PS1000-D2-24.40.RM

Redundancy Module

Technical Information

ISO9001

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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).

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

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2 Terminology and Abbreviations

PE and ⏚ symbol	PE is the abbreviation for **P**rotective **E**arth and has the same meaning as the symbol ⏚.
Earth, Ground	This document uses the term **earth** which is the same as the U.S. term **ground**.
T.b.d.	To be defined, value or description will follow later.
DC 24V	A figure displayed with the AC or DC before the value represents a nominal voltage with standard tolerances (usually ±15%) included. E.g.: DC 12V describes a 12V battery disregarding whether it is full (13.7V) or flat (10V)
24Vdc	A figure with the unit (Vdc) at the end is a momentary figure without any additional tolerances included.
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.
1+1 Redundancy	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.
N+1 Redundancy	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.

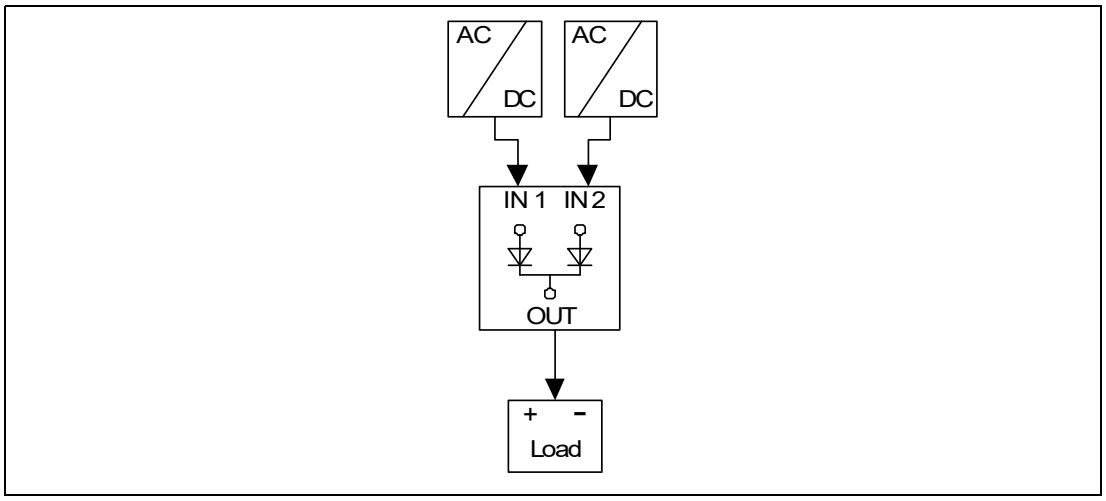

Figure 2.1 1+1 Redundancy

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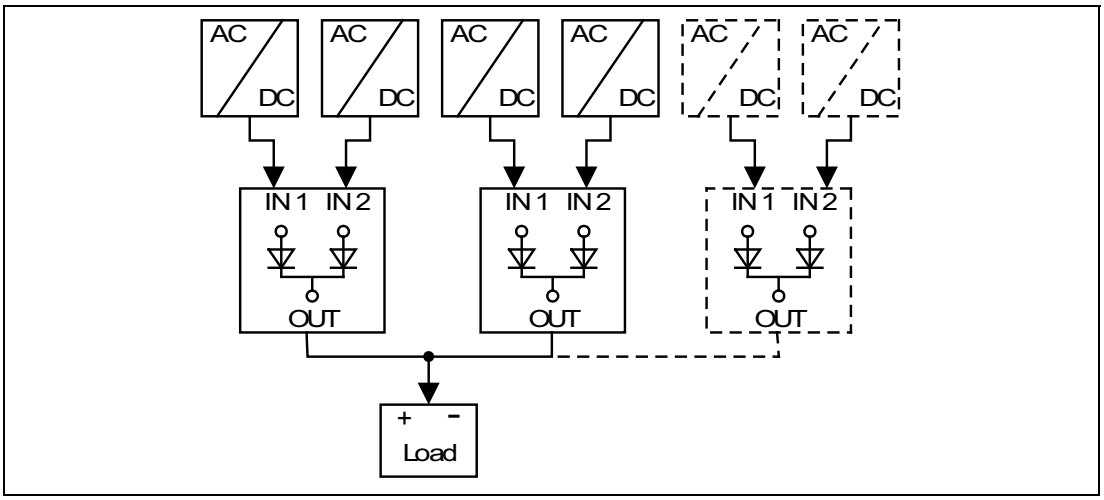

Figure 2.2 N+1 Redundancy

3 Intended Use

This device is designed for installation in an enclosure and is intended for commercial use, such as in industrial control, office, communication and instrumentation equipment.

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

The redundancy module is designed for use in hazardous, non-hazardous, ordinary or unclassified locations

Function

The device is a redundancy module for building redundant power supply systems.

The device is equipped with 2 inputs and 1 output. Power supplies with an output current of up to 20 A and one output can be connected to the inputs. The power supplies can transmit a rated current of up to 40 A and 40 A to 65 A for 5 s.

The both inputs are decoupled by MOSFETs. This reduces heat generation and voltage drop between input and output.

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

Reference Conditions

All parameters are typical values specified at 24 V, 40 A output current, 25 °C ambient and after a 5 minutes run-in time unless otherwise noted.

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4 Installation Instructions

Warning!

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

- Turn power off before working on the device and protect against inadvertent re-powering.
- Do not open, modify or repair the device.
- Use caution to prevent any foreign objects from entering into 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 surface may cause burns.

Warning!

Explosion hazards

- Substitution of components may impair suitability for this environment.
- Do not disconnect the device or operate the voltage adjustment or S/P jumper 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 fulfils the requirements of the EN 60079-15:2010.

Note

If you use the device in hazardous areas, observe the safety information in the instruction manual and in chapter 16.

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 device to the factory for inspection.

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

Do not ground or earth the positive output pole which could prevent redundancy in case of a ground failure. Ground the negative output pole, when needed.

