



### DC/DC CONVERTER

- 12V DC-Input
- Isolated 24Vdc Output
- Efficiency up to 87.7%
- Width only 32mm
- 20% Output Power Reserves
- Full Power Between -25°C and +60°C
- Soft-start Function Included
- Minimal Inrush Current Surge
- Reverse Input Polarity Protection
- 3 Year Warranty

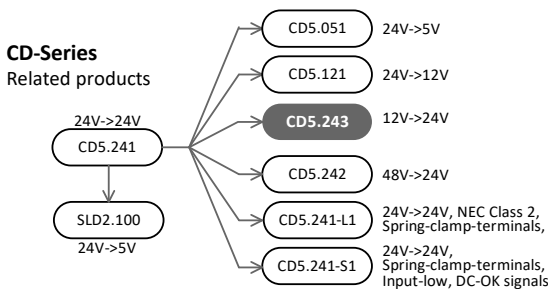
### PRODUCT DESCRIPTION

The Dimension CD-Series offer DIN rail DC/DC converters in the 92-120W output power range in a very compact housing. These DC/DC converters are allowed to run with a battery or similar sources.

The CD5.243 converts a 12V voltage to a 24V voltage.

The CD5.243 includes all the essential basic functions and has a power reserve of 20% included. This extra power can be used continuously up to +45°C.

The output is electrically isolated from the input in a safe way. The input is protected against reversed voltages and contains a soft start function.



### SHORT-FORM DATA

|                      |                 |                |
|----------------------|-----------------|----------------|
| Output voltage       | DC 24V          |                |
| Adjustment range     | 24 - 28V        | *)             |
| Output current       | 4.0 – 3.4A      | ambient <60°C  |
|                      | 4.8 – 4.1A      | ambient <45°C  |
| Output power         | 96W             | ambient <60°C  |
|                      | 116W            | ambient <45°C  |
| Output ripple        | < 50mVpp        | 20Hz to 20MHz  |
| Input voltage        | DC 12V          |                |
| Input voltage range  | 10.8 to 16.2Vdc | full specified |
|                      | 8.4 to 10.8Vdc  | with derating  |
|                      |                 | at 12Vdc input |
| Input current        | typ. 9.2A       |                |
| Input inrush current | typ. 1.0A peak  |                |
| Efficiency           | 87.7%           | at 12Vdc input |
| Losses               | 13.5W           | at 12Vdc input |
| Temperature range    | -25°C to +70°C  | operational    |
| Derating             | 2.5W/°C         | +60 to +70°C   |
| Hold-up time         | typ. 3ms        | at 12Vdc input |
| Dimensions           | 32x124x102mm    | WxHxD          |
| Weight               | 435g / 0.96lb   |                |

\*) extended guaranteed adjustment range down to 23V.

### ORDER NUMBERS

|                 |                |                    |
|-----------------|----------------|--------------------|
| DC/DC Converter | <b>CD5.243</b> | Standard unit      |
| Accessory       | ZM1.WALL       | Wall mount bracket |
|                 | ZM10.WALL      | Wall mount bracket |
|                 | ZM11.SIDE      | Side mount bracket |
|                 | YRM2.DIODE     | Redundancy module  |

### MAIN APPROVALS

For details and the complete approval list, see chapter 18



UL 508



ATEX



UL 60950-1



Marine



Class I Div 2



Marine

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The information presented in this document is believed to be accurate and reliable and may change without notice. Some parts of this unit are patent by PULS (US patent No 091662,063, Des. 424,529, ...).

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## TERMINOLOGY AND ABBREVIATIONS

|  |   |
|--|---|
| <b>PE and <math>\oplus</math> symbol</b> | PE is the abbreviation for <b>Protective Earth</b> and has the same meaning as the symbol $\oplus$ .  |
| <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>DC 24V</b>                            | A figure displayed with the AC or DC before the value represents a nominal voltage with standard tolerances included.<br>E.g.: DC 12V describes a 12V battery disregarding whether it is full (13.7V) or flat (10V) |
| <b>24Vdc</b>                             | A figure with the unit (Vac) at the end is a momentary figure without any additional tolerances included.   |

## 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 and measurement equipment or the like. Do not use this device in equipment where malfunction may cause severe personal injury or threaten human life.

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 instructions:**

This device may only be installed and put into operation by qualified personnel.

This device does not contain serviceable parts. The tripping of an internal fuse is caused by an internal defect.

If damage or malfunction should occur during installation or operation, immediately turn power off and send unit to the factory for inspection.

Install device in an enclosure providing protection against electrical, mechanical and fire hazards.

Install the device onto a DIN rail according to EN 60715 with the input terminals on the bottom of the device. 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 device is designed to withstand impulse voltages of 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 ripple voltage in the low frequency range between 50Hz and 10kHz must be negligible when used in marine applications.

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 III" equipment according to IEC 61140. A PE (ground) connection is not required. However, connecting the chassis ground terminal to ground can be beneficial to gain a high EMI immunity.

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.

### **Installation Instructions for Hazardous Location Areas**

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

Classification: ATEX: EPS 08 ATEX 1 142 X, II 3G EX ec nC IIC T4 Gc / IECEx EPS 14.0001X

### **WARNING EXPLOSION HAZARDS!**

Substitution of components may impair suitability for this environment.

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

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

Reduced output current conditions must be considered for high ambient temperatures and non-standard mounting orientations.

### 3. INPUT VOLTAGE

|   |      |                             |  |
|---|------|-----------------------------|--|
| Input voltage                           | nom. | DC 12V                      |  |
| Input voltage range                     |      | 10.8-16.2Vdc<br>8.4-10.8Vdc | full specified, see Fig. 3-2 for derating below 10.8Vdc maximal 60 seconds or with de-rating see Fig. 3-2. |
|   | max. | 24.0Vdc                     | absolute maximum continuous input voltage with no damage to the DC/DC converter                            |
| Allowed voltage between input and earth | max. | 60Vdc or 42.2Vac            | in case the output voltage is not grounded.  |
| Allowed input ripple voltage            | max. | 5Vpp                        | 47Hz-500Hz, the momentary input voltage must always be within the specified limits.                        |
| Turn-on voltage                         | typ. | 8.7Vdc                      | steady-state value, see Fig. 3-1   |
| Shut-down voltage                       | typ. | 7.2Vdc                      | steady-state value, see Fig. 3-1   |
|   | typ. | 17.0Vdc                     | steady-state value, see Fig. 3-1   |
| Input current                           | typ. | 9.2A                        | at 12Vdc input and output 24V, 4A, see Fig. 3-4  |
| Start-up delay                          | typ. | 450ms                       | see Fig. 3-3   |
| Rise time                               | typ. | 80ms                        | 0mF, 24V, constant current load 4A, see Fig. 3-3   |
|   | typ. | 150ms                       | 4mF, 24V, constant current load 4A, see Fig. 3-3   |
| Turn-on overshoot                       | max. | 300mV                       | see Fig. 3-3   |
| Input capacitance                       | typ. | 3 600µF                     | external capacitors on the input voltage bus are allowed without any limitations.                          |

