

**USER'S GUIDE**  
**Installation & Operation**  
**Instructions**

**BATMAG METER**  
**ELECTROMAGNETIC FLOWMETER**



---

## INDEX

<b>Introduction</b>	<b>1</b>
<b>Installation guides</b>	<b>3</b>
<b>Meter Body</b>	<b>4</b>
<b>Flow Rate Guide</b>	<b>5</b>
<b>Wiring Diagram</b>	<b>6</b>
<b>Output Functions</b>	<b>7</b>
<b>Keypad System</b>	<b>8</b>
<b>Menu System / setup</b>	<b>8</b>
<b>Main Menu</b>	<b>9</b>
<b>Flow Data Menu</b>	<b>10</b>
<b>Setup Data Menu</b>	<b>11</b>
<b>Error Messages / Troubleshooting</b>	<b>13</b>
<b>Features &amp; Specifications</b>	<b>14</b>
<b>Warranty</b>	<b>15</b>

## Introduction

The **Safmag Batmag** display is designed for use with the full range of Safmag flow sensors. The Batmag is a battery powered and provides cost effective measurement of flow rate in applications where mechanical flowmeters are traditionally used. The design concept has focused on simplicity, whilst retaining all benefits associated with the use of an electromagnetic flow meter. The **Batmag** meter comprises a flowtube sensor and a battery powered display unit. The display unit utilises a low power high speed microprocessor. The flow total and flow rate are displayed on a LCD display. Low power consumption is achieved by sampling the flow rate at regular intervals and switching the LCD display off. The coil pulse red LED indicates the coil being pulsed and the flow rate sample being taken and is visible through the display cover. To read the rate and total in low power modes the user presses the **SHOW/SAVE** button.

## Battery life

The **Batmag** is designed to sleep between flow samples and achieve substantial battery life. Battery life is affected by the sample interval and interruptions to the sleep mode. The sample interval is programmable by the user and interruptions to the sleep mode occur for unsteady flow rates which activate smart sampling and the processor staying awake to produce required output pulses. The maximum battery life is therefore achieved with steady flow, the maximum sample interval i.e. 60s and the fewest number of totaliser pulses per unit volume e.g. pulse per 1m<sup>3</sup>.

## Smart Sampling

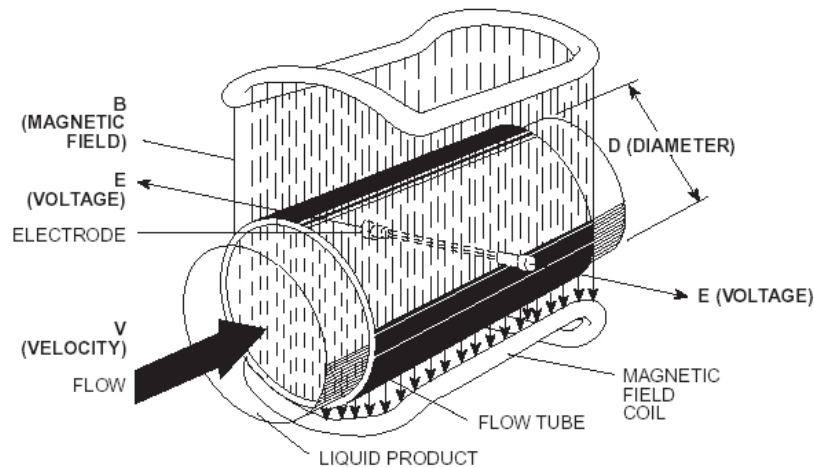
The **Batmag** will sleep in low power mode between flow samples see **M1\_7**. If flow is detected from zero flow or if the flow rate changes significantly the Batmag will enter Smart Sampling mode and sample continuously until the flow rate value is stable, at which time it returns to the programmed sample interval.

## Volumetric Pulse Programming

**N.B.** The Batmag is a low power flow meter. It will sleep between flow samples see **M1\_7**. The Batmag will however stay awake to produce output pulses for up to a maximum time period equal to **50%** of the sample time. That is, an awake time of **30s** is possible for a **60s** sample period. This will impact battery life.

