MAG|RS

MAGNETIC RESEARCH SYSTEM

DISCOVERY
STARTS HERE

Lake Shore
CRYOTRONICS

MAG|RS
MAGNETIC RESEARCH SYSTEM

Contents

Introducing MagRS, the ultimate customizable system for scientific research. This system allows you to take multiple types of measurements using a single electromagnet. Whether you need to work at room temperature, heat your samples up to 1000 °C, or cool them down to 1.5 K, the MagRS has you covered. The best part? With just one initial purchase of a system and measurement package, you can easily add new mesasurement types and temperature ranges at a fraction of the cost of a new system. It's like a 'Choose Your Own Adventure' for your research—flexible, cost-effective, and ready to adapt to whatever scientific journey you travel!

System overview

Measurement options

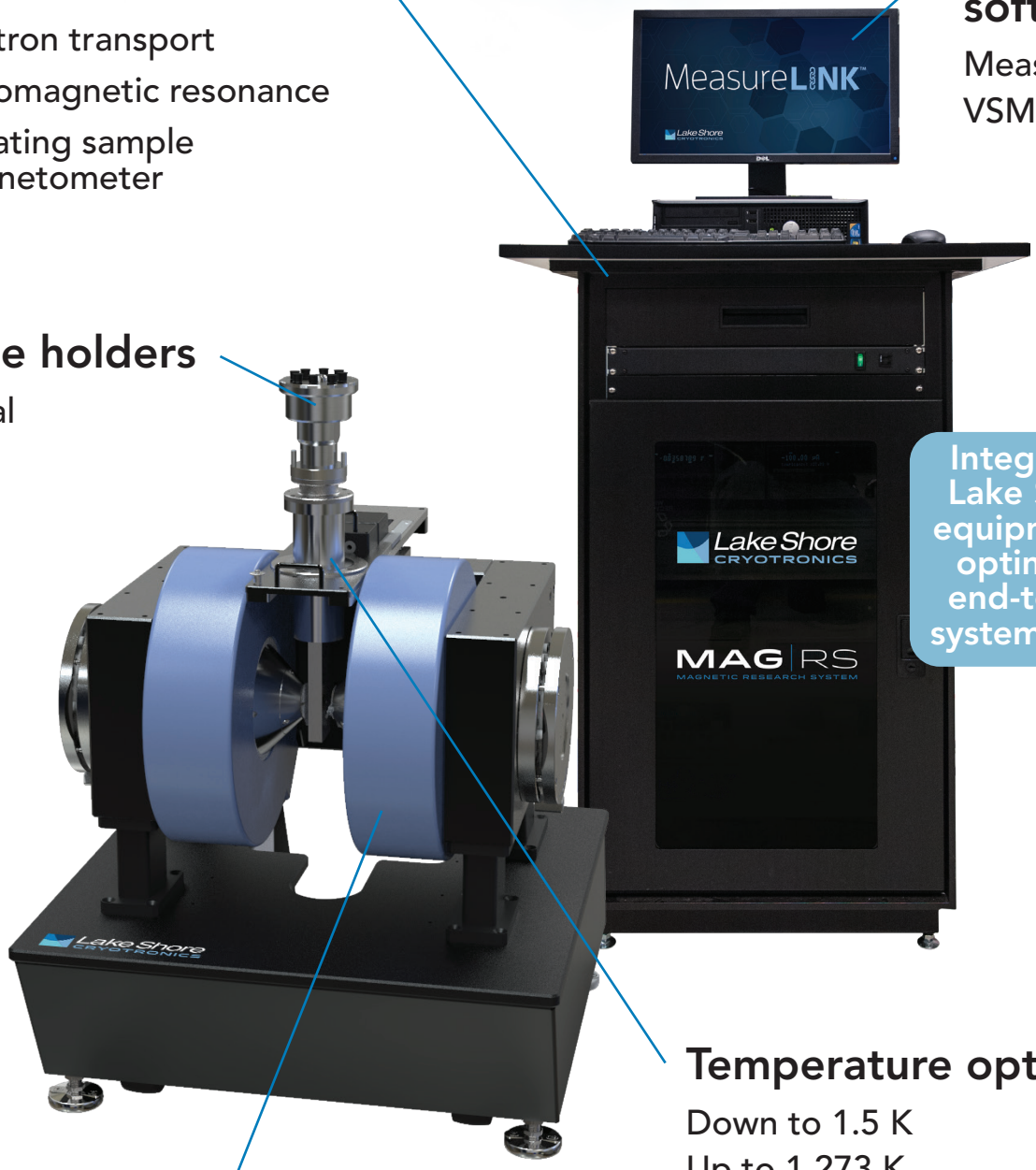
- **H** Hall effect
- **E** Electron transport
- **F** Ferromagnetic resonance
- **V** Vibrating sample magnetometer

Control software

MeasureLINK™
VSM software

Sample holders

Electrical
VSM



Integrated Lake Shore equipment = optimized end-to-end system specs

Temperature options

Down to 1.5 K
Up to 1,273 K

Electromagnet

4 in or 7 in

MEASUREMENT OPTIONS

Add the measurement options *you* need

The MagRS can be equipped to provide the functionality you need on your path to discovery. Choose one or many options, or add options on as you need them. The possibilities are endless.

H **HALL EFFECT MEASUREMENTS**

2× noise improvement over previous 8400 system

ACField option

with optional high-resistance to 200 GΩ

MRS-8400-ACFIELD-MO

or

FastHall option

MRS-FASTHALL-MO

ELECTRON TRANSPORT MEASUREMENTS **E**

ETransport option

coming soon

MRS-ETRANSPORT-MO

F **FERROMAGNETIC RESONANCE MEASUREMENTS**

FMR option

MRS-FMR-1-MO

VIBRATING SAMPLE MAGNETOMETER MEASUREMENTS **V**

VSM option

MRS-8600-VSM-MO

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ACField and FastHall™ options

If you make Hall effect measurements, there are two different options available.

The ACField option combines the best of both DC and AC field measurement capabilities, with the convenience of a wide mobility range. The unique AC field measurement technique extends your mobility measurements down to 0.001 $cm^2/V s$.

The FastHall option uses our patented FastHall measurement technique, which eliminates the need to switch the polarity of the applied magnetic field during the measurement. This significantly reduces analysis time, in some cases by a factor of 100. Materials with resistances less than 1 MΩ can be analyzed in under a minute. Even extremely high resistances—up to 200 GΩ—can be measured quickly, although analysis time will increase. For resistances over 1 MΩ, the measurement time will depend on the time required for the voltages to stabilize.

M81-SSM synchronous source measure system

integrated into the **ACField** option

The M81-SSM synchronous source measure system implements a unique instrument architecture optimized to provide synchronous DC, AC, mixed DC+AC source and lock-in capabilities for low-level measurements.

- MeasureSync™ technology for simultaneous source module update and measure module sampling timing across all channels
- Optimized for fundamental, harmonic, and phase AC plus DC biased measurements

M91 FastHall™ controller

integrated into the **FastHall** option

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

- No need to reverse the magnetic field with FastHall
- Up to 100× faster for low mobility materials
- Improves accuracy by minimizing thermal drift

Hall option measurement applications

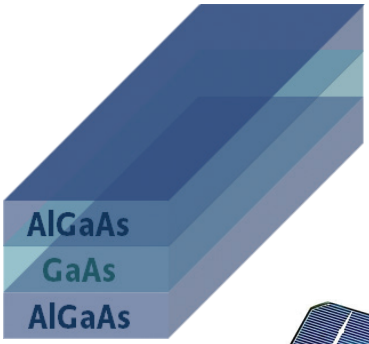
MagRS combines the best of both DC and AC field Hall measurement methodologies for the broadest range of research applications.

Photovoltaic and thermoelectric applications

Photovoltaic (solar cell) and thermoelectric materials are often characterized by low mobilities. This characteristic makes them difficult or impossible to measure using traditional DC field Hall methods. The ACField Hall measurement option makes it possible to easily characterize these materials.

Organics

The ACField measurement option allows you to reliably measure the Hall effect in low-mobility organic electronics. These materials are the basis for printable and flexible electronic devices, as well as organic light emitting diodes and organic solar cell materials.



Materials

Solar cells

OPVs, a:Si, µc-Si, CdTe, CuInGaSe (CIGS)

Organic electronics

OTFTs, Pentacene, Chalcogenides, OLEDs

Transparent conducting oxides

InSnO (ITO), ZnO, GaZnO, InGaZnO (IGZO)

III-V semiconductors

InP, InSb, InAs, GaN, GaP, GaSb, AlN based devices, high electron mobility transistors (HEMTs) and heterojunction bipolar transistors

II-VI semiconductors

CdS, CdSe, ZnS, ZnSe, ZnTe, HgCdTe

Elemental semiconductors

Ge, Si on insulator devices (SOI), SiC, doped diamond
SiGe based devices: HBTs and FETs

Dilute magnetic semiconductors

GaMnAs, MnZnO

Other conducting materials

Metal oxides
Organic and inorganic conductors

High-temperature superconductors

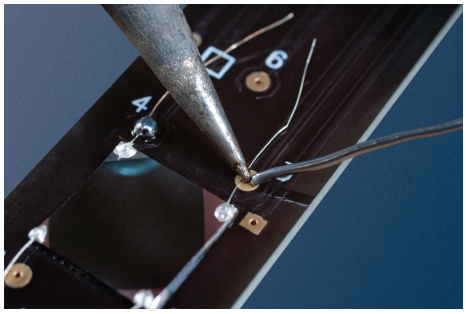
Direct and derived measurements as a function of field and temperature

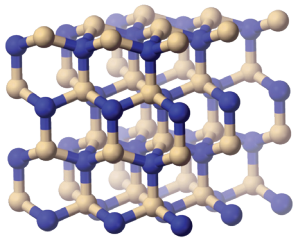
Direct measurements

- DC/AC field Hall voltage
- Resistivity
- Ohmic check
- Four-wire resistance
- IV curves

Derived measurements

- Hall coefficient
- Hall mobility
- Magnetoresistance
- Carrier type
- Carrier density and concentration





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ACField and FastHall™ option specifications

	ACField option MRS-8400-ACFIELD-MO 2× noise improvement over previous 8400 system	FastHall option MRS-FASTHALL-MO
Temperature options	**Standard** room temperature **Low temp** 10 K to 350 K (optical CCR), 400 K (CCR) **High temp** room temperature to 1273 K (oven)	
Sample type	van der Pauw, Hall bar	
Maximum sample size	10 mm × 10 mm × 3 mm	
Software	MeasureLINK™ software included to execute Hall measurements	
Gate bias option	Up to 100 V	
Legacy conversion	Full legacy 8400 replacement	Partial legacy 8400 replacement
Resistance range options	**Low-resistance** Coming soon **Standard resistance** 0.5 mΩ to 10 MΩ **High-resistance** 10 MΩ to 200 GΩ	**Standard resistance** 10 mΩ to 10 MΩ **High-resistance** 10 MΩ to 200 GΩ
Measurement type	DC field Hall measurement AC field Hall measurement	DC field Hall measurement FastHall measurement (AC electrical, DC field)
Measurement-specific instrumentation	**Base** 776B and M81-SSM-6 + BCS-10 **Standard resistance** BCS-10, VM-10 **High-resistance** VM-10, VS-10, CM-10	**Standard resistance** M91 **High-resistance** M91-HR
DC field options (nominal)	**4-inch magnet** 1.69 T room temp and 0.91 T variable temp **7-inch magnet** 2.28 T room temp and 1.54 T variable temp	
AC field range options (fixed field, nominal)	Frequency: 50 mHz or 100 mHz **4-inch magnet** 1.18 T (RMS) room temp and 0.63 T (RMS) variable temp **7-inch magnet** 1.20 T (RMS) room temp and 0.69 T (RMS) variable temp	None
Resistivity	10^{-5} to 10^{5} Ω·cm	10^{-3} to 10^{5} Ω·cm
Carrier concentration density	8×10^{2} to 8×10^{23} cm^{-3}	8×10^{2} to 8×10^{23} cm^{-3}
Mobility range	1×10^{6} (DC field) and 10^{-3} to 10^{6} (AC field) $cm^2/V\ s$	10^{-3} to 10^{6} $cm^2/V\ s$
Multi-carrier analysis	QMSA-compatible (DC field only)	QMSA-compatible

ELECTRON TRANSPORT MEASUREMENTS

E

ETransport option *coming soon*

Using the M81-SSM, the ETransport option allows ultra-low noise AC and DC transport measurements. The system uses a central instrument with remote source and measure modules for the shortest possible signal path to the DUT, separating sensitive analog circuits from digital circuits and unwanted sources of interference typical of traditional instrument designs.

Typical applications

- Spin orbit torque
- Differential conductance
- 3-terminal FET
- High-resistance
- Low-resistance

M81-SSM capabilities

- Source modes: DC, sine, triangle, square
- Source ranges: 1 pA to 100 mA
- Source frequency: 100 µHz to 100 kHz (square <5 kHz)
- Measurement limits: 10 V max
- Input impedance: ≥10 GΩ (differential)

ETransport option specifications

MRS-ETRANSPORT-MO

Temperature options	**Standard** room temperature **Low temp** 10 K to 350 K (optical CCR), 400 K (CCR) **High temp** room temperature to 1273 K (oven)
Max sample size	10 mm × 10 mm × 3 mm
Software	MeasureLINK™ software included to calculate field control, temperature control, measurement sequencing, and integration functions
Field type	AC and DC field
Measurement-specific instrumentation	M81-SSM-6 and application-specific module combinations

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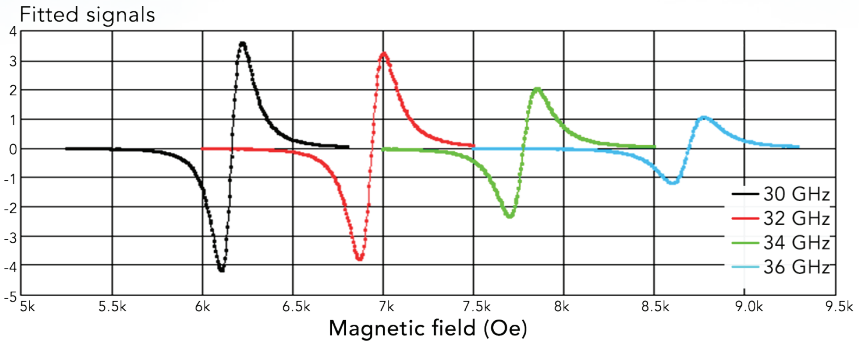
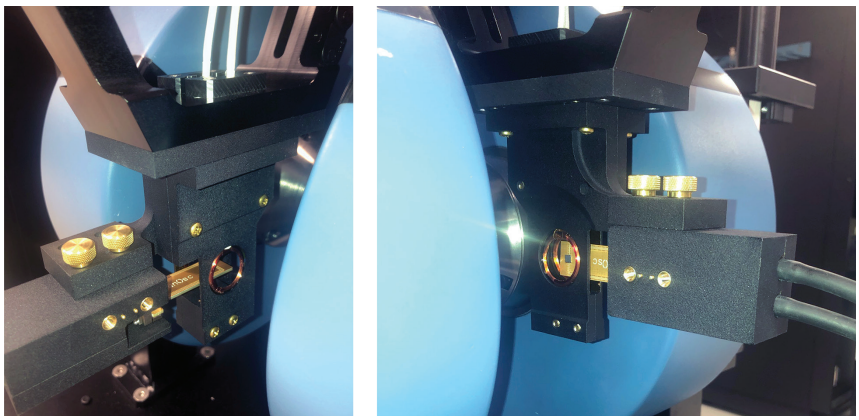
FMR option

The MagRS FMR measurement option enables you to easily use a NanOsc Instruments PhaseFMR or PhaseFMR-40 spectrometer with the 4 in or 7 in MagRS magnet systems for ferromagnetic resonance (FMR) measurements. It provides hardware and software integration of NanOsc instruments and u-type CPW sample holder products in a room temperature application.* With it installed, broadband 2 to 18 GHz (PhaseFMR) or 2 to 40 GHz (PhaseFMR-40) measurements in variable DC magnetic fields are possible. Maximum fields depend on the system and whether in-plane (IP) or out-of-plane (OOP) orientation is used.

