

# Electrical Transport Option (ETO) for MPMS<sup>®</sup>3

The Electrical Transport Option (ETO) has now been designed to work in the MPMS 3 platform and allows users to perform AC resistance, Hall effect, I-V, Differential resistance ( $dV/dI$  vs.  $I_{\text{bias}}$  for 4-wire), and Differential conductance ( $dI/dV$  vs.  $V_{\text{bias}}$  for 2-wire) measurements on a sample using a Printed Circuit Board (PCB) sample holder.

The primary operating mode of this 2-channel measurement system uses an AC current excitation and digital lock-in voltage detection to perform 4-wire measurements of electrical resistance or Hall effect in a sample with resistance up to several mega-ohms. For high impedance mode the stimulus-response circuit can operate the voltage source and nano-ammeter, thus allowing for 2-wire measurements of sample resistance up to 5 giga-ohms.

There are two types of PCB sample holders offered with this option: a 2-sample holder for measurements in a parallel magnetic field and a single-sample holder in a perpendicular magnetic field. These specially designed sample holders allow users to measure magnetic moments by VSM or DC Scan using the same hardware, as well as conduct automated magnetic measurements while applying a voltage bias to the sample using an external source.

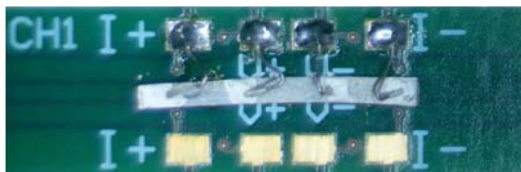


Single-Sample Holder

## Features

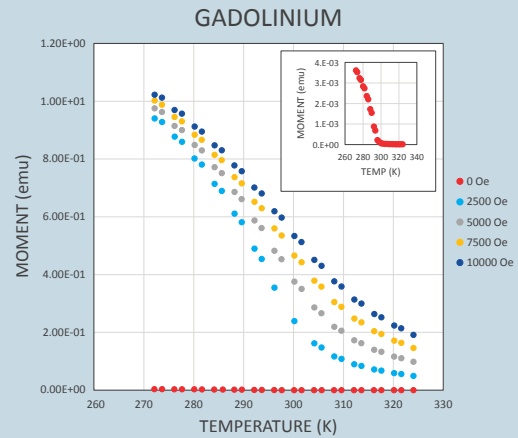
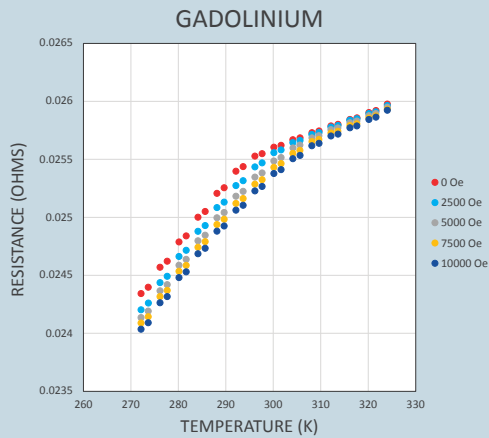
- 2 channel system
- AC and DC source
- 2- or 4-wire mode
- High impedance mode
- Differential resistance
- Differential conductance
- Parallel and perpendicular sample holders

Gadolinium Sample



2-Sample Holder and Rod

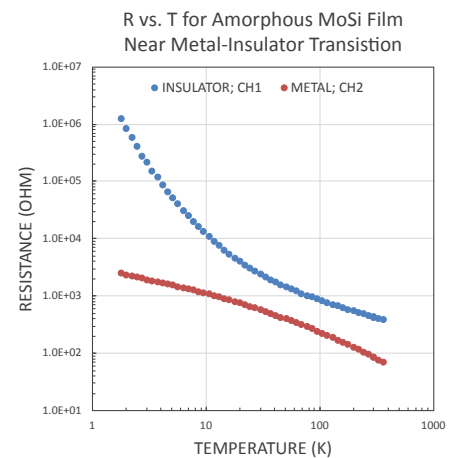
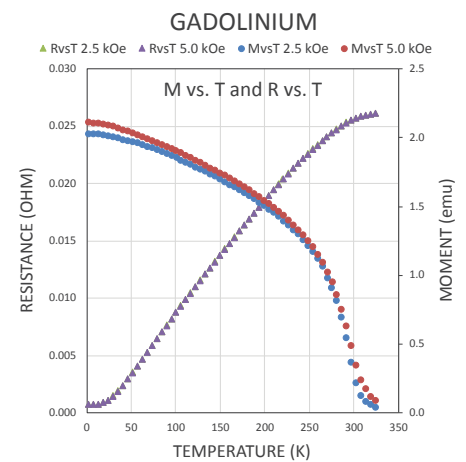
## Resistance and moment measurements for single set-up:



## Resistance and moment measurements over wide parameter range:

### Specifications

Model	M605
<b>Current Source</b>	
Current Range:	10 nA to 100 mA continuous operation
Frequency Range:	0.1 Hz to 200 Hz AC and DC
	0.1 Hz to 200 Hz for 1 $\mu$ A to 100 mA
	0.1 Hz to 25 Hz below 1 $\mu$ A
<b>Resistance</b>	
Measurement Accuracy:	
4-wire:	0.1% (typical for Resistance R < 200 k $\Omega$ )
	0.2% (maximum for R < 200 k $\Omega$ )
	0.2% (typical for R = 1 M $\Omega$ )
2-wire:	2% (typical for R < 1 G $\Omega$ )
	5% (typical for R = 5 G $\Omega$ ) for 0.1 to 10 Hz
Relative Sensitivity:	$\pm 10$ n $\Omega$ RMS (typical)
Resistance Range:	Up to 10 M $\Omega$ in 4-wire mode (typical)
	2 M $\Omega$ to 5 G $\Omega$ in 2-wire mode (typical)
<b>Preamp</b>	
Noise:	
Low Noise Amp:	1 nV/ $\sqrt{\text{Hz}}$ @100 Hz (typical)
	2 nV/ $\sqrt{\text{Hz}}$ (maximum)
Programmable Gain:	
Amp (100 X):	28 nV/ $\sqrt{\text{Hz}}$ @100 Hz (typical)
	30 nV/ $\sqrt{\text{Hz}}$ (maximum)
Voltage Input Range:	$\pm 4.5$ Volts at 1 X Gain
Current Input Range for 2-wire High Impedance Mode:	$\pm 250$ nA
Common Mode Rejection:	-100 dB @100 Hz



Quantum Design, Inc.  
 10307 Pacific Center Court, San Diego, CA 92121  
 Tel: 858.481.4400 Fax: 858.481.7410  
[www.qdusa.com](http://www.qdusa.com) • [info@qdusa.com](mailto:info@qdusa.com)