## Theory of Operation

The operation of an electromagnetic flow meter is explained by reference to Faraday's law of electromagnetic induction. This law states that the voltage induced across an electrical conductor, as it moves at right angles through an electromagnetic field, is directly proportional to the velocity of that conductor through the field. Mathematically this statement is represented as shown below.



$$E = \text{constant} \times B L V$$

Where:

E = the induced voltage

B = the electromagnetic field strength

L = the length of the conductor in the field

V = the velocity of the conductor (average velocity of the medium)

The volumetric flow of a conducting liquid or slurry is derived as follows:

Let L = D (the diameter of the meter)

Then E = constant  $\times$  B D V

Volumetric flow  $Q = V A$  (where A is the Cross-sectional area of the pipe)

Combining the above equations it is seen that if field strength is held constant then

$E = K Q$  (where K is a constant), thus the induced voltage is directly proportional to the volumetric flow rate.

## Installation guides

### Remote Electronics

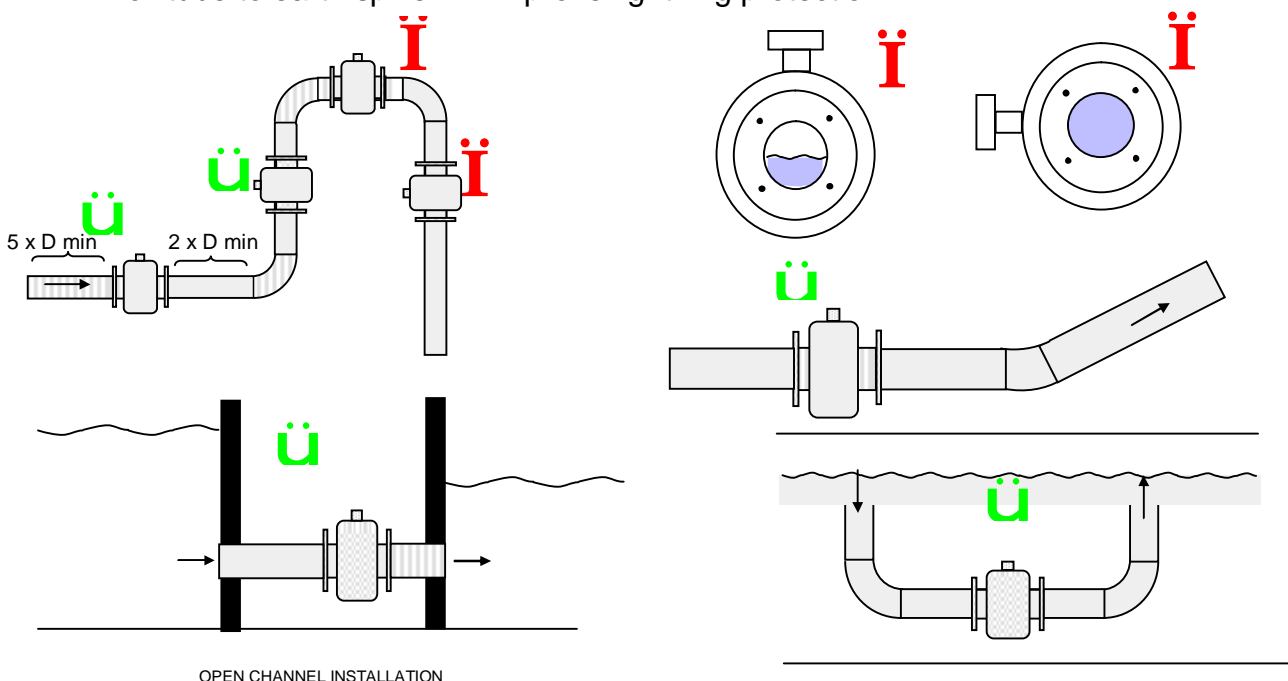
The electronics display may be mounted up to 100 metres from the meter body using SAFMAG cable. It should be mounted on the wall or a pipe stand. The display housing has dedicated pre-moulded holes for mounting located at the corners. **DO NOT** drill into the display enclosure, this will void IP rating and warranty. Avoid direct sunlight on the LCD display as this can make it difficult to read and cause fading over time. If mounted in an area where there is exposure to direct sunlight it is advisable to mount the display facing south and provide shade for the display. Avoid mounting the display in any area where there is a possibility of flooding. The display and glands are rated IP67.

Avoid mounting near VSD (variable speed drives) and motors.

The Batmag meter is not rated for use in hazardous areas.

