



POWER SUPPLY

- 2MOPP Safety Approved for Medical applications according to IEC 60601-1, 3rd edition
- EMC Tested for Medical Use according to IEC 60601-1-2, 4th edition
- Quick-connect Spring-clamp Terminals
- AC 100-240V Wide-range Input
- Width only 32mm
- Efficiency up to 94.3% with 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 CP5.241-M1 is a DIN rail mountable single phase input power supply for industrial use and for use in medical equipment. It provides a stabilized 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 this family are the high efficiency, advanced inrush current limitation and active PFC.

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 make 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	5.0 – 4.3A	Below +60°C ambient
Input voltage AC	AC 100-240V	-15%/+10%
Mains frequency	50-60Hz	±6%
Input current AC	1.09 / 0.6A	At 120 / 230Vac
Power factor	0.98 / 0.91	At 120 / 230Vac
AC Inrush current	5 / 6A	At 40°C 120 / 230Vac
Efficiency	93.6 / 94.3%	At 120 / 230Vac
Power losses	8.2 / 7.3W	At 120 / 230Vac
Hold-up time	35 / 35ms	At 120 / 230Vac
Temperature range	-25°C to +60°C	Continuous
Size (WxHxD)	32x124x102mm	Without DIN rail
Weight	440g / 0.97lb	

ORDER NUMBERS

Power Supply	CP5.241-M1	Medical power supply with Spring-clamp terminal
Mechanical Accessory	ZM10.Wall	Wall/Panel mount bracket

MAIN APPROVALS

Details and complete list of approvals in chapter 19.

IECEE
CB SCHEME

EMC
Medical



Medical
2MOPP - IEC 60601-1



Medical 2MOPP
planned



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TERMINOLOGY AND ABBREVIATIONS

PE and  symbol	PE are the abbreviation for Protective Earth 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 be indicating flexibility of choice with no implied preference.
shall	A key word be indicating a mandatory requirement.
should	A key word be 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 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 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.

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. Use ferrules for wires on the input terminals. 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 terminal and the PE potential must not exceed 300Vac.

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 (9840ft).

Keep the following minimum installation clearances: 40mm on top, 20mm on the bottom, 5mm left and right side.

Increase the 5mm to 15mm in case the adjacent device is a heat source. When the device is permanently loaded with less than 50%, the 5mm can be reduced to zero.

The device is designed, tested and approved for branch circuits up to 32A (IEC) and 30A (UL) without additional protection device. If an external fuse is utilized, do not use circuit breakers smaller than 6A B- or C-Characteristic to avoid a nuisance tripping of the circuit breaker.

The maximum surrounding air temperature is +60°C (+140°F). The operational temperature is the same as the ambient or surrounding air temperature and is defined 2cm below the device.

The device is designed to operate in areas between 5% and 95% relative humidity.

Portable RF communication equipment should be used no closer than 30cm (12 inch) 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 or IT mains networks with AC voltage.

AC input	nom.	AC 100-240V	
AC input range		85-264Vac	Continuous operation
		264-300Vac	Occasionally for maximal 500ms
Allowed voltage L or N to earth	max.	300Vac	Continuous, according to IEC 60664-1
Input frequency	nom.	50–60Hz	±6%
Turn-on voltage	typ.	80Vac	Steady-state value, see Fig. 3-1
Shut-down voltage	typ.	74Vac	Steady-state value, see Fig. 3-1
External input protection	See recommendations in chapter 2.		

		AC 100V	AC 120V	AC 230V	
Input current	typ.	1.30A	1.09A	0.60A	At 24V, 5A, see Fig. 3-3
Power factor	typ.	0.99	0.98	0.91	At 24V, 5A, see Fig. 3-4
Crest factor	Typ.	1.7	1.8	2.2	At 24V, 5A, The crest factor is the mathematical ratio of the peak value to RMS value of the input current waveform.
Start-up delay	typ.	420ms	380ms	385ms	See Fig. 3-2
Rise time	typ.	80ms	80ms	80ms	At 24V, 5A const. current load, 0mF load capacitance, see Fig. 3-2
	typ.	100ms	100ms	110ms	At 24V, 5A const. current load, 5mF load capacitance, see Fig. 3-2
Turn-on overshoot	max.	200mV	200mV	200mV	See Fig. 3-2

