

SECTION 1

INTRODUCTION

1-1 About the Instruction Manual

This Instruction Manual provides guidance on how to use the FM9, FM18 AND FM36 Fluxgate Gradiometers. The text generally assumes that an FM18 is being used but where operation or procedure differs for the FM9 and FM36 this is additionally described.

1-2 Introducing the FM Gradiometers

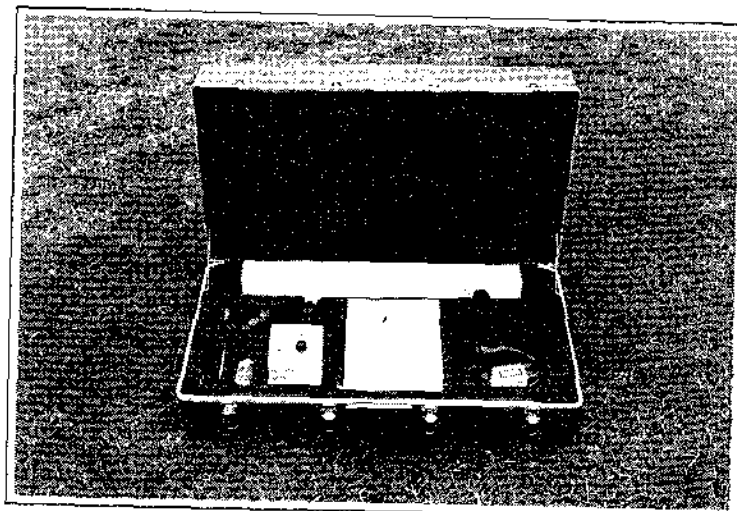
The FM series of Fluxgate Gradiometers, with built-in data-logging facilities, provide many powerful functions to promote fast and efficient surveying, even supporting one man surveys. The FM18 (memory capacity 4000 readings) and the FM36 (memory capacity 16000 readings) keep track of survey position, giving both audible and visual indication of current survey position. Readings may be logged either manually, using an external hand-held key, or they may be logged using pulses from an external distance encoder. Data is stored in a non-volatile memory and may be output via an internal RS232 interface to portable computers such as the Epson HX20 or PX8. The FM9 is a stripped down version of the FM18 and FM36 for applications not requiring data-logging facilities or for use with a DL10 data logger.

Readings are displayed on an alphanumeric, liquid crystal display in either digital or analogue form, the latter being very useful for scanning. Alignment of the fluxgate sensors, critical to good performance, is very rapid compared to other instruments since adjustment of each sensor is essentially independant of the other. The top sensor is used for E-W adjustment and the bottom sensor for N-S adjustment. Control of other instrument functions, including range switching and setting zero, is performed using the membrane keypad, and all settings are stored in the non-volatile memory for recall at power-up. All instruments come complete with a robust executive style carrying case and battery charger. The FM18 and FM36 are also supplied with a hand held external log key and data output cable.

1-3 Display Information

(1) Analogue and Digital Display

Both analogue and digital modes are provided. Pressing the DISPLAY MODE key alternates between each mode. The moving bar of the analogue display mode is ideal for preliminary scanning to locate areas of interest, with the most sensitive range indicating changes of $\ln T$. Once located, the digital mode may then be used for logging readings in the more detailed search. The normal digital display indicates the resolution and if the log zero drift function is selected. Pressing the LOG ENABLE key brings up the survey tracking display.



Figures 1-1 and 1-2. FM18 Fluxgate Gradiometer and carrying case.

(2) Push Button Auto-Zero

Zeroing of the instrument display at the survey reference point is performed using the keyboard - a single key initiates an auto-zero cycle which ensures a rapid and accurate zero. The key must be depressed for 2 seconds before the zero is changed, thereby preventing accidental shift of the zero. If desired the zero adjustment may be removed by using the Check Offset function in the menu sequence.

1-4 Programming the Gradiometers

The gradiometers may be easily and quickly programmed for use by stepping through a menu which displays the current value of each parameter, Table 1-1. This may be changed if desired by using one of the two arrowed keys. All settings, including range and zero, are stored in the non-volatile memory and recalled at power-up.

