

Documentation | EN

# PS2031-2410-0000

Power supply 24 V DC, 10 A, 3-phase, AC 100-240 V





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# 1 Overview

## PS2031-2410-0000 | Power supply 24 V, 10 A, 3-phase, Extra Power



- 3AC 380-480V wide-range input
- 2- or 3-phase operation possible
- Width only 62mm
- Efficiency up to 92.9% thanks to synchronous rectifier
- Excellent part-load efficiency
- 120% peak power, 288W
- Precise triggering of fuses through high overload / peak current
- Integrated input transient suppression circuit
- Minimum inrush current surge
- 3 integrated input fuses
- Current-sharing function for parallel use
- Full output between -25°C and +60°C

The PS2031-2410-0000 is a 3-phase 24 V power supply unit with an output current of 10 A and an output power of 240 W.

On the input side, the device features a wide-range input, harmonic correction (PFC) and inrush current limitation.

The PS2031-2410-0000 features an Extra Power output with a continuous maximum output power of 120% and is able to trigger fuses precisely with a short-term peak current.

The power supply unit is part of the PS2000 family and has a width of 62 mm. A DC OK LED monitors the status of the output voltage

### Overview of technical data \*)

Overview of technical data	PS2031-2410-0000
Output voltage	DC 24V (nominal factory setting 24.1V)
Adjustment range	24 - 28V
Output current	12.0-10.3A (amb. below +45°C) 10.0-8.6A (amb. at +60°C) 7.5-6.5A (amb. at +70°C) Linear load reduction between +45°C and +70°C
Input voltage AC	3AC 380-480V -15%/+20%
Mains frequency	50-60Hz ±6%
Input current AC	0.7 / 0.6A at 3x400 / 480Vac
Efficiency	92.8 / 92.9% at 3x400 / 480Vac
Temperature range	-25°C to +70°C
Size (W x H x D)	62 x 124 x 117mm (without DIN rail)
Weight	750 g
Approvals/markings	CE, EAC, UKCA cULus

\*) All values typical for 24 V, 10 A, 3x 400 Vac, 50 Hz, symmetrical mains voltages, 25°C ambient temperature and after a warm-up time of five minutes, unless otherwise stated

## 2 Foreword

### 2.1 Notes on the documentation

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#### Disclaimer

The documentation has been prepared with care. The products described are, however, constantly under development.

We reserve the right to revise and change the documentation at any time and without prior announcement.

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#### Patent Pending

The EtherCAT Technology is covered, including but not limited to the following patent applications and patents: EP1590927, EP1789857, EP1456722, EP2137893, DE102015105702 with corresponding applications or registrations in various other countries.

#### Intended audience

This description is only intended for the use of trained specialists in control and automation engineering who are familiar with the applicable national standards.

It is essential that the documentation and the following notes and explanations are followed when installing and commissioning these components.

The qualified personnel is obliged to always use the currently valid documentation.

The responsible staff must ensure that the application or use of the products described satisfy all the requirements for safety, including all the relevant laws, regulations, guidelines and standards.

## 2.2 Safety instructions

### Description of instructions

In this documentation the following instructions are used.  
These instructions must be read carefully and followed without fail!

#### **DANGER**

##### **Serious risk of injury!**

Failure to follow this safety instruction directly endangers the life and health of persons.

#### **WARNING**

##### **Risk of injury!**

Failure to follow this safety instruction endangers the life and health of persons.

#### **CAUTION**

##### **Personal injuries!**

Failure to follow this safety instruction can lead to injuries to persons.

#### **NOTICE**

##### **Damage to environment/equipment or data loss**

Failure to follow this instruction can lead to environmental damage, equipment damage or data loss.



#### **Tip or pointer**

This symbol indicates information that contributes to better understanding.

### Intended use

This device is designed for installation in a housing and is intended for general professional use, for example in industrial control systems or office, communication and measuring equipment.

Do not use this power supply in installations where a malfunction could cause serious injury or danger to human life.

### Exclusion of liability

All the components are supplied in particular hardware and software configurations appropriate for the application. Modifications to hardware or software configurations other than those described in the documentation are not permitted, and nullify the liability of Beckhoff Automation GmbH & Co. KG.

### Personnel qualification

This description is only intended for trained specialists in control, automation and drive engineering who are familiar with the applicable national standards.

### Safety regulations

Please note the following safety instructions and explanations!  
Product-specific safety instructions can be found on following pages or in the areas mounting, wiring, commissioning etc.

**Safety instructions and installation requirements for PS2031-2410-0000 power supply unit****⚠ DANGER****Danger of electric shock, fire, injuries, injuries resulting in death!**



- Do not use the power supply without proper earthing (protective conductor). Use the terminal at the input terminal strip for the earth connection, not one of the screws on the housing.
- Switch off the power supply before working on the device. Provide protection against unintentional reconnection.
- Ensure proper wiring by following all local and national regulations.
- Do not modify or attempt to repair the device.
- Do not open the device, as high voltages are present inside.
- Avoid foreign bodies entering the housing.
- Do not use the device in damp locations or in areas where moisture or condensation is likely to occur.
- Do not touch the device when it is switched on or immediately after it has been switched off. Hot surfaces can cause burns.

**i Further notes on installation requirements**

- This device contains no serviceable parts. In the event of damage or malfunction during installation or operation, switch off the device immediately and return it to the factory for inspection. Triggering of an internal fuse indicates an internal defect.
- Install the device in a housing that provides protection against electrical, mechanical and fire hazards.
- Install the device on a DIN rail according to EN 60715, with the input terminals at the bottom of the device. Other mounting positions require a reduction of the output current.
- Make sure that the wiring is correct. Make sure that all individual wires of a strand enter the terminal connection.
- Unused screw terminals should be tightened firmly.
- The device is designed for areas with contamination level 2 in controlled environments. No condensation or frost is allowed.
- The device housing offers IP20 protection.
- The device insulation is designed to withstand surge voltages of overvoltage category III according to IEC 60664-1. For delta protective conductor systems, the overvoltage category is reduced to level II.
- The device is designed to meet the requirements of protection class I according to IEC 61140.
- Do not use the device without a proper PE connection (protective earth).
- The device is suitable for supply from TN, TT and IT networks. The voltage between the L or N terminal and the PE terminal must not exceed 500Vac continuously.
- An isolating device must be provided for the device input.
- This device is designed for convection cooling and does not require an external fan. Do not obstruct the air circulation.
- The device is designed for altitudes up to 6000m (19685ft). Above 2000m (6560ft) a reduction of the output current and overvoltage category is required.
- Maintain the following installation distances: 40 mm at the top, 20 mm at the bottom and 5 mm on the left and right are recommended if the device continuously runs at more than 50% of the rated output. Increase this distance to 15 mm if the adjacent device is a heat source (e.g. another power supply unit). If the device continuously runs at less than 50%, the 5 mm distance can be reduced to zero.
- The device is designed, tested and approved for branch-circuit currents up to 32 A (IEC) and 30 A (UL) without additional protection. If an external fuse is used, do not use circuit breakers smaller than 6A (B or C characteristic) to avoid unwanted tripping of the circuit breaker.
- The maximum ambient air temperature is +70°C (+158°F). The operating temperature corresponds to the ambient or ambient air temperature, per definition at 2 cm below the device.
- The device is designed for operation in the relative humidity range between 5% and 95%.



## 2.3 Terminology and abbreviations

<b>PE and the earthing symbol</b> 	PE is the abbreviation for "protective earth" and has the same meaning as the earthing symbol 
<b>Earth, ground</b>	The terms earth and ground are synonymous and are used interchangeably in this document.
<b>T.b.d.</b>	Still to be defined, value or description will follow in due course.
<b>AC 400 V</b>	A value preceded by "AC" or "DC" represents a nominal voltage or a nominal voltage range. The nominal voltage or the nominal voltage range may be provided with tolerances. (e.g., AC 380 - 480 V $\pm$ 15%). The calculated total range then indicates the working range of the device.  Example: DC 12 V refers to a 12 V battery, regardless of whether it is fully charged (13.7 Vdc) or discharged (10 Vdc).
<b>400 Vac</b>	A value followed by the unit Vac or Vdc is an instantaneous value that does not contain any additional tolerances.
<b>50 Hz vs. 60 Hz</b>	Unless otherwise specified, AC 230 V parameters are valid at a mains frequency of 50 Hz.
<b>may</b>	A keyword indicating a choice without implied preference.
<b>shall</b>	A keyword indicating a mandatory requirement.
<b>should</b>	A keyword indicating a choice with a clearly preferred method of implementation.

### 3 Technical data, mounting, wiring

#### 3.1 AC input

The device is suitable for being supplied with AC voltage from TN, TT and IT networks. Earthing of one phase is permitted, except for UL508 applications.

The device can also be operated at only two phases of a three-phase system. For further information see chapter [Two-phase operation](#) [► 35].

AC input			
AC input	Nom.	3AC 380-480V	Suitable for TN, TT and IT networks
AC input range	Min.	3x 323-576Vac	Continuous operation
	Min.	3x 576-700Vac	For up to 1000ms max.
Permissible voltage L or N to earth	Max.	500 Vac	Continuous according to IEC 62477-1
Input frequency	Nom.	50–60Hz	±6%
Turn-on voltage	Typ.	3x 260Vac	Static, see Fig. <i>Input voltage range; switch-on behavior definitions</i>
Shut-down voltage	Typ.	3x 185Vac	Static, see Fig. <i>Input voltage range; switch-on behavior definitions</i>

AC input		3AC 400V	3AC 480V	
Input current	Typ.	0.7A	0.6A	At 24 V, 10 A per phase, see Fig. <i>Input current over output current; power factor over output current</i>
Power factor*)	Typ.	0.53	0.52	At 24 V, 10 A, see Fig. <i>Input current over output current; power factor over output current</i>
Start-up delay	Typ.	90 ms	90 ms	See Fig. <i>Input voltage range; switch-on behavior definitions</i>
Rise time	Typ.	40 ms	40 ms	At 24 V, 10 A constant current load, 0 mF load capacity, see Fig. <i>Input voltage range; switch-on behavior definitions</i>
	Typ.	85 ms	85 ms	At 24 V, 10 A constant current load, 10 mF load capacity, see Fig. <i>Input voltage range; switch-on behavior definitions</i>
Turn-on overshoot	Max.	200 mV	200 mV	See Fig. <i>Input voltage range; switch-on behavior definitions</i>

\*) The power factor is the ratio of real (or active) power to apparent power in an AC circuit.

