

USER'S GUIDE
Installation & Operation
Instructions

DCP PRO METER
ELECTROMAGNETIC FLOW METER
(DC PULSED)
MODBUS RTU / MODBUS TCP/IP



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General Information

Introduction

This manual covers the theory of operation, installation and field service procedures for SAFMAG electromagnetic flowmeters supplied with the DCP signal convertor. Should further support be required, contact your local representative or Flowmetrix SA directly.

Identification

Before beginning installation of the SAFMAG flowmeter, verify that all parameters of the intended application match those of the flowmeter supplied.

Applications

- Process control
- Pump protection
- Energy consumption and water conservation management

Inspection

Upon delivery, the packing case should be inspected for external damage. If damage is evident, this fact must be reported to the carrier immediately and the case should only be unpacked with a representative of the shipping company present. Check the contents of the case against the packing slip.

Damaged Parts

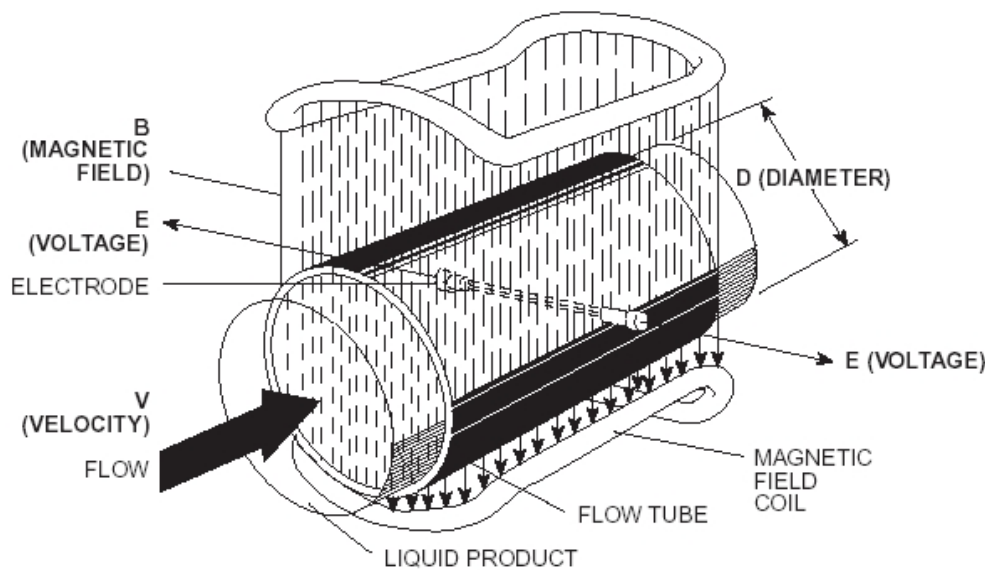
Damaged or defective parts should be returned to the supplier prepaid. Do not return goods until authorisation to do so have been obtained. Returned goods must have accompanying them a letter stating the following:

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

SAFMAG Electromagnetic Flowmeter

Theory of Operation

The operation of an electromagnetic flowmeter 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:



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

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:

$$\begin{aligned} \text{Let } L &= D \text{ (the diameter of the meter)} \\ \text{Then, } E &= \text{constant} \times B \times D \times V \end{aligned}$$

Volumetric flow $Q = V \times A$ (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

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

Description

General

The SAFMAG DCP electromagnetic flowmeter is composed of two principal assemblies:
The meter flow sensor, which is mounted in the pipeline
The flowmeter signal converter, which is remotely or integrally mounted.

Flowtube (Sensor)

The pipeline section, or flowtube, is lined with an insulating material compatible with the process liquid to be monitored. Two field coils are mounted on the flowtube, and these field coils generate the electromagnetic field inside the pipe section. As conductive liquid flows through this pipe section, a voltage is generated. In order to sense the voltage induced in the process fluid, electrodes are inserted through the lining and flowtube. These electrodes are chosen to be compatible with the process fluid.

Remote Electronics

The SAFMAG DCP signal convertor provides pulsed DC coil excitation for the flowtube. Pulsed DC excitation is normally used when the process fluid is a pure liquid, the drive circuit in the electronics unit sending low-frequency pulses to the coils to generate the magnetic field.

Flowtubes with pulsed DC excited fields are not normally suitable for measuring the flow of slurries and pulp mixtures, and we recommend that the SAFMAG ACP AC excited Magmeter is used for these applications.

In certain slurry applications, noise is generated as a result of particles impinging upon the electrodes, and the higher frequency and voltage of the AC excited Magmeter offers a solution to these more difficult applications.

Paper stocks are more complicated, but the chemical additives found in various paper stocks make it difficult to predict accurately whether or not noise will be a problem.

The DCP utilises a multi-tasking microprocessor to handle all the functions simultaneously. The Flowmetrix philosophy of producing easy-to-use instrumentation means that the unit can be programmed in a matter of minutes, even without the instruction manual. The flow rate and total are displayed continuously on a backlit LCD display, clearly visible through the viewing window in the cast aluminium housing.

Application Guidelines

The minimum flow velocity through the SAFMAG DCP Magmeter at full scale (i.e. 20mA), should not be less than 1 metre/second. The meter diameter should therefore be selected accordingly.

The SAFMAG DCP electromagnetic flowmeter has a minimum full-scale velocity of 1 metre/second and a maximum full-scale velocity of 10 metres/second. Velocity is calculated from volumetric flowrate by using the following equation:

$$V = 1273.24 Q/D^2$$

Where: Q is the flowrate in litres/sec
D is the nominal meter size in mm

The table below gives meter capacities for minimum and maximum full-scale velocities, for all meter sizes

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
10	3/8	0.079	0.28	0.003	0.02	0.79	2.8	0.03	0.2
15	5/8	0.18	0.65	0.006	0.048	1.8	6.5	0.06	0.48
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
700	28	385	1386.0	13.60	101.7	3850	13860	135.96	1016.8
750	30	442	1591.2	15.61	116.7	4420	15912	156.09	1167.3
800	32	500	1800.0	17.66	132.1	5000	18000	176.57	1320.5

Conductivity

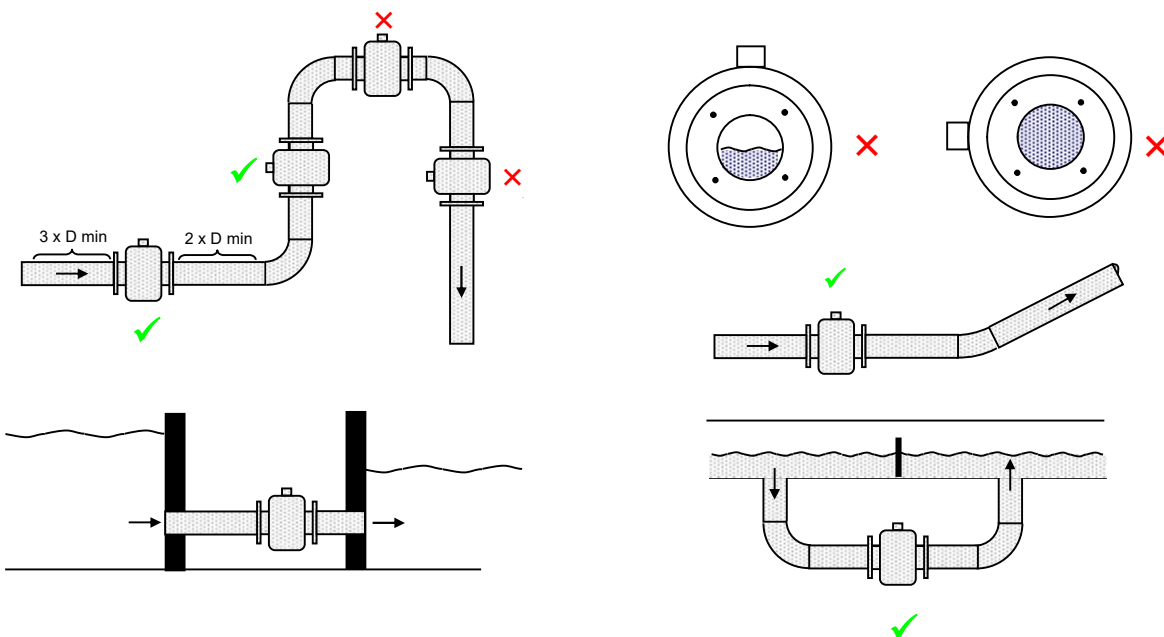
The first parameter to consider in deciding whether or not to use a magnetic flowmeter in a given application is conductivity. The conductivity unit of measure is microsiemens/cm or ($\mu\text{S}/\text{cm}$). The minimum conductivity level for the SAFMAG DCP is $20 \mu\text{S}/\text{cm}$.

