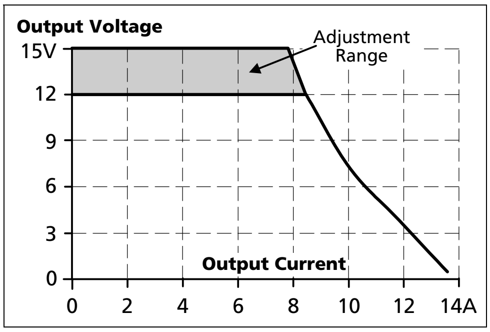
6. OUTPUT

Output voltage	nom.	12V	
Adjustment range	min.	12-15V	guaranteed
	max.	16.0V	at clockwise end position of potentiometer
Factory setting		12.0V	±0.2%, at full load, cold unit
Line regulation	max.	10mV	323-576Vac
Load regulation	max.	100mV	static value, 0A → 8A
Ripple and noise voltage	max.	100mVpp	20Hz to 20MHz, 50Ohm
Output capacitance	typ.	5 200µF	
Output current	nom.	8A	at 12V, see Fig. 6-1
	nom.	6.4A	at 15V, see Fig. 6-1
Output power	nom.	96W	
Short-circuit current	min.	12A	continuous current, short circuit impedance 100mOhm
	max.	15A	continuous current, short circuit impedance 100mOhm

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



Peak current capability (up to several milliseconds)

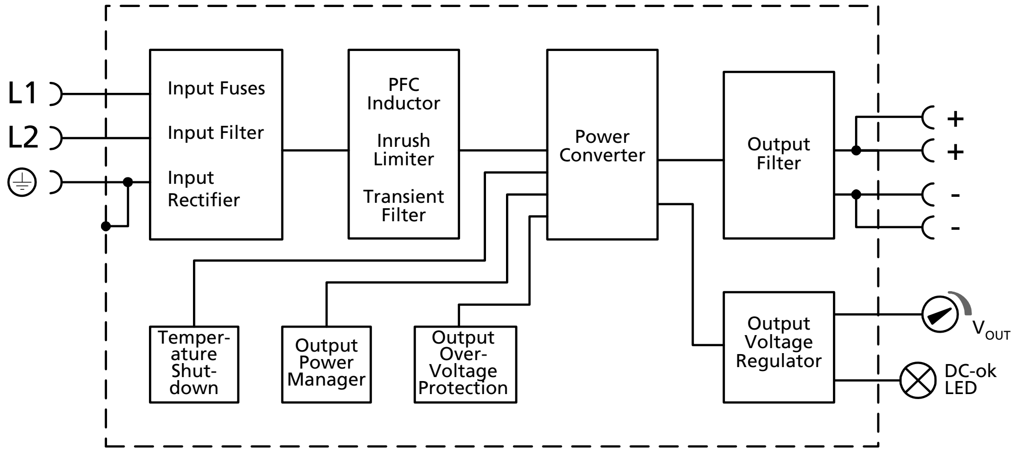
The power supply can deliver a peak current which is higher than the specified short term current. This helps to start current demanding loads or to safely operate subsequent circuit breakers.

The extra current is supplied by the output capacitors inside the power supply. During this event, the capacitors will be discharged and causes a voltage dip on the output. Detailed curves can be found in chapter 23.1.

Peak current voltage dips	typ.	from 12V to 7V	at 16A for 50ms, resistive load
	typ.	from 12V to 7V	at 40A for 2ms, resistive load
	typ.	from 12V to 3.7V	at 40A for 5ms, resistive load

9. FUNCTIONAL DIAGRAM

Fig. 9-1 **Functional diagram**



10. FRONT SIDE AND USER ELEMENTS

Fig. 10-1 **Front side**

A Output Terminals
Screw terminals, dual terminals per pole
\+ Positive output
\- Negative (return) output

B Input Terminals
Screw terminals
L1, L2 Phase input
⏚ PE (Protective Earth) input

