

Grad60 I

Magnetic Gradiometer System

For innovation in magnetic measuring instruments



The **Grad601** is a vertical component fluxgate gradiometer comprising a data logger, battery cassette and either one or two **Grad-01-1000** cylindrical sensors mounted on a rigid carrying bar. Each sensor contains two fluxgate magnetometers with one metre vertical separation. The system provides an enhanced depth response and exceptional stability. Calibration of the gradiometer is by simple push-button control eliminating the uncertainties usually associated with mechanically adjusted instruments.

The **Grad601-1** single-sensor version is ideal for the location of pipes, cables, drums and archaeological features. The **Grad601-2** two-sensor version allows geophysical surveys to be completed in about half the time. Both models have large non-volatile flash memory and fast downloading of data for enhanced survey efficiency.

The **Grad601** provides a linear range of 100nT with a resolution of 0.1nT and a range of 1000nT with a resolution of 1nT. A compressed response is provided to 30,000nT.

The exceptional temperature stability of the sensors ensures minimal drift during surveys and reduces the need for adjustment. All adjustments are accomplished using a single pushbutton and audible cueing. Overall system delay is 27ms providing negligible data skew. Powerline rejection can be keypad selected for 50Hz or 60Hz, giving >1000:1 reduction.

The instrument operates either in survey mode, where data is logged whilst covering the site in parallel or zigzag paths, or in scanning mode as a search tool with an audible alarm without data logging. Data logging can be by continuous measurement or single-shot measurements. The scanning mode is used to locate archaeological features, pipes, cables, waste drums and unexploded ordnance. In scanning mode, the alarm threshold is adjustable.

Survey data are saved in grids of 10, 20 or 30 metre squares. The non-volatile 256kB flash is sufficient, for example, to log 30 grids of 30 x 30 metres with a 1 metre line separation and a resolution of 4 readings per metre. Software is provided for downloading data from the data logger to a PC via the RS232 serial interface and saving it in any of three formats for subsequent data processing. Downloading a full memory takes less than 7 minutes.

The intelligent data logger measures the gradient using a high sample rate with automatic averaging to smooth the data for each reading. Sample rate can be adjusted to suit the operators pace .

The 1 metre vertical gradient separation provides a greater response to a deep anomaly compared to a gradiometer with 0.5 metre separation.



Features:

- Electronic adjustment
- 125k readings (dual array)
- Audio output
- Variable survey pace
- Low power - 24 hour operation (dual array)
- Variable scan threshold
- Simple 6-key operation
- High stability
- Selectable 0.1nT or 1nT resolution
- Fast download - 6.5 mins max
- Automatic averaging
- Survey and Scan modes
- Built-in charger
- Negligible data skew
- 1m vertical spacing for deep anomalies
- 1 to 4 lines/m
- 1 to 8 readings/m along each line
- Non-volatile memory
- 50Hz / 60Hz powerline rejection
- Modular construction
- Battery fuel gauge
- Selectable output format
- Carrying Harness for dual array

Optional alternative arrangements

With some additional parts the *Grad601* can be used as either a dual sensor system (for best survey speed) or single sensor system (for confined spaces).

Conversion	Additional parts required
<i>Grad601-2</i> dual to <i>Grad601-1</i> single system	<i>Grad601-1</i> support beam including BC601 battery cassette extension cable
<i>Grad601-1</i> single to <i>Grad601-2</i> dual system	<i>Grad601-2</i> support beam <i>Grad-01-1000</i> sensor

Environmental Specification

Rating	IP65
Operating temperature	-20°C to +70°C

Dimensions and Weights

<i>Grad601-1</i> Single Gradiometer		2.9kg
<i>Grad601-2</i> Dual Gradiometer		4.3kg
Harness with abdominal spacer and balance weight		1.6kg
Carrying Case <i>Grad601</i> for either system	1160 x 270 x 230mm	9.85kg (empty) 15.75kg(full)

Grad-01-1000 Sensor

The *Grad-01-1000* is a high-stability fluxgate gradient sensor with a 1m separation between the sensing elements and a resolution of 0.1nT/m. The exceptional temperature stability of this sensor ensures minimal drift during surveys and reduces the need for adjustment to a minimum. Each sensor contains electronics and non-volatile memory for calibration data storage and can be operated independently, over very long cables, if required.