Installation

Piping and Other Considerations

The SAFMAG DCP electromagnetic flowmeter is a bi-directional device. The arrow on the flowmeter body indicates the direction of flow used during calibration at the factory, and the meter should be installed in the pipeline with the arrow in the direction of forward flow.

The meter may be installed in horizontal or vertical pipelines. If a vertical pipeline installation is envisaged the meter should be installed with the direction of flow being upwards, to ensure a **full** pipe under low flow conditions. If a horizontal installation is envisaged the meter electrodes should be installed in the horizontal plane in order to prevent entrained air or gasses creating a problem with the measurement.



It is essential that the meter be full of liquid at all times.

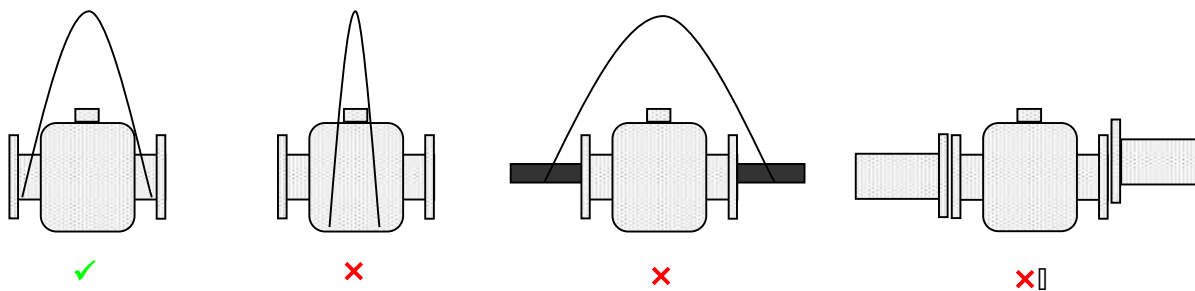
If this is not the case then the meter will produce an artificially high flowrate. If obtaining a full meter is a problem, in some cases this may be solved by repositioning the meter at the lowest point in a “U” shaped pipe section.

Stray electromagnetic or electrostatic fields of high intensity may have an effect on the meter reading. For this reason, the meter should not be installed close to large electric motors, transformers, communications equipment etc.

NB: To ensure accurate flow measurement, the Magmeter should be installed with at least 3 pipe diameters of straight pipe upstream, and 2 pipe diameters downstream of the Magmeter.

Meter Body

The flowmeter 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 pipework, as the meter should not be used to pull pipework into alignment.

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 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.

DCP Signal Converter Installation

The signal convertor unit may be mounted up to 100 metres from the meter body. It should be mounted on the wall or a pipe stand using normal engineering procedures and safety procedures. **Exposure of the LCD to direct sunlight should be avoided.**

Electrical Connections

The first rule to be observed is that the flowmeter body and the fluid should be at the same potential to ensure accurate measurement. Normally the grounding electrode in the flowtube or the metal pipeline ensures that the potentials are equalised. Certain installations however, require special consideration:

Unlined metal pipelines (fig a)

In most installations where the flowtube is installed between the flanges of an unlined metal pipeline, the grounding electrode will be sufficient for accurate measurement. Where the process fluid has low conductivity, or if there is a possibility of induced currents in the pipeline, grounding rings and ground connections should be installed.

Plastic or lined pipelines (fig b)

The grounding electrode will ensure accurate measurement on flowmeters up to 150 mm in size. Above 150 mm, additional precautions may be necessary, such as grounding rings.

NB: Ensure the grounding rings are corrosion-resistant!

Pipelines with cathodic protection (fig c)

Pipelines with electric corrosion protection are generally insulated inside and outside so that the fluid has no conductive connection to ground. The flowtube must be insulated from the pipeline.

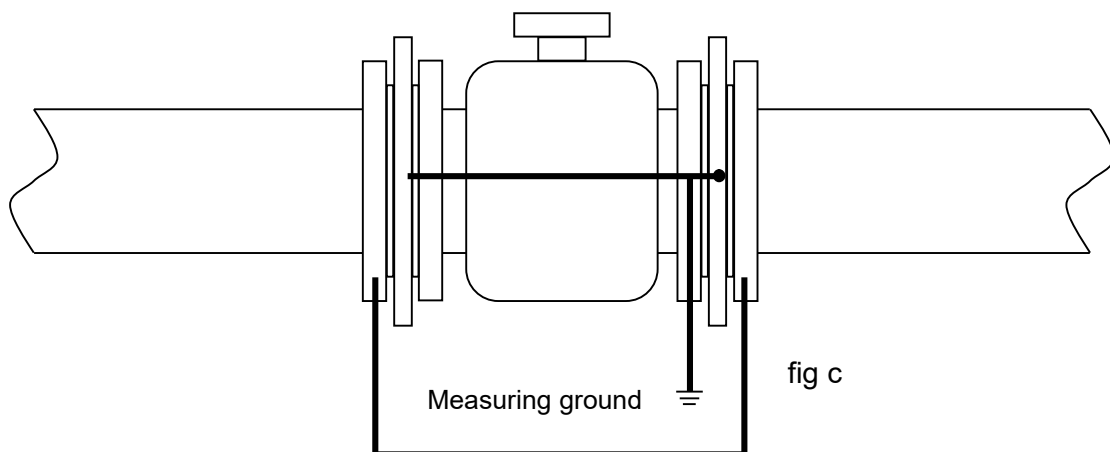
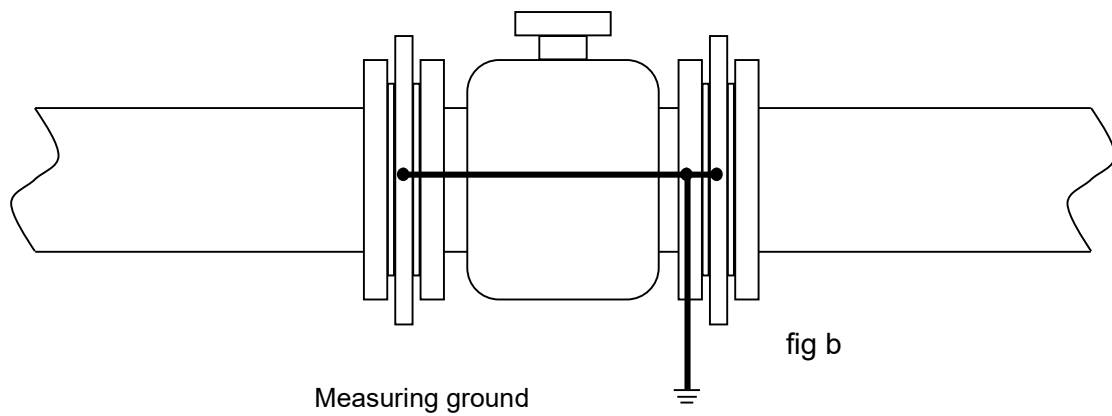
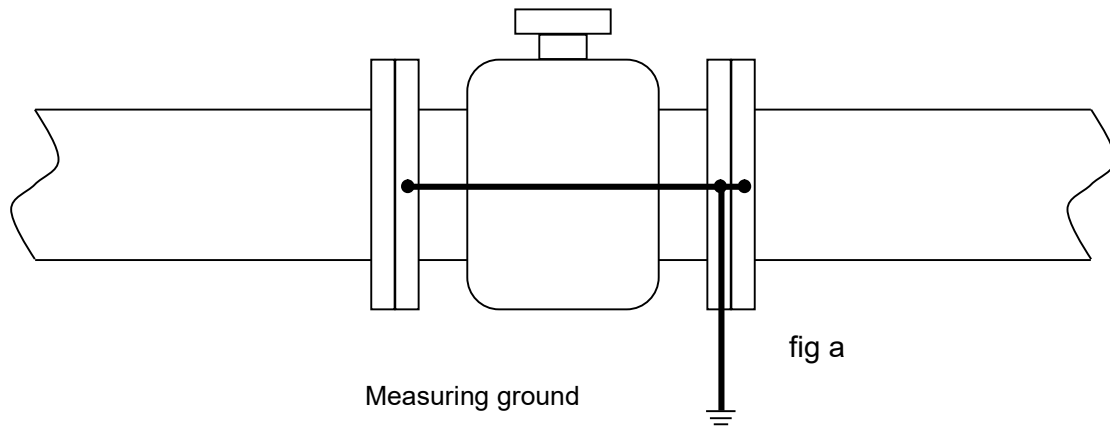
NB: When installing the flowmeter, ensure that the grounding rings are insulated from the pipe flanges on both sides of the flowtube. Grounding rings, flowtube and measuring ground must be interconnected.

