

MF Welding Inverters

PSU 5000 / PSG 3000

Instructions for Assembly and Operation

Version

109

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Instructions for Assembly and Operation

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Possible combinations of MF welding inverters / welding transformers

PSU 5100.XXX / PSG 3050.00 A

PSU 5100.XXX / PSG 3050.10 A

PSU 5100.XXX / PSG 3075.10 A

PSU 5100.XXX / PSG 3100.00 A

PSU 5300.XXX / PSG 3050.00 A

PSU 5300.XXX / PSG 3050.10 A

PSU 5300.XXX / PSG 3075.10 A

PSU 5300.XXX / PSG 3100.00 A

PSU 5200.XXX / PSG 3200.00 A

PSU 5200.XXX / PSG 3100.00 A

PSU 5200.XXX / 2 x PSG 3100.00 A

PSU 5000 / PSG 3000
Instructions for Assembly and Operation



BOSCH

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Safety instructions

The products described were developed, manufactured and tested in compliance with the fundamental safety requirements of the EU machine directive.

Nevertheless, there still is some residual risk!

Please read this manual before putting any of the PSU / PSG units into operation and store it in a place to which all users have access at any time.

Explanation of pictographs and symbols

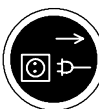
The following warnings and notes may be attached to the individual hardware components which are designed to inform the user of certain circumstances.



➤ Warning of dangerous voltages!



➤ Components subject to electrostatic induction!



➤ Disconnect mains plug before opening!



➤ Bolt for connection of the PE (protective earth) conductor only!



➤ For shield conductor only!



NOTE

Note concerning this manual: Black bars on the margin of a page indicate changes compared to the previous edition.



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. ATTENTION
3. NOTE

**WARNING!**

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

**ATTENTION!**

The term **ATTENTION** will be used wherever a **dangerous situation is possible**.
The possible consequences include death, 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.

Dangers, if any, may arise from alternating magnetic fields (critical frequency: 1.6 Hz).

WARNING for operating personnel!



When using manual welding guns, the limit values may be exceeded for the extremities. In this case, additional work protection measures must be taken. So far, no problems have been reported. Nevertheless, the possible influences are lower with medium- frequency welding than with AC welding.

Not permitted for persons with cardiac pacemakers

WARNING for persons with cardiac pacemakers!



Warning signs should be posted for protecting persons with cardiac pacemakers because the function of these devices may be disturbed (impulse failure, total failure) and a negative influence on the pacemaker programming or even a total program destruction may occur !!!

We recommend posting a warning of the type shown below at all entrances to factory halls containing resistance welding equipment:





Compatibility with residual-current devices to EN 50178

**ATTENTION!**

Compatibility with residual-current devices to EN 50178:

If a residual-current device is used at the mains side of the inverter to protect persons in the event of direct or indirect contact, a type B device must be used. The residual-current device must additionally be capable of safely detecting a possible residual current with a frequency of 1 kHz / 1.2 kHz.

Normal use

The PSU medium-frequency welding inverter in connection with the PSG transformer-rectifier unit serves for

○ **resistance welding of metals**

using rectified secondary current at the welding current transformer.

The medium-frequency welding equipment is only suitable for

○ **industrial applications.**

Definition in accordance with: DIN EN 50082-2 of Electromagnetic Compatibility (EMC).

It is not intended for any other use!

**ATTENTION!**

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!



Ensuring EMC of the comprehensive system

NOTE

The comprehensive system comprising PSU in connection with PSG complies with prEN 50240, the EMC product standard for resistance welding systems, and EN 55011 (October 1997), EMC product family standard class A, group 2, rated current > 100 A.

- only for industrial applications.
- safe clearance to residential areas ≥ 30 m.
- safe clearance to communication systems (wireless, telephone) ≥ 10 m.
- cable length of mains feeder (PSU) ≥ 10 m.
- interference suppression measures: When switch cabinet doors are open, radio devices and cell phones may only be used in a safe clearance of ≥ 2 m.

The assessment and certificate of conformity of a competent authority concerning compliance with the fundamental EMC protection is available.

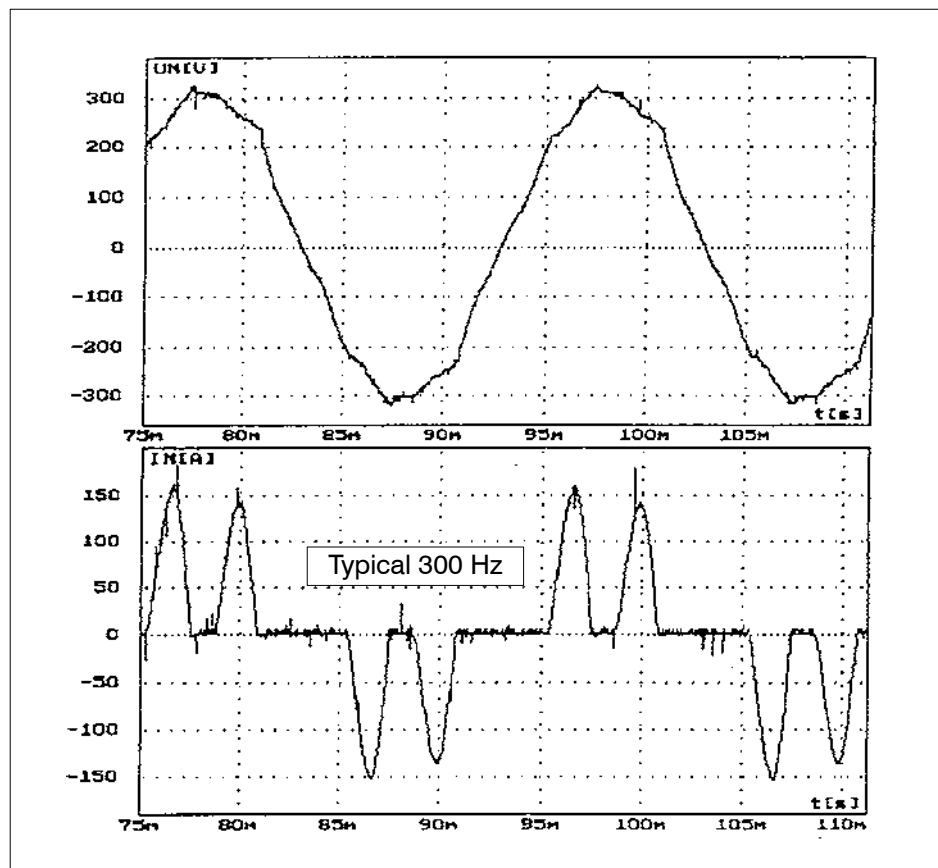
When the MF components are integrated in a Schweisskoffer type GK 100 L MF00, the Schweisskoffer is awarded the CE label in accordance with the EMC Directive 89/336/EEC. Additional EMC tests of the Schweisskoffer are not necessary.



System perturbation

When operating a welding inverter a harmonic load must be accounted for in the mains system. This load is caused by the "B6" rectifier circuit with a smoothing capacitor.

The following figure shows the typical curve of the mains voltage (top) and the related mains current (bottom) in one phase during the welding process:



The 5th, 7th, 11th, 13th, 15th, and 17th harmonic wave are the characteristic harmonics of the mains current curve.

The harmonic component depends on the welding power.

NOTE



We recommend operating the welding inverter on a separate welding mains system. The harmonic content may be considerably reduced, e.g., by using smoothing reactors with 4% short-circuit voltage.

There are no requirements as to harmonic loads in industrial applications.

So far, no impact on other devices (PC's etc.) has been determined.



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 inverter (PSU) and the welding rectifier-transformer (PSG).

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).



Operation of the PSU and PSG modules



ATTENTION!

- 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 X5 of PSU must inhibit the connected timer (cf. also Section 11, "Electrical connection")!
For interpreting the fault messages also note the information contained in Section 7, "Monitoring and diagnostics".
- 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 inappropriate or insufficient cooling of the modules!
Water-cooled PSU and PSG modules may only be operated when the cooling water circuit is active! Condensation is not permitted on water-carrying components. The temperature in the installation room of air-cooled modules must be within the specified limits.
- Damage to property through excessive welding current!
The maximum welding current of the combination of PSG and PSU in use must not be exceeded. No liability is accepted in the event of non-compliance.
The max. admissible welding current of each combination of units is to be determined from the load diagrams (cf. Section 5.3)!

Retrofits and modifications by the user

The MF welding inverter has been designed and manufactured by us as a safe unit.



WARNING!

Retrofits or modifications may have negative effects on the safety of the unit! Therefore, please contact us prior to retrofits or modifications to the MF welding inverter using third-party equipment. This is the only way to determine whether these 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 electrical voltage!
If the inverter housing is to be opened, switch off the system and wait for at least 5 minutes for the inverter to de-energize.
- Danger of life through inappropriate EMERGENCY-OFF facilities!
EMERGENCY-OFF facilities must be operative in all modes of the system. Releasing the EMERGENCY-OFF facility must by no means result in an uncontrolled restart of the system!
- Danger of explosion of batteries!
Batteries must not be opened forcefully, recharged, soldered at the cell body or thrown into fire!
Replace empty batteries with new ones only!

ATTENTION!

- The right to perform repair/maintenance work on the timer components is reserved to the BOSCH service department or to repair/maintenance units authorized by BOSCH!
- Only use spare parts/replacement parts approved by BOSCH!
- Spent batteries or accumulators must be disposed of as hazardous waste.

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

NOTE

- The strong magnetic fields arising in connection with resistance welding may cause lasting damages to wrist watches, pocket watches, or cards with magnetic stripes (e.g. EC cards).
Therefore, you should not carry any such items on you when working in the direct vicinity of the welding equipment.



CE conformity



NOTE

The CE label is valid for the individual PSU unit with respect to the Low-Voltage Directive only.

Concerning EMC, it is always necessary to consider the entire application (cf. below).

The CE label for the PSS - PSU - PSG combination is valid for industrial applications.

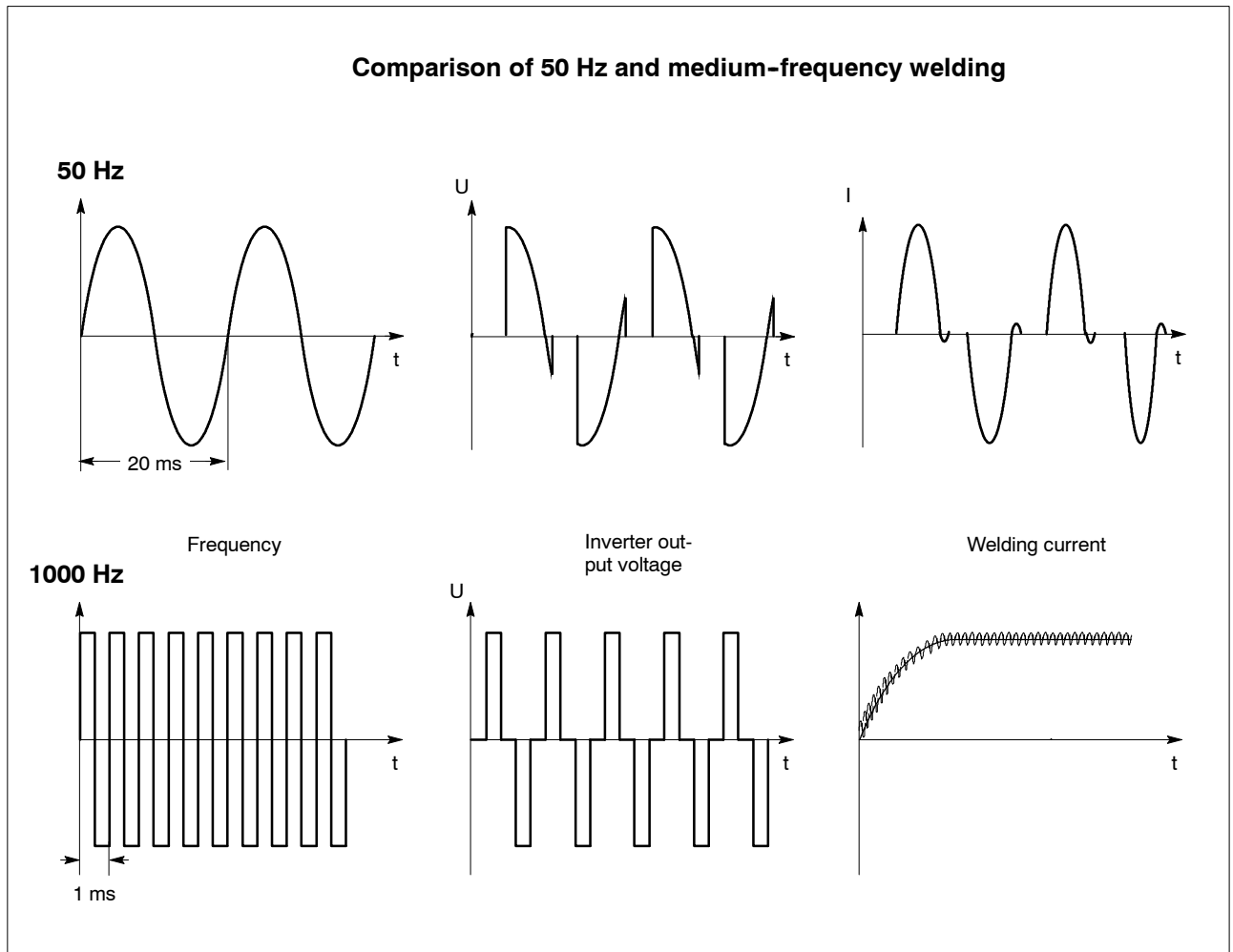
For other combinations/applications, the certificate must be derived from the above, or a new certificate must be issued, if necessary, by the line designer / user.

(cf. also section 16)

1 Advantages and benefits of medium-frequency welding

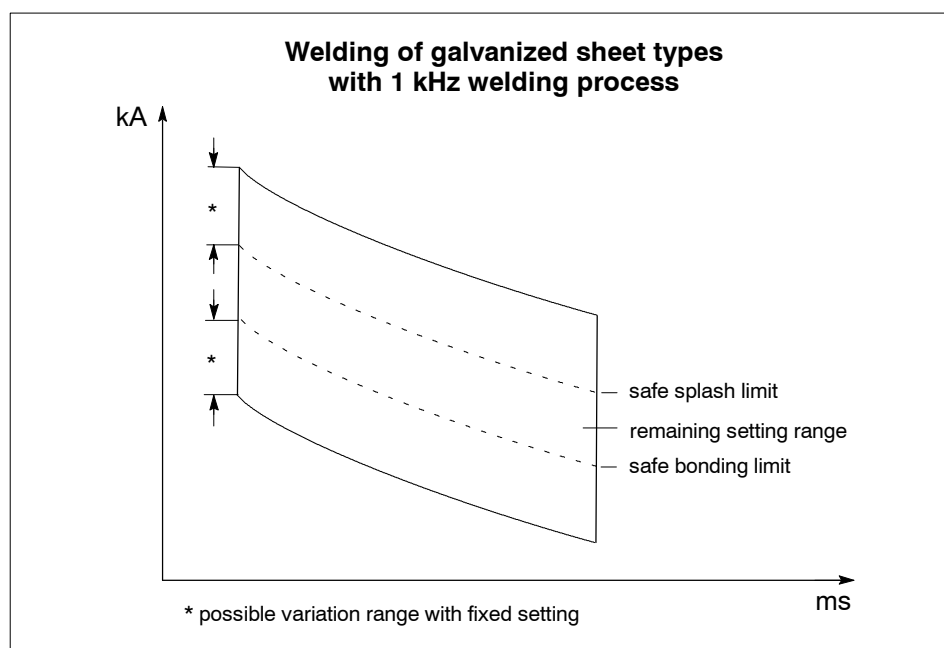
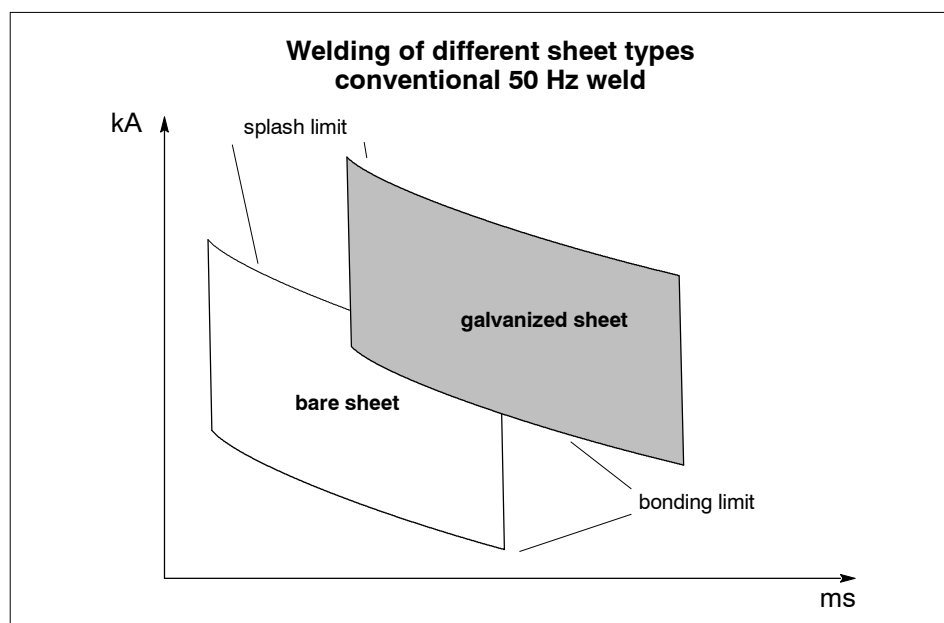
The Bosch medium-frequency welding system uses direct current as the welding current. As a result, the welding process can be controlled more thoroughly and faster and becomes more steady. The "good" welding range becomes larger.

The medium-frequency welding current is clocked at 1 kHz. Current control is definitely faster and more accurate than with 50 Hz welding systems.

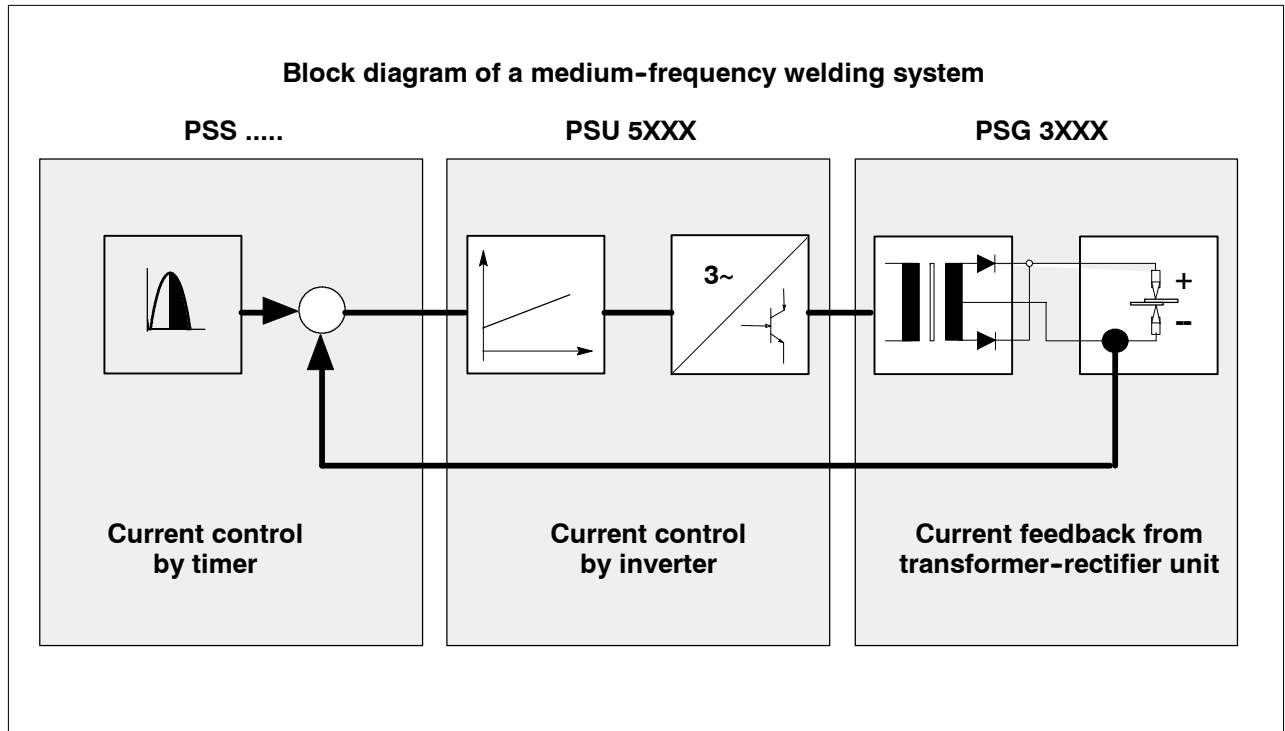


- A direct current flows in the secondary welding circuit of the transformer. As a result, the inductive resistance of the secondary window loses its influence on the welding current with different immersion depths of the electrode gun into the workpiece.
- The weight of the welding transformer is reduced. Due to the higher operating frequency, the iron content required as well as the volume are reduced while the performance data is maintained.
- The more steady welding current without any gaps and the possibility of weld time variation in ms intervals allow for the metered application of energy to the spot weld and a steady growth of the spot.

- The mains load is symmetrical due to the 3-phase connection of the welding equipment.
- Longer electrode life.
- Good results are obtained for welding aluminium and galvanized sheets.
- Especially suitable for 3-sheet welding, very thin sheets and fine spot applications.
- Fewer welding splashes.

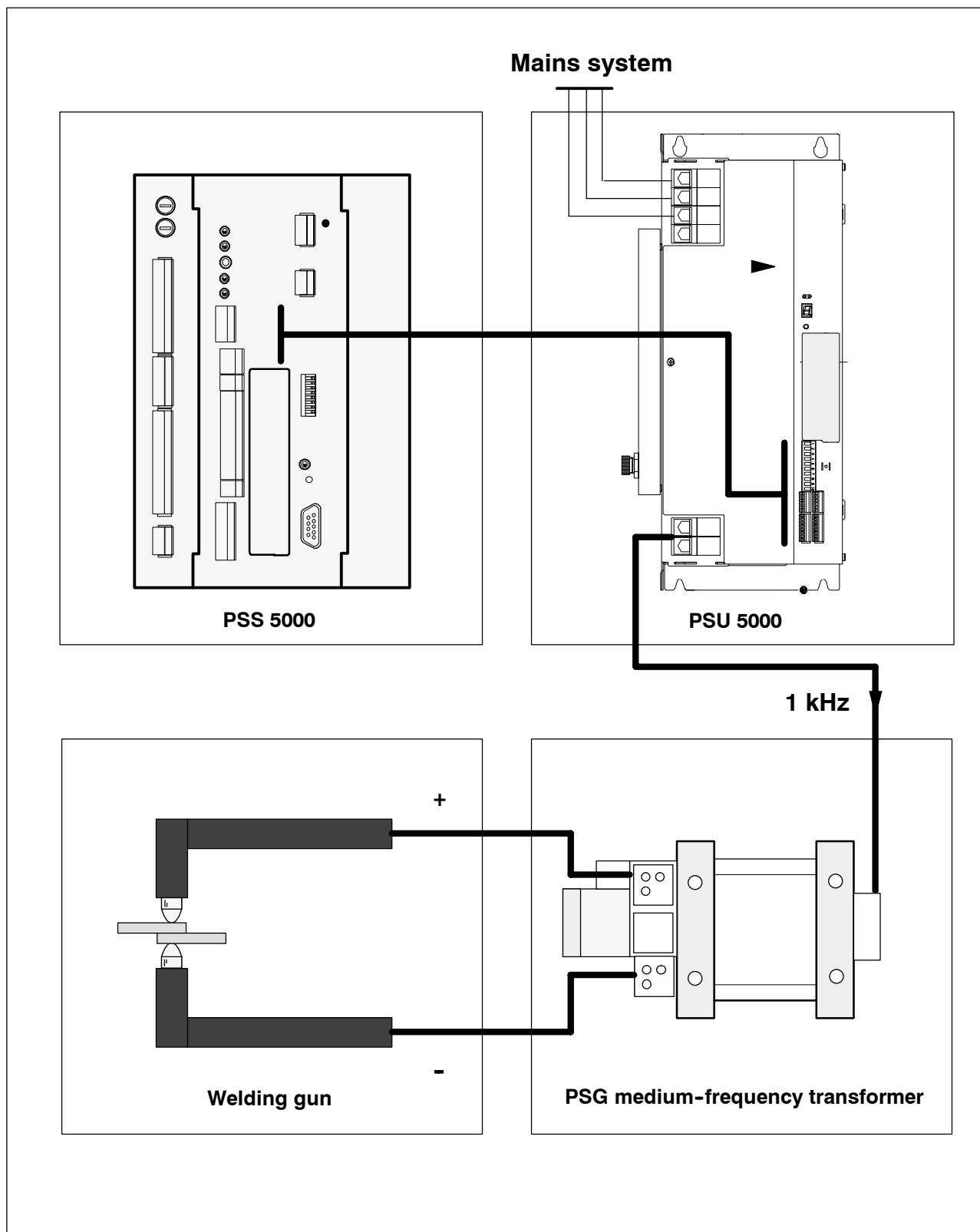


- Medium-frequency welding with current control improves the quality of the spot weld.
 The welding system with constant-current control (KSR) compensates the changes in sheet resistance within the weld time and helps to obtain a constant welding result.
 The Bosch PSU / PSG MF welding system is equipped with an integrated current control.



- Enhanced application range for micro-welds.
 The inverter has a DIP switch bank for setting low welding current ranges. It is driven by a weld timer in millisecond intervals.

1.1 Structure of a medium-frequency welding system

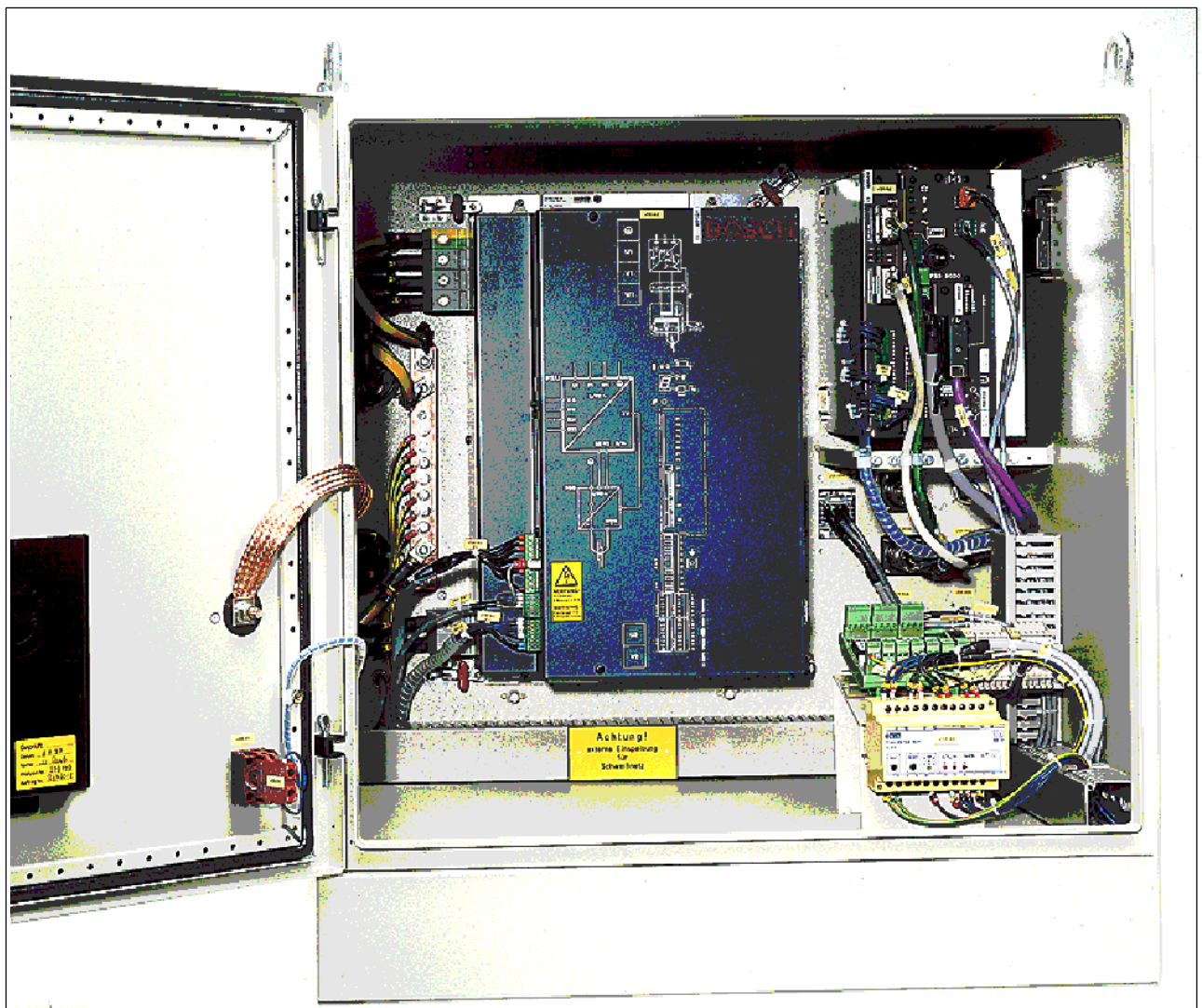




2 Schweisskoffer

The following components may be integrated into the Schweisskoffer as "resistance welding process modules", depending on the requirements:

- PSS 5000 weld timer
This timer range comprises different PSS types with interfaces for medium-frequency and 50 Hz applications. The weld timer is driven by parallel (e.g. PLC) or serial (e.g. bus) systems, depending on its I/O configuration.
- Medium-frequency inverter
The medium-frequency inverters in air- or water-cooled design are supplied with operating voltages of 400 V to 690 V (50 / 60 Hz). A current range between 3 kA and 18 kA can be used (duty cycle depends on cooling and PSG type).
- Instead of a medium-frequency inverter, an AC thyristor power supply (air-cooled) with 76 kVA may be selected.





2.1 Inverter

Inverter features:

- current ranges between 3 kA and 18 kA,
- operating voltages between 400 V and 690 V, 50 / 60 Hz,
- fast replacement through quick-action closing mechanisms,
- different transformer types may be used,
- inverters with integrated current control,
- fault diagnostics through seven-segment display and BCD code.

The heat sinks can be optionally mounted at the rear or side panel. The inverters are plugged onto four guide pins and fixed by quick-action clamps for easy service and replacement.

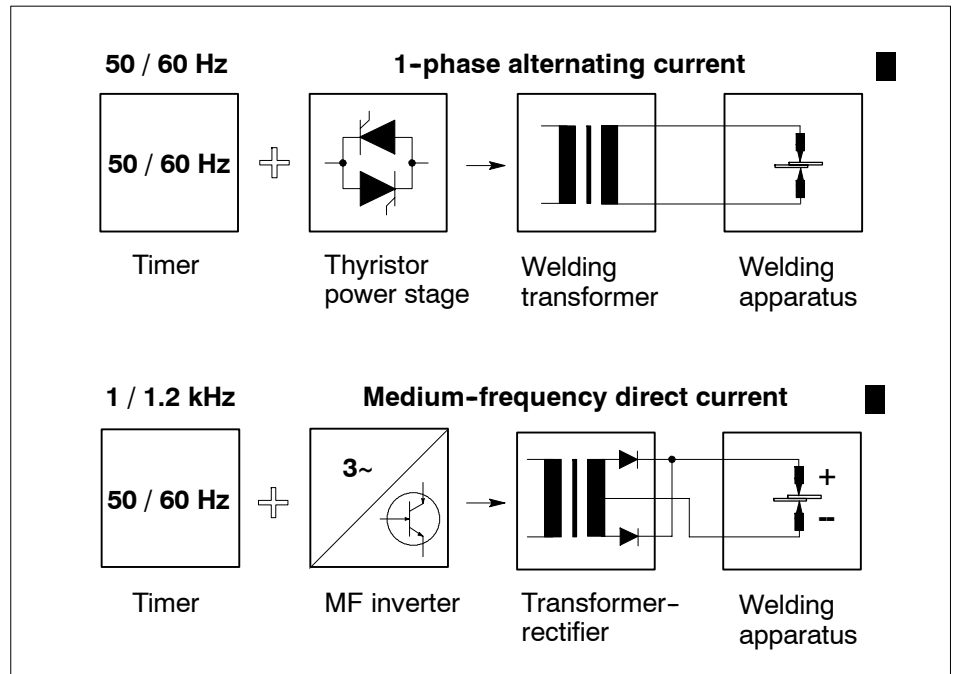
2.2 Driving the inverter

The inverter is driven in the Schweisskoffer by:

- PSS 5000 weld timer in 50 Hz or milliseconds design,
- PSS 2081 weld timer (with 27 VAC booster transformer),
- OEM control unit,
- programmable logic controller with analog value output.

