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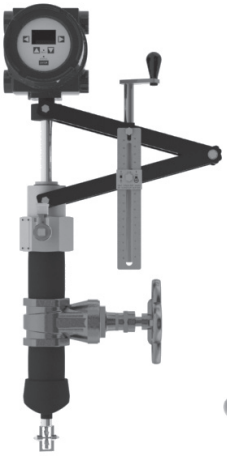
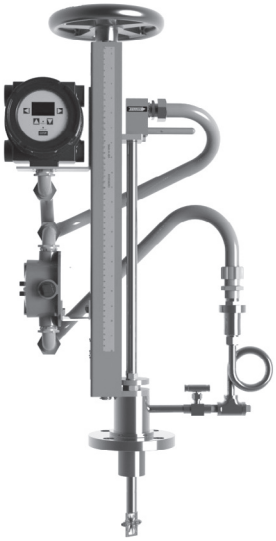
IM-P198-02
MI Issue 5

RIM10 Series
Rotor Insertion Flowmeters
Installation and Maintenance Instructions



RIM10-600

RIM10-700



RIM10-900

1. Safety information

Safe operation of these units can only be guaranteed if they are 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.

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

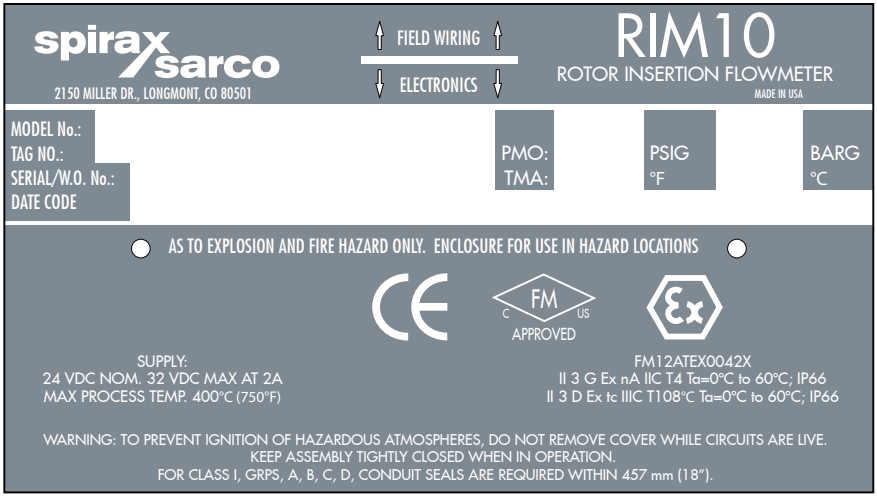
Warning

These products comply with the requirements of the Electromagnetic Compatibility Directive 89/336/EEC by meeting the standards of: EN 61326:1997 Electrical equipment for measurement, control and laboratory use EMC requirements:

- **Immunity to industrial locations annex A -Table A1.**
- **Emissions to domestic locations Table 4.**

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 RIM10 will be placed on the flowmeter, and will appear as this:



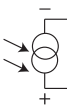
The symbols, used on the product and in this manual, mean:

Equipment protected throughout by double insulation or reinforced insulation.

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

Caution, risk of electric shock.

Caution, risk of danger, refer to accompanying documentation.



Optically isolated current source or sink.

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

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

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

Special conditions for safe use of this product:

1. **The RIM10 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. **The painted surface of the RIM10 may store electrostatic charge and become a source of ignition in applications with a low relative humidity <30% where the painted surface is relatively free of surface contamination such as dirt, dust or oil. Guidance on protection against risk of ignition due to electrostatic discharge can be found in EN TR50404 and IEC TR60079-32. Cleaning of the painted surface should only be done with a damp cloth.**
3. **On installation the RIM10 shall be provided with supply transient protection external to the apparatus such that the voltage at the supply terminals of the RIM10 does not exceed 140% of the voltage rating of the equipment.**
4. **The maximum permitted temperature of the RIM10 is 60°C (140°F). To avoid the effects of process temperature and other thermal effects care must be taken to ensure that the "Enclosure temperature" does not exceed 60°C (140°F).**

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.

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 labelling of closed valves. Do not assume that the system has depressurised 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 the supplier/manufacturer 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.

See Section 2.1 for the contact details regarding the RIM10 product range.

2. General product information and Guide to installation

These Installation and Maintenance Instructions explain how to correctly install, commission and maintain the RIM10 Series of rotor insertion flowmeters.

2.1 Product description

The RIM10 Series of rotor insertion flowmeters are designed to reduce the cost of flowmetering and record total flow by accurately measuring steam, liquid or gas flowrates.

2.2 Copyright notice

2.3 Equipment delivery and handling

Factory shipment
Prior to shipment, the Spirax Sarco RIM10 is tested, calibrated and inspected to ensure proper operation.

Receipt of shipment
Each carton should be inspected at the time of delivery for possible external damage. Any visible damage should be recorded immediately on the carrier's copy of the delivery slip. Each carton should be unpacked carefully and its contents checked for damage. 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.

Contact details for the RIM10 range of products:

Spirax Sarco, Inc.
2150 Miller Drive, Longmont, CO 80501
T: 800.356.9362 or 303.682.7060
F: 303.682.7069
www.spiraxsarco.com/us

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).

Calibration data - Important
Save the RIM10 calibration and application information data sheets when unpacking your new flowmeter. These data sheets are important in setting up and monitoring the performance of your new flowmeter.

2.4 Fitting orientation - see Figure 1

Non-vertical

If non-vertical mounting is required, the deviation from vertical should not exceed 90°. If mounted beyond 90°, the isolation valve may trap steam or hazardous chemicals, presenting a danger to persons servicing the RIM10 Series of rotor insertion flowmeters. These flowmeters should always be self-draining.

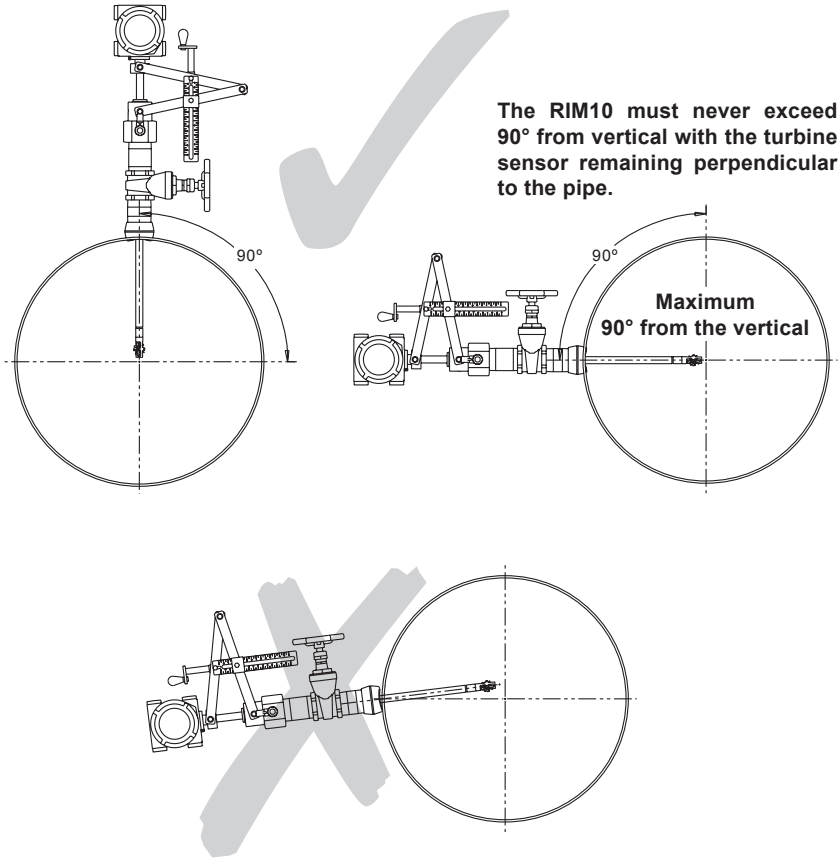


Fig. 1 Fitting orientation

Overhead clearance

A minimum of 300 mm (12") of overhead clearance is recommended for ease of installation.

Easy accessibility

The installation location should be where the flowmeter will be easy for workers to safely and conveniently access all parts of the flowmeter.

2.5 Installation guidelines

Choosing the correct installation location for the RIM10 involves several important considerations:

Ambient temperature limit

The electronics are designed to function in a maximum continuous ambient temperature of 60°C (140°F). If the ambient temperatures exceed this the electronics should be remotely mounted.

Upstream / downstream pipework

The installation location should be selected to minimize possible turbulence and swirl. The extent of flow disturbances depends upon the configuration of the piping. Valves, elbows, control valves and other piping components that may add disturbances to the flow. If such conditions exist and/or sufficient straight pipe is unavailable, a flow conditioner may be used to improve measurement conditions. The minimum straight run requirements for different piping configurations are shown in Figure 2.

Please note that the straight run of pipe must have the same nominal diameter as the flowmeter body.

D = Pipe diameter

Please note that the straight run of pipe must have the same nominal diameter as the flowmeter body.

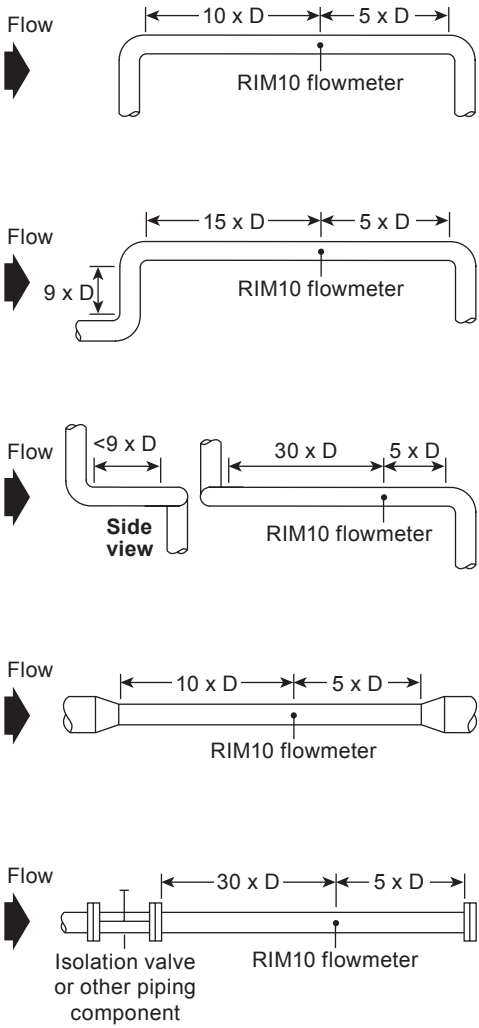


Fig. 2 Minimum straight run requirements for different piping configurations

2.6 Flowmeter location

The RIM10 Series can be mounted in either horizontal or vertical piping runs - See Figure 3. It is important for the pipe to be full for accurate measurements. Follow the guidelines below for the recommended location for installation:

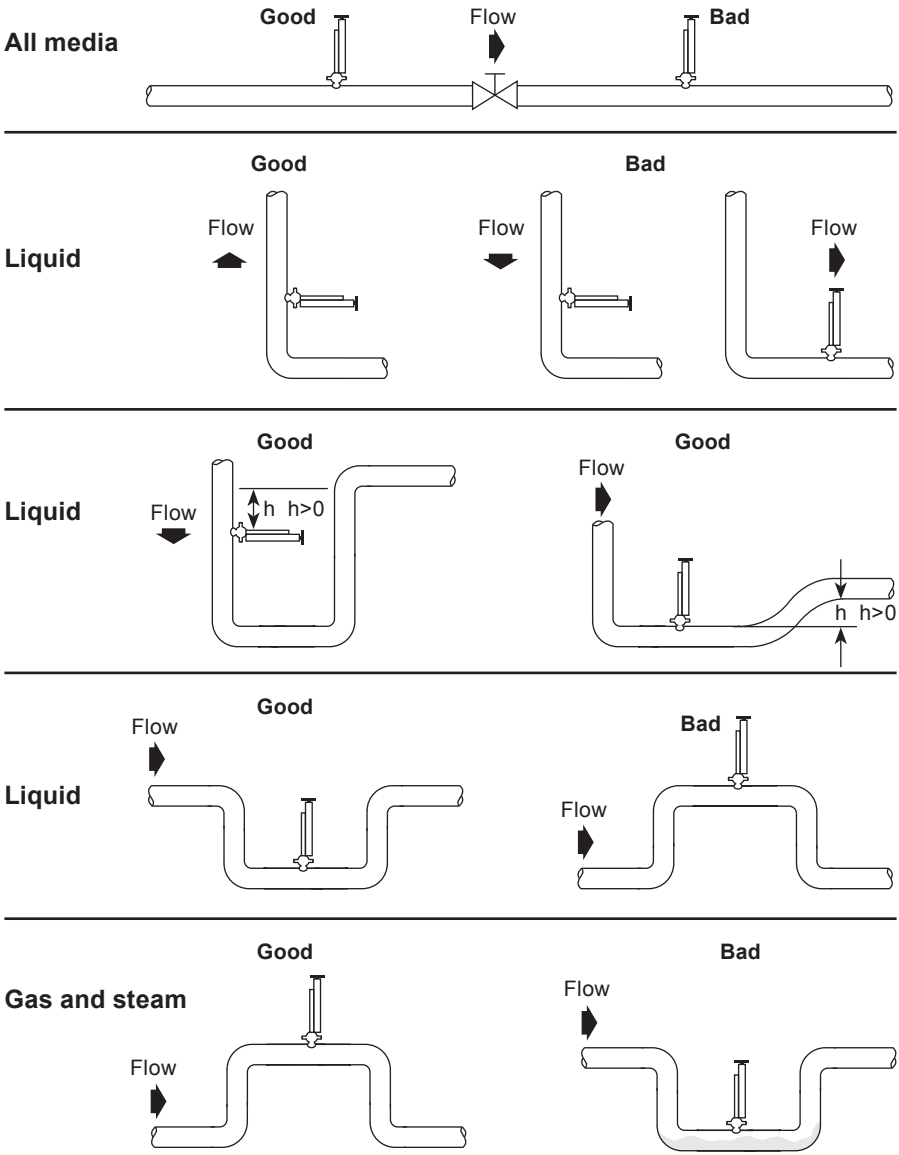


Fig. 3

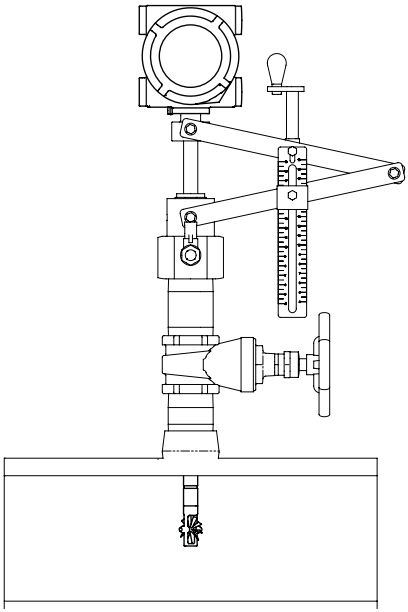
3. Mechanical installation

3.1 Pipe tapping

The pipeline should be prepared for either cold tap or hot tap installations. A cold tap installation involves drilling a hole into a pipeline that has been depressurised and for which service has been shutdown. A hot tap installation involves drilling a hole into a pressurised line without line shutdown and disruption of the process.

The RIM10-600 and RIM10-900 rotor insertion flowmeters can be hot or cold tapped.

Fig. 4 RIM10-600



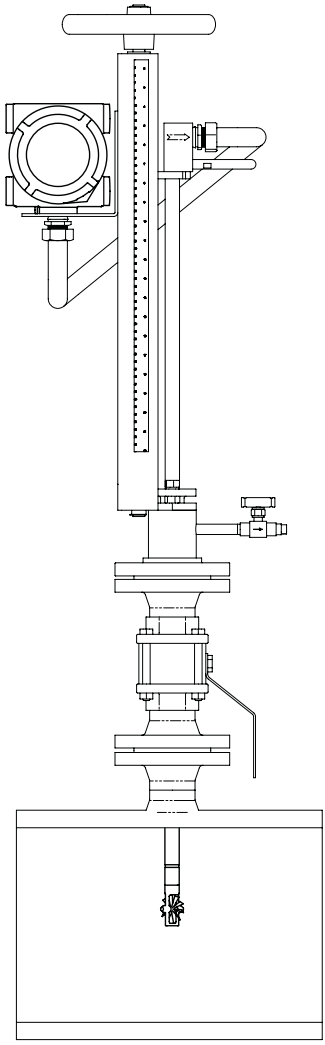


Fig. 5 RIM10-900

The **RIM10-700** rotor insertion flowmeter can only be cold tapped (**it must not be hot tapped**); it can only be installed and removed with process shutdown because it uses a Swagelok® fitting.

3.2 RIM10-600 and RIM10-900 hot tap and cold tap installation

3.2.1 Hot tap installation: M-TMP-600 and M-TMP-900

Caution - Risk of danger: Hot tap installation must only be done by qualified personnel.

The RIM10-600 and RIM10-900 can be installed without process shutdown or line depressurisation. The RIM10-600 is shipped with an isolation valve and a pipe nipple attached to the flowmeter - See Figure 6. For a hot tap installation, the isolation valve and pipe nipple need to be separated from the flowmeter. Use Steps 1 to 5 as a guide.

Fig. 6 RIM10-600

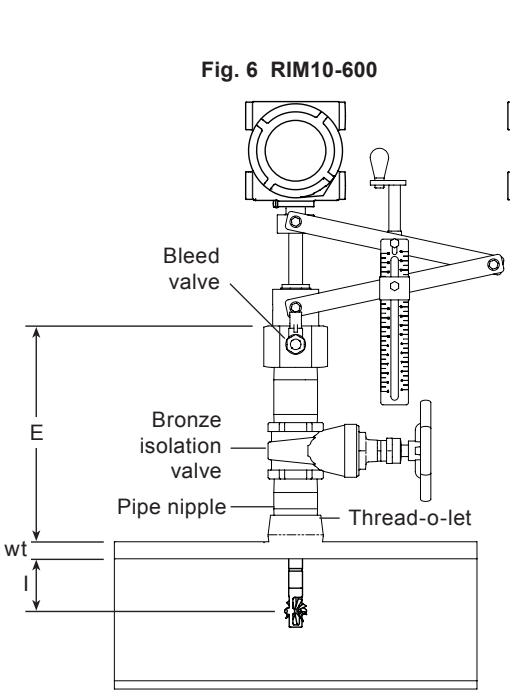
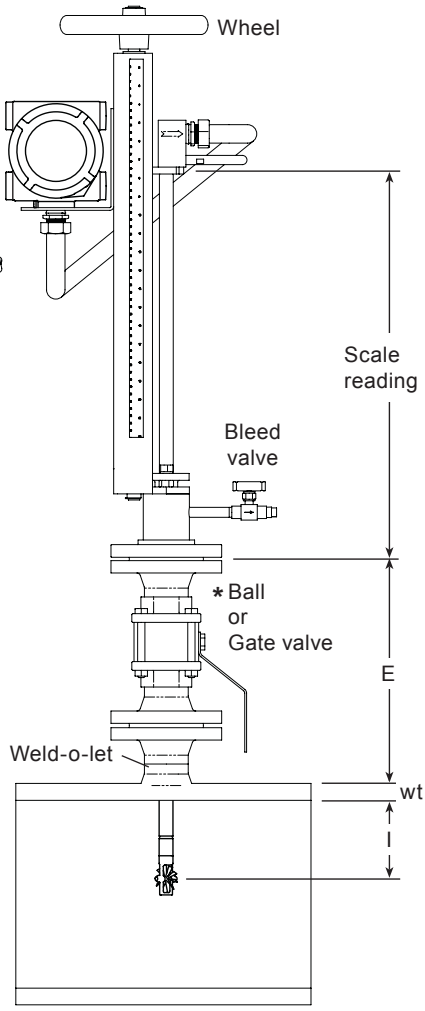


Fig. 7 RIM10-900



* Both the Ball and Gate valve are available from Spirax Sarco

Step 1 - Weld thread-o-let RIM10-600 or weld-o-let RIM10-900.

Step 2 - For the 2" RIM10-600 series, thread the pipe nipple into the thread-o-let and hand tighten. For the DN50 RIM10-900 series, weld the nipple to the weld-o-let, welding the flange to the nipple.

Step 3 - Connect the isolation valve:

- Attach the hot tap tool.
- Fully open the isolation valve.
- Hot tap the pipe.
- The hole should be at least 50 mm (2") in diameter, nominally 50 mm (2").
- Retract the hot tap tool.
- Close the isolation valve.
- Remove the hot tap tool.

Step 4 - **Important -** Attach the tap check tool to the end of the flowmeter stem before proceeding:

- Attach the flowmeter into the isolation valve.
- Verify that the bleed valve is closed.
- Open the isolation valve.
- Turn the retractor handle (RIM10-600 series) or wheel (RIM10-900 series) to insert the tap check tool into the pipe and then, retract the tap check tool completely.
- Close the isolation valve.
- Slowly open the bleed valve to bleed off the trapped fluid inside the isolation valve and flowmeter assembly.
- Remove the flowmeter from the isolation valve.
- Inspect the tap check tool for damage.
- If any has occurred, check the installation for possible clearance problems.

Step 5 - Remove the tap check tool and attach the turbine sensor (rotor assembly) to the end of the stem.

- Verify that the screw and safety wire on the rotor assembly are correctly installed.
- Reconnect the flowmeter into the isolation valve.
- Verify that the bleed valve is closed.
- Fully open the isolation valve.
- If the flowmeter is supplied with a pressure transmitter, open the bleed valve.
- Do not lower the turbine sensor into the pipe before calculating the proper insertion depth.

3.2.2 Cold tap installation

Caution - Risk of danger: Cold tap installation must only be done by qualified personnel.

Process shutdown and line depressurisation are required for cold tap installation. Use Steps 1 to 4 below as a guide.

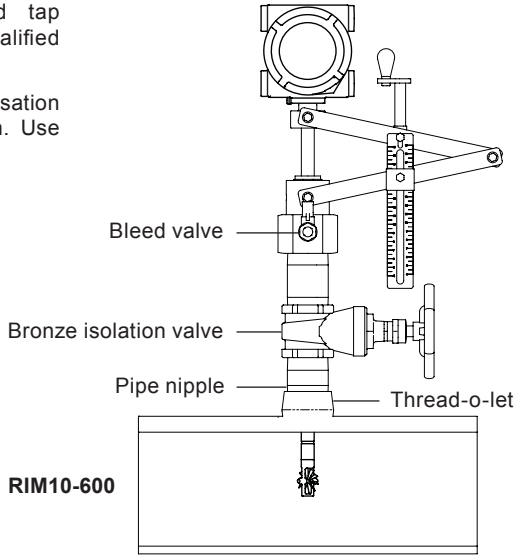


Fig. 8 RIM10-600

Step 1 - Tap the pipe - The hole should be at least 50 mm (2") in diameter, nominally 50 mm (2") in diameter.

Step 2 - For the 2" RIM10-600 series, thread the pipe nipple into the thread-o-let and hand tighten. For the DN50 RIM10-900 series, weld the nipple to the weld-o-let, welding the flange to the nipple.

Step 3 - **Important** - Attach the tap check tool to the end of the flowmeter stem before proceeding:

- Connect the flowmeter to the thread-o-let or weld-o-let.
- Verify that the bleed valve is closed.
- Open the isolation valve.
- Turn the retractor handle (RIM10-600 series) or wheel (RIM10-900 series) to insert the tap check tool into the pipe and then, retract the tap check tool completely.
- Remove the flowmeter from the thread-o-let (weld-o-let) and inspect the tap check tool for damage.
- If any has occurred, check the installation for possible clearance problems.

Step 4 - Remove the tap check tool and attach the turbine sensor (rotor assembly) to the end of the stem:

- Verify that the screw and safety wire on the rotor assembly are correctly installed.
- Reconnect the flowmeter to the thread-o-let.
- Verify that the bleed valve is closed.
- Fully open the isolation valve.
- If the flowmeter is supplied with a pressure transmitter, open the bleed valve.
- Do not lower the turbine sensor into the pipe before calculating the proper insertion depth.

3.2.3 Insertion depth scale reading calculation

After tapping the pipe and installing the RIM10 flowmeter, the turbine sensor needs to be properly positioned within the pipe. To determine the proper insertion depth, the scale reading must be calculated. The scale reading is the figure that the top of the cursor should be set to on the depth scale. Use the correct side of the scale depending on the rotor type:
- For the L1 and G1 - G5 rotors use the left-hand side of the scale.
- For the G6 rotor uses the right-hand side of the scale.

Insertion depth calculation for the RIM10-600 and RIM10-900 Series

Use the following equation to calculate the insertion depth for M-TMP 600 / 900 series:

Scale reading = I + E + Wt

Where:
I = For pipe sizes less than 300 mm (12"), inside pipe diameter ÷ 2.
I = For pipe sizes 300 mm (12") and larger, inside pipe diameter ÷ 4.
E (for the RIM10-600) = Distance from the top of the stem housing to the outside pipe wall. This distance varies depending on how tightly the pipe nipples are screwed into the isolation valve and thread-o-let.

E (for the RIM10-900) = Distance from the top of the isolation valve to the outside pipe wall.

Wt = Thickness of the pipe wall. The disk cut-out or 'coupon' from the tapping procedure can be measured, or this number can also be obtained from a piping handbook.

Example:
A RIM10-600 150 Rotor is to be installed on a 300 mm (12") Schedule 40 pipe. The following measurements have been obtained:

Metric:
I = 303.2 ÷ 4 = 75.8 mm
E = 317.5 mm
Wt = 10.3 mm
Scale reading (B) = 75.8 + 317 + 10.3 = 403.6

Imperial:
I = 11.938 ÷ 4 = 2.98
E = 12.5
Wt = 0.406 300 mm (12") Schedule 40
Scale reading (B) = 2.98 + 12.5 + 0.406 = 15.9

Use the retractor handle to carefully insert the rotor down into the pipe until the calculated insertion depth figure on the depth scale lines up with the top of the cursor. The depth scale is set to read in inches and is in ratio based on its position in relation to the stem.