Bypass the flowtube and the grounding rings with a conductor of sufficient current carrying capacity to pass the cathodic protection current with negligible voltage drop. Customer supplied grounding and connecting cables must have a cross section of 6mm² and be terminated with cable lugs.

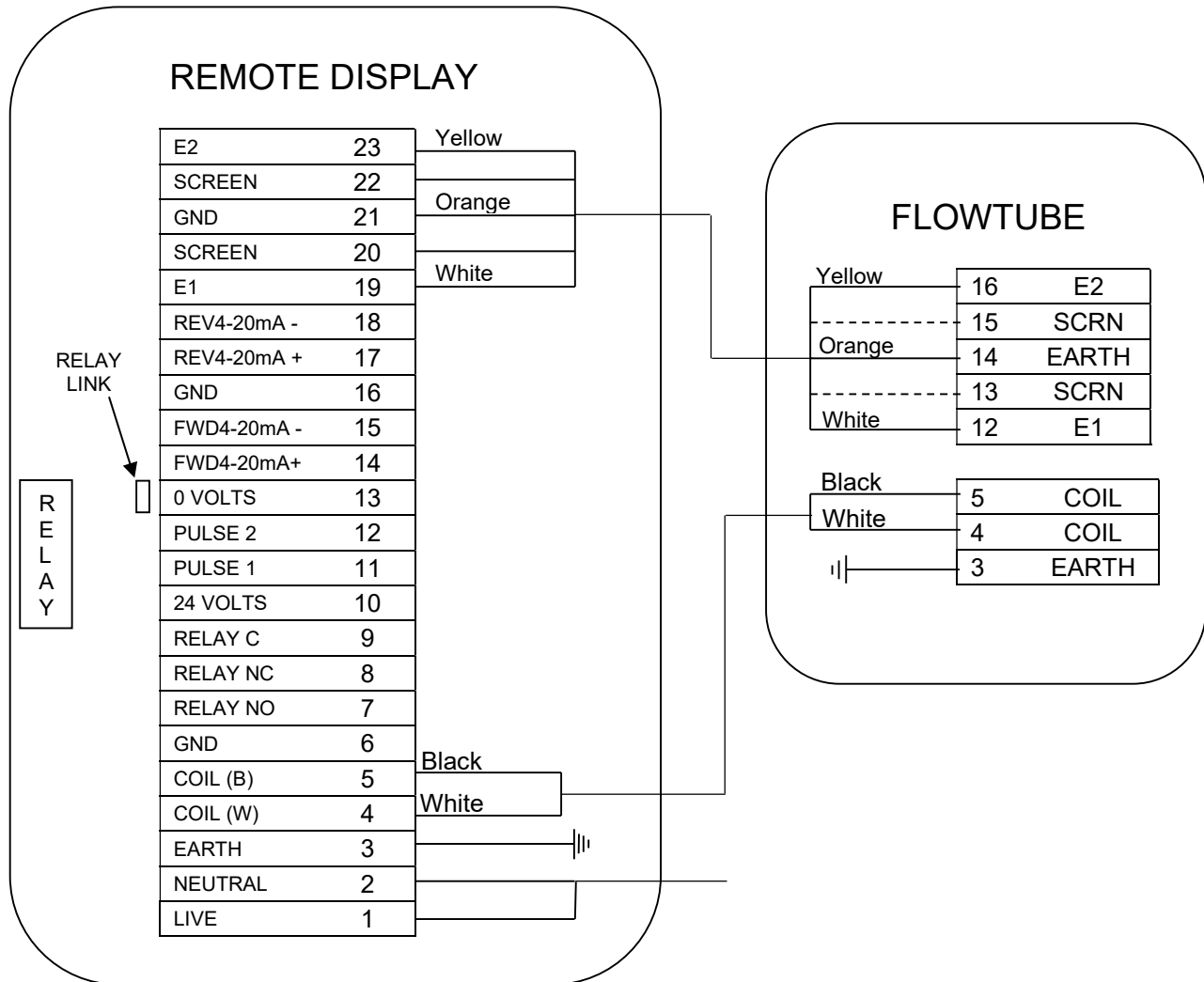
SAFMAG Flowmeters require the use of a special cable supplied by FLOWMETRIX SA for the connections between the meter body and the remote electronics display. Refer to the connection diagram for details.

Normal electrical and safety practices should be followed when making the electrical connections.

NB: AC supplies should not be run in the same cable as output signal. Screened cables should be used for all measurement signals.

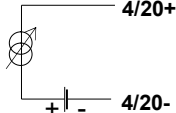
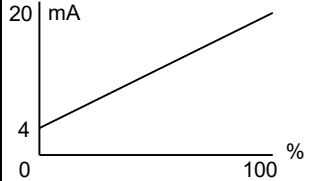


Wiring Diagram

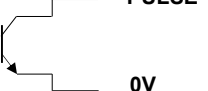
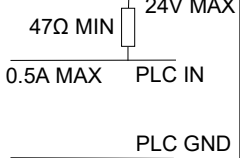
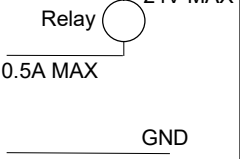
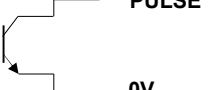
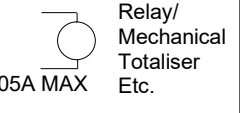
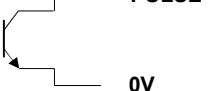
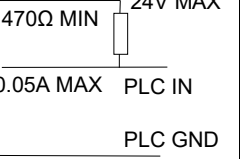


Output Functions

- The 4 – 20mA output signal is proportional to the flow rate. 4mA = 0 flow rate. The full-scale value (20mA) is the flow rate figure programmed into menu item **M1_2** & **M1_3**.
- A resistive load must be present when measuring current out of the 4-20mA outputs.

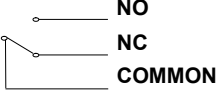
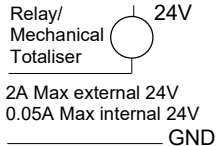
OUTPUT	DCP TERMINALS	EXT. CIRCUIT	SIGNAL
Flow rate Current Loop (Active)		 $R_{LOAD} < 600\Omega$	

- The pulse output signals are either a 24V pulse available between the **24V** terminal and the **PULSE1** or **PULSE 2** terminals, or an open collector output between **PULSE1** or **PULSE 2** terminals and the **0V** terminal. The width of the pulse is selectable in menu item **M2_7**, however if the pulse rate exceeds 3 pulses per second, the pulse output will change to an output with equal mark-space ratio. **M2_6** is used to set the pulse output rate in **m³/pulse**. **Pulse1 output** and **Pulse2 output** have options for 7 modes of operation that can be selected in **M2_8** and **M2_9** and can be wired as described in the below table using the internal 24V power that provides maximum 50mA of current or any external 24V power supply that can supply up to a maximum of 0.5A of current.

