L 309.150 / L 309.250

Power Supply Module
Technical Information

Edition

104

L 309.150 / L 309.250

Power Supply Module
Technical Information

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Safety instructions

The product described here has been developed, manufactured and tested in compliance with the fundamental safety requirements of the EC machinery directive.

Nevertheless, there is some residual risk!

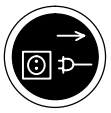
Therefore, you should read this manual before installing, connecting or commissioning the product, and store it in a place to which all users have access at any time!

Description of pictographs and symbols

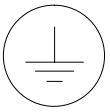
The following warnings and notes may be attached **to the actual timer components** which are designed to inform the user on certain features:

- Warning of dangerous voltages!

- Components subject to electrostatic induction!



- Disconnect mains plug before opening!



- Bolt exclusively designed for PE (protective earth) conductor!

- Only for shield conductor connection!

There is a certain **hierarchy of warnings** in **this manual**. The warnings are printed in **bold letters** and marked by a warning sign at the margin.

The hierarchy of the warnings is as follows:

1. WARNING
2. CAUTION
3. NOTE

WARNING!

The term **WARNING** will be used wherever **danger is imminent.**
The possible consequences may be death or severe injury (personal injury).

CAUTION!

The term **CAUTION** will be used wherever a **dangerous situation is possible.**
The possible consequences include severe or light injury (personal injury), damage to property or environmental hazards.

NOTE

The term **NOTE** will be used for making **recommendations on the use.**
Non-compliance with these recommendations may result in damage to property, e.g. to the machine or the workpiece.

Warning of magnetic fields

In the environment of resistance welding systems magnetic field strengths have to be expected which usually are below the limits specified in VDE 0848 Part 4; in cases of doubt, the field strength must be measured.

WARNING!

The function of cardiac pacemakers may be disturbed!
The possible consequences include death or severe bodily injuries of persons with cardiac pacemakers! These persons have to avoid the welding system.
We recommend posting a warning of the type shown below at all entrances to factory halls containing resistance welding equipment:

No entry for persons with cardiac pacemakers!
Danger!

DIN 40023

CAUTION!

When using manual welding guns, the limit values may be exceeded for the extremities. In this case, additional work protection measures must be taken.

Intended use

The power supply module is used for controlling the welding transformer.
The power supply modules in connection with suitable welding transformers and the PSS.../PSH... timer modules serve for

- **resistance welding of metals** and are suitable for operation only
- **in industrial environments**

in accordance with DIN EN 50082-2 and 50081-2 concerning electromagnetic compatibility (EMC).

The timers are not intended for any other use!

CAUTION!

The use for purposes other than the intended use may result in personal damage to the user or third persons or damage to the equipment, the workpiece to be welded or environmental hazards.
Therefore, our products should only be used for their intended purpose!

Qualified personnel

This manual is designed for welding technicians and engineers with special training and specific knowledge of the welding technology. They require profound knowledge of the hardware components of the timer, the thyristor power supply unit (L309) and the welding transformer.

The term qualified personnel refers to

- engineering personnel familiar with the safety standards of the electrical and automation technology.
- commissioning personnel entitled to commission, earth and label electrical circuits and equipment/systems in compliance with the standards of safety technology.
- operating personnel who have been instructed in operating installations in resistance welding technology and who know the contents of the present documentation as far as operation is concerned.

WARNING!

An exception are persons with cardiac pacemakers!
Due to the strong magnetic fields arising from resistance welding, the function of cardiac pacemakers may be disturbed. This may cause the death or considerable health damages to the persons concerned!
Therefore, these persons should avoid the welding system.

Please note our comprehensive range of training courses. More information is available from our **training center** (Phone: ++49 (0) 6062 / 78258).

Storage

NOTE

Danger of damage caused by frost!
When storing water-cooled modules below the freezing point, the heat sink could get cracked by frozen water.
Therefore, the heat sink must be drained prior to storage. Please also note the maximum temperature range for storage given in the ”Technical Data” section.

Installation and assembly

CAUTION!

- Danger of life and of damage to property through insufficient protection class!
  The protection class of the power supply modules is IP 00. The modules must be installed in a switch cabinet which must at least comply with protection class IP 54 (cf. also "Technical Data" Section).
- Danger of injury and of damage to property through incorrect installation!
  The units, and especially the operating elements, must be installed so as to be sufficiently protected against unintentional operation or contact.
- Danger of injury and of damage to property when operating the units outside a switch cabinet!
  The units are designed to be installed in housings or switch cabinets and may only be operated in such housings or cabinets with the door closed!
- Danger of injury at sharp metal edges!
  You should therefore wear protective gloves.
- Danger of damage to property through short-circuits!
  When drilling or sawing out openings within switch cabinets, metal burr may get inside modules that have already been installed. It is also possible that water may emerge during the installation of the cooling water lines and may enter the modules.
  The possibility of short-circuits and a destruction of the units cannot be entirely ruled out.
  Therefore, the modules should be well partitioned prior to any additional work! No liability is accepted in the event of non-compliance.
- Damages to property through leaks in the cooling water circuit!
  A leak in the cooling water circuit may cause damages to adjacent components through emerging cooling water. Therefore you should install the power supply modules so as to sufficiently protect other units in the switch cabinet against leaking cooling water.

NOTE

- Connecting lines and signal lines must be laid so as to avoid negative effects on the function of the units through capacitive or inductive interference!
- A clearance of min. 100 mm must be available above and below the power supply modules modules. Lower clearances induce the danger of heat accumulations which may result in a failure of the unit.

Electrical connection

The power supply modules are connected to the supplying mains.

WARNING!

- The mains voltage is associated with many dangers!
  The possible consequences of inappropriate handling include death or most severe injuries (personal injuries) and damage to property.
  For this reason, the electrical connection must always be made by an electrical expert in compliance with the valid safety regulations, the mains voltage and the maximum current consumption of the individual units of the equipment.
  The mains voltage must be identical with the nominal voltage given on the nameplate of the product!
  Appropriate electrical fusing equipment must be available on the mains side!
- Danger of life through electrical voltage!
  Changing the system voltage of the power supply module, if necessary, may only be performed when the system is de-energized. In any case, suitable insulated tools should be used for this purpose.
- Danger of life through electrical voltage!
  The power supply modules must be connected to the protective earthing (PE) circuit of the system. Please ensure that a sufficient conductor cross-section is used for wiring the protective conductor. The electrical continuity of the protective earthing circuit must be verified in accordance with EN 60204 Part 1.

