CP20.241-M1

24V, 20A, SINGLE PHASE INPUT

POWER SUPPLY

- 2MOPP safety approved for medical applications according to IEC 60601-1
- Quick-connect spring-clamp terminals
- AC 100-240V wide-range input
- Width only 48mm
- Efficiency up to 95.6%, excellent partial load efficiency
- Easy fuse breaking – 3 times nominal current for 12ms
- Safe Hiccup^{PLUS} overload mode
- Active power factor correction (PFC)
- Minimal inrush current surge
- Full power between -25°C and +60°C
- DC-OK relay contact
- 3 Year warranty

PRODUCT DESCRIPTION

The CP20.241-M1 is a DIN rail mountable single-phase-input power supply for use in industrial and medical equipment. It provides a stable and galvanically separated SELV/PELV output voltage.

The specialty of this power supply is the 2MOPP (two means of patient protection) safety approval for medical use and the fulfillment of the required EMC tests for professional healthcare facility and home healthcare environments.

The CP-Series is part of the DIMENSION power supply family. The most outstanding features of CP20.241-M1 are the high efficiency, advanced inrush current limitation, active PFC and the wide operational temperature range.

High immunity to transients and power surges as well as low electromagnetic emission, a DC-OK relay contact and a large international approval package for a variety of applications makes this unit suitable for nearly every situation.

SHORT-FORM DATA

Output voltage	DC 24V	Nominal
Adjustment range	24 - 28V	Factory setting 24.1V
Output current	20.0 – 17.1A	Up to +60°C ambient
Range A	15.0 – 13.0A	At +70°C ambient
	Derate linearly between +60°C and +70°C	
Output current	18.0 – 15.4A	Up to +60°C ambient
Range B	13.5 – 9.6A	At +70°C ambient
	Derate linearly between +60°C and +70°C	
Input voltage AC		
Range A	AC 120-240V	-15%/+10%
Range B	AC 100-240V	-15%/+10%
Mains frequency	50-60Hz	±6%
Input current AC	4.26 / 2.23A	At 120 / 230Vac
Power factor	0.99 / 0.98	At 120 / 230Vac
Input voltage DC	DC 110-150V	±20%
Input current DC	4.64A	At 110Vdc
Input Inrush current	10.0 / 4.5A$_{peak}$	At 120 / 230Vac
Efficiency	94.2 / 95.6%	At 120 / 230Vac
Power losses	29.6 / 22.1W	At 120 / 230Vac
Hold-up time	32 / 32ms	At 120 / 230Vac
Temperature range	-25°C to +70°C	
Size (WxHxD)	48x124x127mm	Without DIN rail
Weight	830g	

ORDER NUMBERS

Power Supply	**CP20.241-M1**	Medical power supply with Spring-clamp terminal
Accessory	ZM10.WALL	Wall/panel mount bracket
	ZM12.SIDE	Side mount bracket

MAIN APPROVALS

For details and the complete approval list see chapter 20.

CB Report

Medical
2MOPP - IEC 60601-1

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TERMINOLOGY AND ABREVIATIONS

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.
AC 230V	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)
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 use in medical equipment. Do not use this device in HF surgical equipment or similar apertures.

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 power off before working on the device. Protect against inadvertent re-powering.
- 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.

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.

Use shielded or unshielded cables, twisted or untwisted cables of any length. 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 +90°C for ambient temperatures between below +60°C and 1+05°C for ambient temperatures up to +70°C. Ensure that all strands of a stranded wire enter the terminal connection.

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 housing does not provide protection against spilled liquids.

The device is designed for overvoltage category II zones.

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 264Vac.

The device can also be powered from batteries or similar DC sources. The voltage between the input terminals and the PE terminal must not exceed 180Vdc continuously.

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

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

The device is designed for altitudes up to 3000m.

Keep the following minimum installation clearances: 50mm on top, 50mm 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.

Portable RF communication equipment should be used no closer than 30cm to the power supply or the power supply connection cables.

⚠ WARNING

Use of this equipment adjacent to or stacked with other equipment should be avoided because it could result in improper operation. If such use is necessary, this equipment and the other equipment should be observed to verify that they are operating normally.

Please note: This device incorporates a single fuse in the L-input. For medical use an additional external fuse in the N-input may be necessary, depending on the type of medical equipment.

3. AC-INPUT

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

AC input voltage Range A	Nom.	AC 120-240V	-15%/+10%
AC input voltage Range B	Nom.	AC 100-240V	-15%/+10%
AC input range		85-264Vac	
		264-300Vac	Occasionally for maximal 500ms
Allowed voltage L or N to earth	Max.	300Vac	Continuous, according to IEC 60664-1
Input frequency	Nom.	50–60Hz	±6%
Turn-on voltage	Typ.	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 2.		

		AC 120V	**AC 230V**	
Input current	Typ.	4.26A	2.23A	At 24V, 20A, see Fig. 3-3
Power factor	Typ.	0.996	0.980	At 24V, 20A, see Fig. 3-4
Crest factor*)	Typ.	1.63	1.63	At 24V, 20A, The crest factor is the mathematical ratio of the peak value to RMS value of the input current waveform.
Start-up delay	Typ.	450ms	450ms	See Fig. 3-2
Rise time	Typ.	145ms	145ms	At 24V, 20A const. current load, 0mF load capacitance, see Fig. 3-2
	Typ.	160ms	160ms	At 24V, 20A const. current load, 20mF load capacitance, see Fig. 3-2
Turn-on overshoot	Max.	200mV	200mV	see Fig. 3-2

Fig. 3-1 **Input voltage range**

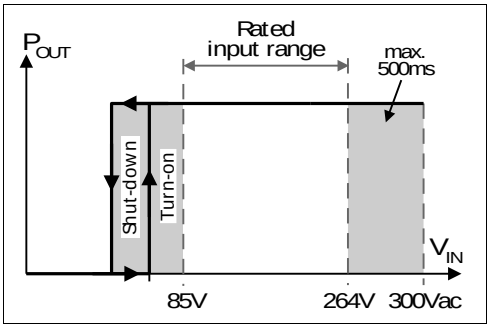


Fig. 3-2 **Turn-on behavior, definitions**

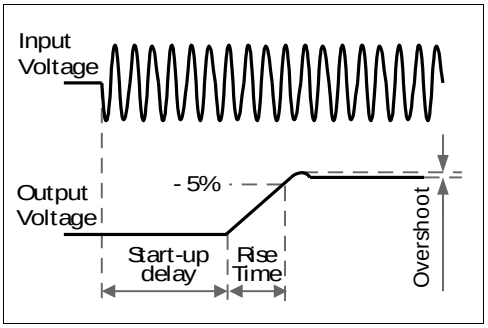


Fig. 3-3 **Input current vs. output current at 24V output voltage**

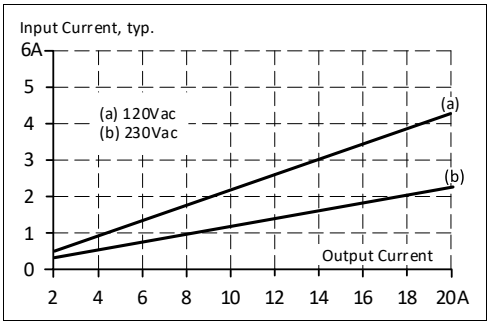
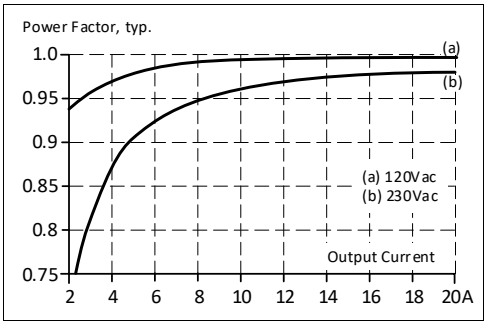


