Operation Manual for

Helmholtz Coil Control Software

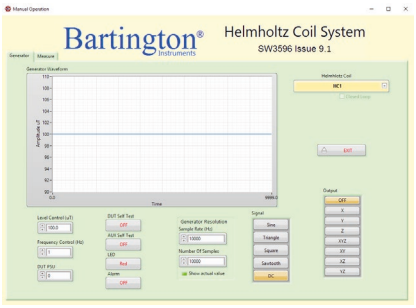

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Table of Contents

1. How to Use this Manual

This manual provides the information necessary to help customers install and operate the Bartington Instruments Helmholtz Coil Control Software version 9.1. This software is one component of Bartington Instruments' Helmholtz Coil System and allow control of the system when the CU1 is connected to a compatible National Instruments acquisition card. This manual should therefore be read in conjunction with:

- Compatible Helmholtz Coils Operation Manuals
- CU1 Control Unit Operation Manual OM3224
- CU2 Closed-Loop Module (if applicable) OM3999
- Helmholtz Coil Control Software OM3596.

All manuals are available from the Helmholtz Coil System Operation Manual page.

This manual should also be read in conjunction with the product brochure DS2613 which can also be found on the product page.

Bartington Instruments cannot advise on the integration of this equipment with any third party products.

Please note that some of the screenshots are from previous version of the software. However the layout of the screen in version 9.1 is identical to these screenshots.

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: Provides useful supporting information on how to make better use of your purchase.

2. Introduction

The Helmholtz Coil Control Software is designed to be used with a Bartington Instruments Helmholtz Coil, using a PA1 Power Amplifier, CU1 Control Unit connected to a National Instruments acquisition card and CU2 Closed-Loop Module where applicable. Compatible coils for software include HC1, HC2, HC9/HC16 and the Ferronato BH1300-C, BH1300HF4-A and BHC2000-A Coils.

The software is a basic package that can be used to drive the coils and to measure the response of both a magnetometer under test and an auxilliary magnetometer. Each axis can be controlled independently or they can all be activated together.

The software is developed in LabVIEW®, and the source files can be supplied to enable users to extend and customise the system, provided they have a suitable licensed LabVIEW® development system.

3. Compatibility

The Helmholtz Control Software is compatible with the following versions of Windows®: Windows® XP, 7, 8, 8.1,10.

4. Important Points to Note Before Using the Software

This software requires the National Instruments LabVIEW® Runtime Environment to function. This can be downloaded from National Instruments website here: http://www.ni.com. Multiple versions are available - ensure to download the version appropriate to your operating system.

The NI-DAQmx driver package is also required, and is available here.

- When running the Helmholtz Control software, do not run any other applications within Windows® as this will limit the processing time available and may cause errors.
- All general Windows® maintenance (Windows® updates, etc...) must be performed when the software is not running.
- Disconnecting the hardware whilst the software is running may cause it to malfunction. Should this occur, stop the PC program, reconnect the CU1, wait 15 seconds and then re-start the program.

5. *Software Installation*

- Install the National Instruments LabVIEW® Runtime Engine to the default directory. Install all features and libraries. Restart your computer once complete.
- Install the NI-DAQmx drivers. Select Typical Installation. Restart your computer again on completion.
- Two versions of the software are available for download. A full version with installer for first installation and the executable for the latest version if a full version (including latest Runtime is installed).
- Once these steps are complete, run the Bartington Helmholtz Control software application file.
- If successful it will not ask for any additional drivers or give any errors and you will see the Generator main screen.