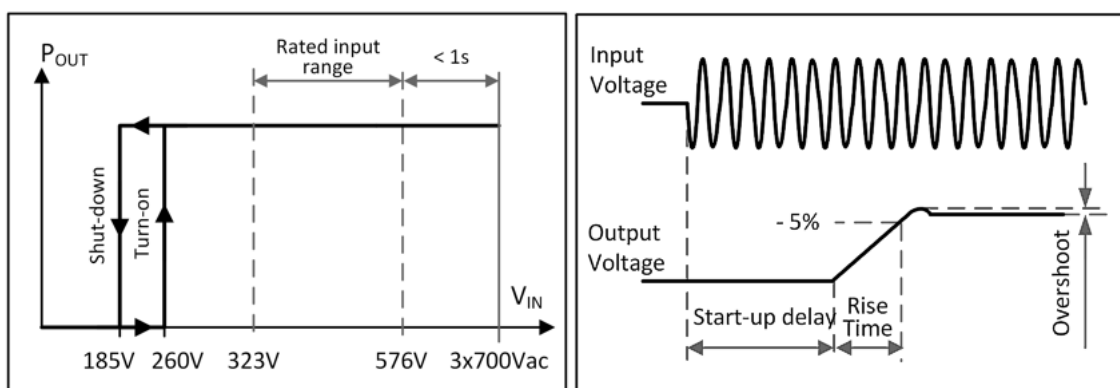


Fig. 1: Input voltage range; switch-on behavior definitions

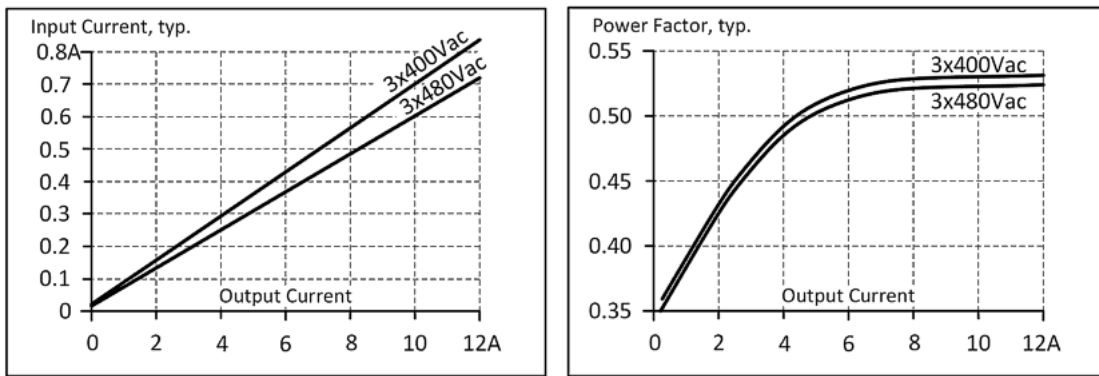


Fig. 2: Input current over output current; power factor over output current

## **3.2 DC input**

Do not use the power supply unit with DC input voltages!

### 3.3 Input inrush current

Active inrush current limitation limits the inrush current surge after the input voltage is switched on.

The charge current of the interference suppression capacitors during the first few microseconds after switching on is not taken into account.

		3AC 400V	3AC 480V	
Input inrush current	Max.	10A <sub>peak</sub>	10A <sub>peak</sub>	temperature-independent
	Typ.	4A <sub>peak</sub>	4A <sub>peak</sub>	
Inrush energy	Max.	0.5A <sup>2</sup> s	0.5A <sup>2</sup> s	

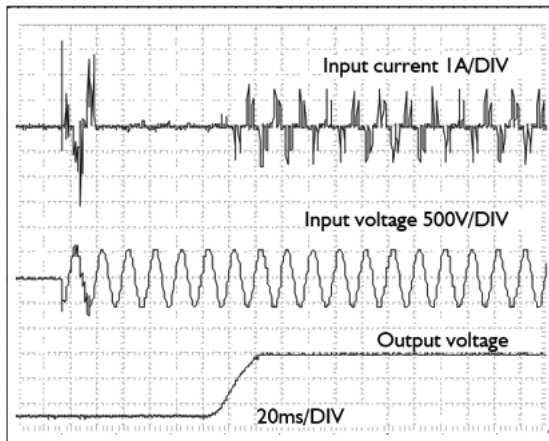


Fig. 3: Typical switch-on behavior at nominal load, 25°C ambient temperature

### 3.4 Output

The output provides an SELV/PELV nominal voltage that is electrically isolated from the input voltage.

The device is designed to supply any type of load, including capacitive and inductive loads.

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

Output voltage	Nom.	24 V	
Adjustment range	Min.	24-28V	Guaranteed value
	Max.	30.0 V	This is the maximum output voltage that can occur in the end position of the potentiometer in clockwise direction due to tolerances. It is not a guaranteed value that can be achieved.
Factory settings	Typ.	24.1 V	±0.2%, single use at full load (cold device) ±0.2%, parallel use at 10A (cold device) (23.9 V ±0.2% at 12 A and 25.0 V ±0.2% at zero load)
Line regulation	Max.	10 mV	Between 3x 323 and 3x 576 Vac
Load regulation	Max.	100 mV	Between 0 and 10 A, static value, single use
	Typ.	1000 mV	Between 0 and 10 A, static value, parallel use, see Fig. <i>Output voltage over output current (parallel use) typ.</i>
Residual ripple and ripple voltage	Max.	50mV <sub>SS</sub>	Bandwidth 20 Hz to 20 MHz, 50 Ohm
Output current	Nom.	12A <sup>1)</sup>	At 24 V and ambient temperature below 45°C
	Nom.	10A	At 24 V and 60°C ambient temperature
	Nom.	7.5A	At 24 V and 70°C ambient temperature
	Nom.	10.3A <sup>1)</sup>	At 28 V and ambient temperature below 45°C
	Nom.	8.6A	At 28 V and 60°C ambient temperature
	Nom.	6.5A	At 28 V and 70°C ambient temperature
	Linear derating between +45°C and +70°C		
Safety switch-off current	Typ.	23A	Up to 20ms once every five seconds, see Fig. <i>Output voltage over output current, typ.</i> The fuse output current is an increased transient current that contributes to the tripping of fuses on faulty output branches. The output voltage remains above 20V.
Overload behavior		Continuous current	see Fig. <i>Output voltage over output current, typ.</i>
Short circuit current	Max.	23A	Continuous current, see Fig. <i>Output voltage over output current, typ.</i>
Output capacity	Typ.	6500µF	Included in the power supply
Load feedback	Max.	35V	The device is resistant to load feedback and will not indicate a malfunction if a load is feeding voltage back into the power supply. It does not matter whether the power supply is switched on or off. The absorbed energy can be determined by means of the built-in large-size output capacitor.

<sup>1)</sup> This current is also available for temperatures up to +70°C with a duty cycle of 10% and/or no more than 1 minute every 10 minutes.

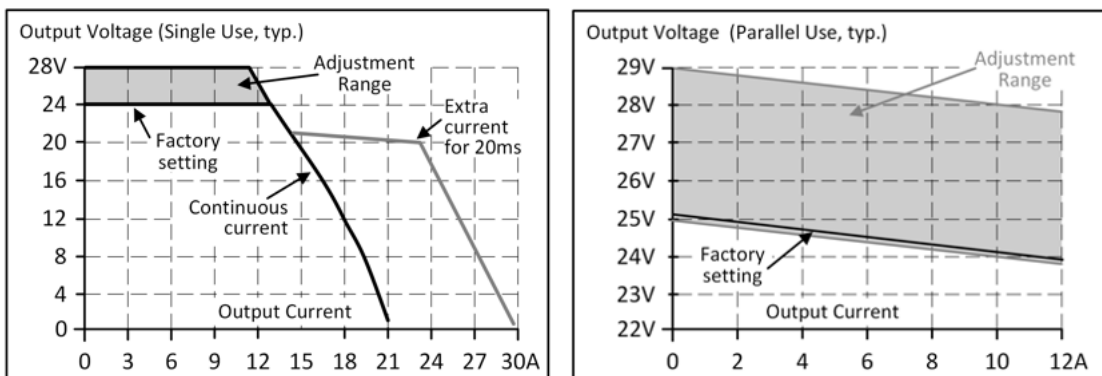


Fig. 4: Output voltage over output current (single use); output voltage over output current (parallel use).

