BECKHOFF New Automation Technology

Documentation | EN

PS2001-2410-0000

Power supply 24 V DC, 10 A, 1-phase, AC 100-240

2021-08-20 | Version: 1.1

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1 Overview

PS2001-2410-0000 | Power supply 24V, 10A, 1 phase, Extra Power

- AC 100-240V wide-range input
- Efficiency of up to 95.2%
- Excellent part-load efficiency
- 120% peak power, 288W
- Safe hiccup overload mode
- Precise triggering of fuses through high overload / peak current
- Active Power Factor Correction (PFC)
- Minimum inrush current surge
- Full output between -25°C and +60°C
- DC-OK relay contact

The power supply PS2001-2410-0000 is a single-phase, 24 V DC power supply 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, Active Power Factor Correction (PFC) and inrush current limiting.
The output operates according to the UI characteristic curve and switches to the safe hiccup mode in case of overload/short-circuit. The PS2001-2410-0000 features extra power with a continuous maximum output power of 120% and can precisely trigger fuses with a short peak current.
The power supply unit is part of the PS2000 family and has a width of 39 mm. A DC-OK LED and a potential-free relay contact monitor the status of the output voltage. Thanks to approvals for the process industry (ATEX/IECEx), shipbuilding (DNV/GL) and the semiconductor industry (SEMI-F47), the power supply unit can be used in a wide range of applications.

Overview of technical data *)

Overview of technical data	PS2001-2410-0000
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	AC 100-240V -15%/+10%
Mains frequency	50-60Hz ±6%
Input current AC	2.15 / 1.13A at 120 / 230Vac
Input voltage DC	DC 110-150V ±20%
Efficiency	93.6 / 95.2% at 120 / 230Vac
Temperature range	-25°C to +70°C
Size (W x H x D)	39 x 124 x 117mm (without DIN rail)
Weight	600 g
Approvals/markings	CE, EAC, U KCA cULus Class I Div2 ATEX IECEx DNV/GL SEMI F47

*) All values typical for 24V, 10A, 230Vac, 50Hz, +25°C ambient temperature and after a warm-up period of five minutes, unless otherwise stated.

2 Foreword

2.1 Notes on the documentation

Copyright

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.

No claims for the modification of products that have already been supplied may be made on the basis of the data, diagrams and descriptions in this documentation.

Trademarks

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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 PS2001-2410-0000 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.

⚠ WARNING

Explosion hazard warning!

Use only in standard vertical mounting orientation with the input terminals at the bottom of the device.
Replacement of components may affect the suitability for this environment.
Do not disconnect the device from the mains and do not operate the voltage adjustment unless the power is switched off or the environment can be considered safe.
For the end product a suitable housing must be provided, which has a minimum protection class of IP54 and meets the requirements of EN 60079-0.

NOTICE

Instructions for use in potentially explosive atmospheres

The device is suitable for use in the following areas:
Class I Division 2 Groups A, B, C, D
and for use in Group II environments of Category 3 (Zone 2).
Classification:
ATEX: EPS 15 ATEX 1 101 X, II 3G EX ec nC IIC T4 Gc / IECEx EPS 20.0046X.

Further notes on installation requirements

- This device contains no parts that require maintenance. If an internal fuse trips, this is due to an internal defect.
- If any damage or malfunction occurs during installation or operation, turn off the power immediately and return the device to the factory for inspection.
- Mount the device on a DIN rail so that the input terminals are at the bottom of the device. For other mounting positions, please refer to the load reduction requirements in this document. See chapter Installation positions.
- This device is designed for convection cooling and does not require an external fan. Do not obstruct the air circulation. No more than 15% of the ventilation grille may be covered (e.g. by cable ducts)!
- 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).

2.3 Terminology and abbreviations

PE and the earthing symbol 	PE is the abbreviation for "protective earth" and has the same meaning as the earthing symbol 
Earth, ground	This document uses the term “earth” which is the same as the U.S. term “ground”.
T.b.d.	Still to be defined, value or description will follow in due course.
AC 230 V	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 230 V ±10%). 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).
230 Vac	A value followed by the unit Vac or Vdc is an instantaneous value that does not contain any additional tolerances.
50 Hz vs. 60 Hz	Unless otherwise specified, AC 100 V and AC 230 V parameters are valid at a mains frequency of 50 Hz. AC 120 V parameters are valid for a mains frequency of 60 Hz.
may	A keyword indicating a choice without implied preference.
shall	A keyword indicating a mandatory requirement.
should	A keyword indicating a choice with a clearly preferred method of implementation.

3 Technical data, mounting, wiring

3.1 AC input

AC input			
AC input	Nom.	AC 100-240V	Suitable for TN, TT and IT networks
AC input range	Min.	85-264Vac	Continuous operation
	Min.	264-300Vac	For up to 500ms max.
Permissible voltage L or N to earth	Max.	300Vac	Continuous according to IEC 62477-1
Input frequency	Nom.	50-60Hz	±6%
Turn-on voltage	Typ.	80Vac	Static, see Fig. *Input voltage range; switch-on behavior definitions*
Shut-down voltage	Typ.	70Vac	Static, see Fig. *Input voltage range; switch-on behavior definitions*
	Typ.	55Vac	Dynamic value for up to 250ms max.
External input protection	See recommendations in chapter External input protection [▶ 29]		

AC input		AC 100V	AC120V	AC230V	
Input current	Typ.	2.60A	2.15A	1.13A	At 24 V, 10 A, see Fig. *Input current over output current; power factor over output current*
Power factor*)	Typ.	0.99	0.99	0.97	At 24 V, 10 A, see Fig. *Input current over output current; power factor over output current*
Peak factor**)	Typ.	1.5	1.5	1.65	At 24V, 10A
Start-up delay	Typ.	300ms	290ms	240ms	See Fig. *Input voltage range; switch-on behavior definitions*
Rise time	Typ.	30ms	30ms	30ms	At 24 V, 10 A constant current load, 0 mF load capacity, see *Fig. Input voltage range; switch-on behavior definitions*
	Typ.	75ms	75ms	75ms	At 24 V, 10 A constant current load, 10 mF load capacity, see Fig. *Input voltage range; switch-on behavior definitions*
Turn-on overshoot	Max.	200 mV	200 mV	200 mV	See Fig. *Input voltage range; switch-on behavior definitions*
External input protection	See recommendations in chapter External input protection [▶ 29]				

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

**) The peak factor is the mathematical ratio of the peak value to the RMS value of the input current waveform.

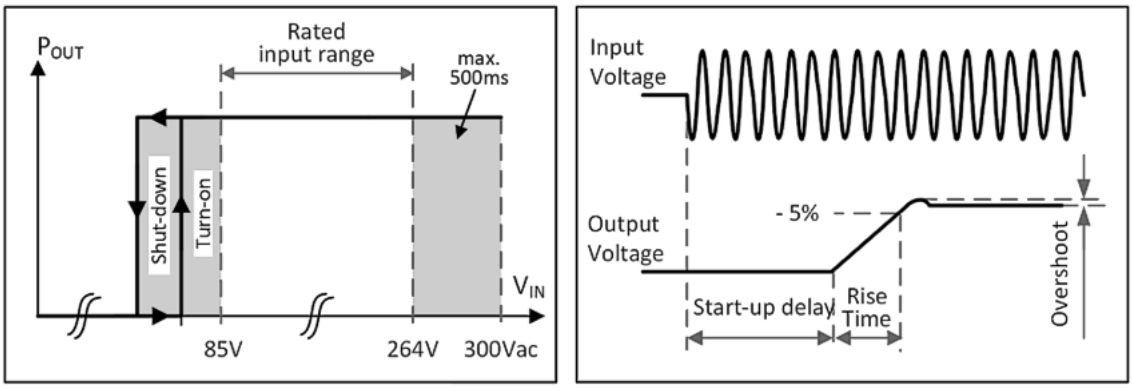

Fig. 1: Input voltage range; switch-on behavior definitions

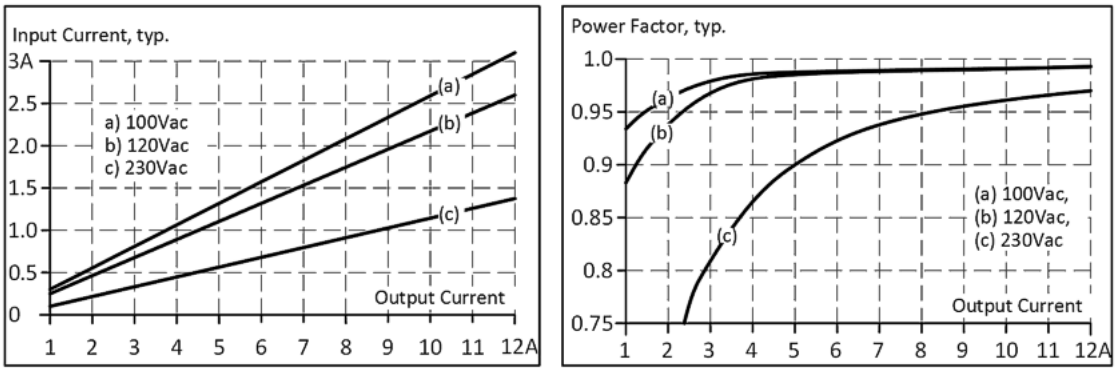

Fig. 2: Input current over output current; power factor over output current

3.2 DC input

DC input			
DC input	Nom.	DC 110-150V	±20%
DC input range	Min.	88-180Vdc	Continuous operation
DC input current	Typ.	2.35A	at 110Vdc, at 24V, 10A
DC input current	Typ.	0.84A	at 300Vdc, at 24V, 10A
Permissible voltage L or N to earth	Max.	375 Vdc	Continuous according to IEC 62477-1
Turn-on voltage	Typ.	80 Vdc	static
Shut-down voltage	Typ.	70 Vdc	static
	Typ.	55 Vdc	Dynamic value for up to 250ms max.

