



### POWER SUPPLY

- 2MOPP Safety Approved for Medical applications According to IEC 60601-2, 3<sup>rd</sup> edition
- EMC Tested for Medical Use According to IEC 60601-1-2, 4<sup>th</sup> edition
- Quick-connect Spring-clamp Terminals
- AC 100-240V Wide-range Input
- Width only 39mm
- Efficiency up to 95.2%, Excellent Partial Load Efficiency
- 20% Output Power Reserves
- Safe Hiccup<sup>PLUS</sup> Overload Mode
- Easy Fuse Breaking due to High Overload Peak Current
- Active Power Factor Correction (PFC)
- Minimal Inrush Current Surge
- Full Power Between -25°C and +60°C
- DC-OK Relay Contact
- 3 Years Limited Warranty

### GENERAL DESCRIPTION

The CP10.241-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 CP10.241-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.

### ORDER NUMBERS

Power Supply **CP10.241-M1** Medical approved device

Accessory ZM12.SIDE Side mount bracket

### SHORT-FORM DATA

|                      |   |                       |
|----------------------|---|-----------------------|
| Output voltage       | DC 24V                                  |                       |
| Adjustment range     | 24 – 28V                                | Factory setting 24.1V |
| Output current       | 12 – 10.3A                              | Below +45°C ambient   |
|                      | 10 – 8.6A                               | At +60°C ambient      |
|                      | 7.5 – 6.5A                              | At +70°C ambient      |
|                      | Derate linearly between +45°C and +70°C |                       |
| Input voltage AC     | AC 100 - 240V                           | -15% / +10%           |
| Mains frequency      | 50 - 60Hz                               | ±6%                   |
| AC Input current     | 2.15 / 1.13A                            | At 120 / 230Vac       |
| Power factor         | 0.99 / 0.97                             | At 120 / 230Vac       |
| Input inrush current | 6 / 9A pk                               | At 40°C 120 / 230Vac  |
| Input voltage DC     | DC 110-150V                             | ±20%                  |
| Input current DC     | 2.35A                                   | At 110Vdc             |
| Efficiency           | 93.6 / 95.2%                            | At 120 / 230Vac       |
| Power losses         | 16.4 / 12.1W                            | At 120 / 230Vac       |
| Hold-up time         | 37ms                                    |                       |
| Temperature range    | -25°C to +70°C                          | Continuous            |
| Size (wxhxd)         | 39x124x117mm                            | Without DIN-rail      |
| Weight               | 620g / 1.37lb                           |                       |

### MARKINGS





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### TERMINOLOGY AND ABBREVIATIONS

|  |  |
|--|--|
| <b>PE and  symbol</b> | PE is the abbreviation for <b>Protective Earth</b> and has the same meaning as the symbol  .  |
| <b>Earth, Ground</b>   | This document uses the term “earth” which is the same as the U.S. term “ground”.   |
| <b>T.b.d.</b>  | To be defined, value or description will follow later.   |
| <b>AC</b>  | <b>Alternating Current</b>   |
| <b>DC</b>  | <b>Direct Current</b>  |
| <b>AC 230V</b>   | A figure displayed with the AC or DC before the value represents a nominal voltage with standard tolerances (usually ±15%) included.<br>E.g.: DC 12V describes a 12V battery disregarding whether it is full (13.7V) or flat (10V) |
| <b>230Vac</b>  | A figure with the unit (Vac) at the end is a momentary figure without any additional tolerances included.  |
| <b>50Hz vs. 60Hz</b>   | As long as not otherwise stated, AC 100V and AC 230V parameters are valid at 50Hz mains frequency. AC 120V parameters are valid for 60Hz mains frequency.  |
| <b>may</b>   | A key word indicating flexibility of choice with no implied preference.  |
| <b>shall</b>   | A key word indicating a mandatory requirement.   |
| <b>should</b>  | A key word indicating flexibility of choice with a strongly preferred implementation.  |

## 1. INTENDED USE

This device is intended for use in medical equipment as well as for general use such as in industrial control, office, communication, and instrumentation equipment.

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

## 2. INSTALLATION REQUIREMENTS

**⚠ 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.

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 the device 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. For other orientations see de-rating requirements in chapter 24.12.

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 specified in chapter 12.

Do not use the device in pollution degree 3 environments without additional protection or in applications where a degree of protection better than IP20 is required.

A disconnecting means shall be provided for the output of the device when used in applications according to CSA C22.2 No 107.1-01.

The device is designed as "Class of Protection I" equipment according to IEC 61140. A PE (Protective Earth) connection is required.

The device is designed for convection cooling and does not require an external fan. Do not obstruct airflow and do not cover ventilation grid (e.g. cable conduits) by more than 15%!

Keep the following minimum installation clearances when the device is permanently loaded with more than 50% of the nominal current: 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.

### 3. AC-INPUT

|                                 |                                      |             |   |
|---------------------------------|--------------------------------------|-------------|---|
| AC input                        | Nom.                                 | AC 100-240V | Suitable for TN-, TT- and IT mains networks |
| AC input range                  | Min.                                 | 85-264Vac   | Continuous operation                        |
|                                 | Min.                                 | 264-300Vac  | For max. 500ms                              |
| Allowed voltage L or N to earth | Max.                                 | 300Vac      | Continuous, IEC 62477-1                     |
| Input frequency                 | Nom.                                 | 50–60Hz     | ±6%   |
| Turn-on voltage                 | Typ.                                 | 80Vac       | Steady-state value, see Fig. 3-1            |
| Shut-down voltage               | Typ.                                 | 70Vac       | Steady-state value, see Fig. 3-1            |
|                                 | Typ.                                 | 55Vac       | Dynamic value (max. 250ms)                  |
| External input protection       | See recommendations in chapter 24.3. |             |   |

|                             |                                      | <b>AC 100V</b> | <b>AC 120V</b> | <b>AC 230V</b> |   |
|-----------------------------|--------------------------------------|----------------|----------------|----------------|---|
| Input current               | Typ.                                 | 2.60A          | 2.15A          | 1.13A          | At 24V, 10A, see Fig. 3-3   |
| Power factor <sup>*)</sup>  | Typ.                                 | 0.99           | 0.99           | 0.97           | At 24V, 10A, see Fig. 3-4   |
| Crest factor <sup>**)</sup> | Typ.                                 | 1.5            | 1.5            | 1.65           | At 24V, 10A   |
| Start-up delay              | Typ.                                 | 300ms          | 290ms          | 240ms          | See Fig. 3-2  |
| Rise time                   | Typ.                                 | 30ms           | 30ms           | 30ms           | At 24V, 10A const. current load, 0mF load capacitance, see Fig. 3-2   |
|                             | Typ.                                 | 75ms           | 75ms           | 75ms           | At 24V, 10A const. current load, 10mF load capacitance,, see Fig. 3-2 |
| Turn-on overshoot           | Max.                                 | 200mV          | 200mV          | 200mV          | See Fig. 3-2  |
| External input protection   | See recommendations in chapter 24.3. |                |                |                |   |

