



Electromagnets



EM4-HVA, EM7-HV

- Continuously adjustable poles allow rapid air gap changes to suit individual experiments, assuring magnet versatility
- Exceptional field intensities achieved with cylindrical or tapered pole caps
- Water-cooled coils provide excellent field stability and uniformity
- Removable pole caps facilitate variable pole face configurations and easy pole cap exchange
- Single axis configuration with 2.5 in, 6 in, and 12 in diameter coils
- Accurate pole alignment by precise construction of the air gap adjustment mechanism
- The EM7 yoke is oriented at a 45° angle and the EM4 yoke at a 40° angle for optimum air gap accessibility
- Compact size of the EM4 permits convenient bench-top mounting
- Optional optical access pole caps available



Introduction

The Lake Shore EM4 and EM7 series electromagnets (EM) produce variable magnetic fields with a variety of air gap and pole cap configurations. The EM series are ideally suited for integration into customer-designed magnetic test platforms for applications including magneto-optical studies, magnetic hysteresis studies, in-line annealing, Hall effect studies, susceptibility measurements, spin magnetic resonance demonstrations, and biological studies.

The HV series feature continuously adjustable poles, allowing rapid air gap changes to suit individual experiments, and threaded or bolt-on mounting that provides easy pole cap exchange. The EM series incorporate 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 EM7 yoke is oriented at a 45° angle and the EM4 yoke at a 40° angle for optimum air gap accessibility. The EM4 series are also compact in size and have steel eyebolts, permitting convenient bench-top mounting to optical tables.

The EM series coupled with a Lake Shore magnet power supply (MPS) form a versatile laboratory electromagnet characterization system. This system, with true bipolar MPS power output, provides rapid uniform magnetic field ramping and field reversal to avoid discontinuities that occur during zero crossover when using unipolar power supplies.

Larger magnets are also available from Lake Shore.

Specifications

Typical field uniformity (EM4 magnets)

Magnet configuration		Uniformity over 1 cm ³	1% cylindrical volume	
Pole cap mm (in)	Air gap mm (in)		Diameter mm (in)	Length mm (in)
102 (4.0)	51 (2.0)	±0.15%	18 (0.7)	51 (2.0)
102 (4.0)	25 (1.0)	±0.05%	64 (2.5)	25 (1.0)
76 (3.0)	25 (1.0)	±0.06%	46 (1.8)	25 (1.0)
51 (2.0)	25 (1.0)	±0.35%	18 (0.7)	25 (1.0)
51 (2.0)	13 (0.5)	±0.16%	36 (1.4)	13 (0.5)

Typical field uniformity (EM7 magnet)

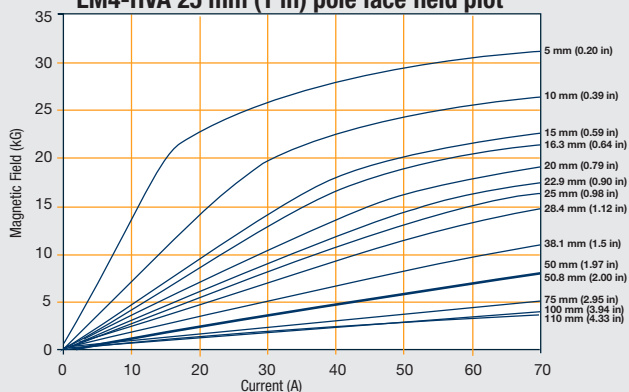
Magnet configuration		Uniformity over 1 cm ³	1% cylindrical volume	
Pole cap mm (in)	Air gap mm (in)		Diameter mm (in)	Length mm (in)
51 (2.0)	16 (0.6)	±0.11%	28 (1.1)	16 (0.6)
51 (2.0)	25 (1.0)	±0.33%	10 (0.4)	25 (1.0)
102 (4.0)	16 (0.6)	±0.03%	74 (2.9)	16 (0.6)
102 (4.0)	25 (1.0)	±0.03%	66 (2.6)	25 (1.0)
102 (4.0)	38 (1.5)	±0.05%	48 (1.9)	38 (1.5)
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.

