14. 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.

EMC Immunity

Electrostatic discharge	EN 61000-4-2	Contact discharge Air discharge	8kV 15kV	Criterion A Criterion A
Electromagnetic RF field	EN 61000-4-3	80MHz-2.7GHz	20V/m	Criterion A
Fast transients (Burst)	EN 61000-4-4	Input lines Output lines	4kV 2kV	Criterion A Criterion A
Surge voltage on input	EN 61000-4-5	+ → - +/- → chassis ground	1kV 2kV	Criterion A Criterion A
Surge voltage on output	EN 61000-4-5	+ → - + / - → chassis ground	500V 1kV	Criterion A Criterion A
Conducted disturbance	EN 61000-4-6	0.15-80MHz	20V	Criterion A

Criterions:

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
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. SAFETY AND PROTECTION FEATURES

Isolation resistance	Min.	500MOhm	At delivered condition between input and output, measured with 500Vdc
	Min.	500MOhm	At delivered condition between input and Chassis Ground, measured with 500Vdc
	Min.	500MOhm	At delivered condition between output and Chassis Ground, measured with 500Vdc
PE resistance	Max.	0.1Ohm	Resistance between PE terminal and the housing in the area of the DIN-rail mounting bracket.
Output over-voltage protection	Typ.	58Vdc	
	Max.	60Vdc	
		In case of an internal defect, a redundant circuit limits the maximum output voltage. The output shuts down and automatically attempts to restart.	
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 14 (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.		

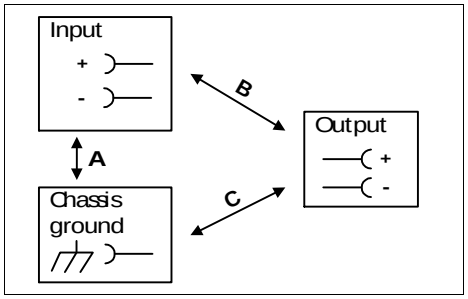
17. DIELECTRIC STRENGTH

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.

Fig. 17-1 **Dielectric strength**



		A	B	C
Type test	60s	1500Vac	1500Vac	500Vac
Routine test	5s	1500Vac	1500Vac	500Vac
Field test	5s	1000Vac	1000Vac	500Vac
Cut-off current setting		20mA	15mA	12mA

It is recommend that either the + pole, the – pole or any other part of the output circuit shall be connected to the earth/ground system. This helps to avoid situations in which a load starts unexpectedly or cannot be switched off when unnoticed earth faults occur.

18. APPROVALS

IEC 60950-1 2nd Edition	IECEE CB SCHEME	CB Scheme, Information Technology Equipment
IEC 61010-2-201 2nd Edition	IECEE CB SCHEME	CB Scheme for electrical equipment for measurement, control, and laboratory use - Part 2-201: Particular requirements for control equipment
ANSI/UL 61010-2-201 (former UL 508)	c UL us LISTED Ind. Cont. Eq.	Listed as Open Type Device for use in Control Equipment UL Category NMTR, NMTR7 E-File: E198865
EN 60079-0, EN 60079-7 ATEX planned	Ex II 3G Ex ec II TX Gc	Approval for use in hazardous locations Zone 2 Category 3G. Number of ATEX certificate: T.B.D.
IEC 60079-0, IEC 60079-7 planned	IECEx	Suitable for use in Class 1 Zone 2 Groups IIa, IIb and IIc locations. Number of IECEx certificate: T.B.D.

