

M800

Steam Flow Computer
Installation and Maintenance Instructions



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1. Safety information

Safe operation of this product can only be guaranteed if it is properly installed, commissioned, used and maintained by qualified personnel (see Section 1.11) 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.

In the UK, your attention is drawn to IEE Regulations (BS 7671). Elsewhere, other regulations will normally apply.

All wiring materials and methods shall comply with relevant EN and IEC standards where applicable.

Warning

This product is designed and constructed to withstand the forces encountered during normal use. Use of the product other than as a steam flow computer, or failure to install the product in accordance with these Instructions, product modifications or repair could:

- Cause damage to the product/property.
- Cause injury or fatality to personnel.
- Invalidate the **CE** marking.

Isolate the mains supply before opening the product as hazardous voltages may be exposed.

These instructions must be stored in a safe place near the installation of the steam flow computer at all times.

Warning

This product complies with the requirements of the following directives and harmonized standards:

Low Voltage Directive (73/23/EEC) by meeting the standards of:

- EN 61010-1: 2001 Safety requirements for electrical equipment for measurement, control and laboratory use.

Electromagnetic Compatibility (89/336/EEC) by meeting the standards of:

- EN 61326: 1997 A1 + A2 Emissions Class B equipment Table 4.
- EN 61326: 1997 A1 + A2 Immunity Class A equipment Table 1.

The product may be exposed to interference above the limits of EN 61326 if:

- The product or its wiring is located near a radio transmitter.
- Excessive electrical noise occurs on the mains supply. Power line protectors (ac) should be installed if mains supply noise is likely. Protectors can combine filtering, suppression, surge and spike arrestors.
- 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.

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



Equipment protected throughout by double insulation or reinforced insulation.



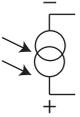
Functional earth (ground) terminal, to enable the product to function correctly.
Not used to provide electrical safety.



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.

1.1 Intended use

- i) Check that the product is suitable for use with the intended fluid.
- ii) Check material suitability, pressure and temperature and their maximum and minimum values. If the maximum operating limits of the product are lower than those of the system in which it is being fitted, or if malfunction of the product could result in a dangerous overpressure or overtemperature occurrence, ensure a safety device is included in the system to prevent such over-limit situations.
- iii) Determine the correct installation situation and direction of fluid flow.
- iv) Spirax Sarco products are not intended to withstand external stresses that may be induced by any system to which they are fitted. It is the responsibility of the installer to consider these stresses and take adequate precautions to minimise them.
- v) Remove protection covers from all connections and protective film from all name-plates, where appropriate, before installation on steam or other high temperature applications.

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 normalise after isolation to avoid danger of burns.

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.

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

The M800G contains a battery. On disposal of the unit or component, appropriate precautions should be taken in accordance with Local/National regulations.

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

1.16 Returning products

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

2. General product and delivery information

The Spirax Sarco M800 series flow computer is normally installed with any of the following Spirax Sarco pipeline units: Gilflo, ILVA, Spiraflo, DIVA, vortex or orifice plate assembly. Depending on the application, it may also be supplied with a differential pressure transmitter, pressure transmitter and /or a temperature transmitter.

This manual will enable the rapid connection and commissioning of the flowmetering system.

All the details for this are displayed in a simple and easy to read format.

2.1 Equipment delivery, handling and storage

Factory shipment

Prior to shipment, the Spirax Sarco M800 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.

Storage

If a flow computer is to be stored for a period prior to installation, the environmental storage conditions should be at a temperature between 0°C and 65°C (32°F and 149°F), and between 10% and 90% relative humidity (non-condensing).

Before installing and connecting the power ensure there is no condensation within the unit.

3. System overview

3.1 Orifice plate installation for steam

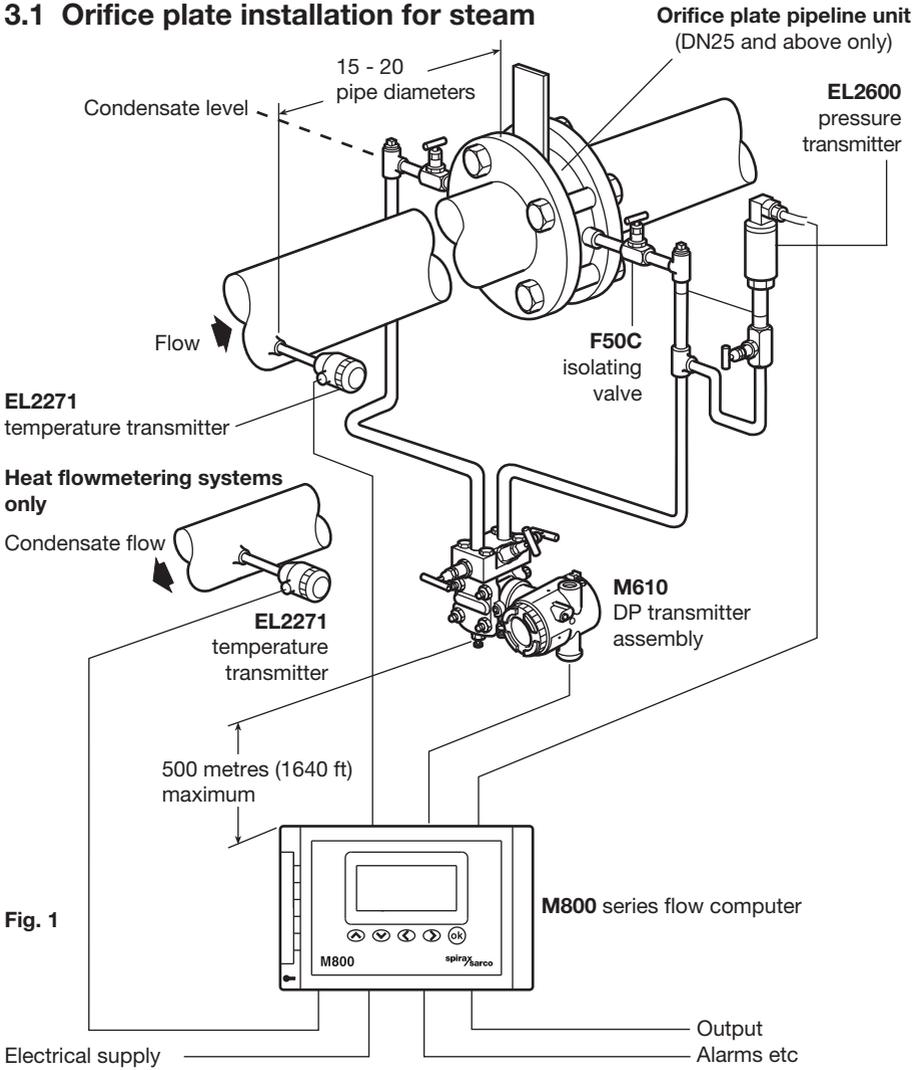


Fig. 1

Installation points to watch:-

1. Ensure all pipework is adequately supported and properly aligned.
2. The minimum recommended lengths of straight pipe are 10 D upstream and 5 D downstream. For full details refer to BS 1042 / ISO 5167.
3. Take care to ensure the correct direction of flow as indicated by the arrow on the flowmeter body. Also ensure that the 45° chamfer on the orifice plate is facing downstream and that the drain hole is at the bottom.
4. Avoid installing the flowmeter downstream of a pressure reducing valve as this may cause inaccuracies. Similarly, avoid installing the flowmeter downstream of a partially open valve.
5. Adequate line drainage should be provided upstream of the flowmeter for all steam applications.
6. Please read Section 5 before wiring the system.

3.2 Gilflo installation for steam

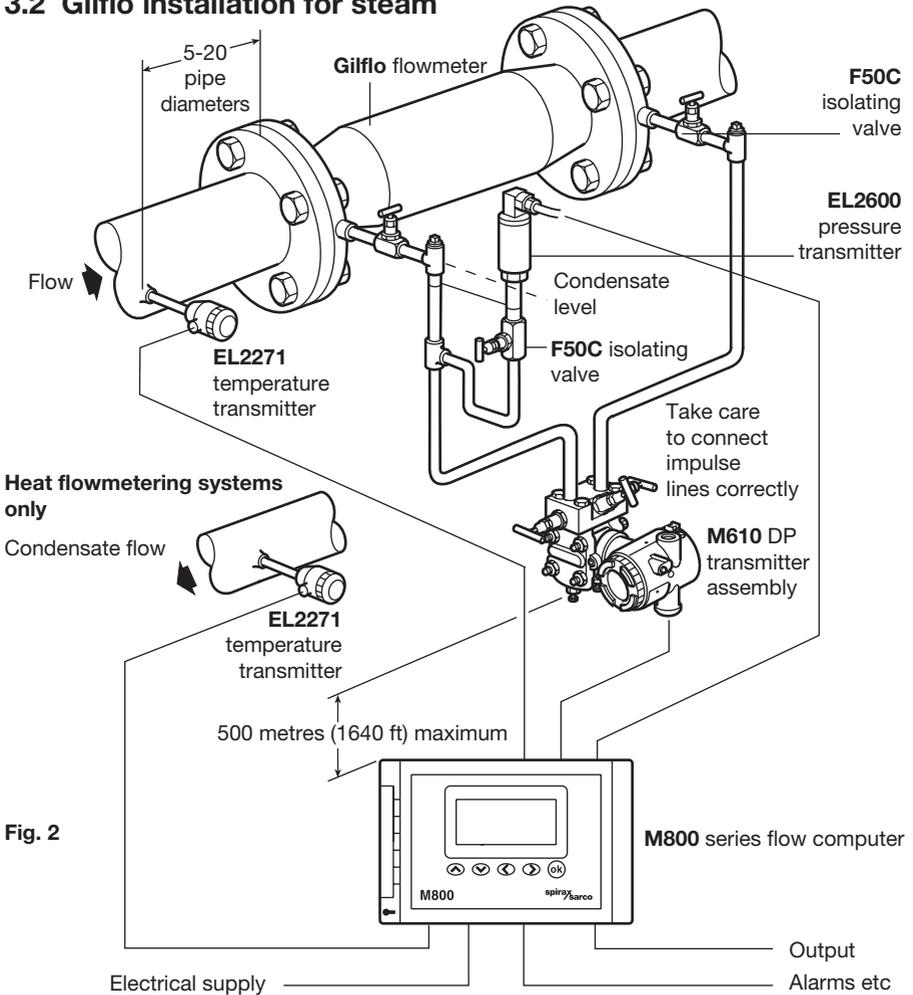


Fig. 2

Installation points to watch:-

1. Ensure all pipework is adequately supported and properly aligned.
2. The minimum recommended lengths of straight pipe are 6 D upstream and 3 D downstream.
3. Take care to ensure the correct direction of flow as indicated by the arrow on the flowmeter body.
4. Take precautions to avoid reverse flow through the flowmeter.
5. Avoid installing the flowmeter downstream of a pressure reducing valve as this may cause inaccuracies and/or possibly damage. Similarly, avoid installing the flowmeter downstream of a partially open valve.
6. Remember that actuated valves may cause rapid pressure fluctuations which could cause damage.
7. Adequate line drainage should be provided upstream of the flowmeter for all steam applications.
8. Please read Section 5 before wiring the system.

3.3 ILVA installation for steam

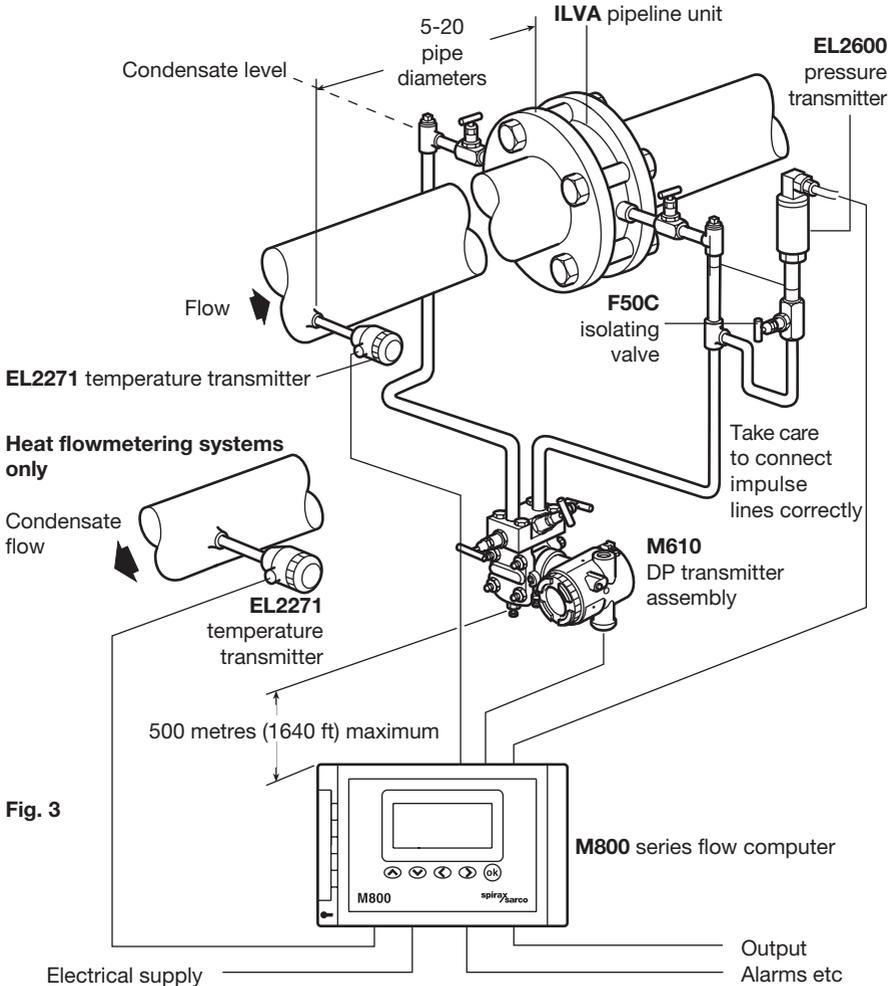


Fig. 3

Installation points to watch:-

1. Ensure all pipework is adequately supported and properly aligned.
2. The minimum recommended lengths of straight pipe are 6 D upstream and 3 D downstream.
3. Take care to ensure the correct direction of flow as indicated by the arrow on the flowmeter body.
4. Take precautions to avoid reverse flow through the flowmeter.
5. Avoid installing the flowmeter downstream of a pressure reducing valve as this may cause inaccuracies and /or possibly damage. Similarly, avoid installing the flowmeter downstream of a partially open valve.
6. Remember that actuated valves may cause rapid pressure fluctuations which could cause damage.
7. Adequate line drainage should be provided upstream of the flowmeter for all steam applications.
8. Please read Section 5 before wiring the system.

3.4 Spiraflo system overview

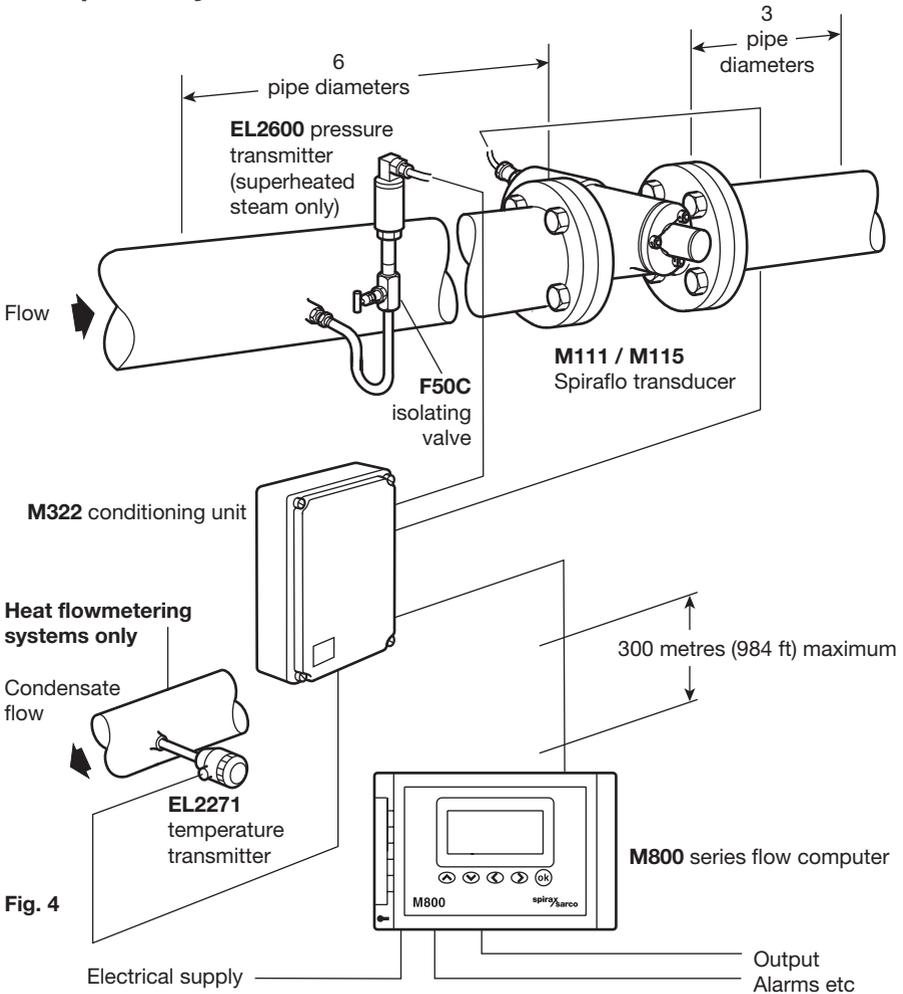


Fig. 4

Installation points to watch:-

1. Ensure all pipework is adequately supported and properly aligned.
2. The minimum recommended lengths of straight pipe are 6 D upstream and 3 D downstream.
3. Take care to ensure the correct direction of flow as indicated by the arrow on the flowmeter body.
4. Avoid installing the flowmeter downstream of a pressure reducing valve as this may cause inaccuracies and/or possibly damage. Similarly, avoid installing the flowmeter downstream of a partially open valve.
5. Adequate line drainage should be provided upstream of the flowmeter for all steam applications.
6. Please read Section 5 before wiring the system.

3.5 Vortex flowmeter installation for steam

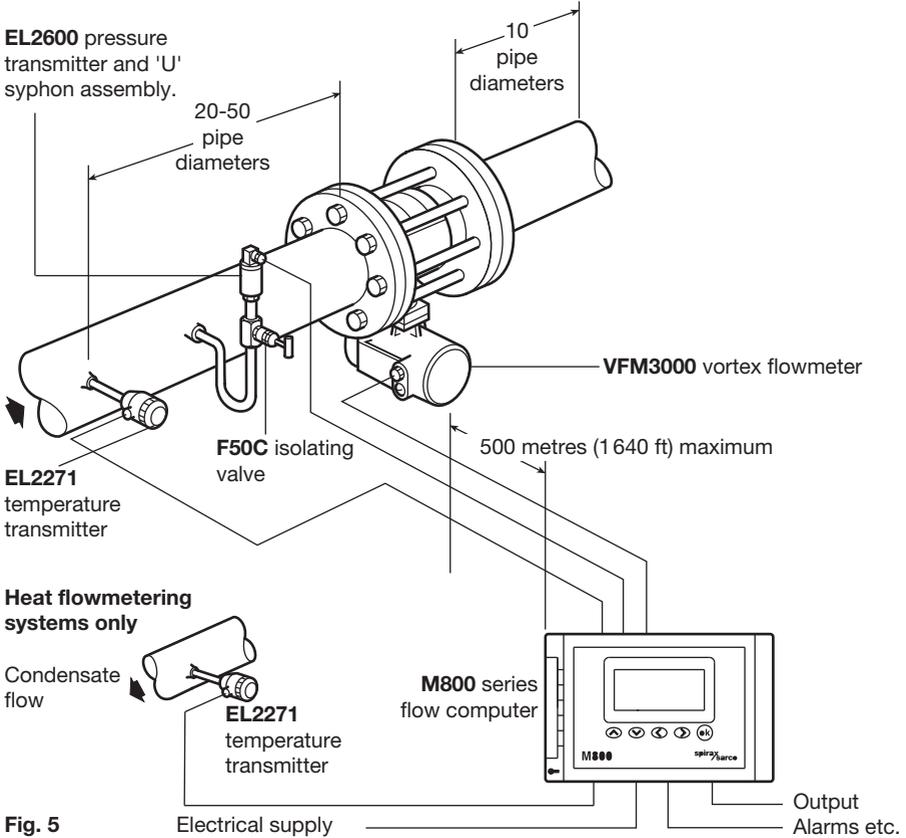


Fig. 5

Installation points to watch:-

1. Ensure all pipework is adequately supported and properly aligned. Ensure that pipe vibration is kept to a minimum as this can affect accuracy. The pipeline in the vicinity of the flowmeter should be supported by horizontal supports.
2. The minimum recommended lengths of straight pipe are 20 D upstream (depending on the ancillaries fitted this may need to be longer - see vortex installation manual for full details) and 10 D downstream. Note: flow straighteners can reduce the length of straight upstream pipe diameters required.
3. Take care to ensure that the vortex flowmeter is installed to suit the correct direction of flow as shown by the arrow on the side of the flowmeter body.
4. Take precautions to avoid reverse flow through the flowmeter. Reverse flow will not damage the flowmeter but is not good steam practice.
5. Avoid installing the flowmeter too closely downstream of pressure reducing valves, actuated valves or partially open valves as these may cause inaccuracies.
6. Adequate line drainage should be provided upstream of the flowmeter for all steam applications.
7. Please read Section 5 before wiring the system.

Note: for full installation details refer to the Installation Instructions supplied with the vortex flowmeter.

3.6 4-20 mA linear device (e.g. DIVA)

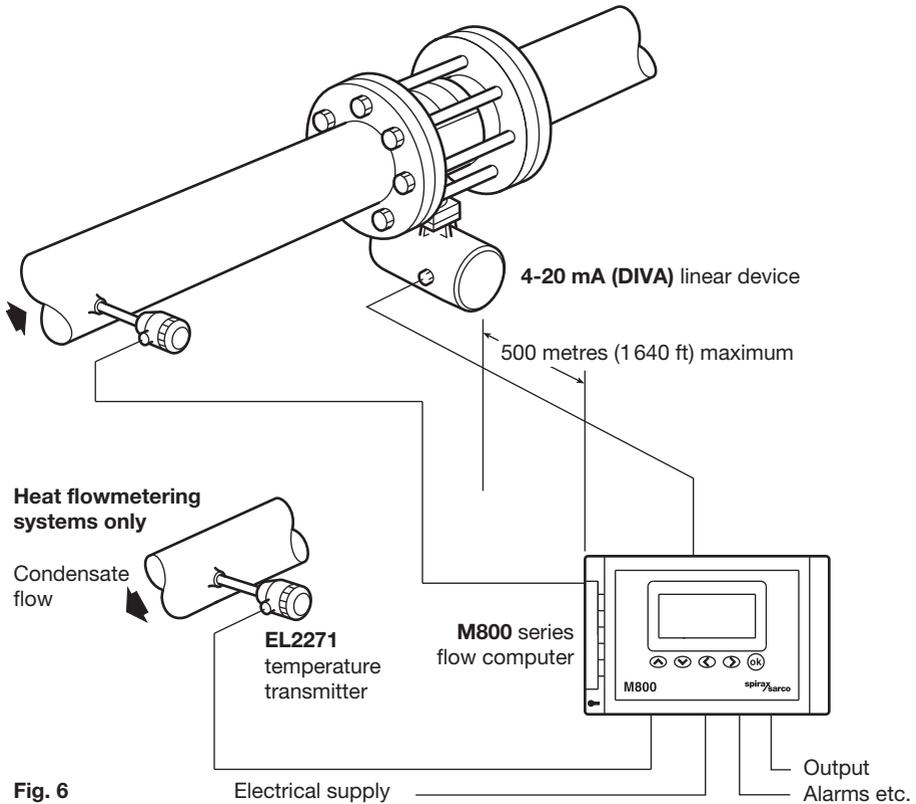


Fig. 6

Installation points to watch:-

1. Ensure all pipework is adequately supported and properly aligned.
2. The minimum recommended lengths of straight pipe are 6 D upstream and 3 D downstream.
3. Take care to ensure the correct direction of flow as indicated by the arrow on the flowmeter body.
4. Take precautions to avoid reverse flow through the flowmeter.
5. Avoid installing the flowmeter downstream of a pressure reducing valve as this may cause inaccuracies and /or possibly damage. Similarly, avoid installing the flowmeter downstream of a partially open valve.
6. Remember that actuated valves may cause rapid pressure fluctuations which could cause damage.
7. Adequate line drainage should be provided upstream of the flowmeter for all steam applications.
8. Please read Section 5 before wiring the system.

