



REDUNDANCY POWER SUPPLY

- AC 100-240V wide-range input
- Width only 48mm
- Marine approvals, EMC Class B (bridge & deck)
- Built-in decoupling MOSFET for 1+1 and N+1 redundancy
- Efficiency up to 95.2%
- 20% output power reserves (PowerBoost)
- Safe Hiccup^{PLUS} Overload Mode
- Easy Fuse Breaking – 3 times nominal current for 12ms
- Active power factor correction (PFC)
- Full power between -40°C and +60°C
- DC-OK relay contact
- Current sharing feature included
- 3 Year Warranty

PRODUCT DESCRIPTION

The Dimension CP-Series are cost optimized power supplies without compromising quality, reliability and performance.

First of all, high immunity to transients and power surges as well as low electromagnetic emission and Marine approvals with EMC Class B make the CP20.245-R2 the best choice for equipment in bridge & deck zones the same way as for oil, gas and chemical plants.

This power supply furthermore features a DC-OK signal contact to remotely monitor error-free operation, a decoupling MOSFET to set-up redundant power supply systems, and plug connector terminals to allow device replacement while the application keeps running. The CP20.245-R2 covers an extreme wide temperature range from -40°C up to +60°C providing full output power.

Outstanding features of CP20.245-R2 are its high efficiency, the electronic inrush current limitation, and an active PFC. The devices also offer PowerBoost: Power reserves of 20%, which may even be used continuously at temperatures up to +45°C. Additionally, the device can deliver about 3 times the nominal output current for 12ms which helps to trip fuses on faulty output branches.

SHORT-FORM DATA

Output voltage	DC 24V	23.8 - 25.2V
Adjustment range	-	
Output current	20A	Up to +60°C ambient
	15A	At +70°C ambient
	Derate linearly between +60°C and +70°C	
PowerBoost	24A	Up to +45°C ambient
	Linear decrease to nominal power between +45°C and +60°C	
Output ripple	max. 100mVpp	10Hz to 20MHz
AC Input voltage	AC 100-240V	-15%/+10%
Mains frequency	50-60Hz	±6%
AC Input current	4.28 / 2.25A	At 120 / 230Vac
Power factor	0.99 / 0.98	At 120 / 230Vac
AC Inrush current	10.0 / 4.5A	At 120 / 230Vac
Efficiency	93.8 / 95.2%	At 120 / 230Vac
Losses	31.7 / 24.2W	At 120 / 230Vac
Temperature range	-40°C to +70°C	
Hold-up time	32ms	
Size w x h x d	48x124x127mm	Without DIN rail and plug connectors
Weight	850g	

ORDER NUMBERS

Power Supply **CP20.245-R2**

Mechanical Accessory
ZM10.WALL Wall/Panel mount bracket

MAIN APPROVALS

For details and the complete approval list, see chapter 20.



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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.

1. INTENDED USE

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

Do not use this device in equipment, where malfunctioning may cause severe personal injury or threaten human life without additional appropriate safety devices that are suited for the end-application.

If this device is used in a manner outside of its specification, the protection provided by the device may be impaired.

2. INSTALLATION INSTRUCTIONS

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

- Turn input 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 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.

Obey the following installation instructions:

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 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 ingress protection of IP20. The housing does not provide protection against spilled liquids.

The isolation of the device is designed to withstand impulse voltages of overvoltage category III according to IEC 61010-2-201.

The device is designed as "Class of Protection I" equipment according to IEC 61140. Do not use without a proper PE (Protective Earth) connection.

The device is suitable to be supplied from TN, TT or IT mains networks. The continuous voltage between the input terminals and the PE potential must not exceed 300Vac.

The input can also be powered from a battery or a similar DC source. The continuous voltage between the supply voltage and the PE/ground potential must not exceed 375Vdc.

A disconnecting means shall be provided for the input of the device.

The device is designed for convection cooling and does not require an external fan. Do not obstruct airflow and do not cover ventilation grid!

The device is designed for altitudes up to 6000m. Above 2000m a reduction in output current and over voltage category is required.

Keep the following minimum installation clearances: 40mm on top, 20mm on the bottom, 5mm left and right side. Increase the 5mm to 15mm in case the adjacent device is a heat source. When the device is permanently loaded with less than 50%, the 5mm can be reduced to zero.

The device is designed, tested and approved for branch circuits up to 32A (IEC) and 30A (UL) without additional protection device. If an external fuse is utilized, do not use circuit breakers smaller than 10A B- or C-Characteristic to avoid a nuisance tripping of the circuit breaker.

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.

Do not unplug the connectors more often than 20 times in total.

Installation Instructions for Hazardous Location Areas

The device is suitable for use in Class I Division 2 Groups A, B, C, D locations and for use in Group II Category 3 (Zone 2) environments.

Classification: ATEX: EPS 17 ATEX 1 089 X, II 3G Ex ec nC IIC T4 Gc / IECEx EPS 17.0046X

WARNING EXPLOSION HAZARDS!

Use only in standard vertical mounting orientation with the input terminals on bottom of the unit.

Maximum output current is limited to 22A.

Substitution of components may impair suitability for this environment.

Do not disconnect the device or operate the voltage adjustment unless power has been switched off or the area is known to be non-hazardous.

A suitable enclosure must be provided for the end product which has a minimum protection of IP54 and fulfils the requirements of the EN 60079-0.

3. AC-INPUT

AC input	nom.	AC 100-240V	Suitable for TN-, TT- and IT mains networks
AC input range		85-264Vac 264-300Vac	< 500ms
Allowed voltage L or N to earth	max.	300Vac	Continuous, IEC 62477-1
Input frequency	nom.	50–60Hz	±6%
Turn-on voltage	typ.	82Vac	Steady-state value, see Fig. 3-1
Shut-down voltage	typ.	72Vac	Steady-state value, see Fig. 3-1
External input protection		See recommendations in chapter 24.4.	

		AC 100V	AC 120V	AC 230V	
Input current	typ.	5.17A	4.28A	2.25A	At 20A, see Fig. 3-3
Power factor ^{*)}	typ.	0.996	0.996	0.980	At 20A, see Fig. 3-4
Crest factor ^{**)}	typ.	1.65	1.63	1.63	At 20A
Start-up delay	typ.	450ms	420ms	440ms	See Fig. 3-2
Rise time	typ.	145ms	145ms	145ms	At 20A const. current load, 0mF load capacitance, see Fig. 3-2
	typ.	160ms	160ms	160ms	At 20A const. current load, 20mF load capacitance, see Fig. 3-2
Turn-on overshoot	max.	1V	1V	1V	See Fig. 3-2

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

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

Fig. 3-1 Input voltage range

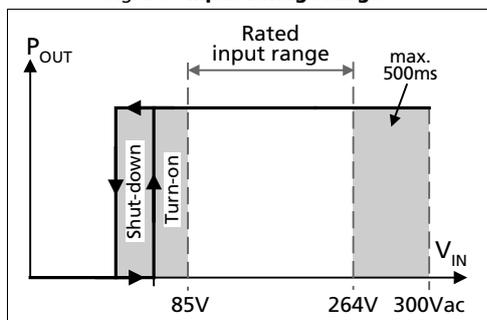


Fig. 3-2 Turn-on behavior, definitions

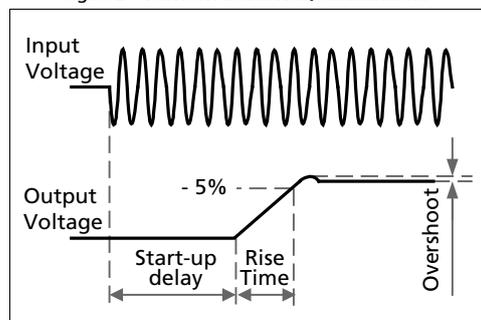


Fig. 3-3 Input current vs. output current

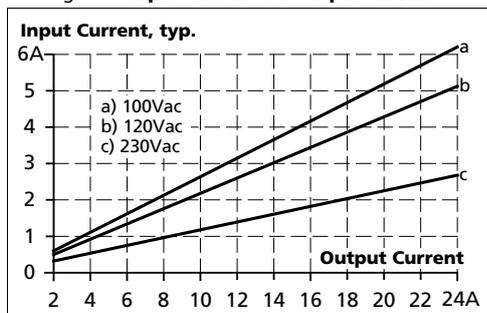
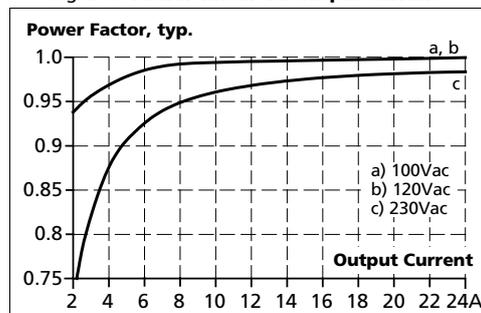