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 > 10.5V

11. TERMINALS AND WIRING

	Input	**Output**
Type	screw terminals	screw terminals
Solid wire	0.5-6mm²	0.5-6mm²
Stranded wire	0.5-4mm²	0.5-4mm²
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	0.8Nm, 7lb.in	0.8Nm, 7lb.in

Instructions:

a) 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.
b) Follow national installation codes and installation regulations!
c) Ensure that all strands of a stranded wire enter the terminal connection!
d) Up to two stranded wires with the same cross section are permitted in one connection point (except PE wire).
e) Do not use the unit without PE connection.
f) Screws of unused terminal compartments should be securely tightened.
g) Ferrules are allowed, but not required

12. RELIABILITY

	AC 400V	**AC 480V**	
Lifetime expectancy *)	51 000h	55 000h	at 12V, 8A and 40°C
	152 000h	147 000h	at 12V, 4A and 40°C
	144 000h	156 000h	at 12V, 8A and 25°C
MTBF **) SN 29500, IEC 61709	983 000h	967 000h	at 12V, 8A and 40°C
	1 799 000h	1 769 000h	at 12V, 8A and 25°C
MTBF **) MIL HDBK 217F	484 000h	455 000h	at 12V, 8A and 40°C; Ground Benign GB40
	636 000h	600 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.

23. Application Notes

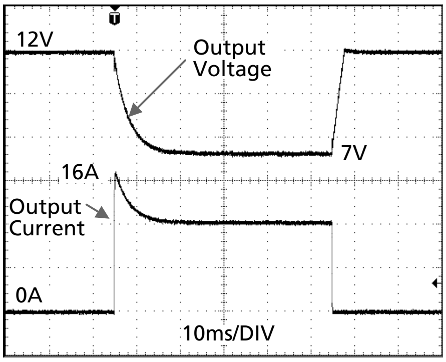
23.1. Peak Current Capability

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.

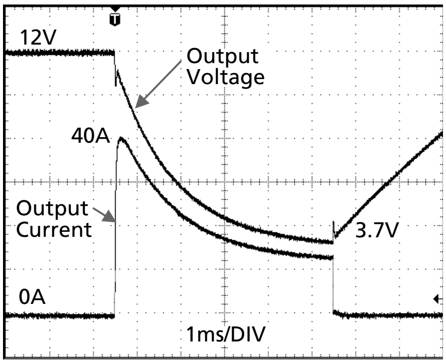
Assuming the input voltage is turned on before such an event, the built-in large sized output capacitors inside the power supply can deliver extra current. Discharging this capacitor causes a voltage dip on the output. The following two examples show typical voltage dips:

Fig. 23-1 **Peak load 16A for 50ms, typ.**



Peak load 16A (resistive load) for 50ms
Output voltage dips from 12V to 7V.

Fig. 23-2 **Peak load 40A for 5ms, typ.**



Peak load 40A (resistive load) for 5ms
Output voltage dips from 12V to 3.7V.

23.2. 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 25Vdc. The absorbing energy can be calculated according to the built-in large sized output capacitance which is specified in chapter 6.

23.3. CHARGING OF BATTERIES

The power supply can be used to charge 12V lead-acid or maintenance free batteries.

Instructions for charging batteries:

a) Ensure that the ambient temperature of the power supply 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	13.9V	13.75V	13.6V	13.4V
Battery temperature	10°C	20°C	30°C	40°C

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

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

e) The return current to the power supply (battery discharge current) is typ. 5.5mA when the power supply is switched off (except in case a blocking diode is utilized).

