

# PS1000-A6-24.10.R

## Power Supply

### Technical Information



---

With regard to the supply of products, the current issue of the following document is applicable:  
The General Terms of Delivery for Products and Services of the Electrical Industry, published by the Central Association of the Electrical Industry (Zentralverband Elektrotechnik und Elektroindustrie (ZVEI) e.V.) in its most recent version as well as the supplementary clause: "Expanded reservation of proprietorship"

#### **Worldwide**

Pepperl+Fuchs Group

Lilienthalstr. 200

68307 Mannheim

Germany

Phone: +49 621 776 - 0

E-mail: [info@de.pepperl-fuchs.com](mailto:info@de.pepperl-fuchs.com)

#### **North American Headquarters**

Pepperl+Fuchs Inc.

1600 Enterprise Parkway

Twinsburg, Ohio 44087

USA

Phone: +1 330 425-3555

E-mail: [sales@us.pepperl-fuchs.com](mailto:sales@us.pepperl-fuchs.com)

#### **Asia Headquarters**

Pepperl+Fuchs Pte. Ltd.

P+F Building

18 Ayer Rajah Crescent

Singapore 139942

Phone: +65 6779-9091

E-mail: [sales@sg.pepperl-fuchs.com](mailto:sales@sg.pepperl-fuchs.com)

<https://www.pepperl-fuchs.com>

---

1	Introduction .....	5
2	Terminology and Abbreviations.....	6
3	Intended Use .....	8
4	Installation Instructions .....	9
5	AC Input .....	11
6	DC Input .....	13
7	Input Inrush Current .....	14
8	Output.....	15
9	Hold-Up Time .....	17
10	DC-OK Relay Contact .....	18
11	Efficiency and Power Losses.....	19
12	Lifetime Expectancy .....	21
13	MTBF.....	22
14	Functional Diagram.....	23
15	Terminals and Wiring.....	24
16	Replacing the Units while the System is Running.....	25
17	Front Side and User Elements.....	26
18	EMC.....	27
19	Environment.....	28
20	Protection Features.....	30
21	Safety Features .....	31
22	Dielectric Strength.....	32
23	Approvals And Fulfilled Standards .....	33
24	Regulatory Compliance .....	34
25	Physical Dimensions and Weight .....	35
26	Application Notes .....	36

2021-11



## 1 Introduction

The information given in this document is correct to the best of our knowledge and experience at the time of publication. If not expressly agreed otherwise, this information does not represent a warranty in the legal sense of the word. As the state of our knowledge and experience is constantly changing, the information in this data sheet is subject to revision.

We therefore kindly ask you to always use the latest issue of this document (available under [www.pepperl-fuchs.com](http://www.pepperl-fuchs.com)).

No part of this document may be reproduced or utilized in any form without our prior permission in writing.

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

## 2 Terminology and Abbreviations

<b>PE and <math>\oplus</math> symbol</b>	PE is the abbreviation for <b>Protective Earth</b> and has the same meaning as the symbol $\oplus$ .
<b>Earth, Ground</b>	This document uses the term <b>earth</b> which is the same as the U.S. term <b>ground</b> .
<b>T.b.d.</b>	To be defined, value or description will follow later.
<b>AC 230V</b>	A figure displayed with the AC or DC before the value represents a nominal voltage with standard tolerances (usually $\pm 15\%$ ) included. E.g.: DC 12V describes a 12V battery disregarding whether it is full (13.7V) or flat (10V)
<b>230Vac</b>	A figure with the unit (Vac) at the end is a momentary figure without any additional tolerances included.
<b>50Hz vs. 60Hz</b>	As long as not otherwise stated, AC 230V parameters are valid at 50Hz mains frequency.
<b>may</b>	A key word indicating flexibility of choice with no implied preference.
<b>shall</b>	A key word indicating a mandatory requirement.
<b>should</b>	A key word indicating flexibility of choice with a strongly preferred implementation.
<b>1+1 Redundancy</b>	Use of two identical power supplies in parallel to provide continued operation following most failures in a single power supply. The two power supply outputs should be isolated from each other by utilizing diodes or other switching arrangements. E.g. two 10A power supplies are needed to achieve a 10A redundant system.
<b>N+1 Redundancy</b>	Use of three or more identical power supplies in parallel to provide continued operation following most failures in a single power supply. All power supply outputs should be isolated from each other by utilizing diodes or other switching arrangements. E.g.: To achieve a 40A redundant system, five 10A power supplies are needed in a N+1 redundant system.

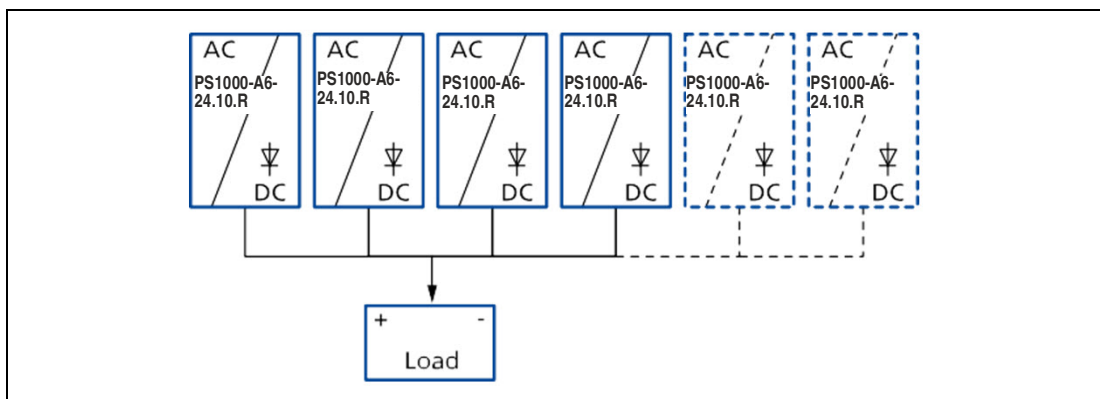


Figure 2.1 N+1 Redundancy

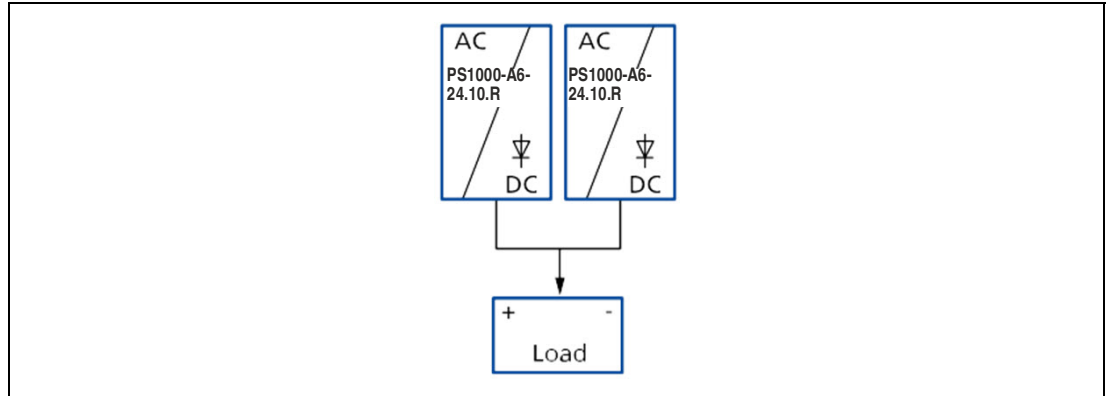


Figure 2.2 1+1 Redundancy

### 3 Intended Use

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

Do not use this device in equipment, where malfunctioning may cause severe personal injury or threaten human life without additional appropriate safety devices, that are suited for the application. If this device is used in a manner outside of its specification, the protection provided by the device may be impaired.

#### Function

The device is used to supply field devices with 24 V DC and 10 A.

The device includes a decoupling MOSFET for building 1+1 or n+1 redundant power supply systems.

To achieve current sharing between power supplies connected in parallel, the device is permanently factory-set to **parallel use** operating mode.

The device status is indicated by an LED.

The device has a relay contact output for remote monitoring.

The device is mounted on a 35 mm DIN mounting rail according to EN 60715.

#### Reference Conditions

All parameters are specified at 24V, 10A, 230Vac, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.



## 4 Installation Instructions



### Warning!

Risk of electrical shock, fire, personal injury or death.

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



### Warning!

Explosion hazards

- Do not use with DC input voltages.
- Use only in standard vertical mounting orientation with the input terminals on bottom of the unit.
- Substitution of components may impair suitability for this environment.
- Do not disconnect the device or operate the voltage adjustment unless power has been switched off or the area is known to be non-hazardous.
- A suitable enclosure must be provided for the end product, which has a minimum protection of IP54 and fulfills the requirements of the EN 60079-0.



### Note

If you use the device in hazardous areas, observe the safety information in the instruction manual and in chapter 23.

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

This device does not contain serviceable parts. The tripping of an internal fuse is caused by an internal defect. If damage or malfunction should occur during installation or operation, immediately turn power off and send the device to the factory for inspection.

Install the device in an enclosure providing protection against electrical, mechanical and fire hazards. Install the device onto a DIN rail according to EN 60715 with the input terminals on the bottom of the device. Other mounting orientations require a reduction in output current.

Make sure that the wiring is correct by following all local and national codes. Use appropriate copper cables that are designed for a minimum operating temperature of 60°C for ambient temperatures up to +45°C, 75°C for ambient temperatures up to +60°C and 90°C for ambient temperatures up to +70°C. Ensure that all strands of a stranded wire enter the terminal connection. Unused screw terminals should be securely tightened.

The device is designed for pollution degree 2 areas in controlled environments. No condensation or frost is allowed.

The enclosure of the device provides a degree of protection of IP20. The enclosure does not provide protection against spilled liquids. The isolation of the device is designed to withstand impulse voltages of overvoltage category III according to IEC 60664-1.

The device is designed as "Class of Protection I" equipment according to IEC 61140. Do not use without a proper PE (Protective Earth) connection. The device is suitable to be supplied from TN, TT or IT mains networks. The continuous voltage between the input terminal and the PE potential must not exceed 300Vac.

The input can also be powered from batteries or similar DC sources. The continuous voltage between the supply voltage and the PE/ground potential must not exceed 375Vdc. A disconnecting means shall be provided for the input of the device.

The device is designed for convection cooling and does not require an external fan. Do not obstruct airflow and do not cover ventilation grid! The device is designed for altitudes up to 5000m (16400ft). Above 2000m (6560ft) a reduction in output current and over voltage category is required. Keep the following minimum installation clearances: 40mm on top, 20mm on the bottom, 5mm left and right side. Increase the 5mm to 15mm in case the adjacent device is a heat source. When the device is permanently loaded with less than 50%, the 5mm can be reduced to zero.

The device is designed, tested and approved for branch circuits up to 20A and without additional protection device. If an external fuse is utilized, do not use circuit breakers smaller than 6A B- or C-Characteristic to avoid a nuisance tripping of the circuit breaker. The maximum surrounding air temperature is +70°C (+158°F). The operational temperature is the same as the ambient or surrounding air temperature and is defined 2cm below the device. The device is designed to operate in areas between 5% and 95% relative humidity. Do not unplug the connectors more often than 20 times in total.

## 5 AC Input

The device is suitable to be supplied from TN-, TT- or IT-mains networks with AC voltage. For suitable DC supply voltages see chapter 6.

AC input AC input range	nom.	AC 100-240V 85-264Vac 264-300Vac	Continuous operation Occasionally for maximal 500ms
Allowed voltage L or N to earth	max.	300Vac	Continuous, according to IEC 60664-1
Input frequency	nom.	50-60Hz	±6%
Turn-on voltage	typ.	80Vac	Steady-state value, see Figure 5.1
Shut-down voltage	typ.	70Vac	Steady-state value, see Figure 5.1
	typ.	55Vac	Dynamic value for max. 250ms
External input protection	See recommendations in chapter 2.		

		AC 100V	AC 120V	AC 230V	
Input current	typ.	2.63A	2.17A	1.14A	At 24V, 10A, see Figure 5.3
Power factor <sup>1</sup>	typ.	0.99	0.99	0.97	At 24V, 10A, see Figure 5.4
Crest factor <sup>2</sup>	typ.	1.5	1.5	1.65	At 24V, 10A
Start-up delay	typ.	300ms	290ms	240ms	See Figure 5.2.
Rise time	typ.	30ms	30ms	30ms	At 24V, 10A const. current load, 0mF load capacitance, see Figure 5.2
	typ.	75ms	75ms	75ms	At 24V, 10A const. current load, 20mF load capacitance, see Figure 5.2
Turn-on overshoot	max.	200mV	200mV	200mV	See Figure 5.2

<sup>1</sup> The power factor is the ratio of the true (or real) power to the apparent power in an AC circuit.

<sup>2</sup> The crest factor is the mathematical ratio of the peak value to RMS value of the input current waveform.

