

Model 475 DSP Gaussmeter



The First
Gaussmeter
with DSP
Technology



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- Full scale ranges from 35 mG to 350 kG
- DC measurement resolution to 0.02 mG
- Basic DC accuracy of $\pm 0.05\%$
- DC to 50 kHz frequency range (probe dependent)
- 15 band-pass and 3 low-pass AC filters
- Peak capture to 20 μ s pulse widths
- Data buffer sampling rates to 1000 readings/s
- Computer interface sampling rates to 100 new readings/s
- Integrated electromagnet field control algorithm
- Standard and custom probes available

The First DSP Gaussmeter...

Lake Shore combined the technical advantages of digital signal processing with over a decade of experience in precision magnetic field measurements to produce the first commercial digital signal processor (DSP) based Hall effect gaussmeter, the Model 475. DSP technology creates a solid foundation for accurate, stable, and repeatable field measurement while simultaneously enabling the gaussmeter to offer an unequalled set of useful measurement features. The Model 475 is intended for the most demanding DC and AC applications. In many cases it provides the functionality of two or more instruments in a field measurement system.

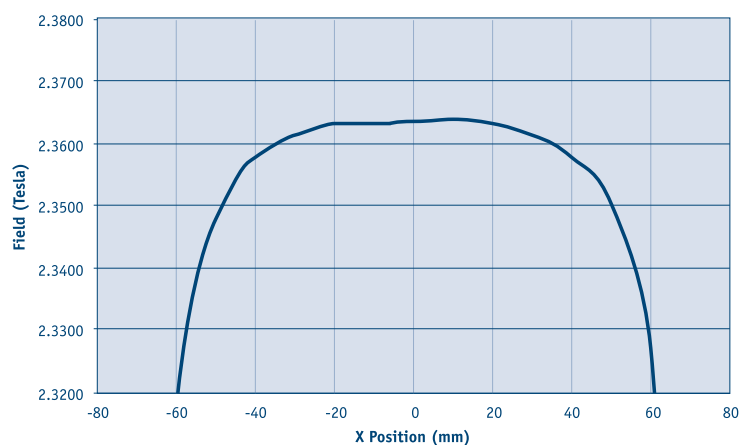
The power of DSP technology is demonstrated in the superior performance of the Model 475 in DC, RMS, and Peak measurement modes.

DC Measurement Mode

Static or slowly changing fields are measured in DC mode, where the accuracy, resolution, and stability of the Model 475 are most evident. In this mode, the gaussmeter takes advantage of the internal auto zero function and probe linearity

compensation to provide its best accuracy. Measurement resolution is enhanced by advanced signal processing capability, allowing users the choice of high reading rates to 100 readings per second or high resolution to $5\frac{3}{4}$ digits. The Model 475 also features front-end amplification specifically designed to complement DSP data acquisition, providing high stability and repeatability. That, along with probe temperature compensation, makes the Model 475 the most stable gaussmeter ever produced by Lake Shore, suiting it perfectly for demanding DC measurement applications such as field mapping and field control.

Field Uniformity Plot Across an Electromagnet Pole Face



RMS Measurement Mode

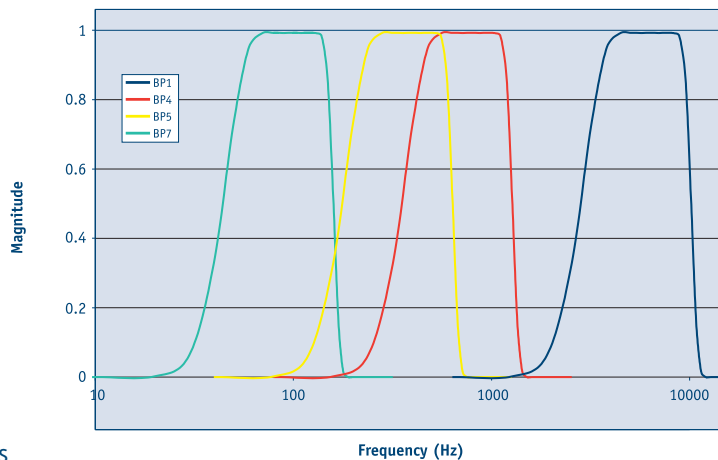
Periodic, AC fields are measured in RMS mode, which highlights the uniquely flexible filter functions of the Model 475.

An overall frequency range of 1 Hz to 50 kHz is offered by the gaussmeter.

Selectable band-pass and low-pass filters allow users

to reject unwanted signals and improve measurement performance. The exclusive Lake Shore Digital Signal Processing algorithms also free the Model 475 from the limitations of conventional RMS conversion hardware and provide better dynamic range, resolution, and frequency response than ever before. These improvements permit meaningful RMS field measurements with broad frequency content or in noisy environments.