Instructions for DC operation

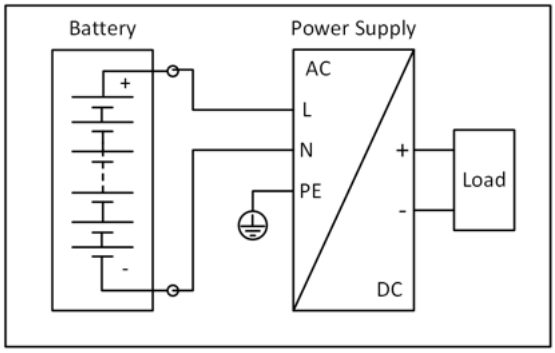

Fig. 3: Wiring for DC input

- Use a battery or a comparable DC source. Operation on the DC link of frequency converters is not recommended and may lead to defects or malfunctions.
- Connect the positive pole to L and the negative pole to N.
- Connect the PE terminal to the protective conductor or machine ground.

3.3 Input inrush current

Active inrush current limitation (NTCs that are bridged by a relay contact) limits the inrush current 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.

		AC 100V	AC 120V	AC 230V	
Input inrush current	Max.	$11A_{peak}$	$7A_{peak}$	$11A_{peak}$	At +40°C, cold start
	Typ.	$9A_{peak}$	$6A_{peak}$	$6A_{peak}$	At +25°C, cold start
	Typ.	$9A_{peak}$	$6A_{peak}$	$9A_{peak}$	At +40°C, cold start
Inrush energy	Max.	$0.1A^2s$	$0.1A^2s$	$0.4A^2s$	At +40°C, cold start

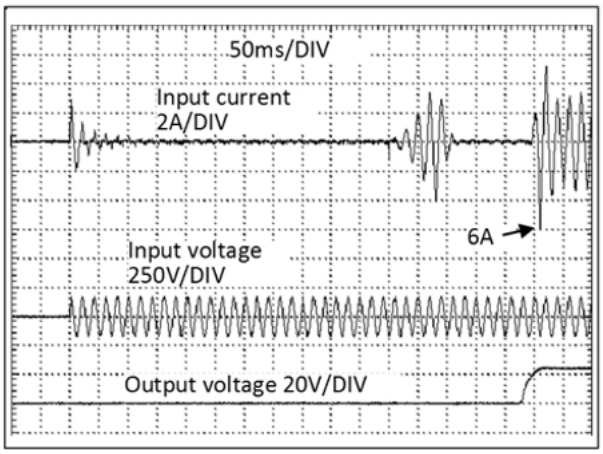

Fig. 4: Typical switch-on behavior at nominal load, 120Vac input voltage and 25°C ambient temperature

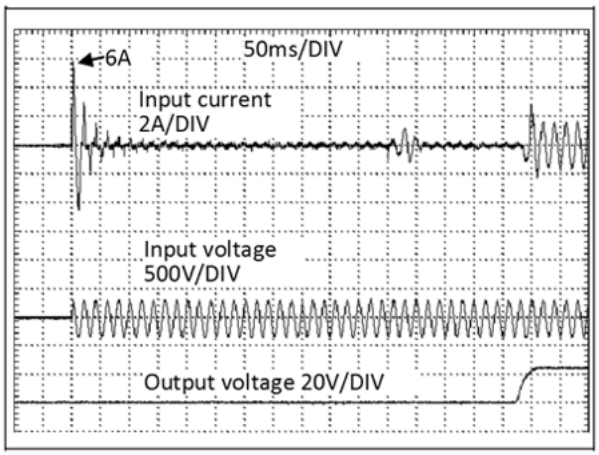

Fig. 5: Typical switch-on behavior at nominal load, 230Vac input voltage and 25°C ambient temperature

3.4 Output

Output voltage	Nom.	24V	
Adjustment range	Min.	24-28V	Guaranteed value
	Max.	30.0V	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.	24.1V	±0.2% at full load (cold device)
Line regulation	Max.	10 mV	Between 85 and 300Vac
Load regulation	Max.	50 mV	Between 0 and 12A, static value, see Fig. *Output voltage over output current, typ.*
Residual ripple and ripple voltage	Max.	$50mV_{ss}$	Bandwidth 20 Hz to 20 MHz, 50 Ohm
Output current	Nom.	12A[1)]	At 24V and an ambient temperature below 45°C, see Fig. *Output current over ambient temperature*
	Nom.	10A	At 24V and 60°C ambient temperature, see Fig. *Output voltage over output current, typ.*
	Nom.	7.5A	At 24V and 70°C ambient temperature, see Fig. *Output current over ambient temperature*
	Nom.	10.3A[1)]	At 28V and an ambient temperature below 45°C, see Fig. *Output current over ambient temperature*
	Nom.	8.6A	At 28V and 60°C ambient temperature, see Fig. *Output voltage over output current, typ.*
	Nom.	6.45A	At 28V and 70°C ambient temperature, see Fig. *Output current over ambient temperature*
	Typ.	30A	For at least 12ms once every five seconds, see Fig. *Dynamic output current capacity, typ*. The output voltage remains above 20V. See chapter on Peak current capability [▶ 28] for further peak current measurements. For AC 100V networks the pulse length is shorter than 12ms.
Overload behavior		Continuous current	Output voltage > 13Vdc, see Fig. *Output voltage over output current, typ.*
		Hiccup mode[2)]	Output voltage < 13Vdc, see Fig. *Output voltage over output current, typ.*
Short circuit current	Min.	12.5A[3)]	Load impedance <45mOhm, see Fig. *Short circuit at output, hiccup mode, typ.*
	Max.	15.5A[3)]	Load impedance <45mOhm, see Fig. *Short circuit at output, hiccup mode, typ.*
	Max.	5A	RMS value of current, load impedance 50mOhm, see Fig. *Short circuit at output, Hiccup mode, typ.*
	Min.	28A	Up to 12ms, load impedance <45mOhm, see Fig. *Dynamic output current capacity, typ*.
	Typ.	30.5A	Up to 12ms, load impedance <45mOhm, see Fig. *Dynamic output current capacity, typ.*
Output capacity	Typ.	4 400µF	Included in the power supply

[1)] **Extra Power**
This continuous power / current is permissible up to an ambient temperature of +45°C. Above +45°C, use this power / current for a maximum duty cycle of 10%, i.e. no more than 1 minute every 10 minutes.

[2)] **Hiccup mode**
In the event of heavy overload (when the output voltage drops below 13V), the power supply provides continuous output current for 2s. The output is then switched off for about 18 seconds before a new switch-on attempt is automatically made. This cycle is repeated as long as the overload persists. After the overload has been rectified, the device will operate normally. See Fig. Short circuit at output, hiccup mode, typ.

[3)] The discharge current of the output capacitors is not included.

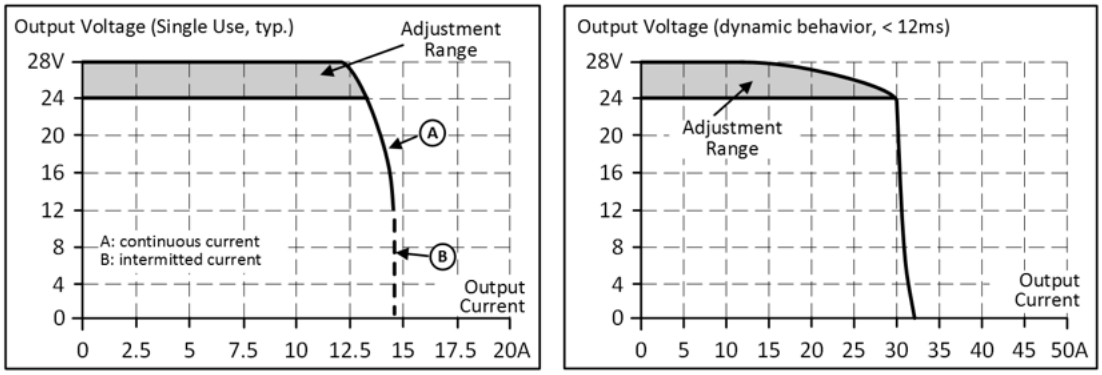

Fig. 6: Output voltage over output current, typ.; Dynamic output current capacity, typ.

