TEKTROL
Technology Solutions

TEK-VOR 1300XP

Explosion-Proof Inline Vortex Flow Meter

Instruction Manual

Document Number: IM-1300XP

www.tek-trol.com

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NOTICE

Read this manual before working with the product. For personal and system safety, and for optimum product performance, make sure you thoroughly understand the contents before installing, using, or maintaining this product.

For technical assistance, contact
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1 Safety Instructions

1.1 Intended Use

Primarily, the Tek-Vor 1300XP is employed to gauge the volumetric flow rate of liquids, steam, and gases. The food, beverage, and pharmaceutical industries can use it for SIP and CIP processes. Additionally, the water and wastewater industries use it. It is possible to monitor any liquid, gas, or steam density, temperature, pressure, and volumetric flow rate. The mass flow rate can be computed using Tek-Vor 1300XP using these values.

1.2 Certifications

FM, FMC, ATEX, IECEx

1.3 Safety Instructions from the Manufacturer

1.3.1 Disclaimer

The manufacturer will not be accountable for any damage by using its product, including, but not limited to direct, indirect incidental, and consequential damages. Any product purchased from the manufacturer is warranted following the relevant product documentation and our Terms and Conditions of Sale.

The manufacturer has the right to modify the content of this document, including the disclaimer, at any time for any reason without prior notice and will not be answerable in any way for the possible consequence of such changes.

1.3.2 Product Liability and Warranty

The operator shall bear authority for the device's suitability for the specific application. The manufacturer accepts no liability for the consequences of misuse by the operator. Wrong installation or operation of the devices (systems) will cause the warranty to be void. The respective "Standard Terms and Conditions", which form the basis for the sales contract shall also apply.

1.3.3 Information Concerning the Documentation

To prevent any injury to the operator and damage to the device it is essential to read the information in this document and read the applicable national standards, and safety instructions.
These operating instructions contain all the information that is required in various stages, like product identification, incoming acceptance, and storage, from mounting, connection, operation, and commissioning through to troubleshooting, maintenance, and disposal.

1.4 Safety Precautions

You must read these instructions carefully before installing and commissioning the device. These instructions are an important part of the products and must be kept for further reference. For additional information or if specific problems occur that are not discussed in these instructions, contact the manufacturer.

Only by observing these instructions can optimum protection of both personnel and the environment, as well as safe and fault-free operation of the device be ensured.

Warnings and Symbols Used

The following safety symbol marks are used in this operating instruction manual and instrument.

WARNING

Indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury under pressure. Always turn off the main power before removing any mass flow meter components.

CAUTION

Indicates a potentially hazardous situation which, if not avoided, may result in minor or moderate injury. It may also be used to alert against unsafe practices.
Need to point downstream in the flow direction.
The temperature rating for AC wire insulation must be at least 85°C (185°F).

NOTE

Indicates an action or procedure which, if not performed correctly, can have an indirect effect on operation or trigger an unexpected response on the part of the device

1.5 Packaging, Transportation and Storage

1.5.1 Packaging

The original package consists of

1. Tek-Vor 1300XP Inline Vortex Flow Meter
2. Documentation

NOTE

Unpack and check the contents for damages or signs of rough handling. Report damage to the manufacturer immediately. Check the contents against the packing list provided.

1.5.2 Transportation

- Avoid impact shocks to the device and prevent it from getting wet during transportation.
- Verify local safety regulations, directives, and company procedures concerning hoisting, rigging, and transportation of heavy equipment.
- Transport the product to the installation site using the original manufacturer's packing whenever possible.

1.5.3 Storage

If this product is to be stored for a long period before installation, take the following precautions:

- Store your product in the manufacturer's original packing used for shipping.
- Storage location should conform to the following requirements:
  - Free from rain and water
  - Free from vibration and impact shock
  - At room temperature with minimal temperature and humidity variation
- Before storing a used flow meter remove any fluid from the flow meter line completely. The properties of the instrument can change when stored outdoors.

1.5.4 Nameplate

NOTE

Verify the device nameplate to make sure the delivery matches your order. Verify the nameplate for the right supply voltage.

Fig 1. Nameplate

2 Product Description

2.1 Introduction

The Tek-Vor 1300XP inline vortex flow meter accurately measures mass or volumetric flow from a single pipeline entry. It uses a vortex-shredding velocity sensor, RTD temperature sensor, and solid-state pressure sensor for gases, fluids, and steam. Offering three 4–20 mA outputs, it supports mass flow, volumetric flow, temperature, pressure, and fluid density with an energy monitoring option for real-time consumption trekking. It has a local display, and pulse output, and supports modebus, heart, or BACNET communication, which ensures easy installation, recommendableness, and long-term reliability.

2.2 Measuring Principle

Tek-Vor 1300XP Explosion-Proof Inline Vortex Flow Meter measures liquid, gas, and steam flows by detecting the frequency at which vortices are alternately shed from a bluff body. According to proven laws of physics, the frequency at which the vortices are alternately shed is directly proportional to the flow velocity. As flow passes a bluff body in the stream, the vortices create low and high-pressure zones behind the bluff body or shedder bar. The Tek-Vor 1300XP Explosion-Proof Inline Vortex Flow Meter uses a piezoelectric crystal sensor to detect the pressure exerted by the vortices on the velocity sensor. The piezoelectric converts these “pulses” into electrical signals. The meter uses an all-welded sensor design to create a robust sensor and minimize potential leakages.

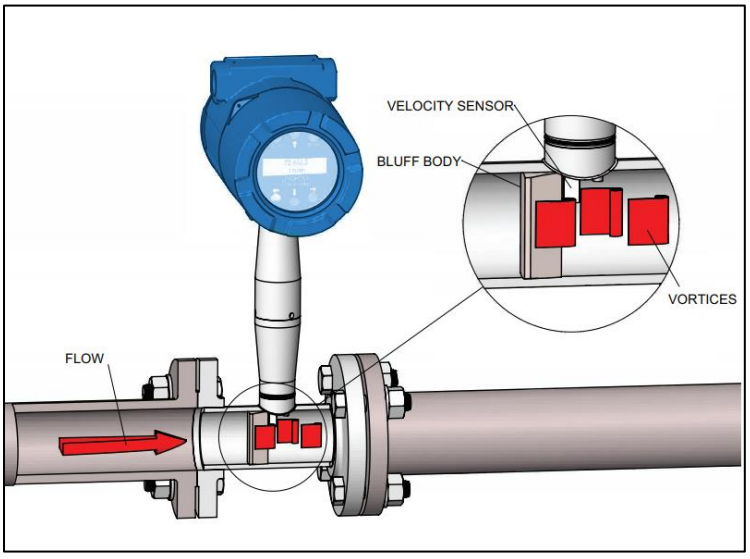


Fig 2. Measuring Principle of Tek-Vor 1300XP Explosion-Proof Inline Vortex Flow Meter

2.3 Specifications

Accuracy	• Volumetric Flow Rate: ±0.7% of rate (for Liquids), ±1% of rate (for Gas or Steam) • Mass Flow Rate: ±1% of rate (for Liquids), ±1.5% of rate (for Gas or Steam) • Temperature: ±2°F (± 1°C) • Pressure: ±0.3% of Full Scale • Density: ± 0.3% of Reading (for Liquids), ± 0.5% of Reading (for Gas or Steam)	
Repeatability	• Mass Flow Rate: ± 0.2 % of rate • Volumetric Flow Rate: ± 0.1 % of rate • Temperature: ± .2° F (± .1° C) • Pressure: ± .05% of full scale • Density: ± 0.1% of readings	
Stability	• Mass Flow Rate: ± 0.2 % of rate • Volumetric Flow Rate: ± 0.1 % of rate • Temperature: ± .2° F (± .1° C) • Pressure: ± .05% of full scale • Density: ± 0.1% of readings	Over 12 months
Response Time	Adjustable from 1 to 100 seconds	
Operating Temperature	-40°F to 140°F (-40°C to 60°C)	
Process Temperature	-330°F to 500°F (-200°C to 260°C)	
Pressure Rating	Full Scale Operating Pressure: 30 to 1500psi (2 to 100bar) Maximum Over Range Pressure: 60 to 2750psi (4 to 175bar)	
Storage Temperature	-40°F to 185°F (-40°C to 85°C)	
Output Signal	• Analog: 4-20mA • Alarm: Solid state relay, 40VDC • Totalizer Pulse: 50-millisecond pulse, 40VDC • Volumetric or Loop Powered Mass: One Analog, One Totalizer Pulse, HART • Multivariable option: Up to Three Analog Signals, • Three Alarms, One Totalizer Pulse, HART • Multivariable option: Modbus, Ethernet, or BACnet process monitoring	
Wetted Materials	• Standard 316L Stainless Steel, Plus • Optional Carbon Steel or Hastelloy C. • DuPont Teflon® based thread sealant on models with pressure transducer.	
Approvals	FM, FMC, ATEX, IECEx	
Display	• Alphanumeric 2-line x 16-character LCD digital display • Six push buttons for full-field configuration Pushbuttons can be operated with a magnetic wand • without the removal of enclosure covers. The display can be mounted in 90° intervals for better viewing.	
Power Supply	• DCL option: 12-36VDC, 25mA, 1W max, loop powered (single output) • DCH option: 12-36VDC, 300mA, 9W max, (multiple outputs) • AC option: 100-240VAC, 50/60Hz line power, 5W (multiple outputs)	

2.4 Dimensional Drawing

Tek-Vor 1300XP Inline Flanged Models

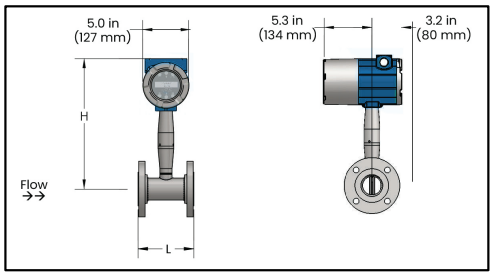


Fig 3. Tek-Vor 1300XP Inline Flanged Models

Tek-Vor 1300XP Inline Water Models

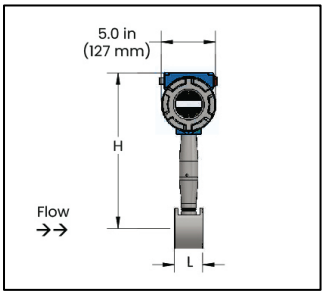


Fig 4. Tek-Vor 1300XP Inline Water Models

Tek-Vor 1300XP Reduced Bore Wafer Models

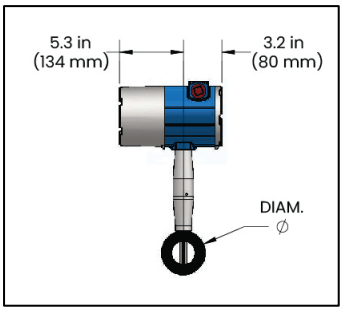


Fig 5. Tek-Vor 1300XP Reduced Bore Wafer Models

Tek-Vor 1300XP Inline Reduced Bore Flanged Models

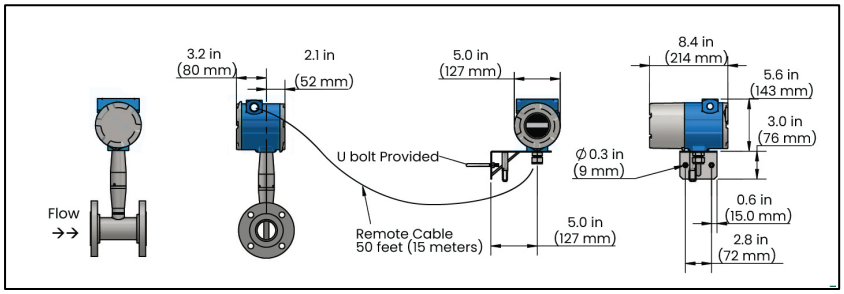


Fig 6. Tek-Vor 1300XP Inline Reduced Bore Flanged Models

2.5 Model Chart

Example – Tek-Vor 1300XP	S	V	50	C	A	1	I	1	S	L	DD	AT	Tek-Vor 1300XP-S-V-50-C-1-I-1-S-I-DD-AT	
Type	S R												Standard Reduced Bore	
Multivaraible Options		V VT VTP											Volumetric Flow Meter for liquid, gas and steam Velocity and Temperature Sensors Velocity, Temperature and Pressure Sensors	
Size			15 20 25 40 50 80 100 150 200 250 300										Standard 1/2" Nominal Bore (15mm) 3/4" Nominal Bore (20mm) 1" Nominal Bore (25mm) 1 1/2" Nominal Bore(40mm) 2" Nominal Bore (50mm) 3" Nominal Bore (80mm) 4" Nominal Bore (100mm) 6" Nominal Bore (150mm) 8" Nominal Bore (200mm) 10" Nominal Bore (250mm) 12" Nominal Bore(300mm)	Reduced Bore 3/4" by 1/2" Reducing Bore (15mm) 1" by 1/2" Reducing Bore (15mm) 1.5" by 1" Reducing Bore (25mm) 2" by by 1.5" Reducing Bore (40mm) 3" by 2" Reducing Bore (50mm) 4"by 3"Reducing Bore (80mm) 6"by4"Reducing Bore (100mm) 8" by 6" Reducing Bore (150mm) 10" by 8"Reducing Bore (200mm) 12"by 10"Reducing Bore (250mm)
Meter Body				C S H									Carbon Steel (1.5 " and Up) 316 Stainless Steel Hastelloy	
Process Connection					A B C D E F G H W								ANSI 150# Flange ANSI 300# Flange ANSI 600# Flange ANSI 900# Flange PN 16 PN 40 PN 64 PN 100 Wafer ANSI 600#	
Pressure Rating						0 1 2 3 4 5							No Pressure Sensor Maximum 30 psia (2 bara), Proof 60 psia (4 bara) Maximum 100 psia (7 bara), Proof 200 psia (14 bara) Maximum 300 psia (20 bara), Proof 600 psia (41 bara) Maximum 500 psia (34 bara), Proof 1000 psia (64 bara) Maximum 1500 psia (100 bara), Proof 2500 psia (175 bara)	
Temperature Rating							S						Standard temperature. Process temperature -330° to 500°F (-200° to 260°C)	

							H						High temperature. Process temperature 750°F (400°C)
Output								I H R T					4 to 20 mA and Pulse 4 to 20 mA, Pulse and HART 4 to 20 mA, Pulse and RS485 modbus 4 to 20 mA, Pulse, RS485 modbus and TCP/IP
Input Power									1 2 3				12-36 VDC, 25mA, 1W max. 12-36 VDC, 300mA, 9W max 100-240 VAC, 50/60 Hz line power, 5W max.
Enclosure										L R			NEMA 4X IP66 Enclosure Remote Electronics NEMA 4X, IP66
Display											DD		Digital Display and Programming Buttons
Approvals												ATEX FM IE	II 2 G Ex d IIB + H2 T6,II 2 D Ex tD A21 IP66 T85°C, Ta = -40 to 60°C CLASS I, DIV. 1, GROUPS B, C, D,CLASS II/III, DIV. 1, GROUPS E, F, G,Type 4X and IP66, T6, Ta = -40 to 60°C Ex d IIB + H2 T6,Ex tD A21 IP66 T85°C, Ta = -40 to 60°C

3 Installation

This section covers instructions on installation and commissioning. Installation of the device must be carried out by trained; qualified specialists authorized to perform such works.