Fig. 3-1 Input voltage range

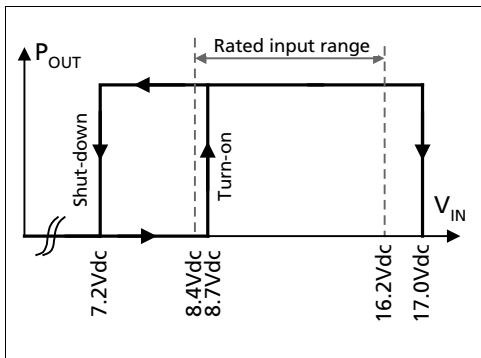


Fig. 3-2 Allowable output current below 10.8V input voltage

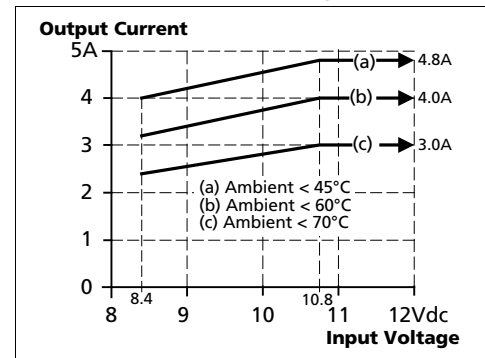


Fig. 3-3 Turn-on behavior, definitions

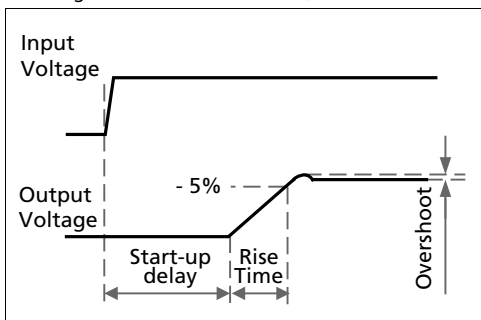
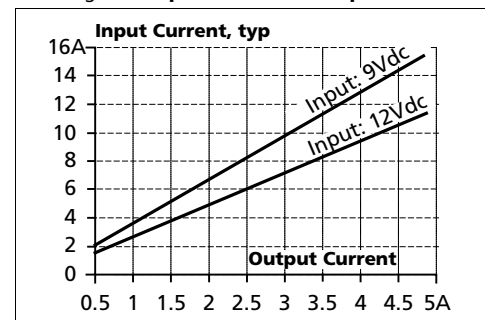


Fig. 3-4 Input current vs. output load



## 4. SOFT-START AND INPUT INRUSH CURRENT SURGE

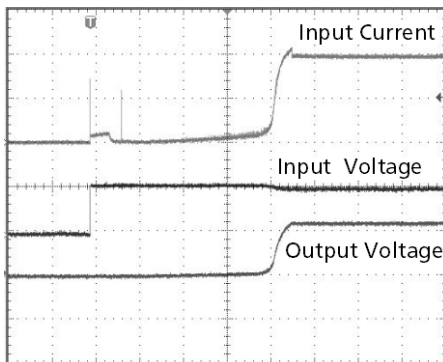
### Inrush current limitation

An active inrush limitation circuit (inrush limiting resistor which is 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.

|                |      |                      |                              |
|----------------|------|----------------------|------------------------------|
| Inrush current | max. | 1.3A <sub>peak</sub> | -25°C to +70°C, input: 12Vdc |
|                | typ. | 1.0A <sub>peak</sub> | -25°C to +70°C, input: 12Vdc |
| Inrush energy  | typ. | negligible           | -25°C to +70°C, input: 12Vdc |

Fig. 4-1 Input inrush current, typical behavior



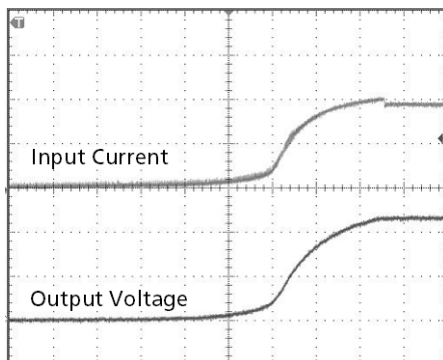
Input: 12Vdc  
 Output: 24V, 4A, constant current load  
 Ambient: 25°C

Upper curve: Input current 5A / DIV  
 Middle curve: Input voltage 10V / DIV  
 Lower curve: Output voltage 20V / DIV  
 Time basis: 100ms / DIV

### Soft-start function:

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.

Fig. 4-2 Soft-start behavior



Input: 12Vdc  
 Output: 24V, 4A, constant current load  
 Ambient: 25°C  
 No additional external output capacitors

Upper curve: Input current 5A / DIV  
 Lower curve: Output voltage 10V / DIV  
 Time basis: 20ms / DIV

### 5. OUTPUT

|                          |      |         |   |
|--------------------------|------|---------|---|
| Output voltage           | nom. | 24V     |   |
| Adjustment range         |      | 24-28V  | *)  |
|                          | max. | 30V     | at clockwise end position of potentiometer  |
| Factory setting          |      | 24.1V   | ±0.2%, at full load, cold unit  |
| Line regulation          | max. | 25mV    | Input voltage variations between 8.4 to 16.2Vdc   |
| Load regulation          | max. | 100mV   | static value, 0A → 4A   |
| Ripple and noise voltage | max. | 50mVpp  | 20Hz to 20MHz, 50Ohm  |
| Output capacitance       | typ. | 2 200µF |   |
| Output current           | nom. | 4.8A    | at 24V, below 45°C ambient temperature, input voltage between 10.8V and 16.2V   |
|                          | nom. | 4.0A    | at 24V, at 60°C ambient temperature, input voltage between 10.8V and 16.2V  |
|                          | nom. | 3.0A    | at 24V, at 70°C ambient temperature, input voltage between 10.8V and 16.2V  |
|                          | nom. | 4.1A    | at 28V, below 45°C ambient temperature, input voltage between 10.8V and 16.2V   |
|                          | nom. | 3.4A    | at 28V, at 60°C ambient temperature, input voltage between 10.8V and 16.2V  |
|                          | nom. | 2.6A    | at 28V, at 70°C ambient temperature, input voltage between 10.8V and 16.2V  |
|                          |      |         | Derate output current at input voltages below 10.8V according to chapter 3.<br>Derate between +45°C and +70°C and between 10.8V and 8.4V input voltage. |
| Output power             | nom. | 116W    | for ambient temperatures < 45°C   |
|                          | nom. | 96W     | for ambient temperatures < 60°C   |
| Short-circuit current    | min. | 6A      | continuous current, short circuit impedance 200mOhm   |
|                          | max. | 9A      | continuous current, short circuit impedance 200mOhm   |

\*) extended guaranteed adjustment range down to 23V.

Fig. 5-1 Output voltage vs. output current at 12Vdc input voltage, typ.

