

Innovation in Magnetic Field Measuring Instruments

BSS-02B

Borehole Magnetic Susceptibility Sonde



Bartington[®]
Instruments

BSS-02B Borehole Magnetic Susceptibility Sonde

The BSS-02B is a borehole probe for measurement of magnetic susceptibility from 10^{-5} to 10^{-1} cgs. It is calibrated for use in 50mm diameter boreholes at temperatures up to $+90^{\circ}\text{C}$, and it is able to operate at depths of up to 6000 metres over a temperature range of ambient to $+120^{\circ}\text{C}$.

The sonde comprises two sections: an aluminium alloy cylindrical enclosure containing electronic circuitry, and a high strength, non-magnetic enclosure in which the detector is located. The electronics enclosure must be surrounded by a pressure enclosure; this is usually provided by the client, to fit the rest of their system.

The sonde operates from an unregulated $+15\text{V}$ nominal supply. It provides an output in the form of a three-wire CMOS serial interface (for integration into the client's data acquisition system), and a single wire pulse rate output for use with rate meters and counters.

Features

- Wide measuring range: 10^{-5} to 10^{-1} cgs
- Low operating frequency: 1.36kHz
- Stratigraphic resolution of 25mm
- Operates to pressures of 10,000 psi maximum
- Operates to temperatures of 120°C : calibrated to 90°C
- Frequency up to 21 readings per second
- Low temperature induced drift: $<20 \times 10^{-5}$ cgs over the calibrated temperature range ambient to 90°C
- Calibration sample supplied

Typical Applications

- Mineral prospecting, including discrimination of kimberlites, iron ore and uranium ore
- Stratigraphic correlation
- Delineation of alteration fronts
- Delineation of strata of economic interest and evaluation of the ore's grade



BSS-02B Specifications

Performance			
Max operating pressure		10,000 psi	
Maximum stratigraphic (spatial resolution) Note: below 20mm a small double response will be recorded.		25mm F.W.H.M. (Full-Width-Half-Maximum)	
Calibration		Calibrated to read directly in $\times 10^{-5}$ cgs units in a 50mm borehole	
Diameter effect (relative to 25mm layer normalised to a 50mm diameter borehole)	Borehole Ø (mm) 70 80 100	Response centralised 0.75 0.275 0.09	Response decentralised 0.725 0.5 0.45
Temperature induced drift Baseline Scaling		<20 x 10^{-5} cgs from 20°C to 90°C <1.0% full scale	
Max operating temperature		120°C	
Pressure induced baseline drift		Typ. -5.5×10^{-5} cgs	
Sensing coil type Overall length Separation Diameter Distance from nose to centre of detection		Focused dual coil 97mm 27mm 35mm 190mm	
Principle of operation discrimination		AC induction by frequency	
Operating frequency		1.36 kHz	
Power supply rejection ratio		Not measurable	

Mechanical	
Construction ¹ - Non-magnetic enclosure - Pressure barrel	PEEK enclosure Supplied by user
Dimensions (mm)	Ø43 x 720 (733 BSS-02B-1)
Weight in air (g)	815
Seals - Pressure barrel to mid-adaptor - Mid-adaptor to PEEK barrel - PEEK barrel to nose	2 Viton "O" rings BS 216 1 Viton "O" ring BS 126 "O" ring BS 126
Mating threads - BSS02B-1 ² - BSS02B-2 - BSS02B-3	1.375" – 18 WHIT FORM 1.375" – 12UNF-3A 1.375" – 16UN
Pressure compensation	Piston
Volume of silicone oil	155ml

1. The sensor coil is housed in a pressure compensated, thin walled cylinder to achieve optimum magnetic coupling to the borehole wall. This cylinder is sufficiently robust for downhole operation but can be damaged if it is subjected to excessive shock through dropping or strain through bending.
2. BSS-02B-1 is chamfered to provide a smooth step down to a Ø38mm outer pipe.

Electrical	
Power requirements	+14 to +18V DC at 32mA
Input connection	300mm of 6-core PTFE coated leads
Connector type	Flying leads
Interface	Three-wire 5V CMOS serial interface and single wire pulse rate output, all ESD protected
Pulse rate output	A pulse of approximately 50µs width is output at a rate which is proportional to the current measurement. Refresh time is 47.5ms but will extend by 0.2ms for every 1000 units of measurement. Maximum output is 16000cps.
Digital data output	The Ready signal goes low for a period of 10ms when the conversion has been completed and bit 24 (MSB) is present on the SDO Line. The minimum repetition period of Ready is 47.5ms in air but will extend by 0.2ms for every 1000 units of measurement. Each low to high transition of Clock In will cause the next bit to be placed on the SDO line. Data can be conveniently clocked into the external interface on high to low transitions of Clock In. Minimum clock pulse width is 0.5µs. Data are presented as 24 bits with the MSB first.

Calibration

The system is scaled to a change of one least significant bit = 1×10^{-5} cgs units. A residual value of circa 1000 accommodates negative values and ageing effects. Departure from linear response will be:

Range $\times 10^{-5}$ cgs	Error %
1-1000	0 to -0.9
1000-10,000	-0.9 to -9.0
10,000-100,000	-9.0 to -50

To calculate true value of K (volume susceptibility):

$K \times 10^{-5} \text{ cgs} = (R + R^2 / 10^5) \times 10^{-5} \text{ cgs}$ where R is the measured value.

Calibration block	
Dimensions of cylinder	Overall diameter 110mm Length 100mm
Bore	44mm
Weight	1.13kg
Calibration value	(as marked)
Temperature coefficient	+0.05% / °C
Note: To simulate groundwater effects the calibrator should be grounded via hand contact. This will depress the measured value by approximately -15×10^{-5} cgs.	