Lake Shore CRYOTRONICS

Guarded Insert for Integration with the Quantum Design PPMS®

MeasureLINK™

+

Introduction

The Lake Shore guarded insert can be used alone or with one of our PPMS Hall measurement packages that include the MeasureReady® M91 FastHall controller. Cut your measurement time up to one-half with the M91. Measurements are so fast that time-dependent misalignment errors are eliminated using the patented FastHall™ measurement technique.

- FastHall eliminates the need for field reversal
- Up to 100× faster for low-mobility materials
- Lower mobilities can be measured using lower fields

Combine the measurement power of the M91, with or without the guarded insert, with Quantum Design's Physical Property Measurement System (PPMS®). In this partnership with Quantum Design, you can now seamlessly integrate with a PPMS application. Two measurement packages are available:

- A high-resistance low-noise option using the Lake Shore fully guarded insert
- A standard resistance option that uses a Lake Shore breakout box to connect the M91 to the PPMS

M91 electrical measurement specifications

The M91 FastHall measurement controller integrates all the required source measure and signal switching capabilities to provide a complete start-to-finish Hall analysis.

Resistance (R)

Standard: 10 mΩ to 10 MΩ source current

High resistance*: Up to 200 GΩ source voltage

Mobility (μ)

Mobility range: 10^6 cm²/(V s) to 0.001 cm²/(V s)

Parameters

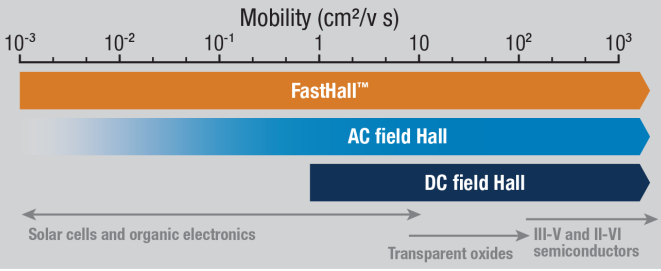
Current source range: 1 μA to 100 mA (lowest usable: 10 nA)

Current measurement range: 100 mA to 10 nA (lowest measurable: 1 pA)

Voltage source range*: 10 mV to 10 V

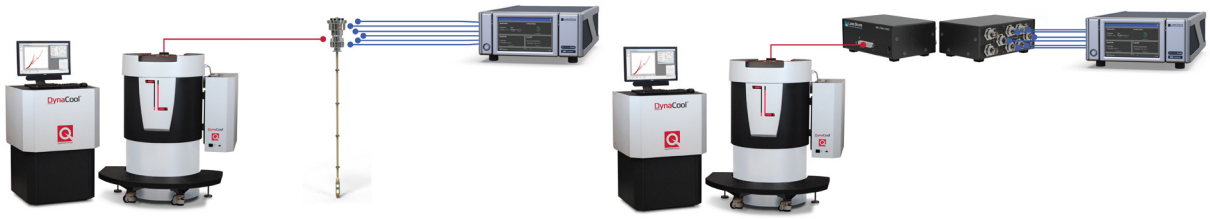
Voltage measurement range: 1 mV to 10 V

* Only available with M91-HR (high resistance) model



Measurement package comparison

Use the guarded insert alone or with the high-resistance Hall measurement package.



	High resistance **up to 200 GΩ**	Standard resistance **up to 10 MΩ**
Benefits	**Benefits with M91 + Lake Shore guarded insert:** ■ Fastest measurements with reduced settling times ■ Best performance for low-noise, low-current measurements ■ Fully guarded from instrument to sample	**Benefits with M91 integration:** ■ Cut measurement time up to one half with no field reversal needed ■ Switching technique minimizes thermal drift ■ Eliminates manual trial-and-error steps with optimized calculations
Cost	$$	$
Resistance range	10 mΩ to 200 GΩ	10 mΩ to 10 MΩ
Integration	M91/PPMS integration with low noise, fully guarded insert	M91/PPMS integration with breakout box
FastHall model	M91-HR (high resistance)	M91 (standard)
FastHall excitation	Current source, voltage source	Current source
Sample mounting	Lake Shore sample board	PPMS sample puck
Signal path	Fully guarded (internal coaxial) from instrument to sample	Standard twisted pair wiring
Mobility	10^6 $cm^2/(V\,s)$ to 0.001 $cm^2/(V\,s)$	
Sample types	Supports van der Pauw and Hall bar samples	
Temperature sensor	Integrated Cernox® temperature sensor local to sample	
Control software	FastHall's MeasureLINK® software for Hall measurement control integrates easily with the PPMS MultiVu™ application software	