### 3.5 Hold-up time

		3AC 400V	3AC 480V	
Power failure Hold-up time	Typ.	34ms	54ms	At 24V, 10A, see Fig. <i>Hold-up time over input voltage</i>
	Typ.	68ms	108ms	At 24V, 5A, see Fig. <i>Hold-up time over input voltage</i>
	Min.	28ms	44ms	At 24V, 10A, see Fig. <i>Hold-up time over input voltage</i>
	Min.	56ms	87ms	At 24V, 5A, see Fig. <i>Hold-up time over input voltage</i>

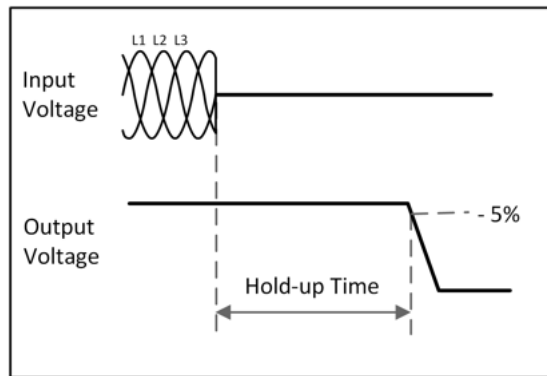
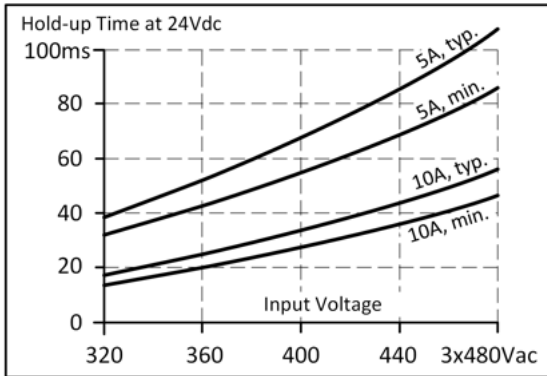


Fig. 5: Hold-up time over input voltage; switch-off behavior, definitions

### 3.6 Efficiency and losses

		3AC 400V	3AC 480V	
Efficiency	Typ.	92.8%	92.9%	At 24V, 10A, 3-phase operation
	Typ.	92.4%	92.6%	At 24V, 10A, 2 phase operation in a 3-phase system, see chapter <a href="#">Two-phase operation</a> [▶ 35]
Average efficiency <sup>*)</sup>	Typ.	92.2%	92.0%	25% at 2.5A, 25% at 5A, 25% at 7.5A, 25% at 10A, 3-phase operation
Losses	Typ.	2.3W	2.6W	At 24V, 0A, 3-phase operation
	Typ.	11.8W	11.8W	At 24V, 5A, 3-phase operation
	Typ.	18.6W	18.3W	At 24V, 10A, 3-phase operation
	Typ.	23.5W	22.8W	At 24V, 12A, 3-phase operation

<sup>\*)</sup> The average efficiency is based on assumptions for a typical application with the power supply unit operating at 25% of the nominal load during 25% of the time, 50% of the nominal load during 25% of the time, 75% of the nominal load during 25% of the time and 100% of the nominal load during the remaining time.

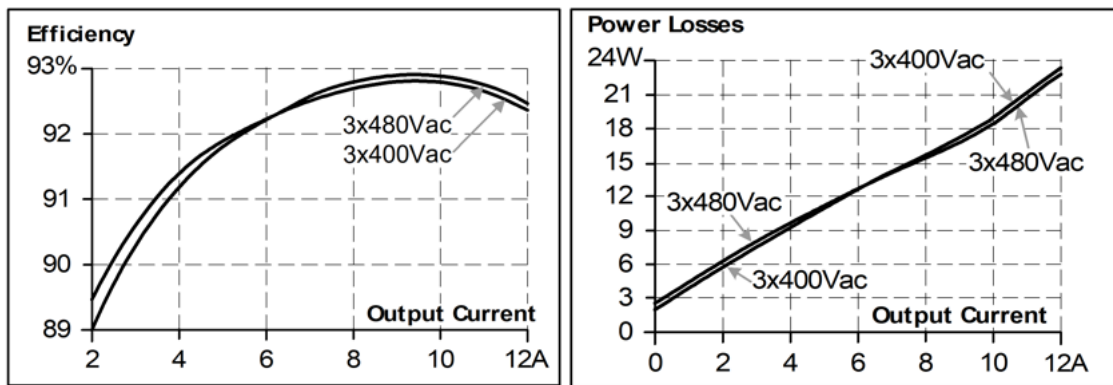


Fig. 6: Efficiency over output current; losses over output current

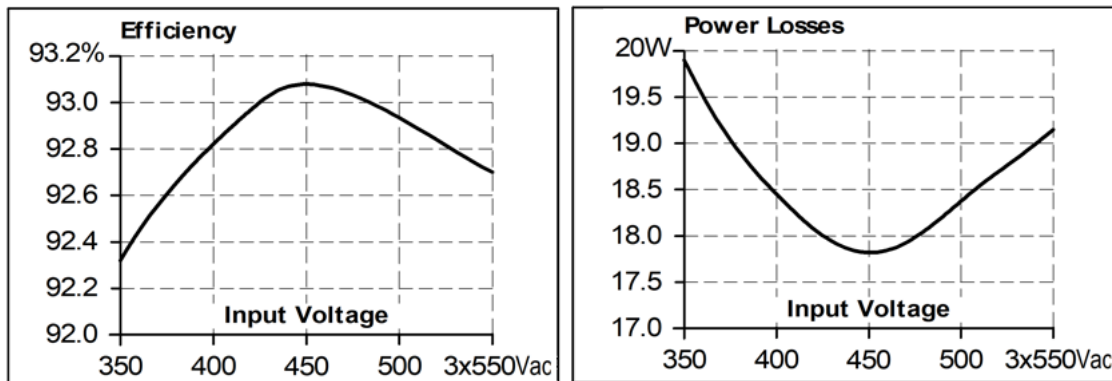


Fig. 7: Efficiency over input voltage; losses over input voltage



### 3.7 Lifetime expectancy

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

	<b>3AC 400V</b>	<b>3AC 480V</b>	
Lifetime expectancy	54,000h	62,000h	At 24V, 10A and +40°C, 3-phase operation
	133,000h	134,000h	At 24V, 5A and +40°C, 3-phase operation
	41,000h	47,000h	At 24V, 12A and +40°C, 3-phase operation
	151,000h	176,000h	At 24V, 10A and +25°C, 3-phase operation
	376,000h	379,000h	At 24V, 5A and +25°C, 3-phase operation
	116,000h	133,000h	At 24V, 12A and +25°C, 3-phase operation
Lifetime expectancy	48,000h	58,000h	At 24V, 10A and +40°C, 2-phase operation
	134,000h	145,000h	At 24V, 5A and +40°C, 2-phase operation
	36,000h	42,000h	At 24V, 12A and +40°C, 2-phase operation
	135,000h	164,000h	At 24V, 10A and +25°C, 2-phase operation
	379,000h	410,000h	At 24V, 5A and +25°C, 2-phase operation
	102,000h	119,000h	At 24V, 12A and +25°C, 2-phase operation

### 3.8 MTBF

MTBF stands for **Mean Time Between Failure**, which is calculated from the statistical failure rate of the components and indicates the reliability of a device. It is a statistical representation of the probability of equipment failure and does not necessarily represent the service life of a product.

The MTBF number is a statistical representation of the probability of equipment failure. An MTBF number of 1,000,000h, for example, means that statistically, if there are 10,000 devices in use, one device will fail every 100 hours. However, it is not possible to say whether the failed device has been in operation for 50,000 hours or only 100 hours.

For these device types the MTTF value (**Mean Time To Failure**) is identical to the MTBF value.

	<b>3AC 400V</b>	<b>3AC 480V</b>	
MTBF SN 29500, IEC 61709	975,000h	985,000h	At 24V, 10A and 40°C, 3-phase operation
	1,706,000h	1,723,000h	At 24V, 10A and 25°C, 3-phase operation
	925,000h	939,000h	At 24V, 10A and 40°C, 2-phase operation
	1,633,000h	1,656,000h	At 24V, 10A and 25°C, 2-phase operation
MTBF MIL HDBK 217F	444,000h	428,000h	At 24V, 10A and 40°C, 3-phase operation, Ground Benign GB40
	584,000h	563,000h	At 24V, 10A and 25°C, 3-phase operation, Ground Benign GB25
	100,000h	100,000h	At 24V, 10A and 40°C, 3-phase operation, Ground Fixed GF40
	132,000h	132,000h	At 24V, 10A and 25°C, 3-phase operation, Ground Fixed GF25
	436,000h	423,000h	At 24V, 10A and 40°C, 2-phase operation, Ground Benign GB40
	555,000h	572,000h	At 24V, 10A and 25°C, 2-phase operation, Ground Benign GB25
	98,000h	98,000h	At 24V, 10A and 40°C, 2-phase operation, Ground Fixed GF40
	129,000h	129,000h	At 24V, 10A and 25°C, 2-phase operation, Ground Fixed GF25

### 3.9 Terminals and wiring

The terminals are designed to be finger-safe according to IP20 and are suitable for field or factory wiring.

Technical data	Input	Output
Connection cross-section	e*: max. 6mm <sup>2</sup> f*: max. 4mm <sup>2</sup> a*: max. 4mm <sup>2</sup> (d<2.8mm)	e*: max. 6mm <sup>2</sup> f*: max. 4mm <sup>2</sup> a*: max 4mm <sup>2</sup> (d<2.8mm)
Connection cross section (AWG)	e*: AWG 20-10 f*: AWG 20-10 a* AWG 20-10 (d<2.8mm)	e*: AWG 20-10 f*: AWG 20-10 a* AWG 20-10 (d<2.8mm)
Strip length	7mm / 0.28inch	7mm / 0.28inch

e\* = solid single wire

f\* = stranded wire

a\* = with ferrule

#### Wiring instructions:

- Use suitable copper cables that are designed for at least the following operating temperatures: +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.
- Observe the national installation rules and regulations!
- Make sure that all single wires of a strand are connected to the terminal!
- Unused terminals should be tightened firmly.
- Ferrules are permitted.

#### Series connection of power supply units:

Series connection (looping from one power supply output to the next) is permitted as long as the average output current flowing through a connection pin does not exceed 25 A. For higher currents please use a separate distributor terminal strip as shown in Fig. *Using distribution terminals*.

