CP20.481-ETC

48 V, 10 A, 480 W, Single Phase



Power Supply

- AC 100-240 V wide-range input
- Width only 48 mm
- Direct access to internal and external parameters via integrated EtherCAT interface
- Efficiency up to 96.2 %
- 20 % output power reserves (PowerBoost)
- Easy Fuse Breaking – 3 times nominal current for 12 ms
- Safe Hiccup^{PLUS} Overload Mode
- Full power between -25 °C and +60 °C
- Current sharing feature for parallel use
- 3 year warranty

Product Description

The CP20.481-ETC is a high-quality power supply based on the popular CP20 series. With the integrated EtherCAT interface the unit is giving access to real-time and recorded data informing about the condition of the power supply itself and the power line. Amongst many electrical operation parameters, DC OK and Alarm signals are available via the interface as well as a remote ON/OFF function and "Single / Parallel Use" feature for load sharing between power supplies connected in parallel.

Like its series members, the CP20.481-ETC comes with advanced features like e.g. PowerBoost: Power reserves of 20 %, which may even be used continuously at temperatures up to +45 °C. Additionally it can deliver 3 times the nominal output current for 12 ms, which helps to trip fuses on faulty output branches.

The Dimension CP-Series are cost optimized power supplies without compromising quality, reliability and performance. The most outstanding features of this series are the high efficiency, electronic inrush current limitation, active PFC, wide operational temperature range and the extraordinary small size.

Short-form Data

Output voltage	DC 48 V	Nominal
Adjustment range	48 – 56 V	Factory setting 48.0 V
	AC 120 – 240 V mains, DC 150-300 V mains	
Output current	10.0 – 8.6 A	Up to +60 °C ambient
PowerBoost	12.0 – 10.3 A	Up to +45 °C ambient
Derating	linear 12.5 W/K	> +60 °C ambient
	AC 100 V mains, DC 110-150 V mains	
Output current	8.75 – 7.4 A	Up to +60 °C ambient
PowerBoost	10.5 – 9.0 A	Up to +45 °C ambient
Derating	linear 10.5 W/K	> +60 °C ambient
Input voltage AC	AC 100-240 V	-15 %/+10 %
Mains frequency	50-60 Hz	±6 %
Input current AC	4.26 / 2.23 A	At 120 / 230 Vac
Power factor	0.99 / 0.98	At 120 / 230 Vac
Input voltage DC	DC 110-300 V	±20 %
Input current DC	4.64 / 1.66 A	At 110 / 300 Vdc
AC Inrush current	10.0 / 4.5 A_{peak}	At 120 / 230 Vac
Efficiency	94.8 / 96.2 %	At 120 / 230 Vac
Losses	26.6 / 18.9 W	At 120 / 230 Vac
Hold-up time	32 / 32 ms	At 120 / 230 Vac
Temperature range	-25 °C to +70 °C	
Size (WxHxD)	48x124x127 mm	Without DIN rail
Weight	830 g	

Order Numbers

Power Supply	**CP20.481-ETC**	
Accessory	**ZM10.WALL**	Wall/Panel mounting bracket

Main Approvals

For details and the complete approval list, see chapter 21.

c UL us LISTED

UL 61010-2-201

All parameters are typical values specified 230 Vac, 50 Hz input voltage, 48 V, 10 A output load, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.

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Packaging and packaging aids can and should always be recycled. The product itself may not be disposed of as domestic refuse.

Terminology and Abreviations

PE and ⏚ symbol	PE is the abbreviation for **P**rotective **E**arth and has the same meaning as the symbol ⏚.
Earth, Ground	This document uses the term “earth” which is the same as the U.S. term “ground”.
t.b.d.	To be defined, value or description will follow later.
AC 230 V	A figure displayed with the AC or DC before the value represents a nominal voltage with standard tolerances (usually ±15 %) included. E.g.: DC 12 V describes a 12 V battery disregarding whether it is full (13.7 V) or flat (10 V)
230 Vac	A figure with the unit (Vac) at the end is a momentary figure without any additional tolerances included.
50 Hz vs. 60 Hz	As long as not otherwise stated, AC 230 V parameters are valid at 50 Hz mains frequency.
may	A key word indicating flexibility of choice with no implied preference.
shall	A key word indicating a mandatory requirement.
should	A key word indicating flexibility of choice with a strongly preferred implementation.

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1. Intended Use

This device is designed for installation in an enclosure and is intended for commercial use, such as in industrial control, process control, monitoring and measurement equipment or the like.

Do not use this device in equipment, where malfunctioning may cause severe personal injury or threaten human life without additional appropriate safety devices, that are suited for the end-application.

If this device is used in a manner outside of its specification, the protection provided by the device may be impaired.

2. Installation Instructions

⚠ WARNING Risk of electrical shock, fire, personal injury or death

- Turn power off before working on the device. Protect against inadvertent re-powering.
- Do not modify or repair the unit.
- Do not open the unit as high voltages are present inside.
- Use caution to prevent any foreign objects from entering the housing.
- Do not use in wet locations or in areas where moisture or condensation can be expected.
- Do not touch during power-on, and immediately after power-off. Hot surfaces may cause burns.

Obey the following installation instructions:

This device may only be installed and put into operation by qualified personnel.

This device does not contain serviceable parts. The tripping of an internal fuse is caused by an internal defect.

If damage or malfunction should occur during installation or operation, immediately turn power off and send unit to the factory for inspection.

Install the device in an enclosure providing protection against electrical, mechanical and fire hazards.
Install the device onto a DIN rail according to EN 60715 with the input terminals on the bottom of the device.
Make sure that the wiring is correct by following all local and national codes. Use appropriate copper cables that are designed for a minimum operating temperature of +60 °C for ambient temperatures up to +45 °C, +75 °C for ambient temperatures up to +60 °C and +90 °C for ambient temperatures up to +70 °C. Ensure that all strands of a stranded wire enter the terminal connection. Use ferrules for wires on the input terminals. Unused screw terminals should be securely tightened.
The device is designed for pollution degree 2 areas in controlled environments. No condensation or frost is allowed.
The enclosure of the device provides a degree of protection of IP20. The housing does not provide protection against spilled liquids.
The isolation of the device is designed to withstand impulse voltages of overvoltage category III according to IEC 60664-1.
The device is designed as “Class of Protection I” equipment according to IEC 61140. Do not use without a proper PE (Protective Earth) connection.
The device is suitable to be supplied from TN, TT or IT mains networks. The continuous voltage between the input terminals and the PE potential must not exceed 300 Vac.
The input can also be powered from a battery or a similar DC source. The continuous voltage between the supply voltage and the PE/ground potential must not exceed 375 Vdc.
A disconnecting means shall be provided for the input of the device.
The device is designed for convection cooling and does not require an external fan. Do not obstruct airflow and do not cover ventilation grid!
The device is designed for altitudes up to 5000 m. Above 2000 m a reduction in output current and overvoltage category is required.

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Keep the following minimum installation clearances:

Output power	Installation clearance (mm)		
related to nominal	top	bottom	side
< 50 %	40	20	0
≥ 50 %	40	20	5
≥ 90 %	40	20	15

The device is designed, tested and approved for branch circuits up to 32 A (IEC) and 30 A (UL) without additional protection device. If an external fuse is utilized, do not use circuit breakers smaller than 10 A B- or C-Characteristic to avoid a nuisance tripping of the circuit breaker.
The maximum surrounding air temperature is +70 °C. The operational temperature is the same as the ambient or surrounding air temperature and is defined 2 cm below the device.
The device is designed to operate in areas between 5 % and 95 % relative humidity.

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3. AC-Input

The device is suitable to be supplied from TN, TT or IT mains networks.

AC input voltage Range A	nom.	AC 120-240 V	-15 %/+10 %
AC input voltage Range B	nom.	AC 100-240 V	-15 %/+10 %
AC input range		85-264 Vac	
		264-300 Vac	Occasionally for maximal 500 ms
Allowed voltage L or N to earth	max.	300 Vac	Continuous, according to IEC 60664-1
Input frequency	nom.	50–60 Hz	±6 %
Turn-on voltage	typ.	82 Vac	Steady-state value, see Fig. 3-1
Shut-down voltage	typ.	72 Vac	Steady-state value, see Fig. 3-1
External input protection	See recommendations in chapter “Installation Instructions”.		

