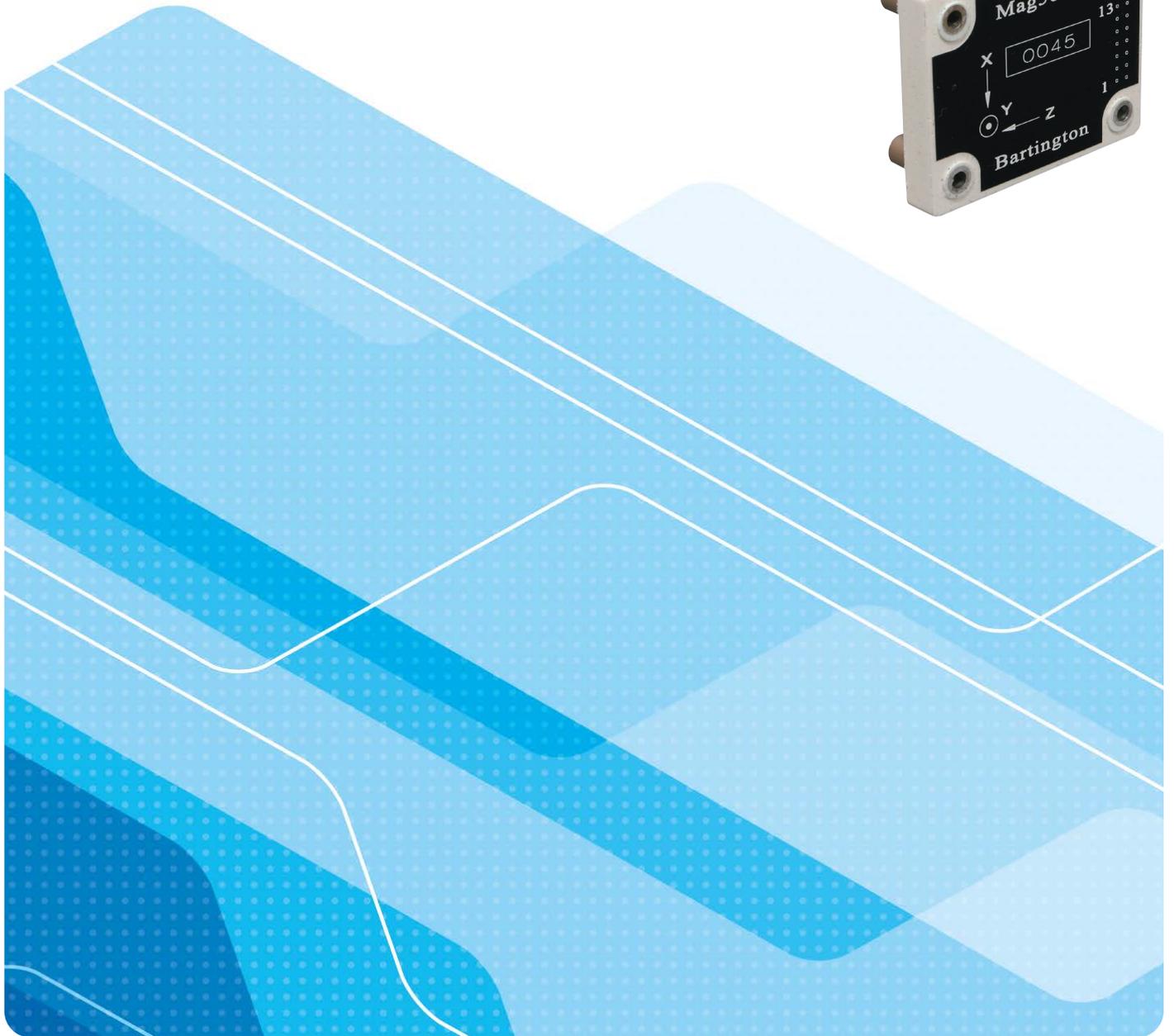


# Mag566

Low Power Three-Axis Magnetometer





## Mag566 Low Power Three-Axis Magnetometer

This low-cost miniature magnetometer comprises a single board assembly with fluxgate sensors and electronic circuitry. The electronics is encapsulated in epoxy resin to provide a high degree of environmental protection, including exposure to increased levels of shock and vibration.

The unit is optimised for low power operation, making it ideal for battery powered applications. It is suitable for use in multi-sensor arrays, with typical applications in vehicle surveillance and orientation control.



## Features

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- Operates from  $\pm 5V$  supply with 20mW power consumption
- Measuring range of  $\pm 100\mu T$
- Bandwidth of 0 to 30-40Hz
- Electronics encapsulated in epoxy resin
- Drop tested in accordance with MIL-STD-810F

## Typical Applications

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- Incorporation in multi-sensor surveillance systems
- Use in remote installations
- Navigation



## Specifications

Performance	
Number of axes	Three
Polarity	+ve non-inverting output when pointing North
Measuring range	$\pm 100\mu\text{T}$
Bandwidth (-3dB)	30-40Hz
Measurement noise floor	$< 1.5\text{nTrms}/\sqrt{\text{Hz}}$ at 1Hz
Scaling	45mV/ $\mu\text{T}$
Scaling temperature coefficient	$\pm 50\text{ppm}/^\circ\text{C}$ ( $\pm 10\%$ )
Offset (in zero field)	$\pm 500\text{nT}$
Offset temperature coefficient	$\pm 0.2\text{nT}/^\circ\text{C}$
Scaling error	$\pm 3\%$
Orthogonality error	$\pm 2^\circ$ maximum
Linearity	$< 50\text{ppm}$
Hysteresis	$< 10\text{nT}$ max/mT external field
Excitation breakthrough	$< 10\text{mV}$ pk-pk, at 5.3-5.7kHz typical
Test response, 0V on test input	$\pm 70$ to $\pm 150\text{nT}$ ( $\pm 10\%$ )

Environmental	
Operating temperature range	$-32^\circ\text{C}$ to $+50^\circ\text{C}$ tested in accordance with MIL-STD-202G
Storage temperature range	$-40^\circ\text{C}$ to $+70^\circ\text{C}$ tested in accordance with MIL-STD-202G
Environmental protection	Resin encapsulation
Transit drop test (in suitable enclosure)	Completed in accordance with MIL-STD-810F method 516.5



Mechanical	
Dimensions (W x H x D)	42 x 20 x 52 ( $\pm 0.5$ )mm
Weight	27g
Enclosure material	Epoxy resin
Connector	14 way, Samtec MTSW-107-08-S-D-340
Mating connector (not supplied)	14 way, Samtec SSM-107-S-DV-LC-P-TR
Mounting	4 x 3.2mm internal diameter chromated aluminium pillars on 40mm x 30mm fixing centres

Electrical	
Supply voltage	$\pm 4.8V$ to $\pm 5.2V$ DC ( $\pm 5.5V$ absolute maximum)
Current consumption	$\pm 2$ ( $\pm 0.4$ )mA quiescent, plus a maximum of 1.5mA/100 $\mu$ T external field
Current surge at power on	$\pm 7-9$ mA (allow 20 seconds for full stability)
Analogue output	$\pm 4.5V$ (unbalanced, single ended ref. 0V)
Output impedance	100 $\Omega$ short circuit protected, drives capacitive loads up to 1 $\mu$ F
Power supply rejection ratio	-60dB
Test input	Active low, 27k $\Omega$ pull-up resistor, over-voltage protection



# Mag613

## Magnetometer Array





## Mag613 Magnetometer Array

The Mag613 is an array of eight miniature three-axis fluxgate sensors, ideal for analysing the magnetic signatures of ship and submarine scaled models.

Each sensor is individually encapsulated in a miniature enclosure, and connected by a 3m cable to the electronics module which contains a power supply, the driving circuitry and an analogue multiplexer. The unit is designed to be used in an oil filled tank at pressures equivalent to 500m depth (50 bar).

The small volume of the sensors enables them to be mounted to achieve high spatial resolution, and crosstalk is suppressed up to 3kHz.



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## Features

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- Range of  $\pm 300\mu\text{T}$  or  $\pm 500\mu\text{T}$
- 6Hz bandwidth
- Test facility allows remote monitoring for fault diagnosis
- Outputs are multiplexed into a single analogue line

## Typical Applications

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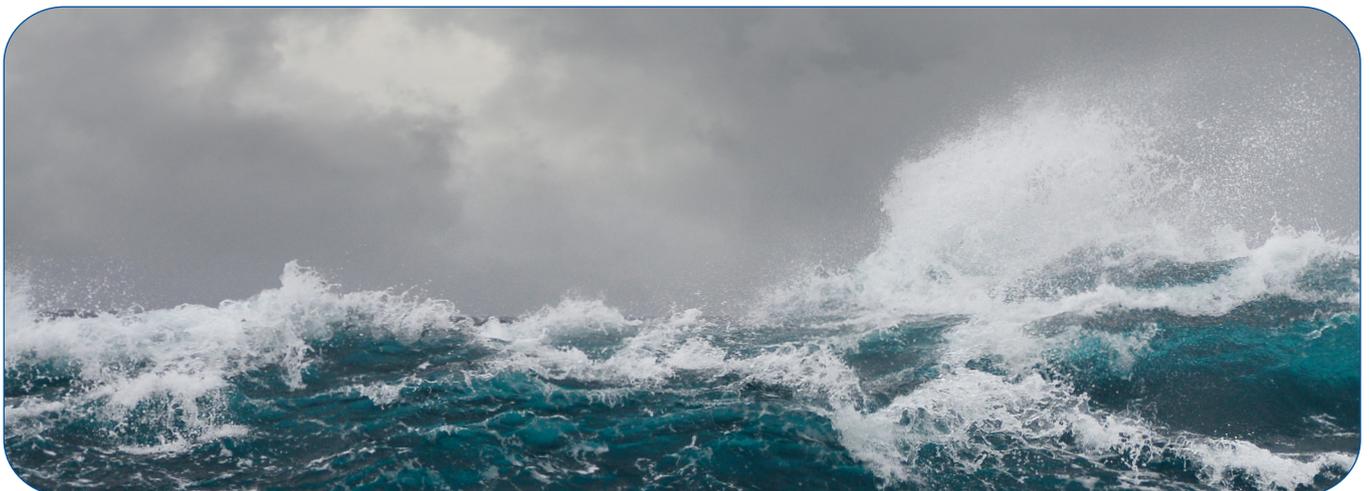
- Simulating closed loop degaussing on scale models
- Magnetic signature analysis during ship design



# Specifications

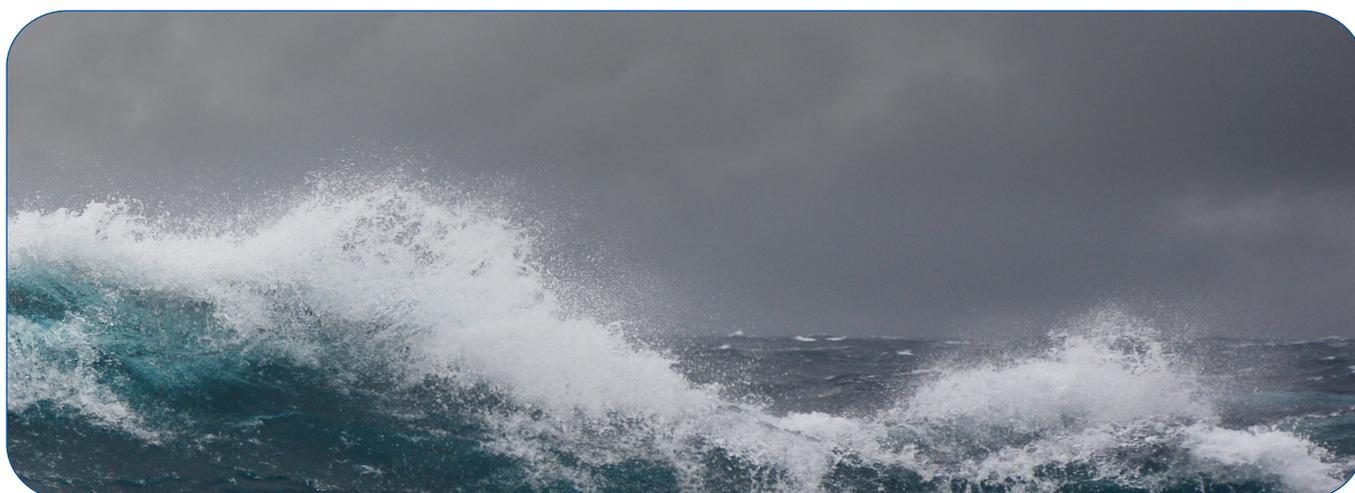
Performance	
Number of axes	24 (3 x 8 - Right Hand XYZ co-ordinate system)
Measuring range	$\pm 300\mu\text{T}$ or $\pm 500\mu\text{T}$
Bandwidth at -3dB (each channel)	>6Hz
Measurement noise floor	$<0.5\text{nTrms}/\sqrt{\text{Hz}}$ at 1Hz
Scaling	33mV/ $\mu\text{T}$ (300 $\mu\text{T}$ ) 20mV/ $\mu\text{T}$ (500 $\mu\text{T}$ )
Scaling temperature coefficient	$<60\text{ppm}/^\circ\text{C}$ ( $\pm 10\text{ppm}/^\circ\text{C}$ )
Offset	$<\pm 250\text{nT}$
Offset temperature coefficient	$\pm 0.1\text{nT}/^\circ\text{C}$
Scaling error	$<\pm 2.5\%$
Orthogonality error	$<3^\circ$
Positional uncertainty	$\pm 0.5\text{mm}$
Offset change with pressure	$\pm 0.25\text{nT}/\text{bar}$ maximum
Monitor voltage for each three axis sensor	400mV ( $\pm 20\text{mV}$ )
Excitation frequency	57.6kHz
Signal frequency	115.2kHz
Sensor active volume	5mm cube

