

MS2/MS3

Magnetic Susceptibility
Measuring Equipment





MS2/MS3 Magnetic Susceptibility Measuring Equipment

This versatile system comprises a meter with a range of sensors for providing high resolution magnetic susceptibility readings from samples including soils, rocks, powders and liquids. These measurements provide important information about the composition and magnetic properties of materials.

The MS2 sensors are interchangeable, with no adjustments required, and lend themselves to a broad range of applications in the field and laboratory. The MS3 is a compact, portable, lightweight meter, with a measuring range of 26SI, which operates with all MS2 sensors.



Supplied with a USB or RS232 interface cable, the acquisition and settings are controlled via Bartsoft software provided. It can be run from PC, laptop, PDA or compatible mobile phone. The software supplied with the unit gives the user control over the measurement protocol and speed, and includes options to display data in both chart and table formats. (Bartsoft details are shown at the end of this brochure)

The meter is sealed and suitable for both indoor and outdoor use. A rugged PDA/GPS is recommended for outdoor use and a fully compatible Trimble Nomad PDA can be supplied.

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MS3 is a registered trade mark of Bartington Holdings Limited in the following territories: European Union, India, United Kingdom, and United States of America.

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Features

- Wide range of laboratory, and field sensors
- Sensors fully interchangeable with no adjustment required
- Resolution to 2×10^{-6} SI
- Range 26 SI
- Measurement period down to 0.1s

Typical Applications

- Palaeomagnetism
- Archaeological prospecting and forensics
- Palaeoclimatic studies
- Sedimentology
- Soil and airborne pollution surveys
- Analysis of ferrites and magnetic inks
- Study of micro/nano magnetic particles and fluids
- Quality assurance



Specifications

Specifications	MS3 Meter
Range	26 SI (volume specific)
Maximum resolution (sensor limited)	1×10^{-6} SI (1×10^{-7} CGS)
Units	SI or CGS
Measurement time	Selectable to 0.1s minimum
Display	No (requires PC or PDA)
Laboratory data logging	Yes (with Bartsoft)
Field data logging	Yes (with Bartsoft for Windows® CE)
Weight	0.13kg
Internal battery	N/A
Enclosure material	White Acetal
Operating temperature	-10°C to +40°C
Dimensions (W x H x D)	50 x 25 x 123.5mm
Battery charger inlet	N/A
Battery charge	N/A
RS232 interface to PC	1200/9600 baud rate – software selectable
Interface connector	Hirose HR10-7R-6P

Accessories

	MS3 Meter
Cables to sensor	Supplied
Cables to PC	USB and RS232 supplied
Power supply	5V mains charger supplied for use with RS232 cable

Serial Interfaces

Standard Serial Interface		Serial Interface for k/T System Operation	Serial Interface for 9600 Baud Option
Baud rate	1200		9600
Bits per character	1 start, 7 data, 2 stop, no parity	1 start, 8 data, 2 stop, no parity	
Number of characters	5 + carriage return		
Character format	Sign, four digits, CR		
Control lines	inactive		
Code	ASCII		



MS2B Dual Frequency Sensor

This sensor is primarily used to measure the magnetic susceptibility of soil, rock and sediment samples, and is widely recognised as a standard instrument in the characterisation of the magnetic properties of soil. The dual frequency facility permits identification of superparamagnetic grains, which helps characterise the processes that affect the sample.

It is also suitable for susceptibility measurements of magnetic fluids, inks and micro/nano particles.

The sensor accepts 10 and 20ml cylindrical bottles, 25.4mm and 23mm cubic boxes, 35mm pots, and 25.4mm cylindrical cores.



Specification	
Calibration accuracy	1% (10ml calibration sample provided)
Measurement period (MS2)*: x 1 range x 0.1 range	1.5s SI (1.2s CGS) 15s SI (12s CGS)
Operating frequencies: LF HF	0.465kHz $\pm 1\%$ 4.65kHz $\pm 1\%$
Amplitude of applied field	250 μ T peak $\pm 10\%$ (LF & HF)
Noise floor	2×10^{-6} SI (vol) (2×10^{-7} CGS) (LF & HF)
HF/LF cross calibration	0.1% worst case (can be adjusted using calibration sample)
Drift at room temperature	$< 2 \times 10^{-5}$ SI ($< 2 \times 10^{-6}$ CGS) in 3 minutes (after 5 minute warm-up)
Dimensions (W x H x D)	110 x 145 x 210mm
Sample cavity internal diameter	36mm
Weight	0.7kg
Enclosure material	High impact ABS

* MS3 measurement period is software selectable

MS2C Core Logging Sensor



The MS2C Sensors are loop sensors, ranging from 30 to 162mm diameter, which provide high resolution volume susceptibility measurements on any type of whole cores: peat, lake or marine sediment.

