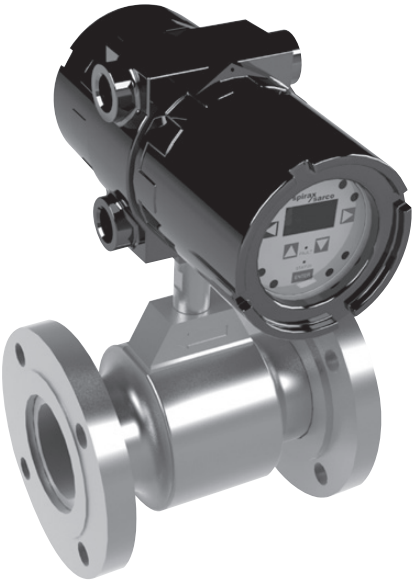
spirax sarco

VLM10
In-line Vortex Mass Flowmeter
Installation and Maintenance Instructions



1. Safety information

Safe operation of this unit can only be guaranteed if it is properly installed, commissioned and maintained by a qualified person in compliance with the operating instructions. General installation and safety instructions for pipeline and plant construction, as well as the proper use of tools and safety equipment must also be complied with.

Manufacturer: Spirax Sarco Inc, 2150 Miller Drive, Longmont, Colorado

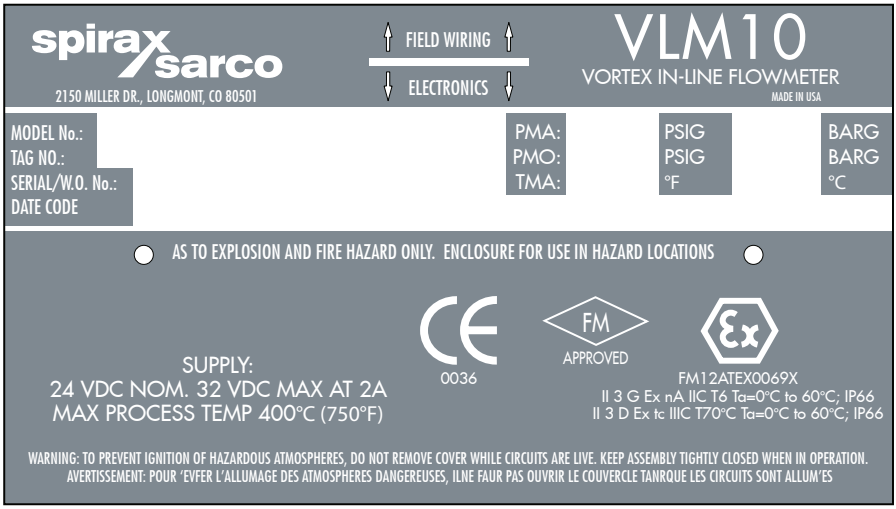
The product is designed and constructed to withstand the forces encountered during normal use. Use of the product for any other purpose, or failure to install the product in accordance with these Installation and Maintenance Instructions, could cause damage to the product, will invalidate the marking, and may cause injury or fatality to personnel.

Warning

This product complies with the requirements of Electromagnetic Compatibility Directive 2004/108/EC by meeting the standards of: EN 61326: 2006 Electrical equipment for measurement, control and laboratory use EMC requirements. Immunity to industrial locations annex A -Table A1. Emissions to domestic locations Table 4 and EN 55011:2007 – Radiated Emissions.

For hazardous locations the following standards have been followed:
EN 60079-0:2012, EN 60079-15:2010, EN 60079-31:2009 and EN 60529:1991+A1:2000.

The ATEX label for the VLM10 will be placed on the flowmeter, and will appear as this:



The following conditions should be avoided as they may create interference above the limits specified in EN 61326: 1997 if:

1. The product or its wiring is located near a radio transmitter.

2. Cellular telephones and mobile radios may cause interference if used within approximately 1 metre (39") of the product or its wiring. The actual separation distance necessary will vary according to the surroundings of the installation and the power of the transmitter. If this product is not used in the manner specified by this IMI, then the protection provided may be impaired.

The symbols, used on the product and in this manual, mean:

Equipment protected throughout by double insulation or reinforced insulation

Functional earth (ground) terminal, to enable product to function correctly. Not used to provide electrical safety.

Caution, risk of electric shock.

Caution, risk of danger, refer to accompanying documention.

Optically isolated current source or sink.

Caution. Electrostatic Discharge (ESD) sensitive circuit. Do not touch or handle without proper electrostatic discharge precautions

Conditions for use / schedule of limitation for this product:

Conditions of use

1. **The VLM10 enclosure contains aluminum and is considered to present a potential risk of ignition by impact or friction. Care must be taken into account during installation and use to prevent impact or friction.**
2. **To prevent the risk of electrostatic sparking of the painted surface of the VLM10 the enclosures surface should only be cleaned with a damp cloth.**

Special conditions of use (ATEX)

The maximum permitted temperature of the VLM10 is 60ºC. To avoid the effects of process temperature and other thermal effects care must be taken to ensure that the 'Enclosure temperature' does not exceed 60ºC.

1. 1 Intended use

Referring to the Installation and Maintenance Instructions, name-plate and Technical Information Sheet, check that the product is suitable for the intended use / application. The product listed complies with the requirements of the European Pressure Equipment Directive 97 / 23 / EC, carries the CE mark when so required. The product falls within the following Pressure Equipment Directive categories:

VLM10 ASME 150	Group 1 Gases	Group 2 Gases	Group 1 Liquids	Group 2 Liquids
DN25 - DN50	-	SEP	-	SEP
DN80 - DN150	-	Cat. 1	-	SEP
DN200 - DN250	-	Cat. 2	-	SEP

1.2 Access

Ensure safe access and if necessary a safe working platform (suitably guarded) before attempting to work on the product. Arrange suitable lifting gear if required.

1.3 Lighting

Ensure adequate lighting, particularly where detailed or intricate work is required.

1.4 Hazardous liquids or gases in the pipeline

Consider what is in the pipeline or what may have been in the pipeline at some previous time. Consider: flammable materials, substances hazardous to health, extremes of temperature.

1.5 Hazardous environment around the product

Consider: explosion risk areas, lack of oxygen (e.g. tanks, pits), dangerous gases, extremes of temperature, hot surfaces, fire hazard (e.g. during welding), excessive noise, moving machinery.

1.6 The system

Consider the effect on the complete system of the work proposed. Will any proposed action (e.g. closing isolation valves, electrical isolation) put any other part of the system or any personnel at risk? Dangers might include isolation of vents or protective devices or the rendering ineffective of controls or alarms. Ensure isolation valves are turned on and off in a gradual way to avoid system shocks.

1.7 Pressure systems

Ensure that any pressure is isolated and safely vented to atmospheric pressure. Consider double isolation (double block and bleed) and the locking or labeling of closed valves. Do not assume that the system has depressurized even when the pressure gauge indicates zero.

1.8 Temperature

Allow time for temperature to normalize after isolation to avoid the danger of burns and consider whether protective clothing (including safety glasses) is required.

1.9 Tools and consumables

Before starting work ensure that you have suitable tools and/or consumables available. Use only genuine Spirax Sarco replacement parts.

1.10 Protective clothing

Consider whether you and/or others in the vicinity require any protective clothing to protect against the hazards of, for example, chemicals, high/low temperature, radiation, noise, falling objects, and dangers to eyes and face.

1.11 Permits to work

All work must be carried out or be supervised by a suitably competent person. Installation and operating personnel should be trained in the correct use of the product according to the Installation and Maintenance Instructions. Where a formal 'permit to work' system is in force it must be complied with. Where there is no such system, it is recommended that a responsible person should know what work is going on and, where necessary, arrange to have an assistant whose primary responsibility is safety. Post 'warning notices' if necessary.

1.12 Handling

Manual handling of large and /or heavy products may present a risk of injury. Lifting, pushing, pulling, carrying or supporting a load by bodily force can cause injury particularly to the back. You are advised to assess the risks taking into account the task, the individual, the load and the working environment and use the appropriate handling method depending on the circumstances of the work being done.

1.13 Residual hazards

In normal use the external surface of the product may be very hot. If used at the maximum permitted operating conditions the surface temperature of some products may reach temperatures of 400°C (750°F). Many products are not self-draining. Take due care when dismantling or removing the product from an installation.

1.14 Freezing

Provision must be made to protect products which are not self-draining against frost damage in environments where they may be exposed to temperatures below freezing point.

1.15 Disposal

Unless otherwise stated in the Installation and Maintenance Instructions, this product is recyclable and no ecological hazard is anticipated with its disposal providing due care is taken.

1.16 Returning products

Customers and stockists are reminded that under EC Health, Safety and Environment Law, when returning products to Spirax Sarco they must provide information on any hazards and the precautions to be taken due to contamination residues or mechanical damage which may present a health, safety or environmental risk. This information must be provided in writing including Health and Safety data sheets relating to any substances identified as hazardous or potentially hazardous.

2. General product information

This document explains how to install, commission, and maintain the VLM10 in-line vortex flowmeter.

2.1 Product description

The VLM10 in-line vortex flowmeter is designed to reduce the cost of flowmetering and is used as an accurate means to measure liquid, gas and steam flowrates and record total flow.

2.2 Copyright notice

2.3 Equipment delivery and handling

Factory shipment

Prior to shipment, the Spirax Sarco VLM10 is tested, calibrated and inspected to ensure proper operation. A packing list is sent with the shipment indicating the product(s) sent with the order.

Receipt of shipment

Each carton should be inspected at the time of delivery for possible external damage. Document any damage found.

If it is found that some items have been damaged or are missing, notify Spirax Sarco immediately and provide full details. In addition, damage must be reported to the carrier with a request for their on-site inspection of the damaged item and its shipping carton.

Storage

If a flowmeter is to be stored prior to installation, the environmental storage conditions should be at a temperature between 0°C and 70°C (32°F and 158°F), and between 10% and 90% relative humidity (non-condensing).

2.4 Theory of operation

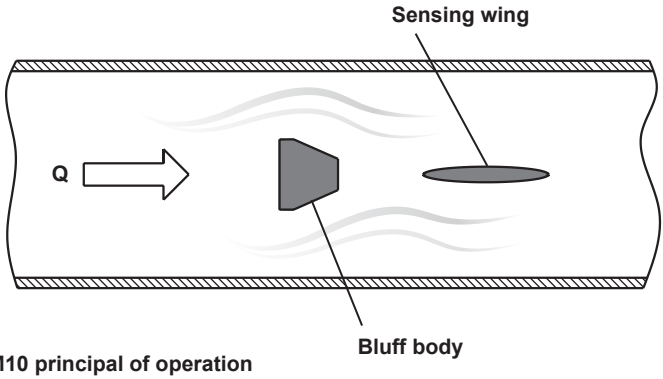


Fig. 1 VLM10 principal of operation

2.5 Cross sectional view of body

The linear range of the flowmeter (where Strouhal number is constant) is for Reynolds numbers between 20 000 and 7 000 000. (The Strouhal and Reynolds numbers are dimensionless and characterize the flow conditions.) Passage of a vortex causes a slight bow of a wing placed downstream of the bluff body. The bend is measured by a piezoelectric crystal sensor in contact with the top of the wing.

The VLM10 in-line vortex measures volumetric flowrate by detecting the frequency at which alternating vortices are shed from a bluff body inserted into the flow stream. These vortices are known as Von Karman vortices. The vortex VLM10 calculates the flow velocity using the following equation:

Q = f / K

Where:
Q = Flowrate
f = Vortex shedding frequency
K = Calibration constant

Microprocessor based electronics amplify, filter, and convert the sensor input into digital or standard pulse or 4 - 20 mA outputs.

2.6 Features

- Volumetric, energy, or mass flow monitoring of liquid, gas, or steam.
- Removable sensor and RTD under flow conditions below 52 bar g (750 psi g).
- Pipeline sizes: 25 mm to 300 mm (1" to 12").
- Fully welded design.
- Multi-variable electronics incorporate an integral RTD for compensated mass flow measurement.
- 50 000 event data logger, date stamped and user selectable.
- BACnet Interface, half-duplex RS-485.
- Modbus RTU, half-duplex RS-485.
- Modbus TCP/IP full-duplex.
- 10/100 Base T Ethernet Http Web Server Interface.
- Virtual front panel display and setup wizard on a standard PC.
- Industry standard 4 - 20 mA , frequency and relay outputs.
- Local display in various engineering and time units.
- Integral or remote configurable outputs, displays and ranges.

2.7 Certifications

- FMus Class I Division II, Groups B, C, D, and Dust-ignition Proof for Class II, Division III, Groups F, and G hazardous (classified) locations.

  ATEX
  II 3 G Ex nA IIC T6 Ta = 0 to +60°C IP66
  II 3 D Ex tc IIIC T70°C Ta = 0 to +60°C IP66

2.8 Pending certifications –

- FMc - Class I, Division II, Groups B, C, and D; and Dust-ignition Proof for Class II, Division III, Groups F, and G hazardous (classified) locations.

3. Mechanical installation

3.1 Piping - Straight run requirements

Note: The straight run of pipe must have the same nominal diameter as the VLM10 flowmeter.

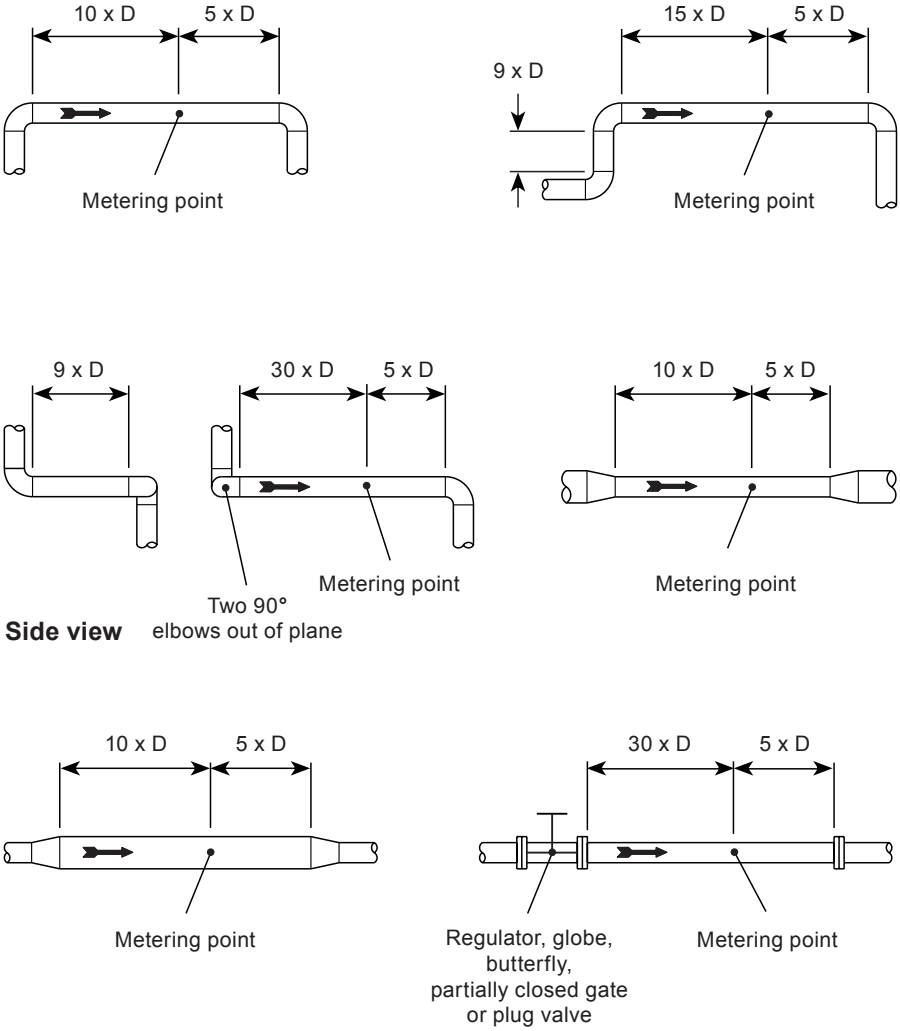
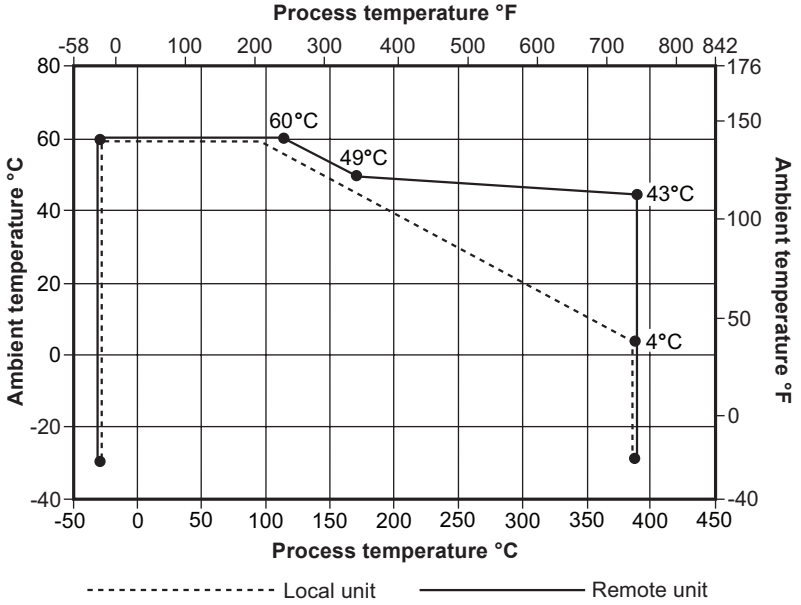


Fig. 2 VLM10 piping - Straight run requirements

3.2 Integral / remote mounting

Sensor and electronics can be mounted either as an integral unit or the electronics can be remotely mounted from the sensor. For integral mounting, the process (medium) and the ambient temperature must be less than the value defined by the dashed line shown on the Ambient vs. Process temperature graph below:

Ambient vs. Process temperature graph



Ambient vs. Process temperature table

If remote electronics are used, the combination of ambient and process temperature must be lower than the dotted line shown on the Ambient vs. Process temperature graph above. It is recommended to shield the electronics from the high temperature of the piping system with thermal insulation blankets. The thermal insulation blankets should not cover the flowmeter's stem or electronics enclosure.

The local electronics do not need to be mounted above the sensor, they can be mounted in any orientation.

The display is rotatable in 90° increments to allow for easy reading of the local display.

3.3 Remote mount electronics

Pipe mount electronics

Note: For best results, mount remote transmitter below horizontal pipe.

All measurements are in mm (inches).

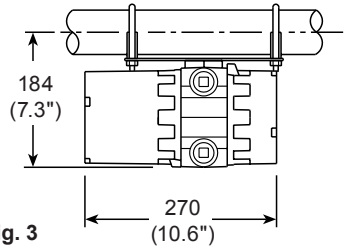
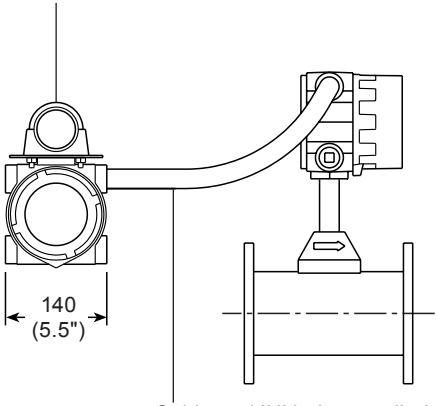


Fig. 3



Cable and 'U' bolts supplied.
Note: Cable must be run in conduit (not supplied).
Conduit connection is ¾" NPT.

Wall mount electronics

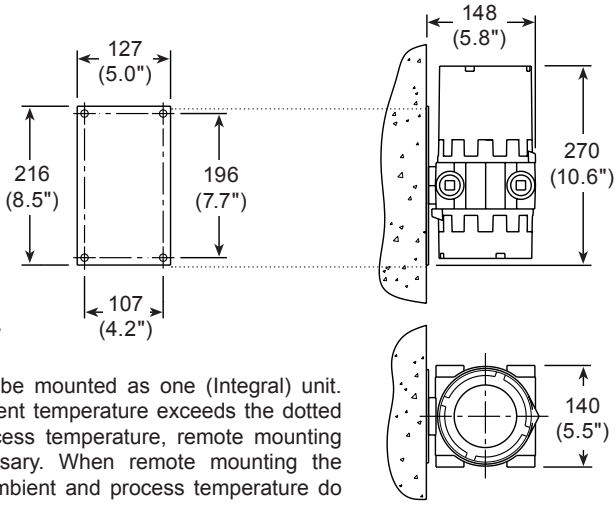


Fig. 4

Sensor and electronics can be mounted as one (Integral) unit. When the process and ambient temperature exceeds the dotted line of the Ambient vs. Process temperature, remote mounting of the electronics is necessary. When remote mounting the electronics, determine the ambient and process temperature do not exceed the dashed values shown on the graph. There are two options for remote mounting, pipe or wall. If remote mounting is ordered, mounting clamps and plate, and 7 metres (25 feet) of cable is supplied (15 or 30 metres (50 or 100 feet) of cable can be ordered as an option).

Integral / remote mounting

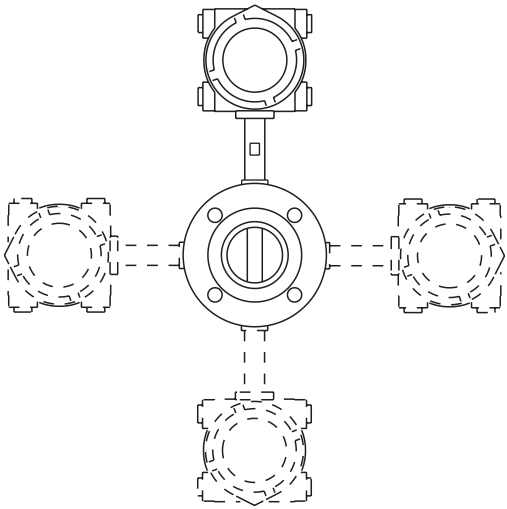


Fig. 5

Integral electronics

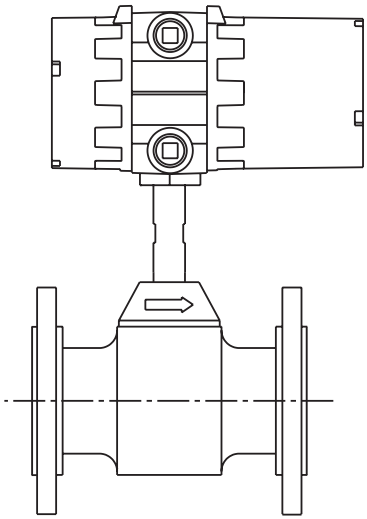


Fig. 6

3.4 Flange style

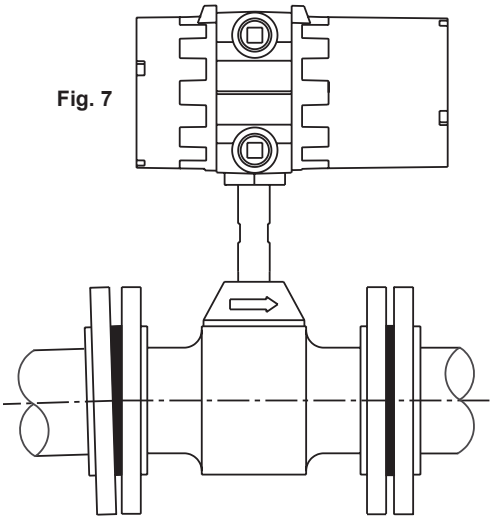
Pipe supports are recommended if mechanical vibration is present. Pipe supports should follow industry standard piping practices.

Install the flowmeter with the flow arrow on the flowmeter body in the direction of flow.

Align the bolt holes of each set of mating flanges. The bolt holes should be directly opposite each other in order to minimize any stress on the flowmeter body. Snug all bolts prior to final tightening.

The VLM10 can be used in systems using pipe I.D.'s ≤ schedule 80 pipe. The schedule of the mating pipe must be ≥ the internal diameter of the flowmeter. Weldneck flanges and self-centering gaskets are recommended for optimum performance, and gaskets should **not** be allowed to protrude into the flow stream.

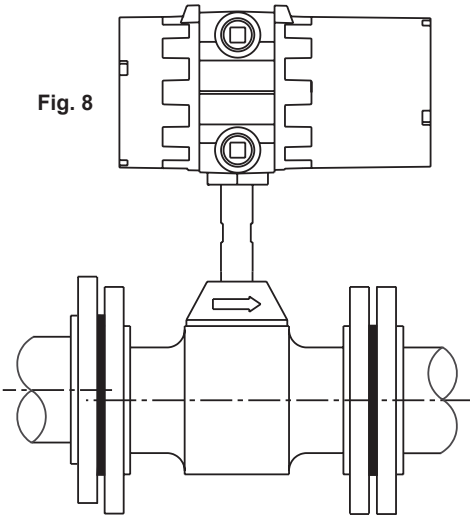
Fig. 7



Tilt caused by uneven tightening of bolts.

Tighten bolts in a staggered fashion to avoid tilt.

Fig. 8

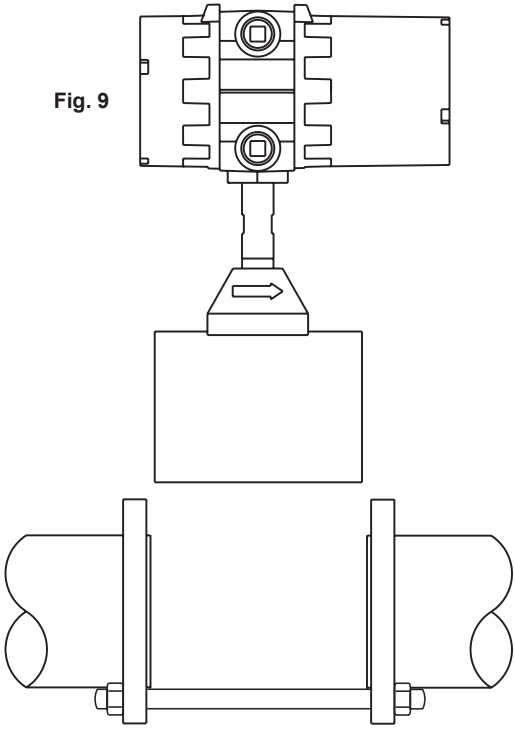


Misaligned flowmeter in the pipeline.

3.5 Wafer style

Tighten the bolts until snug; the bolts should be snug enough to hold the flowmeter, yet loose enough to allow movement. Align the upstream end of the flowmeter by measuring from the outside edge of the flowmeter body to the outside diameter of the flange at several points. Adjust the position of the flowmeter body until these measurements are within 2 mm (1/16") of each other for flowmeter sizes DN50 (2") and less, and 3 mm (1/8") for larger sizes. Repeat for the downstream end of the flowmeter. The alignment of the inlet to the flowmeter is more critical than the outlet; i.e., if the piping system is warped such that both ends cannot be aligned, sacrifice the downstream alignment. Tighten all bolts.

Fig. 9



Place the flowmeter body between flanges;
Make sure that the gaskets don't protrude into the bore.
Install the bolts.

3.6 VLM10 dimensions and weights **All measurements are in mm (inches)**

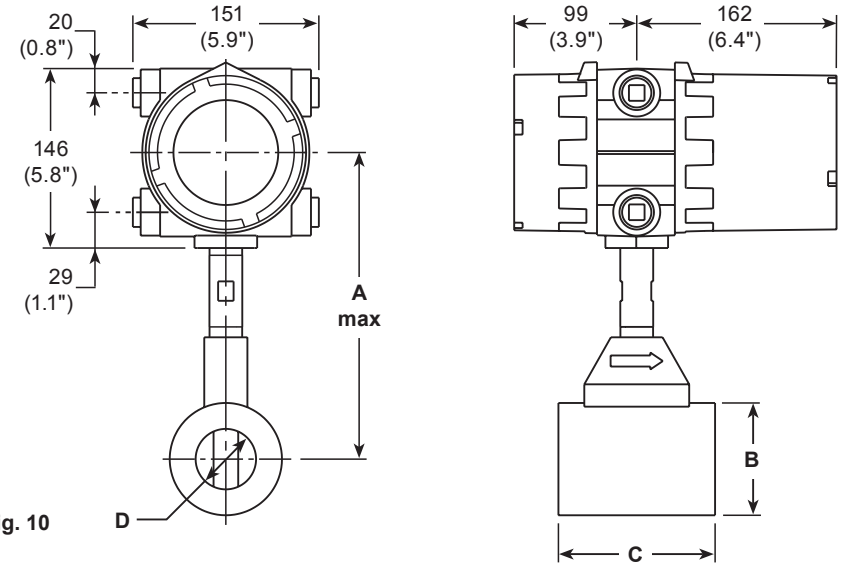


Fig. 10

Wafer connection type, integral mounting

Wafer connection
Wafer connection is available in stainless steel sizes DN25 - DN80 (1" - 3") only. The schedule of the mating pipe's internal diameter.

Wafer dimensions and weights **approximate in mm (inches) and kg (lbs)**

Size	Dimensions				Weight
	A	B	C	D	
DN25 (1")	290 mm (11.4")	84 mm (3.3")	104 mm (4.1")	24 mm (0.957")	5.9 kg (13 lbs)
DN40 (1½")	282 mm (11.1")	79 mm (3.1")	104 mm (4.1")	38 mm (1.500")	6.35 kg (14 lbs)
DN50 (2")	290 mm (11.4")	91 mm (3.6")	127 mm (5")	49 mm (1.939")	7.7 kg (17 lbs)
DN80 (3")	307 mm (12.1")	127 mm (5")	178 mm (7")	74 mm (2.900")	14.5 kg (32 lbs)

Flange connection, integral mounting

All measurements are in mm (inches)

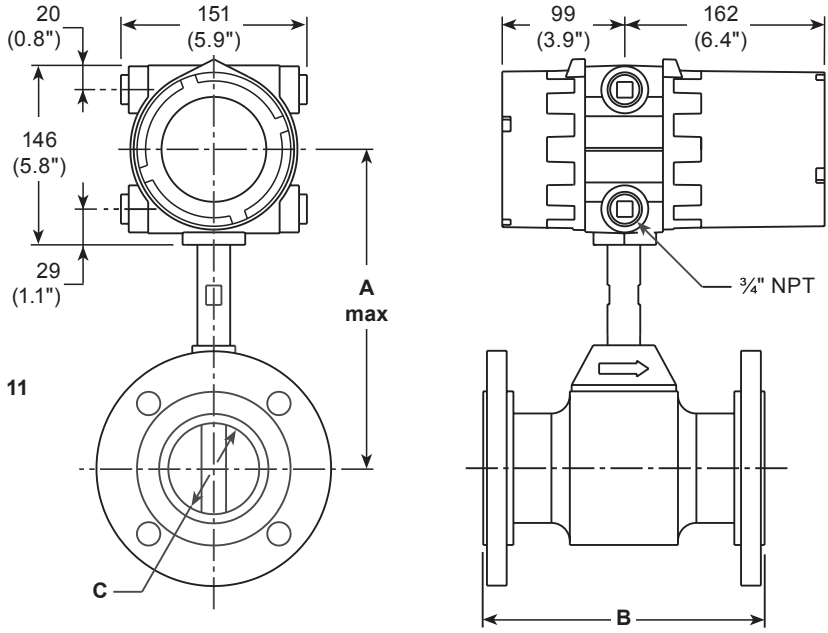


Fig. 11

Note:
The schedule of the mating pipe's internal diameter > dimension '**C**'.

