Quick Start Guide

MeasureReady®

M91 FastHall™ Measurement Controller

Lake Shore CRYOTRONICS

Safety Precautions

Observe these general safety precautions during all phases of instrument operation, service, and repair. Failure to comply with these precautions or with specific warnings elsewhere in this manual violates safety standards of design, manufacture, and intended instrument use. Lake Shore Cryotronics, Inc. assumes no liability for Customer failure to comply with these requirements.

The MeasureReady® M91 FastHall™ measurement controller protects the operator and surrounding area from electric shock or burn, mechanical hazards, excessive temperature, and spread of fire from the instrument. Environmental conditions outside of the conditions below may pose a hazard to the operator and surrounding area.

- Indoor use
- Altitude to 2000 m
- 23 °C ± 5 °C at rated accuracy
- 10 °C to 35 °C at reduced accuracy, <65% relative humidity non-condensing
- Overvoltage category II
- Pollution degree 2
- Mains fluctuations up to ± 10%

Ground the Instrument
To minimize shock hazard, the instrument is equipped with a 3-conductor AC power cable. Plug the power cable into an approved 3-contact electrical outlet or use a 3-contact adapter with the grounding wire (green) firmly connected to an electrical ground (safety ground) at the power outlet. The power jack and mating plug of the power cable meet Underwriters Laboratories (UL) and International Electrotechnical Commission (IEC) safety standards.

Ventilation
The instrument has ventilation holes in its side covers. Do not block these holes when the instrument is operating.

Do Not Operate in an Explosive Atmosphere
Do not operate the instrument in the presence of flammable gases or fumes. Operation of any electrical instrument in such an environment constitutes a definite safety hazard.

Keep Away from Live Circuits
Operating personnel must not remove instrument covers. Refer component replacement and internal adjustments to qualified maintenance personnel. Do not replace components with power cable connected. To avoid injuries, always disconnect power and discharge circuits before touching them. Do not position the instrument so that it is difficult to disconnect the power cord.

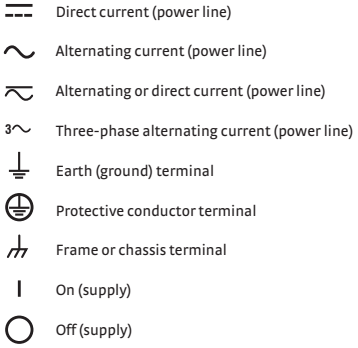
Do Not Substitute Parts or Modify Instrument
Do not install substitute parts or perform any unauthorized modification to the instrument. Return the instrument to an authorized Lake Shore Cryotronics, Inc. representative for service and repair to ensure that safety features are maintained. If the equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

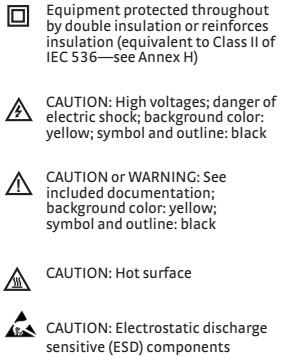
Cleaning
Do not submerge instrument. Clean only with a damp cloth and mild detergent. Exterior only.

Desktop Installation
When installing the instrument in a desktop environment, ensure it is mounted on a flat, level surface.

Improper Use
If the instrument is used in a manner that is not specified by Lake Shore, the safety protections provided by the instrument are no longer guaranteed, and may be impaired.

Child Safety
This equipment is not suitable for use in locations where children are likely to be present.





Key specifications

Ambient temperature
23 °C to ± 5 °C at rated accuracy
10 °C to 35 °C at reduced accuracy

Power requirement
100 V to 240 V (universal input), 50 Hz or 60 Hz, 30 VA

Size
216 mm wide × 87 mm high × 369 mm deep
(8.5 in × 3.4 in × 14.5 in), half rack

Weight
3.2 kg (7 lb)

Approval
CE mark

NOTE: Not all specifications are listed. For full specifications, see:
https://www.lakeshore.com/m91

Introduction

This guide provides basic information for getting started with your MeasureReady® M91 FastHall™ measurement controller. For further information, see our website.