Figure 1. If no hardware is plugged in you will receive the following error:

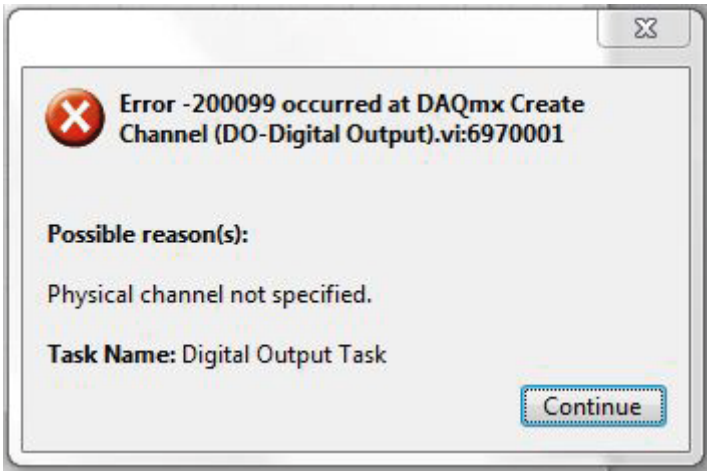

Figure 1: No Hardware Error

6. *Software Operation*

When the software is started, the Generator screen will be displayed. There are two tabs; one for the signal generator, the second for measuring the resulting field.

6.1. Generator Screen

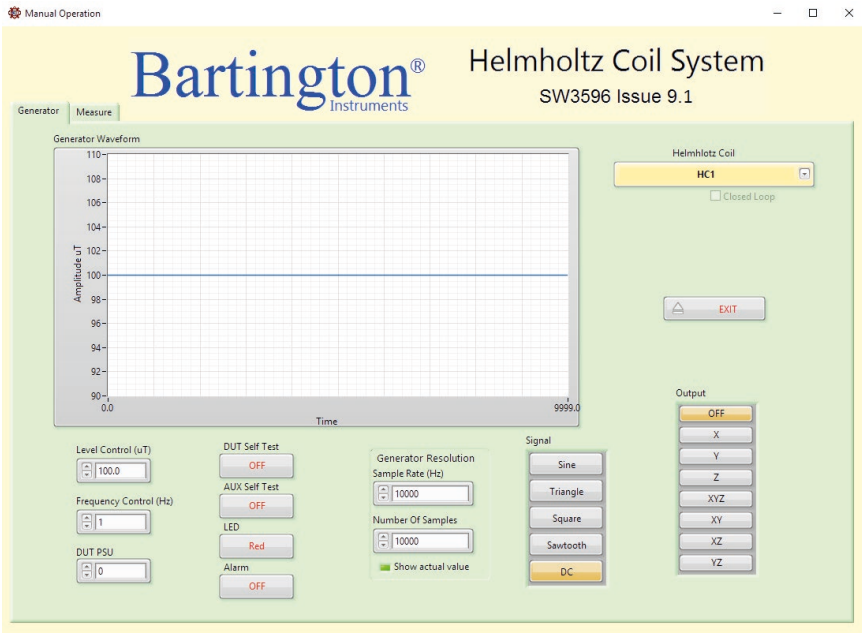

Figure 2. Generator Screen

The signal Generator tab can be used to send a signal with a specified frequency and field magnitude to the coils. A field can be generated in the X, Y or Z axes, any combination of two axes or in all three. The maximum field per axis will be lower when all three are activated – refer to Helmholtz Coil brochure for maximum field values.

6.1.1. List of Generator Functions

HC Type - Allows the user to select either the HC1, HC2, HC9/HC16, BH1300 or BHC2000 Helmholtz Coil type depending on which one is being used.

Closed Loop - Enables Closed loop operation. When this is used, it bypasses any scaling factors and thus remove the need for selecting actively the HC1 coil.

Level Control (µT) - Allows the user to set the magnitude of the magnetic field in each axis in µT.

Frequency Control (Hz) - Allows the user to set the frequency of field oscillation.

DUT PSU Voltage - The DUT PSU Voltage box is used to enter the voltage to be supplied to the device under test. When a device is plugged into the AUX input, 15V is supplied automatically and does not need to be entered in this box.

Sample Rate (Hz) - Used to set the rate at which samples are generated.

Number of Samples - This is used to set the number of samples required.

Signal - Used to select the shape of the signal being generated.

Output - Allows the user to select which axes will output the signal.