Fig. 3-4 **Power factor vs. output current at 24V output voltage**



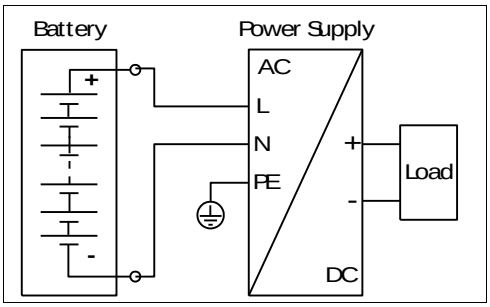
4. DC-INPUT

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

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

DC input	Nom.	DC 110-150V	±20%, derate below 110V acc. to chapter 6: Output Current, Range B
DC input range		88-180Vdc	
DC input current	Typ.	4.64A	At 110Vdc, at 24V, 20A
Allowed voltage (+) or (-) input to Earth	Max.	375Vdc	Continuous according to IEC 60664-1
Turn-on voltage	Typ.	80Vdc	Steady state value
Shut-down voltage	Typ.	70Vdc	Steady state value

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

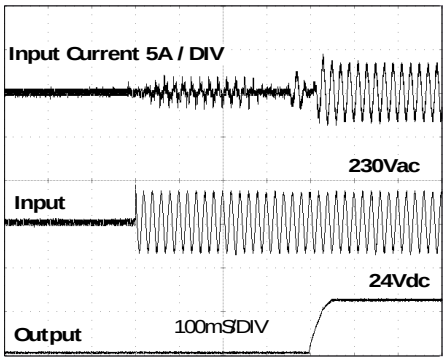


5. INPUT INRUSH CURRENT

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 120V	AC 230V	
Inrush current	Max.	$12A_{peak}$	$5.5A_{peak}$	Temperature independent
	Typ.	$10A_{peak}$	$4.5A_{peak}$	Temperature independent
Inrush energy	Max.	$1A^2s$	$1A^2s$	Temperature independent

Fig. 5-1 **Typical turn-on behavior at nominal load and 25°C ambient**



6. OUTPUT

The output provides a SELV/PELV/ES1 rated voltage, which is galvanically isolated from the input voltage.

The device is designed to supply any kind of loads, including capacitive and inductive loads. If extreme large capacitors, such as EDLCs (electric double layer capacitors or "UltraCaps") with a capacitance > 1F are connected to the output, the unit might charge the capacitor in an intermittent mode.

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

Output voltage	Nom.	24V	
Adjustment range		24-28V	Guaranteed value
	Max.	30V	This is the maximum output voltage which can occur at the clockwise end position of the potentiometer due to tolerances. It is not a guaranteed value which can be achieved.
Factory setting output voltage	Typ.	24.1V	±0.2% at full load, cold unit
Line regulation	Max.	10mV	Between 85 and 300Vac input voltage change
Load regulation	Max.	100mV	Between 0 and 24A , static value
Ripple and noise voltage	Max.	50mVpp	Bandwidth 20Hz to 20MHz, 50Ohm
Output current Range A	Nom.	20A	At 24V and up to +60°C ambient temperature
	Nom.	15A	At 24V and +70°C ambient temperature
	Nom.	17.1A	At 28V and up to +60°C ambient temperature
	Nom.	13A	At 28V and +70°C ambient temperature
		Derate linearly between +60°C and +70°C, see chapter 17	
Output current Range B	Nom.	18A	At 24V and up to +60°C ambient temperature
	Nom.	13.5A	At 24V and +70°C ambient temperature
	Nom.	15.4A	At 28V and up to +60°C ambient temperature
	Nom.	9.6A	At 28V and +70°C ambient temperature
		Derate linearly between +60°C and +70°C, see chapter 17	
Fuse breaking current	Typ.	60A	Up to 12ms once every five seconds, see Fig. 6-3. The fuse breaking current is an enhanced transient current which helps to trip fuses on faulty output branches. The output voltage stays above 20V.
Overload behavior		Continuous current	For output voltage > 13Vdc, see Fig. 6-1
		Intermittent current[2)]	For output voltage < 13Vdc, see Fig. 6-1
Overload/ short-circuit current	Max.	29.8A	Continuous current, see Fig. 6-1
	Typ.	29A	Intermitted current peak value for typ. 2s Load impedance 10mOhm, see Fig. 6-2 Discharge current of output capacitors is not included.
	Max.	9.8A	Intermitted current average value (R.M.S.) Load impedance 10mOhm, see Fig. 6-2
Output capacitance	Typ.	8 500µF	Included inside the power supply
Back-feeding loads	Max.	35V	The unit is resistant and does not show malfunctioning when a load feeds back voltage to the power supply. It does not matter whether the power supply is on or off. The absorbing energy can be calculated according to the built-in large sized output capacitor.

1) 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.

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

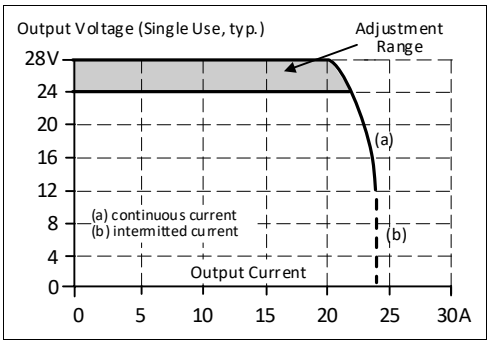


Fig. 6-2 **Short-circuit on output, Hiccup$^{PLUS^{®}}$ mode, typ.**

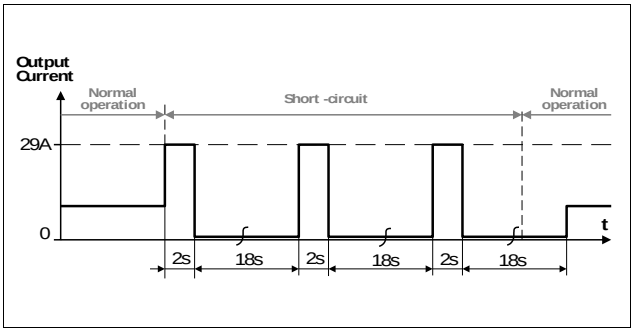
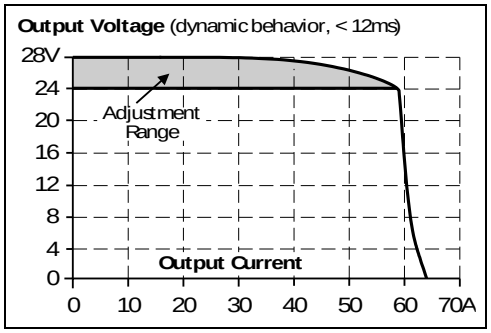