CAUTION

- Keep the instrument away from the fluid and the meter while removing it from potentially dangerous activities.
- Every installation needs to adhere to the local electrical code and installation regulations.

WARNING

Before installing a flow meter in a hazardous area, check the nameplate for special flow meter approvals.

3.1 Recommended Meter Installation

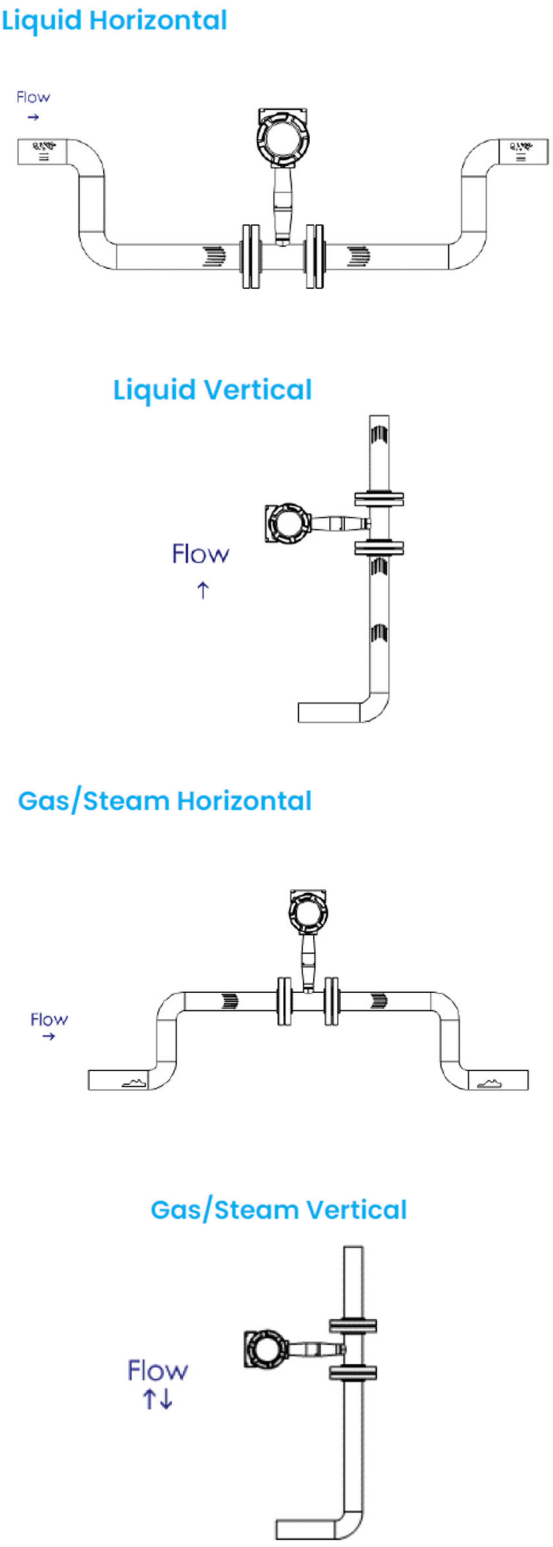


Fig 7. Recommended Meter Installation

The Tek–Vor 1300XP Explosion Proof Inline Flow Meter between two conventional pipe flanges.

The meter inside diameter is equal to the same size nominal pipe ID in schedule 80. For example, a 2" meter has an ID of 1.939" (2" schedule 80). Do not install the meter in a pipe with an inside diameter smaller than the inside diameter of the meter. For schedule 160 and higher pipe, a special meter is required.

NOTE

- Consult the factory before purchasing the meter.
- The 1300XP/ XPR Series require customer-supplied gaskets. When selecting gasket material make sure that it is compatible with the process fluid and pressure ratings of the specific installation. Verify that the inside diameter of the gasket is larger than the inside diameter of the flow meter and adjacent piping. If the gasket material extends into the flow stream, it will disturb the flow and cause inaccurate measurements.

3.2 Wafer-Style Flow Meter Installation

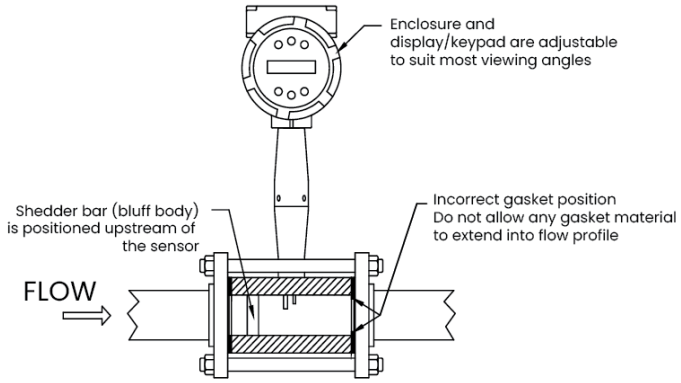


Fig 8. Wafer-Style Flow Meter Installation

Install the wafer-style meter between two conventional pipe flanges of the same nominal size as the flow meter. If the process fluid is a liquid, make sure the meter is located where the pipe is always full. This may require locating the meter at a low point in the piping system.

NOTE

- Vortex flow meters are not suitable for two-phase flows (i.e., liquid and gas mixtures).

- For horizontal pipelines having a process temperature above 300° F, mount the meter at a 45 or 90-degree angle to avoid overheating the electronics enclosure.
- When installing the meter make sure the section marked with a flow arrow is positioned upstream of the outlet, with the arrow head pointing in the direction of flow. (The mark is on the wafer adjacent to the enclosure mounting neck.) This ensures that the sensor head is positioned downstream of the vortex shedder bar and is correctly aligned to the flow. Installing the meter oppo site this direction will result in completely inaccurate flow measurement.

To install the meter: A person with flow meter knowledge should install and maintain the device.

1. Turn off the flow of process gas, liquid or steam. Verify that the line is not pressurized. Confirm that the installation site meets the required minimum upstream and downstream pipe diameters.
2. Insert the studs for the bottom side of the meter body between the pipe flanges. Place the wafer-style meter body between the flanges with the end stamped with a flow arrow on the upstream side, with the arrowhead pointing in the direction of flow. Center the meter body inside the diameter with respect to the inside diameter of the adjoining piping.
3. Position the gasket material between the mating surfaces. Make sure both gaskets are smooth and even with no gasket material extending into the flow profile. Obstructions in the pipeline will disturb the flow and cause inaccurate measurements.

CAUTION

When using toxic or corrosive gases, purge the line with inert gas for a minimum of four hours at full gas flow before installing the flow meter.

3.2.1 Flange Style Flow Meter Installation

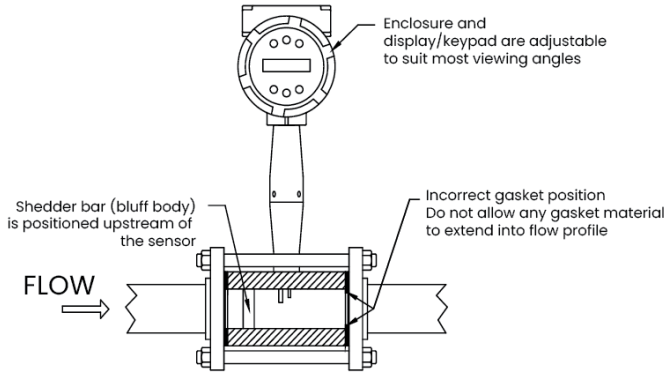


Fig 9. Flange Style Flow Meter Installation

Install the flange-style meter between two conventional pipe flanges of the same nominal size as the flow meter. If the process fluid is a liquid, make sure the meter is located where the pipe is always full. This may require locating the meter at a low point in the piping system.

NOTE

- Vortex flow meters are not suitable for two-phase flows (i.e., liquid and gas mixtures).
- For horizontal pipelines having a process temperature above 300° F, mount the meter at a 45 or 90-degree angle to avoid overheating the electronics enclosure

When installing the meter make sure the flange marked with a flow arrow is positioned upstream of the outlet flange, with the arrowhead pointing in the direction of flow. (The mark is on the flange adjacent to the enclosure mounting neck.) This ensures that the sensor head is positioned downstream of the vortex shedder bar and is correctly aligned to the flow. Installing the meter opposite this direction will result in completely inaccurate flow measurement.

To install the meter:

- Turn off the flow of process gas, liquid or steam. Verify that the line is not pressurized. Confirm that the installation site meets the required minimum upstream and downstream pipe diameters.
- Seat the meter level and square on the mating connections with the flange stamped with a flow arrow on the upstream side, with the arrowhead pointing in the direction of flow. Position a gasket in place for each side. Make sure both gaskets are smooth and even with no gasket material extending into the flow profile. Obstructions in the pipeline will disturb the flow and cause inaccurate measurements.
- Install bolts in both process connections. Tighten the nuts in the sequence. Check for leaks after tightening the flange bolts.

CAUTION

When using toxic or corrosive gases, purge the line with inert gas for a minimum of four hours at full gas flow before installing the flow meter.

3.3 Adjusting Meter Orientation

Depending on installation requirements, you may need to adjust the meter orientation. There are two adjustments available. The first rotates the position of the LCD display/keypad and is available on the Inline Vortex Flow Meter.

3.3.1 Display/Keypad Adjustment

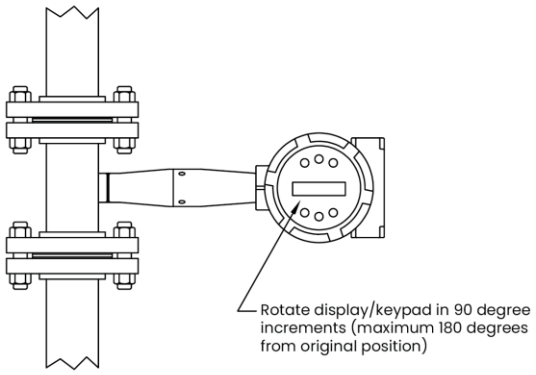


Fig 10. Display/Keypad Viewing Adjustments

The electronics boards are electrostatically sensitive. Wear a grounding wrist strap and make sure to observe proper handling precautions required for static-sensitive components. To adjust the display:

- Disconnect power to the flow meter.
- Loosen the small set screw which secures the electronics enclosure cover. Unscrew and remove the cover.
- Loosen the 4 captive screws.
- Carefully pull the display/microprocessor board away from the meter standoffs. Make sure not to damage the connected ribbon cable.
- Rotate the display/microprocessor board to the desired position. Maximum turn, two positions left or two positions right (180-degrees).
- Align the board with the captive screws. Check that the ribbon cable is folded neatly behind the board with no twists or crimps.
- Tighten the screws. Replace the cover and set screw. Restore power to the meter.

3.3.2 Enclosure Adjustment

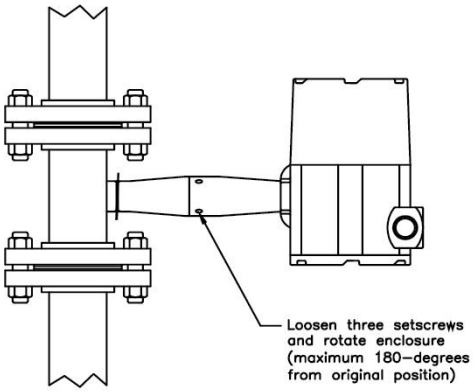


Fig 11. Enclosure Viewing Adjustment

To avoid damage to the sensor wires, do not rotate the enclosure beyond 180-degrees from the original position. To adjust the enclosure:

- Remove power to the flow meter.
- Loosen the three set screws shown above. Rotate the display to the desired position (maximum 180-degrees).
- Tighten the three set screws. Restore power to the meter.

3.4 Keep Safety Precautions

WARNING

- After turning off the electricity, connect all electrical cables. If the device lacks switch-off components, the client is required to supply energy-isolating devices, lightning protection devices, and/or overcurrent protection devices.
- Following rules, the device must be grounded to a location to safeguard staff from electric shocks.

NOTE

The installation of the measuring device must adhere to the relevant national standards and laws as well as the Safety Instructions or Installation or Control Drawings when it is used in hazardous regions.

4 Electrical Installations

All electrical connection requirements are covered in this section. The device's electrical connection must be made by trained, certified professionals who have been permitted by the installation site to do so.

WARNING

- After turning off the electricity, connect all electrical cables. If the device lacks switch-off components, the client is required to supply energy-isolating devices, lightning protection devices, and/or overcurrent protection devices.
- Following rules, the device must be grounded to a location to safeguard staff from electric shocks.

NOTE

The installation of the measuring device must adhere to the relevant national standards and laws as well as the Safety Instructions or Installation or Control Drawings when it is used in hazardous regions.