PULSE 1 or 2			
OUTPUT	DCP TERMINALS	EXT. CIRCUIT	SIGNAL
Totaliser pulse Binary Output (Open-Collector) External supply and external pull up resistor		 47Ω MIN 24V MAX 0.5A MAX PLC IN PLC GND	PULSE – ISO GND 24V 0.8V
Totaliser pulse Binary Output (Open-Collector) External supply and external relay/counter		 Relay 24V MAX 0.5A MAX GND	PULSE – ISO GND 24V 0.8V
Totaliser pulse Binary Output (Open-Collector) Internal supply and external relay/counter		 Relay/ Mechanical Totaliser Etc. 0.05A MAX	PULSE – ISO GND 24V 0.8V
Totaliser pulse Binary Output (Open-Collector) Internal supply and external pull up resistor		 470Ω MIN 24V MAX 0.05A MAX PLC IN PLC GND	PULSE – ISO GND 24V 0.8V

- The forward and reverse totaliser pulse output signal is available on the **PULSE1** or **PULSE 2** terminals. **Pulse1 output** and **Pulse2 output** have options for 7 modes of operation that can be selected in **M2_8** and **M2_9**
- 1) Fwd pulse output – Forward totalizer output
- 2) Rev pulse output – Reverse totalizer output
- 3) Rev flow alarm – Detects change in flow direction
- 4) Flow alarm – Detects high flowrate
- 5) Empty pipe – Detects empty pipe condition
- 6) No coil current – Detects no coil current condition
- 7) Batch function – Batch mode control

Relay

OUTPUT	TERMINALS	EXT. CIRCUIT	SIGNAL
Internal Relay Output with external or internal supply			Relay NC/NO contacts Relay (220VAC – 0.27A, 24VDC – 2A)

- The Internal relay control is connected to **Pulse1 output** though the use of a jumper (Link). The relay has a common connection and a normally open and normally closed switch contact. This switch contact can be wired into any external circuit with its own power supply to either make or break a circuit. The relay contact has a maximum DC rating of 24V DC 2A / 220 VAC 0.27A. This switch contact is independent and is isolated from any internal circuitry. The switch contact can also be externally wired to the internal 24V 50mA and 0V reference to make or break an external circuit.

Start-up and Operation

Before powering up the meter, consider the following:

- Is the meter installed according to the direction of flow as marked on the meter
- Has the wiring been carried out correctly and have all safety procedures been adhered to
- Is the supply voltage correct
- Has the flowmeter been properly earthed
- Lethal power supply voltages may be present, do not apply power with the electronics module cover or terminal box cover removed
- The SAFMAG is not suitable for installation in areas where explosive or flammable gas, vapour or dust is present.

To put the SAFMAG DCP into operation, allow the pipe work to fill with liquid. Purge all air from the pipe work and turn on the power. Allow time for the system to stabilise. With no flow, check that the flowmeter is reading zero, that the analog output is reading 4 mA, and that there is no pulse output.

Empty pipe detection is standard. When the converter detects high impedance in the electrode circuit, typically caused by an empty or partially filled pipe, a signal is sent to the microprocessor, which returns the flow reading to zero.

Although the empty pipe detection is standard, in some applications the conditions can create a situation where the flowmeter will still read intermittently, and **it is essential that for a trouble-free installation the meter be full of liquid at all times.**

CALIBRATION

Factory Calibration and programming

Before despatch the signal converter has been programmed, either to the factory standard or to those specifications advised by the customer. The SAFMAG DCP electromagnetic flowmeter has been calibrated at FLOWMETRIX flow laboratory with direct traceability to the National Standards. The flow sensor will hold its stated accuracy indefinitely provided that it is correctly installed and undamaged. The signal converter can be verified using the DCP calibrator.

Calibration Coefficient

Due to the design characteristics of the various SAFMAG flowmeters, each has its own calibration coefficient (k-factor). This coefficient is determined during the factory calibration, and will not change unless the flowtube is damaged.

Re-Calibration

The SAFMAG DCP microprocessor signal converter has been designed for programming simplicity. The signal converters are interchangeable, and to re-calibrate a flowmeter the new parameters must be entered via the four push buttons.

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

NB: The new data is only accepted if the 'save & exit' instruction is executed.

Menu Organisation (DCP)

With the SAFMAG DCP signal converter powered up flow total and flow rate are displayed

F	00000000	m³
→	5.986	l/s

F indicating Forward Total
→ indicating Forward Flow

R	00000000	m³
←	5.986	l/s

R indicating Reverse Total
← indicating Reverse Flow

N	00000000	m³
→	5.986	l/s

N indicating Net Total
→ indicating Forward Flow

Flow Menu

Password?
* * * *

Enter the required password. The flowmeter is shipped with the password 1000. (Default password = 1973). The signal converter set-up can be viewed without the password; however, no changes can be saved at the Save & exit menu 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 press **MENU** to continue

Change?
1000

Provided 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 **MENU** to continue

Units?
Metric units

Selection of units of flow measurement

Press **▲** to select required units

Press **MENU** to continue to flow setting menus

The flowmeter settings are programmed via **Menu-1**, **Menu-2**, **Save & exit** and **Cal mode** (Calibration Mode)

Batching Function

The SAFMAG DCP signal convertor can be programmed to operate as a simple batch controller. The option is selected under menu item M1_8. See Menu 1 settings for details.

In normal run mode press **M**

Batchmode?

M-no S-yes

Press **S** to enter the Batch Menu

Press **M** to enter Menus

Batch Qty?

1000 m³

Use ► and ▲ to select Batch Quantity.

Press **S** to go to Start Menu

Start batch?

M-exit S-yes

Press **S** to start, the external relay will now energise if the pulse outputs have been correctly wired and have been configured in M2_8 or M2_9 in Menu 2.

Press **M** to exit Batch mode.

B 998 m³
→ 50 l/s

In batch mode a **B** is displayed on the first line of the display, and as the batch proceeds, the batch quantity counts down until it reaches zero for the given flow rate.

B 0 m³
End of Batch

At zero the configured pulse output relay is de-energised and an **End of Batch** message is displayed.

B -10 m³
end of batch

If flow continues the meter will continue counting, but will show a negative total, indicating the overrun.

Restart Batch

Once end of batch is displayed press **S** to restart previous batch (Back to Start batch menu).

Exit Batch

Once batch is complete, press **S** to go back to the Start Batch menu.

Press **M** to exit the batch mode.

Stop Batch

Batch stopped

M-exit S-cont

Stopping the batch will de-energise the configured relay, but if flow continues the batch quantity will continue to count down. Long press **S** to stop the batch.

Press **S** to continue batch, the external relay will now energise. Press **M** to exit batching.

MENU-1 Flow Data

Menu-1
M-cont S-enter

Press **SAVE** to enter or **MENU** to continue

M1_1 rate units
l/s

Press **▲** repeatedly until desired units are displayed and **MENU** to continue
Changing this unit will automatically update the unit in M1_2 max flow FWD and M1_3 max flow REV.

M1_2 max flow F→
100 l/s

Enter the maximum forward flow rate at which to output 20mA Fwd current
Press **►** repeatedly until cursor is under digit to be edited
Press **▲** repeatedly until desired value is displayed and **MENU** to continue
This value is only valid up to 5 digits (99999). Change rate units in M1_1 to avoid this.

M1_3 max flow R←
100 l/s

Enter the maximum reverse flow rate at which to output 20mA Rev current
Press **►** repeatedly until cursor is under digit to be edited
Press **▲** repeatedly until desired value is displayed and **MENU** to continue
This value is only valid up to 5 digits (99999). Change rate units in M1_1 to avoid this.

M1_4 flow alarm
20 l/s

Enter the flow rate at which the flow alarm must operate
Press **►** repeatedly until cursor is under digit to be edited
Press **▲** repeatedly until desired value is displayed and **MENU** to continue

M1 -5 tot units
m3

Select the unit in which you wish to totalise
Press **▲** to select option required and **MENU** to continue

M1_6 total opts
net

Select the total display option required
net total – net flow total continuously displayed
auto select – display automatically selected, forward total if there is forward flow and vice versa
scroll – display will scroll through the forward, reverse, and nett flow totals
forward – displays the forward total only.
Reverse – displays the reverse total only.
Press **▲** to select option required and **MENU** to continue

**M1_7 clr total?
Save tot**

Select between **clear tot** to clear the existing total and **save tot** to keep the existing total.
Press **▲** to select option required and **MENU** to continue.