Align the retractor bar assembly so that the flow direction arrow on the cursor is in line with the pipe and pointing downstream.

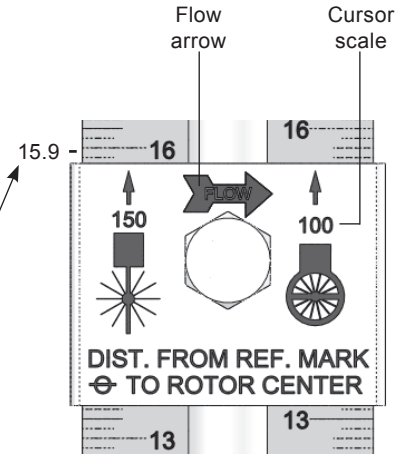


Fig. 9

Caution: Do not allow the orientation of the flowmeter or the insertion depth to change after insertion is complete. A change in insertion depth or alignment will cause inaccurate readings and shortened rotor life.

3.2.4 Rotor orientation and final positioning

Note: Tighten the nuts above the packing gland to 34 N m (25 lbf ft) to stop leakage around the stem. **Do not over tighten!**

Caution: Do not allow the orientation of the flowmeter or the insertion depth to change after insertion is complete. A change in insertion depth or alignment will cause inaccurate readings and shorten rotor life.

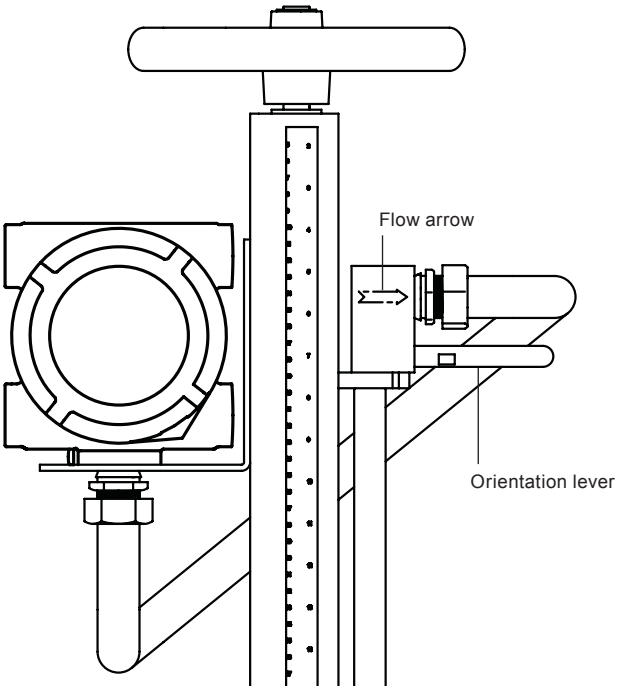


Fig. 10

Step 1 - Carefully insert the rotor into the pipe until the calculated scale reading on the depth scale lines up with the arrow on the retractor bar assembly. If the rotor is a 38 mm (1.5") size (RIM10-600 with ASME [ANSI] Class 150 flanged connection), line up the bottom arrow on the retractor bar assembly marked 1.5 with the depth scale as shown in Figure 10.

Step 2 - Align the rotor by using the orientation lever so the flow direction arrow is in line with the pipe and pointing downstream.

Step 3 - Tighten the nuts above the packing gland to 34 N m (25 lbf ft) to stop leakage around the stem. **Do not over tighten!**

Step 4 - Lock the stem in position by tightening the orientation lock screw.

3.2.5 Rotor orientation and final positioning

Use the retractor handle to carefully insert the rotor down into the pipe until the calculated insertion depth figure on the depth scale lines up with the top of the cursor. Use a pipe wrench to align the retractor bar assembly so the flow direction arrow on the cursor is in line with the pipe and pointed downstream. Lock the stem in position by tightening the orientation set screw - See Figures 11 and 12.

Caution: Do not allow the orientation of the flowmeter or the insertion depth to change after insertion is complete. A change in insertion depth or alignment will cause inaccurate readings and shorten rotor life.

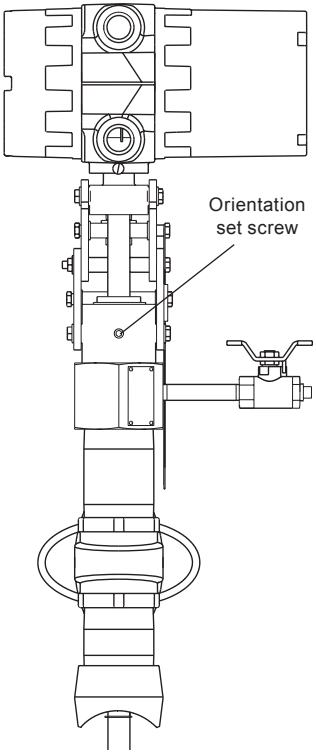


Fig. 11 RIM10-900

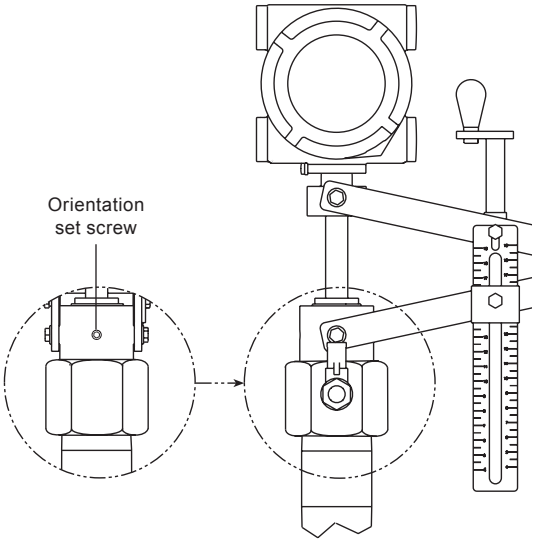


Fig. 12 RIM10-600

3.3 RIM10-700 cold tap installation

The RIM10-700 is non-retractable and must be cold tapped. Process shutdown and line depressurisation are required for cold tapping. There are two mounting connections available: Flanged or Screwed.

3.3.1 Installation for flanged connections:

Step 1 - Tap the pipe, the hole should be at least 50 mm (2") in diameter, nominally 50 mm (2") in diameter.

Step 2 - Weld the thread-o-let to the pipe.

Step 3 - Weld the weldneck flange to the weld-o-let.

Step 4 - **Important** - Attach the tap check tool to the end of the flowmeter stem before proceeding:

- Attach the flowmeter to the flange.
- Verify that the bleed valve is closed.
- Use the orientation levers to manually lower the tap check tool into the pipe and then retract the tap check tool completely.
- Remove the flowmeter from the flange and inspect the tap check took for damage.
- If any has occurred, check the installation for possible clearance problems.

Step 5 - Remove the tap check tool and attach the turbine sensor (rotor assembly) to the end of the stem.

- Verify that the screw and safety wire on the rotor assembly are correctly installed.
- Reconnect the flowmeter to the flange.
- Verify that the bleed valve is closed.
- If the flowmeter is supplied with a pressure transmitter, open the bleed valve.
- Do not lower the turbine sensor into the pipe before calculating the proper insertion depth.

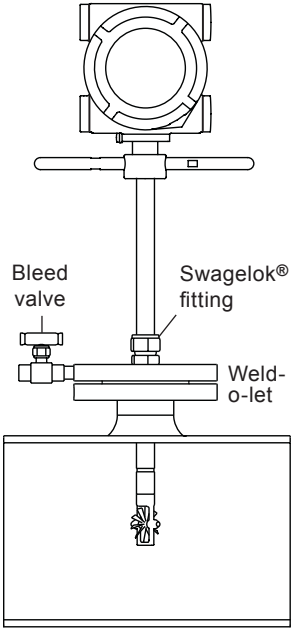


Fig. 13

RIM10-700 Flanged

3.3.2 Installation for screwed connections:

Step 1 - Tap the pipe, the hole should be at least 50 mm (2") in diameter, nominally 50 mm (2") in diameter.

Step 2 - Weld thread-o-let to pipe.

Step 3 - **Important** - Attach the tap check tool to the end of the flowmeter stem before proceeding:

- Attach the flowmeter to the thread-o-let.
- Verify that the bleed valve is closed.
- Use the orientation levers to manually lower the tap check tool into the pipe and then retract the tap check tool completely.
- Remove the flowmeter from the thread-o-let and inspect the tap check took for damage.
- If any has occurred, check the installation for possible clearance problems.

Step 4 - Remove the tap check tool and attach the turbine sensor (rotor assembly) to the end of the stem.

- Verify that the screw and safety wire on the rotor assembly are correctly installed.
- Reconnect the flowmeter to the thread-o-let.
- Verify that the bleed valve is closed.
- Use Teflon tape or PST on the threads to improve the seal and prevent seizing.
- If the flowmeter is supplied with a pressure transmitter, open the bleed valve.
- Do not lower the turbine sensor into the pipe before calculating the proper insertion depth.

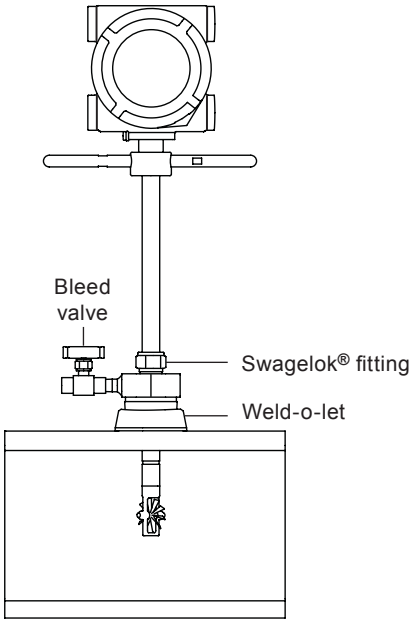


Fig. 14
RIM10-700 Screwed

3.3.3 Insertion depth measurement calculation for the RIM10-700

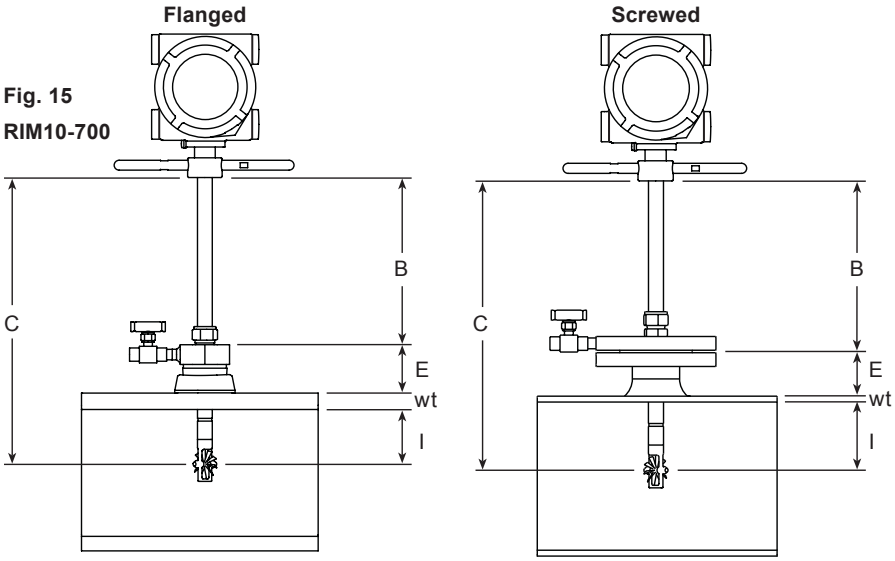
Use the following equation to calculate the insertion depth for the RIM10-700:

$$B = C - I - E - Wt$$

Where:

B = Installed dimension to be set on the flowmeter.
C = For G6 rotor 362 mm (14.25")
For L1 and G1 to G5 rotors 368 mm (14.50")
I = For pipe sizes less than 300 mm (12"), inside pipe diameter ÷ 2
For pipe sizes 300 mm (12") and larger, inside pipe diameter ÷ 4
E = Distance from the raised face of the flange or top of the screwed fitting to the outside pipewall.
Wt = Thickness of the pipe wall. The disk cut-out or 'coupon' from the tapping procedure can be measured, or this number can also be obtained from a piping handbook.

Fig. 15
RIM10-700



Example:

An RIM10-700 with a G6 rotor is to be installed on a 300 mm (12") Schedule 40 pipe. The following measurements have been obtained:

C = 362 mm (14.25")
I = 303.2 ÷ 4 = 75.8 mm (11.938" ÷ 4 = 2.98)
E = 114.3 mm (4.5")
Wt = 10.3 mm (0.406" 12" Schedule 40)
B = C-I-E-Wt = 362 - 75.8 - 114.3 - 10.3 = 161.6 mm (14.25" - 2.98" - 4.5" - 0.406" = 6.364")

Manually insert the stem into the pipe until the calculated insertion depth is obtained. Align the rotor by using the orientation levers so that the flow direction arrow is parallel to the pipe and pointing downstream.

Lock the stem in position by tightening the Swagelok® fitting. Verify insertion depth prior to final tightening of the fitting. When the fitting has been tightened, the stem position becomes permanent and cannot be changed.

3.3.4 Rotor orientation and final positioning

Caution: Do not force the stem into the pipe. If the stem insertion is blocked, retract and remove the flowmeter from the pipeline, checking to make sure the opening conforms with the guidelines listed in the mounting guidelines.

Manually insert the stem into the pipe until the calculated insertion depth is obtained. Align the rotor by using the orientation levers so that the flow direction arrow is parallel to the pipe and pointed downstream.

Lock the stem in position by tightening the Swagelok® fitting. Verify insertion depth prior to final tightening of the fitting. When the fitting has been tightened, the stem position becomes permanent and cannot be changed.

3.4 Remote mounting of the electronics

The RIM10 flowmeter electronics condulet can be remotely mounted using the pipe mount or wall mount options.

Cable and 'U' bolts are supplied with the mounting plate. A maximum of 30.5 m (100 ft) of cable can be used. Cable must be run in conduit (not supplied). Conduit connections are 18 mm (¾").

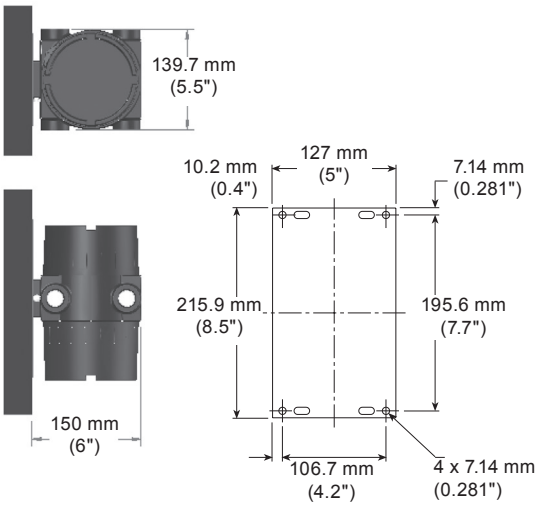


Fig. 16 Wall mount electronics

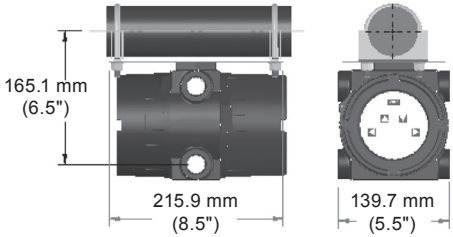


Fig. 17 Pipe mount electronics

4. Electrical installation

4.1 General information - Electrical installation

The electronics within the RIM10 Series rotor insertion flowmeters amplify and convert the raw turbine flow signals into a number of different analog output signals. Available outputs are:

- **Square wave pulses**
  - Raw or adjusted flow frequency.
  - The open-collector output circuit drives inductive loads up to 60 Vdc.
- **4-20 mA current loop**
  - Volumetric, mass, energy flow values, pressure, temperature.

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

- **Modbus RTU**
  - Half-duplex RS-485
- **Modbus TCP/IP**
  - Full-duplex, 10/100 BaseT Ethernet
- **Http Interface (Web)**
  - Virtual front panel display and set-up wizard using Internet Explorer 6.0 or later on a standard PC

The electronics within the RIM10 Series rotor insertion flowmeters are housed in a cast aluminum condulet housing. The condulet is rated for Class I, Div II environments. All field wiring to the flowmeter is connected to the terminal blocks and RJ-45 network port located beneath the rear screw cover (opposite end to the display).

Wiring recommendations

Using the correct wiring is essential to achieving satisfactory performance and reliability. Spirax Sarco recommend the following:

1. Use shielded wire for all inputs and outputs. For example, use Belden 9451P for 4-20 mA current loops, especially in noisy electrical environments.
2. Select the correct wire gauge. 0.52 mm² - 0.20 mm² (20 - 24 AWG) stranded wire is recommended. For Ethernet and Modbus RTU, Cat 5, Cat 5e, or Cat 6 type cable is recommended, such as Belden 1624P.

Interface	Recommended cable	Maximum cable length
RS485	Belden 9841	1 220 m (4 000 ft)
4-20 mA current loop	Belden 9451P	300 m (1 000 ft)
Pulse out	Belden 82842	300 m (1 000 ft)
Ethernet	Belden 1624P	100 m (328 ft)
Relay out	Belden 9504	300 m (1 000 ft)
Remote head	Belden 9504	30 m (100 ft)

Hum and noise

Although the RIM10 is designed to operate reliably in industrial environments, the maximum run length for the 4-20 mA current loop input sensors and Modbus RTU over RS485 may be reduced due to noise and noise pickup along the cable. The use of properly grounded shielded twisted pair (STP) cable helps to limit the effects of interference in most cases.

The electronic signal within a cable can suffer from electrical interference if near to electrically noisy equipment, such as welder and motor drives. If the cable is near to such equipment, the cable should be run inside a grounded conduit to protect it.

4.1.1 Ground loops

Ground loops may interfere with signal transmission by superimposing unwanted signals on the desired signals. This may be prevented by correctly connecting the cable shields. Metal or plastic pipelines determine the shield to be used.

Metal pipelines are usually earth grounded. Thus, the cable shield should not be connected at the flowmeter. The shield should be connected to a specific instrument earth ground at the control panel.

Plastic pipelines require the transmitter condulet to be connected to an earth ground. To do this, connect the condulet to the earth ground by attaching a cable or braid form the earth ground to the external ground lug on the condulet. Alternatively, connect the signal cable shields to the condulet via one of the terminal board mounting screws or J3 pin 19.

The flowmeter enclosure must be connected to the local earth ground by a 3.31 mm² (12 AWG) wire. Use the nut on the side of the condulet to make this ground connection secure.

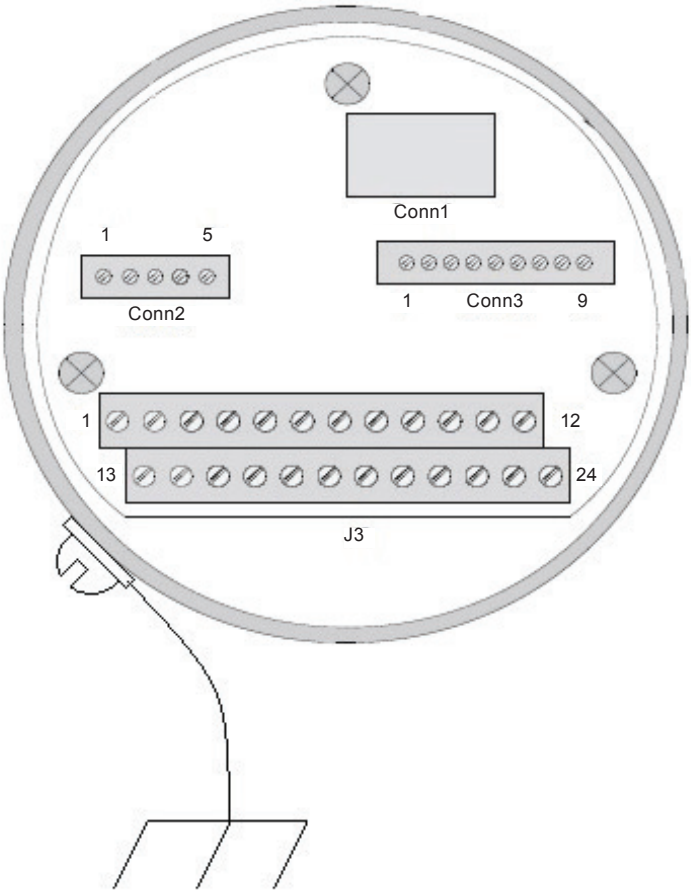


Fig. 18 Enclosure earth ground

4.2 Wiring the flowmeter

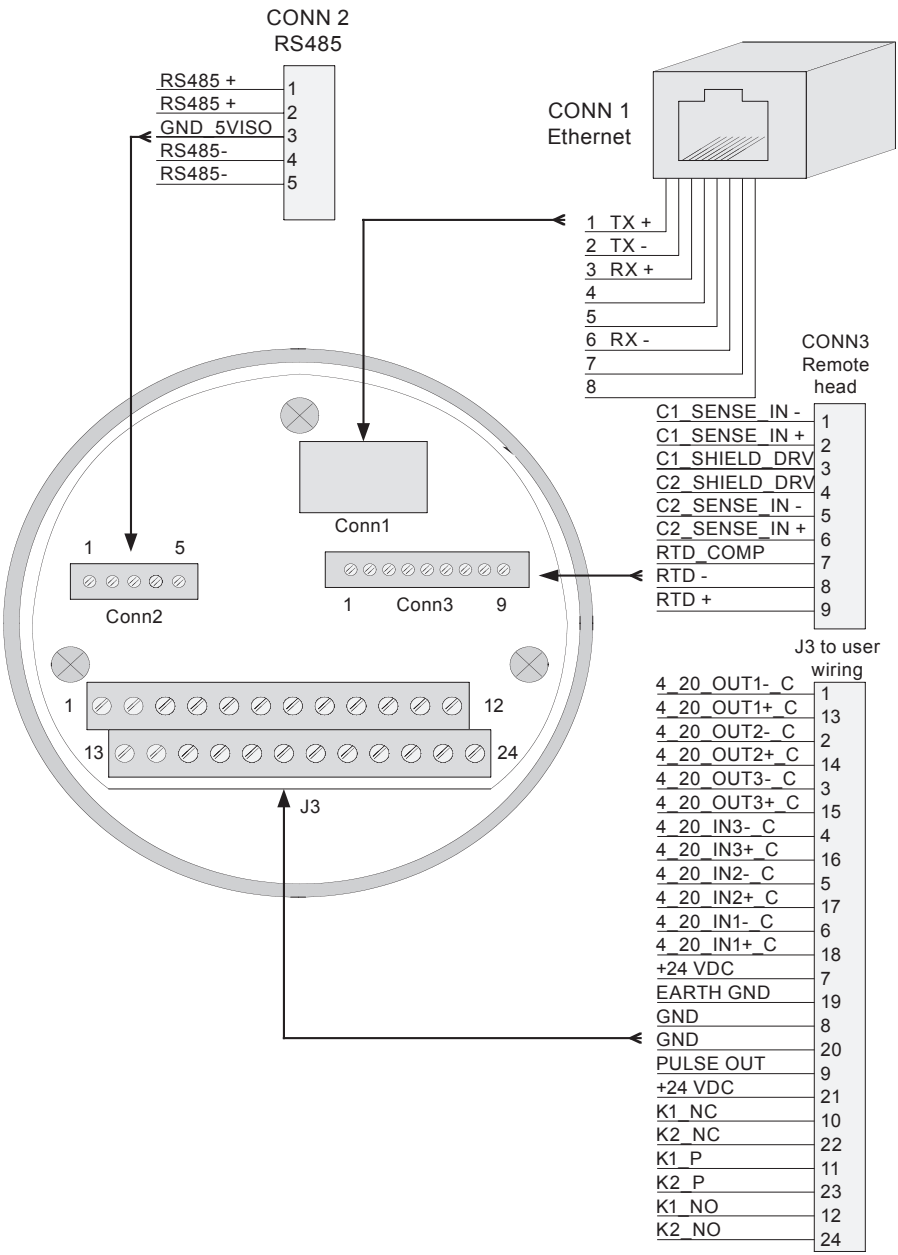
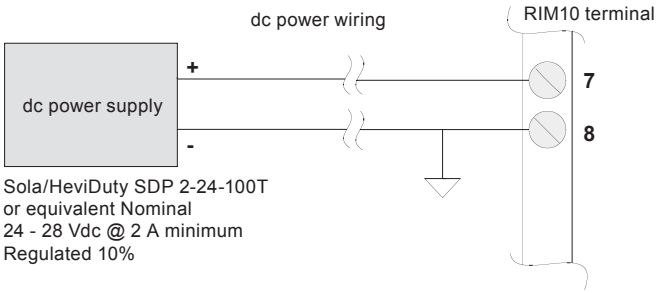


Fig. 19 Wiring connections are summarised in the following figure

4.2.1 dc power

Wire the dc power as shown in Figure 20 using 0.82 mm² - 0.33 mm² (18 - 22 AWG) gauge wire. The dc supply can be anywhere from 12 - 32 V, but 24 V is recommended.
On installation the RIM10 shall be provided with supply transient protection external to the apparatus such that the voltage at the supply terminals of the RIM10 does not exceed 140% of the voltage rating of the equipment.

