JUMO TYA 203

Three Phase Thyristor Power Controller

Typ 709063/X-01-020

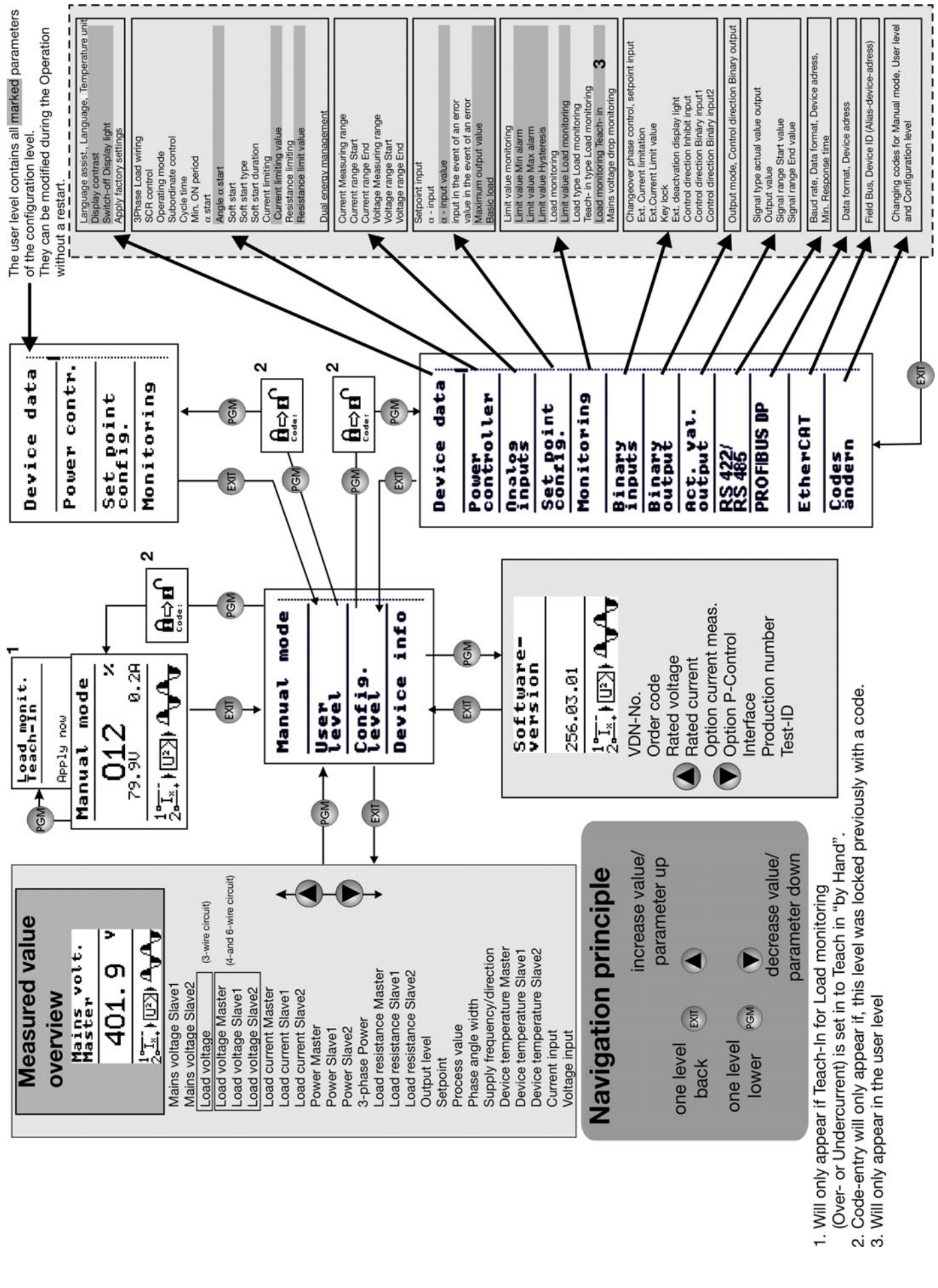
Operating Manual

70906300T90Z001K000

V3.01/EN/00627288

All parameter settings are described in detail in the chapter "Configuration".

This operating overview shows all possible parameters of the device series. Depending on the order specifications or current configuration, any parameters that are not required are hidden.



1. Will only appear if Teach-In for Load monitoring (Over- or Undercurrent) is set in to Teach in "by Hand".
2. Code-entry will only appear if, this level was locked previously with a code.
3. Will only appear in the user level

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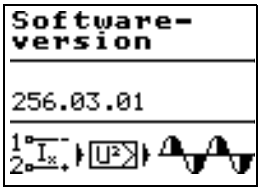
1.1 Preface

Read this operating manual before putting the device into service.

This operating manual is valid from **device software version** [256.03.01].



Keep the operating manual in a place that is accessible to all users at all times.

Your comments are appreciated and may assist us in improving this operating manual.

Phone: +49 661 6003-727
Fax: +49 661 6003-508

The power controller produces the power that is needed at the analog input or in manual mode. Safety systems independent of the power controller must be installed. They should safely switch off the subsequent heating process in the event of excess temperatures.

The power controller may only be operated using original JUMO semiconductor fuses.
In the event of replacement, please check that the correct spare part has been used.

All necessary settings are described in this operating manual.
Manipulations not described in the operating manual or expressly forbidden will jeopardize your warranty rights.
If you have any problems, please contact the nearest branch office or the head office.

Service hotline

For technical questions
Phone support in Germany:
Phone: +49 661 6003-9135
Fax: +49 661 6003-881899
Email: service@jumo.net

Austria:
Phone: +43 1 610610
Fax: +43 1 6106140
Email: info@jumo.at

Switzerland:
Phone: +41 1 928 24 44
Fax: +41 1 928 24 48
Email: info@jumo.ch

1 Introduction

When accessing the inner parts of the device and returning device plug-in units, modules, or components, please observe the regulations according to DIN EN 61340-5-1 and DIN EN 61340-5-2 "Protection of electronic devices from electrostatic phenomena". Use only **ESD** packaging for shipment.

Please note that we cannot accept any liability for damage caused by ESD (electrostatic discharge).

ESD=**E**lectro**s**tatic **D**ischarge

1.2 Typographical conventions

1.2.1 Warning symbols

Caution

This symbol is used when **personal injury** may occur if the instructions are disregarded or not followed correctly.

Caution

This symbol is used when **damage to devices or data** may occur if the instructions are disregarded or not followed correctly.

ESD

This symbol is used if precautionary measures must be taken when handling **components liable to damage through electrostatic discharge**.

Dangerous voltage

This symbol is used if dangerous voltages will cause an electric shock if contact with live parts is made.

Hot surface, fire hazard

This symbol is used if burns can result from touching a hot surface.

Do not install any heat-sensitive components or devices close to the power controller.

1.2.2 Note symbols

Note

This symbol is used when your attention is drawn to a **particular issue**.

Reference

This symbol refers to **further information** in other manuals, chapters, or sections.

Footnote

abc[1] Footnotes are remarks that **refer to** specific parts of the text. Footnotes consist of two parts:
An identification marking in the text, and the footnote text itself.
The identification markings in the text are arranged as sequential superscript numbers.

1.2.3 Performing an action

Action instruction

✱ Plug in the connector This symbol indicates that an **action to be performed** is described. The individual steps are marked by this asterisk.

Vital text

READ THE DOCUMENTATION!

This symbol, which is attached to the device, indicates that the associated **device documentation must be observed**. This is necessary in order to recognize the nature of the potential danger and take the necessary measures to avoid it.

Command sequence

Config. level ➔Power controller ➔Operating mode Small arrows between words are intended to facilitate faster location of parameters in the configuration level.

1.2.4 Representation

Keys

Keys are displayed as symbols or text.
Key combinations are represented by a plus sign.

1 Introduction

1.3 Order details

The nameplate is affixed to the right-hand side of the housing.

(1) Basic type

709063	TYA-203 three-phase thyristor power controller

(2) Version

8	Standard with default settings
9	Customer-specific programming according to specifications

(3) National language of device texts

01	German (default setting)
02	English
03	French
14	Spanish

(4) Load current

020	AC 20 A
032	AC 32 A
050	AC 50 A
100	AC 100 A
150	AC 150 A
200	AC 200 A
250	AC 250 A

(5) Subordinate control loop (see note below)

010	**I, I²** (can be set to U, U²)
001	**P** (can be set to I, I² or U, U²)

(6) Mains voltage[a]

024	AC 24 V	-20 to +15 %, 48 to 63 Hz
042	AC 42 V	-20 to +15 %, 48 to 63 Hz
115	AC 115 V	-20 to +15 %, 48 to 63 Hz
230	AC 230 V	-20 to +15 %, 48 to 63 Hz
265	AC 265 V	-20 to +15 %, 48 to 63 Hz
400	AC 400 V	-20 to +15 %, 48 to 63 Hz
460	AC 460 V	-20 to +15 %, 48 to 63 Hz
500	AC 500 V	-20 to +15 %, 48 to 63 Hz

(7) Interface

00	None
54	RS485/422
64	PROFIBUS-DP
84	EtherCAT/JUMO mTRON T system interface

(8) Extra code

252	Relay (changeover contact) 3 A
257	Optocoupler[b]

(1)		(2)		(3)		(4)		(5)		(6)		(7)		(8)	
	/		-		-		-		-		-		-		**Order code**
709063	/	8	-	01	-	100	-	010	-	400	-	00	-	252	**Order example**

a.Mains voltage = voltage supply for control electronics
b.Enables energy meter

Note:
Subordinate control loop I2, code 010:
enables voltage control, current control, partial load failure detection, dual energy management, current limiting and energy meter
Subordinate control loop P, code 001: enables voltage control, current control, power control, partial load failure detection, dual energy management, current limiting, r-control and energy meter

At a load current of 250 A, observe voltage supply for fan!
⇨ Chapter 3.2.4 "Type 709063/X-0X-250-XXX-XXX-XX-25X"

1.3.1 Scope of delivery

1 operating manual 70906300T90Z001K000
1 thyristor power controller in the version ordered
2 patch cables (1:1)

1.3.2 Accessories

Item	Part no.
Setup program 709061 TYA-201 (can also be run for TYA-202 and TYA-203 power controllers)	00544869
USB cable A-connector B-connector 3 m	00506252
Installation kits:	
Installation kit for DIN-rail 20 A TYA 203	00648636

1.3.3 General accessories

Semiconductor fuses

A semiconductor fuse is fitted in the power controller to protect the thyristor module. The "Fuse LED" is lit red in the event of a fault.

⇨ Chapter 8.2 "Replacing a defective semiconductor fuse"

Item	Load current $I_{nom.} = I_N$	Part no.
Super fast semiconductor fuse 40 A	I_N = 20 A	00513108
Super fast semiconductor fuse 80 A	I_N = 32 A	00068011
Super fast semiconductor fuse 80 A	I_N = 50 A	00068011
Super fast semiconductor fuse 160 A	I_N = 100 A	00081801
Super fast semiconductor fuse 350 A	I_N = 150 A	00083318
Super fast semiconductor fuse 550 A	I_N = 200 A	00371964
Super fast semiconductor fuse 550 A	I_N = 250 A	00371964

1 Introduction

1.4 Brief description

Device

The JUMO TYA-203 represents the consistent development of the JUMO power controller technology and switches resistive loads and transformer loads. The so-called three-wire circuit can be used to interconnect the load in a star connection or a delta connection. A four-wire circuit and an open delta connection (six-wire circuit) can also be implemented. The microprocessor-controlled power controller displays all parameters in an LCD display with background lighting. It can be operated using the 4 keys at the front.

Application

Thyristor power controllers are used where larger resistive and resistive/inductive loads (transformer loads) have to be switched, e.g. in industrial furnace construction and plastics processing. The thyristor power controller consists of thyristors connected in anti-parallel, the insulated heat sink, and the control electronics.

Mounting

The thyristor power controllers with a load current of 20 A can either be clipped to a 35 mm mounting rail or fitted to the wall on a mounting plate. Wall mounting is the only option as of a load current of 32 A.

Operating modes

The TYA-203 works in phase angle control mode or in burst firing mode. In burst firing mode, the first half-wave can be optimally cut with an adjustable phase angle so that transformer loads can also be operated.
It is possible to specify a base load or, depending on the device type, to set current limiting or resistance limitation for the load.
To avoid high starting currents, a soft start can be set.

Load types

All symmetrical resistive loads up to and including transformer loads are permitted.
In the case of transformer loads, the nominal induction of 1.2 tesla must not be exceeded (value is 1.45 T in the case of mains overvoltage).

Subordinate control loop

Depending on the device type, U, U^2, I, I^2, or P controls are available as subordinate control loops. Fluctuations in the mains voltage therefore have no effect on the control-loop regulation during operation.

Standards

The thyristor power controllers are in accordance with VDE 0160 5.5.1.3 (5/88) and VDE 0106 Part 100 (3/83). The devices must be grounded as specified by the responsible energy supplier.

Advantages

- Teach-In function for the detection of partial load failure
- Network load optimization through dual energy management
- Transmission of the setup data is possible even without voltage supply to the device (power supply via USB port)
- Energy meter

1.5 Standards, approvals, and conformity

Inspection basis for the device properties is the Low Voltage Directive DIN EN 50178. Inspection basis for the EMC Directive is DIN EN 61326-1.

	Standard
Electrical connection	DIN VDE 0100
Protection type IP20 built-in devices	DIN EN 60529
Climatic ambient conditions	Class 3K3
Air temperature and rel. humidity	DIN EN 60721-3-3
Storage temperature class 1K5	DIN EN 60721-3-1
Operating conditions Pollution degree Overvoltage category	DIN EN 50178 2 III
Test voltages	DIN EN 50178
Residual current circuit breaker	DIN EN 50178
Electromagnetic compatibility Interference emission Interference immunity	DIN EN 61326-1 Class A - only for industrial use Industrial requirement
Mechanical tests: Vibration test 3M2 Toppling test class 2M1	 DIN EN 60068-2-6, DIN EN 60721-3-3 DIN EN 60068-2-31, DIN EN 60721-3-2
Labels, identification marking	DIN EN 50178, DIN EN 61010-1

Approvals	**Standard**	**Type**
c UL us LISTED	UL 508 (Category NRNT), pollution degree 2 C22.2 NO. 14-10 Industrial Control Equipment (Category NRNT7)	709063/X-XX-020-... Load current 20 A
	UL 508 (Category NRNT) C22.2 NO. 14-10 Industrial Control Equipment (Category NRNT7)	709063/X-XX-032... 709063/X-XX-050... 709063/X-XX-100... 709063/X-XX-150... 709063/X-XX-200... 709063/X-XX-250... Load current 32 to 250 A
Can be used for current circuits with a short-circuit current capacity of ≤ 100 kA (the admissible mains voltage must correspond to the nominal voltage of the thyristor power controller). For plant protection, a fuse up to class RK5 may be used.		

CE conformity	Low Voltage Directives 2006/95/EC Marking Directives 93/68/EEC EMC Directives 2004/108/EC	

Conformity	**Standard**
RoHS	2002/95/EC

1 Introduction

2.1 Important installation notes

Safety regulations

- The choice of cable material, the installation, and the electrical connection of the device must conform to the requirements of VDE 0100 "Regulations on the Installation of Power Circuits with Nominal Voltages below AC 1000 V" or the appropriate local regulations.
- The electrical connection must only be carried out by qualified personnel.
- An isolating switch should be wired between the voltage supply and the device to be able to disconnect the device from the voltage supply on all poles prior to accessing the inner parts of the device.
- Inside the device, safety clearances meet the requirements for double insulation.
  When mounting the connecting cable, ensure that the cables are fitted according to regulations and that the safety clearances are maintained.

Fuse protection

- Fuse protection of the voltage supply in accordance with the VDE regulations must be installed when wiring the voltage supply in the power section. The supply protection can also be achieved by a circuit-breaker in the supply cable. The circuit-breaker must correspond to the power consumption of the power controller.
- The connecting cables used for the terminals U1, U2, N/L2, V, and L1 must feature an electric strength of AC 500 V.
- For UL application, it must be ensured that the fuse for the supply protection of the control electronics is between 2 A and a maximum of 5 A. This also applies to the fan connection.
- To protect the power controller in the event of a ground fault, a semiconductor fuse is installed. In the event of a defect, these may only be replaced with original JUMO semiconductor fuses.

⇨ Chapter 8.2 "Replacing a defective semiconductor fuse"

Wiring

Control cables (SELV potential) must be routed such that they are isolated from cables with mains voltage potential. For supply protection, fuses (e.g. 2 A, Neozed type) must also be installed in the control circuit.

Master/slave 1:1 patch cable

Prior to startup, the enclosed 1:1 patch cables must be inserted into the X8 sockets of the master and connected to the X8 sockets of the slave devices.

PE connection

* A direct protection conductor connection must be provided between the power controller and the PE conductor of the supply network. Connection takes place at the PE connection terminal.

The cross section of the PE conductor must be at least as large as the cross section of the voltage supply cables in the power section. In the event that the protection conductor is not a component of the supply cable or its encasement, the selected conductor cross section may not be less than 2.5 mm^2 (for mechanical protection) or not less than 4 mm^2 (if the protection conductor is not protected mechanically).

⇨ See VDE 0100 Part 540

Check

* That the data given on the nameplate (rated mains voltage, load current) corresponds to the data for the plant.
* That the rotary field has clockwise phasing.
* That the configuration of the analog inputs, for example, corresponds to the wiring.
* The analog input for the setpoint specification only needs to be connected to the master. The slaves are issued with their information via the 1:1 patch cable. This also applies for the setpoint specification via interface.

Load connection

* The electronic switch (2 anti-parallel thyristors) is located between the U1 and U2 terminals.
* Where possible, load cables and cables for control inputs should be routed such that they are isolated.
* Perform connection of mains voltage - thyristor power controller - load in accordance with the connection diagram and check.

Phasing

With regard to the voltage supply for the control electronics and the load voltage, the conductor sequence according to the connection diagram must be observed.

Control inputs

The terminal strips for control connections (inputs and outputs) have been laid out for safe isolation from the mains voltage (SELV). In order not to diminish the safe isolation, all connected current circuits must also be safely isolated. The required auxiliary voltages must be safe extra-low voltages.
The ground terminals X2_2/11 **or** X2_1/6 of the master, slave1, and slave2 must be connected to one another.

2.1.1 Environmental conditions

Incorrect use

The device is not suitable for installation in potentially explosive areas.

Mounting site

The power controller must be installed in a fire-proof control cabinet.
The cabinet should be vibration-free, free from aggressive media, and free from dust to prevent the ventilation slots from becoming blocked.

Climatic conditions

- Relative humidity: 5 to 85 %, no condensation (3K3 according to EN 60721)
- Ambient temperature range: 0 to 45 °C (3K3 according to EN 60721-3-3)
- Storage temperature range: -30 to +70 °C class 1K5

Avoid additional sources of heat

- Ensure that the ambient temperature at the installation site is not increased by other sources of heat or heat accumulation.
- Do not mount the power controller too close to the heating process (kiln)
- Avoid direct sunlight.

Power loss

Occurs as waste heat on the heat sink of the master and slave devices and must be dissipated at the mounting site (e.g. in the control cabinet) in accordance with the climatic conditions.

2.1.2 Filtering and interference suppression

To prevent radio-frequency interference, such as occurs with a soft start in phase angle control, electrical apparatus and plants must have interference suppression implemented.

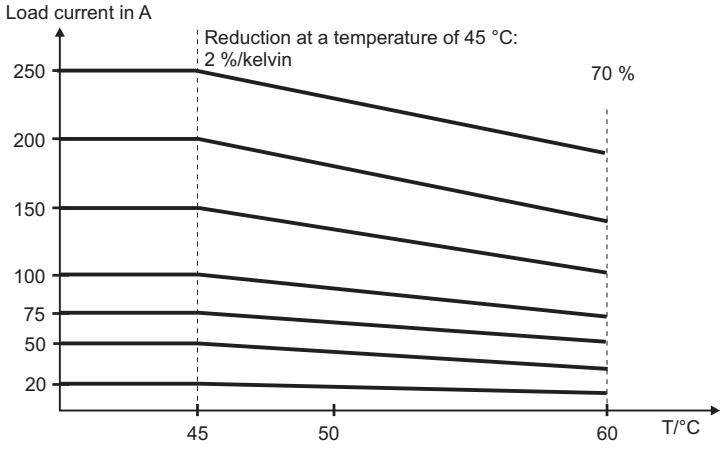
The control electronics of the thyristor power controller correspond to the EMC requirements of EN 61326.

However, modules such as thyristor power controllers do not have any purpose by themselves. They provide a partial function in a complete plant.
Where applicable, the entire load circuit of the power controller must also have suitable interference suppression filters fitted by the plant provider.

There are a number of specialist companies that provide appropriate ranges of interference suppression filters to deal with any interference problems. Such filters are normally supplied as complete modules that are ready to be connected.

2.1.3 Admissible load current depending on the ambient temperature and the site altitude

Ambient temperature



Destruction through overheating:

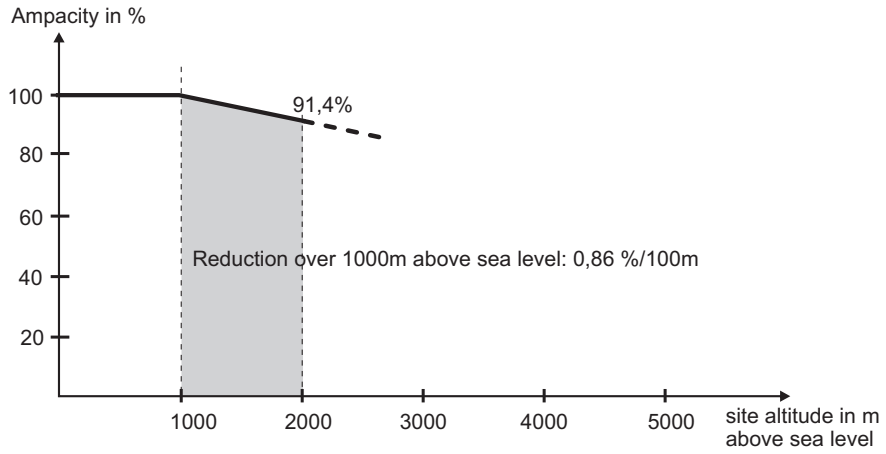
In the event of operation over an extended period at maximum load current, the heat sink and its environment heat up.
For this reason, at ambient temperatures above 45 °C, the maximum load current must be reduced as shown in the diagram, as the thyristor module may otherwise be destroyed.
The device temperature in the master or the two slaves as shown on the display may not exceed 100 °C.

At a device temperature of >100 °C, the message "Warning - high temperature" is displayed.
At a device temperature of >105 °C, the load current is gradually reduced by 10 % of the nominal current each time the temperature increases by one degree.
At a device temperature of >115 °C, the power controller current is completely switched off.

⇨ Chapter 8 "Error messages and alarms"

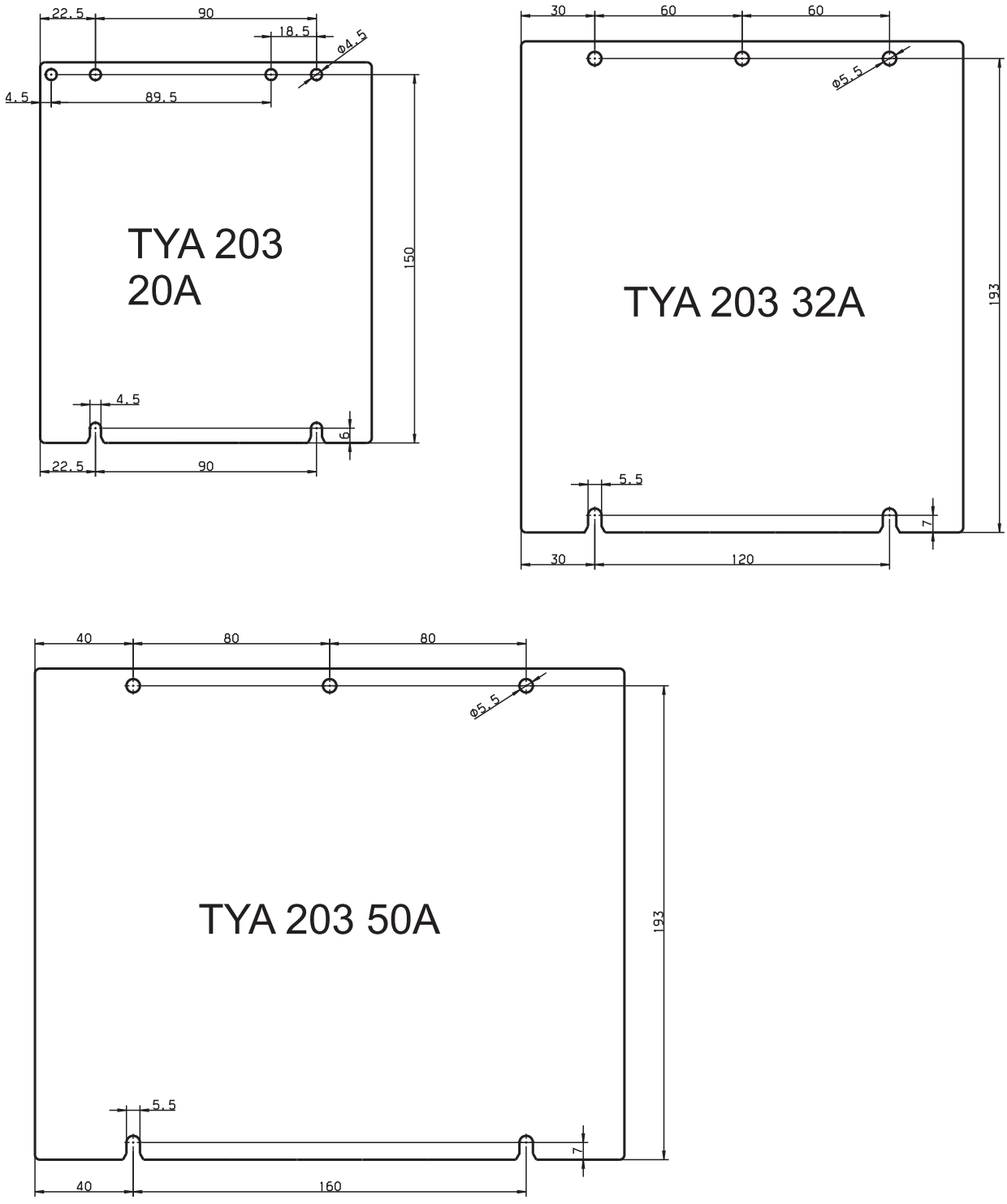
Site altitude

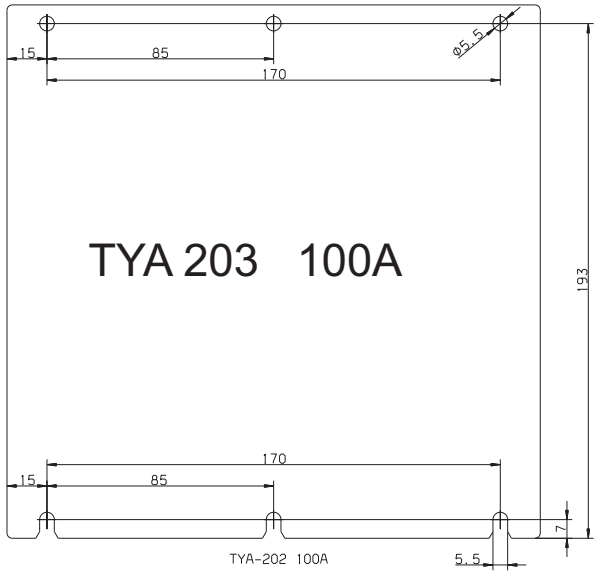
In the case of air cooling, it must be noted that the effectiveness of the cooling is reduced as the site altitude increases. As a result, the ampacity of the thyristor power controller decreases with such a cooler as the site altitude increases, as shown in the diagram.



2.1.4 Wall mounting with screws (per default)

Power controllers with a load current between 20 and 50 A are affixed to a fire-proof control cabinet wall with 4 screws. The left-hand hole is more easily accessible in the upper section.
Power controllers with a load current between 100 and 250 A are affixed with 6 screws.

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85
170
Ø5.5
TYA 203 100A
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85
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TYA-202 100A
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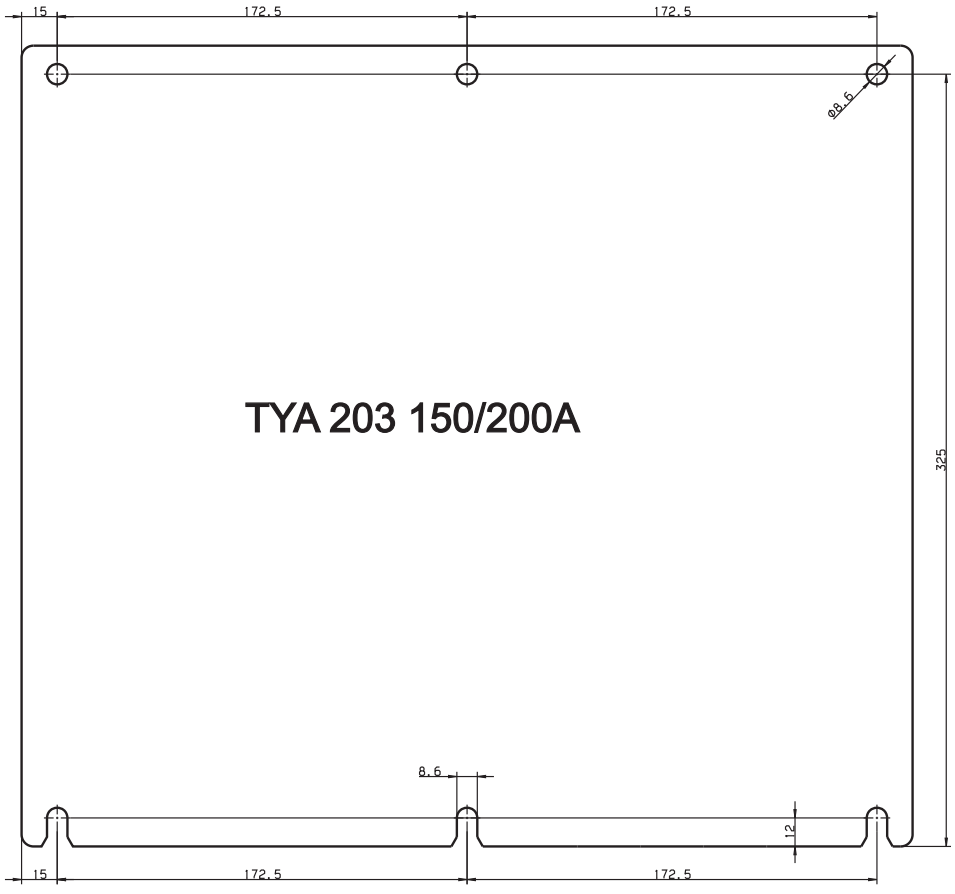
15
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TYA 203 150/200A
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12
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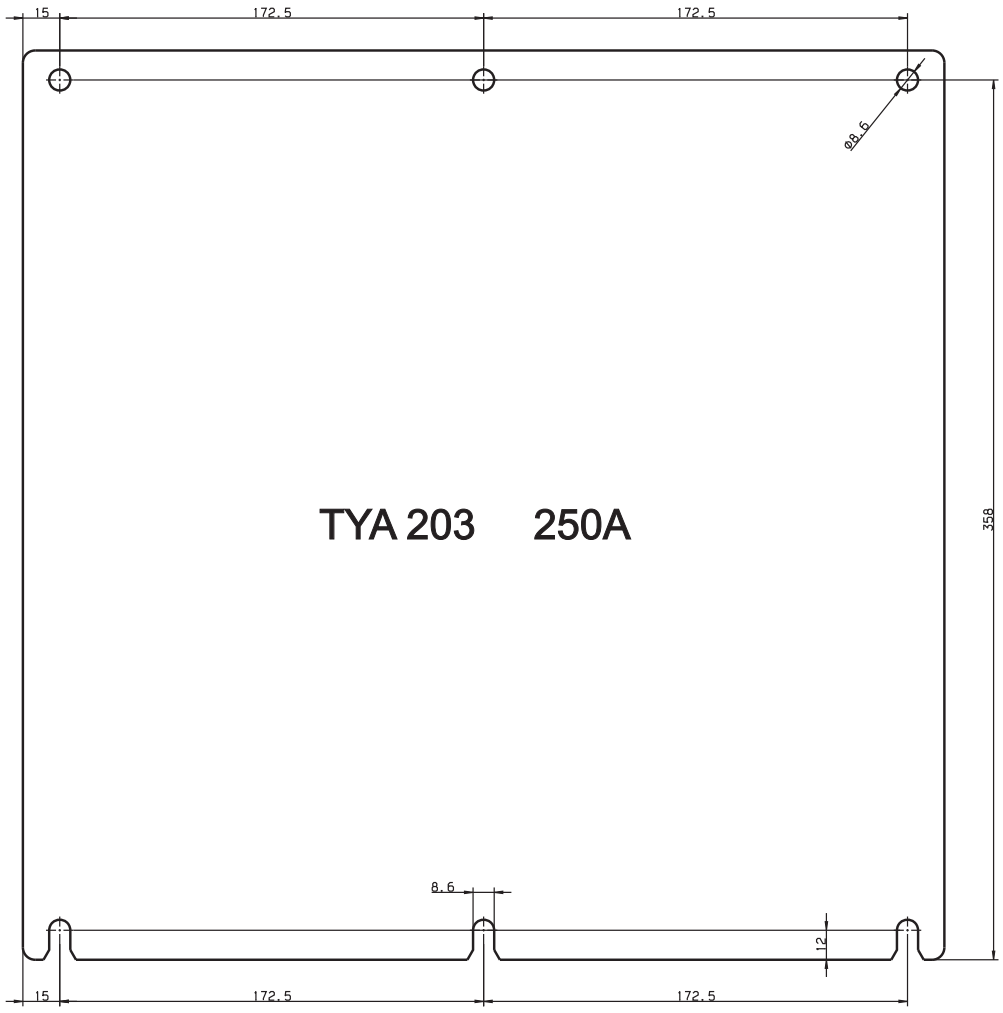
172.5
172.5


15
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Ø8.6
TYA 203 250A
358
8.6
12
15
172.5
172.5

Hot surface

The power controller heats up during operation to a maximum of 110 °C, depending on the load.
Ensure that the lamellae of the heat sink are vertically aligned to allow the heat to be dissipated through natural convection.