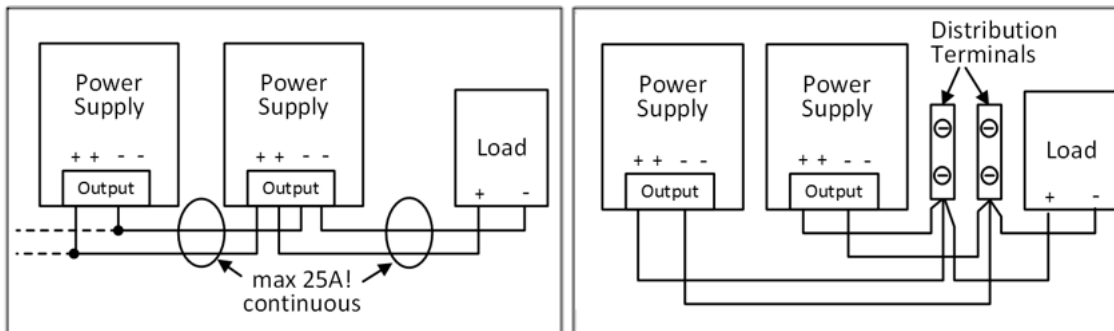


Fig. 8: Series connection of outputs; use of distribution terminals

### 3.10 Functional wiring diagram

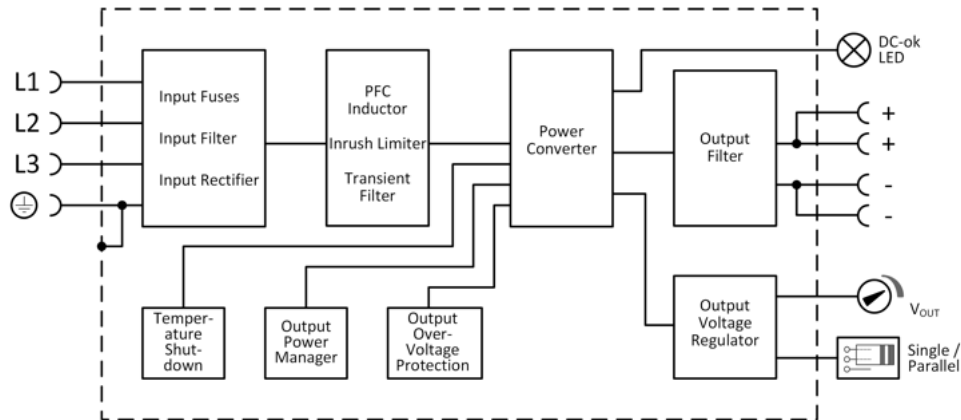


Fig. 9: Functional wiring diagram

### 3.11 Front side and operating elements

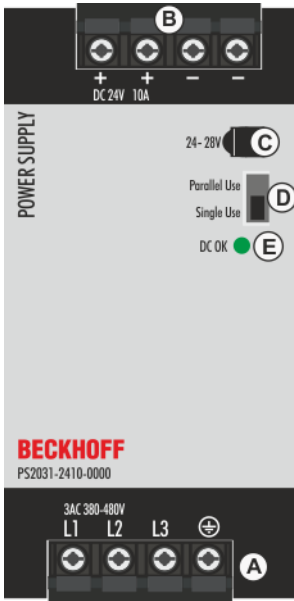



Fig. 10: Front PS2031-2410-0000

#### Input terminals (screw terminals)

Designation (A)	Description
L1, L2, L3	Mains input L1, L2, L3
	PE input (protective conductor)

#### Output terminals (screw terminals)

Designation (B)	Description
+	two identical positive poles, positive output
-	two identical negative poles, negative output

#### Potentiometer for the output voltage

Designation (C)	Description
Potentiometer cover	Open the flap to adjust the output voltage. Factory setting: 24.1 V

#### "Parallel Use" or "Single Use" mode

Designation (D)	Description
Jumper for "Single Use" or "Parallel Use"	Set the jumper to "Parallel Use" if devices are connected in parallel to increase the output power. In order to distribute the load current among the individual power supply units, the "Parallel Use" mode regulates the output voltage so that the voltage at zero load is approx. 4% higher than at nominal load. A missing jumper corresponds to "Single Use" mode, which is the factory setting.

#### DC OK LED

Designation (E)	Description
Push-in terminals 13 / 14	Monitors the output voltage of the active power supply. See chapter on DC OK relay contact for more information.

### 3.12 EMC

The EMC behavior of the device is designed for applications in industrial environments as well as residential, commercial or small business environments. The output may be earthed or non-earthed.

The device was tested according to EN 61000-6-1, EN 61000-6-2, EN 61000-6-3 and EN 61000-6-4.

Without additional measures to reduce emissions at the output (e.g. by using a filter), the device is not suitable for supplying a local DC power network in residential, commercial or small business environments. There are no restrictions for local DC power networks in industrial environments.

EMC interference immunity			
Strong transients	VDE 0160	Over the entire load range	1550V; 1.3ms

EMC interference emission		
Cable-related interference emission, input lines	EN 55011, EN 55022, FCC Part 15, CISPR 11, CISPR 22	Class B
Interference emission	EN 55011, EN 55022	Class B
Harmonic input current	EN 61000-3-2	Class A requirements met
Voltage fluctuations, flicker	EN 61000-3-3	Requirements met <sup>1)</sup>

This device complies with FCC Part 15.  
 Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must be able to deal with any interference received, including interference that may cause undesired operation.

<sup>1)</sup> Tested with constant current loads, non-pulsating

Switching frequencies		
Main converter	80kHz to 140kHz	Output load and input voltage dependent

### 3.13 Environment

Environment		
Operating temperature <sup>1)</sup>	-25°C to +70°C	Reduction of the output power according to Fig. <i>Output current over ambient temperature</i>
Storage temperature	-40°C to +85°C	For storage and transport
Output load reduction (derating)	3.2W/°C / 6W/°C	+45°C to +60°C / +60°C to +70°C
	15W/1000m or 5°C/1000m	For altitudes >2000m, see Fig. <i>Output current over installation altitude</i>
	9W/-5kPa or 3°C/-5kPa	For atmospheric pressures <80kPa, see Fig. <i>Output current over installation altitude</i>
	The derating is not hardware-controlled. The user must take this into account in order to stay below the reduced current limits, so that device overload is avoided.	
Moisture	5 to 95% r.h.	According to IEC 60068-2-30 Do not energize if there is condensation.
Atmospheric pressure	110-47kPa	see Fig. <i>Output current over installation altitude</i>
Installation altitude	up to 6000m	see Fig. <i>Output current over installation altitude</i>
Overvoltage category	III	According to IEC 60664 -1, installation altitudes up to 2000m
	II	According to IEC 60664 -1, installation altitudes above 2000m and atmospheric pressures between 80 and 47kPa
Degree of pollution	2	According to IEC 62477-1, non-conductive
Oscillation, sinusoidal <sup>2)</sup>	2-17.8Hz: ±1.6mm; 17.8-500Hz: 2 g 2 hours/axis	According to IEC 60068-2-6
Impacts <sup>2)</sup>	30g 6ms, 20g 11ms 3 impacts/direction, 18 impacts in total	According to IEC 60068-2-27
LABS-free	The device does not release any silicones or other paint-wetting impairment substances and is suitable for use in paint shops.	
Corrosive gas	Tested according to ISA-71.04-1985, Severity Level G3, IEC 60068-2-60 Test Ke Method 4 for a service life of at least 10 years in these environments.	
Audible noises	In the event of no-load, overload or short circuit, the power supply unit emits audible noises.	

<sup>1)</sup> The working temperature is identical to the room temperature or the ambient temperature and is defined as the air temperature 2cm below the device.

<sup>2)</sup> Tested in conjunction with DIN rails according to EN 60715 with a height of 15mm and a thickness of 1.3mm and standard mounting position.

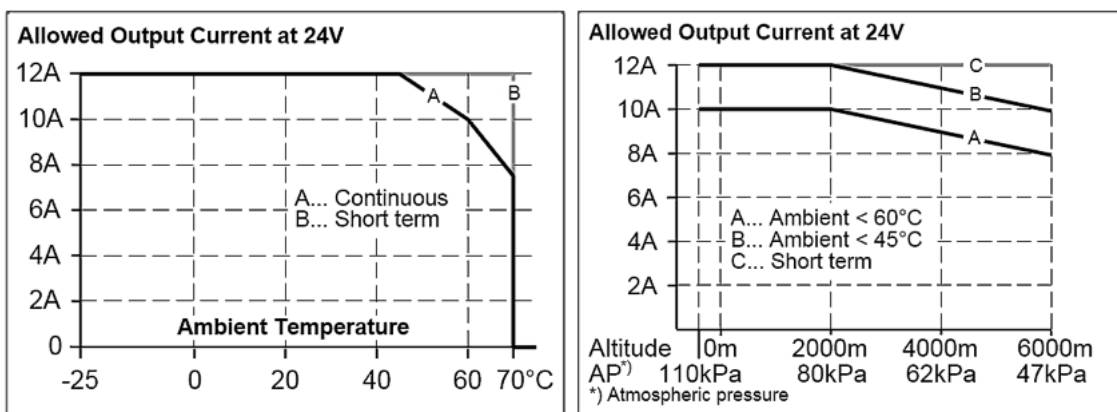


Fig. 11: Output current over ambient temperature; output current over installation altitude

### 3.14 Protective functions

Protective functions		
Output overvoltage protection	Typ. 30.5Vdc Max. 32Vdc	In the event of an internal power supply fault, a redundant circuit limits the maximum output voltage. The output switches off and automatically tries to switch on again.
Protection class	IP 20	EN/IEC 60529
Overtemperature protection	Yes	Output shutdown with automatic restart. The temperature sensor is installed at critical components within the device and switches off the device in safety-critical situations (e.g. load reduction requirements not met, excessive ambient temperature, ventilation blocked or load reduction not observed if the mounting direction is different). There is no correlation between the operating temperature and the switch-off temperature, since the latter depends on the input voltage, the load and the installation type.
Protection against input transients	MOV (metal oxide varistor)	For information on protection see <a href="#">chapter on EMC [▶ 22]</a> .
Input fuse	Included	Non-replaceable slow-blow fuse with high load capacity

### 3.15 Safety features

Safety features		
Protection class	I	Conforms to IEC 61140 PE (protective conductor) connection required
Insulation resistance	> 500MΩ	In the delivery state between input and output, measured with 500Vdc
	> 500MΩ	In the delivery state between input and protective conductor, measured with 500Vdc
	> 500MΩ	In the delivery state between output and protective conductor, measured with 500Vdc
	> 500MΩ	In the delivery state between output and DC OK contacts, measured with 500Vdc
PE resistance	< 0.1Ω	Resistance between the protective conductor connection and the housing near the DIN rail mounting bracket.
Leakage current	Typ. 0.17mA	With 3x 400Vac, 50Hz, TN, TT network
	Typ. 0.24mA	With 3x 480Vac, 60Hz, TN, TT network
	Max. 0.22mA	With 3x 440Vac, 50Hz, TN, TT network
	Max. 0.31mA	With 3x 528Vac, 50Hz, TN, TT network



### 3.16 Dielectric strength

The output voltage is earth-free and has no ohmic connection to earth.  
The output is isolated from the input by double or reinforced insulation.