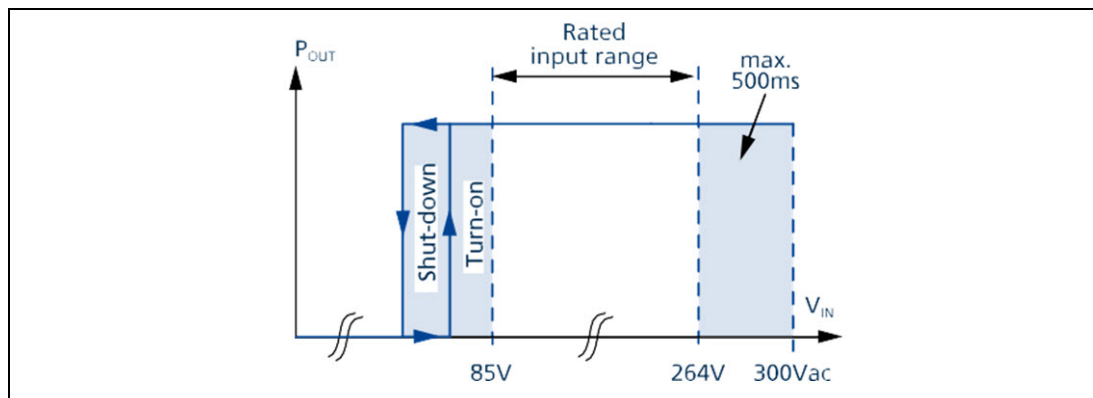


Figure 5.1 Input voltage range

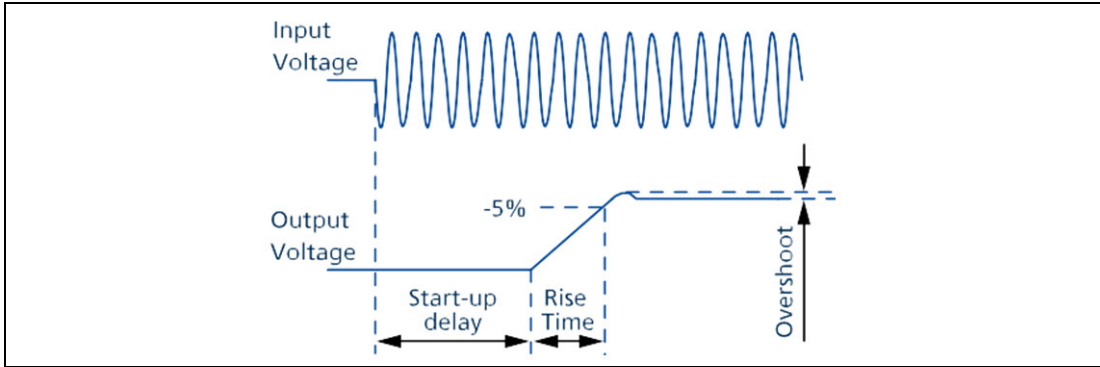


Figure 5.2 Turn-on behavior, definitions

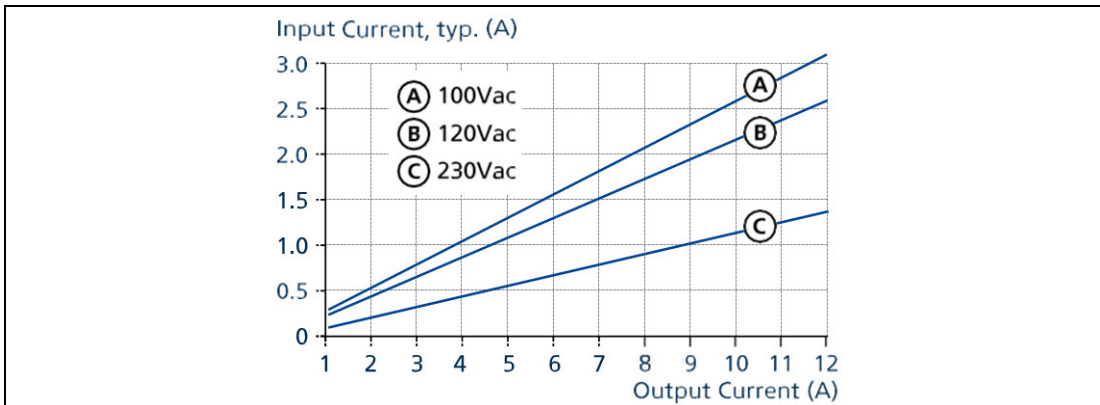


Figure 5.3 Input current vs. output current at 24V output voltage

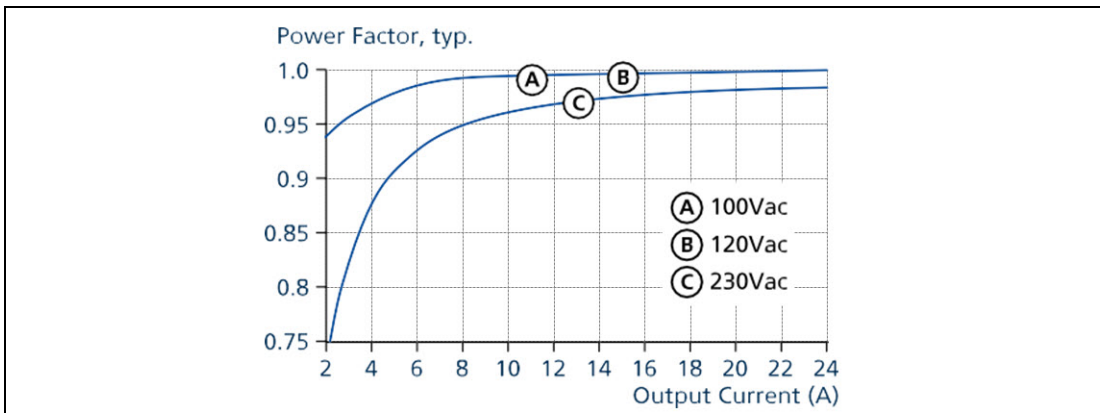


Figure 5.4 Power factor vs. output current at 24V output voltage

## 6 DC Input

DC input	nom.	DC 110-150V	±20%
DC input range		88-180Vdc	Continuous operation
DC input current	typ.	2.35A	At 110Vdc, 24V, 10A
Allowed voltage (+) or (-) input to earth	max.	360Vdc	Continuous, according to IEC 60664-1
Turn-on voltage	typ.	80Vdc	Steady state value
Shut-down voltage	typ.	70Vdc	Steady state value
	typ.	55Vdc	Dynamic value for max. 250ms

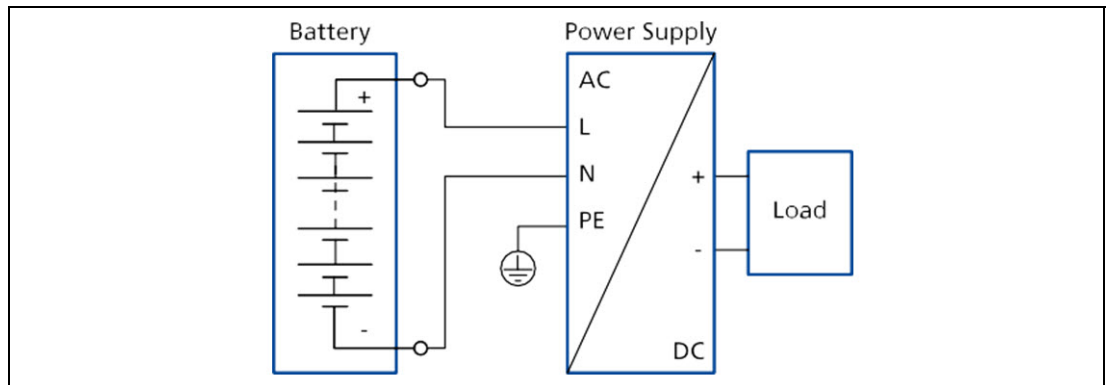


Figure 6.1 Wiring for DC Input

The device is suitable to be supplied from a DC input voltage.



### Using DC

1. Use a battery or a similar DC source.



#### Warning!

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

2. Connect (+) pole to L and (-) pole to N.
3. Connect the PE terminal to an earth wire or to the machine ground.

## 7 Input Inrush Current

An active inrush limitation circuit (NTCs, which are bypassed by a relay contact) limits the input inrush current after turn-on of the input voltage.

The charging current into EMI suppression capacitors is disregarded in the first microseconds after switch-on.

		AC 100V	AC 120V	AC 230V	
Inrush current $I_{peak}$	Max.	11A	7A	11A	At 40°C, cold start
	Typ.	9A	6A	6A	At 25°C, cold start
	Typ.	9A	6A	9A	At 40°C, cold start
Inrush energy $I^2t$	Max.	0.1A <sup>2</sup> s	0.1A <sup>2</sup> s	0.4A <sup>2</sup> s	At 40°C, cold start

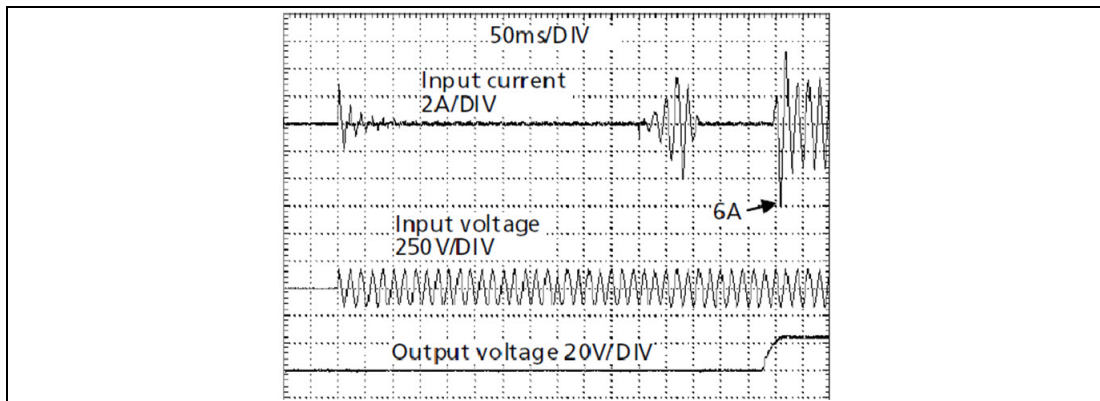


Figure 7.1 Typical turn-on behavior at nominal load, 120Vac input and 25°C ambient

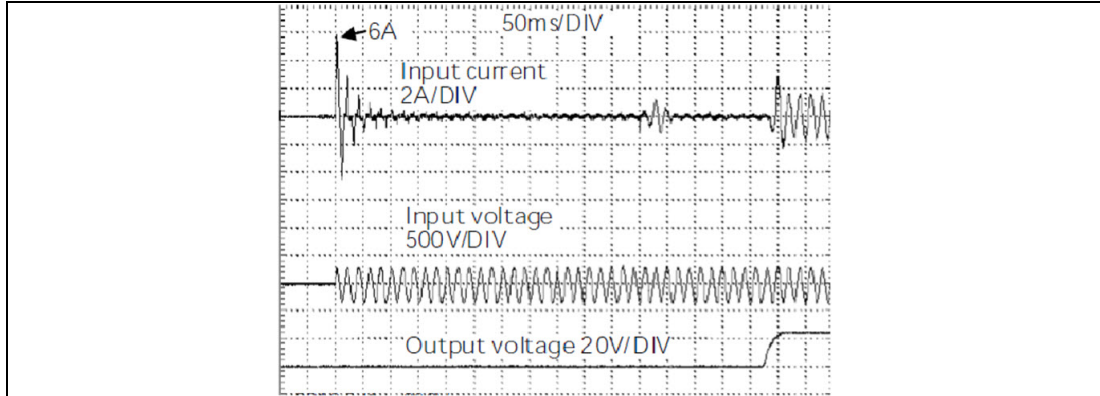


Figure 7.2 Typical turn-on behavior at nominal load, 230Vac input and 25°C ambient

## 8 Output

The output provides a SELV/PELV/ES1 rated voltage, which is galvanically isolated from the input voltage. The output of the devices includes a decoupling MOSFET for building 1+1 or N+1 redundant power supply systems.

The device is designed to supply any kind of loads, including capacitive and inductive loads. If extreme large capacitors, such as EDLCs (electric double layer capacitors or **UltraCaps**) with a capacitance larger than 1.5F are connected to the output, the unit might charge the capacitor in the **Hiccup** mode.

The device is featured with a **soft output regulation characteristic** in order to achieve current share between multiple devices when they are connected in parallel. The **soft output regulation characteristic** regulates the output voltage in such a manner that the voltage at no load is approx. 4% higher than at nominal load.