Fire hazard:

Do not install any heat-sensitive components or devices close to the power controller.

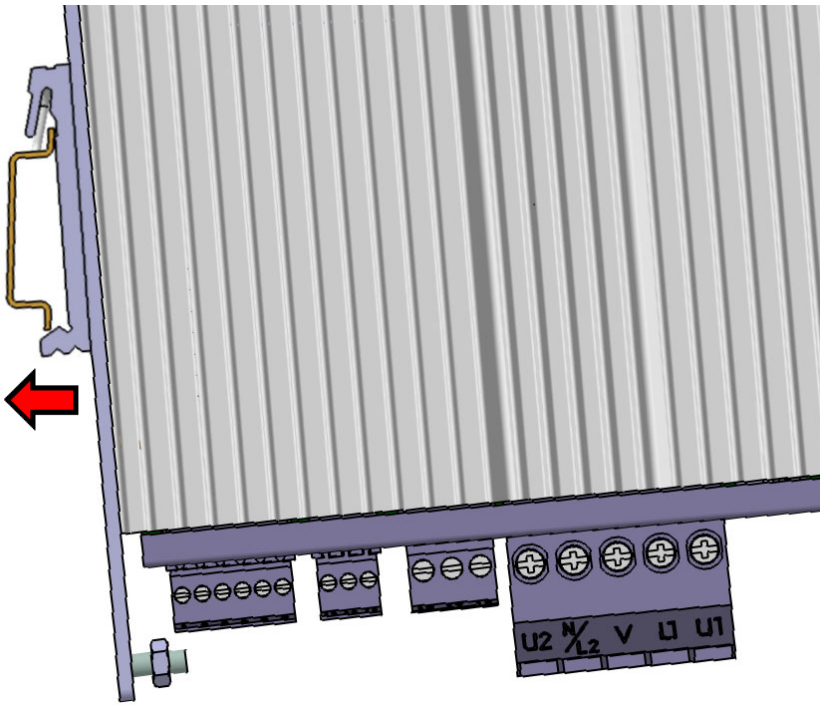
Integrated fan for 250 A power controller:
The intake air at the ventilation grid of the fan may not exceed a maximum inlet air temperature of 35 °C. Ensure that the inlet air for the built-in fans can be taken in from below and escape at the top without obstruction!

2.1.5 Mounting on DIN-rail (accessories)

The 20 A power controller can be affixed to a DIN-rail using the corresponding accessories.

⇨ Chapter 1.3.3 "General accessories"

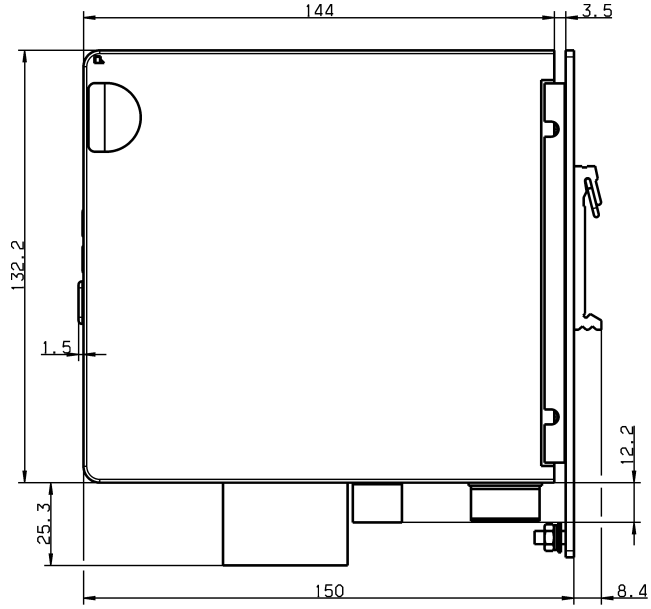
✱ Hook the spring clip into the DIN-rail from above.

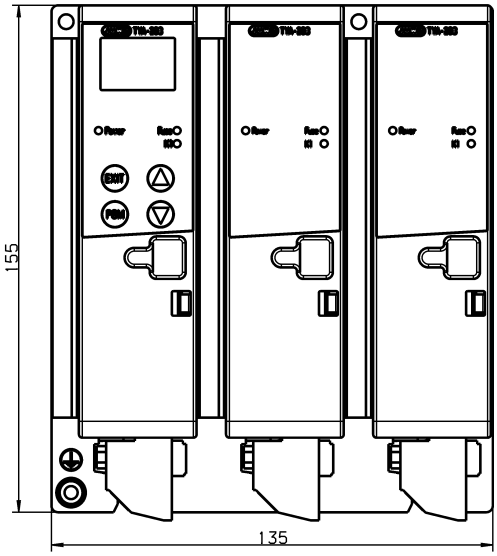


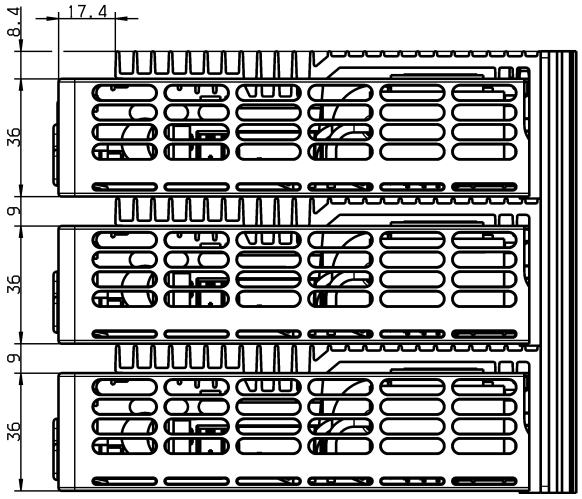
✱ Swivel the power controller downward until the lug engages with the DIN-rail with an audible click.

2.2 Dimensions

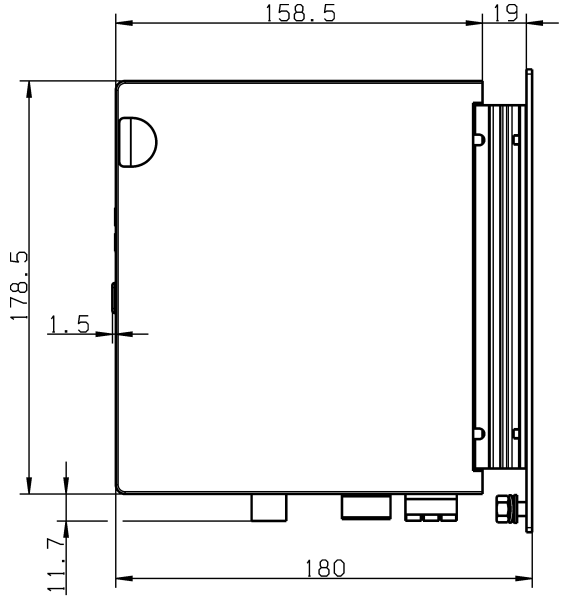
2.2.1 Type 709063/X-0X-020-XXX-XXX-XX-25X

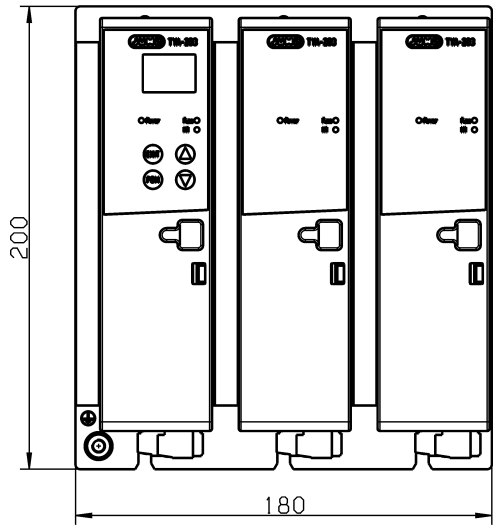


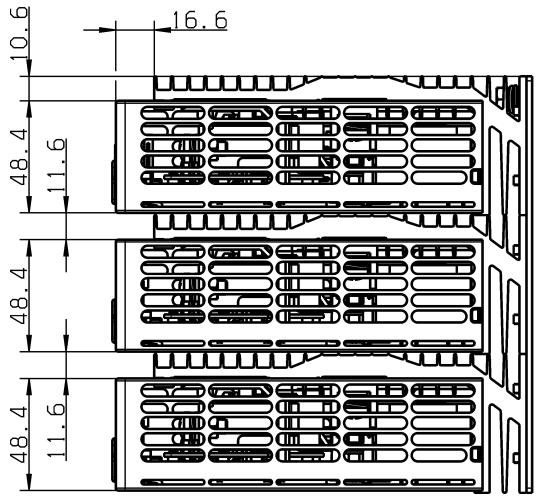




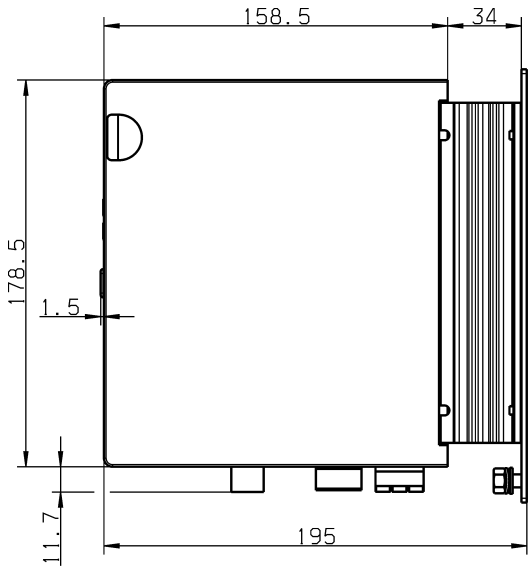
2.2.2 Type 709063/X-0X-032-XXX-XXX-XX-25X

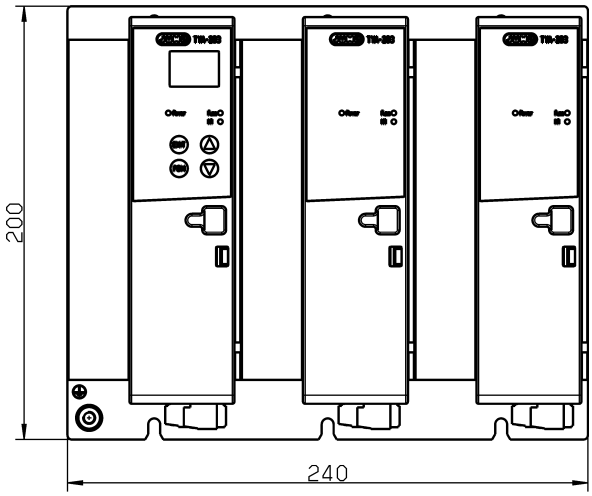


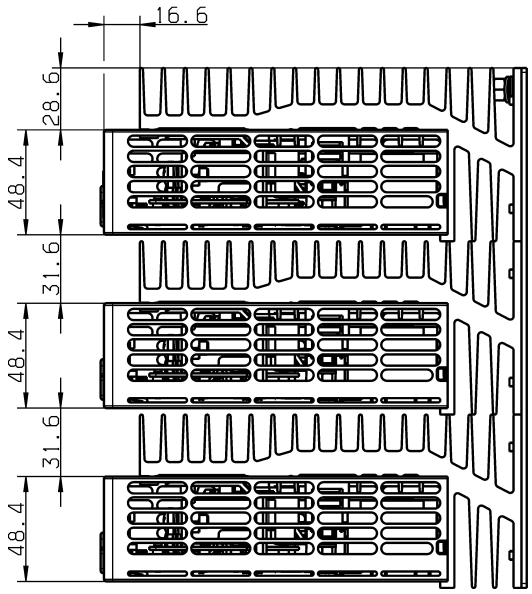




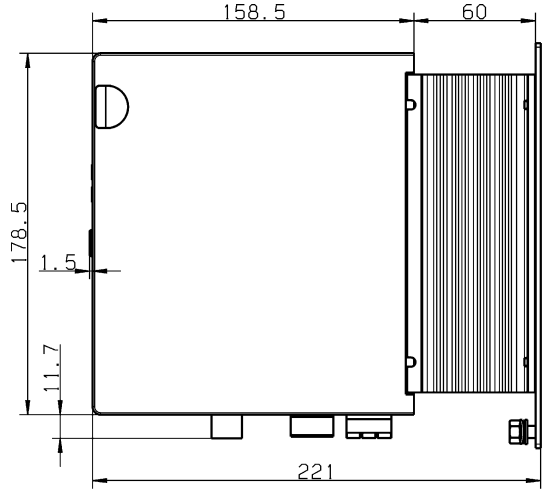
2.2.3 Type 709063/X-0X-050-XXX-XXX-XX-25X

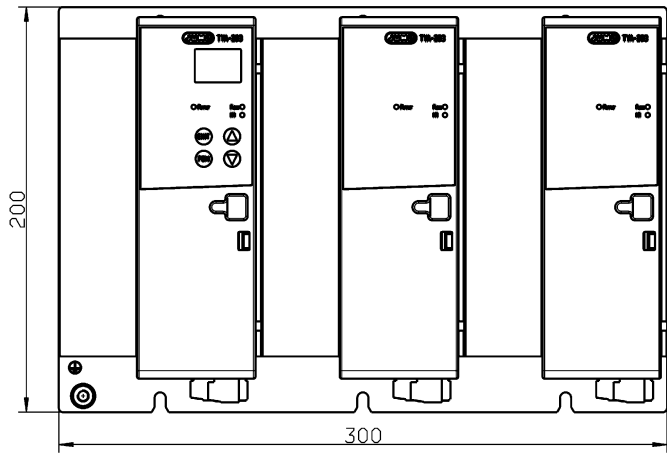


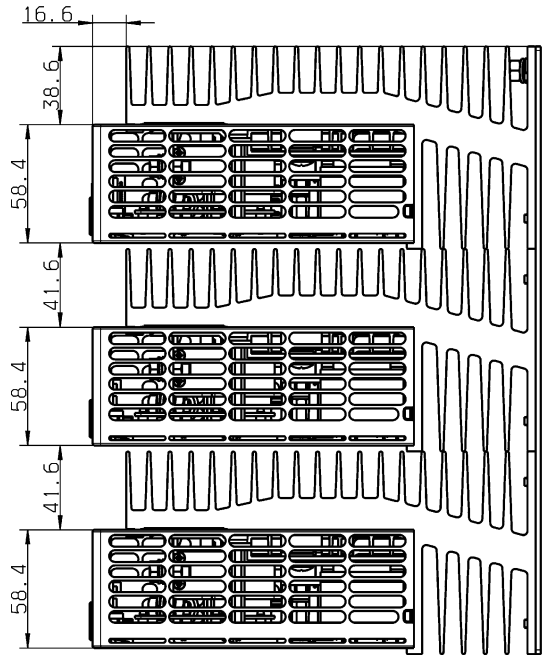




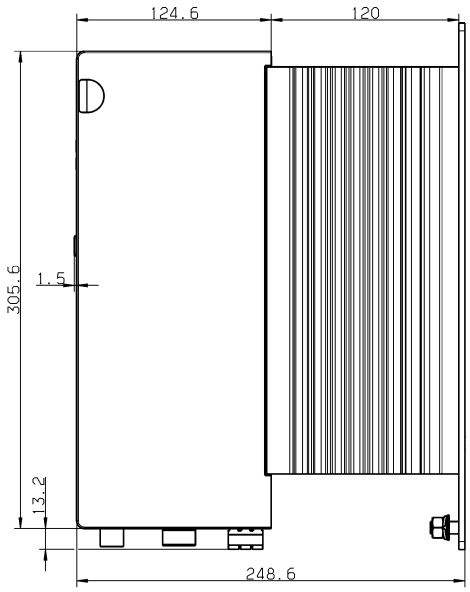
2.2.4 Type 709063/X-0X-100-XXX-XXX-XX-25X

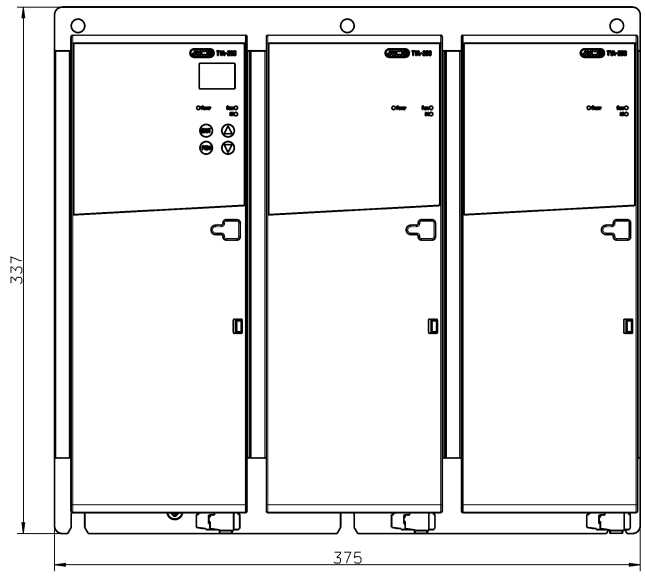


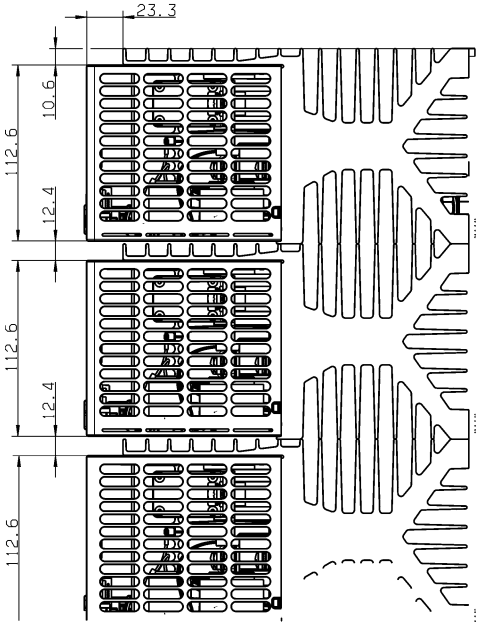




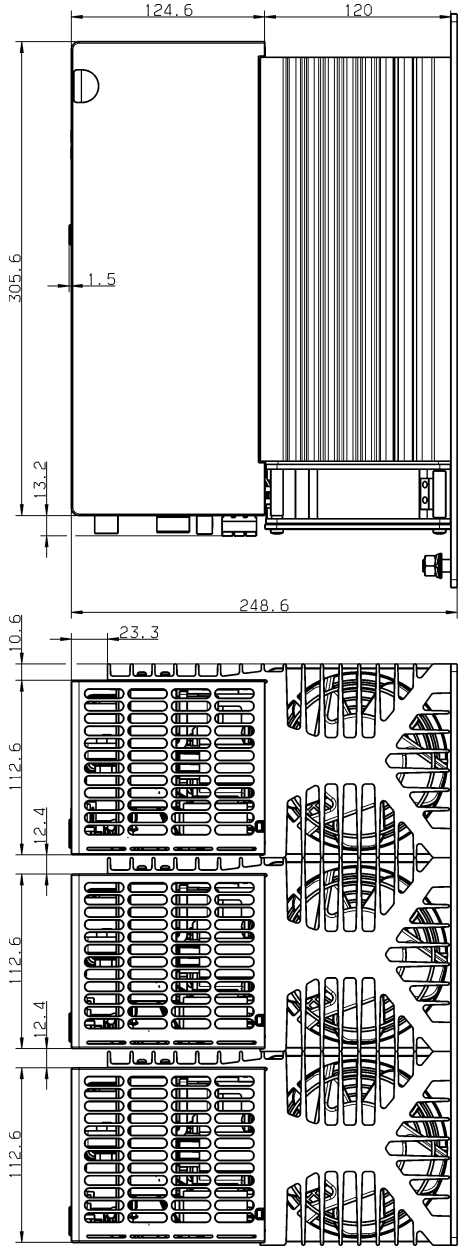
2.2.5 Type 709063/X-0X-150-XXX-XXX-XX-25X
Type 709063/X-0X-200-XXX-XXX-XX-25X

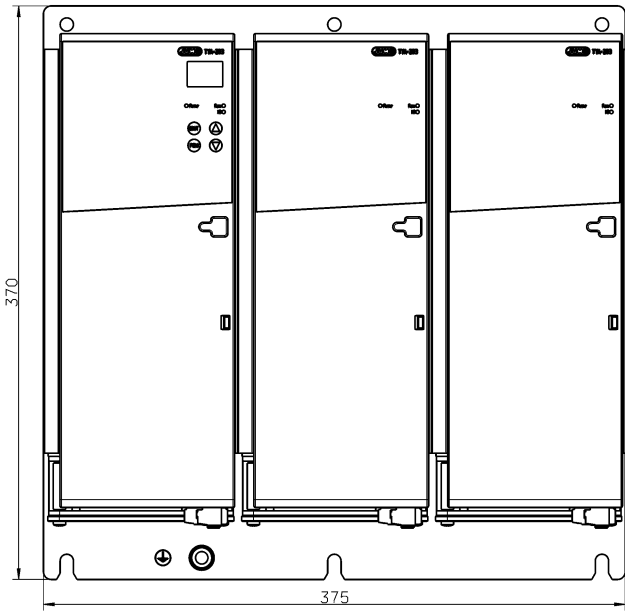






2.2.6 Type 709063/X-0X-250-XXX-XXX-XX-25X





2.2.7 Clearances (all types)

- Allow a clearance of 10 cm from the floor.
- Allow a clearance of 15 cm from the ceiling.
- When fitted next to each other, no spacing between the devices is required.

Dangerous voltage

The electrical connection must only be carried out by qualified personnel! Dangerous voltages will cause an electric shock if contact with live parts is made!

✱ Disconnect the plant from the mains voltage on all poles.

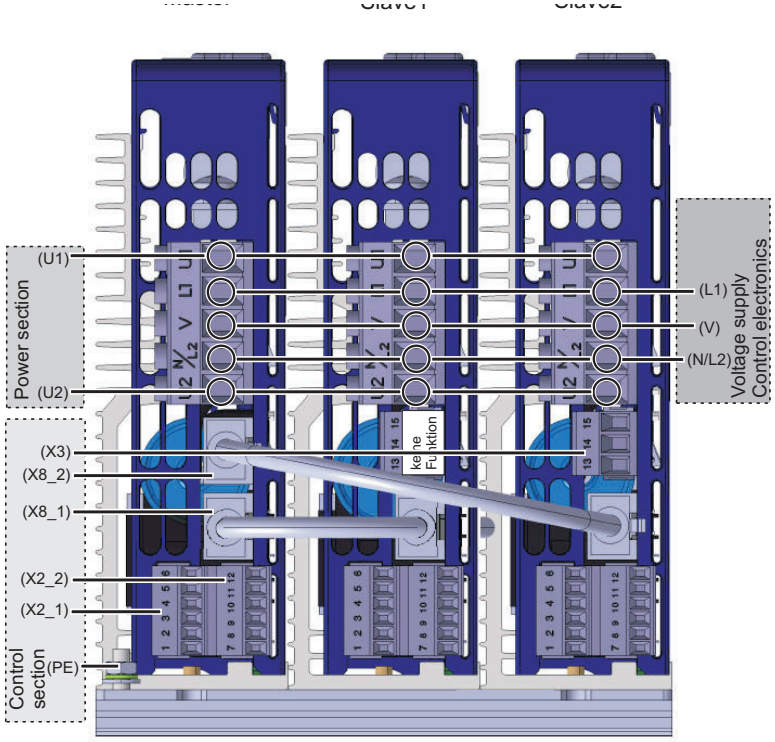
All **screw terminals supplied ex works must be inserted and screwed tight during operation!**

3.1 Plug-in screw terminals with 20 A

Tools - Flat-blade screwdriver, blade width 2, 3, and 5 mm

3.1.1 Type 709063/X-0X-20-XXX-XXX-XX-25X

The device with a load current of 20 A is connected via plug-in screw terminals.



Terminal	Version	Conductor cross section	Maximum tightening torque
X2_1 and X2_2	Slotted screws, blade width 2 mm	0.2-1.5 mm^2	0.25 Nm
X3	Slotted screws, blade width 3 mm	0.5-2.5 mm^2	0.5 Nm
U2, N/L2, V, L1, U1	Slotted screws, blade width 5 mm	0.5-6 mm^2	0.6 Nm
For applications according to UL, only 60 °C or 60 °C/75 °C copper conductors may be used!			

Ground terminal PE	M4 setscrew with hexagon nut Width across flats 7 mm	Cable lug with hole: 4 mm	3 Nm

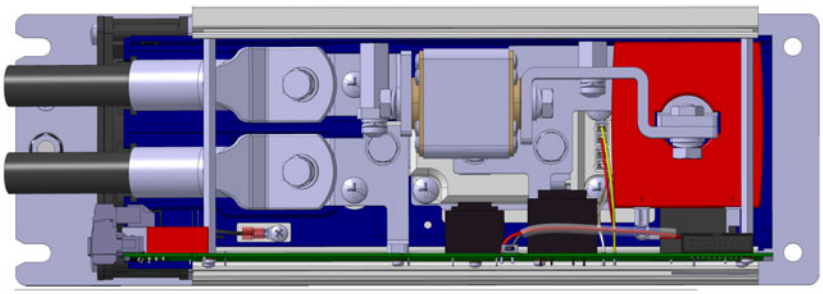
Master-slave connection

Terminal	Connection for
RJ 45 socket X8_1 and X8_2	Master-slave1 and master-slave2 Both 1:1 patch cables (included in scope of delivery) must be plugged in for correct operation (X8_1 connection to slave1, X8_2 connection to slave2). If the patch cables are mixed up on the master, the device reports a rotary field error.

3.2 Cable lugs and plug-in screw terminals as of 32 A

Tools

- Flat-blade screwdriver, blade width 2, 3, and 5 mm
- Ring or open-end wrench, width across flats 7, 10, 13 mm



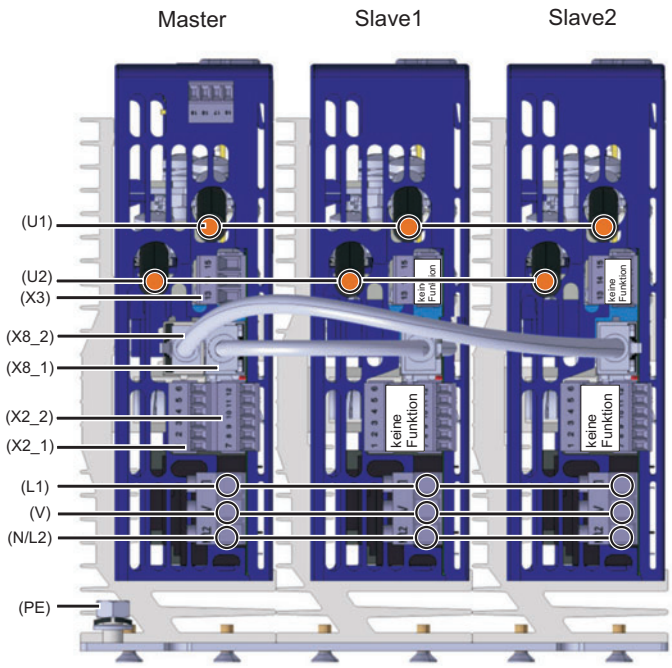
3.2.1 Type 709063/X-0X-032-XXX-XXX-XX-25X
Type 709063/X-0X-050-XXX-XXX-XX-25X

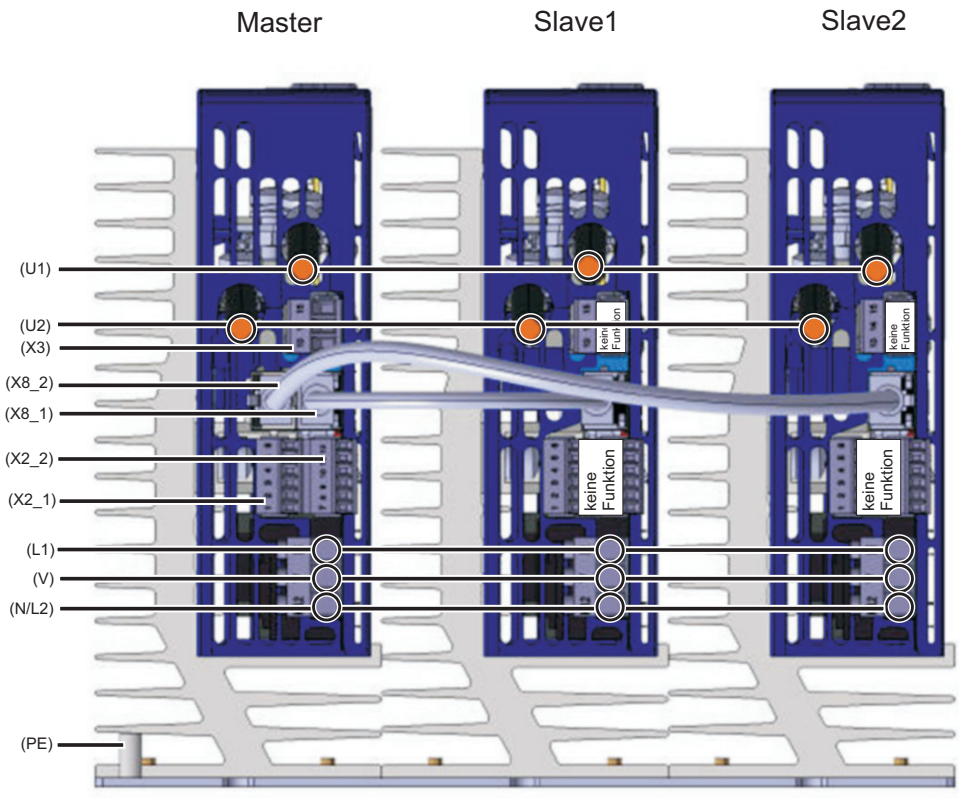
Devices with a load current of 32 A and 50 A are equipped with plug-in screw terminals in the control section and cable lugs in the power section.

