

Ferronato® Helmholtz Coil Systems



BH1300

These Ferronato® Helmholtz coils are used in the calibration of magnetic field sensors, or for conducting tests or experiments that require a known magnetic environment.

The coils are available in a range of diameters from 300mm to 2m.

Bartington's Helmholtz Control System (PA1, CU1 and CU2) can be used with the Ferronato® coils described here. A compatibility table at the end of this brochure details the performance which can be achieved when using the PA1.

Full system specifications for PA1, CU1, CU2 and recommended National Instruments acquisition card, are available in the Helmholtz coil systems brochure DS2613.

Features

- Option of 1, 2 or 3 axes
- DUT (Device Under Test) mounting setup available
- BH1300HF4 coil is suitable for high frequency field generation
- Full system available including active cancellation

Typical Applications

- Calibration of three-axis magnetic field sensors, including satellite and sub assemblies
- Creation of a known magnetic environment

Product Identification

Product name	Variant	Axes	Description
BH300	1A-A	X	1 axis with scaling of 500 μ T/A field/current ratio
	1B-A	Z	1 axis with scaling of 500 μ T/A field/current ratio
	2A-A	X, Y	2-axis with scaling of 500 μ T/A field/current ratio
	2B-A	X, Z	2-axis with scaling of 500 μ T/A field/current ratio
	3-A	X, Y, Z	3-axis with scaling of 500 μ T/A field/current ratio
BH300HF	3-B	X, Y, Z	3-axis with scaling of 54 μ T/A field/current ratio, high frequency
BH600	1A-B	X	1 axis with scaling of 300 μ T/A field/current ratio
	1B-B	Z	1 axis with scaling of 300 μ T/A field/current ratio
	2A-B	X, Y	2-axis with scaling of 300 μ T/A field/current ratio
	2B-B	X, Z	2-axis with scaling of 300 μ T/A field/current ratio
	3-B	X, Y, Z	3-axis with scaling of 300 μ T/A field/current ratio
BH1300	1A-A/C	X	1 axis with scaling of 200 μ T/A (A) or 50.5 μ T/A (C) field/current ratio
	1B-A/C	Z	1 axis with scaling of 200 μ T/A (A) or 50.5 μ T/A (C) field/current ratio
	2A-A/C	X, Y	2-axis with scaling of 200 μ T/A (A) or 50.5 μ T/A (C) field/current ratio
	2B-A/C	X, Z	2-axis with scaling of 200 μ T/A (A) or 50.5 μ T/A (C) field/current ratio
	3-A/C	X, Y, Z	3-axis with scaling of 200 μ T/A (A) or 50.5 μ T/A (C) field/current ratio
BH1300HF4	1A-A	X	1 axis with scaling of ~5.8 μ T/A field/current ratio, high frequency
	1B-A	Z	1 axis with scaling of ~5.8 μ T/A field/current ratio, high frequency
	2A-A	X, Y	2-axis with scaling of ~5.8 μ T/A field/current ratio, high frequency
	2B-A	X, Z	2-axis with scaling of ~5.8 μ T/A field/current ratio, high frequency
	3-A	X, Y, Z	3-axis with scaling of ~5.8 μ T/A field/current ratio, high frequency
BHC2000	1A-A/B	Y	1 axis with scaling of 25 μ T/A (A) or 14.7 μ T/A (B) field/current ratio
	2A-A/B	X, Y	2-axis with scaling of 25 μ T/A (A) or 14.7 μ T/A (B) field/current ratio
	2B-A/B	Y, Z	2-axis with scaling of 25 μ T/A (A) or 14.7 μ T/A (B) field/current ratio
	3-A/B	X, Y, Z	3-axis with scaling of 25 μ T/A (A) or 14.7 μ T/A (B) field/current ratio

BH1300-A Helmholtz Coils

Each pair of coils generates a homogeneous magnetic field in X, Y or Z axis.

BH1300-A customers may specify the number of axes required. One-axis, two-axis, or three-axis versions are available in any combination (1A, 1B, 2A, 2B, or 3) and may be provided assembled or disassembled.

