

PS1000-A6-24.5

Power Supply

Technical Information



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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).

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

PE and \oplus symbol	PE is the abbreviation for Protective Earth and has the same meaning as the symbol \oplus .
Earth, Ground	This document uses the term earth which is the same as the U.S. term ground .
T.b.d.	To be defined, value or description will follow later.
AC 230V	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)
230Vac	A figure with the unit (Vac) at the end is a momentary figure without any additional tolerances included.
50Hz vs. 60Hz	As long as not otherwise stated, AC 230V parameters are valid at 50Hz mains frequency.
may	A key word indicating flexibility of choice with no implied preference.
shall	A key word indicating a mandatory requirement.
should	A key word indicating flexibility of choice with a strongly preferred implementation.

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 and measurement equipment or the like.

Do not use this device in equipment where malfunction may cause severe personal injury or threaten human life.

Function

The device is used to supply field devices with 24 V DC and 5 A.

The device has a power reserve of 20 % included, which may even be used continuously at temperatures up to +45 °C.

The output voltage can be adjusted via a potentiometer. 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 typical values specified at 230Vac, 50Hz input voltage, 24V, 5A output load, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.

4 Installation Instructions



Warning!

Explosion hazard from live wiring of non-intrinsically safe circuits

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



Note

If you use the device in hazardous areas, observe the safety information in the instruction manual and in chapter 21.

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

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

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

Install the device in an enclosure providing protection against electrical, mechanical and fire hazards.

Install the device onto a DIN mounting 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 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. Use the terminal on the input block for earth connection and not one of the screws on the housing.

The device is suitable to be supplied from TN-, TT- and IT mains networks. The voltage between the L or N terminal and the PE terminal must not exceed 300Vac continuously.

The input can also be powered from batteries or similar DC sources. The voltage between the input terminal and the PE terminal must not exceed 360Vdc continuously.

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). See additional requirements in this document for use above 2000m (6560ft).

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 32A (IEC) and 30A (UL) 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.

5 AC Input

The device is suitable to be supplied from TN-, TT- and IT mains networks with AC voltage. For suitable DC supply voltages see chapter 4.

AC input	Nom.	AC 100-240V	
AC input range	Min.	85-264Vac	Continuous operation
	Min.	264-300Vac	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.	74Vac	Steady-state value, see Figure 5.1
External input protection	See recommendations in chapter 2		

		AC 100V	AC 120V	AC 230V	
Input current	Typ.	1.30A	1.09A	0.60A	At 24V, 5A, see Figure 5.3
Power factor	Typ.	0.99	0.98	0.91	At 24V, 5A, see Figure 5.4
Crest factor	Typ.	1.7	1.8	2.2	At 24V, 5A, The crest factor is the mathematical ratio of the peak value to RMS value of the input current waveform.
Start-up delay	Typ.	420ms	400ms	385ms	See Figure 5.2
Rise time	Typ.	80ms	85ms	90ms	At 24V, 5A const. current load, 0mF load capacitance, see Figure 5.2
	Typ.	100ms	100ms	110ms	At 24V, 5A const. current load, 5mF load capacitance, see Figure 5.2
Turn-on overshoot	Max.	200mV	200mV	200mV	See Figure 5.2

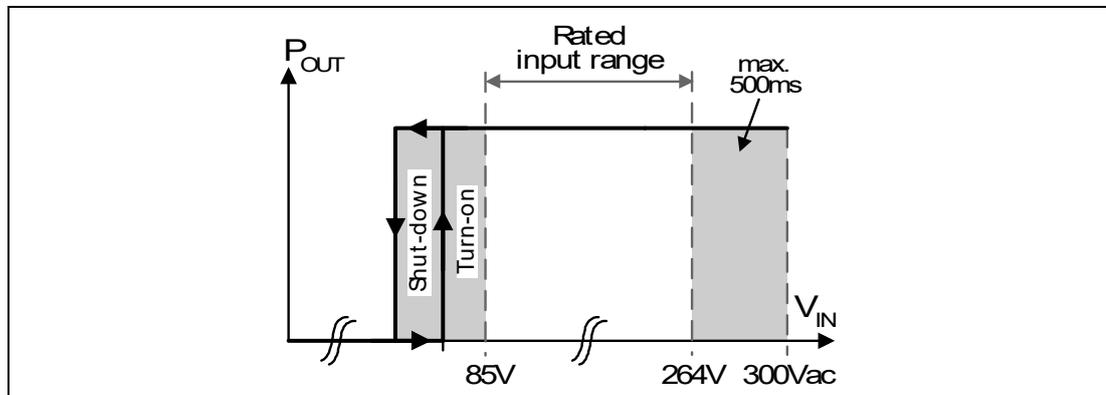


Figure 5.1 Input voltage range

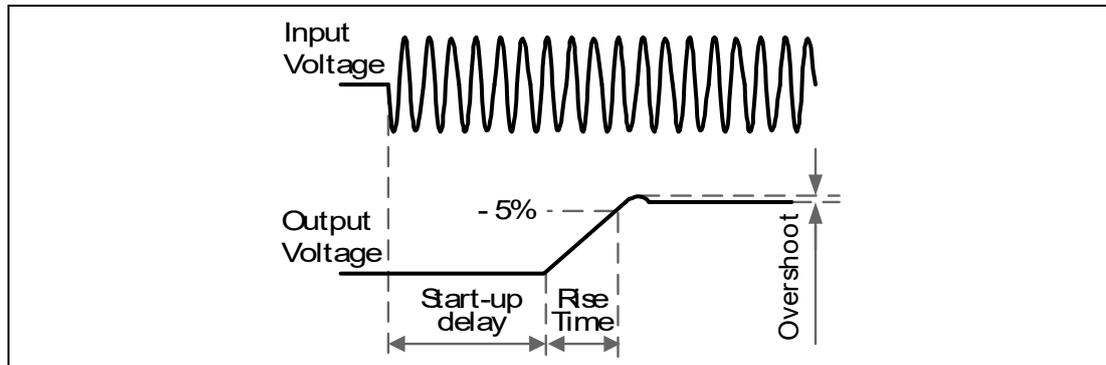


Figure 5.2 Turn-on behavior, definitions

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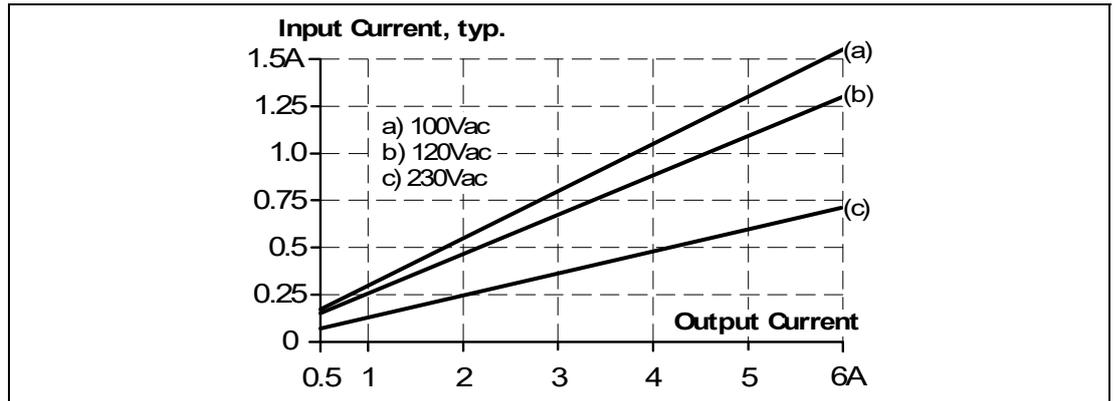


Figure 5.3 Input current vs. output current at 24V output voltage

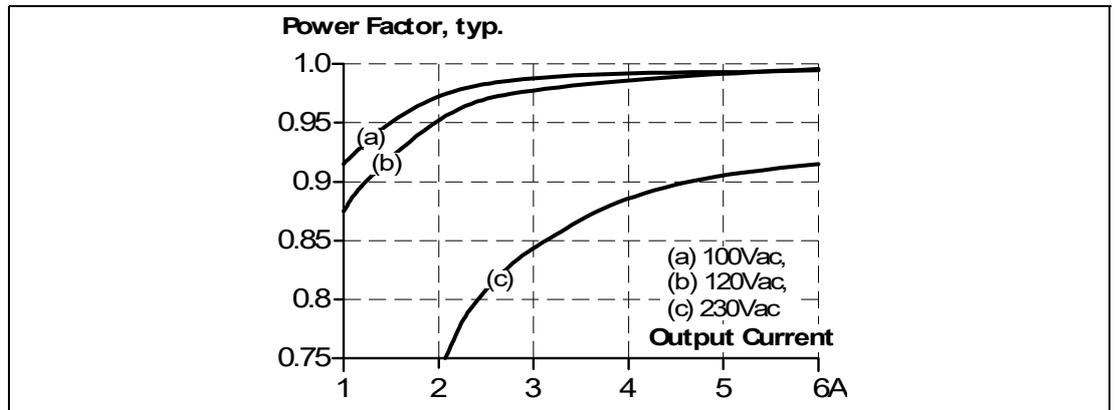


Figure 5.4 Power factor vs. output current at 24V output voltage

6 DC Input

The device is suitable to be supplied from a DC input voltage. Use a battery or a similar DC source. A supply from the intermediate DC-bus of a frequency converter is not recommended and can cause a malfunction or damage the unit.