DUT Self Test - Used to activate the self test function of a compatible Device under Test, DUT.

AUX Self Test - Used to activate the self test function of an Auxiliary device if available.

Alarm - When turned on this will alert the user when the self test functions fail.

Help - Turns on or deactivates the help prompts.

Exit - Ends the current session and closes the software.

Before using the software, the user should select which type of Bartington Instruments Helmholtz coil is to be used using the 'HC Type' selection box. The software settings will vary for each type: HC1, HC2, HC9/HC16, BH1300 and BHC2000, to allow the user to enter the correct field levels and values depending on which coil is used. It is important to select the correct coil or the output will not be correct.

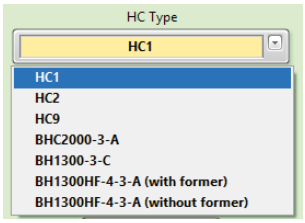

Figure 3. Helmholtz Coil Selection

The magnitude of the field can be entered using the 'Level Control' box. This is the field that will be generated by each axis when they are switched on. The maximum possible field will be greatest with one axis turned on. The more axes switched on, the lower the maximum field possible in each axis.

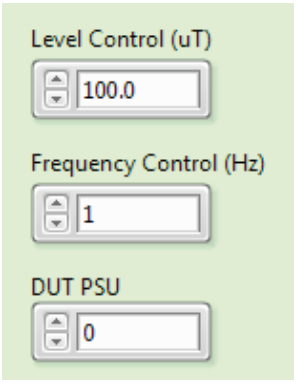

Figure 4. Level, Frequency Control and DUT PSU

The frequency of oscillation can also be set using the 'Frequency Control' box. The frequency should not be set lower than 1Hz when the sample rate is greater than the number of samples. Following from this, the ratio of sample rate/number of samples should not exceed the frequency of oscillation.

The power supply for the DUT is supplied from the CU1 and is variable from 0V to +-20V with a hardware defined current limit of 100mA.

In the Generator Resolution section, the Sample Rate and total Number of Samples can be set. Ensure that the frequency, sample rate, and number of samples are set to generate a complete number of cycles in the buffer. If this is not the case then you will receive an error.

Selecting 'Show actual value' will show the actual number of samples that the software is taking after adjusting the user entered value up or down in order to create a whole waveform.

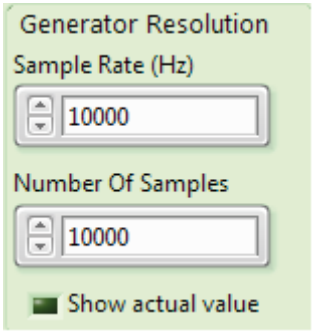

Figure 5. Generator Resolution

The type of signal generated can be selected from 5 options in the 'Signal' section, this is set as a Sine wave by default.

Figure 6. Signal Output

The signal is switched on by selecting an output axis in the 'Output' section. A single axis can be selected, or a combination of axes can be selected together. When a dual axis output is selected the second axis will have a 90° phase lag.

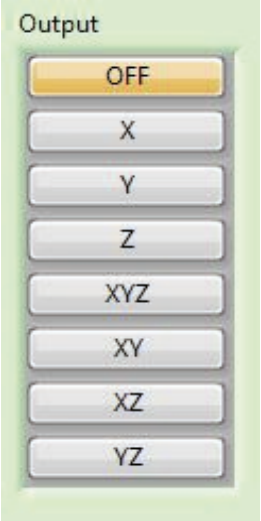

Figure 7. Axis Output

Note: The Outputs should be turned to off before closing down the software.

The waveform of the generated signal will be displayed graphically in the main area of the interface.

The software also includes a function for self testing a Device Under Test (DUT) or AUX connection when using compatible magnetometers. When activated, the alarm function will alert the user if either of the activated self tests fail. The LED button is there to change the LED colour on the control unit to Red or Green. This can be used as an indicator, for example when the coils are turned on.

Figure 8. Self Test, LED, and Alarm Functions

The 'Help' function shows or hides the help pop ups when hovering over the buttons in the interface.

