

*Operation Manual for
Mag-13 Three-Axis Magnetic Field Sensors*



Bartington[®]
Instruments

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1. About this Manual

This manual describes the installation, operation and maintenance of the Mag-13 range of three axis magnetic field sensors. It should be read in conjunction with the product brochure [DS3143](#) and the [outline drawings](#) which can be found on the Mag-13 product page on the Bartington Instruments website at: www.bartington.com.

See Application Note AN0045: 'Magnetic Units and Measurements', available from Bartington Instruments, for important information about magnetic field measurement units.

1.1. Symbols Glossary

The following symbols used within this manual call your attention to specific types of information:



WARNING: Indicates a situation in which serious bodily injury or death could result if the warning is ignored.



Caution: Indicates a situation in which bodily injury or damage to your instrument, or both, could result if the caution is ignored.



Identifies items that must be disposed of safely to prevent unnecessary damage to the environment.

Note: Provides useful supporting information on how to make better use of your purchase.

2 Safe Use



WARNING: These products are not qualified for use in explosive atmospheres or life support systems. Consult Bartington Instruments for advice.

3. Introduction

These compact, high performance sensors with integral electronics provide measurements of static and alternating magnetic fields in three axes. The sensors, also described as magnetometers, convert magnetic flux density, measured in three axes, into a bipolar analogue voltage. Analogue output voltages V_x , V_y and V_z vary linearly with magnetic flux density.

The Mag-13 series are an evolution of the Mag-03 range of sensors and feature a number of improvements. These include improved orthogonality error of the sensing coils, and an inbuilt test coil and temperature sensor. There have also been other refinements in the design.

The analogue output is positive for conventional flux direction, South to North, in the direction of the arrow shown on the label for each axis; i.e. the maximum positive output will be obtained from any axis

when the arrow points towards magnetic north along the total field vector. The measurement axes are designated X, Y and Z in the Cartesian co-ordinate system, when viewed from the top or non-connector end of the sensor.

The analogue outputs may require external filters if not used with a Bartington Instruments data acquisition unit, to achieve the noise specification of the sensor (see [Noise](#)).

4. *General Description*

The Mag-13 contains three fluxgate sensing elements mounted orthogonally in a block at one end of an enclosure, which also contains the electronic circuitry. The connector is mounted at the opposite end of the enclosure. The position and direction of each sensing element is indicated by arrows on the outside of the sensor, together with the product code, measuring range and serial number. The sensor elements are precisely aligned along the centre lines of the package, directly beneath the diagram on the label.

Details of the enclosures, mounting, connector dimensions, connector pin allocation and the position of the sensing elements relative to the enclosure are given in outline drawings on the Mag-13 product page.

The sensors provide three high precision analogue outputs, proportional to the magnetic field along each axis. The relationship between the magnetic field and the analogue output is extremely linear. An additional output is provided in order to take temperature measurements or activate the internal test coil.

The low output impedance of the sensor ensures it can be operated over long cables when interfaced with Bartington Instruments' high impedance data acquisition systems. The zero field offset error, scale factor, orthogonality and frequency response are individually calibrated.

5. *Enclosures*

The sensors are available in a variety of enclosures. All enclosures are environmentally sealed and electrically shielded. A full list of sensors with specifications is provided in the product brochure.

Note: Using your sensor in an environment that exceeds its rating may result in the need for repair at the customer's expense.

6. *Compatible Power Supply and Data Acquisition Units*

A number of other Bartington Instruments products will work with the Mag-13 as power supply and/or data acquisition units. These are listed in the product brochure and can be found at www.bartington.com/data-acquisition-and-conditioning-units.html.

Note: Outputs for the test coil and temperature sensor are presently only available with the DecaPSU Power Supply Unit. See [Test Coil](#) for information on test coil operation.

For further information on power supplies see [Power Supplies](#).

For information on using your own power supply or data acquisition unit see AN0042: 'Connecting your own Power Supply to a Bartington Magnetic Field Sensor', available from Bartington Instruments.

Although the Mag-13 is singled-ended, the cable connecting it to the power supply has a signal ground for each axis. The configuration of the cable pin out for the Mag-13 on the power supply side will require the power supply/signal conditioning unit to be set to the balanced mode to operate the Mag-13 correctly.

For the Spectramag and Mag-03DAM data acquisition units, an adaptor cable will be required. This cable must be used despite the connector of the original cable being compatible with the power supplies.



Caution: The Mag-13 sensor will not function correctly if plugged directly into a Spectramag-6 or Mag-03DAM without the use of an adaptor cable.

7. Cables and Connectors

7.1. Cables

Cables are available to connect the range of Mag-13 sensors to the range of suitable Bartington Instruments power supply and data acquisition units. Specifications for each of the cables are given in the product brochure.

Note: Cables must be ordered separately.

Note: Customers manufacturing their own cables must ensure the cables are shielded to prevent them picking up EM (electromagnetic) interference.

7.2. Mating Connectors

For information on suitable mating connectors refer to the product datasheet.

8. Mounting

The range of compatible mounting accessories are shown in the product brochure.

