



DC/DC CONVERTER

- 48V DC-input
- Isolated 24Vdc output
- Efficiency 94%
- Width only 42mm
- 20% Output power reserves
- Full power between -25°C and +60°C
- Soft-start function
- Minimal inrush current surge
- Reverse input polarity protection
- DC-OK relay contact
- Current sharing feature for parallel use
- 3 Year warranty

PRODUCT DESCRIPTION

The CD10.242 is a DIN rail mountable DC/DC converter of the highly reliable DIMENSION series. It provides a floating, stabilized and galvanically separated SELV/PELV output voltage of 24Vdc with 48Vdc on the input.

The efficiency of 94% and a slim design are cost- and space-saving, while at the same time offering additional power reserves of 20% which may even be used continuously at ambient temperatures up to +45°C.

For even higher power needs, multiple devices can be connected in parallel. At any time, a DC-OK LED and a signal contact are informing about the status of the device.

A high immunity to transients and power surges as well as low electromagnetic emission makes this DC/DC converter suitable for nearly every situation.

For 24Vdc/24Vdc or 48Vdc/48Vdc converters, please see PULS products CD10.241 resp. CD10.482.

SHORT-FORM DATA

| | | |
|----------------------|--------------------------------|-----------------------|
| Output voltage | DC 24V | Nominal |
| 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 between +45°C and +70°C | |
| Input voltage | DC 48V | ±25% |
| Input current | 5.4A | |
| Input inrush current | 5.8A peak | |
| Efficiency | 94% | |
| Power losses | 15.4W | |
| Hold-up time | 7ms | |
| Temperature range | -25°C to +70°C | |
| Size (W x H x D) | 42x124x117mm | Without DIN rail |
| Weight | 520g / 1.15lb | |

ORDER NUMBERS

DC/DC Converter

CD10.242

Mechanical Accessory

ZM10.WALL Wall/panel mount bracket

ZM12.SIDE Side mount bracket

MAIN APPROVALS

For details or a complete approval list, see chapter 19.



UL 61010-1-201
planned



IECEX
planned



ATEX
planned



DNV.COM/AF
Marine
planned



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TERMINOLOGY AND ABBREVIATIONS

| | |
|--|---|
| PE and  symbol | PE is 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. |
| DC 48V | A figure displayed with the AC or DC before the value represents a nominal voltage with standard tolerances included. E.g.: DC 12V describes a 12V battery disregarding whether it is full (13.7V) or flat (10V) |
| 48Vdc | A figure with the unit (Vac) at the end is a momentary figure without any additional tolerances included. |
| may | A key word indicating flexibility of choice with no implied preference. |
| shall | A key word indicating a mandatory requirement. |
| should | A key word indicating flexibility of choice with a strongly preferred implementation. |

1. INTENDED USE

This device is designed for installation in an enclosure and is intended for commercial use, such as in industrial control, process control, monitoring, measurement, Audio/Video, information or communication equipment or the like.

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 and protect against inadvertent re-powering.
- Do not open, modify or repair the device.
- Use caution to prevent any foreign objects from entering into 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 surface may cause burns.

Obey the following installation requirements:

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. Other mounting orientations require a reduction in output current.

Make sure that the wiring is correct by following all local and national codes. Use appropriate copper cables that are designed for a minimum operating temperature of 60°C for ambient temperatures up to +45°C, 75°C for ambient temperatures up to +60°C and 90°C for ambient temperatures up to +70°C. Ensure that all strands of a stranded wire enter the terminal connection. Unused screw terminals should be securely tightened.

The device is designed for pollution degree 2 areas in controlled environments. No condensation or frost is allowed.

The enclosure of the device provides a degree of protection of IP20. The enclosure does not provide protection against spilled liquids. The isolation of the devices is designed to withstand impulse voltages up to 1.5kV according to IEC 60664-1.

The input can be powered from batteries or similar DC sources. The voltage between the input terminals and ground must not exceed 60Vdc continuously. The input must be powered from a PELV or SELV source or an "Isolated Secondary Circuit" in order to maintain a SELV or PELV output.

Check for correct input polarity. The device will not operate when the voltage is reversed. A disconnecting means shall be provided for the input of the device.

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 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 5000m (16400ft). Above 2000m (6560ft) a reduction in output current is required.

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

The device is designed, tested and approved for branch circuits up to 50A without additional protection device. If an external fuse is utilized, do not use circuit breakers smaller than 16A B- or C-Characteristic to avoid a nuisance tripping of the circuit breaker.

The maximum surrounding air temperature is +70°C (+158°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.

3. DC-INPUT

The input can be powered from batteries or similar DC sources and must be a PELV or SELV source or an "Isolated Secondary Circuit" in order to maintain a SELV or PELV output.

Check for correct input polarity. The device will not operate when the voltage is reversed.

| | | | |
|--|-----------------------------------|------------------|--|
| DC input | nom. | DC 48V | ±25% |
| DC input range | | 36-60Vdc | Continuous operation |
| Allowed voltage between input and earth/ground | max. | 60Vdc or 42.2Vac | Continuous operation, according to IEC 62477-1 |
| Allowed input ripple voltage | max. | 10Vpp | In the frequency range from 47 to 500Hz, the momentary input voltage must always be within the specified limits. |
| Turn-on voltage | typ. | 35Vdc | Steady-state value, see Fig. 3-1 |
| Shut-down voltage | typ. | 32Vdc | Steady-state value, see Fig. 3-1 |
| Input current | typ. | 5.4A | At 48Vdc input and 24V, 10A output load, see Fig. 3-3 |
| | typ. | 7.5A | At 36Vdc input and 24V, 10A output load, see Fig. 3-3 |
| Start-up delay | typ. | 200ms | See Fig. 3-1 |
| Rise time | typ. | 150ms | At 48V, 10A constant current load, 0mF load capacitance, see Fig. 3-2 |
| | typ. | 250ms | At 48V, 10A constant current load, 5mF load capacitance, see Fig. 3-2 |
| Turn-on overshoot | max. | 500mV | See Fig. 3-2 |
| Input capacitance | typ. | 1 650µF | Installed inside the device, external capacitors on the input are allowed without any limitations. |
| External input protection | See recommendations in chapter 2. | | |

Fig. 3-1 Input voltage range

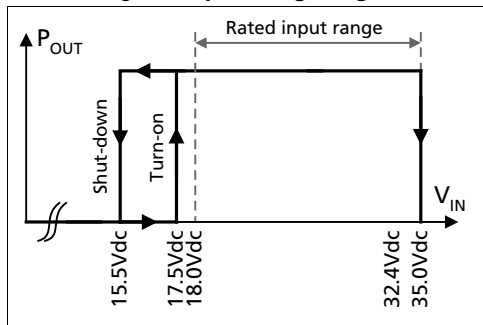


Fig. 3-2 Turn-on behavior, definitions

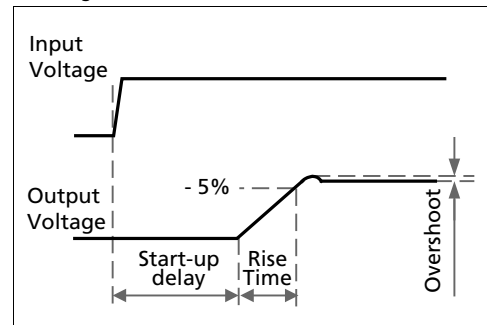
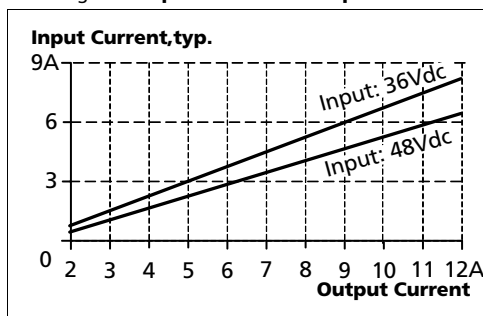


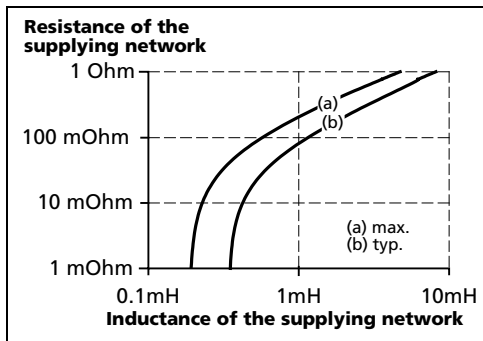
Fig. 3-3 Input current vs. output load



Requirements for the Supplying Source

In certain circumstances, the input filter of the DC/DC converter can show a resonant effect which is caused by the supplying network. Especially when additional external input filters are utilized, a superimposed AC voltage can be generated on the input terminals of the DC/DC converter which might cause a malfunction of the unit. Therefore, additional input filters are not recommended. To avoid the resonant effects, the minimal resistance of the supplying network which depends on the inductance of the input network, shall be above the boundary curve in Fig. 3-4.