Selective Bandpass Filters (4 of a possible 15)

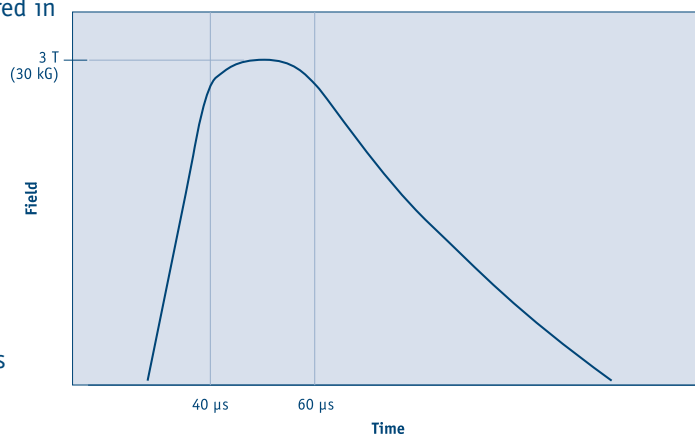


Peak Measurement Mode

Pulsed fields are measured in Peak mode, which is a natural extension of the high-speed data acquisition necessary for DSP operation.

Fast instrument sample rates permit capture of positive and negative field pulses as narrow as 20 μ s in width, which can be held for an unlimited length of time with no sag. This is ideal for most magnetizers and other fast pulse applications. For more moderate field changes, the Model 475 can process the captured data to create other features. The gaussmeter can be configured to follow the peak of a periodic waveform for evaluation of crest factor. The Model 475 can also be used to sample field changes at 1000 readings per second that can later be read over the interface to illustrate the shape of pulses or other waveforms.

Magnetizing Pulse with 20 μ s Width



The Probe Connection

The Model 475 is only half of the magnetic field measurement equation. For the complete solution, Lake Shore offers a full complement of standard and custom Hall effect probes in a variety of sizes and sensitivities – see page 6.



Advanced Features

The Model 475 combines hardware and firmware elements to create advanced features that facilitate automation and materials analysis.

Field Control

A built-in PI control algorithm turns the Model 475 into an essential building block for magnetic field control in electromagnet systems. It, along with a voltage-programmable magnet power supply, is all that is needed to control stable magnetic fields in an electromagnet at the user specified setpoint. One of the built-in analog voltage outputs drives the program input of the power supply for either bipolar or unipolar operation.

High Speed Data Transfer

The IEEE-488 interface can be set to send readings in binary format rather than the more common ASCII format. This reduces interface overhead, enabling real time reading rates up to 100 new readings per second. Temperature compensation is not available at the highest interface rate.

Data Buffer

Internal memory provides storage for 1024 field readings in a data buffer. The buffer can be filled at high speed, up to 1000 readings per second, which is as much as ten times faster than the computer interface. Stored readings can then be retrieved over interface at slower speed and processed off-line. A trigger input can be used to initiate the data log sequence. Slower sample rates can be programmed if desired.

Trigger In and Trigger Out

A TTL-level hardware trigger into the instrument can be used to initiate the data log sequence. A TTL-level hardware trigger out indicates when the instrument completes a reading, and can be used to synchronize other instruments in the system. An IEEE-488 software-based trigger can be used like the hardware trigger in.

Measurement Features

The Model 475 offers a variety of features to enhance the usability and convenience of the gaussmeter.

Auto Range: In addition to manual range selection, the instrument automatically chooses an appropriate range for the measured field. Auto range works in DC and AC measurement modes.

Auto Probe Zero: Allows the user to zero all ranges for the selected measurement mode with the push of a key.

Display Units: Field magnitude can be displayed in units of G, T, Oe, and A/m.

Max/Min Hold: The instrument stores the fully processed maximum and minimum DC or RMS field value. This differs from the faster peak capture feature that operates on broadband, unprocessed field reading information.

Relative Reading: Relative feature calculates the difference between a live reading and the relative setpoint to highlight deviation from a known field point. This feature can be used in DC, RMS, or Peak measurement mode.

Instrument Calibration: Lake Shore recommends an annual recalibration schedule for all precision gaussmeters. Recalibrations are always available from the factory, but the Model 475 allows users to field calibrate the instrument if necessary. Recalibration requires a computer interface and precision low resistance standards of known value.

Instrument Probe Features

The Model 475 has several capabilities that allow the best possible measurements with Lake Shore probes. These firmware-based features work in tandem with the probe's calibration and programming to ensure accurate, repeatable measurements and ease of setup. Many of the features require probe characteristics that are stored in the probe connector's non-volatile memory.

Probe Field Compensation: The Hall effect devices used in gaussmeter probes produce a near linear response in the presence of magnetic field. The small non-linearities present in each individual device can be measured and subtracted from the field reading. Model 475 probes are calibrated in this way to provide the most accurate DC readings.

Probe Temperature Compensation: Hall effect devices show a slight change in sensitivity and offset with temperature. Probe sensitivity temperature effects can be measured and subtracted out of field readings. A temperature sensor in the probe tip relays real time temperature to the gaussmeter, enabling compensation. Although temperature effects contribute only a small fraction of the overall probe measurement accuracy, temperature compensation will often improve measurement and control stability.

Probe Temperature Display: The gaussmeter can display the probe's temperature in °C along with a field reading when using a probe that includes a temperature sensor.