**M1_8 Batchmode?
yes**

Select batch mode if required
Press **▲** to select option and **MENU** to continue

**M1_9 damping
level 0**

level 0, level 1, level 2, level 3, level 4, level 5 damping settings are available (Higher levels are higher levels of damping)

Press **▲** to select the required value and press **MENU** to continue.

**M1_10 % cutoff
2 %**

1%, 2%, 3%, 5% & 10% cutoff settings available

Select the level below which the signal converter will output no flow, based on a percentage of the full scale, set in M1_2 and M1_3 respectively.

Press **▲** to select option required and **MENU** to return to **Main Menu**

**M1_11 empty pipe
activated**

Select to activate or deactivate empty pipe if required.

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

MENU- 2 Setup Data

Menu-2
M-cont S-enter

Press **SAVE** to enter or **MENU** to continue.

M2_1 50/60Hz?
50Hz operation

Select the AC power supply frequency
Press **▲** to select and **MENU** to continue

M2_2 dia mm
150.0

Enter the nominal diameter of the flowmeter stamped on the flowtube.
Press **►** repeatedly until cursor is under digit to be edited
Press **▲** repeatedly until desired value is displayed and **MENU** to continue

M2_3 K-value
1.023

Enter the calibration coefficient stamped on the flowtube
Press **►** repeatedly until cursor is under digit to be edited
Press **▲** repeatedly until desired value is displayed and **MENU** to continue

M2_4 sim% fwd mA
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.
Press **►** repeatedly until cursor is under digit to be edited
Press **▲** repeatedly until desired value is displayed and **MENU** to continue

M2_5 sim% rev mA
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.
Press **►** repeatedly until cursor is under digit to be edited
Press **▲** repeatedly until desired value is displayed and **MENU** to continue

M2_6 volume/pls
1.000 m³

2 open collector pulse outputs are provided.
Pulse1 output and **Pulse2 output** have options for 7 modes of operation, and in addition a relay output connected to **Pulse1 output** though the use of a jumper (Link).
Scaling of both the pulse outputs is provided by this menu item.
Enter the required output pulse rate **m³/pulse**.
Press **►** repeatedly until cursor is under digit to be edited.
Press **▲** repeatedly until desired value is displayed and press **MENU** to continue.

M2_7 puls-width
10ms max

Provided the output pulse rate is less than 3 pulses per second, the width can be varied.

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

NB: the pulse output will change to a frequency with equal on-off period for a pulse rate >3 Hz.

M2_8 pls 1-opts
fwd pulse o/p

There are 7 options available for Pulse1 and Pulse2 outputs. Pulse1 can also operate the relay provided the relay link is inserted. (Refer to page 10 for relay link location)

- 1) Fwd pulse output – forward totalizer output
- 2) Rev pulse output – reverse totalizer output
- 3) Rev flow alarm – detects change in flow direction
- 4) Flow alarm – detects high flowrate
- 5) Empty pipe – detects empty pipe condition
- 6) No coil current – detects no coil current condition
- 7) Batch function – batch mode control (Pulse Outputs only trigger Batch start / stop)

An isolated 24V supply is available at the output terminals limited to 30mA.

Press **▲** repeatedly until the desired option is displayed and **MENU** to return to **Main Menu**

M2_9 pls 2-opts
rev pulse o/p

There are 7 options available for Pulse1 and Pulse2 outputs. Pulse1 can also operate the relay provided the relay link is inserted.

- 1) Fwd pulse output – forward totalizer output
- 2) Rev pulse output – reverse totalizer output
- 3) Rev flow alarm – detects change in flow direction
- 4) Flow alarm – detects high flowrate
- 5) Empty pipe – detects empty pipe condition
- 6) No coil current – detects no coil current condition
- 7) Batch function – batch mode control (Pulse Outputs only trigger Batch start / stop)

An isolated 24V supply is available at the output terminals limited to 30mA.

Press **▲** repeatedly until the desired option is displayed and **MENU** to return to **Main Menu**

M2_10 slave addr
1

This menu is only available in the units that are Modbus and Modbus TCP/IP capable.

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

Press **▲** repeatedly until the desired slave address is entered and **MENU** to continue.

MODBUS RTU (Optional)

The Safmag DCP uses the MODBUS RTU protocol. This protocol defines a message structure that's hosts and clients will recognize and use on the network over which they communicate. The MODBUS RTU uses a Master-Slave Query-Response Cycle in which the signal converter is the slave device. The MODBUS is limited to 20 Registers.

Control Functions

The communications option supports the following function codes:

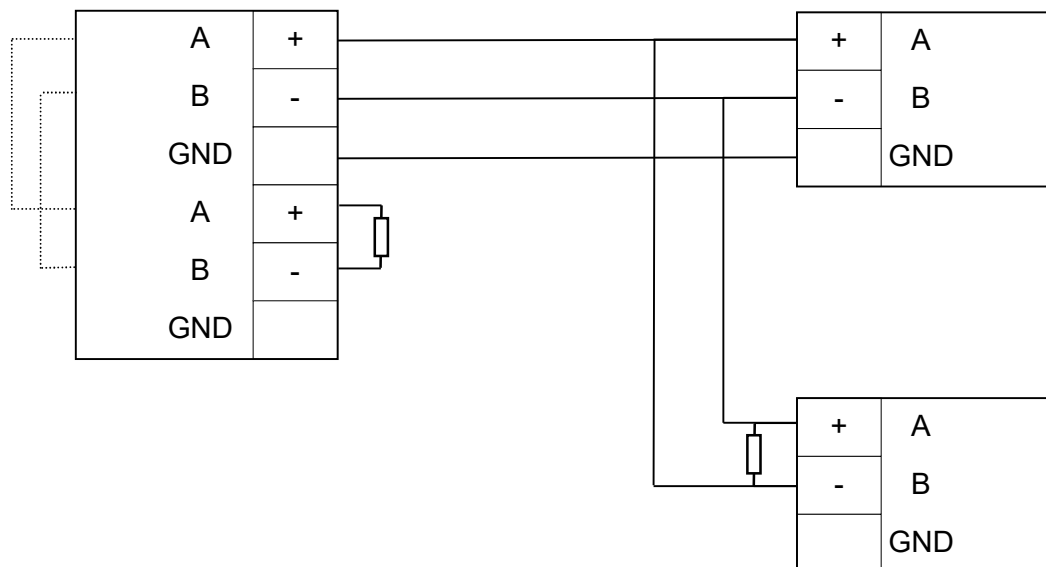
CODE:	NAME:	DESCRIPTION:
03	Read holding registers	Reads the value in a holding register

Installation Overview

RS-485 may be multidropped up to 1200m and up to 32 units may be chained together. An optically isolated adapter is recommended at the PC. Terminators should be used to help improve the quality of electronic signals sent over the RS-485 serial wires. The RS-485 serial chain should be terminated at the beginning (RS-485 adaptor) and at the last device in the RS-485 serial chain. This is accomplished by connecting resistors (180Ω) from (A) to (B) at the RS-485 port. A three way screw terminal is used up and down connected in the RS-485 serial chain

External RS-485 Wiring (Master)

DCP Pro Wiring (Slaves)



Setup

The MODBUS address is set up in **Menu2_10 slave address**. The address can be assigned 1 to 255.

Address	1-255
Baud rate:	9600
Data bits:	8
Stop bit:	1
Flow control:	None

Register and Coil Usage (Max 20 registers)

Data:	Register:	Access:	Type:	Offset	Length	Bit Arr.	32BitTr
Fwd Total	Reg40001	Read	Int32/ Long	1	2	2,1,4,3	Active
Rev Total	Reg40003	Read	Int32/ Long	3	2	2,1,4,3	Active
Fwd Flow	Reg40005	Read	Float 32	5	2	2,1,4,3	Active
Rev Flow	Reg40007	Read	Float 32	7	2	2,1,4,3	Active

Block Sizes

When connecting to a server, the maximum block sizes must be set as follows:

	Max block size
Output Coils:	8
Input Coils:	8
Internal Registers:	8
Holding Registers:	8

MODBUS TCP/IP (Optional)

Modbus TCP/IP is a version of the Modbus protocol that runs over TCP/IP and allows Modbus devices to communicate over Ethernet. Modbus TCP/IP uses standard Ethernet for communication, allowing data exchange over LAN. The SAFMAG DCP signal converter makes use of the same data register structure (Page 21) as Modbus RTU.