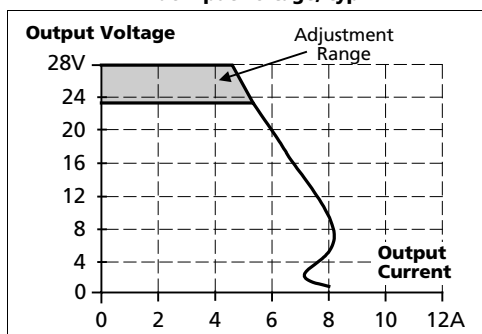
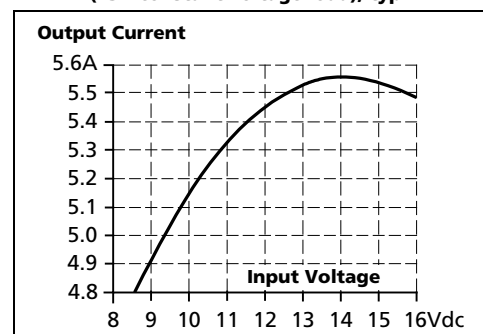


Fig. 5-2 Current limitation vs. input voltage, (23V constant voltage load), typ.



### Peak current capability (up to several milliseconds)

The DC/DC converter can deliver a peak current, which is higher than the specified short term current. This helps to start current demanding loads or to safely operate subsequent circuit breakers.

The extra current is supplied by the output capacitors inside the DC/DC converter. During this event, the capacitors will be discharged and causes a voltage dip on the output. Detailed curves can be found in chapter 21.1.

|                           |      |                   |                                |
|---------------------------|------|-------------------|--------------------------------|
| Peak current voltage dips | typ. | from 24V to 18V   | at 8A for 50ms, resistive load |
|                           | typ. | from 24V to 12.5V | at 16A for 2ms, resistive load |
|                           | typ. | from 24V to 10V   | at 16A for 5ms, resistive load |

## 6. 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.

|              |      |       |  |
|--------------|------|-------|--|
| Hold-up Time | typ. | 5.8ms | input 12Vdc, output: 24Vdc, 2A, see Fig. 6-1 |
|              | typ. | 3.0ms | input 12Vdc, output: 24Vdc, 4A, see Fig. 6-1 |

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

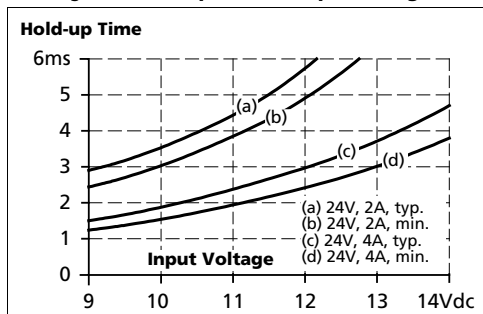


Fig. 6-2 Shut-down test setup

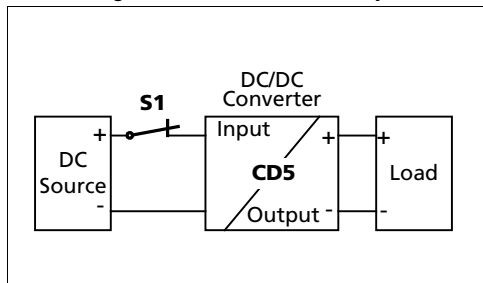
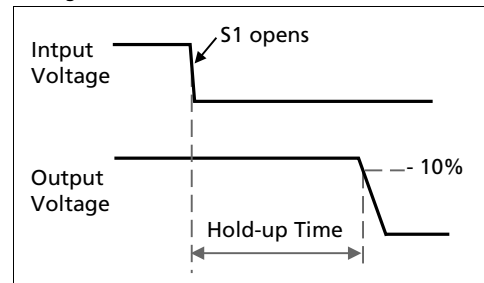


Fig. 6-3 Shut-down behavior, definitions



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



### 7. EFFICIENCY AND POWER LOSSES

| Input 12Vdc  |      |       |                   |
|--------------|------|-------|-------------------|
| Efficiency   | typ. | 87.7% | at 24V, 4A        |
| Power losses | typ. | 0.7W  | at no output load |
|              | typ. | 6.2W  | at 24V, 2A        |
|              | typ. | 13.5W | at 24V, 4A        |
|              | typ. | 17.8W | at 24V, 4.8A      |

Fig. 7-1 Efficiency vs. output current at 24V output and 12Vdc input voltage, typ.

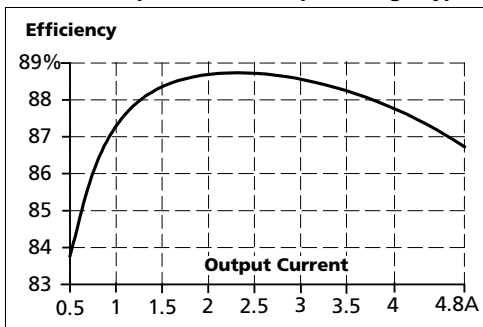


Fig. 7-2 Losses vs. output current at 24V output and 12Vdc input voltage, typ.

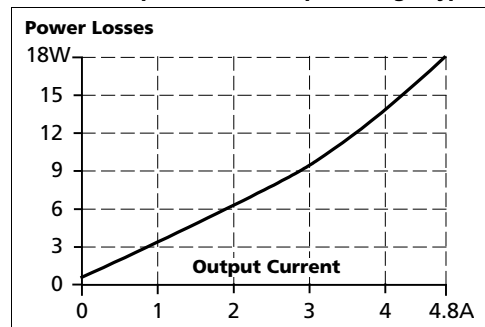


Fig. 7-3 Efficiency vs. input voltage at 24V, 4A, typ.

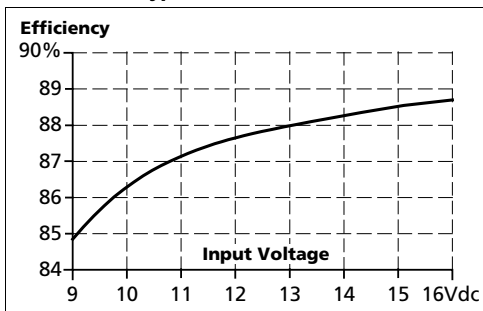
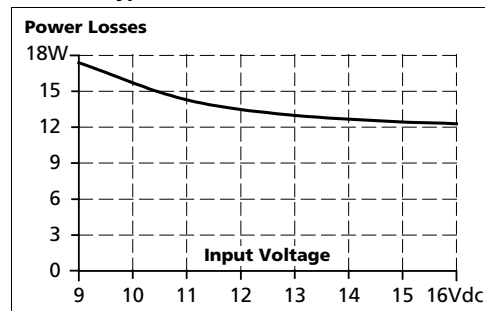
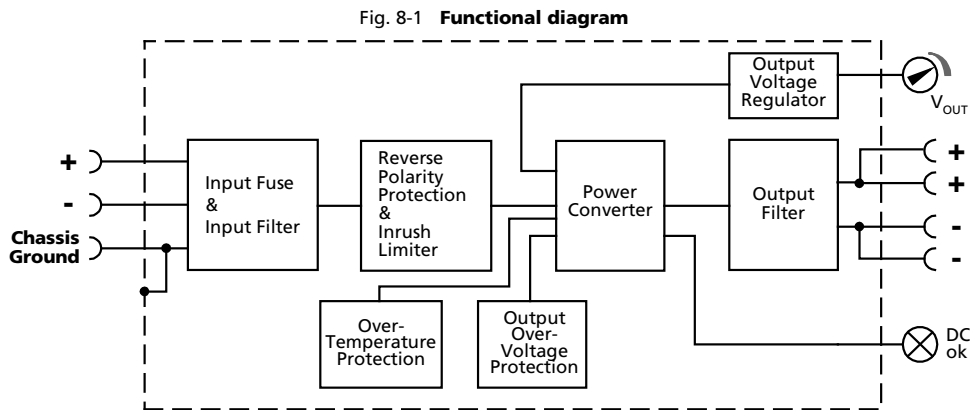