Frequency Display: When operating in RMS mode, the gaussmeter can display the frequency of the measured AC field along with a field reading (up to 20 kHz).

Probe Information: The gaussmeter reads the probe information on power up or any time the probe is changed to allow hot swapping of probes. Critical probe information can be viewed on the front panel and read over the computer interface to ensure proper system configuration.

Extension Cables: The complex nature of Hall effect measurements make it necessary to match extension cables to the probe when longer cables are necessary. Keeping probes and their extensions from getting mixed up can become a problem when more than one probe is in use. The Model 475 alleviates most of the hassle by allowing users to match probes to extensions in the field. Stored information can be viewed on the front panel and read over the computer interface to ensure proper mating.

Hall Effect Generators (Magnetic Field Sensor): The Model 475 will operate with a discrete Hall effect generator when a suitable probe is not available. Users can program nominal sensitivity and serial number into an optional MCBL-6 blank connector to provide all gaussmeter functions except field and temperature compensation. If no sensitivity information is available, the Model 475 reverts to resistance measurement.

Display and Interface Features

Display

The Model 475 has a two line by 20-character vacuum fluorescent display. During normal operation, the display is used to report field readings and give results of other features such as max/min or relative. The display can also be configured to show probe temperature or frequency. When setting instrument parameters, the display gives the operator meaningful prompts and feedback to simplify operation. The operator can also control display brightness.

Following are four examples of the various display configurations:



The display configured to show the RMS field value and frequency, and the probe temperature



The display configured to show both the Maximum and Minimum DC field values



The display configured to simultaneously show the positive and negative Peak readings



The display configured to show the field control setpoint and current field value, when field control is active

Keypad

The instrument has a 22-position keypad with individual keys assigned to frequently used features. Menus are reserved for less frequently used setup operations. The keypad can be locked out to prevent unintended changes of instrument setup.

Alarm and Relay

High and low alarms are included in the instrument. Alarm actuators include display annunciator, audible beeper, and two relays. The relays can also be controlled manually for other system needs.

Voltage Output 1

The first voltage output gives access to amplified voltage signal directly from the probe. This voltage is corrected for the nominal sensitivity of the probe and provides the widest bandwidth of the three voltage outputs. In wideband AC mode, the signal can be viewed on an oscilloscope to observe the shape of AC fields. In peak mode, the output can be used to view a pulse shape or other characteristic of a momentary signal. Output 1 serves only as a diagnostic tool in DC and narrow band AC modes because modulation of the probe signal prevents a clear view of the field response.

- 1 Line Input Assembly
- 2 Serial I/O (DTE)
- 3 Probe Input
- 4 Auxiliary I/O
- 5 IEEE-488 Interface

Voltage Output 2

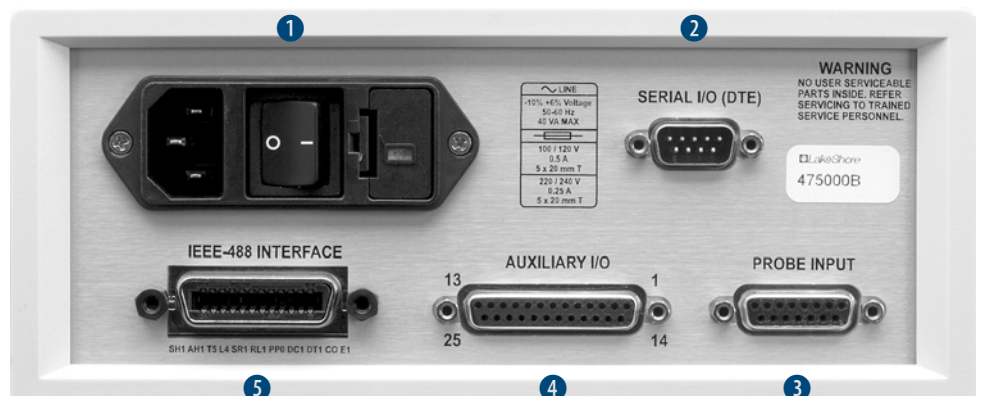
The second voltage output provides a voltage proportional to measured field with the benefits of some signal processing. The output is produced by the DSP through a fast D/A converter. The output signal is updated at 40 kHz, giving good response for low to mid frequency fields. Signal quality degrades at high frequency because of the sampling rate. This voltage can be corrected for probe offset and for the nominal sensitivity of the probe.

Voltage Output 3

The third voltage output provides a voltage proportional to measured field with the most signal processing of the three outputs. All probe compensation available to the display readings, including temperature compensation, can be performed on this output. The output is produced by the microprocessor through a high-resolution, 16-bit, D/A converter updated at 30 readings per second. This output can also be used for field control.

Computer Interface

Two computer interfaces are included with the Model 475, serial RS-232C and parallel IEEE-488. Both allow setup of all instrument parameters and read-back of measured values. The reading rate over the interface is nominally 30 readings per second but ranges from 10 to 100 readings per second are available. LabVIEW™ drivers are provided to instrument users – consult Lake Shore for availability.



