Bartington®
Instruments

Mag-03

Three-axis Magnetic Field Sensors

For innovation in magnetic measuring instruments

Mag-03
Three-Axis Magnetic Field Sensors

These compact, high performance sensors with integral electronics provide precision measurements of static and alternating magnetic fields in three axes. They are available with measuring ranges of ±70, ±100, ±250, ±500 or ±1000µT in a range of enclosures as detailed below. Powered from any ±12V supply, outputs are in the form of three analog voltages from 0 to ±10V, proportional to Bx, By and Bz.

Low noise sensors with a noise level of <6pTrms/√Hz at 1Hz can be supplied in all enclosures with a measuring range of ±70 or ±100µT.

These sensors have a wide range of applications in physics, bioelectromagnetics, geophysical exploration and defence.

Accessories include the *Mag*-03PSU battery power supply unit, *Mag*-03DAM high-resolution data acquisition module and *Mag*-03SCU signal conditioning unit.
A *Mag*-03MC-MB mounting bracket can be supplied for the cylindrical range of sensors.
Calibration check units can be supplied for the complete range of sensors.
A full calibration service is also available.

Enclosures

The *Mag*-03 sensors can be supplied in the following enclosures:

Mag-03MC

- *Mag*-03MC - cylindrical

Mag-03MS

- *Mag*-03MCES - cylindrical - with environmentally sealed connector
- *Mag*-03MCFL - cylindrical - with connections via flying leads
- *Mag*-03MS* - square section

Mag-03MSS

- *Mag*-03MSES* - square section with environmentally sealed connector
- *Mag*-03MSS - square section submersible to 100 metres

Mag-03IE

- *Mag*-03IE - a sensor with the three sensing elements on flying leads.

* These sensors have an orthogonality error of <0.1°

Product identification

Products are specified as *Mag*-03 followed by the enclosure code (MC, MCES, MCFL, MS, MSES, MSS or IE) followed by L for the low noise version only, then the measuring range (70, 100, 250, 500 or 1000µT).
e.g. *Mag*-03MSL70 is a low noise sensor with a square section enclosure and a range of ±70µT, and the *Mag*-03MC1000 has a cylindrical enclosure and a range of ±1000µT.

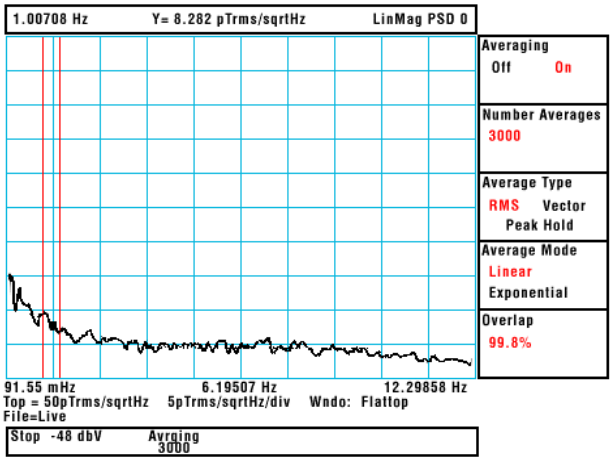
Performance specification

Supply voltage	±12V to ±17V
Analog output	±10V (±12V supply) swings to within 2V of supply voltage
Power supply rejection ratio	5µV/V
Output impedance	<1Ω
Linearity error	<0.0015%
Output ripple	0 to 1kHz maximally flat, ±5% maximum above 1kHz
Calibration accuracy	±0.5%
Bandwidth	0 to 3kHz
Orthogonality error - between sensing axes Z axis to reference face	 <0.5° (<0.1° for *Mag*-03MS and *Mag*-03MSES) <0.1° (*Mag*-03MS and *Mag*-03MSES only)
Internal noise - standard version low noise version	 <12pTrms/√Hz at 1Hz <6pTrms/√Hz at 1Hz
Supply current - standard version low noise version	 +25mA, -8mA (+1.4mA per 100µT for each axis) +30mA, -8mA (+1.4mA per 100µT for each axis)

