PULS

DIMENSION **CD-Series**

CD10.241

DC/DC Converter 24V/24V, 10A, 240W

DC/DC CONVERTER

- 24V DC-Input
- Isolated 24Vdc Output
- Efficiency 94.2%
- 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
- 3 Year Warranty

PRODUCT DESCRIPTION

The CD10.241 is a DIN-rail mountable DC/DC converter of the DIMENSION series which provides a floating, stabilized and galvanically separated SELV/PELV output voltage.

The CD-Series is part of the DIMENSION power supply family. The most outstanding features of CD10.241 are the high efficiency, the small size and the wide operational temperature range.

The CD-Series includes all the essential basic functions. The devices have a power reserve of 20% included, which may even be used continuously at temperatures up to +45°C.

High immunity to transients and power surges as well as low electromagnetic emission and a large international approval package for a variety of applications makes this unit suitable for nearly every situation.

SHORT-FORM DATA

Output voltage	DC 24V	Nominal
Adjustment range	24 - 28V	Factory setting 24.1V
Output current	12 – 10.3A	Below +45°C ambient
	10 – 8.6A	At +60°C ambient
	7.5 – 6.5A	At +70°C ambient
	Derate linearly between +45°C and +70°C	
Input voltage	DC 24V	-25%/+46%
Input current	10.5A	
Input inrush current	6A peak	
Efficiency	94.2%	
Losses	14.8W	
Hold-up time	4ms	
Temperature range	-25°C to +70°C	
Size (W x H x D)	42x124x117mm	Without DIN-rail
Weight	500g / 1.1lb	

ORDER NUMBERS

DC/DC Converter

CD10.241

Mechanical Accessory

ZM2.WALL	Wall/panel mount bracket
ZM12.SIDE	Side mount bracket

MAIN APPROVALS

For details or a complete approval list see section 18.

c UL us LISTED
Ind. Cont. Eq.

IECEx ATEX

CE

DNV·GL
dnvgl.com/af
planned

 All values are typical figures specified at 24Vdc input voltage 24V, 10A output load, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.

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TERMINOLOGY AND ABREVIATIONS

PE and ⏚ symbol	PE is the abbreviation for **P**rotective **E**arth 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 24V	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)
24Vdc	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 the general use such as in industrial control, office, communication, and instrumentation equipment.

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

2. Installation Instructions

⚠ WARNING **Risk of electrical shock, fire, personal injury or death.**

- Turn power off before working on the device. Protect against inadvertent re-powering.
- Do not modify or repair the unit.
- Do not open the unit as high voltages may present inside.
- Use caution to prevent any foreign objects from entering the housing.
- Do not use in wet locations or in areas where moisture or condensation can be expected.
- Do not touch during power-on, and immediately after power-off. Hot 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 allowed.

The enclosure of the device provides a degree of protection of IP20.

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 6000m (19685ft). See additional requirements in this document for use above 2000m (6560ft).

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 20A 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 24V	-25%/+46%
DC input range	Min.	18.0-35.0Vdc	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.	5Vpp	In the frequency range from 47 to 500Hz, the momentary input voltage must always be within the specified limits.
Turn-on voltage	Typ.	17.5Vdc	Steady-state value, see Fig. 3-1
Shut-down voltage	Typ.	15.5Vdc	Steady-state value, see Fig. 3-1
Input current	Typ.	10.5A	At 24Vdc input and 24V, 10A output load , see Fig. 3-3
	Typ.	14.3A	At 18Vdc input and 24V, 10A output load, see Fig. 3-3
Start-up delay	Typ.	200ms	See Fig. 3-1
Rise time	Typ.	200ms	At 24V, 10A constant current load, 0mF load capacitance, see Fig. 3-2
	Typ.	200ms	At 24V, 10A constant current load, 10mF load capacitance, see Fig. 3-2
Turn-on overshoot	Max.	250mV	See Fig. 3-2
Input capacitance	Typ.	4 300µF	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**

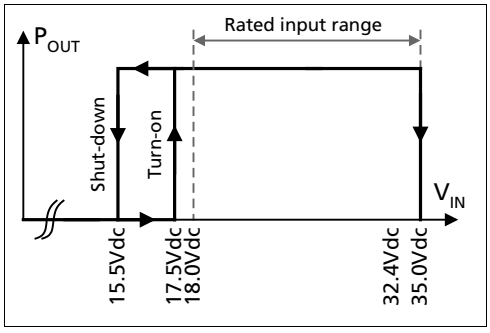


Fig. 3-2 **Turn-on behavior, definitions**

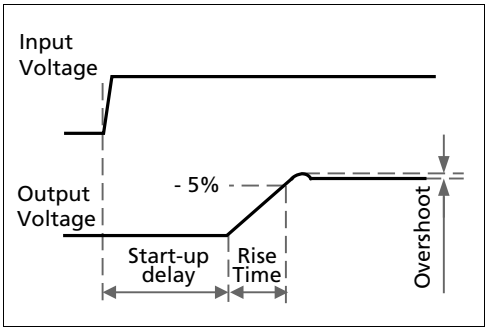
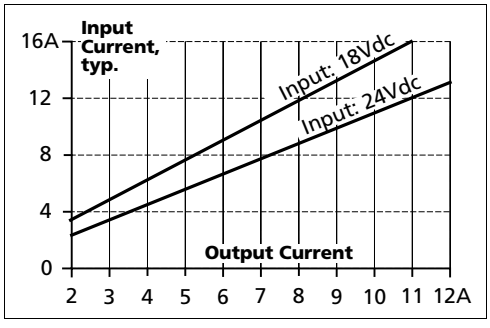


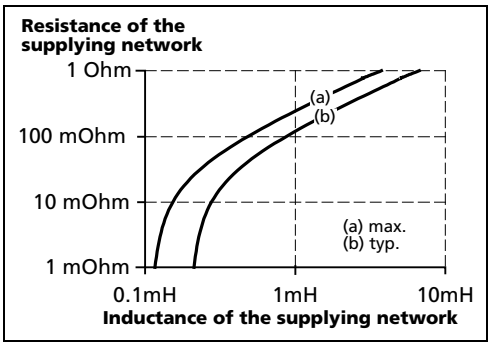
Fig. 3-3 **Input current vs. output load**



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**



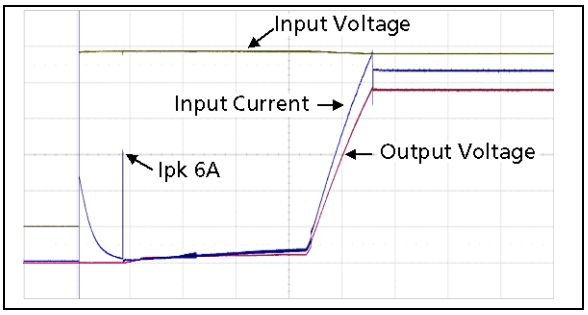
4. Input Inrush Current

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	At +25°C ambient, cold start
	Max.	25A	At +60°C ambient, cold start
	Typ.	$6A_{peak}$	At +25°C ambient, cold start
	Typ.	$22A_{peak}$	At +60°C ambient, cold start
Inrush energy	Max.	$1A^2s$	Between -25°C to +70°C, cold start

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



Input: 24Vdc
Output: 24V, 10A, constant current load
Ambient: 25°C

Input current 2A / DIV
Input voltage 5V / DIV
Output voltage 5V / DIV
Time basis: 100ms / DIV

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	Min.	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	Between 0 and 10A load variation, static value
Ripple and noise voltage	Max.	50mVpp	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.	15A	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 24Vdc input voltage, typ.**

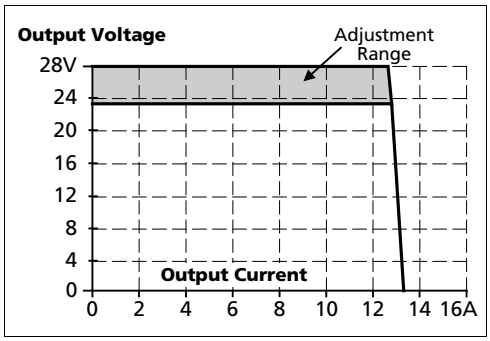
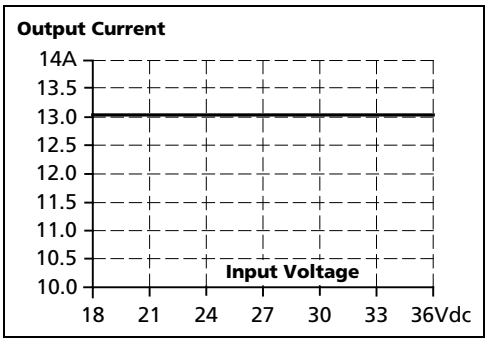


Fig. 6-2 **Current limitation vs. input voltage, (23V constant voltage load), typ.**



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 lamp is also on during this time.

Hold-up Time	Typ.	8ms	At 24Vdc input voltage, 24V, 5A output, see Fig. 7-1
	Min..	6.5ms	At 24Vdc input voltage, 24V, 5A output, see Fig. 7-1
	Typ.	4ms	At 24Vdc input voltage, 24V, 10A output, see Fig. 7-1
	Min..	3.2ms	At 24Vdc input voltage, 24V, 10A output, see Fig. 7-1

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

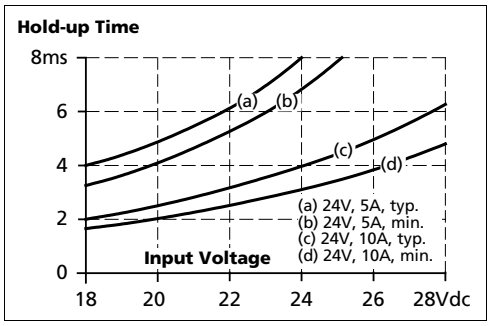


Fig. 7-2 **Shut-down test setup**

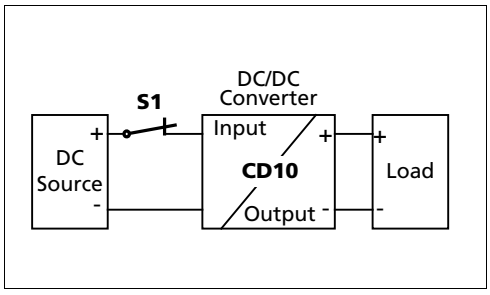
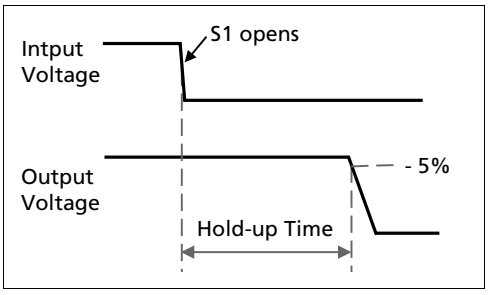


Fig. 7-3 **Shut-down behavior, definitions**



8. Efficiency and Power Losses

		Input 24Vdc	
Efficiency	Typ.	94.2%	At 24V, 10A
	Typ.	93.7%	At 24V, 12A (Power Boost)
Average efficiency*)	Typ.	94.3%	At 25% at 2.5A, 25% at 5A, 25% at 7.5A. 25% at 10A
Power losses	Typ.	1.75W	At no output load
	Typ.	6.8W	At 24V, 5A
	Typ.	14.7W	At 24V, 10A
	Typ.	19.5W	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. 8-1 **Efficiency vs. output current at 24V output and 24Vdc input voltage, typ.**

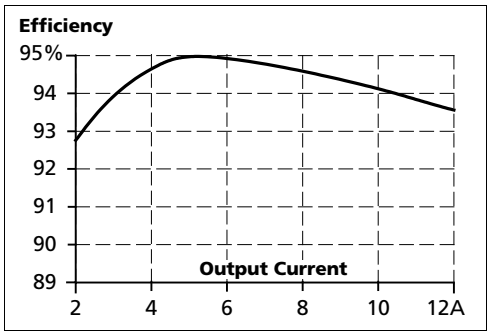


Fig. 8-2 **Losses vs. output current at 24V output and 24Vdc input voltage, typ.**

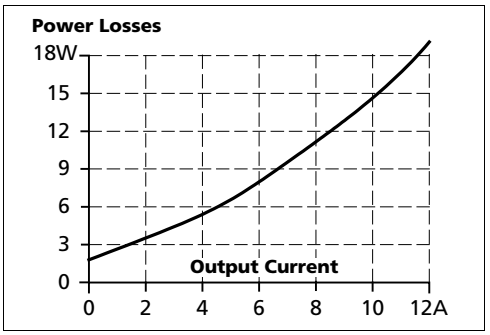


Fig. 8-3 **Efficiency vs. input voltage at 24V, 10A, typ.**

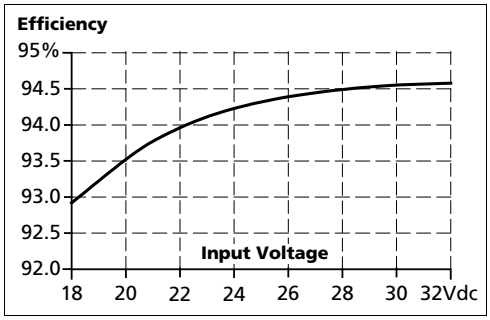
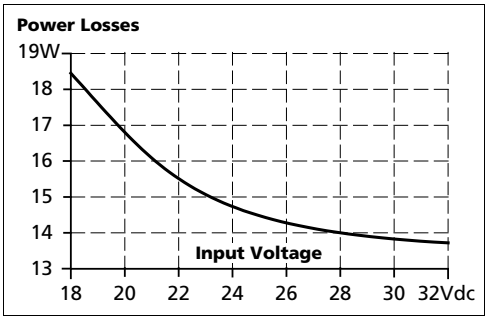
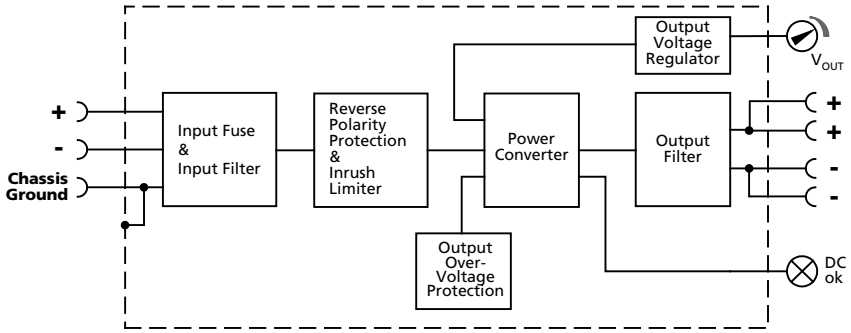


