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Application Note

1 Galvanic Isolation also known as Floating

Electronic devices connected to a non-portable power supply, like a USB or power socket are usually connected to a big mass of conducting material. This big mass is often the earth itself. Connections to this big mass are known as ground, earth, or mass. A device with an insulation, which separates the device from any other ground, is called galvanically isolated or floating. The word floating describes the fact that the device does not have a fix reference point for its potential or voltages.

This application note discusses the galvanic isolation options for the different PalmSens instruments as well as the effect of galvanic isolation on your measurement.

2 PalmSens Devices and Galvanic Isolation

2.1 Galvanic Isolation for instruments connected via USB

EmStat4S, EmStat3(+), Sensit Smart
A USB cable connects the chassis of the instrument to the ground of the power providing device. For example, an EmStat4S connected via USB to a desktop PC, connects to the ground of the PC, which is in turn connects to the ground of the mains power supply.

To isolate an instrument via USB, a galvanic isolation dongle can be inserted in the USB connection between the PC and the potentiostat. A USB GI dongle is available in many electronics stores or via PalmSens.

2.2 Galvanic Isolation for instruments connected via USB or Bluetooth

EmStat3(+) Blue, PalmSens4, PalmSens3 with Bluetooth extension, Sensit BT
There are two options for galvanic isolation:

1. Use a USB GI dongle as detailed previously.
2. Use the internal battery as power supply, use the Bluetooth connection of the potentiostat for communication and remove the USB cable. The absence of any physical connection guarantees that the potentiostat is floating. The potentiostat can be controlled via Bluetooth with our Windows software PSTrace and our Android software PStouch.

2.3 Galvanic Isolation for multichannel instruments

MultiEmStat4, MultiEmStat3(+), MultiPalmSens4
All PalmSens multichannel instruments are available in a galvanic isolated and non-isolated version.

Usually, the modules of each channel in multi-potentiostats like the MultiPalmSens4 share the same ground and share that ground with the chassis. This means each of the potentiostat modules in the multi-potentiostat has its ground connected to the chassis of the device. The housing is connected to the power supply, which is connected to the mains ground. Accordingly, it is not easy to make the device floating.

Galvanic isolation in a multichannel instrument makes every potentiostat module floating, that means having its own ground as indicated in Figure 2.1. Galvanic isolation is available for these instruments, but it must be installed during the assembly of the device. This is an option which needs to be declared when requesting a quote or ordering the device. The galvanic isolation cannot be installed afterwards.

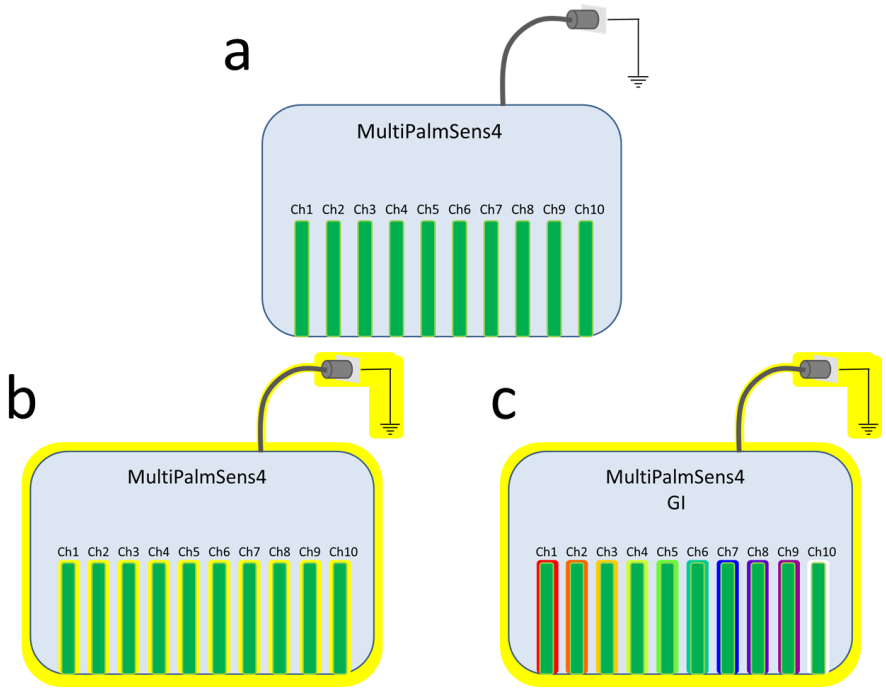

Figure 2.1 a) Scheme of a MultiPalmSens4 with its PCBs; b) MultiPalmSens4 with yellow halo indicating the same ground; c) MultiPalmSens4 with Galvanic Isolation and indication of different ground by different colored halos

3 Effects of Galvanic Isolation

Galvanic isolation makes sure no current can flow from one channel to another channel or from one channel to the common ground. Galvanic isolation therefore creates a non-conductive separation between the channels. The part of the system that is galvanically isolated, has no connection to a common ground and in the majority of situations no other common connection to the other potentiostat-channels. This status is also known as floating or earth / ground potential free. The removal of the ground connection can have some impacts on certain measurements.

Galvanic isolation is often requested for multi-channel devices. The main application for floating instruments is to have shared electrochemical cells or electrolytes with different potentiostat-channels. Without galvanic isolation it is not possible to operate multiple 2- or 3-electrode systems in the same cell.

The potentiostat-channels in a galvanically isolated instrument typically use the common ground as working electrode potential, which is difficult to imagine for electrochemists. In a multichannel potentiostat without galvanic isolation, multiple potentiostat-channels will start to cross talk when used in the same electrochemical cell. The cross talk goes via the shared ground due to a common chassis, a connection to the protection contacts in a USB plug or a power socket. If all potentiostat-channels are floating, there won't be any cross talk, because there is no internal connection.

Another reason to use a floating instrument is to avoid ground loops. If two points in your systems are meant to be ground, but, have a potential difference between them (the potential of the ground is not uniform) then noise is induced. For this reason, a common practice is to ground your devices "star shaped". This means all ground connection of your devices should be connected to the same spot. This is usually a point at the Faraday cage, because it has the biggest mass and doesn't charge easily. And one point at the Faraday cage means here a physical small area, so all connectors should be next to each other leading like the rays of a star away from one point. Of course, if you remove the connection to

the ground (thus having a floating device), there can't be any current flow through the ground connections, because there are no ground connections.

There is, however, a disadvantage: The noise protection is drastically reduced. Usually all conducting shields connected to the ground act as a Faraday cage for the device and protect it against noise. If the connection between the chassis and the potentiostat is removed, the chassis no longer acts as a Faraday cage for the potentiostat. This is an important protection against environmental noise, which is removed. Additionally, the floating device can't share a Faraday cage with any other device, which might create a rather complex setup.

According to our experience most customers don't need to measure with multiple potentiostats in the same cell or use the device as a ZRA. Galvanic isolation increases the price for your multi-channel device and decreases the signal to noise ratio. We therefore recommend galvanic isolation only for customers, who know that they need it and are aware of the drawback.

You need galvanic Isolation, if you want to use your potentiostat with other potentiostats in the same cell. With galvanic isolation, the housing of a multi-channel instrument is no longer a Faraday cage for the potentiostat modules inside.