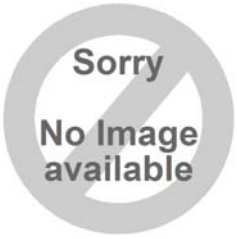
PRELIMINARY

CP10.241-R1, CP10.241-R2, CP10.241-R3

DIMENSION **CP-Series**

24V, 10A, SINGLE PHASE INPUT



REDUNDANCY POWER SUPPLY

- AC 100-240V Wide-range Input
- Width only 39mm
- Built-in Decoupling Mosfet for 1+1 and n+1 Redundancy
- Efficiency up to 94.7%
- 20% Output Power Reserves
- Safe Hiccup^{PLUS} Overload Mode
- Easy Fuse Breaking – 3 times nominal current for 12ms
- Active Power Factor Correction (PFC)
- Minimal Inrush Current Surge
- Full Power Between -25°C and +60°C
- Current Sharing Feature Included
- DC-OK Relay Contact
- 3 Year Warranty

GENERAL DESCRIPTION

The CP-Series, part of the DIMENSION power supply family are cost optimized without compromising quality, reliability and performance.

The CP10.241-Rx units include a decoupling MOSFET for building 1+1 or n+1 redundant power supply systems without the need of external redundancy modules.

These redundancy power supplies come with three connection terminal options; screw terminals, spring-clamp terminals or plug connector terminals which allows replacement on an active application.

The most outstanding features of these units are high efficiency, electronic inrush current limitation, active PFC and the wide operational temperature range.

The devices also have a power reserve of 20% included, which may even be used continuously at temperatures up to +45°C. Additionally, they can deliver 3 times the nominal output current for 12ms which helps to trip fuses on faulty output branches.

With high immunity to transients and power surges, low electromagnetic emission, a DC-OK signal contact for remote monitoring, and a large international approval package, makes this unit suitable for nearly every application.

SHORT-FORM DATA

Output voltage	DC 24V	0%/+6%
Adjustment range	-	
Output current	12A	Below +45°C ambient
	10A	At +60°C ambient
	7.5A	At +70°C ambient
Output ripple	max. 50mVpp	20Hz to 20MHz
AC Input voltage	AC 100-240V	-15%/+10%
Mains frequency	50-60Hz	±6%
AC Input current	2.17 / 1.14A	At 120 / 230Vac
Power factor	0.99 / 0.97	At 120 / 230Vac
AC Inrush current	6 / 9Apk	At 120 / 230Vac
Efficiency	93.0 / 94.7%	At 120 / 230Vac
Losses	18.1 / 13.4W	At 120 / 230Vac
Temperature range	-25°C to +70°C	
Hold-up time	37ms	
Size (w x h x d)	39x124x117mm	Without DIN-rail and plug connectors
Weight	600g / 1.32lb	

ORDER NUMBERS

Power Supply	**CP10.241-R2**	With plug connectors, hot swappable (preferred inventory item)
	CP10.241-R1	With quick-connect spring-clamp terminals
	CP10.241-R3	With screw terminals
Accessory	ZM4.WALL	Wall/panel mount bracket
	ZM12.SIDE	Side mount bracket

MARKINGS

c UL US LISTED IND. CONT. EQ. UL 508, planned

c UL US UL 60950-1, planned

CE

c SP US Class I Div 2, planned

IECEx ATEX II 3G Ex ec nC II T4 Gc planned

All parameters are typical values specified at 10A, 230Vac, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.

INDEX

Page

1. Intended Use 4
2. Installation Requirements....4
3. AC-Input....5
4. DC-Input....6
5. Input Inrush Current 6
6. Output 7
7. Hold-up Time....8
8. DC-OK Relay Contact 9
9. Efficiency and Power Losses....10
10. Lifetime Expectancy 11
11. MTBF....11
12. Functional Diagram....12
13. Terminals and Wiring....13
14. Replacing Units while the System is Running ..14
15. Front Side and User Elements....15
16. EMC....16
17. Environment....17
18. Protection Features 18
19. Safety Features....18
20. Dielectric Strength 19
21. Approvals....20
22. RoHS, REACH and Other Fulfilled Standards .. 20
23. Physical Dimensions and Weight 21
24. Accessories 23
    24.1. ZM4.WALL – Wall/Panel Mount Bracket .23
    24.2. ZM12.SIDE - Side Mounting Bracket....24
25. Application Notes.... 25
    25.1. Peak Current Capability 25
    25.2. Adjusting the Output Voltage....26
    25.3. Charging of Batteries 26
    25.4. Back-feeding Loads 26
    25.5. External Input Protection....27
    25.6. Output Circuit Breakers....27
    25.7. Series Operation 28
    25.8. Parallel Use to Increase Output Power....28
    25.9. Parallel Use for Redundancy 29
    25.10. Inductive and Capacitive Loads....30
    25.11. Operation on Two Phases 30
    25.12. Use in a Tightly Sealed Enclosure 30
    25.13. Mounting Orientations 31

TERMINOLOGY AND ABREVIATIONS

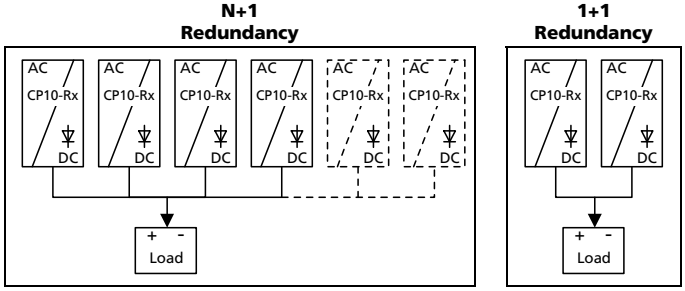
PE and ⏚ symbol	PE is the abbreviation for **P**rotective **E**arth and has the same meaning as the symbol ⏚.
Earth, Ground	This document uses the term "earth" which is the same as the U.S. term "ground".
T.B.D.	To be defined, value or description will follow later.
AC 230V	A figure displayed with the AC or DC before the value represents a nominal voltage with standard tolerances (usually ±15%) included. E.g.: DC 12V describes a 12V battery disregarding whether it is full (13.7V) or flat (10V)
230Vac	A figure with the unit (Vac) at the end is a momentary figure without any additional tolerances included.
50Hz vs. 60Hz	As long as not otherwise stated, AC 230V parameters are valid at 50Hz mains frequency.
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+1 Redundancy

Use of two identical power supplies in parallel to provide continued operation following most failures in a single power supply. The two power supply outputs should be isolated from each other by utilizing diodes or other switching arrangements. E.g. two 10A power supplies are needed to achieve a 10A redundant system.

N+1 Redundancy

Use of three or more identical power supplies in parallel to provide continued operation following most failures in a single power supply. All power supply outputs should be isolated from each other by utilizing diodes or other switching arrangements.
E.g.: To achieve a 40A redundant system, five 10A power supplies are needed in a N+1 redundant system.



1. INTENDED USE

This device is designed for installation in an enclosure and is intended for the general professional use such as in industrial control, office, communication, and instrumentation equipment.

Do not use this power supply 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 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.

Mount the unit on a DIN-rail so that the input terminals are located on the bottom of the unit. For other mounting orientations see de-rating requirements in this document. See chapter 25.13.

Unused screw terminals should be securely tightened.

Do not unplug connectors more often than 20 times in total.

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 15%!

Keep the following installation clearances: 40mm on top, 20mm on the bottom (measured from the ventilation grid), 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 power supply).

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

For use in a controlled environment according to CSA 22.2 No 107.1-01.

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

- Do not use the power supply without proper grounding (Protective Earth). Use the terminal on the input connector for earth connection and not one of the screws on the housing.
- Turn input 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 are 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 surfaces may cause burns.

3. AC-INPUT

AC input	Nom.	AC 100-240V	Suitable for TN-, TT- and IT mains networks
AC input range	Min.	85-264Vac	Continuous operation
	Min.	264-300Vac	For maximal 500ms
Allowed voltage L or N to earth	Max.	300Vac	Continuous, IEC 62477-1
Input frequency	Nom.	50–60Hz	±6%
Turn-on voltage	Typ.	80Vac	Steady-state value, see Fig. 3-1
Shut-down voltage	Typ.	70Vac	Steady-state value, see Fig. 3-1
	Typ.	55Vac	Dynamic value (250ms)
External input protection	See recommendations in chapter 25.5.		

		AC 100V	AC 120V	AC 230V	
Input current	Typ.	2.63A	2.17A	1.14A	At 10A, see Fig. 3-3
Power factor*)	Typ.	0.99	0.99	0.97	At 10A, see Fig. 3-4
Crest factor**)	Typ.	1.5	1.5	1.65	At 10A
Start-up delay	Typ.	300ms	290ms	240ms	See Fig. 3-2
Rise time	Typ.	30ms	30ms	30ms	At 10A const. current load, 0mF load capacitance, see Fig. 3-2
	Typ.	75ms	75ms	75ms	At 10A const. current load, 10mF load capacitance,, see Fig. 3-2
Turn-on overshoot	Max.	200mV	200mV	200mV	See Fig. 3-2

*) The power factor is the ratio of the true (or real) power to the apparent power in an AC circuit.
**) The crest factor is the mathematical ratio of the peak value to RMS value of the input current waveform.