Environmental	
Operating temperature range	$-10^\circ\text{C}$ to $+40^\circ\text{C}$
Storage temperature range	$-40^\circ\text{C}$ to $+50^\circ\text{C}$
Maximum pressure	$<50$ bars (in oil pressure tank)



Mechanical		
	Sensors	Electronics
Dimensions	sensor head WxHxL: 8 x 8 x 15mm cable diameter: 3mm nominal cable length: 3m	WxHxL: 180 x 140 x 21mm
Enclosure material	Epoxy encapsulated PPS GF40	Al. Alloy 5251 with Type II Iridite NCP
Cables	5-way submersible, water-blocked	Interface cable: 10-way screened, water-blocked, length 1m supplied with ends stripped and tinned.
Minimum bend radius	45mm	75mm
Cable material	Viton	
Weight	1.7kg	
Mounting holes	n/a	2 x ø4.5mm - on centreline - 187mm pitch

Electrical	
Power supply	18-24V DC, reverse voltage protected, 1.5kV isolation
Current consumption	1A at 18V, 0.75A at 24V
Signal frequency	115.2kHz
Binary address lines	5 lines TTL and 3V logic compatible, surge protected
Analog output settling time from address change with 10m output cable	400ns + 5ns/m
Short circuit protection	Analog output short circuit and surge protected



# Mag639

Three-Axis Magnetic Field Sensor





## Mag639 Three-Axis Wide Bandwidth Magnetic Field Sensor

This wide bandwidth fluxgate sensor allows for measurements from DC to 12kHz of field strengths up to  $\pm 100\mu\text{T}$ .

Creation of eddy currents is prevented by a non-conductive, cylindrical enclosure. A 2.5m shielded cable removes the sensor connector from the immediate proximity of fluxgates. The three concurrent fluxgate elements minimise the effect of high magnetic field gradients.



## Features

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- Wide bandwidth – DC to 12kHz
- Noise level  $<20\text{pTrms}/\sqrt{\text{Hz}}$  at 1Hz
- $\pm 100\mu\text{T}$  measuring range
- Concurrent axes (single point of intersection)
- Environmentally sealed to IP65

## Typical Applications

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- Time-domain electromagnetics (TDEM)
- Magnetotellurics (MT)
- EMC Interferences measurement
- Unexploded ordnance (UXO) detection



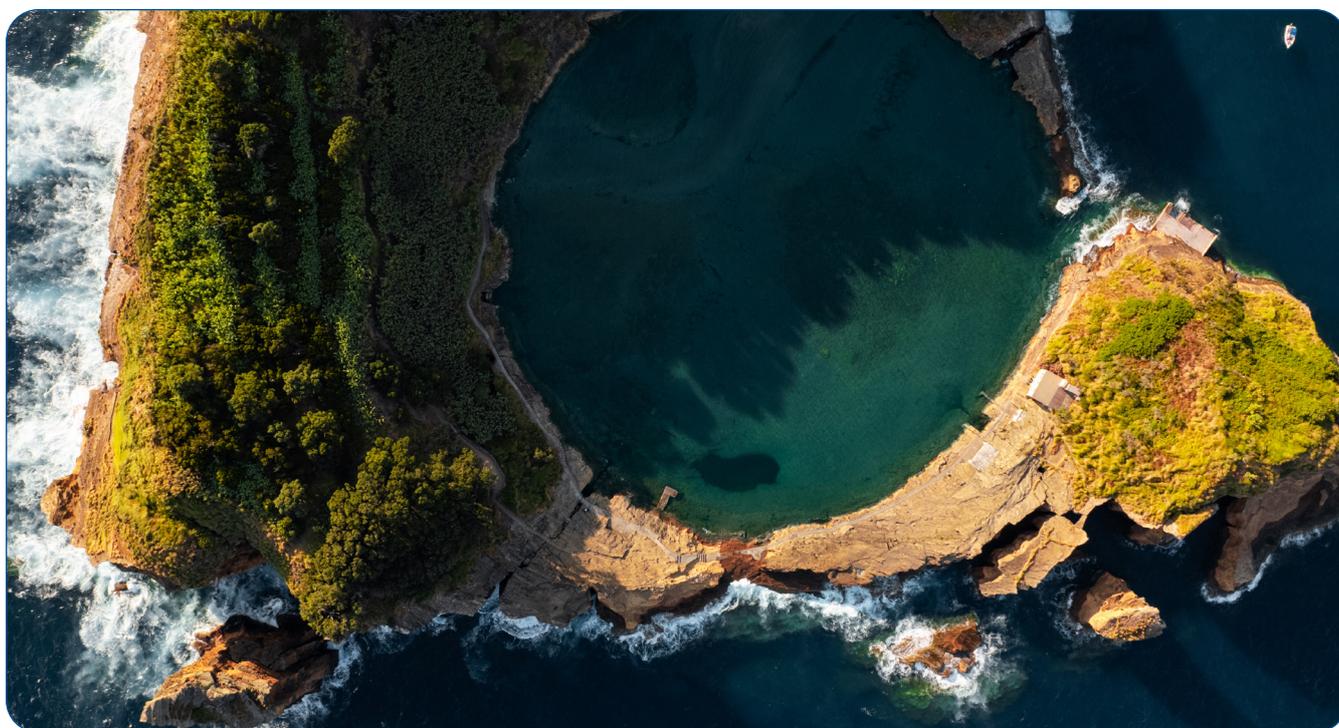
## Specifications

Performance	
Number of Axes	Three
Polarity	+ve non-inverting output when pointing North
Measuring range	$\pm 100\mu\text{T}$
Bandwidth (-3dB)	0 to 12kHz ( $\pm 5\%$ ) (at 50% full scale)
Measurement noise floor	$< 20\text{pTrms}/\sqrt{\text{Hz}}$ at 1Hz
Scaling	100mV/ $\mu\text{T}$
Offset error	$< 50\text{nT}$
Scaling error	$\pm 0.5\%$
Orthogonality error	$< 0.5^\circ$
Roll off (-dB/Octave)	11dB
Frequency response	DC-5kHz ( $\pm 5\%$ )
Hysteresis	$< 5\text{nT}$ at $100\mu\text{T}$
Excitation breakthrough	$< 20\text{mV}$ pk-pk at 31.25kHz typical

Environmental	
Operating temperature	$-20^\circ\text{C}$ to $70^\circ\text{C}$
Environmental protection	IP65

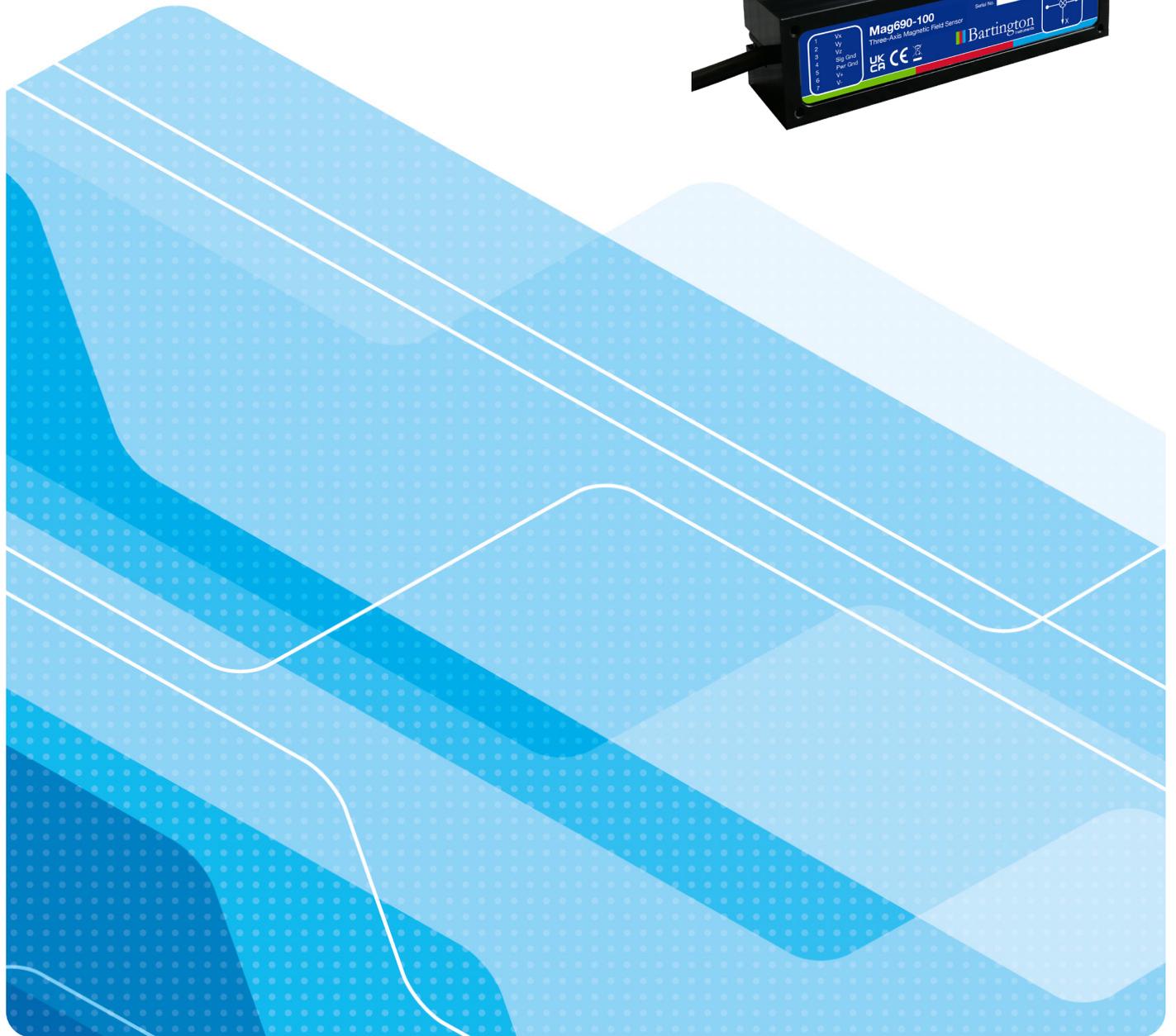
Mechanical	
Dimensions (Ø x L) excluding cable	28.1 x 218mm
Integral cable length	2500mm (Ø 6mm)
Weight	300g
Enclosure	PEEK
Connector	Hirose RM15TRD10S
Mating connector	Hirose RM15TRD10P with 100mm long flying leads (supplied)

Electrical	
Supply Voltage	± 15V to ± 17V
Current Consumption	+59mA, -35mA
Analogue output	±10V (unbalanced, single ended ref. 0V)



# Mag690<sup>®</sup>

Three-Axis Magnetic Field Sensors





## Mag690® Three-Axis Magnetic Field Sensors

These compact and versatile analogue fluxgate sensors provide measurements of static and alternating fields up to 1mT.



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## Features

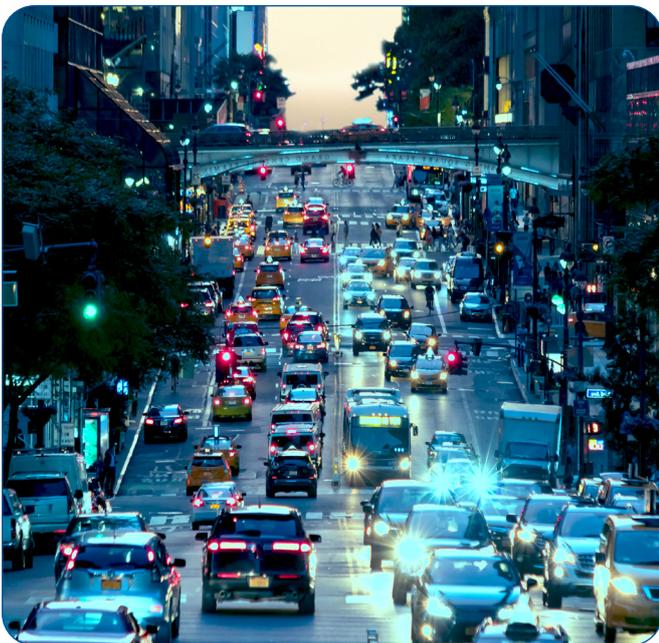
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- Noise  $\leq 25 \text{ pTrms}/\sqrt{\text{Hz}}$  at 1Hz (range dependent)
- Frequency response from DC to 100Hz
- Measuring ranges from  $\pm 100 \mu\text{T}$  to  $\pm 1000 \mu\text{T}$

## Typical Applications

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- Detection of magnetic materials
- Traffic monitoring
- MRI site surveying
- Background field measurement



## Product Identification

Product name	Connector	Range in $\mu\text{T}$
Mag690®	No code = Standard FL = Flying Lead U = Unpackaged	$\pm 100$ $\pm 300$ $\pm 500$ $\pm 1000$

Example: Mag690U-300 is an unpackaged Mag690  $\pm 300\mu\text{T}$  sensor.

