

1 Galvanic Isolation also known as Floating

Electronic devices which are connected to a non-portable power supply (USB socket, power socket, etc.) are usually connected to a big mass of conducting material. This is often the earth itself. These connections 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 that the device doesn't have a fix reference point for its potential or voltages, because this fix point usually is the ground.

In this application note the galvanic isolation options are discussed for the different PalmSens instruments as well as the effect of galvanic isolation on your measurement.

2 PalmSens Devices and Galvanic Isolation

2.1 EmStat3, EmStat3+, PalmSens4C

These instruments are powered through their USB port. A USB cable will connect the chassis of the instruments to the ground of the power providing device. For example, an EmStat3 connected to a desktop PC is connected to its ground, which is the ground of the mains.

An option to isolate these potentiostats is to use a galvanic isolation dongle, which can be bought in many electronics stores or from PalmSens BV (<https://www.palmsens.com/product/galvanic-isolation-dongle/>). This dongle is put between the computer and the potentiostat. It removes the connection to the computers ground.

2.2 EmStat3 Blue, EmStat3+ Blue, EmStat3 Blue, PalmSens4, PalmSens3

These instruments are powered through their USB port or by their battery. Accordingly there are also two options for galvanic isolation. A USB cable will connect the chassis of the instrument to the power providing device's ground. For example, an EmStat3 Blue connected to a desktop PC is connected to the PC's ground, which is the ground of the mains.

An option to isolate a potentiostat connected via USB is to use a galvanic isolation dongle, which can be bought in many electronics stores or from PalmSens BV (<https://www.palmsens.com/product/galvanic-isolation-dongle/>). This dongle is put between the computer and the potentiostat. It removes the connection to the computers ground.

The other option is to use the Bluetooth connection of the potentiostat for communication and the internal battery as power supply. Please note that the PalmSens3 requires a Bluetooth extension (<https://www.palmsens.com/product/bluetooth-extension-palmsens3/>) to be controlled via Bluetooth.

The absence of any physical connection guarantees that the potentiostat is floating. The potentiostat can be controlled via Bluetooth with our Windows software PStTrace and our Android software PStouch.

2.3 MultiEmStat3, MultiEmStat3+, MultiPalmSens4

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 is available for these potentiostats, but it has to 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. The Galvanic Isolation makes every PalmSens4 module in the MultiPalmSens4 floating, that means having its own ground as indicated in Figure 2.1.

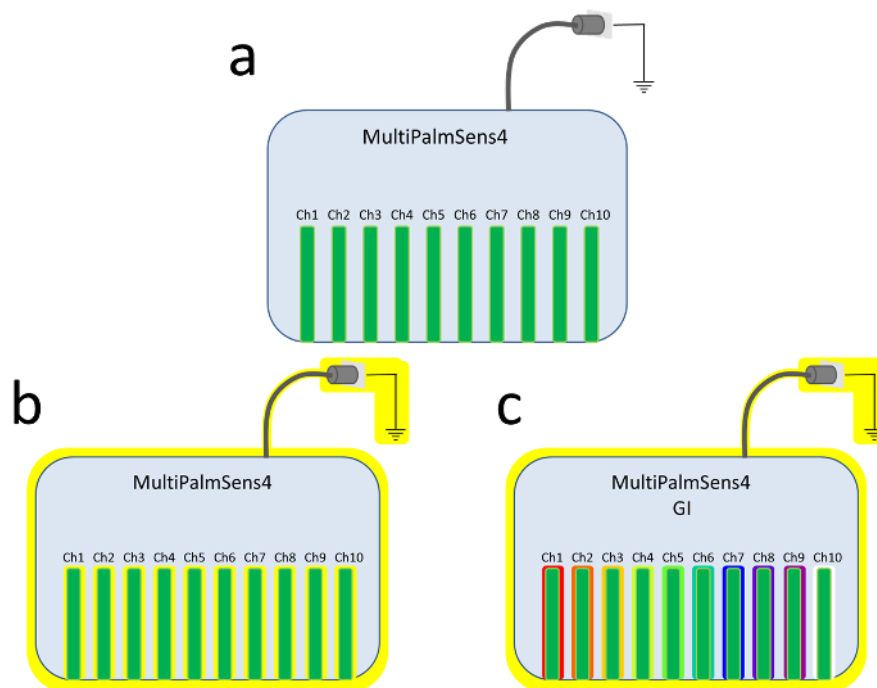


Figure 2.1 a) Scheme of a MultiPalmSens4 with its PCBs; b) MultiPalmSens4 with yellow halo indicating the same ground; c)

MultiPalmSens4 with Galvanic Isolation and indication of different ground by different colored halos

3 Effects of Galvanic Isolation

Galvanic isolation (GI) can be translated to non-conductive separation. The part of system with GI has no connection to a common ground and in the majority of situations no other common connection to the other parts of other potentiostats. This status is also known as floating or earth / ground potential free. The removal of the ground connection has some impacts on your measurement.

GI is often requested for multi-channel devices. The potentiostats in one of these instruments use usually the common ground as working electrode potential, which is difficult to imagine for electrochemists. This means, multiple potentiostats will start to cross talk, if they share the ground due to a common chassis, a connection to the protection contacts in a USB plug or a power socket, and try to work in the same electrochemical cell. If all potentiostats are floating, they can't cross talk, because there is no internal connection. This is the main application for floating instruments: Shared electrochemical cells / electrolytes. Without galvanic isolation it is not possible to operate multiple 2- or 3-electrode systems in the same cell.

Another reason to use a floating instrument is to avoid ground loops. If two points in your systems are meant to be ground, but there is actually a potential difference between them (the potential of the ground isn't uniform) 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.

Furthermore if you want to use your EmStat or PalmSens as a ZRA (Zero Resistance Ammeter), it needs to be floating. With a ZRA you are measuring a current without changing it. You short circuit the RE and CE of the potentiostat and let the current, you want to measure, flow through WE and GND of the device. Would the ZRA share the ground with the flowing current, such a measurement wouldn't be possible.

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. This is why we recommend galvanic isolation only for customers, who know that they need it and are aware of the drawback.

Galvanic Isolation is needed, if you want to use your potentiostat with other potentiostats in the same cell or want to use it as a ZRA. The housing of a multi-channel instrument is no longer a Faraday cage for the potentiostat modules inside.