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Nanopore Reader 10 MHz

Product Code / P/N 003213

10 MHz bandwidth current amplifier for solid-state nanopore experiments

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Revision History

Date	Version	Description
2026-07-08	1.0	First version of document

Acronyms

eNPR-10MHz: 10MHz bandwidth Elements Nanopore Reader.
IN: input pin.
GND: ground. The potential of the Faraday cage.
REF: reference.
DUT: device under test. Usually, a flow cell with a lipid bilayer membrane or a nanopore, but can also be a model cell with resistors and/or capacitors.
EMI: electro-magnetic interference. Environmental noise affecting the measurements

1 Introduction

This manual provides installation, setup, and operating instructions for the **Nanopore Reader 10 MHz**. It is intended for researchers and laboratory personnel performing nanopore-based measurements.

The Nanopore Reader 10 MHz is a high-bandwidth current amplifier specifically designed for measuring ionic currents through solid-state nanopores. The instrument enables the detection of rapid current variations generated by the translocation of molecules and nanoparticles, providing the temporal resolution required for high-speed nanopore sensing experiments.

Together with the Elements nanopore flow cells and the EMCR software, the Nanopore Reader 10 MHz forms a complete measurement platform for experiment control, data acquisition, visualization, recording, and analysis.

1.1 Intended Use

The Nanopore Reader 10 MHz is a single-channel current amplifier designed for high-bandwidth measurements of ionic currents through solid-state nanopores.

The instrument provides low-noise current acquisition together with programmable voltage stimulation, enabling accurate electrical characterization of nanopore devices and translocation events.

Typical applications include: Single-molecule detection; DNA, RNA, and protein translocation studies; nanoparticle detection and characterization; solid-state nanopore characterization

The Nanopore Reader 10 MHz is intended exclusively for laboratory research applications. It is not designed, validated, or approved for diagnostic, therapeutic, or clinical use.

1.2 System Requirements

The minimum and recommended computer specifications for operating the Nanopore Reader 10 MHz with the EMCR software are listed below.

Minimum[1]:

- OS: Windows 10, 11
- CPU: tested with Intel core i7-10700
- RAM: 8 GB DDR4 3200
- Internal SSD: 250GB, 600MB/s write speed
- Display resolution: 1920 x 1080
- Peripherals: 1 dedicated USB 3.0 port (USB hubs should be avoided)

Recommended:

- RAM: 32 GB DDR4 3200
- Internal SSD: 1TB, 3000MB/s write speed

[1] With the minimum hardware configuration, running additional computationally intensive applications while acquiring data at high sampling rates may reduce system performance. Depending on the acquisition settings, some EMCR software features may need to be disabled to ensure reliable recording without data loss. During acquisitions at high sampling rates, monitor the estimated sampling rate displayed by EMCR. If the reported value becomes unstable or differs from the selected acquisition rate, close the Channels Overview and Measurement Overview widgets and collapse all expanded traces in the central plot.

2 Technical Specifications

The table below lists the key technical specifications of the Nanopore Reader 10 MHz.

Parameter	Value	Unit
Current Range	± 100	nA
Voltage Stimulus Range	± 1600	mV
Max available bandwidth	10	MHz
Max sampling rate	40	Msps
Open input (RMS) noise	540 pA rms @ 40 MHz SR; 92 pA rms @ 1.25 MHz SR;	pA
Case Size	20 x 7 x 3.5	cm

Table 1 — Nanopore Reader 10 MHz technical specifications

3 Package Content

1. Nanopore Reader 10 MHz
2. Model Cell for Nanopore Reader 10 MHz
3. Power supply adaptor 5Vdc (P/N: 002754)
4. USB-C cable 1m (P/N: 003040)
5. GND cable (P/N: 000927)
6. ESD wrist strap
7. Nanopore flow cell (P/N: 002188 or 002246)

4 Instructions for Use

4.1 Connectors

The Nanopore Reader 10 MHz connects directly to the host computer through a USB-C cable, forming a complete stand-alone measurement system. The USB connection is used exclusively for data communication, while the instrument is powered through the supplied 5 V DC power supply (Figure 2-3).