High resistance kit — PPMS/M91 integration via Lake Shore guarded insert

Diagram 3: PPMS connected to the M91 with the guarded insert

Features

- Fully guarded from instrument to sample for ultra-low noise measurements
- M91-HR resistance measurements up to 200 GΩ
- Samples mount to consumable Lake Shore sample carrier boards (also pin compatible with Quantum Design sample carrier boards); 12 are included

Specifications summary

Triaxial center conductor leakage current	<500 fA
Max current per pin	100 mA
Max voltage between any 2 pins and insert body	50 V
Operating temperature range	1.9 K to 400 K

Sample connections

Diagram 3 generally shows how the PPMS/M91 connection is made via the Lake Shore guarded insert (Diagram 4).

The M91 supports both van der Pauw (4-connection) and Hall bar (6-connection) geometries. These samples are wired to the Lake Shore sample board (Diagram 5). The sample board then snaps into the sample insert board located on the probe (Diagram 6).

When the guarded insert is loaded into the PPMS, these sample connections are fully guarded up to the M91 via triaxial cables (included in kit). The integrated Cernox® sensor connections go to the PPMS, enabling temperature readings directly through MultiVu. Diagram 7 shows a close up view at the working end of the insert.

Diagram 4: Lake Shore insert

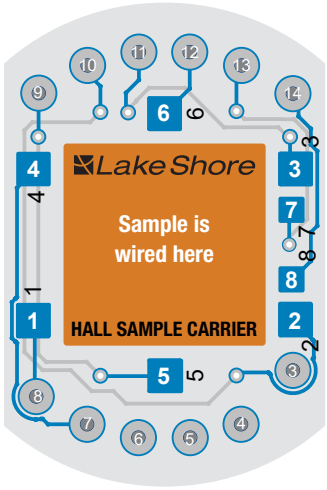


Diagram 5: Sample carrier board

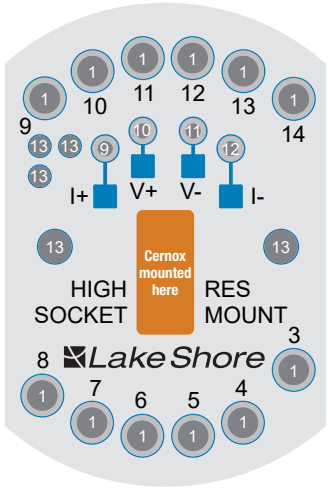


Diagram 6: Sample mount board

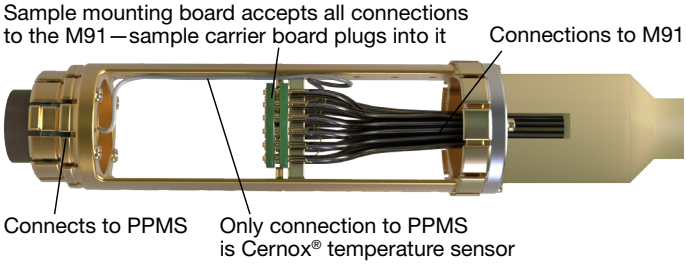


Diagram 7: Insert connections

Standard resistance kit — PPMS/M91 integration via Lake Shore breakout box

Diagram 1: PPMS connected to the M91 via breakout box

Features

- Low-cost option
- Compatible with Quantum Design PPMS puck
- M91 resistance measurements up to 10 MΩ

Sample connections

The M91 supports both van der Pauw (4 connections) and Hall bar (6 connections) geometries. These samples should be wired to Quantum Design's PPMS sample puck as shown in Diagram 2. When inserted into the PPMS, these sample connections are present on the LEMO connector on the side of the PPMS. The M91-TRIAX-DB25 breakout box enables these pins to connect to the M91. Six triaxial cables are included in the kit. Note: guarding is only up to the breakout box.

