

Operation Manual for

Mag628/629 and Mag669

Three-Axis Aerospace Magnetometers

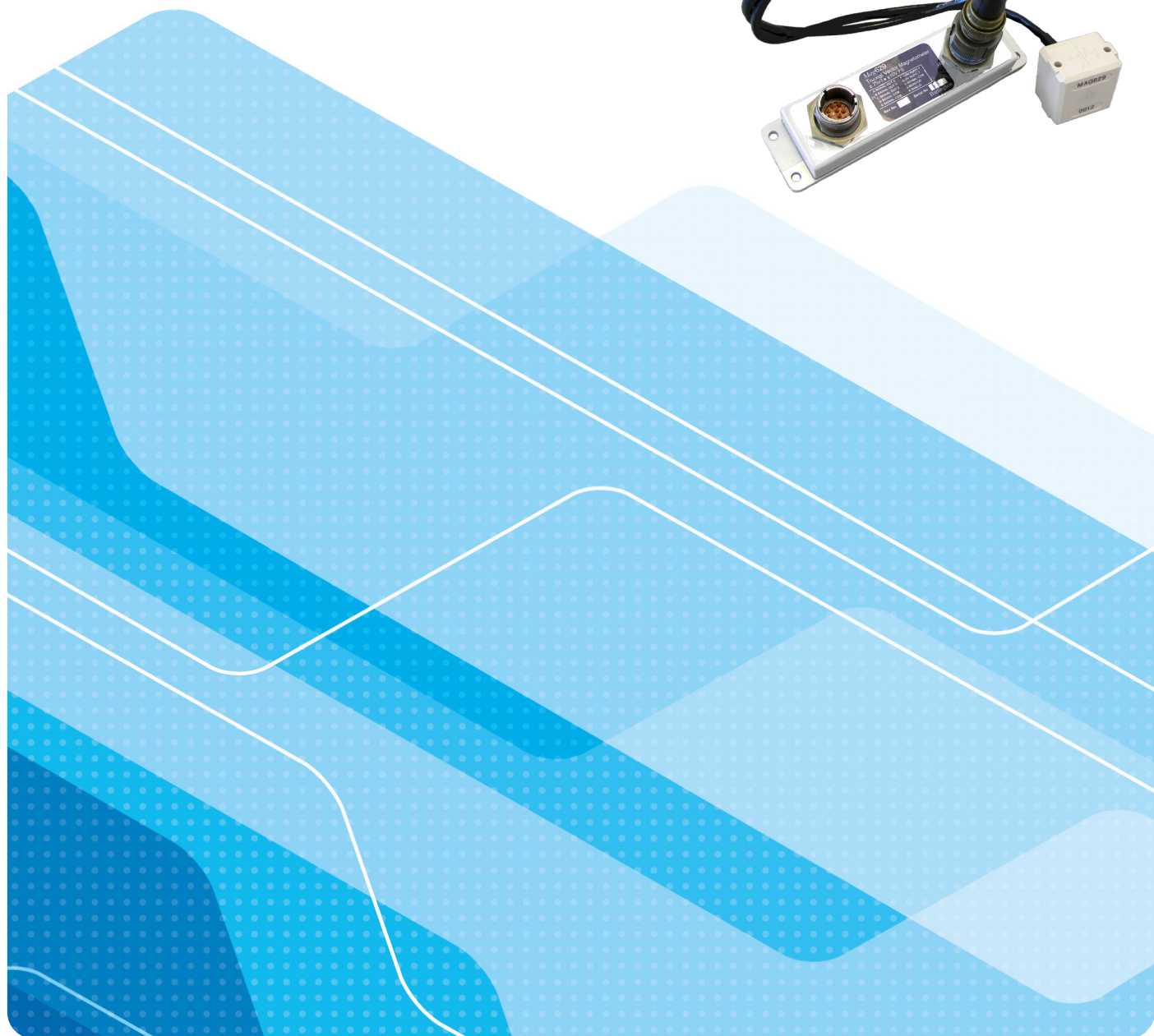


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1. About this Manual

This document describes the installation, operation and maintenance of the Mag628, Mag629 and Mag669 three-axis aerospace magnetometers. It should be read in conjunction with product brochures, 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.



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. Safety Instructions

2.1. Important Information

Note: Early versions of the Mag629 used a Hexavalent Chrome (Cr(VI)) conformal coating, with an epoxy outer layer. The Cr(VI) coating has been phased out as a result of the changing requirements of environmental legislation. See [Hazardous Materials](#).

