Dewesoft application note:
Power supply ground loops

1. Overview
Ground loops in signal lines are well known in data acquisition systems. Measurement errors, higher noise or even damage of the DAQ-System or the connected sensors are the result of these GND-Loops.

But how about the power supply? Are GND-loops there possible as well? Yes, it is exactly the same at non isolated power supply concepts! Care must be taken when supplying multiple devices – even if each device itself has a correct over-voltage and reverse polarity protection like the complete DAQ-System series from DEWESoft (like Sirius, DEWE-43...).

This is the price for higher efficiency and wider input range of non isolated power supplies.

2. Detailed description
Supply topology:
The picture below shows a typical configuration. A sensor and the DAQ-System are supplied out by the same DC power supply (e.g. the vehicle on board network). You can see the GND is connected from two points: The main current flows along the blue thick line (“high current path”), to the load and back. But the GND of both devices are also connected together, through the sensor output and DAQ input.

Note: In general, this supply configuration is also valid connecting two DAQ systems together. The additional connection may be also something else than the sensor input: e.g. be the common GND of the data path (USB-GND) or the common GND of the sync bus.
Error case with broken GND cable:
You can imagine what will happen when “high-current path” is open. The current will flow a different way. Now the return supply path of the sensor is routed through the GND of the sensor input from the DAQ device.

![Diagram showing high current path]

Usually the internal circuitry is not capable of driving this high current. So the DAQ device may be damaged.

Error case with not symmetric supply line resistor:
In practice the supply wiring is more complicated like shown in this basic diagram. A cable brake on the supply line is for sure the worst case. But also line resistances in the supply lines combined with different supply current levels will cause unintentional current flow through the DAQ-system like shown below.

![Diagram showing high current path]
3. Solution

Supply protection box:

An external fuse in the GND line solves this problem already. If the current through the supply line is too high, the will fuse blow. Therefore no damage on the DAQ-system or the sensor may happen.

In addition the supply protection box provides reverse polarity protection. The current is shorted over the diode (failure current does not flow through the sensor) and will blow up the fuse.
Isolated power supply

Another way of protecting the DAQ device is the usage of the “DS isoPower 75W”. This box includes a DC/DC converter which galvanically isolates the power supply input of the DAQ-System (the example shows the DEWE-43). Due to the isolation, no error current is possible through the supply line.

The final result is the same: reverse polarity protection of the supply line.

For support please contact support@dewesoft.org.