Fig. 6-3 **Dynamic overcurrent capability, typ.**



7. HOLD-UP TIME

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

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

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

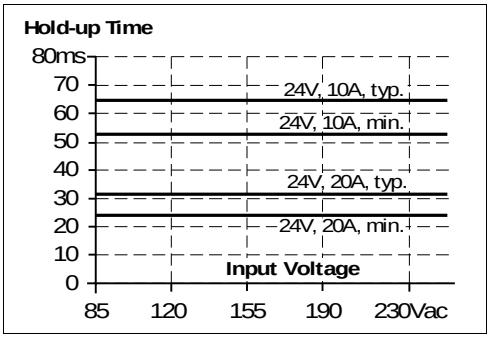
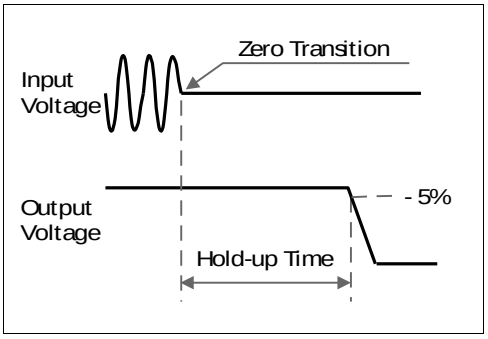


Fig. 7-2 **Shut-down behavior, definitions**

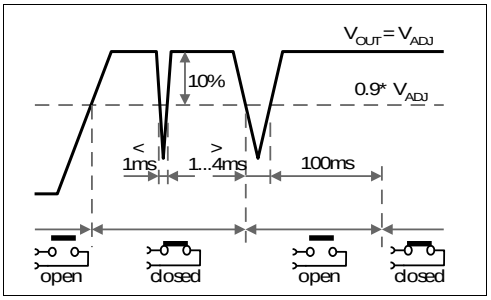


8. DC-OK RELAY CONTACT

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

Contact closes	As soon as the output voltage reaches typ. 90% of the adjusted output voltage level.
Contact opens	As soon as the output voltage dips more than 10% below the adjusted output voltage. Short dips will be extended to a signal length of 100ms. Dips shorter than 1ms will be ignored.
Switching hysteresis	1V
Contact ratings	Maximal 60Vdc 0.3A, 30Vdc 1A, 30Vac 0.5A, resistive load Minimal permissible load: 1mA at 5Vdc
Isolation voltage	See dielectric strength table in chapter 18.

Fig. 8-1 **DC-OK relay contact behavior**



9. EFFICIENCY AND POWER LOSSES

		AC 120V	AC 230V	
Efficiency	Typ.	94.2%	95.6%	At 24V, 20A
Average efficiency*)	Typ.	93.8%	95.0%	25% at 5A, 25% at 10A, 25% at 15A. 25% at 20A
Power losses	Typ.	2.2W	2.2W	At 24V, 0A
	Typ.	15.0W	12.5W	At 24V, 10A
	Typ.	29.6W	22.1W	At 24V, 20A

*) 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 at 24V, typ**

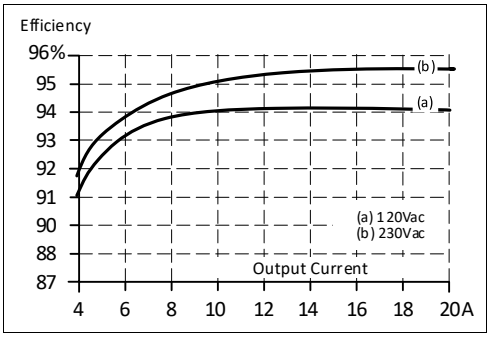


Fig. 9-2 **Losses vs. output current at 24V, typ.**

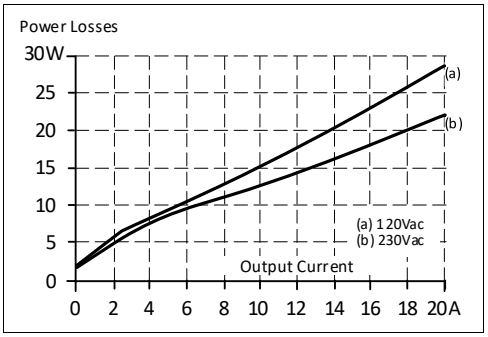


Fig. 9-3 **Efficiency vs. input voltage at 24V, 20A, typ.**

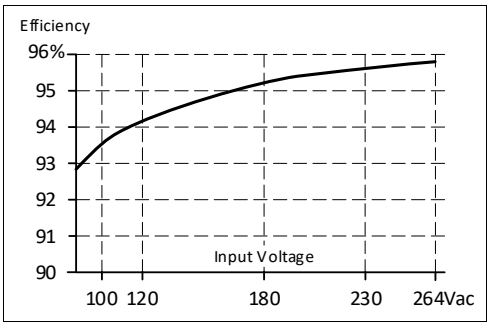
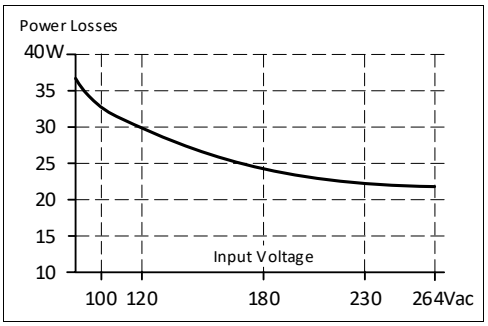
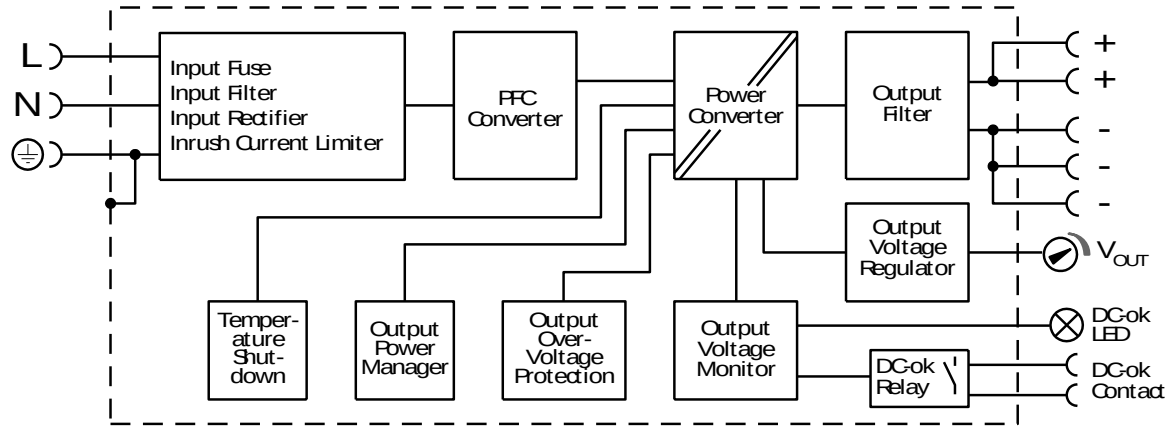


