

Application Note

Picoammeter rbd9103 for Floating Ion Current Measurements

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The rbd9103 picoammeter² is used to detect molecular ion beams in an electrospray ion beam deposition instrument³. The currents are dc, in a range of 1 pA – 200 nA, and a resolution/stability of up to 1 pA is needed. We tested the external bias and the HV-floating version of the device.

Please note: This technical note reflects our experience with the instruments in our application. We do not guarantee for any of the result

HV float option

The HV floating version of the 9103 picoampèremeter can be floated with voltages to 1.5 or 5 kV depending on the exact model. The signal input connector is SHV, the float voltage connected via MHV.

The input shield should usually be grounded via the Shield of the SHV or BNC cable coming from the vacuum chamber. If this is not the case, grounding the shield helps to prevent noise on the measurement.

A protection resistor limiting the current in floating configuration should be used. Keep max. current of 2 mA and fuse range (50 mA) in mind when selecting.

Set the bias to "OFF" for all measurements, whether floating or against GND.

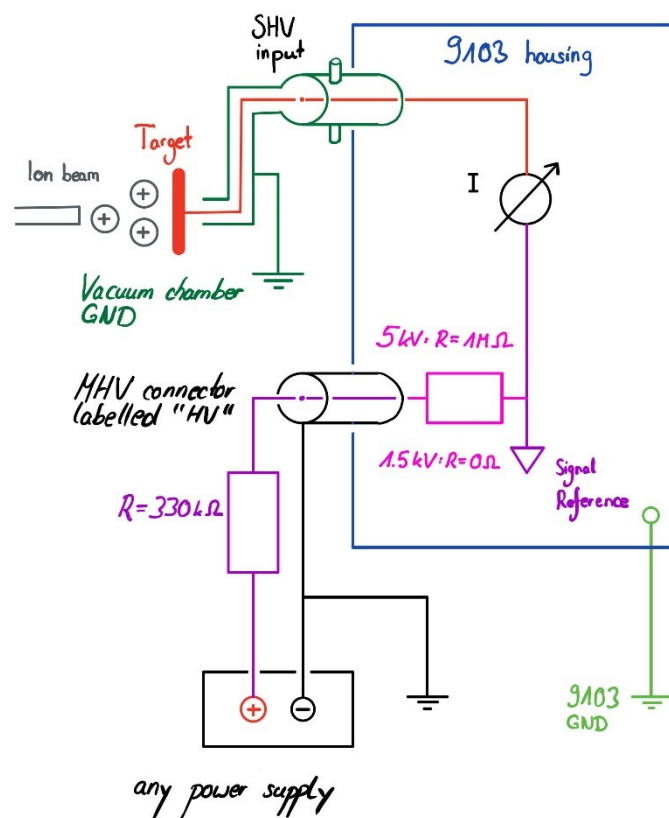


Figure 1. Wiring scheme of the HV floating 9103 picoammeter.

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² <https://rbdinstruments.com/products/picoammeter.html>

³ S. Rauschenbach: Mass Spectrometry as a Preparative Tool for the Surface Science of Large Molecules | Annual Review of Analytical Chemistry <https://www.annualreviews.org/doi/full/10.1146/annurev-anchem-071015-041633>

external Bias version, Bias set = On

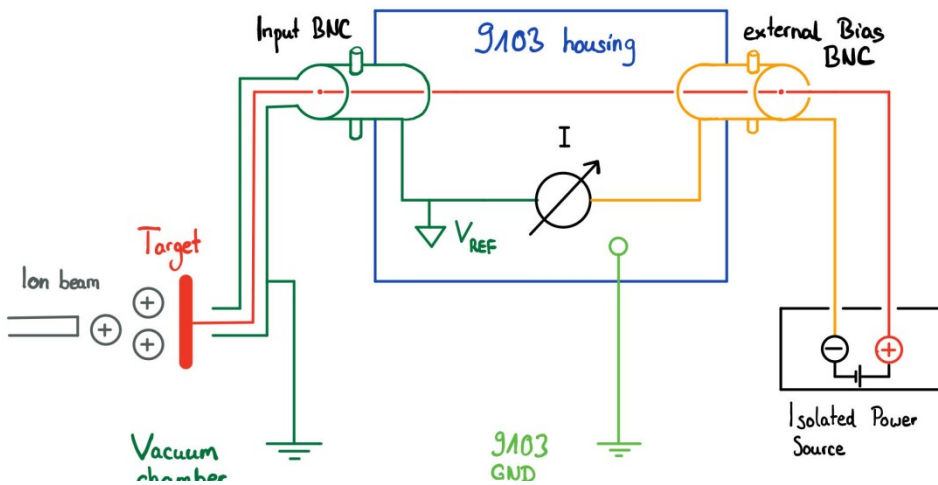


Figure 2. Wiring scheme of the external bias 9103 picoampmeter.

This picoampère-meter cannot be floated at all. It can only be biased to max. 600 V via a BNC connector at the back panel. If the bias is not needed, do not connect this port and set the Bias to OFF

Input Shield must be connected to GND of

vacuum chamber

It is physically impossible to connect a low impedance test source (like a battery + resistor) because such an external source interacts with the internal circuitry.

No problem to connect an ion beam as this is a very high impedance source.

Isolated bias power supply must be low-noise. Tests show that batteries work (high internal resistance $\approx 22 \text{ k}\Omega$ not an issue).

Performance

With the HV floating instrument we achieve 1pA resolution in current detection. We read data points every 30 ms with a LabView software. The function is very robust (see Fig. 3).

Also the current measurement with the external bias option is possible. It works well for measurements vs. ground. For biasing only very stable battery sources work. If a bias is connected the current measurement works, but is very sensitive towards mechanical and electrical disturbances despite our best efforts to isolate the system. If the battery is put into a very well shielded, externally grounded box with isolated BNC connectors, the measurement is not sensitive towards mechanical disturbances.

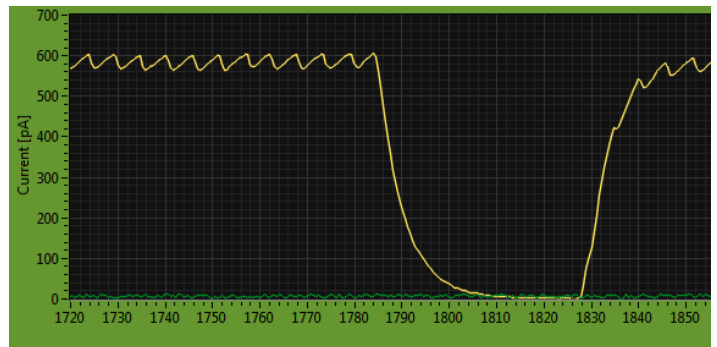


Figure 3 Detected protein ion current using the HV float option. The apparent sawtooth current is due to a pulsed ion current. Switching of at time=1785s shows time constant and a clean zero.