Output voltage	nom.	DC 24V	23.8-25.2V
Adjustment range		See chapter 26.2.	
Factory settings	typ.	24.1V	$\pm 0.2\%$ , at 10A, cold unit (results to typ. $23.9V^{\pm 0.2\%}$ at 12A and typ. $25.1V^{\pm 0.2\%}$ at no load)
Line regulation	max.	10mV	Between 85Vac and 300Vac
Load regulation	max.	1000mV	Between 0A and 10A, static value, see Figure 8.1
Ripple and noise voltage	max.	50mVpp	Bandwidth 20Hz to 20MHz, 50Ohm
Output current	nom.	12A <sup>1</sup>	Below 45°C and ambient temperatures, see Figure 19.1
	nom.	10A	At 60°C ambient temperature, see Figure 19.1
	nom.	7.5A	At 70°C and ambient temperatures below, see Figure 19.1
		Derate between +45°C and +70°C	
Fuse breaking current <sup>2</sup>	typ.	30A	Up to 12ms once every five seconds, see Figure 8.2
Overload behavior		Continuous current Intermittend current <sup>3</sup>	For output voltage above 13Vdc, see Figure 8.1 For output voltage below 13Vdc, see Figure 8.1
Overload/ short-circuit current	max.	15.5A	Continuous current, see Figure 8.1
	typ.	14A	Intermitted current peak value for typ. 2s Load impedance 10mOhm, see Figure 8.2. Discharge current of output capacitors is not included.
	max.	5A	Intermitted current average value (R.M.S.) Load impedance 10mOhm, see Figure 8.2
Output capacitance	typ.	4 400 $\mu$ F	Included inside the power supply
Back-feeding loads	max.	35V	The unit is resistant and does not show malfunctioning when a load feeds back voltage to the power supply. It does not matter whether the power supply is on or off. The absorbing energy can be calculated according to the built-in large sized output capacitor.

<sup>1</sup> This current is also available for temperatures up to +70°C with a duty cycle of 10% and/or not longer than 1 minute every 10 minutes.

<sup>2</sup> The fuse breaking current is an enhanced transient current which helps to start heavy loads or to trip fuses on faulty output branches. The output voltage stays above 20V.

<sup>3</sup> At heavy overloads (when output voltage falls below 13V), the power supply delivers continuous output current for 2s. After this, the output is switched off for approx. 18s before a new start attempt is automatically performed. This cycle is repeated as long as the overload exists. If the overload has been cleared, the device will operate normally. See Figure 8.3

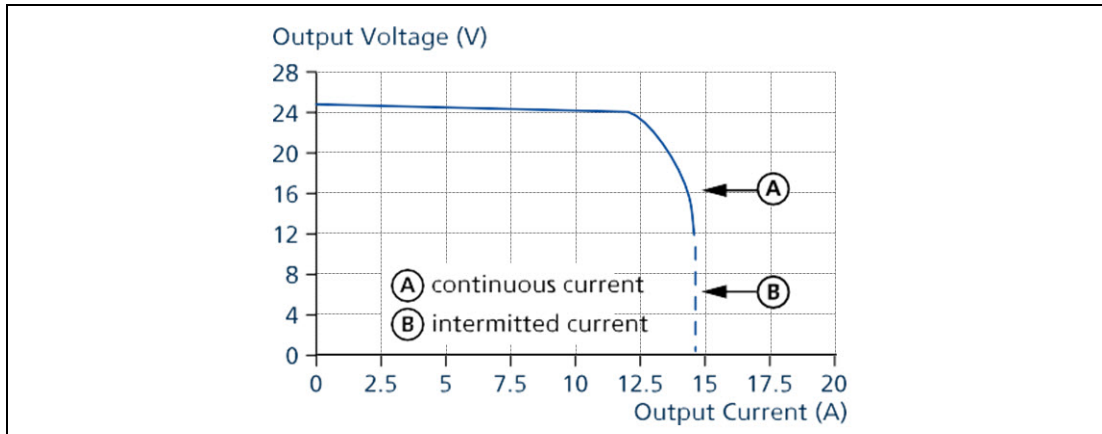


Figure 8.1 Output voltage vs. output current, typ.

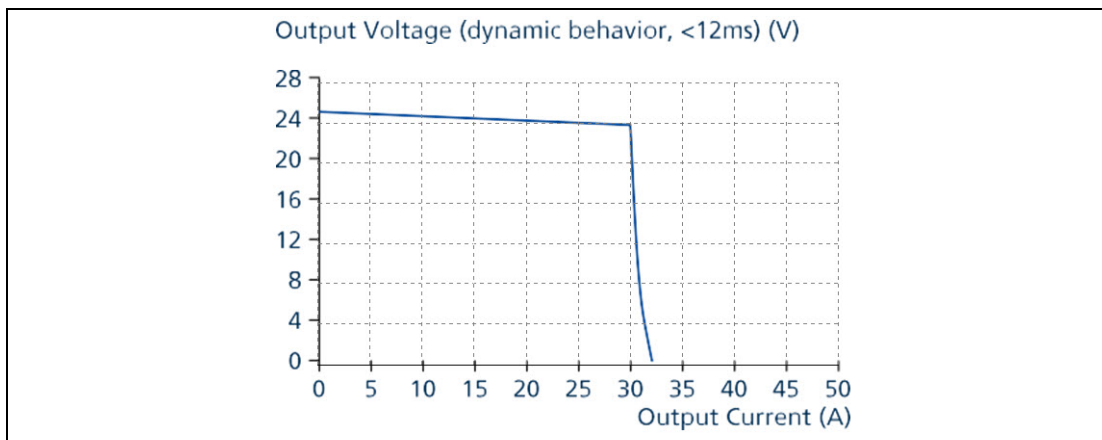


Figure 8.2 Dynamic output current capability, typ.

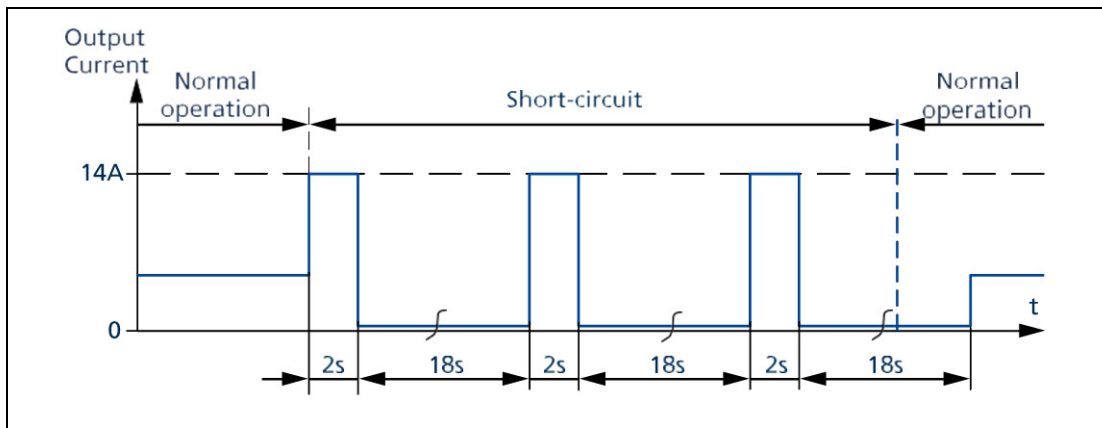


Figure 8.3 Short-circuit on output, Hiccup mode, typ.



## 9 Hold-Up Time

		AC 100V	AC 120V	AC 230V	
Hold-up Time	Typ.	73ms	73ms	73ms	At 24V, 5A, see Figure 9.1
	Min.	55ms	55ms	55ms	At 24V, 5A, see Figure 9.1
	Typ.	37ms	37ms	37ms	At 24V, 10A, see Figure 9.1
	Min.	28ms	28ms	28ms	At 24V, 10A, see Figure 9.1

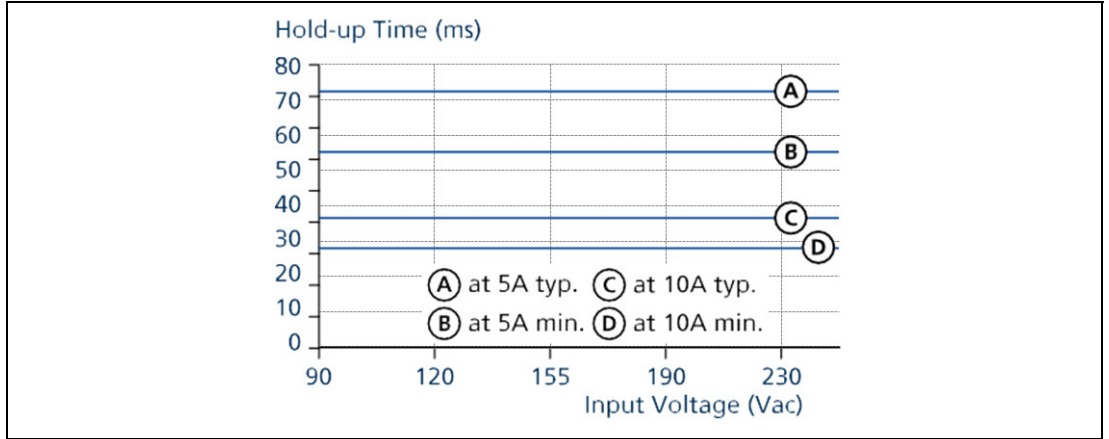


Figure 9.1 Hold-up time vs. input voltage

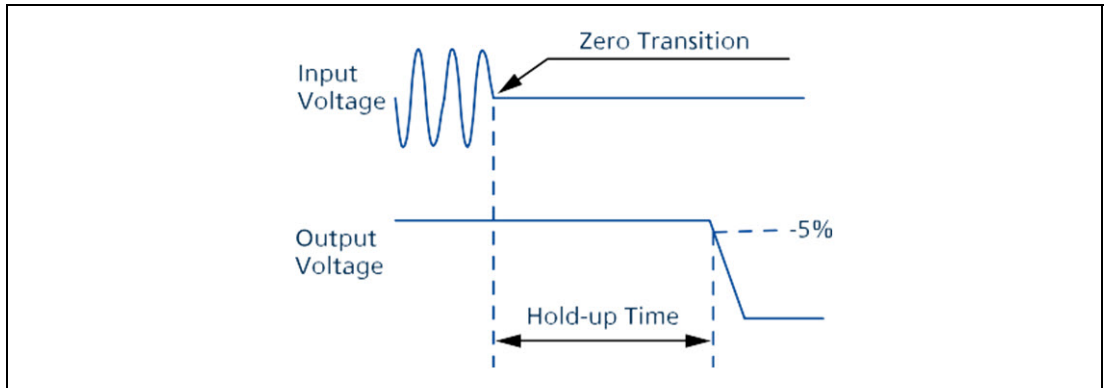


Figure 9.2 Shut-down behavior, definitions

## 10 DC-OK Relay Contact

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

Contact closes	As soon as the output voltage reaches typ. 90% of the adjusted output voltage level.
Contact opens	As soon as the output voltage dips more than 10% below the adjusted output voltage. Short dips will be extended to a signal length of 100ms. Dips shorter than 1ms will be ignored.
Switching hysteresis	typ. 1V
Contact ratings	Maximal 60Vdc 0.3A, 30Vdc 1A, 30Vac 0.5A, resistive load Minimal permissible load: 1mA at 5Vdc
Isolation voltage	See dielectric strength table in chapter 22.

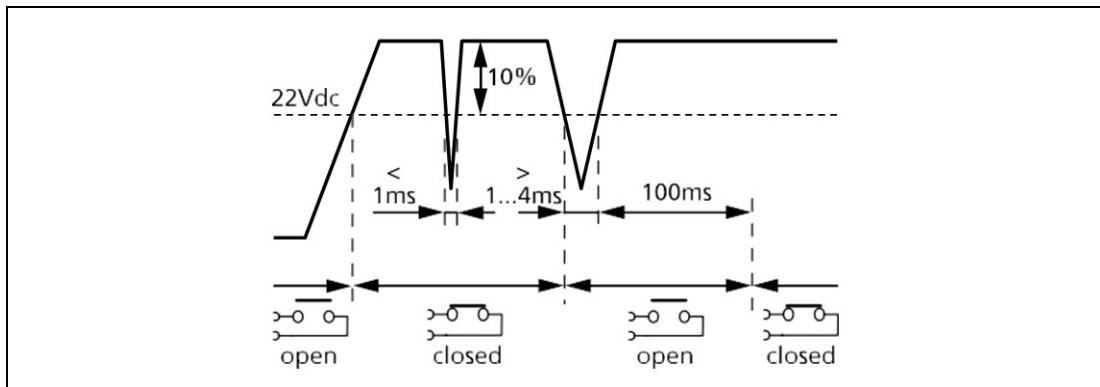


Figure 10.1 DC-OK relay contact behavior

## 11 Efficiency and Power Losses

		AC 100V	AC 120V	AC 230V	
Efficiency	typ.	92.2%	93%	94.7%	At 24V, 10A
	typ.	91.9%	92.8%	94.6%	At 24V, 12A (Power Boost)
Average efficiency <sup>1</sup>	typ.	91.8%	92.4%	93.9%	25% at 2.5A, 25% at 5A, 25% at 7.5A. 25% at 10A
Power losses	typ.	4W	3.7W	2.9W	At 24V, 0A
	typ.	11.3W	10.7W	8.6W	At 24V, 5A
	typ.	20.3W	18.1W	13.4W	At 24V, 10A
	typ.	25.4W	22.3W	16.4W	At 24V, 12A (Power Boost)

<sup>1</sup> The average efficiency is an assumption for a typical application where the power supply is loaded with 25% of the nominal load for 25% of the time, 50% of the nominal load for another 25% of the time, 75% of the nominal load for another 25% of the time and with 100% of the nominal load for the rest of the time.