		AC 100 V	AC 120 V	AC 230 V	
Input current	typ.	5.15 A	4.26 A	2.23 A	At 48 V, 10 A, see Fig. 3-3
Power factor	typ.	0.99	0.99	0.98	At 48 V, 10 A, see Fig. 3-4
Crest factor	typ.	1.65	1.63	1.63	At 48 V, 10 A, The crest factor is the mathematical ratio of the peak value to RMS value of the input current waveform.
Start-up delay	typ.	710 ms	647 ms	506 ms	See Fig. 3-2
Rise time	typ.	119 ms	116 ms	114 ms	At 48 V, 10 A const. current load, 0 mF load capacitance, see Fig. 3-2
	typ.	150 ms	150 ms	150 ms	At 48 V, 10 A const. current load, 20 mF load capacitance, see Fig. 3-2
Turn-on overshoot	max.	200 mV	200 mV	200 mV	In single use mode, see Fig. 3-2

Fig. 3-1 **Input voltage range**

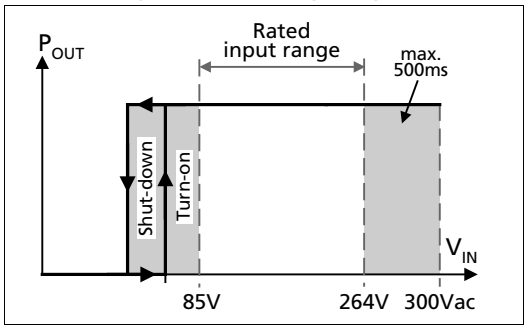


Fig. 3-2 **Turn-on behavior, definitions**

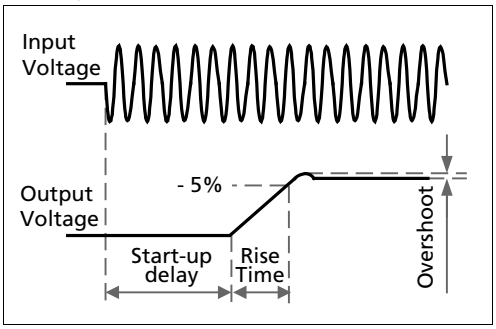


Fig. 3-3 **Input current vs. output current at 48 V output voltage**

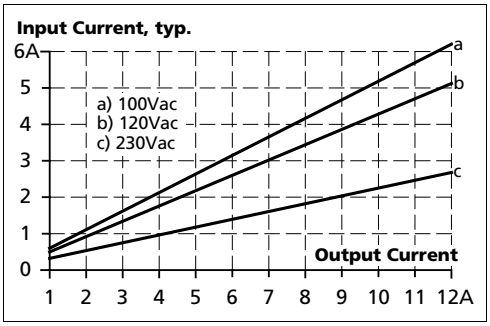
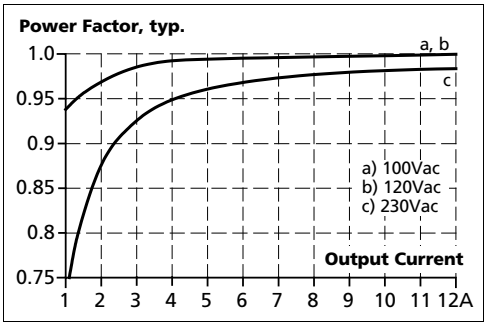


Fig. 3-4 **Power factor vs. output current at 48 V output voltage**



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4. DC-Input

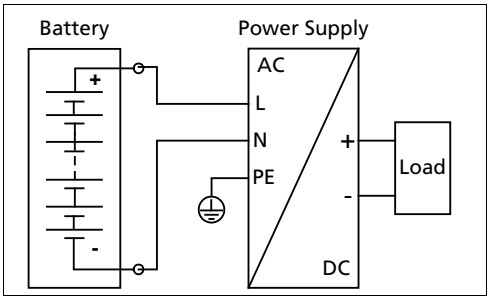
The device is suitable to be supplied from a DC input voltage. Use a battery or a similar DC source.

A supply from the intermediate DC-bus of a frequency converter is not recommended and can cause a malfunction or damage the unit.

Connect +pole to L, –pole to N and the PE terminal to an earth wire or to the machine ground.

DC input voltage Range A	nom.	DC 150-300 V	±20 %
DC input voltage Range B	nom.	DC 110-150 V	±20 %
DC input range		88-360 Vdc	
DC input current	typ.	4.64 A	At 110 Vdc, at 48 V, 10 A
		1.66 A	At 300 Vdc, at 48 V, 10 A
Allowed Voltage L/N to Earth	max.	375 Vdc	Continuous, according to IEC 62477-1
Turn-on voltage	typ.	80 Vdc	Steady state value
Shut-down voltage	typ.	70 Vdc	Steady state value

Fig. 4-1 **Wiring for DC Input**



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5. Input Inrush Current

An active inrush limitation circuit limits the input inrush current after turn-on of the input voltage.
The charging current into EMI suppression capacitors is disregarded in the first microseconds after switch-on.

		AC 100 V	AC 120 V	AC 230 V	
Inrush current	max.	15 A_{peak}	12 A_{peak}	5.5 A_{peak}	Temperature independent
	typ.	12 A_{peak}	10 A_{peak}	4.5 A_{peak}	Temperature independent
Inrush energy	max.	3.0 A^2s	2.0 A^2s	0.5 A^2s	Temperature independent

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6. Output

The output provides a SELV/PELV rated voltage, which is galvanically isolated from the input voltage.

The output is electronically protected against no-load, overload and short circuit. In case of a protection event, audible noise may occur.

The output is designed to supply any kind of loads, including inductive and capacitive loads. If capacitors with a capacitance > 1 F are connected, the unit might charge the capacitor in an intermittent mode.

At heavy overloads (when output voltage falls below 26 V), the power supply delivers continuous output current for 2s. After this, the output is switched off for approx. 18 s before a new start attempt is automatically performed. This cycle is repeated as long as the overload exists. If the overload has been cleared, the device will operate normally.

The device is equipped with a "Single Use / Parallel Use" feature, which can be selected on the front of the unit. The "Parallel Use" mode regulates the output voltage in such a manner that the voltage at no load is approx. 4 % higher than at nominal load. This achieves a load sharing between power supplies when they are connected in parallel.

Output voltage	nom.	48 V	
Adjustment range	min.	48-56 V	Guaranteed value
	max.	60 V	This is the maximum output voltage which can occur at the clockwise end position of the potentiometer due to tolerances. It is not a guaranteed value which can be achieved.
Factory setting output voltage	typ.	48.0 V	±0.2 % in "single use" mode at full load, cold unit
	typ.	47.0 V	±0.2 % in "parallel use" mode at 10 A, cold unit (results to 46.6 V ±0.2 % at 12 A and 49.0 V ±0.2 % at no load)
Line regulation	max.	10 mV	Between 85 and 300 Vac input voltage change
Load regulation	max.	150 mV	Between 0 and 10 A in "single use" mode, static value
	typ.	1000 mV	Between 0 and 12 A in "parallel use" mode, static value
Ripple and noise voltage	max.	50 mVpp	Bandwidth 20 Hz to 20 MHz, 50 Ohm
Output current Range A	nom.	10 A	At 48 V and up to +60 °C ambient temperature
	nom.	7.4 A	At 48 V and +70 °C ambient temperature
	nom.	8.6 A	At 56 V and up to +60 °C ambient temperature
	nom.	6.35 A	At 56 V and +70°C ambient temperature
	Derate linearly between +60 °C to +70 °C, see chapter 18		
PowerBoost Range A [1)]	nom.	12 A	At 48 V and up to +45 °C ambient temperature, see Fig. 18-1
	nom.	10.3 A	At 56 V and up to +45 °C ambient temperature, see Fig. 18-1
	PowerBoost decreases linearly to nominal power between +45 °C and +60 °C, see chapter 18		
Output current Range B	nom.	8.75 A	At 48 V and up to +60 °C ambient temperature
	nom.	6.56 A	At 48 V and +70 °C ambient temperature
	nom.	7.5 A	At 56 V and up to +60 °C ambient temperature
	nom.	5.65 A	At 56 V and +70 °C ambient temperature
	Derate linearly between +60 °C to +70 °C, see chapter 18		
PowerBoost Range B [1)]	nom.	10.5 A	At 48 V and up to +45 °C ambient temperature, see Fig. 18-1
	nom.	9.0 A	At 56 V and up to +45 °C ambient temperature, see Fig. 18-1
	PowerBoost decreases linearly to nominal power between +45 °C and +60 °C, see chapter 18		

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Fuse breaking current	typ.	30 A	Up to 12 ms once every five seconds, see Fig. 6-4. The fuse breaking current is an enhanced transient current which helps to trip fuses on faulty output branches. The output voltage stays above 40 V.
Overload behavior		Continuous current Intermittent current	For output voltage above 26 Vdc, see Fig. 6-1 For output voltage below 26 Vdc, see Fig. 6-1
Overload / short-circuit current	max. typ. max.	14.8 A 15 A 4.7 A	Continuous current, see Fig. 6-1 Intermitted current peak value for typ. 2s Load impedance 10 mOhm, see Fig. 6-3 Discharge current of output capacitors is not included. Intermitted current average value (R.M.S.) Load impedance 10 mOhm, see Fig. 6-3
Output capacitance	typ.	2500 µF	Included inside the power supply
Back-feeding loads	max.	63 V	The unit is resistant and does not show malfunctioning when a load feeds back voltage to the power supply. It does not matter whether the power supply is on or off. The absorbing energy can be calculated according to the built-in large sized output capacitor.

1) **PowerBoost**
This power/ current is continuously allowed up to an ambient temperature of +45 °C.
Above +45 °C, do not use this power/ current longer than a duty cycle of 10 % and/ or not longer than 1 minute every 10 minutes.