\*) 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**

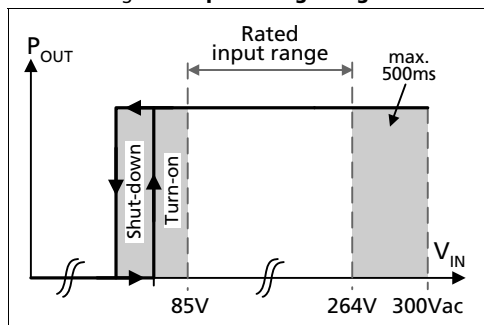


Fig. 3-2 **Turn-on behavior, definitions**

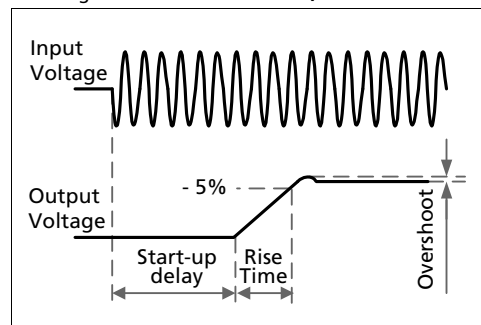


Fig. 3-3 **Input current vs. output current at 24V output voltage**

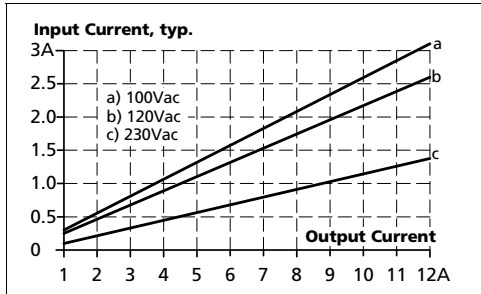
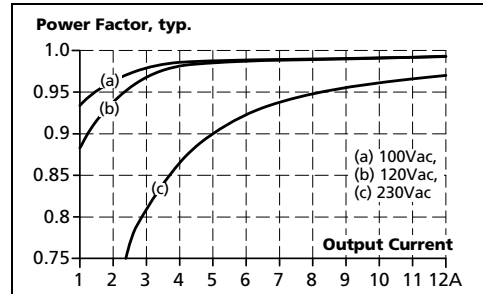


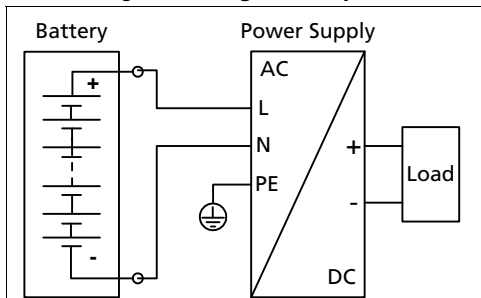
Fig. 3-4 **Power factor vs. output current at 24V output voltage**



## 4. DC-INPUT

|                              |      |                  |                            |
|------------------------------|------|------------------|----------------------------|
| DC input                     | Nom. | DC 110-150V ±20% |                            |
| DC input range               | Min. | 88-180Vdc        | Continuous operation       |
| DC input current             | Typ. | 2.35A            | At 110Vdc, at 24V, 10A     |
| 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         |
|                              | Typ. | 55Vdc            | Dynamic value (max. 250ms) |

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



### Instructions for DC use:

- 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 and -pole to N.
- Connect the PE terminal to an earth wire or to the machine ground.

### 5. 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. | 11A <sub>peak</sub> | 7A <sub>peak</sub>  | 11A <sub>peak</sub> | At 40°C, cold start |
|                | Typ. | 9A <sub>peak</sub>  | 6A <sub>peak</sub>  | 6A <sub>peak</sub>  | At 25°C, cold start |
|                | Typ. | 9A <sub>peak</sub>  | 6A <sub>peak</sub>  | 9A <sub>peak</sub>  | At 40°C, cold start |
| Inrush energy  | Max. | 0.1A <sup>2</sup> s | 0.1A <sup>2</sup> s | 0.4A <sup>2</sup> s | At 40°C, cold start |

Fig. 5-1 Typical turn-on behaviour at nominal load, 120Vac input and 25°C ambient

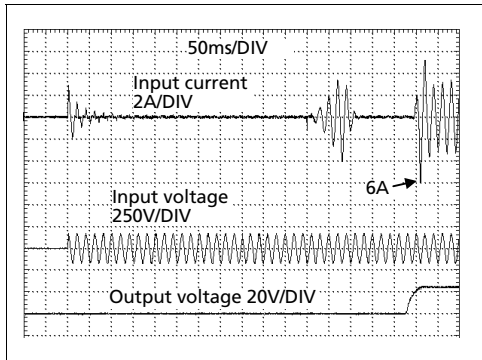
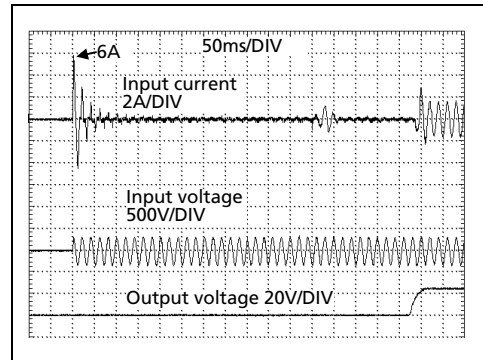


Fig. 5-2 Typical turn-on behaviour at nominal load, 230Vac input and 25°C ambient



### 6. OUTPUT

|                          |      |  |   |
|--------------------------|------|--|---|
| Output voltage           | Nom. | 24V  |   |
| Adjustment range         | Min. | 24-28V                                     | Guaranteed  |
|                          | Max. | 30.0V <sup>****)</sup>                     | At clockwise end position of potentiometer  |
| Factory settings         | Typ. | 24.1V                                      | ±0.2%, at full load and cold unit   |
| Line regulation          | Max. | 10mV                                       | 85-300Vac   |
| Load regulation          | Max. | 50mV                                       | Static value, 0A → 10A; see Fig. 6-1  |
| Ripple and noise voltage | Max. | 50mVpp                                     | 20Hz to 20MHz, 50Ohm  |
| Output current           | Nom. | 10A  | At 24V, ambient temperature <60°C, see Fig. 6-1   |
|                          | Nom. | 12A <sup>*)</sup>                          | At 24V, ambient temperature <45°C, see Fig. 16-1  |
|                          | Nom. | 7.5A                                       | At 24V and 70°C ambient temperature, see Fig. 16-1  |
|                          | Nom. | 8.6A                                       | At 28V, ambient temperature <60°C, see Fig. 6-1   |
|                          | Nom. | 10.3A <sup>*)</sup>                        | At 28V, ambient temperature <45°C, see Fig. 16-1  |
|                          | Nom. | 6.45A                                      | At 28V and 70°C ambient temperature, see Fig. 16-1  |
|                          | Typ. | 30A  | Up to at least 12ms <sup>*****)</sup> , output voltage stays above 20V, see Fig. 6-2 and Fig. 24-3, This peak current is available once every five seconds (hardware controlled). |
| Output power             | Nom. | 240W                                       | Continuously available  |
|                          | Nom. | 288W <sup>*)</sup>                         | Power Boost <sup>*)</sup>   |
| Overload behaviour       |      | cont. current                              | Output voltage > 13Vdc, see Fig. 6-1  |
|                          |      | Hiccup <sup>PLUS</sup> mode <sup>**)</sup> | Output voltage < 13Vdc, see Fig. 6-1  |
| Short-circuit current    | Min. | 12.5A <sup>***)</sup>                      | Load impedance 45mOhm, see Fig. 6-3   |
|                          | Max. | 15.5A <sup>***)</sup>                      | Load impedance 45mOhm, see Fig. 6-3   |
|                          | Max. | 5A   | Average (R.M.S.) current, load impedance 50mOhm, see Fig. 6-3   |
|                          | Min. | 28A  | Up to 12ms, load impedance 45mOhm, see Fig. 6-2   |
|                          | Typ. | 30.5A                                      | Up to 12ms, load impedance 45mOhm, see Fig. 6-2   |
| Output capacitance       | Typ. | 4 400µF                                    | Included inside the power supply  |