3 Functional description

The figure below shows the difference between welding equipment with 1-phase AC and medium-frequency DC.



3.1 Functional principle

The medium-frequency welding system (MF welding system) is used for resistance welding with direct current; it consists of the inverter (PSU) and the transformer-rectifier (PSG).

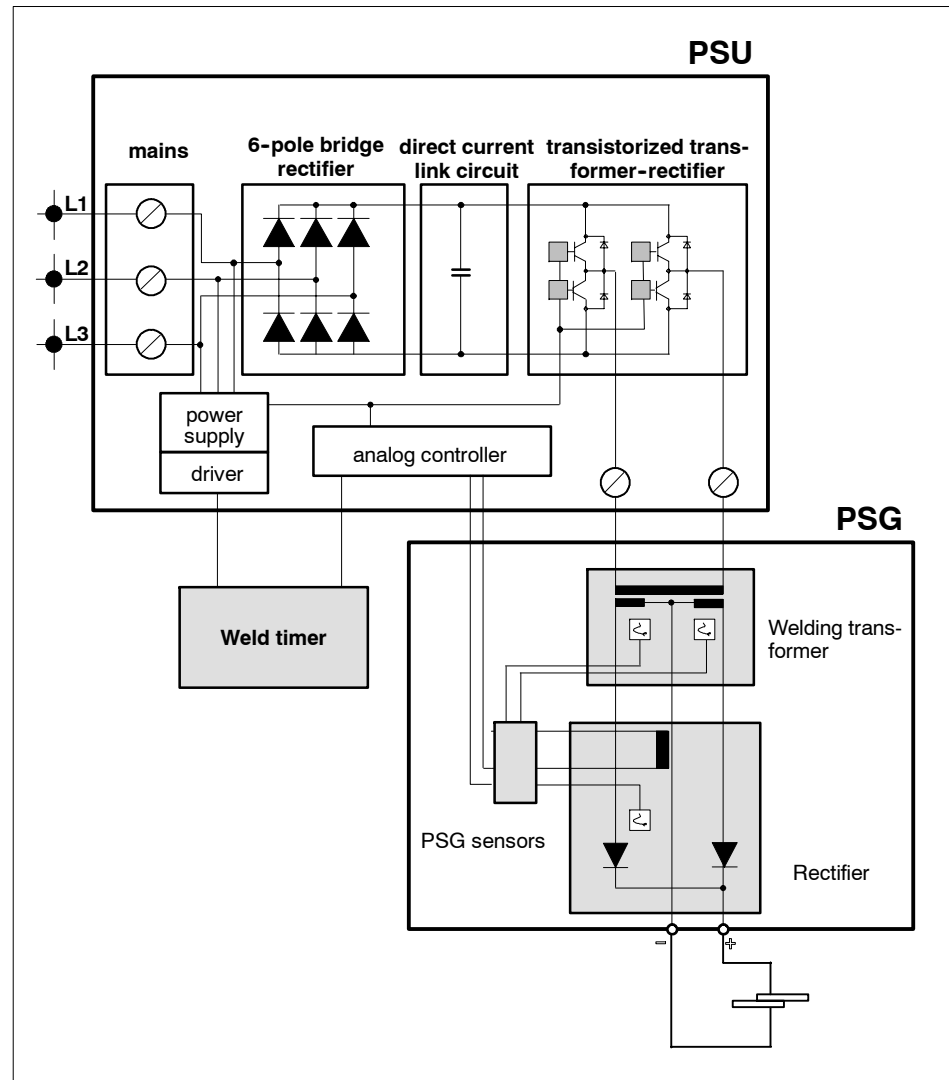
For selection of the welding parameters, the inverter is controlled by a weld timer with a 5 kHz weld output cycle. As an option, it may also be controlled by a 24 V weld time signal and an analog input voltage (1–10V) (for both control options see Section 8, “Controlling the inverter”).

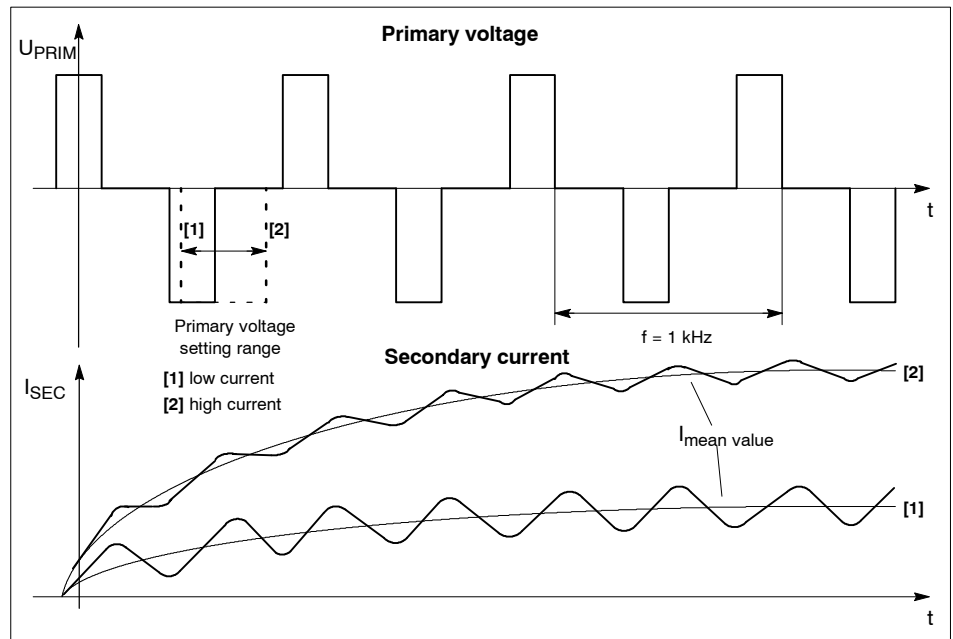
The 3-phase 50 / 60 HZ mains AC is first rectified by a bridge connected rectifier (B6 connection). The direct current thus generated connects a transistorized H-bridge alternatingly to the welding transformer with a frequency of 1 / 1.2 kHz. The welding current is rectified at the secondary side of the welding transformer.

The amount of the welding current is determined by control of the pulse width. The welding current is measured by a toroid measuring coil incorporated in the secondary circuit of the welding transformer.

In contrast to single-phase AC systems, the inverter controls the welding current independently.

The following figure shows a block diagram of an inverter system:





3.2 Monitoring of the secondary current with Bosch weld timers

In its standard mode, the inverter provides independent control of the welding current depending on the firing angle or analog value setpoint.

The welding current can be displayed through the weld timer and a programming unit equipped with the KSR option.

Thus, it is possible to monitor welding current tolerance limits.

Using the calibration function, the measured welding current can be adjusted to your standardized ammeter and the current setpoint can be entered accordingly.

Programming the current tolerance is described in a separate Technical Information "KSR-DYD / DYF" or the type-specific Technical Information brochures of the respective timer module.

If a KSR module is used in the timer, a DIP switch at the inverter must be set accordingly (refer to Settings, section 6.4, and "Adjustment to Timers with / without SSU function" Section 9.6).



3.3 Faults

In order to ensure a high operational reliability, various monitoring functions are incorporated in the PSU module. Any occurring fault is signalled at a seven-segment display of the PSU. The fault number may also be transmitted as a binary code to a PLC.

The Bosch weld timer signals "Power supply fault" (Temperature monitoring circuit of power supply unit).



ATTENTION!

Danger of injury and of damage to property through missing or false interpretation of fault messages!

If the inverter is not controlled by a Bosch timer, it must be ensured that closing of the floating contact between terminals 4 and 5 or opening of the contact between terminals 5 and 10 of connector X5 on the inverter will stop the timer!

When the cause of the fault has been eliminated, the fault message must first be reset with the reset key or via the reset input of the PSU and then with the reset key on the weld timer.

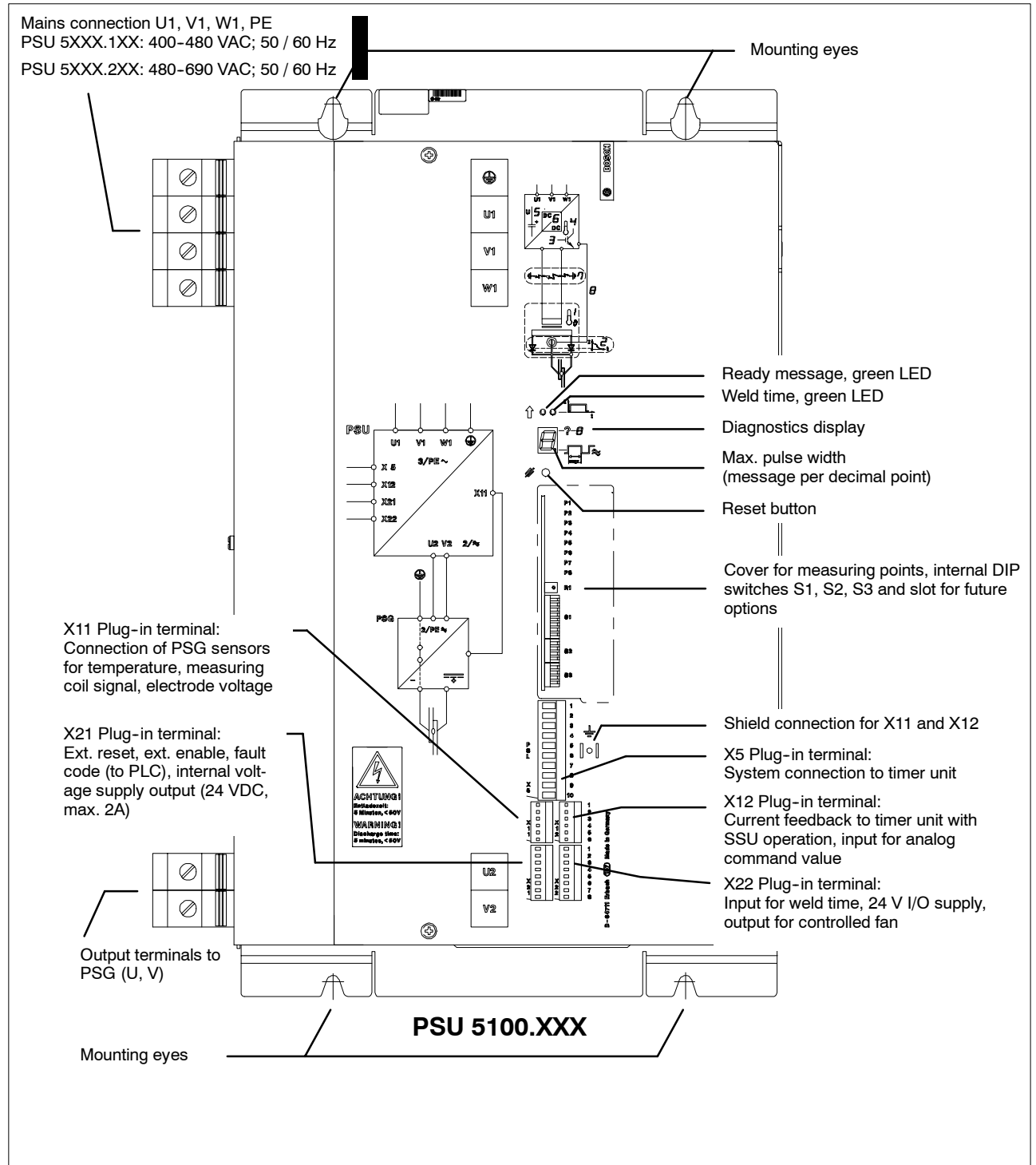
For the individual monitoring functions and diagnostics messages, please refer to Section 7, "Monitoring and diagnostics".

Monitoring displays at the PSU

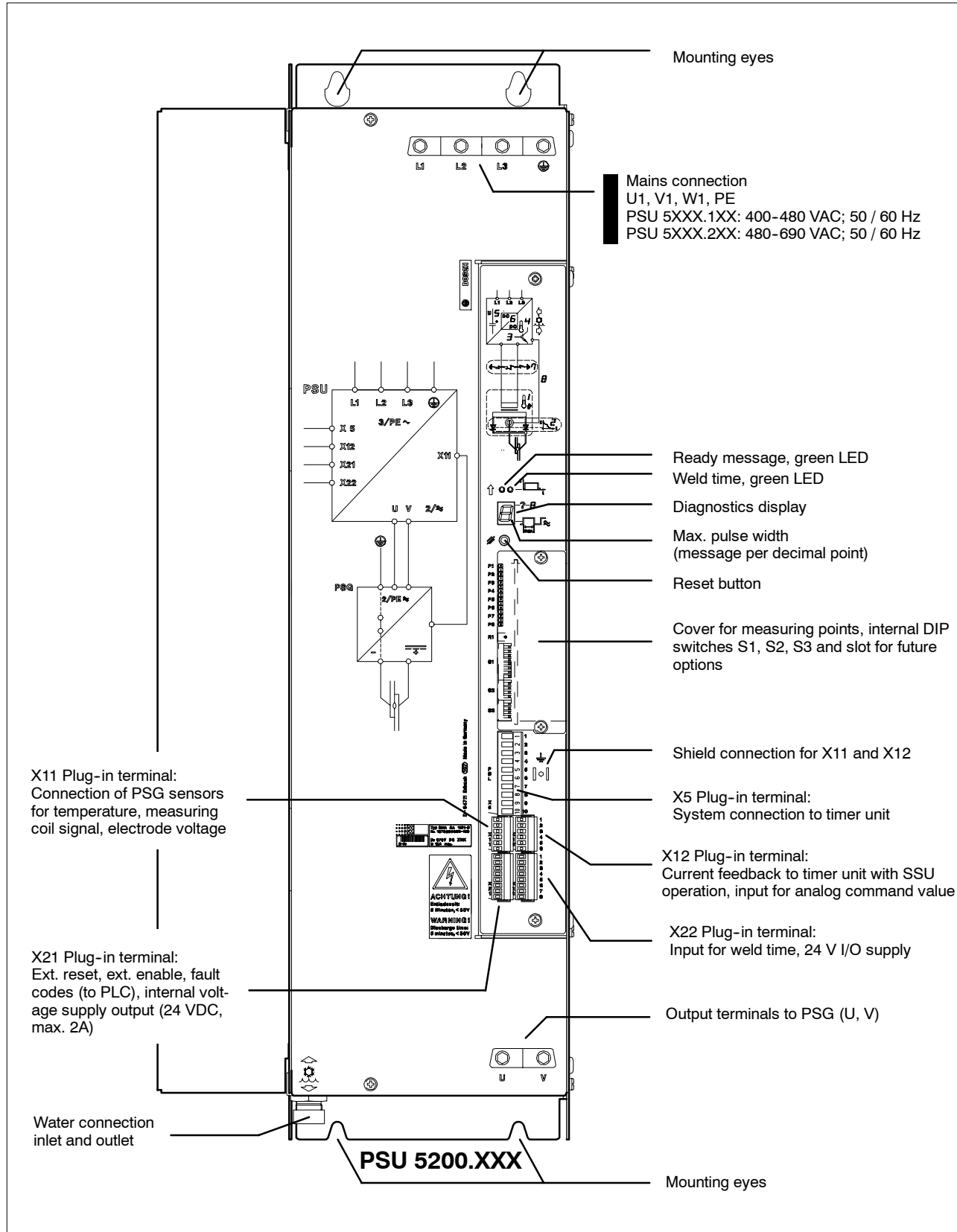
- LED "↑" (inverter ready)
- seven-segment display "?" (diagnostics display)

4 PSU front panel views

4.1 Front panel view of PSU 5100 / PSU 5300



4.2 Front panel view of PSU 5200





5 Technical data

5.1 Technical data of the PSU standard types

5.1.1 Electrical data

	PSU 5100.1XX ¹⁾ PSU 5300.1XX ¹⁾	PSU 5200.1XX	PSU 5100.2XX ¹⁾	PSU 5200.2XX
Mains	3-phase; 400 VAC, -20% to 480 VAC, +10%; 50 or 60 Hz		3-phase; 480 VAC, -20% to 690 VAC, +10%; 50 or 60 Hz	
continuous thermal current	110 A	220 A	110 A	220 A

1): Air-cooled design also available

	PSU 5100 PSU 5300			PSU 5200	
Output power	Can be matched by DIP switch to PSG 3050.xx A; current range: 3 to 18 kA			Can be matched by DIP switch to parallel connection of 2 x PSG 3100.00 A; current range: 9 to 54 kA	
	Transformer 1	Transformer 2	Transformer 3	Transformer 4	Transformer 5
	PSG 3075.00 A; current range: 3 to 18 kA	PSG 3100.00 A; current range: 3 to 18 kA	PSG 5300: 6 to 36 kA	PSG 3200.00 A; current range: 6 to 40 kA	
Cycle frequency	1 kHz or 1.2 kHz				
Weld time	There must be at least 1 cycle cool time between the weld times (max. 50 cycles) if secondary current control is used. With primary current control, a continuous current can be applied.				
Connections	refer to section 11, Electrical connection				

5.1.2 Inverter losses

	PSU 5100 L	PSU 5100 W	PSU 5200 W	PSU 5300 L	PSU 5300 W
Basic switch cabinet loss	69 W				
Loss with max. power including basic loss	170 W	110 W	210 W	170 W	110 W



L: air-cooled, W: water-cooled

max. heat sink loss dissipated by the water or air	
	PSU 5100 PSU 5300
Water	max. 420 W
Air	max. 360 W
	PSU 5200
	max. 700 W
	-

5.1.3 Mechanical data

	PSU 5100 PSU 5300		PSU 5200
	(Air-cooled)	(Water-cooled)	
Dimensions	W: 203 mm H: 463 mm D: 278 mm	W: 203 mm H: 463 mm D: 228 mm	W: 250 mm H: 653 mm D: 280 mm
Weight	approx. 19.3 kg	approx. 17 kg (aluminum heat sink) approx. 25 kg (brass heat sink)	approx. 40 kg (aluminum heat sink) approx. 55 kg (brass heat sink)

5.1.4 Environmental data

	PSU 5100 PSU 5300		PSU 5200
	(Air-cooled)	(Water-cooled)	
Location	Installation in switch cabinet with protection class IP54; note PSU power loss		
Position	vertically; on rear wall	vertically; installation on switch cabinet mounting plate	
Ambient temperature of module	 0 °C to +55 °C; with prescribed cooling		
Storage temperature	-25 °C to +70 °C; when water-cooled: Heat sink must have been drained!		
Protection class	IP 20 to DIN 40050		
Humidity	Humidity class F to DIN 40040; 20 °C with 90% rel. humidity, 40 °C with 50% rel. humidity (to VDE 0113) Condensation on the modules is not permitted.		
Air pressure	in the range up to 2000 m above sea level.		
Corrosion	the ambient air must be free from major concentrations of acids, caustic solutions, corrosive agents, salt and metal vapors		
Cooling	air with Bosch fan cowl max. 45 °C	water; 4 l per min.; max. 30 °C; Δp: max. 1 bar water connection through M16x1.5 external thread with taper steps to DIN EN 560	



5.2 Technical data of the PSG types


5.2.1 Electrical data

	PSG 3050.00 A	PSG 3050.10 A	PSG 3075.10 A	PSG 3100.00 A	PSG 3200.00 A
Primary voltage	connection to PSU 5100.xxx			connection to PSU 5100.xxx or PSU 5200.xxx (2 x parallel)	connection to PSU 5200.xxx
Continuous direct current	4200 A			5800 A (with parallel con- nection to PSU 5200.xxx: 11600 A)	6500 A
Nominal direct voltage	6.3 V		8.4 V	9.0 V	13.0 V
Transformer ratio U	70		55	50	38
Current-carrying capacity, depending on duty cycle	see load diagram page 5-5	see load diagram page 5-6	see load diagram page 5-7	see load diagram page 5-8 and page 5-10	see load diagram page 5-9

5.2.2 Mechanical data

	PSG 3050.00 A	PSG 3050.10 A	PSG 3075.10 A	PSG 3100.00 A	PSG 3200.00 A
Weight (approx.)	14 kg		16 kg	25 kg	40 kg
Connections	mechanical and electrical connections as for standard transformer, series H, M/S EXPERT see dimension drawing sec. 10.2.1 see dimension drawing sec. 10.2.1 see dimension drawing sec. 10.2.2 see dimension drawing sec. 10.2.3 see dimension drawing sec. 10.2.4				

5.2.3 Environmental data

	PSG 3050.00 A	PSG 3050.10 A	PSG 3075.10 A	PSG 3100.00 A	PSG 3200.00 A
Transformer protection class	IP 65				
Insulation class	F				
Primary connection zone protection class	When delivered: IP00; must be covered by terminal box class IP55! For terminal boxes, see section 14, Accessories 				
Cooling	water; 6 l per min.; max. 30 °C; Δp: max. 0.6 bar			water; 10 l per min.; max. 30 °C; Δp: max. 1 bar	
Water connection through G 1/4" internal thread; "WE"= inlet; "WA"=outlet "					

5.3 Load diagrams

5.3.1 Performance features of PSU 5100.XXX

The PSU 5100.XXX inverter has been adapted to the capacity of the transformer-rectifier units type PSG 3050.XXX, PSG 3075.XXX and PSG 3100.XXX. In combination with a transformer-rectifier type PSG 3100.XXX, its peak current is approx. 18 kA (with ~ 9% duty cycle)

5.3.2 Performance features of PSU 5300.XXX

The PSU 5300.XXX inverter (mechanically identical with PSU 5100.XXX) supplies peak currents up to 36 kA (with ~ 1 to 2% duty cycle) when combined with a transformer-rectifier type PSG 3100.XXX. With a PSG 3050.XXX or PSG 3075.XXX, the amount of current is limited by the transformer.

Thus, the inverter type PSU 5300.XXX lies between PSU 5100.XXX and PSU 5200.XXX in the secondary range.

5.3.3 Performance features of PSU 5200.XXX

In combination with **two** PSG 3100.XXX **connected in parallel**, the inverter type PSU 5200.XXX supplies a peak current up to 54 kA. When used in conjunction with a PSG 3200.XXX, peak currents up to 40 kA can be attained. The no-load voltage is 14 Volts.



NOTE

Danger of damage to property through inadmissibly high welding current!
You should therefore check the load diagrams in order to determine whether the maximum welding current of your application is within the admissible ranges. The modules should only be operated with appropriate cooling (cf. also Section 10.3)!

The load diagrams define the maximum admissible welding current of the PSU/PSG combinations depending on the duty cycle (ED).

The maximum admissible welding current depends not only on the duty cycle of the rectifier diodes, but also on the duty cycle of the PSG (transformer) used.

All diagrams are based on the thermal transient recovery times (integration time) of the rectifier diodes (2 seconds) and the transformers (60 seconds). These fixed values and some application-related values (number of spot welds per minute, number of weld time cycles, number of cycles duration) are used to determine

1. the maximum admissible welding current depending on the diode load
- and**
2. the maximum admissible welding current depending on the transformer load.

For proper execution of the welding task the lowermost of these two values must not be exceeded!

An example is given on page 5-12 and the following pages.

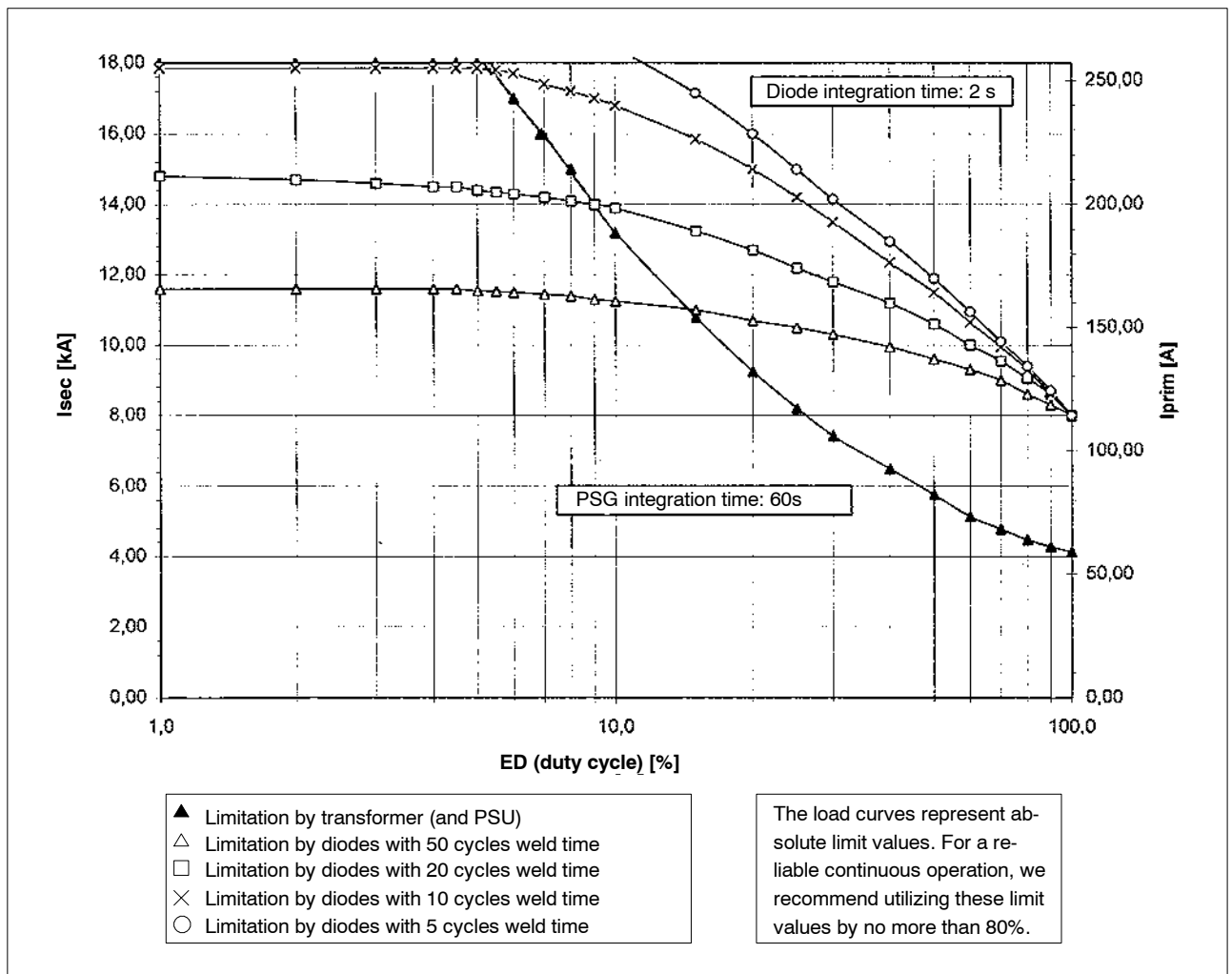
The power data for PSU 5100/PSU 5300 = 50 kW and PSU 5200 = 100 kW are calculated from the respective continuous current (110 A and 220 A) and the 500 V output voltage of the inverters.

PSU 5100 / PSU 5300: $P \approx 110 \text{ A} \times 500 \text{ V} \approx 50 \text{ kW}$
 PSU 5200: $P \approx 220 \text{ A} \times 500 \text{ V} \approx 100 \text{ kW}$

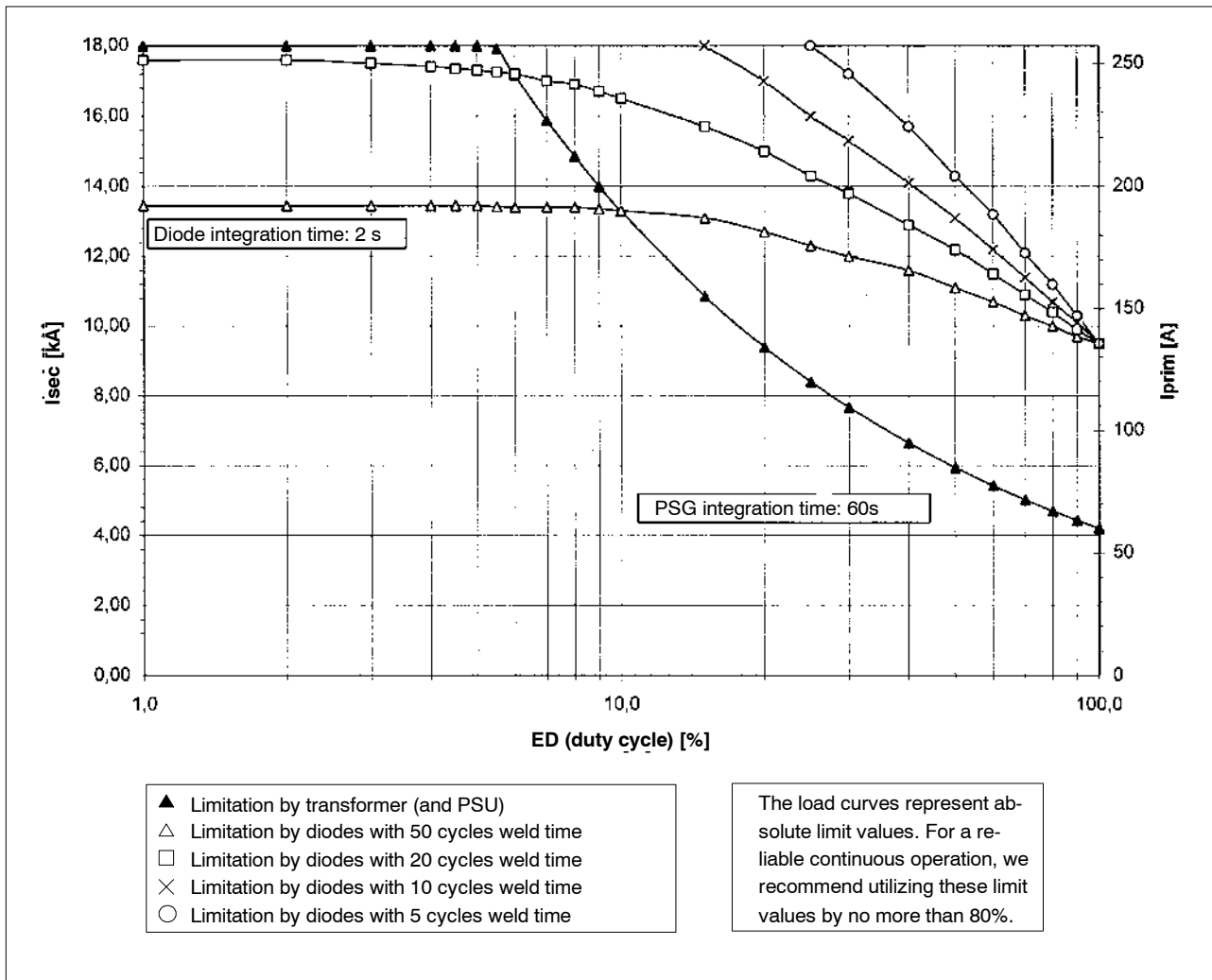
The devices are rated for this load, i.e. the copper bars, connection terminals, electrolyte capacitors are rated accordingly.

For comparing different inverters, it will not be sufficient to verify the peak current (e.g. 20 kA); instead, the respective continuous loads have to be compared.