These rugged sensors have a very low temperature induced drift and are designed for laboratory, field or shipboard use. They can be used with manual or automated core track systems.

The sensors are used in prospection and core correlation, and for the identification of palaeoclimatic sequences. Optimum measurement accuracy is achieved with 5 to 10mm core clearance. Calibration graphs are provided for varying core to sensor diameter.

Specification	
Loop internal diameter	30, 36, 40, 45, 47, 50, 60, 70, 72, 80, 85, 90, 93, 100, 110, 120, 125, 130, 135, 140, 145, 146, 150, 160 or 162mm (Intermediate sizes can be provided at an additional charge)
Calibration accuracy	5% (calibration sample provided)
Measurement period (MS2)*: x 1 range x 0.1range	1.1s SI (0.9s CGS) 11s SI (9s CGS)
Operating frequency	0.565kHz
Spatial resolution	20mm
Drift at room temperature	<2 x 10 ⁻⁵ SI (vol) (<2 x 10 ⁻⁶ CGS) in 10 minutes (after 5 minutes warm-up)
Dimensions (W x H x D)	200 x 290 x 162mm (with feet)
Weight	2 to 2.7kg depending on diameter
Enclosure material	White polyacetal

* MS3 measurement period is software selectable

MS2D Surface Scanning Probe

This probe is designed for rapid assessment of the content of magnetic materials in the top 100mm of the land surface. It is used in studies of slope processes and in archaeological prospecting. The probe is operated in conjunction with the MS2 Probe Handle.

Specification		
Depth of response		50% at 15mm, 10% at 60mm
Measurement period*:	x 1 range x 0.1 range	0.6s SI (0.5s CGS) 6s SI (5s CGS)
Operating frequency		950 ± 60Hz
Drift at room temperature		<10 x 10 ⁻⁵ SI (vol) (<10 x 10 ⁻⁶ CGS) in 20 minutes (after 20 minutes' warm-up)
Dimensions (ø x H): overall coil		208mm x 104mm 185mm mean diameter
Weight		0.5kg
Enclosure material		Reinforced epoxy



* software selectable



MS2E Core Logging Sensor

This sensor is designed for measurements on the surface of split drill or soft sediment cores. The sensitive area of the probe (i.e. the area receiving 50% maximum response) is in the form of a 3.8 x 10.5mm rectangle, enabling high spatial resolution surface measurements. The position of the long axis is identified by marks on the circumference of the sensor. The MS2E is supplied in a protective case.



Specification	
Calibration accuracy	2% (calibration sample provided)
Area of response	3.8mm x 10.5mm at the end of the ceramic cylinder
Depth of response	50% at 1mm, 10% at 3.5mm
Measurement period (MS2)*: x 1 range x 0.1 range	1.5s SI (1.2s CGS) 15s SI (12s CGS)
Operating frequency	2kHz
Drift at room temperature	<2.3 x 10 ⁻⁵ SI (vol) (<2 x 10 ⁻⁶ CGS) in 10 minutes (after 5 minutes' warm-up)
Dimensions (W x H x D)	50 x 25 x 149mm
Weight	0.22kg
Enclosure material	Diecast aluminium and ceramic

* MS3 measurement period is software selectable

MS2E Calibration Sample

Dimensions	15mm x 33mm diameter
Weight	20g approx.
Materials	Fe ₃ O ₄ in alumina and epoxy resin
Markings	Serial number and calibration value



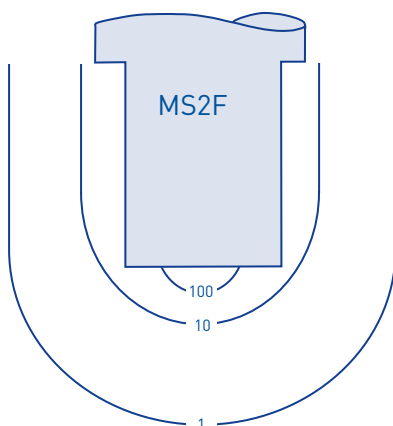
MS2F Surface Point Probe

This miniature probe is ideal for the stratigraphic study of exposed geological and archaeological sections. It is also used where uneven surface conditions prevent good contact with the MS2D loop. The MS2F is operated in conjunction with the MS2 Probe Handle.