### Flowtube (Sensor)

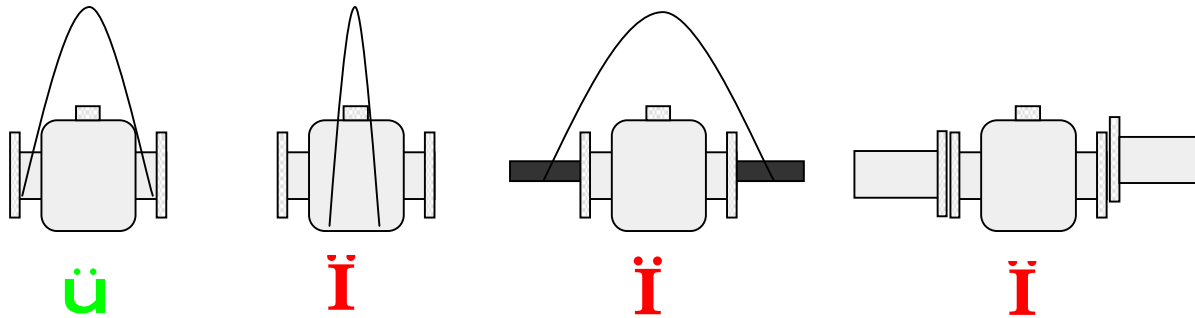
While installing the meter it is recommended to follow the arrow marking [ → ] on the flow meter tube, which indicates the direction of flow. If the meter is installed in the opposite direction to that indicated by the arrow, the meter will read reverse flow for forward flow. This situation can be remedied by swapping the wires marked **COIL** on the electronic board. The flowtube may be installed in horizontal or vertical pipelines. If installed horizontally, the measuring electrodes should be in the horizontal plane avoiding the possibility of contact with bubbles in line. The flowtube should be **FULL OF LIQUID AT ALL TIMES**. Install the flowtube with at least 5 pipe diameters of straight pipe upstream, and 2 pipe diameters downstream. Ensure that the gaskets do not protrude into the pipe. This could affect accuracy of the flow meter. Flowtubes installed in non-conductive pipework (eg PVC HDPE) or lined pipework should have **earthing rings** installed and be electrically bonded to the flowtube ground. Bonding the flowtube to earth spike will improve lightning protection.



OPEN CHANNEL INSTALLATION

## Meter Body

The flow meter should be lifted by a rope sling being passed around the outside of the meter or, in the case of the large meters the lifting lugs should be used. Never pass a cable or beam through the flowtube for lifting purposes, as this will damage the flowtube liner and render the meter unusable. Do not support the meter by its case.



Check for alignment and spacing of pipe work, as the meter should not be used to pull pipe work into alignment. Table overleaf gives face to face and overall dimensions for the various sizes and types of meter.

Place flange gaskets on the flange faces of the meter and position the meter between the flange faces of the piping. Gaskets should be cut 3 mm larger than the inside diameter ID of the pipe.

Insert bolts through the flanges and run washers and nuts onto the bolts. Check the piping for alignment and the gaskets for concentricity. Tighten the nuts evenly – do not over tighten as this may damage the liner. Bolt torque should be limited to that which will produce a positive seal.