The instrument incorporates a miniaturized Faraday cage integrated into the front lid. When using Elements nanopore flow cells, the lid should remain closed during measurements to ensure optimum shielding from electromagnetic interference (EMI).

For experiments requiring custom-made flow cells that cannot fit beneath the integrated lid, the instrument should be operated inside an external Faraday cage. In this configuration, leave the instrument lid open and connect the external Faraday cage to the GND connector using the supplied grounding cable (Figure 3).

> **IMPORTANT NOTE:**
>
> Do not connect the external Faraday cage to any point other than the instrument's GND connector. Incorrect grounding may result in electrical short circuits and degraded measurement performance.

> **CAUTION:**
>
> Before inserting a flow cell into the instrument, ensure that the white flow cell plastic slot (Figure 1) is completely dry. Liquid contamination may cause calibration errors, measurement instability, or permanent damage to the input electronics.

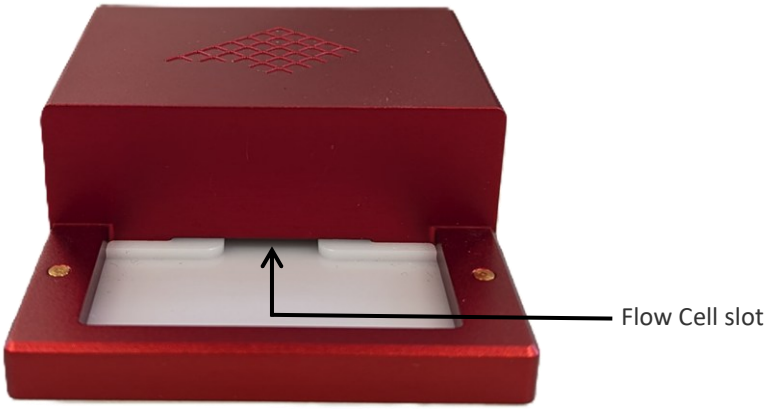


Figure 1 – Front view of the amplifier without the lid.

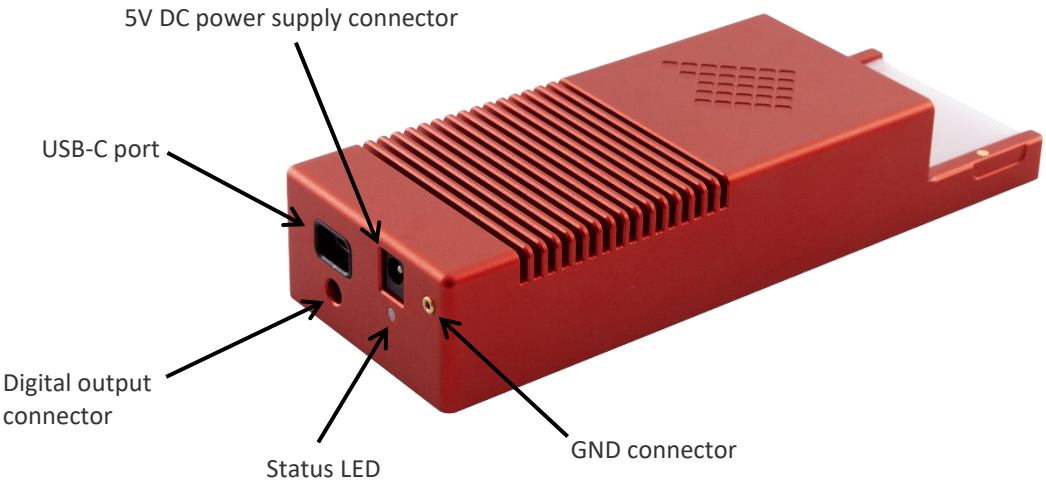


Figure 2 – Back side connectors.