Fig. 8-4 **Losses vs. input voltage at 24V, 10A, typ.**



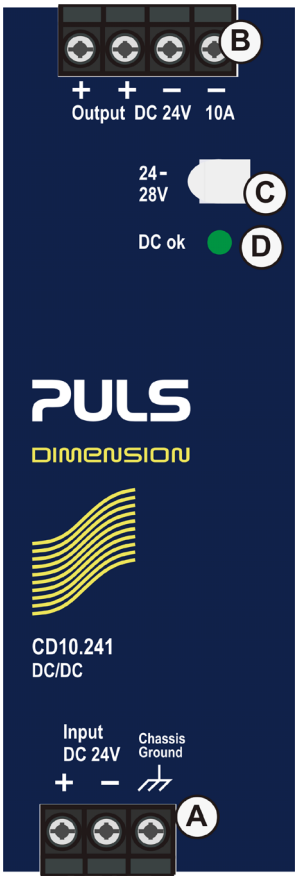
9. Functional Diagram

Fig. 9-1 **Functional diagram**



10. Front Side and User Elements

Fig. 10-1 **Front side**



A Input terminals
+ Positive input
- Negative / return input
Chassis ground: to bond the housing to ground, PE or Functional Earth

B Output terminals
Screw terminals, dual terminals per pole, both pins are equal
+ Positive output (two identical + poles)
- Negative / return output (two identical - poles)

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

11. CONNECTION TERMINALS

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

	Input	**Output**
Type	Screw terminals	Screw terminals
Solid wire	Max. 6mm²	Max. 6mm²
Stranded wire	Max. 4mm²	Max. 4mm²
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. 11-1 Daisy chaining of outputs

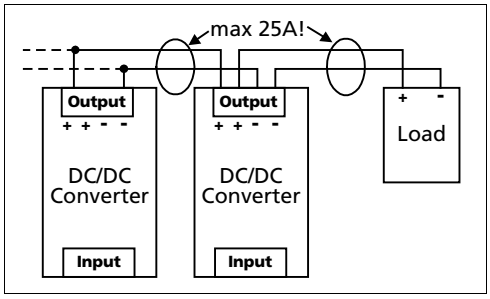
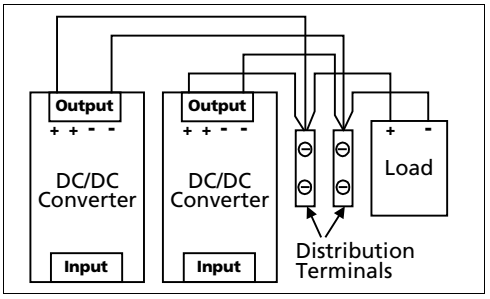


Fig. 11-2 Using distribution terminals



12. LIFETIME EXPECTANCY

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

	Input 24Vdc	
Lifetime expectancy	299 000h	At 24V, 5A and 40°C
	103 000h	At 24V, 10A and 40°C
	56 000h	At 24V, 12A and 40°C
	844 000h	At 24V, 5A and 25°C
	292 000h	At 24V, 10A and 25°C
	159 000h	At 24V, 12A and 25°C

13. MTBF

MTBF stands for **M**ean **T**ime **B**etween **F**ailure, 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.

For these types of units the MTTF (**M**ean **T**ime **T**o **F**ailure) value is the same value as the MTBF value.

	Input 24Vdc	
MTBF SN 29500, IEC 61709	731 000h	At 24V, 10A and 40°C
	1 321 000h	At 24V, 10A and 25°C
MTBF MIL HDBK 217F	358 000h	At 10A and 40°C; Ground Benign GB40
	556 000h	At 10A and 25°C; Ground Benign GB25
	731 000h	At 10A and 40°C; Ground Fixed GF40
	142 000h	At 10A and 25°C; Ground Fixed GF25

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
Conducted emission on output lines	IEC/CISPR 16-1-2, IEC/CISPR 16-2-1	T.B.D.
Radiated emission	EN 55011, EN 55022	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	50kHz to 300kHz	Output load and input voltage dependent

15. 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	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
	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.	
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 6000m (20 000ft)	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	According to IEC 60068-2-27
	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.	
LABS compatibility	As a rule, only non-silicon precipitating materials are used. The unit conforms to the LABS criteria and is suitable for use in paint shops.	
Corrosive gases	Tested according to ISA-71.04-1985, Severity Level G3 and IEC 60068-2-60 Test Ke Method 4 for a service life of minimum 10years in these environments.	
Audible noise	Some audible noise may be emitted from the power supply during no load, overload or short circuit.	

Fig. 15-1 **Output current vs. ambient temp.**

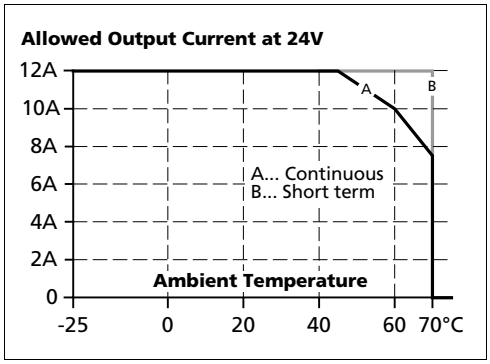
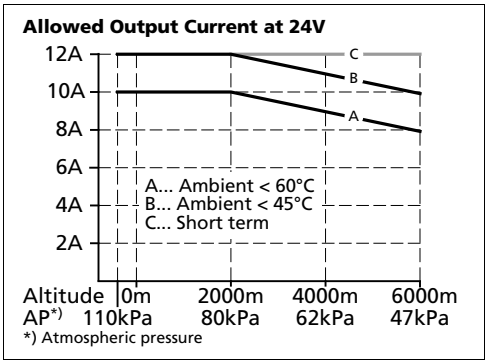


Fig. 15-2 **Output current vs. altitude at 24V**



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.	31Vdc	
	Max.	32.5Vdc	
		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		III	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.		

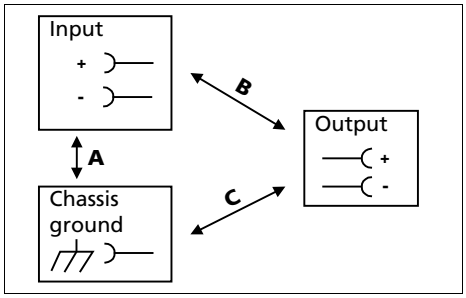
17. Dielectric Strength

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		40mA	20mA	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 can not be switched off when unnoticed earth faults occur.

18. APPROVALS

EC Declaration of Conformity	CE	The CE mark indicates conformance with the - EMC directive and the - ATEX directive (planned).
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.
Marine planned	DNV·GL dnvgl.com/af	GL (Germanischer Lloyd) classified Environmental category: C, EMC2 Marine and offshore applications
EAC TR Registration	EAC	Registration for the Eurasian Customs Union market (Russia, Kazakhstan, Belarus)

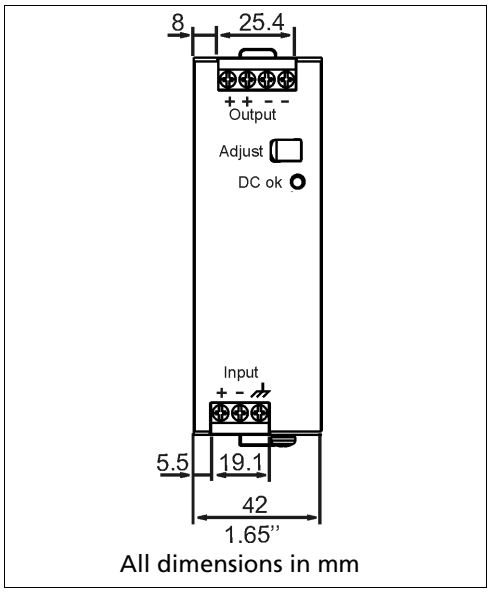
19. ROHS, REACH AND OTHER FULFILLED STANDARDS

RoHS Directive	RoHS ✓	Directive 2011/65/EU of the European Parliament and the Council of June 8th, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.
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)
IEC/EN 61558-2-16 (Annex BB)	Safety Isolating Transformer	Safety Isolating Transformers corresponding to Part 2-6 of the IEC/EN 61558

20. PHYSICAL DIMENSIONS AND WEIGHT

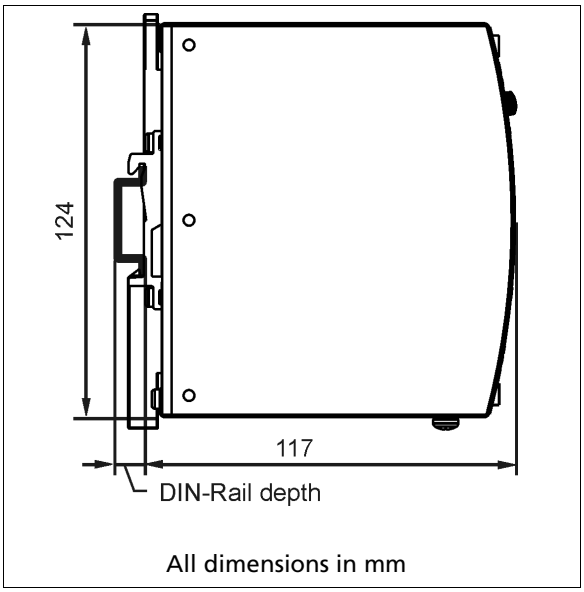
Width	42mm 1.65''
Height	124mm 4.88''
Depth	117mm 4.61'' The DIN-rail height must be added to the unit depth to calculate the total required installation depth.
Weight	500g / 1.10lb
DIN-Rail	Use 35mm DIN-rails according to EN 60715 or EN 50022 with a height of 7.5 or 15mm.
Housing material	Body: Aluminium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

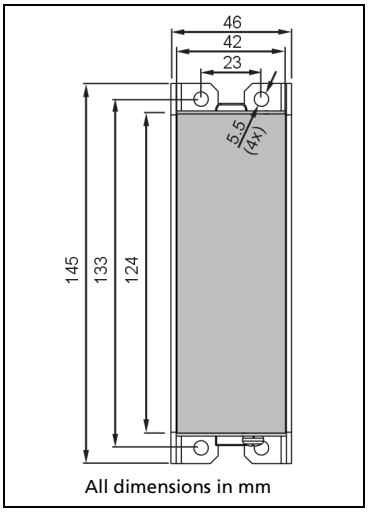
21.1. ZM2.WALL – WALL/PANEL MOUNT BRACKET

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.

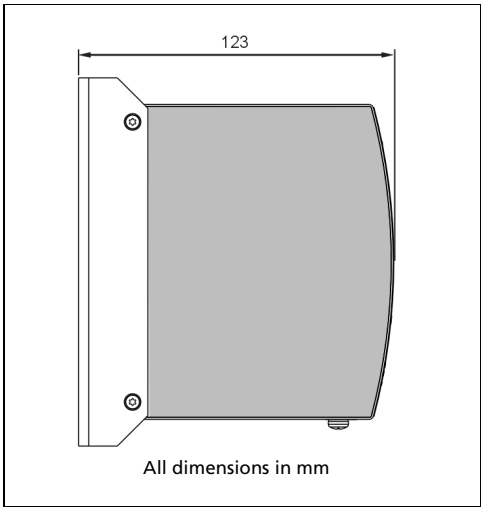
Fig. 1-1 **ZM2.Wall**

Fig. 1-2 **Hole pattern**



All dimensions in mm

Fig. 1-3 **Side view**



All dimensions in mm

Fig. 1-4 **Isometric view**

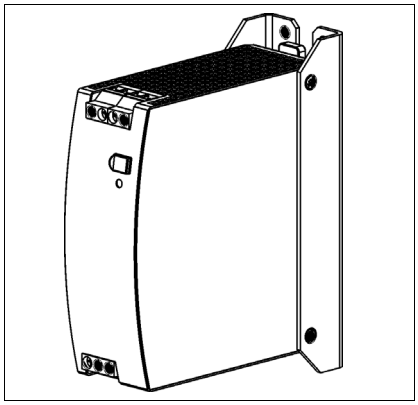


Fig. 1-5 **Isometric view**

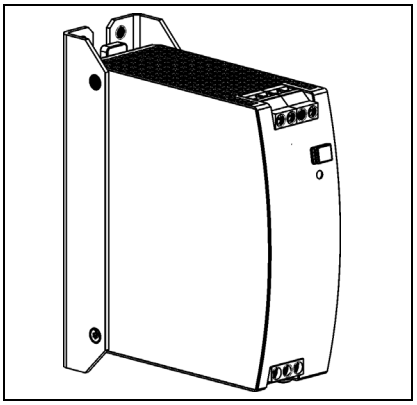
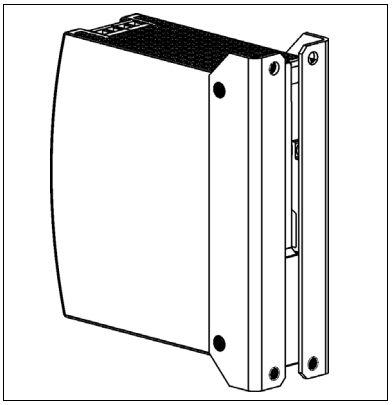