**Does not include NanOsc CPW, Helmholtz coils, cables, and FMR instruments. These NanOsc room temperature FMR products are available from Quantum Design, our preferred source of NanOsc products*



Measured and fitted data for $Ni_{80}Fe_{20}$ (10 nm)/Ta (5 nm) thin film as a function of IP field to 0.94 T at frequencies of 30, 32, 34, and 36 GHz (typical results)



CPW sample holder for NanOsc spectrometer integration

FMR option specifications

MRS-FMR-N

Temperature options	**Standard** room temperature
Max sample size	10 mm × 10 mm
Software	MeasureLINK™ software included to calculate field control, temperature control, measurement sequencing, and integration functions
Measurement-specific instrumentation	NanOsc PhaseFMR-40 (sold separately)
Field range (nominal)	**4-inch magnet** up to 1.69 T in-plane, up to 2.41 T out-of-plane **7-inch magnet** up to 2.34 T in-plane, up to 2.91 T out-of-plane

VIBRATING SAMPLE MAGNETOMETER MEASUREMENTS

V

VSM option

The MagRS VSM option brings cutting-edge levels of measurement performance to magnetic characterization. The system features ultra-high sensitivity (down to 15 nemu), wide dynamic range, faster field ramping (10,000 Oe/s) and rapid data acquisition (up to 10 ms/pt). A complete -2 T to +2 T hysteresis loop with 3,000 measurement points can be completed in about 30 s. Field setting resolution of 1 mOe is available across the entire measurement range, and especially helpful in regions where moment gradient ΔM is high. This fine resolution, combined with high sensitivity and fast measurement speed, makes the MagRS VSM ideal for first order reversal curve (FORC) measurements, which inherently involve very large data sets.

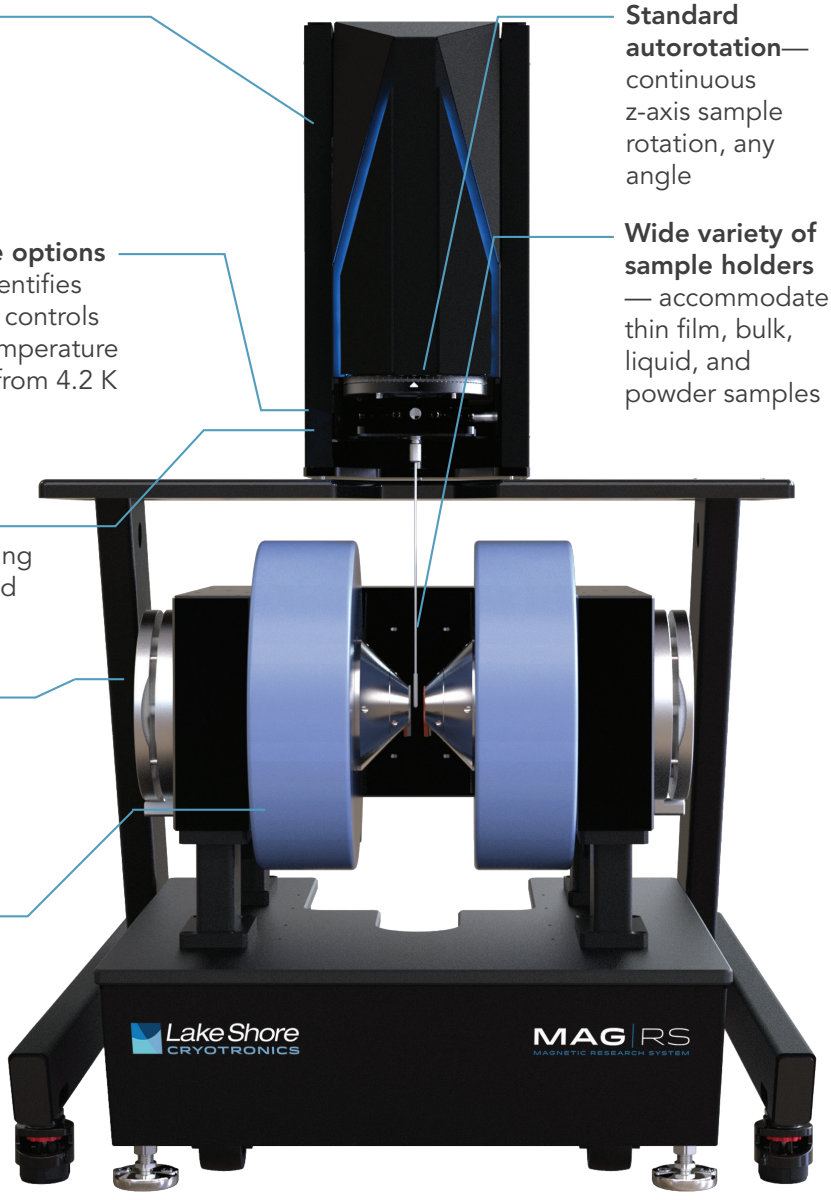
Very easy sample exchange — motorized head movement for sample extraction, allows for one-handed exchange of the QuickLIGN™ sample rods

Easy-to-install temperature options — software automatically identifies and displays option-specific controls for installed GlideLOCK™ temperature options to quickly measure from 4.2 K to 1,273 K

Unattended single-stage control — automatic switching between cryogenic to heated operations

Repeatable gap settings — six indexed ExactGAP™ magnet positions each have their own saved calibration

Two electromagnet configurations — choose from the 4 in or 7 in magnets for field requirements up to 3.22 T



Standard autorotation— continuous z-axis sample rotation, any angle

Wide variety of sample holders — accommodate thin film, bulk, liquid, and powder samples

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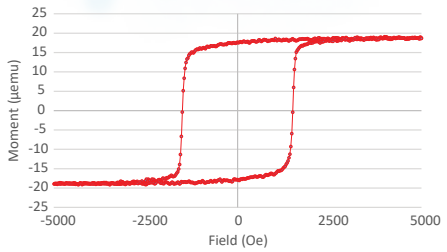
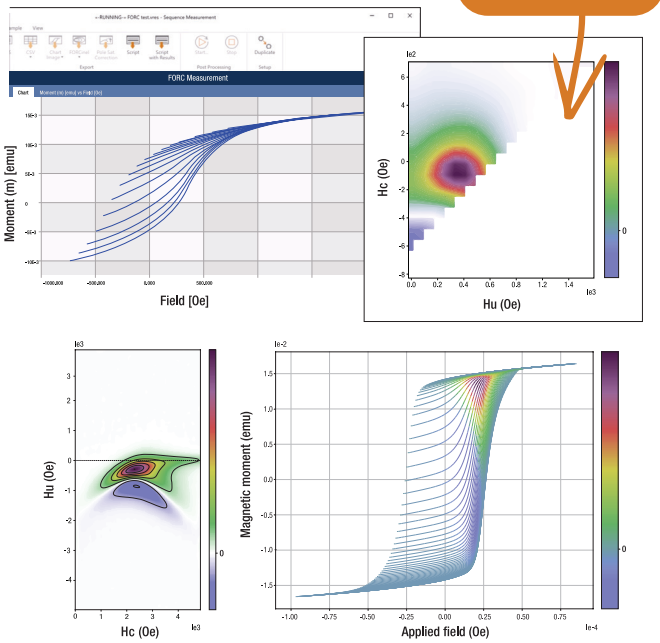
VSM option

The standard for FORC measurements with integrated RTForc™ software

The MagRS VSM option was created with first-order reversal curve (FORC) measurement as a primary objective. FORC analysis is greatly enhanced by the high sensitivity of the vibrating sample magnetometer. FORC also benefits from increased data point density, and the VSM flies through complex FORC data collection sequences in a fraction of the time required on previous systems. In addition, the system includes Real-Time FORC (RTForc™) software, which enables fully automated FORC data acquisition using the VSM software.



Existing 8600 customers can upgrade to all MagRS measurements

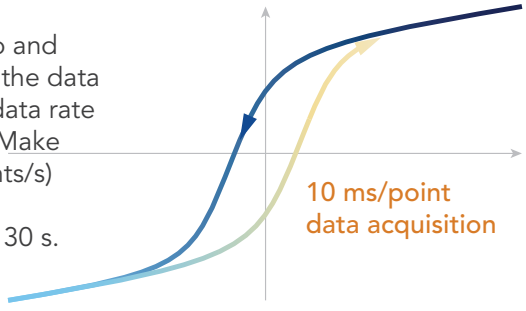


8600 software

- Standard suite of magnetic measurements
- Real-time FORC
- Colorized FORC
- Custom measurements (scripting)

Measurement speed is key

Many of the VSM option features make setup and data collection easy, but the most notable is the data acquisition speed. It has an unprecedented data rate with exceptional, built-in noise suppression. Make continuous 10 ms/point acquisition (100 points/s) measurements and complete a -2 T to +2 T hysteresis loop with 3,000 points in less than 30 s.



VIBRATING SAMPLE MAGNETOMETER MEASUREMENTS

V

VSM option measurement applications

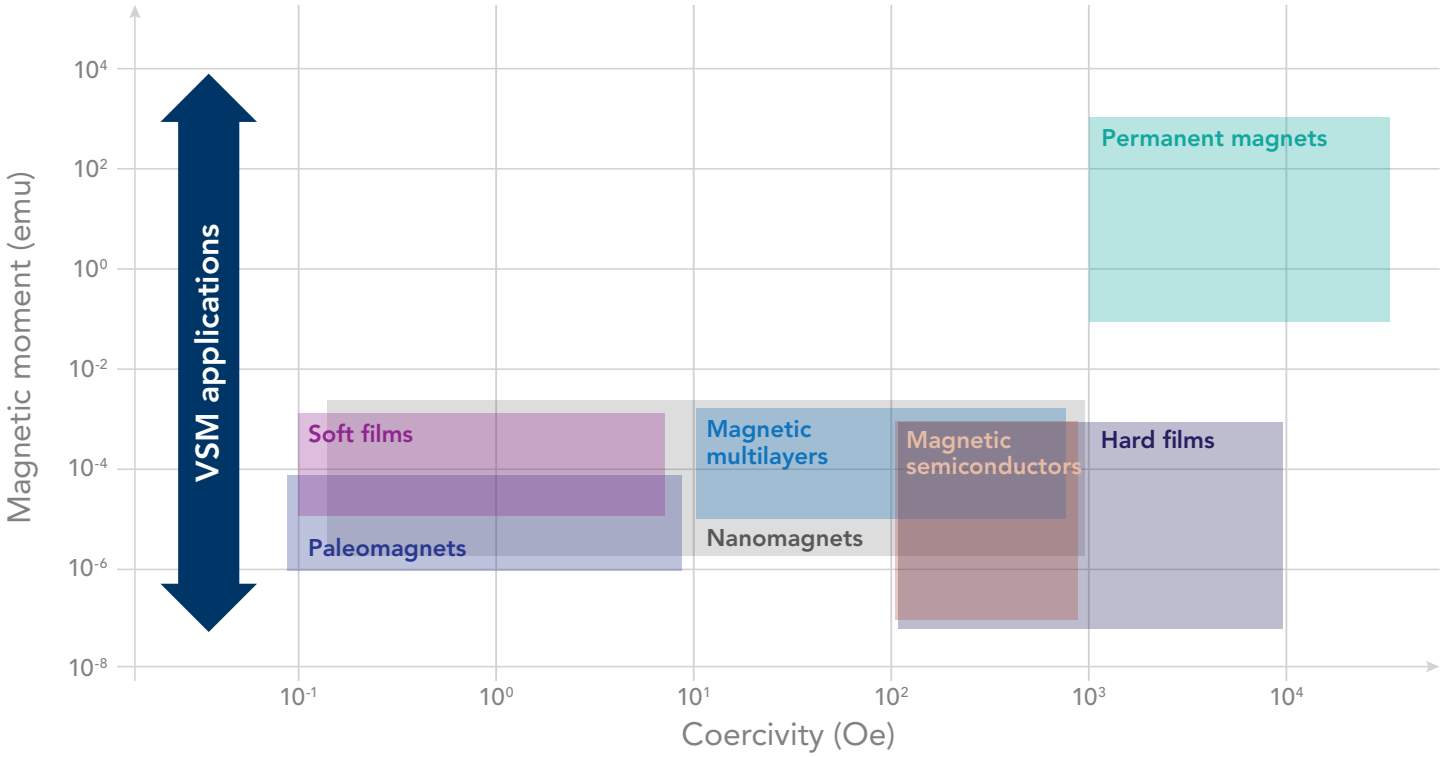
The need to characterize new and emerging materials continues to push the limits of electromagnet-based VSM systems. The MagRS VSM option steps up to meet the most demanding material research applications.

Extremely fast data acquisition cycles make the system ideal for research environments where rapid measurement results can accelerate the discovery of important new properties. QuickLIGN™ sample holders are offered for thin film, liquid, powder, and bulk samples, making the MagRS an excellent choice for busy labs with varying sample measurement needs.

The high sensitivity of the VSM option particularly benefits research into low-moment materials such as ultra-thin magnetic films and multilayers, nanoscale magnetic materials, dilute magnetic semiconductors, and paleomagnets.