Figure 3 – Connections between the Nanopore Reader 10 MHz, the host computer, the power supply, and an optional external Faraday cage.

4.2 Connection diagram

Connect the Nanopore Reader 10 MHz to the DUT and the host computer as shown in Figure 4.

The lower diagram illustrates both the voltage stimulus polarity applied by the instrument and the sign convention used for the measured ionic current.

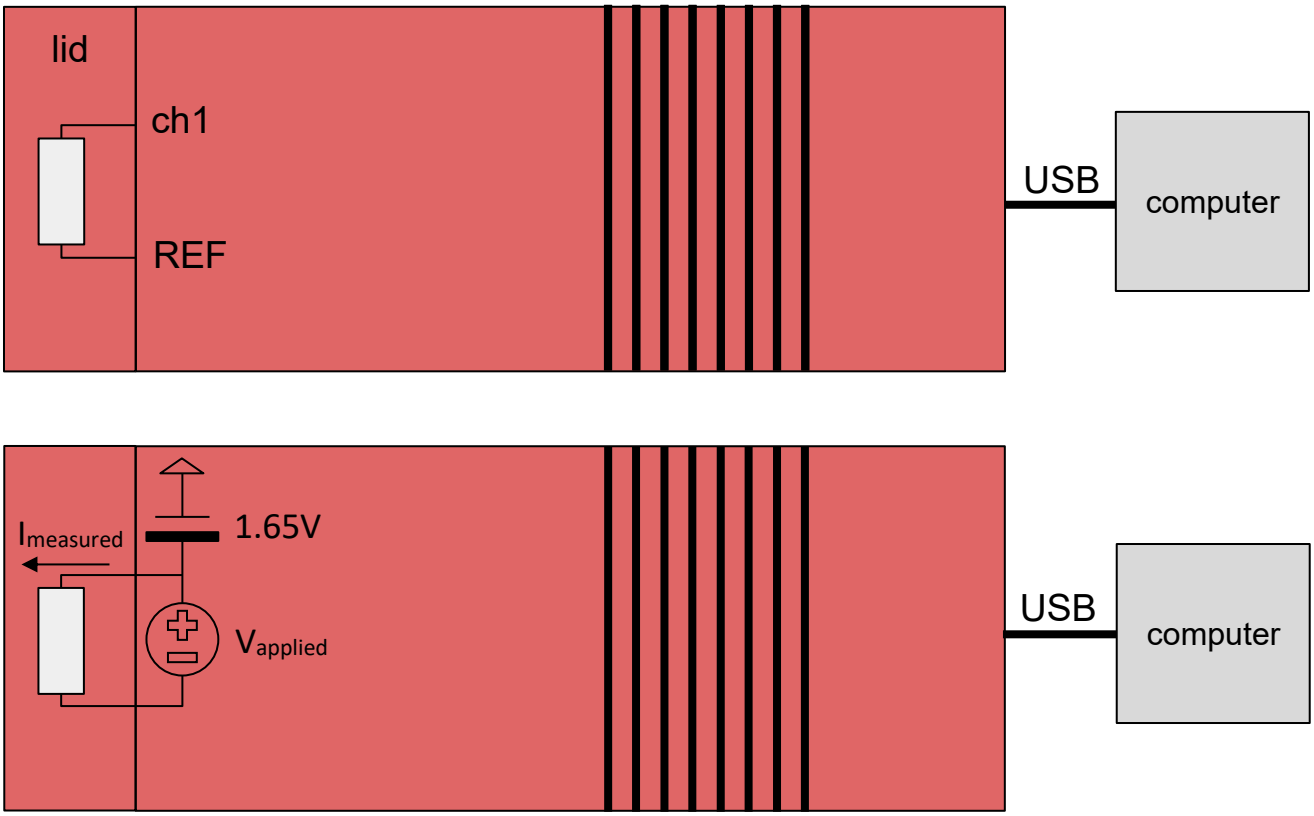


Figure 4 – Connections scheme and signal polarity.