2.2. Hazardous Materials

2.2.1. Applicability

Note: Warnings about the hazards of contact with Hexavalent Chrome (Cr(VI)) apply only to Mag629 magnetometers with **serial numbers from 1 to 33 inclusive**. No other Mag629s contain Cr(VI).



WARNING: The casing of the Mag629 electronics module is constructed from chromate coated aluminium, which is then covered with pale grey epoxy. The grey paint covering prevents contact with the chromate coating as this may contain up to 4 milligrams of Hexavalent Chrome (Cr(VI)) per instrument. Hexavalent Chrome is considered a serious hazard to human health, particularly if inhaled or ingested.



WARNING: Under no circumstances should the electronics enclosure be deliberately modified, for example by sanding, drilling, abrading, machining, etc. as this could potentially cause a risk to health.



WARNING: If a Mag629 electronics module has been damaged to the extent that the grey epoxy coating has been penetrated, avoid contact and consult your local hazardous materials handling expert. Familiarise yourself with current best practice in dealing with hazardous materials, in particular the use of the correct PPE (Personal Protective Equipment).



WARNING: Under no circumstances should the electronics enclosure be disposed of in normal waste. Dispose of hazardous waste according to local regulations.

3. Introduction to Mag628, Mag629 and Mag669

The Mag628, Mag629 and Mag669 three-axis fluxgate magnetometers are designed specifically to meet the environmental requirements of aerospace applications, with applications such as vector compensation in airborne magnetometry. Refer to the product brochure for specifications.

The two-part construction consists of a sensor head assembly with integrated cable and a separate electronics module. The sensing head contains the three concurrently sensing fluxgates arranged along X, Y and Z axes. The electronics module carries processes and outputs the signals, and also provides a monitor signal output to warn of power supply faults.

The sensor head is fully sealed and may be installed in exposed situations. It and the Mag629 electronics enclosure can withstand high levels of shock and vibration, dust, humidity, corrosive atmospheric conditions, acoustic noise and electromagnetic fields, whilst operating within a wide range of both temperatures and pressures.

The electronics of Mag628 and Mag669 are un-encapsulated and must be installed within the customer's electronics enclosure to provide environmental and EMC protection.

3.1. 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. 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 points north, or towards the front of the vehicle; the Y axis points east, or towards the right side of the vehicle; and the Z axis points down.

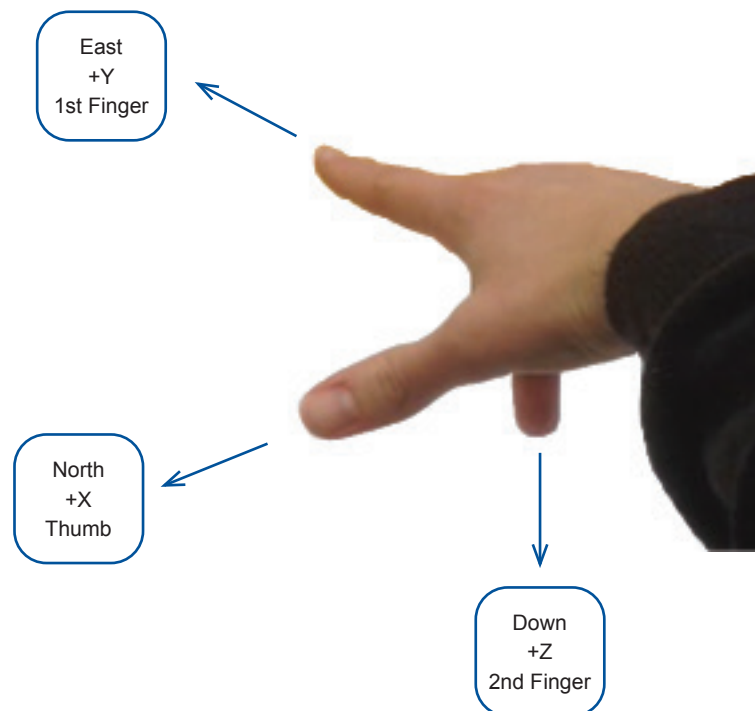


Figure 1. The 'right hand' rule.

The centres of the three vector sensors are superimposed; each orientation is denoted on the sensor head engraving. The point of each vector arrow indicates the positive direction of each axis.

4. Installing the Mag628, Mag629 and Mag669

4.1. Siting the Magnetometer (Environment Recommendations)

In whatever situation the Mag628, Mag629 or Mag669 is to be installed it is important to avoid, or compensate for, local magnetic effects. In general:

- Site the magnetometer several tens of metres from very large ferromagnetic objects that could become magnetised and create fields exceeding the measuring range of the sensor.
- Avoid siting the sensor near any ferromagnetic objects that may be subjected to the effects of magnetic hysteresis, which would affect the sensor in an unpredictable manner.