4. Mechanical installation

Note: Before actioning any installation observe the 'Safety information' in Section 1.

M800

The M800 flow computer is available as a wall or panel mounted version.

Note: All versions must be fitted away from the sources of excessive heat, electrical interference and from all areas liable to flooding.

Safety note - product specific:

The product **must** be protected from the environment and installed in one of the following ways:

Wall mount

Fit cable glands/conduit with a minimum IP54 rating or install in a clean dry room to provide a pollution degree 2 environment in accordance with EN 60529 (Specification for degrees of protection provided by enclosures - IP code).

- Where IP65 environmental protection is required, the seals, enclosures and cable glands/conduit must be of the same rating.
- Any unused cable glands/conduit entries **must** be sealed with an appropriate IP blind grommet.

Panel mount

Fit a suitable seal between the panel and the bezel 'd' (Figure 7) to maintain a minimum environmental rating of IP54 and install in an industrial enclosure with a minimum IP54 rating.



Fig. 7

Environmental conditions

The flow computer should be located in an environment that minimises the effects of heat, vibration, shock and electrical interference.

The flow computer should also be installed away from external magnetic fields, such as those generated from electric motors and large transformers.

Other considerations

Be sure to allow sufficient clearance for:

- Installation of conduit/wiring.
- 3 off - M20 knockouts available.
- Viewing of the display.

Warning: Do not install the flowmeter outdoors without additional weather protection.

4.1 Wall mounted version



1. Unclip the hinge 'a' by pulling the front of the hinge sideways.
2. Unscrew the top and bottom self-tapping screws 'h' (concealed by hinge).
3. Insert a screwdriver into the slot along the right hand hinge 'b'.
4. While supporting the front 'c', prise the right hand fixed hinge 'b' open. Take care not to allow the front cover to fall.
5. Remove the front section and store in a safe place.
6. The rear section 'e' can be attached to a wall using the four keyholes 'f' and suitable fastenings. Refer to Figure 10 for mounting detail.
7. Reassembly is the reverse of the above sequence.

Important: Ensure the front section is secured at the top and bottom using the two self-tapping screws supplied 'h'. These prevent the operator from gaining access to hazardous live parts.

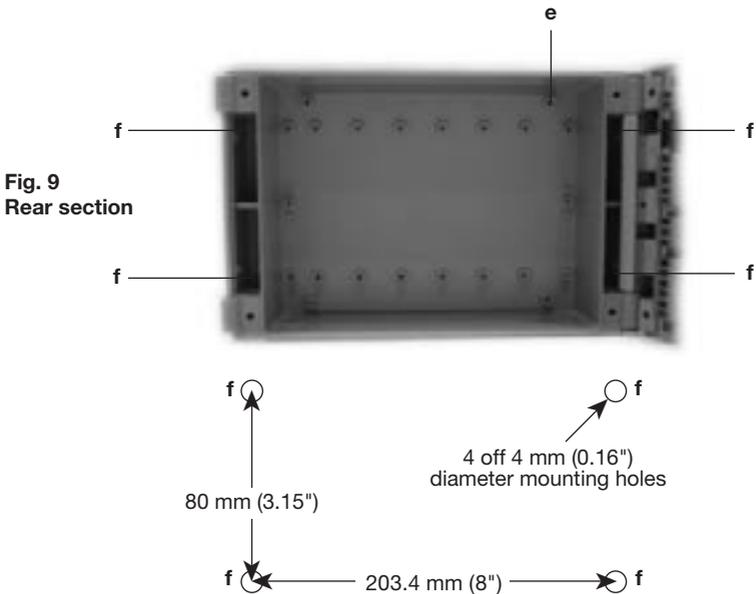


Fig. 10 Mounting detail for wall mounted version

4.2 Panel mounted version

These units have a bezel 'd' on the front section of the enclosure 'e'. Special clamps 'f' allow easy fixing to panels up to 23 mm (0.9") thick.

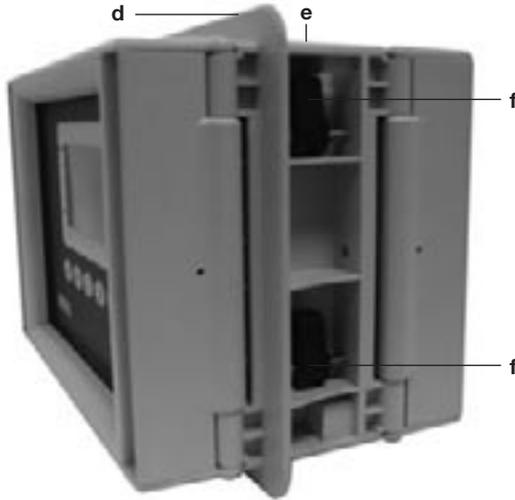


Fig. 11

1. Ensure that there is adequate clearance behind the panel where the M800 flow computer is to be mounted (140 mm [5.5"] minimum). Room should be left for wiring to connect into the rear of the unit.
2. Cut an aperture in the panel as shown in Figure 12.

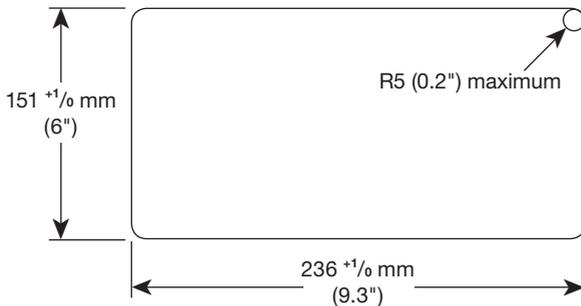


Fig. 12 Cut-out detail for panel mounted version



Fig. 13

3. Unclip the hinge 'a' by pulling the front of the hinge sideways.
4. Unscrew the top and bottom self-tapping screws 'h' (concealed by hinge).
5. Insert a screwdriver into the slot along the right hand hinge 'b'.
6. While supporting the front 'c', prise the right hand fixed hinge 'b' open. Take care not to allow the front cover to fall.
7. Remove the front section and store in a safe place.
8. Slide the M800 flow computer through the aperture until bezel 'd' (Figure 11) butts up against the panel front.
9. Tighten the four clamping screws 'g' through the access holes in the M800 front panel bezel. This will automatically extend the clamping legs 'f' (Figure 11).
10. Replace the front section and clip the hinges back into position.

IMPORTANT: Ensure the front section is secured at the top and bottom using the two self-tapping screws supplied 'h'. These prevent the operator from gaining access to hazardous live parts.



Fig. 14

4.3 Addition of option boards

You can extend the M800's range of functions by adding option boards.

The options available are:

- Isolated dual 4-20 mA re-transmission option board.
- Dual relay alarm option board.
- Modbus RTU communications option board.

Note:

- Two option boards can be fitted at the same time, however it is only possible to have a maximum of one dual 4-20 mA re-transmission option board fitted and a maximum of one Modbus RTU communications option board fitted.
- To provide a duplicate set of isolated contacts, two dual relay alarm option boards can be fitted.

It is recommended the relay option board is fitted in the slot beside the mains terminals. This is to assist in maintaining double/reinforced insulation.

If requested at the time of order placement option boards can be factory fitted prior to despatch. They can also be ordered separately and fitted to the M800 at anytime.



Important: Antistatic discharge procedures are as follows:

The option boards are sensitive to static electricity discharge and as such special handling precautions must be taken to prevent damage to the units.

The option boards must only be changed by competent persons, who must wear an antistatic wrist strap (see Figure 15) fitted with a crocodile clip.



Fig. 15

After removing the M800 cover, (see Section 5 'Electrical installation) the crocodile clip **must** be clipped to the earth connection and remain attached until the installation of the option boards is complete.

Do not remove the option boards from the antistatic bag (silver or black) until the crocodile clip is attached to earth.

Option boards must be fitted into the housing immediately after removal from the bag. Placing the printed circuits on any surface before fitting them into the M800 may permanently damage them.

Fitting of option boards

1. Isolate the power from the M800. Note: Insertion of an option board with the power still applied to the unit could permanently damage the M800 and option board.
2. Remove the front cover 'c' as described in Section 4.1 and Section 4.2.
3. Disconnect the connectors TBK4, TBK2 and TBK3.
4. Remove the option board securing screw from the main PCB.
5. Carefully slide the option board into one of the two slots on the back of the front cover (Figure 16).
6. Secure the board to the main PCB using the option board securing screw.
7. Reconnect the connectors TBK4, TBK2 and TBK3.
8. Replace the front cover.

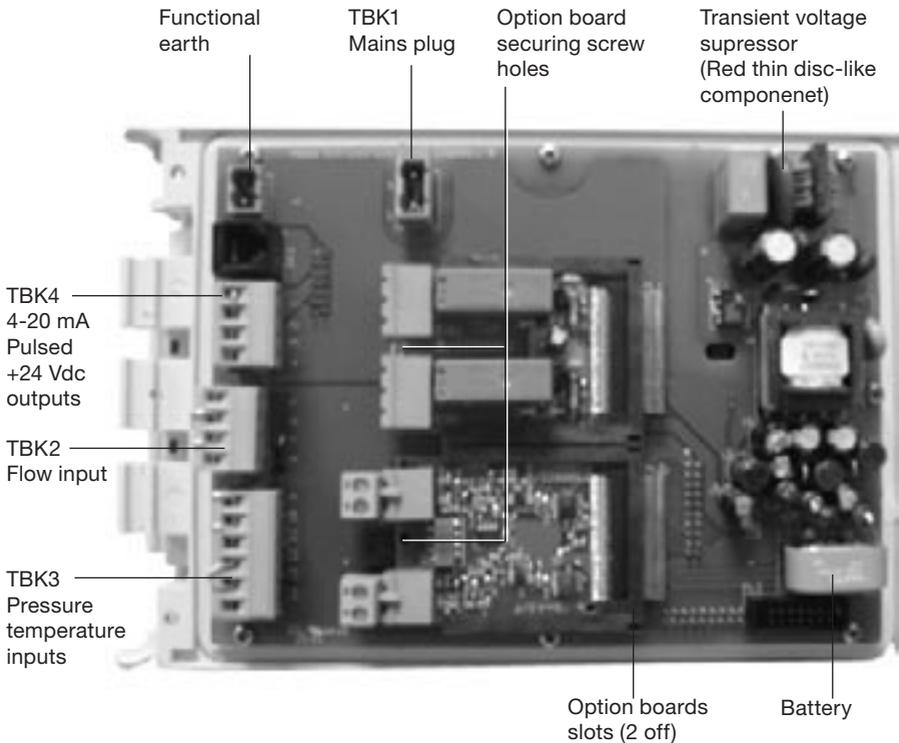


Fig. 16 General circuit board view

5. *Electrical installation*

Note: Before actioning any installation observe the 'Safety information' in Section 1.

5.1 Important - please read the following general wiring notes:

Every effort has been made during the design of the flow computer to ensure the safety of the user but the following precautions must be followed:

1. Maintenance personnel must be suitably qualified in working with equipment containing hazardous live voltages.
2. Ensure correct installation. Safety may be compromised if the installation of the product is not carried out as specified in this manual.
3. Always isolate the flow computer from the mains supply before opening the unit.
4. The design of the flow computer relies on the building installation for overcurrent protection and primary isolation.
5. Overcurrent protection devices rated at 1 amp must be included in all phase conductors of the installation wiring. If overcurrent protection is included in both supply wires then the operation of one must also cause the operation of the other. Refer to IEC 60364 (Electrical Installations of Buildings) or prevalent local standard for full details of requirements for overcurrent protection.
6. Overcurrent protection devices must be fitted to the relay circuit and appropriately rated for the given loads stated in the technical data.
7. Relay contacts must be supplied at the same phase as the product's mains supply.
8. The flow computer is designed as an installation category II product.
9. Wiring should be carried out in accordance with IEC 60364 or prevalent local standards.
10. All external circuits must meet and maintain the requirements of double/reinforced installation as stated in IEC 60364 or equivalent.
11. Additional protection must be provided to prevent accessible parts (e.g. signal circuits) from becoming Hazardous Live if a wire or screw is accidentally loosened or freed. Ensure all wires are secured to at least one other wire from the same circuit. The attachment must be as close to the terminal block as possible but must not apply undue stress on the connection. Example, use a cable tie to secure the live and neutral wire together. If one wire becomes loose the other wire will prevent it from touching accessible parts.
12. A disconnecting device (switch or circuit breaker) must be included in the building installation. It must:
 - Have a rating with sufficient breaking capacity.
 - Be in close proximity to the equipment, within easy reach of the operator but not cause difficulty in operating.
 - Disconnect all phase conductors.
 - Be marked as the disconnecting device for the flow computer.
 - Not interrupt a protective earth conductor.
 - Not be incorporated into a mains supply cord.
 - Comply with the requirements for a disconnecting device specified in IEC 60947-1 (Specification for low-voltage switchgear and controlgear - General rules) and IEC 60947-3 (Switches, disconnectors, switch-disconnectors and fuse-combination units).
13. It is important that the cable screens are connected as shown in order to comply with the electromagnetic compatibility requirements.

5.2 Important -

Please read the following general mains wiring notes:

1. Read Section 5.1 before attempting to wire the supply to the M800.
2. The wiring connections are identified on the PCB and on terminal plugs.
3. Fuses should be fitted in all live conductors.

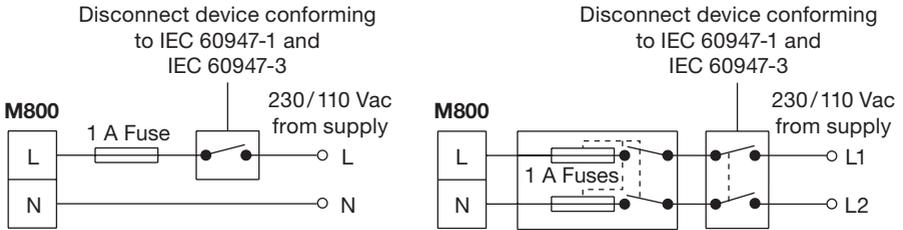


Fig. 17 Single phase supply with neutral at earth potential

4. Mains and relay connector:
 - Cable size: 0.5 mm² to 2.5 mm².
 - Torque range: 0.5 to 0.6 N m
 - Stripping length: 7 mm
5. Double or reinforced insulation must be maintained between:
 - Hazardous live conductors (mains and relays circuits)and
 - Safety extra low voltages (All other components/connectors/conductors).
6. Mains, relay and transducers/sensor plugs **must not** be transposed.
7. The wiring diagrams show relays and switches in the power off position.

General signal wiring:

1. Use screened cable.
2. Maximum length 400 m (1 312 ft).
3. Stranded 7/0.2 or 24 AWG wire is recommended - Do not use solid copper core as continual opening/closing of the front could cause damage.
4. Do not extend the M322 transducer cable.

Screen connection

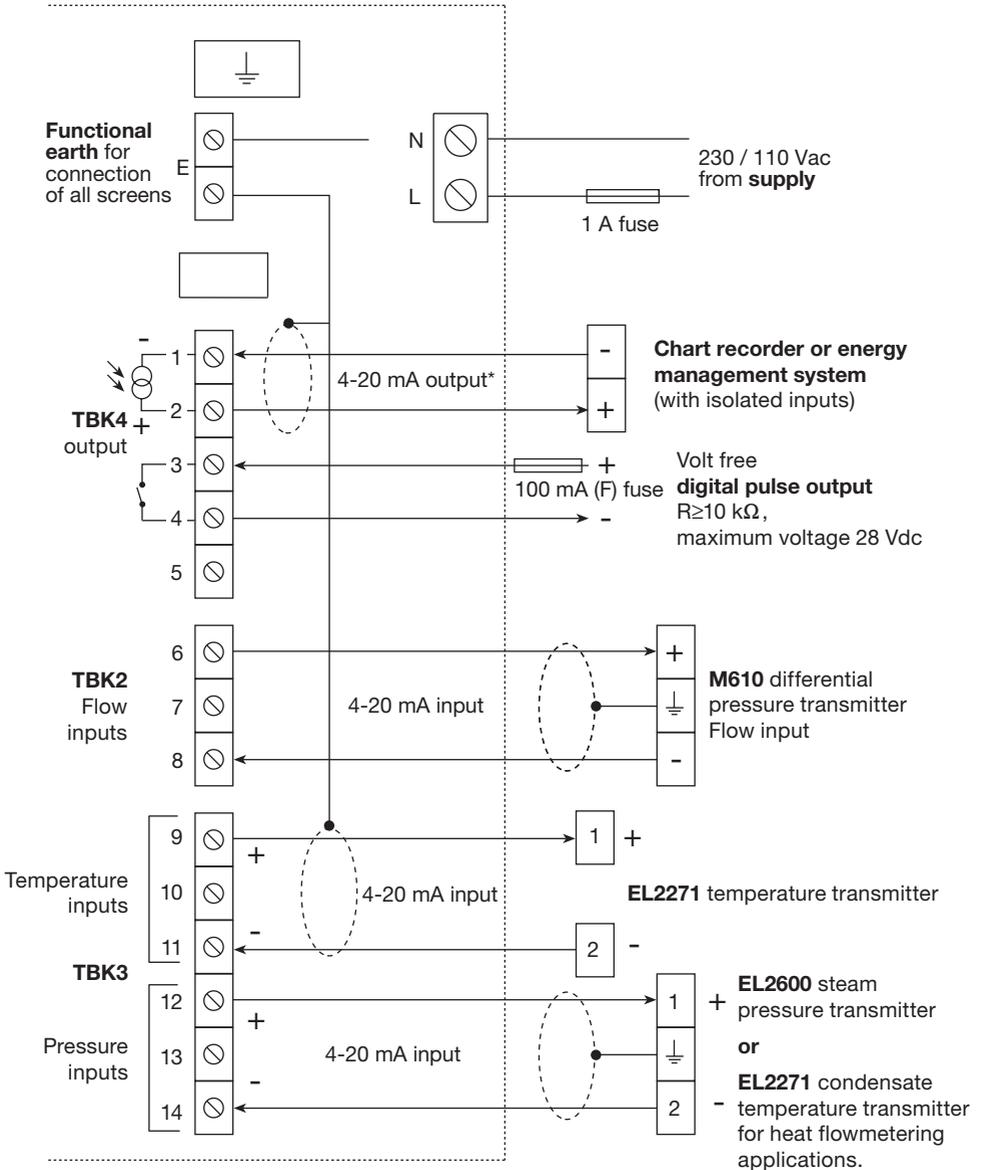
An earth current loop is created if a wire or screen is connected between two earth points, which are at different potential (voltage). If the instructions are followed correctly, then the screen will only be connected to the earth at one end.

The earth terminal is a functional earth rather than a protective earth.

A protective earth provides protection from electric shock under a single fault condition. This product has double insulation and therefore does not require a protective earth. A functional earth is used in order for the product to operate. In this application, the earth is used as a sink or drain for any electrical interference. The screens must be connected to the earth terminal in order to conform to the EMC directive.

5.3 Wiring diagram - Gilflo, ILVA and Orifice plate systems

M800 steam flow computer

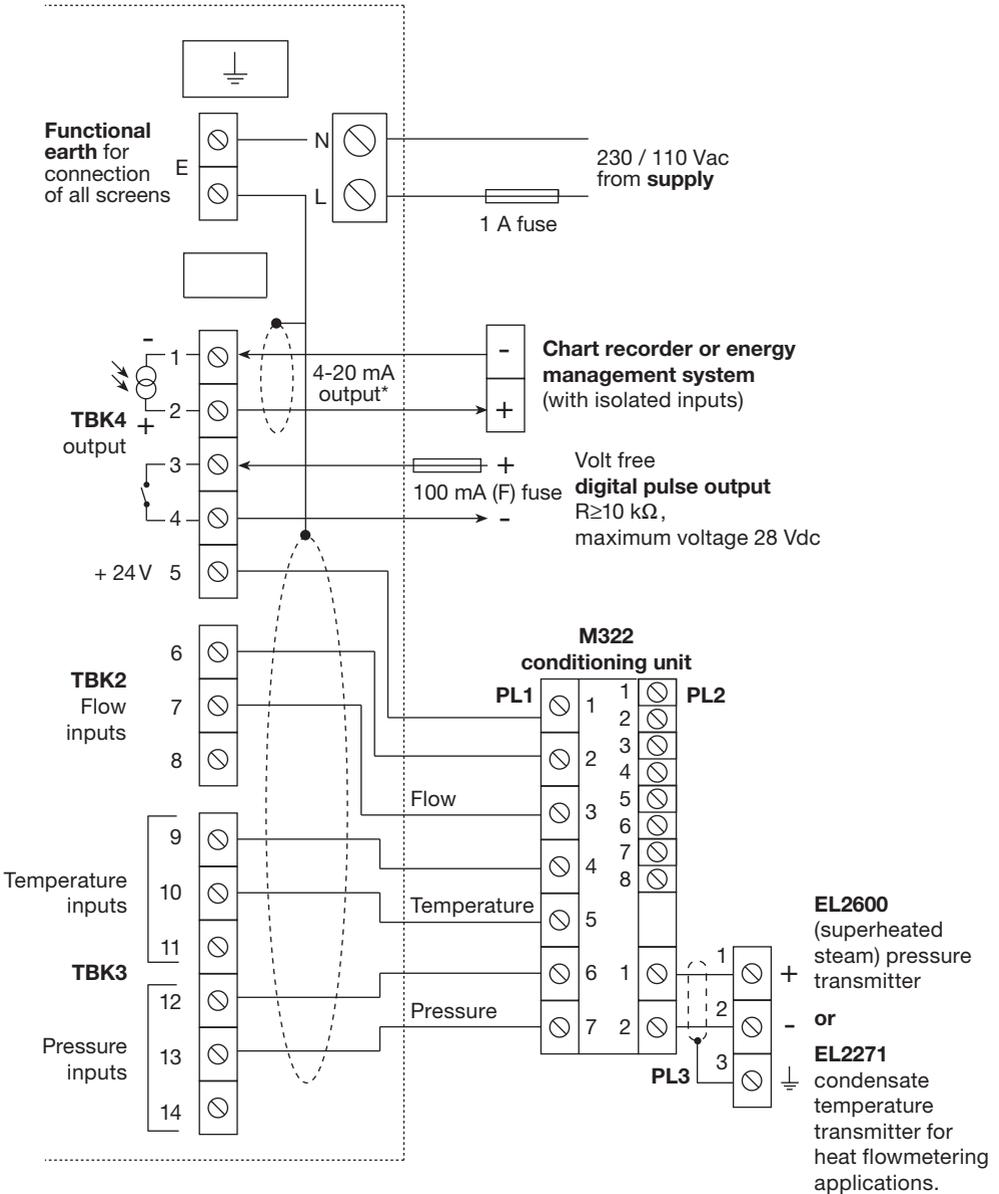


* See Section 5.8 'Option board wiring' for recalibration details.