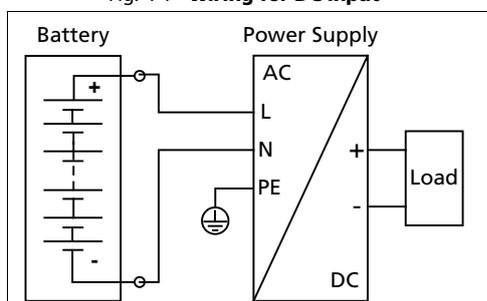
Fig. 3-4 Power factor vs. output current



4. DC-INPUT

DC input	nom.	DC 110-150V	±20%
DC input range		88-180Vdc	
DC input current	typ.	4.64A	At 110Vdc, at 20A
Allowed Voltage L/N to Earth	max.	375Vdc	Continuous, IEC 62477-1
Turn-on voltage	typ.	80Vdc	Steady state value
Shut-down voltage	typ.	70Vdc	Steady state value

Fig. 4-1 **Wiring for DC Input**



Instructions for DC use:

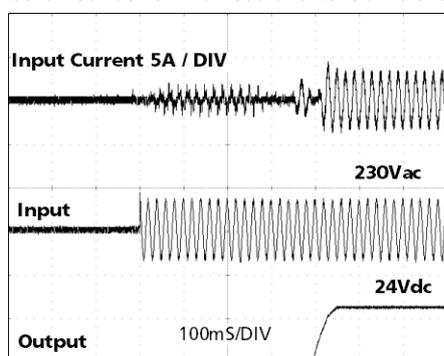
- a) Use a battery or a similar DC source. A supply from the intermediate DC-bus of a frequency converter is not recommended and can cause a malfunction or damage the unit.
- b) Connect +pole to L and –pole to N.
- c) Connect the PE terminal to an earth wire or to the machine ground.

5. INPUT INRUSH CURRENT

An active inrush limitation circuit 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.	15A _{peak}	12A _{peak}	5.5A _{peak}	Temperature independent
	typ.	12A _{peak}	10A _{peak}	4.5A _{peak}	Temperature independent
Inrush energy	max.	negligible small			

Fig. 5-1 **Typical input inrush current behaviour at nominal load and 25°C ambient**



6. OUTPUT

Output voltage	nom.	DC 24V	23.8 - 25.2V
The device is featured with a "soft output regulation characteristic" in order to achieve current share between multiple devices, when they are connected in parallel. The "soft output regulation characteristic" regulates the output voltage in such a manner that the voltage at no load is approx. 4% higher than at nominal load.			
Adjustment range		See chapter 24.2	
Factory settings		24.1V	±0.2%, at 20A, cold unit (results to typ. 23.9V±0.2% at 24A and typ. 25.1V±0.2% at no load)
Line regulation	max.	10mV	85-300Vac
Load regulation	typ.	1000mV	Static value, 0A → 20A; see Fig. 6-1
Ripple and noise voltage	max.	100mVpp	10Hz to 20MHz, 50Ohm
Output current	nom.	20A	Up to 60°C ambient temperature, see Fig. 16-1
	nom.	15A	At 70°C ambient temperature, see Fig. 16-1
		Derate linearly between +60°C to +70°C, see chapter 16	
PowerBoost*)	nom.	24A	Up to 45°C ambient temperature, see Fig. 16-1
		PowerBoost decreases linearly to nominal power between +45°C and +60°C, see chapter 16	
Fuse breaking current	typ.	60A	Up to 12ms once every five seconds, see Fig. 6-3 The output voltage stays above 20V. See chapter 24.1 for more peak current measurements.
Overload behaviour		Continuous current	Output voltage > 13Vdc, see Fig. 6-1
		Hiccup ^{PLUS} mode**)	Output voltage < 13Vdc, see Fig. 6-1
Short-circuit current	min.	26A ^{***)}	Load impedance <10mOhm, see Fig. 6-1
	max.	31A ^{***)}	Load impedance <10mOhm, see Fig. 6-1
	max.	9.8A ^{***)}	Average (R.M.S.) current, load impedance 50mOhm, see Fig. 6-2.
	min.	55A	Up to 12ms, load impedance <10mOhm, see Fig. 6-3
	typ.	70A	Up to 12ms, load impedance <10mOhm, see Fig. 6-3
Output capacitance	typ.	8 000µF	Included inside the power supply

***) PowerBoost**

This power/ current is continuously allowed up to an ambient temperature of 45°C. Above 45°C, do not use this power/ current longer than a duty cycle of 10% and/ or not longer than 1 minute every 10 minutes.

*****) Hiccup^{PLUS} Mode**

At heavy overloads (when output voltage falls below 13V), the power supply delivers continuous output current for 2s. After this, the output is switched off for approx. 18s before a new start attempt is automatically performed. This cycle is repeated as long as the overload exists. If the overload has been cleared, the device will operate normally. See Fig. 6-2.

*****) Discharge current of output capacitors is not included.**

Fig. 6-1 Output voltage vs. output current, typ.

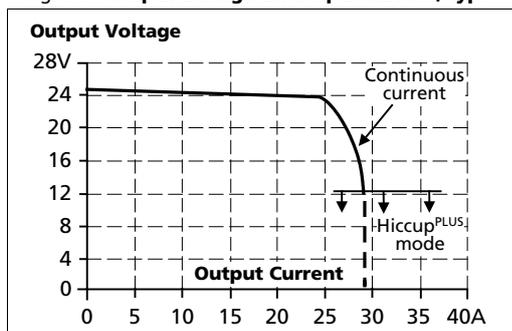


Fig. 6-2 Short-circuit on output, Hiccup^{PLUS} mode, typ.

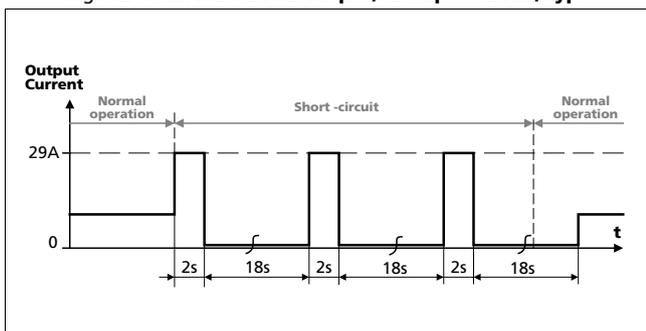
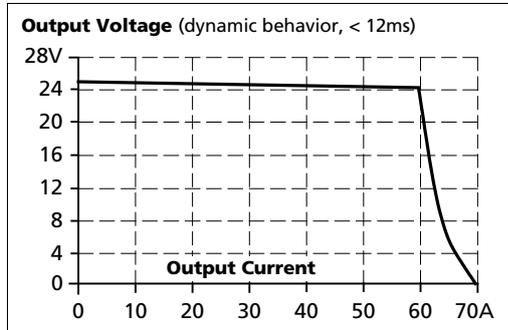


Fig. 6-3 **Dynamic overcurrent capability, typ.**



7. HOLD-UP TIME

		AC 100V	AC 120V	AC 230V	
Hold-up Time	typ.	65ms	65ms	65ms	At 10A, see Fig. 7-1
	min.	54ms	54ms	54ms	At 10A, see Fig. 7-1
	typ.	32ms	32ms	32ms	At 20A, see Fig. 7-1
	min.	24ms	24ms	24ms	At 20A, see Fig. 7-1

Fig. 7-1 **Hold-up time vs. input voltage**

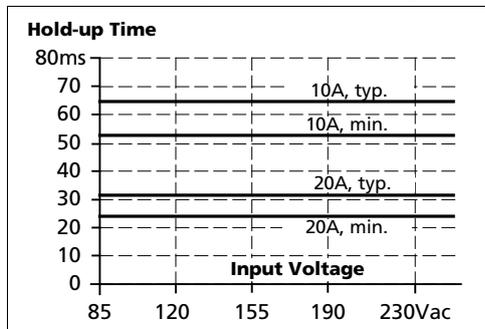
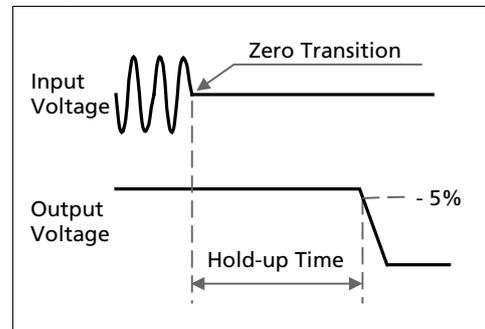


Fig. 7-2 **Shut-down behavior, definitions**

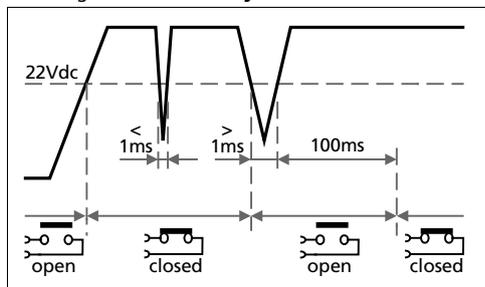


8. DC-OK RELAY CONTACT

This feature monitors the output voltage of the power supply in front of the decoupling device (see also chapter 11).