Items included with the M91 measurement controller:

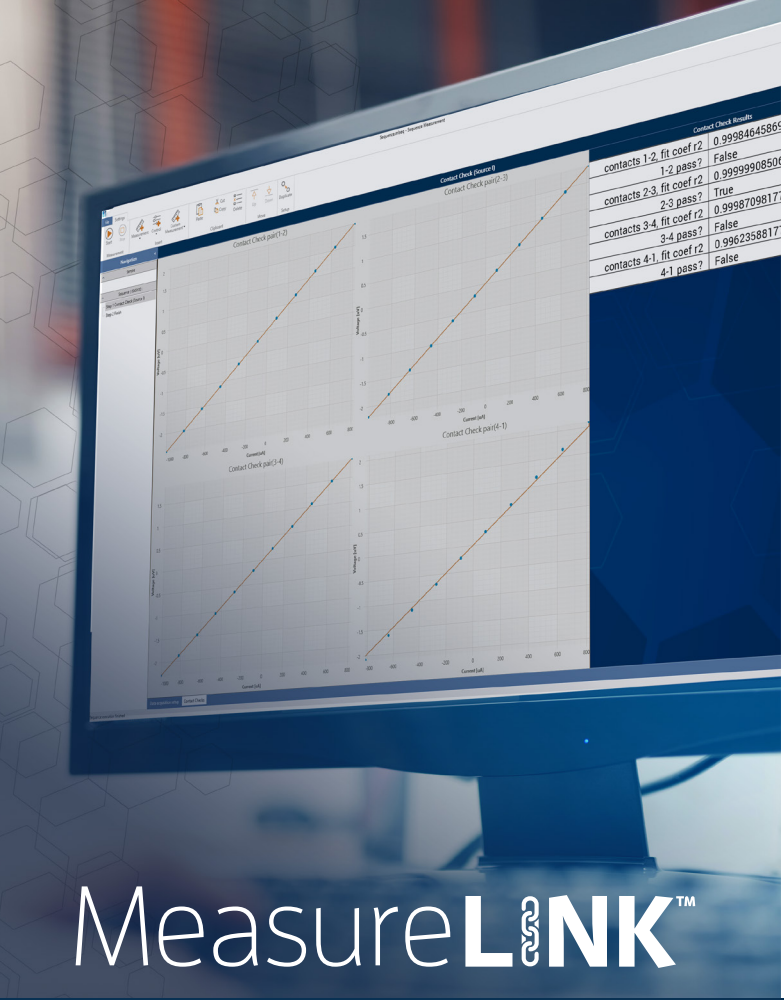
- M91 FastHall™ measurement controller
- Accessory kit:
  - USB Type-A to USB Type-C™ adapter
  - USB Type-A male to USB Type-B male cable, 2 m
  - Two 10-pin terminal block mating connectors, used for digital I/O
  - One 2-pin terminal block connector, used for signal return
- Line power cord

Unpacking

1. Inspect all items for both visible and hidden damage that occurred during shipment. If there is visible damage to the contents, contact the shipping company and Lake Shore immediately.
   NOTE: Procedures vary with shipping companies. Keep all damaged shipping materials and contents until instructed to either return or discard them.
2. Keep the container and shipping materials until all contents have been accounted for.
3. Check off each item on the packing list as it is unpacked.