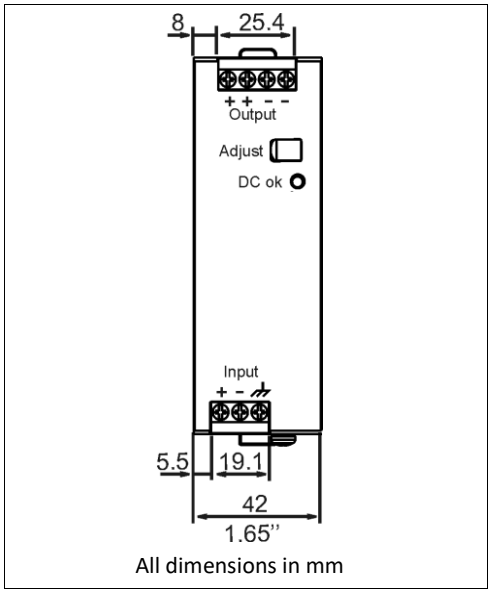
19. OTHER FULFILLED STANDARDS

EC Declaration of Conformity	CE	EU Declaration of Conformity Trade conformity assessment for Europe The CE mark indicates conformance with the European - RoHS directive, - EMC directive, - Low-voltage directive (LVD)
REACH Directive	REACH ✓	Directive 1907/2006/EU of the European Parliament and the Council of June 1st, 2007 regarding the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH)

20. PHYSICAL DIMENSIONS AND WEIGHT

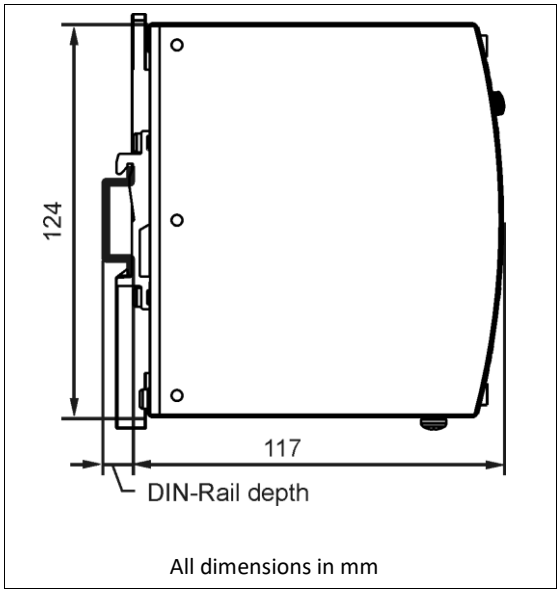
Width	42mm 1.65''
Height	124mm 4.88''
Depth	117mm 4.61'' The DIN-rail height must be added to the unit depth to calculate the total required installation depth.
Weight	500g / 1.10lb
DIN-Rail	Use 35mm DIN-rails according to EN 60715 or EN 50022 with a height of 7.5 or 15mm.
Housing material	Body: Aluminium 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. 20-1 **Front view**



All dimensions in mm

Fig. 20-2 **Side view**



All dimensions in mm

21. ACCESSORIES

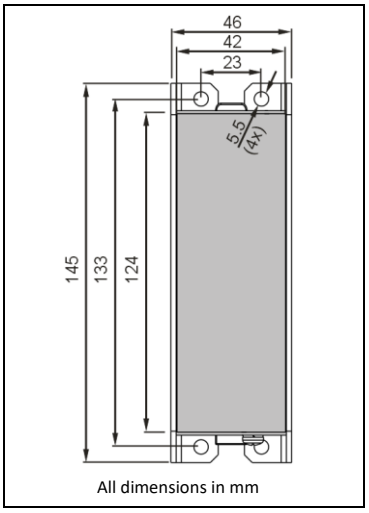
21.1. ZM2.WALL – WALL/PANEL MOUNT BRACKET

These brackets are used to mount the device on a flat surface or panel without utilizing a DIN-rail. The brackets can be mounted without detaching the DIN-rail brackets.

The order number ZM2.WALL contains two brackets needed for one device.

