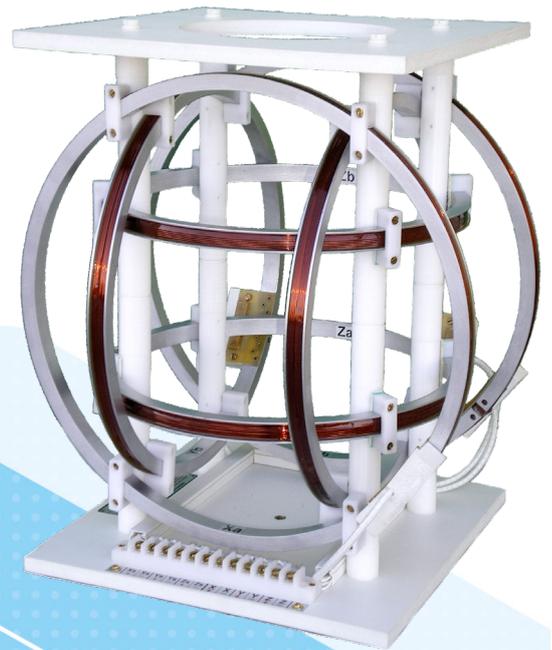


Operation Manual for  
**BH300-A & BH300HF-B**  
Helmholtz Coils



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## 2. About this Manual

This manual provides the information necessary to help customers install and operate the BH300-A and BH300HF-B Helmholtz Coils from Bartington Instruments. The relevant product outline drawings can be found on the [www.bartington.com](http://www.bartington.com) product page.

This manual should also be read in conjunction with the product brochure DS4981 and DS5018 which can also be found on the [www.bartington.com](http://www.bartington.com) product page.

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

### 2.1. 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.

### 3. Safe Use



**WARNING:** This product is not qualified for use in explosive atmospheres or life support systems. Consult Bartington Instruments for advice.

**WARNING:** The electromagnetic field from this product may interfere with the operation of pacemakers and other medical devices. Consult your device's manufacturer before operation.



**WARNING:** Ensure connection strip cover is re-fitted, after connecting BH300 to your power supply, before powering the coil.



**WARNING:** In the UK/EU there is legislation that recommends controlling magnetic field exposure. For this reason safe operation should be observed when using the BH300-A & BH300HF-B by controlling the magnetic field you generate using this product, and understanding the exposure to users.



**Caution:** At maximum current input the coils can warm up to temperatures greater than 50°C. Avoid touching the coils during operation.

### 4. Introduction

The BH300-1/2/3-A, and BH300HF-1/2/3-B are a one, two, or three-axis, desktop-sized set of Helmholtz Coils designed for laboratory use.

The coils produce a magnetic field when a current is circulated through them. The amplitude of the field generated is proportional to the current applied. DC and AC magnetic fields can be generated. The coils are typically used for the calibration of magnetic field sensors, or to generate a stable, controlled field.

The aluminium coil formers can also be connected in a single-turn Helmholtz configuration, using the connection box at the front of the assembly. The coil formers can also be used as screens (shields) for electrical fields. This function could be especially useful for noise suppression when the coils are used as a detector for magnetic flux variations. This is the case, for example, when the magnetic moment of a magnet is measured.

BH300-A has a high turn count for higher field operation. Whereas BH300HF-B has a low turn count for use at higher frequencies.

## 4.1. Recommended Accessories

- BH300-DUTST: This plate affixes to the lower Y coil and contains threaded holes for fixturing jigs, DUTs, etc.
- Magnetometer and associated mounting jig, which can be supplied to check the system at regular intervals.

The BH300-A and BH300HF-B are not compatible with the Bartington Instruments PA1 Power Amplifier.

As an alternative to the PA1, users with their own power supply can use these with the BH300. Refer to the product brochure for the maximum current which can be applied to BH300.