4.1 Loop Power Flow Meter Wiring Connections

WARNING

- To avoid potential electric shock, follow National Electric Code safety practices or your local code when wiring this unit to a power source and to peripheral devices. Failure to do so could result in injury or death. All wiring procedures must be performed with the power off.
- Use a Class 2 isolated power supply that is grounded, provides DC output, and has no more than 10% output ripple.
- A power switch is not provided with this meter, an approved switch meeting the power requirements listed in Appendix A must be provided by the user. It must be easily accessible and marked as the disconnect for the flow meter.
- Only the connectors supplied with the meter are to be used for connecting wiring.
- If the equipment is used in a manner not specified the protection provided by the equipment may be impaired.

The NEMA 4X enclosure contains an integral wiring compartment with one dual strip terminal block (located in the smaller end of the enclosure). Two 3/4-inch female NPT conduit entries are available for separate power and signal wiring.

For all hazardous area installations, only suitable certified cable glands, blanking plugs or thread adapters may be used. The cable entry device shall be of a certified flameproof type, suitable for the conditions of use and correctly installed.

The degree of protection of at least IP66 to EN 60529 is only achieved if certified cable entries are used that are suitable for the application and correctly installed. Unused apertures shall be closed with suitable blanking elements. If conduit seals are used, they must be installed within 18 inches (457 mm) of the enclosure.

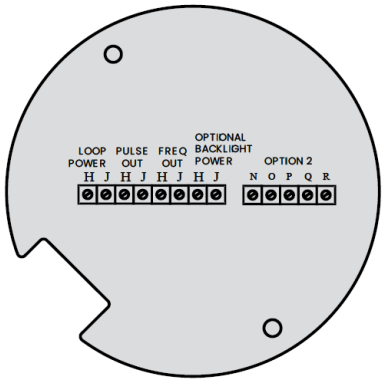


Fig 12. Loop Power Wiring Terminals

4.1.1 Input Power Connection

To access the wiring terminal blocks, locate and loosen the small set screw which locks the small enclosure cover in place. Unscrew the cover to expose the terminal block.

4.1.2 DC Power Wiring

Connect 4-20 mA loop power (12 to 36 VDC at 25 mA, 1W max.) to the +Loop Power and –Loop Power terminals on the terminal block. Torque all connections to 4.43 to 5.31 in-lbs (0.5 to 0.6 Nm). The DC power wire size must be 20 to 12 AWG with the wire stripped 1/4 inch (7 mm).

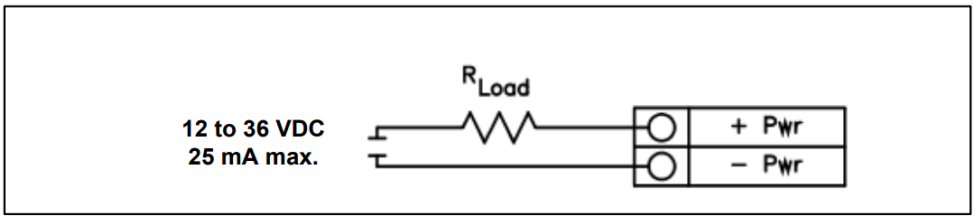
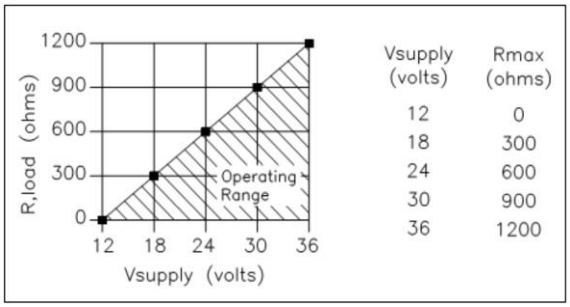


Fig 13. DC Power Connections

4.1.3 4-20 mA Output Connections

The Tek-Vor meter has a single 4-20 mA loop. The 4-20 mA loop current is controlled by the meter electronics. The electronics must be wired in series with the sense resistor or current meter. The current control electronics require 12 volts at the input terminals to operate correctly. The maximum loop resistance (load) for the current loop output is dependent upon the supply voltage and is given in Figure 14. The 4-20 mA loop is optically isolated from the flow meter electronics. R_{load} is the total resistance in the loop, including the wiring resistance ($R_{load} = R_{wire} + R_{sense}$). To calculate R_{max}, the maximum R_{load} for the loop, subtract the minimum terminal voltage from the supply voltage and divide by the maximum loop current, 20 mA. Thus:

$$\text{The maximum resistance } R_{load} = R_{max} = (V_{supply} - 12V) / 0.020\ A$$



The current loop range is 3.8 to 20.5 mA.

Fig 14. Load Resistance Versus Input Voltage

4.2 Pulse Output Connections

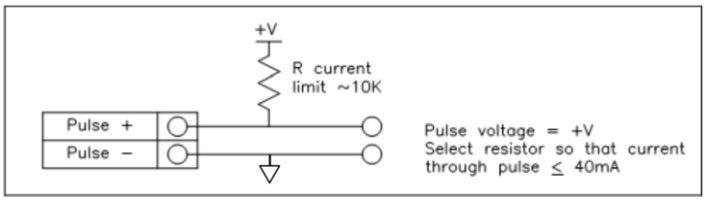


Fig 15. Isolated Pulse Output Using External Power Supply

The pulse output is used for a remote counter. When the preset volume or mass (defined in the totalizer settings, see page 3-10) has passed the meter, the output provides a 50 millisecond square pulse.

The pulse output requires a separate 5 to 36 VDC power supply. The pulse output optical relay is a normally-open single-pole relay. The relay can conduct a current up to 40 mA. It is isolated from the meter electronics and power supply.

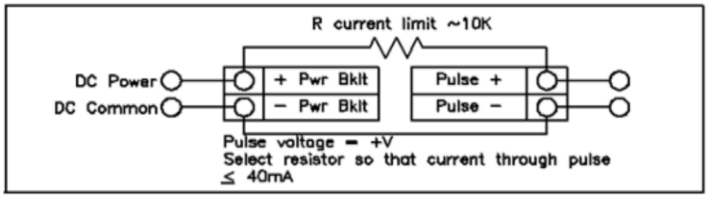


Fig 16. Non-Isolated Pulse Output Using External Power Supply

4.3 Frequency Output Connection

The frequency output is used for a remote counter. It can be scaled to output a 1 to 10 kHz signal proportional to mass or volume flow, temperature, pressure or density.

The frequency output requires a separate 5 to 36 VDC power supply. The frequency output optical relay is a normally-open single-pole relay. The output can conduct a current up to 40 mA. It is isolated from the meter electronics and power supply.

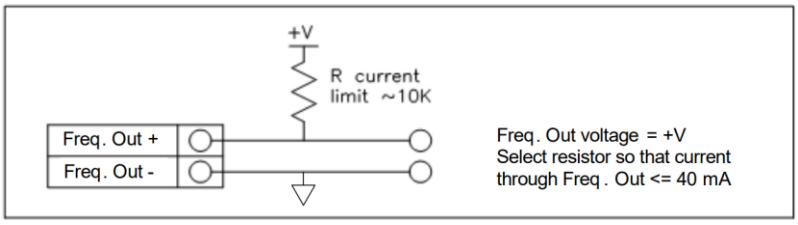


Fig 17. Isolated Frequency Output Using External Power Supply

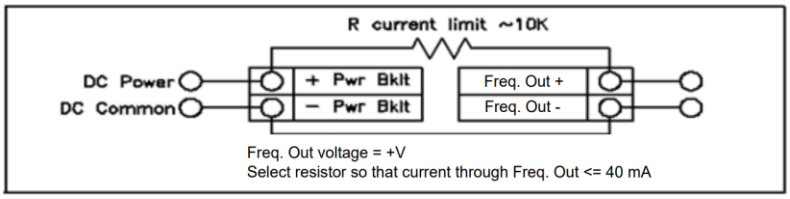


Fig 18. Non-Isolated Frequency Output Using External Power Supply

4.4 Optional Backlight Connection

The loop power meter has an optional backlight connection provided. It is intended to be powered by a separate 12 to 36 VDC at 35 mA max. power supply or by the pulse power input. Both options are shown below.

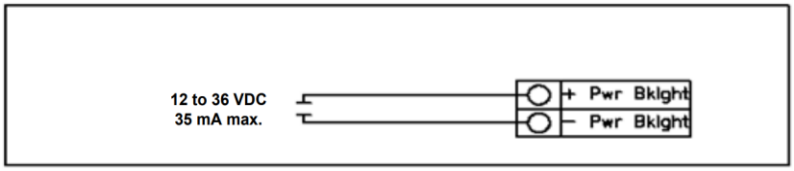


Fig 19. Backlight Using External Power Supply

4.5 Remote Electronics Wiring

The remote electronics enclosure should be mounted in a convenient, easy to reach location. For hazardous location installations, make sure to observe agency requirements for installation. Allow some slack in the interface cable between the junction box and the remote electronics enclosure. To prevent damage to the wiring connections, do not put stress on the terminations at any time.

The meter is shipped with temporary strain relief glands at each end of the cable. Disconnect the cable from the meter's terminal block inside the junction box–not at the remote electronics enclosure. Remove both glands and install appropriate conduit entry glands and conduit. The cable entry device shall be of a certified flameproof type, suitable for the conditions of use and correctly installed.

The degree of protection of at least IP66 to EN 60529 is only achieved if certified cable entries are used that are suitable for the application and correctly installed. Unused apertures shall be closed with suitable blanking elements. When installation is complete, reconnect each labelled wire to the corresponding terminal position on the junction box terminal block. Make sure to connect each wire pair's shield.

Note: incorrect connection will cause the meter to malfunction.
Note: Numeric code on junction box label matches wire labels.

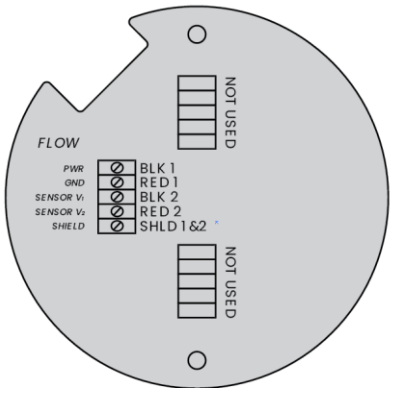


Fig 20. Loop Power Volumetric Flow Meter Junction Box Sensor Connections

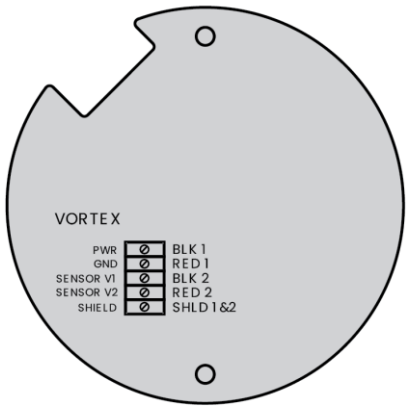


Fig 21. Loop Power Volumetric Flow Meter Junction Box Sensor Connections Supplied

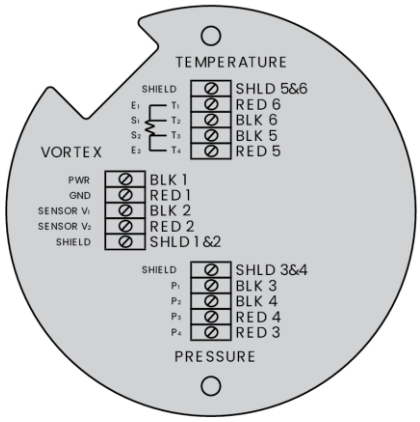


Fig 22. Loop Power Mass Flow Meter Junction Box Sensor Connections

4.6 High Power Meter Wiring Connections

WARNING

- To avoid potential electric shock, follow National Electric Code safety practices or your local code when wiring this unit to a power source and to peripheral devices. Failure to do so could result in injury or death. All AC power connections must be in accordance with published CE directives. All wiring procedures must be performed with the power off.
- A power switch is not provided with this meter, an approved switch meeting the power requirements must be provided by the user. It must be easily accessible and marked as the disconnect for the flow meter.

- Only the connectors supplied with the meter are to be used for connecting wiring.
- If the equipment is used in a manner not specified the protection provided by the equipment may be impaired.

The NEMA 4X enclosure contains an integral wiring compartment with one dual strip terminal block (located in the smaller end of the enclosure). Two 3/4-inch female NPT conduit entries are available for separate power and signal wiring.

For all hazardous area installations, only suitable certified cable glands, blanking plugs or thread adapters may be used. The cable entry device shall be of a certified flameproof type, suitable for the conditions of use and correctly installed. The degree of protection of at least IP66 to EN 60529 is only achieved if certified cable entries are used that are suitable for the application and correctly installed. Unused apertures shall be closed with suitable blanking elements. If conduit seals are used, they must be installed within 18 inches (457 mm) of the enclosure.

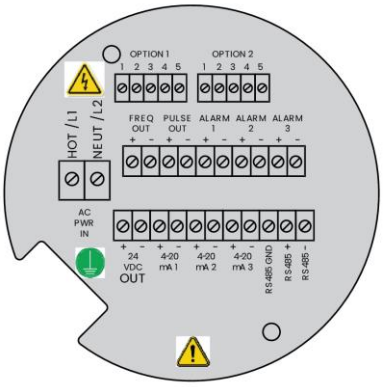


Fig 23. AC Wiring Terminals

4.6.1 Input Power Conncection

To access the wiring terminal blocks, locate and loosen the small set screw which locks the small enclosure cover in place. Unscrew the cover to expose the terminal block.

4.6.2 AC Power Wiring

CAUTION

The AC wire insulation temperature rating must meet or exceed 90°C (194°F), maximum operating voltage 600 VRMS.

The AC power wire size must be 20 to 10 AWG with the wire stripped 1/4 inch (7 mm). The wire insulation temperature must meet or exceed 90°C (194°F). Connect 100 to 240 VAC (5 W maximum) to the Hot and Neutral terminals on the terminal block. Connect the

ground wire to the safety ground lug. Torque all connections to 4.43 to 5.31 in-lbs (0.5 to 0.6 Nm). Use a separate conduit entry for signal lines to reduce the possibility of AC noise interference.