Fig. 1-6 **Isometric view**



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. 2-7
Side mounting without DIN-rail brackets

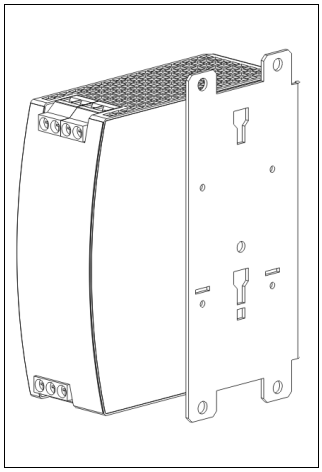


Fig. 2-8
Side mounting with DIN-rail brackets

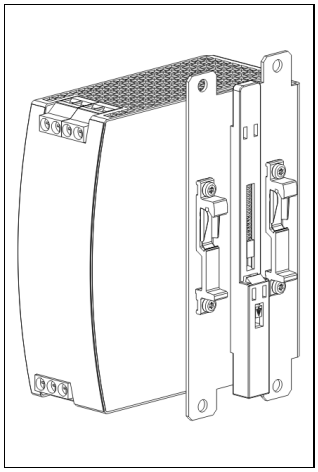
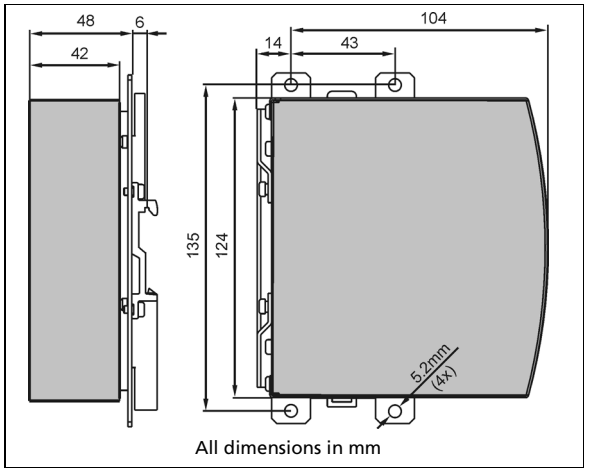


Fig. 2-9
Hole pattern



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 systems.

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.

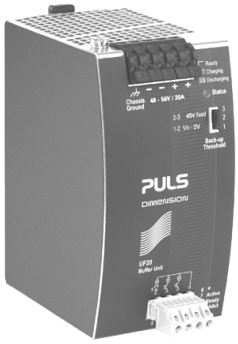
The device does not require an additional auxiliary voltage and is self-powered even in case of a short circuit across the output.

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 is 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. UF20.241 - 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 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

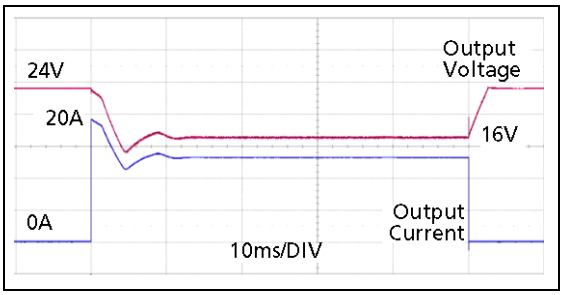
The unit can deliver peak currents (up to several milliseconds) which are higher than the specified short term currents.

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.

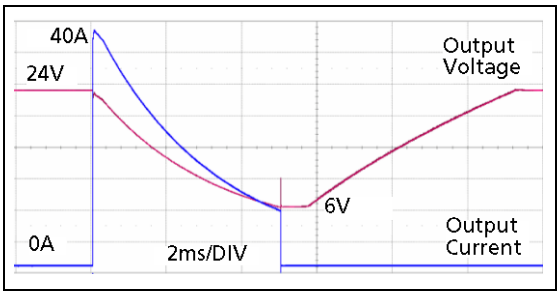
The extra current (peak current) is supplied by the power converter and the built-in large sized output capacitors of the power supply. The capacitors get discharged during such an event, which causes a voltage dip on the output. The following two examples show typical voltage dips:

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



Peak load 20A (resistive load) for 50ms
Output voltage dips from 24V to 16V.

Fig. 22-2 **Peak loading with 4x the nominal current for 5ms, typ.**



Peak load 40A (resistive load) for 5ms
Output voltage dips from 24V to 6V.

Peak current voltage dips	typ.	from 24V to 16V	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

22.2. Output Circuit Breakers

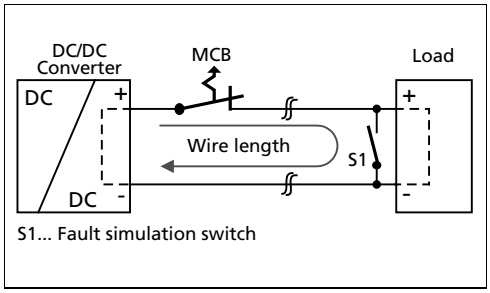
Standard miniature circuit breakers (MCB's or UL 1077 circuit breakers) are commonly used for AC-supply systems and may also be used on 24V branches.

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

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

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	23m	25m	41m	71m
C-3A	13m	15m	23m	33m
C-4A	4m	6m	8m	13m
C-6A	1m	2m	2m	5m
B-6A	8m	10m	14m	23m
B-10A	1m	2m	2m	3m
B-13A		1m	2m	3m

22.3. Charging of Batteries

The device can be used to charge lead-acid or maintenance free batteries. Two 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	27.8V	27.5V	27.15V	26.8V
Battery temperature	10°C	20°C	30°C	40°C

c) Use a 16A circuit breaker or blocking diode between the Device and the battery.

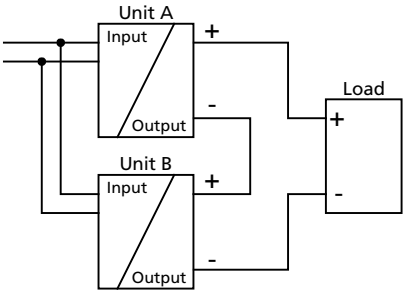
d) Ensure that the output current of the Device is below the allowed charging current of the battery.

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

f) The return current to the Device (battery discharge current) is typ. 10mA 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



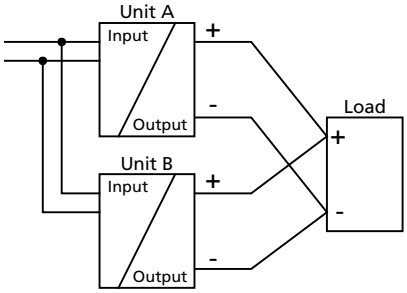
Devices of the same type can be connected in series for higher output voltages. It is possible to connect as many units in series as needed, providing the sum of the output voltage does not exceed 150Vdc. Voltages with a potential above 60Vdc must be installed with a protection against touching.

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 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 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 Redundancy-ok contact, which is included in the YR20.246 redundancy module.
- 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 10A load current**

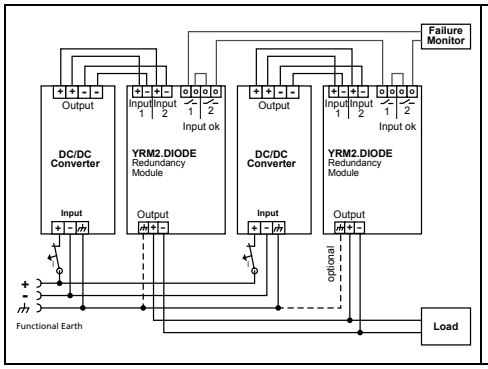
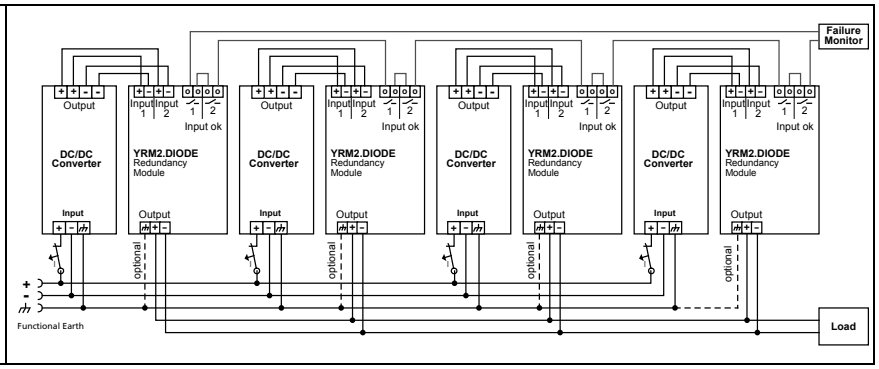


Fig. 22-5 **N+1 Redundant configuration for 30A load current with multiple DC/DC converters and redundancy modules**



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	24Vdc	24Vdc
Load	24V, 8A; (=**80%**)	24V, 10A; (=**100%**)
Temperature inside the box	52.2°C	59.3°C
Temperature outside the box	31.0°C	31.4°C
Temperature rise	21.2K	27.9K

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)

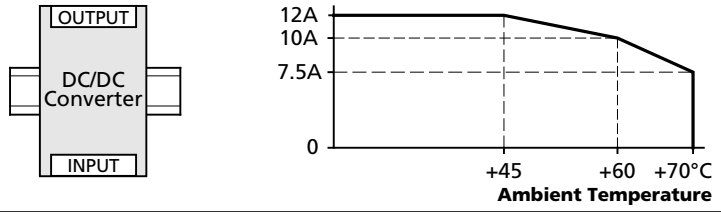


Fig. 22-7
Mounting Orientation B
(Upside down)

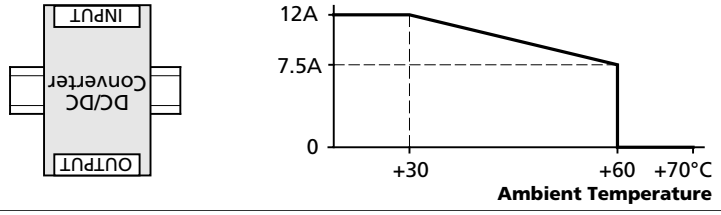


Fig. 22-8
Mounting Orientation C
(Table-top mounting)

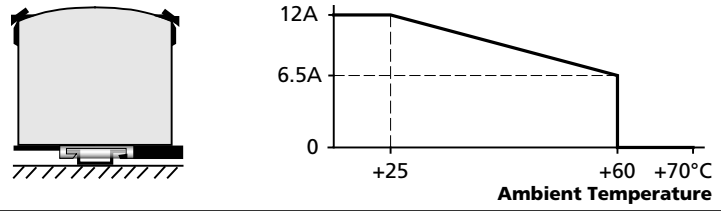


Fig. 22-9
Mounting Orientation D
(Horizontal cw)

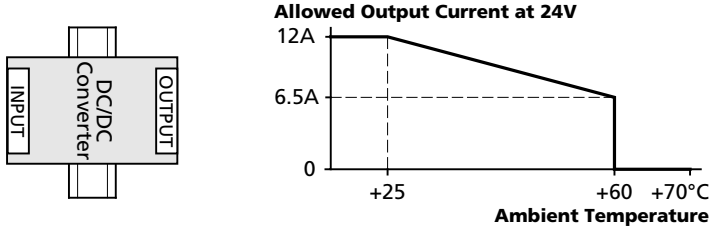
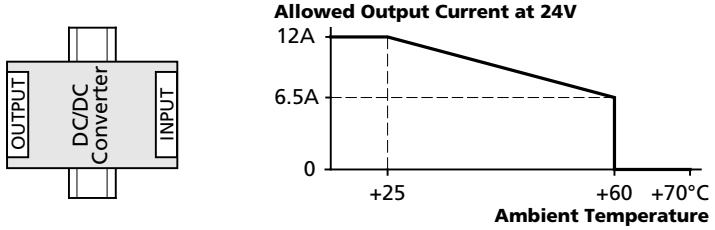


Fig. 22-10
Mounting Orientation E
(Horizontal ccw)



CD5.121

DC/DC Converter 12V, 8A

DC/DC Converter

- 24V DC-Input
- Isolated 12Vdc Output
- Efficiency up to 88.2%
- 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

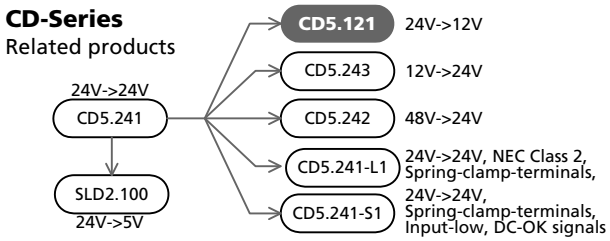
General Description

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 CD5.121 converts a 24V voltage to a 12V voltage.

The CD5.121 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 12V	
Adjustment range	12 - 15V	
Output current	8 – 6.4A	ambient <60°C
	9.6 – 7.7A	ambient <45°C
Output power	96W	ambient <60°C
	115W	ambient <45°C
Output ripple	< 75mVpp	20Hz to 20MHz
Input voltage	DC 24V	
Input voltage range	18 to 32.4Vdc	full specified
	14,4 to 18Vdc	with derating
Input current	typ. 4.6A	at 24Vdc input
Input inrush current	typ. 1.2A peak	
Efficiency	88.2%	at 24Vdc input
Losses	12.8W	at 24Vdc input
Temperature range	-25°C to +70°C	operational
Derating	2.5W/°C	+60 to +70°C
Hold-up time	typ. 7ms	at 24Vdc input
Dimensions	32x124x102mm	WxHxD
Weight	425g / 0.94lb	

Order Numbers

DC/DC Converter	**CD5.121**	Standard unit
Accessory	ZM1.WALL	Wall mount bracket
	ZM11.SIDE	Side mount bracket

Markings

cULus LISTED
Ind. Cont. Eq.
UL 508

cULus
UL 60950-1

CE
EMC, ATEX

cSPus
Class I Div 2

IECEx ATEX
II 3G Ex nA nC II T4 Gc

GL
Marine

INDEX

TERMINOLOGY AND ABREVIATIONS

PE and ⏚ symbol	PE is the abbreviation for **P**rotective **E**arth 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 24V	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)
24Vdc	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 the general use such as in industrial control, office, communication, and instrumentation equipment.