Use only power supplies with a negligible output ripple voltage in the low frequency range between 50Hz and 10kHz when used in marine applications according to the GL regulations.

Install the device onto a DIN-rail according to EN 60715 with the output 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 input must be powered from a PELV or SELV source or an **Isolated Secondary Circuit** in order to maintain a SELV or PELV output.

Check correct input polarity. The device will not operate when input voltage is reversed.

The device is designed as **Class of Protection III** equipment according to IEC 61140.

A PE (ground) connection is not required. However, connecting the chassis ground terminal to ground can be beneficial to gain a high EMI immunity.

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 6000m. See additional requirements in the product datasheet for use above 2000m.

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. Under special circumstances clearances can be reduced. See details in the product datasheet.

The maximum surrounding air temperature is +70°C. 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.

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5 Input and Output Characteristics

Number of inputs		2	
Suitable power supplies			Use only power supplies which are featured with the **Hiccup** overload behaviour
Number of outputs		1	
Input voltage	nom.	DC 12-28V ±30%	The input circuitry must meet the SELV requirements stipulated by IEC/EN/UL 60950-1.
Input voltage range		8.4-36.4Vdc	
Voltage drop, input to output	typ.	140mV	at 2x20A, see Figure 5.1
	typ.	72mV	at 2x10A, see Figure 5.1
	typ.	112mV	at 1x20A, see Figure 5.2
Input current	nom.	2x 0-20A	continuous
	nom.	2x 20-32.5A	for 5 seconds
	max.	2x 13A	in overload (voltage < 6V) or short circuit mode
Peak input current	max.	1000A	for max. 1ms per input
Output current	nom.	40A	continuous
	nom.	40-65A	for 5 seconds
	max.	26A	in overload (voltage < 6V) or short circuit mode
Reverse current	max.	1mA	at 24V, per input, -40°C to +70°C
Reverse voltage	max.	40Vdc	voltage applied to the output, continuously allowed
Output capacitance	typ.	320µF	

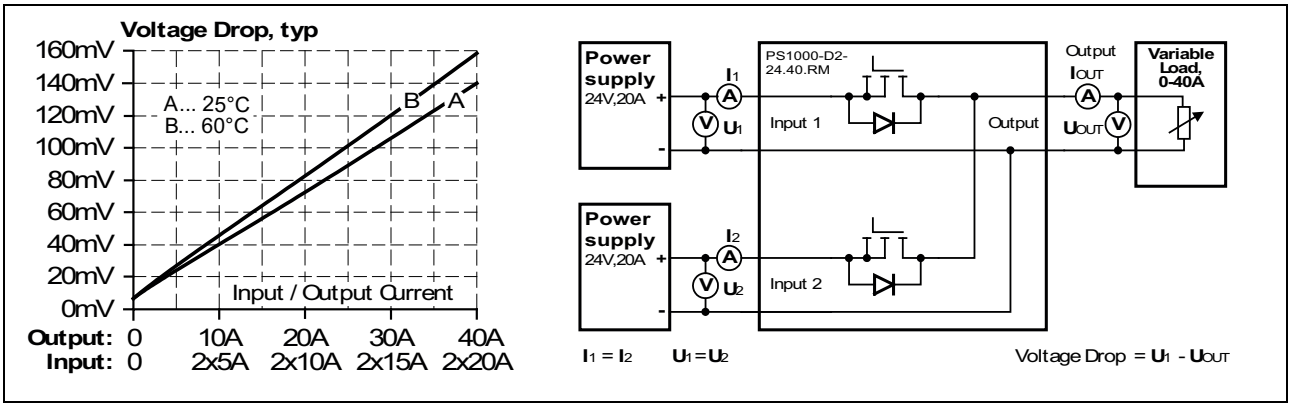

Figure 5.1 Input to output voltage drop when both inputs draw current (typical 1+1 redundant case, when the output voltages of the two devices are equal)

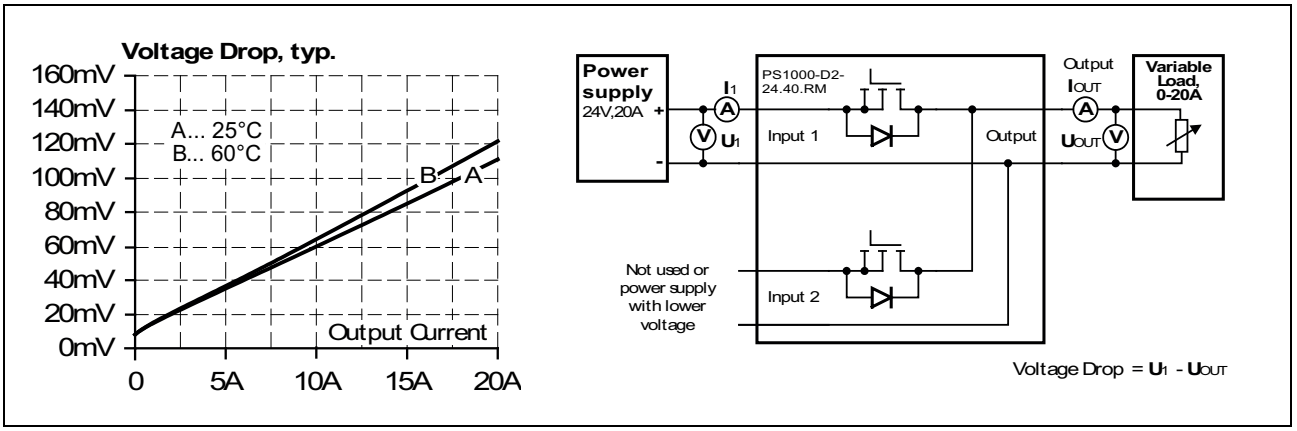

Figure 5.2 Input to output voltage drop when only one input draws current

6 Power Losses

		DC 12V	DC 24V	
Power losses	typ.	1.6W	1.7W	input: 2x10A
	typ.	5.8W	5.9W	input: 2x20A
	typ.	2.3W	2.4W	input: 1x20A, (only one input is connected to input voltage)
Standby power losses	typ.	0.07W	0.15W	at no output current, (only one input is connected to input voltage)
	typ.	0.12W	0.23W	at no output current, (both inputs are connected to input voltages)