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

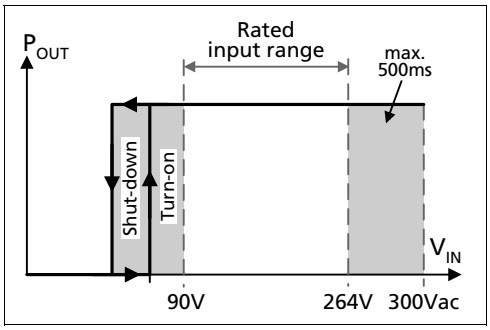


Fig. 3-2 **Turn-on behavior, definitions**

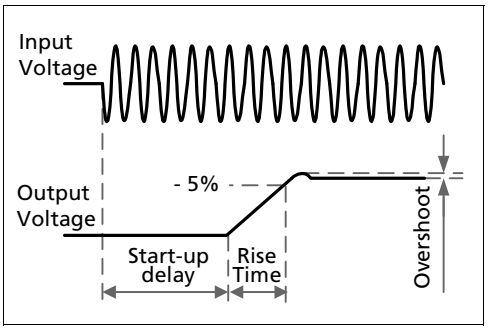


Fig. 3-3 **Input current vs. output current**

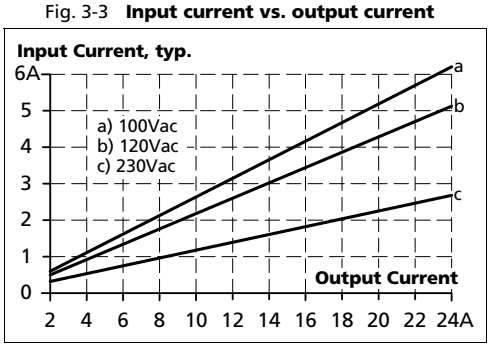
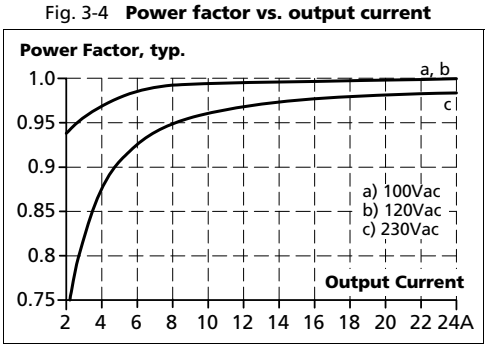


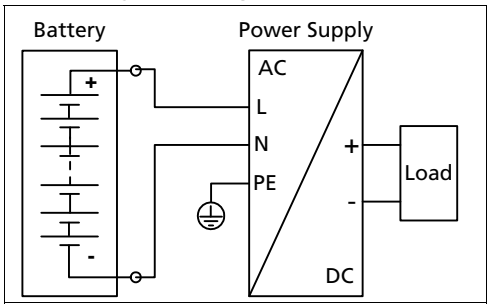
Fig. 3-4 **Power factor vs. output current**



4. DC-INPUT

DC input	Nom.	DC 110-150V	±20%
DC input range	Min.	88-180Vdc	Continuous operation
DC input current	Typ.	2.35A	At 110Vdc, at 10A
Allowed Voltage L/N to Earth	Max.	375Vdc	Continuous, IEC 62477-1
Turn-on voltage	Typ.	80Vdc	Steady state value
Shut-down voltage	Typ.	70Vdc	Steady state value
	Typ.	55Vdc	Dynamic value (250ms)

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



Instructions for DC use:

a) Use a battery or a similar DC source. A supply from the intermediate DC-bus of a frequency converter is not recommended and can cause a malfunction or damage the unit.
b) Connect +pole to L and –pole to N.
c) Connect the PE terminal to an earth wire or to the machine ground.

5. INPUT INRUSH CURRENT

An active inrush limitation circuit (NTCs, which are bypassed by a relay contact) limits the input inrush current after turn-on of the input voltage.

The charging current into EMI suppression capacitors is disregarded in the first microseconds after switch-on.

		AC 100V	AC 120V	AC 230V	
Inrush current	Max.	11A_{peak}	7A_{peak}	11A_{peak}	At 40°C, cold start
	Typ.	9A_{peak}	6A_{peak}	6A_{peak}	At 25°C, cold start
	Typ.	9A_{peak}	6A_{peak}	9A_{peak}	At 40°C, cold start
Inrush energy	Max.	0.1A²s	0.1A²s	0.4A²s	At 40°C, cold start

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

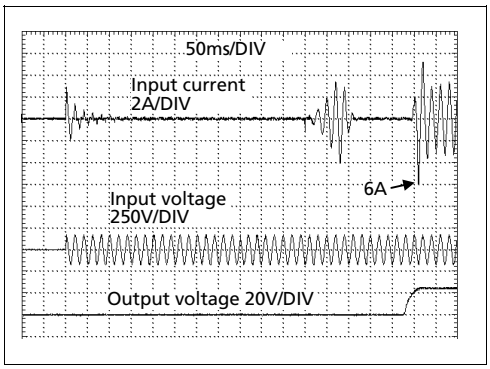
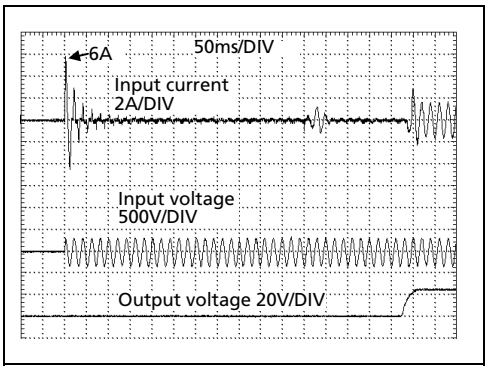


Fig. 5-2 **Typical turn-on behaviour at nominal load, 230Vac input and 25°C ambient**



6. OUTPUT

Output voltage	Nom.	DC 24V	0%/+6%
	The device is featured with a "soft output regulation characteristic" in order to achieve current share between multiple devices, when they are connected in parallel. The "soft output regulation characteristic" regulates the output voltage in such a manner that the voltage at no load is approx. 4% higher than at nominal load.		
Adjustment range		See chapter 25.2	
Factory settings	Typ.	24.1V	±0.2%, at nominal load, cold unit
	Typ.	25.1V	At no load, cold unit
Line regulation	Max.	10mV	85-300Vac
Load regulation	Typ.	1000mV	Static value, 0A → 10A; see Fig. 6-1
Ripple and noise voltage	Max.	50mVpp	20Hz to 20MHz, 50Ohm
Output current	Nom.	12A[1)]	Below 45°C ambient temperature, see Fig. 17-1
	Nom.	10A	At 60°C ambient temperature, see Fig. 17-1
	Nom.	7.5A	At 70°C ambient temperature, see Fig. 17-1
	Typ.	30A	Up to 12ms[4)] once every five seconds, see Fig. 6-3 The output voltage stays above 20V. See chapter 25.1 for more peak current measurements.
Overload behaviour		Continuous current	Output voltage > 13Vdc, see Fig. 6-1
		Hiccup^{PLUS} mode[2)]	Output voltage < 13Vdc, see Fig. 6-1
Short-circuit current	Min.	12.5A[3)]	Load impedance <10mOhm, see Fig. 6-1
	Max.	15.5A[3)]	Load impedance <10mOhm, see Fig. 6-1
	Max.	5A[3)]	Average (R.M.S.) current, load impedance 50mOhm, see Fig. 6-2.
	Min.	28A	Up to 12ms, load impedance <10mOhm, see Fig. 6-3
	Typ.	30.5A	Up to 12ms, load impedance <10mOhm, see Fig. 6-3
Output capacitance	Typ.	4 400µF	Included inside the power supply

1) **Power Boost**
This power/ current is continuously allowed up to an ambient temperature of 45°C.
Above 45°C, do not use this power/ current longer than a duty cycle of 10% and/ or not longer than 1 minute every 10 minutes.

2) **Hiccup^{PLUS} Mode**
At heavy overloads (when output voltage falls below 13V), the power supply delivers continuous output current for 2s. After this, the output is switched off for approx. 18s before a new start attempt is automatically performed. This cycle is repeated as long as the overload exists. If the overload has been cleared, the device will operate normally. See Fig. 6-2.

3) Discharge current of output capacitors is not included.

4) Reduced pulse length for AC 100V mains.

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

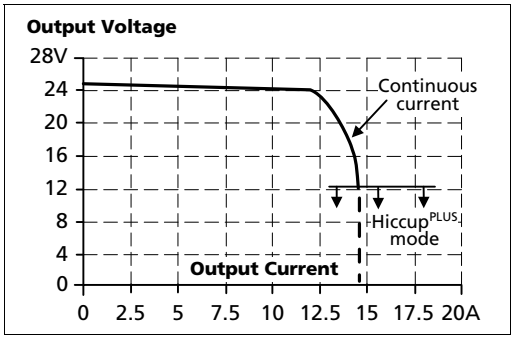


Fig. 6-2 **Short-circuit on output, Hiccup^{PLUS} mode, typ.**

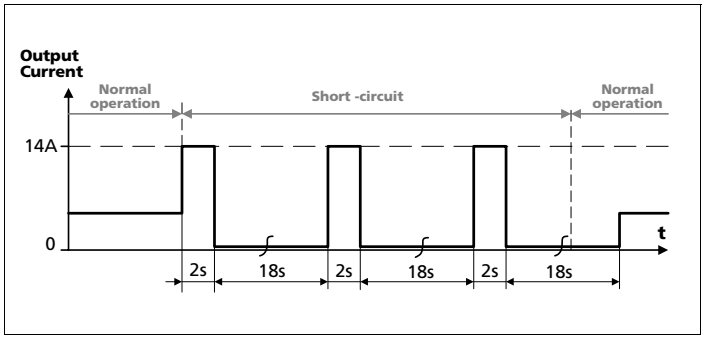
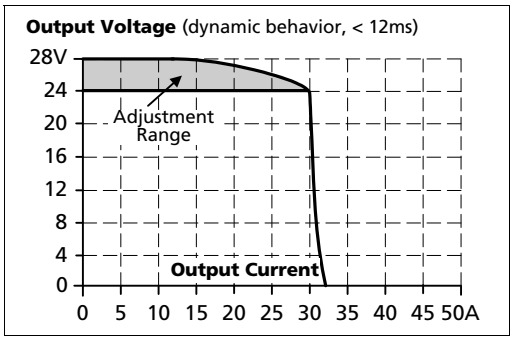


Fig. 6-3 **Dynamic overcurrent capability, typ.**



7. HOLD-UP TIME

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

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

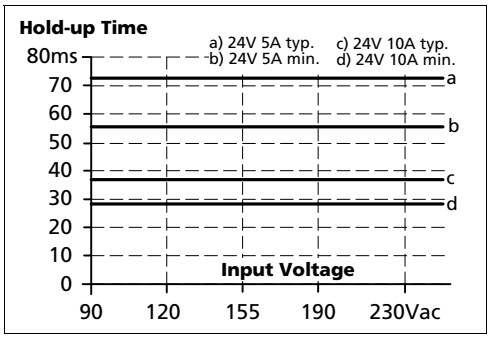
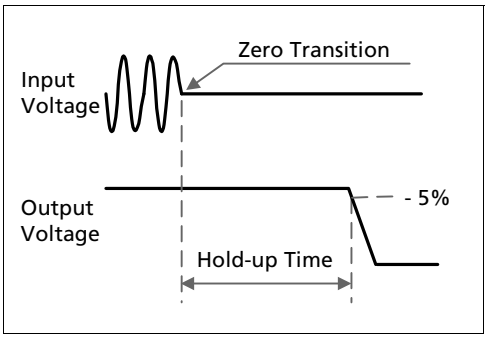


Fig. 7-2 **Shut-down behavior, definitions**

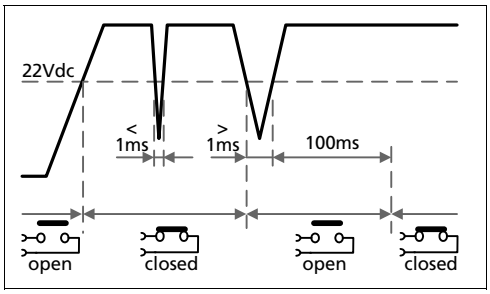


8. DC-OK RELAY CONTACT

This feature monitors the output voltage of the power supply in front of the decoupling device (see also chapter 12).