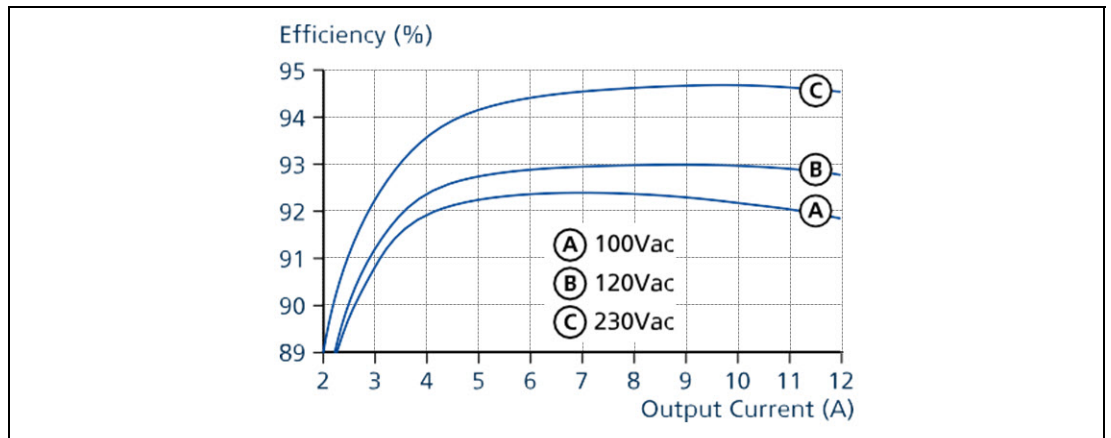


Figure 11.1 Efficiency vs. output current at 24V, typ.

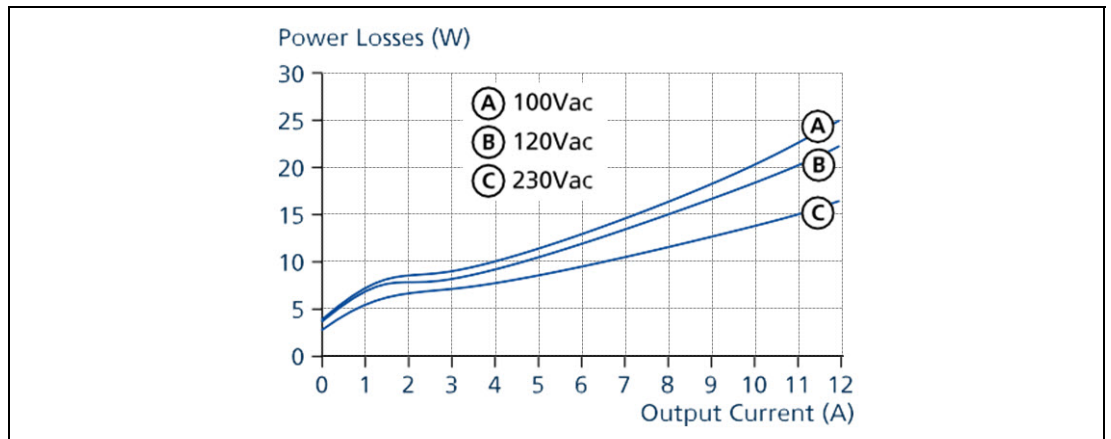


Figure 11.2 Losses vs. output current at 24V, typ.

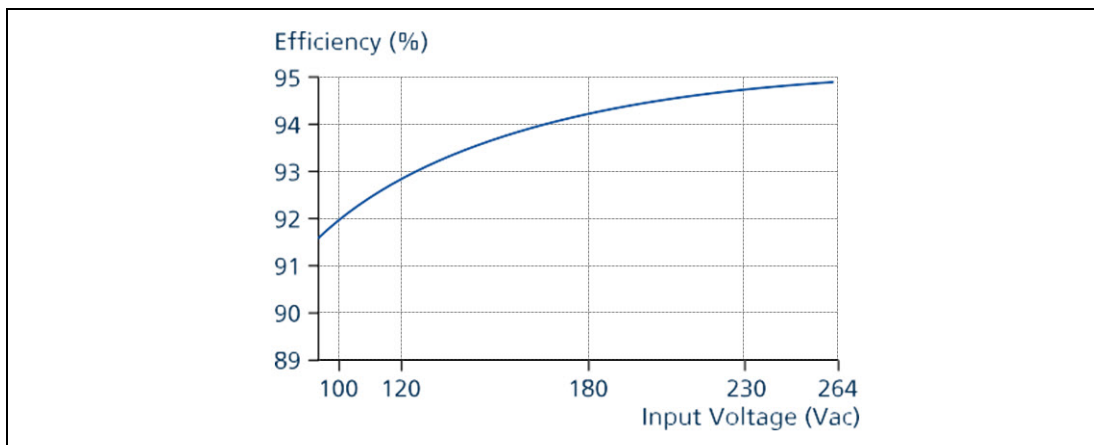


Figure 11.3 Efficiency vs. input voltage at 24V, 10A, typ.

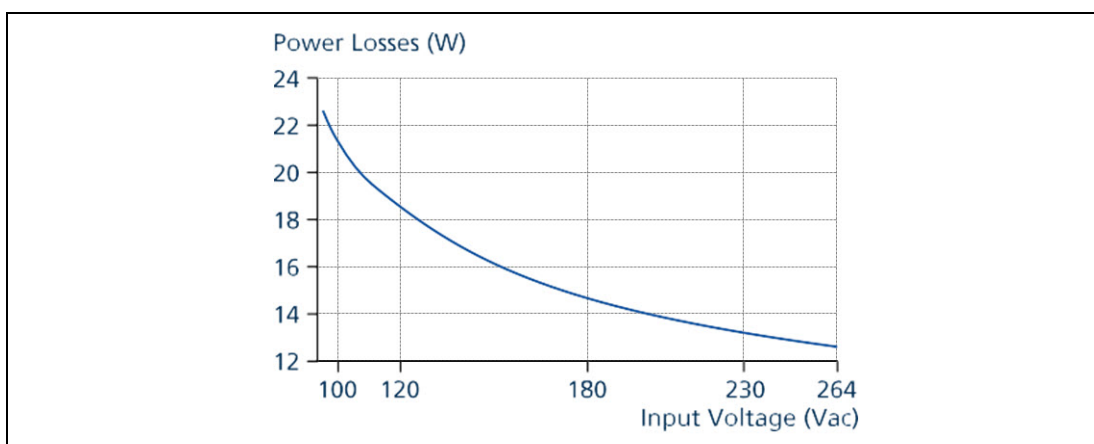


Figure 11.4 Losses vs. input voltage at 24V, 10A, typ.

## 12 Lifetime Expectancy

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

	<b>AC 100V</b>	<b>AC 120V</b>	<b>AC 230V</b>	
Lifetime expectancy	143 000h	153 000h	188 000h	At 24V, 5A and 40°C
	405 000h	434 000h	531 000h	At 24V, 5A and 25°C
	66 000h	78 000h	109 000h	At 24V, 10A and 40°C
	188 000h	220 000h	307 000h	At 24V, 10A and 25°C
	37 000h	47 000h	71 000h	At 24V, 12A and 40°C
	105 000h	132 000h	200 000h	At 24V, 12A and 25°C

## 13 MTBF

**MTBF** stands for **Mean Time Between Failure**, which is calculated according to statistical device failures, and indicates reliability of a device. It is the statistical representation of the likelihood of a unit to fail and does not necessarily represent the life of a product.

The MTBF figure is a statistical representation of the likelihood of a device to fail.

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

For these types of units the MTTF (**Mean Time To Failure**) value is the same value as the MTBF value.

	<b>AC 100V</b>	<b>AC 120V</b>	<b>AC 230V</b>	
MTBF SN 29500, IEC 61709	535 000h	556 000h	641 000h	At 24V, 10A and 40°C
	972 000h	1 006 000h	1 138 000h	At 24V, 10A and 25°C
MTBF MIL HDBK 217F	205 000h	208 000h	232 000h	At 24V, 10A and 40°C; Ground Benign GB40
	279 000h	283 000h	318 000h	At 24V, 10A and 25°C; Ground Benign GB25
	45 000h	46 000h	53 000h	At 24V, 10A and 40°C; Ground Fixed GF40
	58 000h	59 000h	63 000h	At 24V, 10A and 25°C; Ground Fixed GF25

# 14 Functional Diagram

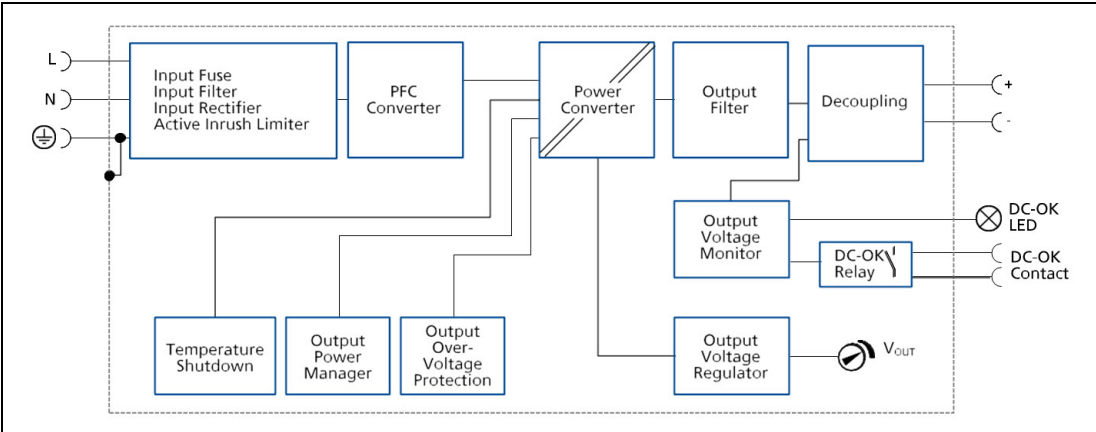


Figure 14.1 Functional diagram

## 15 Terminals and Wiring

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

Type	Input	Output	DC-OK-Signal
	Plug connector with screw terminals	Plug connector with screw terminals	Plug connector with screw terminals
Solid wire	Max. 4mm <sup>2</sup>	Max. 4mm <sup>2</sup>	Max. 1.5mm <sup>2</sup>
Stranded wire	Max. 2.5mm <sup>2</sup>	Max. 2.5mm <sup>2</sup>	Max. 1.5mm <sup>2</sup>
American Wire Gauge	AWG 20-12	AWG 20-12	AWG 26-16
Max. wire diameter (including ferrules)	2.4mm	2.4mm	1.8mm
Recommend tightening torque	max. 0.5Nm, 4.5lb-in	max. 0.5Nm, 4.5lb-in	max. 0.8Nm, 7lb-in
Wire stripping length	7mm / 0.28inch	7mm / 0.28inch	6mm / 0.24inch
Screwdriver	3.5mm slotted or cross-head No 2	3.5mm slotted or cross-head No 2	3mm slotted
	Do not unplug the connectors more often than 20 times in total.	Do not unplug the connectors more often than 20 times in total.	Do not unplug the connectors more often than 20 times in total.



### Connecting Terminals

1. Use appropriate copper cables that are designed for minimum operating temperatures of:
  - 60°C for ambient up to 45°C and
  - 75°C for ambient up to 60°C minimum
  - 90°C for ambient up to 70°C minimum.
2. Follow national installation codes and installation regulations!
3. Ensure that all strands of a stranded wire enter the terminal connection!
4. Unused terminal compartments should be securely tightened.
5. Ferrules are allowed.



