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REDUNDANCY MODULE

- Cost Effective Solution to Build Redundant Systems
- Dual Input with Single Output
- Two Diodes (Common Cathode)
- DC 12-28V $\pm 25\%$ Wide-range Input
- Full Power Between -40°C and $+55^{\circ}\text{C}$
- Width only 39mm
- Large Screw Terminals
- Easy Wiring:
Distribution Terminal for Negative Pole Included
- 3 Year Warranty

GENERAL DESCRIPTION

The PIRD20.241 is a redundancy module, which can be used to build 1+1 and N+1 redundant systems. It is equipped with two input channels, which can be connected to power supplies with up to 10A output current and one output, which can carry nominal currents up to 20A. The module is suitable for power supplies with constant current overload behavior as well as any kind of "hiccup" overload behavior.

The PIRD20.241 is the perfect solution to use in a redundant system, if the power supply itself is equipped with a DC-OK signal.

Another application for this redundancy module is to separate sensitive loads from non-sensitive loads. This avoids the distortion of the power quality for the sensitive loads which can cause controller failures.

SHORT-FORM DATA

Input voltage	DC 12-28V	$\pm 25\%$
Input voltage range	9-35Vdc	
Input current	2x 0-10A 2x 0-6.25A	ambient $< +55^{\circ}\text{C}$ ambient $< +70^{\circ}\text{C}$
Output current	0-20A 0-12.5A 26A	ambient $< +55^{\circ}\text{C}$ ambient $< +70^{\circ}\text{C}$ at cont. overload/ short circuit
Input to output voltage drop	typ. 0.46V typ. 0.56V	input: 2x5A input: 2x10A
Power losses	0W typ. 4.6W typ. 11.2W	at no load input: 2x5A input: 2x10A
Temperature range	-40°C to $+70^{\circ}\text{C}$	operational
Derating	0.5A/ $^{\circ}\text{C}$	$+55$ to $+70^{\circ}\text{C}$
Dimensions	39x124x124mm	WxHxD
Weight	280g / 0.62lb	

ORDER NUMBER

Redundancy Module **PIRD20.241**

MARKINGS



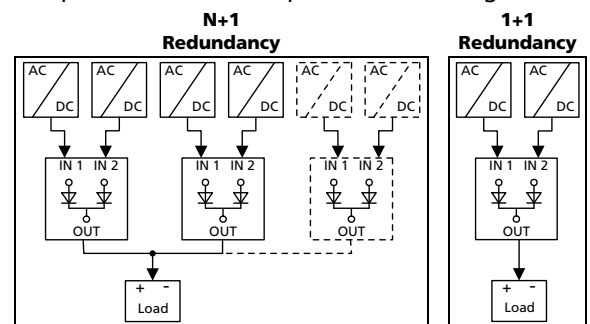
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TERMINOLOGY AND ABBREVIATIONS

DC 24V	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)
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, which are allowed to be connected in parallel for higher output currents, 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. Ensure that the utilized power supplies are allowed to be connected in parallel to increase the output power.



1. INTENDED USE

This redundancy module is designed for installation in an enclosure and is intended for the general use such as in industrial control, office, communication, and instrumentation equipment.

This redundancy module can be used with any type of power supply as long as the maximum output current ratings are not exceeded. It is suitable for power supplies with constant current overload behavior as well as any kind of "Hiccup" overload behavior.

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

2. INSTALLATION REQUIREMENTS

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

This device does not contain serviceable parts.

Do not energize with wrong input polarity. Device might get damaged.

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

Mount the unit on a DIN-rail so that the input terminals are located on the top and the output terminals on the bottom of the unit.

This device is designed for convection cooling and does not require an external fan. Do not obstruct airflow and do not cover the ventilation grid (e.g. cable conduits) by more than 30%!

Keep the following installation clearances:

40mm on top,

20mm on the bottom,

5mm on the left and right sides are recommended when the device is loaded permanently with more than 50% of the rated output current. Increase the side clearance to 15mm in case the adjacent device is a heat source (e.g. another power supply).

The input must be powered from a SELV source (according to IEC 60950-1), a PELV source (according to IEC 62477-1) or an Isolated Secondary Circuit (according to UL 508).

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.