Scaling dependent parameters

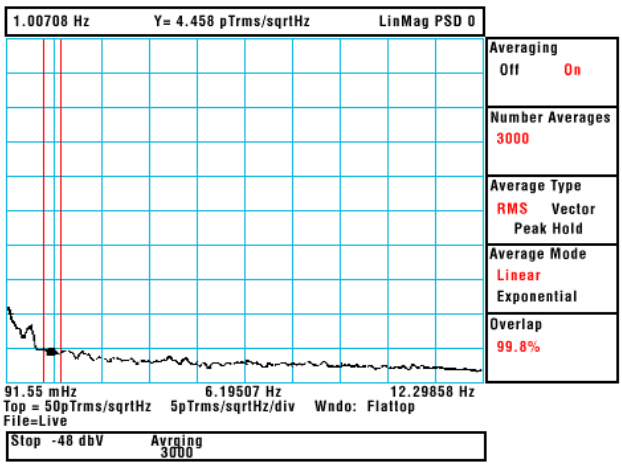
Measuring range	±70	±L70	±100	±L100	±250	±500	±1000	µT
Scaling	143	143	100	100	40	20	10	mV/µT
Offset error	±5	±5	±5	±5	±12	±25	±50	nT
Scaling temperature coefficient	+15	+15	+20	+20	+50	+100	+200	ppm/°C
Offset temperature coefficient	±0.1	±0.1	±0.1	±0.1	±0.2	±0.33	±0.6	nT/°C

Typical noise spectrum for standard version (0.1 to 10Hz)



Mag-03 Noise Plot Standard Version

Typical noise spectrum for low noise version (0.1 to 10Hz



Mag-03 Noise Plot Low Noise Version

Mechanical and environmental specifications

	***Mag*-03MC**	***Mag*-03MCES**
Enclosure	reinforced epoxy	reinforced epoxy
Dimensions (mm)	25 diameter x 202 length	25 diameter x 207 length
Mounting	*Mag*-03MC-BR bracket available	*Mag*-03MC-BR bracket available
Connector	Hirose RM15TRD10P	Amphenol 62GB-51T10-7P
Mating connector	Hirose RM15TPD10S	Amphenol 62GB-16J10-7S
Operating temperature	-40°C to +85°C	-40°C to +85°C
Weight	85g	100g
Environmental	none	splashproof

The specification of the *Mag*-03MCFL is identical to that of the M*ag*-03MC except that connection is made via flying leads.

	***Mag*-03MS**	***Mag*-03MSES**
Enclosure	reinforced epoxy	reinforced epoxy
Dimensions (mm)	32 x 32 x 152 length	32 x 32 x 166 length
Mounting	2 x M5 fixing holes	3 x M5 fixing holes
Connector	ITT Cannon DEM-9P-NMB	Amphenol 62GB-12E10-7P
Mating connector	ITT Cannon DEM-9S-NMB	Amphenol 62GB-16J10-7S
Operating temperature	-40°C to +70°C	-40°C to +70°C
Weight	160g	160g
Environmental	none	splashproof

	***Mag*-03IE**	***Mag*-03MSS**
Enclosure	reinforced epoxy	polyacetal
Dimensions (mm)	Electronics - 25 diameter x 105 length Sensor - 8 diameter x 30 length Sensor-electronics cable - 750 length	30 x 30 x 208 length
Mounting	*Mag*-03MC-BR bracket available	3 x M4 clearance holes
Connector	Hirose RM15TRD10P	Impulse IE XSJ-7-BCR
Mating connector	Hirose RM15TPD10S	Impulse IE XSJ-7-CCP
Operating temperature	-40°C to +85°C	-10°C to +50°C
Weight	80g	185g
Environmental	none	submersible to 100 metres depth

Mating Connectors

With the exception of the *Mag*-03MSS, mating connectors are provided free of charge for all *Mag*-03 sensors without cables and for cables purchased without *Mag*-03PSU, *Mag*-03DAM or *Mag*-03SCU.

Mag-03MC-BR Mounting Bracket

This bracket is supplied for use with the cylindrical range of *Mag*-03 sensors.

Specification	
Dimensions (mm)	55 x 55 x 36
Material	Tufnol

Cables

All cables for connection of the *Mag*-03 range of sensors to the *Mag*-03PSU, *Mag*-03DAM or *Mag*-03SCU are supplied in 5 metre lengths, with alternative lengths to 600 metres on request.

Specification

Mag-03MSS cable	polyurethane jacket, diameter 10mm, 3 pairs of individually screened conductors
All other cables	PVC jacket, diameter 5.9mm, 6 conductors

Mag-03SCU
Signal Conditioning Unit

This unit provides power for any *Mag*-03 sensor and signal conditioning of the sensor outputs. The unit, which is suitable for mounting in a 19 inch rack, operates from a 220 or 110V ac supply. The power supply voltage for the sensor can be increased for operation over very long cables and separate controls are provided for each channel.