The method of mounting will depend on the application and the enclosure. For details of the mounting arrangements for each sensor, refer to the product brochure and the relevant outline drawing on the Mag-13 product page.

Note: The use of magnetic materials in the mounting arrangement must be avoided. Check all mounting components before installation by placing the component within the immediate vicinity of the sensing elements of a working magnetometer and observing any variation in the background field.



Caution: Do not place the sensor head of the unpackaged sensor in the immediate vicinity of electrically conductive materials.



Caution: The absolute maximum screw penetration depth within the body, as shown in the relevant outline drawing on the product page, must not be exceeded.

The analogue output is positive for conventional flux direction, south to north, in the direction of the arrow shown on the label for each axis; i.e. the maximum positive output will be obtained from any axis when the arrow points towards magnetic north along the total field vector.

8.1. Mag-13MC

This sensor can be supported by the Mag-TA Tripod Adaptor described in the product brochure.

The end of the Mag-13MC has a threaded hole for fixing the sensor in place, and three conical indentations that can be used to achieve a more precise alignment of the axes when setting up the sensor.



Caution: The label area of the sensor is recessed and should not be used for clamping.

8.2. Mag-13MS

This sensor can be supported by the Mag-TA Tripod Adaptor described in the product brochure. This sensor has threaded holes tapped in the base which is also the datum face. The sensor can be mounted on any flat, non-magnetic surface, including the Tripod Adaptor, using the two brass screws supplied.



Caution: The absolute maximum screw penetration depth within the body is 8 mm and this must not be exceeded.

9. Operation

9.1. Connector Pin Allocation

The connector pin or cable colour allocation for the connection to each package type is shown on the appropriate outline drawing on the Mag-13 product page.

9.2. Interface

The analogue outputs for the X, Y and Z axes are buffered to give a low output impedance, enabling the unit to be operated over long cables and interfaced with high impedance data acquisition systems.

9.3. Power Supplies

The normal power supply of the sensors is specified in the product brochure. The ideal power supply units are those referenced in [Compatible Power Supply and Data Acquisition Units](#). Alternatively, users may wish to provide their own supply. This should provide a voltage within the specification found in the product brochure. For the low noise applications, any ripple in the power supply should not exceed a few mV.

Note: Adequate performance of the sensor cannot be guaranteed if used with non-Bartington Instruments products. Bartington Instruments cannot advise on the operation of third party products.

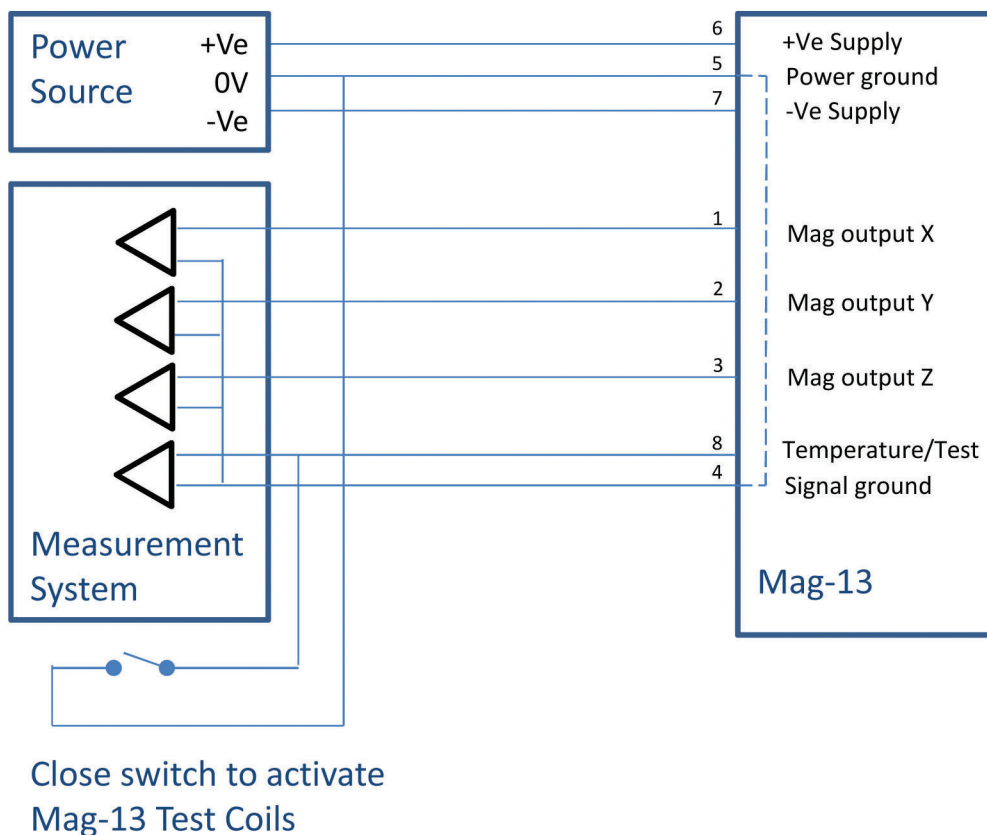
See the product brochure for nominal current requirements. There is an additional current in proportion to the measured field, which is drawn from the positive or negative supply depending on the direction of the field.