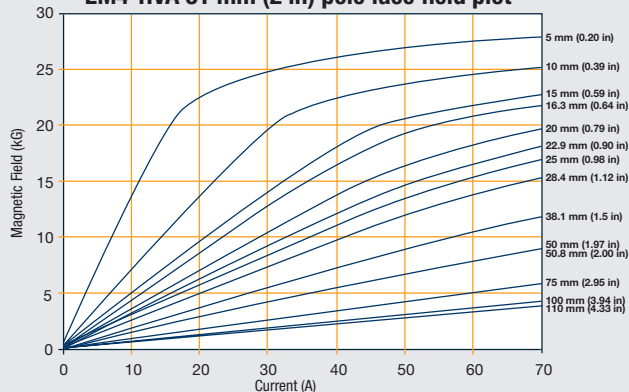
	EM4-HVA	EM7-HV
Air gap	Up to 109 mm (4.3 in) continuously variable	Up to 178 mm (7 in) continuously variable
Coil resistance, nominal	0.25 Ω per coil (0.5 Ω total wired in series)	1.0 Ω per coil (0.5 Ω total wired in parallel)
Standard pole cap diameter	51 mm (2 in)	76 mm (3 in)
Optional pole cap diameter	25 mm, 76 mm, 102 mm (1 in, 3 in, 4 in)	51 mm, 102 mm, 152 mm (2 in, 4 in, 6 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 (in series)	±67.5 A (in parallel)
Voltage, nominal	±35 V	±75 V
Continuous input power, nominal	2.5 kVA	9.1 kVA
Lake Shore power supply (suggested)	Model 643	Model 648
Size		
Height	0.39 m at 40° angle (15.25 in) without stand	0.94 m (37 in)
Width	0.84 m (33.25 in)	1.02 m (40 in)
Depth	0.51 m (20 in)	0.66 m (26 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)



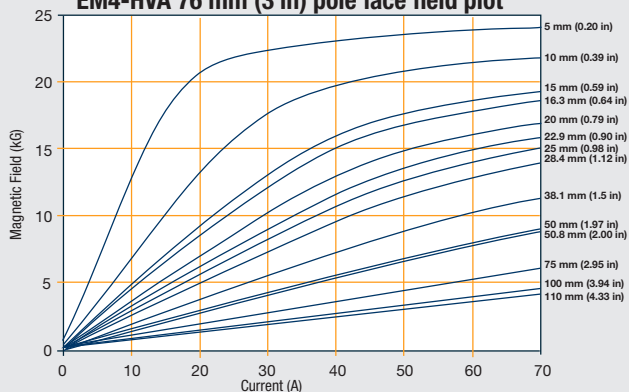
EM4-HVA 25 mm (1 in) pole face field plot



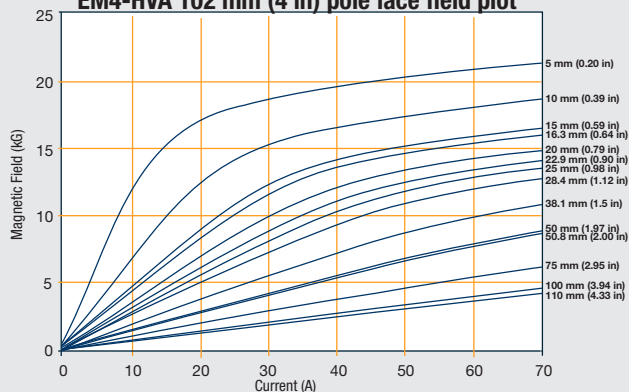
EM4-HVA 51 mm (2 in) pole face field plot



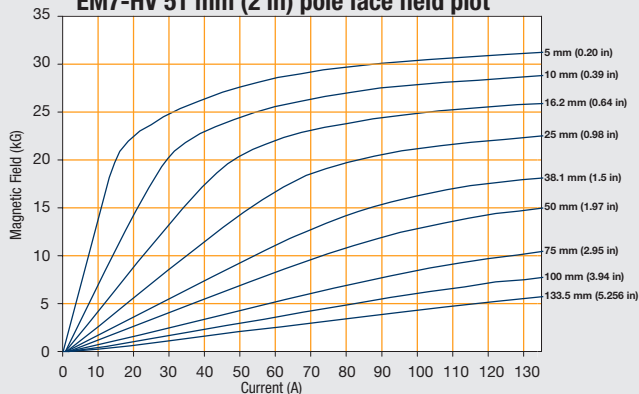
EM4-HVA 76 mm (3 in) pole face field plot