## Mag690® Specifications

Performance				
Number of axes	Three (right hand XYZ coordinate system)			
Polarity	+ve non-inverting output when pointing North			
Measuring range	$\pm 100\mu\text{T}$	$\pm 300\mu\text{T}$	$\pm 500\mu\text{T}$	$\pm 1000\mu\text{T}$
Scaling	100mV/ $\mu\text{T}$	33mV/ $\mu\text{T}$	20mV/ $\mu\text{T}$	10mV/ $\mu\text{T}$
Linearity error	0.01% (least squares fit)			
Frequency response	DC to 100Hz, maximum flat response ( $\pm 5\%$ )			
Bandwidth (-3dB)	>1.5kHz			
Noise	>10 - $\leq 25\text{pTrms}/\sqrt{\text{Hz}}$ at 1Hz		>10 - $\leq 35\text{pTrms}/\sqrt{\text{Hz}}$ at 1Hz	>10 - $\leq 40\text{pTrms}/\sqrt{\text{Hz}}$ at 1Hz
Zero field offset	$\pm 100\text{nT}$	$\pm 250\text{nT}$	$\pm 250\text{nT}$	$\pm 500\text{nT}$
Offset temperature coefficient	$\pm 2\text{nT}/^\circ\text{C}$	$\pm 5\text{nT}/^\circ\text{C}$	$\pm 5\text{nT}/^\circ\text{C}$	$\pm 10\text{nT}/^\circ\text{C}$
Perming (Magnetisation Hysteresis)	<2nT for exposure to up to 2 x full scale			
Orthogonality error between axes	<1°			
Alignment to datum face/s	<2°			
Excitation Breakthrough	<10mV pk-pk at 15.625kHz typical			
Start-up/Settling time	150ms			
Warm-up drift time	15mins			

Environmental	Mag690®	Mag690FL	Mag690U
Operating temperature range	-20°C to +70°C		
Storage temperature range	-20°C to +70°C		
IP Rating	IP67	IP67 (excluding connector)	N/A
Compliance	EMC BS EN 61326 & RoHS		

Mechanical	Mag690®	Mag690-FL	Mag690U
Enclosure material	Black acetal and polyurethane potting compound		FR4 PCB Material
Dimensions	32 x 32 x 122mm	32 x 32 x 122mm	26 x 22 x 94mm
Weight	220g	200g	20g
Connectors	Binder 99 9125 60 08 on 500mm lead	Flying leads 7x0.22mm <sup>2</sup>	AMP 3-640456-7
Mating connectors	Binder 99 9126 60 08	N/A	AMP 3-640441-7
Cable bending radius	41mm	41mm	N/A
Mounting arrangement	4 x M2.5 tapped holes	4 x M2.5 tapped holes	2 x M2.5 on coil block

Electrical	
Supply voltage	±12V to ±17V DC
Current consumption	+44mA, -20mA (+1.5mA/100µT on each axis)
Power-on surge	+200mA at +12V, -40mA at -12V
Analogue output	±10V (unbalanced, single ended ref. 0V)
Output impedance	10Ω
Maximum load capacitance	<1µF
Maximum cable length	1.5km (±12V at the pins)

## Power Supplies

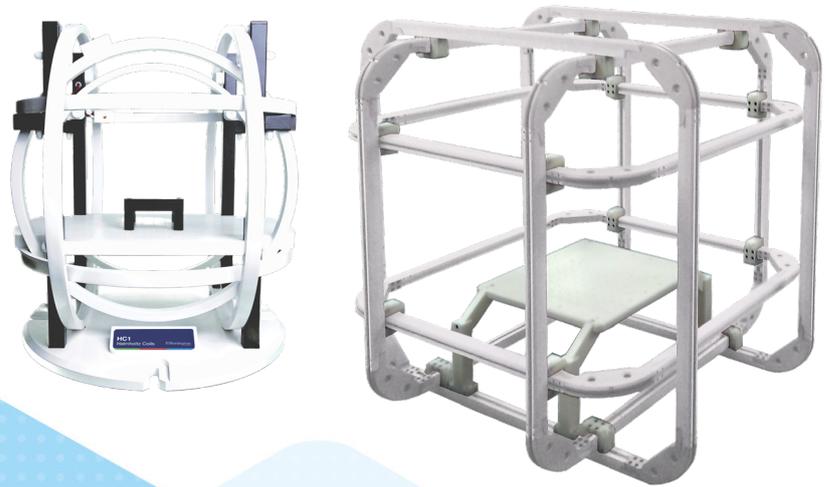
The Mag690® range is compatible with the following data acquisition and power supply units from Bartington Instruments:

- PSU1 Power Supply Unit
- DecaPSU Power Supply Unit (adaptor cable required)
- Magmeter-2 Power Supply and Display Unit
- Spectramag-6 Data Acquisition Unit
- SCU1 Signal Conditioning Unit

## Accessories

	Mag690®	Mag690-FL	Mag690U
Cables	Optional extra	N/A	Optional extra
Mating connectors	Not supplied	N/A	Not supplied

# Helmholtz Coil Systems





## HC1<sup>®</sup>, HC2<sup>®</sup> & HC16 Helmholtz Coil Systems

These Helmholtz Coils are used in the calibration of magnetic field sensors, or for conducting any test or experiment requiring a known magnetic environment.

The coils are available with nominal diameters of 350mm (HC16), 500mm (HC1<sup>®</sup>) or 1m (HC2<sup>®</sup>). They can be supplied on their own, or together with our Power Amplifier (PA1) and Control Unit (CU1).

The CU2 Module allows for closed-loop compensation to take place for improved field stability.

A compatible National Instruments acquisition card enabling software control is also available.

A range of Ferronato Helmholtz Coils with 1.3 and 2m diameters are also available. These are compatible with the control system described in this brochure.

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HC2 is a registered trade mark of Bartington Holdings Limited in the following territories: European Union, United Kingdom, and United States of America.

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## Features

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- PA1 Power Amplifier provides power and offers DC offset compensation
- CU1 interfaces the PA1 to a National Instruments™ acquisition card
- CU2 provides closed-loop control for cancellation of DC and AC field variations
- Mounting table available
- HC2® coils provided in flat-pack assembly to facilitate freight and installation

## Typical Applications

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- Calibration of three-axis magnetic field sensors
- Creation of a known magnetic environment

## Product Identification

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Product name	Code	Item
HC1®	-3	Three-axis Helmholtz Coil 500mm nominal diameter: 3 pairs of coils
HC2®	n/a	Three-axis Helmholtz Coil 1m nominal diameter: 3 pairs of coils
HC16	n/a	Three-axis Helmholtz Coil 350mm nominal diameter: 3 pairs of coils on plastic coil formers
PA1	-3	Power Amplifier for HC1®-3, HC2® or HC16
CU1	n/a	Control Unit for PA1
CU2	n/a	Closed-Loop Module supplied with CU2 Reference Magnetometer

## HC1<sup>®</sup> Helmholtz Coils

A 500mm nominal diameter 3-axis Helmholtz coil compatible with CU1 and PA1.

Each pair of coils generates a homogeneous magnetic field in one specific axis: X, Y or Z. The coils can be calibrated to add or subtract from distortions in the Earth's magnetic field.



## Specifications

Performance	
Number of axes	3
Parallelism	<1°
Orthogonality error	<0.1° (electronic adjustment possible to <0.05° with PA1)
Maximum field (DC, X-axis) - continuous	706µT
Coil homogeneous area (<0.1% error)	8cm diameter sphere
Coil homogeneous area (<1% error)	15cm diameter sphere

Environmental	
Operating temperature range	+15°C to +30°C
Storage temperature	+10°C to +40°C

Mechanical	X	Y	Z
Coil Effective Diameter	507mm $\pm$ 1mm	560mm $\pm$ 1mm	618mm $\pm$ 1mm
Dimensions	674mm H x 584mm W x 642mm D		
Coil maximum aperture	280 x 220mm		
Weight	43kg		
Coil construction material	Plastic coil former		
Optional accessories	Bartington sensor mounting adaptors		

Electrical	X	Y	Z
Field/Current Ratio	35.3 $\mu$ T/A $\pm$ 4%	32.2 $\mu$ T/A $\pm$ 4%	29.1 $\mu$ T/A $\pm$ 4%
DC resistance per axis (with harness)	<0.2 $\Omega$	<0.2 $\Omega$	<0.2 $\Omega$
Number of turns (per coil)	10	10	10
Inductance per axis	TBC	TBC	TBC
Inductance per coil	112 $\mu$ H $\pm$ 5%	127 $\mu$ H $\pm$ 5%	143 $\mu$ H $\pm$ 5%
Coil Maximum current - continuous	20A		
Harness Connectors	Neutrik Speakon 8-Way NL-8-FC		

## HC2<sup>®</sup> Helmholtz Coils

A 1000mm nominal diameter, square profile, 3-axis Helmholtz coil compatible with CU1 and PA1.

Each pair of coils generates a homogeneous magnetic field in one specific axis: X, Y or Z. The coils can be calibrated to add or subtract from distortions in the Earth's magnetic field.

The HC2<sup>®</sup> coils are provided in flat-pack form for assembly at the customer's convenience.



## Specifications

Performance	
Number of axes	3
Parallelism	<±1°
Orthogonality error	<0.1° (electronic adjustment possible to <0.05° with PA1)
Maximum field (DC, Y-axis) - continuous	446µT
Coil homogeneous area (<0.1% error)	13.6cm cube
Coil homogeneous area (<1% error)	24cm cube

Environmental	
Operating temperature range	+15°C to +30°C
Storage temperature	+10°C to +40°C

Mechanical	X	Y	Z
Coil Effective Diameter (Square – edge to edge)	1120mm $\pm$ 1mm	1030mm $\pm$ 1mm	1210mm $\pm$ 1mm
Dimensions	1226mm H x 1136mm W x 1226mm D		
Coil maximum aperture	620 x 550mm		
Weight	130kg		

Electrical	X	Y	Z
Field/Current Ratio	20.5 $\mu$ T/A $\pm$ 4%	22.3 $\mu$ T/A $\pm$ 4%	19 $\mu$ T/A $\pm$ 4%
DC resistance per axis (with harness)	0.4 $\Omega$ $\pm$ 4%	0.36 $\Omega$ $\pm$ 4%	0.44 $\Omega$ $\pm$ 4%
Number of turns (per coil)	14	14	14
Inductance per axis	TBC	TBC	TBC
Inductance per coil	812 $\mu$ H $\pm$ 5%	730 $\mu$ H $\pm$ 5%	892 $\mu$ H $\pm$ 5%
Coil Maximum current - continuous	20A		
Coil Connectors	Neutrik Speakon 4-Way NL-4-MP		
Harness Connectors	Neutrik Speakon 8-Way NL-8-FC Neutrik Speakon 4-Way NL-4-FC (6 off)		

## HC16 Helmholtz Coils

A 270-370mm nominal diameter 3-axis Helmholtz coil compatible with CU1 and PA1.

Each pair of coils generates a homogeneous magnetic field in one specific axis: X, Y or Z. The coils can be calibrated to add or subtract from distortions in the Earth's magnetic field.



## Specifications

Performance	
Number of axes	3
Parallelism	$<\pm 1^\circ$
Orthogonality error	$<0.1^\circ$ (electronic adjustment possible to $<0.05^\circ$ with PA1)
Maximum field (DC, Z-axis) - continuous	2.8mT
Coil homogeneous area ( $<0.1\%$ error)	40mm diameter sphere
Coil homogeneous area ( $<1\%$ error)	65cm diameter sphere
Coil homogeneous area ( $<5\%$ error)	100mm diameter sphere

Environmental	
Operating temperature range	+15°C to +50°C
Storage temperature	0°C to +50°C

Mechanical	X	Y	Z
Coil Effective Diameter	368.5mm $\pm$ 0.5mm	320.5mm $\pm$ 0.5mm	273.5mm $\pm$ 0.5mm
Dimensions	403mm H x 380mm W x 342mm D		
Coil maximum aperture	140 x 134mm		
Weight	10kg		
Coil construction material	Plastic coil former		

Electrical	X	Y	Z
Field/Current Ratio	106 $\mu$ T/A $\pm$ 4%	122 $\mu$ T/A $\pm$ 4%	144 $\mu$ T/A $\pm$ 4%
DC resistance per axis (with harness)	0.158 $\Omega$ $\pm$ 4%	0.138 $\Omega$ $\pm$ 4%	0.114 $\Omega$ $\pm$ 4%
Number of turns (per coil)	22	22	22
Inductance per axis	900 $\mu$ H $\pm$ 5%	760 $\mu$ H $\pm$ 5%	615 $\mu$ H $\pm$ 5%
Coil Maximum current - continuous	20A		
Coil Connectors	4mm sockets		
Harness Connector	Neutrik Speakon 8-Way NL-8-FC & 4mm Plugs		

## PA1 Power Amplifier

This unit supplies the necessary current to the Helmholtz coil assemblies in order to generate the required magnetic field. It also applies a DC offset current to the coils, typically used to cancel the ambient magnetic field.