Choosing a Hall Effect Probe

Proper selection of a Hall probe is probably the most difficult, and important, decision to make after choosing the Model 475. Using the improper probe could lead to less than optimal accuracy or, even worse, costly damage. The next four pages are provided to help you make an informed probe choice. If you have additional questions, contact Lake Shore and our experts can guide you through the selection process.

Field measurement application is the controlling factor in probe selection. Probe characteristics, along with the parameters described below, should be considered when selecting a probe.

Magnitude

Typical Hall effect probes cover an operating range of 4 to 5 orders of magnitude. Operation beyond this field range requires some compromise in performance, often including higher noise or loss of resolution. Choosing the correct probe type ensures optimal performance in the desired measurement range.

High Stability (HST-1 and HST-2):

With a high field range of up to 350 kG (35 T), high stability probes are used when fields exceed the limit of other probe types. Their low field performance is slightly degraded with a minimum sensitivity of 50 mG (5 μ T). HST probes are also inherently more temperature stable than other probes, and should be used when large temperature fluctuations are expected. They are offered in a variety of stem geometries.

High Sensitivity (HSE):

High sensitivity probes are the most common for general-purpose field measurement. They operate effectively in fields up to 35 kG (3.5 T) with excellent sensitivity. At low fields, their sensitivity can be as low as 5 mG (0.5 μ T). Convenient for many applications because of their relatively small active area, HSE probes are offered in the same geometries as HST probes.

Ultra High Sensitivity (UHS):

Low magnitude, large volume fields are most effectively measured with ultra high sensitivity probes, which have unbeatable low field resolution to 0.02 mG (2 nT). UHS probes, or gamma probes, are ideal for measuring fringe fields or variations in the earth's field. They should never be used in fields over 30 G. UHS probes are larger than other probes and have a very large active area, making them impractical for small volume fields or tight spaces.

Orientation

Usable Field Ranges

HST-1	HST-2	HSE	UHS
35 G	35 G	3.5 G	35 mG
350 G	350 G	35 G	350 mG
3.5 kG	3.5 kG	350 G	3.5 G
35 kG	35 kG	3.5 kG	35 G
350 kG		35 kG	

Getting to the field is part of the challenge in selecting a probe. Field orientation dictates the most basic probe geometry choice of transverse versus axial. Other variations are also available for less common, more challenging applications. Listed below are the standard configurations for HSE and HST probes; UHS probes require special packaging that is not described here.

Transverse:

Transverse probes, most often rectangular in shape, measure fields normal to their stem width. They are useful for most general-purpose field measurements and are essential for work in magnet gaps. Several stem lengths and thicknesses are available as standard probes.

Axial:

Axial probes, usually round, measure fields normal to their end. They can also be used for general-purpose measurements, but are most commonly used to measure fields produced by solenoids. Several stem lengths and diameters are available as standard probes.

Flexible:

Flexible probes have a flexible portion in the middle of their stem, while the active area at the tip remains rigid and somewhat exposed. This unique feature makes them significantly more fragile than other transverse probes. Flexible probes should only be selected for narrow-gap measurement applications.

Tangential:

Tangential probes are transverse probes designed to measure fields parallel to and near a surface. The active area is very close to the stem tip. These probes are intended for this specific application and should not be selected for general transverse measurements.



Frequency

Hall effect gaussmeters, like the Model 475, are equally well suited for measuring either static, DC fields or periodic, AC fields, but proper probe selection is required to achieve optimal performance.

Metal Stem:

Metal stem probes are the best choice for DC and low frequency AC measurements. Non-ferrous metals are used for probe stems because they provide the best protection for the delicate Hall effect sensor. Aluminum is the most common metal stem material, but brass can also be used. Metal stems do have one drawback: eddy currents are formed in them when they are placed in AC fields. These eddy currents oppose the field and cause measurement error. The error magnitude is proportional to frequency, and is most noticeable above 800 Hz.

Non-metal Stem:

Non-metal stems are required for higher frequency AC fields and for measuring pulse fields. Fiberglass/epoxy is a common non-metal stem material, or the Hall effect sensor can be left exposed on its ceramic substrate. This provides less protection for the sensor. Eddy currents do not limit the frequency range of these non-conductive materials, but other factors may.

Please note: Neither of these probe types are suitable for direct exposure to high voltage.

Gradient

Probe selection would be easier if all fields were large and uniform, but most fields are limited in volume and contain gradients (changes in magnitude). Hall effect probes measure an average magnitude over their active area, making it necessary to understand the relationship between active area and field gradients.

Severe field gradients are always experienced as the active sense element is moved away from a permanent magnet pole, making it important to know the distance between the active area and probe tip. The distance between probe tip and active area is specified for axial probes, but is less easily defined for transverse probes.

Nominal Active Area:

HSE and HST probes have a nominal active area on the order of 1 mm diameter, which is useful for all but the most stringent applications. The measured field is the average of the active area, but without severe gradients, the measured value accurately represents the true field. Field mapping with standard probes is also practical if a mapping resolution of 1 mm or greater is acceptable.