Fig. 9-4 **Losses vs. input voltage at 24V, 20A, typ.**



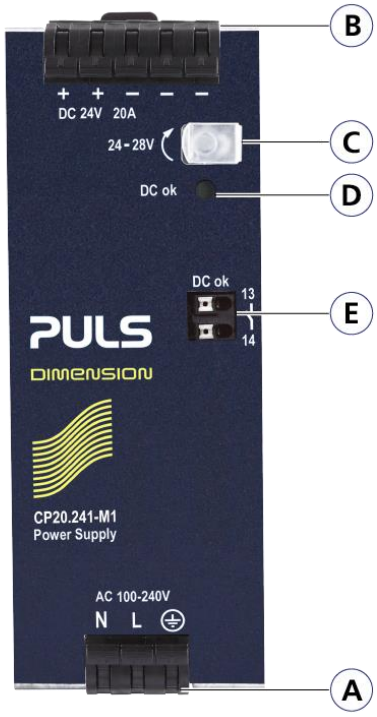
10. FUNCTIONAL DIAGRAM

Fig. 10-1 **Functional diagram CP20.241-M1**



11. FRONT SIDE AND USER ELEMENTS

Fig. 11-1 **Front side**



A **Input Terminals**

Quick-connect spring-clamp terminals

N, L Line input

⏚ PE (Protective Earth) input

B **Output Terminals**

two identical + poles and three identical – poles

Quick-connect spring-clamp terminals

+ Positive output

– Negative (return) output

C **Output Voltage Potentiometer**

Open the flap to adjust the output voltage. The factory setting is 24.1V.

D **DC-OK LED** (green)

On, when the output voltage is >90% of the adjusted output voltage

E **DC-OK Relay Contact**

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

12. CONNECTION TERMINALS

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

	Input and Output	**DC-OK Signal**
Type	Quick-connect spring-clamp terminals	Push-in terminals
Solid wire	max. 6mm²	max. 1.5mm²
Stranded wire	max. 4mm²	max. 1.5mm²
American Wire Gauge	max. AWG 20-10	max. AWG 28-16
Wire diameter (including ferrules)	max. 2.8mm	max. 1.6mm
Wire stripping length	10mm	7mm
Screwdriver	-	3mm slotted to open the spring

13. LIFETIME EXPECTANCY

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

	AC 120V	AC 230V	
Lifetime expectancy	60 000h	94 000h	At 24V, 20A, 40°C
	149 000h	173 000h	At 24V, 10A, 40°C
	31 000h	54 000h	At 24V, 24A, 40°C
	169 000h	265 000h	At 24V, 20A, 25°C
	422 000h	488 000h	At 24V, 10A, 25°C
	88 000h	152 000h	At 24V, 24A, 25°C

14. MTBF

MTBF stands for **M**ean **T**ime **B**etween **F**ailures, which is calculated according to statistical device failures, and indicates reliability of a device. It is the statistical representation of the likelihood of a unit to fail and does not necessarily represent the life of a product.

The MTBF figure is a statistical representation of the likelihood of a device to fail. A MTBF figure of e.g. 1 000 000h means that statistically one unit will fail every 100 hours if 10 000 units are installed in the field. However, it can not be determined if the failed unit has been running for 50 000h or only for 100h.

For these types of units the MTTF (**M**ean **T**ime **T**o **F**ailure) value is the same value as the MTBF value.

	AC 120V	AC 230V	
MTBF SN 29500, IEC 61709	429 000h	569 000h	At 24V, 20A, 40°C
	794 000h	1 012 000h	At 24V, 20A, 25°C
MTBF MIL HDBK 217F	197 000h	233 000h	At 24V, 20A, 40°C; Ground Benign GB40
	267 000h	318 000h	At 24V, 20A, 25°C; Ground Benign GB25
	41 000h	49 000h	At 24V, 20A, 40°C; Ground Fixed GF40
	54 000h	66 000h	At 24V, 20A, 25°C; Ground Fixed GF25

15. EMC – ACCORDING TO MEDICAL STANDARDS

EMC Immunity	**According to medical standard: EN 60601-1-2**			
Electrostatic discharge	EN 61000-4-2	Contact discharge	8kV	Criterion A
		Air discharge	15kV	Criterion A
		Air discharge DC-OK signal	8kV	Criterion A
Electromagnetic RF field	EN 61000-4-3	80MHz-2.7GHz	10V/m	Criterion A
	EN 61000-4-3, EN 60601-1-2 table 9	385MHz-5.78GHz	9-28V/m	Criterion A
Fast transients (Burst)	EN 61000-4-4	Input lines	2kV	Criterion A
		Output lines	1kV	Criterion A
		DC-OK signal (coupling clamp)	1kV	Criterion A
Surge voltage on input	EN 61000-4-5	L → N	1kV	Criterion A
		L → PE, N → PE	2kV	Criterion A
Conducted disturbance	EN 61000-4-6	0.15-80MHz	6V	Criterion A
Rated power frequency magnetic fields	EN 61000-4-8	Frequency 50Hz	30A/m	Criterion A
		Frequency 60Hz	30A/m	Criterion A
Mains voltage dips	EN 61000-4-11	0% of 100Vac	0Vac, 10ms	Criterion A
		0% of 100Vac	0Vac, 20ms	Criterion A
		70% of 100Vac	70Vac, 500ms	Criterion A
		0% of 240Vac	0Vac, 10ms	Criterion A
		0% of 240Vac	0Vac, 20ms	Criterion A
		70% of 240Vac	168Vac, 500ms	Criterion A
Voltage interruptions	EN 61000-4-11	0% of 100Vac	0Vac, 5000ms	Criterion B
		0% of 240Vac	0Vac, 5000ms	Criterion B

Criterions:
A: Power supply shows normal operation behavior within the defined limits.
B: Output voltage out of range or switches off. DC-OK signal might trigger. Restores automatically after the test.

EMC Emission	**According to medical standard: EN 60601-1-2**	
Conducted emission input lines	EN 55011, CISPR 11	Class B for AC Input voltages and Class A for DC input voltages
Radiated emission	EN 55011, CISPR 11	Class B
Harmonic input current	EN 61000-3-2	Class A fulfilled between 0A and 12A load Class C fulfilled between 6A and 12A load
Voltage fluctuations, flicker	EN 61000-3-3	Fulfilled*)

Switching Frequencies	The power supply has three converters with two different switching frequencies included.	
Switching frequency 1	110kHz	PFC converter
Switching frequency 2	84kHz to 140kHz	Main converter, output power dependent
Switching frequency 3	60kHz	Auxiliary converter

16. EMC – ACCORDING TO GENERIC STANDARDS

In regard to EMC, the power supply is designed for applications in medical applications, industrial environment as well as in residential, commercial and light industry environment.