Fig. 3-4 External input filter requirements to avoid filter instabilities



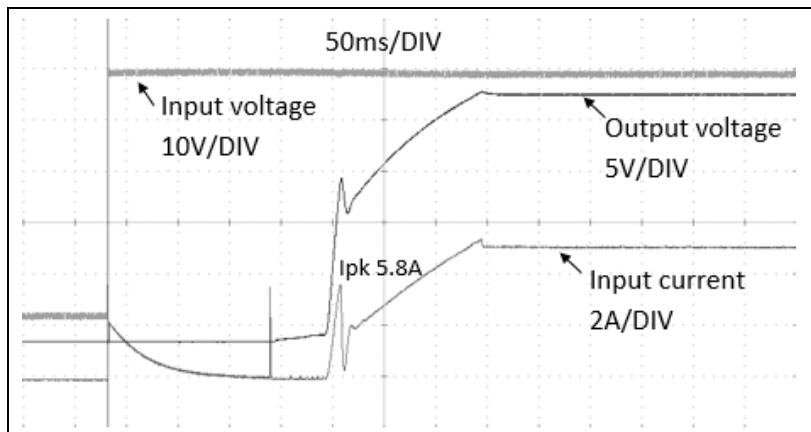
4. INPUT INRUSH CURRENT

An active inrush limitation circuit (inrush limiting NTC resistor which is bypassed by a MOSFET) 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.

| | | | |
|----------------|------|----------------------|---------------------|
| Inrush current | max. | 8A _{peak} | At 40°C, cold start |
| | typ. | 7A _{peak} | At 40°C, cold start |
| | typ. | 5.8A _{peak} | At 25°C, cold start |
| Inrush energy | max. | 1A ² s | At 40°C, cold start |

Fig. 4-1 Typical input inrush current behavior at nominal load and 25°C ambient



5. SOFT-START FEATURE

After the DC/DC converter is turned on, the internal output current rises slowly to its nominal value. This method charges the output capacitors (internal and external capacitors) slowly and avoids high input currents during turn-on. High input currents can produce a high voltage drop on the input wiring (especially with long and thin cables) which reduces the terminal voltage on the DC/DC converter. If the terminal voltage is below the shut-down voltage, the DC/DC converter will turn-off and will make a new start-up attempt. This effect is avoided with the integrated soft-start function. Please note that this function increases the rise time of the output voltage by a small amount.

6. OUTPUT

The output provides a SELV/PELV rated voltage, which is galvanically isolated from the input voltage and is designed to supply any kind of loads, including unlimited capacitive and inductive loads.

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

| | | | |
|---------------------------------|------|--------------------|---|
| Output voltage | nom. | 24V | |
| Adjustment range | | 24-28V | Guaranteed value from 23-28V |
| | max. | 30V | This is the maximum output voltage which can occur at the clockwise end position of the potentiometer due to tolerances. It is not a guaranteed value which can be achieved. |
| Factory setting | | 24.1V | ±0.2%, at full load, cold unit |
| Line regulation | max. | 25mV | Between 18 and 35Vdc input voltage variation |
| Load regulation | max. | 100mV | In "single use" mode: static value, 0A → 10A, see Fig. 6-2 |
| | typ. | 1000mV | In "parallel use" mode: static value, 0A → 10A, see Fig. 6-2 |
| Ripple and noise voltage | max. | 100mVpp | Bandwidth 20Hz to 20MHz, 50Ohm |
| Output current | nom. | 12A | At 24V and an ambient temperature below +45°C |
| | nom. | 10A | At 24V and +60° ambient temperature |
| | nom. | 7.5A | At 24V and +70° ambient temperature |
| | nom. | 10.3A | At 28V and an ambient temperature below +45° |
| | nom. | 8.6A | At 28V and +60° ambient temperature |
| | nom. | 6.5A | At 28V and +70° ambient temperature |
| Overload behavior | | Continuous current | |
| Overload/ short-circuit current | max. | 16A | Continuous current |
| Output capacitance | typ. | 4 500µF | Included inside the power supply |
| Back-feeding loads | max. | 35V | The unit is resistant and does not show malfunctioning when a load feeds back voltage to the power supply. It does not matter whether the power supply is on or off. The absorbing energy can be calculated according to the built-in large sized output capacitor. |

Fig. 6-1 **Output voltage vs. output current at 48Vdc input voltage, typ.**

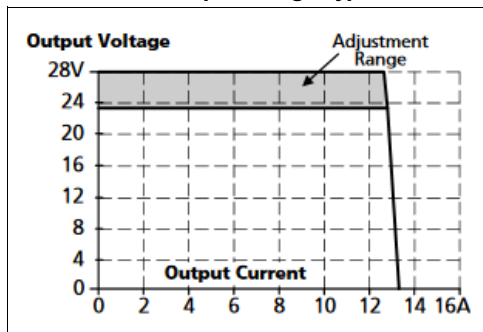
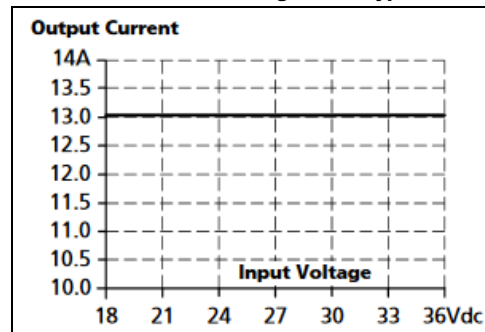


Fig. 6-2 **Current limitation vs. input voltage, (46V constant voltage load), typ.**



7. HOLD-UP TIME

The input side of the DC/DC converter is equipped with a bulk capacitor which keeps the output voltage alive for a certain period of time when the input voltage dips or is removed. The bulk capacitor can be discharged by loading the DC/DC converter on the output side or through a load which is parallel to the input. There is no protection in the DC/DC converter which prevents current from flowing back to the input terminals. If prevention is needed, an external diode should be used.