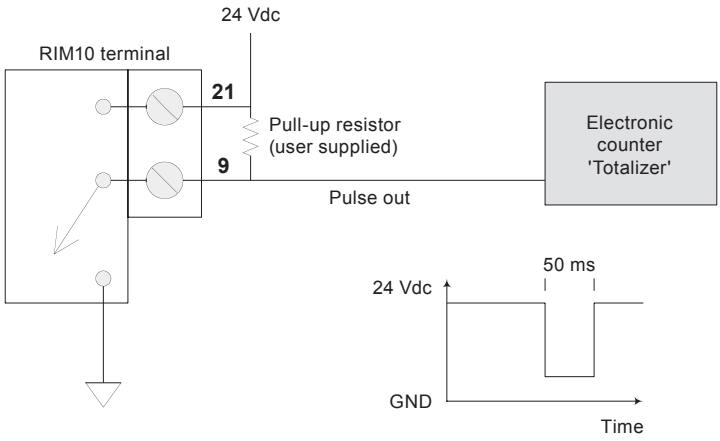
Fig. 20



4.2.2 Pulse output

The pulse output provided by the RIM10 is a sinking type output only. A pull-up resistor is required, and can be installed between pins 9 and 21 on the screw terminal block - See Figure 21. The resistor value is dependent on the totalizer requirements. At 2 k, a half-watt resistor is required. The pulse width is fixed to 50 ms. The load current is 100 mA max, 28 V peak.

Fig. 21



4.2.3 External 4-20 mA current loop output

Three output channels are available for connection. These are 2-wire current loop connections. The positive side is connected to the 24 Vdc supply at pin 7. The negative side is connected to the 4-20 mA receiver input terminal. The receiver should have the common or ground terminal connected to the power supply ground as shown in Figure 22. In the diagram, channel 1 is used as an example with terminal numbers 13 (positive) and 1 (negative). The terminal numbers will change for channels 2 and 3 as listed in Figure 24.

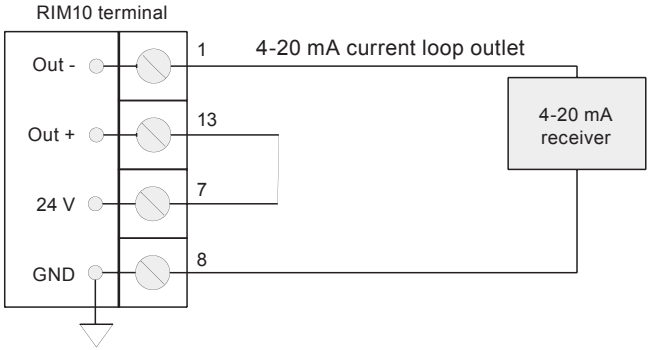


Fig. 22

4.2.4 4-20 mA current loop input

Three channels are available.4-20 mA inputs cannot be used to power the loop interface. For the inputs, the transmitter output is tied to the positive terminal, and the negative terminal is connected at the flowmeter to the supply ground. The transmitter should be powered from an external supply, or can be wired to the 24 V at the flowmeter as shown in Figure 23. The diagram illustrates channel 1 as an example, with terminal numbers 16 (positive side) and 4 (negative side). On channels 2 and 3 the terminal numbers will be different as listed on the summary wiring diagram found at the beginning of this Section - Figure 19.

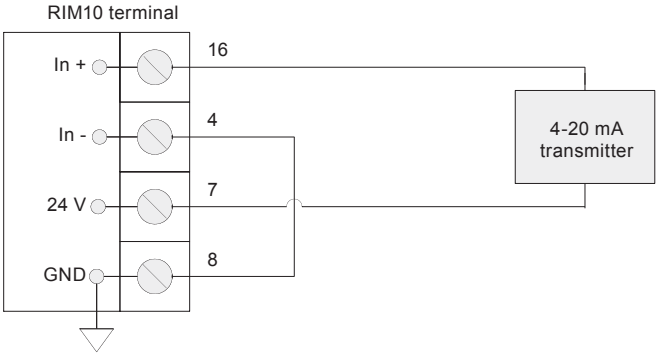
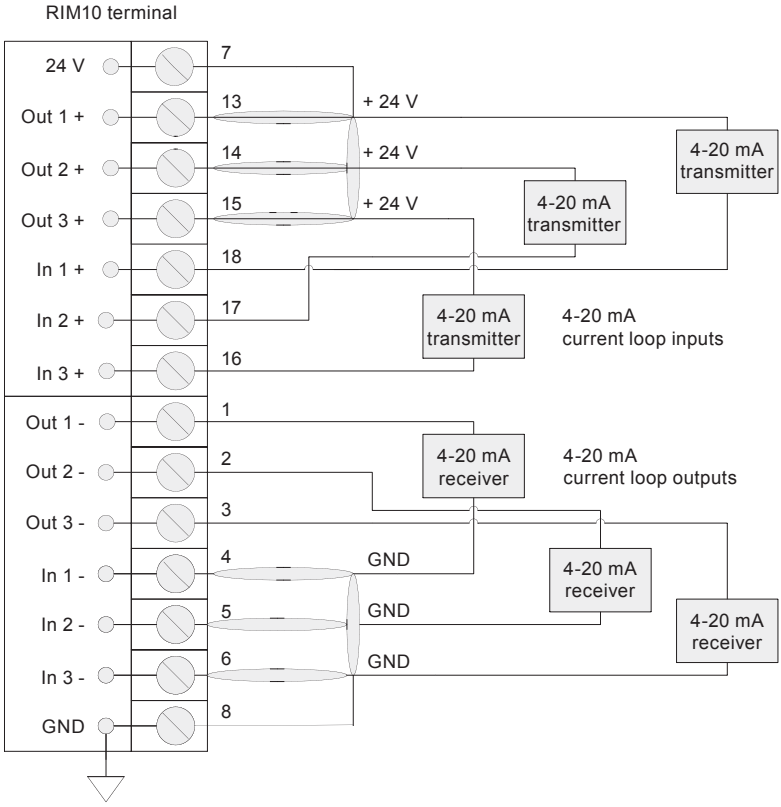


Fig. 23

4.2.5 4-20 mA current loop multiple inputs and outputs

It is not altogether obvious how to wire multiple 4-20 mA current loops without inserting too many wires into the 24 V and GND terminals. One technique is shown in the following wiring diagram - Figure 24, which depicts the worst case, which is 3 inputs and 3 outputs at the same time. In this example no more than 2 wires are tied to any terminal, and some of the ganged connections make use of flat thin jump strips that allow the 2 additional wires into those terminals. Each transmitter is connected between the 24 V supply and In+. Each receiver is connected between the Out- and GND. Each Out+ must be connected to 24 V, and each In- must be connected to GND, and the jump strips are used for these connections.

Fig. 24



4.2.6 Relay output

There are 2 single pole double throw relays available. Each has a normally-closed and normally-open contact which can be wired as shown in Figures 25 and 26. These relays provide resistance of 35 ohms maximum and switching times of less than 1 millisecond. They are limited to 120 mA of current and 350 V blocking voltage. The maximum current and voltage in hazardous environments is 50 mA and 24 V.

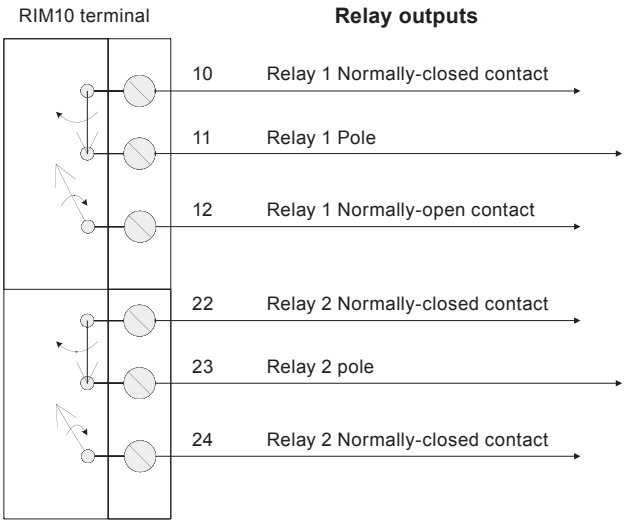


Fig. 25

An alternate view of the relay contacts is shown below:

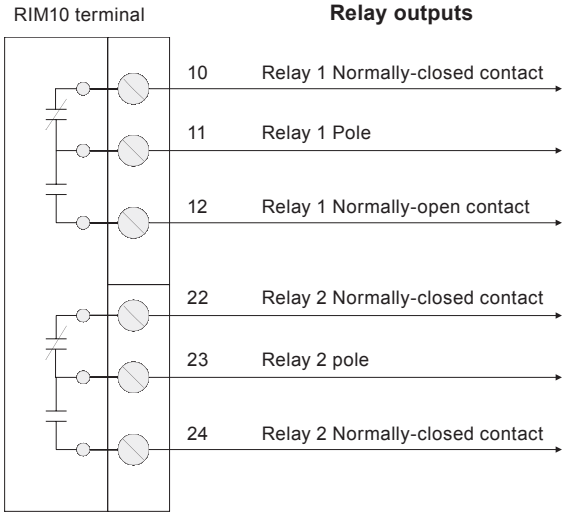


Fig. 26

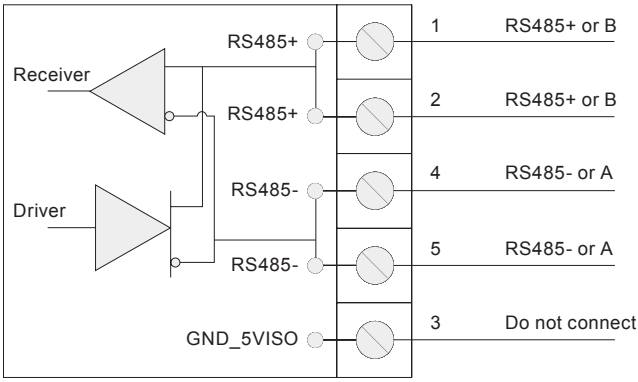
4.2.7 RS485 communications

A single 2-wire RS485 half-duplex communications channel is provided, and can be used as a Modbus RTU. Wiring is as shown in Figure 27.

Caution: Please note that EIA standard 'B' and 'A' terminal labels are used, which are opposite those used by some transceiver manufacturers (for example, Texas Instruments), so care must be taken to not invert the polarity of the signal wires.

Note that by providing 2 pairs of terminals, the connections can be daisy-chained. Typically one pair of wires would come from the previous node, and a separate pair of wires would go on to the next node. In this case, the first paired cable would be connected to pins 1 and 4, and the second paired cable would be connected to pins 2 and 5.

Fig. 27



Placing a jumper between pins 1 and 2 of connection 4 will make the RS485 port a terminal port with 120 ohm resistor termination. This only needs to be done on 2 nodes in the network. Pins 1 and 2 are the 2 pins farthest from connection 2.

4.2.8 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, and can be connected to with readily available Ethernet cables or patch cords.

4.3 Remote mount option

The remote mount option allows the main RIM10 electronics to be mounted at a distance from the RIM10 flowmeter at the pipe. The main electronics may be separated from the flowmeter by up to 30.5 m (100 ft) of wiring. Standard shielded twisted-pair cable (Category 5, 5e or 6) is recommended. Proposed mounting locations should be reviewed and wiring runs measured prior to installation. Failure to observe maximum wiring lengths can prevent the flowmeter from operating and may void the warranty.

In the remote mount situation, the shields from the sensor cable and the pressure transmitter should only be connected to earth ground at the main electronics terminal board. A pigtail from the shields can be inserted in J3 terminal 19 to complete the earth ground connection. **Do not terminate any other cable shields at the main electronics enclosure.**

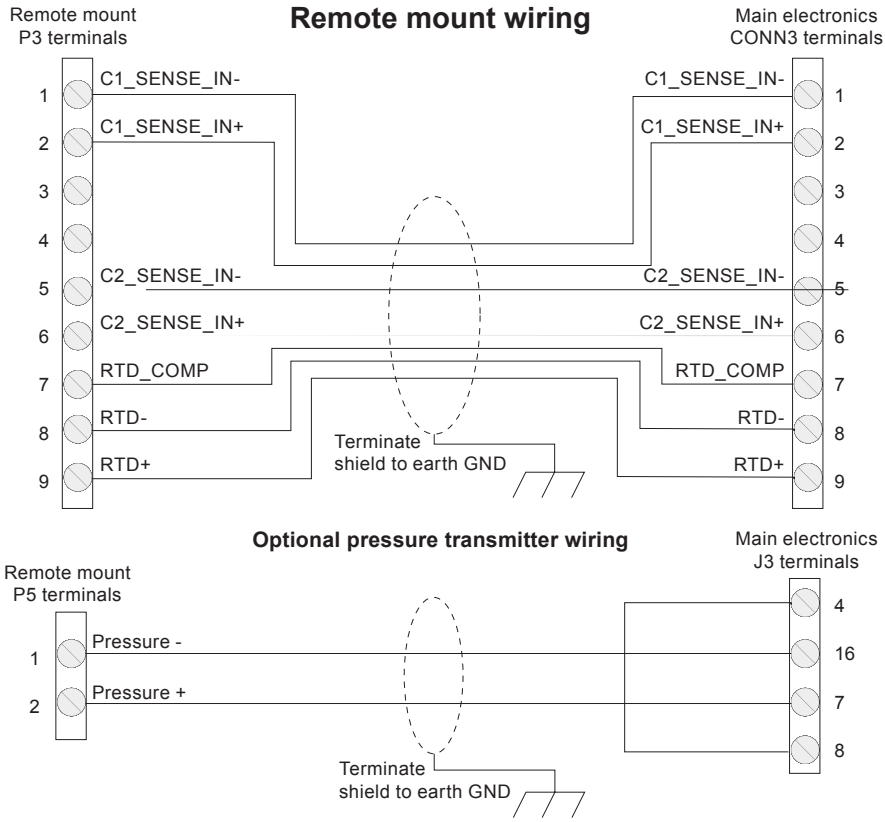


Fig. 28 Remote mount wiring

Note: After wiring is complete, it should be possible to measure the following approximate resistance at 22°C (71.5°F):

RTD- to RTD+	107 Ω to 112 Ω at room temperature
RTD- to RTD_COMP	0 Ω to 1.2 Ω
C1_SENSE_IN+ to C1_SENSE_IN-	310 Ω to 320 Ω
C2_SENSE_IN+ to C2_SENSE_IN-	310 Ω to 320 Ω at stem temperature above 22°C (71.5°F) the resistance values will be greater

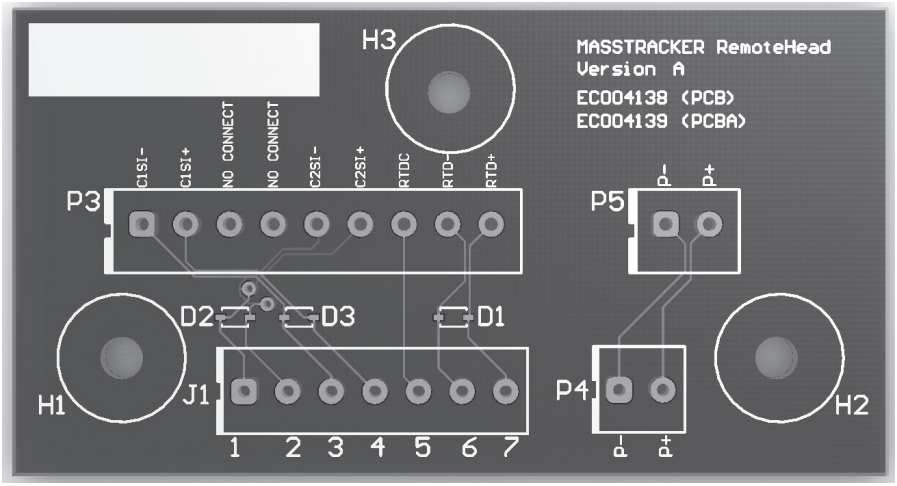
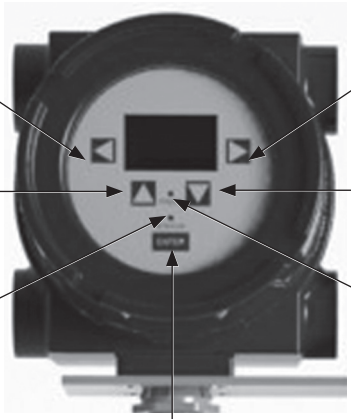


Fig. 29 RIM10 remote mount PCBA

Wiring notes:

1. Use twisted wire for the wire pair C1_SENSE_IN- (P3 Terminal 1) and C1_SENSE_IN+ (P3 Terminal 2).
2. Use twisted wire for the wire pair C2_SENSE_IN- (P3 Terminal 5) and C2_SENSE_IN+ (P3 Terminal 6).
3. Use twisted wire for the wire pair RTD- (P3 Terminal 8) and RTD+ (P3 Terminal 9).

5. Configurating your flowmeter



Left arrow key
moves to the previous screen / digit

Right arrow key
moves to the next screen / digit

Up arrow key
moves up to the next option or increase value

Down arrow key
moves down to the next option or decrease value

Fault indicator light
is lit when there is a problem to address

Status indicator
light blinks when the flowmeter is operating correctly

Enter key
is used to enter a program mode or accept an option

Fig. 30

5.1 General information

The RIM10 Series can be configured through the front panel menu system. The front panel consists of an LCD and 5 button magnetic keypad. It also has an LED backlight to improve visibility in dim environments. The keypad buttons are actuated only by the presence of a magnetic field. A magnetic wand is included with each flowmeter to activate the keys. Each keypad has a green LED behind it. When the keypad senses the magnetic wand over it, the green LED will turn on. A correct key 'press' with the magnetic wand must turn the LED on and then off.

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

Navigating the menus involves using the up and down arrow keys to select (high-light) an option from a list. When the desired option is selected, the enter key or right arrow key goes down into the next menu. To go back to a previous menu, press the left arrow key.

5.2 Run mode

On 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.

Run mode screen

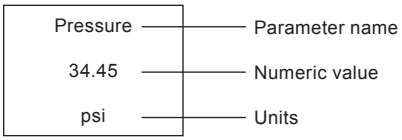


Fig. 31

The user can select which screens are displayed from a menu when in Programming mode.

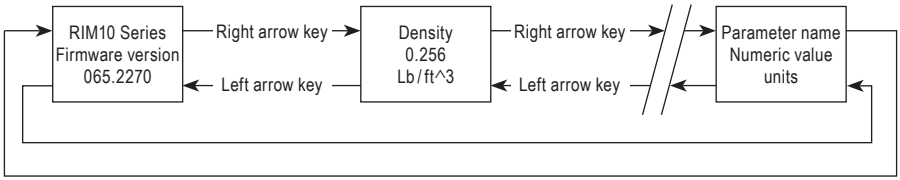


Fig. 32

The default mode cycles through each screen automatically, pausing for a user-defined amount of time between screens. It is also possible to use the left or right arrow keys to move between screens in this mode.

The up and down arrows control the LCD contrast in Run mode. To make the screen darker, press and release the up arrow key. To make the screen lighter, press and release the down arrow key.

A yellow indicator (Fault) on the front panel turns on when a fault is detected. To see a description of the fault the user must enter Programming mode and select the Faults menu.

A green indicator (Status) on the front panel blinks to indicate the unit is operating normally. When in Programming mode, the Status indicator is turned off.

5.3 Program mode

To enter Program mode, the user must hold the magnetic wand over the Enter key for at least 5 seconds. When the unit enters program mode, the Main menu will appear.

In Program mode, there are two different types of displays. The first type is a scrollable list of selectable menu items - See Figure 33. 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 - See Figure 34. The bottom line has 3 selectable fields, a left arrow, text, and a right arrow. 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.

Note: If the flowmeter does not detect a key press for 5 minutes, it will revert back to Run mode without saving any changes.

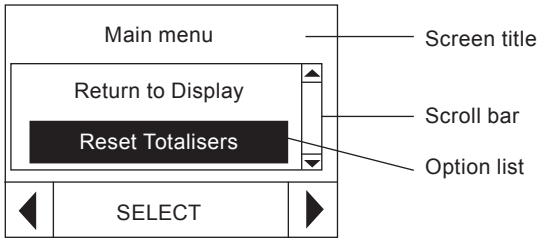


Fig. 33
Scrolling list screen

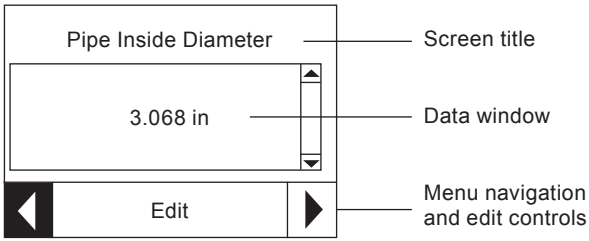


Fig. 34
Data edit screen

5.4 Data edit screen example

This sequence from the set-up wizard menu, shows in detail, the steps required to change the pipe inside diameter using the keypad - See the 'Data edit screen example' Figure 35.

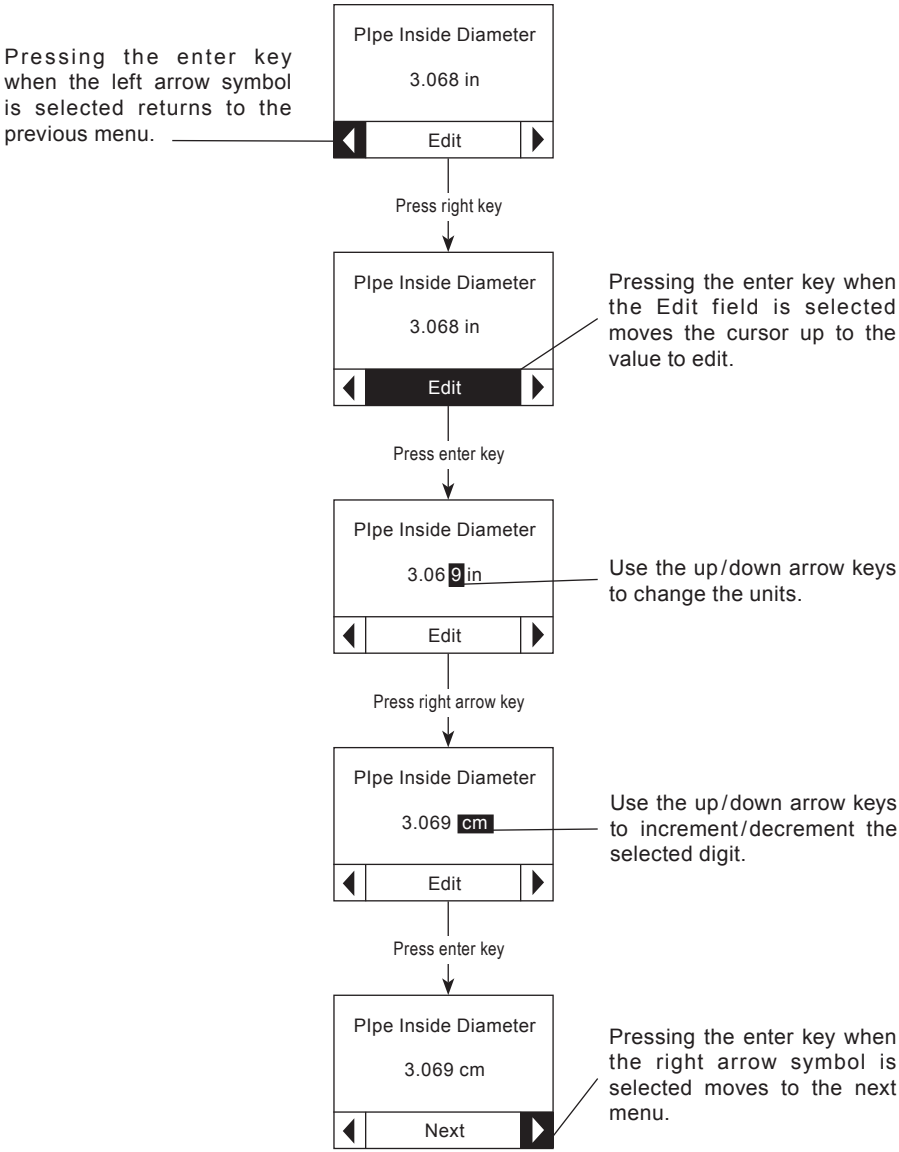


Fig. 35 Data edit screen example

5.5 Program mode menus

The Main menu is the first menu in Programming Mode - see Figure 36. To access one of the sub-menus, select the menu using the up or down arrow keys and then press the enter key 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 Display' option.

The following pages show how to navigate the sub-menus. Duplicate paths through the menus are not shown and the scrolling list screens are not shown with the scroll bar or navigation fields.

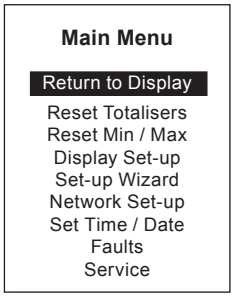


Fig. 36

5.6 Reset totalizers

This menu (Figure 37) lets the user view and/or clear the resetable totalizers. There are 4 totalizer values shown in this menu. Of the 4, only the resetable totalizers can be reset to zero. The non-resetable totalizers can be viewed in this menu, but not reset to zero.

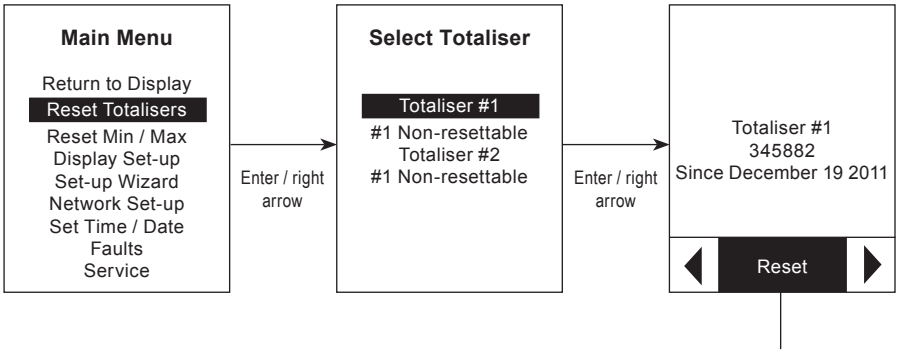


Fig. 37

5.7 Reset min / max

This menu (Figure 38) lets the user view and / or clear the minimum / maximum parameters. The user can reset all simultaneously or individually. The example below shows clearing the minimum and maximum temperature values for the first temperature sensor. The Clear Temp 1 Min / Max screen line 2 shows the maximum measured value and line 3 shows the minimum measured value.

