

## SAFE OPERATION OF A POWER SUPPLY

### Prevention from electrical shock hazard

#### 1) Introduction

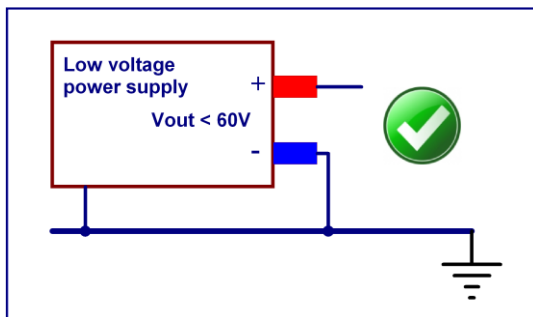
All Delta Elektronika power supplies have a safety insulation barrier that insulates the DC power circuits and programming interfaces from the Mains.

A number of interfaces are insulated, other interfaces are internally connected to the minus DC power terminal, and for those safety is depending on the safety level of this terminal. The DC power terminals are floating which means that different earthing methods are possible.

This document describes the effect of the earthing methods on the safety of personnel. There is a distinction between Safe (no further measures required) and Hazardous levels (additional measures required to ensure safety).

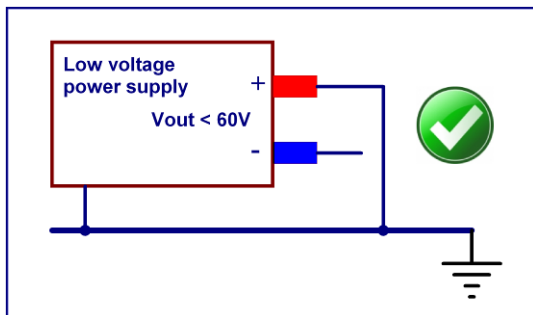
#### 2) Operation of a low voltage power supply

**According to safety standards, voltages of maximum 60VDC are considered safe.**



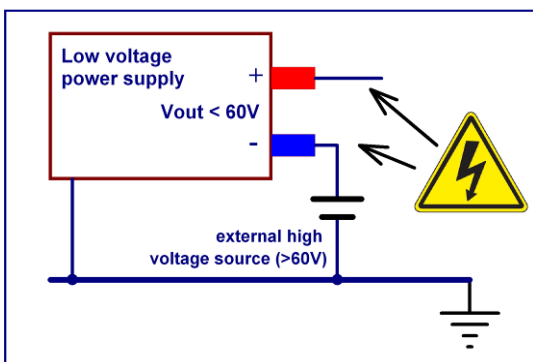
**Fig 1: Minus DC power terminal connected to Protective Earth.**

- No voltages above 60VDC to Protective Earth exist.
- DC power terminals are considered to be safe.
- Note: Sense wires are hard connected to the DC power terminals and have the same safety level.



**Fig 2: Plus DC power terminal connected to Protective Earth.**

- No voltages above 60VDC to Protective Earth exist.
- DC power terminals are considered to be safe.



**Fig 3: An external high voltage source makes DC power terminals unsafe.**

- DC power terminals connected to Protective Earth through an external high voltage source (for example when power supplies are used in series).
- Voltages above 60VDC to Protective Earth exist.
- Both DC power terminals have to be considered as hazardous.
- Interfaces need to be checked for safety.

### 3) Operation of a high voltage power supply

According to safety standards, voltages more than 60V are considered hazardous.

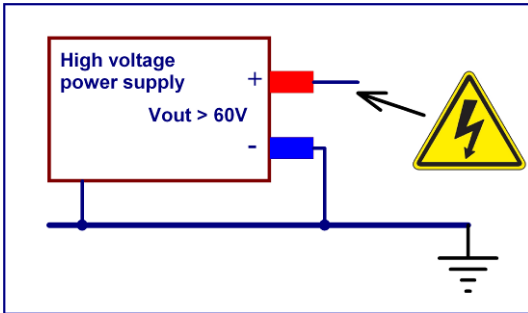


Fig 4: Minus DC power terminal connected to Protective Earth.

- The plus DC power terminal has a voltage higher than 60VDC to Protective Earth.
- Plus DC power terminal has to be considered hazardous.

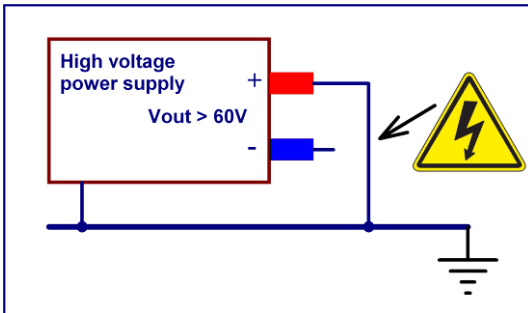


Fig 5: Plus DC power terminal connected to Protective Earth.

- The minus DC power terminal has a voltage higher than 60VDC to Protective Earth.
- The minus DC power terminal has to be considered hazardous.
- Interfaces need to be checked for safety.