At no load, the hold-up time can be up to several seconds. The green DC-OK LED is also on during this time.

| | | | |
|--------------|------|------|---|
| Hold-up Time | typ. | 14ms | At 24Vdc input voltage, 24V, 5A output, see Fig. 7-1 |
| | min. | 11ms | At 24Vdc input voltage, 24V, 5A output, see Fig. 7-1 |
| | typ. | 7ms | At 24Vdc input voltage, 24V, 10A output, see Fig. 7-1 |
| | min. | 5ms | At 24Vdc input voltage, 24V, 10A output, see Fig. 7-1 |

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

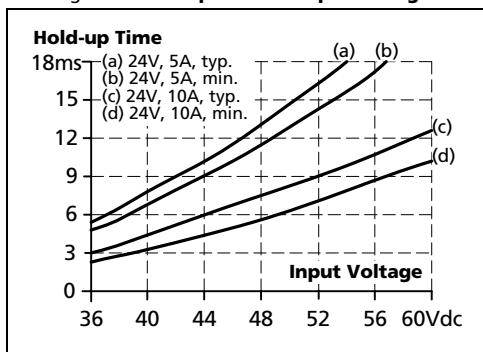


Fig. 7-2 Shut-down test setup

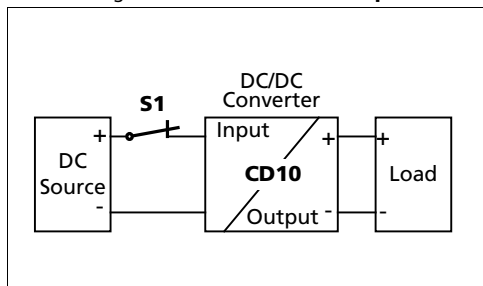
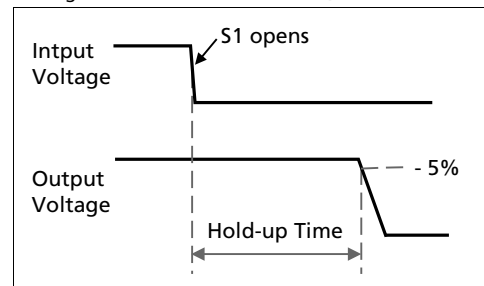


Fig. 7-3 Shut-down behavior, definitions

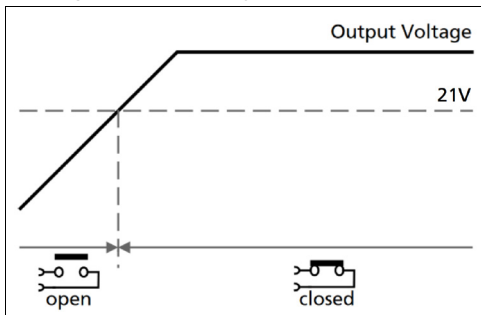


8. DC-OK RELAY CONTACT

This feature monitors the output voltage on the output terminals.

| | |
|-------------------|--|
| Threshold voltage | typ. 21V (fixed) |
| Contact closes | As soon as the output voltage reaches 21V. |
| Contact opens | As soon as the output voltage falls below 21V. |
| Contact ratings | Maximal 60Vdc 0.3A, 30Vdc 1A, 30Vac 0.5A, resistive load Minimal permissible load 1mA at 5Vdc |
| Isolation voltage | See dielectric strength table in chapter 18. |

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



9. EFFICIENCY AND POWER LOSSES

| DC 48V | | | |
|----------------------------------|------|-------|--|
| Efficiency | typ. | 94.0% | At 24V, 10A |
| | typ. | 93.5% | At 24V, 12A (Power Boost) |
| Average efficiency ^{*)} | typ. | 93.8% | At 25% at 2.5A, 25% at 5A, 25% at 7.5A. 25% at 10A |
| Power losses | typ. | 1.2W | At no output load |
| | typ. | 7.5W | At 24V, 5A |
| | typ. | 15.4W | At 24V, 10A |
| | typ. | 20W | At 24V, 12A |

*) 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.

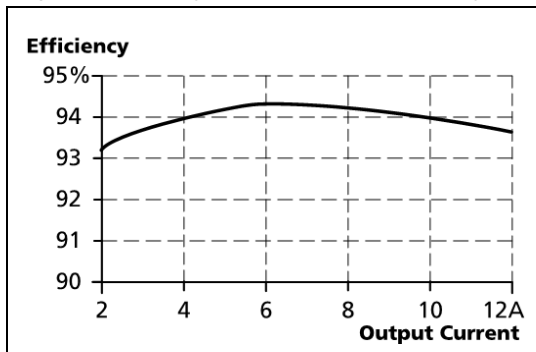


Fig. 9-2 Losses vs. output current at 24V, typ.

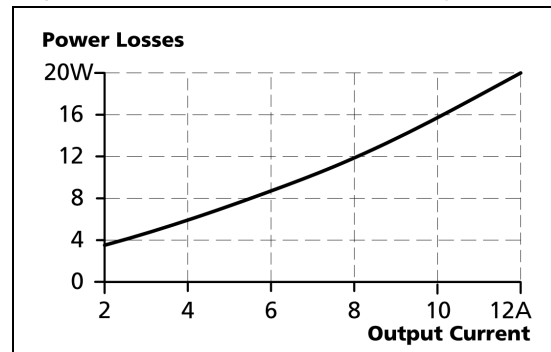


Fig. 9-3 Efficiency vs. input voltage at 48V, 10A, typ.

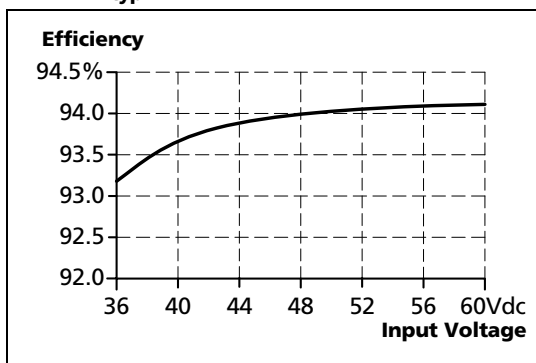
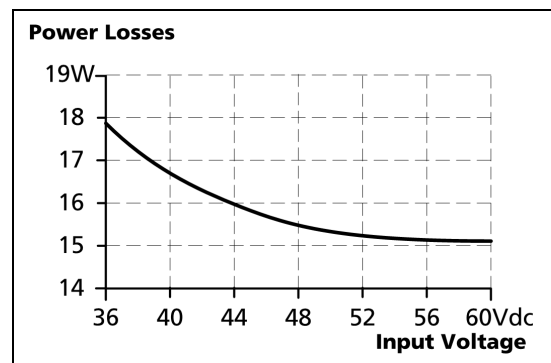
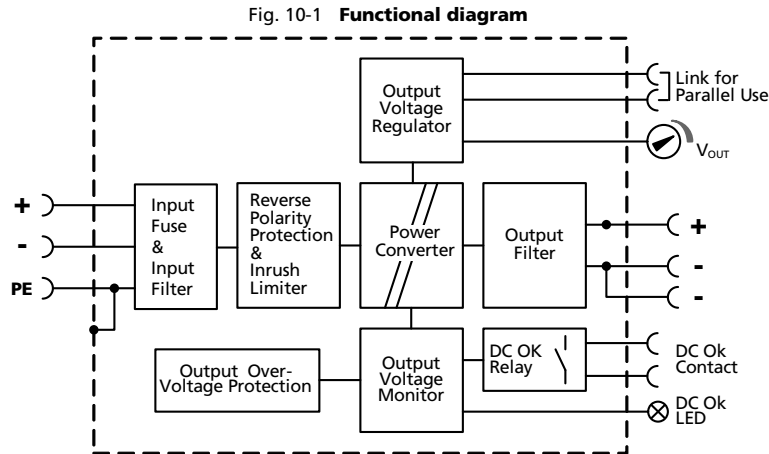


Fig. 9-4 Losses vs. input voltage at 48V, 10A, typ.

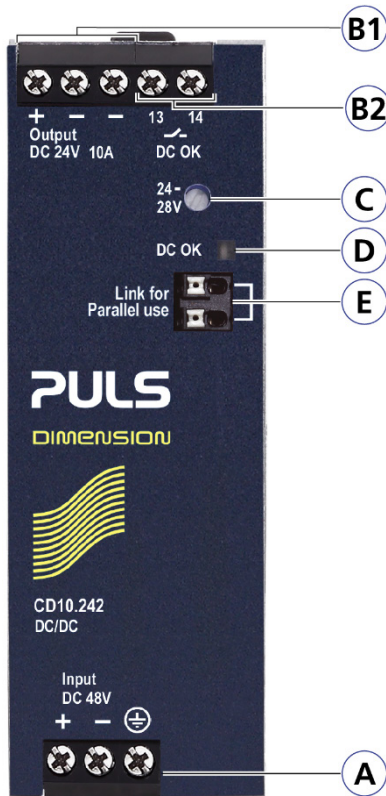


10. FUNCTIONAL DIAGRAM



11. FRONT SIDE AND USER ELEMENTS

Fig. 11-1 Front side



A Input terminals

- + Positive input
- Negative input

PE --> Protective Earth (Ground) connection

B1 Output terminals

Single terminal for the positive pole and dual terminals for the negative pole. Both negative poles are internally connected.