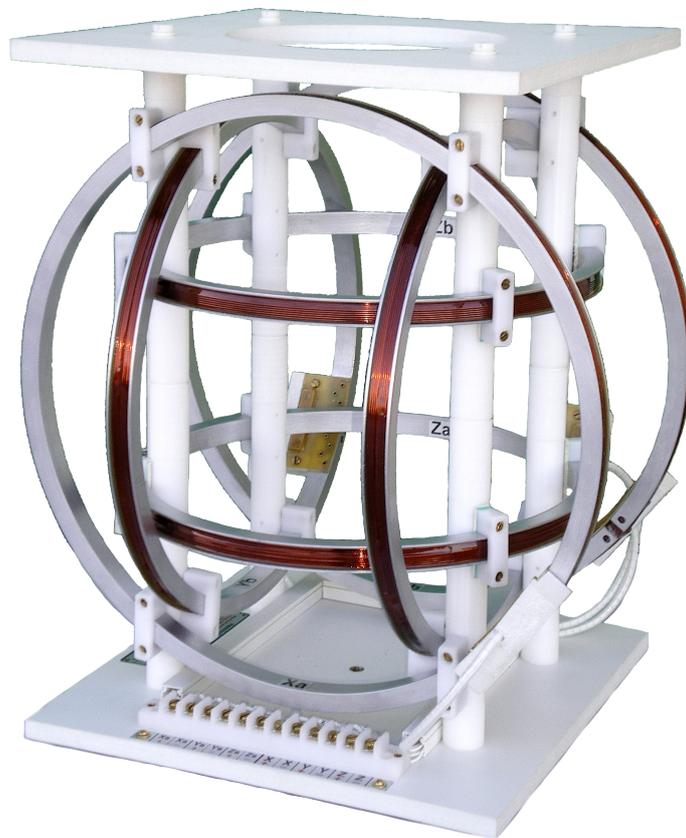


Figure 1. A view of the BH300-A coil set

**Note:** The 3-axis version of the BH300-A Helmholtz coils. Other versions have a similar appearance but with fewer axes present.

