

Tesla System (Physical Property Measurement System)

Manufacturer: [Quantum Design](#)

Model: Ever cool-II

Descriptions

The PPMS (Ever cool-II) enables DC Resistivity, AC transport property, Thermal Transport Property measurements, Heat Capacity Measurement and VSM (Vibrating Sample Magnetometer) measurements in the temperature range from 1.9K to 400K in a magnetic field from -9T to 9T. The system is based on liquid helium operation with re-condensing dewar, filling with liquid helium is not needed.

Specifications

Temp Range: 1.9K -400K (for VSM oven: RT- 1000K)

Ramp Rate: max 20K/min, 200Oe/sec

Atmosphere Gas: Vacuum

1. DC Resistivity

- a. Drive Type: DC 7.5/8.3 Hz Square wave
- b. Current Range: 50 nA to 5 mA
- c. Current Step Size: 1% of range or 10 nA
- d. Current Stability: 0.1% over 6 hours from 295 K to 297 K
- e. Sensitivity: 20 nV
- f. Compliance Voltage: 95 mV
- g. Maximum Resistance: 4 M Ω .
- h. Precision: 0.01% at 2 readings per sec.
- i. Detection Stability: 0.1 % over 6 hours from 295K to 297K

2. Multi Function Probe

To include the puck assembly and housing at the bottom of the probe. Samples are able to be mounted to a plug-in platform assembly, which includes a calibrated thermometer. It provides access to perform AC Transport and Resistivity measurements.

3. VSM (Vibrating Sample Magnetometer)

- i. rms sensitivity: <10⁻⁶ emu or 0.5 %.
- j. Relative Noise with cold head ON: Larger of (6 x 10⁻⁷ emu + 1 x 10⁻⁶ emu/tesla)/ $\sqrt{\text{Hz}}$ or 0.5%/ $\sqrt{\text{Hz}}$.
- k. Accuracy: 0.5 %, using 2.8mm diameter x 4mm high cylinder (shape of Pd standard) or Better than 2% or 6 x 10⁻⁶emu, whichever is greater.
- l. Largest measurable moment (M_{max}) of 80 emu.

4. VSM Oven

- m. Range of Temperature: 300 - 1000 K
- n. RMS Sensitivity: < 10⁻⁵ emu or 0.5%
- o. Noise Floor: < 10⁻⁵ emu rms (H = 0)
- p. Accuracy: < 1 x 10⁻⁵ emu/ tesla
- q. Temperature Precision: 0.5 K
- r. Temperature Accuracy: 2%

5. VSM Large Bore Coil

5.1 Geometry:

- s. Longitudinal configuration: magnetic field, VSM vibration and moment detection all along vertical axis.
- t. Coilset bore > 11.0 mm
- u. Sample Mass of up to 2 grams

- v. VSM measurement parameters:
- w. VSM oscillation frequency (calibrated): 40 Hz.
- x. VSM oscillation amplitude (typical): 2 mm peak - Range of 0.1 mm - 5mm.
- y. Data rate and averaging window (typical): 1 sec - Range of 0.5 to 750 sec.

5.2 Sensitivity using the above typical parameters:

- z. rms sensitivity: $< 1.5 \times 10^{-6} \text{ emu}/\sqrt{\text{Hz}}$.
- aa. Relative Noise, Standard VSM: Larger of $(1.5 \times 10^{-6} \text{ emu} + 3 \times 10^{-7} \text{ emu/tesla})/\sqrt{\text{Hz}}$ or $0.5\%/\sqrt{\text{Hz}}$.
- bb. Accuracy: 0.5 %, using 2.8mm diameter x 4mm high cylinder (shape of Pd standard) or Better than $(6 \times 10^{-6} \text{ emu} + 9 \times 10^{-6} \text{ emu/tesla})$ or 2%, whichever is greater.

6. ACT (AC Transport Property Measurement)

6.1 AC Transport Measurement System (ACT) provides four unique and separate measurements:

- cc. AC Resistivity
- dd. 4 and 5-wire balanced Hall Effect
- ee. I-V Curve
- ff. Critical Current

6.2 DC Resistivity Capability.

6.3 Simple to use sample pucks.

6.4 Multiple sample capability on each measurement run.

6.5 Metal shielded low-noise preamplifier must result in 0.5 nV/Hz: noise level and 1 nV sensitivity for ACT.

6.6 Measurements:

- gg. AC Resistivity
- hh. DC Resistivity
- ii. 5-wire Hall
- jj. I-V Curve
- kk. Critical Current

6.7 DC Resistivity:

- ll. Detection Range: 20 nV to 95 mV.
- mm. Detection Precision: 0.01% (typ.).
- nn. Current Source Range: 5 nA to 5 mA.

6.8 AC Resistivity:

- oo. Voltage Noise: $0.5 \text{ nV}/\sqrt{\text{Hz}}$ @ 1 kHz.
- pp. Voltage Sensitivity: 1 nV.
- qq. Current Range: 10 mA to 2 A.
- rr. Frequency Range: 1 Hz to 1 kHz.
- ss. Absolute Accuracy: 0.03%, 1 Hz to 1 kHz.
- tt. Relative Accuracy: $\pm 5 \text{ nW}$ @ $I = 1 \text{ A}$.

Instruction Manual & Analysis software: available upon request from laboratory.

A picture of the Tesla machine is attached below.