9.4. Signal/Power Ground

Note: The two signal/power ground conductors are connected to a common point within the sensor and the power supply common (power 0V) should be connected to only one of them. The other signal/power ground conductor should be used as the signal output common (0V). Each signal is then measured between the signal output conductor and the signal output common. In this way, the signal output common carries no power supply currents.

Note: In long cables, the minimum current in the power ground conductor will give rise to an appreciable potential difference between the power supply end and the sensor end of the power ground conductor. The use of separate power and signal ground conductors will ensure that this voltage is not included in the voltage measured between the signal output and the signal common.

Wiring for the Mag-13 is shown in the diagram below.



Mag-13 outline wiring diagram

9.5. Test Coil

The Mag-13 features a test coil which applies a magnetic field to all axes when activated. The corresponding changes in X, Y and Z output voltages confirm that all axes of the sensor are operational.

The test coil can be activated by grounding the relevant pin of the Mag-13 output connector, i.e. connecting it to 0V. In this way it can be seen that the sensor is measuring correctly when the corresponding change in field is detected in each of the three axes. Refer to the test record for the field values generated for each individual sensor.

Note: Of the available Bartington power supplies, only the Decaport and the DecaPSU will allow operation of the test coil.

9.6. Temperature Sensor

The Mag-13 features an inbuilt temperature sensor that can be used to measure temperature changes inside the sensor over time while taking measurements.

The temperature can be read from the same pin as the test coil as an analogue voltage output. Measure the output between the relevant pin and signal ground. Refer to the product brochure for the voltage output and temperature scaling parameters.

9.7. Connecting Power



Caution: Check that the polarity of the supply is correct. Incorrect polarity can be prevented by using the power supply and cables provided by Bartington Instruments.



Caution: The power supply should be connected to the sensor before the supply is energised, as this prevents high surge currents which could cause damage. Apply the positive and negative supplies simultaneously and avoid leaving the sensor connected to one polarity only.

9.8. Electromagnetic Compatibility

The Mag-13 range of sensors are electrically shielded from external, and emission of internal, electromagnetic fields. Any emissions generated are at a low level with a primary frequency corresponding to the frequency of the energising field of the sensor. The sensor is required to respond to magnetic fields within the specified frequency band.



Caution: Do not operate the sensor in very strong electromagnetic fields as it may develop a permanent offset, or damage could occur to the sensing coils.

Note: Do not place the sensor near to any equipment which may be affected by the very small local field produced by the sensor excitation.

10. Performance

For detailed figures on the performance of the Mag-13 range of sensors, refer to the product brochure.

10.1. Noise

The Mag-13 range includes different noise versions that are specified in the product brochure. These versions correspond to the internal noise of the sensor, which can only be achieved in a shielded environment where no external fields are present.

10.2 Excitation Frequency

The output signal for each axis will also contain breakthrough, which is a residual signal associated with the excitation frequency. (See the product brochure for frequency and level of breakthrough.) All Bartington Instruments power supply and signal conditioning units have a filter to remove the breakthrough.

Note: When using a non-Bartington Instruments power supply, it will be necessary to provide a filter to remove the breakthrough. Not doing so will lead to a higher noise level than that specified. See application note 'AN0042: Connecting your own Power Supply to a Bartington Magnetic Field Sensor' from Bartington Instruments for further information.

11. Troubleshooting, Care and Maintenance

11.1. Troubleshooting

Special equipment is required for the diagnosis of faults within the unit. Much of this equipment is beyond the scope of normal service facilities. Therefore, in the event of any apparent malfunction, email service@bartington.com or telephone the Bartington Instruments service team on +44 (0)1993 706565.



Caution: Attempted repair or opening of the casing by users may invalidate the warranty.

A calibration service is available from Bartington Instruments which is traceable to international standards.

11.2. Care and Maintenance

Surface or dirt contamination should be removed using a mild detergent solution only. If the connector pins become contaminated then they should be lightly cleaned with a swab of isopropyl alcohol.

Note: Dirt on the connectors may lead to increased noise in the output.

12. Storage & Transport

Your sensor is a precision electronic instrument and should be treated as such.



Caution: Avoid exposing this instrument to shocks or continuous vibration.



Caution: Store only within the temperature range specified in the product brochure.



Caution: Do not expose this instrument to strong magnetic fields while being stored.

13. Disposal

This product should not be disposed of in domestic or municipal waste. For information about disposing of your sensor safely, check local regulations for disposal of electrical / electronic products.

13.1. Waste Electrical and Electronic Equipment (WEEE) Regulations



Bartington Instruments Mag-13 sensors comply fully with Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment (RoHS) and WEEE Regulations current at the time of printing.



Bartington® Instruments

T: +44 (0)1993 706565
F: +44 (0)1993 774813
E: sales@bartington.com

Bartington Instruments Limited
5 Thorney Leys Business Park,
Witney, Oxford, OX28 4GE, England.

www.bartington.com

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