Resolution (digital display)	0.1, 1, 10 nT
Range (analogue display)	+/- 5, 10, 20, 40, 80, 160, 320, 640 nT
Reading Average	ON / OFF
* Log Zero Drift	ON / OFF
* Log Interval	0.25, 0.5, 1 m
* Grid size	10, 20, 30 m
Average period	16, 32, 64, 128 readings
* Baud rate	600, 1200, 2400 baud
* External trigger type	Manual / Encoder
Check offset	ON / OFF

Table 1-1. Menu Parameters (* FM18, FM36 only)

1-5 Special Features

(1) Built-in Data Logger (FM18 and FM36)

Readings are stored in a non-volatile memory which may be partitioned into grids of 10 x 10 m, 20 x 20 m or 30 x 30 m, with the reading interval being either 1m, 0.5m or 0.25m. The data logger keeps track of survey position for both parallel and zig-zag traverses, and displays the current grid, line number and line position. Incorrect readings may be deleted, or even a complete line, with one keystroke. A dummy reading can be inserted if a physical obstacle prevents a true reading being taken or a line may be completed with dummy readings, again with one keystroke. A mirror image "complete line" key is also provided for zig-zag surveying when part of the standard grid cannot be surveyed. The ENABLE LOG key is used to enable and disable all functions associated with the data logger memory, thereby preventing accidental corruption of the data.

(2) Drift Correction (FM18 and FM36)

Any change in the instrument zero may be logged at the end of each grid if desired. This information is dumped along with the data and may be used by the receiving computers software to correct for any zero drift over the grid. This may be especially useful on the 0.1nT range or when the instrument is subjected to extremes of temperature.

(3) Manual or Encoder Logging (FM18 and FM36)

Normally readings are logged by pressing the key of the external hand-held key, or from the instrument keyboard, but they may also be logged using pulses from an external distance encoder, such as a line together with hand held pulley/slotted wheel and optocoupler. This is especially useful if readings are required to be logged at 0.5m or 0.25m intervals at a walking pace. The gradiometers may be easily interfaced to such systems and can log readings at rates of up to 10 readings per second. Please consult separate data sheet for further details.

(4) Digital averaging

The reading may be averaged digitally, not only to reduce sensor noise but also to smooth out tilt errors. This is especially useful on the 0.1nT range, where, for example, buffeting by the wind may cause unavoidable tilting of the instrument, subsequently seen as noise in the normally logged reading. Averaging, however, will considerably reduce this uncertainty. Typically readings may be logged on the 0.1nT range with an uncertainty of $\pm 0.2\text{nT}$ (128 reading average period). In this mode the instrument cycles through the average period, updating the display and sounding a beep at the end of each average period until a log command over-rides and restarts the cycle.

(5) Construction

Waterproof components are used throughout, including all connectors, instrument housing, keypad, outer sensor tube and caps over the sensor alignment controls. A rigid aluminium tube is used to support the sensors and provides excellent stability without the fragility of a pyrex tube.

1-6 Typical Specifications

GRADIOMETER sensor separation	500 mm
Operating field range	+/-100uT, no latch-up for larger fields
Analogue ranges	+/- 5,10,20,40,80,160,320,640 nT
Digital ranges	+/-20000nT +/-2000nT +/-200nT
Digital display resolution	10nT 1nT 0.1nT
Data storage resolution	5nT 0.5nT 0.05nT
Response time	20mS 40mS 120mS
Zero control	push button auto-zero
Zero resolution	5nT 0.5nT 0.05nT
Display update rate	digital - 3 readings / sec. analogue - 9 readings / sec.
Reading average period (determined by signal strength)	0.6-1.2 s (16 readings) 1.2-2.4 s (32 readings) 2.4-4.8 s (64 readings) 4.8-9.6 s (128 readings)
Fluxgate sensor controls	(a) sensitivity balance potentiometer (b) two independant N/S, E/W alignment controls
Analogue output (BNC connector)	+/-2 V fsd each range
Power supply	8 AA batteries, Alkaline or Nickel-cadmium
Battery life	45 hours Alkaline, 12.5 hours, Nickel-cadmium
Battery voltage range	6.5 - 12 V
Power supply sensitivity	< 0.2 nT / V
Working temperature range	0°C.....+40°C
Weight (inc. batteries)	2.35 Kg
Dimensions	620 x 380 x 120 mm
LOGGER capacity	FM9 FM18 FM36 None 4000 16000 readings
Data retention time	- > 10 > 5 years
External encoder trigger	pulse width - min 25 mS, max 50 mS
External trigger rate	maximum 10 pulses per second
Serial output baud rates	600, 1200, 2400 baud
RS232 output	+/- 5V with respect to GND
RS232 connections	1 TXD - Transmitted data 2 GND - Signal ground 3 CTS - Clear to send (input) 4 RTS - Request to send (output)
Data output format	4 digit number plus sign (data), followed by a single digit number (range), output as ASCII code :
	...SPACE sign dig1 dig2 dig3 dig4 SPACE CR LF SPACE range SPACE CR LF...
Character format	One start bit, eight data bits, two stop bits, no parity
CHARGER current	70 ma constant current
Charge time for full capacity	10 hours (Nickel-cadmium AA cells)
Input voltage to charger	240 V,50 Hz (120 V,60 Hz option available)

All specifications subject to change without notice