## 16 Replacing the Units while the System is Running

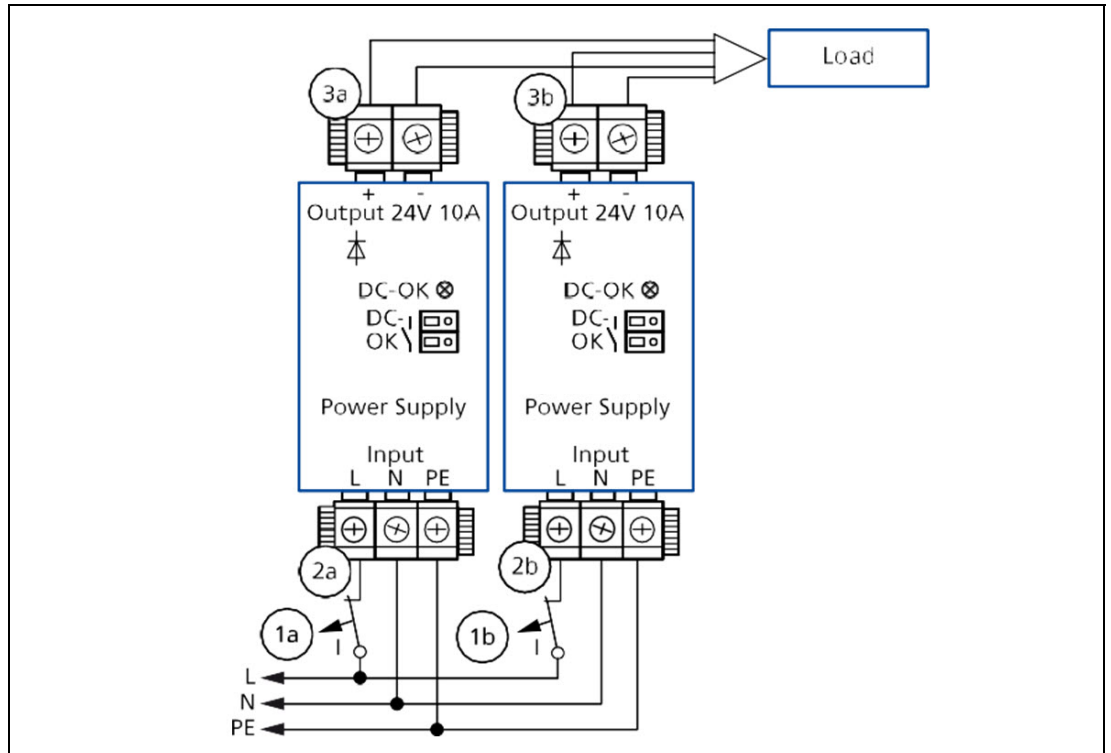


Figure 16.1 Replacing the power supply or redundancy module while the system is running



### Replacing the Units

1. Switch-off circuit breaker (1a).
2. Remove plug (2a).
3. Remove plug (3a). The plug prevents the cables from shorting.
4. Change power supply.
5. Put the plug (3a) back in.
6. Put the plug (2a) back in.
7. Turn-on the circuit breaker (1a).
8. The circuit is redundant again.
9. To replace the right power supply, repeat the process above using (1b), (2b) and (3b).

## 17 Front Side and User Elements

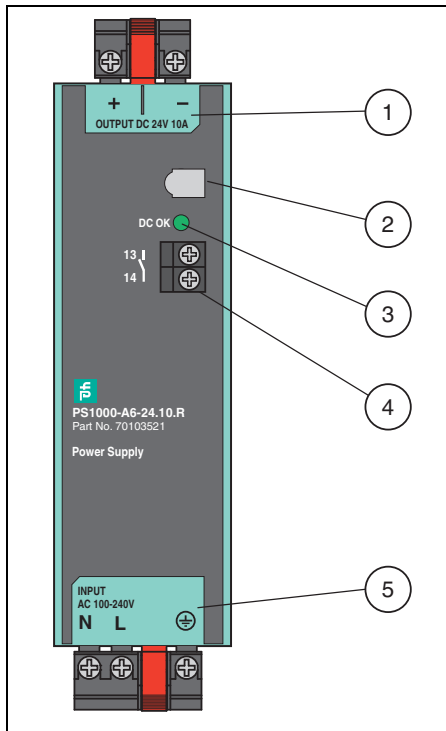


Figure 17.1 Front side

- 1 Output Terminals**  
 (+) Positive output  
 (-) Negative output (return)
- 2 Output Voltage Potentiometer**  
 See chapter 26.2.
- 3 DC-OK LED (green)**  
 On, when the output voltage is above 22V.
- 4 DC-OK Relay Contact**  
 The DC-OK relay contact is synchronized with the DC-OK LED. See chapter 10 for details.
- 5 Input Terminals**  
 N, L Line input  
 ⊕ PE (Protective Earth) input

## 18 EMC

The EMC behavior of the device is designed for applications in industrial environment as well as in residential, commercial and light industry environments.

<b>EMC Immunity</b>	According to generic standards: EN 61000-6-1 and EN 61000-6-2			
Electrostatic discharge	EN 61000-4-2	Contact discharge Air discharge	8kV 15kV	Criterion A Criterion A
Electromagnetic RF field	EN 61000-4-3	80MHz-2.7GHz	20V/m	Criterion A
Fast transients (Burst)	EN 61000-4-4	Input lines Output lines DC-OK signal (coupling clamp)	4kV 2kV 2kV	Criterion A Criterion A Criterion A
Surge voltage on input	EN 61000-4-5	L → N L → PE, N → PE	2kV 4kV	Criterion A Criterion A
Surge voltage on output	EN 61000-4-5	+ → - + / - → PE	1kV 2kV	Criterion A Criterion A
Surge voltage on DC-OK	EN 61000-4-5	DC-OK signal → PE	1kV	Criterion A
Conducted disturbance	EN 61000-4-6	0.15-80MHz	20V	Criterion A
Mains voltage dips	EN 61000-4-11	0% of 100Vac 40% of 100Vac 70% of 100Vac 0% of 200Vac 40% of 200Vac 70% of 200Vac	0Vac, 20ms 40Vac, 200ms 70Vac, 500ms 0Vac, 20ms 80Vac, 200ms 140Vac, 500ms	Criterion A Criterion C Criterion A Criterion A Criterion A Criterion A
Voltage interruptions	EN 61000-4-11	0% of 200Vac (=0V)	5000ms	Criterion C
Voltage sags	SEMI F47	Dips on the input voltage according to SEMI F47 standard 80% of 120Vac (96Vac) 70% of 120Vac (84Vac) 50% of 120Vac (60Vac)	1000ms 500ms 200ms	Criterion A Criterion A Criterion A
Powerful transients	VDE 0160	Over entire load range	750V, 0.3ms	Criterion A

**Criterion A** The device shows normal operation behavior within the defined limits.

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

<b>EMC Emission</b>	According to generic standards: EN 61000-6-3 and EN 61000-6-4	
Conducted emission input lines	EN 55011, EN 55015, EN 55032, FCC Part 15, CISPR 11, CISPR 32	Class B
Conducted emission output lines	IEC/CISPR 16-1-2, IEC/CISPR 16-2-1	Limits for DC power port according EN 61000-6-3 fulfilled
Radiated emission	EN 55011, EN 55032	Class B
Harmonic input current	EN 61000-3-2	Class A fulfilled between 0A and 12A load Class C fulfilled between 6A and 12A load
Voltage fluctuations, flicker	EN 61000-3-3	Fulfilled, tested with constant current loads, non pulsing

This device complies with FCC Part 15 rules.

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

### Switching Frequencies

PFC converter	110kHz	Fixed frequency
Main converter	84kHz to 140kHz	Output load dependent
Auxiliary converter	60kHz	Fixed frequency

## 19 Environment

Operational temperature <sup>1</sup>	-25°C to +70°C (-13°F to 158°F)	
Storage temperature	-40°C to +85°C (-40°F to 185°F)	For storage and transportation
Output de-rating <sup>2</sup>	0.13A/°C	Between +45°C and +60°C (113°F to 140°F)
	0.25A/°C	Between +60°C and +70°C (140°F to 158°F)
	0.63A/1000m or 5°C/1000m	For altitudes >2000m (6560ft), see Figure 19.2
	0.38A/-5kPa or 3°C/-5kPa	For atmospheric pressures <80kPa, see Figure 19.2
	The de-rating is not hardware controlled. The user has to take care by himself to stay below the de-rated current limits in order not to overload the unit.	
Humidity <sup>3</sup>	5 to 95% r.h.	According to IEC 60068-2-30
Atmospheric pressure	110-47kPa	See Figure 19.2. for details.
Altitude	Up to 6000m (20 000ft)	See Figure 19.2. for details.
Over-voltage category	III	
	II	According to IEC 60664-1 for altitudes >2000m and 6000m and atmospheric pressures from 80-47kPa
Degree of pollution	2	According to IEC 60664-1, not conductive
Vibration sinusoidal	2-17.8Hz: ±1.6mm;	According to IEC 60068-2-6
	17.8-500Hz: 2g 2 hours / axis	
Shock	30g 6ms, 20g 11ms	According to IEC 60068-2-27
	3 bumps per direction, 18 bumps in total	
Audible noise	Some audible noise may be emitted from the power supply during no load, overload or short circuit.	

<sup>1</sup> Operational temperature is the same as the ambient or surrounding temperature and is defined as the air temperature 2cm below the unit.

<sup>2</sup> The de-rating is not hardware controlled. The user has to take this into consideration to stay below the de-rated current limits in order not to overload the unit.

<sup>3</sup> Do not energize while condensation is present.

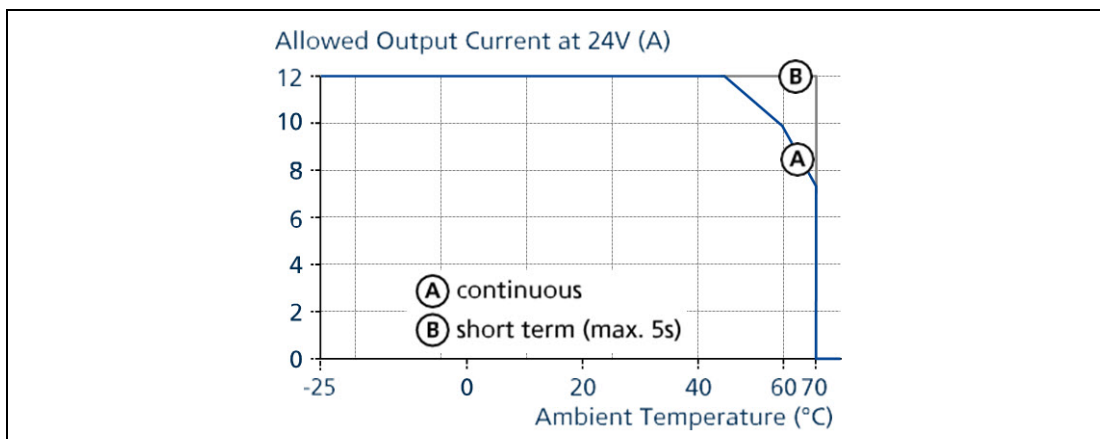


Figure 19.1 Output current vs. ambient temp.

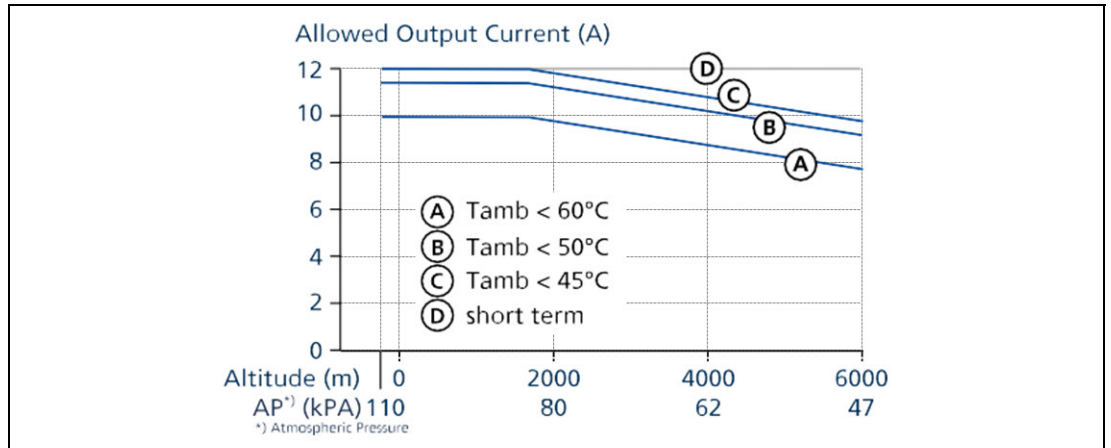


Figure 19.2 Output current vs. altitude

## 20 Protection Features

Output over-voltage protection <sup>1</sup>	typ. 30.5Vdc max. 32Vdc	
Degree of protection	IP 20	EN/IEC 60529
Penetration protection	>4mm	E.g. screws, small parts
Over-temperature protection <sup>2</sup>	Included	Output shut-down with automatic restart.
Input transient protection	MOV (Metal OxideVaristor)	For protection values see chapter 18 (EMC).
Internal input fuse	Included	Not user replaceable slow-blow high-braking capacity fuse

<sup>1</sup> In case of an internal power supply defect, a redundant circuit limits the maximum output voltage. The output shuts down and automatically attempts to restart.

<sup>2</sup> In safety critical situations a temperature sensor, which is installed inside the unit on a critical component, turns the unit off (e.g. de-rating requirements not observed, high ambient temperature, ventilation obstructed or the mounting orientation de-rating is not followed). There is no correlation between the operating temperature and turn-off temperature since this is dependent on input voltage, load and installation methods.

## 21 Safety Features

Class of protection	I	According to IEC 61140
Isolation resistance	> 500MΩ	At delivered condition between input and output, measured with 500Vdc
	> 500MΩ	At delivered condition between input and PE, measured with 500Vdc
	> 500MΩ	At delivered condition between output and PE, measured with 500Vdc
	> 500MΩ	At delivered condition between output and DC-OK contacts, measured with 500Vdc
PE resistance	< 0.1Ω	Resistance between PE terminal and the housing in the area of the DIN rail mounting bracket.
Touch current (leakage current)	typ. 0.14mA / 0.36mA	At 100Vac, 50Hz, TN-, TT-mains / IT-mains
	typ. 0.20mA / 0.50mA	At 120Vac, 60Hz, TN-, TT-mains / IT-mains
	typ. 0.33mA / 0.86mA	At 230Vac, 50Hz, TN-, TT-mains / IT-mains
	max. 0.18mA / 0.43mA	At 110Vac, 50Hz, TN-, TT-mains / IT-mains
	max. 0.26mA / 0.61mA	At 132Vac, 60Hz, TN-, TT-mains / IT-mains
	max. 0.44mA / 1.05mA	At 264Vac, 50Hz, TN-, TT-mains / IT-mains

## 22 Dielectric Strength

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

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

We recommend that either the (+) pole or the (-) pole shall be connected to the protective earth system. This helps to avoid situations in which a load starts unexpectedly or can not be switched off when unnoticed earth faults occur.