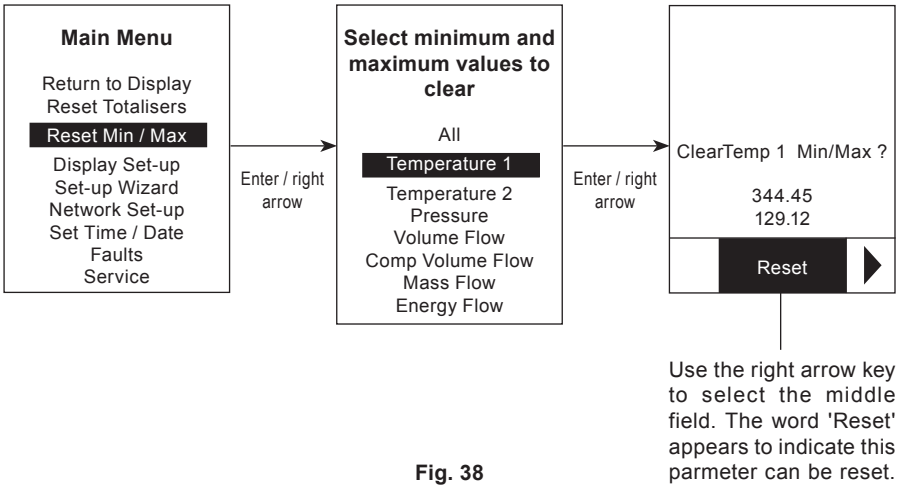


Fig. 38

5.8 Display set-up (screen selection menu) - Figure 39

This menu has 3 sub-menus: Screens On / Off, Display Units, and LCD set-up. Screens On / Off lets the user select which parameter screens they want to see during Run mode. Display Units lets the user configure different output units. LCD set-up lets the user adjust the display time delay, contrast, and backlight brightness

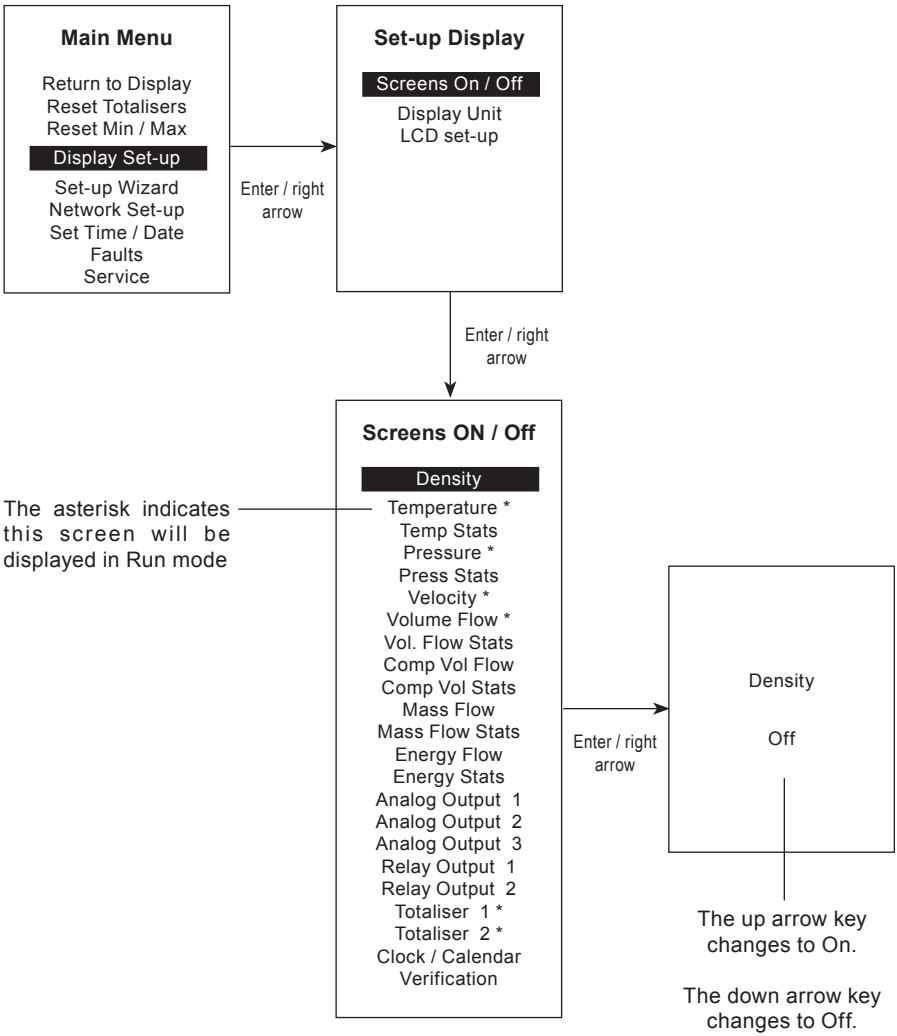


Fig. 39

5.9 Display set-up (LCD set-up menu)

LCD set-up lets the user adjust the display time delay, contrast, and backlight brightness.

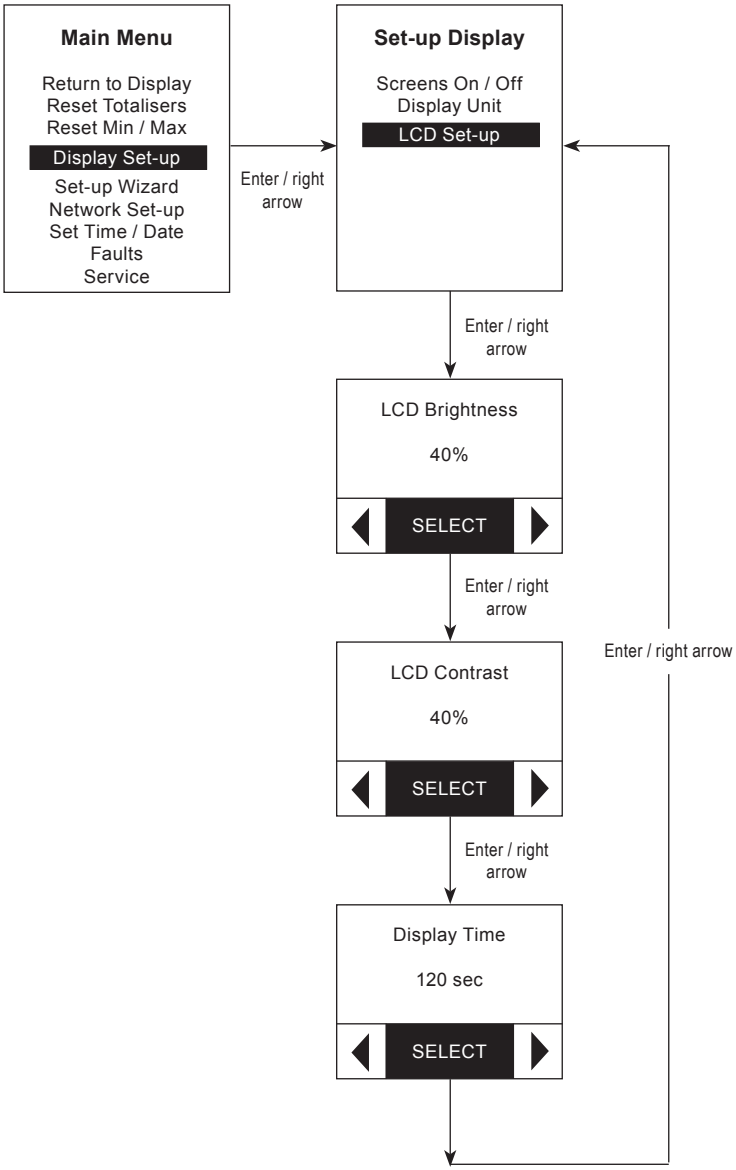


Fig. 40

5.10 Display set-up (display units menu)

Display units lets the user configure different output units.

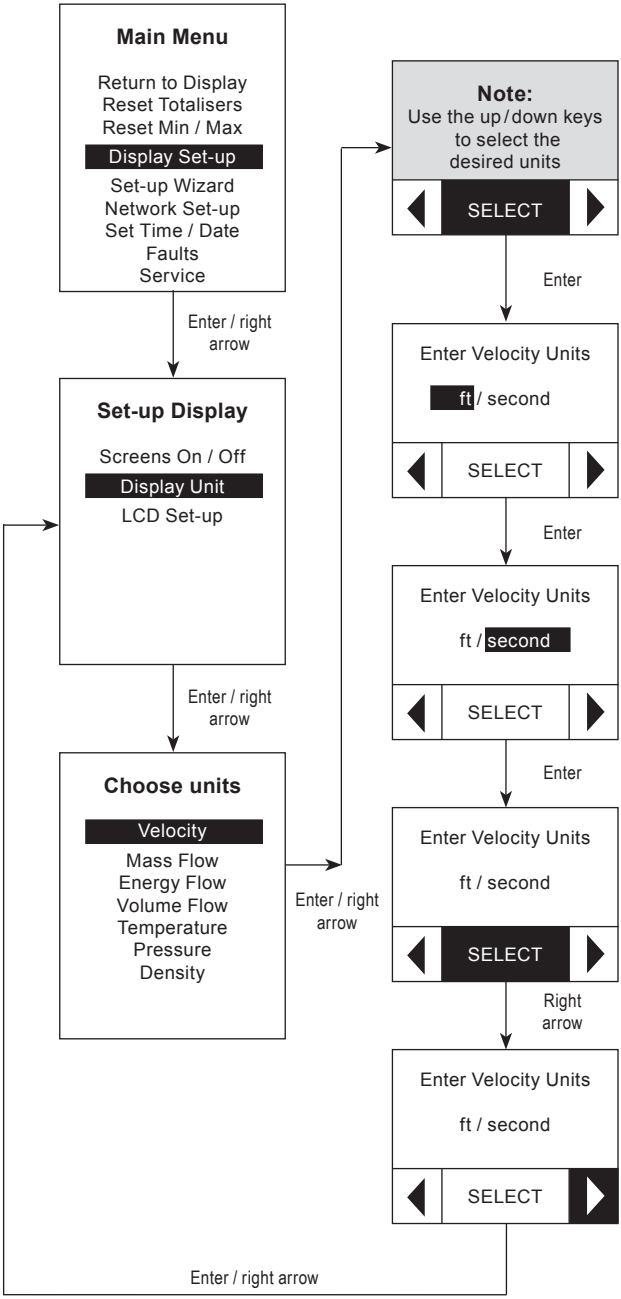


Fig. 41

5.11 Set-up wizard (general settings)

This menu (Figure 42) assists the user in setting up the flowmeter. A series of screens guides the user through set-up of the flowmeter measurement type, input and output sensor configuration, relay alarms, pulse output, and totalizer assignments.

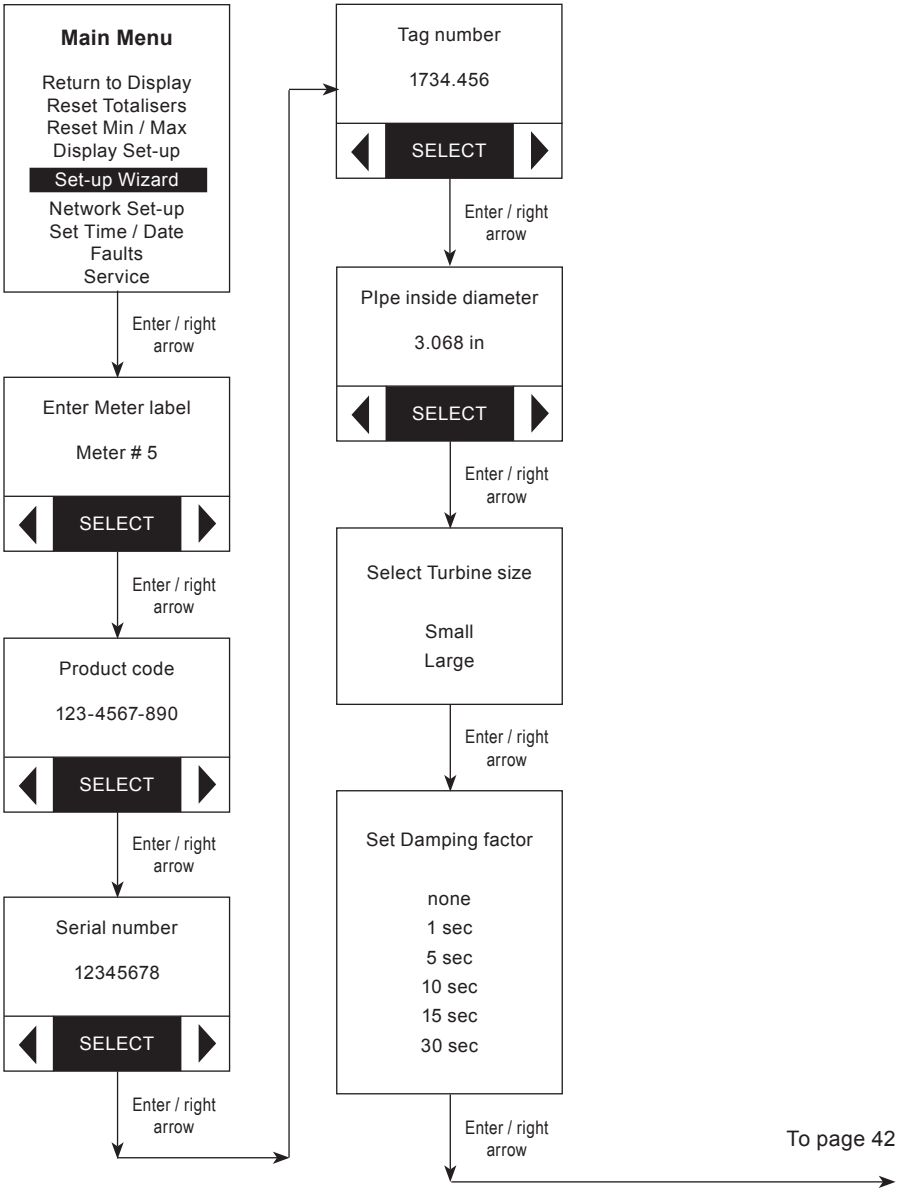


Fig. 42

5.12 Set-up wizard (frequency / velocity calibration data)

If the user needs to install a new RIM10, this menu is where the new frequency / velocity calibration data is entered - See Figure 43.

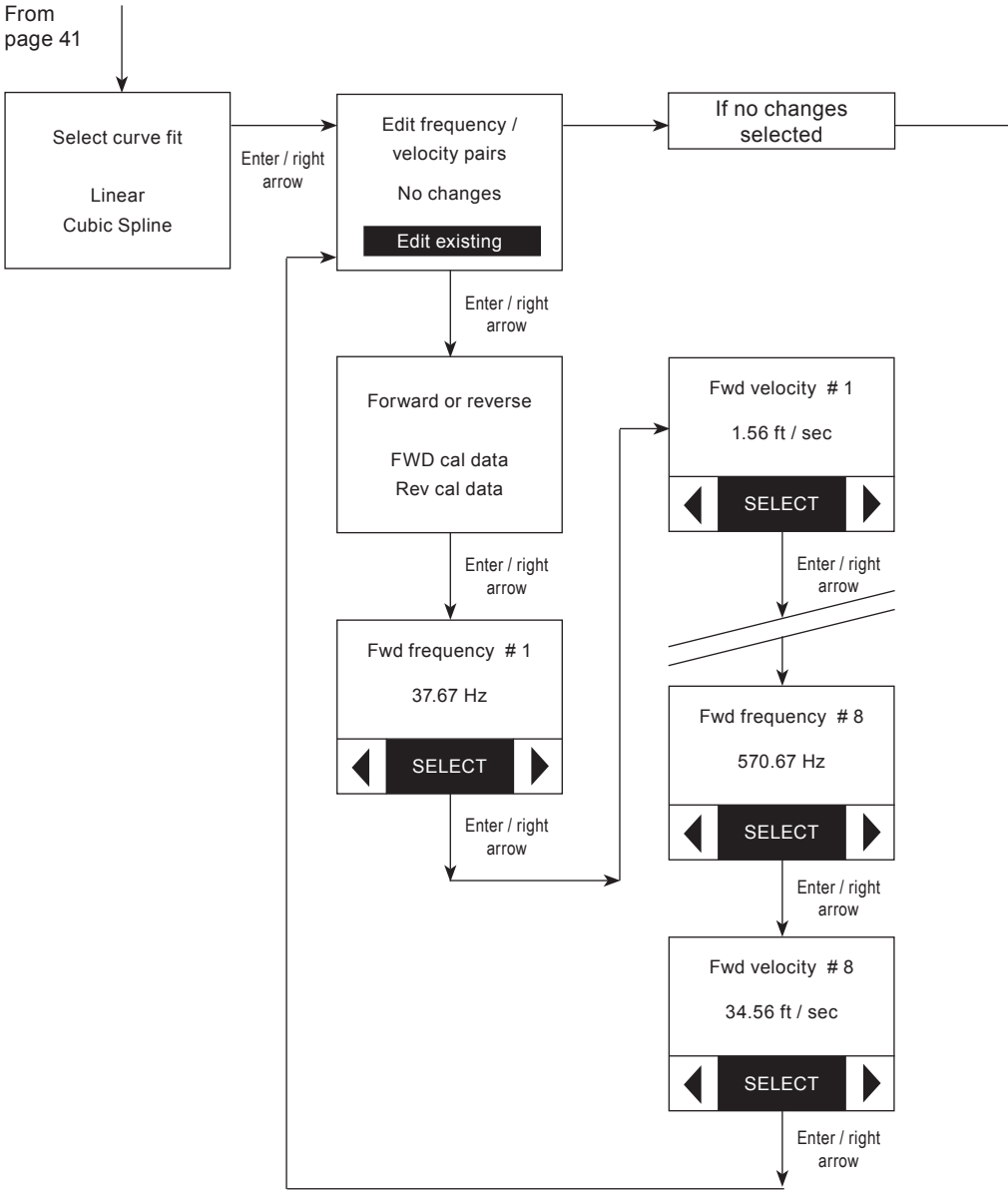


Fig. 43

5.13 Set-up wizard (measurement type)

This menu (Figure 44) lets the user select the type of measurement and configure the sensor inputs.

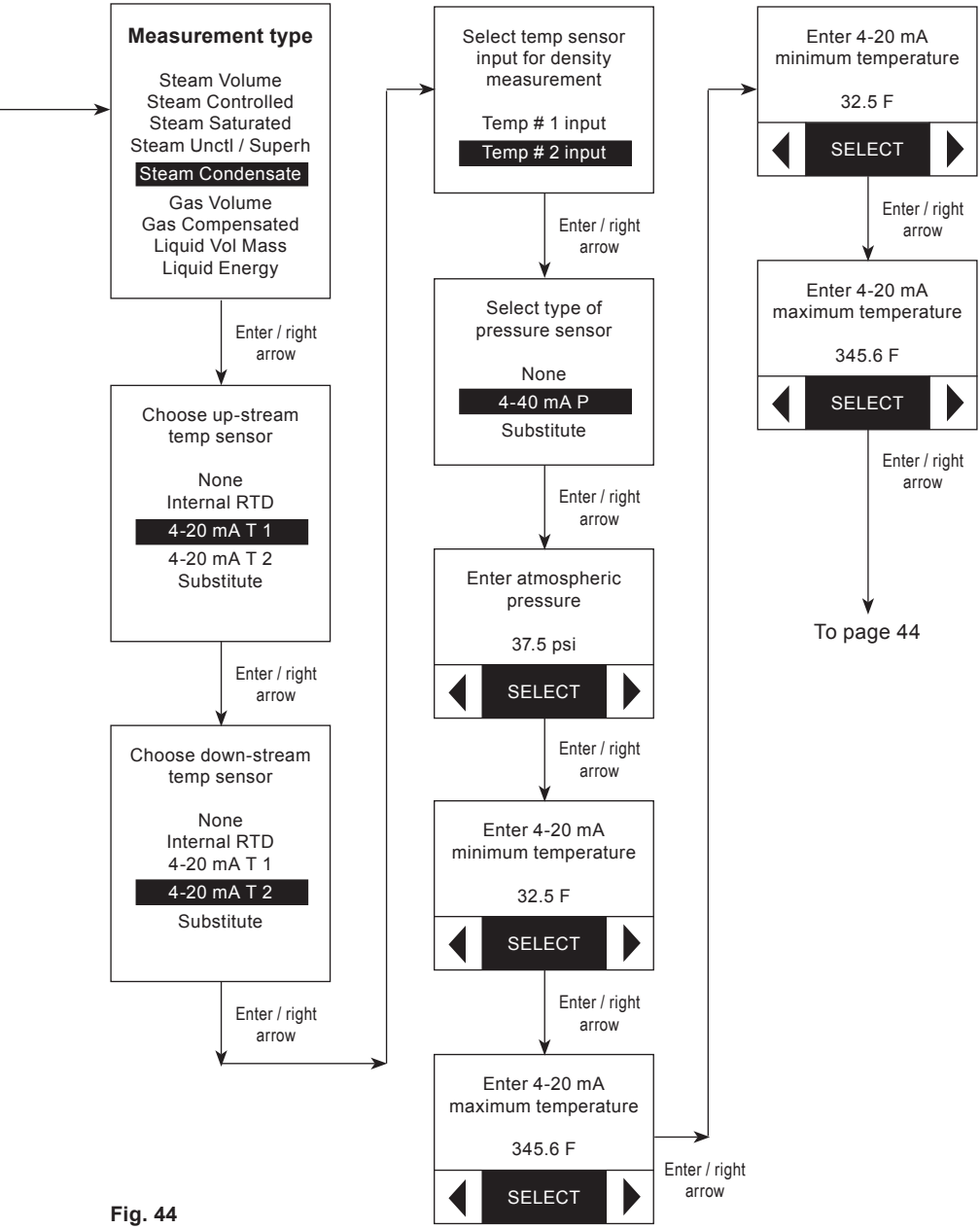


Fig. 44

5.14 Set-up wizard (totalizer assignment)

This menu (Figure 45) lets the user configure the 2 totalizers.

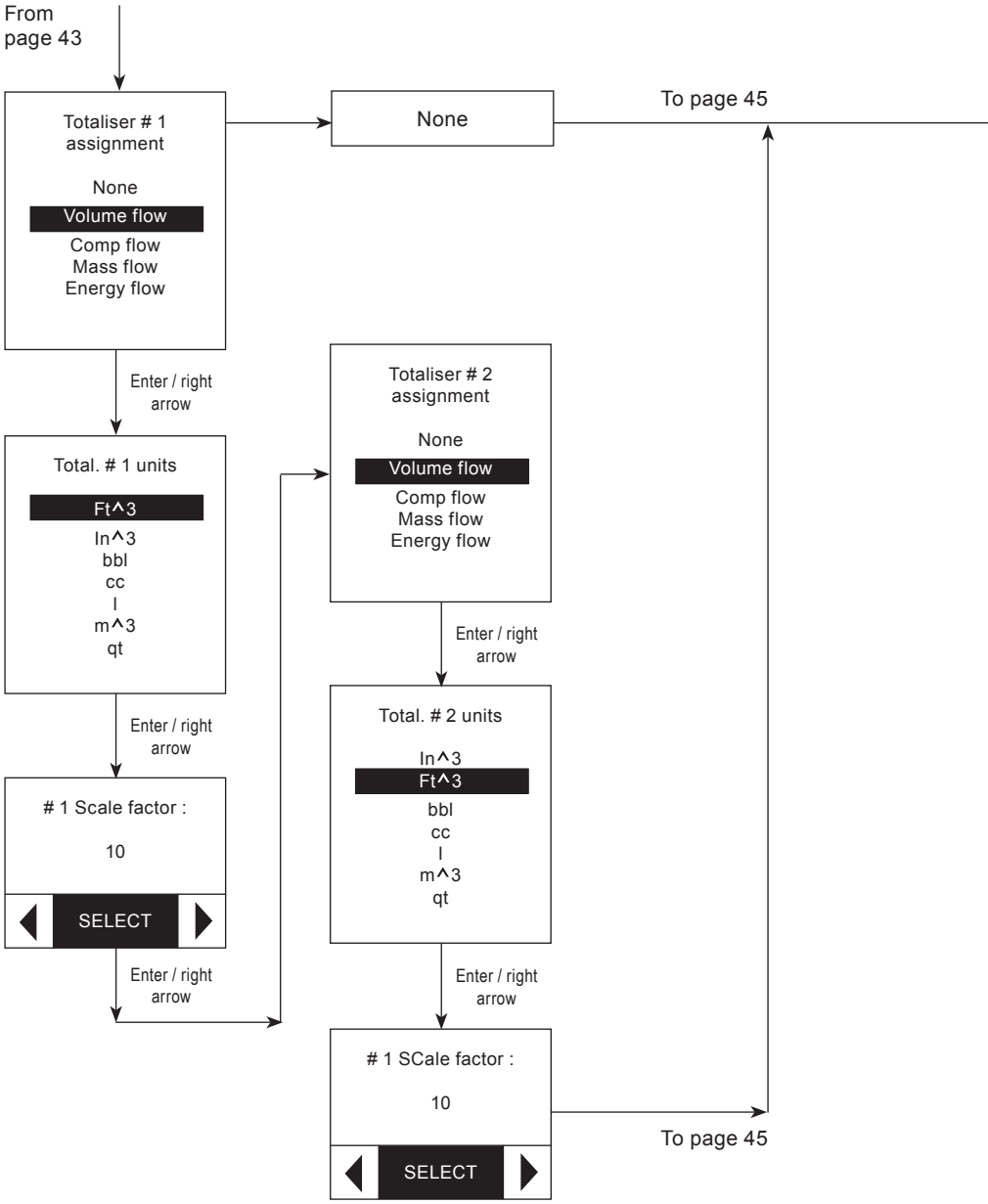


Fig. 45

5.15 Set-up wizard (analog outputs)

This menu (Figure 46) lets the user configure the three analog outputs.