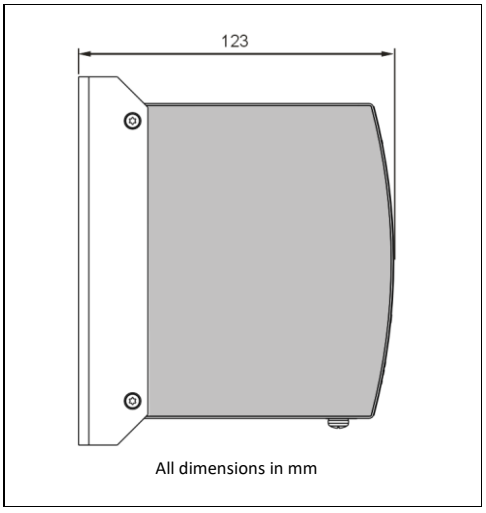
Fig. 21-1 **ZM2.Wall**

Fig. 21-2 **Hole pattern**



All dimensions in mm

Fig. 21-3 **Side view**



All dimensions in mm

Fig. 21-4 **Isometric view**

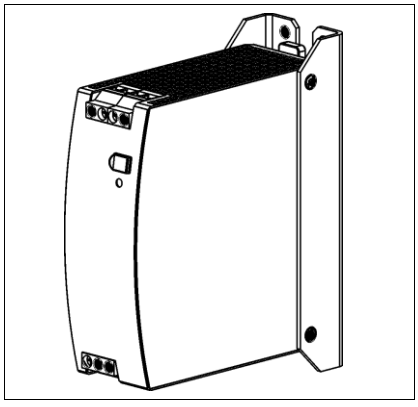


Fig. 21-5 **Isometric view**

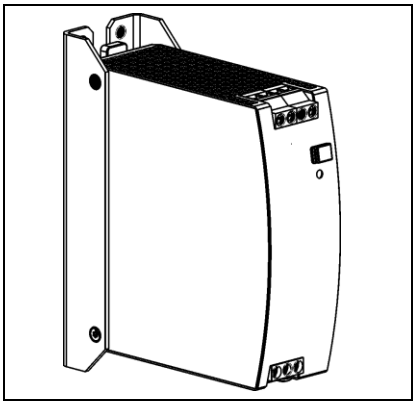
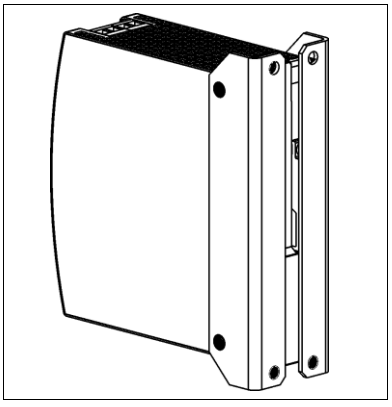


Fig. 21-6 **Isometric view**



21.2. 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.

Fig. 21-7
Side mounting without DIN-rail brackets

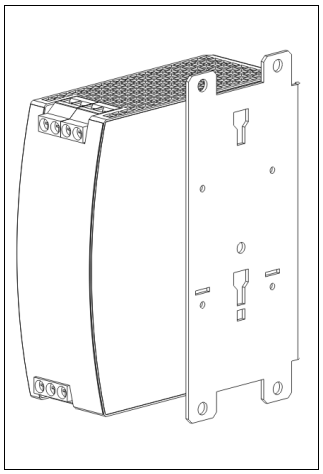


Fig. 21-8
Side mounting with DIN-rail brackets

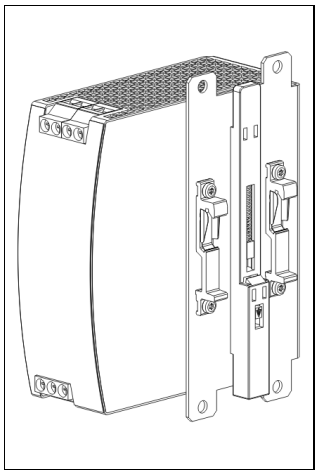
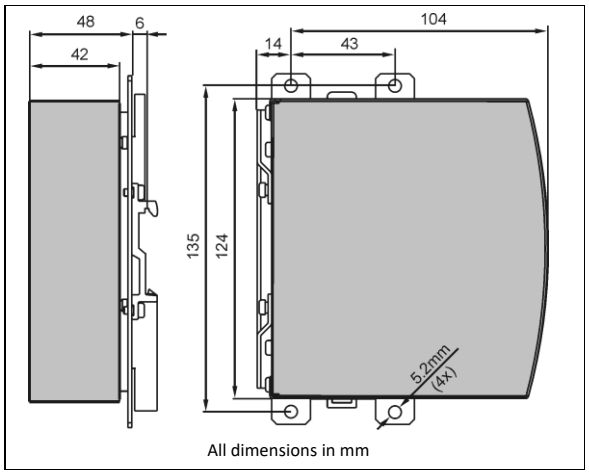


Fig. 21-9
Hole pattern



All dimensions in mm

21.3. YRM2.DIODE - REDUNDANCY MODULE

The YRM2.DIODE is a dual redundancy module, which can be used to build 1+1 or N+1 redundant system.