Do not use this DC/DC converter in equipment where malfunction may cause severe personal injury or threaten human life.

2. 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 (if included) 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.

Mount the unit on a DIN-rail so that the output terminals are located on top and input terminal on the bottom. For other mounting orientations see de-rating requirements in this document.

This device is designed for convection cooling and does not require an external fan. Do not obstruct airflow and do not cover ventilation grid (e.g. cable conduits) by more than 30%!

Keep the following installation clearances: 40mm on top, 20mm on the bottom, 5mm on the left and right sides are recommended when the device is loaded permanently with more than 50% of the rated power. Increase this clearance to 15mm in case the adjacent device is a heat source (e.g. another DC/DC converter).

The input must be powered from a SELV source (according to IEC 60950-1), a PELV source (according to IEC 62477-1) or an Isolated Secondary Circuit (according to UL 508).

⚠ WARNING Risk of electrical shock, fire, personal injury or death.

- Do not use the DC/DC-converter without proper grounding (Protective Earth). Use the terminal on the input block for earth connection and not one of the screws on the housing.
- Turn power off before working on the device. Protect against inadvertent re-powering.
- Make sure that the wiring is correct by following all local and national codes.
- Do not modify or repair the unit.
- Do not open the unit as high voltages may present inside.
- Use caution to prevent any foreign objects from entering the housing.
- Do not use in wet locations or in areas where moisture or condensation can be expected.
- Do not touch during power-on, and immediately after power-off. Hot surface may cause burns.

Notes for use in hazardous location areas:

The DC/DC Converter 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 and are evaluated according to EN 60079-0 and EN 60079-15.

WARNING EXPLOSION HAZARDS!

Substitution of components may impair suitability for this environment. Do not disconnect the unit 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 60079-15.

3. INPUT VOLTAGE

Input voltage	nom.	DC 24V	
Input voltage range		18.0-32.4Vdc	full specified
		14.4-18.0Vdc	maximal 60 seconds or with de-rating see Fig. 3-2
	max.	36.0Vdc	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.	17.5Vdc	steady-state value, see Fig. 3-1
Shut-down voltage	typ.	14.0Vdc	steady-state value, see Fig. 3-1
	typ.	35.0Vdc	steady-state value, see Fig. 3-1
Input current	typ.	4.6A	at 24Vdc input and output 12V, 8A, see Fig. 3-4
Start-up delay	typ.	420ms	see Fig. 3-3
Rise time	typ.	210ms	0mF, 12V, constant current load 5A, see Fig. 3-3
	typ.	240ms	8mF, 12V, constant current load 5A, see Fig. 3-3
Turn-on overshoot	max.	500mV	see Fig. 3-3
Input capacitance	typ.	3 000µF	external capacitors on the input voltage bus are allowed without any limitations.

Fig. 3-1 **Input voltage range**

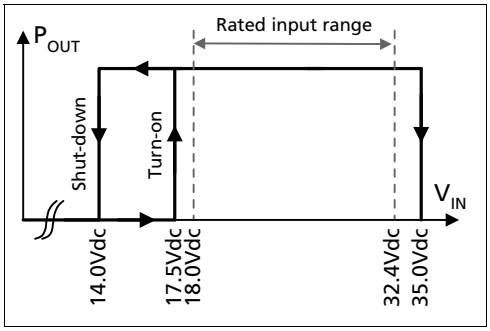


Fig. 3-2 **Allowable output current below 18V input voltage**

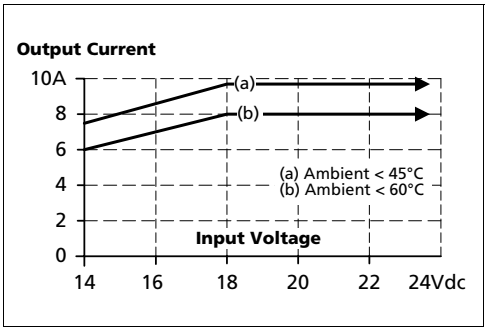


Fig. 3-3 **Turn-on behavior, definitions**

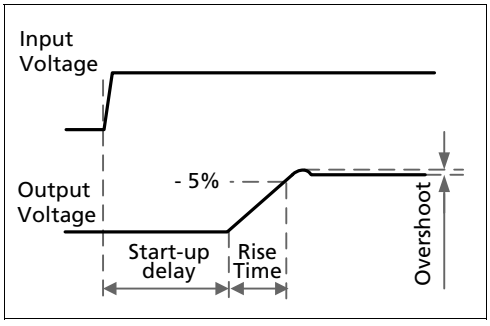
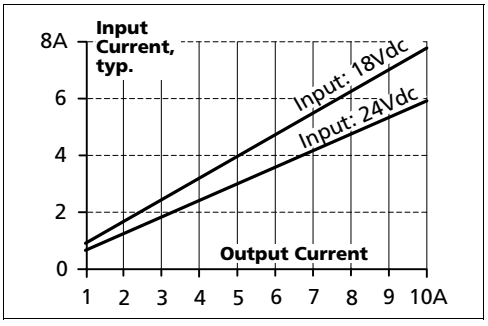


Fig. 3-4 **Input current vs. output load**



4. SOFT-START AND INPUT INRUSH CURRENT SURGE

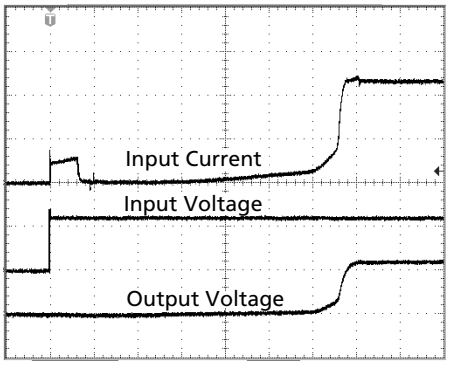
Inrush current limitation

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.	$1.6A_{peak}$	-25°C to +70°C, input: 24Vdc
	typ.	$1.2A_{peak}$	-25°C to +70°C, input: 24Vdc
Inrush energy	typ.	negligible	-25°C to +70°C, input: 24Vdc

Fig. 4-1 **Input inrush current, typical behavior**



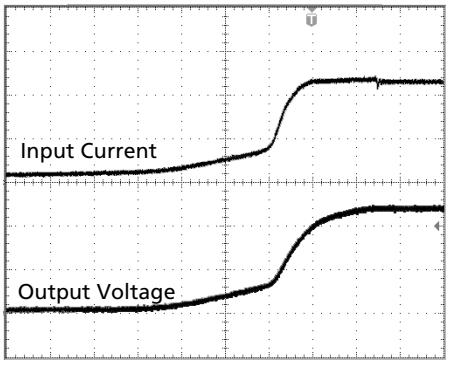
Input: 24Vdc
Output: 12V, 8A, constant current load
Ambient: 25°C

Upper curve: Input current 2A / DIV
Middle curve: Input voltage 20V / DIV
Lower curve: Output voltage 10V / 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: 24Vdc
Output: 12V, 8A, constant current load
Ambient: 25°C
No additional external output capacitors

Upper curve: Input current 2A / DIV
Lower curve: Output voltage 5V / DIV
Time basis: 20ms / DIV

5. OUTPUT

Output voltage	nom.	12V	
Adjustment range	min.	12-15V	guaranteed
	max.	16.1V	at clockwise end position of potentiometer
Factory setting		12.0V	±0.2%, at full load, cold unit
Line regulation	max.	25mV	Input voltage variations between 18 to 32.4Vdc
Load regulation	max.	120mV	static value, 0A → 8A
Ripple and noise voltage	max.	75mVpp	20Hz to 20MHz, 50Ohm
Output current	nom.	9.6A	at 12V, ambient < 45°C, see Fig. 5-1
	nom.	8A	at 12V, ambient < 60°C, see Fig. 5-1
	nom.	7.7A	at 15V, ambient < 45°C, see Fig. 5-1
	nom.	6.4A	at 15V, ambient < 60°C, see Fig. 5-1
Output power	nom.	115W	for ambient temperatures < 45°C
	nom.	96W	for ambient temperatures < 60°C
Short-circuit current	min.	14A	continuous current, short circuit impedance 150mOhm
	max.	18A	continuous current, short circuit impedance 150mOhm
Output capacitance	typ.	6 500µF	

Fig. 5-1 **Output voltage vs. output current at 24Vdc input voltage, typ.**

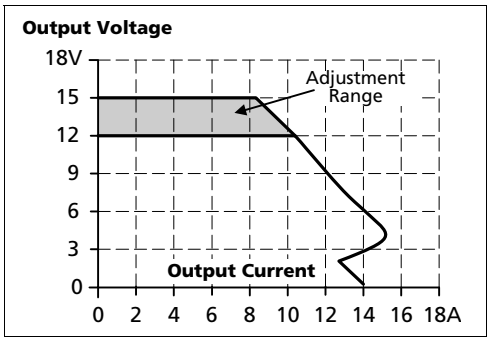
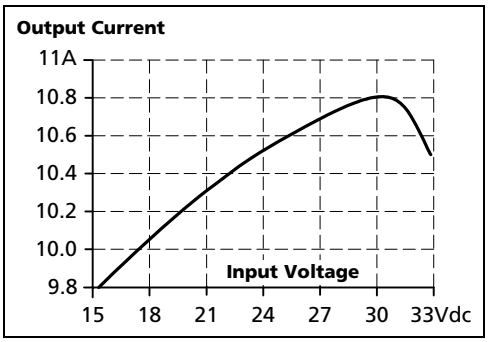


Fig. 5-2 **Current limitation vs. input voltage, (11.5V constant voltage load), typ.**



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 12V to 8.3V	at 16A for 50ms, resistive load
	typ.	from 12V to 6.2V	at 40A for 2ms, resistive load
	typ.	from 12V to 4.3V	at 40A 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.	12.8ms	input 24Vdc, output: 12Vdc, 4A, see Fig. 6-1
	typ.	7ms	input 24Vdc, output: 12Vdc, 8A, see Fig. 6-1

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

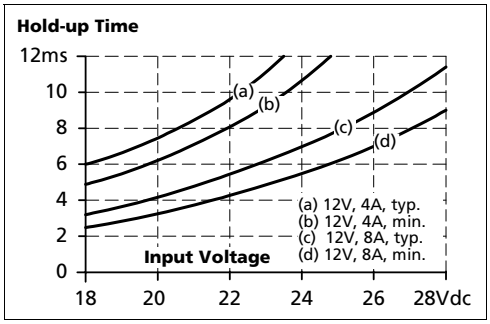


Fig. 6-2 **Shut-down test setup**

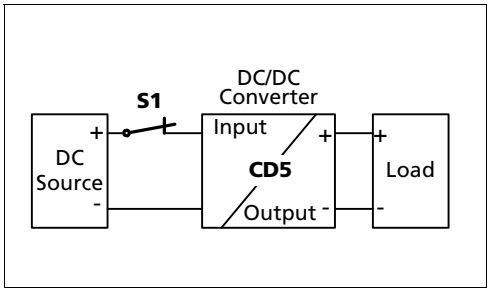
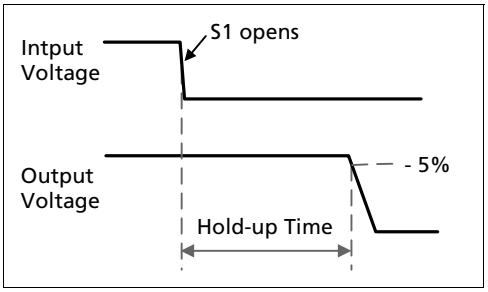


Fig. 6-3 **Shut-down behavior, definitions**



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

7. Efficiency and Power Losses

		Input 24Vdc	
Efficiency	typ.	88.2%	at 12V, 8A
Power losses	typ.	0.6W	at no output load
	typ.	6.4W	at 12V, 4A
	typ.	12.8W	at 12V, 8A
	typ.	16.8W	at 12V, 9.6A

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

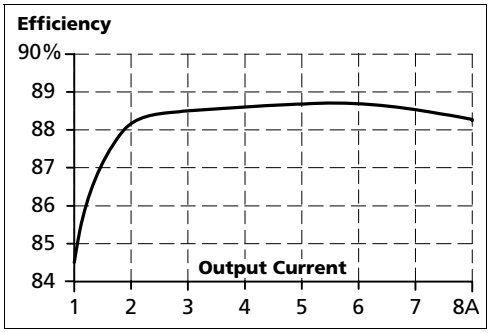


Fig. 7-2 **Losses vs. output current at 12V output and 24Vdc input voltage, typ.**