Flange dimensions and weights approximate in mm (inches) and kg (lbs)

Size	Dimensions						Weight		
	A	B	C						
			Stainless steel		Carbon steel				
			PN16 PN40 ASME 150 ASME 300	PN64 ASME 600	PN16 PN40 ASME 150 ASME 300	PN64 ASME 600	PN16 ASME 150	PN40 ASME 300	PN64 ASME 600
DN25 (1")	287 mm (11.3")	193 mm (7.6")	24 mm (0.957")	24 mm (0.957")			8 kg (18 lbs)	9 kg (20 lbs)	9 kg (20 lbs)
DN40 (1½")	287 mm (11.3")	206 mm (8.1")	40 mm (1.500")	40 mm (1.500")			10 kg (22 lbs)	13 kg (28 lbs)	13 kg (28 lbs)
DN50 (2")	330 mm (13.0")	216 mm (8.5")	49 mm (1.939")	49 mm (1.939")			14 kg (31 lbs)	16 kg (36 lbs)	16 kg (36 lbs)
DN80 (3")	366 mm (14.4")	229 mm (9.0")	74 mm (2.900")	74 mm (2.900")			23 kg (51 lbs)	27 kg (60 lbs)	27 kg (60 lbs)
DN100 (4")	378 mm (14.9")	241 mm (9.5")	97 mm (3.826")	97 mm (3.826")			25 kg (55 lbs)	33 kg (72 lbs)	33 kg (72 lbs)
DN150 (6")	404 mm (15.9")	345 mm (13.6")	146 mm (5.761")	146 mm (5.761")	146 mm (5.761")	146 mm (5.761")	42 kg (92 lbs)	53 kg (116 lbs)	64 kg (140 lbs)
DN200 (8")	429 mm (16.9")	470 mm (18.5")	194 mm (7.625")	194 mm (7.625")	194 mm (7.625")	194 mm (7.625")	65 kg (144 lbs)	83 kg (182 lbs)	100 kg (220 lbs)
DN250 (10")	457 mm (18.0")	470 mm (18.5")	255 mm (10.020")		255 mm (10.020")		82 kg (180 lbs)	118 kg (260 lbs)	
DN300 (12")	483 mm (19.0")	470 mm (18.5")	300 mm (12.000")		300 mm (12.000")		120 kg (265 lbs)	166 kg (365 lbs)	

3.6 VLM10 dimensions and weights (continued)

All measurements are in mm (inches)

Remote mount electronics

Pipe mount electronics

Note: For best results, mount the remote transmitter below the horizontal pipe.

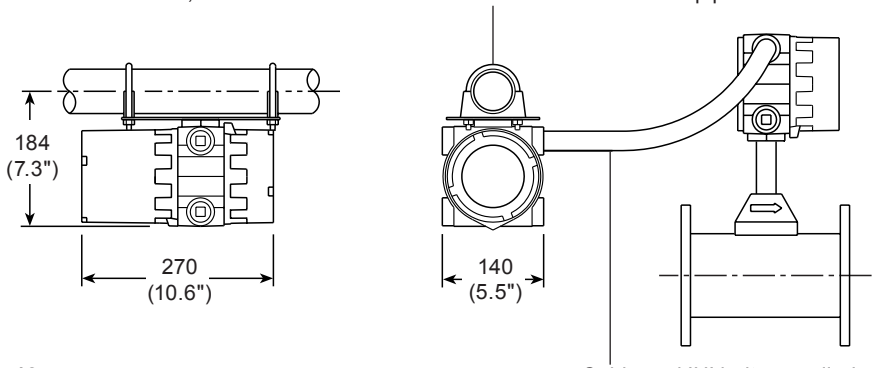


Fig. 12

Cable and 'U' bolts supplied.
Note: Cable must be run in conduit (not supplied).
Conduit connection is ¾" NPT.

Wall mount electronics

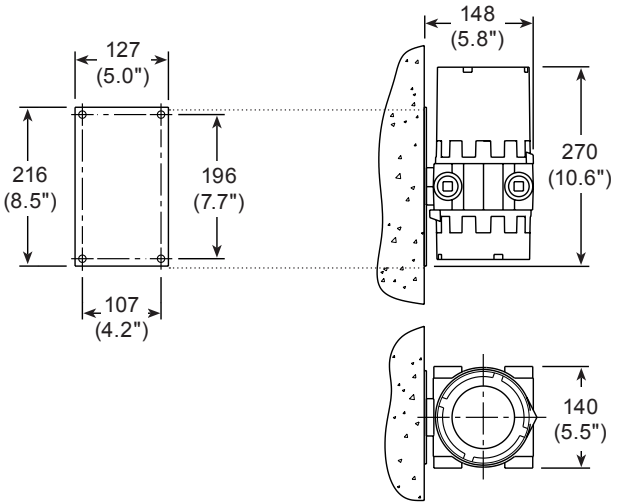


Fig. 13

Remote mount electronics weight approximate in kg (lbs)

Size	Weights			
	Flanged PN16 ASME 150	Flanged PN40 ASME 300	Flanged PN64 ASME 300	Wafer
DN25 (1")	11 kg (24 lbs)	12 kg (26 lbs)	12 kg (26 lbs)	9 kg (19 lbs)
DN40 (1½")	13 kg (28 lbs)	15 kg (34 lbs)	15 kg (34 lbs)	9 kg (20 lbs)
DN50 (2")	17 kg (37 lbs)	19 kg (42 lbs)	19 kg (42 lbs)	10 kg (23 lbs)
DN80 (3")	26 kg (57 lbs)	30 kg (66 lbs)	30 kg (66 lbs)	17 kg (38 lbs)
DN100 (4")	33 kg (72 lbs)	40 kg (89 lbs)	48 kg (105 lbs)	
DN150 (6")	44 kg (98 lbs)	55 kg (122 lbs)	66 kg (146 lbs)	
DN200 (8")	68 kg (150 lbs)	85 kg (188 lbs)	103 kg (226 lbs)	
DN250 (10")	84 kg (186 lbs)	121 kg (266 lbs)		
DN300 (12")	123 kg (271 lbs)	168 kg (371 lbs)		

4. Electrical installation

The electronics within the VLM10 and RIM10 provide a variety of interfaces to communicate with the flowmeter. Each interface is provided with a discrete connector on the terminal board to simplify wiring of the flowmeter. Available interfaces include Ethernet, RS-485, pulse output, two relay outputs, three 4-20 mA current loop outputs, two 4-20 mA current loop inputs, and an additional RS-485 link for remote mount communications.

The VLM10 and RIM10 flowmeter electronics amplify and convert the sensor signals into a number of different analog output signals. Available outputs are:

- **Pulse output**
  - Generates pulses based on internal totalizer increments.
  - Adjustable pulse width and polarity.

- **4-20 mA current loop output**
  - Volumetric, mass, energy flow values, pressure, temperature.
  - 4-20 mA outputs provide 2500 Vrms electrical isolation.

Flow information is also available in digital format. The available interfaces are:

- **BACnet Interface**
  - Half-duplex RS-485
- **Modbus RTU**
  - Half-duplex RS-485
- **Modbus TCP/IP**
  - Full-duplex, 10/100 BaseT Ethernet
- **Http Web server interface**
  - Virtual front panel display using Windows Explorer or Mozilla Firefox on a standard PC

4.1 Relay outputs

The electronics within the VLM10 and RIM10 flowmeter provide two single-pole, double-throw relays. Each relay has a common terminal, a normally-open terminal, and a normally-closed terminal. Also provided are two 4-20 mA current loop inputs for connection to external transducers. Refer to Figure 14, for a diagram of all available I/O.

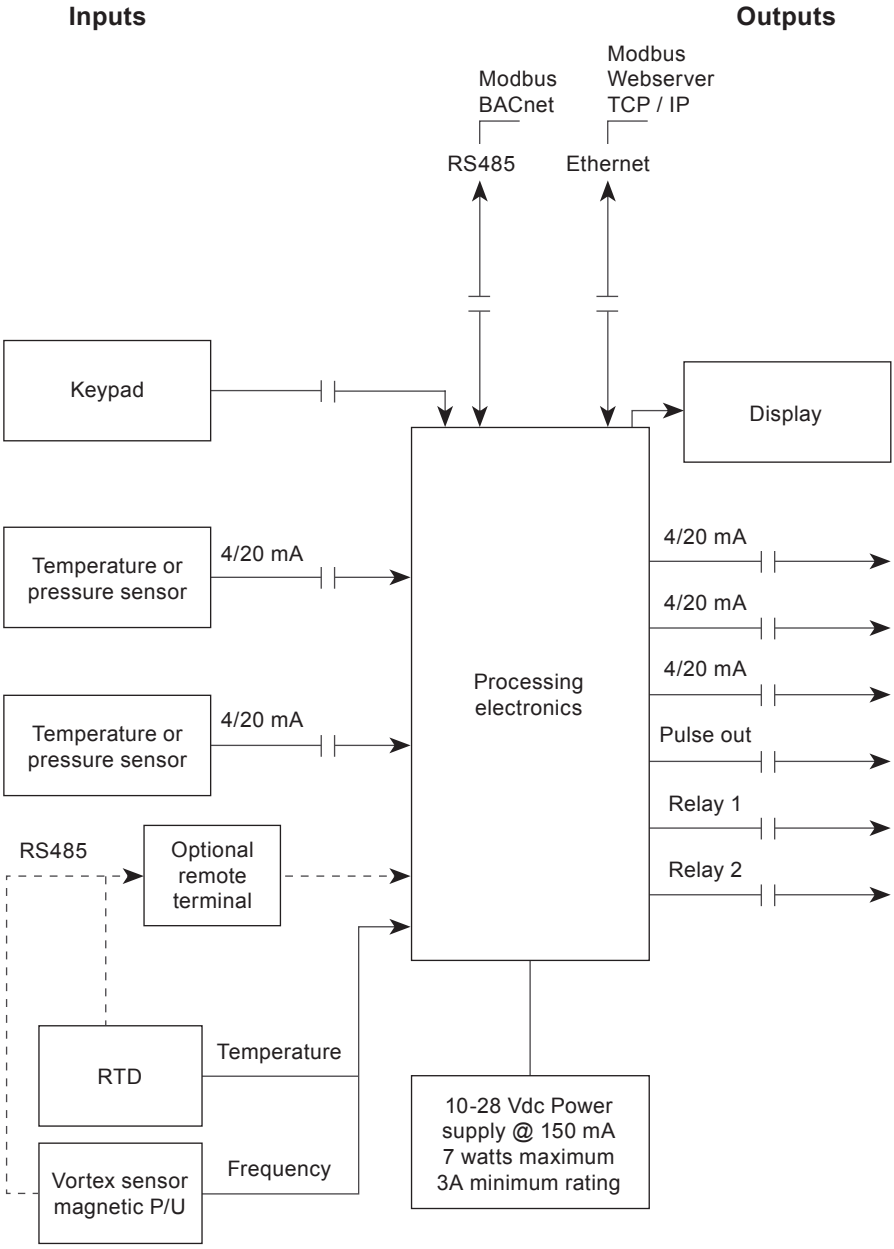


Fig. 14 Block diagram of the VLM10 and RIM10 I/O

4.2 Maximum ratings

Stresses above those listed in Table 1 'Maximum ratings' may cause permanent damage to the electronics.

Table 1 Maximum ratings

Parameter	Maximum rating
V+ to V-, +24 Vdc supply input	0 V to +32 Vdc
V+ to V-, remote slave electronics supply	0 V to +32 Vdc
I4-20, IN, 4-20 mA input current	24 mA dc maximum
V4-20, OUT, 4-20 mA output loop voltage	+28 Vdc maximum
P4-20, OUT, 4-20 mA output power rating	600 mW maximum
IRELAY, continuous relay current	50 mA dc maximum
VRELAY, relay blocking voltage	24 Vdc/Vac maximum
PRELAY, relay power rating	400 mW maximum
IPULSE, continuous pulse output relay current	650 mA dc maximum
IPULSE, PK, peak pulse output relay current	2 A maximum, 100 ms
VPULSE, pulse output blockingvoltage	50 Vac maximum
PPULSE, pulse output power rating	350 mW maximum

4.3 Recommended operation conditions

The Table 2 defines the normal operating conditions of the VLM10 electronics.

Table 2 Recommended operating conditions

Parameter		Minimum	Typical	Maximum
V+ to V-, +24 Vdc supply input		+10 Vdc	+24 Vdc	+28 Vdc
dc power supply – current output		3 Adc1		
V+ to V-, remote slave electronics supply		+10 Vdc	+24 Vdc	+28 Vdc
I4-20, IN, 4-20 mA input current range		3.5 mA		20.5mA
4-20 mA input accuracy, % full-scale error				0.1%
4-20 mA input voltage drop				+7 Vdc
4-20 mA output galvanic isolation				1 kV_{rms}
V4-20, OUT, 4-20 mA output loop voltage	Load resistance < 200 Ω	+12 Vdc	+24 Vdc	+28 Vdc
	Load resistance > 200 Ω	+14 Vdc	+24 Vdc	+28 Vdc
V4-20, OUT, 4-20 mA output current range		3.5 mA ±5%		21 mA
4-20 mA output accuracy, % full-scale error				0.1%
4-20 mA output load resistance		0 Ω		350 Ω[2]
4-20 mA output galvanic isolation				1 kV_{rms}[3]
VRELAY, relay operating voltage		+3 V	+24 V	+175 V
IRELAY, continuous relay current			12 mA	50 mA
Relay galvanic isolation				1 kV_{rms}[3]
VPULSE, pulse output operating voltage		+3 V	+24 V	+50 V
IPULSE, continuous pulse output current			12 mA	650 mA
Pulse output galvanic isolation				1 kV_{rms}[3]
RS-485 resistive load		54 Ω	120 Ω ±10%	132 Ω

1. In order to guarantee that the fuse on-board the electronics will blow under fault conditions, a minimum supply current is specified. When selecting a power supply, be sure to follow the minimum current output specification.
2. To drive the maximum resistive load on the 4-20 mA outputs, a minimum loop supply voltage of +14 Vdc is required.
3. The galvanic isolation is across the circuit under test and the electronics supply reference; and across the circuit under test and chassis. If the on-board supply is used to bias an isolated circuit, the galvanic isolation is defeated, which means there is no galvanic isolation.

4.4 Terminal board and electronics enclosure

All VLM10 and RIM10 electronics are housed in a cast aluminium enclosure. The electronics enclosure is rated for Class I, Div II environments.

ATEX / FM option. The VLM10 and RIM10 enclosure contains aluminium and is considered to present a potential risk of ignition by impact or friction. **Warning:** Care must be taken during installation and use to prevent impact or friction.

Connection of user wiring is made on the terminal board. To access the terminal board, remove the back cover on the electronics enclosure. The terminal board provides pluggable, screw-terminal connectors to simplify wiring. Before wiring, be sure to turn-off power to the VLM10 flowmeter and all interfaces connecting to the flowmeter. ESD safe procedures must be followed to avoid damage to the electronics. Refer to Figure 15 for a diagram of the terminal board.

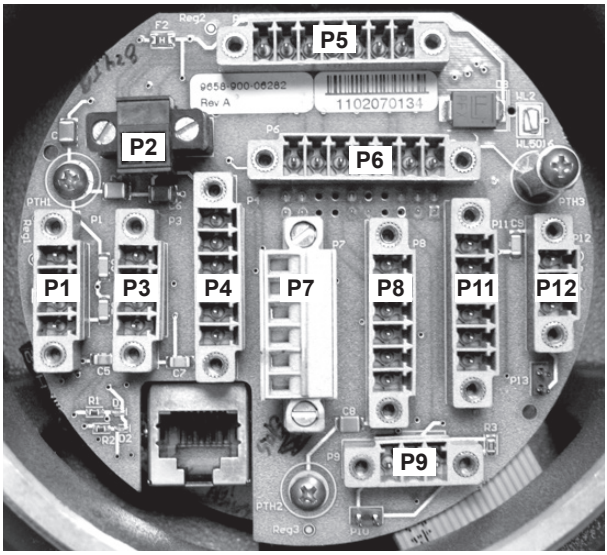


Fig. 15 VLM10 terminal board diagram

4.5 Connector pinouts

Each pluggable, screw-terminal connector on the terminal board is dedicated to a user accessible circuit. Table 3 defines the mapping of connectors to circuits.

For all pluggable screw-terminals, pin #1 is indicated on the printed circuit board by the location of the reference designator, which is adjacent to pin #1.

Table 3 Mapping of connectors to circuits

Connector reference designator	Circuit
P2	dc supply input
P1	Relay channel 1
P3	Relay channel 2
P7	Pulse output
P5	4 - 20 mA input channel 1
P6	4 - 20 mA input channel 2
P4	4 - 20 mA output channel 1
P8	4 - 20 mA output channel 2
P11	4 - 20 mA output channel 3
P9	User RS-485
P12	Remote link RS-485
P10	User RS-485 termination jumper
P13	Remote link RS-485 termination jumper

P2: dc supply input connector

Pin #	Signal
1	V(–) input, dc supply reference
2	V(+) input, dc supply positive

P1: relay channel 1

Pin #	Signal
1	Normally-open
2	Common
3	Normally-closed
4	**Not used**

P3: relay channel 2

Pin #	Signal
1	Normally-open
2	Common
3	Normally-closed
4	**Not used**

P7: pulse output

Pin #	Signal
1	Pulse contact 1
2	Pulse contact 2
3	**Not used**
4	**Not used**
5	V(+) output (non-isolated)
6	V(–) output (non-isolated)

P5: 4-20 mA input channel 1

Pin #	Signal
1	IN(+), 4 - 20 mA input positive
2	IN(–), 4 - 20 mA input negative
3	**Not used**
4	**Not used**
5	**Not used**
6	V(+) output (non-isolated)
7	V(–) output (non-isolated)

P6: 4-20 mA input channel 2

Pin #	Signal
1	IN(+), 4 - 20 mA input positive
2	IN(–), 4 - 20 mA input negative
3	**Not used**
4	**Not used**
5	**Not used**
6	V(+) output (non-isolated)
7	V(–) output (non-isolated)

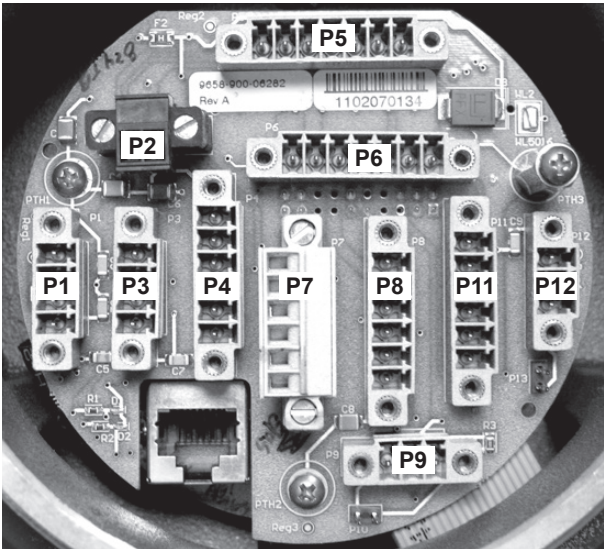


Fig. 16 VLM10 terminal board diagram

P4: 4-20 mA output channel 1

Pin #	Signal
1	OUT(+), 4 - 20 mA output positive
2	OUT(–), 4 - 20 mA output negative
3	**Not used**
4	**Not used**
5	V(+) output (non-isolated)
6	V(–) output (non-isolated)

P8: 4-20 mA output channel 2

Pin #	Signal
1	OUT(+), 4 - 20 mA output positive
2	OUT(–), 4 - 20 mA output negative
3	**Not used**
4	**Not used**
5	V(+) output (non-isolated)
6	V(–) output (non-isolated)

P11: 4-20 mA output channel 3

Pin #	Signal
1	OUT(+), 4 - 20 mA output positive
2	OUT(–), 4 - 20 mA output negative
3	**Not used**
4	**Not used**
5	V(+) output (non-isolated)
6	V(–) output (non-isolated)

P9: User RS-485

Pin #	Signal
1	RS-485(+) positive
2	RS-485(–) negative
3	RS-485 shield termination

P12: Remote link RS-485

Pin #	Signal
1	RS-485(+) positive
2	RS-485(–) negative
3	RS-485 reference

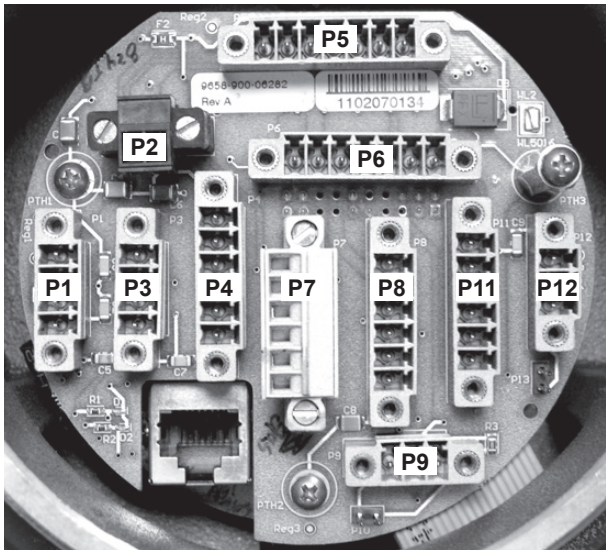


Fig. 17 VLM10 terminal board diagram

4.6 Wiring recommendations

Before wiring, be sure to turn-off power to the VLM10 and RIM10 flowmeter and all interfaces connecting to the flowmeter. Proper wiring is essential to achieving satisfactory performance and reliability. The following is recommended:

1. Use shielded wire, for example, Belden 82641 or Belden 9451P, for 4 - 20 mA current loops, especially in noisy electrical environments.

2. Select the proper wire gauge. 20 - 24 AWG stranded wire is recommended. For Ethernet and Modbus RTU CAT5, Cat 5e, or Cat 6 type cable is recommended, such as Belden 1624P.

3. When wiring, tighten the screw terminals to a torque of 0.22 Nm to 0.25 Nm.

Warning: Do not exceed maximum wiring distances for the various interfaces - See Table 4:

Table 4 Maximum recommended wiring distances

Interface	Recommended cable	Maximum cable length
RS485	Belden 9841	1 220 m (4 000 feet)
4 - 20 mA current loop	Belden 9451P	304 m (1 000 feet)
Pulse out	Belden 82842	304 m (1 000 feet)
Ethernet	Belden 1624P or 7929A	100 m (328 feet)
Relay out	Belden 8334	304 m (1 000 feet)
Remote head	Belden 8334	50 m (150 feet)

4.7 Hum and noise

Although the electronics are designed to operate reliably in industrial environments, some precautions should be followed to minimise interference on the flowmeter. It is recommended that the VLM10 and RIM10 flowmeter be powered using an Omron S8VM-10024CD or S8VM-10024C dc power supply to achieve the best noise performance.

The maximum run length for the 4 - 20 mA current loop input sensors and RS-485 may be reduced due to noise and noise pick-up along the cable. The use of properly grounded shielded twisted pair (STP) cable helps to limit the effects of interference in most cases.

Cables should be run inside grounded conduit anytime these signals must be pulled near welders, motor drives, arc furnaces or other noisy electrical equipment in order to provide additional shielding.

For noise immunity, while using the user RS-485 link, ac termination to chassis is provided on-board the VLM10 and RIM10 electronics for the RS-485 cable shield. It is recommended to terminate the cable shield at both ends. At the VLM10 electronics, terminate the RS-485 cable shield to the shield termination terminal, P9 pin 3, which is ac coupled to chassis. The dc galvanic isolation provided by the ac shield termination is rated to 1 kV peak. At the other end of the user RS-485 cable, terminate the shield directly to earth. This will improve performance in noisy environments, and the ac coupling will block low-frequency currents commonly seen in ground loops.

4.8 Grounding

Termination of the VLM10 and RIM10 chassis (electronics enclosure) to a protective earth ground is required when installing the flowmeter and remote electronics. The electronics are designed to withstand surge voltages up to +/- 2kV common-mode (dc supply to Earth) and 1 +/-kV differential mode (dc supply positive to dc supply negative) at the power supply input. In order for the on-board, over-voltage protection circuity to function it si necessary to provide a return path to earth by connecting the chassis of the electronics to a known good, low-impedance, protective earth ground. Damage to the electronic can offer in the presence of surge voltages if the electronics chassis in not properly grounded.

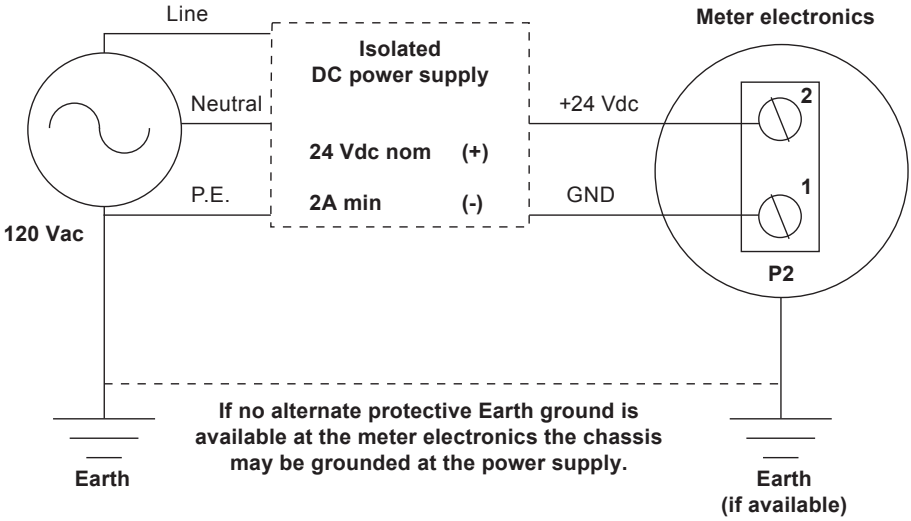


Fig. 18 VLM10 and RIM10 Integral Mounted Grounded Installation.

For Remote Mounted Electronics installation, the use of conductive conduit between the pipe mounted electronics and remote electronic enclosures, to install the remote link cable through, is recommended. Care must be taken to ensure the installation does not introduce the potential for ground loops. This can be acconmplished by using non-conductive conduit fittings to break the galvanic / electrical connection otherwise created by the use of conductive conduit.

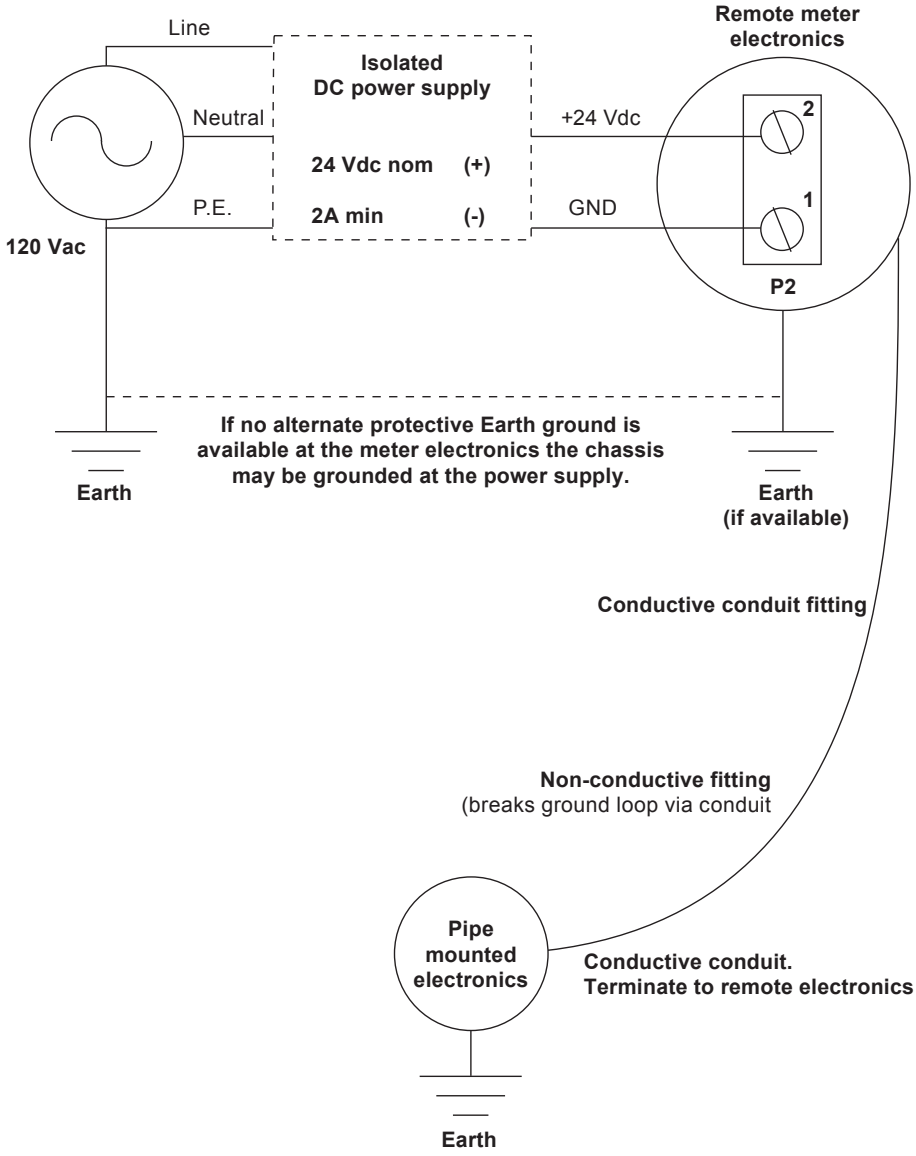


Fig. 19 VLM10 and RIM10 Remote Mounted Grounded Installation.

4.9 Remote mount option

The remote mount option allows the main electronics, remote master, to be mounted at a distance from the flowmeter at the pipe, remote slave. The main electronics may be separated from the flowmeter by up to 30 m (100 ft) of wiring. Proposed mounting locations should be reviewed and wiring runs measured prior to installation. Failure to observe the maximum wiring lengths can prevent the flowmeter from operating correctly and may void the warranty.

In the remote mount situation, the shields from the interface cable should be connected to earth ground at the main electronics terminal board. A pigtail from the shields can then be screwed down onto a stand-off that extends up from the terminal board mounting hole. Do not terminate any other cable shields to chassis at the main electronics enclosure.

4.10 Wiring the flowmeter

4.10.1 dc power

The flowmeter is powered by an external dc power supply as shown in Figure 20. Use 18 to 22 gauge wire between the dc supply and the flowmeter electronics. It is recommended to use an Omron S8VM-10024CD or S8VM-10024C +24 Vdc power supply to supply power to the VLM10 flowmeter and achieve the best noise performance.

ATEX / FM option. On installation the electronics shall be provided with supply transient protection external to the apparatus such that the voltage at the supply terminals of the electronics do not exceed 140% of the voltage rating of the equipment.

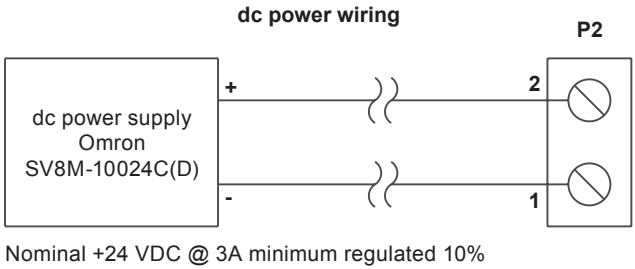


Fig. 20 VLM10 and RIM10 dc power supply wiring example

4.10.2 Pulse-out

The pulse output provided by the flowmeter is implemented with a solid-state relay. The relay has two contacts. When the relay is closed, a contact closure is formed permitting the flow of current. When the relay is open, no current is permitted to flow.

The maximum pulse output relay current must not be exceeded. A current limiting resistor is required to limit current through the relay. A 2 k, 0.5 W resistor is recommended on a +24 V supply. The pulse output is galvanically isolated from the dc supply reference and chassis inside the electronics. If the on-board supply is used to bias this circuit, the electrical isolation will be defeated. The on-board supply positive is available on pin 5 of P7 and its reference is available on pin 6 of P7.

Figure 21 shows an example of wiring the pulse output circuit to an external totalizer using an external supply.