The VSM option benefits applications involving the study of:

- Natural magnets (rocks, sediments, etc.)
- Nanoscale wires, particles, nano-crystalline alloys, etc.
- Magnetic semiconductors
- Ferrofluids
- Magnetic thin films and multi-layers
- Ferrites and permanent magnets, including rare-earth materials
- Magnetocaloric effect materials



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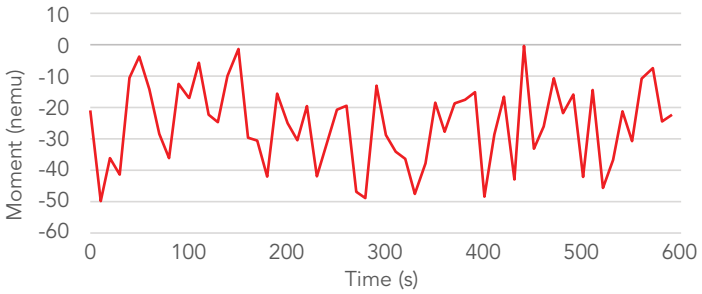
VSM option measurement examples

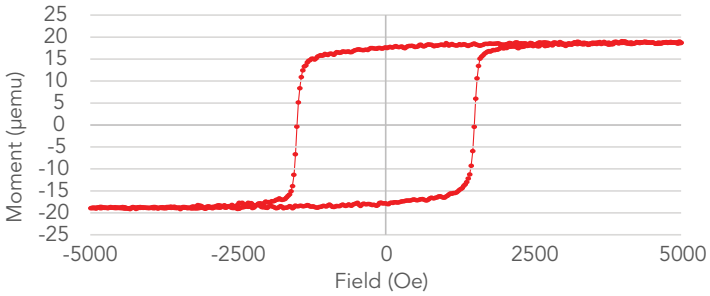
Noise at 10 s/point averaging at ExactGAP™ Index 1. The observed noise is only 13 nemu RMS and 50 nemu peak-to-peak.



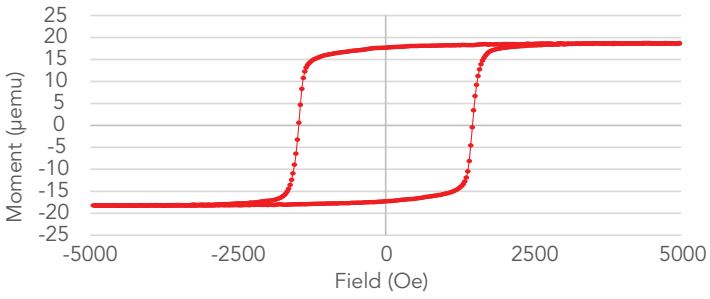
RMS noise (μemu) versus gap and signal averaging for the VSM option.

ExactGAP™ setting	10 s/pt	1 s/pt	100 ms/pt	10 ms/pt
Index 1	0.013	0.04	0.12	0.30
Index 3 (SSVT option)	0.07	0.27	0.78	2.2

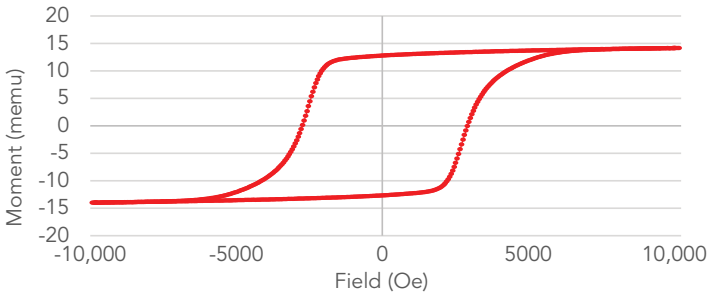
1 min 25 s hysteresis loop at 100 ms/point for a 20 μemu CoPt thin film.



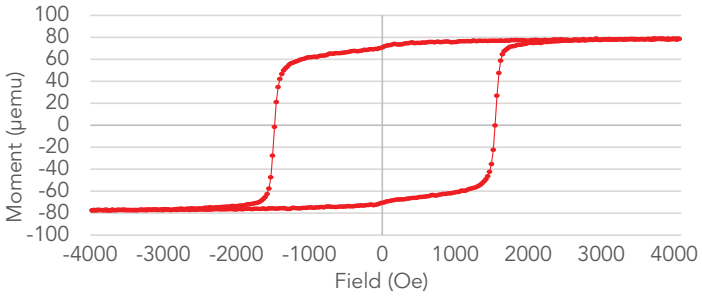
13 min 30 s hysteresis loop at 1 s/point for a 20 μemu CoPt thin film.



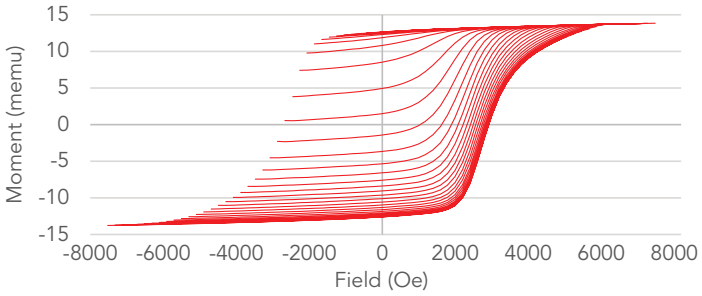
13 s hysteresis loop at 10 ms/point for a 14 memu magnetic stripe.



69 s hysteresis loop at 100 ms/point for a 80 μemu CoPt thin film.



4 min 32 s measurement of 46 FORCs for a 14 memu magnetic stripe.



VSM option

VSM option specifications

MRS-8600-VSM-MO

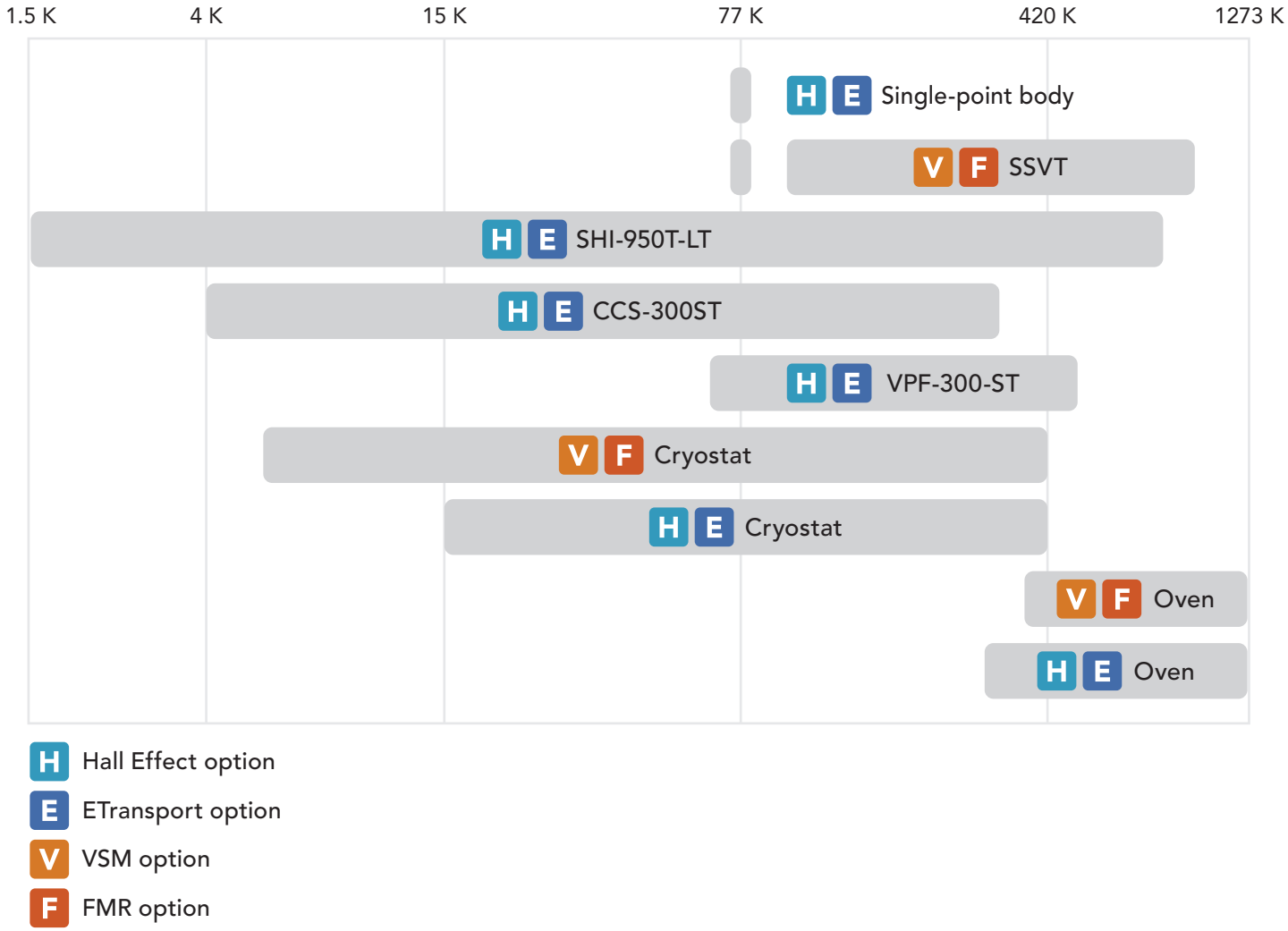
Temperature options	**Standard** room temperature **Low temp** 4.2 K to 420 K (CCR) **High temp** room temperature to 1273 K (oven) **Variable temp** 77 K to 950 K (SSVT)
Max sample mass	10 g
Software	8600 VSM software
Noise floor	15 nemu at 10 s/pt (room temperature)
Closed-loop field control stability	100 nT (1 mOe)
Field range (nominal)	**4-inch magnet** up to 2.67 T **7-inch magnet** up to 3.22 T

TEMPERATURE OPTIONS

Expand your temperature range

While room temperature measurements are sufficient in many cases, transport properties can change significantly as temperature varies. Measuring a sample at variable temperatures allows carriers to be identified by their excitation energies and provides clues to the dominating scattering mechanism.

MagRS is available with a variety of temperature options to further extend its functionality. Cryostats are available for taking measurements from <1.5 K to 420 K, and an oven extends your temperature measurement capabilities from room temperature to 1,273 K. These options can be ordered with a system or they can also be added in the field at any time.



H Hall Effect option
E ETransport option
V VSM option
F FMR option

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Cryostats

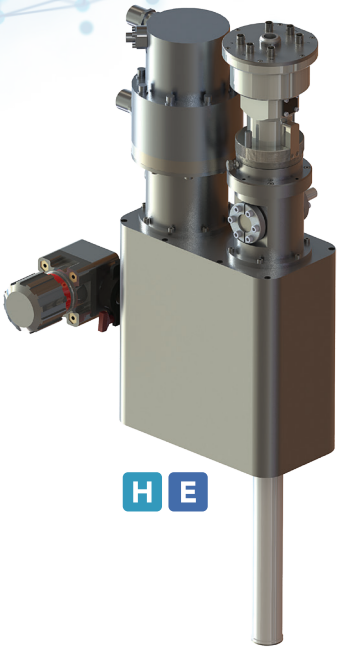
CCR cryostats provide a closed-system cryogenic cryogenic environment. No liquid cryogens are required so ongoing operating costs are minimal. In order to optimize efficiency and throughput, your sample is surrounded by helium gas at a pressure slightly above atmosphere, allowing samples to be exchanged without breaking vacuum or warming the CCR. Pump out of the vacuum jacket to 100 Pa (0.1 Torr) is required prior to cool down.

The Hall CCR operates from 15 K to 420 K. It is also available in a sample top-side optical access version. When combined with the sample top-side optical access kit, the optical access CCR allows you to study the effects that various wavelengths of light may have on your material samples at cryogenic temperatures.

Wet cryostats use liquid cryogens to cool the sample. They are designed for rapid sample cooling as well as easy sample insertion and interchange.

The VSM cryostat operates from 5.5 K to 420 K using LHe and from 85 K to 420 K using LN_2. A single-point measurement can be taken at 4.2 K (LHe) and at 77.6 K (LN_2). The sample is suspended in a proprietary insulated tube constructed of nonmagnetic material.

We can also adapt various Environment by Janis cryostats to use with the MagRS. CCR versions include the CCS-300ST (4 K to 325 K) and the SHI-950T-LT (1.5 K to 800 K). The wet VPF-300-ST (65 K to 500 K) can also be adapted.



H Hall Effect option E ETransport option V VSM option F FMR option

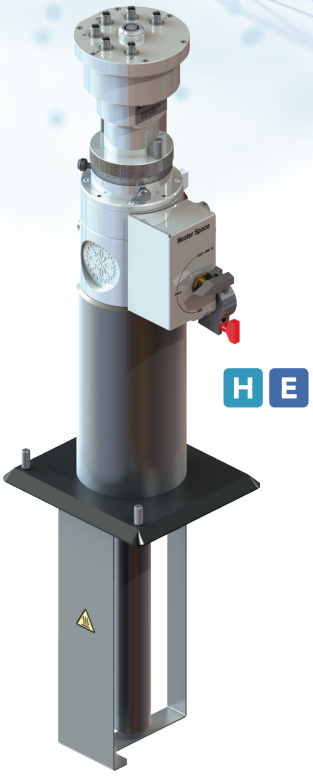
Ovens

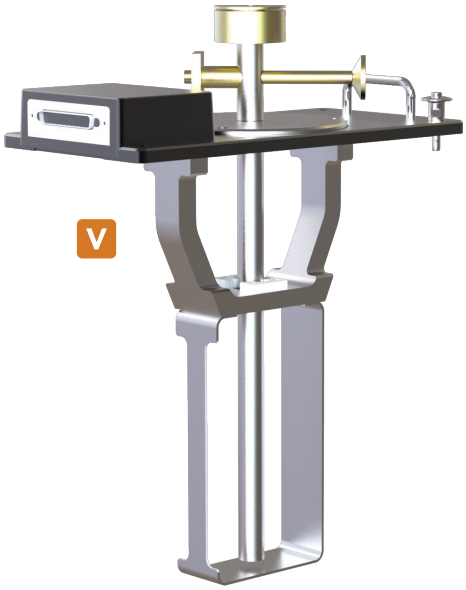
Ovens allow you to study the effects on your material as you heat your sample. They provide sample-zone temperatures from 100 °C to 1000 °C (373 K to 1273 K). Temperatures from 30 °C to 1000 °C (303 K to 1273 K) are also possible, however, below 100 °C (373 K) measurement time increases. Argon gas inside the sample chamber enhances heat flow with the sample. The gas controller option can be added to automatically stop the argon feed after the measurement is completed, but is not required for operation. The oven inserts have a temperature sensor mounted near the sample location to ensure a reliable temperature measurement feedback loop.

The efficient thermal insulation consists of an evacuation outer chamber with multiple reflective heat shields. Sample zone temperatures as high as 1000 °C are attained with a power consumption of approximately 70 W. Two results of the low power consumption are minimal magnetic interference and increased temperature uniformity in the sample zone.