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

- Turn power off before working on the device. Protect against inadvertent re-powering.
- Make sure that the wiring is correct by following all local and national codes.
- Do not open, modify or repair the unit.
- 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.

3. INPUT AND OUTPUT CHARACTERISTICS

Number of inputs	-	2	
Number of outputs	-	1	
Input voltage	nom.	DC 12-28V \pm 25%	
Input voltage range	-	9-35Vdc	
Voltage drop, input to output	typ.	0.46V	at 2x5A, see Fig. 3-1
	typ.	0.56V	at 2x10A, see Fig. 3-1
Input current	nom.	2x 0-10A	continuous
	nom.	2x 10-16A	for 5 seconds
Peak input current	max.	1000A	for maximal 10ms per input
Output current	nom.	20A	continuous
	nom.	20-32A	for 5 seconds
	max.	26A *)	at continuous overload or short circuit
Reverse current	max.	4mA	per input, -40°C to +70°C
Reverse voltage	max.	45Vdc	voltage applied to the output, continuously allowed

*) Ensure that the continuous output current does not exceed 26A. Check the short-circuit current of the power sources and if the power source can deliver more than 26A together, use an appropriate fuse on the output.

Fig. 3-1 Input to output voltage drop

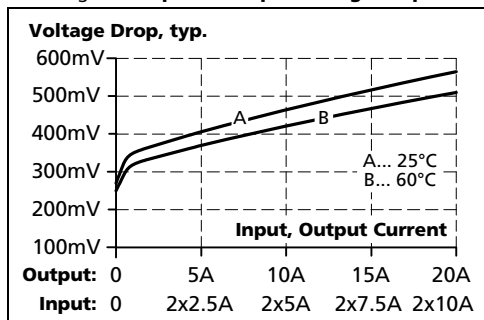
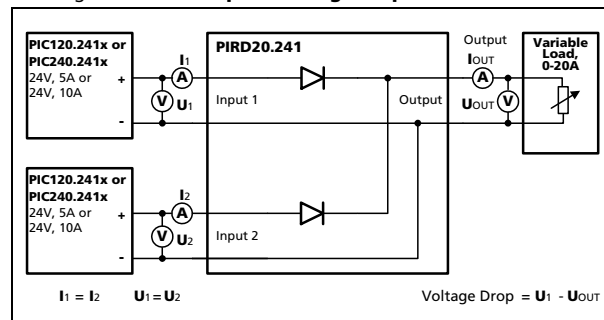


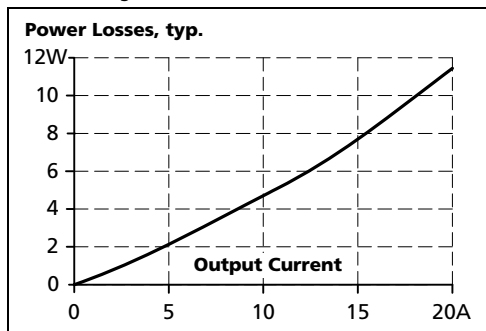
Fig. 3-2 Test setup for voltage drop measurements



4. POWER LOSSES

Power losses	0W	at no load (stand-by)
typ.	4.6W	at 24V and 2x5A input current
typ.	11.2W	at 24V and 2x10A input current

Fig. 4-1 Power losses at 25°C



5. LIFETIME EXPECTANCY AND MTBF

The redundancy module has two input channels which are completely independent from each other. 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		N+1 Redundancy Input: 2x10A Output: 20A	1+1 Redundancy Input: 2x5A Output: 10A	
Lifetime expectancy *)	min.	113 000h	309 000h ^{*)}	at 24V and 40°C
	min.	320 000h ^{*)}	874 000h ^{*)}	at 24V and 25°C
MTBF **) SN 29500, IEC 61709		7 837 000h	20 310 000h	at 24V 40°C
		19 408 000h	46 382 000h	at 24V 25°C
MTBF **) MIL HDBK 217F		1 774 000h	1 817 000h	at 24V and 40°C (Ground Fixed GF40)
		2 709 000h	2 782 000h	at 24V and 25°C (Ground Fixed GF25)
		3 675 000h	3 707 000h	at 24V and 40°C (Ground Benign GB40)
		5 620 000h	5 674 000h	at 24V and 25°C (Ground Benign GB25)

*) 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.