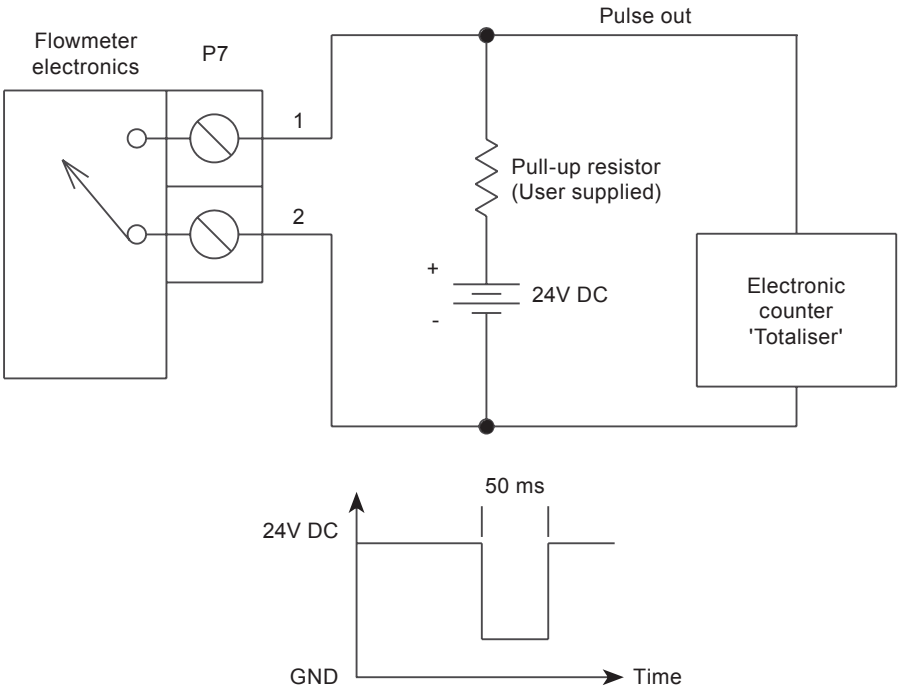


Fig. 21 VLM10 and RIM10 pulse output wiring example

4.10.3 4-20 mA current loop outputs

The flowmeter provides up to three 4-20 mA output channels. These are 2-wire current loop connections that regulate current through the loop based on a flow parameter and scale. Each 4-20 mA output is galvanically isolated from the dc supply reference and chassis. If the on-board supply is used to power these circuits, the electrical isolation will be defeated.

Figure 22 illustrates the use of the on-board supply to power a 4-20 mA current loop. The 4-20 mA output, OUT (+), is connected to the V (+) OUTPUT terminal. The 4-20 mA output, OUT (-) is connected to the 4-20 mA receiver positive input terminal. The receiver return current should complete the loop and connect to the V (-) OUTPUT terminal.

Alternatively, an external supply can be used to supply loop power by replacing the connections to the V (+) OUTPUT and V (-) OUTPUT terminals with an external supply.

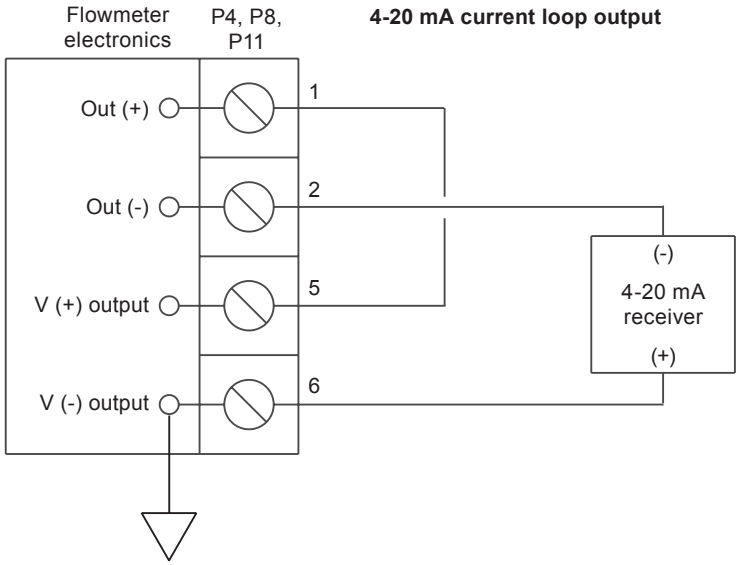


Fig. 22 VLM10 and RIM10 4-20 mA pulse output wiring example

4.10.4 4-20 mA current loop inputs

The flowmeter provides up to two 4-20 mA input channels. These are 2-wire current loop connections that measure the current flowing through the loop. Each 4-20 mA input is galvanically isolated from the dc supply reference and chassis. If the on-board supply is used to power this circuit, the electrical isolation will be defeated.

Figure 23 illustrates the use of the on-board supply to power a 4-20 mA current loop. The V (+) OUTPUT terminal is connected to the positive input of a 4-20 mA transmitter. The 4-20 mA input, IN (+), is connected to the negative side of the 4-20 mA transmitter. Current is passed measured and passed through the 4-20 mA input channel and then returned to the V (-) OUTPUT terminal.

Alternatively, an external supply can be used to supply loop power by replacing the connections to the V (+) OUTPUT and V (-) OUTPUT terminals with an external supply.

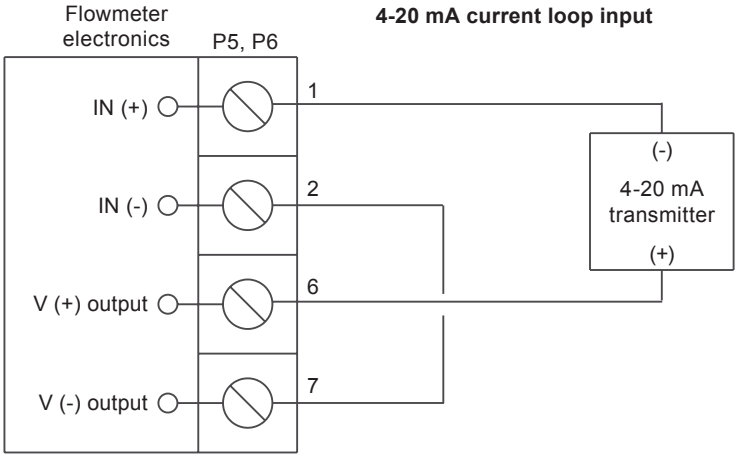


Fig. 23 VLM10 and RIM10 4-20 mA input wiring example

4.10.5 Relay output

The flowmeter provides up to two single-pole, double-throw relay channels. These channels are implemented using solid-state relays, each with a common, normally-closed and normally-open contact. Each relay channel is galvanically isolated from the dc supply reference and chassis. If the on-board supply is used to bias this circuit, the electrical isolation will be defeated.

Figure 24 illustrates the function of each relay channel with its corresponding pin-out.

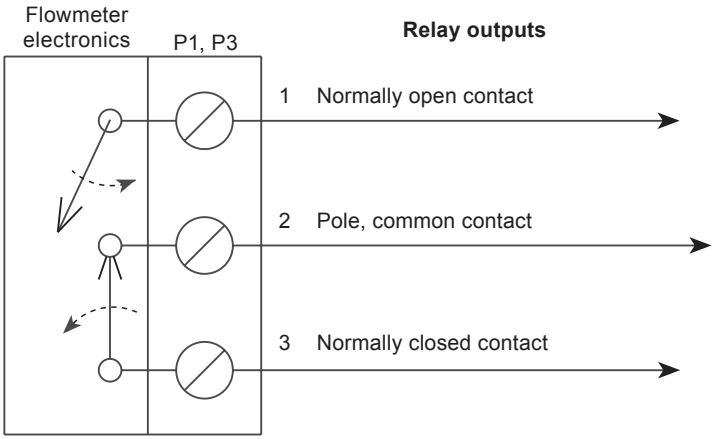


Fig. 24 VLM10 and RIM10 relay circuitry

An alternate view of the relay contacts is shown below:

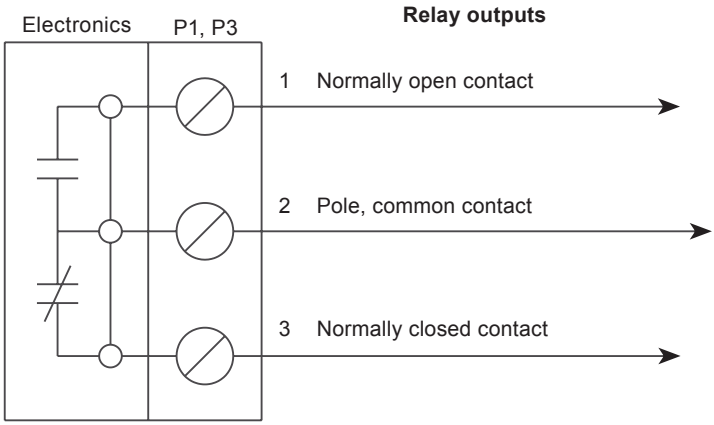


Fig. 25 VLM10 and RIM10 an alternate view of the relay contacts shown in Figure 20

4.10.6 User RS-485 communications

The flowmeter provides a 2-wire, half-duplex, RS-485 communications channel that can be used as a Modbus RTU or BACnet interface. This RS-485 channel is galvanically isolated from the dc supply reference and chassis.

For noise immunity, while using the user RS-485 link, ac termination to chassis is provided on-board the electronics for the RS-485 cable shield. It is recommended to terminate the cable shield at both ends. At the electronics, terminate the RS-485 cable shield to the shield termination terminal, P9 pin 3, which is ac coupled to chassis. The dc galvanic isolation provided by the ac shield termination is rated to 1 kV peak. At the other end of the user RS-485 cable, terminate the shield directly to earth. This will improve performance in noisy environments, and the ac coupling will block low-frequency currents commonly seen in ground loops. Note: the electronics enclosure must be connected to earth ground for effective termination.

The RS-485 bus requires 120 Ω termination. If the bus is not terminated, it is possible to terminate the RS-485 bus with 120 Ω by populating jumper P10 on the terminal board. When P10 is populated with a jumper, 120 Ω is placed across RS-485(+) to RS-485(-). When P10 is open, not populated, there is no resistance placed across RS-485(+) to RS-485(-) and termination is required elsewhere. Figure 26 illustrates the RS-485 driver and pin-out.

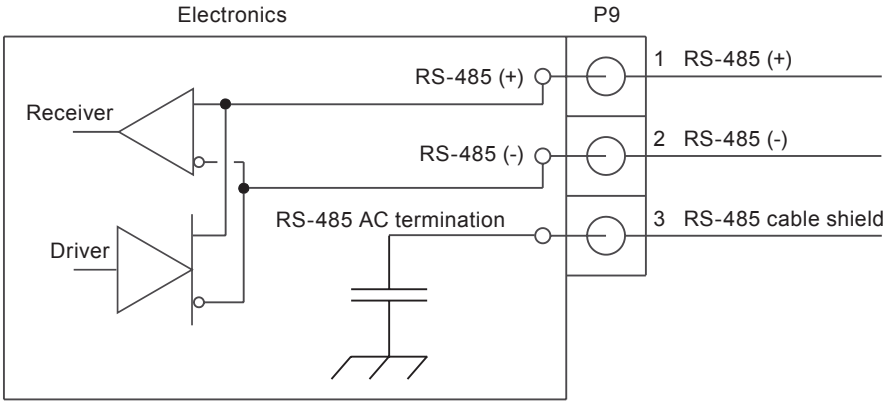


Fig. 26 VLM10 and RIM10 users RS-485 circuitry and connector pinout

4.10.7 Ethernet

The Ethernet connection is standard 10 / 100 BaseT. Shielded twisted pair (STP) cable of category 5 or greater is recommended. The termination is a standard RJ45 jack accessible through the cut-out in the terminal board, and can be connected to with readily available shielded Ethernet cables or patch cords.

4.10.8 Remote mount electronics

Connection of the remote slave, pipe-mount wiring is made on the remote slave electronics terminal board. To access the remote slave terminal board, remove the cover on the remote electronics enclosure. The remote slave terminal board provides two, pluggable screw-terminal connectors to simplify wiring. Before wiring, be sure to turn-off the power to the VLM10 flowmeter electronics, remote slave electronics and all interfaces connecting to the flowmeter. ESD safe procedures must be followed to avoid damage to the electronics. Refer to Figure 27 for a diagram of the remote slave terminal board.

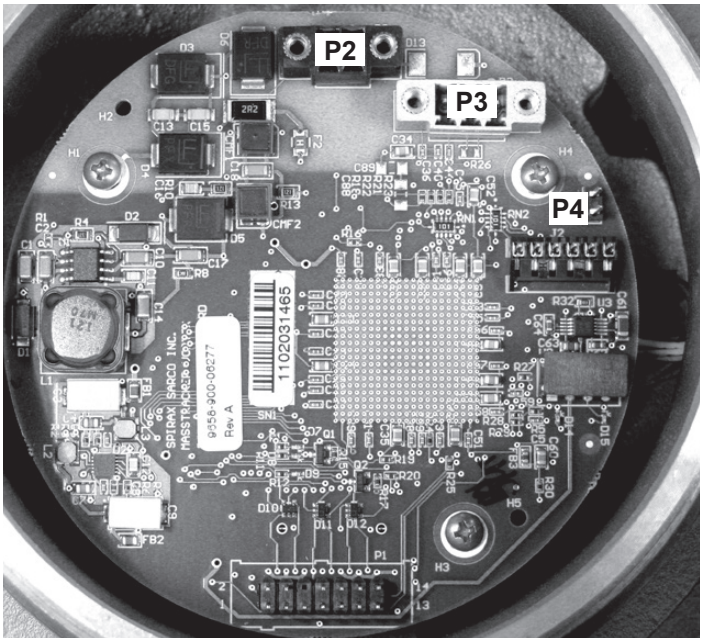


Fig. 27 VLM10 and RIM10 remote slave, pipe-mount terminal board diagram

4.10.9 Remote slave connector pinouts

Table 5 defines the mapping of connectors on the remote slave terminal board.

For all pluggable screw-terminals, pin #1 is indicated on the printed circuit board by the location of the reference designator, which is adjacent to pin #1.

Table 5: Mapping of connectors to circuits at remote slave

Connector reference designator	Circuit
P2	dc supply input
P3	RS-485 remote link
P4	RS-485 termination jumper

P2: Remote slave - dc supply input connector

Pin #	Signal
1	V(–) input, dc supply reference
2	V(+) input, dc supply positive

P3: Remote slave - RS-485 link

PIN #	Signal
1	RS-485(+) positive
2	RS-485(-) negative
3	RS-485 reference

4.10.10 Remote link RS-485 communications

The flowmeter provides a 2-wire, half-duplex, RS-485 communications channel that is intended exclusively for remote mount communications between the remote master (main electronics enclosure) and the remote slave (pipe mount flowmeter). This RS-485 channel is galvanically isolated from the dc supply reference and chassis at both the remote master and remote slave electronics.

The RS-485 bus requires 120 Ω termination. By default, the remote slave electronics comes from the factory pre-terminated with 120 Ω termination. This is accomplished by populated the jumper P4 on the remote slave terminal board.

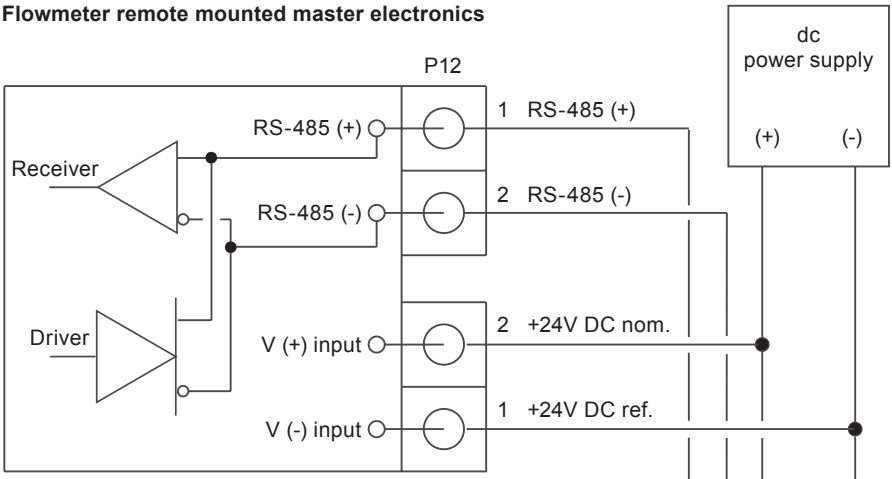
In addition to RS-485 communications, power must be supplied to the remote slave electronics. The remote slave electronics have the same dc power requirements as the remote master electronics. It is recommended to power the remote slave electronics by wiring in parallel with the dc power supply used to supply power to the remote master (main electronics). This can be accomplished by using an adapter that connects between the dc power supply, remote master terminal board and the remote slave cable; or by twisting wires from the dc power supply together with wires from the remote cable and inserting them into the power connector on the remote master terminal board. Screw terminals can also be used to wire the dc power to the remote master and remote slave electronics in parallel.

It is recommended to use one cable to wire power and RS-485 between the remote master and remote slave electronics. See Section 4.6 to view the recommended cables.

ATEX / FM option. Conductive conduit must be used per NEC and local requirements between the two enclosures.

Refer to Figure 28 for a wiring diagram that illustrates the proper connection of the remote electronics.

Flowmeter remote mounted master electronics



Flowmeter Local Slave, pipe mounted electronics

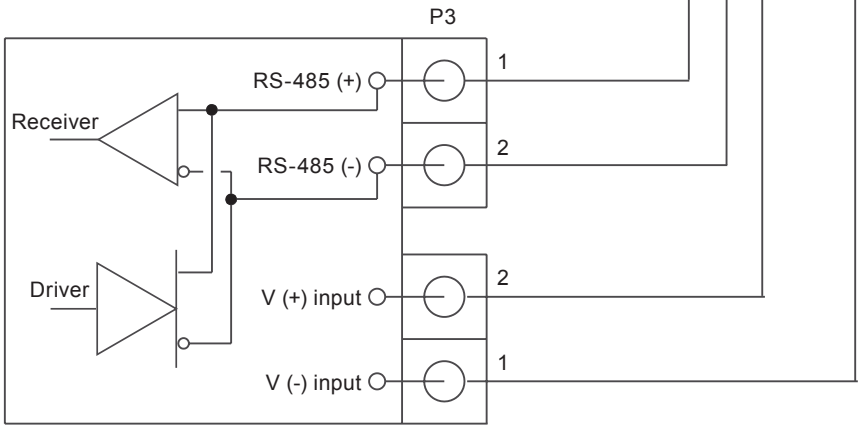


Fig. 28 VLM10 and RIM10 remote electronics wiring diagram

4.10.11 Ethernet

The Ethernet connection is standard 10/100 Base T. Shielded twisted pair (STP) cable of category 5 or greater is recommended. The termination is a standard RJ45 jack accessible through the cut-out in the terminal board, and can be connected to with readily available shielded Ethernet cables or patch cords.

5. Front panel interface

This Section describes the VLM10 and RIM10 front panel interface.

The front panel consists of a display and 5 keypads. The keypads can only be actuated by the presence of a magnetic field. A magnetic wand is included with each flowmeter to activate the keypads. Each keypad has a green LED behind it. When the keypad senses the magnetic wand over it, a green LED behind the keypad will turn on.

Note: Holding the wand over a key will not actuate the key – the key LED must turn on, and then off to be sensed as a valid key press by the flowmeter.

Use the up and down arrow keys to select (highlight) an option from the display menus. When the desired option is selected, pressing the enter key or right arrow key enters the next menu. To go back to a previous menu, press the left arrow key.

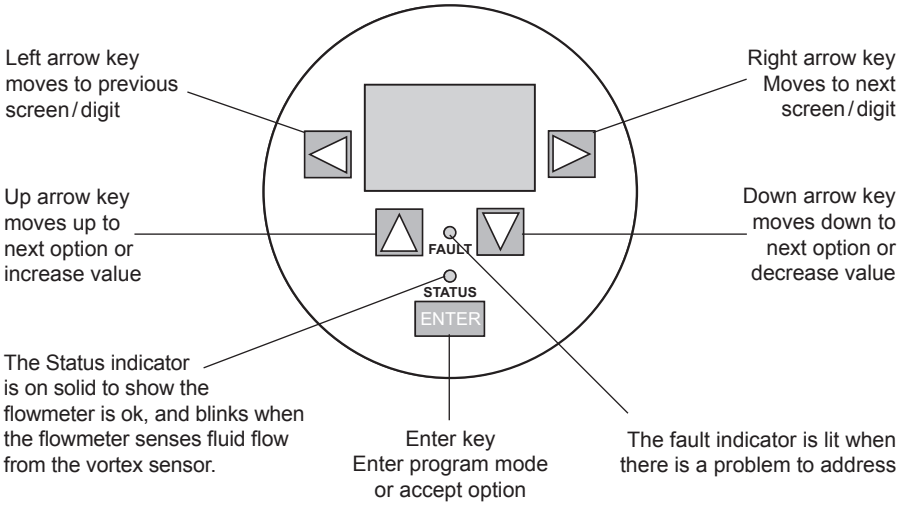


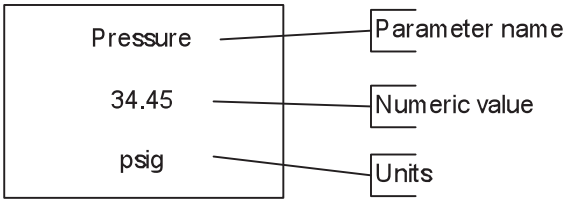
Fig. 29

5.1 Run mode

The front panel interface has 2 operating modes: Run and Programming. After power-up, the flowmeter enters Run mode. In this mode, individual flow data is displayed on separate screens.

Each screen has the same format. The top line describes the measurement name, the middle line is the numerical value of the measurement, and the bottom line contains the measurement units.

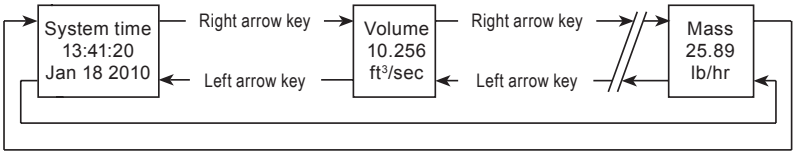
Fig. 30 Run mode screen



The user can select which screens are displayed from the Set Display Options menu in Programming mode.

Run mode cycles through each screen automatically, pausing for 5 seconds between screens. It is also possible to use the left or right arrow keys to move between screens.

Fig. 31



When the front panel has not detected any key activity for 10 minutes, it turns off the display and enters 'sleep' mode. In sleep mode, the display will turn on for 15 seconds every 5 minutes. Pressing any of the arrow keys will exit the display sleep mode.

The flowmeter will still calculate flow parameters, and the fault and status LED indicators will still be active in display sleep mode.

A yellow indicator (FAULT) on the front panel turns on when a fault is detected. A fault screen will also display for 5 seconds with a description of the latest fault. To clear the fault the user must enter Programming mode and select the View / Clear Faults menu.

A green indicator (STATUS) on the front panel blinks fast to indicate the unit senses fluid flow. The STATUS indicator blinks slowly when the flowmeter detects no flow.

5.2 Program mode

To enter Program mode, the user must tap the Enter key with the magnetic wand 5 times. When the unit enters program mode, the Meter Setup menu will appear.

In Program mode, there are two different types of displays. The first type is a scrollable list of selectable menu items - Figure 32. When the desired item is selected, pressing the right arrow or enter key goes deeper into the menu. A vertical slider bar located on the right side of the screen shows the relative position of the cursor in the list.

The second type contains a display window and a bottom line for viewing or editing operations. The bottom line has 3 selectable fields, a left arrow, text, and a right arrow - Figure 33. Selecting the left arrow and pressing enter returns to the previous screen. Selecting the right arrow and pressing enter proceeds to the next screen. The text field tells the user what action can be performed at this screen.

Fig. 32 Scrolling list screen

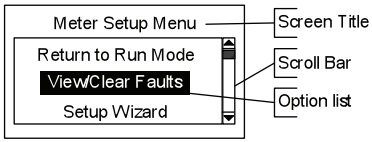
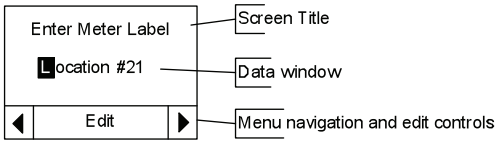


Fig. 33 Data edit screen



Note: If the flowmeter does not detect a key press for 5 minutes, it will revert back to Run mode.

5.3 Data edit screen example

This sequence from the Service menu shows the steps required to change the minimum flow threshold value using the keypad.

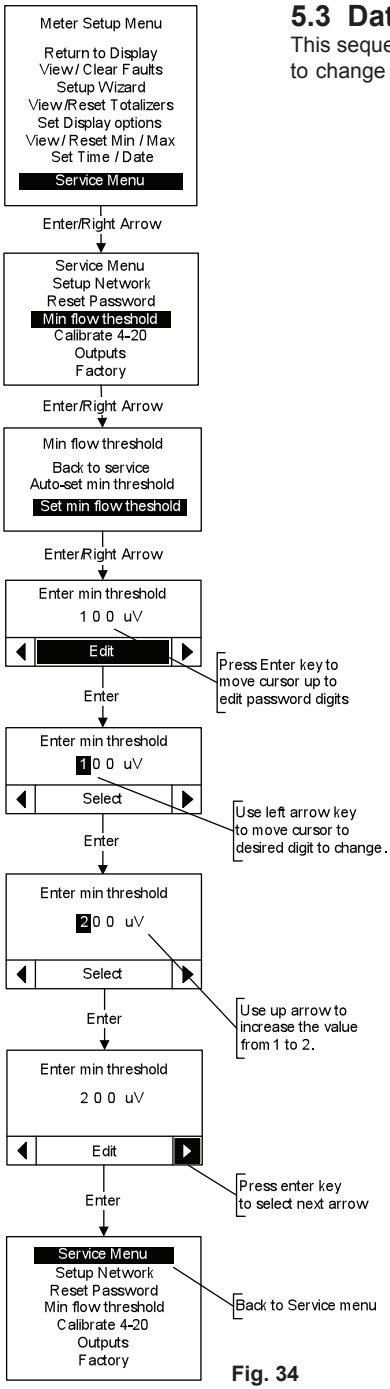


Fig. 34

5.4 Program mode menus

The Meter Setup Menu is the first menu in Programming Mode.
To access one of the sub-menus, select the menu using the up or down arrow keys and then press the enter or right arrow key.

The sub-menus are described below in the sequence in which they appear in the Main Menu.

The user can return to Run mode by selecting the 'Return to Run Mode' item.

The following pages show how to navigate the sub-menus. To make this process simple and clear, duplicate paths through the menus are not shown, and the scrolling list screens are not shown with the scroll bar or navigation fields.

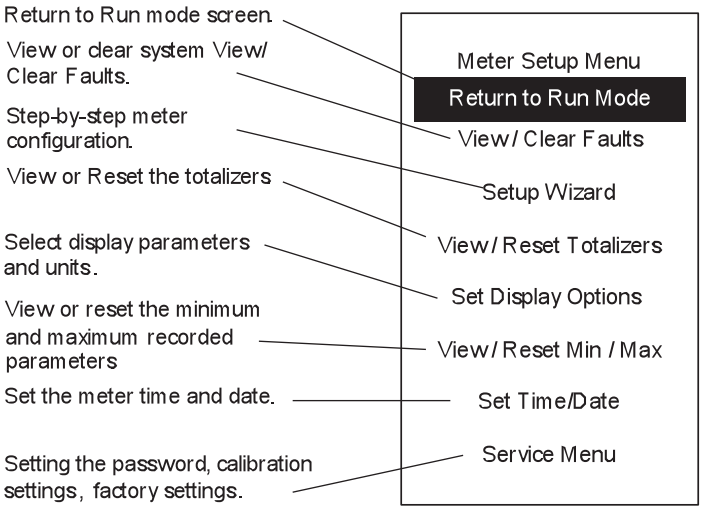


Fig. 35

5.5 View / clear faults

In this menu the user can view and / or clear the flowmeter faults.
Each fault has a code number and a message that describes the details of the fault.

A list of faults is stored in memory. Some faults are 'latched' which means they must be cleared from the list by the user.

The fault indicator on the front panel will turn on if any faults are detected, and will not turn off until all faults have been corrected and cleared from the list.

If a fault condition is occurring continuously, the fault will not clear until the cause of the fault is corrected.

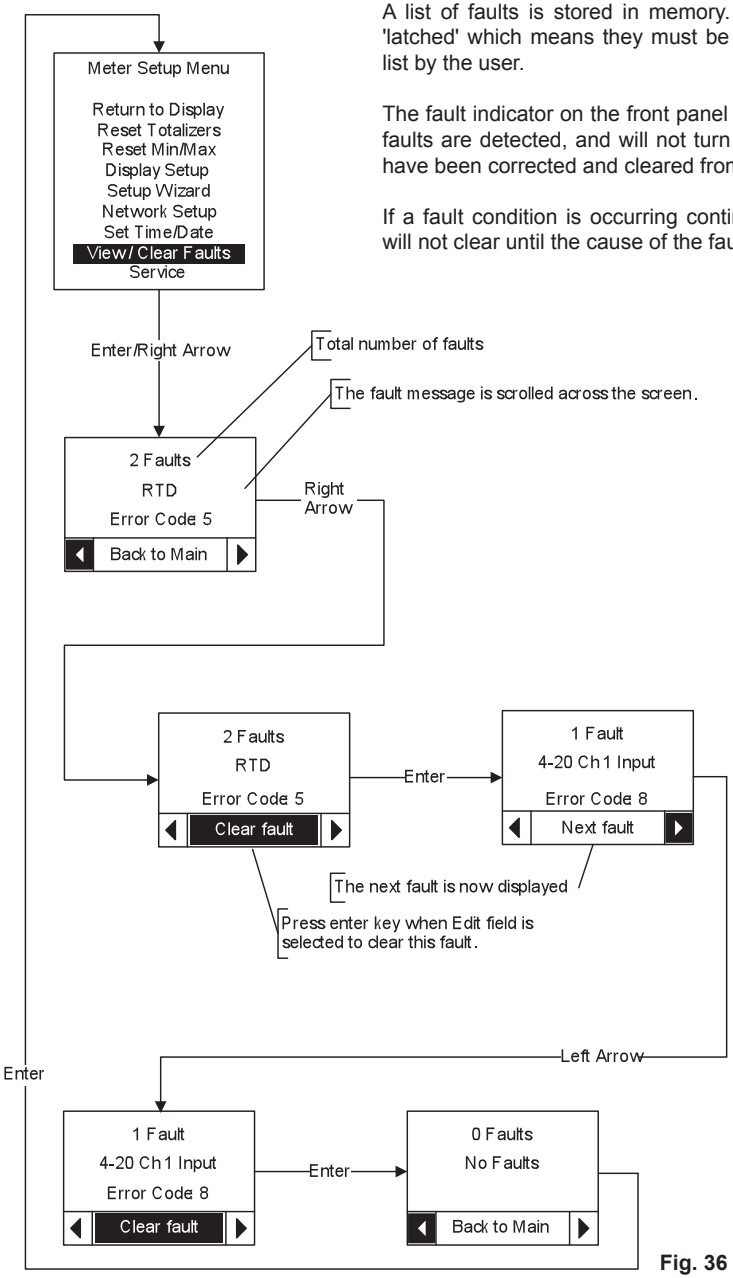


Fig. 36

5.6 Set-up wizard (General settings)

This menu assists the user in setting up the flowmeter. This menu starts by asking the user to select one of 4 configurations. If the flowmeter is to be run in a single configuration, it is best to load the User Current configuration and save it back to the Current configuration at the end of the setup wizard. The Original factory configuration cannot be over-written. The following screens let the user enter a flowmeter label and tag number – the Product code, serial number, and pipe inside diameter are not editable by the user.