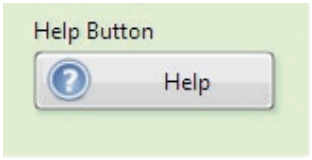

Figure 9. Help Button

Pressing the 'Exit' button at any time will cause the software to close without further prompting.

Figure 10. Exit Button

6.2. *Measurement Screen*

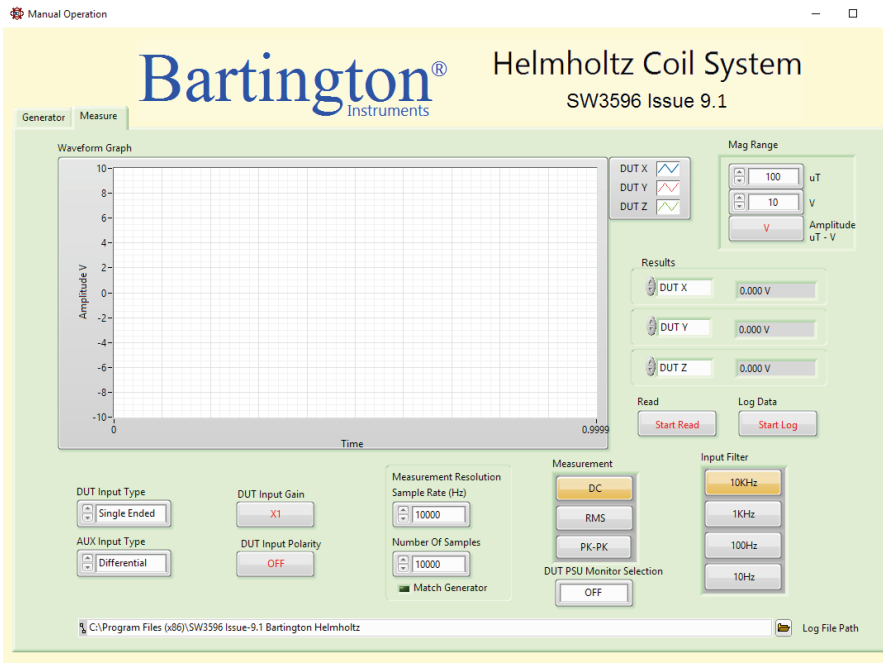

Figure 11. Measure Tab

The Measure Tab can display the output of a Magnetic Field Sensor (Device under Test, DUT), an Auxiliary input, or used to monitor the axes or power in the coils.

6.2.1. List of Measurement Functions

Mag Range - Used to set the range and voltage output of the magnetic sensor being used.

DUT Input Type - Can be changed between differential and single ended devices depending on the configuration of the Device Under Test.

AUX Input Type - Can be changed between differential and single ended devices depending on the configuration of the Auxiliary input device.

DUT PSU Monitor Selection - Switches on/off the DUT power supply monitor.

DUT Input Gain - Changes the DUT gain settings.

DUT Input Polarity - Changes the input polarity of the DUT.

Input Filter - Set the low-pass input filter to the selected frequency: 10kHz, 1kHz, 100Hz, or 10Hz.

Start Read - Starts or halts the measurement.

Start Log - Begins logging of the data and saves output to location specified in the Log File Path.

Sample Rate (Hz) - Defines the sample rate of the measurement.

Number of Samples - Defines the number of measurement samples taken.

Measurement - Used to select the way the measurement is to be displayed; DC, RMS, or Peak to Peak.

Results - Displays 3 voltage outputs. Can be changed between devices/axes and used to monitor the coils.

Before taking any measurements the scaling of the magnet sensor should be set by entering the range in μT, and the output voltage in V. Clicking the Amplitude button underneath will change the graph display to read in μT or in V.