Specification	
Area of response	End face and cylinder wall up to the shoulder
Depth of response	10% at 6mm from end face and 4.5mm from outer diameter of end cap
Measurement period (MS2)*: x 1 range x 0.1 range	1.1s SI (0.9s CGS) 11s SI (9s CGS)
Operating frequency	0.58kHz
Drift at room temperature	$<10 \times 10^{-5}$ SI (vol) ($<5 \times 10^{-6}$ CGS) in 20 minutes (after 20 minutes' warm-up)
Dimensions: sensitive volume overall	15mm diameter x 20mm 35mm diameter x 85mm
Weight	0.05kg
Enclosure material	Nylon 66



* MS3 measurement period is software selectable



MS2F iso-magnetic field plot showing relative (%) variation in sensitivity with distance from tip



MS2G Single Frequency Sensor

The MS2G is designed for magnetic susceptibility measurements of 1ml liquid or powder samples. The calibrated volume is 1ml, but scaling correction values allow volumes down to 0.2ml to be measured. The sensor operates at a low frequency, and has excellent temperature stability.

This sensor is used for susceptibility measurements where only very small samples of homogeneous fine-grained material are available; for example, airborne particulates collected in filter, or particles in colloidal suspension.

The sensor accepts polythene vials with a diameter of 8mm and a length of 30mm. The sample holder is compatible with other rock measuring equipment, allowing a comprehensive range of measurements to be taken without the need for re-packing the sample. The sample cavity is situated at the tip of a boom mounted on the aluminium electronics enclosure.



Specification		
Calibration accuracy		2% (1ml calibration check sample provided)
Measurement period*:	x 1 range x 0.1 range	0.9s SI (0.7s CGS) 9s SI (7s CGS)
Operating frequency		1.3kHz
Drift at room temperature		$<2 \times 10^{-5}$ SI (vol) ($<2 \times 10^{-6}$ CGS) in 5 minutes (after 5 minutes' warm-up)
Sample cavity dimensions		8.5mm diameter x 28mm in height
Sensitive region		5mm height at centre of cavity
Dimensions (W x H x D)		91 x 67 x 184mm
Weight		0.67kg
Enclosure material		Aluminium and ceramic

* MS3 measurement period is software selectable



MS2K Surface Sensor



This handheld sensor is designed to provide highly repeatable measurements of the volume magnetic susceptibility of moderately smooth surfaces. Applications include description of magnetic stratigraphy and identification of horizons. It can also be used for characterisation of outcrops and logging split cores.

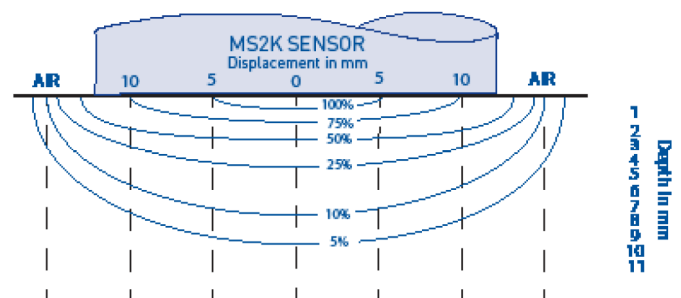
The sensor has applications in materials testing where the relatively low operating frequency permits measurement on some of the less electrically conductive metal alloys, for example stainless steel, without magnetisation.

Specification	
Calibration accuracy	1% (calibration sample provided)
Area of response	25.4mm diameter (full-width, half-maximum)
Depth of response	50% at 3mm, 10% at 8mm
Measurement period (MS2)*: x 1 range x 0.1 range	1.2s SI (1s CGS) 12s SI (10s CGS)
Operating frequency	0.93kHz
Drift at room temperature	$<2 \times 10^{-5}$ SI (vol) ($<2 \times 10^{-6}$ CGS) in 5 minutes (after 5 minutes' warm-up)
Environmental	May be used under wet conditions: not suitable for immersion
Dimensions (W x H x D)	50 x 170 x 165mm
Weight	0.32kg (1.20kg with carrying case)

* MS3 measurement period is software selectable

MS2K Calibration Sample

Dimensions	15mm x 33mm diameter
Weight	20g approx.
Materials	Fe ₃ O ₄ in alumina and epoxy resin
Markings	Serial number and calibration value



MS2K sensor % relative sensitivity iso-plots for displacement and depth

MS2H Downhole Sensor

The MS2H is a downhole sensor for profiling the magnetic susceptibility of strata in 25mm nominal diameter auger holes. The detachable probe is fitted to the lower end of a push-tube to give an assembled length of 1 metre. Waterproof screw couplings allow further 1-metre extension tubes to be added to achieve any practical length. The probe assembly is hand guided within the hole during logging. Graduations ensure depth control to a resolution of 1cm. The probe connects to the meter via a 5mm diameter cable, which may be extended to any practical length up to 100m.