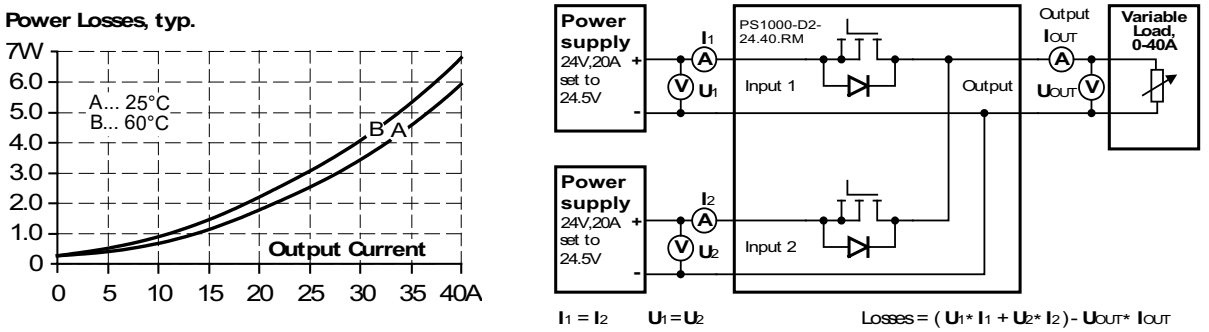

Figure 6.1 Power losses when both inputs draw equal current

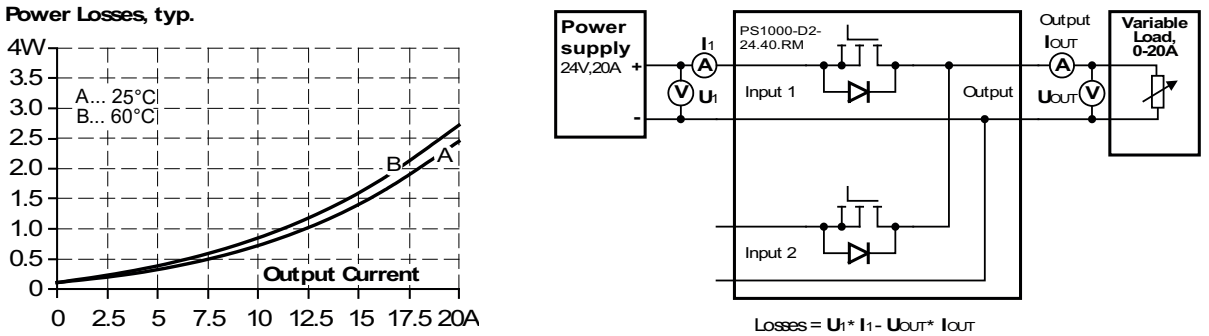

Figure 6.2 Power losses when only one input is used

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7 Lifetime Expectancy and MTBF

The redundancy module has two input channels which are completely independent from each other. Each control circuit, auxiliary voltage source, or other circuitry in the module are designed separately for each input. The dual input redundancy module can be considered as two single redundancy modules combined together in one housing. The only common point is the circuit trace that ties the two separate circuits together at the output.

The MTBF figures below are for the entire dual input module. If the MTBF number of only one path is needed, simply double the value from the table.

Input / output current conditions	**Input: 2x10A Output: 20A**	**Input: 2x20A Output: 40A**	
Lifetime expectancy [1]	672 000h [1]	255 000h [1]	at 24V and 40°C
	1 900 000h [1]	720 000h [1]	at 24V and 25°C
MTBF [2] SN 29500, IEC 61709	7 234 000h	4 533 000h	at 24V and 40°C
	12 445 000h	8 218 000h	at 24V and 25°C
MTBF [2] MIL HDBK 217F	325 000h	294 000h	Ground Fixed GF40 (24V and 40°C)
	438 000h	392 000h	Ground Fixed GF25 (24V and 25°C)
	1 588 000h	1 457 000h	Ground Benign GB40 (24V and 40°C)
	2 159 000h	1 964 000h	Ground Benign GB25 (24V and 25°C)

[1] 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.

[2] **MTBF** stands for **M**ean **T**ime **B**etween **F**ailure, which is calculated according to statistical device failures, and indicates reliability of a device. It is the statistical representation of the likelihood of a device 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 device will fail every 100 hours if 10 000 devices are installed in the field. However, it can not be determined if the failed device has been running for 50 000h or only for 100h.

8 Terminals and Wiring

	Input	Output
Type	Screw termination IP20 Finger safe construction. Suitable for field installation.	Screw termination IP20 Finger safe construction. Suitable for field installation.
Solid wire	0.5-6mm^2	0.5-16mm^2
Stranded wire	0.5-4mm^2	0.5-10mm^2
American Wire Gauge	20-10 AWG	22-8 AWG
Max. wire diameter	2.8mm (including ferrule)	5.2mm (including ferrules)
Wire stripping length	7mm	12mm
Screwdriver	3.5mm slotted or Pozidrive No 2	3.5mm slotted or Pozidrive No 2
Recommended tightening torque	0.8Nm, 7lb.in	1.2Nm, 10.6lb.in

To connect the chassis to ground, use a ring-type terminal (ring cable lug) which is suitable for a M4 screw and connect it to the chassis ground terminal on top of the device.

Connecting Terminals

1. The external circuitry of all terminals must meet the safety requirements stipulated by IEC/EN/UL 60950-1: SELV.
2. 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.
3. Follow national installation codes and installation regulations!
4. Ensure that all strands of a stranded wire enter the terminal connection!
5. Screws of unused terminal compartments should be securely tightened.
6. Ferrules are allowed.
7. Do not connect or disconnect the wires from the terminals below -25°C.