**\*) Power Boost**

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<sup>PLUS</sup> 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. 6-3

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

**\*\*\*\*\*) 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. The typical value is about 28.5V.**

**\*\*\*\*\*) Reduced pulse length for AC 100V mains.**

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

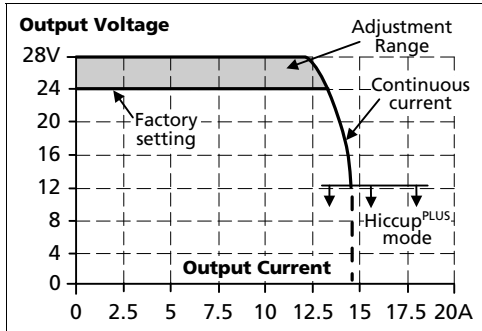


Fig. 6-2 **Dynamic output current capability, typ.**

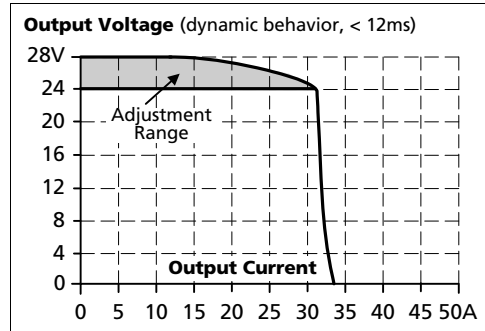
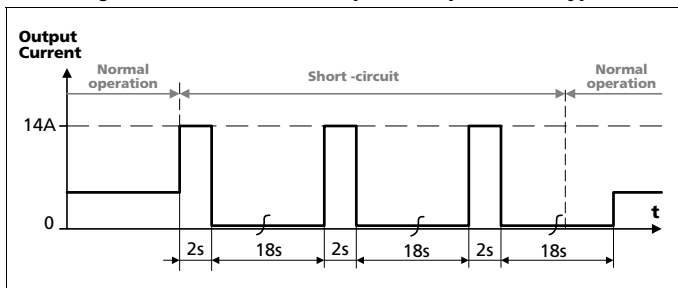


Fig. 6-3 **Short-circuit on output, Hiccup<sup>PLUS</sup> mode, typ.**



## 7. HOLD-UP TIME

|              |      | AC 100V | AC 120V | AC 230V |                           |
|--------------|------|---------|---------|---------|---------------------------|
| Hold-up Time | Typ. | 73ms    | 73ms    | 73ms    | At 24V, 5A, see Fig. 7-1  |
|              | Min. | 55ms    | 55ms    | 55ms    | At 24V, 5A, see Fig. 7-1  |
|              | Typ. | 37ms    | 37ms    | 37ms    | At 24V, 10A, see Fig. 7-1 |
|              | Min. | 28ms    | 28ms    | 28ms    | At 24V, 10A, see Fig. 7-1 |

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

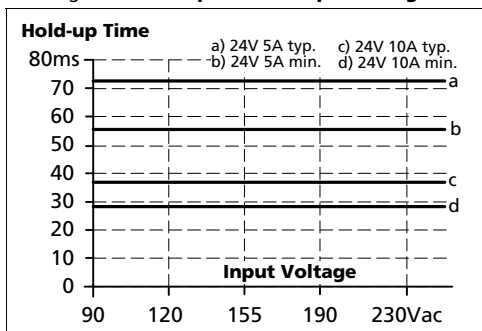
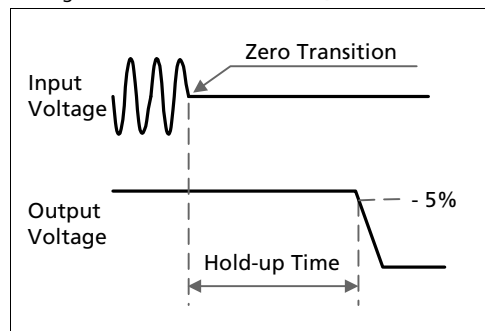


Fig. 7-2 **Shut-down behavior, definitions**



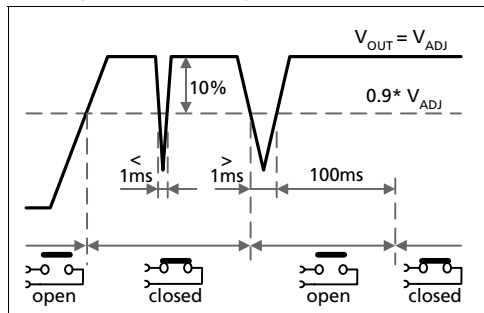


### 8. DC-OK RELAY CONTACT

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.<br>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 section 18.   |                       |

Fig. 8-1 DC-ok relay contact behavior



### 9. EFFICIENCY AND POWER LOSSES

|                      |      | <b>AC 100V</b> | <b>AC 120V</b> | <b>AC 230V</b> |   |
|----------------------|------|----------------|----------------|----------------|---|
| Efficiency           | Typ. | 92.9%          | 93.6%          | 95.2%          | At 24V, 10A                                     |
|                      | Typ. | 92.5%          | 93.4%          | 95.1%          | At 24V, 12A (Power Boost)                       |
| Average efficiency*) | Typ. | 92.5%          | 93.0%          | 94.3%          | 25% at 2.5A, 25% at 5A, 25% at 7.5A. 25% at 10A |
| Power losses         | Typ. | 2.5W           | 2.1W           | 1.8W           | At 24V, 0A                                      |
|                      | Typ. | 9.8W           | 8.9W           | 7.1W           | At 24V, 5A                                      |
|                      | Typ. | 18.3W          | 16.4W          | 12.1W          | At 24V, 10A                                     |
|                      | Typ. | 23.4W          | 21.7W          | 14.8W          | At 24V, 12A (Power Boost)                       |