Fig. 18

5.4 Wiring diagram - Spiraflo flowmeter system

M800 steam flow computer

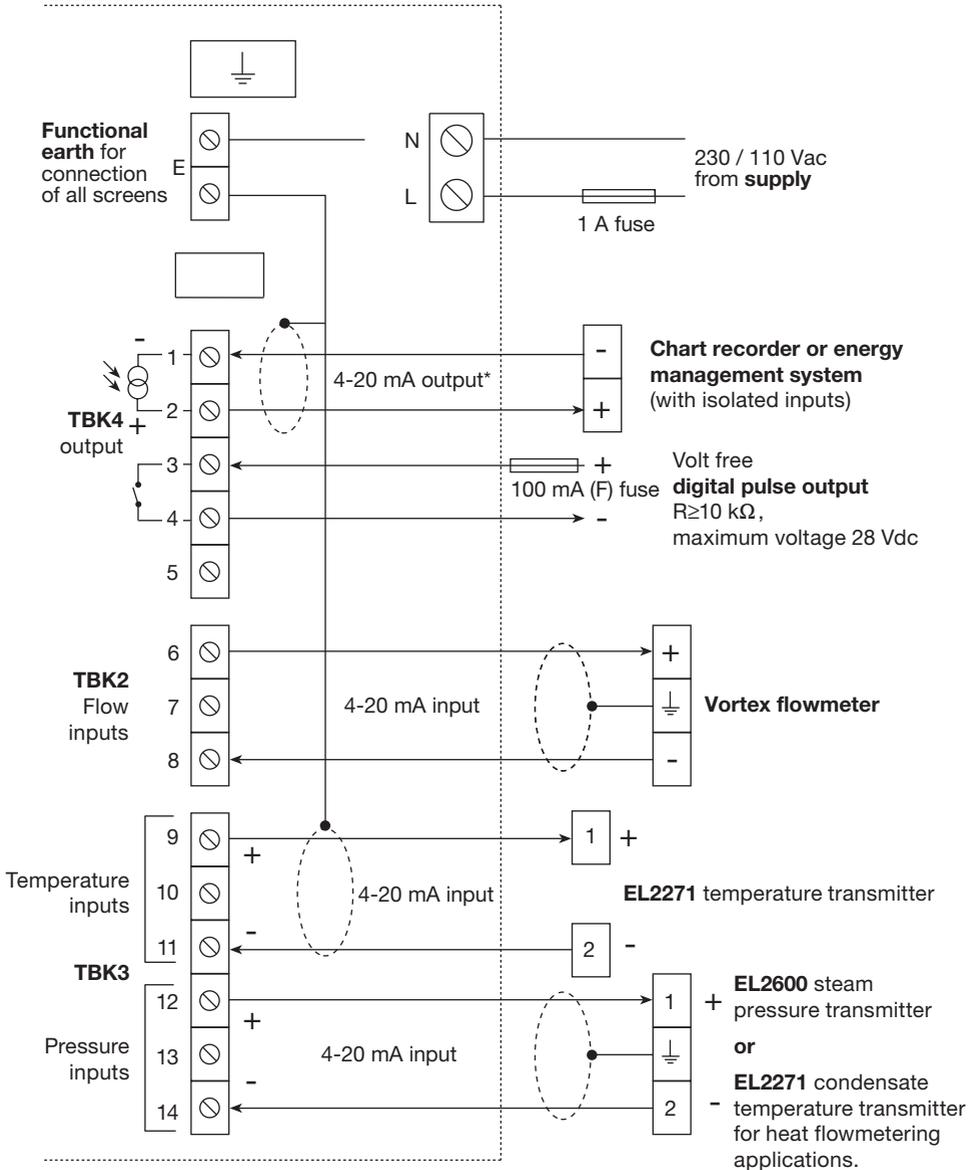


* See Section 5.8 'Option board wiring' for recalibration details.

Fig. 19

5.5 Wiring diagram - Vortex flowmeter system

M800 steam flow computer

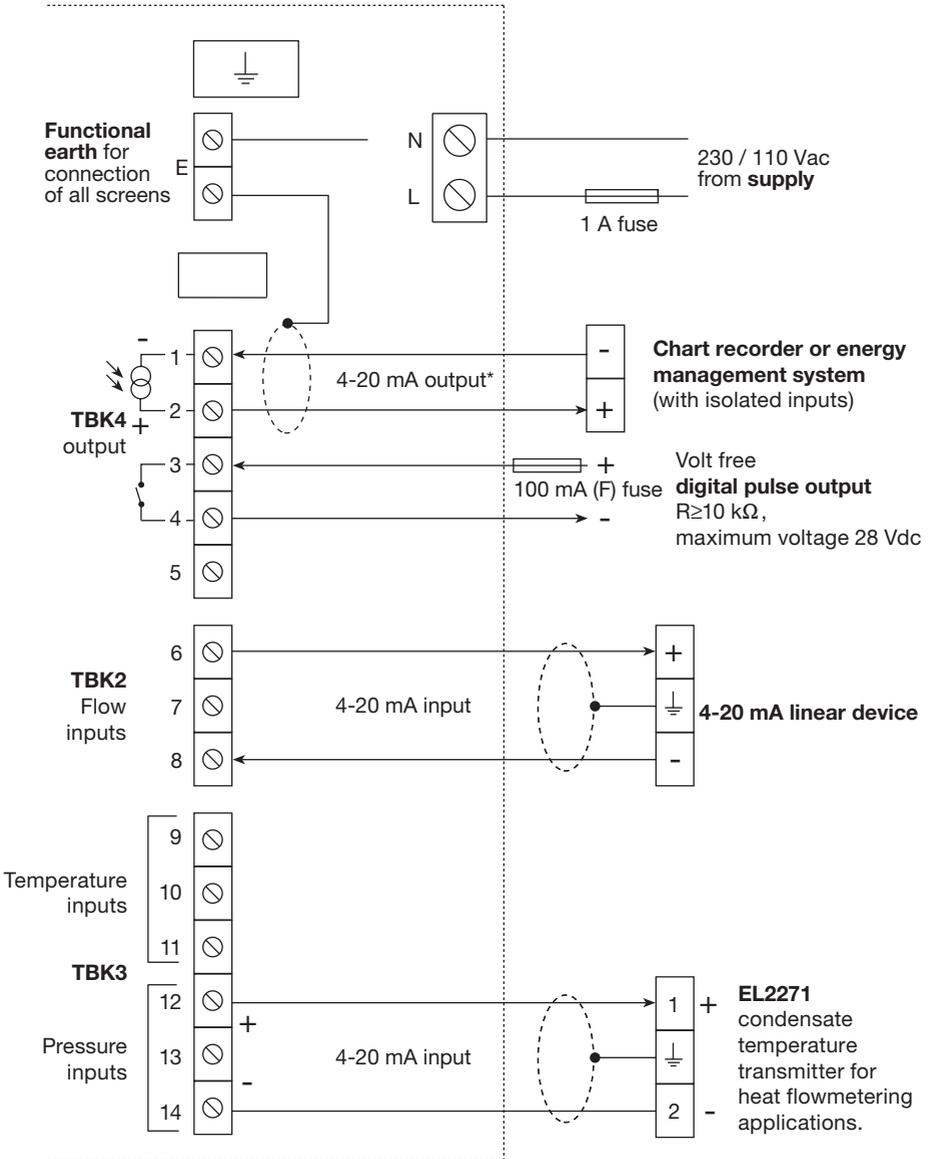


* See Section 5.8 'Option board wiring' for recalibration details.

Fig. 20

5.6 Wiring - 4-20 mA linear devices (e.g. DIVA)

M800 steam flow computer



* See Section 5.8 'Option board wiring' for recalibration details.

Fig. 21

5.7 Wiring diagram - Pulsed output

M800 steam flow computer

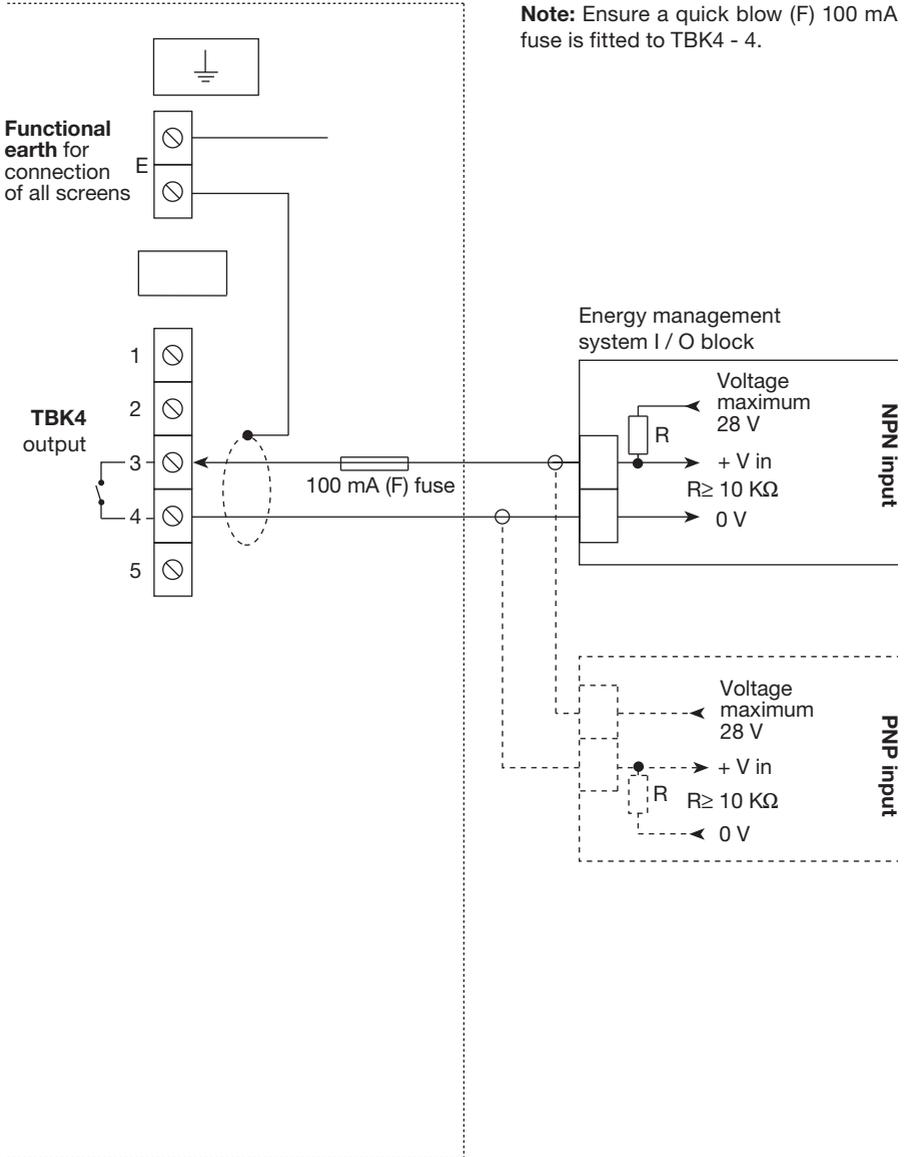


Fig. 22

5.8 Option board wiring

4-20 mA option board

Additional notes:

- All three 4-20mA outputs are current sinks. They are optically isolated from the other outputs and inputs, although they are not isolated from each other.
- If more than one 4-20mA output is connected to the same instrument, this instrument must have isolated inputs.

Note: For heat flowmetering applications the optional 4-20 mA outputs will be proportional to steam pressure and condensate temperature.

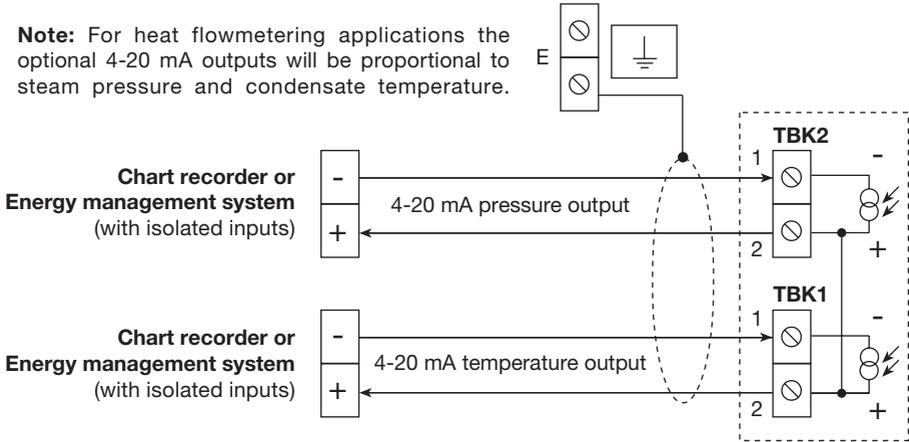


Fig. 23 Wiring diagram - 4-20 mA option board

4-20 mA outputs calibration:

- The flow 4-20 mA output is factory calibrated. If higher accuracy is required for the pressure and temperature 4-20 mA outputs, then calibration of these outputs can be performed at commissioning.
- Calibration is performed using the menu and a multimeter or ammeter (see Figure 24).
- The multimeter or ammeter must be capable of measuring 22 mA.
- The accuracy is defined by the multimeter or ammeter and the M800's 4-20 mA output resolution (See Section 9 'Technical information').

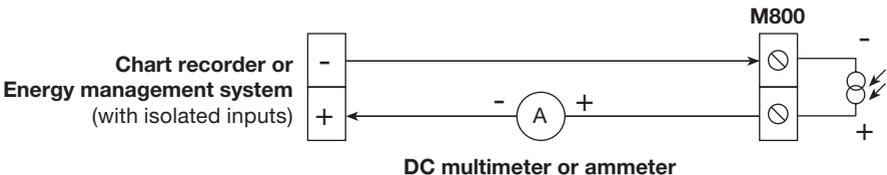


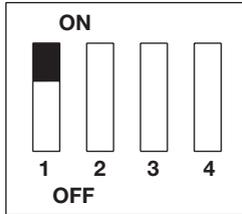
Fig. 24

RS485 option board

Additional notes

- Consider terminating the two furthest ends of the bus to match the transmission line impedance. A 120 Ω resistor is commonly used, but ideally the line impedance should be matched to each individual installation. The product is fitted with an internal 120 Ω resistor, which can be connected to the Rx terminals by setting SW1 - 1 to ON (Figure 25).
- Termination for short lengths of cable should not be necessary < 300 m (< 1 000 ft) @ 9 600 Baud.
- Twisted pair cable should not be required for short lengths of cable < 1.5 m (< 5 ft). Standard screened cable should suffice.

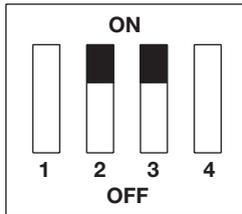
Fig. 25 SW1



Two-wire installation

- Set SW1 - 2 and SW1 - 3 to ON (Figure 26).
- Use an EIA RS485 screened single twisted pair communication cable (e.g.: Alpha wire part 6412).
- Connect TBK1 - 1 to Master +Tx or +Rx.
- Connect TBK1 - 2 to Master -Tx or -Rx.
- See Figure 28, for a typical installation.

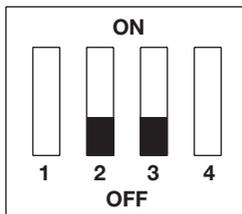
Fig. 26 SW1



Four-wire installation

- Set SW1 - 2 and 3 to OFF (Figure 27).
- Use an EIA RS 485 screened double twisted pair communication cable (e.g.: Alpha wire, part 6413).
- Using one twisted pair connect: - TBK1 - 1 to Master +Rx
- TBK1 - 2 to Master -Rx
- Using the other twisted pair connect: - TBK1 - 4 to Master +Tx
- TBK1 - 3 to Master -Tx
- See Figure 29, for a typical installation.

Fig. 27 SW1



5.9 Wiring diagrams - RS485 option board

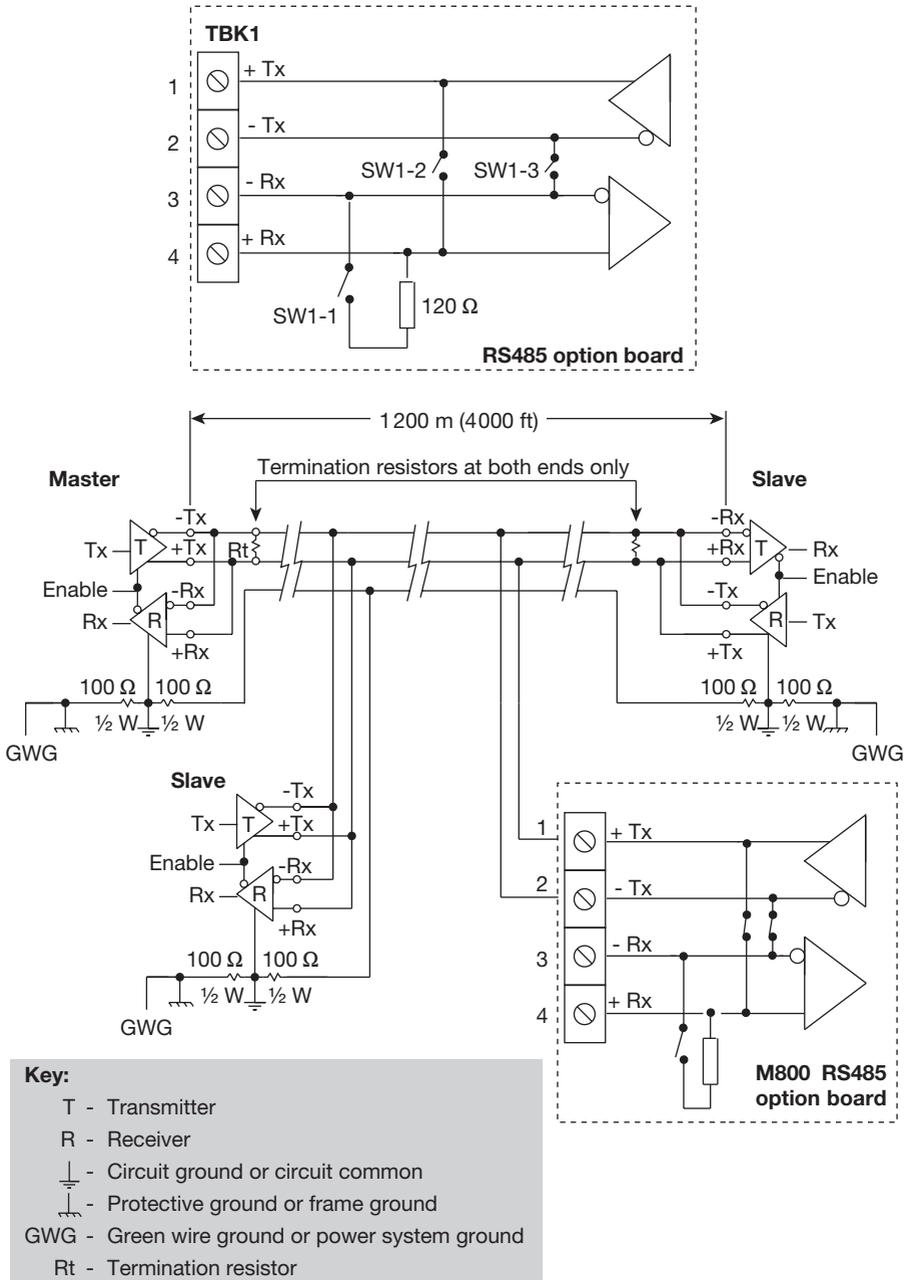


Fig. 28 Typical RS485 two-wire multi-drop network

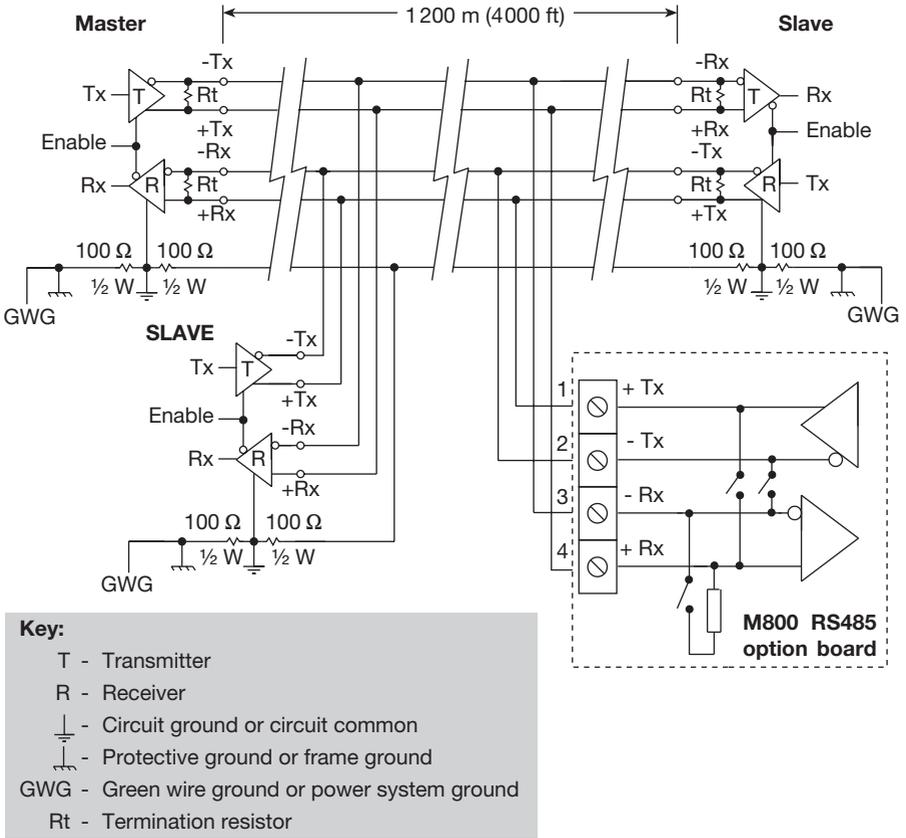


Fig. 29 Typical RS485 four-wire multi-drop network

5.10 Relay (dual) option board

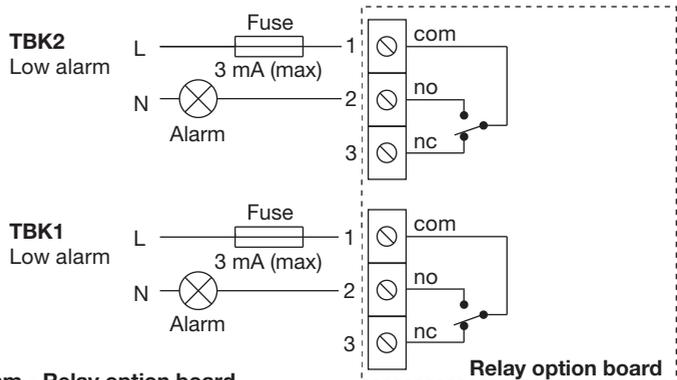


Fig. 30 Wiring diagram - Relay option board

6. Commissioning

6.1 General information

After the mechanical and electrical installation has been completed, the following commissioning instructions within this section should be followed.