Fig. 3-1 Input voltage range

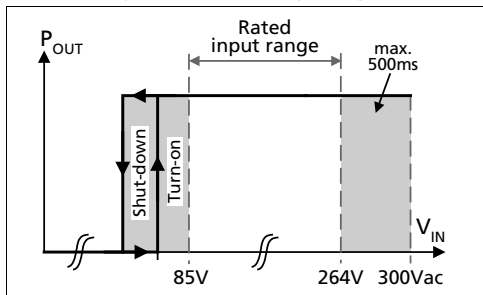


Fig. 3-3 Input current vs. output current at 24V output voltage

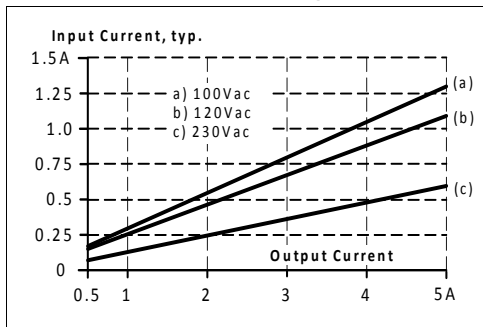


Fig. 3-2 Turn-on behaviour, definitions

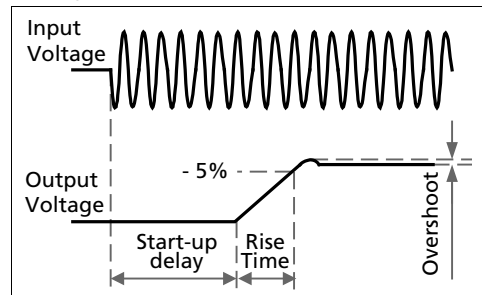
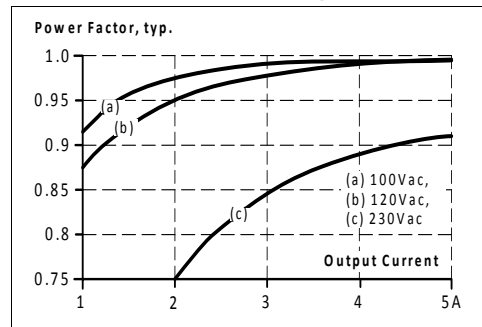


Fig. 3-4 Power factor vs. output current at 24V output voltage



4. INPUT INRUSH CURRENT

An active inrush limitation circuit (NTCs, which are bypassed by a relay contact) limits the input inrush current after turn-on of the input voltage.

The charging current into EMI suppression capacitors is disregarded in the first microseconds after switch-on.

		AC 100V	AC 120V	AC 230V	
Inrush current	max.	8A _{peak}	7A _{peak}	7A _{peak}	At 40°C, cold start
	typ.	5A _{peak}	4A _{peak}	4A _{peak}	At 25°C, cold start
	typ.	5A _{peak}	5A _{peak}	6A _{peak}	At 40°C, cold start
Inrush energy	max.	0.4A ² s	0.5A ² s	1A ² s	At 40°C, cold start

Fig. 4-1 Typical turn-on behaviour at nominal load, 120Vac input and 25°C ambient

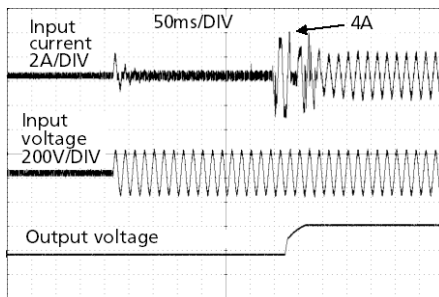
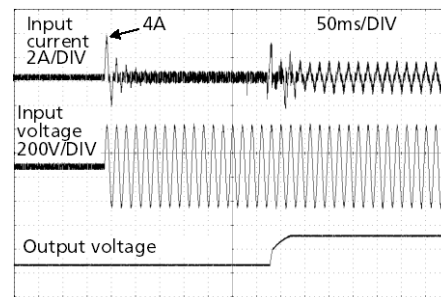


Fig. 4-2 Typical turn-on behaviour at nominal load, 230Vac input and 25°C ambient



5. OUTPUT

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

The output is designed to supply any kind of loads, including capacitive and inductive loads. If extreme large capacitors, such as EDLCs (electric double layer capacitors or "Ultracapacitors" with a capacitance > 0.3F are connected to the output, the unit might charge the capacitor in an intermittent mode.

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

Output voltage	Nom.	24V	
Adjustment range	min.	24-28V	Guaranteed value 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.
	max.	30.0V	
Factory settings	typ.	24.1V	±0.2%, at full load and cold unit
Line regulation	max.	10mV	Between 85 and 300Vac
Load regulation	max.	50mV	Between 0A and 5A, static value, see Fig. 6-1
Ripple and noise voltage	max.	50mVpp	Load >0.2A, Bandwidth 20Hz to 20MHz, 50Ohm
	max.	200mVpp	Load <0.2A, Bandwidth 20Hz to 20MHz, 50Ohm
Output current	nom.	5A	At 24V and 60°C ambient temperature
	nom.	4.3A	At 28V and 60°C ambient temperature
Fuse breaking current	typ.	15A	Up to 12ms once every five seconds, see Fig. 5-2. The fuse braking current is an enhanced transient current which helps to trip fuses on faulty output branches. The output voltage stays above 20V.
Overload behaviour	Continuous current		For output voltage above 13Vdc, see Fig. 6-1
	Intermittent current ¹⁾		For output voltage below 13Vdc, see Fig. 6-1
Overload/ short-circuit current	max.	7.2A	Continuous current, see Fig. 6-1 Intermittent current peak value for typ. 1s Load impedance 50mOhm, see Fig. 6-3 Discharge current of output capacitors is not included.
	typ.	9A	
	max.	3.5A	
Output capacitance	typ.	1 800µF	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 1s. After this, the output is switched off for approx. 9s before a new start attempt is automatically performed. This cycle is repeated as long as the overload exists. If the overload has been cleared, the device will operate normally. See Fig. 6-3.