The Nanopore Reader 10 MHz interfaces with the flow cell through a PCB having the dimensions shown in Figure 5. When a positive bias voltage is applied, the polarity of the flow cell compartments corresponds to the **+** and **–** markings shown on the PCB.
All Elements flow cells use the same contact-pad layout. Refer to Figure 5 to identify the polarity of the cis and trans compartments before performing measurements.

> **IMPORTANT NOTE:**
>
> The PCB Keep-Out Area must be completely inserted into the flow-cell slot to ensure proper electrical contact and reliable mechanical alignment.

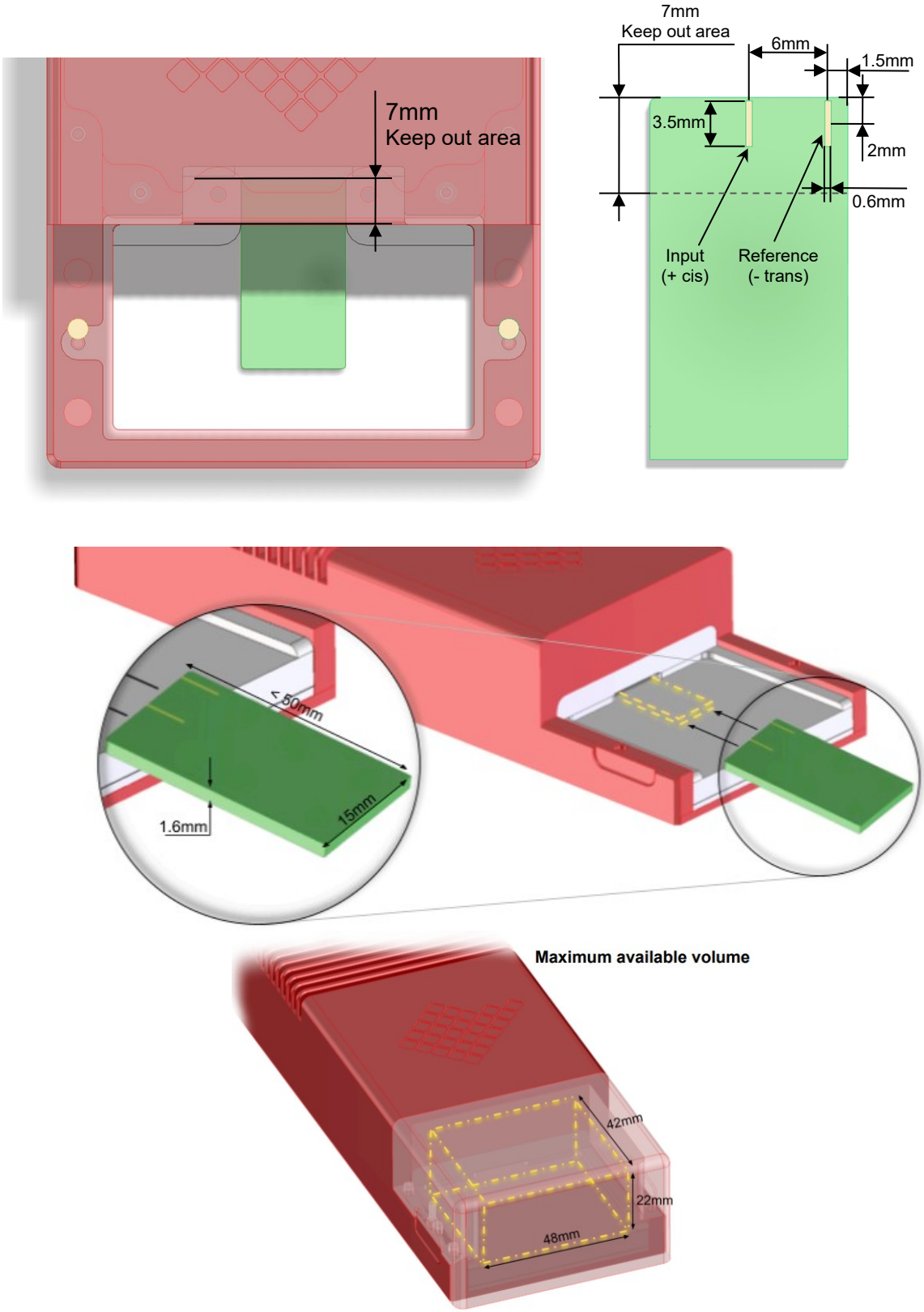


Figure 5 – PCB dimensions required for mechanical compatibility with the Nanopore Reader 10 MHz. The electrical polarity of the input and reference contacts are shown.

4.3 Setup and functional checkout

> **CAUTION:**
>
> Before handling the instrument, the flow cell PCB, or the model cell, wear the supplied ESD wrist strap and connect it to a proper earth ground or to the laboratory grounding point. Failure to observe proper ESD precautions may result in permanent damage to the instrument electronics.