The VSM oven is particularly well suited to measuring Curie temperatures of ferromagnetic or ferrimagnetic materials at temperatures up to 1000 °C. The VSM option sensitivity permits Curie temperature determinations at relatively low field intensities, allowing more inherently accurate determinations.

At room temperature and above, measurements may be performed in an argon atmosphere to protect the sample from oxidation.





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Variable and single-point temperature

The SSVT for the VSM option allows you to take measurements from 100 K to 950 K using LN_2, nitrogen gas, and argon gas. A single-point measurement can be taken at 77 K. The fully automated gas controller permits unattended operation from high to low temperatures, eliminating the need to remove or resaddle your sample. This ensures accurate measurements throughout the full operating range. Rapid cooldown from 950 K to room temperature and from room temperature to 100 K provides efficiency and high throughput. The unit's vacuum insulation prevents freeze-over at low temperatures and can operate safely at high temperatures without the risk of damaging neighboring components.

For the Hall options, the single-point LN_2 body combined with the standard insert allows you to take a measurement at a fixed temperature of 77 K in addition to room temperature. You can then determine if the temperature behavior of the resistivity and Hall coefficient of your samples is as expected without having to add a full variable temperature assembly. Simply fill the sample environment with liquid nitrogen, and proceed with your measurements. Operation is both easy and efficient. A sample rotation option is also available.

While not required, if you would like to monitor the temperature of your samples, you may choose to purchase one of our sample temperature monitoring or variable temperature control options separately.

H Hall Effect option E ETransport option V VSM option F FMR option

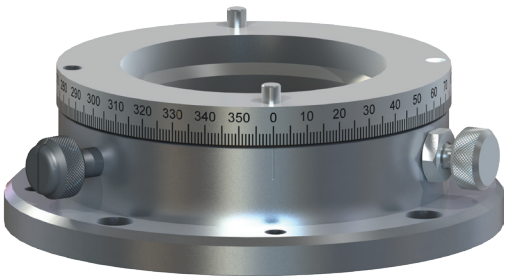
Temperature option kit H E V

The cryogenic temperature controller is used to measure and control our full suite of variable temperature options. It includes a Lake Shore temperature controller, thermocouple input card (when purchased for use with the high temperature oven or single stage variable temperature assembly), GlideLOCK alignment system mount, vacuum handling kit, mounting hardware, flanges, hoses, connectors, and accessories. Note: only one temperature option kit is required for all variable temperature options.

Gas controller H E V

The gas controller automates the gas handling for the VSM temperature options. Its operation is controlled by the VSM software and allows unattended operation from 4.2 K to 1,273 K. In addition, when used in conjunction with the TPS-FRG turbomolecular pump, the system monitors the vacuum space surrounding each temperature option to ensure insulation.

Sample rotation H E



The sample rotation option adds 0° to 360° manual sample rotation to the Hall or ETransport options. It is available as an option with the high-performance light-tight body. It comes standard with the Hall CCR option (MRS-84-CCR) and the Hall oven option (MRS-84-OVEN). Sample rotation is usable with the 10 mm sized sample cards. It is not compatible with 50 mm cards.

Vector option and mount V

The vector option extends the VSM option measurement capabilities to facilitate investigations of anisotropic magnetic materials, allowing you to determine their vector magnetization components and susceptibility tensor. When used in combination with autorotation, the vector coils provide information that is essentially identical to that provided by a dedicated torque magnetometer. The vector coils mount directly to the 86-VTA option for use with all temperature options or can be mounted to the 86-VEC-MOUNT (sold separately) for room temperature measurements.

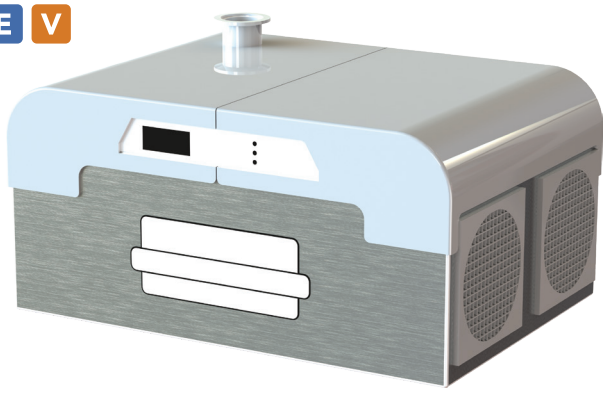
The vector option mount is used to mount the vector coils in the magnetic gap of the MagRS when room temperature measurements are desired. For measurements in conjunction with a temperature option, the vector coils mount directly to the 86-VTA.

86-VEC attached to SSVT option

86-VEC attached to 86-VEC-MOUNT for room temperature operation

Turbomolecular vacuum pump station H E V

Used to annually evacuate the cryogen transfer line of the optional cryostat and single stage variable temperature assembly (transfer line and kit are included with these options), the TPS-FRG provides vacuum to 1.33×10^{-3} Pa (10^{-6} Torr). In addition to annual cryogen transfer line maintenance, the turbomolecular vacuum pump can also be used in place of the E2M rotary vacuum pump for evacuating the cryostat vacuum space.



Recirculating chillers H E V

Lake Shore offers NesLab® recirculating chillers in order to provide a complete laboratory solution. The NesLab chillers feature a CFC-free refrigeration system.

The refrigeration system uses a hermetically sealed compressor and hot gas bypass system of temperature control. This system eliminates on/off cycling and premature wear of the compressor. Strong pumps provide continuous flow even through cooling lines with small IDs.

H Hall Effect option E ETransport option V VSM option F FMR option

SAMPLE HOLDERS

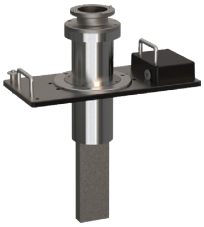
MAG|RS
MAGNETIC RESEARCH SYSTEM

Electrical sample holders

High-performance insert H E

The Hall high-performance insert provides physical mounting and electrical connection to the sample card. The standard insert is compatible with the light-tight body and optical access body for operation at room temperature. The insert includes eight triaxial connectors for guarded signals to the sample for resistance measurements (up to 200 GΩ) depending on your system's configuration. Its circular connector contains temperature monitor leads, insert identification, and safety interlock. The standard insert is compatible with a variety of standard and optional sample cards.

Room temperature light-tight body H E

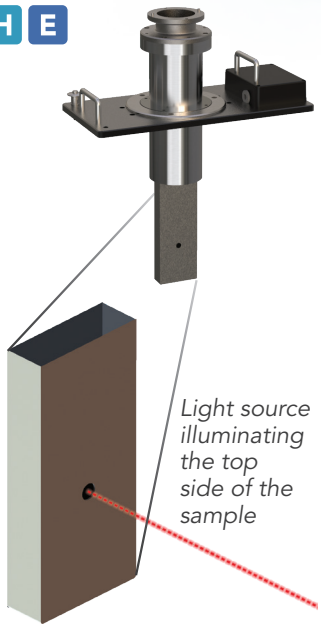


The light-tight body serves as a support for the included standard insert, allows for consistent sample alignment, and provides a light-tight, draft-free environment for the sample. It is designed to fit a 25 mm (1 in) magnet air gap. It is also compatible with all standard and optional sample cards. Optional optical access is available.

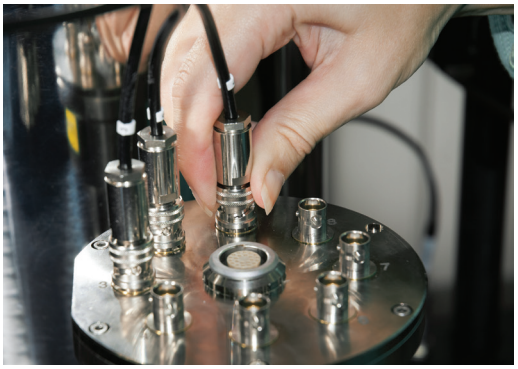
The MRS-HP-RT includes the room temperature body and insert (MRS-HP-SI)

Room temperature top-side optical access body H E

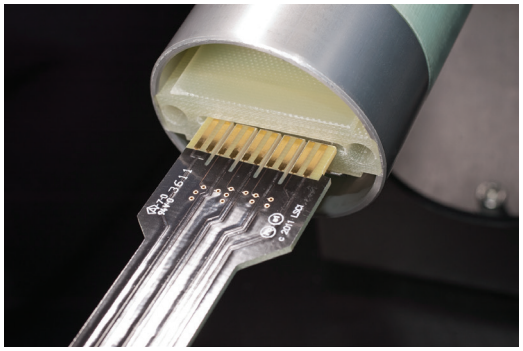
Optical access allows you to expose samples to different wavelengths of light via a laser or fiber optic. This option adds an optical port to the standard room temperature body.



Light source illuminating the top side of the sample



The triaxial cables being attached to the insert



Sliding a sample card into the insert

H Hall Effect option E ETransport option V VSM option F FMR option

Sample holder accessories H E

A variety of sample cards are available to facilitate sample mounting and storage as well as expedite sample exchange. Standard plug-in sample cards allow mounting of up to a 10 mm sample. An optional card can accommodate up to a 50 mm sample. The 10 mm sample cards are available in prober pin or solder pad style while the 50 mm sample card is available in prober pin style only. The prober pin style sample cards allow you to mount your samples without requiring contact pad soldering.

Sample cards are also available with an integrated platinum RTD to ensure you get temperature measurements right by your sample.

Available sample cards and kits

MRS-HP-SC-10-S: 10 mm prober pin sample card with PT sensor for use with standard insert; compatible with 840-VTA and 841-STM.

MRS-HP-SC-50-P: 50 mm prober pin sample card kit for use with standard insert; includes 50 mm prober pin sample card with PT sensor and required guide stem; compatible with 840-VTA and 841-STM. NOTE: Not compatible with variable temperature or sample rotation options.

841-026: Sample mounting kit for use with standard insert: includes (4) 10 mm solder pad sample cards, (1) 10 mm solder pad sample card with PT sensor, copper wire, and indium foil; (1) included with system purchase; compatible with 840-VTA and 841-STM.

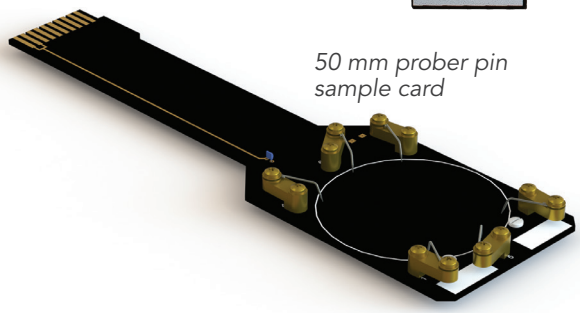
MRS-HP-SC-10-P: Sample card; 10 mm (0.4 in) solder pads with PT sensor for use with standard insert; sample limited to 10 mm × 10 mm square; pack of 5.

10 mm solder pad sample card

10 mm prober pin sample card

Field calibration card (included with the system)

50 mm prober pin sample card



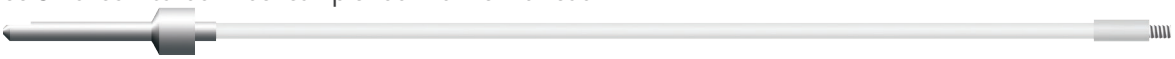
MAG | RS
MAGNETIC RESEARCH SYSTEM

VSM sample rods and holders

Use sample rods and corresponding sample holders, or choose one of the integrated rod/holders.

Room temperature and cryogenic application sample rods and holders V

86-SR-0935A carbon fiber sample rod with kel-f thread

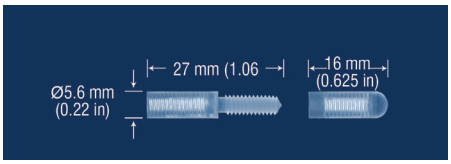


Sample holders for 86-SR-0935A

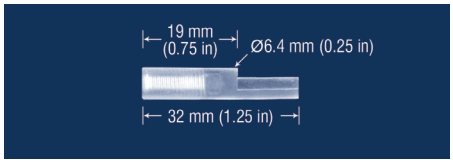
Sample holder	Sample orientation	Holder material	Minimum ExactGAP™ index
730931	Powder disposable cup	Kel-F®	2 (8 mm)
730933	Thin film side mount	Kel-F®	
730934	Thin film bottom mount	Kel-F®	
730935	Liquid disposable cup	Kel-F®	
86-SH-0840	Gel cap straw mount	Kel-F®	
86-SH-0841	Disposable gel caps and straws (1000 count)*	Gelatin	

**Room temperature use only*

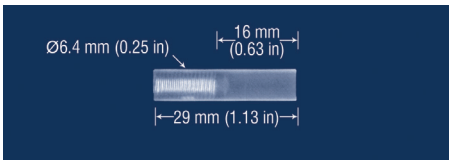
730931 Kel-F powder disposable cup



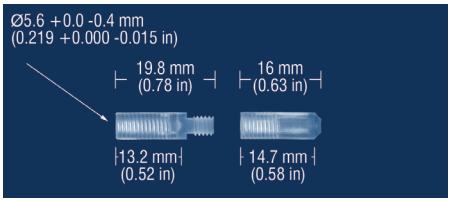
730933 Kel-F side mount



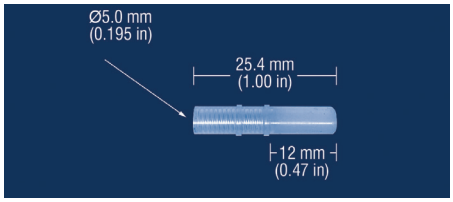
730934 Kel-F bottom mount



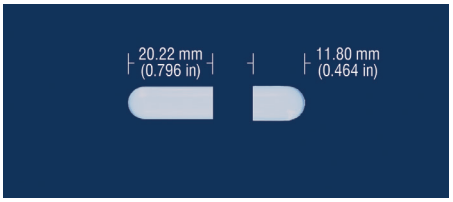
730935 Kel-F liquid disposable cup



86-SH-0840 gel cap straw mounts



86-SH-0841 disposable gel caps and straws



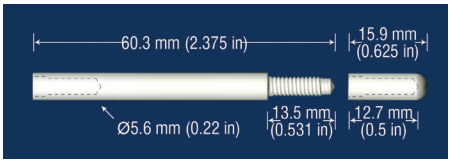
High temperature application sample rods and holders V

86-SR-0932 quartz Sample ROD with bn thread

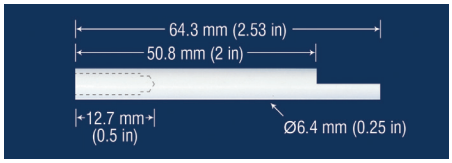
Sample holders for 86-SR-0932/8610-SR-0932