Features

- FastHall technology eliminates the need for magnetic field reversal for van der Pauw samples
- Applicable to any magnet type
- More than 100 times faster than previous Hall measurements
- Ideal for measuring low mobility materials
- Hall analysis including calculation of derived parameters for van der Pauw and Hall bar samples
- Manual step-by-step operation for full control
- Extends mobility range down to 0.001 $cm^2/V\,s$, without using AC field techniques
- High-resistance option enables measurement of samples from 10 MΩ to 200 GΩ
- Derived parameter calculations that include the errors of all measurements in the calculation
- Digital and analog I/O for simplifying integration and data gating
- 3-year standard warranty



MeasureLINK™-MCS software

A license for MeasureLINK™-MCS software is included with the M91. The software can be downloaded at no charge from https://www.lakeshore.com/software. An activation code is required. If you don't have one, contact Lake Shore. The scripting development license (ML-SDL), which allows users to edit the standard experiments and create new ones, can be purchased from Lake Shore. MeasureLINK software and the scripting development license need to be reactivated annually.

The software allows the user to combine environmental and electrical instrumentation into a coordinated measurement system. The software provides a simple software driver connection for Lake Shore instruments, and a generic driver for third-party instruments. MeasureLINK™ has a built in Visual Basic interpreter that permits simple user Interfaces and measurements, including the ability to construct, save and run data tables, charts and output files.

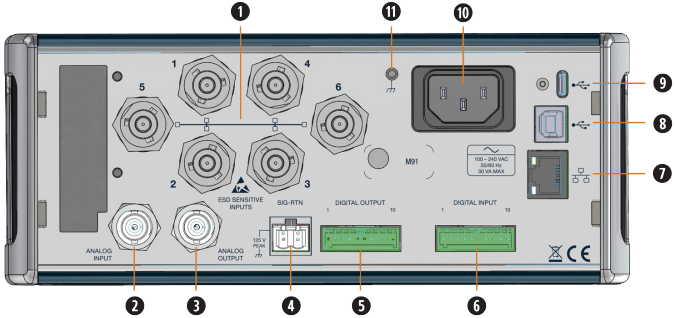
Please see https://www.lakeshore.com/software for software updates, and to download the MeasureLINK™-MCS software manual. See the integrated Help files within the MeasureLINK™-MCS software for specific scripting examples for the M91.

Front panel

The front panel consists of:

1. Power button
2. TiltView™ touchscreen

Rear panel

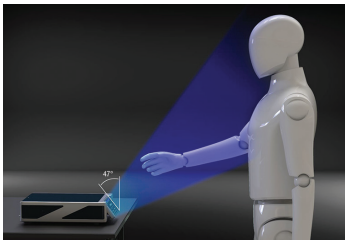


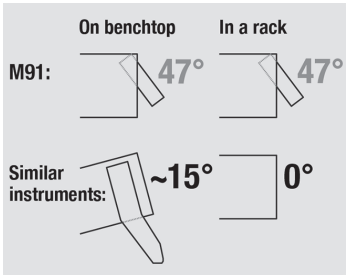
The rear panel consists of:

1. Triaxial sample connectors
2. Analog input
3. Analot output
4. Signal return
5. Digital output
6. Digital input
7. RJ-45 Ethernet interface
8. USB Type-B communications interface
9. USB Type-C™ interface
10. Line input assembly
11. Chassis ground connection

Placement

The M91 FastHall™ measurement controller is an out-of-the-box benchtop instrument with an adjustable TiltView™ screen for an improved viewing angle. The screen adjusts from a 0° to a 47° viewing angle, whether mounted in a rack or on a bench top.





Rack mounting

The M91 can be installed into a half rack or dual half rack mount using the optional Lake Shore rack mount kits. The kits contain the necessary parts to mount one instrument with the provided blank, or two instruments side by side in a rack mount space, 483 mm (19 in) wide by 88.9 mm (3.5 in) high.

NOTE: Ensure that there is 1 in (25 mm) clearance on both sides of the instrument after rack mounting.