All commissioning for the M800 flow computer is carried out through the front panel. The front panel consists of a graphics display and a 5 button key pad:



Enter parameters, and commissioning mode (5 seconds) when the parameter or digit is flashing



Enter sub-menus and shift right to the next digit when the parameter or digit is flashing



Exit menus/sub-menus and shift left to the next digit when the parameter or digit is flashing



Scroll down menus/sub-menus and decrement digits



Fig. 31 Scroll up menus/sub-menus and increment digits

6.2 Run mode

After initially applying power to the M800, it will automatically enter its run mode. In this mode the steam data is displayed on several screens, which can be accessed by pressing the up (↑) or down (↓) keys.

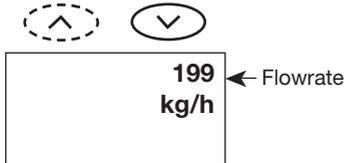
In the run mode, the M800 displays the steam's total, rate of flow, power, pressure and temperature. It can also show the time and date, a trend graph of the flowrate and any error or alarm messages that occur.

Note: The M800 is factory set to display data in metric units (see Section 6.4 'basic data sub-menu' to change to M800 to display in imperial units).

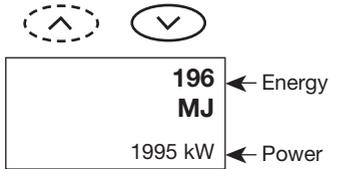
Run mode data sequence



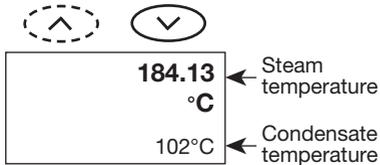
Note: If the M800 is configured for a linear input, depending on what the input source is, the total will be in mass or energy units; and flowrate will be in mass or power units.



Note: Flowrate will not be shown if the M800 is configured for a linear input proportional to power.



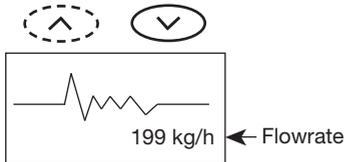
Note: Power will not be shown if the M800 is configured for a linear input proportional to mass flow.



Note: Temperature will not be shown if the M800 is configured for a linear input.

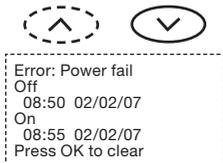


Note: Pressure will not be shown if the M800 is configured for a linear input.



Trend graph representing mass flow, or power.

Note: the % axis corresponds to the 4-20 mA output setting.



If there are any problems with the M800, an error or alarm screen will appear. The example shown is the power fail error screen.

Note: Pressure sensor error becomes condensate temperature error for heat flowmetering applications.

Pressing the button will return you to the top of this sequence.

Alarm/Error display messages

These are shown on a screen in the run mode. This screen is normally hidden and will only appear if there's a problem. Alarm and error messages are prioritised, so if there are two active problems, clearing the first will immediately cause the lower priority one to appear. Some, such as the power-fail error message (as shown on the previous page), can be cleared by pressing and holding the OK key for three seconds. Others, such as a sensor error or a commissioning error will need further action to clear them.

The alarm and error messages displayed are:

Alarms

These show the alarm start and stop times. They can be set as follows:

- The High and Low flow alarm limits are 0 and 1999999.
- High and Low temperature alarm limits are 0 and 500°C (932°F).
- High and Low pressure alarm limits are 0 and 119 bar g (or 1726 psi g).

Commissioning errors:

- **No t or p data** - If the M800 has been commissioned without any temperature or pressure input data.
- **Beta < min** - The orifice plate beta ratio is less than 0.1
- **Beta > max** - The orifice plate beta ratio is greater than 0.75
- **Pipe dia < ISO min** - The pipe diameter is less than 50 mm, but greater than 25 mm.
- **Pipe dia > max** - The pipe diameter is greater than 1000 mm.

General errors:

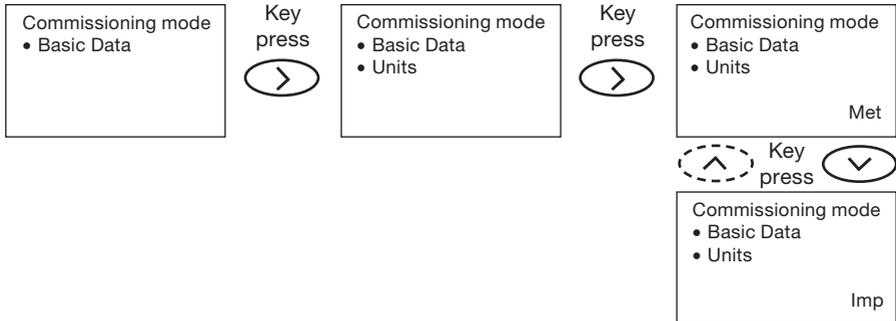
- **Power interruption** - Shows the power off and on times.
- **Flow sensor error** - Activates if the M800 detects a flow signal below 3.85 mA or above 22 mA.
- **Temp sensor error** - Activates if the M800 detects a temperature signal below 3.85 mA or above 22 mA.
- **Pres sensor error** - Activates if the M800 detects a pressure signal below 3.85 mA or above 22 mA.
- **Out of range** - Indicates that the M800 is calculating a flowrate outside its calibrated range. Activates if the flow input current is below 4 mA (but above 3.85 mA) or above 20 mA (but below 22 mA).
- **Sub saturation alarm** - Activates if the measured temperature drops by more than 2°C below the steam saturation temperature, as calculated from the pressure data.
- **Totaliser error** - An error has occurred with the totaliser. The total displayed may not be correct. Pressing the OK key will cancel the error; it will not reset the total.
- **Timer error** - An error has occurred with a timer. The timer information displayed may not be correct. Pressing the OK key will cancel the error; it will not reset the timer.

6.3 Commissioning mode

The commissioning mode is used to set the M800 to the pipeline flow, temperature and pressure sensors, set and test the outputs and change the pass code.

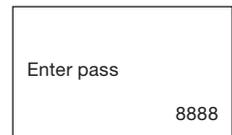
All data entry is performed via a menu and sub menu configuration with the key pad buttons used for navigation, i.e. to go deeper into the menu the right hand key  is pressed, to scroll up and down the menu the up  and down  keys are pressed and to exit from a sub-menu the left key  is pressed. The display will step down a line each time a sub-menu is entered and display the previous menu title.

For example:-



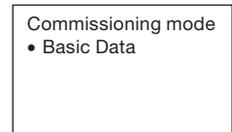
Data to be edited is always displayed on the bottom right of the screen. Pressing the OK key will enter new data. By pressing the up and down keys, the display will scroll through the available data and the previously entered selection will flash. After a period of ten minutes without any keys being pressed, the M800 will automatically return to the run mode.

You can enter the commissioning mode from the run mode (apart from the error and alarm screen) by pressing and holding down the 'OK' key for 5 seconds. The display then shows:



The flashing leading digit indicates the position of the cursor. The default, or factory set pass code is 8888 (this can be changed from within the commissioning mode). The pass code can be entered by using the up and down keys to increment or decrement the flashing value and the left and right keys to move the cursor.

Pressing 'OK' will enter the pass code. If an incorrect pass code is used, the display automatically returns to the run mode. After the correct pass code is entered the display shows:

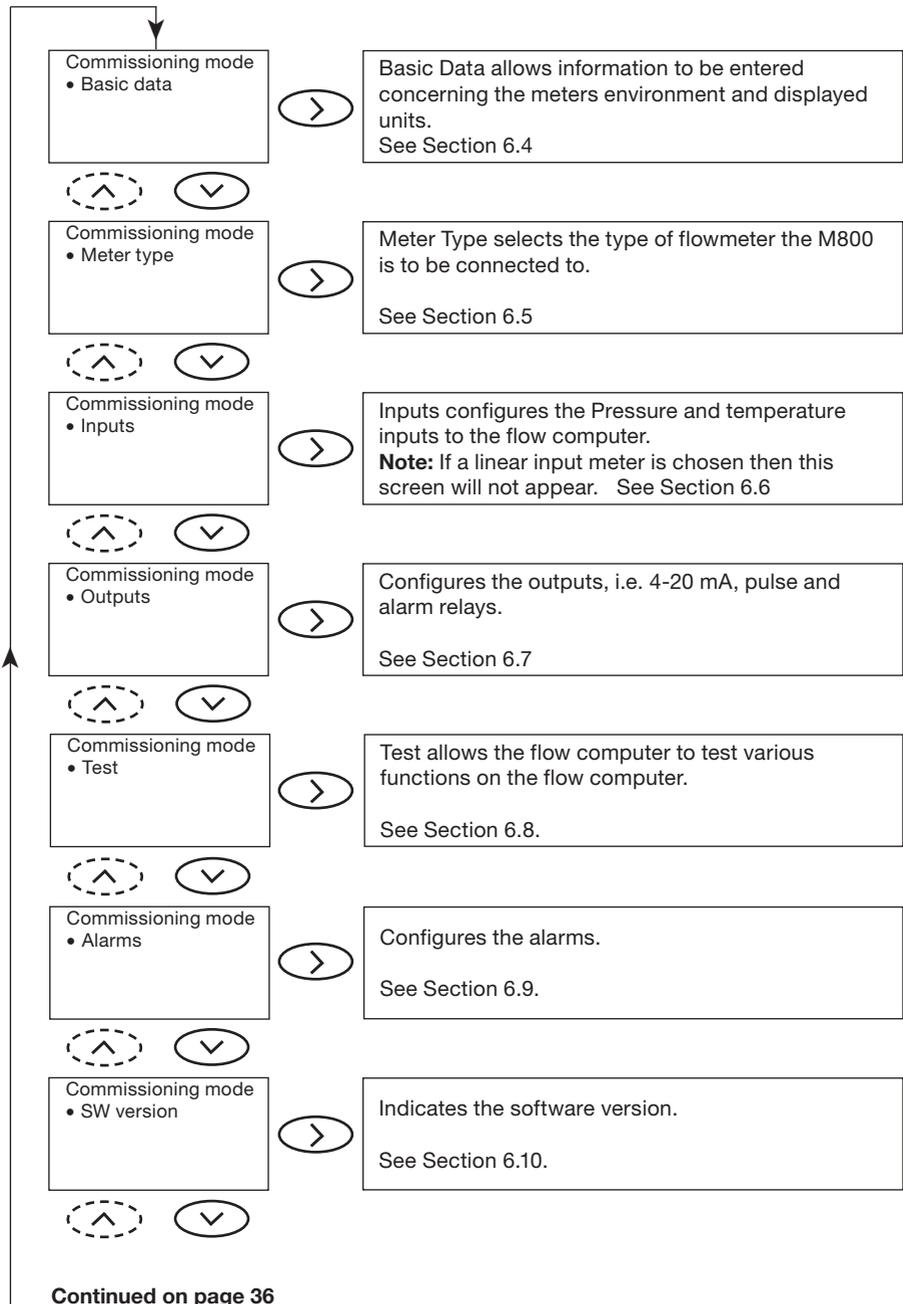


To exit the commissioning mode at any stage, pressing and holding the left key  will return the M800 to the run mode.

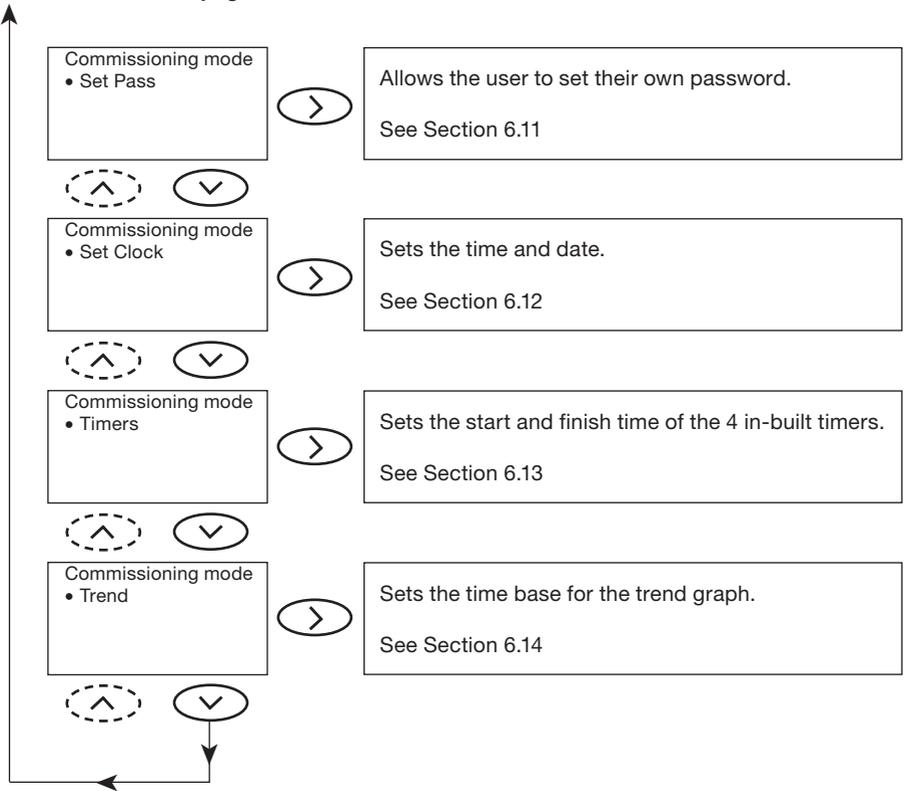
Pressing the up  and down  buttons scrolls through the various first level menus.

Pressing the right arrow button  enters a particular sub-menu.

Commissioning mode main menu



Continued from page 35



6.4 Basic Data sub-menu

The basic data sub-menu (shown on page 38) allows data concerning the environment about the flowmeter to be entered. This includes the units, atmospheric pressure and dryness fraction.

Notes on basic data sub-menu

Units:

The M800 is factory set to display data in metric units. The data displayed can be changed to transmit imperial (Imp) units.

A summary of the units is detailed in the Table below:

Metric	Imperial
mm, kg, kg/h, MJ, kW, bar g, °C	ins, lb, lb/h, MBtu, MBtu/h, psi g, °F

Select either 'Met' or 'Imp' and press the 'OK' button to confirm.

After the units are entered the display will automatically step to the next sub-menu.

Atmos pres

This value compensates the flowrates for atmospheric pressure. It should be used if a high degree of accuracy is required or when the meter is installed high above sea level.

Note: If metric units are selected pressure units are mbar absolute, for imperial units psi absolute. Default setting is 1013 mbar.

Note: This screen does not appear if a linear meter input is selected.

Dryness

This is the dryness fraction of the saturated steam being measured. This can then be edited to suit the application. Press the 'OK' button to confirm the selection.

After the dryness fraction is entered the display will automatically step to the next sub-menu.

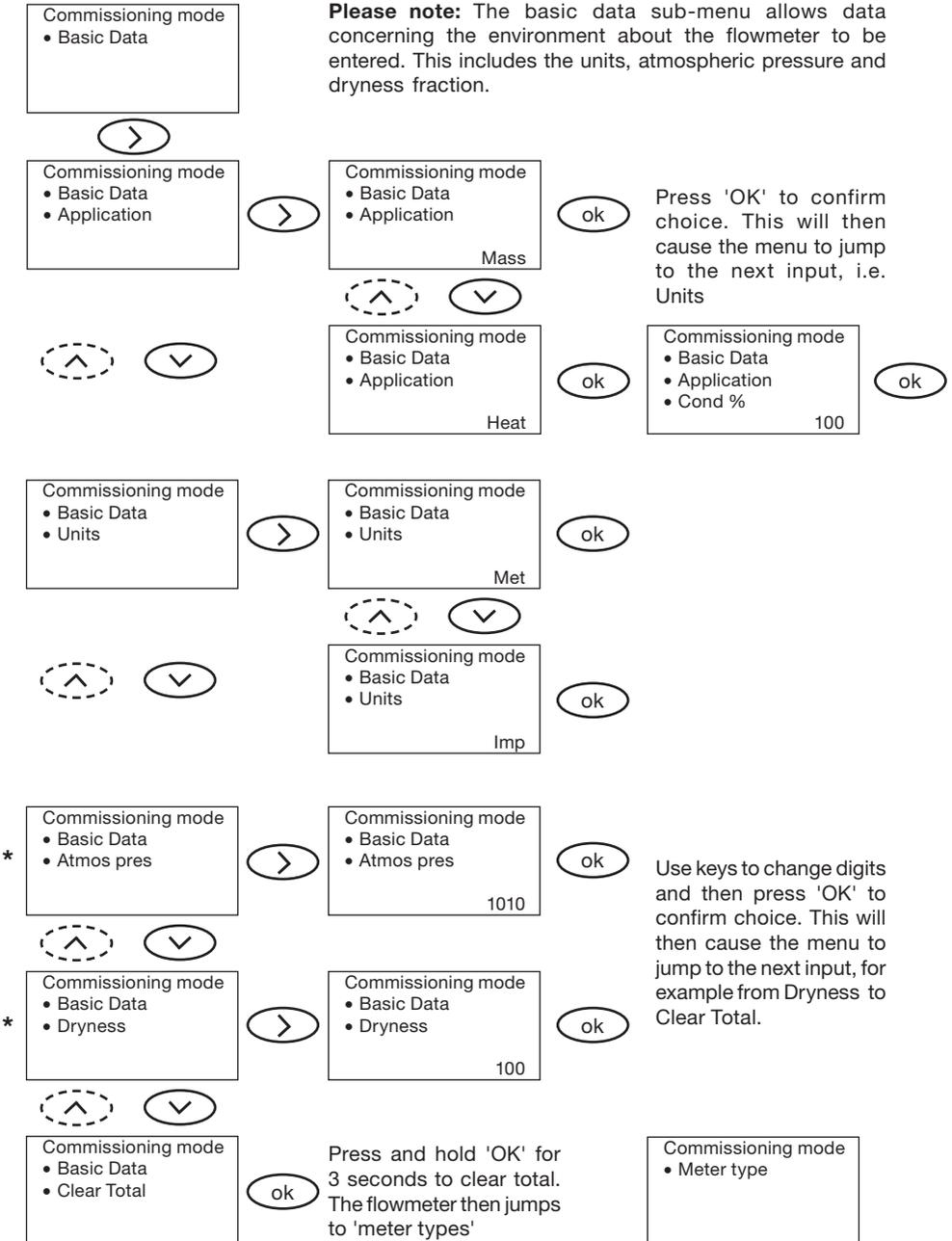
Note: This screen does not appear if a linear meter input is selected.

Clear Total

This function allows the totalised flow to be reset back to zero. To activate this function, press the 'OK' button for 3 seconds.

Basic Data sub-menu

Please note: The basic data sub-menu allows data concerning the environment about the flowmeter to be entered. This includes the units, atmospheric pressure and dryness fraction.

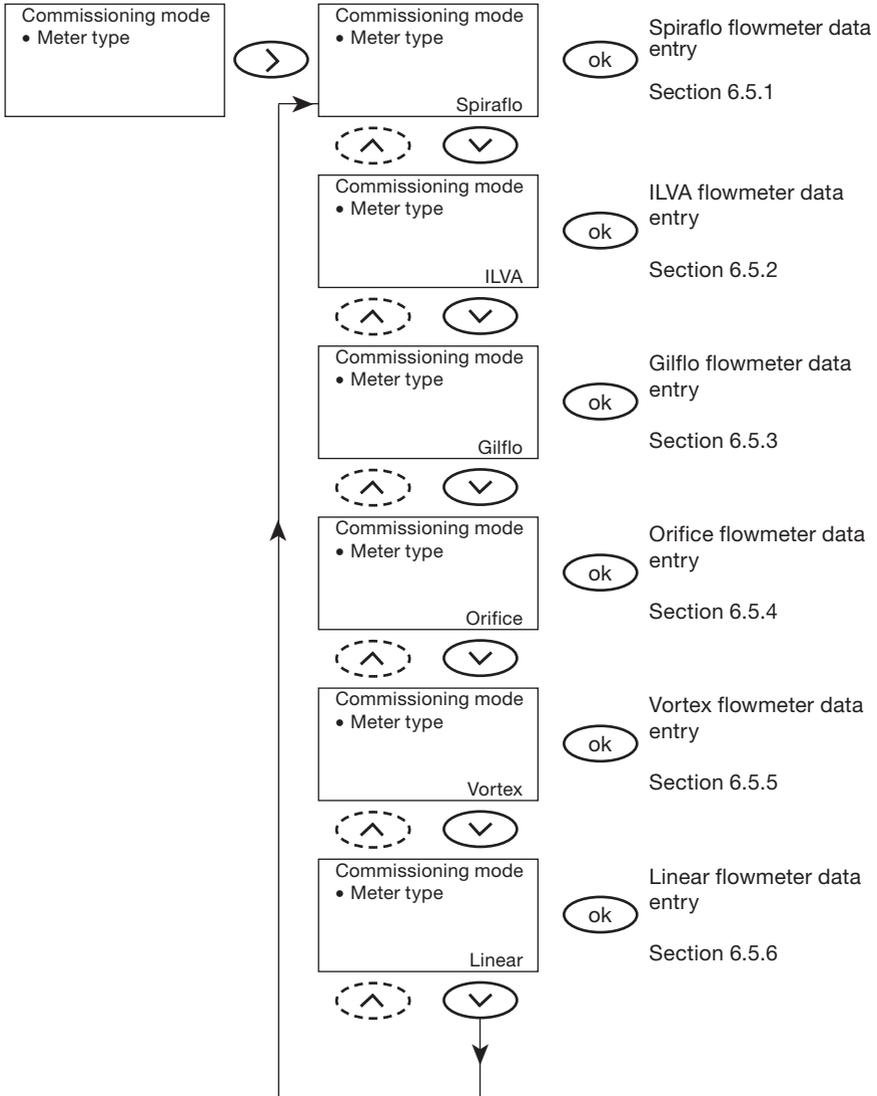


* **Note:** These screens do not appear if a linear meter input is selected.