Contact closes	As soon as the output voltage reaches typically 22Vdc.
Contact opens	As soon as the output voltage dips below 22Vdc. Short dips will be extended to a signal length of 100ms. Dips shorter than 1ms will be ignored.
Contact ratings	Maximal 60Vdc 0.3A, 30Vdc 1A, 30Vac 0.5A, resistive load Minimal permissible load 1mA at 5Vdc
Isolation voltage	See dielectric strength table in chapter 20.

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



9. EFFICIENCY AND POWER LOSSES

		AC 100V	AC 120V	AC 230V	
Efficiency	Typ.	92.2%	93.0%	94.7%	At 24V, 10A
	Typ.	91.9%	92.8%	94.6%	At 24V, 12A (Power Boost)
Average efficiency*)	Typ.	91.8%	92.4%	93.9%	At 25% at 2.5A, 25% at 5A, 25% at 7.5A. 25% at 10A
Power losses	Typ.	4W	3.7W	2.9W	At 24V, 0A
	Typ.	11.3W	10.7W	8.6W	At 24V, 5A
	Typ.	20.3W	18.1W	13.4W	At 24V, 10A
	Typ.	25.4W	22.3W	16.4W	At 24V, 12A (Power Boost)

*) The average efficiency is an assumption for a typical application where the power supply is loaded with 25% of the nominal load for 25% of the time, 50% of the nominal load for another 25% of the time, 75% of the nominal load for another 25% of the time and with 100% of the nominal load for the rest of the time.

Fig. 9-1 **Efficiency vs. output current at 24V, typ.**

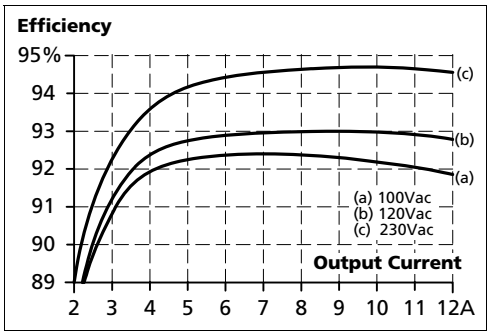


Fig. 9-2 **Losses vs. output current at 24V, typ.**

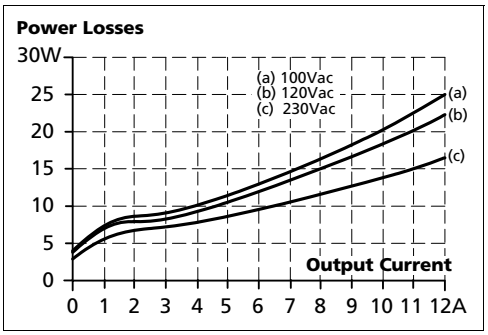


Fig. 9-3 **Efficiency vs. input voltage at 24V, 10A, typ.**

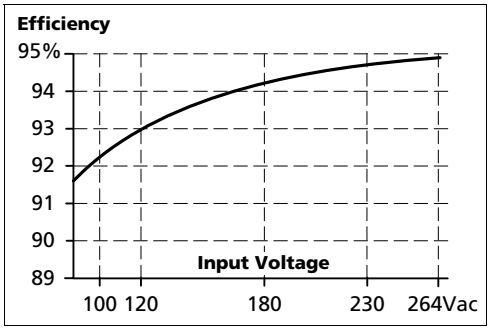
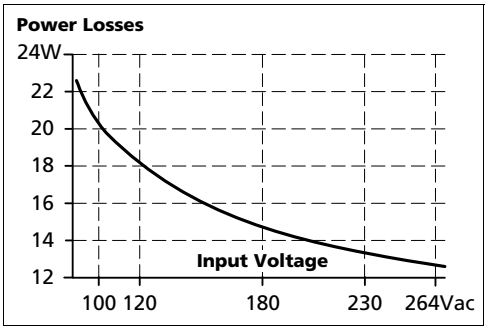


Fig. 9-4 **Losses vs. input voltage at 24V, 10A, typ.**



10. LIFETIME EXPECTANCY

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.

	AC 100V	AC 120V	AC 230V	
Lifetime expectancy	143 000h	153 000h	188 000h	At 5A and 40°C
	405 000h	434 000h	531 000h	At 5A and 25°C
	66 000h	78 000h	109 000h	At 10A and 40°C
	188 000h	220 000h	307 000h	At 10A and 25°C
	37 000h	47 000h	71 000h	At 12A and 40°C
	105 000h	132 000h	200 000h	At 12A and 25°C

11. 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.

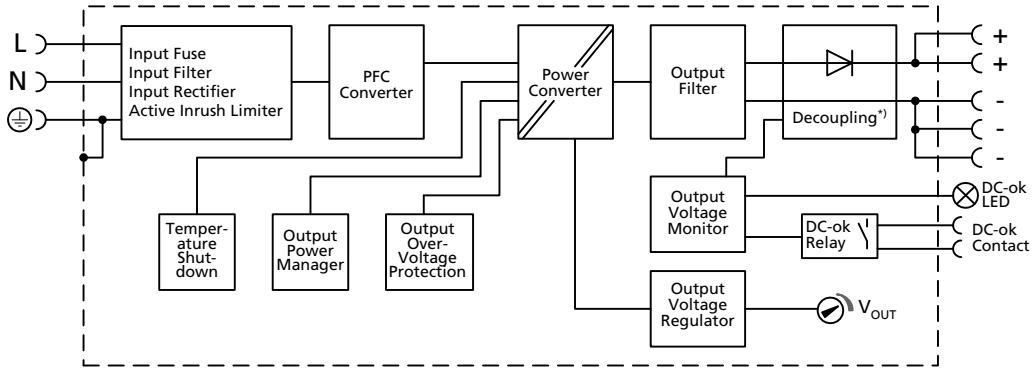
The MTBF figure is a statistical representation of the likelihood of a device to fail. A MTBF figure of e.g. 1 000 000h means that statistically one unit will fail every 100 hours if 10 000 units are installed in the field. However, it can not be determined if the failed unit has been running for 50 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.

	AC 100V	AC 120V	AC 230V	
MTBF SN 29500, IEC 61709	T.B.D.	T.B.D.	T.B.D.	At 10A and 40°C
	T.B.D.	T.B.D.	T.B.D.	At 10A and 25°C
MTBF MIL HDBK 217F	T.B.D.	T.B.D.	T.B.D.	At 10A and 40°C; Ground Benign GB40
	T.B.D.	T.B.D.	T.B.D.	At 10A and 25°C; Ground Benign GB25
	T.B.D.	T.B.D.	T.B.D.	At 10A and 40°C; Ground Fixed GF40
	T.B.D.	T.B.D.	T.B.D.	At 10A and 25°C; Ground Fixed GF25

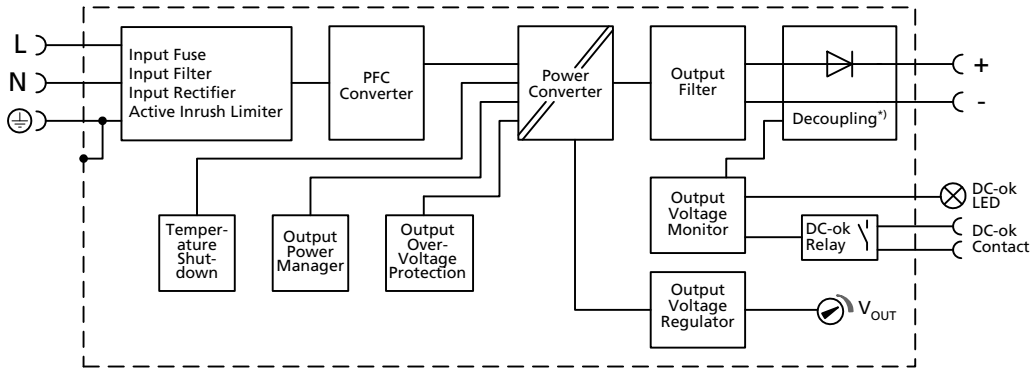
12. FUNCTIONAL DIAGRAM

Fig. 12-1 **Functional diagram CP10.241-R1 and CP10.241-R3**



*) Decoupling utilizes a MOSFET

Fig. 12-2 **Functional diagram CP10.241-R2**



*) Decoupling utilizes a MOSFET

13. TERMINALS AND WIRING

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

CP10.241-R1	**Input**	**Output**	**DC-OK-Signal**
Type	Quick-connect spring-clamp termination	Quick-connect spring-clamp termination	Push-in termination
Solid wire	Max. 6mm²	Max. 6mm²	Max. 1.5mm²
Stranded wire	Max. 4mm²	Max. 4mm²	Max. 1.5mm²
American Wire Gauge	AWG 20-10	AWG 20-10	AWG 24-16
Max. wire diameter (including ferrules)	2.8mm	2.8mm	1.6mm
Wire stripping length	10mm / 0.4inch	10mm / 0.4inch	7mm / 0.28inch
Screwdriver			3mm slotted to open the spring

