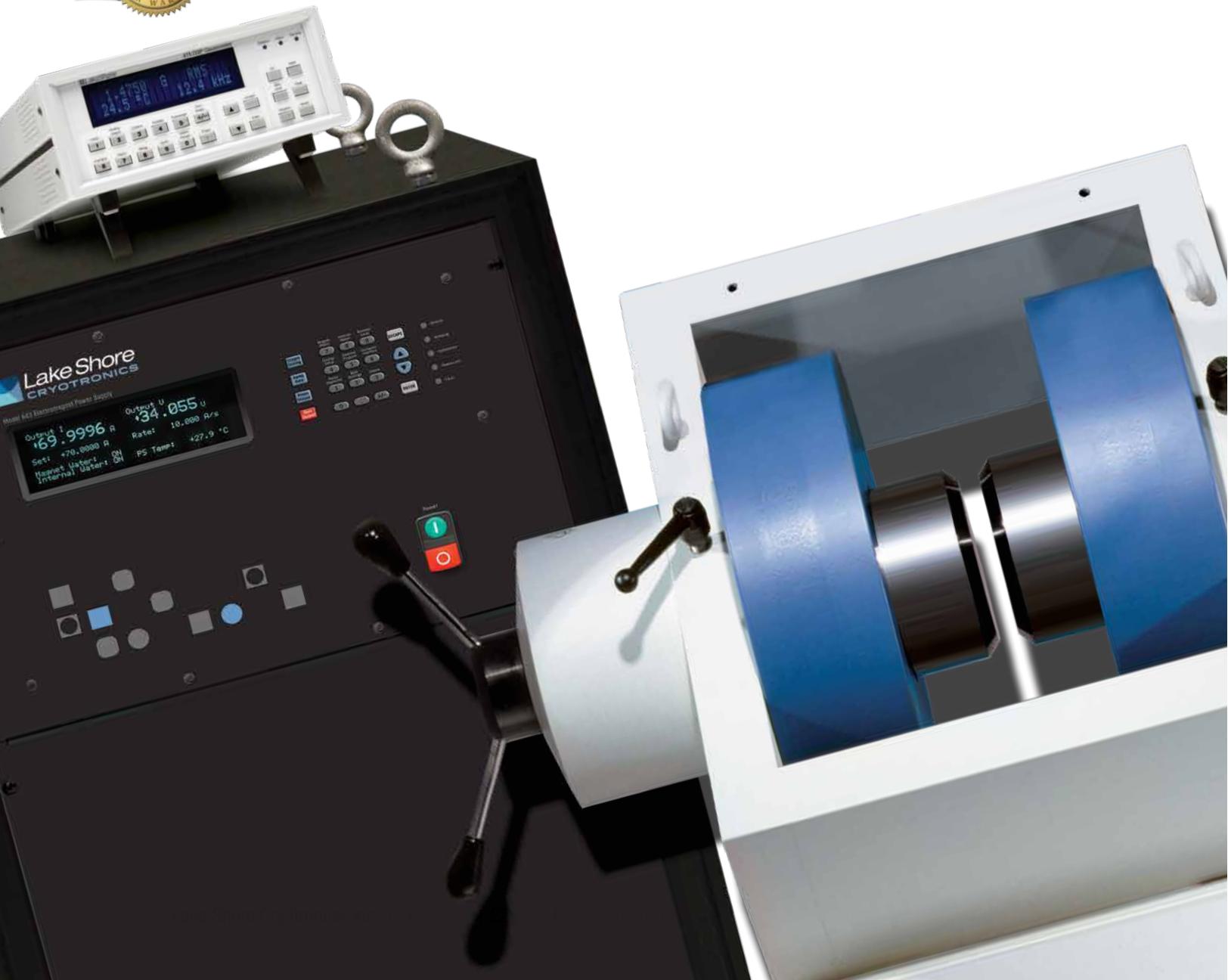




Field Controlled Electromagnet Platforms

FCP features

- Ideal for user designed magnetic measurement systems
- Fields exceeding 3 T
- Solid and optical access pole caps available
- 4-, 7-, and 10-inch electromagnet configurations
- Continuously variable air gap electromagnets available
- Linear, bipolar, true 4-quadrant electromagnet power supplies
- Stable field control with the Lake Shore Model 475 gaussmeter





Product description

The electromagnet field control platform (FCP) integrates hardware and firmware components to form a variable magnetic field platform that can be used independently or as the foundation for a user-designed magnetic measurement system.

