

25. APPLICATION NOTES

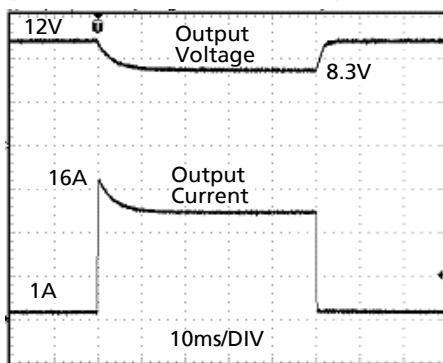
25.1. PEAK CURRENT CAPABILITY

Solenoids, contactors and pneumatic modules often have a steady state (sealed) 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.

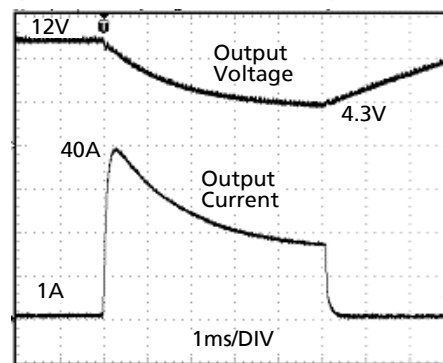
Assuming the input voltage is turned on before such an event, the built-in large sized output capacitors inside the DC/DC converter can deliver extra current. Discharging this capacitor causes a voltage dip on the output. The following two examples show typical voltage dips:

Fig. 25-1 Peak load 16A for 50ms, typ.



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

Fig. 25-2 Peak load 40A for 5ms, typ.



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

25.2. 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 capacitor which is specified in chapter 7.

25.3. INDUCTIVE AND CAPACITIVE LOADS

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

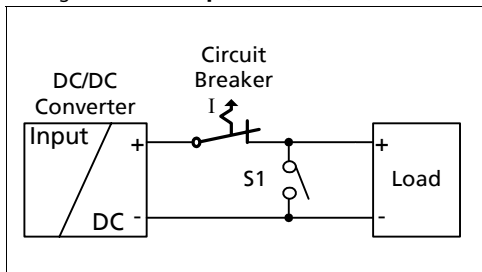
25.4. OUTPUT CIRCUIT BREAKERS

Standard miniature circuit breakers (MCBs or UL1077 circuit breakers) can be used for branch circuit protection. Ensure that the MCB is also rated for DC voltage. The following tests show which circuit breakers the DC/DC converter typically trips.

Circuit breakers have huge tolerances in their tripping behavior, therefore, these typical tests can only be used as a recommendation or for comparing two different DC/DC converters. Furthermore, the loop impedance has a major influence on whether a breaker trips or not. Two tests were performed, representing typical situations:

Test 1: Short circuit with S1 on the DC/DC converter end of the cable (loop impedance approx. 20mOhm)

Fig. 25-3 Branch protectors, test circuit 1



Parameters:

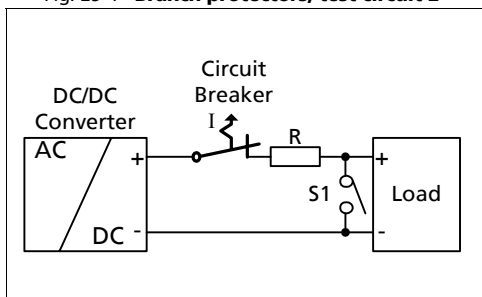
Input voltage: 24Vdc, load current: 0A

The following circuit breaker tripped during the test:

- A- or Z- Characteristic:** equal or smaller 10A *)
- B- Characteristic:** no tripping $\geq 6A$ *)
no breaker available $< 6A$
- C- Characteristic:** equal or smaller 2A *)

Test 2: Short circuit with S1 on the load end (additional impedance included; represents longer load wire length).

Fig. 25-4 Branch protectors, test circuit 2



Parameters:

Input voltage: 24Vdc, load current: 0A

The following circuit breaker tripped during the test:

- A- or Z- Characteristic:** $\leq 4A$ and $R = 220m\Omega$ *)
- B- Characteristic:** no tripping $\geq 6A$ *)
no breaker available $< 6A$
- C- Characteristic:** $\leq 2A$ and $R = 270m\Omega$ *)

What does this resistance mean in wire length?

	0.5mm ²	0.7mm ²	1.0mm ²	1.5mm ²	2.5mm ²	4.0mm ²
220mOhm	5.9m	8.2m	11.8m	17.6m	29.4m	47m
270mOhm	7.5m	10.5m	15m	23m	38m	60m

*) A list of the circuit breakers under test is available on request.

Example:

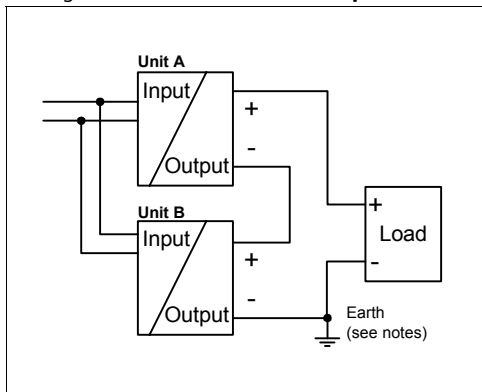
Which wire gauge must be used to trip a C-Characteristic circuit breaker with a rating of 2A? The load wire length is 21m.

Answer: A 2A C-Characteristic circuit breaker requires a loop impedance of less than 270mOhm (test results). The wire length table shows that up to 23m wire with a cross section of 1.5mm² are below 270mOhm. A wire not smaller than 1.5mm² shall be used.