Item	Description	Qty
❶	Rack mount panel	1
❷	Rack mount ear	2
❸	Screw, M4 × 8 mm FHM Phillips	2
❹	Screw, M4 × 16 mm FHM Phillips (original touchscreen instrument screws)	4
	-- OR --	
	Screw, 6-32 × 0.5 in FHM Phillips	4

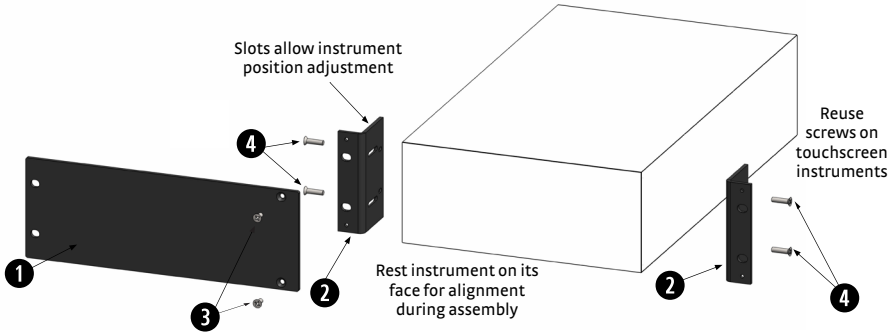
1. Remove instrument feet.
2. Attach the blank to the rack ear using the supplied screws.
3. *For dark blue touchscreen instruments:*

   Remove the front screws from the side panels and use these M4 screws to attach the rack ears.

   For beige keypad instruments:

   a. Remove the front screws from the sides of the instrument and retain for future use, if the rack kit is ever removed.

   b. Use the 6-32 screws ❹ to attach the rack ears.



Connections and Installation

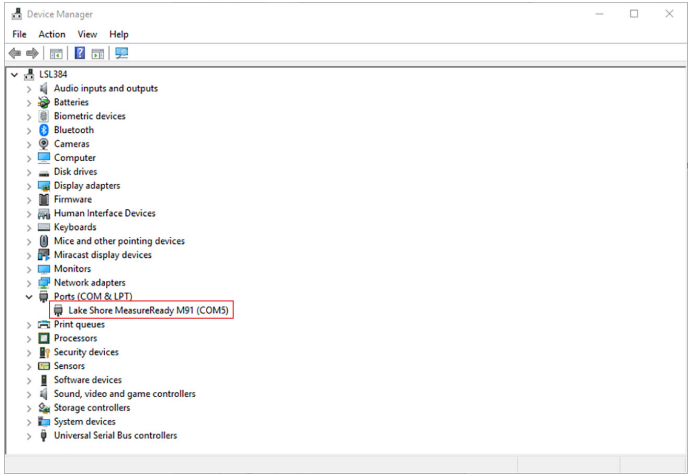
The M91 FastHall™ measurement controller includes a 3-conductor power cord that mates with the IEC 320-C14 line cord receptacle. Line voltage is present on the two outside conductors and the center conductor is a safety ground. The safety ground attaches to the instrument chassis and protects the user in case of a component failure.

WARNING: Always plug the power cord into an easily accessible, properly grounded receptacle to ensure safe instrument operation.

NOTE: If the power supply cord is damaged or lost, it must be replaced. Contact Lake Shore for a replacement to ensure proper voltage, current and type of cord.

Connect to the instrument

You must use SCPI commands or MeasureLINK™-MCS software to run measurements. Use the command list (see the user's manual) and your favorite serial terminal program (such as Putty or Termite) to communicate with the M91 via the remote interface. The USB connection will be listed as a virtual COM port on your PC. If you are not able to connect, make sure you have the correct COM port selected. You can do this by checking Device Manager:



If the instrument is connected and you are still unable to see the M91 in this view, you may need to install the USB driver that can be found on the Lake Shore Software web page: https://www.lakeshore.com/software/. If you have previously downloaded the driver, you may need to update it when adding a new instrument.