Fig. 7-4 Losses vs. input voltage at 24V, 4A, typ.



### 8. FUNCTIONAL DIAGRAM



### 9. FRONT SIDE AND USER ELEMENTS

Fig. 9-1 Front side



- A** Input terminals  
Screw terminals  
+ Positive input  
- Negative (return) input  
Chassis ground: can be used to bond the housing to PE  
Ground this terminal to minimize high-frequency emissions.
- B** Output terminals  
Screw terminals, dual terminals per pole, both pins are equal  
+ Positive output  
- Negative (return) output Screw terminals
- C** Output voltage potentiometer  
Open the flap to set the output voltage. Factory set: 24.1V
- D** DC-OK LED (green)  
On when the voltage on the output terminals is > 21V

## 10. TERMINALS AND WIRING

|                               | <b>Input</b>                       | <b>Output</b>                      |
|-------------------------------|------------------------------------|------------------------------------|
| Type                          | screw terminals                    | screw terminals                    |
| Solid wire                    | max. 6mm <sup>2</sup>              | max. 6mm <sup>2</sup>              |
| Stranded wire                 | max. 4mm <sup>2</sup>              | max. 4mm <sup>2</sup>              |
| American Wire Gauge           | 20-10 AWG                          | 20-10 AWG                          |
| Wire stripping length         | 7mm / 0.275inch                    | 7mm / 0.275inch                    |
| Screwdriver                   | 3.5mm slotted or<br>Pozidrive No 2 | 3.5mm slotted or<br>Pozidrive No 2 |
| Recommended tightening torque | 1Nm, 9lb.in                        | 1Nm, 9lb.in                        |

### Instructions:

- a) The external circuitry of all terminals must meet the safety requirements stipulated by IEC/EN/UL 60950-1: SELV.
- b) Use appropriate copper cables that are designed for an operating temperature of:  
60°C for ambient up to 45°C and  
75°C for ambient up to 60°C minimum.
- c) Follow national installation codes and installation regulations!
- d) Ensure that all strands of a stranded wire enter the terminal connection!
- e) Do not load the terminals with more than 25A! See chapter 21.9
- f) Screws of unused terminal compartments should be securely tightened.
- g) Ferrules are allowed.
- h) Do not connect or disconnect the wires from the terminals below -25°C (-13°F).

## 11. 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 prediction model allows only a calculation of up to 15 years from date of shipment.

|                     | Input 12Vdc |                       |
|---------------------|-------------|-----------------------|
| Lifetime expectancy | 199 000h    | at 24V, 2A and 40°C   |
|                     | 73 000h     | at 24V, 4A and 40°C   |
|                     | 33 000h     | at 24V, 4.8A and 40°C |
|                     | 206 000h    | at 24V, 4A and 25°C   |

## 12. 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 can not be determined if the failed unit has been running for 50 000h or only for 100h.

|                          | Input 12Vdc |   |
|--------------------------|-------------|---|
| MTBF SN 29500, IEC 61709 | 1 056 000h  | at 24V, 4A and 40°C                     |
|                          | 1 934 000h  | at 24V, 4A and 25°C                     |
| MTBF MIL HDBK 217F       | 552 000h    | at 24V, 4A and 40°C; Ground Benign GB40 |
|                          | 770 000h    | at 24V, 4A and 25°C; Ground Benign GB25 |

## 13. EMC

The DC/DC converter is suitable for applications in industrial environment as well as in residential, commercial and light industry environment without any restrictions.

| <b>EMC Immunity</b>      |              | 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                                     | 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                                       | 10V   | Criterion A |

**Criteria:**

- A:** DC/DC converter shows normal operation behavior within the defined limits.
- C:** Temporary loss of function is possible. DC/DC converter may shut-down and restarts by itself. No damage or hazards for the DC/DC converter will occur.

| <b>EMC Emission</b>         |                                    | Generic standards: EN 61000-6-3 and EN 61000-6-4      |  |
|-----------------------------|------------------------------------|---|--|
| Conducted emission on input | IEC/CISPR 16-1-2, IEC/CISPR 16-2-1 | Limits for DC power ports acc. EN 61000-6-3 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**

Variable between 75kHz and 140kHz depending on load and input voltage (output current > 0.5A)

### 14. ENVIRONMENT

|   |   |   |
|---|---|---|
| Operational temperature *)  | -25°C to +70°C (-13°F to 158°F)                             | reduce output power according Fig. 13-1                           |
| Storage temperature   | -40 to +85°C (-40°F to 185°F)                               | for storage and transportation                                    |
| Output de-rating  | 1.28W/°C  | 45-60°C (113°F to 140°F)  |
|   | 2.5W/°C   | 60-70°C (140°F to 158°F)  |
| Additional derating is required for input voltages below 10.8Vdc, see chapter 3 for further details and values. |   |   |
| Humidity **)  | 5 to 95% r.H.   | IEC 60068-2-30  |
| Vibration sinusoidal ***)   | 2-17.8Hz: ±1.6mm; 17.8-500Hz: 2g<br>2 hours / axis          | IEC 60068-2-6   |
| Shock ***)  | 30g 6ms, 20g 11ms<br>3 bumps / direction, 18 bumps in total | IEC 60068-2-27  |
| Altitude  | 0 to 6000m (0 to 20 000ft)                                  | reduce output power or ambient temperature above 2000m sea level. |
| Altitude de-rating  | 6W/1000m or 5°C/1000m                                       | above 2000m (6500ft), see Fig. 13-2                               |
| Over-voltage category   | III   | IEC 62477-1, EN 50178, altitudes up to 2000m                      |
|   | II  | altitudes from 2000m to 6000m                                     |
| Degree of pollution   | 2   | IEC 62477-1, EN 50178, not conductive                             |

\*) Operational temperature is the same as the ambient 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 mounting orientation.