CP10.241-R2	**Input**	**Output**	**DC-OK-Signal**
Type	Plug connector with screw termination	Plug connector with screw termination	Plug connector with screw termination
Solid wire	Max. 4mm²	Max. 4mm²	Max. 1.5mm²
Stranded wire	Max. 2.5mm²	Max. 2.5mm²	Max. 1.5mm²
American Wire Gauge	AWG 20-12	AWG 20-12	AWG 26-14
Max. wire diameter (including ferrules)	2.4mm	2.4mm	1.8mm
Recommended tightening torque	Max. 0.5Nm, 4.5lb-in	Max. 0.5Nm, 4.5lb-in	Max. 0.8Nm, 7lb-in
Wire stripping length	7mm / 0.28inch	7mm / 0.28inch	6mm / 0.24inch
Screwdriver	3.5mm slotted or cross-head No 2	3.5mm slotted or cross-head No 2	3.5mm slotted

CP10.241-R3	**Input**	**Output**	**DC-OK-Signal**
Type	Screw termination	Screw termination	Push-in termination
Solid wire	Max. 6mm²	Max. 6mm²	Max. 1.5mm²
Stranded wire	Max. 4mm²	Max. 4mm²	Max. 1.5mm²
American Wire Gauge	AWG 20-10	AWG 20-10	AWG 24-16
Max. wire diameter (including ferrules)	2.8mm	2.8mm	1.6mm
Recommended tightening torque	Max. 1Nm, 9lb-in	Max. 1Nm, 9lb-in	-
Wire stripping length	7mm / 0.28inch	7mm / 0.28inch	7mm / 0.28inch
Screwdriver	3.5mm slotted or cross-head No 2	3.5mm slotted or cross-head No 2	3mm slotted to open the spring

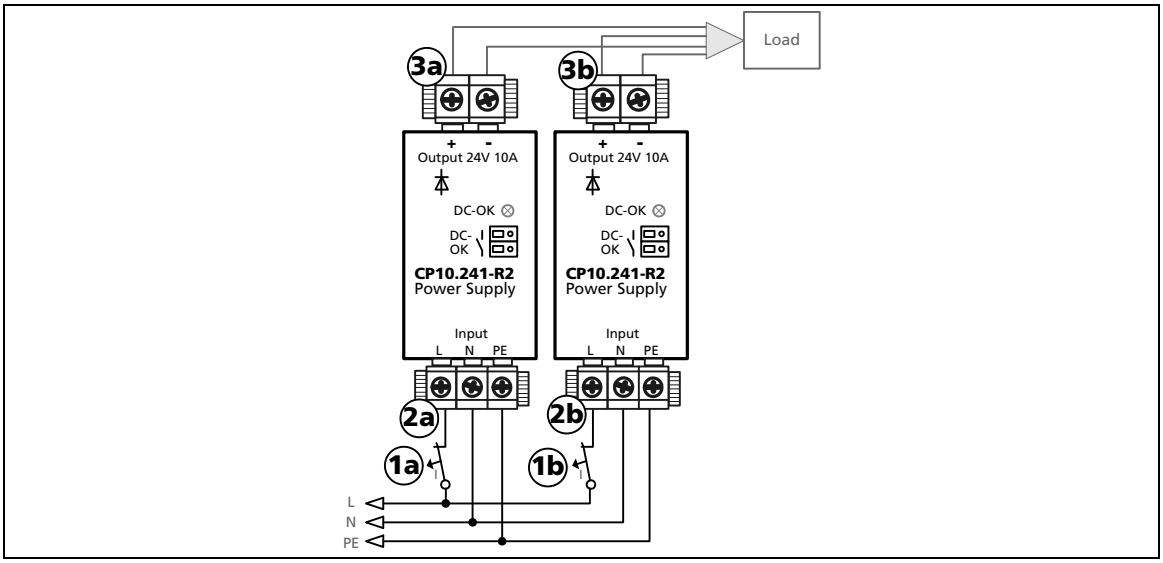
Instructions for wiring:

a) Use appropriate copper cables that are designed for minimum operating temperatures of:
   60°C for ambient up to 45°C and
   75°C for ambient up to 60°C and
   90°C for ambient up to 70°C minimum.
b) Follow national installation codes and installation regulations!
c) Ensure that all strands of a stranded wire enter the terminal connection!
d) Unused terminal compartments should be securely tightened.
e) Ferrules are allowed.

14. REPLACING UNITS WHILE THE SYSTEM IS RUNNING

This feature is available only for the CP10.241-R2 unit, which is equipped with hot-swappable plug connectors.

Fig. 14-1 **Replacing the power supply or redundancy module while the system is running**



Replacement instructions (Example for left power supply):

- Switch-off circuit breaker (1a).
- Remove plug (2a).
- Remove plug (3a). The plug prevents the cables from shorting.
- Change power supply.
- Put the plug (3a) back in.
- Put the plug (2a) back in.
- Turn-on the circuit breaker (1a).
- The circuit is redundant again.

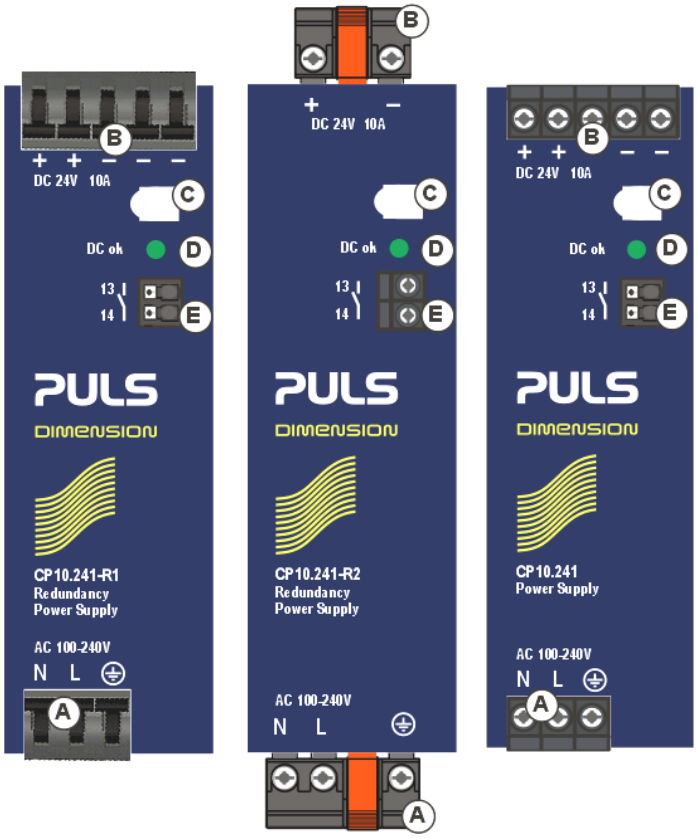
To replace the right power supply, repeat the process above using (1b), (2b) and (3b).

15. FRONT SIDE AND USER ELEMENTS

Fig. 15-1 **Front side CP10.241-R1**

Fig. 15-2 **Front side CP10.241-R2**

Fig. 15-3 **Front side CP10.241-R3**



A **Input Terminals**

N, L Line input

⏚ PE (Protective Earth) input

B **Output Terminals**

+ Positive output

– Negative (return) output

C **Output voltage potentiometer**
See chapter 25.2.

D **DC-OK LED** (green)
On, when the output voltage is above 22V.

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

16. EMC

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

EMC Immunity	According to 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	20V/m	Criterion A
Fast transients (Burst)	EN 61000-4-4	Input lines Output lines DC-OK signal (coupling clamp)	4kV 2kV 2kV	Criterion A Criterion A Criterion A
Surge voltage on input	EN 61000-4-5	L → N L → PE, N → PE	2kV 4kV	Criterion A Criterion A
Surge voltage on output	EN 61000-4-5	+ → - + / - → PE	1kV 2kV	Criterion A Criterion A
Surge voltage on DC-OK	EN 61000-4-5	DC-OK signal → PE	1kV	Criterion A
Conducted disturbance	EN 61000-4-6	0.15-80MHz	20V	Criterion A
Mains voltage dips	EN 61000-4-11	0% of 100Vac 40% of 100Vac 70% of 100Vac 0% of 200Vac 40% of 200Vac 70% of 200Vac	0Vac, 20ms 40Vac, 200ms 70Vac, 500ms 0Vac, 20ms 80Vac, 200ms 140Vac, 500ms	Criterion A Criterion C Criterion A Criterion A Criterion A Criterion A
Voltage interruptions	EN 61000-4-11	0% of 200Vac (=0V)	5000ms	Criterion C
Voltage sags	SEMI F47 0706	Dips on the input voltage according to SEMI F47 standard		
		80% of 120Vac (96Vac) 70% of 120Vac (84Vac) 50% of 120Vac (60Vac)	1000ms 500ms 200ms	Criterion A Criterion A Criterion A
Powerful transients	VDE 0160	Over entire load range	750V, 0.3ms	Criterion A

Criterions:

A: Power supply shows normal operation behavior within the defined limits.

C: Temporary loss of function is possible. Power supply may shut-down and restarts by itself. No damage or hazards for the power supply will occur.

EMC Emission	According to generic standards: EN 61000-6-3 and EN 61000-6-4	
Conducted emission input lines	EN 55011, EN 55022, FCC Part 15, CISPR 11, CISPR 22	Class B
Conducted emission output lines*)	IEC/CISPR 16-1-2, IEC/CISPR 16-2-1	Limits for DC power port according EN 61000-6-3 fulfilled
Radiated emission	EN 55011, EN 55022	Class B
Harmonic input current	EN 61000-3-2	Class A equipment: fulfilled Class C equipment: fulfilled in the load range from 8 to 24A
Voltage fluctuations, flicker	EN 61000-3-3	Fulfilled, tested with constant current loads, non pulsing

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.