) **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.

6. TERMINALS AND WIRING

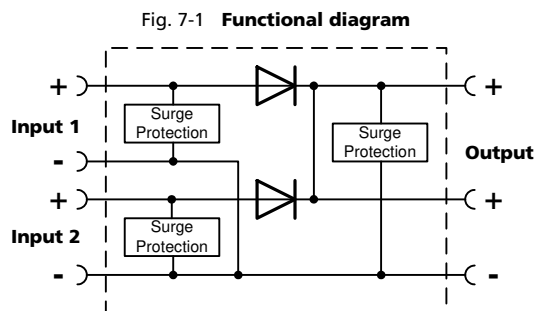
The terminals are IP20 finger safe constructed and suitable for field- and factory wiring.

Type	screw terminals
Solid wire	max. 6mm ²
Stranded wire	max. 4mm ²
American Wire Gauge	AWG20-10
Max. wire diameter	2.8mm (including ferrules)
Wire stripping length	7mm / 0.28inch
Screwdriver	3.5mm slotted or cross-head No 2
Recommended tightening torque	1Nm, 9lb.in

Instructions:

- a) Use appropriate copper cables that are designed for minimum operating temperatures of: 75°C for ambient up to 55°C minimum and 90°C for ambient up to 70°C minimum.
- b) Follow national installation codes and installation regulations!
- c) Ensure that all strands of a stranded wire enter the terminal connection!
- d) Unused terminal compartments should be securely tightened.
- e) Ferrules are allowed.

7. FUNCTIONAL DIAGRAM



8. FRONT SIDE AND USER ELEMENTS

Fig. 8-1 Front side



A Output terminals
Two identical (+) poles.

B Input terminals for input 1 and input 2

9. EMC

The redundancy module is suitable for applications in industrial environment as well as in residential, commercial and light industry environment without any restrictions.

EMC Immunity	According to generic standards: EN 61000-6-1 and EN 61000-6-2			
Electrostatic discharge	EN 61000-4-2	Contact discharge	8kV	Criterion A
		on indirect coupling plane		
		Air discharge	15kV	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	2kV	Criterion A
		Output lines	2kV	Criterion A
Surge voltage on input lines	EN 61000-4-5	+ → -	500V	Criterion A
		+/- → earthed DIN-rail	1kV	Criterion A
Surge voltage on output lines	EN 61000-4-5	+ → -	500V	Criterion A
		+/- → earthed DIN-rail	1kV	Criterion A
Conducted disturbance on input lines	EN 61000-4-6	0.15-80MHz	20V	Criterion A
Conducted disturbance on output lines	EN 61000-4-6	0.15-80MHz	20V	Criterion A
Power-frequency magnetic field ¹⁾	EN 61000-4-8	50Hz	30A/m	Criterion A

Criteria:

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

Notes:

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.

EMC Emission ⁴⁾	According to generic standards: EN 61000-6-3 and EN 61000-6-4	
Conducted emission input lines	IEC/CISPR 16-1-2, IEC/CISPR 16-2-1	limits for DC power ports according EN 61000-6-3 fulfilled ^{2) 3)}
Conducted emission output lines	IEC/CISPR 16-1-2, IEC/CISPR 16-2-1	limits for DC power ports according EN 61000-6-3 fulfilled ^{2) 3)}
Radiated emission	EN 55011, EN 55022	Class B ³⁾

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.

Notes:

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

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

4) The redundancy module incorporates only diodes and no RF-generating circuits and does not contribute to EMC emissions.

10. ENVIRONMENT

Operational temperature ¹⁾	-40°C to +70°C (-40°F to 158°F)	Reduce output power above +60°C
Output de-rating	0.5A/°C	+55 to +70°C (140°F to 158°F), see Fig. 10-1
Storage temperature	-40 to +85°C (-40°F to 185°F)	For storage and transportation
Humidity ²⁾	5 to 95% r.H.	IEC 60068-2-30
Vibration sinusoidal ³⁾	2-17.8Hz: ±1.6mm 17.8-500Hz: 2g 2 hours / axis	IEC 60068-2-6
Shock ³⁾	30g 6ms, 20g 11ms 3 bumps / direction 18 bumps in total	IEC 60068-2-27
Altitude	0 to 2000m (0 to 6 560ft) 2000 to 6000m (6 560 to 20 000ft)	Without any restrictions Reduce output power or ambient temperature, see Fig. 10-2
Altitude de-rating	1.25A/1000m or 5°C/1000m	> 2000m (6500ft), see Fig. 10-2
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	IEC 62103, EN 62477-1, not conductive
LABS compatibility	The unit does not release any silicone or other LABS-critical substances and is suitable for use in paint shops.	