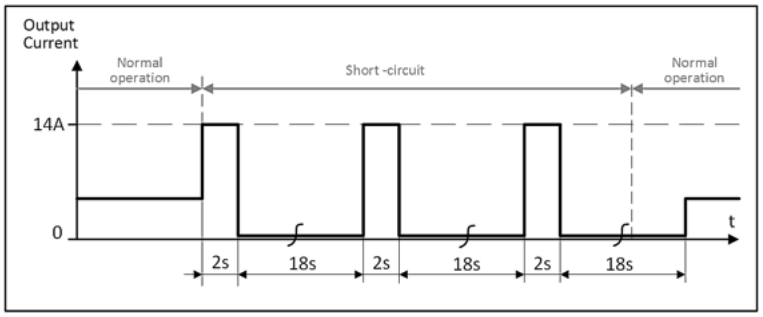

Fig. 7: Short circuit at output, hiccup mode, typ.

3.5 Hold-up time

		AC 100V	AC 120V	AC 230V	
Power failure Hold-up time	Typ.	73ms	73ms	73ms	At 24V, 5A, see Fig. *Hold-up time over input voltage*
	Min.	55ms	55ms	55ms	At 24V, 5A, see Fig. *Hold-up time over input voltage*
	Typ.	37ms	37ms	37ms	At 24V, 10A, see Fig. *Hold-up time over input voltage*
	Min.	28ms	28ms	28ms	At 24V, 10A, see Fig. *Hold-up time over input voltage*

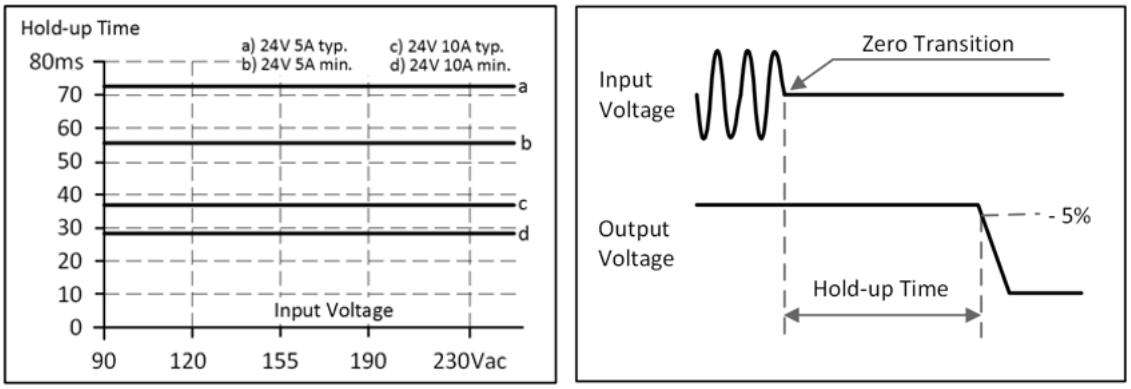

Fig. 8: Hold-up time over input voltage; switch-off behavior, definitions

3.6 DC-OK relay contact

This feature monitors the output voltage at the output terminals of an active power supply.

The contact closes	when the output voltage typically reaches 90% of the set output voltage.
The contact opens	when the output voltage drops more than 10% below the set output voltage. Short drops are extended to a signal length of 100ms. Drops that are shorter than 1ms are ignored.
Switching hysteresis	1 V
Contact load capacity	Maximum 60Vdc 0.3A, 30Vdc 1A, 30Vac 0.5A, ohmic load
	Minimum permissible load: 1mA at 5Vdc
Insulation voltage	See the dielectric strength table in the chapter on Safety features [▶ 24]

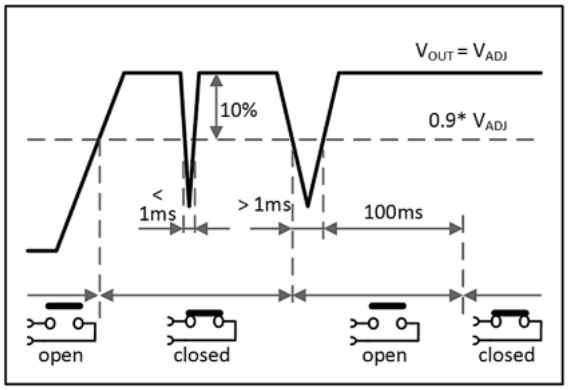

Fig. 9: Behavior of the DC-OK relay contact

3.7 Efficiency and losses

		AC 100V	AC 120V	AC 230V	
Efficiency	Typ.	92.9%	93.6%	95.2%	At 24V, 10A
	Typ.	92.5%	93.4%	95.1%	At 24V, 12A (Extra Power)
Average efficiency*)	Typ.	92.5%	93.0%	94.3%	25% at 2.5A, 25% at 5A, 25% at 7.5A. 25% at 10A
Losses	Typ.	2.5W	2.1W	1.8W	At 24V, 0A
	Typ.	9.8W	8.9W	7.1W	At 24V, 5A
	Typ.	18.3W	16.4W	12.1W	At 24V, 10A
	Typ.	23.4W	21.7W	14.8W	At 24V, 12A (Extra Power)

*) 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.

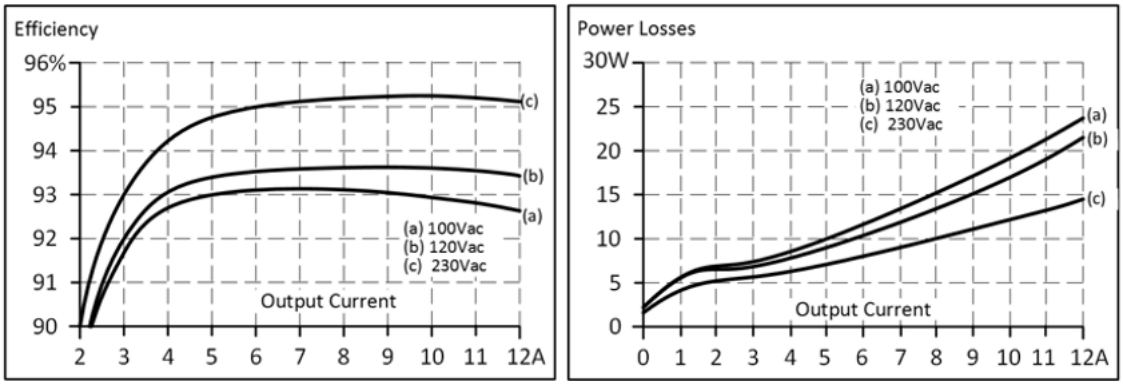

Fig. 10: Efficiency over output current; losses over output current

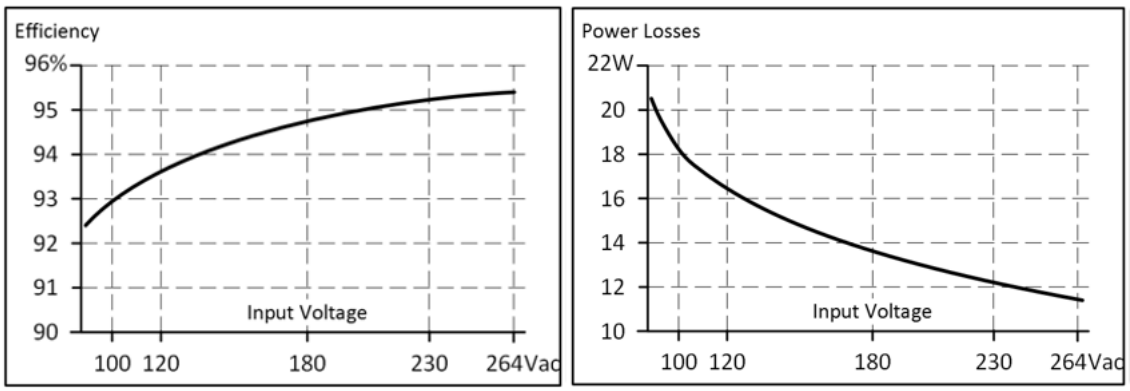

Fig. 11: Efficiency over input voltage; losses over input voltage

3.8 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.