25.5. SERIES OPERATION

DC/DC converters can be connected in series to increase the output voltage.

Fig. 25-5 Schematic for series operation



Instructions for use in series:

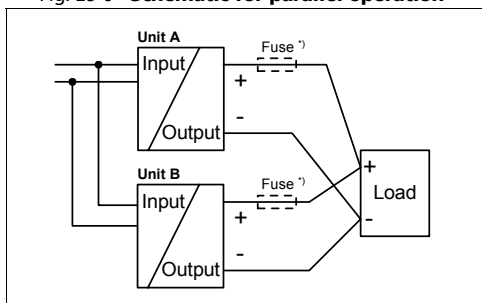
- It is possible to connect as many units in series as needed, providing the sum of the output does not exceed 150Vdc.
- Voltages with a potential above 60Vdc are not SELV any more and can be dangerous. Such voltages must be installed with a protection against touching.
- For serial operation use DC/DC converters of the same type.
- Earthing of the output is required when the sum of the output voltage is above 60Vdc.
- 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.

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

25.6. PARALLEL USE TO INCREASE OUTPUT POWER

Several DC/DC converter can be paralleled to increase the output power.

Fig. 25-6 Schematic for parallel operation



Instructions for parallel use:

- Use only DC/DC converters from the same series (C-Series) or consult PULS.
- Adjust the output voltages of all power supplies to approximately the same value ($\pm 200\text{mV}$).
- A fuse (or diode) on the output is only required if more than three units are connected in parallel.
- Do not load terminals with more than 25A. Follow wiring instructions according to chapter 25.7
- Ensure that the ambient temperature of the power supply does not exceed 45°C.

25.7. DAISY CHAINING OF OUTPUTS

Daisy chaining (jumping from one power supply output to the next) is allowed as long as the maximum current through one terminal pin does not exceed 25A. If the current is higher, use a separate distribution terminal block.

Fig. 25-7 Daisy chaining of outputs

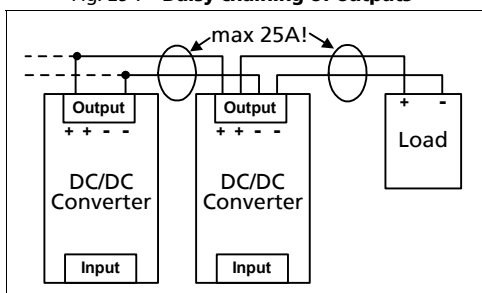
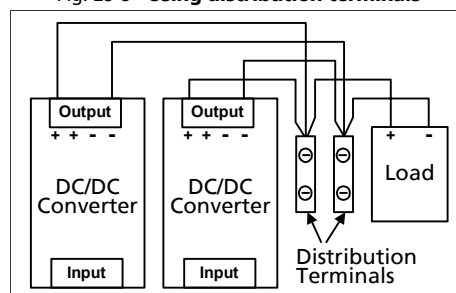


Fig. 25-8 Using distribution terminals



25.8. PARALLEL USE FOR 1+1 REDUNDANCY

DC/DC converters can be paralleled for 1+1 redundancy to gain a higher system availability. Redundant systems require a certain amount of extra power to support the load in case one DC/DC converter unit fails. The simplest way is to put two DC/DC converters in parallel. In case one converter fails, the other one is automatically able to support the load current without any interruption.

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

Recommendations for building redundant power systems:

- a) Use the decoupling module YR2.DIODE in combination with two CD5.121.
- b) Use separate input fuses for each DC/DC converter.
- c) When possible, connect each DC/DC converter to different power sources.

25.9. CHARGING OF BATTERIES

The power supply can be used for float-charging of lead-acid or maintenance free 12V VRLA batteries.

Instructions for charging batteries:

- a) Ensure that the ambient temperature of the power supply does not exceed 50°C.
- b) Set the output voltage on a disconnected load, very precisely to the end-of-charge voltage according to the expected battery temperature.

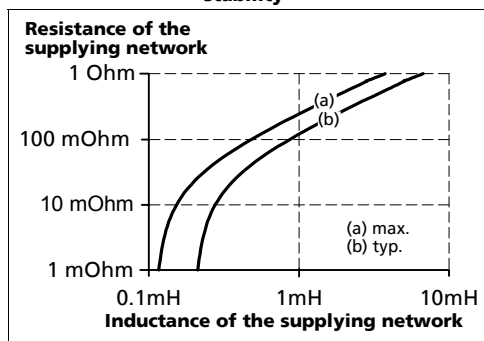
End-of-charge voltage	13.9V	13.75V	13.6V	13.4V
Battery temperature	10°C	20°C	30°C	40°C

- 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 is typ. 15mA at 12.5Vdc when the power supply is switched off (except in case a blocking diode is utilized).

25.10. 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. 25-9.

Fig. 25-9 Requirements for an input filter stability



25.11. EXTERNAL INPUT PROTECTION

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

If an external fuse is necessary or utilized, a minimum value is required to avoid undesired tripping of the fuse.

		B-Characteristic	C-Characteristic
Ampacity	max.	50A	50A
	min.	10A	8A

25.12. 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 the outside. The inside temperature defines the ambient temperature for the DC/DC converter.

Results from such an installation:

DC/DC converter is placed in the middle of the box, no other heat producing equipment inside the box

Enclosure:	Rittal Type IP66 Box PK 9516 100, plastic, 110x180x165mm
Load:	12V, 6.4A; (=80%) load is placed outside the box
Input:	24Vdc
Temperature inside the box:	58.0°C (in the middle of the right side of the DC/DC converter with a distance of 2cm)
Temperature outside the box:	22.6°C
Temperature rise:	35.4K