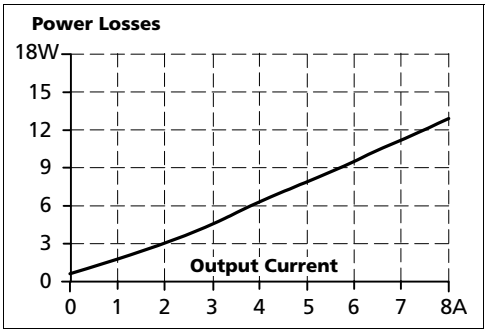


Fig. 7-3 **Efficiency vs. input voltage at 12V, 8A, typ.**

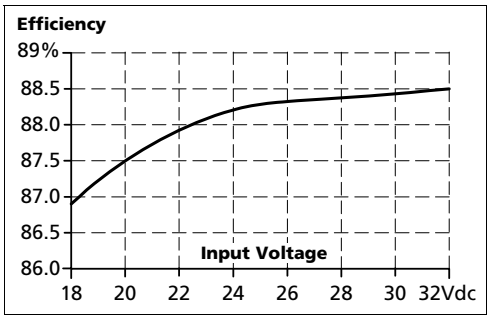
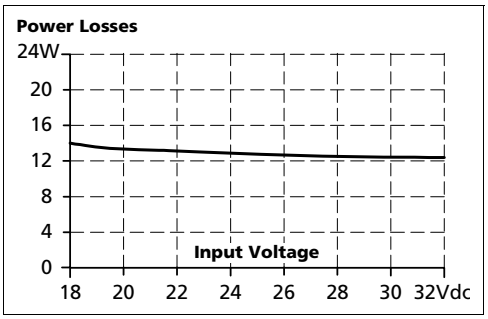
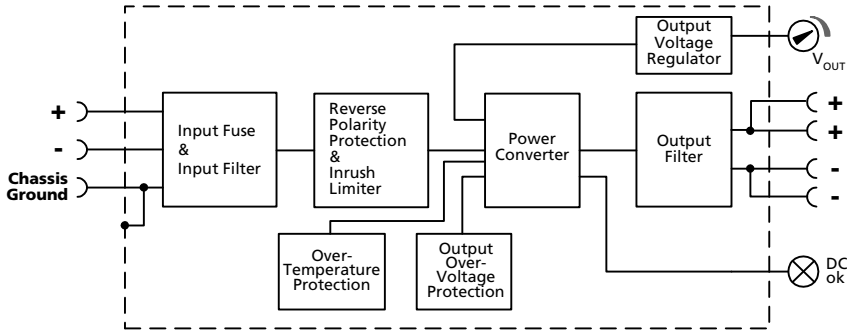


Fig. 7-4 **Losses vs. input voltage at 12V, 8A, typ.**



8. FUNCTIONAL DIAGRAM

Fig. 8-1 **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: 12.0V

D DC-OK LED (green)
On when the voltage on the output terminals is > 8.5V

10. TERMINALS AND WIRING

	Input	Output
Type	screw terminals	screw terminals
Solid wire	max. 6mm²	max. 6mm²
Stranded wire	max. 4mm²	max. 4mm²
American Wire Gauge	20-10 AWG	20-10 AWG
Wire stripping length	7mm / 0.275inch	7mm / 0.275inch
Screwdriver	3.5mm slotted or Pozidrive No 2	3.5mm slotted or 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 section 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. RELIABILITY

	Input 24Vdc	
Lifetime expectancy *)	173 000h	at 12V, 4A and 40°C
	63 000h	at 12V, 8A and 40°C
	35 000h	at 12V, 9.6A and 40°C
	179 000h	at 12V, 8A and 25°C
MTBF **) SN 29500, IEC 61709	1 161 000h	at 12V, 8A and 40°C
	1 904 000h	at 12V, 8A and 25°C
MTBF **) MIL HDBK 217F	610 000h	at 12V, 8A and 40°C; Ground Benign GB40
	817 000h	at 12V, 8A and 25°C; Ground Benign GB25

*) 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.

) **MTBF stands for **M**ean **T**ime **B**etween **F**ailure, 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.

12. 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.

EMC Immunity	Generic standards: EN 61000-6-1 and EN 61000-6-2			
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	10V/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	10V	Criterion A

Criterions:

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.

EMC Emission	Generic standards: EN 61000-6-3 and EN 61000-6-4	
Conducted emission	IEC/CISPR 16-1-2, IEC/CISPR 16-2-1	Class B, input lines (Limits for DC power ports)
Radiated emission	EN 55011, EN 55022	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 90kHz and 145kHz depending on load and input voltage (output current > 0.5A)

13. 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	1.25W/°C	45-60°C (113°F to 140°F)
	2.5W/°C	60-70°C (140°F to 158°F)
Humidity **)	5 to 95% r.H.	IEC 60068-2-30
Vibration sinusoidal ***)	2-17.8Hz: ±1.6mm; 17.8-500Hz: 2g 2 hours / axis	IEC 60068-2-6
Shock ***)	30g 6ms, 20g 11ms 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
LABS compatibility	The unit does not release any silicone or other LABS-critical substances and is suitable for use in paint shops.	

*) Operational temperature is the same as the ambient 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.**

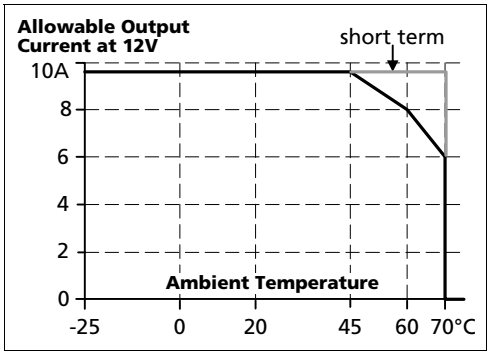
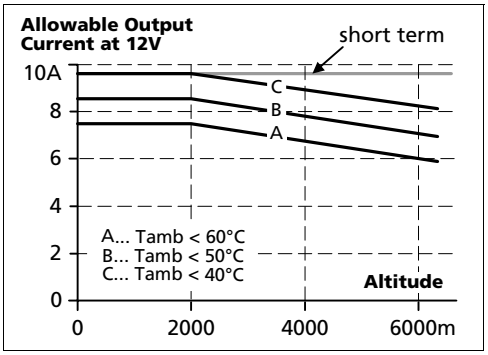


Fig. 13-2 **Output current vs. altitude at 24V**



14. PROTECTION FEATURES

Output protection	Electronically protected against overload, no-load and short-circuits *)	
Output over-voltage protection	typ. 16.5Vdc max. 16.8Vdc	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.

15. SAFETY FEATURES

Classification of output voltage	SELV	IEC/EN 60950-1
	PELV	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	> 5MOhm	input to output, 500Vdc
PE resistance	< 0.1Ohm	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. For a smooth DC input voltage, the produced leakage current is less than 100µA.	

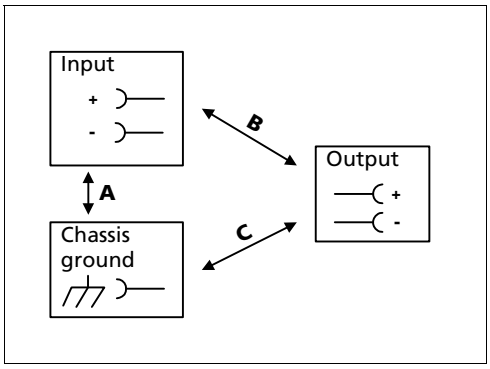
*) provided, that the input voltage meets the requirements of chapter 2.

16. 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 phase-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**



		A	B	C
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.

17. APPROVALS

EC Declaration of Conformity	CE	The CE mark indicates conformance with the - EMC directive and the - ATEX directive.
IEC 60950-1 2nd Edition	IECEE CB SCHEME	CB Scheme, Information Technology Equipment
UL 508	c UL US LISTED IND. CONT. EQ.	LISTED for use as Industrial Control Equipment; U.S.A. (UL 508) and Canada (C22.2 No. 107-1-01); E-File: E198865
UL 60950-1	c UL us	RECOGNIZED for the use as Information Technology Equipment, Level 3; U.S.A. (UL 60950-1) and Canada (C22.2 No. 60950-1); E-File: E137006
EN 60079-0, EN 60079-15 ATEX	Ex II 3G Ex nA nC II T4 Gc	Approval for use in hazardous locations Zone 2 Category 3G. Number of ATEX certificate: EPS 08 ATEX 1 142 X The device must be built-in in an IP54 enclosure.
IEC 60079-0, IEC 60079-15	IECEx	Suitable for use in Class 1 Zone 2 Groups IIa, IIb and IIc locations. Number of IECEx certificate: IECEx EPS 14.0001X
ANSI / ISA 12.12.01-2007 Class I Div 2	SP C US	Recognized for use in Hazardous Location Class I Div 2 T4 Groups A,B,C,D systems; U.S.A. (ANSI / ISA 12.12.01) and Canada (C22.2 No. 213-M1987)
Marine	GL ABS	GL (Germanischer Lloyd) classified and ABS (American Bureau for Shipping) PDA Environmental category: C, EMC2 Marine and offshore applications
EAC TR Registration	EAC	Registration for the Eurasian Customs Union market (Russia, Kazakhstan, Belarus)

18. ROHS, REACH AND OTHER FULFILLED STANDARDS

RoHS Directive	RoHS ✓	Directive 2011/65/EU of the European Parliament and the Council of June 8th, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.
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)

19. Physical Dimensions and Weight

Weight	425g / 0.94lb
DIN-Rail	Use 35mm DIN-rails according to EN 60715 or EN 50022 with a height of 7.5 or 15mm. The DIN-rail height 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**

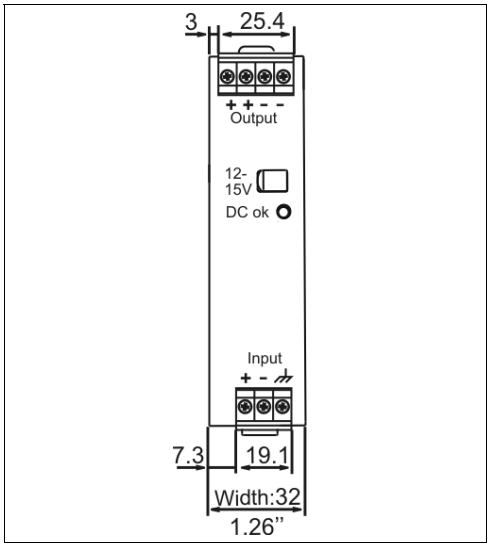
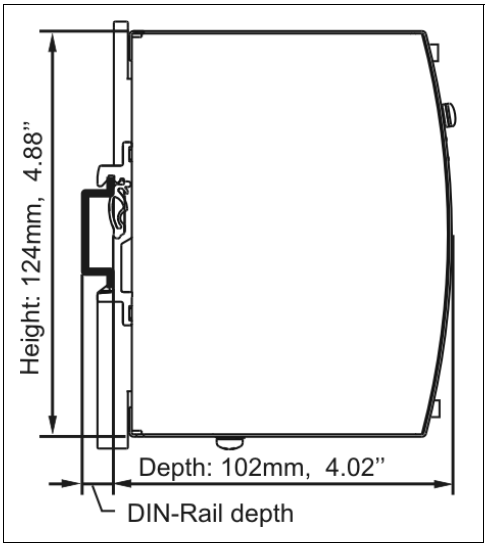


Fig. 19-2 **Side view**



20. ACCESSORIES

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. 20-1 **ZM1.WALL Wall mounting bracket**

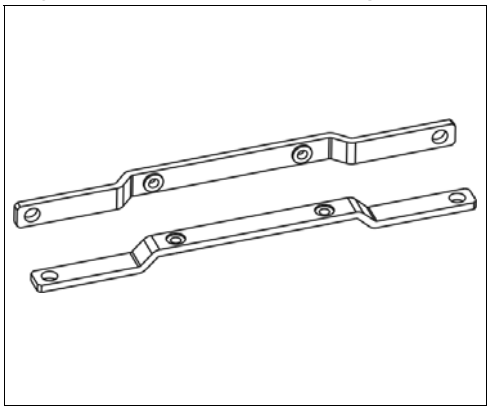
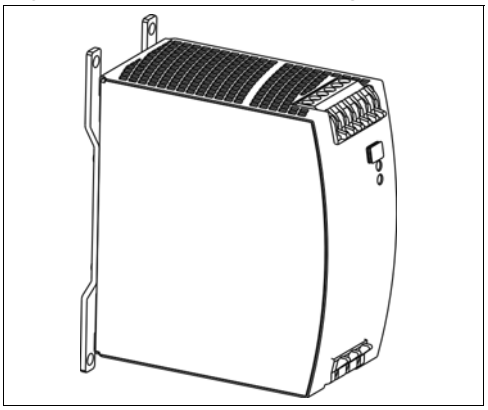


Fig. 20-2 **Assembled wall mounting bracket *)**



*) Picture of the DC/DC converter is for representation only

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

Fig. 20-3
ZM11.SIDE Side mounting bracket *)

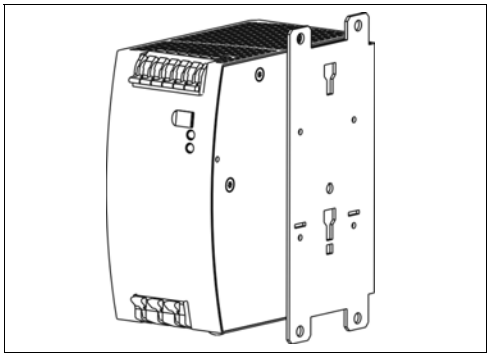
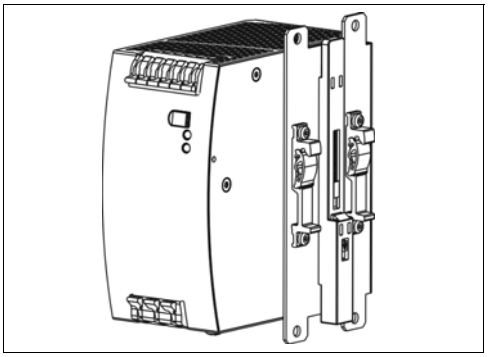


Fig. 20-4
Side mounting with DIN-rail brackets *)



*) Picture of the DC/DC converter is for representation only

21. Application Notes

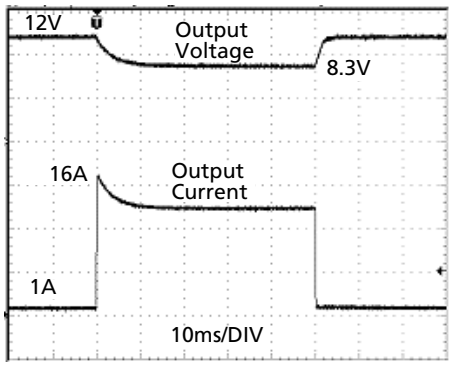
21.1. Peak Current Capability

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.