Fig. 5-1 **Output voltage vs. output current, typ.**

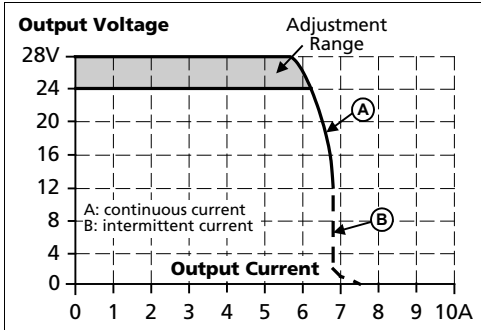


Fig. 5-2 **Dynamic output current capability, typ.**

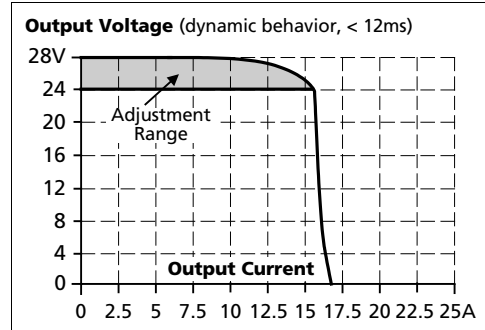
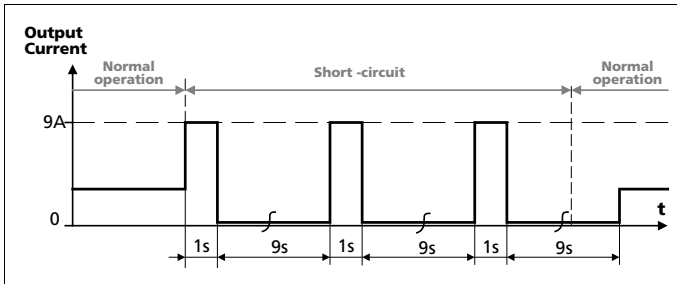


Fig. 5-3 **Short-circuit on output, Hiccup^{PLUS} mode, typ.**



6. 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 100V	AC 120V	AC 230V	
Hold-up Time	typ.	70ms	70ms	70ms	At 24V, 2.5A, see Fig. 7-1
	min.	55ms	55ms	55ms	At 24V, 2.5A, see Fig. 7-1
	typ.	35ms	35ms	35ms	At 24V, 5A, see Fig. 7-1
	Min.	27ms	27ms	27ms	At 24V, 5A, see Fig. 7-1

Fig. 6-1 Hold-up time vs. input voltage

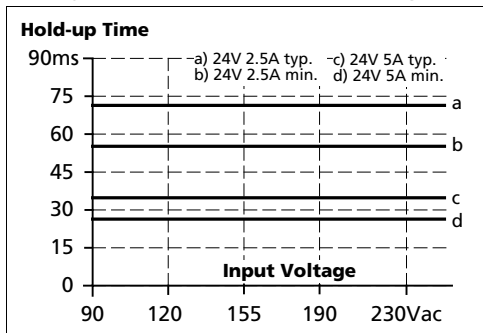
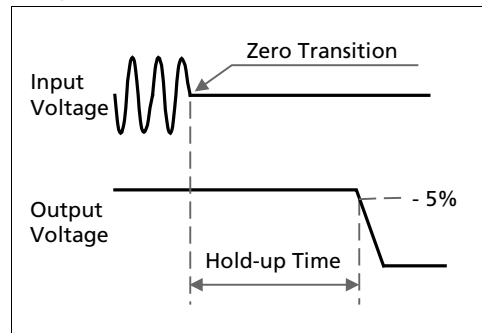


Fig. 6-2 Shut-down behaviour, definitions

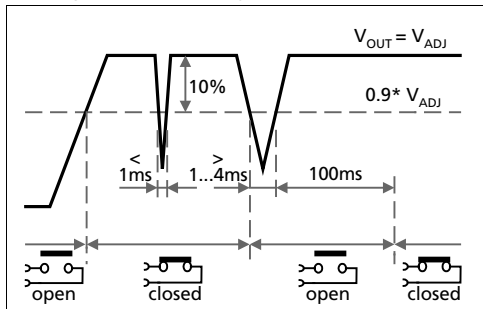


7. DC-OK RELAY CONTACT

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

Contact closes	As soon as the output voltage reaches typ. 90% of the adjusted output voltage level.
Contact opens	As soon as the output voltage dips more than 10% below the adjusted output voltage. Short dips will be extended to a signal length of 100ms. Dips shorter than 1ms will be ignored.
Switching hysteresis	Typically, 0.7V
Contact ratings	Maximal 60Vdc 0.3A, 30Vdc 1A, 30Vac 0.5A, resistive load Minimal permissible load: 1mA at 5Vdc
Isolation voltage	See dielectric strength table in section 18.

Fig. 7-1 DC-ok relay contact behaviour



8. EFFICIENCY AND POWER LOSSES

		AC 100V	AC 120V	AC 230V	
Efficiency	typ.	92.9%	93.6%	94.3%	At 24V, 5A
Average efficiency ^{*)}	typ.	91.3%	91.7%	92.0%	25% at 1.25A, 25% at 2.5A, 25% at 3.75A. 25% at 5A
Power losses	typ.	1.3W	1.3W	1.4W	At 24V, 0A
	typ.	4.6W	4.4W	4.1W	At 24V, 2.5A
	typ.	9.2W	8.2W	7.3W	At 24V, 5A

*) 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. 8-1 Efficiency vs. output current at 24V, typ.

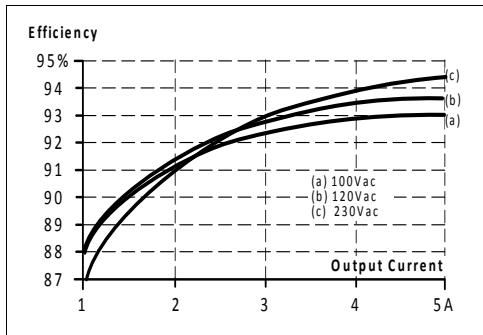


Fig. 8-2 Losses vs. output current at 24V, typ.