- 1) Operational temperature is the same as the ambient temperature and is defined as the air temperature 2cm below the unit.
- 2) Do not energize while condensation is present
- 3) Tested in combination with DIN-Rails according to EN 60715 with a height of 15mm and a thickness of 1.3mm and standard mounting orientation.

Fig. 10-1 Output current vs. ambient temp.

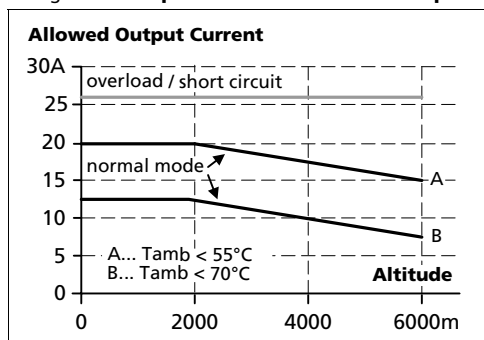
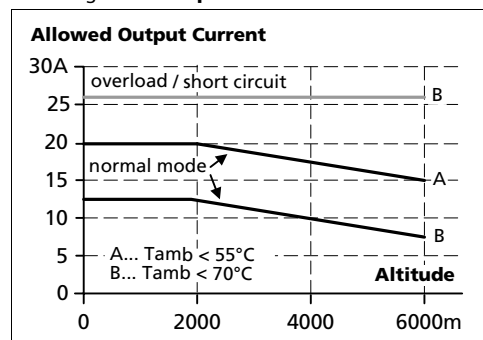


Fig. 10-2 Output current vs. altitude



11. PROTECTION FEATURES

Output over-current protection	not included	
Reverse input polarity protection	not included	Wrong input polarity might damage the device.
Degree of protection	IP 20	EN/IEC 60529
Over-temperature protection	not included	
Input transient protection	included	see chapter 9 for details and values
Output transient protection	included	see chapter 9 for details and values
Internal input fuse	not included	






12. SAFETY FEATURES

Input / output separation	no galvanic separation	Schottky diode between input and output
Safety level of output voltage	The output voltage is regarded to be SELV (EN 60950-1) or PELV (EN 60204-1, EN 62477-1, IEC 60364-4-41) if the input voltage fulfills the requirements for a SELV source or PELV source.	
Class of protection	III	



13. DIELECTRIC STRENGTH

Not applicable (plastic housing and no galvanic isolation)

14. APPROVALS

EC Declaration of Conformity		The CE mark indicates conformance with the EMC directive.
IEC 60950-1		CB Scheme, Information Technology Equipment
UL 508		Listed for use as Industrial Control Equipment; U.S.A. (UL 508) and Canada (C22.2 No. 107-1-01); E-File: E198865
UL 60950-1		Recognized for use as Information Technology Equipment, Level 5; U.S.A. (UL 60950-1) and Canada (C22.2 No. 60950); E-File: E137006
EAC TR Registration		Registration for the Eurasian Customs Union market (Russia, Kazakhstan, Belarus)

15. ROHS, REACH AND OTHER FULFILLED STANDARDS

RoHS Directive		Directive 2011/65/EU of the European Parliament and the Council of June 8 th , 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.
REACH Directive		Directive 1907/2006/EU of the European Parliament and the Council of June 1 st , 2007 regarding the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

16. PHYSICAL DIMENSIONS AND WEIGHT

Width	39mm 1.54"
Height	124mm 4.88"
Depth	124mm 4.88" The DIN-rail height must be added to the unit depth to calculate the total required installation depth.
Weight	280g / 0.62lb
DIN-Rail	Use 35mm DIN-rails according to EN 60715 or EN 50022 with a height of 7.5 or 15mm.
Plastic Material of Housing	Flame retardant Polycarbonate (PC) - UL94-V0 Vicat softening temperature specified with 149°C according to ASTM D1525
Installation Clearances	See chapter 2