Specification - *Grad-01-1000* fluxgate gradiometer sensor

Sensor element spacing	1m
Gradient range (linear)	±100nT/m or ±1000nT/m full scale
Extended range	±3000nT/m or ±30,000nT/m
Accuracy	±2%
Maximum ambient field	±100µT
Noise	100pT pk-pk
Drift	<1nT in 24 hours
Bandwidth	d.c. to 14Hz with -40dB 50Hz/60Hz rejection
Power supply current	60mA
Connector	12-way Tajimi R04-R12M
Dimensions	38mm diameter x 1050mm in length
Weight	0.825kg



DL601 Datalogger

The data logger has a simple six-key control panel for menu-selected operation and liquid crystal display. External push buttons are provided for optional use during survey operations.

Specification - **DL60I** Datalogger

Sensors	1 or 2 Grad-01-1000 gradiometers
Gradient ranges	±100nT and ±1000nT linear with compression at higher values
Resolution	0.1nT on ±100nT range, 1nT on ±1000nT range
Attenuation	-20dB 50Hz/60Hz rejection
Controls	ON/OFF switch, keypad and external switch
Display	liquid crystal 2 rows x 20 characters
Display update rate	operation dependent
Connectors	
Grad-01-1000	Two 12-way Tajimi R04-R12F
RS232 output	9-way D type
Battery	2-way 62GB type
External switch	3-way series 712 sub miniature
Gradiometer adjustment	via keypad
Data logging memory	256 kbytes flash non-volatile
Data logging output	RS232 interface using Grad-01-1000 Datalog software
Audio output	Variable rate bleeper
Power supply/current	9-18V DC; <45mA
Dimensions	160 x 80 x 60mm
Weight	0.485kg



BC60I

Battery Cassette

The battery is a Lithium Ion type and is housed in a sealed cassette which also contains the automatically terminating charging circuitry. The battery is charged by the mains adaptor supplied, or any isolated 9-18V DC supply (at 1.2A minimum) in 6-8 hours. One charge will operate the system for up to 24 hours with two gradiometer sensors or 36 hours with one gradiometer. A push-button charge indicator is provided

Specification - **BC60I** Battery Cassette

Battery	1 off 12V 4Ah Lithium Ion
Indicators	Push-button charge state indicator, Red LED lit when charging, off when finished.
Connectors	2.1mm socket
Charger input	2-way 62GB type on a 250mm cable
Output	
Battery charging	6-8 hours with mains adaptor supplied (automatic termination)
Fuse	2A 20mm anti-surge internal
Dimensions	210 x 120 x 25mm
Weight	0.910kg including battery

Grad60I Carrying Bar

The appropriate carrying bar is supplied for each configuration. The gradiometers are attached at the ends of the carrying bar by quick release clamps.

The data logger and battery cassette are normally left attached to the carrying bar. All cables are routed through the carrying bar.

A green and a red push button are provided on the carrying bar as alternatives to the keypad *ENTER* and *ESC* keys, for synchronising the data collection and interruption during surveys and for setting up. The auxiliary push button sub-assembly, which is easily replaced, is conveniently located near the operator's hand, and reduces excessive wear of the most frequently used keys.

Accessories

Each gradiometer system is supplied in a universal, rugged, carrying case with cut-outs for either a single or dual system together with the following accessories:

- Carrying harness (**Grad**601-2 only)
- Mains adaptor: 110V-240V/47-63Hz; Charging current 1.25A maximum
- In-car charger: Regulated 12V-24V DC-DC; 2A current rating, short circuit protected, automatic thermal and overload cut-off.
- 9-pin serial cable and USB adaptor
- Downloading software on disc
- **Grad**601 Operating Manual
- Spare rubber rings for harness.

The **Grad**601-2 carrying harness provided for the dual gradiometer system relieves the operator's arms of the weight of the gradiometer, whilst enhancing the user's ability to operate the instrument. A water filled bag in the back of the harness counter balances the gradiometer.

The harness can be adjusted to fit all sizes of operator and positions the gradiometer at the required carrying height. The dual gradiometer bar sits in quick release swivel mounts on the abdominal spacer bar to assist in keeping the sensor vertical. The spacer is attached to the harness by shock mounting rubber rings.

Software

Data from the **Grad**601 system can be downloaded directly into ArcheoSurveyor (available from DW Consulting). Alternatively, data can be downloaded via the program provided into other proprietary packages such as Surfer or Geoplot.

*For further reading refer to a paper entitled "A High-stability Fluxgate Magnetic Gradiometer for Shallow Geophysical Survey Applications"
G.Bartington and C.E.Chapman.*

Published online 4 November 2003 in Wiley InterScience (www.interscience.wiley.com)

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

Bartington® is a registered trademark of Bartington Instruments Ltd

Bartington Instruments Ltd.
5 & 10 Thorney Leys Business Park
Witney, Oxford, OX28 4GE, England

T +44 1993 706565
F +44 1993 774813
E sales@bartington.com
www.bartington.com