- + Positive output
- Negative (return) output

B2 DC-OK relay contact

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

C Output voltage potentiometer

D DC-OK LED (green)

The LED is on, when the output voltage is above 21V.

E "Parallel Use" "Single Use" link

Link the two terminal poles when outputs of devices are connected in parallel. In order to achieve a sharing of the load current between the individual devices, the "parallel use" regulates the output voltage in such a manner that the voltage at no load is approx. higher than at nominal load.

See chapter 23.5 for details.

12. TERMINALS AND WIRING

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

| | Input | Output |
|---|--------------------------------|--------------------------------|
| Type | Screw terminals | Screw terminals |
| Solid wire | max. 6mm ² | max. 6mm ² |
| Stranded wire | max. 4mm ² | max. 4mm ² |
| American Wire Gauge | 20-10 AWG | 20-10 AWG |
| Max. wire diameter (including ferrules) | 2.8mm | 2.8mm |
| Recommended tightening torque | 1Nm, 9lb.in | 1Nm, 9lb.in |
| Wire stripping length | 7mm / 0.28inch | 7mm / 0.28inch |
| Screwdriver | 3.5mm slotted or Phillips No 1 | 3.5mm slotted or Phillips No 1 |

Daisy chaining of outputs:

Daisy chaining (jumping from one DC/DC-converter 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.

Fig. 12-1 Daisy chaining of outputs

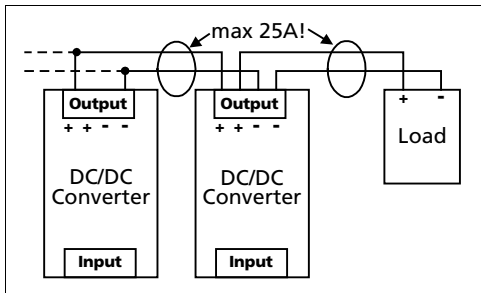
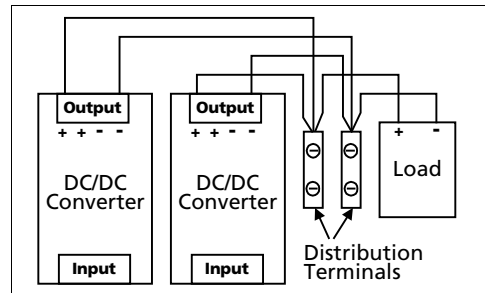


Fig. 12-2 Using distribution terminals



13. LIFETIME EXPECTANCY

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

| | Input 48Vdc | |
|---------------------|-------------|----------------------|
| Lifetime expectancy | 275 000h | At 24V, 5A and 40°C |
| | 117 000h | At 24V, 10A and 40°C |
| | 70 000h | At 24V, 12A and 40°C |
| | 788 000h | At 24V, 5A and 25°C |
| | 327 000h | At 24V, 10A and 25°C |
| | 197 000h | At 24V, 12A and 25°C |

14. 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.

| | Input 48Vdc | |
|--------------------------|-------------|-------------------------------------|
| MTBF SN 29500, IEC 61709 | t.b.d. | At 24V, 10A and 40°C |
| | t.b.d. | At 24V, 10A and 25°C |
| MTBF MIL HDBK 217F | t.b.d. | At 10A and 40°C; Ground Benign GB40 |
| | t.b.d. | At 10A and 25°C; Ground Benign GB25 |
| | t.b.d. | At 10A and 40°C; Ground Fixed GF40 |
| | t.b.d. | At 10A and 25°C; Ground Fixed GF25 |

15. EMC

The EMC behavior of the device is designed for applications in industrial environment as well as in residential, commercial and light industry environments.

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

Without additional measures to reduce the conducted emissions on the output (e.g. by using a filter), the device is not suited to supply a local DC power network in residential, commercial and light-industrial environments. No restrictions apply for local DC power networks in industrial environments.

| EMC Immunity | Power lines and housing | | | |
|--------------------------|-------------------------|------------------------|-------|-------------|
| 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 |
| | | 2.7GHz-6.0GHz | 10V/m | Criterion A |
| Fast transients (Burst) | EN 61000-4-4 | Input lines | 4kV | Criterion A |
| | | Output lines | 2kV | Criterion A |
| Surge voltage on input | EN 61000-4-5 | + → - | 1kV | Criterion A |
| | | +/- → chassis ground | 2kV | Criterion A |
| Surge voltage on output | EN 61000-4-5 | + → - | 500V | Criterion A |
| | | + / - → chassis ground | 1kV | Criterion A |
| Conducted disturbance | EN 61000-4-6 | 0.15-80MHz | 20V | Criterion A |

| EMC Immunity | DC-OK signal lines | | | |
|--------------------------|--------------------|---------------------------------|-------|-------------|
| Electromagnetic RF field | EN 61000-4-3 | 80MHz-2.7GHz | 20V/m | Criterion A |
| | | 2.7GHz-6.0GHz | 10V/m | Criterion A |
| Fast transients (Burst) | EN 61000-4-4 | DC-OK lines with coupling clamp | 2kV | Criterion A |
| Surge | EN 61000-4-5 | DC-OK lines → chassis ground | 1kV | Criterion A |
| Conducted disturbance | EN 61000-4-6 | 0.15-80MHz | 20V | Criterion A |

Criteria:

A: The device shows normal operation behavior 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 on input lines | IEC/CISPR 16-1-2, IEC/CISPR 16-2-1 | Limits for DC power networks according to EN 61000-6-3 fulfilled |
| Conducted emission on output lines | IEC/CISPR 16-1-2, IEC/CISPR 16-2-1 | Limits for DC power networks according to IEC 61000-6-4 fulfilled |
| Radiated emission | EN 55011, EN 55032 | Class B |

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 Frequency

| | | |
|----------------|-----------------|---|
| Main converter | 75kHz to 500kHz | Output load and input voltage dependent |
|----------------|-----------------|---|

16. ENVIRONMENT

| | | |
|-------------------------|--|---|
| Operational temperature | -25°C to +70°C (-13°F to 158°F) | The operational temperature is the ambient or surrounding temperature and is defined as the air temperature 2cm below the device. |
| Storage temperature | -40°C to +85°C (-40°F to 185°F) | For storage and transportation |
| Output de-rating | 3.2W/°C 6W/°C 15W/1000m or 5°C/1000m 9W/5kPa or 3°C/5kPa The de-rating is not hardware controlled. The customer has to take care by himself to stay below the de-rated current limits in order not to overload the unit. | Between +45°C and +60°C (113°F to 140°F) Between +60°C and +70°C (140°F to 158°F) For altitudes >2000m (6560ft), see Fig. 15-2 For atmospheric pressures <80kPa, see Fig. 15-2 |
| Humidity | 5 to 95% r.h. | According to IEC 60068-2-30 |
| Atmospheric pressure | 110-47kPa | See Fig. 15-2 for details |
| Altitude | Up to 5000m (16 400ft) | See Fig. 15-2 for details |
| 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 / direction, 18 bumps in total Shock and vibration is 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 |
| Audible noise | Some audible noise may be emitted from the power supply during no load, overload or short circuit. | |

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

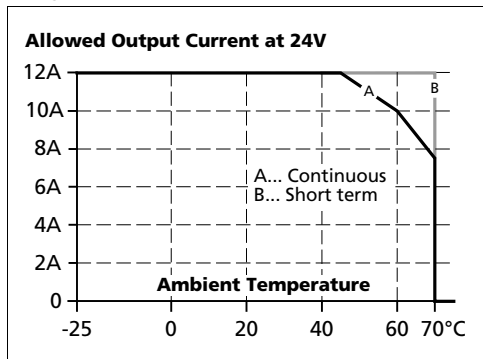
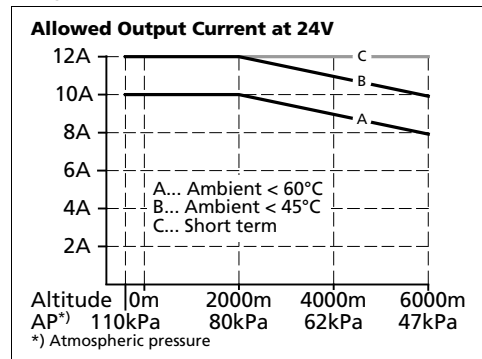