Fig. 6-1 **Output voltage vs. output current, typ.**

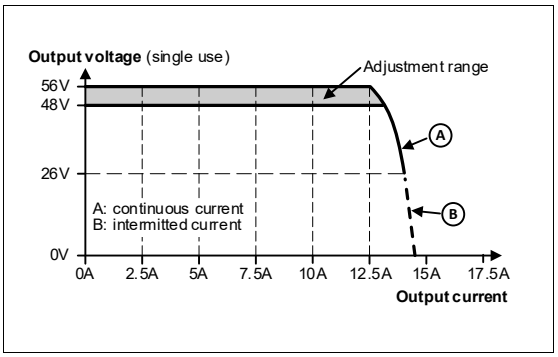


Fig. 6-2 **Output voltage in "parallel use" mode, typ.**

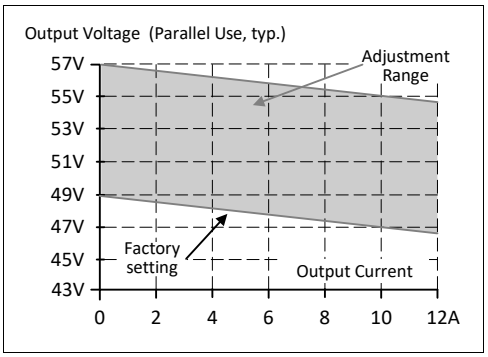


Fig. 6-3 **Short-circuit on output, Hiccup$^{PLUS®}$ mode, typ.**

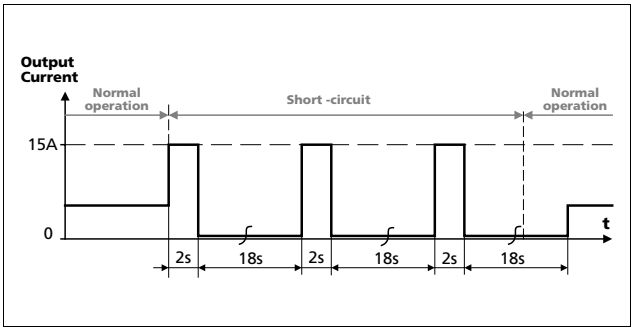
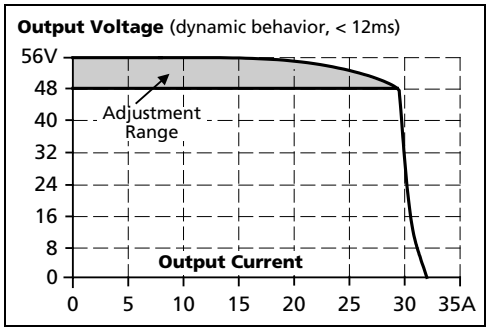


Fig. 6-4 **Dynamic overcurrent capability, typ.**



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7. Hold-up Time

The hold-up time is the time during which a power supply's output voltage remains within specification following the loss of input power. The hold-up time is output load dependent. At no load, the hold-up time can be up to several seconds. The green DC OK LED is also on during this time.

		AC 100 V	AC 120 V	AC 230 V	
Hold-up Time	typ.	65 ms	65 ms	65 ms	At 48 V, 5 A, see Fig. 7-1
	min.	54 ms	54 ms	54 ms	At 48 V, 5 A, see Fig. 7-1
	typ.	32 ms	32 ms	32 ms	At 48 V, 10 A, see Fig. 7-1
	min.	24 ms	24 ms	24 ms	At 48 V, 10 A, see Fig. 7-1

Fig. 7-1 **Hold-up time vs. input voltage**

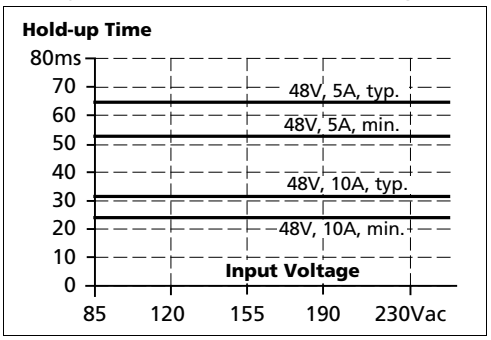
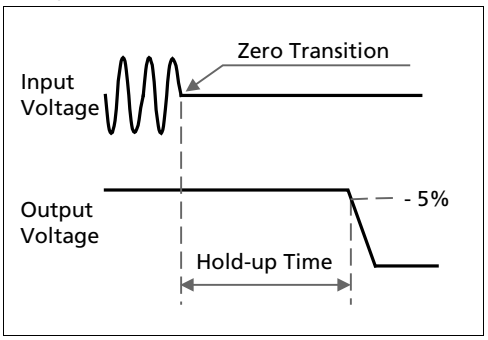


Fig. 7-2 **Shut-down behavior, definitions**



8. DC OK Function

This feature monitors the output voltage on the output terminals of a running power supply.

The DC OK Function can be monitored via the EtherCAT interface. It corresponds with the DC OK LED.

The value of the setpoint can be adjusted via the EtherCAT interface.

DC OK	As soon as the output voltage reaches the setpoint (default 44 V).
DC NOK	As soon as the output Voltage dips below a value, which is typically 0.5 V lower than the setpoint value (Hysteresis)
Hysteresis	Typically 0.5 V

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9. Remote ON / OFF Function

This feature enables to switch off the output voltage via the EtherCAT interface.

Note: The remote ON / OFF function has no safety feature included.

10. EtherCAT Interface

Three kinds of data are exchanged via the EtherCAT interface (for detailed information please refer to the EtherCAT interface description):

Process Data

Some important parameters are continuously sent and updated from the PSU to the controller. As a standard, the DC-Output voltage and -current and some status information are included. Additionally, two more parameters out of a big pool of data may be selected as process data, e.g. the actual input voltage or the internal temperature value.

Events and errors

Error reports, warnings and status information are transmitted acyclically to the controller. This includes e.g. an over-/undervoltage at the input, an overvoltage or overcurrent at the output, overtemperature on the inside of the PSU or when the output voltage falls below a certain level (DC OK-Warning). The different thresholds may be adjusted via the interface.

Parameters

The values of the parameters are exchanged acyclically between the PSU and the controller. On the input side, dropouts and sags of the supply voltage are detected as well as surge events, which allows a comprehensive monitoring of the line supply quality. Same is true for the output voltage to detect the load behavior. All values can be reset via the interface. Output voltage and the parallel mode can be enabled/disabled in the same way.

- Actual RMS input voltage
- Min. RMS input voltage
- Min. RMS input voltage count
- Max. RMS input voltage
- Max. peak input voltage
- Max. Peak/RMS input voltage count
- Actual temperature
- Min. temperature
- Max. temperature
- Overtemperature warning threshold
- Actual output current
- Max. output current
- Overcurrent warning threshold
- Actual output voltage
- Max. output voltage
- Output overvoltage warning threshold
- DC OK threshold
- Operating time
- Uptime
- Turn on counter
- Parallel mode
- Switch off output voltage

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11. Efficiency and Power Losses

All values are measured with active EtherCAT communication.

		AC 100 V	AC 120 V	AC 230 V	
Efficiency	typ.	94.2 %	94.8 %	96.2 %	At 48 V, 10 A
	typ.	94.1 %	94.8 %	96.1 %	At 48 V, 12 A (PowerBoost)
Average efficiency	typ.	93.6 %	94.1 %	95.1 %	25 % at 2.5 A, 25 % at 5 A, 25 % at 7.5 A, 25 % at 10 A
Power losses	typ.	1.6 W	1.7 W	2.1 W	Output voltage switched off
	typ.	6.3 W	5.8 W	4.8 W	At 48 V, 0 A
	typ.	16.3 W	13.4 W	12.0 W	At 48 V, 5 A
	typ.	29.5 W	26.2 W	18.9 W	At 48 V, 10 A
	typ.	36.1 W	31.7 W	23.1 W	At 48 V, 12 A (PowerBoost)

The average efficiency is an assumption for a typical application where the power supply is loaded with 25 % of the nominal load for 25 % of the time, 50 % of the nominal load for another 25 % of the time, 75 % of the nominal load for another 25 % of the time and with 100 % of the nominal load for the rest of the time.

Fig. 11-1 **Efficiency vs. output current at 48 V, typ.**

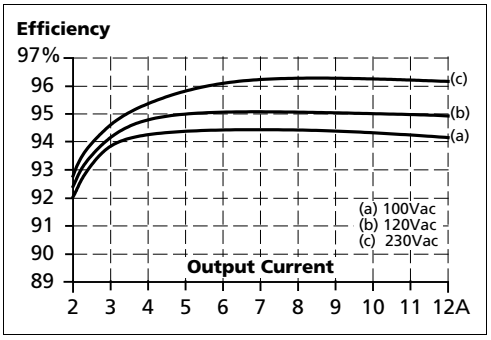


Fig. 11-2 **Losses vs. output current at 48 V, typ.**

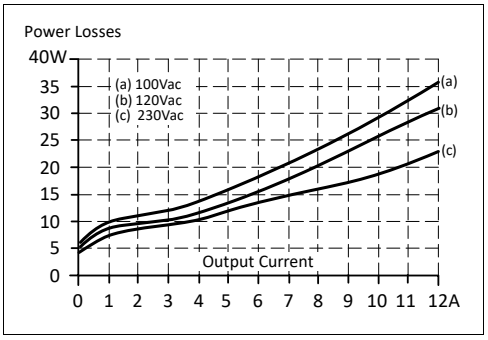


Fig. 11-3 **Efficiency vs. input voltage at 48 V, 10 A, typ.**

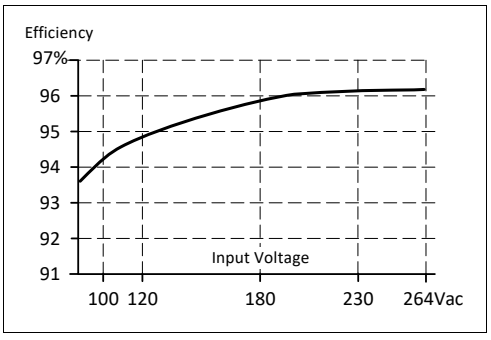
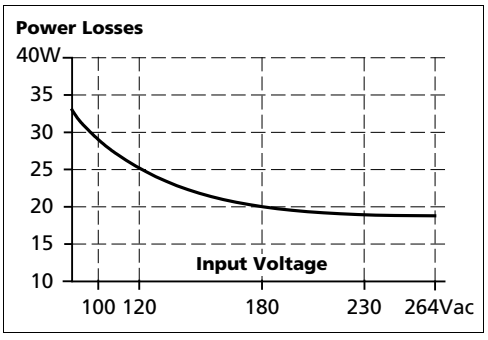