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

DC input	Nom.	DC 110-150V	±20%
DC input range	Min.	88-180Vdc	Continuous operation
DC input current	Typ.	1.21A	At 110Vdc, at 24V, 5A
	Typ.	0.43A	At 300Vdc, at 24V, 5A
Allowed Voltage (+) or (-) input to Earth	Max.	360Vdc	Continuous according to IEC 60664-1
Turn-on voltage	Typ.	74Vdc	Steady state value
Shut-down voltage	Typ.	67Vdc	Steady state value

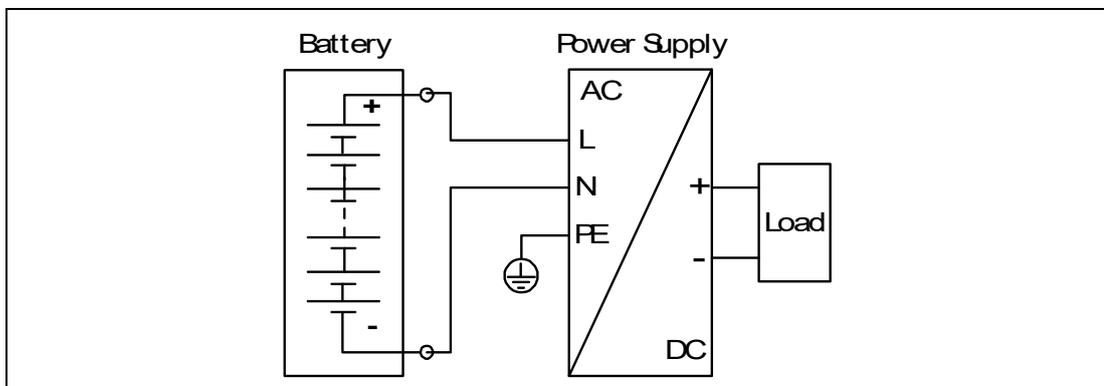


Figure 6.1 Wiring for DC Input

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	Max.	8A _{peak}	7A _{peak}	7A _{peak}	At 40°C, cold start
	Typ.	5A _{peak}	4A _{peak}	4A _{peak}	At 25°C, cold start
	Typ.	5A _{peak}	5A _{peak}	6A _{peak}	At 40°C, cold start
Inrush energy	Max.	0.4A ² s	0.5A ² s	1A ² s	At 40°C, cold start

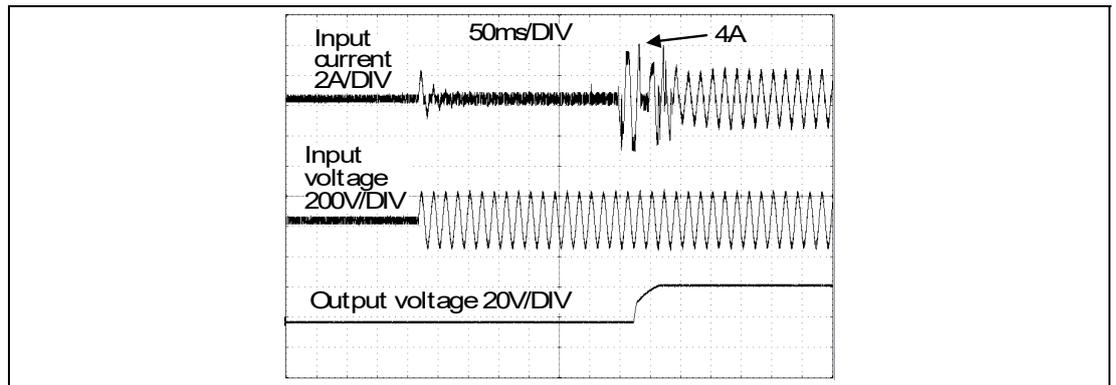


Figure 7.1 Typical turn-on behavior at nominal load, 120Vac input and 25°C ambient

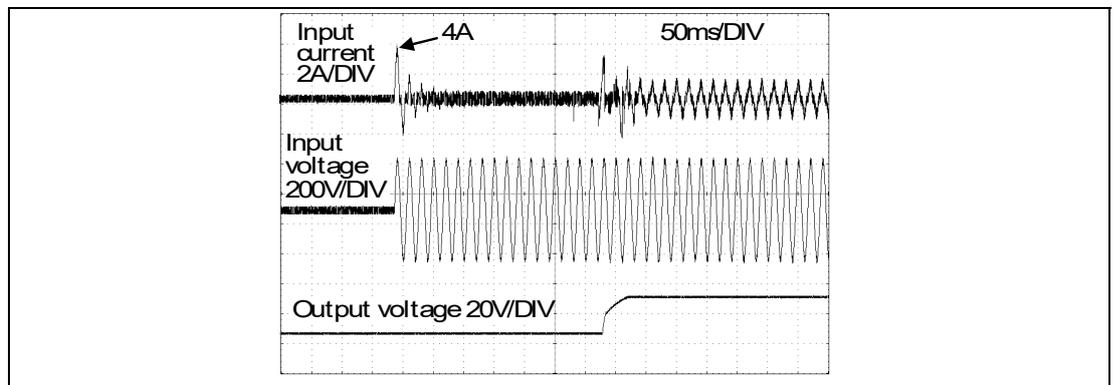


Figure 7.2 Typical turn-on behavior at nominal load, 230Vac input and 25°C ambient

8 Output

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

The output 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 > 0.3F are connected to the output, the unit might charge the capacitor in an intermittent mode.

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

Output voltage	Nom.	24V	
Adjustment range	Min.	24-28V	Guaranteed value
	Max.	30.0V	This is the maximum output voltage which can occur at the clockwise end position of the potentiometer due to tolerances. It is not a guaranteed value which can be achieved.
Factory settings	Typ.	24.1V	±0.2%, at full load and cold unit
Line regulation	Max.	10mV	Between 85 and 300Vac
Load regulation	Max.	50mV	Between 0A and 6A, static value, see Figure 8.1
Ripple and noise voltage	Max.	50mVpp	Load >0.2A, Bandwidth 20Hz to 20MHz, 50Ohm
	Max.	200mVpp	Load <0.2A, Bandwidth 20Hz to 20MHz, 50Ohm
Output current	Nom.	6A ¹	At 24V and an ambient temperatures below 45°C
	Nom.	5A	At 24V and 60°C ambient temperature
	Nom.	3.8A	At 24V and 70°C ambient temperature
	Nom.	5.1A ¹	At 28V and an ambient temperatures below 45°C
	Nom.	4.3A	At 28V and 60°C ambient temperature
	Nom.	3.2A	At 28V and 70°C ambient temperature
		Derate linearly between +45°C and +70°	
Fuse breaking current	Typ.	15A	Up to 12ms once every five seconds, see Figure 8.2. The fuse braking current is an enhanced transient current which helps to trip fuses on faulty output branches. The output voltage stays above 20V.
Overload behaviour	Continuous current		For output voltage above 13Vdc, see Figure 8.1
	Intermittent current ²		For output voltage below 13Vdc, see Figure 8.1
Overload/ short-circuit current	Max.	7.2A	Continuous current, see Figure 8.1
	Typ.	9A	Intermittent current peak value for typ. 1s Load impedance 50mOhm, see Figure 8.3 Discharge current of output capacitors is not included.
	Max.	3.5A	Intermittent current average value (R.M.S.) Load impedance 50mOhm, see Figure 8.3
Output capacitance	Typ.	2 000µF	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.

¹ 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.

² At heavy overloads (when output voltage falls below 13V), the power supply delivers continuous output current for 1s. After this, the output is switched off for approx. 9s 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.

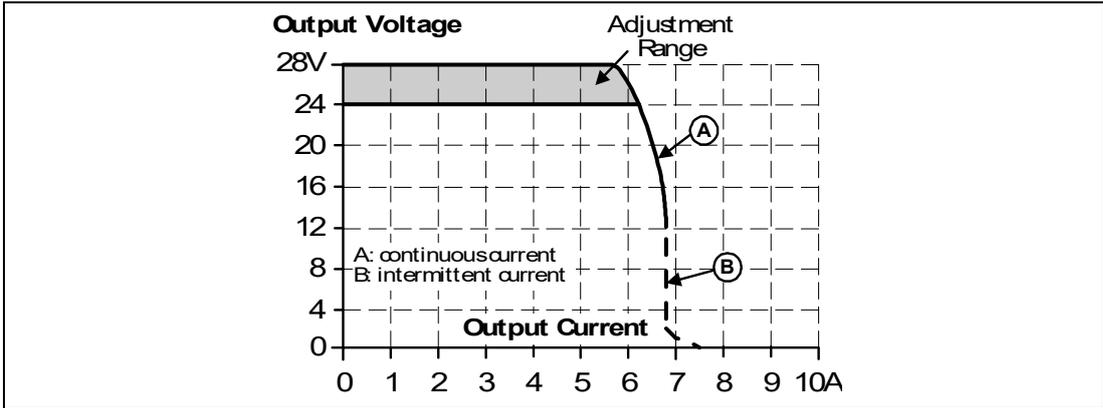


Figure 8.1 Output voltage vs. output current, typ.

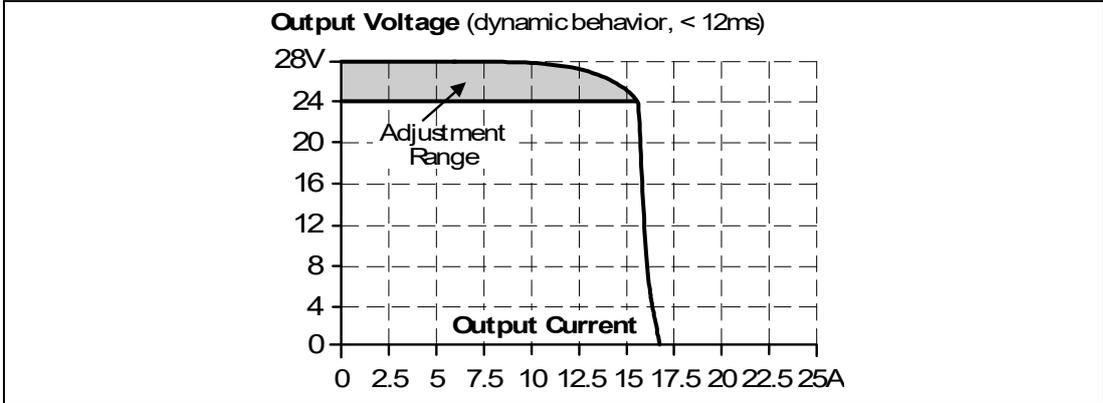


Figure 8.2 Dynamic output current capability, typ.