Additional electronic adjustment of the scaling and orthogonality enables the generation of high precision magnetic field with excellent orthogonality accuracy.

The PA1 runs from a standard mains AC supply. The amplifier is fan-cooled with a self-resetting thermal shut-down mechanism to prevent damage through overheating.



## Specifications

Environmental	
Operating temperature range	+15°C to +30°C
Storage temperature	+10°C to +40°C
Operating humidity	Up to 90% RH non-condensing
Usable locations	Indoor use only
Maximum operating altitude	2000m
Pollution degree	Pollution Degree 2

Mechanical	
Enclosure dimensions	6U 19in rack mount box Height: 27cm Width: 51cm Depth: 60cm
Enclosure gross weight	50kg

## Electrical

Input connector	Hirose RM15TRD-10S
Coils output connector	Neutrik NLT8MPXX Speakon 8 poles
Current monitor output connector	Hirose RM15TRD-10P
Power requirement	100V–240V AC, 50/60Hz permanent installation
Maximum power consumed	1.5kW
Mains supply voltage fluctuation	±10% max
Overvoltage category	OVC II
Control input (maximum voltage)	±10V
Current monitor output (maximum voltage)	±15V
Coil drive output (minimum voltage)	±25V (no load)
Maximum total output current to Helmholtz coils	29A (maximum 20A per axis)
Output impedance per individual axis	1.35Ω

## CU1 Control Unit

This unit is an interface between the PA1 and a National Instruments™ based control system. The signal required to generate the field is routed through the CU1.

The CU1 also provides power to two sensors, with signals from these and the current monitor, filtered and sent to the National Instruments™ system.



## Specifications

Functionality		
Magnetometer / auxiliary sensing	Description	Two separate inputs compatible with most Bartington magnetometers with up to 3 axes, differential or single-ended output, dual or single rail
	Analogue input	Up to $\pm 10V$ differential or single-ended
	Input filter	Type Butterworth 2-pole 12dB per octave low pass Frequencies (software selectable): 10kHz, 1kHz, 100Hz & 10Hz
	Supply output: Magnetometer	0 to $\pm 20V$ programmable, limited to 100mA (compatible with single or dual supply devices)
	Auxiliary	$\pm 15V$ limited to 50mA per sensor channel. Power output protected by self-resetting semiconductor fuses
	Connector	Hirose RM15TRD-10P (front panel)
	Mating connector	Hirose RM15TRD-10S (supplied on request)
Maximum cable length	10m <sup>1</sup>	
Current sense	Description	Up to three axes connected to current sense output on Helmholtz drive amplifier
	Analogue input	Up to $\pm 10V$ differential
	Input filter	Type Butterworth 2-pole 12dB per octave low pass Frequencies (software selectable): 10kHz, 1kHz, 100Hz & 10Hz
	Connector	Hirose RM15TRD-10P (front panel)
	Mating connector	Hirose RM15TRD-10S (supplied on request)
	Maximum cable length	3m <sup>1</sup>

Output to PA1 Power Amplifier	Description	Up to three axes connected to Helmholtz drive amplifier
	Analogue output	±10V differential
	Connector	Hirose RM15TRD-10S (front panel)
	Mating connector	Hirose RM15TRD-10P (supplied on request)
	Maximum cable length	3m*
NI DAQ interface	Description	Two separate interfaces for NI DAQ card
	Connector	2 x 68-way Harting 6001 068 5232
	Mating cable	NI cable SHC68-68EPM
	Maximum cable length	3m <sup>1</sup>

\*This is to ensure compliance with FCC and CE regulatory approvals.

Environmental	
Operating temperature range	+10°C to +30°C
Operating humidity	0 to 90% RH non-condensing
Storage temperature	+10°C to +40°C
Usable locations	Indoor use only
Maximum operating altitude	2000m
Pollution degree	Pollution Degree 2

Mechanical	
Dimensions	The CU1 conforms to the standard 19-inch rack mount specification and is 1U high
Weight	2.4kg

Electrical	
Power supply voltage	100–240V AC 50/60Hz
Power supply current	1100mA (115V) / 640mA (230V) type
Mains supply voltage fluctuation	±10% max
Overvoltage Category	OVC II
Power input (rear panel)	3-way IEC 320 with integral filter (mains cable provided)
Working common mode input voltage	±10V
Absolute maximum input voltage	±15V on any input pin
ESD Protection	±15V on any input pin Comprehensive ESD surge protection on input and output channels for ESD protection

## CU2 Closed-Loop Module

The CU2 Closed-Loop Module, supplied with a dedicated Reference Magnetometer, provides active compensation for external DC and AC magnetic field variations. This module is only compatible with 3-axis coils.



## Specifications

Functionality when used with CU1 and PA1	
DC disturbance field attenuation	-46dB $\pm$ 1dB
AC Disturbance Field Attenuation @ 50Hz: HC1, HC2, HC16, BH1300-3-C & BH1300HF-4-3-A BH1300-3-C	-34dB $\pm$ 1dB -24dB $\pm$ 2dB
AC Disturbance Field Attenuation @ 60Hz: HC1, HC2, HC16, BH1300-3-C & BH1300HF-4-3-A BH1300-3-C	-32dB $\pm$ 1dB -22dB $\pm$ 2dB
Zero field DC drift over 6 hours	<10nT
System noise	<3nT peak to peak
Bandwidth: HC1, HC2, HC16, BH1300-3-C & BH1300HF-4-3-A BH1300-3-C	DC to 12Hz -3dB, one pole LPF DC to 4Hz -3dB, one pole LPF
Reference magnetometer range	$\pm$ 500 $\mu$ T
Reference magnetometer scaling	20mV/ $\mu$ T ( $\pm$ 10V full scale)
Maximum field per axis	< $\pm$ 500 $\mu$ T (applied and disturbing field combined)
Warm-up time	30min
Orthogonality error adjustment range	$\pm$ 1° nominal
Gain adjustment range	$\pm$ 10% nominal
Offset adjustment range	$\pm$ 800nT nominal

Environmental	
Operating temperature range	+10°C to +50°C
Operating humidity	0 to 50% RH non-condensing
Storage temperature	-40°C to +85°C
IP Rating	IP20

Mechanical	CU2 Module	CU2 Reference Magnetometer
Dimensions (W x H x L)	106.1 x 57.6 x 143.8mm	25 x 23.4 x 73mm (excluding cable)
Weight	430g	320g (approximate)
Mounting	N/A	4 x M2.5 tapped holes, centres are 67 x 18 mm
Mounting accuracy relative to Helmholtz Coils	N/A	$<\pm 10^\circ$

Electrical	
Power supply voltage	$\pm 15V$ DC from the CU1 Auxiliary
Power supply current	$<50mA$ in zero field
Working common mode input voltage	$\pm 10V$
Absolute maximum input voltage	$\pm 15V$ on any input pin

Connections	Reference Magnetometer	Auxiliary Connection	Current Control Input	Current Control Output
Analogue Input/output	Excitation signal outputs and Detection coil inputs	$\pm 10V$ single-ended output (Reference Magnetometer signal)	$\pm 10V$ differential input	$\pm 10V$ differential output
Connector	Hirose RM15TRD-10P		Hirose RM15TRD-10S	
Maximum cable length	10m	1m	1m	1m

## Control System Components

In order to control the Helmholtz Coil system from a PC, a suitable National Instruments™ acquisition card can be supplied. This connects to the CU1, and enables a user to control the field generated using the supplied control software.

Signals from the Device Under Test and Auxiliary sensor are also digitised by the acquisition card.

Standalone suitable acquisition cards include the USB-6363.

## Compatibility

Combination	HC1® with PA1	HC2® with PA1	HC16 with PA1
Maximum field DC single axis*	>±500µT	>±250µT	>±1mT
Corner frequency	100Hz	20Hz	>100Hz
Maximum field at AC (single axis)*	>±100µT at 3kHz	>±100µT at 300Hz	>±100µT at 5kHz
DC field compensation	>±80µT	>±45µT	>±80µT

\* Axis dependent, stated for larger coil. Smaller coils can achieve approximately 20% higher fields.

HC16 additional PA1 compatibility information	
Max DC Field (all axes simultaneously driven)	1mT (target)
Max AC Field (all axes simultaneously driven)	1mT Peak <440 Hz (target)
Maximum frequency	5kHz
Field at maximum frequency (per axis, all axes simultaneously driven – value for largest diameter axis, other axes are higher)	110 µT Peak

## Accessories

### Sensor for Helmholtz Coil Setup and Recalibration

A sensor is required to complete the setup procedure of the Helmholtz Coil at the customer location. Bartington recommends the use of the Mag-13MS and associated mounting accessories. This equipment will allow for final checks and adjustments after installation of the coils, together with periodical calibration.

### Sensor Mounting Accessories

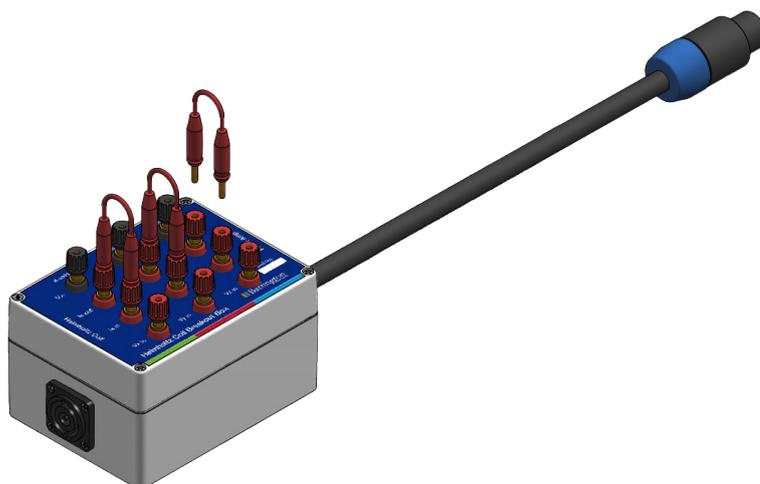
Bartington offers a range of mounting accessories for positioning of Bartington sensors within the centre of the homogeneous volume.

HC1<sup>®</sup> and HC2<sup>®</sup> coils are supplied with mounting tables. HC16 coils are supplied with mounting tables or pillars. These make it possible to bring test jigs to the centre of the coil.

### Helmholtz Coil Breakout Box

A Helmholtz Coil Breakout box can be supplied for monitoring the voltage and current between the HC1<sup>®</sup>, HC2<sup>®</sup> or HC16 and a PA1 on each axis.

The box enables straightforward testing and real-time monitoring of the system.



# Mag629

Aerospace Three-Axis Magnetometer





## Mag629 Aerospace Three-Axis Magnetometer

This low noise fluxgate magnetometer is designed specifically to meet the exacting environmental requirements of aerospace applications.

The magnetometer has two-part construction, consisting of a sensor head assembly and packaged electronics.

With a full-scale range of  $\pm 75\mu\text{T}$  and low noise characteristics, this sensor is ideally suited to applications such as vector compensation in airborne magnetometry.

The three sensor axes are arranged to have a common point of intersection (concurrent), clearly defining the centre of measurement of the magnetic field being examined. The sensing head has an integral cable.



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## Features

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- Designed to MIL-STD-810 (environmental) and MIL-STD-461E (EMC/EMI) for integration into airborne platforms
- $\pm 75\mu\text{T}$  full-scale range
- Concurrent sensing axes

## Typical Applications

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- Magnetic Anomaly Detection
- Navigation
- Vector compensation in airborne magnetometry



## Product Identification

The Mag629 can be specified as follows:

Product Name	Package	Noise	Range in $\mu\text{T}$
Mag629	No code = Standard	No code = Standard noise	No code = $\pm 75\mu\text{T}$

## Mag629 Specifications

Performance	
Number of axes	Three
Polarity	+ve when pointing North
Full Scale Measuring Range	$\pm 75\mu\text{T}$
Bandwidth at -3dB	1.1 to 1.3kHz
Scale factor	7.5nT/mV
Scaling Calibration Error	$\pm 0.75\%$
Scaling Temperature Coefficient	$< 0.007\%$ of full scale/ $^{\circ}\text{C}$
Linearity Error	$< 0.0015\%$ of full scale at any point
Frequency Response	$\pm 1\%$ DC to 100Hz
Bandwidth at -3dB	1.1 to 1.3kHz
Noise	$< 8\text{pTrms}/\sqrt{\text{Hz}}$ at 1Hz
Zero Field Offset	$\pm 40\text{nT}$
Offset Temperature Coefficient	$< 0.6\text{nT}/^{\circ}\text{C}$
Orthogonality error between axes	$< 1^{\circ}$
Excitation Breakthrough	$< 20\text{mV}$ pk-pk at 15.625kHz typ.
Sensor head magnetic signature	$< 4\text{nT}$ at 25mm
MTBF (MIL-HDBK-217F)	110,000 hours