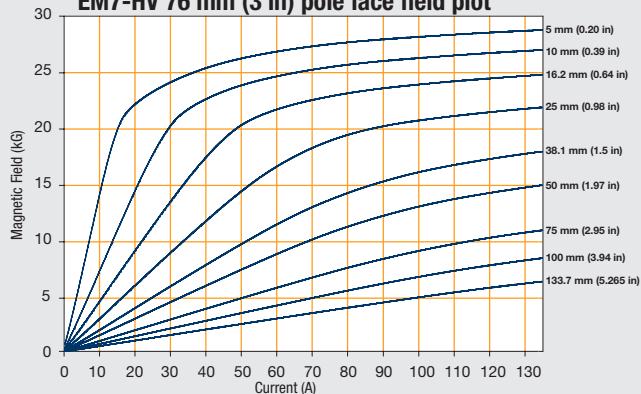
EM4-HVA 102 mm (4 in) pole face field plot



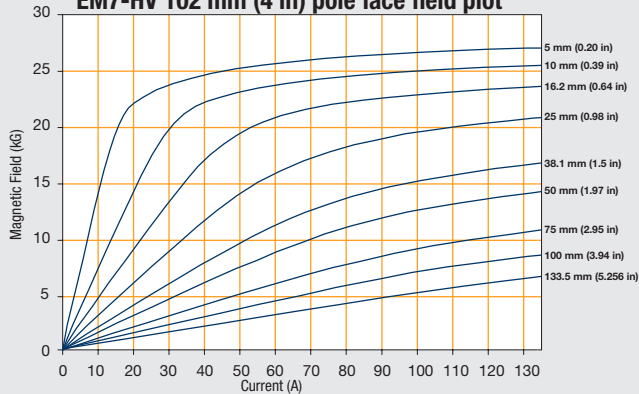
EM7-HV 51 mm (2 in) pole face field plot



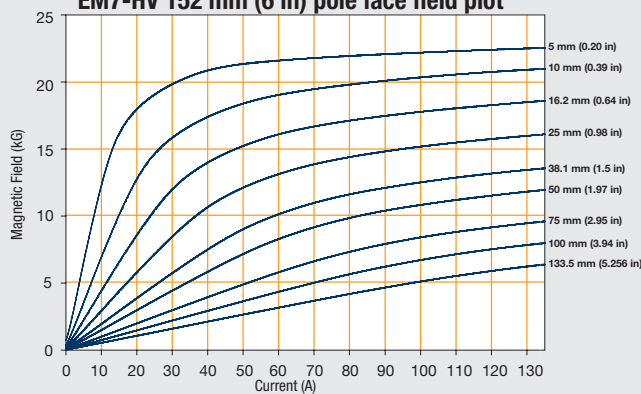
EM7-HV 76 mm (3 in) pole face field plot



EM7-HV 102 mm (4 in) pole face field plot



EM7-HV 152 mm (6 in) pole face field plot



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Technical drawings of the 1000 W prototype system, showing front, top, and side views with dimensions in cm and inches.

Front View Dimensions:

- Overall width: 101.6 cm (40 in)
- Overall height: 63.5 cm (25 in)
- Top section width: 44.5 cm (17.5 in)
- Top section height: 35 cm (13.75 in)
- Intercoil space: 17.8 cm (7 in)
- Air gap: 0-17 cm (0-7 in)
- Bottom section width: 55.9 cm (22 in)
- Bottom section height: 31 cm (12.2 in)
- Mounting holes: 1.5 cm (0.6 in) \varnothing holes (4) for mounting to floor
- Mounting flange width: 50.8 cm (20 in)
- Mounting flange height: 2.5 cm (1 in)
- 3/8-16 tap holes (2)

Top View Dimensions:

- Overall width: 94 cm (37 in)
- Overall height: 52 cm (20.5 in)
- Mounting holes: 1.5 cm (0.6 in) \varnothing holes (4) for mounting to floor
- Mounting flange width: 45.8 cm (18 in)
- Mounting flange height: 30.5 cm (12 in)
- Mounting flange width: 35.6 cm (14 in)
- Mounting flange height: 5.1 cm (2 in)
- 3/8-16 tap holes (2)