Contact closes	As soon as the output voltage reaches typ. 22Vdc.		
Contact opens	As soon as the output voltage dips below 22Vdc. Short dips will be extended to a signal length of 100ms. Dips shorter than 1ms will be ignored.		
Contact ratings	max. 60Vdc 0.3A, 30Vdc 1A, 30Vac 0.5A	resistive load	
	min. 1mA at 5Vdc	min. permissible load	
Isolation voltage	See dielectric strength table in chapter 19.		

Fig. 8-1 DC-ok relay contact behavior



9. EFFICIENCY AND POWER LOSSES

		AC 100V	AC 120V	AC 230V	
Efficiency	typ.	93.2%	93.8%	95.2%	At 20A
	typ.	93.1%	93.7%	95.1%	At 24A (PowerBoost)
Average efficiency*)	typ.	92.8%	93.4%	94.6%	25% at 5A, 25% at 10A, 25% at 15A, 25% at 20A
Power losses	typ.	3.9W	3.5W	3.3W	At 0A
	typ.	17.4W	16.4W	13.8W	At 10A
	typ.	35.0W	31.7W	24.2W	At 20A
	typ.	42.7W	38.7W	29.7W	At 24A (PowerBoost)

*) 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.

Fig. 9-1 Efficiency vs. output current, typ.

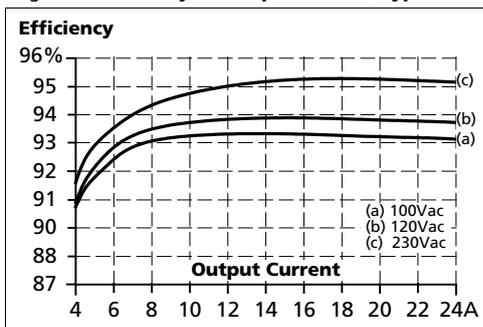


Fig. 9-2 Losses vs. output current, typ.

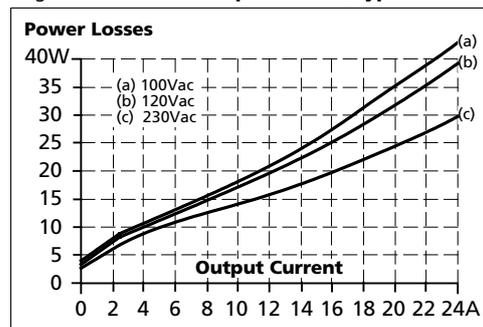


Fig. 9-3 Efficiency vs. input voltage at 20A, typ.

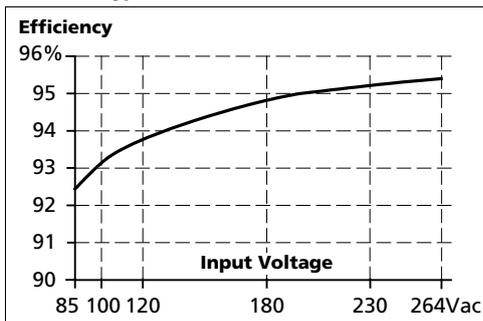
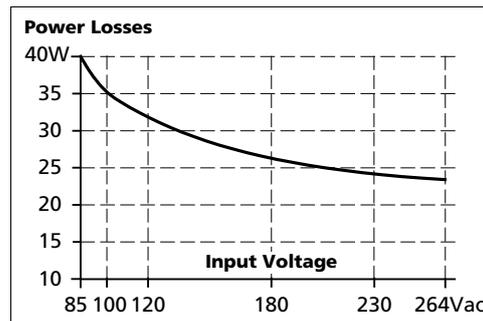


Fig. 9-4 Losses vs. input voltage at 20A, typ.

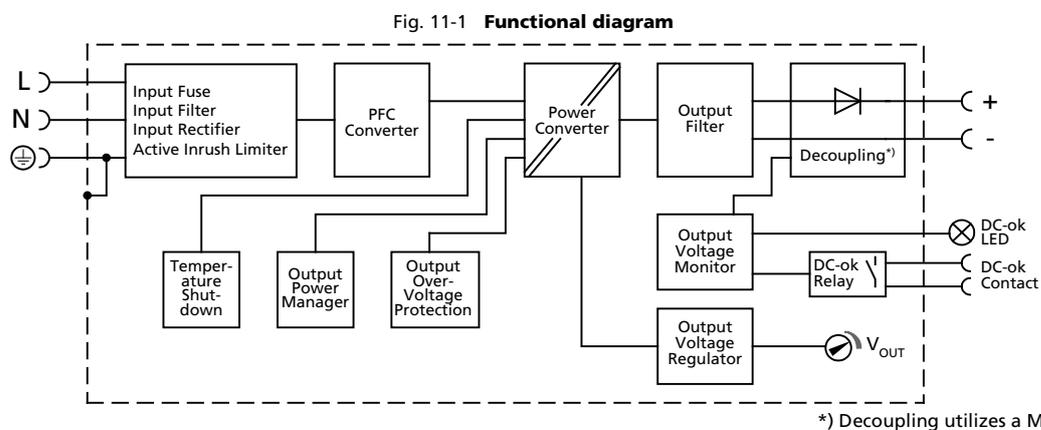


10. LIFETIME EXPECTANCY AND MTBF

	AC 100V	AC 120V	AC 230V	
Lifetime expectancy*)	117 000h	136 000h*)	164 000h*)	At 10A and 40°C
	331 000h*)	386 000h*)	465 000h*)	At 10A and 25°C
	40 000h	53 000h	90 000h	At 20A and 40°C
	114 000h	150 000h*)	253 000h*)	At 20A and 25°C
	16 000h	25 000h	47 000h	At 24A and 40°C
	44 000h	69 000h	134 000h*)	At 24A and 25°C
MTBF**) SN 29500, IEC 61709	387 000h	412 000h	543 000h	At 20A and 40°C
	723 000h	768 000h	976 000h	At 20A and 25°C
MTBF**) MIL HDBK 217F	164 000h	169 000h	199 000h	At 20A and 40°C; Ground Benign GB40
	224 000h	231 000h	272 000h	At 20A and 25°C; Ground Benign GB25
	34 000h	36 000h	42 000h	At 20A and 40°C; Ground Fixed GF40
	45 000h	47 000h	56 000h	At 20A and 25°C; Ground Fixed GF25

- *) 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 Failures**, which is calculated according to statistical device failures, and indicates reliability of a device. It is the statistical representation of the likelihood of a unit to fail and does not necessarily represent the life of a product. The MTBF figure is a statistical representation of the likelihood of a device to fail. A MTBF figure of e.g. 1 000 000h means that statistically one unit will fail every 100 hours if 10 000 units are installed in the field. However, it cannot be determined if the failed unit has been running for 50 000h or only for 100h.