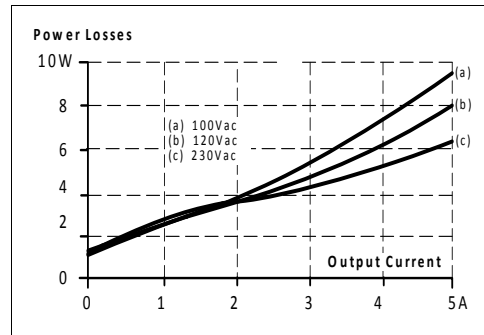


Fig. 8-3 Efficiency vs. input voltage at 24V, 5A, typ.

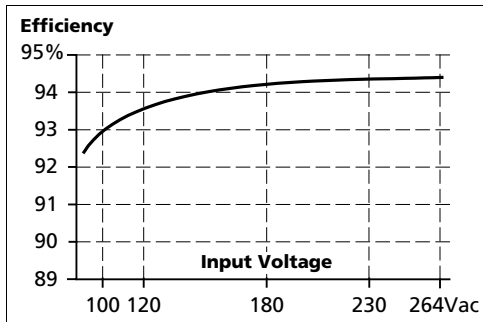
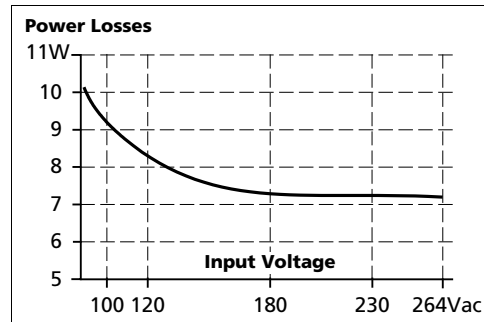
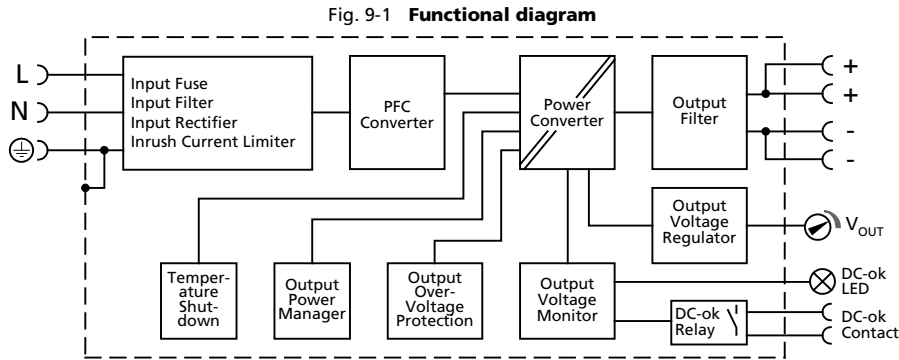


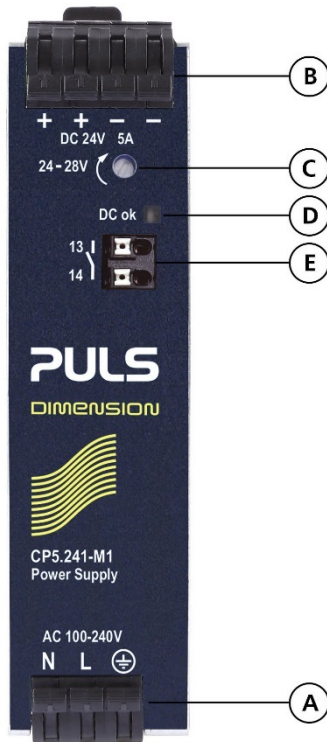
Fig. 8-4 Losses vs. input voltage at 24V, 5A, typ.



9. FUNCTIONAL DIAGRAM



10. FRONT SIDE AND USER ELEMENTS



A Input Terminals

- N, L Line input
- ⊕ PE (Protective Earth) input

B Output Terminals

- Two identical + poles and two identical - poles
- + Positive output
- Negative output (return)

C Output Voltage Potentiometer

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 7 for details.

11. CONNECTION TERMINALS

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

CP5.241-M1	Input	Output	DC-ok Signal
Type	Quick-connect spring-clamp termination	Quick-connect spring-clamp termination	Push-in termination
Solid wire	Max. 6mm ²	Max. 6mm ²	Max. 1.5mm ²
Stranded wire	Max. 4mm ²	Max. 4mm ²	Max. 1.5mm ²
American Wire Gauge	AWG 20-10	AWG 20-10	AWG 24-16
Max. wire diameter (including ferrules)	2.8mm	2.8mm	1.6mm
Wire stripping length	10mm / 0.4inch	10mm / 0.4inch	7mm / 0.28inch
Screwdriver	-	-	3mm slotted to open the spring

12. LIFETIME EXPECTANCY

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

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

13. MTBF

MTBF stands for **Mean Time Between Failure**, which is calculated according to statistical device failures, and indicates reliability of a device. It is the statistical representation of the likelihood of a unit to fail and does not necessarily represent the life of a product.

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

For these types of units, the MTTF (**Mean Time To Failure**) value is the same value as the MTBF value.