Environmental	
Operating temperature range	-40°C to +55°C continuous, up to +71°C intermittent (5 mins ON, 15 mins OFF)
Storage temperature range	-62°C to +85°C
IP Rating Sensor head Electronics assembly	IP68 IP68
High temperature storage	Tested at +85°C
Low temperature storage	Tested at -62°C
Temperature shock	MIL-STD-202G Method 107, Test Condition A-1
Functional vibration	MIL-STD-810F Method 514.5
Endurance vibration	Five-hour duration on each axis
Functional shock	MIL-STD-810C Method 516.2
Altitude and air pressure	Tested from sea level to 50,000 ft
Fungus mould growth	MIL-STD-810F Method 508.5
Dust	MIL-STD-810C Method 510.1
Humidity	MIL-STD-810F Method 507.4 Procedure I (Aggravated)
Salt fog atmosphere	MIL-STD-810F Method 509.4
Acoustic noise	MIL-STD-810F Method 515.5
EMC/EMI	MIL-STD-461E



## Mag629 Aerospace Three-Axis Magnetometer

Mechanical	
Construction	2-part assembly with separate sensor head and electronics
Enclosure Material – Sensor Head	PEEK
Enclosure Material - Electronics	Aluminium Alloy
Dimensions – Sensor Head	31 x 40 x 40mm
Dimensions – Electronics	165 x 42 x 43.4mm
Cable length	1.0m
Weight – Sensor Head	171g
Weight – Electronics	202g
Connectors – Sensor Head	Amphenol D3899926WC98PN
Connectors - Electronics	Amphenol D3899924WC98SN & Amphenol D3899924WC98PA
Mounting Arrangements	See Interface Control Drawing



## Electrical

Supply voltage	+28V ( $\pm 10\%$ )
Current Consumption – Positive	+51mA ( $\pm 3\text{mA}$ )
Current Consumption – Negative	N/A
Analogue Output	$\pm 10\text{V} = \pm 75\mu\text{T}$ (unbalanced, single ended ref. 0V)
Monitor test signal (BIT)	Open-drain output with 10mA sink capacity if magnetometer internal fault or unpowered; open circuit when operating correctly



# Mag-13<sup>®</sup>

Three-Axis Magnetic Field Sensors





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## Mag-13® Three-Axis Magnetic Field Sensors

The Mag-13 range of sensors provide high precision measurements of static and alternating magnetic fields. Different combinations of noise level, measuring range, and a range of enclosures, make the sensors suitable for use in many applications. These include defence, physics, geophysics, bioelectromagnetics and mineral exploration.



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Mag-13 is a registered trade mark of Bartington Holdings Limited in the following territories: European Union, United Kingdom, and United States of America.

## Features

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- Wide range of enclosures; unpackaged and submersible versions available
- Noise levels down to  $<5\text{pT}_{\text{rms}}/\sqrt{\text{Hz}}$  at 1Hz
- Measuring ranges from  $\pm 70\mu\text{T}$  to  $\pm 1000\mu\text{T}$
- Bandwidth of up to 3kHz
- Environmentally sealed and shielded from electrical interference

## Typical Applications

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- Magnetic field monitoring
- Use as feedback sensors in active magnetic field cancellation systems
- Magnetic signature measurements
- Electromagnetic surveys



## Product Identification

Product name	Package	Noise	Range in $\mu\text{T}$
Mag-13	MC = Circular enclosure MS = Square enclosure MCD = Deep submersible circular enclosure U = Unpackaged U-TPU = Unpackaged 2-part MSS = Submersible square enclosure	No code = Standard noise L = Low noise Q = Very low noise	70 = $\pm 70\mu\text{T}$ 100 = $\pm 100\mu\text{T}$ 250 = $\pm 250\mu\text{T}$ 500 = $\pm 500\mu\text{T}$ 1000 = $\pm 1000\mu\text{T}$

Example: Mag-13U-TPUL100 = A low noise unpackaged 2-part Mag-13 with a measuring range of  $\pm 100\mu\text{T}$ .

Sensors with ranges  $\geq 250\mu\text{T}$  are only available in standard noise option.



# Mag-13<sup>®</sup> Specifications

Performance					
Number of axes	Three				
Polarity	+ve when pointing North				
Full Scale Measuring Ranges	±70µT	±100µT	±250µT	±500µT	±1000µT
Scaling	143mV/µT	100mV/µT	40mV/µT	20mV/µT	10mV/µT
Scaling error	±0.5%				
Scaling Temperature Coefficient	<±60ppm				
Linearity error	0.0015% (least squares fit)				
Frequency response at 50µT peak	DC to 1kHz (±5%)				
Max Bandwidth at 50µT peak	3400Hz	3100Hz	3000Hz	3000Hz	3000Hz
Max Bandwidth at full scale	3000Hz	2500Hz	1100Hz	700Hz	300Hz
Primary Resistance	10Ω ±1.5Ω				
Primary Inductance	1000µH typical				
Secondary Resistance	36Ω ±4Ω				
Secondary Inductance	5600µH typical				
Noise: Standard Low noise (L) Very low noise (Q)	≤10pT rms / √Hz @1Hz <6pT rms / √Hz @1Hz (70 and 100µT range only) <5pTrms/√Hz at 1Hz (70 and 100µT range only)				
Zero Field Offset	≤±30nT			≤±40nT	≤±50nT
Offset Temperature Coefficient	≤±0.6nT/°C			≤±1nT/°C	
Perming (Magnetisation Hysteresis)	<2nT (at 1 x Full-scale, when powered)				
Orthogonality error between axes	<±0.1° (<±0.2° for MCD)				
Alignment to datum face/s	<±0.1° (Mag-13MS only)				
Excitation Breakthrough	<5mV pk-pk 15.625kHz typical				
Start-up/Settling time	<100ms				
Warm-up drift time	15 minutes to meet specifications for scaling <60 minutes to meet specifications for noise				

Electrical	
Supply Voltage	±12 to 17V
Current Consumption – Positive	35 to 41mA in zero-field
Current Consumption – Negative	13 to 17mA in zero-field
Power Supply Rejection Ratio	120dB
Power-on Surge	+90mA, -25mA, 20ms
Analogue Output	±10V
Output Impedance	10Ω
Test function field in each axis	-1µT ±10%
Maximum cable length	1.5km

## Mag-13<sup>®</sup> Three-Axis Magnetic Field Sensors

### Environmental

Operating temperature range	-40 to +70°C
Storage temperature range	-40 to +70°C
Compliance (CE, etc.)	EMC BS EN 61326 & RoHS
Additional environmental qualifications	Mag-13MCD 550bar hydrostatic pressure test
Environmental protection / sealing	
MC	IP67
MS	IP67
MCD	IP68 (5000m)
U	N/A (unpackaged)
U-TPU	N/A (unpackaged)
MSS	IP68 (200m)

### Mechanical

Package options	Cylindrical (MC)	Square (MS)	Square Submersible (MSS)	Cylindrical Deep Submersible (MCD)	Unpackaged (U)	Unpackaged 2-part (U-TPU)
Dimensions	Ø 25.4 x 203mm	32 x 32 x 203mm	30 x 30 x 251mm	Ø 60 x 301mm	Ø 23.2 x 150mm	Probe: Ø23.2 x 43mm Electronics: 19.5 x 129mm Harness length max 5m
Weight	82.5g	222.6g	300g	950g	23.5g	157g (max cable length)
Enclosure material	Acetal & PEEK	Acetal	Acetal	PEEK	n/a	n/a
Connector	Fischer AL-1731-DEU-1031-A010-SR-11-11-G-12		SubConn MCBH10FNM (under-water mateable)	SubConn MCB-H10F (under-water mateable)	Molex 53047-0810	Molex 53047-0810
Mating connector	Fischer AL1731-S-1031-A010SR11-11 with E3-1031.2/6.2		SubConn MCOM10M or MCIL10M (underwater mateable)		Molex Pico-blade 51021-0800	Molex Pico-blade 51021-0800

### MTBF

MTBF – MIL-HDBK-217F:	
Ground Fixed - 70°C	60,000 hours
Ground Fixed - 50°C	86,000 hours
Ground Benign - 70°C	95,000 hours
Ground Benign - 50°C	157,000 hours

## Mating Connectors

Mating connectors for the Mag-13MC and Mag-13MS models are supplied free of charge. Submersible mating connectors are not supplied.

## Cables

The standard cable length is 5m; alternative lengths are available on request.

All cables are terminated with a Hirose RM15TPD10S, suitable for connection to Bartington Instruments' range of data acquisition and power supply units.

Mag-13MC, Mag-13MS	
Conductors	7/0.2 PVC insulated conductors, overall braided screen and PVC sheath
Type no.	7-2-8C Black to Def Stan 61-12, part 4
Conductor resistance	0.092 $\Omega$ /m
Capacitance	100pF/m core to core 170pF/m core to screen

Mag-13MCD, Mag-13MSS submersible cable	
Conductors	8 conductors, 3x shielded twisted pairs, 2x untwisted, overall screen and polyurethane sheath
Conductor resistance	20.5 $\Omega$ /km at 20°C
Weight	0.2kg/m (in air) 0.075kg/m (in seawater)
Cable bending radius	95mm (static) 130mm (dynamic)



## Compatibility

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The Mag-13 range is compatible with the following data acquisition and power supply units from Bartington Instruments.

- PSU1 Power Supply Unit
- Magmeter-2 Power Supply and Display Unit
- Spectramag-6 Data Acquisition Unit
- SCU1 Signal Conditioning Unit
- Decaport Analogue Interface Module
- DAS1 Data Acquisition System
- DecaPSU Power Supply Unit

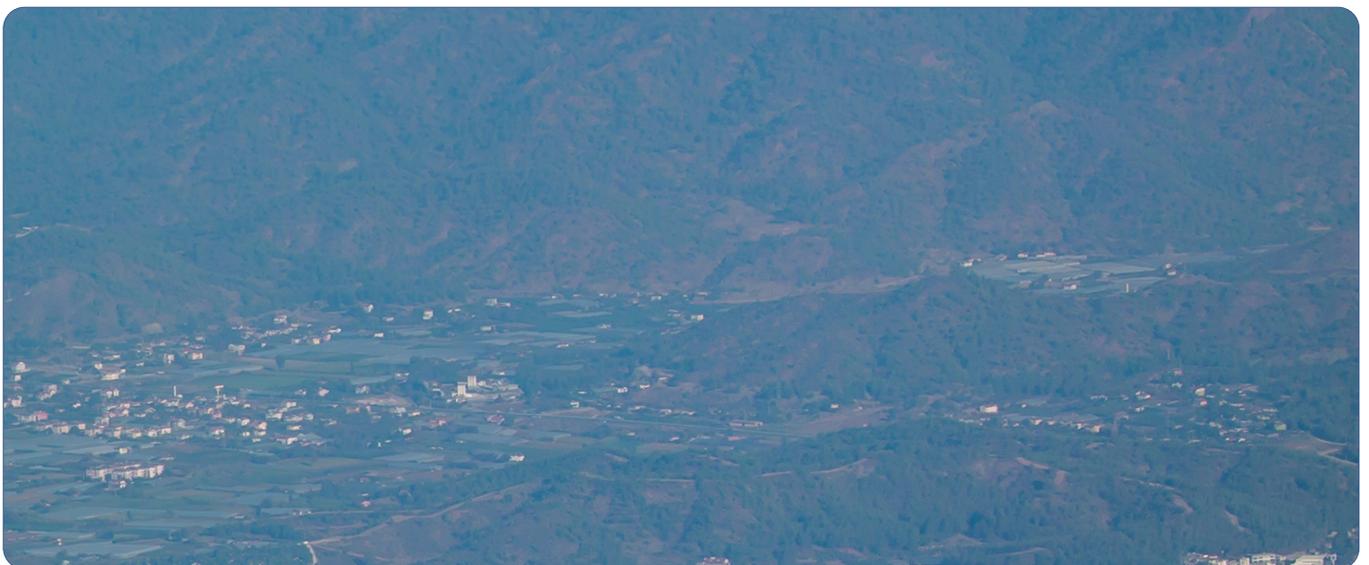
(Outputs for the test coil are presently only available with the DecaPSU).



# Mounting Accessories

A range of mounting accessories are available.

Specification	
Mag-BR	Mounting bracket for use with the Mag-13MC
Mag-T	Tripod
Mag-TA	Tripod adaptor
Mag-LP	Levelling platform for use with the Mag-T, Mag-TA and Mag-MR
Mag-MR	Mounting rack for the installation of Mag-LP and Mag-13 sensors, available in lengths of 1 metre and multiples



# DG-1

24-bit Digitiser





## DG-1 Digitiser

DG-1 is a digitiser designed to convert the output signals from most Bartington analogue magnetometers to digital format.

DG-1 is small, at just 80mm long and 35mm depth.

Also available is a robust and well-documented API, supporting both .NET Framework 4.8.1 (C#, VB.NET) and native C++ (ISO C++ 20).

The API encapsulates the device's protocol, simplifying communication and integration. It is fully compatible with Windows 10 x64 (version 1607 and later) and Windows 11 x64.

Example code for C++, C#, and VB.NET is provided to accelerate development and streamline integration into your software.