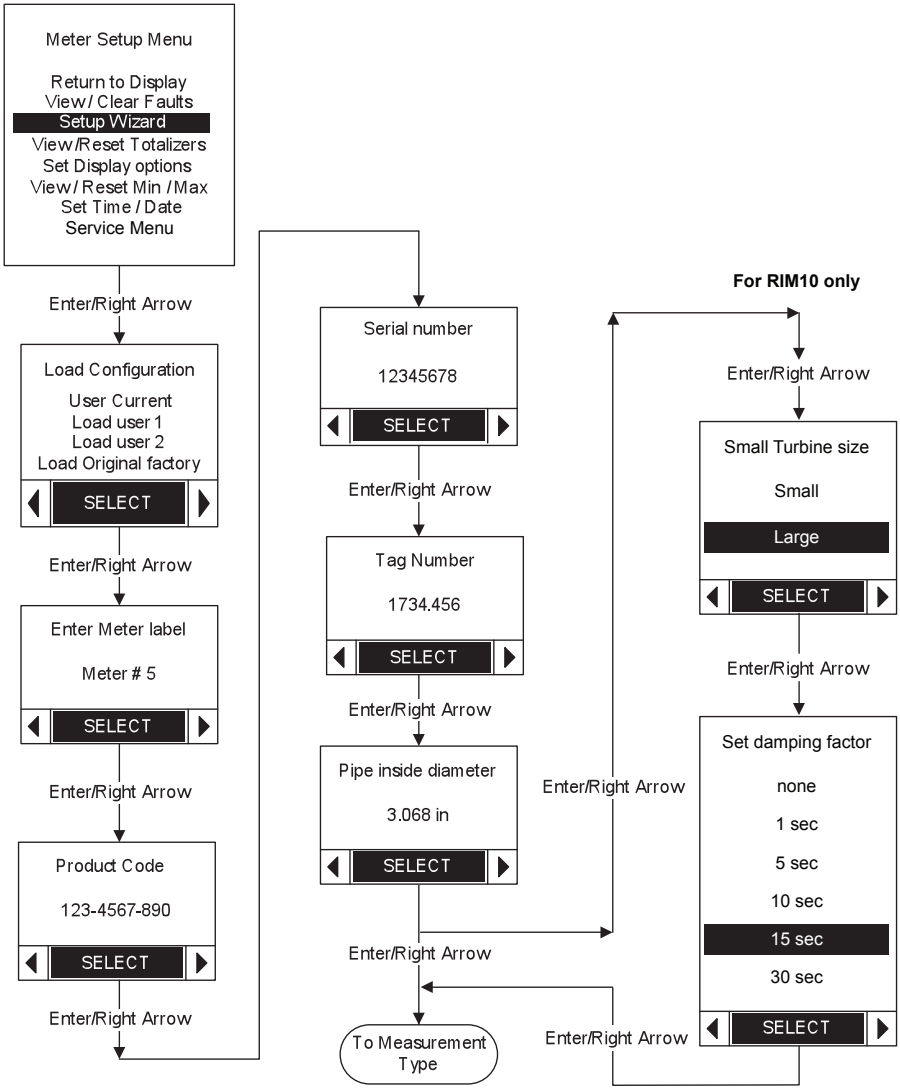


Fig. 37

5.7 Set-up wizard (Measurement type)

This menu lets the user select the type of measurement and configure the sensor inputs.

Shown below is a sequence to configure the flowmeter for measuring saturated steam.

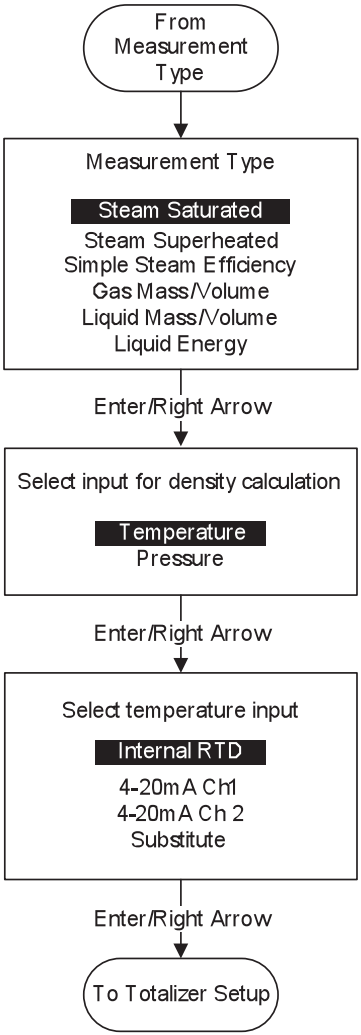


Fig. 38

If Saturated Steam is selected, the flowmeter can use either Temperature or Pressure to calculate the steam density using the saturated steam tables.

By selecting Temperature and the Internal RTD a separate transmitter is not required to calculate the steam density.

Simple Steam Efficiency measurement type calculates steam system energy use by measuring steam flow, temperature (with internal RTD), and return temperature of condensate.

5.8 Set-up wizard (Totalizer assignment)

This menu lets the user configure the 2 totalizers. Note that any changes to a totalizer configuration will result in the resetting of the original totalizer value to zero.

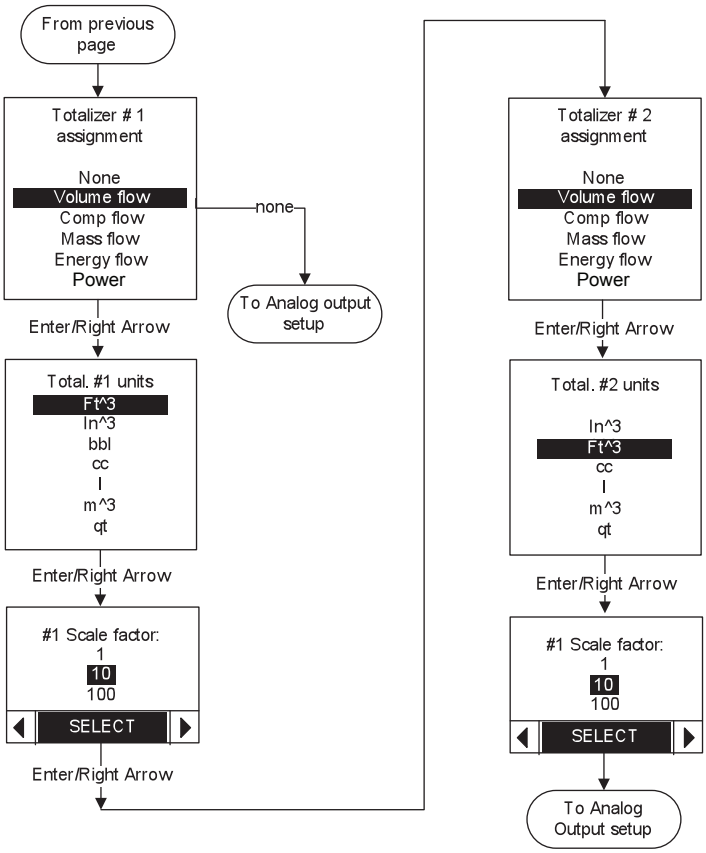


Fig. 39

5.9 Set-up wizard (Analog outputs)

This menu lets the user configure the three analog outputs.

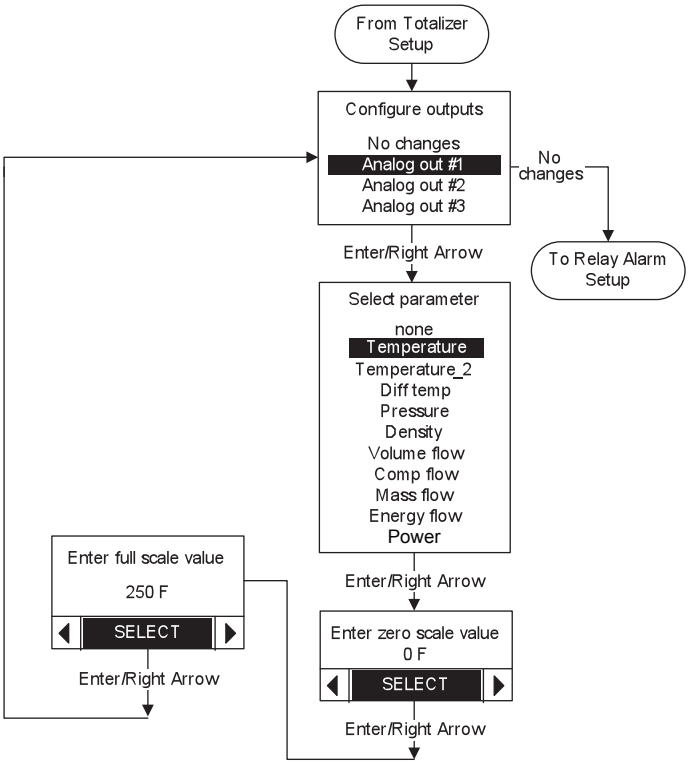


Fig. 40

5.10 Set-up wizard (Relay)

This menu lets the user configure the 2 alarms or scaled pulse output based on internal totalizers 1 or 2. These settings actuate the flowmeter relay outputs. Note that the Relay alarm function is a purchased option, and this menu will only display if enabled.

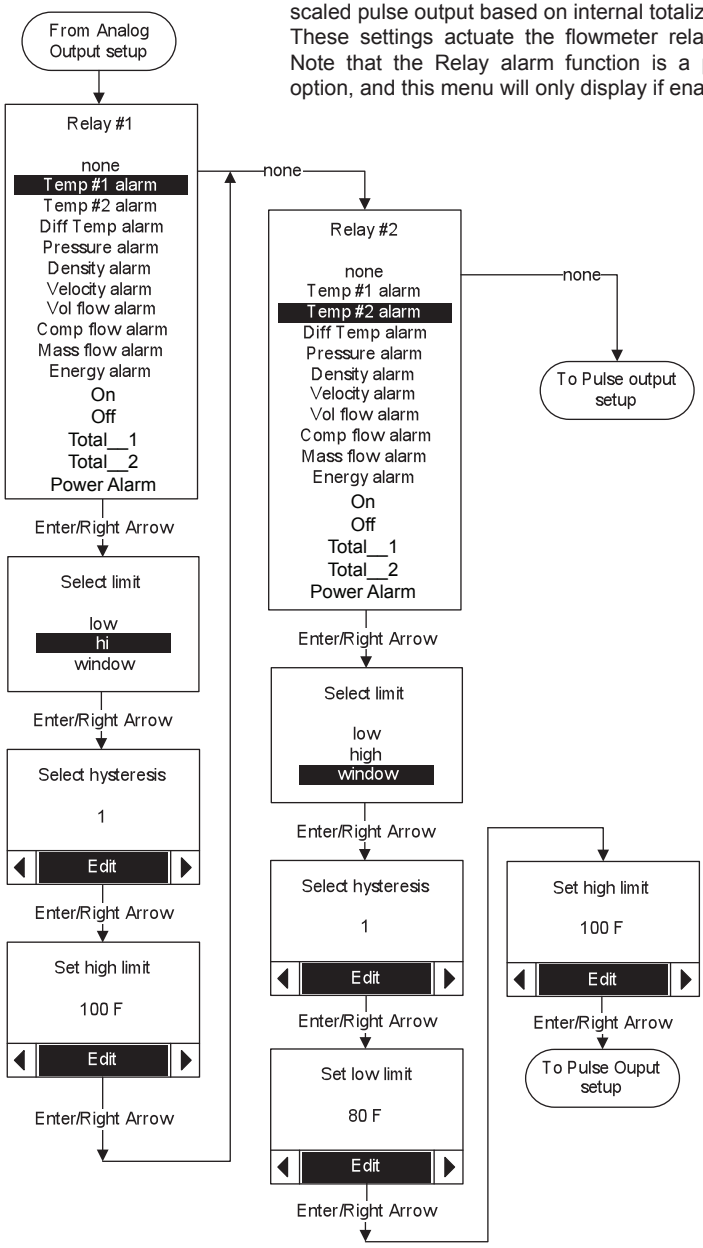


Fig. 41

5.11 Set-up wizard (Pulse / relay output totalizers)

This menu lets the user configure the pulse output.

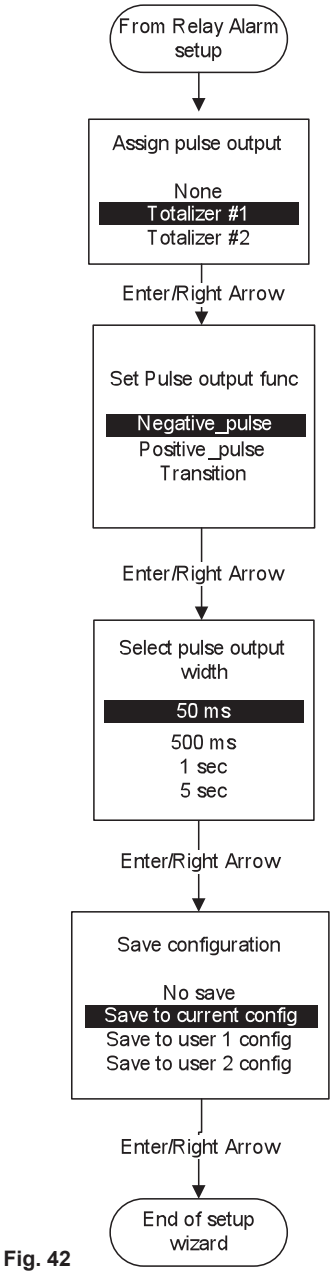


Fig. 42

5.12 Reset totalizers

Allows the user to view all totalizers and to clear the resettable totalizers.

There are 4 totalizer values shown in this menu, only the resettable totalizers can be reset to zero. The non-resettable totalizers can be viewed in this menu, but not reset to zero. The non-resettable totalizers are only resettable through the Service menu via the factory password.

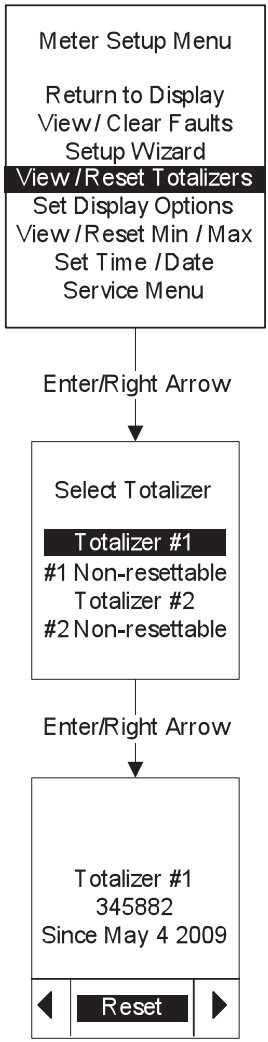


Fig. 43

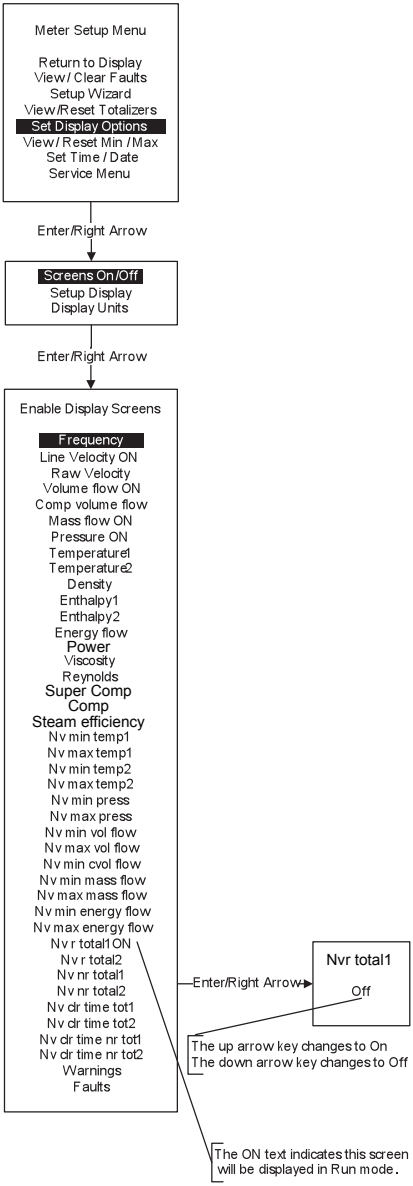
5.13 Set Display Options (Screen selection menu)

This Display Setup has 2 sub-menus: Screens On / Off, and Display Units.

Screens On / Off - allows the user select which parameter screens they want to see during Run mode.

Display Units - allows the user configure different output units.

Fig. 44

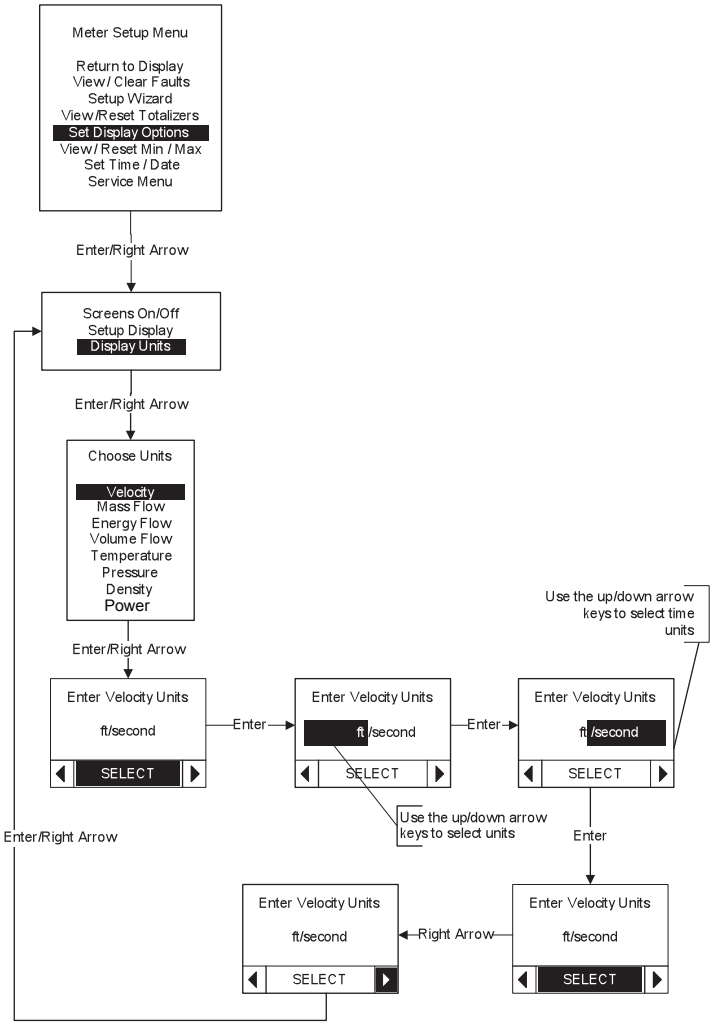


5.14 Set Display Options (Display units)

Display Units allows the user configure the engineering unit and the time element.

In this example the user is reviewing the Velocity and may change either the engineering unit (ft), and the time element (second).

Fig. 45



5.15 View / Reset Min / Max

The Reset Min / Max allows the user to view and / or reset the minimum / maximum parameters.

The user can reset all simultaneously or individually. After a reset, the min. and max. values will be nearly equal.

The example below illustrates resetting the minimum and maximum temperature values for the first temperature sensor (Temperature 1).

The Reset Temp 1 Min/Max screen displays the maximum measured value (line 2) and the minimum measured value (line 3).

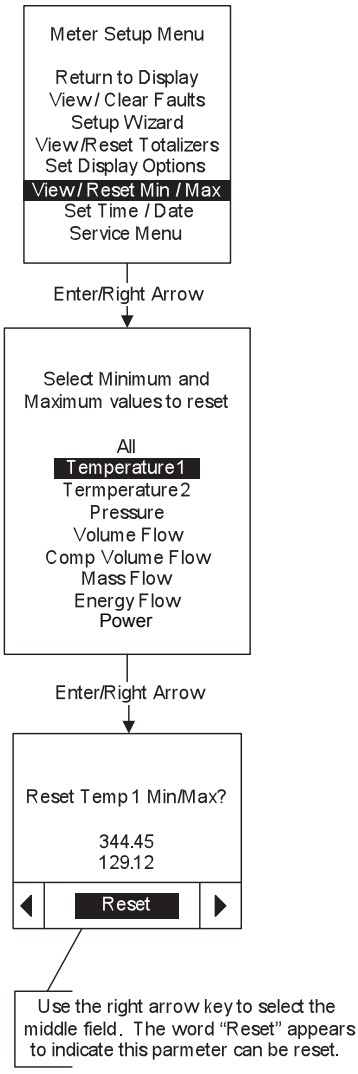


Fig. 46

5.16 Set Time / Date

Allows the user to adjust the month, date, year, and local time. Note that the flowmeter will restart after completing this menu.

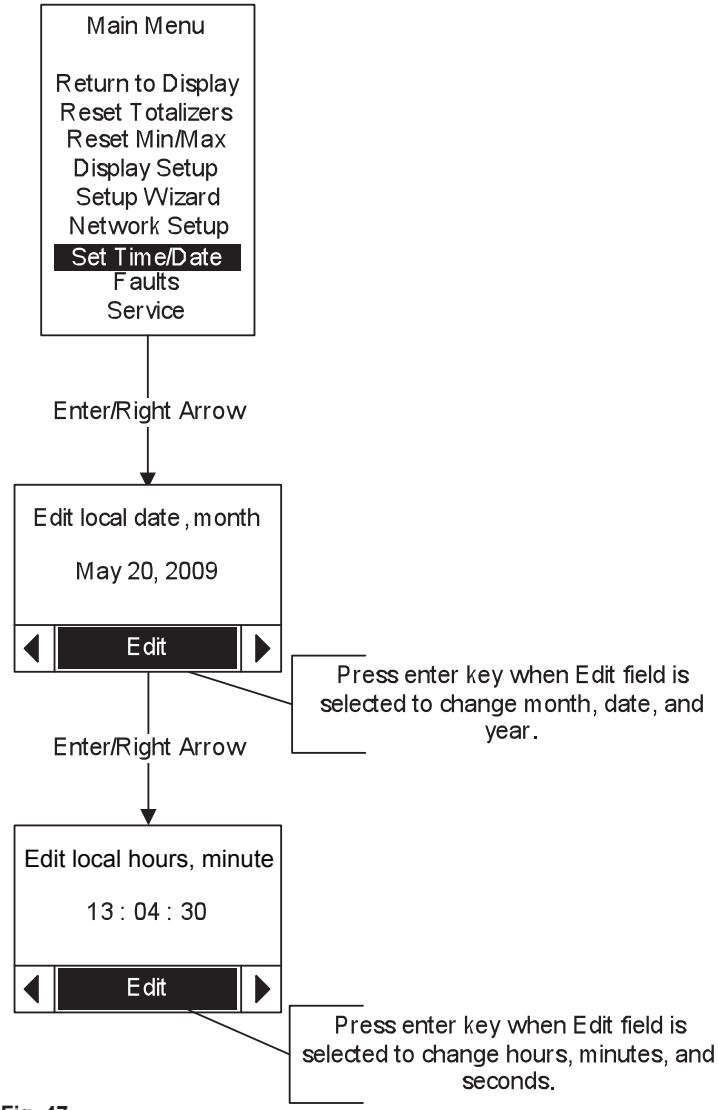


Fig. 47

5.17 Service Menu

This menu lets the user change the password, perform analog input/output calibration, test the relay and pulse outputs, and enter frequency / velocity pairs for RIM10.

Edit freq/velocity menu item for RIM10 Insertion Turbine Meter Only.

5.18 Service Menu (Reset Password)

The screen below demonstrates how the user Resets the Password. The Password must be six digits, all numeric. The default Password is 000000.

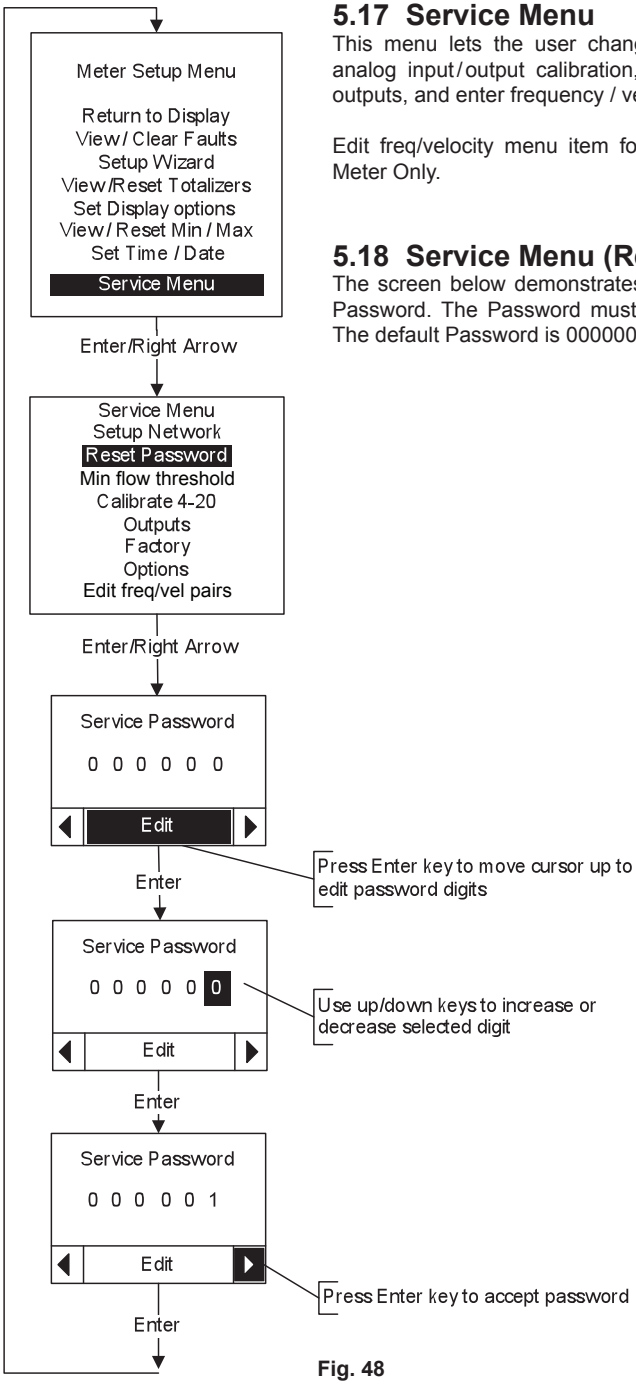


Fig. 48

5.19 Service (Minimum flow threshold)

This allows the user set the minimum flow threshold. The purpose of adjusting the flow threshold is to eliminate system noise.

Auto-set threshold – should be run when the flowmeter is first installed and can only be run when there is no flow.

Set min. flow threshold - allows the user to select the threshold value manually. This may be done to eliminate system noise, such as pumps, which are not eliminated when the Auto Threshold is run.

The minimum flow threshold values can be set between 0 – 5000. Increasing the Noise Threshold value will decrease the flowmeter's low-end sensitivity.

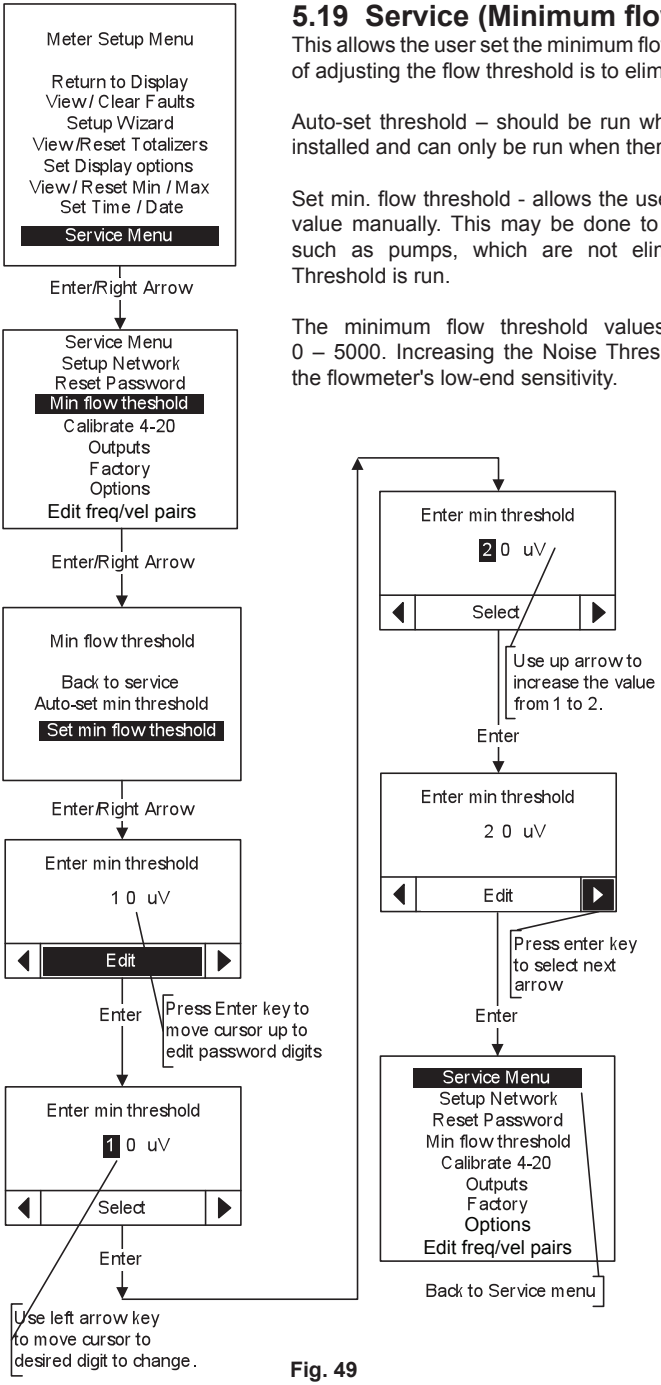


Fig. 49

5.20 Service (Calibrate 4-20 input / outputs)

This allows the user to calibrate the three 4 - 20 mA input and output channels. It requires a connection of an external ammeter to measure the calibration current.

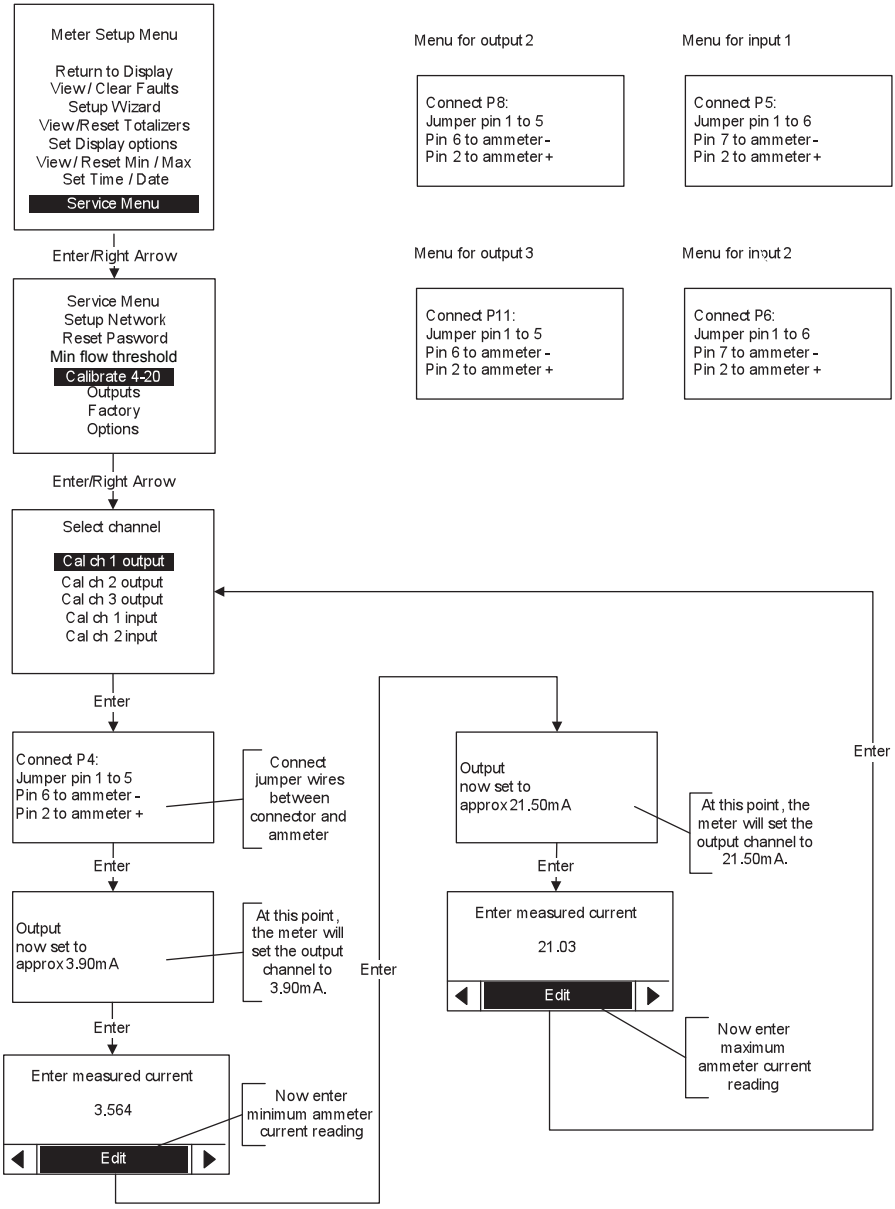


Fig. 50

5.21 Service (Outputs)

Allows the user to test the two relay alarms and the pulse output.