## 5. BHC300 Helmholtz Coil Features

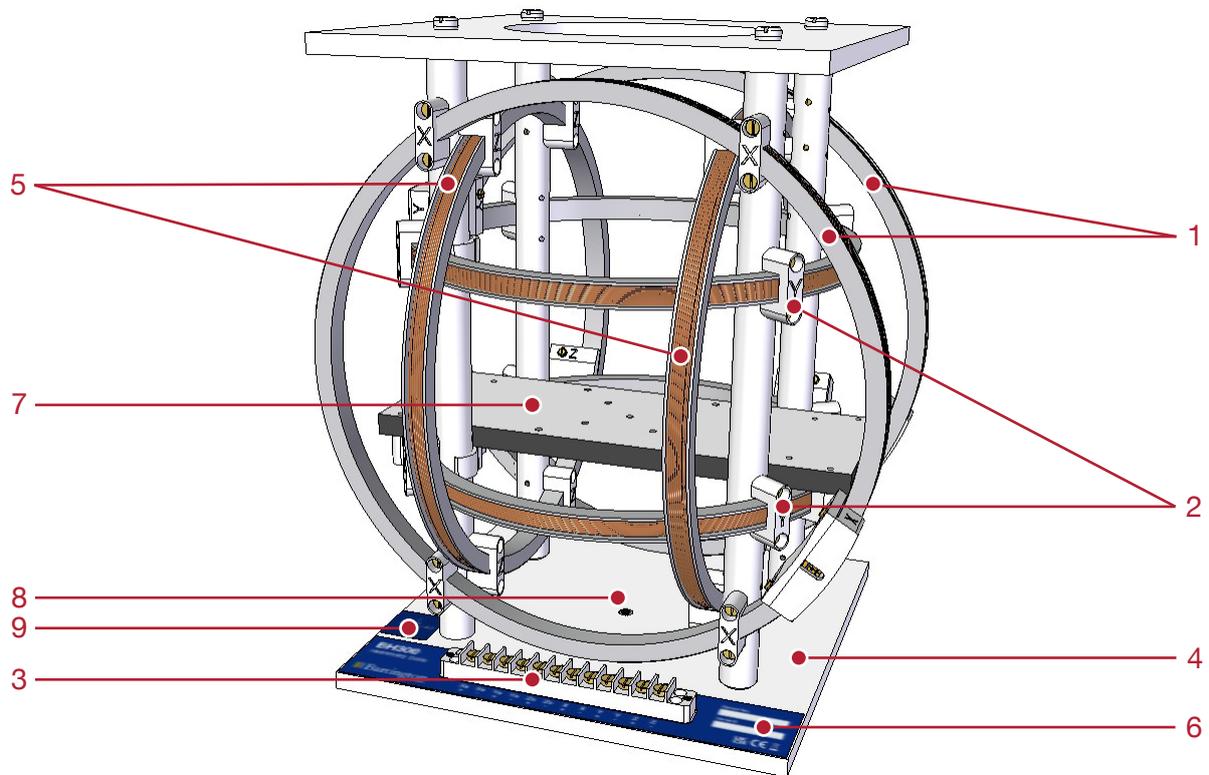


Figure 2. BH300-A features

### Key

- |                               |                            |
|-------------------------------|----------------------------|
| 1. X-axis coils               | 5. Z-axis coils            |
| 2. Y-axis coils               | 6. BH300 label             |
| 3. Connection block and cover | 7. BH300-DUTST accessory   |
| 4. Base plate                 | 8. M6 mounting feature     |
|                               | 9. Field orientation label |

## 6. Compatibility

The BH300 is not compatible with the Bartington Instruments PA1 Power Amplifier. An alternative current source will be required.

Mounting accessories for various Bartington sensors are available as an additional option.

### 6.1. Assembly

Assembly is not required. The Helmholtz Coil is supplied ready to be used.

## 7. BH300 Helmholtz Coil Operation

### 7.1. Installation

The BH300 Helmholtz Coils should be installed in a magnetically clean area, that is, an area with small magnetic gradient, and with little magnetic disturbances.

The BH300 should be installed on a non-metallic base and kept away from:

- Large conductive objects which may induce currents, and therefore secondary magnetic fields, when generating AC magnetic fields.
- Sources of magnetic field, either DC (for example, large objects made of magnetic materials) or AC (for example, mains powered equipment) as these will distort the magnetic field around them, and may affect the shape and extent of the homogeneous area.

The Helmholtz Coils have four fixed anti-slip feet, fastened with the same screws that fix the lower plate to the pillars.



**WARNING:** To pick up the Helmholtz Coils, it must not be lifted by the coils as these, or their brackets, may become damaged.

Lift with both hands, only by the base.

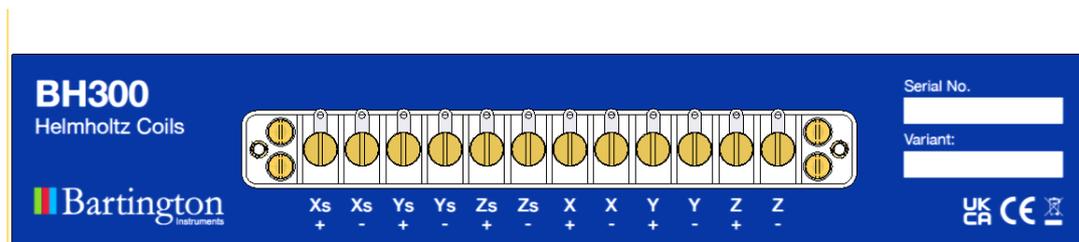
Ideally, a magnetic field survey should be carried out to assess the suitability of the site. This can be carried out using a Mag-03 Three-axis fluxgate magnetometer connected to a Spectramag-6 Data Acquisition Unit, or DG-1 Digitiser. Contact [support@bartington.com](mailto:support@bartington.com) for further assistance.