Fig. 13-1 **Output current vs. ambient temp.**

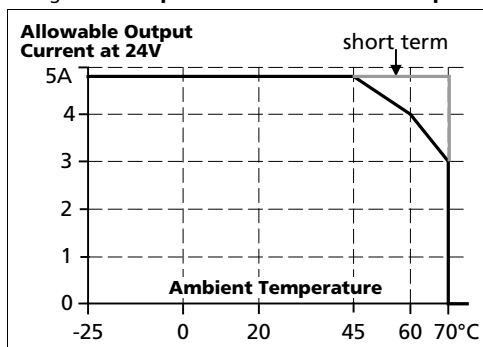
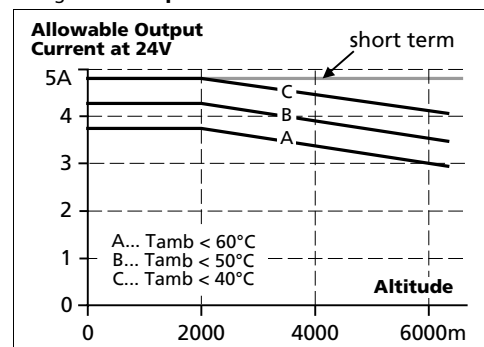


Fig. 13-2 **Output current vs. altitude at 24V**



### 15. PROTECTION FEATURES

|                                   |  |   |
|-----------------------------------|--|---|
| Output protection                 | Electronically protected against overload, no-load and short-circuits *) |   |
| Output over-voltage protection    | typ. 31Vdc<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. |
| Reverse input polarity protection | Included   | unit does not start when input voltage is reversed  |
| Output over-current protection    | electronically limited *)  | see Fig. 5-1  |
| Degree of protection              | IP 20  | EN/IEC 60529  |
| Penetration protection            | > 3.5mm  | 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.

### 16. SAFETY FEATURES

|                                  |  |  |
|----------------------------------|--|--|
| Classification of output voltage | SELV<br>PELV   | IEC/EN 60950-1<br>IEC/EN 60204-1, EN 50178, IEC 62477-1, IEC 60364-4-41  |
| Class of protection              | III  | PE (Protective Earth) connection not required. A connection of the "Chassis Ground" pin to earth is recommended for best EMI performance |
| Isolation resistance             | > 5M $\Omega$  | input to output, 500Vdc  |
| PE resistance                    | < 0.1 $\Omega$   | between housing and Chassis Ground terminal  |
| 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.<br>For a smooth DC input voltage, the produced leakage current is less than 100 $\mu$ A. |  |

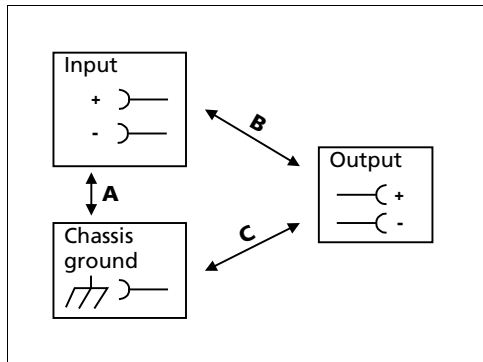
\*) provided, that the input voltage meets the requirements of chapter 2.

## 17. 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. 16-1 Dielectric strength



|                         |     | <b>A</b> | <b>B</b> | <b>C</b> |
|-------------------------|-----|----------|----------|----------|
| Type test               | 60s | 1500Vac  | 1500Vac  | 500Vac   |
| Factory test            | 5s  | 1500Vac  | 1500Vac  | 500Vac   |
| Field test              | 5s  | 1000Vac  | 1000Vac  | 500Vac   |
| Cut-off current setting |     | > 30mA   | > 30mA   | > 12mA   |

To fulfill 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.



### 18. APPROVED, FULFILLED OR TESTED STANDARDS

UL 508



UL Certificate  
Listed equipment for category NMTR - Industrial Control Equipment  
Applicable for US and Canada  
E-File: E198865

IEC 60950-1

**CB Report**

CB Scheme Certificate  
General safety requirements for Information Technology Equipment (ITE)

UL 60950-1



UL Certificate  
Recognized component for category QQQQ - Information Technology Equipment (ITE)  
Applicable for US and Canada  
E-File: E137006

ATEX



Agency Certificate (Bureau Veritas)  
EN 60079-0 Explosive atmospheres - General requirements  
EN 60079-7, EN 60079-15 Equipment protection by type of protection "e" and "n"  
Certificate: EPS 08 ATEX 1 142 X  
Temperature Code: T4  
Type of Protection: ec nC

IECEX

**IECEX**

IECEX Certificate  
IEC 60079-0 Explosive atmospheres - General requirements  
IEC 60079-15 Equipment protection by type of protection "n"  
Certificate: IECEX EPS 14.0001X  
Temperature Code: T4  
Type of Protection: ec nC

Class I Div 2



CSA Certificate  
Power Supplies for Hazardous Location  
Applicable for Canada and US  
CSA Class: 5318-01 (Canada), 5318-81 (USA)  
Temperature Code: T4  
Groups: A, B, C and D

Class I Div 2



UL Certificate  
Listed equipment for category NRAD - Listed equipment  
Industrial Control Equipment for Use in Hazardous Locations  
Applicable for US and Canada  
E-File: E327416  
Temperature Code: T4  
Groups: A, B, C and D

Marine (DNV)



DNV Certificate  
DNV Type approved product  
Certificate: TAA00002YX  
Temperature: Class D  
Humidity: Class B  
Vibration: Class C  
EMC: Class B  
Enclosure: Class A

Marine (ABS)

## ABS

ABS Design Assessment Certificate  
ABS (American Bureau of Shipment) assessed product  
Certificate: 17-HG1599236-PD

IEC 60068-2-60

**Corrosion**  
IEC 60068-2-60  
Method 4 ✓

Manufacturer's Declaration (Online Document)  
Environmental Tests, Flowing Mixed Gas Corrosion Test  
Test Ke - Method 4  
H2S: 10ppb  
NO2: 200ppb  
Cl2: 10ppb  
SO2: 200ppb  
Test Duration: 3 weeks, which simulates a service life of 10 years.

ISA-71.04-1985

**Corrosion**  
G3-ISA-71.04 ✓

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

VDMA 24364

**LABS**  
VDMA 24364-C1-L/W

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

## 19. REGULATORY PRODUCT COMPLIANCE

EU Declaration of  
Conformity



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

KC



KC Registration  
Korean registration of Broadcasting and Communication  
Equipment  
Registered under Clause 3, Article 58-2 of Radio Waves Act.

REACH Directive

**REACH** ✓

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

WEEE Directive



Manufacturer's Statement  
EU-Regulation on Waste Electrical and Electronic Equipment  
Registered in Germany as business to business (B2B) products.