>
> For detailed information on ESD precautions and the correct use of the supplied ESD wrist strap, refer to the ESD handling guidelines user guide.

Perform the following procedure to verify that the instrument is correctly installed and operating properly before starting an experiment.

1. Remove the instrument from its packaging and inspect it for visible signs of damage.
2. Install the latest version of EMCR software from the Elements website (link to the download page).
3. Connect the supplied 5 V DC power supply and the USB-C cable. Launch EMCR and verify that the instrument is correctly detected (S/N should appear in the connect box). Click Connect and verify that communication has been established by checking the real-time sampling rate displayed in the main window (red arrow in the screenshot below).
4. Ensure that:

   - the lid is properly closed

   - no model cell or flow cell is inserted

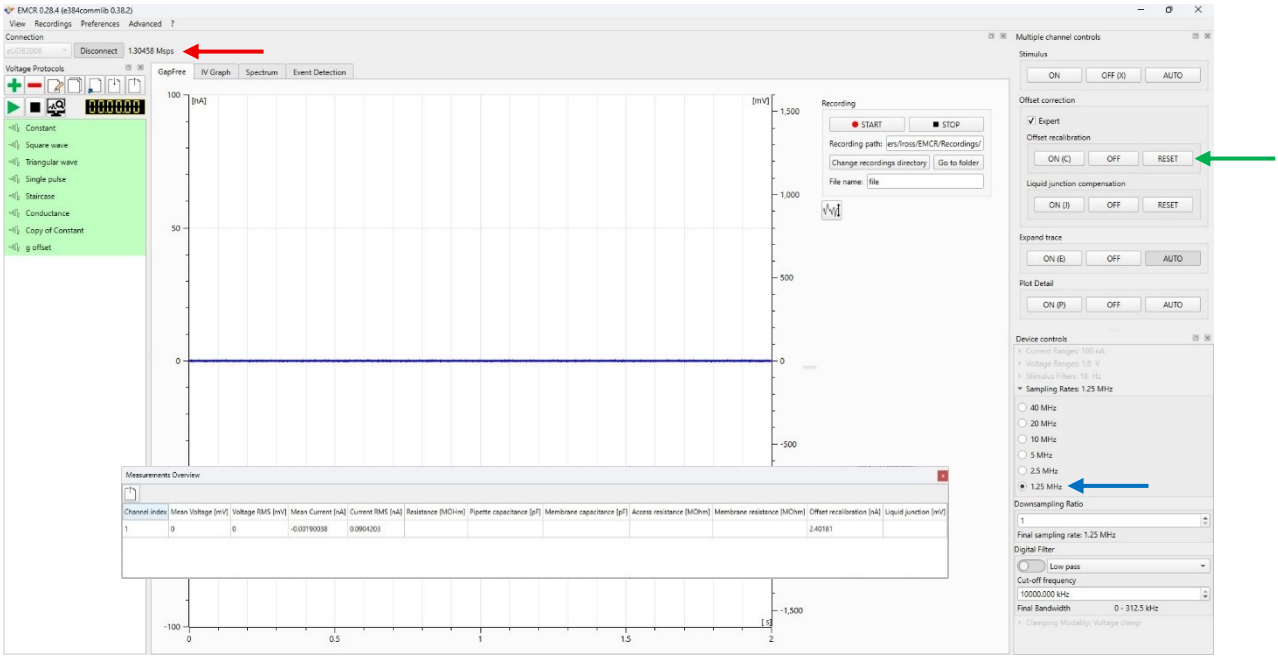
   - a constant voltage stimulus at 0 mV is applied