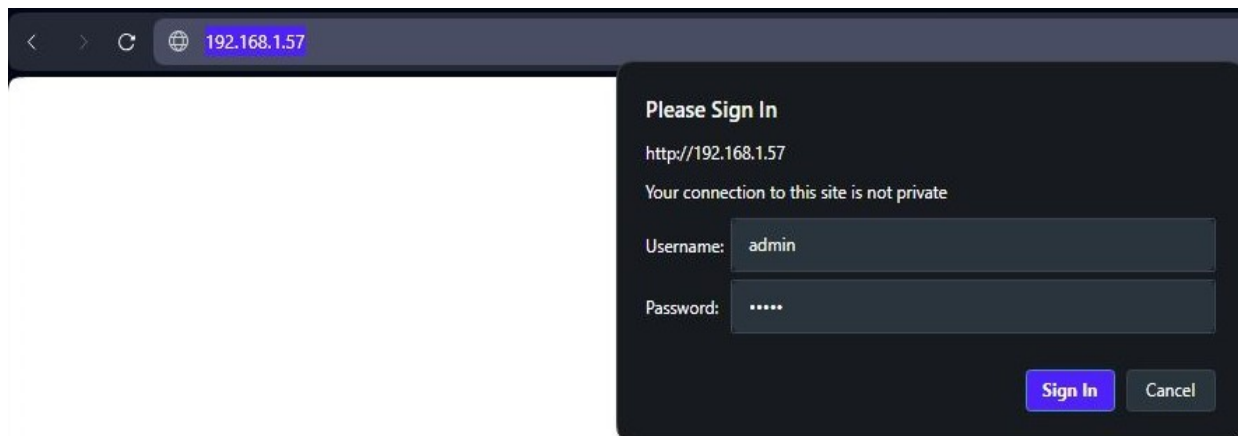
Modbus TCP/IP Setup

When connecting the unit directly to the computer, use the following IP address:
169.254.173.207

If connected to the network, use a network scanner to get the device IP address. By default, the device DHCP is active, so an IP address will automatically be assigned to the device. The Device name is the serial number of the electronics (i.e., FMX12345).

Open the web browser and enter the IP (web) address.
A prompt will appear asking for a username and password
Enter the details below and click sign in.

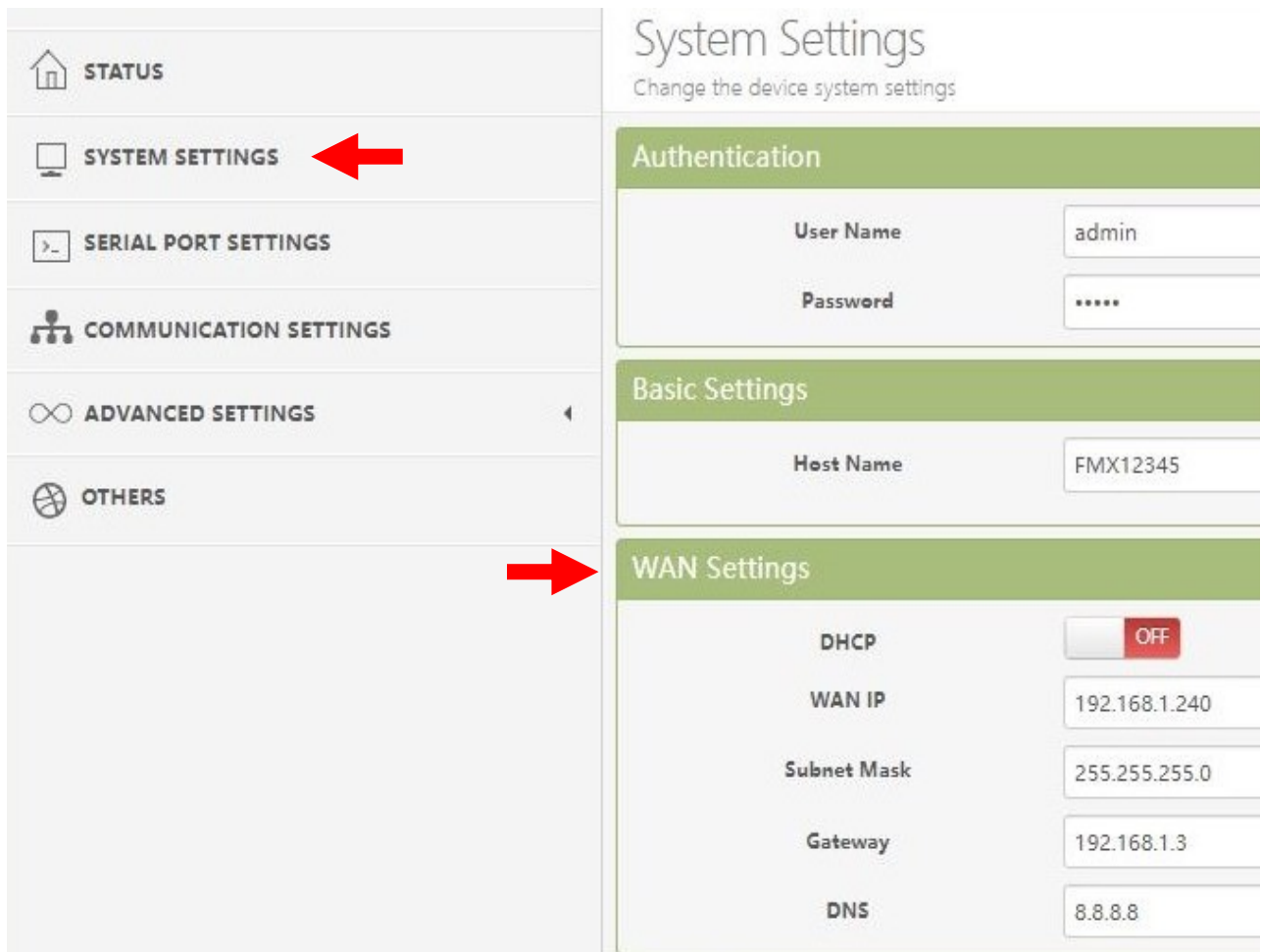
Username: admin
Password: admin



A status window will then open up. This is an overview of the device's configuration.

Change Modbus unit to Static IP address:

To setup the unit with a Static IP address, go to the **System Settings** tab, then scroll down to **WAN settings**. Toggle DHCP to off and fill in the details for: Wan IP, Subnet mask, Gateway and DNS (As shown below). Click apply at the bottom of the window.



System Settings
Change the device system settings

Authentication

User Name: admin

Password: *****

Basic Settings

Host Name: FMX12345

WAN Settings

DHCP: OFF

WAN IP: 192.168.1.240

Subnet Mask: 255.255.255.0

Gateway: 192.168.1.3

DNS: 8.8.8.8

Remember to power cycle the unit, so that the Modbus module can load the new settings.

Reset Modbus TCP/IP module.

If the Modbus TCP/IP module is configured incorrectly. The module can be restored back to factory default (Not Flowmetrix SA setup). This is done by bridging the two links for 3 seconds. The links are located at the top left of the display.



Once the module is reset, the user must input all the correct settings as displayed below.

Restore Flowmetrix SA settings after device reset

To start the setup, select **System Settings** tab. A new window will appear
Under **basic settings**, make the host name the serial number of the electronics e.g., FMX12345

To give the unit a static IP address, under **WAN settings**, toggle DHCP **OFF** and fill in the WAN IP, Subnet Mask, Gateway and DNS information.

Under **Telnet settings**, toggle the enable to **off**. Click the submit button at the bottom of the webpage, to save the settings for that window.