Fig. 16-1 Front view

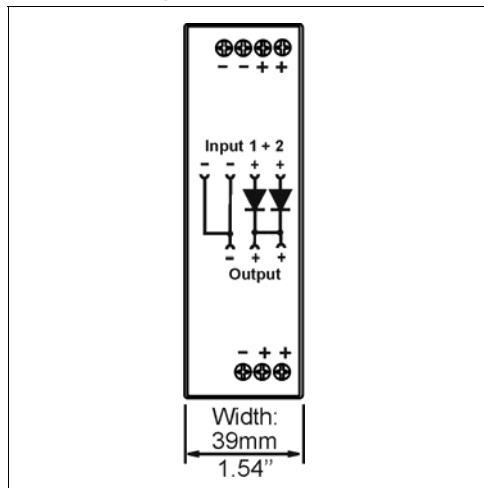
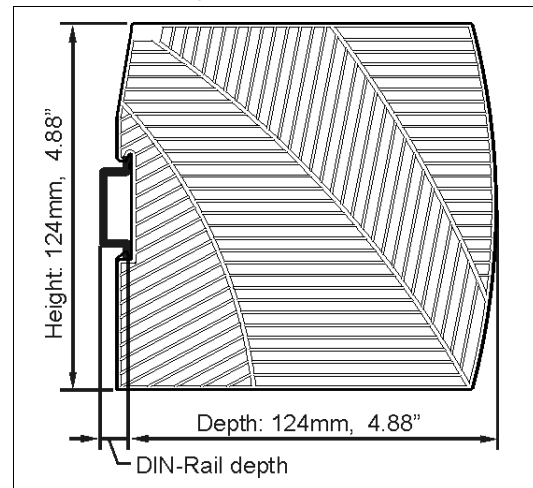


Fig. 16-2 Side view



17. APPLICATION NOTES

17.1. USING ONLY ONE INPUT INSTEAD OF BOTH CHANNELS

Using only one input instead of both is allowed up to a nominal input current of 20A at max. +55°C ambient temperature.

However, it is always recommended to connect both input path in parallel for reduced power losses and voltage drop. In cases when this is not possible, the following values can be expected:

Voltage drop, input to output	typ.	585mV	at 1x10A, 25°C, see Fig. 17-1
	typ.	645mV	at 1x20A, 25°C, see Fig. 17-1
Power losses		0W	at 0A, 25°C
	typ.	5.85W	at 10A, 25°C
	typ.	12.9W	at 20A, 25°C

Fig. 17-1 Input to output voltage drop when only one input is used

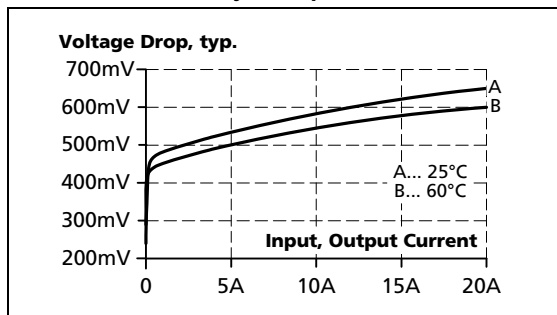
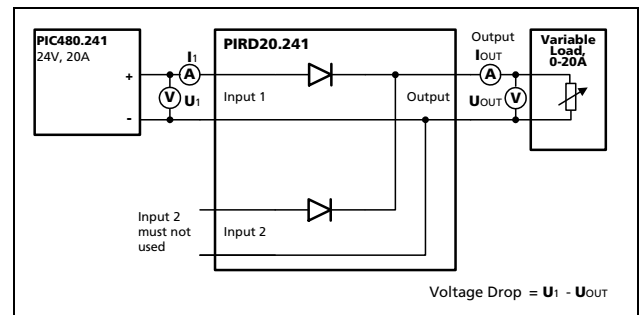


Fig. 17-2 Test setup for voltage drop measurements



17.2. RECOMMENDATIONS FOR REDUNDANCY

Recommendations for the configuration of redundant power systems:

- 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.
- Use separate input fuses for each power supply.
- 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.

