



## *DryMag*

# DryMag 1.5 K cryogenic-free measurement system

The Lake Shore **DryMag** provides a high magnetic field and low-temperature sample environment without the use of liquid helium. Samples are cooled by static helium thermal exchange gas throughout the entire temperature range, providing uniform cooling of solids, powders, liquids, and irregularly shaped samples to 1.5 K. Heaters and sensors on both the copper sample chamber and sample mount are used with a dual-loop temperature controller for rapid and precise sample temperature control.



## DryMag 1.5 K cryogen-free measurement system

The Lake Shore DryMag provides cryogen-free cooling to 1.5 K combined with magnetic fields to 12 T. Cooling is provided by a powerful Sumitomo 4 K refrigerator, available in either Gifford-McMahon or pulse tube configuration. The refrigerator cools a sample chamber filled with static helium thermal exchange gas, while samples are mounted on a top-loading positioner assembly. This indirect cooling mechanism provides effective cooling of samples regardless of sample size, shape, or material. Thermal exchange gas cooling is especially useful for liquid, powder, and irregularly shaped samples that are not easily mounted to the flat surface of a sample holder. Samples can be exchanged without warming the cryocooler to room temperature, reducing turnaround time.

Continuous operation to 1.5 K is achieved through the use of a recirculating helium gas loop. Helium gas is first cooled by the cryocooler using a series of heat exchangers, and then used to cool the sample chamber and thermal exchange gas. The helium gas recirculates in a continuous loop for extended duration measurements.

The DryMag can be equipped with optional electrical connectors and wiring, and is ideal for use in studying the electronic properties of materials. An optional transport measurements package integrates the Lake Shore MeasureLINK software and the M81-SSM synchronous source measure system and the M91 FastHall controller for turnkey automated magnetolectric measurements.



### Key features

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Top-loading static helium thermal exchange gas configuration

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Independent recirculating helium gas loop cools the sample chamber to 1.5 K without the use of liquid helium

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Choice of GM or PT cryocooler to match performance and budget requirements

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Vertical fields to 12 T and horizontal fields to 7 T

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Optimized for two-loop temperature control; helium thermal exchange gas is heated and controlled by one heater and calibrated temperature sensor while a second heater and sensor on the sample mount enable rapid temperature sweeps and precise sample temperature control

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Sample is accessed by opening a single clamp and removing the top-loading sample positioner

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O-ring sealed ports accept DC and RF electrical feedthroughs

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Optional DC and RF wires and cables for electrical measurements

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Optional automated electrical transport measurements using MeasureLINK™, M81-SSM, and M91 FastHall™ controller

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## DryMag

### Featured components

Continuous temperature range of 1.5 K to 300 K (420 K optional), with the magnet at full field

Sample in static helium thermal exchange gas for uniform cooling of powders, liquids, and irregularly shaped solids

Recirculating helium gas loop for cooling the copper sample chamber, independent from the thermal exchange gas surrounding the sample

Dual-loop heater configuration for rapid and precise sample temperature control (simultaneous control of helium thermal exchange gas and sample mount)

Removable sample positioner with manual linear and rotational adjustment, including copper sample mount with heater and calibrated Cernox sensor, removable gold-plated sample holder, experimental and housekeeping feedthroughs, and two spare sample wiring ports

Aluminum thermal radiation shield

Rigid lifting support for use with overhead hoist

Recirculating helium gas handling system including scroll pump and all necessary gas lines, valves, and full charge of helium gas

## Selections

### Magnet selections

7 T split, 7 T, 9 T or 12 T solenoid

### Maximum temperature

300 K: Standard

420 K: Both heater loops on non-optical systems

420 K: Only sample mount loop on optical systems

### Optical access

Bottom optical access (compatible with solenoid magnets)

Horizontal optical access (compatible with 7 T split magnet)

