

Operation Manual for
CryoMag Three-Axis
Magnetic Field Sensors



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1. About this Manual

This manual describes the installation, operation and maintenance of the CryoMag range of three axis magnetic field sensors. It should be read in conjunction with the product brochure [DS4476](#) and the [outline drawings](#) which can be found on the CryoMag 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.



WARNING: If you are planning on de-soldering the Beryllium-Copper (BeCu) loom at the interconnection PCB, you may need to prepare the BeCu wires for re-soldering. For best results, we recommend that you remove the area of wire that was previously soldered with a cutter or scissors and prepare a new area for soldering. Please note that you must remove the insulation on the BeCu wire first in order to obtain a good solder connection. This can be done using a scalpel blade, by scraping away the insulation. The wires are very small so you may need to use magnification to ensure that you have correctly cleared enough of the insulation. An example of how this should look is shown below.

Beryllium-Copper particles (i.e. dust or small scrapings) are toxic and if inhaled, can cause Berylliosis which poses a fatal risk to human health. However, if the following precautions are taken, the risk from the operation described above is negligible. When scraping BeCu wire, a dust mask (with filtration of airborne particles and aerosols at 0.3 micron and above) must be worn, and a fume extractor must be used as close to the work area as possible.



Additional information can be found here: <https://www.hse.gov.uk/pubns/indg311.pdf>

3. Introduction

This compact, high performance sensor provides measurements of static and alternating magnetic fields in three axes. A two-part design allows the probe to be fitted in locations where temperature goes down to -271°C . This device is a magnetometer which converts magnetic flux density into bipolar analogue voltages. Analogue output voltages V_x , V_y and V_z vary linearly with magnetic flux density.

The analogue output is positive for conventional flux direction, South to North, in the direction of the arrow shown on the sensor head 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 Bartington Instruments data acquisition units, to achieve the noise specification of the sensor.

4. General Description

The CryoMag contains three fluxgate sensing elements mounted orthogonally within the probe part of the sensor. This is connected using a beryllium-copper loom to an interconnection PCB. The beryllium-copper loom is designed to be reliable when cycled between cryogenic temperatures and room temperature, and the interconnection PCB is designed to fit through a 40mm diameter feedthrough tube typically used in cryostats. Wiring at the interconnection board may be desoldered by the customer if required. Please refer to section 2 for more information and guidelines when desoldering from the interconnection board. The interconnection PCB is connected to the drive electronics part of the sensor via a multicore cable. 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.

Product drawing, wiring information, dimensions, position of sensing elements and more can be found on the product Outline Drawing.

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.

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. *Compatible Power Supply and Data Acquisition Units*

A number of other Bartington Instruments products will work with the CryoMag 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.

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 CryoMag 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 CryoMag on the power supply side will require the power supply/signal conditioning unit to be set to the balanced mode to operate the CryoMag 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 CryoMag sensor will not function correctly if plugged directly into a Spectramag-6 or Mag-03DAM without the use of an adaptor cable.

6. *Cables and Connectors*

6.1. *Cables*

Cables are available to connect the CryoMag 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.

6.2. *Mating Connectors*

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

For submersible connectors see [Submersible Connectors guide](#).

7. Mounting

The different parts of the CryoMag can be mounted differently.

1. The Probe: This can be taped or clamped dependent on your application. Do not clamp using magnetic materials. Do not exceed a clamping force of 15N when securing this part.
2. Beryllium-Copper Loom This can be taped or cable-tied. Do not exceed the maximum bend radius of 30mm.
3. Interconnection PCB: This PCB has 4 x 3.2mm diameter holes for mounting purposes.
4. Drive Electronics Cable: This can be taped or cable-tied. Do not exceed the maximum bend radius of 30mm.
5. Drive Electronics Enclosure: This can be taped or clamped dependent on your application. Magnetic materials can be used if necessary but it is not recommended. Do not exceed a clamping force of 15N when securing this part.

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.

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. Operation

8.1. 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 CryoMag product page.

8.2. 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.

8.3. 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.

8.4. 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.

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

8.5. 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.

8.6. Electromagnetic Compatibility

The CryoMag 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.

9. Performance

For detailed figures on the performance of the CryoMag range of sensors, refer to the product brochure.

9.1. 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.

10. Troubleshooting, Care and Maintenance

10.1. 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.

10.2. 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.

11. 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.

12. 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.

12.1. Waste Electrical and Electronic Equipment (WEEE) Regulations



Bartington Instruments CryoMag 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.

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