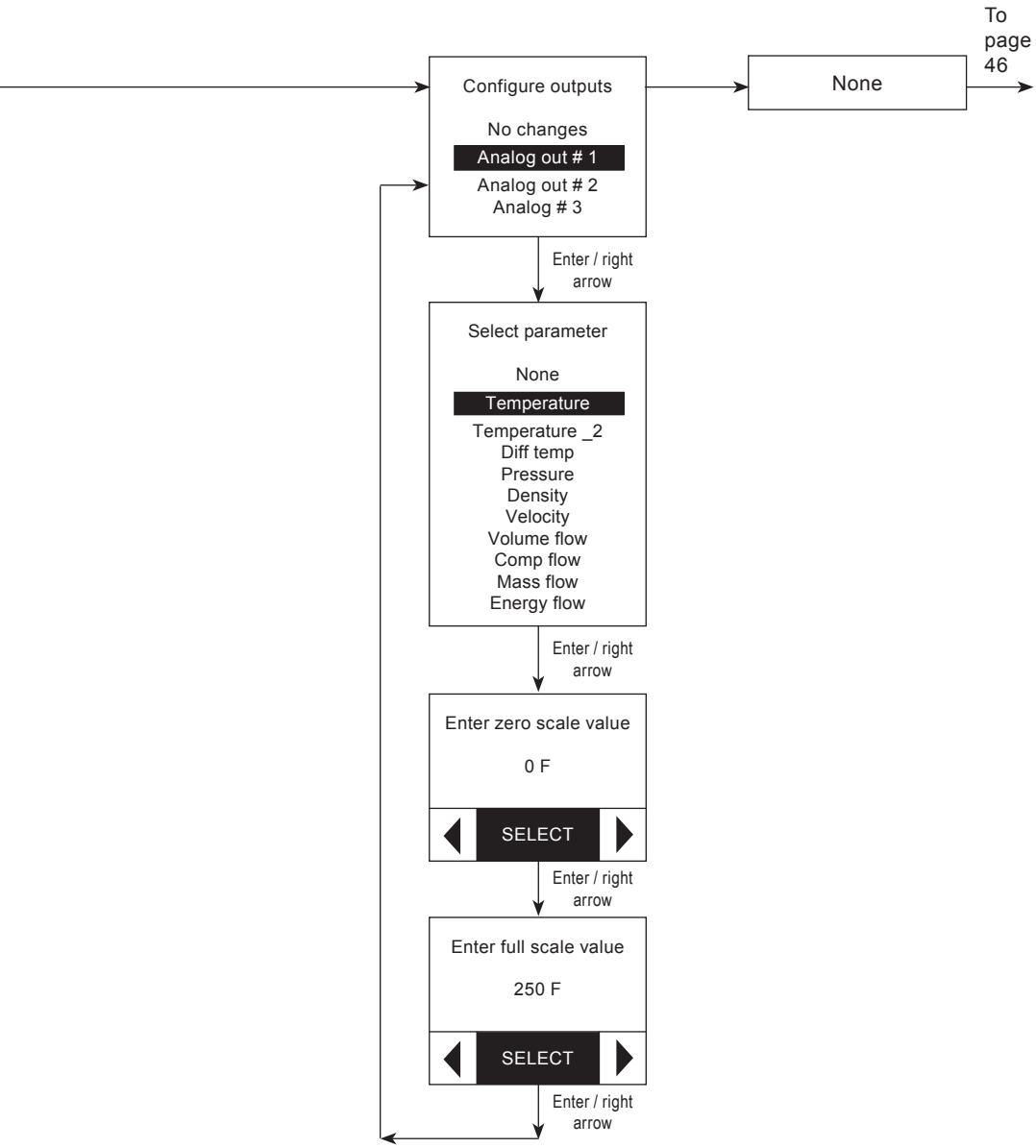


Fig. 46

5.16 Set-up wizard (relay 1 alarm)

This menu (Figure 47) lets the user configure Relay 1 alarms.

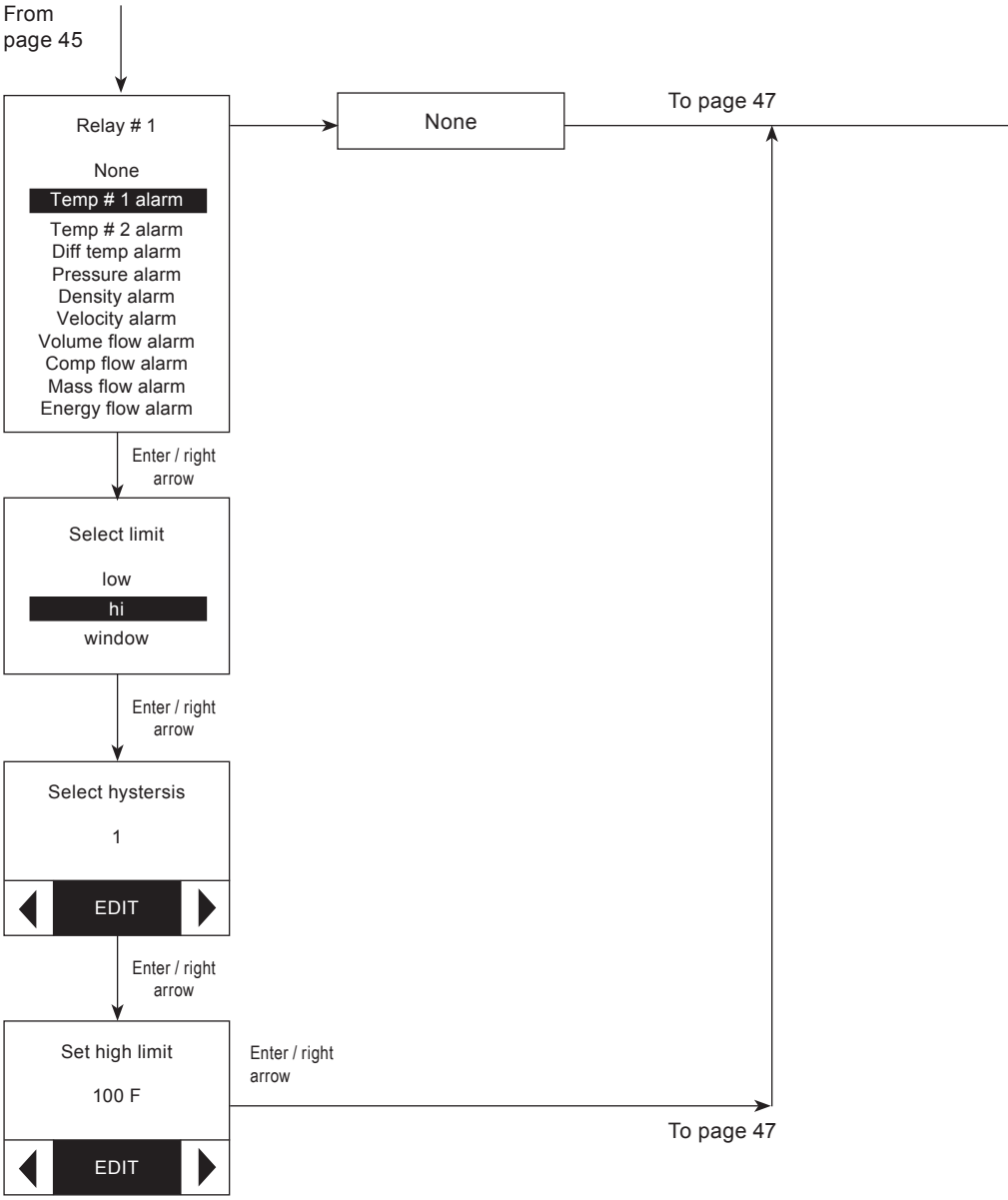


Fig. 47

5.17 Set-up wizard (relay 2 alarm)

This menu (Figure 48) lets the user configure Relay 2 alarms.

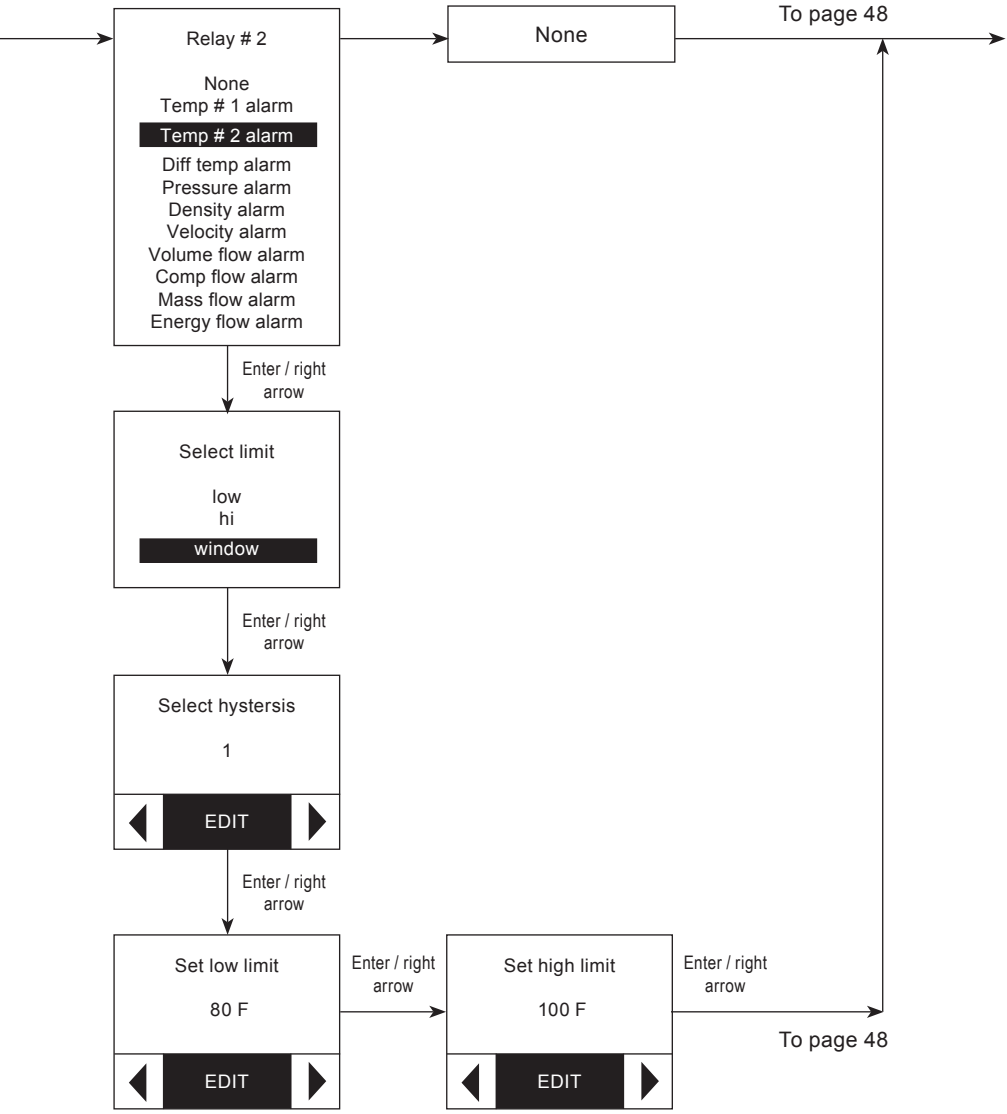


Fig. 48

5.18 Set-up wizard (pulse output frequency)

This menu (Figure 49) lets the user configure the pulse output.

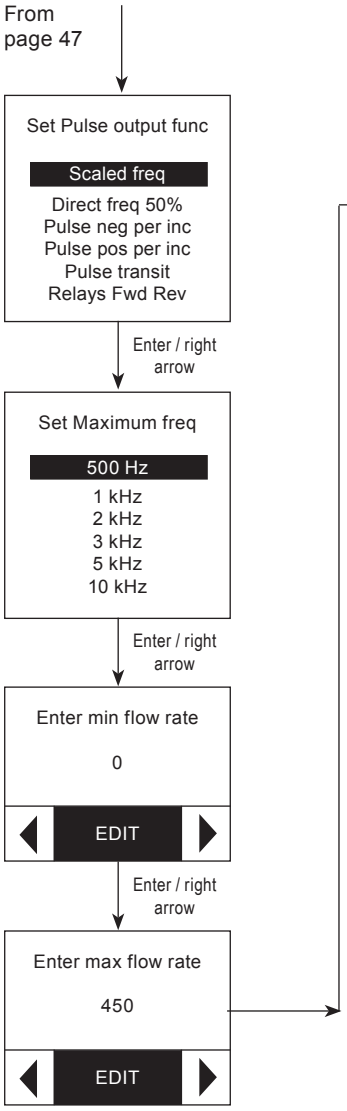


Fig. 49

5.19 Set-up wizard (pulse output totalizers)

This menu (Figure 50) lets the user configure the pulse output.

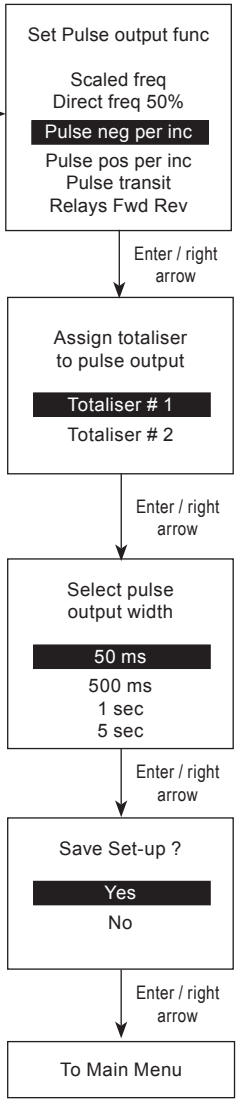


Fig. 50

5.20 Set-up network (ModBus RTU)

This menu lets the user set the Modbus or Ethernet parameters. Two ModBus interfaces are available: RTU or TCP. The menu below (Figure 51) shows the RTU set-up.

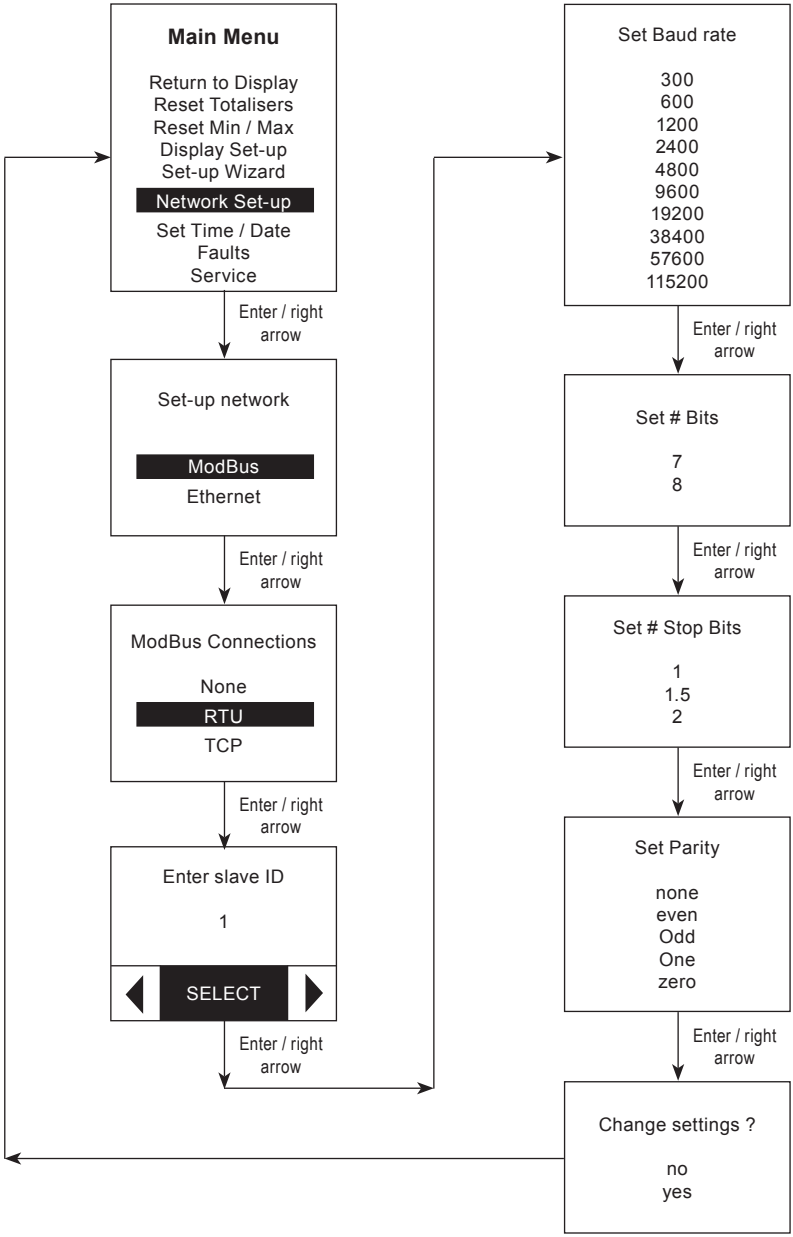


Fig. 51

5.21 Set-up network (Modbus TCP)

This menu (Figure 52) shows the TCP Modbus menu.

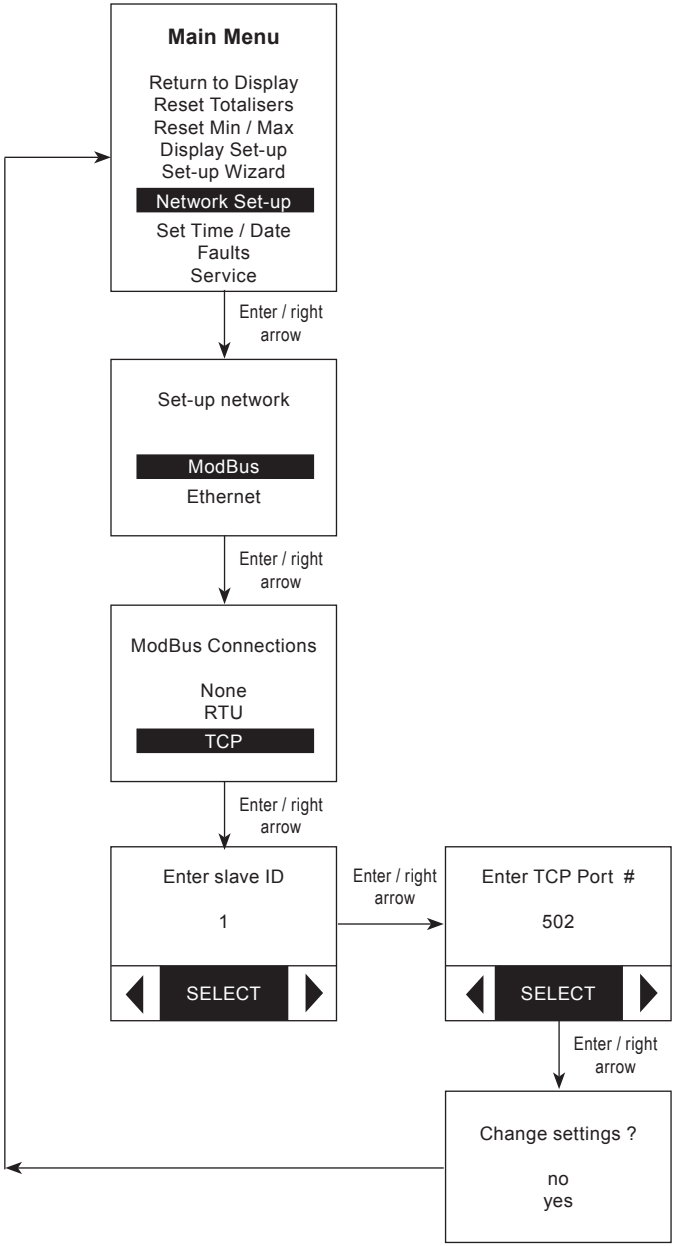


Fig. 52

5.22 Set-up network (Ethernet)

This menu (Figure 53) lets the user enter Ethernet parameters.

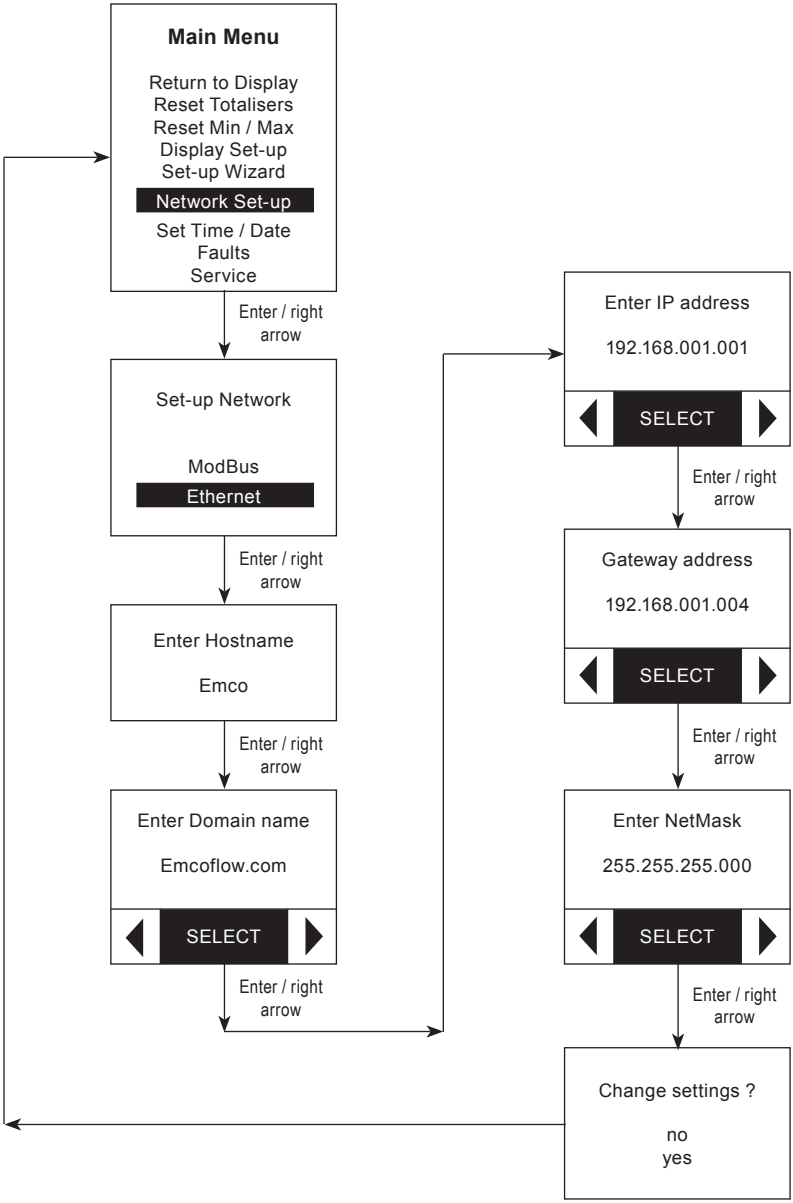
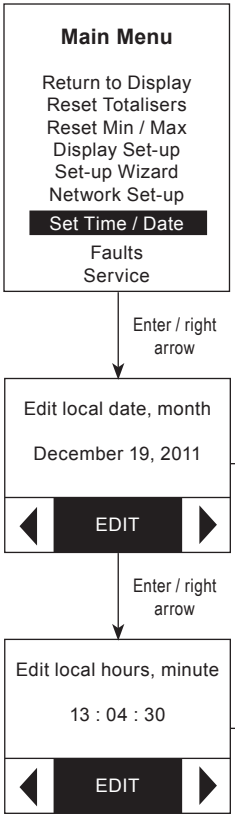


Fig. 53

5.23 Set time / date

This menu (Figure 54) lets the user adjust the month, date, year, and local time.



Press the enter key when the Edit field is selected to change the month, date and year.

Press the enter key when the Edit field is selected to change the hours, minutes and seconds.

Fig. 54

5.24 Faults

This menu (Figure 55) lets the user 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 the 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.

For a complete list of fault error codes see pages 82 and 83.