**Note:** The largest coil of the Helmholtz Coils should be positioned so that the field it generates is in the direction of the lowest ambient field strength. This will reduce the level of DC offset applied, and optimise the maximum field which can be generated in that direction.

**Note:** It is not recommended to place the BH300 on the floor, as there may be unknown elements in or below it that will affect its operation.

## 7.2. Connecting the BH300

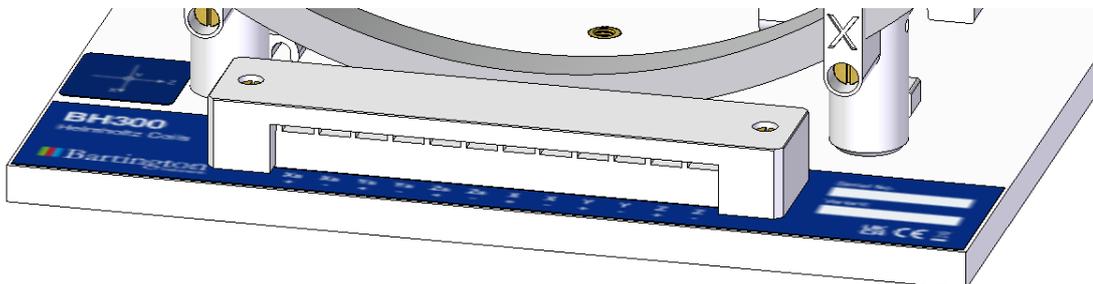
The BH300 is a passive coil with no controls of its own. When connected to a current source, and current is circulated through the coils, a magnetic field is induced.



Connections to the BH300 are made via the connection block on the base plate, in front of one of the X-coils.

A cover is provided, and must be removed before connections to the coil can be made.

**WARNING:** This cover must be re-fitted after connections are made to ensure there are no exposed live terminals.



**WARNING:** Xs+, Ys+ and Zs+ must be connected to mains Earth if using the coil at high voltages to protect the user and power supply from fault conditions.

### 7.3. Coil Circuits

Each coil from a pair is identified with an “a” or with a “b”. In this way, for example, the X pair is formed by the X-a and X-b coils.

The aluminium coil formers of each coil makes a loop itself; it is also used as if it were a one-turn coil, with its respective independent connections on the connection block. These coils are described with the “s” suffix, so, for example, the X pair is associated to the Xs pair.

The following drawing shows the previous X pair example. This is just a simplified diagram only for the X pair, but it is equally valid for the Y and Z pairs.

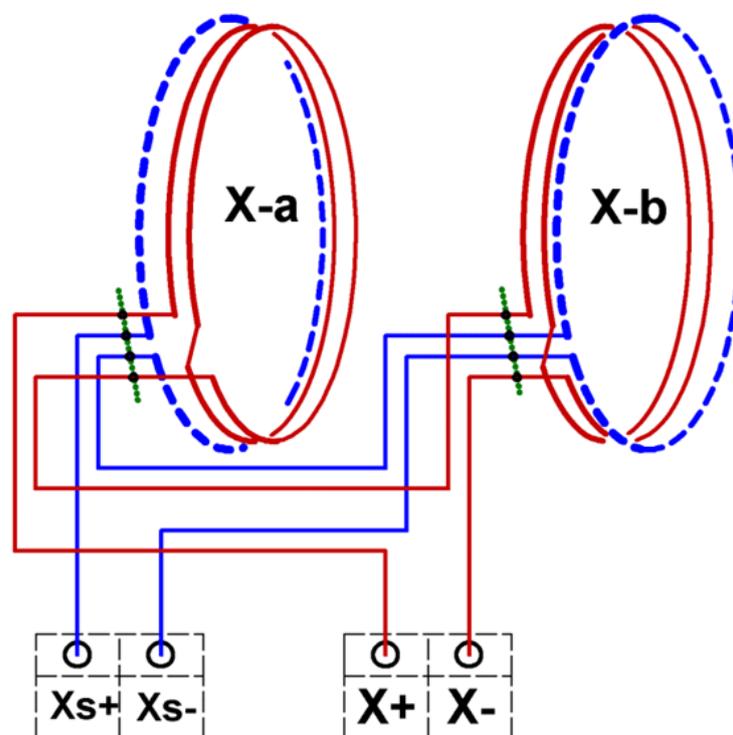
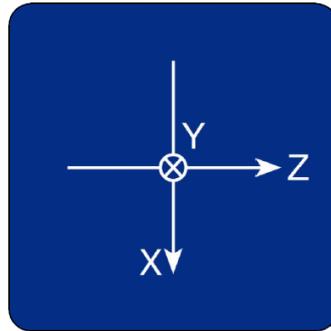


