

25. APPLICATION NOTES

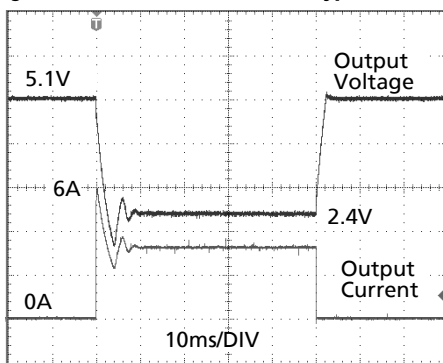
25.1. PEAK CURRENT CAPABILITY

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. 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 protective device (fuse, circuit breaker) needs a certain amount of over-current to trip or to blow. The peak current capability ensures the safe operation of subsequent circuit breakers.

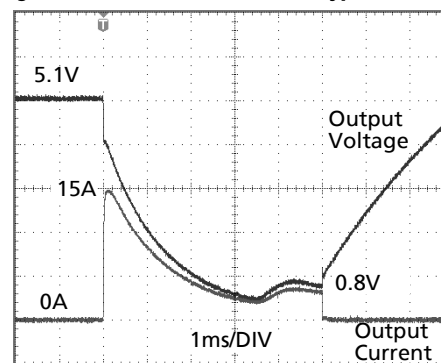
Assuming the input voltage is turned on before such an event, the built-in large sized output capacitors inside the power supply can deliver extra current. Discharging this capacitor causes a voltage dip on the output. The following two examples show typical voltage dips:

Fig. 25-1 **Peak load 6A for 50ms, typ.**



Peak load 6A (resistive) for 50ms
Output voltage dips from 5V to 2.4V.

Fig. 25-2 **Peak load 15A for 5ms, typ.**



Peak load 15A (resistive) for 5ms
Output voltage dips from 5V to 0.8V.

25.2. 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).

The maximum allowed feed back voltage is 6.3Vdc. The absorbing energy can be calculated according to the built-in large sized output capacitor which is specified in chapter 9.

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. However, please note that the output voltage can dip to zero for approximately 200ms if the back-feed voltage is removed.

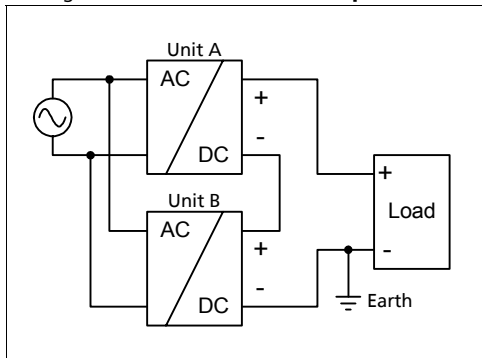
25.3. INDUCTIVE AND CAPACITIVE LOADS

The unit is designed to supply unlimited inductive loads. The max. capacitive load depend on the steady state output current. At 3A output current, the output capacity should not be larger than 10 000µF at 1.5A output not larger than 25 000µF. In case of larger capacitors, the unit can show start-up attempts or start-up problems.

25.4. SERIES OPERATION

The power supply can be put in series to increase the output voltage.

Fig. 25-3 Schematic for series operation



Instructions for use in series:

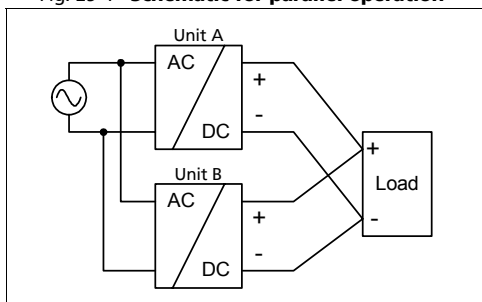
- It is possible to connect as many units in series as needed, providing the sum of the output voltage does not exceed 150Vdc.
- Voltages with a potential above 60Vdc are not SELV any more and can be dangerous. Such voltages must be installed with a protection against touching.
- For serial operation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

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

25.5. PARALLEL USE TO INCREASE OUTPUT POWER

Several power supplies can be paralleled to increase the output power. The ML15.051 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. This means no harm to this power supply as long as the ambient temperature stays below 50°C.