Fig. 11-4 **Losses vs. input voltage at 48 V, 10 A, typ.**

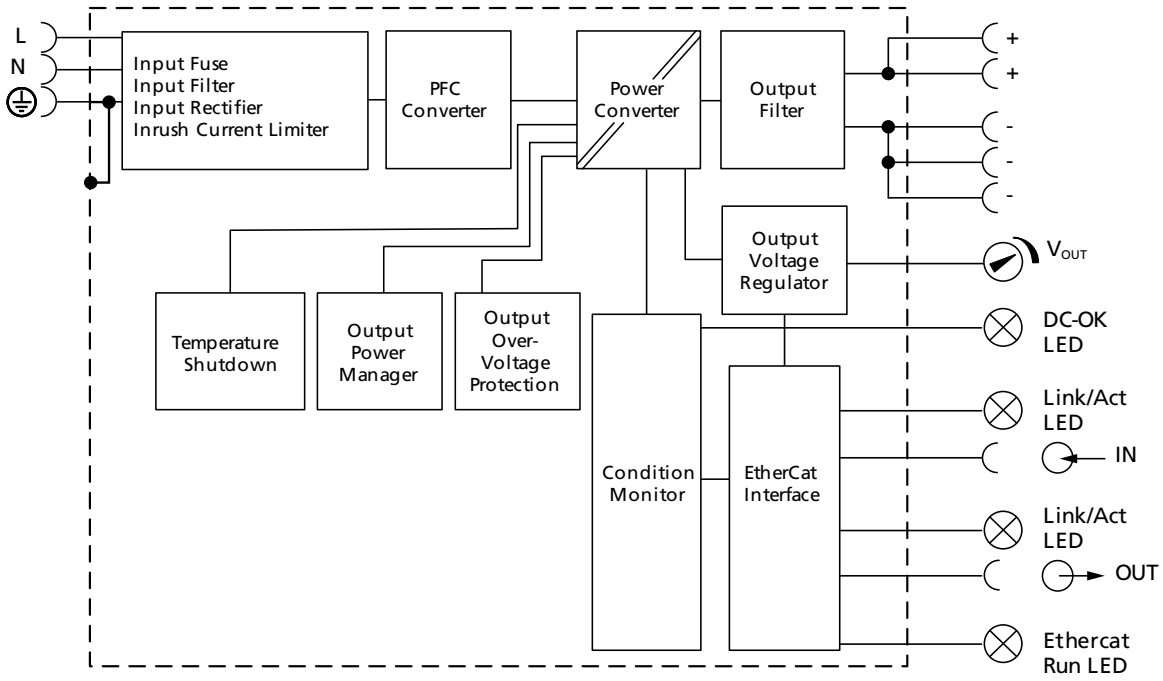


All parameters are typical values specified 230 Vac, 50 Hz input voltage, 48 V, 10 A output load, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.

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12. Functional Diagram

Fig. 12-1 **Functional diagram**

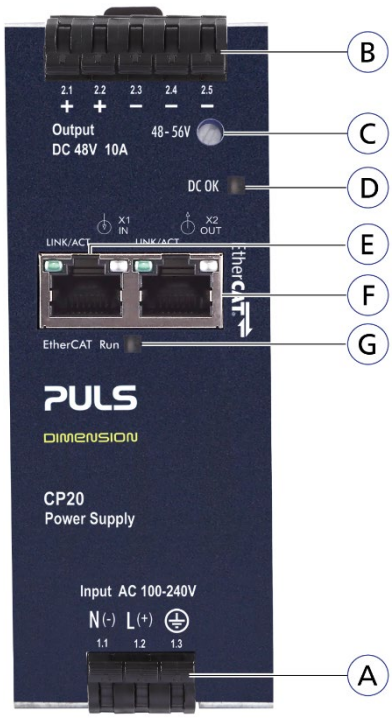


All parameters are typical values specified 230 Vac, 50 Hz input voltage, 48 V, 10 A output load, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.

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13. Front Side and User Elements

Fig. 13-1 **Front side**



A **Input Terminals**
- L Phase (Line) input
- N Neutral conductor input
- ⏚ PE (Protective Earth) input

B **Output Terminals**
Three terminals for the negative and two terminals for the positive pole. Identical poles are internally connected.
- \+ Positive output
- \- Negative (return) output

C **Output Voltage Adjustment Potentiometer**
for adjustment of output voltage
Factory setting: 48.0 V

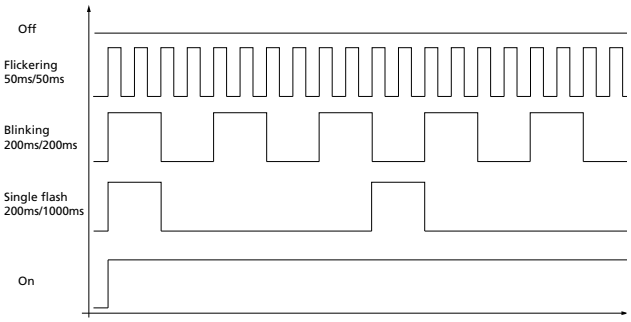
D **DC OK LED (green)**
ON, when the voltage on the output terminals is > level set by EtherCAT parameter index 8000:16 (DC OK threshold)

E **EtherCAT (X1) In-Port with Link/Activity LEDs**

F **EtherCAT (X2) Out-Port with Link/Activity LEDs**

G **EtherCAT LED "Run" shows EtherCAT State, see Fig. 13-2**

Fig. 13-2 **EtherCAT State**



- **Off** INIT(IALISATION) state
- **Flickering** BOOT state (INIT state not entered)
- **Blinking** PRE-OPERATIONAL state
- **Single flash** SAFE-OPERATIONAL state
- **On** OPERATIONAL state

All parameters are typical values specified 230 Vac, 50 Hz input voltage, 48 V, 10 A output load, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.

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14. Terminals and Wiring

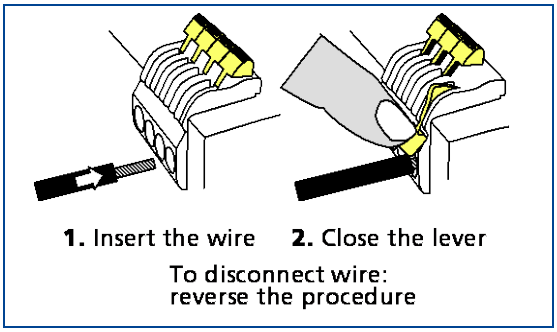
The terminals are IP20 Finger safe constructed and suitable for field- and factory wiring.

	Input	Output	EtherCAT Connectors
Type	Spring Terminal	Spring Terminal	RJ45 Receptable
Solid wire	max. 6 mm²	max. 6 mm²	-
Stranded wire	max. 4 mm²	max. 4 mm²	-
American Wire Gauge	AWG 20-10	AWG 20-10	-
Max. wire diameter (including ferrules)	2.8 mm	2.8 mm	-
Wire stripping length	10 mm	10 mm	-

Instructions:

a) Use appropriate copper cables that are designed for minimum operating temperatures of:
+60 °C for ambient up to +45 °C and
+75 °C for ambient up to +60 °C minimum
+90 °C for ambient up to +70 °C minimum.
b) Follow national installation codes and installation regulations!
c) Ensure that all strands of a stranded wire enter the terminal connection!
d) Do not use the unit without PE connection.
e) Unused terminal compartments should be securely tightened.
f) Ferrules are allowed.

Fig. 14-1 **Connecting a wire**



Daisy chaining:

Daisy chaining (jumping from one power supply output to the next) is allowed as long as the average output current through one terminal pin does not exceed 25 A. If the current is higher, use a separate distribution terminal block as shown in Fig. 14-3.

Fig. 14-2 Daisy chaining of outputs

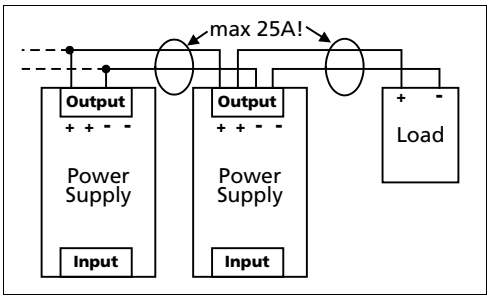
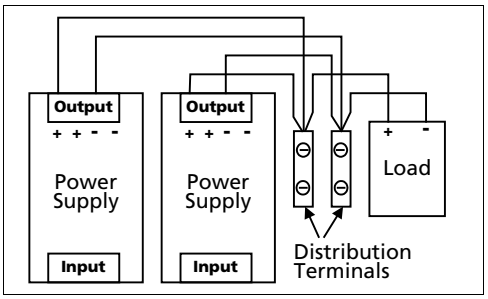


Fig. 14-3 Using distribution terminals



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15. Lifetime Expectancy

The Lifetime expectancy shown in the table indicates the minimum operating hours (service lifetime) and is determined by the lifetime expectancy of the built-in electrolytic capacitors. Lifetime expectancy is specified in operational hours and is calculated according to the capacitor's manufacturer specification. The manufacturer of the electrolytic capacitors only guarantees a maximum lifetime of up to 15 years (131 400 h). Any number exceeding this value is a calculated theoretical lifetime which can be used to compare devices.