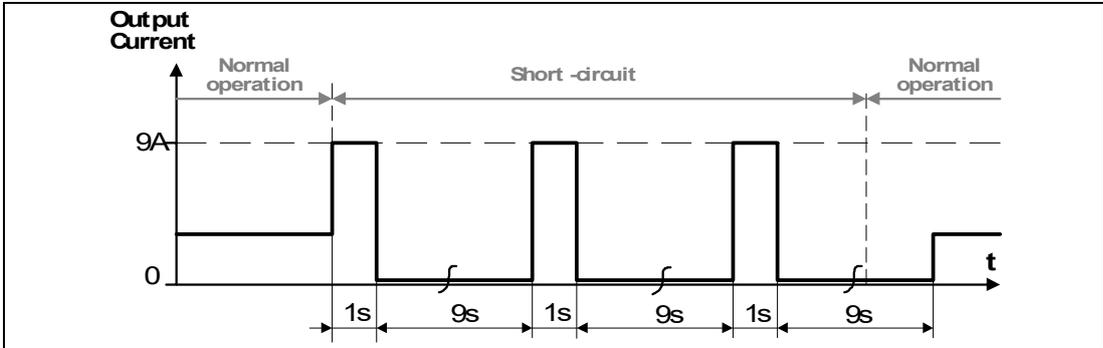


Figure 8.3 Short-circuit on output, Hiccup mode, typ.

9 Hold-Up Time

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

		AC 100V	AC 120V	AC 230V	
Hold-up Time	Typ.	70ms	70ms	70ms	At 24V, 2.5A, see Figure 9.1
	Min.	55ms	55ms	55ms	At 24V, 2.5A, see Figure 9.1
	Typ.	35ms	35ms	35ms	At 24V, 5A, see Figure 9.1
	Min.	27ms	27ms	27ms	At 24V, 5A, see Figure 9.1

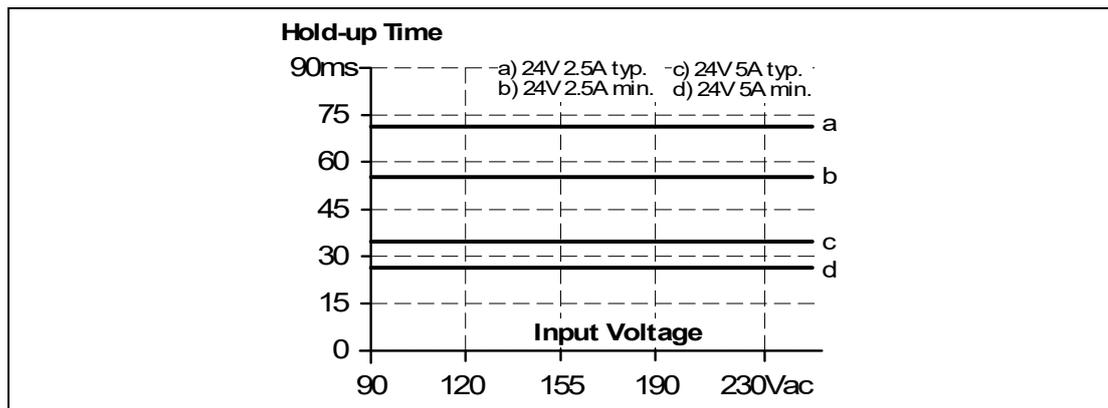


Figure 9.1 Hold-up time vs. input voltage

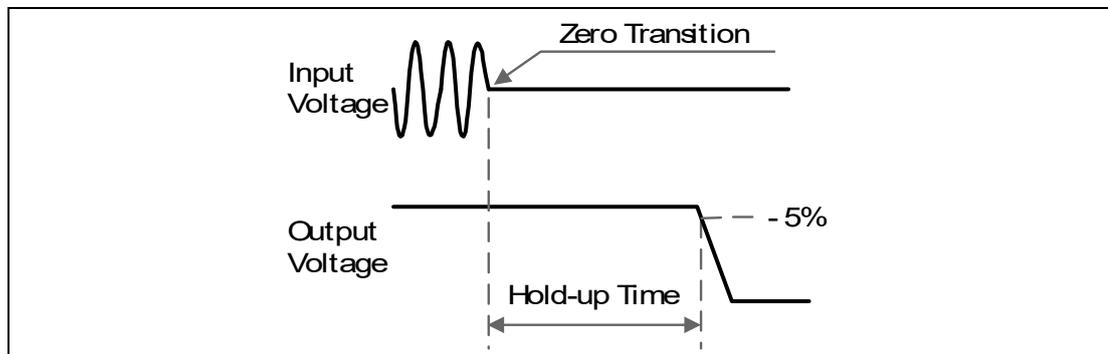


Figure 9.2 Shut-down behavior, definitions

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	Typically 0.7V
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 20.

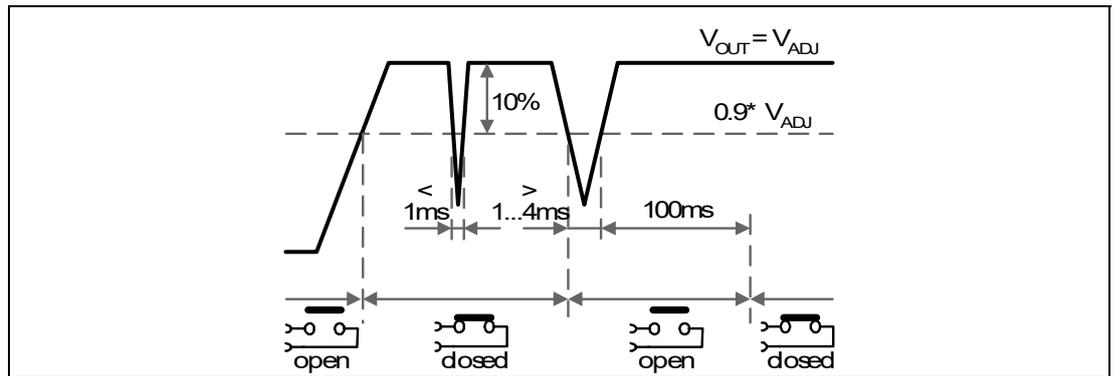


Figure 10.1 DC-OK relay contact behavior

11 Efficiency and Power Losses

		AC 100V	AC 120V	AC 230V	
Efficiency	Typ.	92.9%	93.6%	94.3%	At 24V, 5A
	Typ.	92.7%	93.5%	94.5%	At 24V, 6A (Power Boost)
Average efficiency ¹	Typ.	91.3%	91.7%	92.0%	25% at 1.25A, 25% at 2.5A, 25% at 3.75A, 25% at 5A
Power losses	Typ.	1.3W	1.3W	1.4W	At 24V, 0A
	Typ.	4.6W	4.4W	4.1W	At 24V, 2.5A
	Typ.	9.2W	8.2W	7.3W	At 24V, 5A
	Typ.	11.3W	9.8W	8.4W	At 24V, 6A (Power Boost)

¹ 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.

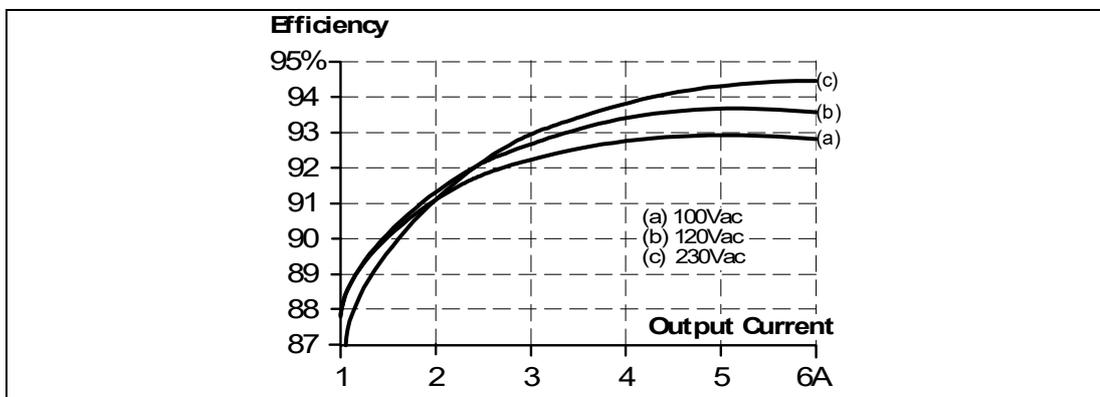


Figure 11.1 Efficiency vs. output current at 24V, typ.