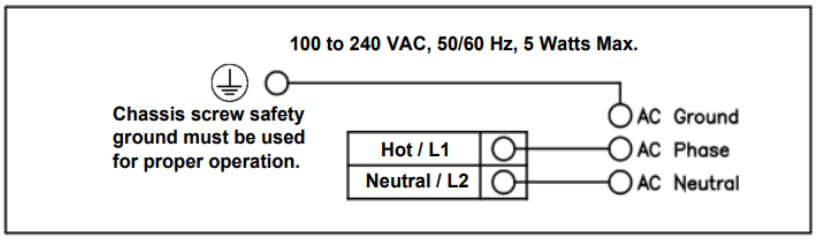


Fig 24. AC Power Connections

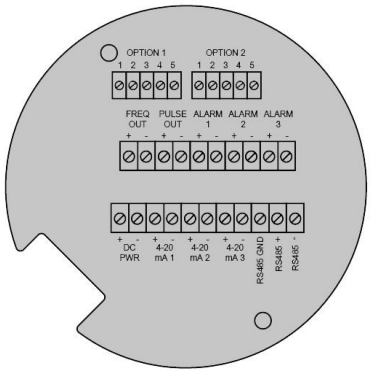


Fig 25. DC Wiring Terminals

4.6.3 DC Power Wiring

WARNING

- Use a Class 2 isolated power supply that is grounded, provides DC output, and has no more than 10% output ripple.
- A power switch is not provided with this meter, an approved switch meeting the power requirements listed in Appendix A must be provided by the user. It must be easily accessible and marked as the disconnect for the flow meter.
- Only the connectors supplied with the meter are to be used for connecting wiring.
- If the equipment is used in a manner not specified the protection provided by the equipment may be impaired.

CAUTION

The DC wire insulation temperature rating must meet or exceed 85°C (185°F), maximum operating voltage 300 VRMS.

The DC power wire size must be 20 to 12 AWG with the wire stripped 1/4 inch (7 mm). Connect 18 to 36 VDC (300 mA, 9 W maximum) to the +DC Pwr and –DC Pwr terminals on the terminal block. Torque all connections to 4.43 to 5.31 in-lbs (0.5 to 0.6 Nm).

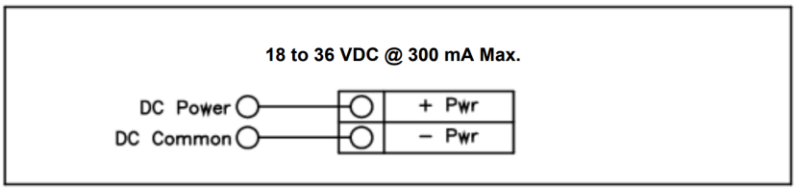


Fig 26. DC Power Connections

4.6.4 4-20 mA Output Connections

The standard 1300XP Inline Vortex Flow Meter has a single 4-20 mA loop. Two additional loops are available on the optional communication board. The 4-20 mA loop current is controlled by the meter electronics. The electronics must be wired in series with the sense resistor or current meter.

The current control electronics require 12 volts at the input terminals to operate correctly. The maximum loop resistance (load) for the current loop output is dependent upon the supply voltage and is given in Figure 27. The 4-20 mA loop is optically isolated from the flow meter electronics. R_{load} is the total resistance in the loop, including the wiring resistance ($R_{load} = R_{wire} + R_{sense}$). To calculate R_{max}, the maximum R_{load} for the loop, subtract the minimum terminal voltage from the supply voltage and divide by the maximum loop current, 20 mA. Thus:

The maximum resistance $R_{load} = R_{max} = (V_{supply} - 12V) / 0.020$ A

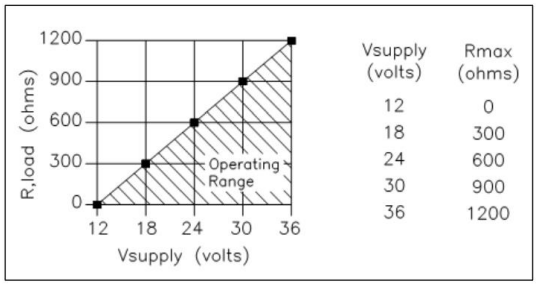


Fig 27. Load Resistance Versus Input Voltage

The current loop range is 3.8 to 20.5 mA.

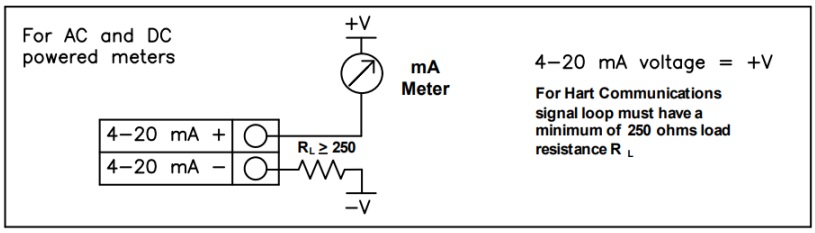


Fig 28. Isolated 4–20 mA Output Using External Power Supply

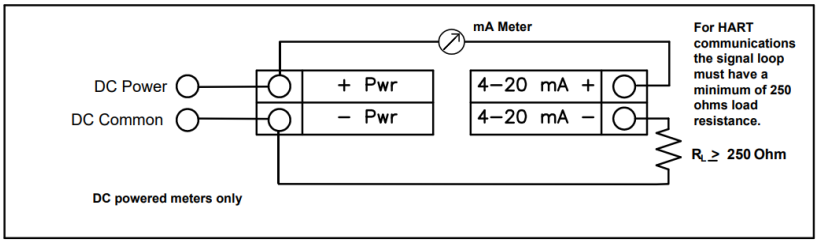


Fig 29. Non-Isolated 4–20 mA Output Using Meter Input Power Supply

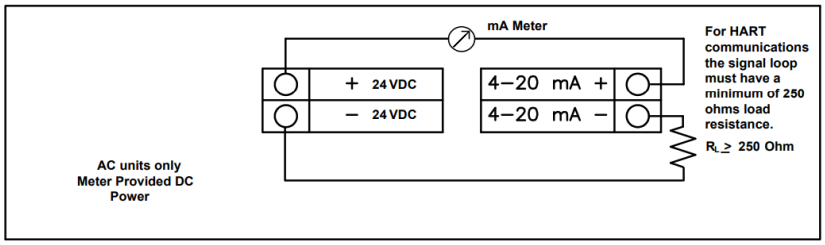


Fig 30. Isolated 4–20 mA Output Using Meter Provided Power Supply

4.7 Frequency Output Connection

The frequency output is used for a remote counter. It can be scaled to output a 1 to 10 kHz signal proportional to mass or volume flow, temperature, pressure or density. The frequency output requires a separate 5 to 36 VDC power supply. The frequency output optical relay is a normally-open single-pole relay. The output can conduct a current up to 40 mA. It is isolated from the meter electronics and power supply.

There are three connection options for the frequency output–the first with a separate power supply (Figure 31), the second using the flow meter power supply (Figure 32)(DC powered units only), and the third using the internal 24 VDC power supply (Figure 33)(AC powered units only). Use the first option with a separate power supply (5 to 36 VDC) if a specific voltage is needed for the frequency output.

Use the second configuration if the voltage at the flow meter power supply is an acceptable driver voltage for the load connected. (Take into account that the current used by the frequency load comes from the meter's power supply). Use the third configuration if you have an AC powered unit only. In any case, the voltage of the frequency output is the same as the voltage supplied to the circuit.

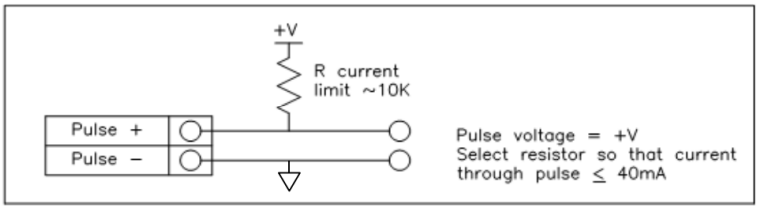


Fig 31. Isolated Frequency Output Using External Power Supply

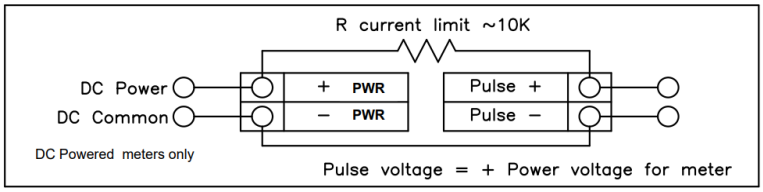


Fig 32. Non-Isolated Frequency Output Using Input Power Supply

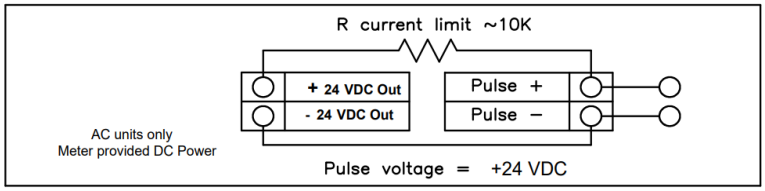


Fig 33. Isolated Frequency Output Using Meter Provided Power Supply

4.8 Alarm Output Connections

One alarm output (Alarm 1) is included on the standard 1300XP Flow Meter. Two or more alarms (Alarm 2 and Alarm 3) are included on the optional communication board. The alarm output requires a separate 5 to 36 VDC power supply. The alarm output optical relay is a normally-open single-pole relay.

The relay can conduct a current up to 40 mA. It is isolated from the meter electronics and power supply. When the alarm relay is closed, the current draw will be constant. Make sure to size R_{load} appropriately. There are three connection options for the alarm output– the first with a separate power supply (Figure 34), the second using the flow meter power supply (Figure 35)(DC powered units only) and the third with the meter provided power supply (Figure 36)(AC powered units only).

Use the first option with a separate power supply (5 to 36 VDC) if a specific voltage is needed for the alarm output. Use the second configuration if the voltage at the flow meter power supply is an acceptable driver voltage for the load connected. (Take into account that the current used by the alarm load comes from the meter's power supply). Use the third if you have an AC powered unit only. In any case, the voltage of the alarm output is the same as the voltage supplied to the circuit.

The alarm output is used for transmitting high or low process conditions as defined in the alarm settings.

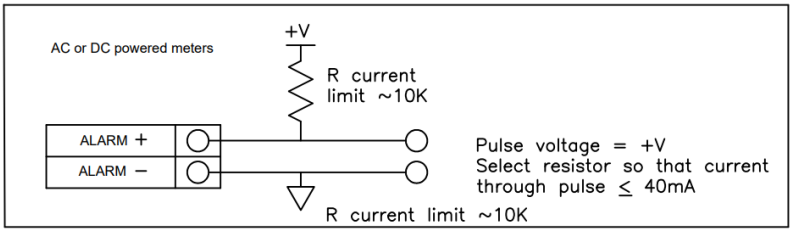


Fig 34. Isolated Alarm Output Using External Power Supply

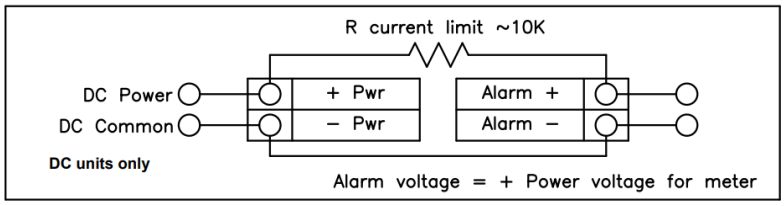


Fig 35. Non-Isolated Alarm Output Using Internal Power Supply

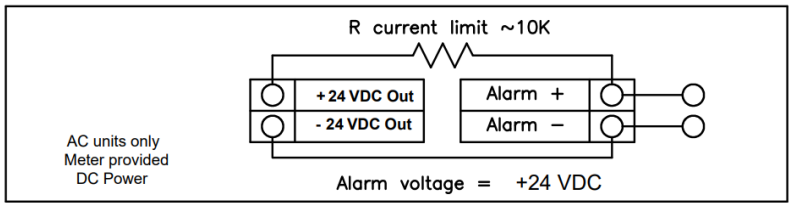


Fig 36. Isolated Alarm Output Using Meter Provided Power Supply

4.9 Remote Electronics Wiring

The remote electronics enclosure should be mounted in a convenient, easy to reach location. For hazardous location installations, make sure to observe agency requirements for installation. Allow some slack in the interface cable between the junction box and the remote electronics enclosure. To prevent damage to the wiring connections, do not put stress on the terminations at any time.

The meter is shipped with temporary strain relief glands at each end of the cable. Disconnect the cable from the meter's terminal block inside the junction box–not at the remote electronics enclosure. Remove both glands and install appropriate conduit entry glands and conduit. The cable entry device shall be of a certified flameproof type, suitable for the conditions of use and correctly installed.

The degree of protection of at least IP66 to EN 60529 is only achieved if certified cable entries are used that are suitable for the application and correctly installed. Unused apertures shall be closed with suitable blanking elements. When installation is complete, reconnect each labeled wire to the corresponding terminal position on the junction box terminal block. Make sure to connect each wire pair's shield. Note: incorrect connection will cause the meter to malfunction.

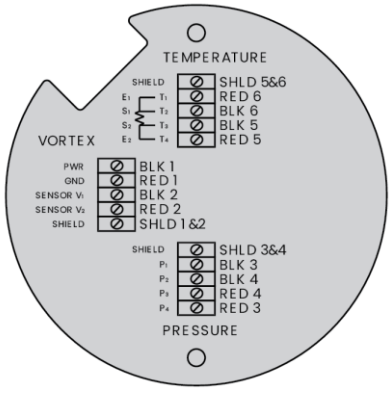


Fig 37. High Power Flow Meter Junction Box Sensor Connections

4.10 Optional Input Electronics Wiring

The meter has two optional input wiring terminals, maximum wire size is 16 AWG. These can be used to input a Remote or Second RTD input in the case of an Energy Monitoring meter, for the input of a Remote Pressure Transducer, to pass a Contact Closure or for a Remote Density measurement to name a few. In any case, the wiring diagram will be included with the meter if any of the options are specified. Otherwise, the optional terminal blocks will be left blank and nonfunctional.

