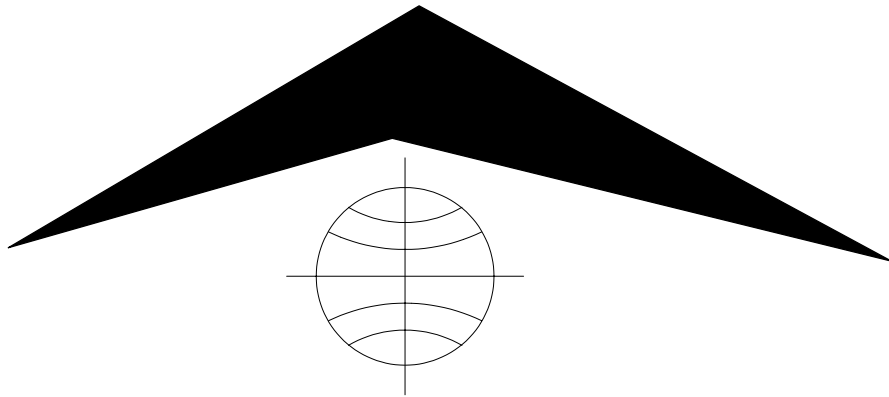


User Manual for the 2BSA-1000 Magnetic Susceptibility Probe



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General Information

Overview

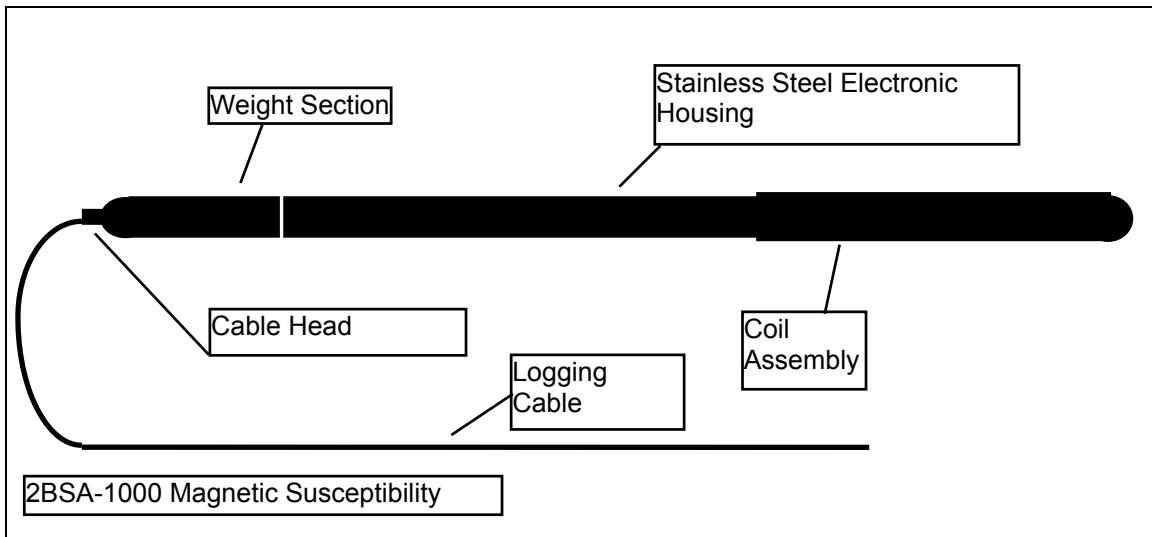
The 2BSA-1000 probe is a combination of the Bartington BSS-02A magnetic susceptibility probe (Bartington Instruments, Witney, Oxford, England), and a Mount Sopris digitizing and telemetry system. The 2BSA-1000 was designed to operate with the MGX II series portable digital logger or the Series V digital logger. The information presented in this manual is a supplement to the Bartington operation and service manuals. The 2BSA-1000 probe is not intended to be operated with the Bartington BSS-02A surface module; and the surface module is not included.

Modem note

The MGX II standard FSK modem is used to communicate with this probe. It may be necessary to tune the modem when operating the MGX II with this probe on different or longer wirelines than the MGX II was originally tested with. See the MSLog Help Topic: Appendix - MGX II Modem Tuning. Consult Mount Sopris Instruments for more information.

Connector and Layout

An outline of the probe is presented below. From top to bottom, the probe consists of the probe top, the weight section, the electronics section, and the coil assembly. The probe top connector mates with a standard Mt. Sopris single conductor cable head.



Specifications

Length	64.14 inches (168 cm)
Diameter	1.7 inches (43 mm)
Operating Temperature	0 to 70 degrees C
Storage Temperature	-40 to 125 degrees C
Maximum Pressure.....	3000 PSI (20.68 MPa)
Magnetic Susceptibility Measurement.....	10^{-5} to 1 CGS
Resolution.....	$5 * 10^{-6}$ CGS when over sampled
Accuracy	9 % (Bartington specification)

Installation

Installing the 2BSA-1000 Magnetic Susceptibility Probe

The most common reason for failure of a logging probe is mechanical damage. Often this occurs in transportation. The only installation requirement is to provide a safe place for the probe during transportation and storage. Despite efforts to make logging probes as rugged as possible, they are still fragile instruments; they need to be protected.