Gray LEMO (puck) pins	FastHall triaxial
3 (CH 1, I+)	1
7 (CH 2, I+)	2
8 (CH 2, I-)	3
12 (CH 3, I-)	4
4 (CH 1, I-)	5
11 (CH 3, I+)	6
10 (CH 2, V-)	AUX 1
9 (CH 2, V+)	AUX 2
6 (CH 1, V-)	Measure common

Note:
Internal jumper on measure common:

Gray LEMO pin 6, puck CH 1, V-

P1-user bridge D shield, pin 13

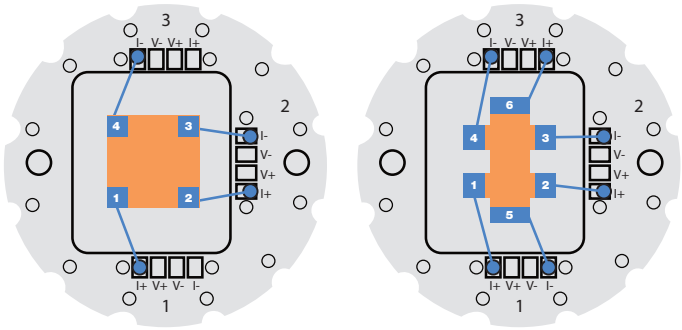
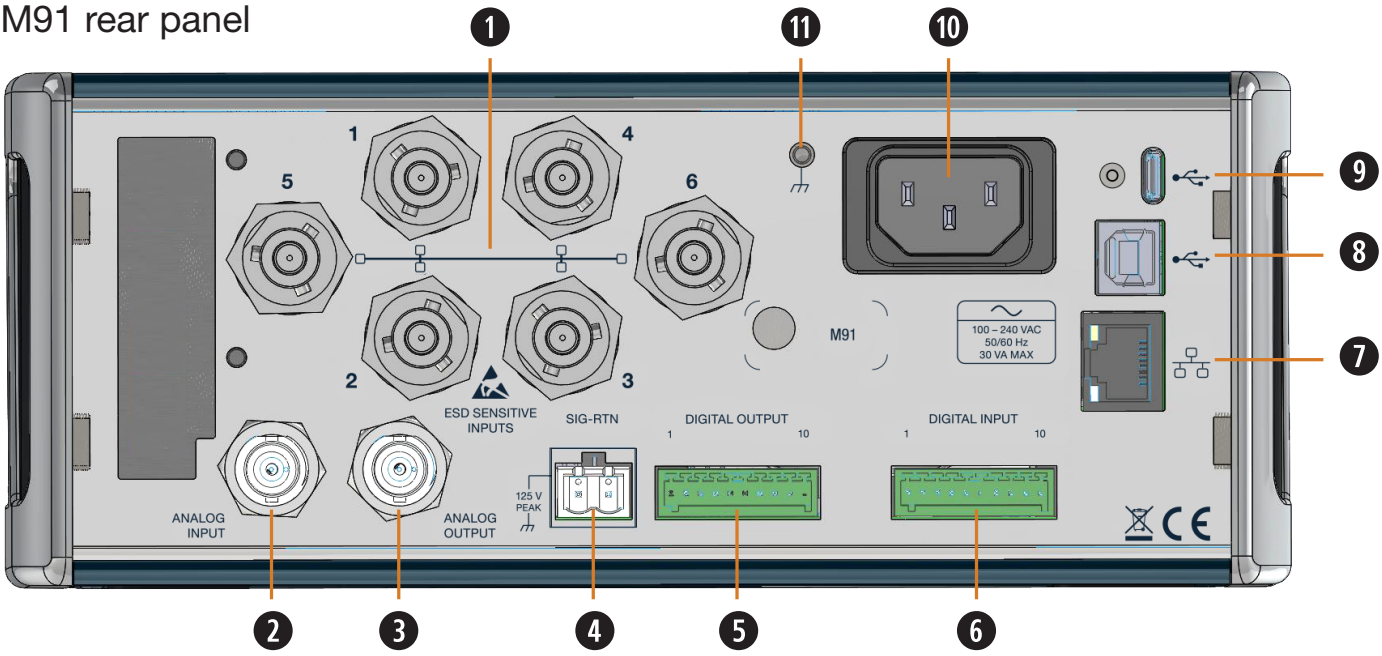