	AC 100 V	AC 120 V	AC 230 V	
Lifetime expectancy	159 000 h	185 000 h	223 000 h	At 48 V, 5 A and +40 °C
	450 000 h	523 000 h	630 000 h	At 48 V, 5 A and +25 °C
	48 000 h	63 000 h	121 000 h	At 48 V, 10 A and +40 °C
	137 000 h	179 000 h	422 000 h	At 48 V, 10 A and +25 °C
	23 000 h	38 000 h	73 000 h	At 48 V, 12 A and +40 °C
	69 000 h	108 000 h	207 000 h	At 48 V, 12 A and +25 °C

16. MTBF

MTBF stands for **M**ean **T**ime **B**etween **F**ailures, which is calculated according to statistical device failures, and indicates reliability of a device. It is the statistical representation of the likelihood of a unit to fail and does not necessarily represent the life of a product.

The MTBF figure is a statistical representation of the likelihood of a device to fail. A MTBF figure of e.g. 1 000 000 h means that statistically one unit will fail every 100 h if 10 000 units are installed in the field. However, it cannot be determined if the failed unit has been running for 50 000 h or only for 100 h.

For these types of units the MTTF (**M**ean **T**ime **T**o **F**ailure) value is the same value as the MTBF value.

	AC 100 V	AC 120 V	AC 230 V	
MTBF SN 29500, IEC 61709	291 000 h	297 000 h	337 000 h	At 48 V, 10 A, +40 °C
	525 000 h	533 000 h	599 000 h	At 48 V, 10 A, +25 °C
MTBF MIL HDBK 217F	182 000 h	184 000 h	211 000 h	At 48 V, 10 A and +40 °C; Ground Benign GB40
	253 000 h	256 000 h	297 000 h	At 48 V, 10 A and +25 °C; Ground Benign GB25

All parameters are typical values specified 230 Vac, 50 Hz input voltage, 48 V, 10 A output load, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.

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17. EMC

The EMC behavior of the device is designed for applications in industrial environments as well as in professional equipment in commercial and light-industrial locations.

The device complies with EN IEC 61000-6-1, EN IEC 61000-6-2, EN IEC 61000-6-8, EN IEC 61000-6-4, EN IEC 61000-3-2 and EN 61000-3-3.

The device complies with FCC Part 15 rules. Operation is subjected to following two conditions: (1) this device may not cause harmful interference and (2) this device must accept any interference received, including interference that may cause undesired operation.

EMC Immunity	**Power lines and housing**			
Electrostatic discharge	EN 61000-4-2	Contact discharge Air discharge	8 kV 15 kV	Criterion A Criterion A
Electromagnetic RF field	EN 61000-4-3	80 MHz-2.7 GHz 2.7-6 GHz	10 V/m 10 V/m	Criterion A Criterion A
Fast transients (Burst)	EN 61000-4-4	Input lines Output lines	4 kV 2 kV	Criterion A Criterion A
Surge voltage on input	EN 61000-4-5	L → N N → PE L → PE	2 kV 4 kV 4 kV	Criterion A Criterion A Criterion A
Surge voltage on output	EN 61000-4-5	+ → - + → PE - → PE	1 kV 1 kV 1 kV	Criterion A Criterion A Criterion A
Conducted disturbance	EN 61000-4-6	0.15-80 MHz	10 V	Criterion A
Mains voltage dips	EN 61000-4-11	0 % of 100 Vac 40 % of 100 Vac 70 % of 100 Vac 0 % of 120 Vac 40 % of 120 Vac 70 % of 120 Vac 0 % of 200 Vac 40 % of 200 Vac 70 % of 200 Vac	0 Vac, 20 ms 40 Vac, 200 ms 70 Vac, 500 ms 0 Vac, 20 ms 48 Vac, 200 ms 84 Vac, 500 ms 0 Vac, 20 ms 80 Vac, 200 ms 140 Vac, 500 ms	Criterion A Criterion C Criterion A Criterion A Criterion C Criterion A Criterion A Criterion A Criterion A
Voltage interruptions	EN 61000-4-11	0 V	5000 ms	Criterion C
Powerful transients	VDE 0160	Over entire load range	750 V, 0.3 ms	Criterion A

EMC Immunity	**Signal and communication lines**			
Fast transients (Burst)	EN 61000-4-4	Signals with coupling clamp	2 kV	Criterion B
Surge voltage	EN 61000-4-5	EtherCAT lines → PE	1 kV	Criterion B
Conducted disturbance	EN 61000-4-6	EtherCAT lines	10 V	Criterion A

Performance criterions:

A: Device shows normal operation behavior within the defined limits.

B: Device shows normal operation behavior within the defined limits. During burst or surge events small reduction of EtherCAT transmission rate is possible.

C: Temporary loss of function is possible. The device may shut-down and restarts by itself. No damage or hazards for the device will occur.

All parameters are typical values specified 230 Vac, 50 Hz input voltage, 48 V, 10 A output load, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.

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EMC Emission

Conducted emission input lines	EN 55011, EN 55032, FCC Part 15, CISPR 11, CISPR 32	Class B
Conducted emission output lines	IEC/CISPR 16-1-2, IEC/CISPR 16-2-1	EN IEC 61000-6-8 Limits for DC power ports fulfilled
Conducted emission EtherCAT lines	EN 55032, CISPR 32	EN IEC 61000-6-8 Limits for wired ports fulfilled
Radiated emission	EN 55011, EN 55032, CISPR 11, CISPR 32	Class A
Harmonic input current	EN IEC 61000-3-2 - Class A equipment	Fulfilled
	EN IEC 61000-3-2 - Class C equipment	Fulfilled in the load range from 4 to 12 A
Voltage fluctuations, flicker	EN 61000-3-3	Fulfilled, tested with non-pulsing constant current loads.

Switching Frequencies

PFC converter	100 kHz	Fixed frequency
Main converter	80 kHz to 140 kHz	Output load dependent
Auxiliary converter	60 kHz	Fixed frequency
Microcontroller	24 MHz, 48 MHz, 64 MHz	The device utilizes in total 3 microcontrollers

All parameters are typical values specified 230 Vac, 50 Hz input voltage, 48 V, 10 A output load, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.

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18. Environment

Operational temperature	-25 °C to +70 °C	The operational temperature is the ambient or surrounding temperature and is defined as the air temperature 2 cm below the device.
Storage temperature	-40 °C to +85 °C	For storage and transportation
Output derating	12.5 W/K 32 W / 1000 m or 5 K / 1000 m	Between +60 °C and +70 °C at AC 120 – 240 V For altitudes > 2000 m, see Fig. 18-2
	10.5 W/K 28 W/1000 m or 5 K/1000 m	Between +60 °C and +70 °C at AC 100 V For altitudes > 2000 m, see Fig. 18-2
	The derating is not hardware controlled. The user has to take care by himself to stay below the derated current limits in order not to overload the unit.	
Humidity	5 to 95 % r.h.	According to IEC 60068-2-30
Atmospheric pressure	110-54 kPa	See Fig. 18-2 for details
Altitude	Up to 5000 m	See Fig. 18-2 for details
Overvoltage category	II	According to IEC 60664-1, for altitudes up to 5000 m
Impulse withstand voltage	4 kV (according to overvoltage category III)	Input to PE According to IEC 60664-1, for altitudes up to 2000 m
Degree of pollution	2	According to IEC 60664-1, not conductive
Vibration sinusoidal	2-17.8 Hz: ±1.6 mm 17.8-500 Hz: 2 g 2 hours / axis	According to IEC 60068-2-6
Shock	30 g 6 ms, 20 g 11 ms 3 bumps / direction 18 bumps in total	According to IEC 60068-2-27
	Shock and vibration are tested in combination with DIN rails according to EN 60715 with a height of 15 mm and a thickness of 1.3 mm and standard orientation.	

Fig. 18-1 **Output power vs. ambient temp.**

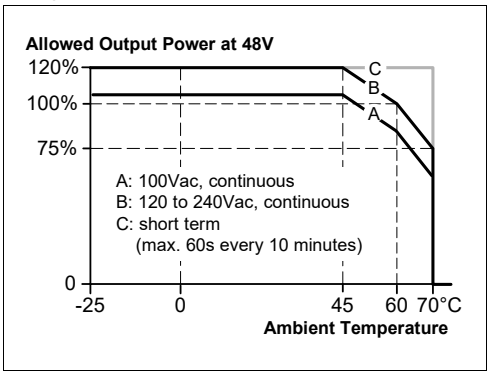
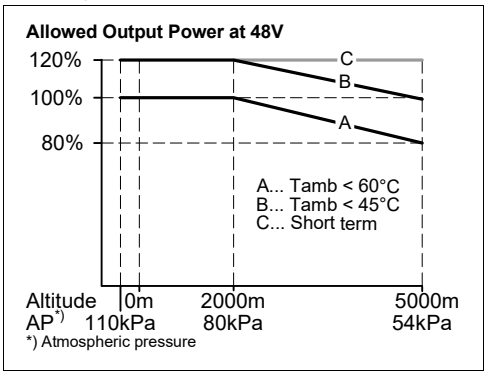


Fig. 18-2 **Output power vs. altitude**



All parameters are typical values specified 230 Vac, 50 Hz input voltage, 48 V, 10 A output load, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.

