



Grad601

High Resolution Vertical Magnetic Gradiometer
for Shallow Geophysical Prospection

- 1 or 2 sensor operation
- 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 innovation in magnetic measuring instruments

Grad601 Magnetic Gradiometer System



The *Grad601* is a vertical component fluxgate gradiometer system comprising the DL601 data logger, the BC601 battery cassette and either one or two *Grad-01-1000* cylindrical sensor assemblies mounted on a rigid carrying bar. Each sensor assembly contains two fluxgate magnetometers with one metre vertical separation. The system provides an enhanced depth response, exceptional stability and electronic adjustment.

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. In addition, the large non-volatile flash memory and fast downloading of data offer 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 output 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.

Survey data is saved in grids of 10, 20 or 30 metre squares with 1,2 or 4 traverses per metre and 1 to 8 readings per metre along each traverse. A non-volatile 256kB flash is sufficient for 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 one 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 which adjusts to the operators pace to smooth the data for each reading.

The 1 metre vertical separation of the gradiometer elements in the sensor provides a greater response to a deep anomaly compared to a gradiometer with 0.5 metre separation. The enhancement is up to 40% at a depth of 2 metres and 50% at a depth of 3 metres. This results in enhanced image resolution even when high ground clearance is required. The following plots compare the survey data using a 1m separation *Grad601* with those from a 0.5m gradiometer over the same archaeological site. The full scale range is $\pm 2\text{nT/m}$.



1m vertical separation gradiometer



0.5m vertical separation gradiometer

Grad-01-1000 fluxgate gradiometer sensor

The *Grad-01-1000* sensor is a high-stability fluxgate gradient sensor with a 1m separation between the sensing elements. The resolution is 0.1nT/m when used on the 100nT/m range and 1nT when used on the 1000nT range. 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 *Grad601* fluxgate gradiometer sensor

Sensor element spacing	1m
Gradient range (linear)	$\pm 100\text{nT/m}$ or $\pm 1000\text{nT/m}$ full scale
Extended range	$\pm 3000\text{nT}$ or $\pm 30,000\text{nT}$
Accuracy	$\pm 2\%$
Maximum ambient field	$\pm 100\mu\text{T}$
Noise	100pT pk-pk
Drift	$< 1\text{nT}$ 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 *DL601* Datalogger

Sensors	1 or 2 <i>Grad-01-1000</i> gradiometers
Gradient ranges	$\pm 100\text{nT}$ and $\pm 1000\text{nT}$ linear with compression at higher values
Resolution	0.1nT on $\pm 100\text{nT}$ range, 1nT on $\pm 1000\text{nT}$ 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	
<i>Grad-01-1000</i>	2 off 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 <i>Grad-01-1000</i> Datalog software
Audio output	Variable rate bleeper
Power supply / current	9-18V DC; $< 45\text{mA}$
Dimensions	160 x 80 x 60mm
Weight	0.55kg

BC601 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 – *BC601* Battery Cassette

Battery	1 off 12V 4Ah Lithium Ion
Indicators	Red LED lit when charging, off when finished Push-button charge state indicator
Connectors	
Charger input	2.1mm socket
Output	2-way 62GB type on a 250mm cable
Battery charging	6-8 hours with mains adaptor supplied (automatic termination)
Fuse	2A 20mm anti-surge internal
Dimensions	210 x 120 x 25mm
Weight	0.86kg including battery

Grad601 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.

Heading labels on the connector blocks on each gradiometer assist re-fitting in the exact previous position.

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 respectively 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 reduce excessive wear of the most frequently used keys.

Accessories



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

Carrying harness (*Grad601-2* only)

Mains adaptor: 100-240V/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

Grad601 Operating Manual

Spare plastic knobs, plastic chain links and carrying bar grips.



The *Grad601-2* carrying harness provided for the dual gradiometer system completely relieves the operator's arms of the weight of the gradiometer, whilst enhancing the user's ability to operate the instrument.

The harness can be adjusted to fit all sizes of operator and can position the gradiometer at the required height whilst the abdominal spacer determines the carrying distance in front of the operator. The gradiometer can be quickly attached and detached from the harness using two simple hooks.

Software

The *Grad601* software provided allows the data to be downloaded to files for importing into other proprietary processing and plotting software such as ArcheoSurveyor from DW Consulting B.V. (recommended) or Surfer from Golden Software Inc. Data can also be directly downloaded into ArcheoSurveyor

Environmental (all components)

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 including Harness with abdominal spacer and balance weight		4.3kg + 1.6kg
Carrying Case <i>Grad601</i> for either system (empty)	1160 x 270 x 230mm	9.85kg

The specifications of the products described in this brochure are subject to change without prior notice. Specifications for all Bartington Instruments' products are available on the Internet.