Operation Manual for

Mag648 and Mag649™

Low Power Three-Axis Magnetic Field Sensors

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Bartington® Instruments

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1. About this Manual

This manual provides the information necessary to help customers connect, install and operate, the Mag648 and Mag649™ magnetic field sensors.

Technical specifications of the products, including power supply requirements and analogue output details, can be found in DS2298, whilst outline drawings of both sensor head, electronics board and cable can be found on the Mag648/Mag649 product page.

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.

Indicates a situation in which ESD protection should be used.

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

Note: A paragraph in this format 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: Environmental and electrical specifications should not be exceeded.

To prevent irreparable damage, electrostatic discharge (ESD) protection and precautions must be used when handling the unpackaged sensor electronics board.

Note: Do not expose to strong magnetic fields while being stored as this can magnetise the sensor and affect its offset performance.

3. Introduction

Both the Mag648 and Mag649™ are magnetometers consisting of a cluster of three, feedback stabilised, fluxgate sensors arranged along X, Y and Z axes. Each axis provides a highly linear magnetic response, with low hysteresis and low crosstalk between axes. These characteristics, combined with the compact design and very low power consumption, make these magnetometers ideally suited for perimeter surveillance within a multi-sensor network. Regulating the power supply internally ensures the Mag64x series is suitable for battery powered operation, over both long and short cables.

The Mag649™ offers a wider bandwidth than the standard Mag648.

High stability circuitry ensures that a minimum of ten years' service should be expected.

4. General Description

Key:

1. Connector cable 2. Sensing Elements

3. Mounting Holes

4.1. Vector Measurements and Conventions

Each magnetometer produces three independent analogue output voltages in response to the magnitude and direction of the orthogonal components of a magnetic field. A "right-hand" co-ordinate system is adopted (see figure 1). In this system the X, Y and Z axis correspond to the thumb, first and second finger respectively of the right hand. By convention, the magnetometer should be installed so that the X axis is arranged to point North, the Y axis to point East and the Z axis to point down.

The centres of the three vector sensors are superimposed; each orientation is denoted on the magnetometer's label. The point of each vector arrow indicates the positive direction of each axis.

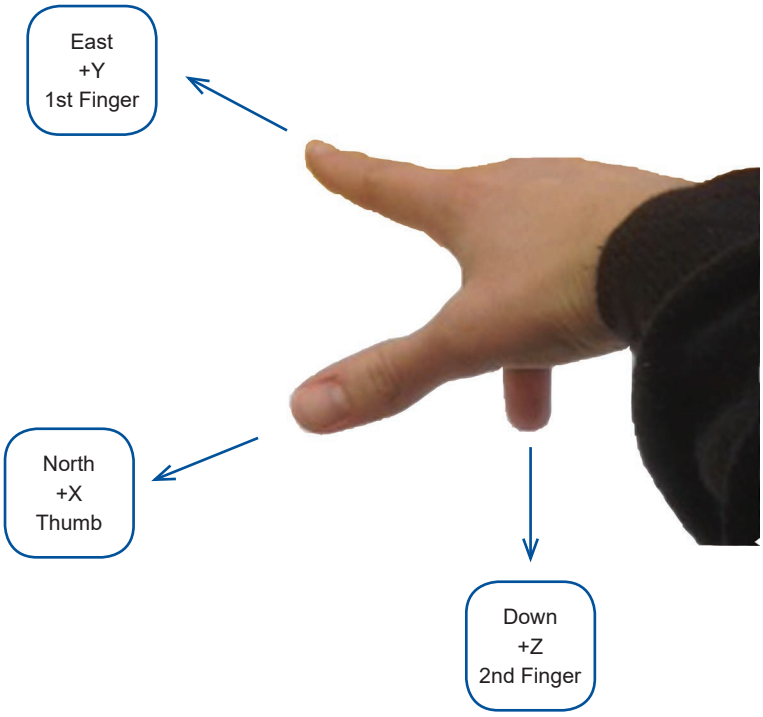

Figure 1. The 'right hand' rule.

5. Connections

5.1. Cable Recommendations

The Mag648 and Mag649™ electronics board provides balanced output lines for analogue signal transmission. Suitable shielded cables can be supplied.

Cables are particularly prone to wear and damage if twisted, flexed beyond their design limits, or subjected to excessive or repeated movement. All cables should be mounted securely in place.

When designing their own cable, the following recommendation should be followed:

- ensure that the cables are shielded to prevent them picking up electromagnetic interference.
- the cable shield should be connected to power supply ground at the power supply end (either through the connector body, or by connecting the shield to the power ground wire).