   - the sampling rate is set to 1.25 MHz (blue arrow).

   Find the *offset correction* widget and check the *expert* checkbox. Run the *offset recalibration* procedure by clicking the ON button (green arrow in the screenshot below).

   Open the *Measurement Overview* widget (available by opening the *View* menu in the top bar) and verify that the measured RMS noise is equal to or lower than the value specified in Table 1 (see Section 2).

   Repeat the same verification after selecting the 40 MHz sampling rate.



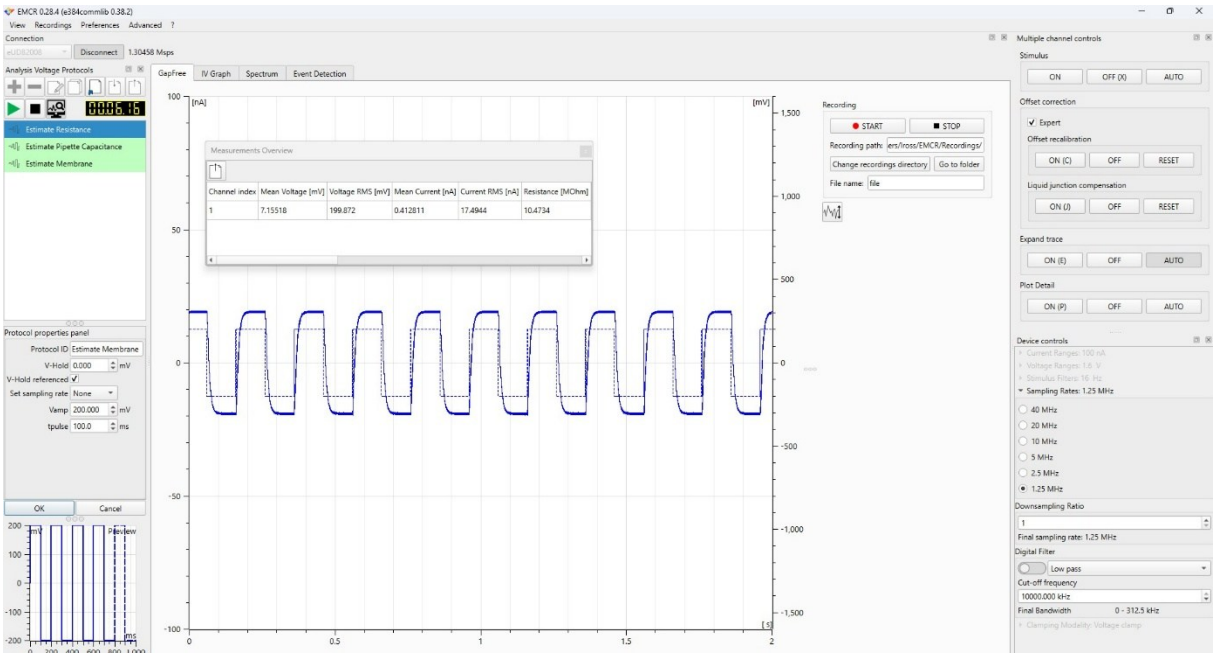
5. Select the Estimate Resistance protocol from the protocol list and start the measurement by pressing the *play* button  . The software applies a 200 mV, 100 ms square-wave voltage pulse and calculates in real time the resistance value, displayed in the *Measurement Overview* widget.