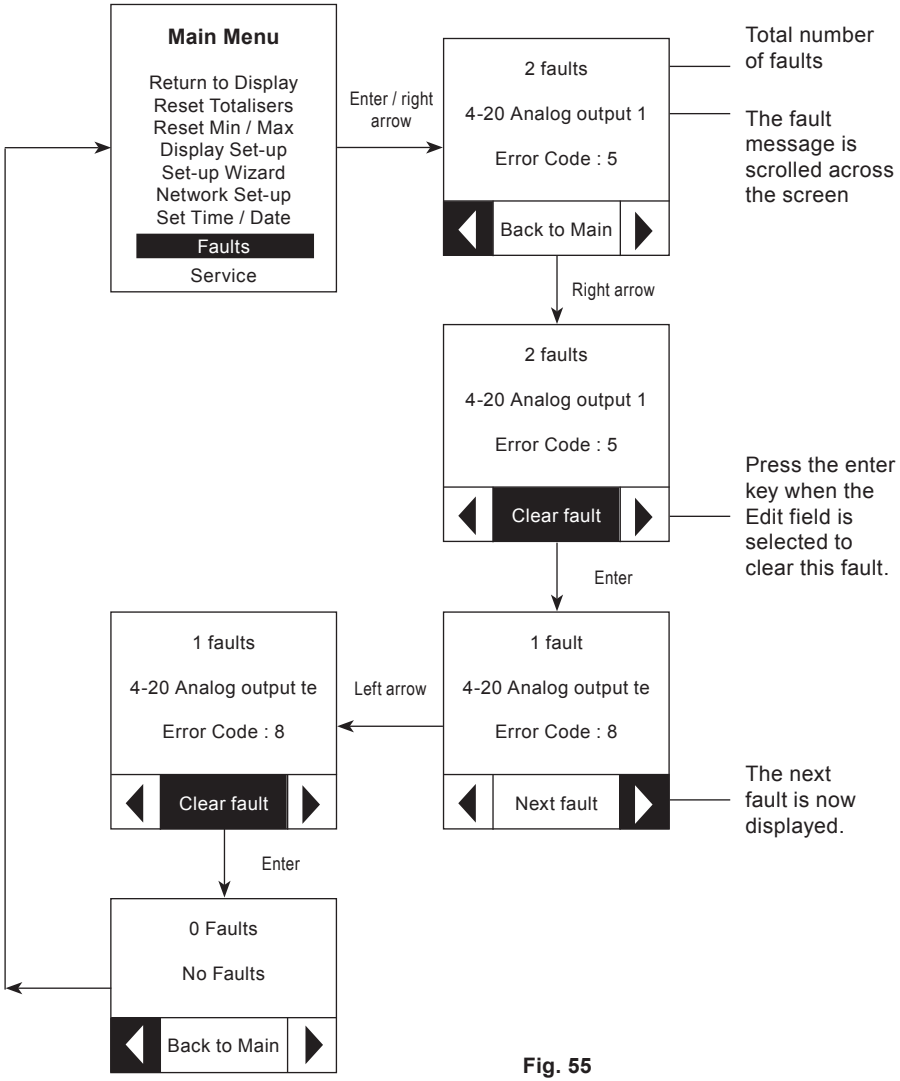


Fig. 55

5.25 Service (calibrate 4-20 mA input / output)

This menu (Figure 56) lets the user calibrate the three 4-20 mA input and output channels. It requires the user to use an external ammeter to measure the calibration current. See the Section on calibrating Analog Input and Output - page 84.

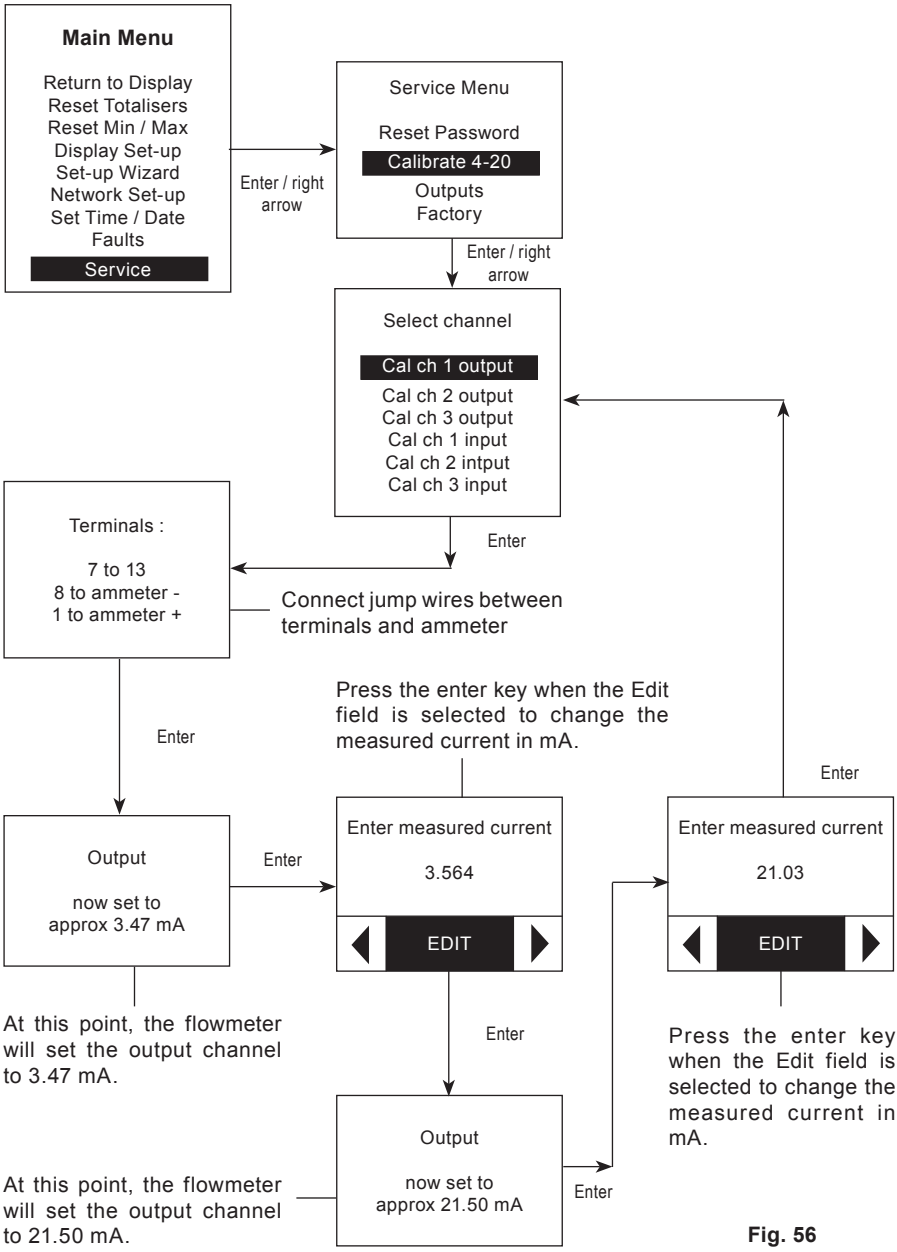


Fig. 56

5.26 Service (reset password)

This menu lets the user change the 6-digit password, perform analog input / output calibration, test the relay and pulse outputs, and clear the non-resetable totalizers via the factory password. The sequence shown in Figure 57 illustrates how to change the password. Contact the factory for the service default password.

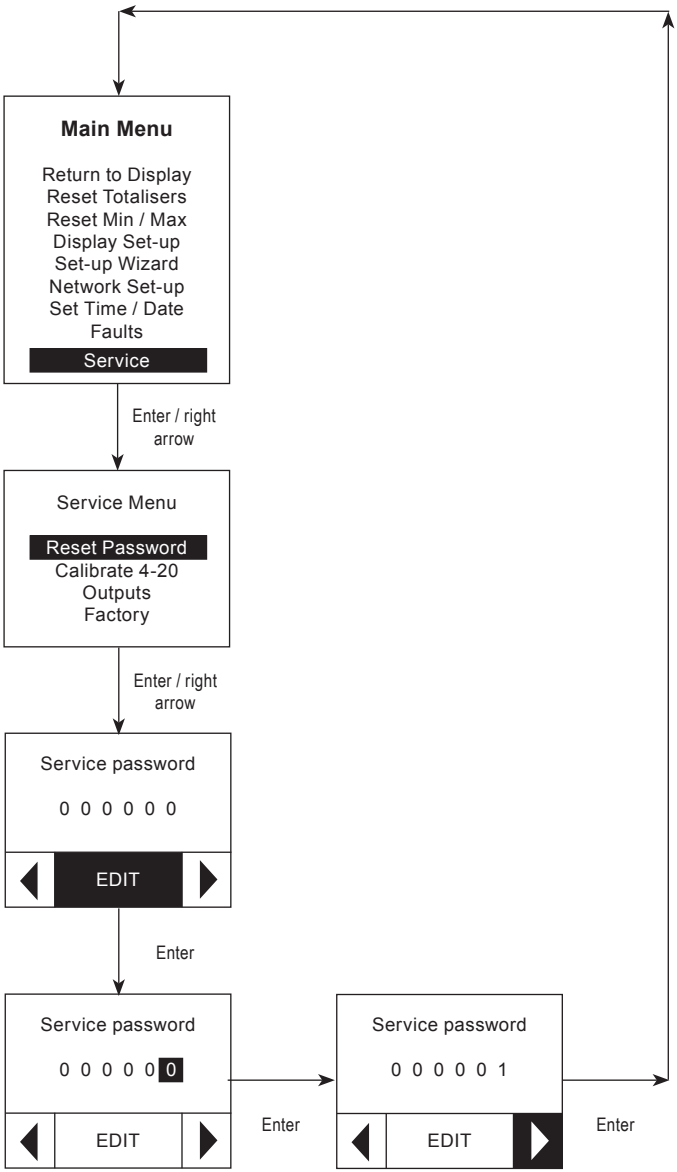
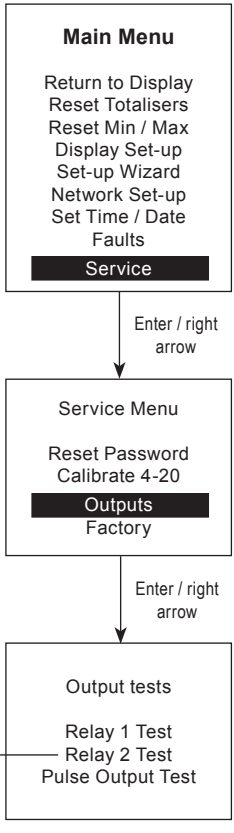


Fig. 57

5.27 Service (outputs test)

This menu (Figure 58) lets the user test the 2 relay alarms and the pulse output.



The Relay tests close the selected relay for 3 seconds.
The Pulse Output Test produces a 500 ms square wave for 2 seconds.

Fig. 58

5.28 Service (factory settings)

This menu (Figure 59) lets a qualified service technician reset the non-resetable totalizers.

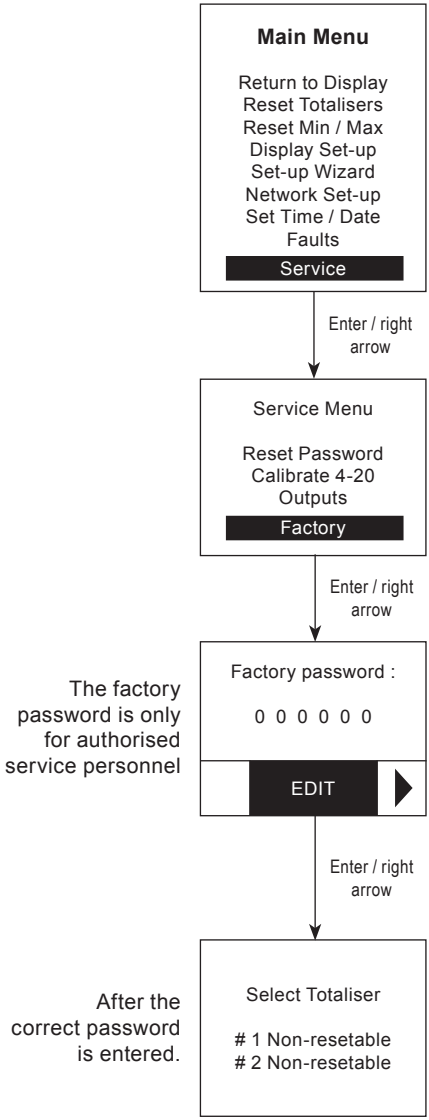


Fig. 59

6. RIM10 series web interface

6.1 General information

The web interface is designed to easily lead the user through a variety of options to set-up the RIM10 system, using easy to navigate menus and drop down lists - See Figure 60.

To access the RIM10 through the web interface, enter the IP address for the RIM10 into the address field of a web browser like Internet Explorer or Firefox. If the flowmeter is correctly connected to a LAN, the Operating Display page is shown in the browser.

The Operating Display shows current values, faults, product version information, and verifies that the RIM10 flowmeter is on-line.

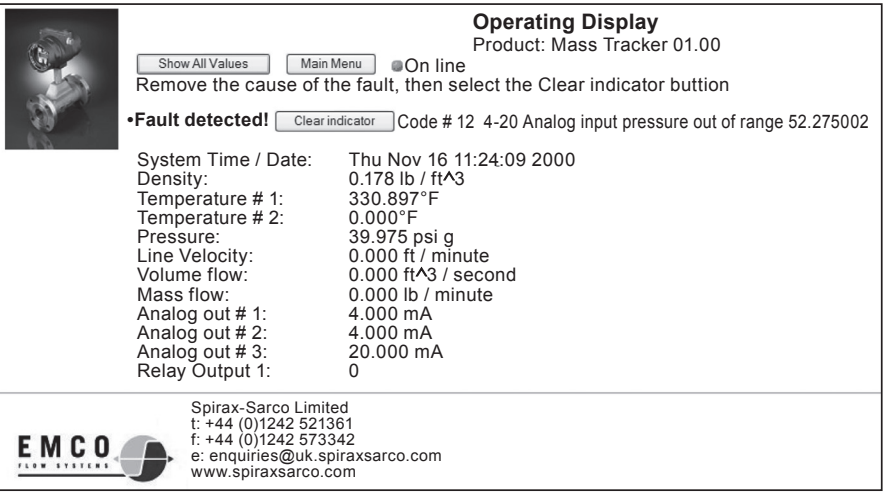


Fig. 60

Product name	Current firmware of product
Show all values	Displays all inputs and outputs
Main Menu	Returns to main menu
Online/Offline	Display current network connection
Faults	Current faults
Values	Displays chosen values

The green on-line indicator should be showing and no faults/errors listed.

There are two options for viewing:

- Show All Values, which shows all inputs and outputs.
- Main Menu, which provides detailed set-up information and options for network, configuration and display.

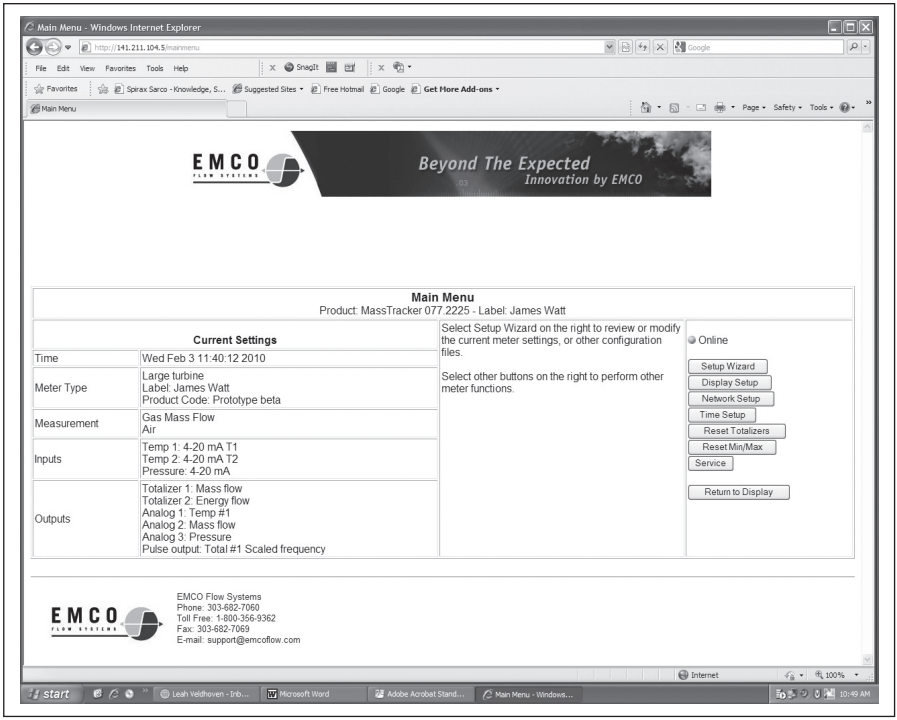


Fig. 61

From the Main Menu screen, the user can view the current settings or use the buttons on the right to reconfigure various aspects of the system.

- Set-up wizard Section 6.2
- Display set-up Section 6.3
- Network set-up Section 6.4
- Time set-up Section 6.5
- Reset totalizers Section 6.6
- Reset min/max Section 6.7
- Service Section 6.8
- Return to display (mode)

6.2 Set-up wizard

Click the Set-up Wizard button to enter the set-up configuration series of screens.

The first screen is Configuration Load Options - Figure 62. This function is only available on the web interface.

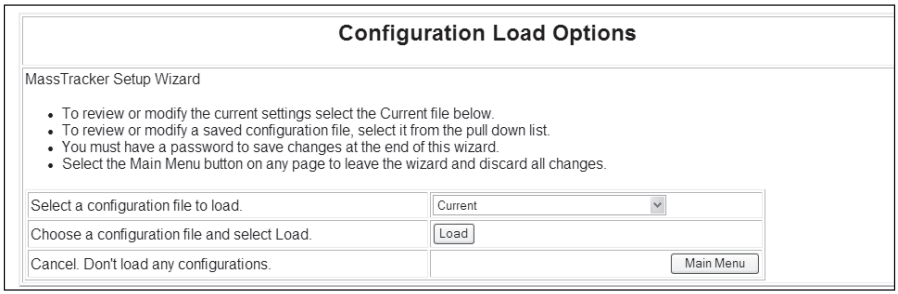


Fig. 62

Configuration load options

This page begins the set-up process. It allows for the following:

- Review or modify the current settings.
- Review or modify a saved configuration file.

To select a configuration file to load, select one of the following from the drop down menu:

- Current
- User 1 Configuration file
- User 2 Configuration file
- Last back-up of the previous current file
- Default EMCO factory (unalterable) file

If you select Current and click Load, current settings are displayed.

To change current settings, select Next.

Step 1: Time – If the time and date are incorrect, click on the Edit button and enter the correct information in the Local Time and Date fields, then click Set Time.

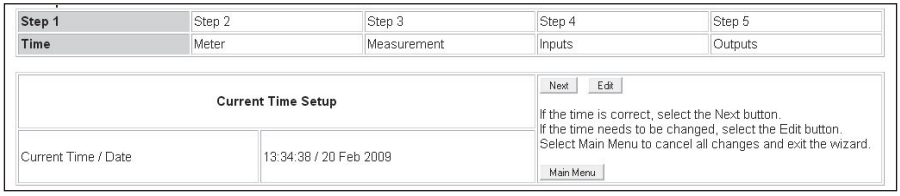


Fig. 63

Select Next to go to the next set-up screen.

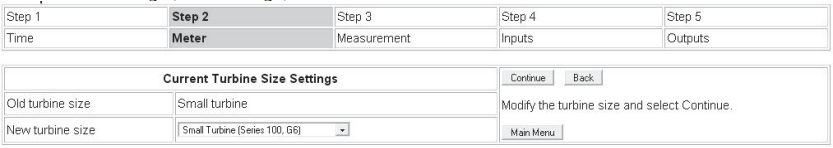
Step 2: Flowmeter - This is where all identifying information for the flowmeter is entered. If any of this data is incorrect, click on the Edit button and you will be guided through the various flowmeter data screens.

- Meter Label

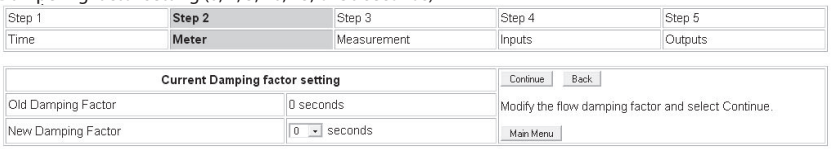
- Tag Number

- Pipe Inside Diameter Settings

- Turbine Size Settings (small or large)



- Dampering factor setting (0, 1, 5, 10, 15, or 30 seconds)



- Curve Fit Settings (Linear or Cubic Spline)

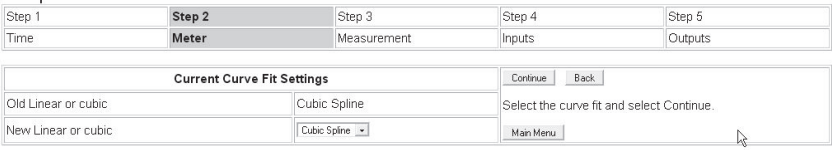


Fig. 64

You will be returned to the main Flowmeter Set-up screen once you have cycled through the set-up screens listed above.

Step 3: Measurement – The type of product to be measured with accompanying values are edited on this screen.

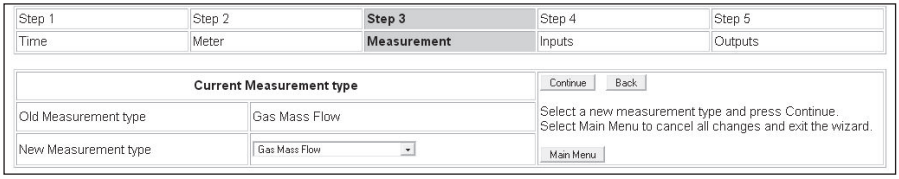


Fig. 65

Select a measurement type:

- Steam volume
- Steam controlled
- Steam saturated
- Steam uncontrolled / superheated
- Steam condensate
- Gas volume
- Gas mass flow
- Gas compensated
- Liquid volume / mass
- Liquid energy

Based on the measurement type, the wizard guides the next screens. Values will be appropriate for the type of measurement.

Step 4: Inputs:

Values selected in measurement affect the display for inputs. **Depending on what you put in, you may be asked to choose the following:**

- Pressure from 4-20 mA channel 3 input or substitute
- Temperature from internal RTD, 4-20 mA channel 1 or 4-20 mA channel 2

For 4-20 mA values, enter the minimum and maximum units. Choose the type of temperature measurement.

- Fahrenheit
- Celsius
- Kelvin

For substitute values, enter the temperature and choose the temperature measurement.

- Fahrenheit
- Celsius
- Rankine
- Kelvin

For pressure, enter the minimum and maximum values and the units.

Click the Next button when finished.

Step 5: Outputs

The following can be set-up for outputs:

- Totalizer 1
- Totalizer 2
- Analog Output 1
- Analog Output 2
- Analog Output 3
- Relay 1
- Relay 2
- Pulse - Frequency

For Totalizers 1 and 2, select one of the following:

- None
- Volume flow
- Comp flow
- Mass flow
- Energy flow

Then, select the units. For Volume and Comp flow:

- Feet cubed
- Inches cubed
- Gallons
- Bbl
- Cc
- Liters
- Meters cubed
- Quarts

For Mass flow:

- Pounds
- Tons
- Grams
- Kilograms
- Metric tons

For Energy flow:

- Btu
- Kj
- Cal
- Kcal
- Mcal
- Ton
- Kw
- Mw
- gw

Edit the totalizer scale factor for the measurement selected. Repeat process for Totalizer 2.

For Analog Outputs 1-3:

Select an analog output parameter:

- None
- Temperature
- Temperature number 2
- Differential temperature
- Pressure
- Density
- Velocity
- Volume flow
- Comp flow
- Mass flow
- Energy flow

Enter the units for the selected parameter. Repeat for Analog Outputs 2 and 3.

For Relays 1 and 2:

Select a configuration:

- None
- Temperature number 1 alarm
- Temperature number 2 alarm
- Differential temperature alarm
- Pressure alarm
- Density alarm
- Velocity alarm
- Volume flow alarm
- Comp flow alarm
- Mass flow alarm
- Energy alarm
- On
- Off

Select a limit:

- Low
- High
- Window

Edit hysteresis value. Repeat for Relay 2.

For the Pulse Output Set-up, select a pulse output function:

- None
- Scaled frequency
- Sensor frequency, 50% duty cycle
- Pulse, negative
- Pulse, positive
- Transit

For Scaled frequency, select one of the following:

- Out min.
- Out max.
- Out max freq. 1 khz

For Sensory frequency, 50% duty - No configuration.

For Pulse negative.

- Totalizer selected
- Pulse width

For Pulse positive, see Pulse Negative.

For Transit, see Pulse Negative.

When the output settings have been completed, click the Finish button to go to the screen where all proposed settings are summarized. Once these are verified, click the Save button to go to the Configuration Save Options page.

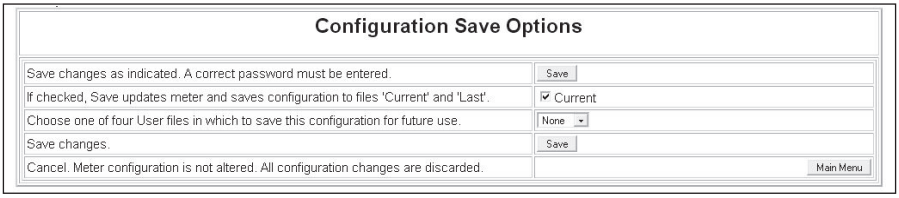


Fig. 66

If all are correct, click the Save button again to return to the Main Menu screen.

6.3 Display set-up

Click the Display Set-up button to go to the Display Configuration Menu, where you can choose the parameters you wish to see on the Operating Display screen. Check the box beside each value you wish to have displayed on start-up, then click the Save Changes button.

Fig. 67

6.4 Network set-up

To set-up a network connection, select Network Set-up from the Main Menu of the RIM10 web interface.

The web interface configures the network settings for the RIM10 flowmeter. Select either Ethernet (Section 6.4.1) or Modbus Network (Section 6.4.2).

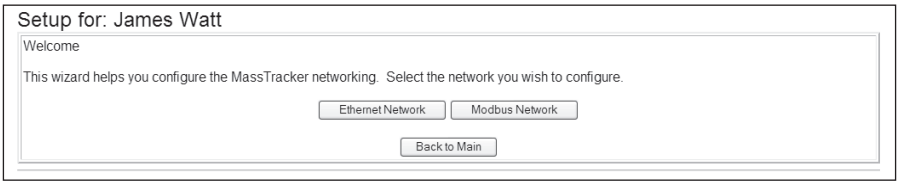


Fig. 68

6.4.1 Ethernet Network set-up wizard

The current Ethernet settings are displayed.

Select Next to change the current settings.

or

Select Main Menu to cancel and return to the start page.