Diagram 2: Pinning for PPMS sample puck

M91 rear panel

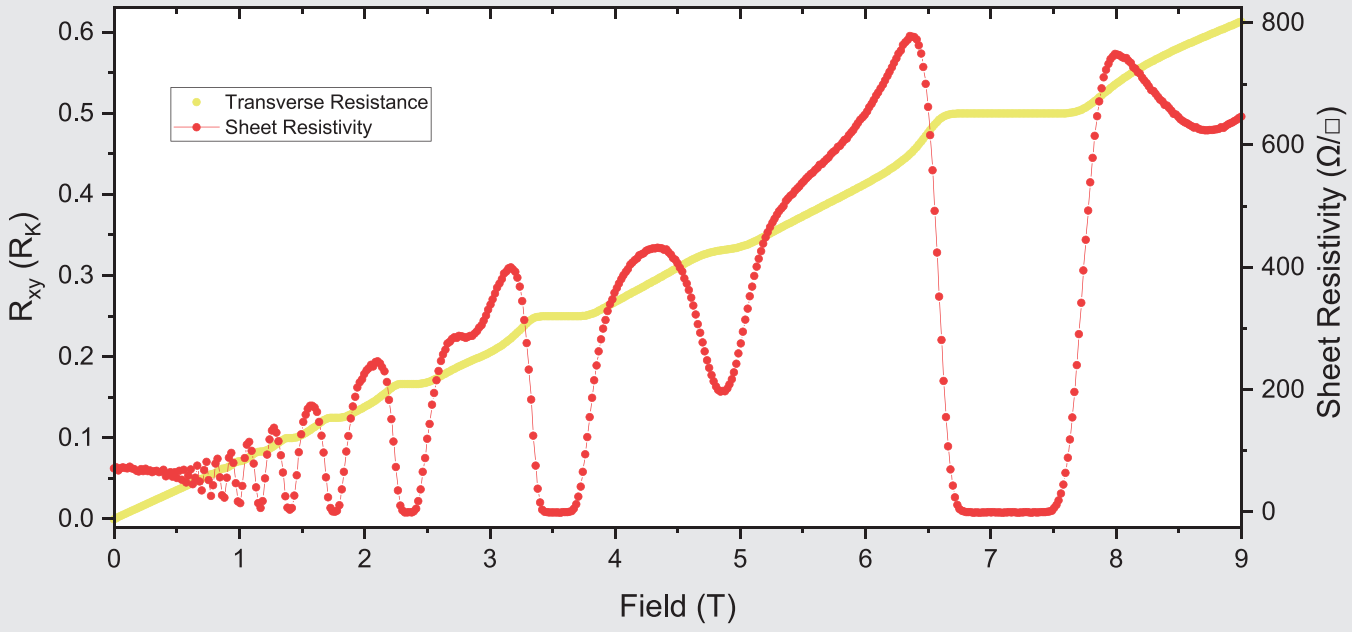


1. Triaxial sample connectors
2. Analog input
3. Analog output
4. Signal RTN
5. Digital output
6. Digital input
7. RJ-45 Ethernet interface
8. USB communications interface
9. USB thumb drive interface
10. Line input assembly
11. Chassis ground connection

Diagram 8: Back panel of M91 instrument

Field-dependent transverse and longitudinal transport measurements for a GaAs 2-D electron gas system at 2 K with 1 μA sourced excitation current in the van der Pauw geometry. Plateaux in the transverse channel demonstrate the integer quantum Hall effect and correspond to where the Fermi level falls in an area of localized states between neighboring Landau levels.

Sample provided by Dr. M. Pendharkar,Chris Palmstrøm Group,University of California Santa Barbara.



MeasureLINK software

The M91's MeasureLINK™ software for Hall measurement control integrates easily with the PPMS MultiVu application software. MeasureLINK can be installed on the same PC with the MultiVu software or on a separate PC that is on the same network as the MultiVu PC.