23.4. EXTERNAL INPUT PROTECTION

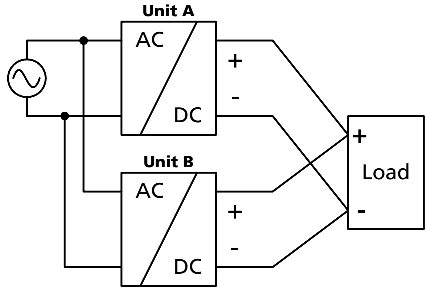
The unit is tested and approved for branch circuits up to 30A (U.S.A.) and 32A (IEC). An external protection is only required, if the supplying branch has an ampacity greater than this. Check also local codes and local requirements. In some countries local regulations might apply.

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 3A C-Characteristic breaker should be used

23.5. INDUCTIVE AND CAPACITIVE LOADS

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

23.6. PARALLEL USE TO INCREASE OUTPUT POWER



CT5.121 power supplies can be paralleled to increase the output power. This power supply has no feature included which balances the load current between the power supplies. Usually the power supply with the higher adjusted output voltage draws current until it goes into current limitation. Therefore, the power supply can only be used in parallel as long as the ambient temperature stays below 45°C. The output voltages of all power supplies shall be adjusted to the same value (±100mV). A fuse or diode on the output of each unit is only required if more than three units are connected in parallel. If a fuse (or circuit breaker) is used, choose one with approximately 150% of the rated output current of one power supply. 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 the bottom and output terminals on top of the unit) or in any other condition where a derating of the output current is required (e.g. altitude, above 60°C, …). Pay attention that leakage current, EMI, inrush current, harmonics will increase when using multiple power supplies.

23.7. PARALLEL USE FOR REDUNDANCY

Power supplies 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 power supply unit fails. The simplest way is to put two power supplies in parallel. This is called a 1+1 redundancy. In case one power supply unit 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 a N+1 method. E.g. six power supplies, each rated for 8A are paralleled to build a 40A redundant system. For N+1 redundancy the same restrictions apply as for increasing the output power, see also section 23.6.

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 power supply. In such a case, the defect unit becomes a load for the other power supplies 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 power supply.

b) Monitor the individual power supply 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.

23.8. DAISY CHAINING OF OUTPUTS

Daisy chaining (jumping from one power supply 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. 23-3 Daisy chaining of outputs

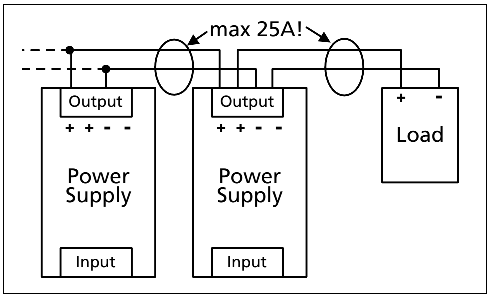
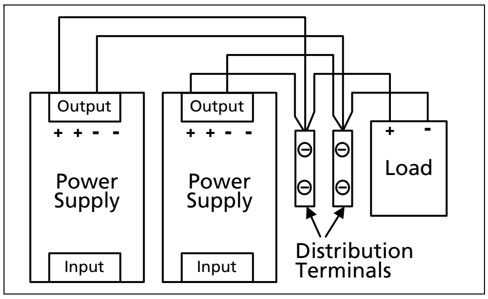
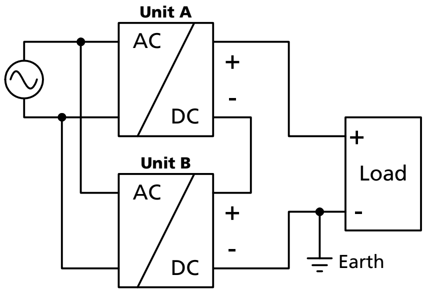


Fig. 23-4 Using distribution terminals



23.9. 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. 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 power supplies and avoid installing the power supplies on top of each other. Pay attention that leakage current, EMI, inrush current, harmonics will increase when using multiple power supplies.