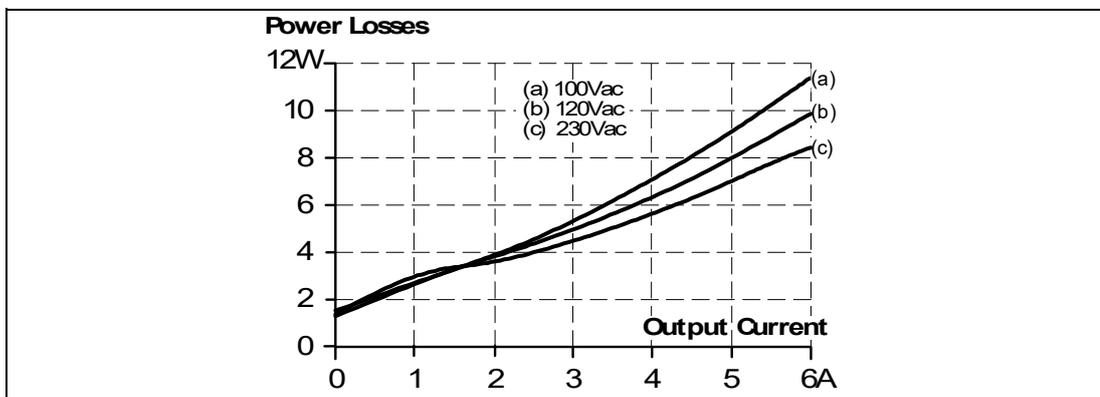


Figure 11.2 Losses vs. output current at 24V, typ.

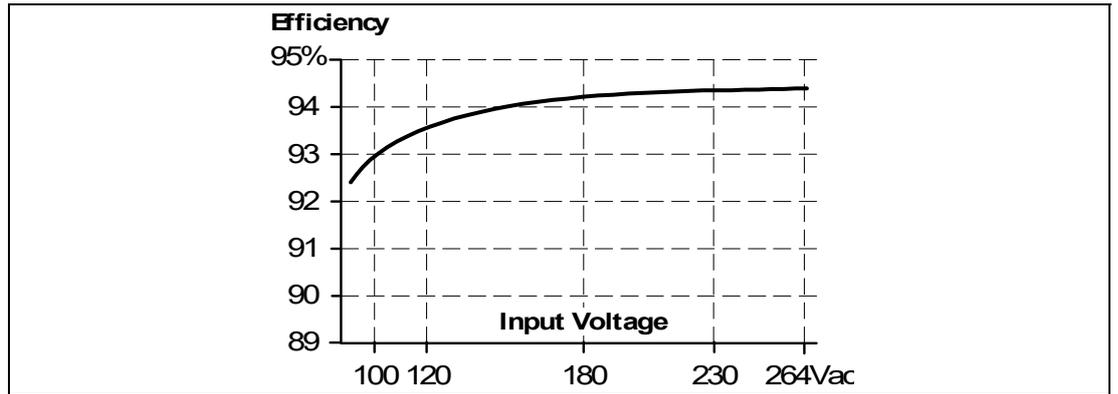


Figure 11.3 Efficiency vs. input voltage at 24V, 5A, typ.

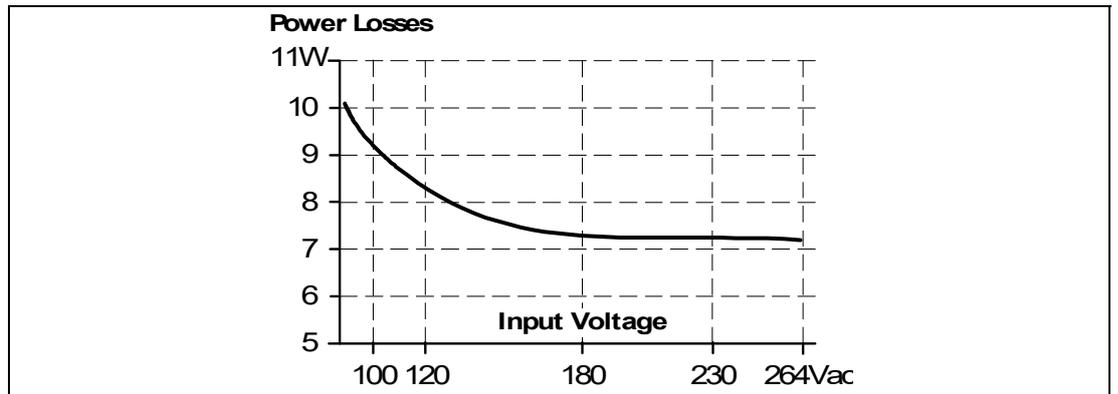


Figure 11.4 Losses vs. input voltage at 24V, 5A, typ.

12 Functional Diagram

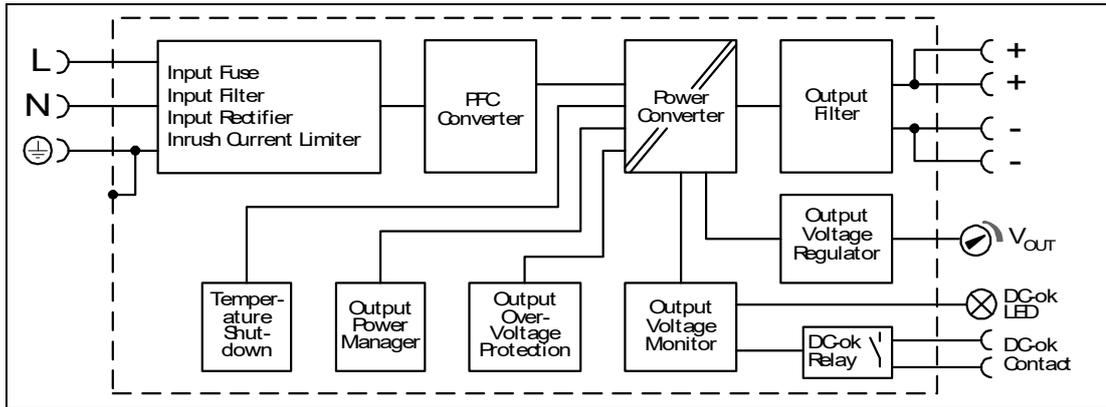
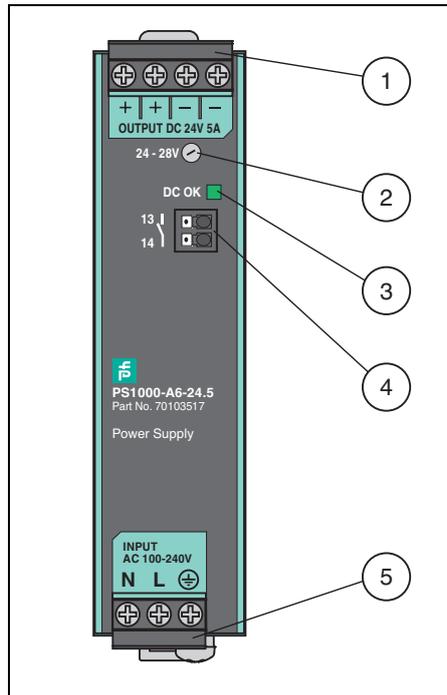


Figure 12.1 Functional diagram

13 Front Side and User Elements



- 1 Output Terminals**
Two identical +poles and two identical -poles
+ Positive output
- Negative (return) output
- 2 Output Voltage Potentiometer**
- 3 DC-OK LED (green)**
On, when the output voltage is >90% of the adjusted output voltage
- 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

Figure 13.1 Front side

14 Connection Terminals

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

	Input	Output	DC-OK-Signal
Type	Screw termination	Screw termination	Push-in termination
Solid wire	Max. 6mm ²	Max. 6mm ²	Max. 1.5mm ²
Stranded wire	Max. 4mm ²	Max. 4mm ²	Max. 1.5mm ²
American Wire Gauge	AWG 20-10	AWG 20-10	AWG 24-16
Max. wire diameter (including ferrules)	2.8mm	2.8mm	1.6mm
Recommended tightening torque	Max. 1Nm, 9lb-in	Max. 1Nm, 9lb-in	–
Wire stripping length	7mm / 0.28inch	7mm / 0.28inch	7mm / 0.28inch
Screwdriver	3.5mm slotted or cross-head No 2	3.5mm slotted or cross-head No 2	3mm slotted to open the spring

Daisy chaining:

Daisy chaining (jumping from one power supply output to the next) is allowed as long as the average output current through one terminal pin does not exceed 25A. If the current is higher, use a separate distribution terminal block as shown in Figure 14.2.

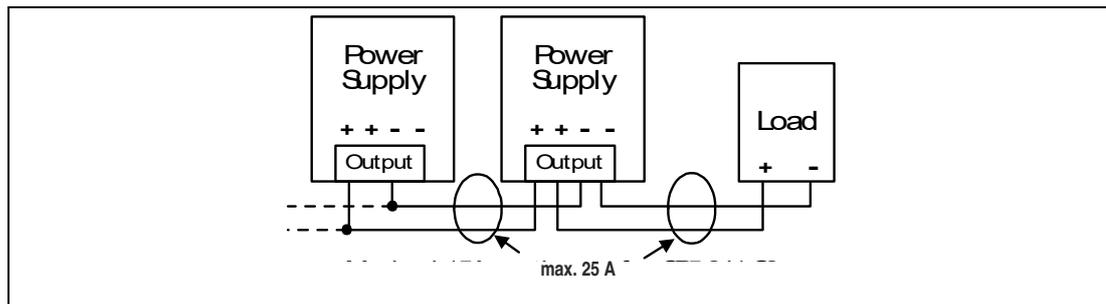


Figure 14.1 Daisy chaining of outputs

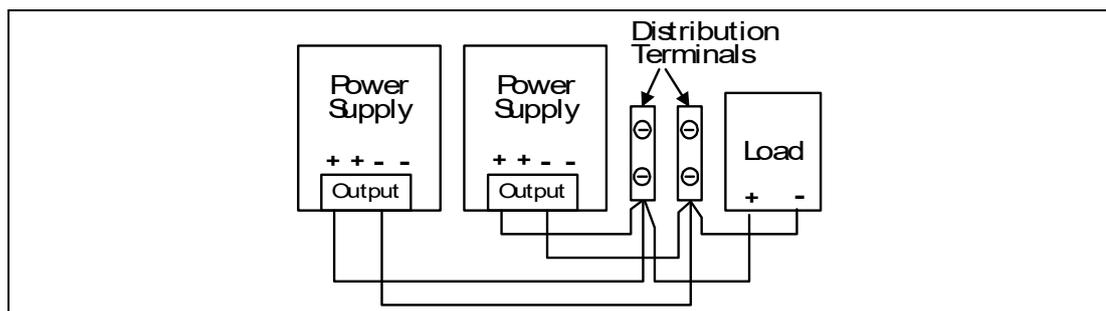


Figure 14.2 Using distribution terminals

15 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.