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19. Safety and Protection Features

Insulation resistance	min.	500 MOhm	At delivered condition between input and output, measured with 500 Vdc
	min.	500 MOhm	At delivered condition between input and PE, measured with 500 Vdc
	min.	500 MOhm	At delivered condition between output and PE, measured with 500 Vdc
	min.	500 MOhm	At delivered condition between output and DC OK or Alarm contacts, measured with 500 Vdc
PE resistance	max.	0.1 Ohm	Resistance between PE terminal and the housing in the area of the DIN rail mounting bracket.
Output overvoltage protection	typ.	58.5 Vdc	
	max.	60 Vdc	
		In case of an internal defect, a redundant circuit limits the maximum output voltage to 60 V. The output switches off and performs three restart attempts. If the failure continues, the output shuts down. Cycle input power to reset.	
Class of protection		I	According to IEC 61140 A PE (Protective Earth) connection is required
Degree of protection		IP20	According to EN/IEC 60529
Overtemperature protection		Included	Output shuts down with automatic restart. Temperature sensors are installed on critical components inside the unit and turn the unit off in safety critical situations, which can happen e.g. when ambient temperature is too high, ventilation is obstructed or the derating requirements are not followed. There is no correlation between the operating temperature and turn-off temperature since this is dependent on input voltage, load and installation methods.
Input transient protection		MOV (Metal Oxide Varistor)	For protection values see chapter “EMC”.
Internal input fuse		Included	Not user replaceable slow-blow high-breaking capacity fuse
Touch current (leakage current)	typ.	0.12 mA / 0.31 mA	At 100 Vac, 50 Hz, TN-,TT-mains / IT-mains
	typ.	0.18 mA / 0.45 mA	At 120 Vac, 60 Hz, TN-,TT-mains / IT-mains
	typ.	0.30 mA / 0.76 mA	At 230 Vac, 50 Hz, TN-,TT-mains / IT-mains
	max.	0.16 mA / 0.38 mA	At 110 Vac, 50 Hz, TN-,TT-mains / IT-mains
	max.	0.23 mA / 0.55 mA	At 132 Vac, 60 Hz, TN-,TT-mains / IT-mains
	max.	0.39 mA / 0.94 mA	At 264 Vac, 50 Hz, TN-,TT-mains / IT-mains

All parameters are typical values specified 230 Vac, 50 Hz input voltage, 48 V, 10 A output load, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.

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20. Dielectric Strength

The output voltage is floating and has no ohmic connection to the ground.

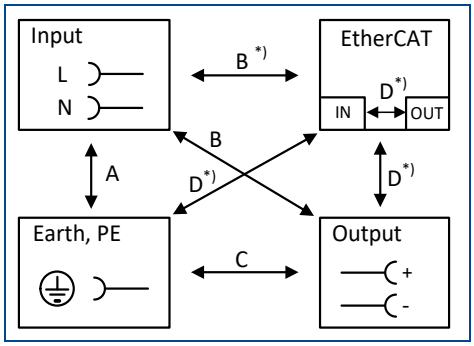
The output is insulated to the input by a double or reinforced insulation.

Type and routine tests are conducted by the manufacturer. Field tests may be conducted in the field using the appropriate test equipment which applies the voltage with a slow ramp (2 s up and 2 s down). Connect all input-terminals together as well as all output poles before conducting the test. When testing, set the cut-off current settings to the value in the table below.

We recommend that that pole where the actuators in a control system are connected shall be grounded via protective earth. This helps to avoid situations in which a load starts unexpectedly or cannot be switched off when unnoticed earth faults occur.

When EtherCAT interfaces are tested, all 8 corresponding lines of each RJ45-connector must also be shorted to apply the test voltage.

Fig. 20-1 **Dielectric strength**



		A	B	C	D
Type test	60 s	2500 Vac	3000 Vac	1000 Vac	1500 Vac
Routine test	5 s	2500 Vac	2500 Vac	500 Vac	1350 Vac
Field test	5 s	2000 Vac	2000 Vac	500 Vac	1350 Vac
Cut-off current setting for field test		> 10mA	> 10 mA	> 20 mA	> 1 mA

B*)
When testing the EtherCAT IN/OUT, ensure that the max. voltage between EtherCAT lines and the output is not exceeded. We recommend connecting all EtherCAT and the output pins together when performing the test.
D*)
All tests are conducted to EtherCAT IN and EtherCAT OUT individually.

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21. Approved, Fulfilled or Tested Standards

IEC 61010-2-201	CB Report	CB Scheme Certificate IEC 61010-2-201 Electrical Equipment for Measurement, Control and Laboratory Use - Particular requirements for control equipment
UL 61010-2-201	c UL us LISTED	UL Certificate Listed equipment for category NMTR - Electrical Equipment for Measurement, Control and Laboratory Use - Particular requirements for control equipment Applicable for US and Canada E-File: E198865
SEMI 47	SEMI F47	Test Report Voltage Sag Immunity for Semiconductor Processing Equipment Tested for AC 208 V L-L or L-N mains voltages, nominal output voltage and nominal output load

22. Regulatory Product Compliance

EU Declaration of Conformity	CE	EU Declaration of Conformity Trade conformity assessment for Europe The CE mark indicates conformance with the European - RoHS directive, - EMC directive and the - Low-voltage directive (LVD)
REACH Regulation (EU)	REACH COMPLIANT	Manufacturer's Statement EU regulation regarding the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) fulfilled.
WEEE Regulation		Manufacturer's Declaration EU Regulation on Waste Electrical and Electronic Equipment Registered as business to business (B2B) products. EU Regulation 2012/19/EU
RoHS (China RoHS 2)	25	Manufacturer's Statement Administrative Measures for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products 25 years

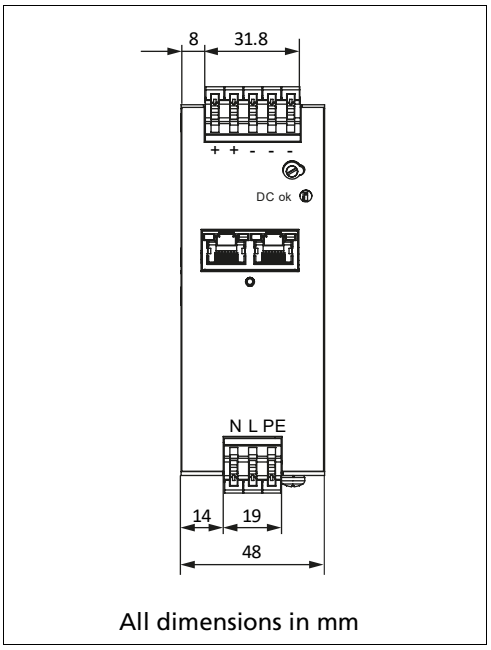
All parameters are typical values specified 230 Vac, 50 Hz input voltage, 48 V, 10 A output load, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.

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23. Physical Dimensions and Weight

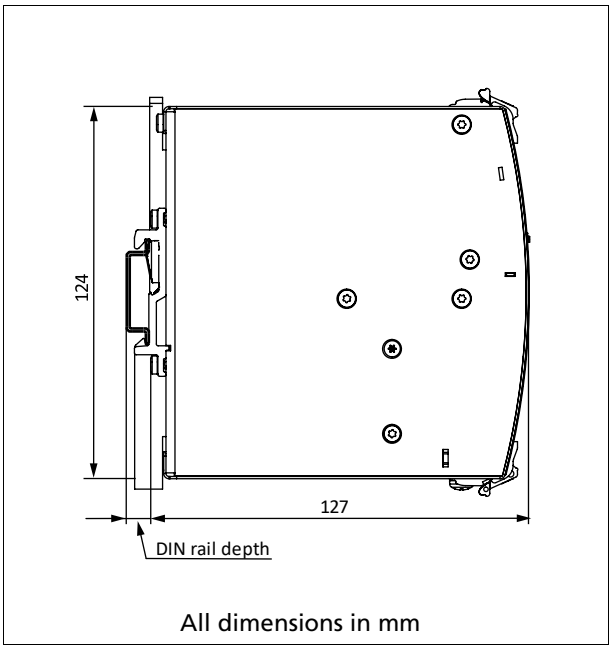
Width	48 mm
Height	124 mm
Depth	127 mm The DIN rail depth must be added to the unit depth to calculate the total required installation depth.
Weight	830 g
DIN rail	Use 35 mm DIN rails according to EN 60715 or EN 50022 with a height of 7.5 or 15 mm.
Housing material	Body: aluminium alloy Cover: zinc-plated steel
Installation clearances	See chapter 2

Fig. 23-1 **Front view**



All dimensions in mm

Fig. 23-2 **Side view**



All dimensions in mm

All parameters are typical values specified 230 Vac, 50 Hz input voltage, 48 V, 10 A output load, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.

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24. Accessories

24.1.ZM10.WALL – Wall/Panel Mounting Bracket

This bracket is used to mount the devices on a wall/panel without utilizing the DIN rail. The bracket can be mounted without detaching the DIN rail brackets from the power supply. Product for illustration purposes only.