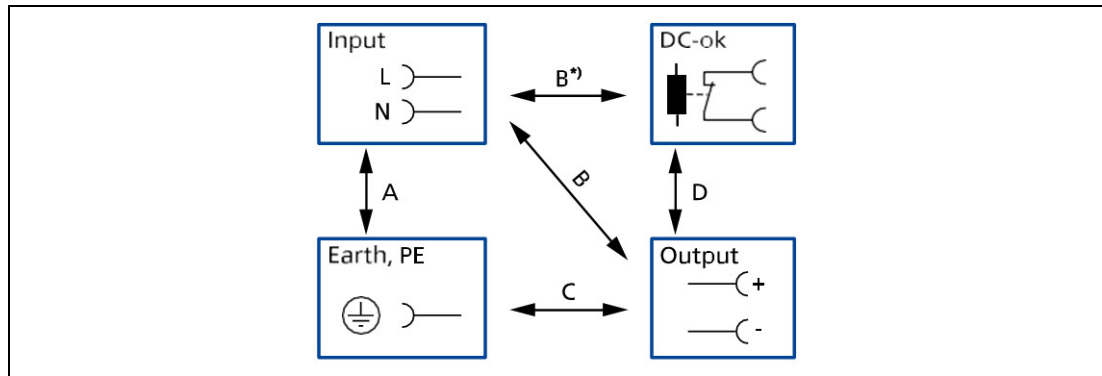


Figure 22.1 Dielectric strength

B\*) When testing input to DC-OK ensure that the max. voltage between DC-OK and the output is not exceeded (column D). We recommend connecting DC-OK pins and the output pins together when performing the test.

		<b>A</b>	<b>B</b>	<b>C</b>	<b>D</b>
Type test	60s	2 500Vac	4 000Vac	1 000Vac	500Vac
Factory test	5s	2 500Vac	2 500Vac	500Vac	500Vac
Field test	5s	2 000Vac	2 000Vac	500Vac	500Vac
Cut-off current setting		> 10mA	> 10mA	> 20mA	> 1mA



## 23 Approvals And Fulfilled Standards

UL 61010



UL Certificate  
Listed equipment for category NMTR - UL 61010-2-201  
Electrical Equipment for Measurement, Control and  
Laboratory Use - Particular requirements for control  
equipment  
Applicable for US and Canada  
E-Files: E350173 , E223176

---

EN 60079-0:2012+A11:2013,  
EN 60079-7:2015+A1:2018,  
EN 60079-15:2010



ATEX certificate: EPS 15 ATEX 1101 X  
ATEX marking: Ex II 3G Ex ec nC II T4 Gc

---






IEC 60079-0:2011,  
IEC 60079-7:2015,  
IEC 60079-15:2010



IECEx certificate: IECEx EPS 20.0055X  
IECEx marking: Ex ec nC IIC T4 Gc

---

## 24 Regulatory Compliance

EU Declaration of Conformity		<p>The CE mark indicates conformance with the European</p> <ul style="list-style-type: none"> <li>• ATEX directive</li> <li>• EMC directive</li> <li>• Low-voltage directive (LVD)</li> <li>• RoHS directive</li> </ul>
WEEE Directive		<p>Manufacturer's Statement EU-Regulation on Waste Electrical and Electronic Equipment Registered in Germany as business to business (B2B) products.</p>
REACH Directive		<p>Manufacturer's Statement EU-Regulation regarding the Registration, Evaluation, Authorization and Restriction of Chemical</p>
RoHS-China		<p>Manufacturer's Statement Administrative Measures for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products 25 years</p>
EAC TR Registration		<p>EAC Certificate EAC EurAsian Conformity Registration Russia, Kazakhstan and Belarus</p>

## 25 Physical Dimensions and Weight

Width	39mm, 1.54 inch
Height	124mm, 4.88 inch, without plug connectors
Depth	117mm, 4.61 inch, without plug connectors The DIN mounting rail height must be added to the unit depth to calculate the total required installation depth.
Weight	600g/1.3lb
DIN mounting rail	Use 35mm DIN mounting rails according to EN 60715 or EN 50022 with a height of 7.5 or 15mm.
Housing material	Body: Aluminium alloy Cover: zinc-plated steel
Installation instructions	See chapter 4.
Penetration protection	Small parts like screws, nuts, etc. with a diameter larger than 4mm

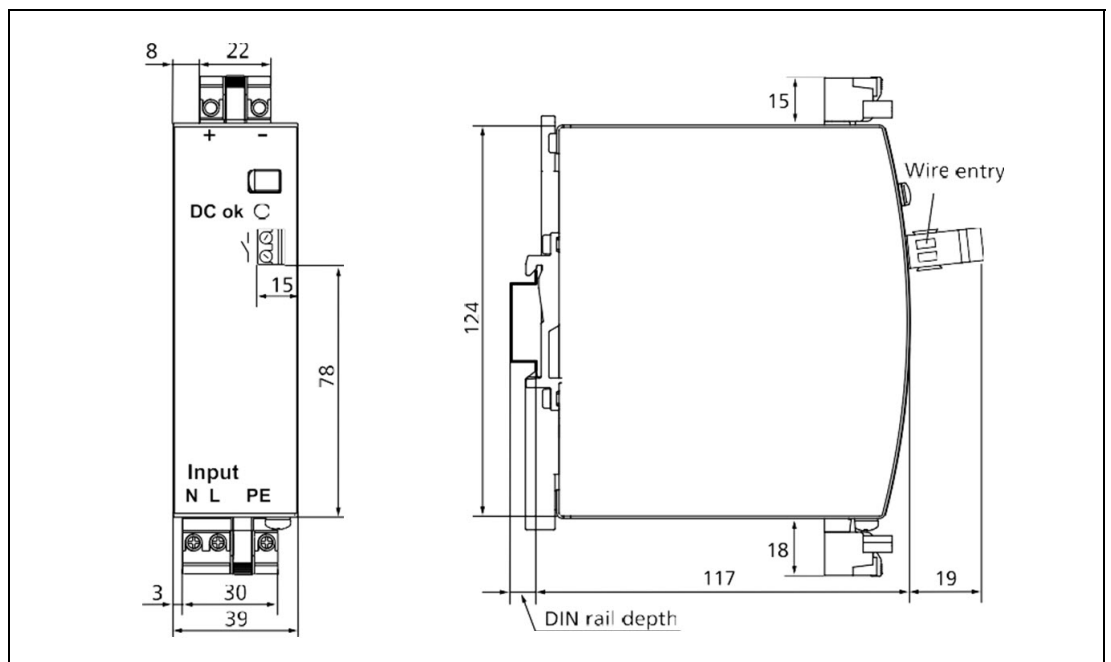


Figure 25.1 Device dimensions, all dimensions in mm

## 26 Application Notes

### 26.1 Peak Current Capability

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

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

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

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

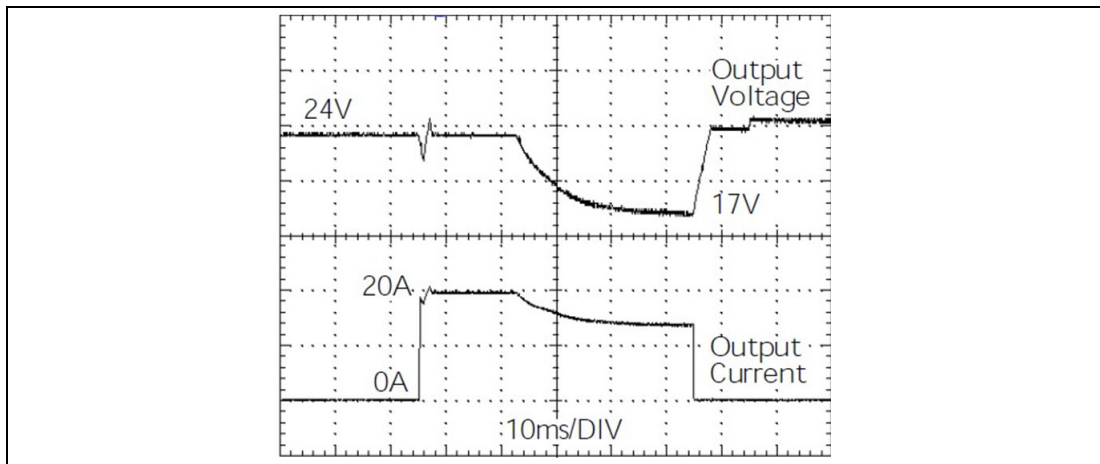


Figure 26.1 20A peak current for 50ms , typ. (2x the nominal current)

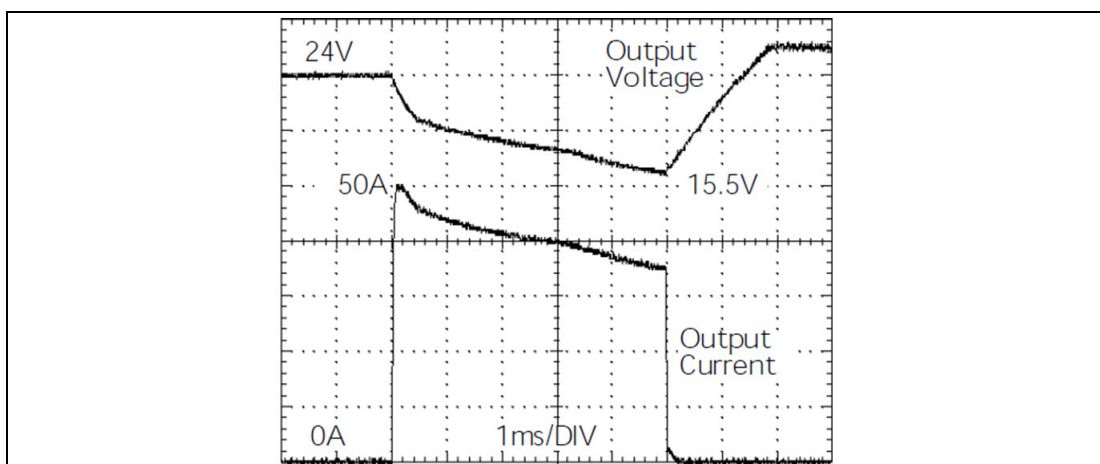


Figure 26.2 50A peak current for 5ms , typ. (5x the nominal current)

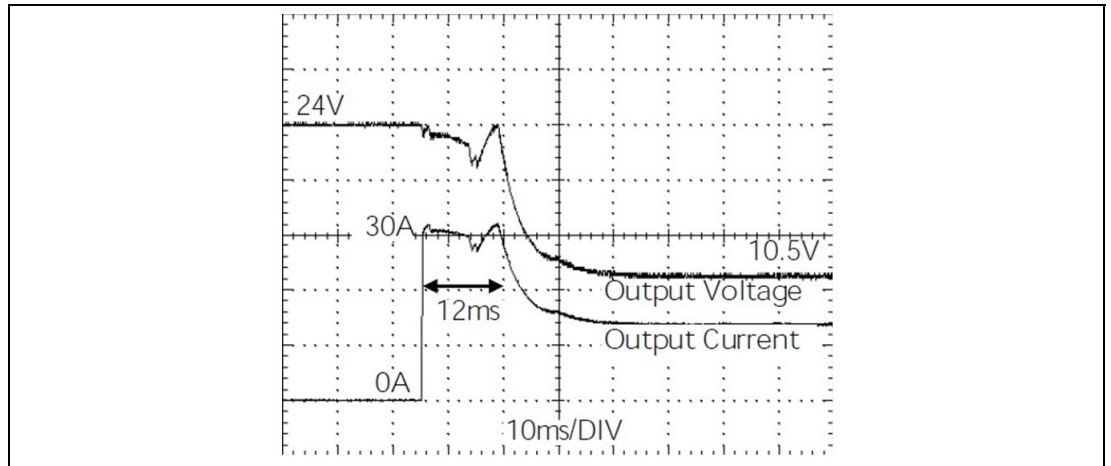


Figure 26.3 30A peak current for 12ms , typ. (3x the nominal current)



**Note**

The DC-OK relay triggers when the voltage dips more than 10% for longer than 1ms.

Peak current voltage dips	Typically from 24V to 17V at 20A for 50ms, resistive load Typically from 24V to 19V at 50A for 2ms, resistive load Typically from 24V to 15.5V at 50A for 5ms, resistive load
---------------------------	---

## 26.2 Adjusting the Output Voltage

A voltage adjustment potentiometer can be found behind the flap on the front of the unit, see chapter 18. However, it is not recommended to change the output voltage since load sharing between power supplies connected in parallel can only be achieved by a precise setting of the output voltages. The factory settings allow precise load sharing and only qualified personnel should change the adjustment potentiometer.