	AC 100V	AC 120V	AC 230V	
Lifetime expectancy	265 000h	270 000h	274 000h	At 24V, 2.5A and 40°C
	748 000h	764 000h	775 000h	At 24V, 2.5A and 25°C
	128 000h	143 000h	166 000h	At 24V, 5A and 40°C
	363 000h	405 000h	469 000h	At 24V, 5A and 25°C
	81 000h	96 000h	119 000h	At 24V, 6A and 40°C
	228 000h	271 000h	336 000h	At 24V, 6A and 25°C

16 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 can not 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.

	AC 100V	AC 120V	AC 230V	
MTBF SN 29500, IEC 61709	800 000h	807 000h	867 000h	At 24V, 5A and 40°C
	1 402 000h	1 414 000h	1 510 000h	At 24V, 5A and 25°C
MTBF MIL HDBK 217F	339 000h	343 000h	368 000h	At 24V, 5A and 40°C; Ground Benign GB40
	490 000h	496 000h	529 000h	At 24V, 5A and 25°C; Ground Benign GB25
	81 000h	83 000h	89 000h	At 24V, 5A and 40°C; Ground Fixed GF40
	109 000h	111 000h	119 000h	At 24V, 5A and 25°C; Ground Fixed GF25

17 EMC

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

The device is investigated according to EN 61000-6-1, EN 61000-6-2, EN 61000-6-3 and EN 61000-6-4.

EMC Immunity

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 40% of 200Vac 70% of 200Vac	0Vac, 20ms 40Vac, 200ms 70Vac, 500ms 0Vac, 20ms 80Vac, 200ms, <4A 80Vac, 200ms, >4A 140Vac, 500ms	Criterion A Criterion C Criterion A Criterion A Criterion A Criterion C Criterion A
Voltage interruptions	EN 61000-4-11	0% of 200Vac (=0V)	5000ms	Criterion C
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. Power supply may shut-down and restarts by itself. No damage or hazards for the power supply will occur.

EMC Emission

According to the generic standards EN 61000-6-3 and EN 61000-6-4.

Conducted emission input lines	EN 55011, EN 55022, FCC Part 15, CISPR 11, CISPR 22	Class B
Conducted emission output lines	IEC/CISPR 16-1-2, IEC/CISPR 16-2-1	Limits for local DC power networks fulfilled
Radiated emission	EN 55011, EN 55022	Class B
Harmonic input current (PFC)	EN 61000-3-2	Fulfilled for Class A equipment
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	30kHz to 140kHz	Input voltage and output load dependent
Main converter	60kHz to 140kHz	Output load dependent
Auxiliary converter	30kHz to 60kHz	Output load dependent

18 Environment

Operational temperature	-25°C to +70°C (-13°F to 158°F)	Operational temperature is the same as the ambient or surrounding temperature and is defined as the air temperature 2cm below the unit.
Storage temperature	-40°C to +85°C (-40°F to 185°F)	For storage and transportation
Output de-rating	1.6W/°C 3W/°C 0.33A/1000m or 5°C/1000m	Between +45°C and +60°C (113°F to 140°F) Between +60°C and +70°C (140°F to 158°F) For altitudes >2000m (6560ft), see Figure 18.2 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.
Humidity	5 to 95% r.h.	According to IEC 60068-2-30
Atmospheric pressure	110-54kPa	See Figure 18.2 for details
Altitude	Up to 5000m (16 400ft)	See Figure 18.2 for details
Over-voltage category	III II	According to IEC 60664-1 for altitudes up to 2000m According to IEC 60664-1, for altitudes above 2000m
Degree of pollution	2	According to IEC 62477-1, not conductive
Vibration sinusoidal	2-17.8Hz: ±1.6mm; 17.8-500Hz: 2g 2 hours / axis	According to IEC 60068-2-6
Shock	30g 6ms, 20g 11ms 3 bumps per direction, 18 bumps in total	According to IEC 60068-2-27 Shock and vibration is tested in combination with DIN mounting rails according to EN 60715 with a height of 15mm and a thickness of 1.3mm and standard orientation.
LABS compatibility	As a rule, only non-silicon precipitating materials are used. The unit conforms to the LABS criteria and is suitable for use in paint shops.	
Corrosive gases	Tested according to ISA-71.04-1985, Severity Level G3 and IEC 60068-2-60 Test Ke Method 4 for a service life of minimum 10years in these environments.	
Audible noise	Some audible noise may be emitted from the power supply during no load, overload or short circuit.	

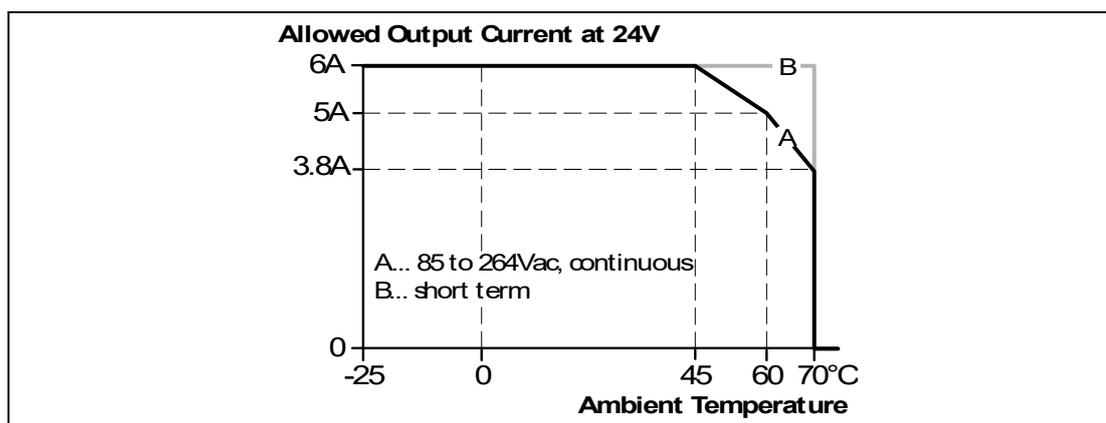


Figure 18.1 Output current vs. ambient temp.

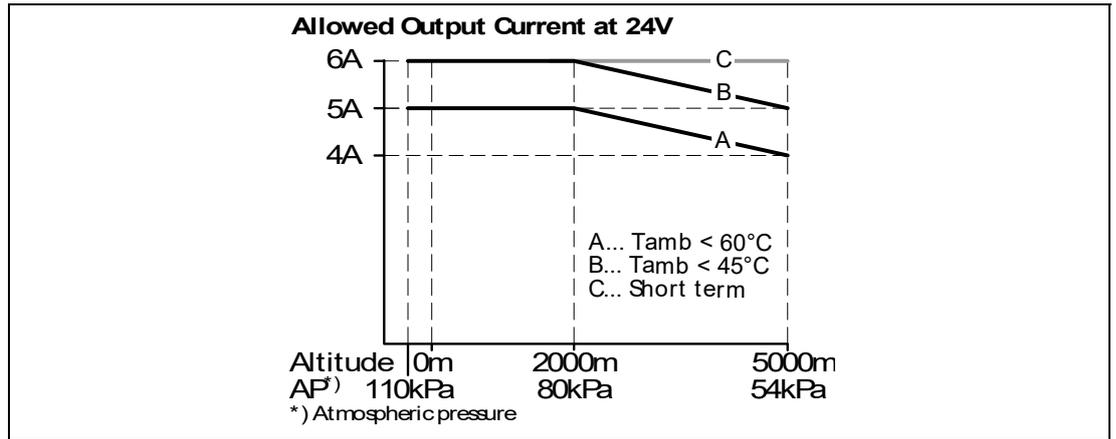


Figure 18.2 Output current vs. altitude

19 Safety and Protection Features

Isolation resistance	Min.	500MΩ	At delivered condition between input and output, measured with 500Vdc
	Min.	500MΩ	At delivered condition between input and PE, measured with 500Vdc
	Min.	500MΩ	At delivered condition between output and PE, measured with 500Vdc
	Min.	500MΩ	At delivered condition between output and DC-OK contacts, measured with 500Vdc
PE resistance	Max.	0.1Ω	Resistance between PE terminal and the housing in the area of the DIN mounting rail mounting bracket.
Output over-voltage protection	Typ.	30.5Vdc	In case of an internal defect, a redundant circuit limits the maximum output voltage. The output shuts down and automatically attempts to restart.
	Max.	32.0Vdc	
Class of protection		I	According to IEC 61140 A PE (Protective Earth) connection is required
Degree of protection		IP 20	According to EN/IEC 60529
Over-temperature protection		Included	Output shut-down with automatic restart. Temperature sensors are installed on critical components inside the unit and turn the unit off in safety critical situations, which can happen e.g. when ambient temperature is too high, ventilation is obstructed or the de-rating requirements are not followed. There is no correlation between the operating temperature and turn-off temperature since this is dependent on input voltage, load and installation methods.
Input transient protection		MOV (Metal Oxide Varistor)	For protection values see chapter 17 (EMC).
Internal input fuse		Included	Not user replaceable slow-blow high-braking capacity fuse
Touch current (leakage current)	Typ.	0.10mA / 0.27mA	At 100Vac, 50Hz, TN-, TT-mains / IT-mains
	Typ.	0.13mA / 0.38mA	At 120Vac, 60Hz, TN-, TT-mains / IT-mains
	Typ.	0.20mA / 0.60mA	At 230Vac, 50Hz, TN-, TT-mains / IT-mains
	Max.	0.13mA / 0.35mA	At 110Vac, 50Hz, TN-, TT-mains / IT-mains
	Max.	0.17mA / 0.51mA	At 132Vac, 60Hz, TN-, TT-mains / IT-mains
	Max.	0.27mA / 0.81mA	At 264Vac, 50Hz, TN-, TT-mains / IT-mains

20 Dielectric Strength

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

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

Type and routine tests are conducted by the manufacturer. Field tests may be conducted in the field using the appropriate test equipment which applies the voltage with a slow ramp (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.