Fig. 24-1 **Isometric view**

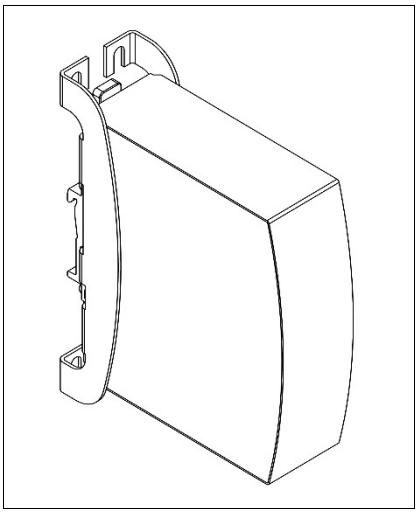


Fig. 24-2 **Isometric view**

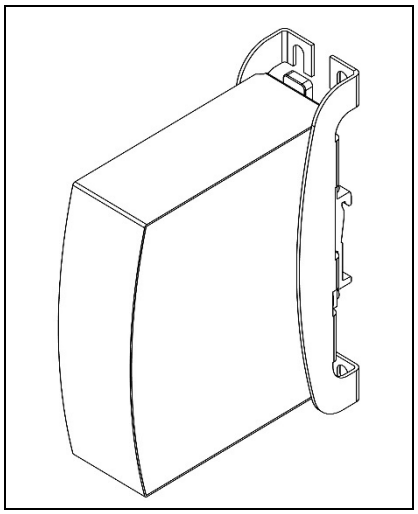


Fig. 24-3 **Isometric view**

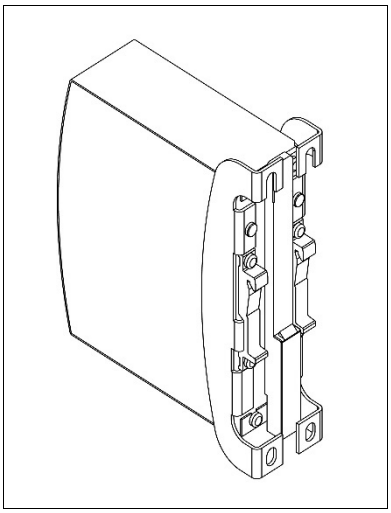


Fig. 24-4 **Wall/panel mounting, front view**

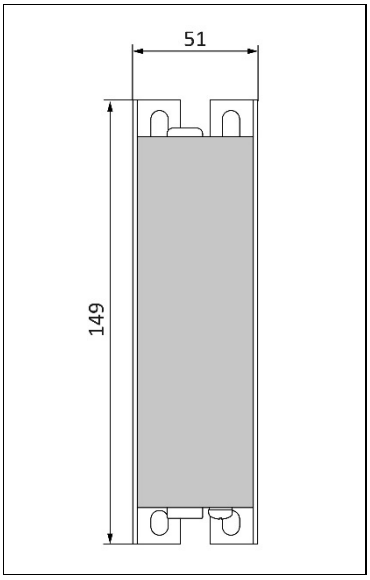


Fig. 24-5 **Hole pattern for wall mounting**

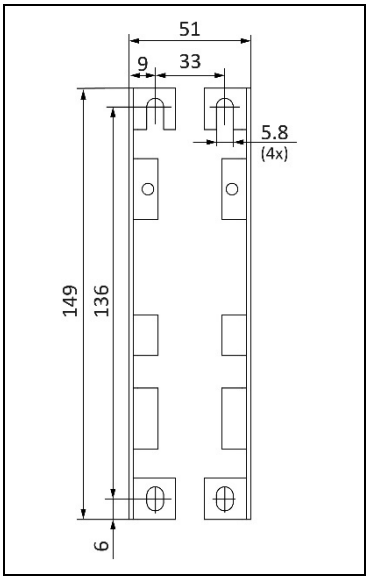
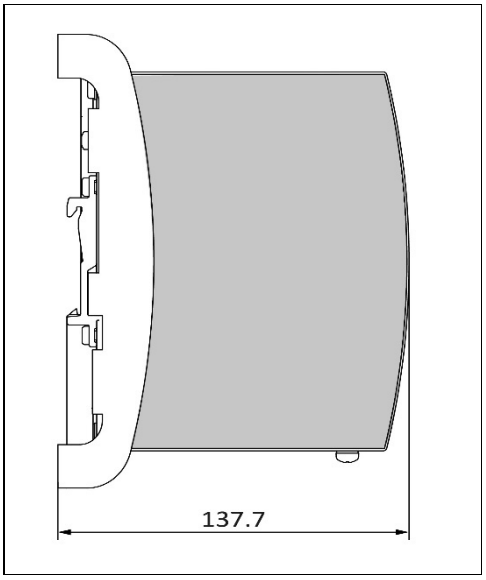


Fig. 24-6 **Wall/panel mounting, side view**



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24.2. UF20.481 Buffer Module



The UF20.481 buffer module is a supplementary device for DC 48 V power supplies. It delivers power to bridge typical mains failures or extends the hold-up time after the AC power is turned off.

When the power supply provides a sufficient voltage, the buffer module stores energy in the integrated electrolytic capacitors. When the mains voltage is lost, the stored energy is released to the DC-bus in a regulated process.

The buffer module can be added in parallel to the load circuit at any given point and does not require any control wiring.

One buffer module can deliver 20 A additional current and can be added in parallel to increase the output ampacity or the hold-up time.

24.3. YR40.482 - Redundancy Module



The is a dual redundancy module, which can be used to build 1+1 or N+1 redundant system.

The device is equipped with two 20 A nominal input channels, which are individually decoupled by utilizing MOSFET technology. The output can be loaded with a nominal 40 A continuous current.

Using MOSFETSs instead of diodes reduces heat generation, losses and voltage drop between input and output. Due to these advantages, the unit is very narrow and only requires 36 mm width on the DIN rail.

The device does not require an additional auxiliary voltage and is self-powered even in case of a short circuit across the output.

A feature of this redundancy module is a special circuit, which keeps the losses and temperature low, even at overload and short circuit conditions up to 65 A continuous current.

See chapter “Parallel Use for Redundancy” for wiring information.

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25. Application Notes

25.1. Peak Current Capability

The unit can deliver peak currents (up to several milliseconds) which are higher than the specified short term currents.

This helps to start current demanding loads. Solenoids, contactors and pneumatic modules often have a steady state coil and a pick-up coil. The inrush current demand of the pick-up coil is several times higher than the steady-state current and usually exceeds the nominal output current. The same situation applies when starting a capacitive load.

The peak current capability also ensures the safe operation of subsequent circuit breakers of load circuits. The load branches are often individually protected with circuit breakers or fuses. In case of a short or an overload in one branch circuit, the fuse or circuit breaker need a certain amount of overcurrent to open in a timely manner. This avoids voltage loss in adjacent circuits.

The extra current (peak current) is supplied by the power converter and the built-in large sized output capacitors of the power supply. The capacitors get discharged during such an event, which causes a voltage dip on the output. The following three examples show typical voltage dips for resistive loads:

Fig. 25-1 **20 A_{peak} current for 50 ms, typ. (2x the nominal current)**

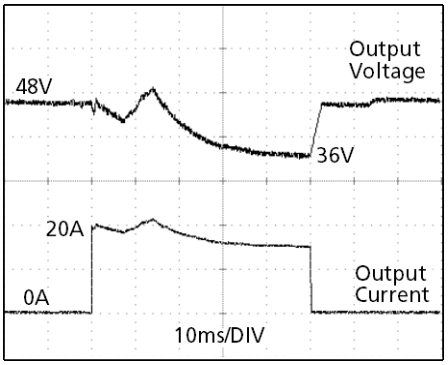


Fig. 25-2 **50 A_{peak} current for 5 ms, typ. (5x the nominal current)**

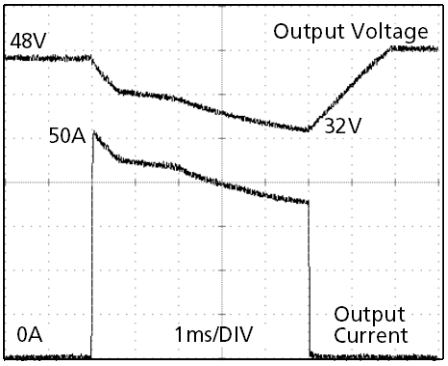
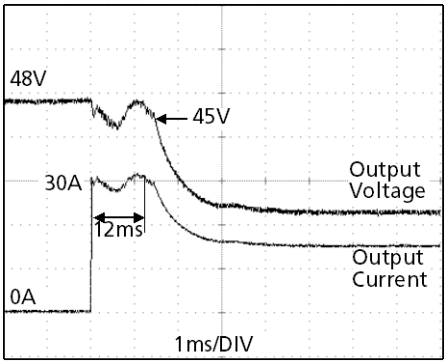


Fig. 25-3 **30 A_{peak} current for 12 ms, typ. (3x the nominal current)**



Peak current voltage dips	typ.	from 48 V to 36 V	At 20 A for 50 ms, resistive load
	typ.	from 48 V to 39 V	At 50 A for 2 ms, resistive load
	typ.	from 48 V to 32 V	At 50 A for 5 ms, resistive load

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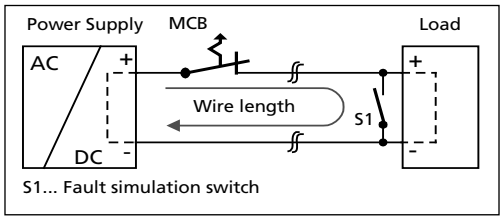
25.2. Output Circuit Breakers

Standard miniature circuit breakers (MCB's or UL 1077 circuit breakers) are commonly used for AC-supply systems and may also be used on 48 V branches.

MCB's are designed to protect wires and circuits. If the ampere value and the characteristics of the MCB are adapted to the wire size that is used, the wiring is considered as thermally safe regardless of whether the MCB opens or not.

To avoid voltage dips and under-voltage situations in adjacent 48 V branches which are supplied by the same source, a fast (magnetic) tripping of the MCB is desired. A quick shutdown within 10 ms is necessary corresponding roughly to the ride-through time of PLC's. This requires power supplies with high current reserves and large output capacitors. Furthermore, the impedance of the faulty branch must be sufficiently small in order for the current to actually flow. The best current reserve in the power supply does not help if Ohm's law does not permit current flow. The following table has typical test results showing which B- and C-Characteristic MCBs magnetically trip depending on the wire cross chapter and wire length.

Fig. 25-4 **Test circuit**



Maximal wire length*) for a fast (magnetic) tripping:

	0.75 mm²	**1.0 mm²**	**1.5 mm²**	**2.5 mm²**
C-2A	85 m	117 m	165 m	>200 m
C-3A	54 m	85 m	117 m	176 m
C-4A	35 m	48 m	65 m	107 m
C-6A	13 m	19 m	25 m	39 m
C-8A	4 m	7 m	9 m	14 m
C-10A	3 m	6 m	8 m	13 m
C-13A		1 m	1 m	1 m
B-6A	36 m	52 m	75 m	116 m
B-10A	12 m	20 m	25 m	39 m
B-13A	9 m	13 m	17 m	28 m
B-16A	2 m	3 m	5 m	6 m

*) Don't forget to consider twice the distance to the load (or cable length) when calculating the total wire length (+ and – wire).