	AC 100V	AC 120V	AC 230V	
Lifetime expectancy	128,000h	141,000h	176,000h	At 24V, 5A and +40°C
	61,000h	75,000h	120,000h	At 24V, 10A and +40°C
	47,000h	59,000h	101,000h	At 24V, 12A and +40°C
	363,000h	399,000h	499,000h	At 24V, 5A and +25°C
	173,000h	211,000h	338,000h	At 24V, 10A and +25°C
	132,000h	166,000h	286,000h	At 24V, 12A and +25°C

3.9 MTBF

MTBF stands for **M**ean **T**ime **B**etween **F**ailure, 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 (**M**ean **T**ime **T**o **F**ailure) is identical to the MTBF value.

	AC 100V	AC 120V	AC 230V	
MTBF SN 29500, IEC 61709	550,000h	560,000h	661,000h	At 24V, 10A and 40°C
	1,003,000h	1,017,000h	1,176,000h	At 24V, 10A and +25°C
MTBF MIL HDBK 217F	188,000h	188,000h	213,000h	At 24V, 10A and 40°C; Ground Benign GB40
	252,000h	252,000h	290,000h	At 24V, 10A and 25°C; Ground Benign GB25
	40,000h	40,000h	47,000h	At 24V, 10A and 40°C; Ground Fixed GF40
	51,000h	51,000h	61,000h	At 24V, 10A and 25°C; Ground Fixed GF25

3.10 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	DC-OK signal
Connection cross-section	e*: max. 6mm² f*: max. 4mm² a*: max. 4mm² (d<2.8mm)	e*: max. 6mm² f*: max. 4mm² a*: max 4mm² (d<2.8mm)	e*: max. 1.5mm² f*: max. 1.5mm² a*: max. 1.5mm² (d<1.6mm)
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)	e*: AWG 24-16 f*: AWG 24-16 a*: AWG 24-16 (d<1.6mm)
Strip length	7mm / 0.28inch	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:

Power supply units may be connected in series.

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*.

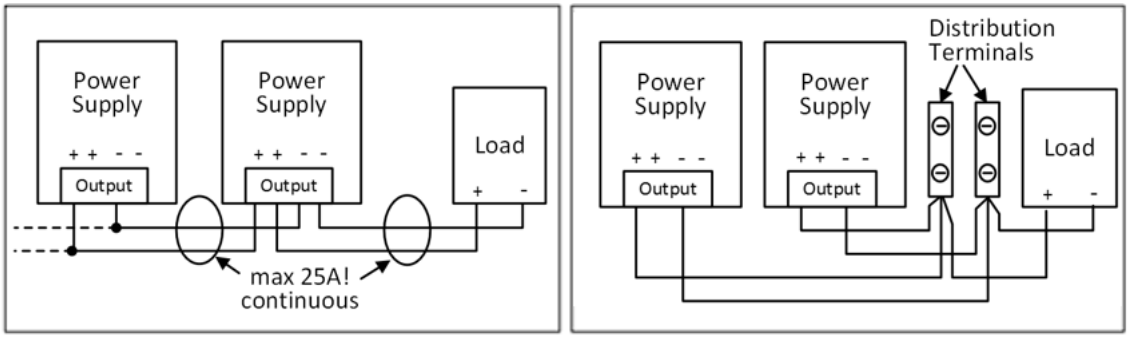

Fig. 12: Series connection of outputs; use of distribution terminals

3.11 Functional wiring diagram

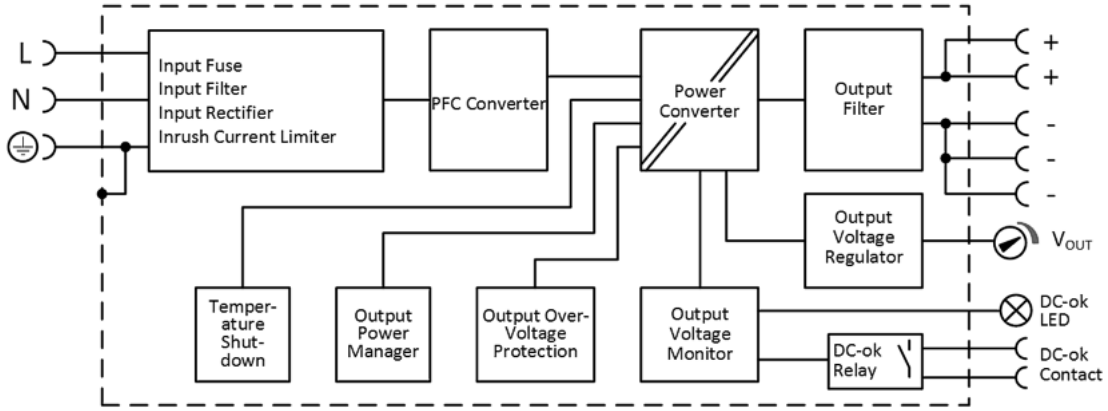

Fig. 13: Functional wiring diagram

3.12 Front side and operating elements

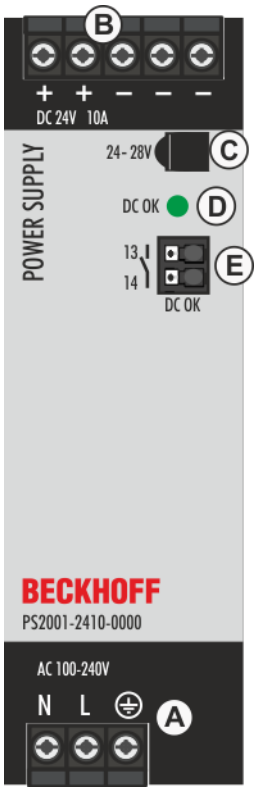

Fig. 14: Front PS2001-2410-0000

Input terminals (screw terminals)

Designation (A)	Description
N	Mains input N
L	Mains input L
⏚	PE input (protective conductor)

Output terminals (screw terminals)

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

DC-OK LED

Designation (D)	Description
LED green	Lights up when the output voltage is within the expected range and the DC OK contact is closed.

DC-OK relay contact

Designation (E)	Description
Push-in terminals 13 / 14	Monitors the output voltage of the active power supply. See DC-OK relay contact [▶ 16] for further information.

3.13 EMC

The power supply is suitable for application in industrial environments as well as in residential, commercial and light industrial areas and small businesses.

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

EMC interference immunity			
Strong transients	VDE 0160	Over the entire load range	750V, 0.3ms

EMC interference emission	**According to the generic standards: EN 61000-6-3 and EN 61000-6-4**	
Cable-related interference emission, input lines	EN 55011, EN 55015, EN 55022, FCC Part 15, CISPR 11, CISPR 22	Class B
Cable-related interference emission output lines [2)]	IEC/CISPR 16-1-2, IEC/CISPR 16-2-1	Limit values for the DC current connection according to EN 61000-6-3 are met
Interference emission	EN 55011, EN 55022	Class B
Harmonic input current	EN 61000-3-2	Class A met between 0A and 12A load Class C met between 6A and 12A load
		Class A met between 0A and 12A load Class C met between 6A and 12A load
Voltage fluctuations, flicker	EN 61000-3-3	Requirements met [1)]
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.		

[1)] Tested with constant current loads, non-pulsating
[2)] For information only, not mandatory for EN 61000-6-3

Switching frequencies		
PFC converter	110kHz	fixed frequency
Main converter	84kHz to 140kHz	Output load dependent
Auxiliary converter	60kHz	fixed frequency

3.14 Environment

Environment		
Operating temperature [1]	-25°C to +70°C	Reduction of the output power according to Fig. *Output current over ambient temperature*
Storage temperature	-40°C to +85°C	For storage and transport
Output load reduction	3.2W/°C 6W/°C	+45°C to +60°C / +60°C to +70°C
Moisture	5 to 95% r.h.	According to IEC 60068-2-30 Do not energize if there is condensation.
Oscillation, sinusoidal [2]	2–17.8Hz: ±1.6mm; 17.8-500Hz: 2g 2 hours/axis	According to IEC 60068-2-6
Impacts [2]	30g 6ms, 20g 11ms 3 impacts / direction, 18 impacts in total	According to IEC 60068-2-27
Installation altitude	0 to 2000m	Without any restrictions
	2000 to 6000m	Reduce the output power or ambient temperature, see Fig. *Output current over installation altitude*.
Load reduction due to installation altitude	15W/1000m or 5°C/1000m	Above 2000m, see Fig. *Output current over installation altitude*
Overvoltage category	III	According to IEC 62477 -1, installation altitudes up to 2000m
	II	According to IEC 62477-1, installation altitudes between 2000m and 6000m
Degree of pollution	2	According to IEC 62477-1, non-conductive
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	ISA-71.04-1985, Severity Level G3, IEC 60068-2-60 Test Ke Method 4	
Audible noises	In the event of no-load, overload or short circuit, the power supply unit emits audible noises.	

[1] The working temperature is identical to the room temperature or the ambient temperature and is defined as the air temperature 2cm below the device.