*) for information only, not mandatory for EN 61000-6-3

Switching Frequencies	The power supply has three converters included with three different switching frequencies included.	
Switching frequency 1	110kHz	PFC converter
Switching frequency 2	110kHz to 140kHz	Main converter, output power dependent
Switching frequency 3	60kHz	Auxiliary converter

17. ENVIRONMENT

Operational temperature[1]	-25°C to +70°C (-13°F to 158°F)	See also Fig. 17-1
Storage temperature	-40°C to +85°C (-40°F to 185°F)	For storage and transportation
Output de-rating	3.2W/°C 6W/°C	45°C to 60°C (113°F to 140°F), see Fig. 17-1 60°C to 70°C (140°F to 158°F) , see Fig. 17-1
Humidity[2]	5 to 95% r.h.	IEC 60068-2-30
Vibration sinusoidal	2-17.8Hz: ±1.6mm; 17.8-500Hz: 2g[3] 2 hours / axis[3]	IEC 60068-2-6
Shock	30g 6ms, 20g 11ms[3] 3 bumps / direction, 18 bumps in total	IEC 60068-2-27
Altitude	0 to 2000m (0 to 6 560ft)	Without any restrictions
	2000 to 6000m (6 560 to 20 000ft)	Reduce output power or ambient temperature, see Fig. 17-2. IEC 62477-1, overvoltage category II
Altitude de-rating	15W/1000m or 5°C/1000m	Above 2000m (6500ft), see Fig. 17-2
Over-voltage category	III	IEC 62477-1, altitudes up to 2000m
	II	For altitudes from 2000m to 6000m
Degree of pollution	2	IEC 62477-1, not conductive
LABS compatibility	The unit does not release any silicone or other LABS-critical substances and is suitable for use in paint shops.	
Corrosive gases	ISA-71.04-1985, Severity Level G3, IEC 60068-2-60 Test Ke Method 4	
Audible noise	Some audible noise may be emitted from the power supply during no load, overload or short circuit.	

1) Operational temperature is the same as the ambient or surrounding temperature and is defined as the air temperature 2cm below the unit.
2) Do not energize while condensation is present
3) Tested in combination with DIN-Rails according to EN 60715 with a height of 15mm and a thickness of 1.3mm and standard orientation.

Fig. 17-1 **Output current vs. ambient temp.**

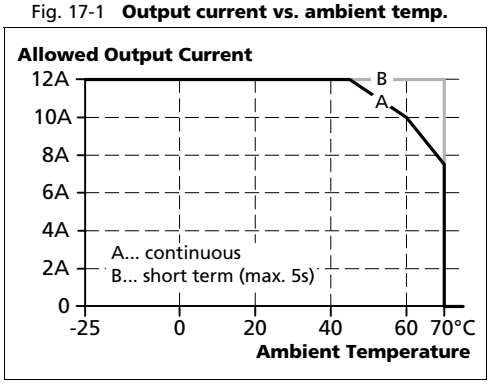
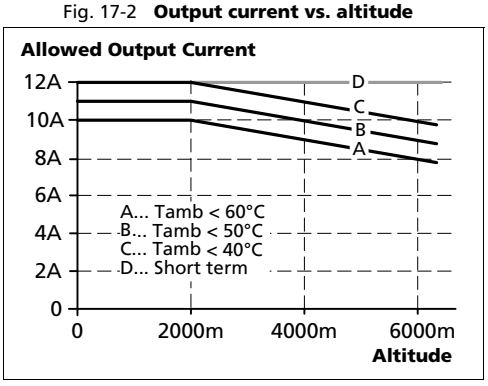


Fig. 17-2 **Output current vs. altitude**



18. PROTECTION FEATURES

Output protection	Electronically protected against overload, no-load and short-circuits. In case of a protection event, audible noise may occur.	
Output over-voltage protection	Typ. 30.5Vdc Max. 32Vdc	In case of an internal power supply defect, a redundant circuit limits the maximum output voltage. The output shuts down and automatically attempts to restart.
Degree of protection	IP 20	EN/IEC 60529
Penetration protection	> 4mm	E.g. screws, small parts
Over-temperature protection	Yes[1)]	Output shut-down with automatic restart.
Input transient protection	MOV (Metal Oxide Varistor)	For protection values see chapter 16 (EMC).
Internal input fuse	Included	Not user replaceable slow-blow high-braking capacity fuse

1) The temperature sensor is installed on critical components inside the unit and turns the unit off in safety critical situations (e.g. de-rating requirements not observed, high ambient temperature, ventilation obstructed or the mounting orientation de-rating is not followed). There is no correlation between the operating temperature and turn-off temperature since this is dependent on input voltage, load and installation methods.

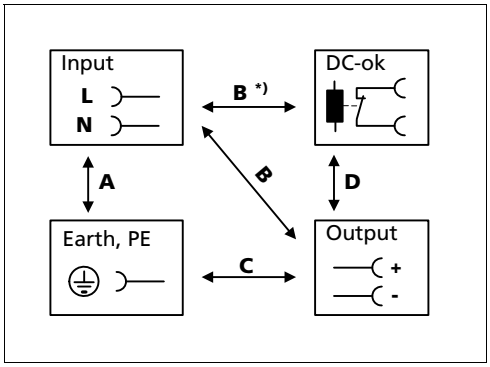
19. SAFETY FEATURES

Input / output separation	Double or reinforced galvanic isolation	
	SELV	IEC/EN 60950-1
	PELV	IEC/EN 60204-1, EN 62477-1, IEC 60364-4-41
Class of protection	I	PE (Protective Earth) connection required
Isolation resistance	> 500MOhm	At delivered condition between input and output, measured with 500Vdc
	> 500MOhm	At delivered condition between input and PE, measured with 500Vdc
	> 500MOhm	At delivered condition between output and PE, measured with 500Vdc
	> 500MOhm	At delivered condition between output and DC-OK contacts, measured with 500Vdc
PE resistance	< 0.1Ohm	Resistance between PE terminal and the housing in the area of the DIN-rail mounting bracket.
Touch current (leakage current)	Typ. 0.14mA / 0.36mA	At 100Vac, 50Hz, TN-,TT-mains / IT-mains
	Typ. 0.20mA / 0.50mA	At 120Vac, 60Hz, TN-,TT-mains / IT-mains
	Typ. 0.33mA / 0.86mA	At 230Vac, 50Hz, TN-,TT-mains / IT-mains
	Max. 0.18mA / 0.43mA	At 110Vac, 50Hz, TN-,TT-mains / IT-mains
	Max. 0.26mA / 0.61mA	At 132Vac, 60Hz, TN-,TT-mains / IT-mains
	Max. 0.44mA / 1.05mA	At 264Vac, 50Hz, TN-,TT-mains / IT-mains

20. DIELECTRIC STRENGTH

The output voltage is floating and has no ohmic connection to the ground. Type and factory tests are conducted by the manufacturer. Field tests may be conducted in the field using the appropriate test equipment which applies the voltage with a slow ramp (2s up and 2s down). Connect all input-terminals together as well as all output poles before conducting the test. When testing, set the cut-off current settings to the value in the table below.

Fig. 20-1 **Dielectric strength**



		A	B	C	D
Type test	60s	2500Vac	4000Vac	1000Vac	500Vac
Factory test	5s	2500Vac	2500Vac	500Vac	500Vac
Field test	5s	2000Vac	2000Vac	500Vac	500Vac
Cut-off current setting		> 10mA	> 10mA	> 20mA	> 1mA

To fulfil the PELV requirements according to EN60204-1 § 6.4.1, we recommend that either the + pole, the – pole or any other part of the output circuit shall be connected to the protective earth system. This helps to avoid situations in which a load starts unexpectedly or can not be switched off when unnoticed earth faults occur.

B*) When testing input to DC-OK ensure that the max. voltage between DC-OK and the output is not exceeded (column D). We recommend connecting DC-OK pins and the output pins together when performing the test.

21. APPROVALS

EC Declaration of Conformity	CE	The CE mark indicates conformance with the - EMC directive (available), - Low-voltage directive (available) and the - ATEX directive (planned)
IEC 60950-1 2nd Edition planned	IECEE CB SCHEME	CB Scheme, Information Technology Equipment
UL 508 planned	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 2nd Edition planned	c UL US	Recognized for use as Information Technology Equipment, Level 5; U.S.A. (UL 60950-1) and Canada (C22.2 No. 60950-1); E-File: E137006 Applicable for altitudes up to 2000m.
ANSI / ISA 12.12.01-2007 Class I Div 2 planned	C SP US	Recognized for use in Hazardous Location Class I Div 2 T4 Groups A,B,C,D systems; U.S.A. (ANSI / ISA 12.12.01-2007) and Canada (C22.2 No. 213-M1987)
EN 60079-0, EN 60079-7 ATEX planned	Ex II 3G Ex ec nC II T4 Gc	Approval for use in hazardous locations Zone 2 Category 3G. Number of ATEX certificate: will follow after certification process. The power supply must be built-in in an IP54 enclosure.
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: will follow after certification process.
EAC TR Registration (except CP10.241-R3)	EAC	Registration for the Eurasian Customs Union market (Russia, Kazakhstan, Belarus)

22. ROHS, REACH AND OTHER FULFILLED STANDARDS

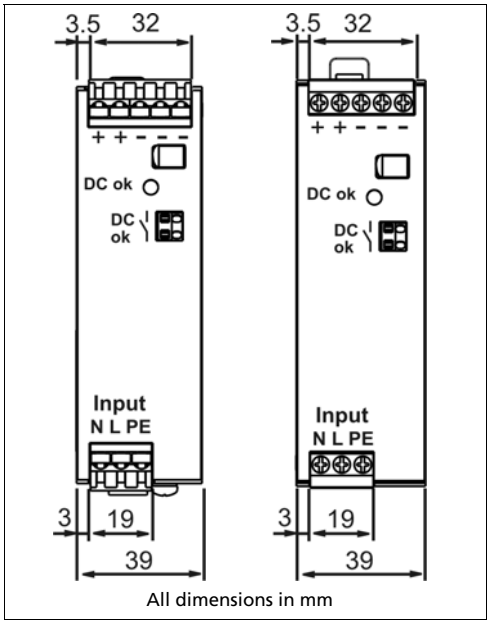
RoHS Directive	RoHS ✓	Directive 2011/65/EU of the European Parliament and the Council of June 8th, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.
REACH Directive	REACH ✓	Directive 1907/2006/EU of the European Parliament and the Council of June 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