A software driver for the probe must be installed on the PC for the acquisition software to operate with the 2BSA-1000 probe. The MSLConfig program performs this function for the MSLog software. Consult the software instruction manual for specific instructions.

Modem Tuning for Wireline Length

The 2BSA-1000 uses the standard MGX II FSK modem. This modem operates the 2BSA-1000 to 1km of 0.1, 0.125" single conductor cable but may need to be tuned specifically to this particular length. Factory tuning is for 500 meters. See the MSLog Help Topic: Appendix - MGX II Modem Tuning. Consult the factory for other cable line type length restrictions. Generally similar restrictions length restrictions will apply to other cable types.

Operating Procedure

Operation

Operation of the 2BSA-1000 magnetic susceptibility probe is straightforward. Make sure that probe power is off, then connect the probe to the cable head by screwing the probe onto the cable head. Make sure that the cable head 'O' ring is clean, lubricated, and in good shape. Make sure that the cable head is screwed on tight by hand. Place the probe in the borehole and route the logging cable over the necessary rigging. Follow the procedure outlined below.

Logging Instructions for MSLog with the MGX II

- Select the correct tool driver from the Tool panel selection box. If the correct one is not available, run MSLConfig to install it.
- In the Tool panel, click the Power On button. **It is advisable to power the probe while it is in the hole for a few minutes to warm up the electronics before logging for optimum accuracy.**
- Place the tool in the borehole and position the top of the tool at the zero depth point. Click the Depth panel upper right corner icon. Click Zero Tool. If you can not place the tool top at depth reference, press the Change Depth button and enter the depth of the bottom of the tool.
- If you wish to fill out the header, in the Acquisition panel click Header button.
- In the Acquisition panel, click Record and select a file name.
- Place the probe at the beginning of the interval to be logged. When measuring small magnetic susceptibility values ($< 10^{-4}$ CGS), over sampling should be used. To do this, set a depth digitize interval 5 or 10 times smaller than normal, and use a plotting filter of 5 or 10 points. Note that logging speed will be reduced.
- Turn on the desired, Depth Sampling mode.
- If you are printing, turn on the printer in MCHCurve.
- Log to the desired interval as normal. Refer to the MSLog manual for additional information on logging.
- When done, in the Acquisition panel, click Stop.

Note that the maximum recommended logging speed is determined by the depth sample rate as follows: $\text{Max Speed (feet/min or meters/min)} = 240/(\text{samples per ft or meter})$.

Generally speaking, the resolution of the probe is a function of sample rate. To measure susceptibility on the 10^{-5} CGS order of magnitude, the digitizing rate must be decreased (This is also how the Bartington surface module works). The internal digitizing rate of the 2BSA-1000 is fixed at about 4 measurements per second. In order to effectively increase the resolution of the 2BSA-1000, over sampling is used. That is, multiple samples are averaged together. In practice, averaging 10 samples will result in a resolution better than 10^{-5} CGS.

Note that the volume of investigation for this probe is quite small. Operation in boreholes larger than 10 cm is not recommended. The horizontal penetration of the measurement is only 2.5 cm; subsequently the tool should be decentralized for proper operation. The probe should only be used after drilling mud has been washed from the hole to avoid contamination effects. Good vertical resolution is a result of the small volume of investigation. The full 'width half maximum' vertical resolution is 12 cm, and anomalies as small as 2.5 cm can be observed. The following table shows the response in different size boreholes relative to a 25 mm layer in a 50 mm hole.

Borehole diameter (mm)	Response centralized	Response decentralized
70	0.75	0.725
80	0.275	0.5
100	0.09	0.45

Performance Checks and Calibrations

The probe is delivered with factory determined calibration numbers. Use these numbers if it is not possible to calibrate the probe in the field. To calibrate the probe in the field, power up the probe and wait a few minutes for the probe to temperature stabilize with the probe in the borehole. Set your logging data waterfall display to a sensitive range that encompasses the two calibration points. Next, remove the probe from the hole, and have an assistant raise the probe vertically in the air. This is the zero CGS calibration point – calibrate the probe to read zero at this time with the acquisition software. Next, place the calibration block over the coil section of the probe. Slowly slide the block over the probe until the reading from the probe is maximized. This is the other calibration point – calibrate the probe to read the value printed on the calibration block at this time with the acquisition software.

Calibration has two purposes. The first is to make sure that the probe is returning values as accurate as possible. The second is to verify the probe is functioning correctly before logging data. Calibrations should be performed routinely to assure quality logs.

Calibration Instructions for MSLog

- Turn Probe power On.
- Turn Sampling to Time and On.
- Measure a calibration standard as described above.
- Allow to warm up for 10-15 minutes.
- Right click on MCHNum.
- Uncheck Use calibration
- Right click on the MCHNum title bar.
- Click Calibration Settings.
- Enter the value of the calibration standard (i.e. 0 CGS) in the Reference edit box for the first point.