## Application Guidelines

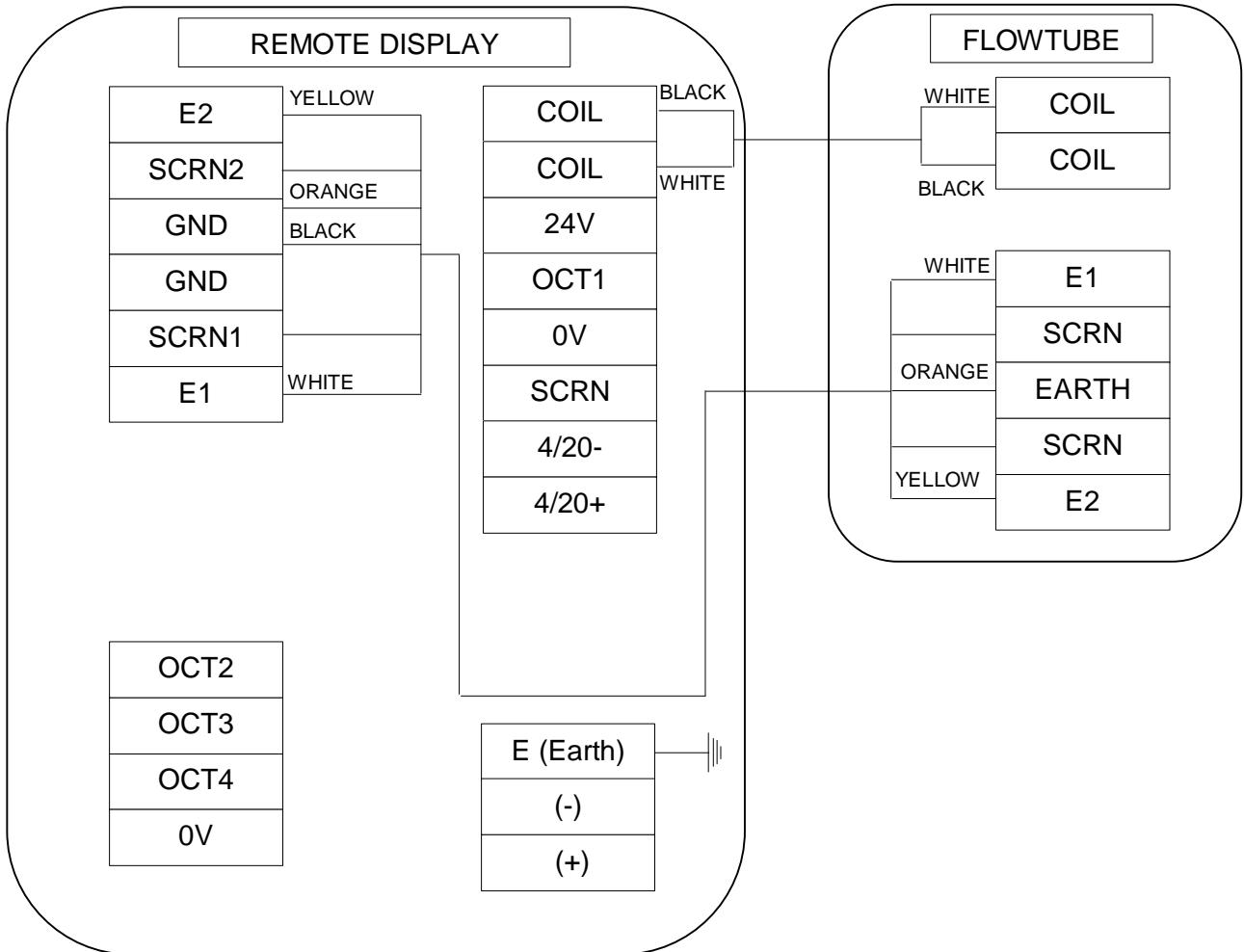
1. The velocity at maximum flow should be greater than 1 m/s. (select the meter size accordingly)
2. The minimum flow velocity the flow meter will measure is 0,1m/s.
3. The maximum velocity the flow meter will measure is 10 m/s
4. The conductivity of the liquid should be greater than 20µs/cm.

### FLOW RATE GUIDE

PIPE SIZE (mm)	PIPE SIZE (INCH)	FLOWRATE @ 1m/s (3ft/s)				FLOWRATE @ 10m/s (30ft/s)			
		(l/s)	m3/hr	ft3/s	gal(US)/s	(l/s)	m3/hr	ft3/s	gal(US)/s
25	1	0.5	1.8	0.02	0.13	5	18	0.18	1.32
40	1.6	1.25	4.5	0.04	0.33	12.5	45	0.44	3.30
50	2	2	7.2	0.07	0.53	20	72	0.71	5.28
65	2.6	3.3	11.9	0.12	0.87	33	118.8	1.17	8.72
80	3.2	5	18.0	0.18	1.32	50	180	1.77	13.2
100	4	8	28.8	0.28	2.11	80	288	2.83	21.1
125	5	12	43.2	0.42	3.17	120	432	4.24	31.7
150	6	18	64.8	0.64	4.75	180	648	6.36	47.5
200	8	31	111.6	1.09	8.19	310	1116	10.95	81.9
250	10	49	176.4	1.73	12.9	490	1764	17.30	129.4
300	12	70	252.0	2.47	18.5	700	2520	24.72	184.9
350	14	96	345.6	3.39	25.4	960	3456	33.90	253.5
400	16	125	450.0	4.41	33.0	1250	4500	44.14	330.1
450	18	159	572.4	5.62	42.0	1590	5724	56.15	419.9
500	20	196	705.6	6.92	51.8	1960	7056	69.22	517.6
600	24	283	1018.8	9.99	74.7	2830	10188	99.94	747.4