23. PHYSICAL DIMENSIONS AND WEIGHT

Width	39mm 1.54''
Height	124mm 4.88'' (without connectors)
Depth	117mm 4.61'' (without connector) The DIN-rail height must be added to the unit depth to calculate the total required installation depth.
Weight	600g / 1.32lb
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

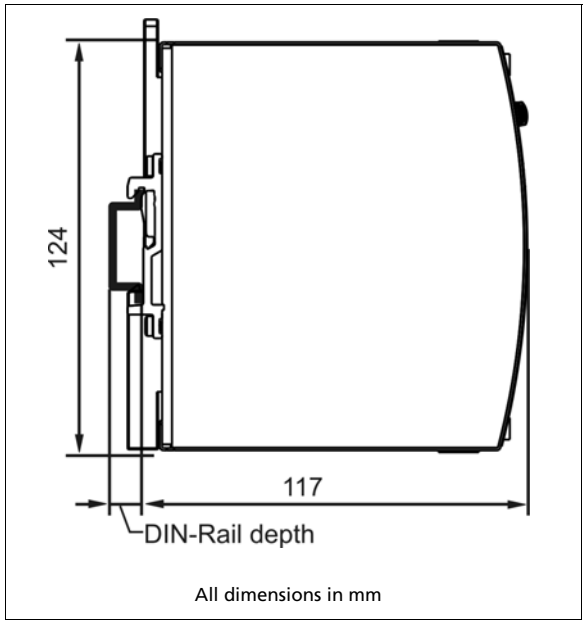
Fig. 23-1 **Front view**

CP10.241-R1 **CP10.241-R3**



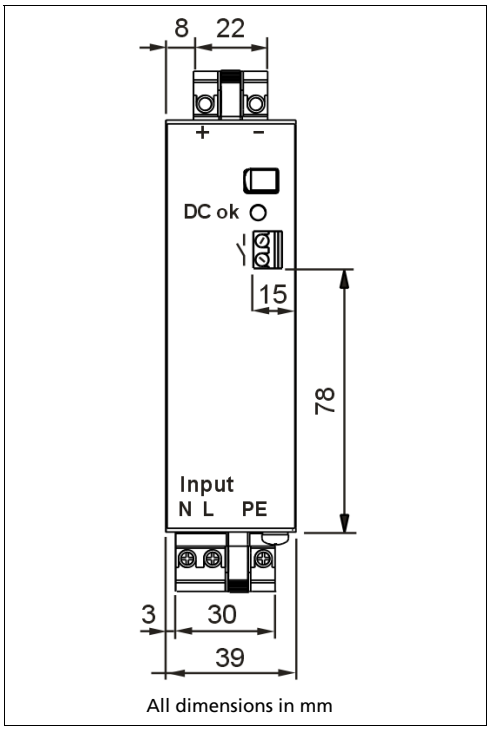
All dimensions in mm

Fig. 23-2 **Side view CP10.241-R1 and CP10.241-R3**



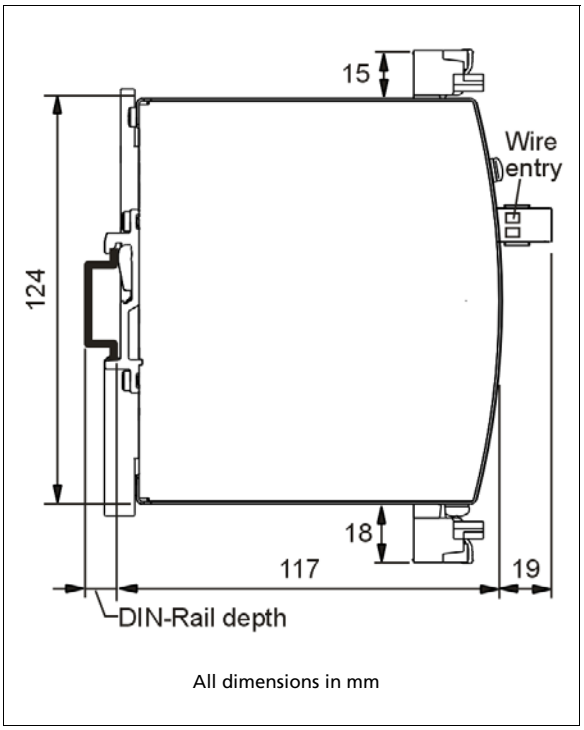
All dimensions in mm

Fig. 23-3 **Front view CP10.241-R2**



All dimensions in mm

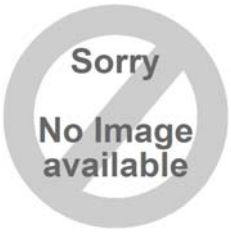
Fig. 23-4 **Side view CP10.241-R2**



All dimensions in mm

24. ACCESSORIES

24.1. ZM4.WALL – WALL/PANEL MOUNT BRACKET



This bracket is used to mount the devices on a wall/panel without utilizing a DIN-Rail. It is suitable for the CP10.241-R1, CP10.241-R2 and CP10.241-R3.

The bracket can be mounted without detaching the DIN-rail brackets.

Fig. 24-1 **Isometric view**
(Picture shows the CP10.241-R3)

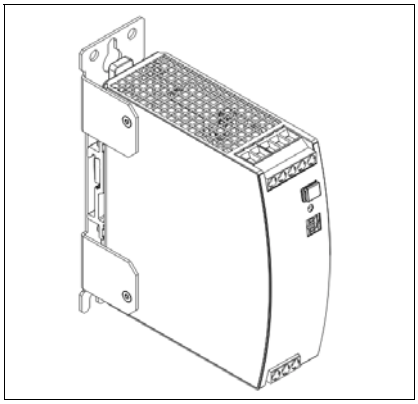


Fig. 24-2 **Isometric view-**
(Picture shows the CP10.241-R3)

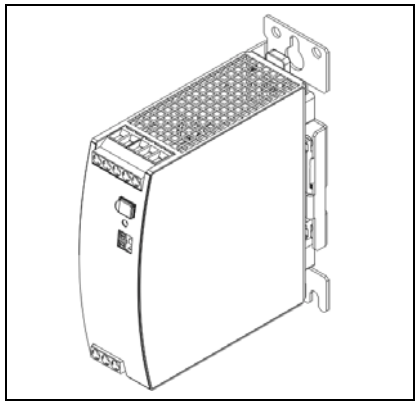


Fig. 24-3 **Isometric view**
(Picture shows the CP10.241-R3)

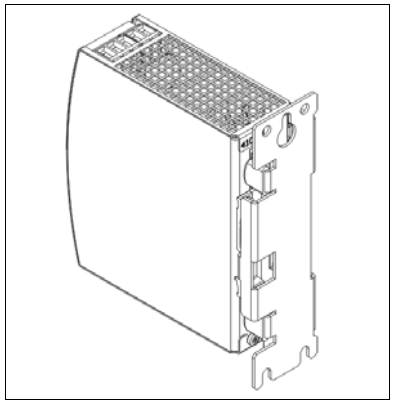


Fig. 24-4 **Wall/panel mounting, front view**
(Picture shows the CP10.241-R3)

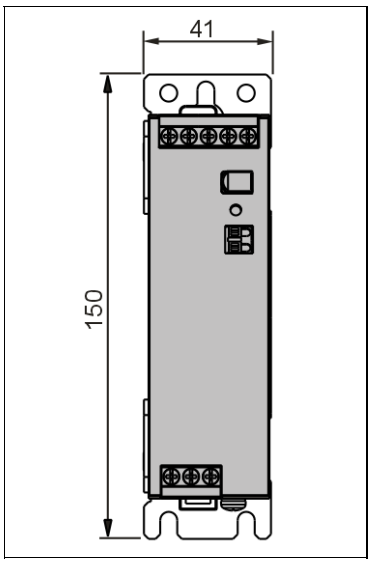


Fig. 24-5 **Hole pattern for wall mounting**

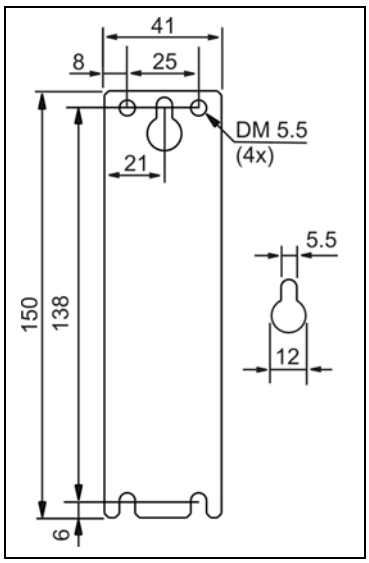
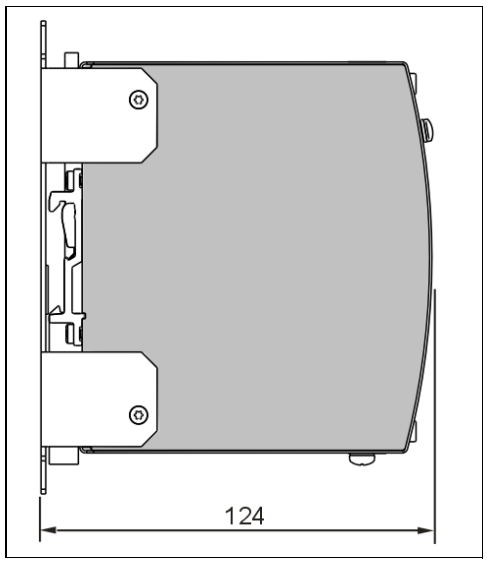


Fig. 24-6 **Wall/panel mounting, side view**
(Picture shows the CP10.241-R3)