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

EMC Immunity

Electrostatic discharge	EN 61000-4-2	Contact discharge	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	4kV	Criterion A
Surge voltage on output	EN 61000-4-5	+ → -	1kV	Criterion A
		+ / - → PE	2kV	Criterion A
Surge voltage on Signals	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	0Vac, 5000ms	Criterion C
Voltage sags	SEMI F47	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

Criterions:

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

Conducted emission input lines	EN 55011, EN 55015, EN 55032, FCC Part 15, CISPR 11, CISPR 32	Class B for AC Input voltages and Class A for DC input voltages
Conducted emission output lines**)	IEC/CISPR 16-1-2, IEC/CISPR 16-2-1	8dB higher than average limits for DC power port according to EN 61000-6-3**)
Radiated emission	EN 55011, EN 55032	Class B
Harmonic input current	EN 61000-3-2	Class A fulfilled between 0A and 12A load Class C fulfilled between 6A and 12A load
Voltage fluctuations, flicker	EN 61000-3-3	Fulfilled*)

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, non pulsing

**) For information only, not mandatory for EN 61000-6-3 or EN 61000-6-4
Restrictions apply only for applications in residential, commercial and light-industrial environments, where local DC power networks according to EN 61000-6-3 are involved. No restrictions for all kinds of industrial applications.

17. ENVIRONMENT

Operational temperature*)	-25°C to +70°C	Reduce output power according Fig. 17-1
Non-operational temperature	-40°C to +85°C	For storage and transportation
Output derating	12W/K	Between 60°C and 70°C
Humidity**)	5 to 95% r.h.	For operation, storage and transportation according to IEC 60068-2-30
Atmospheric pressure	110-70kPa	For operation, storage and transportation
Vibration sinusoidal	2-17.8Hz: ±1.6mm; 17.8-500Hz: 2g***) 2 hours / axis***)	IEC 60068-2-6
Shock	30g 6ms, 20g 11ms***) 3 bumps / direction, 18 bumps in total	IEC 60068-2-27
Altitude	Up to 3000m	See Fig. 17-2 for details
Altitude derating	1.33A/1000m or 5K/1000m	For altitudes >2000m, see Fig. 17-2
	The derating is not hardware controlled. The user has to take this into consideration to stay below the derated current limits in order not to overload the unit.	
Over-voltage category	III	Altitudes up to 2000m according to IEC/EN 62477-1

*) Operational temperature is the same as the ambient or surrounding temperature and is defined as the air temperature 2cm below the unit.

**) Do not energize while condensation is present

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

Fig. 17-1 **Output current vs. ambient temp.**

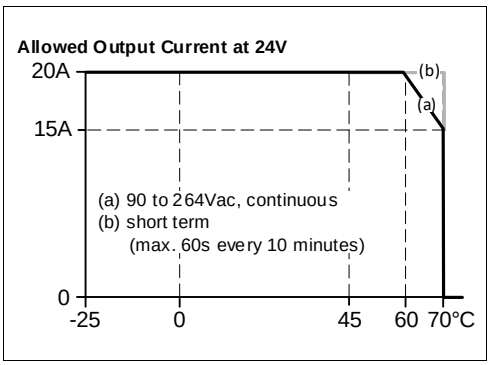
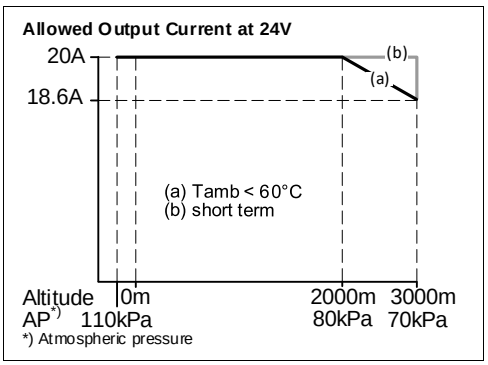


Fig. 17-2 **Output current vs. altitude**



18. SAFETY AND PROTECTION FEATURES

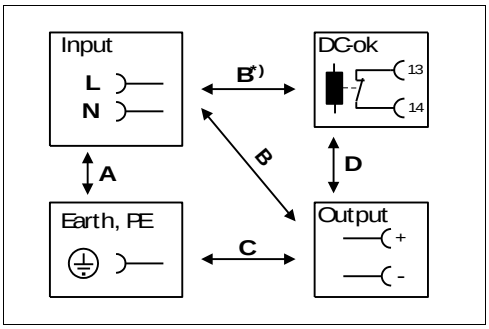
Input / output separation[1]		SELV PELV double or reinforced insulation	IEC/EN 61010-2-201 IEC/EN 60204-1, IEC/EN 62477-1, IEC 60364-4-41
Transformers		Safety Isolating Transformers acc. IEC/EN 61558-2-16	Safety Isolating Transformers corresponding to Part 2-6 of the IEC/EN 61558
Class of protection		I	PE (Protective Earth) connection required
Insulation resistance	min.	500MOhm	Input to output, measured with 500Vdc
PE resistance	max.	0.1Ohm	PE terminal to enclosure
Earth leakage current[2] [3], medical	typ.	0.39mA	264Vac, 60Hz, normal condition
	max.	0.47mA	264Vac, 60Hz, normal condition
	typ.	0.65mA	264Vac, 60Hz, single fault condition
	max.	0.78mA	264Vac, 60Hz, single fault condition
Touch current[2] [3], medical, Mains to enclosure	typ.	0.01mA	264Vac, 60Hz, normal condition
	max.	0.02mA	264Vac, 60Hz, normal condition
	typ	0.40mA	264Vac, 60Hz, single fault condition
	max.	0.48mA	264Vac, 60Hz, single fault condition
Touch current[2] [3], medical, Mains to output GND (-) pole	typ.	0.04mA	264Vac, 60Hz, normal condition
	max.	0.05mA	264Vac, 60Hz, normal condition
	typ.	0.40mA	264Vac, 60Hz, single fault condition
	max.	0.48mA	264Vac, 60Hz, single fault condition
Touch current[2] [3], medical, Mains to output plus (+) pole	typ.	0.04mA	264Vac, 60Hz, normal condition
	max.	0.05mA	264Vac, 60Hz, normal condition
	typ.	0.40mA	264Vac, 60Hz, single fault condition
	max.	0.48mA	264Vac, 60Hz, single fault condition

1) Double or reinforced insulation
2) After humidity preconditioning treatment
3) No classification according class B, BF and CF since the power supply is not suitable for application parts with direct patient contact.

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	3000Vac	4500Vac	1500Vac	500Vac
Factory test	5s	3000Vac	4000Vac	1000Vac	500Vac
Field test	5s	2700Vac	3500Vac	800Vac	500Vac
Cut-off current setting		> 10mA	> 5mA	> 5mA	> 1mA

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.