## Easily add DC, AC, and mixed DC+AC measurement capabilities to your cryostat with an M81-SSM

This modular, multichannel system provides highly synchronized DC, 100 kHz AC, and mixed DC + AC sourcing and measuring — including both voltage and current lock-in measurement capabilities — for low-temperature material research performed in your cryostat. It supports up to three remote-mountable source and three measure modules per a single M81-SSM-6 instrument and, owing to its modularity, allows signal and source amplifiers to be located as close as possible to the sample being characterized. This minimizes the signal wiring to the sample, reduces noise, and increases measurement sensitivity. The modules also leverage patent-pending MeasureSync™ real-time sampling technology to ensure synchronous sourcing and measuring across all channels. Plus, by having both DC and AC sourcing and measurement in one instrument, the M81-SSM can eliminate the need for mixed-instrument setups, greatly simplifying the setup of complex characterization configurations.



M81-SSM synchronous source measure system

Real-time sampling architecture for synchronous sourcing/measuring

All source and measure channels are capable of DC and AC to 100 kHz signals

100% linear circuitry for the lowest possible source/measure noise

Optimized for fundamental, harmonic, and phase AC plus DC biased measurements

Unique, flexible instrument/distributed module architecture

Provides the absolute precision of DC plus the detection sensitivity performance of AC instrumentation

Uses a clean, simple UI and common programming API for fast setup

Included MeasureLINK software enables full end-to-end measurement and cryostat temperature control

# MeasureLINK™

## For total control of measurements performed in a cryostat, add our MeasureLINK software

Our optional MeasureLINK software enables a wide range of capabilities including charting and logging, system monitoring with a cryostat-specific process view, and even controlling Lake Shore equipment as well as some third-party instrumentation, in a non-programming environment. You can also create unlimited functionality using the scripting development environment.

Create multiple configurations to support separate measurements

Monitor temperature and change setpoints with the monitor pane

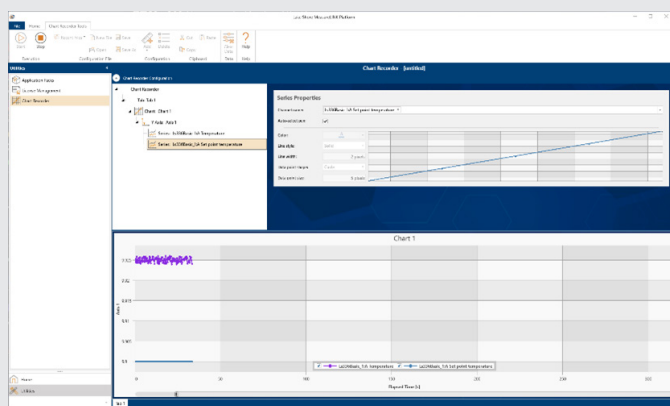
Easily create nested, multi-level measurement loop sequences

See real-time internal cryostat temperatures in Process View

Charts and log all system variables with Chart Recorder

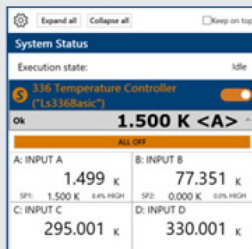
No programming required – drag and drop to create temperature sweeps, access measurements, and add third-party instruments

Custom scripting function allows you to construct new and edit existing measurement scripts



The chart recorder utility enables charting and logging of all system variables, for example, so you can keep a close eye on temperature trends in a cryostat experiment in real-time; it also helps you determine when steady-state conditions have been reached.

MeasureLINK  
Monitor Pane



MeasureLINK™

## Options

### Sample positioner

Single rotation about the vertical axis: standard

Double rotating sample positioner, permitting rotation around both the vertical axis and the horizontal axis

Precision sample positioner with linear translation stage and graduated (manual) rotation