For these reasons, a magnetic evaluation of any proposed installation site should be conducted to establish that it is free from magnetic contaminants. It is recommended that such an evaluation be carried out using total field or resonance magnetometers.

4.2. Connection Recommendations

4.2.1. Cables and connections

Note: Cables are particularly prone to wear and damage if twisted, flexed beyond their design limits, or subjected to excessive or repeated movement. It is recommended that all cables are mounted securely in place. For further details refer to [Mounting Recommendations](#).

Mag628 and Mag669

Note: The sensor head cable is supplied without a connector. The customer must provide the connection between the sensor head cable and the electronics assembly. Connection details are provided in outline drawings, available from Bartington Instruments.

Mag629

Note: The cable between the sensor head and electronics module of the Mag629 is an integral part of the sensor head and cannot be modified except at Bartington Instruments.

Note: To connect your Mag629 to a data acquisition unit via a recommended mating connector, you will need to refer to outline drawing for cable and connector details, pinouts, etc.

Interface

The electronics assembly is plugged directly via PL1 and PL2 onto the customer's electronics PCB (motherboard) using connectors and screws detailed in outline drawing DR2591.

Power supplies



Caution: Power is supplied by the customer as per the product brochure. Current is specified in the product brochure. There is no protection on the electronics assembly; the customer must ensure that the correct voltages are provided on the motherboard connectors.

Signals and ground

The 0V (ground) for the unit is applied to PL1 4, 5, 8 and 10 alongside the power supply.

Note: The ground voltages on PL2 pins 1 and 5 are the returns for the sensor excitation and detection respectively; they are connected on the electronics PCB and should not be connected to the 0V plane of the customer's motherboard.

PL2 pin 9 is used to detect if the sensor head is connected; it is connected to pin 5 through the sensor head wiring. When sensor is connected, pin 9 is grounded and the test signal is cleared.

4.2.2. Pre-Installation Tests

Mag628 and Mag669

Prior to the assembly of the system the connection to the motherboard must be checked as follows:

1. Check the power supply voltages to be $\pm 15V$ ($\pm 5\%$) using a voltmeter.
2. Ensure each sensor head lead is connected to the correct pin on the electronics assembly; see outline drawing for details. Wiring and connectors are supplied and fitted by the customer.

Mag629

Prior to the installation of the system, the magnetometer, cable and power supply must be fully tested to ensure correct function as follows:



Caution: Take care to avoid bending, or otherwise damaging the contacts whilst conducting the tests.

1. Test the cables for continuity (using an electrical continuity tester or ohmmeter).
 - a. Test the cables end to end at the connectors to ensure the correct pins have been allocated to the conductors and there are no open or high resistance circuits.

Note: Cable resistance will vary; refer to the product brochure for the expected values.

- b. Test the cables at the connectors to ensure there are no short circuits between the conductors.
2. Check the power supply output voltage using a voltmeter. Refer to the product brochure for the expected values.
 3. Check no dust or obstructions have fallen into the cable connector or its socket and clean if necessary using an air duster.
 4. Connect the sensor head and integrated cable to the electronics module. The two connector sockets on the electronics module are different to ensure correct connection. The connector can only be installed in one orientation. Hand-tighten the securing collar.
 5. Connect the magnetometer to the cable connector.
 6. Connect the power supply to the other cable connector.
 7. Switch on the power supply and confirm that the monitor line output is high.
 8. For each of the three (X, Y and Z) axes in turn:

- a. Connect a voltmeter to the axis sensor outputs, i.e. across signal X and common.
- b. Whilst monitoring the voltmeter readings, align the magnetometer with the terrestrial field.
- c. Confirm the measured readings approach the local geomagnetic field value.

Note: Geomagnetic field values can be provided by your local magnetic observatory. A margin of error due to local disturbance should be taken into account.

4.3. Mounting Recommendations

Each magnetometer sensor head and electronics module has a set of mounting holes to allow attachment to a stable base or fixture. Refer to the mechanical drawings on the product page on the Bartington Instruments website.

The sensor can also be mounted on the Bartington Instruments Mag-TA Tripod Adaptor using the Mag-TA Product Adaptor mounting plate. See datasheet DS3140 for instructions on how to do this.



Caution: Once the sensor head and electronics module have been installed as required, route the sensor cable so that the minimum bend radius is 75mm (3 inches) in the most flexible plane (see [Connection Recommendations](#)). Once in place, secure the cable at sufficient points along the length of the cable to avoid excessive flexing.