The device is equipped with two input channels each 10A nominal, which are individually decoupled by utilizing diode technology. The output can be loaded with nominal 20A.

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

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

The unit is very slender and only requires 32mm width on the DIN-rail.

See chapter 22.6 for wiring information.

21.4. UF20.481 - BUFFER MODULE

The UF20.481 buffer module is a supplementary device for 48V DC/DC converters. It delivers power to bridge typical supply voltage faults or extends the hold-up time after turn-off of the input power.

In times when the DC/DC converter provides sufficient voltages, the buffer module stores energy in integrated electrolytic capacitors. In case of a supply voltage fault, this energy is released again in a regulated process.

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

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

22. APPLICATION NOTES

22.1. 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. 22-1 **10A Resistive peak load (2x the nominal current) for 50ms, typ.**

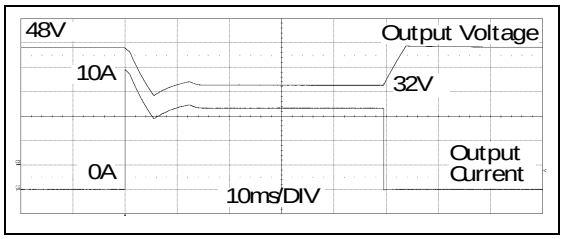
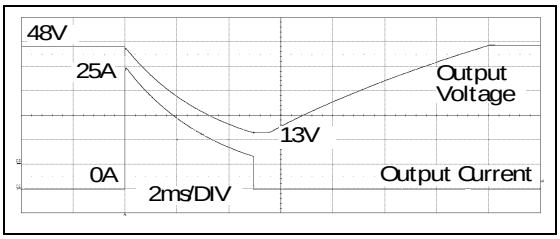


Fig. 22-2 **25A Resistive peak load (5x the nominal current) for 5ms, typ.**



Peak current voltage dips	typ.	from 48V to 32V	At 10A for 50ms, resistive load
	typ.	from 48V to 28V	At 25A for 2ms, resistive load
	typ.	from 48V to 13V	At 25A for 5ms, resistive load

22.2. Output Circuit Breakers

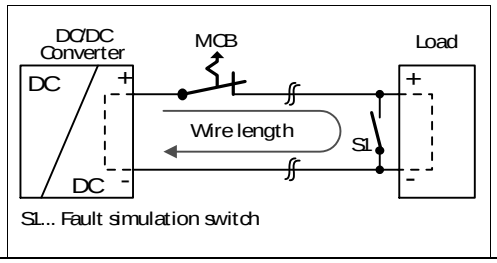
Standard miniature circuit breakers (MCB's or UL 1077 circuit breakers) are commonly used for AC-supply systems and may also be used on 48V branches.

MCB's are designed to protect wires and circuits. If the ampere value and the characteristics of the MCB are adapted to the wire size that is used, the wiring is considered as thermally safe regardless of whether the MCB opens or not.

To avoid voltage dips and under-voltage situations in adjacent 24V branches which are supplied by the same source, a fast (magnetic) tripping of the MCB is desired. A quick shutdown within 10ms is necessary corresponding roughly to the ride-through time of PLC's. This requires power supplies with high current reserves and large output capacitors. Furthermore, the impedance of the faulty branch must be sufficiently small in order for the current to actually flow. The best current reserve in the power supply does not help if Ohm's law does not permit current flow. The following table has typical test results showing which B- and C-Characteristic MCBs magnetically trip depending on the wire cross section and wire length.

The following test results indicate the maximal wire length for a magnetic (fast) tripping. The wire length is always two times the distance to the load (+ and – wire).