## Wiring Diagram



**Remote Display**

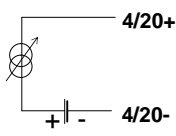
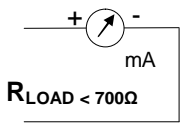
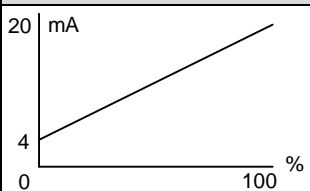


**Flowtube**

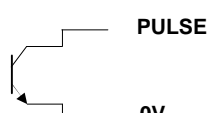
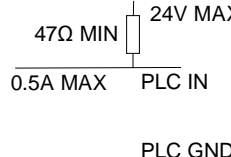
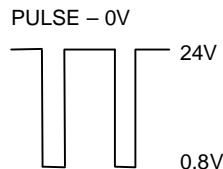
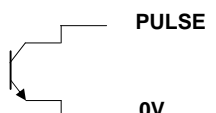
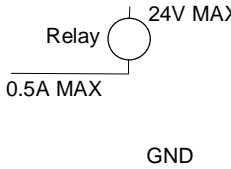
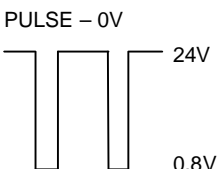
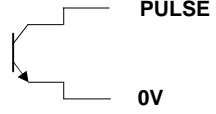
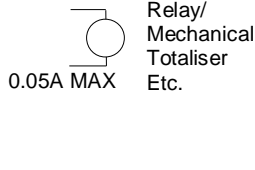
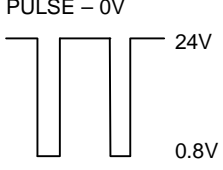
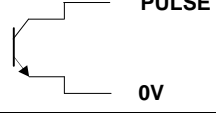
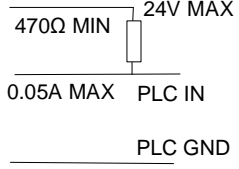
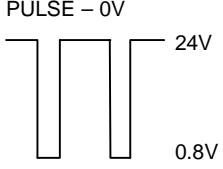


## Output Functions

- The 4-20mA signal output requires external supply of 24VDC  $\pm$ 2VDC connected at **+ & - terminals**. The active 4-20mA output signal is available at terminals 4/20+ & 4/20- proportional to the flow rate. 4mA = 0 flow rate. The full-scale value (i.e. 20mA) is the flow rate figure programmed into menu item M1\_2.

OUTPUT	BATMAG TERMINALS	EXT. CIRCUIT	SIGNAL
Flow rate Current Loop (Active, requires external supply at <b>+ &amp; - terminals</b> )			

- The batmag will produce a totaliser pulse string of equal mark space ratio after it has sampled the flow rate. The totaliser pulse output signal is either a 24V pulse available between the **24V** terminal and the **OCT** terminal, or an open collector output between **OCT** terminal and the **0V** terminal. The 24V pin requires external supply of 24VDC  $\pm$ 2VDC at **+ & - terminals**. The width of the pulse is selectable in menu item M2\_5. The error message “**pulse-out error**” will be displayed if the pulse string cannot be produced within half the sample period.

<b>OCT</b>			
OUTPUT	BATMAG TERMINALS	EXT. CIRCUIT	SIGNAL
Totaliser pulse Binary Output (Open-Collector) External supply and pull up resistor			
Totaliser pulse Binary Output (Open-Collector) External supply and relay/counter			
Totaliser pulse Binary Output (Open-Collector) Internal/External supply and relay/counter			
Totaliser pulse Binary Output (Open-Collector) Internal/External supply and external pull up resistor			

## Keypad System

The Batmag meter has a 4-button programming system.

- The **MENU** button (**M**) is used to scroll through the menu structure.
- The **SAVE** button (**S**) is used to view rate and total during low power modes, to view battery voltage and to save entered changes to the flow meter programme.
- The **▶** and **▲** buttons are used to change numbers and scroll through options.