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

14. 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
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	3-6V	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

Criteria:

A: Power supply shows normal operation behaviour 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
Radiated emission	EN 55011, CISPR 11	Class B
Harmonic input current	EN 61000-3-2	Fulfilled for Class A equipment
Voltage fluctuations, flicker	EN 61000-3-3	Fulfilled, tested with constant current loads, no pulsing

15. 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 Air discharge	8kV 15kV	Criterion A Criterion A
Electromagnetic RF field	EN 61000-4-3	80MHz-2.7GHz	20V/m	Criterion A
Fast transients (Burst)	EN 61000-4-4	Input lines Output lines DC-OK signal (coupling clamp)	4kV 2kV 2kV	Criterion A Criterion A Criterion A
Surge voltage on input	EN 61000-4-5	L → N L → PE, N → PE	2kV 4kV	Criterion A Criterion A
Surge voltage on output	EN 61000-4-5	+ → - + / - → PE	1kV 2kV	Criterion A Criterion A
Surge voltage on DC-OK	EN 61000-4-5	DC-OK signal → PE	1kV	Criterion A
Conducted disturbance	EN 61000-4-6	0.15-80MHz	20V	Criterion A
Mains voltage dips	EN 61000-4-11	0% of 100Vac 40% of 100Vac 70% of 100Vac 0% of 200Vac 40% of 200Vac 40% of 200Vac 70% of 200Vac	0Vac, 20ms 40Vac, 200ms 70Vac, 500ms 0Vac, 20ms 80Vac, 200ms, <4A 80Vac, 200ms, >4A 140Vac, 500ms	Criterion A Criterion C Criterion A Criterion A Criterion A Criterion C Criterion A
Voltage interruptions	EN 61000-4-11	0% of 200Vac (=0V)	5000ms	Criterion C
Powerful transients	VDE 0160	Over entire load range	750V, 0.3ms	Criterion A

Performance criterions:

A: The device shows normal operation behaviour within the defined limits.

C: Temporary loss of function is possible. The device may shut-down and restarts by itself. No damage or hazards for the device will occur.

EMC Emission

Conducted emission input lines	EN 55011, EN 55032, FCC Part 15, CISPR 11, CISPR 32	Class B
Conducted emission output lines	IEC/CISPR 16-1-2, IEC/CISPR 16-2-1	Limits for local DC power networks according EN 61000-6-3 fulfilled, but with little margin only
Radiated emission	EN 55011, EN 55032	Class B
Harmonic input current (PFC)	EN 61000-3-2	Fulfilled for Class A equipment
Voltage fluctuations, flicker	EN 61000-3-3	Fulfilled: tested with constant current loads, no pulsing

This device complies with FCC Part 15 rules.

Operation is subjected to following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Switching Frequencies

PFC converter	30kHz to 140kHz	Input voltage and output load dependent
Main converter	60kHz to 140kHz	Output load dependent
Auxiliary converter	30kHz to 60kHz	Output load dependent
Microcontroller	8MHz	

16. ENVIRONMENT

Operational temperature	-25°C to +60°C (-13°F to 140°F)	Operational temperature is the same as the ambient or surrounding temperature and is defined as the air temperature 2cm below the unit, see Fig. 16-1
Storage temperature	-40°C to +85°C (-40°F to 185°F)	For storage and transportation
Humidity	5 to 95% r.h.	According to IEC 60068-2-30
Atmospheric pressure	110-70kPa	See Fig. 16-2 for details
Altitude	Up to 3000m (9840ft)	See Fig. 16-2 for details
Altitude derating	0.33A/1000m or 5°C/1000m The derating is not hardware controlled. The user has to take this into consideration to stay below the de-rated current limits in order not to overload the unit.	For altitudes >2000m (6560ft), see Fig. 16-2
Over-voltage category	II	According to IEC 60664-1, IEC 60601-1
Degree of pollution	2	According to IEC 62477-1, not conductive
Vibration sinusoidal	2-17.8Hz: ±1.6mm; 17.8-500Hz: 2g 2 hours / axis	According to IEC 60068-2-6
Shock	30g 6ms, 20g 11ms 3 bumps per direction, 18 bumps in total Shock and vibration are tested in combination with DIN rails according to EN 60715 with a height of 15mm and a thickness of 1.3mm and standard orientation.	According to IEC 60068-2-27
LABS compatibility	As a rule, only non-silicon precipitating materials are used. The unit conforms to the LABS criteria and is suitable for use in paint shops.	
Corrosive gases	Tested according to ISA-71.04-1985, Severity Level G3 and IEC 60068-2-60 Test Ke Method 4 for a service life of minimum 10years in these environments.	
Audible noise	Some audible noise may be emitted from the power supply during no load, overload or short circuit. Also see chapter 5.	

Fig. 16-1 **Output current vs. ambient temp.**

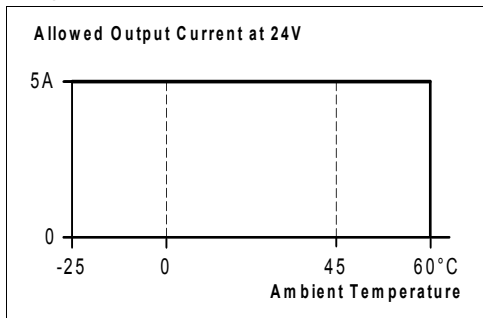
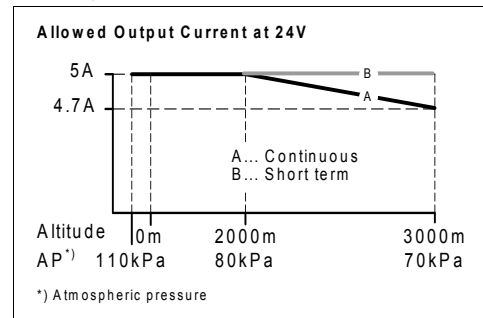