5.2. Connection to Power Supply/Acquisition Unit

Caution: When providing your own power supply, do not exceed the voltage rating, provide sufficient current, and ensure correct polarity is respected see DS2298.

Caution: Connect the Mag648/Mag649™ sensor before the supply is energized, as this prevents high surge currents which could cause damage.

Note: Apply the positive and negative supplies simultaneously, and avoid leaving the electronics board connected to one polarity only.

The analogue output of the sensors as well as the power supply connectors are available on the outline drawing DR2389.

Where no Bartington power supply or acquisition unit is used, some basic recommendation for integration of the sensor are available in AN0042.

5.3. Mounting Recommendations

Each magnetometer has a set of mounting holes to allow attachment to a stable base or fixture. Refer to the mechanical drawings on the product page.

Caution: (For the Mag648S and Mag649S only) Take care to align the cable to the connector correctly, to avoid damage to the connector or magnetometer. When aligned correctly, hand tighten the connector. Refer to the product brochure for detailed information.

Caution: (For the Mag648U and Mag649U only) Allow for recess above the coil blocks when mounting the sensor. Mounting screws may protrude on top.

Note: Other versions of the Mag648 and Mag649™ have plug-in type connectors.

The sensor can also mounted on the Bartington Instruments Mag-TA Universal Tripod Adaptor. See drawing DR3140, available from Bartington Instruments, for instructions on how to do this.

6. Using the Mag648 and Mag649™

6.1. Mag648 and Mag649™ Operation

The sensor will provide an analogue output which is proportional to the field measured. Please refer to DS2298 for the sensor's scaling factor.

Testing of the sensor's response can be done, as an example, by moving the sensor in the Earth's field and ensuring that the signal varies in relation to orientation. In the horizontal plane, a minimum value is obtained when the axis is in the magnetic East-West direction, and maximum when pointing Magnetic North.

6.2. Electromagnetic Compatibility

Note: The Mag648 and Mag649™ sensors are not shielded for immunity from, or emission of, electromagnetic fields.

7. Troubleshooting

The sensor is unlikely to suffer any defects in normal use: no internal components are serviceable. The most likely causes of failure, and their solutions, are detailed in the following table.

In the event of any apparent malfunction beyond those described in the table below, please email service@bartington.com, or telephone the Bartington Instruments service team on +44 (0)1993 706565.

Problem	Cause	Solution
There are no analogue outputs present in X, Y or Z	Sensor head not connected	Ensure that the sensor head and electronics are connected as per Probe and Electronics wiring.
	Power supply not connected or not sufficient to power the sensor	Check that the power supply meets the requirement provided in DS2298 and that the connection is as per Connection to Power Supply/Acquisition Unit.
	Broken coil	If only one or two axes is (are) not responding, one of the fluxgate coil could be damaged. Please return the unit to us for assessment.
	Component damage	If only one or two axes is (are) not responding, one component could be damaged. Please return the unit to us for assessment.
There is an abnormal current draw on the sensor	Faulty component	A faulty component can lead to an abnormal current draw before it fails. Please return the unit to us for assessment.
The amplitude of the Earth's field is abnormal	Erroneous scaling factor	If the scaling factor applied to convert volts into field amplitude is erroneous, the field reading will appear either systematically high or low depending on the error on the scaling factor. Please check the conversion rate used in the acquisition software.

The noise on the output is much higher than the specified noise at low frequency	Ambient environment is noisy	A noisy environment will be picked up by the sensor. Noise tests should be carried out in a shielded environment.
	Sensor breakthrough not filtered properly	The sensor has a high frequency noise component referred to as breakthrough in the datasheet. This signal at the excitation frequency of the sensor, if unfiltered can be aliased creating an apparent low frequency noise. Check that a suitable low pass filter is used or that the signal is sampled at a suitable frequency (at least twice the breakthrough frequency).

8. Care and Maintenance

Surface dirt contamination on the Mag648 and Mag649™ probe should be removed using a mild detergent solution only. Electronics should be cleaned with an antistatic cloth only. ESD protection should be used when handling the electronics board, to prevent irreparable damage.

The Mag648 and Mag649™ electronics board should be treated subject to ESD precautions.

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

Note: Do not expose to strong magnetic fields while being stored as this can magnetise the sensor and affect its offset performance.

8.1. Calibration

Return the Mag648 or Mag649™ to Bartington Instruments for calibration at the recommended intervals. Refer to the Calibration Certificate for further details.

9. End of Life 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.

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