Terminal	Version	Conductor cross section	Maximum tightening torque
X2_1 and X2_2	Slotted screws, blade width 2 mm	0.2 to 1.5 mm^2	0.25 Nm
X3	Slotted screws, blade width 3 mm	0.5 to 2.5 mm^2	0.5 Nm
U2, U1	M6 recessed head screws	6 to 25 mm^2	5 Nm
For applications according to UL, only 60 °C or 60 °C/75 °C copper conductors may be used!			
N/L2, V, L1	Slotted screws, blade width 3 mm	0.5 to 4 mm^2 or (0.5 to 2.5 mm^2 with ferrule) for UL AWG 20-12	0.5 Nm
Ground terminal PE	M6 setscrew with hexagon nut Width across flats 10 mm	Cable lug hole: 6 mm	5 Nm

Master-slave connection

Terminal	Connection for
RJ 45 socket X8_1 and X8_2	Master-slave1 and master-slave2 Both 1:1 patch cables (included in scope of delivery) must be plugged in for correct operation (X8_1 connection to slave1, X8_2 connection to slave2). If the patch cables are mixed up on the master, the device reports a rotary field error.




Master
Slave1
Slave2
(U1)
(U2)
(X3)
(X8_2)
(X8_1)
(X2_2)
(X2_1)
(L1)
(V)
(N/L2)
(PE)
keine Funktion
keine Funktion
keine Funktion

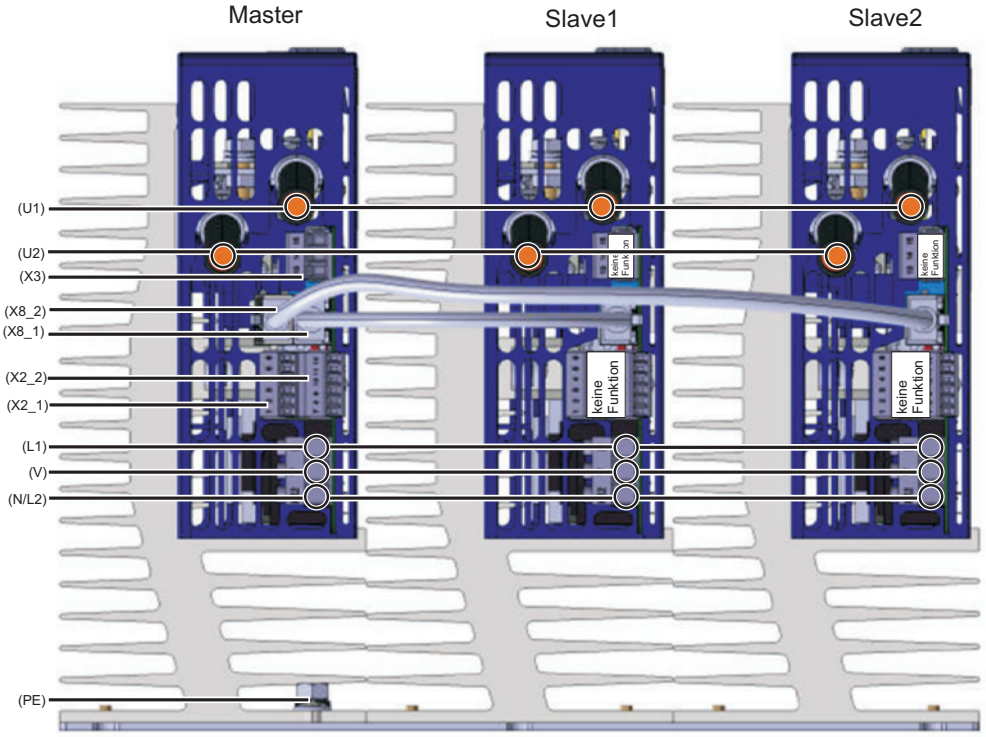
3.2.2 Type 709063/X-0X-100-XXX-XXX-XX-25X

Devices with a load current of 100 A are equipped with plug-in screw terminals in the control section and cable lugs in the power section.

Terminal	Version	Conductor cross section	Maximum tightening torque
X2_1 and X2_2	Slotted screws, blade width 2 mm	0.2 to 1.5 mm^2	0.25 Nm
X3	Slotted screws, blade width 3 mm	0.5 to 2.5 mm^2	0.5 Nm
U2, U1	M6 hex-headed screws, width across flats 10 mm	16 to 50 mm^2	5 Nm
For applications according to UL, only 75 °C copper conductors may be used!			
N/L2, V, L1	Slotted screws, blade width 3 mm	0.5 to 4 mm^2 or (0.5 to 2.5 mm^2 with ferrule) for UL AWG 20-12	0.5 Nm
Ground terminal PE	M6 setscrew with hexagon nut Width across flats 10 mm	Cable lug hole: 6 mm	5 Nm

Master-slave connection

Terminal	Connection for
RJ 45 socket X8_1 and X8_2	Master-slave1 and master-slave2 Both 1:1 patch cables (included in scope of delivery) must be plugged in for correct operation (X8_1 connection to slave1, X8_2 connection to slave2). If the patch cables are mixed up on the master, the device reports a rotary field error.



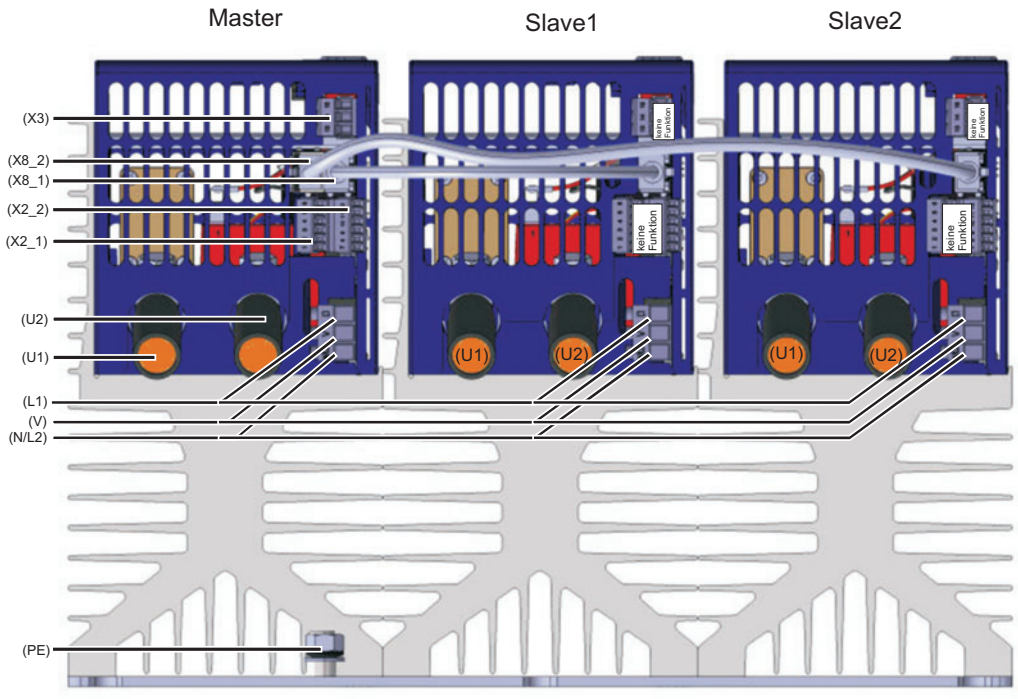
3.2.3 Type 709063/X-0X-150-XXX-XXX-XX-25X
Type 709063/X-0X-200-XXX-XXX-XX-25X

Devices with a load current of 150 A are equipped with plug-in screw terminals in the control section and cable lugs in the power section.

Terminal	Version	Conductor cross section	Maximum tightening torque
X2_1 and X2_2	Slotted screws, blade width 2 mm	0.2 to 1.5 mm^2	0.25 Nm
X3	Slotted screws, blade width 3 mm	0.5 to 2.5 mm^2	0.5 Nm
U2, U1	M8 hex-headed screws, width across flats 13 mm	95 to 150 mm^2	12 Nm
For applications according to UL, only 75 °C copper conductors may be used!			
N/L2, V, L1	Slotted screws, blade width 3 mm	0.5 to 4 mm^2 or (0.5 to 2.5 mm^2 with ferrule) for UL AWG 20-12	0.5 Nm
Ground terminal PE	M8 setscrew with hexagon nut, width across flats 13 mm	Cable lug hole: 8 mm	12 Nm

Master-slave connection

Terminal	Connection for
RJ 45 socket X8_1 and X8_2	Master-slave1 and master-slave2 Both 1:1 patch cables (included in scope of delivery) must be plugged in for correct operation (X8_1 connection to slave1, X8_2 connection to slave2). If the patch cables are mixed up on the master, the device reports a rotary field error.



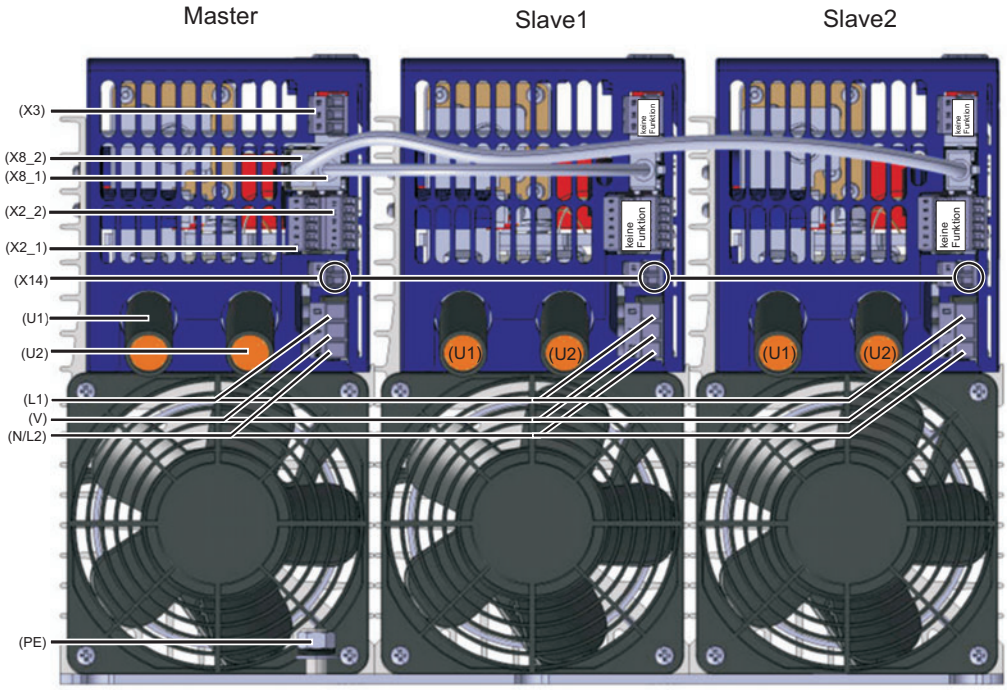
3.2.4 Type 709063/X-0X-250-XXX-XXX-XX-25X

Devices with a load current of 200 to 250 A are equipped with plug-in screw terminals in the control section and cable lugs in the power section.

Terminal	Version	Conductor cross section	Maximum tightening torque
X2_1 and X2_2	Slotted screws, blade width 2 mm	0.2 to 1.5 mm^2	0.25 Nm
X3	Slotted screws, blade width 3 mm	0.5 to 2.5 mm^2	0.5 Nm
U2, U1	M8 hex-headed screws, width across flats 13 mm	95 to 150 mm^2	12 Nm
For applications according to UL, only 75 °C copper conductors may be used!			
N/L2, V, L1	Slotted screws, blade width 3 mm	0.5 to 4 mm^2 or (0.5 to 2.5 mm^2 with ferrule) for UL AWG 20-12	0.5 Nm
Ground terminal PE	M8 setscrew with hexagon nut, width across flats 13 mm	Cable lug hole: 8 mm	12 Nm
Fan X14	Slotted screws, blade width 3 mm	0.5 to 2.5 mm^2	0.5 Nm

Master-slave connection

Terminal	Connection for
RJ 45 socket X8_1 and X8_2	Master-slave1 and master-slave2 Both 1:1 patch cables (included in scope of delivery) must be plugged in for correct operation (X8_1 connection to slave1, X8_2 connection to slave2). If the patch cables are mixed up on the master, the device reports a rotary field error.



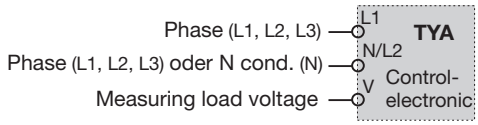
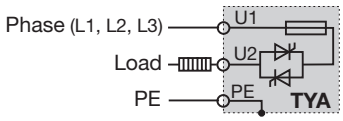
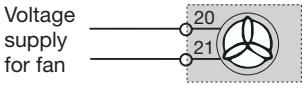
3 Electrical connection

Depending on the mains voltage, the X14 fan terminals must be supplied with the voltage specified below.
The lead protection of the fan circuit must be between **2 A and a maximum of 5 A**.
The fan is temperature-controlled, switches on automatically when the device temperature reaches 85 °C, and remains in operation until the device temperature falls below 70 °C.

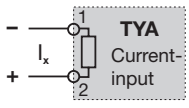
Voltage supply for fan

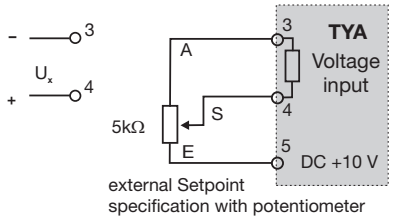
Mains voltage on the power controller	**Tolerances**	**Fan specifications**
Mains voltage AC 24 V	-20 to +15 %, 48 to 63 Hz	AC 24 V/30 VA
Mains voltage AC 42 V	-20 to +15 %, 48 to 63 Hz	
Mains voltage AC 115 V	-15 to +6 %, 48 to 63 Hz	AC 115 V/30 VA
Mains voltage AC 230 V	-15 to +6 %, 48 to 63 Hz	AC 230 V/30 VA
Mains voltage AC 265 V		
Mains voltage AC 400 V		
Mains voltage AC 460 V		
Mains voltage AC 500 V		

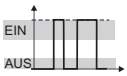
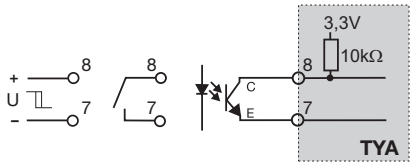
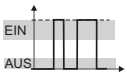
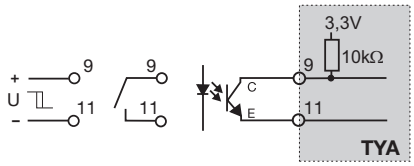
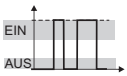
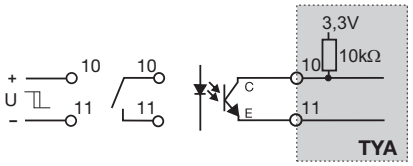
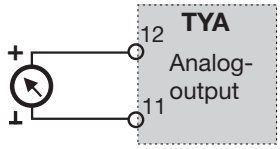
3.3 Connection diagram

Connection for	**Screw terminals**	**Connection side Device side**
Voltage supply for **control electronics** (Corresponds to the max. mains voltage of the ordered device type)	L1 N/L2 V	
Load connection in the **power section** and Protection conductor	U1 U2 PE	
Fan X14	20, 21 (only for load current of 250 A)	

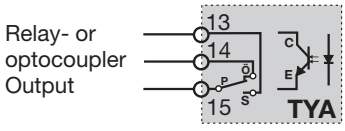
Control section

Connection for	**Screw terminal X2_1**	**Connection side Device side**
Setpoint specification for current input	1 2	

Setpoint specification for voltage input (surge proof up to max. DC +32 V)	3 (GND) (for continous control) 4	
Binary input SPS 0/24 V ON logical „1“ = DC +5...32 V OFF logical „0“ = DC 0...< 5 V	3 (GND) (for SPS-Logic signals) 4	
Output DC 10 V fixed voltage (max. +10 V, 2 mA)	5	
Ground potential	6 (GND)	

Connection for	Screw terminal X2_2	Connection side Device side
Firing pulse inhibit ON logical "1" = DC +2 to 32 V OFF logical "0" = DC 0 to +0.8 V 	8 (not for SPS-Logic signals) 7 (GND)	
Digital input1 ON logical "1" = DC +2 to 32 V OFF logical "0" = DC 0 to +0.8 V 	9 (not for SPS-Logic signals) 11 (GND)	
Digital input2 ON logical "1" = DC +2 to 32 V OFF logical "0" = DC 0 to +0.8 V 	10 (not for SPS-Logic signals) 11 (GND)	
GND	7, 11	Ground potential
The ground terminals X2_2/11 of the master, slave1, and slave2 must be connected to one another.		
Analog output Various internal controller variables can be output as a standard signal of 0(4) to 20 mA, 0(2) to 10 V, and 0(1) to 5 V. ⇨ Chapter 10.4 "Analog output (master only)"	12 11(GND)	

Fault signal output

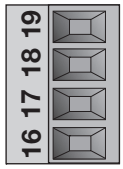
Connection for	Screw terminal X3	Connection side Device side
Relay or optocoupler is on slave2 at load current of 20 A and on master at 32 to 250 A	13 N/O contact or collector 14 N/C contact 15 pole or emitter	

3 Electrical connection

Master-slave connection

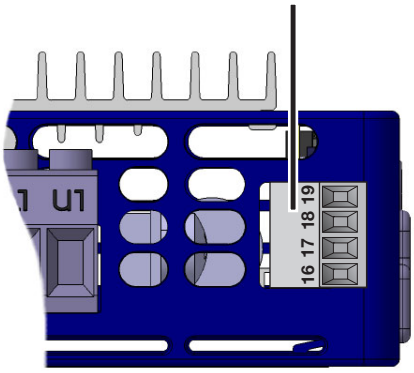
Terminal	Connection for
RJ 45 socket X8_1 and X8_2	Master-slave1 and master-slave2 Both 1:1 patch cables (included in scope of delivery) must be plugged in for correct operation (X8_1 connection to slave1, X8_2 connection to slave2). If the patch cables are mixed up on the master, the device reports a rotary field error.

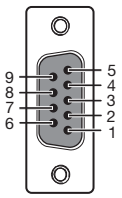
Interfaces

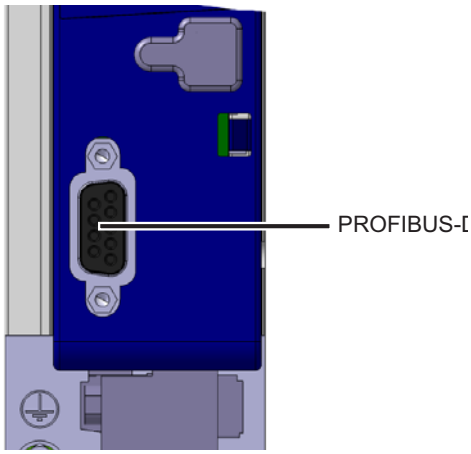
Connection	Modbus		RS422	RS485
Plug-in screw terminals on the bottom of the housing	19		TxD (-)	RxD/TxD B(-)
	18		TxD (+)	RxD/TxD A(+)
	17		RxD (-)	-
	16		RxD (+)	-

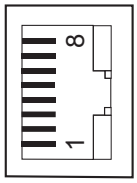
The shield of the Modbus cables must be routed to ground potential (PE)!

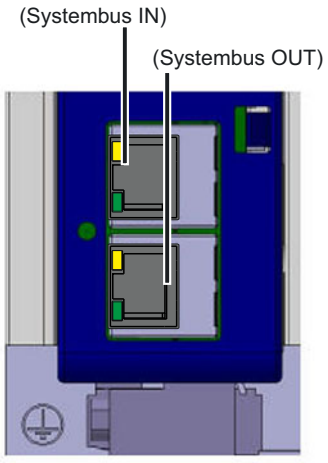
(RS422/485 Modbus)



Connection	PROFIBUS-DP	
SUB-D socket 9-pin (on the front)	3 A(+)	
	8 B(-)	
	6 VCC	
	5 GND	
	Shield	



Connection	JUMO mTRON T system bus or EtherCAT conf. tested		
2 RJ-45 sockets (on the front)		1 TX+	Transmission data +
		2 TX-	Transmission data -
		3 RX+	Received data +
		6 RX-	Received data -



3.4 Switch-on sequence

Observe the general switch-on sequence

The **S2** switch is not required if no bus system is used.
The control section and power section are switched on simultaneously via switch **S1**.

This is particularly important for the operation of transformer loads and resistance loads with a
high temperature coefficient (TC >> 1). This makes sure the necessary load start functions (soft start, current limiting, etc.) are activated accordingly.

Switch-on sequence when using bus systems

When using a bus system, the control section and power section are switched on via **S1** and **S2**.
The TYA's control section must remain connected to the mains voltage at all times (e.g. S1 permanently connected) to maintain the flield-bus communication.
S2 is used to activate the load.
In the event of transformer loads or loads with a large temperature coefficient (TC >> 1), the controller output must be blocked using the inhibit function prior to opening **S2**. After closing **S2**, the controller output must be reactivated via the inhibit function.

3.5 Wiring diagrams

3.5.1 Delta connection (three-wire circuit)

⇨ see Picture 1

In a three-wire circuit the terminals V of Master, Slave1 and Slave2 have to be connected with each other, but **not connected with N**!

3.5.2 Star connection without neutral conductor (three-wire circuit)

⇨ see Picture 1

In a three-wire circuit the terminals V of Master, Slave1 and Slave2 have to be connected with each other, but **not connected with N**!

3.5.3 Star connection with neutral conductor (four-wire circuit)

⇨ see Picture 1(dashed blue lines)

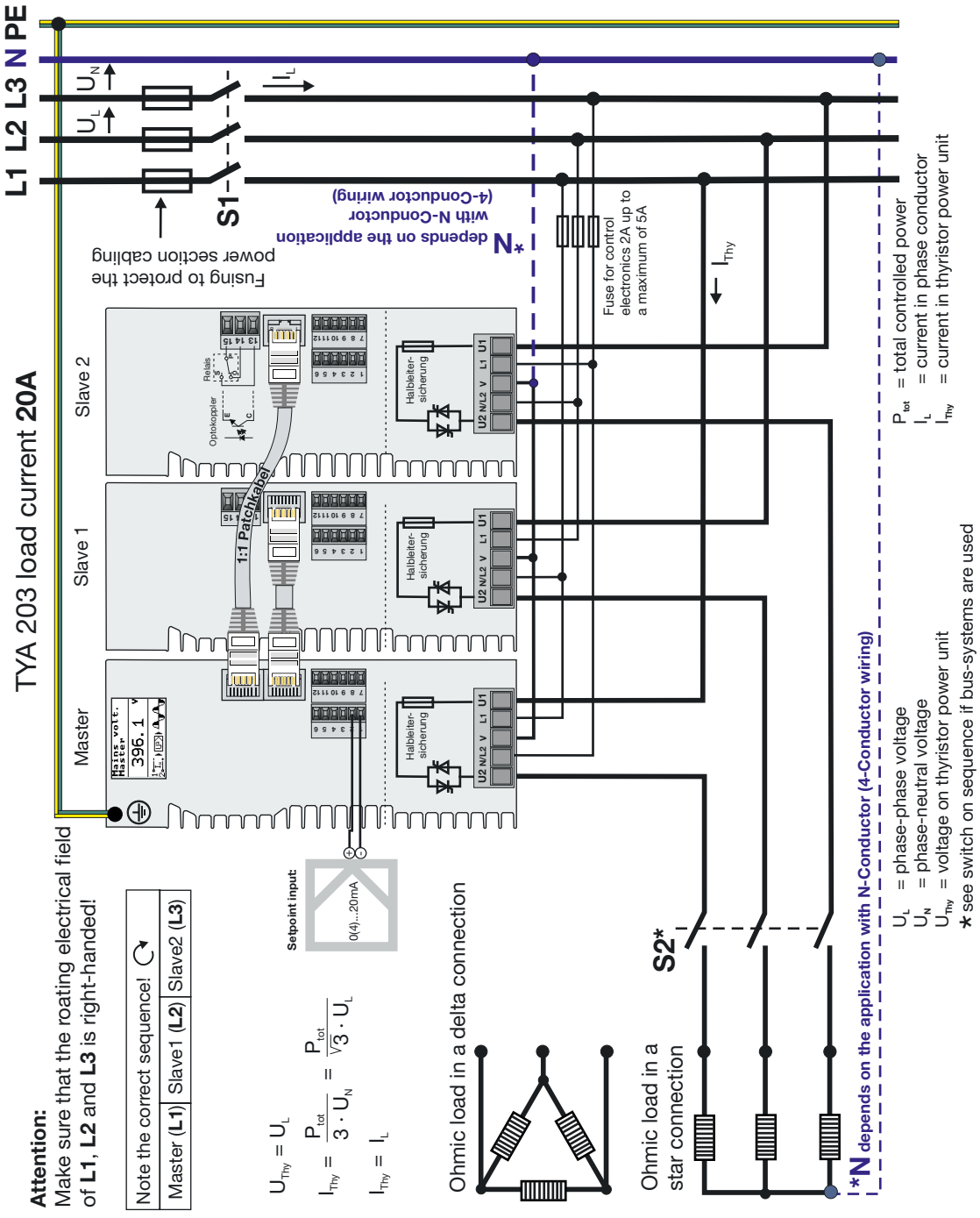
In a four-wire circuit the terminals V of Master, Slave1 and Slave2 have to be connected with each other **and with N**!
Also **connect** the star point at the load **with N**!

3.5.4 Open delta connection (six-wire connection)

⇨ see Picture 2

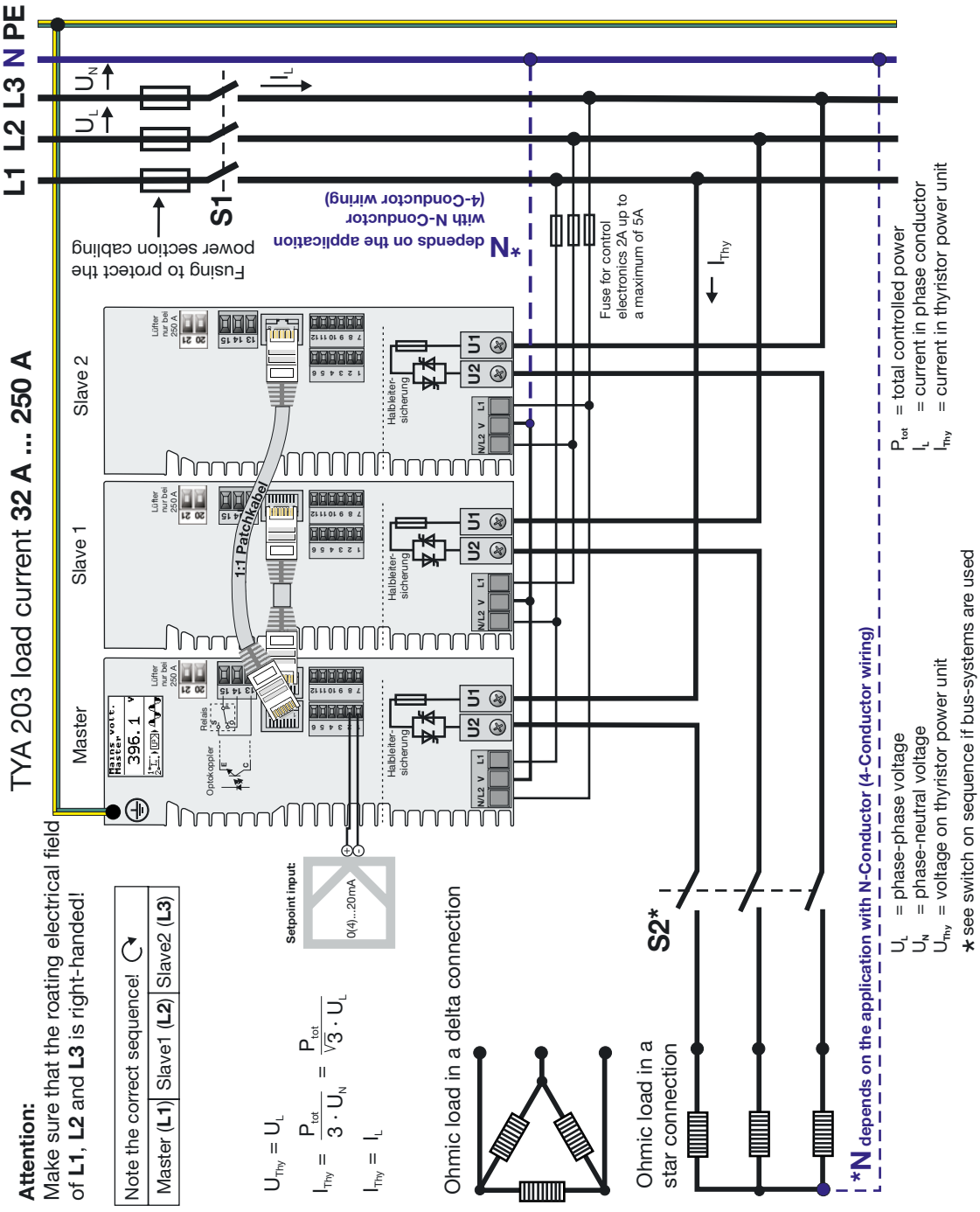
Picture 1: (three- and four-wire circuit)

This circuit example can only be applied in TN-Systems. In TT-Systems additionally the neural conductor has to be switched with S1 and S2.



Picture 1: (three- and four-wire circuit

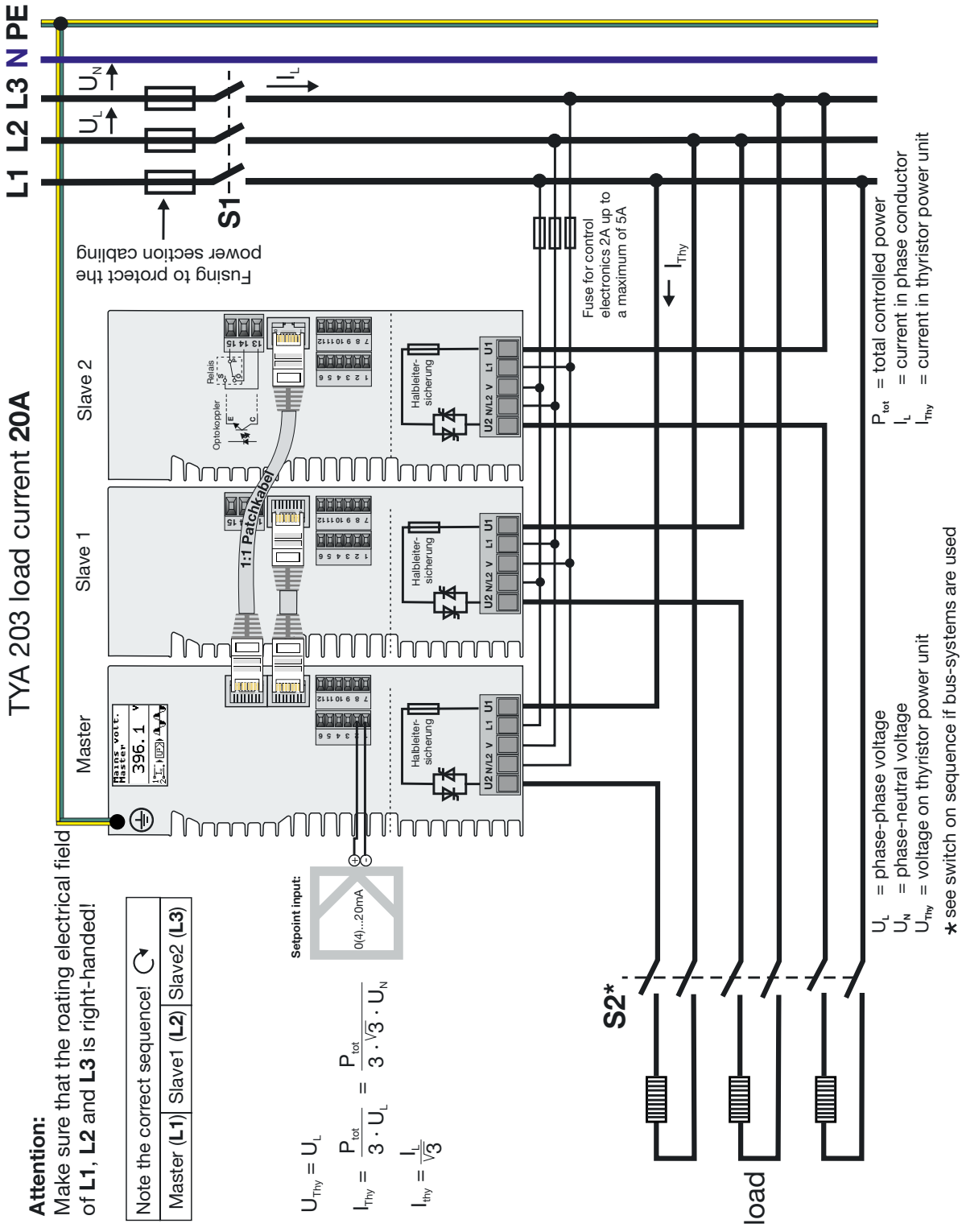
This circuit example can only be applied in TN-Systems. In TT-Systems additionally the neural conductor has to be switched with S1 and S2.