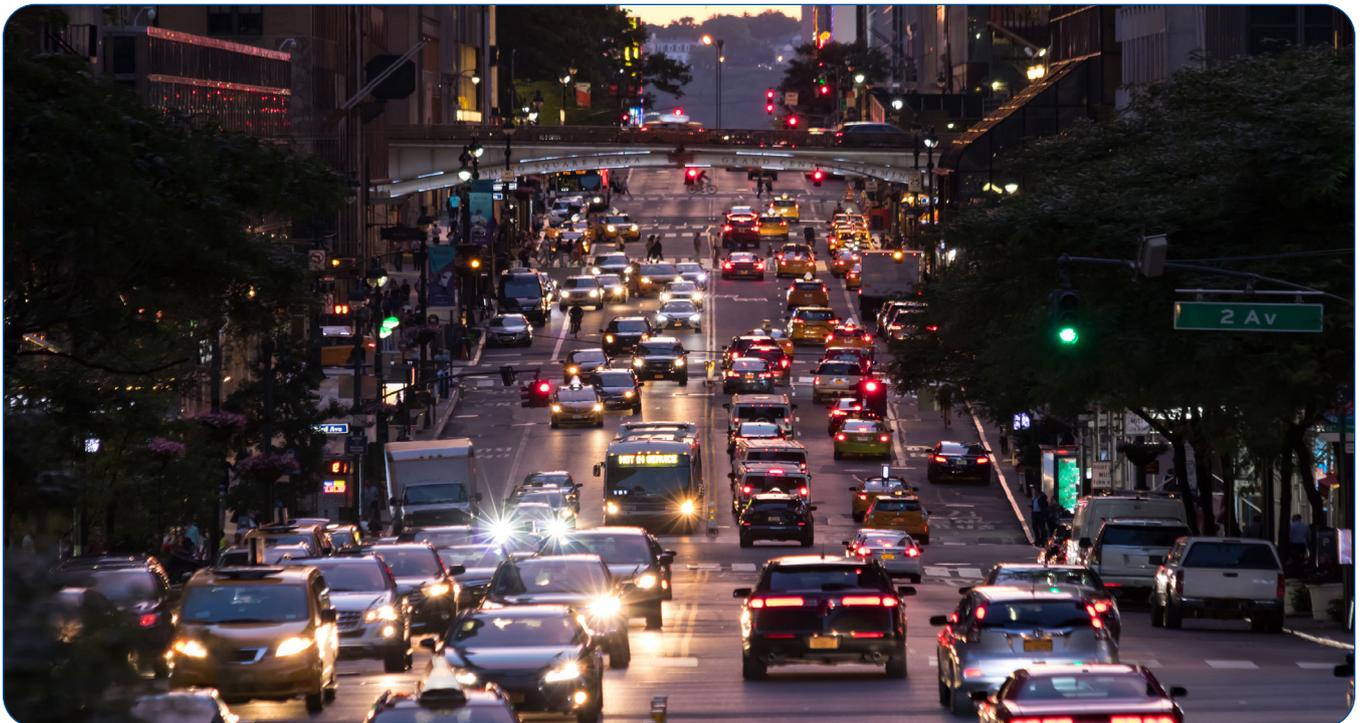
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## Features

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- 3 input channels
- 24-bit resolution
- Digital bandwidth of 1kHz, 3kHz, 5kHz (-3dB point)
- Compact size
- Windows desktop data-logging software (API available)
- LabView software available (for development use only)



# Specifications

Performance	
Number of input channels	Three
Input sensor mode	Differential/single-ended (with Single to Differential Cable)
Sensor input signal ranges	$\pm 3V$ , $\pm 8V$ , $\pm 10V$
Input coupling	DC
Resolution	24bits
ADC Sampling Rate	1.024MHz
ADC data transfer rate	32KHz max for all three channels (configurable)
ADC anti-alias filter	4.8kHz $\pm 10\%$ -3dB point
Scaling Error at 23°C	$< \pm 0.25\%$
Offset Error at 23°C	$< 1.5mV$
Bandwidth	Digital – 1kHz, 3kHz, 5kHz -3dB point, $\pm 10\%$ selectable Low-Pass Filter: FIR
Phase delay between all digitized inputs	$< 1\mu S$
Time base accuracy	$\pm 50ppm$
Input impedance	40k $\Omega$
Communication Interface	USB 2.0 Hi-Speed, 12MBaud

Environmental	
Operating temperature range	0°C to +60°C
Storage temperature range	-10°C to +60°C
Compliance	BS EN 61326-1 & RoHS

Mechanical

Enclosure Material		Anodised Aluminium
Dimensions		80 x 35 x 24mm
Weight		150g
Connectors	USB	USB Type-C Cable
	Magnetometer	Hirose LF10WBR-12S
Cable length USB		0.5m

Electrical

Supply Voltage (USB)	5V $\pm$ 12%
Output Voltage (to sensor)	$\pm$ 12V
Absolute max current drive output USB2.0	$\pm$ 45mA @ $\pm$ 12V
Absolute max current drive output USB3.0	$\pm$ 80mA @ $\pm$ 12V
Maximum Cable Length	25m
Interface Connection	USB 3.0 (to achieve power requirements)



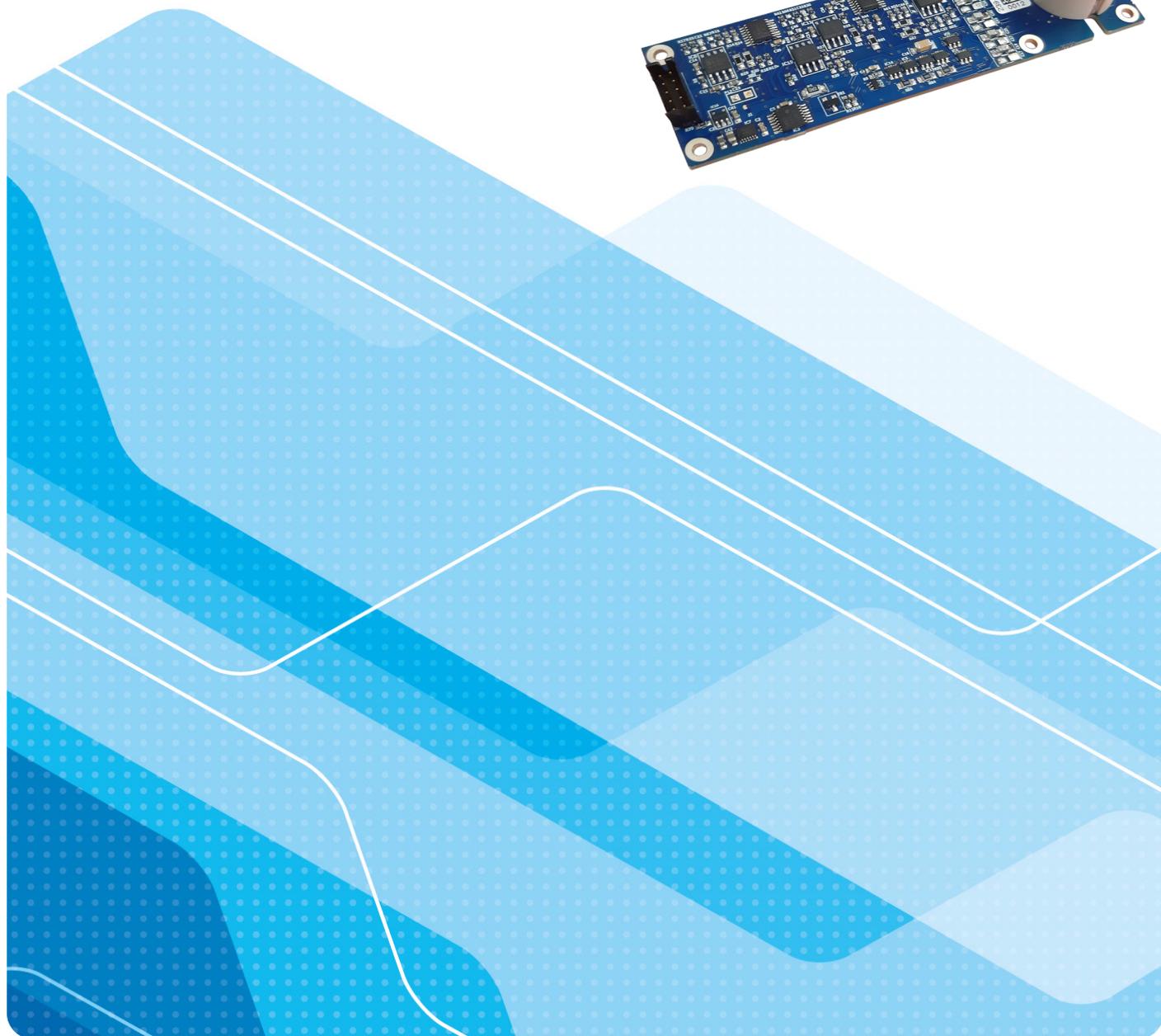
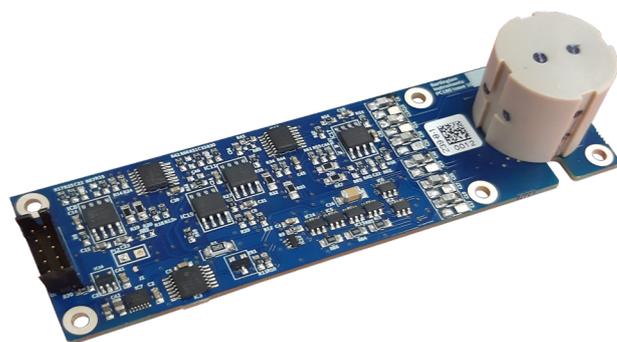
## Compatibility

Compatible Products	
Mag-03	CryoMag/CryoMag-IE
Mag-13	Mag610/611 RTUDE/RTPDE
Mag612U	Mag614-FL RTUDE/RTPDE
Mag619U	Mag648/649
Mag690	Mag900/901



# Mag900 & Mag901

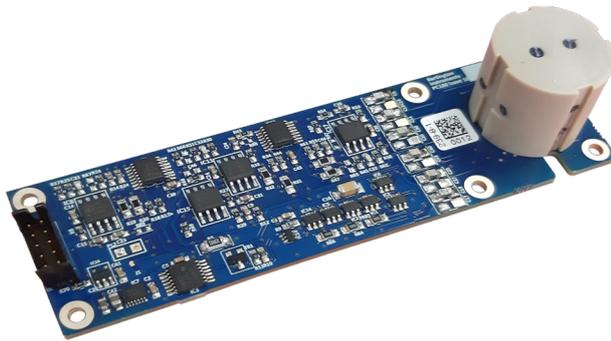
Low Power Three-Axis Magnetic Field Sensors





## Mag900 & Mag901 Low Power 3-Axis Magnetic Field Sensors

These low power unpackaged 3-axis magnetic field sensors offer high sensitivity magnetic field measurements within a narrow noise band. Its exceptionally low power consumption makes it ideal for surveillance and perimeter security applications.



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## Features

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- Noise band of  $\leq 10 \text{pT}_{\text{rms}}/\text{Hz}$  @ 1Hz (After magnetic settling time)
- Low power consumption
- Unpackaged for easy incorporation in multi-sensor systems
- Measuring range  $\pm 60$  and  $\pm 100 \mu\text{T}$

## Typical Applications

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- Detection of vehicles
- Detection of personnel carrying metal equipment
- Magnetic field measurement in remote locations
- Multi-sensor magnetic signature ranges



## Product Identification

Product name	Noise	Range
Mag900 & Mag901	No code = Standard noise L = Low noise	60 = $\pm 60\mu\text{T}$ 100 = $\pm 100\mu\text{T}$

Example: Mag900L-60 = Un-packaged Mag900, low-noise and  $\pm 60\mu\text{T}$  range.

## Specifications

Performance	Mag900	Mag901
Number of axes	Three (Right Hand XYZ co-ordinate system)	
Polarity	+ve non-inverting output when pointing North	
Range	$\pm 60\mu\text{T}$ $\pm 100\mu\text{T}$	
Scaling Calibration Error	$\pm 0.5\%$	
Scaling Temperature Coefficient	<135ppm/ $^{\circ}\text{C}$ (60 $\mu\text{T}$ ) <200ppm/ $^{\circ}\text{C}$ (100 $\mu\text{T}$ )	
Linearity Error	<0.0033% (least squares fit)	
Frequency Response	DC to 10Hz <5% deviation from DC	DC to 500Hz <5% deviation from DC
Bandwidth at -3dB	>30Hz	>1kHz
Noise - Analog	Low (60 $\mu\text{T}$ range): $\leq 10\text{pTrms}/\text{Hz}$ @ 1Hz Low (100 $\mu\text{T}$ range): $\leq 12\text{pTrms}/\text{Hz}$ @ 1Hz Standard: >10pT to $\leq 25\text{pTrms}/\text{Hz}$ @ 1Hz	
Zero Field Offset	< $\pm 100\text{nT}$	
Offset Temperature Coefficient	<1.25nT/ $^{\circ}\text{C}$	
Perming (Magnetisation Hysteresis)	<2nT at 1 x full scale (powered)	
Orthogonality error between axes	<1 $^{\circ}$	
Excitation Breakthrough	<20mV pk-pk at 8.192kHz	<50mV pk-pk at 8.192kHz
Start-up time	150ms	
Magnetic settling time	30-60mins	

Environmental	
Operating temperature range - continuous	-40°C to +70°C
Storage temperature range	-40°C to +50°C (in max ambient field <300µT)
Compliance	EMC BS EN 61326:2013 & RoHS