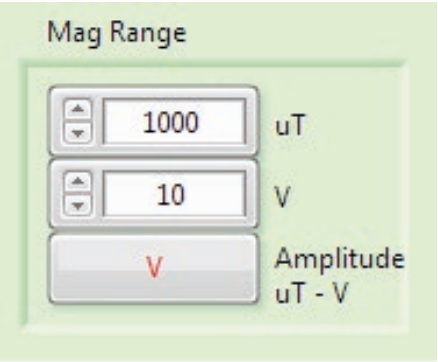

Figure 12. Sensor Range and Voltage Output

Differential or single ended inputs can be selected for different input types. When using a Bartington Instruments sensor, please refer to the relevant sensor data sheet to determine its output type. There are also different gain settings for the DUT, and the input polarity can be reversed.

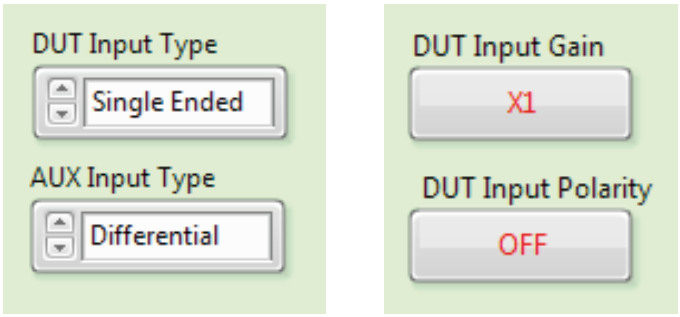

Figure 13. Input Type, Gain and Polarity

Four frequency filters can be applied to the input signal ranging from 10 to 10,000Hz. These select the nominal -3dB point of the data acquisition input filter and are intended as basic anti-aliasing filters.

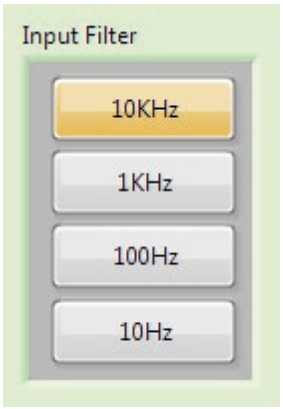

Figure 14. Input Filter Selection

Measurement begins when the 'Start Read' button is pressed. Pressing this button again whilst a measurement is in progress will stop it. The measured output on each axis is displayed in the graph. When 'Start Log' is pressed the output from the sensor will be saved to the location specified in the 'Log File Path' box at the bottom of the screen.

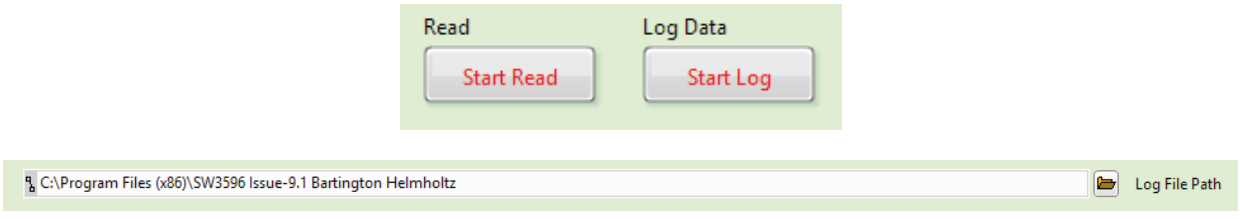

Figure 15. Start Read, Start Log and File Path

The Measurement Resolution can be defined by setting the Sample Rate and number of samples. The sample rate is limited to the maximum sample rate of the data acquisition system. When measuring an AC signal ensure that the sample rate and number of samples are set to acquire a number of complete cycles at the frequency of the signal being measured.

The Match Generator tick box will match the same values for Sample Rate and Number of Samples that were entered in the generator tab.