Select the **Serial Port Settings** tab. Under **Basic Settings**, update the configuration to the following:

Baud rate: 9600
Data bit: 8
Stop bit: 1
Parity: None

Under **Flow Control Settings**, make sure the flow control is **disabled**.

Under **Protocol Settings**, change the protocol to **Modbus** and then click submit to save all the changes for that window.

The screenshot shows the 'Serial Port Settings' web interface. The left sidebar contains a navigation menu with the following items: STATUS, SYSTEM SETTINGS, SERIAL PORT SETTINGS (highlighted with a red arrow), COMMUNICATION SETTINGS, ADVANCED SETTINGS, and OTHERS. The main content area is titled 'Serial Port Settings' with the subtitle 'change the device serial port settings'. It contains several sections: 'Basic Settings' with fields for Baud Rate (9600), Data Bit (8), Stop Bit (1), and Parity (None); 'Buffer Settings' with fields for Buffer Size (512) and Gap Time (50); 'Flow Control Settings' with a dropdown for Flow Control set to 'Disable'; 'Cli Settings' with fields for Cli (Serial String), Serial String (+++), and Waiting Time (300); and 'Protocol Settings' with a dropdown for Protocol set to 'Modbus'. Red arrows point to the 'Serial Port Settings' tab in the sidebar, the 'Basic Settings' section, the 'Flow Control Settings' section, and the 'Protocol Settings' section. At the bottom right, there are 'Submit' and 'Reset' buttons.

Select the **Communications Settings** tab. Under **Basic Settings**, make sure the protocol is **TCP Server**

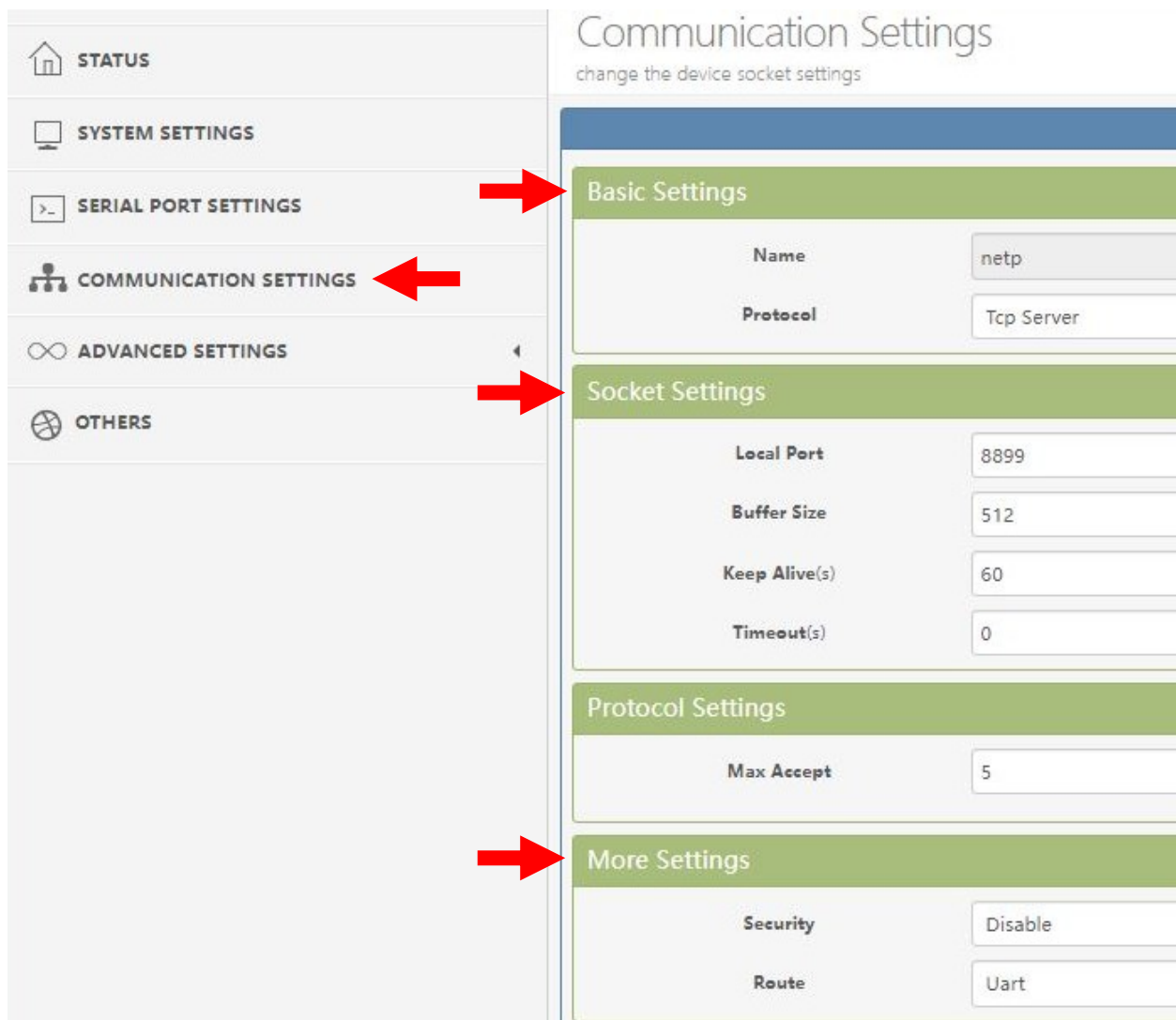
Under **Socket Settings**, make sure the local port is **8899**.

Under **More Settings**, make sure route is set to **UART**.

Click submit to save the settings for this window.

Modbus TCP/IP has now been setup.

Power cycle the unit, so that the Modbus module can load the new settings.



The screenshot shows the 'Communication Settings' web interface. On the left is a sidebar menu with the following items: STATUS, SYSTEM SETTINGS, SERIAL PORT SETTINGS, COMMUNICATION SETTINGS (highlighted with a red arrow), ADVANCED SETTINGS, and OTHERS. The main content area is titled 'Communication Settings' with the subtitle 'change the device socket settings'. It contains four sections: 'Basic Settings' with 'Name' set to 'netp' and 'Protocol' set to 'Tcp Server'; 'Socket Settings' with 'Local Port' set to '8899', 'Buffer Size' set to '512', 'Keep Alive(s)' set to '60', and 'Timeout(s)' set to '0'; 'Protocol Settings' with 'Max Accept' set to '5'; and 'More Settings' with 'Security' set to 'Disable' and 'Route' set to 'Uart' (highlighted with a red arrow). Red arrows also point from the 'COMMUNICATION SETTINGS' menu item to the 'Basic Settings' and 'Socket Settings' sections.

Calibration Mode

To access the calibration menu enter the correct password and then press menu continuously until you reach Menu-2. **Hold MENU key depressed for 5 seconds and the Calibration menu will appear.**

Entry to Calibration menu is only possible if the correct password has been entered, and if the **MENU** key is held depressed at the correct time. (*see below*)

Calibration Menu M-exit S-enter

This menu option is used to calibrate the 4-20mA outputs, It can also be used in conjunction with the **SAFMAG CALIBRATOR** to calibrate the signal converter. The calibration procedure is supplied with the calibrator.

CAL MENU (hidden menu)

M3_1 set 4mA-F 720
--

Connect an accurate milliamp meter with series load resistor to the current output terminals Select a value that drives the output to 4.00mA (approx. 720)

Press ► repeatedly until cursor is under digit to be edited

Press ▲ to select the output required and **MENU** to continue

M3_2 set 20mA-F 3800
--

Connect an accurate milliamp meter with series load resistor to the current output terminals Select a value that drives the output to 20mA (approx. 3800)

Press ► repeatedly until cursor is under digit to be edited

Press ▲ repeatedly until desired value is displayed

Press **MENU** to continue

M3_3 set 4mA-R 720
--

Refer M3_1 above

Press **MENU** to continue

M3_4 set 20mA-R 3800
--

Refer M3_2 above

Press **MENU** to continue.

M3_5 clear OBD? save OBD
--

This menu is used to clear or save the On-Board Diagnostics (IWDG and POR counters).