NOTE

We recommend operating the complete welding system on a separate welding grid. For smaller welding powers, smoothing reactors may be used to achieve certain improvements.

Operation of the power supply modules

CAUTION!

- Danger of injury and of damage to property when operating the units outside a switch cabinet!
  The units are designed to be installed in housings or switch cabinets and may only be operated in such housings or cabinets with the door closed!
- Danger of injury and of damage to property through missing or false interpretation of fault messages!
  Therefore, closing of the temperature contact connected to X1 (thermostatic switch) of the modules must inhibit the connected timer! For interpreting the fault messages also note the information contained in the ”Fault messages” Section.
- Danger of bruises through electrode movement!
  All users, line designers, welding machine manufacturers and welding gun producers are obliged to connect the output signal of the Bosch weld timer which initiates the electrode movement so that the applicable safety regulations are complied with.
  The risk of bruises can be considerably reduced by means of,
  e.g.,
  - two-handed start
  - guard rails
  - light barriers etc.

NOTE

- Damage to property through insufficient cooling of the modules!
  The power supply modules must not be operated unless the cooling water circuit is active!
- Damage to property through excessive welding current!
  The maximum admissible welding current depends on the thyristors of the power supply modules and must not be exceeded.
  Therefore, the thyristor load must be verified in each individual case by the user. For more information, please refer to the ”Dimensioning instructions” Section. No liability is accepted in the event of non-compliance.

Retrofits and modifications by the user

The power supply units have been designed and manufactured by us as safe units.

WARNING!

Modifications may have negative effects on the safety of the unit!
The possible consequences include death, severe or light injury (personal injury), damage to property and environmental hazards.
Therefore, please contact us prior to modifications. This is the only way to determine whether modified parts are suitable for use with our product.

Maintenance, repair

WARNING!

- Danger of life through electrical voltage!
  Prior to any maintenance work - unless described otherwise - the system must always be switched off! In the event of necessary measurement or test procedures on the active system, the applicable safety and accident prevention regulations must be strictly observed. In any case, suitable insulated tools must be used!
- Danger of life through inappropriate EMERGENCY-STOP facilities!
  EMERGENCY-STOP facilities must be operative in all modes of the system. Releasing the EMERGENCY-STOP facility must by no means result in an uncontrolled restart of the system!

CAUTION!

- The right to perform repair/maintenance work on the timer compenents is reserved to the BOSCH service department or to repair/maintenance units authorized by BOSCH!
- Only use spare parts/replacement parts approved by BOSCH!

Working safely

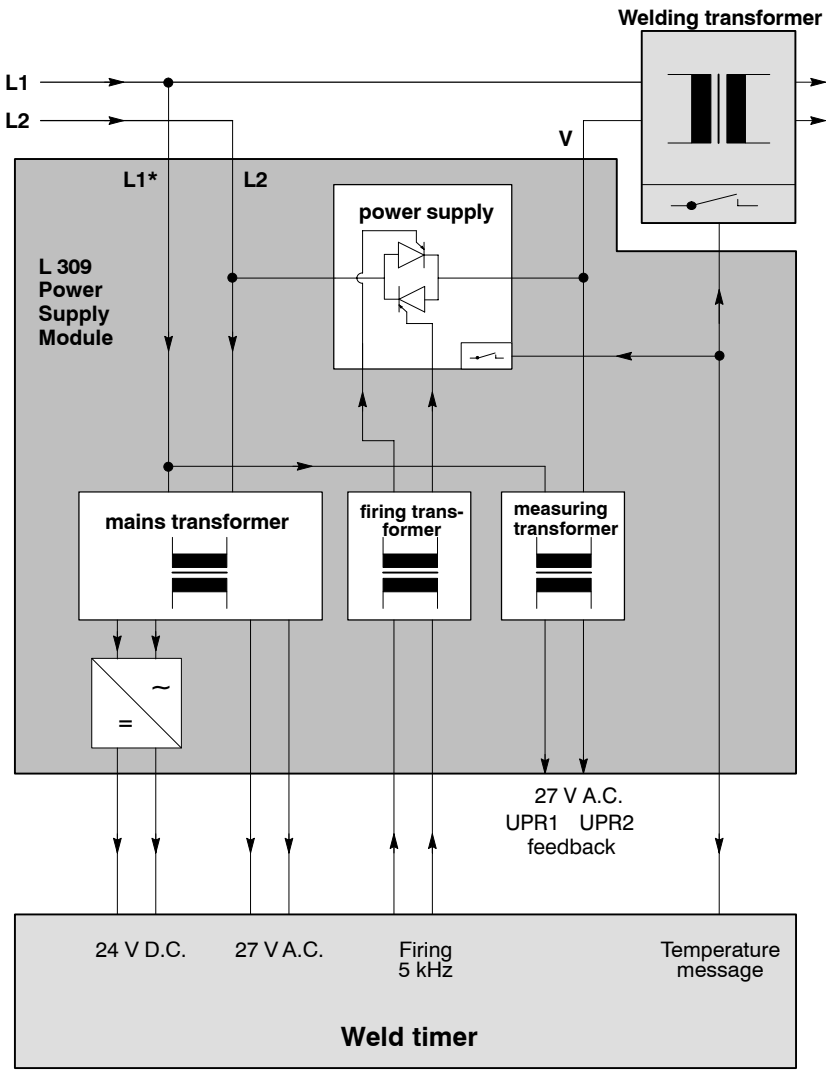
WARNING!

- During operation of the welding equipment welding splashes are to be expected! The consequence may be injuries to the eyes or burns.
  Therefore:
  - ◔ wear protective goggles
  - ◔ wear protective gloves
  - ◔ wear flame-retardant clothes
- Danger of injury at sheet metal edges and danger of getting burnt at the parts to be welded!
  Therefore:
  - ◔ wear protective gloves

1. Structure

The L 309 power supply modules serve to operate a welding transformer with max. 150 kVA or 250 kVA. Three types are available, L 309.150, L 309.151 and L 309.250 with different mains voltages and power data (see Section 2., "Technical Data").