Fig. 25-4 Schematic for parallel operation



Instructions for parallel use:

- Use only power supplies from the same series (ML-Series).
- Adjust the output voltages of all power supplies to approximately the same value ($\pm 50\text{mV}$).
- A fuse (or diode) on the output is only required if more than three units are connected in parallel.
- Ensure that the ambient temperature of the power supply does not exceed 50°C.

25.6. PARALLEL USE FOR REDUNDANCY

Power supplies can be paralleled for redundancy to gain a higher system reliability. 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 MiniLine 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. Five power supplies, each rated for 3A are paralleled to build a 12A redundant system. If one unit fails, the 12A can still be drawn.

25.7. EXTERNAL INPUT PROTECTION

The unit is tested and approved for branch circuits up to 15A (UL) or 16A (IEC). 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 requirements.

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

		B-Characteristic	C-Characteristic
Ampacity	max.	15A (UL), 16A (IEC)	15A (UL), 16A (IEC)
	min.	10A	6A

25.8. FUNCTIONAL EARTH TERMINAL

From a safety standpoint, the unit is designed according to the requirements for Protection Class 2 which does not require an earth connection. However, connecting the Functional Earth terminal can be beneficial to gain a high EMI immunity.

Symmetrical spikes or fast transients on the input side can be conducted directly to earth by the built-in filter capacitors. The magnitude of such spikes or fast transients on the output side caused by the input are much smaller compared to not connecting the FE terminal to ground.

Therefore, we recommend to connect the FE terminal to ground.

Fig. 25-5 **Functional earth terminal connected to earth**

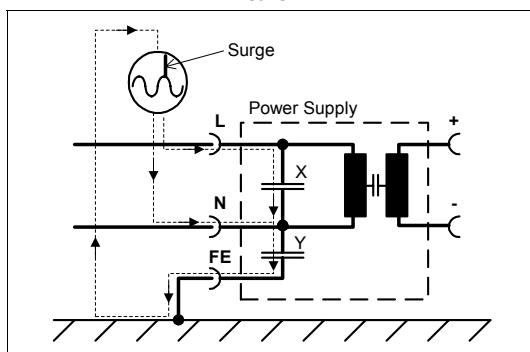
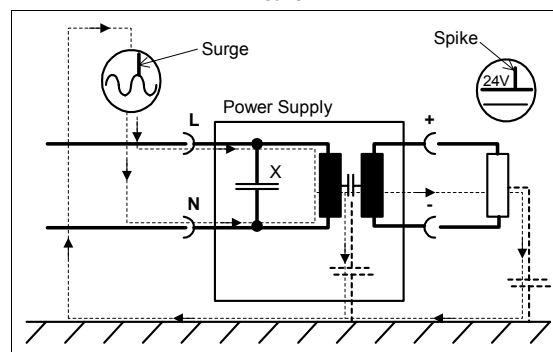


Fig. 25-6 **Functional earth terminal not connected to earth**



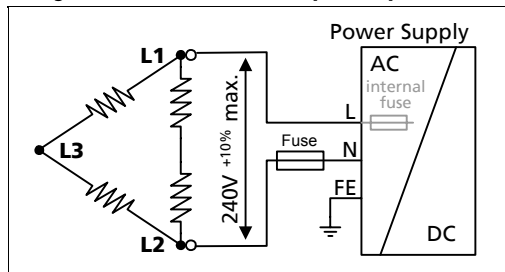
25.9. OPERATION ON TWO PHASES

The power supply can be used on two phases of a three-phase-system

Instructions for two phase operation:

- A phase to phase connection is allowed as long as the supplying voltage is below $240V^{+10\%}$.
- Use a fuse or a circuit breaker to protect the N input. The N input is internally not protected and is in this case connected to a hot wire. Appropriate fuses or circuit breakers are specified in section 25.7 "External Input Protection".

