments" document
X6.2		TxD -	
X6.3		RxD +	
X6.4		N.c.	
X6.5		N.c.	
X6.6		RxD -	
X6.7		N.c.	
X6.8		N.c.	
X7.1		TxD +	see separate "Pin assignments" document
X7.2		TxD -	
X7.3		RxD +	
X7.4		N.c.	
X7.5		N.c.	
X7.6		RxD -	
X7.7		N.c.	
X7.8		N.c.	

Technical data

Parameters	Value	Remark
PROFINET IO	Up to 64 slots / 1 sub-slot Up to 240 bytes I/O	
Real time capability (IRT)	Recommended cycle time value = 1 ms	
Connection	RJ45, STP and UTP	
Assignment of station names and IP addresses	Via master	
Transmission	Full duplex	
Data rate	100 Mbit/s	
GSDML file	Supported	Request from info@harms-wende.de
Auto cross-over	Not supported	

14.13 G413-PNI

The plug-in module enables connection to the Profinet field bus system with optical fibres. The Profinet specifications can be found in the IEC61158 and 61784 standards.

This plug-in module permits data exchange in isochrone mode, also referred to as "IRT" (Isochronous Real Time, with I ≤ 1 ms), however, all other plug-in modules must also have IRT functionality, otherwise the system will only work with RT (Real Time, without isochrone mode) functionality.

LED display

LED	Display	Module status	function
LA1	On	Data exchange	Connection status X6
	Off	No connection	
LA2	On	Data exchange	Connection status X7
	Off	No connection	
Comm. Status	On	Operational	Communication status
	Off	Not operational	
	Flashing	Operational but no data exchange	
Module status	Green on	Initialised	Module status
	Green flashing 1 Hz	Diagnosis data	
	Green flashing 2 Hz	Module identification	
	Red flashing 1 Hz	Configuration error	
	Red flashing 3 Hz	No station name or no IP address assigned	
	Red flashing 4 Hz	Internal error	
	Off	No supply voltage or not initialised	

Connection	I/O	Name	function
X5.1			
X5.2			
X5.3	E*	0 V	External voltage supply
X5.4	E*	24 V	

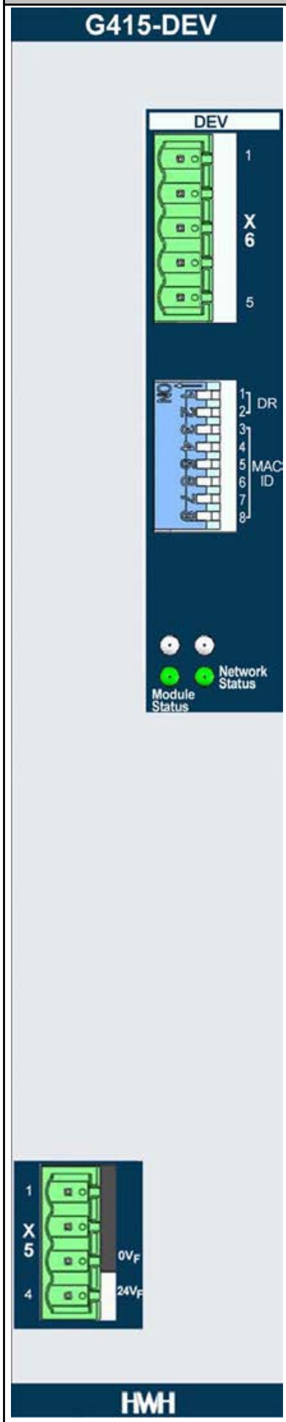
Technical data

Parameters	Value	Remark
PROFINET IO	Up to 17 slots, 4 sub-slots per slot Up to 220 bytes I/O	
Real time capability (IRT)	Recommended cycle time value = 1 ms	
Connection	SC-RJ	
Assignment of station names and IP addresses	Via master	
Transmission	Full duplex	
Transmission speed	100 Mbit/s	
GSDML file	Supported	Request from info@harms-wende.de

14.14 G415-DEV

The plug-in module enables connection to the DeviceNet field bus system. The specifications can be found in EN50325 and at ODVA.

LED display



LED	Display	Module status	function
Module status	Off	Module has no supply voltage	Module status
	Green	Normal operation	
	Green flashing	Determine data transmission rate	
	Red flashing	Error	
	Red	Severe error	
	Alternating red/green	Self-test active	
Network status	Off	No connection or no supply voltage	Network status
	Green	Connected, connection established	
	Green flashing	Connected, no connection	
	Red	Connection error	
	Red flashing	Connection timeout	
	Alternating red/-green	Self-test active	

Connection	I/O	Name	function
X5.1			
X5.2			
X5.3	E*	0 V	External DeviceNet module voltage supply
X5.4	E*	24 V	
X6.1		V-	Negative supply voltage
X6.2		CAN_L	CAN_L bus line
X6.3		Shield	Shielded line
X6.4		CAN_H	CAN_H bus line
X6.5		V+	Positive supply voltage

DR/MAC ID DIP switch

The DIP switches are used to set the transmission speed and the Mac ID for DeviceNet.

The transmission speed is set using switches 1 and 2.

The Mac ID is set using switches 3 – 8. The value range for the Mac ID lies between 0 and 63.

The following transmission speed settings are possible:

S1	S2	Transmission speed
OFF	OFF	125 kbit/s
OFF	ON	250 kbit/s
ON	OFF	500 kbit/s
ON	ON	Currently without function

The following Mac ID settings are possible:

S3	S4	S5	S6	S7	S8	Mac ID
OFF	OFF	OFF	OFF	OFF	OFF	1
OFF	OFF	OFF	OFF	OFF	ON	2
OFF	OFF	OFF	OFF	ON	OFF	3
OFF	OFF	OFF	OFF	ON	ON	4
…	…	…	…	…	…	…
ON	ON	ON	ON	OFF	OFF	60
ON	ON	ON	ON	OFF	ON	61
ON	ON	ON	ON	ON	OFF	62
ON	ON	ON	ON	ON	ON	63

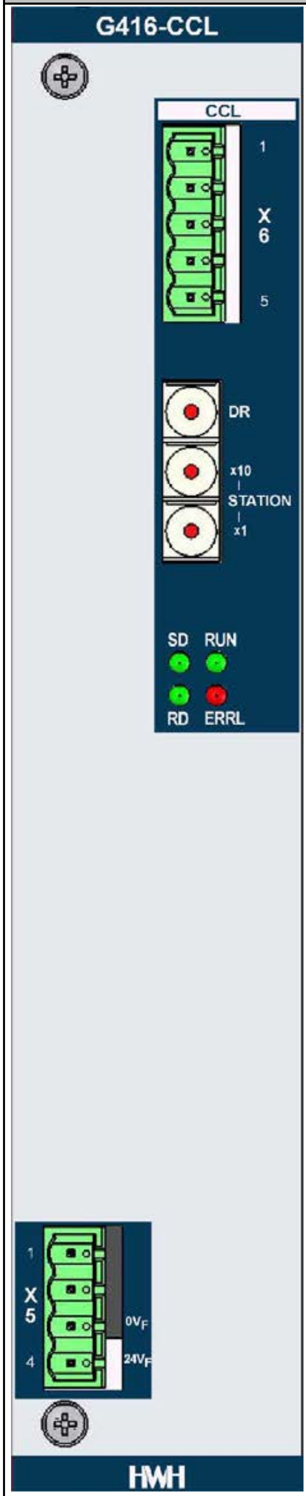
Technical data

Parameters	Value	Remark
DeviceNet	Up to 240 bytes I/O	
Data transmission rate	125 kbit/s, 250 kbit/s or 500 kbit/s	Automatic recognition
EDS file	Supported	Request from info@harms-wende.de
Quick connect	Supported	

14.15 G416-CCL

The plug-in module enables connection to the CC-Link field bus system.

LED display



LED	Display	Module status	function
RUN	On	Normal operation	Operation
	Off	No supply voltage or no network connection	
ERRL	On	CRC error detected	Error
	Off	Normal operation	
RD	On	Receiving data	Data reception
	Off	No data reception	
SD	On	Transmitting data	Data transmission
	Off	No data transmission	

Connection	I/O	Name	function
X5.1			
X5.2			
X5.3	E*	0 V	External voltage supply
X5.4	E*	24 V	
X6.1		DA	Communication line
X6.2		DB	Communication line
X6.3		DG	Digital ground
X6.4			Shielding
X6.5		FG/PE	Housing ground

Rotary switch DR

Rotary switch DR defines the transmission speed:

Switch position	Transmission speed
0	156 kbit/s
1	625 kbit/s
2	2.5 Mbit/s
3	5 Mbit/s
4	10 Mbit/s
5	Currently without function
6	Currently without function
7	Currently without function
8	Currently without function
9	Currently without function

STATION rotary switches

Rotary switches x10 and x1 define the station number for the module.

The value range for the station number lies between 1 and 64.

- Rotary switch x10: 10 digit
- Rotary switch x1: 1 digit

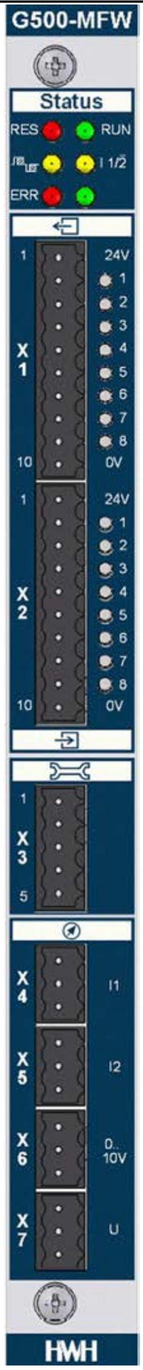
Technical data

Parameters	Value	Remark
CC-Link slave	Up to 128-bit I/O Assigns up to 4 stations	CC-Link V1.0
Data transmission speed	Up to 10 Mbit/s	Can be set using rotary switch DR
CSP file	Supported	Request from info@harms-wende.de
Interface	RS-485	

14.16 G500-MFW

Plug-in module for the inverter with digital 24 V inputs and outputs. This type of plug-in module must be inserted to the left of further I/O and field bus plug-in modules.

LED display

	LED	Display	Module status	function
	RUN		Loading firmware	Operating status
			Initialisation	
			Operation	
		Off	Module not running	
	RES	On	Restart	Module reset
		Off	Ready	
		On	Ignition pulses are output	
		Off	Ignition pulses are not output	
	I 1/2	On	Measurement is performed via measuring belts	Current measuring device
		Off	Measurement is performed via a current sensor	
	ERR	On	Error	Error status
		Flashing	Error	

Connection	I/O	Name	function
X1.1	A	24 V	see separate "Pin assignments" document
X1.2	A	A1 1)	
X1.3	A	A2 1)	
X1.4	A	A3 1)	
X1.5	A	A4 1)	
X1.6	A	A5	
X1.7	A	A6	
X1.8	A	A7	
X1.9	A	A8	
X1.10		0 V	
X2.1	A	24 V	see separate "Pin assignments" document
X2.2	E*	E1	
X2.3	E*	E2	
X2.4	E*	E3	
X2.5	E*	E4	
X2.6	E*	E5	
X2.7	E*	E6	
X2.8	E*	E7	
X2.9	E*	E8	
X2.10		0 V	
X3.1		N.c.	Currently without function
X3.2		N.c.	
X3.3		N.c.	
X3.4		N.c.	
X3.5		N.c.	
X4.1	E*	Secondary current +	Measuring belt R_i = 1 kOhm
X4.2	E*	Secondary current -	
X4.3	E	Secondary current FE	
X5.1	E*	Secondary current +	Current sensor, currently without function
X5.2	E*	Secondary current -	
X5.3	E	Secondary current FE	
X6.1	E*	Analogue IN + 0 – 10 V	12-bit
X6.2	E*	Analogue IN -	R_i= 50 kOhm
X6.3	E*	Analogue IN FE	E.g. travel sensor 0 – 10 V
X7.1	E*	Electrode voltage +	12-bit
X7.2	E*	Electrode voltage -	R_i= 80 kOhm
X7.3	E*	Electrode voltage FE	Voltage measurement facility connection

[1)] The output only switches when E1 or E2 are active. The output also becomes inactive when the emergency stop input is inactive to avoid unintentional solenoid valve switching.

Technical data

Digital inputs

Parameters	Value	Remark
Input type		As per EN 61131-2, type 1
Rated voltage (U_e)	24 V DC (-15/+20%)	
Input current, typical at U_e	5 mA	
Switching delay 0 to 1	≤ 100 µs + input filter	
Switching delay 1 to 0	≤ 100 µs + input filter	
Signal flank gradient	≥ 24 V/ms	
Insulation voltage inputs/logic	≥ 500 V_{eff}	
Input filter	0.2 ms	
Status display	LED lights: input active	
Permissible input voltage	-30 to +30 V	
Working ranges:		As per EN 61131-2, type 1
Signal voltage 0-status (UL)	-30 to +5 V (+15 V)	
Signal voltage 1-status (UH)	+15 to +30 V	

Digital outputs

Parameters	Value	Remark
Output type	Semiconductor	As per EN 61131-2
Rated voltage (U_e)	24 V DC (-15/+20%)	
Rated current 1-status (I_e)	0.5 A	
Insulation voltage outputs/logic	≥ 500 V_{eff}	
Protection type	Protected output with automatic restart	As per EN 61131-2
Rated load	65 ohm / 9 W 9 W 9 VA (1 H, 50 ohm)	Ohmic Lamps Inductivities
Max. total current output of all outputs	0.7 A	Self-healing fuse

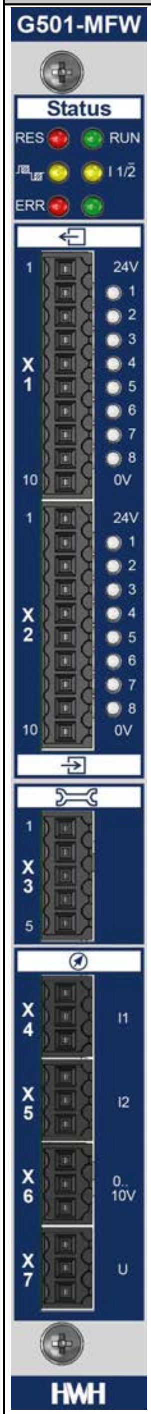
Secondary current measurement input

Parameters	Value	Remark
Input type	Voltage input for current measurement	
Measuring sensor	Measuring belt/coil, differentiating, 150 mV/kA	Must be insulated
Measuring ranges	2 kA ..200 kA	1-2-5 division
Internal resistance	1 kohm	
Accuracy	1%	Of end measuring range value with max. 7 s measurement duration
Insulation voltage input/logic	Not insulated	

14.17 G501-MFW

Plug-in module for the inverter with digital 24 V inputs and outputs. This type of plug-in module must be inserted to the left of further I/O and field bus plug-in modules.

LED display

	LED	Display	Module status	function
	RUN		Loading firmware	Operating status
			Initialisation	
			Operation	
		Off	Module not running	
	RES	On	Restart	Module reset
		Off	Ready	
		On	Ignition pulses are output	
		Off	Ignition pulses are not output	
	I 1/2	On	Measurement is performed via measuring belts	Current measuring device
		Off	Measurement is performed via a current sensor	
	ERR	On	Error	Error status
		Flashing	Error	

Connection	I/O	Name	function
X1.1	A	24 V	see separate "Pin assignments" document
X1.2	A	A1 [1)]	
X1.3	A	A2 [1)]	
X1.4	A	A3 [1)]	
X1.5	A	A4 [1)]	
X1.6	A	A5	
X1.7	A	A6	
X1.8	A	A7	
X1.9	A	A8	
X1.10		0 V	
X2.1	A	24 V	see separate "Pin assignments" document
X2.2	E*	E1	
X2.3	E*	E2	
X2.4	E*	E3	
X2.5	E*	E4	
X2.6	E*	E5	
X2.7	E*	E6	
X2.8	E*	E7	
X2.9	E*	E8	
X2.10		0 V	
X3.1		N.c.	Currently without function
X3.2		N.c.	
X3.3		N.c.	
X3.4		N.c.	
X3.5		N.c.	
X4.1	E*	Secondary current +	Measuring belt R_i = 1 kOhm
X4.2	E*	Secondary current -	
X4.3	E	Secondary current FE	
X5.1	E*	Secondary current +	Current sensor, currently without function
X5.2	E*	Secondary current -	
X5.3	E	Secondary current FE	
X6.1	E*	Analogue IN + 0 – 10 V	12-bit
X6.2	E*	Analogue IN -	R_i= 50 kOhm
X6.3	E*	Analogue IN FE	E.g. travel measurement sensor 0 – 10 V
X7.1	E*	Electrode voltage +	12-bit
X7.2	E*	Electrode voltage -	R_i= 80 kOhm
X7.3	E*	Electrode voltage FE	Voltage measuring facility connection

[1)] The output only switches when E1 or E2 are active. The output also becomes inactive when the emergency stop input is inactive to avoid unintentional solenoid valve switching.

Technical data

Digital inputs

Parameters	Value	Remark
Input type		As per EN 61131-2, type 1
Rated voltage (U_e)	24 V DC (-15/+20%)	
Input current, typical at U_e	5 mA	
Switching delay 0 to 1	≤ 100 µs + input filter	
Switching delay 1 to 0	≤ 100 µs + input filter	
Signal flank gradient	≥ 24 V/ms	
Insulation voltage inputs/logic	≥ 500 V_{eff}	
Input filter	0.2 ms	
Status display	LED lights: input active	
Permissible input voltage	-30 to +30 V	
Working ranges:		As per EN 61131-2, type 1
Signal voltage 0-status (UL)	-30 to +5 V (+15 V)	
Signal voltage 1-status (UH)	+15 to +30 V	

Digital outputs

Parameters	Value	Remark
Output type	Semiconductor	As per EN 61131-2
Rated voltage (U_e)	24 V DC (-15/+20%)	
Rated current 1-status (I_e)	0.5 A	
Insulation voltage outputs/logic	≥ 500 V_{eff}	
Protection type	Protected output with automatic restart	As per EN 61131-2
Rated load	65 ohm / 9 W 9 W 9 VA (1 H, 50 ohm)	Ohmic Lamps Inductivities
Max. total current output of all outputs	0.7 A	Self-healing fuse

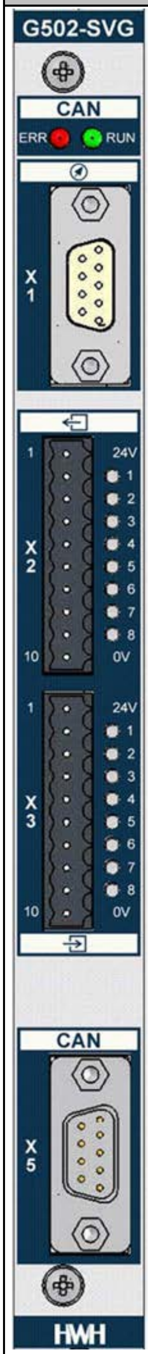
Secondary current measurement input

Parameters	Value	Remark
Input type	Voltage input for current measurement	
Measuring sensor	Measuring belt/coil, differentiating, 150 mV/kA	Must be insulated
Measuring ranges	5 kA ..500 kA	1-2-5 division
Internal resistance	1 kohm	
Accuracy	1%	Of end measuring range value with max. 7 s measurement duration
Insulation voltage input/logic	Not insulated	

14.18 G502-SVG

Plug-in module for servo electrode holders with CANopen bus system and digital 24 V inputs and outputs. This type of plug-in module must be inserted to the left of further I/O and field bus plug-in modules.

LED display

	LED	Display	Module status	function
	RUN	On	Network started, CANopen: operational	Operating status
		Off	Network not in operation; devices not initialised	
		Flashing	Network not yet started or stopped again	
	ERR	On	Transmission error, disconnection from the network, CANopen: bus off	Error status
		■−■−■	Warning threshold for transmission errors or error monitoring inactive, CANopen: error warning or error passive	
		■■−■■	Incorrect feedback from at least one device, CANopen: node guarding error	

Connection	I/O	Name	function
X1.1	E*	U+	Measuring input pos. difference 0 – 10 V
X1.2	E*	I+	Measuring input 0 – 20 mA, optional
X1.3		0 V	Reference potential for 24 V
X1.4			
X1.5	A	24 V	From central supply
X1.6	E*	U-	Measuring input neg. difference 0 – 10 V
X1.7	E*	I-	Measuring input 0 – 20 mA
X1.8			
X1.9			
X2.1	A	24 V	From central supply
X2.2	A	A1	Digital output 1
X2.3	A	A2	Digital output 2
X2.4	A	A3	Digital output 3
X2.5	A	A4	Digital output 4
X2.6	A	A5	Digital output 5
X2.7	A	A6	Digital output 6
X2.8	A	A7	Digital output 7
X2.9	A	A8	Digital output 8
X2.10		0 V	Reference potential for digital I/O
X3.1	A	24 V	From central supply
X3.2	E*	E1	Digital input 1
X3.3	E*	E2	Digital input 2
X3.4	E*	E3	Digital input 3
X3.5	E*	E4	Digital input 4
X3.6	E*	E5	Digital input 5
X3.7	E*	E6	Digital input 6
X3.8	E*	E7	Digital input 7
X3.9	E*	E8	Digital input 8
X3.10		0 V	Reference potential for digital I/O
X5.1		N.c.	
X5.2	I/O	CAN_L	Data, dominant low
X5.3		CAN_GND	Reference potential for CAN H/L/5 V
X5.4		N.c.	
X5.5		N.c.	
X5.6		CAN_GND	Reference potential for CAN H/L/5 V
X5.7	I/O	CAN_H	Data, dominant high
X5.8		N.c.	
X5.9	A	CAN_5 V	Supply voltage

Technical data

24 V

Parameters	Value	Remark
Max. current output	0.6 A	Self-healing fuse

Digital inputs

Parameters	Value	Remark
Input type		As per EN 61131-2, type 1
Rated voltage (U_e)	24 V DC (-15/+20%)	
Input current, typical at U_e	5 mA	
Switching delay 0 to 1	≤ 100 µs + input filter	
Switching delay 1 to 0	≤ 100 µs + input filter	
Signal flank gradient	≥ 24 V/ms	
Insulation voltage inputs/logic	≥ 500 V_{eff}	
Input filter	0.2 ms	
Status display	LED lights: input active	
Permissible input voltage	-30 to +30 V	
Working ranges:		As per EN 61131-2, type 1
Signal voltage 0-status (UL)	-30 to +5 V (+15 V)	
Signal voltage 1-status (UH)	+15 to +30 V	

Digital outputs

Parameters	Value	Remark
Output type	Semiconductor	As per EN 61131-2
Rated voltage (U_e)	24 V DC (-15/+20%)	
Rated current 1-status (I_e)	0.5 A	
Insulation voltage outputs/logic	≥ 500 V_{eff}	
Protection type	Protected output with automatic restart	As per EN 61131-2
Rated load	48 ohm / 12 W 12 W 12 VA (x.x H, xx ohm)	Ohmic Lamps Inductivities
Status display	1-status, yellow	Lit yellow
Max. total current output of all outputs	1.3 A	Self-healing fuse

Analogue inputs

Parameters	Value	Remark
Input type		As per EN61131-2 type 1
Rated voltage	24 V DC (-15/+20%)	
Permissible input voltage	-30 V – +30 V	
Working range	0 – 10 V	
Accuracy	≤ 1%	
Insulation voltage input/logic	≥ 500 V_{eff}	

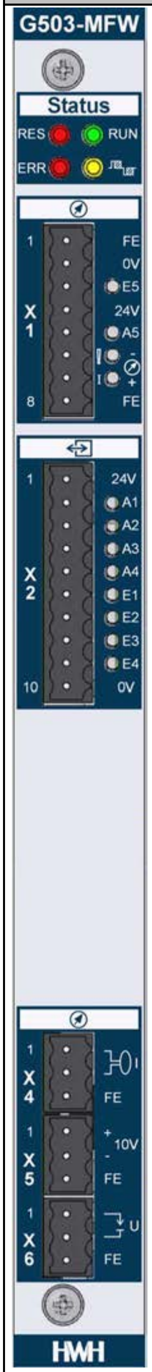
CAN interface

Parameters	Value	Remark
Transmission speed	100 – 1000 kBit/s	
Line termination	120 ohm	
Insulation voltage CAN/logic, I/O	≥ 500 V_{eff}	
Current output CAN_5 V	Max. 10 mA	

14.19 G503-MFW

Plug-in module for the inverter with digital 24 V inputs and outputs. This type of plug-in module must be inserted to the left of further I/O and field bus plug-in modules.

LED display



LED	Display	Module status	Function
RUN		Loading firmware	Operating status
		Initialisation	
		Operation	
	Off	Module not in operation	
RES	On	Restart	Module reset
	Off	Ready	
	On	Ignition pulses are output	
	Off	Ignition pulses are not output	
ERR	On/flashing	Error	Error status
!	On	With voltage output: overload/short-circuit	Load error
		With current output: no load connected	
	Off	Load in the permissible range	
I	On	Operation as current output	Output type
	Off	Operation as voltage output	

Connection	I/O	Name	Function
X1.1		FE	Functional earth
X1.2		0 V	Reference potential for digital I/O
X1.3	E*	E5	Digital input 5
X1.4	A	24 V	From central supply
X1.5	A	A5	Digital output 5
X1.6	A		Analogue output -
X1.7	A		Analogue output +
X1.8		FE	Functional earth
X2.1	A	24 V	From central supply
X2.2	A	A1	Digital output 1[1)]
X2.3	A	A2	Digital output 2[1)]
X2.4	A	A3	Digital output 3
X2.5	A	A4	Digital output 4
X2.6	E*	E1	Digital input 1
X2.7	E*	E2	Digital input 2
X2.8	E*	E3	Digital input 3
X2.9	E*	E4	Digital input 4
X2.10		0 V	Reference potential for digital I/O
X4.1	E*	Secondary current +	Secondary current measurement input
X4.2	E*	Secondary current -	
X4.3		FE	
X5.1	E*	Measurement input +	Measurement input 10 V E.g. travel sensor 0 – 10 V
X5.2	E*	Measurement input -	
X5.3		FE	
X6.1	E*	Electrode voltage +	Electrode voltage measurement input
X6.2	E*	Electrode voltage -	
X6.3		FE	

[1)] The output only switches when E1 or E2 are active. The output also becomes inactive when the emergency stop input is inactive to avoid unintentional solenoid valve switching.

DIP switch for the proportional valve value range

The value range for X1.6 and X1.7 is set to 0 – 10 V as default. The value range can be changed using a DIP switch. The DIP switch can only be set when the plug-in module is removed.

The following settings are possible:

1	2	Setting
OFF	OFF	0 – 10 V
ON	OFF	0 – 20 mA
ON	ON	4 – 20 mA

Technical data

24 V

Parameters	Value	Remark
Max. current output	0.6 A	Self-healing fuse

Digital inputs

Parameters	Value	Remark
Input type		As per EN 61131-2, type 1
Rated voltage (U_e)	24 V DC (-15/+20%)	
Input current, typical at U_e	5 mA	
Switching delay 0 to 1	≤ 100 µs + input filter	
Switching delay 1 to 0	≤ 100 µs + input filter	
Signal flank gradient	≥ 24 V/ms	
Insulation voltage inputs/logic	≥ 500 V_{eff}	
Input filter	0.2 ms	
Status display	LED lights: input active	
Permissible input voltage	-30 to +30 V	
Working ranges:		As per EN 61131-2, type 1
Signal voltage 0-status (UL)	-30 to +5 V (+15 V)	
Signal voltage 1-status (UH)	+15 to +30 V	

Digital outputs

Parameters	Value	Remark
Output type	Semiconductor	As per EN 61131-2
Rated voltage (U_e)	24 V DC (-15/+20%)	
Rated current 1-status (I_e)	400 mA	
Insulation voltage outputs/logic	≥ 500 V_{eff}	
Protection type	Protected output without automatic restart	As per EN 61131-2
Rated load	65 Ohm / 9 W 9 W 9 VA (1 H, 50 Ohm)	Ohmic Lamps Inductivities
Max. total current output of all outputs	A1 + A2: 650 mA A3...A5: 650 mA	Self-healing fuse

Secondary current measurement input

Parameters	Value	Remark
Input type	Voltage input for current measurement	
Sensor	Measuring belt/coil, differentiating, 150 mV/kA	Must be insulated
Measuring ranges	Two: 20 kA, 40 kA	Automatic change-over
Internal resistance	1 kohm	

Parameters	Value	Remark
Accuracy	1%	Of end measuring range value with max. 7 s measurement duration
Insulation voltage input/logic	Not insulated	

Measurement input 10 V

Parameters	Value	Remark
Input type	Voltage input difference	
Permissible input voltage	-30 V – +30 V	
Working range, working area	-10 V – +10 V	One measuring range
Internal resistance	50 kohm	
Accuracy	1%	Of end measuring range value
Insulation voltage input/logic	Not insulated	

Electrode voltage measurement input

Parameters	Value	Remark
Input type	Voltage input difference	
Permissible input voltage	-30 V – +30 V	
Working range, working area	-6 V – +6 V	One measuring range
Internal resistance	80 kOhm	
Accuracy	1%	Of end measuring range value
Insulation voltage input/logic	≥ 500 V_{eff}	

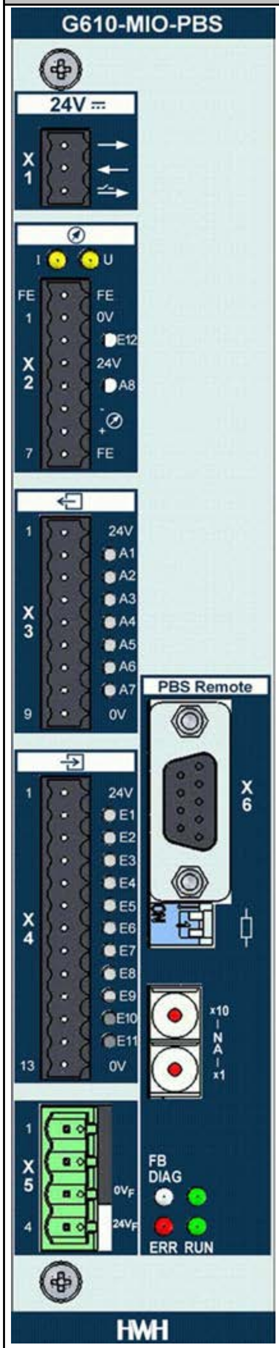
Analogue output

Parameters	Value	Remark
Output type	Voltage output, current output	
Working range, working area	0 –10 V, 0 – 20 mA, 0 – 40 mA	Can be internally selected using switch
Max. output current	20 mA	
Load	Type 1 kOhm, max. 600 Ohm	
Type of protection	Protected output with automatic restart	
Insulation voltage output/logic	≥ 500 V_{eff}	

14.20 G610-MIO-PBS

The plug-in module has digital 24 V inputs and outputs, one output for controlling a proportional valve and the Profibus field bus system. Profibus specifications can be found in the IEC61158 and IEC61784 standards.

LED display

	LED	Display	Module status	Function
	RUN	On	Module is operational	Module status
		Off	Module not in operation	
	ERR	On	Data exchange not possible, module not operational	Error
		Off	No error	
	FB DIAG	Flashing	Diagnosis	Fieldbus diagnosis
		1 Hz	Configuration error	
		2 Hz	Parameter data fields	
		4 Hz	Initialisation error	
	I	On	Current	Nominal pressure
		Off	No current	
	U	On	Voltage	
		Off	No voltage	

Connection	I/O	Name	Function
X1.1	A	24 V	From the central supply, non-switched
X1.2	E*	24 V	Supply for this module
X1.3	A	24 V	From the central supply, switched with emergency stop
X2		FE	Screen
X2.1		0 V	see separate "Pin assignments" document
X2.2	E*	E12	
X2.3	A	24 V / max. 200 mA	
X2.4	A	Enable	
X2.5	A	Analogue output -	0 – 10 V, optionally 0 – 20 mA, 4 – 20 mA
X2.6	A	Analogue output +	see separate "Pin assignments" document
X2.7	FE		
X3.1	A	24 V	see separate "Pin assignments" document
X3.2	A	A1	
X3.3	A	A2	
X3.4	A	A3	
X3.5	A	A4	
X3.6	A	A5	
X3.7	A	A6	
X3.8	A	A7	
X3.9	A	0 V	
X4.1	A	24 V	see separate "Pin assignments" document
X4.2	E*	E1	
X4.3	E*	E2	
X4.4	E*	E3	
X4.5	E*	E4	
X4.6	E*	E5	
X4.7	E*	E6	
X4.8	E*	E7	
X4.9	E*	E8	
X4.10	E*	E9	
X4.11	E*	E10	
X4.12	E*	E11	
X4.13	A	0 V	
X5.1			
X5.2			
X5.3	E*	0 V	External Profibus plug-in module voltage supply
X5.4	E*	24 V	
X6.1		N.c.	
X6.2		N.c.	
X6.3	I/O	RxD/TxD-P B line	B line reception/transmission

Connection	I/O	Name	Function
X6.4		N.c.	
X6.5		GND_{BUS}	Ground
X6.6	E*	+5 V BUS	BUS current supply
X6.7		N.c.	
X6.8	I/O	RxD/TxD-P A line	A line reception/transmission
X6.9		N.c.	

Profibus line termination DIP switch

The switch for line termination is located beneath the X6 interface.