24.2. ZM12.SIDE - SIDE MOUNTING BRACKET

This bracket is used to mount the power supply 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. 24-7
Side mounting without DIN-rail brackets
(Picture shows the CP10.241-R3)

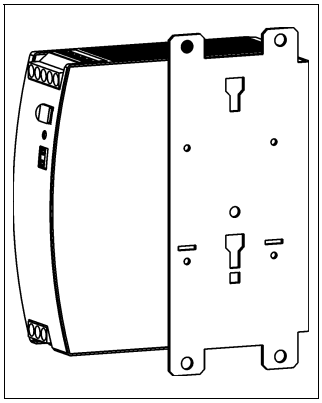


Fig. 24-8
Side mounting with DIN-rail brackets
(Picture shows the CP10.241-R3)

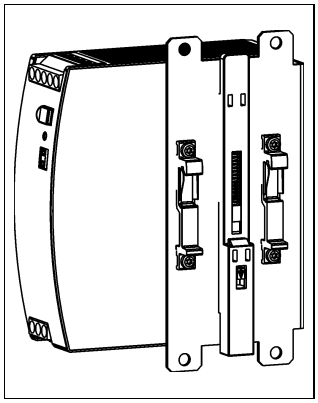
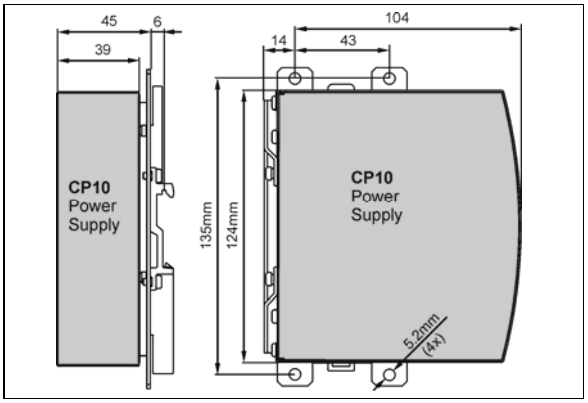


Fig. 24-9
Mounting Dimensions
Side mounting bracket



25. APPLICATION NOTES

25.1. PEAK CURRENT CAPABILITY

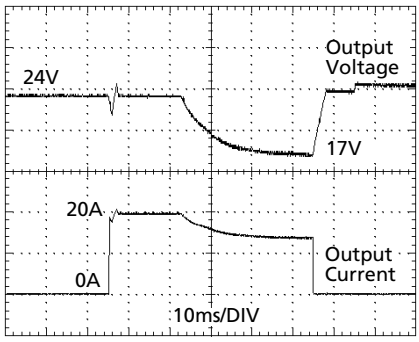
The unit can deliver peak currents (up to several milliseconds) which are higher than the specified short term currents.

This helps to start current demanding loads. Solenoids, contactors and pneumatic modules often have a steady state coil and a pick-up coil. The inrush current demand of the pick-up coil is several times higher than the steady-state current and usually exceeds the nominal output current (including the PowerBoost). The same situation applies when starting a capacitive load.

The peak current capability also ensures the safe operation of subsequent circuit breakers of load circuits. The load branches are often individually protected with circuit breakers or fuses. In case of a short or an overload in one branch circuit, the fuse or circuit breaker need a certain amount of over-current to open in a timely manner. This avoids voltage loss in adjacent circuits.

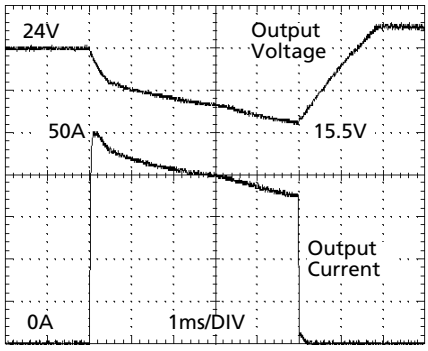
The extra current (peak current) is supplied by the power converter and the built-in large sized output capacitors of the power supply. The capacitors get discharged during such an event, which causes a voltage dip on the output. The following two examples show typical voltage dips:

Fig. 25-1 **Peak load with 2x the nominal current for 50ms, typ.**



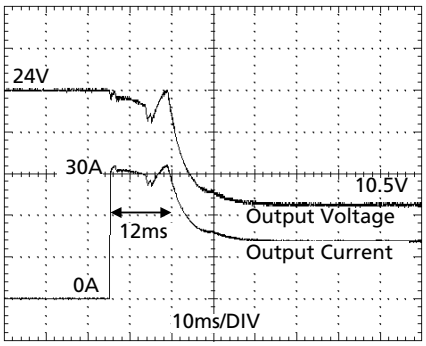
20A Peak load (resistive) for 50ms
Output voltage dips from 24V to 17V.

Fig. 25-2 **Peak load with 5x the nominal current for 5ms, typ.**



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

Fig. 25-3 **30A Peak load, typ.**



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

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

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

25.2. ADJUSTING THE OUTPUT VOLTAGE

A voltage adjustment potentiometer can be found behind the flap on the front of the unit (see chapter 15). However, it is not recommended to change the output voltage since load sharing between power supplies connected in parallel can only be achieved by a precise setting of the output voltages. The factory settings allow precise load sharing and only qualified personnel should change the adjustment potentiometer.

Adjustment range	Min.	24 - 27V	Please note the "soft output regulation characteristic" where the voltage at no load is approx. 4% higher than at nominal load. See chapter 6 for details.
	Max.	30V	Maximum output voltage which can occur at the clockwise end position of the potentiometer due to tolerances. It is not a guaranteed value which can be achieved. The typical value is about 29.5V.
Output current at 27V	Nom.	10.7A	Below +45°C ambient
	Nom.	8.9A	At +60°C ambient
	Nom	6.7A	At +70°C ambient
		Current values between 24V and 27V can be interpolated.	

The output voltage shall only be changed when absolutely necessary, e.g. for battery charging.

25.3. CHARGING OF BATTERIES

This redundancy power supply is ideal for charging batteries due to the decoupling circuit built in to the output stage which does not require a fuse or diode between the power supply and the battery.

It can be used to charge sealed lead acid (SLA) or valve regulated lead acid (VRLA) lead batteries when following these instructions:

a) Set output voltage (measured at disconnected battery) very precisely to the end-of-charge voltage. Use the potentiometer, which is hidden behind the flap on the front of the unit.

Battery temperature	10°C	20°C	30°C	40°C
End-of-charge voltage	27.8V	27.5V	27.15V	26.8V

b) Ensure that the ambient temperature of the power supply stays below 40°C.

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

d) The return current to the power supply (battery discharge current) is typically 3mA when the power supply is switched off.

25.4. BACK-FEEDING LOADS

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

This power supply is resistant and does not show malfunctioning when a load feeds back voltage to the power supply. It does not matter whether the power supply is on or off.

The maximum allowed feed-back-voltage is 35Vdc.

25.5. EXTERNAL INPUT PROTECTION

The unit is tested and approved for branch circuits up to 30A (UL) and 32A (IEC). An external protection is only required if the supplying branch has an ampacity greater than this. Check also local codes and local requirements. In some countries local regulations might apply.

If an external fuse is necessary or utilized, minimum requirements need to be considered to avoid nuisance tripping of the circuit breaker. A minimum value of 6A B- or C-Characteristic breaker should be used.

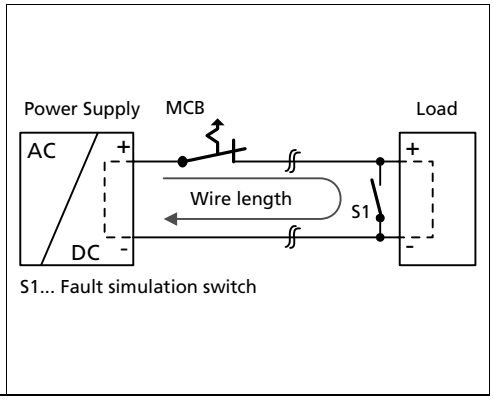
25.6. OUTPUT CIRCUIT BREAKERS

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

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

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

Fig. 25-4 **Test circuit**



S1... Fault simulation switch

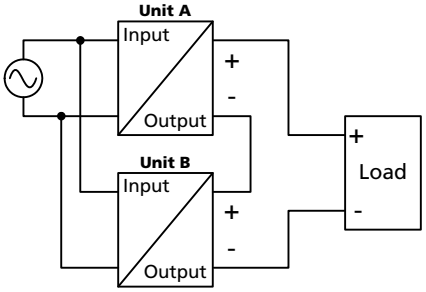
Maximal wire length*) for a fast (magnetic) tripping:

	0.75mm²	1.0mm²	1.5mm²	2.5mm²
C-2A	30 m	37 m	54 m	84 m
C-3A	25 m	30 m	46 m	69 m
C-4A	9 m	15 m	25 m	34 m
C-6A	3 m	3 m	4 m	7 m
C-8A				
B-6A	12 m	15 m	21 m	34 m
B-10A	3 m	3 m	4 m	9 m
B-13A	2 m	2 m	3 m	6 m

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

25.7. SERIES OPERATION

Power supplies 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 are not SELV any more and can be dangerous. Such voltages must be installed with a protection against touching.



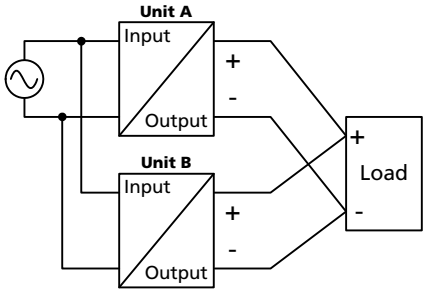
Avoid return voltage (e.g. from a decelerating motor or battery) which is applied to the output terminals.

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 (input terminals on bottom of the unit).

Pay attention that leakage current, EMI, inrush current, harmonics will increase when using multiple power supplies.

25.8. PARALLEL USE TO INCREASE OUTPUT POWER

Power supplies can be paralleled to increase the output power. For redundancy applications one extra power supply is always needed for sufficient output current in case one unit fails.



