Tensormeter Model RTM1 front panel

Tensormeter Model RTM1

Sheet and Hall resistance measurements: automated, ultra-precise, offset-free

The Tensormeter is designed for automated precision measurements of resistances and voltages. It unites the benefits of Lock-in Amplifiers and Source/Measure Units through an innovative flexible architecture. Tensormeter RTM1 enables the automated recording of the complete Resistivity Tensor (R_x, R_y, R_H) with one single device, even on unpattern thin films. With excellent AC and DC performance, it covers the range from Nano-Ohm to Giga-Ohms with at least 8 digits of dynamic range.

Applications:

Materials research and characterization

- solid state physics
- semiconductor physics
- magnetism
- flexible electronics
- spintronics
- new functional electronic materials and devices

Industrial R&D and wafer/device testing

- microelectronic devices
- memory devices
- transistors
- diodes
- LED/OLED
- solar cells
- displays, TCO
- sensors

Benefits:

- Replaces all standard devices for electrical characterization measurements (e.g. Lock-in Amplifier, SMU, DMM, Analog Matrix Switch)
- Overcomes the limitations of conventional 4-point measurements by automatically measuring the complete Resistivity Tensor (R_x, R_y, R_H)
- Makes complex sample preparation unnecessary (e.g. lithographic structuring)
- Allows for easy connectivity to many different measurement setups (e.g. probe stations, cryostats, vacuum systems)
- Saves measuring time and enhances sample throughput

Features:

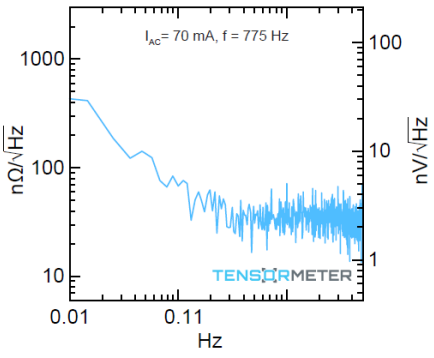
- Reconfigurable device architecture based on an integrated switching matrix
- 8 user-defined channels (BNC connectors), whose function (input or output) can be freely determined
- Conventional AC and DC 4-wire measurements with fixed connections (Kelvin/ Hall geometry)
- AC and DC measurements with alternating connections (van-der-Pauw geometry) with one device
- Simultaneous measurement of exactly separated absolute values for longitudinal and transverse resistances without lithographic patterning
- Software presets for common measurement modes, but any user-specific switching sequences can be specified
- TCP-based communication, easy integration in any environment (e.g. Labview, C, Python)

Typical measurement examples:

- Ultra-low noise and high stability AC & DC 4-wire measurements in standard geometries (Kelvin and Hall layouts)
- Van-der-Pauw switched connection 4-wire measurements on irregular, unstructured thin-film samples
- Zero-Offset Hall 4-wire measurements (exact separation of longitudinal and transverse resistance even with unstructured samples)
- Sub-ppm relative resistance change measurements
- Ratiometric resistance measurements to eliminate sample and device drifts
- High drive harmonic distortion measurements, pulse & measure routines

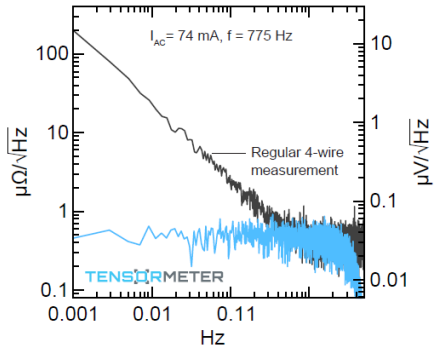
Low Resistive Sensors and Specimen

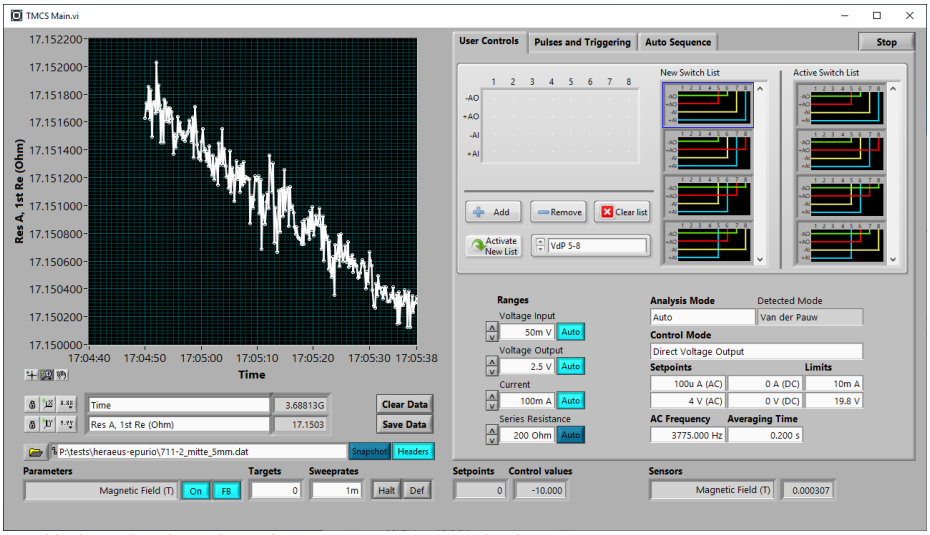
Differential Input Noise Spectrum of a resistive sensor. Ultra-low wideband & 1/f noise AC measurements allow accurate sensor characterization and operation.



Zero-Offset Hall: Eliminate Drift and Parasitics

Differential Input Noise Spectrum of a Hall measurement on a thin film sample. The Zero-Offset Hall preset of the Tensormeter eliminates thermal drift and allows long integration and orders of magnitude improved sensitivity compared to regular 4-wire Hall measurements.





Graphical user interface of proprietary Tensormeter control software

Electrical Specifications

- Precision: <0.1 ppm
- Continuous dynamic range: > 8 digits
- Symmetrical Output: DC to 20 kHz, ±20 V, ±100 mA
- Output noise: < -140 dBFS
- Pulse / arbitrary function output with 10 µs resolution
- Fully controllable integrated 8x4 switching matrix
- BJT option input noise: $3\,\mathrm{nV}/\sqrt{\mathrm{Hz}}$, $400\,\mathrm{fA}/\sqrt{\mathrm{Hz}}$
- FET option input noise: $5\,\mathrm{nV}/\sqrt{\mathrm{Hz}}$, $1\,\mathrm{fA}/\sqrt{\mathrm{Hz}}$
- Gain change with temperature: 100 ppm/K, <1 ppm/K (ratiometric)
- DC offset voltage change with temperature: 1 µV/K
- Arbitrary function reference input/output: single-ended ±10 V
- Trigger input/output: single-ended 5V TTL

Hardware/software specifications

- TCP-based user connection
- Client communication examples for LabView and Python (more on request)
- 19” rack-mountable device, 3 height units, 25 cm depth
- Power demand < 30 W, PSU included
- BNC front connectors, 50 Ω type
- USB Type B communication connector