Side View Dimensions:

- Overall width: 61 cm (2.4 in)
- Overall height: 31 cm (12.2 in)
- Mounting holes: 1.5 cm (0.6 in) \varnothing holes (4) for mounting to floor
- Mounting flange width: 45.8 cm (18 in)
- Mounting flange height: 30.5 cm (12 in)
- Mounting flange width: 35.6 cm (14 in)
- Mounting flange height: 5.1 cm (2 in)
- 3/8-16 tap holes (2)



Ordering information

102 mm (4 in) electromagnets

EM4-HVA-S	H yoke, variable gap (up to 102 mm (4 in) with stand
EM4-HVA-O-S	H yoke, variable gap (up to 102 mm (4 in) with optical access & stand

Accessories included

1 set of pole caps (EM4-2PB, 51 mm [2 in] pole cap standard — different size can be specified at time of order); corresponding pair of lead screws; flow switch; 3 m (10 ft) #4 AWG cables

Accessories available

EM4-1PB	Pole cap, 1 pair, 102 mm (4 in) dia. tapered to 25 mm (1 in) face
EM4-2PB	Pole cap, 1 pair, 102 mm (4 in) dia. tapered to 51 mm (2 in) face
EM4-3PB	Pole cap, 1 pair, 102 mm (4 in) dia. tapered to 76 mm (3 in) face
EM4-4PB	Pole cap, 1 pair, 102 mm (4 in) dia. with 102 mm (4 in) face
EM4-1PB-O-1-2	Pole cap, 1 pair, 102 mm (4 in) tapered to 25 mm (1 in) face, 3.2 mm ($\frac{1}{8}$ in) dia. bore for optical access through one pole
EM4-1PB-O-2-2	Pole cap, 1 pair, 102 mm (4 in) tapered to 25 mm (1 in) face, 3.2 mm ($\frac{1}{8}$ in) dia. bore for optical access through both poles
EM4-1PB-O-1-4	Pole cap, 1 pair, 102 mm (4 in) tapered to 25 mm (1 in) face, 6.4 mm ($\frac{1}{4}$ in) dia. bore for optical access through one pole
EM4-1PB-O-2-4	Pole cap, 1 pair, 102 mm (4 in) tapered to 25 mm (1 in) face, 6.4 mm ($\frac{1}{4}$ in) dia. bore for optical access through both poles
EM4-2PB-O-1-2	Pole cap, 1 pair, 102 mm (4 in) tapered to 51 mm (2 in) face, 3.2 mm ($\frac{1}{8}$ in) dia. bore for optical access through one pole
EM4-2PB-O-2-2	Pole cap, 1 pair, 102 mm (4 in) tapered to 51 mm (2 in) face, 3.2 mm ($\frac{1}{8}$ in) dia. bore for optical access through both poles
EM4-2PB-O-1-4	Pole cap, 1 pair, 102 mm (4 in) tapered to 51 mm (2 in) face, 6.4 mm ($\frac{1}{4}$ in) dia. bore for optical access through one pole
EM4-2PB-O-2-4	Pole cap, 1 pair, 102 mm (4 in) tapered to 51 mm (2 in) face, 6.4 mm ($\frac{1}{4}$ in) dia. bore for optical access through both poles
EM4-3PB-O-1-2	Pole cap, 1 pair, 102 mm (4 in) tapered to 76 mm (3 in) face, 3.2 mm ($\frac{1}{8}$ in) dia. bore for optical access through one pole
EM4-3PB-O-2-2	Pole cap, 1 pair, 102 mm (4 in) tapered to 76 mm (3 in) face, 3.2 mm ($\frac{1}{8}$ in) dia. bore for optical access through both poles
EM4-3PB-O-1-4	Pole cap, 1 pair, 102 mm (4 in) tapered to 76 mm (3 in) face, 6.4 mm ($\frac{1}{4}$ in) dia. bore for optical access through one pole
EM4-3PB-O-2-4	Pole cap, 1 pair, 102 mm (4 in) tapered to 76 mm (3 in) face, 6.4 mm ($\frac{1}{4}$ in) dia. bore for optical access through both poles
EM4-4PB-O-1-2	Pole cap, 1 pair, 102 mm (4 in) dia. with 102 mm (4 in) face, 3.2 mm ($\frac{1}{8}$ in) dia. bore for optical access through one pole
EM4-4PB-O-2-2	Pole cap, 1 pair, 102 mm (4 in) dia. with 102 mm (4 in) face, 3.2 mm ($\frac{1}{8}$ in) dia. bore for optical access through both poles
EM4-4PB-O-1-4	Pole cap, 1 pair, 102 mm (4 in) dia. with 102 mm (4 in) face, 6.4 mm ($\frac{1}{4}$ in) dia. bore for optical access through one pole
EM4-4PB-O-2-4	Pole cap, 1 pair, 102 mm (4 in) dia. with 102 mm (4 in) face, 6.4 mm ($\frac{1}{4}$ in) dia. bore for optical access through both poles
EM4-CABLE	Cable from magnet to supply (#4 AWG, 3 m [10 ft])
EM4-FLOW	Flow switch, replacement