Specifications

Performance:	X axis	Y axis	Z axis
Field/current ratio	200 μ T/A (2.0 Gauss/A) \pm 1%. Optionally 400 μ T/A or 2 x 100 μ T/A by modifying wiring at the terminal block		
Maximum field	800 μ T (8 Gauss). 2mT (20 Gauss) during 2 minutes		
Maximum current	4A limited by wiring capacity. After about 1 hour at 20A coil temperature stabilises at about 75°C with room temperature 22°C		
Coil homogeneous volume (<1% error)	Spherical 404 mm diameter		
Coil homogeneous volume (<5% error)	Spherical 586 mm diameter		
Orthogonality error	Within \pm 0.2°		
Nominal diameter \pm 1mm	1295mm	1241mm	1187mm
Number of turns (standard configuration)	144	138	132
Secondary field generated by the coil formers when used as coils (Xs, Ys, Zs) \pm 3%	1.39 μ T/A	1.45 μ T/A	1.51 μ T/A

Environmental	
Maximum operating temperature	80°C for the whole set, 100°C for the coils. Maximum 37°C ambient.

Mechanical	BH1300-3-A	BH1300-2A-A	BH1300-2B-A	BH1300-1A-A	BH1300-1B-A
Winding	2+2mm bifilar copper wire				
Coil formers	Aluminium alloy				
Dimensions (W x H x D)	1256 x 1420 x 1309mm				
Weight	77kg	60kg	58kg	41kg	39kg

Electrical	X axis	Y axis	Z axis
DC resistance at 20°C \pm 3% measured at the general terminal block with factory wiring configuration	12.6 Ω	11.6 Ω	10.6 Ω
Self-inductance \pm 5%	160mH	141mH	122mH

BH1300-C Helmholtz Coils

Each pair of coils generates a homogeneous magnetic field in X, Y or Z axis.

BH1300-C customers may specify the number of axes required. One-axis, two-axis, or three-axis versions are available in any combination (1A, 1B, 2A, 2B, or 3) and may be provided assembled or disassembled.

Specifications

Performance:	X axis	Y axis	Z axis
Field/current ratio	50.5 μ T/A (0.505 Gauss/A) \pm 2%. Optionally 101 μ T/A or 2 x 50 μ T/A by modifying wiring at the terminal block		
Maximum field	1.0mT (10 Gauss)		
Maximum current	20A limited by wiring capacity. After about 1 hour at 20A coil temperature stabilises at about 75°C with room temperature 22°C		
Coil homogeneous volume (<1% error)	Spherical 404 mm diameter		
Coil homogeneous volume (<5% error)	Spherical 586 mm diameter		
Orthogonality error	Within \pm 0.2°		
Nominal diameter \pm 1mm	1295mm	1241mm	1187mm
Number of turns (standard configuration)	36	35	33
Secondary field generated by the coil formers when used as coils (Xs, Ys, Zs) \pm 3%	1.39 μ T/A	1.45 μ T/A	1.53 μ T/A

Environmental	
Maximum operating temperature	80°C for the whole set, 100°C for the coils. Maximum 37°C ambient.

Mechanical	BH1300-3-C	BH1300-2A-C	BH1300-2B-C	BH1300-1A-C	BH1300-1B-C
Winding	2+2mm bifilar copper wire				
Coil formers	Aluminium alloy				
Dimensions (W x H x D)	1256 x 1420 x 1309mm				
Weight	73kg	56kg	54kg	37kg	35kg

Electrical	X axis	Y axis	Z axis
Field/current ratio \pm 1%	50.1 μ T/A	50.9 μ T/A	50.1 μ T/A
DC resistance at 20°C \pm 5% measured at the general terminal block with factory wiring configuration	0.84 Ω	0.79 Ω	0.72 Ω
Self-inductance \pm 2%	10.1mH	9.2mH	7.7mH

BH1300HF4-A Helmholtz Coils

The BH1300HF4 is a variant from the standard BH1300, designed to operate at higher frequency than the standard version.

BH1300HF4-A customers may specify the number of axes required. One-axis, two-axis, or three-axis versions are available in any combination (1A, 1B, 2A, 2B, or 3) and may be provided assembled or disassembled.