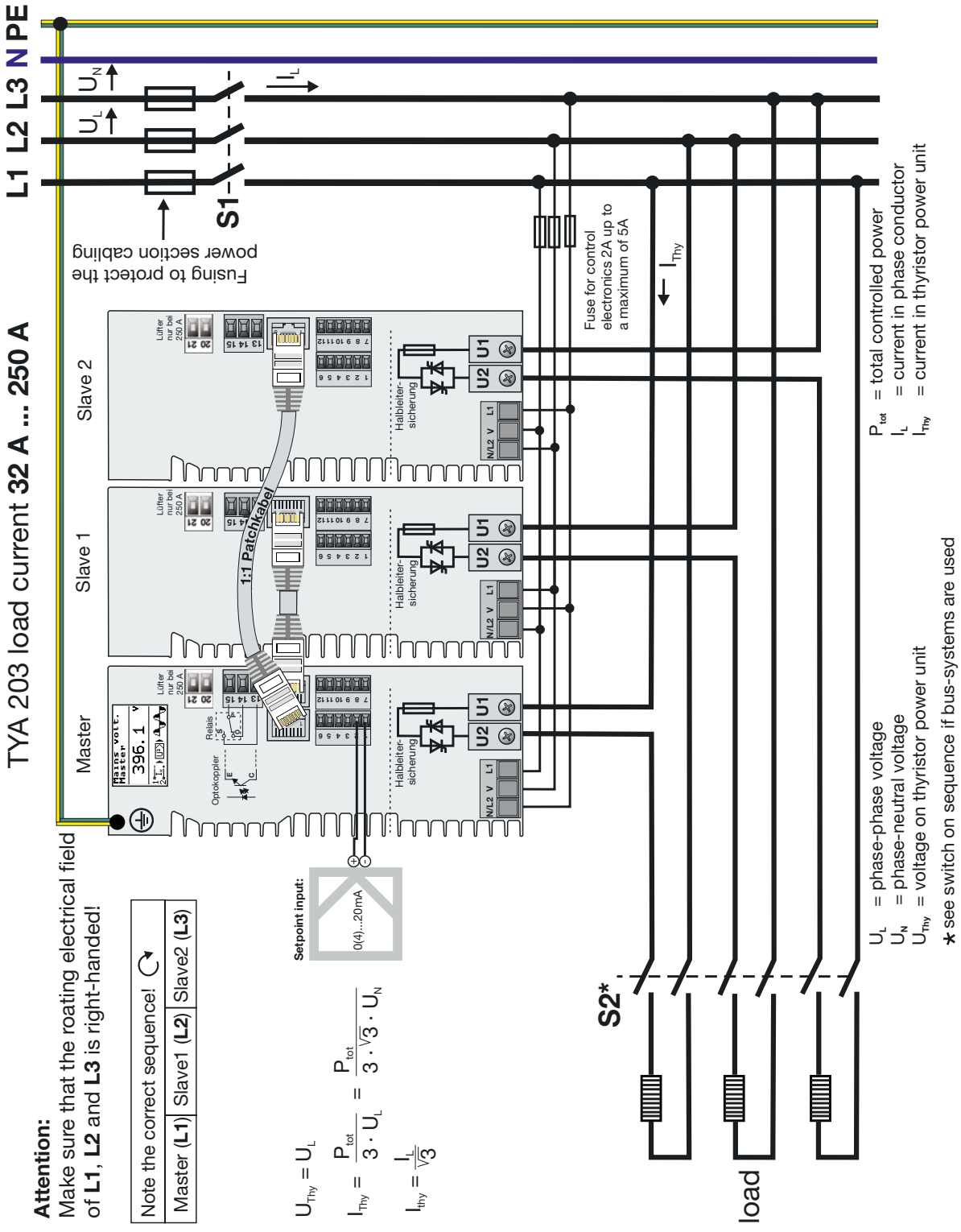
In the case of power controllers with a load current of 250 A, the fan terminal X14 must also be supplied with the specified voltage!
The lead protection of each fan must be between **2 A and a maximum of 5 A**.

⇨ Chapter 3.2.4 "Type 709063/X-0X-250-XXX-XXX-XX-25X"

Picture 2: Open delta connection (six-wire connection)



Picture 2: Open delta connection (six-wire connection)



In the case of power controllers with a load current of 250 A, the fan terminal X14 must also be supplied with the specified voltage!
The lead protection of each fan must be between **2 A and a maximum of 5 A**.

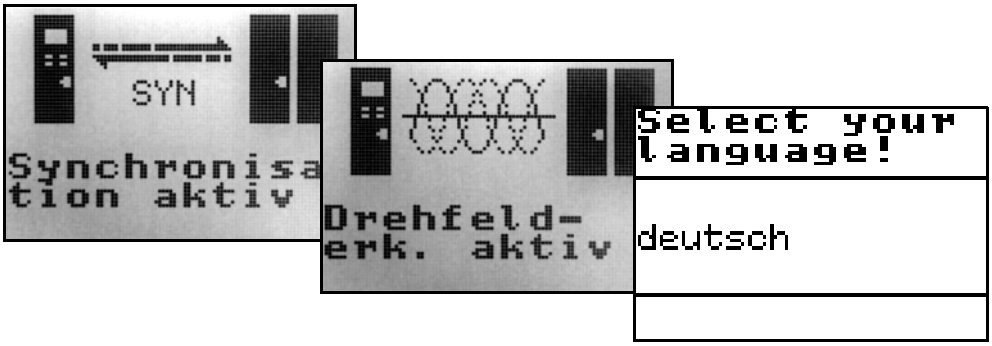
⇨ Chapter 3.2.4 "Type 709063/X-0X-250-XXX-XXX-XX-25X"

3 Electrical connection

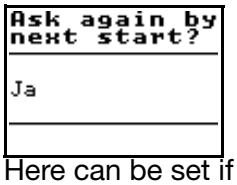
4.1 Display after switching on the device

Hourglass and national language selection

Initially, as soon as the voltage supply is switched on, the Power LED is permanently lit in green and an hourglass appears on the display. The master is then synchronized with the slave devices and rotary field detection is carried out. If everything is wired correctly, the power controller shows a national language selection on the display.
The national language can be selected here before the device starts with an unknown national language and therefore prevents further operation.



Language assistant



Here can be set if the language assistant should appear again at the next start or not.

select „Ja“ (for yes) or „Nein“ (for no) and press PGM .

The device proceeds with showing the measured values.

⇨ Chapter 4.1.2 "Appearance of measured values".

If an error message should appear in the info line at the bottom, this is explained in the following chapter:

Error messages

⇨ Chapter 8 "Error messages and alarms"

4 Operation

4.1.1 Display and control elements

Legend	Comment	Diagram
1	The Power LED (green) is permanently lit when the voltage supply is connected. Flashes at regular intervals if display lighting is switched off. ⇨ Chapter 9 "What to do, if ..."	
2	Display (96 x 64 pixels) with white background lighting (no LCD display on the slave devices on the right).	
3	Fuse LED (red) is lit in the event of a defective semiconductor fuse on the corresponding power controller.	
4	K1 LED (yellow) error message indicators light up simultaneously on all devices in the event of a fault.	
5	**Keys:** Increase value / previous parameter Decrease value / next parameter EXIT Abort / one level back PGM Programming / one level forward	
6	USB setup interface The configuration is made on the left device (master) and automatically transferred to both slaves via the patch cables.	
7	Spring clip to release the plastic housing ⇨ Chapter 8.2 "Replacing a defective semiconductor fuse"	

Using ▲ and ▼ the current measured values such as currents, voltage actual values, setpoint value load resistance, device temperature, and power can be viewed.

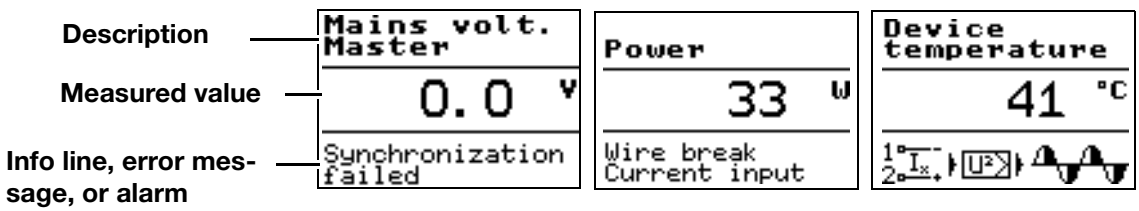
This information is also displayed in the diagnosis window of the setup program.

⇨ Chapter 7 "Setup program"

4.1.2 Appearance of measured values

Overview of measured values

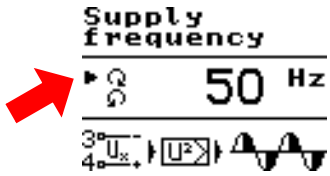
At this level, the description of the measured value is displayed in the top line, and the numerical value together with the unit is displayed in the middle.



The info line shows the selected input (with terminal designation), the set subordinate control loop, and the operating mode. It is also used to show error messages and alarms. These are time-limited and subsequently disappear once more.
⇨ Chapter 8 "Error messages and alarms"

Supply frequency

In this window, the rotary field direction is shown alongside the supply frequency. The small triangle indicates the corresponding direction of rotation.



Meaning of the symbols in the info line

Input signal		Subordinate control loop		Operating mode load output	
	Voltage		None		Phase-angle control
	Current		U^2		Soft start with phase angle control
	Interface		I^2		Burst firing mode
	Digital input1		U		Burst firing mode with α start
	Digital input2		I		Half-wave control
	Configurable value		P		General logic
	Input signal incorrectly configured		Logic (switch)		Logic with α start
			Invalid control configured		Logic with α input
					Logic with α start and α input
					Firing pulse inhibit

4.1.3 Meaning of the displayed measured values

Measured value	Meaning	Unit
Master mains voltage	Effective value of the mains voltage – measured on the master between the L1 and N/L2 terminals	V

Mains voltage slave1, 2	Effective value of the mains voltage – measured on the slave between the L1 and N/L2 terminals	V
Load voltage	(for three-wire circuit) Represents the effective value of the external conductor voltage of all three phases.	
Master load voltage	Effective value of the load voltage – measured on the master between the V and U2 terminals (for four-wire and six-wire circuit)	V
Load voltage slave1, 2	Effective value of the load voltage – measured on slave1 and 2 between the V and U2 terminals (for four-wire and six-wire circuit)	V
Master load current	Effective value of the load current I1 measured from the master	A
Load current slave1, 2	Effective value of the load current I2, I3 measured from slave1 or slave2	A
Master power	Effective power measured from the master	W or kW
Power slave1, 2	Effective power measured from slave1 or 2	W or kW
Three-phase power	Total effective power on the master and the slaves	W or kW
Master load resist.	Effective resistance measured from the master	?
Slave1, 2 load resist.	Effective resistance measured from slave1, 2	?
Output level	Output value of the subordinate control loop	%
Setpoint value	Effective setpoint value for the subordinate control loop (with calculated base load and max. output level)	%
Actual value [2]	Measured value as a percentage of the set control variable U^2, U, I^2, I, or P	%
Phase control angle[3]	Currently output phase control angle	°el
Supply frequency	Currently measured supply frequency	Hz
Master device temperature	Currently measured temperature inside the master power controller	°C or °F
Slave1, 2 device temperature	Currently measured temperature inside the slave power controllers	°C or °F
Current input	Measured value of the current input – measured on the master power controller between terminals 1 and 2 on X2_1	mA
Voltage input	Measured value of the voltage input – measured on the master power controller between terminals 3 and 4 on X2_1	V

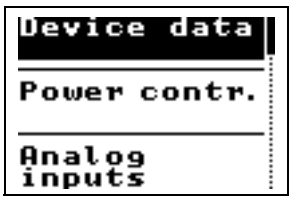
2. Is not displayed if the subordinate control loop is switched off
3. Is only displayed for phase angle control mode

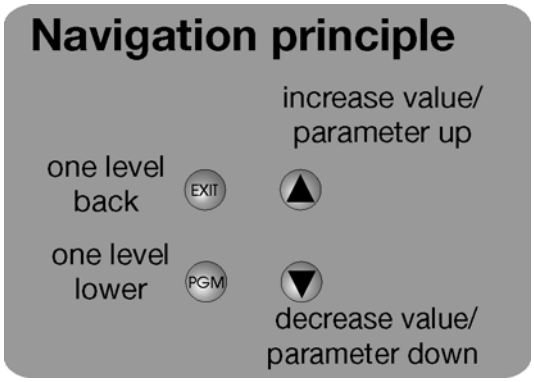
4.1.4 Appearance in the configuration level

Scroll bar

The entry highlighted in black is selected and contains further parameters. If there are more than three entries in one level, a scroll bar that shows the current position in the menu appears.

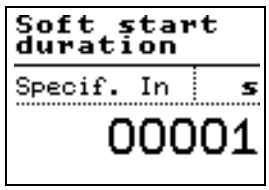
Navigation

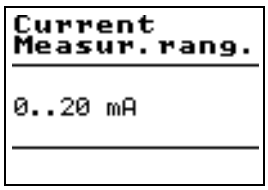




Numerical entry or selection

Once you have reached the required parameter, the ▲ or ▼ key can be used to enter a numerical value or to select a parameter.





* Save the setting using PGM.

If you do not want to apply the value, the entry can be aborted by selecting EXIT.

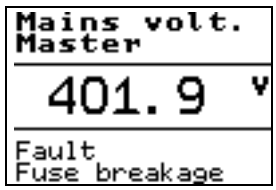
4.1.5 Appearance of error messages and particular states

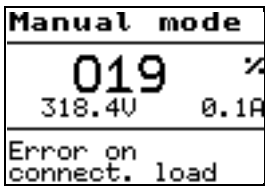
Cyclical appearance

The symbols for input, subordinate control loop, and operating mode are displayed alternately in the info line together with error messages or information about particular states.

⇨ Chapter 8 "Error messages and alarms"

Examples

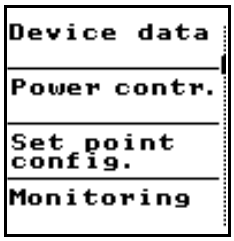




4 Operation

4.2 Operating level

All parameters for the maximum device extension level are listed in the following tables. Depending on the device version (see nameplate) or configuration, parameters that are not required are hidden.



Here you will find the parameters that can be modified **during ongoing operation** without restarting (resetting) the device.
They can be accessed without a password per default, but can also be protected with a 4-digit code if necessary.

⇨ Chapter 5.1.12 "Changing codes"

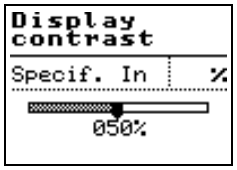
During ongoing operation, the power controller can be adapted to the plant and optimized.

- In the measured value overview, press the PGM key
- Select the operating level and press PGM again

Editing a parameter

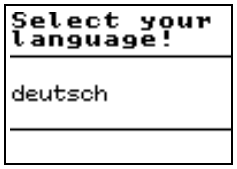
The changes are effective **immediately**.
Once the correct setting (e.g. for display contrast) has been found, the parameter can be stored by pressing PGM .
If you do not want to apply the value, the entry can be aborted by pressing EXIT .

4.2.1 Device data



Value range	Description
0 to **50** to 100 %	50 % is set per default.

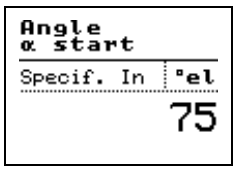
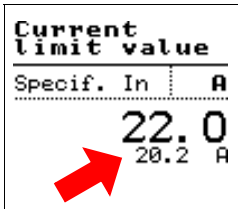
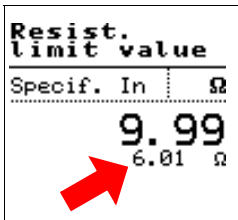
Value range	Description
0000 to 1440 min	0000 minutes are set per default, which means the display is not switched off.



Value range	Description
deutsch english francais National language4	German (deutsch), English, and French (francais) are permanently stored in the device 1 additional national language can be subsequently loaded via Setup.

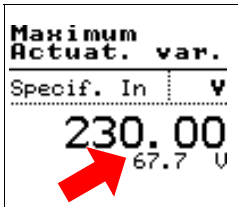
■ / **bold** = default setting

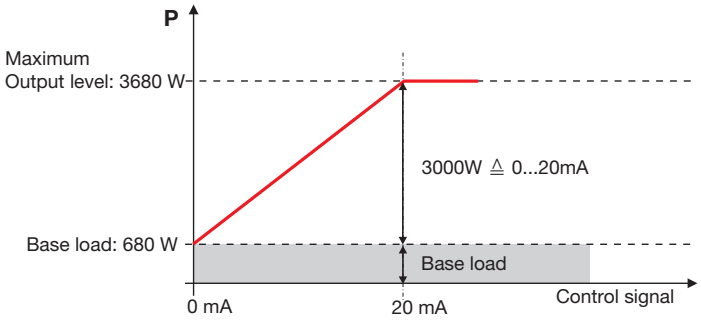
4.2.2 Power controller

	Value range	Description
	0 to **75** to 90° el	75° el is set per default. If "α start" is set to "No" in the configuration, this window is not displayed and α start is set to 0° el.
 Current load current	10 % to **max. load current for the device type** +10 %	**Current limiting:** It is possible to modify the current limit value in phase angle control mode during operation. Limiting applies to the largest respective current (master, slave1, or slave2). This window is not displayed if "Current limiting" is set to "No" in the configuration.
 Current resistance	0 to **999.99** Ω	**Resistance limitation:** Indirect temperature limit for a heating element with a positive temperature coefficient. Limitation applies to the largest resistance value (in the master, slave1, or slave2 strand) $R = U_N / I_{Thy}$ at U_N= voltage between an external conductor and neutral conductor. ⇨ Chapter 5.1.2 "Power controller" ⇨ Chapter 6.6 "Resistance limitation (R control)"

■ / **bold** = default setting

4.2.3 Setpoint value configuration

	Value range	Description
 Current load voltage	0 to **$U_{nom.}$** to 1.15 $U_{nom.}$ of the load voltage, 0 to **$P_{nom.}$** to 1.15 $P_{nom.}$ of the power 0 to **$I_{nom.}$** of the max. load current 0 to **100** % of the output level	In the case of **continuous** thyristor control via the analog input, the maximum actuating variable at the measuring range end (e.g. 20 mA) can be varied during operation. The measurands in the master branch are measured. The value to be entered depends on the "Subordinate control loop" setting: U^2 and U: Entry in V (**Interlinked** value for three-wire and six-wire circuit) (Example: 0 to **400** to 460 V) (**Strand** value for four-wire circuit) (Example: 0 to **230** to 264 V) P: Entry in kW **(three-phase power/3)** (Example: 0 to **4.60** to 5.29 kW) I^2 and I: Entry in A (example: 0 to **20** A) None: Entry in % (example: 0 to **100** %)
	Example for three-wire circuit: I_{Nenn} = Laststrom des Stellers: 20 A U_{Nenn} = Lastspannung des Stellers: 400 V (verkettete Spannung im Drehstromsystem) $P_{Nenn} = I_{Nenn} \cdot \frac{U_{Nenn}}{\sqrt{3}}$ = 20 A · 230 V = 4,60 kW	

Basic load Specif. In V 000.00 30.1 V Current load voltage	**0** to $U_{nom.}$ of the load voltage, **0** to $P_{nom.}$ of the power **0** to $I_{nom.}$ of the max. load current **0** to 100 % of the output level	In the case of **continuous** thyristor control via the analog input, the base load at the measuring range start (e.g. 0 mA) can be varied **during operation**. **Note:** This setting is only available if Power controller ➔ Thyristor control ➔ Continuous (power controller) is set. The unit depends on the setting for subordinate control loop and device type: - For voltage: **0** to 100 % of max. load voltage (e.g. **0 V**) (**Interlinked** value for three-wire and six-wire circuit) (**Strand** value for four-wire circuit) - For current: **0** to 100 % of max. load current (e.g. **0 A**) - For power: **0** to 100 % of power (e.g. **0 W**) **(three-phase power/3)** - None: **0** to 100 % of output level (e.g. **0 %**) The measurands in the master branch are measured. ⇨ Chapter 1.3 "Order details" 

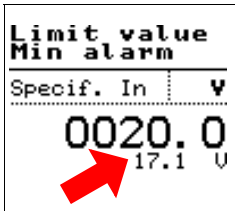
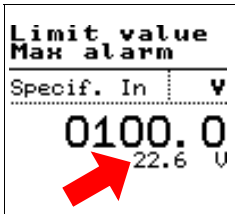
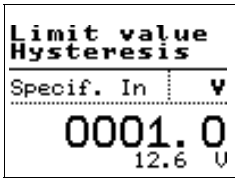
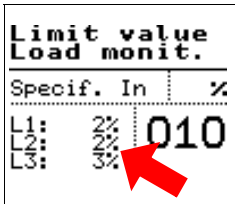
■ / **bold** = default setting

4.2.4 Monitoring

The value to be monitored can be adjusted.

⇨ Chapter 5.1.5 "Monitoring"

The load voltage was used in this example.

	Value range	Your setting:
 Current measured value	**0** to 9999.9	The **absolute** minimum limit values for load voltage, load current, power, resistance, mains voltage, or device temperature can be monitored. The measurands in the master branch are measured. ⇨ Chapter 5.1.5 "Monitoring" Example: If the voltage falls below 20 V, an alarm is issued.
 Current measured value	0 to **9999.9**	The **absolute** maximum limit values for load voltage, load current, power, resistance, mains voltage, or device temperature can be monitored. The measurands in the master branch are measured. ⇨ Chapter 5.1.5 "Monitoring" Example: If the voltage exceeds 100 V, an alarm is issued.
	0 to **1** to 9999.9	The **switching differential** at the minimum or maximum limit value
 Current deviation from Teach-In i.e. if it exceeds 0 % the load has become higher-impedance; if it is below 0 %, the load has become lower-impedance	0 to **10** to 100 %	**Partial load failure** or **partial load short circuit**: The monitoring value for the **percentage** modification of the load is set (undercurrent or overcurrent). ⇨ Chapter 5.1.5 "Monitoring" By displaying the current deviations from the Teach-In value in all three phases, it is possible to check how, for example, the resistance change behaves over the entire setting range. The load monitoring limit value can then be adjusted accordingly. Guide values for the identification of load errors: ⇨ Chapter 6.1 "Detection of load faults"

■ / **bold** = default setting

	This function is not configured per default. This window only appears if the following setting has been made in the configuration level: * Press the PGM key to switch to the **configuration level** * Set Monitoring ➔Teach-In type load monit. ➔Manual * Press the PGM key The "Manual Teach-In" function is now configured. * Change to the **operating level** ➔Monitoring ➔Load monit. Teach-In * Press the PGM key A screen now appears asking whether the state should be applied now. If so: * Press the PGM key to apply the current load state as the OK state. A change in the load (load error) will be evaluated by the device on the basis of this state.

▪ / **bold** = default setting

5.1 Configuration level

The configuration level contains parameters for configuring the power controller.
If the parameters at this level are modified during operation, the power controller is locked (inhibit) as a result. In this state, it does not provide any power.
When the configuration level is exited, a restart (reset) is performed and the power controller provides the required power once again.

This level can be locked with a password.
However, no password is set per default.

All parameters for the maximum device extension level are listed in the following tables. Depending on the device version (see nameplate) or configuration, parameters that are not required are hidden.

The configuration level can be accessed from the overview of measured values by pressing the following keys:

* In the measured value overview, press the PGM key
* Select the configuration level and press PGM

The parameters are combined in the following groups, which are explained in detail as sub-chapters in the tables on the following pages.

Parameter groups

Device data	⇨ Chapter 5.1.1 "Device data"
Power contr.	⇨ Chapter 5.1.2 "Power controller"
Analog inputs	⇨ Chapter 5.1.3 "Analog inputs"
Set point config.	etc.
Monitoring	
Binary inputs	
Binary output	
Act. val. output	
RS 422/ RS 485	⇨ see Chapter 5.1.9 "RS422/485"
PROFIBUS DP	⇨ see Chapter 5.1.10 "PROFIBUS-DP"
EtherCAT	⇨ see Chapter 5.1.11 "EtherCAT"
Change codes	

5.1.1 Device data

Basic settings for display and temperature unit.

	Value / settings	Description
Language assistant active	Yes	A query appears when the device is started, asking which national language is to be used to display the subsequent operation.
	No	No query appears
National language	Deutsch	
	English	
	Francais	
	Setup	Setup is populated with Spanish per default. If other national languages are to be used, Spanish can be replaced with this national language.
Temperature unit	°C	Defines the unit for the displayed temperatures, such as the device temperature.
	°F	
Display contrast	0 to **50** to 100 %	Bright/dark contrast setting
Switch-off Display lighting	**0000** to 1440 min	After the set number of minutes, the background lighting of the display switches off. Power LED (green) flashes. 0000 means: lighting is always switched on
Apply default settings	Apply now?	If the PGM key is pressed, the default settings are restored.

■ / **bold** = default setting

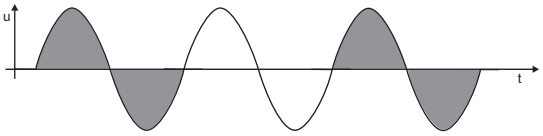
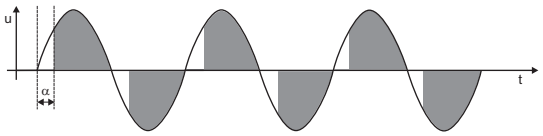
5.1.2 Power controller

Settings for the switching behavior of the power controller in the plant

	Value / settings	Description
Three-phase load wiring	Star without neutral conductor	⇨ Chapter 3.5.2 "Star connection without neutral conductor (three-wire circuit)"
	Star with neutral conductor	⇨ Chapter 3.5.3 "Star connection with neutral conductor (four-wire circuit)"
	Delta connection	⇨ Chapter 3.1.1 "Type 709063/X-0X-20-XXX-XXX-XX-25X"
	Open delta connection	⇨ Chapter 3.5.4 "Open delta connection (six-wire connection)"
Thyristor control	Continuous (power controller)	The power controller provides the power for the load continuously according to the setpoint specification.
	Logic (switch)	The power controller acts like a switch and provides the power by either switching ON or OFF.

■ / **bold** = default setting

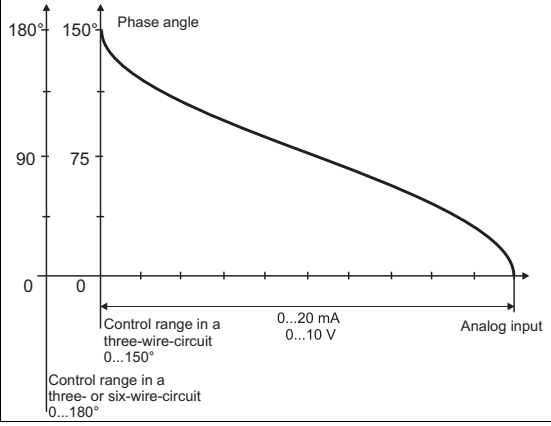
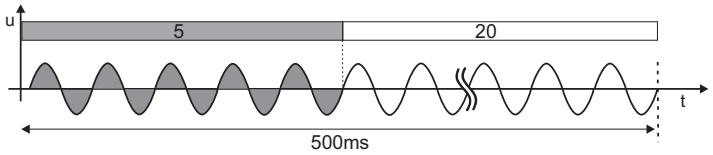
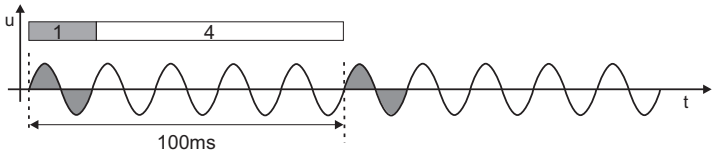
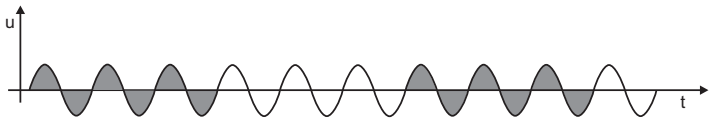
Operating mode

Value / settings	Description
Pulse groups	- For slow control loops - For free-running economy circuit - Low EMC interference through zero-voltage switching - No reactive power is generated 
Phase angle control	- For fast control loops, such as lighting controls - No flickering 

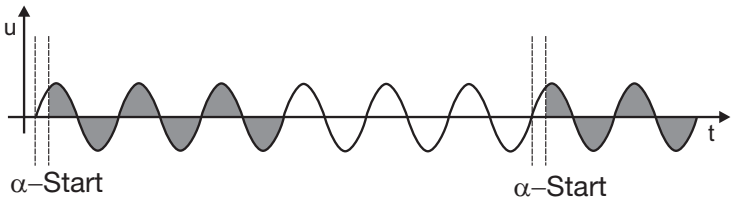
■ / **bold** = default setting

	Value / settings	Description
Subordinate control loop	**U^2**, U, I^2, I, P     	**Note:** The subordinate control loop only appears for: Power controller ➔ Thyristor control ➔ Continuous (power controller). Subordinate control loops are used to eliminate or compensate for external disturbances, such as mains voltage fluctuations and changes in load resistance that would have a negative effect on the control process. The measurands for load voltage, load current, or power determined in the master are constantly applied as the actual value. The **U** setting is used when the load voltage should be linear to the setpoint specification. The **I** setting is used when the load current should be linear to the setpoint specification. The following subordinate control loops have proven advantageous for heating elements that do not have linear temperature behavior or are subject to aging: **U^2** is used for: - Positive temperature coefficient, molybdenum disilicide - If R ∪ is constant - Brightness controls - Indirect power control via the load voltage **I^2** is used for: - Negative temperature coefficient (TC) - Indirect power control via the load current **P** is used for: - Temperature-dependent temperature coefficient - Free-running economy circuit - General applications - SIC load with automatic aging compensation The load voltage, load current, or power measured by the master are always applied as the actual value for the subordinate control loop.