The L 309 power supply module contains the firing component as well as the thyristor power supply for triggering the welding transformer. The firing component is triggered by the weld timer. It transmits firing pulses to the thyristor power supply. The integrated power supply unit generates the 27 V A.C. and 24 V D.C. synchronization voltage for the weld timer.
The primary voltage of the welding transformer is measured and transmitted to the weld timer for evaluation and control (UPR).
If the welding transformer or the thyristor power supply is overloaded, a thermostatic switch is released, thus stopping the weld timer which will output a fault message.



Block diagram: L 309 Power Supply Module

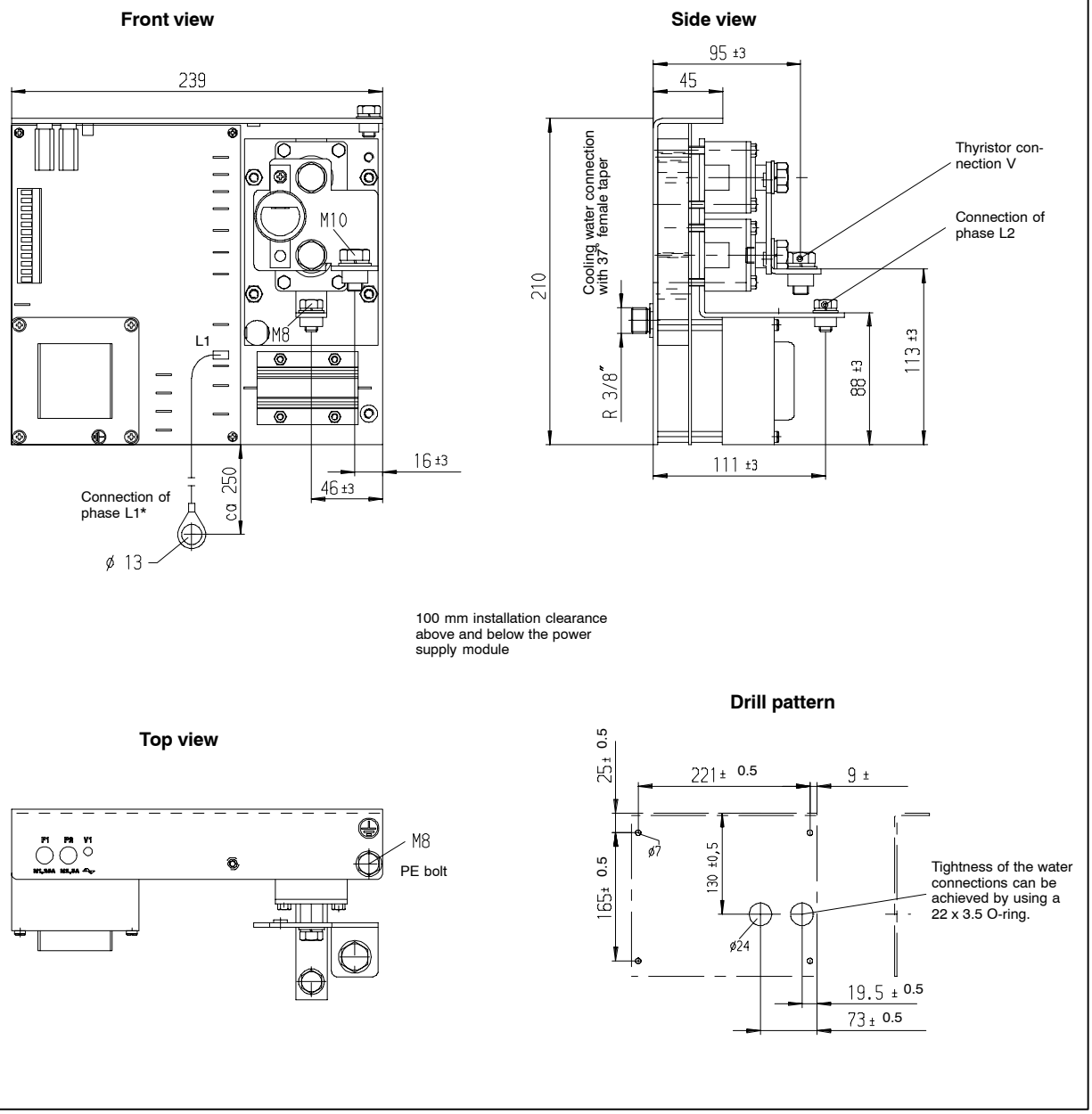
2. Technical data

Type of construction:	2-phase thyristor A.C. power controller as built-in module in open construction
Protection standard:	IP 00; designed for installation in housing or switch cabinet with IP54
Ambient temperature:	max. 60 °C with prescribed cooling, referred to the room of the installation
Storage temperature:	-25 °C to +70 °C, **heat sink must have been drained!**
Mains voltage connection:	**Types L 309.150 and L 309.250:** 400 V; 415-440 V; 500-550 V 50 - 60 Hz (set to 400 V when delivered) **Type L 309.151:** 400 V; 460-480 V; 575 V 50 - 60 Hz (set to 460-480 V when delivered)
Admissible voltage variations:	+15%, -20%
Synchronization and supply voltage generation:	for timer modules type PSH, PSS: 27 V A.C. (fused with M 1.25 A at F1); for triggering of inputs: 24 V D.C. (fused with M 2.5 A at F2)
Percentage duty cycle (ED):	independent from the possible thyristor switching currents, limited by built-in de-excitation resistor. up to 400 V: 100 % duty cycle up to 440 V: 75 % duty cycle up to 480 V: 70 % duty cycle up to 575 V: 50 % duty cycle integration time: $\leq$ 1 minute
Connected load:	**Types L 309.150 and L 309.151:** for welding transformers up to approx. 150 kVA (with 400 V). **Type L 309.250:** for welding transformers up to approx. 250 kVA (with 400 V). Max. admissible switching currents depend on the duty cycle and the weld time, see load diagram in Section ”Dimensioning instructions”.

