

Grad601

Magnetic Gradiometer System



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The Grad601 is a fluxgate gradiometer, used for measuring minute variations in the magnetic field that are caused by hidden anomalies in the ground such as archaeological and geophysical features, pipes, cables, waste drums, unexploded ordnance, and other signs of human activity.

The full system comprises a Data Logger (DL601), a battery cassette (BC601), and either one or two Grad-01-1000L sensors mounted on a rigid carrying bar together with a carrying harness (Grad601-2 only). Calibration is made easy via simple push-button control.

The Data Logger's non-volatile flash memory will hold surveyed grids. These can be downloaded as individual files, so different size grids may be recorded during a survey.

Features

- Electronic adjustment
- Push button operation
- Available modes: Grid (Scan or Survey) and NMEA (Run)
- Selectable resolution 0.01nT or 0.1nT (Grid mode); 0.1nT (NMEA mode)
- Exceptional temperature stability ensures minimal drift and reduces need for adjustment
- One metre baseline provides ideal depth response for distinguishing important sub-surface features
- 50Hz or 60Hz electricity power line rejection
- Low power consumption allows 24 hour operation with two sensors

Typical Applications

- Archaeological prospecting
- Forensics
- Unexploded ordnance (UXO) detection
- Pipe, cable and drum location



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Components

The Grad601 system includes the following components:

- Grad-01-1000 sensor(s)
- DL601 Data Logger
- BC601 Battery Cassette and charger
- Single or dual-sensor carrying bar and associated cables
- Carrying harness (Grad601-2 only)
- Grad-601 DATALOG downloading software and USB to RS232 converter
- Carrying case.



Alternative Configurations

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:
Grad601-2 dual to Grad601-1 single system	Single sensor carrying bar + BC601 battery cassette extension cable
Grad601-1 single to Grad601-2 dual system	Dual-sensor carrying bar and harness + Grad-01-1000L Sensor

Specifications

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

Mechanical		
Weight	Grad601-1 Single Sensor	2.9kg
	Grad601-2 Dual Sensor	4.3kg
	Harness with abdominal spacer and balance weight	1.6kg
	Carrying case for either system (dimensions 1250 x 280 x 260mm)	9.85kg (empty) 15.75kg (full Grad601-2)



Grad-01-1000L Sensor



The Grad-01-1000L is a high stability fluxgate gradient sensor, with a 1m separation between the sensing elements and an effective sensitivity of 0.03nT/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 long cables, if required.

The sensors may also be fitted to the Non-Magnetic Cart, also available from Bartington® Instruments, for surveys over wider areas.

Specification	
Number of axes	One (vertical)
Sensor element spacing	1m
Gradient range	±100nT/m or ± 1000nT/m full-scale
Bandwidth	DC to 14Hz with -40dB 50Hz/60Hz rejection
Sensitivity	0.03nT/m (max effective)
Calibration error	±2%
Maximum ambient field	±100µT
Drift	<1nT in 24 hours
Dimensions	38mm diameter x 1050mm in length
Weight	0.83kg
Connector	12-way Tajimi R04-R12M
Power supply current	60mA
Minimum sensor spacing in multi-sensor array	250mm between sensors



DL601 Data Logger



The Data Logger stores collected grids. These can be downloaded to a PC using either a serial RS232 cable connected directly to an RS232 port on the PC, or a USB to RS232 converter cable connected to the USB port of the PC. Data is made available in any of three formats for subsequent data processing.

All functions are selected via a simple six-key control panel and LCD display. The Data Logger can be set to either Grid or NMEA survey mode by the operator. Grid mode saves survey data in predefined grid format; NMEA mode sends data through to a PC in real time using NMEA format. It is then associated with location information to produce a reliable map of the survey site regardless of the surveyor's course.

The Data Logger measures the magnetic gradient during surveys using a high sampling rate, with automatic averaging for each reading. Sampling rate can be adjusted to suit the operator's pace.