## Menu System / setup

The Batmag meter menu system is easy to use and designed for programming simplicity.

With the Batmag meter powered up the Batmag meter will test the flowtube sensor wiring and test that liquid is present. If correct, the flow total and flow rate are displayed, if not an error message is displayed.

<b>F0000100</b>	<b>I</b>	= Forward total or Reverse Total total see <b>M1_8 tot display</b>
<b>3.9768</b>	<b>l/s</b>	= Flow rate

All set-up requirements are contained in the menus, and each item is stepped to by pressing the **M** button.

**N.B.** The new data is only stored if the **Save & exit** instruction is executed.

## START PROGRAMMING - Press MENU

### Main Menu

The Main Menu consists of **Password?**, **Change?**, **Units?**, **Menu-1**, **Menu-2**, and **Save & exit**

#### Password?

\*\*\*\*

Enter the required password. The flow meter is shipped with the password 1000. (Default password = **1942**). The set-up can be viewed without the password, however, no changes can be saved at the **Save & exit** menu item and the error message **wrong password** is displayed.

Press **▶** repeatedly until cursor is under digit to be edited

Press **▲** repeatedly until desired value is displayed and **M** to continue

#### Change ?

1000

Providing the correct password was entered, a new password can now be entered. Enter the required password.

Press **▶** repeatedly until cursor is under digit to be edited

Press **▲** repeatedly until desired value is displayed

Press **M** to continue

#### Units?

Metric

**Metric** and **US** units of rate and total measurement are available.

Press **▲** until desired units are displayed and **M** to continue.

#### Menu-1

M-cont S-enter

Press **S** to enter or **M** to continue

#### Menu-2

M-cont S-enter

Press **S** to enter or **M** to continue

#### Cal mode

M-cont S-enter

Press **S** to enter or **M** to continue (Cal mode is a hidden menu)

#### Save & exit

M-cont S-yes

Press **S** to save and exit or **M** to continue

## MENU-1 Flow Data

**M1\_1 rate units**  
l/s

Press **▲** repeatedly until desired units are displayed and **M** to continue

**M1\_2 max flow**  
100l/s

Enter the maximum flow rate at which to output 20mA. mA must be enabled **M2\_9**

Press **▶** repeatedly until cursor is under digit to be edited

Press **▲** repeatedly until desired value is displayed and **M** to continue

**M1\_3 tot units**  
m<sup>3</sup>

Select the unit in which you wish to totalise.

Press **▶** repeatedly until cursor is under digit to be edited

Press **▲** repeatedly until desired value is displayed and **M** to continue

**M1\_4 clr total?**  
save tot

Select between **clear tot** to clear the existing flow total, **save tot** to keep the existing flow total

Press **▲** to select option required and **M** to continue

**M1\_5 damping**  
minimum

Minimum, medium, maximum damping settings are available

Press **▲** to select the required value and **M** to continue

**M1\_6 cutoff**  
2%

1%, 2%, 3%, 5% & 10% of full scale **M1\_2** cutoff settings are available

Select the level below which the Batmag meter will output zero flow rate

Press **▲** to select the required value and **M** to continue to **Main Menu**

**M1\_7 sampling**  
60s

**Continuous, 10s, 20s, 30s, 40s, 50s, 60s** settings are available. Maximum battery life will be achieved at 60s sampling.

Select the interval at which the Batmag meter will sample flow.

Press **▲** to select the required value and **M** to continue to **Main Menu**

**M1\_8 tot display  
auto**

**Auto, scroll, net** settings are available. Auto displays forward flow and total during forward flow and displays reverse flow and total during reverse flow. Scroll alternates between displaying forward flow and total, reverse flow and total and net flow and total. Net only displays net total.

Press **▲** to select the required value and **M** to continue to **Main Menu**

## MENU - 2 Setup Data

**M2\_1 dia. mm  
100.**

Enter the Nominal Bore of the flowtube as displayed on its data plate.

Press **▶** repeatedly until cursor is under digit to be edited.

Press **▲** repeatedly until desired value is displayed and **M** to continue.

**M2\_2 K-value  
1.002**

Enter the calibration coefficient stamped on the flow tube.

Press **▶** repeatedly until cursor is under digit to be edited.