Specification

Input channels	3 from *Mag*-03 three-axis magnetic field sensor (X, Y & Z)
Input signal range	±18V maximum - surge protection with ±18V clamp
Common mode rejection ratio	>30dB - fully differential input
Signal output	three unfiltered analog, three filtered analog
Signal coupling	ac or dc depending upon filter selection
Low pass filter	1, 10, 100, 1000 or 10000Hz switch selected
High pass filter	0 (dc), 0.01 or 1.0Hz switch selected
Filter roll off	-18dB/octave for low and high pass
Gain	1, 50, 100, 300, 500 or 1000 switch selected
Offset range	1 to ±10V
Offset control - coarse fine	 10 turn potentiometer with polarity switch for each channel centre-off position potentiometer
Thermal drift	≤6mV/hour for filtered/null signal output with gain = 300
System noise	minimum discernible input signal variation of ±0.1mV with signal/noise ratio of ≥10dB at all gain settings
Operating temperature	-20°C to +70°C
Humidity	0 - 50% (non-condensing)
Power input	110/220V ac selectable
Fuses	1A, 250V rating, 20mm or ¾ inch
Power output	±12V, ±15V, ±17V at 250mA ripple <1mV p-p, short circuit protected, surge protection provided with ±18V clamp
Dimensions (mm)	483 width (19" rack) x 88 height (2U) x 300 depth
Weight	5.5kg
Display	3 x 3½ digit LCD
Controls	Power ON, low pass filter, high pass filter, supply voltage, gain (3), offset coarse (3), offset fine (3), polarity (3)
Connectors - power input sensor input analog output	 3-way IEC with integral filter (mains cable provided) 10-way Hirose RM15TRD10P 6 x BNC sockets

Mag-03DAM
Data Acquisition Module

The *Mag*-03DAM is a 6 channel, 24-bit resolution module for the collection of data from any two *Mag*-03 sensors. If used in conjunction with one sensor only, other outputs can be used to record analog signals such as temperature. All inputs are protected against voltage surges.

The unit is designed for measurements at low rates for the highest resolution. For a resolution of 24-bits, one scan of all six inputs per five seconds is typical. To resolve small anomalies or record changes in the geomagnetic field, further averaging of these values may be required.

The unit incorporates a battery-backed power supply for the sensors. Power is provided via a mains adaptor and data transmitted to the user's computer via n optically isolated RS232 serial link. The analog signals from the sensors are available for external use. The module can be located up to several hundfed metres from the sensors.

The parameters of the data acquisition module are user selectable. Calibration is carried out under program control using two dedicated differential inouts. Software for DOS or Microsoft Windows XP is provided to record time-stamped magnetic field values to disc.

Specification

Input channels	6 differential
Data acquisition card	Lawson Laboratories type 201
Resolution	16 or 24-bits - 24-bit monotonicity at up to 50Hz rate (single channel only)
Linearity (typical)	0.002% of full scale at up to 50Hz data rate
Scaling error	±0.05%
Sample rate	Programmable
Analog input	±10V full scale
Computer interface	RS232, optically isolated, full duplex 300 to 9600 baud rate
RS232 cable	6 metres standard, lengths to 30 metres on request
Power input	9 to 24V dc, 120mA via mains adaptor provided
Battery	12V, 2.1Ah, lead acid, 10 hours use
Fuse	1A
Dimensions (mm)	265 x 255 x 55
Weight	2.8kg
Connectors: Mains adaptor Sensor RS232 Analog output	 2.1mm dc inlet RM15TRD10P 25-way D type 9-way D type

Mag-03PSU
Power Supply Unit

The *Mag*-03PSU provides power to any *Mag*-03 sensor via the mains adaptor or the internal rechargeable battery and contains high and low pass filters for the analog signals from the *Mag*-03 sensor. The low pass (<4.5kHz) filter removes HF noise from feedthrough of the sensor excitation frequency and any external sources. The high pass (>0.1Hz) filter can be switched to provide ac or dc operation.

Specification

Enclosure	high strength ABS
Dimensions (mm)	133 x 84 x 46
Weight	550g
Battery	sealed lead acid
Connectors -	
sensor	HRS RM15TRD10P
analog outputs	3 BNC connectors
battery charger inlet	2.1mm socket

Mag-03MS-CU and *Mag*-03MSS-CU
Calibration Units

The *Mag*-03MS-CU and *Mag*-03MSS-CU are battery-powered units which produce a sinusoidal alternating magnetic field of defined frequency and magnitude. The units provide a reference magnetic field for checking the calibration of the *Mag*-03MS and the *Mag*-03MSS sensors. A temperature-stabilised constant current is passed through a single Helmholtz coil with guides to align each of the sensor axes in turn. For the *Mag*-03MC and *Mag*-03IE sensors, adaptors are available for use with the *Mag*-03MS unit.

Specification

Sinewave magnitude	50µT p-p (17.5µT rms) ±1% (distortion 5% typical)	
Frequency	190Hz ±2%	
Battery	PP3 9V alkaline or lithium dioxide (20 hours continuous use) with tri-colour LED indicator	
Enclosure	polyethylene terephthalate	
Environmental	IP60 not suitable for use in wet conditions	
	Mag-03MSS-CU	*Mag*-03MS-CU
Dimensions (mm)	100 dia. x 117 long	100 dia. x 125 long
Weight	1100g	990g

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