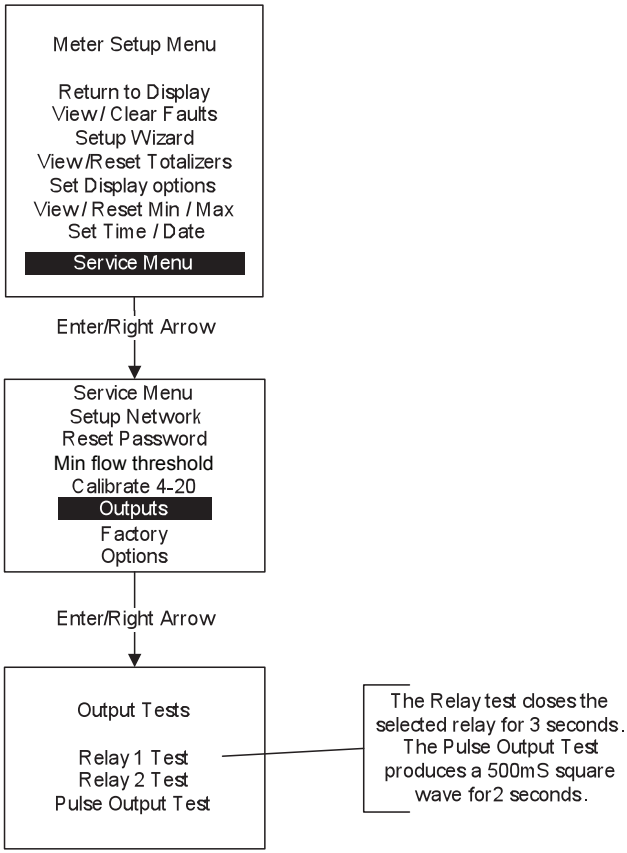


Fig. 51

5.22 Service (Factory settings)

This allows a qualified service technician to reset the non-resettable totalizers using the factory password.

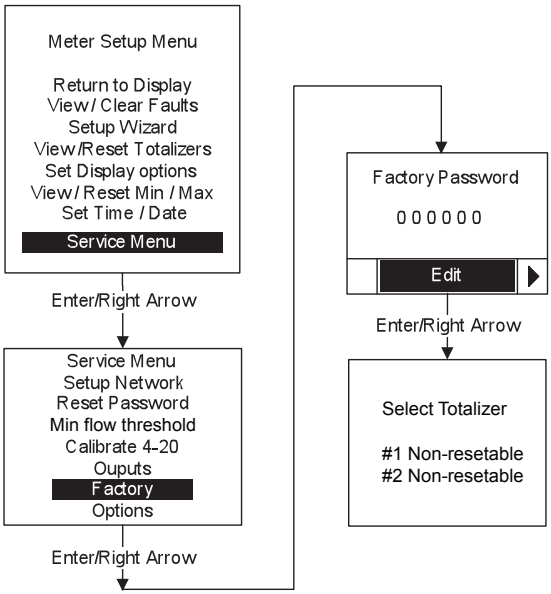


Fig. 52

5.23 Service (Setup network)

This allows the user to set the Ethernet, Modbus, or BACnet parameters.

Note that the Modbus and BACnet interfaces are purchased options, and the menu will only display the Modbus or BACnet options if they have been enabled.

5.24 Setup Network (Modbus)

Two kinds of Modbus interfaces are available: RTU or TCP. The RTU interface uses connector P9, which is also used for the BACnet MS/TP interface; therefore it is not possible to use both Modbus RTU and BACnet MS/TP simultaneously.

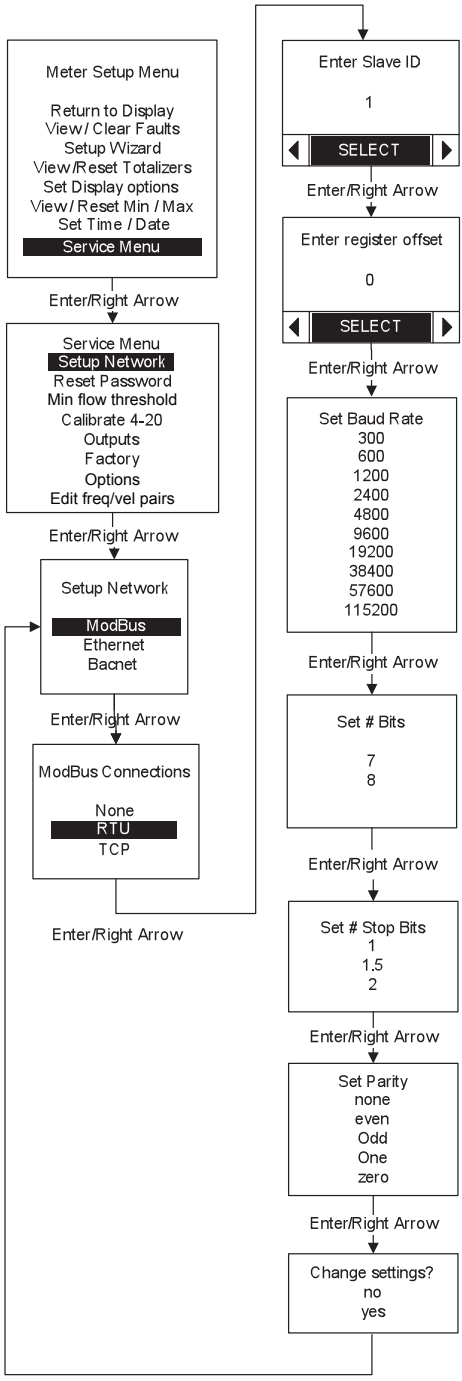


Fig. 53

5.25 Network setup (Modbus TCP)

This menu shows the TCP Modbus menu. Note that the flowmeter will restart if the user answers yes to Change settings.

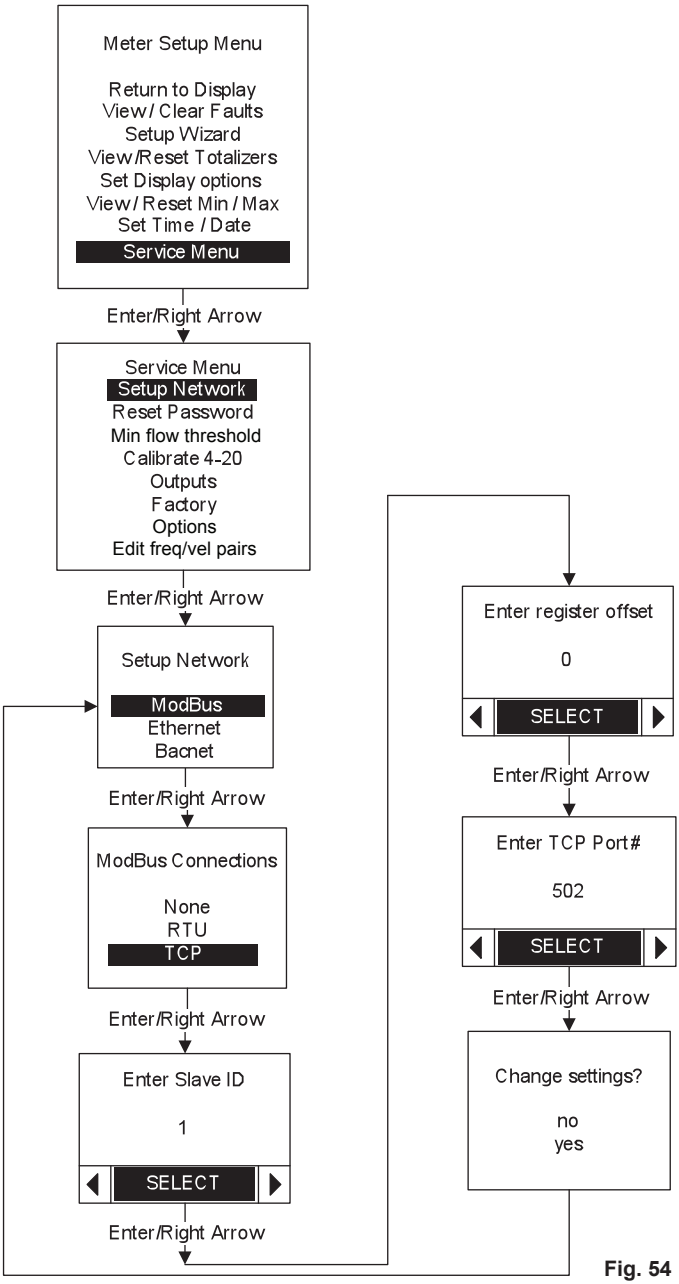


Fig. 54

5.26 Setup Network (Ethernet)

This allows the user to view / change the Ethernet parameters.

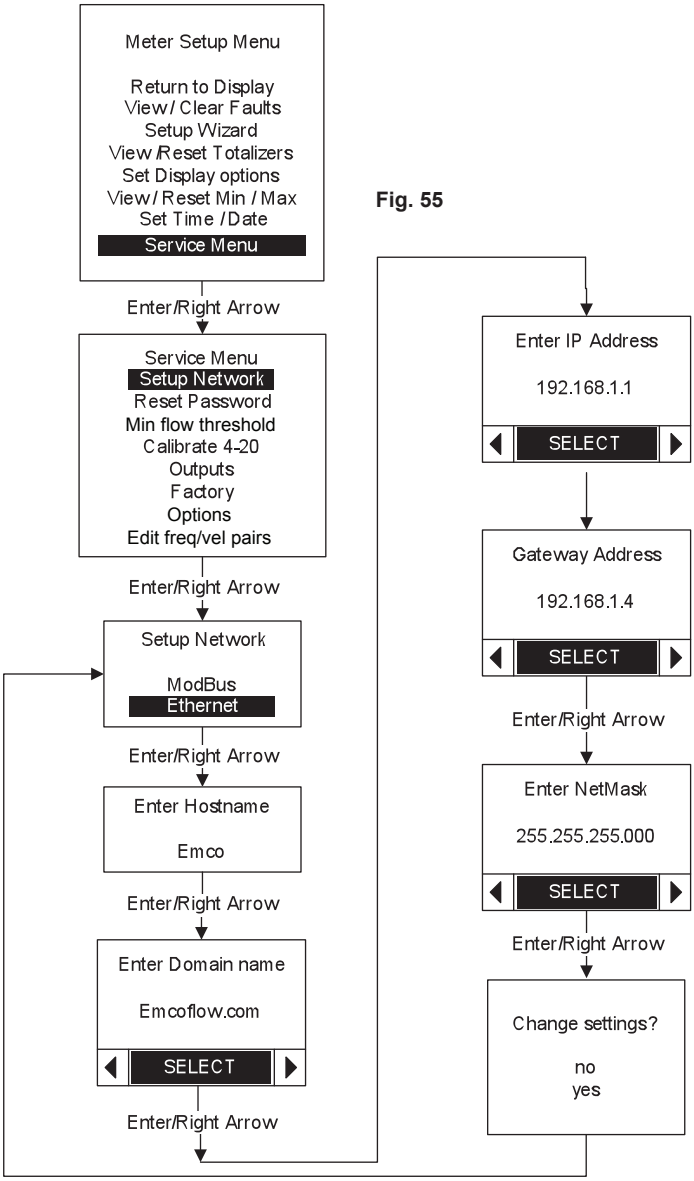


Fig. 55

5.27 Network setup (BACnet MS/TP)

This menu lets the user set up the BACnet MS/TP parameters.

The BACnet interface uses connector P9, which is also used for the Modbus RTU interface; therefore it is not possible to use both BACnet and Modbus RTU simultaneously.

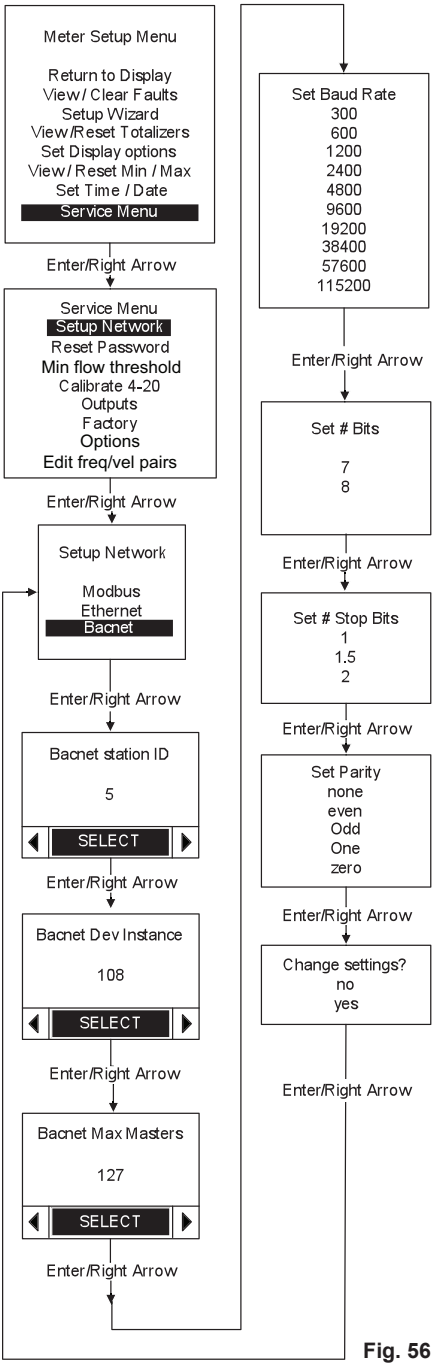


Fig. 56

5.28 RIM10 Only Service - Frequency/Velocity Data

If the user needs to install a new RIM10 rotor, this is where the new frequency/velocity calibration data is entered.

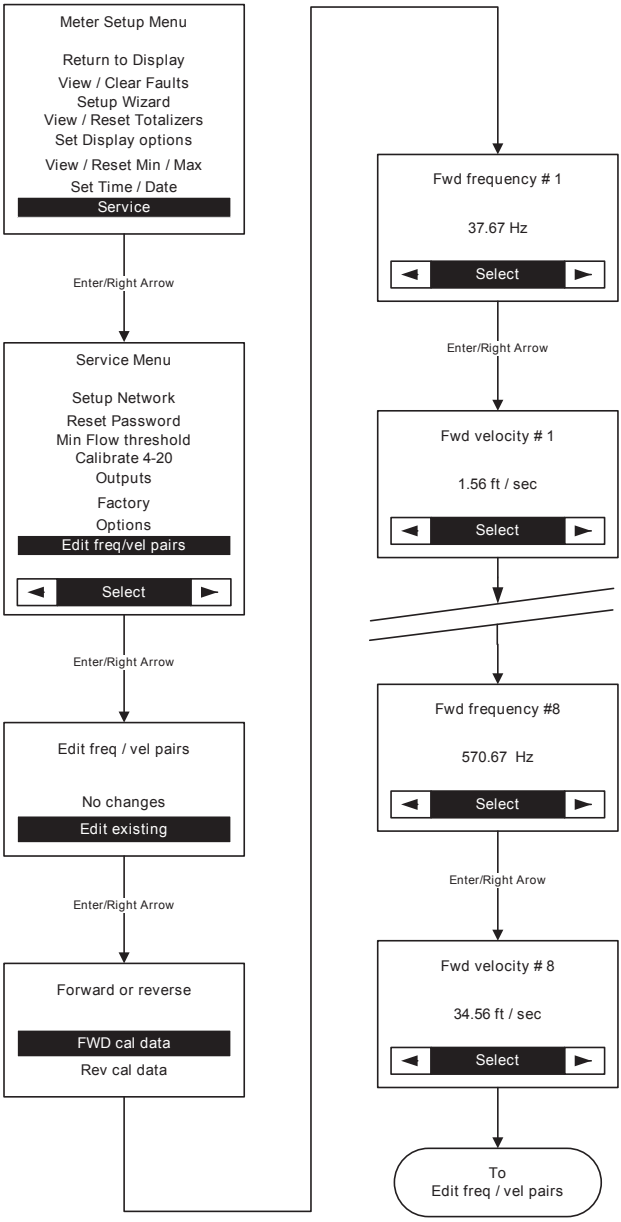


Fig. 57

6. Web server interface

6.1 Introduction

The Web server lets the user monitor and configure the flowmeter, including inputs / outputs, using any device capable of internet access via a web browser.

The VLM10 and RIM10 uses static IP addressing, which means that the user must assign an IP address to the flowmeter. This is different than using a dynamic IP addressing scheme where the network router assigns an address. The advantage in using a static address is that the IP address will never change.

For assistance in setting up a static IP address, consult the troubleshooting portion of the instruction manual.

The flowmeter IP address is displayed on the front panel on the third line of the start-up screen as IP Addr: xxx.xxx.xxx.xxx. The flowmeter home page is accessed by entering the IP address into a web browser address bar. For example, if the flowmeter IP address is 192.168.6.188, then the browser address bar should read http://192.168.6.188/home.

6.2 Web page format

The top of the web page displays the product and software version, along with the 4 navigation buttons. The buttons allow for navigation to other web functions.

The product code, flowmeter location, serial number, and support information are shown at the bottom of the web page.

Clicking on the Spirax Sarco image at the top right of the web page brings up the Spirax Sarco, Inc. company website

6.3 Navigation buttons

Home - displays the fluid being measured and the current values of the product, including any faults.

Service - allows the user to view the current configuration, view and download the log files, clear the log files and totalizers, and set or modify the noise threshold setting.

Setup - Set variables displayed on the home page, set variables the data logger will capture, set the system time, set up the Ethernet, Modbus or BACnet interfaces, and change the system password.

Wizard - guides the user through a complete flowmeter configuration. This includes the fluid type, units measured, sensor inputs, and outputs.

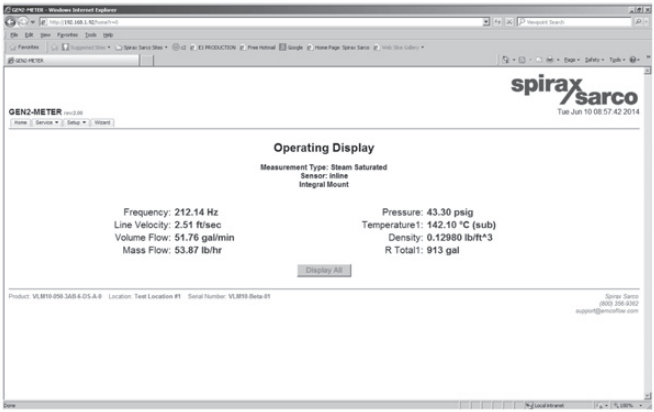
6.4 Home page

The operating display shows fluid measured, current values, and any faults

The values shown on the home page are selected using the Setup button.

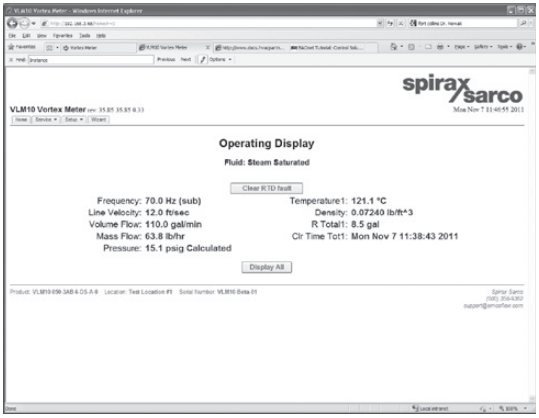
The 'Display All' button below the parameters will display all parameters, to display the original parameters select the 'Display' button again.

Fig. 58



An example of a system fault is shown below. This fault occurs when the flowmeter has an RTD sensor failure. For a list of faults and fault resolution please consult 'Troubleshooting' in Section 10.

Fig. 59



To clear this fault, it is necessary to fix the problem, and click on the 'Clear RTD fault' button. If the fault condition has been fixed, the 'Clear RTD fault' button will be removed from the home page. The time at which a fault occurred and when it was cleared is saved in the fault file, which can be viewed by clicking the Service button.

6.5 Service

The Service menu has 4 drop down menus, Status, View Logs, Clear, and Noise Threshold and Calibration.

6.6 Status

Selecting this brings up a web page that displays all configuration settings. The information on this page is read-only, and is intended as an advanced troubleshooting guide.

Fig. 60

6.7 Service

6.7.1 View logs - Faults

The Faults log contains information about the type and time at which a serious system fault occurred. When a fault occurs, the yellow fault LED on the front panel turns on, a fault will also be displayed on the home page.

A Fault is considered to be failure that will affect the flowmeter's ability to accurately calculate flow parameters, and must be addressed quickly.

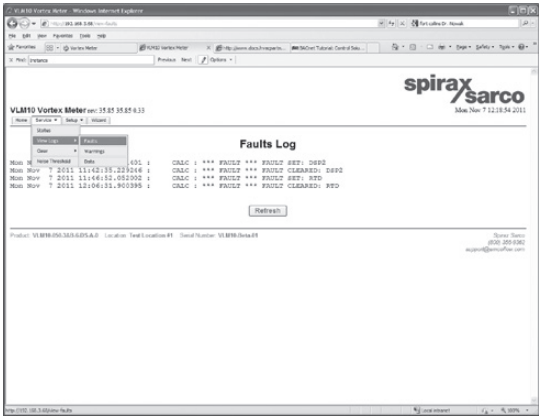


Fig. 61

6.7.2 View logs - Warnings

The warnings log contains general information about the flowmeter state, such as power interruptions, min / max value changes, and relay / alarm conditions. A warning may not affect the flowmeter's performance, but it does indicate a condition which is not considered normal.

Warnings are not displayed on the front panel or the web home page, and are viewed by reviewing the Warnings Log.

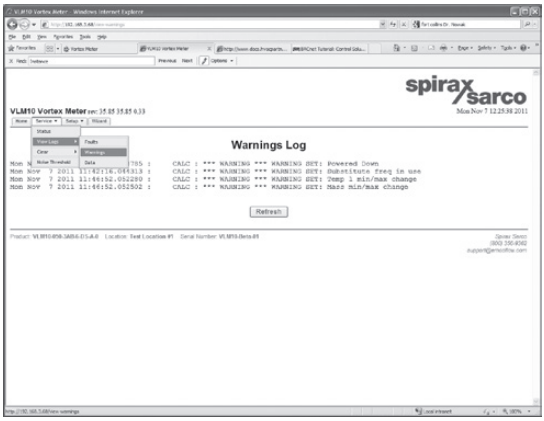


Fig. 62

6.7.3 View logs - Data

The Data Log page contains a timestamp of parameters the meter saves to the log file.

This file is in coma delimited format, to make it easy to select and copy the data to a spreadsheet. Instructions on how to download the data log file are displayed on this page.

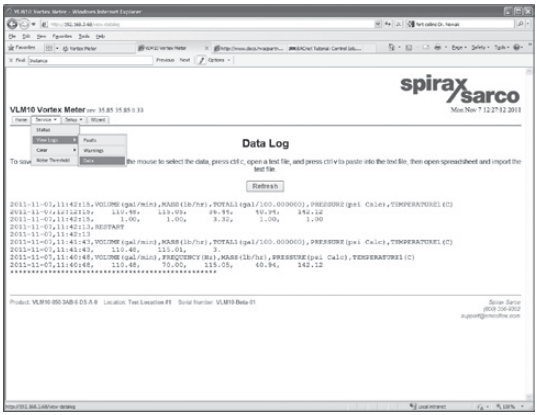


Fig. 63

6.8 Clear - Totalizers

The clear totalizers page shows the current resettable totalizer values and times when last cleared. A user may clear up to 2 totalizers. The user must enter the system password before clearing a Totalizer. The default password is '000000'.

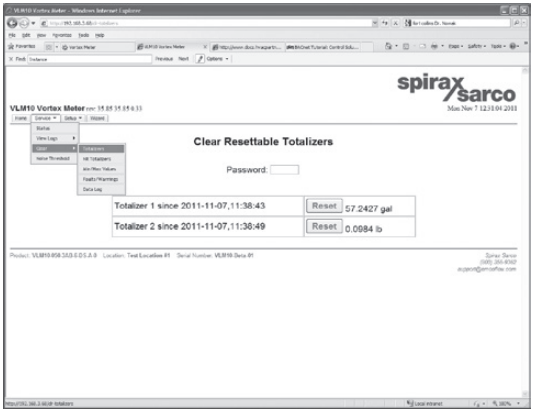


Fig. 64

6.9 Clear - NR Totalizers

The non-resettable factory totalizers can only be reset using the factory password.

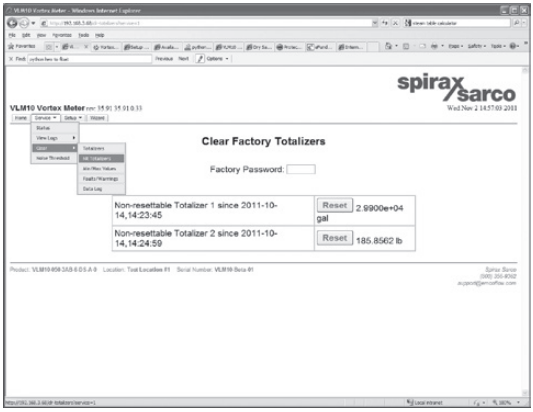
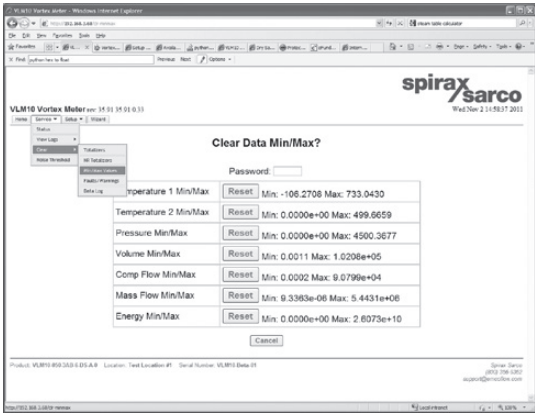


Fig. 65

6.10 Clear - Min / Max Values

The Clear Data Min / Max page allows the user view and reset the minimum and maximum values of default runtime parameters. The system password must be entered before clicking the parameter reset button. When a parameter is reset, both the minimum and maximum values are set to the currently computed parameter value. For example, if Temperature 1 is currently at 278.0 degrees, and the Temperature 1 Min / Max reset button is clicked, both the Min: and Max: will read 278.0. After the reset, the flowmeter will update the minimum and maximum values as they change over time.

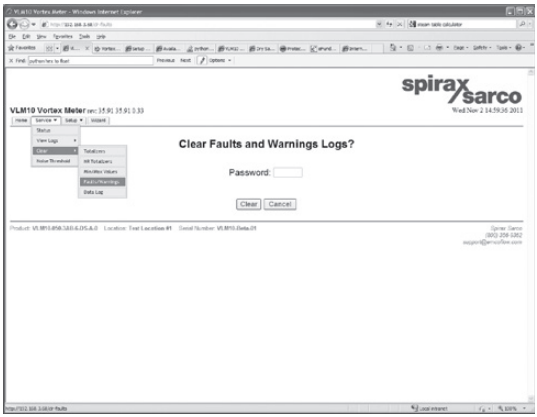
Fig. 66



6.11 Clear – Faults / Warnings

It's also possible to Clear Faults and Warnings Log files after entering the system password.

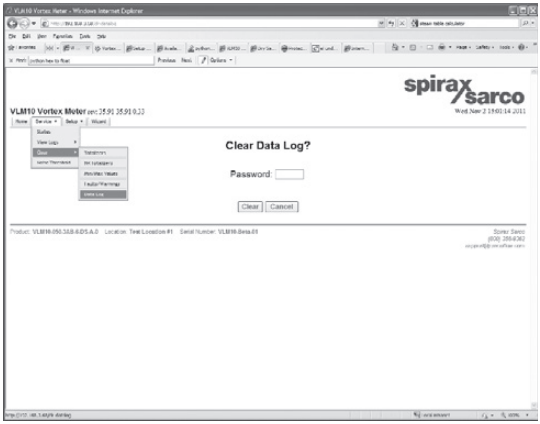
Fig. 67



6.12 Clear - Data Log

Clearing the data log file requires the user to enter the system password.

Fig. 68



6.13 Service - Noise Threshold

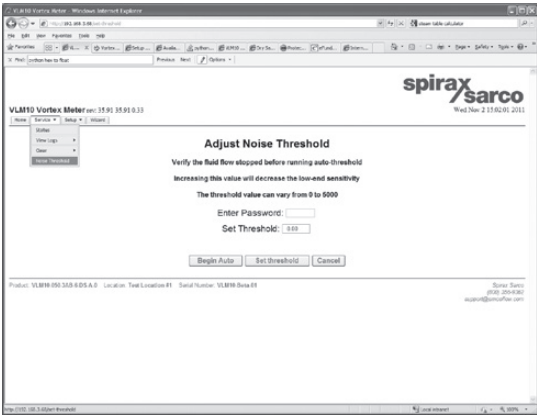
The Adjust Noise Threshold allows the user to control the amplitude filter of the vortex and magnetic pick-up sensor. The purpose of adjusting the noise threshold is to eliminate system noise.

It is recommended that the Auto Threshold be run when the flowmeter is first installed. The Begin Auto button can only be run when there is no flow.

The Set threshold button allows the user to select the threshold value manually. This may be done to eliminate system noise, such as pumps, which are not eliminated when the Auto Threshold is run.

Note: The value in Set Threshold represents the current Noise Threshold. Increasing the Noise Threshold value will decrease the low-end sensitivity of the VLM10 inline vortex meter.

Fig. 69



6.14 Setup

The Setup button is used to set the Web page and Front Panel Display, Data Log, Time, Network (Ethernet, Modbus, BACnet), and Password on the flowmeter.

6.15 Setup - Display

The Setup Display page lets the user set which variables are to be displayed on the home page and the front panel.

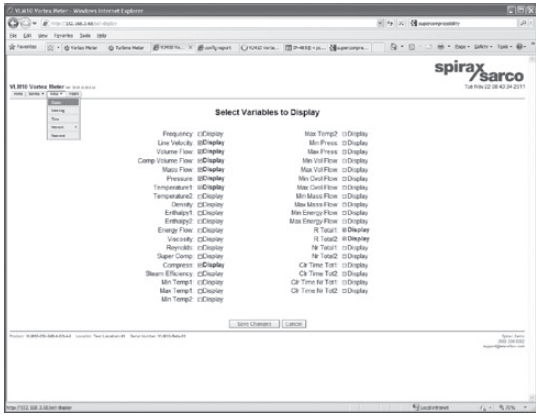


Fig. 70

6.16 Setup - Data Log

The Setup Data Log page lets the user select which variables are to be saved in the log file.

The user can also select the log time interval from 30 minutes to 31 days.

• Delay24hr - enables a delay of 24 hours before logging begins.

• Linewrap - enables the meter to over-write the top of the file when the log file reaches the end.

A chart at the bottom of the page provides an estimate of how much data can be saved based on the log interval.

After the Save Changes button is selected, the flowmeter will restart.

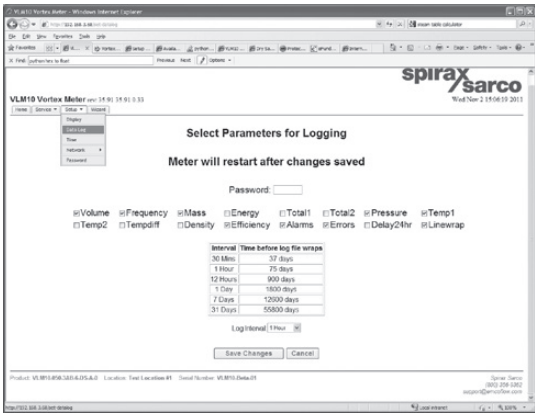


Fig. 71

6.17 Setup – Time

System time is adjusted from the Setup / Time page.

Note that after the update button is clicked, the flowmeter will restart.