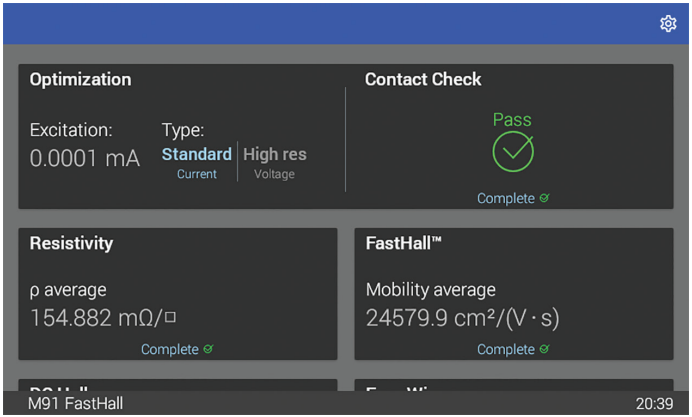
See page 12 for Serial port settings.

Startup

Connection

The M91 is powered on by plugging in the power supply. The instrument powers up in the power up state with the output disabled. The instrument should be powered on for 30 minutes before using for rated specifications.

NOTE: No measurements can be started from the front panel screen; it is used only to display high-level measurement results.



Starting a Measurement

The MeasureReady® M91 FastHall™ measurement controller executes the following measurements: contact check, resistivity, and Hall measurement. Each time a new measurement is run, it overwrites the existing measurement data of its type (a contact check will overwrite a contact check, but will not overwrite a resistivity measurement). Cycling power or resetting the instrument will clear all data.

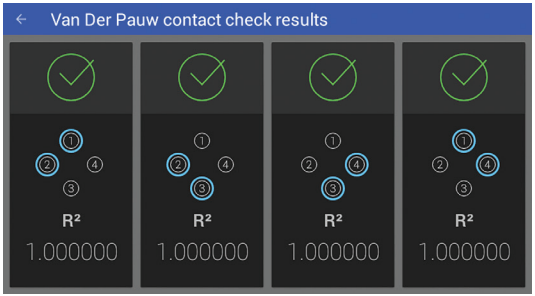
Optimization

The M91 is able to optimize your sample setup parameters, which can be used in all of your measurements. Optimization allows the user to rapidly find the proper excitation for a sample without a lengthy trial and error process.

Running a Hall Analysis Using SCPI Commands

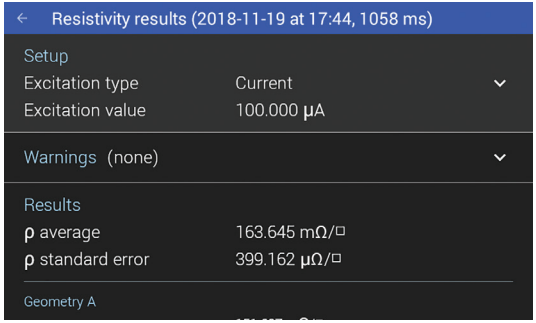
Step 1: Contact Check

Contact check is required to validate that the physical sample contacts are sufficient for the Hall analysis to be complete accurately over the specified range of excitations. This is done by rotating through either four contact alignments (for van der Pauw samples) or six contact alignments (for Hall bar samples). For each alignment, the excitation is swept through a specified range of values and the response is measured.



Step 2: Resistivity

This measurement determines the resistivity of the sample between two adjacent points. In this measurement, the sample should be subjected to zero field. View the results from a SCPI command or view the high-level results from the M91 front panel. Results returned are resistivity, F-value, and geometry dependent values.

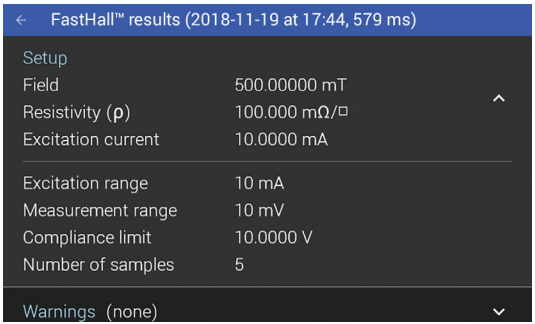


Step 3: Hall Measurement

To complete a Hall measurement, either run a FastHall™ measurement (for van der Pauw samples only), or the traditional DC Hall method is available for both van der Pauw and Hall bar samples.