Type and component tests are carried out by the manufacturer. Field tests can be performed in the field using suitable test equipment that ramps up the voltage with a slow ramp (2s rising and 2s falling). Connect all input terminals and all output poles to each other before performing the tests. During the test, set the cut-off current to the value shown in the table below.

We recommend connecting either the positive pole, the negative pole or another part of the output circuit to the protective conductor system. This avoids situations in which the load starts unexpectedly or cannot be disconnected if an unnoticed earth leakage occurs.

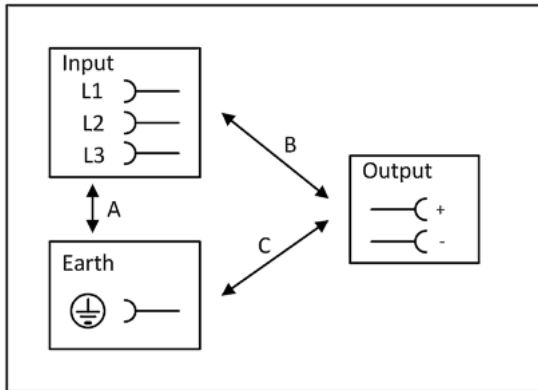


Fig. 12: Dielectric strength

		<b>A</b>	<b>B</b>	<b>C</b>
Type test	60s	2500Vac	3000Vac	500Vac
Component test	5s	2500Vac	2500Vac	500Vac
Field test	5s	2000Vac	2000Vac	500Vac
Setting the cut-off current		> 10mA	> 10mA	> 30mA

### 3.17 Declaration of conformity and approvals

	EU declaration of conformity
	UK Declaration of Conformity Trade conformity assessment for England, Scotland and Wales The UKCA mark indicates conformity with the UK Statutory Instruments 2016 No. 1101 (LVD) 2016 No. 1091 (EMC) and 2012 No. 3032 (RoHS)
	Registration for the Eurasian Customs Union market (Russia, Kazakhstan and Belarus)
	UL Certificate: UL 508, Applicable for US and Canada

### 3.18 Dimensions and weight

Dimensions and weight	
Overall width	62mm
Height	124mm
Depth	127mm The height of the DIN rails must be added to the depth of the device to calculate the total installation depth required
Weight	750 g
DIN rail	Use 35 mm DIN rails according to EN 60715 or EN 50022 with a height of 7.5 or 15mm.
Housing material	Housing: Aluminum alloy Cover: Galvanized steel
Ingress protection	Small parts such as screws, nuts, etc. with a diameter greater than 3.5 mm
Installation clearances	See chapter on <u>Safety instructions and installation requirements</u> [▶ 8]

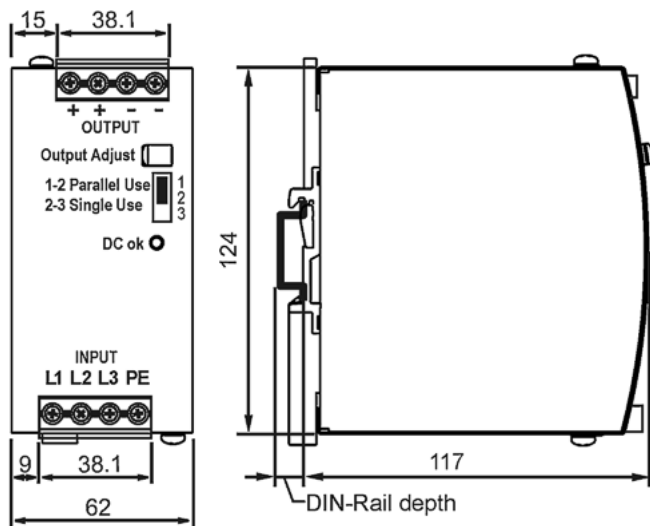


Fig. 13: Front/side view PS2031-2410-0000

## 4 Application notes

### 4.1 Peak current capability

The device can deliver peak currents (for up to several milliseconds) that are higher than the specified short-term currents.

This helps when starting loads with high current intensity. Magnetic coils, contactors and pneumatic modules often have a stationary coil and a pick-up coil. The inrush current requirement of the pick-up coil is several times higher than the stationary current and usually exceeds the rated output current (including extra power). The situation is exactly the same when starting a capacitive load.

The peak current capability also ensures safe operation of downstream circuit breakers of load circuits. The load circuits are often individually fused with circuit breakers or fuses. In the event of a short circuit or overload in a circuit, the fuse or circuit breaker needs a certain amount of overcurrent to open in time. This prevents a voltage drop in adjacent circuits.

The additional current (peak current) is supplied by the power converter and the built-in large-size output capacitors of the power supply unit. The capacitors are discharged during such an event, which leads to a voltage drop at the output. The following two examples show typical voltage drops for ohmic loads:

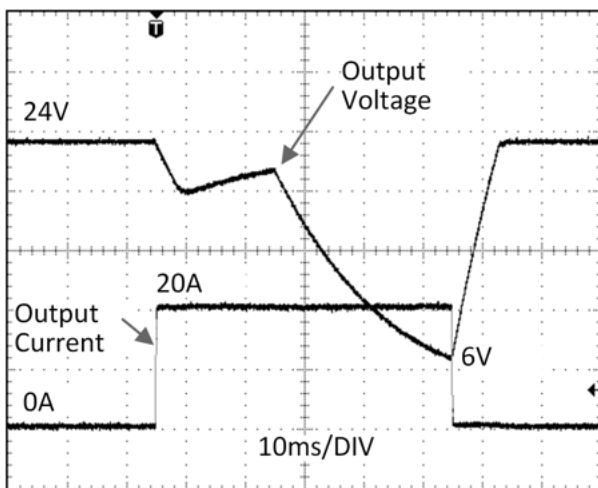


Fig. 14: 20A peak current for 50ms, typ. (2x nominal current)

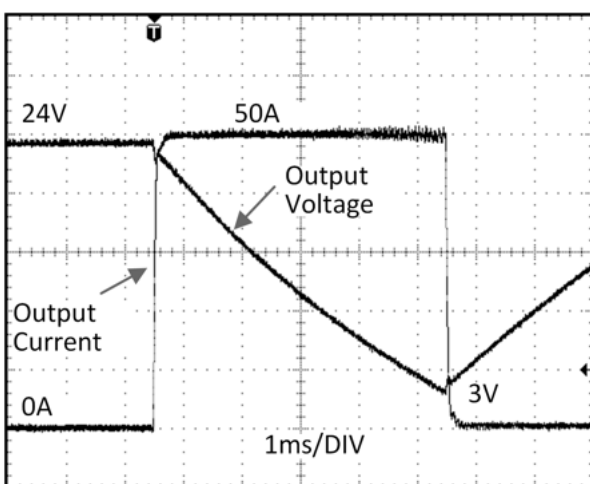


Fig. 15: 50A peak current for 5ms, typ. (5x nominal current)

Peak current voltage drops	
Typically from 24V to 6V	At 20A for 50ms, ohmic load
Typically from 24V to 12V	At 50A for 2ms, ohmic load
Typically from 24V to 3V	At 50A for 5ms, ohmic load

## 4.2 Output circuit breakers

Standard circuit breakers (or UL1077 circuit breakers) are generally used for AC supply systems and can also be used for 24V branches.

Circuit breakers are used to protect wires and circuits. If the ampere value and the characteristics of the circuit breaker are matched to the wire thickness used, the wiring is considered thermally safe, regardless of whether the circuit breaker opens or not.

To avoid voltage drops and situations with undervoltage in adjacent 24V branches fed from the same source, a fast (magnetic) trip of the circuit breaker is desirable. Fast switch-off within 10ms is required, which approximately corresponds to the bridging time of PLC. This requires power supplies with high reserve current and large output capacitors. In addition, the impedance of the faulty branch must be sufficiently small for the current to actually flow. The strongest power supply is of no use if the ohmic law does not allow current to flow. The following table contains typical test results that show which circuit breakers with B and C characteristics trip magnetically, depending on the wire cross-section and the wire length.