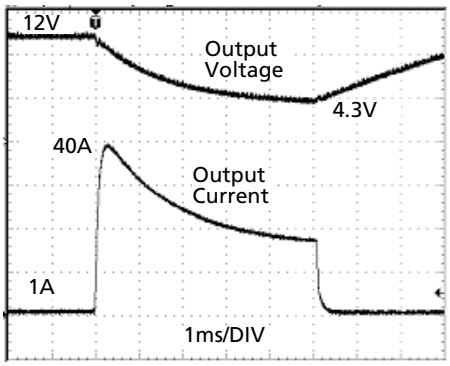
Assuming the input voltage is turned on before such an event, the built-in large sized output capacitors inside the DC/DC converter can deliver extra current. Discharging this capacitor causes a voltage dip on the output. The following two examples show typical voltage dips:

Fig. 21-1 **Peak loading with 2x the nominal current for 50ms, typ.**



Peak load 16A (resistive load) for 50ms
Output voltage dips from 12V to 8.3V.

Fig. 21-2 **Peak loading with 5x the nominal current for 5ms, typ.**



Peak load 40A (resistive load) for 5ms
Output voltage dips from 12V to 4.3V.

21.2. 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 16Vdc. The absorbing energy can be calculated according to the built-in large sized output capacitance which is specified in chapter 5.

21.3. Inductive and Capacitive Loads

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

21.4. Charging of Batteries

The DC/DC converter can be used to charge lead-acid or maintenance free 12V VRLA batteries.

Instructions for charging batteries:

a) Ensure that the ambient temperature of the DC/DC converter is below 45°C

b) 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).

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	13.9V	13.75V	13.6V	13.4V
Battery temperature	10°C	20°C	30°C	40°C

d) Use a 10A circuit breaker (or blocking diode) between the DC/DC converter and the battery.

e) Ensure that the output current of the DC/DC converter is below the allowed charging current of the battery.

f) The return current to the DC/DC converter (battery discharge current) is typ. 15mA when the DC/DC converter is switched off (except in case a blocking diode is utilized).

21.5. External Input Protection

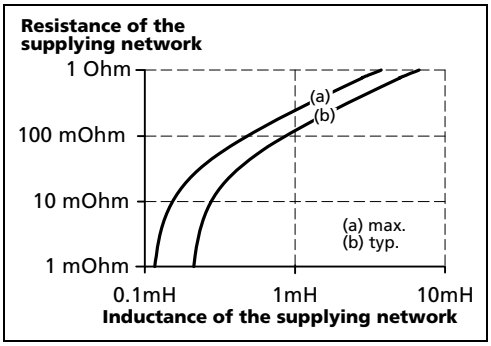
The unit is tested and approved for branch circuits up to 50A. An external protection is only required, if the supplying branch has an ampacity greater than this. Check also local codes and local requirements. In some countries local regulations might apply.

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 10A B- or 8A C-Characteristic breaker should be used.

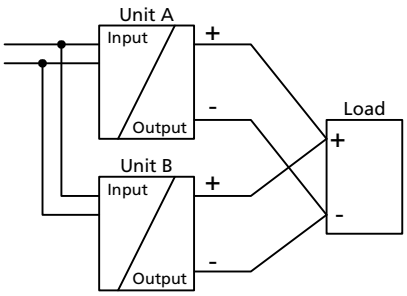
21.6. Requirements for the Supplying Source

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. 21-3.

Fig. 21-3 **External input filter requirements to avoid filter instabilities**



21.7. 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 CD5.121 can also be paralleled with power supplies from the QS10.121 from the DIMENSION QS-series. For other power supplies consult PULS.

The output voltages of all DC/DC-converters shall be adjusted to the same value (±100mV) 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 one 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).

21.8. 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. six DC/DC converters, each rated for 8A are paralleled to build a 40A 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 YR2.DIODE.

Recommendations for building redundant power systems:

a) Use separate input fuses for each DC/DC-converter.

b) Monitor the individual DC/DC-converter units.

c) 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

d) It is desirable to set the output voltages of all units to the same value (± 100mV) or leave it at the factory setting.

21.9. 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. 21-4 Daisy chaining of outputs

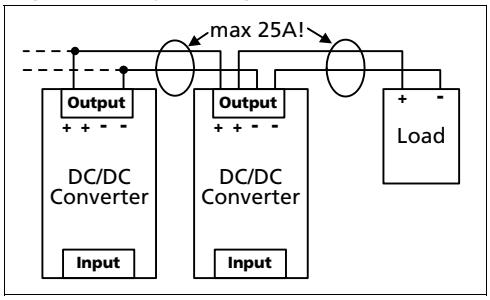
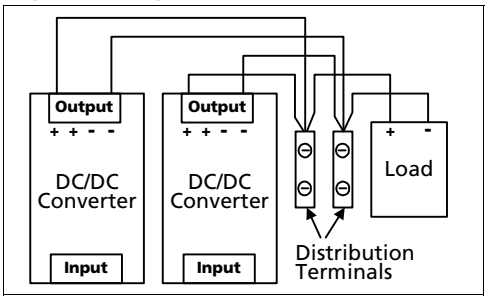
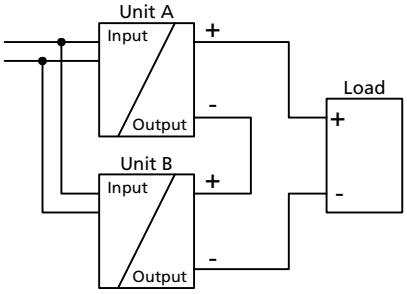


Fig. 21-5 Using distribution terminals



21.10. 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).

21.11. 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:	12V, 6.4A; (=80%) load is placed outside the box
Input:	24Vdc
Temperature inside enclosure:	48.0°C (in the middle of the right side of the DC/DC converter with a distance of 2cm)
Temperature outside enclosure:	22.6°C
Temperature rise:	25.4K

21.12. 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. 21-6
Mounting Orientation A
(Standard orientation)

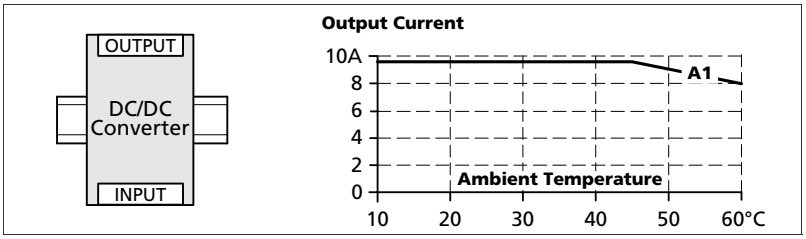


Fig. 21-7
Mounting Orientation B
(Upside down)

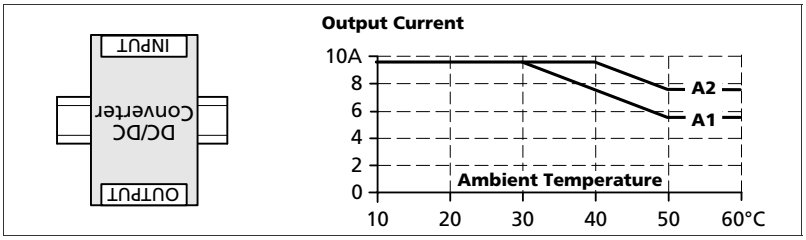


Fig. 21-8
Mounting Orientation C
(Table-top mounting)

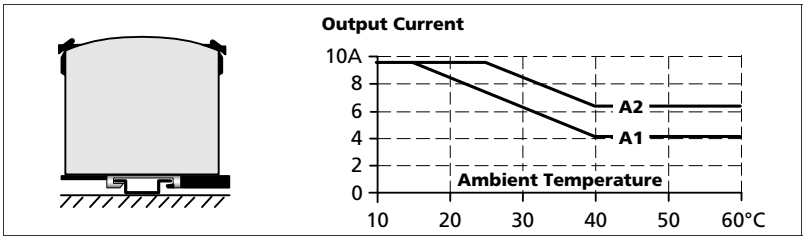


Fig. 21-9
Mounting Orientation D
(Horizontal cw)

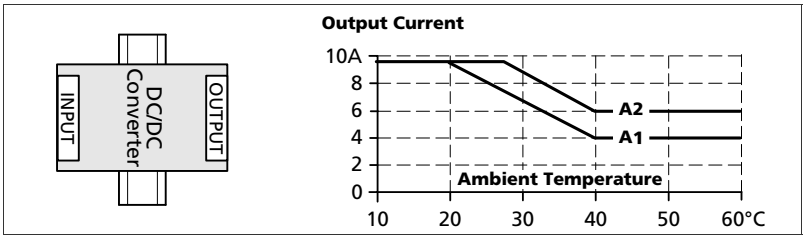
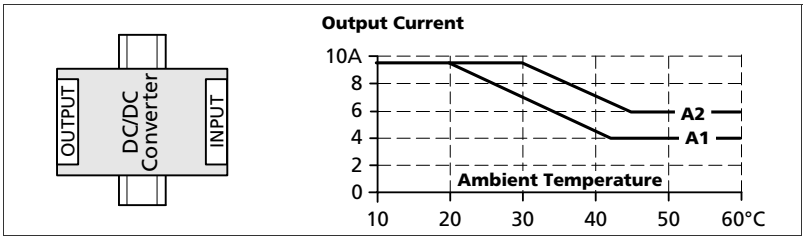


Fig. 21-10
Mounting Orientation E
(Horizontal ccw)



CD5.243

DC/DC Converter 24V, 4A

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

General Description

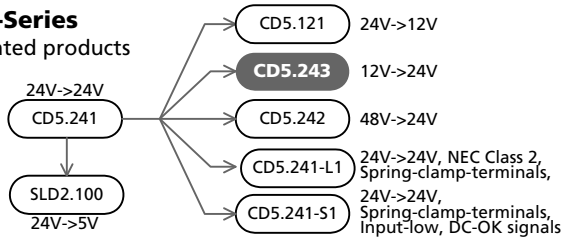
The Dimension CD-Series offer DIN-rail DC/DC converters in the 92-120W output power range in a very compact housing. These DC/DC converters are allowed to run with a battery or similar sources.

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.

CD-Series
Related products



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
Input current	typ. 9.2A	at 12Vdc input
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	**CD5.243**	Standard unit
Accessory	ZM1.WALL	Wall mount bracket
	ZM11.SIDE	Side mount bracket
	YRM2.DIODE	Redundancy module

Markings

c UL us LISTED
Ind. Cont. Eq. UL 508

c TÜV us
UL 60950-1

CE
EMC, ATEX

c SP us
Class I Div 2

IECEx Ex ATEX
II 3G Ex nA nC II T4 Gc

GL
Marine

INDEX

TERMINOLOGY AND ABREVIATIONS

PE and ⏚ symbol	PE is the abbreviation for **P**rotective **E**arth 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 24V	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)
24Vdc	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 the general use such as in industrial control, office, communication, and instrumentation equipment.

Do not use this DC/DC converter in equipment where malfunction may cause severe personal injury or threaten human life.

2. 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 (if included) 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.

Mount the unit on a DIN-rail so that the output terminals are located on top and input terminal on the bottom. For other mounting orientations see de-rating requirements in this document.

This device is designed for convection cooling and does not require an external fan. Do not obstruct airflow and do not cover ventilation grid (e.g. cable conduits) by more than 30%!

Keep the following installation clearances: 40mm on top, 20mm on the bottom, 5mm on the left and right sides are recommended when the device is loaded permanently with more than 50% of the rated power. Increase this clearance to 15mm in case the adjacent device is a heat source (e.g. another DC/DC converter).

The input must be powered from a SELV source (according to IEC 60950-1), a PELV source (according to IEC 62477-1) or an Isolated Secondary Circuit (according to UL 508).

⚠ WARNING Risk of electrical shock, fire, personal injury or death.

- Do not use the DC/DC converter without proper grounding (Protective Earth). Use the terminal on the input block for earth connection and not one of the screws on the housing.
- Turn power off before working on the device. Protect against inadvertent re-powering.
- Make sure that the wiring is correct by following all local and national codes.
- Do not modify or repair the unit.
- Do not open the unit as high voltages may present inside.
- Use caution to prevent any foreign objects from entering the housing.
- Do not use in wet locations or in areas where moisture or condensation can be expected.
- Do not touch during power-on, and immediately after power-off. Hot surface may cause burns.

Notes for use in hazardous location areas:

The DC/DC Converter 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 and are evaluated according to EN 60079-0 and EN 60079-15.

WARNING EXPLOSION HAZARDS!

Substitution of components may impair suitability for this environment. Do not disconnect the unit 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 60079-15.