Thyristor off-state voltage:	2000 V
Overvoltage protection:	by MOV (metal-oxide varistor)
Electrical connection:	Mains connection L1* as auxiliary phase with 6.3 mm flat connector. Mains connection L2 with bolt M8 (**Types L 309.150**/**151**) or M10 (**L 309.250**). Welding transformer connection V with bolt M10
Connection to timer unit:	via 12-pin plug-in connector
Cooling:	Water cooling without internal piping. Water inlet temperature: max. 30 ° C Water throughput: $\geq$ 4 liters/min. Differential inlet-outlet: $\leq$ 1 bar at 4 liters/min. Cooling thermostatically controlled
Water connection:	Inlet / outlet: R 3/8", 37° female taper
Fault messages:	Thermostatic switch signal, floating relay contact; it is evaluated by the timer which outputs the fault message: "Overtemperature - power supply fault"
Monitoring:	Feedback transformer. Primary voltage of the welding transformer is reduced to 24 V A.C.
Display:	Incoming firing pulses are indicated by yellow LED - 5 kHz firing

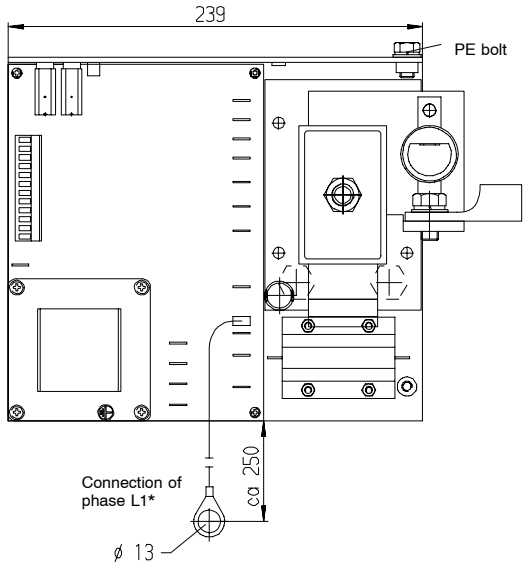
3. Dimensions

Types L 309.150 and L 309.151

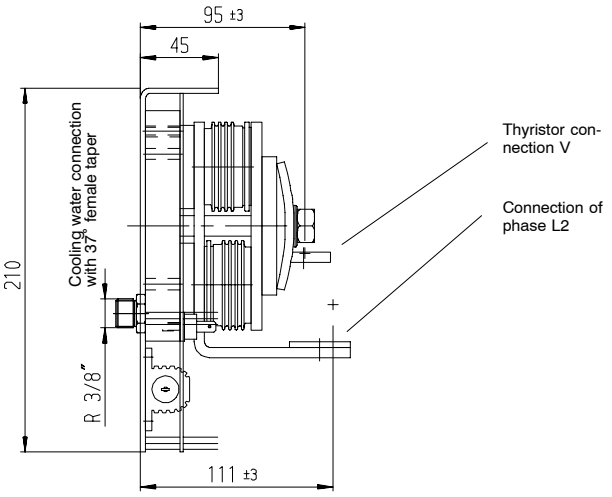


Type L 309.250

Front view

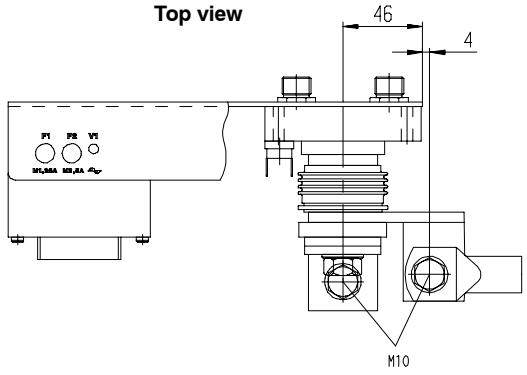


Side view

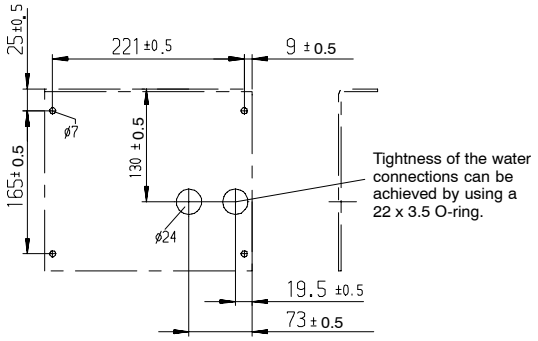


100 mm installation clearance above and below the power supply module

Top view



Drill pattern



4. Installation instructions

WARNING!

- Danger of life through mains voltage!
  Therefore, the space designed for installation must be disconnected from the supply and sufficiently protected against accidental or unauthorized reclosing prior to installation.

CAUTION!

- Danger of life and of damage to property through insufficient protection class!
  The protection class of the power supply modules is IP 00. The modules must be installed in a switch cabinet which must at least comply with protection class IP 54 (cf. also ”Technical Data” Section).
- Danger of injury and of damage to property through incorrect installation!
  The units, and especially the operating elements, must be installed so as to be sufficiently protected against unintentional operation or contact.
- Danger of injury and of damage to property when operating the units outside a switch cabinet!
  The units are designed to be installed in housings or switch cabinets and may only be operated in such housings or cabinets with the door closed!
- Danger of injury at sharp metal edges!
  You should therefore wear protective gloves.
- Danger of damage to property through short-circuits!
  When drilling or sawing out openings within switch cabinets, metal burr may get inside modules that have already been installed. It is also possible that water may emerge during the installation of the cooling water lines and may enter the modules.
  The possibility of short-circuits and a destruction of the units cannot be entirely ruled out.
  Therefore, the modules should be well partitioned prior to any additional work! No liability is accepted in the event of non-compliance.
- Damages to property through leaks in the cooling water circuit!
  A leak in the cooling water circuit may cause damages to adjacent components through emerging cooling water. Therefore you should install water-cooled modules so as to sufficiently protect other units in the switch cabinet against leaking cooling water.

NOTE

- Connecting lines and signal lines must be laid so as to avoid negative effects on the function of the units through capacitive or inductive interference!
- A clearance of min. 100 mm must be available above and below the power supply modules. If these clearances are not maintained, there is a risk of heat accumulation which may lead to a failure of the unit.