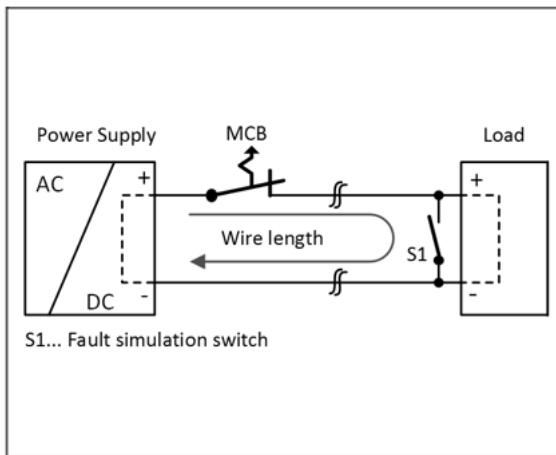


Fig. 16: Test circuit

Maximum wire length<sup>\*)</sup> for fast (magnetic) tripping:

	0.75mm <sup>2</sup>	1.0mm <sup>2</sup>	1.5mm <sup>2</sup>	2.5mm <sup>2</sup>
<b>C-2A</b>	23m	28m	43m	69m
<b>C-3A</b>	18m	23m	34m	54m
<b>C-4A</b>	6m	12m	18m	28m
<b>C-6A</b>	3m	4m	6m	7m
<b>C-8A</b>	2m	3m	4m	5m
<b>C-10A</b>	1m	2m	3m	4m

	0.75mm <sup>2</sup>	1.0mm <sup>2</sup>	1.5mm <sup>2</sup>	2.5mm <sup>2</sup>
<b>B-6A</b>	9m	14m	19m	33m
<b>B-10A</b>	4m	5m	6m	9m
<b>B-13A</b>	3m	4m	5m	8m

<sup>\*)</sup> Don't forget to double the distance to the load (or the cable length) when calculating the total cable length (plus and minus cable).

### 4.3 Charging batteries

The power supply can be used to charge lead-acid batteries or maintenance-free batteries (SLA or VRLA batteries). Two 12V batteries connected in series are required.

**Instructions for charging batteries:**

- Make sure that the ambient temperature of the power supply remains below 45°C.
- Adjust the output voltage, measured at no load and at the battery end of the cable, very precisely to the end-of-charge voltage.

End-of-charge voltage	27.8V	27.5V	27.15V	26.8V
Battery temperature	10°C	20°C	30°C	40°C

- Use a 16A protective circuit breaker or a decoupling diode between the power supply and the battery.
- Make sure that the output current of the power supply is below the permissible charging current of the battery.
- Only use matched batteries when connecting 12V types in series.
- The reverse current to the power supply is typically 8mA. This reverse current can discharge the battery when the power supply is switched off, unless a decoupling diode is used.

### 4.4 Series connection

Power supplies of the same type can be connected in series to increase the output voltages. As many devices can be connected in series as necessary, as long as the sum of the output voltages does not exceed 150Vdc. Voltages with a potential higher than 60Vdc are no longer regarded as safety extra-low voltage and can be dangerous. Such voltages must be protected with a touch guard.

Avoid application of return voltage (e.g. from a braking motor or battery) to the output terminals.

Restrictions: Keep a mounting distance of 15mm (left/right) between two power supplies and do not install the power supplies above each other. Power supplies connected in series should only be used in the standard installation position (terminals on the underside of the device).

Remember that leakage current, electromagnetic interference, inrush current and harmonics increase when using multiple power supplies.

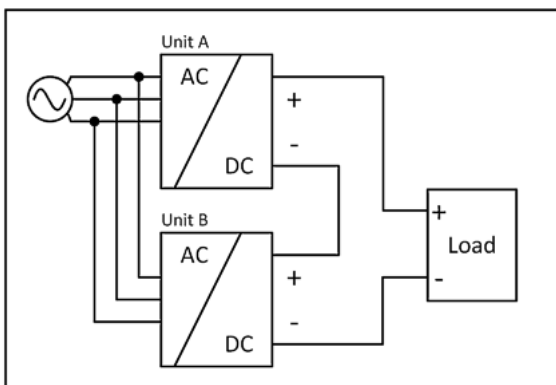


Fig. 17: Series connection

## 4.5 Parallel use to increase power

PS2031-2410-0000 power supplies can be connected in parallel to increase the output power. The output voltage of all power supplies must be set to the same value ( $\pm 100\text{mV}$ ) in "Single Use" mode and with the same load conditions on all devices, or the factory settings of the devices can be retained. After making adjustments, set the unit to "Parallel Use" mode to achieve load sharing. "Parallel Use" mode regulates the output voltage so that the voltage at no load is approx. 4% higher than at nominal load. See also [Output chapter](#) [▶ 14]

The ambient temperature may not exceed  $+60^{\circ}\text{C}$ .

If more than three devices are connected in parallel, a fuse or circuit breaker with a rated current of 15A or 16A is required at each output. Alternatively a diode can be used.

Restrictions: Keep a mounting distance of 15mm (left/right) between two power supplies and do not install the power supplies above each other. In parallel mode power supplies should only be used in the standard installation position (terminals on the underside of the device), not in other installation positions or under other conditions that require a reduction in the output current (e.g. installation altitude ...).

Remember that leakage current, electromagnetic interference, inrush current and harmonics increase when using multiple power supplies.

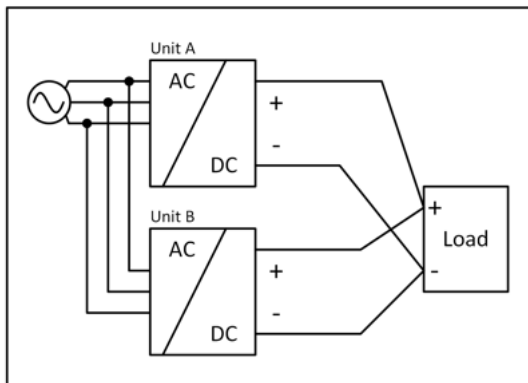


Fig. 18: Parallel connection



## 4.6 Parallel use for redundancy

### Recommendations for the construction of redundant power supply systems:

- Power supplies that contain a DC-OK signal contact are best suited for the construction of redundant power supply systems.
  - Use this DC-OK signal contact to monitor the individual power supplies.
- Use separate grids for each power supply whenever possible.
- It is recommended to set the output voltages of all devices to the same value ( $\pm 100$  mV) or to leave them at the factory setting.

### 4.6.1 1+1 Redundancy

It is possible to connect power supplies in parallel for redundancy operation in order to achieve better system availability. Redundant systems provide a certain amount of additional power to operate the load when a power supply unit fails. The simplest method is to connect two power supplies in parallel. This is called 1+1 redundancy. If one power supply fails, the other can automatically supply the load current without interruption.

The 1+1 redundancy allows ambient temperatures up to  $+70^{\circ}\text{C}$ .

#### **i** Notes on parallel use for 1+1 redundancy

- Be sure to use a redundancy module in order to decouple devices from one another. This prevents the defective device from becoming a load for the other device and the output voltage no longer being maintainable.
- Note that leakage current, EMI, input inrush current and harmonics increase when using multiple devices.

#### Wiring example:

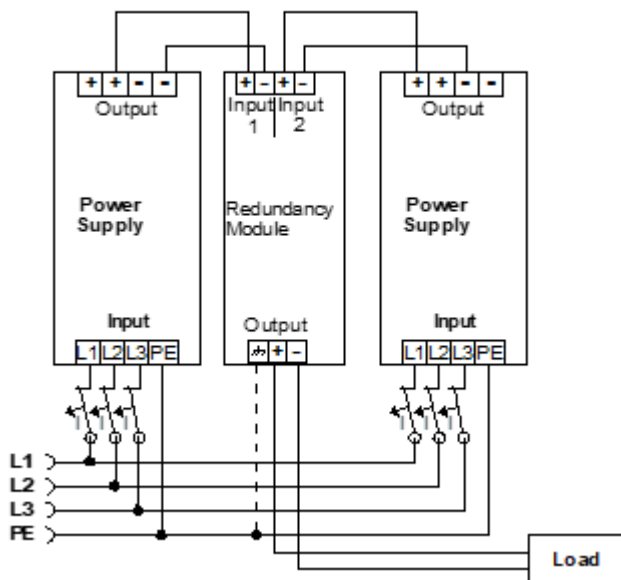


Fig. 19: Wiring for 1+1 - redundancy with one redundancy module PS9401-2440-0000

## 4.6.2 N+1 Redundancy

### Notes on parallel use for N + 1 redundancy

- Note that leakage current, EMI, input inrush current and harmonics increase when using multiple devices.
- The ambient temperature may not exceed +60 °C for N + 1 redundancy systems.

Redundancy systems for higher power requirements are usually set up using the N + 1 method. For example, four devices with a nominal current of 10 A are connected in parallel for a 30 A redundancy system.

- Keep a mounting distance of 15 mm (left/right) between two power supplies.
- Do not install the power supplies above each other.
- Do not use power supplies connected in parallel in an installation position that deviates from the standard installation position (connection terminals on the underside of the device) or in a different state requiring a reduction in the output current.

### Wiring example:

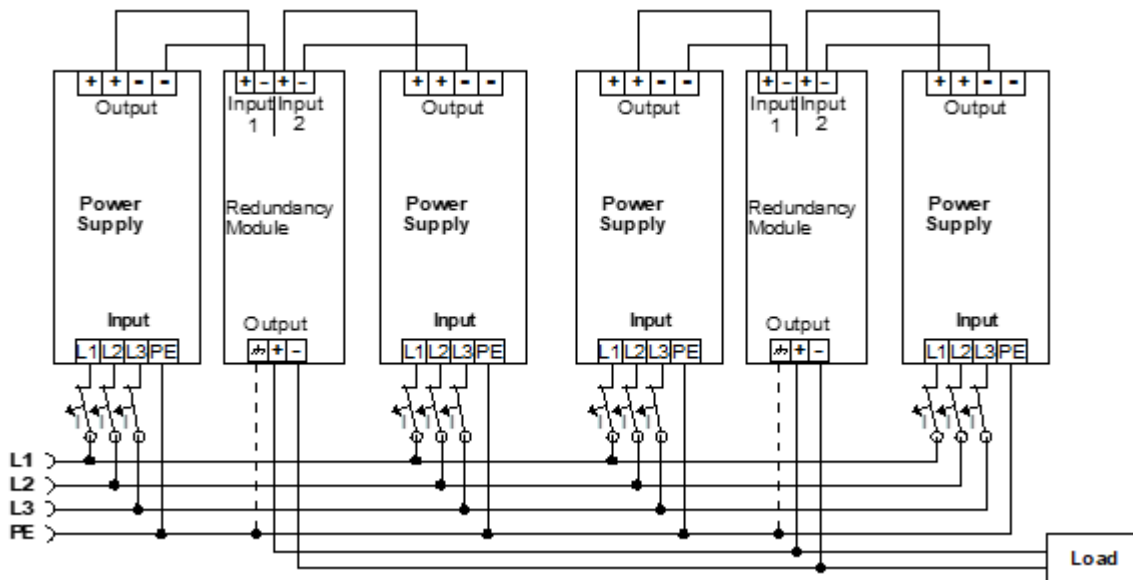


Fig. 20: Wiring for n+1 - redundancy with two redundancy modules PS9401-2440-0000

## 4.7 Operation on two phases

No external protective device is required to protect against phase failure.