The following settings are possible:

- ON = line termination on
- OFF = line termination off

Rotary switches NA

The NA rotary switches can be used to manually set the subscriber address for the Profibus.

The two rotary switches are located beneath the DIP switch for line termination.

The default subscriber address is 77.

Rotary switch x10 sets the 10 digit.

Rotary switch x1 sets the 1 digit.

DIP switch for the proportional valve value range

The value range for X2.5 and X2.6 is set to 0 – 10 V as default.

The value range can be changed using a DIP switch.

The DIP switch can only be set when the plug-in module is removed.

The following settings are possible:

S1	S2	S3	S4	Setting
1	1	0	1	0 – 20 mA
1	0	1	0	4 – 20 mA
0	X	X	X	0 – 10 V / 5 mA max.

Technical data

Profibus

Parameters	Value	Remark
HWH GSD file		Request from info@harms-wende.de
Maximum number of subscribers	32	
Transmission speed	9.6 kbit/s – 12000 kbit/s	
Transmission technology	RS485	

Supply

Parameters	Value	Remark
Supply voltage dig. I/O	+18 – +30 V	With external supply
24 V supply voltage fusing	2 A	With external supply
Max. current output of all 24 V pins	1.3 A	Self-healing fuse
Current consumption of all outputs	≤ 80 mA	All outputs 0-status and without load

Digital inputs

Parameters	Value	Remark
Input type		As per EN 61131-2, type 1
Rated voltage (U_e)	24 V DC (-15/+20%)	
Input current, typical at U_e	5 mA	
Switching delay 0 to 1	≤ 100 µs + input filter	
Switching delay 1 to 0	≤ 100 µs + input filter	
Signal flank gradient	≥ 24 V/ms	
Insulation voltage inputs/logic	≥ 500 V_{eff}	
Input filter	0.2 ms	
Status display	LED lights: input active	
Permissible input voltage	-30 to +30 V	
Working ranges:		As per EN 61131-2, type 1
Signal voltage 0-status (UL)	-30 to +5 V (+15 V)	
Signal voltage 1-status (UH)	+15 to +30 V	

Digital outputs

Parameters	Value	Remark
Output type	Semiconductor	As per EN 61131-2
Rated voltage (U_e)	24 V DC (-15/+20%)	
Rated current 1-status (I_e)	0.5 A	
Insulation voltage outputs/logic	≥ 500 V_{eff}	
Protection type	Protected output with automatic restart	As per EN 61131-2
Rated load	48 Ohm / 12 W 12 W 12 VA (1.2 H, 50 Ohm)	Ohmic Lamps Inductivities
Max. total current output of all outputs	0.7 A	Self-healing fuse

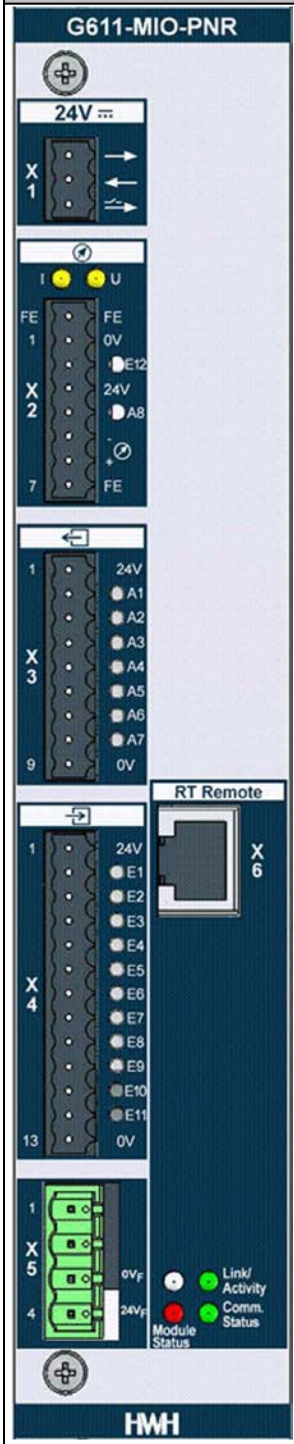
Analogue outputs

Parameters	Value	Remark
Output type	Current/voltage	Optionally switchable (S1 – S4)
Voltage	0 – 10 V 2% R_L ≥ 24 Ohm, I max. 5 mA	10-bit
Current 1	0 – 20 mA 2% R_L ≥ 600 Ohm, max. 800 Ohm	10-bit
Current 2	4 – 20 mA 2% R_L ≥ 600 Ohm, max. 800 Ohm	10-bit

14.21 G611-MIO-PNR

The plug-in module has digital 24 V inputs and outputs, one output for controlling a proportional valve and the Profibus field bus system. The Profinet specifications can be found in the IEC61158 and 61784 standards.

LED display



LED	Display	Module status	Function
LA	On	Data exchange	Connection status
	Off	No connection	
Comm. Status	On	Operational	Communication status
	Off	Not operational	
	Flashing	Operational, no data exchange	
Module status	Green on	Initialised	Module status
	Green flashing 1 Hz	Diagnosis data	
	Green flashing 2 Hz	Module identified	
	Red flashing 1 Hz	Configuration error	
	Red flashing 3 Hz	No station name or no IP address assigned	
	Red flashing 4 Hz	Internal error	
	Off	No supply voltage or not initialised	
I	On	Current	Nominal pressure
	Off	No current	
U	On	Voltage	
	Off	No voltage	

Connection	I/O	Name	Function
X1.1	A	24 V	From the central supply, non-switched
X1.2	E*	24 V	Supply for this module
X1.3	A	24 V	From the central supply, switched with emergency stop
X2		FE	Screen
X2.1		0 V	see separate "Pin assignments" document
X2.2	E*	E12	
X2.3	A	24 V / max. 200 mA	
X2.4	A	Enable	
X2.5	A	Analogue output -	0 – 10 V, optionally 0 – 20 mA, 4 – 20 mA
X2.6	A	Analogue output +	see separate "Pin assignments" document
X2.7	FE		
X3.1	A	24 V	see separate "Pin assignments" document
X3.2	A	A1	
X3.3	A	A2	
X3.4	A	A3	
X3.5	A	A4	
X3.6	A	A5	
X3.7	A	A6	
X3.8	A	A7	
X3.9	A	0 V	
X4.1	A	24 V	see separate "Pin assignments" document
X4.2	E*	E1	
X4.3	E*	E2	
X4.4	E*	E3	
X4.5	E*	E4	
X4.6	E*	E5	
X4.7	E*	E6	
X4.8	E*	E7	
X4.9	E*	E8	
X4.10	E*	E9	
X4.11	E*	E10	
X4.12	E*	E11	
X4.13	A	0 V	
X5.1			
X5.2			
X5.3	E*	0 V	External voltage supply
X5.4	E*	24 V	
X6.1		TxD +	Data transmission

Connection	I/O	Name	Function
X6.2		TxD -	Data transmission
X6.3		RxD +	Data reception
X6.4		N.c.	
X6.5		N.c.	
X6.6		RxD -	Data reception
X6.7		N.c.	
X6.8		N.c.	

DIP switch for the proportional valve value range

The value range for X2.5 and X2.6 is set to 0 – 10 V as default.

The value range can be changed using a DIP switch.

The DIP switch can only be set when the plug-in module is removed.

The following settings are possible:

S1	S2	S3	S4	Setting
1	1	0	1	0 – 20 mA
1	0	1	0	4 – 20 mA
0	X	X	X	0 – 10 V

Technical data

Profinet

Parameters	Value	Remark
PROFINET IO	Up to 64 slots / 1 sub-slot Up to 240 bytes I/O	
Real time capability (RT)	Recommended cycle time value = 10 ms	
Connection	RJ45, STP and UTP	
Assignment of station names and IP addresses	Via master	
Transmission	Full duplex	
Data rate	100 Mbit/s	
GSDML file	Supported	Request from info@harms-wende.de
Auto cross-over	Not supported	

Supply

Parameters	Value	Remark
Supply voltage dig. I/O	+18 – +30 V	With external supply
24 V supply voltage fusing	2 A	With external supply
Max. current output of all 24 V pins	1.3 A	Self-healing fuse
Current consumption of all outputs	≤ 80 mA	All outputs 0-status and without load

Digital inputs

Parameters	Value	Remark
Input type		As per EN 61131-2, type 1
Rated voltage (U_e)	24 V DC (-15/+20%)	
Input current, typical at U_e	5 mA	
Switching delay 0 to 1	≤ 100 µs + input filter	
Switching delay 1 to 0	≤ 100 µs + input filter	
Signal flank gradient	≥ 24 V/ms	
Insulation voltage inputs/logic	≥ 500 V_{eff}	
Input filter	0.2 ms	
Status display	LED lights: input active	
Permissible input voltage	-30 to +30 V	
Working ranges:		As per EN 61131-2, type 1
Signal voltage 0-status (UL)	-30 to +5 V (+15 V)	
Signal voltage 1-status (UH)	+15 to +30 V	

Digital outputs

Parameters	Value	Remark
Output type	Semiconductor	As per EN 61131-2
Rated voltage (U_e)	24 V DC (-15/+20%)	
Rated current 1-status (I_e)	0.5 A	
Insulation voltage outputs/logic	≥ 500 V_{eff}	
Protection type	Protected output with automatic restart	As per EN 61131-2
Rated load	48 Ohm / 12 W 12 W 12 VA (1.2 H, 50 Ohm)	Ohmic Lamps Inductivities
Max. total current output of all outputs	0.7 A	Self-healing fuse

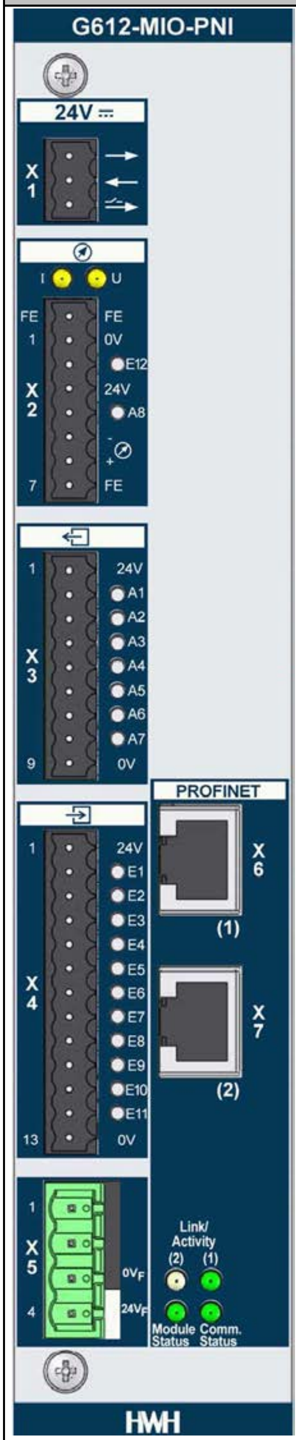
Analogue outputs

Parameters	Value	Remark
Output type	Current/voltage	Optionally switchable (S1 – S4)
Voltage	0 – 10 V 2% R_L ≥ 24 Ohm, I max. 5 mA	10-bit
Current 1	0 – 20 mA 2% R_L ≥ 600 Ohm, max. 800 Ohm	10-bit
Current 2	4 – 20 mA 2% R_L ≥ 600 Ohm, max. 800 Ohm	10-bit

14.22 G612-MIO-PNI

The plug-in module has digital 24 V inputs and outputs, one output for controlling a proportional valve and the Profibus field bus system. The Profinet specifications can be found in the IEC61158 and 61784 standards.

LED display



LED	Display	Module status	Function
LA1	On	Data exchange	Connection status X6
	Off	No connection	
LA2	On	Data exchange	Connection status X7
	Off	No connection	
Comm. Status	On	Operational	Communication status
	Off	Not operational	
	Flashing	Operational but no data exchange	
Module status	Green on	Initialised	Module status
	Green flashing 1 Hz	Diagnosis data	
	Green flashing 2 Hz	Module identification	
	Red flashing 1 Hz	Configuration error	
	Red flashing 3 Hz	No station name or no IP address assigned	
	Red flashing 4 Hz	Internal error	
	Off	No supply voltage or not initialised	
I	On	Current	Nominal pressure
	Off	No current	
U	On	Voltage	
	Off	No voltage	

Connection	I/O	Name	Function
X1.1	A	24 V	From the central supply, non-switched
X1.2	E*	24 V	Supply for this module
X1.3	A	24 V	From the central supply, switched with emergency stop
X2		FE	Screen
X2.1		0 V	see separate "Pin assignments" document
X2.2	E*	E12	
X2.3	A	24 V / max. 200 mA	
X2.4	A	Enable	
X2.5	A	Analogue output -	0 – 10 V, optionally 0 – 20 mA, 4 – 20 mA
X2.6	A	Analogue output +	see separate "Pin assignments" document
X2.7	FE		
X3.1	A	24 V	see separate "Pin assignments" document
X3.2	A	A1	
X3.3	A	A2	
X3.4	A	A3	
X3.5	A	A4	
X3.6	A	A5	
X3.7	A	A6	
X3.8	A	A7	
X3.9	A	0 V	
X4.1	A	24 V	see separate "Pin assignments" document
X4.2	E*	E1	
X4.3	E*	E2	
X4.4	E*	E3	
X4.5	E*	E4	
X4.6	E*	E5	
X4.7	E*	E6	
X4.8	E*	E7	
X4.9	E*	E8	
X4.10	E*	E9	
X4.11	E*	E10	
X4.12	E*	E11	
X4.13	A	0 V	
X5.1			
X5.2			
X5.3	E*	0 V	External voltage supply
X5.4	E*	24 V	

Connection	I/O	Name	Function
X6.1		TxD +	see separate "Pin assignments" document
X6.2		TxD -	
X6.3		RxD +	
X6.4		N.c.	
X6.5		N.c.	
X6.6		RxD -	
X6.7		N.c.	
X6.8		N.c.	
X7.1		TxD +	see separate "Pin assignments" document
X7.2		TxD -	
X7.3		RxD +	
X7.4		N.c.	
X7.5		N.c.	
X7.6		RxD -	
X7.7		N.c.	
X7.8		N.c.	

DIP switch for the proportional valve value range

The value range for X2.5 and X2.6 is set to 0 – 10 V as default.

The value range can be changed using a DIP switch.

The DIP switch can only be set when the plug-in module is removed.

The following settings are possible:

S1	S2	S3	S4	Setting
1	1	0	1	0 – 20 mA
1	0	1	0	4 – 20 mA
0	X	X	X	0 – 10 V

Technical data

Profinet

Parameters	Value	Remark
PROFINET IO	Up to 64 slots / 1 sub-slot Up to 240 bytes I/O	
Real time capability (IRT)	Recommended cycle time value = 1 ms	
Connection	RJ45, STP and UTP	
Assignment of station names and IP addresses	Via master	
Transmission	Full duplex	
Data rate	100 Mbit/s	
GSDML file	Supported	Request from info@harms-wende.de
Auto cross-over	Not supported	

Supply

Parameters	Value	Remark
Supply voltage dig. I/O	+18 – +30 V	With external supply
24 V supply voltage fusing	2 A	With external supply
Max. current output of all 24 V pins	0.7 A	Self-healing fuse
Current consumption of all outputs	≤ 80 mA	All outputs 0-status and without load

Digital inputs

Parameters	Value	Remark
Input type		As per EN 61131-2, type 1
Rated voltage (U_e)	24 V DC (-15/+20%)	
Input current, typical at U_e	5 mA	
Switching delay 0 to 1	≤ 100 µs + input filter	
Switching delay 1 to 0	≤ 100 µs + input filter	
Signal flank gradient	≥ 24 V/ms	
Insulation voltage inputs/logic	≥ 500 V_{eff}	
Input filter	0.2 ms	
Status display	LED lights: input active	
Permissible input voltage	-30 to +30 V	
Working ranges:		As per EN 61131-2, type 1
Signal voltage 0-status (UL)	-30 to +5 V (+15 V)	
Signal voltage 1-status (UH)	+15 to +30 V	

Digital outputs

Parameters	Value	Remark
Output type	Semiconductor	As per EN 61131-2
Rated voltage (U_e)	24 V DC (-15/+20%)	
Rated current 1-status (I_e)	0.5 A	
Insulation voltage outputs/logic	≥ 500 V_{eff}	
Protection type	Protected output with automatic restart	As per EN 61131-2
Rated load	48 Ohm / 12 W 12 W 12 VA (1.2 H, 50 Ohm)	Ohmic Lamps Inductivities
Max. total current output of all outputs	0.7 A	Self-healing fuse

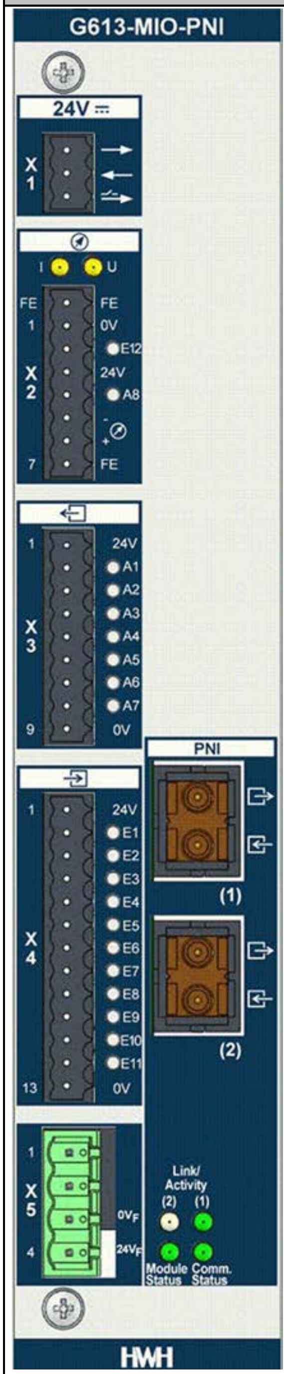
Analogue outputs

Parameters	Value	Remark
Output type	Current/voltage	Optionally switchable (S1 – S4)
Voltage	0 – 10 V 2% R_L ≥ 24 Ohm, I max. 5 mA	10-bit
Current 1	0 – 20 mA 2% R_L ≥ 600 Ohm, max. 800 Ohm	10-bit
Current 2	4 – 20 mA 2% R_L ≥ 600 Ohm, max. 800 Ohm	10-bit

14.23 G613-MIO-PNI

The plug-in module has digital 24 V inputs and outputs, one output for controlling a proportional valve and the Profinet field bus system with optical fibres. The Profinet specifications can be found in the IEC61158 and 61784 standards.

LED display

	LED	Display	Module status	Function
	LA1	On	Data exchange	Connection status X6
		Off	No connection	
	LA2	On	Data exchange	Connection status X7
		Off	No connection	
	Comm. Status	On	Operational	Communication status
		Off	Not operational	
		Flashing	Operational, no data exchange	
	Module status	Green on	Initialised	Module status
		Green flashing 1 Hz	Diagnosis data	
		Green flashing 2 Hz	Module identification	
		Red flashing 1 Hz	Configuration error	
		Red flashing 3 Hz	No station name or no IP address assigned	
		Red flashing 4 Hz	Internal error	
		Off	No supply voltage or not initialised	
	I	On	Current	Nominal pressure
		Off	No current	
	U	On	Voltage	
		Off	No voltage	

Connection	I/O	Name	Function
X1.1	A	24 V	From the central supply, non-switched
X1.2	E*	24 V	Supply for this module
X1.3	A	24 V	From the central supply, switched with emergency stop
X2		FE	Screen
X2.1		0 V	see separate "Pin assignments" document
X2.2	E*	E12	
X2.3	A	24 V / max. 200 mA	
X2.4	A	Enable	
X2.5	A	Analogue output -	0 – 10 V, optionally 0 – 20 mA, 4 – 20 mA
X2.6	A	Analogue output +	see separate "Pin assignments" document
X2.7	FE		
X3.1	A	24 V	see separate "Pin assignments" document
X3.2	A	A1	
X3.3	A	A2	
X3.4	A	A3	
X3.5	A	A4	
X3.6	A	A5	
X3.7	A	A6	
X3.8	A	A7	
X3.9	A	0 V	
X4.1	A	24 V	see separate "Pin assignments" document
X4.2	E*	E1	
X4.3	E*	E2	
X4.4	E*	E3	
X4.5	E*	E4	
X4.6	E*	E5	
X4.7	E*	E6	
X4.8	E*	E7	
X4.9	E*	E8	
X4.10	E*	E9	
X4.11	E*	E10	
X4.12	E*	E11	
X4.13	A	0 V	
X5.1			
X5.2			
X5.3	E*	0 V	External voltage supply
X5.4	E*	24 V	

DIP switch for the proportional valve value range

The value range for X2.5 and X2.6 is set to 0 – 10 V as default.

The value range can be changed using a DIP switch.

The DIP switch can only be set when the plug-in module is removed.

The following settings are possible:

S1	S2	S3	S4	Setting
1	1	0	1	0 – 20 mA
1	0	1	0	4 – 20 mA
0	X	X	X	0 – 10 V

Technical data

Profinet

Parameters	Value	Remark
PROFINET IO	Up to 17 slots, 4 sub-slots per slot Up to 220 bytes I/O	
Real time capability (IRT)	Recommended cycle time value = 1 ms	
Connection	SC-RJ	
Assignment of station names and IP addresses	Via master	
Transmission	Full duplex	
Data rate	100 Mbit/s	
GSDML file	Supported	Request from info@harms-wende.de

Supply

Parameters	Value	Remark
Supply voltage dig. I/O	+18 – +30 V	With external supply
24 V supply voltage fusing	2 A	With external supply
Max. current output of all 24 V pins	1.3 A	Self-healing fuse
Current consumption of all outputs	≤ 80 mA	All outputs 0-status and without load

Digital inputs

Parameters	Value	Remark
Input type		As per EN 61131-2, type 1
Rated voltage (U_e)	24 V DC (-15/+20%)	
Input current, typical at U_e	5 mA	
Switching delay 0 to 1	≤ 100 µs + input filter	
Switching delay 1 to 0	≤ 100 µs + input filter	
Signal flank gradient	≥ 24 V/ms	

Parameters	Value	Remark
Insulation voltage inputs/logic	≥ 500 V_{eff}	
Input filter	0.2 ms	
Status display	LED lights: input active	
Permissible input voltage	-30 to +30 V	
Working ranges:		As per EN 61131-2, type 1
Signal voltage 0-status (UL)	-30 to +5 V (+15 V)	
Signal voltage 1-status (UH)	+15 to +30 V	

Digital outputs

Parameters	Value	Remark
Output type	Semiconductor	As per EN 61131-2
Rated voltage (U_e)	24 V DC (-15/+20%)	
Rated current 1-status (I_e)	0.5 A	
Insulation voltage outputs/logic	≥ 500 V_{eff}	
Protection type	Protected output with automatic restart	As per EN 61131-2
Rated load	48 Ohm / 12 W 12 W 12 VA (1.2 H, 50 Ohm)	Ohmic Lamps Inductivities
Max. total current output of all outputs	0.7 A	Self-healing fuse

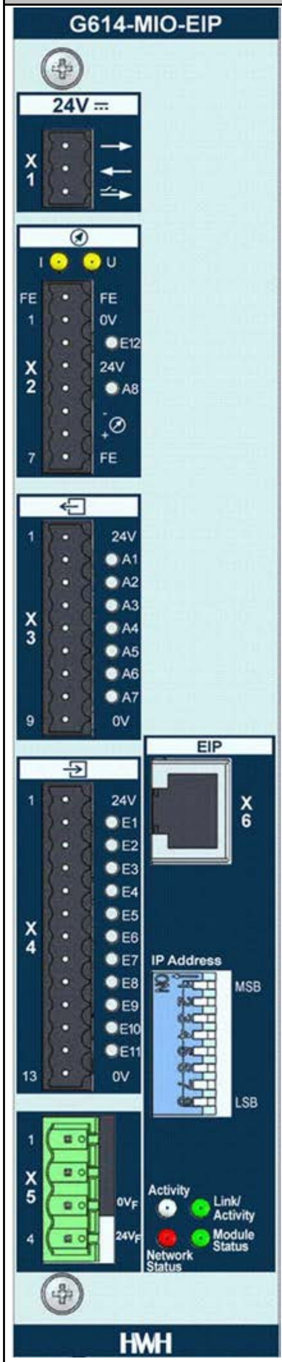
Analogue outputs

Parameters	Value	Remark
Output type	Current/voltage	Optionally switchable (S1 – S4)
Voltage	0 – 10 V 2% R_L ≥ 24 Ohm, I max. 5 mA	10-bit
Current 1	0 – 20 mA 2% R_L ≥ 600 Ohm, max. 800 Ohm	10-bit
Current 2	4 – 20 mA 2% R_L ≥ 600 Ohm, max. 800 Ohm	10-bit

14.24 G614-MIO-EIP

The plug-in module has digital 24 V inputs and outputs, one output for controlling a proportional valve and the EtherNet/IP field bus system.

LED display



LED	Display	Module status	Function
Activity	Green flashing	Receiving data package	Communication status
Link/activity	On	Connection established	Connection status
	Off	No connection or switched off	
	Green flashing	Receiving or transmitting Ethernet data	
Module status	Off	Not operational	Module status
	Green on	No IP address set using DIP switch	
	Green flashing	Not configured or scanner not active	
	Red flashing	An insignificant error has occurred	
	Red on	A significant error has occurred	
	Alternating red/green	Self-test active	
Network status	Off	Not operational or no IP address assigned	Network status
	Green on	Connected, CIP class 1 or 3 connection established	
	Green flashing	Connected, no connection established	
	Red on	Double IP address	
	Red flashing	One or more connections have a time-out, CIP class 1 or 3	
	Alternating red/green	Self-test active	
I	On	Current	Nominal pressure
	Off		
U	On	Voltage	
	Off		

Connection	I/O	Name	Function
X1.1	A	24 V	From the central supply, non-switched
X1.2	E*	24 V	Supply for this module
X1.3	A	24 V	From the central supply, switched with emergency stop
X2		FE	Screen
X2.1		0 V	see separate "Pin assignments" document
X2.2	E*	E12	
X2.3	A	24 V / max. 200 mA	
X2.4	A	Enable	
X2.5	A	Analogue output -	0 – 10 V, optionally 0 – 20 mA, 4 – 20 mA
X2.6	A	Analogue output +	see separate "Pin assignments" document
X2.7	FE		
X3.1	A	24 V	see separate "Pin assignments" document
X3.2	A	A1	
X3.3	A	A2	
X3.4	A	A3	
X3.5	A	A4	
X3.6	A	A5	
X3.7	A	A6	
X3.8	A	A7	
X3.9	A	0 V	
X4.1	A	24 V	see separate "Pin assignments" document
X4.2	E*	E1	
X4.3	E*	E2	
X4.4	E*	E3	
X4.5	E*	E4	
X4.6	E*	E5	
X4.7	E*	E6	
X4.8	E*	E7	
X4.9	E*	E8	
X4.10	E*	E9	
X4.11	E*	E10	
X4.12	E*	E11	
X4.13	A	0 V	
X5.1			
X5.2			
X5.3	E*	0 V	External voltage supply
X5.4	E*	24 V	

Connection	I/O	Name	Function
X6.1		TxD +	see separate "Pin assignments" document
X6.2		TxD -	
X6.3		RxD +	
X6.4		N.c.	
X6.5		N.c.	
X6.6		RxD -	
X6.7		N.c.	
X6.8		N.c.	

DIP switch for the IP address

The last byte of the IP address can be set manually using the DIP switch.

Switch 1 sets the most significant bit (MSB), switch 8 the least significant bit (LSB).

The IP address is obtained automatically when all switches are set to OFF.

DIP switch for the proportional valve value range

The value range for X2.5 and X2.6 is set to 0 – 10 V as default.

The value range can be changed using a DIP switch.

The DIP switch can only be set when the plug-in module is removed.

The following settings are possible:

S1	S2	S3	S4	Setting
ON	ON	OFF	ON	0 – 20 mA
ON	OFF	ON	OFF	4 – 20 mA
OFF	X	X	X	0 – 10 V

X = any setting

Technical data

Ethernet/IP

Parameters	Value	Remark
Ethernet/IP	Up to 240 bytes I/O	
Baud rate	10 or 100 Mbit/s	
I/O data exchange	Cyclical or triggered	
RJ45	STP and UTP cable	
EDS file	Supported	Request from info@harms-wende.de
IP address assignment	DHCP	
Auto cross-over	Not supported	
CIP	Supported up to application level	

Supply

Parameters	Value	Remark
Supply voltage dig. I/O	+18 – +30 V	With external supply
24 V supply voltage fusing	2 A	With external supply
Max. current output of all 24 V pins	1.3 A	Self-healing fuse
Current consumption of all outputs	≤ 80 mA	All outputs 0-status and without load

Digital inputs

Parameters	Value	Remark
Input type		As per EN 61131-2, type 1
Rated voltage (U_e)	24 V DC (-15/+20%)	
Input current, typical at U_e	5 mA	
Switching delay 0 to 1	≤ 100 µs + input filter	
Switching delay 1 to 0	≤ 100 µs + input filter	
Signal flank gradient	≥ 24 V/ms	
Insulation voltage inputs/logic	≥ 500 V_{eff}	
Input filter	0.2 ms	
Status display	LED lights: input active	
Permissible input voltage	-30 to +30 V	
Working ranges:		As per EN 61131-2, type 1
Signal voltage 0-status (UL)	-30 to +5 V (+15 V)	
Signal voltage 1-status (UH)	+15 to +30 V	

Digital outputs

Parameters	Value	Remark
Output type	Semiconductor	As per EN 61131-2
Rated voltage (U_e)	24 V DC (-15/+20%)	
Rated current 1-status (I_e)	0.5 A	
Insulation voltage outputs/logic	≥ 500 V_{eff}	
Protection type	Protected output with automatic restart	As per EN 61131-2
Rated load	48 Ohm / 12 W 12 W 12 VA (1.2 H, 50 Ohm)	Ohmic Lamps Inductivities
Max. total current output of all outputs	0.7 A	Self-healing fuse

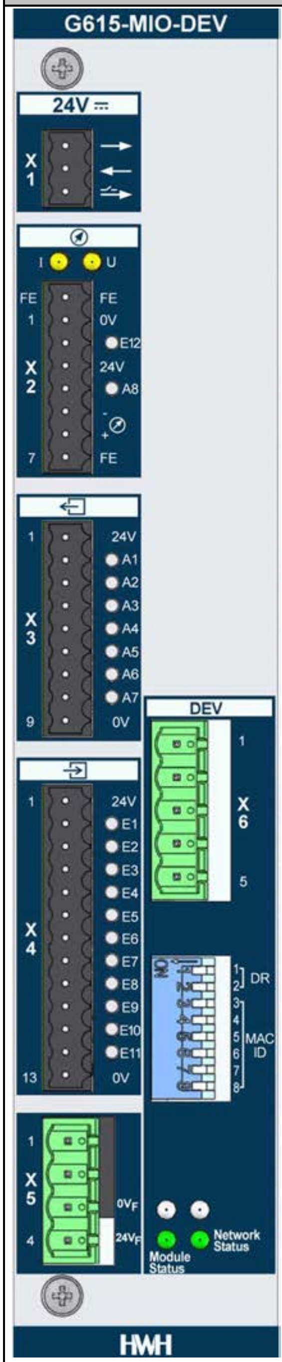
Analogue outputs

Parameters	Value	Remark
Output type	Current/voltage	Optionally switchable (S1 – S4)
Voltage	0 – 10 V 2% R_L ≥ 24 Ohm, I max. 5 mA	10-bit
Current 1	0 – 20 mA 2% R_L ≥ 600 Ohm, max. 800 Ohm	10-bit
Current 2	4 – 20 mA 2% R_L ≥ 600 Ohm, max. 800 Ohm	10-bit

14.25 G615-MIO-DEV

The plug-in module has digital 24 V inputs and outputs, one output for controlling a proportional valve and the DeviceNet field bus system. The specifications can be found in EN50325 and are available from the ODVA.

LED display



	LED	Display	Module status	Function
	Module status	Off	Module has no supply voltage	Module status
		Green	Normal operation	
		Green flashing	Determine data transmission rate	
		Red flashing	Error	
		Red	Severe error	
		Alternating red/-green	Self-test active	
	Network status	Off	No connection or no supply voltage	Network status
		Green	Connected, connection established	
		Green flashing	Connected, no connection	
		Red	Connection error	
		Red flashing	Connection timeout	
		Alternating red/-green	Self-test active	
	I	On	Current	Nominal pressure
		Off	No current	
	U	On	Voltage	
		Off	No voltage	

Connection	I/O	Name	Function
X1.1	A	24 V	From the central supply, non-switched
X1.2	E*	24 V	Supply for this module
X1.3	A	24 V	From the central supply, switched with emergency stop
X2		FE	Screen
X2.1		0 V	see separate "Pin assignments" document
X2.2	E*	E12	
X2.3	A	24 V / max. 200 mA	
X2.4	A	Enable	
X2.5	A	Analogue output -	0 – 10 V, optionally 0 – 20 mA, 4 – 20 mA
X2.6	A	Analogue output +	see separate "Pin assignments" document
X2.7	FE		
X3.1	A	24 V	see separate "Pin assignments" document
X3.2	A	A1	
X3.3	A	A2	
X3.4	A	A3	
X3.5	A	A4	
X3.6	A	A5	
X3.7	A	A6	
X3.8	A	A7	
X3.9	A	0 V	
X4.1	A	24 V	see separate "Pin assignments" document
X4.2	E*	E1	
X4.3	E*	E2	
X4.4	E*	E3	
X4.5	E*	E4	
X4.6	E*	E5	
X4.7	E*	E6	
X4.8	E*	E7	
X4.9	E*	E8	
X4.10	E*	E9	
X4.11	E*	E10	
X4.12	E*	E11	
X4.13	A	0 V	
X5.1			
X5.2			
X5.3	E*	0 V24	External DeviceNet module voltage supply
X5.4	E*	24 V	
X6.1		V-	Negative supply voltage
X6.2		CAN_L	CAN_L bus line
X6.3		Shield	Shielded line
X6.4		CAN_H	CAN_H bus line

Connection	I/O	Name	Function
X6.5		V+	Positive supply voltage

DR/MAC ID DIP switch

The DIP switches are used to set the transmission speed and the Mac ID for DeviceNet.