Insulation Safety Ratings

Input to Ground	MOPP, MOOP
Input to Output	2MOPP, 2MOOP
Output to Ground	MOPP, MOOP

20. APPROVED, FULFILLED OR TESTED STANDARDS

IEC 60601-1	CB Report	CB Scheme, Medical electrical equipment – Part 1: General requirements for basic safety and essential performance 2MOPP and 2MOOP (Except risk assessment)
IEC 60068-2-60	Corrosion IEC 60068-2-60 Method 4 ✓	Manufacturer's Declaration (Online Document) Environmental Tests, Flowing Mixed Gas Corrosion Test Test Ke - Method 4 H2S: 10ppb NO2: 200ppb Cl2: 10ppb SO2: 200ppb Test Duration: 3 weeks, which simulates a service life of 10 years.
ISA-71.04 G3	Corrosion G3-ISA-71.04 ✓	Manufacturer's Declaration (Online Document) Airborne Contaminants Corrosion Test Severity Level: G3 Harsh H2S: 100ppb NOx: 1250ppb Cl2: 20ppb SO2: 300ppb Test Duration: 3 weeks, which simulates a service life of 10 years
VDMA 24364	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

EU Declaration of Conformity	CE	The CE mark indicates conformance with the - EMC directive - Low-voltage directive - RoHS directive
REACH Regulation (EU)	REACH COMPLIANT	Manufacturer's Statement EU regulation regarding the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH) fulfilled.
WEEE Regulation		Manufacturer's Declaration EU Regulation on Waste Electrical and Electronic Equipment Registered as business to business (B2B) products. EU Regulation 2012/19/EU

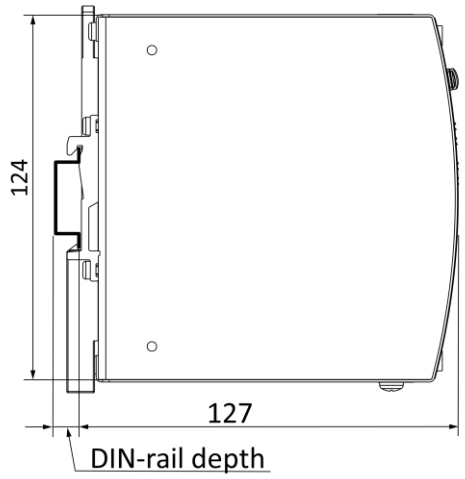
22. PHYSICAL DIMENSIONS AND WEIGHT

Width	48mm
Height	124mm
Depth	127mm The DIN rail depth must be added to the unit depth to calculate the total required installation depth.
Weight	830g
DIN rail	Use 35mm DIN rails according to EN 60715 or EN 50022 with a height of 7.5 or 15mm.
Housing material	Body: Aluminium alloy Cover: Zinc-plated steel
Installation clearances	See chapter 2
Penetration protection	Small parts like screws, nuts, etc. with a diameter larger than 5mm

Fig. 22-1 **Front view**

All dimensions in mm

Fig. 22-2 **Side view**



All dimensions in mm

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. PSU for illustration purpose only.

Fig. 23-1 **Isometric view**

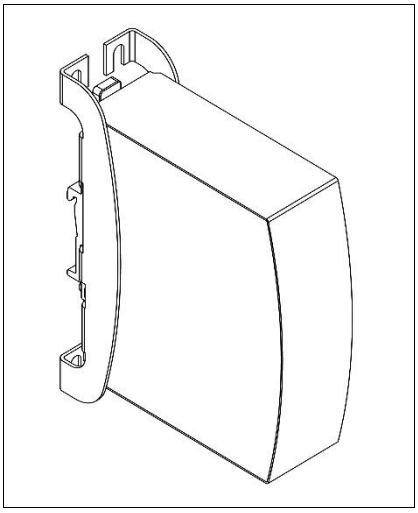


Fig. 23-2 **Isometric view**

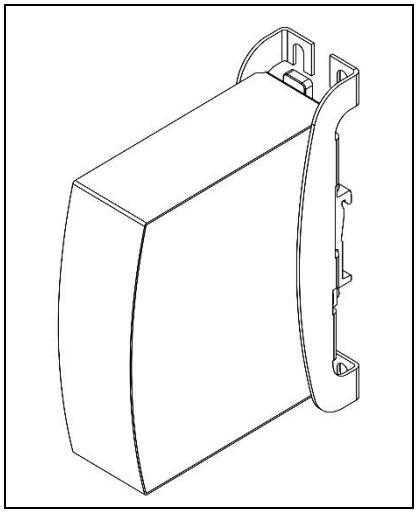


Fig. 23-3 **Isometric view**

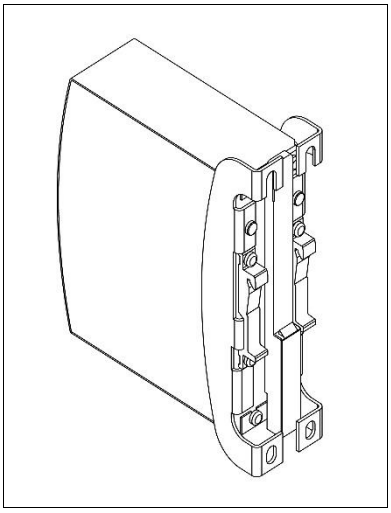


Fig. 23-4 **Wall/panel mounting, side view**

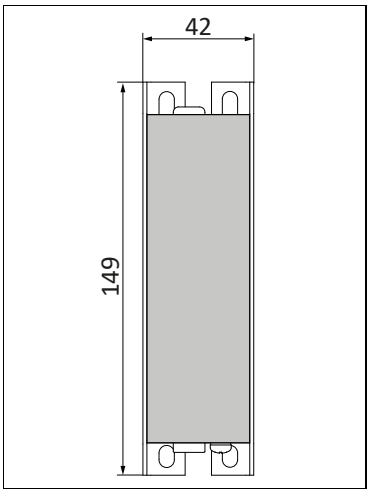


Fig. 23-5 **Hole pattern for wall mounting**

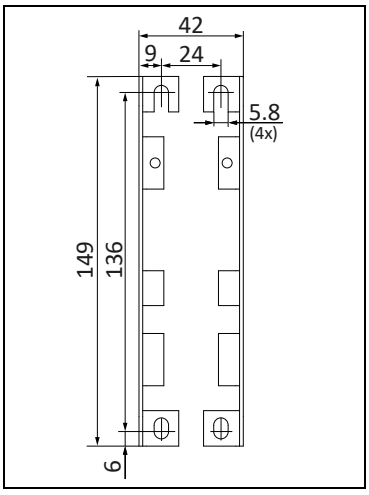
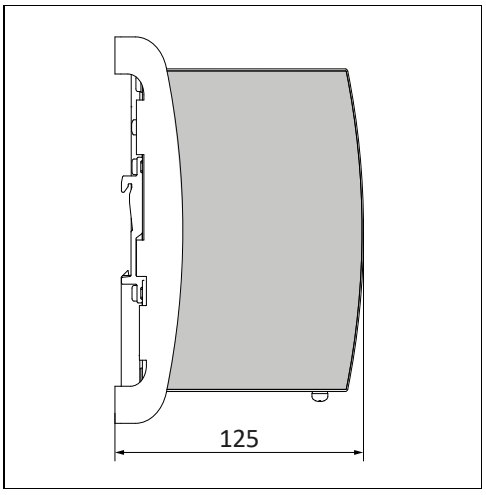


Fig. 23-6 **Wall/panel mounting, side view**



23.2. ZM12.SIDE - SIDE MOUNTING BRACKET

This bracket is used to mount the device sideways with or without utilizing a DIN rail.
The two aluminum brackets and the black plastic slider of the unit have to be detached, so that the steel brackets can be mounted.
For sideway DIN rail mounting, the removed aluminum brackets and the black plastic slider need to be mounted on the steel bracket.