11. FUNCTIONAL DIAGRAM



12. TERMINALS AND WIRING

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

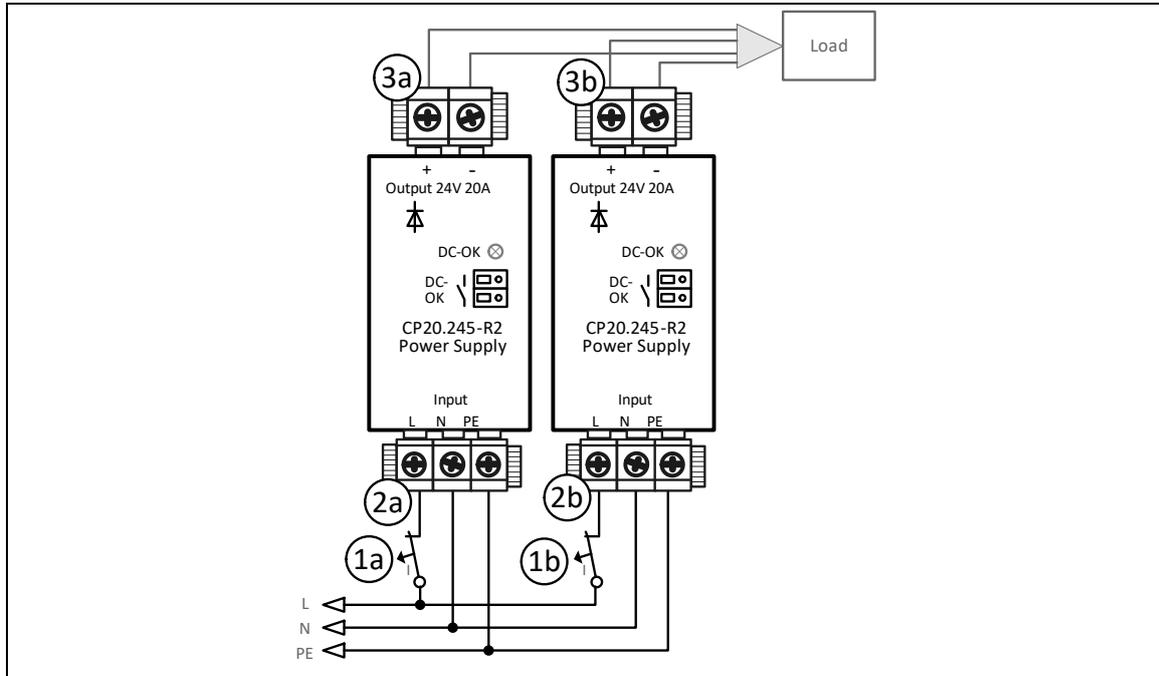
Type	Input	Output	DC-OK-Signal
	plug connector with screw termination	plug connector with screw termination	plug connector with screw termination
Solid wire	max. 4mm ²	max. 6mm ²	max. 1.5mm ²
Stranded wire	max. 2.5mm ²	max. 6mm ²	max. 1.5mm ²
American Wire Gauge	AWG 20-12	AWG 24-10	AWG 26-14
Max. wire diameter	2.4mm (including ferrules)	3.2mm (including ferrules)	1.8mm (including ferrules)
Recommended tightening torque	max. 0.5Nm	max. 0.6Nm	max. 0.8Nm
Wire stripping length	7mm	12mm	6mm
Screwdriver	3.5mm slotted or cross-head No 2	3.5mm slotted or cross-head No 2	3.5mm slotted

Instructions:

- a) 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.
- 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.

13. REPLACING UNITS WHILE THE SYSTEM IS RUNNING

Fig. 13-1 Replacing the power supply or redundancy module while the system is running



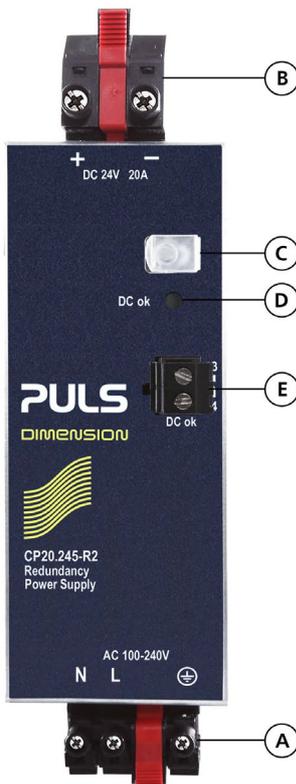
Instructions:

- Switch-off circuit breaker (1a).
- Remove plug (2a).
- Remove plug (3a). The plug prevents the cables from shorting.
- Change power supply.
- Put the plug (3a) back in.
- Put the plug (2a) back in.
- Turn-on the circuit breaker (1a).
- The circuit is redundant again.

To replace the right power supply or redundancy module, use the same procedure but turn off circuit breaker (1b) and remove plug / plug in (2b) and (3b).

14. FRONT SIDE AND USER ELEMENTS

Fig. 14-1 Front side



A Input Terminals (plug connector)

N, L Line input

 PE (Protective Earth) input

B Output Terminals (plug connector)

+ Positive output

- Negative (return) output

C Output voltage potentiometer

See chapter 24.2.

D DC-OK LED (green)

On, when the output voltage is above 22V.

E DC-OK Relay Contact (plug connector)

The DC-OK relay contact is synchronized with the DC-OK LED. See chapter 8 for details.

15. EMC

The power supply 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
		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	4kV	Criterion A
		Output lines	2kV	Criterion A
		DC-OK signal (coupling clamp)	2kV	Criterion A
Surge voltage on input	EN 61000-4-5	L → N	2kV	Criterion A
		L → PE, N → PE	3kV	Criterion A
Surge voltage on output	EN 61000-4-5	+ → -	1kV	Criterion A
		+ / - → PE	2kV	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	0Vac, 20ms	Criterion A
		40% of 100Vac	40Vac, 200ms	Criterion C
		70% of 100Vac	70Vac, 500ms	Criterion A
		0% of 200Vac	0Vac, 20ms	Criterion A
		40% of 200Vac	80Vac, 200ms	Criterion A
70% of 200Vac	140Vac, 500ms	Criterion A		
Voltage interruptions	EN 61000-4-11	0% of 200Vac (=0V)	5000ms	Criterion C
Voltage sags	SEMI F47 0706	Dips on the input voltage according to SEMI F47 standard		
		80% of 120Vac (96Vac)	1000ms	Criterion A
		70% of 120Vac (84Vac)	500ms	Criterion A
50% of 120Vac (60Vac)	200ms	Criterion A		
Powerful transients	VDE 0160	Over entire load range	750V, 0.3ms	Criterion A

Criteria:

- A:** Power supply shows normal operation behavior within the defined limits.
- 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 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 DC power port according EN 61000-6-3 fulfilled	
Radiated emission	EN 55011, EN 55022	Class B	
Harmonic input current	EN 61000-3-2	Class A equipment: fulfilled Class C equipment: fulfilled in the load range from 8 to 24A	
Voltage fluctuations, flicker	EN 61000-3-3	Fulfilled*)	

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.

*) tested with constant current loads, no pulsing

**) for information only, not mandatory for EN 61000-6-3

Switching Frequencies	The power supply has two converters with two different switching frequencies included.	
Switching frequency 1	70kHz to 130kHz	PFC converter, input voltage and output power dependent
Switching frequency 2	80kHz to 140kHz	Main converter, output power dependent

16. ENVIRONMENT

Operational temperature ¹⁾	-40°C to +70°C	Reduce output power according Fig. 16-1
Storage temperature	-40°C to +85°C	For storage and transportation
Output derating ⁴⁾	12W/K	+60°C to +70°C
Humidity ²⁾	5 to 95% r.h.	IEC 60068-2-30
Atmospheric pressure	110-80kPa 80-47kPa	De-rating requirements of Fig. 16-2 apply
Altitude	Up to 2000m 2000 to 6000m	Without any restrictions Derating ⁴⁾ requirements of Fig. 16-2 apply
Altitude derating ⁴⁾	30W/1000m or 5K/1000m	Above 2000m , see Fig. 16-2
Over-voltage category	III II	acc. IEC 61010-2-201, altitudes up to 2000m acc. IEC 61010-2-201, altitudes up to 6000m and atmospheric pressures from 80-47kPa
Degree of pollution	2	acc. IEC 61010-2-201, not conductive
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
LABS compatibility	The unit does not release any silicone or other LABS-critical substances and is suitable for use in paint shops.	
Audible noise	Some small audible noise will be emitted from the power supply	

- 1) Operational temperature is the same as the ambient or surrounding 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 orientation.
- 4) The de-rating is not hardware controlled. The customer has to take care by himself to stay below the de-rated current limits in order not to overload the unit.