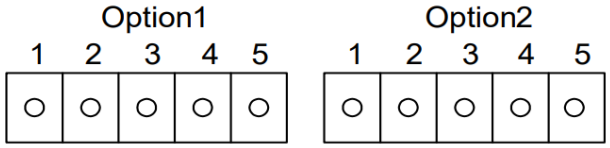


Fig 38. Optional Energy EMS RTD Input Wiring

4.10.1 Optional Energy EMS RTD Input Wiring

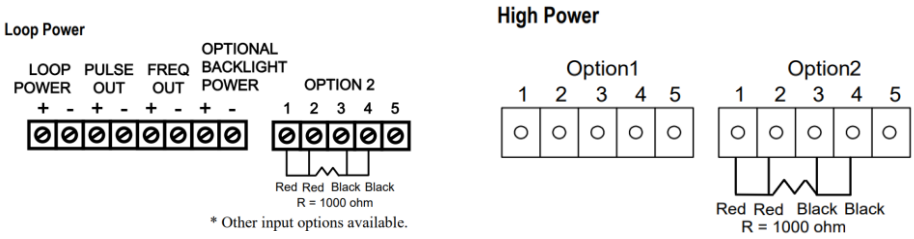


Fig 39. Optional Energy EMS RTD Input Wiring

The recommended customer supplied second RTD is a Class A 1000 ohm 4-wire platinum RTD. If a second RTD is not being used, then the factory supplied 1000 ohm resistor needs to be installed in its place.

4.10.2 Optional External 4-20 mA Input Wiring

The meter is set to have Option 1 used for the external input. Programming menus that pertain to the optional 4-20 mA input are located in the Hidden Diagnostics Menu.

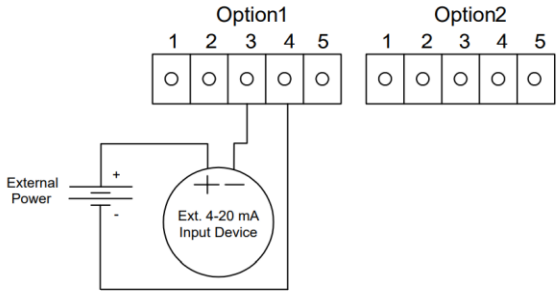


Fig 40. External 4-20 mA Input Wiring - External Power Supply

Follow the above diagram to wire the external 4-20 mA input into the flow meter using an external power supply.

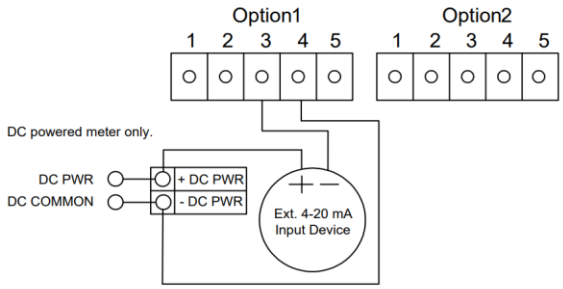


Fig 41. External 4-20 mA Input Wiring - DC Powered Meter

Follow the above diagram to wire the external 4-20 mA input into the flow meter using power supplied to the input of a DC powered meter.

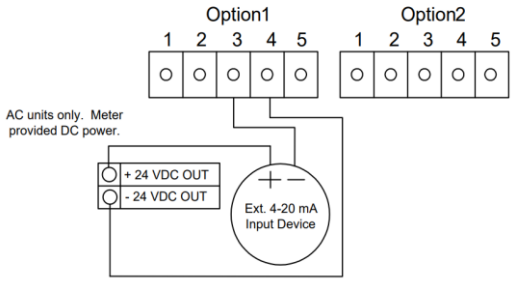


Fig 42. External 4-20 mA Input Wiring - AC Powered Meter

Follow the above diagram to wire the external 4-20 mA input into the flow meter using power from the 24 VDC output of an AC powered meter.

4.10.3 Optional External 4-20 mA Input and RTD Wiring

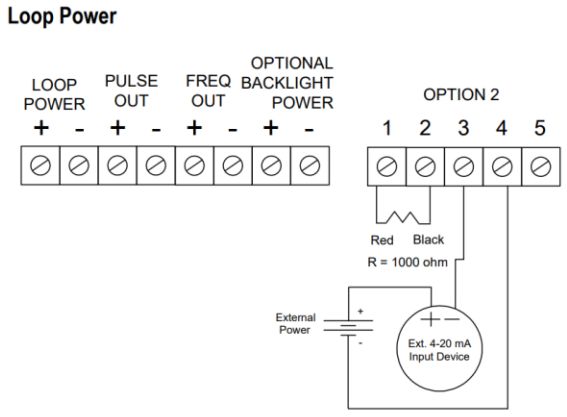


Fig 43. External 4-20 mA Input and RTD Wiring – Loop Power

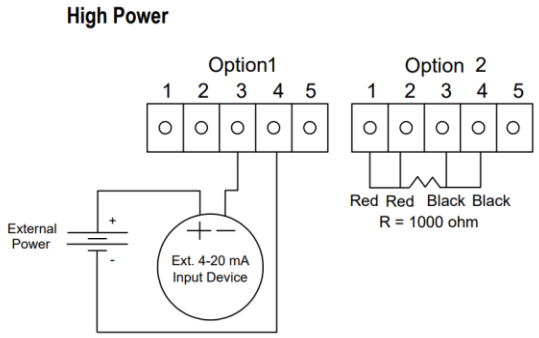


Fig 44. External 4-20 mA Input and RTD Wiring – High Power

4.10.4 Optional Energy EMS External 4-20 mA Input and RTD Wiring

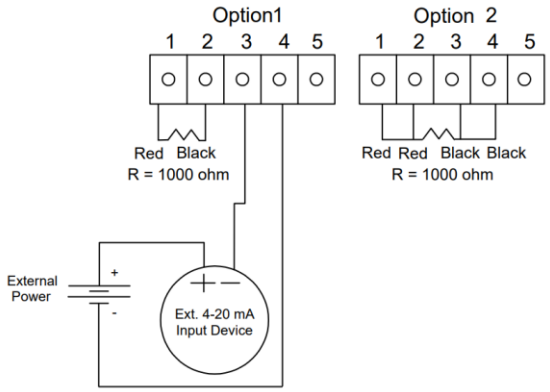


Fig 45. Energy EMS External 4-20 mA Input and RTD Wiring – High Power

4.10.5 Optional External Contact Closure Input Wiring

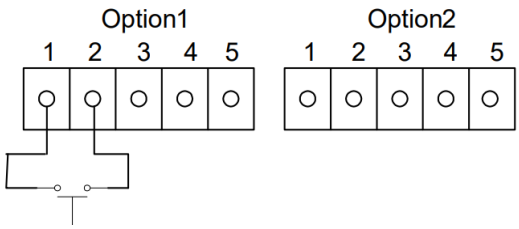


Fig 46. Optional External Contact Closure Input Wiring

Follow the above diagram to wire an external switch input into the flow meter. The meter is configured to have Option 1 used for the external input. If the above switch is used to remotely reset the totalizer a pushbutton switch with a momentary contact closure is recommended.

4.11 HART Communication

The HART Communications Protocol (Highway Addressable Remote Transducer Protocol) is a bidirectional digital serial communications protocol. The HART signal is based on the Bell 202 standard and is superimposed on 4-20 mA Output 1. Peer-to-peer (analog / digital) and multi-drop (digital only) modes are supported.

4.11.1 Wiring

WARNING

Place controls in manual mode when making configuration changes to the vortex meter.

The diagrams below detail the proper connections required for HART communications:

Loop Powered Meter Wiring:

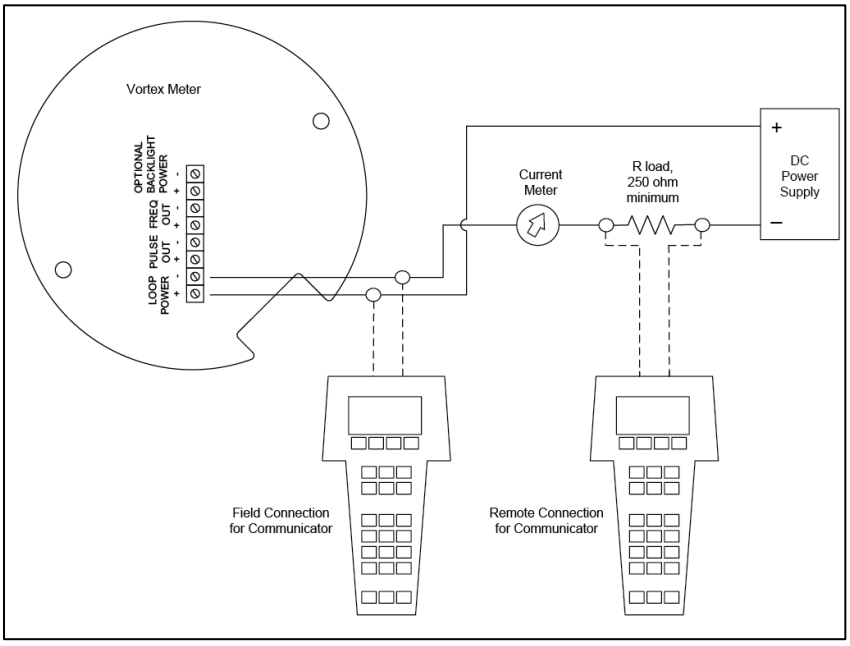


Fig 47. Loop Powered Meter Wiring (HART)

DC Powered Meter Wiring:

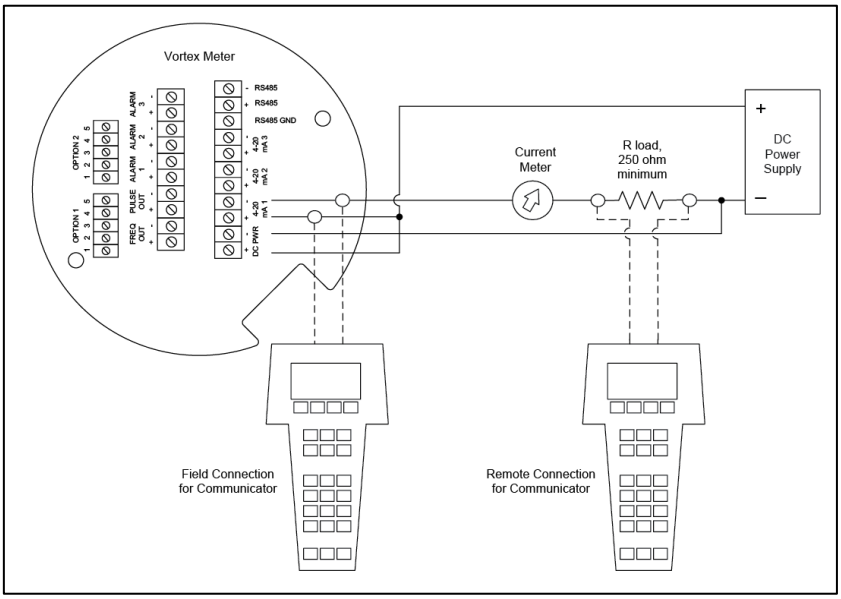


Fig 48. DC Powered Meter Wiring (HART)

AC Powered Meter Wiring:

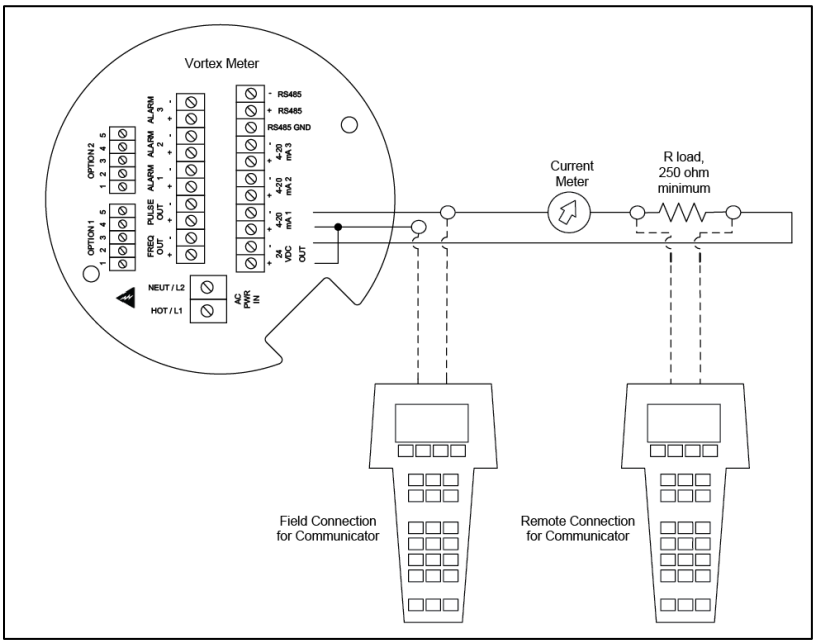


Fig 49. AC Powered Meter Wiring (HART

4.12 RS485 (Modbus) Wiring

An RS485 daisy chained network configuration as depicted below is recommended. Do not use a star, ring, or cluster arrangement.