Sample holder	Sample orientation	Holder material	ExactGAP™ index
730937	Disposable BN cup	BN	OVEN—5 (6.4 mm) SSVT—3 (6.4 mm)
730938	Thin film side mount	BN	
730939	Thin film bottom mount	BN	

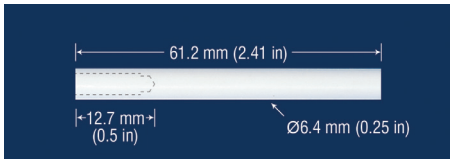
730937 disposable BN cup



730938 BN side mount



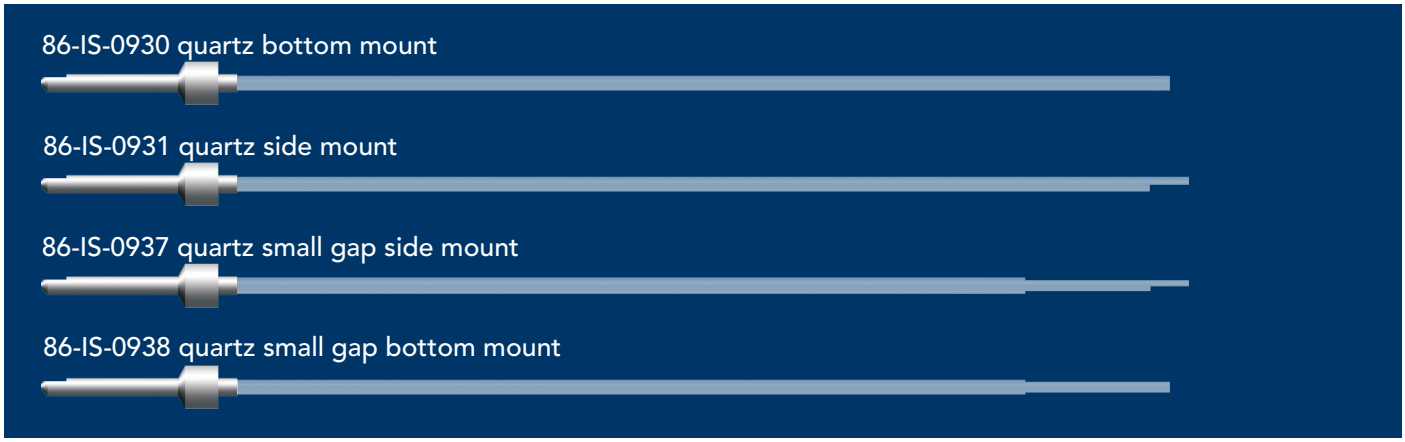
730939 BN bottom mount



MAG|RS
MAGNETIC RESEARCH SYSTEM

Single-piece integrated sample rods/holders for room temperature and cryogenic applications V

Integrated sample rod/holder	Sample orientation	Material	Gap	Minimum ExactGAP™ index
86-IS-0930	Bottom mount	Quartz	Standard gap	2 (8 mm)
86-IS-0931	Side mount	Quartz	Standard gap	2 (8 mm)
86-IS-0937	Side mount	Quartz	Small gap	1 (3.5 mm)
86-IS-0938	Bottom mount	Quartz	Small gap	1 (3.5 mm)



Sample assemblies included with base system and options V

	Sample holders							Sample rods		Single piece integrated sample rod/holder			
	730931	730933	730934	730935	730937	730938	730939	86-SR-0932	86-SR-0935A	86-IS-0930	86-IS-0931	86-IS-0937	86-IS-0938
	Kel-F powder disposable cup	Kel-F thin film side mount	Kel-F thin film bottom mount	Kel-F liquid disposable cup	Disposable BN cup	BN thin film side mount	BN thin film bottom mount	Quartz sample rod, BN thread	Carbon fiber sample rod, Kel-F thread	Quartz bottom mount	Quartz side mount	Quartz side mount (small gap)	Quartz bottom mount (small gap)
Base system	**3**	**3**	**3**	**1**					**1**			**1**	**1**
With cryostat										**1**	**1**		
With oven					**1**	**1**	**1**	**1**		**1**	**1**		
With SSVT					**1**	**1**	**1**	**1**		**1**	**1**		

H Hall Effect option E ETransport option V VSM option F FMR option

SOFTWARE

MeasureLINK™ H E

MeasureLINK-MCS software is the key component of each MagRS system. It facilitates field control, temperature control, measurement sequencing, and integration functions.

This flexible software allows real-time system performance monitoring and to construction of measurement sequences from a set of predefined controls. The menu-driven graphical user interface (GUI) provides the ability to control field and temperature to a specific setpoint or to loop these parameters through a range of settings with a specified step value. The sequences can be saved and recalled for use in repeated measurements.

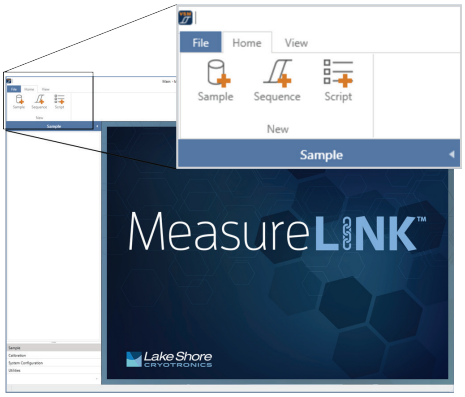
MeasureLINK™ software features

- Temperature and field control
- Measurement sequences
- Integrate Lake Shore or third-party instruments
- Integration with other lab software
- Custom measurements with scripting

Home screen

Three main functions:

- Sample setup
- Sequencing
- Scripting

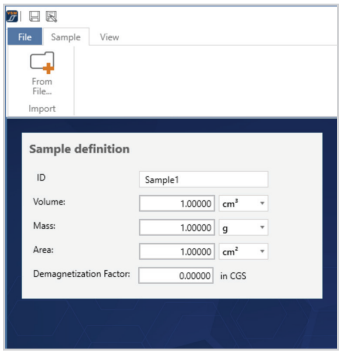


Sample setup screen

Associate sample information with a measurement sequence

Enter new sample information directly

Import existing sample information from a previously-saved file



Sequence screen

Build a sequence of steps that define the desired measurement protocol

Choose from:

Measurement functions

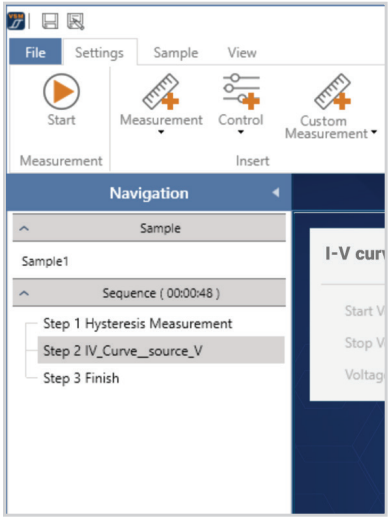
- Built-in functions

Control functions

- Go to field or temperature
- Loop field or temperature

Custom measurements

- Modified or specialized routines, previously defined by scripts



Script screen

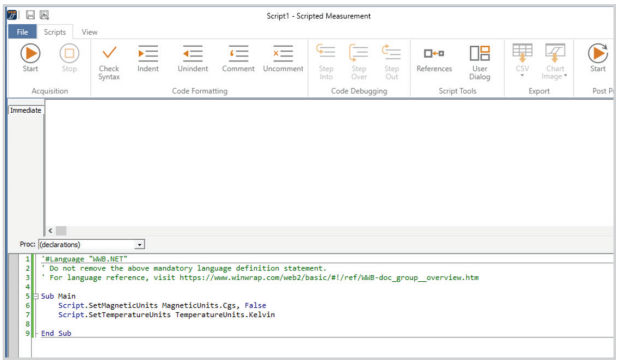
Create custom scripts

- Implement nearly any measurement
- Integrate third-party instruments

Modify existing scripts

Import other scripts

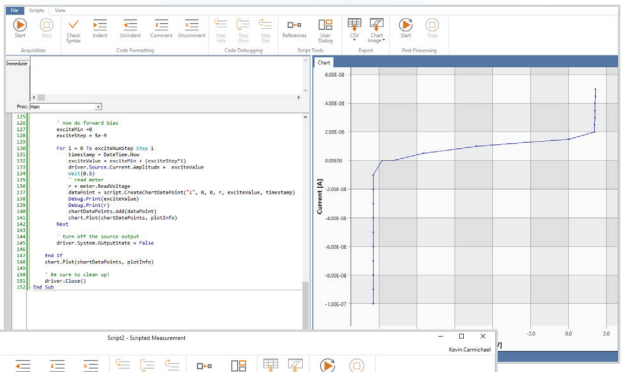
Simpler and faster than writing code



H Hall Effect option E ETransport option V VSM option F FMR option

MAG | RS
MAGNETIC RESEARCH SYSTEM

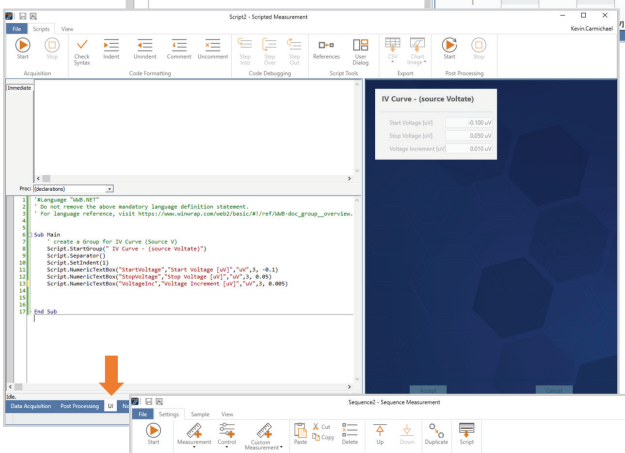
MeasureLINK scripting example



I-V measurement

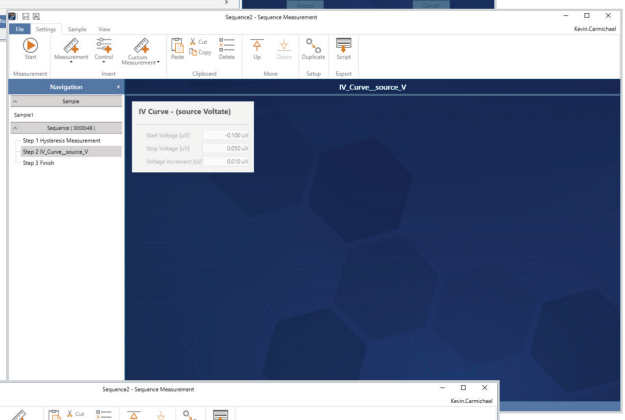
Loop through 20 voltage steps

- Set V
- Measure I



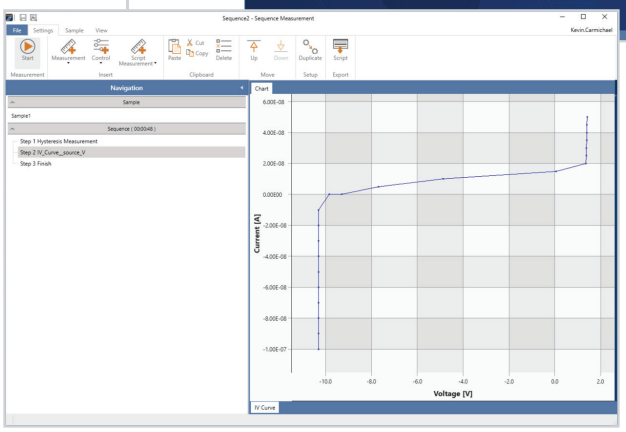
Scripting tool enables presentation of a simple user interface

- Start voltage
- Finish voltage
- Number of steps



Once script is ready

- Add to Custom Measurement list
- Select and add the custom script to the sequence steps from the drop-down list
- Appears exactly like built-in functions



Customized measurement sequence

- Executes sequential steps as defined
- Presents UI steps such as data entry windows
- Custom scripts execute like other steps
- Data collection and graphing can be included

VSM software V F

Easily execute measurement routines and experiments

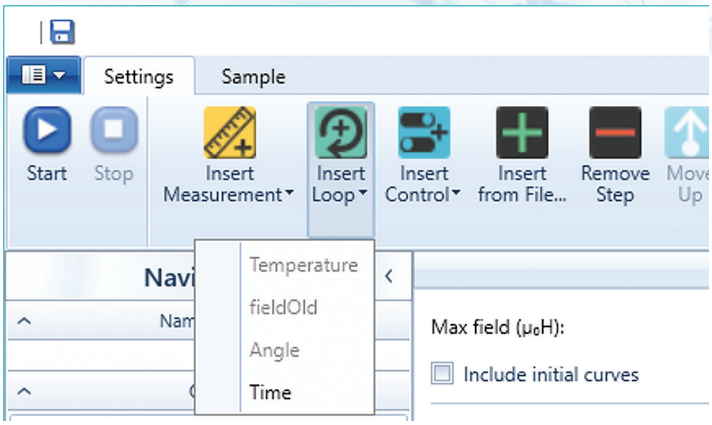
The 8600 Series comprehensive Windows®-based software simplifies the process of acquiring data. The flexible software allows the user to monitor the real-time performance of the VSM and to construct measurement sequences from a set of predefined controls. The menu-driven graphical user interface (GUI) provides the ability to control field and temperature to a specific setpoint or to loop these parameters through a range of settings with a specified step value. Predefined measurement controls are also provided to complete individual moment readings, hysteresis loops and even collect first order reversal curve (FORC) data. The sequences can be saved and recalled for repeated measurements.

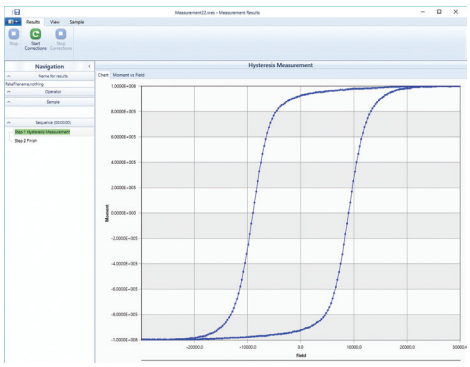
The interface also simplifies the implementation of the three GlideLOCK™ temperature options (86-OVEN, 86-CRYO, and 86-SSVT) by automatically detecting and displaying each option as it is plugged into the system. With the integrated Model 705 gas controller, the software can provide automated, unattended VSM measurements throughout the entire temperature range (4.2 K to 1273 K).

