Operation Manual for

Mag690 Three-Axis Fluxgate Magnetometer

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Bartington® Instruments

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1. About this Manual

This manual describes the installation, operation and maintenance of the Mag690 Magnetic Field Sensors. It should be read in conjunction with product brochure DS2604 and outline drawings which can be found on the product page on the Bartington Instruments website at www.bartington.com.

Note that failure to follow the instructions in this manual may invalidate your product's warranty. If in doubt, do not hesitate to contact Bartington Instruments.

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.

This symbol identifies items that must be disposed of safely to prevent unnecessary damage to the environment.

Note: A note provides useful supporting information and sometimes suggests 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.

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

3. Introduction to the Mag690

The Mag690 is a magnetic field sensor consisting of three fluxgate sensing elements in an orthogonal configuration along X, Y and Z axes. This low cost, general purpose sensor is suitable for use in the field as well as in a laboratory environment.

The sensor include fluxgate elements and associated drive electronics and will require an external power supply and acquisition unit. Bartington Instruments offers a range of suitable units. For further information please refer to our website or contact us at sales@bartington.com.

3.1. Vector Measurements and Conventions

The three axes of the sensor are concurrent and arranged following a 'right-hand rule' (Figure 1). Details of the axes position and orientation can be found in the outline drawing and on the sensor's label. The arrow indicates the direction for which a positive field will provide a positive output.

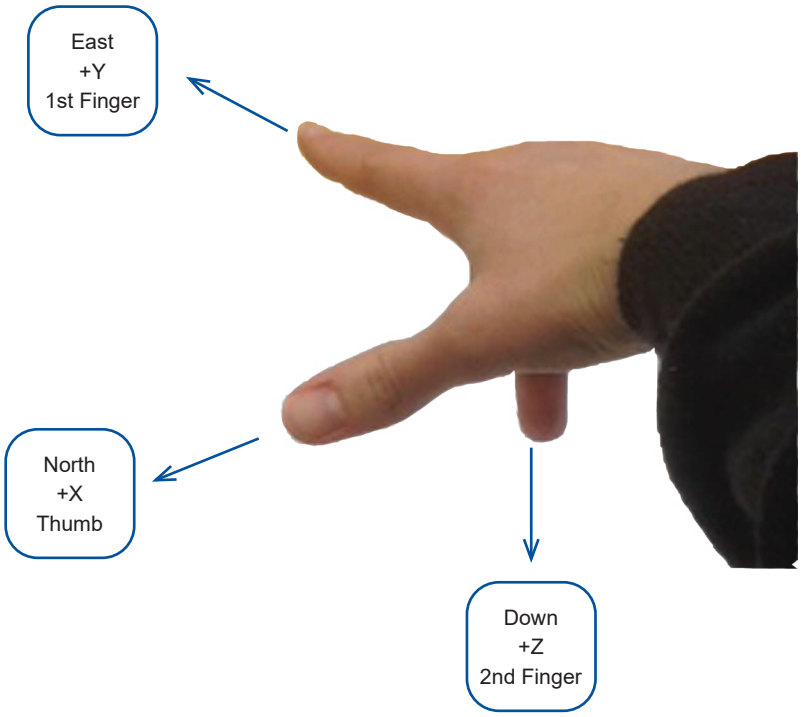

Figure 1. Illustration of the Right Hand Rule

4. Installing the Mag690

4.1. Positioning the Magnetometer (Environmental Recommendations)

It is recommended to keep the sensor away from strong sources of AC and/or DC magnetic fields which may saturate the sensor. Due consideration should also be given in the position of the sensor in respect of ferromagnetic objects (application dependent).

> **Note:** Avoid placing the sensor in contact with electrically conductive material in order to prevent the generation of eddy currents. These may create additional offsets.

4.2. 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 for details.

The sensor can also be mounted on the Bartington Instruments Mag-TA Universal Tripod Adaptor.

4.3. Connection Recommendations

4.2.1. Connector Pin Allocation

Connector pin-out or cable wiring schedule for each sensor variant can be found on the outline drawing available on the website product page.

Caution: When fitting your choice of connector to the Mag690FL, refer to the product brochure for wire gauge and carefully follow any instructions and recommendations issued by the connector manufacturer.

Do not use a Mag648 cable (Black Binder connector) to connect a Mag690 (Blue Binder connector) as this can damage the device. Always match the colours of the Binder connectors; Blue to Blue, Black to Black.

4.2.2. Interface

Diodes protect against reverse connection of power voltages of up to 40V. X, Y and Z outputs are protected against short circuit to 0V.

Caution: Short circuits from output to either power rail may result in permanent damage to the sensor. Limit the power supply current to 100mA to minimise risk of damage caused by incorrect connection.

The low impedance of the three analogue outputs enables the unit to be operated over long cables and interfaced to high impedance data acquisition systems.