\*) 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.**

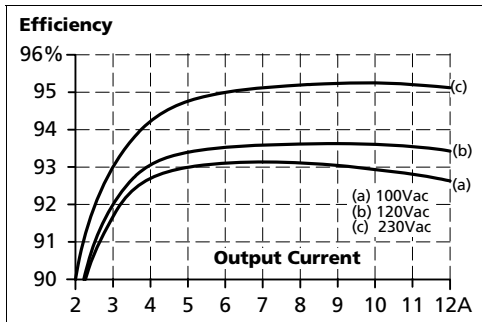


Fig. 9-2 **Losses vs. output current at 24V, typ.**

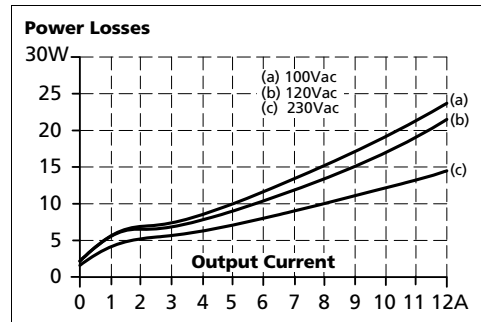


Fig. 9-3 **Efficiency vs. input voltage at 24V, 10A, typ.**

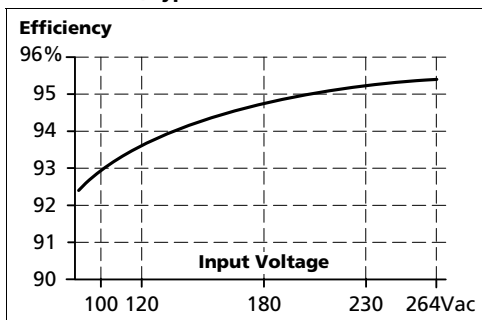
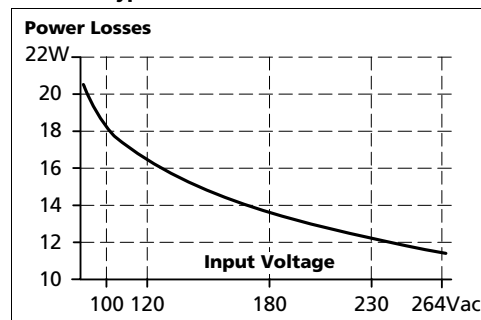


Fig. 9-4 **Losses vs. input voltage at 24V, 10A, typ.**



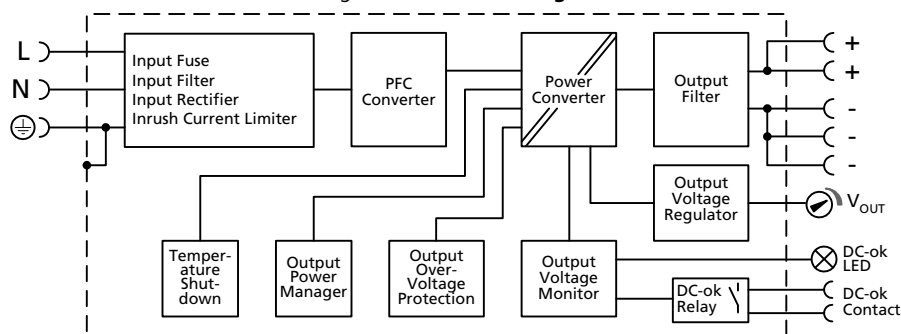
### 10. LIFETIME EXPECTANCY AND MTBF

|   | AC 100V                | AC 120V                | AC 230V                |   |
|---|------------------------|------------------------|------------------------|---|
| Lifetime expectancy <sup>*)</sup>       | 128 000h               | 141 000h <sup>*)</sup> | 176 000h <sup>*)</sup> | At 24V, 5A and 40°C                         |
|   | 61 000h                | 75 000h                | 120 000h               | At 24V, 10A and 40°C                        |
|   | 47 000h                | 59 000h                | 101 000h               | At 24V, 12A and 40°C                        |
|   | 363 000h <sup>*)</sup> | 399 000h <sup>*)</sup> | 499 000h <sup>*)</sup> | At 24V, 5A and 25°C                         |
|   | 173 000h <sup>*)</sup> | 211 000h <sup>*)</sup> | 338 000h <sup>*)</sup> | At 24V, 10A and 25°C                        |
|   | 132 000h <sup>*)</sup> | 166 000h <sup>*)</sup> | 286 000h <sup>*)</sup> | At 24V, 12A and 25°C                        |
| MTBF <sup>**) SN 29500, IEC 61709</sup> | 550 000h               | 560 000h               | 661 000h               | At 24V, 10A and 40°C                        |
|   | 1 003 000h             | 1 017 000h             | 1 176 000h             | At 24V, 10A and 25°C                        |
| MTBF <sup>**) MIL HDBK 217F</sup>       | 188 000h               | 188 000h               | 213 000h               | At 24V, 10A and 40°C;<br>Ground Benign GB40 |
|   | 252 000h               | 252 000h               | 290 000h               | At 24V, 10A and 25°C;<br>Ground Benign GB25 |
|   | 40 000h                | 40 000h                | 47 000h                | At 24V, 10A and 40°C;<br>Ground Fixed GF40  |
|   | 51 000h                | 51 000h                | 61 000h                | At 24V, 10A and 25°C;<br>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 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.

### 11. FUNCTIONAL DIAGRAM

Fig. 11-1 Functional diagram



## 12. TERMINALS AND WIRING

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

| Type                               | Input and Output                     | DC-OK-Signal            |
|------------------------------------|--------------------------------------|-------------------------|
|                                    | Quick-connect spring-clamp terminals | Push-in terminals       |
| Solid wire                         | Max. 6mm <sup>2</sup>                | Max. 1.5mm <sup>2</sup> |
| Stranded wire                      | Max. 4mm <sup>2</sup>                | Max. 1.5mm <sup>2</sup> |
| 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 / 0.4inch                       | 7mm / 0.28inch          |
| Screwdriver                        | Not applicable                       | Not required            |
| Recommended tightening torque      | Not applicable                       | Not applicable          |

### Instructions:

- Use appropriate copper cables that are designed for minimum operating temperatures of:  
90°C for ambient between 45°C and 60°C minimum  
105°C for ambient up to 70°C minimum.
- Follow national installation codes and installation regulations!
- Ensure that all strands of a stranded wire enter the terminal connection!
- Do not use the unit without PE connection.
- Unused terminal compartments should be securely tightened.
- Ferrules are allowed.

### Daisy chaining:

Daisy chaining (jumping from one power supply output to the next) is allowed as long as the average output current through one terminal pin does not exceed 25A. If the current is higher, use a separate distribution terminal block as shown in Fig. 12-2.

Fig. 12-1 Daisy chaining of outputs

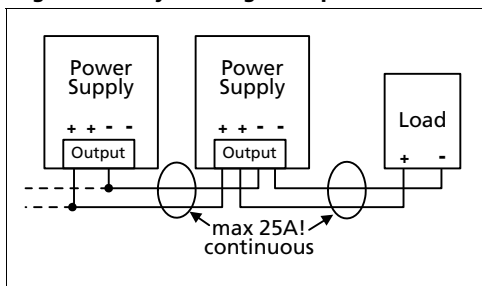
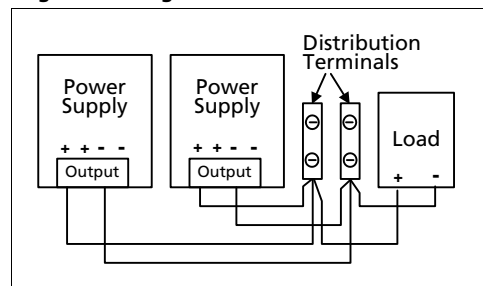


Fig. 12-2 Using distribution terminals



### 13. FRONT SIDE AND USER ELEMENTS

Fig. 13-1



#### **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. Factory set: 24.1V

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

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

#### **E DC-OK Relay Contact**

(Push-in terminals)

Monitors the output voltage of the running power supply.

