Tensormeter RTM1 Product Overview

- Tensormeter device front panel with 8 signal connectors, reference and trigger connector

- Simultaneously determine Sheet & Hall resistance at highest precision and extremely low noise
- Measure irregularly shaped samples without need for lithographic patterning

- Replace several other devices (Lock-in Amplifier, Source-Measure-Unit, Digital Multimeter, Analog Matrix Switch)
- Save measuring time, achieve higher throughput

Materials Research and Characterization
- High precision to study small effects
- Flexibility for custom measurement sequences
- Controlled sourcing
- 2D materials
- Magnetic materials
- Transverse resistance

Improved Wafer and Device Testing
- High stability
- Faster binning
- Tighter specs
- DC and AC
- Fewer contacts
- Integrated calibration

Unique Measurements
- Irregular sample shapes
- van-der-Pauw
- Zero-offset Hall
- Dummy compensation
- Device differential
- Pulse and measure
- Custom protocols
- Up to 8 contacts
### Interface

Graphical user interface of the server background program, which relays communications between the Tensormeter and the user.

### Electrical Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensing precision:</td>
<td>&lt;0.1 ppm</td>
</tr>
<tr>
<td>Continuous dynamic range:</td>
<td>&gt;8 digits</td>
</tr>
<tr>
<td>Symmetrical output:</td>
<td>DC – 20 kHz, ±20 V, ±100 mA</td>
</tr>
<tr>
<td>Output noise floor:</td>
<td>&lt; -140 dBFS</td>
</tr>
<tr>
<td>Pulse and arbitrary function output with 10 µs resolution</td>
<td></td>
</tr>
<tr>
<td>Input demodulation at multiple frequencies up to 20 kHz</td>
<td></td>
</tr>
<tr>
<td>Differential input noise:</td>
<td>3 nV/√Hz, 500 fA/√Hz</td>
</tr>
<tr>
<td>Differential input bias current:</td>
<td>1 nA</td>
</tr>
<tr>
<td>Optional input transformer for sub-nV/√Hz measurements on low-R DUTs</td>
<td></td>
</tr>
<tr>
<td>Gain change with temperature:</td>
<td>100 ppm/K, &lt;1 ppm/K (ratiometric)</td>
</tr>
<tr>
<td>DC offset voltage change with temperature:</td>
<td>1 µV/K</td>
</tr>
<tr>
<td>Fully controllable integrated 8x4 switching matrix</td>
<td></td>
</tr>
<tr>
<td>Arbitrary function reference input/output:</td>
<td>single-ended ±10 V</td>
</tr>
<tr>
<td>Trigger input/output:</td>
<td>single-ended 5V TTL</td>
</tr>
</tbody>
</table>

### Software and Communication Protocol Specifications

- TCP-based user connection independent of platform and software
- Client communication examples for LabView and Python (more on request)
- Tensormeter RTM1 connects via USB2.0 to a Windows-PC
- Software and drivers are provided as Windows Executable Installer
- For target OS other than Windows, a small relay computer can be provided
- All functions can be controlled from the GUI or via TCP

### Hardware, Power and Environmental Specifications

- 19” rack-mountable device, 3 height units, 25 cm depth
- Power demand < 30 W, PSU included, user-specified AC connector
- Operation range: 0 – 70 °C, non-condensing humidity
- Free convection cooling (can be closed at expense of warmup time)
- All front connectors are BNC, 50 Ω type
- USB Type B communication connector
- Channel and power LED indicators are user-dimmable or can be switched off
**Typical Measurement Examples**

- Low noise AC & DC 4-wire measurements in standard geometries (Kelvin, Hall layouts)
- Presets for van-der-Pauw switched connection 4-wire measurements
- New Zero-Offset Hall 4-wire preset grants independent longitudinal and transverse resistance
- Ultra-low noise and high stability Hall measurements outclassing other equipment
- Sub-ppm relative resistance change investigations
- Eliminate sample & device drifts with ratiometric resistance measurements
- High drive harmonic distortion measurements, Pulse & Measure routines, Custom presets

**Low Resitive Sensors and Specimen**


**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 RTM1 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 antiferromagnetic 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).
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