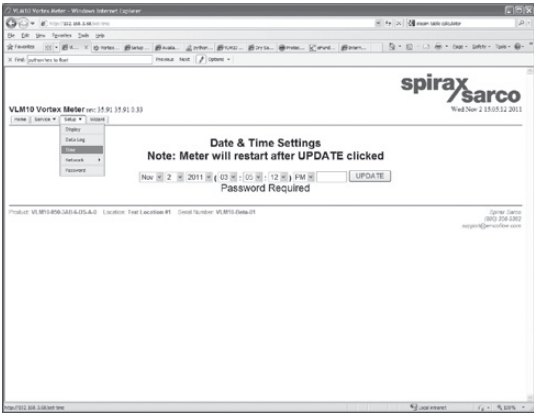


Fig. 72

6.18 Setup – Network Ethernet

The Ethernet interface configuration page:

This is where the user enters the Hostname, static IP address, netmask, and gateway. The flowmeter IP address is also displayed on the front panel on the third line of the start-up screen as IP Addr: xxx.xxx.xxx.xxx.

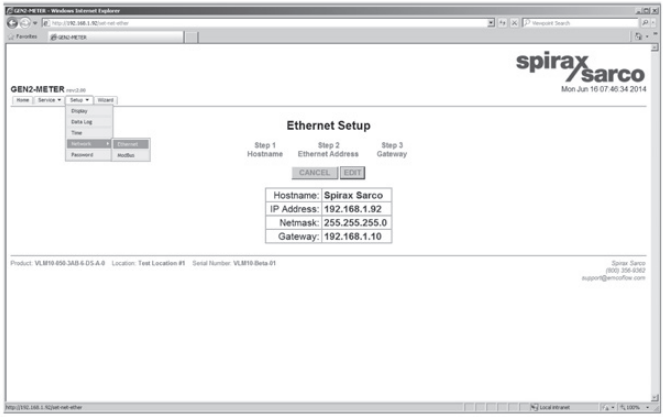


Fig. 73

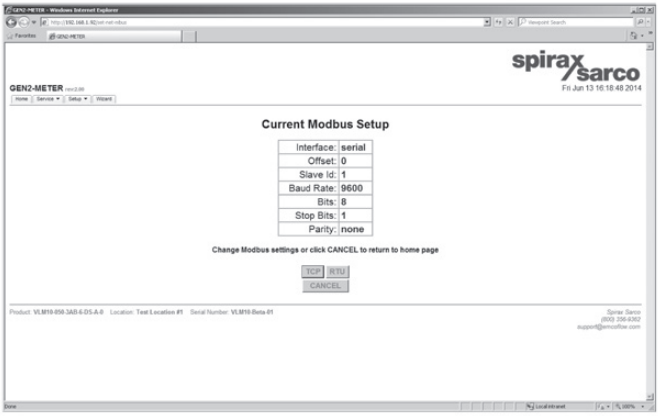
6.19 Setup – Network Modbus

If the Modbus interface option has been purchased, the Setup / Modbus tab is visible.

The VLM10 and RIM10 supports Modbus over TCP / IP and RTU (RS-485).

Unit - requires the user to set the Modbus unit number if the flowmeter is installed on an RS-485 network with other Modbus devices.

Fig. 74



6.20 Setup – Modbus TCP

If TCP is selected, it is only necessary to check the port number. Usually, port 502 is dedicated to the Modbus TCP / IP interface and needs not be changed. The flowmeter IP address and the port number are all that is necessary. Note that the flowmeter will restart after the Modbus setup is complete and the ok button clicked.

Offset - allows the user to 'adjust' the actual Modbus register addresses by subtracting the offset from the original address. As an example, the default address of the line velocity register is 41000, and the volume is at address 41002. If the offset is set to 41000, then the address the Modbus master should use to read the line velocity would be 0. The volume would then be accessed at address 2, etc.

Fig. 75

6.21 Modbus RTU Setup

User must define the serial port parameters (Baud Rate, Number of Bits, Stop Bits, and Parity).

The default settings are shown below:

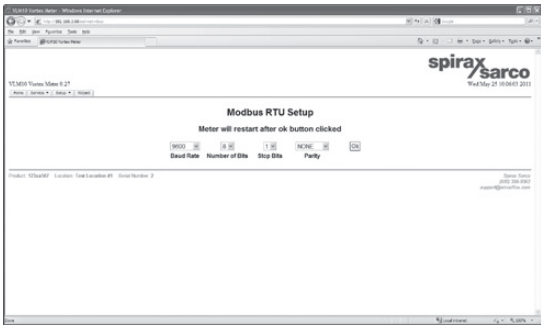


Fig. 76

Note that because BACnet MS/TP and Modbus RTU share the same RS-485 port (P9 on the terminal board) it is not possible to use both simultaneously.

6.22 Network - BACnet

If the BACnet interface option has been purchased, the Setup/BACnet tab is visible.

The BACnet setup page lets the user view and modify the Station ID, Device Instance and Max Masters parameters.

Station ID - is a local address, used to link physical devices. It is comparable to the Modbus RTU slave address.

Device Instance - is the logical address that must be unique in the entire BACnet network.

Max Masters - defines the highest MAC address on the BACnet network.

The default Max masters value is 127, but if all MACs are known on the network, then this value can be set to the device with the highest MAC address to improve communication performance.

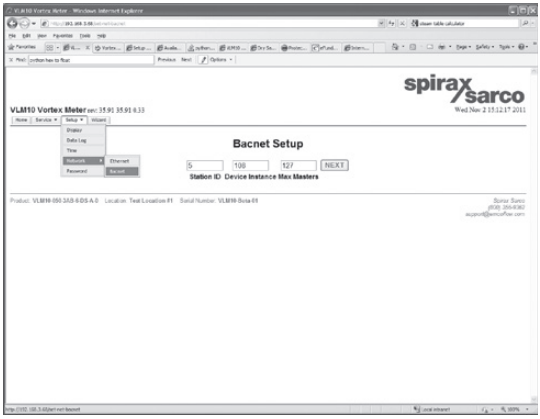


Fig. 77

6.23 Network - BACnet

BACnet MS/TP Setup - The final BACnet setup page is similar to the Modbus RTU setup (Baud Rate, Number of Bits, Stop Bits, and Parity).

Note that because BACnet MS/TP and Modbus RTU share the same RS-485 port (P9 on the terminal board) it is not possible to use both simultaneously.

Fig. 78

6.24 Network - Password

Set Password – this allows the user to change the system password. The password can only be a 6-digit number, and the default password is 000000.

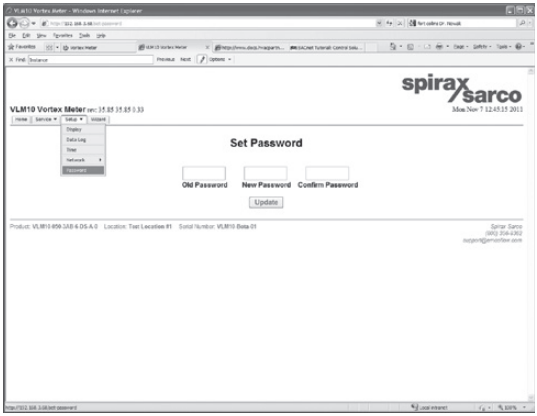


Fig. 79

6.25 Wizard

The Setup Wizard starts the flowmeter configuration utility. This utility takes the user through a series of 5 steps to ensure a correct configuration.

The first page asks the user to load a previously saved configuration to modify.

The Current selection is the configuration currently being used by the flowmeter.

The Default selection will load in the original factory settings. User 1 and User 2 are for user customized settings.

When using the Setup Wizard and if no changes are required in that Step, the user may select 'Next' to move to the next step in the Setup Wizard.

Note: None of the changes made in the Setup Wizard will take effect until the Setup is saved. Saving occur after Step 5 of the Setup Wizard.

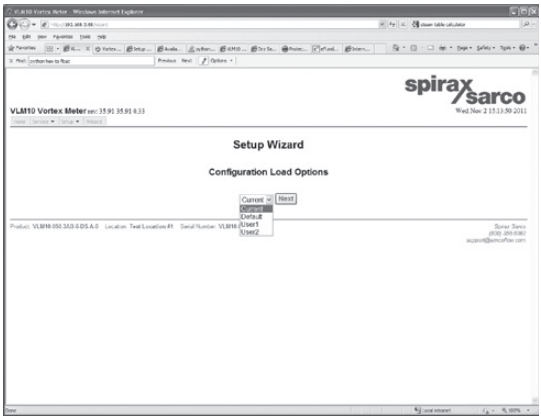


Fig. 80

6.26 Wizard

Step 1 – Meter

The flowmeter's Location, Tag and Pipe Diameter are shown on the top of the page.

Location and Tag can be modified on this page by moving the cursor to the appropriate text and changing the text.

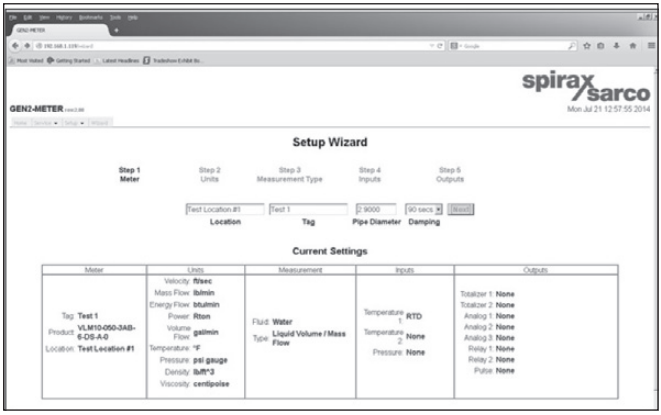


Fig. 81

If using a VLM10 the Diameter is for reference only. It is set at the factory based on the size of flow tube being used. It is grayed out and cannot be updated. If for the RIM10 the Pipe Diameter is set at the factory but can be configured in the field.

The Current Settings chart summarizes the Meter, Units, Measurement, Inputs and Outputs that the flowmeter is currently set.

6.27 Setup Wizard

Step 2 - Units

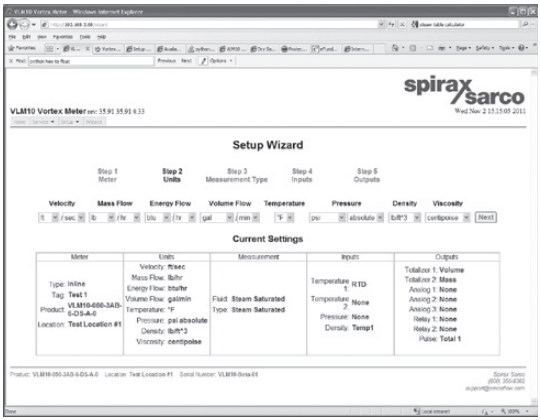
Allows the user to choose the appropriate engineering units and time element for all variables shown on the web page, front panel and outputs.

The defined units are:

- **Velocity** – engineering unit and time element
- **Mass Flow** – engineering unit and time element
- **Energy Flow** – engineering unit and time element
- **Power -** engineering unit
- **Volume Flow** – engineering unit and time element
- **Temperature** – engineering unit
- **Pressure** – engineering unit, absolute or gauge
- **Density** – engineering unit
- **Viscosity** – engineering unit

There is a drop down menu for each engineering and time element.

Fig. 82



Selecting the Next button will advance to Step 3 Measurement Type.

Step 3 - Measurement Type

The flowmeter has 6 measurement types and each requires specific variables in order to properly calculate flow.

The Measurement Types and required input variables are:

- **Steam Saturated** – temperature or pressure
- **Steam Superheated** – temperature and pressure
- **Simple Steam Efficiency** – two temperatures
- **Gas Volume / Mass Flow** – temperature and pressure
- **Liquid Volume / Mass Flow** – temperature
- **Liquid Energy** – two temperatures

Step 3 - Saturated Steam
For the Saturated Steam setup, the wizard asks the user to pick which sensor will calculate fluid density.

The Wizard then asks the user to select whether the user wants to use Pressure or Temperature to calculate fluid density.

Note: All VLM10 and RIM10 flowmeters have an internal RTD, which can be used as the temperature input if the user does not want to use an external sensor to calculate the fluid's density. Continuing the Saturated steam setup, the wizard will now ask the user to pick the temperature input.

Fig. 83

There are four Temperature options:

None - The flowmeter will need to use pressure to calculate the density

Substitute – The user enters the temperature value manually and the flowmeter will calculate density based on this value. This is not recommended because a steam system's temperature is not static.

RTD - The flowmeter will calculate the density based on the internal temperature sensor.

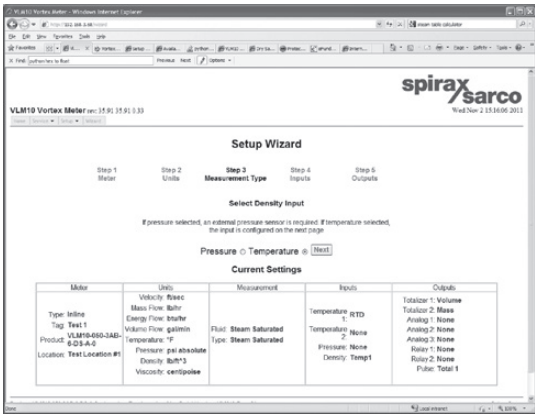


Fig. 84

Ch1 4 - 20 mA - The user needs to connect the temperature sensor to Channel 1 4 - 20 mA input, and define the minimum temperature in °F (4 mA) and the maximum temperature in °F (20 mA). The 4 mA should be set to 0 and the 20 mA to the maximum measurable temperature indicated on the temperature transmitter.

Ch2 4 - 20 mA - the user needs to connect the temperature sensor to Channel 2 4 - 20 mA input, and define the minimum temperature in °F (4 mA) and the maximum temperature in °F (20 mA). The 4 mA should be set to 0 and 20 mA to the maximum measurable temperature indicated on the temperature transmitter.

If pressure is selected, there is a drop down menu with 2 pressure options:

Step 3 - saturated steam

Substitute – The user enters the pressure value manually and the flowmeter will calculate density based on this value. This is not recommended because a steam system's pressure is not static.

Ch1 4-20 mA - the user needs to connect the pressure sensor to Channel 1 4-20 mA input, and define the minimum pressure in psi g (4 mA) and the maximum pressure in psi g (20 mA). The 4 mA should be set to 0 and the 20 mA to the maximum measurable pressure indicated on the pressure transmitter.

Ch2 4-20 mA - Channel 2 if for temperature transmitter inputs only.

The Wizard will not move onto the next step until a Temperature or Pressure option is selected.

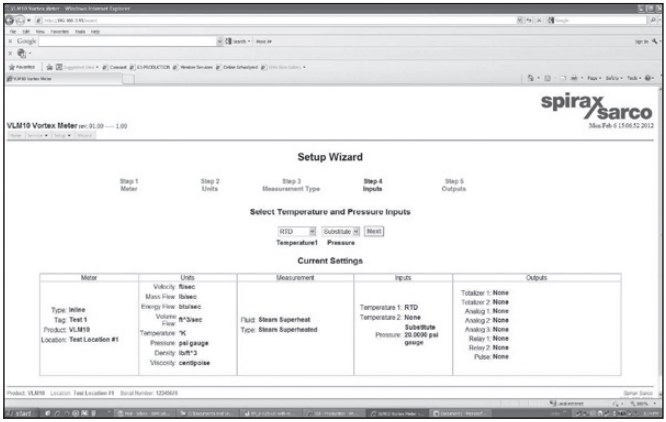
When temperature is finalized select Next to go to Step 5 Outputs.

Step 3 - Superheated Steam
Choosing the Superheated Steam measurement type will bring up a page that will ask the user to select a temperature and a pressure input.

There is a drop down menu for both the Temperature and Pressure inputs which must be selected prior to moving to the next step.

Clicking on the Next button will present the user with the configure temperature and pressure inputs page.

Fig. 85

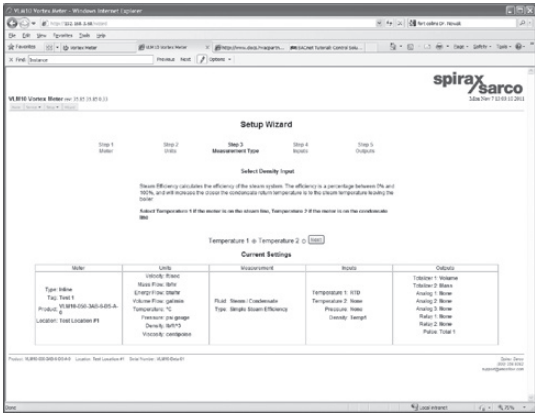


Step 3 - Simple Steam Efficiency
Simple Steam Efficiency calculates the efficiency of the steam system by measuring the steam temperature and the condensate return temperature. The efficiency is a percentage between 0% and 100%, and will increase as the condensate return temperature approaches the steam temperature.

Choosing the Simple Steam Efficiency measurement type will bring up a page that will ask the user to select which temperature input will be used for the density calculation.

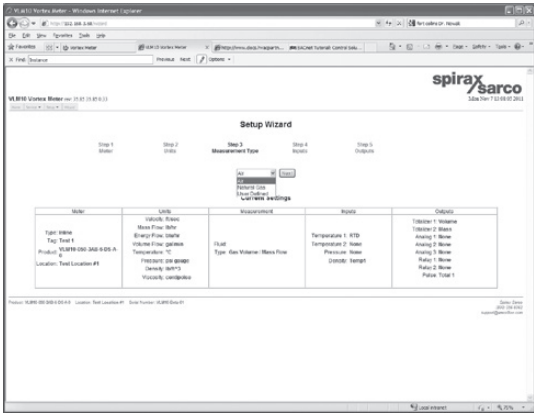
Clicking on the Next button will ask the user to configure the two temperature inputs.

Fig. 86



Step 3 - Gas Volume / Mass flow - Air
Choosing the Gas Volume / Mass flow measurement type will bring up a page that will ask the user to select what type of gas is being measured. If air is selected, clicking on the Next button will ask the user to configure the temperature and pressure input.

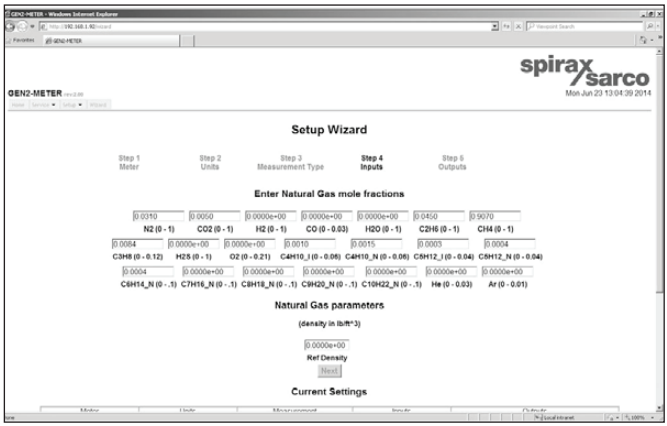
Fig. 87



Step 3 - Gas Volume / Mass flow – Natural Gas

Choosing the fluid as Natural Gas will bring up a page that will ask the user to enter the mole fractions of the natural gas mixture. Note that the total of all 21 parameters must equal 1.0. It is acceptable to leave fields with a value of 0.0 as long as the sum of all is 1.0. Clicking on the Next button will ask the user to configure the temperature and pressure input.

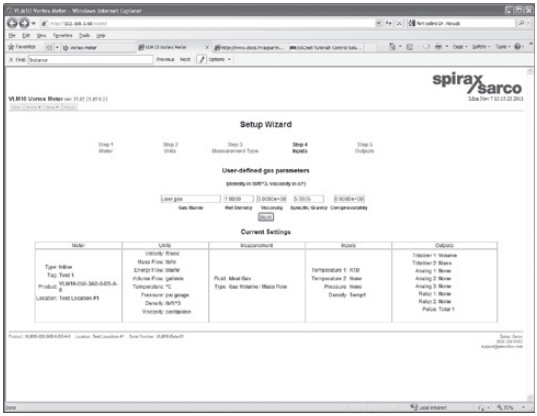
Fig. 88



Step 3 - Gas Volume / Mass flow – User Defined

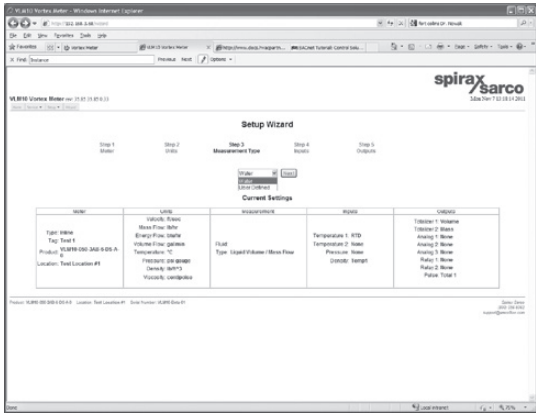
Choosing the fluid as User Defined will bring up a page that will ask the user to enter the User gas name, reference density, viscosity, specific gravity, and compressibility of the gas mixture. Clicking on the Next button will ask the user to configure the temperature and pressure input.

Fig. 89



Step 3 - Liquid Volume / Mass flow – Water
Choosing the Liquid Volume / Mass flow measurement type fluid and fluid type as Water and clicking on the Next button will ask the user to configure the temperature input.

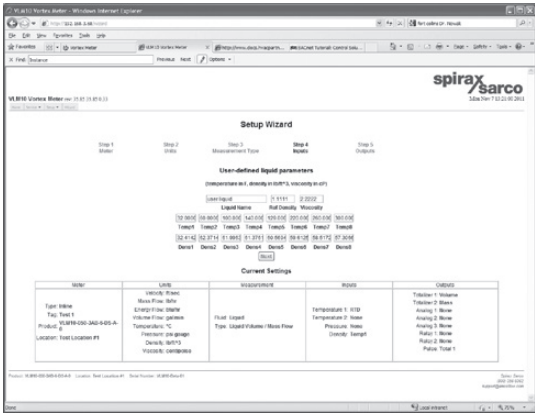
Fig. 90



Step 3 - Liquid Volume / Mass flow – User Defined
Choosing the Liquid Volume / Mass flow measurement type fluid and fluid type as User Defined will take the user to a screen that will ask for the Liquid name, reference density, viscosity, and a set of eight temperature / density pairs.

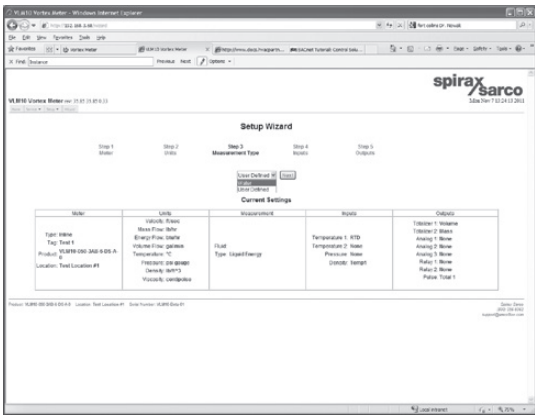
Clicking on the Next button will ask the user to configure the temperature input.

Fig. 91



Step 3 - Liquid Energy – Water
Choosing the Liquid Energy measurement type fluid and fluid type as Water and clicking on the Next button will take the user to a page that will ask the user to choose which temperature input will calculate the water density.

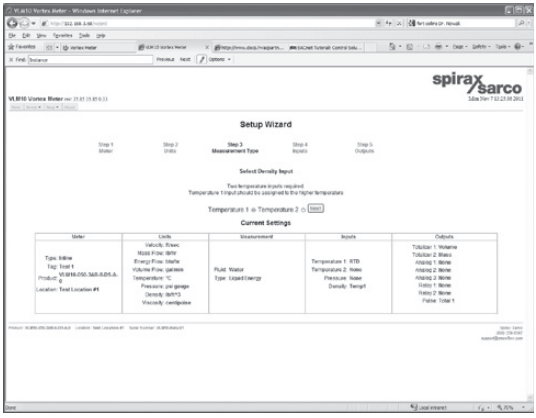
Fig. 92



Step 3 - Liquid Energy – Water
Choosing the Liquid Energy measurement type fluid and fluid type as Water will take the user to a screen that will ask the user to select the temperature input for the density calculation.

Clicking on the Next button will ask the user to configure the two temperature inputs.

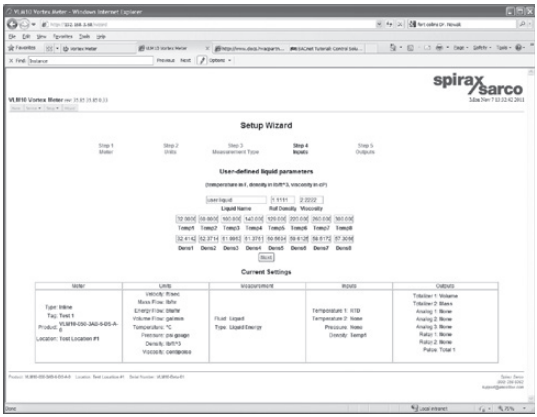
Fig. 93



Step 3 - Liquid Energy – User Defined
Choosing the Liquid Energy measurement type fluid and fluid type as User Defined will take the user to a screen that will ask for the Liquid name, reference density, viscosity, and a set of eight temperature / density pairs.

Clicking on the Next button will ask the user to configure the temperature input.

Fig. 94

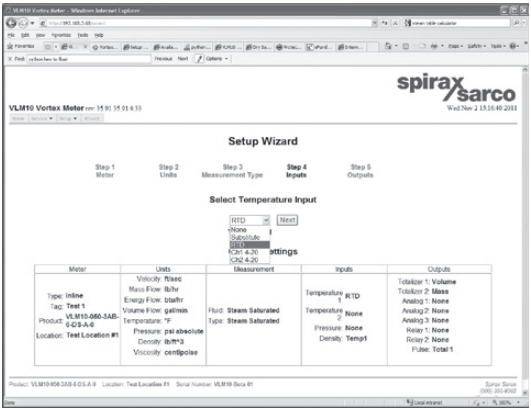


Step 4 – Inputs

Temperature Input
This screen shows the options available for a single temperature input.

Clicking on the Next button will take the user to a pressure input configuration if required, or if there is no pressure the Wizard will go to Step 5 Outputs.

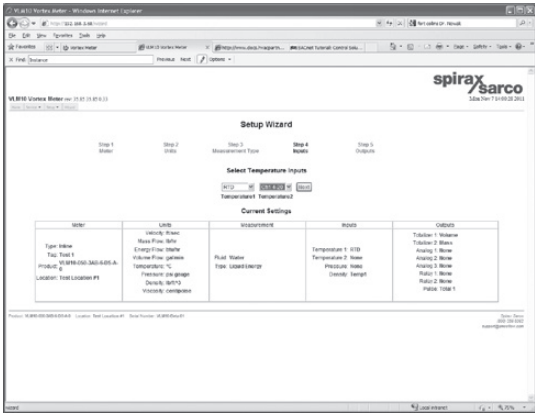
Fig. 95



Step 4 - 2 Temperature Inputs
This screen shows the options available for two temperature inputs.

Clicking on the Next button will take the user to Step 5 Outputs.

Fig. 96



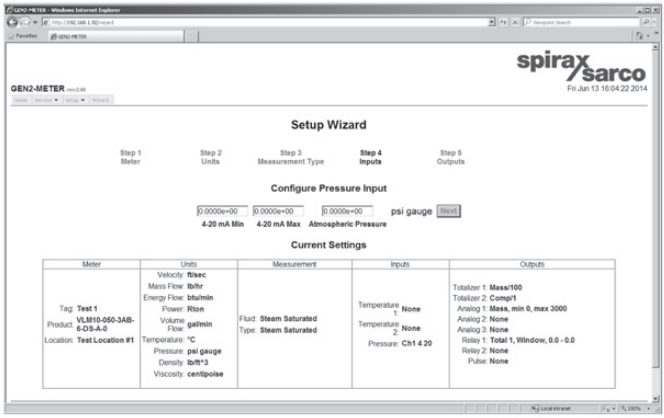
Step 4 - Pressure Input
This screen Configures a 4 - 20 mA pressure input.

Note: The engineering unit for the pressure input is set in Step 2 Units of the Setup Wizard.

The minimum input (or 4 mA) must always be set to 0 (zero), and the 20 mA (Max) is set to the maximum measurable pressure indicated on the pressure transmitter.

Clicking on the Next button will take the user to the Step 5 Outputs.

Fig. 97



Step 5 – Outputs

At this step the user configures the various outputs.

Guides the user through configuration of the following outputs:

- Totalizer 1
- Totalizer 2
- 1 Analog output Standard (Analog 1). Optional 3 analog outputs (Analog 1, Analog 2, Analog 3)
- 2 Relay outputs (if electronics option purchased)
- Pulse output

The Totalizers, 1 analog outputs, and the pulse output are all available in the standard configuration.

If the relay / alarm / scaled pulse option has been purchased, then the 2 alarm options are editable.

Totalizers

This example shows the options available for the Totalizers. A selection of None disables the selected output.

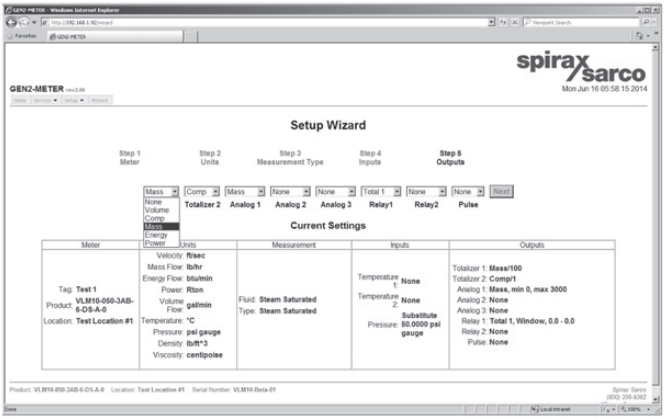


Fig. 98

Step 5 - Totalizers – Scale factor
At this step the user sets a scale factor to the totalizer counters. The scale factor is the volume, mass, or energy represented by one count of the totalizer.

For example, if the totalizer is configured to accumulate mass flow in pounds, and the scale factor is set to 100, then each increment of the totalizer represents 100 pounds of fluid. Both settable and non-resettable totalizers use the same scale factor.

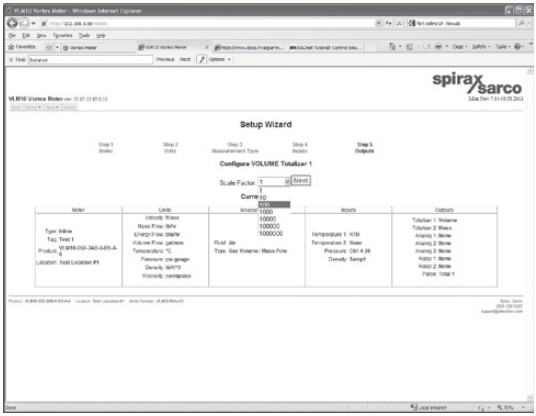


Fig. 99

Step 5 - Analog outputs
The 4 - 20 mA Analog output selections are shown next.

Selecting 'None' will disable the output and force the un-configured output channel current to 4.00 mA.

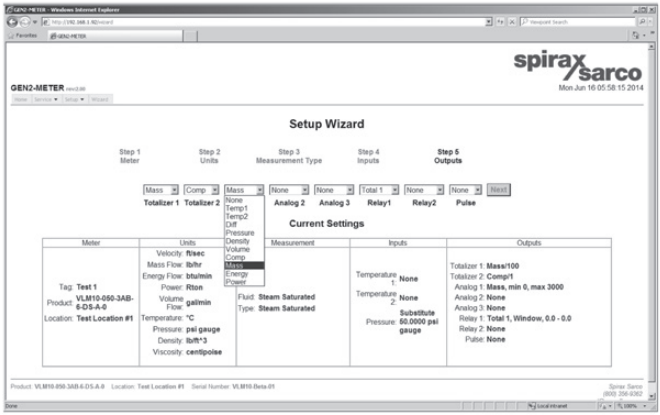


Fig. 100

Step 5 - Analog outputs
Following the selection of an output channel, minimum and maximum values are set. The minimum value is mapped to 4.0 mA and the maximum value mapped to 20.0 mA.

Note: The minimum value (or 4 mA) must always be set to 0 (zero).