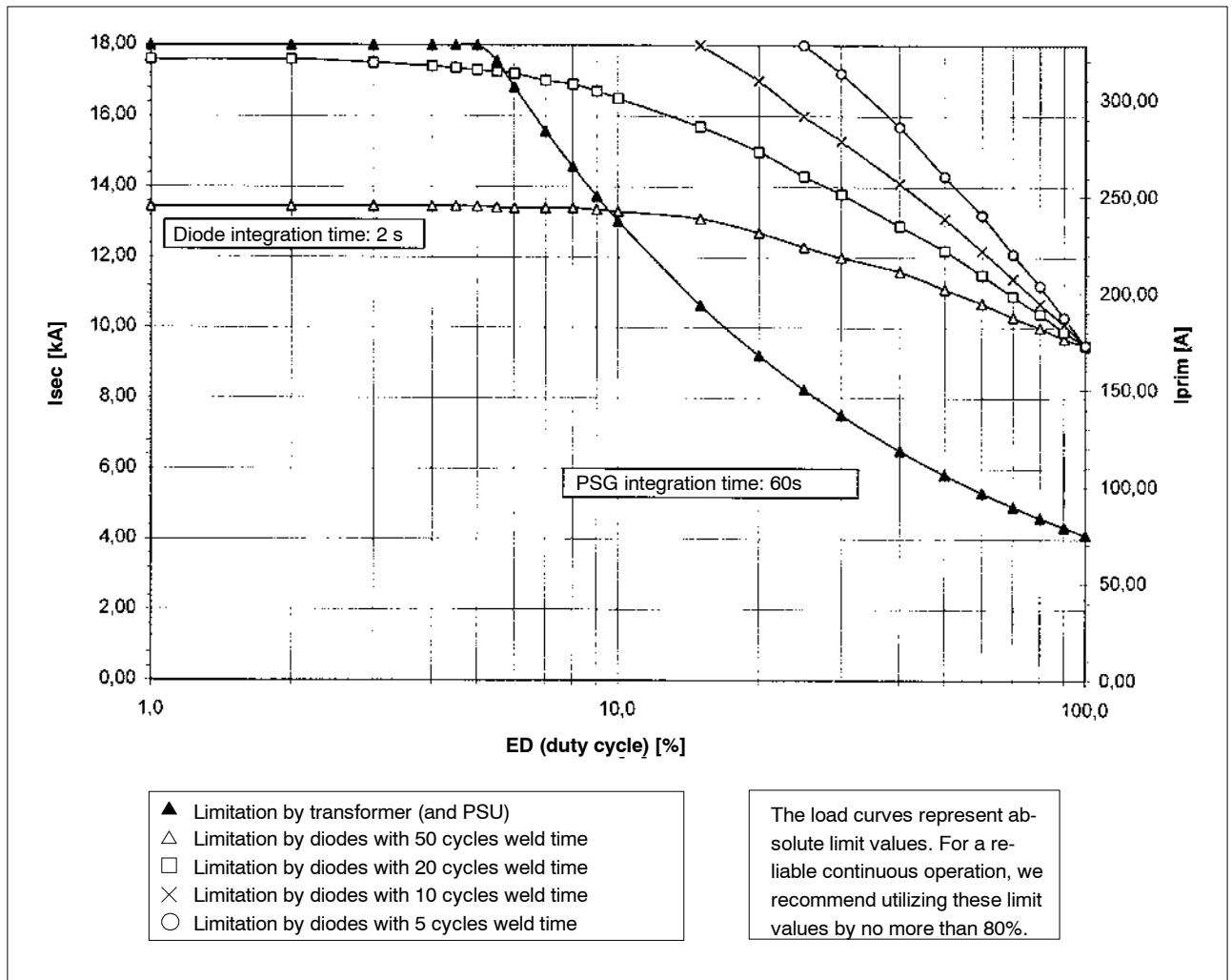
5.3.4 PSU 5100.XXX / PSU 5300.XXX and PSG 3050.00 A



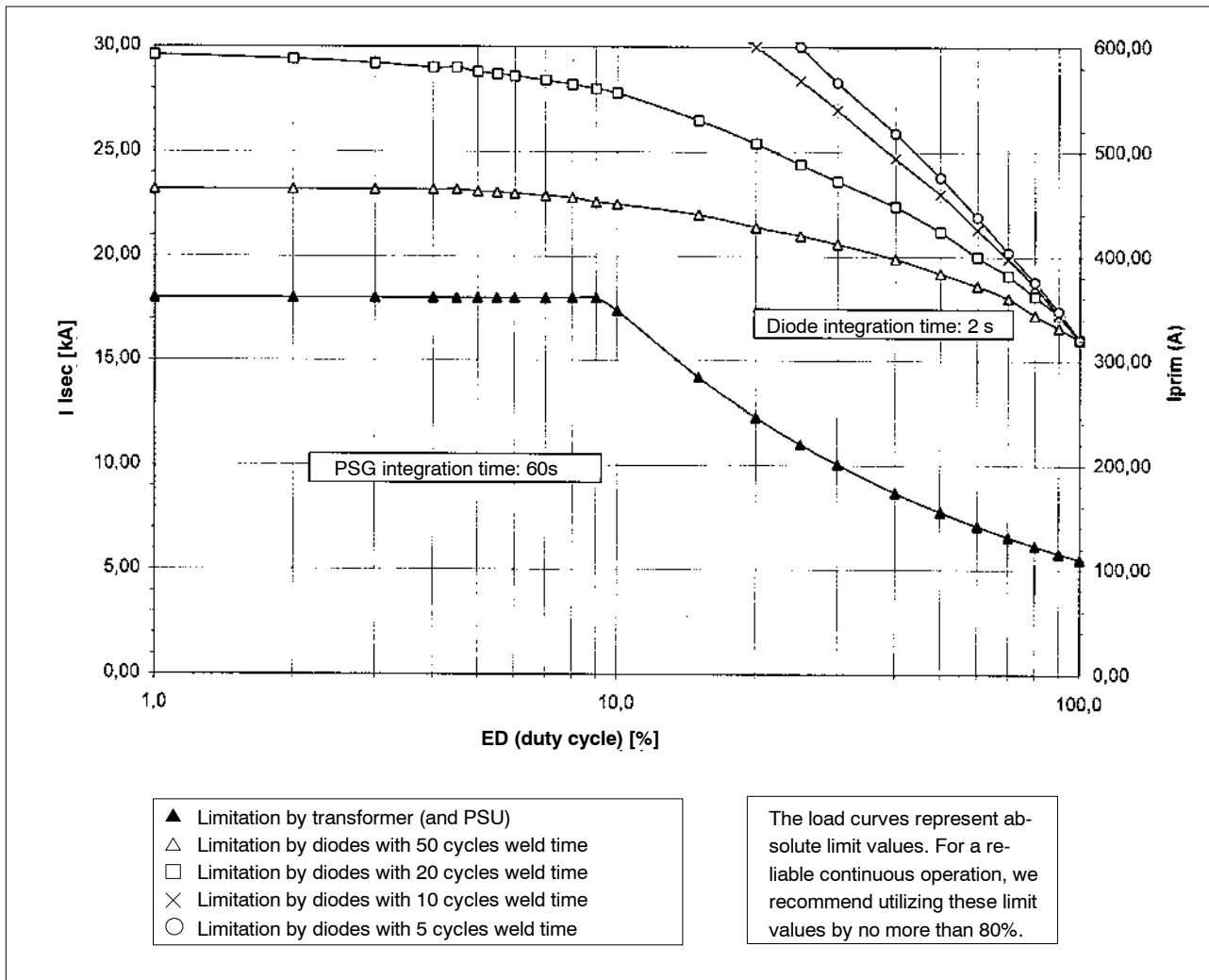
5.3.5 PSU 5100.XXX / PSU 5300.XXX and PSG 3050.10 A



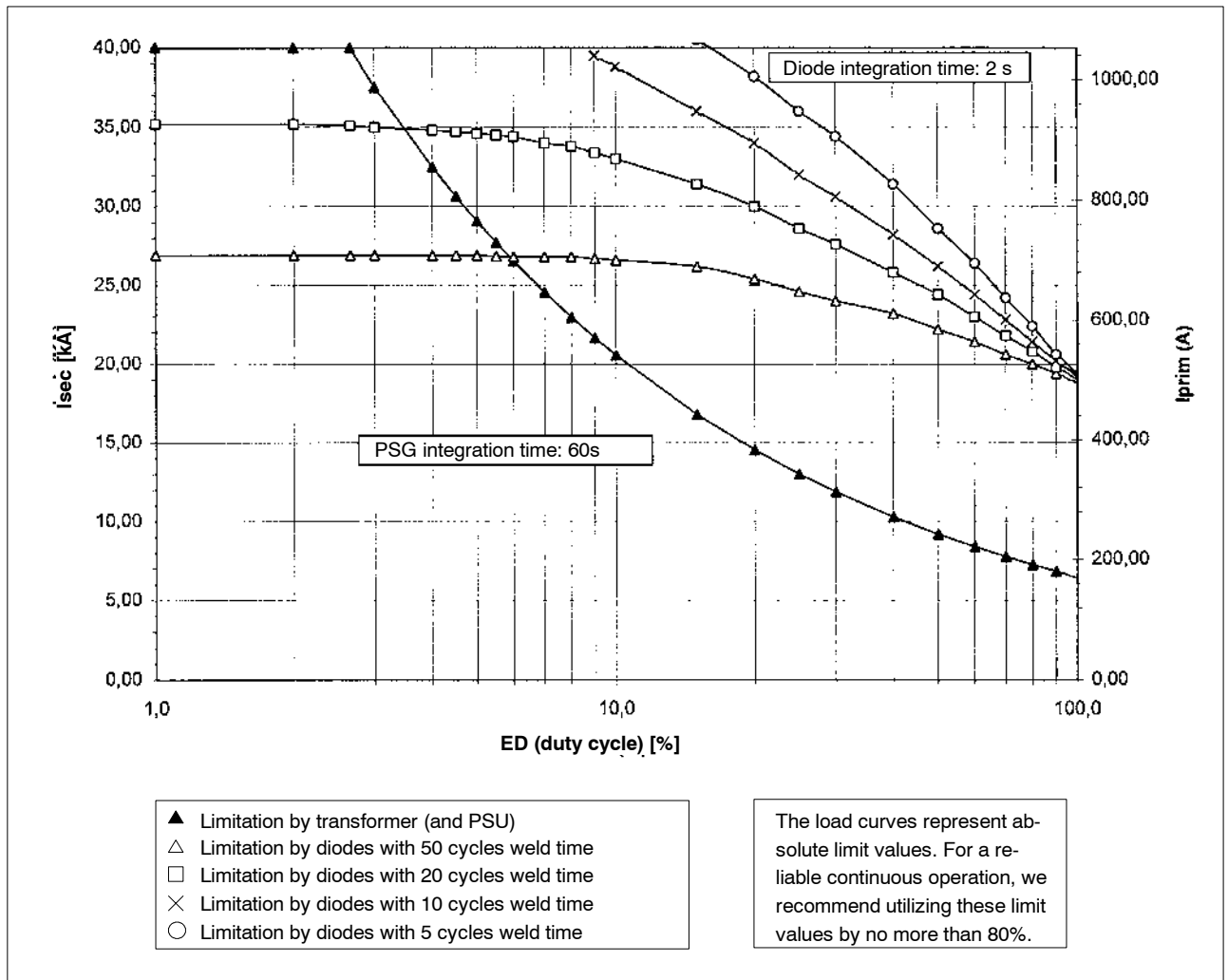
5.3.6 PSU 5100.XXX / PSU 5300.XXX and PSG 3075.10 A



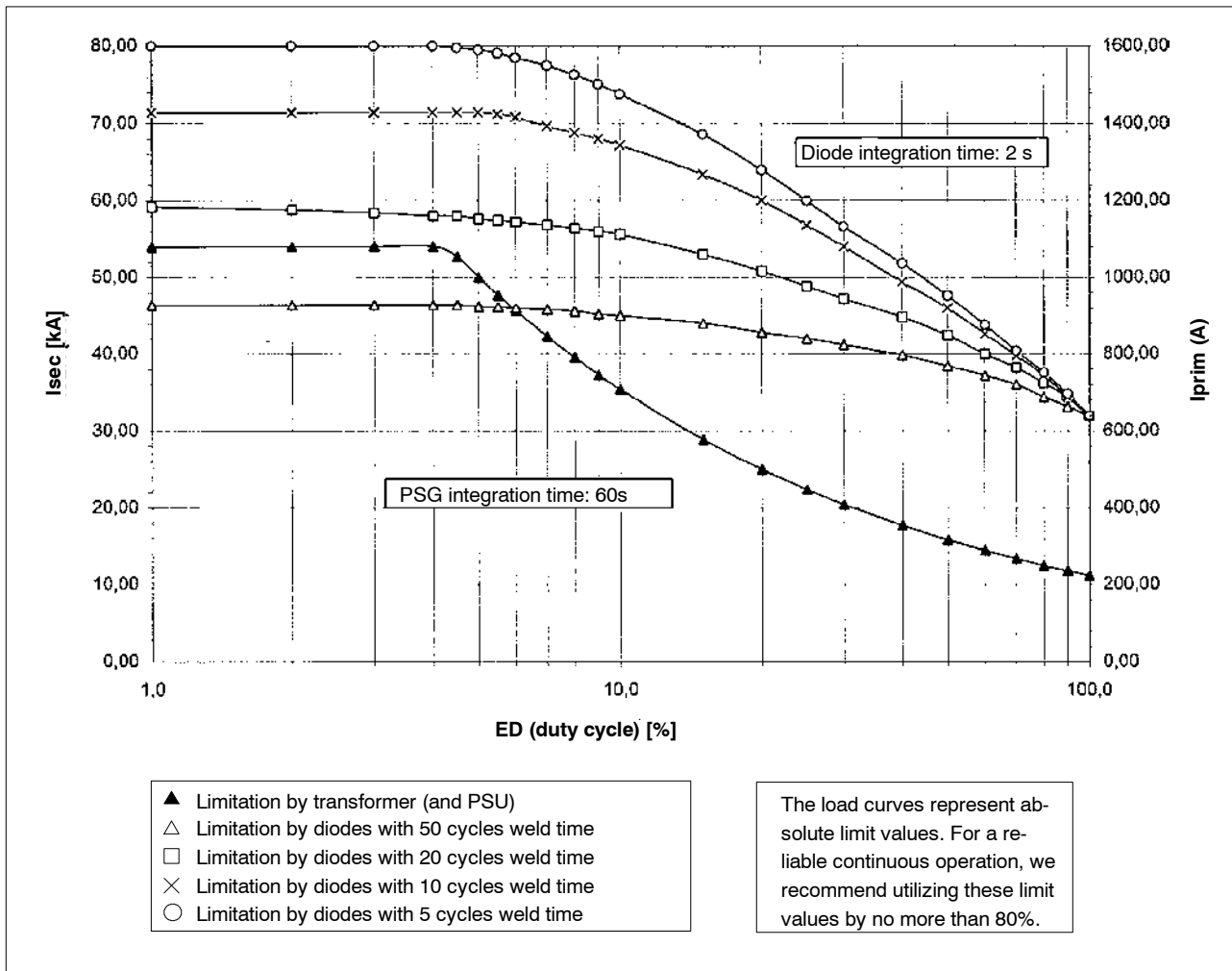
5.3.7 PSU 5100.XXX / PSG 3100.00 A



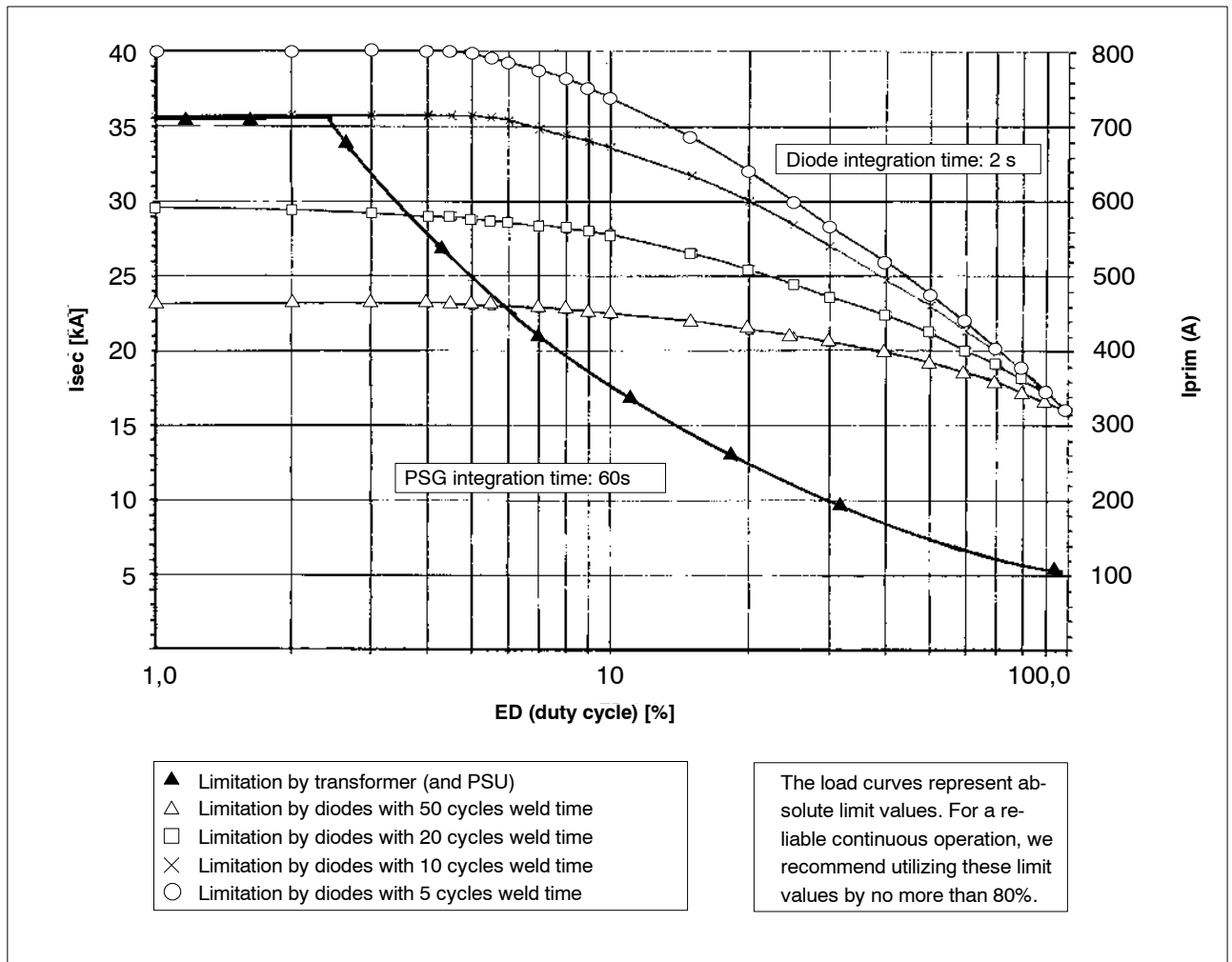
5.3.8 PSU 5200.XXX and PSG 3200.00 A



5.3.9 PSU 5200.XXX and 2 x PSG 3100.00 A parallel

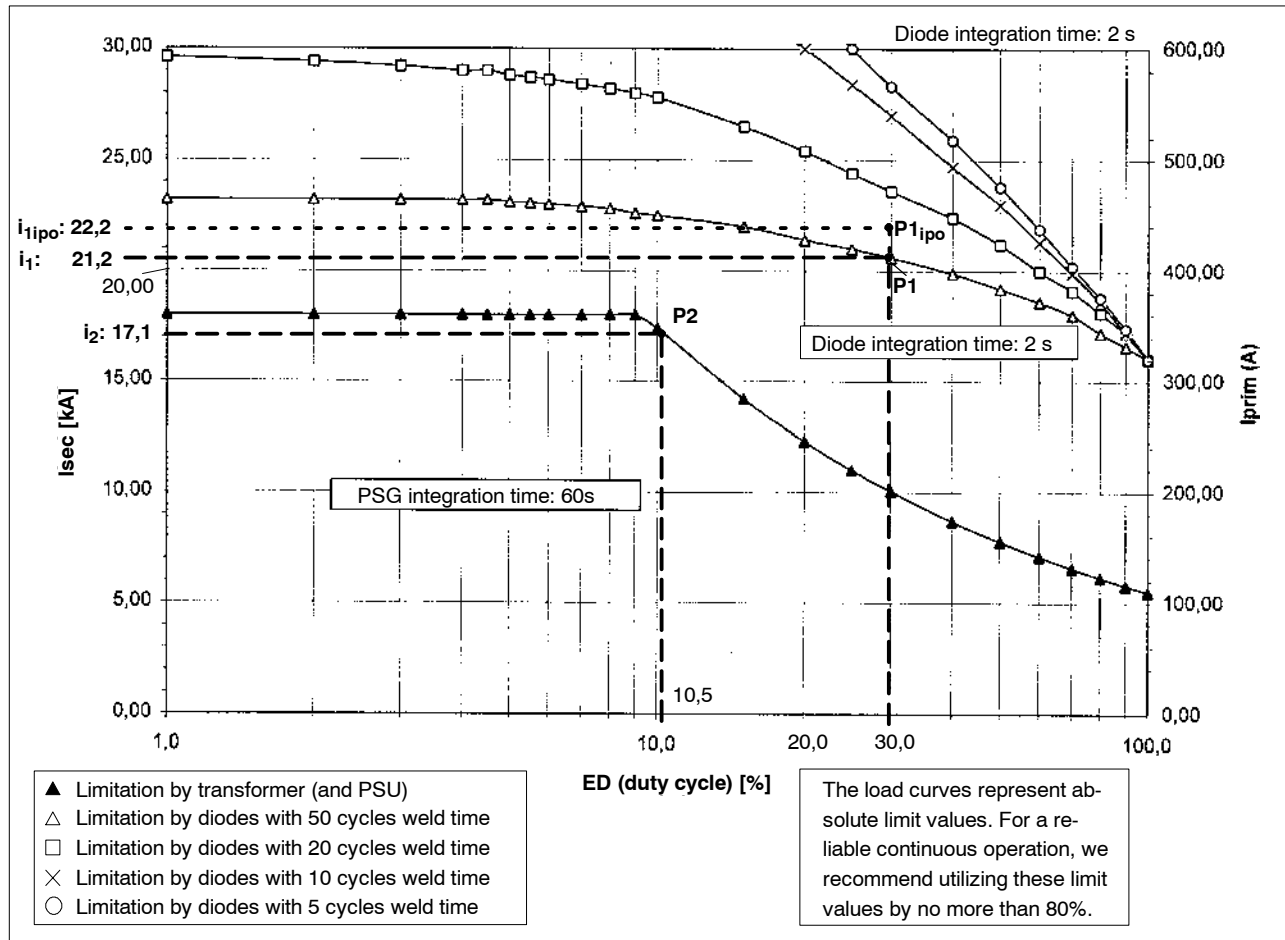


5.3.10 PSU 5200.XXX / PSU 5300.XXX and 1 x PSG 3100.00 A



5.3.11 Example of PSU 5100.XXX and PSG 3100.00 A

1. Look for the related diagram (PSU 5100.XXX and PSG 3100.00 A).



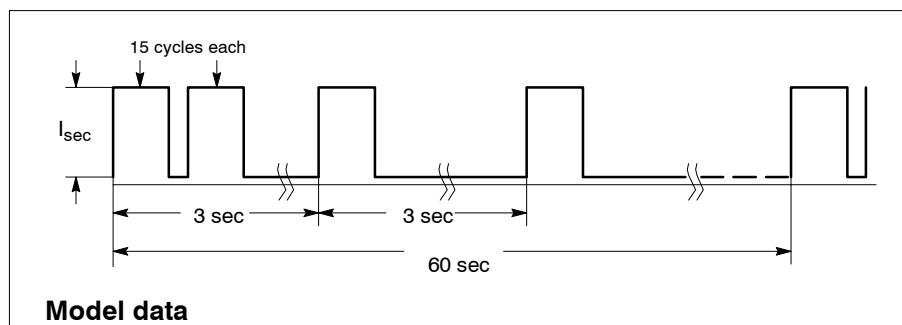
2. Note down your welding parameters. Model data:

20 cycles per minute (↗ 1 sequence = 60s/20=3s).

150 cycles duration (including ancillary times such as SQZ, OFF, CT, WLD, HOLD and all idle times) ↗ 150 cycles = 1 sequence ↗ 1 cycle = 3s/150=0.02s.

1st sequence: 2 x 15 cycles weld time:

subsequent sequences: 15 cycles weld time each (↗ $t_s=15 \times 0.02s=0.3s$)



3. Calculate the duty cycle (ED) [2s] of the diodes on the basis of the sequence with the highest number of weld time cycles:

$$ED [2s] = \frac{\text{number of weld time cycles}}{2 \text{ seconds}} \times 100 \% = \frac{30 \text{ cycles} \times 0.02}{2 \text{ seconds}} \times 100 \% = 30 \%$$

4. Use the diagram to determine the maximum welding current for the diodes. For this purpose, first draw a vertical line at the duty cycle value of the diodes which you calculated before (ED=30%).

Combine this diode characteristic with the higher next number of weld time cycles (i.e. characteristic \triangle with a given 30 weld time cycles). At the intersection level (cf. P1) you can directly read off the max. welding current i_1 for the diodes from the left axis (in this case approx. 21 kA).

Taking into account the actual number of weld time cycles (in this case 30 cycles), you may also obtain the intersection by interpolating between two adjacent characteristics (in this case characteristics \triangle and \square ; cf. intersection P1_{ipo}). In this case, you will obtain the (more accurate) max. welding current of approx. 22.2 kA (i_{1ipo}) for this example.

5. Calculate the duty cycle ED[60s] of the PSG:

$$ED [60s] = \frac{t_s \times \text{number of spots per min.} + 1}{60s} \times 100 \% = \frac{0.3s \times 21}{60s} \times 100 \% = 10.5 \%$$

(Note : For the calculation of t_s refer to item 2)

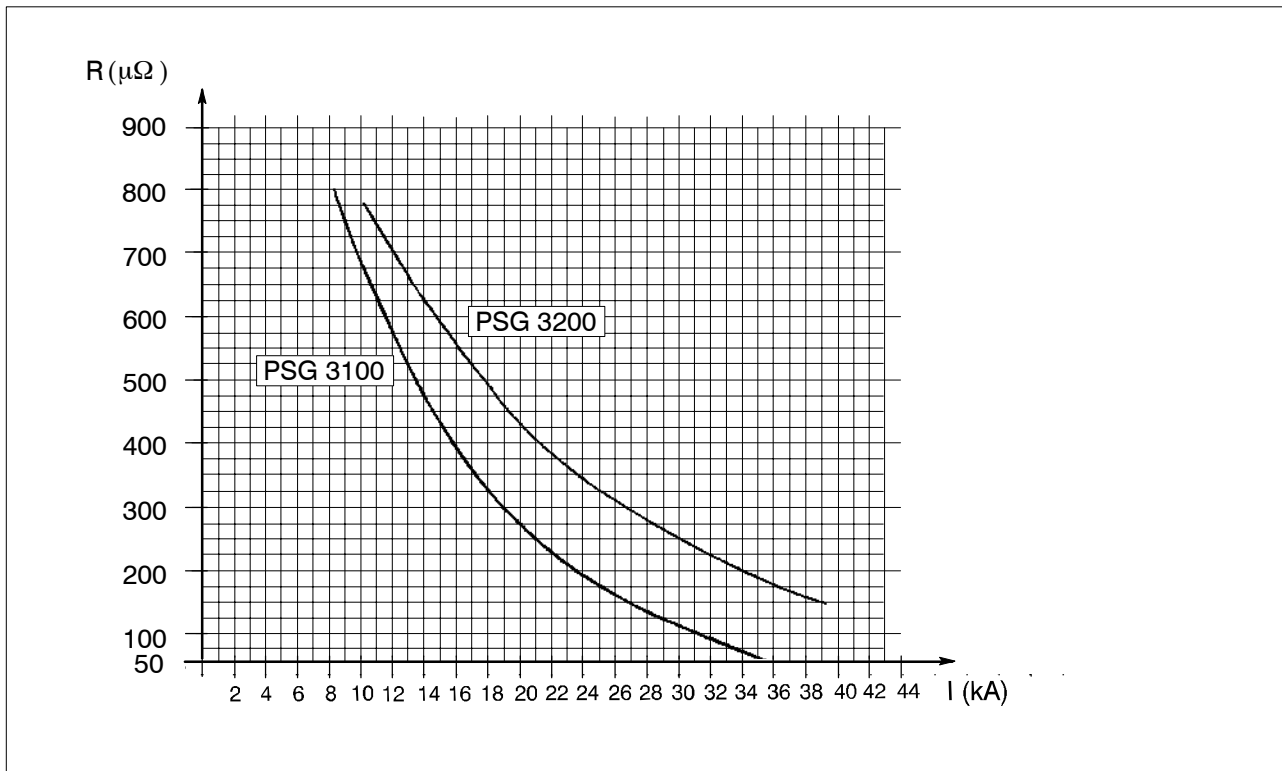
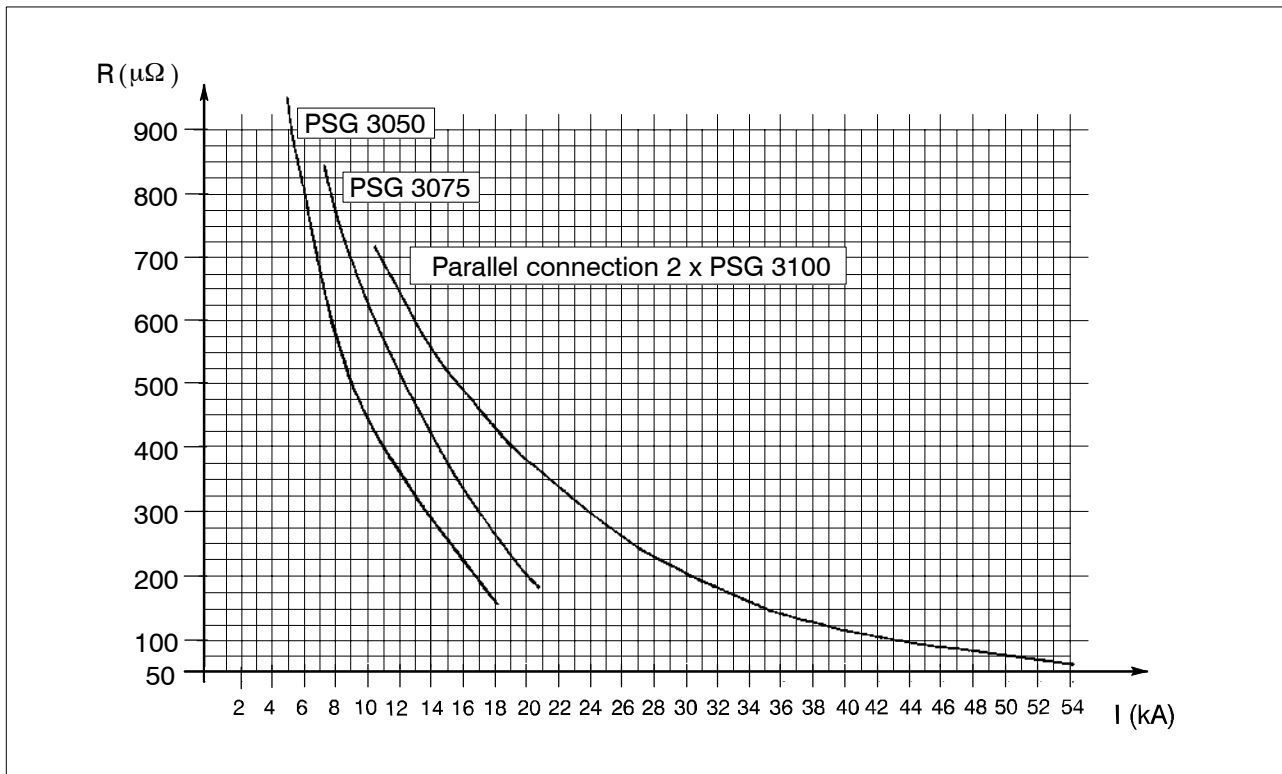
6. Determine the maximum welding current of the PSG with the help of the diagram. For this purpose, you should first draw a vertical line at the value of the PSG duty cycle you calculated before (ED=10.5%).

Now use characteristic \blacktriangle .

At the intersection level (cf. P2) you can directly read off the max. welding current i_2 for the PSG from the left axis: in this example approx. 17 kA.

7. Always use **the lowermost value** of the two welding currents i_1 and i_2 as maximum welding current for your welding task (in this case 17 kA).

5.3.12 Current resistance characteristics





6 Operating modes

6.1 Current control function

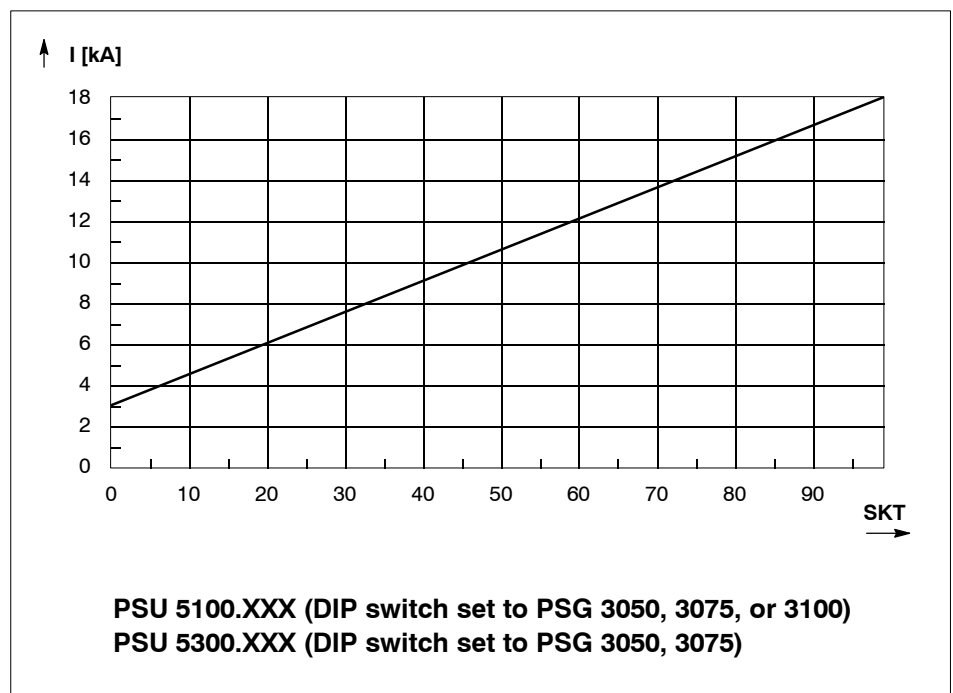
The setpoint value of the heat is entered in scale divisions (SKT), the resulting secondary current is automatically adjusted according to the corresponding diagram.