Specification	
Sensors	1 or 2 Grad-01-1000L Sensors
Gradient ranges	$\pm 100\text{nT}$ and $\pm 1000\text{nT}$
Resolution	0.01nT on $\pm 100\text{nT}$ range (Grid mode)* 0.1nT on $\pm 1000\text{nT}$ range (Grid mode) and on all ranges in NMEA mode
Attenuation	-20dB 50Hz/60Hz rejection
Control delay	27ms
Controls	ON/OFF switch, keypad and external switch
Display	2 rows x 20 characters LCD
Display update rate	Operation dependent
Gradiometer adjustment	Automatic via keypad
Data logging memory	125k data points non-volatile
Data output	RS232 interface USB converter supplied NMEA output available
Audio output	Variable rate bleeper
Dimensions (H x W x D)	160 x 80 x 60mm
Weight	0.49kg
Connectors: Grad-01-1000L RS232 output Battery External switch	Two 12-way Tajimi R04-R12F 9-way D type 2-way Amphenol 62GB-57A8-2P 3-way series 712 subminiature
Power supply requirements	9V-18V DC, 45mA (max)
Survey mode	1 to 4 lines/m 1 to 8 readings/m along each line (4 max on 40m grids) Capacity to store 125k readings

* Effective resolution with Grad-01-1000L Sensor is 0.03nT/m.

BC601 Battery Cassette

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



Specification - BC601 Battery Cassette	
Battery	10.8V 72Wh UN approved Lithium ion battery
Battery charging	6 to 8 hours with mains adaptor supplied (automatic termination)
Indicators	Red LED lit when charging, off when complete
Fuse	2A 20mm anti-surge internal
Dimensions (H x W x D)	120 x 210 x 25mm
Weight	0.91kg including battery
Connectors: charger input output	2.1mm socket 2-way 62GB type on 250mm cable



Grad601 Carrying Bar

An appropriate carrying bar is supplied for each configuration, Grad601-1 or Grad601-2. The sensors 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.

For ease of use during surveys, green and red push-buttons are provided on the carrying bar, near the operator's hand, as alternatives to the keypad ENTER and ESC keys.

The dual-sensor carrying bar is attached by swivel mounts to an abdominal spacer bar to assist in keeping the sensor vertical. The spacer bar is attached to the harness by shock absorbing rubber rings.

Accessories

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

- Carrying harness with spare rings (Grad601-2 only). The harness can be adjusted to fit the operator and enables the gradiometer to be positioned at the required carrying height. A bag in the back of the harness can be water-filled to counter balance the instrument.
- 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 CD
- Grad601 Operation Manual on CD



Software

Most users will find that processing and interpretation of survey results is greatly simplified if graphical mapping software is used. The typical graphical image plots shown here indicate how detected features can be clearly identified.

Grad601 Download Software

This utility is supplied free of charge and allows survey data to be downloaded to a Windows™ PC. Several file formats (including 'xyz', 'z data' and 'spreadsheet mode') are available, and are compatible with most common mapping software packages (e.g. Surfer™, Geoplot). The plots on the right illustrate how the 1m vertical spacing of the sensors on the Grad601 provides an increased depth of response compared to a 0.5m spacing gradiometer.

TerraSurveyor by DW Consulting

TerraSurveyor (formerly ArcheoSurveyor) is a fully featured and powerful graphical imaging application, specifically designed for archaeological geophysics. It can read data directly from the Grad601 Gradiometer (and other commonly used survey instruments such as resistivity) via the serial/USB connection. The user can then apply a wide variety of data filters and algorithms (e.g. clip, destripe, destagger, etc.) to enhance the clarity of any magnetic anomalies.

TerraSurveyorLite is a 'lite' version of this graphical mapping software, providing the user with the majority of functions needed to process instrument data. There is a simple upgrade path to the full version when further features become necessary.

TerraSurveyor and TerraSurveyorLite demonstration versions can be downloaded from the DW Consulting website at www.dwconsulting.nl.



Example of survey from Grad601-2 plotted in TerraSurveyor

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