[2] 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.

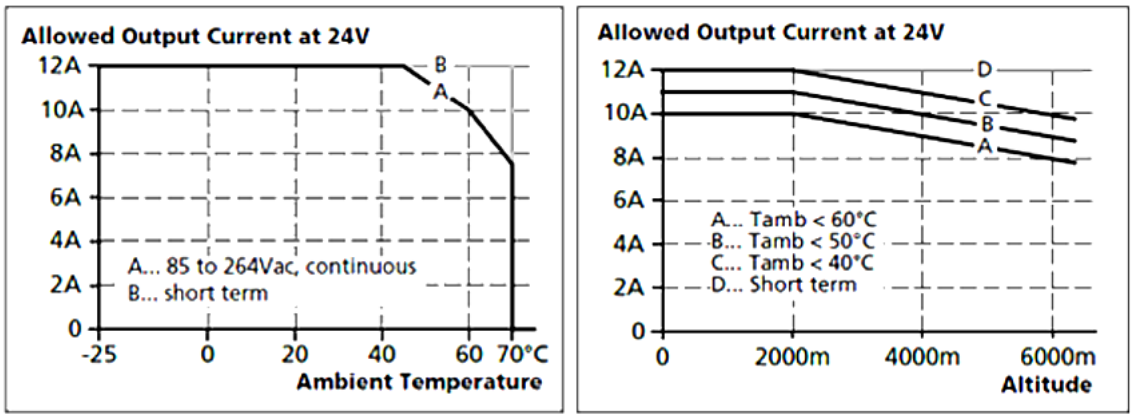

Fig. 15: Output current over ambient temperature; output current over installation altitude

3.15 Protective functions

Protective functions		
Output protection	Electronically protected against overload, no load and short circuits. If the electronic output fuse is activated, an audible noise may occur.	
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
Ingress protection	> 4mm	e.g. screws, small parts
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 further information see EMC chapter [▶ 22]
Input fuse	Included	Non-replaceable slow-blow fuse with high load capacity

3.16 Safety features

Safety features		
Input/output isolation	Double or reinforced electrical isolation	
	SELV	IEC/EN 60950-1
	PELV	IEC/EN 60204-1, EN 62477-1, IEC 60364-4-41
Protection class	I	PE (protective conductor) connection required
Insulation resistance	> 500MOhm	In the delivery state between input and output, measured with 500Vdc
	> 500MOhm	In the delivery state between input and protective conductor, measured with 500Vdc
	> 500MOhm	In the delivery state between output and protective conductor, measured with 500Vdc
	> 500MOhm	In the delivery state between output and DC OK contacts, measured with 500Vdc
PE resistance	< 0.1Ohm	Resistance between the protective conductor connection and the housing near the DIN rail mounting bracket.
Leakage current	Typ. 0.14mA / 0.36mA	At 100Vac, 50Hz, TN, TT / IT network
	Typ. 0.20mA / 0.50mA	At 120Vac, 60Hz, TN, TT / IT network
	Typ. 0.33mA / 0.86mA	At 230Vac, 50Hz, TN, TT / IT network
	Max. 0.18mA / 0.43mA	At 110Vac, 50Hz, TN, TT / IT network
	Max. 0.26mA / 0.61mA	At 132Vac, 60Hz, TN, TT / IT network
	Max. 0.44mA / 1.05mA	At 264Vac, 50Hz, TN, TT / IT network

3.17 Dielectric strength

The output voltage is earth-free and has no ohmic connection to earth. 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.

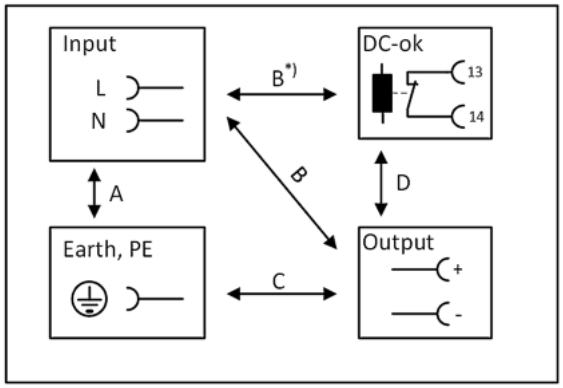

Fig. 16: Dielectric strength

B*) When checking the input to DC-OK, make sure that the maximum voltage between DC-OK and the output is not exceeded (column D). When performing the test, we recommend connecting the DC OK contact pins and the output contact pins.

		A	B	C	D
Type test	60s	2500Vac	4000Vac	1000Vac	500Vac
Component test	5s	2500Vac	2500Vac	500Vac	500Vac
Field test	5s	2000Vac	2000Vac	500Vac	500Vac
Setting the cut-off current		> 10mA	> 10mA	> 20mA	> 1mA

To meet the PELV requirements according to EN60204-1 section 6.4.1, 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.

3.18 Declaration of conformity and approvals

CE	EU declaration of conformity
UK CA	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)
EAC	Registration for the Eurasian Customs Union market (Russia, Kazakhstan and Belarus)
c UL US LISTED	UL Certificate: UL 508 Applicable for US and Canada
c UL US LISTED	UL Certificate: Class I Division 2, Groups A, B, C, D location and for use in Group II, Category 3 (Zone 2) environments Applicable for US and Canada
Ex	Classification: ATEX: EPS 15 ATEX 1 101 X, II 3G EX ec nC IIC T4 Gc
IECEx	Classification: IECEx EPS 20.0046X
DNV·GL dnvgl.com/af	DNV/GL

3.19 Dimensions and weight

Dimensions and weight	
Overall width	39mm
Height	124mm
Depth	117mm The height of the DIN rails must be added to the depth of the device to calculate the total installation depth required
DIN rail	Use 35 mm DIN rails according to EN 60715 or EN 50022 with a height of 7.5 or 15mm.
Weight	600 g
Housing material	Housing: Aluminum alloy Cover: Galvanized steel
Installation clearances	See chapter on Safety instructions and installation requirements [▶ 8]

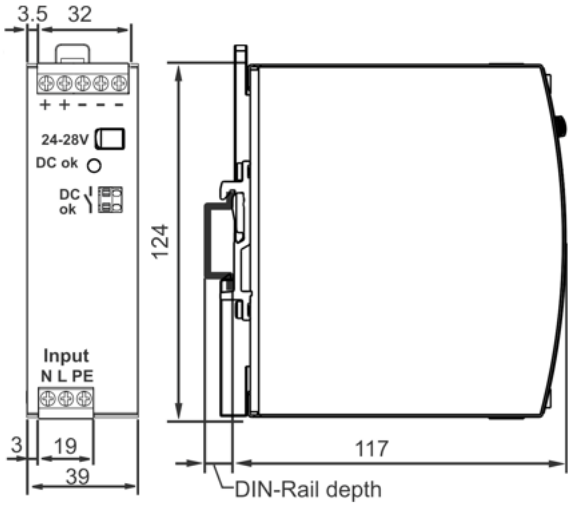

Fig. 17: Front/side view PS2001-2410-0000, all specifications in mm

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:

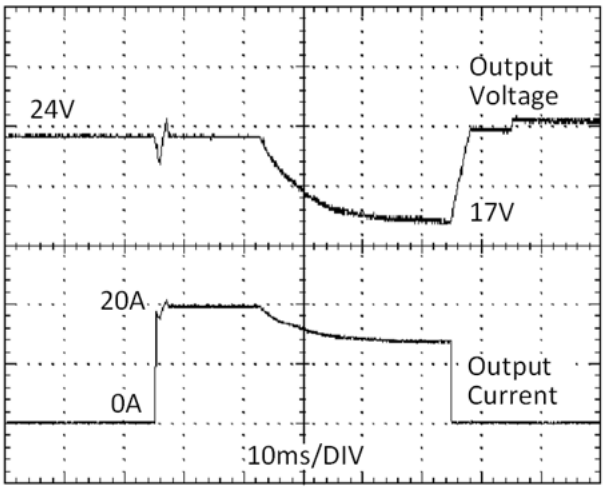

Fig. 18: 20A peak current for 50ms, typ. (2x nominal current)

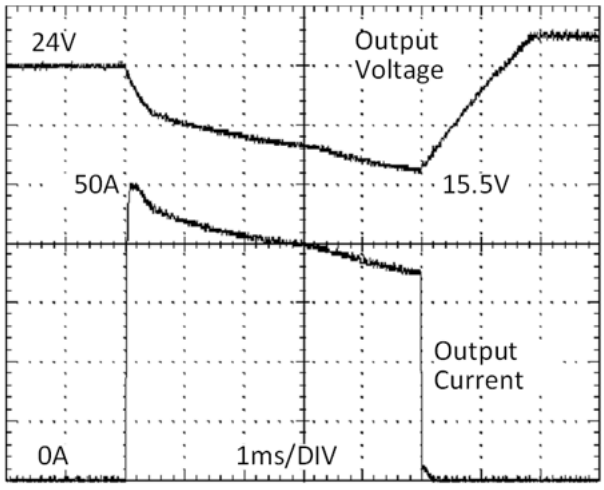

Fig. 19: 50A peak current for 5ms, typ. (5x nominal current)