Fig. 16-2 **Output current vs. altitude at 48V**



17. SAFETY AND PROTECTION FEATURES

| | | | |
|---------------------------------|--|----------------------------|--|
| Isolation resistance | min. | 500MΩ | At delivered condition between input and output, measured with 500Vdc |
| | min. | 500MΩ | At delivered condition between input and Chassis Ground, measured with 500Vdc |
| | min. | 500MΩ | At delivered condition between output and Chassis Ground, measured with 500Vdc |
| | min. | 500MΩ | At delivered condition between output and DC-OK contacts, measured with 500Vdc |
| PE resistance | max. | 0.1Ω | Resistance between PE terminal and the housing in the area of the DIN rail mounting bracket. |
| Output over-voltage protection | typ. | 31Vdc | In case of an internal defect, a redundant circuit limits the maximum output voltage. The output shuts down and automatically attempts to restart. |
| | max. | 32.5Vdc | |
| Class of protection | | I | According to IEC 61140 |
| Degree of protection | | IP 20 | According to EN/IEC 60529 |
| Over-temperature protection | | Not included | |
| 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 |
| Touch current (leakage current) | The leakage current, which is produced by the DC/DC converter itself, depends on the input voltage ripple and need to be investigated in the final application. For a smooth DC input voltage, the produced leakage current is less than 100µA. | | |

18. DIELECTRIC STRENGTH

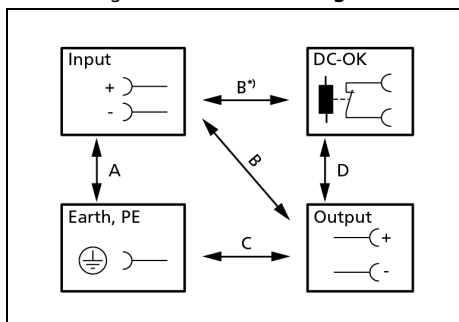
The output voltage is floating and has no ohmic connection to the ground.

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 | 1500Vac | 1500Vac | 500Vac | 500Vac |
| Routine test | 5s | 1500Vac | 1500Vac | 500Vac | 500Vac |
| Field test | 5s | 1000Vac | 1000Vac | 500Vac | 500Vac |
| Field test cut-off current setting | | >20mA | >10mA | >12mA | >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.

19. APPROVED, FULFILLED OR TESTED STANDARDS

UL 61010
planned



UL Certificate
Listed equipment for category NMTR - UL 61010-2-201 Electrical Equipment for Measurement, Control and Laboratory Use - Particular requirements for control equipment
Applicable for US and Canada
E-File: E198865

IEC 61010
planned

CB Report

CB Scheme Certificate
IEC 61010-2-201 Electrical Equipment for Measurement, Control and Laboratory Use - Particular requirements for control equipment

ATEX
planned



Agency Certificate (Bureau Veritas)
EN 60079-0 Explosive atmospheres - General requirements
EN 60079-7, EN 60079-15 Equipment protection by type of protection "e" and "n"
Certificate: t.b.d.
Temperature Code: t.b.d.
Type of Protection: t.b.d.

IECEX
planned

IECEX

IECEX Certificate
IEC 60079-0 Explosive atmospheres - General requirements
IEC 60079-7, IEC 60079-15 Equipment protection by type of protection "e" and "n"
Certificate: t.b.d.
Temperature Code: t.b.d.
Type of Protection: t.b.d.

Marine (DNV)
planned



DNV Certificate
DNV Type approved product
Certificate: t.b.d.
Temperature: t.b.d.
Humidity: t.b.d.
Vibration: t.b.d.
EMC: t.b.d.
Enclosure: t.b.d.

ISA-71.04-1985



Manufacturer's Declaration (Online Document)
Airborne Contaminants Corrosion Test
Severity Level: G3 Harsh
H2S: 100ppb
NOx: 1250ppb
Cl2: 20ppb
SO2: 300ppb
Test Duration: 3 weeks, which simulates a service life of at least 10 years

VDMA 24364



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

20. REGULATORY PRODUCT COMPLIANCE

EU Declaration of
Conformity



The CE mark indicates conformance with the
- EMC directive
- RoHS directive

REACH Directive



Manufacturer's Statement
EU-Directive regarding the Registration, Evaluation,
Authorization and Restriction of Chemicals

EAC TR Registration



EAC Certificate
EAC EurAsian Conformity - Registration Russia, Kazakhstan
and Belarus
8504408200, 8504409000

21. PHYSICAL DIMENSIONS AND WEIGHT

| | |
|--------|---|
| Width | 42mm 1.65" |
| Height | 124mm 4.88" |
| Depth | 117mm 4.61" |
| | The DIN rail height must be added to the unit depth to calculate the total required installation depth. |

| | |
|-------------------------|--|
| Weight | 520g / 1.15lb |
| 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

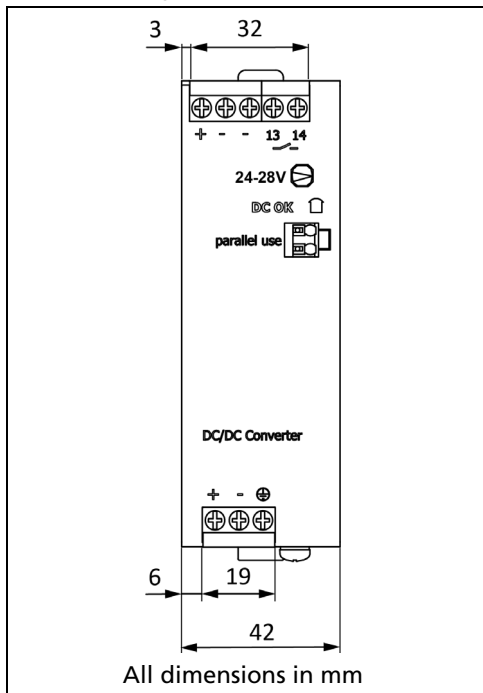
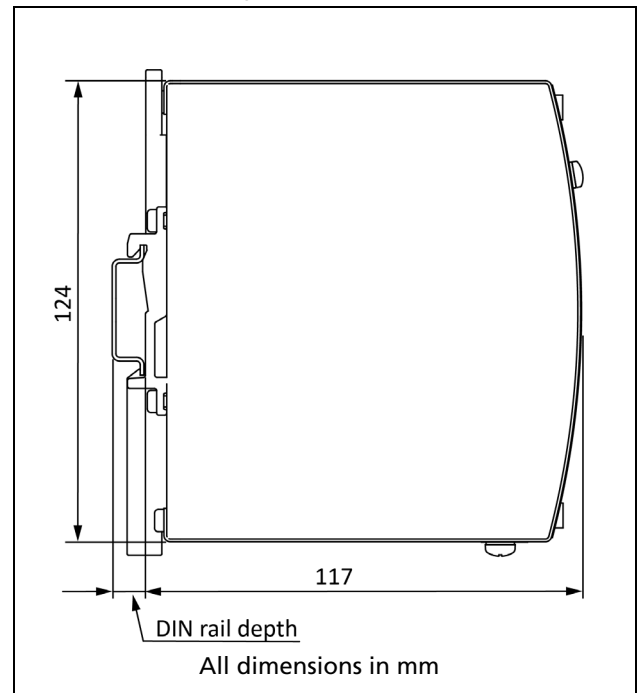