Sample in vacuum configuration

### He-3 sample insert

For operation to 300 mK

### Sample holders

User-specified mounting sample mounting provisions



## Options

### Electrical feedthroughs

- 
- (1) BNC grounded EF-BNC-1-B-AL
- 
- (2) BNC grounded EF-BNC-2-S-AL
- 
- (6) BNC grounded EF-BNC-6-G
- 
- (1) BNC insulated EF-BNC-1-B-NC
- 
- (2) BNC insulated EF-BNC-2-S-NC
- 
- (6) BNC insulated EF-BNC-6-I
- 
- (1) triaxial grounded EF-TRIAX-1-B-AL
- 
- (6) triaxial grounded EF-TRIAX-6-G
- 
- (1) triaxial insulated EF-TRIAX-1-B-NC
- 
- (6) triaxial insulated EF-TRIAX-6-I
- 
- (2) SMA grounded EF-SMA-2-B-AL
- 
- (6) SMA grounded EF-SMA-6-G
- 
- (2) SMA insulated EF-SMA-2-B-NC
- 
- (6) SMA insulated EF-SMA-6-I
- 
- 10-pin 10P-ASSEMBLY
- 
- 19-pin 19P-ASSEMBLY
- 
- 26-pin 26P-ASSEMBLY
- 
- 32-pin 32P-ASSEMBLY
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### Additional temperature sensors

#### **One Lake Shore Cernox sensor is now included**

Cernox® magnetic field independent, calibrated CX-1050-CU-HT-1.4M

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### Installed wiring

- 
- (1), (2), or (6) coaxial cables, SMA CABLEASSY-63340
- 
- (1), (2), or (6) coaxial cables, BNC CABLEASSY-63342
- 
- (1) or (6) triaxial cables CABLEASSY-63341
- 
- (10), (19), (26), or (32) PhBr wires WIRE-PHBR
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## Accessories

Available at [www.lakeshore.com](http://www.lakeshore.com)

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Vacuum pumping station 10RVP, 10DDP, or TS-85-D

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Temperature controller 336 or 335

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336 temperature controller



335 temperature controller



## Specifications

### DryMag

Temperature range	<1.5 K to 300 K (420 K optional)
Initial cooldown time	~24 h
Control stability	±50 mK
Sample change time	90 min
Recommended maintenance	10,000 h (GM) or 20,000 h (PT)

### Size

Height	1295.4 to 1397 mm (51 to 55 in)
Sample chamber inner diameter	Solenoid 50 mm (1.9 in), Split magnet 23 mm (0.9 in)
Sample mount diameter	Solenoid 38.1 mm (1.5 in), Split magnet 19.05 mm (0.75 in)
Weight of cryostat plus cold head	145.15 kg (320 lbs)
Shipping weight (approximate)	590.57 kg (1302 lbs)
Shipping dimensions (approximate)	Cryostat: 1016 mm × 1016 mm × 1727.2 mm (40 in × 40 in × 68 in) Gas Handling System: 1092.2 mm × 838.2 mm × 1473.2 mm (43 in × 33 in × 58 in) Compressor: 812.8 mm × 812.8 mm × 914.4 mm (32 in × 32 in × 36 in) Accessories: 812.8 mm × 812.8 mm × 889 mm (32 in × 32 in × 35 in)



## Ordering information

### Options

#### Sample positioner

<b>Standard</b>	Single rotation about the vertical axis: standard
<b>Optional</b>	Double rotating sample positioner, permitting rotation around both the vertical axis and the horizontal optical axis
<b>Optional</b>	Precision sample positioner with linear translation stage and graduated (manual) rotation
<b>Optional</b>	Sample in vacuum configuration

#### He-3 sample insert

<b>DryMag</b>	For operation to 300 mK
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#### Sample holders

User-specified mounting sample mounting provisions

#### Electrical feedthroughs

<b>EF-BNC-1-B-AL</b>	(1) BNC grounded
<b>EF-BNC-2-S-AL</b>	(2) BNC grounded
<b>EF-BNC-6-G</b>	(6) BNC grounded
<b>EF-BNC-1-B-NC</b>	(1) BNC insulated
<b>EF-BNC-2-S-NC</b>	(2) BNC insulated
<b>EF-BNC-6-I</b>	(6) BNC insulated
<b>EF-TRIAX-1-B-AL</b>	(1) triaxial grounded
<b>EF-TRIAX-6-G</b>	(6) triaxial grounded
<b>EF-TRIAX-1-B-NC</b>	(1) triaxial insulated
<b>EF-TRIAX-6-I</b>	(6) triaxial insulated
<b>EF-SMA-2-B-AL</b>	(2) SMA grounded
<b>EF-SMA-6-G</b>	(6) SMA grounded
<b>EF-SMA-2-B-NC</b>	(2) SMA insulated
<b>EF-SMA-6-I</b>	(6) SMA insulated
<b>10P-ASSEMBLY</b>	10-pin
<b>19P-ASSEMBLY</b>	19-pin
<b>26P-ASSEMBLY</b>	26-pin
<b>32P-ASSEMBLY</b>	32-pin