The power supply module is best installed at a housing/switch cabinet wall (fastening bolts M6. The dimensions for the fastening holes are shown in the ”Dimensions” section). Since the cooling water connections are located at the back of the power supply module, cooling water lines in the actual housing/switch cabinet are not necessary.

During installation it must be ensured that the contact surfaces are bare, i.e. free from paint, plastics coatings or dirt/oxidation.

5. Connection instructions

5.1. Mains and welding transformer connection

WARNING!

- The mains voltage is associated with many dangers!
  The possible consequences of inappropriate handling include death or most severe injuries (personal injuries) and damage to property.
  For this reason, the electrical connection must always be made by an electrical expert in compliance with the valid safety regulations, the mains voltage and the maximum current consumption of the individual units of the equipment.
  The mains voltage must be identical with the nominal voltage given on the nameplate of the product!
  Appropriate electrical fusing equipment must be available on the mains side!
- Danger of life through electrical voltage!
  Changing the system voltage of the power supply module (cf. ”Mains voltage selection” section), if necessary, may only be performed when the system is de-energized. In any case, suitable insulated tools should be used for this purpose.
- Danger of life through electrical voltage!
  The power supply modules must be connected to the protective earthing (PE) circuit of the system. Please ensure that a sufficient conductor cross-section is used for wiring the protective conductor. The electrical continuity of the protective earthing circuit must be verified in accordance with EN 60204 Part 1.

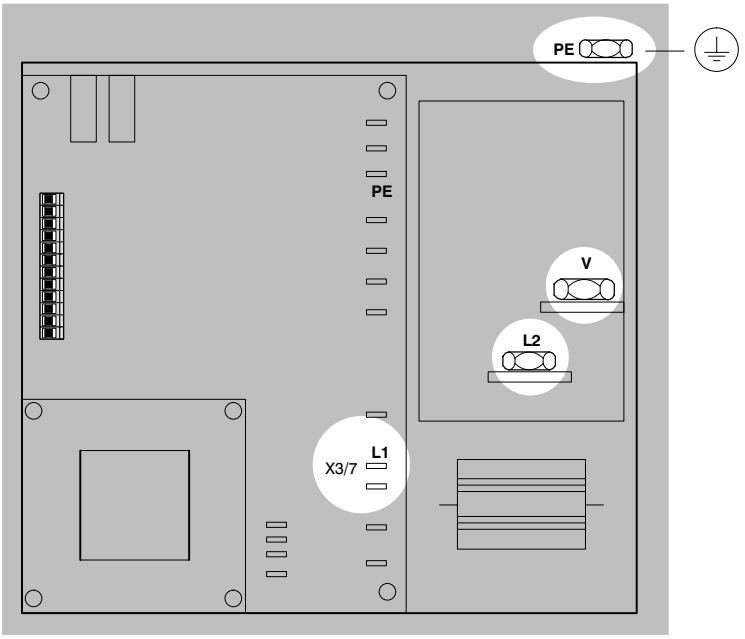
CAUTION!

- The following must be noted before making the connection:
  - mains OFF
  - protection against reclosing
  - verify safe isolation from supply
  - earthing and short-circuiting
  - cover or barrier adjacent live parts
- Mains voltage variations or deviations from the rated value must be within the specified tolerance limits (cf. ”Technical data” section). Otherwise, failures and/or dangerous situations at the electrical components cannot be entirely ruled out.

- Connect the **PE bolt** of the power supply module's base plate with a centralized earthing point. Please ensure a sufficient cable cross-section!
- Lead mains **connection L1*** (cf. dimensioned drawings in "Dimensions" section) as an auxiliary phase of mains phase L1 to flat connector X3/7 (L1) of the power supply module's circuit board using a suitable cable (1.5 mm^2 min., short-circuit-proof).
- The conductor cross-sections for phase L2 and the welding transformer's outgoing feeder V must be dimensioned depending on the connected load.
- Connect phase **L2** to the marked thyristor connection using a cable lug for threaded bolts and a suitable bolt.
- Connect outgoing welding transformer feeder **V** to the marked thyristor connection using a cable lug for threaded bolts and a suitable bolt.

NOTE

Bolted cable lug connections must be properly tightened. Use second wrench, if necessary.



5.2. Water connection

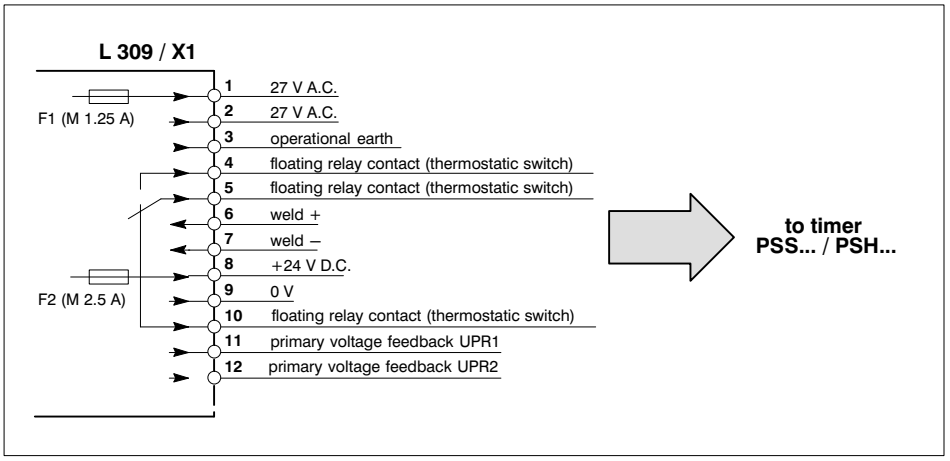
The cooling water connections are located at the back of the power supply module's base plate (dimensions and connections see dimensioned drawings in "Dimensions" section). If the module is directly installed at the housing or switch cabinet wall, cooling water lines in the actual housing/switch cabinet are not necessary.

CAUTION!

- Check the cooling water lines for leaks before switching the mains voltage on.
- Ensure that the required water throughput is guaranteed and that the max. water inlet temperature is not exceeded (see "Cooling" in "Technical data" section)!