Fig. 23-7 **ZM12.SIDE Side mounting bracket*)**

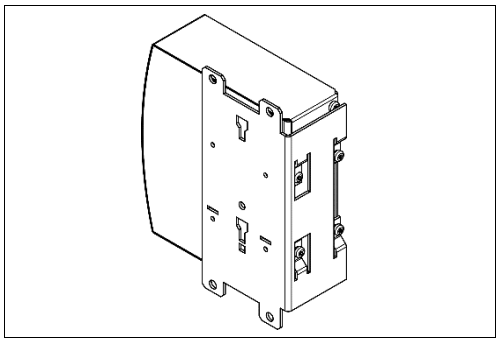
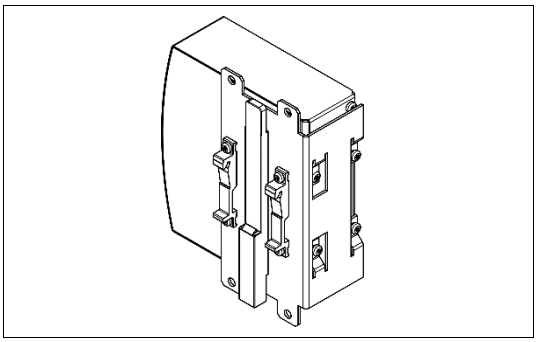


Fig. 23-8 **Side mounting with DIN rail brackets*)**



*) PSU for illustration purpose only.

24. APPLICATION NOTES

24.1. PEAK CURRENT CAPABILITY

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

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

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

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

Fig. 24-1 **40A peak current for 50ms, typ. (2x the nominal current)**

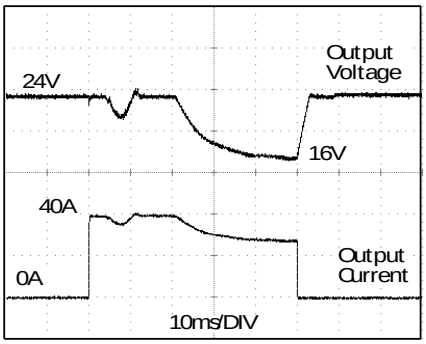


Fig. 24-2 **100A peak current for 5ms, typ. (5x the nominal current)**

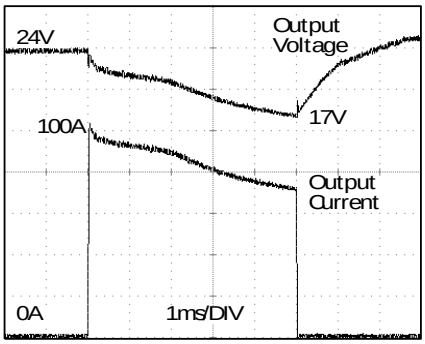
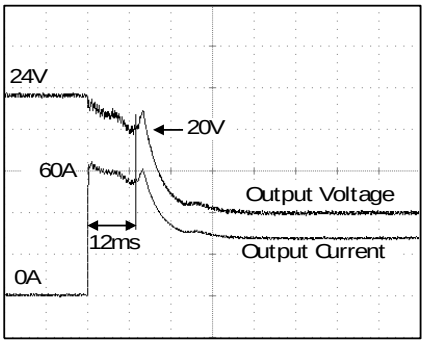


Fig. 24-3 **60A peak current for 12ms, typ. (3x the nominal current)**



Please note: The DC-OK relay might trigger when the voltage dips more than 10% for longer than 1ms.

Peak current voltage dips	Typ.	from 24V to 16V	At 40A for 50ms, resistive load
	Typ.	from 24V to 21V	At 100A for 2ms, resistive load
	Typ.	from 24V to 17V	At 100A for 5ms, resistive load

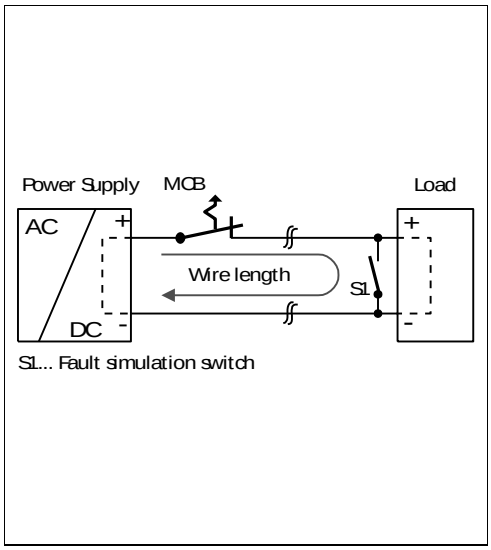
24.2. OUTPUT CIRCUIT BREAKERS

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.

Fig. 24-4 **Test circuit**



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

	0.75mm²	**1.0mm²**	**1.5mm²**	**2.5mm²**
C-2A	31 m	37 m	63 m	98 m
C-3A	28 m	34 m	51 m	78 m
C-4A	18 m	25 m	38 m	58 m
C-6A	9 m	11 m	18 m	26 m
C-8A	6 m	7 m	12 m	14 m
C-10A	4 m	6 m	11 m	13 m
C-13A	2 m	2 m	4 m	7 m
B-6A	23 m	28 m	46 m	66 m
B-10A	11 m	14 m	19 m	32 m
B-13A	7 m	11 m	16 m	29 m
B-16A	5 m	6 m	8 m	15 m
B-20A	1 m	1 m	2 m	4 m
B-25A				1 m

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

24.3. CHARGING OF BATTERIES

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

Instructions for charging batteries:

a) Set output voltage (measured at no load and at the battery end of the cable) very precisely to the end-of-charge voltage.

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

b) Use a 15A or 16A circuit breaker (or blocking diode) between the power supply and the battery.

c) Ensure that the output current of the power supply is below the allowed charging current of the battery.

d) Use only matched batteries when putting 12V types in series.

e) Ensure that the ambient temperature of the power supply stays below 40°C.

f) The return current to the power supply (battery discharge current is typ. 3.5mA when the power supply is switched off (except in case a blocking diode is utilized).

24.4. SERIES OPERATION

Do not use multiple power supplies in series. The leakage current will be too high to meet the medical requirements.

24.5. PARALLEL USE TO INCREASE OUTPUT POWER

Do not use multiple power supplies in parallel. The leakage current will be too high to meet the medical requirements.

24.6. PARALLEL USE FOR REDUNDANCY

Do not use multiple power supplies in parallel. The leakage current will be too high to meet the medical requirements.

24.7. INDUCTIVE AND CAPACITIVE LOADS

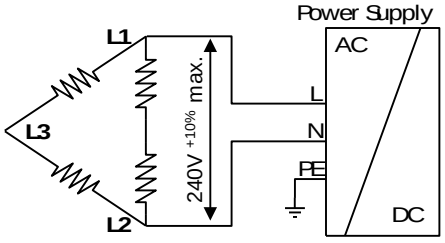
The unit is designed to supply any kind of loads, including capacitive and inductive loads. If extreme large capacitors, such as EDLCs (electric double layer capacitors or "UltraCaps") with a capacitance larger than 1.5F are connected to the output, the unit might charge the capacitor in the Hiccup^{PLUS}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

24.8. 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 if the supplying voltage is below 240V$^{+10\%}$.

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

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



24.9. USE IN A TIGHTLY SEALED ENCLOSURE

When the device 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 device.

In the following test setup, the device is placed in the middle of the box, no other heat producing items are inside the box. The load is placed outside the box.