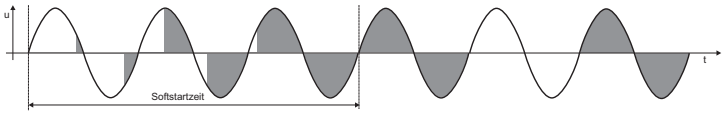
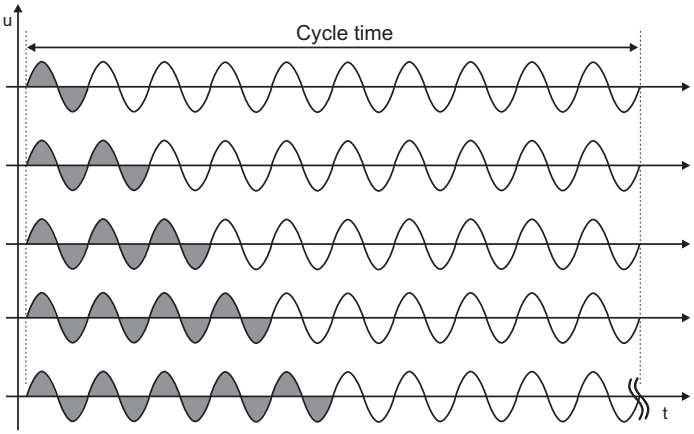
■ / **bold** = default setting

	Value / settings	Description
	Switched off 	The diagram shows how the phase angle is specified via a standard signal without a subordinate control loop. 
Cycle time	Fixed (500 ms) (For slow heating elements)	**Note:** This setting is only available in burst firing mode. For example, for a fixed period of 500 ms, 5 sine waves are switched on and 20 switched off at an output level of 20 %. 
	Fastest possible (For quick-response heating elements)	With this setting, the cycle time is variable. At the required output level, the device attempts to find the shortest possible cycle time for entire sine waves. For an output level of 20 %, this means one sine wave ON and four sine waves OFF. 
Min. ON period	None	
	3 full sine waves	Dependent on the cycle time setting. At least three full sine waves are always let through. For example, at an output level of 50 % and the fastest possible cycle time, three sine waves are switched on and three switched off.  **Note:** Particularly suitable for the control of transformer loads

■ / **bold** = default setting

	Value / settings	Description
α **start**	No	**Note:** This setting is available in continuous burst firing mode and in logic operation. No: for resistive load Yes: for transformer loads If set to "Yes", the first half-wave of each pulse group is cut with the set phase control angle α. 
	Yes	
Angle α start	0 to **75** to 90° el	Phase control angle for α start
Soft start	No	This setting determines the starting behavior of the power controller after power ON and is deactivated per default
	Yes	"Yes" means that a soft start with phase angle control or pulse groups is performed after power ON.

■ / **bold** = default setting

	Value / settings	Description
Soft start type	With phase angle control	This parameter only appears if soft start is set to "Yes". Starting from 180°, the phase control angle α is steadily reduced until a full wave has passed through. This ends the soft start and a switchover to burst firing mode is performed.  **Note:** If the output level is reduced to 0 % for longer than 8 seconds, a soft start is initiated again as soon as the output level is increased once more. If current limiting is activated during the soft start phase, the soft start duration is extended because the phase control angle cannot be reduced further during current limiting.
	With pulse groups	This setting is available in burst firing operating mode with a fixed cycle time and with the fastest possible cycle time. During the soft start time, the ON/OFF ratio is increased from 0 to a maximum of 100 %. 
Soft start duration	**1** to 65535 s	Specifies the duration of the soft start. **Note:** Due to the system, when current limiting is switched on, the soft start duration is at least 4 s, even if a shorter time is configured as the soft start duration.
Current limiting	No	No current limiting
	Yes	The current limiting is implemented via phase angle control. In the process, the load currents of the master, slave1, and slave2 are monitored at the set current limiting value. Only the phase control angle that does not cause the current limit value to be exceeded in any of the three strands is permitted. It is also possible to activate an **external current limit value** via a digital input. ⇨ Chapter 5.1.6 "Digital inputs"

■ / **bold** = default setting

	Value / settings	Description
Current limit value	10 % to **max. load current** +10 % **of the device type**	Varies depending on the device type. For 20 A power controllers, 2 to 22 A can be set. ⇨ Chapter 1.3 "Order details" **Note:** The minimum value must exceed 10 % of the maximum power controller current (i.e. > 2 A in the case of 709063/X-01-020...)
Resistance limitation		**Note:** Resistance limitation is only possible in the case of power controllers with integrated subordinate control loop P (code 001 in the order code). Limitation always applies to the largest measured value in one of the three phases (strand value).
	No	No limitation through load resistance
	Yes	The load resistance is monitored to ensure the set resistance limit value is not exceeded. For phase angle control, the limitation is implemented through the phase control angle α. For burst firing mode, the limitation is implemented through the ON/OFF ratio of the sine waves. ⇨ Chapter 6.6 "Resistance limitation (R control)"
Resistance limit value	0 to **999.99** Ω	**Resistance limitation:** Indirect temperature limit for a heating element with a positive temperature coefficient. Limitation applies to the largest resistance value (in the master, slave1, or slave2 strand) $R = U_N / I_{Thy}$ at U_N= voltage between an external conductor and neutral conductor. ⇨ Chapter 5.1.2 "Power controller" ⇨ Chapter 6.6 "Resistance limitation (R control)"
Dual energy management	Switched off	This parameter only appears with the following settings: Cycle time: fixed (500 ms), Operating mode: burst firing mode. This setting allows 2 devices[1] to be configured in such a way that they do not simultaneously draw power from the mains at small output levels. This prevents current peaks. ⇨ Chapter 6.4 "Dual energy management"
	Device1	
	Device2	

1. The master-slave group type 709063 is regarded as "one" device.

■ / **bold** = default setting

5.1.3 Analog inputs

The power controller has a voltage input and a current input.
These inputs (setpoint specification) specify the output to be provided by the power controller at the load output.

In most cases, this signal is sent as a standard signal from an electronic controller or PLC and is adjusted with these settings.

	Value / settings	Description
Current measuring range	0 to 20 mA	This setting specifies which current standard signal is connected. ⇨ Chapter 3.3 "Connection diagram"
	4 to 20 mA	
	Customer-specific[1]	
Current measuring range, start	**0** to 20 mA	**Note:** This parameter only appears if "Customer-specific" is set for the current measuring range (see above)!
Current measuring range, end	0 to **20** mA	**Note:** This parameter only appears if "Customer-specific" is set for the current measuring range (see above)!
Voltage measuring range	0 to 10 V	This setting specifies which voltage standard signal is connected. ⇨ Chapter 3.3 "Connection diagram"
	2 to 10 V	
	0 to 5 V	
	1 to 5 V	
	Customer-specific[1]	
Voltage measuring range, start	**0** to 10 V	**Note:** This parameter only appears if "Customer-specific" is set for the voltage measuring range (see above)!
Voltage measuring range, end	0 to **10** V	**Note:** This parameter only appears if "Customer-specific" is set for the voltage measuring range (see above)!

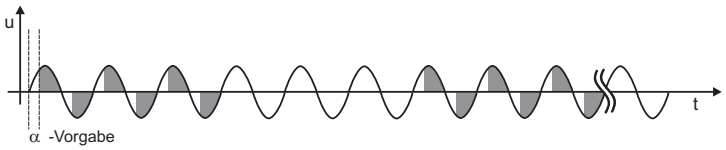
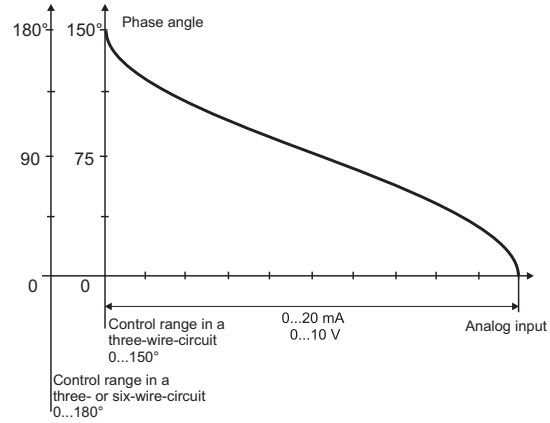
■ / **bold** = default setting

[1] **Inverting analog inputs:**
If, for example, the current measuring range start is set to 20 mA and the current measuring range end is set to 0 mA, the power controller is switched off at 20 mA and switched on at 0 mA.

5.1.4 Setpoint value configuration

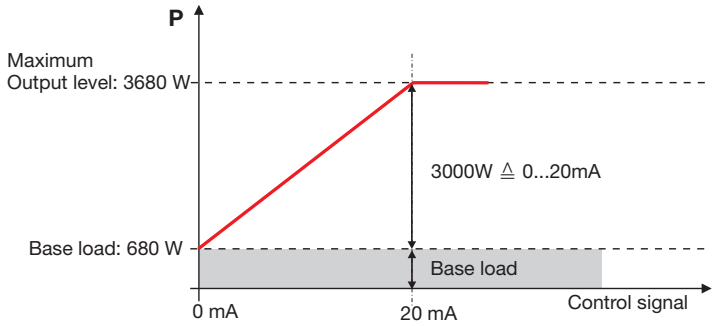
This setting determines which analog input specifies the setpoint value, how high the base load is, and which replacement value should be applied in the event of a fault.

	Value / settings	Description
Setpoint specification	Current input 	This setting specifies which analog input supplies the setpoint value for the power output. **Note:** These inputs can also be used for logic operation. ⇨ For switching level, see Chapter 10.7 "General specifications"
	Voltage input 	
	Via interface 	Means that the setpoint value for the power output is provided via an interface.
	Digital input1 	**Note:** This setting is only available if Power controller ➔Thyristor control ➔Logic (switch) is set. In this case, the power controller is controlled in the same way as a solid-state relay (SSR) via digital input 1 or 2: contact: closed ➔ 100 % and open ➔ 0 % (for control direction set per default).
	Digital input2 	

α input	This setting is only available if Power controller ➔Thyristor control ➔**Logic** (switch) is set. This setting specifies <u>which signal</u> the α input should control or whether it should be <u>fixed</u>. The "α input" value is a phase angle with which all sine waves are cut to limit the power. Not to be confused with the value for α **start!** 	
	No input	No phase angle is specified (full sine waves)
	Voltage input or current input	This standard signal specifies the phase angle as shown in the diagram. 
	Value, adjustable	The phase angle is entered as "α input value".
	Via interface	The phase angle is set via an interface.

α input value	**0** to 180° el (150° el)	This is the phase angle if "Value, adjustable" was set under **α input**. (Can only be set up to α = 150° el for three-wire circuit)
Input in the event of an error		Current, voltage, and interface input are monitored for errors (wire breaks or bus errors). This setting specifies which replacement value the power controller should use if the setpoint specification is incorrect.
	Last value	The last valid value is used per default.
	Voltage input or current input	Depending on which input is set for the setpoint specification, the second input – which is still free – appears at this point. If an error (e.g. wire break) now occurs at the current input which is set per default for the setpoint specification, the power controller uses the value at the voltage input.
	Value, adjustable	This means that the "**Value in the event of an error**" is used.
Value in the event of an error	000.0	This value is used in the event of an error.
Maximum actuating variable	0 to **$U_{nom.}$** to 1.15 $U_{nom.}$ of the load voltage, 0 to **$P_{nom.}$** to 1.15 $P_{nom.}$ of the power 0 to **$I_{nom.}$** of the max. load current 0 to **100** % of the output level	In the case of **continuous** thyristor control via the analog input, the maximum actuating variable at the measuring range end (e.g. 20 mA) can be varied during operation. The measurands in the master branch are measured. The value to be entered depends on the "Subordinate control loop" setting: U^2 and U: Entry in V (**Interlinked** value for three-wire and six-wire circuit) (Example: 0 to **400** to 460 V) (**Strand** value for four-wire circuit) (Example: 0 to **230** to 264 V) P: Entry in kW **(three-phase power/3)** (Example: 0 to **4.60** to 5.29 kW) I^2 and I: Entry in A (example: 0 to **20** A) None: Entry in % (example: 0 to **100** %)
	Example for three-wire circuit: I_{Nenn} = Laststrom des Stellers: 20 A U_{Nenn} = Lastspannung des Stellers: 400 V (verkettete Spannung im Drehstromsystem) $P_{Nenn} = I_{Nenn} \cdot \frac{U_{Nenn}}{\sqrt{3}} = 20\ A \cdot 230\ V =$ 4,60 kW	

Base load

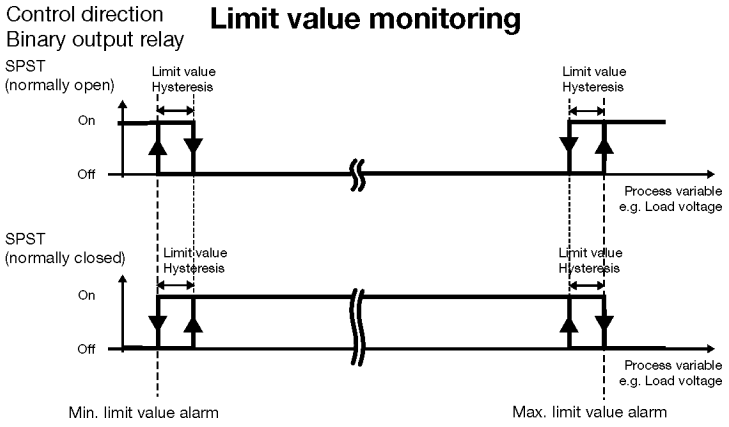
0 to $U_{nom.}$ of the load voltage, **0** to $P_{nom.}$ of the power **0** to $I_{nom.}$ of the max. load current **0** to 100 % of the output level	**Note:** This setting is only available if Power controller ➔Thyristor control ➔Continuous (power controller) is set. The **unit** depends on the setting for subordinate control loop and device type: - For voltage: **0** to 100 % of max. load voltage (e.g. **0 V**) (**Interlinked** value for three-wire and six-wire circuit) (**Strand** value for four-wire circuit) - For current: **0** to 100 % of max. load current (e.g. **0 A**) - For power: **0** to 100 % of power (e.g. **0 W**) **(three-phase power/3)** - None: **0** to 100 % of output level (e.g. **0 %**) The measurands in the master branch are measured. 

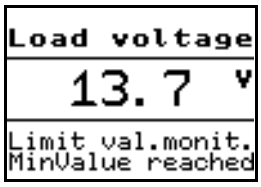
■ / **bold** = default setting

5.1.5 Monitoring

This allows an internal measurand to be monitored for compliance with limit values.
Depending on the switching behavior, an overrange or underrange is output at the digital output (option: relay or optocoupler).

>Limit value monitoring

Value / settings	Description
Switched off	No monitoring
Load voltage Load current Power (in W) Power (in kW) Resistance Mains voltage Device temperature	These measurands can be monitored and are dependent on the ordered device type.  The limit values are monitored in the master and in the slaves and, if the limit value is breached, the corresponding error message is shown in the info line at the bottom of the display (e.g. "Slave2:Limit val. MinVal reached") Exception: In the three-wire circuit (delta or star without neutral conductor), the load voltage represents the symmetrical value of all three measured voltage values (external conductor load voltage). If the limit value for this voltage is breached, the message ("Limit value mon. MinVal reached") is shown on the display. **Note:** If Power controller -> Thyristor control -> Logic (switch) and Monitoring -> Limit value monitoring -> Load voltage, load current, power (in W), or power (in kW) is set, the limit value monitoring only operates in the periods in which the thyristors have been fired. If the thyristors block, as a general rule, the min. and max. alarms are switched off.



Min. limit value alarm	**0** to 9999.9	The **absolute** minimum limit values for load voltage, load current, power, resistance, mains voltage, or device temperature can be monitored. If the measurand falls below this value, an error message appears at the bottom of the display and the yellow K1 LED lights up. Depending on the set control direction, the digital output switches as shown in the diagram. The unit of the limit value corresponds to the measurand to be monitored.
Max. limit value alarm	0 to **9999.9**	The **absolute** maximum limit values for load voltage, load current, power, resistance, mains voltage, or device temperature can be monitored. If the measurand exceeds this value, an error message appears at the bottom of the display and the yellow K1 LED lights up. Depending on the set control direction, the digital output switches as shown in the diagram. The unit of the limit value corresponds to the measurand to be monitored.
Limit value hysteresis	0 to **1** to 9999.9	Switching differential at the upper and lower limit of the monitoring range
>Load monitoring	None	The load is not monitored.
	Undercurrent	⇨ Chapter 6.1 "Detection of load faults"
	Overcurrent	
		Note: This setting is only available if **load monitoring** has been set to undercurrent or overcurrent.
Limit value load monitoring	0 to **10** to 100 %	**Partial load failure** or **partial load short circuit**: This setting specifies the percentage by which the load current must have decreased or increased for a load error to be triggered.
Load type load monitoring	Standard	Default setting (suitable for most load types)
	Infrared radiator (short-wave)	Especially suitable for short-wave infrared radiators
Teach-In type load monitoring	Automatic, once	The Teach-In value is automatically determined once after each power ON. ⇨ Chapter 6.1.1 "Teach-In"
	Manual	Teach-In can be performed **in manual mode** or **at the operating level**. ⇨ Chapter 6.2.2 "Configuring the Teach-In (prerequisite for Teach-In in manual mode)" ⇨ Chapter 4.2.4 "Monitoring"
	Automatic, cyclical	Teach-In is performed cyclically at a time interval of 1 minute.

>Mains voltage drop monitoring	No	No monitoring
	Yes	If the effective values of the analyzed half-waves are more than 10 % apart, an alarm message is displayed and the digital output for the collective alarm switches depending on the set control direction. Immediate firing pulse inhibit prevents the connected transformer loads from destroying the semiconductor fuse due to a DC component. If there are no further mains voltage drops, the firing pulse inhibit is removed and the power controller continues operation (e.g. with a soft start).
>Control loop monitoring	No	No monitoring
	Yes	The control loop monitoring is mostly implemented for the purpose of monitoring SIC heating elements. It uses a binary signal to indicate when the power required by the setpoint specification can no longer be reached with the load present, potentially due to aging of the heating elements. This error is shown in the info line when the actual value of the subordinate control loop is smaller than the required setpoint value for an uninterrupted period of 15 minutes. ⇨ Chapter 8 "Error messages and alarms"

■ / **bold** = default setting

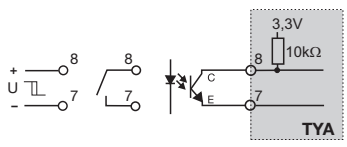
5.1.6 Digital inputs

There are 2 digital inputs and one additional digital input for firing pulse inhibit available, to which a potential-free contact can be connected.
The following functions can be triggered with digital input 1 and 2:

✱ Use the PGM key to switch to the configuration level ➔ Digital inputs

	Value / settings	Description
Toggling the operating mode to phase angle control		**Note:** The toggling to phase angle control mode is only possible if the setting ➔ Power controller ➔ Operating mode ➔ Burst firing mode has been made in the configuration level.
	Switched off	No toggling
	Digital input1	Toggling is controlled by digital input1
	Digital input2	Toggling is controlled by digital input2
	Ext. digital input1	Toggling is controlled via an interface
	Ext. digital input2	Toggling is controlled via an interface
External toggling of setpoint specification	Switched off	No external toggling of setpoint specification
	Digital input1	Toggling is controlled by digital input1
	Digital input2	Toggling is controlled by digital input2
	Ext. digital input1	Toggling is controlled via an interface
	Ext. digital input2	Toggling is controlled via an interface
Setpoint specification when toggling	Voltage input Current input Value, adjustable	Selects the source that is used to specify the setpoint value when external toggling of the setpoint specification is activated. **Note:** The only analog inputs that are available here are those that have **not yet** been populated by a setpoint specification, for example.
Value when toggling	0 % to 100 %	**Note:** This parameter is available only if **"Value, adjustable"** is set for setpoint specification when toggling.

■ / **bold** = default setting

	Value / settings	Description
Ext. current limiting		This function can only be set if the following presettings have been made: Option 1: Power controller ➔ Operating mode ➔Phase angle control and Power controller ➔ Current limiting ➔Yes Option 2: Power controller ➔ Operating mode ➔ Pulse groups Power controller ➔ Soft start ➔ Yes Power controller ➔ Current limiting ➔Yes If, for example, "Digital input 1" is set here, when the digital input is closed, the current limit value set under "Power controller ➔ Current limit value" is overwritten and the "**External current limit value**" (further down in the table) becomes effective.
	Switched off	No ext. current limiting
	Digital input1	Ext. current limiting is controlled by digital input1
	Digital input2	Ext. current limiting is controlled by digital input2
	Ext. digital input1	Ext. current limiting is controlled via an interface
	Ext. digital input2	Ext. current limiting is controlled via an interface
External current limit value	10 % to **max. load current of the device** +10 %	**Note:** This parameter is only available if a digital input is set for ext. current limiting. The max. load current varies depending on the device type. For 20 A power controllers, 2 to 22 A can be set. ⇨ Chapter 1.3 "Order details"
Key lock	Switched off	No key lock
	Digital input1	Key lock is controlled by digital input1
	Digital input2	Key lock is controlled by digital input2
	Ext. digital input1	Key lock is controlled via an interface
	Ext. digital input2	Key lock is controlled via an interface
External switch-off of display lighting	Switched off	No external switch-off, i.e. the background lighting behaves according to the configuration in Chapter 5.1.1
	Digital input1	Switch-off is controlled by digital input1
	Digital input2	Switch-off is controlled by digital input2
	Ext. digital input1	Switch-off is controlled via an interface
	Ext. digital input2	Switch-off is controlled via an interface
Control direction inhibit input		The firing pulse inhibit can be triggered when the switching contact is closed or open. ⇨ Chapter 3.3 "Connection diagram"
	Open, load ON	Per default: Inhibit input open, power controller supplies power. Inhibit input closed, power controller does not supply power. 
	Open, load OFF	

■ / **bold** = default setting

	Value / settings	Description
Control direction, digital input1	Open, inactive	The function for digital input1 can be triggered when the switching contact is open or closed.
	Open, active	
Control direction, digital input2	Open, inactive	The function for digital input2 can be triggered when the switching contact is open or closed.
	Open, active	

■ / **bold** = default setting

5.1.7 Digital output

The digital output consists of a relay or an optocoupler, depending on the order code.
With the digital output, it is possible to choose between the output mode "collective fault transmitter", "energy meter", and "Interf. signal".

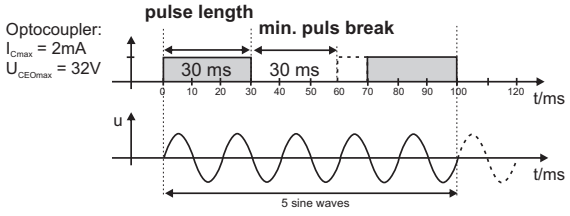
⇨ Chapter 8.1 "Binary signal for collective fault"

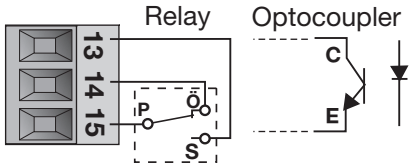
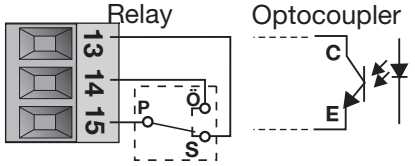
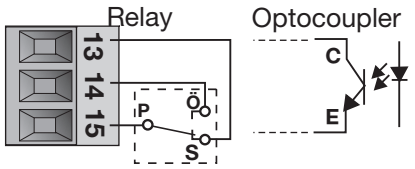
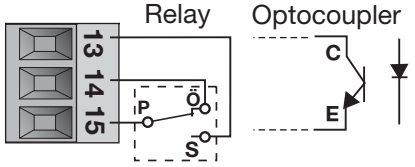
The control direction is used to set the switching behavior of the relay and whether, in the event of an error message, it should switch on (error message via N/O contact) or drop out (error message via **N/C contact**). In the optocoupler, the control direction determines whether the collector-emitter loop should be conductive or **high-impedance** in the event of an error message.

The energy meter function can only be activated if extra code 257 optocoupler is integrated into the device.

⇨ Chapter 1.3 "Order details"

✱ Use the PGM key to switch to the configuration level ➔ Digital output

	Value / settings	Description
Output mode	Collective fault transmitter	If a collective fault occurs on the device, the digital output switches. This can be configured as an "N/C contact" or as an "N/O contact" (see below). The K1 LEDs on the master, slave1, and slave2 also light up in the event of a fault.
	Energy meter	The digital output functions as an energy meter and emits pulses depending on the energy consumed. If a collective fault signal occurs in energy meter mode, the K1 LED lights up yellow at all points simultaneously. 
	Pulses per kWh: 1 to 10000	Specifies how many **pulses per kWh** are to be emitted. Select this value such that the **maximum power (power controller nominal power)** can also be shown.

	Pulse length: 30 to 2000 ms	Specifies how long the high phase of the pulse should be. (Value is rounded up internally by the device to a multiple of the half-wave length of the mains voltage)
	Min. pulse interval: 30 to 2000 ms	Specifies the minimum period for which the signal must be at Low until a new pulse is emitted. (Value is rounded up internally by the device to a multiple of the half-wave length of the mains voltage)
	Interf. signal	The digital output is controlled via an interface
Control direction, digital output	**N/O contact**	No error message or energy meter pulse OFF or signal via interface is logically 0 "Low": Switching behavior: 14 and 15 pole and N/C contact closed or 13 and 15 optocoupler collector-emitter loop high-impedance  **Error message present or energy meter pulse ON or signal via interface is logically 1 "High":** Switching behavior: 13 and 15 pole and **N/O contact closed** or 13 and 15 optocoupler collector-emitter loop low-impedance 
	N/C contact	No error message or energy meter pulse OFF or signal via interface is logically 0 "Low": Switching behavior: 13 and 15 pole and N/O contact closed or 13 and 15 optocoupler collector-emitter loop low-impedance  **Error message present or energy meter pulse ON or signal via interface is logically 1 "High":** Switching behavior: 14 and 15 pole and N/C contact closed or 13 and 15 optocoupler collector-emitter loop high-impedance 

■ / **bold** = default setting

5.1.8 Analog output

The analog output can also be used to output different internal values as a standard signal.

	Value / settings	Description
Signal type analog output		This setting specifies the standard signal that should be output at the analog output.
	Switched off	The analog output does not output a signal.
	0 to 20 mA	The analog output outputs the "Value to be output" in the form of a current signal.
	4 to 20 mA	
	0 to 10 V	The analog output outputs the "Value to be output" in the form of a voltage signal.
	2 to 10 V	
	0 to 5 V	
	1 to 5 V	
Value to be output		This setting involves the selection of the value that should be output at the analog output.
	Load voltage	**Example:** The load voltage can vary between 0 and 500 V depending on the device type. As the signal range is set per default to 0 to 9999.9, the end value must be adjusted to 500.0 to make use of the full signal range. These measured values are determined in the master branch. **Exception:** When selecting the power (in W or kW), the three-phase power is output at the analog output. **Note:** Load voltage^2 = load voltage squared
	Load voltage^2	
	Load current	
	Load current^2	
	Power (in W)	
	Power (in kW)	
	Resistance	
	Mains voltage	
	Device temperature	
	Setpoint value	
	Via interface	This setting is used to output a percentage value (0 to 100 %) via an interface. At 50 % (standard signal 0 to 10 V), 5 V would be output.
Signal range start value	**0** to 9999.9	Lower limit for the "Value to be output"
Signal range end value	0 to **9999.9**	Upper limit for the "Value to be output"

■ / **bold** = default setting

5.1.9 RS422/485

Interface parameters for RS422/485 (see interface description B709061.2)

	Value / settings	Description
Baud rate	9600	
	19200	
	38400	
Data format	8-1-none	Data bits-stop bits-parity check
	8-1-odd	
	8-1-even	
	8-2-none	
Device address	**1** to 255	
Min. response time	**0 to 500 ms**	

■ / **bold** = default setting

5.1.10 PROFIBUS-DP

Interface parameters for PROFIBUS-DP (see separate manual)

	Value / settings	Description
Device address	1 to **125**	If "0" is set as the device address, the bus fault error message is not displayed.
Data format	**Motorola®,** Intel®	The different data formats are set here

■ / **bold** = default setting

5.1.11 EtherCAT

For communication with EtherCAT see documentation 70906108T92Z000K000.

For communication with the JUMO mTRON T automation system, see documentation 70500153T90...

	Value / settings	Description
Fieldbus	**ECAT Conf. tested** SB JUMO mTRON T	To connect TwinCAT or other EtherCAT Master To connect JUMO mTRON T automation system
Device ID (Alias-Adr.)	**0** ... 65535 **0** ...99	in case of EtherCAT in case of Systembus JUMO mTRON T If several TYA-20X devices are located in the JUMO mTRON T system bus or EtherCAT, the user can identify each individual device by entering various alias device addresses.

■ / **bold** = default setting

5.1.12 Changing codes

Here, it is possible to assign passwords (4-digit numeric codes) for **manual mode**, **operating level**, and **configuration level** to protect them from unauthorized access.

	Value / settings	Description
Code, manual mode	**0000** to 9999	0000 means: no inhibit 9999 means: level is hidden
Code, operating level	**0000** to 9999	0000 means: no inhibit 9999 means: level is hidden
Code, config. level	**0000** to 9999	0000 means: no inhibit

■ / **bold** = default setting

5 Configuration

5.2 Configuration example

Requirements

Mains voltage on the power controller 400 V

Load voltage 230 V (star connection without neutral conductor)

9 heating elements each with 2 kW

Load current: 18,000 W / (3 × 230 V) = 26 A

Temperature coefficient TC = 1

Subordinate control loop: U^2

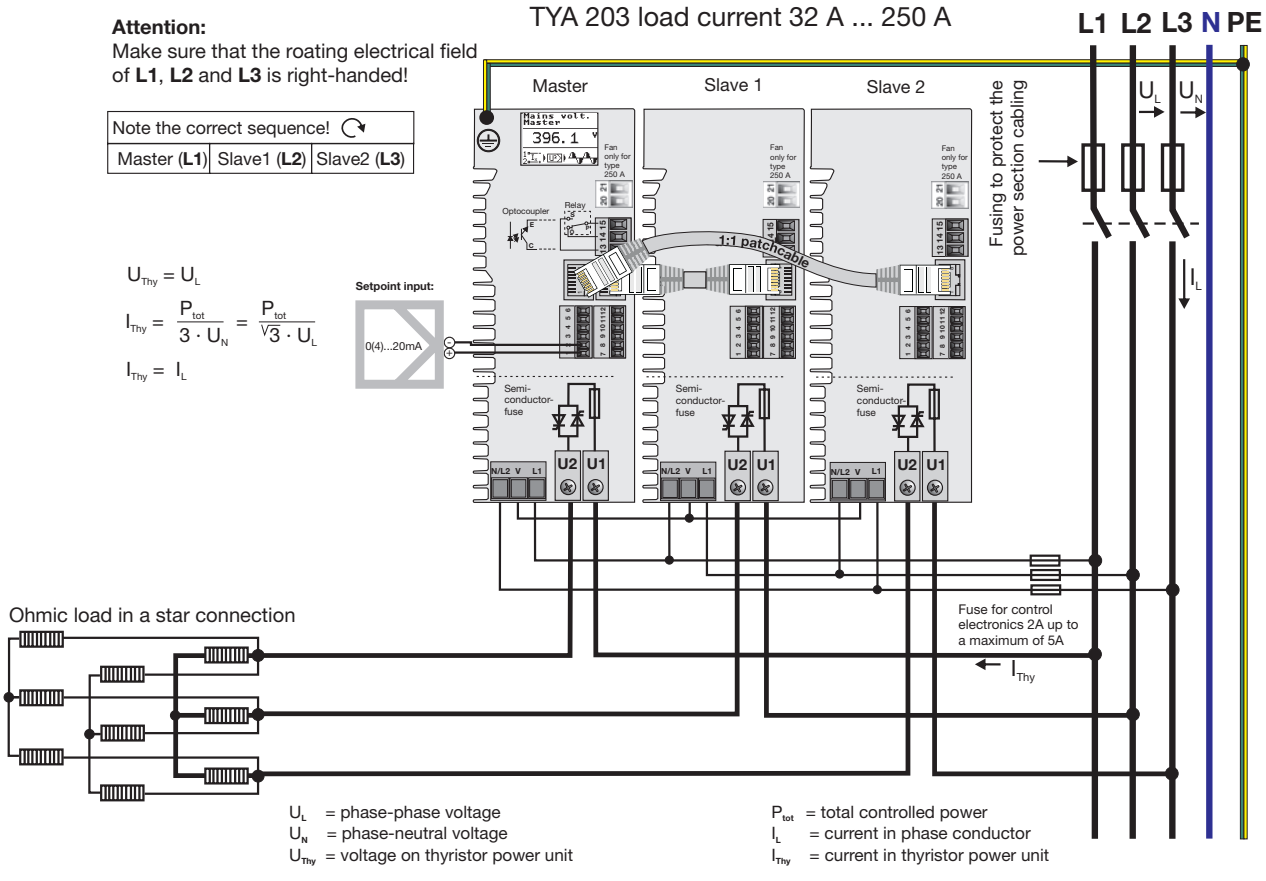
Base load: 0 %; maximum output level 100 %

Setpoint specification via standard signal of 0 to 20 mA.