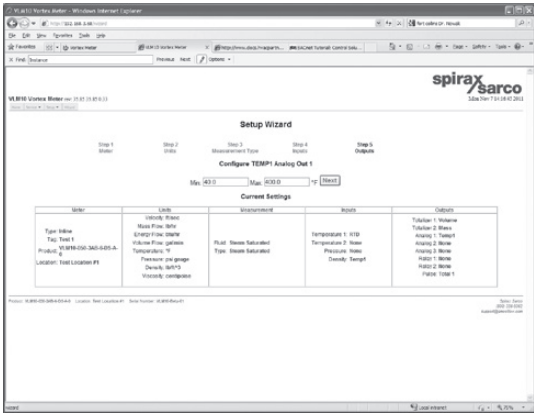


Fig. 101

Step 5 - Relay / Alarm / Scaled Pulse outputs
The relay / alarm / scaled pulse setup, if enabled, lets the user actuate the relay based on a number of different input values.

Note that the relay can be disabled or forced on or off. An upcoming page will detail the other alarm settings.

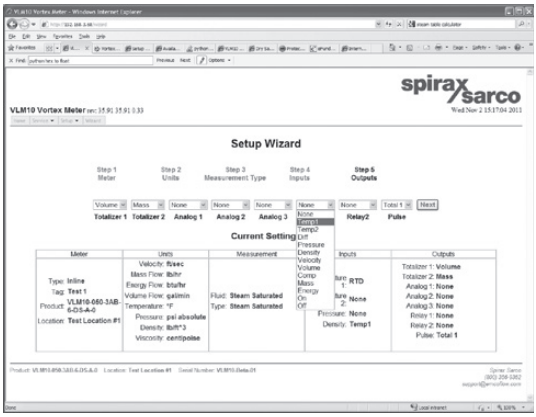


Fig. 102

Step 5 - Relay / Alarm outputs – type
The type of relay alarm defines the way in which the relay activates:

Low setting - means that the relay will close when the value falls below the set-point.

High setting - means the relay will close when the value is above the set-point.

Step 5 - Window setting - means the relay will close when the assigned value is above or below the high and low set-points.

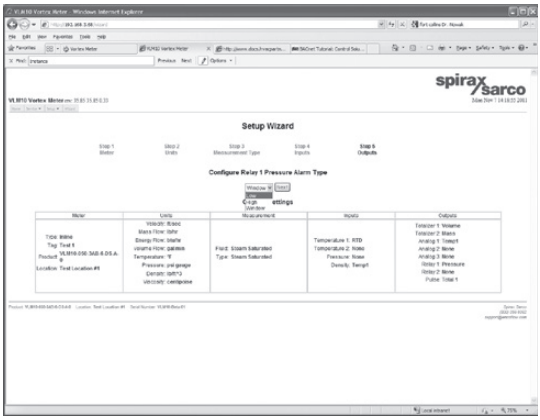


Fig. 103

Step 5 - Relay / Alarm outputs – set-point and hysteresis
This page lets the user enter the set-point and hysteresis for the selected relay / alarm. In this example, relay 1 has been configured to activate if the pressure drops below 5.0 psi. The hysteresis value of 1.0 means the relay cannot de-activate until the pressure rises to 4.0 psi. This prevents relay 'chatter' if the selected alarm value stays near the set-point.

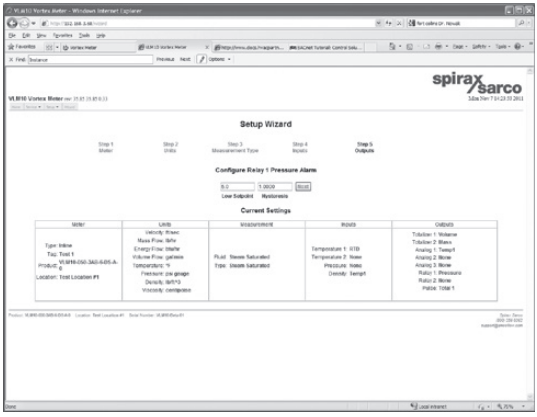


Fig. 104

Step 5 - Relay and pulse output
The pulse output setup lets the user select which of the 2 totalizer counters control the pulse output.

Clicking 'Next' takes the user to the pulse output polarity setting.

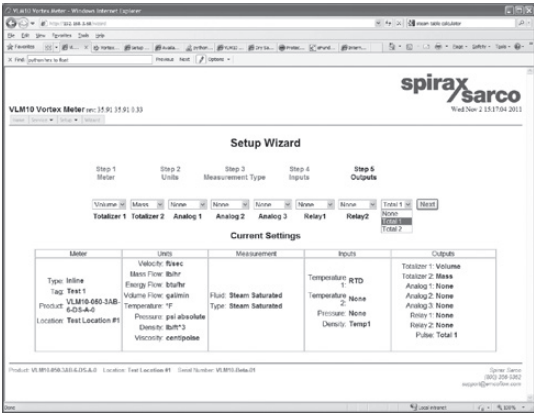


Fig. 105

Step 5 - Relay and pulse output – polarity and width
The relay and pulse output setup lets the user set the way the relay actuates when the totalizer it's assigned to increments. Negative pulse causes the relay N.O. contacts to close for 50 ms, then open when totalizer 2 increments by one. The positive pulse causes the relay N.O. contacts to open for 50 ms when totalizer 2 increments. The Transition setting causes the relay N.O. contacts to toggle each time the totalizer increments. Note that the transition setting doesn't use the Width value. The available pulse widths are 50 ms, 500 ms, 1 sec, and 5 sec. Also note that if the pulse width is set too long, and the totalizer is incrementing too fast, a pulse output overflow error will result. To clear this error, the totalizer scale should be increased, or the pulse output width decreased.

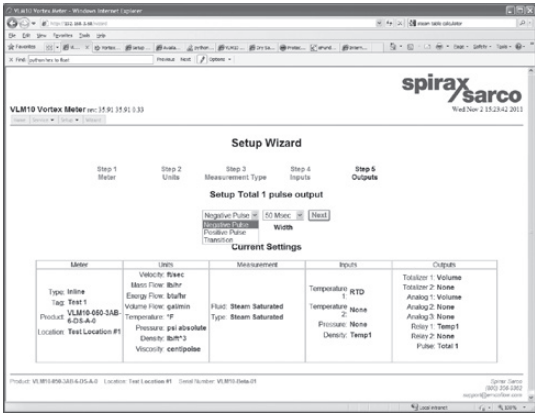


Fig. 106

6.28 Configuration save options

The final wizard setup step is the saving of the configuration to the selected file.

Note that Current, User 1 and User 2 files are available.

After entering the password and selecting 'Save', the flowmeter will save the new configuration, and return to the home page. Setup is now complete.

If 'Don't Save' is selected, none of the changes made in the Setup Wizard will be saved and the flowmeter will continue to use the original Setup.

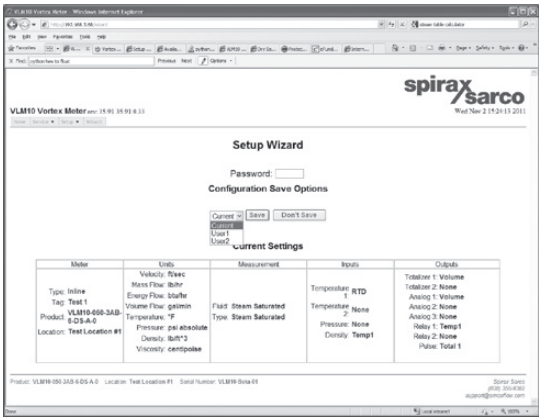


Fig. 107

7. MODBUS

7.1 Introduction

Modbus is a serial communication protocol commonly used in industrial applications.

It allows communications between many devices and is typically used to transmit data from instruments or control devices back to a main controller or data gathering system.

The Modbus implementation for the VLM10 and RIM10 allows the user to view and modify flowmeter parameters. Appendix A lists the available Modbus registers. Modbus uses a Master / Slave communication scheme. The VLM10 and RIM10 is always the Modbus slave. The customer must provide the Modbus Master. A Modbus Master we've used for testing is available at http://www.simplymodbus.ca. The initial free version allows a limited number of uses before a restart is required.

7.2 Supported Modbus protocols

The VLM10 and RIM10 supports two types of Modus communications.

(1) Modbus TCP / IP.

(2) Modbus RS-485. (RTU)

7.3 Configuration:

Configuration of the VLM10 and RIM10 for Modbus consists of software setup and wiring.

(1) **Software:** Front Panel interface, select 'Service / Setup Network / Modbus'. Web Page interface, select 'Setup / Network / Modbus'. Select 'TCP' for Ethernet or 'RTU' for RS-485. Be sure to save when done. See Section 6 Web server interface for web page screen shots. The Front Panel and Web page interface documentation provides details on the flowmeter operation.

Note: Always power-cycle the flowmeter after making any changes to the Modbus configuration.

(2) **Wiring:** TCP / IP requires connecting an Ethernet cable from the flowmeter to a PC / Controller or network. RS-485 requires wiring from the terminal block of the flowmeter to a PC / Controller. A termination jumper is provided if the unit is the last device in the RS-485 network. See Section 4 for details of the wiring diagram.

7.4 Operation:

All registers are readable. Only the totalizer registers allow writes (to clear)

The following operations are required to perform a read operation using Modbus:

1. Start the Modbus master program, and verify connectivity to the flowmeter. If using TCP / IP, verify the IP address, unit, port number and offset. For RTU, check the RS-485 serial parameters, unit number, and offset.
2. Select a register from the Modbus register list. Appendix A contains the registers whose values are converted to the user-selected units. Appendix B contains register values with the fixed, default units.
3. Read the register from the master. Note: Reading or writing a Modbus register typically requires specifying the slave device ID code, function code, register address, and the number of registers to access. Appendixes A and B contain the default register map. Note that the actual register address required is the default address – the offset value. For example, if the Modbus offset is set to 0, then the register addresses are exactly as shown in the appendix table. If an offset of 41000 is configured, then the addresses all start at 0. The user can use any offset. Two registers are not affected by the offset: Flowmeter name (4101) and Flowmeter serial number (4242).
4. The Modbus data packets are transferred as 2, 16-bit words, low word / high word, low byte / high byte. The Modbus master program must ensure that the 2 bytes that form the 16-bit words are ordered as high byte / low byte or Big-endian. See Appendix D

7.5 Modbus RTU read example:

Read float 4.560085 from holding register 41000 with an offset of 0.

Command: (from Master)

Field Name	Hex value
Slave ID	01
Function	03
Address byte Hi	A0
Address byte Lo	28
Bytes to read Hi byte	00
Bytes to read Lo byte	02
CRC Hi byte	66
CRC Lo byte	03

Response: (from VLM10 and RIM10)

Field Name	Hex value
Slave ID	01
Function	03
Byte Count	04
Data Hi (41000)	40
Data Lo (41000)	91
Data Hi (41000)	EC
Data Lo (41000)	38
CRC Hi byte	0C
CRC Lo byte	00

The returned 4 bytes will be in the order: 0x38 0xEC 0x91 0x40.
To get the correct value of 4.560085 the bytes must be ordered as:
0x40 0x91 0xEC 0x38.

7.6 Appendix A: Modbus user units register table

Register Name	Not Word Swapped Address	Word Swapped Address	R/W	Type	Bytes	Description
Flowmeter Name	4101	N/A	R	Char	18	String describing flowmeter
Flowmeter Serial Number	4242	N/A	R	Char	18	String describing serial number
Calculated Velocity	41000	41300	R	Float	4	Line velocity [user units]
Volumetric Flow	41002	41302	R	Float	4	Volumetric flow rate [user units]
Pipe ID	41004	41304	R	Float	4	Pipe inside diameter [inches]
Resettable Totalizer #1	41006	41306	R/W	Unsigned Integer	4	Resettable totalizer, reset by writing 0 to this register
Resettable Totalizer #2	41008	41308	R/W	Unsigned Integer	4	Resettable totalizer, reset by writing 0 to this register
Temperature Input #1	41010	41310	R	Float	4	Temperature input 1 [user units]
Temperature Input #2	41012	41312	R	Float	4	Temperature input 2 [user units]
RTD Temperature	41014	41314	R	Float	4	RTD sensor temperature [user units]
Differential Temperature	41016	41316	R	Float	4	Difference between temperature 1 and temperature 2, [user units]
Pressure	41018	41318	R	Float	4	Pressure [user units]
Compensated Volume Flow	41020	41320	R	Float	4	Compensated volume flow based on a reference density, [user units]
Mass Flow	41022	41322	R	Float	4	Mass flow rate [user units]
Energy Flow	41024	41324	R	Float	4	Energy flow rate [user units]
Density	41026	41326	R	Float	4	Density [user units]
Viscosity	41028	41328	R	Float	4	Viscosity [user units]
Non-resettable Totalizer #1	41030	41330	R	Unsigned Integer	4	Non resettable totalizer
Non-resettable Totalizer #2	41032	41332	R	Unsigned Integer	4	Non resettable totalizer
Flow Sensor Frequency	41034	41334	R	Float	4	Frequency of sensor signal [Hz]
Fault Code	41036	41336	R	Unsigned Integer	4	System faults, 0 indicates no active faults. See Appendix for fault code definitions
Power	41038	41338	R	Float	4	Power [user units]
Flow Direction	41040	41340	R	Unsigned Integer	4	Direction of flow, bi-directional mode only. 0 = forward, 1 = reverse

Note: The procedure to offset the Modbus Register can be found in the network setup portion of the Web server.

7.7 Appendix B: Modbus core value register table

Register Name	Not Word Swapped Address	Word Swapped Address	R/W	Type	Bytes	Description
Calculated Velocity	41200	41400	R	Float	4	Line velocity [ft/sec]
Volumetric Flow	41202	41402	R	Float	4	Volumetric flow rate [ft^3/sec]
Temperature Input #1	41204	41404	R	Float	4	Temperature input 1 [F]
Temperature Input #2	41206	41406	R	Float	4	Temperature input 2 [F]
RTD Temperature	41208	41408	R	Float	4	RTD sensor temperature [F]
Differential Temperature	41210	41410	R	Float	4	Difference between temperature 1 and temperature 2, [F]
Compensated Volume Flow	41212	41412	R	Float	4	Compensated volume flow based on a reference density, [ft^3/sec]
Pressure	41214	41414	R	Float	4	Pressure [psi absolute]
Mass Flow	41216	41416	R	Float	4	Mass flow rate [lbs/sec]
Energy Flow	41218	41418	R	Float	4	Energy flow rate [btu/sec]
Density	41220	41420	R	Float	4	Density [lb/ft^3]
Viscosity	41222	41422	R	Float	4	Viscosity [cP]
Enthalpy 1	41224	41424	R	Float	4	Enthalpy based on temperature 1, [btu/lb]
Enthalpy 2	41226	41426	R	Float	4	Enthalpy based on temperature 2, [btu/lb]
Gas Compressibility	41228	41428	R	Float	4	Compressibility
Super Compressibility	41230	41430	R	Float	4	Super compressibility

Example - Word swap

Float =	2.9	1	8	23
ieee-754 32-bit Hex =	0x4039999a	Sign	Exponent	Significand
		0	1E+07	1.01110011001100000000000
Value =	± Significand x 2(Exponent-127)			
Quasi Big-Endian Range =	0x39409a99	(byte swapped)... must still be stored at 16-bit addresses in little endian		
Little-Endian Range =	0x9a993940	(byte and word swapped)... true little endian		

Float Dec =	20.3	
ieee-754 32-bit Hex =	0x41a26666	
20.3/2/2/2/2 = 1.26875		Exponent = exp + 127 = 131
exp = 4 (4 divide by 2s)		131 dec --> 10000011 --> 128 + 2 + 1
Significand = 1.26875 = 20.3/2^4		Significand --> 1.010001... --> 1.(1/4 + 1/64 + ...)

7.8 Appendix C: Fault codes

This table defines the meaning of the bits in the faults register. The order is in Little- Endian, which means the least significant bit is on the right side, the most significant is on the left.

Fault code bit position	Fault description
0	DSP 1 (hardware failure)
1	DSP 2 (hardware or remote communications failure)
2	RTC (real-time clock failure)
3	Back-up RAM (corrupt memory)
4	Back-up EEPROM (corrupt memory)
5	Keypad (communication failure with keypad module)
6	Internal RTD sensor (connection failure to temperature senor in stem)
7	Pulse output overflow (configuration problem)
8	Analog output 1 (configuration problem)
9	Analog output 2 (configuration problem)
10	Analog output 3 (configuration problem)
11	Analog input 1 (configuration problem)
12	Analog input 2 (configuration problem)
13	Internal temperature (PCB temperature exceeds maximum)
14	Configuration (configuration problem)
31 - 15	Unused, always zero

— 8. Bacnet Protocol Implementation — conformance statement

spirax sarco

2nd Generation Meter

BACnet Protocol Implementation Conformance Statement

(PICS)

Document ID:
Creation Date: 2014-06-19
Last Revision Date: 2014-06-24
Version: .2
Status: Draft

Document Revision History

Revision	Date	Reason	Author
Draft 0.1	19 June, 2014	Initial Version	E. Herrera
Draft 0.2	24 June, 2014	Removed naming of any products. Added "Resettable" to totalizers description.	E. Herrera

Table of Contents

1 Introduction

1.1 Purpose

This document details the BACnet PICS requirements for all BACnet devices. The purpose of this document is to fill the BACnet requirements for Spiraqx Sarco/Emco flow meter GEN2 product line. This document will be used to specify data points that are currently supported in the GEN2 product line.

1.2 Reference Documents

1. Internal Documents
   - Marketing Requirements Document (MRD) for this product.
   - Engineering Requirements Specification (ERS) for this product
   - VLM 10 BACnet Inputs Software Development Document
   - Oasis BACnet Unit Testing Sudo Code Text File
2. External Documents and Web links
   - 135-2008-ANNEX-A-rev-2010-11-02.doc
     - http://www.bacnet.org/DL-Docs/index.html
   - Conformance to BACnet (The Old Idea)
     - http://www.polarsoft.biz/conform.html
   - Achieving BACnet Compliance
     - http://www.ccontrols.com/pdf/Extv8n6.pdf
   - BACnet®—A Data Communication Protocol for Building Automation and Control Networks
     - http://www.bacnet.org/Addenda/Add-2001-135d.pdf

1.3 Scope

The scope of this document concerns the BACnet memory map for the GEN2 based products. It describes the major sections of BACnet PICS requirements: Product Description and Profile, BIBB, Standard Object Types Supported, Data Link Options, Address Binding and Network Options. . It does not describe how product is designed, does it calculations or process signals. .

1.4 How to Use This Document

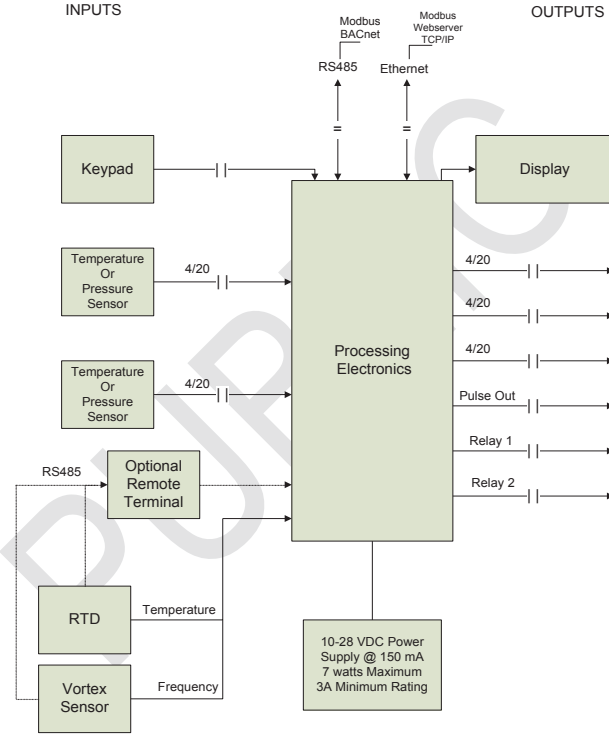
This document is attended for software and test developers that are crating BACnet applications and test cases.

2 BACnet PICS

Date: June 19, 2012
Vendor Name: Spirax Sarco
Product Name: 2nd Generation Meters
Product Model Number: n/a

Application Software Version: V2.00
Firmware Revision: VSBCS V2.71
BACnet Protocol Revision: 4

2.1.1 Product Block Diagram



2.1.2 Applications:

- Data Source for energy management system, DCS, district-wide systems.
- Energy-Customer Billing from accurately totalized flow measurements.
- Basis for internal cost distribution using campus-wide systems.
- Process monitoring from central control rooms.
- Direct Steam measurements at both Boiler and point of use locations.
- Natural Gas measurements for Boiler fuel flow.

3 BACnet Standardized Device Profile

☐ **BACnet Operator Workstation (B-OWS)**
☐ **BACnet Advanced Operator Workstation (B-AWS)**
☐ **BACnet Operator Display (B-OD)**
☐ **BACnet Building Controller (B-BC)**
☐ **BACnet Advanced Application Controller (B-AAC)**
■ **BACnet Application Specific Controller (B-ASC)**
☐ **BACnet Smart Sensor (B-SS)**
☐ **BACnet Smart Actuator (B-SA)**

3.1 Building Blocks Supported

List all BACnet Interoperability Building Blocks Supported:

BIBBs
DS-RP-B
DS-WP-B
DM-DDB-B
DM-DOB-B
DM-DCC-B

Services Supported	
Read Property	Execute
Write Property	Execute
Who-Is	Initiate / Execute
I-Am	Initiate / Execute
Who-Has	Execute
I-Have	Initiate
Device Communication Control	Execute

3.2 Segmentation Capability: (Not Supported)

☐ Able to transmit segmented messages Window Size N/A
☐ Able to receive segmented messages Window Size N/A

3.3 Standard Object Types Supported:

An object type is supported if it may be present in the device. For each standard Object Type supported provide the following data:

1) Whether objects of this type are dynamically creatable using the CreateObject service
2) Whether objects of this type are dynamically deletable using the DeleteObject service
3) List of the optional properties supported
4) List of all properties that are writable where not otherwise required by this standard
5) List of all properties that are conditionally writable where not otherwise required by this standard
6) List of proprietary properties and for each its property identifier, datatype, and meaning
7) List of any property range restrictions

Standard Object Types Supported				
Object Type	**Dynamically Creatable**	**Dynamically Delete-able**	**Additional Writable Properties**	**Range Restrictions**
Analog Input (AI)	no	no	none	none
Analog Value (AV)	no	no	none	none
Binary Value (BV)	no	no	none	none
Multi-State Value (MSV)	no	no	none	none
Device	no	no	none	none

Standard Object Types Supported Writable Properties			
Object Type	**Properties**		
Analog Input (AI)	Present Value		
Analog Value (AV)	Present Value	Relinquish Default	Out-Of-Service
Binary Value (BV)	Present Value	Out-Of-Service	
Multi-State Value (MSV)	Present Value	Relinquish Default	Out-Of-Service
Device			

3.3.1 Object List

3.3.1.1 Analog Input

Available Properties of Analog Input Objects	
Property	**Default Values**
Present Value	0
Status Flags	F,F,F,F
Event State	Normal
Out of Service	False

Analog Input Objects	
ID	**Object Name**
AI0	Volume Flow
AI1	Compensated Volume Flow
AI2	Mass Flow
AI3	Energy Flow
AI4	Pressure
AI5	Temperature 1
AI6	Temperature 2
AI7	Diff Temperature
AI8	Density
AI9	Line Velocity
AI10	Power

3.3.1.1 Analog Value

Analog Value Objects	
ID	**Object Name**
AV0	Resettable Totalizer 1
AV1	Resettable Totalizer 2

Properties of Analog Value Objects Type	
Property	**Default Values**
Present Value	0.0
Description	"None" *<will change to assigned data point>*
Status Flags	F,F,F,F
Event State	Normal
Out of Service	False
Units	No Units (95)
Priority Array	*<ALL NULLS>*
Relinquish Default	0.0

3.3.1.1 Binary Value

Binary Value Objects	
ID	**Name**
BV0	Watchdog Reset
BV1	Signal Board Communication
BV2	Configuration
BV3	RTC
BV4	Backup RAM
BV5	EEPROM
BV6	Keypad
BV7	RTD
BV8	Vortex Sensor
BV9	Pulse Output Overflow
BV10	Analog Output
BV11	Analog Input
BV12	Temperature
BV13	Pressure
BV13	Configuration Changed
BV15	Calibration Mode
BV16	Thread
BV17	Temperature 1 Min/Max Changed
BV18	Temperature 2 Min/Max Changed
BV19	Pressure Min/Max Changed
BV20	Volume Min/Max Changed
BV21	Volume Comp Min/Max Changed
BV22	Compressed Volume Min/Max Changed
BV23	Mass Min/Max Changed
BV24	Energy Flow Min/Max Changed
BV25	Totalizer 1
BV26	Totalizer 2
BV27	Analog In
BV28	Analog Out
BV29	Power Down

Properties of Binary Value Objects	
Property	**Default Values**
Present Value	Inactive
Status Flags	F,F,F,F
Event State	Normal
Out of Service	False
Time Delay	Normal
Notification Class	1
Alarm Value	ACTIVE
Event Enable	T,F,T
ACKed Transitions	T,T,T
Notify Type	ALARM
Event Time Stamps	2010/August/05, Thursday 10:10:00.00

3.3.1.1 Multi-State Value

Multi-State Value Objects			
ID	Name	# of States	State Text
MSV0	Velocity Units	4	FT,CM,M,IN
MSV1	Volume Units	8	FT3,CM3,GAL,BBL,CC,L,M 3,QT
MSV2	Mass Units	5	LB,TON,G,KG, MTON
MSV3	Energy Units	9	BTU,KG,CAL,KCAL,MCAL, TON,KW, MW,GW
MSV4	Volume Time Units	4	SEC,MIN,HR,DAY
MSV5	Mass Time Units	4	SEC,MIN,HR,DAY
MSV6	Energy Time Units	4	SEC,MIN,HR,DAY
MSV7	Temperature Units	4	K,C,R,F
MSV8	Pressure Units	5	PSI,ATM,BAR,KGCM3,MM HG
MSV9	Pressure Type	2	GUAGE, ABSOLUTE
MSV10	Density Units	3	LBFT3,GCC,KGM3
MSV11	Power Units	3	Rton, Kw, Mw, Gw

Properties of Multi-State Value Objects	
Property	Default Value
Present Value	1
Status Flags	F,F,F,F
Event State	Normal
Out of Service	False
# of States	
State Text	
Priority Array	*ALL NULLs
Relinquish Defaults	1

3.3.2 Device Specific Units Enumeration

- Enumerated values 0-255 are reserved for definition by ASHRAE.
- Enumerated values 256-65535 are user defined subject to the procedures and constraints described in Clause 23.

Extended Units Enum.		
Enum Value	**Enum Name**	**Unit Abbreviation**
256	BAPI_UNITS_POUNDS_PER_CUBIC_FOOT	
	/* Volume */	
258	BAPI_UNITS_QUART	
259	BAPI_UNITS_CUBIC_INCH	
260	BAPI_UNITS_BARREL	
261	BAPI_UNITS_CUBIC_CENTIMETER	
	/* Velocity */	
262	BAPI_UNITS_FEET_PER_HOUR	
263	BAPI_UNITS_FEET_PER_DAY	
264	BAPI_UNITS_METERS_PER_DAY	
265	BAPI_UNITS_CENTIMETERS_PER_SECOND	
266	BAPI_UNITS_CENTIMETERS_PER_MINUTE	
267	BAPI_UNITS_CENTIMETERS_PER_HOUR	
268	BAPI_UNITS_CENTIMETERS_PER_DAY	
269	BAPI_UNITS_INCHES_PER_SECOND	
270	BAPI_UNITS_INCHES_PER_MINUTE	
271	BAPI_UNITS_INCHES_PER_HOUR	
272	BAPI_UNITS_INCHES_PER_DAY	
	/* Energy */	
273	BAPI_UNITS_CALORIES	
274	BAPI_UNITS_KILOCALORIES	
275	BAPI_UNITS_MEGACALORIES	
276	BAPI_UNITS_GIGAWATT_HOURS	
	/* Temperature */	
277	BAPI_UNITS_DEGREES_RANKINE	
	/* Mass */	
278	BAPI_UNITS_GRAMS	
279	BAPI_UNITS_MEGATONS	
	/* Mass Flow */	
280	BAPI_UNITS_POUNDS_MASS_PER_DAY	
281	BAPI_UNITS_KILOGRAMS_PER_DAY	
282	BAPI_UNITS_TONS_PER_SECOND	
283	BAPI_UNITS_TONS_PER_MINUTE	
284	BAPI_UNITS_TONS_PER_DAY	
285	BAPI_UNITS_GRAMS_PER_HOUR	
286	BAPI_UNITS_GRAMS_PER_DAY	
287	BAPI_UNITS_MTONS_PER_SECOND	
288	BAPI_UNITS_MTONS_PER_MINUTE	
289	BAPI_UNITS_MTONS_PER_HOUR	
290	BAPI_UNITS_MTONS_PER_DAY	

	/* Energy Flow */	
291	BAPI_UNITS_BTUS_PER_SECOND	
292	BAPI_UNITS_BTUS_PER_MINUTE	
294	BAPI_UNITS_BTUS_PER_DAY	
295	BAPI_UNITS_KILOJOULES_PER_SECOND	
296	BAPI_UNITS_KILOJOULES_PER_MINUTE	
297	BAPI_UNITS_KILOJOULES_PER_HOUR	
298	BAPI_UNITS_KILOJOULES_PER_DAY	
299	BAPI_UNITS_CALORIES_PER_SECOND	
300	BAPI_UNITS_CALORIES_PER_MINUTE	
301	BAPI_UNITS_CALORIES_PER_HOUR	
302	BAPI_UNITS_CALORIES_PER_DAY	
303	BAPI_UNITS_KILOCALORIES_PER_SECOND	
304	BAPI_UNITS_KILOCALORIES_PER_MINUTE	
305	BAPI_UNITS_KILOCALORIES_PER_HOUR	
306	BAPI_UNITS_KILOCALORIES_PER_DAY	
307	BAPI_UNITS_MEGACALORIES_PER_SECOND	
308	BAPI_UNITS_MEGACALORIES_PER_MINUTE	
309	BAPI_UNITS_MEGACALORIES_PER_HOUR	
310	BAPI_UNITS_MEGACALORIES_PER_DAY	
311	BAPI_UNITS_TON_HOURS_PER_SECOND	
312	BAPI_UNITS_TON_HOURS_PER_MINUTE	
313	BAPI_UNITS_TON_HOURS_PER_HOUR	
314	BAPI_UNITS_TON_HOURS_PER_DAY	
315	BAPI_UNITS_KILOWATT_HOURS_PER_SECOND	
316	BAPI_UNITS_KILOWATT_HOURS_PER_MINUTE	
317	BAPI_UNITS_KILOWATT_HOURS_PER_HOUR	
318	BAPI_UNITS_KILOWATT_HOURS_PER_DAY	
319	BAPI_UNITS_MEGAWATT_HOURS_PER_SECOND	
320	BAPI_UNITS_MEGAWATT_HOURS_PER_MINUTE	
321	BAPI_UNITS_MEGAWATT_HOURS_PER_HOUR	
322	BAPI_UNITS_MEGAWATT_HOURS_PER_DAY	
323	BAPI_UNITS_GIGAWATT_HOURS_PER_SECOND	
324	BAPI_UNITS_GIGAWATT_HOURS_PER_MINUTE	
325	BAPI_UNITS_GIGAWATT_HOURS_PER_HOUR	
326	BAPI_UNITS_GIGAWATT_HOURS_PER_DAY	
	/* Volume Flow */	
328	BAPI_UNITS_CUBIC_FEET_PER_DAY	
329	BAPI_UNITS_US_GALLONS_PER_SECOND	
330	BAPI_UNITS_US_GALLONS_PER_HOUR	
331	BAPI_UNITS_US_GALLONS_PER_DAY	
332	BAPI_UNITS_LITERS_PER_DAY	
333	BAPI_UNITS_CUBIC_METERS_PER_DAY	
334	BAPI_UNITS_QUARTS_PER_SECOND	
335	BAPI_UNITS_QUARTS_PER_MINUTE	
336	BAPI_UNITS_QUARTS_PER_HOUR	
337	BAPI_UNITS_QUARTS_PER_DAY	
338	BAPI_UNITS_CUBIC_INCHES_PER_SECOND	

339	BAPI_UNITS_CUBIC_INCHES_PER_MINUTE	
340	BAPI_UNITS_CUBIC_INCHES_PER_HOUR	
341	BAPI_UNITS_CUBIC_INCHES_PER_DAY	
342	BAPI_UNITS_BARREL_PER_SECOND	
343	BAPI_UNITS_BARREL_PER_MINUTE	
344	BAPI_UNITS_BARREL_PER_HOUR	
345	BAPI_UNITS_BARREL_PER_DAY	
346	BAPI_UNITS_CUBIC_CENTIMETERS_PER_SECOND	
347	BAPI_UNITS_CUBIC_CENTIMETERS_PER_MINUTE	
348	BAPI_UNITS_CUBIC_CENTIMETERS_PER_HOUR	
349	BAPI_UNITS_CUBIC_CENTIMETERS_PER_DAY	
350	BAPI_UNITS_IMPERIAL_GALLONS_PER_SECOND	
351	BAPI_UNITS_IMPERIAL_GALLONS_PER_HOUR	
352	BAPI_UNITS_IMPERIAL_GALLONS_PER_DAY	
353	BAPI_UNITS_US_BARREL_PER_SECOND	
354	BAPI_UNITS_US_BARREL_PER_MINUTE	
355	BAPI_UNITS_US_BARREL_PER_HOUR	
356	BAPI_UNITS_US_BARREL_PER_DAY	
	/* Pressure */	
357	BAPI_UNITS_KILOGRAMS_PER_CUBIC_CENTIMETER	
358	BAPI_UNITS_ATMOSPHERES	
359	BAPI_UNITS_FEET_OF_WATER	
360	BAPI_UNITS_MEGAPASCALS	
361	BAPT_UNITS_TORR	
362	BAPT_UNITS_KILOGRAM_PER_SQUARE_CENTIMETER	
	/* Density*/	
363	BAPT_UNITS_POUNDS_PER_GALLON	
364	BAPT_UNITS_GRAMS_PER_MILILITER	
365	BAPT_UNITS_KGRAMS_PER_LITER	
366	BAPT_UNITS_POUNDS_PER_IN3	
	/* Power */	
367	BAPT_UNITS_GIGAWATTS	

3.4 Data Link Layer Options:

☐ BACnet IP, (Annex J)
☐ BACnet IP, (Annex J), Foreign Device
☐ ISO 8802-3, Ethernet (Clause 7)
☐ ATA 878.1, 2.5 Mb. ARCNET (Clause 8)
☐ ATA 878.1, EIA-485 ARCNET (Clause 8), baud rate(s):
■ MS/TP master (Clause 9), baud rate(s): 9600(default),19200,38400
☐ MS/TP slave (Clause 9), baud rate(s):
☐ Point-To-Point, EIA 232 (Clause 10), baud rate(s):_____
☐ Point-To-Point, modem, (Clause 10), baud rate(s): _____
☐ LonTalk, (Clause 11), medium: _____
☐ BACnet/ZigBee (ANNEX O)
☐ Other: _____

3.5 Device Address Binding:

Is static device binding supported? (This is currently necessary for two-way communication with MS/TP slaves and certain other devices.) ☐ Yes ■ No

3.6 Networking Options:

☐ Router, Clause 6 - List all routing configurations, e.g., ARCNET-Ethernet, Ethernet-MS/TP, etc.
☐ Annex H, BACnet Tunneling Router over IP
☐ BACnet/IP Broadcast Management Device (BBMD)
Does the BBMD support registrations by Foreign Devices? ☐ Yes ☐ No
Does the BBMD support network address translation? ☐ Yes ☐ No

3.6.1 Network Security Options:

■ Non-secure Device - is capable of operating without BACnet Network Security
☐ Secure Device - is capable of using BACnet Network Security (NS-SD BVBB)
☐ Multiple Application-Specific Keys:
☐ Supports encryption (NS-ED BVBB)
☐ Key Server (NS-KS BVBB)

3.7 Character Sets Supported:

Indicating support for multiple character sets does not imply that they can all be supported simultaneously.