Small Active Area:

HSE and HST probes with a smaller active area are also available from Lake Shore for measurements in severe gradients, or for high resolution mapping applications.

UHS Probes:

UHS probes have a very large active length, up to 3.5 in (8.9 cm). They are designed to measure very small, ambient fields with little gradient.

Probe Durability

All Hall effect probes are fragile. The sensor, normally located at the tip of the probe stem, must not be bent, physically shocked, or abraded. It may be tempting to choose a probe with the thinnest transverse stem or smallest diameter axial stem; however, it is always best to choose the most robust probe that fits the immediate application. For example, the HMMT-6J04-VR (aluminum stem) is less prone to damage than the HMFT-3E03-VR (flexible stem), and the HMMA-2502-VR (1/4 in diameter aluminum) is more durable than the HMNA-1904-VR (3/16 in diameter fiberglass) with its exposed Hall sensor. Note: never fasten a probe stem to another object. If a probe is to be clamped, always apply the clamp to the handle.

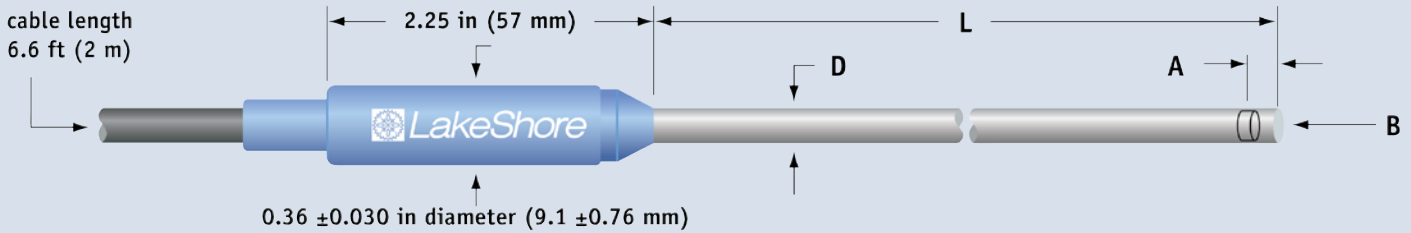
Hall Probe Selection Guide

Listed below with specifications are the commonly used probes for the Model 475 gaussmeter. Other standard probes are available.

Lake Shore prides itself on making every attempt to satisfy customer requests for special probes. If you need a custom probe, contact Lake Shore for availability.

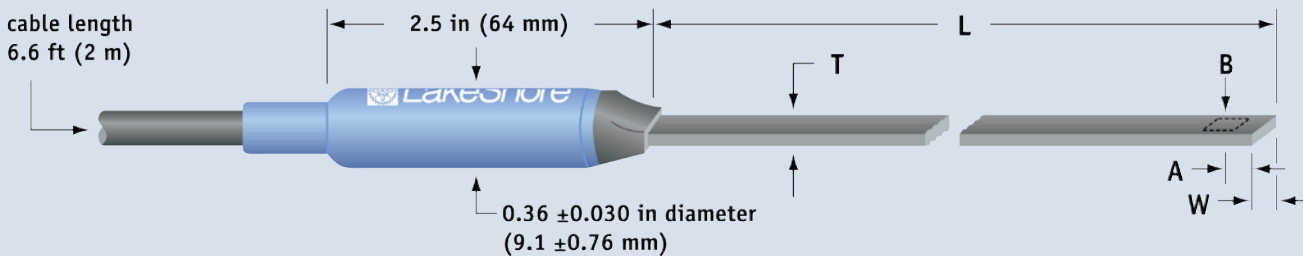
All probes shown contain temperature sensors.

Axial Probes



	L	D	A	Active area	Stem material	Frequency range	Probe type	Corrected accuracy (% of reading)	Operating temperature range	Temperature coefficient (maximum) zero	Temperature coefficient (maximum) calibration
HMMA-2502-VR	2 in ±0.063 in	0.25 in dia ±0.006 in	0.015 in ±0.005 in	0.030 in dia (approx)	Aluminum	DC to 10 kHz	HSE	±0.20% to 30 kG	0 °C to +75 °C	±0.09 G/°C	±0.015%/°C
HMNA-1904-VR	4 in ±0.125 in	0.187 in dia ±0.005 in	0.005 in ±0.003 in		Fiberglass epoxy	DC to 20 kHz					
HMMA-2502-VF	2 in ±0.063 in	0.25 in dia ±0.006 in	0.015 in ±0.005 in		Aluminum	DC to 400 Hz	HST-2	±0.10% to 30 kG		±0.13 G/°C	−0.005%/°C
HMNA-1904-VF	4 in ±0.125 in	0.187 in dia ±0.005 in	0.005 in ±0.003 in		Fiberglass epoxy	DC to 800 Hz					