6.5 Meter Type

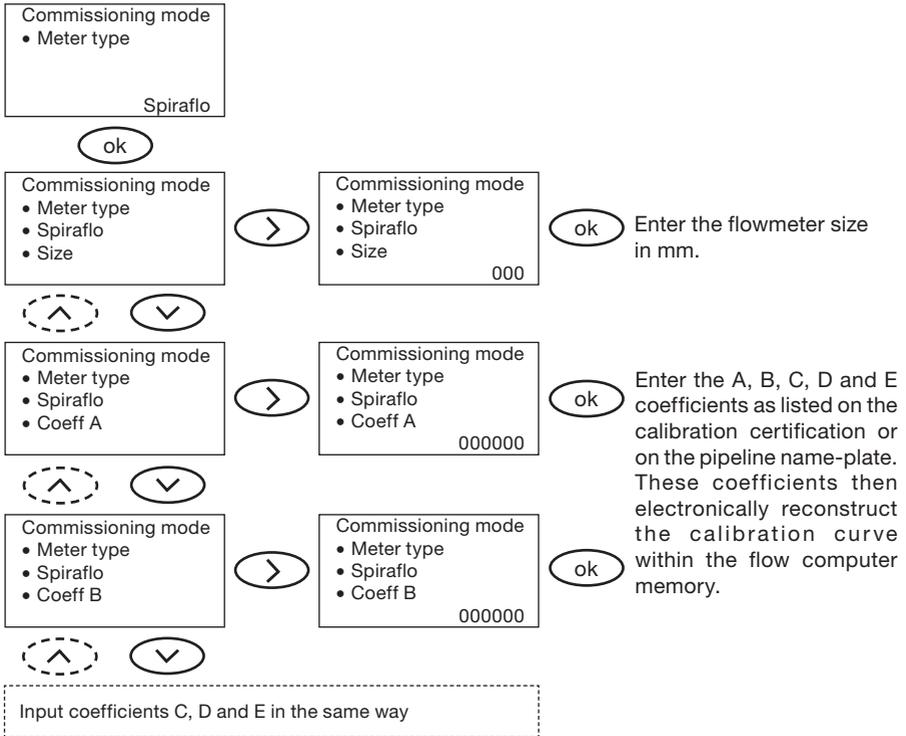
This allows the type of flowmeter to be selected and its parameters to be entered.

On entering the Meter Type menu the previous flowmeter selection is shown flashing. By pressing the up or down buttons you can scroll through the flowmeter types until the required flowmeter is seen flashing. Pressing the 'OK' button will select that flowmeter and the appropriate flowmeter menu is opened.



6.5.1 Commissioning sequence for the Spiraflo flowmeter

This allows the calibration data for a Spiraflo pipeline unit to be entered:

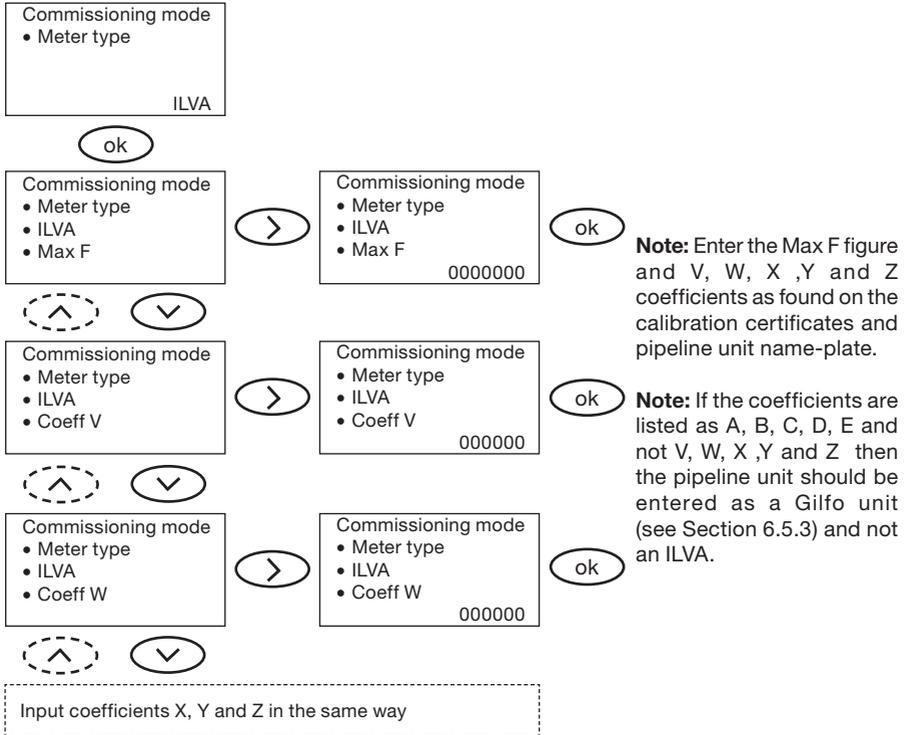


After the coefficients have been entered, exit the Spiraflo sub-menu by pressing . The menu will then step to Inputs (see Section 6.6).

6.5.2 Commissioning sequence for the ILVA flowmeter.

This allows the calibration data for an ILVA pipeline unit to be entered.

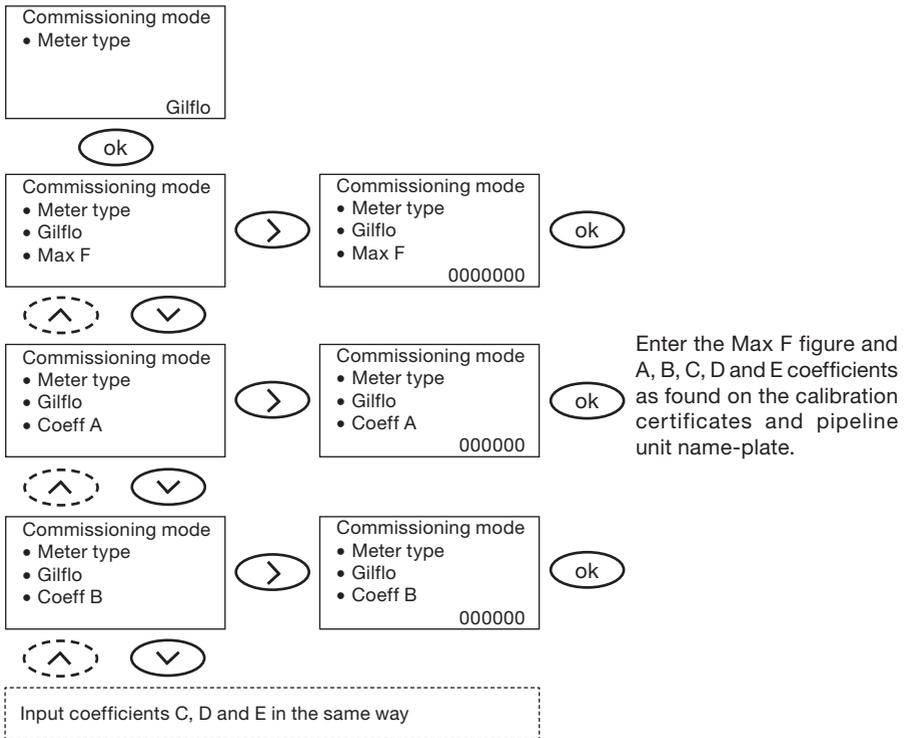
Note: Some of the older ILVA flowmeters use only 6 digit figures for the Max F figure as opposed to the 7 digits currently used. For 6 digit Max F insert an additional 0 before the figure.



After the coefficients have been entered, exit the ILVA sub-menu by pressing . The menu will then step to Inputs (see Section 6.6).

6.5.3 Commissioning sequence for the Gilflo flowmeter

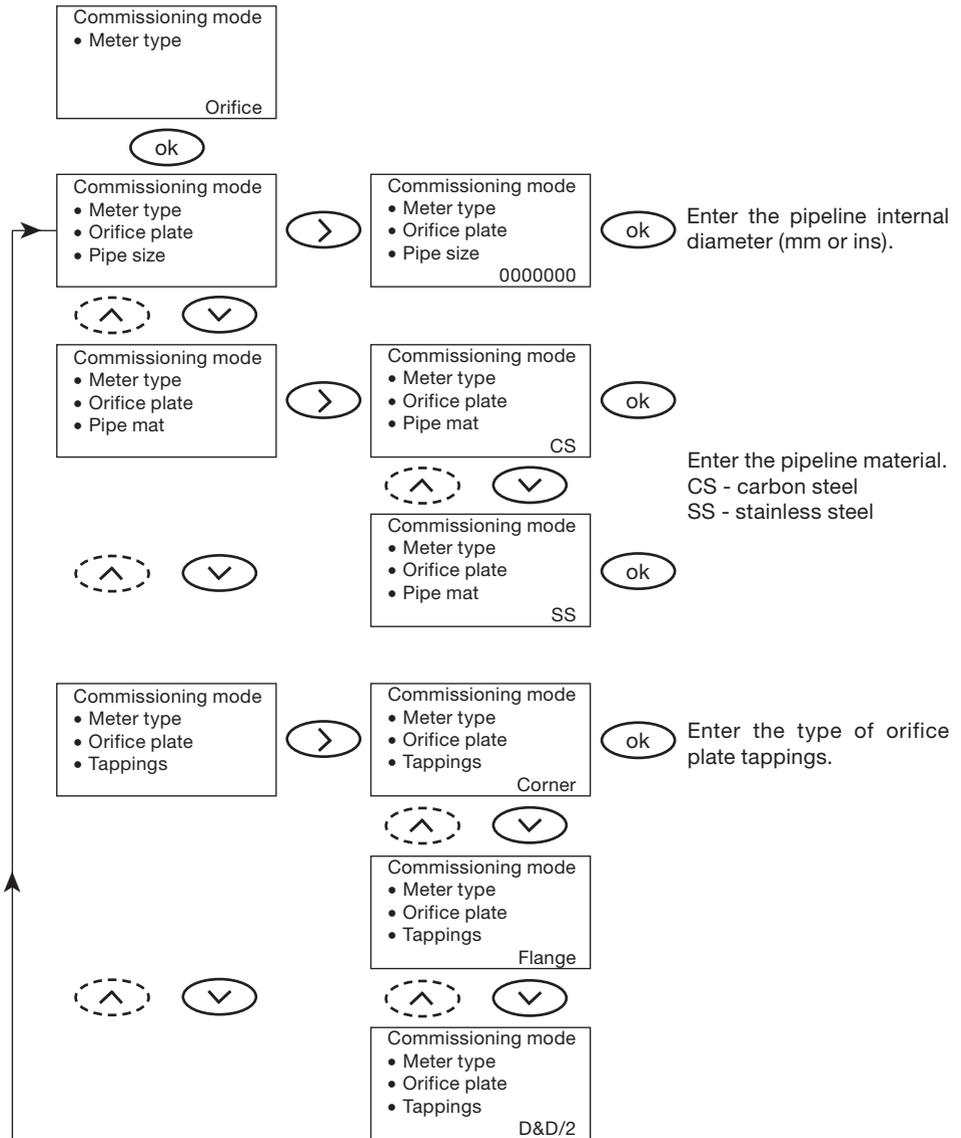
This allows the calibration data for a Gilflo pipeline unit to be entered:



After the coefficients have been entered, exit the Gilflo sub-menu by pressing . The menu will then step to Inputs (see Section 6.6).

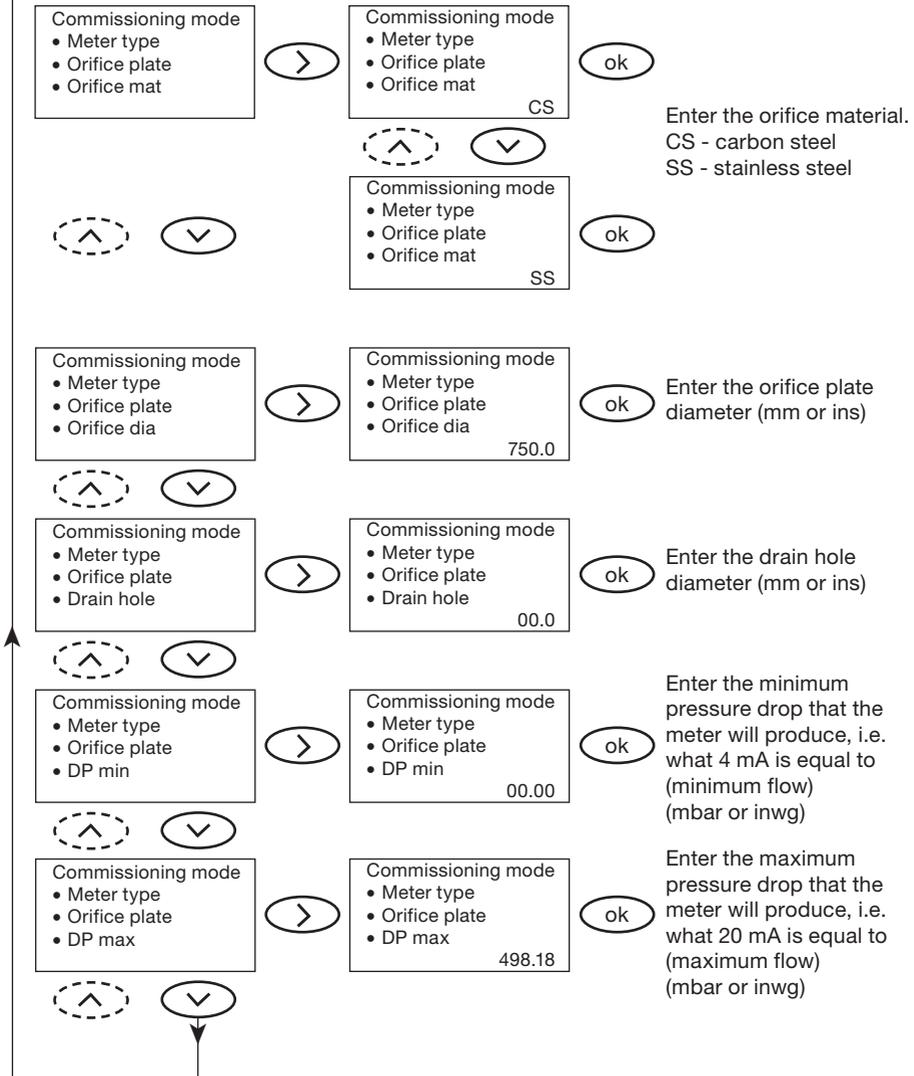
6.5.4 Commissioning sequence for the Orifice plate flowmeter

This allows the calibration data for an orifice plate pipeline unit to be entered.



Continued on page 43

Continued from page 43



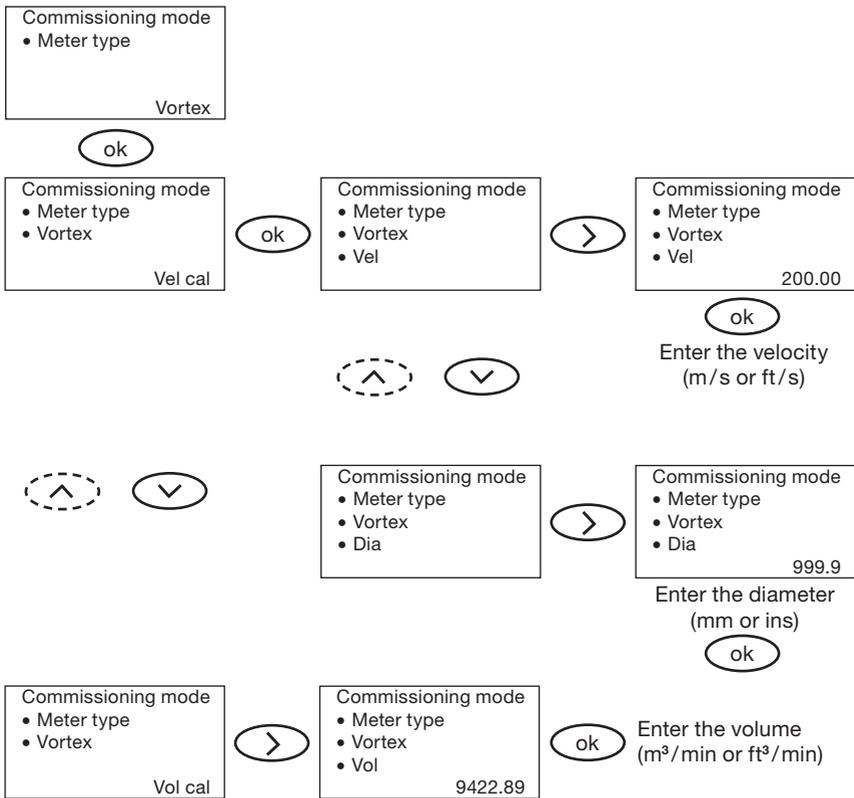
After the coefficients have been entered, exit the Orifice sub-menu by pressing . The menu will then step to Inputs (see Section 6.6).

6.5.5 Commissioning sequence for the Vortex flowmeter

This allows the calibration data for a vortex pipeline unit to be entered. The vortex flowmeter can either have a velocity or volumetric calibration.

Note:

- **Vel Cal** is for vortex flowmeters, which have been calibrated on velocity. Enter the velocity equal to 20 mA from the calibration certificate and the internal diameter of the vortex flowmeter. Where an insertion type vortex flowmeter is used the Dia is the internal diameter of the pipe.
- **Vol Cal** is used for vortex flowmeters calibrated on volumetric flowrate. Enter the volume flowrate in m³/minute equal to 20 mA.
Note. The volumetric flowrate needs to be in the same fluid as is being measured.



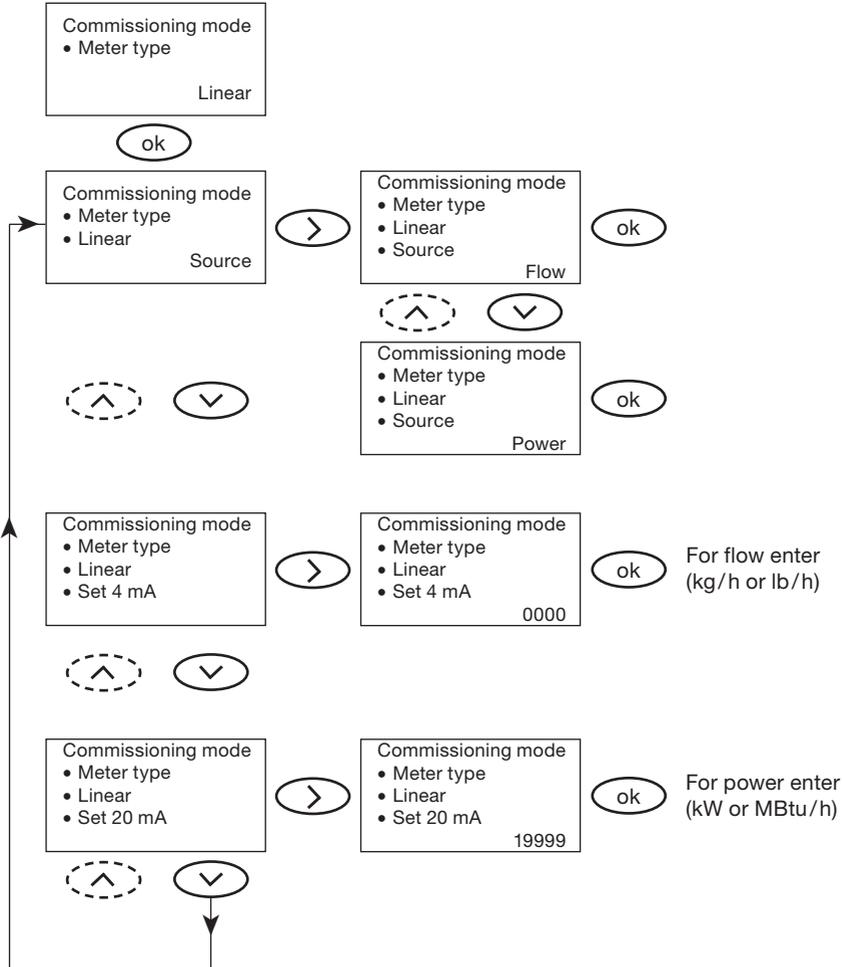
After the data has been entered, exit the Vortex velocity sub-menu by pressing . The menu will then step to Inputs (see Section 6.6).

When the data for the Vortex volumetric sub-menu has been entered the menu will automatically move to Inputs (see Section 6.6)

6.5.6 Commissioning sequence for the Linear flowmeter

Linear devices are any device that outputs a linear 4-20 mA output. Note the M800 when selected to accept a linear output will not density compensate the signal and various menu screens will not be shown.

Note: By selecting a Linear flowmeter various menu screens will be disabled, such as the pressure and temperature inputs.

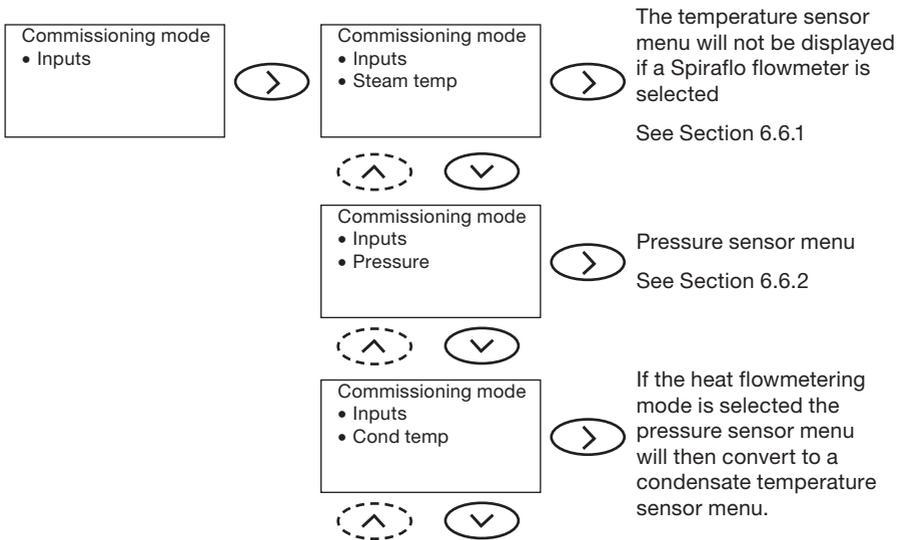


After the data has been entered, exit the Linear sub-menu by pressing . The menu will then step to Outputs (see Section 6.7).

6.6 Inputs

Note: If a linear input type flowmeter is selected then the input menus do not appear.

This menu configures the temperature and pressure transmitters. The signals from the pressure and temperature transmitters are used by the M800 to compensate for density changes within the fluid that the pipeline unit is measuring.