#### Additional temperature sensors

<b>DT-670-CU-HT-1.4L</b>	Silicon diode, calibrated (one included with cryostat)
<b>CX-1050-CU-HT-1.4M</b>	Cernox <sup>®</sup> magnetic field independent, calibrated
<b>TC-Y-ZZ-03</b>	Thermocouple, Type E

#### Installed wiring

<b>CABLEASSY-63340</b>	(1), (2), or (6) coaxial cables, SMA
<b>CABLEASSY-63342</b>	(1), (2), or (6) coaxial cables, BNC
<b>CABLEASSY-63341</b>	(1) or (6) triaxial cables
<b>WIRE-PHBR</b>	(10), (19), (26), or (32) PhBr wires

### Accessories

#### Automated electrical transport measurements

The DryMag system, when integrated with the groundbreaking Lake Shore Cryotronics M91 FastHall™ controller, offers breakthrough speed and accuracy as compared with conventional Hall effect measurement systems. The M91 eliminates the need to reverse polarity of the applied magnetic field during measurements, especially critical during high field measurements or when measuring low mobility materials, resulting in measurement times up to 100× faster than typical Hall systems. Operation of the DryMag cryostat and M91 controller are fully integrated, providing seamless operation via the supplied Lake Shore MeasureLINK™ software. Measurement applications include Hall voltage, resistance/resistivity, magnetoresistance, Hall coefficient, Hall mobility, anomalous Hall effect (AHE), and carrier type/concentration/density.

#### M81-SSM electronic synchronous source measure system

Contact us for standard/optical sample mounts or for interface cables/adapters for M81-SSM system/cryostat integration. Also available: specially priced preconfigured M81-SSM/cryostat packages for certain cryostat models—contact Sales for details.

<b>M81-SSM-2</b>	M81-SSM instrument with 1 source and 1 measure channel, including M81-SSM accessory kit (USB-A to USB-C adapter, USB-A male to USB-B male cable, terminal connectors for digital I/O, terminal connectors for chassis ground, quick-start guide) and a 2 m (6.6 ft) LEMO to BNC adapter cable
<b>M81-SSM-4</b>	M81-SSM instrument with 2 source and 2 measure channels, including M81-SSM accessory kit (USB-A to USB-C adapter, USB-A male to USB-B male cable, terminal connectors for digital I/O, terminal connectors for chassis ground, quick-start guide) and a 2 m (6.6 ft) LEMO to BNC adapter cable
<b>M81-SSM-6</b>	M81-SSM instrument with 3 source and 3 measure channels, including M81-SSM accessory kit (USB-A to USB-C adapter, USB-A male to USB-B male cable, terminal connectors for digital I/O, terminal connectors for chassis ground, quick-start guide) and a 2 m (6.6 ft) LEMO to BNC adapter cable
<b>ML-MCS</b>	MeasureLINK-MCS software with scripting development license. Includes complete MeasureLINK installation with Lake Shore instrument drivers, chart recorder functionality and drag-and-drop measurement sequences. Some application packs sold separately.
<b>Other accessories</b>	
<b>CF-100</b>	100 L LHe storage Dewar
<b>LN-50</b>	50 L LN <sub>2</sub> storage Dewar
<b>10RVP</b>	Vacuum pumping station
<b>10DDP</b>	Vacuum pumping station
<b>TS-85-D</b>	Turbomolecular pumping station
<b>336</b>	Model 336 temperature controller
<b>335</b>	Model 335 temperature controller



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