The following power controller is selected for this requirement:

Device type

709063/X-01-032-010-400-00 / 252



6.1 Detection of load faults

The load monitoring function detects the percentage change of the load resistance. The function can also detect and signal a load failure, partial load failure, or a partial load short circuit.

Undercurrent This function is used for one or more heating elements connected in parallel that are to be monitored for failure.

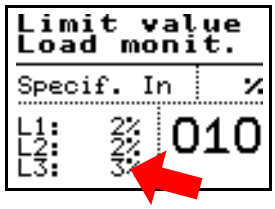
Overcurrent This function is used for several heating elements connected in series that are to be monitored for short circuits.

Function This function not only takes the decreasing or increasing load current into consideration but also includes the load voltage in the monitoring process.

The correct load ratios of the plant are saved during Teach-In.
Based on this state, the load changes are continuously monitored irrespective of the required output level. In the event of a failure or short circuit of a heating element, the load current increases or decreases. This is detected by the load monitor and a load fault is signaled.

Limit value A limit value must be entered in the configuration or operating level in % for the load monitoring. This limit value depends upon the number of heating elements connected in parallel or in series.

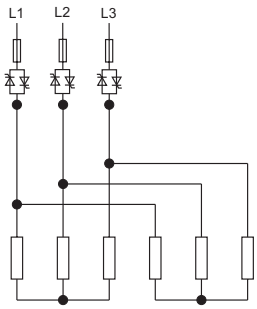
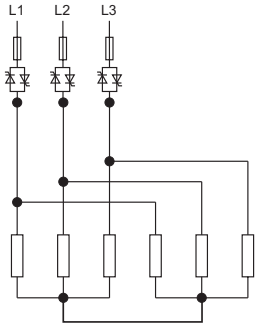
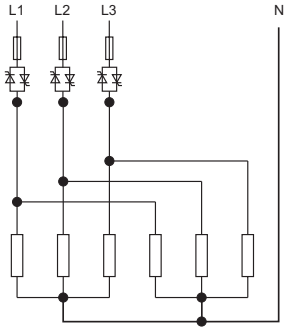
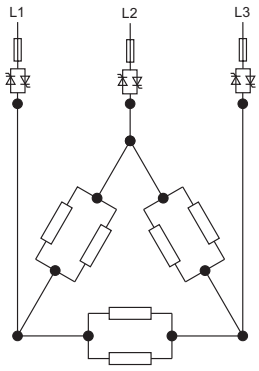
For heating elements with a high positive or negative temperature coefficient, a suitable limit value must be determined independently. The values in % given below (see arrow) are used for this purpose.
A value in % is displayed for each of the three phases, which represents the current deviation from the Teach-In values as a percentage. Access this window via Operating level ➔ Monitoring ➔ Limit value load monit.



☞ These values can be used to find out in what phase a load error occurred. If a load break occurs in phase L3, for example, the value in % exceeds the set limit value (10 % in the table).

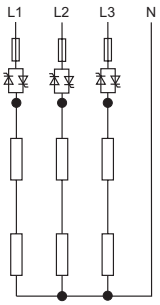
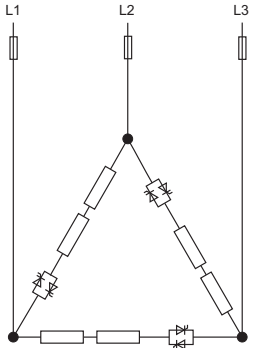
For heating elements with a temperature coefficient TC ≈ 1, the limit value can be taken directly from the following tables:

Undercurrent Example diagrams for 2 heating elements

Number of heating elements		**1**	**2**	**3**	**4**	**5**
Star connection with isolated star points without neutral conductor		50 %	25 %	17 %	13 %	10 %
Star connection with common star points without neutral conductor		50 %	20 %	13 %	10 %	-
Star connection with connected neutral conductor		50 %	25 %	17 %	13 %	10 %
Delta connection		21 %	12 %	10 %	-	-

The specifications in % refer to **load resistance changes**

Overcurrent Example diagrams for 2 heating elements

Number of heating elements		2	3	4	5	6
Star connection with connected neutral conductor		50 %	25 %	17 %	13 %	10 %
Delta connection		50 %	25 %	17 %	13 %	10 %

The specifications in % refer to **load resistance changes**

As a general rule, load monitoring does not yet take place during the soft start phase (which can last for an extended period due to active current limiting) as the standard working range of the load has not yet been reached. Teach-In cannot yet be performed in this phase either.

6.1.1 Teach-In

Depending on the configuration of the parameter "Load monit. Teach-In", Teach-In (i.e. determination of the load measured values in the OK state) is either performed once automatically after power ON or automatically and cyclically, repeatedly every minute, or manually.

"Manual" Teach-In

For "Manual Teach-In", the power controller must be told once after the operating point has been reached that it is now to perform the Teach-In.
This is possible in the operating level or in manual mode.

⇨ Chapter 4.2.4 "Monitoring"

⇨ Chapter 6.2.2 "Configuring the Teach-In (prerequisite for Teach-In in manual mode)"

In this variant of Teach-In, the Teach-In values are then permanently saved. It is not necessary to perform the Teach-In again when the power controller is switched off and on again.
The Teach-In can be repeated whenever necessary. The old Teach-In values are then overwritten by the new ones.
The Teach-In values are only deleted if the load monitoring Teach-In parameter is explicitly configured to "Manual Teach-In" or when the default setting is applied. The Teach-In is not affected by reconfiguration of other parameters.

The determined Teach-In values are also transferred when the setup data of one power controller is transferred to another.

If "Manual Teach-In" has been configured but no Teach-In has been conducted, the message "Teach-In load monitoring!" appears on the display as a reminder. Manual Teach-In can only be performed on the device itself, not via the setup program.

To ensure that the load ratios for later operation are recorded precisely, only perform the Teach-In at a load current of at least 20 % of the nominal value.

Teach-In "Automatically once"

"Automatically once" means that the Teach-In values are temporarily saved after each power ON.
This setting is suitable only for heating elements with a temperature coefficient TC ≈ 1.
When the power controller is disconnected from the mains voltage, the Teach-In values are deleted again. After another power ON, the load monitoring therefore remains inactive until the new Teach-In is performed. To ensure that the load ratios for later operation are recorded precisely, the Teach-In is only performed in phase angle control with at least 30 % of the output level. (In burst firing mode, this restriction is not necessary because a sufficiently high current always flows when the thyristor is fired. In this case, the Teach-In is always performed shortly after a power ON or – if configured – after the completion of the soft start.)

Teach-In "Automatically cyclically"

"Automatically cyclically" means that the Teach-In values are temporarily saved again at intervals of 1 minute. This setting is particularly suitable for SIC heating elements as in this case the resistance in the load point changes with time due to aging.
When the power controller is disconnected from the mains voltage, the most recently detected Teach-In values are deleted again. After another power ON, the power controller resumes automatic Teach-In detection.

6.2 Manual mode

In this case, the setpoint value can be manually preset in % without the need for external wiring via the analog input.

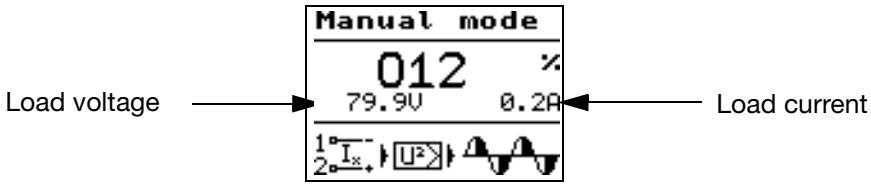
6.2.1 Setpoint specification in manual mode

Starting

Manual mode, as set per default, can be accessed without entering a code.

* Press the PGM key once (selection menu)
* Press the PGM key again (manual mode)
* Use the ▲ or ▼ key to increase or decrease the setpoint value

The changes become effective immediately at the load output and are indicated on the display.



☞ The setpoint value for manual mode is not saved in the event of a power failure!

6.2.2 Configuring the Teach-In (prerequisite for Teach-In in manual mode)

The Teach-In function records the current/voltage ratio of a load in the OK state.
This function is not configured per default.

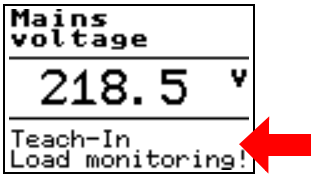
⇨ Configuration level See "Teach-In type load monitoring" on page 70.

Configuring "manual" Teach-In

The power controller is in the "Measured value overview" level

* Press the PGM key
* Config. level ➔ Monitoring ➔ Load monitoring ➔ Undercurrent or overcurrent ➔ Teach-In type load monit. ➔ Set to "manual"
* Press the PGM key
* Press the EXIT key twice
  The device performs a reset.

If the Teach-In is being performed for the first time, the message "Teach-In load monitoring" appears in the bottom line of the display.

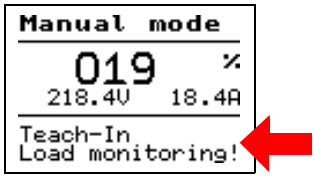


6.2.3 Performing Teach-In in manual mode

The power controller is in the "Measured value overview" level

* Press the PGM key twice to return to **manual mode**.

If the Teach-In is being performed for the first time, the message "Teach-In load monitoring" now appears in the bottom line of the display.



* Press the PGM key and the following message will appear:

* Press the PGM key to apply the current load state as the OK state.

A change in the load (load error) will be evaluated by the device on the basis of this state.

Repeating Teach-In

The Teach-In can be repeated any number of times in manual mode

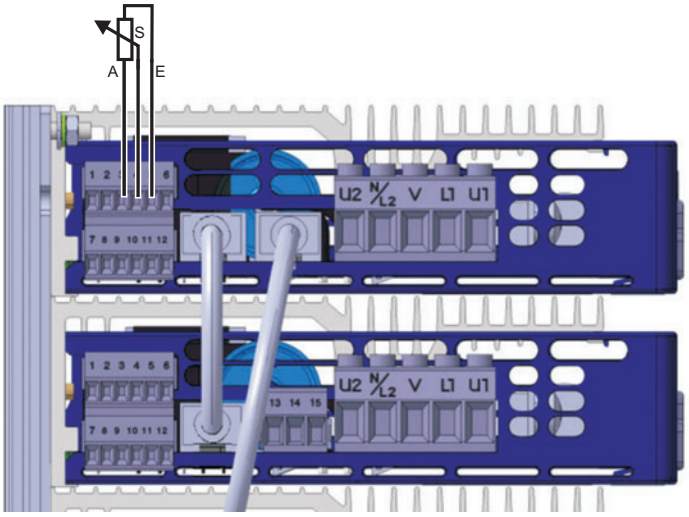
* Press the PGM key and the following message will appear:

* Press the PGM key to apply the current load state as the OK state.

6.3 Setpoint specification via potentiometer

For this, a 5 kΩ potentiometer is connected to the voltage input.

It is supplied with DC 10 V at terminal 5 of the power controller.



* Configuration level ➔ Analog inputs ➔ Set voltage measuring range 0 to 10 V
* Configuration level ➔ Setpoint config. ➔ Setpoint specification ➔ Set voltage input

Now the power controller power is preset via the external potentiometer.

6.4 Dual energy management

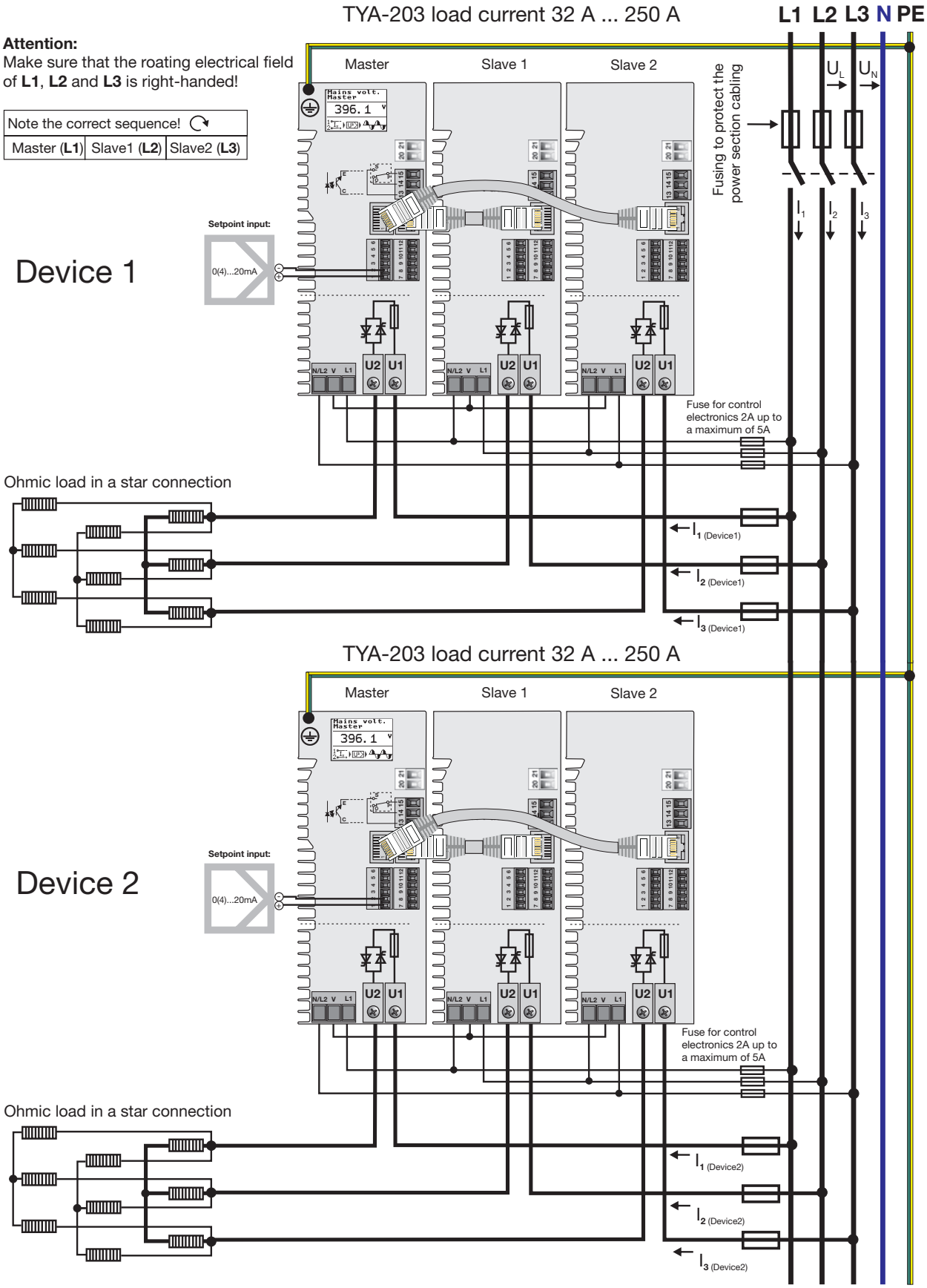
This allows setpoint values of up to 50 % each to be preset on 2 power controllers in burst firing mode operating mode without causing current peaks in the network when they are switched on simultaneously.
No current peaks are caused in the network even if the setpoint values are asymmetrically distributed (e.g. 30 % and 70 %).

More than 2 power controllers

If more than 2 power controllers are required in a plant, they must be divided into groups of 2. The "Dual energy management" parameter (Device1 and Device2) is set in each group.

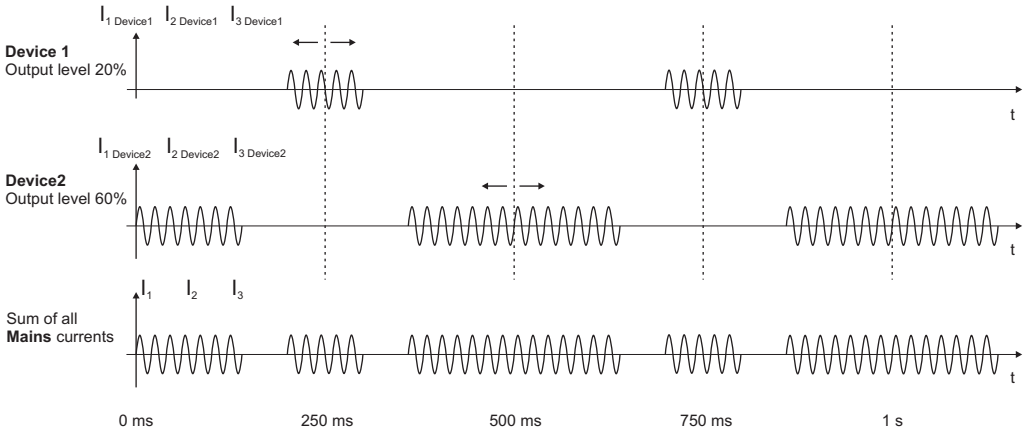
Prerequisites

- The 2 three-phase devices must be wired identically as shown in the following diagram
- The control electronics and the load circuit must have the same phase
- Synchronize both three-phase devices in a group by switching them on simultaneously
- **Burst firing mode** must be configured
- The cycle time must be set to **500 ms (fixed)**
- Within a group, one three-phase device must be configured as **device1** and the other three-phase device must be configured as **device2**.


TYA-203 load current 32 A ... 250 A
L1 L2 L3 N PE
Attention:
Make sure that the roating electrical field of L1, L2 and L3 is right-handed!
Note the correct sequence!
Master (L1) Slave1 (L2) Slave2 (L3)
Master
Slave 1
Slave 2
Fusing to protect the power section cabling
Setpoint input:
0(4)...20mA
Device 1
Fuse for control electronics 2A up to a maximum of 5A
Ohmic load in a star connection
I1 (Device1)
I2 (Device1)
I3 (Device1)
TYA-203 load current 32 A ... 250 A
Master
Slave 1
Slave 2
Setpoint input:
0(4)...20mA
Device 2
Fuse for control electronics 2A up to a maximum of 5A
Ohmic load in a star connection
I1 (Device2)
I2 (Device2)
I3 (Device2)

The two power controllers switch on in a chronologically staggered manner. Starting from the dashed lines, the dispersion of energy takes place symmetrically to the left and right (see arrows). For as long as the total output level of the two devices is below 100 %, overlaps of the two device currents in a single phase are prevented. The next current level in the network is not started until the total output level exceeds 100 %.

If a power controller performs a restart when the configuration level is exited, it no longer operates synchronously with the others.
All power controllers have to be switched on again simultaneously via a joint main switch!

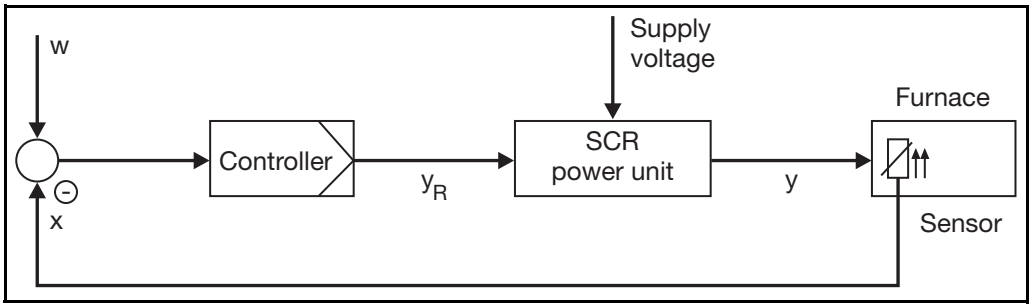


6 Special device functions

6.5 Subordinate control

Subordinate control loops are used to eliminate or compensate for external interference, such as fluctuations in the mains voltage and changes in resistance which would have a negative effect on the control loop.

6.5.1 Closed control loop without subordinate control



Example Furnace/kiln control system

The electrical mains voltage is connected to the power controller. The controller derives the output level y_R from the difference between the setpoint value (w) for the furnace temperature and the actual (or $_{process}$) value (x) which is acquired by a sensor inside the furnace. The controller output level can range from 0 to 100 % and is output at the output of the controller as a standard signal, for ex-ample, 0 to 10 V. The output level signal is fed to the power controller.

The task of the power controller is to feed energy to the heating elements in the furnace, proportional to the controller output level:

- For a **thyristor power controller** using **phase angle control**, this means that it alters the firing angle over the range from 180° to 0°, corresponding to a controller output level of 0 to 100 %.
- If the **thyristor power controller** is using the **burst firing mode**, it increases the duty cycle T from 0 to 100 %, corresponding to a controller output level of 0 to 100 %.

If the mains voltage drops from AC 230 V to AC 207 V (-10 %) at controller output level YR, the power fed to the furnace is reduced by 19 %.

$$P_{230V} - \Delta P = \frac{(U-(0,1U))^2}{R} = \frac{(0,9U)^2}{R} = 0.81 \bullet P_{230\,V} \qquad (2)$$

P_{230V}: Power in the load resistance at a mains voltage U of 230 V

ΔP: Power reduction resulting from reduced mains voltage

R: Resistance of the load

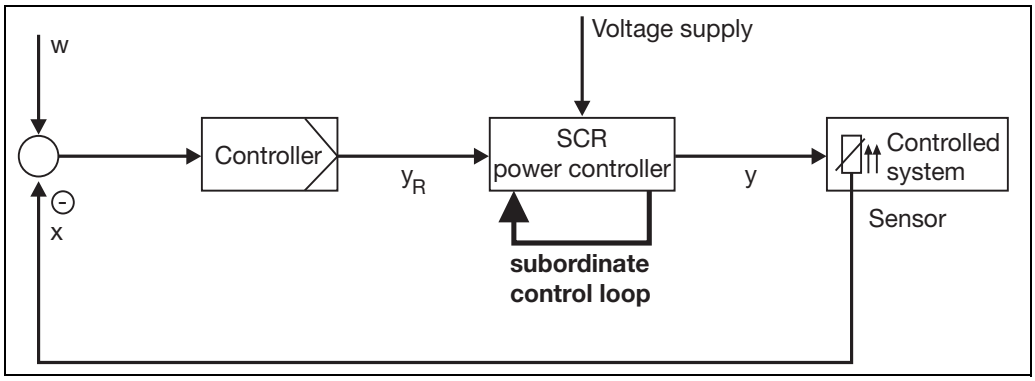
This 19 % reduction in the energy being fed in means that the **furnace temperature falls.**

Disadvantage: **A continuing constant temperature is no longer assured.**

The power controller recognizes the deviation through the relatively slow re-- sponse of the temperature control loop and increases its output level (y_R) until the furnace reaches the original temperature (250 °C) again.

6.5.2 Closed control loop with subordinate control

To avoid power variations caused by mains voltage fluctuations, a **subordi-- nate control loop** is built into the power controllers. The subordinate control loop immediately counterbalances any fluctuations in the amount of supplied power. This means that the power controller always provides a power level at the output (y) that is proportional to its input signal (yR). The principle of a sub- ordinate control loop is shown in Figure .



A distinction is made between U^2, I^2, and P control loops. U^2 control is used in most applications. There are, however, some applications where an I^2 or P control has advantageous control-loop characteristics (requires recording of the current in the power controller).
The three different types of subordinate control are described in the following chapters.

U^2 control

Considering the power P_{load} in a resistive load, we know that it is determined by the voltage on the load, U_{load} and the resistance of load, R, as follows:

$$P_{load} = \frac{U_{load}^2}{R} \quad (3)$$

Equation 3 shows that, for a constant load resistance, the power in this resis-- tance is proportional to U_{load}^2.

$$P_{load} \sim U_{load}^2 \quad (4)$$

A power controller with a U^2 control will regulate in such a manner that the square of the load voltage is proportional to the signal input (e.g. 0 to 20 mA) to the controller.

$$U_{load}^2 \sim \text{input signal of the power controller} \quad (5)$$

Combining equations 5 and 4, we can see that the power in the load resis--

tance is proportional to the input signal to the power controller.

$$P_{load} \sim \text{input signal of the power controller (0 to 20 mA)} \quad (6)$$

Heating elements that have a positive temperature coefficient (TC) (i.e. where the **electrical resistance increases with increasing temperature)** are usually driven by a power controller that incorporates a subordinate control (**U^2 control**) (Figure 1).

These are resistive materials such as

- Kanthal-Super
- Tungsten
- Molybdenum
- Platinum
- Quartz radiators

Their cold resistance is substantially lower than their resistance when hot (by a factor of 6 to 16). These heating elements are usually run at temperatures above 1000 °C.

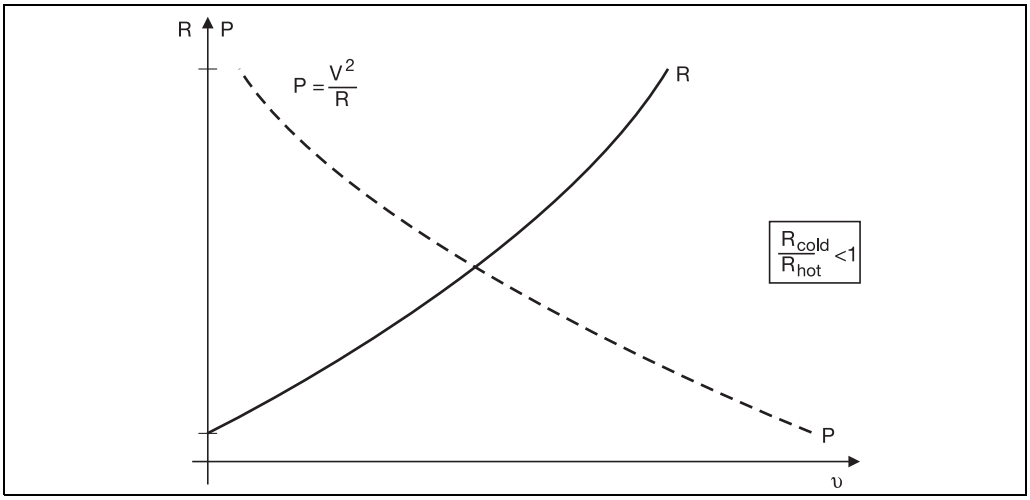


Figure 1: Heating element with a positive TC

Power controllers need current limiting for the starting phase. The constant current and the increasing resistance mean that, initially, the power in the heating element increases in proportion to R, since the power $P = I^2 \cdot R$.

When the current falls below the preset limit value, the automatic current limiting is no longer effective and the power controller operates with the subordinate U^2 control, i.e. if the resistance continues to increase at a constant voltage level, the power $P_{load} = \frac{U_{load}^2}{R}$ fed to the heating elements is automatically reduced.

This effect supports the complete control loop. As the furnace temperature ris--

es toward the configured setpoint value, the power fed to the furnace is reduced (at the same load voltage level). This means that, through the power controller alone, the approach to the setpoint value is slowed. This damps out any tendency to overshoot the final temperature.

Other applications for U^2 control are:

- In lighting systems: in this case, the intensity of the lighting is proportional to U^2.
- Some resistance materials have a TC that is close to 1. These include heating elements made from nickel/chrome, constantan, etc. This does not place any special demands on the thyristor power controller (e.g. current limiting). The resistance characteristic for a heating element with a TC ~ 1 is shown in Figure 2.

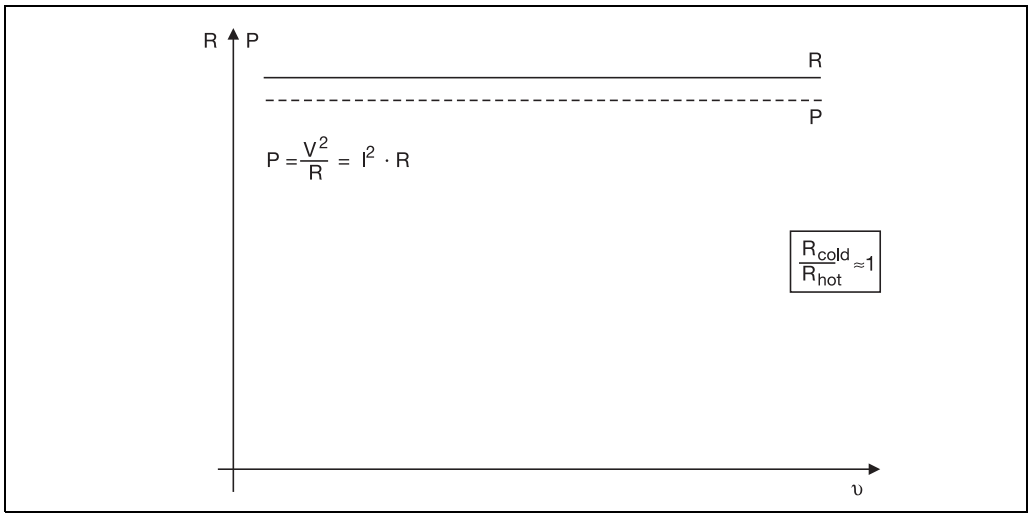


Figure 2: Heating element with TC ~ 1

I^2 control

Current control (I^2 control) is advantageous for heating elements with a negative TC, where the electrical resistance becomes smaller as the temperature increases (Figure 3).

This behavior is shown by non-metallic materials such as graphite or glass melts. Molten glass is not usually heated by heating elements but by letting a current flow through the melt, so that the electrical energy is converted directly into heat in the molten material. The current is applied through electrodes.

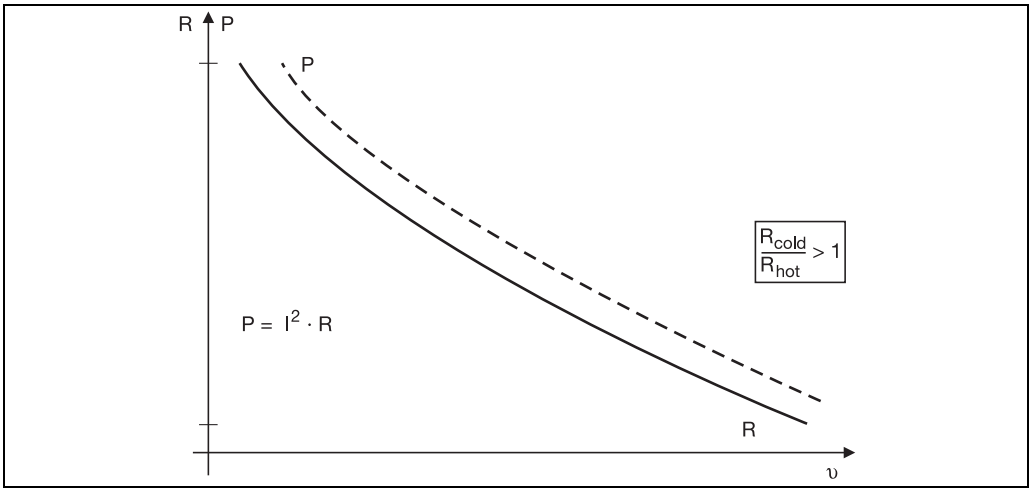


Figure 3: Heating element with a negative TC

Looking at the power equation $P = I^2 \cdot R$, we can see that an I^2 control has the same regulatory effect on the power as already described for the U^2 control. This means that, by regulating a constant current while the temperature rises, the power in the process is automatically reduced as the resistance falls.

P control

Power control (P control) is a continuous regulation of the product V · I, the power. In this case, there is a precise linear relationship between the output power and the level of the signal input (e.g. 0 to 20 mA) to the thyristor power con-troller.

A typical application of this type of subordinate control is for regulating heating elements which are subject to long-term aging combined with a temperature-dependent change in resistance, as is the case with silicon carbide elements (Figure 4).