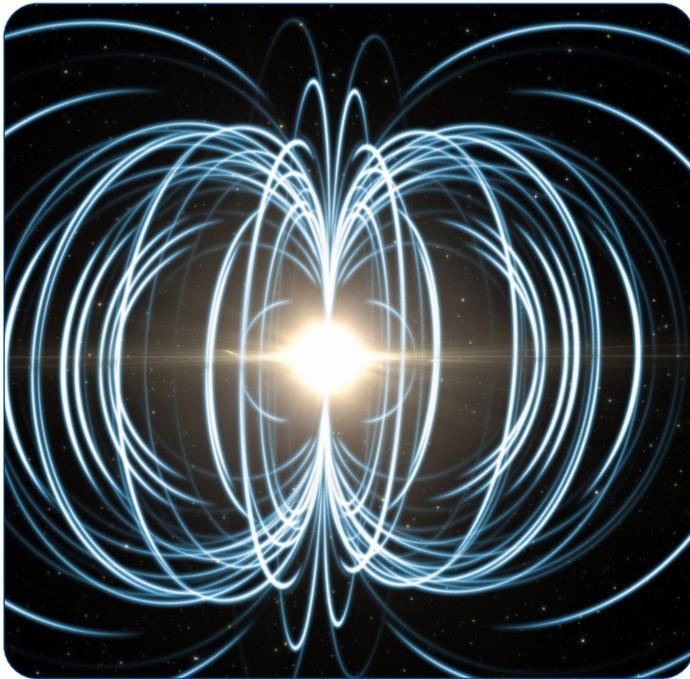
Mechanical	
Dimensions	29 x 25 x 100mm
Weight	25g
Connector	Hirose DF11-10DP-2DSA(01)
Mating Connector	Hirose DF11-10DS-2DSA(06)
Mounting Arrangements	6 x 2.7mm dia holes

Electrical	
Supply Voltage	+4.5V to 15V
Current Consumption - Mag900 (Standard Noise) Zero-Field In-field	<6.5mA (typical) in zero field +1mA nominal in 50µT field
Current Consumption - Mag900 (Low Noise) Zero-Field In-field	<6.8mA (typical) in zero field +1mA nominal in 50µT field
Current Consumption - Mag901 (Standard Noise) Zero-Field In-field	<5.5mA (typical) in zero field +1mA nominal in 50µT field
Current Consumption - Mag901 (Low Noise) Zero-Field In-field	<6.8mA (typical) in zero field +1mA nominal in 50µT field
Power-on surge	400mA Max, 260mA typical
Analogue Output	±3V (balanced differential, each output 0.15V to 3.15V, 1.65V zero-field)
Output Impedance	20Ω typical
Excitation frequency	8.192kHz (<±0.1%)

# BHC2000

Ferronato® Helmholtz Coils





## BHC2000 Ferronato® Helmholtz Coils

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These 2m three-axis Helmholtz Coils are used in the calibration of magnetic field sensors, and for conducting tests or experiments that require a known magnetic environment.

The coils are available in two models, with heavier and lighter windings. Both models use bifilar windings to achieve two identical circuits in each coil, and include independent connecting terminals to facilitate different winding configurations.



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## Features

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- Option of 1, 2 or 3 axes
- DUT (Device Under Test) mounting setup available

## Typical Applications

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



## Product Identification

Product name	Variant	Axes	Description
BHC2000-A	1A-A	Y	1 axis with scaling of 25 $\mu$ T/A field/current ratio
	2A-A	X, Y	2-axis with scaling of 25 $\mu$ T/A field/current ratio
	2B-A	Y, Z	2-axis with scaling of 25 $\mu$ T/A field/current ratio
	3-A	X, Y, Z	3-axis with scaling of 25 $\mu$ T/A field/current ratio
BHC2000-B	1A-B	Y	1 axis with scaling of 14.7 $\mu$ T/A field/current ratio
	2A-B	X, Y	2 axis with scaling of 14.7 $\mu$ T/A field/current ratio
	2B-B	Y, Z	2 axis with scaling of 14.7 $\mu$ T/A field/current ratio
	3-B	X, Y, Z	3 axis with scaling of 14.7 $\mu$ T/A field/current ratio



## BHC2000-A

Each pair of coils generates a homogeneous magnetic field X, Y or Z axis. You may specify the number of axes required. One-axis, two-axis, or three-axis versions are available in any combination (1A, 2A, 2B, or 3) and are provided in flat-pack assembly to facilitate easier freight carriage and installation.



## Specifications

Performance	X axis	Y axis	Z axis
Field/current ratio	25.0 $\mu$ T/A. For bifilar winding in parallel, as delivered from factory, or 25.0+25.0 $\mu$ T/A for independent split windings.		
Maximum field	1.0 mT DC for each axis		
Maximum current	40A, each axis, with bifilar windings in parallel. For maximum heating to around 70°C measured on coil surface. 20A, each axis, for each independent bifilar circuit (20 + 20A).		
Coil homogeneous volume ( $\pm$ 1% error)	Cubic 48cm side		
Coil homogeneous volume ( $\pm$ 5% error)	Cubic 92.5cm side		
Nominal diameter in $\pm$ 4mm	2046mm	2000mm	1954mm
Secondary field generated by the coil formers when used as coils (Xs, Ys, Zs) $\pm$ 3%	0.82 $\mu$ T/A (max. 16.4 $\mu$ T) (20A max)		

Mechanical	
Winding	Bifilar wire in parallel
Dimensions	2086 x 2086 x 2040mm
Weight	Single coil about 35kg. Total about 220kg.

Electrical	X axis	Y axis	Z axis
Field/current ratio $\pm$ 1%, circuits in parallel	24.8 $\mu$ T/A	25.3 $\mu$ T/A	25.1 $\mu$ T/A
Field/current ratio $\pm$ 1%, circuits in series	49.5 $\mu$ T/A	50.6 $\mu$ T/A	50.1 $\mu$ T/A
DC resistance at 20°C $\pm$ 5% measured at the general terminal block with factory wiring configuration	0.62 $\Omega$	0.61 $\Omega$	0.57 $\Omega$
Resistance for each separated circuit at 20°C $\pm$ 5%	1.24 $\Omega$	1.21 $\Omega$	1.15 $\Omega$
Self-inductance at 120Hz $\pm$ 5%	14.7mH	14.3mH	13.1mH

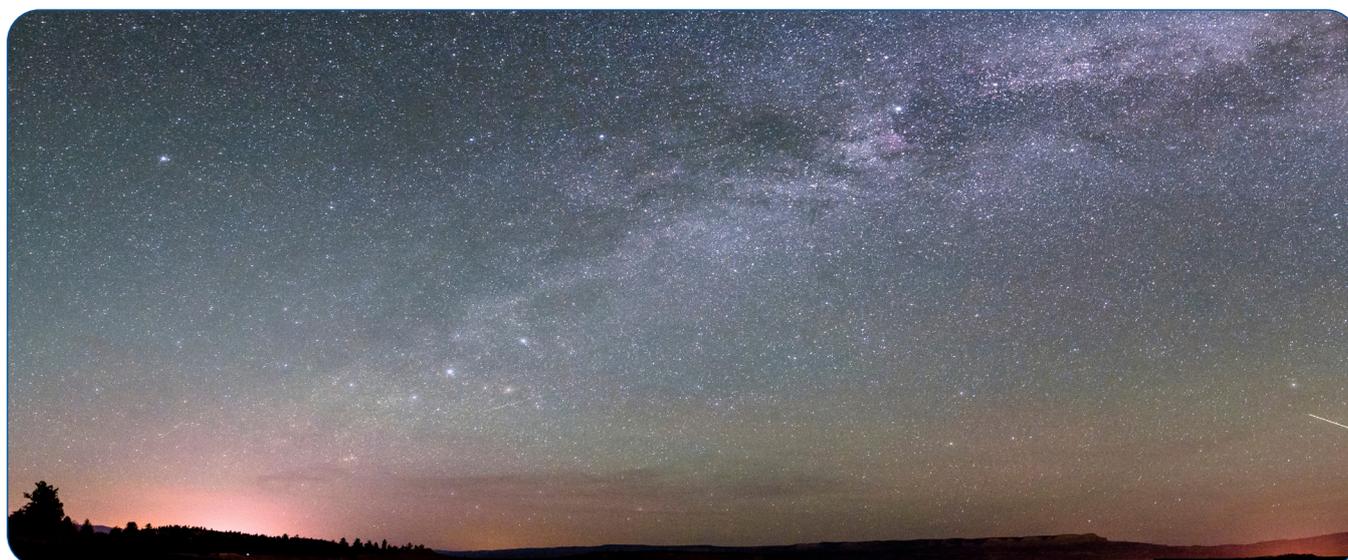
## BHC2000-B

Each pair of coils generates a homogeneous magnetic field X, Y or Z axis. You may specify the number of axes required. One-axis, two-axis, or three-axis versions are available in any combination (1A, 2A, 2B, or 3) and are provided in flat-pack assembly to facilitate easier freight carriage and installation.



## Specifications

Performance	X axis	Y axis	Z axis
Field/current ratio	14.7 $\mu$ T/A. For bifilar winding in parallel, as delivered from factory, or 14.7+14.7 $\mu$ T/A for independent split windings.		
Maximum field	240 $\mu$ T DC for each axis		
Maximum current	16A, each axis, with bifilar windings in parallel. 8A, each axis, for each independent bifilar circuit (5 + 5A).		
Coil homogeneous volume ( $\pm$ 1% error)	Cubic 48cm side		
Coil homogeneous volume ( $\pm$ 5% error)	Cubic 92.5cm side		
Nominal diameter in $\pm$ 4mm	2046mm	2000mm	1954mm
Secondary field generated by the coil formers when used as coils (Xs, Ys, Zs) $\pm$ 3%	0.82 $\mu$ T/A (max. 16.4 $\mu$ T) (20A max)		



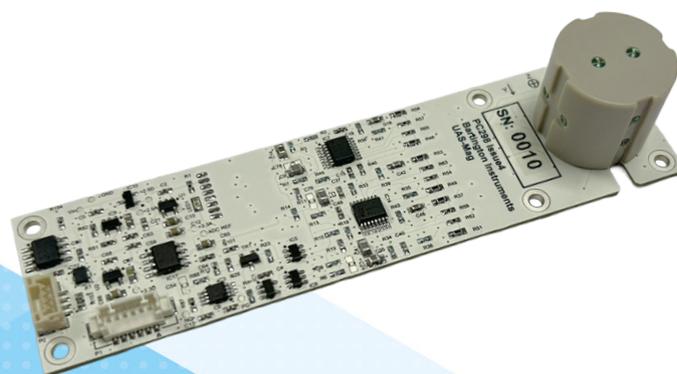
Mechanical	
Winding	Bifilar wire in parallel
Dimensions	2086 x 2086 x 2040mm
Weight	Single coil about 35kg. Total about 220kg

Electrical	X axis	Y axis	Z axis
Field/current ratio $\pm 1\%$ , circuits in parallel	14.4 $\mu$ T/A	14.7 $\mu$ T/A	15.1 $\mu$ T/A
Field/current ratio $\pm 1\%$ , circuits in series	28.7 $\mu$ T/A	29.4 $\mu$ T/A	30.1 $\mu$ T/A
DC resistance at 20°C $\pm 5\%$ measured at the general terminal block with factory wiring configuration	1.8 $\Omega$	1.7 $\Omega$	1.6 $\Omega$
Resistance for each separated circuit at 20°C $\pm 5\%$	3.6 $\Omega$	3.4 $\Omega$	3.2 $\Omega$
Self-inductance at 120Hz $\pm 5\%$	4.9mH	4.8mH	4.7mH



# UAS-Mag™

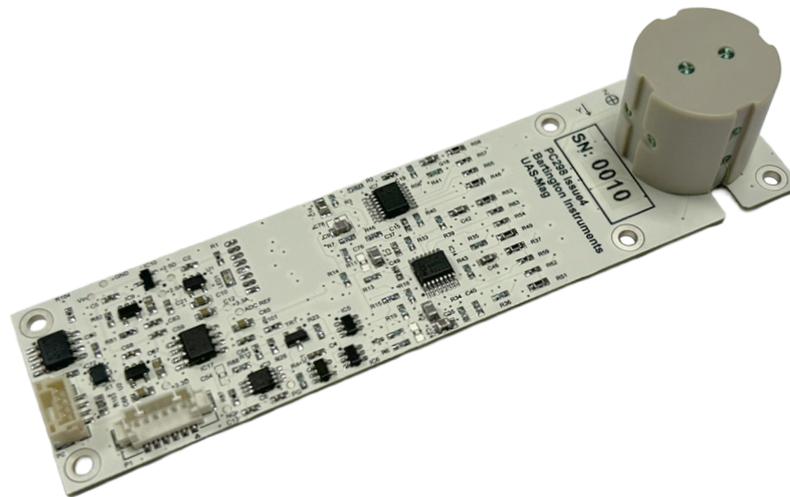
High Performance DroneCAN Magnetometer





## UAS-Mag™ High Performance DroneCAN Magnetometer

A 3-Axis fluxgate magnetic field sensor with a DroneCAN communication interface, for use on UAS platforms.



