

MeasureReady® M91 FastHall™ for PPMS® Platforms

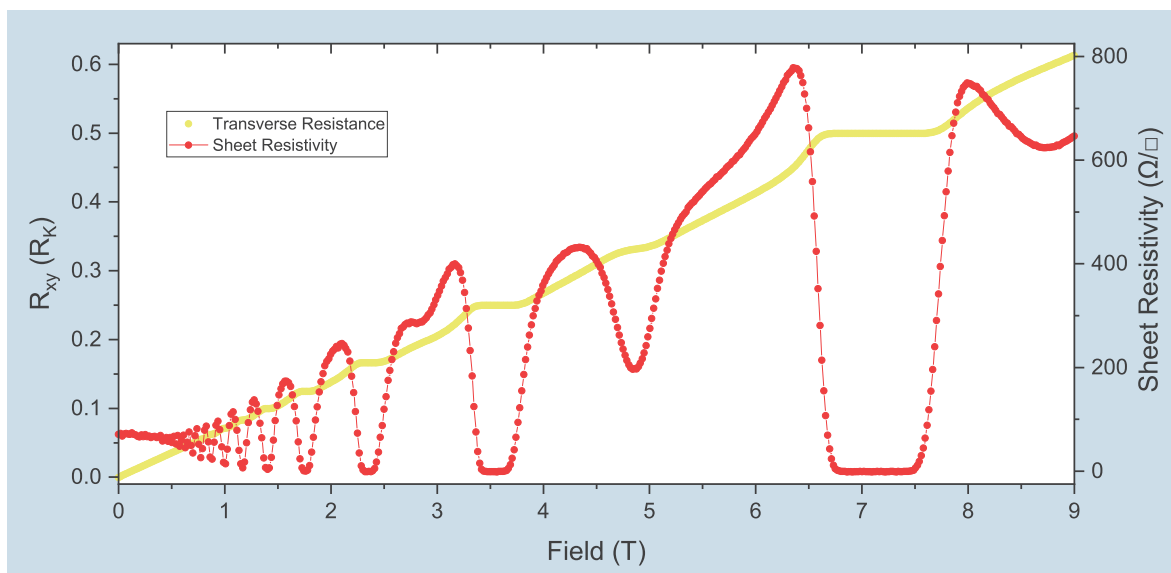
Lake Shore Cryotronics

The Lake Shore Cryotronics MeasureReady M91 FastHall option delivers significantly higher levels of precision, speed, and convenience as compared to traditional Hall effect measurement solutions. Combining all the necessary Hall measurement functions into a single instrument, the M91 automatically executes measurements and calculates the final Hall and mobility parameters. The instrument eliminates manual trial-and-error steps and ensures that measurements are always made under optimal conditions for the sample.



The M91 and its patented FastHall technology eliminates the need to reverse the magnetic field during the measurement. This is particularly beneficial when using the M91 with the superconducting magnet of a PPMS, allowing for much faster analysis of low-mobility material samples in van der Pauw (vdP) wired geometries. Two options are available to easily integrate the M91 into a PPMS:

- Standard resistance: uses a Lake Shore feedthrough box to connect the M91 to the PPMS
- High resistance: uses low-noise, fully guarded custom probe for your PPMS



Field-dependent transverse and longitudinal transport measurements for a GaAs 2-D electron gas system at 2 K with 1 μ A sourced excitation current in the van der Pauw geometry. Plateaus 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 Palmström Group, University of California Santa Barbara).



Quantum Design PPMS family

Standard resistance option — PPMS/M91 integrated via Lake Shore feedthrough box



Diagram 1: PPMS connected to the M91 via feedthrough 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

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 DB25-M91-TRIAX feedthrough box enables these pins to connect to the M91. Six triaxial cables are included in the kit. Note: guarding is only up to the feedthrough box.