Fig. 16-1 **Output current vs. ambient temp.**
(Inom = 20A; Iout with PowerBoost = 24A)

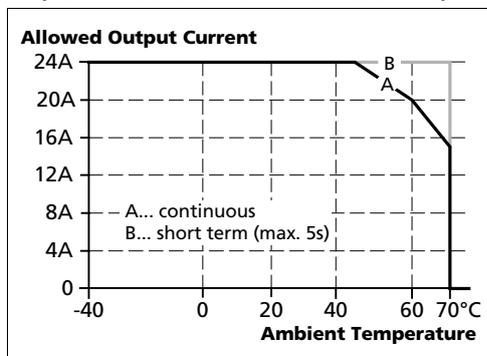
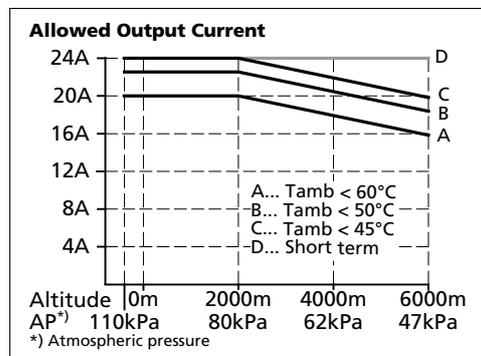


Fig. 16-2 **Output current vs. altitude**



17. PROTECTION FEATURES

Output protection	Electronically protected against overload, no-load and short-circuits ^{*)}	
Output over-voltage protection	typ. 30.5Vdc max. 32Vdc	In case of an internal power supply defect, a redundant circuit limits the maximum output voltage. The output shuts down and performs three restart attempts. If the failure continues for longer than 1s, the output shuts down. Cycle input power to reset.
Degree of protection	IP20	EN/IEC 60529
Penetration protection	> 5mm	E.g. screws, small parts
Over-temperature protection	yes ^{**)}	Output shut-down with automatic restart
Input transient protection	MOV (Metal Oxide Varistor)	For protection values see chapter 15 (EMC).
Internal input fuse	included	Not user replaceable slow-blow high-braking capacity fuse

^{*)} In case of a protection event, audible noise may occur.

^{**)} The temperature sensor is installed inside the isolating transformer and turns the unit off in safety critical situations (e.g. customer does not care about de-rating requirements, ambient temperature too high, obstructs the airflow or install the unit in unsuitable mounting orientation)
There is no correlation between the operating temperature and turn-off temperature since this is dependent on input voltage, load and installation methods.

18. SAFETY FEATURES

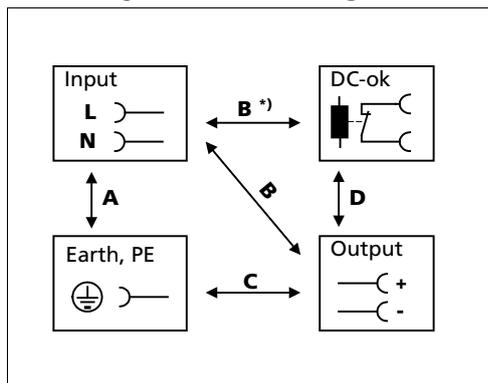
Input / output separation ^{*)}	SELV PELV double or reinforced insulation	IEC/EN 60950-1 IEC/EN 60204-1, EN 62477-1, IEC 60364-4-41
Class of protection	I	PE (Protective Earth) connection required
Isolation resistance	> 500MOhm	At delivered condition between input and output, measured with 500Vdc
	> 500MOhm	At delivered condition between input and PE, measured with 500Vdc
	> 500MOhm	At delivered condition between output and PE, measured with 500Vdc
	> 500MOhm	At delivered condition between output and DC-OK contacts, measured with 500Vdc
PE resistance	< 0.1Ohm	Resistance between PE terminal and the housing in the area of the DIN rail mounting bracket.
Touch current (leakage current)	typ. 0.32mA / 0.89mA	At 100Vac, 50Hz, TN-,TT-mains / IT-mains
	typ. 0.46mA / 1.27mA	At 120Vac, 60Hz, TN-,TT-mains / IT-mains
	typ. 0.73mA / 1.91mA	At 230Vac, 50Hz, TN-,TT-mains / IT-mains
	max. 0.40mA / 1.07mA	At 110Vac, 50Hz, TN-,TT-mains / IT-mains
	max. 0.56mA / 1.53mA	At 132Vac, 60Hz, TN-,TT-mains / IT-mains
	max. 0.90mA / 2.34mA	At 264Vac, 50Hz, TN-,TT-mains / IT-mains

^{*)} double or reinforced insulation

19. DIELECTRIC STRENGTH

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

Fig. 19-1 Dielectric strength



		A	B	C	D
Type test	60s	2500Vac	3000Vac	1000Vac	500Vac
Factory test	5s	2500Vac	2500Vac	500Vac	500Vac
Field test	5s	2000Vac	2000Vac	500Vac	500Vac
Cut-off current setting		>15mA	>15mA	>20mA	>1mA
Field test)					

To fulfil the PELV requirements according to EN60204-1 § 6.4.1, we recommend that either the + pole, the - pole or any other part of the output circuit shall be connected to the protective earth system. This helps to avoid situations in which a load starts unexpectedly or cannot be switched off when unnoticed earth faults occur.

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

20. APPROVED, FULFILLED OR TESTED STANDARDS

IEC 61010-2-201	CB Report	CB Scheme Certificate Electrical Equipment for Measurement, Control and Laboratory Use - Particular requirements for control equipment
IEC 62368-1	CB Report	CB Scheme Certificate IEC 62368-1 Audio/video, information and communication technology equipment - Safety requirements Output safety level: ES1
UL 61010-2-201		UL Certificate Listed equipment for category NMTR - Electrical Equipment for Measurement, Control and Laboratory Use - Particular requirements for control equipment Applicable for US and Canada E-File: E198865
ATEX		Agency Certificate (Bureau Veritas) EN 60079-0 Explosive atmospheres - General requirements EN 60079-7, EN 60079-15 Equipment protection by type of protection "e" and "n" Certificate: EPS 17 ATEX 1 089 X Temperature Code: T4 Type of Protection: ec nC
IEC 60079 (IECEX)	IECEX	IECEX Certificate IEC 60079-0 Explosive atmospheres - General requirements IEC 60079-7, IEC 60079-15 Equipment protection by type of protection "e" and "n" Certificate: IECEX EPS 17.0046X Temperature Code: T4 Type of Protection: ec nC
Marine (DNV)		DNV Certificate DNV Type approved product Certificate: TAA00002A7 Temperature: Class D Humidity: Class B Vibration: Class C EMC: Class B Enclosure: Class A
Marine (LR)		Loyds Register Certificate Lloyds Register Type approved product Certificate: LR2001711TA Category: ENV3 EMC: for bridge and deck zones
Marine (BV)		Bureau Veritas Marine and Offshore Certificate BV (Bureau Veritas) type approved product Certificate: 58507/A0 BV EC-Code: 31B EMC: for bridge and deck zones

Marine (ABS)

ABS

BS Design Assessment Certificate
 ABS (American Bureau of Shipment) assessed product
 Certificate: 20-1980458-PDA
 Bridge and deck zone

ANSI/ISA-71.04-2013

Corrosion
G3-ISA-71.04 ✓

Agency Test Report supplemented by a rationale report
 Airborne Contaminants Corrosion Test
 Severity Level G3
 H2S: 50ppb
 NOx: 1250ppb
 Cl2: 10ppb
 SO2: 300ppb
 Test Duration: 30 days, simulates a service life of 10 years.

Labs

LABS
 VDMA 24364-C1-L/W

Paint Wetting Impairment Substances Test (or LABS-Test)
 Tested for Zone 2 and test class C1 according to VDMA
 24364-C1-L/W for solvents and water-based paints

21. REGULATORY PRODUCT COMPLIANCE

CE

CE

EU Declaration of Conformity
 Trade conformity assessment for Europe
 The CE mark indicates conformance with the European
 - RoHS directive
 - EMC directive,
 - Low-voltage directive and the
 - ATEX directive

REACH Directive

REACH ✓

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 RoHS 2)



Manufacturer's Statement
 Administrative Measures for the Restriction of the use of
 hazardous substances in electrical and electronic products
 25 years

22. PHYSICAL DIMENSIONS AND WEIGHT

Width	48mm
Height	124mm (without plug-connectors)
Depth	127mm (without plug-connector) The DIN rail depth must be added to the unit depth to calculate the total required installation depth.
DIN rail	Use 35mm DIN rails according to EN 60715 or EN 50022 with a height of 7.5 or 15mm.
Weight	850g
Housing material	Body: Aluminium alloy Cover and mounting bracket: zinc-plated steel
Installation clearances	See chapter 2