Fig. 22-3 **Test circuit for maximum wire length**



Test results for maximum wire length:

	0.75mm²	**1.0mm²**	**1.5mm²**	**2.5mm²**
C-2A	43m	54m	82m	117m
C-3A	21m	28m	41m	66m
C-4A	9m	11m	15m	23m
C-6A	3m	3m	4m	6m
B-6A	11m	13m	20m	30m
B-10A	2m	2m	3m	4m

22.3. 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:

a) Ensure that the ambient temperature of the Device is below 45°C.

b) 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	55.6V	55.0V	54.3V	53.6V
Battery temperature	10°C	20°C	30°C	40°C

c) Use a 10A circuit breaker or blocking diode between the Device and the battery.

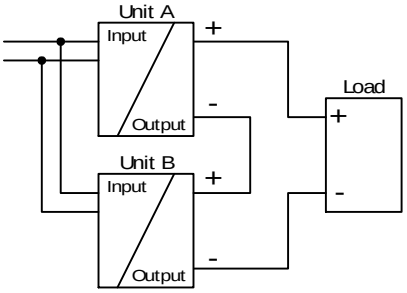
d) Ensure that the output current of the Device is below the allowed charging current of the battery.

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

f) The return current to the Device (battery discharge current) is typ. 6mA when the Device is switched off (except in case a blocking diode is utilized).

g) 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).

22.4. SERIES OPERATION



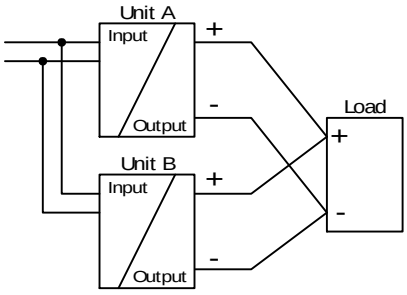
Devices of the same type can be connected in series for higher output voltages. It is possible to connect as many units in series as needed, providing the sum of the output voltage does not exceed 150Vdc. Voltages with a potential above 60Vdc must be installed with a protection against touching.

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.

22.5. PARALLEL USE TO INCREASE OUTPUT POWER



Devises can be paralleled to increase the output power. The output voltage shall be adjusted to the same value (±100mV) with the same load conditions on all devices, or the devices can be left with the factory settings.

The ambient temperature is not allowed to exceed +45°C.

If more than three devices are connected in parallel, a fuse or circuit breaker with a rating of 10A 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 EMI and inrush current will increase when using multiple devices.

22.6. 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.
- Monitor the outputs of the individual devices. Use the DC-ok lamp or the DC-ok contact, which are included in the redundancy module YRM2.DIODE.
- It is desirable to set the output voltages of all devices to the same value (± 100mV) 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. 22-4 **1+1 Redundant configuration for 5A load current with a dual redundancy module**

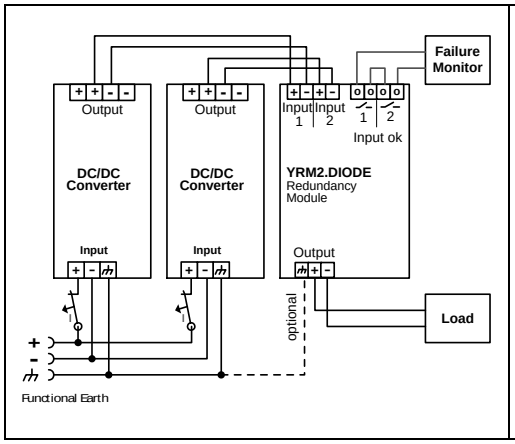
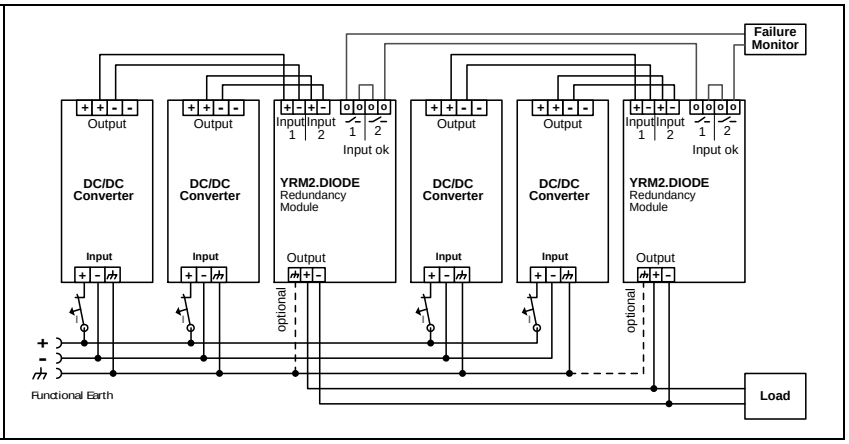