■ ANSI X3.4	☐ IBM™/Microsoft™ DBCS	☐ ISO 8859-1
☐ ISO 10646 (UCS-2)	☐ ISO 10646 (UCS-4)	☐ JIS X 0208

If this product is a communication gateway, describe the types of non-BACnet equipment/networks(s) that the gateway supports:

- N/A

4 Glossary

Acronyms	
Item	**Description**
BVBB	BACnet InteroperaBVlity Building Block
DS	Data Sharing
DM	Device Management
RP	Read Property
WP	Wright Property
A	Client
B	Server

9. 4-20 mA loop calibration

The VLM10 and RIM10 flowmeter supports one (three optional) 4-20 mA output channels and two 4-20 mA input channels. Each channel is calibrated at the factory. If a field calibration is required, follow the procedure outlined below.

9.1 Loop calibration methodology

The 4-20 mA loops are each calibrated by a two-point slope and offset calibration, as illustrated in the diagram below. The slope and offset calibration nulls out any offset and gain errors that could occur in a system. While the VLM10 and RIM10 flowmeters are factory calibrated to within the specified accuracy on all 4-20 mA input and output channels, errors can be introduced when using the 4-20 mA loops in a system that may add offset or gain errors to the current measurement.

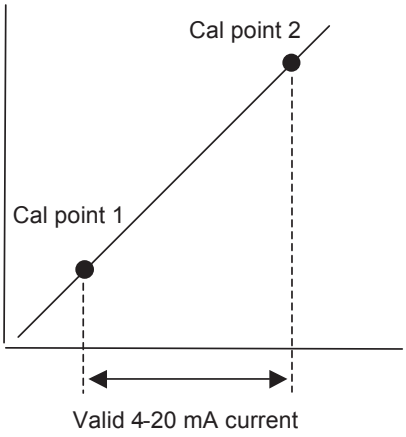


Fig. 108

9.2 Loop calibration procedure

Caution: Before applying loop power to the VLM10 and RIM10 flowmeter, ensure that each 4-20 mA loop will not exceed the maximum ratings, defined in the Electrical section of this document, when the power is applied.

1. While in run mode (normal operating mode) activate the 'ENTER' key on the front panel five times, using the magnetic wand, to enter the 'Meter Setup Menu'.

2. In the 'Meter Setup Menu', scroll down by activating the 'DOWN arrow' key until the 'Service Menu' option is highlighted. Activate the 'ENTER' key to select the 'Service Menu'.

3. In the 'Service Menu', scroll down by activating the 'DOWN arrow' key until the 'Calibrate 4-20' option is highlighted. Activate the 'ENTER' key to select the 'Calibrate 4-20' option.

4. To calibrate an input channel go to step 15. To calibrate an output channel go to step 5.

4-20 mA output calibration:

5. From the 'Select Channel' menu, which appears after selecting 'Calibrate 4-20' in step 3, highlight the output channel to be calibrated by activating the 'UP' and 'DOWN' arrow keys until the correct channel is highlighted. Activate the 'ENTER' key to select the channel.

6. The first screen that is displayed describes the connector and pin-out that should be used to wire the channel to be calibrated. Activate the 'ENTER' key to continue.

7. The screen should now display 'Output set to approx. 3.90 mA' and the output current from the 4-20 mA channel should measure approximately 3.9 mA dc. Activate the 'ENTER' key to continue.

8. The screen should now display '3.9 mA' and 'Edit' should be highlighted at the bottom of the display. Activate the 'ENTER' key while 'Edit' is highlighted to edit the current value.

9. The measured current should be entered into the value on this screen. The entry of the measured current is best entered from right to left. With the cursor now highlighting the '9', use the 'UP' and 'DOWN' arrow keys to enter the least significant digit in the reported loop current. For example, if the measured loop current is 3.87 mA, the least significant digit is a 7.

10. To edit the next digit to the left, use the 'LEFT' arrow key to move the cursor over. (Note that the decimal point can be changed to a number by highlighting it and using the 'UP' and 'DOWN' arrows to change it. Conversely, a number can be converted to a decimal point by highlighting the number and using the 'UP' or 'DOWN' arrow keys to change it to a decimal) Continuing the example from step 9 above, with 3.87 mA measured current, move the cursor to the decimal point and use the 'UP' arrow to change the decimal point to the number 8.

11. Continue to enter the rest of the measured current using the arrow keys to move the cursor and change the value. When the current is entered correctly, activate the 'ENTER' key to highlight the right arrow icon at the bottom right of the screen. Activate the 'ENTER' key one more time to move to the next screen.

12. The screen should now display 'Output now set to approx. 21.50 mA' and the output current from the 4-20 mA channel should measure a little above 20 mA dc. Activate the 'ENTER' key to continue.

13. Enter the measured current value. When the current is entered correctly, activate the 'ENTER' key to highlight the right arrow icon at the bottom right of the screen. Activate the 'ENTER' key one more time to move to the next screen.

14. The screen should now return to the 'Select Channel' menu, and the 4-20 mA output channel should now be calibrated to the system. To calibrate additional outputs, select them and repeat the same process. Otherwise, to return to run mode, activate the 'LEFT' arrow key until the 'Meter Setup Menu' is displayed. From the 'Meter Setup Menu' highlight the 'Return to Run Mode' option and activate the 'ENTER' key.

4-20 mA input calibration:

15. From the 'Select Channel' menu, which appears after selecting 'Calibrate 4-20' in step 3, highlight the input channel to be calibrated by activating the 'UP' and 'DOWN' arrow keys until the correct channel is highlighted. Activate the 'ENTER' key to select the channel.

16. The first screen that is displayed describes the connector and pin-out that should be used to wire the channel to be calibrated. Activate the 'ENTER' key to continue.

17. The screen should now display 'Set input current to 4 mA or less'. At this point, the input current to the 4-20 mA channel should be set to a value between 3.5 mA to 4.0 mA dc. Activate the 'ENTER' key to continue.

18. The screen should now display '3.9 mA' and 'Edit' should be highlighted at the bottom of the display. Activate the 'ENTER' key while 'Edit' is highlighted to edit the current value.

19. The measured current should be entered into the value on this screen. The entry of the measured current is best entered from right to left. With the cursor now highlighting the '9', use the 'UP' and 'DOWN' arrow keys to enter the least significant digit in the reported loop current. For example, if the measured loop current is 3.87 mA, the least significant digit is a 7.

20. To edit the next digit to the left, use the 'LEFT' arrow key to move the cursor over. (Note that the decimal point can be changed to a number by highlighting it and using the 'UP' and 'DOWN' arrows to change it. Conversely, a number can be converted to a decimal point by highlighting the number and using the 'UP' or 'DOWN' arrow keys to change it to a decimal) Continuing the example from step 19 above, with 3.87 mA measured current, move the cursor to the decimal point and use the 'UP' arrow to change the decimal point to the number 8.

21. Continue to enter the rest of the measured current using the arrow keys to move the cursor and change the value. When the current is entered correctly, activate the 'ENTER' key to highlight the right arrow icon at the bottom right of the screen. Activate the 'ENTER' key one more time to move to the next screen.

22. The screen should now display 'Set input current to 20 mA or more'. At this point, the input current to the 4-20 mA channel should be set to a value between 20 mA to 21 mA dc. Activate the 'ENTER' key to continue.

23. Enter the measured current value. When the current is entered correctly, activate the 'ENTER' key to highlight the right arrow icon at the bottom right of the screen. Activate the 'ENTER' key one more time to move to the next screen.

24. The screen should now return to the 'Select Channel' menu, and the 4-20 mA input channel should now be calibrated to the system. To calibrate additional inputs, select them and repeat the same process. Otherwise, to return to run mode, activate the 'LEFT' arrow key until the 'Meter Setup Menu' is displayed. From the 'Meter Setup Menu' highlight the 'Return to Run Mode' option and activate the 'ENTER' key.

–10. Diagnostics, troubleshooting and – maintenance diagnostics

The VLM10 and RIM10 flowmeter monitors its internal status during normal operation. Three specific conditions are monitored by the flowmeter: faults, warnings, and alarms.

10.1 Faults

A fault is a condition that will negatively affect the flowmeter's performance. In the event of a fault condition, the yellow fault light on the front panel will illuminate, the fault will also be displayed on the home page or the web-page interface. Fault conditions can be viewed using the front-panel, web-page, MODBUS or BACnet interfaces. All fault events are stored in a log file in the flowmeter's internal memory.

User intervention is required to clear a fault. A user can clear faults by using the front-panel or web-page interfaces. If the fault condition is still active when a user attempts to clear the fault, the flowmeter will reassert the fault. However, if the fault condition is no longer active when a user attempts to clear the fault, the flowmeter will clear the fault and return to a normal operating state.

To view and clear the active faults using the front-panel, follow the procedure below:

1. Activate the 'RIGHT' arrow key using the magnetic wand to take the meter out of screen saver mode.
2. While in run mode (normal operating mode) activate the 'ENTER' key on the front panel five times to enter the 'Meter Setup Menu'.
3. In the 'Meter Setup Menu', scroll down by activating the 'DOWN arrow' key until the 'View / Clear Faults' option is highlighted. Activate the 'ENTER' key to select the 'View / Clear Faults' menu.
4. Any active faults will be displayed in this menu. To scroll through each fault, activate the 'LEFT' and 'RIGHT' arrow keys.
5. To clear a fault, move the cursor using the 'LEFT' or 'RIGHT' arrow keys until 'Clear Fault' is highlighted. Activate the 'ENTER' key to clear the fault.

To view and clear the active faults using the web-page interface, establish an Ethernet connection to the flowmeter and then type the flowmeter's IP address into an internet browser's URL. The faults will be displayed on the flowmeter's home page and can be cleared by clicking on the fault.

The Tables on the following pages list each fault condition and a suggested solution:

10.2 Fault condition and suggested solution table

Fault code	Description	Possible reason	Solution
0	DSP	Internal communications failure	Power cycle the flowmeter
			Replace electronics stack in the flowmeter
1	DSP2	Remote communications failure	Verify remote wiring, including polarity of RS-485 bus
			Verify power is supplied to pipe-mount electronics
			Verify RS-485 bus is terminated
			Verify remote wiring is appropriately shielded from noise sources

10.2 Fault condition and suggested solution table (continued)

Fault code	Description	Possible reason	Solution
2	RTC	Real-time clock	Power cycle the flowmeter
			Replace electronics stack in the flowmeter
3	BACKUP_RAM	Faulty backup RAM battery	Power cycle the flowmeter
			Replace electronics stack in the flowmeter
4	EEPROM	Analog calibration values are out of range	Recalibrate the 4 - 20 mA input and output circuits
5	KEYPAD	Internal communications failure to the keypad	Verify keypad ribbon cable is securely connected
6	RTD	RTD in flow tube is not reading correctly	Verify the RTD connector, in the terminal side of the enclosure, is securely connected
			Verify the signal connector, connecting on a right-angle to the signal board on the display side of the enclosure, is securely connected
			Replace RTD
			Replace electronics stack in the flowmeter
7	PULSE_OUTPT_OFLOW	Pulse output queue is full, pulses lost	Verify the totalizer is set to increment at a rate slow enough to allow a full pulse to occur before the next totalizer event
8	ANALOG_OUTPT_1	Analog output value is exceeding its scale	Verify the analog output is scale is set appropriately, if not adjust the scale
9	ANALOG_OUTPT_2	Analog output value is exceeding its scale	Verify the analog output is scale is set appropriately, if not adjust the scale
10	ANALOG_OUTPT_3	Analog output value is exceeding its scale	Verify the analog output is scale is set appropriately, if not adjust the scale
11	ANALOG_INPT_1	Analog input value is exceeding its scale	Verify the analog input is scale is set appropriately, if not adjust the scale
12	ANALOG_INPT_2	Analog input value is exceeding its scale	Verify the analog input is scale is set appropriately, if not adjust the scale
13	INTERNAL_TEMP	Electronics at the meter, on the pipe, are too hot	Power-down the flowmeter and verify proper installation for thermal mitigation, including thermal insulation blankets
			Power-down the flowmeter and verify that the ambient air temperature is not exceeding the max specified
14	CONFIG	Invalid configuration setting	Power cycle the flowmeter and verify that the configuration is correct
15	FREQ_OUT_RANGE	Frequency is exceeding the expected range based on fluid type and line size	With no flow, run the auto-threshold routine to set the noise level of the flowmeter
			Verify that the flowmeter's configuration is correct
			Verify that the flow conditions are within the specified operating conditions of the flowmeter
			Verify that the flowmeter chassis is connected to earth ground through either the pipe-work or by use of an earth ground wire
			Verify the signal connector, connecting on a right-angle to the signal board on the display side of the enclosure, is securely connected

10.3 Warnings

A warning is an informational event that will not negatively affect the meter's performance. Warnings are logged to internal memory and can be viewed by a user for informational purposes.

Warning codes and possible reasons table

Warning code	Description	Possible reason
0	CFG_CHANGE	The configuration was changed
1	CAL_MODE	The flowmeter was in a calibration mode
2	THREAD	Internal software failure. Flowmeter will restart automatically.
3	TEMP1_MIN_MAX	The TEMPERATURE 1 parameter hit a new minimum or maximum value
4	TEMP2_MIN_MAX	The TEMPERATURE 2 parameter hit a new minimum or maximum value
5	PRESS_MIN_MAX	The PRESSURE parameter hit a new minimum or maximum value
6	VOL_MIN_MAX	The VOLUMETRIC flowrate parameter hit a new minimum or maximum value
7	CVOL_MIN_MAX	The 'C' VOLUMETRIC flowrate parameter hit a new minimum or maximum value
8	MASS_MIN_MAX	The MASS flowrate parameter hit a new minimum or maximum value
9	ENERGY_MIN_MAX	The ENERGY flowrate parameter hit a new minimum or maximum value
10	TOTALIZER1	Totalizer 1 assignment changed
11	TOTALIZER2	Totalizer 2 assignment changed
12	ANALOG_INPT	Analog input assignment changed
13	ANALOG_OUTPT	Analog output assignment changed
14	PWR_DOWN	The meter was powered-down
15	ALARM1_ON	ALARM 1 event turned-on
16	ALARM1_OFF	ALARM 1 event turned-off
17	ALARM2_ON	ALARM 2 event turned-on
18	ALARM2_OFF	ALARM 2 event turned-off
19	TEMP1_MIN_MAX_CHANGE	Temperature input 1 hit a new minimum or maximum value
20	TEMP2_MIN_MAX_CHANGE	Temperature input 2 hit a new minimum or maximum value

Warning codes and possible reasons table (continued)

Warning code	Description	Possible reason
21	PRESS_MIN_MAX_CHANGE	Pressure input hit a new minimum or maximum value
22	VOLUME_MIN_MAX_CHANGE	Calculated volume hit a new minimum or maximum value
23	CVOLUME_MIN_MAX_CHANGE	Calculated compensated volume hit a new minimum or maximum value
24	MASS_MIN_MAX_CHANGE	Calculated mass hit a new minimum or maximum value
25	ENERGY_MIN_MAX_CHANGE	Calculated energy hit a new minimum or maximum value
26	SUB_FREQ_IN_USE	The flowmeter was set to use a substitute frequency as a sensor input
27	SUB_TEMP1_IN_USE	The flowmeter was set to use a substitute input for TEMPERATURE 1
28	SUB_TEMP2_IN_USE	The flowmeter was set to use a substitute input for TEMPERATURE 2
29	SUB_PRESS_IN_USE	The flowmeter was set to use a substitute input for PRESSURE

10.4 Alarms

Alarms are user-defined events that indicate a configured parameter is exceeding its user defined minimum or maximum value. Alarms can be configured by a user via the front-panel or web-page interfaces.

Symptom	User interface	Possible reason	Solution
Invalid or Missing Alarm	All	Incorrect configuration	Verify that the alarm event is configured correctly
	Relays	Relay not toggling on alarm event	Verify that the relay wiring is in accordance with the electrical installation and wiring instructions
			Verify that the relay is configured correctly for an alarm condition
		Faulty hardware	Replace electronics stack in the flowmeter
		Inverted polarity	Swap the normally open and normally closed connections

10.5 Troubleshooting

If the VLM10 flowmeter is not functioning as expected, refer to the table below for recourse. If an error, warning or alarm condition exists, refer to the Diagnostics section above. If, after trying the solutions listed in this document, the malfunction still exists, contact your local Spirax Sarco sales representative.

Symptom	User interface	Possible reason	Solution
Blank display	Front panel	Supply voltage	Verify that the flowmeter power on the terminal board is within its operational specifications
		Display in screen saver mode	Verify that the flowmeter's display is not in its screen saver mode. Use the magnetic wand to activate the 'LEFT' or 'RIGHT' arrow keys
		Keypad cable not connected or loose	Verify keypad ribbon cable is securely connected
		Defective electronics	Replace electronics stack in the flowmeter
Displays flow without output signal	4 - 20 mA Output	Wrong configuration	Verify that the 4 - 20 mA output configuration, including scale and offset, is correct
		Loop supply voltage	Verify that the 4 - 20 mA loop supply voltage is within its operational specifications
		Loop load impedance	Verify that the 4 - 20 mA loop load impedance is within its operational specifications
		Incorrect wiring	Verify that the 4 - 20 mA loop wiring is in accordance with the electrical installation and wiring instructions
		Incorrect calibration values	Recalibrate the 4 - 20 mA output channel
No flow reported with flow present	All	Wrong configuration	Verify that the flowmeter's configuration is correct for the process fluid type
		Flow velocity too low or high	Verify that the process velocity is within the minimum and maximum specified velocity for the line size and fluid type
		Noise threshold set too high	Run the auto noise threshold routine with no flow to set the noise threshold
		No signal from piezoelectric crystal	Verify the signal connector, connecting on a right-angle to the signal board on the display side of the enclosure, is securely connected
			Check the resistance across piezo sensor wires: should be more than 20 Mohms

10.5 Troubleshooting (continued)

Symptom	User interface	Possible reason	Solution
Flow reported with no flow present	All	Noise threshold set too low	Run the auto noise threshold routine with no flow to set the noise threshold. If after running the routine the flowmeter still reports a flow with no flow present, manually change the noise threshold to a higher value.
		Electro-magnetic interference	Verify that the flowmeter chassis is connected to earth ground through either the pipework or by use of an earth ground wire
		Pipe vibration or flow pulsations disturb flow signal	Manually increase the noise threshold value
Unstable flow signal	All	Flow velocity too low or high	Verify that the process velocity is within the minimum and maximum specified velocity for the line size and fluid type
		Noise threshold set too high	Run the auto noise threshold routine with no flow to set the noise threshold
		Electro-magnetic interference	Verify that the flowmeter chassis is connected to earth ground through either the pipework or by use of an earth ground wire
		Air bubbles in the media	Follow piping guidelines
		Pulsating flow	Flowmeter averages faster variation in flow but slower variation will be displayed
Symptom	User interface	Possible reason	Solution
Incorrect flow reading	All	Flow velocity too low or high	Verify that the process velocity is within the minimum and maximum specified velocity for the line size and fluid type
		Wrong calibration data	Verify that the K-factor / Reynolds pairs in the web-page correspond to the values in the calibration certificate
		Wrong configuration	Verify that the flowmeter's configuration is correct for the process fluid type
		Piping not correct	Verify the piping installation has allowed for the required straight pipe run.
		RTD temperature errors	Verify that the reported RTD temperature is correct

10.5 Troubleshooting (continued)

Symptom	User interface	Possible reason	Solution
No Web-page access	Ethernet	Wrong IP address	Verify that the browser's URL address is set to the flowmeter's IP address. The flowmeter's IP address is displayed on a scrolling screen on the front panel display.
		Subnet wrong	Verify with your IT department that the meter's subnet is valid for the network
		Firewall	Verify with your IT department that no firewalls are blocking access to the flowmeter
		Network mask	Verify with your IT department that the flowmeter's network mask is valid for the network
		Gateway IP	Verify with your IT department that the flowmeter's gateway IP address is valid for the network
		Direct to PC connection	Verify that the PC has a static IP address with the same subnet as the flowmeter's IP address
		Ethernet cable not connected	Verify that the Ethernet cable is connected and fully seated into the RJ-45 jack on the terminal side of the flowmeter
No MODBUS comms. or invalid data	MODBUS RTU over RS-485	Incorrect wiring	Verify that the wiring is in accordance with the electrical installation and wiring instructions
		Wrong polarity	Verify that the wiring is connected to the correct polarity at each end of the RS-485 network
		Termination missing or excessive	Verify that the RS-485 bus is terminated in accordance with the electrical installation and wiring instructions
		Wrong baud rate	Verify that the host device has the same baud rate as the flowmeter. Default baud rate is 9600 baud.
		Wrong data encoding	Verify that the host device has the same data encoding as the flowmeter. The default encoding is 8 data bits, no parity, and 1 stop bit.
		Wrong address	Verify that the register set is addressed correctly as defined in the MODBUS register map
		Wrong data type	Verify that the data type of the addressed register matches the host command

10.5 Troubleshooting (continued)

Symptom	User interface	Possible reason	Solution
No BACnet comms. or invalid data	BACnet MS/TP RS-485	Incorrect wiring	Verify that the wiring is in accordance with the electrical installation and wiring instructions
		Wrong polarity	Verify that the wiring is connected to the correct polarity at each end of the RS-485 network
		Termination missing or excessive	Verify that the RS-485 bus is terminated in accordance with the electrical installation and wiring instructions
		Wrong baud rate	Verify that the host device has the same baud rate as the flowmeter. Default baud rate is 9600baud.
		Wrong data encoding	Verify that the host device has the same data encoding as the flowmeter. The default encoding is 8 data bits, no parity, and 1 stop bit.
		Conflicting Station ID 1-127	Verify that the BACnet network stations have unique IDs. The default is 1.
		Conflicting Device ID 1-4194303	No more than 2 devices can have the same Device ID. Verify that all devices are configured with unique IDs.
		Max Masters 2-127	Verify that the number of BACnet masters on the network do not exceed the configured number of masters. The default is 127.

10.6 Maintenance

The VLM10 flowmeter does not have a scheduled maintenance programme. Recalibration of the flowmeter does not need to be performed after the initial factory calibration because of the nature of a vortex flowmeter. The frequency response from the sensor will not change over time unless the bluff body is physically damaged or worn. The RTD circuitry could exhibit some drift over time, and it could be recalibrated to maintain the best possible performance. If there is a need to recalibrate the flowmeter, contact your local Spirax Sarco sales representative for further information on how to return a flowmeter to the factory for recalibration. Note: it is possible to recalibrate 4 - 20 mA input and output circuits in the field. Refer to Section 9, '4-20 mA Loop Calibration', for further details.

10.7 Setting a static IP on a PC

It is possible to establish a direct connection between a PC and the VLM10 flowmeter using Ethernet. This is often easier than networking the VLM10 flowmeter, and it will allow a user to access the flowmeter's web pages to view and configure flowmeter parameters. In order to establish a connection, it is necessary to configure the PC or laptop with a static IP address. The instructions below detail the steps necessary to set a static IP address using the Windows XP operating system. Other operating systems will require a different procedure, but the concept is the same.

1. Connect an Ethernet CAT5 cable between the VLM10 flowmeter's RJ-45 jack, accessible from the terminal side of the enclosure, and the PC's Ethernet port. The flowmeter's electronics will automatically correct for a straight-through or cross-over cable, so it is not necessary to use one versus the other.

2. Power-on the flowmeter.

3. Check the flowmeter's IP address using the front-panel. Scroll through the displayed screens, using the 'LEFT' or 'RIGHT' arrow keys, until the flowmeter's IP address is displayed.

4. If the PC has a wireless connection, disable the connection to avoid IP conflicts between the wireless network assignment and the steps in this procedure.

5. Double click on the network icon, located in the lower right corner of the screen, beside the time. The connection indicator will likely display 'Not Connected' until the IP address is configured.

Fig. 109

6. This will bring up the Ethernet Status window.

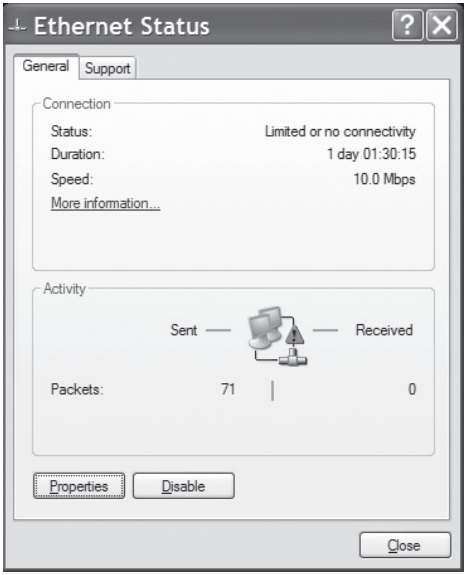


Fig. 110

7. Click on the 'Properties' button in the Ethernet Status window.

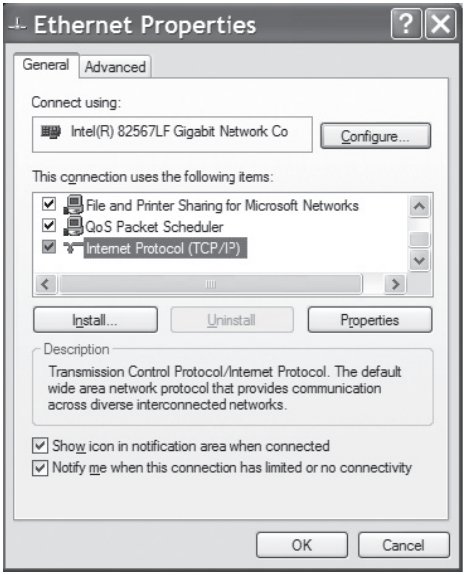


Fig. 111

8. Highlight the Internet Protocol (TCP/IP) option and click on the 'Properties' button.

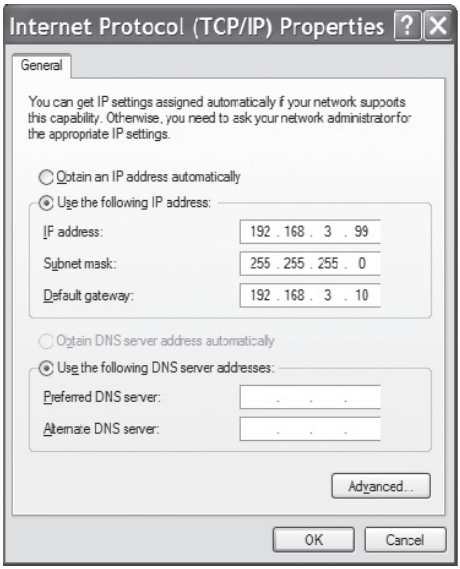


Fig. 112

9. Click on the 'Use the following IP address:' option and enter in an IP address, where the subnet, represented by the first 3 numbers, matches the flowmeter's subnet. For example, if the flowmeter has an IP address of 192.168.3.55, then the PC must be set to an IP address of 192.168.3.XXX, where XXX is any number between 0 and 255 that is unique from the flowmeter's IP address and the gateway address.

10. Set the 'Subnet mask:' to 255.255.255.0.

11. Set the 'Default gateway:' to match the flowmeter's subnet. The gateway address, the flowmeter's IP address and the PC's IP address must have the same subnet but different addresses. For example, if the flowmeter's IP address is 192.168.3.65, then the PC can have an address of 192.168.3.99 and the gateway can have an address of 192.168.3.10. It is also valid to set the gateway to 192.168.3.3 and the PC's IP address to 192.168.3.100 because the last number in the address should be unique, but the first three numbers in the address should be the same.

12. Click on 'OK'.

13. The Ethernet should now be connected between the flowmeter and the PC.

Open a web browser and enter the flowmeter's IP address into the URL to view the flowmeter's web pages.

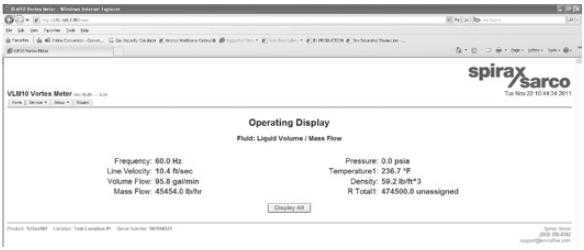


Fig. 113