See chapter 8 for details.

### 14. EMC – ACCORDING TO GENERIC STANDARDS

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

| <b>EMC Immunity</b>      |               | 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  | 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 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.

| <b>EMC Emission</b>                |   | According to generic standards: EN 61000-6-3 and EN 61000-6-4                          |  |
|------------------------------------|---|--|--|
| Conducted emission input lines     | EN 55011, EN 55015, EN 55022, FCC Part 15, CISPR 11, CISPR 22 | 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                            | 12dB higher than average limits for DC power port according to EN 61000-6-3**)         |  |
| Radiated emission                  | EN 55011, EN 55022  | Class B  |  |
| Harmonic input current             | EN 61000-3-2  | Class A fulfilled between 0A and 12A load<br>Class C fulfilled between 6A and 12A load |  |
| Voltage fluctuations, flicker      | EN 61000-3-3  | Fulfilled <sup>3)</sup>  |  |

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.

**15. EMC – ACCORDING TO MEDICAL STANDARDS**

| <b>EMC Immunity</b>                   |                                    | 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 |

**Criteria:**

**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.

| <b>EMC Emission</b>            |                    | According to generic 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<br>Class C fulfilled between 6A and 12A load |  |
| Voltage fluctuations, flicker  | EN 61000-3-3       | Fulfilled <sup>*)</sup>  |  |

**Switching Frequencies** The power supply has three converters with two different switching frequencies included.

|                       |                  |   |
|-----------------------|------------------|---|
| Switching frequency 1 | 110kHz           | PFC converter, input voltage and output power dependent |
| Switching frequency 2 | 110kHz to 140kHz | Main converter, output power dependent                  |
| Switching frequency 3 | 60kHz            | Auxiliary converter                                     |

### 16. ENVIRONMENT

|                                       |  |  |
|---------------------------------------|--|--|
| Operational temperature <sup>*)</sup> | -25°C to +70°C (-13°F to 158°F)  | Reduce output power according Fig. 16-1  |
| Non-operational temperature           | -40°C to +85°C (-40°F to 185°F)  | For storage and transportation   |
| Output de-rating                      | 3.2W/°C<br>6W/°C   | 45°C to 60°C (113°F to 140°F)<br>60°C to 70°C (140°F to 158°F)   |
| Humidity <sup>**)</sup>               | 5 to 95% r.h.  | For operation, storage and transportation according to IEC 60068-2-30  |
| Atmospheric pressure                  | 106-70kPa  | For operation, storage and transportation  |
| Vibration sinusoidal                  | 2-17.8Hz: ±1.6mm; 17.8-500Hz: 2g <sup>***)</sup><br>2 hours / axis <sup>***)</sup>                               | IEC 60068-2-6  |
| Shock                                 | 30g 6ms, 20g 11ms <sup>***)</sup><br>3 bumps / direction, 18 bumps in total                                      | IEC 60068-2-27   |
| Altitude                              | 0 to 3000m (0 to 9 840ft)<br>0 to 2000m (0 to 6 560ft)<br>2000 to 6000m (6 560 to 20 000ft)                      | For medical applications<br>For all other applications<br>Reduce output power or ambient temperature, see Fig. 16-2. |
| Altitude de-rating                    | 15W/1000m or 5°C/1000m   | Above 2000m (6500ft), see Fig. 16-2  |
| Over-voltage category                 | III<br><br>II  | Altitudes up to 2000m according to IEC/EN 62477-1,<br>For altitudes from 2000m to 6000m                              |
| Degree of pollution                   | 2  | According to IEC/EN 62477-1, not conductive  |
| LABS compatibility                    | The unit does not release any silicone or other LABS-critical substances and is suitable for use in paint shops. |  |

\*) 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. 16-1 Output current vs. ambient temp.

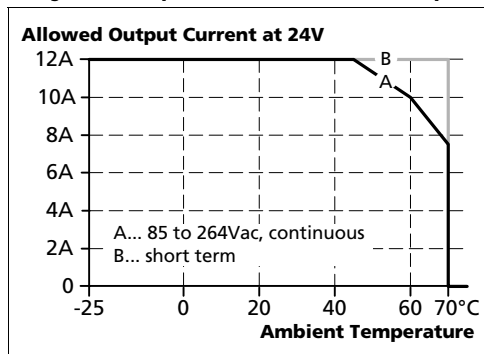
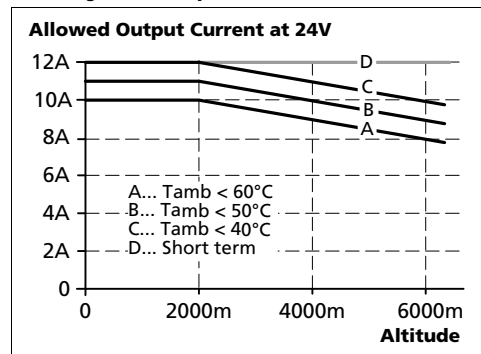


Fig. 16-2 Output current vs. altitude





### 17. SAFETY FEATURES

|   |  |  |
|---|--|--|
| Input / output separation <sup>1)</sup>                                 | SELV<br>PELV<br>double or reinforced insulation  | IEC/EN 60950-1<br>IEC/EN 60204-1, IEC/EN 62477-1, IEC 60364-4-41   |
| Transformers  | Safety Isolating Transformers<br>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  |
| Isolation resistance  | Min. 500MΩ   | Input to output, measured with 500Vdc  |
| PE resistance   | Max. 0.1Ω  | PE terminal to enclosure   |
| Earth leakage current, industrial                                       | Typ. 0.06mA / 0.17mA<br>Typ. 0.09mA / 0.24mA<br>Typ. 0.15mA / 0.42mA<br>Max. 0.08mA / 0.20mA<br>Max. 0.11mA / 0.30mA<br>Max. 0.20mA / 0.55mA | 100Vac, 50Hz, TN-,TT-mains / IT-mains<br>120Vac, 60Hz, TN-,TT-mains / IT-mains<br>230Vac, 50Hz, TN-,TT-mains / IT-mains<br>110Vac, 50Hz, TN-,TT-mains / IT-mains<br>132Vac, 60Hz, TN-,TT-mains / IT-mains<br>264Vac, 50Hz, TN-,TT-mains / IT-mains |
| Earth leakage current <sup>2) 3)</sup> , medical                        | Typ. 0.21mA<br>Max. 0.24mA<br>Typ. 0.41mA<br>Max. 0.47mA   | 264Vac, 60Hz, normal condition<br>264Vac, 60Hz, normal condition<br>264Vac, 60Hz, single fault condition<br>264Vac, 60Hz, single fault condition   |
| Touch current <sup>2) 3)</sup> , medical, Mains to enclosure            | Typ. 0.001mA<br>Max. 0.001mA<br>Typ. 0.21mA<br>Max. 0.24mA   | 264Vac, 60Hz, normal condition<br>264Vac, 60Hz, normal condition<br>264Vac, 60Hz, single fault condition<br>264Vac, 60Hz, single fault condition   |
| Touch current <sup>2) 3)</sup> , medical, Mains to output GND (-) pole  | Typ. 0.009mA<br>Max. 0.015mA<br>Typ. 0.13mA<br>Max. 0.15mA   | 264Vac, 60Hz, normal condition<br>264Vac, 60Hz, normal condition<br>264Vac, 60Hz, single fault condition<br>264Vac, 60Hz, single fault condition   |
| Touch current <sup>2) 3)</sup> , medical, Mains to output plus (+) pole | Typ. 0.008mA<br>Max. 0.013mA<br>Typ. 0.14mA<br>Max. 0.16mA   | 264Vac, 60Hz, normal condition<br>264Vac, 60Hz, normal condition<br>264Vac, 60Hz, single fault condition<br>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.