The FCPs include a Lake Shore electro-magnet, a bipolar magnet power supply, a DSP gaussmeter with integrated field control firmware, and a gaussmeter Hall probe and holder.

Lake Shore FCPs can be configured to accommodate specific user requirements based on magnetic field strength, field uniformity, sample size, and custom measurement applications. The platforms are ideally suited for integration into user-designed magnetic test systems for applications including magneto-optical studies, in-line annealing, Hall effect studies, susceptibility measurements, spin magnetic resonance demonstrations, B-H curves, and precision sensor calibration.

System features

The FCP electromagnets feature continuously adjustable air gaps, allowing rapid air gap changes to suit individual experiments. They have water-cooled coils and precision yokes made of magnetically soft, ultra-pure steel, assuring precise pole cap alignment as well as excellent field homogeneity and stability. The H-yoke configurations are oriented at a 45° angle for optimum air gap accessibility. The electromagnets also incorporate compact size with steel eyebolts, permitting bench-top mounting to optical tables.

The FCP magnet power supplies provide stable current regulation and bipolar power output. The bipolar output allows rapid uniform magnetic field ramping and field reversal, avoiding discontinuities that occur during zero crossover when using unipolar power supplies. The bipolar output also eliminates the need for current reversal contactors or relays. The magnet power supplies are CE compliant and include features such as automatic power output disable upon failure detection, operation as

a current or voltage source, and operation in either manual or remote mode.

Unlike other commercial solutions, the Lake Shore FCP system incorporates closed-loop field control (also called feedback control) capability directly into the Model 475 DSP gaussmeter, eliminating the need for a separate computer with redundant software control. The Model 475 includes the electronics and firmware to perform closed-loop, digital PI field control of the electromagnet and magnet power supply.

Control features

The Model 475 attempts to keep the magnetic field density at exactly the user-entered control setpoint, expressed in gauss, tesla, oersted, or ampere/meter. To do this, the Model 475 uses feedback from the gaussmeter Hall probe to calculate and actively adjust the control (analog) output. In order to maximize control stability, the Model 475 updates the analog output every 33 ms. The result is an internal PI controller providing peak-to-peak field stability of 0.5 G*.

When the setpoint ramp is enabled, the instrument will start ramping from the current field reading, rather than the current setpoint, based on the user settable P and I settings. In addition, the 475 can be configured to ramp the control setpoint from the present field reading to a new value by using a smooth linear transition in field rather than the step response PI control.

Open-loop field control is also possible by using the Model 475 analog output in manual output, meaning feedback is ignored and the analog output stays at the manual user setting. This method makes the magnet power supply operate in constant current mode.

The Model 475 also incorporates user-settable control slope limits and analog output voltage limits. These software limits assure that the magnet power supply is not damaged if the field control system is improperly tuned or begins to oscillate.

*Measured at 0 G and 1000 G

Gaussmeter display

The Model 475 has a 2-line by 20-character vacuum fluorescent display. During normal operation, the display is used to report the current field value and field control setpoint. When setting instrument field control parameters, the display provides prompts for turning the control on/off, entering the control setpoint, entering the control P and I values, entering a ramp rate, and entering the control slope limit. When field control is not active, the display can be configured to show features such as maximum and minimum DC field values, RMS field value, frequency, or probe temperature.

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.

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 maximum reading rate over the interface is nominally 30 readings per second during field control. LabVIEW™ driver for the Model 475 is provided. Application software is not included with the FCP.



compliant to both the low voltage directive and the electromagnetic compatibility (EMC) directive, which includes the radiated emissions requirements

Specifications

The features and specifications of Lake Shore field control platforms are consistent with their individual components and are summarized below. Detailed component specifications are included in their individual sections. Typical system performance illustrates how the components behave as a system. Field stability values were measured on a FC-EM7 system. Results will vary with magnet size, magnet gap, and system setup.