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9 Functional Diagram

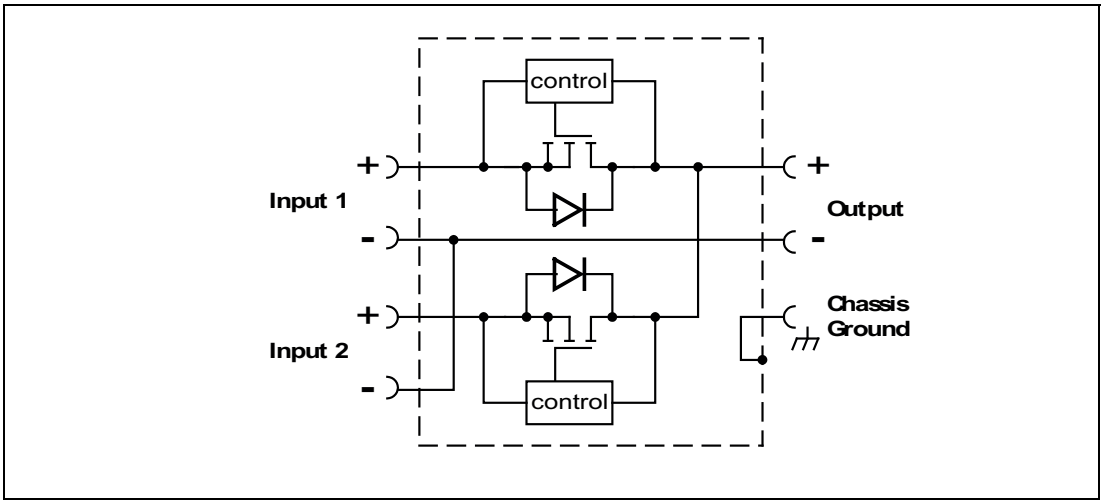

Figure 9.1 Functional diagram

10 Front Side and User Elements

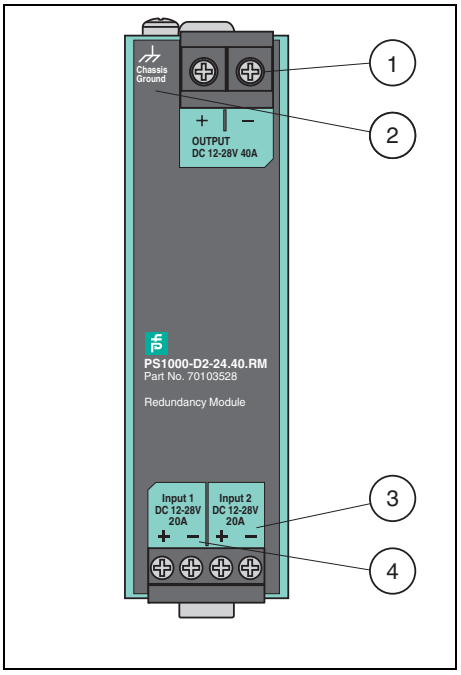

Figure 10.1 Front side

1 **Output terminals** (screw terminals)
2 **Chassis-ground terminal**
To be connected on the top side of the housing with a ring-type terminal (ring cable lug) which is suitable for a M4 screw.
Connection of the chassis is optional and not required since the device fulfills the requirements according to protection class III.
3 **Input terminals for input 1** (screw terminals)
4 **Input terminals for input 2** (screw terminals)

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11 EMC

The redundancy module is suitable for applications in industrial environment as well as in residential, commercial and light industry environment without any restrictions. A detailed EMC report is available on request.

EMC Immunity	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	2kV 2kV	Criterion A Criterion A
Surge voltage on input lines	EN 61000-4-5	+ → – + / – → Chassis ground	500V 1kV	Criterion A Criterion A
Surge voltage on output lines	EN 61000-4-5	+ → – + / – → Chassis ground	500V 1kV	Criterion A Criterion A
Conducted disturbance	EN 61000-4-6	0.15-80MHz	20V	Criterion A
Power-frequency magnetic field [1]	EN 61000-4-8	50Hz	30A/m	Criterion A

1 A test is not applicable according to EN 61000-6-2, since the device does not contain components susceptible to magnetic fields, e.g. hall elements, electrodynamic microphones, etc.

Criterion A Redundancy module shows normal operation behavior within the defined limits.

EMC Emission	According to generic standards: EN 61000-6-3 and EN 61000-6-4	
Conducted emission	IEC/CISPR 16-1-2, IEC/CISPR 16-2-1	Limits for DC power port according EN 61000-6-3 fulfilled [1 2]
Radiated emission	EN 55011, EN 55032	Class B
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.		

1 For information only, not mandatory for EN 61000-6-3.

2 Provided, that power sources connected on the inputs fulfill the requirements too.

Switching frequency	The internal auxiliary supply is generated with a boost converter. The switching frequency varies from 140kHz to 500kHz depending on the input voltage.

12 Environment

Operational temperature [1]	-40°C to +70°C	
Storage temperature	-40 to +85°C	for storage and transportation
Output de-rating	1A/K	60-70°C
Humidity [2]	5 to 95% r.h.	According to IEC 60068-2-30
Vibration sinusoidal [3]	2-17.8Hz: ±1.6mm; 17.8-500Hz: 2g 2 hours / axis	According to IEC 60068-2-6
Shock [3]	30g 6ms, 20g 11ms 3 bumps / direction, 18 bumps in total	According to IEC 60068-2-27
Altitude	0 to 2000m	without any restrictions
	2000 to 6000m	reduce output power or ambient temperature, see Figure 12.2
Altitude de-rating	2.5A/1000m or 5K/1000m	For altitudes >2000m, see Figure 12.2
Over-voltage category	not applicable	The concept of the overvoltage category is used for equipment energized directly from the low voltage mains (IEC 60664-1 §4.3.3.2.1).
Degree of pollution	2	According to IEC 62103, EN 50178, not conductive

1 Operational temperature is the same as the ambient or surrounding temperature and is defined as the air temperature 2cm below the device.