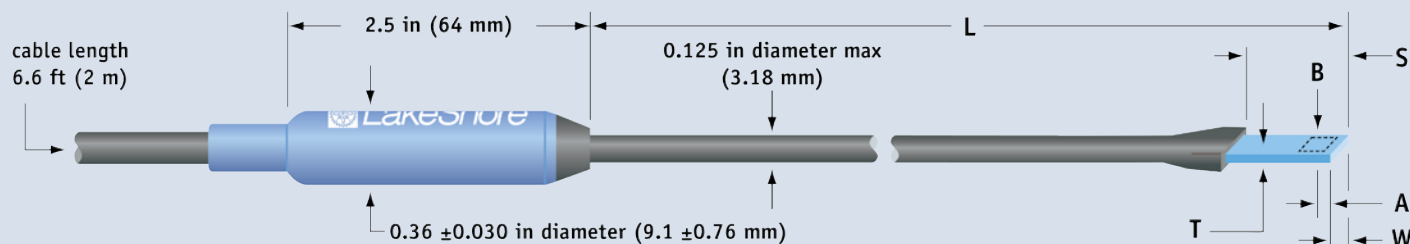
Transverse Probes



	L	T	W	A	Active area	Stem material	Frequency range	Probe type	Corrected accuracy (% of reading)	Operating temperature range	Temperature coefficient (maximum) zero	Temperature coefficient (maximum) calibration
HMMT-6J04-VR	4 in ±0.125 in	0.061 in max	0.180 in ±0.005 in	0.150 ±0.005 in	0.040 in dia (approx)	Aluminum	DC to 800 Hz	HSE	±0.20% to 30 kG	0 °C to +75 °C	±0.09 G/°C	±0.015%/°C
HMNT-4E04-VR	4 in ±0.125 in	0.045 in max	0.150 in ±0.005 in			Fiberglass epoxy	DC to 20 kHz					
HMMT-6J04-VF	4 in ±0.125 in	0.061 in max	0.180 in ±0.005 in			Aluminum	DC to 400 Hz	HST-2	±0.10% to 30 kG		±0.13 G/°C	−0.005%/°C
HMNT-4E04-VF	4 in ±0.125 in	0.045 in max	0.150 in ±0.005 in			Fiberglass epoxy	DC to 800 Hz					

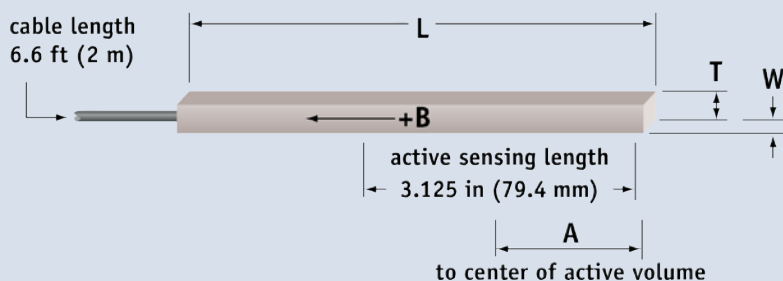


Flexible Transverse Probes



	W	T	A	L	S	Active area	Stem material	Frequency range	Probe type	Corrected accuracy (% of reading)	Operating temperature range	Temperature coefficient (maximum) zero	Temperature coefficient (maximum) calibration
HMFT-3E03-VR	0.135 in max	0.025 in max	0.125 in ±0.005 in	3 in	0.375 in	0.040 in dia	Flexible tubing	DC to 20 kHz	HSE	±0.20% to 30 kG	0 °C to +75 °C	±0.09 G/°C	±0.015%/°C
HMFT-3E03-VF						(approx)		DC to 800 Hz	HST-2	±0.10% to 30 kG		±0.13 G/°C	-0.005%/°C

Gamma Probes



	W	T	A	L	Frequency range	Probe type	Corrected accuracy (% of reading)	Operating temperature range	Temperature coefficient (maximum) zero	Temperature coefficient (maximum) calibration
HMLA-5006-HJ	0.25 in ±0.03 in	0.5 in	2.2 in	5.7 in	DC to 400 Hz	UHS	±0.5% to 2 G	0 °C to +75 °C	1 mG/°C	±0.02%/°C

Small variations in, or low values of large volume magnetic fields (such as that of the earth or fringe fields, around large solenoids) can be measured with these ultra high sensitivity probes.

Resolutions of several gammas (10^{-5} G) to tens of gammas are available.

Application is optimum when fields are homogeneous over lengths greater than 1 ft. The active sensing length of the gamma probe is approximately 3.125 in.

When ordering a gamma probe, a 4065 zero gauss chamber is suggested. The standard 4060 zero gauss chamber is too small for the gamma probe.

