Data Sheet | Specifications

Tensormeter Model RTM1

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

Tensormeter model RTM1 front panel

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 based on an integrated matrix switch. 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.

Application fields

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

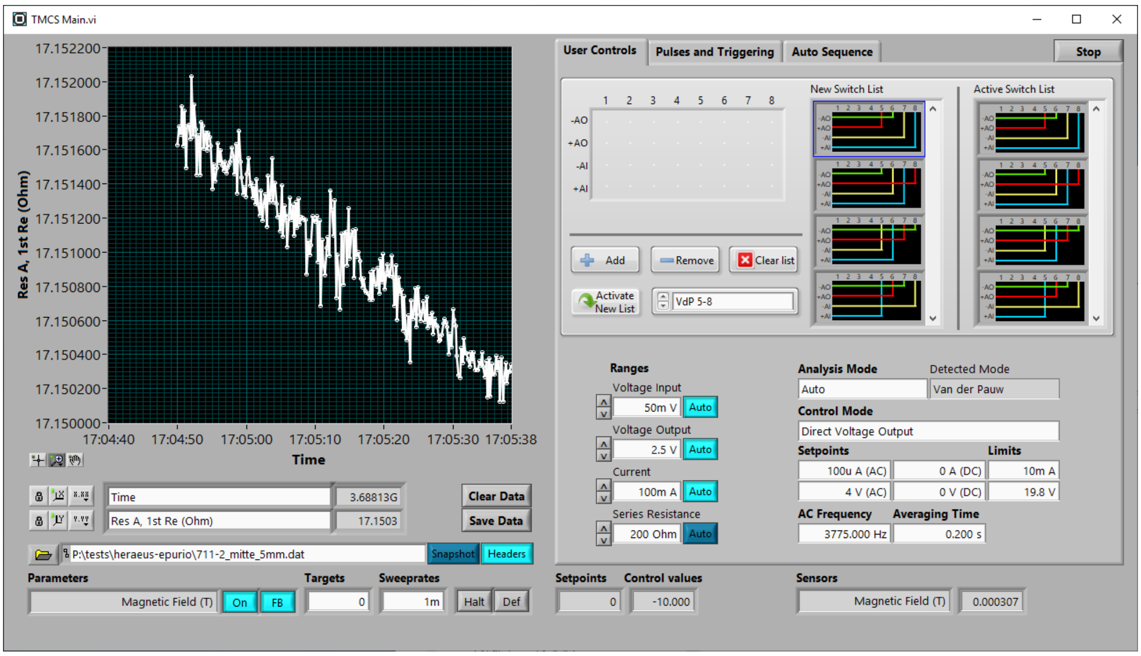
- microelectronic devices
- memory devices
- transistors, diodes
- LED/OLED
- solar cells
- displays, TCO
- sensors

Benefits:

- Replaces all standard devices for electrical characterization measurements (e.g. Lock-in Amplifier, SMU, DMM).
- Overcomes the limitations of stationary 4-point measurements by an integrated Matrix Switch.
- Offers presets for van-der-Pauw and Resistance Tensor measurements and allows for full user configurability.
- 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)



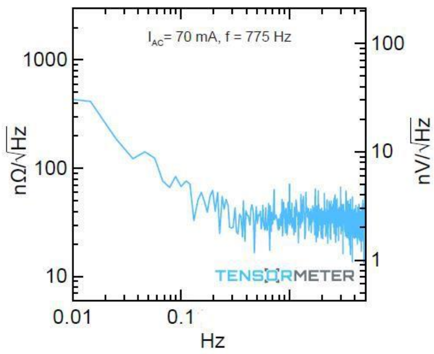
Graphical user interface of proprietary Tensormeter control software

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

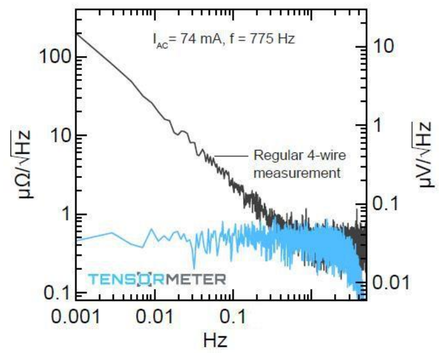
Low Resistive Sensors and Specimen

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

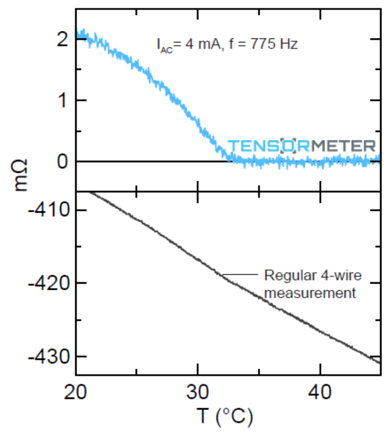


Zero-Offset Hall: Eliminate Drift and Parasitics

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.



Loss of magnetization during warmup of an anti-ferromagnetic sample monitored in Hall Resistance. The Zero-Offset Hall preset of the RTM1 (top) clearly shows the loss of signal. On the contrary, parasitic signal contributions overshadow the useful magnetization signal in a regular 4-wire Hall measurement of the same sample (bottom).



Electrical Specifications (typ.)

- 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
- Default FET option input noise: 5 nV/$\sqrt{Hz}$, 1 fA/$\sqrt{Hz}$
- Optional BJT replacement input noise: 3 nV/$\sqrt{Hz}$, 400 fA/$\sqrt{Hz}$
- Gain change with temperature: 100 ppm/K
- Gain change with temperature in ratiometric mode: <1 ppm/K
- DC offset voltage change with temperature: ±1 µV/K, ±3 ppm/K
- DC offset voltage change with temperature in differential mode: <0.1 ppm/K
- Arbitrary function reference input/output: single-ended ±10 V
- Trigger input/output: single-ended 5V TTL

Hardware/software specifications

- 19” rack-mountable device, 3 height units, 25 cm depth
- TCP-based user connection
- Windows driver and client communication examples for LabView and Python (more on request); for driver operation a PC with the following minimum requirements is needed: min. Windows 7, min. 8 GB RAM, min. AMD Athlon 240GE or Intel Core i5 6200U or comparable
- Power demand < 30 W, PSU included
- BNC front connectors, 50 Ω coaxial type
- USB2.0 Type B communication connector
- DC power supply, mains connection type F (others on request)
- Factory calibration

Scope of delivery

- Tensormeter RTM1 19” rack-mountable device
- Software package with Windows drivers and client code examples for LabVIEW and Python
- Tensormeter RTM1 User Guide incl. TCP Commands, Operation Parameter Guidelines
- USB cable, power cable, power supply 24V / 40W