Press **▲** repeatedly until desired value is displayed and **M** to continue.

**M2\_3 sim% o/p  
100.**

The output current can be driven to any percentage of full scale by entering the desired value. This facility can be used for testing the mA loop, if activated.

Press **▶** repeatedly until cursor is under digit to be edited.

Press **▲** repeatedly until desired value is displayed and **M** to continue.

**M2\_4 puls-factor  
1.000m<sup>3</sup>/puls**

Volume in m<sup>3</sup> per pulse is programmable.

Press **▶** repeatedly until cursor is under digit to be edited.

Press **▲** repeatedly until desired value is displayed and **M** to continue.

**M2\_5 puls-width  
50ms**

The output pulse width can be varied.

Press **▲** repeatedly until the desired value is displayed and **M** to continue

**N.B.** pulse width is fixed with equal mark space ratio.

**M2\_6 puls1 opts  
FWD Total**

Pulse output is available for FWD Total, REV Total, FWD/REV Total, Empty pipe Alarm, Low Battery Alarm, REV Flow Alarm

Press **▲** to select the option required and **M** to continue.

**M2\_7 puls2 opts  
FWD Total**

Pulse output is available for FWD Total, REV Total, FWD/REV Total, Empty pipe Alarm, Low Battery Alarm, REV Flow Alarm  
Press **▲** to select the option required and **M** to continue.

**M2\_8 puls3 opts  
FWD Total**

Pulse output is available for FWD Total, REV Total, FWD/REV Total, Empty pipe Alarm, Low Battery Alarm, REV Flow Alarm  
Press **▲** to select the option required and **M** to continue.

**M2\_9 mA enable  
mA disabled**

24Vdc is required at +/- terminals. Select between mA disabled and mA enabled. The 4-20mA signal is held steady between samples and adjusted at each sample of flow rate, i.e. a 60s sample interval will have a 60s interval between changes in 4-20mA signal.

Press **▲** to select the option required and **M** to continue.

**M2\_10 Total opts  
Grand**

The top line of the LCD display is used for the totaliser. A Grand totaliser and a Resettable Totaliser are selectable. To reset the Resettable totaliser press DATA and VOLTAGE buttons simultaneously.

**Save & Exit  
M-cont S-yes**

**NOTE:**

Changes that are made to values in the menu system will only be saved when accessing the **Save & Exit** menu and the **S** button is pressed.

## Error/Warning Messages

ERROR MESSAGE	ERROR	POSSIBLE SOLUTION
<ul style="list-style-type: none"> <li>empty pipe</li> </ul>	<ul style="list-style-type: none"> <li>No liquid in flowtube</li> <li>Faulty electrode / coil cable</li> </ul>	<ul style="list-style-type: none"> <li>Fill pipe</li> <li>Repair / replace cable</li> </ul>
<ul style="list-style-type: none"> <li>no coil current</li> </ul>	<ul style="list-style-type: none"> <li>Faulty electrode / coil cable</li> <li>Faulty flowtube</li> </ul>	<ul style="list-style-type: none"> <li>Repair / replace cable</li> <li>Check coil resistance (approx. 40 ohms)</li> </ul>
<ul style="list-style-type: none"> <li>Puls-out error</li> </ul>	<ul style="list-style-type: none"> <li>Totaliser count-rate too high</li> </ul>	<ul style="list-style-type: none"> <li>Select larger total units, e.g. m<sup>3</sup>, Ml</li> </ul>

During sleep, if pulses take longer than a second, on average, to output then the puls-error message is shown. The equation is;

Error if: (max flow) / (tot units) \* (puls-factor) \* (sampling) \* (puls-width) \* 2 > 1000ms

## Troubleshooting

PROBLEM	POSSIBLE SOLUTION
<b><i>Meter not reading</i></b>	
<ul style="list-style-type: none"> <li>No display</li> <li>Zero flow</li> <li>No flow</li> <li>Contaminated electrodes</li> <li>Leaking electrodes</li> </ul>	<ul style="list-style-type: none"> <li>Press SAVE to power LCD</li> <li>Turn meter around or reverse coil wires</li> <li>Establish a flow.</li> <li>Remove flowtube and clean electrodes</li> <li>Replace flowtube</li> </ul>
<b><i>Meter reading lower/higher than expected</i></b>	
<ul style="list-style-type: none"> <li>Incorrect setup data programmed</li> <li>Faulty display unit (signal converter)</li> <li>Leaking electrodes</li> </ul>	<ul style="list-style-type: none"> <li>Program correct setup data</li> <li>Replace display unit</li> <li>Replace flowtube</li> </ul>