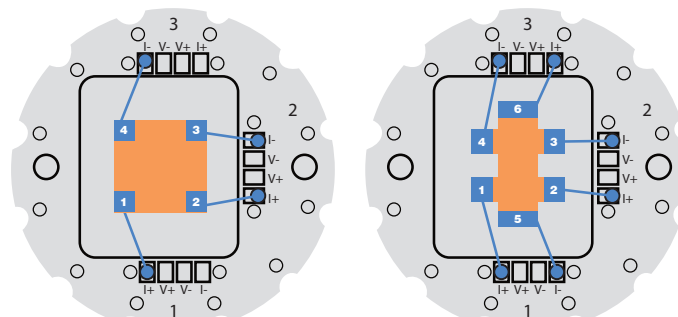
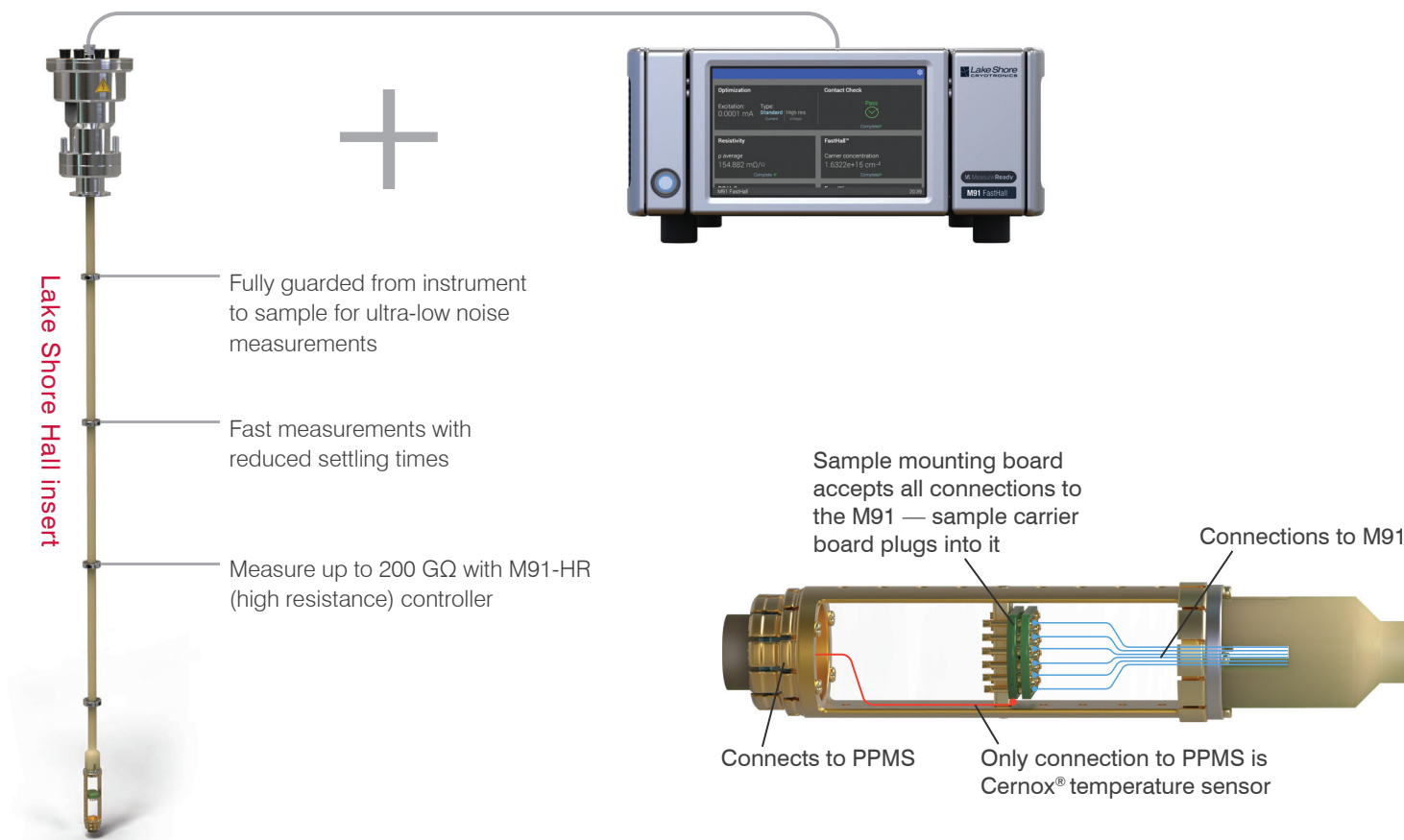