Fig. 21-2 Side view



22. ACCESSORIES

22.1. ZM10.WALL - WALL/PANEL MOUNT BRACKET

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

Fig. 22-1 **Isometric view**

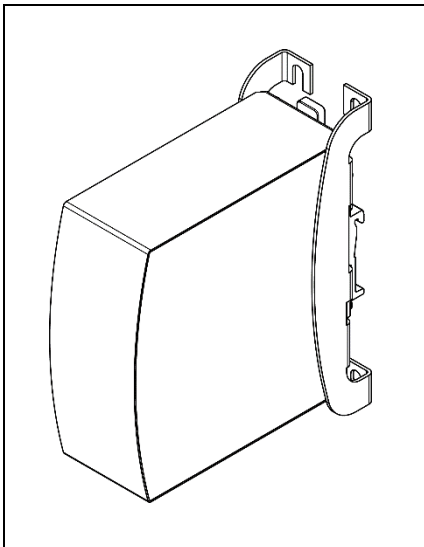


Fig. 22-2 **Isometric view**

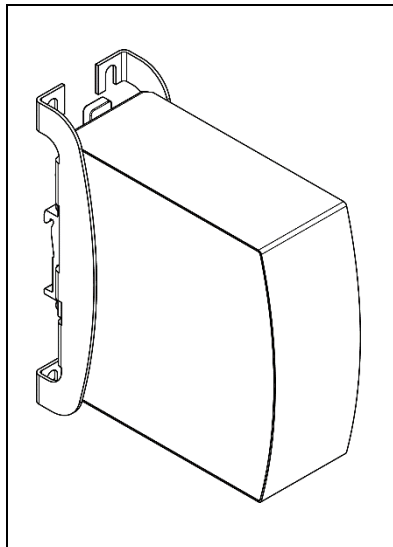


Fig. 22-3 **Isometric view**

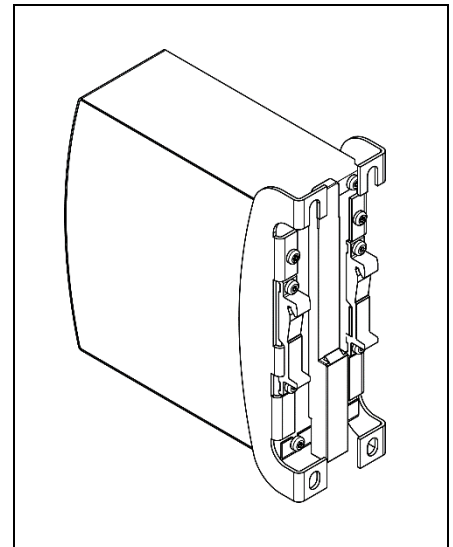


Fig. 21 4 **Wall/panel mounting, front view**

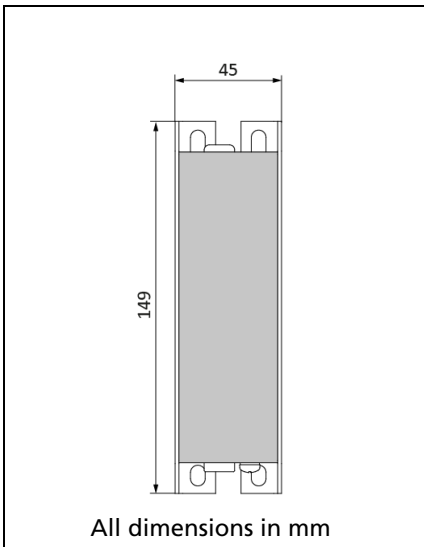


Fig. 21 5 **Hole pattern for wall mounting**

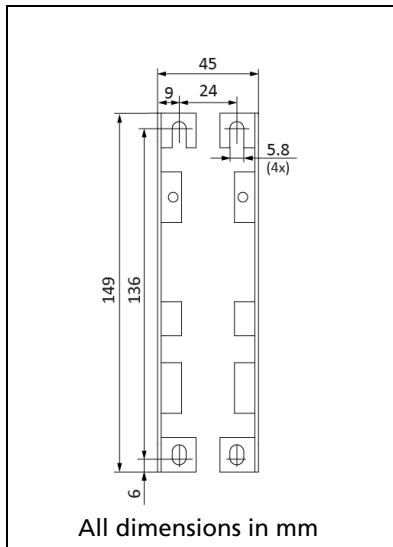
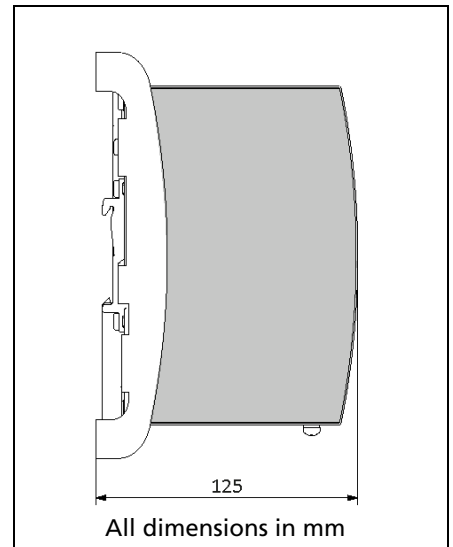


Fig. 22-4 **Wall/panel mounting, side view**



22.2. ZM12.SIDE - SIDE MOUNT BRACKET

This ZM12.SIDE bracket is used to mount the device sideways with or without utilizing a DIN rail to save installation depth.

The two aluminum brackets and the black plastic slider of the unit have to be detached, so that the ZM12.SIDE steel bracket can be mounted.

For sideway DIN rail mounting, the removed aluminum brackets and the black plastic slider need to be mounted on the ZM12.SIDE steel bracket.

PSU for illustration purpose only.



Fig. 22-5 Side mounting without DIN rail brackets

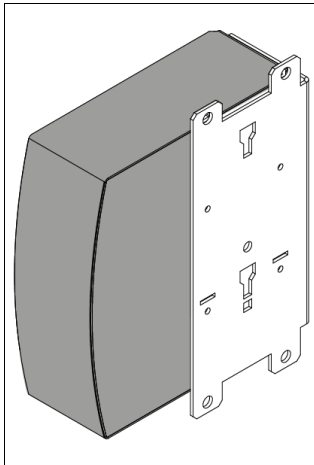


Fig. 22-6 Side mounting with DIN rail brackets

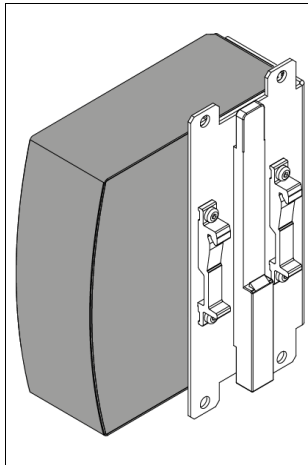
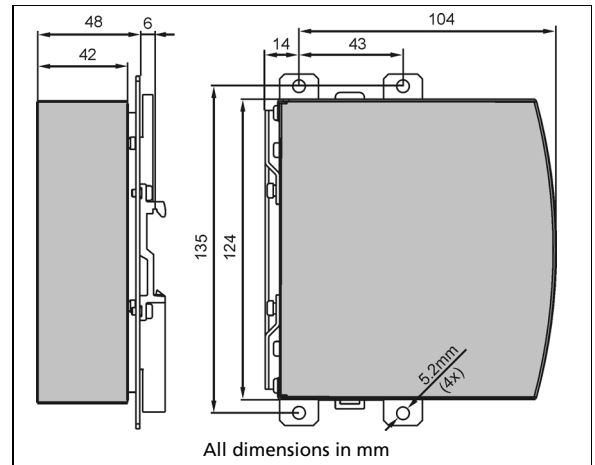


Fig. 22-7 Hole pattern



22.3. UF20.241 BUFFER MODULE



The UF20.241 buffer module is a supplementary device for 24V DC/DC converters. It delivers power to bridge typical supply voltage faults or extends the hold-up time after the input power is turned off.

When the DC/DC converter provides a sufficient voltage, the buffer module stores energy in the integrated electrolytic capacitors. When the input voltage is lost, the stored energy is released to the DC-bus in a regulated process.

The buffer module can be added in parallel to the load circuit at any given point and does not require any control wiring.