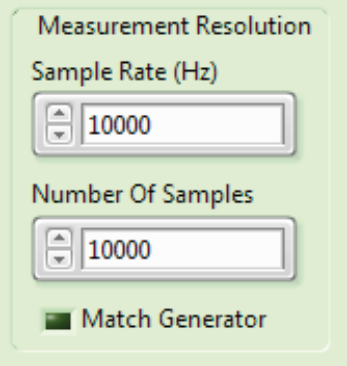

Figure 16. Measurement Resolution

The measurement can be displayed as DC, RMS, or Peak to Peak. DC is measured by taking the average of the acquired samples discarding the highest and lowest 5% of values to get rid of noise and outliers. RMS is an RMS calculation of the acquired samples. The peak to peak measurement is taken using a National Instruments processing module.

The DUT PSU Monitor Selection box is used to toggle the DUT power supply monitor on or off. This allows you to monitor the voltage and current supplied to the DUT. Note that the voltage information will appear as half of the value applied (please refer to appendix A of OM3224).

The results from each axis are displayed on the right hand side of the screen. These can be changed between outputs of a device under test, those of an auxiliary input, or used to monitor the coils.

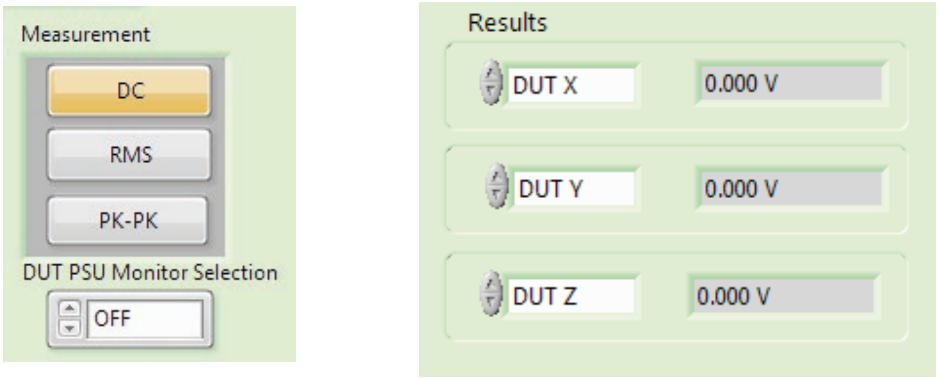

Figure 17. Measurement type and Results Display

6.3. Graphical Interface

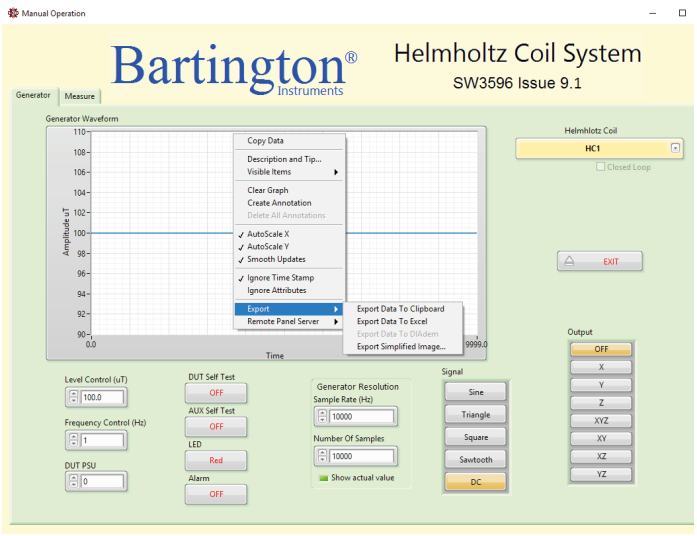

Figure 18. Graphical Display

The generated signal and the measured output will both be displayed on the graphical displays in their respective tabs. There are several operations that can be performed on the graphs by right clicking and accessing the graph menu.

The autoscale function is selected by default but can be turned off if a specific scale is desired. Under the 'Visible Items' category, legends can be selected to display more, or less, information. Annotations can be added and moved around the graph, or locked to a particular plot.

The export category can be used to export your data either to the clipboard or to Microsoft Excel. A simplified image of the graph can also be saved as a .bmp, ems, or .emf file.

7. Troubleshooting

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

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