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25.3. Charging of Batteries

The power supply can be used to charge lead-acid or maintenance-free batteries. Four 12 V SLA or VRLA batteries are needed in series connection.

Instructions for charging batteries:

a) Use only matched batteries when putting 12 V types in series.

b) Ensure that the ambient temperature of the power supply stays below +40 °C.

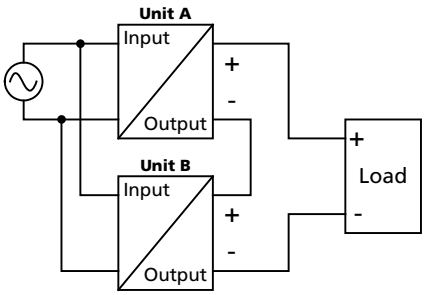
c) Use a 15 A or 16 A circuit breaker or a blocking diode between the power supply and the battery.

d) Ensure that the output current of the power supply is below the allowed charging current of the battery.

e) The return current to the power supply is typically 6 mA. This return current can discharge the battery when the power supply is switched off except in case a blocking diode is utilized.

f) Set the device into "Parallel Use" mode and adjust the output voltage, measured at no load and at the battery end of the cable, very precisely to the end-of-charge voltage of 55.6 V at +10 °C, 55 V at +20 °C, 54.3 V at +30 °C /and 53.6 V at +40 °C ambient temperature.

25.4. Series Operation



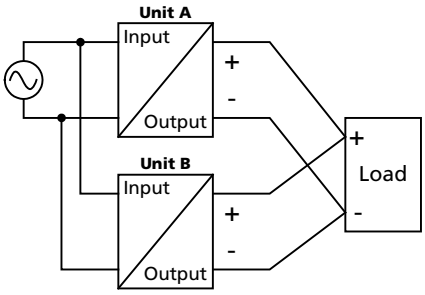
Devices of the same type can be connected in series for higher output voltages. It is possible to connect as many units in series as needed, providing the sum of the output voltage does not exceed 150 Vdc. Voltages with a potential above 60 Vdc must be installed with a protection against touching.

Avoid return voltage (e.g. from a decelerating motor or battery) which is applied to the output terminals.

Keep an installation clearance of 15 mm (left / right) between two power supplies and avoid installing the power supplies on top of each other. Do not use power supplies in series in mounting orientations other than the standard mounting orientation.

Pay attention that leakage current, EMI, inrush current, harmonics will increase when using multiple devices.

25.5. Parallel Use to Increase Output Power



Devices can be paralleled to increase the output power. The output voltage of all power supplies shall be adjusted to the same value (±100 mV) in "Single Use" mode with the same load conditions on all units, or the units can be left with the factory settings. After the adjustments, set the unit to "Parallel Use" mode via EtherCAT interface in order to achieve load sharing. The "Parallel Use" mode regulates the output voltage in such a manner that the voltage at no load is approx. 4 % higher than at nominal load.

The ambient temperature is not allowed to exceed +60 °C.

If more than three units are connected in parallel, a fuse or circuit breaker with a rating of 15 A or 16 A is required on each output. Alternatively, a diode or redundancy module can also be utilized.

Energize all units at the same time. It also might be necessary to cycle the input power (turn-off for at least five seconds), if the output was in overload or short circuits and the required output current is higher than the current of one unit.

Keep an installation clearance of 15 mm (left / right) between two devices and avoid installing devices on top of each other. Do not use devices in parallel in mounting orientations other than the standard mounting orientation or in any other condition where a reduction of the output current is required (e.g. altitude).

Pay attention that leakage current, EMI, inrush current will increase when using multiple devices.

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25.6. Parallel Use for Redundancy

1+1 Redundancy:
Devices can be paralleled for redundancy to gain higher system availability. Redundant systems require a certain amount of extra power to support the load in case one device fails. The simplest way is to put two devices in parallel. This is called a 1+1 redundancy. In case one device fails, the other one is automatically able to support the load current without any interruption. It is essential to use a redundancy module to decouple devices from each other. This prevents that the defective unit becomes a load for the other device and the output voltage cannot be maintained any more.

1+1 redundancy allows ambient temperatures up to +70 °C.

Pay attention that leakage current, EMI, inrush current, harmonics will increase when using multiple devices.

Recommendations for building redundant power systems:

- Use separate input fuses for each device.
- Use separate mains systems for each device whenever it is possible.
- Monitor the individual devices via EtherCAT interface.
- It is desirable to set the output voltages of all devices to the same value (± 100 mV) or leave it at the factory setting.
- Set the devices into "Parallel Use" mode via EtherCAT interface.

N+1 Redundancy:
Redundant systems for a higher power demand are usually built in a N+1 method. E.g. four devices, each rated for 10 A are paralleled to build a 30 A redundant system.

Pay attention that leakage current, EMI, inrush current, harmonics will increase when using multiple power supplies.

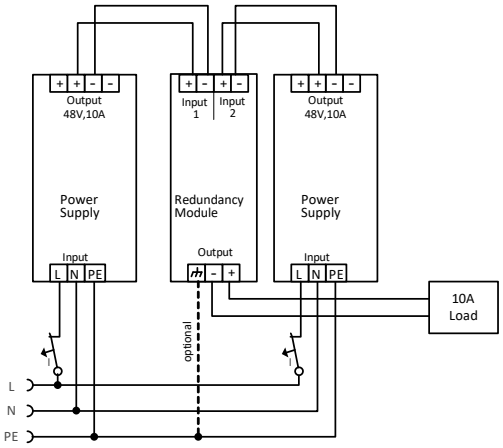
Keep an installation clearance of 15 mm (left / right) between two power supplies and avoid installing the power supplies on top of each other.

Do not use devices in parallel in mounting orientations other than the standard mounting orientation or in any other condition, where a derating of the output current is required.

For N+1 redundancy the ambient temperature is not allowed to exceed +60 °C.

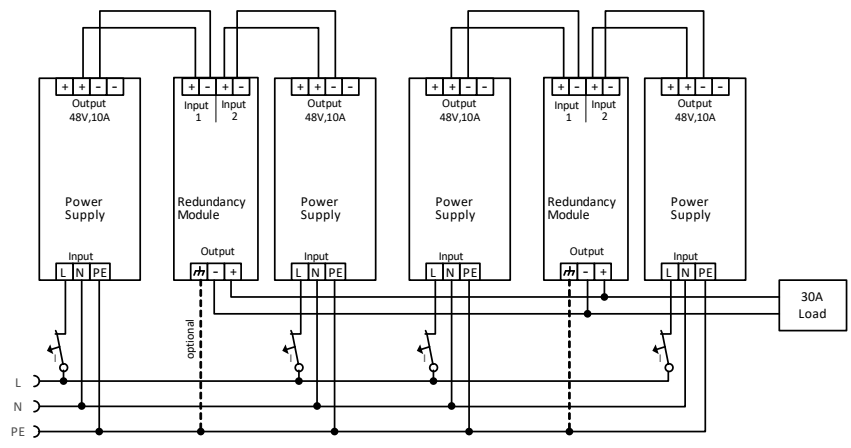
Wiring examples for 1+1 and N+1 redundancy:

Fig. 25-5 **1+1 Redundant configuration for 10 A load current with a dual redundancy module**



Alternatively, the YR40.482 redundancy module can be used but has the input and output terminals reversed.

Fig. 25-6 **N+1 Redundant configuration for 30 A load current with multiple power supplies and redundancy modules**



Alternatively, the YR40.482 redundancy module can be used but has the input and output terminals reversed.

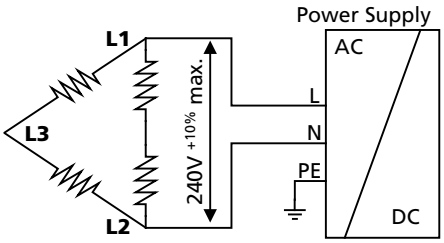
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25.7. Operation on Two Phases

The power supply can also be used on two-phases of a three-phase-system. Such a phase-to-phase connection is allowed as long as the supplying voltage is below 240 V$^{+10\ \%}$.

Ensure that the wire, which is connected to the N-terminal, is appropriately fused.

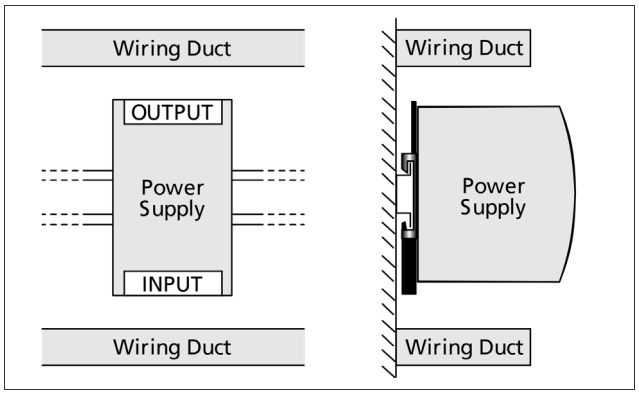


25.8. Mounting Orientation

Install the device onto a DIN rail with the input terminals on the bottom of the device.

The test environment is set up installing wiring ducts (depth: 80 mm) with clearances seen in chapter 2.

Fig. 25-7
Mounting Orientation A (Standard orientation)



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