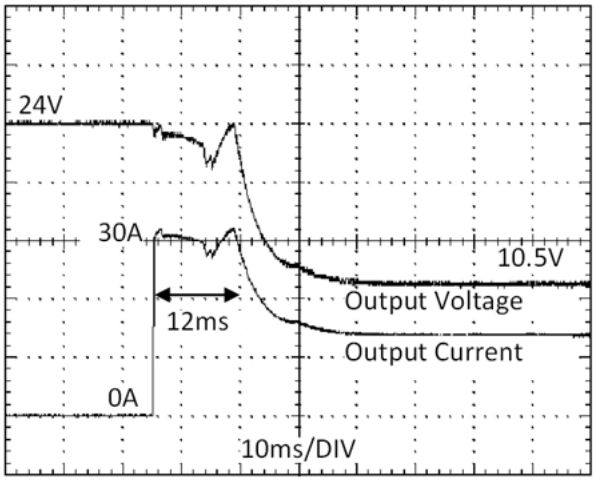

Fig. 20: 30A peak current for 12ms, typ. (3x nominal current)

Control of DC-OK relay

Please note: The DC-OK relay is activated if the voltage drops by more than 10% for more than 1ms.

Peak current voltage drops	
Typically from 24V to 17V	At 20A for 50ms, ohmic load
Typically from 24V to 19V	At 50A for 2ms, ohmic load
Typically from 24V to 15.5V	At 50A for 5ms, ohmic load

4.2 Back-feeding loads

Loads such as braking motors or inductors can feed back voltage to the power supply. This feature is also known as back EMF. (electromagnetic force).

This power supply is stable and will not malfunction if a load is feeding back voltage to the power supply. It is irrelevant whether the power supply is switched on or off.

The maximum permissible feed-back voltage is 35Vdc. The maximum allowed feed-back peak current is 40A. Higher currents can temporarily switch off the output voltage. The absorbing energy can be calculated according to the large built-in output capacitor indicated in the output data.

4.3 External input protection

The device is tested and approved for circuits that are fused up to 30A (UL) and 32A (IEC). External protection is only required if the supply line has a protection that is higher than this. Also check the local regulations and requirements. Local regulations may apply in some countries.

If an external fuse is required or used, minimum requirements must be taken into account to avoid false tripping of the circuit breaker. A circuit breaker with a minimum value of 6A with B or C characteristic should be used.

4.4 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 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.

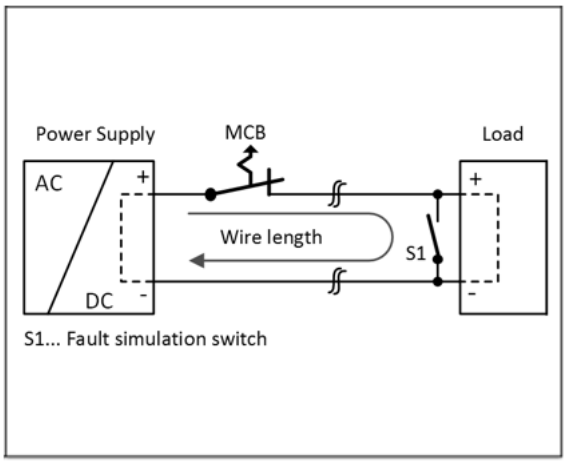

Fig. 21: Test circuit

Maximum wire length*) for fast (magnetic) tripping:

	0.75mm²	1.0mm²	1.5mm²	2.5mm²
C-2A	30m	37m	54m	84m
C-3A	25m	30m	46m	69m
C-4A	9 m	15 m	25m	34m
C-6A	3 m	3 m	4 m	7 m

	0.75mm²	1.0mm²	1.5mm²	2.5mm²
B-6A	12 m	15 m	21m	34m
B-10A	3 m	3 m	4 m	9 m
B-13A	2 m	2 m	3 m	6 m

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

4.5 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.

Grounding of the output is required if the sum of the output voltage is more than 60Vdc.

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.

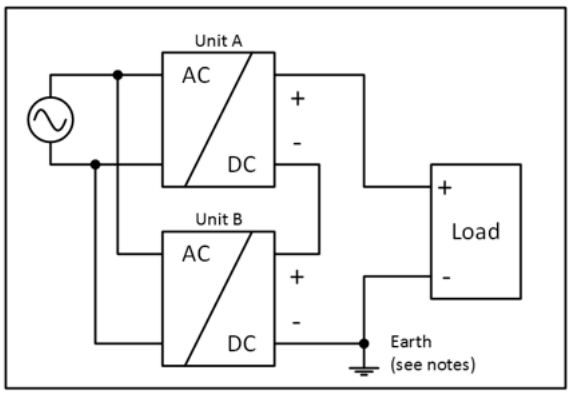

Fig. 22: Series connection

4.6 Parallel use to increase power

PS2001-2410-0000 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 (±100mV) and with the same load conditions on all devices, or the factory settings of the devices can be retained. No feature is included to balance the load current between the power supplies. Normally the power supply draws current at the higher set output voltage until its current limitation takes effect. This power supply is therefore not damaged as long as the ambient temperature is less than 40°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.

Energize all devices at the same time to avoid overload hiccup mode. It may also be necessary to ramp up and shut down the input power (turn off for at least five seconds) if the output was in hiccup mode due to overload or short circuit and the required output current is higher than the current of a device.

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.

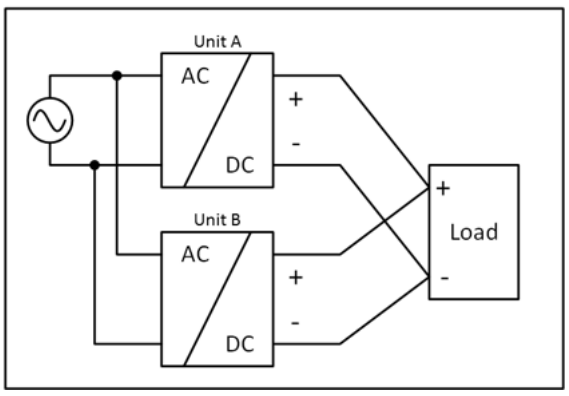

Fig. 23: Parallel connection

4.7 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 (± 100 mV) or to leave them at the factory setting.

4.7.1 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°C.

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:

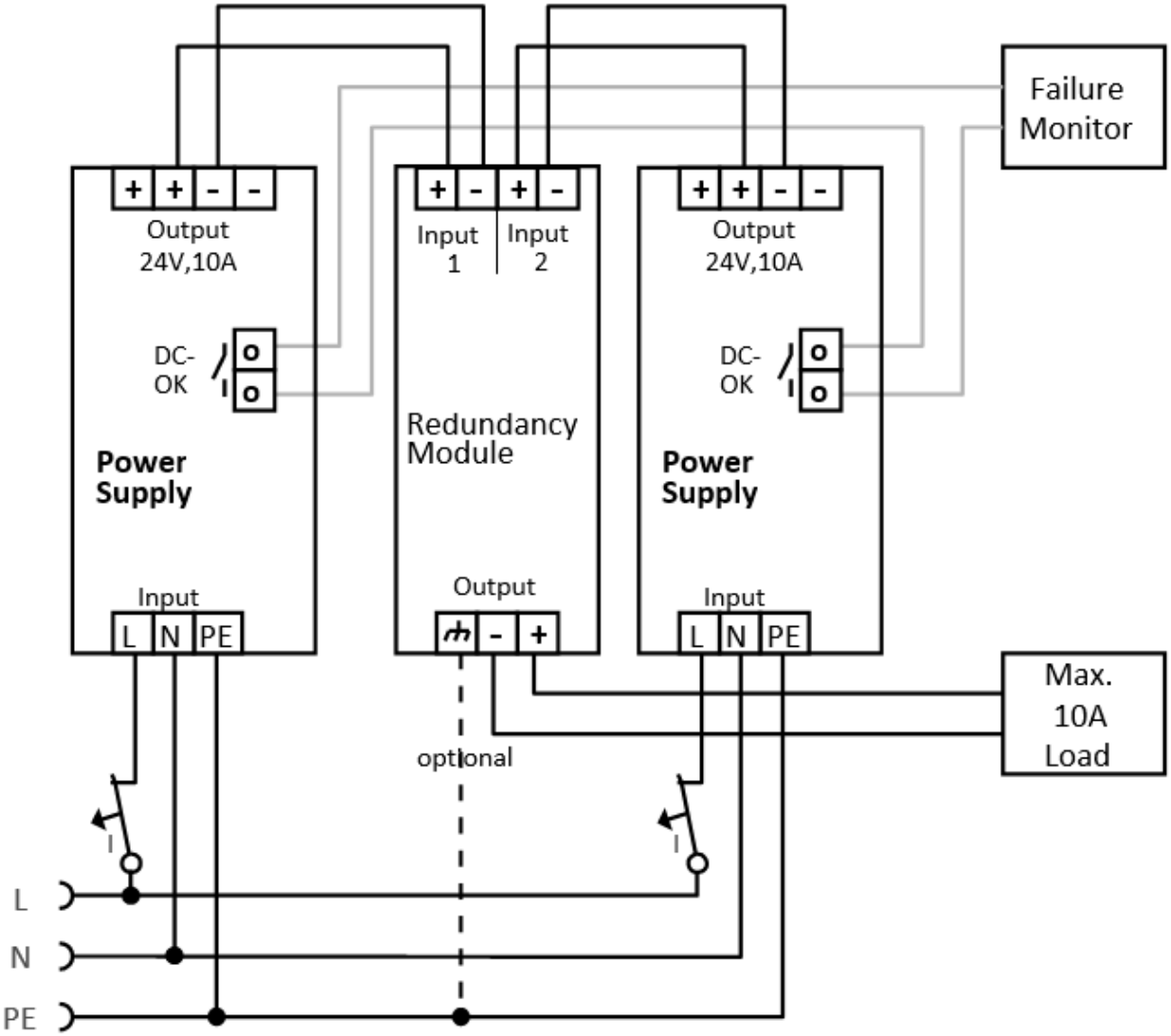

Fig. 24: Wiring for 1+1 - redundancy with one redundancy module PS9401-2420-0000

4.7.2 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:

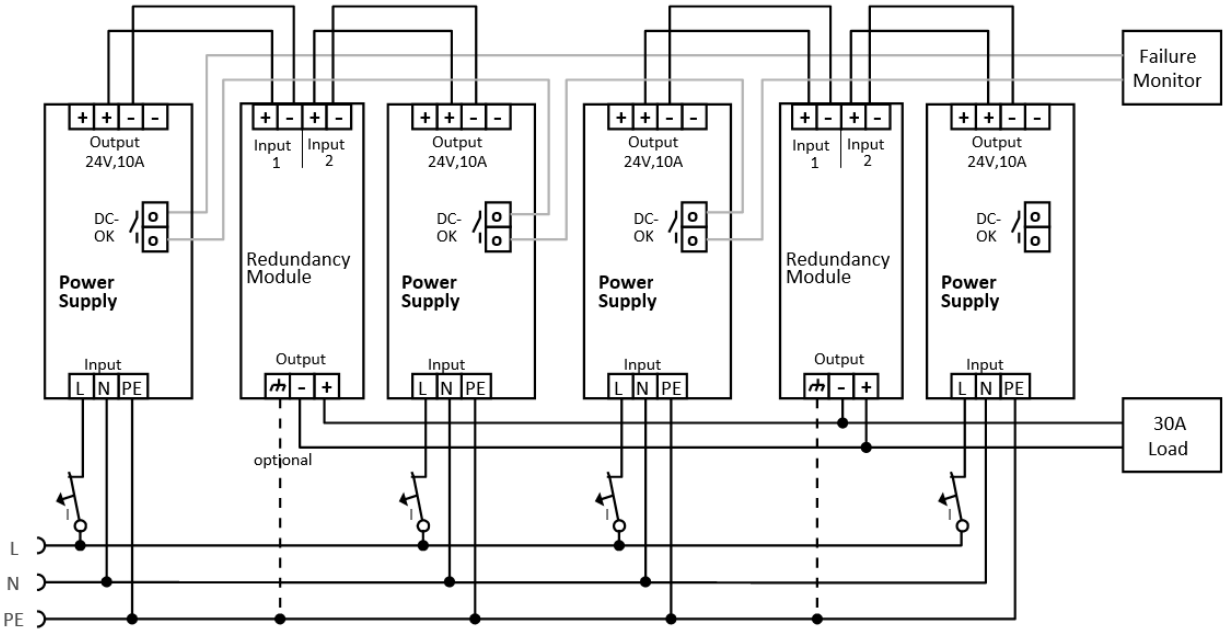

Fig. 25: Wiring for n+1 - redundancy with two redundancy modules PS9401-2420-0000

4.8 Inductive and capacitive loads

The device is designed to supply all load types, including capacitive and inductive loads. If very large capacitors such as EDLCs (electric double-layer capacitors or "UltraCaps") with a capacitance of more than 1.5 F are connected to the output, the device charges the capacitor in hiccup mode if necessary (see Output chapter).

4.9 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:

- Set the output voltage (measured at no load and at the end of the battery 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 15A or 16A 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 matching batteries when connecting 12V types in series.
- Make sure that the ambient temperature of the power supply remains below 40°C.
- The reverse current to the power supply (battery discharge current) is typically 3.5mA when the power supply is switched off (except when using a decoupling diode).

4.10 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 permissible as long as the supply voltage is below 240V+10%.

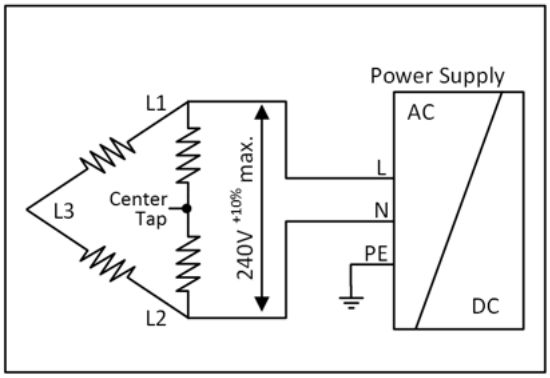

Fig. 26: Operation on two phases

Make sure that the conductor connected to the N terminal is appropriately fused.

The maximum permissible voltage between a phase and the PE must be less than 300 Vac.

4.11 Use in a tightly sealed enclosure

When the power supply is installed in a 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.

The following measurement results can be used as reference for estimating the temperature rise inside the enclosure.

The power supply is positioned at the center of the enclosure. There are no other heat-generating elements in the enclosure.

The temperature sensor in the enclosure is positioned at the center on the right side of the power supply with a distance of 1cm.

	Case A	Case B	Case C	Case D
Housing size	**110**x180x165mm Rittal housing, protection class IP66 PK 9516 100, plastic	**110**x180x165mm Rittal housing, protection class IP66 PK 9516 100, plastic	**180**x180x165mm Rittal housing, protection class IP66 PK 9519 100, plastic	**180**x180x165mm Rittal housing, protection class IP66 PK 9519 100, plastic
Input voltage	230Vac	230Vac	230Vac	230Vac
Load	24V, 8A; (=**80%**)	24V, 10A; (=**100%**)	24V, 8A; (=**80%**)	24V, 10A; (=**100%**)
Temperature inside the housing	48.6°C	53.8°C	42.0°C	48.1°C
Temperature outside the housing	26.3°C	26.6°C	25.8°C	26.2°C
Temperature increase	22.3K	27.3K	16.2K	21.9K

4.12 Installation positions

Mounting positions that deviate from the standard mounting position require a reduction of the continuous output power or a limitation of the maximum permissible ambient temperature. The extent of the reduction affects the lifetime expectancy of the power supply unit. Therefore, two different characteristic curves for load reduction are provided below:

Characteristic curve A1: Recommended output current.
Characteristic curve A2: Max. permissible output current (results in about half the lifetime expectancy of A1).