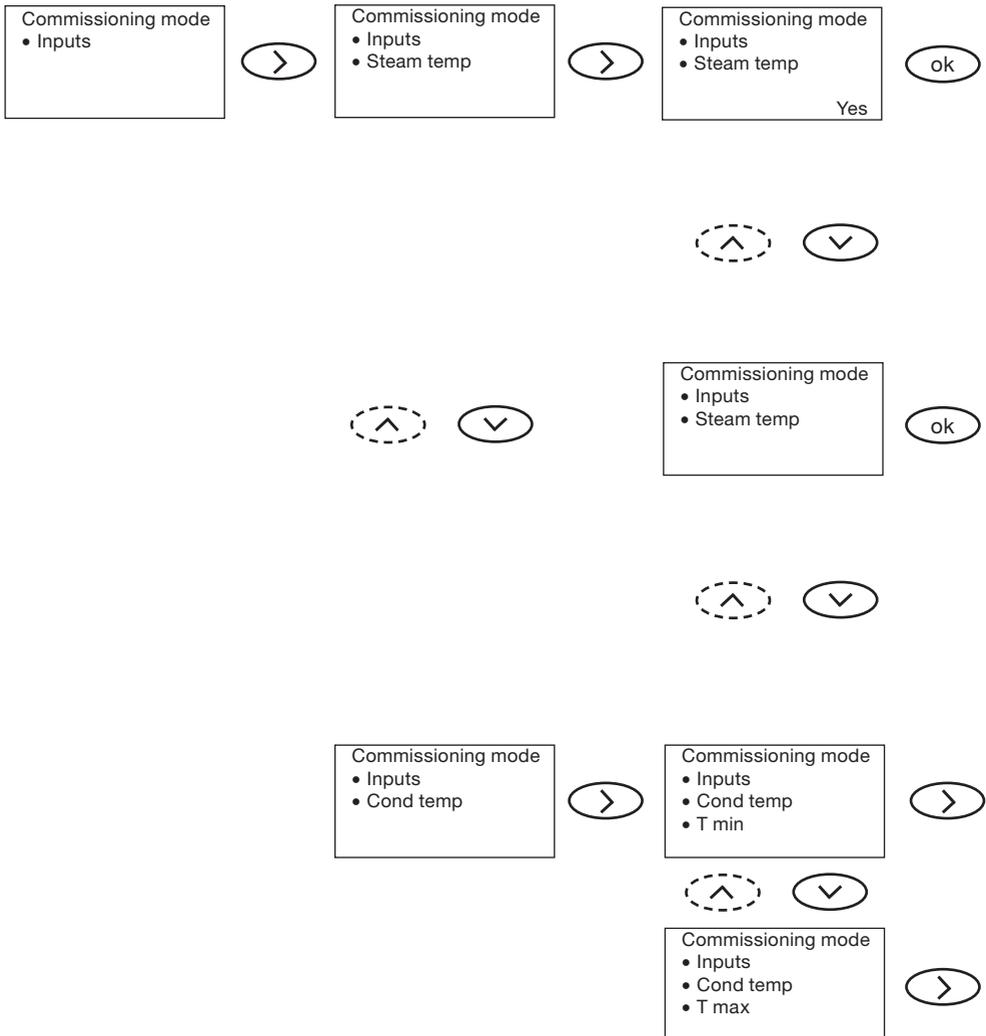


6.6.1 Temperature sensor menu.

The temperature sensor menu configures the temperature transmitter or allows a nominal line temperature to be entered. **Note:** If a Spiraflo flowmeter is selected the temperature sensor input menu does not appear as the Spiraflo has its own standard in-built sensor.

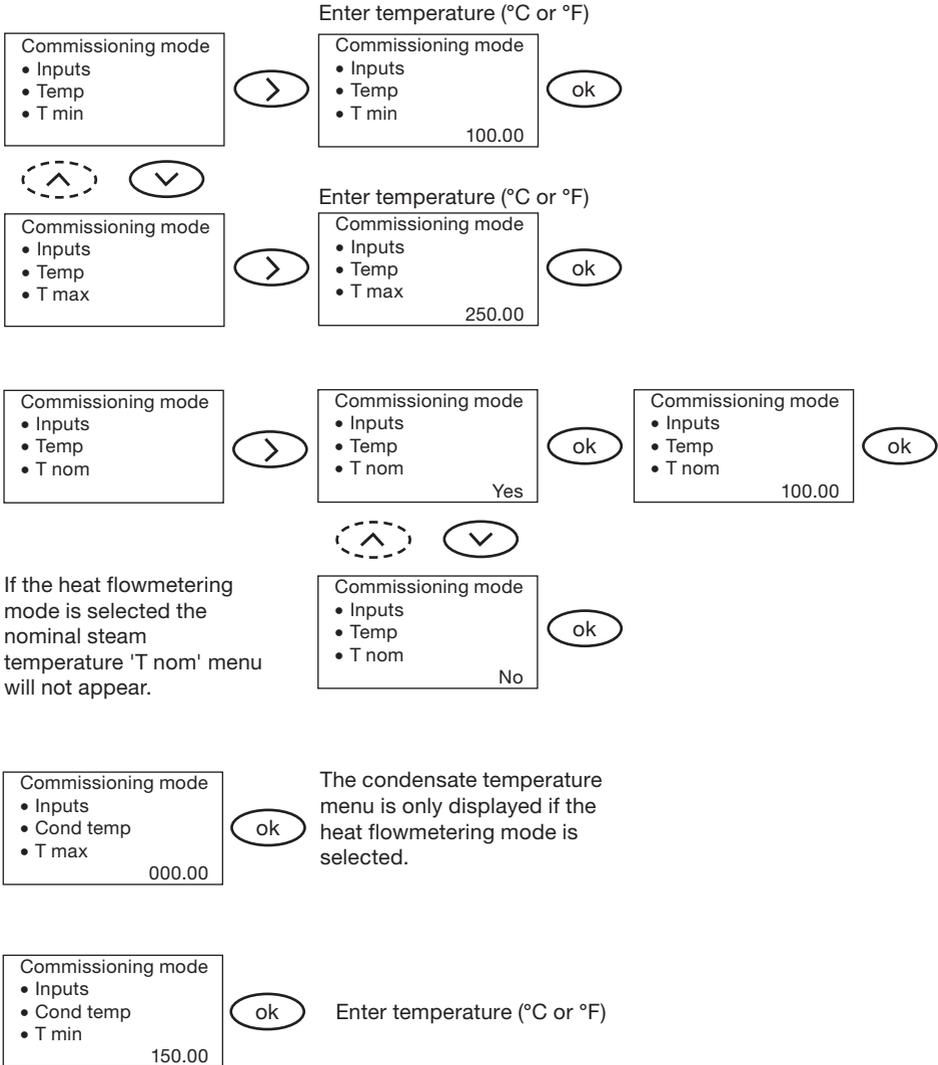
T min is the temperature when the transmitter outputs 4 mA and **T max** is the temperature when the transmitter outputs 20 mA.

If a temperature sensor is not fitted and 'No' is selected, the M800 will ask whether a nominal temperature is to be used. If 'Yes' then this nominal temperature needs to be entered.



Note: 'No' should be selected if the density compensation is only relying on pressure and no temperature transmitter is fitted, for example on a saturated steam system.

If the heat flowmetering is selected, the menu to configure the condensate temperature transmitter will appear. **T min** is the temperature when the transmitter outputs 4 mA and **T max** is the temperature when the transmitter outputs 20 mA.



6.6.2 Pressure input

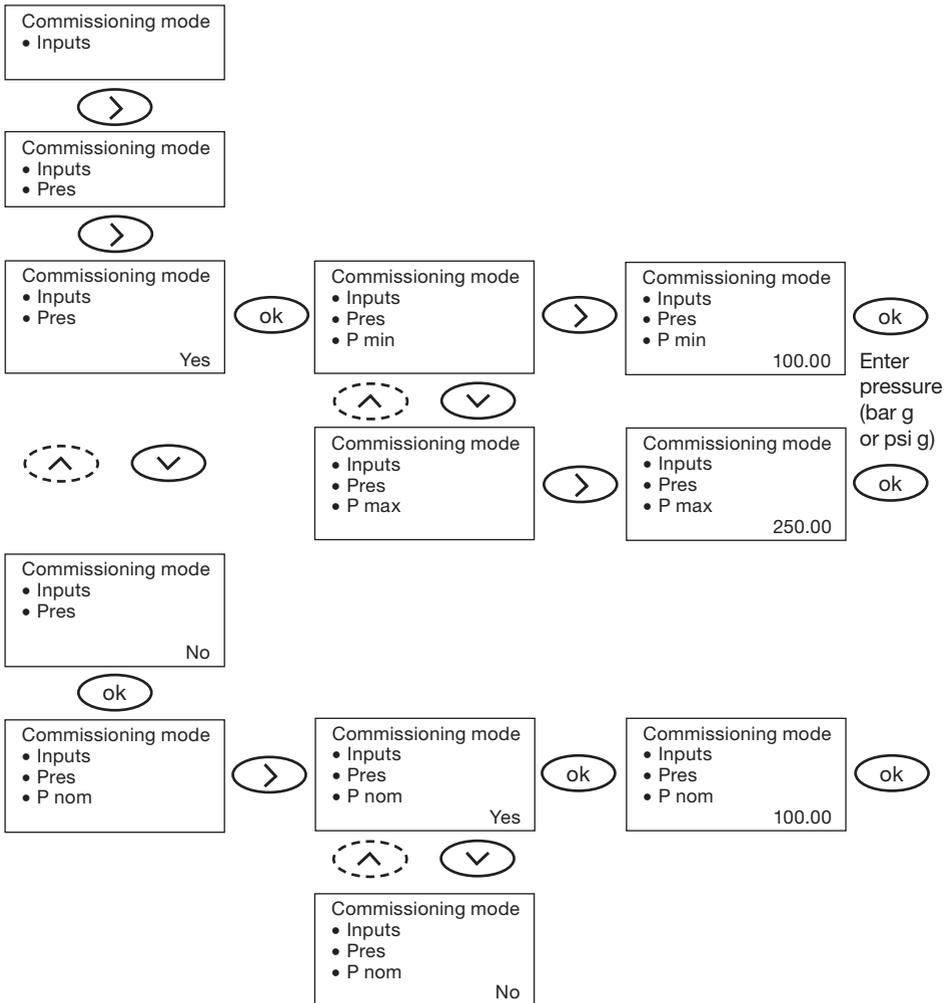
This menu configures the pressure transmitter or allows a nominal line pressure to be entered.

P min is the pressure when the transmitter outputs 4 mA and **P max** is the pressure when the transmitter outputs 20 mA.

If a pressure sensor is not fitted and **'No'** is selected, the M800 will ask whether a nominal pressure is to be used. If **'Yes'** then this nominal pressure needs to be entered.

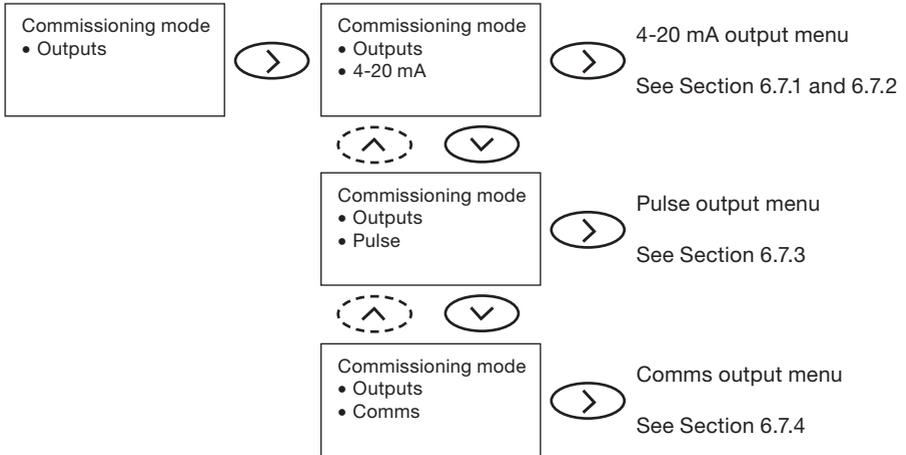
Note: 'No' should be selected if the density compensation is only relying on temperature and no pressure transmitter is fitted, for example on a saturated steam system.

If the heat flowmetering mode is selected the pressure sensor input menu does not appear, as the condensate temperature transmitter sensor replaces the pressure transmitter sensor.



6.7 Outputs

The Outputs sub-menu allows the M800's outputs to be configured. The M800 operates on a 'plug and play' principle and hence will only show the configuration menus for the selected options, i.e. if no additional 4-20 mA outputs are purchased the menu will only show the configuration menu for the flow 4-20 mA.



6.7.1 4-20 mA outputs - standard

The M800 can be configured for a maximum of three 4-20 mA outputs, one 4-20 mA comes as standard on the M800, the other two are available on a single option board.

The standard 4-20 mA always represents flow. The option board 4-20 mA outputs will represent temperature and pressure (see Section 6.7.2.1 and Section 6.7.2.2).

Flow

This menu structure sets the 4-20 mA in-built output to represent flow, this can either be mass flow or power.)

SOURCE

This changes the source data for the 4-20 mA between flow and power.

Set 4 mA

This sets the value for the flowrate or power that is equivalent to 4 mA. The minimum value that can be set as 4 mA is 0, the maximum is the 20 mA equivalent value less 10 kg/h (22 lb/h) for flow or 10 kW (0.03 MBtu/h) for Power.

Set 20 mA

This sets the value for the flowrate or power that is equivalent to 20 mA. The minimum value that can be set as 20 mA is the 4 mA equivalent value plus 10 kg/h (22 lb/h) for flow or 10 kW (0.03 MBtu/h) for power. The 20 mA value must always be a minimum of 10 greater than the 4 mA value.

Check 4 mA

This allows the 4 mA value to be re-calibrated. A digital ammeter/multimeter should be connected in series with the 4- 20 mA output. Pressing the right arrow button  will display OP = 4 mA and the M800 will output a steady 4 mA. If the multimeter does not read 4 mA the up  and down  arrow buttons can be pressed to alter this current until 4 mA exactly is indicated. Pressing the 'OK' button confirms the setting.

Check 20 mA

This allows the 20 mA value to be re-calibrated. A digital ammeter/multimeter should be connected in series with the 4-20 mA output. Pressing the right arrow button  will display OP = 20 mA and the M800 will output a steady 20 mA. If the multimeter does not read 20 mA the up  and down  arrow buttons can be pressed to alter this current until 20 mA exactly is indicated. Pressing the 'OK' button confirms the setting.

Commissioning mode
• Outputs



Commissioning mode
• Outputs
• 4-20 mA



Commissioning mode
• Outputs
• 4-20 mA Flow



Commissioning mode
• Outputs
• 4-20 mA Flow
• Source



Commissioning mode
• Outputs
• 4-20 mA Flow
• Source
Flow



Commissioning mode
• Outputs
• 4-20 mA Flow
• Source
Power



Note: In the heat flowmetering mode Power is 'Net Power'.

Commissioning mode
• Outputs
• 4-20 mA Flow
• Set 4 mA



Commissioning mode
• Outputs
• 4-20 mA Flow
• Set 4 mA
0000000



For flow enter
(kg/h or lb/h)

For power enter
(kW or MBtu/h)



Commissioning mode
• Outputs
• 4-20 mA Flow
• Set 20 mA



Commissioning mode
• Outputs
• 4-20 mA Flow
• Set 20 mA
1999999



Commissioning mode
• Outputs
• 4-20 mA Flow
• Check 4 mA



Commissioning mode
• Outputs
• 4-20 mA Flow
• Check 4 mA
op = 4 mA



Commissioning mode
• Outputs
• 4-20 mA Flow
• Check 20 mA



Commissioning mode
• Outputs
• 4-20 mA Flow
• Check 20 mA
op = 20 mA



The 4-20 mA sub-menu also allows re-ranging and re-calibrating of the 4-20 mA flow output.

After the data has been entered, exit the Flow sub-menu by pressing

The menu will then step to Optional 4-20 mA outputs, Temp (see Section 6.7.2.1).

6.7.2 Optional 4-20 mA outputs

Note: If a linear input type flowmeter is selected then these menus do not appear.

The sub-menus, 6.7.2.1 and 6.7.2.2 refer to the optional 4-20 mA outputs from the M800, which can be fitted and configured for either retransmission of temperature or pressure. If these optional outputs are not fitted then the relevant sub-menus will not appear.

Each output is configured in the same way and can either be set to give a 4-20 mA output of pressure or temperature.

Check 4 mA

This allows the 4 mA value to be re-calibrated. A digital ammeter/multimeter should be connected in series with the 4- 20 mA output. Pressing the right arrow button  will display OP = 4 mA and the M800 will output a steady 4 mA. If the multimeter does not read 4 mA the up  and down  arrow buttons can be pressed to alter this current until 4 mA exactly is indicated. Pressing the 'OK' button confirms the setting.

Check 20 mA

This allows the 20 mA value to be re-calibrated. A digital ammeter/multimeter should be connected in series with the 4- 20 mA output. Pressing the right arrow button  will display OP = 20 mA and the M800 will output a steady 20 mA. If the multimeter does not read 20 mA the up  and down  arrow buttons can be pressed to alter this current until 20 mA exactly is indicated.

Pressing the 'OK' button confirms the setting.

6.7.2.1 Optional 4-20 mA temperature output

Commissioning mode
• Outputs



Commissioning mode
• Outputs
• 4-20 mA



Commissioning mode
• Outputs
• 4-20 mA Temp



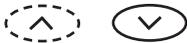
Commissioning mode
• Outputs
• 4-20 mA Temp
• Set 4 mA



Commissioning mode
• Outputs
• 4-20 mA Flow
• Set 4 mA
000.00



Enter temperature
(°C or °F)



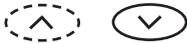
Commissioning mode
• Outputs
• 4-20 mA Temp
• Set 20 mA



Commissioning mode
• Outputs
• 4-20 mA Flow
• Set 20 mA
500.00



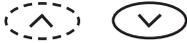
Enter temperature
(°C or °F)



Commissioning mode
• Outputs
• 4-20 mA Temp
• Check 4 mA



Commissioning mode
• Outputs
• 4-20 mA Flow
• Check 4 mA
op = 4 mA



Commissioning mode
• Outputs
• 4-20 mA Temp
• Check 20 mA

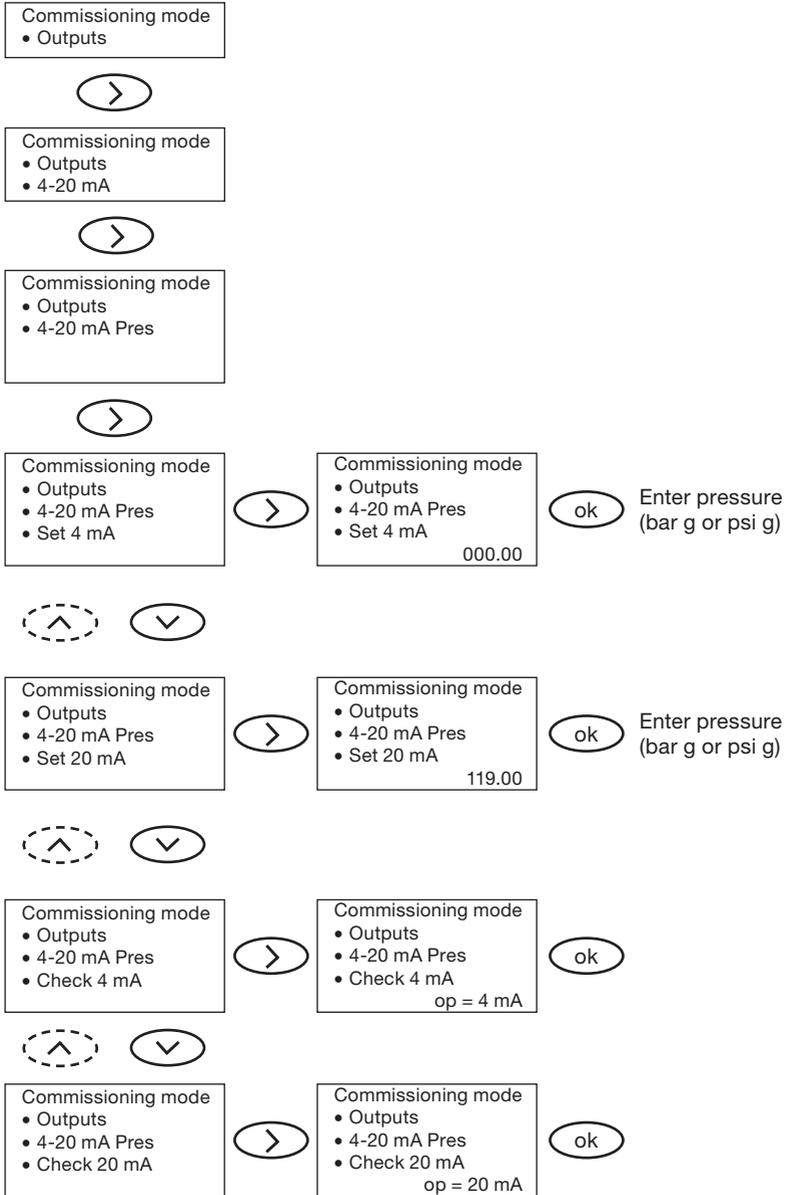


Commissioning mode
• Outputs
• 4-20 mA Flow
• Check 20 mA
op = 20 mA



After the data has been entered, exit the 4-20 mA output sub-menu by pressing . The menu will then step to Optional 4-20 mA outputs, Pres (see Section 6.7.2.2).

6.7.2.2 Optional 4-20 mA pressure output



After the data has been entered, exit the 4-20 mA output sub-menu by pressing . The menu will then step to Pulse output (see Section 6.7.3).

6.7.3 Pulse output

This sub-menu allows the pulsed output to be configured. The pulse output is a volt free digital pulse output $R \geq 10 \text{ K}\Omega$, Maximum voltage 28 Vdc.

Source

This selects the source data for the pulsed output. The source data can be either unit mass per pulse (Total) or unit energy per pulse (Energy).

Note: If a linear input type flowmeter is selected then this menu does not appear and the pulse is always a representation of total.

No/Pulse

This allows the total mass, or energy, which is equivalent to one pulse to be configured.

Units are dependent on the Unit setting.

Pulse width

This allows the width of the pulse to be set. The width can be set in 0.01 second increments from 0.02 seconds to a maximum of 0.2 seconds.

Commissioning mode
• Outputs



Commissioning mode
• Outputs
• Pulse



Commissioning mode
• Outputs
• Pulse
• Source



Commissioning mode
• Outputs
• Pulse
• Source
Total



Note: In the heat flowmetering mode Energy is 'Net Energy'.



Commissioning mode
• Outputs
• Pulse
• Source
Energy



Commissioning mode
• Outputs
• Pulse
• No/pulse



Commissioning mode
• Outputs
• Pulse
• No/pulse
0001



Commissioning mode
• Outputs
• Pulse
• Width S



Commissioning mode
• Outputs
• Pulse
• Width S
0.02



After the data has been entered, exit the 4-20 mA output sub-menu by pressing . The menu will then step to Pulse output (see Section 6.7.4).

6.7.4 Comms output

The M800 communicates using a sub-set of the Modbus protocol. A summary of the MODBUS protocol for the M800 can be seen on pages 57 and 58. RS485 is available as an option.

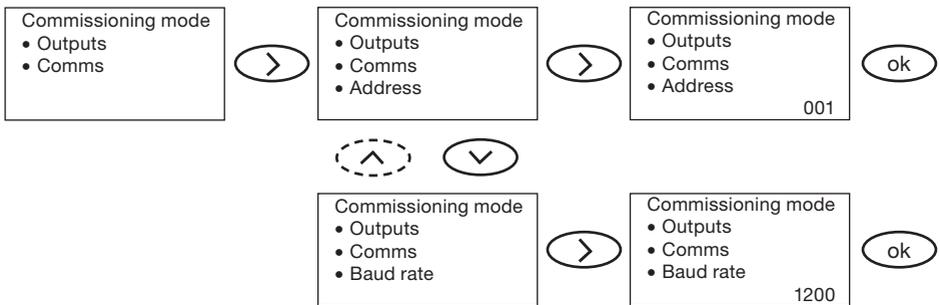
The M800's communications can be configured using the menus below. For wiring details please see Section 5.9

Address

This sets the address for Modbus communications. The default is 1 and the maximum is 247.

Baud rate

This defines the speed of communication between the M800 and an interrogating device in bits per second. The M800 can be set up to 1200, 9600 or 19200 Baud, with a default setting of 9600.