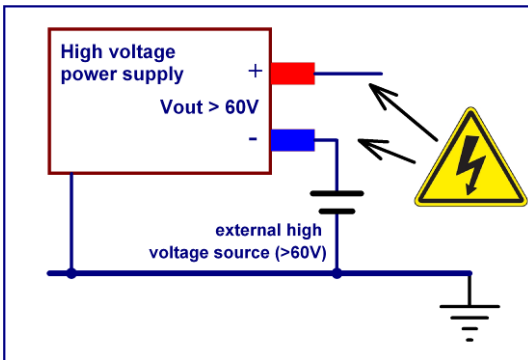


Fig 6: An external high voltage source makes DC power terminals unsafe.

- DC power terminals connected to Protective Earth through an external high voltage source (for example when power supplies are used in series).
- Voltages above 60VDC to Protective Earth exist.
- Both DC power terminals have to be considered as hazardous.
- Interfaces need to be checked for safety.

### 4) Programming interfaces

Interfaces are divided in three groups:

#### 1) Safety insulated interfaces.

- (1) These interfaces have a reinforced safety insulation barrier of 1000VDC working voltage. For SM1500-CP-30 this is 1500VDC working voltage.
- (2) The connections can be considered safe up to voltages of 1000VDC between minus DC power terminal and Protective Earth. For SM1500-CP-30 this is 1500VDC.
- (3) Interfaces in this group are:
  - (a) LAN, Interlock and INT MOD XXX interfaces on SM3300 & SM15K.
  - (b) ISO-AMP (=isolated analog programming).
  - (c) PSC-232.
  - (d) PSC-488.

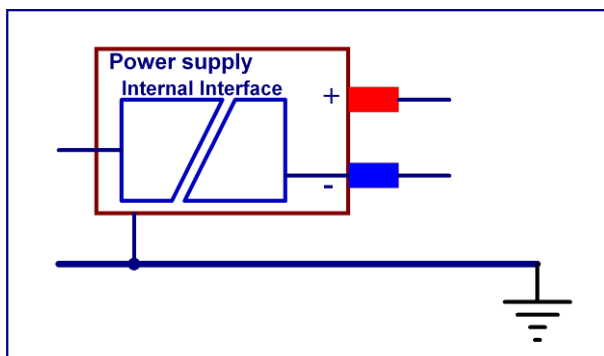


Fig 7: Interface of group I.

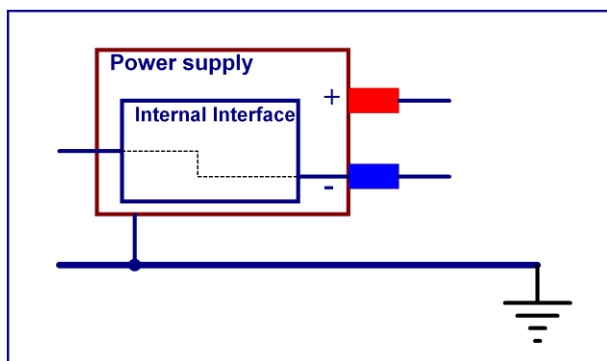
- The user side of the interface is safe, up to a working voltage of 1000VDC between the minus DC power terminal and Protective Earth.

## II) Functional insulated interfaces.

- (1) These interfaces have a functional insulation, only for the correct functioning of the equipment.  
For example to prevent earth loop related errors.
- (2) Warning! Functional insulation by definition does not protect against electric shock.
- (3) For safety, the inputs have to be considered at the same level as the minus DC power terminal.
- (4) Interfaces in this group are:
  - (a) PSC-ETH-2, PSC-ETH.
  - (b) PSC-PB.
  - (c) PSC-CAN.
  - (d) Alarm relays on SM800, SM1500, SM6000.
  - (e) Old versions of ISO-AMP and PSC-232/488 (2014 or older).

## III) Non-insulated interfaces

- (1) These interfaces are hard connected to the minus DC power terminal and the inputs are at the same safety level. The voltage on the minus DC power terminal determines the safety level of the programming interfaces.
- (2) Interfaces in this group are:
  - (a) Analog programming connector on ES150, ES300, SM800, SM1500, SM6000.  
*Exceptions: SM300-20 & SM600-10 have standard a safety insulated ISO-AMP.*
  - (b) Interlock on SM800, SM1500, SM6000.
  - (c) Master/Slave connections on SM800, SM1500, SM6000.



**Fig 8: Interface of groups II and III.**

- The user side of the interface has the same safety level (safe or hazardous) as the minus DC power terminal.

## 5) Safety measures

### Create a safe situation for:

#### I) DC power terminal connections and wiring

- (1) If possible, keep voltage at a safe level by earthing the minus DC power terminal.
- (2) Prevent access of hazardous parts by putting them in a “restricted access location”.)
- (3) Accessible wiring, carrying hazardous voltages must have a sufficient voltage rating.

#### II) Interface connections and wiring.

- (1) If possible, make interface connections safe by either:
  - (a) Keep minus DC power terminal at a safe level by earthing.
  - (b) Use an interface with “reinforced insulation” and make sure the minus DC power terminal stays below the rating of the insulation.
- (2) Prevent access of hazardous parts by putting them in a “restricted access location”.)
- (3) Accessible wiring, carrying hazardous voltages must have a sufficient voltage rating.

#### \*) Requirements for a restricted access location.

- Access can only be gained by SERVICE PERSONS or by USERS who have been instructed about the reasons for the restrictions applied to the location and about any precautions that shall be taken; and
- Access is through the use of a TOOL or lock and key, or other means of security, and is controlled by the authority responsible for the location.