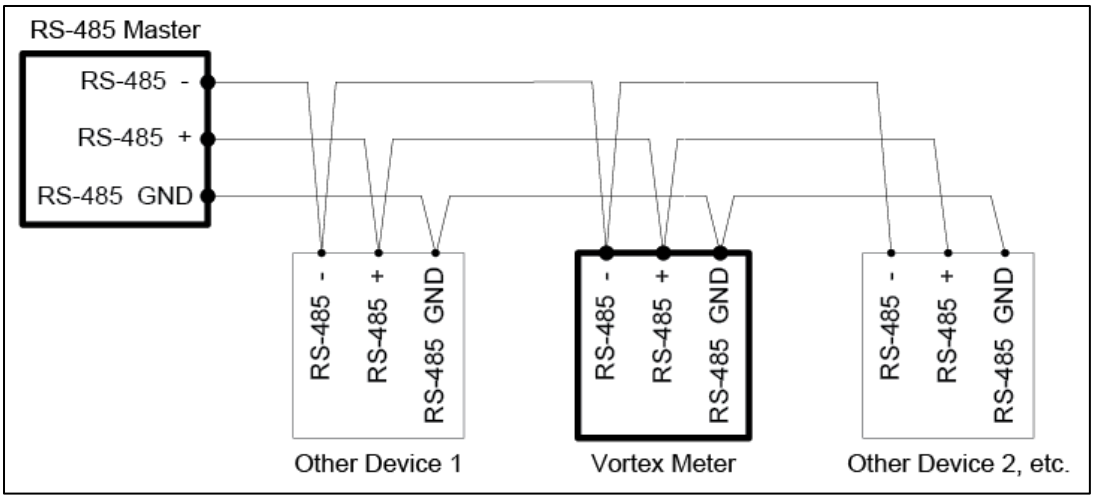


Fig 50. RS-485 Wiring (MODBUS)

4.12.1 Power Over Ethernet (POE) Wiring Connections

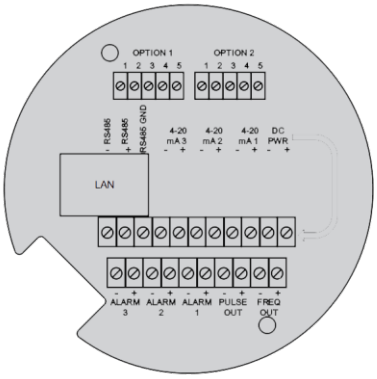


Fig 51. Power Over Ethernet (POE) Wiring Connections

The NEMA 4X enclosure contains an integral wiring compartment with one dual strip terminal block (located in the smaller end of the enclosure). Two 3/4-inch female NPT conduit entries are available for separate power and signal wiring. For all hazardous area installations, only suitable certified cable glands, blanking plugs or thread adapters may be used.

The cable entry device shall be of a certified flameproof type, suitable for the conditions of use and correctly installed. The degree of protection of at least IP66 to EN 60529 is only achieved if certified cable entries are used that are suitable for the application and correctly installed. Unused apertures shall be closed with suitable blanking elements. If conduit seals are used, they must be installed within 18 inches (457 mm) of the enclosure.

4.12.2 DC Power Wiring

The DC power wire size must be 20 to 12 AWG with the wire stripped ¼ inch (7 mm). Connect 18 to 16 VDC (300 mA, 9 W maximum) to the +DC Pwr and -DC Pwr terminals on the terminal block.

Torque all connections to 4.43 to 5.31 in-lbs (0.5 to 06 Nm).

Alternatively POE injector may be used for example: TRENDnet TPE-155Gi

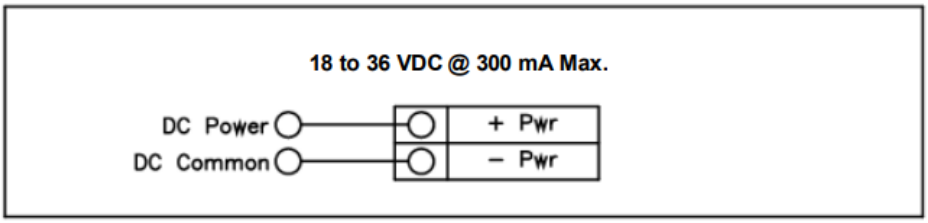


Fig 52. DC Power Wiring

4.13 POE Power Wiring

Connect the unit with the Ethernet cable to POE enable Ethernet switch (POE option does not require a separate power supply).

Plug Ethernet drop off cable from your Local Area Network (LAN) switch to LAN connector Tek-Vor 1300XP Meter. You should see a blinking orange LED and a solid green on the front of the LAN connector of the meter henCAT5 Ethernet cable is plugged in the communicating.

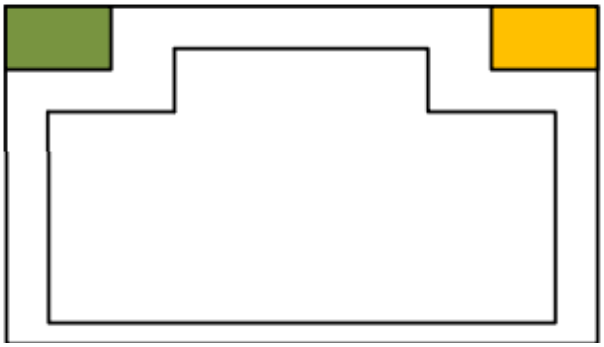


Fig 53. POE Power Wiring

5 Operation

After installing the Tek-Vor 1300XP Vortex Flow Meter, you are ready to begin operation. The sections in this chapter explain the display/keypad commands, meter start-up and programming. The meter is ready to operate at start up without any special programming. To enter parameters and system settings unique to your operation, see the following pages for instructions on using the setup menus.

5.1 Display

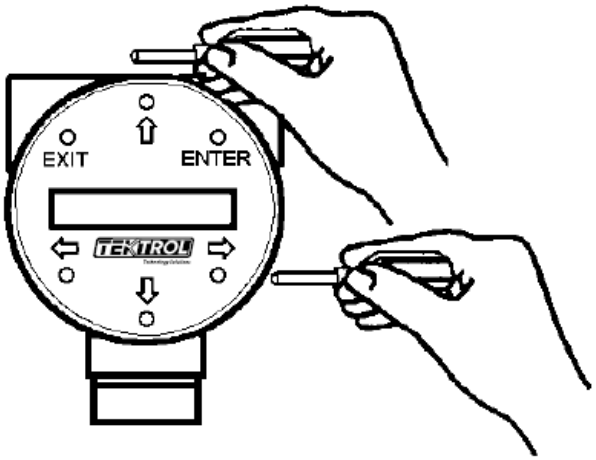


Fig 54. Display Configuration

The Tek-Vor 1300XP flow meter is equipped with digital electronics that allow users to set, adjust, and monitor system parameters and performance. A comprehensive range of commands is accessible through the integrated display and keypad.

The LCD display, featuring 2 x 16 characters, facilitates both flow monitoring and programming. The configuration of the Tek-Vor 1300XP can be done using six pushbuttons. Like A black triangle with two arrows.

▲▼ The Up-Down Button, A black and white arrow ◀ ▶ and L-R buttons these buttons can be operated with the enclosure cover removed for direct access. Alternatively, if the explosion-proof cover remains in place, users can operate the keypad using a hand-held magnet positioned at the side of the enclosure, as illustrated in the diagram.

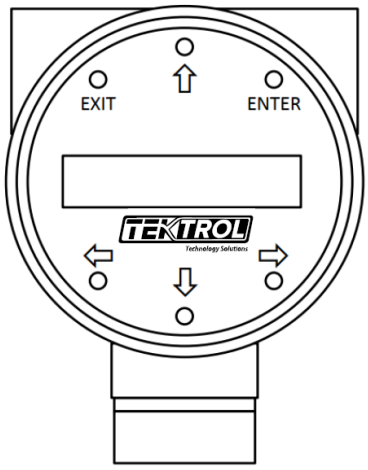


Fig 55. Display

Below are the available keypad commands for configuring the device:

1. Run Mode: the ENTER key allows access to the Setup Menus (through a password screen). Within the Setup Menus, pressing ENTER activates the current field.
2. Set Up Menu, press the ENTER key until an underline cursor appears. Use the ▲ ▼ ◀ ▶ keys to select new parameters. Press ENTER to continue. (If change is not allowed, ENTER has no effect.) All outputs are disabled when using the Setup Menus. The EXIT key is active within the Setup Menus. When using a Setup Menu, EXIT returns you to the Run Mode. If you are changing a parameter and make a mistake, EXIT allows you to start over.
3. The ▲ ▼ ◀ ▶ keys advance through each screen of the current menu. When changing a system parameter, all ▲ ▼ ◀ ▶ keys are available to enter new parameters.

5.2 Display Contrast Adjustment

The flow meter display contrast is set at the factory but if the display characters appear too dark or too light proceed as follows:

1. Hold down the "Exit" button on the front panel for 5 to 10 seconds. "Setting Contrast" will appear.
2. Push the "Up" arrow to darken the display or the "Down" arrow to lighten it.
3. Push the "Enter" button to save the contrast setting.

5.2.1 Start-Up

To begin flow meter operation:

1. Verify the flow meter is installed and wired as described in point 3
2. Apply power to the meter. At start up, the unit runs a series of self-tests that check the RAM, ROM, EPROM and all flow sensing com ponents. After completing the self-test sequence, the Run Mode screens appear.
3. The Run Mode displays flow information as determined by system settings. Some screens depicted on the next page may not be displayed based on these settings. Press the ñò arrow keys to view the Run Mode screens.
4. Press the ENTER key from any Run Mode screen to access the Setup Menus. Use the Setup Menus to configure the meter's multi parameter features to fit your application.

NOTE

Starting the flow meter or pressing EXIT will always display the Run Mode screens.

5.2.2 Programming the Flow Meter

1. Enter the Setup Menu by pressing the ENTER key until prompted for a password. (All outputs are disabled while using the Setup Menus.)
2. Use the ▲ ▼ ◀ ▶ keys to select the password characters (1234 is the factory-set password). When the password is correctly displayed, press ENTER to continue.
3. Use the Setup Menus described on the following pages to customize the multiparameter features of your Tek-Vor 1300XP Flow Meter. (The entire lower display line is available for entering parameters.) Some items depicted in the graphic on the preceding page may not be displayed based on flow meter configuration settings
4. To activate a parameter, press ENTER. Use the ▲ ▼ ◀ ▶ keys to make selections. Press ENTER to continue. Press EXIT to save or discard changes and return to Run Mode.
5. Program the UNITS menu first because later menus will be based on the units selected.

5.2.3 Setting an Output

The following shows how to set Output 1 to measure mass flow with 4 mA = 0 lb/hr and 20 mA = 100 lb/hr with a time constant of 5 seconds. (All outputs are disabled while using the Setup Menus.)

First, set the desired units of measurement:

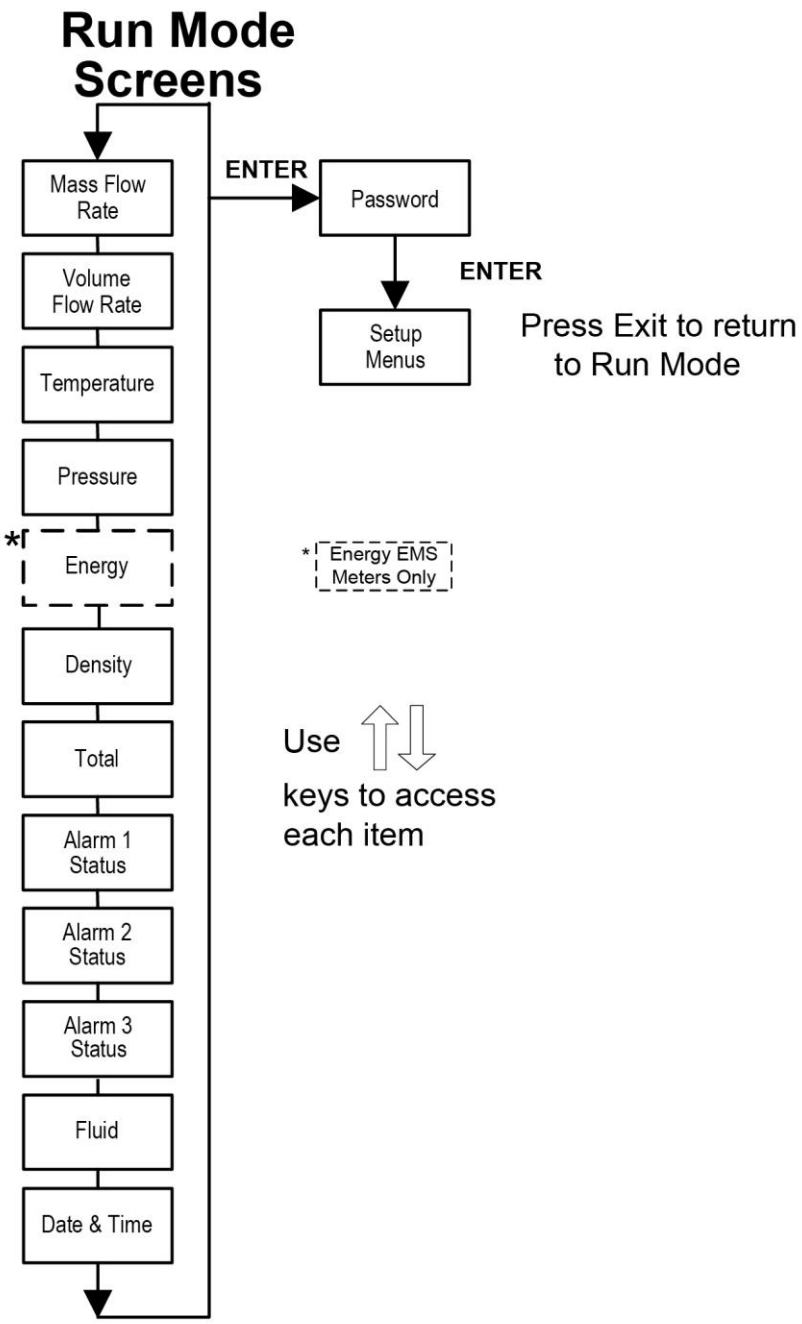
1. Use ◀ ▶ keys to move to the Units Menu.
2. Press ▼ key until Mass Flow Unit appears. Press ENTER.
3. Press ▼ key until lb appears in the numerator. Press ▶ key to move the underline cursor to the denominator. Press the ▼ key until hr appears in the denominator. Press ENTER to select.
4. Press ▲ key until Units Menu appears.