Fig. 22-1 **Front view**

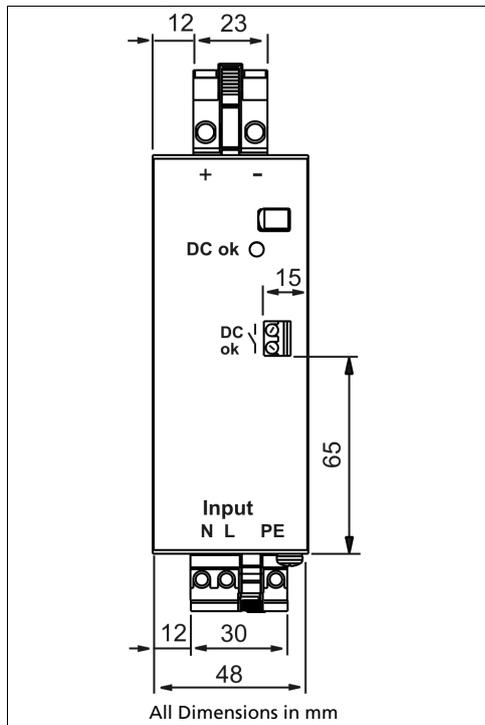
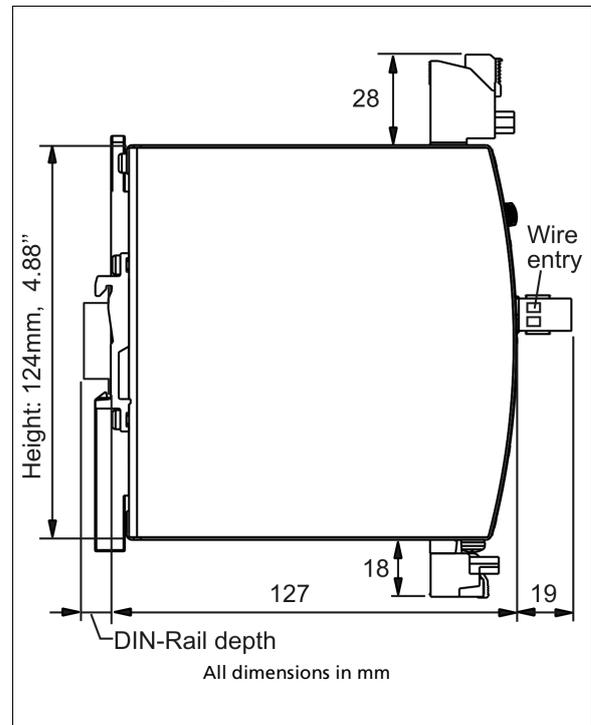


Fig. 22-2 **Side view**



23. ACCESSORIES

23.1. ZM10.WALL – WALL/PANEL MOUNT BRACKET

This bracket is used to mount the devices on a wall/panel without utilizing the DIN rail. The bracket can be mounted without detaching the DIN rail brackets from the power supply. Product for illustration purpose only.

Fig. 23-1 **Isometric view**

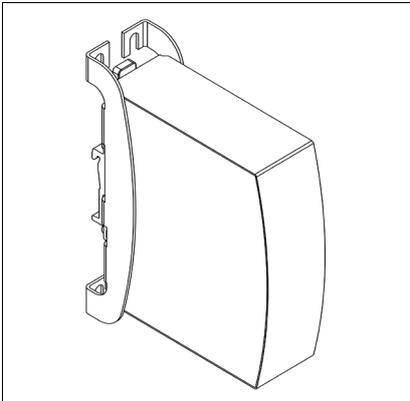


Fig. 23-2 **Isometric view**

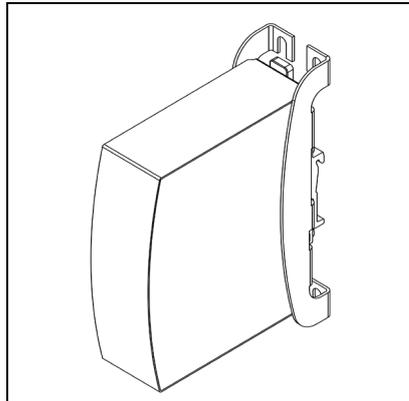


Fig. 23-3 **Isometric view**

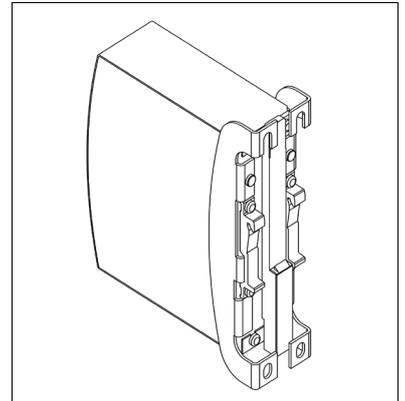


Fig. 23-4 **Wall/panel mounting, front view**

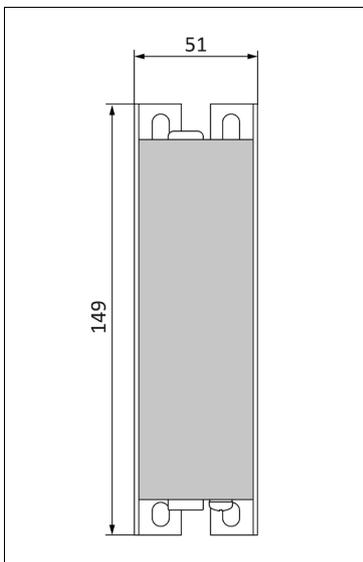


Fig. 23-5 **Hole pattern for wall mounting**

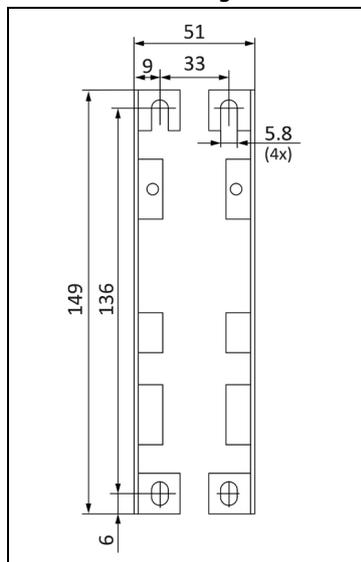
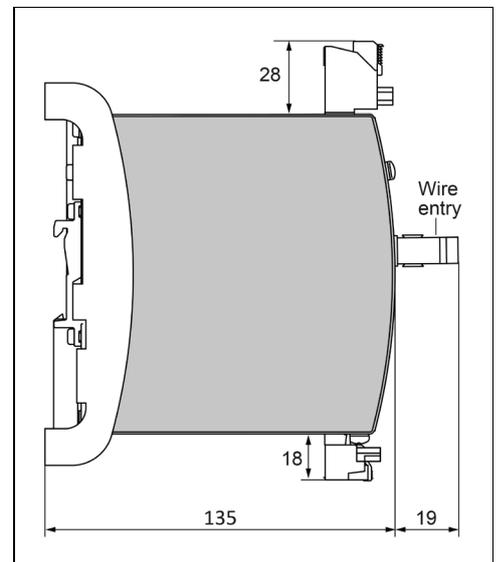


Fig. 23-6 **Wall/panel mounting, side view**



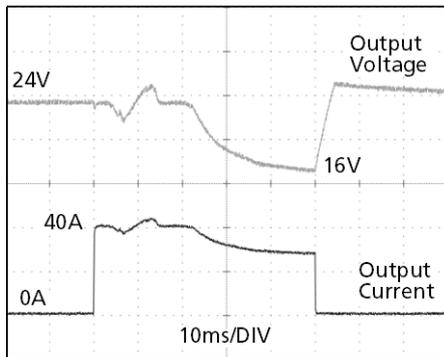
24. APPLICATION NOTES

24.1. PEAK CURRENT CAPABILITY

The device has a power reserve of 20% included, which may even be used continuously at temperatures up to +45°C. Additionally, it can deliver about 3 times the nominal output current for 12ms which helps to trip fuses on faulty output branches or to start peak 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 (including the PowerBoost). The same situation applies when starting a capacitive load.

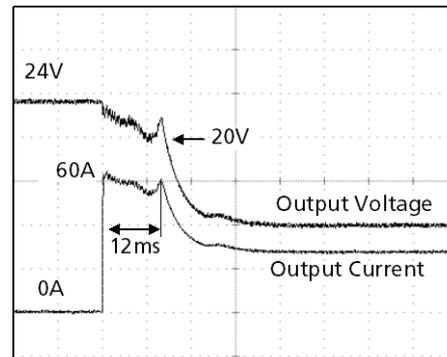
The following examples show typical voltage dips:

Fig. 24-1 **Peak load with 2x the nominal current for 50ms, typ.**



40A Peak load (resistive) for 50ms
Output voltage dips from 24V to 16V.

Fig. 24-2 **60A Peak load for 12ms, typ.**



Please note: The DC-OK relay triggers when the voltage dips below 22Vdc for longer than 1ms.

24.2. ADJUSTMENT OF THE OUTPUT VOLTAGE

A voltage adjustment potentiometer can be found behind the flap on the front of the unit (see chapter 14). However, it is not recommended to change the output voltage since load sharing between power supplies connected in parallel can only be achieved by a precise setting of the output voltage. This is the case with the factory settings.

Only trained personnel should operate the voltage adjustment potentiometer.

