Operation Manual for

Mag614 Miniature High Temperature Three-Axis Magnetic Field Probes

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1. About this Manual

This manual provides the information necessary to help customers connect, install and operate, the Mag614 Miniature Three-Axis Fluxgate magnetometer.

Photographs of key components are included, labelled with numbers. A number in the text in square brackets [ ] refers to that label.

Technical specifications of the products, including power supply requirements and analogue output details, can be found in DS3629, whilst outline drawings of both sensor head, electronics board and cable can be found on product outline drawing 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

The Mag614 is a miniature three-axis fluxgate probes for operation at high temperatures, up to 175°C. The probe is available in two versions, one with pins, and one with flying leads. This manual describes the mounting of both versions. Two mounting holes variants exist for both the Mag614 and Mag614-FL. Please refer to the datasheet or outline drawings for further details.

These probes are designed for integration into measurement while drilling tools, and built to withstand high levels of shock and vibration.

The probes are designed to be operated with separate drive electronics. A suitable fluxgate electronics design document can be purchased from Bartington Instruments. A room temperature unpackaged drive electronics board is available for initial testing.

> **Note:** The Mag614 requires a dedicated electronics and is not compatible with other Bartington Instruments electronics boards.

4. General Description

4.1. Mag614 Sensor head (pin version)

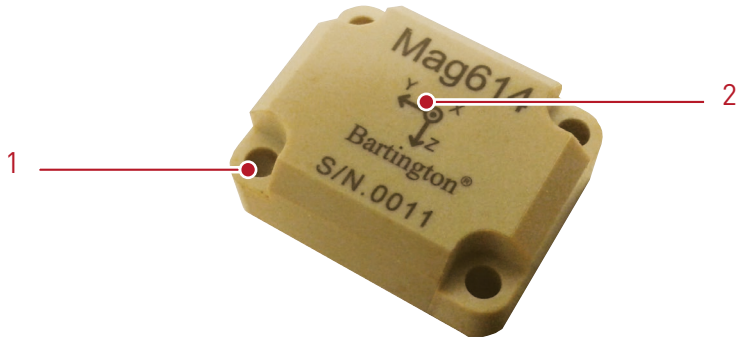

Figure 1. Mag614 probe (top view)

Key

1. Mounting Holes (see DR3551 or DR4363) 2. Axes direction indicator

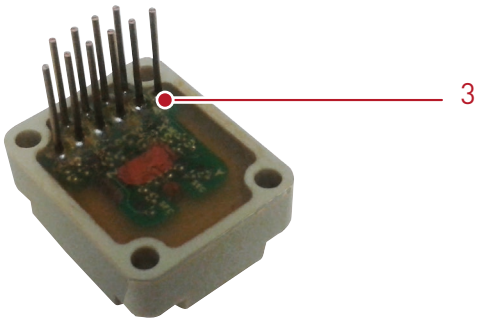

Figure 2. Mag614 Probe (bottom view).

Key

3. Connection pins - refer to DR3551 for connection details.

4.2. *Mag614-FL Probe (flying lead version)*

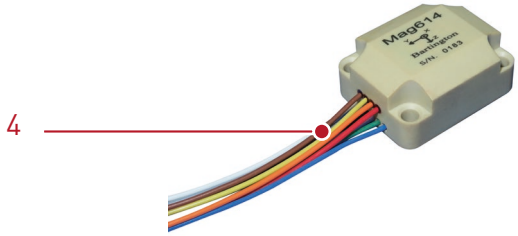

Figure 3. Mag614-FL Probe (top view)

Key

4. Flying leads - refer to DR4363 for connection details.

4.3. *Mag614-RTUDE Drive Electronics*

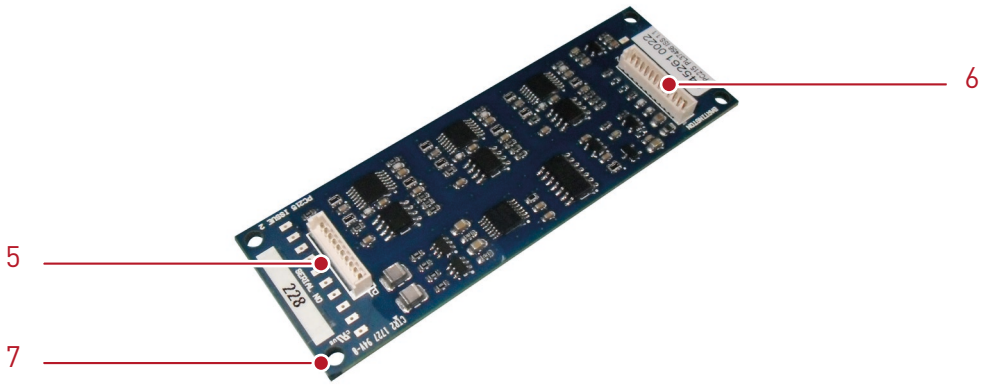

Figure 4. Mag614 Drive Electronics

Key:

5. PCB connector P1/solder pads for connection to Mag614 probe 7. Mounting Holes
6. PCB connector P2/solder pads for sensor's analogue output (refer to DR4374 for pin-out information)

4.4. Excitation synchronisation

The Mag614-RTUDE provides the ability to synchronise multiple sensors to a master sensor's excitation clock. Two pins are provided on connector P2 (CLOCK_IN and CLOCK_OUT - see DR4374). The master sensor's CLOCK_OUT pin should be connected to the CLOCK_IN of the second sensor in the chain. Subsequent sensors are then daisy chained as illustrated below.