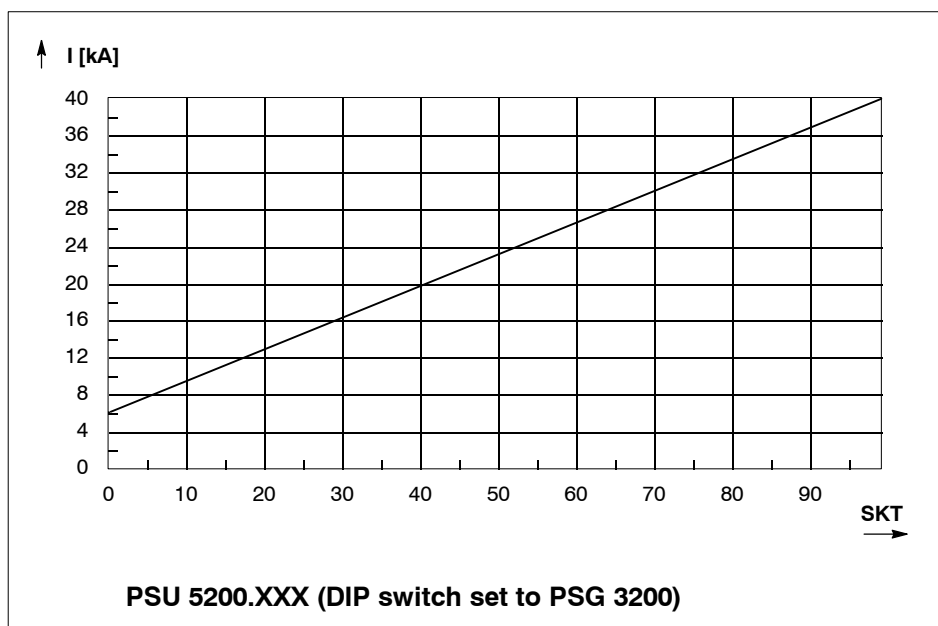
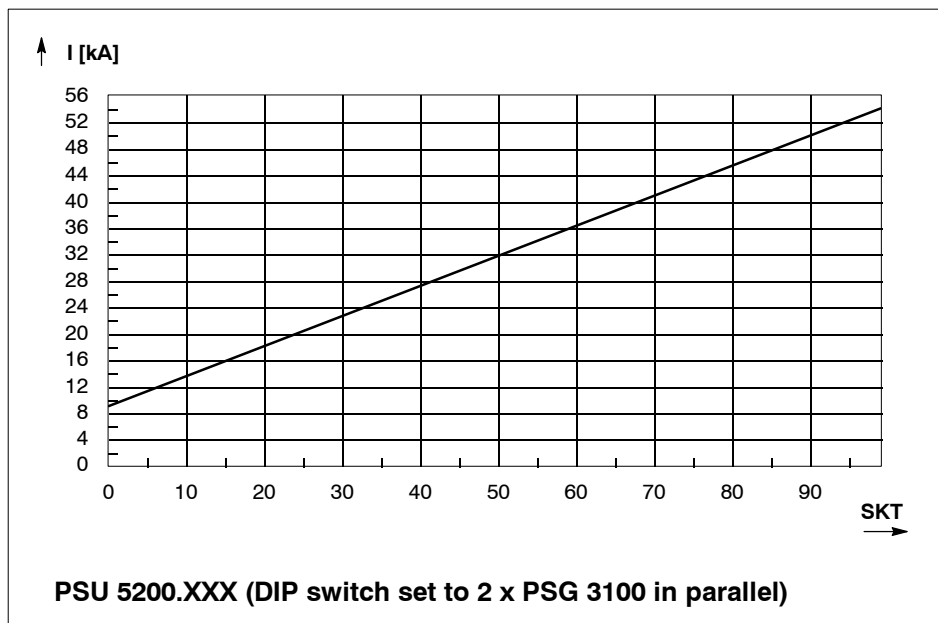
The actual value of the welding current is measured at the secondary side and signalled to the PSU for comparing the setpoint and actual values.

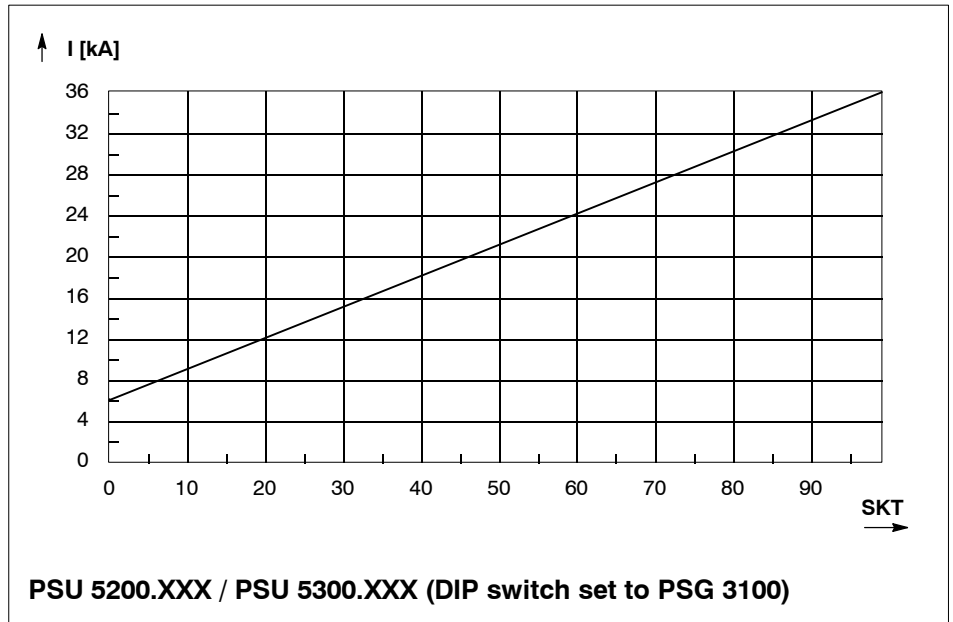
The current controller is very dynamic. The permanent activity of the controller (max. delay time 500 μ sec) provides for a maximum stability of the welding DC.

In the following diagrams, the secondary welding current [kA] is shown depending on the programmed heat value [scale values SKT] for the individual PSU's. The tolerance is $\pm 3\%$.

If the KSR function of the weld timer is available, the current value is specified with maximum precision in kA after current calibration.







6.2 Pulse width mode

In this operating mode, the PSU inverts the heat scale value predetermined by the timer into the corresponding pulse width.

The welding current is not controlled!

In this case, the welding current is determined by the resistances in the secondary circuit. Due to the small dimensions and the low overall weight of the welding transformer, the transformer can be installed close to the electrode guns in order to keep the resistance of the secondary circuit as low as possible. The following relations apply:

- 00 SKT (scale values) minimum pulse width (approx. 80 μ s)
- 99 SKT (scale values) maximum pulse width (approx. 450 μ s)

6.3 Change-over of operating modes



WARNING!

Possible danger of injury and/or damage to property through unauthorized change-over of operating modes!

The right to interfere with the timer components is reserved to the BOSCH service department or to repair/maintenance units authorized by BOSCH!

If the operating mode is to be changed over, the system must be switched off beforehand! In any case, insulated tools must be used!



WARNING!

Danger of life through electrical voltage!

When the system is switched off, the inverter inside is not immediately de-energized! De-energization is performed slowly.

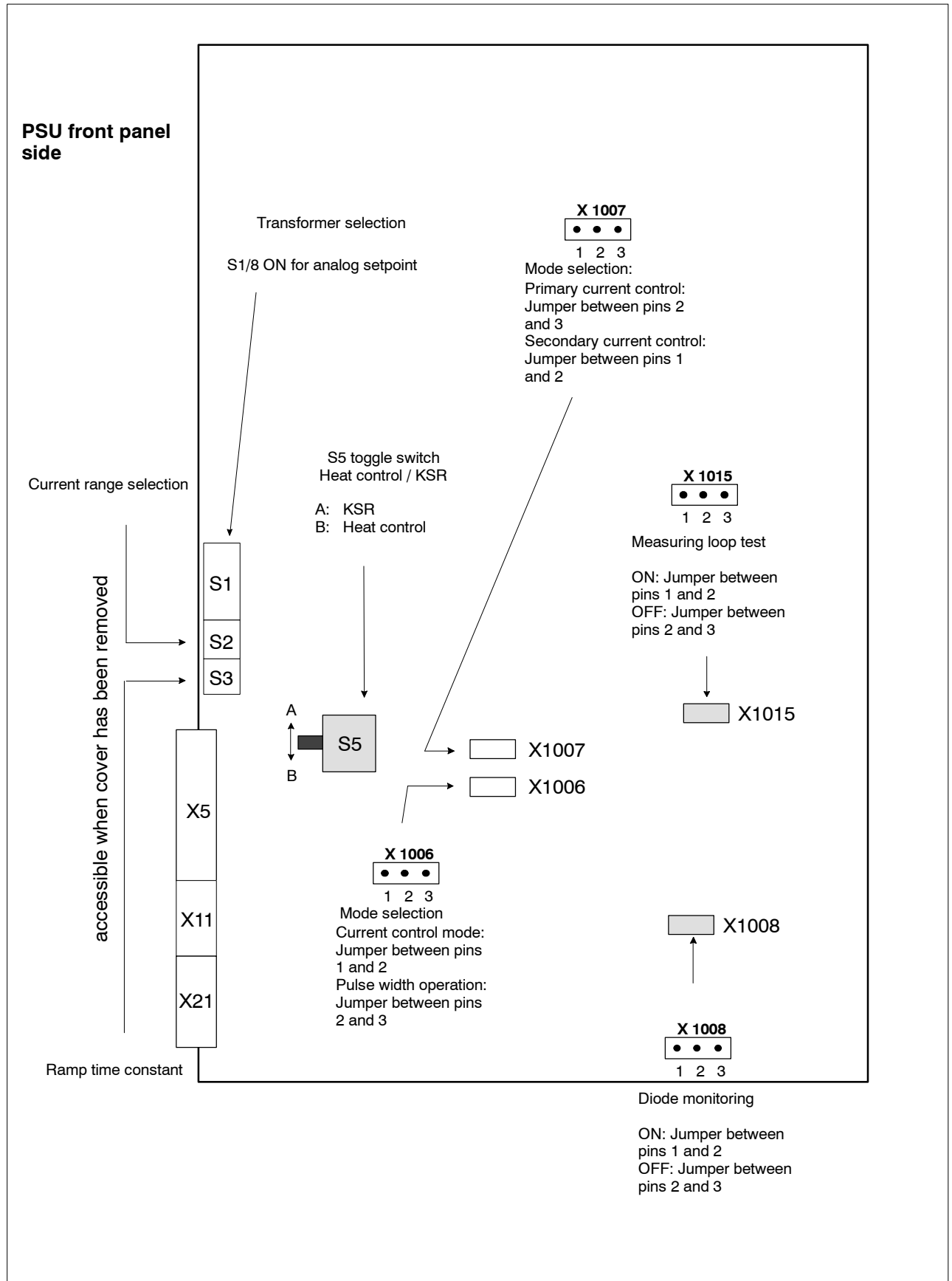


Therefore, you should switch off the system and wait for at least 5 minutes before you can open the inverter housing.

- To change over from primary current control to secondary current control, change the jumper position on terminal post **X1007**.
Primary current control: the secondary welding current is controlled via the measured primary current and the transformer ratio programmed with the BOS-5000 software.
- To change over from current control mode (state as delivered) to pulse width mode (special mode), change the jumper position on terminal post **X1006**.
- To disable diode monitoring, change the jumper position on terminal post **X1008**.
- To disable the measuring loop test, change the jumper position on terminal post **X1015**.
- To change over from KSR to heat control, set switch **S5** accordingly. Potentiometer **R1** is used to adjust the electrode voltage.
- The ramp time constant is set with switch **S3** (refer to section 9.7).
S3/1 in position ON: ramp default setting
S3/2 to S3/4 in position ON: increases the ramp's time constant

With a secondary line length > 5 m, **S3/1**, **S3/3** and **S3/4** should be set to OFF and **S3/2** to ON in order to avoid current overshoot and possible faults (seven-segment display: 7) when the inverter current limit is reached.

6.4 Settings





6.5 Setting instructions

Settings and connections of PSU 5000 for heat control:

- Set switch S5 on the analog control module to position B (cf. section 6.4).
- Connect the electrode voltage signal to terminals X11/5 and X11/6.
- Set switch S2/3 to ON for a current range of 1 to 6 kA.).

Setting the inverter to operation with an external analog setpoint:

- Set switch S1/8 to ON
- Connect analog value to X12/5 and X12/6.
- Connect weld time signal to X22/1 and X22/2.

Settings for seam welding or operation without secondary current sensor:

- Set primary current control mode on analog control module (X1007: jumper between pins 2 and 3).
- Disable diode monitoring (X1008: jumper between pins 2 and 3).
- Disable measuring loop test (X1015: jumper between pins 2 and 3).

7 Monitoring and diagnostics



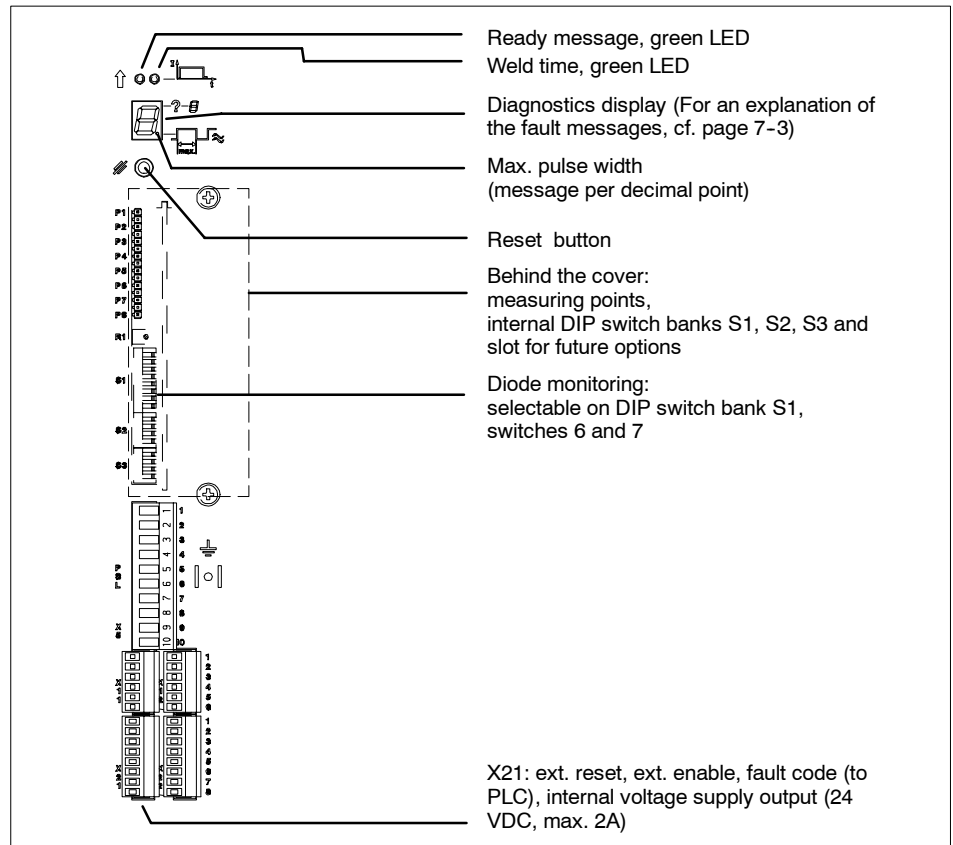
ATTENTION!

Danger of injury and/or damage to property through missing or inappropriate interpretation of fault messages! If the inverter is not controlled by a Bosch timer it must be ensured that closing of the floating contact between terminals 4 and 5 or opening of the connection between terminals 5 and 10 of the X5 terminal connector at the inverter stops the timer!

The inverter already provides the following functions:

- Indication of the "inverter ready" state by green LED
- Indication of the weld time (incoming firing pulses) by green LED
- Indication of the "maximum pulse width reached" condition by the decimal point on the seven-segment display "?"
- Change-over of diode monitoring from 2 diodes per branch to one diode (with DIP switch)
- Reset fault messages: external (at X21) or through reset button
- Indication of fault numbers on the seven-segment display "?"
- Encoded output of fault messages with output signals (at X21). For encoding, see section 7.5.

The following partial view of the inverter indicates only those elements which are relevant for the functions mentioned above. For further elements, please refer to the "Controlling the inverter" and "Electrical connection" sections.



7.1 "Inverter ready" LED

The LED is lighted when

- no inverter fault message is active
- the "Stop current" input signal is not active. The function of "Stop current" corresponds to an **inverted** "external enable" signal.

0V at X21/pin 6: output stage is switched on
+24V at X21/pin 6: output stage is blocked.

7.2 "Weld time" LED

The LED is lighted when

- 5 kHz firing pulses arrive from the timer (at X5, pins 6 and 7), or
- the "weld time" input signal (at X22, see Section 8) is high

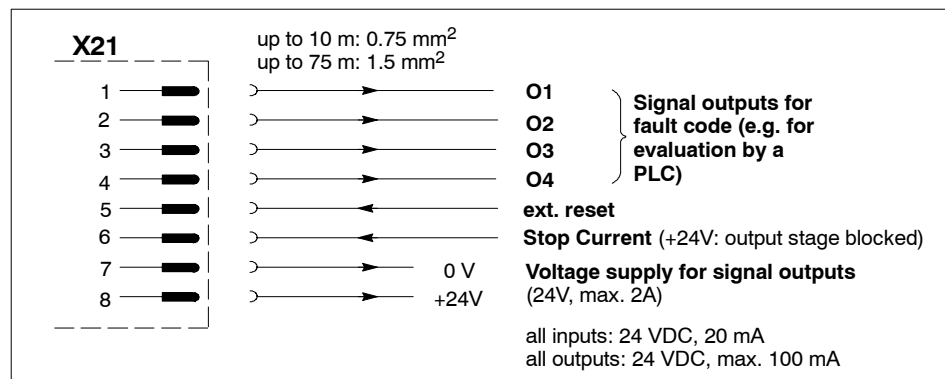
7.3 "Max. pulse width reached" display

The decimal point of the seven-segment display is lighted when

- the maximum pulse width is reached. In control operation, this display appears only when the commanded current cannot be reached. In this case, the inverter must have worked at the limit for at least 5 consecutive mains cycles.

Please note: The inverter continues working despite this display. It is not switched off!

7.4 X21 pin assignment



For the encoding of outputs A1 to A4, please refer to page 7-5.

7.5 Fault numbers at the seven-segment display

The fault numbers given in the following table correspond to the LED numbers that may appear at the seven-segment display.

If no fault has been recognized, the value "0" will be displayed.

In the event of a fault, the welding sequence is immediately stopped. In this case, the Bosch weld timer will immediately signal "Power supply fault" (temperature monitoring circuit for power supply unit).

When the cause of the fault has been removed, you should first reset the fault

- at the PSU with the reset button or the "Reset" input at X21/5, and then press
- the acknowledgement button on the weld timer.

Please note: Fault "3" can only be reset by power off/on.

1	<p><i>Transformer temperature</i></p> <p>The temperature of the welding transformer is permanently monitored by thermostatic switches. If the maximum admissible value is exceeded, the thermostatic switch opens terminals X11/1 and X11/2 of the PSU.</p>
Remedy	<p>Check cooling circuit of PSG for proper functioning.</p> <p>Reduce welding heat.</p>
2	<p><i>Thermal diode overcurrent</i></p> <p>The type of load is not permitted for the high-current diodes used.</p>
Remedy	<p>Select lower welding current.</p> <p>Select shorter ED (see load diagrams)</p>
3	<p><i>Driver fault</i></p> <p>Transistor monitoring activated. Transistors may be defective.</p>
Remedy	<p>Call Bosch service department</p>
4	<p><i>Inverter temperature</i></p> <p>The temperature of the PSU is permanently monitored. The maximum admissible value was exceeded.</p>
Remedy	<p>Check PSU cooling system for proper functioning (water circuit ok?).</p> <p>Reduce welding heat.</p>



5

DC link voltage

The DC link voltage of the inverter is outside the permitted range.

*Remedy***Check mains supply.**

6

Power supply unit fault

The voltage for the internal logic is outside the limit values. The power supply unit board may be defective.

*Remedy***Call Bosch service department.**

7

Overcurrent / Earth fault

- Earth fault of primary cable or primary winding of the welding current transformer.
- Short-circuit in the primary circuit of the welding transformer.
- Overcurrent due to controller overshoot with long secondary cables (length of secondary welding circuit > 5 m).

*Remedy***Eliminate earth fault.****Eliminate short-circuit.****Set DIP switch S3/2 to ON and S3/1 to OFF for long secondary cables****NOTE**

This earth fault monitoring function does not guarantee personal protection.

8

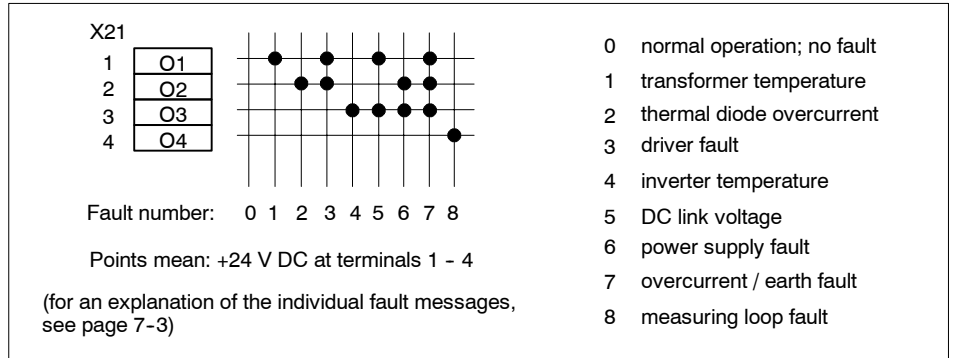
Measuring loop fault

The measuring loop (between X11/3 and X11/4) is checked for short-circuits or interruption prior to the beginning of the weld time.

*Defective sensor cable**Remedy***Replace cable***Faulty plug-in connections**Remedy***Check plug-in connections***Incorrect connector assignment**Remedy***Check connector assignment***Defective sensor**Remedy***Replace transformer**

7.6 Fault message encoding

All fault messages indicated at the seven-segment display can also be transmitted in binary code to an external PLC for evaluation. The pin assignment of output bits 1 to 4 is shown on page 7-2.





8 Controlling the inverter



ATTENTION!

Danger of injury and/or damage to property through missing or inappropriate interpretation of fault messages!

If the inverter is not controlled by a Bosch timer it must be ensured that closing of the floating contact between terminals 4 and 5 or opening of the connection between terminals 5 and 10 of the X5 terminal connector at the inverter stops the timer!

This section contains an explanation of the principles for controlling the inverter. The inverter can be controlled with 5 kHz firing pulses (default) or with a 24 V weld time signal and an analog input voltage.

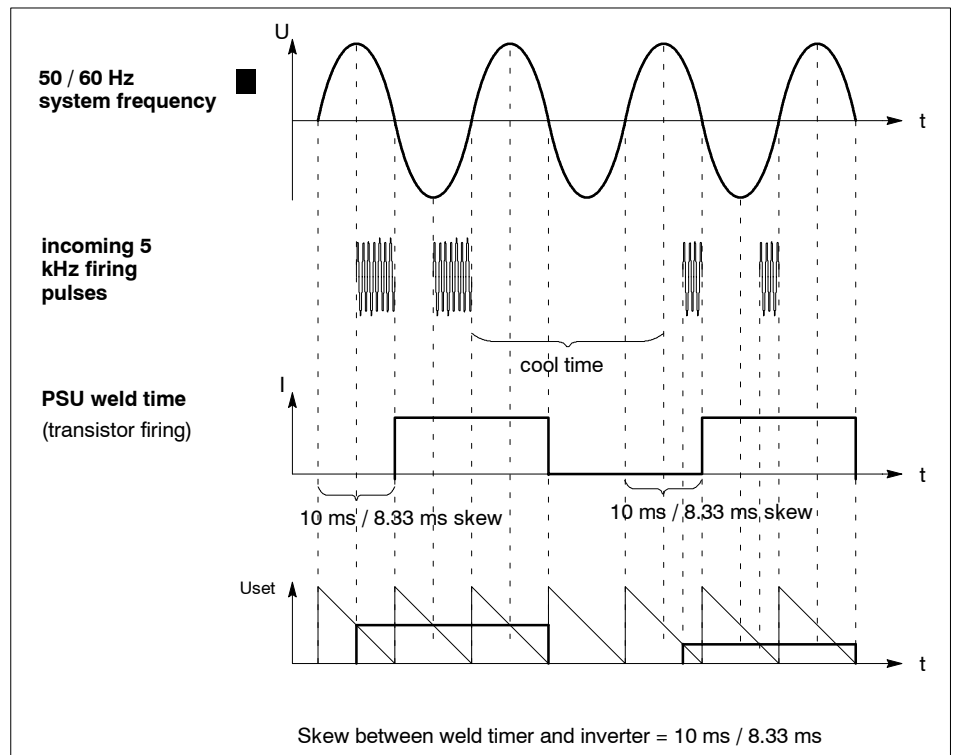
For the integration of the inverter in the welding system, please refer to Section 11.

8.1 5 kHz firing pulses

8.1.1 Function

The inverter can be controlled with 5 kHz firing pulses. In this case, it inverts the firing pulses into the weld time and the current setpoint value.

Example:



8.1.2 Displays and pin assignment

”Weld time” LED

The LED is lighted when

- 5 kHz firing pulses are received from the timer (at X5, pins 6 and 7)

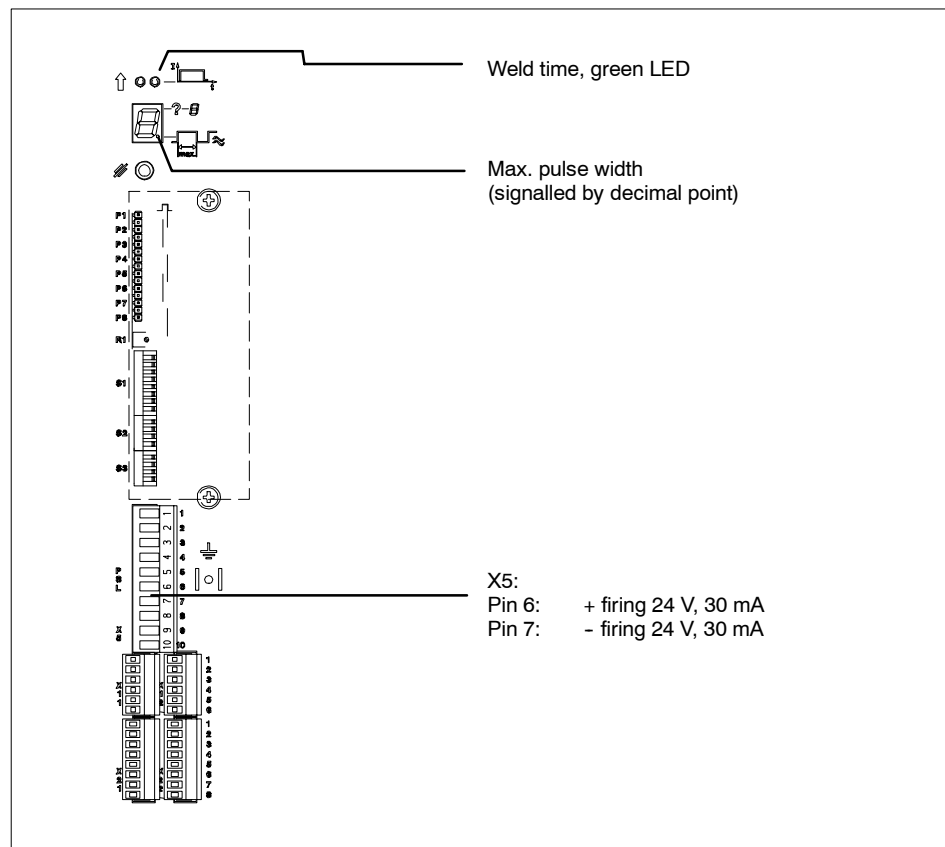
”max. pulse width reached” display

The decimal point of the seven-segment display is lighted when

- the maximum pulse width has been reached. In control operation, this display appears only when the commanded current cannot be reached. In this case, the inverter must have worked at the limit for at least 5 consecutive mains cycles.

Please note: The inverter continues working despite this display. It is not switched off!

The following partial view of the inverter indicates only those elements which are relevant for the functions mentioned above. For further elements, please refer to section 11.



8.2 24 V weld time signal and analog input voltage

As an **option**, the inverter can be controlled by a 24 V weld time signal and an analog input voltage in the range of 1 to 10 V. For this purpose, switch 8 of DIP switch bank S1 must be set to "ON" (cf. Section 9.5). The 5 kHz firing signal (X5) and the synchronization voltage connection (X5) must be disconnected beforehand.

8.2.1 Function

Condition for firing

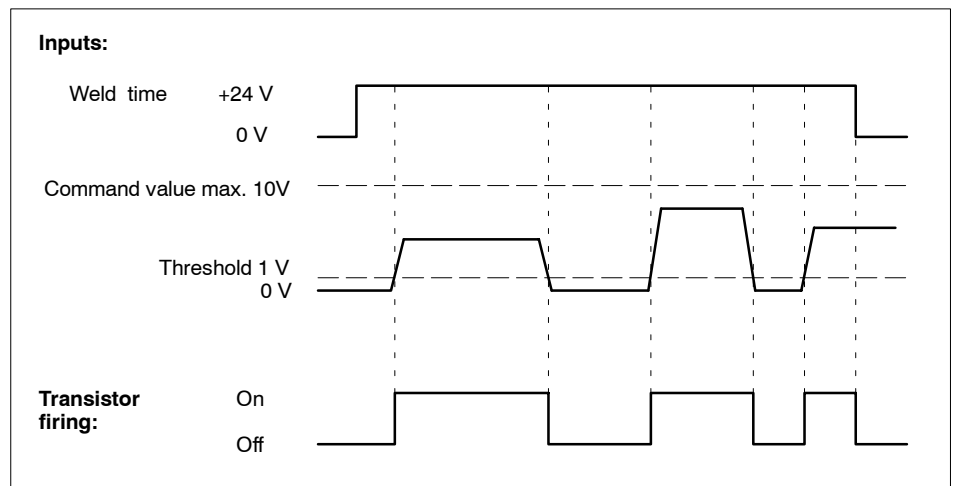
If the 24 V weld time signal is present, and if the analog input voltage has passed the 1 V threshold, the transistors are fired.

Conversion of the analog signal with respect to the current control range:

$$U_{\text{set}} = 1.6 \text{ V} \quad \blacktriangleright \text{ min. value}$$

$$U_{\text{set}} = 10 \text{ V} \quad \blacktriangleright \text{ max. value}$$

The weld time signal can be applied independent from the mains system, it is processed synchronous with the internal ms cycle.



8.2.2 Displays and pin assignment

"Weld time" LED

The LED is lighted when

- the "weld time" signal (at X22) and an analog value > 1V are present.