### Lower end of the specified adjustment range

Output voltage	nom.	24V	Due to the soft output voltage regulation characteristic (parallel mode feature) a setting to 24V results to an output voltage of $23.8V^{\pm 0.2\%}$ at 12A and $25.0V^{\pm 0.2\%}$ at no load. See Figure 26.4.
Output current	min.	12A	At +45°C
	min.	10A	At +60°C
	min.	7.5A	At +70°C

Reduce output current linearly between +45°C and +70°C

### Upper end of the specified adjustment range

Output voltage	nom.	27V	Due to the soft output voltage regulation characteristic (parallel mode feature) a setting to 27V results to an output voltage of $26.7V^{\pm 0.2\%}$ at 10.6A and $28.2V^{\pm 0.2\%}$ at no load. See Figure 26.4.
Output current	min.	10.6A	At +45°C
	min.	8.9A	At +60°C
	min.	6.7A	At +70°C

Reduce output current linearly between +45°C and +70°C

The maximum output voltage which can occur at the clockwise end position of the potentiometer due to tolerances is 30V. It is not a guaranteed value which can be achieved.

Current values between 24 and 27V can be interpolated.

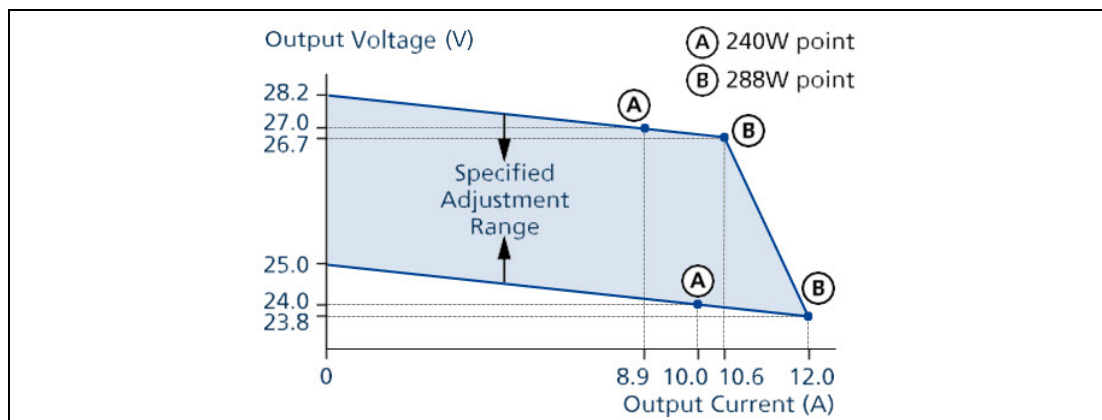


Figure 26.4 Adjustment range of the output voltage

The output voltage shall only be changed when absolutely necessary, e.g. for battery charging as described in the next chapter.

## 26.3 Output Circuit Breakers

Standard miniature circuit breakers (MCBs or UL 1077 circuit breakers) are commonly used for AC-supply systems and may also be used on 24V branches.

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

To avoid voltage dips and under-voltage situations in adjacent 24V branches which are supplied by the same source, a fast (magnetic) tripping of the MCB is desired.

A quick shutdown within 10ms is necessary corresponding roughly to the ride-through time of PLC's. This requires power supplies with high current reserves and large output capacitors. Furthermore, the impedance of the faulty branch must be sufficiently small in order for the current to actually flow. The best current reserve in the power supply does not help if Ohm's law does not permit current flow. The following table has typical test results showing which B- and C-Characteristic MCBs magnetically trip depending on the wire cross section and wire length.

Maximal wire length <sup>1</sup> for a 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>	30 m	37 m	54 m	84 m
<b>C-3A</b>	25 m	30 m	46 m	69 m
<b>C-4A</b>	9 m	15 m	25 m	34 m
<b>C-6A</b>	3 m	3 m	4 m	7 m
<b>C-8A</b>	–	–	–	–
<b>B-6A</b>	12 m	15 m	21 m	34 m
<b>B-10A</b>	3 m	3 m	4 m	9 m
<b>B-13A</b>	2 m	2 m	3 m	6 m

<sup>1</sup> Don't forget to consider twice the distance to the load (or cable length) when calculating the total wire length (+ and - wire).

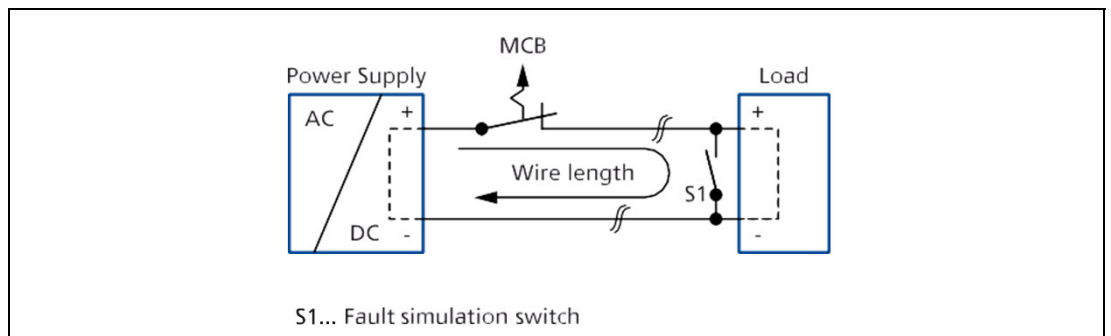


Figure 26.5 Test circuit

## 26.4 Parallel Use to Increase Output Power

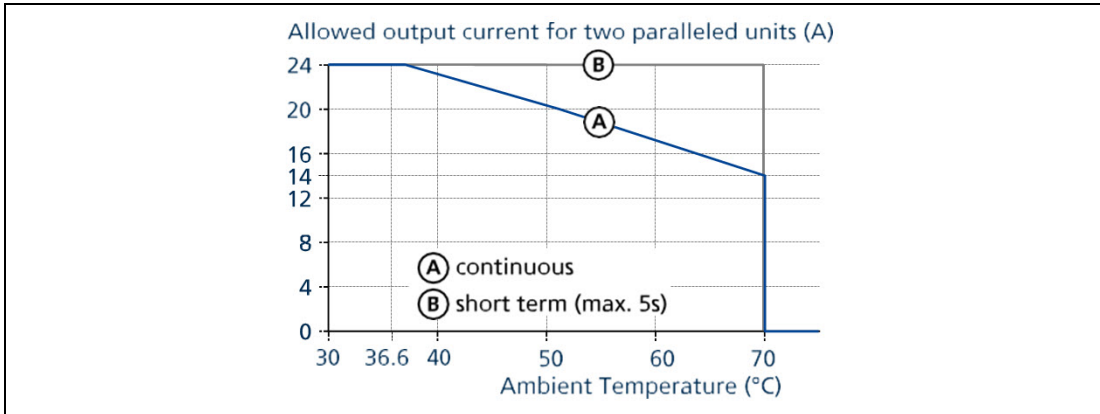


Figure 26.6 Output current vs. ambient temp. for two paralleled units

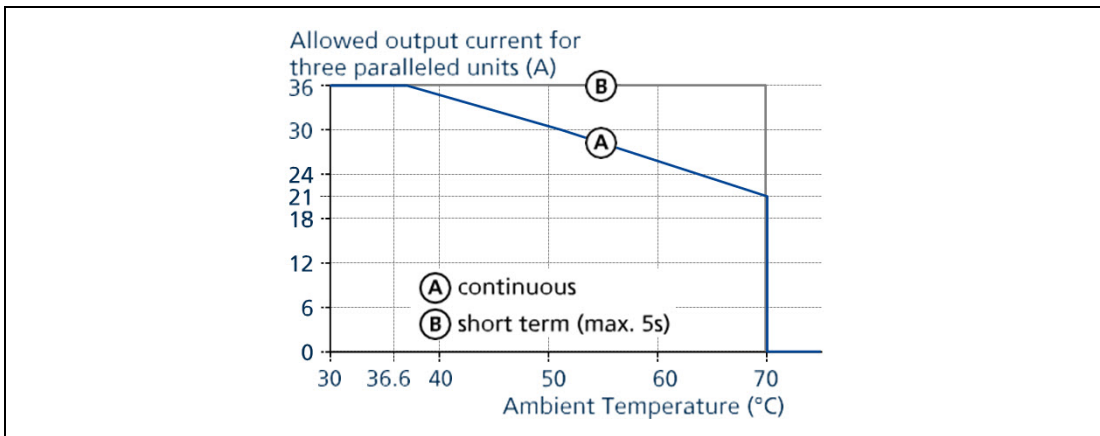


Figure 26.7 Output current vs. ambient temp. for three paralleled units



## 26.5 Parallel Use for Redundancy

Power supplies can be paralleled for redundancy to gain higher system availability. The unit is already equipped with a MOSFET as decoupling device on the output to avoid, that a faulty unit becomes a load for the other power supplies and the output voltage cannot be maintained any more.

### Recommendations for building redundant power systems:

- Use separate input fuses for each power supply.
- Monitor the individual power supply units by utilizing the built-in DC-OK relay contacts on each power supply.

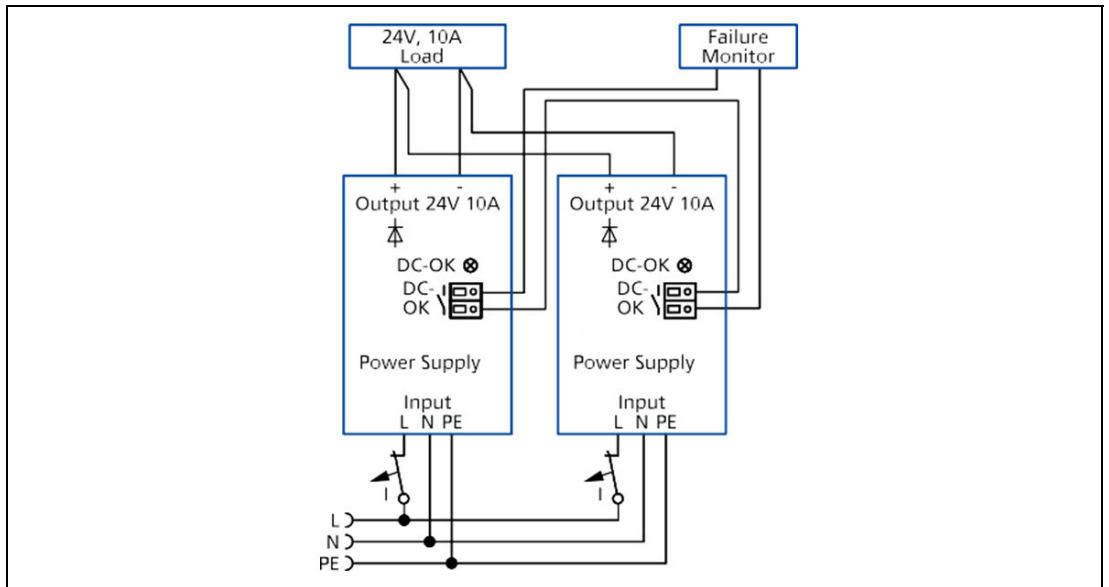


Figure 26.8 Wiring diagram, 1+1 Redundancy for 10A output current

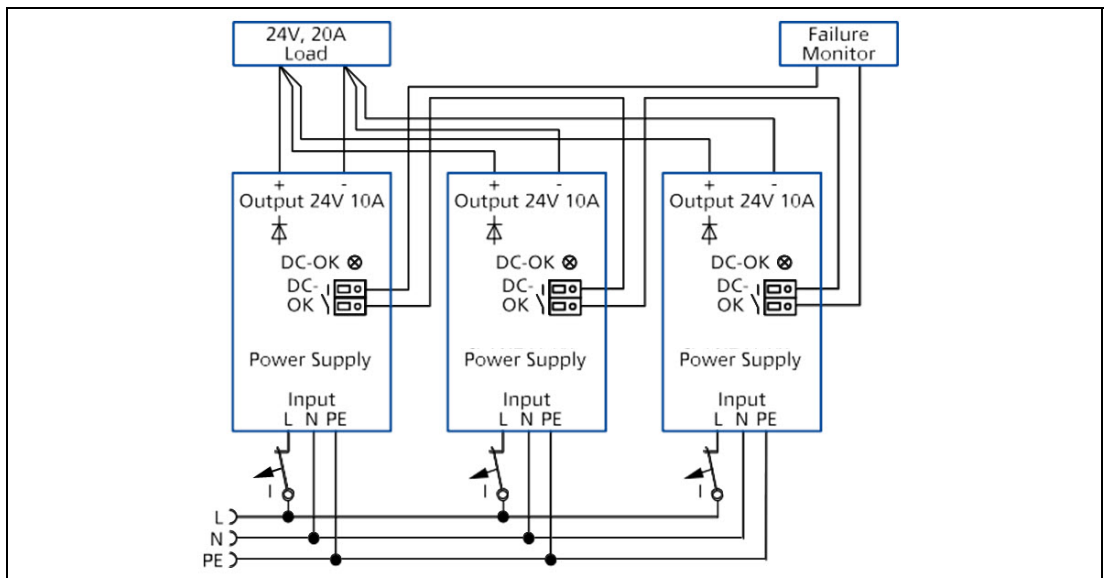


Figure 26.9 Wiring diagram, N+1 Redundancy for 20A output current



### Note

- Observe the temperature derating requirements of Figure 26.6 and Figure 26.7 for N+1 redundancy applications.
- Use separate mains systems for each power supply whenever it is possible.