Fig. 16-2 **Output current vs. altitude**



17. SAFETY AND PROTECTION FEATURES

Class of protection	I	PE (Protective Earth) connection required
Isolation resistance	min. 500MΩ	At delivered condition between input and output, measured with 500Vdc
	min. 500MΩ	At delivered condition between input and PE, measured with 500Vdc
	min. 500MΩ	At delivered condition between output and PE, measured with 500Vdc
	min. 500MΩ	At delivered condition between output and DC-OK contacts, measured with 500Vdc
PE resistance	max. 0.1Ω	PE terminal to enclosure
Earth leakage current ^{1) 2)} , medical	typ. 0.22mA	264Vac, 60Hz, normal condition
	max. 0.26mA	264Vac, 60Hz, normal condition
	typ. 0.43mA	264Vac, 60Hz, single fault condition
	max. 0.49mA	264Vac, 60Hz, single fault condition
Touch current ^{1) 2)} , medical, Mains to enclosure	typ. 0.001mA	264Vac, 60Hz, normal condition
	max. 0.001mA	264Vac, 60Hz, normal condition
	typ. 0.20mA	264Vac, 60Hz, single fault condition
	max. 0.23mA	264Vac, 60Hz, single fault condition
Touch current ^{1) 2)} , medical, Mains to output GND (-) pole	typ. 0.005mA	264Vac, 60Hz, normal condition
	max. 0.006mA	264Vac, 60Hz, normal condition
	typ. 0.15mA	264Vac, 60Hz, single fault condition
	max. 0.18mA	264Vac, 60Hz, single fault condition
Touch current ^{1) 2)} , medical, Mains to output plus (+) pole	typ. 0.005mA	264Vac, 60Hz, normal condition
	max. 0.006mA	264Vac, 60Hz, normal condition
	typ. 0.15mA	264Vac, 60Hz, single fault condition
	max. 0.17mA	264Vac, 60Hz, single fault condition
Output over-voltage protection	typ. 30.5Vdc	In case of an internal defect, a redundant circuit limits the maximum output voltage. The output shuts down and performs three restart attempts. If the failure continues, the output shuts down. Cycle input power to reset.
	max. 32.0Vdc	
Degree of protection	IP 20	According to EN/IEC 60529
Over-temperature protection	Included	Output shut-down with automatic restart. Temperature sensors are installed on critical components inside the unit and turn the unit off in safety critical situations, which can happen e.g. when ambient temperature is too high, ventilation is obstructed, or the de-rating requirements are not followed. There is no correlation between the operating temperature and turn-off temperature since this is dependent on input voltage, load and installation methods.
Input transient protection	MOV (Metal Oxide Varistor)	For protection values see chapter 15 (EMC).
Internal input fuse	Included	Not user replaceable slow-blow high-braking capacity fuse

1) After humidity preconditioning treatment

2) No classification according class B, BF and CF since the power supply is not suitable for application parts with direct patient contact.

18. DIELECTRIC STRENGTH

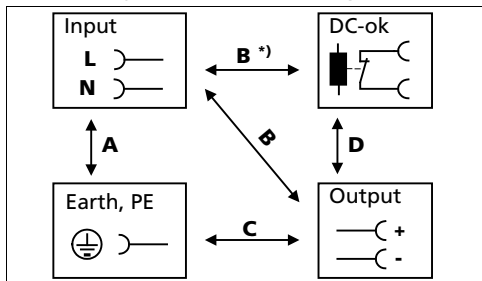
The output voltage is floating and has no ohmic connection to the ground.

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

Type and routine tests are conducted by the manufacturer. Field tests may be conducted in the field using the appropriate test equipment which applies the voltage with a slow ramp (2s up and 2s down). Connect all input-terminals together as well as all output poles before conducting the test. When testing, set the cut-off current settings to the value in the table below.

We recommend that either the + pole or the – pole shall be connected to the protective earth system. This helps to avoid situations in which a load starts unexpectedly or cannot be switched off when unnoticed earth faults occur.

Fig. 18-1 Dielectric strength



		A	B	C	D
Type test	60s	3200Vac	4200Vac	1000Vac	500Vac
Routine test	5s	2700Vac	3400Vac	700Vac	500Vac
Field test	5s	2200Vac	2700Vac	500Vac	500Vac
Field test cut-off current settings		> 10mA	> 10mA	> 20mA	> 1mA

B^{*)}

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

Insulation Safety Ratings

Input to Ground	1x MOPP, 1x MOOP
Input to Output	2x MOPP, 2x MOOP
Output to Ground	1x MOPP, 1x MOOP

19. APPROVALS AND FULFILLED STANDARDS

IEC 60601-1
3rd Edition



CB Scheme,
Medical electrical equipment – Part 1: General requirements
for basic safety and essential performance
2x MOPP and 2x MOOP
(Except risk assessment)

UL 60601-1 (2MOPP)
planned



UL Certificate
Recognized component for category QQHM - UL 60601-1
Medical Electrical Equipment - General Requirements for
Safety
Applicable for US and Canada
E207953
2MOPP

20. REGULATORY COMPLIANCE

CE



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

REACH Directive



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

WEEE Directive



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

RoHS (China RoHS 2)



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

EN 60601-1-2



Medical electrical equipment - Part 1-2: General requirements
for basic safety and essential performance - Collateral
standard: Electromagnetic compatibility - Requirements and
tests
Notes:
- Clause 4.1 (RMA) is exempted
- To maintain basic safety in regard to EMC check PE
connection every year. Units with mechanical defects or
corrosive surfaces should no longer be used.