### 18. PROTECTION FEATURES

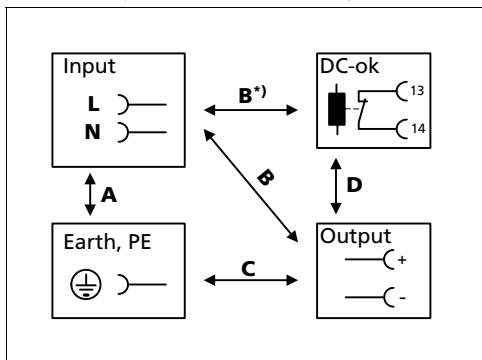
|                                |   |   |
|--------------------------------|---|---|
| Output protection              | Electronically protected against overload, no-load and short-circuits*) |   |
| Output over-voltage protection | Typ. 30.5Vdc<br>Max. 32Vdc  | In case of an internal power supply defect, a redundant circuit limits the maximum output voltage. The output shuts down and automatically attempts to restart. |
| Degree of protection           | IP 20   | EN/IEC 60529<br>For use in a controlled environment according to CSA 22.2 No 107.1-01.  |
| Penetration protection         | > 4mm   | e.g. screws, small parts  |
| Over-temperature protection    | yes   | Output shut-down with automatic restart   |
| Input transient protection     | MOV (Metal Oxide Varistor)  |   |
| Internal input fuse            | Included  | not user replaceable  |

\*) In case of a protection event, audible noise may occur.

### 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  |






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 can not 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.




#### Insulation Safety Ratings

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

### 20. APPROVALS

|   |   |   |
|---|---|---|
| EC Declaration of Conformity                      |  | The CE mark indicates conformance with the<br>- EMC directive and the<br>- Low-voltage directive (LVD)  |
| IEC 60601-1<br>3 <sup>rd</sup> Edition            |  | CB Scheme,<br>Medical electrical equipment – Part 1: General requirements<br>for basic safety and essential performance<br>2x MOPP and 2x MOOP<br>(Except risk assessment)          |
| IEC 60950-1<br>2 <sup>nd</sup> Edition<br>planned |  | CB Scheme,<br>Information Technology Equipment  |
| UL 508<br>planned                                 |  | Listed for use as Industrial Control Equipment;<br>U.S.A. (UL 508) and Canada (C22.2 No. 107-1-01);<br>E-File: E198865  |
| UL 60950-1<br>2 <sup>nd</sup> Edition<br>planned  |  | Recognized for use as Information Technology Equipment,<br>Level 5; U.S.A. (UL 60950-1) and Canada (C22.2 No. 60950-1);<br>E-File: E137006<br>Applicable for altitudes up to 2000m. |

### 21. ROHS, REACH AND OTHER FULFILLED STANDARDS

|                 |   |   |
|-----------------|---|---|
| RoHS Directive  |  | Directive 2011/65/EU of the European Parliament and the<br>Council of June 8 <sup>th</sup> , 2011 on the restriction of the use of<br>certain hazardous substances in electrical and electronic<br>equipment.   |
| REACH Directive |  | Directive 1907/2006/EU of the European Parliament and the<br>Council of June 1 <sup>st</sup> , 2007 regarding the Registration,<br>Evaluation, Authorisation and Restriction of Chemicals<br>(REACH)  |
| EN 60601-1-2    |  | Medical electrical equipment - Part 1-2: General requirements<br>for basic safety and essential performance - Collateral<br>standard: Electromagnetic compatibility - Requirements and<br>tests<br>Notes:<br>- Clause 4.1 (RMA) is exempted<br>- To maintain basic safety in regards to EMC check PE<br>connection every year. Units with mechanical defects or<br>corrosive surfaces should no longer be used. |

### 22. PHYSICAL DIMENSIONS AND WEIGHT

|                         |  |
|-------------------------|--|
| Width                   | 39mm 1.54"   |
| Height                  | 124mm 4.88"  |
| Depth                   | 117mm 4.61"<br>The DIN-rail height must be added to the unit depth to calculate the total required installation depth. |
| Weight                  | 620g / 1.37lb  |
| 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<br>Cover: zinc-plated steel  |
| Installation clearances | See chapter 2  |

Fig. 22-1 **Front view**

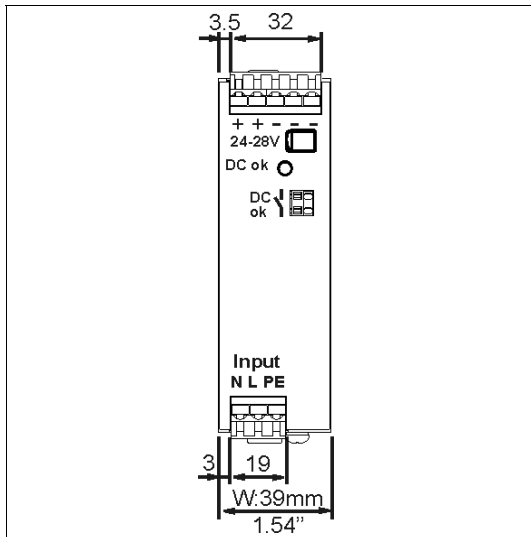
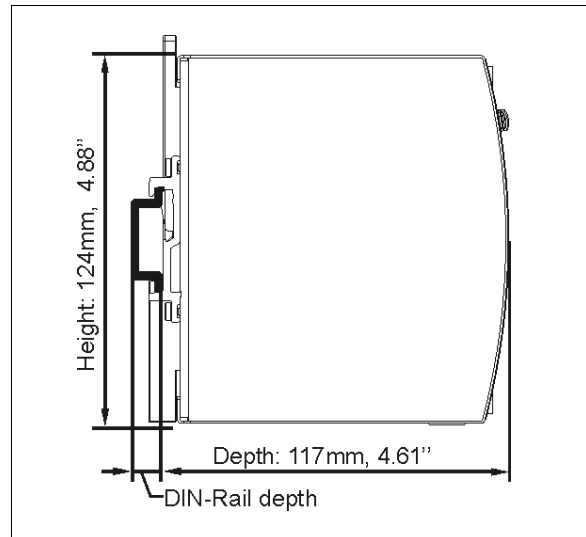


Fig. 22-2 **Side view**



### 23. ACCESSORIES

#### 23.1. 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 sideways DIN-rail mounting, the removed aluminum brackets and the black plastic slider need to be mounted on the steel bracket.