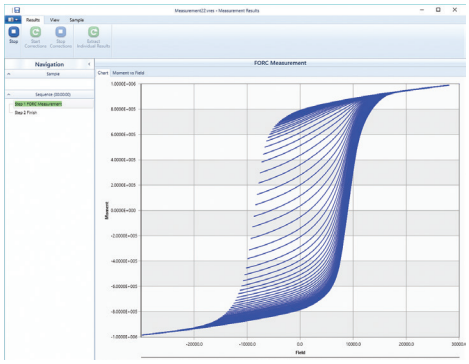
Advanced data processing capabilities of the software include expand and offset data, correct for demagnetization and slope factors, normalize for sample mass and volume, subtract substrate corrections and backgrounds from measurement data, calculate and display derivative curves, and much more.

In addition to measuring magnetization curves and magnetization vs. time or temperature, the 8600 Series VSM provides insight for a host of measurements including:

- Hysteresis loop
- Isothermal remnant magnetization
- DC demagnetization remanence
- Minor loops
- FORC
- M(T)—temperature dependent magnetization
- M(Θ)—rotational hysteresis and anisotropy



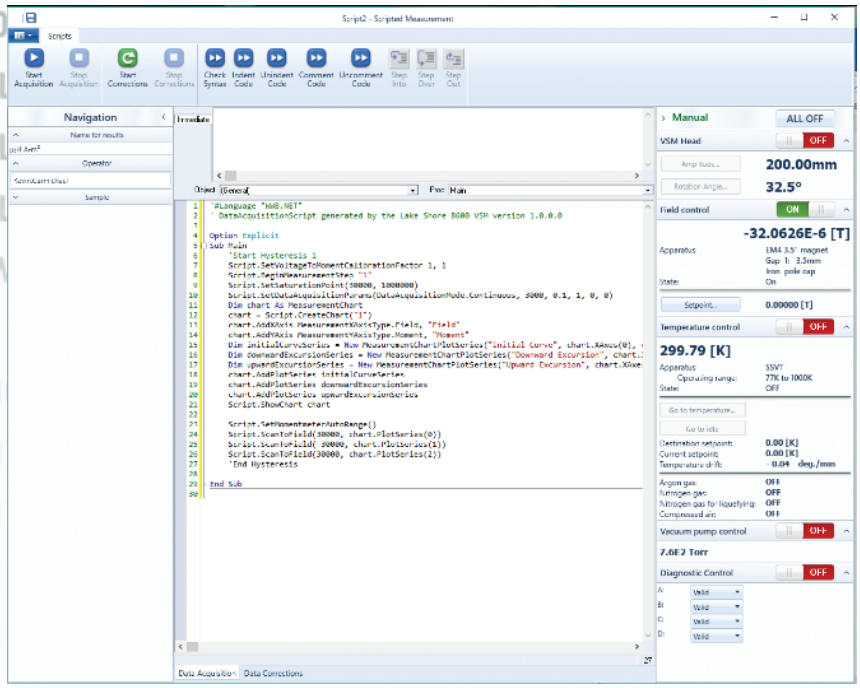




H Hall Effect option E ETransport option V VSM option F FMR option

Custom scripting

For customized experiments, the VSM software offers advanced scripting capabilities through an integrated interface easily accessible from the data acquisition tab in the software. Scripting is extremely useful for implementing customized VSM functionality that may not have been implemented in the standard software release. High level system calls are exposed so that the user can easily control the VSM data collection process and interweave external process calls. The script window enables you to capture the predefined measurements to view as a script. This is useful for understanding exactly how the MagRS is executing the measurements, but also provides an easy way to create a starting template for customized measurements. This powerful addition to the software puts the researcher fully in control of their unique measurement process.



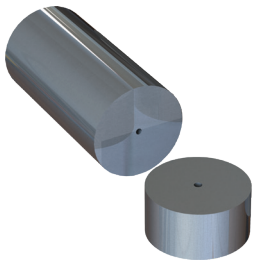
ELECTROMAGNET

MAG|RS
MAGNETIC RESEARCH SYSTEM

Magnet field options

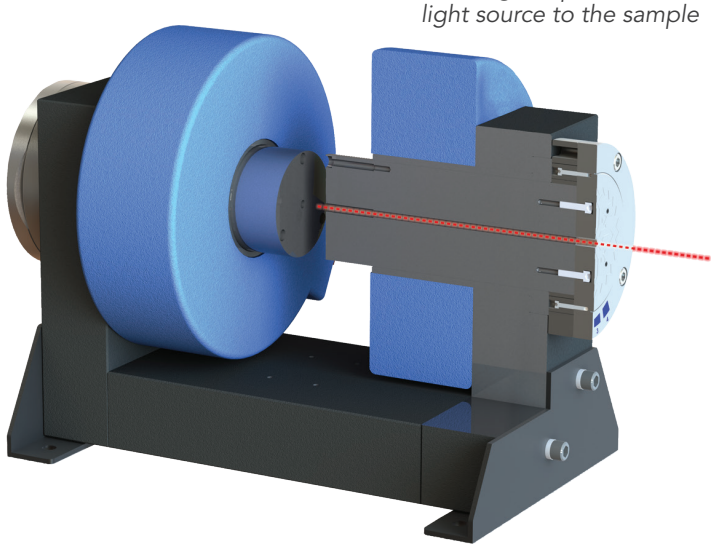
Sample top-side optical access kit H E V

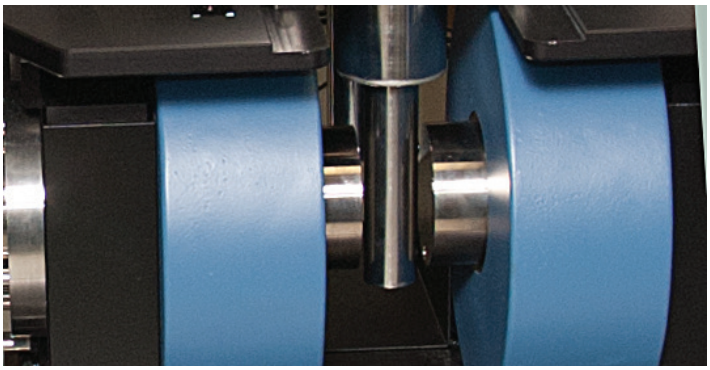
Used in combination with the room temperature optical access body or CCR with optical access, this option includes core pole cap modifications for 6.35 mm (0.25 in) optical access to the top side of the sample (in the magnetic field direction).



Modified magnet pole caps and cores for optical access (if ordered with the system, these will already be installed)

Showing the path of the light source to the sample





Pole cap choices for higher uniformity or higher field density H E V

With the 4-inch MagRS you receive 51 mm (2 in) face diameter pole caps. These tapered caps yield higher fields but lower field uniformity. However, as an option, you can order cylindrical 102 mm (4 in) face diameter pole caps. Featuring a larger face diameter, these pole caps ensure higher uniformity over the full surface of your sample (while sacrificing a small amount of magnetic field density).

The 7-inch system includes cylindrical 102 mm (4 in) face diameter pole caps as standard for higher field uniformity over the full surface. Higher uniformity is required when using the closed loop field control capability that is standard in the 7-inch MagRS (optional in the 4-inch MagRS) and also provides better measurement results when using any temperature options. If you value magnet strength over uniformity and want to maximize the larger field of the 7 in electromagnet, you can optionally order 51 mm (2 in) face diameter pole caps. These focus the magnetic flux from the pole core to the face.

Because the pole caps are bolted on, they can easily be exchanged for different pole face diameters at any time.

The 51 mm (2 in) EM7-2P pole cap

The 102 mm (4 in) EM4-4PB pole cap

H Hall Effect option E ETransport option V VSM option F FMR option

MAG|RS
MAGNETIC RESEARCH SYSTEM

EM-V Series electromagnet specifications

The EM-V Series electromagnets produce variable magnetic fields with a variety of air gap and pole cap configurations. They are ideal for applications including magneto-optical studies, magnetic hysteresis studies, in-line annealing, Hall effect studies, susceptibility measurements, spin magnetic resonance demonstrations, and biological studies.

Applied field strength with optional high-field 2 in pole face—EMP-HF (±1%)

ExactGAP™ setting	Air gap	EM-4V maximum field	EM-7V maximum field
Index 1	7.5 mm (0.30 in)	27.6 kOe (2.76 T)	32.2 kOe (3.22 T)
Index 2	12 mm (0.47 in)	25.2 kOe (2.52 T)	29.8 kOe (2.98 T)
Index 3	20 mm (0.79 in)	20.3 kOe (2.03 T)	26.0 kOe (2.60 T)
Index 4	25 mm (0.98 in)	17.2 kOe (1.72 T)	23.8 kOe (2.38 T)
Index 5	28 mm (1.10 in)	15.5 kOe (1.55 T)	22.7 kOe (2.27 T)
Index 6	50 mm (1.97 in)	9.1 kOe (0.91 T)	16.0 kOe (1.60 T)

Applied field strength with standard 2 in pole face (±1%)

ExactGAP™ setting	Air gap	EM-4V maximum field	EM-7V maximum field
Index 1	7.5 mm (0.30 in)	26.1 kOe (2.61 T)	30.5 kOe (3.05 T)
Index 2	12 mm (0.47 in)	23.7 kOe (2.37 T)	28.3 kOe (2.83 T)
Index 3	20 mm (0.79 in)	19.6 kOe (1.96 T)	24.7 kOe (2.47 T)
Index 4	25 mm (0.98 in)	16.9 kOe (1.69 T)	22.8 kOe (2.28 T)
Index 5	28 mm (1.10 in)	15.4 kOe (1.54 T)	21.7 kOe (2.17 T)
Index 6	50 mm (1.97 in)	9.1 kOe (0.91 T)	15.4 kOe (1.54 T)

Applied field strength with standard 4 in pole face[1] (±1%)

ExactGAP™ setting	Air gap	EM-4V maximum field	EM-7V maximum field
Index 1	57.5 mm (2.26 in)	7.9 kOe (0.79 T)	13.5 kOe (1.35 T)
Index 2	62 mm (2.44 in)	7.3 kOe (0.73 T)	12.8 kOe (1.28 T)
Index 3	70 mm (2.76 in)	6.5 kOe (0.65 T)	11.7 kOe (1.17 T)
Index 4	75 mm (2.95 in)	6.1 kOe (0.61 T)	11.0 kOe (1.10 T)
Index 5	78 mm (3.07 in)	5.9 kOe (0.59 T)	10.7 kOe (1.07 T)
Index 6	100 mm (3.94 in)	4.6 kOe (0.46 T)	8.6 kOe (0.86 T)

Applied field strength with standard 7 in pole face[2] (±1%)

ExactGAP™ setting	Air gap	EM-7V maximum field
Index 1	146.5 mm (5.77 in)	6.0 kOe (0.60 T)
Index 2	151 mm (5.94 in)	5.9 kOe (0.59 T)
Index 3	159 mm (6.26 in)	5.6 kOe (0.56 T)
Index 4	164 mm (6.46 in)	5.4 kOe (0.54 T)
Index 5	Not recommended for this pole cap configuration	
Index 6	Not recommended for this pole cap configuration	

[1] Achieved by removing high or standard 4 in to 2 in pole caps
[2] Achieved by removing standard 7 in to 4 in pole caps; only valid for EM-7V magnet

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EM-4V typical field uniformity

Magnet configuration		Uniformity over 1 cm³	1% cylindrical volume	
Pole cap mm (in)	Air gap mm (in)		Diameter mm (in)	Length mm (in)
51 (2.0)	13 (0.5)	±0.16%	36 (1.4)	13 (0.5)
51 (2.0)	25 (1.0)	±0.35%	18 (0.7)	25 (1.0)
102 (4.0)	25 (1.0)	±0.05%	64 (2.5)	25 (1.0)
102 (4.0)	51 (2.0)	±0.15%	18 (0.7)	51 (2.0)

EM-7V typical field uniformity

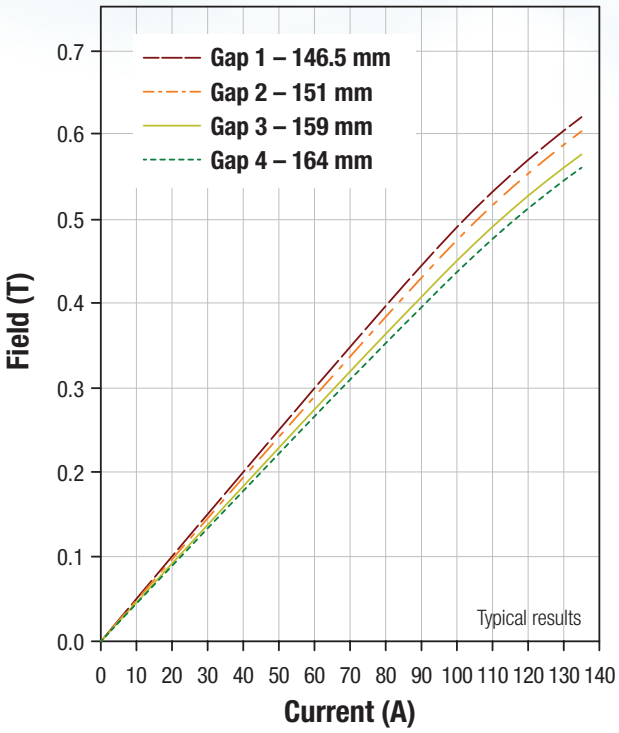
Magnet configuration		Uniformity over 1 cm³	1% cylindrical volume	
Pole cap mm (in)	Air gap mm (in)		Diameter mm (in)	Length mm (in)
51 (2.0)	13 (0.5)	±0.11%	36 (1.4)	13 (0.5)
51 (2.0)	25 (1.0)	±0.33%	10 (0.4)	25 (1.0)
102 (4.0)	25 (1.0)	±0.03%	66 (2.6)	25 (1.0)
102 (4.0)	51 (2.0)	±0.08%	23 (0.9)	51 (2.0)

NOTE: The third column gives uniformity over one cubic centimeter volume centered in the magnet gap. The last two columns give the cylindrical volume within which the magnetic field deviates by less than 1% from the central field. The cylindrical volume is coaxial with the magnet poles and centered in the gap.