EAC TR Registration



Registration for the Eurasian Customs Union market
(Russia, Kazakhstan, Belarus)

IEC/EN 61558-2-16
(Annex BB)
planned

Safety Isolating
Transformers

Safety Isolating Transformers corresponding to Part 2-6 of the
IEC/EN 61558

21. PHYSICAL DIMENSIONS AND WEIGHT

Width	32mm 1.26"
Height	124mm 4.88"
Depth	102mm 4.02"
	The DIN rail height must be added to the unit depth to calculate the total required installation depth.
Weight	440g / 0.97lb
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 3.5mm

Fig. 21-1 Front view

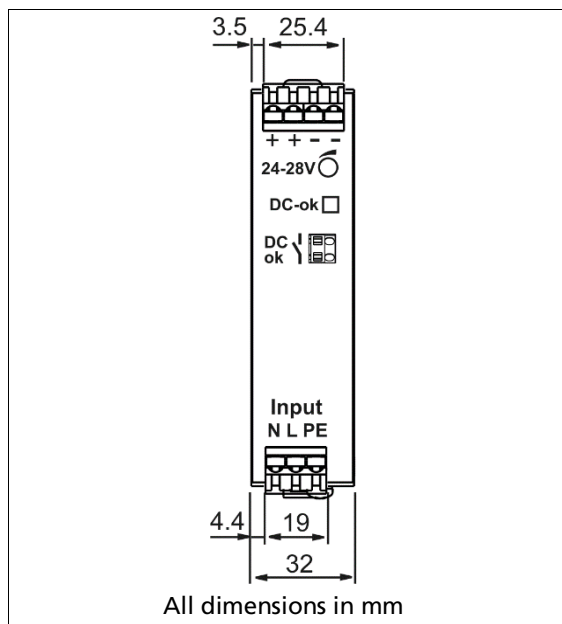
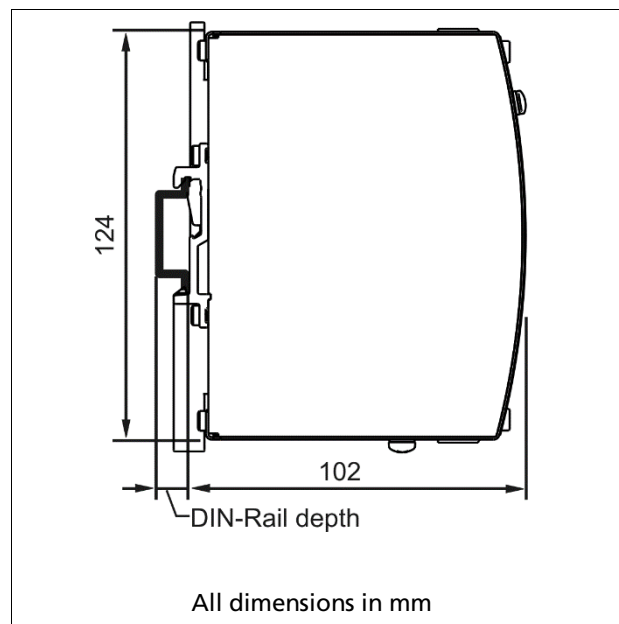


Fig. 21-2 Side view



22. ACCESSORIES

22.1. ZM10.WALL – WALL/PANEL MOUNT BRACKET

This bracket is used to mount the devices on a wall/panel without utilizing a DIN rail. The bracket can be mounted without detaching the DIN rail brackets.

For illustration purposes only, dimensions may vary.