Fig. 25-7 Schematic for two phase operation



25.10. 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 the outside. The inside temperature defines the ambient temperature for the power supply.

Results from such an installation:

Power supply is placed in the middle of the box, no other heat producing equipment inside the box

Enclosure: Rittal Type IP66 Box PK 9510 100, plastic, 130x130x75mm
 Input: 230Vac

Load: 5V, 3A; load is placed outside the box
 Temperature inside the box: 38.2°C (in the middle of the right side of the power supply with a distance of 1cm)
 Temperature outside the box: 26.0°C
 Temperature rise: 12.2K

Load: 5V, 2.4A; (=80%) load is placed outside the box
 Temperature inside the box: 35.3°C (in the middle of the right side of the power supply with a distance of 1cm)
 Temperature outside the box: 25.6°C
 Temperature rise: 9.7K

25.11. MOUNTING ORIENTATIONS

Mounting orientations other than input terminals on the bottom and output on the top requires 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 power.

Curve A2 Max allowed output power (results approx. in half the lifetime expectancy of A1).

Fig. 25-8

Mounting Orientation A
Standard Orientation

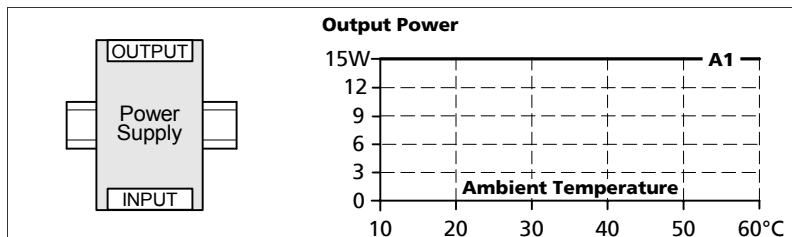


Fig. 25-9

Mounting Orientation B
(Upside down)

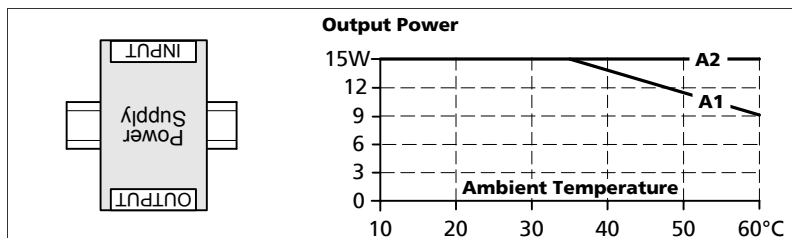


Fig. 25-10

Mounting Orientation C
(Table-top mounting)

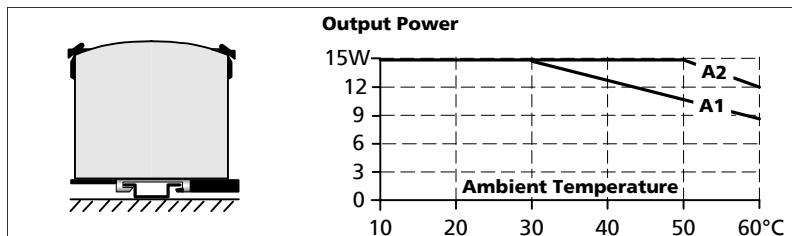


Fig. 25-11

Mounting Orientation D
(Horizontal cw)

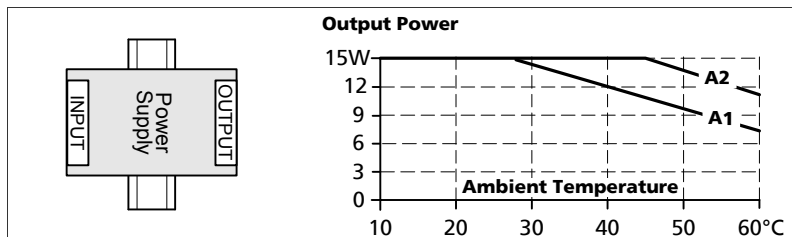


Fig. 25-12

Mounting Orientation E
(Horizontal ccw)