2 Do not energize while condensation is present.

3 Tested in combination with DIN mounting rails according to EN 60715 with a height of 15mm and a thickness of 1.3mm and standard mounting orientation.

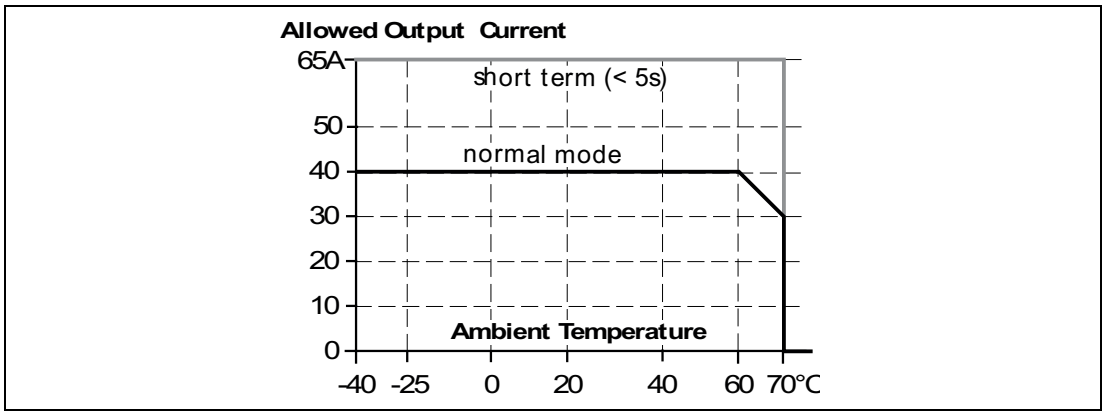

Figure 12.1 Output current vs. ambient temperature

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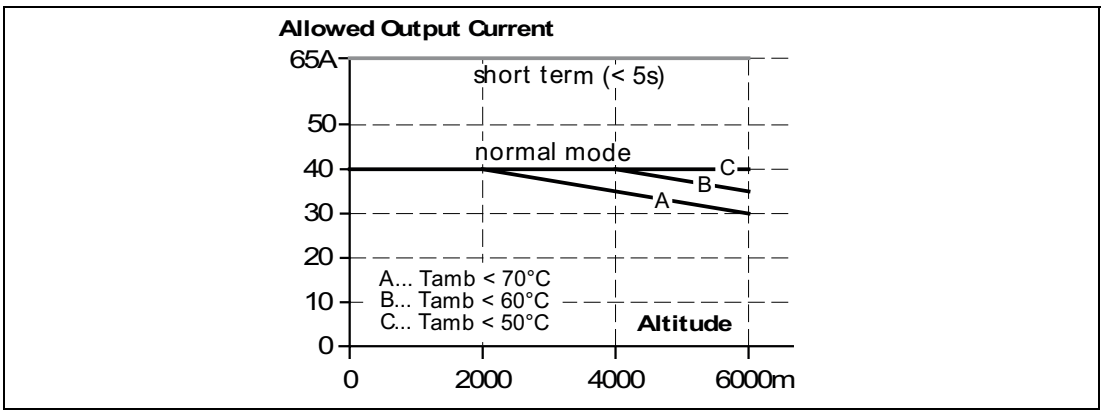

Figure 12.2 Output current vs. altitude

13 Protection Features

Output over-current protection	not included	
Reverse input polarity protection	included	device does not start when input voltage is reversed
Degree of protection	IP 20	EN/IEC 60529
Penetration protection	> 3.6mm	e.g. screws, small parts
Over-temperature protection	not included	
Input transient protection	not included	
Output transient protection	included	see EMC section
Internal input fuse	not included	

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14 Safety Features

Input / output separation	no galvanic separation	MOSFET between input and output
Class of protection	III	PE (Protective Earth) or chassis connection not required
PE resistance	< 0.1Ohm	between housing and chassis-ground terminal

15 Dielectric Strength

The input and output voltages have the same reference, are floating and have no ohmic connection to ground.

Type and factory 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 input/output terminals together before conducting the test.

When testing, set the cut-off current settings to the value in the table below.

		A
Type test	60s	500Vac
Factory test	5s	500Vac
Field test	5s	500Vac
Cut-off current setting		> 2mA

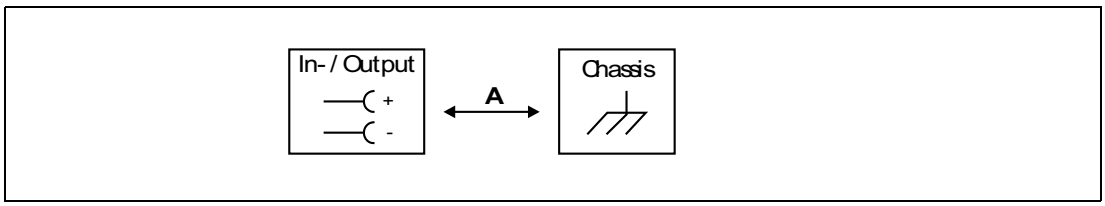

Figure 15.1 Dielectric strength

16 Approvals And Fulfilled Standards

UL 508 UL 61010-1 UL 61010-2-201 CAN/CSA C22.2 No. 107.1-01 CAN/CSA C22.2 No. 61010-1-12 CAN/CSA-IEC 61010-2-201:18	c UL US LISTED	UL Certificate Listed equipment for category NMTR - Electrical Equipment Applicable for US and Canada E-File: E223176
EN 60079-0:2012+A11:2013 , EN 60079-7:2016 , EN 60079-15:2010	Ex	ATEX certificate: EPS 11 ATEX 1312 X ATEX marking: Ⓔx II 3G Ex ec II T4 Gc
IEC 60079-0:2011 , IEC 60079-7:2015 , IEC 60079-15:2010	IEC IECEx	IECEx certificate: IECEx EPS 20.0057X IECEx marking: Ex ec IIC T4 Gc
IEC 60068-2-60	Corrosion IEC 60068-2-60 Method 4 ✓	Environmental Tests, Flowing Mixed Gas Corrosion Test IEC 60068-2-60 Method 4 Test Ke - Method 4 H2S: 10ppb, NO2: 200ppb, Cl2: 10ppb, SO2: 200ppb Test Duration: 3 weeks, this simulates a service life of 10 years.
ISA-71.04 G3	Corrosion G3-ISA-71.04 ✓	Airborne Contaminants Corrosion Test ISA-71.04 G3 Severity Level: G3 Harsh H2S: 100ppb, NOx: 1250ppb, Cl2: 20ppb, SO2: 300ppb Test Duration: 3 weeks, this simulates a service life of 10 years.