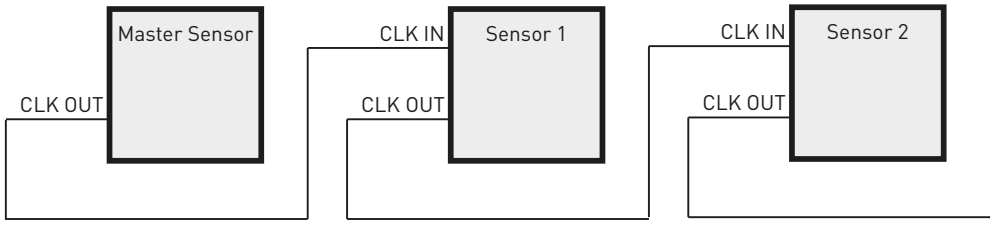

Figure 5. Mag614 Sensor Daisy Chain

5. Magnetic Field Sensor Circuit Design

High temperature magnetic field sensor circuit schematics and design notes are available, at additional cost, from Bartington Instruments.

Optionally, unpackaged room temperature electronics are available that are compatible with the Mag614 sensors. See DS3629.

Contact the Bartington Instruments sales team for more information on sales@bartington.com.

6. Probe Location and Mounting Recommendations

The probe should be located away from large sources of magnetic fields that may over-range the sensor or interfere with the field being measured. The probe should not be mounted on an electrically conductive surface, as this may trigger some apparent offsets.

The method of mounting will depend on the application and the enclosure. The probe is available in two versions, with pins or flying leads.

Two mounting hole options are available (see outline drawings). In both cases, the probe should be securely fastened to a stable base.

Caution: Users should be careful not to overtighten threaded holes

For details of the mounting arrangements for the probe, refer to drawing DR3551 and DR4363 available on the product page of the Bartington Instruments website.

Note: The use of magnetic materials in the mounting arrangement must be avoided. All mounting components should be checked before installation, by introducing the

component within the immediate vicinity of the sensing elements of a working magnetic field sensor, 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 DR3551 and DR4363 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.

7. Connections

Connection details for the Mag614 probe is provided in DR3551 or DR4363, available on the Bartington Instruments website.

7.1. Soldering Guidelines (Mag614 pin version only)

Caution: Ensure that the Mag614 pins are not over heated during soldering/de-soldering from the board or they may be damaged.

When soldering a Mag614, a 320˚C (600˚F) soldering iron should be used. Apply heat for no longer than 7 seconds, per pin, to prevent permanent internal damage.

Caution: When de-soldering, care must be taken to ensure all solder joints are flowing before attempting to remove the Mag614 from the PCB. Ideally a solder pump should be used to minimise heat soak.

7.2. Probe and Electronics wiring

First connect the sensor head to its electronics where applicable. When supplied as a pair Mag614 Probe and Mag614-RTUDE, the serial number of the electronics will be identical to that of the probe. These should be matched. Using unmatched probe and electronics will lead to deterioration in performances including orthogonality and scaling error.

Connection of the sensor head to the electronics can be done via the connectors supplied on the Mag614-FL flying leads and the connector P1 on the electronics or by soldering the Mag614-FL flying leads directly to the pads located near connector P1 (see DR4374).

Note: When wiring the probe, ensure you correctly identify Pin 1 of the connectors, shown on drawing DR4374.

When connecting the Mag614 Probe (pin version) this will be soldered onto a suitable PCB following the soldering instructions above.

7.3. 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 DS3629.

Caution: Connect the Mag614-RTUDE 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 are available on connector P2 on the electronics board. Alternatively these are also available on a set of pads near P2. Refer to the outline drawing DR4374.

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

8. Cable Recommendations

When using the Mag614-RTUDE electronics board provides unbalanced output lines for analogue signal transmission.

When designing your 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).
- shielding of the wires connecting the sensor head to the electronics is strongly recommended.

9. Mag614 Operation

Once the electronics is fully connected to both sensor head and power supply/acquisition unit, the supply can be switched on. The sensor will provide an analogue output which is proportional to the field measured. Please refer to DS3629 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 vary in relation to their 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.

10. Electromagnetic Compatibility

Note: The Mag614 probe and electronics board are not shielded for immunity from, or emission of, electromagnetic fields.

Note: The Mag614 is intended for integration into other systems. Ensure these meet the appropriate level of shielding.

11. 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 DS3629 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 can be damaged. Please return the unit to us for assessment.
	Component damage	If only one or two axes is (are) not responding, one component can 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).

12. *Care and Maintenance*

Surface dirt contamination on the Mag614 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 Mag614 electronics board, to prevent irreparable damage.

The Mag614 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.

13. *End of Life Disposal*

This product (electrical and electronic equipment) should not be placed in municipal waste. Check local regulations for disposal of electronic products.

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