## Features & Specifications

Sensor size	DN150..600 MX/I PN 10/16 IP67, IP68 (optional) DN25..150 W PN 16 IP67, IP68 (optional)
Accuracy	+/- 1% of flow rate >0.5m/s
Repeatability	+/- 0,25% of flow rate >0.5m/s
Range	0.1-10m/s
Response Time	3 Selectable levels of damping
Transmitter/Display	Batmag remote wall mount/integral mount IP67
Model No.	BATMAG-I5
Display enclosure	IP67 (NEMA 6) Polycarbonate Wall Mount 125 x 125 x 75mm HxWxD (5" x 5" x 3")
Power supply	3.6Vdc 2 x D 19000mAh cell standard
Indication	Two-line rate and totals Displayed totals reverse, forward & net
Configuration	Supplied to customers spec or modified on site via easy to use menu structure with touch keypad
Units	Rate units: m/s, l/s, l/m, l/hr, m3/s, m3/m, m3/hr, ft/s, ft3/s, ft3/m, ft3/hr, USgps, USgpm, USgph, USmgd Total units: cl, dl, ml, l, m3, MI, ft3, 103ft3, 106ft3, USG, 103USG, 106USG
Outputs	Isolated open collector pulse x 4 Isolated active 4-20mA, external 24Vdc supply required
Calibration	Standard 3-Point calibration certificate
Features	Low Cost Non-intrusive No pressure loss No maintenance No moving parts Active empty pipe detection Password and tamper protection Error displays for easy diagnostics Easy to install
Options	GSM telemetry, extended battery pack up to 6 x D cells Installation Kit (Bolt sets & gaskets) Grounding rings (for lined or non-conductive pipe)
Standards	ISO 6817 First Edition 1992-12-01 Magflow design, CE Certified, IEC 60068-2-6 Vibration, IEC-60068-2-27 Shock

## **Warranty**

Flowmetrix SA CC warrants to the purchaser that the equipment to be delivered hereunder will be free from defects in materials, workmanship and title and will be of the kind and quality designated in the proposal.

The foregoing warranty is exclusive and in lieu of all other warranties whether express or implied including any warranty of merchantability or of fitness for a particular purpose.

Warranties other than the above will only be effective if written and signed by an officer of Flowmetrix SA CC

If within 1 (one) year from the date of delivery, the equipment delivered hereunder does not meet the warranties specified above, Flowmetrix SA CC shall thereupon correct such defects, at its sole discretion, either by repairing or by replacing the instrument in its entirety.

The costs of returning the equipment to Flowmetrix SA CC and for the repaired or replaced item being returned to the purchaser shall be for the account of the purchaser.

The liability of Flowmetrix SA CC is conditioned upon the equipment covered hereunder being handled, installed, operated, maintained, stored or used, as the case may be, in strict accordance with the written instructions or technical direction supplied by Flowmetrix SA CC, and is further conditioned upon the purchasers prompt written notice (within 30 days) to Flowmetrix SA CC of such defects.

Flowmetrix SA CC makes no warranties which extend to the items covered hereby due to improper handling, installation, operation, maintenance, storage or use; abnormal or undisclosed environmental conditions; or operating or use in an otherwise improper manner.

The liability of Flowmetrix SA CC to the purchaser, except as to title, arising out of the supplying of the equipment or its use, under this warranty article, shall not, in any case, exceed the cost of correcting defects in the equipment as herein provided and upon the expiration of the warranty described herein, all such warranty liability shall terminate. The foregoing shall constitute sole warranty remedy of the purchaser and the sole warranty liability of Flowmetrix SA CC.

## **Goods Return Procedure**

Damaged or defective equipment should be returned to the supplier prepaid. Do not return goods until written authorisation to do so has been obtained. Returned goods must have accompanying them a letter stating the following:

- Your company name and order number
- The contact person at your company
- Serial number and name of product
- Description of damage and cause if known
- Nature of any repair attempted by the user
- Type of repair, replacement or adjustment requested