178 mm (7 in) electromagnets

EM7-HV	H yoke, variable gap (up to 178 mm [7 in]) with stand
EM7-HV-O	H yoke, variable gap (up to 178 mm [7 in]) with optical access and stand

Accessories included

1 set of pole caps, corresponding pair of lead screws, flow switch, 3 m (10 ft) #4 AWG cables

Accessories available

EM7-2P-FECO	Pole cap, 1 pair, 178 mm (7 in) dia. tapered to 51 mm (2 in) face, FeCo
EM7-2P	Pole cap, 1 pair, 178 mm (7 in) dia. tapered to 51 mm (2 in) face
EM7-3P	Pole cap, 1 pair, 178 mm (7 in) dia. tapered to 76 mm (3 in) face
EM7-4P	Pole cap, 1 pair, 178 mm (7 in) dia. tapered to 102 mm (4 in) face
EM7-6P	Pole cap, 1 pair, 178 mm (7 in) dia. tapered to 152 mm (6 in) face
EM7-3P-O-1-2	Pole cap, 1 pair, 178 mm (7 in) tapered to 76 mm (3 in) face, 3.2 mm ($\frac{1}{8}$ in) dia. bore for optical access through one pole
EM7-3P-O-2-2	Pole cap, 1 pair, 178 mm (7 in) tapered to 76 mm (3 in) face, 3.2 mm ($\frac{1}{8}$ in) dia. bore for optical access through both poles
EM7-3P-O-1-4	Pole cap, 1 pair, 178 mm (7 in) tapered to 76 mm (3 in) face, 6.4 mm ($\frac{1}{4}$ in) dia. bore for optical access through one pole
EM7-3P-O-2-4	Pole cap, 1 pair, 178 mm (7 in) tapered to 76 mm (3 in) face, 6.4 mm ($\frac{1}{4}$ in) dia. bore for optical access through both poles
EM7-6P-O-1-2	Pole cap, 1 pair, 178 mm (7 in) tapered to 152 mm (6 in) face, 3.2 mm ($\frac{1}{8}$ in) dia. bore for optical access through one pole
EM7-6P-O-2-2	Pole cap, 1 pair, 178 mm (7 in) tapered to 152 mm (6 in) face, 3.2 mm ($\frac{1}{8}$ in) dia. bore for optical access through both poles
EM7-6P-O-1-4	Pole cap, 1 pair, 178 mm (7 in) tapered to 152 mm (6 in) face, 6.4 mm ($\frac{1}{4}$ in) dia. bore for optical access through one pole
EM7-6P-O-2-4	Pole cap, 1 pair, 178 mm (7 in) tapered to 152 mm (6 in) face, 6.4 mm ($\frac{1}{4}$ in) dia. bore for optical access through both poles
EM7-CABLE	Cable from magnet to supply (#4 AWG, 3 m [10 ft])
EM7-FLOW	Flow switch, replacement

Consult Lake Shore for FeCo and other pole cap materials

Additional requirements for EM4 and EM7 electromagnets:

1. Water supply (see flow rate in specifications table) or recirculating water chiller (see www.lakeshore.com for available chillers)
2. Crane or lifting equipment capable of lifting or moving the weight of magnet (see specifications)
3. Magnet power supply
4. Area that can support the magnet weight

All specifications are subject to change without notice