17.3. INDUCTIVE AND CAPACITIVE LOADS

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

17.4. USE IN A TIGHTLY SEALED ENCLOSURE

When the redundancy module is installed in a tightly sealed enclosure, the temperature inside the enclosure will be higher than outside. The inside temperature defines the ambient temperature for the redundancy module.

Results from such an installation:

Power supply is placed in the middle of the box, no other heat producer inside the box

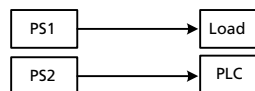
Enclosure:	Rittal Typ IP66 Box PK 9516 100, plastic, 110x180x165mm
Load:	24V, 16A; (=80%) load is placed outside the box
Input:	2x 24Vdc, 8A
Temperature inside enclosure:	42.4°C (in the middle of the right side of the power supply with a distance of 2cm)
Temperature outside enclosure:	23.1°C
Temperature rise:	19.3K

17.5. EXAMPLE: REDUNDANCY FOR CONTROLS

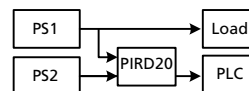
The example shows a cost effective solution to get redundant power for a PLC or controller system.

In many cases, two power supplies are used; one for the demanding loads and another one for the controls and sensitive loads. The power supply for the demanding loads can be used as a redundant source to supply the controls.

Traditional approach:



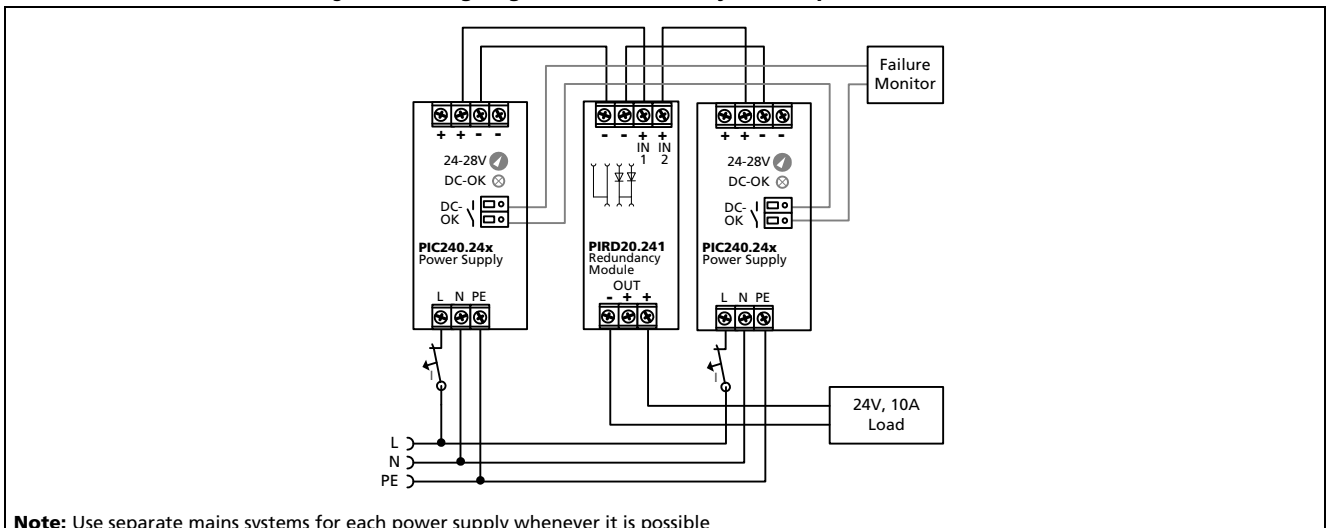
Improved approach:



17.6. EXAMPLE: 1+1 REDUNDANCY UP TO 10A

1+1 Redundancy up to 10A requires two 10A power supplies and one PIRD20.241 redundancy module.

Fig. 17-3 **Wiring diagram, 1+1 Redundancy, 10A output current**



17.7. EXAMPLE: 1+1 REDUNDANCY UP TO 20A

1+1 Redundancy up to 20A requires two 20A power supplies and two PIRD20.241 redundancy modules.

Fig. 17-4 **Wiring diagram, 1+1 Redundancy, 10A output current**