Caution (Mag629): 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 collar. Refer to the product brochure for detailed information.

4.4. Installation

1. Site the magnetometer, and install the power supply and cabling.
2. Switch on the power supply and wait until the magnetometer has stabilised.
3. Confirm no magnetic objects are moving in the vicinity.
4. Monitor the sensor outputs.
5. Confirm that the 'test' output is high.
6. Confirm that the sum of the measured magnetic field vectors is similar to the expected local earth field.

Note: The outputs from the sensor should remain stable to within the quoted noise limits. Refer to the product brochure for the expected values.

4.5. Post Installation Testing

When the sensor and electronics are installed and power is applied, the following checks can be made:

1. The 'test' output (Mag628 and Mag669: PL1 pin 9) is open circuit (normally pulled to a positive voltage by a resistor).
2. Each of the analogue outputs will register a voltage equivalent to the earth's magnetic field. The level on each channel will vary depending on sensor head orientation between equal positive and negative maximum values of approximately 6V corresponding to typical earth field.

5. Using the Mag628, Mag629 and Mag669

5.1. Operation

The sensor functions immediately after power is supplied, providing an analogue voltage on each of three channels in response to the applied magnetic field.

5.2. Magnetic Hysteresis

The Mag628, Mag629 and Mag669 are 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.

5.3. Environmental Precautions

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



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

6. Troubleshooting

Your Mag628, Mag629 or Mag669 are unlikely to suffer any defects in normal use. Neither the electronics nor the sensor head are user serviceable. As the sensor head and the electronics assembly are matched, in the event of damage to either, return both to Bartington Instruments.

Mag628 and Mag669 customers should supply (details of) a mating connector to allow Bartington to make connection between sensor head and electronics connector; otherwise the customer's connector will have to be permanently removed to allow servicing to be carried out.

The most likely causes of failure for Mag628, Mag629 and Mag669, and their solutions, are detailed in the following table:

Function	Failure Symptom	Failure Cause	Failure Analysis/severity and solution*
Output signals for one or more axes.	Output floats to saturation (close to supply rails).	Severance or uncoupling of sensor head to electronics unit cable.	Major failure – will immediately be detected by operator.
	Output goes high impedance.	Loss of power to the	Check connections to sensor head (Mag628, Mag629 and Mag669) and/or voltages on PL1 (Mag628 and Mag669 only). 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.
	Output becomes 0V.	Internal component failure.	Return to Bartington Instruments for servicing.

Test signal: PL1 pin 9 (Mag628 and Mag669) or J1 pin J (Mag629) usually pulled up through a resistor to a positive voltage, e.g. 10k to +5V.	Test pin is high impedance when OK; sinks up to 10mA to GND/0V when fault is detected or unit is not powered.	Severance or uncoupling of sensor head to electronics unit cable.	Major failure – will immediately be detected by operator.
		Loss of power to the	See above.
		Internal component failure.	Return to Bartington Instruments for servicing.

7. Care and Maintenance

No user repair or servicing is possible. For further details refer to the section on [Troubleshooting](#).

7.1. Cleaning the Mag628, Mag629 and Mag669

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



Caution: Never use chemicals, such as solvents, when cleaning the sensor head or Mag629 enclosure.



Caution: Take particular care when cleaning around electrical connections. Bent or damaged pins may cause the magnetometer to malfunction. Use an air duster to blow out dust and debris if required. Use appropriate PPE, such as eye protection, when carrying out this task.

7.2. Calibration

Return the Mag628, Mag629 or Mag669 to Bartington Instruments for calibration at the recommended intervals. Refer to the Calibration Certificate for further details.

8. End of Life Disposal



WARNING: Under no circumstances should the electronics enclosure be disposed of in normal waste.

See the [Safety Instructions](#) for warnings concerning early models of Mag629.

8.1. Waste Electrical and Electronic Equipment (WEEE) Regulations

At the time of writing, the Mag628, Mag629 and Mag669 comply fully with current RoHS (restriction of the use of certain hazardous substances in electrical and electronic equipment) regulations, but this manual retains WARNING information as a reference for users of the earlier versions of Mag629 (specified by Serial Number in the section on Hazardous Materials later in this manual).



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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The specifications of the products described in this brochure are subject to change without prior notice.

Bartington Instruments Ltd
5, 8, 10, 11 & 12 Thorney Leys Business Park
Witney, Oxford OX28 4GE. England

Telephone: +44 (0)1993 706565
Email: sales@bartington.com

 **Bartington**[®]
Instruments