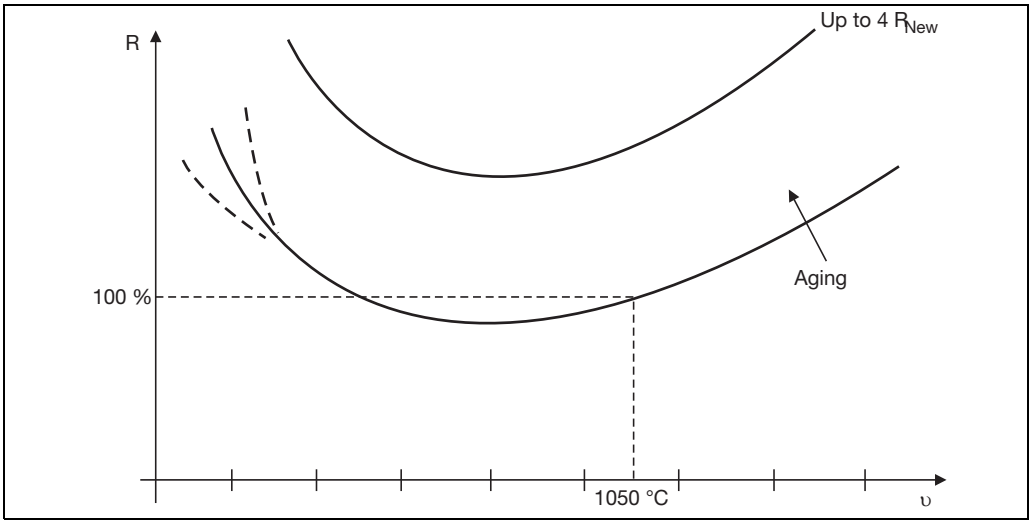


Figure 4: Resistance changes for silicon carbide

Silicon carbide heating elements have a nominal resistance that can increase by a factor of 4 over the long term. When dimensioning a system, it is therefore nec-essary to adapt the power controller to produce twice the power for the heat-ing elements.

This results in double the current for the thyristor power controller.

Old = old state of the heating element $R_{old} = \frac{R_{old}}{4}$

New = new state of the heating element

The relationship is illustrated by the following formula:

$$P_{new} = U_{new} \bullet I_{new} = \frac{U_{old}}{2} \bullet 2I_{old} = U_{old} \bullet I_{old} = P_{old} \quad (12)$$

P control is also used for free-running economy circuits running off a 3-phase supply network.

Which operating mode is suitable for which load?

Operating mode	Resistive load				Inductive load
	TC constant	TC positive	TC nega-- tive	Long- term ag-- ing	
Burst firing mode	X				
Burst firing mode with α start	X				X
Burst firing mode with current limiting		X	X	X	
Subordinate control					
U^2	X	X			X
I^2			X		X
P				X	X

6 Special device functions

6.6 Resistance limitation (R control)

This is only possible in power controllers with current and voltage measurement that are fitted with subordinate control P (code 001 in the order code) and only functions for load resistors with positive temperature coefficient.

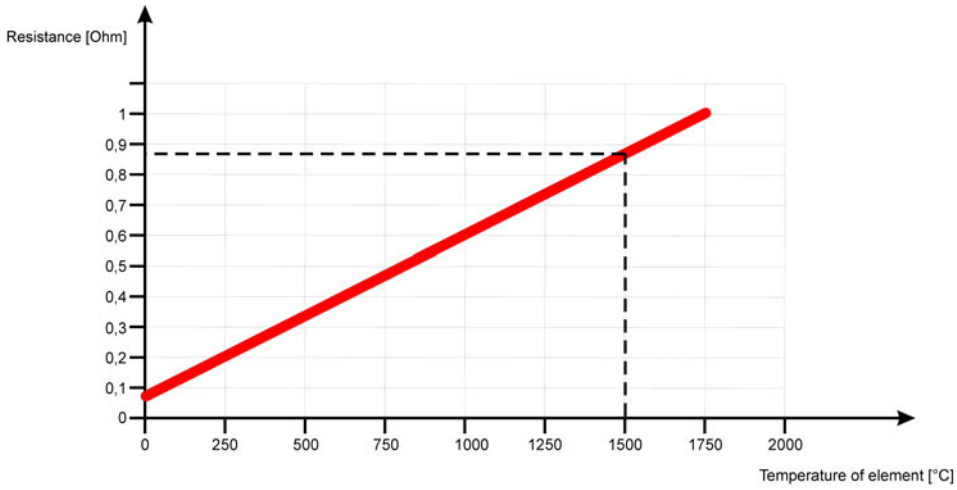
Function

If the current measured value for resistance exceeds the resistance limit, it is limited by phase angle control or limitation of the switched sine waves.

Limitation of the power

The resistance limitation parameter can be used to activate a limitation of the power output depending on the resistance value R when operating molybde-num disilicide heating elements in order to prevent overheating of the heating element in the upper temperature range. By measuring the resistance of the heating elements it is possible to assign a precise heating element temperature.

If the load resistance exceeds this value, it is limited by phase angle control or limitation of the switched sine waves.
This protects the heating element from overheating.



6.7 Current limiting

Current limiting is only possible for power controllers with load current measurement, i.e. in the order details, subordinate control **I, I^2** (code 010 in the order code), or **P** (code 001 in the order code) must be selected.

The current limiting is implemented via phase angle control. It therefore only operates permanently in phase angle control mode.
If burst firing mode is set, current limiting only operates in the soft start phase if "With phase angle control" is set as the soft start type.

In three-phase economy circuit, only the current in the strand of the master power controller is limited to the configured value. As a result of the economy circuit, significantly greater load currents can flow in the other two phases.

Function

Current limiting prevents overcurrents in the load current circuit. It limits the load current independently of the load resistance and the setpoint value to the required current limit value by enlarging the phase control angle, if necessary.

Current limiting is unavoidable for heating elements with a high positive temperature coefficient, such as Kanthal-Super, for example. Without current limiting, the load current would accept inadmissibly high values when such heating elements are in a cold state.

Default setting

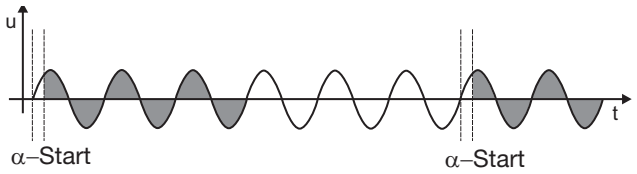
Current limiting is not activated.

⇨ Chapter 5.1.2 "Power controller"

6.8 α start

Default setting

The phase angle of the first half-wave (α start) is not activated.
For transformer loads, the thyristor power controllers operate in continuous burst firing mode and in logic operation with phase control of the first half-wave.
The default setting is an angle of 70° el. (electrical). This value can be adjusted at the configuration level or operating level within the range of 0 to 90° el.



6 Special device functions

6.9 Monitoring of the mains voltage drop

If the effective values of the analyzed half-waves are more than 10 % apart, there is an immediate firing pulse inhibit. This prevents the connected transformer loads from destroying the semiconductor fuse due to a DC component. In addition, an alarm message is displayed and the digital output for the collective alarm switches depending on the set control direction.

If there are no further mains voltage drops, the firing pulse inhibit is removed and the power controller continues operation (e.g. with a soft start).

Default setting Monitoring is not activated.

⇨ Chapter 5.1.5 "Monitoring"

6.10 Firing pulse inhibit

The inhibit function serves to protect the thyristor power controller and the connected devices.

Internal The thyristor output is locked during:

- Device switch-on (during the startup procedure)
- Changes in the configuration level
- Insufficient or excessive voltage supply
- Master/slave data line interruption
- Master/slave synchronization failure
- Setup of data transfer to the device
- Device temperature greater than 115 °C
- Rotary field error
- Temporary mains voltage drops (with configured mains voltage drop monitoring)

⇨ Chapter 5.1.5 "Monitoring"

External Via the "Inhibit" digital input

⇨ Chapter 3.3 "Connection diagram"

Alternatively, the thyristor output can also be switched off via the PROFIBUS, RS422/485 interfaces and the JUMO mTRON T system interface.

6.11 Thyristor control logic (switch)

Operating mode

If the power controller is set to ➔Thyristor control ➔Logic (switch), the power controller operates as an electronic switch.
For as long as the configured digital or analog input is closed, the thyristors are fired in zero crossing of the mains voltage and are only locked once again when the digital or analog input is opened.
In the case of short pulse packets, it is recommended to control the digital input (control direction "Open inactive") using an optocoupler.

Transformer loads

In the case of transformer loads, the first mains voltage half-wave of each pulse group must be cut. This can be done by configuring α **start** and entering **a value**.

⇨ Chapter 5.1.2 "Power controller"

The phase control angle for each first half-wave can be selected between 0 and 90°.

α input

The full power is switched by closing the digital input. If this is too high for the case at hand (e.g. in the case of quick heat-up processes), the output power can be reduced by cutting all sine waves ("α input").

⇨ Chapter 5.1.4 "Setpoint value configuration"

6 Special device functions

The setup program enables convenient configuration of all data for the device on a PC, which can then be transferred to the device.

☞ For configuration of the power controller it is sufficient to insert the USB cable into the master power controller and connect it to the PC.

The configuration data is applied as soon as the device is switched on.

7.1 Hardware

- 500 MB hard disk space
- 512 MB RAM

7.2 Compatible operating systems

- Microsoft Windows® XP/Vista
- Windows® 7 32-bit
- Windows® 7 64-bit
- Windows® 8.0

Users

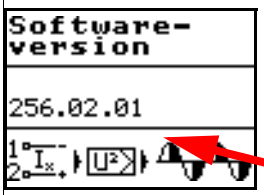
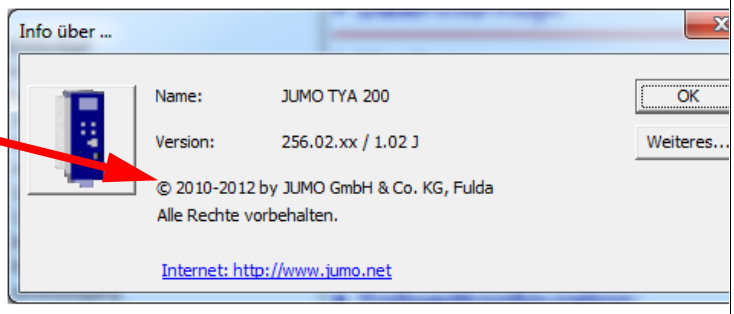
☞ If several users are managed on the computer, ensure that the user who will work with the program later is logged in.
The user must have administrator rights for the installation of the software. After installation, the rights can be restricted again.

In the event of non-observance of this information, correct and complete installation cannot be guaranteed!

Software versions

The software versions of the device and the setup program must be compatible. If this is not the case, an error message will appear!

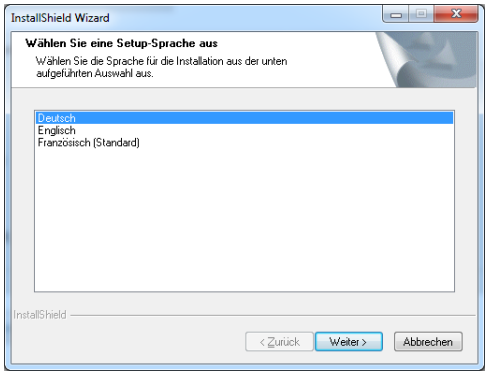
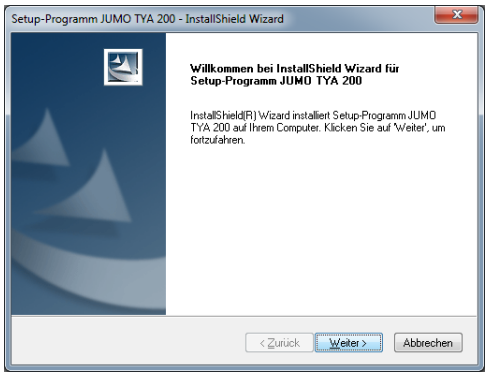
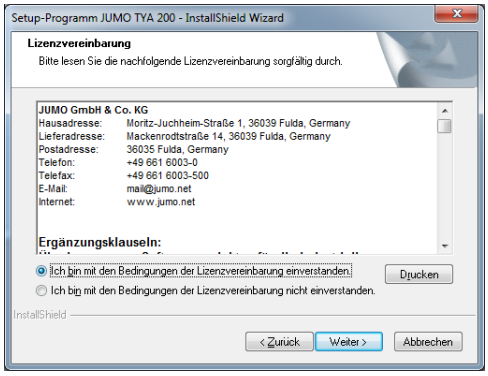
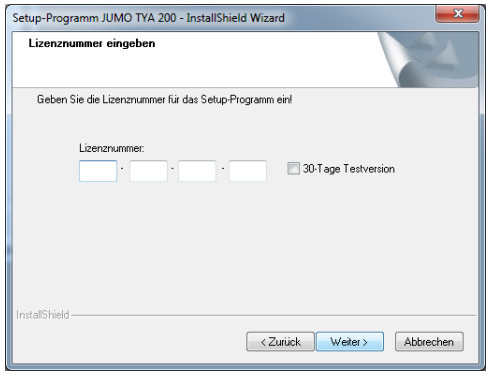
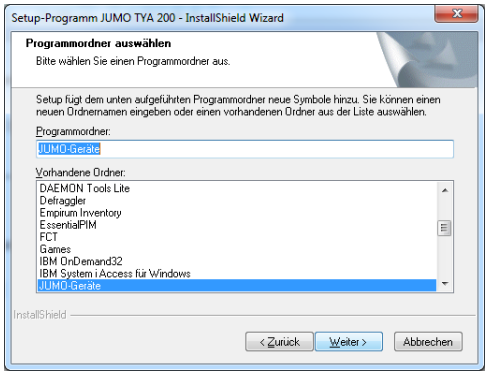
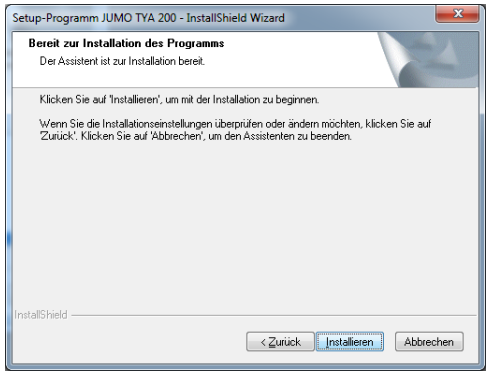
* After switching on the device, press PGM
  The device software version is shown in the Device info menu.
* Click "Info" in the menu bar of the setup program

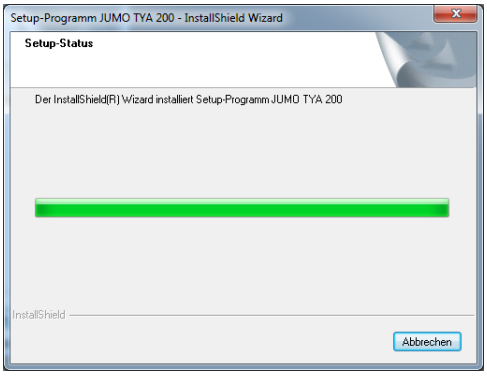
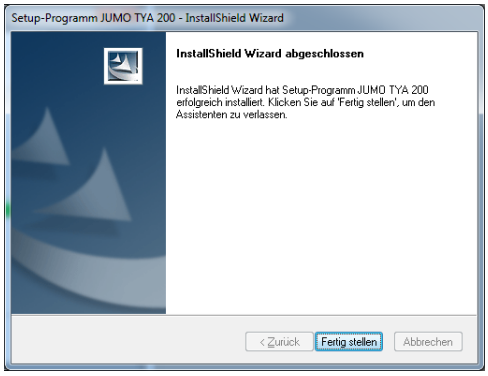
On the device	In the setup program
	

7 Setup program

7.3 Installation

✱ Install the setup program

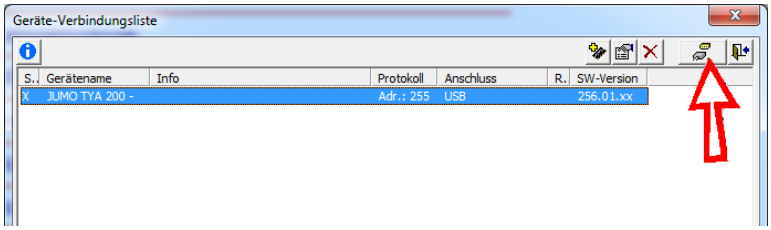
Installation steps	Appearance on the PC screen	
	1 	2 
Enter license number	3 	4 
	5 	6 

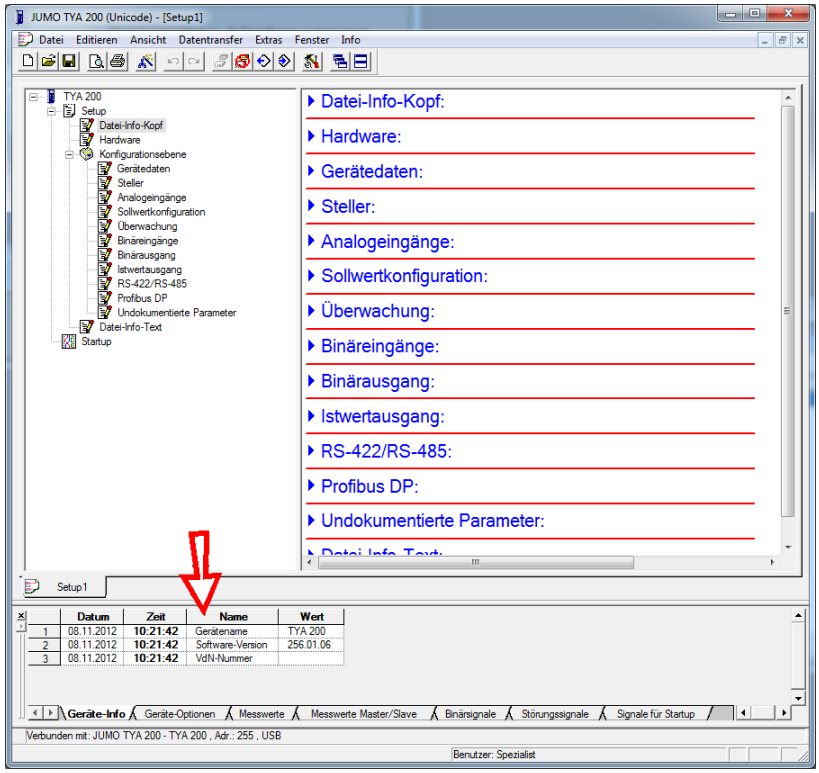
Installation steps	Appearance on the PC screen	
Installation complete	7 	8 
Launch setup program	9 	

7 Setup program

7.4 Program start

* Start the setup program using the Windows® Start menu
* Connect the socket of the power controller to a USB socket on the PC using the supplied USB cable
* Click *Connect* in the menu bar





Diagnosis

The diagnosis window appears at the bottom of the screen and shows the device info and the current measurement data. The connection has thus been established.

The power controller supplies no power while setup data is being transferred "to the device". The device performs a restart after the transmission.

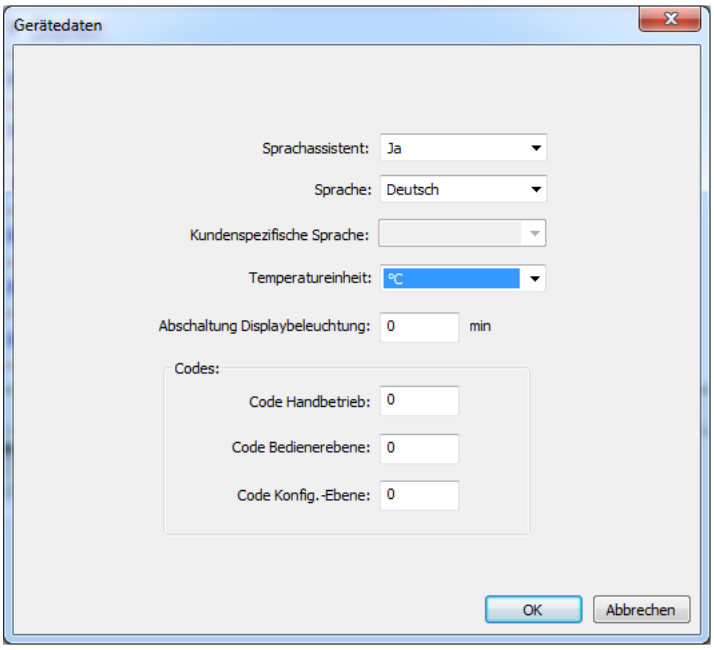
7.5 Have you forgotten your password protection code?

If you have forgotten your password, you can extract the device data or enter a new code word via the setup program.

Extracting set-up data

* Perform a *Data transfer* ➔ *from the device*

The extracted codes are visible in the Device data menu.



Entering new codes

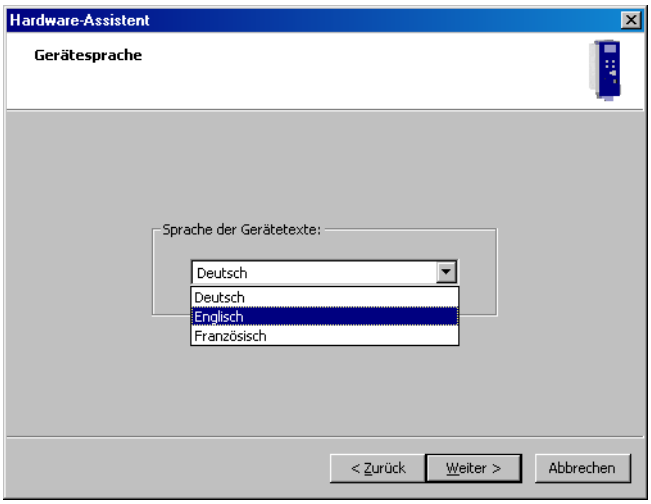
* Enter a new code
* Perform a *Data transfer* ➔ *to the device*
  After the setup data transfer, the device performs a restart and the codes are activated.

7 Setup program

7.6 Changing the national language of the device texts

The national language set per default is specified in the order details. Only one national language can be transmitted to the device with the setup program.

* Connect the device to the PC using the USB cable
* Start the setup program
* Perform a *Data transfer* ➔ *from the device*
* *Edit* ➔ *Execute hardware* and the hardware assistant will start
* Click *Automatic detection* and the dialog for the device language will appear.



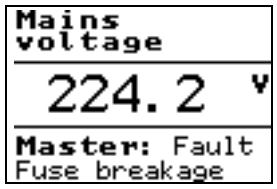
* Select the desired national language
* Continue in the hardware assistant by clicking *Continue* until it is completed The device texts in the selected national language can now be found in the setup file.
* Perform a *Data transfer* ➔ *to the device*
* Save the setup file and wait until the data transmission has been successfully completed

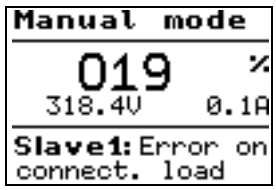
The device now performs a restart and texts will appear on the display in the desired national language.

Cyclical appearance

The symbols for input, subordinate control loop, and operating mode are displayed alternately in the info line together with error messages or alarms as previously described in Chapter 4.1.5 "Appearance of error messages and particular states".

Examples





Alarms are limits entered by the user themselves that are intended to monitor the process:

Alarms	Cause	Remedy
Master: Limit val. MinVal reached	The value has gone below the set limit value for the min. alarm in the master, slave1, or slave2 power controller	-
Slave1: Limit val. MinVal reached		
Slave2: Limit val. MinVal reached		
Master: Limit val. MaxVal reached	The value has exceeded the set limit value for the max. alarm in the master, slave1, or slave2 power controller	-
Slave1: Limit val. MaxVal reached		
Slave2: Limit val. MaxVal reached		

The following error messages are detected separately in the master, slave1, and slave2:

Error message	Cause	Remedy
Master: Error in conn. load	Failure or short circuit of a load resistance in the master, slave1, or slave2 power controller. ⇨ Chapter 6.1 "Detection of load faults"	Replace defective heating elements.
Slave1: Error in conn. load		
Slave2: Error in conn. load		

8 Error messages and alarms

Error message	Cause	Remedy
Master: Fault, fuse failure ---------- Slave1: Fault, fuse failure ---------- Slave2: Fault, fuse failure	1. Semiconductor fuse in the master, slave1, or slave2 power controller defective; the red Fuse LED is lit accordingly.	⇨ Chapter 8.2 "Replacing a defective semiconductor fuse"
	2. No voltage at terminal U1 on the master, slave1, or slave2 power controller; the red Fuse LED is lit accordingly	- Check wiring - Check the wire fuse for the load circuit
	3. The voltage supply for the control electronics L1/N does not have the same phase as the load circuit U1/U2 in the master, slave1, or slave2 power controller.	Check wiring
	4. Thyristor failure (only in operating states in which it is not possible to clearly distinguish between thyristor failure and fuse failure).	Check fuse If the fuse is not defective, this relates to a thyristor failure: The device must be returned to JUMO for repair. ✱ Return the device
Master: Fault, thyristor failure Slave1: Fault, thyristor failure Slave2: Fault, thyristor failure	1. Thyristor in the master, slave1, or slave2 power controller defective. 2. Fuse failure (only in operating states in which it is not possible to clearly distinguish between thyristor failure and fuse failure)	Check fuse If the fuse is not defective, this relates to a thyristor failure: The device must be returned to JUMO for repair. ✱ Return the device
Master: Thyristor short circuit Slave1: Thyristor short circuit Slave2: Thyristor short circuit	Thyristor in the master, slave1, or slave2 power controller defective **Note:** Monitoring only functions when the load resistance is so low that at least 10 % of the power controller nominal current is flowing. This error message may also occur if the load wiring parameter is incorrectly configured. For example, if the three-phase current power controller is wired in a four-wire circuit (star with N conductor) but the load wiring parameter is set to "Y without N conductor", then this error will also be reported.	The device must be returned to JUMO for repair. ✱ Return the device
Master: Caution! High temperature Slave1: Caution! High temperature Slave2: Caution! High temperature	Device temperature is higher than 100 °C (excess temperature) in the master, slave1, or slave 2 power controller	- Ensure adequate ventilation - Reduce load current - Use power controller with higher maximum load current

Error message	Cause	Remedy
Master: Limit. active high temp. Slave1: Limit. active high temp. Slave2: Limit. active high temp.	Device temperature is higher than 105 °C Device is too hot, power is reduced! (power limiting due to excess temperature) in the master, slave1, or slave2 power controller	- Ensure adequate ventilation - Reduce load current - Use power controller with higher maximum load current
Master: Mains volt. too low Slave1: Mains volt. too low Slave2: Mains volt. too low	Mains voltage is not within specified tolerance range in the master, slave1, or slave2 power controller ⇨ Chapter 10.1 "Voltage supply, Fan specifications for 250A, load current"	Check nominal voltage of the device type ⇨ Chapter 1.3 "Order details"
Master: Mains volt. too high Slave1: Mains volt. too high Slave2: Mains volt. too high	Mains voltage is not within specified tolerance range in the master, slave1, or slave2 power controller ⇨ Chapter 10.1 "Voltage supply, Fan specifications for 250A, load current"	Check nominal voltage of the device type ⇨ Chapter 1.3 "Order details"
Master: Tempor. mains drop Slave1: Tempor. mains drop Slave2: Tempor. mains drop	Dangerous temporary DC component for transformer loads was detected in the master, slave1, or slave2 power controller. ⇨ Chapter 5.1.5 "Monitoring"	Ensure stable mains supply.
	The following error messages apply for the entire power controller and are not divided into master, slave1, and slave2:	
Master-slave rotary field error	-Counterclockwise rotary field was detected -May also appear if the 1:1 patch cables of slave1 and slave2 are mixed up. ⇨ Chapter 3.1.1 "Type 709063/X-0X-20-XXX-XXX-XX-25X"	⇨ Chapter 3.5.1 "Delta connection (three-wire circuit)"
Master-slave incorrectly wired.	Wiring error was detected in the master, slave1, or slave2	
Rotary field det. failed	Rotary field detection not possible	- Check connection ⇨ Chapter 3.3 "Connection diagram" - Eliminate mains disturbances
Master-slave error in comm.	Error in the data transfer between master and slaves	Check data connection of the 1:1 patch cable
Data cable faulty	Communication between master and slave interrupted.	Check the 1:1 patch cables and replace if necessary
Synchronization failed	Slave device switched off or communication between master and slave interrupted	Check data connection of the 1:1 patch cable or voltage supply
	Messages for special device states:	

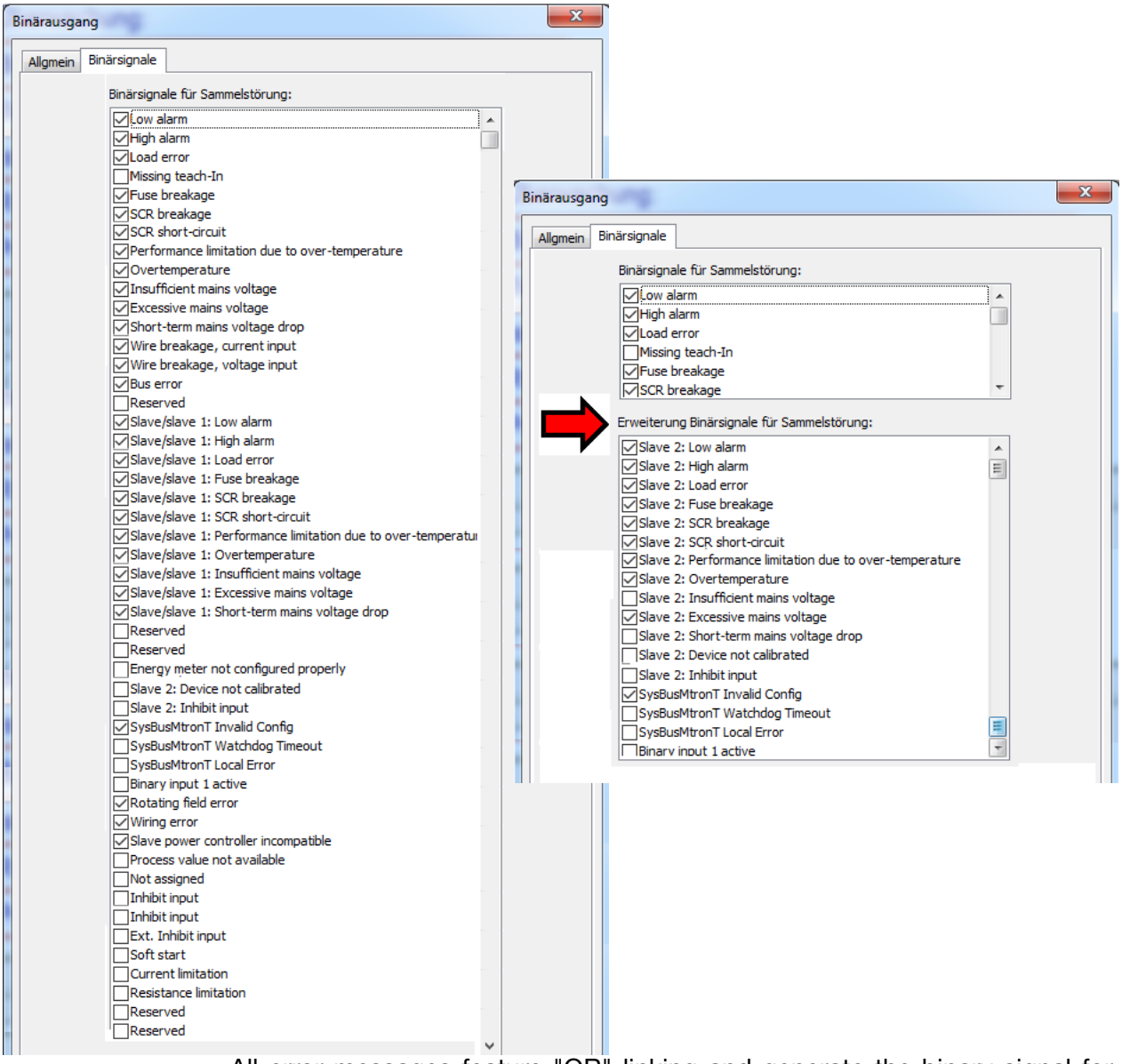
8 Error messages and alarms

Error message	Cause	Remedy
Teach-In load monitoring!	Reminder that "manual" Teach-In has been configured but not yet executed.	Perform Teach-In ⇨ Chapter 6.1 "Detection of load faults"
Inhibit by inhibit input	A firing pulse inhibit has been triggered via a potential-free contact. No power from the power controller.	⇨ Chapter 3.3 "Connection diagram" Open contact between terminal 7 and 8 at screw terminal X_2.
Inhibit by ext. inhibit	The firing pulse inhibit has been triggered via an interface.	⇨ Interface manual "Ext. inhibit"
Soft start phase	This display appears until the soft start period has elapsed.	⇨ Chapter 5.1.2 "Power controller" -> Soft start duration
Current limiting active	The required output level causes an excessive load current and is limited to the set value.	⇨ Chapter 5.1.2 "Power controller" -> Current limiting
Resistance limiting active	The desired output level leads to current/voltage values that are limited to the set load resistance value. The output level is limited to the admissible resistance to prevent the heating element from overheating.	⇨ Chapter 5.1.2 "Power controller" -> Resistance limitation
Wire break Current input	Input current for the set measuring range outside the valid range.	- Check wiring for wire breaks and reverse polarity. - Check upstream devices (controllers)
Wire break Voltage input	Input current for the set measuring range outside the valid range.	- Check wiring for wire breaks and reverse polarity. - Check upstream devices (controllers)
Malfunction Bus error	No connection to Modbus, Profibus, or JUMO mTRON T system interface	Check wiring and master device (PLC).
EtherCAT: InvalConfig	Wrong EtherCAT configuration	check EtherCAT configuration
EtherCAT: PdoWdTimeout	EtherCAT watchdog timeout e.g. not connected Ethernet cable	check EtherCAT wiring
EtherCAT: LocalError	Internal Error	✱ contact JUMO Service
Setpoint value cannot be reached	This message appears when the power required by the setpoint specification can no longer be reached with the load present.	⇨ Chapter 5.1.5 "Monitoring" -> >Control loop monitoring
Config. energy meter faulty	-Total of **pulse length** and **min. pulse interval** too large - Value for **pulses per kWh** too large	⇨ Chapter 5.1.7 "Digital output" -> Output mode

8.1 Binary signal for collective fault

This signal is used for controlling the digital output (if this is not already being used by the energy meter) and the K1 LED, and can also be extracted from the power controller via the interfaces.