5.3. Connection to the timer module

The connection between the L 309 power supply module and the PSS... or PSH ... timer module (PSL, UPR connections) is made via terminal connector X1.
The terminal for X1 is included in the delivery. Max. clampable wire cross-section: 1.5 mm^2.
Required conductor cross-sections: up to 10 m: $\geq$ 0.75 mm^2
up to 75 m: $\geq$ 1.5 mm^2

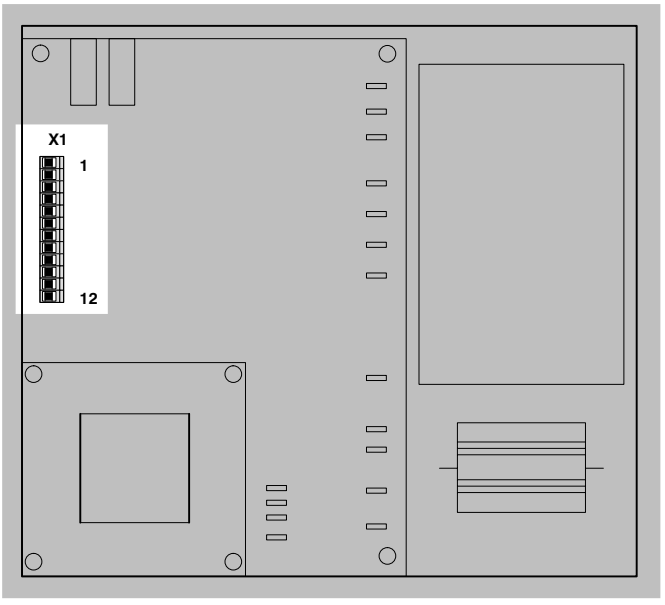


CAUTION!

- The X1 connection may only be made or removed when the unit is safely isolated from supply!

NOTE

Provide wire ends with end sleeves and properly tighten the terminals!
The connection cable is **not** included in the delivery!



5.4. Mains voltage selection

WARNING!

- Make sure that the mains voltage is set when the unit is safely isolated from supply! Use suitable insulated tools!

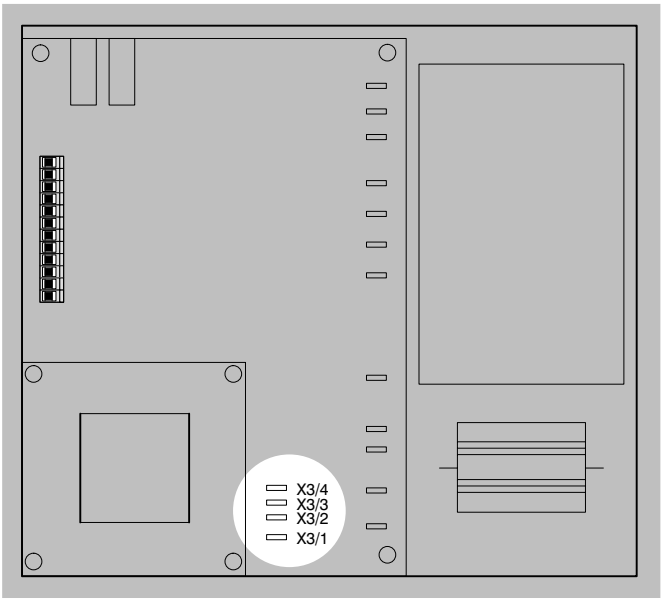
If necessary, the customer himself may select the following voltages:

Types L 309.150 and L 309.250:

- 400 V jumper between X3/1 and X3/2 **(state as delivered)**
- 415-440 V jumper between X3/1 and X3/3
- 500-550 V jumper between X3/1 and X3/4

Type L 309.151:

- 400 V jumper between X3/1 and X3/2
- 460-480 V jumper between X3/1 and X3/3 **(state as delivered)**
- 575 V jumper between X3/1 and X3/4



6. Maintenance

The power supply module is maintenance-free. However, a faulty connection or mains overvoltages can cause an activation of the protective fuses in the device. If necessary, these can be replaced by the customer himself.
Any other defects should be remedied by the manufacturer.

WARNING!

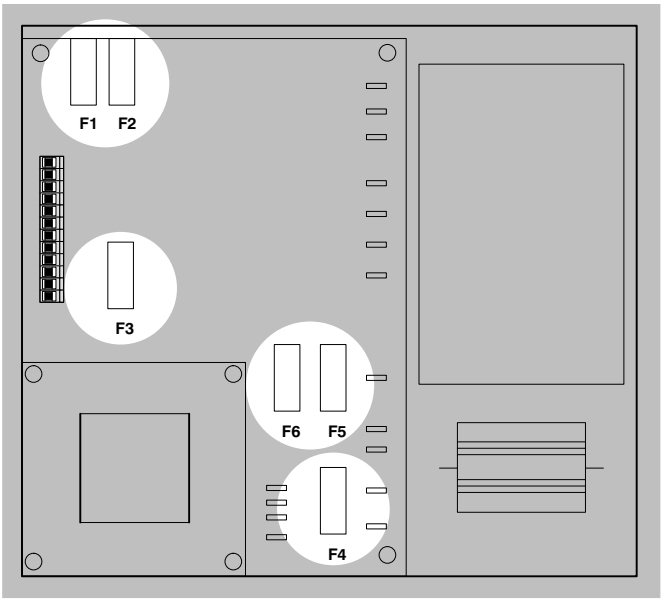
- Danger of life through electrical voltage!
  Disconnect the power supply module from the mains before locating faults or replacing fuses!

CAUTION!

- Danger of personal injury or damage to property!
  Only use the fuse types and ratings specified. Fuses must not be bridged!