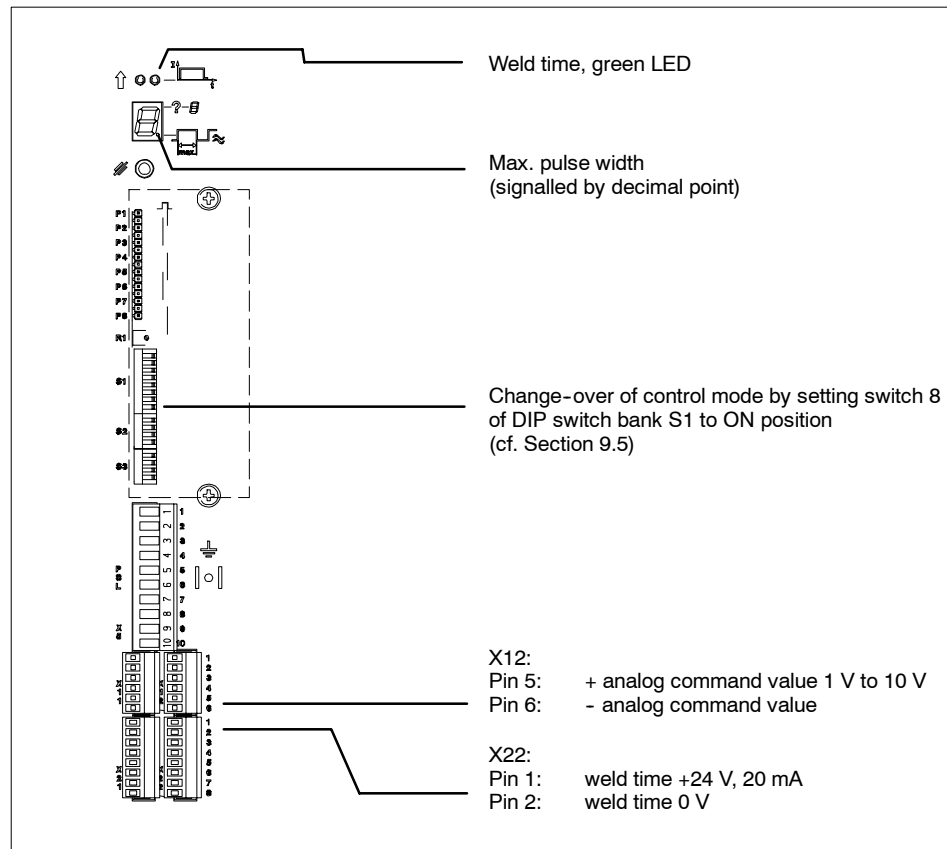
"max. pulse width reached" display

The decimal point of the seven-segment display is lighted when

- the maximum pulse width has been reached. In control operation, this display appears only when the commanded current cannot be reached. In this case, the inverter must have worked at the limit for at least 5 consecutive mains cycles.

Please note: The inverter continues working despite this display. It is not switched off!

The following partial view of the inverter indicates only those elements which are relevant for the functions mentioned above. For further elements, please refer to section 11.



9 Adjustment functions



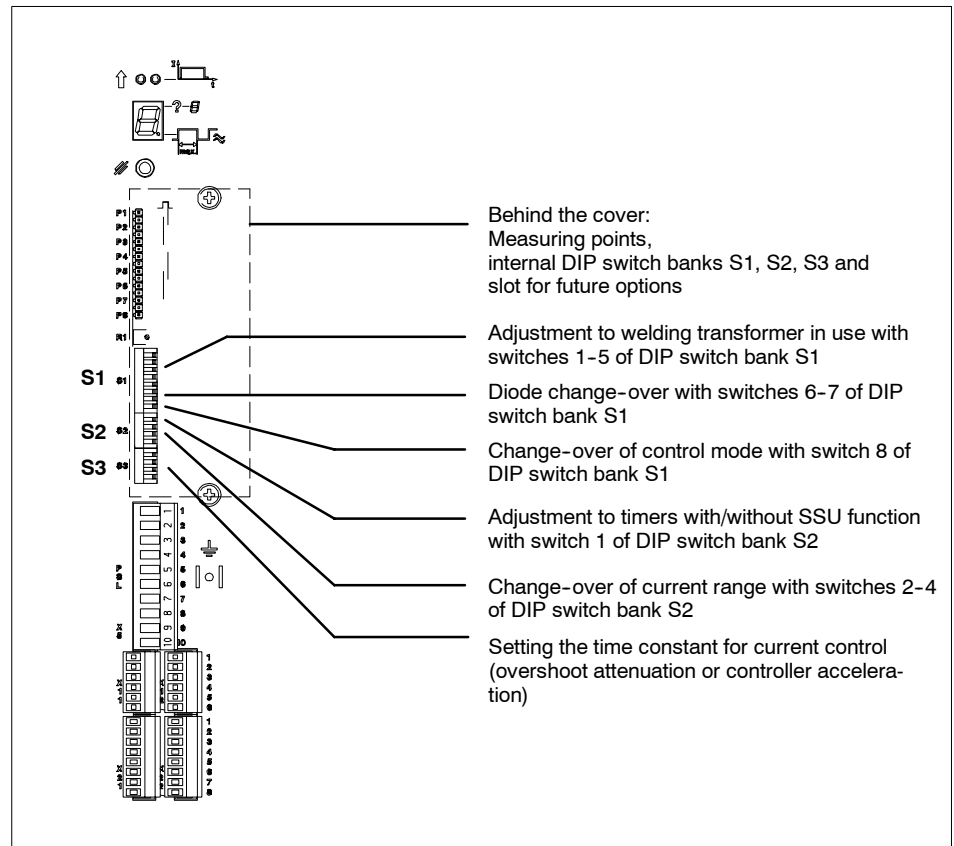
ATTENTION!

Danger of personal injury and of damage to property through false settings!
 The functions described below serve to adjust the inverter to the PSG used as well as to certain timer functions.
 Modifications are reserved to the Bosch service department or to technical personnel authorized by Bosch.

The following functions are included in the inverter:

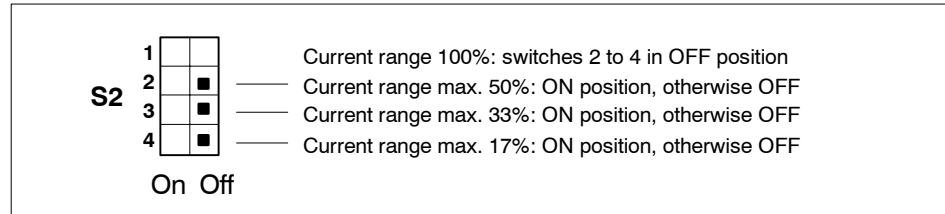
- Adjustment to the welding transformer used
- Diode change-over
- Selection of firing mode (5 kHz firing pulse or analog signal, for a description of these options cf. Section 8)
- Adjustment to timers with/without SSU function
- Ramp time constant
- Transformer change-over board

The following partial view of the inverter indicates only those elements which are relevant for the functions mentioned above.

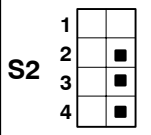
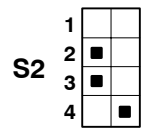
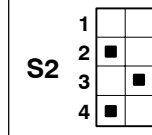
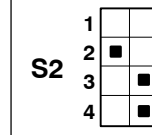
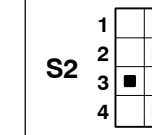
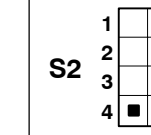


9.1 Change-over of current range

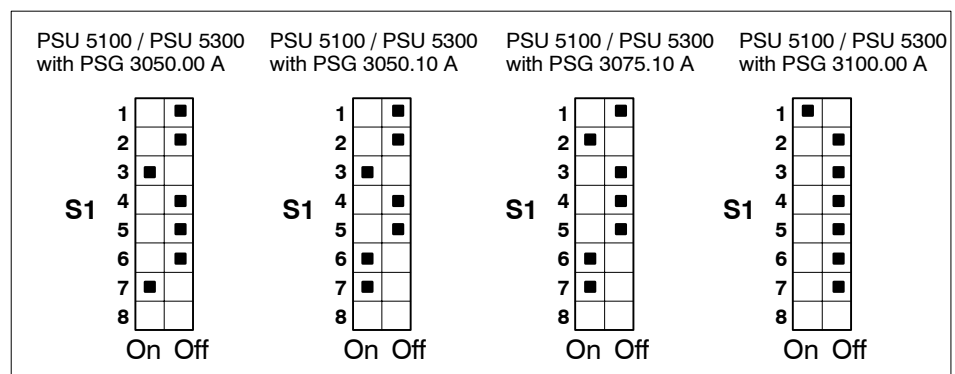
Switches 2 to 4 serve for the reduction of the current ranges by certain percentages, for example, in order to achieve a higher resolution (kA/SKT) for fine-spot applications.



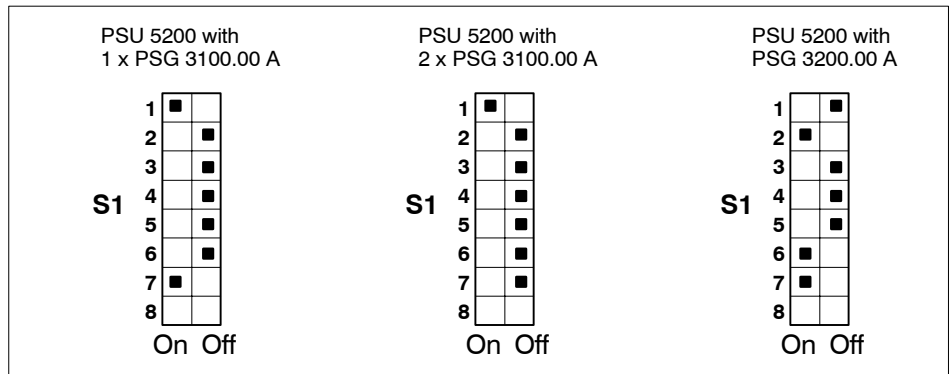
Examples: S2 settings and current ranges

	100%	83%	67%	50%	33%	17%
						
PSG 3XXX.XX A	3 to 18 kA	2.5 to 15 kA	2 to 12 kA	1.5 to 9 kA	1 to 6 kA	0.5 to 3 kA
2 x PSG 3100.00 A	9 to 54 kA	7.5 to 45 kA	6 to 36 kA	4.5 to 27 kA	3 to 18 kA	1.5 to 9 kA
PSG 3200.00 A	6 to 40 kA	5 to 33.33 kA	4 to 26.66 kA	3 to 20 kA	2 to 13.33 kA	1 to 6.66 kA
PSG 3100.00 A	6 to 36 kA	5 to 30 kA	4 to 24 kA	3 to 18 kA	2 to 12 kA	1 to 6 kA

9.2 Adjustment of PSU 5100 / PSU 5300 to the welding transformer

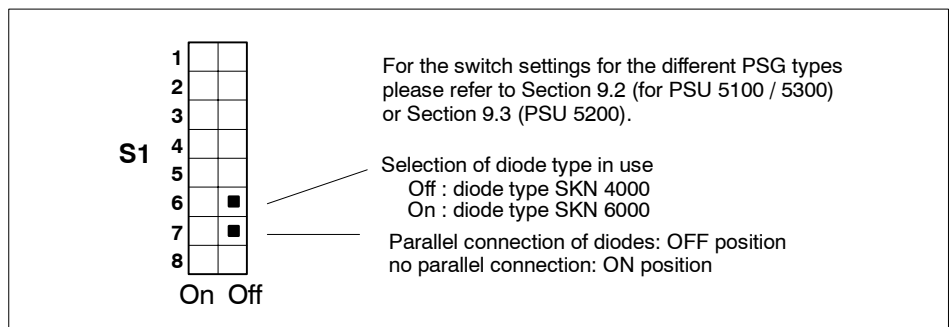


9.3 Adjustment of PSU 5200 to the welding transformer



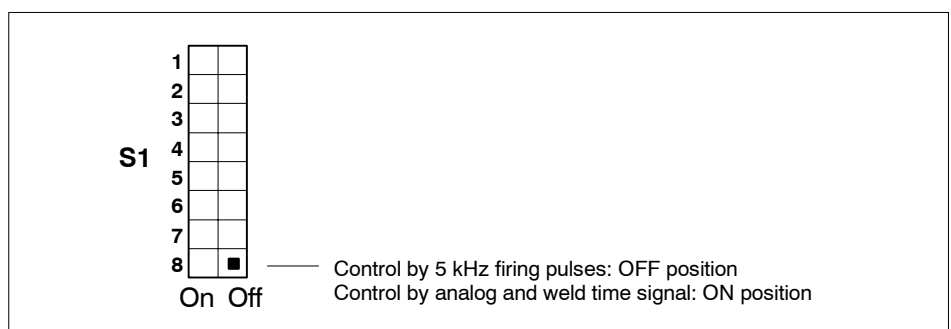
9.4 Diode change-over

This function serves for the adjustment of diode monitoring



9.5 Selection of the control mode

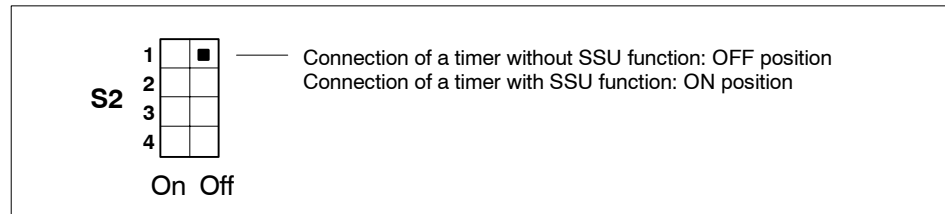
For a description of the options, please refer to Section 8.





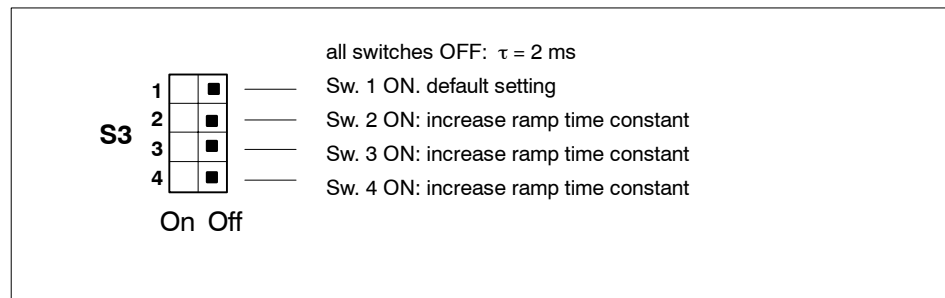
9.6 Adjustment to timers with / without KSR module and SSU function

If switch S2/1 is in ON position, the internal ohmic resistance of the PSU is switched off, the measuring loop test in the PSU is disabled. In this case, the measuring loop test must be performed by the weld timer.



9.7 Ramp time constant

Setting of the ramp time constant (slope) of the welding current (cf. also section 6.3).



- S3/1** in ON position: default setting of ramp
- S3/2 to S3/4** in ON position: increase ramp time constant

With a secondary line length > 5 m, **S3/1**, **S3/3** and **S3/4** should be set to OFF and **S3/2** to ON in order to avoid current overshoot and possible faults (seven-segment display: 7) when the inverter current limit is reached.

9.8 Transformer change-over board

The PSU 5100.XXX, PSU 5200.XXX and PSU 5300.XXX inverter types are equipped with an additional slot for a transformer change-over board. This slot is concealed by a dummy cover.

The transformer change-over board serves for the external selection of the connected medium-frequency rectifier unit.

Change-over is by means of a 24 V signal (e.g. from a PLC or robot control with automatic electrode gun change).

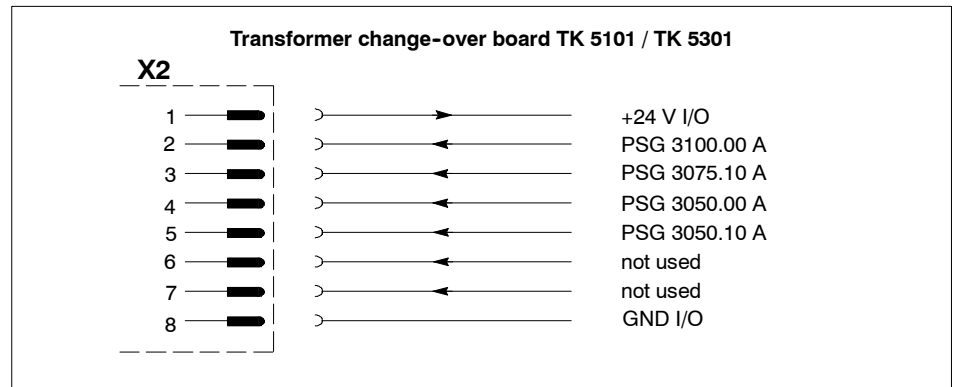
When a transformer selection has been made via the change-over board, the functions of switch S1/1 to 7 are not operative.

As an additional function, the change-over board supplies the "maximum pulse width reached" signal (feedback message to external control unit: e.g. electrode gun not closed) via a floating contact.

In contrast to the decimal point of the seven-segment display, the signal remains high until the next weld time and does not produce an inverter fault.

Possible causes:

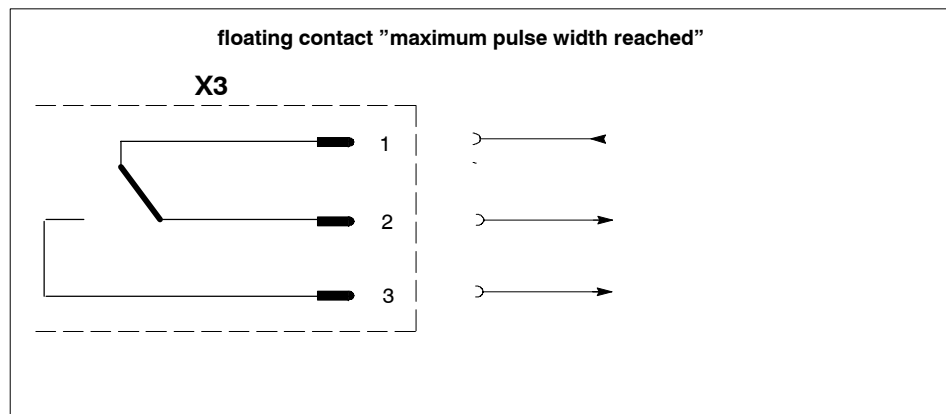
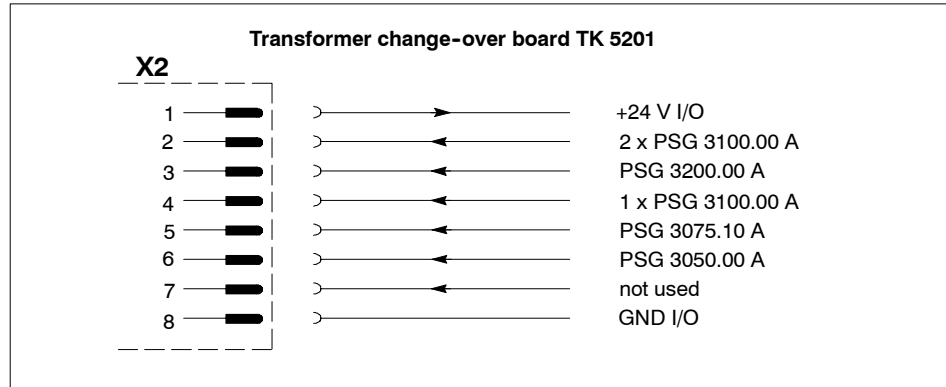
- no transformer
- mains voltage too low
- excessive power demand on transformer
- secondary welding circuit open



NOTE



The combination between a PSG 3075.XX A or a PSG 3050.XX A with a PSU 5200.XXX is not intended to be used without a TK 5201.



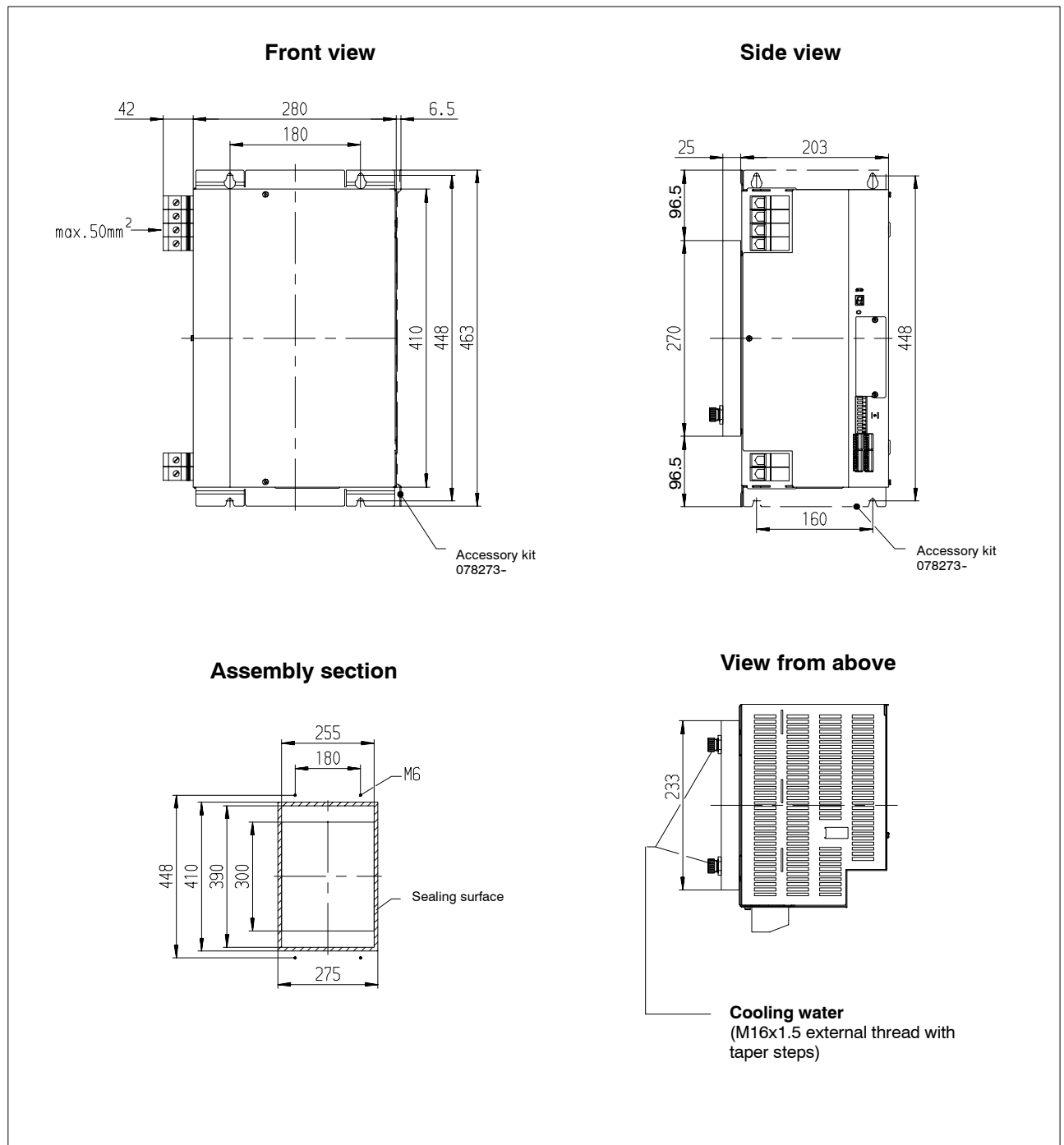


10 Dimensions

10.1 Dimensions of PSU

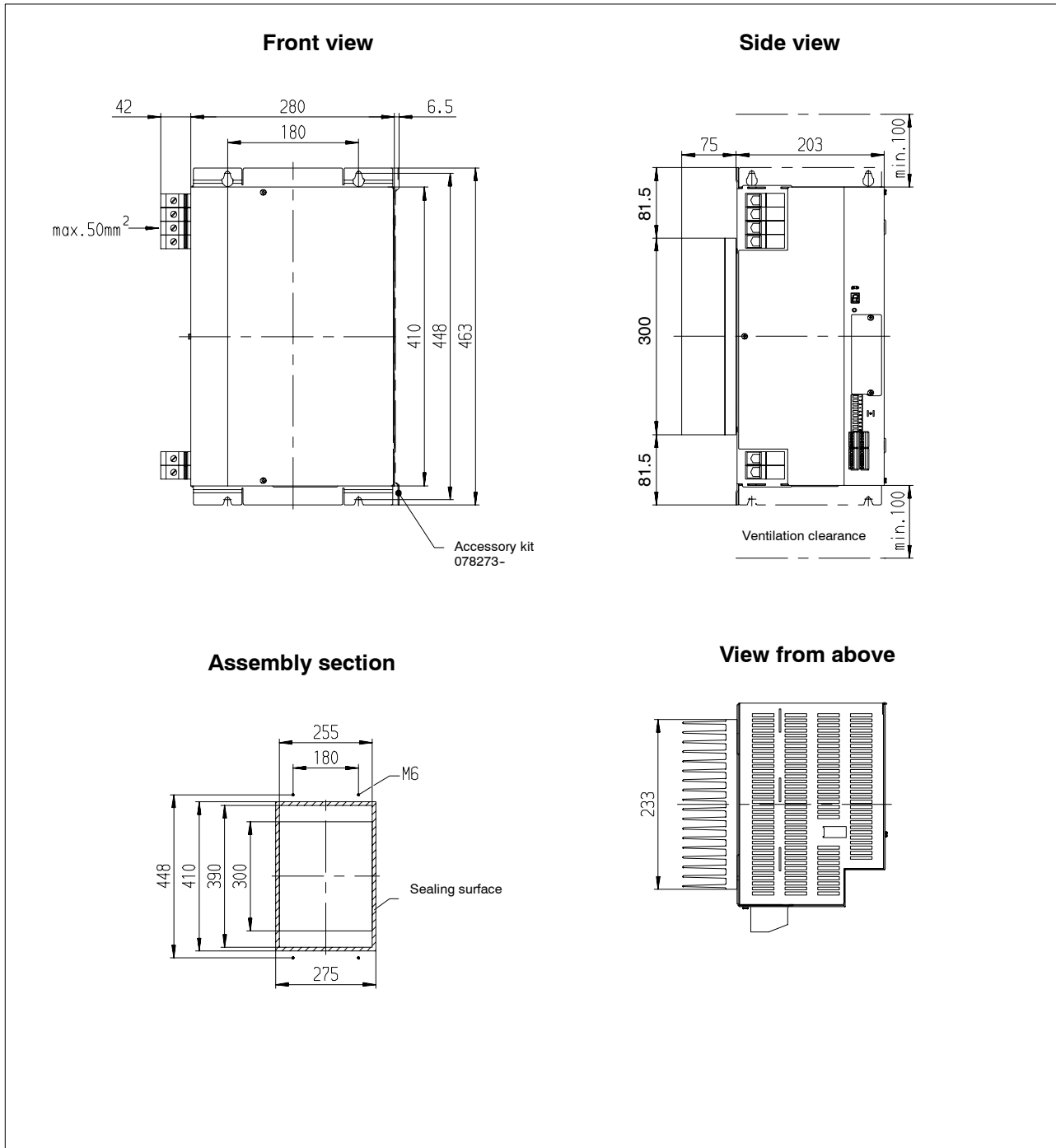
The figures show the housing dimensions as well as the points for connecting the mains system, cooling water and the welding transformer (PSG).

10.1.1 PSU 5100 / PSU 5300 with water cooling



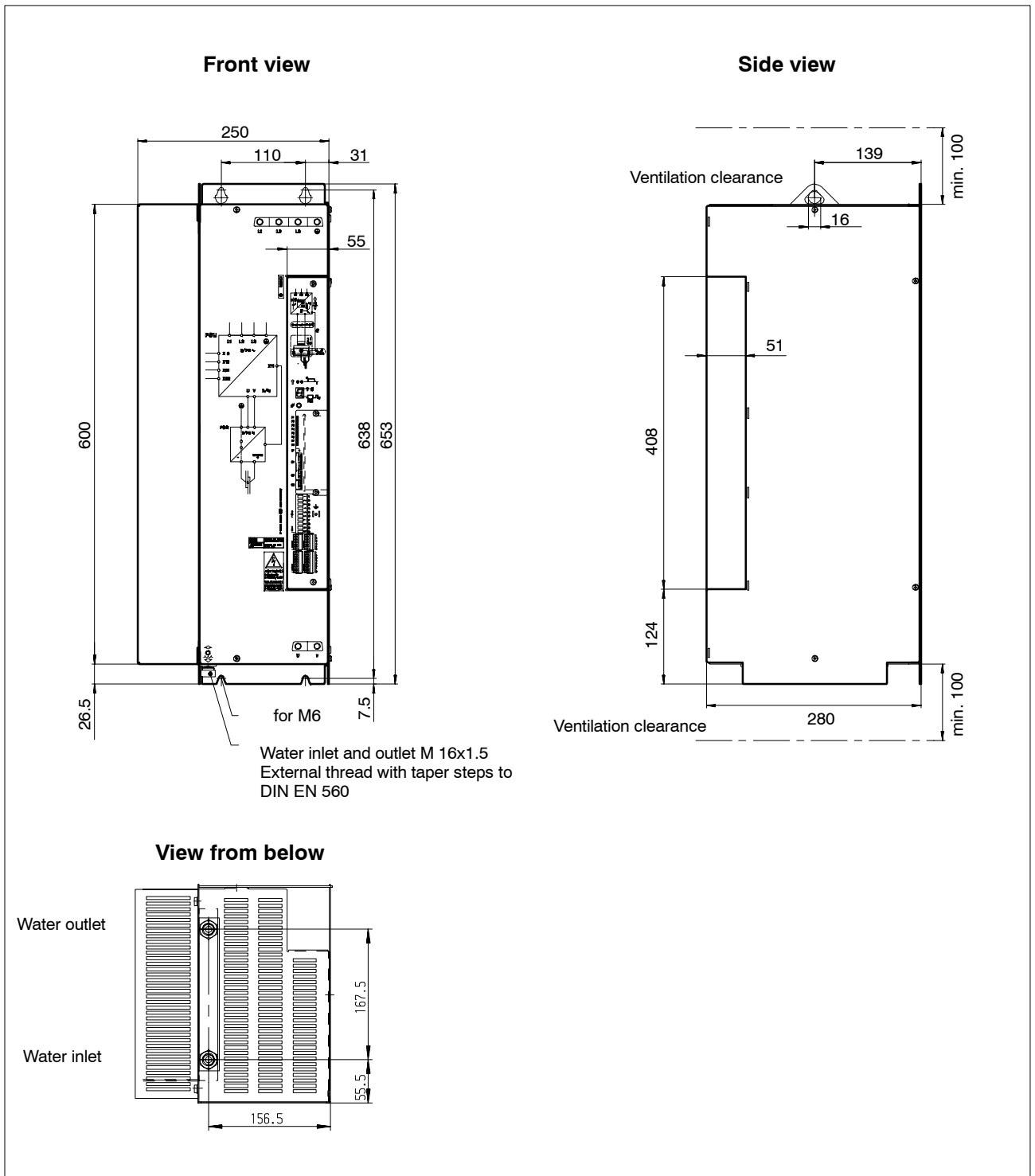


10.1.2 PSU 5100 / PSU 5300 with air cooling





10.1.3 PSU 5200 with water cooling



10.2 Dimensions of PSG

10.2.1 PSG 3050.00 A and PSG 3050.10 A

Touch guard required for primary connection!
For connection, cover type and order data, cf. attached sheet no. SKT 0058

M 8 (6x)
12 deep

Thermal release Rectifier

All sides 4 x M8 - 10 deep

All sides 2 x \varnothing 6H7 - 8 deep

Earthing sign

Contact surfaces $\sqrt{\text{A}_s} = \sqrt{\text{A}_s \cdot 3,2}$

Connection lines
150 mm long (T+M)

Cooling water inlet G 1/4"

Cooling water outlet G 1/4"

Connection T
Thermal release

M 5 (4x)
10 deep

M 6 (5x)
8 deep

View X:

Accessories (supplied loosely): 4 straight pins ISO 8735 diam. 06x12; 3 contact pins MC135 diam. 06

Terminal connector external

MPE

Connection M: white, brown: Current transformer, secondary measuring voltage $U_m = 150 \text{ mV} / \text{kA} \pm 2.5\%$ at ohmic resistance of 1kOhm

Connection T1: 1 x rectifier set 80 °C

Connection T2: 2 x transformer primary side 150 °C

Earth For removing the MPE neutral earth conductor, a suitable protective measure to EN 50063 is to be installed.