23.10. 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

Enclosure:	Rittal Typ IP66 Box PK 9516 100, plastic, 110x180x165mm
Load:	12V, 6.4A; (=80%) load is placed outside the box
Input:	2x 400Vac
Temperature inside enclosure:	51.1°C (in the middle of the right side of the power supply with a distance of 2cm)
Temperature outside enclosure:	25.2°C
Temperature rise:	25.9K

23.11. 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 maximal 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. 23-5
Mounting Orientation A
(Standard orientation)

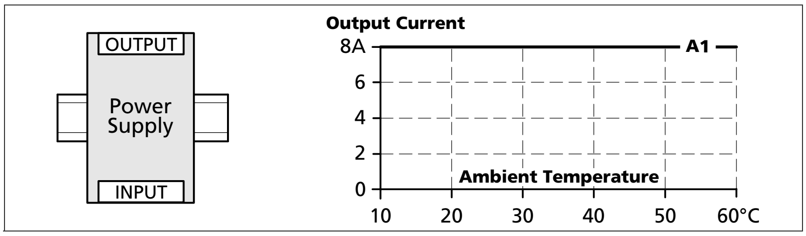


Fig. 23-6
Mounting Orientation B
(Upside down)

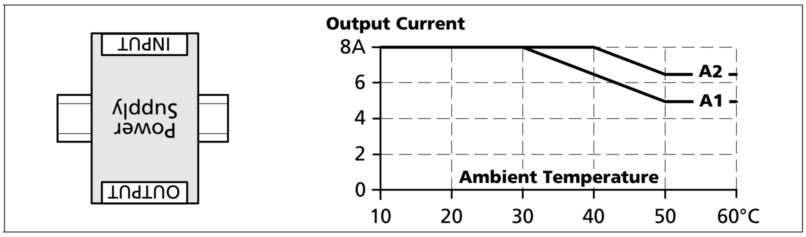


Fig. 23-7
Mounting Orientation C
(Table-top mounting)

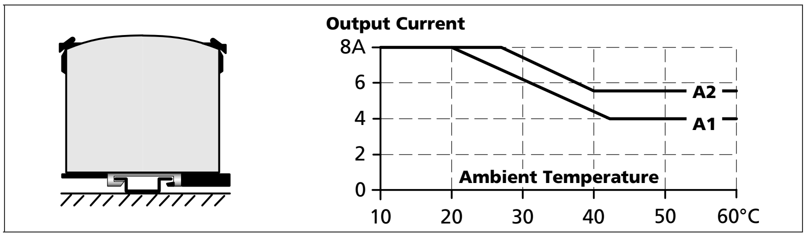


Fig. 23-8
Mounting Orientation D
(Horizontal cw)

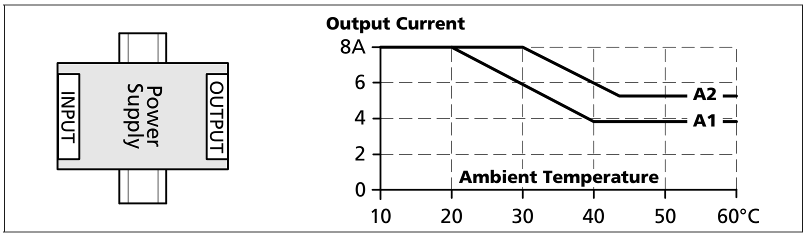
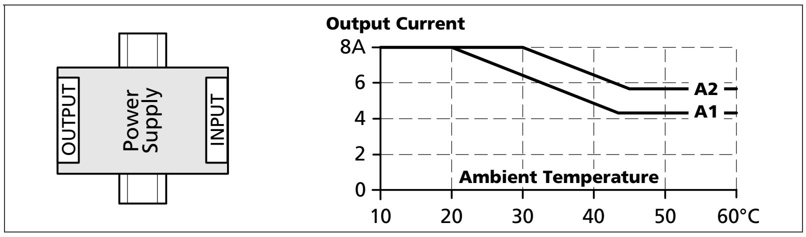


Fig. 23-9
Mounting Orientation E
(Horizontal ccw)



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