The following fuses may be used:

F1:	M 1.25 A	27 V A.C. output voltage (X1/1)
F2:	M 2.5 A	24 V D.C. output voltage (X1/8)
F3:	M 4 A	rectifier input (for generating the 24 V D.C. output voltage)
F4:	FF 6.3 A 500 V 6.3 x 32 mm	mains transformer primary input (L2)
F5:	FF 6.3 A 500 V 6.3 x 32 mm	mains transformer primary input and measuring transformer primary input (L1*)
F6:	FF 6.3 A 500 V 6.3 x 32 mm	measuring transformer primary input (V)



7. Dimensioning instructions

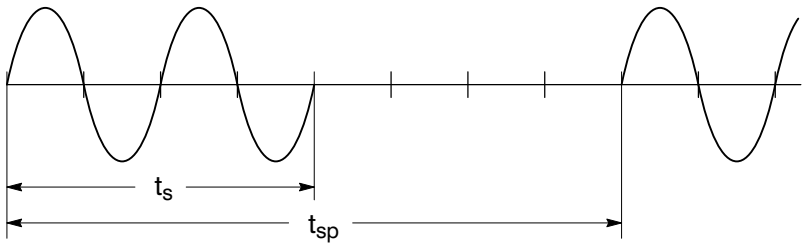
In principle, the load capacity of thyristors is predetermined by the type allocation to specified max. welding transformer sizes.

CAUTION!

- The actual load of the thyristor should be checked by the user in each specific case!

For this purpose, the load diagram is used. This load diagram indicates
the effective currents (I_{RMS} in A) which the thyristor is capable of switching as a function of
the duty cycle (ED in %) at max.
cooling agent temperature (in °C) and minimum
water throughput (in l/min.).

For determining the percentage duty cycle (ED), the weld time t_s and the weld cycle time t_{sp} must be known.



Weld time and weld cycle time

The duty cycle (ED) is calculated as follows:

$$ED = \frac{t_s}{t_{sp}} * 100\%$$

Example: In the figure above, the weld time is 2 cycles and the weld cycle time is 4 cycles.
This results in a duty cycle of ED=50%.

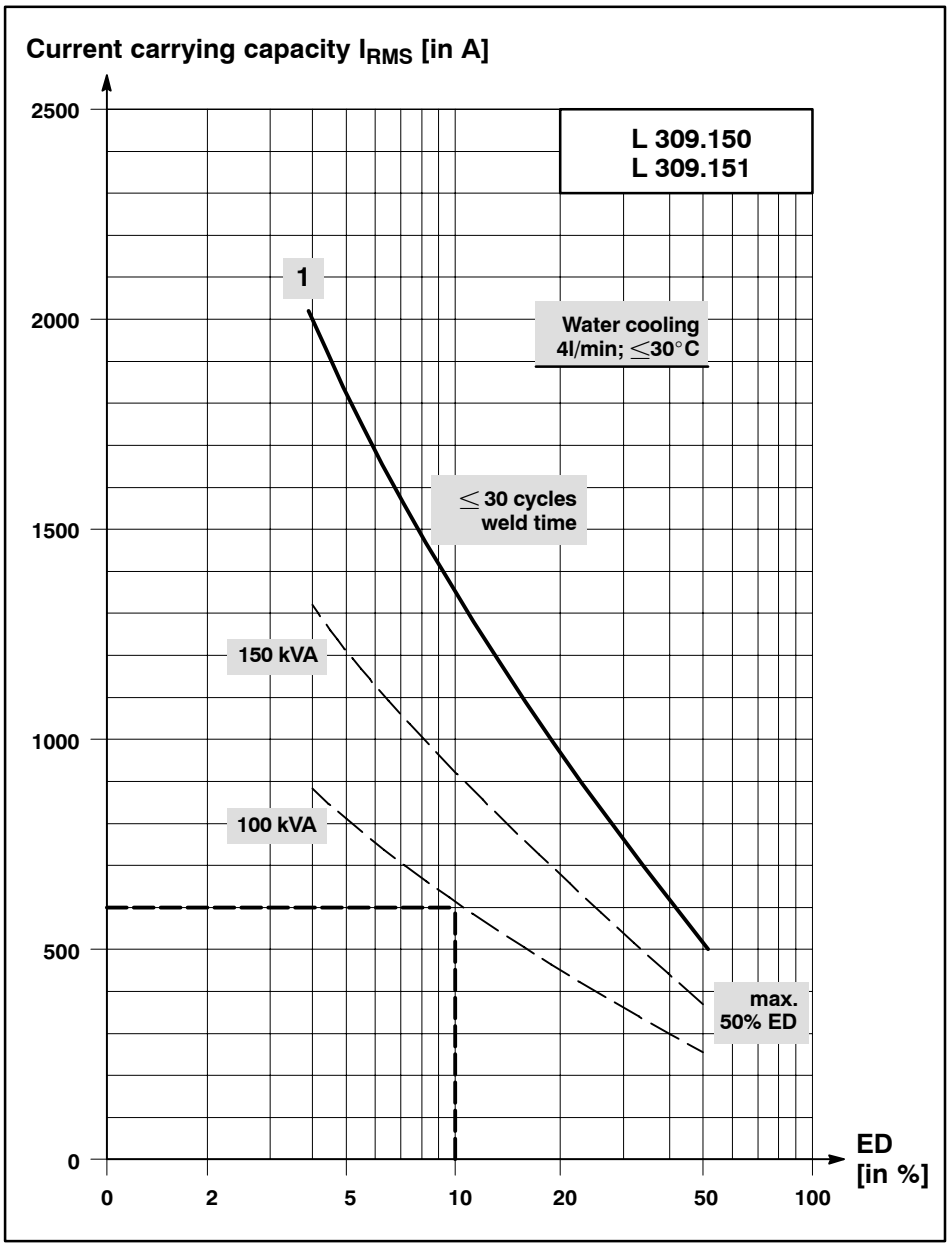
$$ED = \frac{2 \text{ cycles}}{4 \text{ cycles}} * 100\% = 50\%$$

CAUTION!

- If there are different weld times and cycle times at one machine, the longest weld time and the shortest cycle time (if necessary, by adding the longest weld time and the shortest pause time) are to be used for calculating the ED!