After the data has been entered, exit the Comms output sub-menu by pressing . The menu will then step to the 4-20 mA output (see Section 6.7.1).

Pressing again causes the menu to step to the Test menu (see Section 6.8).

Summary of the Modbus Protocol for the M800

Format: Request frame

Address	1 byte
Function code	1 byte
Start address	2 bytes
Quantity of registers	2 bytes
Cyclic redundancy check (CRC)	2 bytes
Total	8 bytes

Format: Response frame

Address	1 byte
Function code	1 byte (or error code = function code plus 128)
Byte count	1 byte (or Exception code, see below)
Register data	4 bytes, most significant first
Error check (CRC)	2 bytes
Total	9 bytes if correct (or 5 bytes if in error)

Only Function Code 04, 'Read input registers' is allowed.

Exception codes

- 01 Illegal function
- 02 Illegal data address

Parameters and register data

Address	Parameter
0	Total
1	Flowrate
2	Power
3	Temperature
4	Pressure
5	Energy

The format of the register data is unsigned binary, with the most significant byte transmitted first.

Request frame structure (in hex) received by the M800

Parameter	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8
	Device address	Function code	Register start address (MSB)	Register start address (LSB)	Register quantity (MSB)	Register quantity (LSB)	CRC (LSB)	CRC (MSB)
Total	xx	04	00	00	00	02	xx	xx
Flowrate	xx	04	00	02	00	02	xx	xx
Power	xx	04	00	04	00	02	xx	xx
Temperature	xx	04	00	06	00	02	xx	xx
Pressure	xx	04	00	08	00	02	xx	xx
Energy	xx	04	00	0A	00	02	xx	xx

Response frame structure (in hex) transmitted by the M800

Parameter	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5	Byte 6	Byte 7	Byte 8	Byte 9
	Device address	Function code	Byte Count	Data (MSB)	Data (MSB-1)	Data (MSB-2)	Data (LSB)	CRC (LSB)	CRC (MSB)
Total	xx	04	04	xx	xx	xx	xx	xx	xx
Flowrate	xx	04	04	xx	xx	xx	xx	xx	xx
Power	xx	04	04	xx	xx	xx	xx	xx	xx
Temperature	xx	04	04	xx	xx	xx	xx	xx	xx
Pressure	xx	04	04	xx	xx	xx	xx	xx	xx
Energy	xx	04	04	xx	xx	xx	xx	xx	xx

Error frame structure (in hex) transmitted by the M800

Parameter	Byte 1	Byte 2	Byte 3	Byte 4	Byte 5
	Device address	Function code	Exception code	CRC (LSB)	CRC (MSB)
Illegal function	xx	84	01	xx	xx
Illegal data address	xx	84	02	xx	xx

The Modbus Cyclic Redundancy Routine (CRC) is defined as follows:

- First load the 16 bit CRC register with FFFF hex.
- Copy an 8 bit data character into the least significant byte of a 16 bit register, setting the most significant byte (MSB) = 00 hex.
- Exclusive-or (XOR) this with the CRC register contents.
- If the least significant bit (lsb) of the result is 0, the CRC is shifted right.
- If the lsb is 1, the CRC is shifted right, then XOR'ed with A001 hex.
- This is repeated for all 8 bits of the data character, the most significant bit after the shift is filled with a 0.
- After the 8th shift, the next data char is XOR'ed with the CRC's current value.
- Repeat for all characters.
- Transmit the resulting 2 byte CRC LSB first.

Modbus CRC programme in BASIC

```

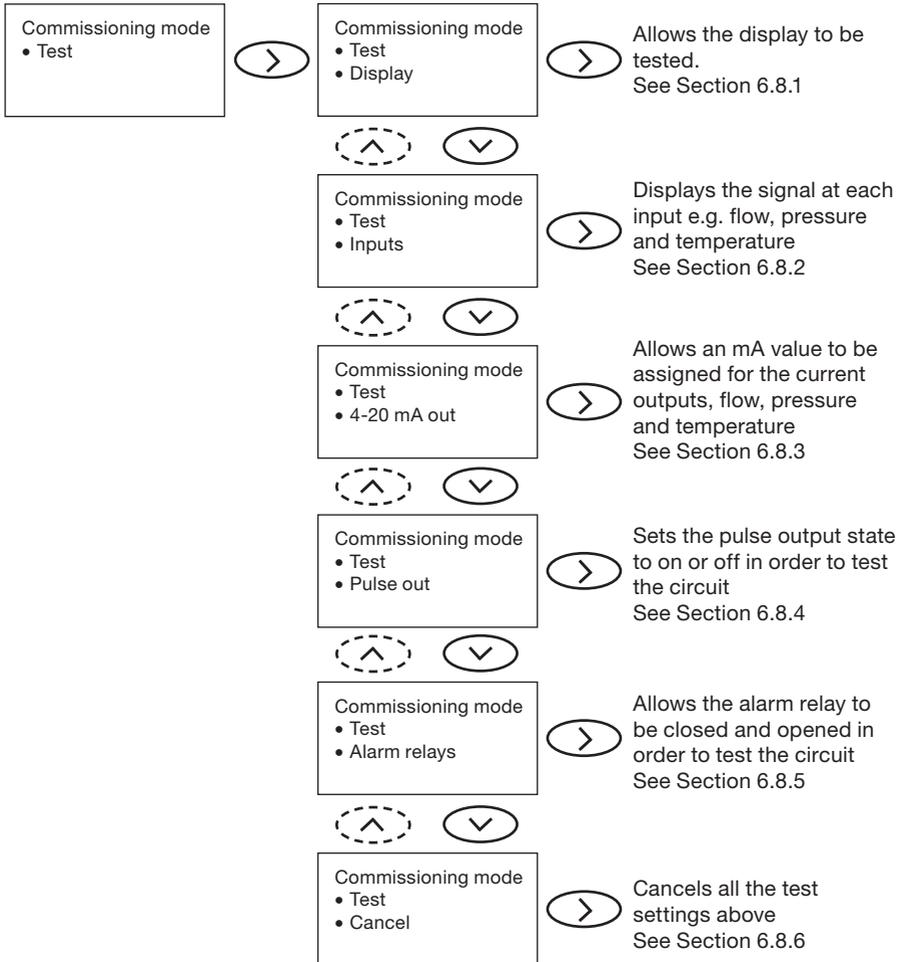
Dim crc
Dim TempCrc
Dim i As Integer
Dim j As Integer
Dim Character

crc = 65535
For i = 1 To Len(message)
  Character = Asc(Mid$(message, i, 1))
  crc = crc Xor Character
  For j = 1 To 8
    TempCrc = (crc / 2)
    If Int(TempCrc) <> TempCrc Then
      TempCrc = Int(TempCrc)
      TempCrc = TempCrc Xor 40961
    End If
    crc = TempCrc
  Next j
Next i
CalculateCRC = crc

```

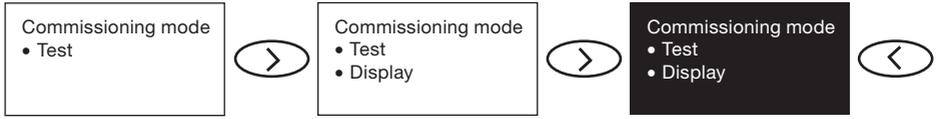
6.8 Test menu

The test sub-menu allows access to the M800's diagnostic tools. From here the display, 4-20 mA, pulse outputs and alarm relays can be tested.



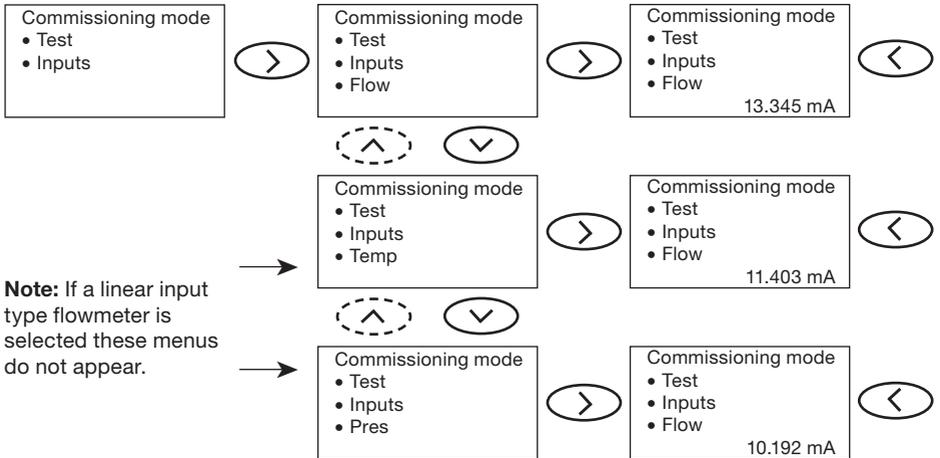
6.8.1 Display test

This allows the display to be tested. Pressing the right button will cause all the segments on the display to be turned on. Pressing the left button cancels the test and steps to the next stage.



6.8.2 Testing the 4-20 mA Inputs

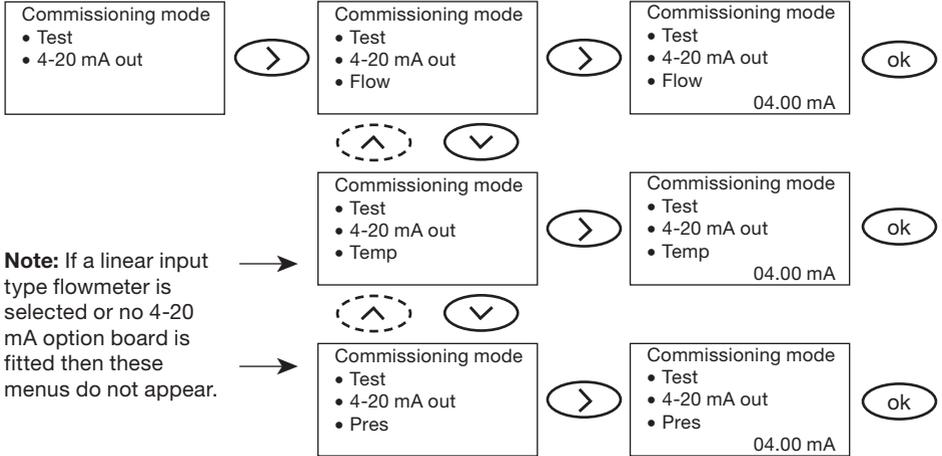
This allows the 4-20 mA input from the sensors to be displayed. The 4-20 mA input can be displayed for the flow, pressure and temperature.



Note: If a linear input type flowmeter is selected these menus do not appear.

6.8.3 Testing the 4-20 mA outputs

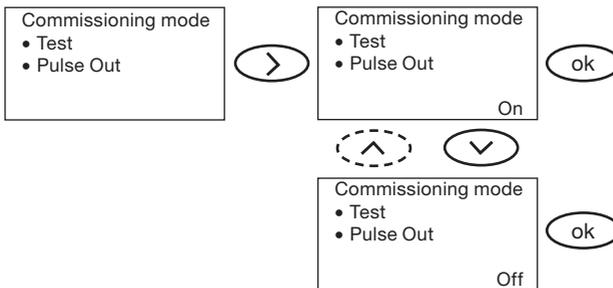
This allows the 4-20 mA outputs to be tested. Editing the value and pressing the 'OK' button can set the output to the selected current output. This current will continue to be transmitted for ten minutes unless the cancel option is chosen. The 4-20 mA output can be set for the flow, pressure and temperature depending on the options fitted.



After the data has been entered, exit the 4-20 mA output test by pressing . The menu will then step to Testing the pulse output (see Section 6.8.4).

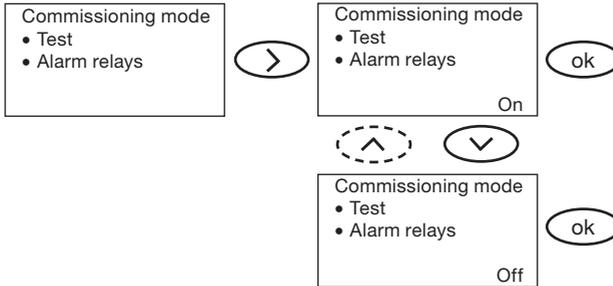
6.8.4 Testing the Pulse output

This allows the pulsed output to be tested. By selecting 'ON' or 'OFF' the desired test state of the pulsed output can be selected. Once the 'OK' button is pressed the pulsed output will remain in the selected state for ten minutes or until the cancel option is chosen.



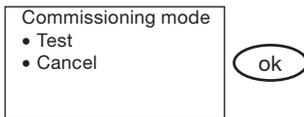
6.8.5 Alarm relays

This menu is only shown if the alarm relay option board is fitted. This menu allows the alarm relay to be tested. By selecting 'ON' or 'OFF' the desired test state of the alarm relay can be selected. Once the 'OK' button is pressed the alarm relay will remain in the selected state for ten minutes or until the cancel option is chosen.



6.8.6 CANCEL

This allows the 4-20 mA output, pulsed output and alarm relay test signal selected above to be cancelled before the ten minutes duration has expired.



6.9 Alarms

Alarms can be set for flow, temperature and pressure. If the alarm relay option board is fitted then one relay gives a high alarm, the other a low alarm. The 'Latch relays' feature causes the relay to remain switched after the alarm condition goes away. Alarms are either all latching or all non-latching.

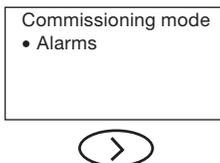
Note: In the heat flowmetering mode the M800 alarms work in heat units.

HIGH

This allows a value to be set above which the alarm relay will operate. The maximum value is 1999999 kg/h (4409244 lb/h).

LOW

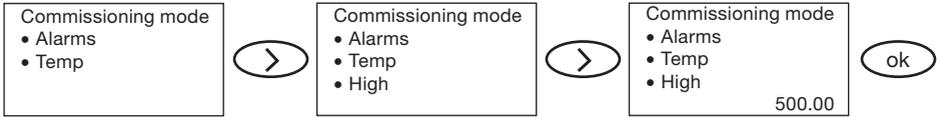
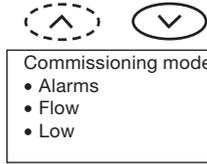
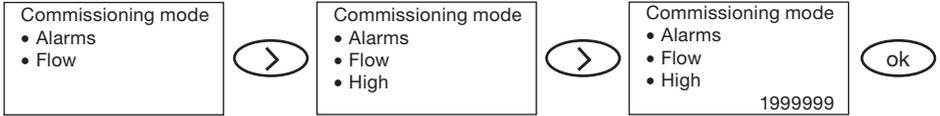
This allows a flow value to be set below which the alarm relay will operate.



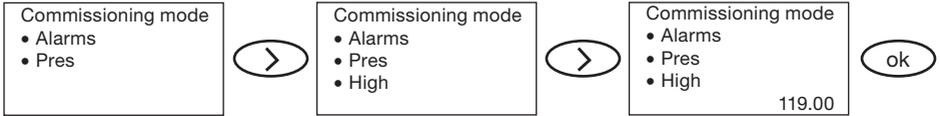
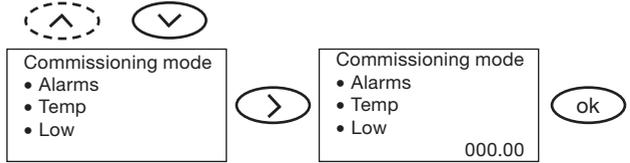
Continued on page 65



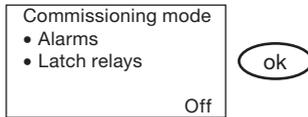
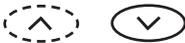
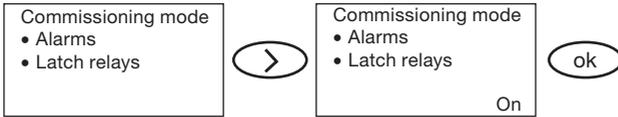
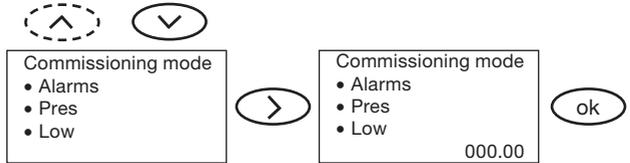
↓
Continued from page 64



↑
Note: This menu does not appear if a Linear device is selected.

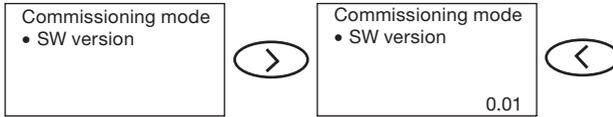


↑
Note: This menu does not appear if a Linear device is selected.



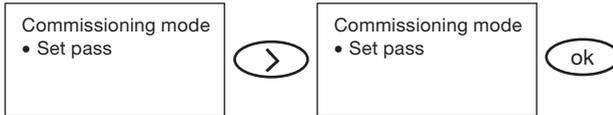
6.10 Software version

This allows the software version to be viewed.



6.11 Set password

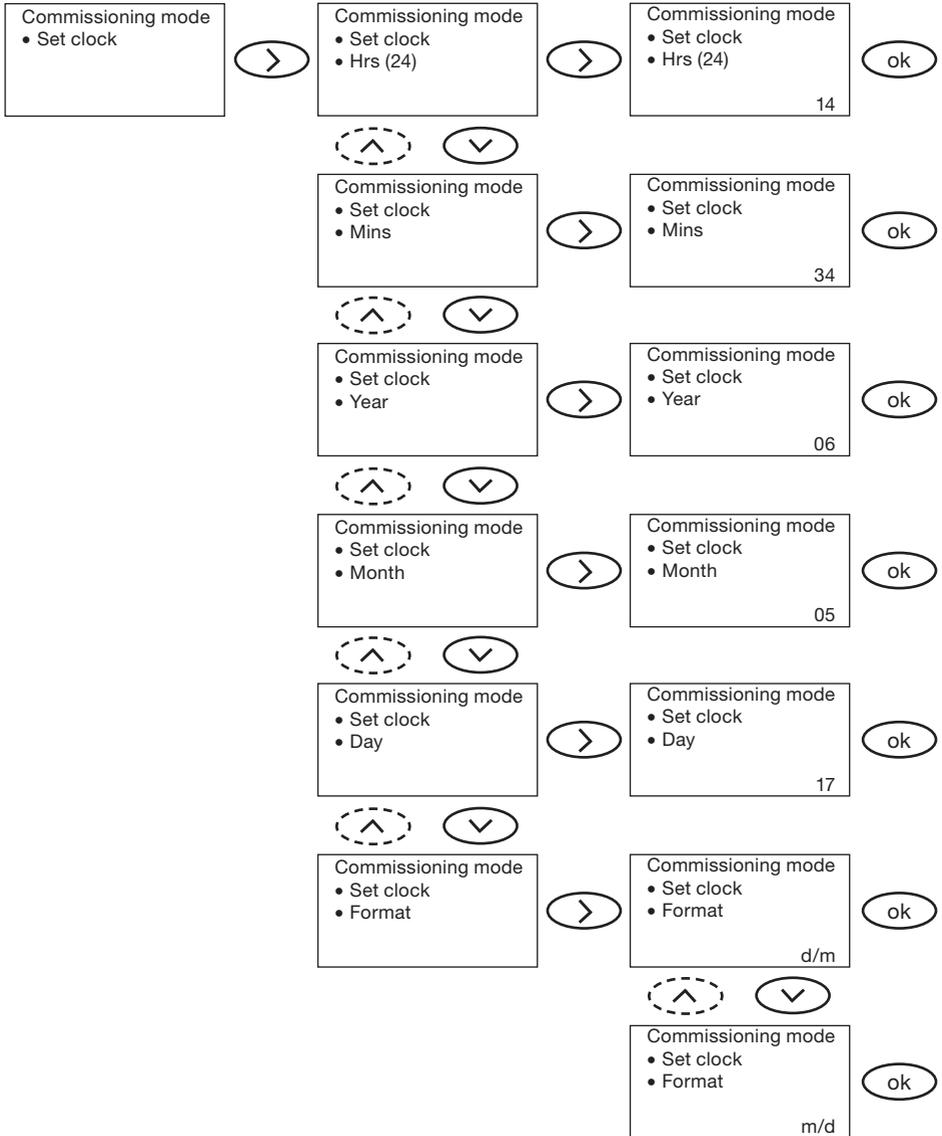
This allows the default pass code to be changed to a user defined value.



It is important that if the default pass code is changed that the new value is noted and kept safe.

6.12 Clock

This allows the time and date to be set. The time is entered in the 24 hr format. The Format menu sets the date as either Day/Month or Month/Day.

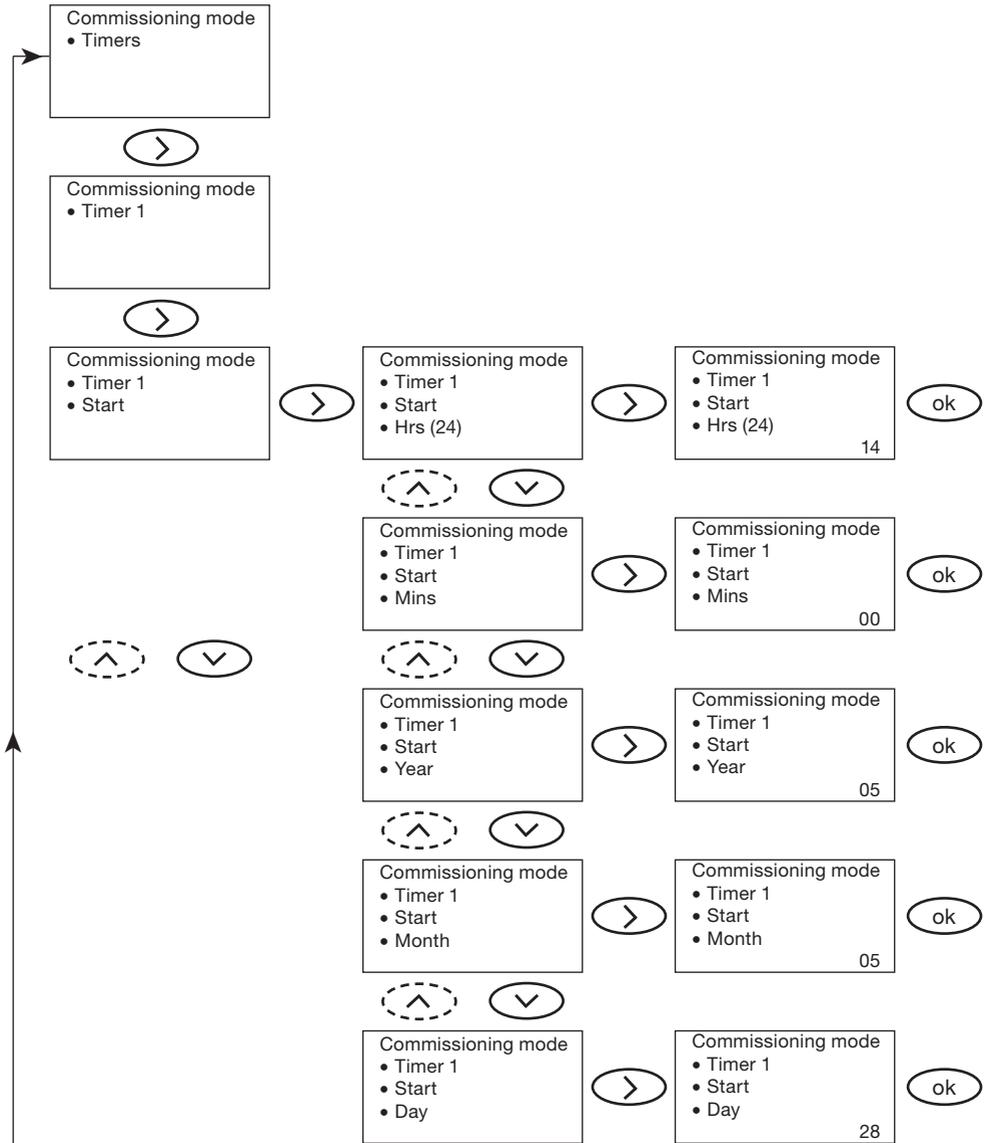


After the data has been entered, exit the set clock menu by pressing **<**. The menu will then step to the Timers menu (see Section 6.13).