The area of sensitivity for magnetic investigation radiates uniformly from the end of the probe, resulting in tolerance to inhomogeneities. Strata as narrow as 12.5mm in thickness can be discriminated. Measurements to a resolution of 1×10^{-5} SI (volume) are obtained in less than 1 second. A low operating frequency of 1.3kHz ensures immunity to electrical conductivity effects.



Applications include cultural stratigraphy in archaeology, geomorphology, landslide characterisation, paleosol identification, pedology, erosion studies and stratigraphic correlation.

Specification - MS2H Sensor	
Calibration accuracy	1% (calibration sample provided)
Spatial resolution (vertical)	12.5mm (full-width, half-maximum)
Depth of horizontal penetration	50%/2mm, 10%/5.5mm, 1%/13mm
Operating frequency	1.3kHz
Calibration accuracy	5% in ø22mm sample
Measurement period (MS2)*: x 1 range x 0.1 range	0.9s SI (0.7s CGS) 9s SI (7s CGS)
Thermal drift (typical)	2×10^{-5} SI/°C (below 20°C) -1×10^{-5} SI/°C (above 20°C)
Thermal setting time (typical)	30s/°C (step change)
Markings for plane of sensitivity	Lowest graduation
Dimensions (Ø x L)	21.5 x 153mm
Weight	0.13kg

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* MS3 measurement period is software selectable

Specification – Push tubes

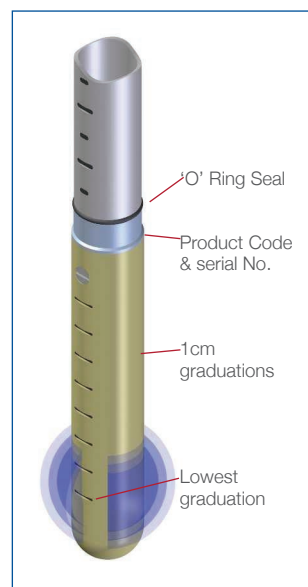
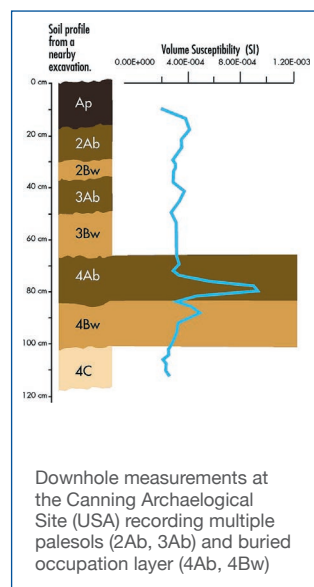
Construction	Anodised aluminium alloy with BS015 'O' ring seal and stainless steel threaded couplings
Lengths including union: extension primary	101.5cm 91.5cm
Weight	0.35kg each

Specification – Connecting cable

Construction	10m length, 5mm diameter co-axial (may be extended to 100m max)
Weight	0.4kg/10m

Specification – Carrying case

Dimensions (W x H x D)	380 x 140 x 138mm
Weight (full)	10kg



MS2 Probe Handle

This device incorporates the electronics for both the MS2D and MS2F probes and is required for connection of these sensors to the MS2 or MS3 meter. The handle is submersible to the depth of the electronics unit (0.6m).

Specification	
Dimensions: upper section lower section	430mm length 360mm length
Weight	0.6kg
Connections: mechanical electrical	11TPI 'O' ring sealed screw coupling 50Ω TNC



Equipment Carrying Case

Tough, lockable cases are available in a variety of sizes and carrying weights, to suit the combination of instruments ordered. Interior cut-outs provide maximum protection for the equipment.

Specification	
Maximum dimensions (W x H x D)	710 x 310 x 570mm
Maximum weight	18.6kg including equipment



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

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 **Bartington**[®]
Instruments