Second, set the analog output:

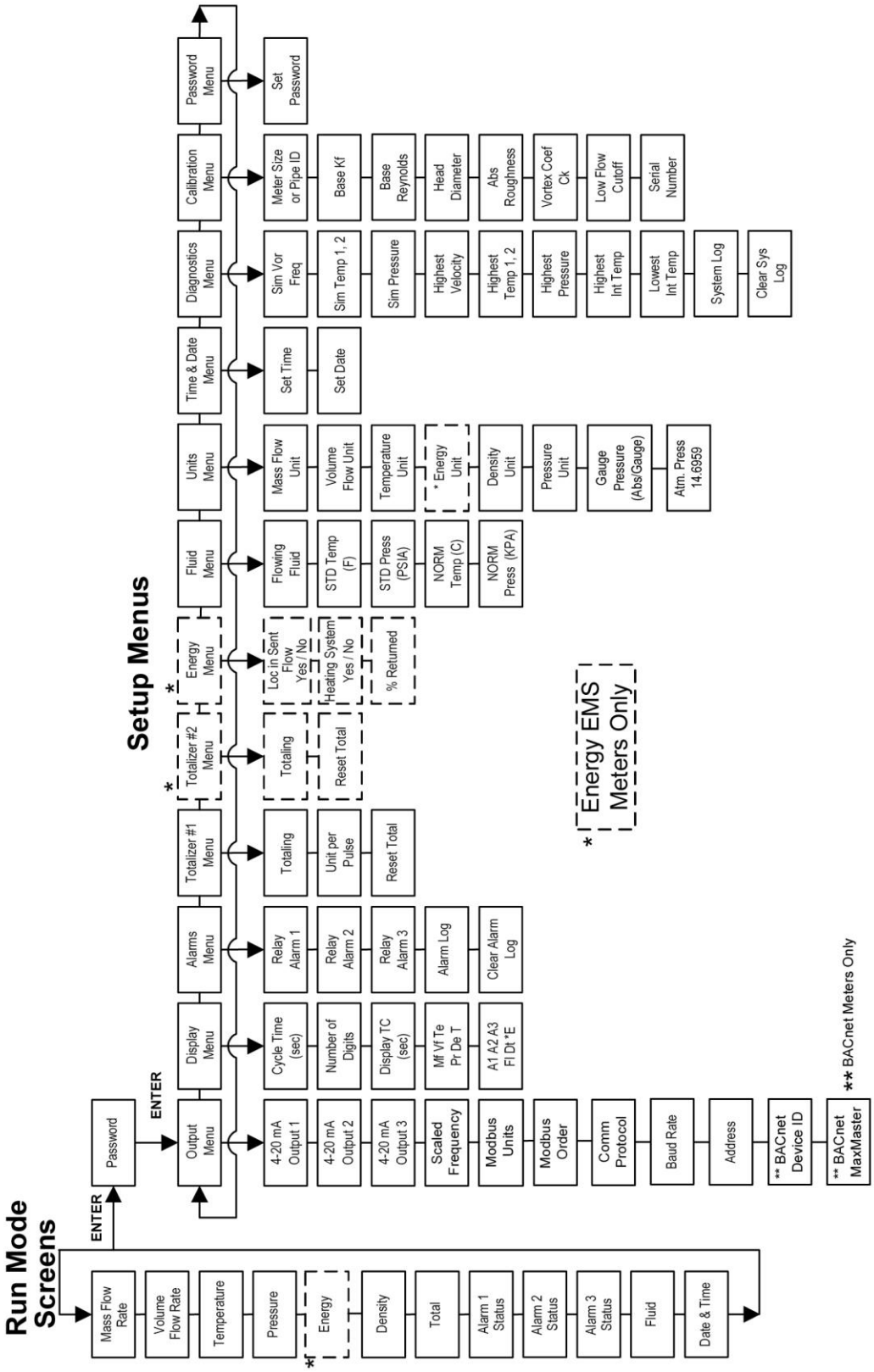
1. Use ◀ ▶ keys to move to the Output Menu.
2. Press the ▼ key until 4-20 mA Output 1 appears.
3. Press ▶ key to access Measure selections. Press ENTER and press the ∫ key to select Mass. Press ENTER.
4. Press ▶ key to set the 4 mA point in the units you have selected for mass of lb/hr. Press ENTER and use ▲ ▼ ◀ ▶ keys to set 0 or 0.0. Press ENTER.
5. Press ▶ key to set the 20 mA point. Press ENTER and use ▲ ▼ ◀ ▶ keys to set 100 or 100.0. Press ENTER.
6. Press ▶ key to select the Time Constant. Press ENTER and use ▲ ▼ ◀ ▶ keys to select 5 Press ENTER.
7. Press the EXIT key and answer YES to permanently save your changes.

6 Menu Tree

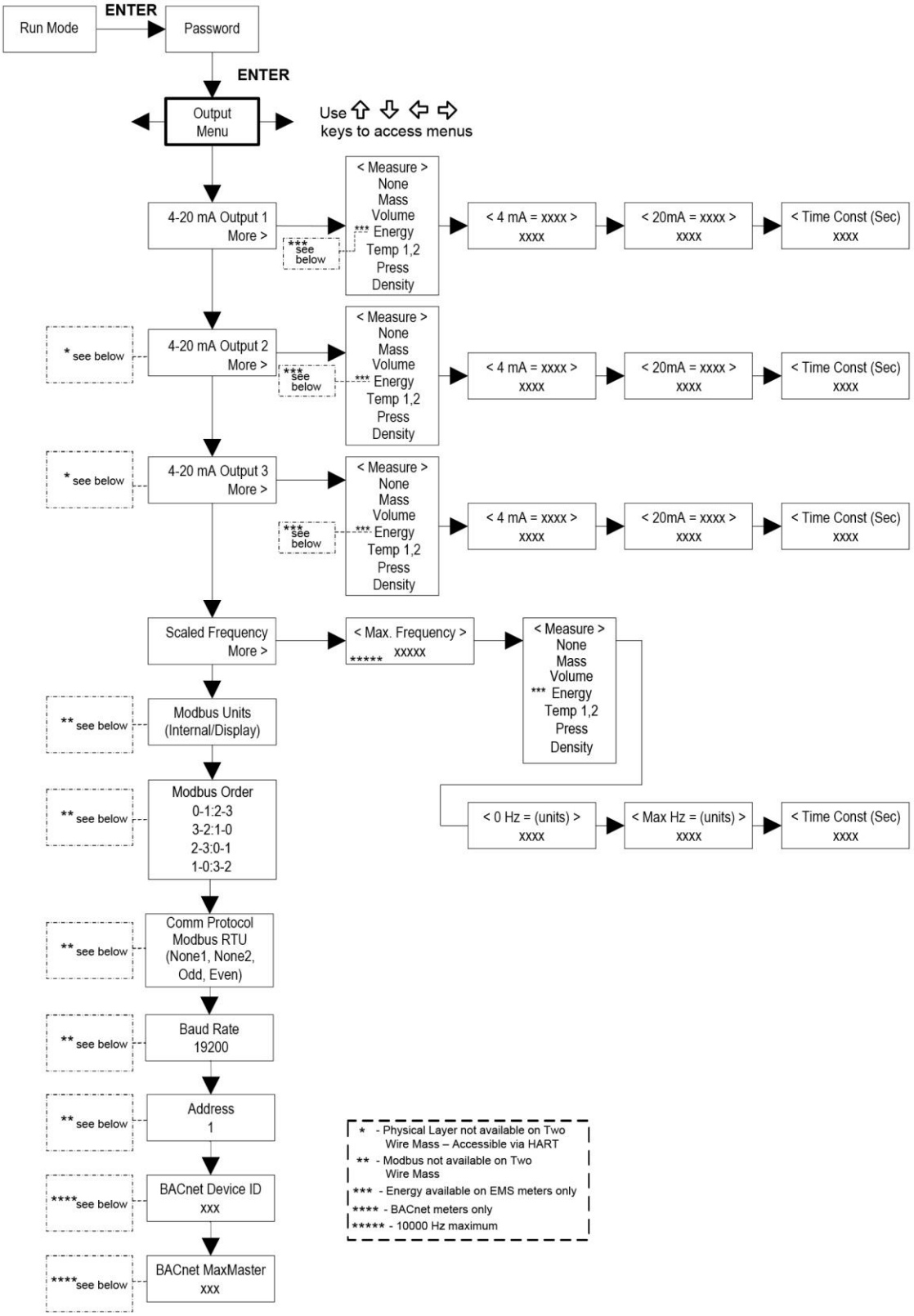
6.1 Run Mode Screens



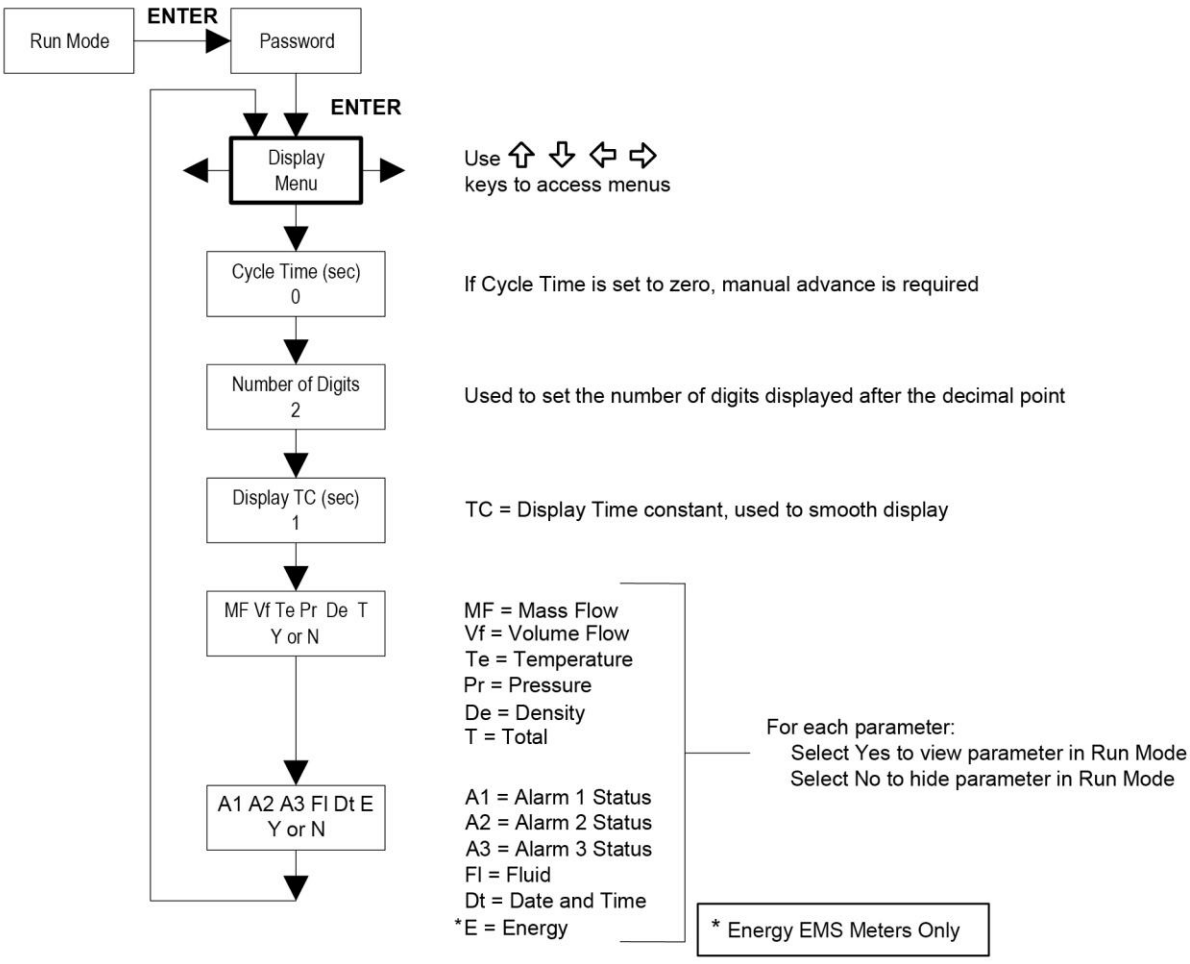
6.2 Set Up Menus



6.3 Output Menus



6.4 Display Menus



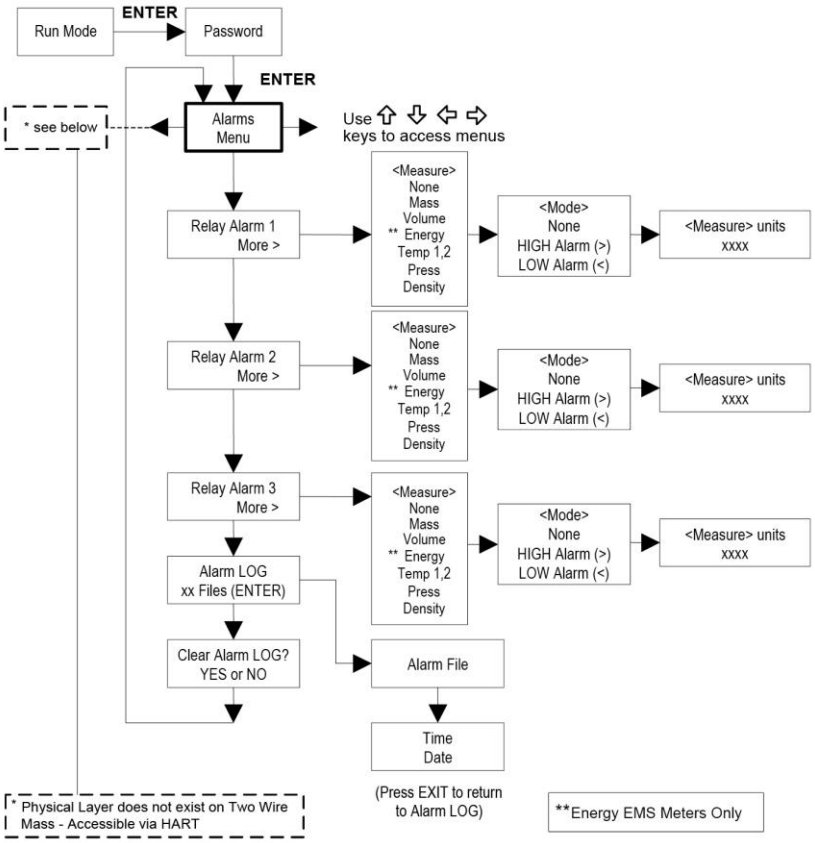
Use the Display Menu to set the cycle time for automatic screen sequencing used in the Run Mode, change the precision of displayed values, smooth the values or enable or disable each item displayed in the Run Mode screens.

