

# Grad-01-1000L 单轴磁通门梯度仪探头

## 简述

Grad-01-1000L 是一个高稳定性的磁通门梯度仪探头，其中感应芯片间距为1m，有效灵敏度为0.03nT/m。该探头卓越的(exceptional)温度稳定性确保探头在检验期间最小的偏移和减少了调整到最低限度的需要。每个探头包括电子元件和用于储存校准数据的非易失性存储器，如果有需要，探头可以通过长电缆，单独使用。

Grad-01-1000L 单轴磁通门梯度仪探头可固定在无磁车上，也可与巴庭顿仪器搭配使用，用于广泛区域的调查(for surveys over wider areas)。



## 技术规格

轴数	1 (垂直方向)
传感器元件间距/探头间距	1m
梯度范围	$\pm 100\text{nT/m}$ 或者 $\pm 1000\text{nT/m}$ full-scale
带宽	DC to 14Hz with -40dB 50Hz/60Hz rejection
灵敏度	0.03nT/m (最有效)
校准误差	$\pm 2\%$
最大环境磁场	$\pm 100\mu\text{T}$
漂移	$< 1\text{nT}$ , 24小时内
尺寸	38mm 直径 x 1050mm 长度
重量	0.83kg
连接头	12路 Tajimi R04-R12M
电源电流	60mA
在多探头阵列中，最小探头间距	250mm

## Grad-01-1000L

### Very High Stability Single Axis Fluxgate Magnetic Gradiometer

Bartington®  
Instruments



The *Grad-01-1000L* is a vertical component magnetic gradiometer for archaeological and geophysical surveys and UXO detection. It is designed for use alone or as one element in a gradiometer array for rapid data collection over large areas. An open interface is provided to allow settings to be adjusted by the user. Resolution which is mostly limited by thermal drift, is around 50pT/m.

The Gradiometer contains two directionally sensitive fluxgate elements spaced 1m apart on a very stable beam together with the necessary electronics to provide an analog output representing the magnetic gradient along the main axis. It is housed in a rugged, lightweight 38mm diameter protective tube which is fully sealed for operation under wet conditions.

The unit operates from a 12V unregulated power supply, has a bandwidth of d.c. to 10Hz and a range which can be switched between  $\pm 100\text{nT/m}$  ( $\pm 1\text{mGauss/m}$ ) and  $\pm 1000\text{nT/m}$  ( $\pm 10\text{mGauss/m}$ ). The analog output is  $\pm 4\text{V}$  full scale. Beyond four volts, a logarithmic compensation extends the range to 3 and  $30\mu\text{T/m}$ . The interface allows directional and offset errors of the sensing elements to be nulled electronically. The influence of the background field can thereby be eliminated and only anomalies in the field will be recorded. This compensation also applies where the gradiometer is rigidly mounted near a magnetic structure. The enclosure is clearly labelled with a direction arrow to facilitate orientation during set-up, see figure 3.

技术规格 – Grad-01-1000L	
探头间距	1m
梯度范围	$\pm 100\text{nT/m}$ 或者 $\pm 1000\text{nT/m}$ full scale ( $3\mu\text{T}$ 或者 $30\mu\text{T}$ compressed)
输出	$\pm 4\text{V}$ full scale, 输出阻抗 $1\text{k}\Omega$ ( $\pm 5\text{V}$ compressed)
精度	$\pm 1\%$
最大环境磁场	$\pm 100\mu\text{T}$
噪声	$100\text{pT}$ pk-pk max.
差分漂移	$< 0.02\text{nT}/^\circ\text{C}$ (预热时间 2-3 分钟)
带宽 *	d.c. to 10Hz min. with $-12\text{dB/octave}$ 滚降
电源	12V 标称值 (9.5 -18.5V) 非稳定电源; 极性保护
电源电流	58mA
上拉电流(管脚5-11)	0.5mA when held low
连接头	12 pole Tajimi R04-R12M
环保等级	IP65
工作温度	$-20^\circ\text{C}$ 至 $+70^\circ\text{C}$
尺寸	38mm 直径 x 1052mm 长度
重量	0.82kg (1.8lb)

\* 可选200Hz带宽

## Operation

The unit requires a power supply of 12V unregulated. The input is protected against reversed polarity. The analog output of  $\pm 4V$  full scale is referenced to power ground within the gradiometer. A separate signal ground connection permits the use of a differential input data logger for good noise immunity. The normal scale factor is  $\pm 100nT$  full scale but a high scale of  $\pm 1000nT$  can be selected by pulling input /HR to ground at any time. The analog output is active irrespective of the status of the other digital control lines. Enquiries are welcomed for suitable data loggers and power supplies.