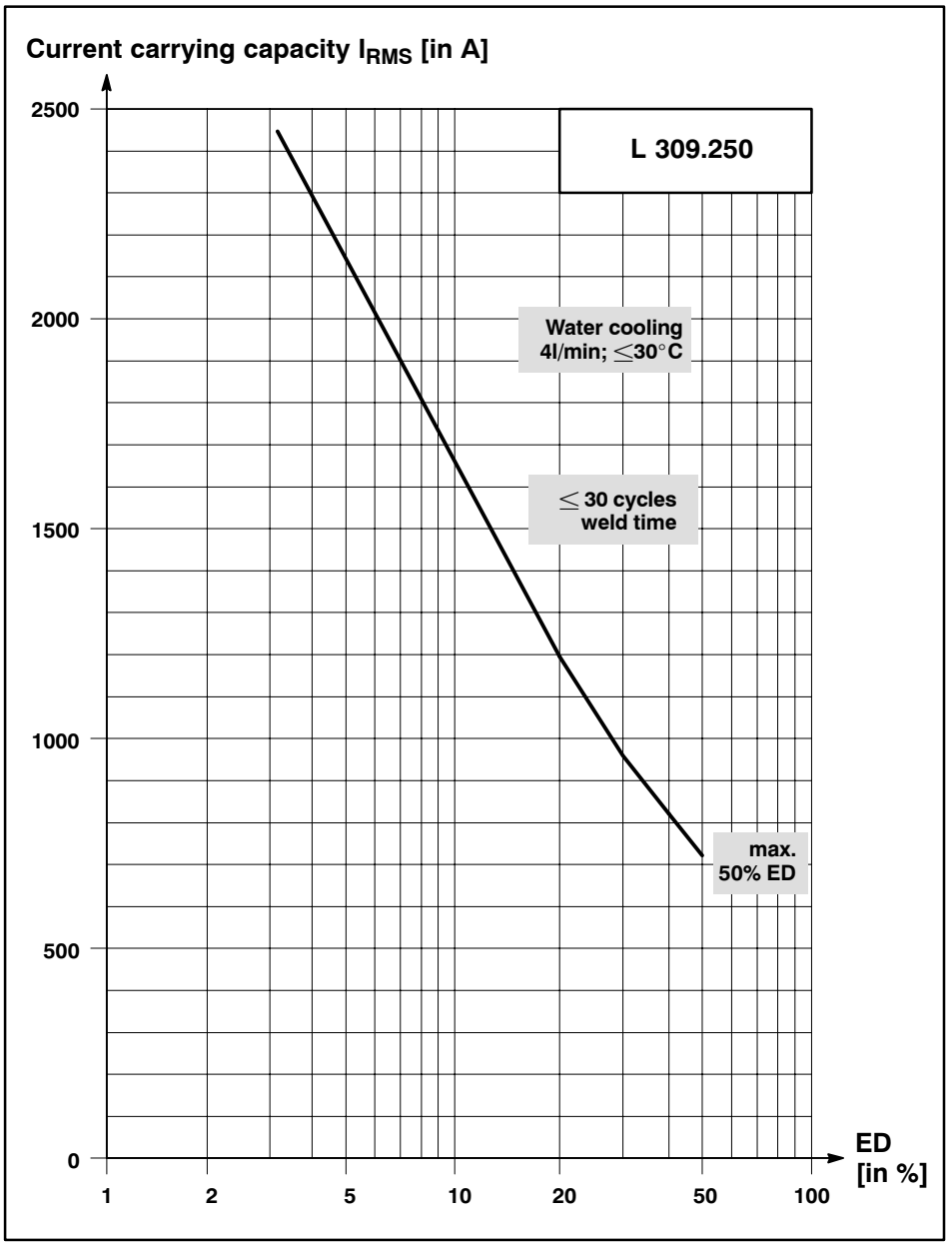
When the duty cycle has been calculated, the following load diagrams can be used to verify the correct dimensioning of the thyristors:

Load diagram of types L 309.150 and L 309.151:



Example: Weld data of the machine: 100 kVA
Weld time: t_s = 10 cycles (< 30 cycles)
Duty cycle: ED = 10 %
Current: I_{RMS} = 600 A
The intersection for ED = 10% and I_{RMS} = 600 A found in the diagram is below curve “1”.
Thus, the thyristor has been properly dimensioned.

Load diagram of type L 309.250:



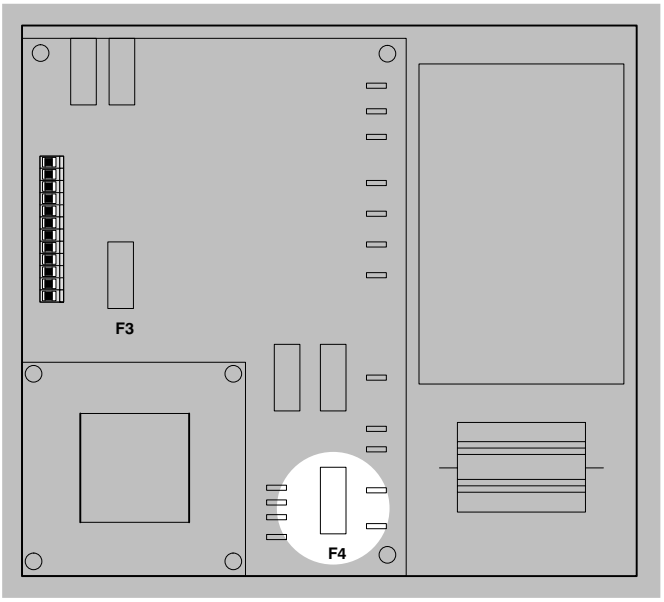
8. Fault messages

Extensive precautions were taken for protecting the thyristor block. These include, i.a., the following

- **Temperature monitoring**
  A bimetallic switch is located at the thyristor block which transmits a message to the timer unit when temperatures $\geq$ 56 °C are reached. As a consequence, the timer is inhibited - the ready signal at the timer goes off and the fault message "Overtemperature - power supply fault" will be output.

Possible causes	Elimination
- not enough cooling water	check water inlet and outlet
- thyristor rating too small	calculate % duty cycle, check thyristor dimensioning on the basis of the load diagram (please refer to section "Dimensioning instructions").

- **Protective circuit against transient overvoltages**
  In order to prevent the thyristor from being destroyed by overvoltages, it is protected by an MOV (metal-oxide varistor). In the case of overvoltages in the mains (e.g. due to spurious peaks or pulses), the MOV acts as a protective diode, cutting off the peaks. As a result, fuse F4 (FF 6.3 A 500 V 6.3 x 32 mm) might melt.
  For replacement of fuses, please refer to "Maintenance" section.



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