		A	B	C	D
Type test	60s	2500Vac	3000Vac	1000Vac	500Vac
Routine test	5s	2500Vac	2500Vac	500Vac	500Vac
Field test	5s	2000Vac	2000Vac	500Vac	500Vac
Field test cut-off current settings		> 10mA	> 10mA	> 20mA	> 1mA

B*

When testing input to DC-OK ensure that the maximal 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.

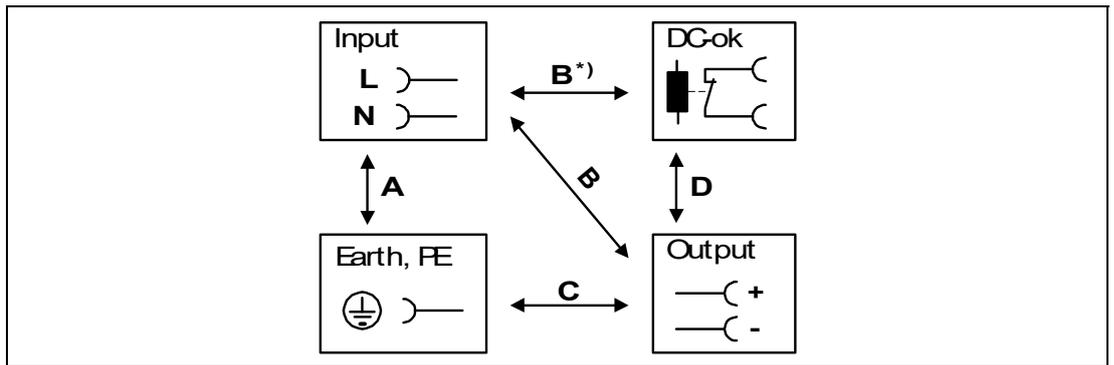


Figure 20.1 Dielectric strength

21 Approvals and Fulfilled Standards

UL 61010-2:201 (former UL 508)	 Ind. Cont. Eq.	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 19 ATEX 1201 X ATEX marking: Ⓜ II 3G Ex ec nC II T4 Gc
IEC 60079-0:2017, IEC 60079-7:2017, IEC 60079-15:2017		IECEX certificate: IECEX EPS 20.0058X IECEX marking: Ex ec nC IIC T4 Gc
EAC		EAC Certificate EAC EurAsian Conformity Registration Russia, Kazakhstan and Belarus

22 Regulatory Compliance

CE



EU Declaration of Conformity
Trade conformity assessment for Europe
The CE mark indicates conformance with the European

- ATEX directive
- EMC directive
- Low-voltage directive (LVD)
- RoHS directive

REACH Directive



Manufacturer's Statement
EU-Regulation regarding the Registration, Evaluation, Authorisation and Restriction of Chemicals

WEEE Directive



Manufacturer's Statement
EU-Directive on Waste Electrical and Electronic Equipment

RoHS-China



Manufacturer's Statement
Administrative Measures for the Restriction of the Use of Hazardous Substances in Electrical and Electronic Products 25 years

23 Physical Dimensions and Weight

Width	32mm, 1.26 inch
Height	124mm, 4.88 inch
Depth	102mm, 4.02 inch The DIN mounting rail height must be added to the unit depth to calculate the total required installation depth.
Weight	440g/0.97lb
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 clearances	See chapter 2
Penetration protection	Small parts like screws, nuts, etc. with a diameter larger than 3.5mm

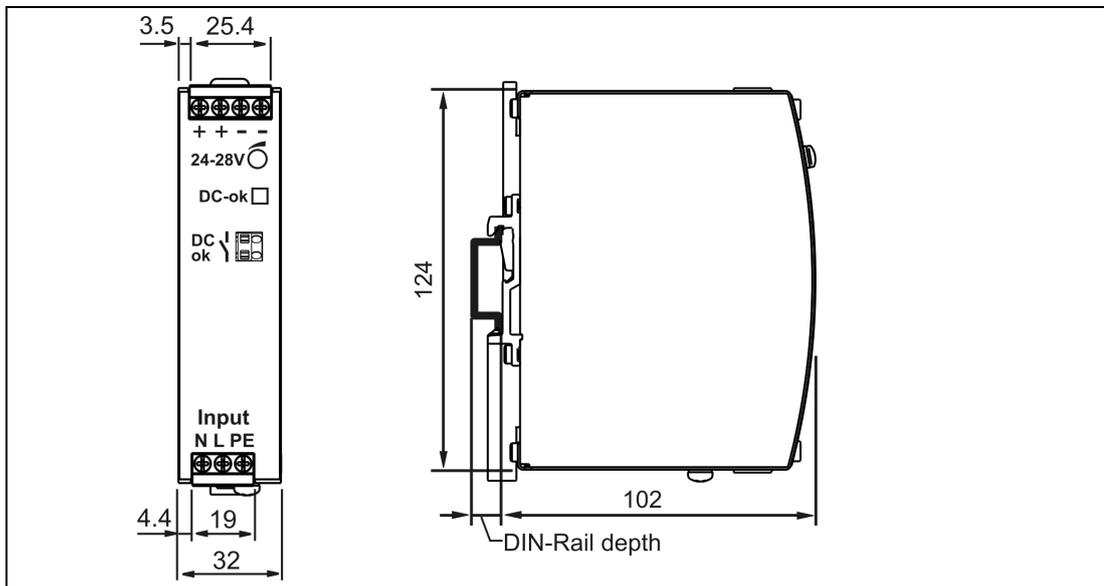


Figure 23.1 Device dimensions, all dimensions in mm

24 Accessories

PS1000-D2-24.20.RM – Redundancy Module with Automated Load Sharing



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

The device is equipped with two input channels, each rated for 10A for ambient temperatures up to +70°C and are individually decoupled by utilizing MOSFET technology. The inputs can also be operated up to 12A when the ambient temperature does not exceed +45°C.

The output can be loaded with nominal 20A at +70°C or 24A at 45°C continuous current.

Using MOSFETs instead of diodes reduces heat generation, losses and voltage drop between input and output. Due to these advantages, the unit is very narrow and only requires 32mm width on the DIN mounting rail.

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

The device is equipped with an automated load sharing feature, which balances the load current between the two input channels. It also monitors the function of the redundancy circuitry and provides a signal if the output current is too high, which could prevent redundancy if one power supply fails. The signal also reports too low or too high input voltages.

See chapter 25.5 for wiring information.

25 Application Notes

25.1 Peak Current Capability

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

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

The peak current capability also ensures the safe operation of subsequent circuit breakers of load circuits. The load branches are often individually protected with circuit breakers or fuses. In case of a short or an overload in one branch circuit, the fuse or circuit breaker need a certain amount of 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 examples show typical voltage dips for resistive loads:

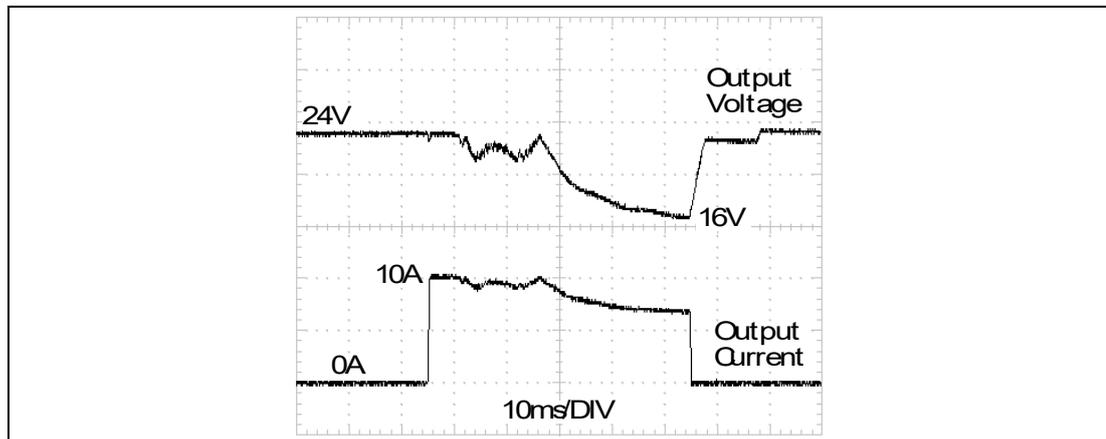


Figure 25.1 10A peak current for 50ms , typ. (2x the nominal current)