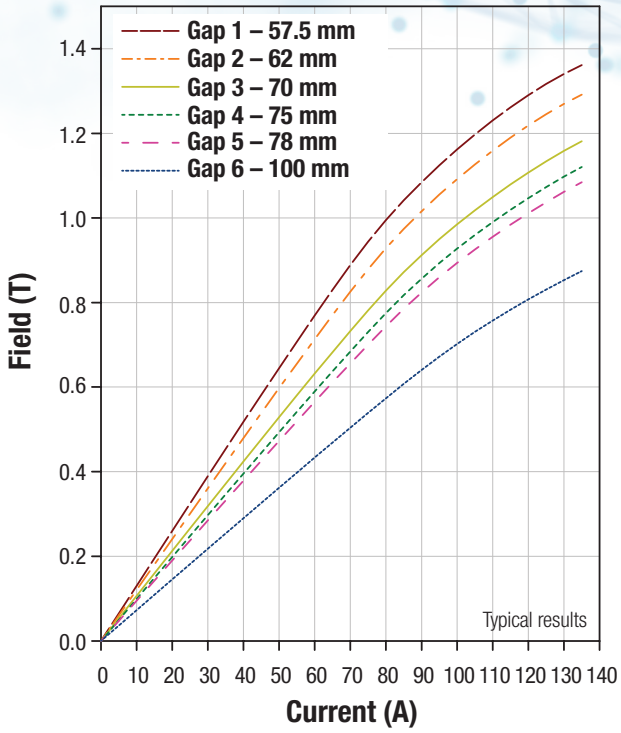
	EM-4V	EM-7V
Air gaps With no pole caps	57.5, 62, 70, 75, 78, and 100 mm	
With 2 in pole caps	7.5, 12, 20, 25, 28, and 50 mm	
Coil resistance, nominal	0.25 Ω per coil (0.5 Ω total wired in series)	1.00 Ω per coil (0.5 Ω total wired in parallel)
Coil resistance, cold	0.23 Ω per coil (0.46 Ω total wired in series)	0.92 Ω per coil (0.46 Ω total wired in parallel)
Coil resistance, maximum	0.27 Ω per coil (0.54 Ω total wired in series)	1.08 Ω per coil (0.54 Ω total wired in parallel)
Integrated pole diameter	100 mm (4 in)	178 mm (7 in)
Available pole cap diameters	50 mm (2 in)	100 mm (4 in) and 50 mm (2 in)
Cooling water	Tap water or closed cooling system	
Water flow rate	7.6 L/min (2 gal/min)	11.4 L/min (3 gal/min)
Pressure drop	200 kPa (30 psi)	220 kPa (32 psi)
Water chiller cooling capacity	2.5 kW (8,530 BTU/h)	5.0 kW (17,060 BTU/h)
Water inlet temperature	15 °C to 25 °C (59 °F to 77 °F)	
Coil over temperature limit	45 °C (113 °F)	
Coil spacing, nominal	121 mm (4.75 in)	178 mm (7 in)
Coil size-width, nominal	121 mm (4.75 in)	132 mm (5.2 in)
Coil size-diameter, nominal	311 mm (12.25 in)	445 mm (17.5 in)
Current (maximum continuous operating)	±70 A	±135 A
Voltage, nominal	±35 V (approximately 38 V at maximum coil temperature)	±70 V (approximately 38 V at maximum coil temperature)
Continuous input power, nominal	2.5 kVA (2.65 kVA at max temperature)	9.45 kVA (10.125 kVA at max temperature)
Suggested power supply	Lake Shore Model 643	Lake Shore Model 648
Size		
Height	77 cm (30.3 in)	52.7 cm (20.8 in)
Width	78.7 cm (31 in)	78.7 cm (31 in)
Depth	88.9 cm (35 in)	88.9 cm (35 in)
Weight	201.9 kg (445 lb)	635 kg (1400 lb)
Shipping weight	215.5 kg (475 lb)	660 kg (1500 lb)
Shipping dimensions	0.97 m × 0.58 m × 0.56 m (38 in × 23 in × 22 in)	0.86 m × 1.22 m × 1.19 m (34 in × 48 in × 47 in)

EM-V Series field plots (nominal)

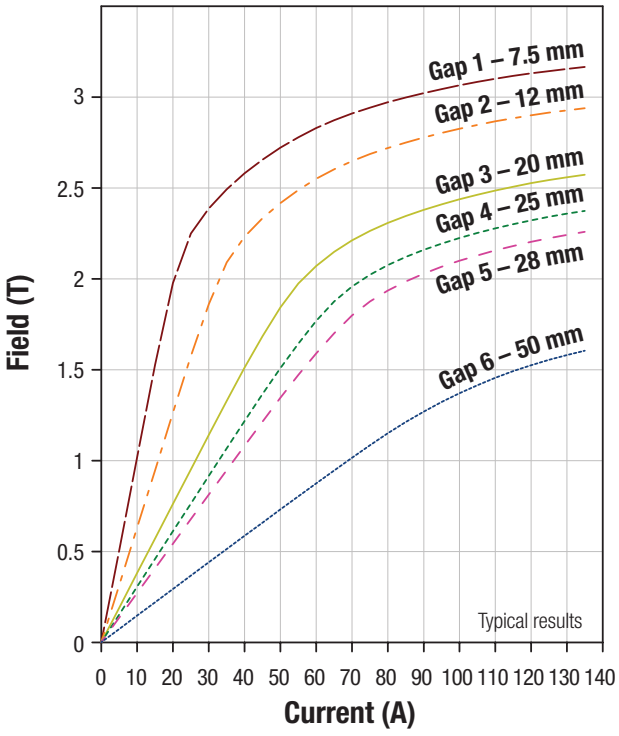
EM-7V no pole caps field plot



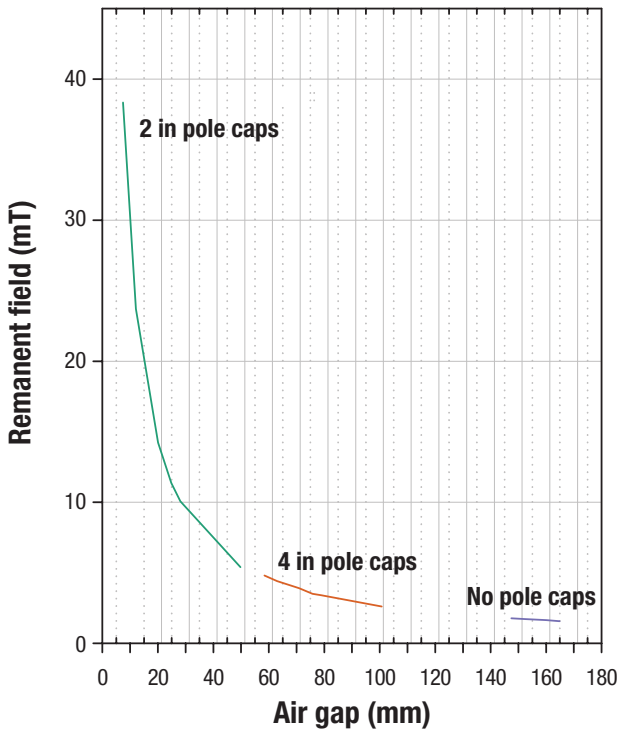
EM-7V 100 mm (4 in) pole caps field plot



EM-7V 50 mm (2 in) pole caps field plot



EM-7V remanent field



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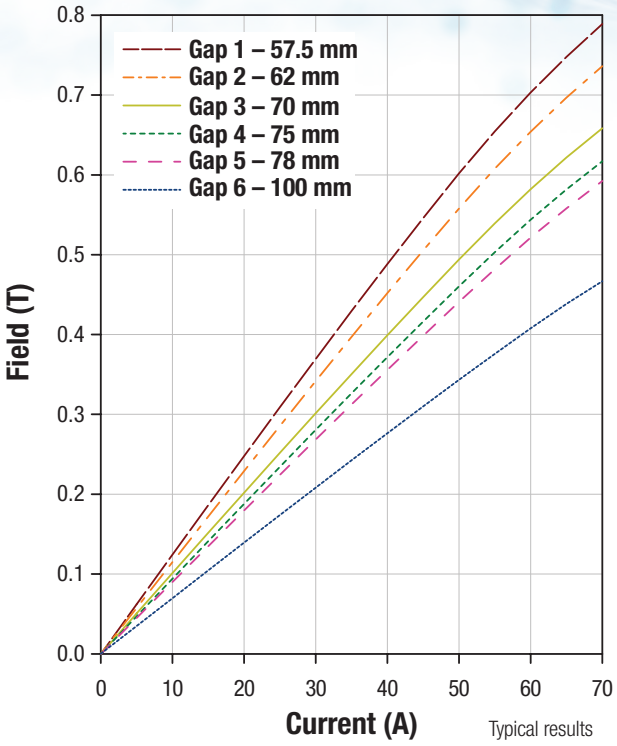
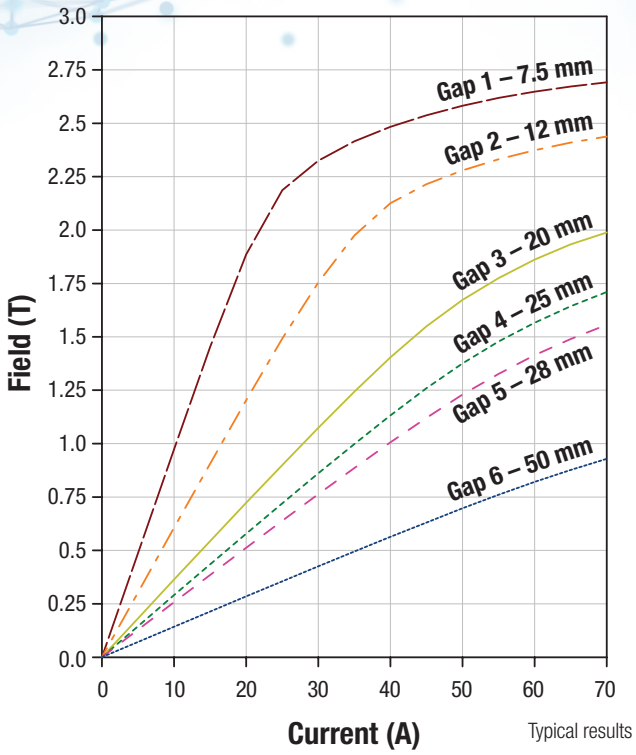
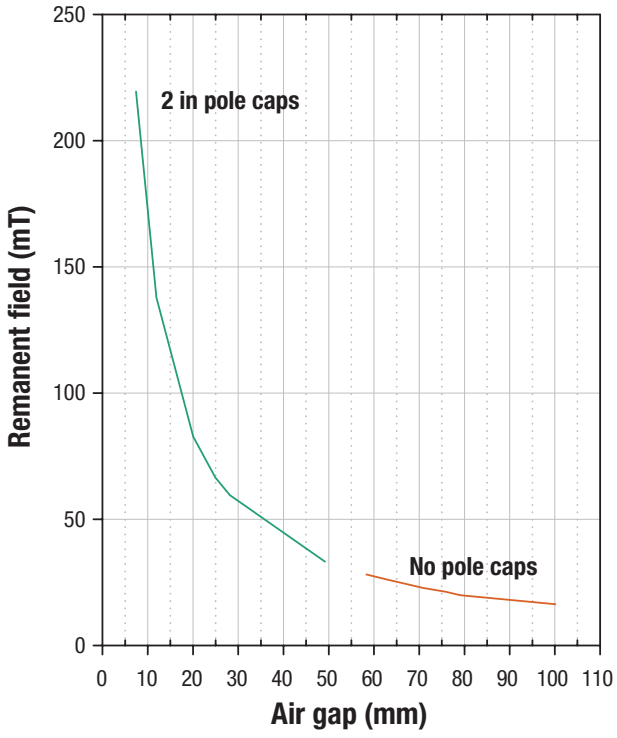
EM-4V no pole caps field plot