4.2.3. Power Supplies and Acquisition Units

The Bartington PSU1, Magmeter-2, SCU1, Spectramag-6, Mag-03DAM and DecaPSU are ideal power supply units and/or acquisition units. Alternatively, users may wish to provide their own power supply.

4.4. Pre-Installation Tests

Prior to using the magnetometer, cable and power supply, ensure that system is correctly setup:

1. Ensure that the sensor and cable are properly connected.

Caution: Avoid bending the cable more than its minimum bend radius.

Caution: For Mag690FL and Mag690U carefully check for correct connection before applying power. Applying incorrect polarity or power to output connections may cause irreparable damage to the sensor.

2. Check the power supply output voltage is suitable for the sensor. Refer to the product brochure for the required values.

Caution: Switch off the power supply before connecting to the Mag690.

3. Connect the power supply to the sensor.

4. Switch on the power supply and wait until the magnetometer has stabilised. Refer to the product brochure for warm-up times.

4.5. Post-Installation Testing

1. After warm-up, monitor the sensor's outputs and ensure the response corresponds to the local field.

2. Apply a magnetic disturbance to each axis and monitor axes' response.

5. Using the Mag690

5.1. Cabling

Note: The connecting cable to the sensor should be an eight-core screened cable. Two cores will be used for positive and negative power supply lines, three cores for output signals, one core for signal common and one for power supply ground. The screen should be connected to supply ground at the supply end only. The capacitance between cores should be less than 200pF per metre. A cable with individually shielded cores should be considered for long cable applications.

Note: Leads are susceptible to EM interference and should be screened wherever possible.

Note: The length of the cable is limited by the voltage drop in the power supply lines and the capacitance between the cores. For this reason the cable should be limited to a maximum length of 600 metres.

Bartington Instruments can supply cables for connecting the sensor to the PSU1, Magmeter-2, SCU1, Spectramag-6 and Mag-03DAM.

5.2. Connecting Power

Caution: Check that the polarity of the supply is correct. 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.

5.3. Response

The analogue output of any channel, will be proportional to the magnetic field present in the direction of the fluxgate sensing element. The proportionality factor (scaling factor) can be found in the product brochure.

5.4. Electromagnetic Compatibility

Note: The Mag690 is not shielded for immunity from, or emission of, electromagnetic fields. Any shield placed around the sensor will limit the bandwidth of the sensor response. The emissions generated are at a low level at the excitation frequency - refer to the product brochure Breakthrough entry for the excitation frequency.

Note: When operating the sensor in environment where electromagnetic fields are present, ensure to use a suitable sampling frequency so as to avoid aliasing.

Note: Do not place the sensor near to any equipment which may be affected by the AC fields produced by the sensor's excitation.

5.5. Performance

Optimum performance of the sensor will be obtained after warm up of the sensor (please refer to product brochure).

The sensor's breakthrough, the amount of excitation signal at the excitation frequency (please refer to product brochure) is typically filtered when using Bartington Instruments power supplies or data acquisition units.

5.6. Magnetic Hysteresis

The Mag690 is designed to have an extremely low magnetic hysteresis. However, Bartington Instruments recommends your magnetometer is not subjected to magnetic fields greater than their stated measuring range for extended periods, as this could alter the DC offset. If this occurs, the offset will exhibit drift as it returns to its original offset specification.

Caution: Subjecting the magnetometer to fields in excess of 2 x the nominal range may cause inaccuracy in future measurements. Degaussing the magnetometer can reverse such an effect.

5.7. Environmental Precautions

Refer to the product brochure for maximum environmental electrical and mechanical ratings.

Caution: Exceeding the maximum ratings may cause irreparable damage to your sensor.

6. 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.

Cause of failure	Solution
Power supply	Check the power supply as detailed in Pre-Installation Tests.
Cables	Check cables continuity using a ohmmeter.
Power Input	If no fault can be found in the power supply or cables, ensure the cable length is not too long, causing excessive voltage drop between the power supply and magnetometer. Refer to the specifications defined in the product brochure.
Magnetometer	No physical damage to the Mag690 can be repaired. Replace with a new unit. For information about disposal of the damaged unit, refer to End of Life Disposal.

7. Care and Maintenance

No repair or servicing is possible with the Mag690. For further information, refer to Troubleshooting.

7.1. Cleaning the Mag690

Use water and mild soap to remove grime from external enclosures.

Caution: Do not clean the unpackaged Mag690U.

Caution: Never use chemicals, such as solvents, when cleaning the Mag690.

Caution: Take particular care when cleaning around electrical connections. Bent or damaged pins may cause the magnetometer to malfunction.

Return the Mag690 to Bartington Instruments for calibration at the recommended intervals. Refer to the Calibration Certificate for further details.

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

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

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

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

Note: If the instrument is left to stand for a long period of time, move it to prevent magnetisation of the cores.

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.

For details of when to dispose of your magnetometer refer to Troubleshooting.

9.1. Waste Electrical and Electronic Equipment (WEEE) Regulations

This sensor complies 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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