Typical system performance	FC-EM4	FC-EM7	FC-EM10
Field stability (peak-to-peak)	—	0.5 G at 0 G and 1 kG	—
Control type	Closed loop PI		
Control output resolution	0.001% of full/ scale output		
Control output update period	33 ms		
Electromagnet	EM4-HVA	EM7-HV	EM10-HV
<i>See page 71 for field plots and detailed specifications</i>			
Frame, gap	H frame, variable gap		
Nominal coil (Ω)	0.5 Ω	1.0 Ω	0.25 Ω
Coil connection	Series	Parallel	Series
Pole size	Customer specified		
Air gap	Up to 102 mm (4 in), continuously variable	Up to 178 mm (7 in), continuously variable	Up to 160 mm (6.3 in), continuously variable
Field strength	See page 71		Consult Lake Shore
Power supply	643	648	648
<i>See page 77 for detailed specifications</i>			
Output	Linear, bipolar		
Current output	±35 A per coil	±67.5 A per coil	±67.5 A per coil
Voltage	±35 V nominal	±67.5 V nominal	±67.5 V nominal
Power output	2450 W	9.1 kW nominal	9.1 kW nominal
AC line input	204/208, 220/230, 380, 400/415 VAC, 3-phase (3 wire plus ground)	200, 208, 220, 230, 380, 400, 415 VAC, 3-phase (3 wire plus ground)	200, 208, 220, 230, 380, 400, 415 VAC, 3-phase (3 wire plus ground)
Gaussmeter	475		
<i>See page 16 for detailed specifications</i>			
Resolution	5 3/4 digit (1 part out of ±350,000)		
Ranges	8 ranges from 35 mG to 350 kG full scale		
Basic DC accuracy	±0.05%		
Frequency ranges	DC, 1 Hz to 1 kHz, and 50 Hz to 20 kHz		
Update rate	Display: 5 readings per s; IEEE-488: 30 rdg/s		
Hall probe	HMMT-6J02-VF	HMMT-6J04-VF	HMMT-6J08-VF
<i>See page 43 for detailed specifications</i>			
Length	5.1 ±3.2 mm (2 ±0.125 in)	10.2 ±3.2 mm (4 ±0.125 in)	20.3 ±3.2 mm (8 ±0.125 in)
Size/weight (H × D × W)			
Electromagnet	0.81 × 0.51 × 0.54 m (32 × 21 × 33 in); 247 kg (545 lb)	0.94 × 0.66 × 1.02 m (37 × 26 × 40 in); 614 kg (1350 lb)	0.87 × 0.64 × 0.92 m (34 × 25 × 36 in); 1800 kg (3970 lb)
Power supply	0.31 × 0.57 × 0.48 m (12 × 23 × 19 in); 74 kg (163 lb)	1.35 × 0.70 × 0.60 m (53 × 28 × 24 in); 250 kg (550 lb)	1.35 × 0.70 × 0.60 m (53 × 28 × 24 in); 354 kg (780 lb)
Gaussmeter/Hall probe	89 × 318 × 216 mm (3.5 × 12.5 × 8.5 in); 3 kg (6.6 lb)		

Gaussmeter Hall probe



Following are examples of the various display configurations and setup screens:



The display configured to turn the field control On/Off



The display configured to enter the field control setpoint



The display configured to enter the field control 'P' value



The display configured to enter the field control 'I' value



The display configured to enter the field control ramp rate



The display configured to set the field control slope limit



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

Ordering information

Customer specifies single-phase voltage, 3-phase voltage, and pole cap diameter

Part number	Description
FC-EM4-HVA	Field controlled platform with EM4-HVA-S electromagnet
FC-EM7	Field controlled platform with EM7-HV electromagnet
FC-EM10	Field controlled platform with EM10-HV electromagnet

All specifications are subject to change without notice