The power supply may only be operated continuously on two strands of a three-phase system if the output power is reduced according to the curves shown below. Exceedance of these limit values over extended periods leads to thermal shutdown of the device.

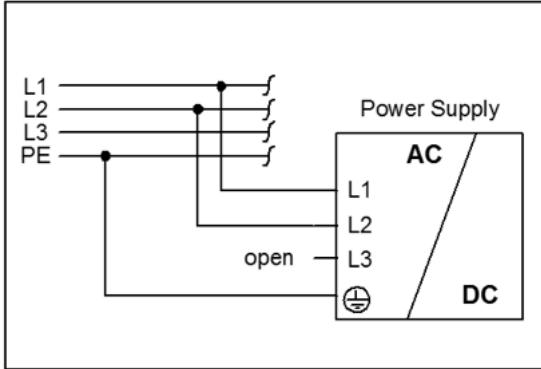


Fig. 21: Operation on two phases

Make sure the EMC performance, Hold-up time and losses are different from three-phase operation. Therefore check the suitability of your individual application.

The use of only two strands of a three-phase system is not covered by the official approval. Therefore, additional examinations may be required during the approval process of the final system.

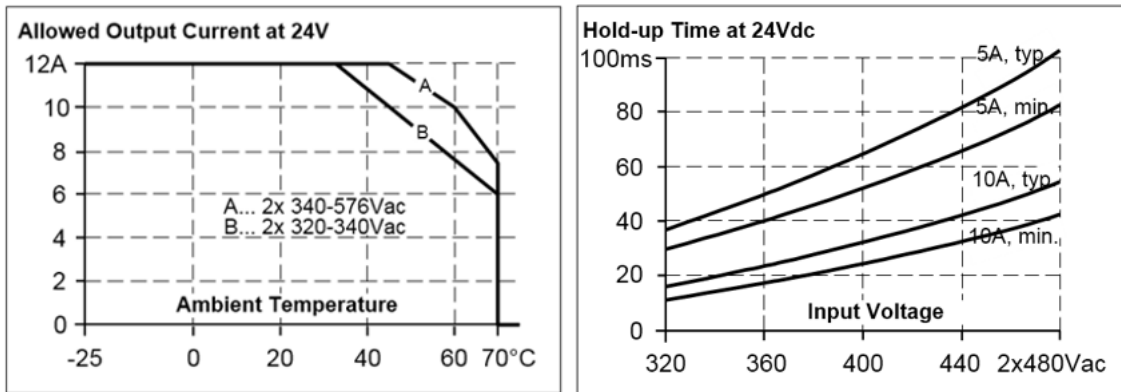


Fig. 22: When using only two phases: Permissible output current; Hold-up time

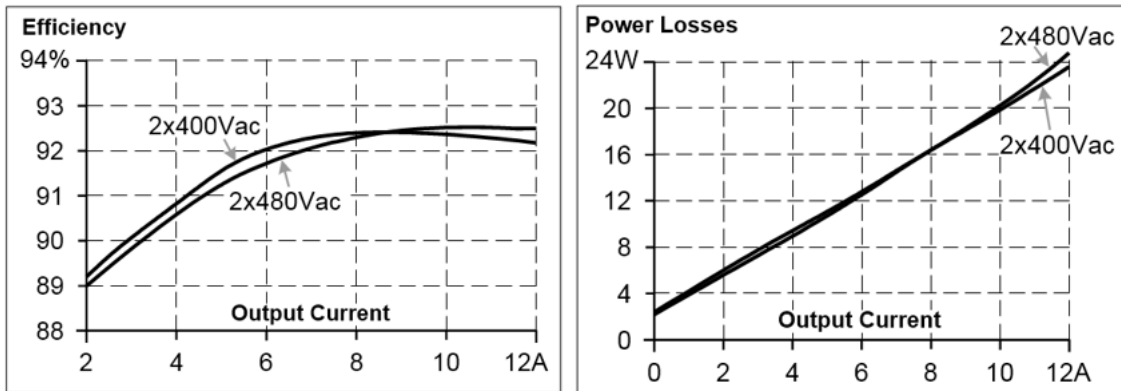


Fig. 23: When using only two phases: Efficiency relative to output current at 24 V; losses relative to output current at 24 V

## 4.8 Use in a tightly sealed enclosure

When the power supply is installed in a tightly sealed enclosure, the temperature inside the enclosure is higher than outside. In this case, the temperature inside the enclosure is considered the ambient temperature for the power supply.

In the following test arrangement, the device is placed at the center of the enclosure, and there are no other heat-generating objects in the enclosure. The load is placed outside the box.

The temperature sensor inside the box is placed at the center of the right side of the power supply at a distance of 1 cm.

The following measurement results can be used as a reference to estimate the temperature rise within the enclosure.

	Case A	Case B
Housing size	180x180x165mm Rittal housing, protection class IP66 PK 9519 100, plastic	180x180x165mm Rittal housing, protection class IP66 PK 9519 100, plastic
Input voltage	3x 400Vac	3x 400Vac
Load	24V, 8A; (=80%)	24V, 10A; (=100%)
Temperature inside the housing	48.4°C	54.7°C
Temperature outside the housing	24.5°C	24.9°C
Temperature increase	23.9K	29.8K

## 4.9 Installation positions

Installation positions other than the input connections at the bottom and the output at the top require a reduction of the continuous output power or a limitation of the maximum permissible ambient temperature.

The values for service life and MTBF given in this data sheet are only valid for the standard mounting orientation.

The following curves give an indication of permissible output currents for altitudes up to 2000m.

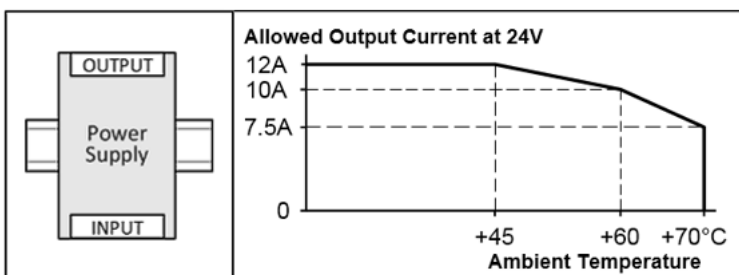


Fig. 24: Mounting position A (standard mounting position)

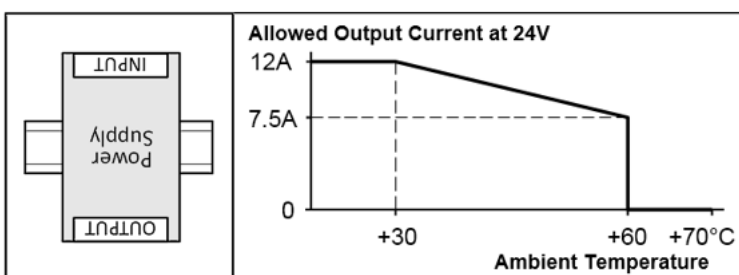


Fig. 25: Mounting position B (upside down)

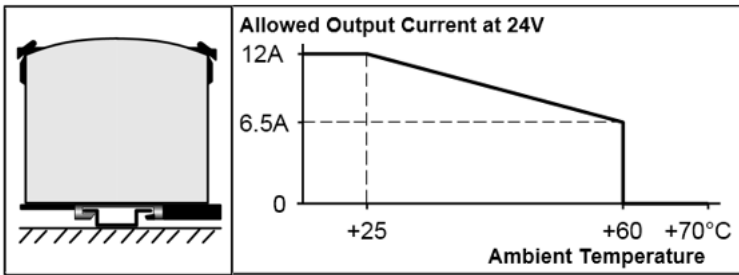


Fig. 26: Mounting position C (table mounting)

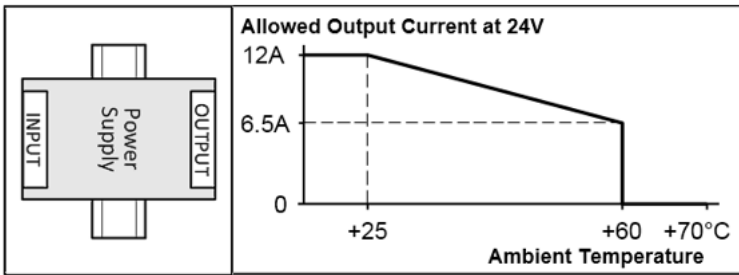


Fig. 27: Mounting position D (horizontal clockwise)

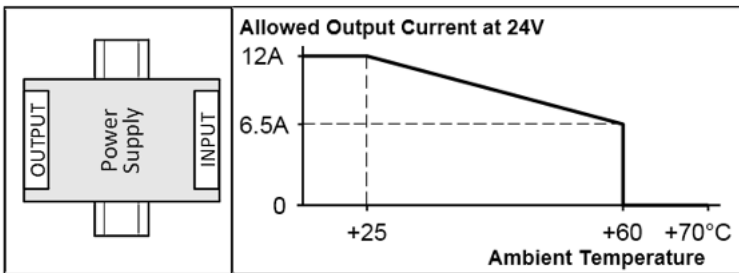


Fig. 28: Mounting position E (horizontal counterclockwise)

## 5 Disposal



Products marked with a crossed-out wheeled bin shall not be discarded with the normal waste stream. The device is considered as waste electrical and electronic equipment. The national regulations for the disposal of waste electrical and electronic equipment must be observed.