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## Features

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- Low weight
- Unpackaged for system integration
- DroneCAN (UAVCAN) communication interface
- Adjustable data output rate
- Digital offset adjustment parameters

## Typical Applications

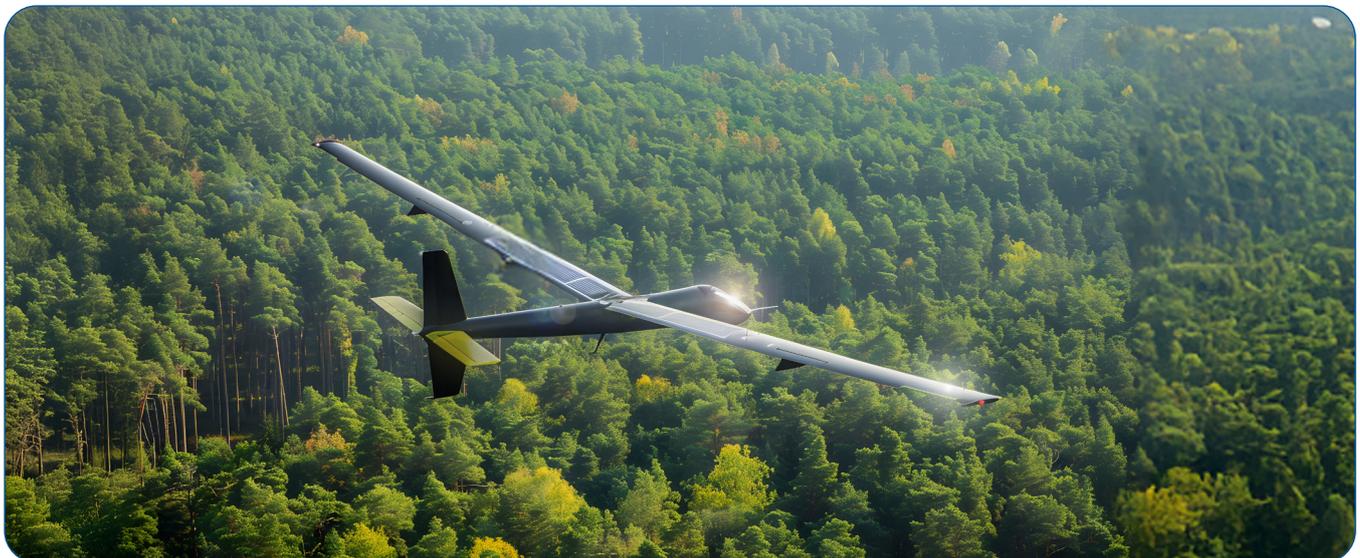
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- Unmanned aircraft system navigation
- Compassing or payload measurements

## Product Identification

Product name	Package	Noise	Range
UAS-Mag™	-U = Unpackaged	No code = standard noise	105 = $\pm 105\mu\text{T}$

Example: UAS-Mag-U105 = Unpackaged, standard noise, 105 $\mu\text{T}$  range.



## Specifications

Performance (Analogue Output)	
Number of Axes	Three, mutually orthogonal (Right Hand XYZ co-ordinate system)
Polarity	+ve output when pointing North
Axis Orientation	X-Axis = +ve forward (Roll) Y-Axis = +ve starboard (Pitch) Z-axis = +ve down (Yaw)
Maximum Measuring Range	$\pm 105\mu\text{T}$ ( $\pm 1.05$ Gauss) $\pm 5\mu\text{T}$
Scaling Calibration Error	$< \pm 0.5\%$
Linearity Error	$< 0.02\%$
Bandwidth at -3dB	$> 300\text{Hz}$
Noise Floor	$\leq 20\text{pTrms}/\text{Hz}$ @ 1Hz
Zero Field Offset	$< \pm 100\text{nT}$
Perming (Magnetisation Hysteresis)	$< 2\text{nT}$ (at 1 x Full-scale, when powered)
Orthogonality	$< \pm 0.1^\circ$
Start-up/Settling time	$< 150\text{ms}$
Warm-up drift time	15 minutes



## UAS-Mag™ High Performance DroneCAN Magnetometer

Performance (Digital CAN Output)	
Number of Axes	Three, mutually orthogonal (Right Hand XYZ co-ordinate system)
Polarity	+ve output when pointing North
Axis Orientation	X-Axis = +ve forward (Roll) Y-Axis = +ve starboard (Pitch) Z-axis = +ve down (Yaw)
Maximum Measuring Range	$\pm 105\mu\text{T}$ ( $\pm 1.05$ Gauss) $\pm 5\mu\text{T}$
Scaling Calibration Error	$< \pm 0.5\%$
Linearity Error	$< 0.02\%$ (least squares fit)
Noise Floor	$\leq 20\text{pTrms}/\text{Hz}$ @ 1Hz
Zero Field Offset	$< \pm 100\text{nT}$
Orthogonality	$< \pm 0.1^\circ$
Start-up/Settling time	$< 150\text{ms}$
Warm-up drift time	15 minutes
Output Data Rate	1 to 200 samples/second on all 3 axes simultaneously (selectable) (50smps default)
Communication Protocol	DroneCAN v1
DroneCAN Data Type	MagneticFieldStrength MagneticFieldStrength2

Environmental	
Operating temperature range	$-40^\circ\text{C}$ to $+85^\circ\text{C}$
Storage temperature range	$-40^\circ\text{C}$ to $+85^\circ\text{C}$
Compliance	BS EN 61326 & RoHS

**Mechanical**

Enclosure	Unpackaged – no enclosure
Dimensions	110 x 29 x 24mm
Weight	25g
Connector	JST-GH-4P
Solder	Unleaded Solder
Mounting Arrangements	6 x Ø2.65mm thru' holes

**Electrical**

Supply Voltage	+4.5V to +15V DC
Current Consumption	60mA typical @5V
Analog Output Scaling	3V balanced differential (0.15 – 3.15V) / 100µT
ADC	AD7767BRUZ-2 (24-bit)
ADC sample rate	1MHz
ADC output rate	31.25kSPS

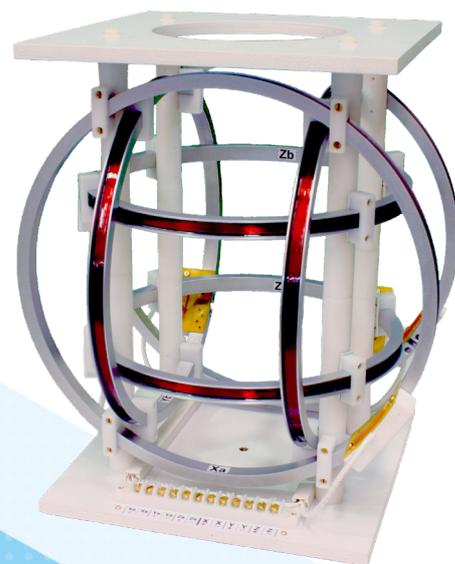
**Other Information**

Military Control List Classification	Dual-use (6a006a3)
ITAR components	No ITAR components to be used in the product



# BH300HF-B

Helmholtz Coils





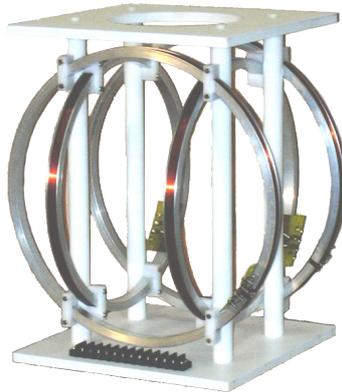
## BH300HF-B Helmholtz Coils

A desktop-sized, lightweight, set of Helmholtz Coils for laboratory and general-purpose use.

Based on the design of the BH300-A, but with a reduced number of turns. This allows the coil to be driven at much higher frequencies.

The coils are available in five models, each with different combinations of X, Y and Z axis configurations.

Mounting plate and sensor jigs are available.



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## Features

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- Option of 1, 2 or 3 axes
- Coil formers can be used as a single-turn Helmholtz coil to add additional signals on top of the main field
- Optional mounting plate and jig available

## Typical Applications

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- Calibration of three-axis magnetic field sensors
- Creation of a known magnetic environment



## Product Identification

Product name	Variant	Axes	Description
BH300HF	3-B	X, Y, Z	3-axis
	2A-B	X, Z	2-axis
	2B-B	X, Y	2-axis
	1A-B	X	1-axis
	1B-B	Y	1-axis



## Specifications

Performance	
Number of Axes	3, 2, or 1
Orthogonality Error	<0.2°
Maximum field (DC single axis) - continuous	430µT
Isolation voltage	250V
Coil homogeneous area (<1% error)	70mm diameter sphere
Coil homogeneous area (<5% error)	100mm diameter sphere

Environmental	
Operating temperature range	+15 to +30°C
Storage temperature range	+10 to +40°C
Compliance	RoHS

Mechanical	X axis	Y axis	Z axis
Coil Effective Diameter	299mm ±1mm	236.4mm ±1mm	265.6mm ±1mm
Dimensions	364mm H x 309mm W x 276mm D		
Coil Maximum aperture	120 x 106mm		
Weight	3.0kg (for 3-axis coil set)		

Electrical	X axis	Y axis	Z axis
Field/Current Ratio (Main windings)	54.2µT/A ±2%	53.7µT/A ±2%	53.7µT/A ±2%
DC resistance per axis	0.49Ω ±3%	0.31Ω ±3%	0.40Ω ±3%
Number of turns (per coil)	9	7	8
Inductance per axis	146µH ±5%	72µH ±5%	98.5µH ±5%
Field/Current Ratio (Coil Former)	6.8µT/A ±5%	7.1µT/A ±5%	6.1µT/A ±5%
Coil Maximum current - continuous	8.0 A		
Coil Connector	12-way connection strip with M4 brass terminals		

Optional Accessories	
BH300-DUTST	Mounting plate for devices under test.
Helmholtz Jig	Jig designed to fit to the BH300-DUTST for mounting Bartington Instruments sensors onto.

# BHC2000-A

Ferronato® Helmholtz Coils





## BHC2000-A Ferronato® Helmholtz Coils

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These 2m three-axis Helmholtz Coils are used in the calibration of magnetic field sensors, and for conducting tests or experiments that require a known magnetic environment.

BHC2000-A uses bifilar windings to achieve two identical circuits in each coil, and include independent connecting terminals to facilitate different winding configurations.



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## Features

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- Option of 1, 2 or 3 axes
- DUT (Device Under Test) mounting setup available
- Internal flooring available

## Typical Applications

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



## Product Identification

Product name	Variant	Axes
BHC2000-A	1A-A	Y
	2A-A	X, Y
	2B-A	Y, Z
	3-A	X, Y, Z



# BHC2000-A

Each pair of coils generates a homogeneous magnetic field X, Y or Z axis. You may specify the number of axes required. One-axis, two-axis, or three-axis versions are available in any combination (1A, 2A, 2B, or 3) and are provided in flat-pack assembly to facilitate easier freight carriage and installation.

## Specifications

Performance	
Number of Axes	3, 2, or 1
Orthogonality Error	<0.2° (only when adjusted using PA1 Power Amplifier)
Maximum field DC single axis	1.0mT
Maximum field DC single axis using PA1	300μT
Maximum frequency single axis using PA1	50Hz
Isolation Voltage	100V
Coil homogeneous volume (<1% error)	480mm cube
Coil homogeneous volume (<5% error)	925mm cube

Environmental	
Operating temperature range	+15 to +30°C
Storage temperature range	+10 to +40°C
Compliance	RoHS

## BHC2000-A Ferronato® Helmholtz Coils

Mechanical	X	Y	Z
Coil Effective Diameter	2057mm $\pm$ 4mm	1941mm $\pm$ 4mm	1998mm $\pm$ 4mm
Dimensions	2113mm H x 2043mm W x 2086mm D		
Coil Maximum aperture	1068mm x 1045mm		
Weight	235kg (each coil roughly 38kg)		

Electrical	X	Y	Z
Field/Current Ratio – Windings in parallel	24.8 $\mu$ T/A $\pm$ 1%	25.3 $\mu$ T/A $\pm$ 1%	25.1 $\mu$ T/A $\pm$ 1%
Field/Current Ratio – Windings in series	49.5 $\mu$ T/A $\pm$ 1%	50.6 $\mu$ T/A $\pm$ 1%	50.1 $\mu$ T/A $\pm$ 1%
DC resistance per axis – Windings in parallel	0.73 $\Omega$ $\pm$ 5%	0.68 $\Omega$ $\pm$ 5%	0.76 $\Omega$ $\pm$ 5%
DC resistance per axis – Windings in series	1.46 $\Omega$ $\pm$ 5%	1.36 $\Omega$ $\pm$ 5%	1.52 $\Omega$ $\pm$ 5%
Coil Maximum Inductance per axis	14.1mH $\pm$ 5%	12.1mH $\pm$ 5%	13.6mH $\pm$ 5%
Number of turns	31 + 31	30 + 30	31 + 31
Field/Current Ratio (Coil Formers)	0.82 $\mu$ T/A $\pm$ 3%		
Maximum Current - Parallel Windings	40A		
Maximum Current - Series Windings	40A		
Maximum Current - Coil Formers	20A		
Coil Connector	M4 brass terminals		

Accessories

Elevated Floor	Non-magnetic, modular, flooring system to be located inside the coil assembly.
DUT Stand – BHC2000-DUTST-1	A variable height stand for mounting various DUTs. Feet can be screwed into flooring (using 6mm or 1/4" screws). Fits inside the elevated flooring (above). Plate size 525 x 525mm. Load capacity: 120kg.



The specifications of the products described in this brochure are subject to change without prior notice.

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