## Resolution limit

The gradiometer output represents the difference between the outputs of the two sensors. The resolution of any fluxgate gradiometer is limited by small errors in offset, gain and angular alignment between these sensors. These errors appear in response to changes in the sensor orientation. The *Grad-01-1000L* has a digital interface to allow the user to minimise these errors. The errors are classified as follows:

### Offset Error - O

This is the departure from zero output regardless of the orientation of the gradiometer.

### Vertical Error – V

This error alternates in magnitude when the long axis of the gradiometer is alternately inverted and non-inverted. This error increases in significance as the inclination of the terrestrial field increases, that is, towards the poles.

### North/South Error – N

This error is due to misalignment of the sensors in the direction of the arrow and therefore is discovered by pointing the arrow alternately north and south.

### East/West Error – E

This error is due to misalignment of the sensors at right angles to the direction of the arrow and is discovered by pointing the arrow east and west.

## Digital adjustment

Compensation for the above errors is set using six CMOS/TTL inputs. The most recent settings are stored internally even with the power disconnected. They may be revised at any time whilst in use. The digital lines are active in the low state and are fitted with internal pull-up resistors. All lines are heavily protected against electrical damage and false operation. The lines are inhibited for a time of 2 seconds following power up. The lines operate as follows:

### Device Select /DS

This line must be held low to select the gradiometer which is to be adjusted and held low during adjustment. Settings are stored when this line returns high but only if the /INC line is stable and high. A delay of 20mS must be allowed for the /DS line to stabilise after each level change.

### Parameter Address Lines A, B, C

Three lines are used to address the relevant control within the gradiometer, as shown below.




### Polarity POL

This line determines the polarity of the desired correction (increase or decrease).

### Increment - /INC

Each time this line goes low the selected compensation setting is incremented one step to remove the error under investigation. A delay of 1mS must be allowed for the /INC line to stabilise after each level change.

Specification – Error Parameter Address Lines			
A	B	C	Function
H	H	H	Zero Offset fine Of
L	H	H	Zero Offset coarse Oc
H	L	H	Vertical fine Vf
L	L	H	Vertical coarse Vc
H	H	L	North/South fine Nf
L	H	L	North/South coarse Nc
H	L	L	East/West fine Ef
L	L	L	East/West coarse Ec

Specification – Parameter adjustment			
/DS	/INC	POL	Mode
L		H	Step adjustment +ve direction
L		L	Step adjustment -ve direction
	H	X	Store current value

Specification – Digital Interface Timing		
Symbol	Parameter	Minimum ms
t <sub>AC</sub>	Address stable to DS	0.5
t <sub>CL</sub>	/DS to /INC setup	0.5
t <sub>ID</sub>	/INC HIGH to POL Change	0.5
t <sub>DI</sub>	POL to /INC Setup	0.5
t <sub>IL</sub>	/INC LOW Period	0.5
t <sub>IH</sub>	/INC HIGH Period	0.5
t <sub>IC</sub>	/INC Inactive to /DS Inactive	0.5
t <sub>CPH</sub>	/DS Deselect time	22
t <sub>IW</sub>	/INC to output change	1
t <sub>CYC</sub>	/INC Cycle time	0.5
t <sub>R</sub> , t <sub>F</sub>	/INC Input rise and fall time	1

## Connector Cabling

See Figure. Electrical connection to the gradiometer is via a waterproof connector mounted on the side of the tube. The cable should be screened and the power conductors (pins A and B) should be a tightly twisted pair to minimise the production of stray magnetic fields. As a precaution the cable should be immobilised relative to the gradiometer when in use.

