

## SAFE OPERATION OF A POWER SUPPLY

### Prevention from electrical shock hazard

#### 1) Introduction

All Delta Elektronika power supplies have a safety insulation barrier that isolates all power output circuits and programming interfaces from the mains. The interfaces are internally connected to the minus output, so safety is depending on the safety level of the minus output. The outputs 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

a) According to safety standards, voltages <60V are considered safe.

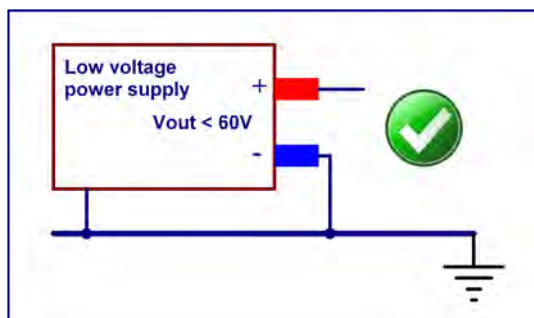


Fig 1: Negative output connected to earth.

- No voltages above 60Vdc to earth exist.
- Outputs are considered to be safe.
- Note: Sense wires are hard connected to the outputs and have the same safety level as the corresponding output.

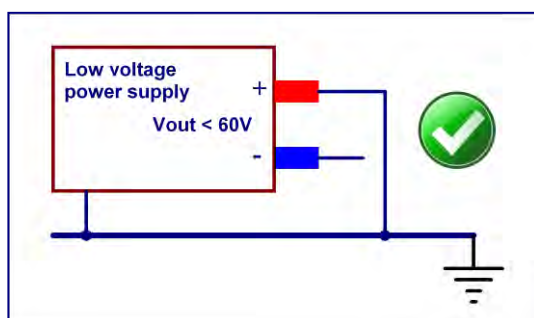


Fig 2: Positive output connected to earth.

- No voltages above 60Vdc to earth exist.
- Outputs are considered to be safe.

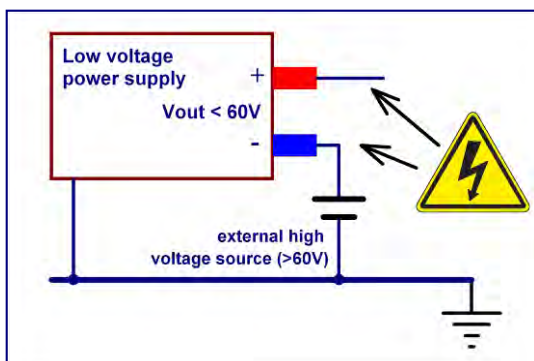


Fig 3: An external high voltage source makes the output unsafe.

- Output connected to earth through an external high voltage source (for example when power supplies are used in series).
- Voltages above 60Vdc to earth exist.
- Both outputs have to be considered as hazardous.
- Interfaces need to be checked for safety.

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

a) According to safety standards, voltages >60V are considered hazardous.

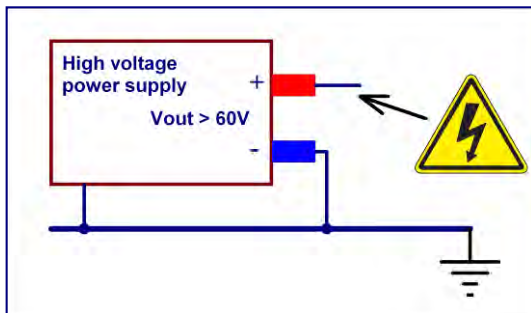


Fig 4: Negative output connected to earth.

- The positive output has a voltage higher than 60Vdc to earth.
- Positive output has to be considered hazardous.

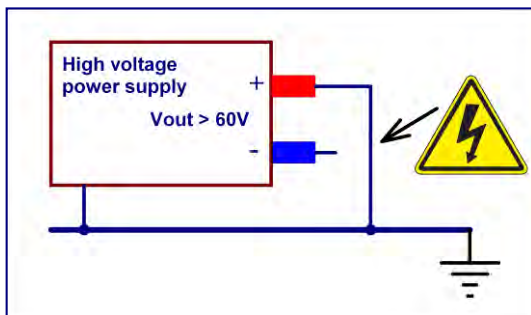


Fig 5: Positive output connected to earth.

- The negative output has a voltage higher than 60Vdc to earth.
- Negative output has to be considered hazardous.
- Interfaces need to be checked for safety.