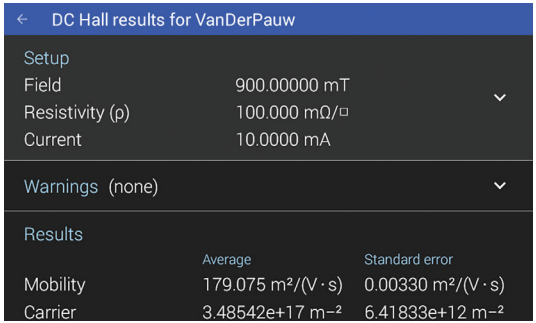
FastHall™

The FastHall™ command utilizes the FastHall technology developed by Lake Shore Cryotronics. It permits a full Hall analysis to be completed without performing an actual field reversal step, as with a traditional Hall analysis.



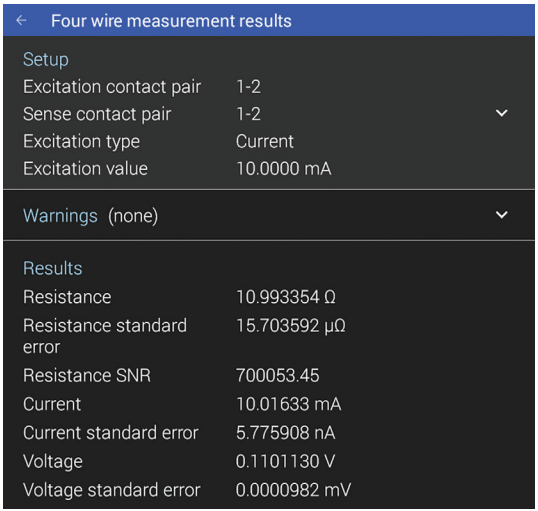
DC Hall

A DC Hall measurement is available for both van der Pauw and Hall Bar samples. DC Hall requires the magnet field to physically change from +B to -B in a Hall measurement.



Four Wire measurement

Use four wire measurement to take samples for an IV curve, or to determine settling times.



Computer interface connections

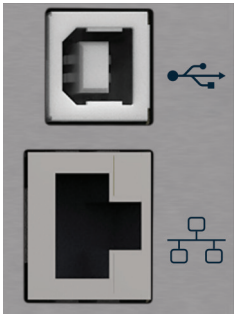
Attach the MeasureReady® M91 FastHall™ measurement controller to your PC using Ethernet or USB. This programming interface requires a certain configuration to communicate properly with the M91. Refer to the user's manual for more information.

GPIB is also available for remote interface capability via an external adapter, which can be purchased from Lake Shore. Visit https://www.lakeshore.com/products/product-detail/measureready/gpib-adapter/ for more information.

NOTE: In order to use the adapter, the instrument must have operating system version 2.6.4 (or later) installed.

Serial port settings	
Baud rate	921,600
Data bits	8
Parity	None
Stop bits	1
Flow control	RTS/CTS

Ethernet settings	
IP address	DHCP or Manual
Port	7777



Contacting Lake Shore

The Lake Shore Service Department is staffed Monday through Friday between the hours of 8:00 a.m. and 5:00 p.m. EST, excluding holidays and company shut down days.

Contact Lake Shore Service through any of the means listed below. However, the most direct and efficient way is to complete the online service request form at https://www.lakeshore.com/Service/.

The Lake Shore Forum is also a great place to look for solutions, to post issues, and to share successes: http://forums.lakeshore.com/.

For further documentation and information, please see https://www.lakeshore.com/m91/

Lake Shore Service

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