Specifications

Performance:	X axis	Y axis	Z axis
Field/current ratio	5.8μT/A ±1%		
Maximum DC field steady	112μT	116μT	122μT
Maximum current	20A at 0 - 10kHz, and 10A at 10 - 120kHz		
Coil homogeneous volume (<0.1% error)	Spherical 228mm diameter		
Coil homogeneous volume (<1% error)	Spherical 404mm diameter		
Coil homogeneous volume (<5% error)	Spherical 586mm diameter		
Orthogonality error	<0.2°		
Nominal diameter ±1mm	1290mm	1237mm	1183mm
Number of turns (standard configuration)	4		
Secondary field generated by the coil formers when used as coils (Xs, Ys, Zs) ±3%	1.4μT/A (max. 28μT)	1.5μT/A (max. 30μT)	1.5μT/A (max. 30μT)

Environmental	
Maximum operating temperature	40°C for the whole set. 100°C for the coils

Mechanical	BH1300HF4-3-A	BH1300HF4-2A-A	BH1300HF4-2B-A	BH1300HF4-1A-A	BH1300HF4-1B-A
Winding	Enamelled copper wire of diameter 2.4mm				
Coil formers	Aluminium alloy				
Dimensions (W x H x D)	1256 x 1420 x 1309mm				
Weight	35kg	<35kg	<35kg	<35kg	<35kg

Electrical	X axis	Y axis	Z axis
Field/current ratio ±1%	5.58μT/A	5.81μT/A	6.08μT/A
DC resistance at 20°C ±3% measured at the general terminal block with factory wiring configuration	0.17Ω	0.18Ω	0.19Ω
Self-inductance ±2%	135μH	127μH	122μH

Ferronato Coils Compatibility Table

When using Bartington's Helmholtz Control System (PA1 and CU1), the following field performances can be achieved.

The values given are worst case scenario (i.e. the smallest calculated field which can be generated) and are calculated using the axis with the highest DC resistance and inductance.

All calculations assume the standard factory wiring without the use of the coil formers.

The PA1 DC offset adjustment will apply a DC bias and therefore when used, reduces the current available.

Coil Version:	DC Max Field (Current)	AC 100Hz Max Field (Current)	AC 500Hz Max Field (Current)
BH300-A	~2mT each axis - Max current per axis 4A (coil limited) - Max current delivered by PA1 - ~5A spread across 3 axes	~2mT each axis - Max current per axis 4A (coil limited) - Max current delivered by PA1 - ~6A spread across 3 axes	~800μT each axis - Max current delivered by PA1 - ~1.6A spread across 3 axes
BH300HF-B	~430μT each axis - Max current per axis 8A (coil limited) - Max current delivered by PA1 - ~15A spread across 3 axes	~430μT each axis - Max current per axis 8A (coil limited) - Max current delivered by PA1 - ~28A spread across 3 axes	~430μT each axis - Max current per axis 8A (coil limited) - Max current delivered by PA1 - ~28A spread across 3 axes
BH600-B	~810μT each axis - Max current delivered by PA1 - ~2.7A spread across 3 axes	~600μT each axis - Max current delivered by PA1 - ~2A spread across 3 axes	~120μT each axis - Max current delivered by PA1 - ~0.4A spread across 3 axes
BH1300-A	~400μT each axis - Max current delivered by PA1 - ~2A spread across 3 axes	~100μT each axis - Max current delivered by PA1 - ~0.5A spread across 3 axes	~20μT each axis - Max current delivered by PA1 - ~0.1A spread across 3 axes
BH1300-C	~620μT each axis - Max current delivered by PA1 - ~12.5A spread across 3 axes	~350μT each axis - Max current delivered by PA1 - ~7A spread across 3 axes	~80μT each axis - Max current delivered by PA1 - ~1.7A spread across 3 axes
BH1300HF-A	~100μT each axis - Max current delivered by PA1 - ~18A spread across 3 axes	~110μT each axis - Max current per axis 20A (coil limited) - Max current delivered by PA1 - ~28A spread across 3 axes	~110μT each axis - Max current per axis 20A (coil limited) - Max current delivered by PA1 - ~28A spread across 3 axes
BHC2000-A	~350μT each axis - Max current delivered by PA1 - ~14A spread across 3 axes	~125μT each axis - Max current delivered by PA1 - ~5A spread across 3 axes	~25μT each axis - Max current delivered by PA1 - ~1A spread across 3 axes
BHC2000-B	~130μT each axis - Max current delivered by PA1 - ~9A spread across 3 axes	~161μT each axis - Max current per axis 10A (coil limited) - Max current delivered by PA1 - ~11A spread across 3 axes	~44μT each axis - Max current delivered by PA1 - ~3A spread across 3 axes