## 26.6 Series Operation

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

Earthing of the output is required when the sum of the output voltage is above 60Vdc.

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

### Restrictions

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

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

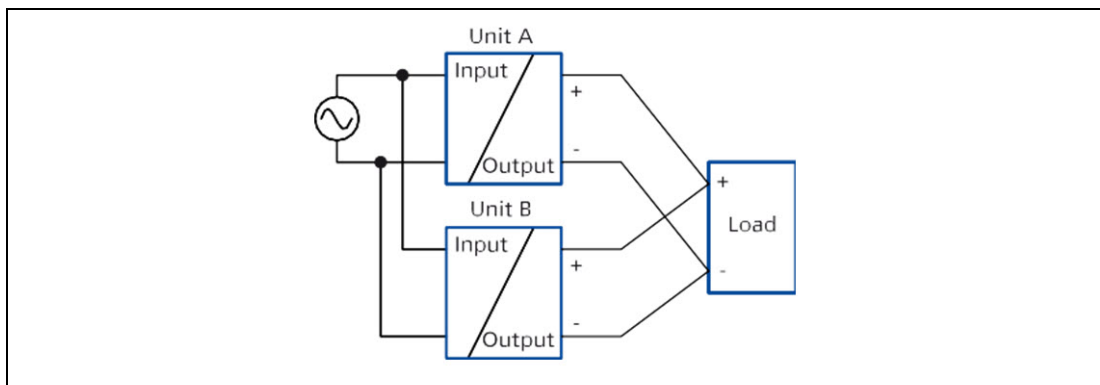


Figure 26.10 Series operation

## 26.7 Charging of Batteries

This redundancy power supply is ideal for charging batteries due to the decoupling circuit built in to the output stage which does not require a fuse or diode between the power supply and the battery.

It can be used to charge sealed lead acid (SLA) or valve regulated lead acid (VRLA) lead batteries when following these instructions:

### Charging Batteries

1. Set output voltage (measured at no load and at the battery end of the cable) very precisely to the end-of-charge voltage, see table below.
2. Ensure that the output current of the power supply is below the allowed charging current of the battery.
3. Use only matched batteries when putting 12V types in series.
4. The return current to the power supply (battery discharge current is typ. 3mA when the power supply is switched off (except in case a blocking diode is utilized)).

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

## 26.8 Two Phases Operation

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

The maximum allowed voltage between a Phase and the PE must be below 300Vac.

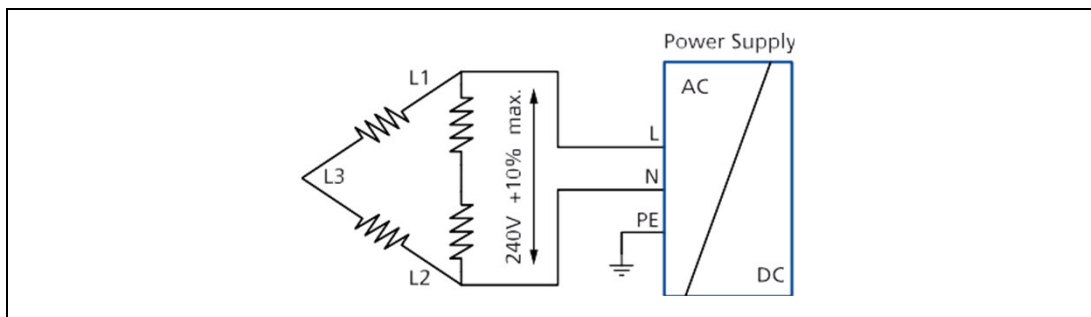


Figure 26.11 Two phases operation

## 26.9 Use in a Tightly Sealed Enclosure

When the power supply is installed in a tightly sealed enclosure, the temperature inside the enclosure will be higher than outside. In such situations, the inside temperature defines the ambient temperature for the power supply.

The power supply is placed in the middle of the box, no other heat producing items are inside the box.

The temperature sensor inside the box is placed in the middle of the right side of the power supply with a distance of 1cm. The following measurement results can be used as a reference to estimate the temperature rise inside the enclosure.

	<b>Case A</b>	<b>Case B</b>	<b>Case C</b>	<b>Case D</b>
Enclosure size	<b>110x180x165mm</b> Rittal Typ IP66 Box PK 9516 100, plastic	<b>110x180x165mm</b> Rittal Typ IP66 Box PK 9516 100, plastic	<b>180x180x165mm</b> Rittal Typ IP66 Box PK 9519 100, plastic	<b>180x180x165mm</b> Rittal Typ IP66 Box 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 box	45.4°C	49°C	42°C	44.4°C
Temperature outside the box	25°C	25°C	25°C	25°C
Temperature rise	20.4K	24K	17K	19.4K

## 26.10 Mounting Orientations

Mounting orientations other than all terminals on the bottom require a reduction in continuous output power or a limitation in the maximum allowed ambient temperature.

The amount of reduction influences the lifetime expectancy of the power supply. Therefore, two different derating curves for continuous operation can be found below:

**Curve A1** Recommended output current.

**Curve A2** Max allowed output current (results in approximately half the lifetime expectancy of A1).

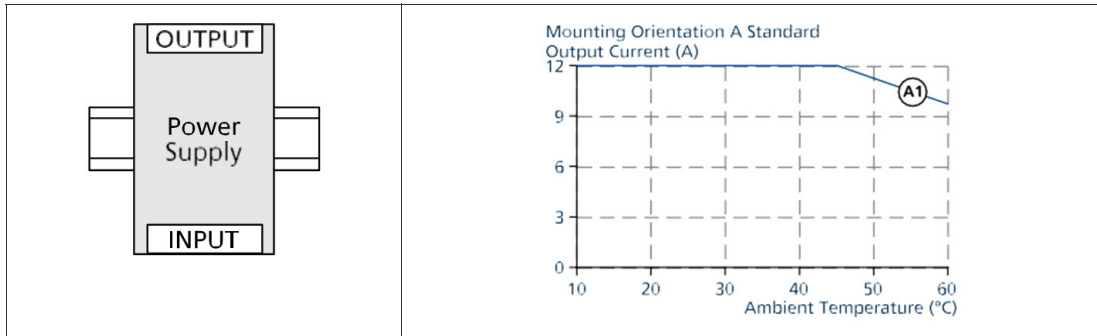


Figure 26.12 Mounting orientation A (standard orientation)

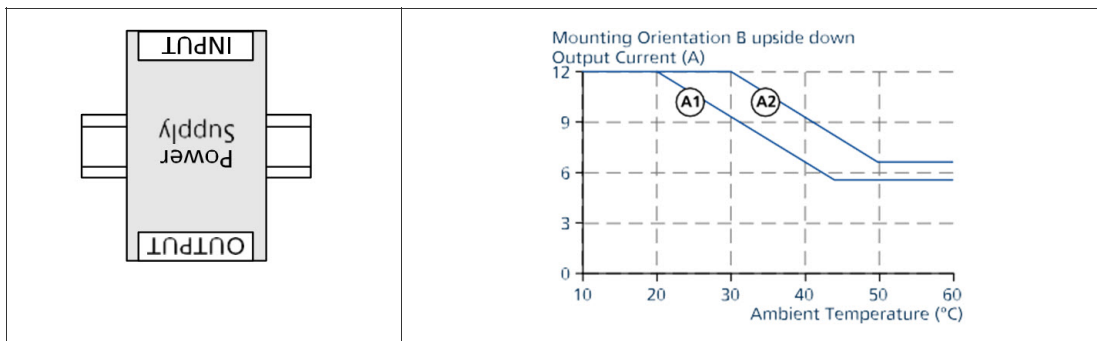


Figure 26.13 Mounting orientation B (upside down)

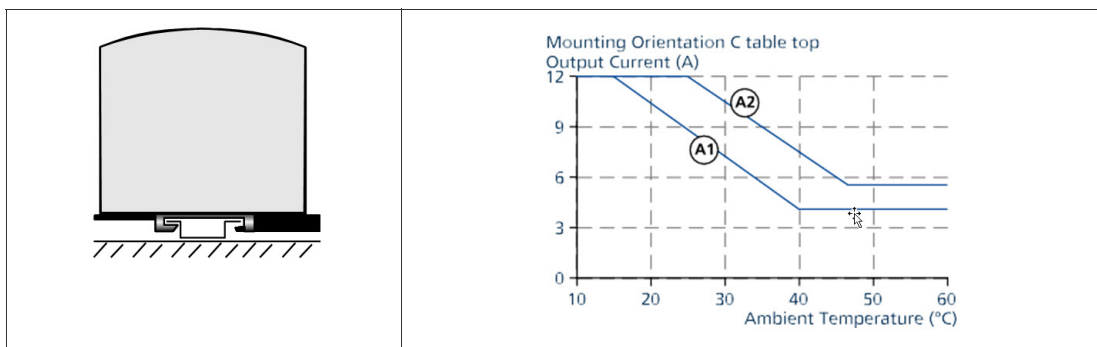


Figure 26.14 Mounting orientation C (table-top mounting)

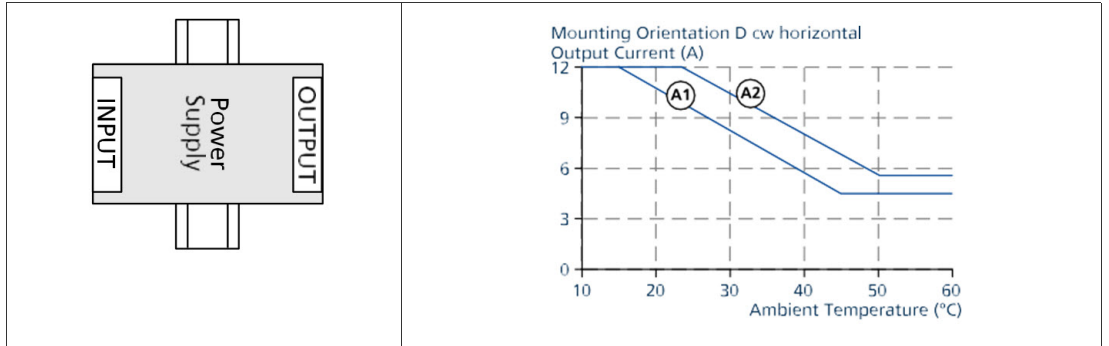


Figure 26.15 Mounting orientation D (horizontal cw)

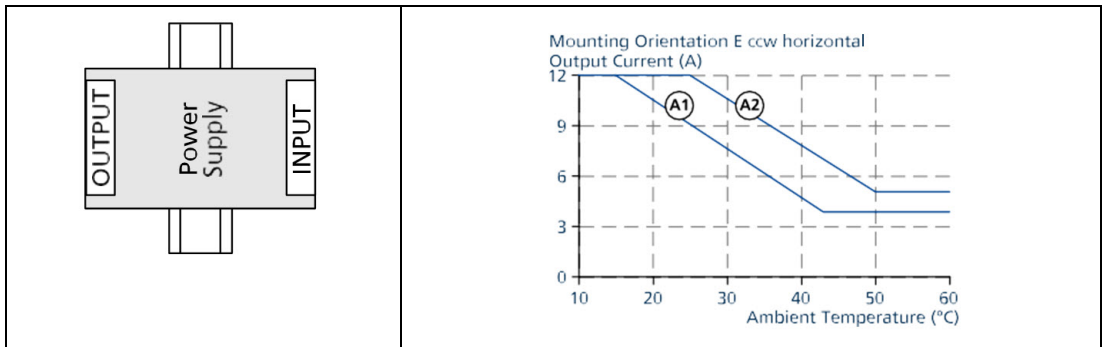


Figure 26.16 Mounting orientation E (horizontal ccw)

# Your automation, our passion.

## Explosion Protection

- Intrinsic Safety Barriers
- Signal Conditioners
- FieldConnex® Fieldbus
- Remote I/O Systems
- Electrical Ex Equipment
- Purge and Pressurization
- Industrial HMI
- Mobile Computing and Communications
- HART Interface Solutions
- Surge Protection
- Wireless Solutions
- Level Measurement

## Industrial Sensors

- Proximity Sensors
- Photoelectric Sensors
- Industrial Vision
- Ultrasonic Sensors
- Rotary Encoders
- Positioning Systems
- Inclination and Acceleration Sensors
- Fieldbus Modules
- AS-Interface
- Identification Systems
- Displays and Signal Processing
- Connectivity

### Pepperl+Fuchs Quality

Download our latest policy here:

[www.pepperl-fuchs.com/quality](http://www.pepperl-fuchs.com/quality)