The transmission speed is set using switches 1 and 2.

The Mac ID is set using switches 3 – 8. The value range for the Mac ID lies between 0 and 63.

The following transmission speed settings are possible:

S1	S2	Transmission speed
OFF	OFF	125 kbit/s
OFF	ON	250 kbit/s
ON	OFF	500 kbit/s
ON	ON	Currently without function

The following Mac ID settings are possible:

S3	S4	S5	S6	S7	S8	Mac ID
OFF	OFF	OFF	OFF	OFF	OFF	1
OFF	OFF	OFF	OFF	OFF	ON	2
OFF	OFF	OFF	OFF	ON	OFF	3
OFF	OFF	OFF	OFF	ON	ON	4
...	...	...	...	...	...	...
ON	ON	ON	ON	OFF	OFF	60
ON	ON	ON	ON	OFF	ON	61
ON	ON	ON	ON	ON	OFF	62
ON	ON	ON	ON	ON	ON	63

DIP switch for the proportional valve value range

The value range for X2.5 and X2.6 is set to 0 – 10 V as default.

The value range can be changed using a DIP switch.

The DIP switch can only be set when the plug-in module is removed.

The following settings are possible:

S1	S2	S3	S4	Setting
ON	ON	OFF	ON	0 – 20 mA
ON	OFF	ON	OFF	4 – 20 mA
OFF	X	X	X	0 – 10 V

X = any setting

Technical data

DeviceNet

Parameters	Value	Remark
DeviceNet	Up to 240 bytes I/O	
Transmission speed	125 kbit/s, 250 kbit/s or 500 kbit/s	Automatic recognition
EDS file	Supported	Request from info@harms-wende.de
Quick connect	Supported	

Supply

Parameters	Value	Remark
Supply voltage dig. I/O	+18 – +30 V	With external supply
24 V supply voltage fusing	2 A	With external supply
Max. current output of all 24 V pins	1.3 A	Self-healing fuse
Current consumption of all outputs	≤ 80 mA	All outputs 0-status and without load

Digital inputs

Parameters	Value	Remark
Input type		As per EN 61131-2, type 1
Rated voltage (U_e)	24 V DC (-15/+20%)	
Input current, typical at U_e	5 mA	
Switching delay 0 to 1	≤ 100 µs + input filter	
Switching delay 1 to 0	≤ 100 µs + input filter	
Signal flank gradient	≥ 24 V/ms	
Insulation voltage inputs/logic	≥ 500 V_{eff}	
Input filter	0.2 ms	
Status display	LED lights: input active	
Permissible input voltage	-30 to +30 V	
Working ranges:		As per EN 61131-2, type 1
Signal voltage 0-status (UL)	-30 to +5 V (+15 V)	
Signal voltage 1-status (UH)	+15 to +30 V	

Digital outputs

Parameters	Value	Remark
Output type	Semiconductor	As per EN 61131-2
Rated voltage (U_e)	24 V DC (-15/+20%)	
Rated current 1-status (I_e)	0.5 A	
Insulation voltage outputs/logic	≥ 500 V_{eff}	
Protection type	Protected output with auto-matic restart	As per EN 61131-2
Rated load	48 Ohm / 12 W 12 W	Ohmic Lamps

Parameters	Value	Remark
	12 VA (1.2 H, 50 Ohm)	Inductivities
Max. total current output of all outputs	0.7 A	Self-healing fuse

Analogue outputs

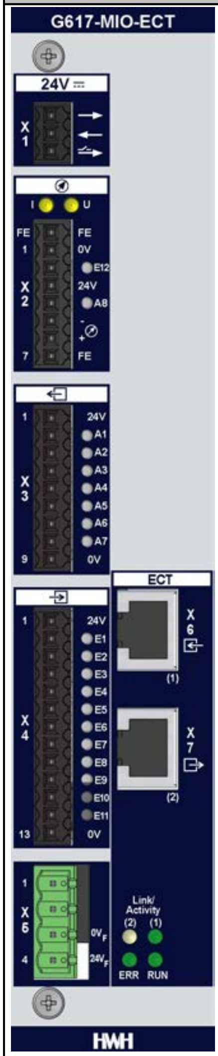
Parameters	Value	Remark
Output type	Current/voltage	Optionally switchable (S1 – S4)
Voltage	0 – 10 V 2% R_L ≥ 24 Ohm, I max. 5 mA	10-bit
Current 1	0 – 20 mA 2% R_L ≥ 600 Ohm, max. 800 Ohm	10-bit
Current 2	4 – 20 mA 2% R_L ≥ 600 Ohm, max. 800 Ohm	10-bit

14.26 G617-MIO-ECT

The plug-in module includes the digital 24 V inputs and outputs as well as an output for controlling a proportional valve.

The plug-in module enables connection to the EtherCAT field bus system. Detailed information on EtherCAT is available at www.ethercat.org. Harms & Wende is a member of the EtherCAT Technology Group (EPG).

LED display



LED	Display	Module status	Function
Link/Activity 1	On	Connection to Ethernet port 1 established	Input connection status
	Off	No connection to Ethernet port 1	
	Flickering	Data exchange with previous EtherCAT device	
Link/activity 2	On	Connection to Ethernet port 2 established	Output connection status
	Off	No connection to Ethernet port 2	
	Flickering	Data exchange with subsequent EtherCAT device	
RUN	Off	The device is in initialisation state	Module status
	On, green	The appliance is ready for operation. Data exchange is possible in all directions (OPERATIONAL state).	
	Flashing	The connection is established, but the device is still not operational (PRE-OPERATIONAL state).	
	Flashing	Communication from module to master possible. No data exchange from master to module possible (SAFE-OPERATIONAL state).	
ERR	Off	No error, operational	Error
	On, red	Timeout	
	Flashing	Configuration error	
	Flashing	Slave reports error	
	Double flashing	Timeout, synchronisation error with master	

Connection	I/O	Name	Function
X1.1	A	24 V	From the central supply, non-switched
X1.2	E*	24 V	Supply for this module
X1.3	A	24 V	From the central supply, switched with emergency stop
X2		FE	Screen
X2.1		0 V	see separate "Pin assignments" document
X2.2	E*	E12	
X2.3	A	24 V / max. 200 mA	
X2.4	A	Enable	
X2.5	A	Analogue output -	0 – 10 V, optionally 0 – 20 mA, 4 – 20 mA
X2.6	A	Analogue output +	see separate "Pin assignments" document
X2.7	FE		
X3.1	A	24 V	see separate "Pin assignments" document
X3.2	A	A1	
X3.3	A	A2	
X3.4	A	A3	
X3.5	A	A4	
X3.6	A	A5	
X3.7	A	A6	
X3.8	A	A7	
X3.9	A	0 V	
X4.1	A	24 V	see separate "Pin assignments" document
X4.2	E*	E1	
X4.3	E*	E2	
X4.4	E*	E3	
X4.5	E*	E4	
X4.6	E*	E5	
X4.7	E*	E6	
X4.8	E*	E7	
X4.9	E*	E8	
X4.10	E*	E9	
X4.11	E*	E10	
X4.12	E*	E11	
X4.13	A	0 V	
X5.1			
X5.2			
X5.3	E*	0 V	External voltage supply
X5.4	E*	24 V	

Connection	I/O	Name	Function
X6.1	E	TxD +	see separate "Pin assignments" document
X6.2	E	TxD -	
X6.3	E	RxD +	
X6.4	E	n.c.	
X6.5	E	n.c.	
X6.6	E	RxD -	
X6.7	E	n.c.	
X6.8	E	n.c.	
X7.1	A	TxD +	see separate "Pin assignments" document
X7.2	A	TxD -	
X7.3	A	RxD +	
X7.4	O	n.c.	
X7.5	O	n.c.	
X7.6	A	RxD -	
X7.7	O	n.c.	
X7.8	O	N.c.	

DIP switch for the IP address

The last byte of the IP address can be set manually using the DIP switch.

Switch 1 sets the most significant bit (MSB), switch 8 the least significant bit (LSB).

The IP address is obtained automatically when all switches are set to OFF.

DIP switch for the proportional valve value range

The value range for X2.5 and X2.6 is set to 0 – 10 V as default.

The value range can be changed using a DIP switch.

The DIP switch can only be set when the plug-in module is removed.

The following settings are possible:

S1	S2	S3	S4	Setting
ON	ON	OFF	ON	0 – 20 mA
ON	OFF	ON	OFF	4 – 20 mA
OFF	X	X	X	0 – 10 V

X = any setting

Technical data

EtherCat

Parameters	Value	Remark
EtherCat	up to 512 bytes I/O, cyclical , in each direction up to 2048 bytes, noncyclical, in each direction	

Parameters	Value	Remark
I/O data exchange	Cyclical	
RJ45	STP and UTP cable	
Auto cross-over	Not supported	
XML-file	Supported	Request from info@harms-wende.de

Supply

Parameters	Value	Remark
Digital I/O supply voltage	+18 – +30 V	With external supply
24 V supply voltage fusing	2 A	With external supply
Max. current output of all 24 V pins	0.7 A	Self-healing fuse
Current consumption of all outputs	≤ 80 mA	All outputs 0-status and without load

Digital inputs

Parameters	Value	Remark
Input type		As per EN 61131-2, type 1
Rated voltage (U_e)	24 V DC (-15/+20%)	
Input current, typical at U_e	5 mA	
Switching delay 0 to 1	≤ 100 µs + input filter	
Switching delay 1 to 0	≤ 100 µs + input filter	
Signal flank gradient	≥ 24 V/ms	
Insulation voltage inputs/logic	≥ 500 V_{eff}	
Input filter	0.2 ms	
Status display	LED lights: input active	
Permissible input voltage	-30 to +30 V	
Working ranges:		As per EN 61131-2, type 1
Signal voltage 0-status (UL)	-30 to +5 V (+15 V)	
Signal voltage 1-status (UH)	+15 to +30 V	

Digital outputs

Parameters	Value	Remark
Output type	Semiconductor	As per EN61131-2
Rated voltage U_e	24 VDC	
Rated current 1-status I_e	0.5 A	
Protection type	Protected output with automatic restart	As per EN61131-2
Rated load	48 Ohm/12 W 12 W 12 VA (1.2 H, 50 Ohm)	Ohmic Lamps Inductivities
Max. total current output of all outputs	0.7 A	Self-healing fuse

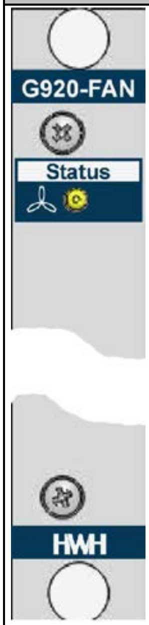
Analogue outputs

Parameters	Value	Remark
Output type	Current/voltage	Optionally switchable (S1 – S4)
Voltage	0 – 10 V 2% R_L ≥ 500 Ohm	10-bit
Current 1	0 – 20 mA 2% R_L ≥ 600 Ohm	10-bit
Current 2	4 – 20 mA 2% R_L ≥ 600 Ohm	10-bit

14.27 G920-FAN

The plug-in module contains a fan to support heat dissipation. It is controlled depending on the temperature.

LED display

	LED	Display	Module status	Function
	Status	On	Fan is switched on	Module status
		Off	Fan is switched off	

Technical data

Parameters	Value	Remark
Supply voltage	24 VDC (18 – 30 V)	
Current consumption	Approx. 100 mA	

15 Maintenance

Maintenance

As a precaution, it should be checked once a year as to whether:

- The fan is free from dirt
- All connections are tightly seated

The module is otherwise maintenance free.

CAUTION

Solenoid valve outputs

The solenoid valve outputs are wired with semiconductor switches and an additional contact section within the inverter. In <With pre-stroke solenoid valve> operating mode, additional separation of the solenoid valve outputs through a contact section is withdrawn when the start input is inactive.

Crushing possible during maintenance work.

- If output contact separation is necessary when the start input is inactive, this must be implemented externally in series in addition to the outputs.

16 Storage

Due to the integrated capacitors, inverters may be stored for a maximum of two years.

Note

The following steps are necessary so that an inverter can be commissioned with full functionality after a long storage period:

- Connect voltage.
- Leave connected and at rest for at least 15 min. The capacitors are reformatted during this time.

17 Disposal

The operator is responsible for proper disposal of the module and all relevant components.

Electronic scrap

Exchanged, defective electronic parts must be disposed of as electronic scrap if repair is not possible.

18 Technical data

General

Technical data	
Maximum welding time	7 s
Regulation	Constant current regulation based on 1000 Hz
Ambient temperature (outside heat sink)	+10°C to max. 45°C
Mains frequency	50 Hz / 60 Hz
Working frequency	1000 Hz

18.1 GeniusHWI weights

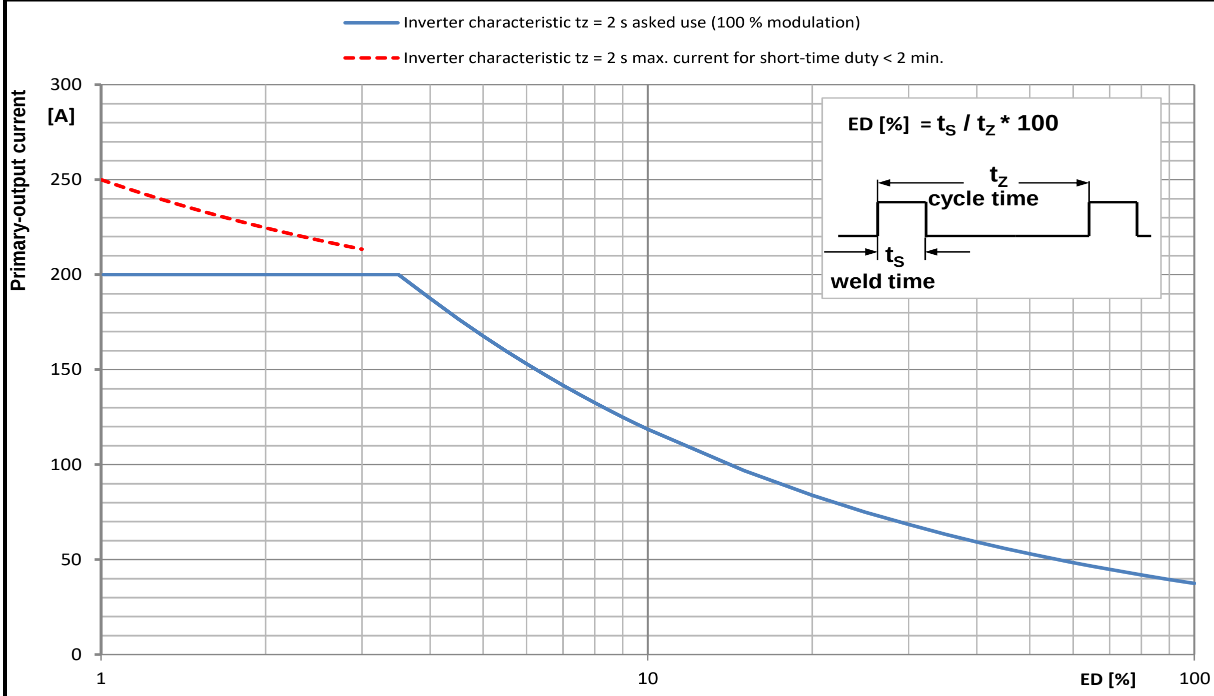
Net in kg

Inverter	Weight in kg	
	Air cooling	Water cooling
HWI403	27	21
HWI406	27	21
HWI408	27	21
HWI413	30	24
HWI416	30	24
HWI424	---	26
HWI436	---	26
HWI503	27	21
HWI506	27	21
HWI508	27	23
HWI513	30	24
HWI516	30	24
HWI524	---	26
HWI536	---	26
HWI708	27	23
HWI713	30	24
HWI716	30	24
HWI3440	---	75
HWI3445	---	75
HWI3460	---	77
HWI3540	---	75
HWI3545	---	75
HWI3560	---	77

18.2 GeniusHWI with air cooling, output classes x03L-x08L

18.2.1 Output class x03L

Load Limit Diagram



Load curve represents the absolute limits. For reliable continuous operation, these limits should be exploited with a maximum of 85 %.

Technical data

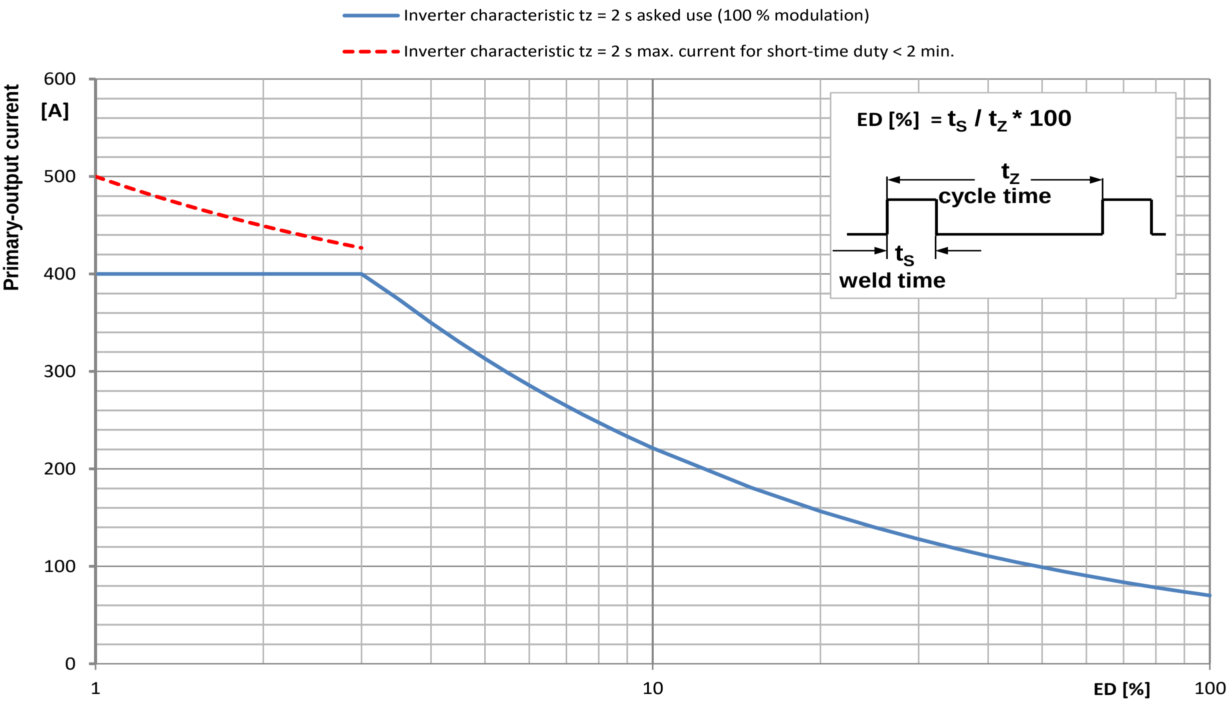
Designation		HWI403L	HWI503L
Cooling medium		Air	
Line voltage range	3 ph, -15 %, +20 %	400 / 440 V	
Line voltage range	3 ph, -15 % +10 %		480 V
Output voltage		500 / 550 V	
Output voltage			600 V
Rated output	20 % ED 2)	42 kVA	
Primary output current	20 % ED 1)	84 A	
Primary output current	100 % ED 1)	38 A	
Max. primay output current	[10 ms]	250 A	
Main nominal current (max. thermal continuous current) 3)		27 A	
Cooling water requirements			
Cooling water pressure			
Cooling water connection			
Ambient temperature		+10 °C bis max. +45 °C	
Relative humidity		5 % – 85 % No condensation	
Air pressure		86 kPa – 106 kPa	

1) Peak current is specified.
2) The rated output at 500 V mains voltage is specified.
3) Main nominal current for dimensioning the fuses is specified. The currents may also be lower / higher depending on application

HWH HARMS+WENDE		GEZEICHNET	GEPRÜFT				
	DATUM	2017-07-18	2017-07-18	DRAWINGNUMBER	41174-01en	SHEET	1
	NAME	Reichardt	Erdmann				
	STATUS:			TITLE	HWI2803L / Genius-, Sinius-, AnalogHWIx03L, MFPx03L	SHEETS	1

18.2.2 Output class x06L

Load Limit Diagram



Load curve represents the absolute limits. For reliable continuous operation, these limits should be exploited with a maximum of 85 %.

Technical data

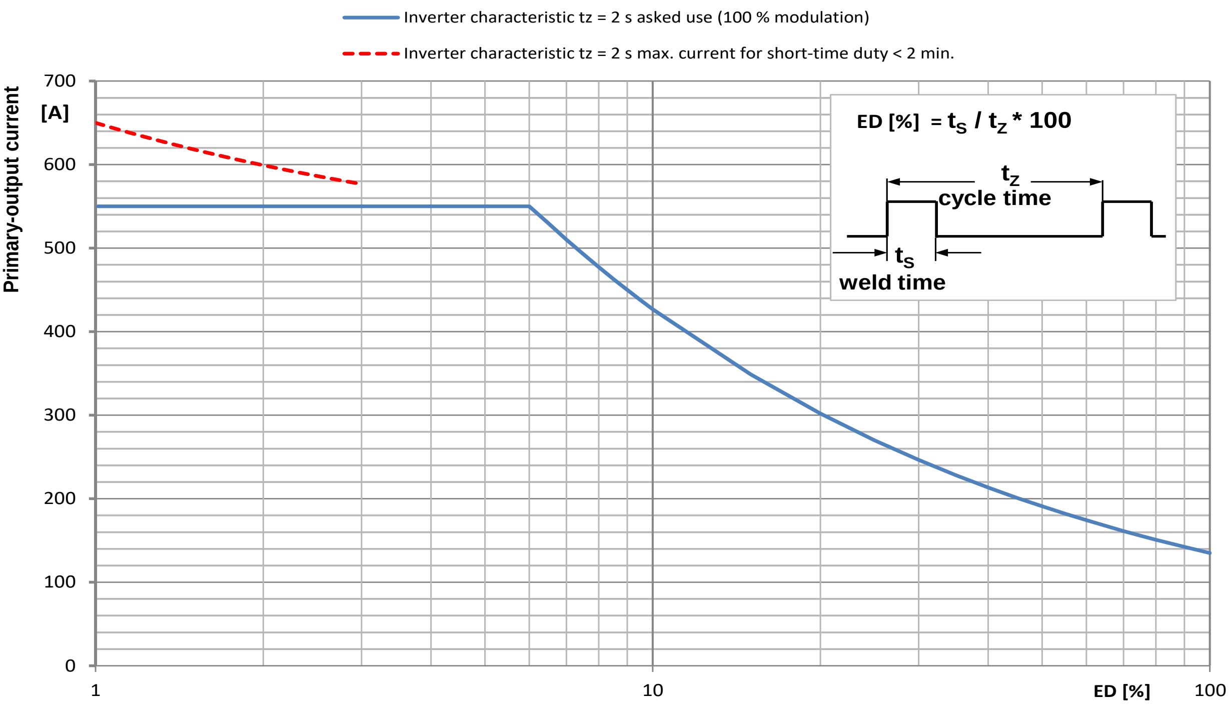
Designation		HWI406L	HWI506L
Cooling medium		Air	
Line voltage range	3 ph, -15 %, +20 %	400 / 440 V	
Line voltage range	3 ph, -15 % +10 %		480 V
Output voltage		500 / 550 V	
Output voltage			600 V
Rated output	20 % ED[2]	79 kVA	
Primary output current	20 % ED[1]	157 A	
Primary output current	100 % ED[1]	70 A	
Max. primay output current	[10 ms]	500 A	
Main nominal current (max. thermal continuous current) [3]		49 A	
Cooling water requirements			
Cooling water pressure			
Cooling water connection			
Ambient temperature		+10 °C bis max. +45 °C	
Relative humidity		5 % – 85 % No condensation	
Air pressure		86 kPa – 106 kPa	

[1] Peak current is specified.
[2] The rated output at 500 V mains voltage is specified.
[3] Main nominal current for dimensioning the fuses is specified. The currents may also be lower / higher depending on application

HWH HARMS+WENDE		GEZEICHNET	GEPRÜFT	DRAWINGNUMBER	41178-01en	SHEET	1
	DATUM	2017-07-11	2017-07-13				
	NAME	Reichardt	Erdmann				
	STATUS:			TITLE	HWI2806L / Genius-, Sinius-, AnalogHWIx06L, MFPx06L	SHEETS	1

18.2.3 Output class x08L

Load Limit Diagram



Load curve represents the absolute limits. For reliable continuous operation, these limits should be exploited with a maximum of 85 %.

Technical data

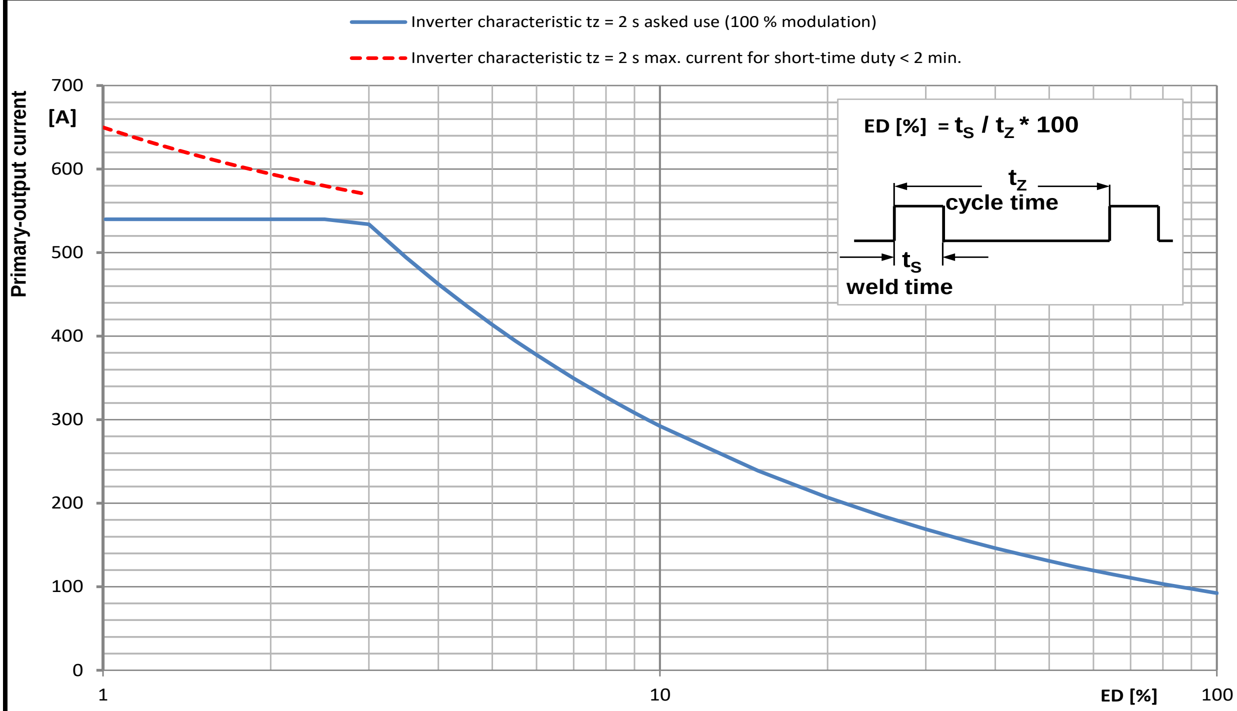
Designation		HWI408L	HWI508L
Cooling medium		Air	
Line voltage range	3 ph, -15 %, +20 %	400 / 440 V	
Line voltage range	3 ph, -15 % +10 %		480 V
Output voltage		500 / 550 V	
Output voltage			600 V
Rated output	20 % ED[2)]	151 kVA	
Primary output current	20 % ED[1)]	302 A	
Primary output current	100 % ED[1)]	135 A	
Max. primay output current	[10 ms]	650 A	
Main nominal current (max. thermal continuous current) [3)]		95 A	
Cooling water requirements			
Cooling water pressure			
Cooling water connection			
Ambient temperature		+10 °C bis max. +45 °C	
Relative humidity		5 % – 85 % No condensation	
Air pressure		86 kPa – 106 kPa	

[1)] Peak current is specified.
[2)] The rated output at 500 V mains voltage is specified.
[3)] Main nominal current for dimensioning the fuses is specified. The currents may also be lower / higher depending on application

HWH HARMS+WENDE		GEZEICHNET	GEPRÜFT	DRAWINGNUMBER	41180-01en	SHEET	1
	DATUM	2017-07-11	2017-07-13				
	NAME	Reichardt	Erdmann				
	STATUS:			TITLE	HWI2808L / Genius-, Sinius-, AnalogHWIx08L, MFPx08L	SHEETS	1

18.2.4 Output class 708L

Load Limit Diagram



Load curve represents the absolute limits. For reliable continuous operation, these limits should be exploited with a maximum of 85 %.

Technical data

Designation		HWI708L
Cooling medium	Air	
Line voltage range	3 ph, N, -15 %, +20 %	690 V
Line voltage range		
Output voltage		500 V
Output voltage		
Rated output	20 % ED[2)]	104 kVA
Primary output current	20 % ED[1)]	207 A
Primary output current	100 % ED[1)]	93 A
Max. primay output current	[10 ms]	650 A
Main nominal current (max. thermal continuous current) [3)]		66 A
Cooling water requirements		
Cooling water pressure		
Cooling water connection		
Ambient temperature	+10 °C bis max. +45 °C	
Relative humidity	5 % – 85 % No condensation	
Air pressure	86 kPa – 106 kPa	

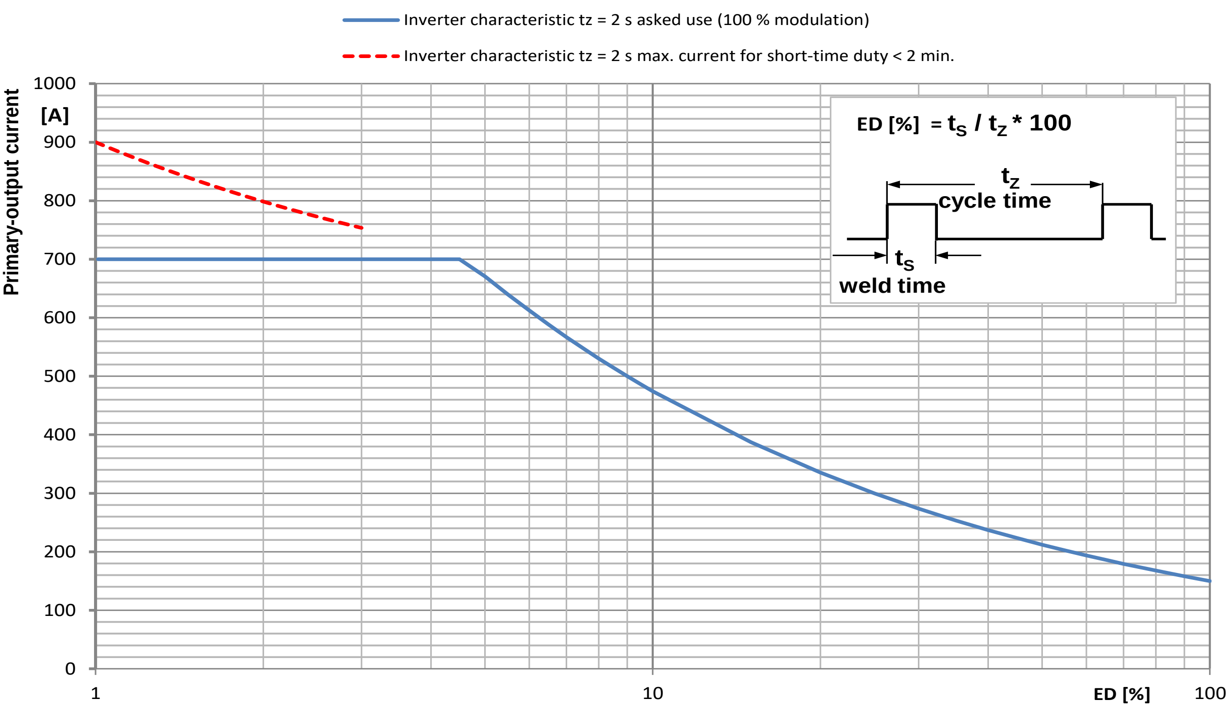
[1)] Peak current is specified.
[2)] The rated output at 500 V mains voltage is specified.
[3)] Main nominal current for dimensioning the fuses is specified. The currents may also be lower / higher depending on application

		GEZEICHNET	GEPRÜFT				
HWH HARMS+WENDE	DATUM	2017-07-11	2017-07-13	DRAWINGNUMBER	41189-01en	SHEET	1
	NAME	Reichardt	Erdmann				
	STATUS:			TITLE	HWI2908L, GeniusHWI708L	SHEETS	1

18.3 GeniusHWI with air cooling, output classes x13L-x16L

18.3.1 Output class x13L

Load Limit Diagram



Load curve represents the absolute limits. For reliable continuous operation, these limits should be exploited with a maximum of 85 %.