Instrument Specifications

General Measurement

(Does not include probe error, unless otherwise specified)

Input type: Single Hall effect sensor

Probe features: Linearity Compensation, Temperature Compensation,

Auto Probe Zero, and Hot Swap

Measurement features: Auto Range, Max/Min Hold, Relative Mode, and Frequency

Connector: 15-pin D style

DC Measurement

Probe Type Ranges	5¼-digit Resolution	4¼-digit Resolution	3¼-digit Resolution
<i>HST Probe</i>			
350 kG	000.001 kG	000.01 kG	000.1 kG
35 kG	00.0001 kG	00.001 kG	00.01 kG
3.5 kG	0.00001 kG	0.0001 kG	0.001 kG
350 G	000.003 G	000.02 G	000.1 G
35 G	00.0030 G	00.015 G	00.04 G
<i>HSE Probe</i>			
35 kG	00.0001 kG	00.001 kG	00.01 kG
3.5 kG	0.00001 kG	0.0001 kG	0.001 kG
350 G	000.001 G	000.01 G	000.1 G
35 G	00.0003 G	00.002 G	00.01 G
3.5 G	0.00030 G	0.0015 G	0.004 G
<i>UHS Probe</i>			
35 G	00.0001 G	00.001 G	00.01 G
3.5 G	0.00001 G	0.0001 G	0.001 G
350 mG	000.003 mG	000.02 mG	000.1 mG
35 mG	00.0030 mG	00.015 mG	00.04 mG

Measurement resolution (RMS noise floor): Indicated by value in above table for shorted input (probe effects not included); value measured as peak-to-peak divided by 6.6

Display resolution: Indicated by number of digits in above table

	5¼-digit Resolution	4¼-digit Resolution	3¼-digit Resolution
3 dB bandwidth:	1 Hz	10 Hz	100 Hz
Time constant:	1 s	0.1 s	0.01 s
Maximum reading rate:	10 rdg/s	30 rdg/s	100 to 1000 rdg/s*

*Limited feature set, interface dependent

DC accuracy: $\pm 0.05\%$ of reading $\pm 0.005\%$ of range

DC temperature coefficient: $\pm 0.01\%$ of reading $\pm 0.003\%$ of range/°C

AC RMS Measurement

Probe Type Ranges	4¼-digit Resolution
<i>HST Probe</i>	
350 kG	000.01 kG
35 kG	00.001 kG
3.5 kG	0.0002 kG
350 G	000.02 G
35 G	00.020 G
<i>HSE Probe</i>	
35 kG	00.001 kG
3.5 kG	0.0001 kG
350 G	000.02 G
35 G	00.002 G
3.5 G	0.0020 G
<i>UHS Probe</i>	
35 G	00.001 G
3.5 G	0.0002 G
350 mG	000.02 mG
35 mG	00.020 mG

Measurement resolution (RMS noise floor): Indicated by value in above table for shorted input

Display resolution: Indicated by number of digits in above table

Max reading rate: 30 rdgs/s (100 to 1000 rdgs/s; limited feature set, interface dependent)

AC accuracy: $\pm 1\%$ of reading

AC frequency range: 1 Hz to 1000 Hz, narrow band mode, 50 Hz to 20 kHz, wide band mode

AC band limiting (filters): 18 user selected frequencies of 3 low-pass or 15 band-pass

Peak Measurement

Probe Type Ranges	4¼-digit Resolution
<i>HST Probe</i>	
350 kG	000.01 kG
35 kG	00.001 kG
3.5 kG	0.0002 kG
350 G	000.02 G
35 G	00.020 G
<i>HSE Probe</i>	
35 kG	00.001 kG
3.5 kG	0.0001 kG
350 G	000.02 G
35 G	00.002 G
3.5 G	0.0020 G
<i>UHS Probe</i>	
35 G	00.001 G
3.5 G	0.0002 G
350 mG	000.02 mG
35 mG	00.020 mG

Measurement resolution (RMS noise floor): Indicated by value in above table for periodic mode and shorted input

Display resolution: Indicated by number of digits in above table

Max reading rate (periodic mode): 30 rdgs/s (100 to 1000 rdgs/s; limited feature set, interface dependent)

Peak accuracy: $\pm 2\%$ of reading (20 μ s or longer)

Peak frequency range (periodic mode): 50 Hz to 5 kHz

Peak frequency range (pulse mode): 5 Hz to 50 kHz

Front Panel

Display type: 2 line × 20 character, vacuum fluorescent with 9 mm high characters

Display resolution: To $\pm 5\frac{3}{4}$ digits

Display update rate: 5 rdgs/s

Display units: Gauss (**G**), Tesla (**T**), Oersted (**Oe**), and Ampere per meter (**A/m**)

Units multipliers: **μ** , **m**, **k**, **M**

Display annunciators:

DC – DC measurement mode

RMS – AC RMS measurement mode

PK – Peak measurement mode

MX – Max Hold value

MN – Min Hold value

SP – Relative setpoint value

CSP – Field Control setpoint value

LED annunciators:

Relative – Relative reading mode

Alarm – Alarm active

Remote – Remote IEEE-488 operation

Keypad: 22 full travel keys

Front panel features: Display prompts, front panel lockout, and brightness control

Interfaces

RS-232C

Baud: 9600, 19200, 38400, and 57600

Update rate: 30 rdgs/s (ASCII)

Software support: LabVIEW™ driver

(consult Lake Shore for availability)

Connector: 9-pin D-style, DTE configuration

IEEE-488.2

Capabilities: SH1, AH1, T5, L4, SR1, RL1, PPO, DC1, DT1, C0, and E1

Update rate: 30 rdgs/s (ASCII), to 100 rdgs/s (binary, no temperature compensation)