Using the setup program, it is possible to configure which events (alarm and error messages) are to be grouped together as a binary signal for a collective fault.



All error messages feature "OR" linking and generate the binary signal for a collective fault. This can be output on the collective fault indicator output (relay or optocoupler).

In addition, the K1 LEDs on all three power controllers light up yellow simultaneously.

⇨ Chapter 5.1.7 "Digital output"

8 Error messages and alarms

8.2 Replacing a defective semiconductor fuse

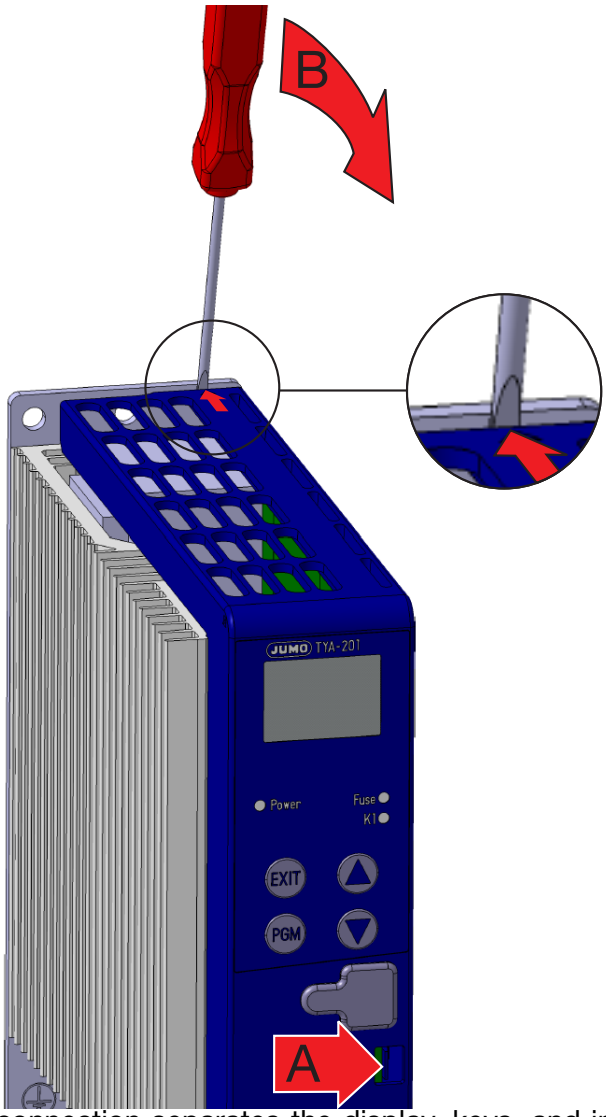
Opening the housing

Caution! Risk of burns!
The device can heat up at the heat sink during operation.

The current device temperature is shown on the display.

⇨ Operating overview (on the first cover page)

* Disconnect the built-in device from the voltage supply on all poles
⇨ Chapter 3.3 "Connection diagram"
* Check that the device is isolated (green Power LED must not be lit)
* Press spring clip (A) to the right and lever up the plastic housing (at the point marked with an arrow) using a screwdriver (B).



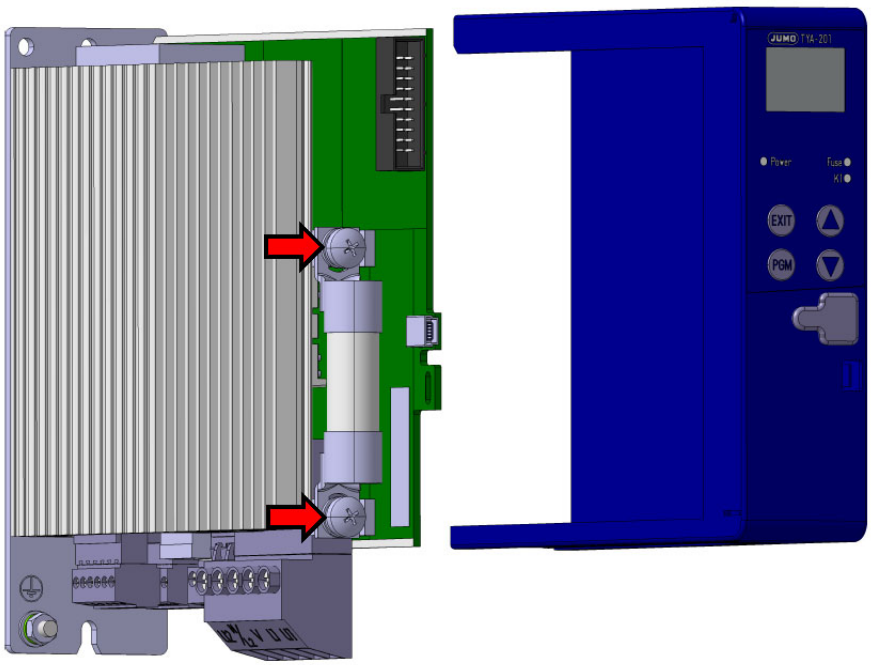
A plug connection separates the display, keys, and interface from the power section and you will be able to see the semiconductor fuse.

8.2.1 Accessories: semiconductor fuses

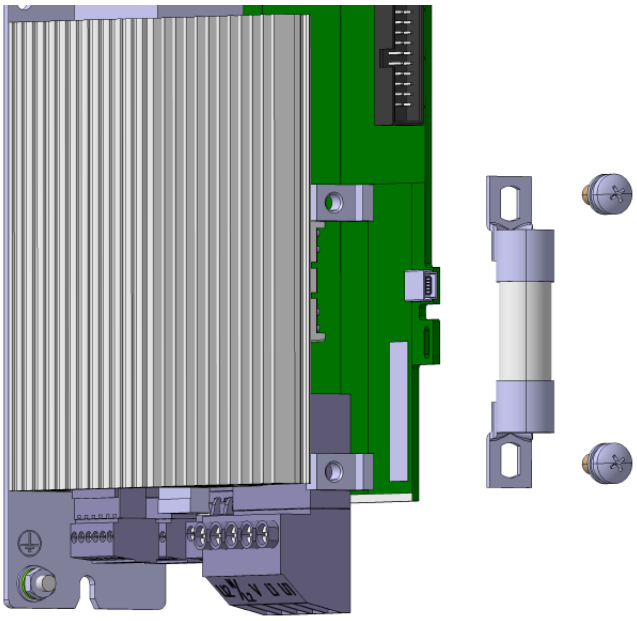
The design of the semiconductor fuse differs according to the device type.

Power controller type	Tripping current	Screws	Tightening torque	Sales no.
20 A	Tripping current: 40 A	Recessed head	3 Nm	70/00513108
32 A	Tripping current: 80 A	Recessed head	5 Nm	70/00068011
50 A	Tripping current: 80 A	Recessed head	5 Nm	70/00068011
100 A	Tripping current: 160 A	Hex-headed, width across flats 10 mm	5 Nm	70/00081801
150 A	Tripping current: 350 A	Hex-headed, width across flats 13 mm	12 Nm	70/00083318
200 A	Tripping current: 550 A	Hex-headed, width across flats 13 mm	12 Nm	70/00371964
250 A	Tripping current: 550 A	Hex-headed, width across flats 13 mm	12 Nm	70/00371964

8.2.2 Semiconductor fuses type 709063/X-0X-20...

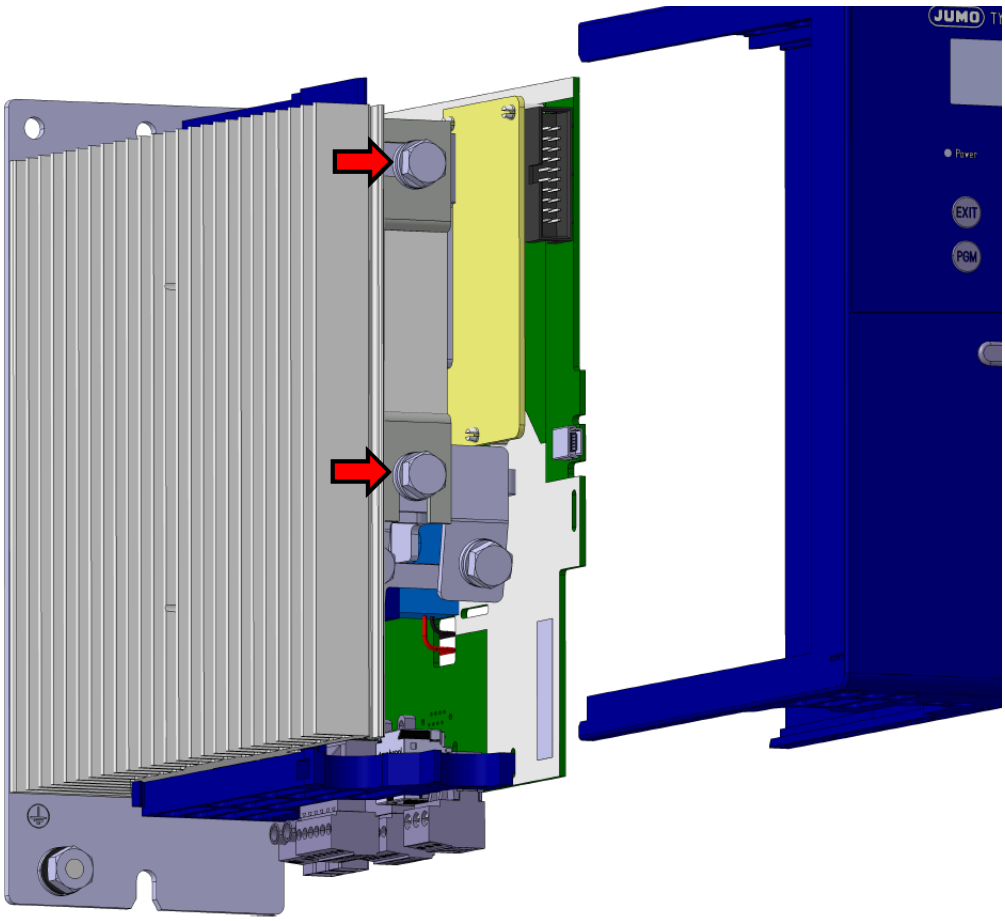


✱ Undo 2 recessed head screws

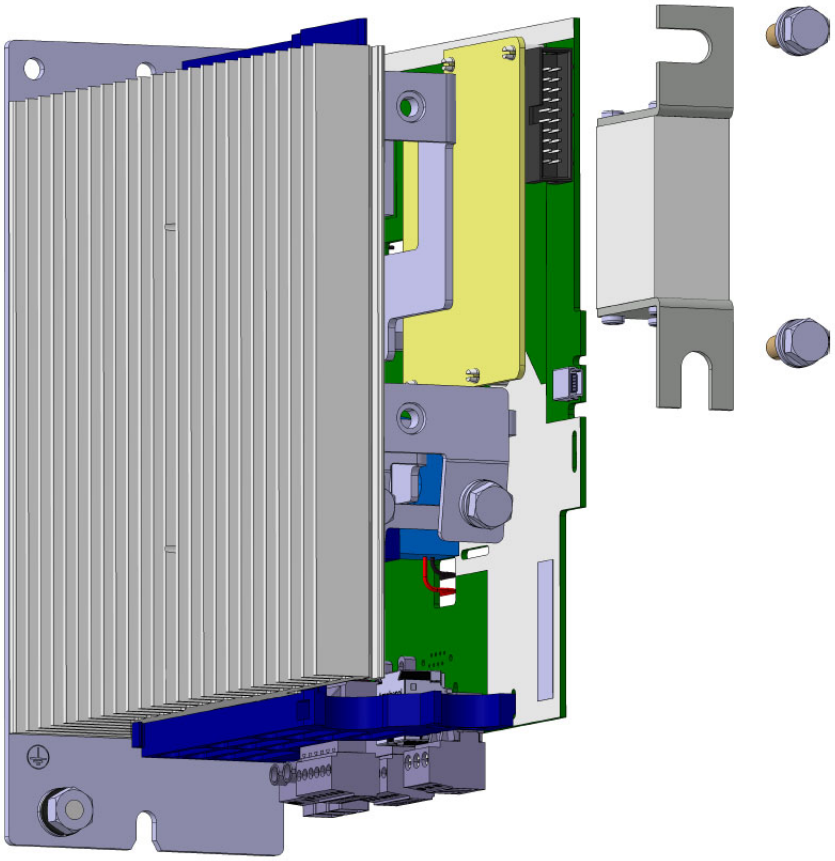


* Replace the defective semiconductor fuse with a new one
* Tighten the screws with the specified tightening torque

8.2.3 Semiconductor fuses type 709063/X-0X-32 to 250...



* Undo 2 hex-headed screws



* Replace the defective semiconductor fuse with a new one
* Tighten the screws with the specified tightening torque

Reassembling the housing

* Push the plastic housing back into the guide rails until the spring clip engages.

8 Error messages and alarms

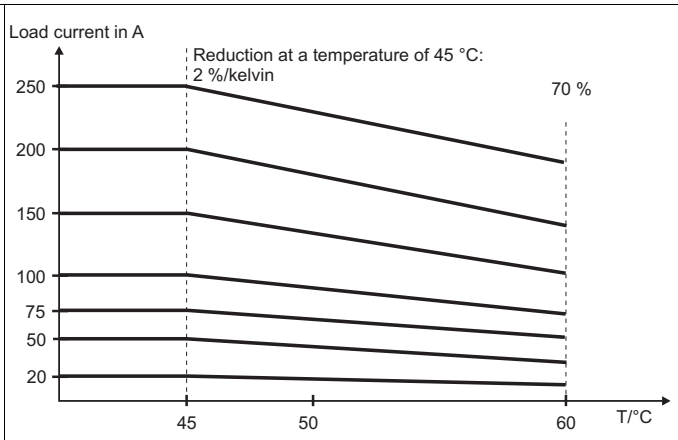
What is happening?	Cause / remedy	Info
Green Power LED is flashing	- Display switch-off active ✱ Press any key	⇨ Chapter 5.1.1 "Device data"
Power controller is not producing any output power even though the green Power LED is lit and a setpoint value has been set.	- Parameters have been changed in the configuration level but not completed. ✱ Leave the configuration level by pressing EXIT and wait for a restart.	-
	- Wire break at the analog input or incorrect analog input wiring	⇨ Chapter 3.3 "Connection diagram"
	- Setpoint value configuration incorrectly configured, e.g. set via interface.	⇨ Chapter 5.1.4 "Setpoint value configuration"
	- Input for firing pulse inhibit active A padlock symbol is shown in the info line as the operating mode. Undo connection between screw terminal 7 and 8 at terminal X2_2.	⇨ Chapter 4.1.2 "Appearance of measured values"
	- Load break ✱ Check load and load connections	⇨ Chapter 8 "Error messages and alarms"
Fuse LED is lit on master, slave1, or slave2	- Semiconductor fuse defective due to short circuit in power section ✱ Remedy short circuit in the load or load circuit ✱ Fit a new semiconductor fuse	⇨ Chapter 8.2 "Replacing a defective semiconductor fuse"
Power controller is producing power even though no setpoint value (output level) is specified by the controller.	- Configuration problem: Controller output signal set to 4 to 20 mA and current set to 0 to 20 mA at analog input of power controller. ✱ Check configuration and set same standard signals at the controller and power controller.	⇨ Chapter 5.1.3 "Analog inputs" ⇨ Chapter 5.1.4 "Setpoint value configuration"
	- Power controller in manual mode ✱ Exit manual mode by pressing EXIT	⇨ Chapter 6.2 "Manual mode"
	- Base load settings set ✱ Check settings for base load settings	⇨ See "Base load" on page 68.
	- Thyristor short circuit	⇨ Chapter 8 "Error messages and alarms"

9 What to do, if ...

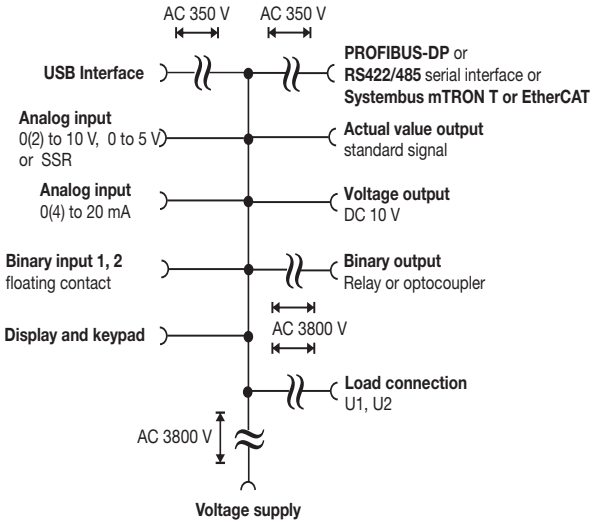
What is happening?	Cause / remedy	Info
Power controller is not producing full power even though the setpoint value is set to 100 %	- Current limiting active ✱ Check settings	⇨ See "Current limiting" on page 63.

10.1 Voltage supply, Fan specifications for 250A, load current

Code	Voltage supply for control electronics = max. load voltage	Fan specifications Type 709063/X-0X-250...
024	AC 24 V -20% to +15%, 48 to 63 Hz	AC 24 V / 3x30 VA
042	AC 42 V -20% to +15%, 48 to 63 Hz	AC 24 V / 3x30 VA
115	AC 115 V -20% to +15%, 48 to 63 Hz	AC 115 V / 3x30 VA
230	AC 230 V -20% to +15%, 48 to 63 Hz	AC 230 V / 3x30 VA
265	AC 265 V -20% to +15%, 48 to 63 Hz	AC 230 V / 3x30 VA
400	AC 400 V -20% to +15%, 48 to 63 Hz	AC 230 V / 3x30 VA
460	AC 460 V -20% to +15%, 48 to 63 Hz	AC 230 V / 3x30 VA
500	AC 500 V -20% to +15%, 48 to 63 Hz	AC 230 V / 3x30 VA
Load current $I_{L\ rms}$	AC 20, 32, 50, 100, 150, 200, 250 A	
Load type	Resistive and resistive/inductive (transformer) loads	
Power consumption of control sections	max. 60 VA	

Admissible load current depending on the ambient temperature	
Load types	All resistive loads up to and including transformer loads are permitted. In the case of transformer loads, the nominal induction of 1.2 tesla must not be exceeded (value is 1.45 T in the case of mains overvoltage).

10.2 Galvanic isolation



10 Technical data

10.3 Analog inputs (master only)

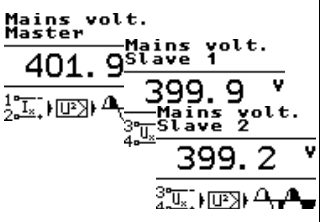
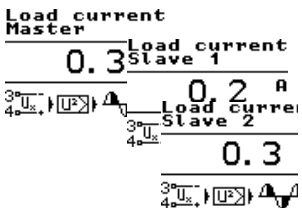
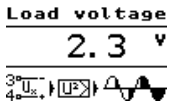
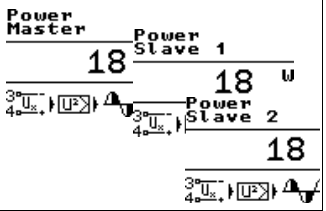
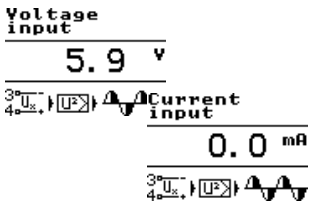
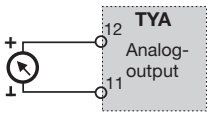
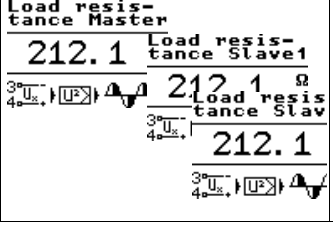
Current	0 (4) to 20 mA R_i = 50 Ω
Voltage	0 (2) to 10 V R_i = 25 kΩ
	0 (1) to 5 V R_i = 25 kΩ

10.4 Analog output (master only)

Analog output	Switched off as standard. I_{max} = 20 mA with standard signal, voltage: 0 to 10 V, 2 to 10 V, 0 to 5 V up to 1 to 5 V. Burden max. 500 Ω with standard signal, current: 0 to 20 mA up to 4 to 20 mA Depending on the device type, various internal measurands such as load current, load voltage, or power can be output.

10.4.1Display and measuring accuracy

All specifications refer to the power controller nominal data.

Mains voltage: ±2.5 % 	**Load current:** ±1 % (2 %) 	**Load voltage:** ±1 % (2.5 %) 	**Power:** ±2 % (4 %) 
Analog input voltage/current: ±1 % 	**Analog output voltage/current:** ±1 % (2.5 %) 	**Load resistance:** ±2 % (4 %) (for resistive load) 	

The values in brackets apply to the three-wire circuit as of a phase angle of α ≤ 120° el.

10.5 Digital inputs

Digital input 1	For connection to potential-free contact
Digital input 2	

10.6 Digital output

The fault signal output (relay or optocoupler) is installed at a load current of 20 A in slave2 and from 32 to 250 A in the master.

Relay (changeover contact) without contact protection circuit	30,000 switching operations at a switching capacity of AC 230 V / 3 A (1.5 A), 50 Hz, B300 (UL 508)
Optocoupler output	I_{Cmax} = 2 mA, U_{CEOmax} = 32 V
Optocoupler as energy meter (can be adjusted via Setup)	Number of pulses per kWh: 1 to 10000 Pulse length: 30 ms to 2 sec.

10.7 General specifications

Thyristor control:	**Setpoint specification current input** (can carry current up to 25 mA)	**Setpoint specification voltage input** (surge proof up to max. DC 32 V**)**	**Setpoint specification digital input1, 2** (surge proof up to max. DC 32 V**)**	**Via interface**
Continuous	The power controller provides the power for the load continuously depending on the configured setpoint specification.		-	Possible
Logic (Solid state relay SSR)	The power controller acts like a switch and switches the load ON and OFF. The switching threshold is always in the middle of the configured current/voltage range. At 4 to 20 mA, it is 12 mA; at 0 to 10 V, it is 5 V.		OFF logical "0" = 0 to +0.8 V; ON logical "1" = +2 to 3.3 V	Possible

Circuit options	- Delta connection (three-wire circuit) - Star connection without neutral conductor (three-wire circuit) - Star connection with neutral conductor (four-wire circuit) - Open delta connection (six-wire circuit)
Operating modes	- Phase angle control and burst firing mode for resistive and transformer loads
Special features	- Dual energy management - Soft start with pulse groups
Load types	All symmetrical resistive loads up to and including transformer loads are permitted. In the case of transformer loads, the nominal induction of 1.2 tesla must not be exceeded (value is 1.45 T in the case of mains overvoltage).
Subordinate control loop	U^2 set as standard Can be freely switched over to U, I, I^2, P control depending on device type
Electrical connection	For type 709063/X -0X-020... Control and load leads are connected via screw terminals. From type 709063/X -0X-032... Control leads are connected via screw terminals and load leads via cable lugs DIN 46235 and DIN 46234 or tubular cable lugs.
Operating conditions	The power controller is designed as a built-in device according to: EN 50178, pollution degree 2, overvoltage category Ü III
Electromagnetic compatibility	According to DIN 61326-1 Interference emission: Class B Interference immunity: to industrial requirements
Protection type	All device types IP20 according to EN 60529
Protection rating	Protection rating I, with isolated control circuitry for connection to SELV circuits

10 Technical data

<table>
<tr><td>Admissible ambient temperature range</td><td>40 °C with forced air cooling using fan for type 709063/X-0X-250...
0 to 45 °C with natural air cooling (extended temperature range class 3K3 according to EN 60721-3-3)
At higher temperatures, operation with reduced type current is possible.
(from 45 °C with type current -2 %/°C)
⇨ Chapter 2.1.3 "Admissible load current depending on the ambient temperature and the site altitude"</td></tr>
<tr><td>Admissible storage temperature range</td><td>-30 to +70 °C (1K5 according to EN 60721-3-1)</td></tr>
<tr><td>Altitude</td><td>≤ 2000 m above MSL
Caution: At site altitudes > 1000 m above MSL, the ampacity of the power controller decreases by 0.86 % per 100 m</td></tr>
<tr><td>Cooling</td><td>- Natural convection up to a load current of 200 A
- From 250 A of load current, forced convection
- At installation heights over 1000 m, the ampacity of the power controller decreases
⇨ Chapter 2.1.3 "Admissible load current depending on the ambient temperature and the site altitude"</td></tr>
<tr><td>3 fans (only for type 709063/X-0X-250...)</td><td>Depending on the mains voltage of the power controller, all three X14 fan terminals must be supplied with the voltage specified below.
The lead protection must be between 2 A and a maximum of 5 A.
The fan is temperature-controlled, switches on automatically when the device temperature reaches 85 °C, and remains in operation until the device temperature falls below 70 °C.
<table>
<tr><th>Mains voltage of the power controller</th><th>Tolerances</th><th>Fan specifications</th></tr>
<tr><td>Mains voltage AC 24 V</td><td>-20 to +15 %, 48 to 63 Hz</td><td rowspan="2">AC 24 V/3x30 VA</td></tr>
<tr><td>Mains voltage AC 42 V</td><td>-20 to +15 %, 48 to 63 Hz</td></tr>
<tr><td>Mains voltage AC 115 V</td><td>-15 to +6 %, 48 to 63 Hz</td><td>AC 115 V/3x30 VA</td></tr>
<tr><td>Mains voltage AC 230 V</td><td rowspan="5">-15 to +6 %, 48 to 63 Hz</td><td rowspan="5">AC 230 V/3x30 VA</td></tr>
<tr><td>Mains voltage AC 265 V</td></tr>
<tr><td>Mains voltage AC 400 V</td></tr>
<tr><td>Mains voltage AC 460 V</td></tr>
<tr><td>Mains voltage AC 500 V</td></tr>
</table></td></tr>
<tr><td>Resistance to climatic conditions</td><td>Rel. humidity ≤ 85 % annual average, no condensation 3K3 according to EN 60721</td></tr>
<tr><td>Installation position</td><td>Vertical</td></tr>
<tr><td>Test voltage</td><td>According to EN 50178 Tab. 18</td></tr>
<tr><td>Creepage distances</td><td>8 mm between supply current circuit and SELV circuits
For type 709063/X -0X-020...
12.7 mm between supply current circuit and SELV circuits
From type 709063/X -0X-032...
SELV = Separate Extra Low Voltage (safe low voltage)</td></tr>
<tr><td>Housing</td><td>Plastic, flammability class UL94 V0, color: cobalt blue RAL 5013</td></tr>
<tr><td>Power loss</td><td>The power loss can be calculated using the following empirical formula:
$P_v = 3x\ (20\ W + 1.3\ V \times I_{Load}\ A)$</td></tr>
</table>

Maximum temperature of the heat sink	110°C
Weight	Load current 20 A approx. 3.3 kg Load current 32 A approx. 6.3 kg Load current 50 A approx. 8.1 kg Load current 100 A approx. 11.4 kg Load current 150 A approx. 25.5 kg Load current 200 A approx. 28.5 kg Load current 250 A approx. 30.6 kg
Scope of delivery	1 operating manual 70906300T90Z000K000

10.8 Approvals / approval marks

Approval mark	Test facility	Certificates/ certification numbers	Inspection basis	Valid for type
c UL us LISTED	Underwriters Laboratories	20150630-E223137	UL 508 (Category NRNT), pollution degree 2 C22.2 NO. 14-10 Industrial Control Equipment (Category NRNT7)	709063/X-XX-020-... Load current 20 A
			UL 508 (Category NRNT) C22.2 NO. 14-10 Industrial Control Equipment (Category NRNT7)	709063/X-XX-032... 709063/X-XX-050... 709063/X-XX-100... 709063/X-XX-150... 709063/X-XX-200... 709063/X-XX-250... Load current 32 to 250 A

Lead protection for the control electronics	2 A up to max. 5 A, conductor cross section maximum AWG 20-12

10 Technical data

11.1 UL

CERTIFICATE OF COMPLIANCE

Certificate Number	20160609-E223137
Report Reference	E223137-20140218
Issue Date	2016-JUNE-09
Issued to:	JUMO GMBH & CO KG MORITZ-JUCHHEIM-STRASSE 1 36039 FULDA GERMANY
This is to certify that representative samples of	SWITCHES, INDUSTRIAL CONTROL See addendum page
	Have been investigated by UL in accordance with the Standard(s) indicated on this Certificate.
Standard(s) for Safety:	UL 508 & C22.2 No. 14-13 - Industrial Control Equipment
Additional Information:	See the UL Online Certifications Directory at www.ul.com/database for additional information

Only those products bearing the UL Certification Mark should be considered as being covered by UL's Certification and Follow-Up Service.

Look for the UL Certification Mark on the product.

Bruce Mahrenholz, Director North American Certification Program

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CERTIFICATE OF COMPLIANCE

Certificate Number	20160609-E223137
Report Reference	E223137-20140218
Issue Date	2016-JUNE-09

This is to certify that representative samples of the product as specified on this certificate were tested according to the current UL requirements.

Industrial Control Switches, open types, Cat. Nos. 709061 / 709062 or 709063 /, followed by 8 or 9, followed by - 01, - 02 or - 03, followed by - 020, - 032, - 050, - 100, - 150, - 200 or - 250, followed by - 100, - 010 or - 001, followed by - 024, - 042, - 115, - 230, - 265, - 400, - 460 or - 500, followed by - two digits, followed by / 252 or / 257.

Bruce Mahrenholz, Director North American Certification Program

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11.2 China RoHS

部件名称 Product group: 709061	 有毒有害物质或元素 Hazardous substances					
	铅（Pb）	汞（Hg）	镉（Cd）	六价铬（Cr(VI)）	多溴联苯（PBB）	多溴二苯醚（PBDE）
外壳 Housing (Gehäuse)	X	○	○	○	○	○
过程连接 Process connection (Prozessanschluss)	○	○	○	○	○	○
-螺母 Nut (Mutter)	○	○	○	○	○	○
螺钉 Screw (Schraube)	○	○	○	○	○	○

本表格依据 SJ/T 11364-2014**的规定编制。**
(This table is prepared in accordance with the provisions of SJ/T 11364-2014.)
O：**表示**该有害物质在该部件所有均质材料中的含量均在 GB/T 26572 规定的限量要求以下。
(O: Indicates that said hazardous substance contained in all of the homogeneous materials for this part is below the limit requirement of GB/T 26572.)
X：**表示**该有害物质至少在该部件的某一均质材料中的含量超出 GB/T 26572 规定的限量要求。
(X: Indicates that said hazardous substance contained in one of the homogeneous materials used for this part is above the limit requirement of GB/T 26572.)

11 Certificates

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