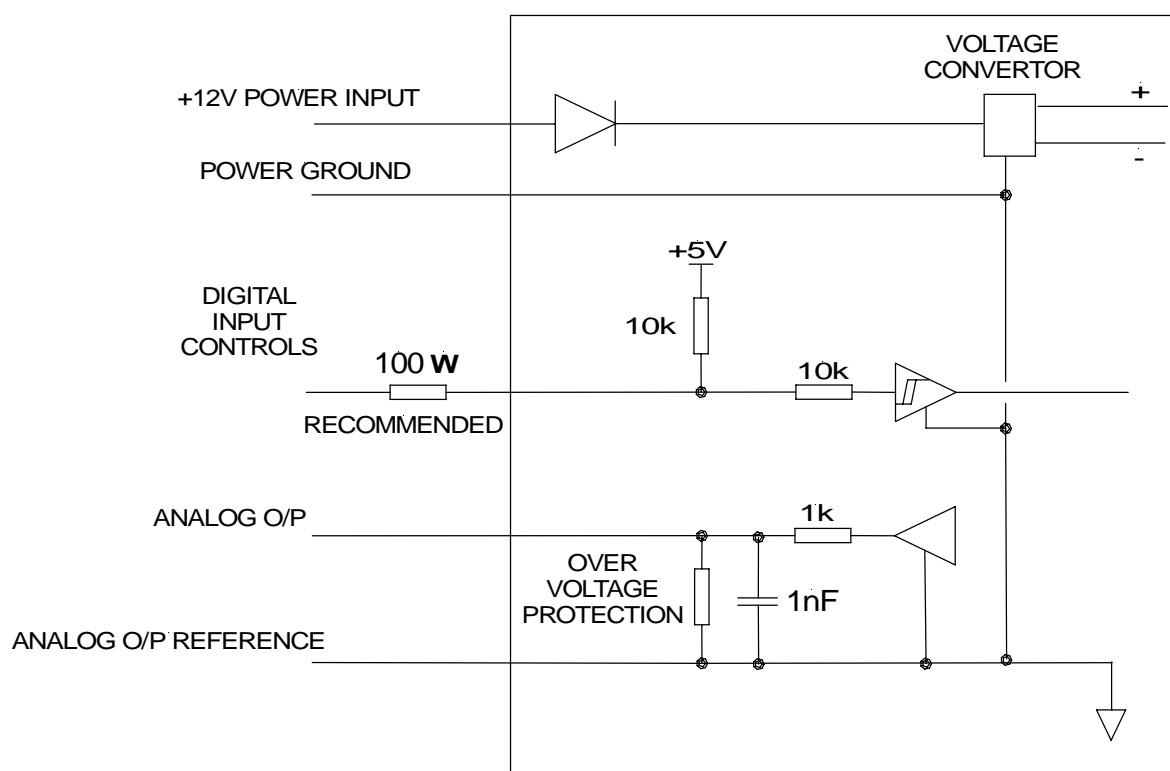
A mating connector can be supplied upon request.

Specification – Pin Connections		
Grad-01-1000L / Cable	Symbol	Function
A	V <sub>s</sub>	V supply
B	V <sub>so</sub>	Power ground (0V)
C	V <sub>a</sub>	Analog output (±4V)
D	V <sub>ao</sub>	Analog output reference (0V)
E	/HR	Lo = High Range Select
F	/DS	Lo = Device Selected
G	Add A	Address A (LSB) Input
H	Add B	Address B Input
J	Add C	Address C (MSB) Input
K	POL	Direction of Setting Hi = positive
L	/INC	Incremental Setting
M		Shield

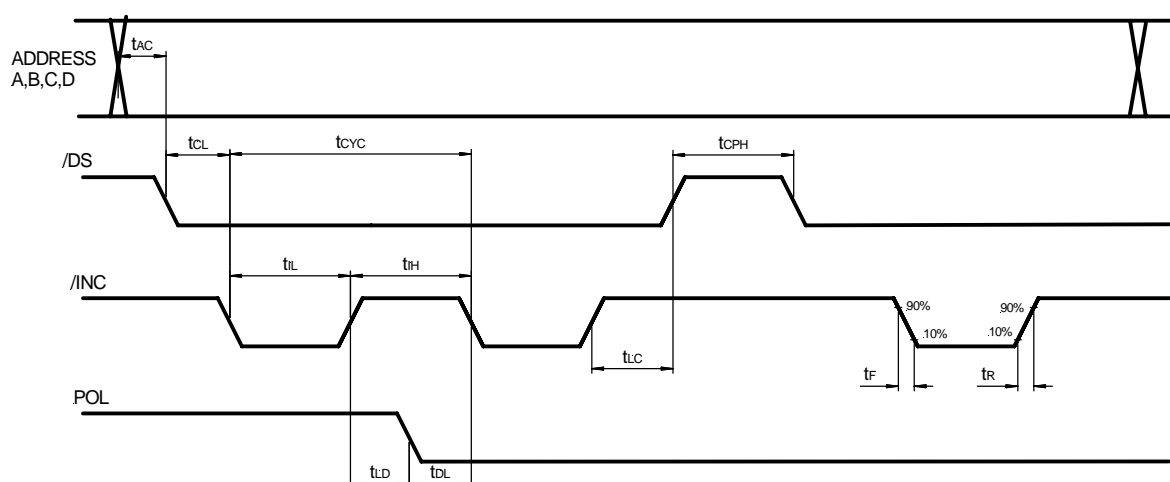
## Mounting

The Gradiometer may be mounted using a suitable clamp at any point or points along the tube.