Once installed, MeasureLINK:

- Provides a simple way to start and step through your measurement sequences, as well as chart, log, and organize the result
- Includes scripts for running Hall measurements and reporting the result
- Enables automated control of field and management of sample temperature
- Generates detailed reports including all the supporting intermediate data so you can readily confirm the integrity of the final results
- Allows for customization of measurement sequences for specific Hall research requirements (optional upgrade)

Home screen

Three main functions:

- Sample setup
- Sequencing
- Scripting

Sample setup screen

Associate sample information with a measurement sequence

Enter new sample information directly

Import sample information from previously-saved file

Sequence screen

Build a sequence of steps that define the desired measurement protocol

Choose from:

Measurement functions

- Built-in functions

Control functions

- Go to field or temperature
- Loop field or temperature

Custom measurements

- Modified or specialized routines, previously defined by scripts

Script screen

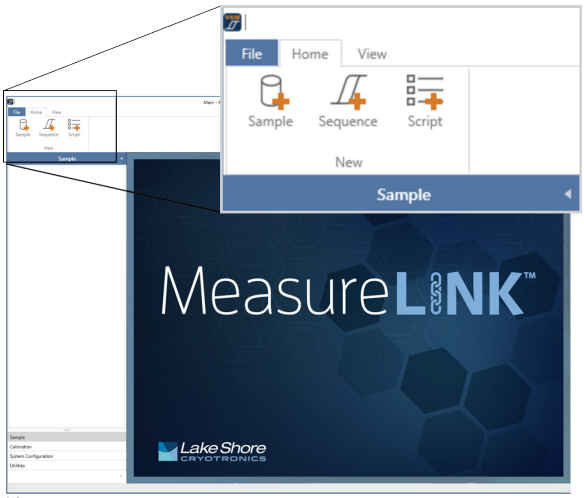
Extend your system functionality by creating custom scripts

- Implement nearly any measurement
- Integrate third-party instruments

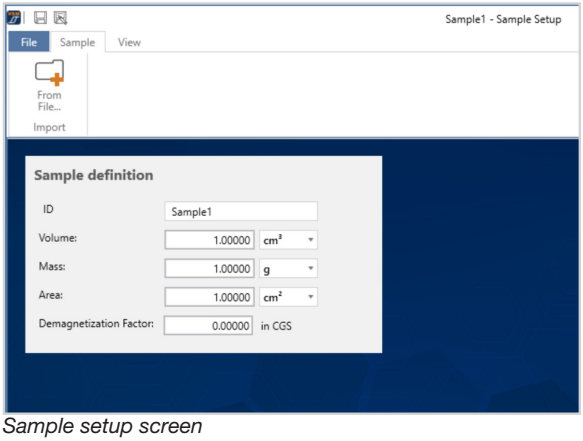
Modify existing scripts

Import other scripts

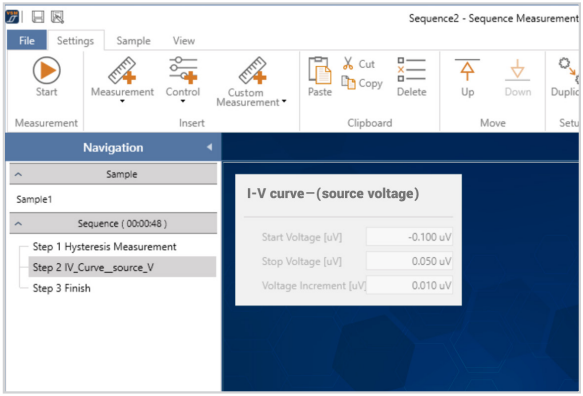
Simpler and faster than writing code



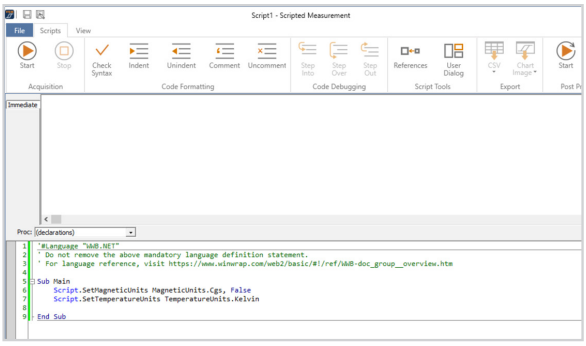
Home screen



Sample setup screen



Sequence screen



Script screen

060624

Questions? Answers?

Visit http://forums.lakeshore.com/
and become part of the conversation!