One buffer module can deliver 20A additional current and can be added in parallel to increase the output ampacity or the hold-up time.

For longer hold-up times the UF40.241 might also be an option.

22.4. YR40.241 - REDUNDANCY MODULE



The YR40.241 is a dual redundancy module, which can be used to build 1+1 or N+1 redundant systems.

The device is equipped with two 20A nominal input channels, which are individually decoupled by utilizing MOSFET technology. The output can be loaded with a nominal 40A continuous current.

Using MOSFETs instead of diodes reduces heat generation, losses and voltage drop between input and output. Due to these advantages, the unit is very narrow and only requires 36mm width on the DIN rail.

The device does not require an additional auxiliary voltage and is self-powered even in case of a short circuit across the output.

A feature of this redundancy module is a special circuit, which keeps the losses and temperature low, even at overload and short circuit conditions up to 65A continuous current.

See chapter 12 for wiring information.

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 two examples show typical voltage dips:

Fig. 23-1 **20A Resistive peak load (2x the nominal current) for 50ms, typ.**

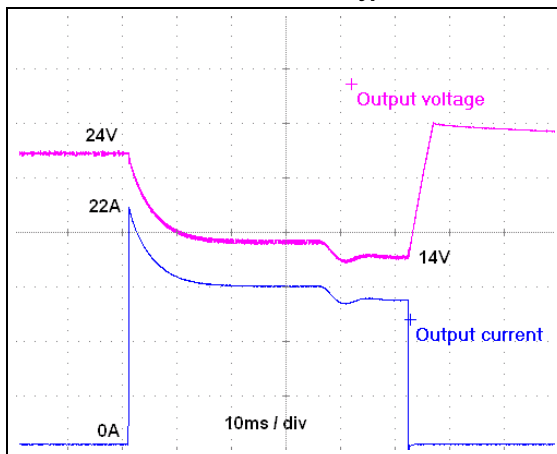
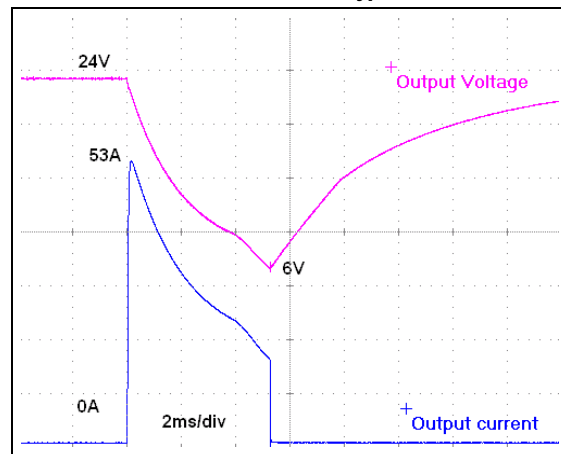


Fig. 23-2 **50A Resistive peak load (5x the nominal current) for 5ms, typ.**



| | | | |
|---------------------------|------|-----------------|---------------------------------|
| Peak current voltage dips | typ. | from 24V to 14V | at 20A for 50ms, resistive load |
| | typ. | from 24V to 12V | at 40A for 2ms, resistive load |
| | typ. | from 24V to 6V | at 40A for 5ms, resistive load |

23.2. OUTPUT CIRCUIT BREAKERS

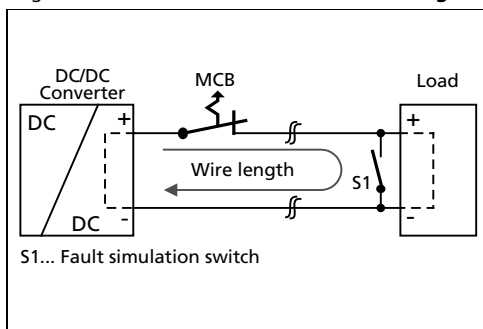
Standard miniature circuit breakers (MCBs) are commonly used for AC supply systems, but can also be used in DC branches if specified.

Such MCBs are designed to protect wires and circuits. When the ampere rating and characteristics of the MCB are matched to the wire size used, the wiring is considered thermally safe whether the MCB opens or not.

To avoid voltage dips and undervoltage situations in adjacent DC branches fed by the same source, fast (magnetic) tripping of the MCB is desirable. For example, a fast trip within 10ms avoids a shutdown and restart of the PLC. For this purpose, power supplies with high current reserves and large output capacitors are advantageous. In addition, the impedance of the faulty circuit must be sufficiently small so that the current can actually flow. The best current reserves of a power supply are of no help if Ohm's law does not allow the current to flow.

The following table provides typical test results showing which MCBs magnetically trip as a function of wire size and length. The lengths given correspond to the total length, which is the sum of the outgoing (+) and return (-) wire. The tests were performed without additional load.

Fig. 23-3 Test circuit for maximum wire length



Test results for maximum wire length:

| | 0.75mm ² | 1.0mm ² | 1.5mm ² | 2.5mm ² |
|--------------|---------------------|--------------------|--------------------|--------------------|
| C-2A | 23m | 32m | 43m | 62m |
| C-3A | 14m | 18m | 26m | 39m |
| C-4A | 8m | 9m | 14m | 18m |
| C-6A | 2m | 2m | 4m | 6m |
| C-8A | 0m | 1m | 1m | 1m |
| B-6A | 11m | 13m | 21m | 29m |
| B-10A | 2m | 2m | 4m | 4m |
| B-13A | 1m | 1m | 1m | 2m |

23.3. CHARGING OF BATTERIES

The device can be used to charge lead-acid or maintenance free batteries. Four 12V SLA or VLRA batteries are needed in series connection.

Instructions for charging batteries:

- Ensure that the ambient temperature of the Device is below 45°C.
- 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 |

- Use a 16A circuit breaker or blocking diode between the Device and the battery.
- Ensure that the output current of the Device is below the allowed charging current of the battery.
- Use only matched batteries when putting 12V types in series.
- The return current to the device (battery discharge current) is typ. 10mA when the Device is switched off except in case a blocking diode is utilized.
- Do not use the devices for battery charging in mounting orientations other than the standard mounting orientation or in any other condition where a reduction of the output current is required (e.g. altitude).

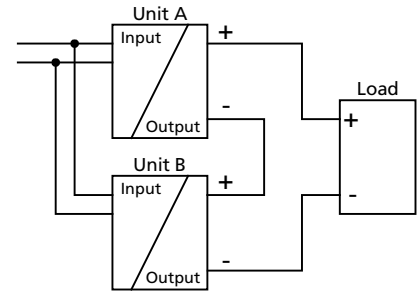
23.4. SERIES OPERATION

Devices of the same type can be connected in series for higher output voltages. It is possible to connect as many units in series as needed, providing the sum of the output voltage does not exceed 150Vdc. Voltages with a potential above 60Vdc must be installed with a protection against touching.

Avoid return voltage (e.g. from a decelerating motor or battery) which is applied to the output terminals.

Keep an installation clearance of 15mm (left / right) between two power supplies and avoid installing the power supplies on top of each other. Do not use power supplies in series in mounting orientations other than the standard mounting orientation.

Pay attention that EMI and inrush current will increase when using multiple devices.



23.5. PARALLEL USE TO INCREASE OUTPUT POWER

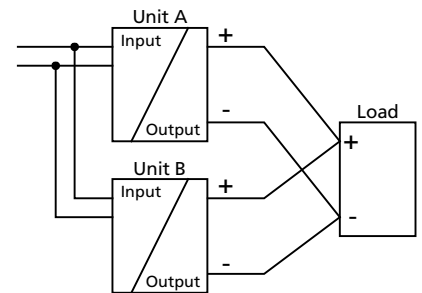
Devices can be paralleled to increase the output power. The output voltage of all power supplies shall be adjusted to the same value ($\pm 100\text{mV}$) in "Single Use" mode with the same load conditions on all units, or the units can be left with the factory settings. After the adjustments, set the unit to "Parallel Use" mode, in order to achieve load sharing. The "Parallel Use" mode regulates the output voltage in such a manner that the voltage at no load is approx. 4% higher than at nominal load. See also chapter 6.