3. INPUT VOLTAGE

Input voltage	nom.	DC 12V	
Input voltage range		10.8-16.2Vdc	full specified, see Fig. 3-2 for derating below 10.8Vdc
		8.4-10.8Vdc	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**

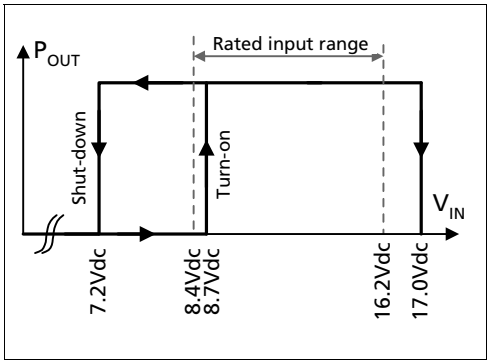


Fig. 3-2 **Allowable output current below 10.8V input voltage**

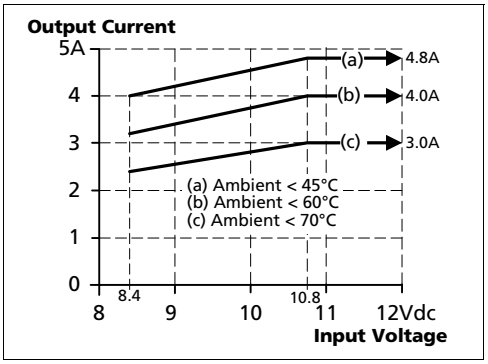


Fig. 3-3 **Turn-on behavior, definitions**

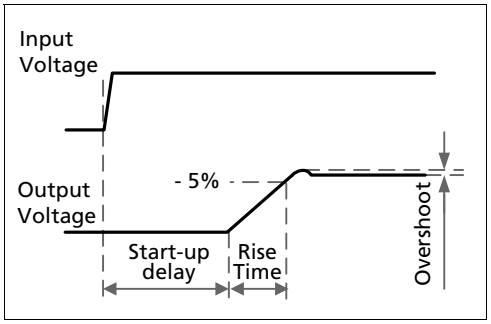
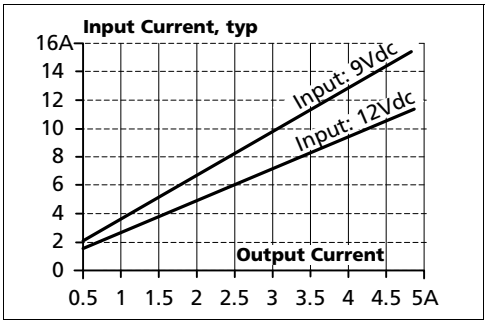


Fig. 3-4 **Input current vs. output load**



4. SOFT-START AND INPUT INRUSH CURRENT SURGE

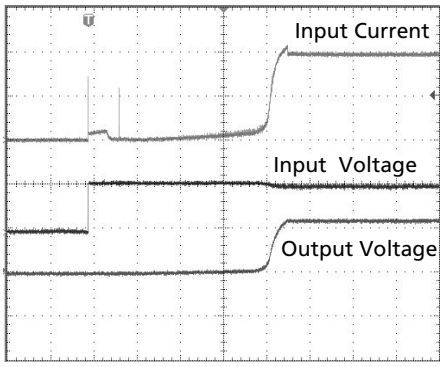
Inrush current limitation

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.	$1.3A_{peak}$	-25°C to +70°C, input: 12Vdc
	typ.	$1.0A_{peak}$	-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**



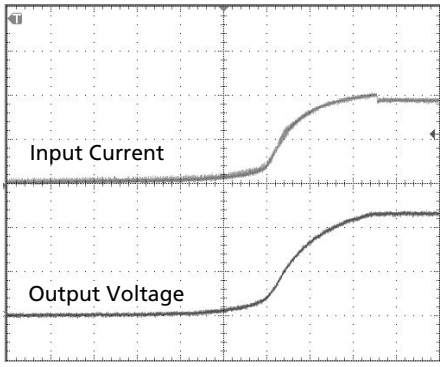
Input: 12Vdc
Output: 24V, 4A, constant current load
Ambient: 25°C

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	min.	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. Derate linearely 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.**

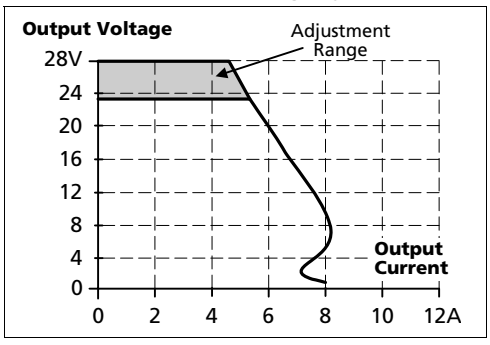
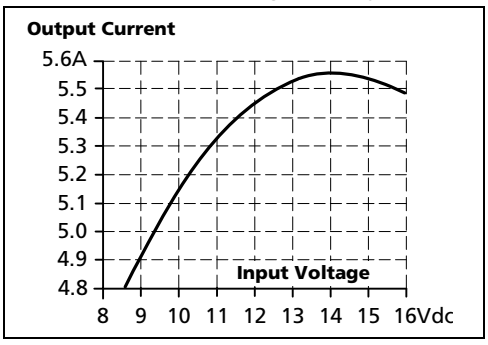


Fig. 5-2 **Current limitation vs. input voltage, (23V constant voltage load), typ.**



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**

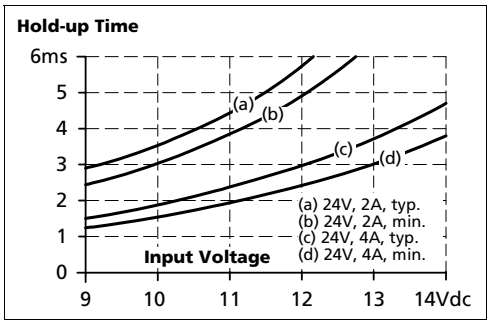


Fig. 6-2 **Shut-down test setup**

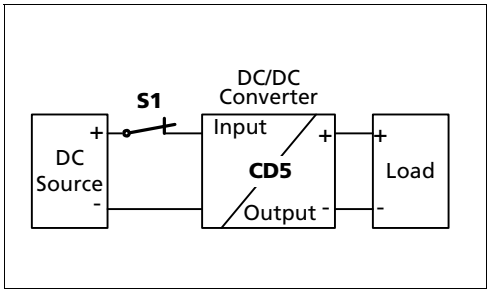
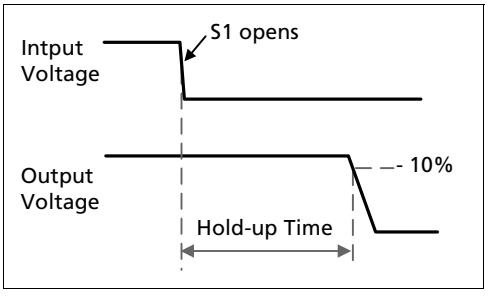


Fig. 6-3 **Shut-down behavior, definitions**



Note: At no load, the hold-up time can be up to several seconds. The green DC-ok lamp 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.**

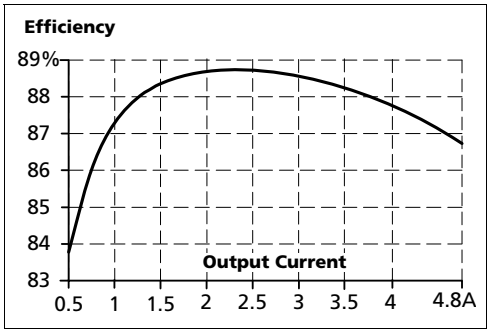


Fig. 7-2 **Losses vs. output current at 24V output and 12Vdc input voltage, typ.**

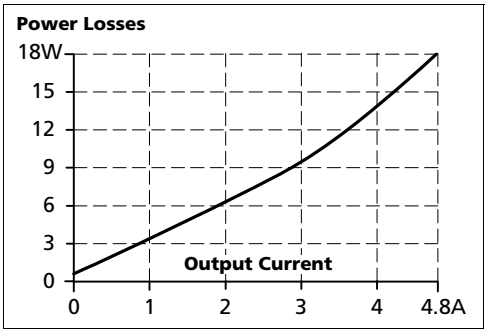


Fig. 7-3 **Efficiency vs. input voltage at 24V, 4A, typ.**

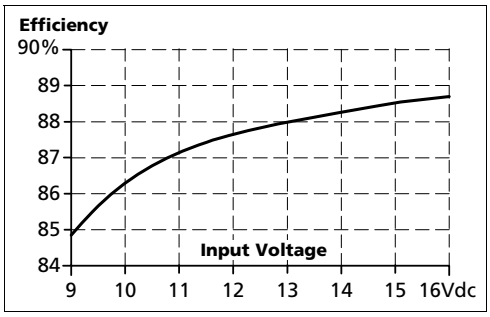
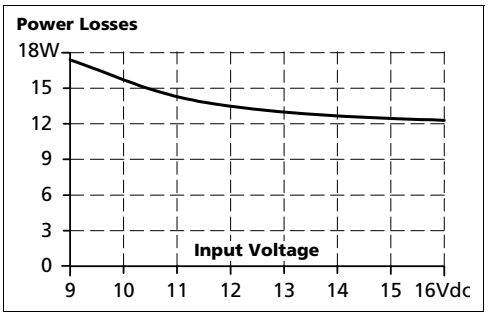
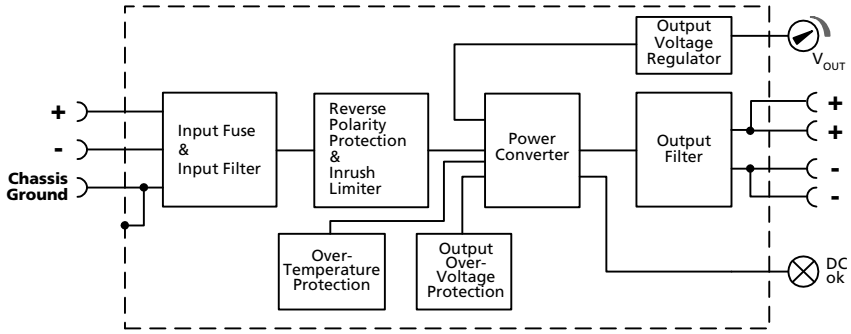


Fig. 7-4 **Losses vs. input voltage at 24V, 4A, typ.**



8. FUNCTIONAL DIAGRAM

Fig. 8-1 **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

	Input	Output
Type	screw terminals	screw terminals
Solid wire	max. 6mm²	max. 6mm²
Stranded wire	max. 4mm²	max. 4mm²
American Wire Gauge	20-10 AWG	20-10 AWG
Wire stripping length	7mm / 0.275inch	7mm / 0.275inch
Screwdriver	3.5mm slotted or Pozidrive No 2	3.5mm slotted or 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 section 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. RELIABILITY

	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
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

*) 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.

) **MTBF stands for **M**ean **T**ime **B**etween **F**ailure, 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.

12. 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.

EMC Immunity	Generic standards: EN 61000-6-1 and EN 61000-6-2			
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	10V/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	10V	Criterion A

Criterions:

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.

EMC Emission	Generic standards: EN 61000-6-3 and EN 61000-6-4	
Conducted emission	IEC/CISPR 16-1-2, IEC/CISPR 16-2-1	Class B, input lines (Limits for DC power ports)
Radiated emission	EN 55011, EN 55022	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)

13. 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 2 hours / axis	IEC 60068-2-6
Shock ***)	30g 6ms, 20g 11ms 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
LABS compatibility	The unit does not release any silicone or other LABS-critical substances and is suitable for use in paint shops.	

*) Operational temperature is the same as the ambient 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.**

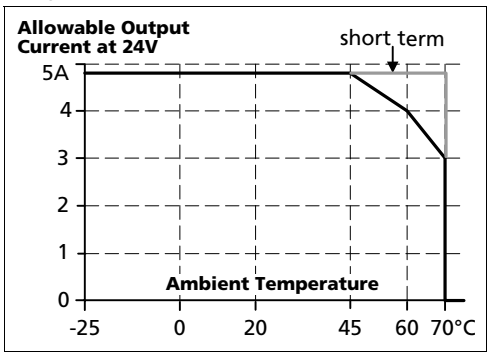
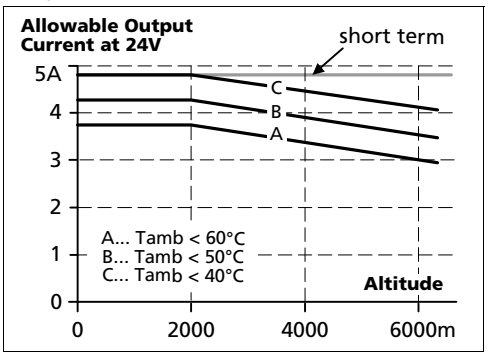


Fig. 13-2 **Output current vs. altitude at 24V**



14. PROTECTION FEATURES

Output protection	Electronically protected against overload, no-load and short-circuits *)	
Output over-voltage protection	typ. 31Vdc 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.

15. SAFETY FEATURES

Classification of output voltage	SELV	IEC/EN 60950-1
	PELV	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	> 5MOhm	input to output, 500Vdc
PE resistance	< 0.1Ohm	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. For a smooth DC input voltage, the produced leakage current is less than 100µA.	

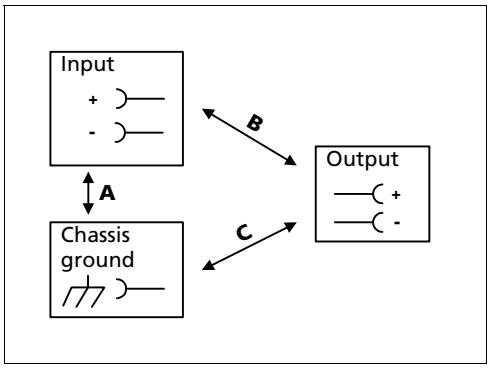
*) provided, that the input voltage meets the requirements of chapter 2.

16. 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 phase-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**



		A	B	C
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.