Fig. 23-1  
Side mounting without  
DIN-rail brackets

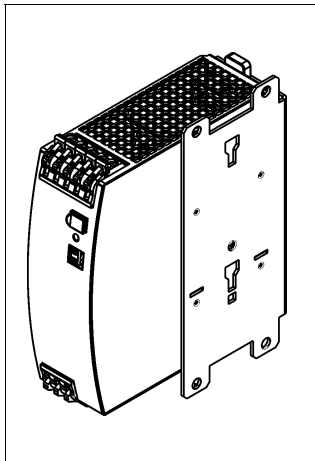


Fig. 23-2  
Side mounting with  
DIN-rail brackets

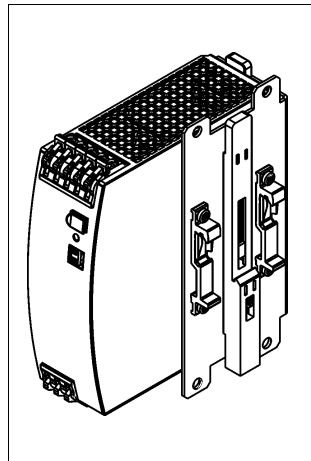
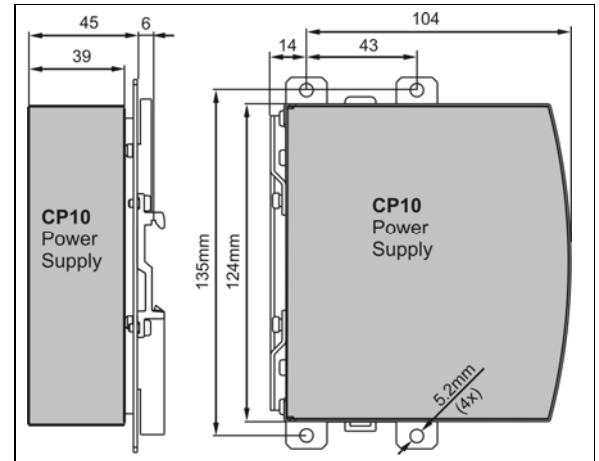


Fig. 23-3  
Mounting Dimensions  
Side mounting bracket



### 23.2. YR20.242 - REDUNDANCY MODULE



The YR20.242 is equipped with two input channels, which are individually decoupled by utilizing MOSFET technology. Using MOSFETs instead of diodes reduces the heat generation and the voltage drop between input and output. The YR20.242 does not require an additional auxiliary voltage and is self-powered even in case of a short circuit across the output.

Due to the low power losses, the unit is very slender and only requires 32mm width on the DIN-rail. The YR20.242 can be used for n+1 and 1+1 redundancy systems.

Further information and wiring configurations can be found in chapter 24.7.

### 23.3. YR20.246 - REDUNDANCY MODULE WITH AUTOMATED LOAD SHARING



The YR20.246 is equipped with two input channels, which are individually decoupled by utilizing MOSFET technology. Using MOSFETs instead of diodes reduces the heat generation and the voltage drop between input and output. The YR20.246 does not require an additional auxiliary voltage and is self-powered even in case of a short circuit across the output.

Due to the low power losses, the unit is very slender and only requires 32mm width on the DIN-rail. The YR20.246 is optimized for 1+1 redundancy systems.

Compared to the YR20.242, the YR20.246 is featured with an automated load sharing between the connected power supplies. The YR20.246 monitors the function of the redundancy circuitry and provides a signal in case of too high of output current, which could prevent redundancy, if one

power supply fails.

Further information and wiring configurations can be found in chapter 24.7.

## 24. APPLICATION NOTES

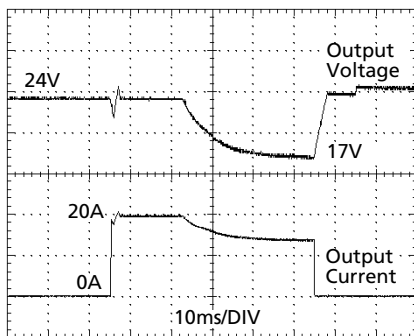
### 24.1. PEAK CURRENT CAPABILITY

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 (including the PowerBoost). 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.

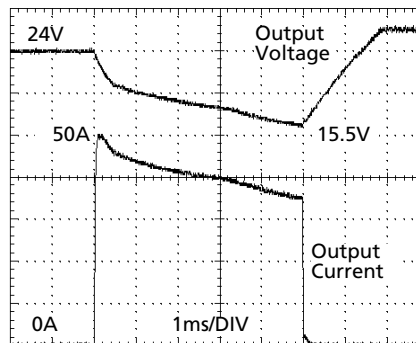
The extra current (peak current) is supplied by the power converter and the built-in large sized output capacitors of the power supply. The capacitors get discharged during such an event, which causes a voltage dip on the output. The following two examples show typical voltage dips:

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



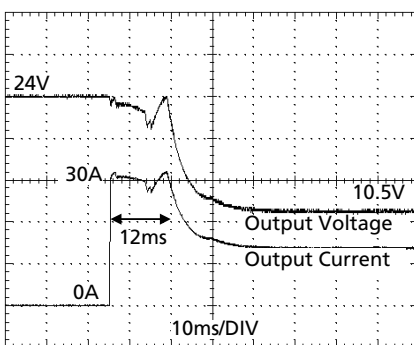
20A Peak load (resistive) for 50ms  
Output voltage dips from 24V to 17V.

Fig. 24-2 **Peak load with 5x the nominal current for 5ms, typ.**



50A Peak load (resistive) for 5ms  
Output voltage dips from 24V to 15.5V.

Fig. 24-3 **30A Peak load, typ.**



High Overload Current (typ. 30A for 12ms) enables easy fuse tripping

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

|                           |      |                   |                                 |
|---------------------------|------|-------------------|---------------------------------|
| Peak current voltage dips | Typ. | From 24V to 17V   | At 20A for 50ms, resistive load |
|                           | Typ. | From 24V to 19V   | At 50A for 2ms, resistive load  |
|                           | Typ. | From 24V to 15.5V | At 50A for 5ms, resistive load  |

### 24.2. 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. The maximum allowed feed-back peak current is 40A. Higher currents can temporarily shut-down the output voltage. The absorbing energy can be calculated according to the built-in large sized output capacitor which is specified in chapter 6.