The ambient temperature is not allowed to exceed $+60^\circ\text{C}$.

If more than three devices are connected in parallel, a diode, fuse or circuit breaker with a rating of 15A or 16A is required on each output. Alternatively, a diode or redundancy module can also be utilized.

Keep an installation clearance of 15mm (left / right) between two devices and avoid installing devices on top of each other. Do not use devices in parallel in mounting orientations other than the standard mounting orientation or in any other condition where a reduction of the output current is required (e.g. altitude).

Pay attention that leakage current, EMI, inrush current will increase when using multiple devices.



23.6. PARALLEL USE FOR REDUNDANCY

1+1 Redundancy:

Devices can be paralleled for redundancy to gain higher system availability. Redundant systems require a certain amount of extra power to support the load in case one device fails. The simplest way is to put two devices in parallel. This is called a 1+1 redundancy. In case one device fails, the other one is automatically able to support the load current without any interruption. It is essential to use a redundancy module to decouple devices from each other. This prevents that the defective unit becomes a load for the other device and the output voltage cannot be maintained any more.

1+1 redundancy allows ambient temperatures up to +70°C.

Pay attention that EMI and inrush current will increase when using multiple devices.

Recommendations for building redundant power systems:

- Use separate input fuses for each device.
- Use separate supply systems for each device whenever it is possible.
- It is desirable to set the output voltages of all devices to the same value ($\pm 100\text{mV}$) or leave it at the factory setting.

N+1 Redundancy:

Redundant systems for a higher power demand are usually built in a N+1 method. E.g. four devices, each rated for 10A are paralleled to build a 30A redundant system.

Pay attention that EMI and inrush current will increase when using multiple devices.

Keep an installation clearance of 15mm (left / right) between two devices and avoid installing the devices on top of each other.

Do not use devices in parallel in mounting orientations other than the standard mounting orientation or in any other condition, where a reduction of the output current is required.

For N+1 redundancy the ambient temperature is not allowed to exceed +45°C.

Wiring examples for 1+1 and n+1 redundancy:

Fig. 23-4 **1+1 Redundant configuration for 10A load current**

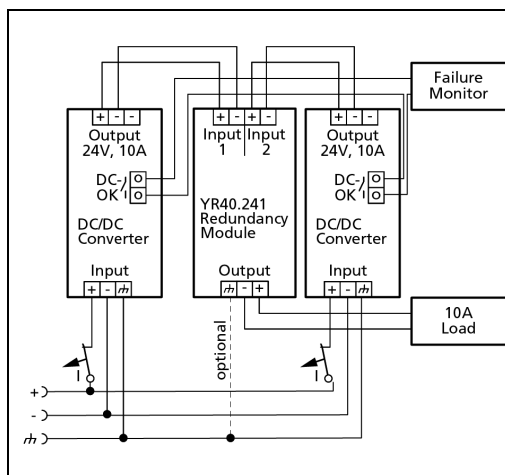
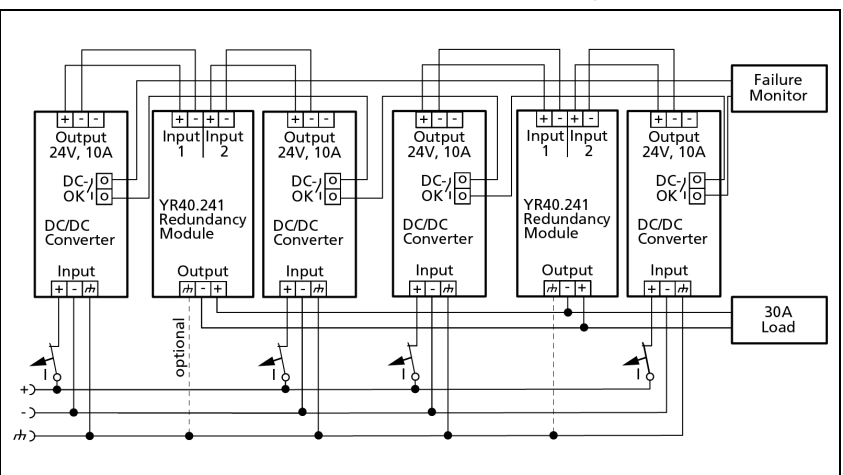


Fig. 23-5 **N+1 Redundant configuration for 30A load current with multiple DC/DC converters and redundancy modules**



23.7. USE IN A TIGHTLY SEALED ENCLOSURE

When the DC/DC Converter 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 DC/DC Converter.

The following measurement results can be used as a reference to estimate the temperature rise inside the enclosure. The DC/DC Converter 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 DC/DC Converter with a distance of 1cm.

| | 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 | 48Vdc | 48Vdc |
| Load | 24V, 8A; (=80%) | 24V, 10A; (=100%) |
| Temperature inside the box | 45.4°C | 52.4°C |
| Temperature outside the box | 21.0°C | 21.0°C |
| Temperature rise | 24.4K | 31.4K |

23.8. MOUNTING ORIENTATIONS

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

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

The following curves give an indication for allowed output currents for altitudes up to 2000m (6560ft).

Fig. 23-6
Mounting Orientation A
(Standard orientation)

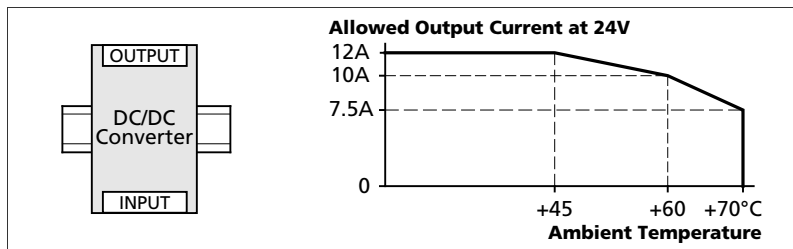


Fig. 23-7
Mounting Orientation B
(Upside down)

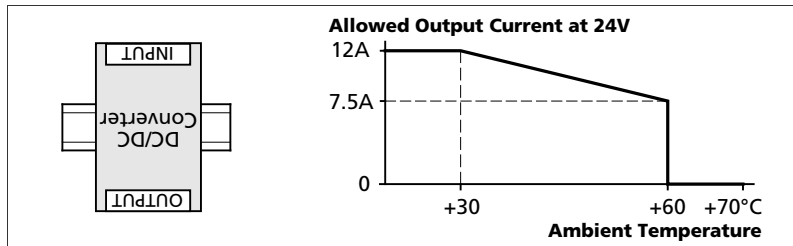


Fig. 23-8
Mounting Orientation C
(Table-top mounting)

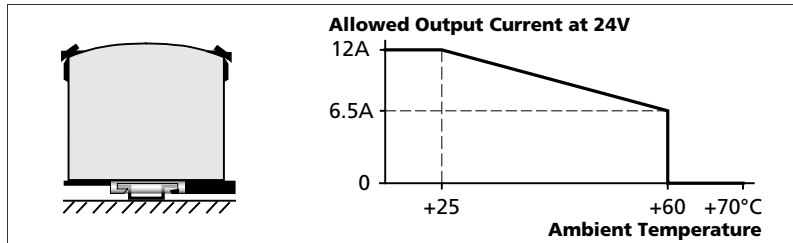


Fig. 23-9
Mounting Orientation D
(Horizontal cw)

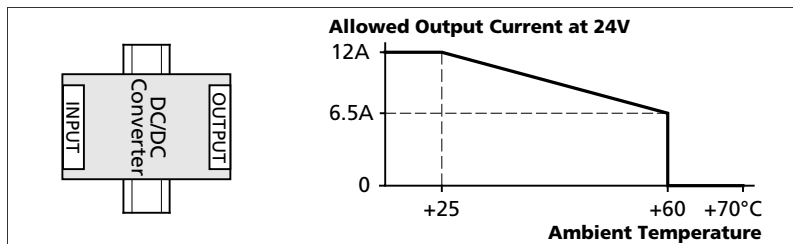


Fig. 23-10
Mounting Orientation E
(Horizontal cw)