EAC TR Registration



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

## 20. PHYSICAL DIMENSIONS AND WEIGHT

|                         |   |
|-------------------------|---|
| Weight                  | 435g / 0.96lb   |
| DIN rail                | Use 35mm DIN rails according to EN 60715 or EN 50022 with a height of 7.5 or 15mm. The DIN rail depth must be added to the unit depth (102mm) to calculate the total required installation depth. |
| Installation Clearances | See chapter 2   |

Fig. 19-1 **Front view**

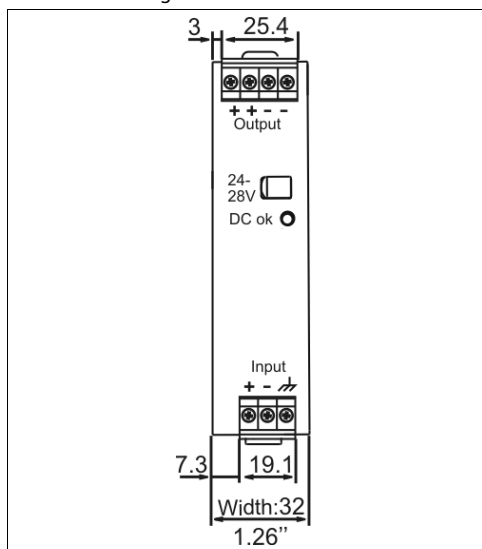
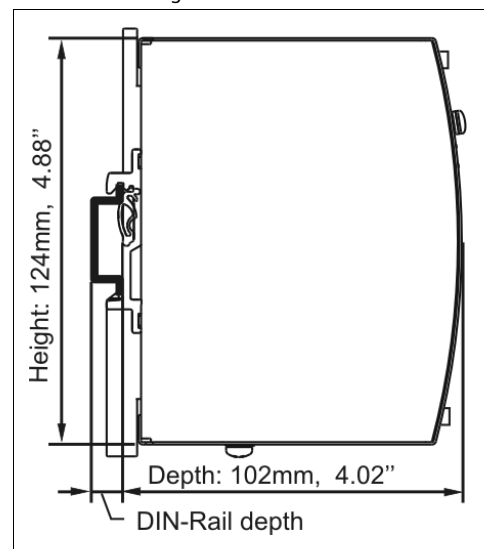


Fig. 19-2 **Side view**

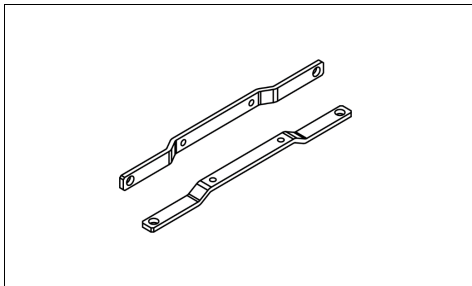


## 21. ACCESSORIES

### 21.1. ZM1.WALL - WALL MOUNTING BRACKET

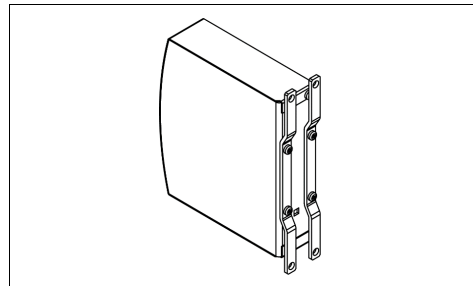
This bracket is used to mount specific Dimension units onto a flat surface without utilizing a DIN rail. The two aluminum brackets and the black plastic slider of the unit have to be removed, so that the two steel brackets can be mounted.

Fig. 21-1 ZM1.Wall Wall mounting bracket\*)



\*) PSU for illustration purpose only.

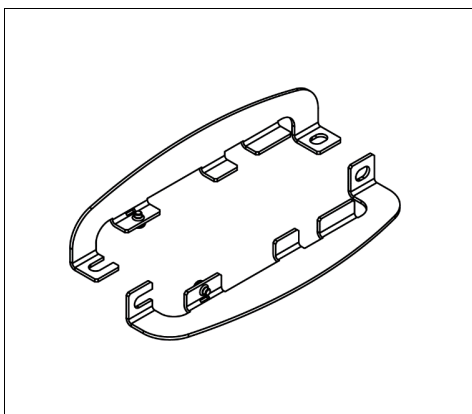
Fig. 21-2 Wall mounting with DIN rail brackets\*)



### 21.2. ZM10.WALL - WALL/PANEL MOUNT BRACKET

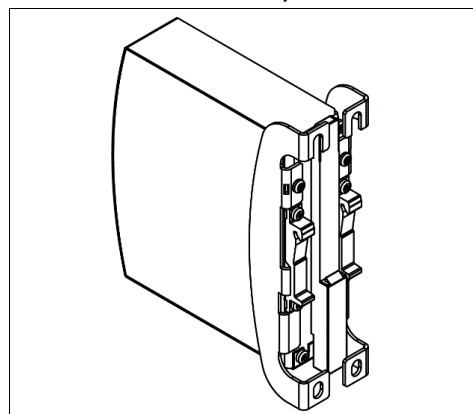
This bracket is used to mount the devices on a wall/panel without utilizing the DIN rail. The bracket can be mounted without detaching the DIN rail brackets from the power supply.

Fig. 21-3 ZM10.Wall mounting bracket\*)



\*) PSU for illustration purpose only.

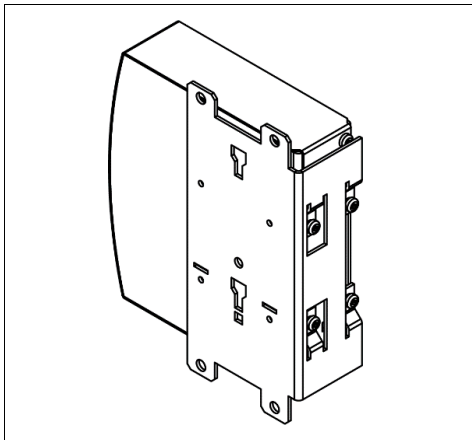
Fig. 21-4 Wall mounting with DIN rail brackets\*)



### 21.3. ZM11.SIDE - SIDE MOUNTING BRACKET

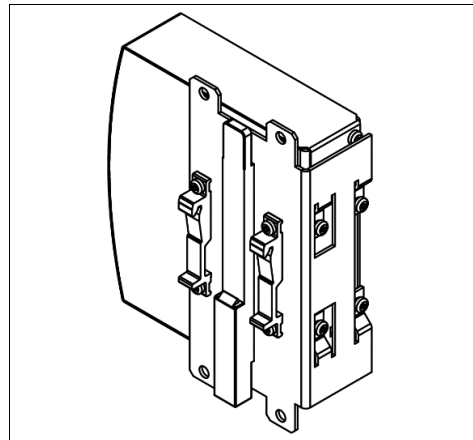
This bracket is used to mount Dimension units sideways with or without utilizing a DIN rail. The two aluminum brackets and the black plastic slider of the unit have to be detached, so that the steel brackets can be mounted. For sideways DIN rail mounting, the removed aluminum brackets and the black plastic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

Fig. 21-5 ZM11.SIDE Side mounting bracket\*)



\*) PSU for illustration purpose only.