Lower end of the specified adjustment range

Output voltage	min.	24.0V	At 20A Due to the soft output voltage regulation characteristic a setting to 24.0V results to an output voltage of $23.8V \pm 0.2\%$ at 24A and $25.0V \pm 0.2\%$ at no load. See Fig. 24-3.
Output current	min.	24A	At 45°C
	min.	20A	At 60°C
	min.	15A	At 70°C
Reduce output current linearly between +45°C and +70°C.			

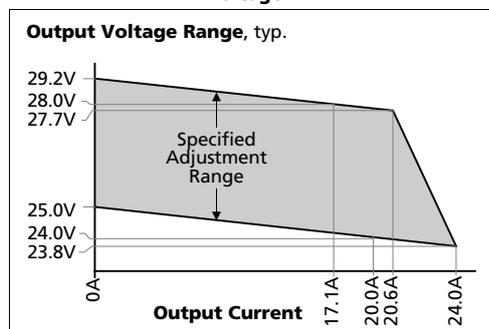
Upper end of the specified adjustment range

Output voltage	min.	28.0V	At 17.1A Due to the soft output voltage regulation characteristic a setting to 28.0V results to an output voltage of $27.7V \pm 0.2\%$ at 20.6A and $29.2V \pm 0.2\%$ at no load. See Fig. 24-3.
Output current	min.	20.6A	At 45°C
	min.	17.1A	At 60°C
	min.	13.0A	At 70°C
Reduce output current linearly between +45°C and +70°C.			

The maximum output voltage which can occur at the clockwise end position of the potentiometer due to tolerances is 30V. It is not a guaranteed value which can be achieved. The typical value is 29.5V.

Current values between 24 and 28V can be interpolated.

Fig. 24-3 Adjustment range of the output voltage



24.3. BACK-FEEDING LOADS

Loads such as decelerating motors and inductors can feed voltage back to the power supply. This feature is also called return voltage immunity or resistance against Back- E.M.F. (Electro Magnetic Force).

This power supply 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 maximum allowed feed-back-voltage is 35Vdc.

24.4. EXTERNAL INPUT PROTECTION

The unit is tested and approved for branch circuits up to 30A (UL) and 32A (IEC). An external protection is only required if the supplying branch has an ampacity greater than this. Check also local codes and local requirements. In some countries local regulations might apply.

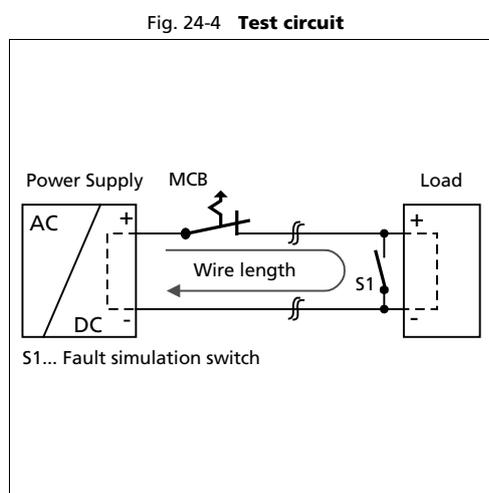
If an external fuse is necessary or utilized, minimum requirements need to be considered to avoid nuisance tripping of the circuit breaker. A minimum value of 10A B- or C-Characteristic breaker should be used.

24.5. OUTPUT CIRCUIT BREAKERS

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

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

To avoid voltage dips and under-voltage situations in adjacent 24V branches which are supplied by the same source, a fast (magnetic) tripping of the MCB is desired. A quick shutdown within 10ms is necessary corresponding roughly to the ride-through time of PLC's. This requires power supplies with high current reserves and large output capacitors. Furthermore, the impedance of the faulty branch must be sufficiently small in order for the current to actually flow. The best current reserve in the power supply does not help if Ohm's law does not permit current flow. The following table has typical test results showing which B- and C-Characteristic MCBs magnetically trip depending on the wire cross section and wire length.



Maximal wire length^{*)} for a fast (magnetic) tripping:

	0.75mm ²	1.0mm ²	1.5mm ²	2.5mm ²
C-2A	34m	45m	64m	101m
C-3A	27m	36m	52m	79m
C-4A	19m	26m	35m	56m
C-6A	9m	12m	16m	23m
C-8A	4m	8m	12m	18m
C-10A	4m	6m	9m	15m
C-13A	2m	3m	4m	5m
B-6A	23m	30m	38m	67m
B-10A	11m	14m	21m	32m
B-13A	7m	12m	17m	23m
B-16A	4m	6m	8m	11m
B-20A	1m	1m	2m	4m

*) Don't forget to consider twice the distance to the load (or cable length) when calculating the total wire length (+ and - wire).

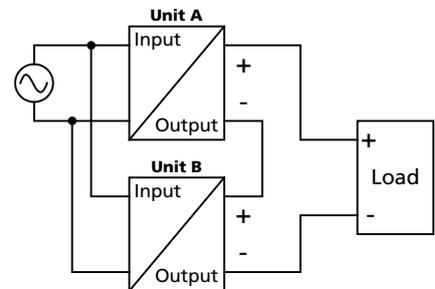
24.6. SERIES OPERATION

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

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 (input terminals on bottom of the unit).

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



24.7. PARALLEL USE TO INCREASE OUTPUT POWER

Power supplies can be paralleled to increase the output power. For redundancy applications one extra power supply is always needed for sufficient output current in case one unit fails.

The unit is permanently set to "parallel use" mode in order to achieve load sharing between power supplies connected in parallel. The "Parallel use" mode regulates the output voltage in such a manner that the voltage at no load is approx. 4% higher than at nominal load. See also chapter 6.

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

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 parallel in mounting orientations other than the standard mounting orientation (input terminals on bottom of the unit) or in any other condition where a derating of the output current is required (e.g. altitude).

Pay attention that leakage current, EMI, inrush current, harmonics will increase when using multiple power supplies. Do not load paralleled power supplies with higher currents as shown in the following diagrams:

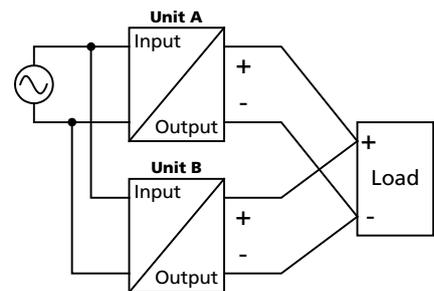


Fig. 24-5 **Output current vs. ambient temp. for two paralleled units**

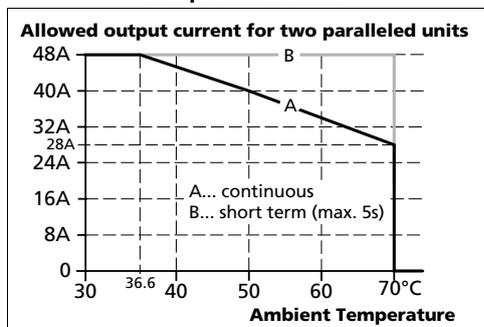
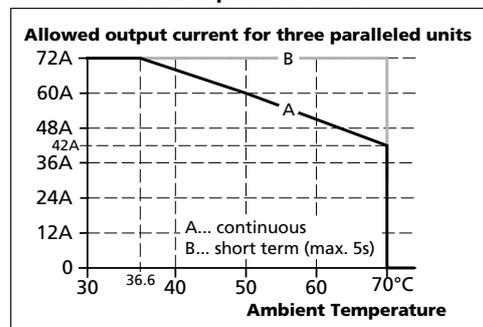


Fig. 24-6 **Output current vs. ambient temp. for three paralleled units**



24.8. PARALLEL USE FOR REDUNDANCY

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

Recommendations for building redundant power systems:

- Use separate input fuses for each power supply.
- Monitor the individual power supply units. Therefore, use the built-in DC-OK relay contact of the power supply.