Fig. 22-5 **N+1 Redundant configuration for 15A load current with multiple DC/DC converters and redundancy modules**



22.7. USE IN A TIGHTLY SEALED ENCLOSURE

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

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

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

	Case A	**Case B**
Enclosure size	110x180x165mm Rittal Typ IP66 Box PK 9516 100, plastic	110x180x165mm Rittal Typ IP66 Box PK 9516 100, plastic
Input voltage	48Vdc	48Vdc
Load	48V, 4A; (=**80%**)	48V, 5A; (=**100%**)
Temperature inside the box	43.5°C	48.1°C
Temperature outside the box	26.2°C	26.6°C
Temperature rise	17.3K	21.5K

22.8. 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. 22-6
Mounting Orientation A
(Standard orientation)

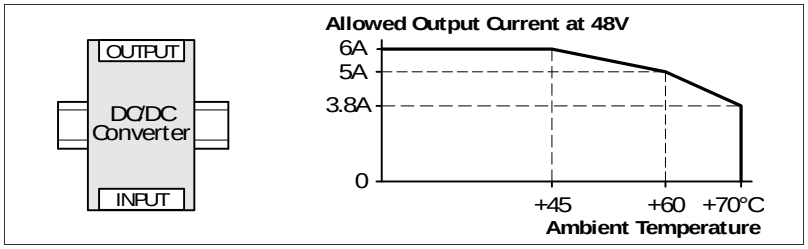


Fig. 22-7
Mounting Orientation B
(Upside down)

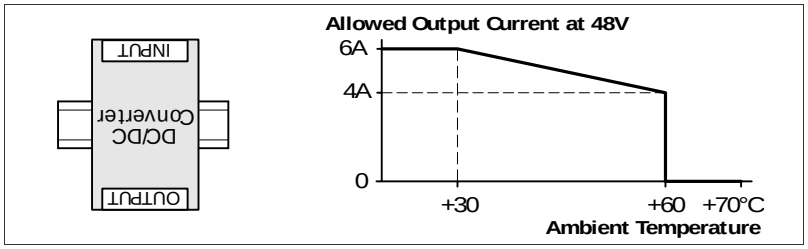


Fig. 22-8
Mounting Orientation C
(Table-top mounting)

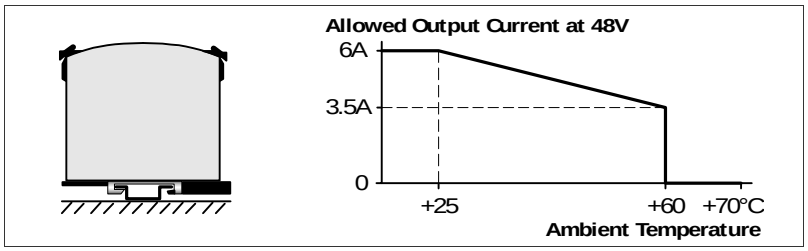


Fig. 22-9
Mounting Orientation D
(Horizontal cw)

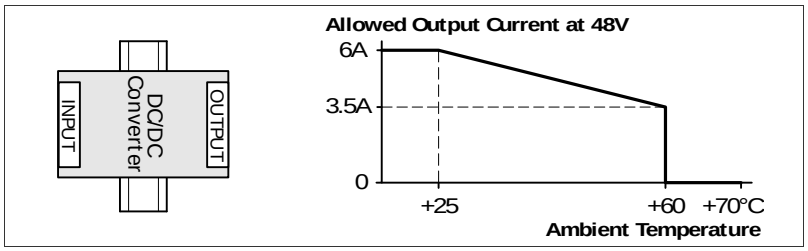


Fig. 22-10
Mounting Orientation E
(Horizontal ccw)