17 Regulatory Product Compliance

CE	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	REACH ✓	Manufacturer's Statement EU-Regulation regarding the Registration, Evaluation, Authorization and Restriction of Chemical
WEEE Directive		Manufacturer's Statement EU-Regulation on Waste Electrical and Electronic Equipment Registered in Germany as business to business (B2B) products.

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18 Physical Dimensions and Weight

Width	36mm
Height	124mm
Depth	127mm The DIN mounting rail height must be added to the device depth to calculate the total required installation depth.
Weight	280g
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: galvanized steel
Installation istructions	See chapter 4.

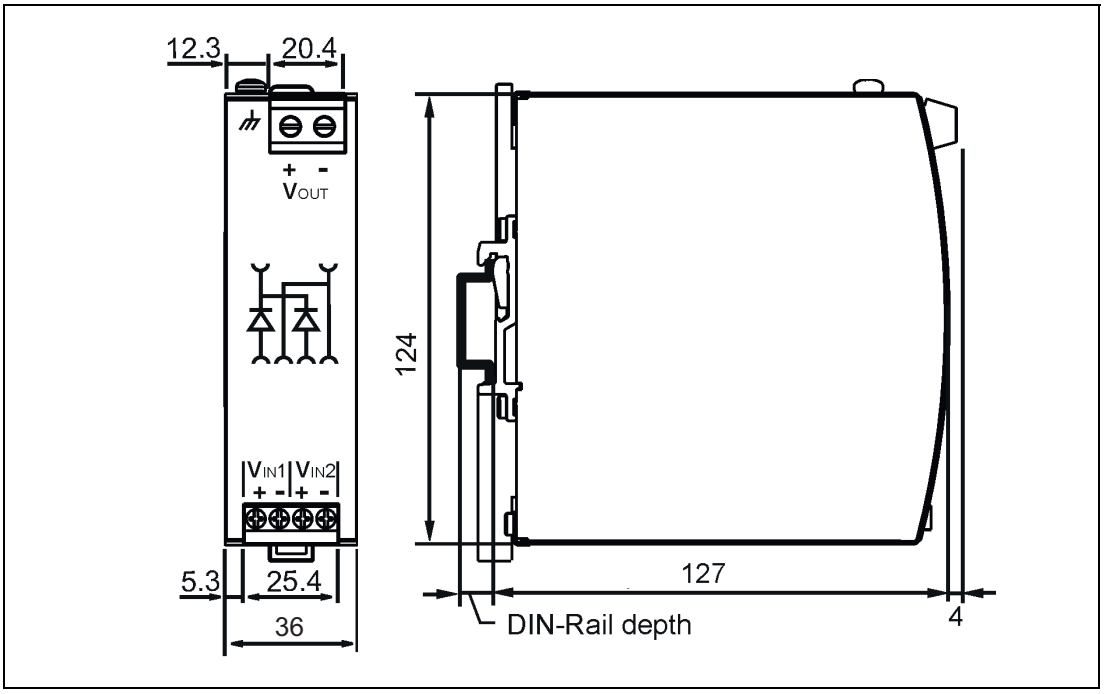

Figure 18.1 Device dimensions, all dimensions in mm

19 Application Notes

19.1 Recommendations for Redundancy

Recommendations for the configuration of redundant power systems:

- Use separate input fuses for each power supply.
- Use three-phase power supplies to gain functional safety if one phase fails.
- When single-phase power supplies are utilized connect them to different phases or mains circuits if possible.
- Set the power supply in **parallel use** mode if this feature is available
- It is desirable to set the output voltages of all power supplies to the same value.

19.2 Inductive and Capacitive Loads

The device is designed to supply any kind of loads, including unlimited capacitive and inductive loads.

19.3 Sideward Installation Clearances

The minimum clearance recommendations are defined in chapter 4.

Normally, the following installation clearance are recommended: 40mm on top, 20mm on the bottom, 5mm on the left and right sides when the device is loaded permanently with more than 50% of the rated power. Increase this clearance to 15mm in case the adjacent device is a heat source (e.g. another power supply).

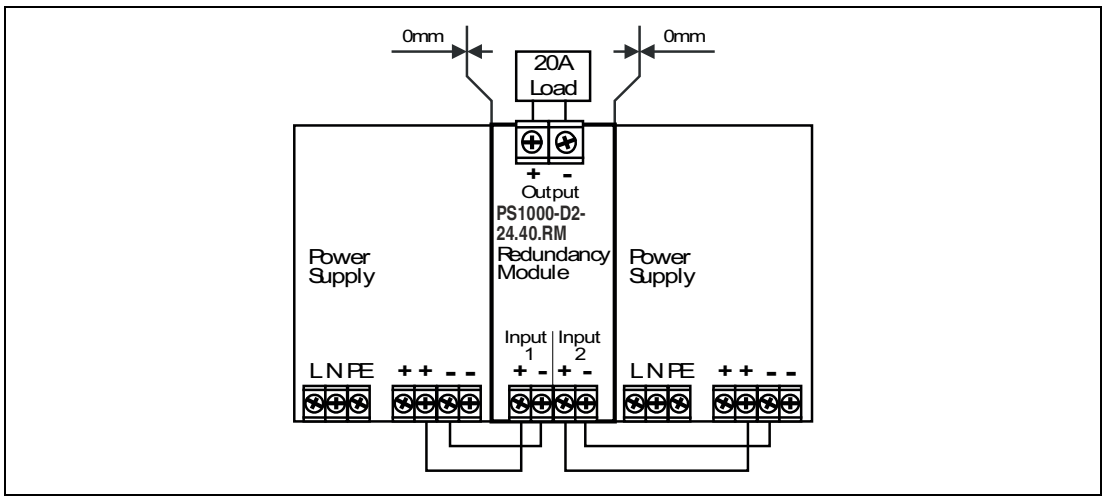

Figure 19.1

The clearance between the power supplies and the redundancy module can be reduced to zero under the following conditions:

- 1+1 redundancy application with maximum 20A output current.
- The power supplies are from the PS1000 series.
- The redundancy module is placed between the two power supplies.
- The output voltage is set to the same level on both power supplies.

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19.4 1+1 Redundancy up to 20A

1+1 Redundancy up to 20A requires two 20A power supplies and one redundancy module.

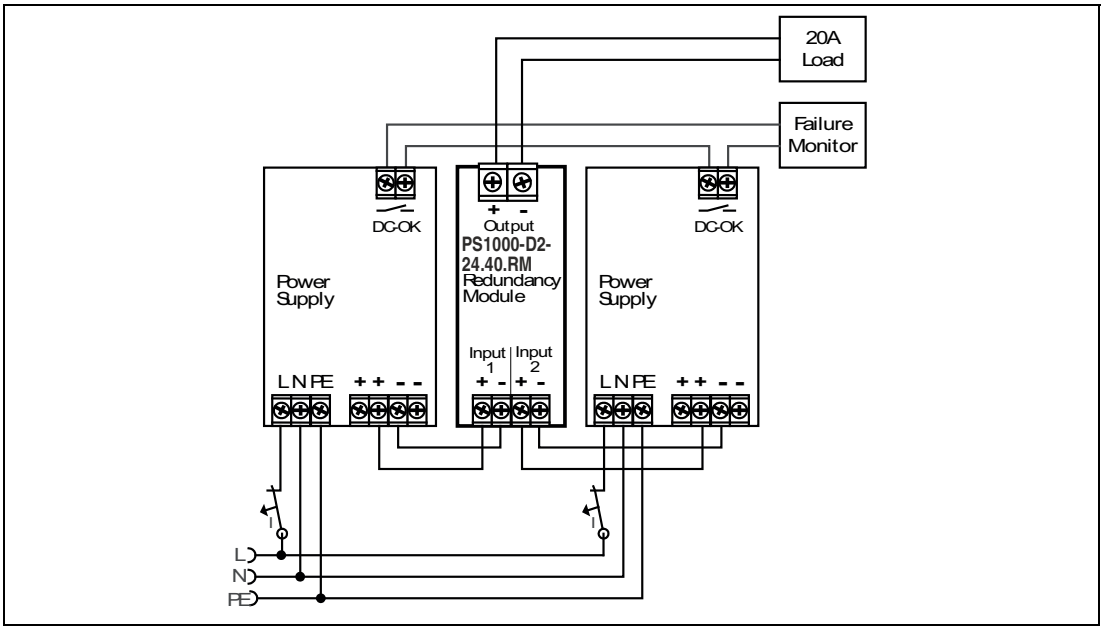

Figure 19.2 Wiring diagram, 1+1 redundancy, 20A output current

Note

Use separate mains systems for each device whenever it is possible.

19.5 N+1 Redundancy, Example with 60A

N+1 Redundancy up to 60A requires four 20A power supplies and two redundancy modules.

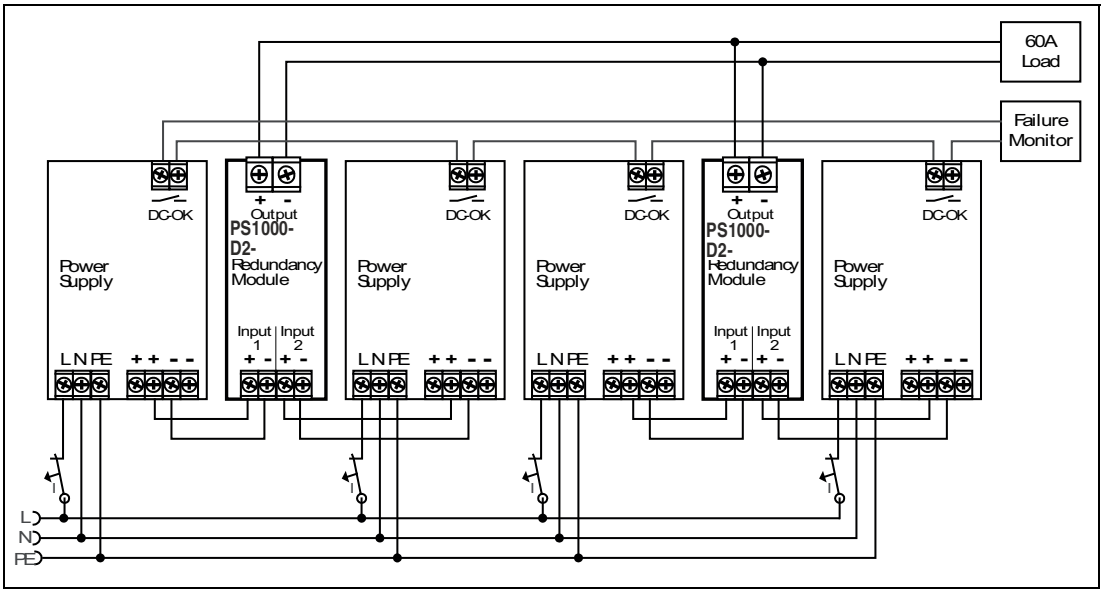

Figure 19.3 Wiring diagram, n+1 redundancy, 60A output current

Note

Use separate mains systems for each device whenever it is possible.