Press ▲ to toggle between save OBD and clear OBD

Troubleshooting

Troubleshooting should be confined to establishing whether the fault lies in the flowtube assembly or in the signal convertor.

The information provided should assist in this.

The flowtube coils have a resistance of approximately 20Ωs.

All DC pulsed meters are supplied with the coils connected in series, giving a measured value of approximately 40Ωs at the terminals @ 20°C.

If the coil resistance differs from these values, it indicates a fault in the measuring head.

Error / Warning Messages

ERROR MESSAGE	ERROR	POSSIBLE SOLUTION
# empty pipe	- No liquid in flowtube - Faulty electrode / coil cable	- Fill pipe - Repair / replace cable
# no coil current	- Faulty cable - Faulty flowtube	- Repair / replace cable - Check coil resistance (should be approx. 40 ohms)
# Pulses > 500 /s	Output pulse greater than 500 Hz	Select more suitable volume per pulse
# *****	Rate > 99999	Select more suitable rate units
# tot overflow	Total > 9999 9999	Reset/clear the total.
# F flowrate > max	Flowrate > M1_2 max flow F value	Enter in a more suitable max flowrate value.
# R flowrate > max	Flowrate > M1_3 max flow R value	Enter in a more suitable max flowrate value.
# Sample Error	DMA faulty	Contact Tech Support
# UNHEALTHY DCP!	IWDG or POR triggered > 100 000	Contact Tech Support
# Error max flow	Max flow rate is greater than 15 m/s or rate > 99999	Press M to go to the error in M1_2 or M1_3 to adjust

Troubleshooting (continued)

PROBLEM	POSSIBLE SOLUTION
<i>Meter not reading</i>	
• Reverse flow • No flow • Contaminated electrodes • Leaking electrodes	• Turn meter around or reverse coil wires • Establish a flow • Remove flowtube and clean electrodes • Replace flowtube
<i>Meter reading lower/higher than expected</i>	
• Incorrect data programmed • Faulty display unit • Leaking electrodes	• Program correct data • Replace display unit • Replace flowtube

On Board Diagnostics (OBD)

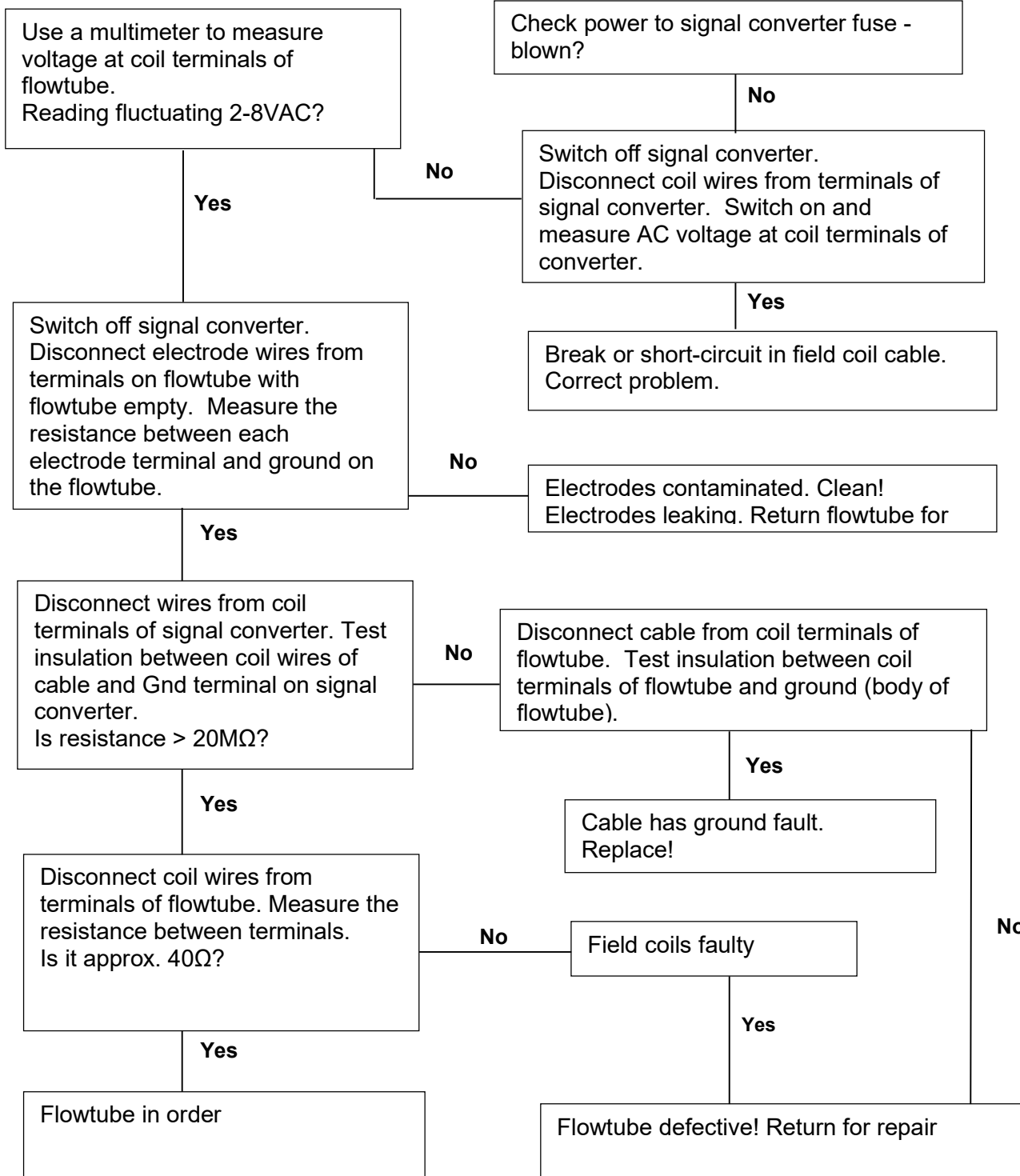
The Onboard diagnostics allows the user to see various useful diagnostic tools such as the IWDG – Independent Watchdog counter which increments each time the unit recovers from freezing and the POR – Power On Reset counter which increments each time the unit is power cycled. ADdata and Flow Velocity as well as the CALFIG setup value can also be displayed.

Press and hold the following keypad buttons to display the following diagnostics:

Key	Description
▲	Scrolls between IWDG and POR values. Values over 100 000 will trigger - UNHEALTHY DCP! Error
▶	ADdata and Flow Velocity. This is the Analog to digital value of the flow velocity read by the Micro Controller Unit and the flow velocity in m/s for information only.
SAVE	Displays the CALFIG setup value from the last calibration of the unit.

Testing of Flowtube

Always switch off power source before connecting and disconnecting cables.



Features & Specifications

Velocity Range	0.1-10 m/s (0.33-33ft/s)
Accuracy	Display and frequency output ± 0.5% of rate for velocity > 0.5m/s
Repeatability	± 0.1 % of rate
Sensor size	25mm to 800mm (flanged format) PN10/16/25 IP67,IP68(optional) 10mm to 100mm (wafer format) PN 16 IP67, IP68 (optional)
Response time	6 Selectable levels of damping
Temperature limit	Converter: -10 to 50°C
Display	Flow total and flow rate 2 - line backlit LCD display.
Display Enclosure	IP65 138 x 178 x 73mm
Supply	85V to 265V ac, 50 or 60Hz
Outputs	Two 4 - 20mA into 600Ω load each. (Isolated outputs). Two 24V active pulse outputs. Relay (220VAC – 0.27A, 24VDC – 2A)
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
Configuration	Supplied to customers spec or modified on site via easy to use menu structure and touch keypad
Communication	Modbus or Modbus TCP/IP
Options	GSM telemetry - Installation Kit (Bolt sets &gaskets) Grounding rings (for lined or nonconductive pipe)
Features	Low cost Non-intrusive No pressure loss No moving parts No maintenance Active empty pipe detection Integral spike suppression Password and tamper protection Error displays for easy diagnosis Easy to install Easy to use Batch function for Batch control
Low flow cutoff	Adjustable. Below value outputs are driven to zero

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 expressed 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