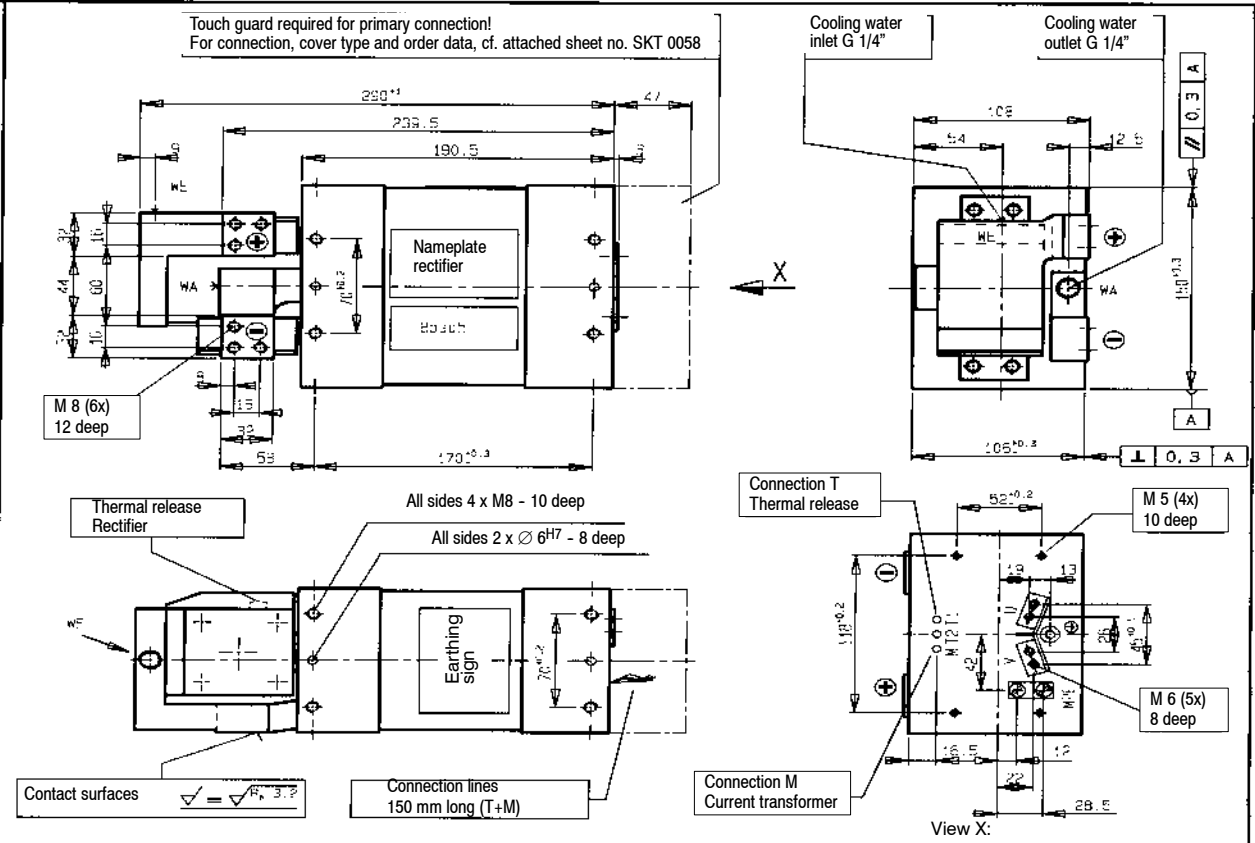
In this case, the earth connection between the transformer neutral and the earthing bolt must be crossed out in an indelible manner.

Standard:	Primary voltage	Frequency	Prim. perman. current max	Short-circuit values			Part no.
				Voltage	Power factor	Current	
Type:	U_{1N} / V	f / Hz	I_{1P} / A	$U_{sc} / \%$	$\cos \phi_{sc}$	I_{sc} / kA	
M2-6, 3-56-500/1K-TM-MC/1	500	1000	60				TGE 56/0001 ¹⁾
M2-6, 3-56-500/1K-TM-MC/2	500	1000	60				TGE 56/0002 ²⁾
M2-6, 3-56-500/1K-TM-MC/5	500	1000	60				TGE 56/0005 ³⁾
No-load direct voltage U_{d10} / V	Level U1		Level U2	Level U3		Level U4	Level U5
	6, 3						
Continuous forward current I_{F50} / kA 100% duty cyc.	4, 2	1) Diode type: SCN 4300/05p		Cooling water quantity: 1.6 l/hr; max 30 °C			
Continuous forward current power P_{d10} / kW 100% duty cyc.	26, 2	2) Diode type: SCN 6000/05p		Max. pressure drop: 0,5 bar			
Max. rated surge forward current I_{F54} / kA (10 ms; T_v : max 180 °C)	50	3) Diode type: 5SDJ760200		MF Transformer-Rectifier Unit			
max. direct current (see diagram) $I_{D \text{ max}} = f$ (duty cycle, n periods)		Dimensions without tolerances are subject to "mean" deviations to DIN 7168		Standards: V 50063; EN 50178; EN 50004; EN 50029; IEC 60281; VDE 0113; VDE 0113; VDE 0113; VDE 0113; VDE 0113			$S_N / \text{kVA} = 56$; with X = 50%
Degree of protection		Transformer insulation class		Mass	Colour blue	Substitute for drawing dated	
Transformer	Primary terminal area	Prot. as delivered	IP 00	F	π / kg	14,5	GA, 5013
IP 65							
						1399	Date
						Drawn	2.1.05.
						Checked	
						EXPERT MASCHINENBAU GMBH D-64653 LORSCH	

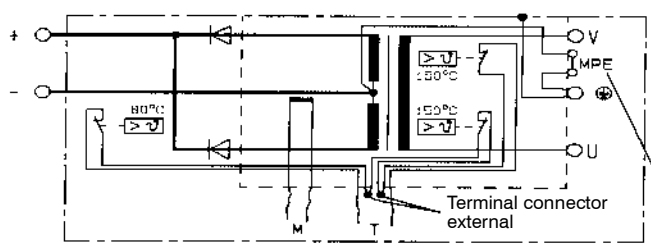
CAD



10.2.2 PSG 3075.10 A



Accessories (supplied loosely): 4 straight pins ISO 8735 diam. 06x12; 3 contact pins MC135 diam. 06



Connection M: white, brown: Current transformer, secondary measuring voltage Um = 150 mV / kA ± 2.5 % at ohmic resistance of 1kOhm
Connection T1: 1 x rectifier set 80 °C
Connection T2: 2 x transformer primary side 150 °C
Earth For removing the MPE neutral earth conductor, a suitable protective measure to EN 50063 is to be installed.

Techn. alterations reserved

Table with technical specifications including Standard, Primary voltage, Frequency, Short-circuit values, Part no., and a detailed specification table for the MF Transformer-Rectifier Unit.

10.2.3 PSG 3100.00 A

Touch guard required for primary connection!
For connection, cover type and order data, cf. attached sheet no. SKT 0058

Information sign
Earthing sign
Nameplates
M 8 (8x) 15 deep
All sides 4 x M8 - 10 deep
All sides 2 x \varnothing 6^{H7} - 8 deep
Thermal release Rectifier
Contact surfaces $\sqrt{\text{Ra}} = \sqrt{\text{Ra}} \cdot 3 \text{ ?}$
Connection lines 150 mm long (T+M)
Connection T Thermal release
Connection M Current transformer
View X:
M 5 (4x) 10 deep
M 8 (3x) 10 deep
M 5 (4x) 15 deep

Accessories (supplied loosely): 4 straight pins ISO 8735 diam. 06x12; 3 contact pins MC180 diam. 08

Connection M: white, brown: Current transformer, secondary measuring voltage $U_m = 150 \text{ mV} / \text{kA} \pm 2.5\%$ at ohmic resistance of 1kOhm
Connection T1: 1 x rectifier set 80 °C
Connection T2: 2 x transformer primary side 150 °C
Earth For removing the MPE neutral earth conductor, a suitable protective measure to EN 50063 is to be installed.
In this case, the earth connection between the transformer neutral and the earthing bolt must be crossed out in an indelible manner.

Standard:	Primary voltage U_{1N} / V	Frequency f / Hz	Prim. perman. current max. I_{1N} / A	Short-circuit values			Part no.
				Voltage U_{sc} / V	Power factor $\cos \phi_{sc}$	Current I_{sc} / kA	
Type:							
M2-9_0-110-500/1K-TM-MC/5	500	1000	116				TGE100/0005 ¹⁾
M2-9_0-110-500/1K-TM-MC/14	500	1000	116				TGE100/0014 ²⁾
No-load direct voltage U_{210} / V	Level U1		Level U2		Level U3	Level U4	Level U5
	9.0						
Continuous forward current I_{c1} / kA 100% duty cyc.	5.8		Diode type 3xN 4C08/06 Diode type 5332715020C	Cooling water quantity: : 10 l/min ; max 30 °C			
Continuous forward current power P_{110} / kW 100% duty cyc.	52.2		Max. pressure drop: 2.5 bar				
Max. rated surge forward current I_{c1s} / kA (10 ms; $T_{vj} \leq 180^\circ\text{C}$)	120		Dimensions without tolerances are subject to "mean" deviations to DIN 7168			MF Transformer-Rectifier Unit	
max. direct current (see diagram) $I_{c1max} = f$ (duty cycle, n periods)			Standards: EN 50063, EN 50175, EN 50204, EN 6129, IEC 60325, VDE 0100, VDE 0102, VDE 0110, VDE 0105			$S_N / \text{kVA} = 100$; with X = 50%	
Degree of protection	Transformer insulation class	Mass	Colour yellow	Substitute for drawing dated	1592	Date	Name
Transformer IP 65	Prot. as delivered IP 00	7 / kg	RAL 1004		Drawn	27.25	At
		24.4		Checked			

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**BOSCH**

PSU 5000 / PSG 3000
Instructions for Assembly and Operation

Installation
Dimensions of PSG

10.2.4 PSG 3200.00 A

Touch guard required for primary connection!
 For connection, cover type and order data, cf. attached sheet no. SKT 0058

Accessories (supplied loosely): 4 straight pins ISO 8735 diam. 06x12

Connection M: white, brown: Current transformer, secondary measuring voltage $U_m = 150 \text{ mV} / \text{kA} \pm 2.5\%$ at ohmic resistance of 1kOhm

Connection T1: 1 x rectifier set 80 °C

Connection T2: 2 x transformer primary side 150 °C

Earth For removing the MPE neutral earth conductor, a suitable protective measure to EN 50063 is to be installed.

In this case, the earth connection between the transformer neutral and the earthing bolt must be crossed out in an indelible manner.

Standard:	Primary voltage	Frequency	Prim. perman. current max.	Short-circuit values			Part no.
				Voltage	Power factor	Current	
Type:	U_{1N} / V	f / Hz	I_{1N} / A	U_{sc} / V	p_{sc}	I_{sc} / kA	
M2-13, 0-200-500/1K-TM	500	1000	171				TGE 200/0002

No-load direct voltage	Level					
	U _{din} / V	U1	U2	U3	U4	U5
	13,0					

Continuous forward current	Continuous forward current power	Max. rated surge forward current	max. direct current	Degree of protection	Transformer insulation class	Mass	Colour brown	Substitute for drawing dated
I_d / kA 100% duty cyc. 6,5	P_{d50} / kW 100% duty cyc. 85,0	I_{15V} / kA (10 ms; $T_V: \pm 0,5 \times 180^\circ\text{C}$) 120	$I_{dmax} = f(\text{duty cycle, n periods})$	IP 65	F	39,5	PAL 8001	1998

Cooling water quantity:		Max. pressure drop:	
: 10 l/min : $\pm 0,3 \times 30^\circ\text{C}$: 2,0 bar	

MF Transformer-Rectifier Unit		S _N / kVA = 200; with X = 50%	
Standards: EN 50063, EN 50078, EN 60904, EN 60624, IEC 5826, VDE 0100, VDE 0106, VDE 0110, VDE 0146	Drawn	Date	Name
	Checked		

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10.3 Cooling



NOTE

- Damage to property in the event of inappropriate/insufficient module cooling!
Water-cooled PSU and PSG modules may only be operated when the cooling water circuit is active! Condensation is not permitted on water-carrying components.
The temperature in the installation room of **air-cooled** modules must be within the specified limits. Furthermore, these modules may only be operated with "forced cooling" (with fan cowl). Cooling by convection is not sufficient!
- Damage to property through insufficient water quality in the cooling water circuit!
Deposits in the cooling system may reduce the water flow, thus impairing the performance of the cooling system with time.
Therefore, you should ensure that your cooling water has the following properties:
 - pH value: 7 to 8.5
 - Degree of hardness Dmax: 10 German degrees
(1 German degree = 1.25 British degrees = 1.05 US degrees = 1.8 French degrees)
 - Chlorides: max. 20 mg/l
 - Nitrates: max. 10 mg/l
 - Sulfates: max. 100 mg/l
 - Insoluble substances: max. 250 mg/l
 Tap water usually meets these requirements. However, an algicide should be added.

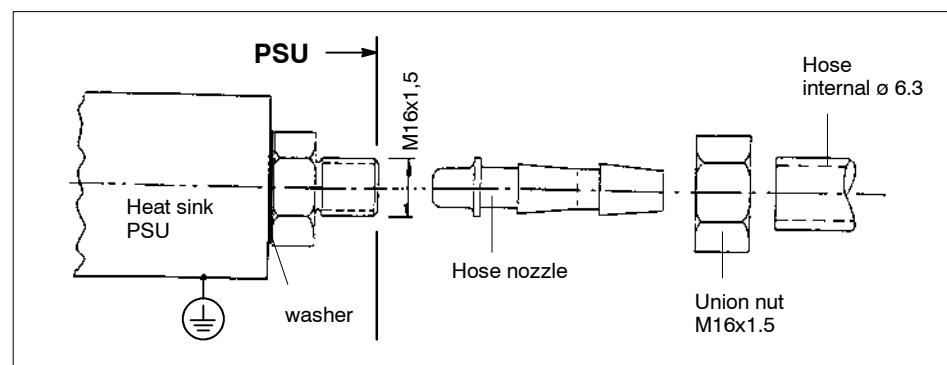
The location of the water connections is shown on the dimension drawings in Section 10.1, "Dimensions of PSU" and Section 10.2, "Dimensions of PSG".

10.3.1 Water connection to PSU

The heat sink of the PSU modules is internally connected to the protective earth conductor.

Maximum water inlet temperature: 30 °C

Water connection: M 16 x 1.5, external thread with taper steps (DIN EN 560, nut: DIN 13-6)

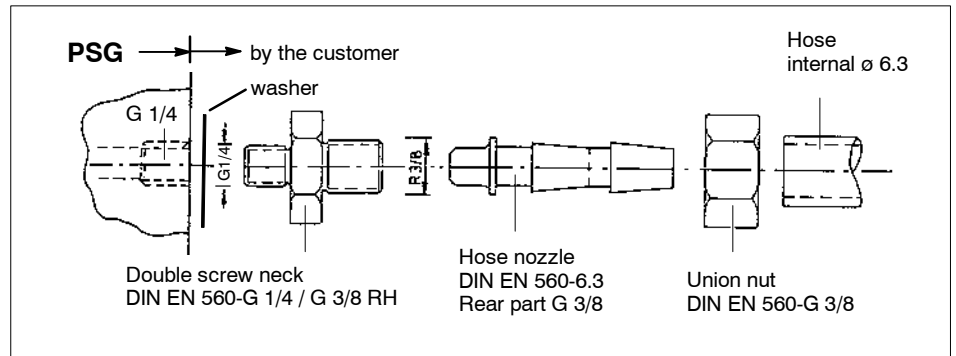


10.3.2 Water connection to PSG

Maximum water inlet temperature: 30 °C

WE = inlet, WA = outlet

Water connection: G 1/4" internal thread (for example, see sketch)



10.4 Installation and assembly



ATTENTION!

- Danger of life and of damage to property through insufficient protection class! The protection class of the PSU modules is IP 20. PSU modules must be installed in a switch cabinet which must at least comply with protection class IP 54 (cf. also Section 5, "Technical Data").
When delivered, the protection class of the primary connecting zone of all PSG modules is IP 00 (cf. also Section 5, "Technical Data"). It must be covered with a suitable terminal box (cf. Section 14, "Accessories") in order to increase the protection class of the primary connection zone to IP 55.
- 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 or of damage to property due to inappropriate fastening! The place for installing the modules, and their method of fastening, must be suitable for their weight!
- Injuries and bruises may be caused by lifting weights which are too heavy or by sharp metal edges!
Due to the heavy weight of individual modules (for weight data, see Section 5, "Technical Data") several persons are required for installation and assembly. Please observe all applicable safety and accident prevention regulations! Wear safety shoes and safety 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 modules so as to sufficiently protect other units in the switch cabinet against leaking cooling water.



- Damage to property through insufficient water quality in the cooling water circuit!

Deposits in the cooling system may reduce the water flow, thus impairing the performance of the cooling system with time.

Therefore, you should ensure that your cooling water has the following properties:

- pH value: 7 to 8.5
- Degree of hardness D_{\max} : 10 German degrees
(1 German degree = 1.25 British degrees = 1.05 US degrees = 1.8 French degrees)
- Chlorides: max. 20 mg/l
- Nitrates: max. 10 mg/l
- Sulfates: max. 100 mg/l
- Insoluble substances: max. 250 mg/l

Tap water usually meets these requirements. However, an algicide should be added.

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!
- Interference is frequently coupled and de-coupled in long cables. Therefore, inverter cables and control cables must be routed separately. The influence of interfering cables on cables susceptible to interference can be minimized by keeping the following distances:

- > 100 mm with parallel connection of cables < 10 m

- > 250 mm with parallel connection of cables > 20 m.

Install the inverters near the welding equipment in order to avoid cable lengths > 25 m wherever possible.

- A clearance of min. 100 mm must be available above and below air-cooled modules. Lower clearances induce the danger of heat accumulations which may result in a failure of the unit.



11 Electrical connection

The MF welding inverter is connected to the supplying mains.

**WARNING!**

- Working with system voltage may result in death, severe bodily injury or considerable damage to property unless the appropriate precautionary measures are taken.

Therefore, you should carefully read the safety instructions at the beginning of this manual where you will find a description of a number of features to be strictly observed! The system voltage is associated with considerable 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!

The equipment must be appropriately fused at the mains side!

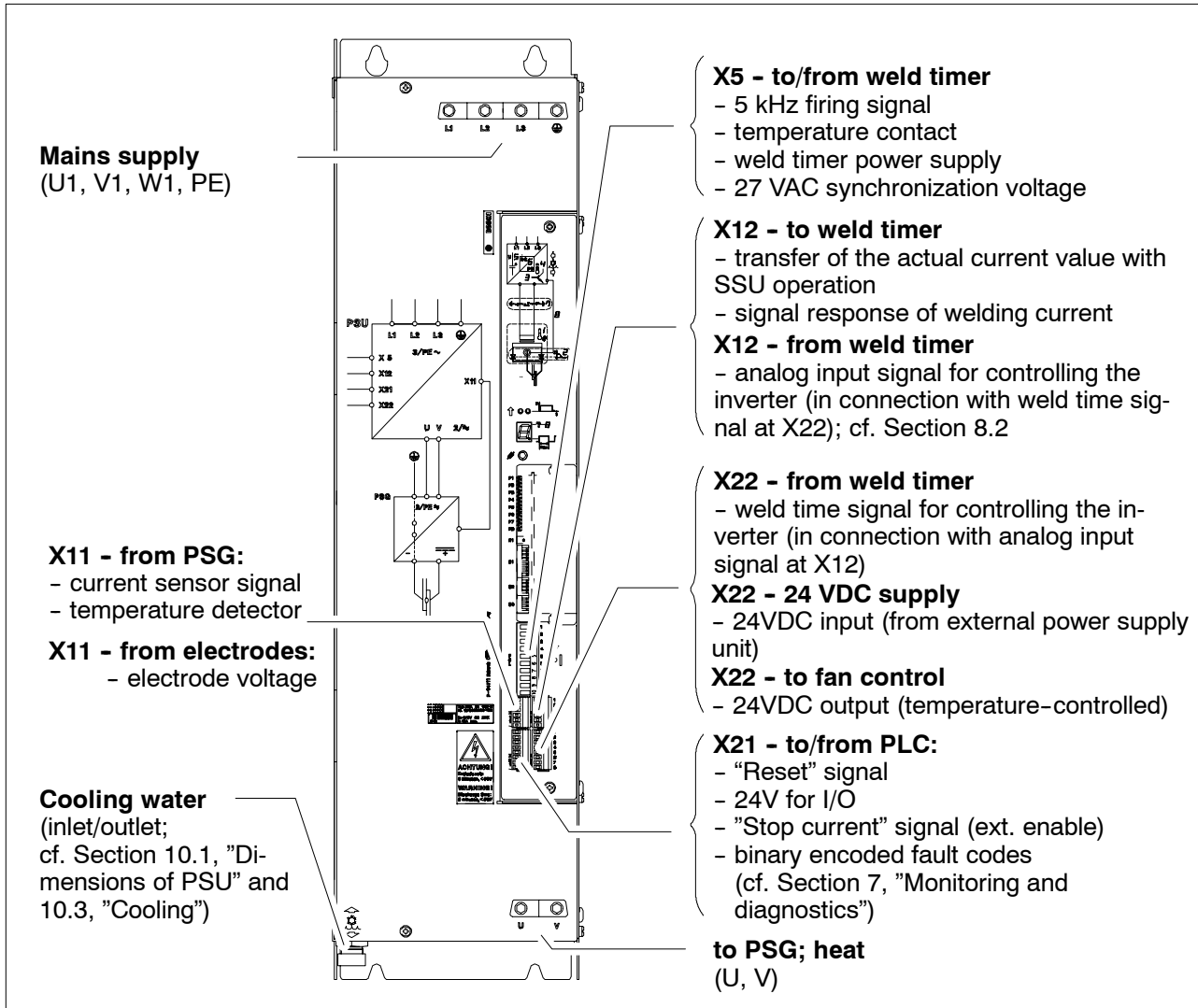
- Danger of life through electrical voltage!
The protective earth for the negative pole of the PSG can be interrupted by opening the protective earth conductor connection at the PSG. In order to protect the operating personnel against dangerous electrical voltages in the event of a possible break-down of the primary side of the transformer to the secondary side, in this case, a suitable protective measure is to be provided in accordance with EN 60 204 Part 1 (e.g. by earthing the electrode gun)! In addition, the transformer must be marked accordingly (cf. also dimension drawing of the transformer, Section 10.2).
- Danger of life through electrical voltage!
The PSU 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.
- Danger of life through electrical voltage!
When working at the mains system or making connections involving the welding plant it must be ensured that the inverter has been safely isolated from the supply for at least 5 minutes (capacitor discharge time).
- Suitable insulated tools must be used for all electrical connection work!

**ATTENTION!**

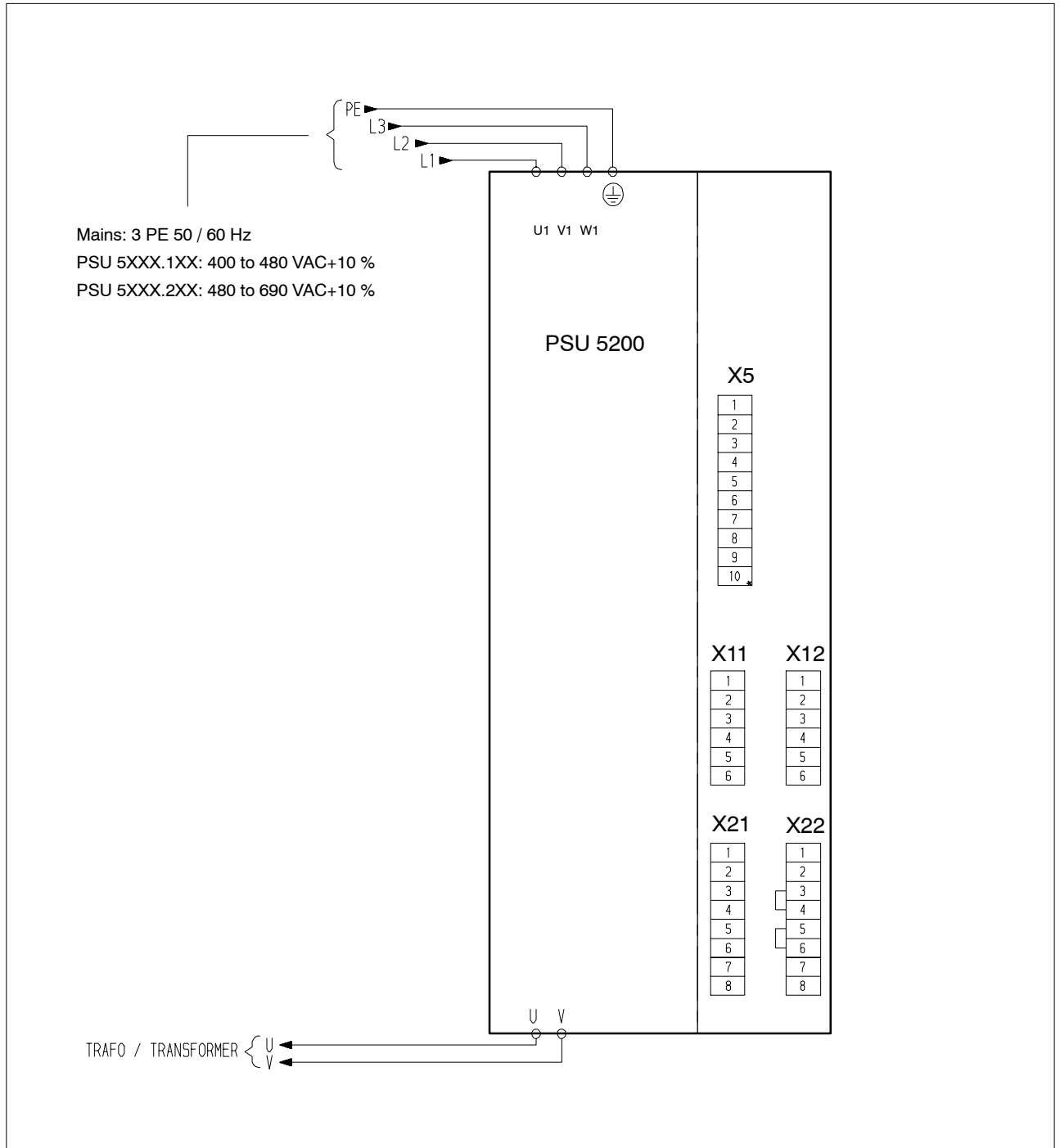
Compatibility with residual-current devices to EN 50178:

If a residual-current device is used at the mains side of the inverter to protect persons in the event of direct or indirect contact, a type B device must be used. The residual-current device must additionally be capable of safely detecting a possible residual current with a frequency of 1 kHz / 1.2 kHz.