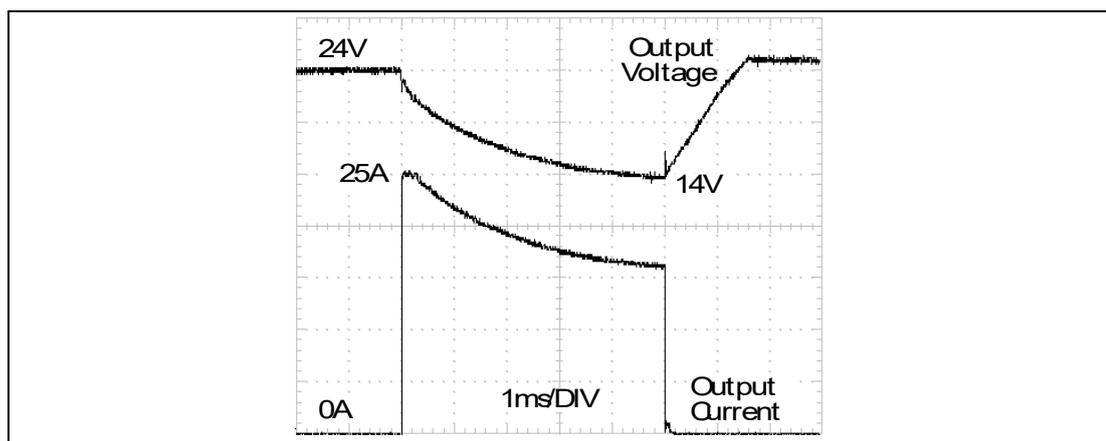


Figure 25.2 25A peak current for 5ms , typ. (5x the nominal current)

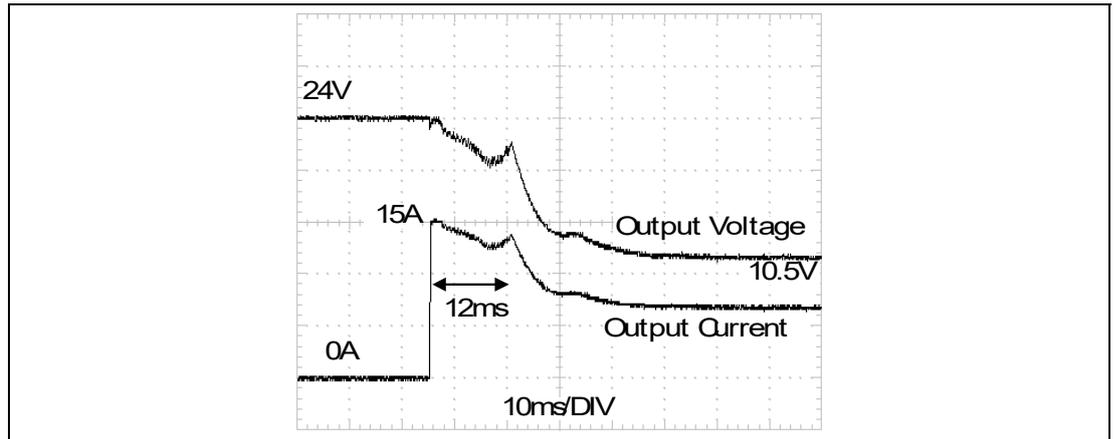


Figure 25.3 15A peak current for 12ms , typ. (3x the nominal current)



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 16V	At 10A for 50ms and resistive load
	Typically from 24V to 16.5V	At 25A for 2ms and resistive load
	Typically from 24V to 14V	At 25A for 5ms and resistive load

25.2 Charging of Batteries

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



Charging Batteries

1. Set the 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. Use only matched batteries when putting 12V types in series.
3. Ensure that the ambient temperature of the power supply stays below 40°C.
4. Use a 10A circuit breaker or a blocking diode between the power supply and the battery.
5. Ensure that the output current of the power supply is below the allowed charging current of the battery.
6. The return current to the power supply is typically 8mA. This return current can discharge the battery 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

25.3 Series Operation

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

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

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.

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

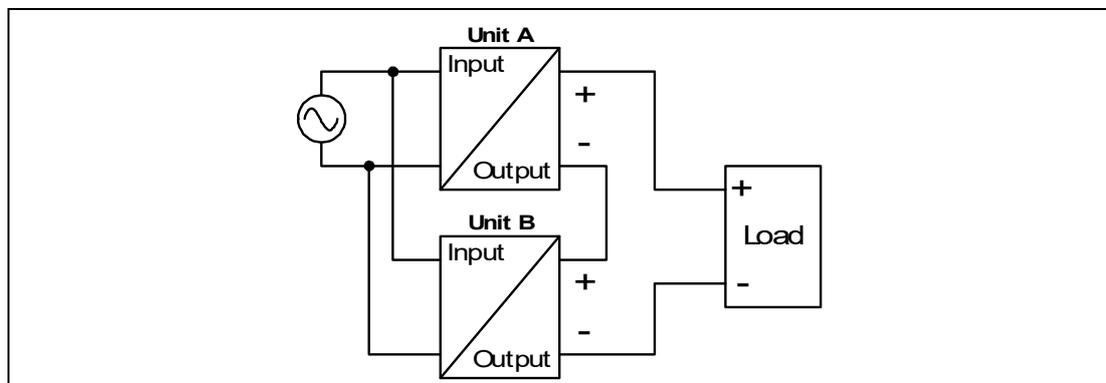


Figure 25.4 Series operation

25.4 Parallel Use to Increase Output Power

Devices can be paralleled to increase the output power. The output voltage shall be adjusted to the same value ($\pm 100\text{mV}$) with the same load conditions on all devices, or the devices can be left with the factory settings.

The ambient temperature is not allowed to exceed $+40^\circ\text{C}$.

If more than three devices are connected in parallel, a fuse or circuit breaker with a rating of 10A is required on each output. Alternatively, a diode or redundancy module can also be utilized.

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

Restrictions

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

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

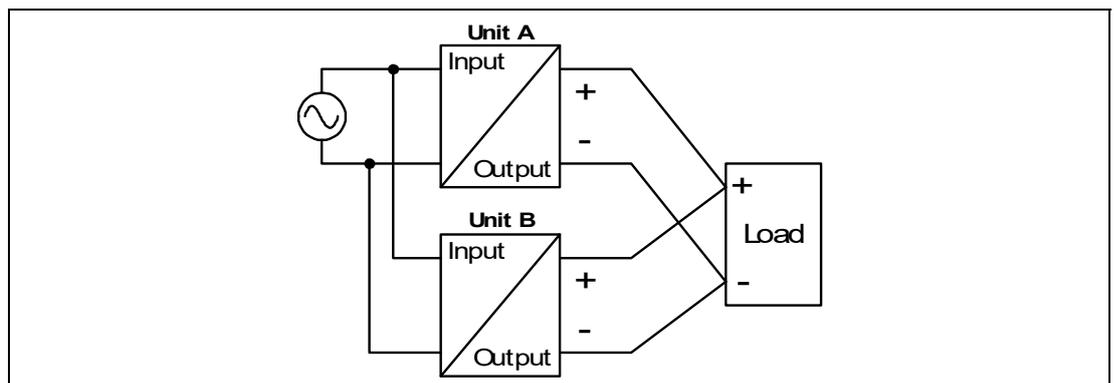


Figure 25.5 Parallel use to increase output power

25.5 Parallel Use for Redundancy

1+1 Redundancy

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

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

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

Recommendations for building redundant power systems:

- Use separate input fuses for each device.
- Use separate mains systems for each device whenever it is possible.
- Monitor the individual devices. Therefore, use the DC-OK signal of the device.
- It is desirable to set the output voltages of all devices to the same value ($\pm 100\text{mV}$) or leave it at the factory setting.

N+1 Redundancy

Redundant systems for a higher power demand are usually built in a N+1 method. E.g. four devices, each rated for 5A are paralleled to build a 15A redundant system.

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

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

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

For N+1 redundancy the ambient temperature is not allowed to exceed +40°C.

Wiring examples:

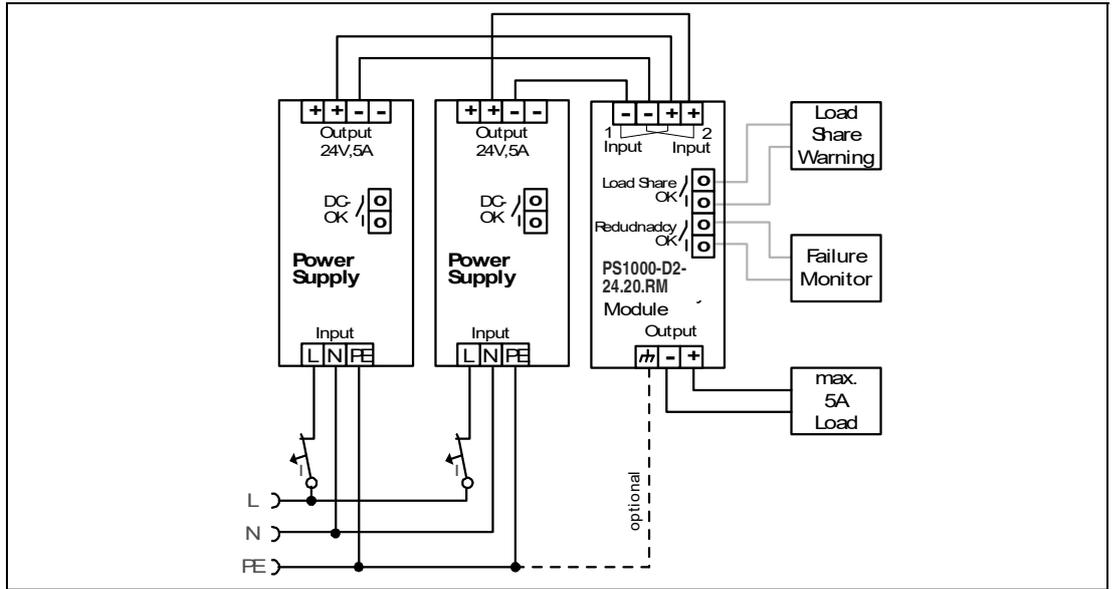


Figure 25.6 1+1 redundant configuration with active load share for 5A load current with a dual redundancy module