17. APPROVALS

EC Declaration of Conformity	CE	The CE mark indicates conformance with the - EMC directive and the - ATEX directive.
IEC 60950-1 2nd Edition	IECEE CB SCHEME	CB Scheme, Information Technology Equipment
UL 508	c UL US LISTED IND. CONT. EQ.	LISTED for use as Industrial Control Equipment; U.S.A. (UL 508) and Canada (C22.2 No. 107-1-01); E-File: E198865
UL 60950-1	c UL us	RECOGNIZED for the use as Information Technology Equipment, Level 3; U.S.A. (UL 60950-1) and Canada (C22.2 No. 60950-1); E-File: E137006
EN 60079-0, EN 60079-15 ATEX	Ex II 3G Ex nA nC II T4 Gc	Approval for use in hazardous locations Zone 2 Category 3G. Number of ATEX certificate: EPS 08 ATEX 1 142 X The device must be built-in in an IP54 enclosure.
IEC 60079-0, IEC 60079-15	IECEx	Suitable for use in Class 1 Zone 2 Groups IIa, IIb and IIc locations. Number of IECEx certificate: IECEx EPS 14.0001X
ANSI / ISA 12.12.01-2007 Class I Div 2	SP C US	Recognized for use in Hazardous Location Class I Div 2 T4 Groups A,B,C,D systems; U.S.A. (ANSI / ISA 12.12.01) and Canada (C22.2 No. 213-M1987)
Marine	GL ABS	GL (Germanischer Lloyd) classified and ABS (American Bureau for Shipping) PDA Environmental category: C, EMC2 Marine and offshore applications
EAC TR Registration	EAC	Registration for the Eurasian Customs Union market (Russia, Kazakhstan, Belarus)

18. ROHS, REACH AND OTHER FULFILLED STANDARDS

RoHS Directive	RoHS ✓	Directive 2011/65/EU of the European Parliament and the Council of June 8th, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.
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)

19. 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 height 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**

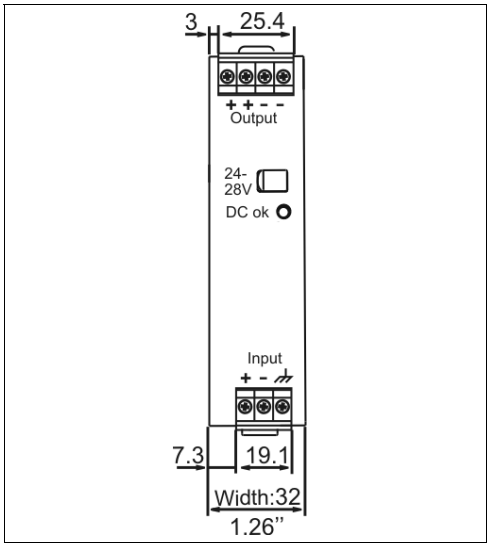
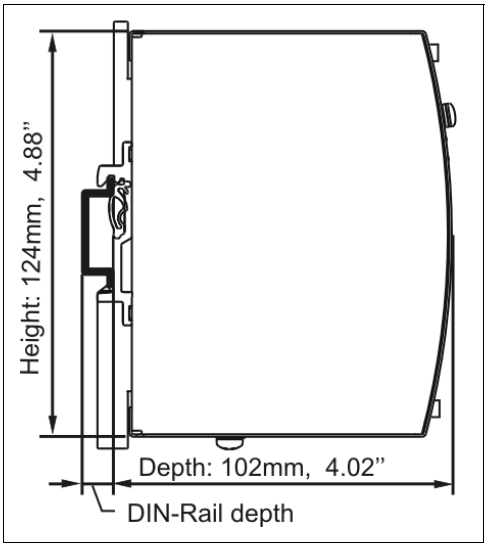


Fig. 19-2 **Side view**



20. ACCESSORIES

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. 20-1 **ZM1.WALL Wall mounting bracket**

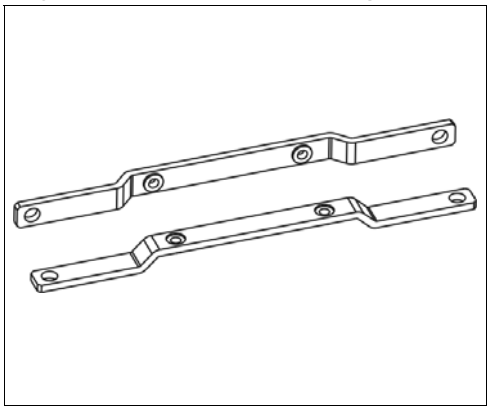
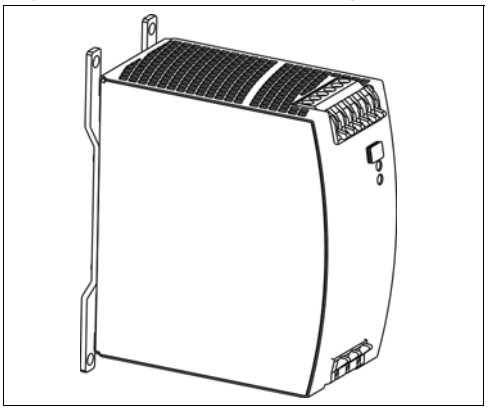


Fig. 20-2 **Assembled wall mounting bracket *)**



*) Picture of the DC/DC converter is for representation only

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

Fig. 20-3
ZM11.SIDE Side mounting bracket *)

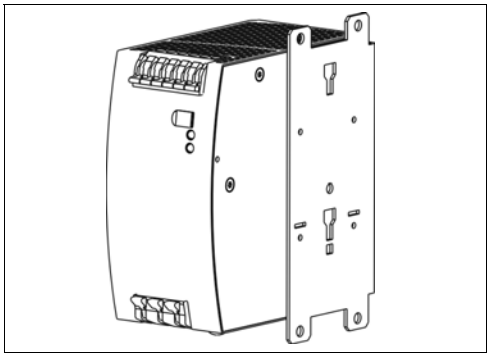
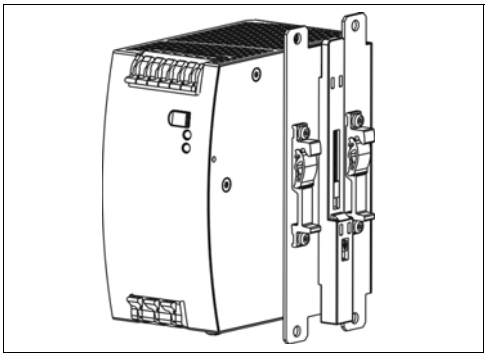


Fig. 20-4
Side mounting with DIN-rail brackets *)



*) Picture of the DC/DC converter is for representation only

21. Application Notes

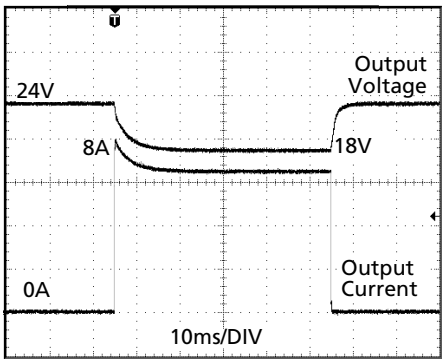
21.1. Peak Current Capability

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.

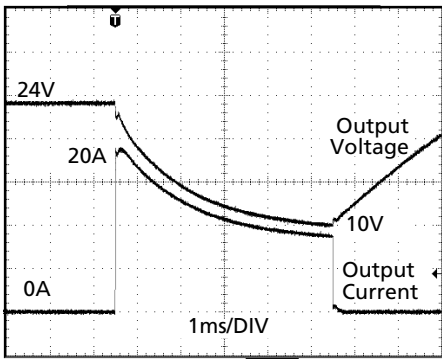
Assuming the input voltage is turned on before such an event, the built-in large sized output capacitors inside the DC/DC converter can deliver extra current. Discharging this capacitor causes a voltage dip on the output. The following two examples show typical voltage dips:

Fig. 21-1 **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. 21-2 **Peak loading with 5x the nominal current for 5ms, typ.**



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

21.2. 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.

21.3. Inductive and Capacitive Loads

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

21.4. 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:

a) Ensure that the ambient temperature of the DC/DC converter is below 45°C

b) 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).

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

d) Use a 6A or 10A circuit breaker (or blocking diode) between the DC/DC converter and the battery.

e) Ensure that the output current of the DC/DC converter is below the allowed charging current of the battery.

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

g) 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).

21.5. External Input Protection

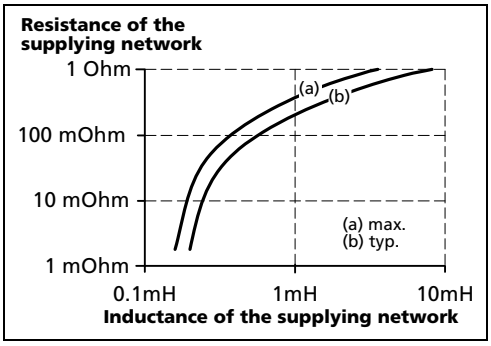
The unit is tested and approved for branch circuits up to 50A. An external protection is only required, if the supplying branch has an ampacity greater than this. Check also local codes and local requirements. In some countries local regulations might apply.

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.

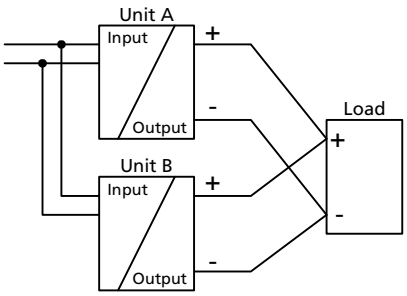
21.6. Requirements for the Supplying Source

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. 21-3.

Fig. 21-3 **External input filter requirements to avoid filter instabilities**



21.7. 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 (±100mV) 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).

21.8. 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:

a) Use separate input fuses for each DC/DC converter.

b) Monitor the individual DC/DC converter units. A DC-ok lamp and a DC-ok contact is included in the redundancy module YRM2.DIODE. This feature reports a faulty unit.

c) 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

d) It is desirable to set the output voltages of all units to the same value (± 100mV) or leave it at the factory setting.

21.9. 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. 21-4 Daisy chaining of outputs

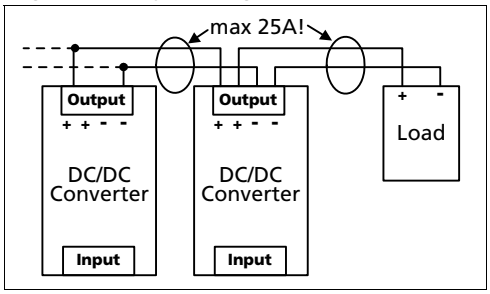
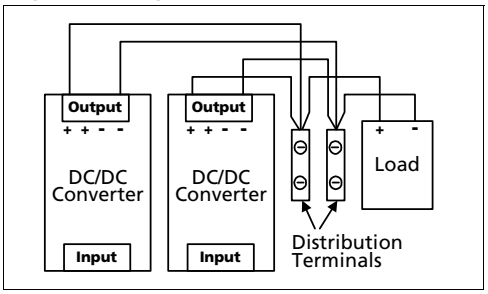
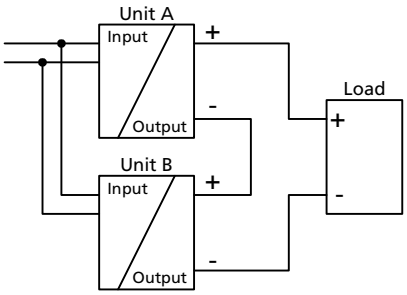


Fig. 21-5 Using distribution terminals



21.10. 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).

21.11. 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

21.12. 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. 21-6
Mounting Orientation A
(Standard orientation)

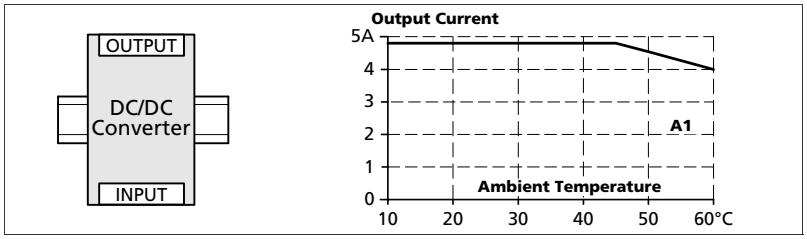


Fig. 21-7
Mounting Orientation B
(Upside down)

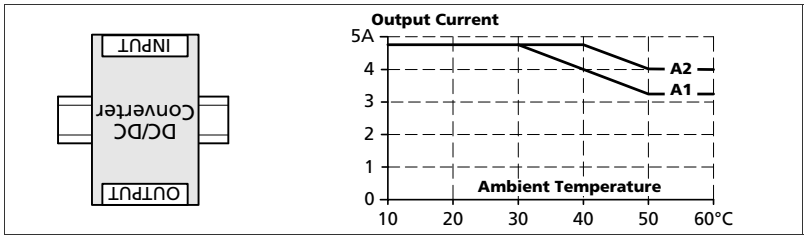


Fig. 21-8
Mounting Orientation C
(Table-top mounting)

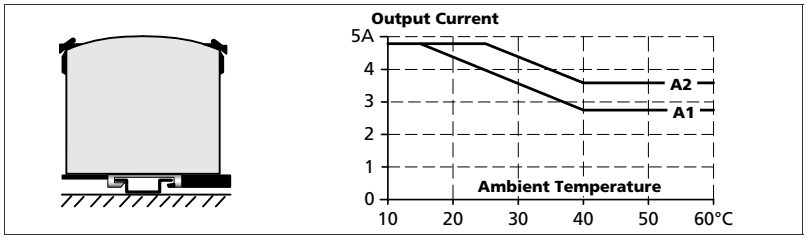


Fig. 21-9
Mounting Orientation D
(Horizontal cw)

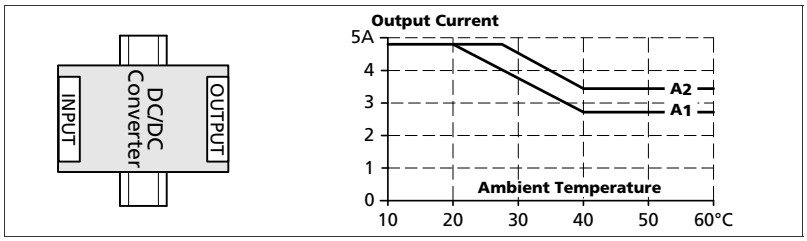


Fig. 21-10
Mounting Orientation E
(Horizontal ccw)