Technical data

Designation		HWI413L	HWI513L
Cooling medium	Air		
Line voltage range	3 ph, -15 %, +20 %	400 / 440 V	
Line voltage range	3 ph, -15 % +10 %		480 V
Output voltage		500 / 550 V	
Output voltage			600 V
Rated output	20 % ED[2]	168 kVA	
Primary output current	20 % ED[1]	335 A	
Primary output current	100 % ED[1]	150 A	
Max. primay output current	[10 ms]	900 A	
Main nominal current (max. thermal continuous current) [3]		106 A	
Cooling water requirements			
Cooling water pressure			
Cooling water connection			
Ambient temperature	+10 °C bis max. +45 °C		
Relative humidity	5 % – 85 % No condensation		
Air pressure	86 kPa – 106 kPa		

[1] Peak current is specified.

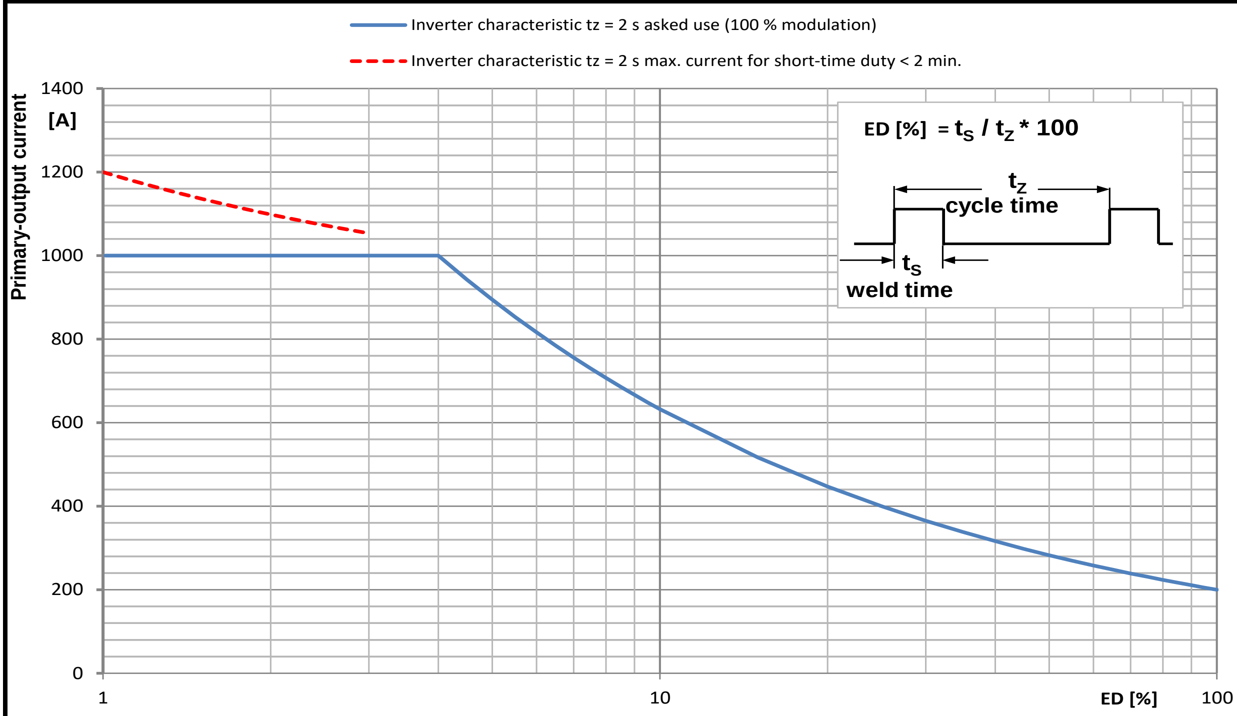
[2] The rated output at 500 V mains voltage is specified.

[3] Main nominal current for dimensioning the fuses is specified. The currents may also be lower / higher depending on application

HWH HARMS+WENDE		GEZEICHNET	GEPRÜFT				
	DATUM	2017-07-11	2017-07-13	DRAWINGNUMBER	41182-01en	SHEET	1
	NAME	Reichardt	Erdmann				
	STATUS:			TITLE	HWI2813L / Genius-, Sinius-, AnalogHWIx13L, MFPx13L	SHEETS	1

18.3.2 Output class x16L

Load Limit Diagram



Load curve represents the absolute limits. For reliable continuous operation, these limits should be exploited with a maximum of 85 %.

Technical data

Designation		HWI416L	HWI516L
Cooling medium	Air		
Line voltage range	3 ph, -15 %, +20 %	400 / 440 V	
Line voltage range	3 ph, -15 % +10 %		480 V
Output voltage		500 / 550 V	
Output voltage			600 V
Rated output	20 % ED[2)]	224 kVA	
Primary output current	20 % ED[1)]	447 A	
Primary output current	100 % ED[1)]	200 A	
Max. primay output current	[10 ms]	1200 A	
Main nominal current (max. thermal continuous current) [3)]		141 A	
Cooling water requirements			
Cooling water pressure			
Cooling water connection			
Ambient temperature	+10 °C bis max. +45 °C		
Relative humidity	5 % – 85 % No condensation		
Air pressure	86 kPa – 106 kPa		

[1)] Peak current is specified.

[2)] The rated output at 500 V mains voltage is specified.

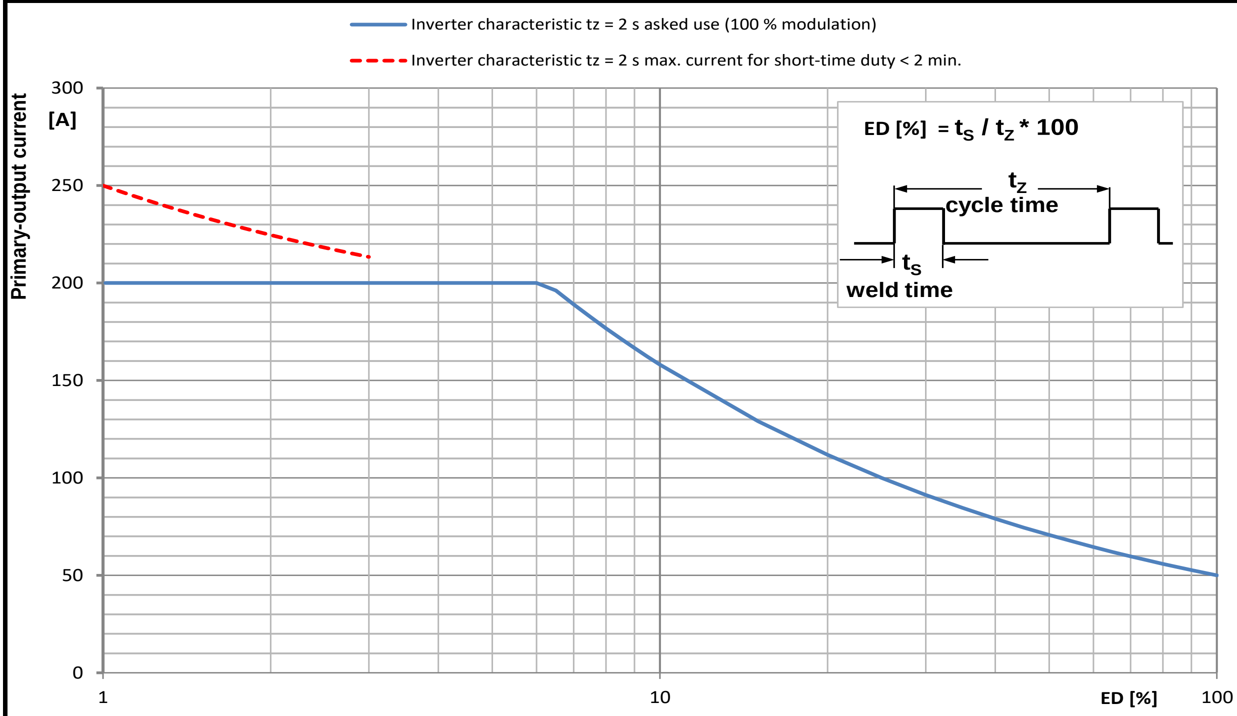
[3)] Main nominal current for dimensioning the fuses is specified. The currents may also be lower / higher depending on application

HARMS+WENDE		GEZEICHNET	GEPRÜFT	DRAWINGNUMBER	41187-01en	SHEET	1
	DATUM	2017-07-11	2017-07-13				
	NAME	Reichardt	Erdmann				
	STATUS:			TITLE	HWI2816L / Genius-, Sinius-, Slave-, AnalogHWIx16L, MFPx16L	SHEETS	1

18.4 GeniusHWI with water cooling, output classes x03W-x08W

18.4.1 Output class x03W

Load Limit Diagram



Load curve represents the absolute limits. For reliable continuous operation, these limits should be exploited with a maximum of 85 %.

Technical data

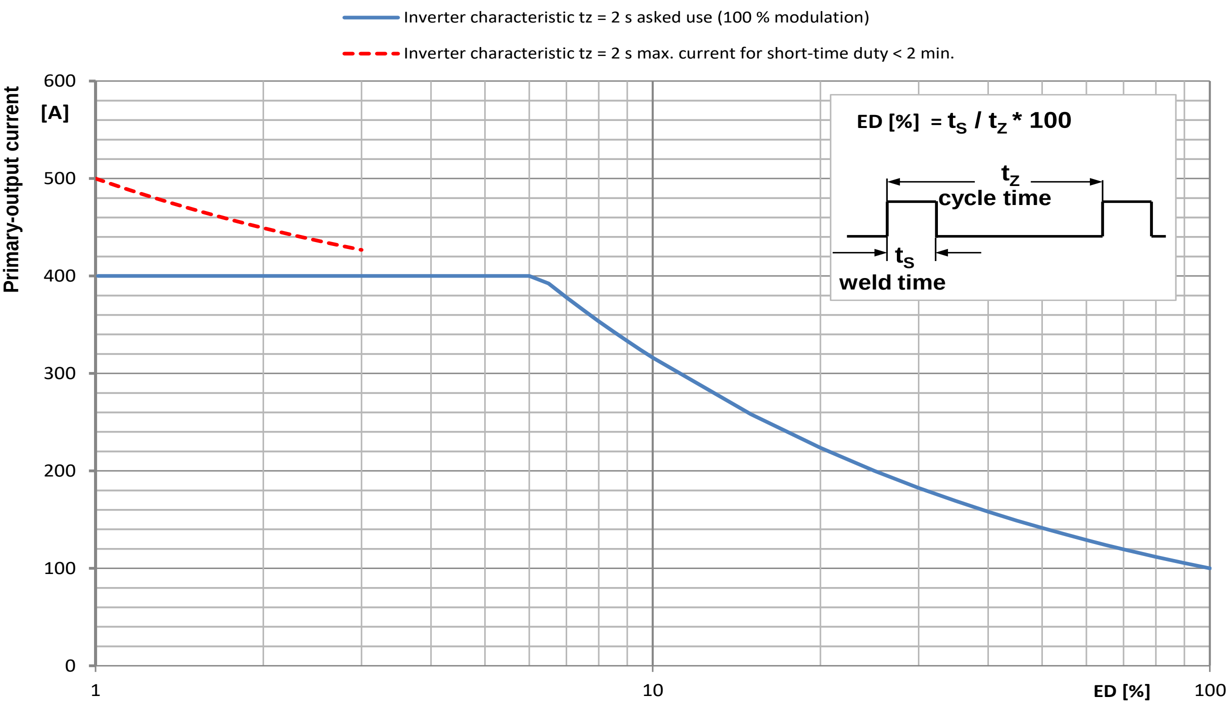
Designation		HWI403W	HWI503W
Cooling medium	Water		
Line voltage range	3 ph, -15 %, +20 %	400 / 440 V	
Line voltage range	3 ph, -15 % +10 %		480 V
Output voltage		500 / 550 V	
Output voltage			600 V
Rated output	20 % ED[2)]	56 kVA	
Primary output current	20 % ED[1)]	112 A	
Primary output current	100 % ED[1)]	50 A	
Max. primay output current	[10 ms]	250 A	
Main nominal current (max. thermal continuous current) [3)]		35 A	
Cooling water requirements	4 l/min		
Cooling water pressure	max. 6 bar		
Cooling water connection	G1/4" nipple with internal cone according to DIN EN 560		
Ambient temperature	+10 °C bis max. +45 °C		
Relative humidity	5 % – 85 % No condensation		
Air pressure	86 kPa – 106 kPa		

[1)] Peak current is specified.
[2)] The rated output at 500 V mains voltage is specified.
[3)] Main nominal current for dimensioning the fuses is specified. The currents may also be lower / higher depending on application

HWH HARMS+WENDE		GEZEICHNET	GEPRÜFT	DRAWINGNUMBER	41175-01en	SHEET	1
	DATUM	2017-07-11	2017-07-13				
	NAME	Reichardt	Erdmann				
	STATUS:			TITLE	HWI2803W / Genius-, Sinius-, AnalogHWIx03W, MFPx03W	SHEETS	1

18.4.2 Output class x06W

Load Limit Diagram



Load curve represents the absolute limits. For reliable continuous operation, these limits should be exploited with a maximum of 85 %.

Technical data

Designation		HWI406W	HWI506W
Cooling medium		Water	
Line voltage range	3 ph, -15 %, +20 %	400 / 440 V	
Line voltage range	3 ph, -15 % +10 %		480 V
Output voltage		500 / 550 V	
Output voltage			600 V
Rated output	20 % ED[2)]	112 kVA	
Primary output current	20 % ED[1)]	224 A	
Primary output current	100 % ED[1)]	100 A	
Max. primay output current	[10 ms]	500 A	
Main nominal current (max. thermal continuous current) [3)]		71 A	
Cooling water requirements		4 l/min	
Cooling water pressure		max. 6 bar	
Cooling water connection		G1/4" nipple with internal cone according to DIN EN 560	
Ambient temperature		+10 °C bis max. +45 °C	
Relative humidity		5 % – 85 % No condensation	
Air pressure		86 kPa – 106 kPa	

[1)] Peak current is specified.

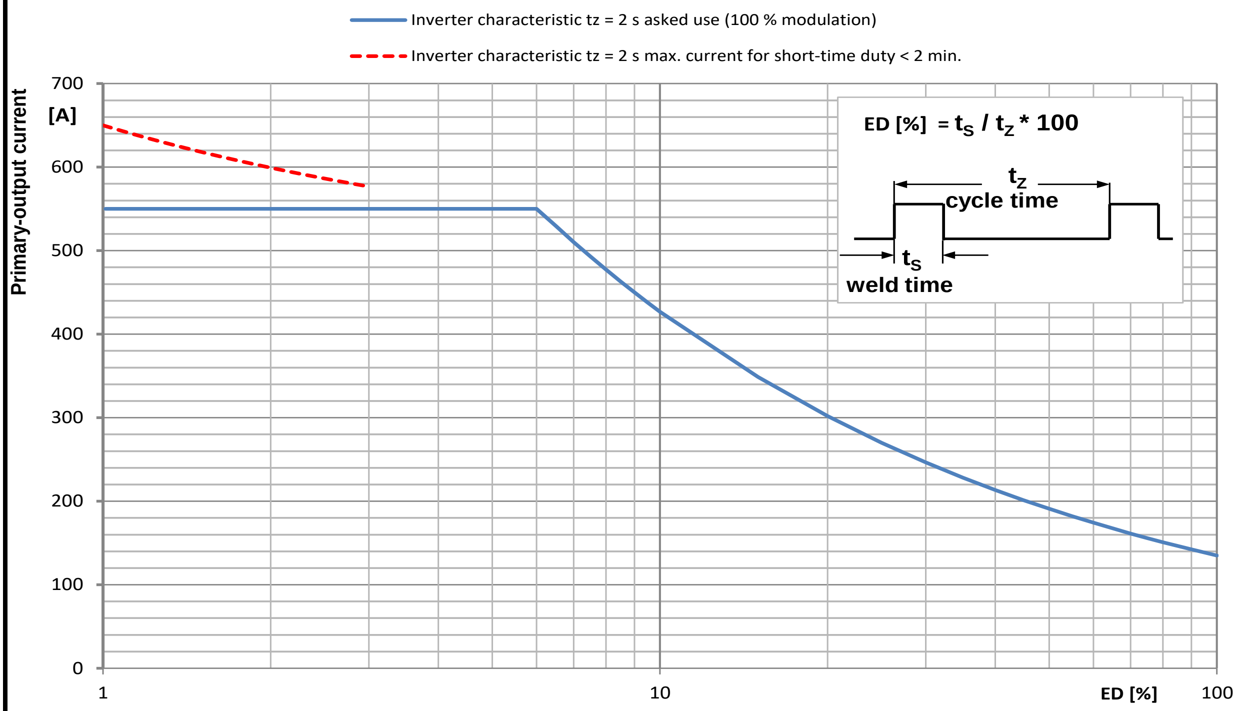
[2)] The rated output at 500 V mains voltage is specified.

[3)] Main nominal current for dimensioning the fuses is specified. The currents may also be lower / higher depending on application

		GEZEICHNET	GEPRÜFT				
HWH HARMS+WENDE	DATUM	2017-07-11	2017-07-13	DRAWINGNUMBER	41179-01en	SHEET	1
	NAME	Reichardt	Erdmann				
	STATUS:			TITLE	HWI2806W / Genius-, Sinius-, AnalogHWIx06W, MFPx06W	SHEETS	1

18.4.3 Output class x08W

Load Limit Diagram



Load curve represents the absolute limits. For reliable continuous operation, these limits should be exploited with a maximum of 85 %.

Technical data

Designation		HWI408W	HWI508W
Cooling medium	Water		
Line voltage range	3 ph, -15 %, +20 %	400 / 440 V	
Line voltage range	3 ph, -15 % +10 %		480 V
Output voltage		500 / 550 V	
Output voltage			600 V
Rated output	20 % ED[2]	151 kVA	
Primary output current	20 % ED[1]	302 A	
Primary output current	100 % ED[1]	135 A	
Max. primay output current	[10 ms]	650 A	
Main nominal current (max. thermal continuous current) [3]		95 A	
Cooling water requirements	4 l/min		
Cooling water pressure	max. 6 bar		
Cooling water connection	G1/4" nipple with internal cone according to DIN EN 560		
Ambient temperature	+10 °C bis max. +45 °C		
Relative humidity	5 % – 85 % No condensation		
Air pressure	86 kPa – 106 kPa		

[1] Peak current is specified.
[2] The rated output at 500 V mains voltage is specified.
[3] Main nominal current for dimensioning the fuses is specified. The currents may also be lower / higher depending on application

	GEZEICHNET	GEPRÜFT				
DATUM	2017-07-11	2017-07-13	DRAWINGNUMBER	41181-01en	SHEET	1
NAME	Reichardt	Erdmann				
STATUS:			TITLE	HWI2808W / Genius-, Sinius-, AnalogHWIx08W, MFPx08W	SHEETS	1

HARMS+WENDE

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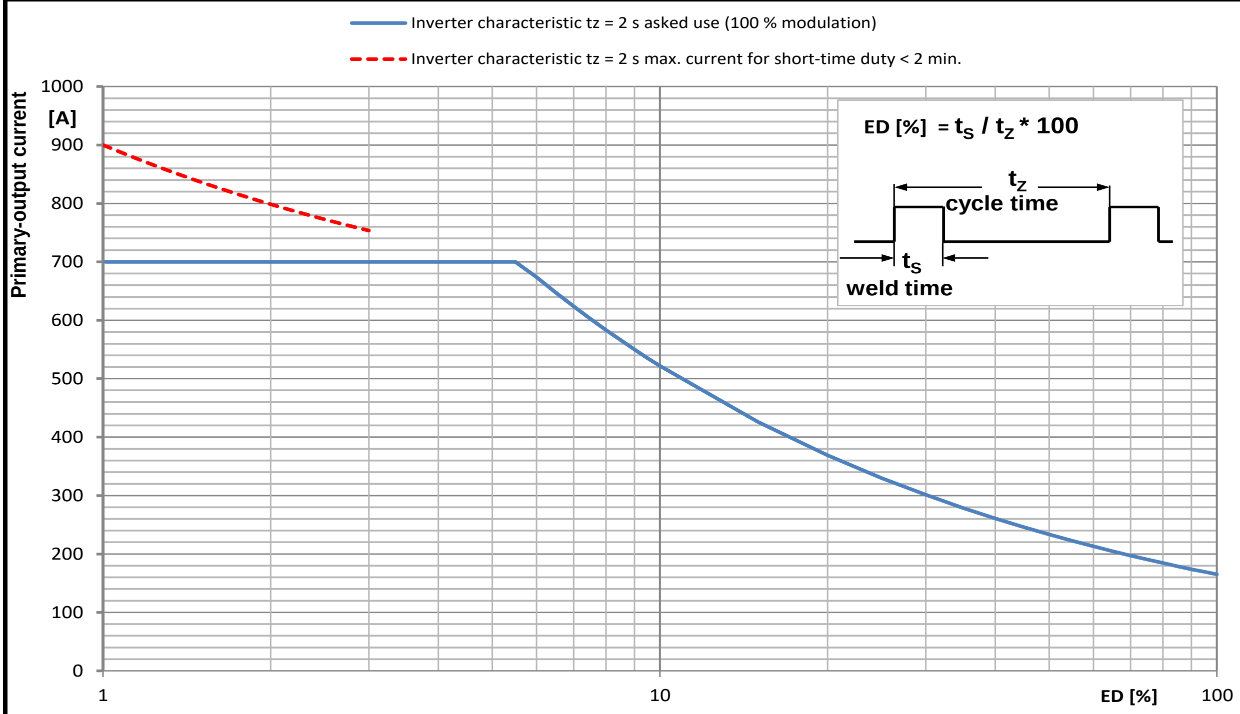
18.5 GeniusHWI with water cooling, output classes x13W-x16W

18.5.1 Output class x13W

Load Limit Diagram



Load curve represents the absolute limits. For reliable continuous operation, these limits should be exploited with a maximum of 85 %.

Technical data

Designation		HWI413W	HWI513W
Cooling medium		Water	
Line voltage range	3 ph, -15 %, +20 %	400 / 440 V	
Line voltage range	3 ph, -15 % +10 %		480 V
Output voltage		500 / 550 V	
Output voltage			600 V
Rated output	20 % ED 2)	185 kVA	
Primary output current	20 % ED 1)	369 A	
Primary output current	100 % ED 1)	165 A	
Max. primay output current	[10 ms]	900 A	
Main nominal current (max. thermal continuous current) 3)		117 A	
Cooling water requirements		4 l/min	
Cooling water pressure		max. 6 bar	
Cooling water connection		G1/4" nipple with internal cone according to DIN EN 560	
Ambient temperature		+10 °C bis max. +45 °C	
Relative humidity		5 % – 85 % No condensation	
Air pressure		86 kPa – 106 kPa	

1) Peak current is specified.

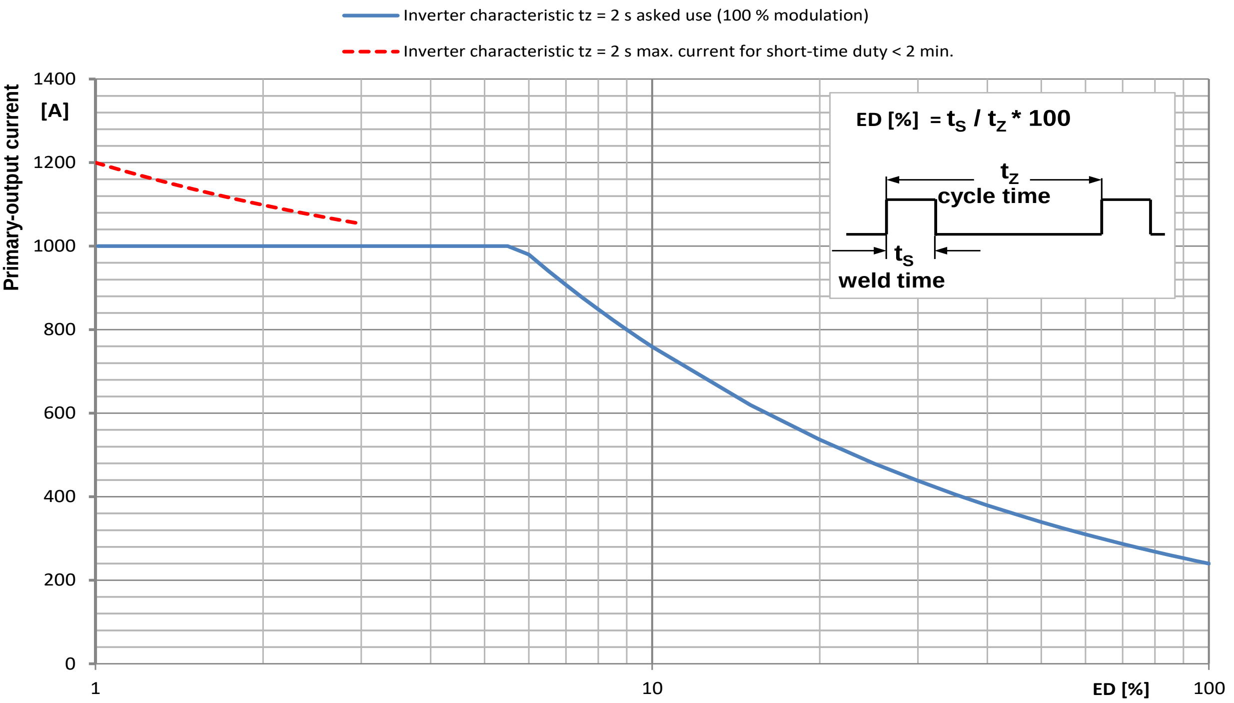
2) The rated output at 500 V mains voltage is specified.

3) Main nominal current for dimensioning the fuses is specified. The currents may also be lower / higher depending on application

HWH HARMS+WENDE		GEZEICHNET	GEPRÜFT			
	DATUM	2017-07-11	2017-07-13	DRAWINGNUMBER	41183-01en	SHEET 1
	NAME	Reichardt	Erdmann			
	STATUS:			TITLE	HWI2813W / Genius-, Sinius-, AnalogHWIx13W, MFPx13W	SHEETS 1

18.5.2 Output class x16W

Load Limit Diagram



Load curve represents the absolute limits. For reliable continuous operation, these limits should be exploited with a maximum of 85 %.

Technical data

Designation		HWI416W	HWI516W
Cooling medium	Water		
Line voltage range	3 ph, -15 %, +20 %	400 / 440 V	
Line voltage range	3 ph, -15 % +10 %		480 V
Output voltage		500 / 550 V	
Output voltage			600 V
Rated output	20 % ED[2]	269 kVA	
Primary output current	20 % ED[1]	537 A	
Primary output current	100 % ED[1]	240 A	
Max. primay output current	[10 ms]	1200 A	
Main nominal current (max. thermal continuous current) [3]		170 A	
Cooling water requirements	4 l/min		
Cooling water pressure	max. 6 bar		
Cooling water connection	G1/4" nipple with internal cone according to DIN EN 560		
Ambient temperature	+10 °C bis max. +45 °C		
Relative humidity	5 % – 85 % No condensation		
Air pressure	86 kPa – 106 kPa		

[1] Peak current is specified.

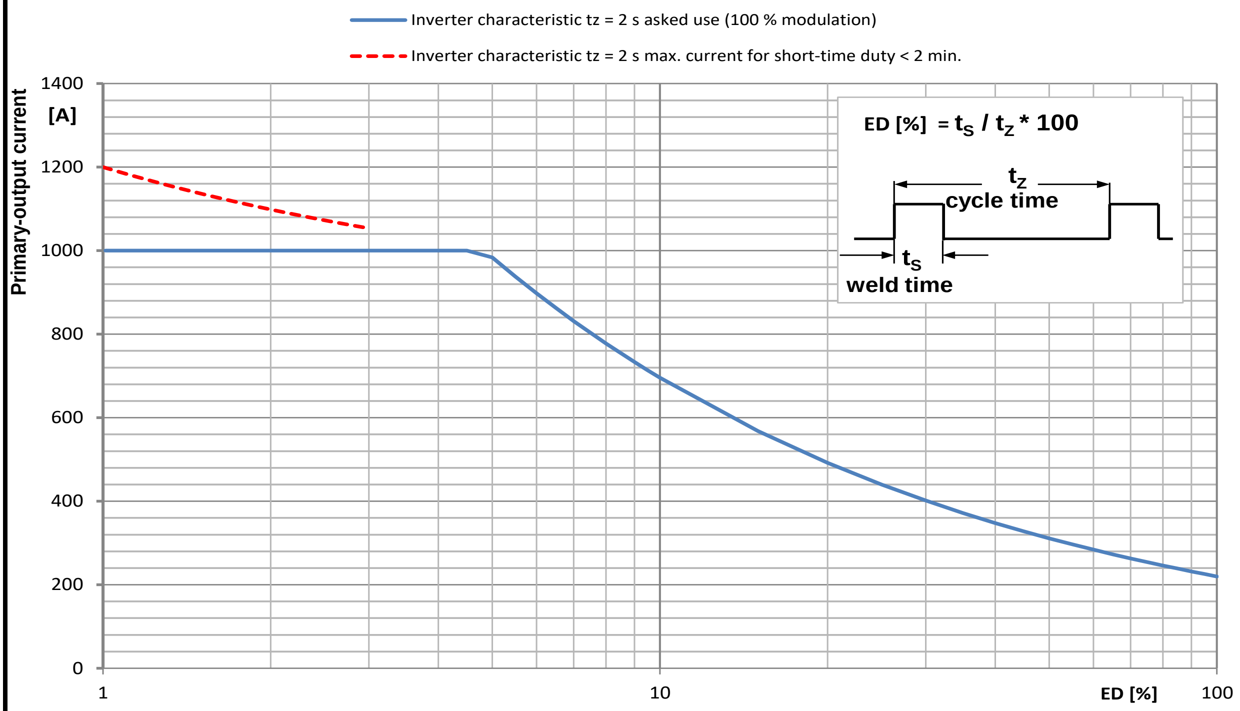
[2] The rated output at 500 V mains voltage is specified.

[3] Main nominal current for dimensioning the fuses is specified. The currents may also be lower / higher depending on application

HWH HARMS+WENDE		GEZEICHNET	GEPRÜFT				
	DATUM	2017-07-11	2017-07-13	DRAWINGNUMBER	41188-01en	SHEET	1
	NAME	Reichardt	Erdmann				
	STATUS:			TITLE	HWI2816W / Genius-, Sinius-, Slave-, AnalogHWIx16W, MFPx16W	SHEETS	1

18.5.3 Output class 716W

Load Limit Diagram



Load curve represents the absolute limits. For reliable continuous operation, these limits should be exploited with a maximum of 85 %.

Technical data

Designation		HWI716W
Cooling medium	Water	
Line voltage range	3 ph, N, -15 %, +20 %	690 V
Line voltage range		
Output voltage		500 V
Output voltage		
Rated output	20 % ED[2]	246 kVA
Primary output current	20 % ED[1]	492 A
Primary output current	100 % ED[1]	220 A
Max. primay output current	[10 ms]	1200 A
Main nominal current (max. thermal continuous current) [3]		156 A
Cooling water requirements	4 l/min	
Cooling water pressure	max. 6 bar	
Cooling water connection	G1/4" nipple with internal cone according to DIN EN 560	
Ambient temperature	+10 °C bis max. +45 °C	
Relative humidity	5 % – 85 % No condensation	
Air pressure	86 kPa – 106 kPa	

[1] Peak current is specified.

[2] The rated output at 500 V mains voltage is specified.