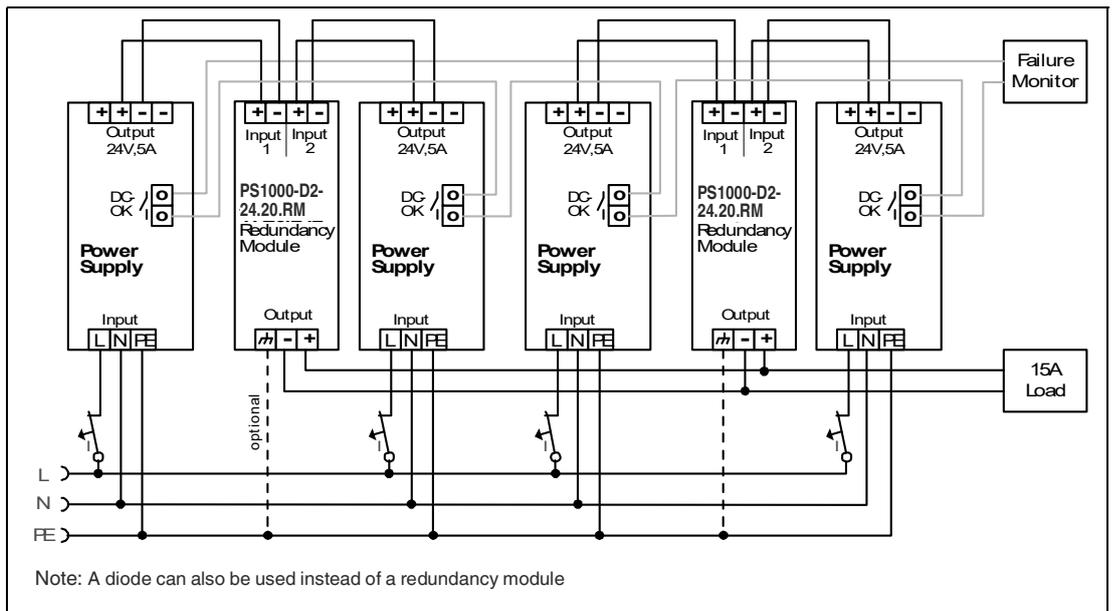


Figure 25.7 N+1 Redundant configuration for 15A load current with multiple power supplies and redundancy modules

25.6 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 $240V^{+10\%}$.

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

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

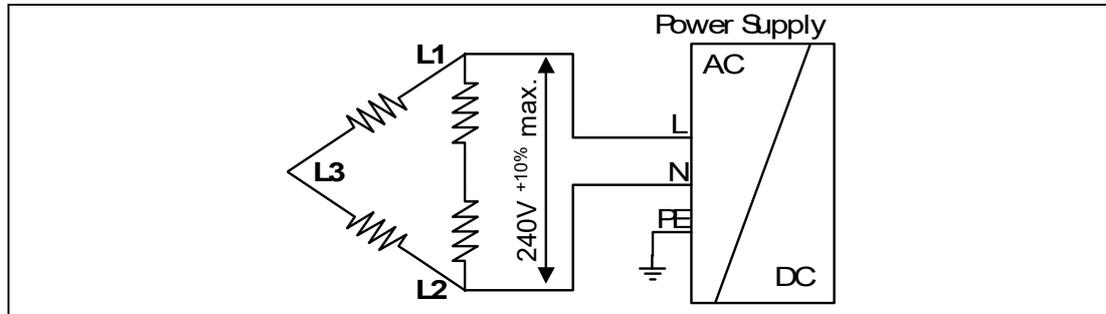


Figure 25.8 Two phases operation

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

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.

	Case A	Case B
Enclosure size	110x180x165mm Rittal Typ IP66 Box PK 9516 100, plastic	110x180x165mm Rittal Typ IP66 Box PK 9516 100, plastic
Input voltage	230Vac	230Vac
Load	24V, 4A; (=80%)	24V, 5A; (=100%)
Temperature inside the box	38.3°C	39.6°C
Temperature outside the box	26.1°C	25.5°C
Temperature rise	12.2K	14.1K

25.7 Mounting Orientations

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

The listed lifetime and MTBF values from this datasheet apply only for the standard mounting orientation.

The following curves give an indication for allowed output currents for altitudes up to 2000m (6560ft).

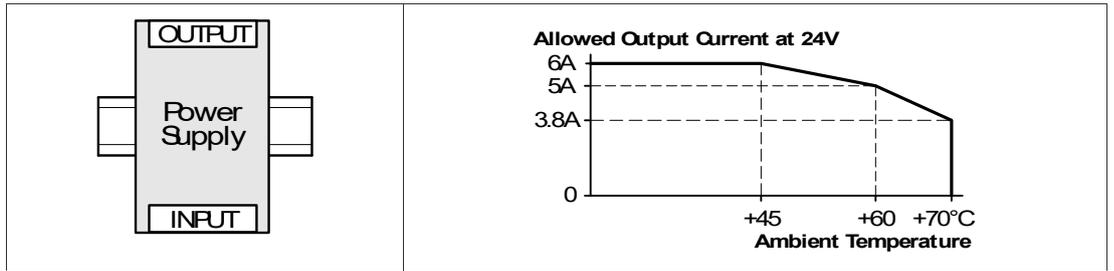


Figure 25.9 Mounting orientation A (standard orientation)

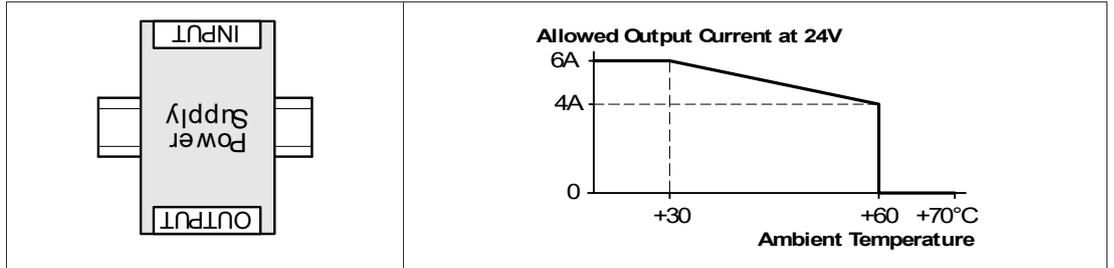


Figure 25.10 Mounting orientation B (upside down)

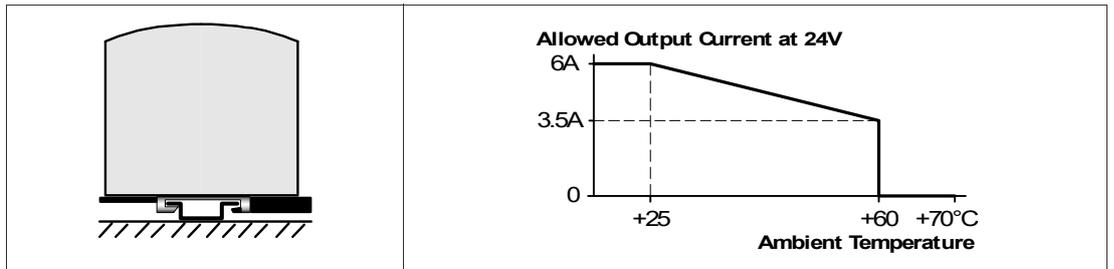


Figure 25.11 Mounting orientation C (table-top mounting)

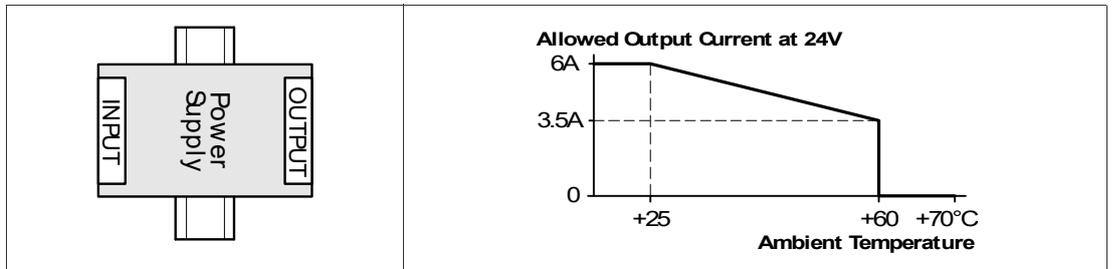


Figure 25.12 Mounting orientation D (horizontal cw)

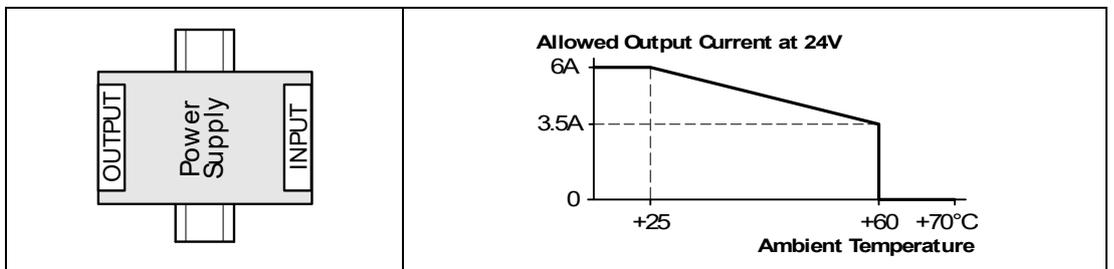


Figure 25.13 Mounting orientation E (horizontal ccw)

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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

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