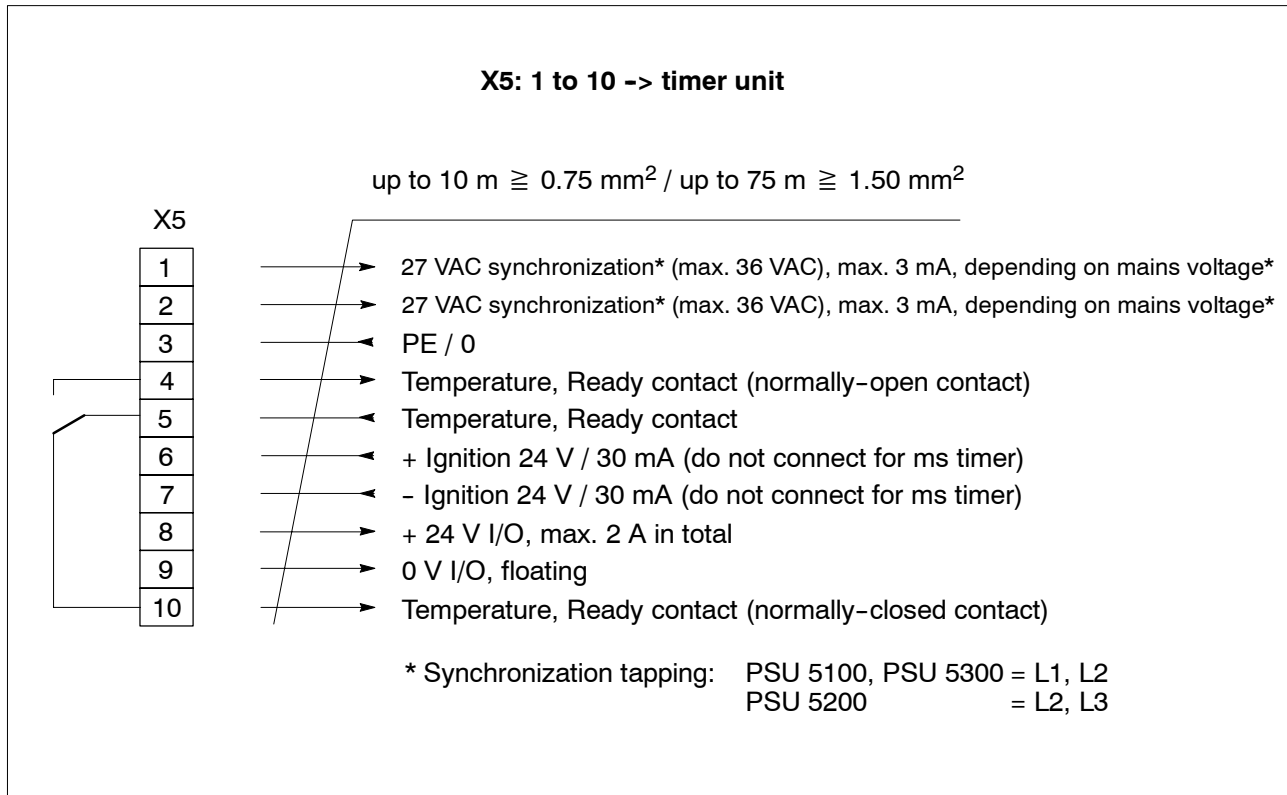
11.1 PSU connection overview



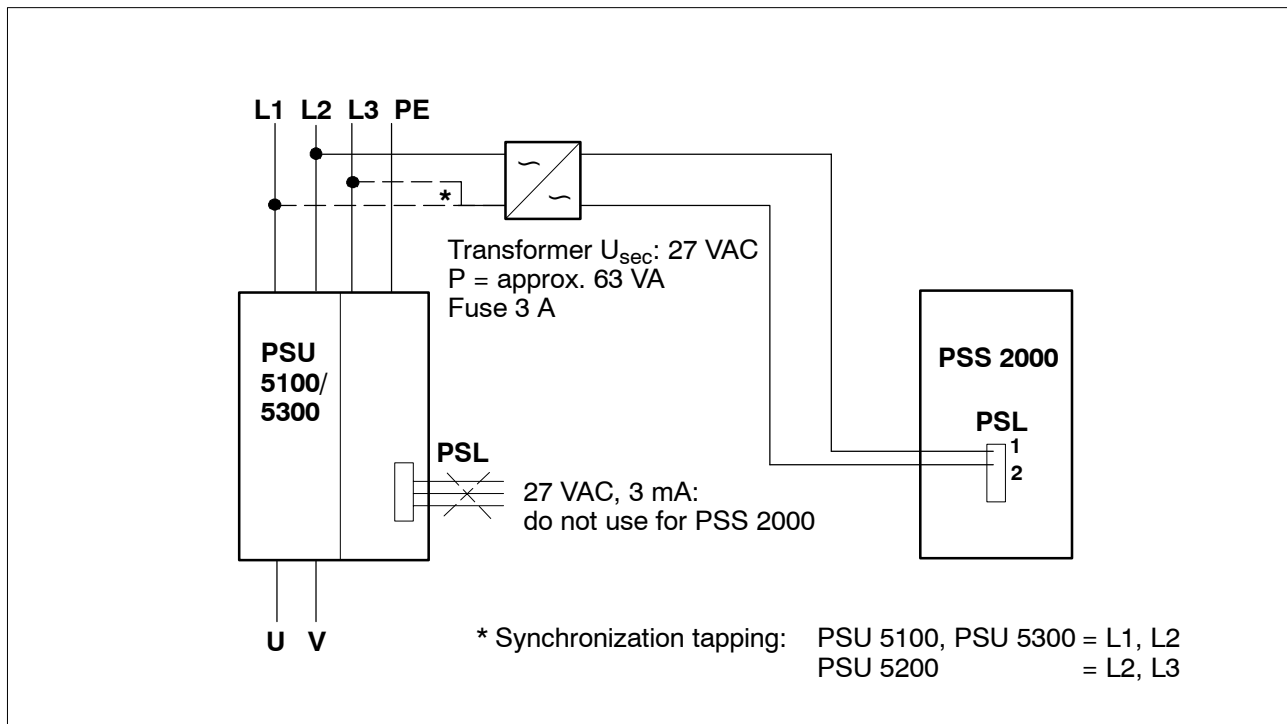
11.2 PSU overall wiring diagram



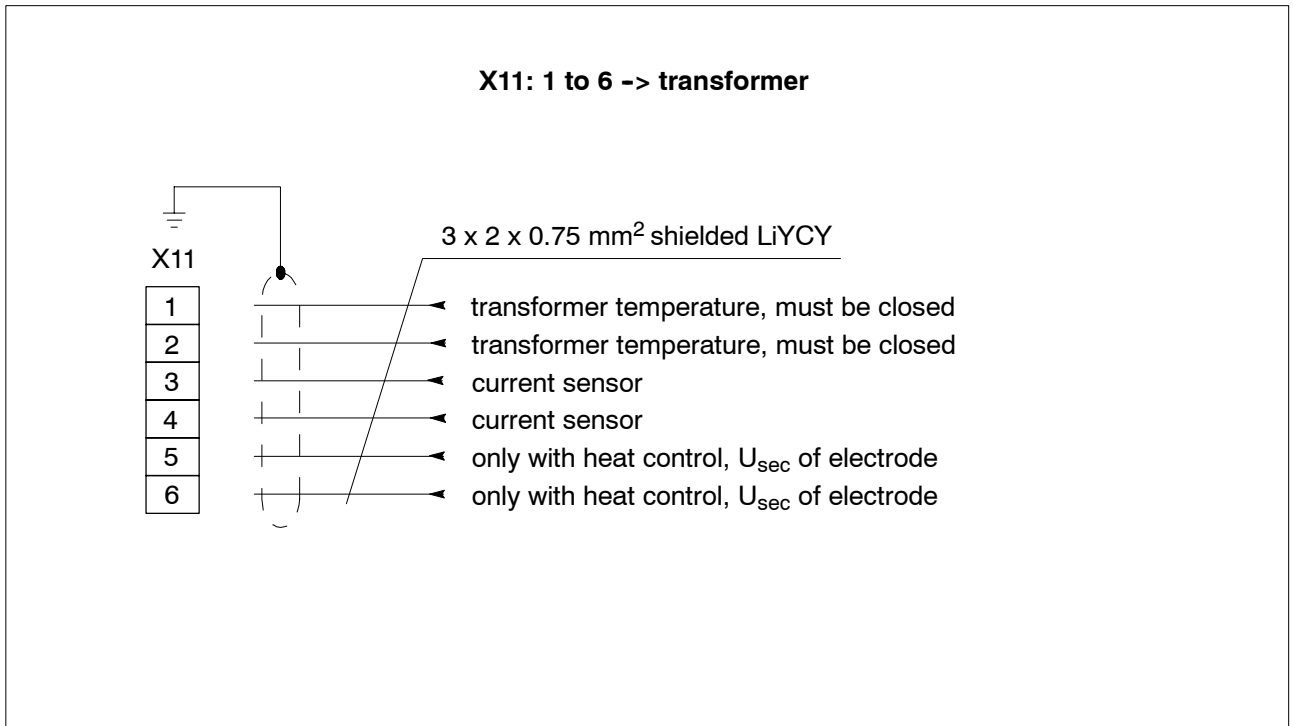
11.2.1 Connection of X1 interface



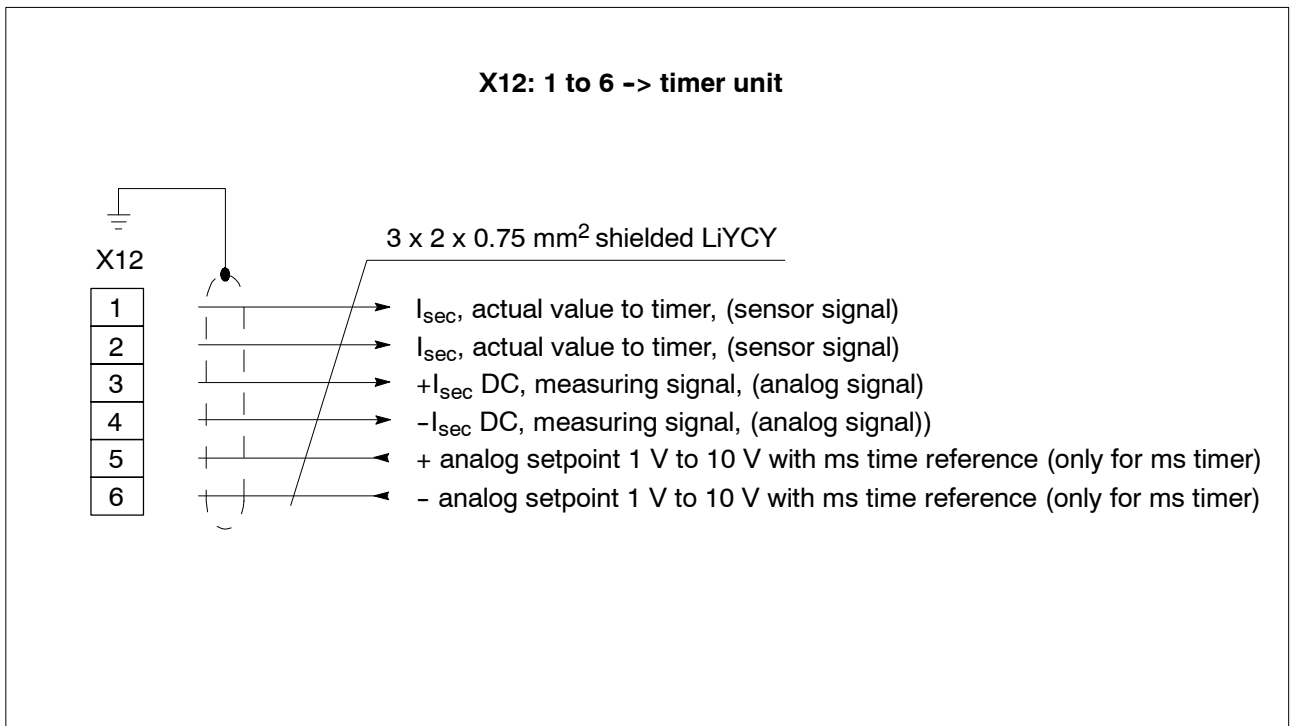
11.2.2 Connection of a PSS 2000 to the inverters



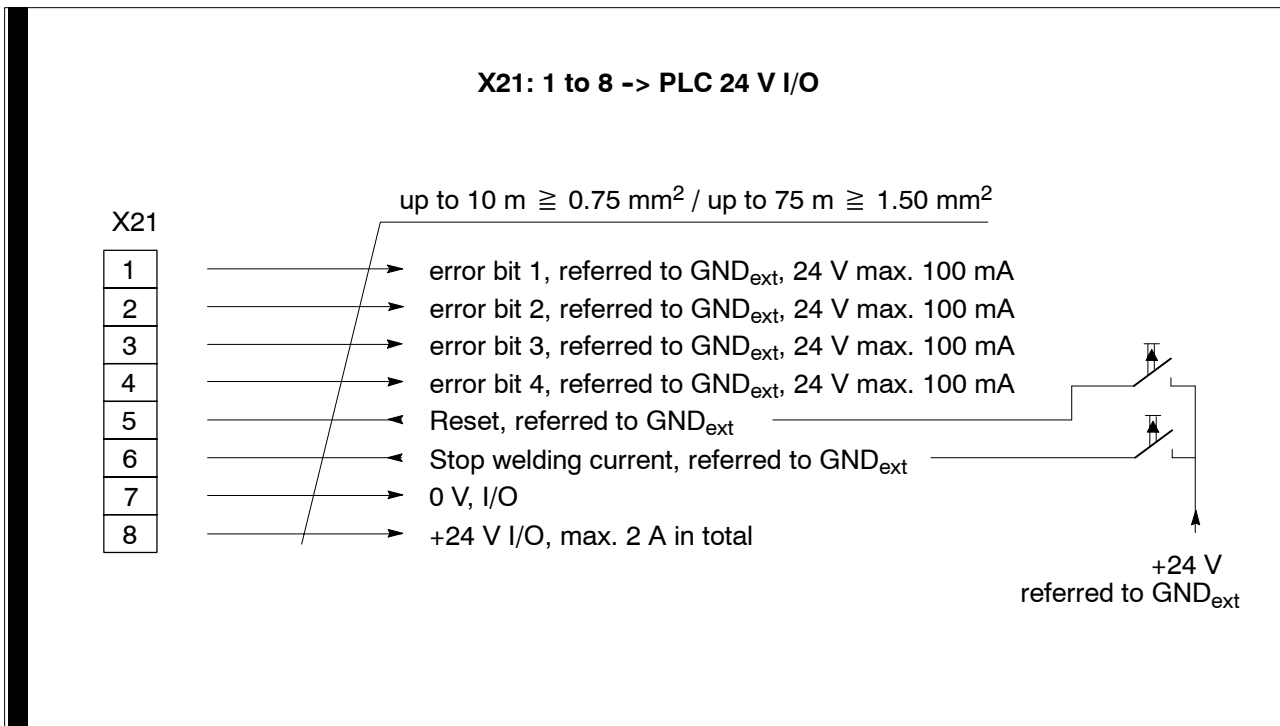
11.2.3 Connection of X11 interface



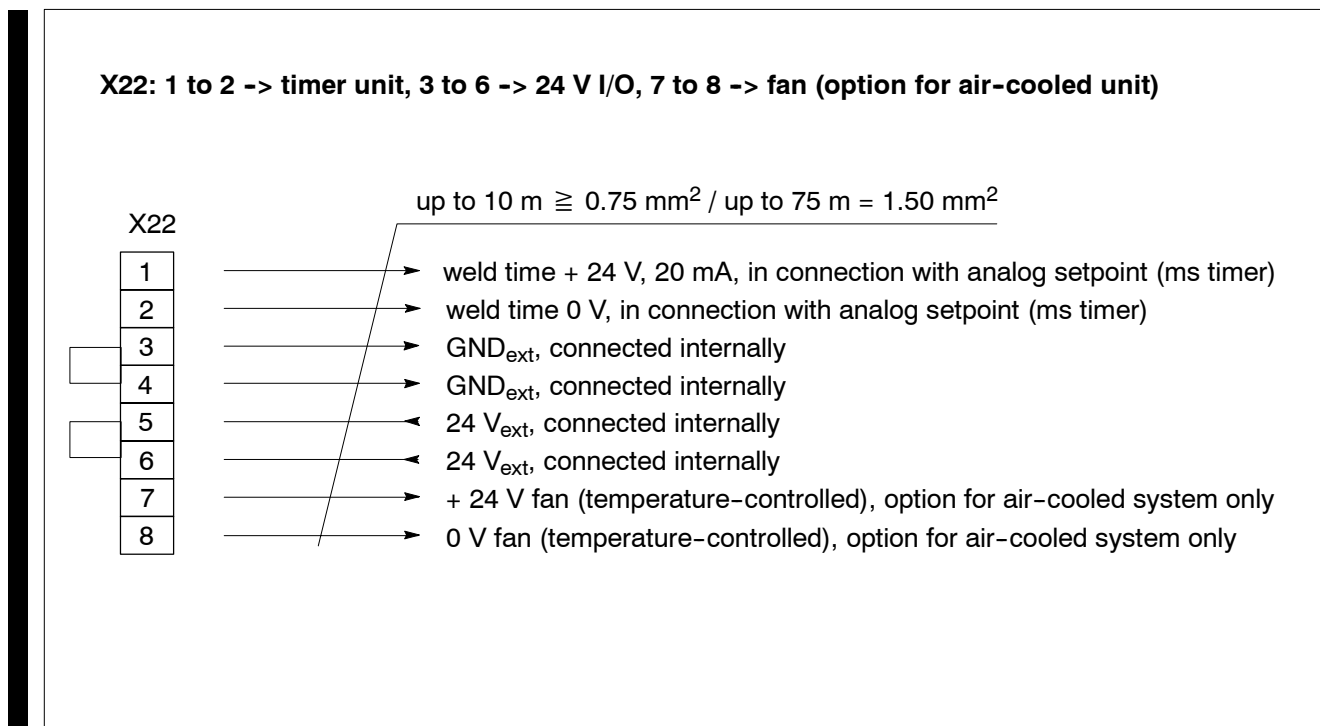
11.2.4 Connection of X12 interface



11.2.5 Connection of X21 interface



11.2.6 Connection of X22 interface



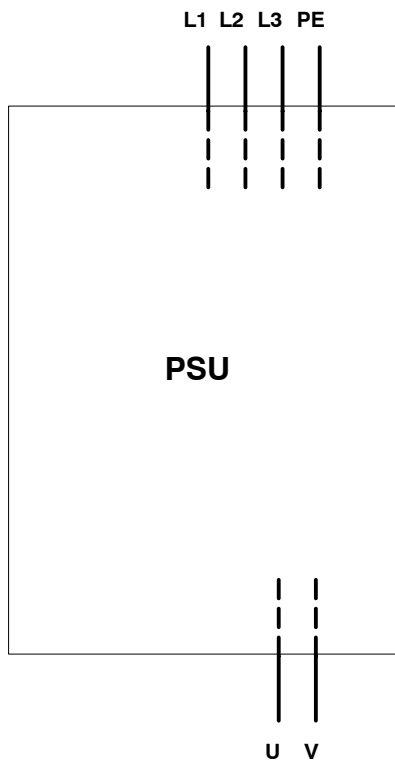


11.3 PSU mains connection and PSG power connection for nominal operation

PSU 5XXX.1XX: 400 to 480 VAC+10% -20%, 50 / 60 Hz
PSU 5XXX.2XX: 480 to 690 VAC+10% -20%, 50 / 60 Hz
PSU 5100.XXX: 110 A, 35 mm² conductor cross-section
PSU 5200.XXX: 220 A, 95 mm² conductor cross-section

All mains connections are led through openings in the housing cover. There are drilled holes in the front panel through which the conductor terminals can be opened or tightened:

PSU 5100.XXX / PSU 5300.XXX: with Allen key
PSU 5200.XXX: with Allen key



Please note:
When the mains voltage has been switched on, it takes approx. 10 sec. before the "ready" signal goes on and supply voltage is available at the timer.

All connections are made through cut-outs in the housing bottom. There are drilled holes at the front panels through which the conductor terminals can be opened or tightened.

PSU 5100.XXX / PSU 5300.XXX: with Allen key
PSU 5200.XXX: with Allen key

Power supply feeder to PSG

- PSG 3050: ≥ 16 mm² conductor cross-section (max. 50 mm²)
- PSG 3075: ≥ 16 mm² conductor cross-section (max. 50 mm²)
- PSG 3100: ≥ 35 mm² conductor cross-section (max. 50 mm²)
- PSG 3200: ≥ 95 mm² conductor cross-section (max. 95 mm²)

NOTE



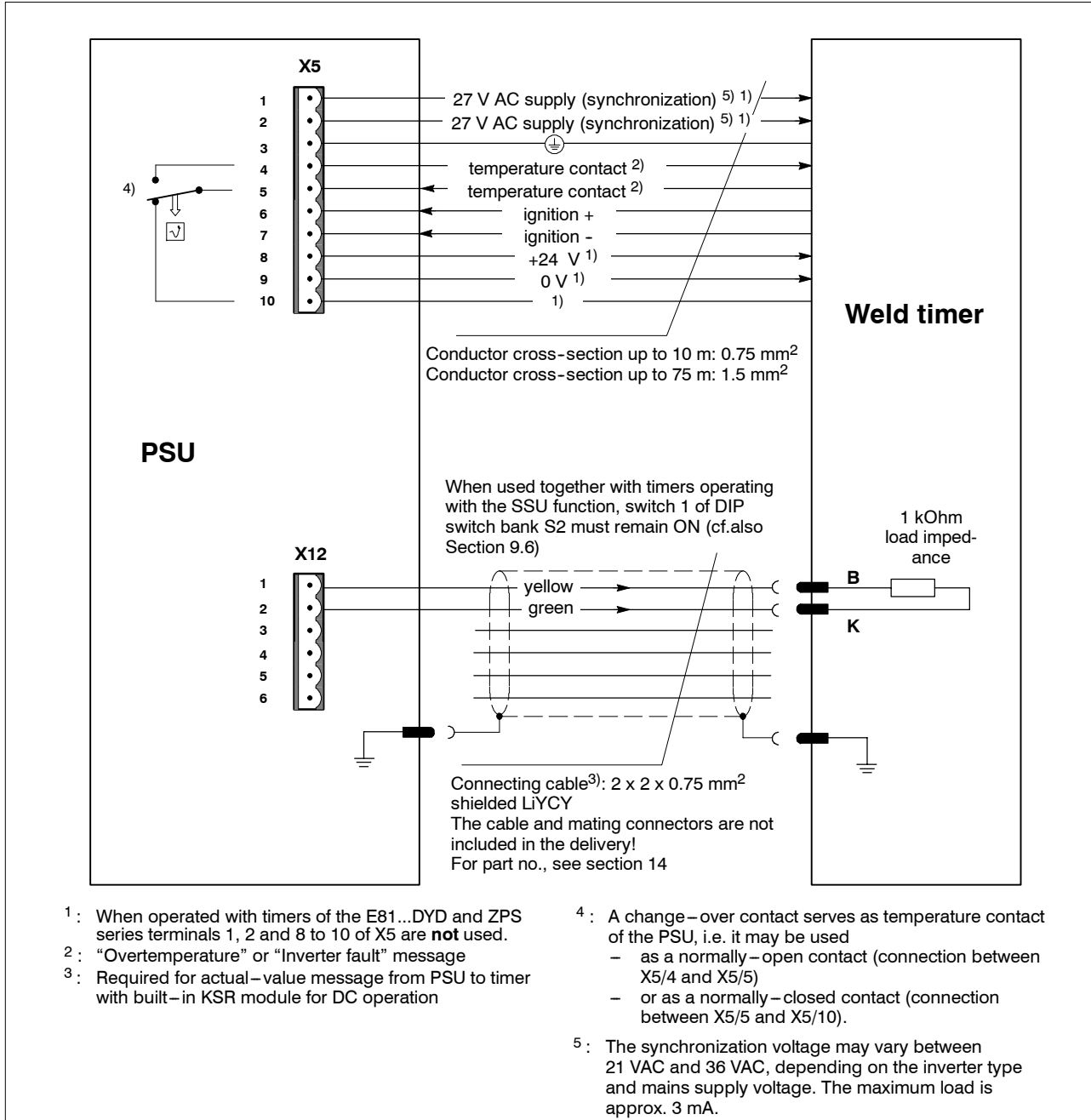
Micro-welding:

Insertable pins may be used for mains and transformer terminal connections with smaller conductor cross-sections, however, plug connectors must be used in this case.

Part no. of insertable section: 1070 918 779.

11.4 Connection between PSU and timer module

Control option: 5 kHz firing pulses (cf. also Section 8.1)



NOTE



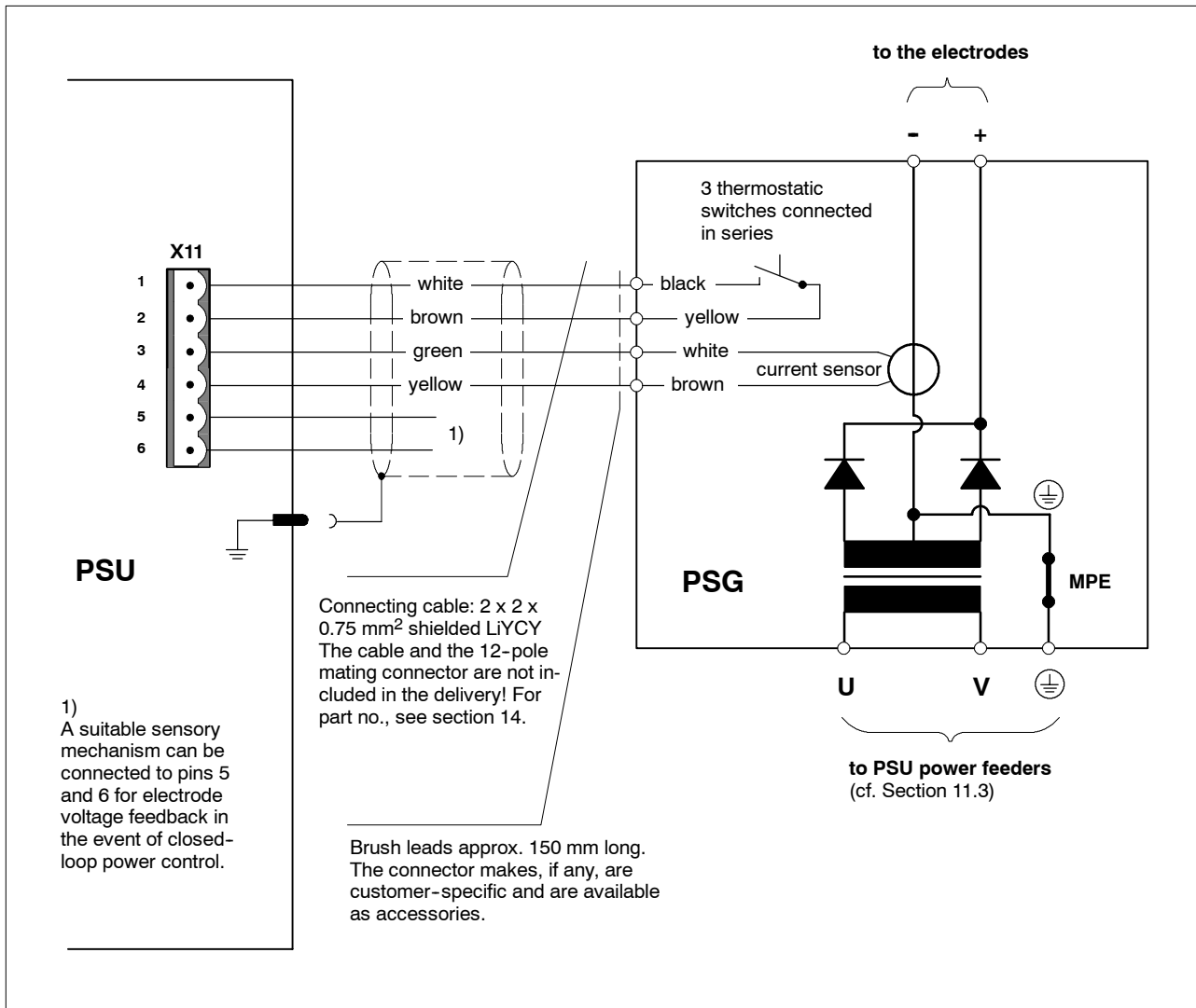
Please note that if timer types "ZPS", "E81...DYD", and "PSS 2000" are used, the synchronization voltage (which also serves as timer supply voltage) for these timers must be generated externally and cannot be derived from pins 1 and 2 of X5 (cf. section 11.2.2).

ATTENTION!

Danger of injury and/or damage to property through missing or inappropriate interpretation of fault messages!

In connection with a Bosch timer module, the overtemperature contact of the PSU may only be used as a normally-open contact (connector X5, pins 4 and 5).

11.5 Connection between PSU and PSG



WARNING!



Danger through electrical voltage!



The protective earth for the negative pole of the PSG can be interrupted by opening the protective earth conductor connection at the PSG (see MPE point in diagram above). In order to protect the operating personnel against dangerous electrical voltages in the event of a break-down of the transformer primary side to the secondary side, in this case, a suitable protective measure pursuant to DIN 57 113, VDE 0113 is to be provided (e.g. by earthing the welding gun)! In addition, the transformer is to be marked accordingly (see also dimension drawing of the transformer, Section 10.2).

11.6 Protective conductor connection to medium–frequency transformers

BOSCH medium–frequency transformers comply with protection class 1 in accordance with DIN VDE 0551 Part 1.

For protection class 1, additional protective measures must be applied in accordance with EN 50063 (DIN VDE 0545, Part 1) to provide protection against inadmissibly high contact voltages in the event of an insulation breakdown between the primary and the secondary circuit. The implementation of these measures is the responsibility of the machine/plant manufacturer/operator.

If these protective measures are not applied, or if they are ineffective, touching the secondary connections, the welding gun or the workpiece is associated with **danger of life and limb!**

When delivered, a detachable protective conductor jumper (MPE) is connected between the secondary circuit (negative pole) of the medium–frequency transformer and the transformer’s protective conductor connection. This is in compliance with the protective measure “direct protective conductor connection” to EN 50063, Section 5.1.4.1.

If another protective measure to EN 50063 is implemented instead of “direct protective conductor connection”, the protective conductor jumper (MPE) must be removed.

The removal of the protective conductor jumper (MPE) must be indicated on the label provided on the transformer in a permanent way.

As an additional measure for achieving protection class 1, the housing of the medium–frequency transformers is permanently connected to the protective conductor connection of the transformer. This connection cannot be removed.

ATTENTION!



Under certain circumstances (cf. NOTE section), circulating currents (“crossover currents” to EN 50063) can flow through the MPE protective conductor connection.

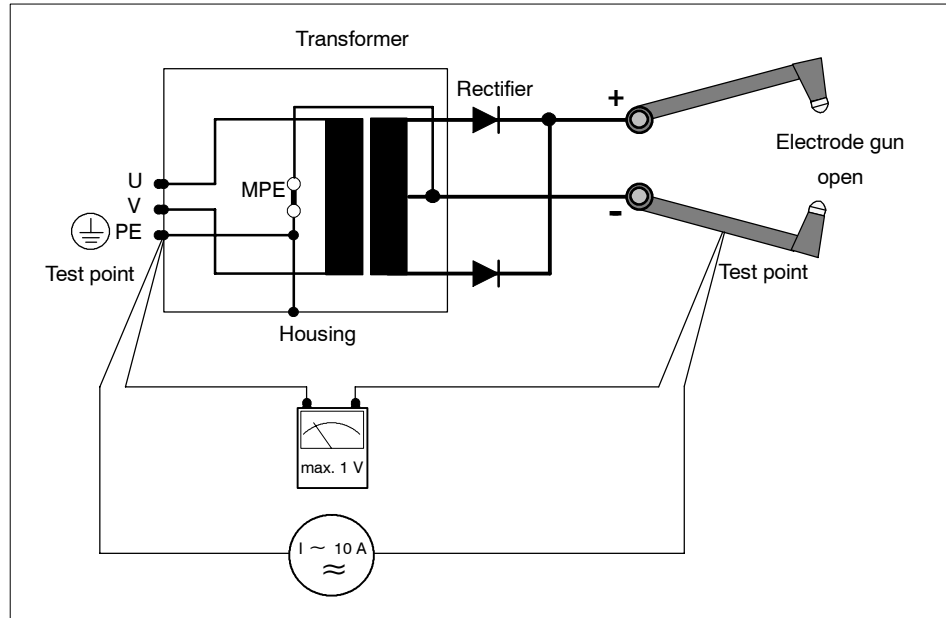
These circulating currents must be avoided under any circumstances because they may interrupt the protective conductor continuity through the protective conductor jumper (MPE).

Interrupting the protective conductor connection will render the protective measure “direct protective conductor connection” ineffective. Therefore, in the case of an insulation breakdown there is **danger of life!**

How to recognize a "defective" (ineffective) MPE protective conductor connection



NOTE



- 1.) Subject the protective conductor jumper (MPE) to a visual inspection for damages.
- 2.) Perform the following measurement with the protective conductor jumper (MPE) installed!
 - Supply an AC current of approx. 10 A between the PE connection of the transformer and the negative pole of the rectifier/electrode gun.
 - The voltage measured between the PE connection and the test point (negative pole) must not exceed 1 V (cf. EN 60204, Section 20.2 and Table 7).
 If a voltage > 1 V is measured, the jumper (MPE) between the protective conductor and the negative pole of the rectifier is defective (ineffective). This defect may have been caused by circulating currents. There is **danger of life**.



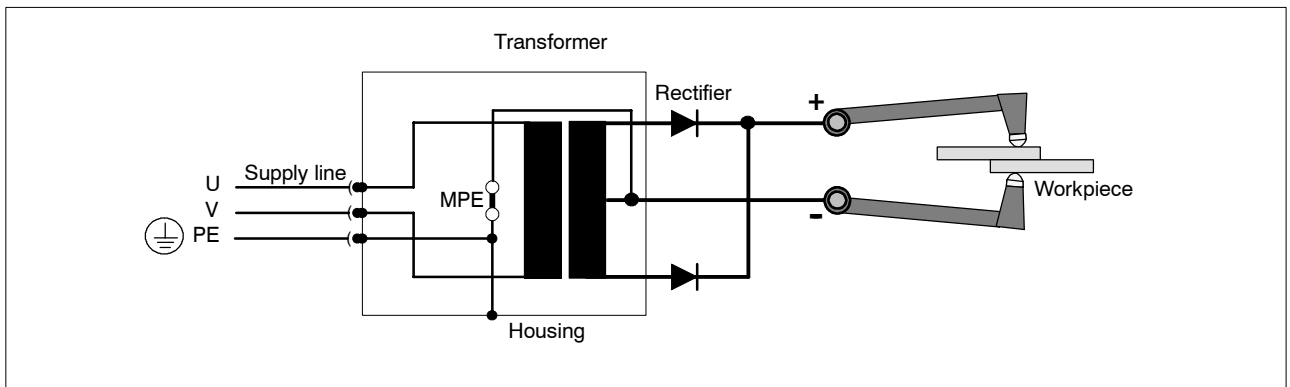
Please note: The measurement described above may be performed analogously to check the protective conductor connection to the transformer housing.

Circulating currents

Circulating currents are defined as currents which do not flow as desired from the positive pole of the welding equipment through the workpiece and to the negative pole of the welding equipment during the welding process, but rather through the workpiece and then through external "ground connections" and the protective conductor jumper (MPE) to the negative pole.

When do circulating currents occur?

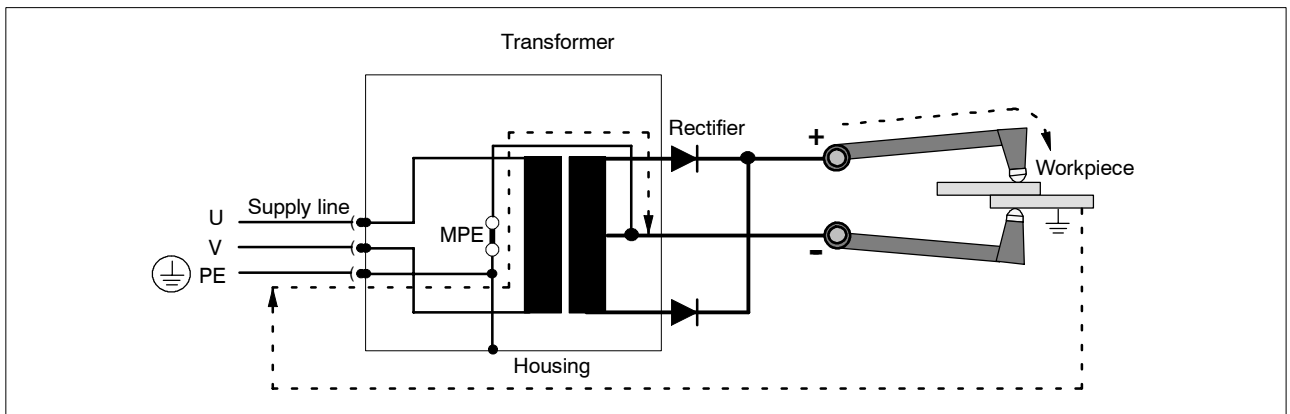
Case 1



Negative pole grounded through protective conductor jumper (MPE), workpiece not grounded (ideal arrangement).

Circulating currents are not possible.

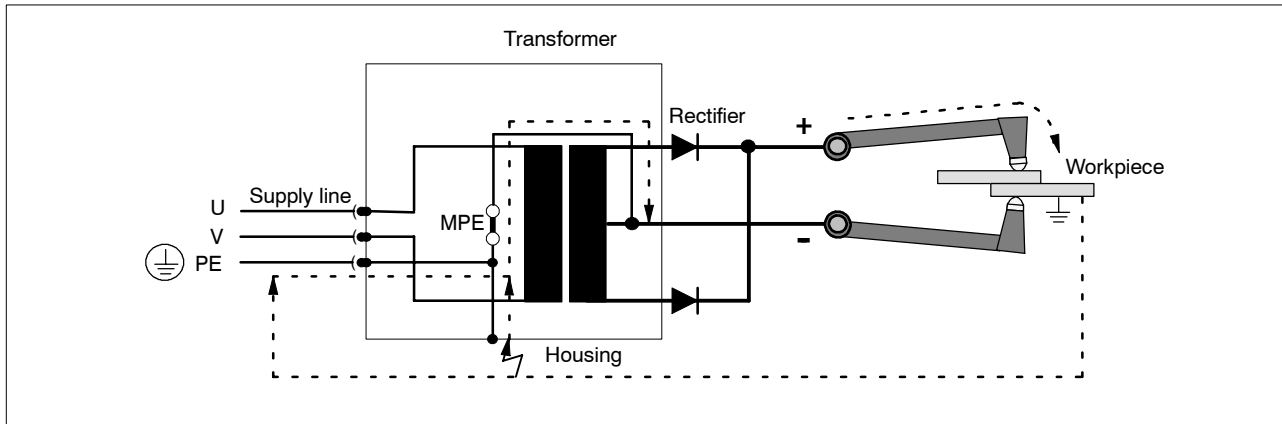
Case 2



Negative pole grounded via protective conductor jumper (MPE), workpiece grounded, transformer housing insulated from \perp .

