

Setting up an EQCN measurement system in a noisy lab environment

1. Interference

Select a place in the lab which is far from devices generating strong electromagnetic fields, such as transformers, electromagnet valves, high voltage power supplies, electronic voltage regulators, NMR, ESR, *etc.* The computer monitor (CRT, but not an LCD type) should also be placed as far as possible from the oscillator circuit. For most of the small laboratory devices generating electromagnetic fields, the distance of 6 or more feet from the oscillator circuit should be sufficient to reduce the interference.

2. Grounding

All instruments should be appropriately grounded. Usually, grounding with an a.c. ground (ac-GND) available in the standard, HP-type, 3-prong power outlets is sufficient. The potentiostat model PS-605, EQCN models 600 and 700, and Data Logger DAQ-616, have chassis connected internally to the ac-GND. On the back panels of these instruments, the ac-GND banana sockets (metal hex-nut type) are provided for grounding of other instruments if necessary. The electrical common (or: analog ground, A-GND) is also available on back panels of these instruments in isolated (black or brown) banana sockets. Use the A-GND for reference purposes only.

In a noisy environment, you may externally connect chassis of all instruments of the set-up (including the computer) to the ac-GND (or a water pipe) with short copper braid high-conductance cables (provided). Do not ground the Faraday Cage. When using the quartz crystal oscillator with potentiostat, the working electrode of the quartz crystal is grounded through the potentiostat circuitry and no additional grounding of the oscillator should be employed. When potentiostat is not used in measurements and oscillator frequency is monitored as a function of time only, connect the working electrode of the quartz crystal to ground by changing the position of the OSC toggle switch on the side panel of the Faraday Cage, from FLOAT to GND.

When making ground connections, remember not to create ground loops.

3. Faraday Cage and oscillator

The purpose of the Faraday Cage is to screen the quartz crystal oscillator from external electromagnetic interference and also, to prevent emission of electromagnetic waves generated by the resonator itself. The oscillator cannot be sealed and has to remain open by the nature of EQCN measurements. For less sensitive measurements, the door to the Faraday Cage may stay wide open. However, for sensitive measurements, the door should be in a near-closed position to prevent interference and control the amount of energy loss to radiation. Do not lock the door as it would not increase the shielding efficiency. The locking itself may introduce unnecessary vibrations and shock disturbance to the system.

Normally, the Faraday Cage does not need to be grounded.

4. Using an oscilloscope

You can view and record the oscillation functions for the reference oscillator (RO) sealed inside the Remote Probe Unit on the back of Faraday Cage and the working oscillator (WO) using an external oscilloscope. To do this, connect the oscilloscope input to the BNC output **F-OUT** on the side panel of the Faraday Cage and observe the signal using the time base of 50 ns per division and sensitivity of 2 V per division. The signal is a square wave, TTL/CMOS logic compatible, with voltage levels 0 and +5 V.

Remember that, usually, the oscilloscope low input (the shield) is shorted internally to the ac-GND. For sensitive EQCN measurements, disconnect the oscilloscope from the Faraday Cage and remove all unnecessary cables (which may act as antennae wires).

5. Using an external frequency meter

You can measure the oscillation frequency of the reference oscillator (RO) and the working oscillator (WO) using an external frequency meter. To do this, connect the input of the frequency meter to the BNC output **F-OUT** on the side panel of the Faraday Cage. The output signal is a square wave, TTL/CMOS compatible, 0 to +5 V logic wave, so you can use any frequency meter to measure these frequencies, however, high-resolution (at least 8-digits) instruments with oven stabilized time base are recommended. Note that the EQCN front panel frequency meter is providing measurements of the frequency shift $|f_{WO} - f_{RO}|$ which is necessary for conversion to mass changes. See the EQCN-600 manual for further details.

Usually, the frequency meter low input (the shield) is grounded. For sensitive EQCN measurements, disconnect the external frequency meter from the Faraday Cage and remove all unnecessary cables.