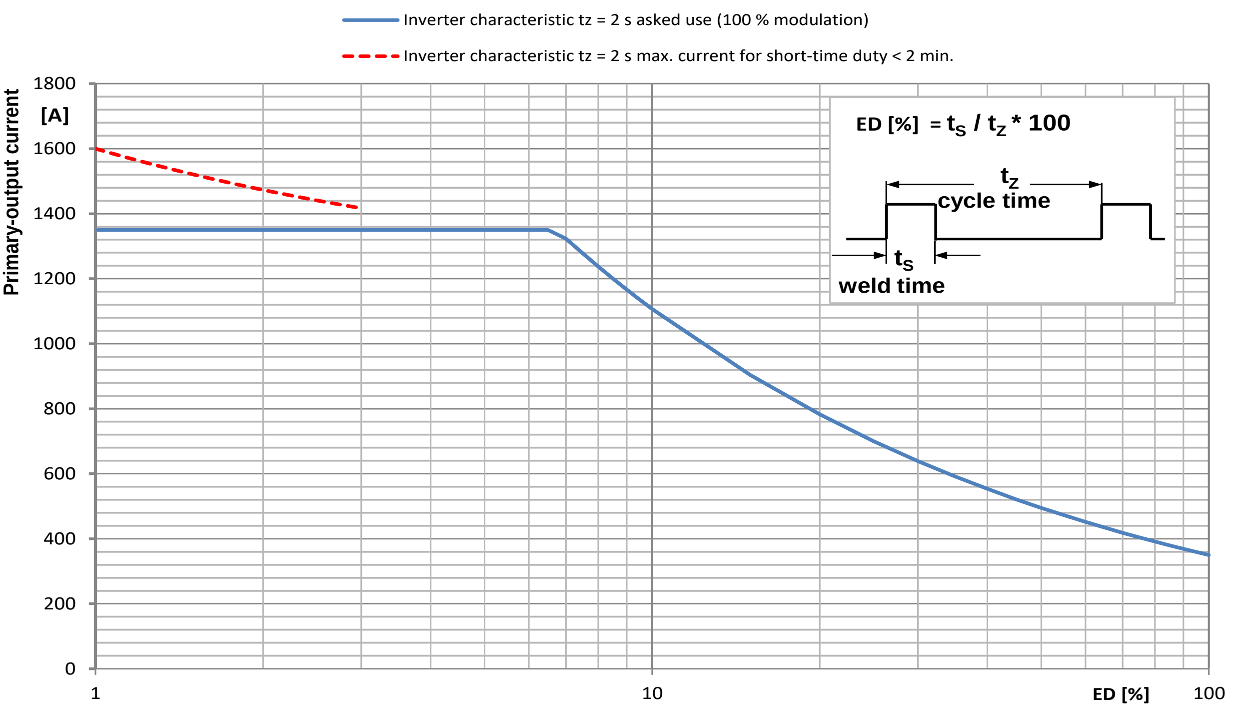
[3] Main nominal current for dimensioning the fuses is specified. The currents may also be lower / higher depending on application

HWH HARMS+WENDE		GEZEICHNET	GEPRÜFT				
	DATUM	2017-07-11	2017-07-13	DRAWINGNUMBER	41191-01en	SHEET	1
	NAME	Reichardt	Erdmann				
	STATUS:			TITLE	HWI2916W, GeniusHWI716W	SHEETS	1

18.6 GeniusHWI with water cooling, output classes x24W-x36W

18.6.1 Output class x24W

Load Limit Diagram



Load curve represents the absolute limits. For reliable continuous operation, these limits should be exploited with a maximum of 85 %.

Technical data

Designation		HWI424W	HWI524W
Cooling medium	Water		
Line voltage range	3 ph, -15 %, +20 %	400 / 440 V	
Line voltage range	3 ph, -15 % +10 %		480 V
Output voltage		500 / 550 V	
Output voltage			600 V
Rated output	20 % ED 2)	392 kVA	
Primary output current	20 % ED 1)	783 A	
Primary output current	100 % ED 1)	350 A	
Max. primay output current	[10 ms]	1600 A	
Main nominal current (max. thermal continuous current) 3)		247 A	
Cooling water requirements	4 l/min		
Cooling water pressure	max. 6 bar		
Cooling water connection	G1/4" nipple with internal cone according to DIN EN 560		
Ambient temperature	+10 °C bis max. +45 °C		
Relative humidity	5 % – 85 % No condensation		
Air pressure	86 kPa – 106 kPa		

1) Peak current is specified.

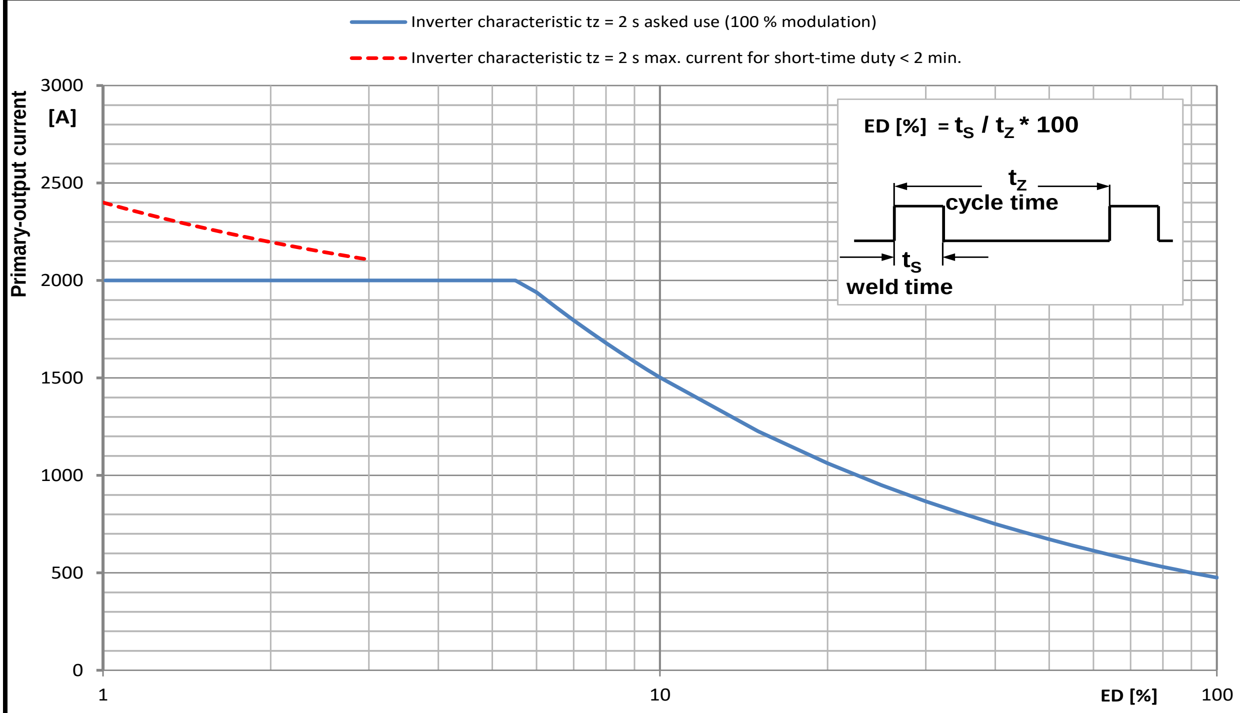
2) The rated output at 500 V mains voltage is specified.

3) Main nominal current for dimensioning the fuses is specified. The currents may also be lower / higher depending on application

HWH HARMS+WENDE		GEZEICHNET	GEPRÜFT	DRAWINGNUMBER	41190-01en	SHEET	1
	DATUM	2017-07-11	2017-07-13				
	NAME	Reichardt	Erdmann				
	STATUS:			TITLE	HWI2824W, Genius-, Sinius-, Slave-, AnalogHWIx24W, MFPx24W	SHEETS	1

18.6.2 Output class x36W

Load Limit Diagram



Load curve represents the absolute limits. For reliable continuous operation, these limits should be exploited with a maximum of 85 %.

Technical data

Designation		HWI436W	HWI536W
Cooling medium		Water	
Line voltage range	3 ph, -15 %, +20 %	400 / 440 V	
Line voltage range	3 ph, -15 % +10 %		480 V
Output voltage		500 / 550 V	
Output voltage			600 V
Rated output	20 % ED 2)	531 kVA	
Primary output current	20 % ED 1)	1062 A	
Primary output current	100 % ED 1)	475 A	
Max. primay output current	[10 ms]	2400 A	
Main nominal current (max. thermal continuous current) 3)		336 A	
Cooling water requirements	4 l/min		
Cooling water pressure	max. 6 bar		
Cooling water connection	G1/4" nipple with internal cone according to DIN EN 560		
Ambient temperature	+10 °C bis max. +45 °C		
Relative humidity	5 % – 85 % No condensation		
Air pressure	86 kPa – 106 kPa		

1) Peak current is specified.

2) The rated output at 500 V mains voltage is specified.

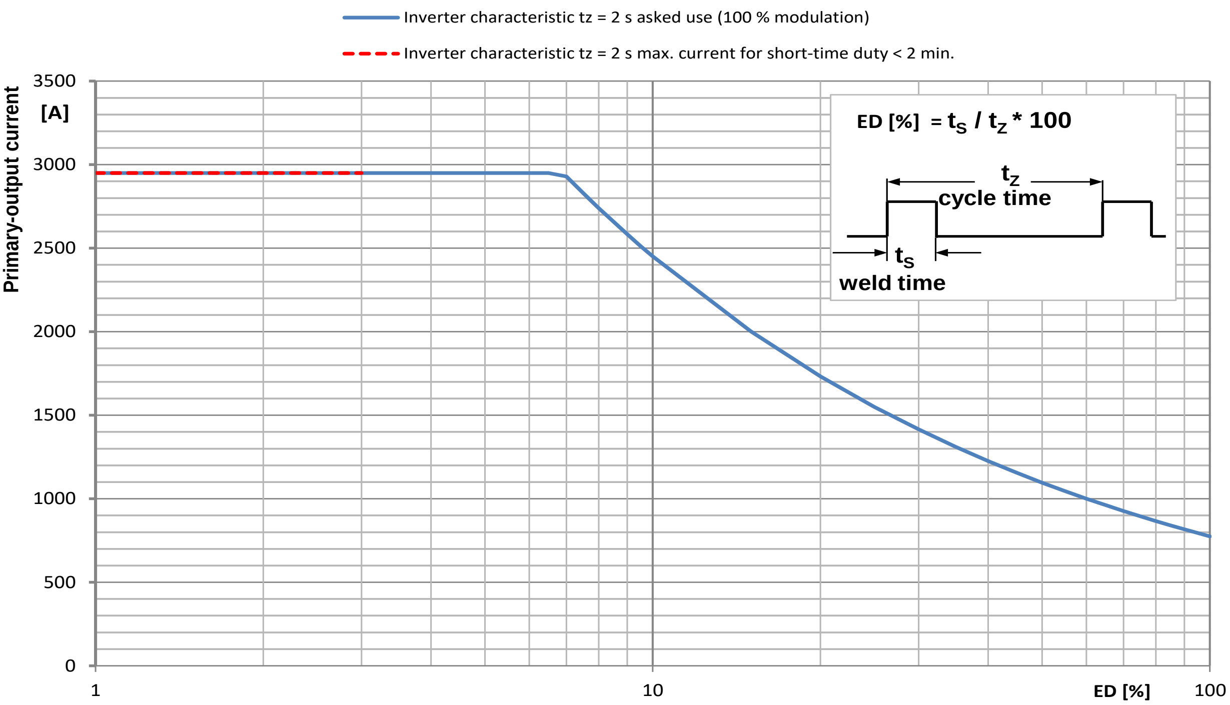
3) Main nominal current for dimensioning the fuses is specified. The currents may also be lower / higher depending on application

HARMS+WENDE		GEZEICHNET	GEPRÜFT				
	DATUM	2017-07-11	2017-07-13	DRAWINGNUMBER	41192-01en	SHEET	1
	NAME	Reichardt	Erdmann				
	STATUS:			TITLE	HWI2836W, Genius-, Sinius-, Slave-, AnalogHWIx36W, MFPx36W	SHEETS	1

18.7 GeniusHWI with water cooling, output classes 3x40W, 3x45W, 3x60W

18.7.1 Output class x40W

Load Limit Diagram



Load curve represents the absolute limits. For reliable continuous operation, these limits should be exploited with a maximum of 85 %.

Technical data

Designation		HWI3440W	HWI3540W
Cooling medium	Water		
Line voltage range	3 ph, -15 %, +20 %	400 / 440 V	
Line voltage range	3 ph, -15 % +10 %		480 V
Output voltage		500 / 550 V	
Output voltage			600 V
Rated output	20 % ED²⁾	867 kVA	
Primary output current	20 % ED¹⁾	1733 A	
Primary output current	100 % ED¹⁾	775 A	
Max. primay output current	[10 ms]	2950 A	
Main nominal current (max. thermal continuous current) ³⁾		548 A	
Cooling water requirements	6 l/min		
Cooling water pressure	max.7 bar		
Cooling water connection	M16x1.5 bulkhead fittings 24° inner cone (DIN 3861)		
Ambient temperature	+10 °C bis max. +45 °C		
Relative humidity	5 % – 85 % No condensation		
Air pressure	86 kPa – 106 kPa		

1) Peak current is specified.

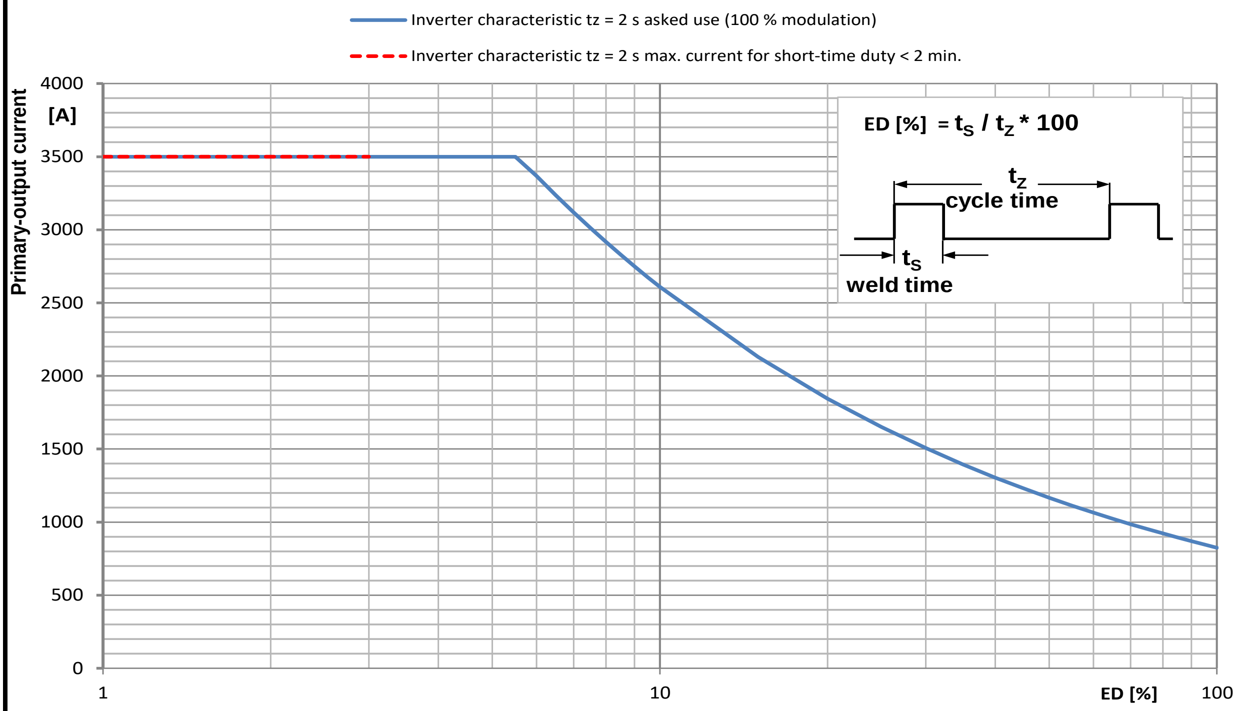
2) The rated output at 500 V mains voltage is specified.

3) Main nominal current for dimensioning the fuses is specified. The currents may also be lower / higher depending on application

HWH HARMS+WENDE		GEZEICHNET	GEPRÜFT				
	DATUM	2017-07-11	2017-07-13	DRAWINGNUMBER	41195-01en	SHEET	1
	NAME	Reichardt	Erdmann				
	STATUS:			TITLE	HWI2540W, Genius-, Sinius-, Slave-, AnalogHWI3x40W	SHEETS	1

18.7.2 Output class 3x45W

Load Limit Diagram



Load curve represents the absolute limits. For reliable continuous operation, these limits should be exploited with a maximum of 85 %.

Technical data

Designation		HWI3445W	HWI3545W
Cooling medium	Water		
Line voltage range	3 ph, -15 %, +20 %	400 / 440 V	
Line voltage range	3 ph, -15 % +10 %		480 V
Output voltage		500 / 550 V	
Output voltage			600 V
Rated output	20 % ED[2)]	923 kVA	
Primary output current	20 % ED[1)]	1845 A	
Primary output current	100 % ED[1)]	825 A	
Max. primay output current	[10 ms]	3500 A	
Main nominal current (max. thermal continuous current) [3)]		583 A	
Cooling water requirements	6 l/min		
Cooling water pressure	max. 7 bar		
Cooling water connection	M16x1.5 bulkhead fittings 24° inner cone (DIN 3861)		
Ambient temperature	+10 °C bis max. +45 °C		
Relative humidity	5 % – 85 % No condensation		
Air pressure	86 kPa – 106 kPa		

[1)] Peak current is specified.

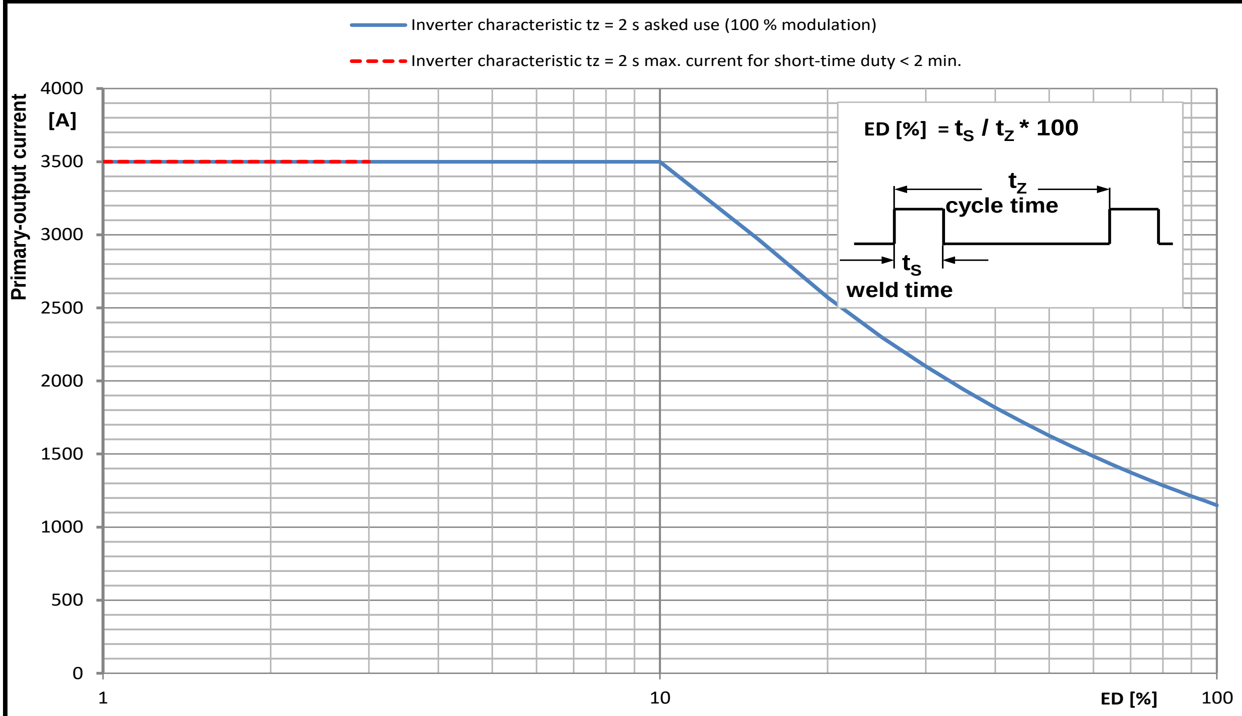
[2)] The rated output at 500 V mains voltage is specified.

[3)] Main nominal current for dimensioning the fuses is specified. The currents may also be lower / higher depending on application

HWH HARMS+WENDE		GEZEICHNET	GEPRÜFT				
	DATUM	2017-07-11	2017-07-13	DRAWINGNUMBER	41196-01en	SHEET	1
	NAME	Reichardt	Erdmann				
	STATUS:			TITLE	HWI2545W,Genius-, Sinius-, Slave-, AnalogHWI3x45W	SHEETS	1

18.7.3 Output class x60W

Load Limit Diagram



Load curve represents the absolute limits. For reliable continuous operation, these limits should be exploited with a maximum of 85 %.

Technical data

Designation		HWI3460W	HWI3560W
Cooling medium	Water		
Line voltage range	3 ph, -15 %, +20 %	400 / 440 V	
Line voltage range	3 ph, -15 % +10 %		480 V
Output voltage		500 / 550 V	
Output voltage			600 V
Rated output	20 % ED[2)]	1286 kVA	
Primary output current	20 % ED[1)]	2571 A	
Primary output current	100 % ED[1)]	1150 A	
Max. primay output current	[10 ms]	3500 A	
Main nominal current (max. thermal continuous current) [3)]		813 A	
Cooling water requirements	6 l/min		
Cooling water pressure	max. 7 bar		
Cooling water connection	G1/4" nipple with internal cone according to DIN EN 560		
Ambient temperature	+10 °C bis max. +45 °C		
Relative humidity	5 % – 85 % No condensation		
Air pressure	86 kPa – 106 kPa		

[1)] Peak current is specified.

[2)] The rated output at 500 V mains voltage is specified.

[3)] Main nominal current for dimensioning the fuses is specified. The currents may also be lower / higher depending on application

		GEZEICHNET	GEPRÜFT				
HARMS+WENDE	DATUM	2017-07-11	2017-07-13	DRAWINGNUMBER	41197-01en	SHEET	1
	NAME	Reichardt	Erdmann				
	STATUS:			TITLE	HWI2560W,Genius-, Sinius-, Slave-, AnalogHWI3x60W	SHEETS	1

18.8 Fuses and leads

Fuses and leads x03 - x08

The maximum lead length is 30 m.

All specifications apply only for copper cables.

Cable cross-sections and fuses are adjusted according to use.

Output classes	**403 /503**	**406 / 506**	**408 / 508**	**708**
Mains fuse on external supply 1) 2) 3)	Recommended 25 A	recommended 50 A	recommended 63 A	63 A
F1 mains (400 V/440 V/480 V)	T; 2 A; 500 V; 6.3 x 32 mm			
F2 Mains	T; 2 A; 500 V; 6.3 x 32 mm			
F3 internal 24 V	T; 1.25 A; 250 V; 5 x 20 mm			
Lead cross-section of the power supply 2) 3) 4)	min. 4 mm^2 recommended **25 mm^2** max. 185 mm^2	min. 4 mm^2 recommended **25 mm^2** max. 185 mm^2	min. 4 mm^2 recommended **35 mm^2** max. 185 mm^2	**50 mm^2** 2) 3) 4)
Lead cross-section for HWI-HWT connection 2) 3) 4)	min. 4 mm^2 recommended **25 mm^2** max. 185 mm^2	min. 4 mm^2 recommended **25 mm^2** max. 185 mm^2	min. 4 mm^2 recommended **35 mm^2** max. 185 mm^2	**50 mm^2** 2) 3) 4)
Connection technology	Terminals (protected against access with the back of the hand corresponding to IP10; a cover to prevent finger access corresponding to IP20 is optionally available)			
Lead cross section for control connections	0.08 mm^2 to 1.5 mm^2			
Lead cross-section of the Rogowski belt connection	2 x 0.75 mm^2 shielded and unilaterally loaded			
Lead cross-section for voltage measuring signal	2 x 0.75 mm^2 shielded and unilaterally loaded			

1) Fuse protection may vary depending on load and cable cross-section used.

2) The cable cross-section chosen depends on the respective load.

3) The current norms and standards for laying cable and cable cross-sections must be observed.

4) Ambient temperature 30°C.

Fuses and leads x13, x16, x24, x36

The maximum lead length is 30 m.

All specifications apply only for copper cables.

Cable cross-sections and fuses are adjusted according to use.

Output classes	413 / 513	416 / 516	424 / 524	436 / 536
Main fuse on external supply[1) 2) 3)]	Recommended 100 A		recommended 160 A	
F1 mains (400 V/440 V/480 V)	T; 2 A; 500 V; 6.3 x 32 mm			
F2 Mains	T; 2 A; 500 V; 6.3 x 32 mm			
F3 internal 24 V	T; 1.25 A; 250 V; 5 x 20 mm			
Lead cross-section of the power supply 2) 3) 4)	min. 4 mm^2 recommended **50 mm^2** max. 2 x 95 mm^2	min. 4 mm^2 recommended **50 mm^2** max. 2 x 95 mm^2	recommended **150 mm^2** max. 2 x 150 mm^2	recommended **150 mm^2** max. 2 x 150 mm^2
Lead cross-section for HWI-HWT connection 2) 3) 4)	min. 4 mm^2 recommended **50 mm^2** max. 185 mm^2	min. 4 mm^2 recommended **70 mm^2** max. 185 mm^2	recommended **150 mm^2** max. 2 x 150 mm^2	recommended **150 mm^2** max. 2 x 150 mm^2
Connection technology	Terminals (protected against access with the back of the hand corresponding to IP10, a cover to prevent finger access corresponding to IP20 is optionally available).		M12 ring lug	
Lead cross section for control connections	0.08 mm^2 to 1.5 mm^2			
Lead cross-section of the Rogowski belt connection	2 x 0.75 mm^2 shielded and unilaterally loaded			
Lead cross-section for voltage measuring signal	2 x 0.75 mm^2 shielded and unilaterally loaded			

1)Fuse protection may vary depending on load and cable cross-section used.

2) The cable cross-section chosen depends on the respective load.

3) The current norms and standards for laying cable and cable cross-sections must be observed.

4) Ambient temperature 30 °C.

Fuses and leads 3x40, 3x45, 3x60

The maximum lead length is 30 m.

All specifications apply only for copper cables.

Cable cross-sections and fuses are adjusted according to use.

Output classes	3440 / 3540	3445 / 3545	3460 / 3560
Main fuse on external supply 1) 2) 3)	Recommended 630 A	recommended 630 A	recommended 800 A
F1 mains (400 V / 440 V / 480 V)	T; 2 A; 500 V; 6.3 x 32 mm		
F2 Mains	T, 2 A; 500 V, 6.3 x 32 mm		
F7 solenoid valve voltage	T; 2 A; 500 V; 6.3 x 32 mm		
Lead cross-section of the power supply 2) 3) 4)	Recommended 2 x 120 mm^2 max. 2 x 240 mm^2	Recommended 2 x 120 mm^2 max. 2 x 240 mm^2	Recommended 2 x 185 mm^2 max. 2 x 300 mm^2
Lead cross-section for HWI-HWT connection 2) 3) 4)	Recommended 2 x 185 mm^2 max. 2 x 240 mm^2	Recommended 2 x 185 mm^2 max. 2 x 240 mm^2	Recommended 2 x 240 mm^2 max. 2 x 300 mm^2
Connection technology	M12 ring lug		
Lead cross section for control connections	0.08 mm^2 to 1.5 mm^2		
Lead cross-section of the Rogowski belt connection	2 x 0.75 mm^2 shielded and unilaterally loaded		
Lead cross-section for voltage measuring signal	2 x 0.75 mm^2 shielded and unilaterally loaded		

1) Fuse protection may vary depending on load and cable cross-section used.

2) The cable cross-section chosen depends on the respective load.

3) The current norms and standards for laying cable and cable cross-sections must be observed.

4) Ambient temperature 30°C.

18.9 Cooling water data

Output classes	4xx / 5xx / 7xx	34xx / 35xx
Cooling water requirement	4 l/min	3x60: 8 l/min 3x45, 3x40: 6 l/min
Cooling water pressure	Max. 6 bar	Max. 7 bar
Cooling water connection	G1/4" nipple with inner cone as per DIN EN 560	M16x1.5 bulkhead union with inner cone 24° (DIN 3861) for sealing head with union nut (hose fitting DIN 20078). The cooling water connection is internally connected to the protective earthing conductor
Tightening torque	10.5 Nm	26 Nm
Control cabinet cooling	---	Recommended cooling capacity approx. 0.5 to 1 kW/inverter Control cabinet temperature approx. 20° to 30°C

Designation	Value
Inlet temperature	< 30 °C
Hydrogen ion concentration	pH 7 to 9
Chlorides	Max. 20 mg/l
Nitrates	Max. 10 mg/l
Sulphates	Max. 100 mg/l
Insoluble substances	Max. 250 mg/l
Particle size	Max. 0.8 mm
Total hardness D	Max. 10 German degrees (1 German degree = 1.25 English degrees = 1.05 US degrees = 1.8 French degrees)

18.10 HWI 4xx/5xx/7xx dimensions

External dimensions of the inverters.

All dimensions are specified in mm.