There will be circulating currents through the mains supply line.

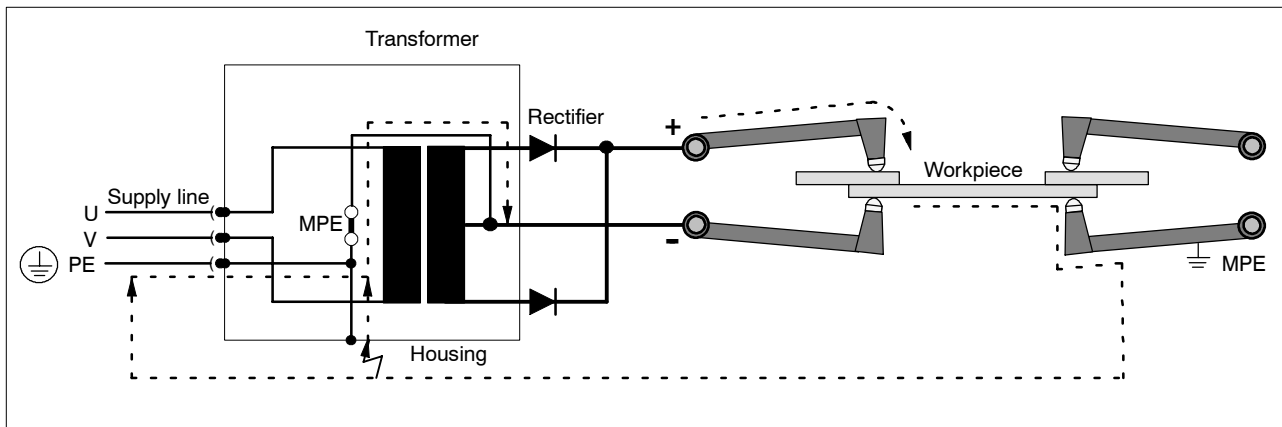
Case 3



Negative pole grounded via protective conductor jumper (MPE), workpiece grounded, transformer housing has a low-resistance connection to \perp through the welding equipment (practical case).

There will be circulating currents through the mains supply line and furthermore through the welding equipment.

Case 4

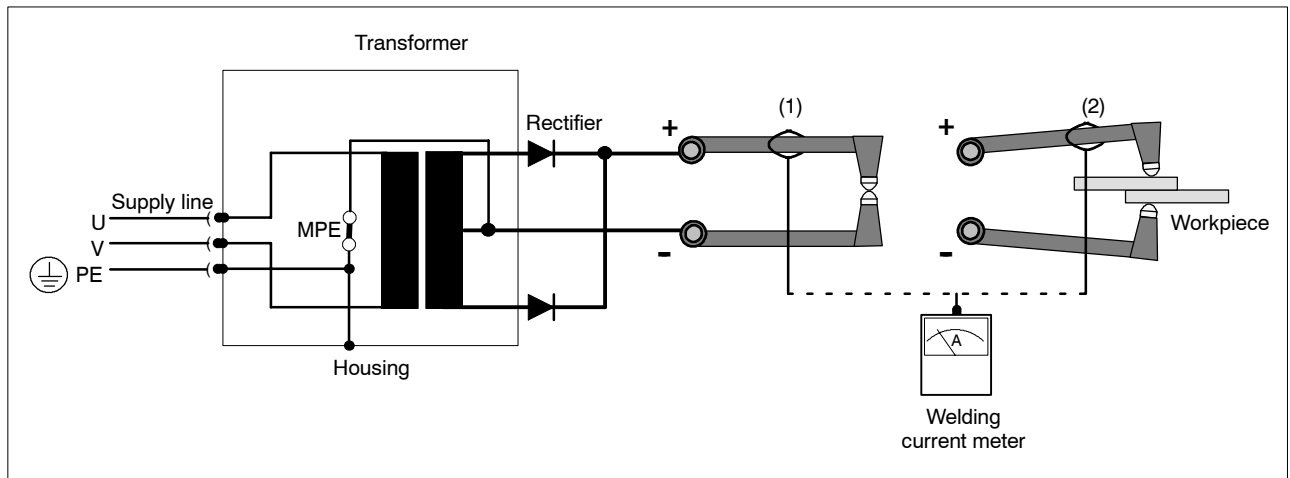


Negative pole grounded via protective conductor jumper (MPE), workpiece not grounded, several electrode guns simultaneously weld the workpiece (whose negative pole is also grounded).

There will be circulating currents through the "neighboring" electrode guns.

More circulating currents are present if the workpiece is additionally grounded (cf. Case 3).

How to measure circulating currents



A welding current meter for measuring DC current is required for measuring the circulating currents.

- (1) Apply measuring belt to positive pole of the electrode gun and fix its position. Close the electrode gun without a workpiece, apply welding current (MF inverter in current control mode). Measure and record welding current $I_{(1)}$.
- (2) Close the welding gun with the workpiece, close "neighboring gun", if any, (Case 4), apply welding current with current specification as described under (1). Measure and record welding current $I_{(2)}$.

If the current values are different, the presence of circulating currents has to be assumed. The amount of the circulating current is calculated as $I_{(2)} - I_{(1)} = \text{approx. circulating current}$.

Remedying circulating currents

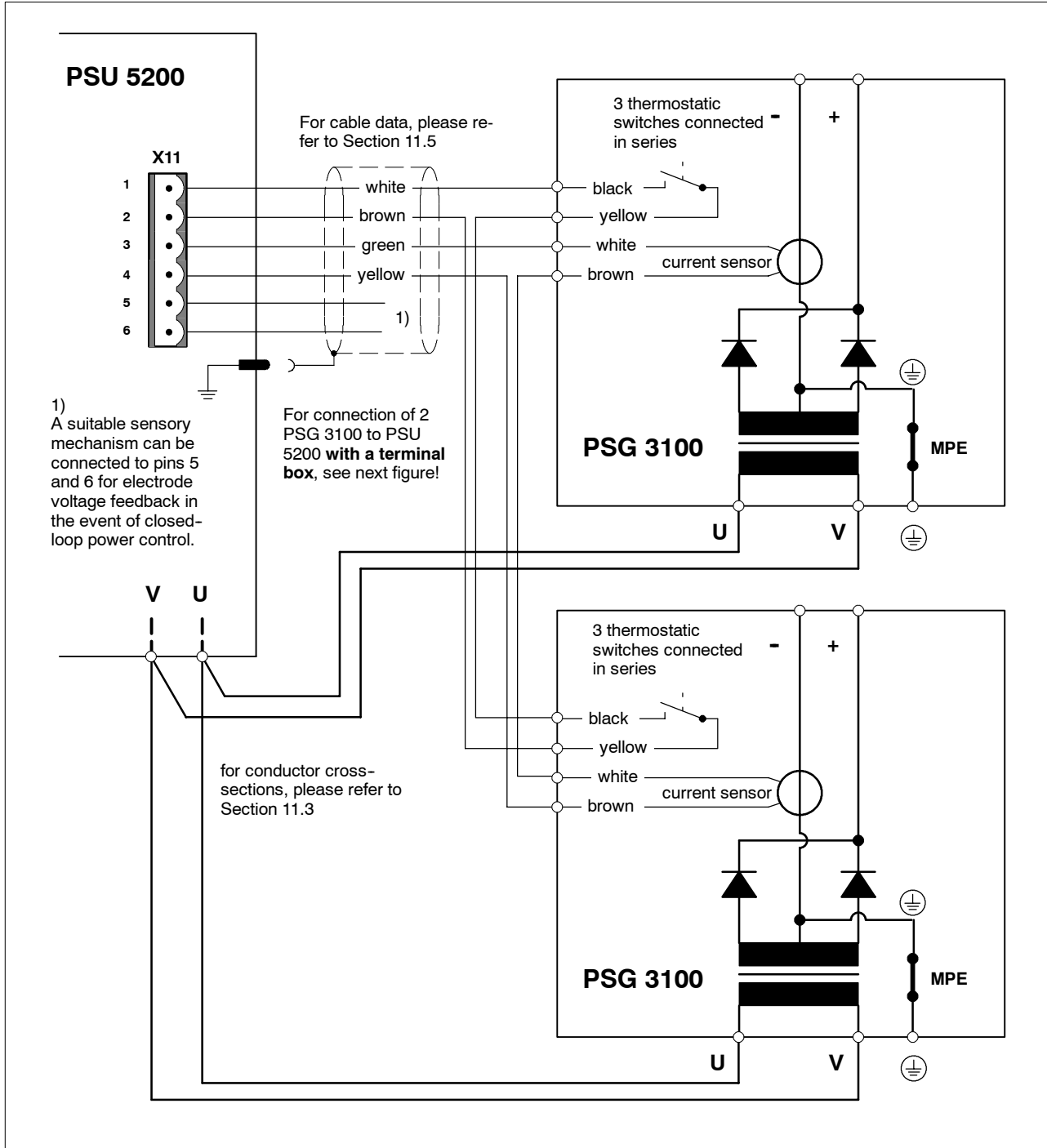
If circulating currents cannot be avoided by the protective measure "direct protective conductor connection", other protective measures to EN 50063 must be installed by the machine/plant manufacturer/operator.

For example, protective measures such as current-operated e.l.c.b. systems or voltage-operated e.l.c.b. systems (cf. EN 50063, Sections 5.1.4.3 and 5.1.4.4) may be installed for medium-frequency systems.

However, it must be noted that the equipment used for the measures described above must be suitable for operation with medium-frequency systems with a DC link circuit and a frequency of 1000 Hz. The manufacturer's specifications must be verified accordingly. The applicable standards are to be observed.

11.7 Parallel connection of 2 PSG's to PSU 5200

Please note the information given in Section 9.4 !



WARNING!

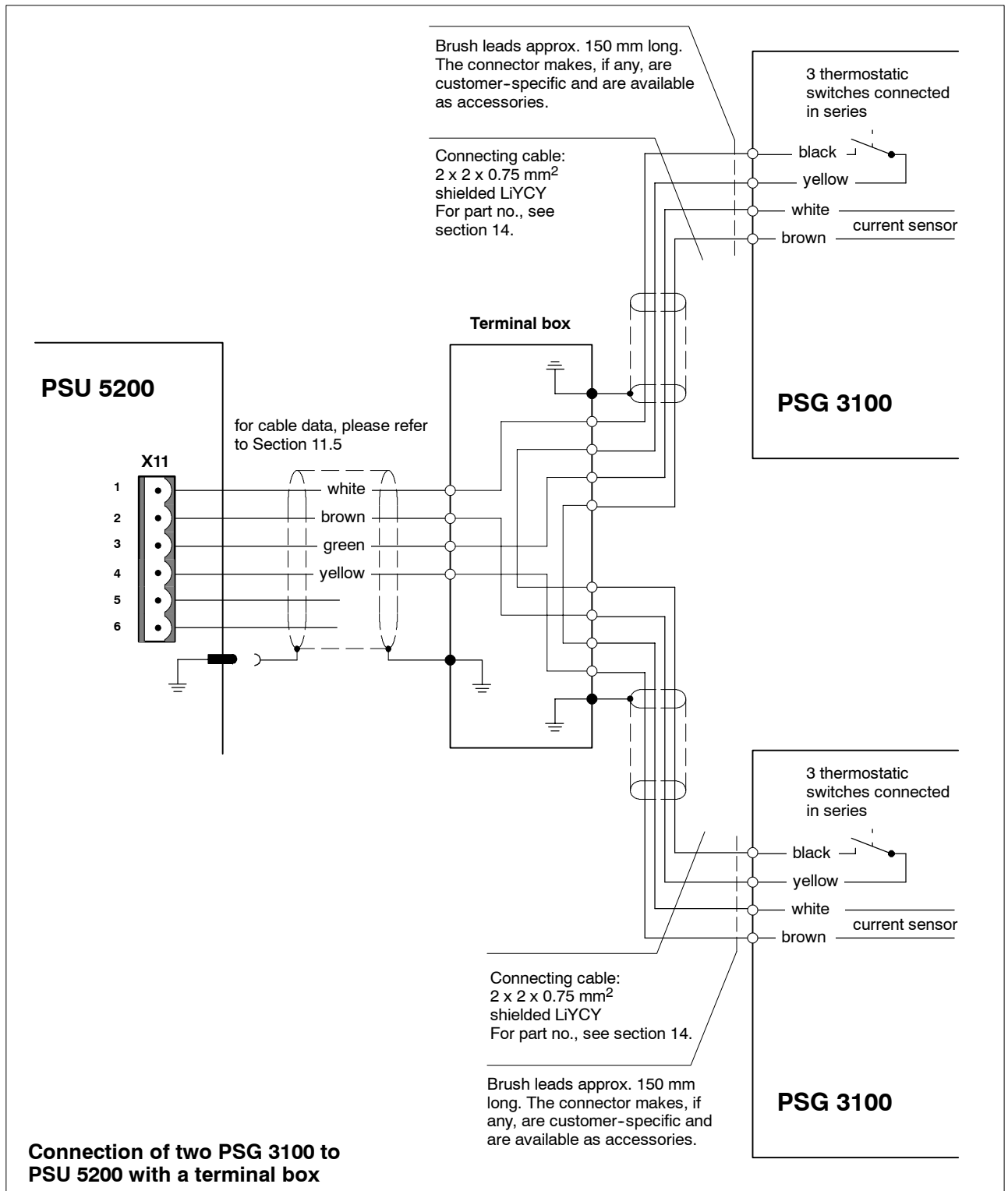


Danger through electrical voltage!



The protective earth for the negative pole of the PSG can be interrupted by opening the protective earth conductor connection at the PSG (see MPE point in diagram above). In order to protect the operating personnel against dangerous electrical voltages in the event of a break-down of the transformer primary side to the secondary side, in this case, a suitable protective measure pursuant to DIN 57 113,

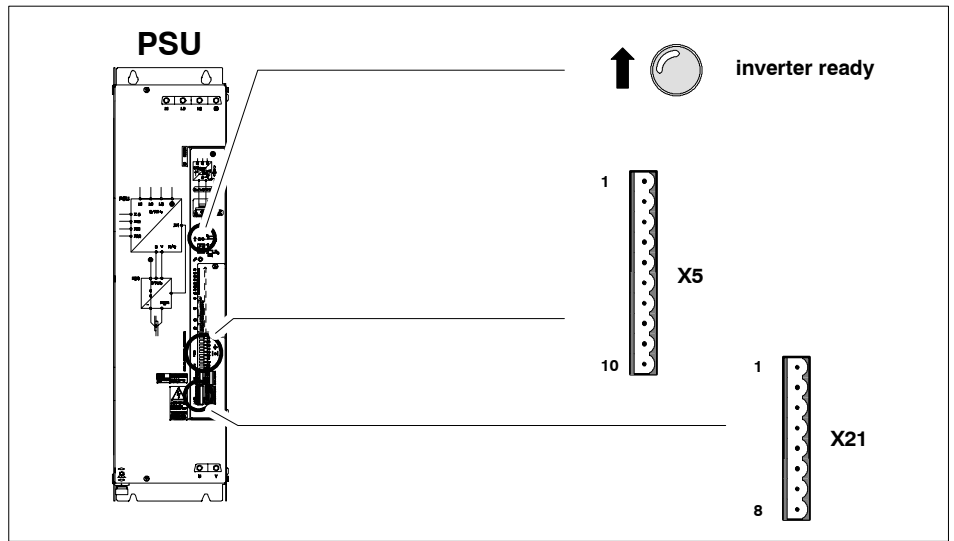
VDE 0113 is to be provided (e.g. by earthing the welding gun)! In addition, the transformer is to be marked accordingly (see also dimensioned drawing of the transformer, Section 10.2).







12 Activation/deactivation of the inverter



○ Activation of the inverter

1. Apply mains voltage

The inverter starts up. After approx. 10 s the DC link circuit is charged to reach its maximum voltage, and the green LED "inverter ready" lights up.

WARNING!



Danger of life through contact with live parts!
In this moment, the inverter is energized!



If the inverter housing is to be opened, switch off the system and wait for at least 5 minutes until the inverter is de-energized.

○ Deactivation of the inverter

1. When the supply has been switched off, the bridge rectifiers are blocked, and the DC link is being discharged.

WARNING!



Danger of life through electrical voltage!



If the inverter housing is to be opened, switch off the system and wait for at least 5 minutes until the inverter is de-energized.





13 Maintenance

**WARNING!**

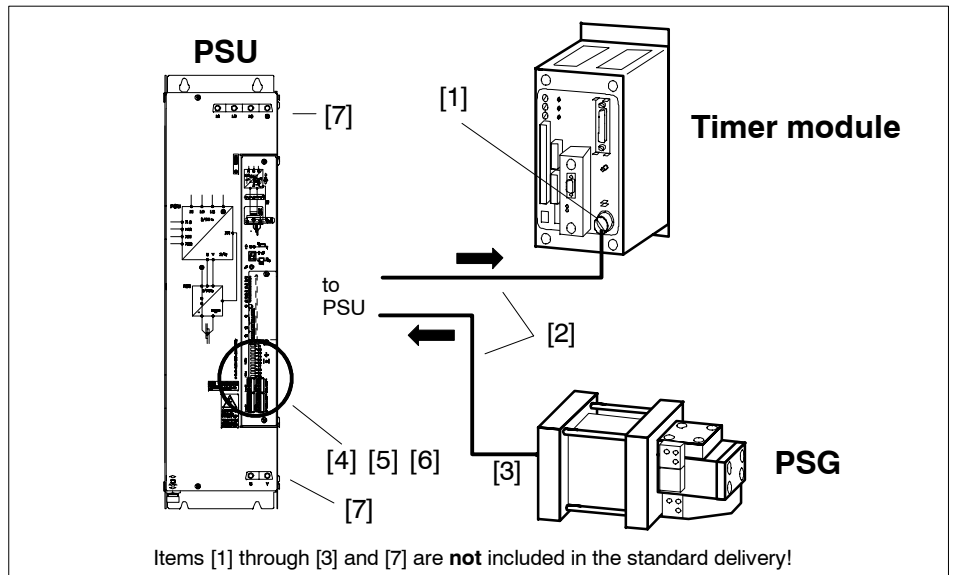
- Danger of life through electrical voltage!
Prior to any maintenance work – unless described otherwise – the system must always be switched off! If the system had been active shortly before, wait until the system is totally de-energized before starting the maintenance work (e.g. because of charged capacitors, etc.). For the duration of the maintenance work the system must always be protected against re-closing.
In the event of necessary measurement or test procedures at 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 electrical voltage!
If the inverter housing is to be opened, switch off the system and wait for at least 5 minutes for the inverter to de-energize.
- Danger of life through inappropriate EMERGENCY-OFF facilities!
EMERGENCY-OFF facilities must be operative in all modes of the system. Releasing the EMERGENCY-OFF facility must by no means result in an uncontrolled restart of the system!
- Danger of explosion of batteries!
Batteries must not be opened forcefully, recharged, soldered at the cell body or thrown into fire!
Replace empty batteries with new ones only!

**ATTENTION!**

- The right to perform repair/maintenance work on the timer components is reserved to the BOSCH service department or to repair/maintenance units authorized by BOSCH!
- Only use spare parts/replacement parts approved by BOSCH!
- Spent batteries or accumulators must be disposed of as hazardous waste.

- Check the cooling water circuit regularly for tightness.
- Add an algicide to the cooling water.
- The connections and termination points of all connecting cables must be checked in regular intervals for firm sit. Check all cables for damages.
- Clean the air cooler.



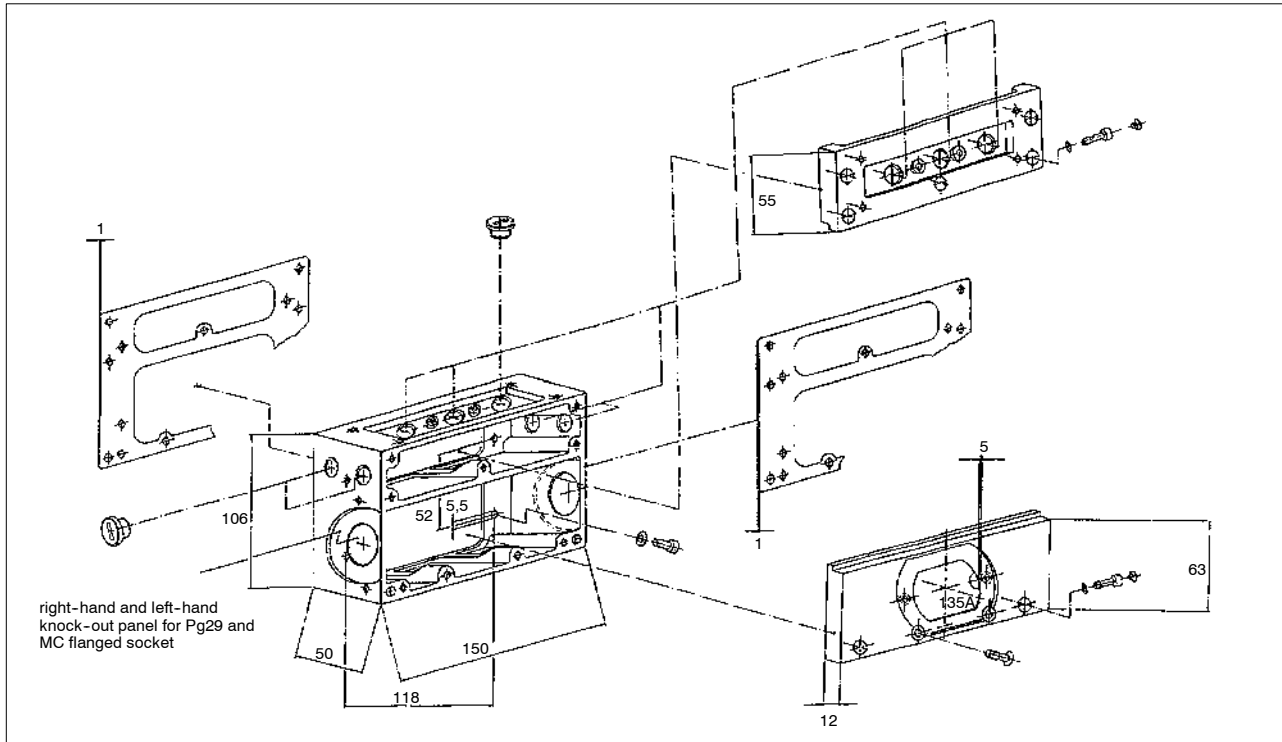
**14 Accessories**

- [1] Mating connector, 12-pole, at Bosch timer module PSS2000/E81... (only when equipped with direct-current KSR module) for actual-current value message KSR connector assembly
 comprising: 1 x plug-in contact Part no. 1070 069 061
 1 x strain relief Part no. 1070 913 496
 4 x female contact Part no. 1070 912 650
 Part no. 1070 902 428
- [2] Special connecting cable; 2 x 2 x 0.75 mm² shielded; LiYCY
 Part no. 1070 913 494
- [3] Primary cable connection, current transformer, thermostatic contacts, at the PSG via transformer terminal box depending on customer's specification or standard terminal box.
- [4] X5 mating connector, 10-pole Part no. 1070 913 813
 [5] Mating connector for X11 and X12 Part no. 1070 916 554
 (6-pole)
 [6] Mating connector for X21 and X22 Part no. 1070 916 553
 (8-pole)
 [7] Insertable pins for smaller conductor cross-sections (4 or 6 mm²) (only together with plug connectors) Part no. 1070 918 779

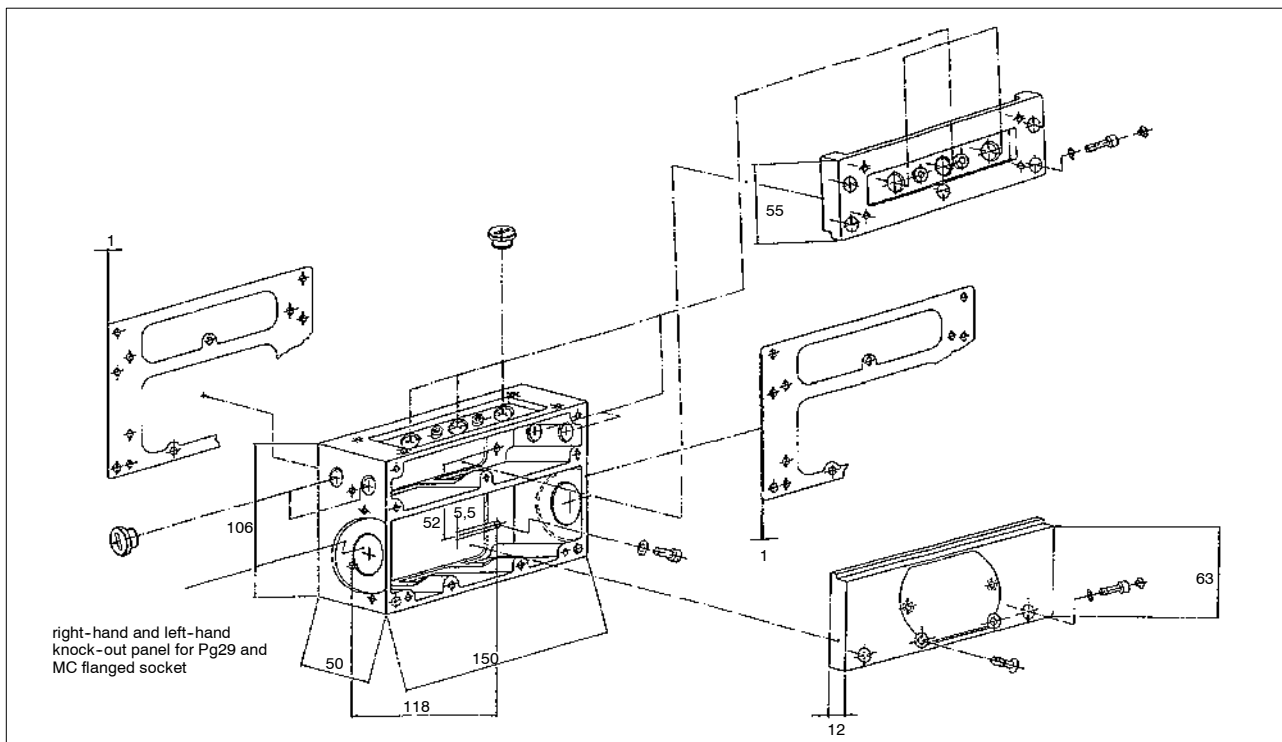
ATTENTION!

Danger of life and/or damage to property through insufficient protection class!
 In order to obtain protection class IP 55 at the PSG connections (cf. item [3]), a suitable terminal box must be used!
 The standard terminal boxes available from us are shown on the following figures.

Terminal box TH 3050/MC Part-no.: 1070 917 828
 suitable for PSG 3050 or PSG 3075
 for MC contact connection



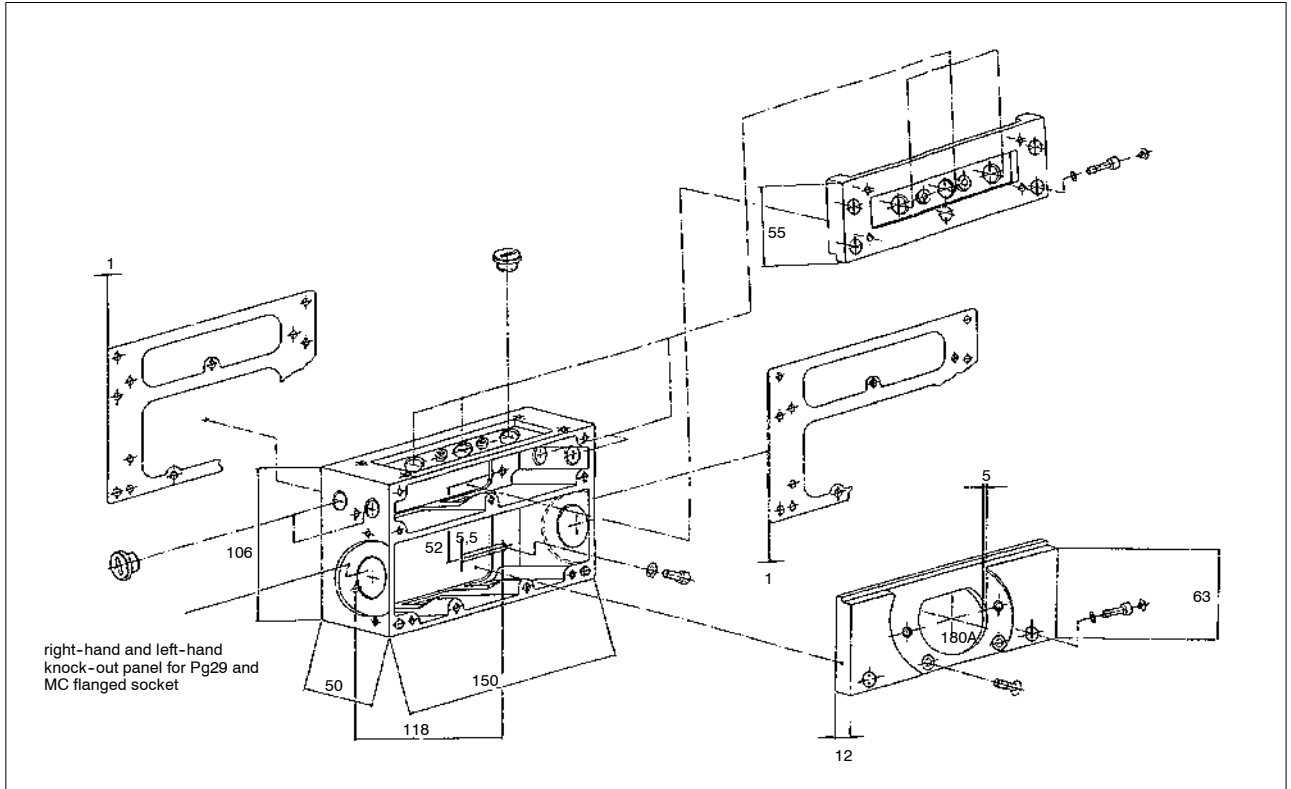
Terminal box TH 3000/PG Part-no.: 1070 917 826
 suitable for all transformer types
 primary connection through bolted PG connection





Terminal box TH 3100/MC
suitable for PSG 3100
for MC contact connection

Part-no.: 1070 917 827



Advice on request:

Robert Bosch GmbH, AT/VWS

Phone: ++(49) 6062/78 0 (exchange)

Fax: ++(49) 6062 / 78 728



15 Storage and transport

**ATTENTION!**

Injuries and bruises may be caused by lifting weights which are too heavy! Depending on the weight of individual modules (for weight data, see Section 5, "Technical Data") a suitable device or several persons are required for transporting.

In any case, wear safety shoes for transporting the modules.

**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 Section 5, "Technical Data".





16 EC Declaration of Conformity

**EG Konformitätserklärung
EC declaration of conformity
Déclaration "CE"**

Hiermit erklären wir, daß unser Produkt, Typ: PSU 5000
We hereby declare that our product, type:
Nous déclarons par la présente que notre produit, type: PSU 5100.100 und PSU 5100.200

folgenden einschlägigen Bestimmungen entspricht:
complies with the following relevant provisions:
correspond aux dispositions pertinentes suivantes:

Maschinenrichtlinie (89/392/EWG, 91/368/EWG, 93/68/EWG und 93/44/EWG)
Machinery Directive (89/392/EEC, 91/368/EEC, 93/68/EEC and 93/44/EEC)
Directive sur les machines (89/392/CEE, 91/368/CEE, 93/68/CEE et 93/44/CEE)

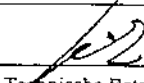

Niederspannungsrichtlinie (73/23/EWG, 93/68/EWG und 93/44/EWG)
Low voltage Directive (73/23/EEC, 93/68/EEC and 93/44/EEC)
Directive sur les basses tensions (73/23/CEE, 93/68/CEE et 93/44/CEE)


EMV-Richtlinie (89/336/EWG, 93/68/EWG und 93/44/EWG)
EMC Directive (89/336/EEC, 93/68/EEC and 93/44/EEC)
Directive EMV (89/336/CEE, 93/68/CEE et 93/44/CEE)

Angewendete harmonisierte Normen, insbesondere:
Applied harmonized standards, in particular:
Normes harmonisées utilisées, notamment:
EN 60204-1
EN 60529
prEN 50178

Angewendete nationale Normen und technische Spezifikationen, insbesondere:
Applied national technical standards and specifications, in particular:
Normes et spécifications techniques nationales qui ont été utilisées, notamment:

Formular 1070074976 - 102W611

30.1.1997  
Datum / Unterschrift / Technische Betriebsleitung

30.1.1997 AT/ENS A. 
Datum / Unterschrift / Entwicklungsleitung

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