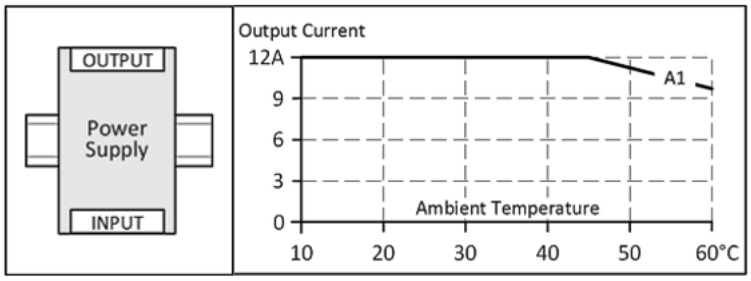

Fig. 27: Mounting position A (standard mounting position)

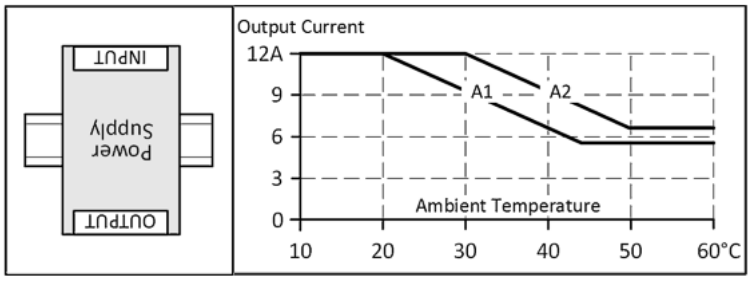

Fig. 28: Mounting position B (upside down)

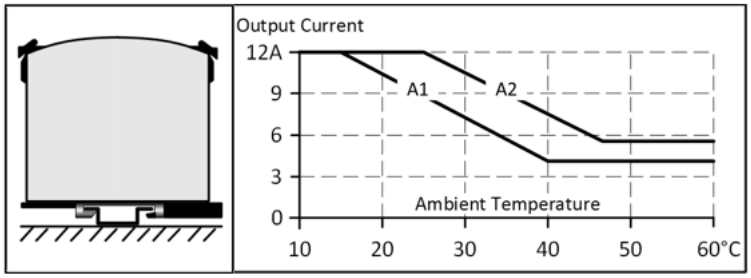

Fig. 29: Mounting position C (table mounting)

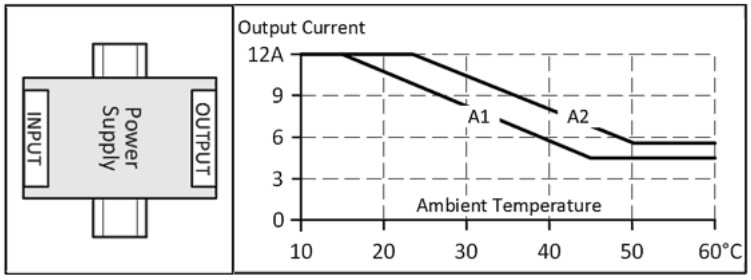

Fig. 30: Mounting position D (horizontal clockwise)

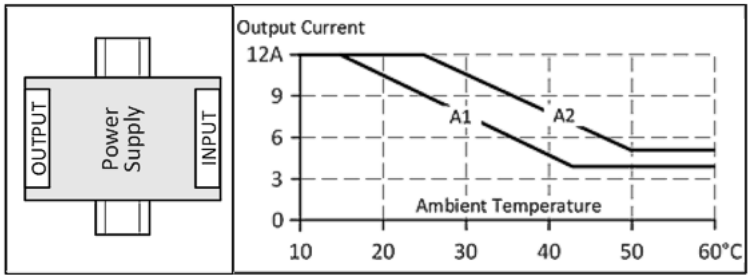

Fig. 31: Mounting position E (horizontal counterclockwise)

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	UPS component
PS2001-2410-0000	PS9401-2420-0000	PS9011-2420-0001	CU8130-0xxx

PS9401-2420-0000 – Redundancy Module

The PS9401-2420-0000 is a redundancy module that can be used to construct 1+1 and N+1 redundant systems.

It has two input channels, to which power supplies with an output current of up to 12 A can be connected, and an output that can carry nominal currents up to 20 A. The output can also be operated with up to 24 A if the ambient temperature is < +45°C.

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 32 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 [▶ 31]"!

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 device on a level surface or panel without the use of a DIN rail. The bracket can be mounted without loosening the DIN rail brackets.

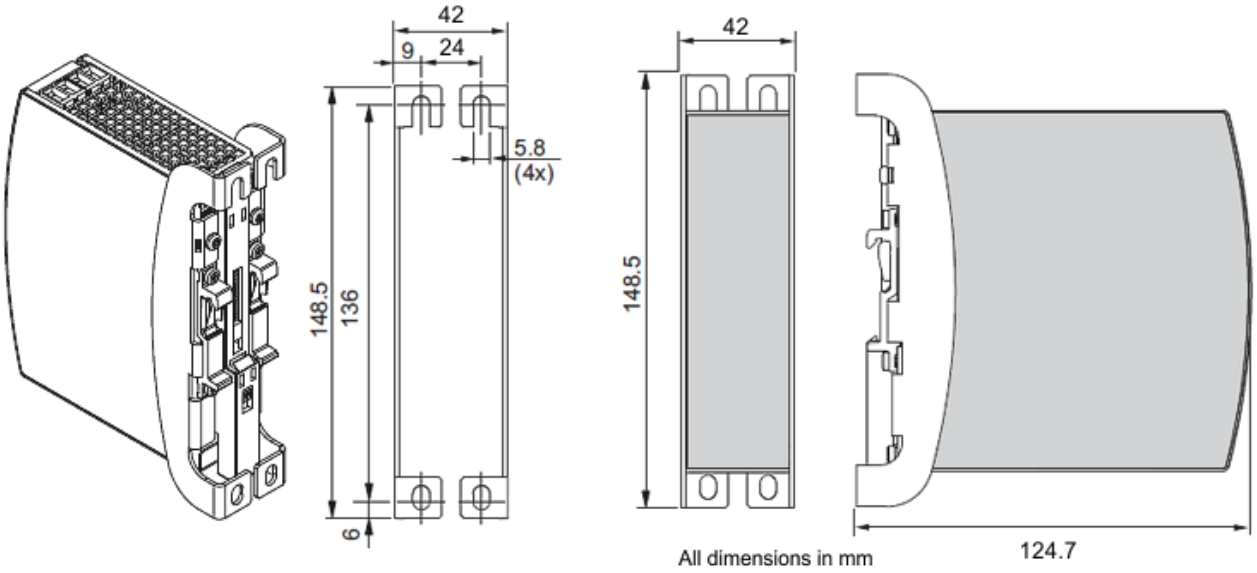

Fig. 32: Isometric view, installation dimensions bracket for wall mounting

ZS5301-0005 – Bracket for side mounting

This bracket is used to mount the power supply unit laterally with or without a DIN rail.

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 ZS5301-0005 documentation.

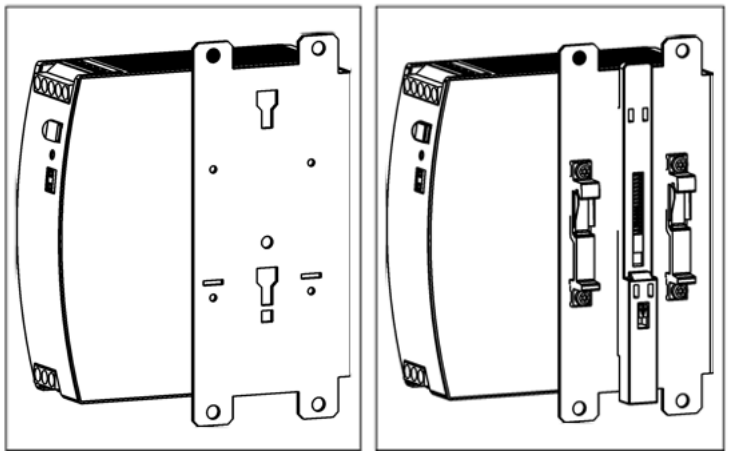

Fig. 33: Lateral mounting with and without DIN rail brackets

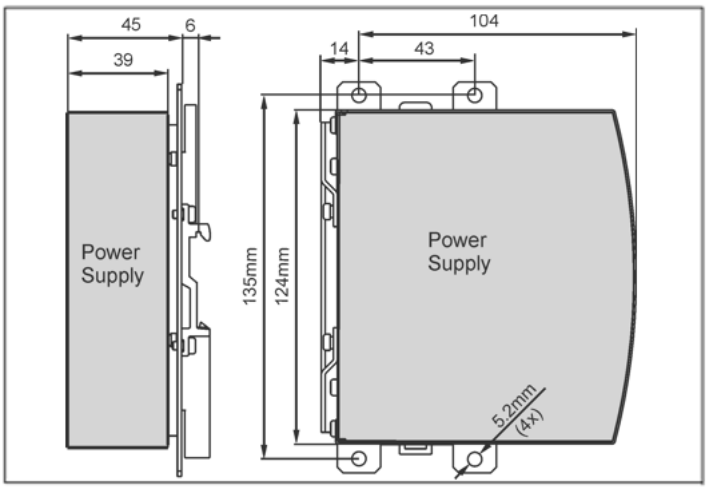

Fig. 34: Installation dimensions Angle for side mounting

6.2 Documentation issue status

Version	Comment
1.1	- Chapter “Parallel use for redundancy” added - Chapter “Declaration of conformity and approvals” updated - Chapter “Accessories” updated - Chapter “Disposal” added - Update structure
1.0	- First public issue
0.3	- Complements, corrections
0.2	- Complements, corrections
0.1	- Preliminary documentation for PS2001-2410-0000

6.3 Support and Service

Beckhoff and their partners around the world offer comprehensive support and service, making available fast and competent assistance with all questions related to Beckhoff products and system solutions.

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You will also find further documentation for Beckhoff components there.

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