6.13 Timers

The flow computer has 4 independent timers. Each timer can be used to record: **Total flow**, **Peak flow** and **Time of peak flow** for each timed period.

Note: In the heat flowmetering mode the M800 timers work in heat units.

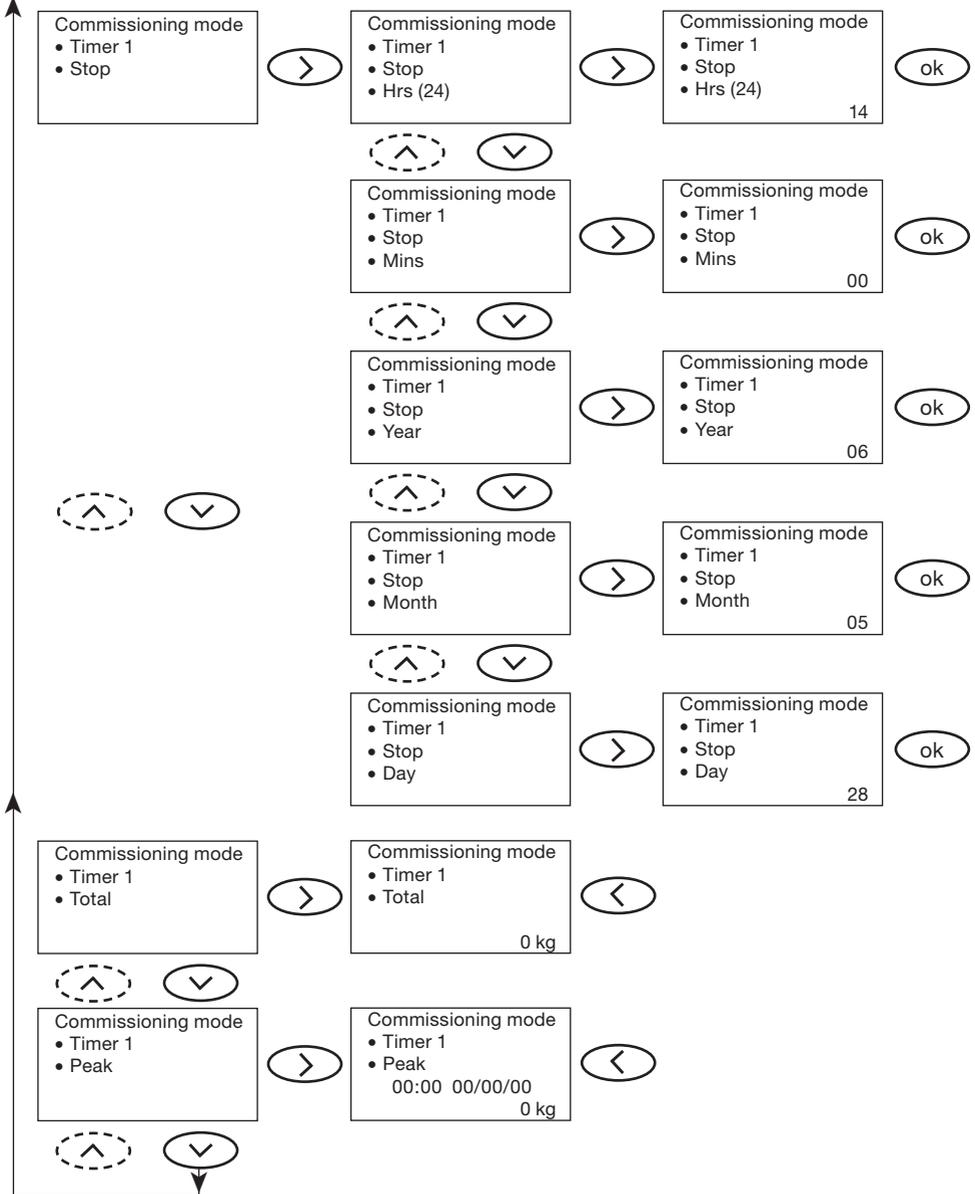


Continued on page 69

From page 69

To page 68

Continued from page 68



Timers 2, 3 and 4 are set and viewed in the same way. Each can have a different start and finish time. The finish time can be selected to be 24 hours, 7 days or any settable date after the start time.

After the data has been entered, exit the Timer menu by pressing . The menu will then step to the Trend menu (see Section 6.14)

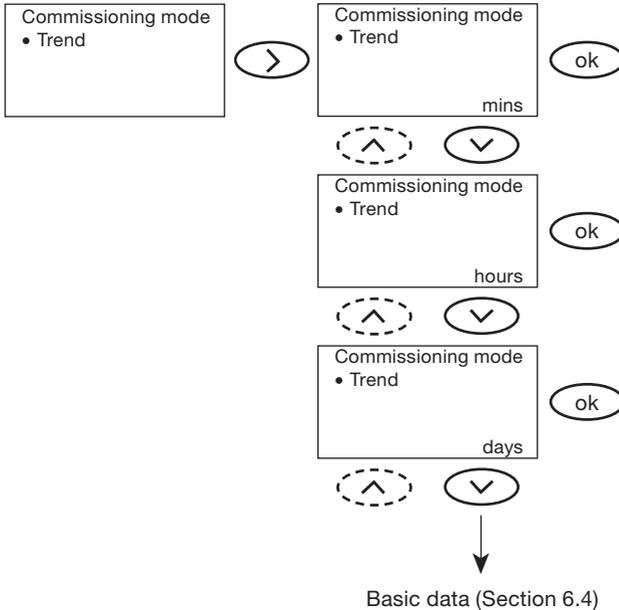
6.14 Trend

The trend feature is a visual representation of the in-built 4-20 mA output. If this output source is set to flow, the trend graph will be of the flowrate, if the source is set to power, the trend will represent the power.

The 0% and 100% are equivalent to the values set for 4 mA and 20 mA.

Note: if 4 mA is set to a higher value than 0, then the 0% is also set to this value.

The time base for the trend is in units of eight, 8 mins, 8 hours or 8 days and the units are displayed as m, h or d respectively.



By pressing the  button after the data has been entered, the menu will return to the Basic data sub-menu, Section 6.4.

7. Fault finding

WARNING:

Before commencing fault finding read the Safety information in Section 1 and the General wiring notes in Section 5.1.

Please note that the hazardous voltages are present and only suitably qualified personnel should carry out fault finding.

The flow computer must be isolated from the mains supply before opening and must be closed before power is reapplied.

Safety may be compromised if the fault finding procedures are not carried out in line with this manual.

If for any reason an error occurs on the flow computer, the simple and easy to follow instructions in this Section will allow the fault to be isolated and corrected.

The most likely time for faults to occur is during installation and commissioning. The most common type of fault is incorrect wiring.

If after applying power to the flowmetering system an error message is displayed, it may be necessary to fault find. To simplify and aid in this process, the flow computer has been fitted with a Test menu (see Section 6.8).

There are three viewable 4-20 mA (Hz for Spiraflo) channels, one for each of the flow, temperature and pressure signals. By looking at the flow computer display, the input signal can be viewed (see Test menu inputs 'Section 6.8.2' - To view input currents from flow, temperature and pressure transmitters). This will prove whether or not the flow computer is functioning correctly.

Symptom	Action
1 Display not illuminated	<ol style="list-style-type: none">1. Remove power from the flow computer.2. Check that all wiring is correct.3. Check that all external fuses are intact. Replace if necessary.4. Check the mains voltage is within the specified limits.5. Reapply power to the flow computer. <p>IF: The symptom is still present then:</p> <ol style="list-style-type: none">5.1. Inspect the Transient Voltage Suppressor, located on the termination PCB (See Figure 16, page 19 - General Circuit board view). <p>IF: The Transient Voltage Suppressor is damaged, cracked and/or discoloured in any way then it should be replaced:</p> <ol style="list-style-type: none">5.2. Before installing a replacement product, install an additional ac power line protector (filtering, suppression, surge and spike arrester) between the product's mains plug and the mains supply. The protector needs to be positioned as close to the product to gain full protection.

Symptom	Action
<p style="text-align: center; font-size: 48pt; font-weight: bold;">2</p> <p>Display flashes on and off (1 second approximately)</p>	<ol style="list-style-type: none"> 1. Remove power from the flow computer 2. Disconnect all option modules and plugs (except the mains). 3. Reapply power to the flow computer <p style="margin-left: 20px;">IF: The flow computer still exhibits the same fault THEN:</p> <ol style="list-style-type: none"> 3.1. The product is faulty and should be replaced <p>ELSE:</p> 4. Methodically replace each plug/module until the fault occurs. 5. Investigate and rectify any faults in the wiring, external sensor/transducers and modules associated to that plug. <p>Explanation: The internal power supply is unable to power up. If the voltages cannot be generated, the power supplies switches off for approximately 1 second. The power supply then attempts to power up again. If the fault is still present, the cycle is repeated until the fault is rectified. This is a safety feature and does not permanently damage the product.</p>
<p style="text-align: center; font-size: 48pt; font-weight: bold;">3</p> <p>Product powers up for a period of time (greater than 1 minute), then switches off</p>	<ol style="list-style-type: none"> 1. Monitor the mains supply and ensure it is continuous and within the specified limits. 2. Measure the ambient temperature and ensure it is less than specified. 3. Investigate symptom 2. <p>Explanation: A resettable thermal cut out device will operate if one or more of the following occur:</p> <ul style="list-style-type: none"> - The power drawn exceeds the specification, - The input mains voltage is less than specified, - The ambient temperature is greater than specified. The internal power supply will switch off until the product's internal temperature drops to below 65°C. This is a safety feature and does not permanently damage the product.
<p style="text-align: center; font-size: 48pt; font-weight: bold;">4</p> <p>Clock and calendar keeps resetting</p>	<ol style="list-style-type: none"> 1. Ensure the product is powered up for 24 hours. 2. Replace battery (See Section 8 'Maintenance').
<p style="text-align: center; font-size: 48pt; font-weight: bold;">5</p> <p>Error message displayed</p>	<ol style="list-style-type: none"> 1. Commissioning Error messages (see page 73). 2. Operational Error messages (see page 74).

Commissioning Error messages

Error message	Cause	Action
Beta < min	The beta ratio (d/D) for the orifice plate is less than 0.1	Check that the sizing of the orifice is correct
Beta > max	The beta ratio (d/D) for the orifice plate is greater than 0.75	Check that the sizing of the orifice is correct
Pipe dia < ISO min	The pipe diameter is less than 50 mm, but greater than 12.5 mm. This is a warning as the pipe size is now below the limits of the ISO standard, however calculation is still possible following the guidelines within the standard.	The warning can be cancelled by pressing the OK button.
Pipe dia > max	The pipe diameter is greater than the maximum of 1000 mm	The application is outside of the M800 limits.

Operational Error messages

Any operational errors that occur will be displayed in the run mode, on the alarms and errors screen.

Error message	Cause	Action
Power fail	This will be displayed if there has been a loss of power during operation.	<ol style="list-style-type: none"> 1. Remove power from the flow computer. 2. Check that all wiring is correct. 3. Check that the power supply is secure, i.e. does not suffer from 'brown outs' 4. Reapply power and cancel error.
Flow sensor	Activates if there is a flow/DP transmitter fault, i.e. the flow computer detects signals below 3.85 mA or above 22 mA.	<ol style="list-style-type: none"> 1. Check the flow input signal via the Test menu (Section 6.8). 2. Check the wiring between the flow/DP transmitter and the flow computer. 3. Check and replace if necessary the flow/DP transmitter.
Temp sensor	Activates if there is a temperature transmitter fault, i.e. the flow computer detects signals below 3.85 mA or above 22 mA.	<ol style="list-style-type: none"> 1. Check the temperature input signal via the Test menu (Section 6.8) 2. Check the wiring between the temperature transmitter and the flow computer. 3. Check and replace if necessary the temperature transmitter.
Pres sensor	Activates if there is a pressure transmitter fault, i.e. the flow computer detects signals below 3.85 mA or above 22 mA.	<ol style="list-style-type: none"> 1. Check the pressure input signal via the Test menu (Section 6.8). 2. Check the wiring between the pressure transmitter and the flow computer. 3. Check and replace if necessary the pressure transmitter.
Out of Range	Indicates that the M800 is calculating a flowrate outside its calibrated range. Activates if the flow input current is below 4 mA (but above 3.85 mA) or above 20 mA (but below 22 mA).	<ol style="list-style-type: none"> 1. Check the sizing of the pipeline unit and replace if necessary. 2. Check and replace if necessary the flow/DP transmitter.
Sub saturation	Activates if the measured temperature drops by more than 2°C (3.6°F) below the steam saturation temperature, as calculated from the pressure data.	<ol style="list-style-type: none"> 1. Check that the pressure/temperature transmitter is ranged correctly or is faulty and replace if necessary. 2. Check the fluid being measured is steam.
Totaliser	An error has occurred with the totaliser and the total displayed may not be correct.	<ol style="list-style-type: none"> 1. Press the OK button to cancel the error. This does not reset the total.
Timers	An error has occurred with a timer and the information displayed for the timer may not be correct.	<ol style="list-style-type: none"> 1. Press the OK button to cancel the error. This does not reset the timer values.

8. Maintenance

Note: Before actioning any maintenance observe the 'Safety information' in Section 1.

Safety guidelines - batteries

- **Do not** apply power to the product without the correct battery fitted.
- **The battery disposal method** should be in accordance with Local/National regulations.
- **Do not** incinerate or mutilate, as the battery may burst or release toxic material.
- **Do not** short-circuit as the battery may cause burns.
- **Do not** deep discharge or charge the battery in reverse.

A qualified person in compliance with the operating instructions must perform all maintenance.

No special servicing, preventative maintenance or inspection of the product is required.

Battery

The product is fitted with a 2.4 V Nickel Metal Hydride battery to power the internal clock when the mains power is switched off. The battery is located on the bottom right hand side of the termination board (see Figure 32). It is secured to the board using a double-sided adhesive pad (used for transporting purposes only) and three connectors.

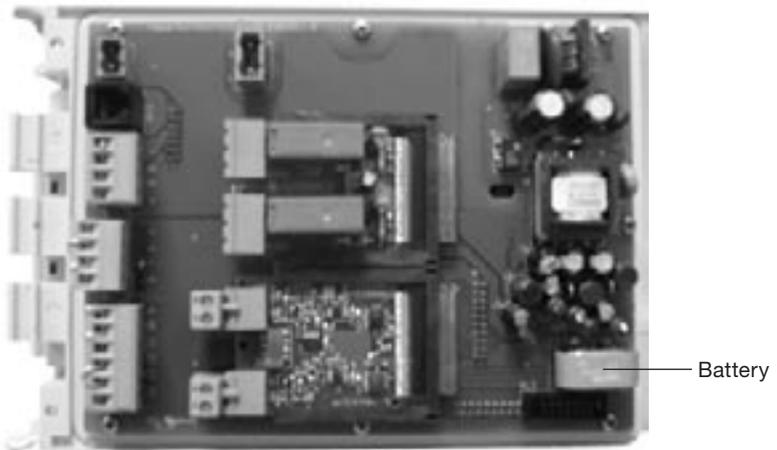


Fig. 32

If it is necessary to replace the battery, isolate the power from the product, open the product up and carefully ease the battery off the board. **Do not** use a metal or sharp tool, as this may pierce the battery skin. A replacement battery **must** be obtained through your local Spirax Sarco representative, quoting the following part number:

1 off spare battery for an M800 steam flowmeter Spirax Sarco stock number: 0965056

Carefully locate the three pins of the replacement battery into the three termination board connectors. Gently push down on the top of the battery until it is flush with the board. If the product is not to be transported, it is not necessary to apply a new adhesive pad.

It is recommended to apply power to the product for a minimum of 24 hrs to achieve or restore the full performance of the battery.

9. Technical information

9.1 For technical assistance

Contact your local Spirax Sarco representative. Details can be found on accompanying order/delivery documentation or on our web site: www.spiraxsarco.com

9.2 Returning equipment for repair

Please provide the following information with any equipment being returned:-

1. Your name, company name, address and telephone number, order number and invoice and return delivery address.
2. Description and serial number of equipment being returned.
3. Description of the fault or repair required.
4. If the equipment is being returned under warranty, please indicate:
 - (i) Date of purchase.
 - (ii) Original order number.

Please return all items to:

Your local Spirax Sarco representative. Details can be found on accompanying order/delivery documentation or on our web site: www.spiraxsarco.com

Please ensure all items are suitably packed for transit (preferably in the original cartons).

9.3 Cleaning instructions

Use a damp cloth soaked in tap/de-ionized water or isopropyl alcohol. Use of other cleaning materials could damage the product and invalidate the  marking.

9.4 Calculation rate

10 times a second, unless the M800 is configured for use with an orifice plate, in which case the calculation rate is 2 times a second.

9.5 Power supply

Mains voltage range	99 V to 264 V at 50/60 Hz
Power consumption	7.5 W (maximum)

9.6 Environmental

General	Indoor use only
Maximum altitude	2 000 m (6 562 ft) above sea level
Ambient temperature limits	0 - 55°C (32 - 131°F)
Maximum relative humidity	80% up to 31°C (88°F) decreasing linearly to 50% at 40°C (104°F)
Overvoltage category	II
Pollution degree	3
Enclosure rating	IP65 see Section 4 'Mechanical installation')
LVD: Electrical Safety	BS EN 61010-1 EN 61326: A1 + A2 Emissions - Class A equipment Table 4
EMC: Emissions and immunity	EN 61326: A1 + A2 Immunity for industrial locations Annex A Table 1
Enclosure colours and materials	Light grey (similar to RAL7035) ABS polycarbonate plastic
Front panel colours and materials	Pantone 294 (blue) on Lexan polycarbonate plastic

9.7 Input technical data

4-20 mA input(s)

Input voltage (maximum)	2.5 Vdc
Input impedance	110 Ω
Input current (maximum)	22 mAdc
Resolution	0.01%
Measurement rate	10/second
Termination	Screw terminals (supplied)

Current source(s)

Current output (per channel)	30 mAdc \pm 15%
Open circuit voltage (maximum)	32 Vdc
Total voltage drop (maximum)	19 Vdc @ 22 mAdc
Termination	Screw terminals (supplied)

9.8 Output technical data

Pulse output

Contacts:	Volt free digital transistor (NPN or PNP)
Maximum supply voltage:	28 Vdc
Maximum voltage in closed/on position	1 V
Minimum load resistor:	\geq 10 K Ω
Termination	Screw terminals (supplied)

4-20 mA output(s)

Range	4-20 mA
Minimum current	0 mA
Maximum current	22 mA
Open circuit voltage (maximum)	19 Vdc
Resolution	0.01%
Maximum output load	500 Ω
Isolation	100 V
Output rate	10/second
Termination	Screw terminals (supplied)

9.9 Option board technical data

Dual relay alarm option board

Two independent mains rated relay outputs	
Contacts	2 x changeover relays with common
Ratings	
Maximum load	3 A resistive @ 250 Vac 1 A Inductive @ 250 Vac
Voltage rating	250 Vac
Electrical life	3 x 10 ⁵ or greater depending on load
Mechanical life	30 x 10 ⁶
Termination	Screw terminals (supplied)

Isolated dual 4-20 mA re-transmission option board

Two independent 4-20 mA isolated re-transmission	
Range	4-20 mA
Minimum current	0 mA
Maximum current	22 mA
Open circuit voltage (maximum)	19 Vdc
Resolution	0.01%
Maximum output load	500 Ω
Isolation	100 V
Output rate	10/second
Termination	Screw terminals (supplied)

RS485 option board

Physical layer	RS485 4-wire full duplex or 2-wire half duplex
Protocol	Modbus RTU format
Isolation	500 Vac/dc
Receiver unit load	1/8 (256 devices - maximum)
Output rate	Up to 10 frames/second
Termination	Screw terminals (supplied)

9.10 Maximum and minimum programmable limits

General

Total	Maximum	999 999 999 (Total then rolls over to 0)
Flow alarm	Maximum	1 999 999 kg/h (4409244 lb/h)
	Minimum	0
No of pulses per flow unit	Maximum	1000
	Minimum	1
Pulse width	Maximum	0.2 secs
	Minimum	0.02 secs
Atmospheric pressure	Maximum	1100 mbar (15.954 psi)
	Minimum	700 mbar (10.153 psi)
Dryness fraction	Maximum	100%
	Minimum	70%

Heat data

Condensate % (this is the % of the steam returned as condensate)	Maximum	100%
	Minimum	0

Inputs

Temperature	Steam	Maximum	500°C (932°F)
		Minimum	0°C (32°F)
	Condensate	Maximum	150°C (302°F)
		Minimum	0°C (32°F)
Pressure (excluding Vortex)	Maximum	85 bar g (1232.82 psi g)	
	Minimum	-1.01 bar g (-14.65 psi g)	
Pressure (Vortex)	Maximum	32 bar g (464.12 psi g)	
Flow cut low	mA	4.08 mA	

Gilflo/ILVA meters

Max F	Maximum	1 999 999
	Minimum	0001380
Coefficients	Maximum	999 999
	Minimum	000 000

Vortex

Velocity	Maximum	200 m/s (656.17 ft/s)
	Minimum	0 m/s (0 ft/s)
Diameter	Maximum	999.9 mm (39.4 inches)
	Minimum	25.4 mm (1 inch)
Volumetric flow	Maximum	9422 m ³ /min (332766 ft ³ /min)
	Minimum	0 m ³ /min (0 ft ³ /min)

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Linear meter

Flow	Maximum	40 000 kg/h (88 000 lb/h)
	Minimum	0
Power	Maximum	32 000 kW (110 MBtu/h)
	Minimum	0

Orifice meters

Beta ratio	Maximum	0.75
	Minimum	0.1
Nominal pipe diameter	Maximum	1000 mm (39.37")
	Minimum	50 mm (2") following the ISO standard 12.5 mm (½") absolute minimum
Differential pressure	Maximum	747.27 mbar (300" wg)
	Minimum	0

Outputs**4-20 mA**

Flow	Maximum	1 999 999 kg/h (4 409 244 lb/h)
	Minimum	0
Condensate temperature	Maximum	500°C (932°F)
	Minimum	0°C (32°F)
Steam pressure	Maximum	119 bar g (1 725.95 psi g)
	Minimum	0
Power	Maximum	1 999 999 kW (6823.59 MBtu/h)
	Minimum	0