HWIx03 – HWIx16, air-cooled

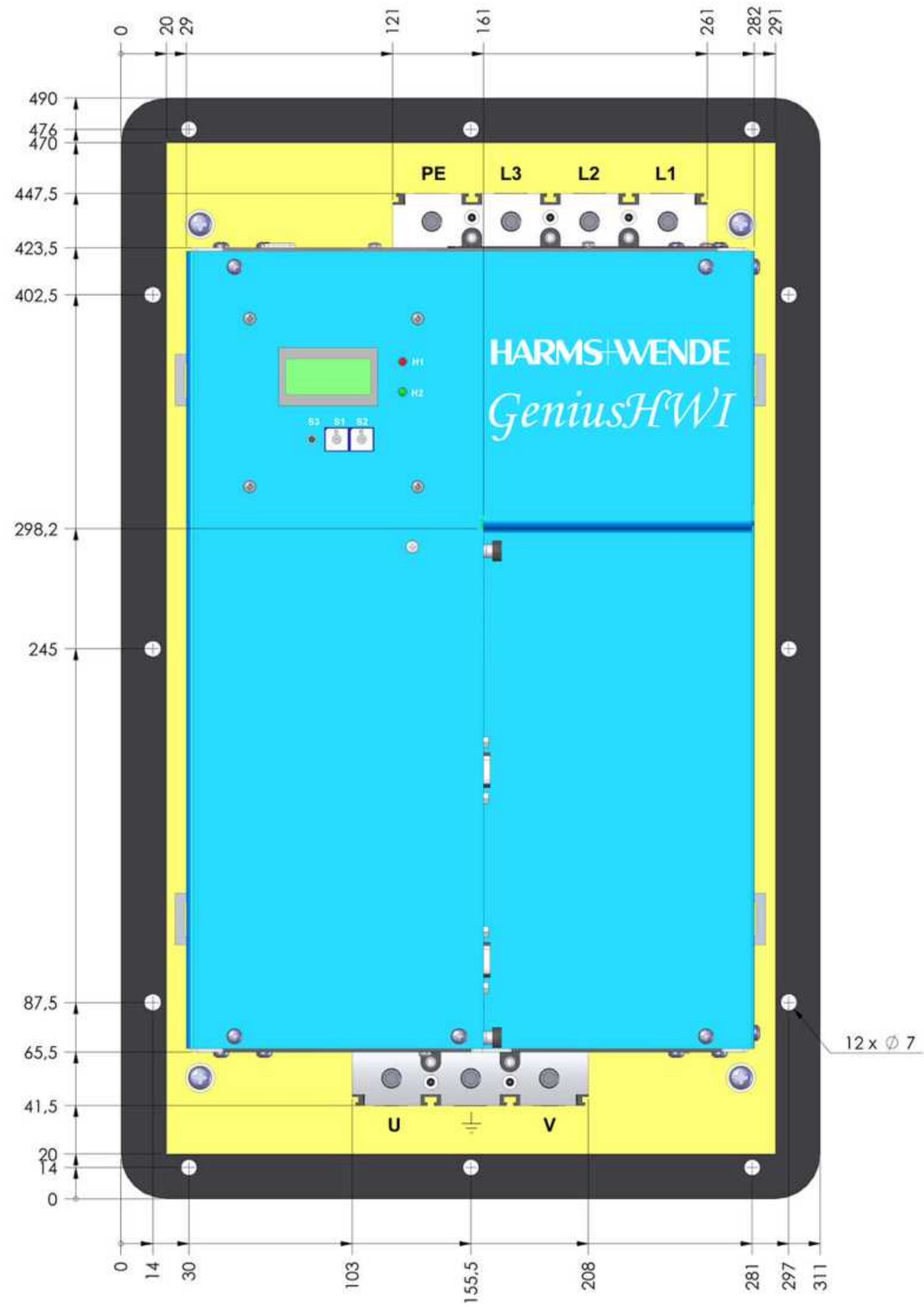


Fig. 18-1: HWIx03 – HWIx16, air-cooled, view from the front

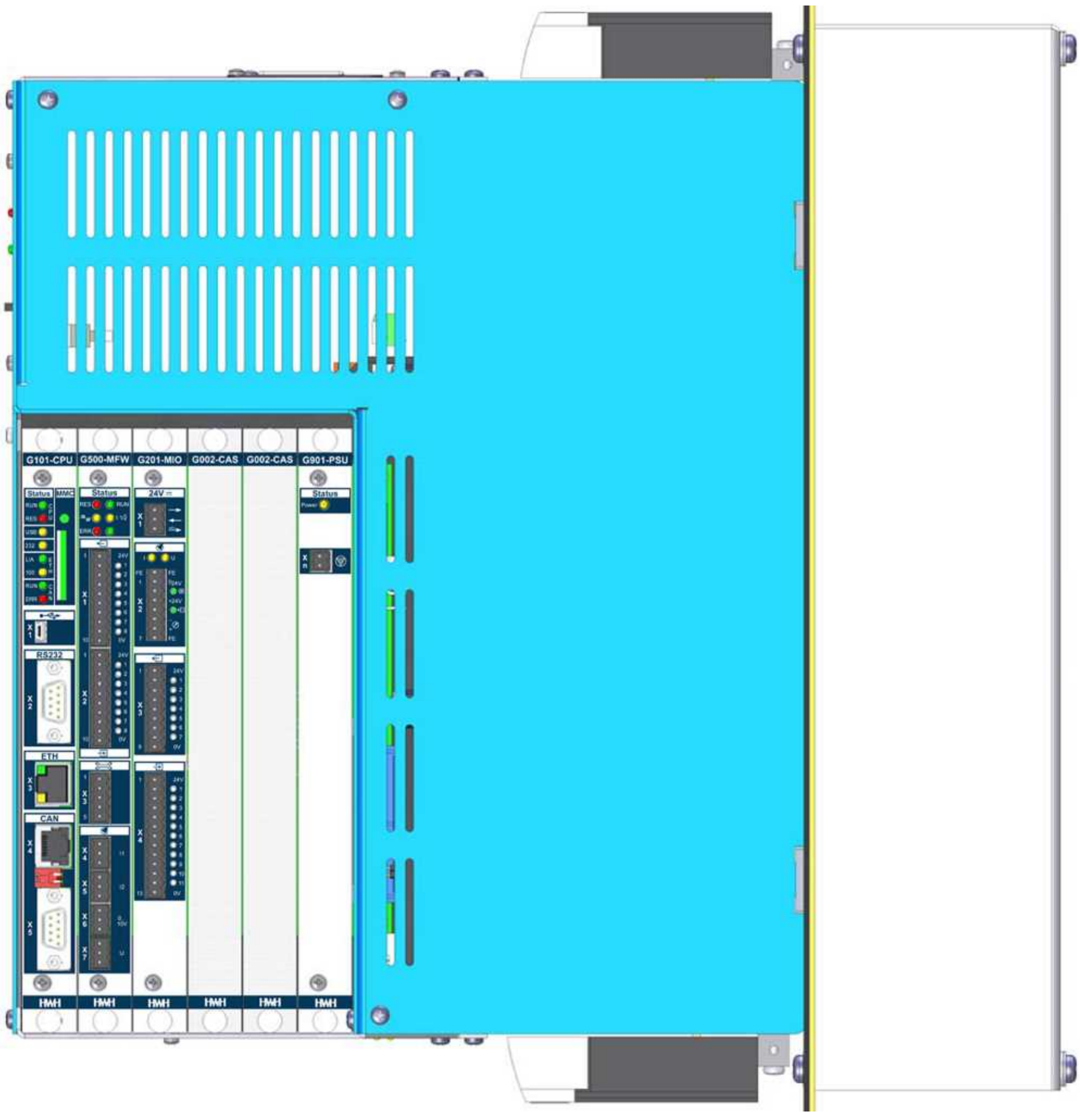


Fig. 18-2: HWIx03 – HWIx16, air-cooled, view from the right

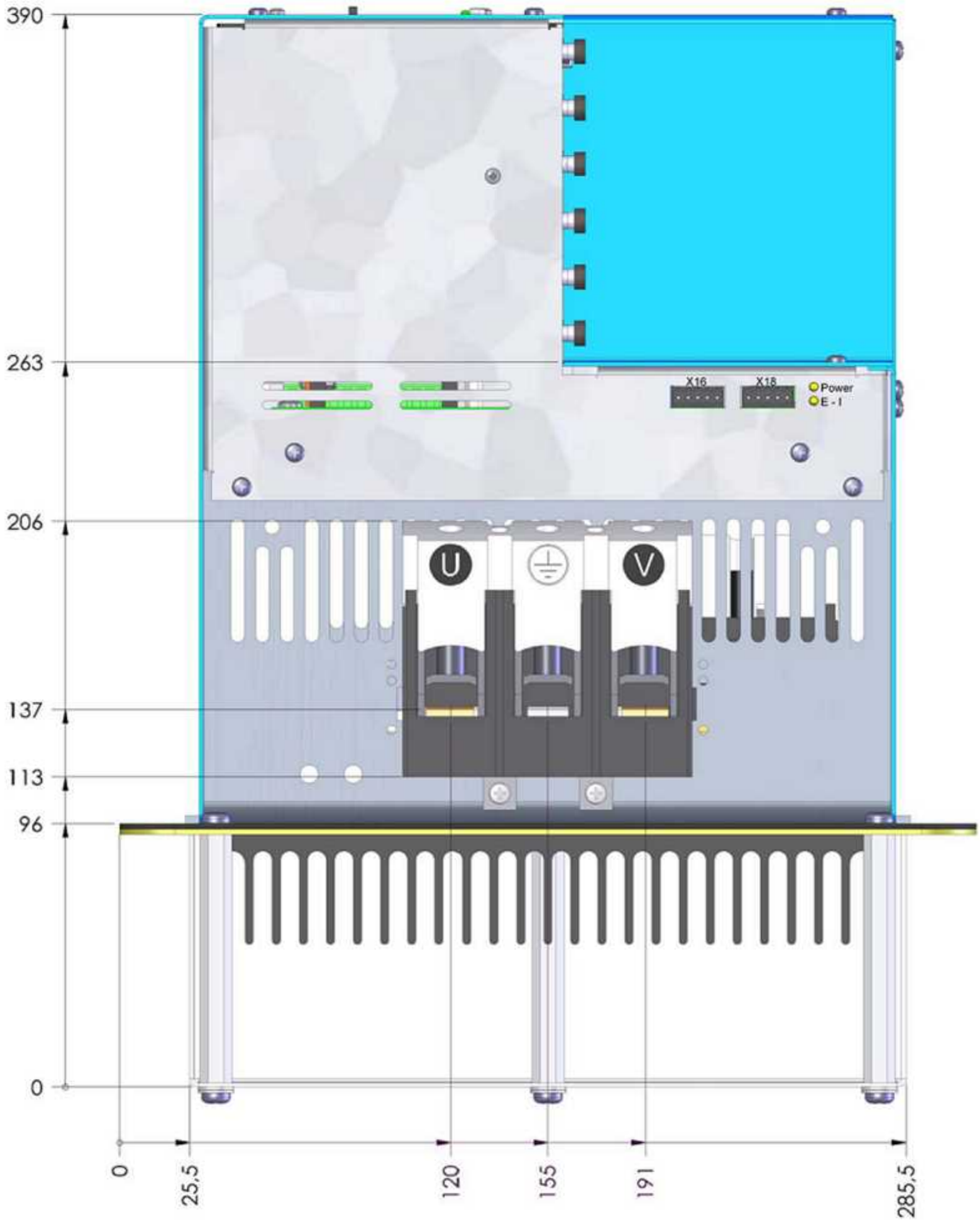


Fig. 18-3: HWIx03 – HWIx16, air-cooled, view from the bottom

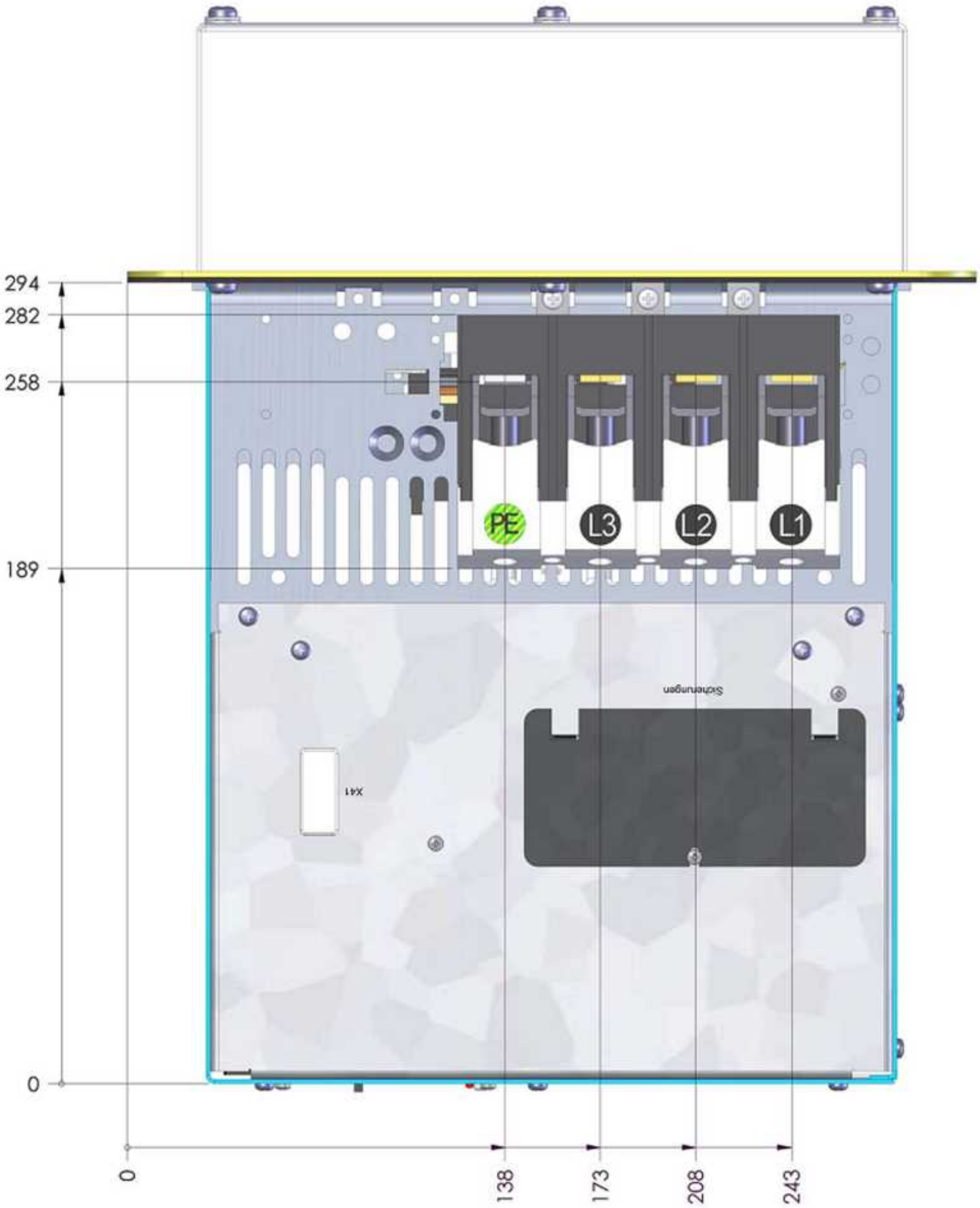


Fig. 18-4: HWIx03 – HWIx16, air-cooled, view from the top

HWIx03 – HWIx16, water-cooled

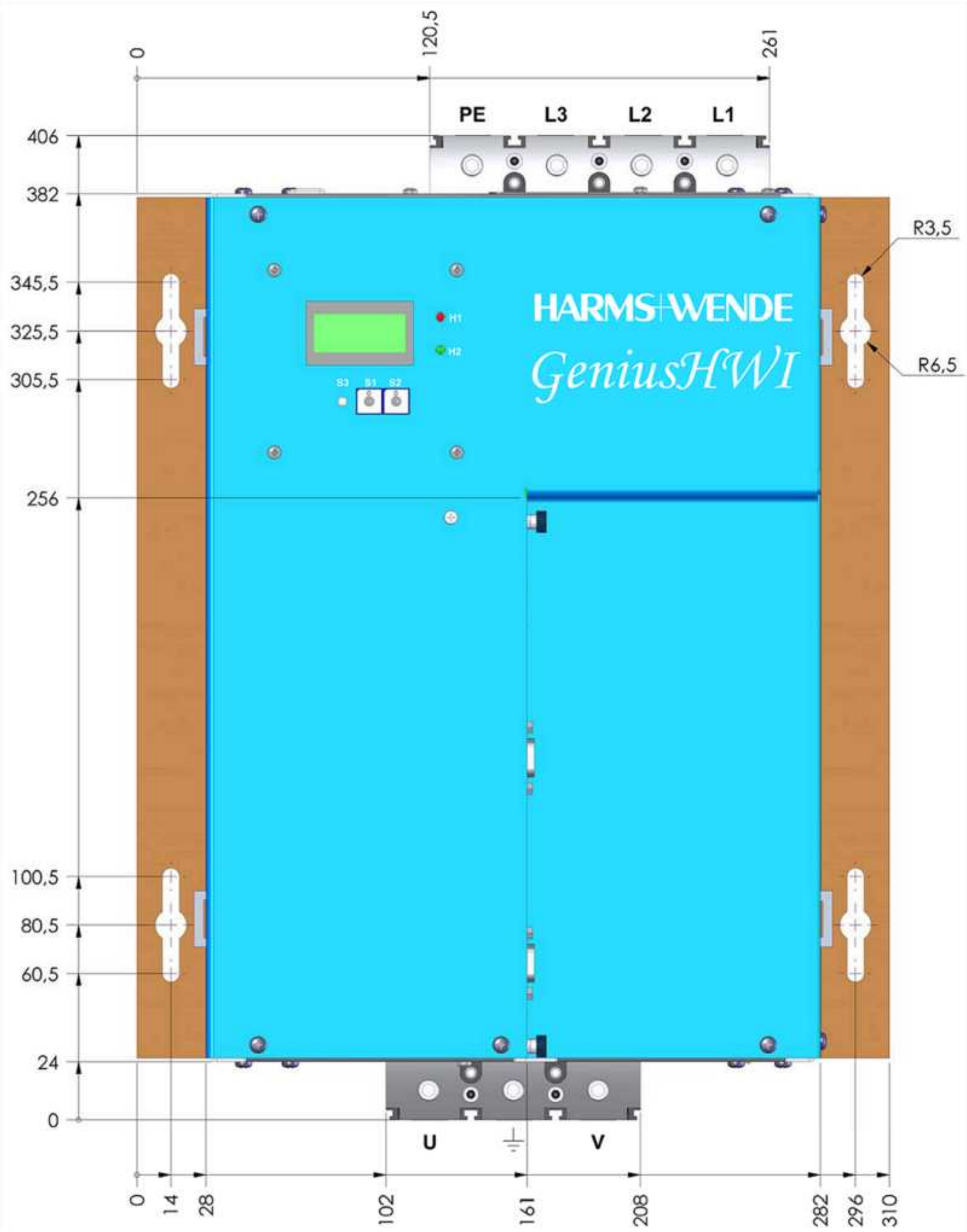


Fig. 18-5: HWIx03 – HWIx16, water-cooled, view from the front

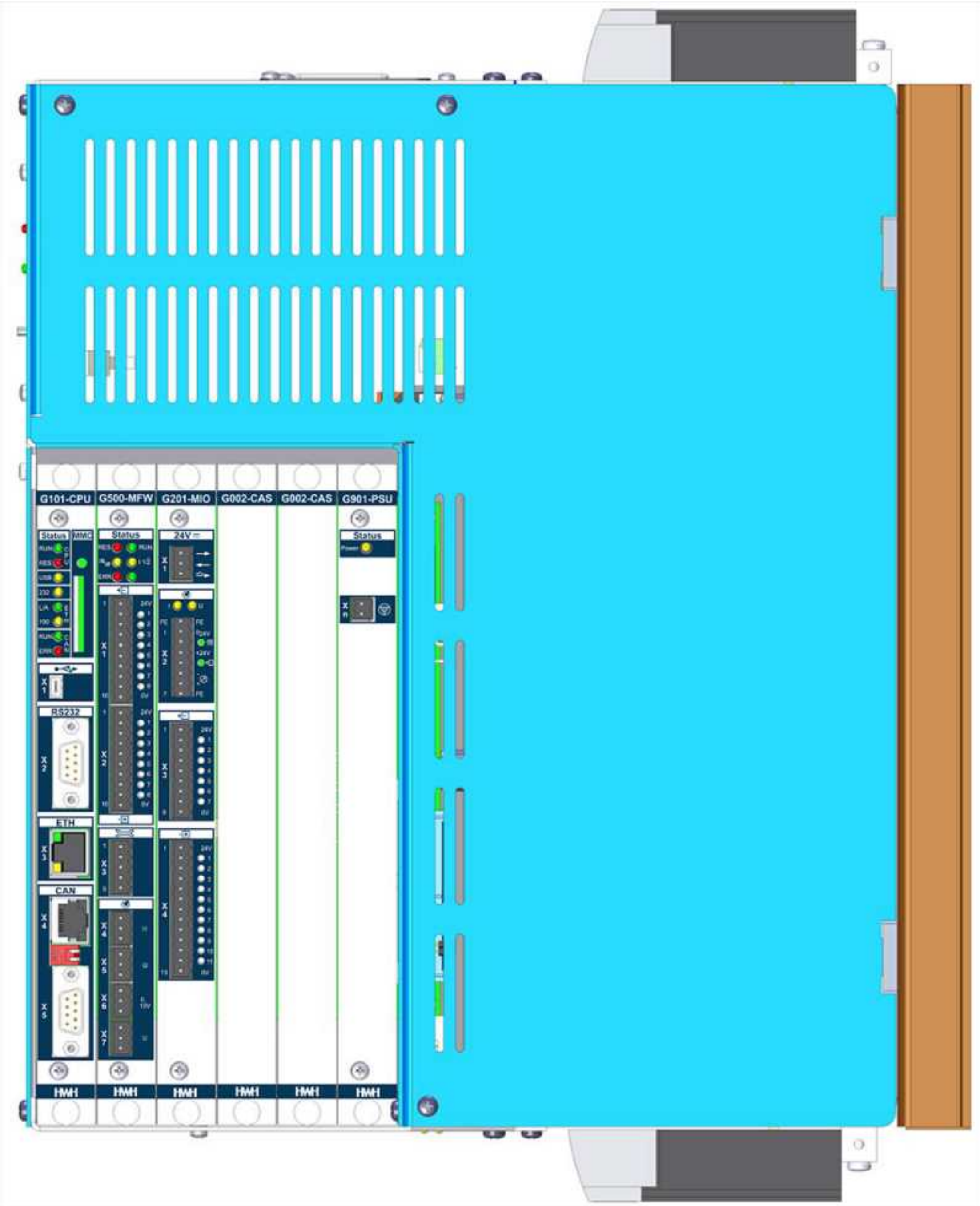


Fig. 18-6: HWIx03 – HWIx16, water-cooled, view from the right

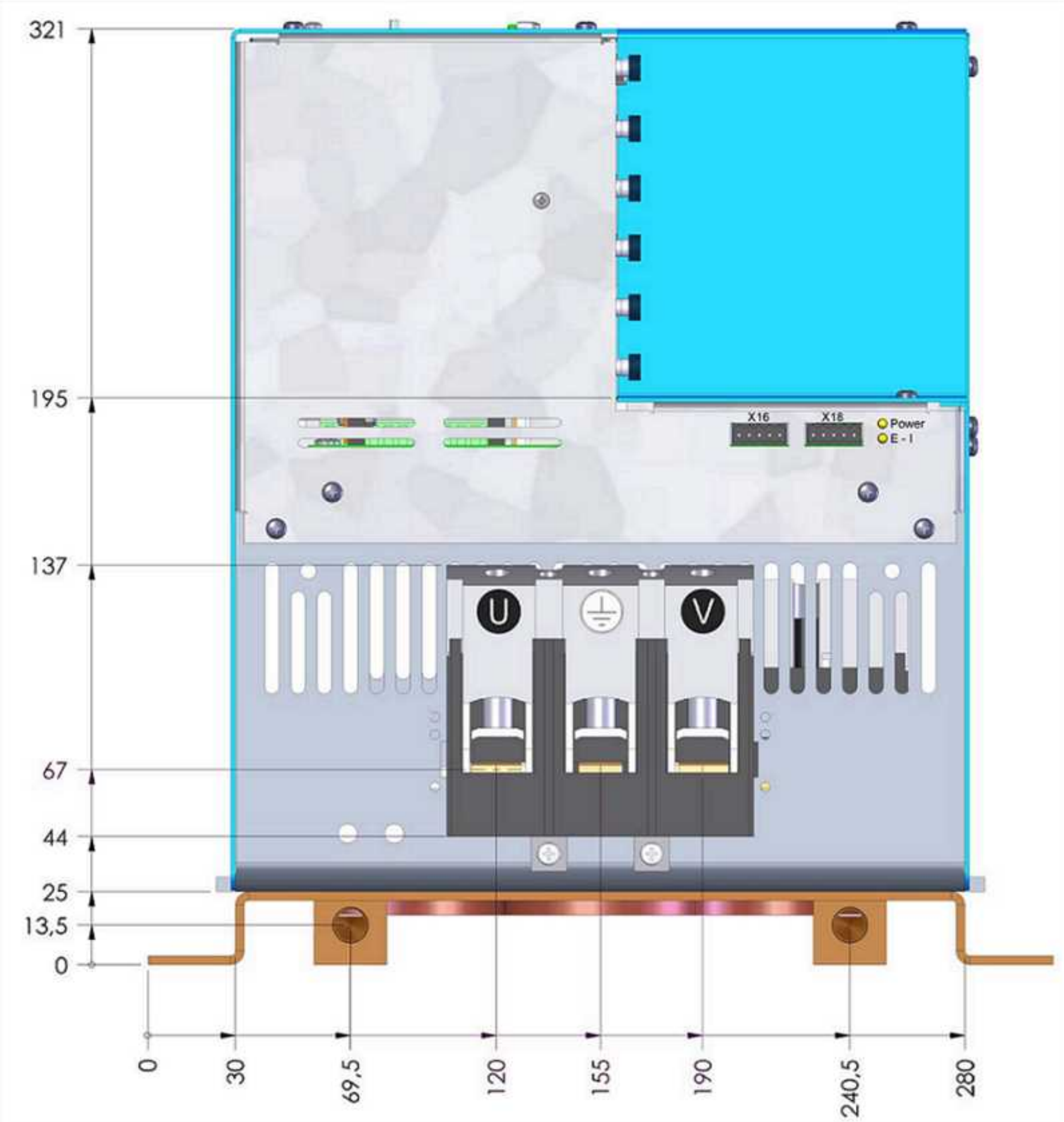


Fig. 18-7: HWIx03 – HWIx16, water-cooled, view from the bottom

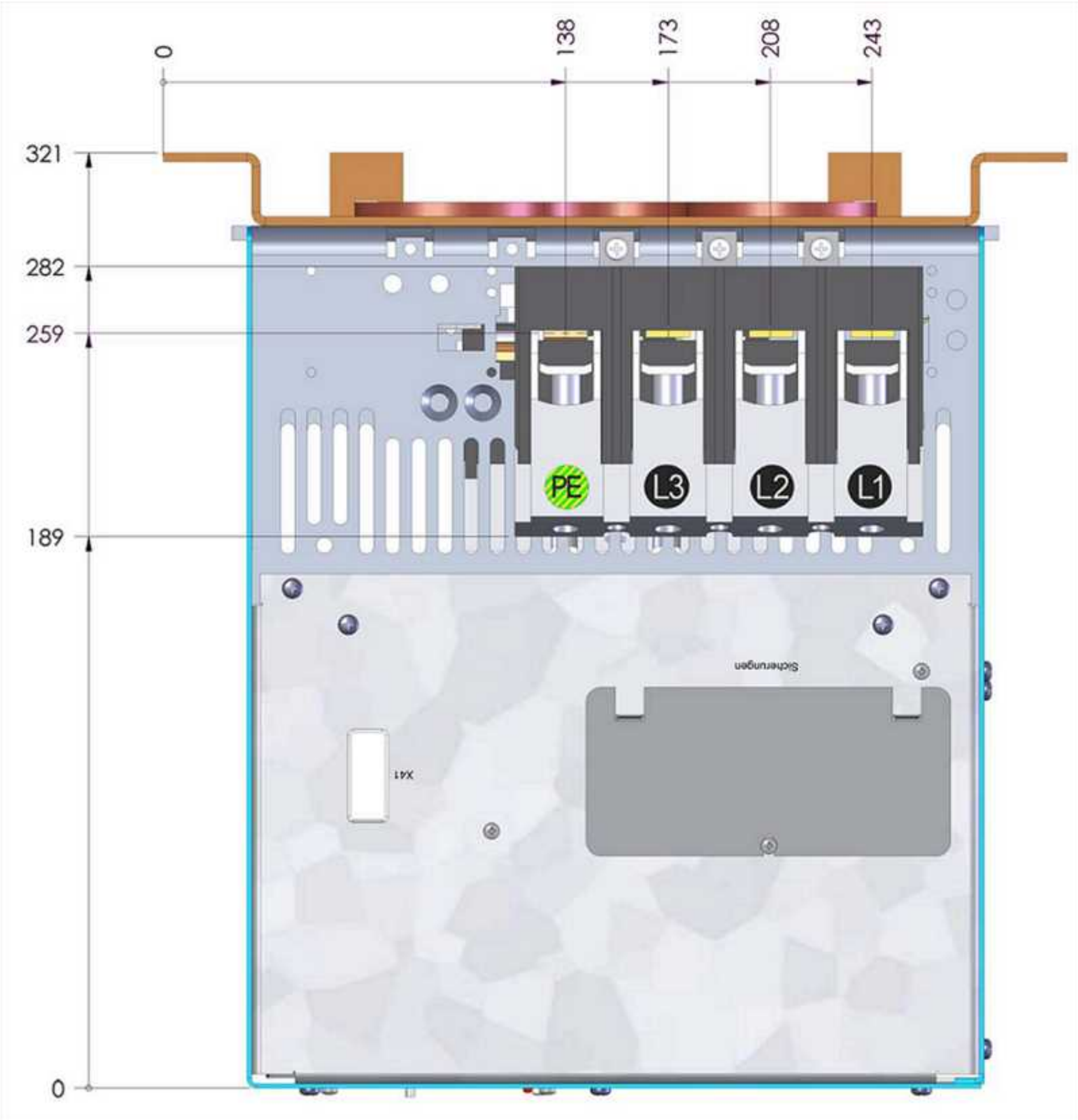


Fig. 18-8: HWIx03 – HWIx16, water-cooled, view from the top

HWIx03 – HWIx16, externally water-cooled

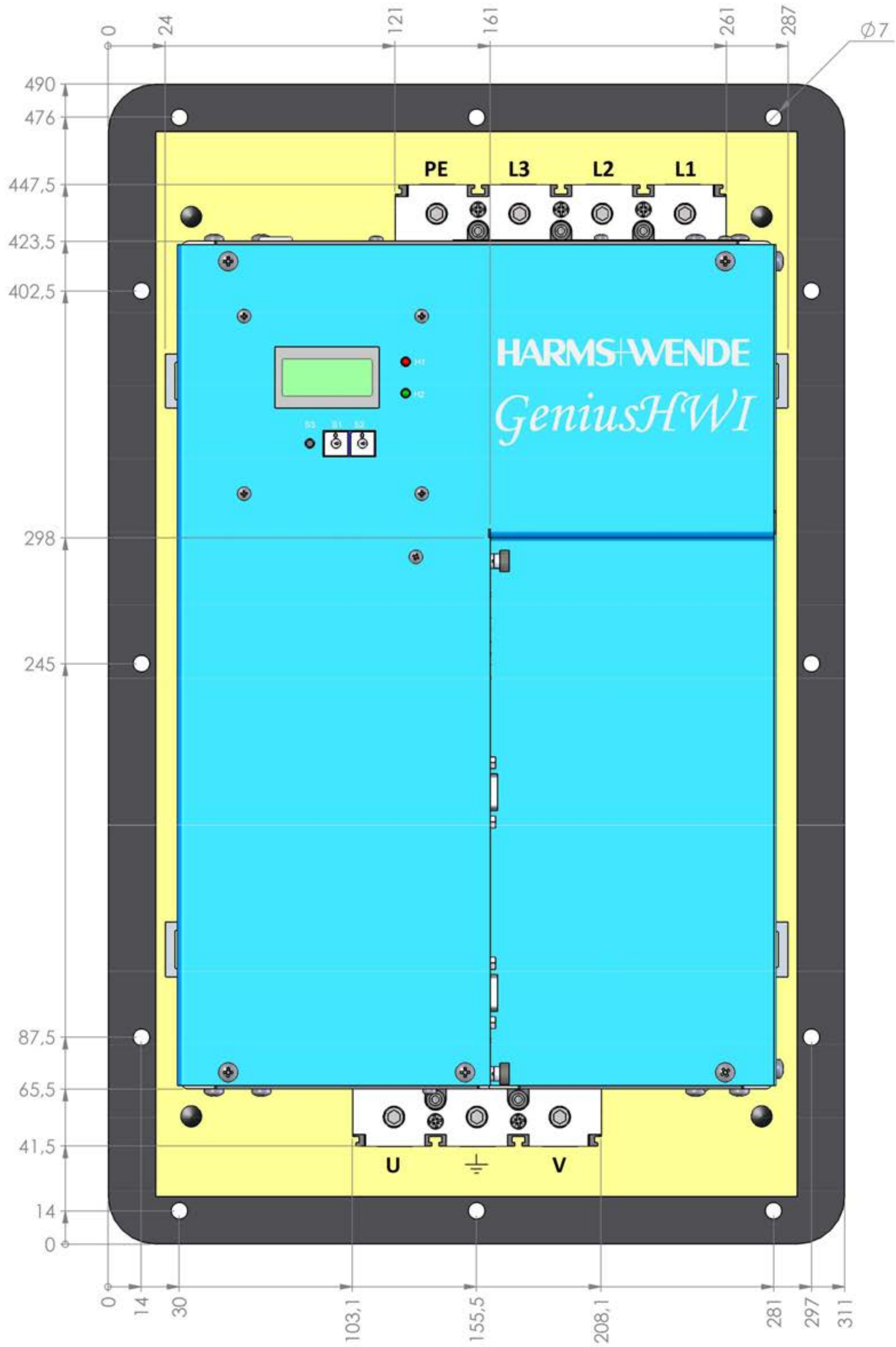


Fig. 18-9: HWIx03 – HWIx16, externally water-cooled, view from the front

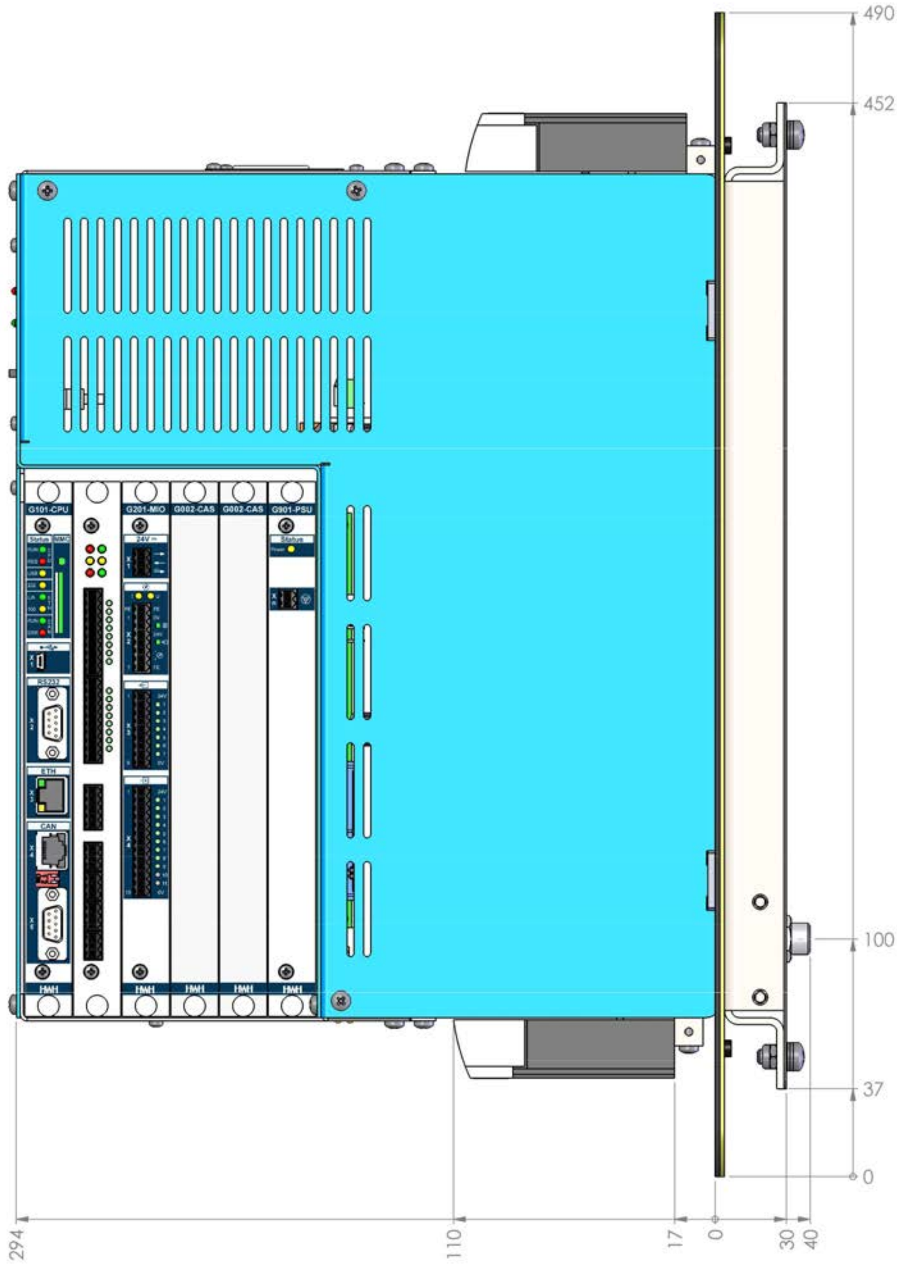


Fig. 18-10: HWIx03 – HWIx16, externally water-cooled, view from the right

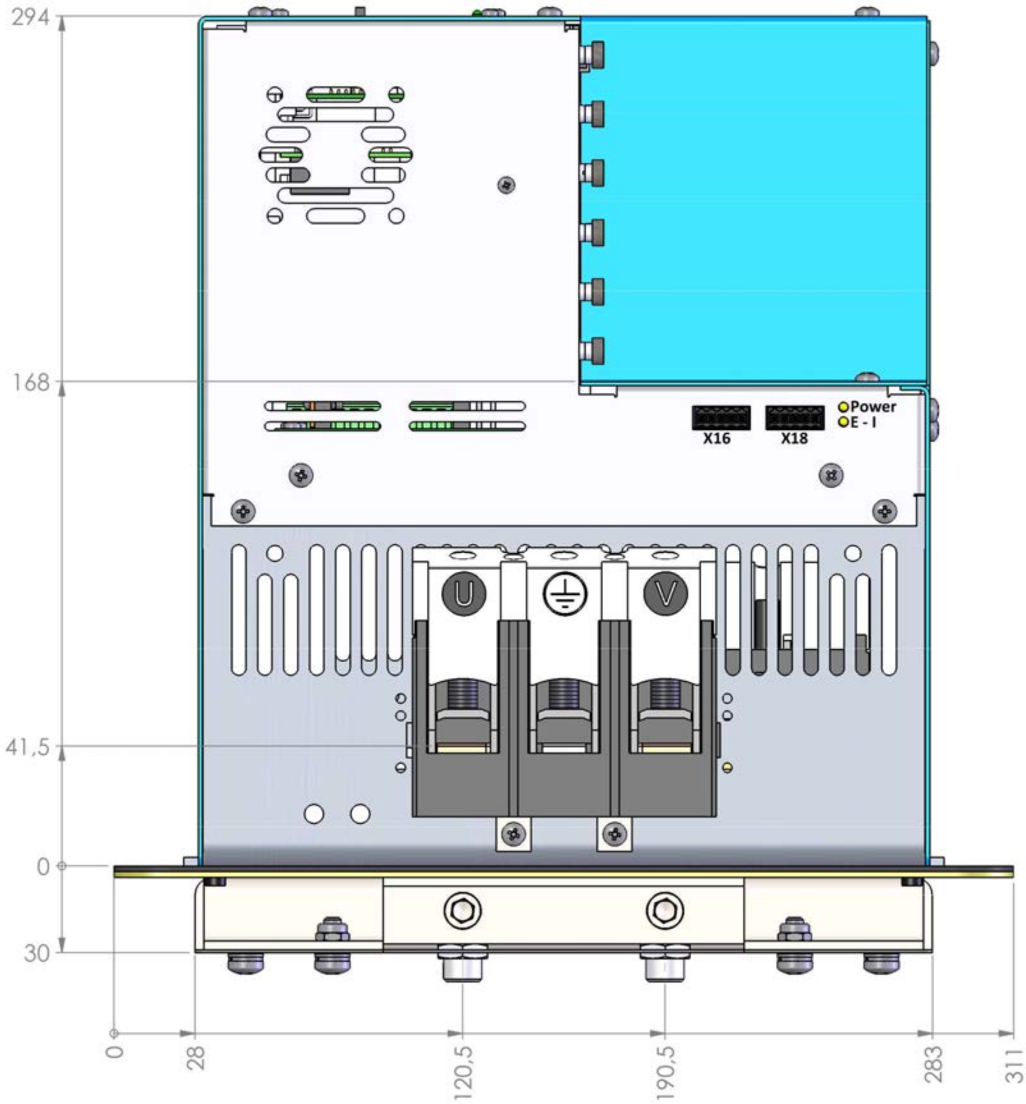


Fig. 18-11: HWIx03 – HWIx16, externally water-cooled, view from the bottom

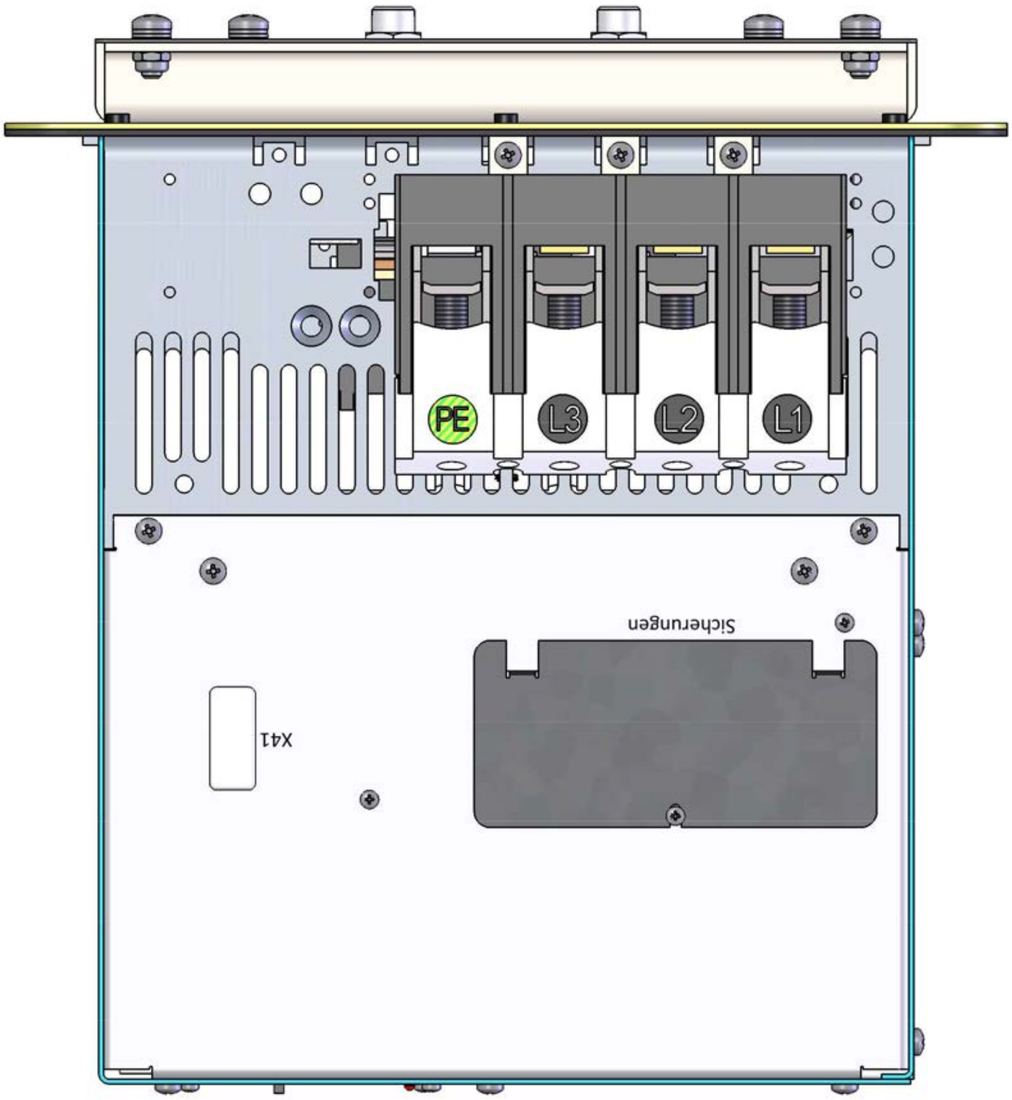


Fig. 18-12: HWIx03 – HWIx16, externally water-cooled, view from the top

HWIx24 – HWIx36, water-cooled

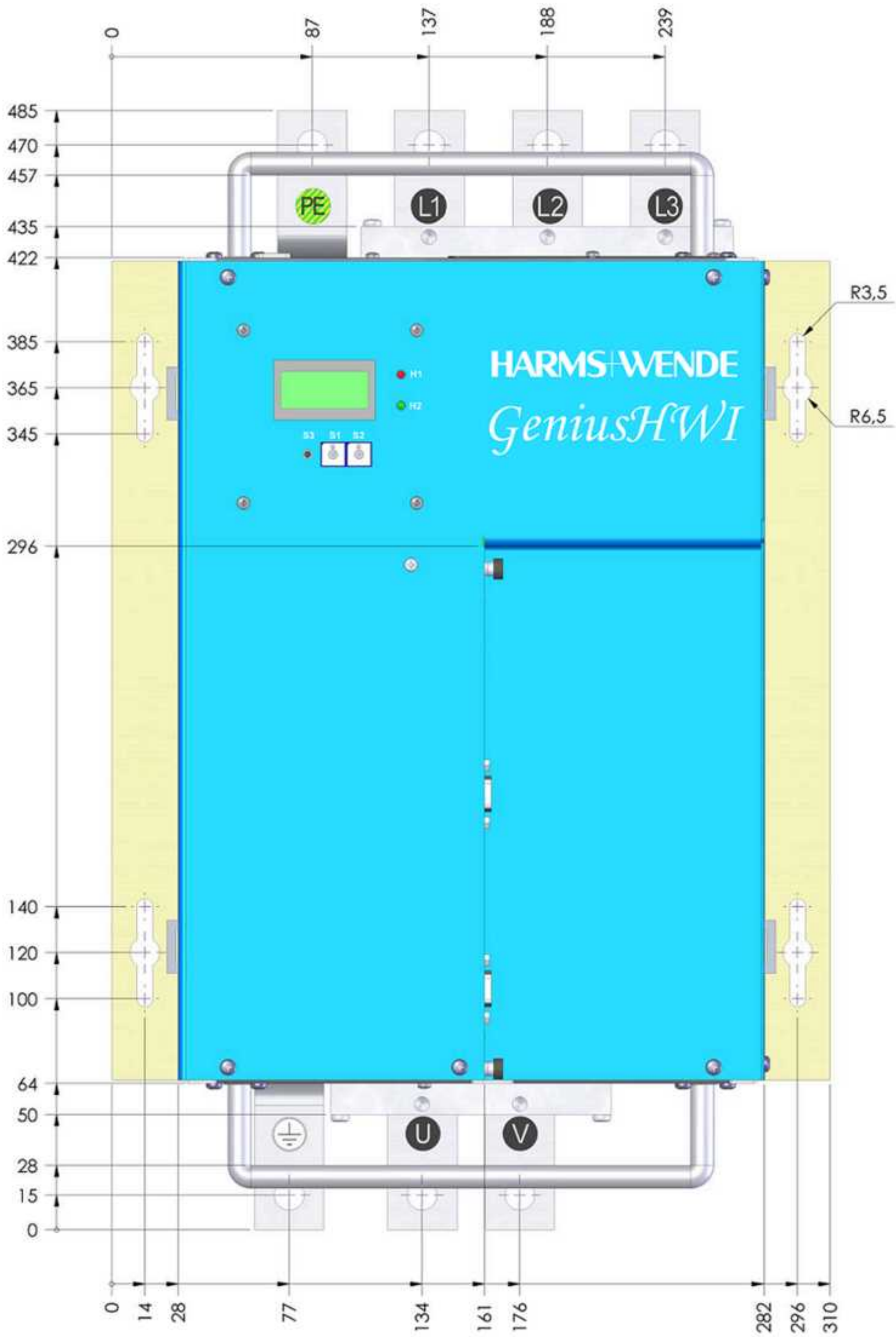


Fig. 18-13: HWIx24 – HWIx36, water-cooled, view from the front

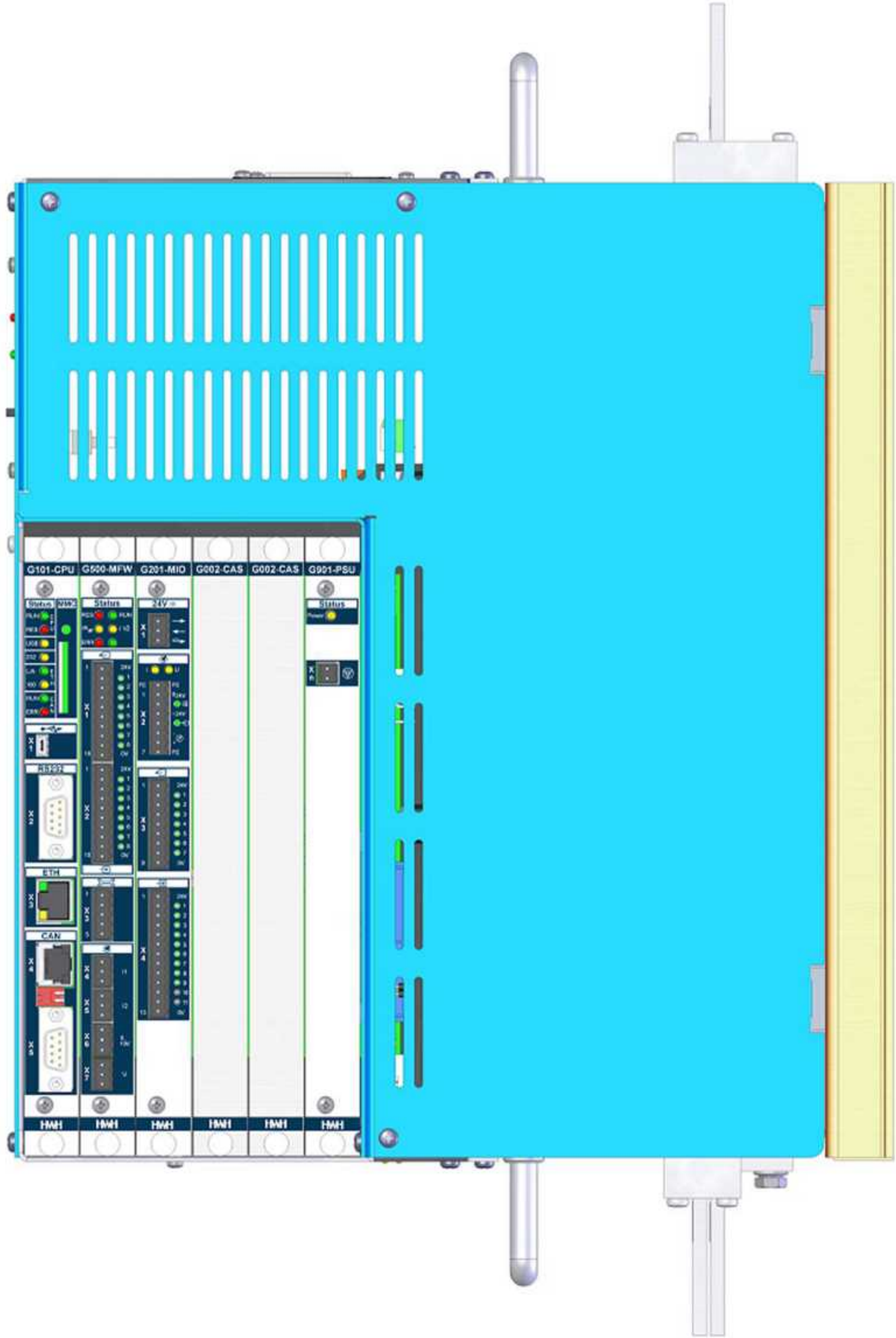


Fig. 18-14: HWIx24 – HWIx36, water-cooled, view from the right

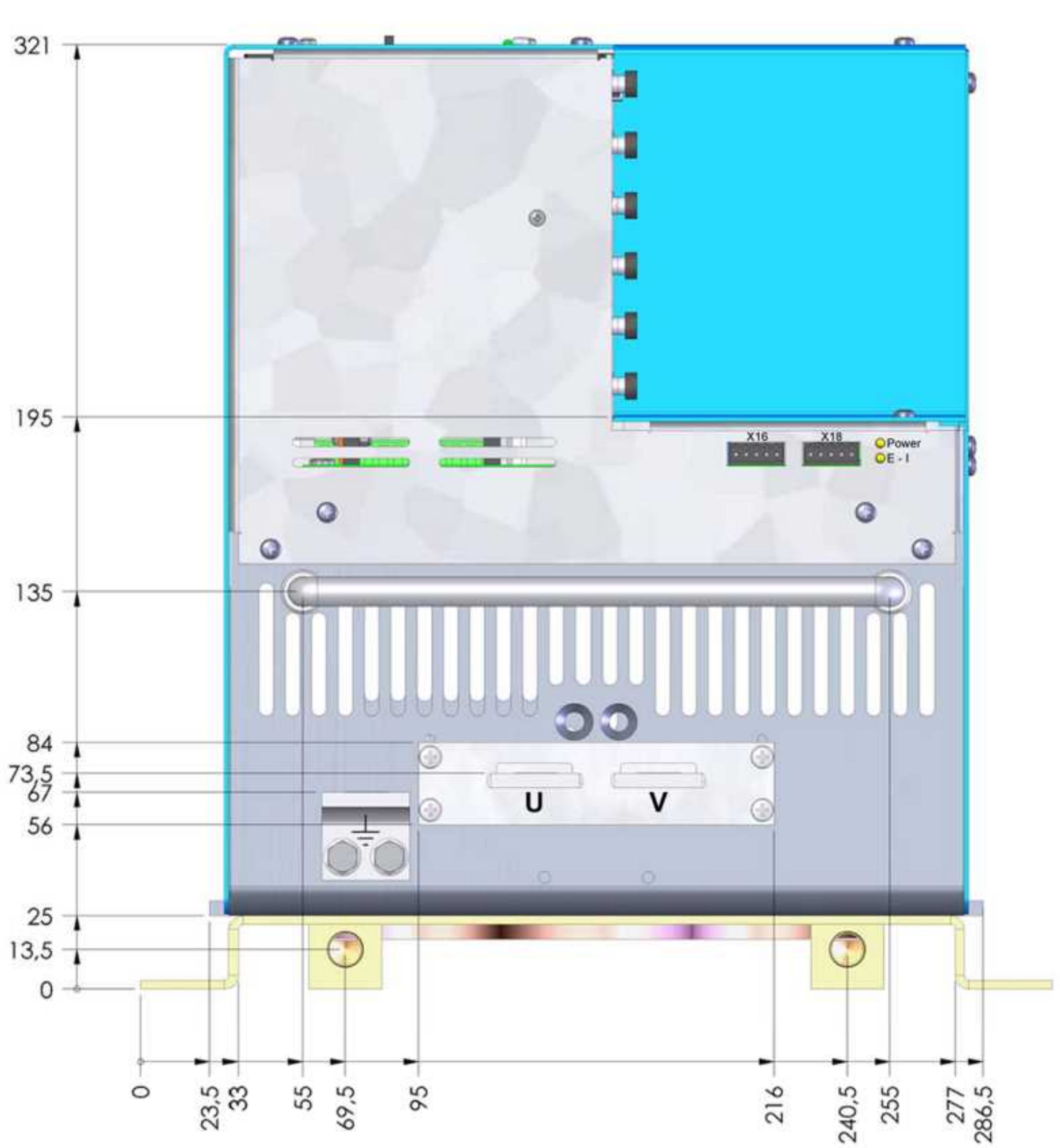


Fig. 18-15: HWIx24 – HWIx36, water-cooled, view from the bottom

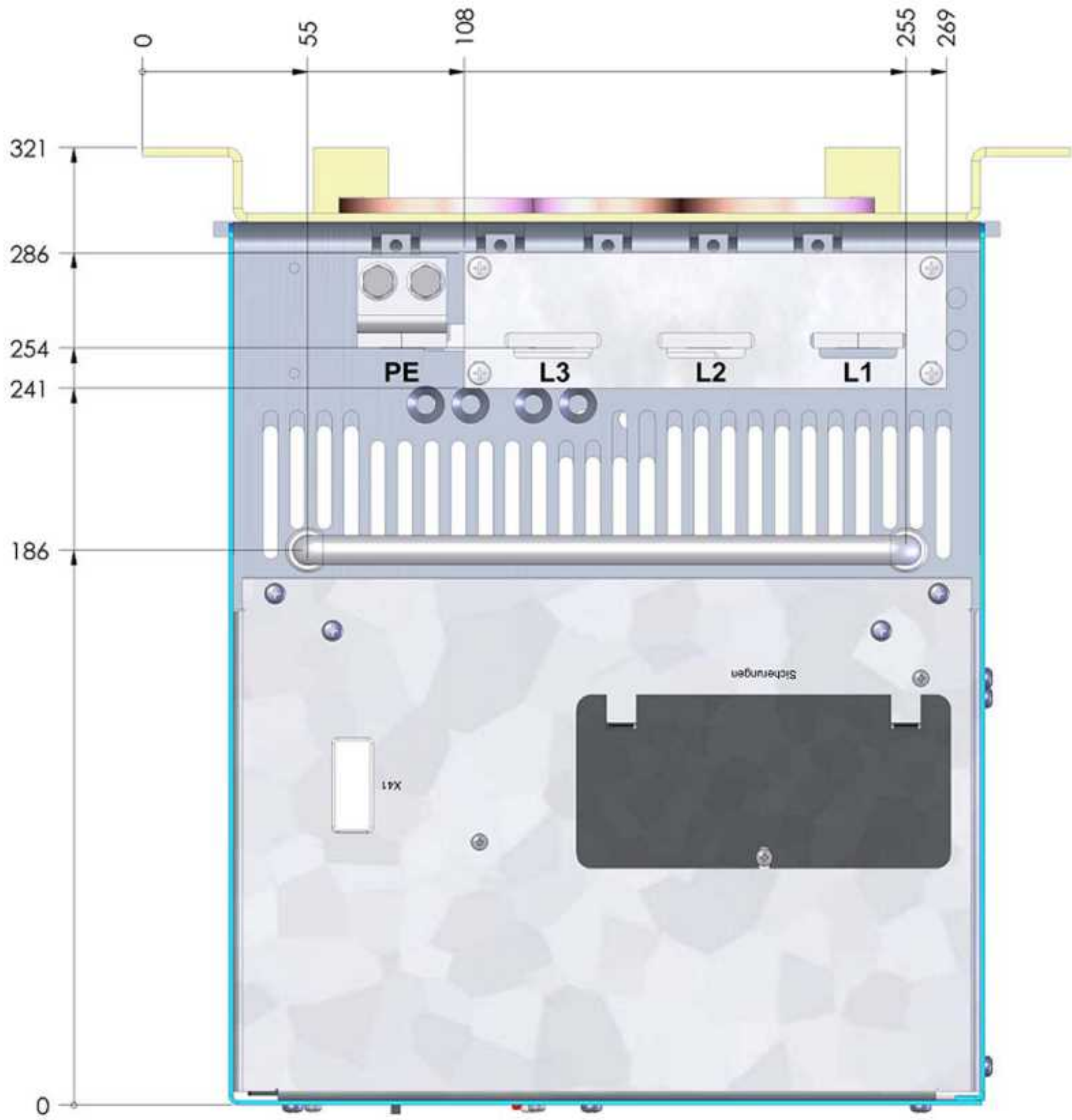


Fig. 18-16: HWIx24 – HWIx36, water-cooled, view from the top

HWIx24 – HWIx36, externally water-cooled

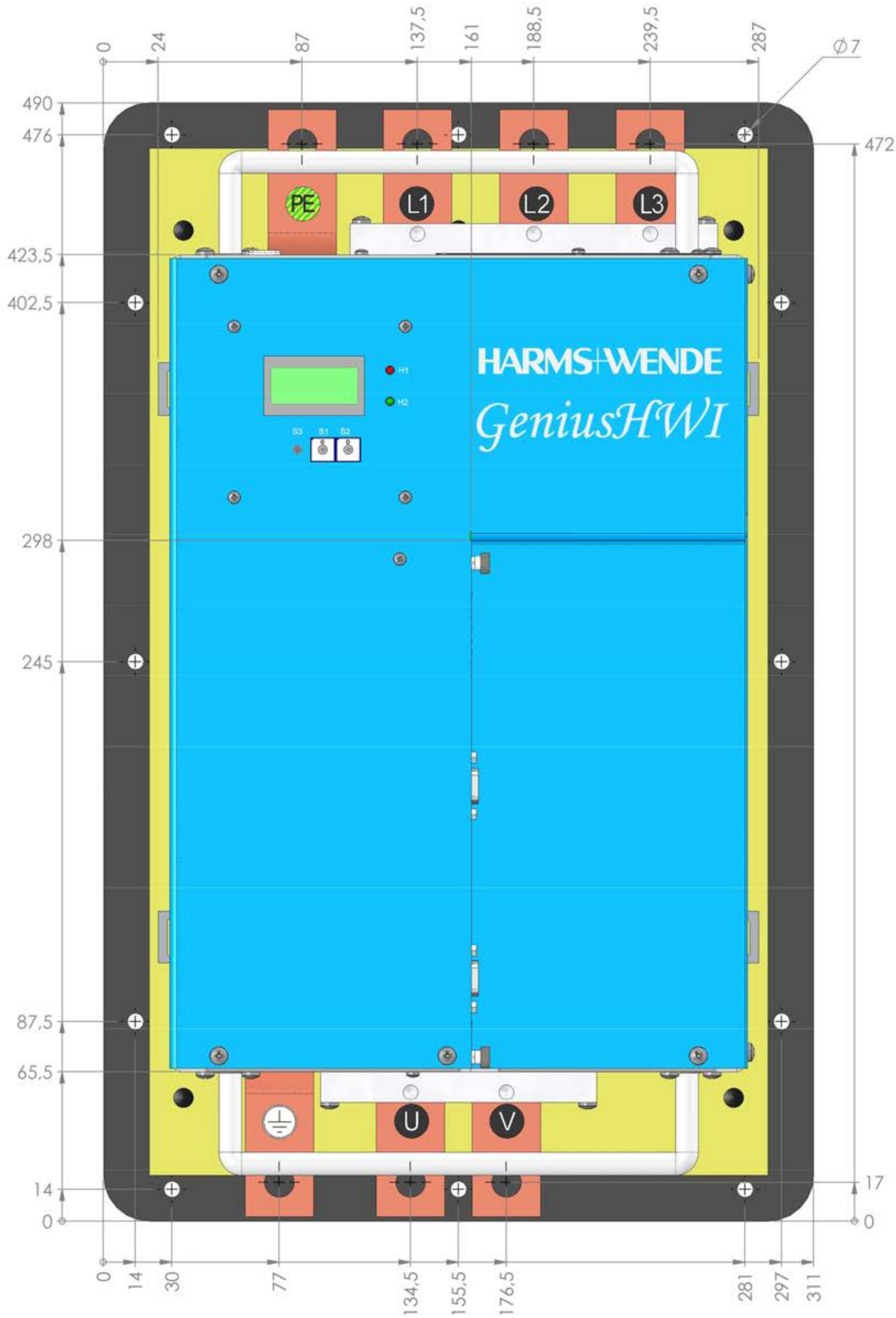


Fig. 18-17: HWIx24 – HWIx36, externally water-cooled, view from the front

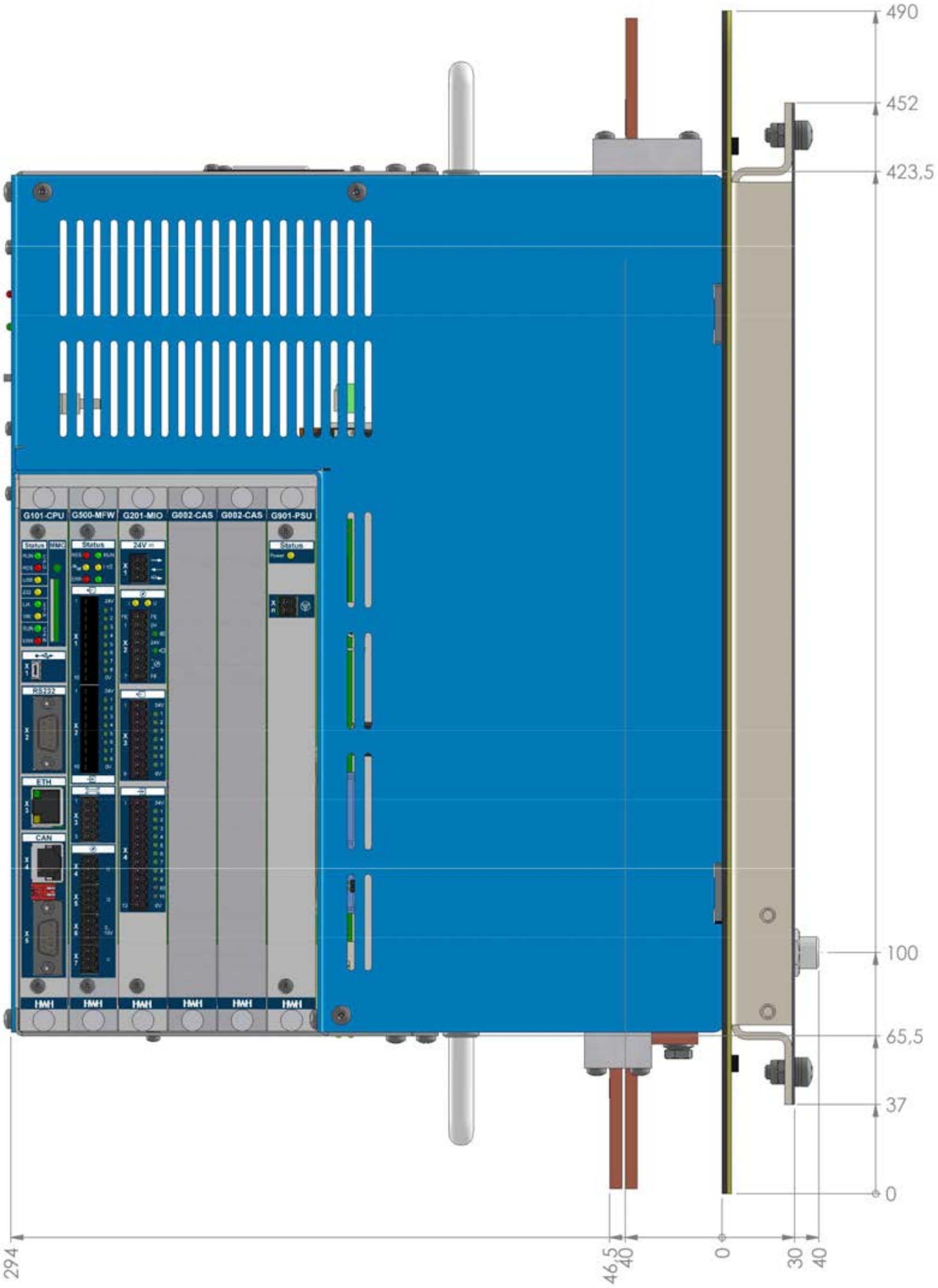


Fig. 18-18: HWIx24 – HWIx36, externally water-cooled, view from the right

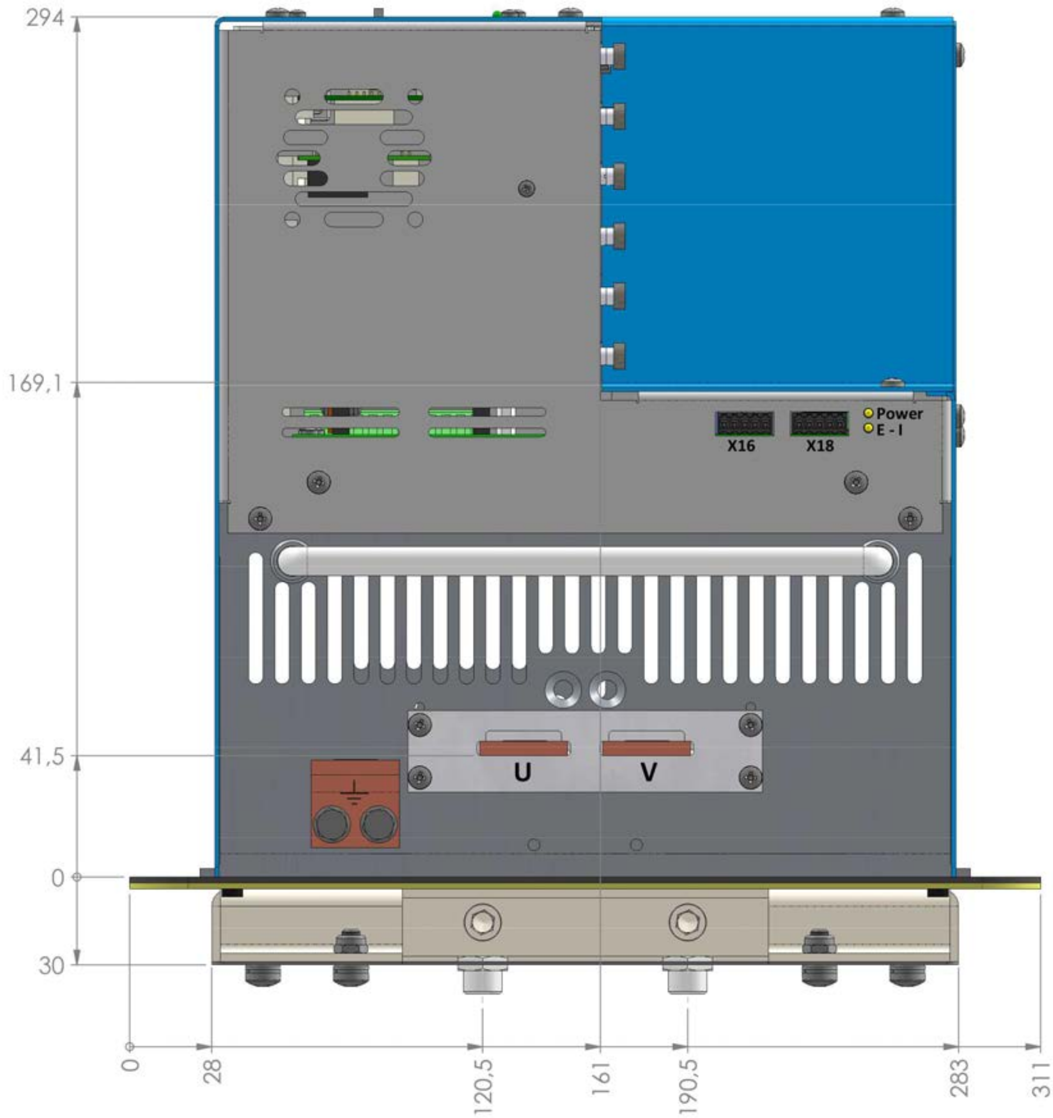


Fig. 18-19: HWIx24 – HWIx36, externally water-cooled, view from the bottom

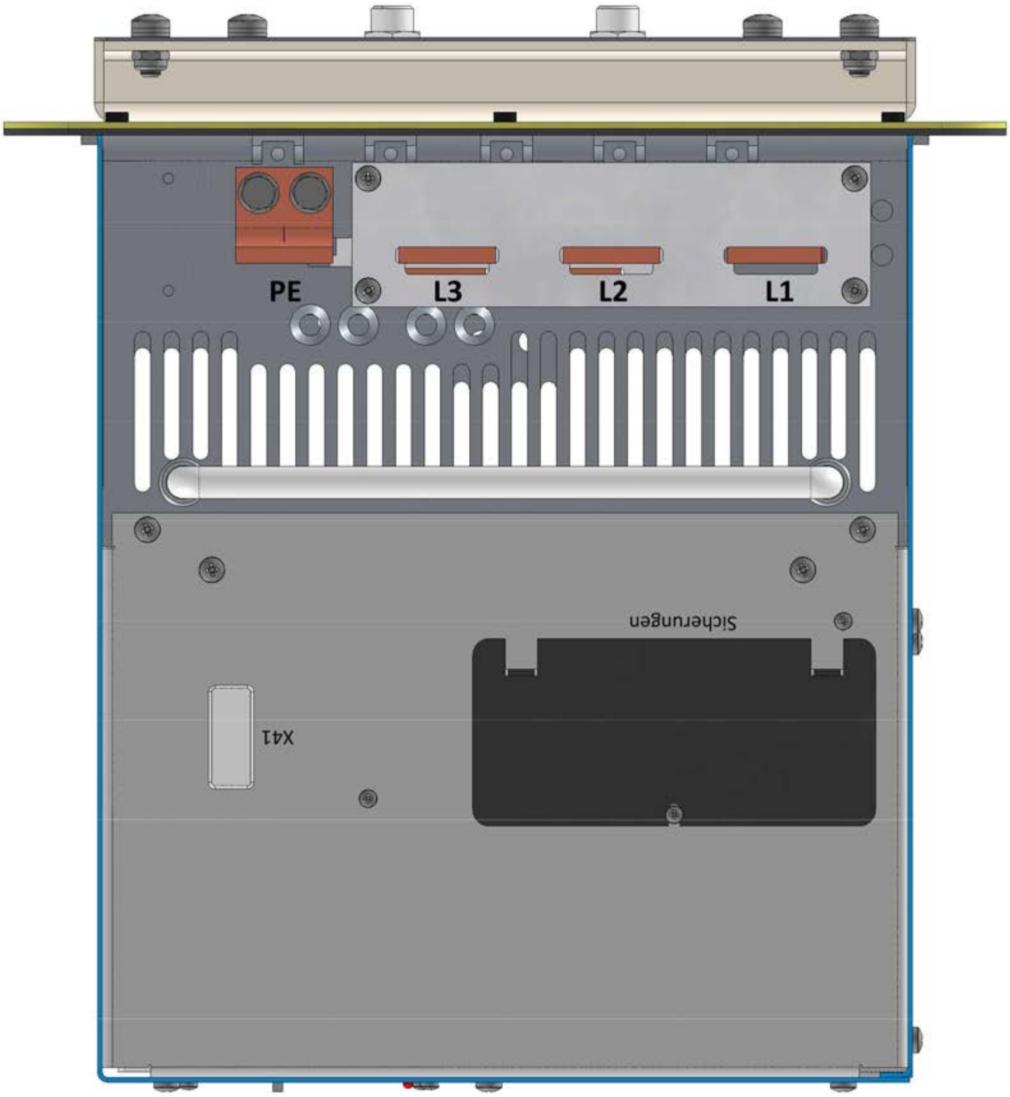


Fig. 18-20: HWIx24 – HWIx36, externally water-cooled, view from the top

Cabinet cut-out

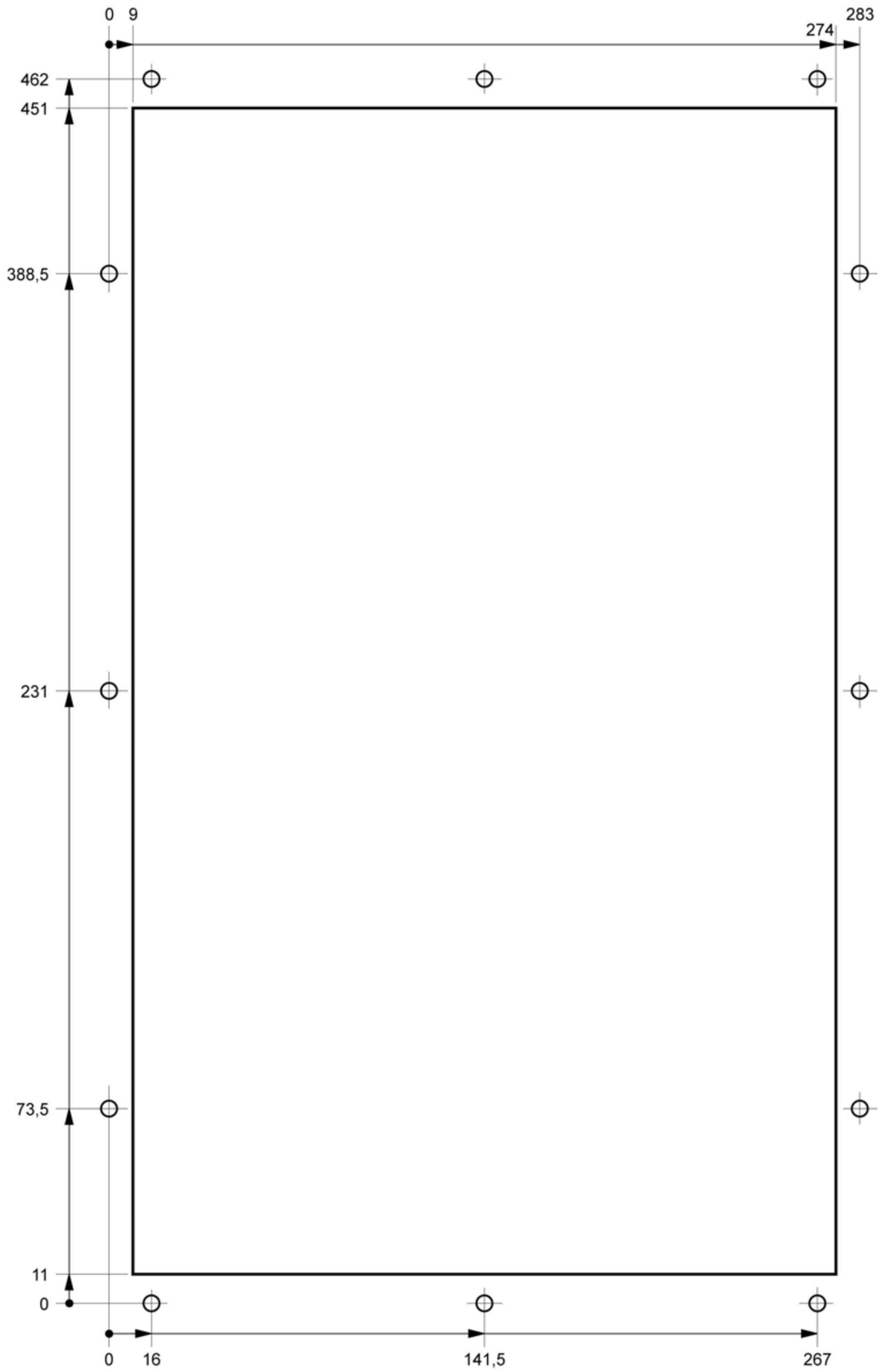


Fig. 18-21: Dimensions in mm, cabinet cut-out

18.11 HWI dimensions 3x40/3x45

All dimensions are specified in mm.

Exterior dimensions of the inverter without carrying handle

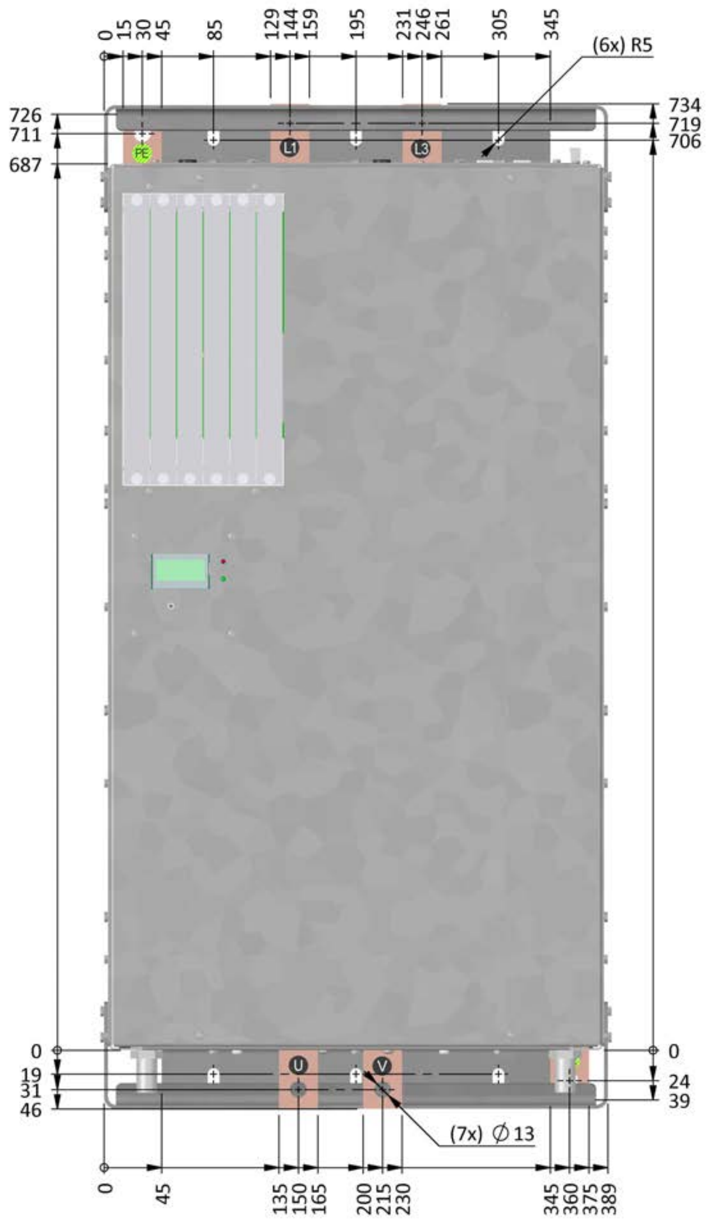


Fig. 18-22: HWI3x40 - HWI3x45, view from the front

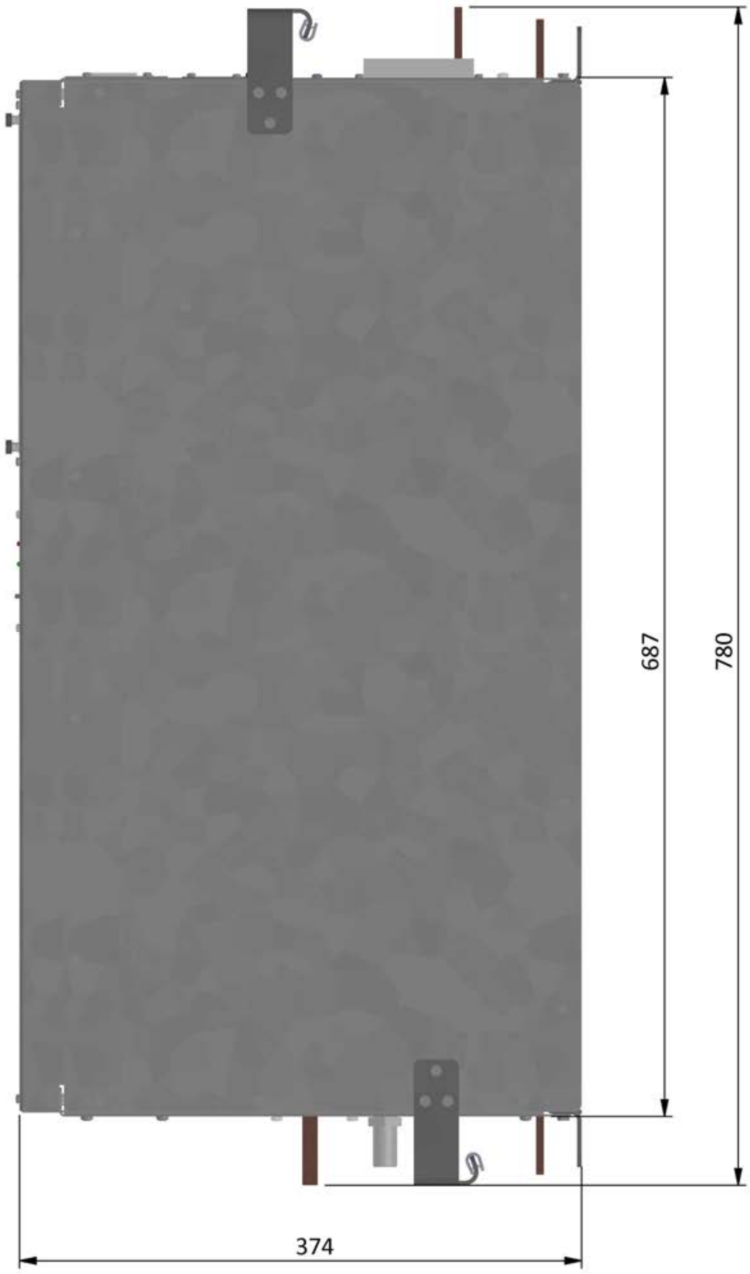


Fig. 18-23: HWI3x40 - HWI3x45, view from the right

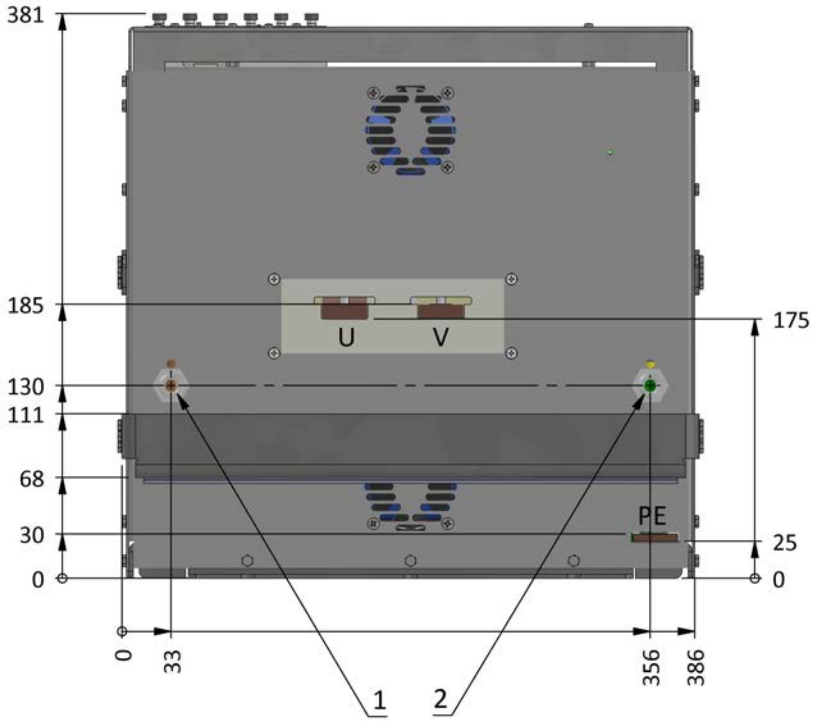


Fig. 18-24: HWI3x40 - HWI3x45, view from the bottom

1	Water connection - inlet
2	Water connection - outlet

Hose for water connections:

- 3/8" hose
- M16x1.5 external thread connection

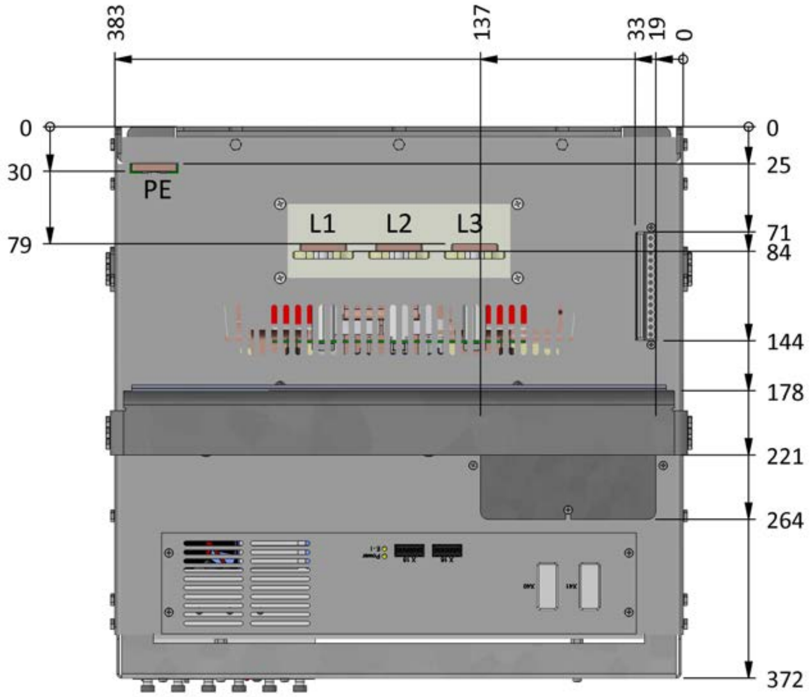


Fig. 18-25: HWI3x40 - HWI3x45, view from the top

19 Appendix

19.1 Available components

Amongst others, the components listed in the following are available for the GeniusHWI:

- Water cooling
- Manual electrode holder mode
- Master-slave mode

Plug-in modules

- Plug-in module for G101-CPU, central logic
- Plug-in module for G101-CPU with memory card slot, central logic
- Plug-in module for G102-CPU, central logic
- Plug-in module for G130-PLC, internal PLC
- Plug-in module for G200-DIO, digital inputs and outputs
- Plug-in module for G201-MIO, digital I/O with proportional valve
- Plug-in module for G202-AIO, analogue I/O, with proportional valve
- Plug-in module for G203-MIO, digital I/O with proportional valve
- Plug-in module for G400-IBS, InterBus optical
- Plug-in module for G401-IBS, InterBus electrical
- Plug-in module for G402-CAN, CANopen
- Plug-in module for G410-PBS, ProfiBus
- Plug-in module for G412-PNI, ProfiNet IRT electrical
- Plug-in module for G413-PNI, ProfiNet IRT optical
- Plug-in module for G415-DEV, DeviceNet
- Plug-in module for G416-CCL, CCLink
- Plug-in module for G500-MFW, welding control
- Plug-in module for G501-MFW, welding control
- Plug-in module for G502-SVG, servo electrode holder control system
- Plug-in module for G503-MFW, welding control
- Plug-in module for G610-MIO-PBS, digital inputs and outputs and ProfiBus
- Plug-in module for G611-MIO-PNR, digital inputs and outputs with proportional valve and ProfiNet
- Plug-in module for G612-MIO-PNI, digital inputs and outputs with proportional valve and ProfiNet IRT, electrical
- Plug-in module for G613-MIO-PNI, digital inputs and outputs with proportional valve and ProfiNet IRT, optical

- Plug-in module for G614-MIO-EIP, digital inputs and outputs with proportional valve and EthernetIP
- Plug-in module for G615-MIO-DEV, digital inputs and outputs with proportional valve and DeviceNet
- Plug-in module for G617-MIO-ECT, digital I/O with proportional valve and EtherCAT
- Plug-in module for G920-FAN, air cooling module

Monitoring and control

- I inspector (current)
- U inspector (voltage)
- F inspector (force)
- H inspector (control stroke)
- Q inspector (process flow)
- S inspector (travel measurement)
- SP inspector (spatter detection)
- TIP monitor (electrode management)
- Component documentation
- Q logic
- AMC - Aluminium Mode Classic
- AMF - Aluminium Mode Force
- IQR - intelligent quality control
- PQS – process and quality management system

19.2 Available quick guides

The following quick guides are available in German, and the majority also in English, in the download area:

- 35495-02de_HWH welding systems quick guides
- 36045-00de_initial commissioning quick guide
- 36046-01de_spot assignment quick guide
- 36047-01de_import/export quick guide
- 41079-00de_X process data archiving quick guide
- 35483-01de_Genius firmware update quick guide