   The measured open-circuit resistance should exceed 10 GΩ.

6. Insert the supplied 10 MΩ Model Cell into the flow-cell slot (see Figure 1).

   Ensure that the *Estimate Resistance* protocol is still running.

   Verify that the measured resistance is 10 MΩ ±30%.



4.4 Best Practices

- **Prevent electrostatic discharge (ESD)**: the amplifier input is directly connected to sensitive low-noise front-end electronics and may be damaged by electrostatic discharge.
  Before handling the instrument, the flow cell PCB, or the model cell, wear the supplied ESD wrist strap and connect it to a proper earth ground or to the laboratory grounding point.
  Whenever possible, avoid touching the PCB contacts or the electrical pads of the flow cell. Handle the flow cell by its body or edges only.
  Failure to observe proper ESD precautions may result in permanent damage to the instrument electronics.
- **Use the integrated Faraday cage whenever possible**: when using Elements nanopore flow cells, always perform measurements with the instrument lid fully closed. This configuration provides optimum shielding from electromagnetic interference.
- **Use an external Faraday cage only when necessary**: If the integrated lid cannot be closed because of a custom-made flow cell or external wiring, place both the instrument and the DUT inside an external Faraday cage.
  Connect the Faraday cage exclusively to the instrument's **GND connector** using the supplied grounding cable.

  Long cables increase stray capacitance and act as antennas that collect environmental electromagnetic noise. Whenever possible, minimize the distance between the flow cell and the amplifier.

  Avoid placing the amplifier, the DUT, or the connecting cables in direct contact with the external Faraday cage. Nearby powered instruments may introduce additional electrical noise. Remove unnecessary equipment from the Faraday cage or switch it off during acquisitions.

> **IMPORTANT NOTE:** If an external Faraday cage is used, do not connect it to any part of the device other than the GND connector, as this may cause short circuits. To further reduce the risk of accidental electrical contact, it is recommended to apply a layer of insulating material (e.g. a tape) to the inner surface of the Faraday cage.

- **Verify the flow cell before installation**: Before inserting the flow cell into the instrument, verify that it is properly sealed. Place the flow cell on absorbent paper, fill both reservoirs with electrolyte solution, and inspect the paper for signs of leakage.

  Installing a leaking flow cell may contaminate the amplifier input connector and permanently damage the instrument.

  Refer to the Flow Cell User Guide for additional information.

5 FAQ / Troubleshooting

Common issues and their solutions are listed below. For further assistance, refer to Section 5.

During the installation procedure a popup error window appears

Visit the EMCR Installation guide and follow the instructions.

The device is not recognized by the software. What should I do?

Verify that the 5Vdc power supply is properly connected. Check that the USB cable is correctly connected to both the device and the computer. Try a different USB port. Check the installation troubleshooting section in the EMCR installation guide.

The software does not start or crashes on launch

Ensure your operating system meets the minimum requirements. Reinstall the software and check for any pending system updates. Contact support if the issue persists.

I observe high low frequency noise levels in my measurements. How can I reduce them?

Verify that the Faraday cage lid is properly closed. If using an external Faraday cage do not use the lid of the amplifier and make sure that the GND cable is connected and remove other powered instruments from inside the Faraday cage. If using a custom-made flow cell, reduce the length of cables between the device and the DUT.

The resistance value in open circuit is smaller than 10 GOhm

Make sure that no model cell or flow cell is inserted into the flow cell slot. Visually check for the presence of traces of liquid on the flow cell slot. If the issue persist contact support@elements-ic.com

6 Contacts & Support

For technical support, product information, or to report an issue, contact the Elements team using the details below.

Technical Support

Email: [support@elements-ic.com]

Website: www.elements-ic.com

Company Information

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