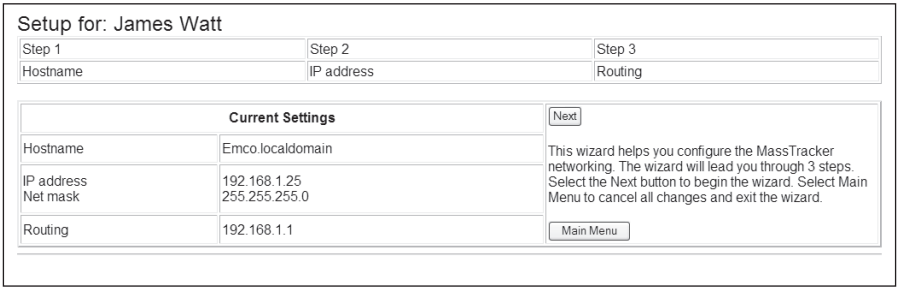


Fig. 69

The Ethernet Network set-up is completed in three steps:
1. Hostname
2. IP address
3. Routing

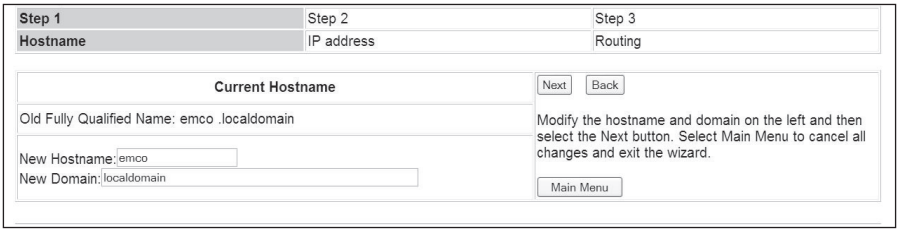


Fig. 70

Step 1. Hostname

The Current Hostname is displayed. To enter a new hostname, type the name in the New Hostname box.

To select a new domain, type the new domain name in the box displayed.

Click on Next to move to Step 2.

Step 2. Current IP address

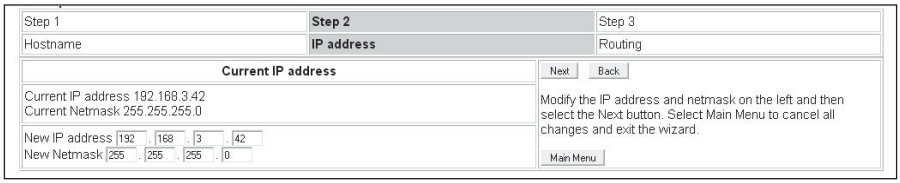


Fig. 71

The current IP address and Current netmask are shown. To modify:

1. Enter the new IP address in the dialogue boxes next to New IP address.
2. Enter the new Netmask in the dialogue boxes next to New Netmask.

Step 3. Routing

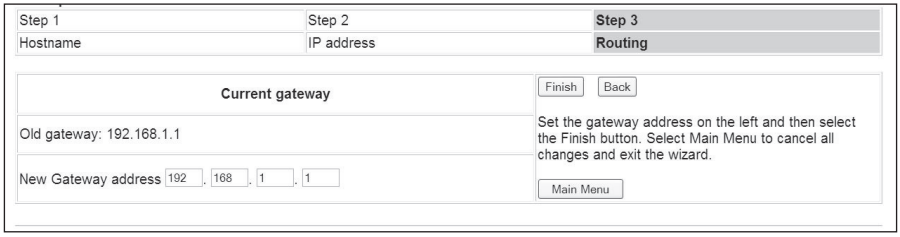


Fig. 72

The old gateway address is shown. To modify:

1. Enter the new gateway address in the dialogue boxes next to New Gateway address.
2. Select Finish. The Save screen appears

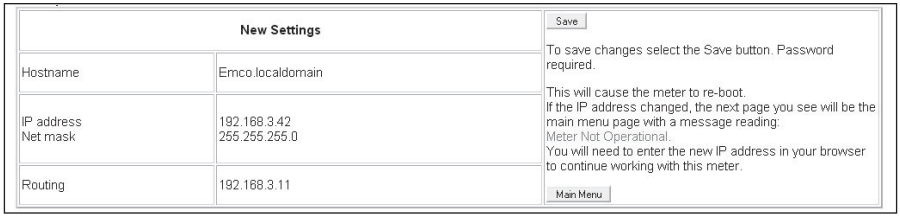


Fig. 73

The new settings are shown. This saves the changes to all three steps.

Note: If the IP address changed, the next page will state that the floweter Not operational. Use the new IP address to access the flowmeter.

6.4.2 Modbus network set-up wizard

The Modbus connection wizard is completed in two steps:

- Unit number
- Comm parameters

After selecting the Modbus Network, the following screen appears.

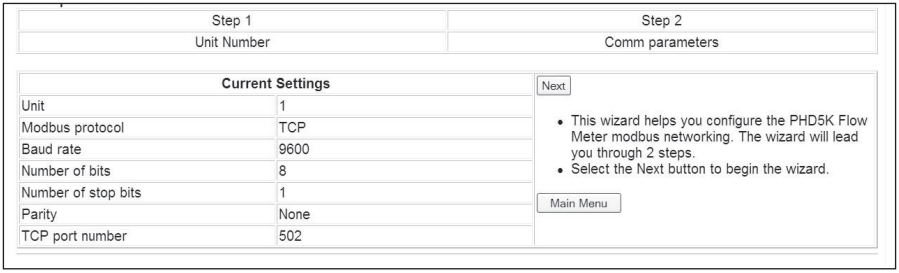


Fig. 74

Select Next to change the current settings.

or

Select Main Menu to cancel and return to the Main Menu.

Step 1. Unit Number

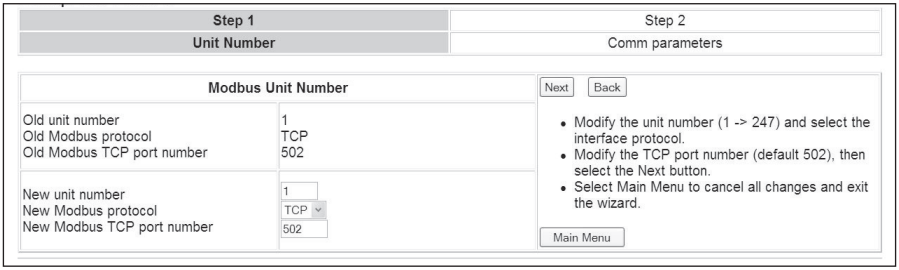


Fig. 75

Enter the following:

- New Unit number (1-247)
- New Modbus protocol

The default Modbus TCP port number is 502.

Select Next to move on to the next screen.

Step 2. Communication parameters

Enter the following:

- New baud rate
- New number of bits
- New stop bits
- New parity

Select Finish to move to the next screen.

Fig. 76

To save the changes entered, select Save. You will now be returned to the Main Menu.

Or, you can click on the Main Menu button to cancel changes and return to the Main Menu screen.

Fig. 77

6.5 Time set-up

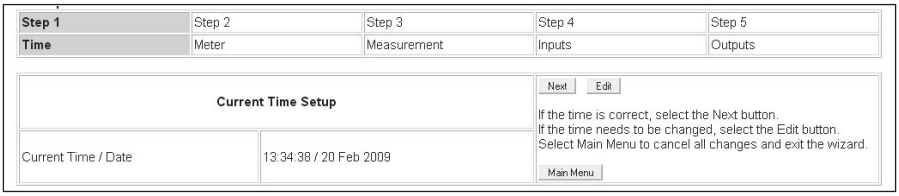


Fig. 78

6.6 Reset Totalizers

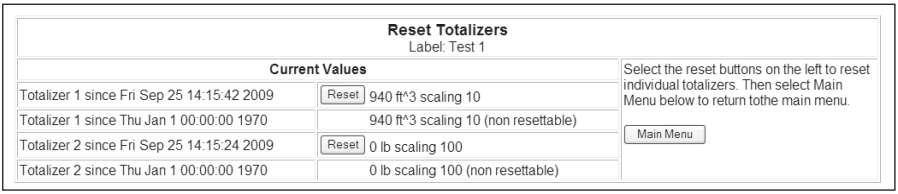


Fig. 79

6.7 Reset Min/Max

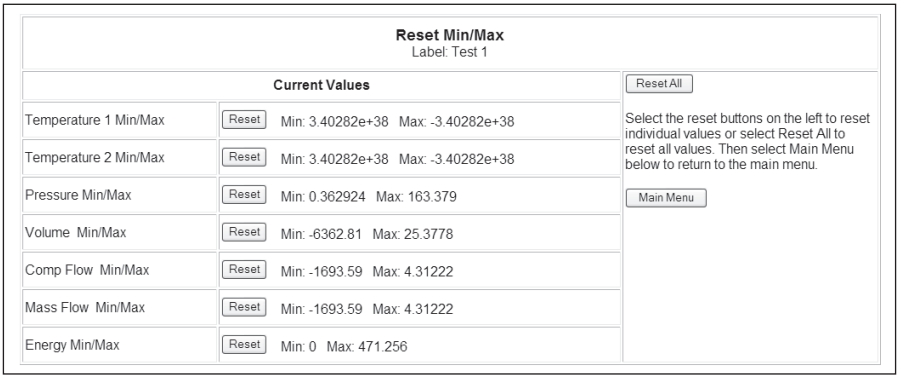


Fig. 80

6.8 Service

For user of the service options in the RIM10 web interface refer to Section 8 'Diagnostics and Calibration' and Section 9 'Troubleshooting and Maintenance'.

Fig. 81

6.8.1 Service (Loop Calibration)

This following will assist the user to calibrate each of the 4-20 mA input or output current loops.
Use example: calibrate 4-20 mA input channel 1 - See section on Calibration of Analog Input and Output: page 82.

Step 1 Take the flowmeter 'offline' by clicking the Go Offline button.

Step 2 Using an ammeter and external current source, set the input current to 4.00 mA.

Step 3 Enter the current into the Enter Input Current 1 box and click the save_input 1 button.

Step 4 Using an ammeter and external current source, set the input current to 20.00 mA.

Step 5 Enter the current into the Enter Input Current 2 box and click the cal_input 1 button.

Step 6 The Slope and Offset values will change to reflect the new calibration.

Step 7 Click the save button to permanently save the calibration data.

Step 8 Click the Go On line button to resume normal operation.

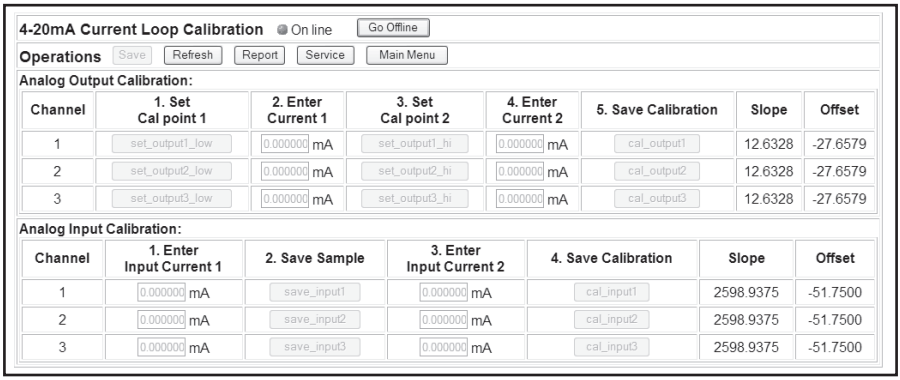


Fig. 82

6.8.2 Service (RIM10 calibration)

The following will assist the user in entering frequency / velocity data for a calibrated RIM10.
Note: this data should not be changed unless the user is replacing a damaged RIM10 and has new calibration data from EMCO.

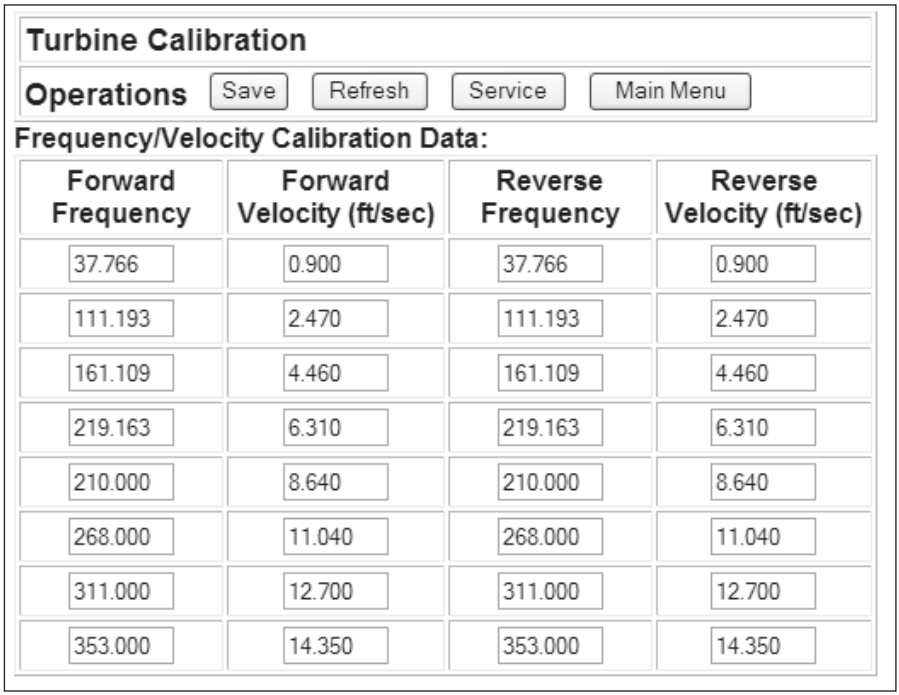


Fig. 83

6.8.3 Service (configure data log)

The following will assist the user in selecting and saving the flowmeter parameters to the log file and how often to save the data. Note: Clicking on the Clear Log button will permanently erase the Log file.

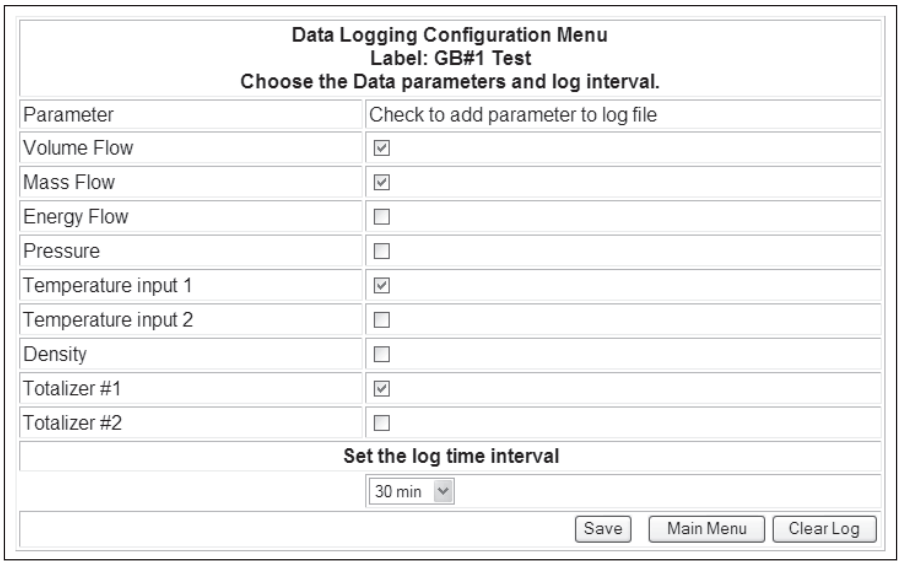


Fig. 84

6.8.4 Service (view data log)

The following will assist the user to see the contents of the data log. Note the parameters are all comma separated to allow easy transfer to a spreadsheet. When a Clear Log operation is performed, or a parameter is added or removed from the log list, a new time stamp and parameter header is written. This ensures that any changes made to the log file are saved, and the user can tell when the change occurred.

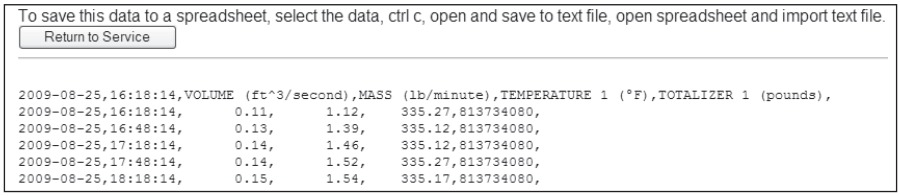


Fig. 85

7. MODBUS

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 RIM10 Series allows the user to view and modify flowmeter parameters. Appendix A lists the available Modbus registers. Modbus uses a Master/Slave communication scheme. The RIM10 is always the Modbus slave. The customer must provide the Modbus Master.

Supported Modbus Protocols

The RIM10 supports two types of Modus communications.

- Modbus TCP/IP.
- Modbus RS-485. (RTU)

Configuration

Configuration of the RIM10 consists of software set-up and physical wiring.

1. **Software set-up:** Using the LCD or Web interface, select 'Network Set-up', 'Modbus Network'. Select 'TCP' for Ethernet or 'RTU' for RS-485. Be sure to save when done. See Appendix B for web page screen shots. The LCD or Web page interface documentation provides details on flowmeter operation.

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

2. **Physical Wiring:** TCP/IP requires connecting an Ethernet cable from the flowmeter to a PC/Controller. RS-485 requires wiring from the terminal block of the flowmeter to a PC/Controller. Only a 2 wire configuration is supported for RS-485. A termination jumper is provided if the unit is the last device. See wiring diagram section for details.

Read operation

The RIM10 flowmeter only supports Modbus register reads.

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

1. Connect to the flowmeter using a Modbus master program.
2. Select a register from the Modbus register list.
3. Read/write the register from the master. **Note:** Reading or writing a Modbus register typically requires specifying the number of bytes. See appendix A for register map.
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.

Modbus RTU read example:

Read float123.456 from holding register 40984.

Command: (from Master)

Field name	Hex value
Slave address	01
Function	03
Address byte Hi	A0
Address byte Lo	18
Bytes to read Hi byte	00
Bytes to read Lo byte	02
CRC Hi byte	66
CRC Lo byte	0C

Response: (from RIM10)

Field name	Hex value
Slave address	01
Function	03
Byte Count	04
Data Hi (40984)	E9
Data Lo (40984)	79
Data Hi (40985)	42
Data Lo (40985)	F6
CRC Hi byte	AF
CRC Lo byte	50

The returned 4 bytes will be in the order:
0xF6 0x42 0x79 0xE9

To get the correct value of 123.456, the bytes must be re-ordered as:
0x42 0xF6 0xE9 0x79

Appendix A - Modbus Register Table (rev 3)

	Parameter	Register	Type	Bytes	Description
1	Flowmeter Name	4101	char	18	The flowmeter name, identifier
2	Flowmeter Serial Number	4242	char	18	Flowmeter unique serial number
3	Alarm relay #1 status	12400	short	2	Relay output status 1 = on/closed
4	Alarm relay #2 status	12401	short	2	Relay output status 1 = on/closed
5	Flow direction	12403	short	2	Flow direction input 0 = Fwd, 1 = Rev
6	Resetable Totalizer #1	20623	long	4	Resettable totalizer #1
7	Totalizer 1 remainder	41082	float	4	Resettable Totalizer #1 remainder count
8	Non-resetable Totalizer #1	20625	long	4	Non-resettable totalizer #1
9	Resetable Totalizer #2	20627	long	4	Resettable totalizer #2
10	Totalizer 2 remainder	41086	float	4	Resettable Totalizer #2 remainder count
11	Non-resetable Totalizer #2	20629	long	4	Non-resettable totalizer #2
12	Pipe diameter	40002	float	4	Pipe diameter, inches
13	Temperature input #1	40984	float	4	Temperature input #1, °F
14	Min Temp 1	41054	Float	4	Minimum temperature, input 1 recorded, °F
15	Max Temp 1	41068	Float	4	Maximum temperature, input 1 recorded, °F
16	Temperature input #2	40986	float	4	Temperature input #2, °F
17	Internal RTD temperature	40988	float	4	Temperature, internal RTD, °F
18	Min Temp 2	41056	Float	4	Minimum temperature, input 2recorded, °F
19	Max Temp 2	41056	Float	4	Maximum temperature, input 2recorded, °F
20	Differential temperature	40990	float	4	Temperature, difference between T1 and T2
21	Turbine frequency	40996	float	4	Frequency input from turbine
22	Calculated velocity	41000	float	4	Line velocity value, ft/sec
23	Volumetric flow	41004	float	4	Volume flow, cu ft/sec

	Parameter	Register	Type	Bytes	Description
24	Compensated Volume flow	41006	float	4	Temperature compensated vol flow, cfm
25	Mass flow	41008	float	4	Mass flow, lb/min
26	Energy flow	41010	float	4	Energy flow, Btu/min
27	Density	41018	float	4	Density, lb/cu ft
28	Viscosity	41030	float	4	Fluid viscosity, centipoise
29	Pressure	40992	float	4	Pressure, psig
30	Min Pressure	41058	Float	4	Min pressure recorded, psig
31	Max Pressure	41072	Float	4	Max pressure recorded, psig
32	Analog Input #1	40978	Float	4	4-20 mA input current channel 1, mA
33	Analog Input #2	40980	Float	4	4-20 mA input current channel 2, mA
34	Analog Input #3	40982	Float	4	4-20 mA input current channel 3, mA
35	Analog Output 1	41012	Float	4	4-20 mA output current channel 1, mA
36	Analog Output 2	41014	Float	4	4-20 mA output current channel 2, mA
37	Analog Output 3	41016	Float	4	4-20 mA output current channel 3, mA
38	Enthalpy 1	41022	Float	4	Water or Steam enthalpy, temp input 1, Btu/lb
39	Enthalpy 2	41024	Float	4	Water or Steam enthalpy, temp input 2, Btu/lb
40	Min Energy flow	41066	Float	4	Minimum recorded energy flow, Btu/min
41	Max Energy flow	41080	float	4	Maximum recorded energy flow, Btu/min
42	Super Comp.	41026	Float	4	Supercompressibility
43	Compressibility	41028	Float	4	Compressibility
44	User Velocity	41038	Float	4	Fluid velocity converted to user-selected units
45	User Volume	41040	Float	4	Fluid volume converted to user-selected units
46	User Mass	41042	Float	4	Fluid mass flow converted to user-selected units
47	User Energy	41044	Float	4	Fluid energy converted to user-selected units
48	User Temp 1	41046	Float	4	Temperature input 1 converted to user-selected units
49	User Temp 2	41048	Float	4	Temperature input 2 converted to user-selected units
50	User Pressure	41050	Float	4	Pressure converted to user-selected units
51	User Density	41052	Float	4	Density converted to user-selected units

Appendix B - Web page screen shots

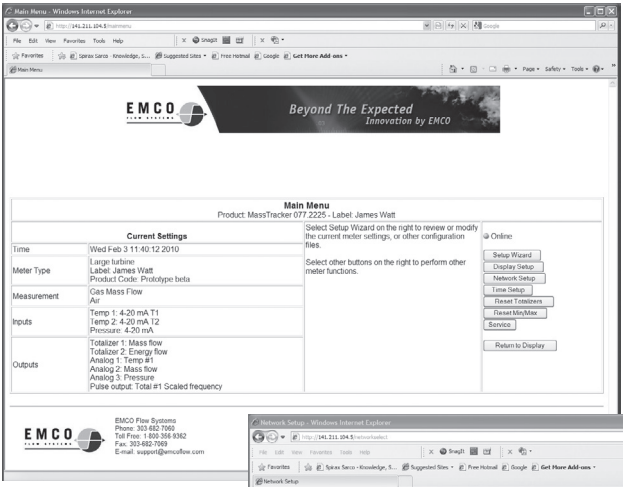


Fig. 86

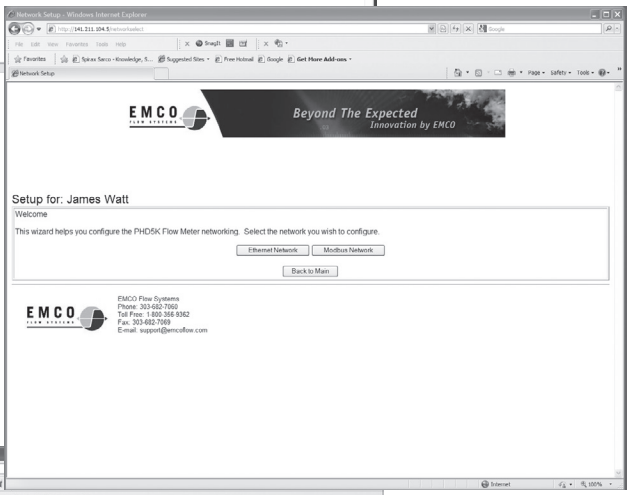


Fig. 87

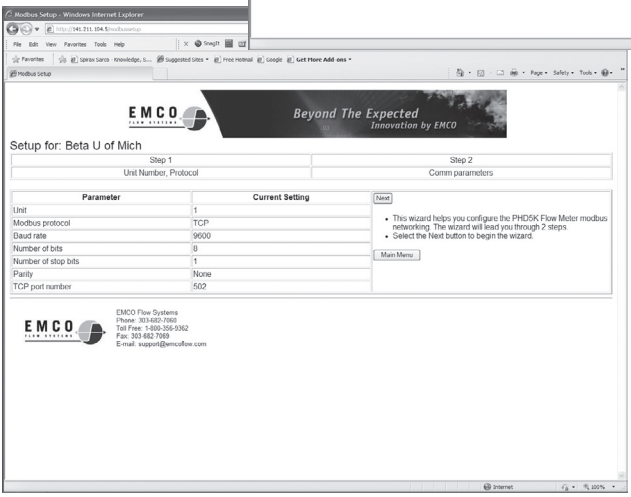


Fig. 88

8. Diagnostics and Calibration

8.1 General information

The RIM10 system self-checks its internal status every 500 ms (1/2 second). If there is a problem with any part of the system, the yellow fault light will appear on the flowmeter front panel and the main web page screen will show a fault message.