Fig. 22-1 **Isometric left view**

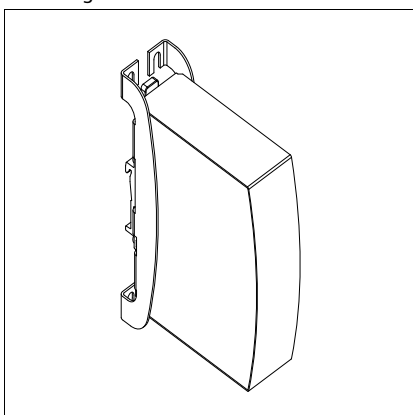


Fig. 22-2 **Isometric right view**

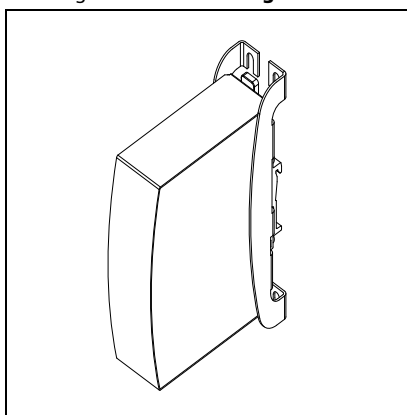


Fig. 22-3 **Isometric back view**

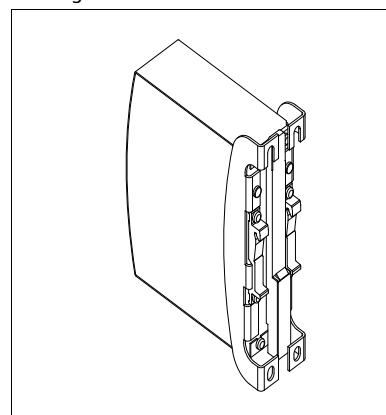


Fig. 22-4 **Wall/panel mounting, front view**

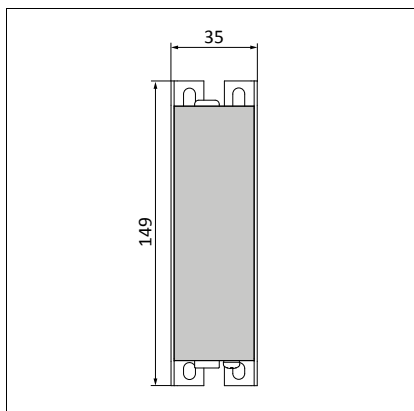


Fig. 22-5 **Hole pattern for wall mounting**

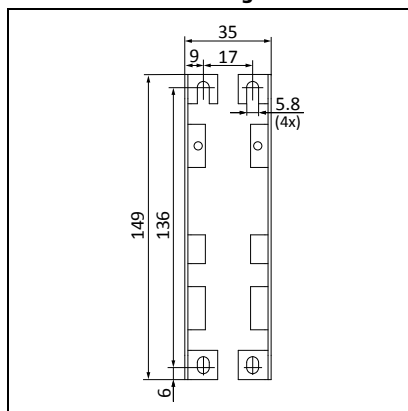
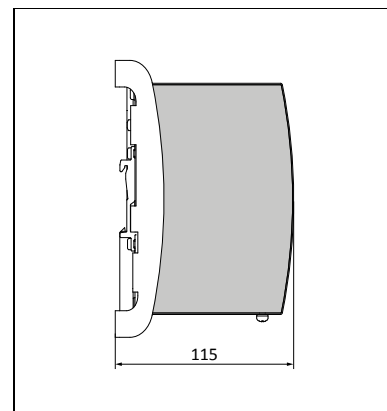


Fig. 22-6 **Wall/panel mounting, back view**



23. APPLICATION NOTES

23.1. 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. 23-1 **10A peak current for 50ms , typ. (2x the nominal current)**

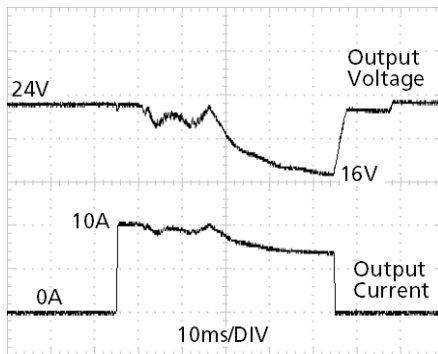


Fig. 23-2 **25A peak current for 5ms , typ. (5x the nominal current)**

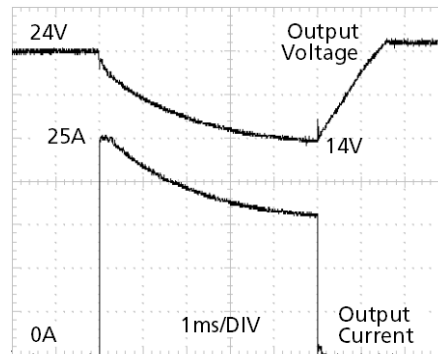
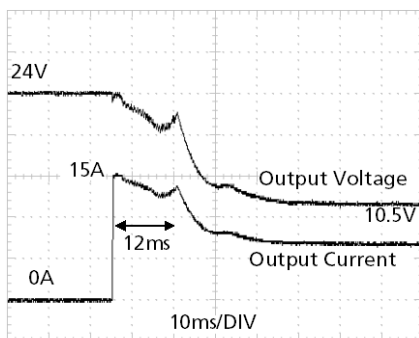


Fig. 23-3 **15A peak current for 12ms , typ. (3x the nominal current)**



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

Peak current voltage dips	typically, from 24V to 16V	At 10A for 50ms and resistive load
	typically, from 24V to 16.5V	At 25A for 2ms and resistive load
	typically, from 24V to 14V	At 25A for 5ms and resistive load

23.2. CHARGING OF BATTERIES

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

Instructions for charging batteries:

- a) Use only matched batteries when putting 12V types in series.
- b) Ensure that the ambient temperature of the power supply stays below 40°C for mains voltage of AC 120V or higher and 35°C for main voltage of AC 100V.
- c) Use a 10A circuit breaker or a blocking diode between the power supply and the battery.
- d) Ensure that the output current of the power supply is below the allowed charging current of the battery.
- e) The return current to the power supply is typically 8mA. This return current can discharge the battery when the power supply is switched off except in case a blocking diode is utilized.
- f) Set the output voltage, measured at no load and at the battery end of the cable, very precisely to the end-of-charge voltage. The voltage should be set to 27.8V at 10°C, 27.5V at 20°C, 27.15V at 30°C and 26.8V at 40°C ambient temperature.

23.3. SERIES OPERATION

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

23.4. PARALLEL USE TO INCREASE OUTPUT POWER

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

23.5. PARALLEL USE FOR REDUNDANCY

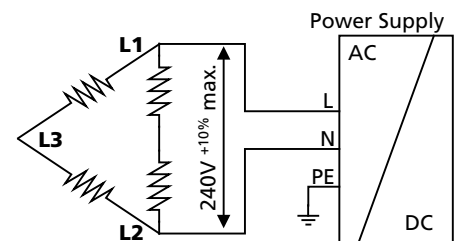
Do not use the power supply in parallel. The leakage current will be too high to meet the medical requirements.

23.6. 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%}.

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.



23.7. USE IN A TIGHTLY SEALED ENCLOSURE

When the power supply is installed in a tightly sealed enclosure, the temperature inside the enclosure will be higher than outside. In such situations, the inside temperature defines the ambient temperature for the power supply.

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

The power supply is placed in the middle of the box, no other heat producing items are inside the box

The temperature sensor inside the box is placed in the middle of the right side of the power supply with a distance of 1cm.

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

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