## 6 Appendix

### 6.1 Accessories

#### 6.1.1 Redundancy and Buffer Modules

Power supply	Accessories		
	Redundancy module	Buffer module	USV component
PS2031-2410-0000	PS9401-2440-0000	PS9011-2420-0001	CU8130-0xxx

##### PS9401-2440-0000 – Redundancy Module



The PS9401-2440-0000 is a redundancy module that can be used for the construction of 1+1 and N+1 redundancy systems.

It has two input channels, to which power supplies with output currents of up to 20 A can be connected, and one output that can carry nominal currents of up to 40 A.

The redundancy module uses MOSFET technology instead of diodes for decoupling the two input channels. This reduces the heat development and the voltage drop between input and output. Due to the low power loss, the device is very narrow and requires a width of just 36 mm on the DIN rail.

Large connection terminals enable secure and fast installation.

The redundancy module requires no additional auxiliary voltage.

Due to the international approvals package, the device is suitable for virtually every application.

Observe the connection instructions in the chapter "[Parallel use for redundancy \[► 33\]](#)"

##### PS9011-2420-0001 – Buffer Module



The PS9011-2420-0001 buffer module is an additional device for 24 V DC power supply units. It supplies power to bridge typical mains power failures or extends the hold-up time after switching off the AC voltage.

If the power supply unit supplies sufficient voltage, the buffer module stores energy in the integrated electrolytic capacitors. In the event of a failure of the mains voltage, the stored energy is supplied to the DC bus in a controlled process.

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

A buffer module can provide 20 A of additional power and can be added in parallel to increase the output current or hold-up time.

The PS9011-2440-0000 buffer module can optionally be used to achieve longer hold-up times.

## 6.1.2 USV component

### CU8130-0xxx – UPS component



CU8130-0xxxs are battery-backed, uninterruptible power supplies (UPS). If the external 24 V DC input voltage is lost, the UPS takes over the supply of the devices connected to it thanks to its regulated and buffered 24 V DC output voltage.

The CU81xx UPS series is suitable for all Beckhoff components, particularly Industrial PCs, Embedded PCs, Panels and Panel PCs.

The main features of this UPS are:

- battery module based on NiMH cells
- mounting of the UPS on the DIN rail or on the rear panel of the control cabinet
- protocol-based communication with the Industrial PC either via OCT (**O**ne **C**able **T**echnology) or USB
- digital signals for communication with non-protocol-capable end devices
- TwinCAT PLC function blocks for querying the UPS operation

A special feature of the Beckhoff CU81xx devices is OCT (**O**ne **C**able **T**echnology) as communication technology between UPS and Industrial PC. This means that the two connecting lines (+24 V, 0 V) between Industrial PC and UPS are used not only to supply the Industrial PC, but also for bidirectional data transmission.

If both sides are OCT-capable, no further connection, e.g., via USB, is required.

Further information on UPS components can be found on the Beckhoff [homepage](#).



### 6.1.3 Accessories for mounting

#### ZS5301-0003 – Bracket for wall mounting

This bracket is used to mount the devices to a wall or panel without using a DIN rail. The bracket can be mounted without loosening the DIN rail brackets.

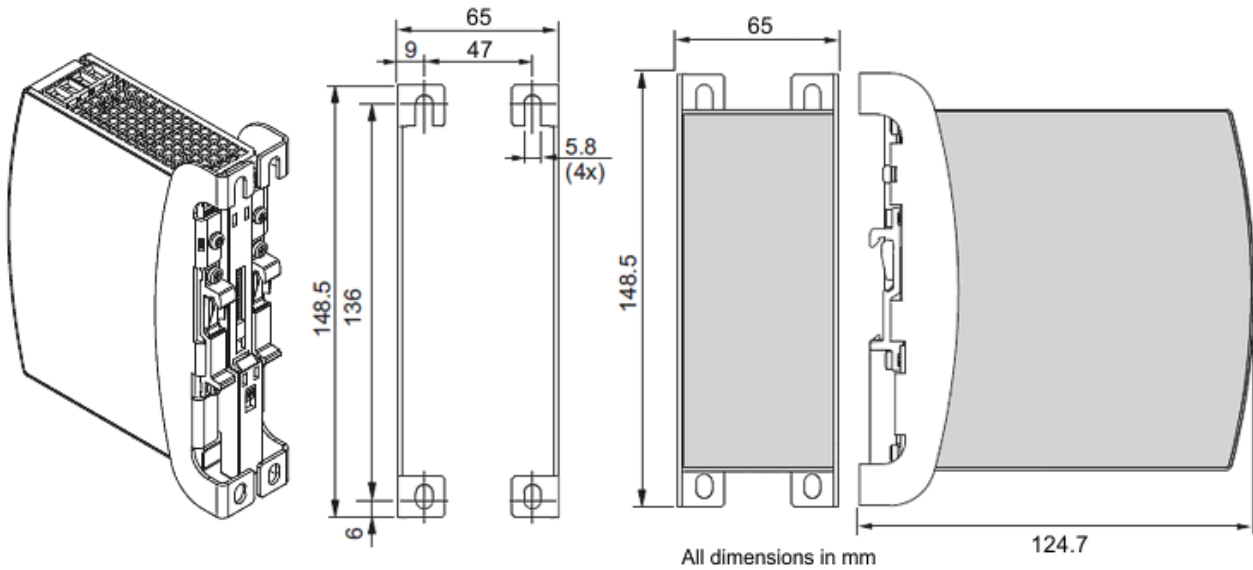


Fig. 29: Isometric view, installation dimensions bracket for wall mounting

#### ZS5301-0006 – Bracket for side mounting

This bracket is used to mount the power supply unit laterally with or without the use of a DIN rail to save installation depth.

The two aluminum brackets and the black plastic slider of the device must be removed to allow the steel brackets to be mounted.

For lateral DIN rail mounting, the previously removed aluminum brackets and the plastic slider must be mounted on the steel bracket.

For more information please refer to the ZS5301-0006 documentation.

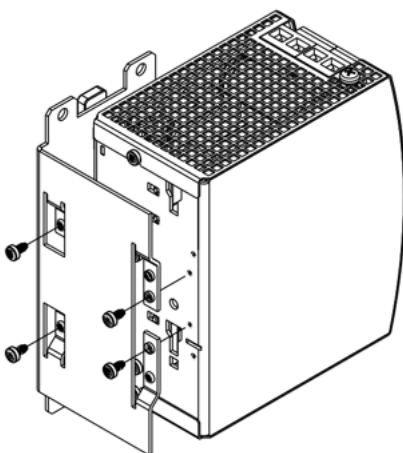


Fig. 30: Mounting information

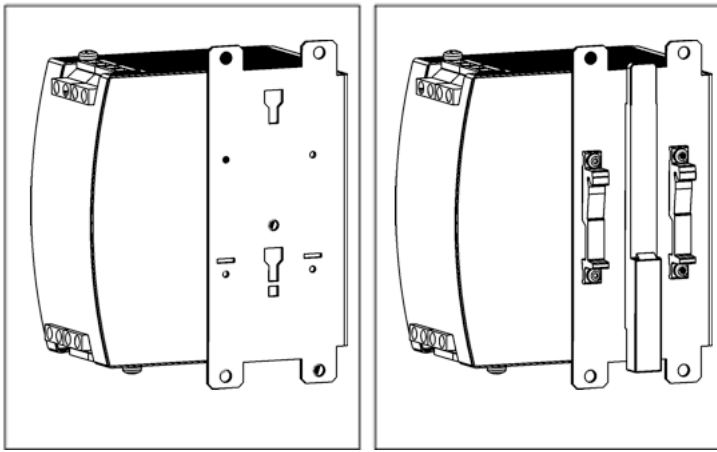


Fig. 31: Lateral mounting with and without DIN rail brackets

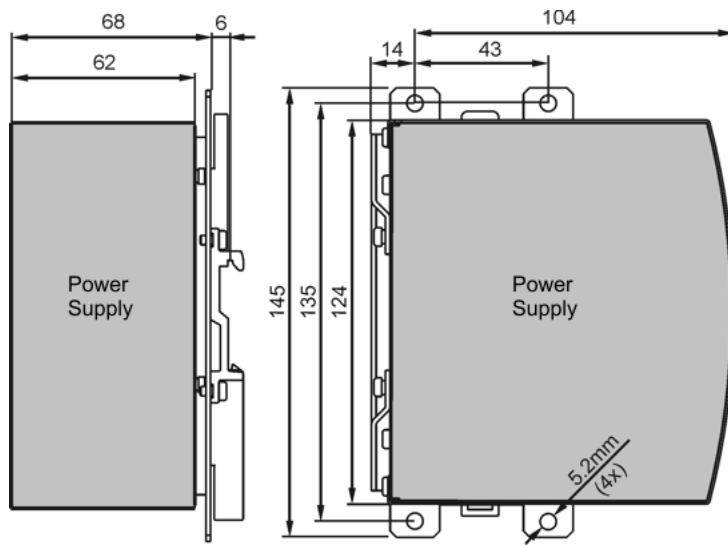


Fig. 32: Installation dimensions Angle for side mounting

## 6.2 Documentation issue status

Version	Comment
1.1	<ul style="list-style-type: none"><li>- Chapter "Overview" updated</li><li>- Chapter "Declaration of conformity and approvals" updated</li><li>- Chapter "Accessories" updated</li><li>- Chapter "Parallel use for redundancy" and "Disposal" added</li><li>- Update structure</li></ul>
1.0	<ul style="list-style-type: none"><li>- First public issue</li></ul>
0.3	<ul style="list-style-type: none"><li>- Complements, corrections</li></ul>
0.2	<ul style="list-style-type: none"><li>- Complements, corrections</li></ul>
0.1	<ul style="list-style-type: none"><li>- Preliminary documentation for PS2031-2410-0000</li></ul>

## 6.3 Support and Service

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