Fig. 21-6 Side mounting with DIN rail bracket\*)



### 21.4. YRM2.DIODE REDUNDANCY MODULE



The YRM2.DIODE is a dual redundancy module, which can be used to build 1+1 and N+1 redundant systems. It is equipped with two input channels, which are individually decoupled by utilizing diodes.

The YRM2.DIODE does not require an additional auxiliary voltage and is self-powered even in case of a short circuit across the output.

The YRM2.DIODE has a monitoring circuit included and is the perfect solution when the power supply has no DC-OK function. Two LEDs and two relay contacts signal when one of the two DC-input voltages is not in range due to a non-functioning or disconnected power supply.

Due to the compact design, the unit is very slender and only requires 32mm width on the DIN rail.

## 22. APPLICATION NOTES

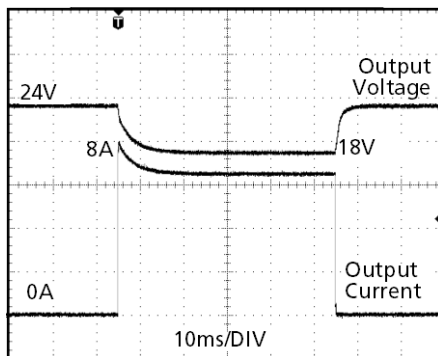
### 22.1. PEAK CURRENT CAPABILITY

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.

Branch circuits are often protected with circuit breakers or fuses. In case of a short or an overload in the branch circuit, the fuse needs a certain amount of over-current to trip or to blow. The peak current capability ensures the safe operation of subsequent circuit breakers.

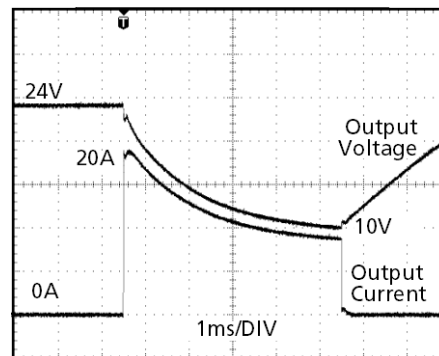
Assuming the input voltage is turned on before such an event, the built-in large sized output capacitors inside the DC/DC converter can deliver extra current. Discharging this capacitor causes a voltage dip on the output. The following two examples show typical voltage dips:

Fig. 22-1 Peak loading with 2x the nominal current for 50ms, typ.



Peak load 8A (resistive load) for 50ms  
Output voltage dips from 24V to 18V.

Fig. 22-2 Peak loading with 5x the nominal current for 5ms, typ.



Peak load 20A (resistive load) for 5ms  
Output voltage dips from 24V to 10V.

### 22.2. BACK-FEEDING LOADS

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

This DC/DC converter is resistant and does not show malfunctioning when a load feeds back voltage to the DC/DC converter. It does not matter, whether the DC/DC converter is on or off.

The maximum allowed feed-back-voltage is 30Vdc. The absorbing energy can be calculated according to the built-in large sized output capacitance which is specified in chapter 5.

### 22.3. INDUCTIVE AND CAPACITIVE LOADS

The unit is designed to supply any kind of loads, including unlimited capacitive and inductive loads.

## 22.4. CHARGING OF BATTERIES

The DC/DC converter can be used to charge lead-acid or maintenance free batteries. (Two 12V batteries in series)

### Instructions for charging batteries:

- Ensure that the ambient temperature of the DC/DC converter is below 45°C
- Do not use DC/DC converters in mounting orientations other than the standard mounting orientation (input terminals on the bottom and output terminals on top of the unit).
- 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 6A or 10A circuit breaker (or blocking diode) between the DC/DC converter and the battery.
- Ensure that the output current of the DC/DC converter is below the allowed charging current of the battery.
- Use only matched batteries when putting 12V types in series.
- The return current to the DC/DC converter (battery discharge current) is typ. 18mA when the DC/DC converter is switched off (except in case a blocking diode is utilized).

## 22.5. EXTERNAL INPUT PROTECTION

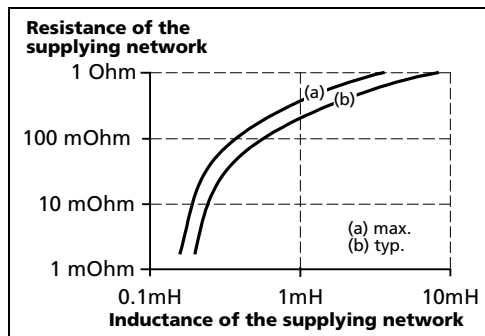
The unit is tested and approved for branch circuits up to 50A. An external protection is only required, if the supplying branch has an ampacity greater than this. Check also local codes and local requirements. In some countries local regulations might apply.

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 16A B- or C-Characteristic breaker should be used.

## 22.6. 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. 22-3.

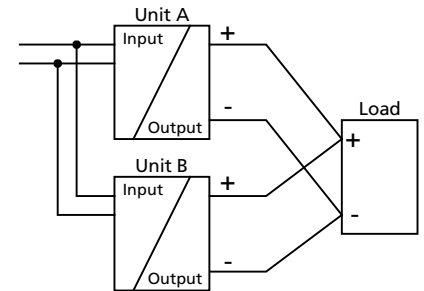
Fig. 22-3 External input filter requirements to avoid filter instabilities



### 22.7. PARALLEL USE TO INCREASE OUTPUT POWER

The DC/DC-converter can be paralleled to increase the output power. There are no feature included which balances the load current between the DC/DC converters. Therefore some restrictions and limitations apply. The DC/DC converter with the higher adjusted output voltage draws current until it goes into current limitation. This means no harm or switch-off to this DC/DC converter as long as the ambient temperature stays below 45°C. The CD5.243 can also be paralleled with power supplies from the DIMENSION CT, QS or QT-series. For other power supplies consult PULS. Set the "single use / parallel use" jumper to "parallel use" if such an option is available.

The output voltages of all DC/DC converter shall be adjusted to the same value ( $\pm 100\text{mV}$ ) at full load. A fuse or diode on the output of each unit is only required if more than three units are connected in parallel. This avoid that more than 2 times of the nominal output current can flow backwards into the DC/DC converter in case the output stage of the DC/DC converter has a defect. If a fuse (or circuit breaker) is used, choose one with approximately 150% of the rated output current of one DC/DC converter. Keep an installation clearance of 15mm (left / right) between two DC/DC converters and avoid installing the DC/DC converters on top of each other. Do not use DC/DC converters in parallel in mounting orientations other than the standard mounting orientation (input terminals on the bottom and output terminals on top of the unit).



### 22.8. PARALLEL USE FOR REDUNDANCY

The DC/DC converters can be paralleled for 1+1 redundancy to gain higher system availability. Redundant systems require a certain amount of extra power to support the load in case one DC/DC converter fails. The simplest way is to put two DC/DC converters in parallel. This is called a 1+1 redundancy. In case one DC/DC converter fails, the other one is automatically able to support the load current without any interruption. Redundant systems for a higher power demand are usually built in an N+1 method. E.g. four DC/DC converters, each rated for 4A are paralleled to build a 12A redundant system.