### 24.3. 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 6A B- or C-Characteristic breaker should be used.

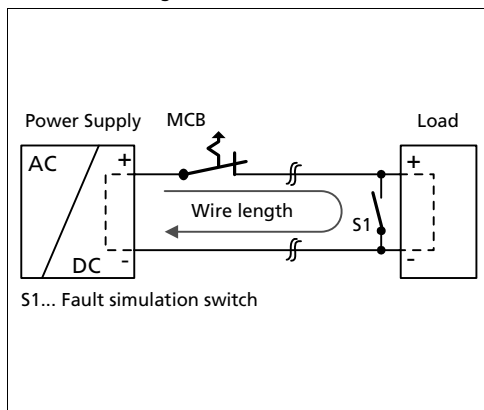
### 24.4. OUTPUT CIRCUIT BREAKERS

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<sup>\*)</sup> for a fast (magnetic) tripping:

|              | 0.75mm <sup>2</sup> | 1.0mm <sup>2</sup> | 1.5mm <sup>2</sup> | 2.5mm <sup>2</sup> |
|--------------|---------------------|--------------------|--------------------|--------------------|
| <b>C-2A</b>  | 30m                 | 37m                | 54m                | 84m                |
| <b>C-3A</b>  | 25m                 | 30m                | 46m                | 69m                |
| <b>C-4A</b>  | 9m                  | 15m                | 25m                | 34m                |
| <b>C-6A</b>  | 3m                  | 3m                 | 4m                 | 7m                 |
| <b>B-6A</b>  | 12m                 | 15m                | 21m                | 34m                |
| <b>B-10A</b> | 3m                  | 3m                 | 4m                 | 9m                 |
| <b>B-13A</b> | 2m                  | 2m                 | 3m                 | 6m                 |

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



### 24.5. SERIES OPERATION

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

### 24.6. 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.

### 24.7. PARALLEL USE FOR REDUNDANCY

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

### 24.8. 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<sup>PLUS</sup> mode (see chapter 6).

### 24.9. 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:**

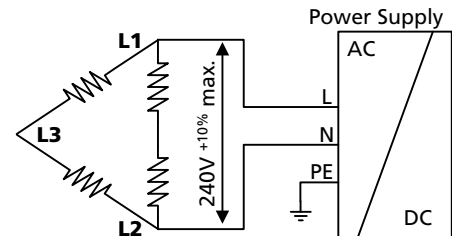
- a) Set output voltage (measured at no load and at the battery end of the cable) very precisely to the end-of-charge voltage.

|                       |       |       |        |       |
|-----------------------|-------|-------|--------|-------|
| 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).

### 24.10. 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

Input: 230Vac

**Case A:** Enclosure: Rittal Typ IP66 Box PK 9519 100, plastic, 180x180x165mm  
 Load: 24V, 8A; (=80%) load is placed outside the box  
 Temperature inside the box: 42.0°C (in the middle of the right side of the power supply with a distance of 1cm)  
 Temperature outside the box: 25.8°C  
 Temperature rise: 16.2K

**Case B:** Enclosure: Rittal Typ IP66 Box PK 9519 100, plastic, 180x180x165mm  
 Load: 24V, 10A; load is placed outside the box  
 Temperature inside the box: 48.1°C (in the middle of the right side of the power supply with a distance of 1cm)  
 Temperature outside the box: 26.2°C  
 Temperature rise: 21.9K

**Case C:** Enclosure: Rittal Typ IP66 Box PK 9516 100, plastic, 110x180x165mm  
 Load: 24V, 8A; (=80%) load is placed outside the box  
 Temperature inside the box: 48.6°C (in the middle of the right side of the power supply with a distance of 1cm)  
 Temperature outside the box: 26.3°C  
 Temperature rise: 22.3K

**Case D:** Enclosure: Rittal Typ IP66 Box PK 9519 100, plastic, 110x180x165mm  
 Load: 24V, 10A; load is placed outside the box  
 Temperature inside the box: 53.8°C (in the middle of the right side of the power supply with a distance of 1cm)  
 Temperature outside the box: 26.6°C  
 Temperature rise: 27.3K

## 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. 24-5  
**Mounting Orientation A**  
(Standard orientation)

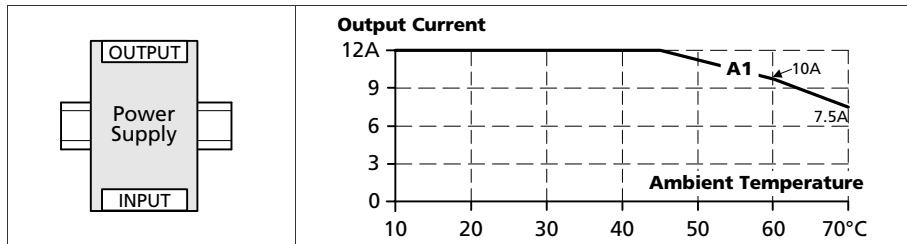


Fig. 24-6  
**Mounting Orientation B**  
(Upside down)

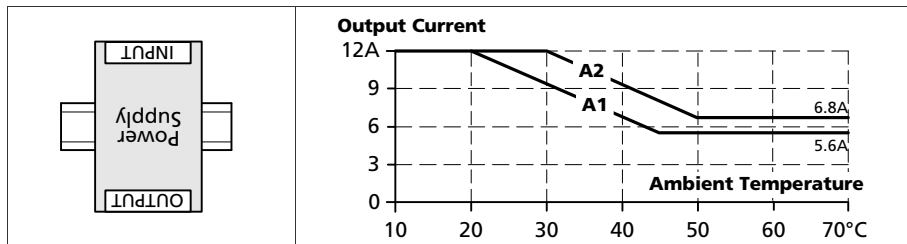


Fig. 24-7  
**Mounting Orientation C**  
(Table-top mounting)

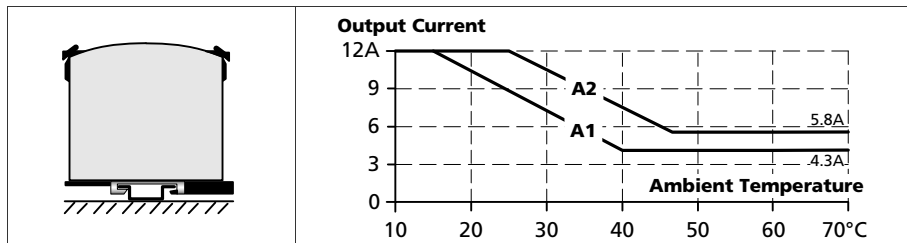


Fig. 24-8  
**Mounting Orientation D**  
(Horizontal cw)

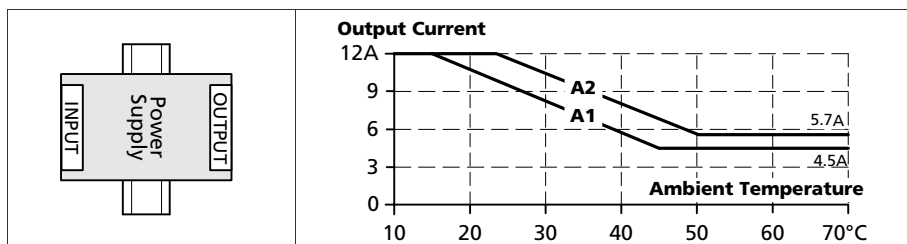


Fig. 24-9  
**Mounting Orientation E**  
(Horizontal ccw)