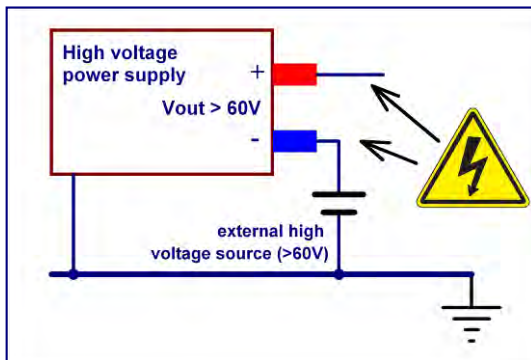


Fig 6: An external high voltage source makes the output unsafe.

- Output connected to earth through an external high voltage source (for example when power supplies are used in series).
- Voltages above 60Vdc to earth exist.
- Both outputs have to be considered as hazardous.
- Interfaces need to be checked for safety.

### 4) Programming interfaces

a) Programming interfaces are internally connected to the negative output.

(1) The voltage on the negative output determines the safety level of the programming interfaces.

b) Interfaces are divided in three groups:

1) Safety insulated interfaces.

(1) These interfaces have a reinforced safety insulation barrier of 1000Vdc working voltage (test voltage 4250Vdc). The exception is 1500Vdc working voltage for SM1500-CP-30.

(2) The connections can be considered safe up to voltages of 1000Vdc between negative output and earth. For SM1500-CP-30 this is 1500Vdc.

(3) Interfaces in this group are:

- Interface modules, LAN interface and Interlock for SM3300- & SM15K-series.
- ISO AMP.
- PSC-232.
- PSC-488.

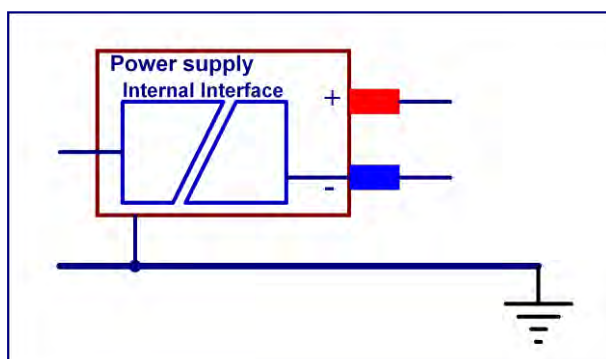


Fig 7: Interface of group I.

- The user side of the interface is safe, up to a working voltage of 1000Vdc between the negative output and earth (1500Vdc for SM1500-CP-30).

## II) Functional insulated interfaces.

- (1) These interfaces have a functional isolation, necessary only for the correct functioning of the equipment, like to prevent earth loop related errors.
- (2) NOTE; functional isolation by definition does not protect against electric shock.
- (3) For safety, the inputs have to be considered at the same level as the negative output.
- (4) Interfaces in this group are:
  - (a) PSC-ETH.
  - (b) PSC-PB.
  - (c) PSC-CAN.
  - (d) Alarm relays.
  - (e) Old versions of ISO-AMP and PSC-232/488.

## III) Non-insulated interfaces (not applicable for the SM3300 and SM15K series)

- (1) These interfaces are hard connected to the negative output. The inputs are at the same safety level as the negative output.
- (2) Interfaces in this group are:
  - (a) Analogue programming interface.
  - (b) Interlock.
  - (c) Master/Slave connections.

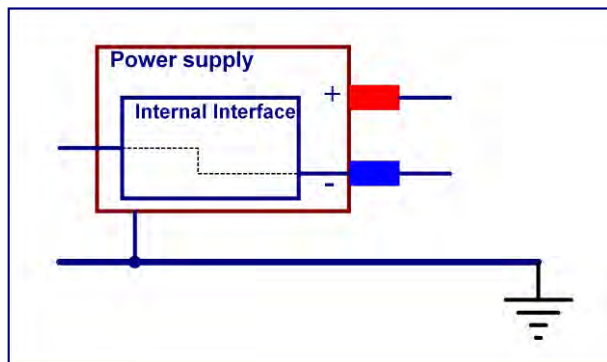


Fig 8: Interface of groups II and III.

- The user side of the interface has the same safety level (safe or hazardous) as the negative output.

## 5) Safety measures

### a) Create a safe situation for:

#### I) Output connections and wiring

- (1) If possible, keep voltage at a safe level by earthing.
- (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 negative output at a safe level by earthing.
  - (b) Use an interface with "reinforced isolation" and make sure the negative output stays below the 1000Vdc rating of the isolation (below 1500Vdc for SM1500-CP-30).
- (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.

(4)

#### \*) 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.