The unit is permanently set to “parallel use” mode in order to achieve load sharing between power supplies connected in parallel. The “Parallel use” mode regulates the output voltage in such a manner that the voltage at no load is approx. 4% higher than at nominal load. See also chapter 6.

Energize all units at the same time to avoid the overload Hiccup^{PLUS} mode. It also might be necessary to cycle the input power (turn-off for at least five seconds), if the output was in Hiccup^{PLUS} mode due to overload or short circuits and the required output current is higher than the current of one unit.

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 parallel in mounting orientations other than the standard mounting orientation (input terminals on bottom of the unit) or in any other condition where a derating of the output current is required (e.g. altitude).

Pay attention that leakage current, EMI, inrush current, harmonics will increase when using multiple power supplies.

Do not load paralleled power supplies with higher currents as shown in the following diagrams:

Fig. 25-5 **Output current vs. ambient temp. for two paralleled units**

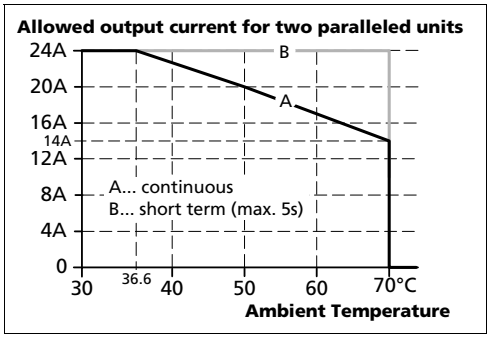
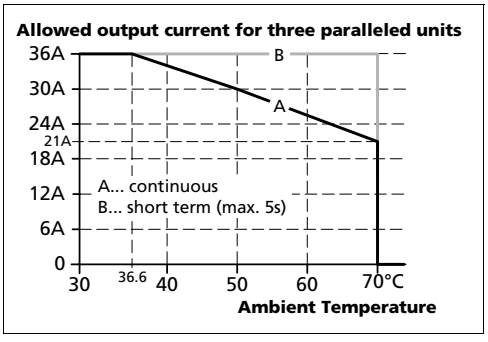


Fig. 25-6 **Output current vs. ambient temp. for three paralleled units**



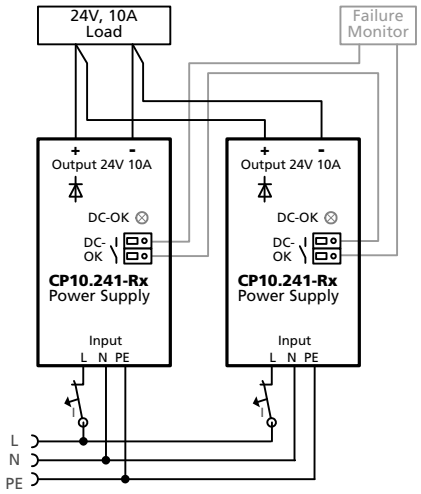
25.9. PARALLEL USE FOR REDUNDANCY

Power supplies can be paralleled for redundancy to gain higher system availability. The unit is already equipped with a MOSFET as decoupling device on the output to avoid, that a faulty unit becomes a load for the other power supplies and the output voltage cannot be maintained any more.

Recommendations for building redundant power systems:

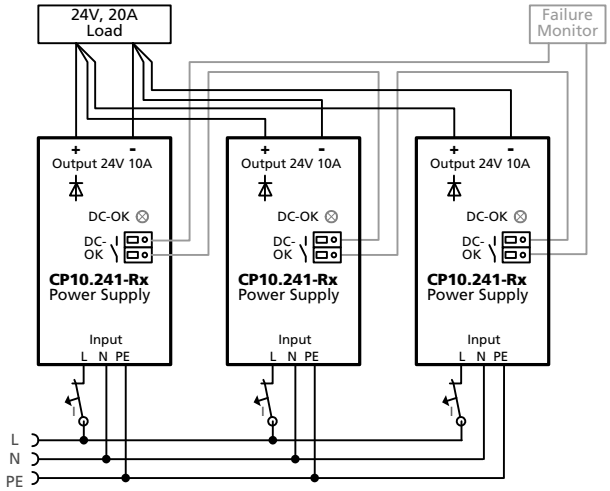
a) Use separate input fuses for each power supply.
b) Monitor the individual power supply units by utilizing the built-in DC-OK relay contacts on each power supply.

Fig. 25-7 **Wiring diagram, 1+1 Redundancy for 10A output current**



Note: Use separate mains systems for each power supply whenever it is possible

Fig. 25-8 **Wiring diagram, N+1 Redundancy for 20A output current**



Observe the temperature derating requirements of Fig. 25-5 and Fig. 25-6 for n+1 redundancy applications.

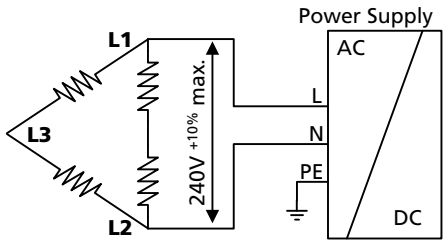
Note: Use separate mains systems for each power supply whenever it is possible.

25.10. INDUCTIVE AND CAPACITIVE LOADS

The unit is designed to supply any kind of loads, including capacitive and inductive loads. If extreme large capacitors, such as EDLCs (electric double layer capacitors or "UltraCaps") with a capacitance larger than 1.5F are connected to the output, the unit might charge the capacitor in the Hiccup^{PLUS} mode (see chapter 6).

25.11. OPERATION ON TWO PHASES

The power supply can also be used on two-phases of a three-phase-system. Such a phase-to-phase connection is allowed as long as the supplying voltage is below 240V$^{+10\%}$.



25.12. USE IN A TIGHTLY SEALED ENCLOSURE

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

The following measurement results can be used as a reference to estimate the temperature rise inside the enclosure.

The power supply is placed in the middle of the box, no other heat producing items are inside the box

The temperature sensor inside the box is placed in the middle of the right side of the power supply with a distance of 1cm.

	Case A	**Case B**	**Case C**	**Case D**
Enclosure size	**110**x180x165mm Rittal Typ IP66 Box PK 9516 100, plastic	**110**x180x165mm Rittal Typ IP66 Box PK 9516 100, plastic	**180**x180x165mm Rittal Typ IP66 Box PK 9519 100, plastic	**180**x180x165mm Rittal Typ IP66 Box PK 9519 100, plastic
Load	24V, 8A; (=**80%**)	24V, 10A; (=**100%**)	24V, 8A; (=**80%**)	24V, 10A; (=**100%**)
Temperature inside the box	45.4°C	49.0°C	42.0°C	44.4°C
Temperature outside the box	25.0°C	25.0°C	25.0°C	25.0°C
Temperature rise	20.4K	24.0K	17.0K	19.4K

25.13. MOUNTING ORIENTATIONS

Mounting orientations other than all terminals on the bottom require a reduction in continuous output power or a limitation in the maximum allowed ambient temperature. The amount of reduction influences the lifetime expectancy of the power supply. Therefore, two different derating curves for continuous operation can be found below:

Curve A1 Recommended output current.
Curve A2 Max allowed output current (results in approximately half the lifetime expectancy of A1).

Fig. 25-9 **Mounting Orientation A** (Standard orientation)

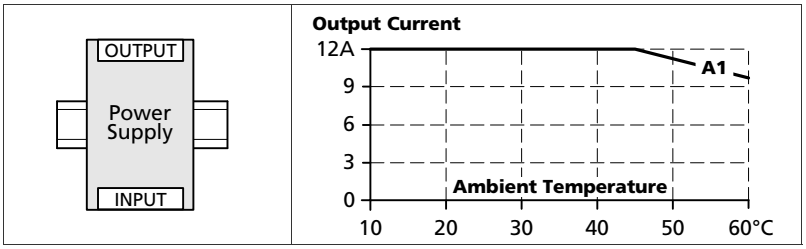


Fig. 25-10 **Mounting Orientation B** (Upside down)

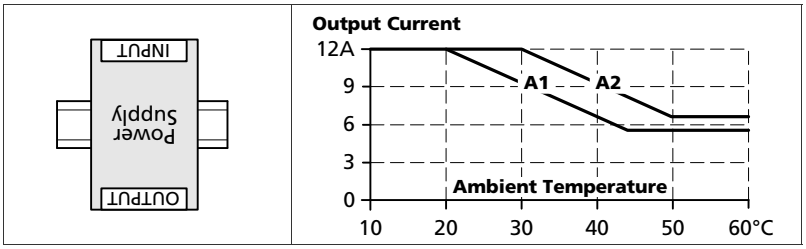


Fig. 25-11 **Mounting Orientation C** (Table-top mounting)

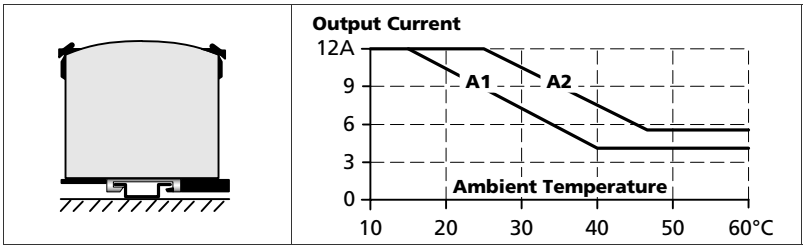


Fig. 25-12 **Mounting Orientation D** (Horizontal cw)

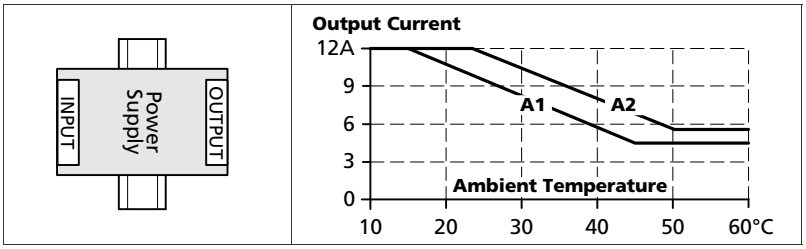


Fig. 25-13 **Mounting Orientation E** (Horizontal ccw)