- 36976-01de_measuring transducer MPS100_MPX101 quick guide
- 39818-01de_Genius incremental travel measurement TYPE_ST1278 quick guide
- 39912-00de_Genius incremental travel measurement TYPE_LS328C quick guide
- 40687-00de_inverter conversion supply voltage quick guide

The complete documentation is available in the download area at www.harms-wende.de or will be provided upon request. Registration is required to use the download area.

19.3 EU declaration of conformity

GeniusHWI403-408, GeniusHWI413-416

HWH	**EC declaration of conformity** **in accordance with the EC directives**	**FO 063** Edition 9

Document-No. - Index-No. / Year-Month: 0104 - 01 / 2016-09

Manufacturer: Harms & Wende GmbH & Co. KG
Welding systems

Address: Großmoorkehre 9
D-21079 Hamburg
Phone: +49 (40) 766 904-0

Product details (also see page 2)

Product name: MF-Inverter
Type: GeniusHWI403-408, GeniusHWI413-416
Article number: 27330, 27960
Year of manufacture:

The manufacturer declares that

[X] this product [ ] this machine

is in compliance with the essential requirements and provisions of the following directive:

[ ] **Directive 2006/42/EC on machinery**

[X] **Directive 2014/35/EU**

[X] **Directive 2014/30/EU (EMC)**

This declaration shall become null and void should any alterations be made to the product without our express approval.
The harmonised standards and technical specifications listed on page 2 have been applied.

The CE marking was affixed in the year 2013

Responsible for documentation: Michael Gercke

Place, Date: Hamburg, 2016-09-26

Signer: Ralf Bothfeld

Position of signatory: [X] General Manager
[ ] Deputy Manager

Legally binding signature:

This declaration does not include a property assurance.
The safety instructions given in the product documentation must be observed.

translation en

0104-01_2016-09-K_GeniusHWI403-408_413-416 (2).xlsx / 2016-01-20 / Ge 3/32

GeniusHWI424-436

HWH	**EC declaration of conformity** **in accordance with the EC directives**	**FO 063** Edition 9

Document-No. - Index-No. / Year-Month: 0071 - 01 / 2016-09

Manufacturer:	**Harms & Wende GmbH & Co. KG** **Welding systems**
Address:	**Großmoorkehre 9** **D-21079 Hamburg** **Phone: +49 (40) 766 904-0**
Product details	(also see page 2)
Product name:	MF-Inverter
Type:	GeniusHWI424-436
Article number:	27959
Year of manufacture:	

The manufacturer declares that

[X] this product [ ] this machine

is in compliance with the essential requirements and provisions of the following directive:

[ ] **Directive 2006/42/EC on machinery**

[X] **Directive 2014/35/EU**

[X] **Directive 2014/30/EU (EMC)**

This declaration shall become null and void should any alterations be made to the product without our express approval.
The harmonised standards and technical specifications listed on page 2 have been applied.

The CE marking was affixed in the year 2011

Responsible for documentation:	Michael Gercke
Place, Date:	Hamburg, 2016-09-26
Signer:	Ralf Bothfeld
Position of signatory:	[X] General Manager [ ] Deputy Manager

Legally binding signature:

This declaration does not include a property assurance.
The safety instructions given in the product documentation must be observed.

translation en

0071-01-K_2016-09_GeniusHWI424-436 .xlsx / 2016-01-20 / Ge 3/32

	EC declaration of conformity in accordance with the EC directives	FO 063 Edition 9

Applied harmonized standards:

Reference number:	Date of issue:	Reference number:	Date of issue:
EN 50178	1998-04		
EN 62135-1	2009-07		
EN 61000-6-2	2006-03		
EN 61000-6-4	2007-09		

Applied national standards:

Reference number:	Date of issue:	Reference number:	Date of issue:
VDE 0160	1998-04		
VDE 0545-1	2009-07		
VDE 0839-6-2	2006-03		
VDE 0839-6-4	2007-09		

Applied technical specifications:

Reference number:	Date of issue:	Reference number:	Date of issue:

Product details (continuation)

Product name: MF-Inverter

Type:	Article number:	Type:	Article number:

translation en

0071-01-K_2016-09_GeniusHWI424-436 .xlsx / 2016-01-20 / Ge 4/32

GeniusHWI503-508, GeniusHWI513-516

HWH	EC declaration of conformity in accordance with the EC directives	FO 063 Edition 9

Document-No. - Index-No. / Year-Month: 0097 - 01 / 2016-09

Manufacturer:	**Harms & Wende GmbH & Co. KG** **Welding systems**
Address:	**Großmoorkehre 9** **D-21079 Hamburg** **Phone: +49 (40) 766 904-0**
Product details	(also see page 2)
Product name:	MF-Inverter
Type:	GeniusHWI503-508, GeniusHWI513-516
Article number:	34504, 31496
Year of manufacture:	

The manufacturer declares that

[X] this product [ ] this machine

is in compliance with the essential requirements and provisions of the following directive:

[ ] **Directive 2006/42/EC on machinery**

[X] **Directive 2014/35/EU**

[X] **Directive 2014/30/EU (EMC)**

This declaration shall become null and void should any alterations be made to the product without our express approval.
The harmonised standards and technical specifications listed on page 2 have been applied.

The CE marking was affixed in the year 2012

Responsible for documentation:	Michael Gercke
Place, Date:	Hamburg, 2016-09-26
Signer:	Ralf Bothfeld
Position of signatory:	[X] General Manager [ ] Deputy Manager

Legally binding signature:

This declaration does not include a property assurance.
The safety instructions given in the product documentation must be observed.

translation en

0097-01_2016-09-K_GeniusHWI503-508_513-516.xlsx / 2016-01-20 / Ge 3/32

HWH	EC declaration of conformity in accordance with the EC directives	FO 063 Edition 9

Applied harmonized standards:

Reference number:	Date of issue:	Reference number:	Date of issue:
EN 50178	1998-04		
EN 62135-1	2009-07		
EN 61000-6-2	2006-03		
EN 61000-6-4	2007-09		

Applied national standards:

Reference number:	Date of issue:	Reference number:	Date of issue:
VDE 0160	1998-04		
VDE 0545-1	2009-07		
VDE 0839-6-2	2006-03		
VDE 0839-6-4	2007-09		

Applied technical specifications:

Reference number:	Date of issue:	Reference number:	Date of issue:

Product details (continuation)

Product name: MF-Inverter

Type:	Article number:	Type:	Article number:

translation en

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GeniusHWI524-536

HWH	EC declaration of conformity in accordance with the EC directives	FO 063 Edition 9

Document-No. - Index-No. / Year-Month: 0105 - 01 / 2016-09

Manufacturer:	**Harms & Wende GmbH & Co. KG** **Welding systems**
Address:	**Großmoorkehre 9** **D-21079 Hamburg** **Phone: +49 (40) 766 904-0**
Product details	(also see page 2)
Product name:	MF-Inverter
Type:	GeniusHWI524-536
Article number:	32581
Year of manufacture:	

The manufacturer declares that

[X] this product [ ] this machine

is in compliance with the essential requirements and provisions of the following directive:

[ ] **Directive 2006/42/EC on machinery**

[X] **Directive 2014/35/EU**

[X] **Directive 2014/30/EU (EMC)**

This declaration shall become null and void should any alterations be made to the product without our express approval.
The harmonised standards and technical specifications listed on page 2 have been applied.

The CE marking was affixed in the year 2013

Responsible for documentation:		Michael Gercke
Place, Date:	Hamburg,	2016-09-26
Signer:		Ralf Bothfeld
Position of signatory:		[X] General Manager [ ] Deputy Manager
Legally binding signature:		

This declaration does not include a property assurance.
The safety instructions given in the product documentation must be observed.

translation en

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HWH	EC declaration of conformity in accordance with the EC directives	FO 063 Edition 9

Applied harmonized standards:

Reference number:	Date of issue:	Reference number:	Date of issue:
EN 50178	1998-04		
EN 62135-1	2009-07		
EN 61000-6-2	2006-03		
EN 61000-6-4	2007-09		

Applied national standards:

Reference number:	Date of issue:	Reference number:	Date of issue:
VDE 0160	1998-04		
VDE 0545-1	2009-07		
VDE 0839-6-2	2006-03		
VDE 0839-6-4	2007-09		

Applied technical specifications:

Reference number:	Date of issue:	Reference number:	Date of issue:

Product details (continuation)

Product name: MF-Inverter

Type:	Article number:	Type:	Article number:

translation en

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19.4 Table of figures

19.5 Abbreviations

+

+Imess / -Imess
Current sensor

+Isek / -Isek
Secondary current measurement

+Isoll / -Isoll
Analogue secondary voltage measurement

+TEMP1 / -TEMP1
Temperature measurement 1

+TEMP2 / -TEMP2
Temperature measurement 2

+U_POT1
Supply for distance measuring potentiometer 1

+U_SENSE1
Sensor connection for potentiometer supply 1

+Usek / -Usek
Secondary voltage measurement

0

0V_POT1
0 V of supply for distance measuring potentiometer 1

0V_SENSE1
0 V sensor cable connection for potentiometer supply 1

A

A
Ampere

ABZ
Start delay time

AC
Alternating current

B

b.i.O.
Not in order

BTB
Operational

C

CAN
Controller Area Network

CPU
Central Processing Unit

D

DC
Direct current

DK
Pressure contact

DS
Current decrease time (down slope time)

E

EGB
Electrostatically sensitive components

ENP
First delayed half-wave after pause time

ESD
Electrostatic discharging

EVH
First delayed half-wave

ext.
External, from outside

F

F
Force

FAT
File Allocation Table

FE
Functional earth

FEHLER-RES
Error reset input

FI
Fault current protection

FK
Stepping contact

G

GB
Gigabyte

GND-ZT1
Ignition transformer 1 ground

GW
Limit value

H

HBT
Manual control unit

Hz
Hertz

I

I
Current

i.O.
In order

IG1
Current limit for pre-heating current

IG2
Current limit for main current

IG3
Current limit for post-heating current

IGBT
Insulated Gate Bipolar Transistor

IMP
Pulses

IQR
Integrated quality control

IRT
Isochronous Real Time

J

JJJJ-MM-TT
Year-Month-Day (date format)

K

kA
Kiloampere

KSR
Constant current regulation

L

LED
Light-emitting diode

LSB
Least Significant Bit

M

MG
Measuring coil

MSB
Most Significant Bit

MV
Solenoid valve

N

n.c.
Not connected

n.i.O.
Not okay

NBS
Mains load limitation control

NHZ
Dwell time

NOT
Emergency stop

NWZ
Post-heating time

O

OHZ
Open time

P

PE
Protection earth

Per
Period

PKT
Spot

PKTZ
Spot counter

PQS
Process and quality management system

PROG
Program

PROP VENTIL
Proportional valve

PWH
Spot repetition

PZ
Pause time

R

RCD
Residual Current Protective Device

RKZ
Recooling time

RT
Real Time

S

SAZ
Current increase time (up slope time)

SFR
Initial milling

SHLD
Shielding

SKT
Scale division

SPS
Programmable logic controller

STP
Shielded Twisted Pair

SWZ
Welding time

SZ
Current time (main current time)

T

t
Time

TEMP
Temperature

TEMPKON
Temperature contact

U

U
Voltage

U_MESS1
Measurement signal connection of distance measuring potentiometer 1

Uac
Compare mains voltage

UacA
Mains voltage actual value

UacMin
Permissible minimum value below which a message is output

UacS
Mains voltage nominal value

USB
Universal Serial Bus

Usek
Secondary voltage measurement

USYNC
Synchronising voltage

UTP
Unshielded Twisted Pair

V

V
Volt

VDE
VDE (Association for Electrical, Electronic & Information Technologies)

VH
Pre-stroke

VHZ
Squeeze time

vVHZ
First prolonged squeeze time

VWZ
Pre-heating time

VZ
Interlock addition

Z

Zgrp
Counter group

ZME
Gun measuring unit

ZT
Ignition transformer

19.6 Index

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20 Pin assignments

Your individual pin assignments can be found on the following pages or in the download area at www.harms-wende.de.

Registration is required to use the download area.

HARMS+WENDE GROUP

HWH

Harms & Wende GmbH & Co. KG

Grossmoorkehre 9
21079 Hamburg

Germany

Tel.: +49 40 766 904-0

Service: +49 40 766 904-84

Fax: +49 40 766 904-88

E-Mail: hwh@harms-wende.de
Internet: www.harms-wende.de

Harms & Wende International

Your global partner: established in Hamburg

ISO 9001 CERTIFICATION Intertek

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