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

	Case A	**Case B**
Enclosure size	180x180x165mm Rittal Typ IP66 Box PK 9519 100, plastic	180x180x165mm Rittal Typ IP66 Box PK 9519 100, plastic
Input voltage	230Vac	230Vac
Load	24V, 16A; (=**80%**)	24V, 20A; (=**100%**)
Temperature inside the box	51.7°C	55.8°C
Temperature outside the box	25.9°C	25.6°C
Temperature rise	25.8K	30.2K

24.10. MOUNTING ORIENTATIONS

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

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

The test environment is set up installing wiring ducts (depth: 80mm) with clearances seen in chapter 2.

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

Curve A: AC Input voltage Range A (120-240V)
Curve B: AC Input voltage Range B (100-240V)

Fig. 24-5
Mounting Orientation A
(Standard orientation)

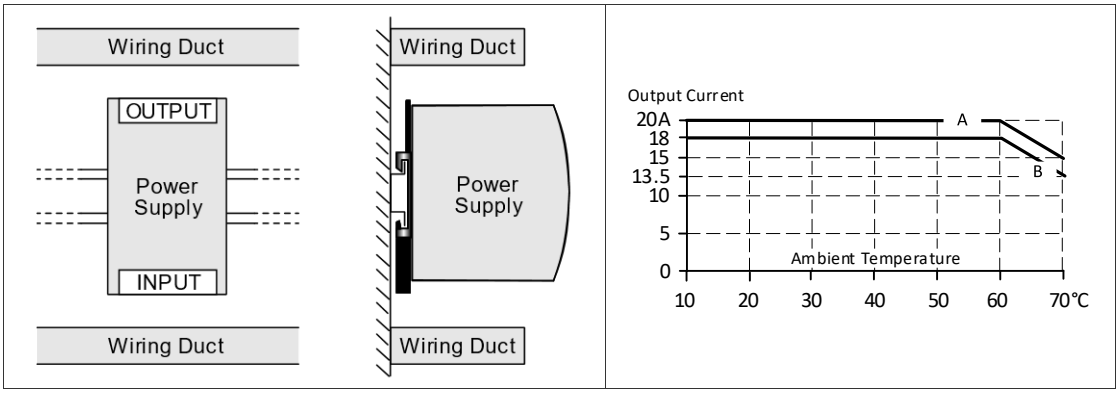


Fig. 24-6
Mounting Orientation B
(Upside down)

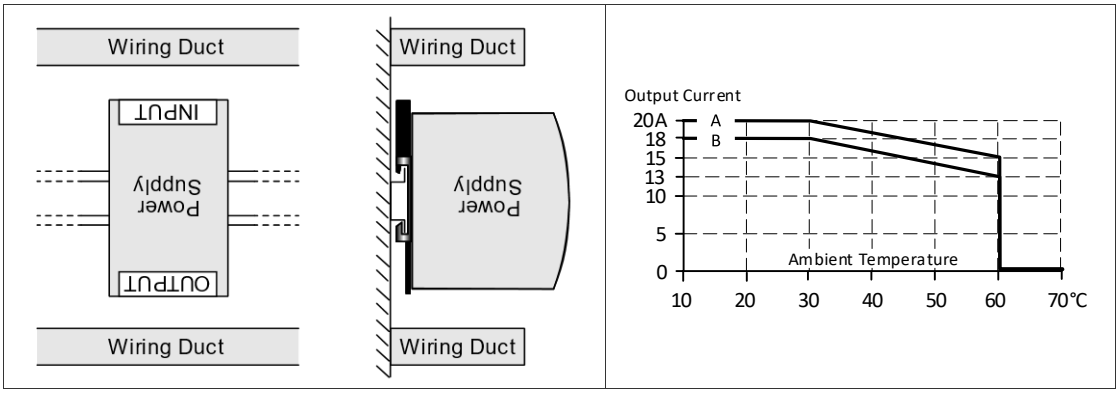


Fig. 24-7
Mounting Orientation C
(Table-top mounting)

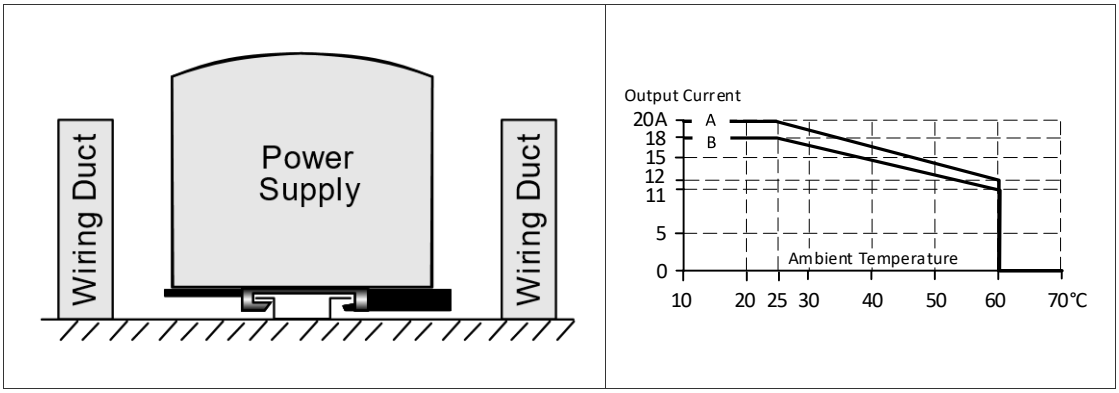


Fig. 24-8
Mounting Orientation D
(Horizontal cw)

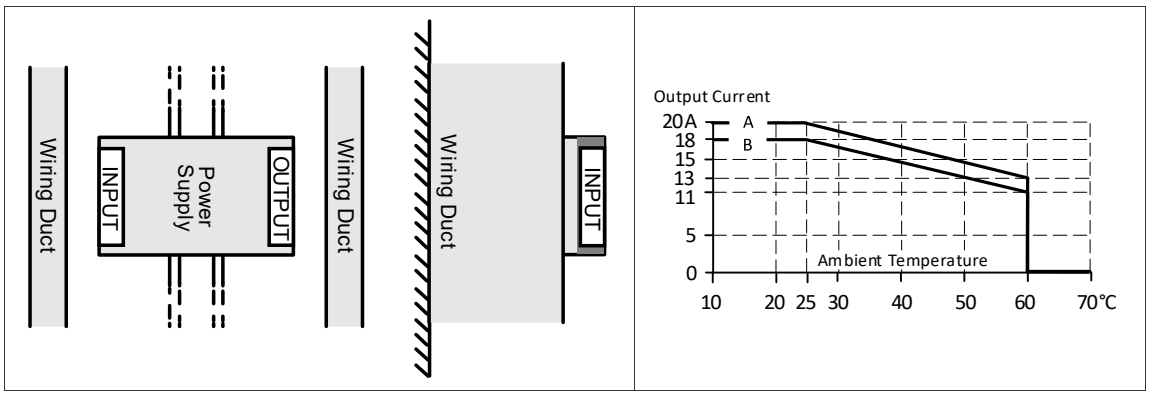


Fig. 24-9
Mounting Orientation E
(Horizontal ccw)