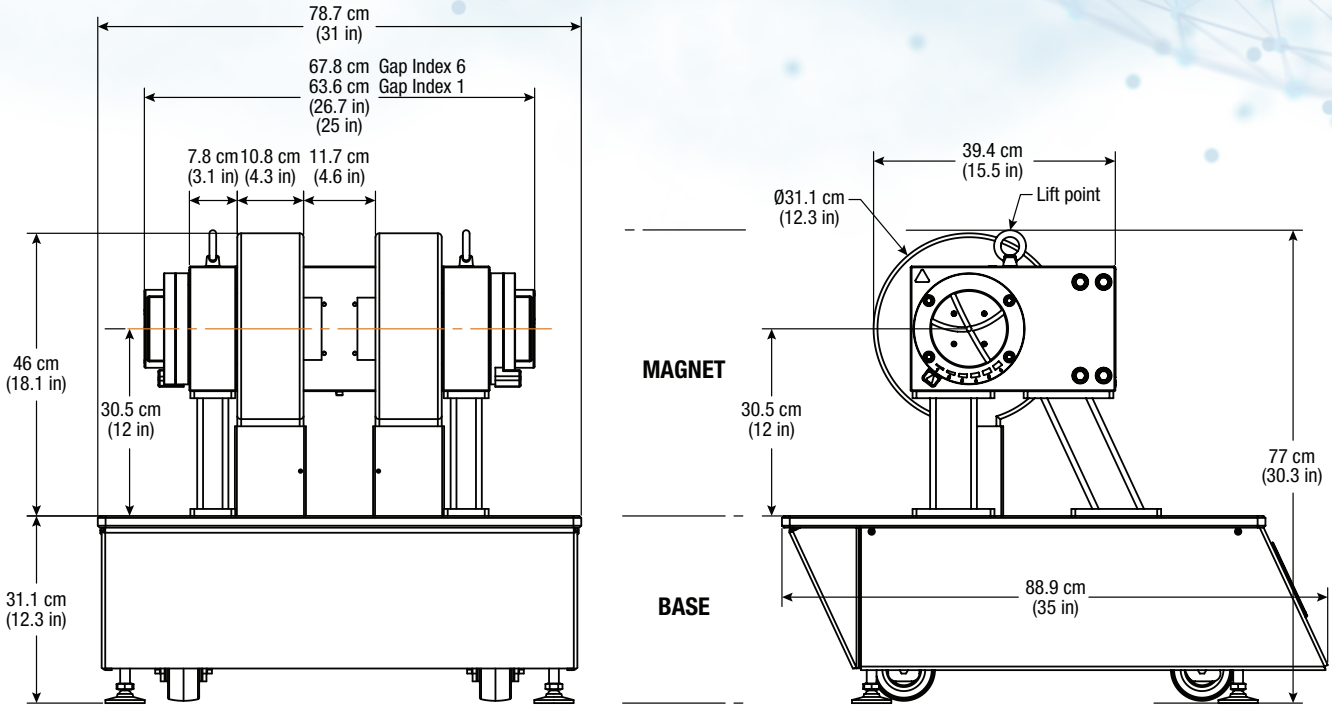
EM-4V 50 mm (2 in) pole caps field plot



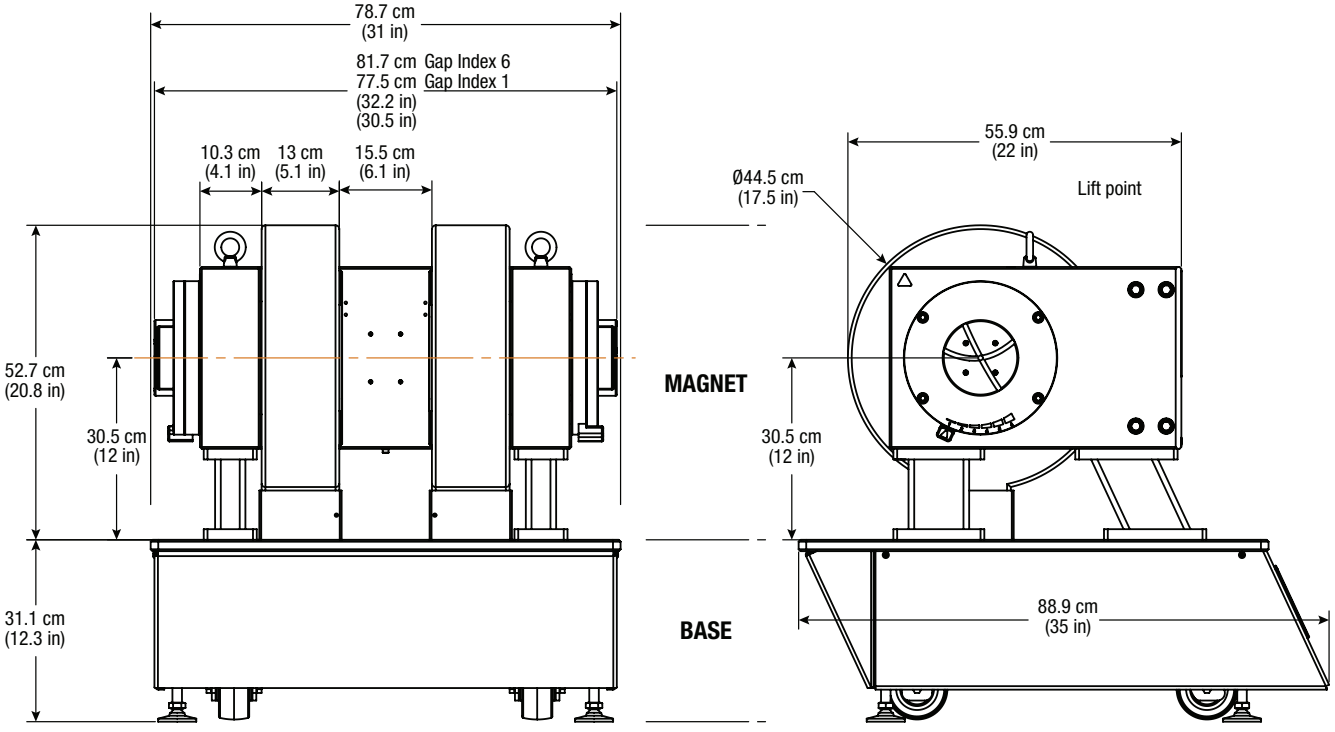
EM-4V remanent field



EM-4V


78.7 cm
(31 in)
67.8 cm Gap Index 6
63.6 cm Gap Index 1
(26.7 in)
(25 in)
7.8 cm
(3.1 in)
10.8 cm
(4.3 in)
11.7 cm
(4.6 in)
46 cm
(18.1 in)
30.5 cm
(12 in)
31.1 cm
(12.3 in)
MAGNET
BASE
39.4 cm
(15.5 in)
Ø31.1 cm
(12.3 in)
Lift point
30.5 cm
(12 in)
77 cm
(30.3 in)
88.9 cm
(35 in)

EM-7V

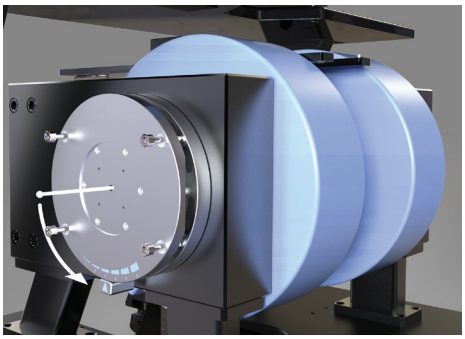

78.7 cm
(31 in)
81.7 cm Gap Index 6
77.5 cm Gap Index 1
(32.2 in)
(30.5 in)
10.3 cm
(4.1 in)
13 cm
(5.1 in)
15.5 cm
(6.1 in)
52.7 cm
(20.8 in)
30.5 cm
(12 in)
31.1 cm
(12.3 in)
MAGNET
BASE
55.9 cm
(22 in)
Ø44.5 cm
(17.5 in)
Lift point
30.5 cm
(12 in)
88.9 cm
(35 in)

ORDERING

Configure your system

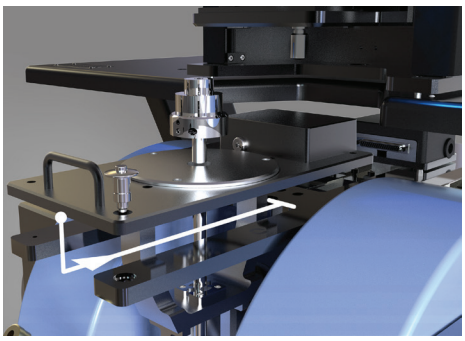
The MagRS base system comes with either a 4 or 7 in magnet, with additional options to customize the system for your experimental needs. Choose to add VSM capability, temperature option accessories, or optical access. MagRS comes with ExactGAP magnet pole gap indexing and GlideLOCK precision sample positioning.

Magnet features



ExactGAP™

ExactGAP magnet pole gap indexing makes it fast and easy to reconfigure the gap for the required sample or option size without having to recalibrate the magnet after a change.



GlideLOCK™

Slide in and out of the magnet on the precision-aligned GlideLOCK tray, and click into place to ensure repeatable positioning of the enclosed sample within the magnet poles.

Applied field strength with standard 2 in pole face (±1%)

ExactGAP™ setting	Air gap	4 in magnet maximum field	7 in magnet maximum field
Index 1	7.5 mm	2.61 T	3.05 T
Index 2	12 mm	2.37 T	2.83 T
Index 3	20 mm	1.96 T	2.47 T
Index 4	25 mm	1.69 T	2.28 T
Index 5	28 mm	1.54 T	2.17 T
Index 6	50 mm	0.91 T	1.54 T

Choose the exact configuration you need

Includes electromagnet with standard pole caps and electromagnet system controller with magnet power supply

MRS-EM*WX-Y-Z*

Specify AC power and CE mark in configurator

W = **Magnet size**

4 = 4 in (102 mm)
7 = 7 in (178 mm)

X = **Field options**

T = F71 (standard)
7 = 737 (required for magnetometer applications)

Y = **Temperature option accessories**

(required if temperature options will be used)
N = None (standard)
V = Variable temperature kit installed (includes 336 temperature controller, GlideLOCK™ option mount, and cabling)
G = GlideLOCK™ option for physical mount only (no cabling supplied)

Z = **Optical access**

= None (standard)
O = 0.25 in access (only includes pole caps with optical hole; solid pole caps should be ordered separately)

For example, an MRS-EM7-T-V-O is the base platform with a 7 in (102 mm) magnet, an F71 teslameter, variable temperature kit installed, and optical access added.

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Ordering information

Measurement options

MRS-FASTHALL-MO	MagRS FastHall measurement option; includes M91-HR and MRS-HP-RT sample holder, wiring and sample kits
MRS-8400-ACFIELD-MO	MagRS AC field Hall measurement option; includes M81-SSM, modules, and MRS-HP-RT sample holder
MRS-ETRANSPORT-MO	MagRS Electron transport measurement option (coming soon)
MRS-FMR-1-MO	MagRS ferromagnetic resonance measurement option for NanOsc FMR; includes mount for NanOsc CPW; instrument not included
MRS-8600-VSM-MO	MagRS vibrating sample ma gnetometer measurement option; includes VSM head and vibration isolation stand

Temperature options

MRS-84-OVEN	High-temperature oven for Hall options on the MagRS system
MRS-84-CCR	10 K cryostat with sample insert for Hall options on the MagRS system
MRS-84-CCR-O	Optical access 10 K cryostat with sample insert for Hall options on the MagRS system
MRS-84-LN2-VAC	Sample in vacuum; 77 K to 500 K
MRS-86-CRYO	5.5 K cryostat with sample insert for VSM option on the MagRS system
MRS-86-OVEN	High-temperature oven for VSM option on the MagRS system
MRS-86-SSVT	Single-stage variable temperature option; 77 K (flooded), 100 K to 950 K control range

Electrical sample holders

MRS-HP-RT	High-precision light-tight room temperature sample holder; includes MRS-HP-SI
MRS-HP-SI	Additional sample insert for MRS-HP-RT room temperature body (one included with MRS-HP-RT)
MRS-OVEN-SI	Sample insert for MRS-84-OVEN
MRS-CCR-SI	Sample insert for MRS-84-CCR
MRS-HP-SC-10-S	Sample card, 10 mm, solder pad, and platinum sensor
MRS-HP-SC-10-P	Sample card, 10 mm, prober pin, PT sensor
MRS-HP-SC-50-P	Sample card, 50 mm, prober pin (room temperature only)
841-026	Sample mount accessory kit

VSM sample holders

86-IS-0930	Sample rod, quartz with integrated thin film bottom mount, required sample access is 8 mm (ExactGAP™ index 2)
86-IS-0931	Sample rod, quartz with integrated thin film side mount, required sample access is 8 mm (ExactGAP™ index 2)
86-SR-0932	Sample rod, quartz rod only—requires separate sample holder, required sample access is 8 mm (ExactGAP™ index 2)
86-SR-0935A	Sample rod, carbon fiber rod only—requires separate sample holder, required sample access is 8 mm (ExactGAP™ index 2)
86-IS-0937	Sample rod, quartz with integrated thin film side mount, required sample access is 3.5 mm (ExactGAP™ index 1)
86-IS-0938	Sample rod, quartz with integrated thin film bottom mount, required sample access is 3.5 mm (ExactGAP™ index 1)
730931	Sample holder, 2-piece cup, Kel-F®, upper and lower portion, required sample access is 8 mm (magnet index 2)
730933	Sample holder, thin film side mount, Kel-F®, required sample access is 8 mm (magnet index 2)
730934	Sample holder, thin film bottom mount, Kel-F®, required sample access is 8 mm (magnet index 2)
730935	Sample holder, liquid, upper and bottom portion, Kel-F®, required sample access is 8 mm (magnet index 2)
730937	Sample holder, 2-piece cup, boron nitride, required sample access is 8 mm (magnet index 2)
730938	Sample holder, thin film side mount, boron nitride, required sample access is 8 mm (magnet index 2)
730939	Sample holder, thin film bottom mount, boron nitride, required sample access is 8 mm (magnet index 2)
86-SH-0840	Sample holder, gel cap straw mount (room temperature only), required sample access is 8 mm (magnet index 2)
86-SH-0841	Sample holder, disposable gel cap with straw, 1000 quantity (room temperature only), required sample access is 8 mm (magnet index 2)

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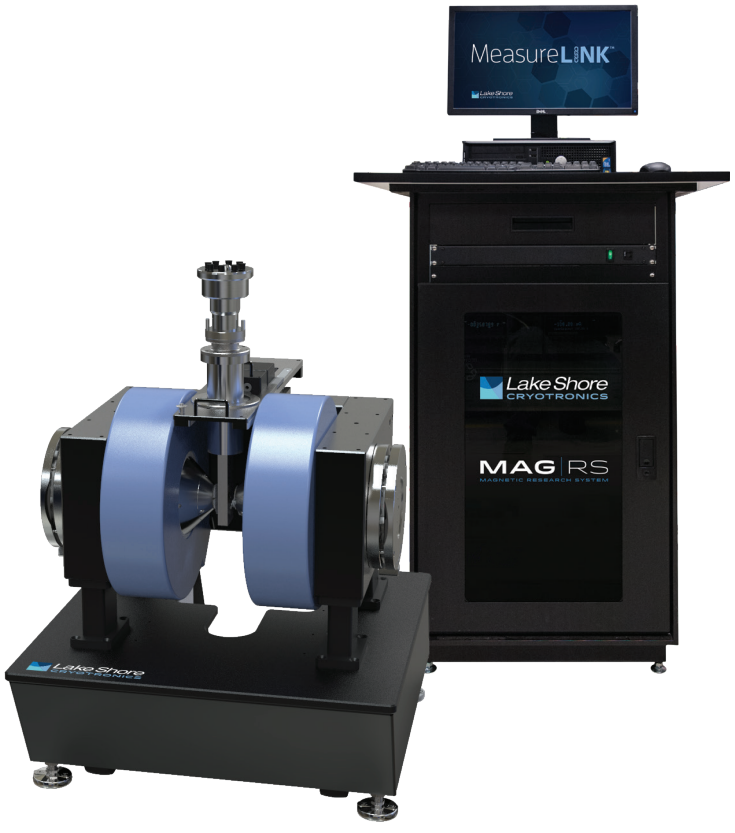
Other accessories

MRS-8400-ADD-GATEBIAS	Gate bias option (includes Keithley 6487)
MRS-TABLE	Table for mounting on top of MagRS Series electromagnets
MRS-HF	High field pole caps
MRS-SHIMS-4	4-inch shim kit
MRS-SHIMS-7	7-inch shim kit
MRS-GHA	Gas handling kit option for MagRS to support variable temperature capability
MRS-HP-ADD-O	Enables optical access for the MRS-HP-RT standard high-precision body and insert
MRS-HP-ROTATE	Sample rotation for MRS-HP-SI with 10 mm cards
840-VTA	Variable temperature control: includes software, temperature controller, gas handler, associated gas lines, cables, and rack mount kit
841-STM	Sample temperature monitoring: includes software, temperature controller, cables, and rack mount kit; requires sample card with platinum sensor
FP-2X-250-TS15	Replacement Hall probe for MagRS with F71 teslameter
TPS-FRG-100/120V	Compact turbo pumping system; includes V-84 turbo pump (NW 40) with oil free dry scroll backing pump, FRG-700 full range gauge, controller, and interface cable to USB port; includes Agilent 24 month warranty NOTE: requires SYS-TP-KIT
TPS-FRG-220/240V-CE	Compact turbo pumping system; includes V-84 turbo pump (NW 40) with oil free dry scroll backing pump, FRG-700 full range gauge, controller, and interface cable to USB port; includes Agilent 24 month warranty NOTE: requires SYS-TP-KIT
SYS-TP-KIT	Includes all components necessary to connect NW 40 turbo pumping system to the vacuum port of any Lake Shore system
1220-50	50 L LN_2 Dewar with 0.5 in top withdraw port and 10 psi pressure relief valve
E2M-110/120V	Two-stage rotary vacuum pump with mist filter; 110 to 120 VAC NOTE: requires SYS-RP-KIT
E2M-220/240V	Two-stage rotary vacuum pump with mist filter; 220 to 240 VAC NOTE: requires SYS-RP-KIT



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CRYOTRONICS

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