Fig. 24-7 **Wiring diagram, 1+1 Redundancy for 20A output current**

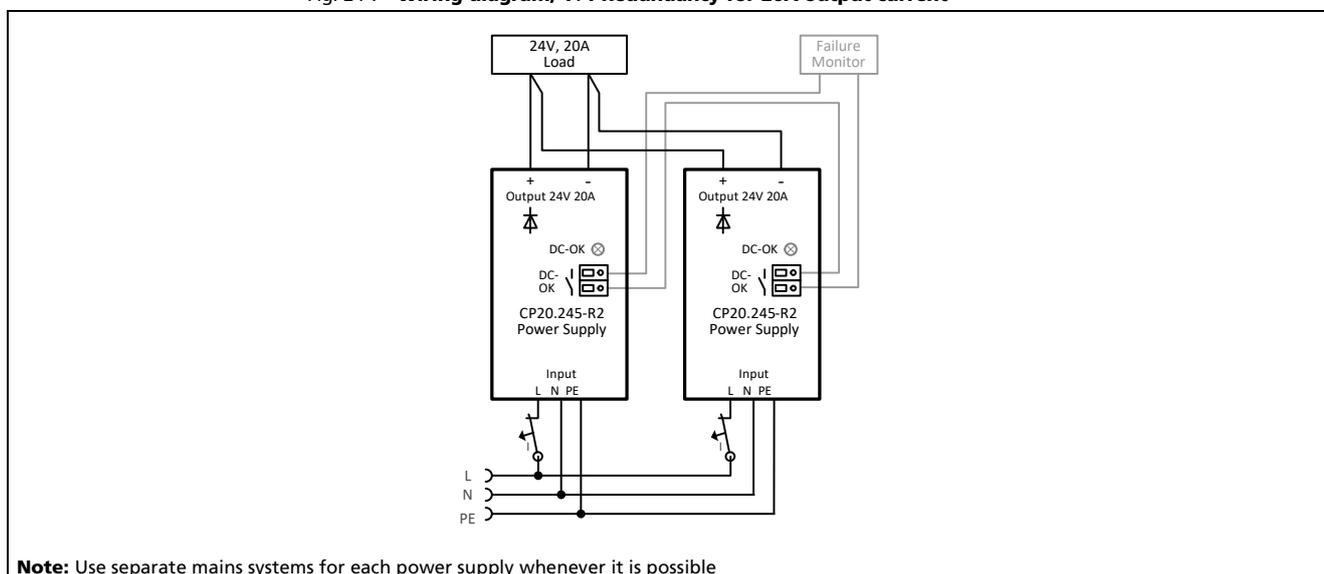
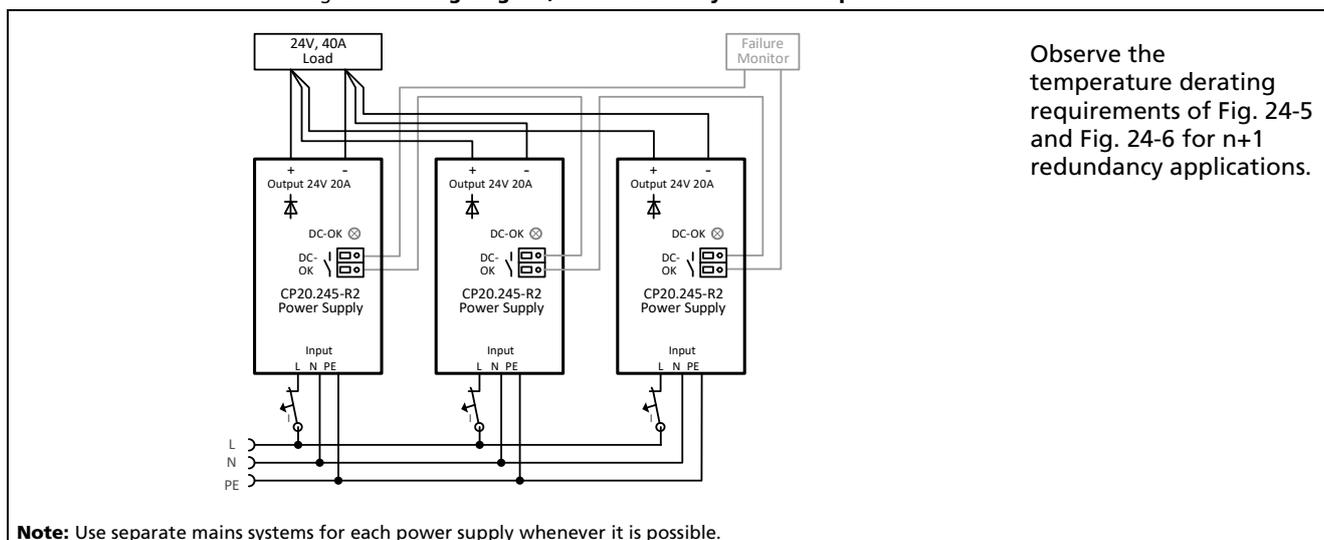


Fig. 24-8 **Wiring diagram, N+1 Redundancy for 40A output current**



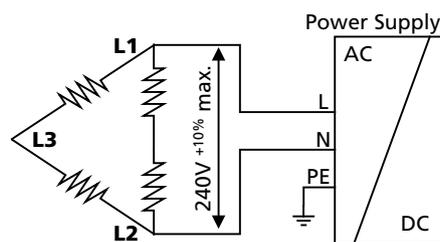
Observe the temperature derating requirements of Fig. 24-5 and Fig. 24-6 for n+1 redundancy applications.

24.9. INDUCTIVE AND CAPACITIVE LOADS

The unit 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 > 1F are connected to the output, the unit might charge the capacitor in the Hiccup^{PLUS®} mode (see chapter 6).

24.10. OPERATION ON TWO PHASES

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



24.11. 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

Enclosure:	Rittal Typ IP66 Box PK 9519 100, plastic, 180x180x165mm
Load:	24V, 16A; (=80%) load is placed outside the box
Input:	230Vac
Temperature inside enclosure:	51.9°C (in the middle of the right side of the power supply with a distance of 2cm)
Temperature outside enclosure:	25.6°C
Temperature rise:	26.3K

24.12. MOUNTING ORIENTATIONS

Mounting orientations other than all terminals on the bottom require a reduction in continuous output power or a limitation in the maximum allowed ambient temperature. The amount of reduction influences the lifetime expectancy of the power supply. Therefore, two different derating curves for continuous operation can be found below:

Curve A1 Recommended output current.

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

Fig. 24-9
Mounting
Orientation A
(Standard
orientation)

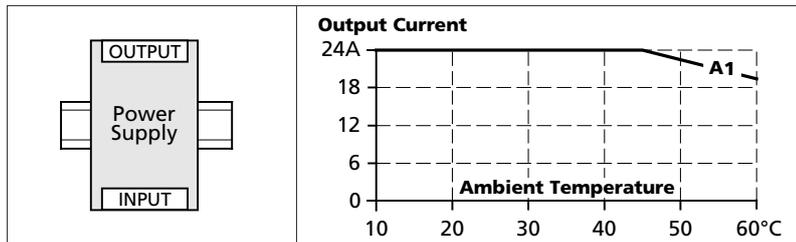


Fig. 24-10
Mounting
Orientation B
(Upside down)

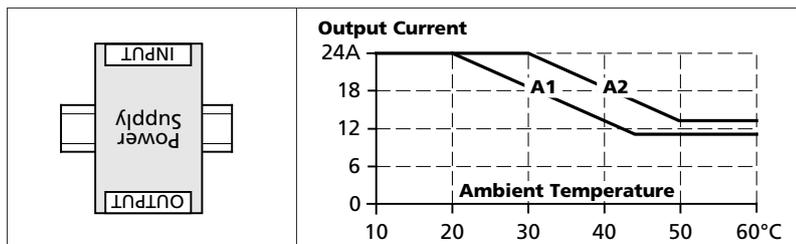


Fig. 24-11
Mounting
Orientation C
(Table-top
mounting)

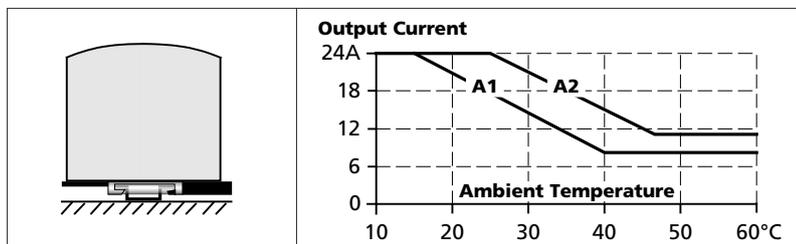


Fig. 24-12
Mounting
Orientation D
(Horizontal cw)

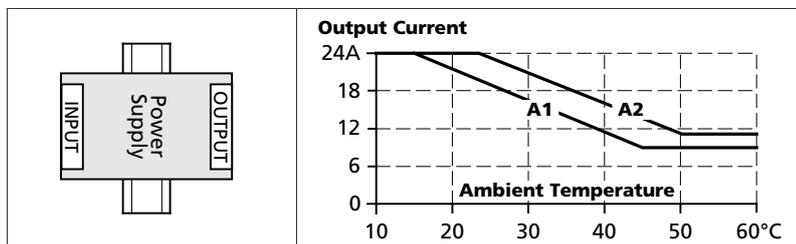


Fig. 24-13
Mounting
Orientation E
(Horizontal ccw)