Calibration Settings

Mag. Susc.

First Point

Reference mCGS

Value cps

Use Current

Second Point

Reference mCGS

Value cps

Use Current

Channel Calibration Factors

Mag. Susc.(mCGS) = x Mag. Susc.(cps) +

Store Unit

- Press the First Point Use Current button to capture the raw tool output for the first calibration point.
- Connect a different calibration standard as described above.

- Enter the value of the second calibration standard (i.e. 5000×10^{-6} CGS) in the Reference edit box for the first point.
- Press the Second Point Use Current button to capture the raw tool output for the second calibration point.
- Press Store to save the values to the tool driver file.
- Press the X in the upper right corner of the browser to close the dialog.
- On the MSLog Browsers and Processors menu press Close all.
- Select each Browser or Processor from the menu individually and press the Start button. Wait until the browser or processor Connects then select the next one in the list, press Start and so on until all the processors and browsers are running. This is necessary so that the browsers and processors can read the new calibration information stored in the tool driver file in step 12 above.

Preventative Maintenance

The 2BSA-1000, probe should require little preventative maintenance. The 'O' rings and mating surfaces need to be kept clean and lubricated. Parker 'O' ring lubricant is recommended. It is available from the factory. To keep the probe from suffering damage during transportation, it is recommended that a place be built to store the probe during transportation such as a locking rack or a padded shipping case. Padded shipping cases are available from the factory.

Troubleshooting

Problems with the 2BSA-1000 Probe

The 2BSA-1000, probe should provide years of trouble free use. When problems arise, first check the weakest links in the logging system. These are the cable head, the logging cable, and all surface connectors and cables. Next make sure that the acquisition software is installed and configured properly. If the probe does not communicate (no data from the probe), check the following items:

- Is the correct probe driver chosen in the acquisition software?
- Are the cables between winch, MGX II and the PC connected properly?
- Check the cable for conductive leakage across the center conductor to cable armor *when power to the logger is switched off*. There should be at least 20 mega ohms between the center conductor and armor. Also, check continuity between the red banana jack on the logger and the center conductor if the cable head *when power to the logger is switched off*. Repeat the same test with the black banana jack on the logger and the cable armor.

If you are able to collect data from the probe, but the data seems incorrect, make sure that there is no foreign material embedded in the grease on the bottom of the probe. If this does not solve the problem, then the probe must be sent back to the factory for testing and/or repair.

Disassembly Instructions

Disassembly of the probe is not recommended because there are no user serviceable parts inside. If it is deemed necessary to take the probe apart, start by removing the radial screws at the top of the steel electronics housing and below the weight section. Next, carefully pull the weight section out of the electronic housing. Be careful not to break the internal wires when the weight section suddenly releases from the electronics housing. Remove the wire connector from the top of the circuit board in the electronics section. Last, unscrew the electronics housing from the PEEK coil assembly. If necessary, the probe top can be disconnected from the weight section by removing the radial screws.

Note that the 'O' rings sealing between the PEEK coil assembly and the stainless steel electronics assembly are not BS126 nitrile rings as mentioned in the Bartington documentation. The 'O' rings are of type Parker 2-216 (MSI P/N 25-402-216).

Servicing the Bottom of the Tool

The bottom of the tool should be periodically cleaned to remove borehole cuttings and other foreign material from the tool's grease. Remove the contaminated grease and replace it. This procedure is outlined in the Bartington service manual.

Appendix

Suggested Quality Assurance Procedure

General notes for Quality Assurance (QA) are presented here for users who need to utilize these techniques when collecting data. These users will need to periodically calibrate their equipment using equipment whose calibration is traceable to an approved standard. Details of these calibrations must be recorded.

When an instrument is calibrated, records need to be kept regarding the calibration standard(s) used and what was changed on the instrument to calibrate it. Typically, the corrections made to the instrument involve changing constants that are used to scale the raw instrument reading so that the proper value is reported. The constants must be recorded during a calibration procedure. The Mt. Sopris family of Acquire programs records the calibration constants that were used to acquire the data. This aids the QA process, but does not replace the need for recording these constants at the time of calibration. The reason for this is that the length of time since the last calibration is unknown with only this information.

The device providing the standard must be traceable to an accepted standard. Examples of organizations providing standards for measuring instrumentation are: The U. S. National Bureau of Standards, The American Petroleum Institute, and the American Society for Testing Materials. For example, if the voltmeter or the density standard used for calibration is not traceable to an approved organization, such as those listed above, the calibration should not be considered valid. Records should be kept indicating the last time that standard being used for calibration was calibrated or checked against an approved standard. The QA procedure necessary for some programs mandate that the calibration standards be periodically checked against a standard approved by a proper agency.

A QA procedure may dictate that data taken from a given locale be associated with records indicating the exact time and location that the data was collected. The data itself may have to be collected in a certain format to meet requirements. Often, QA procedure specifies that surveys must be repeated and the data from the successive surveys compared. This technique is used to eliminate poor or invalid data.