Diagram 2: Pinning for PPMS sample puck

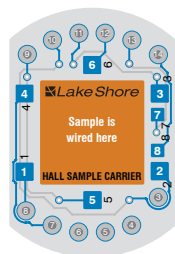
High resistance option — PPMS/M91 integrated via Lake Shore Hall insert

Seamlessly integrate Hall measurements into the PPMS



This diagram is a close-up of the sample connections on the Hall insert. 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, which snaps inside the insert.

When the insert is loaded into the PPMS, these sample connections are fully guarded up to the M91 via triaxial cables (included in the kit). The integrated Cernox® sensor connections go to the PPMS, enabling temperature readings directly through MultiVu. For more information, contact Quantum Design at: info@qdusa.com.



Lake Shore sample board

Samples mount to consumable Lake Shore sample carrier boards (also pin compatible with Quantum Design sample carrier boards); 12 are included in the kit.

Specifications summary

Pin-to-pin leakage current (base temperature): 10 fA

Pin-to-insert body leakage current (base temperature): 10 fA

Maximum current per pin: 100 mA

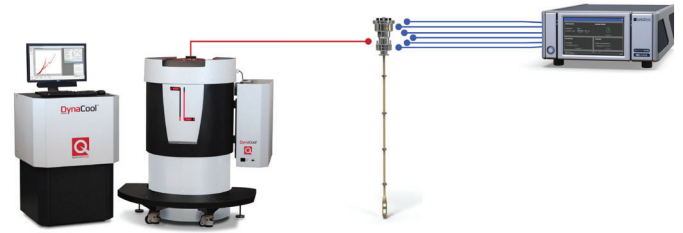
Maximum voltage between any 2 pins and insert body: 50 V

Operating temperature range: 1.9 K to 400 K

Comparison of standard and high resistance models

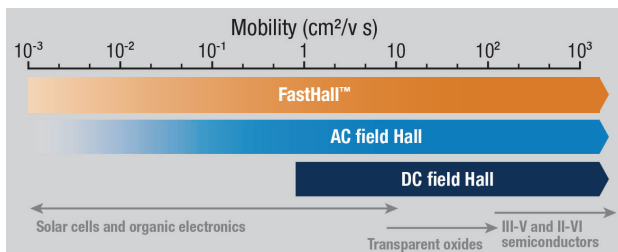


Standard resistance up to 10 MΩ



High resistance up to 200 GΩ

Benefits	<p>Benefits with M91 integration:</p> <ul style="list-style-type: none"> ■ 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 	<p>Additional benefits with M91 + Lake Shore insert:</p> <ul style="list-style-type: none"> ■ Fastest measurements with reduced settling times ■ Best performance for low-noise, low-current measurements ■ Fully guarded from instrument to sample
Resistance range	10 mΩ to 10 MΩ	10 mΩ to 200 GΩ
Integration	M91/PPMS integration with feedthrough box	M91/PPMS integration with low noise, fully guarded insert
FastHall model	M91 (standard)	M91-HR (high resistance)
FastHall excitation	Current source	Current source, voltage source
Sample mounting	PPMS sample puck	Lake Shore sample board
Signal path	Standard twisted pair wiring	Fully guarded (internal coaxial) from instrument to sample
Sample types	Supports van der Pauw and Hall bar samples	
Temp 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	



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 included in kit

Specifications subject to change. October 2023
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