Figure 3. Simplified wiring diagram

## 7.4. Coil Polarity

The direction of the magnetic field generated is dependent on how the current supply is connected to the connection block. If the current supply is wired “positive to positive” and “negative to negative” then the direction of the magnetic fields will be as shown on the field orientation label, shown below.



## 7.5. Basic Coil-set Use

The connection block located at the assembly base is used for the current supply of each pair of coils.

For the BH300-A, each coil pair will generate an “in-air” magnetic field of approximately  $500\mu\text{T}$ , at its centre, for each Ampere of input current. It is equivalent to a magnetising field of  $398\text{A/m}$  per Ampere.

For a current of 1A to pass by a coil pair, it is necessary to apply a voltage of around 2.7 to 4.2V. Each coil pair has a slightly different resistance, which furthermore varies with temperature. It must be taken into account that the copper wire resistance increases substantially when coil temperature rises. For this reason, constant current power supplies are more suitable than constant voltage power supplies, generally.

For the BH300HF-B, each coil pair will generate an “in-air” magnetic field of approximately  $54\mu\text{T}$ , at its centre, for each Ampere of input current. It is equivalent to a magnetising field of  $43\text{A/m}$  per Ampere.

For a current of 1A to pass by a coil pair it is necessary to apply a voltage of around 0.5V. Each coil pair has a slightly different resistance, which furthermore varies with temperature.

At high frequencies, the required voltage to run 1A would be much higher than at DC, as the impedance of the coils increases with frequency.

It is normal that the coils get hot with current. This heating is noticeable from about 3 Amperes per pair.



**WARNING:** When using higher currents the coils can burn the skin if touched.



**WARNING:** The coils do not have any protecting device against excessive currents. The currents as indicated on the specifications must not be exceeded.

## 7.6. The forms as Secondary Coils

As described earlier, each one of the aluminium coil formers can be used as a one-turn coil. The coil-set is supplied with the forms connected between them making extra Helmholtz pairs (or secondary pairs), whose connections are found on the connection block. The forms from the X pair make the Xs pair, the Y pair has the Ys associated pair and the Z has the Zs associated pair.

The pairs constituted by the forms can be powered independently from the main pairs. In this way they can be used, for example, to modulate the field generated by the main pairs.

## 8. Troubleshooting, Care and Maintenance

In the event of any apparent malfunction, please email: [service@bartington.com](mailto:service@bartington.com) or telephone the Bartington Instruments service team on: +44 (0)1993 706565.

## 9. Storage and Transport



**WARNING:** Do not lift by the coils as this may cause mechanical damage to the assembly. Lift only by the base.

The BH300 assembly is a precision electronic instrument and should be treated as such.

Bartington Instruments has supplied this product in appropriate packaging for transportation. It is recommended that this packaging is used for any future transport.

Refer to the product brochure for this product's maximum environmental, electrical and mechanical ratings.



**Caution:** Exceeding the maximum environmental ratings may cause irreparable damage to the equipment.

## 10. Disposal

This product should not be disposed of in domestic or municipal waste. For information about disposing of this product safely, check local regulations for disposal of electrical / electronic products.

### 10.1. Waste Electrical and Electronic Equipment (WEEE) Regulations



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

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