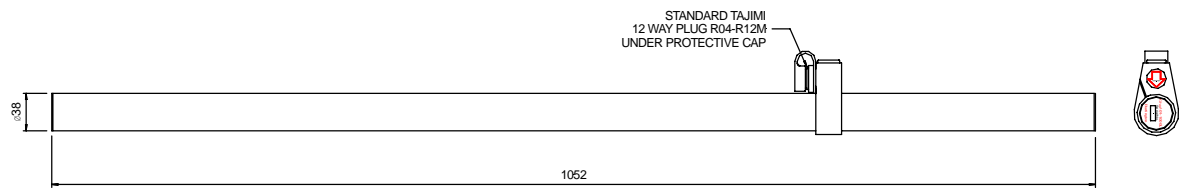
**Figure 1 Electronic Interface**



**Figure 2 DIGITAL INTERFACE TIMING**

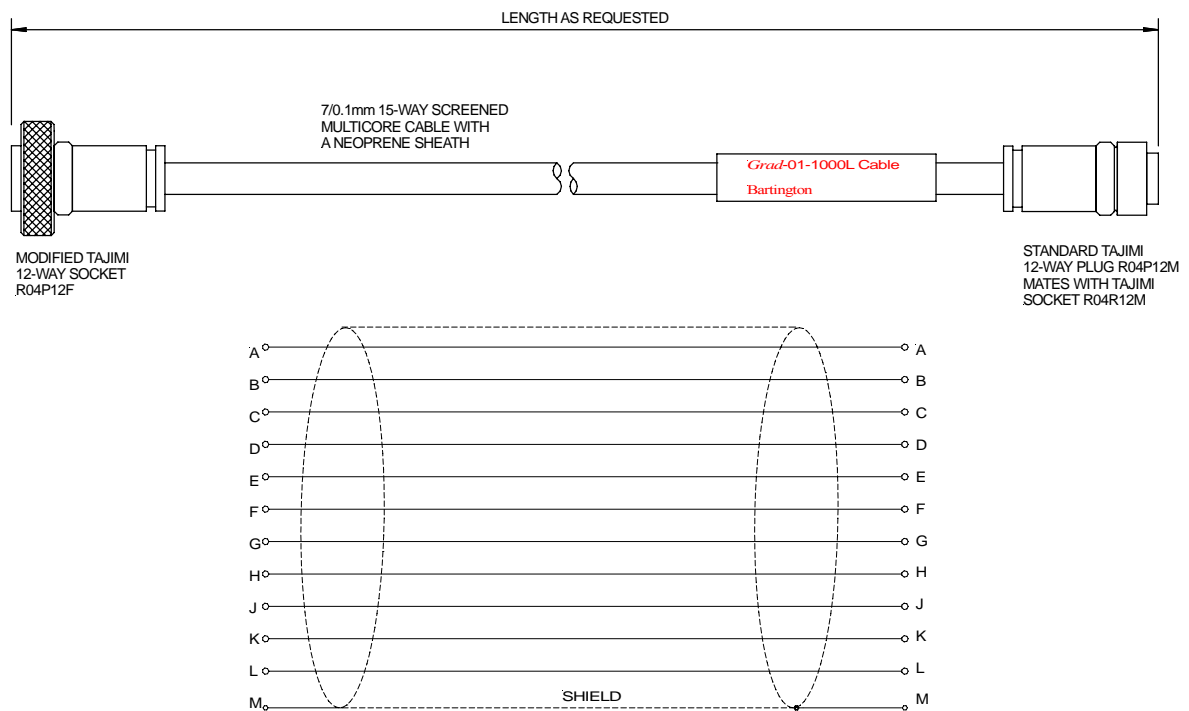


**Figure 3 Outline Drawing**



Grad-01-1000L  
Gradiometer Assembly

**Figure 4 Cable Drawing**



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