19.6 Mounting Orientations

Mounting orientations other than input terminals on the bottom and output terminals on the top 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).

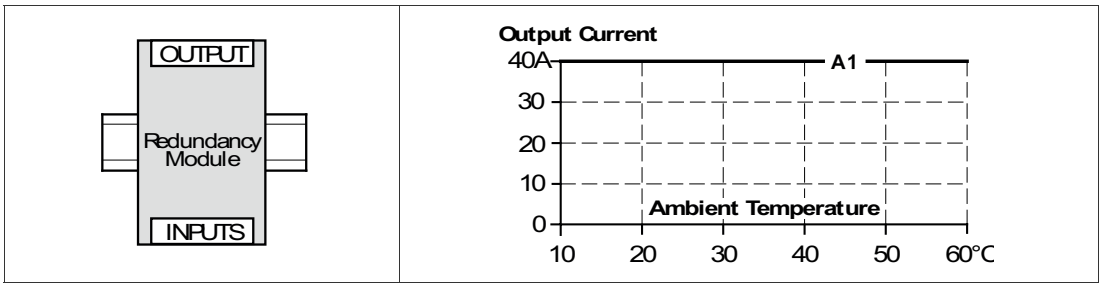

Figure 19.4 Mounting orientation A (standard orientation)

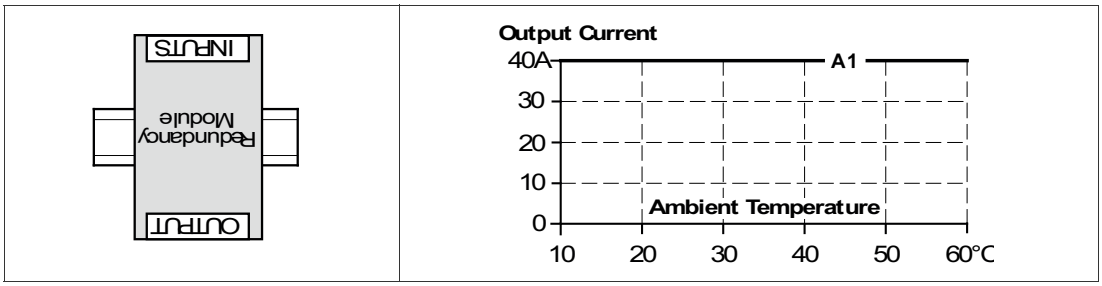

Figure 19.5 Mounting orientation B (upside down)

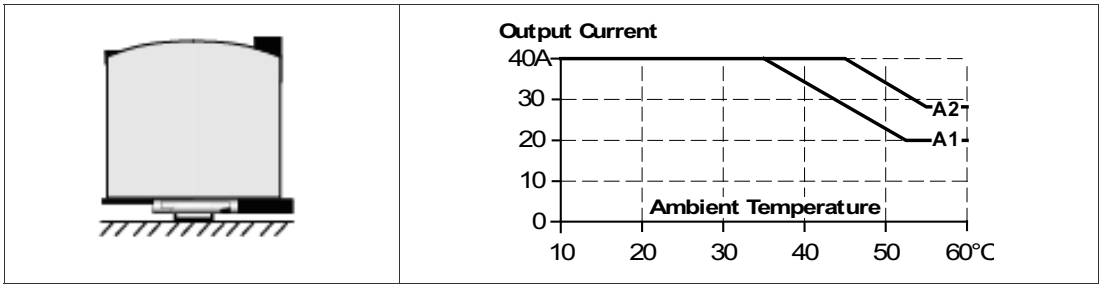

Figure 19.6 Mounting orientation C (table-top mounting)

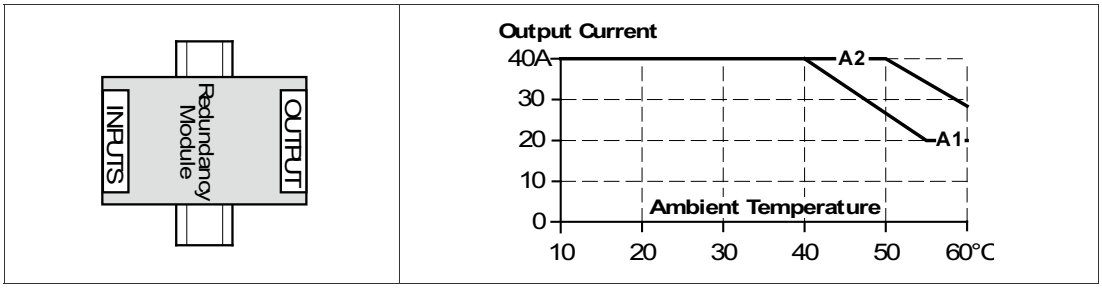

Figure 19.7 Mounting orientation D (horizontal cw)

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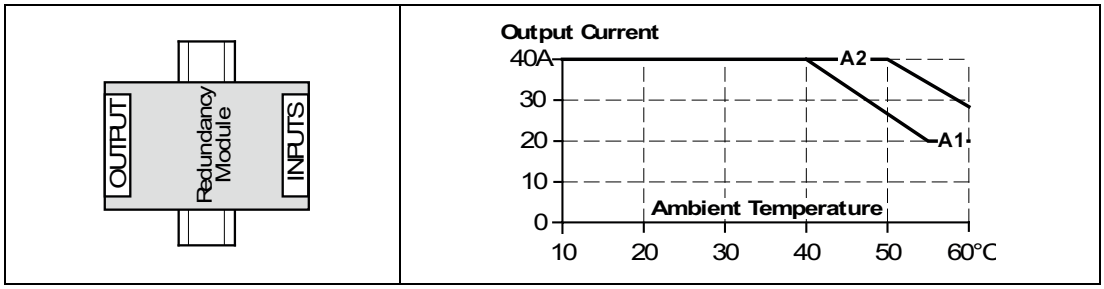

Figure 19.8 Mounting orientation E (horizontal ccw)

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