Furthermore, 1+1 redundant systems can be built by using a DC/DC converter powered from a battery and a power supply with AC input.

**Please note:** This simple way to build a redundant system does not cover failures such as an internal short circuit in the secondary side of the DC/DC converter. In such a case, the defect unit becomes a load for the other DC/DC converters and the output voltage can not be maintained any more. This can only be avoided by utilizing decoupling diodes which are included in the decoupling module YRM2.DIODE.

Recommendations for building redundant power systems:

- Use separate input fuses for each DC/DC converter.
- Monitor the individual DC/DC converter units. A DC-OK LED and a DC-OK contact is included in the redundancy module YRM2.DIODE. This feature reports a faulty unit.
- 1+1 Redundancy is allowed up to an ambient temperature of 60°C  
N+1 Redundancy is allowed up to an ambient temperature of 45°C
- It is desirable to set the output voltages of all units to the same value ( $\pm 100\text{mV}$ ) or leave it at the factory setting.



### 22.9. 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. 22-4 Daisy chaining of outputs

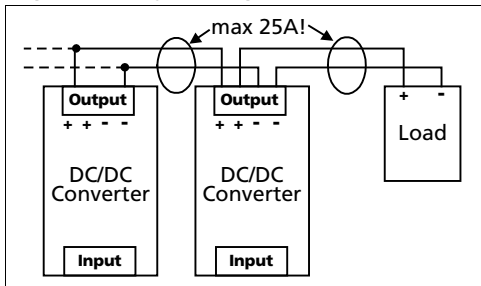
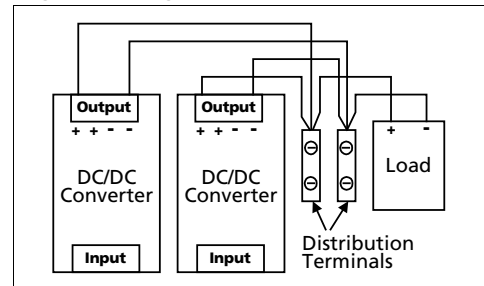
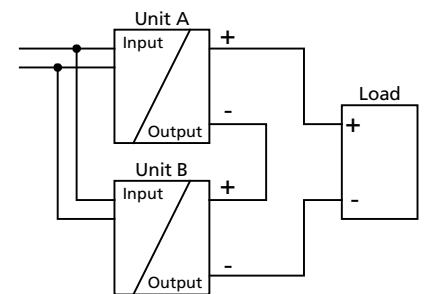


Fig. 22-5 Using distribution terminals



### 22.10. SERIES OPERATION

DC/DC converters of the exact same type can be connected in series for higher output voltages. It is possible to connect as many units in series as needed, providing the sum of the output voltage does not exceed 150Vdc. Voltages with a potential above 60Vdc are not SELV any more and can be dangerous. Such voltages must be installed with a protection against touching. Earthing of the output is required when the sum of the output voltage is above 60Vdc. 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 DC/DC converters and avoid installing the DC/DC converters on top of each other. Do not use DC/DC converters in series in mounting orientations other than the standard mounting orientation (input terminals on the bottom and output terminals on top of the unit).



### 22.11. 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

|                                |  |
|--------------------------------|--|
| Enclosure:                     | Rittal Typ IP66 Box PK 9516 100, plastic, 110x180x165mm                                |
| Load:                          | 24V, 3.2A; (=80%) load is placed outside the box                                       |
| Input:                         | 12Vdc  |
| Temperature inside enclosure:  | 44.8°C (in the middle of the right side of the DC/DC converter with a distance of 2cm) |
| Temperature outside enclosure: | 23.2°C   |
| Temperature rise:              | 21.6K  |

## 22.12. 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 max. allowed ambient temperature. The amount of reduction influences the lifetime expectancy of the DC/DC converter. 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. 22-6  
**Mounting Orientation A**  
(Standard orientation)

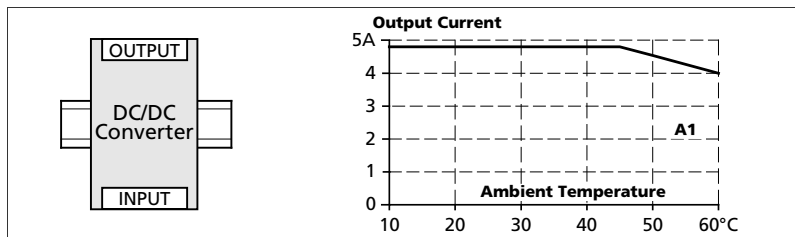


Fig. 22-7  
**Mounting Orientation B**  
(Upside down)

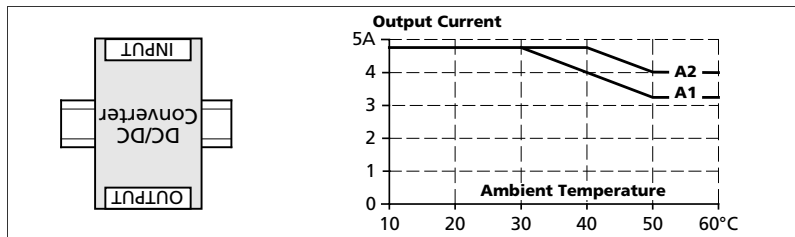


Fig. 22-8  
**Mounting Orientation C**  
(Table-top mounting)

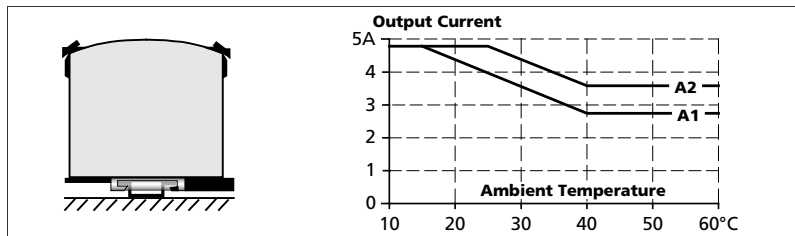


Fig. 22-9  
**Mounting Orientation D**  
(Horizontal cw)

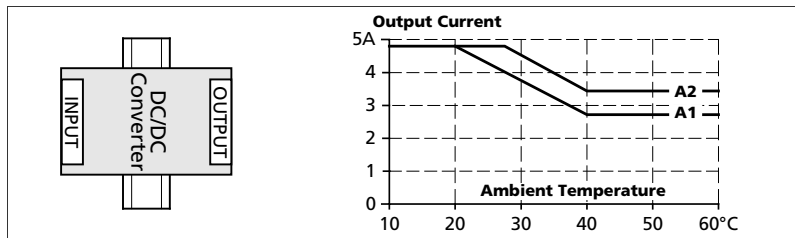


Fig. 22-10  
**Mounting Orientation E**  
(Horizontal ccw)