8.2 Web interface Error Checking and Calibration

All faults may be viewed on the Fault Event log through the web user interface.

1. From the main menu, click the Service button to go to the Service Console page. If a password has been set, it will need to be entered here (6-digit number).

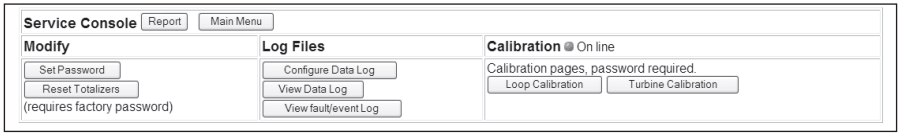


Fig. 89

2. Click the Inputs or Outputs buttons on the right side of the screen to go to the Diagnostics / Calibration pages for the input or output data.

3. Before running any reports or calibrating the inputs or output, you must take the interface off line. Click the Go Offline button at the top of the Diagnostic, Calibration page. The fields that were grayed out will now be editable. The green state of the LED on the flowmeter front panel will stop blinking. You can now calibrate or view reports.

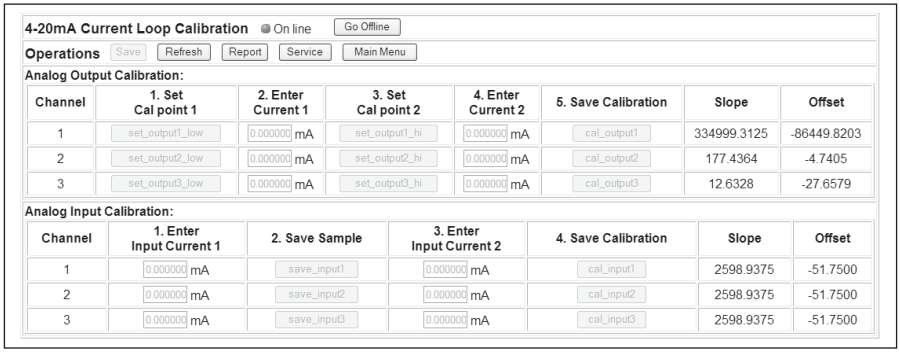
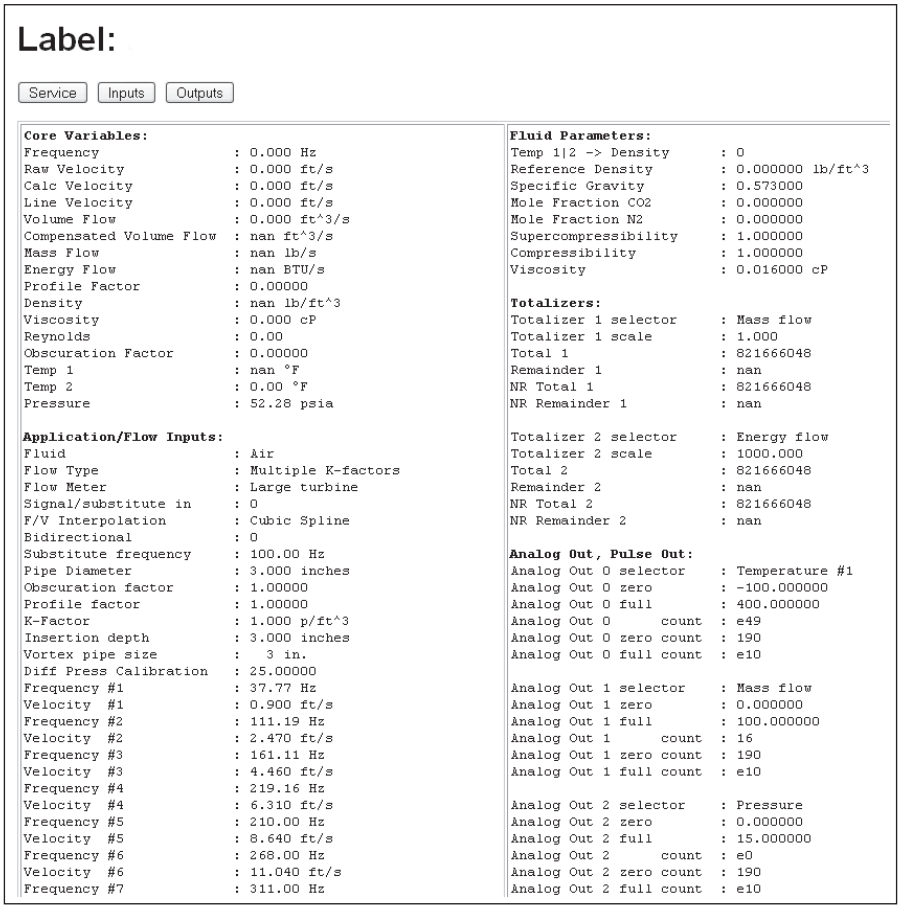


Fig. 90

4. The report page is a condensed text display of all internal settings. To view an output or input report, click on the Report button in the Operations line.



Label:

Service | Inputs | Outputs

Core Variables:

Frequency	: 0.000 Hz
Raw Velocity	: 0.000 ft/s
Calc Velocity	: 0.000 ft/s
Line Velocity	: 0.000 ft/s
Volume Flow	: 0.000 ft^3/s
Compensated Volume Flow	: nan ft^3/s
Mass Flow	: nan lb/s
Energy Flow	: nan BTU/s
Profile Factor	: 0.00000
Density	: nan lb/ft^3
Viscosity	: 0.000 cP
Reynolds	: 0.00
Obscuration Factor	: 0.00000
Temp 1	: nan °F
Temp 2	: 0.00 °F
Pressure	: 52.28 psia

Application/Flow Inputs:

Fluid	: Air
Flow Type	: Multiple K-factors
Flow Meter	: Large turbine
Signal/substitute in	: 0
F/V Interpolation	: Cubic Spline
Bidirectional	: 0
Substitute frequency	: 100.00 Hz
Pipe Diameter	: 3.000 inches
Obscuration factor	: 1.00000
Profile factor	: 1.00000
K-Factor	: 1.000 p/ft^3
Insertion depth	: 3.000 inches
Vortex pipe size	: 3 in.
Diff Press Calibration	: 25.00000
Frequency #1	: 37.77 Hz
Velocity #1	: 0.900 ft/s
Frequency #2	: 111.19 Hz
Velocity #2	: 2.470 ft/s
Frequency #3	: 161.11 Hz
Velocity #3	: 4.460 ft/s
Frequency #4	: 219.16 Hz
Velocity #4	: 6.310 ft/s
Frequency #5	: 210.00 Hz
Velocity #5	: 8.640 ft/s
Frequency #6	: 268.00 Hz
Velocity #6	: 11.040 ft/s
Frequency #7	: 311.00 Hz

Fluid Parameters:

Temp 1|2 -> Density	: 0
Reference Density	: 0.000000 lb/ft^3
Specific Gravity	: 0.573000
Mole Fraction CO2	: 0.000000
Mole Fraction N2	: 0.000000
Supercompressibility	: 1.000000
Compressibility	: 1.000000
Viscosity	: 0.016000 cP

Totalizers:

Totalizer 1 selector	: Mass flow
Totalizer 1 scale	: 1.000
Total 1	: 821666048
Remainder 1	: nan
NR Total 1	: 821666048
NR Remainder 1	: nan
Totalizer 2 selector	: Energy flow
Totalizer 2 scale	: 1000.000
Total 2	: 821666048
Remainder 2	: nan
NR Total 2	: 821666048
NR Remainder 2	: nan

Analog Out, Pulse Out:

Analog Out 0 selector	: Temperature #1
Analog Out 0 zero	: -100.000000
Analog Out 0 full	: 400.000000
Analog Out 0 count	: e49
Analog Out 0 zero count	: 190
Analog Out 0 full count	: e10
Analog Out 1 selector	: Mass flow
Analog Out 1 zero	: 0.000000
Analog Out 1 full	: 100.000000
Analog Out 1 count	: 16
Analog Out 1 zero count	: 190
Analog Out 1 full count	: e10
Analog Out 2 selector	: Pressure
Analog Out 2 zero	: 0.000000
Analog Out 2 full	: 15.000000
Analog Out 2 count	: e0
Analog Out 2 zero count	: 190
Analog Out 2 full count	: e10

Fig. 91

5. The Data Log page shows a list of selected flow parameters that are saved to flash memory at selected intervals. The data log will wrap after 'x' lines.

To view faults and history, return to the service console by clicking the Service button. At the Service Console, click either the View History data or View fault/event log buttons.

Service Console | Report | Main Menu

Modify	Log Files	Calibration ● On line
Set Password	Configure Data Log	Calibration pages, password required.
Reset Totalizers	View Data Log	Loop Calibration | Turbine Calibration
(requires factory password)	View fault/event Log	

Fig. 92

8.3 History Data Log

To save this data to a spreadsheet, select the data, ctrl c, open and save to text file, open spreadsheet and import text file.

Return to Service

```
2000-11-16,14:04:49,VOLUME (ft^3/second),MASS (lb/minute),PRESSURE (psi gauge),TEMPERATURE 1 (°F),TOTALIZER 1 (ft^3),TOTALIZER 2 (pounds),
2000-11-16,14:04:49,      0.82,      8.19,     39.98,    388.75,057966,211982
2000-11-16,14:05:15,      0.68,      6.79,     39.98,    388.44,057969,211982
2000-11-16,14:06:15,      0.57,      5.68,     39.98,    387.88,057972,211982
2000-11-16,14:07:15,      0.60,      5.95,     39.98,    387.38,057976,211982
2000-11-16,14:08:15,      0.60,      6.03,     39.98,    387.02,057980,211982
```

Fig. 93

The Fault event log is a time-stamped listing of faults or significant changes in the flowmeter settings. The state shows fault / event activity. 'A' means a fault has been added to the list. 'C' means an existing fault is cleared. Some faults are cleared automatically and some must be cleared manually on the operating display web page.

Fault/Event Log

Return to Service

Date	Time	Code	State	Description
2009-11-04	10:08:11	03	A	Meter powered down
2009-11-04	10:08:11	07	A	4-20 Analog output 3 out of range 20.000000
2009-11-04	10:10:41	07	C	4-20 Analog output 3 out of range 4.000000
2009-11-04	10:10:41	12	A	4-20 Analog input pressure out of range 52.275002
2009-11-04	10:10:41	30	A	Meter configuration changed
2009-11-04	10:10:52	31	C	Min/Max temperature 1 changed 68.956917 68.956917
2009-11-04	10:10:52	33	C	Min/Max pressure changed 52.275002 52.275002
2009-11-04	10:10:52	34	C	Min/Max volume flow changed 0.000000 0.000000
2009-11-04	10:10:52	35	C	Min/Max compensated volume flow changed 0.000000 0.000000
2009-11-04	10:10:52	36	C	Min/Max mass flow changed 0.000000 0.000000
2009-11-04	10:10:52	38	C	Min/Max temperature 1 cleared
2009-11-04	10:10:52	40	C	Min/Max pressure cleared
2009-11-04	10:10:52	41	C	Min/Max volume flow cleared
2009-11-04	10:10:52	42	C	Min/Max compensated volume flow cleared
2009-11-04	10:10:52	43	C	Min/Max mass flow cleared
2009-11-04	10:10:52	44	C	Min/Max energy flow cleared
2009-11-04	10:11:06	45	C	Resettable Totalizer 1 cleared
2009-11-04	10:11:08	45	C	Resettable Totalizer 1 cleared
2009-11-04	10:11:10	47	C	Non-resettable Totalizer 1 cleared
2009-11-04	10:11:12	46	C	Resettable Totalizer 2 cleared
2009-11-04	10:11:15	48	C	Non-resettable Totalizer 2 cleared

Fig. 94

8.4 Flowmeter faults menu

When the fault LED turns on, details of the problem can be viewed using the LCD interface:

1. Hold the magnet over the Enter button for five seconds to enter programming mode.

2. Using the magnet with the down arrow, scroll to the Fault line item. When selected, a screen will appear displaying how many faults there are.

3. Select Enter to see a list and use the arrow keys to scroll through and view the faults.

4. Once a fault has been corrected, the fault list on the LCD interface must still be cleared. To clear a fault, scroll down to the Clear bar at the bottom of the LCD screen. Select Enter to clear that error.

In cases where there are two or more faults at one time, it is suggested that each fault be corrected and then cleared individually rather than all at once.

Error Code	Description
00	Substitute values in use
01	Relay 1 Alarm
02	Relay 2 Alarm
03	Meter powered down
04	Pulse out queue full, pulses lost
05	4-20 Analog output 1 out of range
06	4-20 Analog output 2 out of range
07	4-20 Analog output 3 out of range
08	4-20 Analog input temperature 1 out of range
09	4-20 Analog input temperature 2 out of range
10	Open circuit on internal RTD sensor
11	Open circuit on external RTD sensor
12	4-20 Analog input pressure out of range
13	adc input voltage exceeded conversion range
14	Internal clock failed, time stamps inaccurate/wrong
15	RAM failed to read correct value after write
16	Configuration data checksum fault
17	Flash memory checksum fault
18	Insertion Vortex sensor disconnected
19	Velocity below minimum
20	Velocity above maximum
21	Keypad fault,
22	Web server is down
23	Modbus server is down
24	Flow calculator is down, flowmeter is not functional
25	Data acquisition is down, flowmeter is not functional

Error Code	Description
26	Failed to open internal drivers, flowmeter is not functional
27	Watchdog
28	Flowmeter running factory settings, not user configured
29	Unable to load configuration file, using built-in defaults
30	Flowmeter configuration changed
31	Min / Max temperature 1 changed
32	Min / Max temperature 2 changed
33	Min / Max pressure changed
34	Min / Max volume flow changed
35	Min / Max compensated volume flow changed
45	Resettable Totalizer 1 cleared
46	Resettable Totalizer 2 cleared
47	Non-resettable Totalizer 1 cleared
48	Non-resettable Totalizer 2 cleared,
49	Frequency out flow below minimum
50	Frequency out flow above maximum
51	LCD process is down, no display
52	Sequencer is down, flowmeter is not functional
53	Configuration file save failed
54	Flash memory read failed
55	Flash memory save failed
56	Modbus configured as both TCP and RS-485 - pick one
57	Modbus not configured as either TCP or RS-485 - pick one
58	Flowmeter is offline
59	Turbine signal excess variation detected

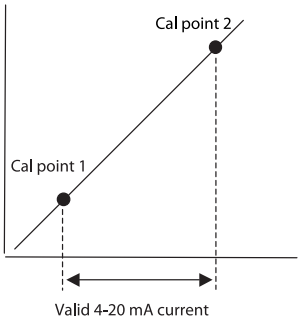
8.5 Calibrating Analog Input and Output in the LCD

Calibration of analog input and output from the LCD interface is done through the Service menu.

To get to the Service menu:

1. Go into programming mode by holding the magnet over the Enter button for approximately five seconds.
2. Using the down arrow, scroll down to the Calibrate 4-20 line item.
3. Select it with the Enter button. This will take you to the Select Channel screen. You will be able to scroll through three input and three output settings. These settings will determine two points; the bottom end and the top end of the input and output currents.

Fig. 95



4. Select the Cal ch 1 output line item and select it. The first screen will show you how to connect the terminals.

8.5.1 Output calibration:

5. When the terminals have been connected as indicated, select Next for the following screen.
6. This screen will show 'Output now set to approx. 3.47 mA.'
7. Confirm that your low end output is set as close as possible to this number.
8. Select the bottom navigation bar to go to the next screen.
9. 'Enter measured current message' will scroll across the screen.
10. Select Edit in the navigation bar to enter edit mode. The cursor will blink over the last number.
11. Use the left and right arrow keys to move around within the number displayed. Use the top and bottom arrow keys to increase or decrease each number until it is set to the correct mA.
12. Select the Enter button to save, then select Next.
13. The screen will now show 'Output now set to approx. 21.50 mA.'
14. Confirm that your high end output is set to approximately this number.

15. Select Edit in the navigation bar to enter the edit mode. The cursor will blink over the last number.

16. Use the left and right arrow keys to move around within the number displayed. Use the top and bottom arrow keys to increase or decrease each number until it is set to the correct mA.

17. Select the Enter button to save, then select Next.

18. You will be returned to the Select channel screen.

19. Select the Cal ch 1 input line item.

20. The first screen will show you how to connect the terminals.

8.5.2 Input calibration:

21. When done with the terminal connections, choose Select to go to the next input calibration screen.

22. The screen will now show 'Set input current to 4 mA or less.'

23. Confirm that your low end input is set correctly. We suggest 3.8.

24. Select the bottom navigation bar to go to the next screen.

25. 'Enter measured current' message will scroll across the screen.

26. Select Edit in the navigation bar to enter edit mode.

27. Use the left and right arrow keys to move around within the number displayed. Use the top and bottom arrow keys to increase or decrease each number until it is set to the correct mA.

28. Select the Enter button to save, then select Next.

29. 'Set input current to 20 mA or more' will now show on the screen.

30. Confirm that your high end input is set correctly. We suggest 20.8 to 23.0.

31. 'Enter measured current' message will now scroll across the screen.

32. Select Edit in the navigation bar to enter the edit mode.

33. Use the left and right arrow keys to move around within the number displayed. Use the top and bottom arrow keys to increase or decrease each number until it is set to the correct mA.

34. Select the Enter button to save, then select Next.

35. You will be returned to the Select channel screen.

– 9. Maintenance and Troubleshooting –

9.1 General information

If you are experiencing difficulties with your RIM10 flowmeter, use the following information to identify and solve problems:

9.2 No output

Verify wiring is in accordance with all wiring diagrams in Section 4 'Electrical installation'.

1. Check supply power to the flowmeter. Supply voltage should be 24 Vdc.
2. Check the pickup coil for shorts, both across the coil and coil to ground. To do this, shut off power to the flowmeter. Remove the condulet cap over the terminal board. First, check for a short across the coil by attaching an ohmmeter to the pickup coil wires on pins 1 and 2 of CONN3, the small 9-pin connector. The coil should have a nominal resistance of 300 ohms at ambient temperature (Resistance will change with temperature). Zero or infinite resistance indicates a defective pickup. If a bi-directional meter, repeat on the 2nd coil at pins 5 and 6 of CONN3.

   Next, check for a coil to ground short. Using the same two wires from the previous example, hold one of the coil wires and make solid contact with one of the ohmmeter leads. Take the other ohmmeter lead and touch it to the stem or to a mounting screw on the terminal board. The ohmmeter should read infinite resistance. Zero resistance indicates a coil to ground short and the stem and coil assembly should be replaced. Repeat this step for the other coil wires.
3. Check the rotor for bearing drag or seizure. To do this, check by holding the rotor assembly between the thumb and forefinger while blowing on the rotor. If the bearings are worn the rotor may seize or spin poorly.
4. Check the rotor for bent blades or a bent yoke. All turbine blades are profiled for different flow conditions. Look for blade(s), which are clearly different from the factory, profiled blades. The yoke, which houses the turbine, is usually damaged when the gate valve is inadvertently shut before the turbine is fully retracted. Over-inserting the rotor into the bottom of the pipe yields the same result. Be very careful when lowering and retracting the sensor.
5. Check the rotor for contamination. Look for debris sticking to the rotor blades. If the rotor stops spinning, the blades may be unbalanced by debris. A contaminated blade will always stop or unbalance the rotor. To remove heavy contaminants from the rotor or bearings, use an ultrasonic cleaner.
6. Check the rotor for magnetization. If a rotor has been left on a flowmeter, which is out of service, or in flows without enough kinetic energy to spin the rotor, the blade nearest the magnetic pickup will become over-magnetized. As a result, the rotor spins unevenly or does not spin at all. To demagnetize a rotor, return the rotor to Spirax Sarco, for service.
7. Contact your sales representative.

9.3 Analog output equals 0 mA

1. Verify wiring is in accordance with the power and wiring diagrams in Section 4 'Electrical installation'.
2. Check the power supply voltage.
3. Check the voltage at the flowmeter.
4. Contact your sales representative.

9.4 Analog output less than 4 mA

1. Verify wiring is in accordance with the power and wiring diagrams in Section 4 'Electrical installation'.
2. Check the power supply voltage.
3. Check the voltage at the flowmeter.
4. Verify the analog zero and span calibration.
5. Contact your sales representative.

9.5 Inaccurate output

1. Verify the piping installation has allowed for the required straight pipe run. See Section 2.4
2. Verify flow is within the range of the rotor. See Figure 96.

English Units			Liquid	Gas or Steam					
Pipe Size		Rotor	L1 (40° pitch)	G1 (40° pitch)	G2 (30° pitch)	G3 (20° pitch)	G4 (15° pitch)	G5 (10° pitch)	G6[1] (5° pitch)
All	$V_{max.}$	*(ft/sec)*	30	55	70	85	115	145	175
3 - 5"	V_{lin}	*(ft/sec)*	1.4	3.19 / $\sqrt{\rho}$	3.98 / $\sqrt{\rho}$	4.52 / $\sqrt{\rho}$	5.84 / $\sqrt{\rho}$	6.91 / $\sqrt{\rho}$	6.10 / $\sqrt{\rho}$
	V_{min}	*(ft/sec)*	0.5	1.94 / $\sqrt{\rho}$	2.26 / $\sqrt{\rho}$	2.42 / $\sqrt{\rho}$	3.85 / $\sqrt{\rho}$	4.57 / $\sqrt{\rho}$	N/A
6"	V_{lin}	*(ft/sec)*	1.5	2.00 / $\sqrt{\rho}$	2.27 / $\sqrt{\rho}$	2.52 / $\sqrt{\rho}$	3.78 / $\sqrt{\rho}$	4.78 / $\sqrt{\rho}$	5.53 / $\sqrt{\rho}$
	V_{min}	*(ft/sec)*	0.6	1.23 / $\sqrt{\rho}$	1.63 / $\sqrt{\rho}$	1.95 / $\sqrt{\rho}$	2.84 / $\sqrt{\rho}$	3.47 / $\sqrt{\rho}$	N/A
8" +	V_{lin}	*(ft/sec)*	1.6	1.50 / $\sqrt{\rho}$	1.90 / $\sqrt{\rho}$	2.18 / $\sqrt{\rho}$	3.00 / $\sqrt{\rho}$	3.54 / $\sqrt{\rho}$	5.00 / $\sqrt{\rho}$
	V_{min}	*(ft/sec)*	0.7	1.00 / $\sqrt{\rho}$	1.31 / $\sqrt{\rho}$	1.40 / $\sqrt{\rho}$	2.19 / $\sqrt{\rho}$	2.81 / $\sqrt{\rho}$	N/A
Metric Units			**Liquid**	**Gas or Steam**					
All	V_{max}	*(m/sec)*	9	17	21	26	35	44	53
75-125 mm	V_{lin}	*(m/sec)*	0.4	3.89 / $\sqrt{\rho}$	4.86 / $\sqrt{\rho}$	5.51 / $\sqrt{\rho}$	7.12 / $\sqrt{\rho}$	8.43 / $\sqrt{\rho}$	7.44 / $\sqrt{\rho}$
	V_{min}	*(m/sec)*	0.2	2.37 / $\sqrt{\rho}$	2.76 / $\sqrt{\rho}$	2.95 / $\sqrt{\rho}$	4.70 / $\sqrt{\rho}$	5.57 / $\sqrt{\rho}$	N/A
150 mm	V_{lin}	*(m/sec)*	0.5	2.44 / $\sqrt{\rho}$	2.77 / $\sqrt{\rho}$	3.07 / $\sqrt{\rho}$	4.61 / $\sqrt{\rho}$	5.83 / $\sqrt{\rho}$	6.75 / $\sqrt{\rho}$
	V_{min}	*(m/sec)*	0.2	1.50 / $\sqrt{\rho}$	2.00 / $\sqrt{\rho}$	2.38 / $\sqrt{\rho}$	3.46 / $\sqrt{\rho}$	4.23 / $\sqrt{\rho}$	N/A
200 mm +	V_{lin}	*(m/sec)*	0.5	1.83 / $\sqrt{\rho}$	2.32 / $\sqrt{\rho}$	2.67 / $\sqrt{\rho}$	3.66 / $\sqrt{\rho}$	4.32 / $\sqrt{\rho}$	6.10 / $\sqrt{\rho}$
	V_{min}	*(m/sec)*	0.2	1.22 / $\sqrt{\rho}$	1.60 / $\sqrt{\rho}$	1.71 / $\sqrt{\rho}$	2.67 / $\sqrt{\rho}$	3.43 / $\sqrt{\rho}$	N/A

Fig. 96

Where:
V max = maximum velocity of fluid [ft/sec (m/sec)]
V lin = minimum velocity of fluid at which rotor response is linear [ft/sec (m/sec)]
V min = minimum measurable velocity of fluid [ft/sec (m/sec)]
r = density of fluid [lbs/ft 3 (kg/m)]
N/A = No Application

3. Check the quality of the rotor signal. To do so, look for the turbine variation warning on the web page.

9.6 Normal rotor

The normal signal from the magnetic pickup coil is a sine wave. For a normal ten-blade rotor, there are ten identical sinewaves per revolution.

9.7 Bent blades

Bent blades display one or more cycles, which lean away from perpendicular or drop below the centerline.

9.8 Missing rotor

A rotor missing a blade produces an abnormal waveform or cycle. Typically, the wave pattern will have a gap left from the missing blade.

9.9 Magnetized rotor

A rotor with residual magnetism produces an erratic signal, which will appear as if a high frequency signal has been combined with a longer, lower frequency signal.

9.10 Overranged flowmeter

Excessive flow velocity can cause the rotor to overspeed. The sine wave of an over-ranged rotor looks as if several sine waves were superimposed on each other each wave slightly offset from the other.

9.11 Chatter

Worn bearings or a bent yolk can cause chatter. The waveform of chatter will show the horizontal sweep pulled down from the center.

1. Check for electrical noise according to Section 4 'Electrical installation'.
2. Contact your sales representative.