Software support: LabVIEW™ driver

(consult Lake Shore for availability)

Data Buffer

Capacity: 1024 field readings

Reading rate: 1 to 1000 rdgs/s

Data transfer: Through computer interface after data is logged

Trigger: Hardware trigger to begin data log sequence

Alarm

Settings: High/low setpoint, Inside/Outside, Audible, and Sort

Actuators: LED annunciator, beeper, and relays

Relays

Number: 2

Contacts: Normally open (NO), normally closed (NC), and common (C)

Contact rating: 30 VDC at 2 A

Operation: Follows alarm or operated manually

Connector: In 25-pin I/O connector

Voltage output 1

Configuration: Real-time analog voltage output of wide band AC signal

Range: ± 3.5 V

Scale: ± 3.5 V = \pm FS on selected range

Frequency response: 1 Hz to 40 kHz (wide band AC)

Accuracy: Probe dependent

Noise: ± 1.0 mV

Minimum load resistance: 1 k Ω (short-circuit protected)

Connector: In 25-pin I/O connector

Voltage Output 2

Configuration: Voltage output of field value, generated by DAC

Range: ± 5 V

Scale: ± 3.5 V = \pm FS on selected range

Resolution: 16-bit, 0.15 mV

Update Rate: 40,000 updates per s

Accuracy: ± 10 mV

Noise: ± 0.3 mV

Minimum load resistance: 1 k Ω (short-circuit protected)

Connector: In 25-pin I/O connector

Voltage Output 3

Configuration: Voltage output of compensated DC or RMS field value, generated by DAC (also used for field control)

Range: ± 10 V

Scale: User specified (defaults same as Voltage Output 2)

Resolution: 16-bit, 0.3 mV

Update rate: 30 updates per s

Accuracy: ± 2.5 mV

Noise: ± 0.3 mV

Minimum load resistance: 1 k Ω (short-circuit protected)

Connector: In 25-pin I/O connector

General

Ambient temperature: 15 °C to 35 °C at rated accuracy, 5 °C to 40 °C with reduced accuracy

Power requirement: 100, 120, 220, and 240 VAC (+5%, -10%), 50 Hz or 60 Hz, 20 W

Size: 217 mm W × 90 mm H × 317 mm D, half rack (8.5 × 3.5 × 12.5 in)

Weight: 3 kg (6.6 lb)

Probes & Extensions

Probe compatibility: Full line of standard probes available – custom probes also available (not compatible with Model 450/421 probes)

Hall sensor compatibility: Front panel programmable sensitivity and serial number for user supplied Hall sensor

Extension cable compatibility: Probe extension cables with EEPROM available from 25 ft to 100 ft (extension cables can be matched to probes in the field)

Lake Shore calibrated extension cables maintain the same accuracy as the Model 475 probe.

The uncalibrated version involves the operator loading the matching probe data file into the cable PROM directly from the Model 475 front panel. Additional errors caused by the uncalibrated extension cables are $\pm 0.1\%$ of field reading error and 1 °C temperature reading error.

Ordering Information

Part Number	Description
475	Model 475 DSP gaussmeter

Please indicate your power/cord configuration:

100 VAC, U.S. power cord
120 VAC, U.S. power cord
220 VAC, European power cord
240 VAC, European power cord

Accessories Included

106-253	I/O mating connector
4060	Zero gauss chamber
MAN-475	Model 475 gaussmeter user manual

Accessories Available

4005	1 m (3.3 ft) long IEEE-488 (GPIB) computer interface cable assembly – includes extender required for simultaneous use of IEEE cable and auxiliary I/O connector
RM-1/2	Rack mount kit for one 1/2-rack gaussmeter in 483 mm (19 in) rack
RM-2	Rack mount kit for two 1/2-rack gaussmeter in 483 mm (19 in) rack
HMCBL-6	User programmable cable with EEPROM (6 ft)
HMPEC-10	Probe extension cable with EEPROM (10 ft), calibrated
HMPEC-10-U	Probe extension cable with EEPROM (10 ft), uncalibrated
HMPEC-25	Probe extension cable with EEPROM (25 ft), calibrated
HMPEC-25-U	Probe extension cable with EEPROM (25 ft), uncalibrated
HMPEC-50	Probe extension cable with EEPROM (50 ft), calibrated
HMPEC-50-U	Probe extension cable with EEPROM (50 ft), uncalibrated
HMPEC-100	Probe extension cable with EEPROM (100 ft), calibrated
HMPEC-100-U	Probe extension cable with EEPROM (100 ft), uncalibrated

(Extension cables must be matched to probes)

Calibration Service

CAL-475	Instrument calibration
CAL-475DATA	Instrument calibration with report and data

All specifications are subject to change without notice

LakeShore®

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Established in 1968, Lake Shore Cryotronics, Inc. is an international leader in developing innovative measurement and control solutions. Founded by Dr. John M. Swartz, a former professor of electrical engineering at the Ohio State University, and his brother David, Lake Shore produces equipment for the measurement of cryogenic temperatures, magnetic fields, and the characterization of the physical properties of materials in temperature and magnetic environments.