6.4.1 Changing a Run Mode Display Item

The following shows how to remove the temperature screen from the Run Mode screens. Note: all outputs are disabled while using the Setup Menus.

4. Use ◀ ▶ keys to move to the Display Menu.
5. Press ▼ key until Mf Vf Pr Te De T appears.
6. Press ENTER to select. Press ▶ key until the cursor is positioned below Te.
7. Press ▼ key until N appears. Press ENTER to select.
8. Press EXIT and then ENTER to save changes and return to the Run Mode.

6.5 Alarm Menu



6.5.1 Setting an Alarm

The following shows how to set Relay Alarm 1 to activate if the mass flow rate is greater than 100 lb/hr. You can check the alarm configuration in the Run Mode by pressing the ▲▼ keys until Alarm [1] appears. The lower line displays the mass flow rate at which the alarm activates. Note: all outputs are disabled while using the Setup Menus.

First, set the desired units of measurement:

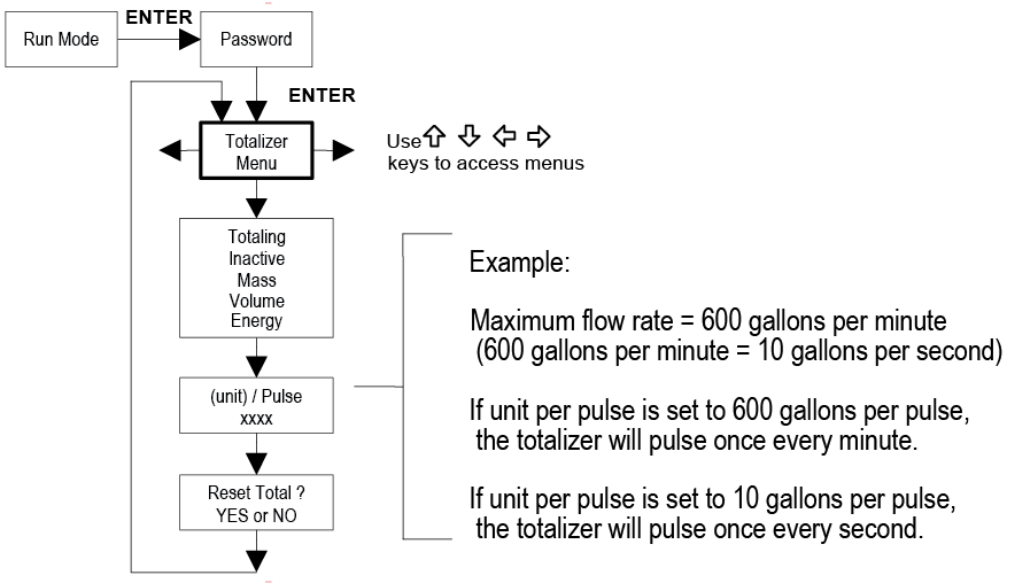
1. Use ◀ ▶ keys to move to the Units Menu.
2. Press ▼ key until Mass Flow Unit appears. Press ENTER.
3. Press ▼ key until lb appears in the numerator. Press □ key to move the underline cursor to the denominator. Press the ▼ key until hr appears in the denominator. Press ENTER to select.
4. Press ▲ key until Units Menu appears.

Second, set the alarm:

1. Use ◀ ▶ keys to move to the Alarms Menu.
2. Press the ▼ key until Relay Alarm 1 appears.
3. Press ▶ key to access Measure selections. Press ENTER and use the ▼ key to select Mass. Press ENTER.

4. Press ▶ key to select the alarm Mode. Press ENTER and use ▼ key to select HIGH Alarm. Press ENTER.
5. Press ▶ key to select the value that must be exceeded before the alarm activates. Press ENTER and use ▲ ▼ ◀ ▶ keys to set 100 or 100.0. Press ENTER.
6. Press the EXIT key to save your changes. (Alarm changes are always permanently saved.) (Up to three relay alarm outputs are available depending on meter configuration.)

6.6 Totalizer Menu



Use the Totalizer Menu to configure and monitor the totalizer. The totalizer maximum count is 999,999,999 at which point it will roll over to 0. The totalizer output is a 50 millisecond (.05 second) positive pulse (relay closed for 50 milliseconds). The totalizer cannot operate faster than one pulse every 100 millisecond (.1 second). A good rule to follow is to set the unit per pulse value equal to the maximum flow in the same units per second. This will limit the pulse to no faster than one pulse every second.

6.6.1 Setting an Totalizer

The following shows how to set the totalizer to track mass flow in kg/sec. (All outputs are disabled while using the Setup Menus.)

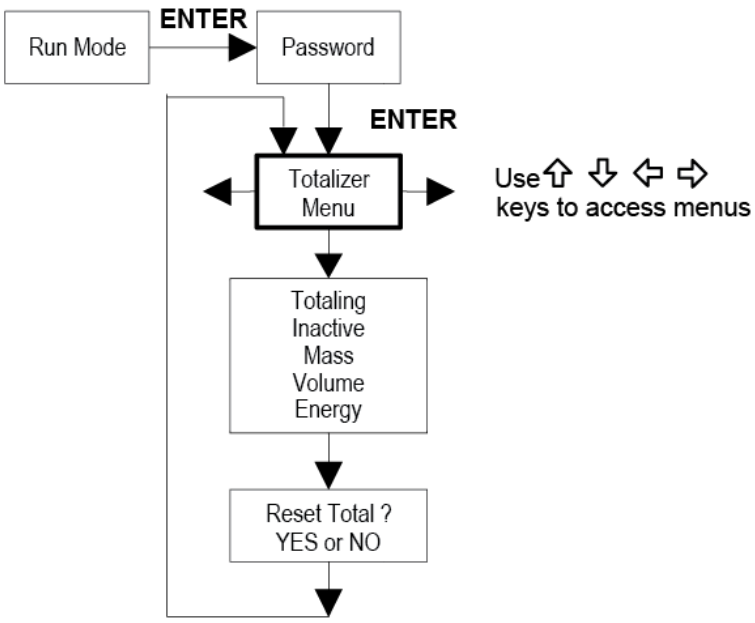
First, set the desired units of measurement:

1. Use ◀ ▶ keys to move to the Units Men
2. Press ▼ key until Mass Flow Unit appears. Press ENTER.
3. Press ▼ key until kg appears in the numerator. Press ▶ key to move the underline cursor to the denominator. Press the ▼ key until sec appears in the denominator. Press ENTER to select.
4. Press ▲ key until Units Menu appears.

Second, set the pulse output:

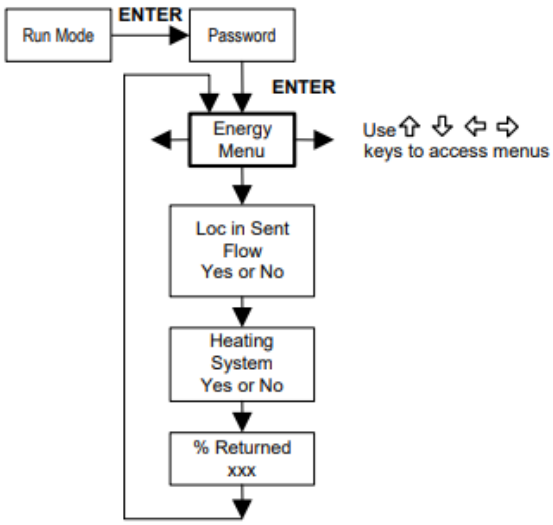
1. Use ◄ ► keys to move to the Totalizer Menu.
2. Press the ▼ key until Totaling appears.
3. Press ENTER and press the ▼ key to select Mass. Press ENTER.
4. Press ▼ key to set the pulse output in the units you have selected for mass flow of kg/sec. Press ENTER and use ▲ ▼ ◄ ► keys to set the pulse value equal to the maximum flow in the same units per second. Press ENTER.
5. To reset the totalizer, press ▼ key until Reset Total? appears. Press ENTER and the ▼ key to reset the totalizer if desired. Press ENTER.
6. Press the EXIT key and answer YES to permanently save your changes

6.7 Totalizer Menu 2



Use the Totalizer #2 to Monitor Flow or Energy. The totalizer maximum count is 999,999,999 at which point it will roll over to 0. Note that Totalizer #2 does not operate a relay, it is for monitoring only.

6.8 Energy Menu-For EMS Energy Meters Only



Configuration:

There are several possibilities regarding the measurement of water or steam energy given the location of the meter and the use of a second RTD. The table below summarizes the possibilities.

Fluid	Meter Location	Second RTD	Measurement
Water	"Sent" Flow Line	"Return Flow Line	Change in Energy
Water	"Return" Flow Line	"Sent" Flow Line	Change in Energy
Water	"Sent" Flow Line	None	Outgoing Energy
Steam	"Sent" Flow Line	"Return" Flow Line (condensate)	Change in Energy
Steam	"Sent" Flow Line	None	Outgoing Energy

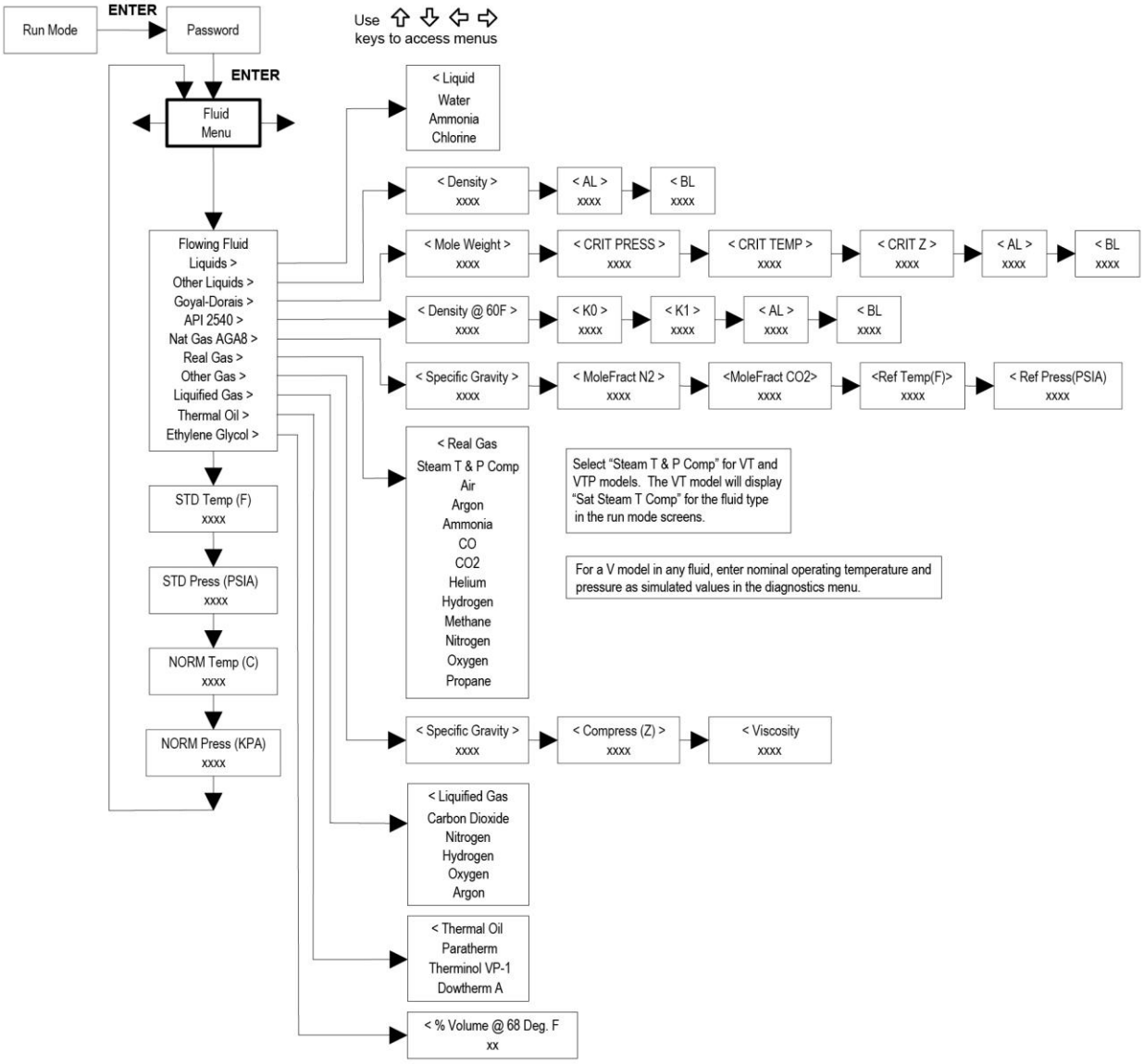
As above, you must properly configure the meter in the Energy Menu.

1. Loc in Sent Flow? Select Yes or No based on where the meter is located. Refer to the above table
2. Heating System? Select Yes for a hot water system used for heating. Select No for a chilled water system used for cooling. Always select Yes for a steam system.
3. % Returned. Select a number between 0% and 100%. Estimate the amount of water that returns. It is usually 100%, or can be less than 100% if historical data shows the amount of makeup water used. If a second RTD is not used, set to 0%. When 0% is selected, the energy calculation represents the outgoing energy only (no return energy is subtracted).

NOTE: the meter ships from the factory assuming 0% return and has a 1000 ohm resistor installed in the RTD #2 wiring location. This needs to be removed if the meter is to be used in a manner other than with 0% return and with the customer supplied RTD in its place.

6.9 Fluid Menu

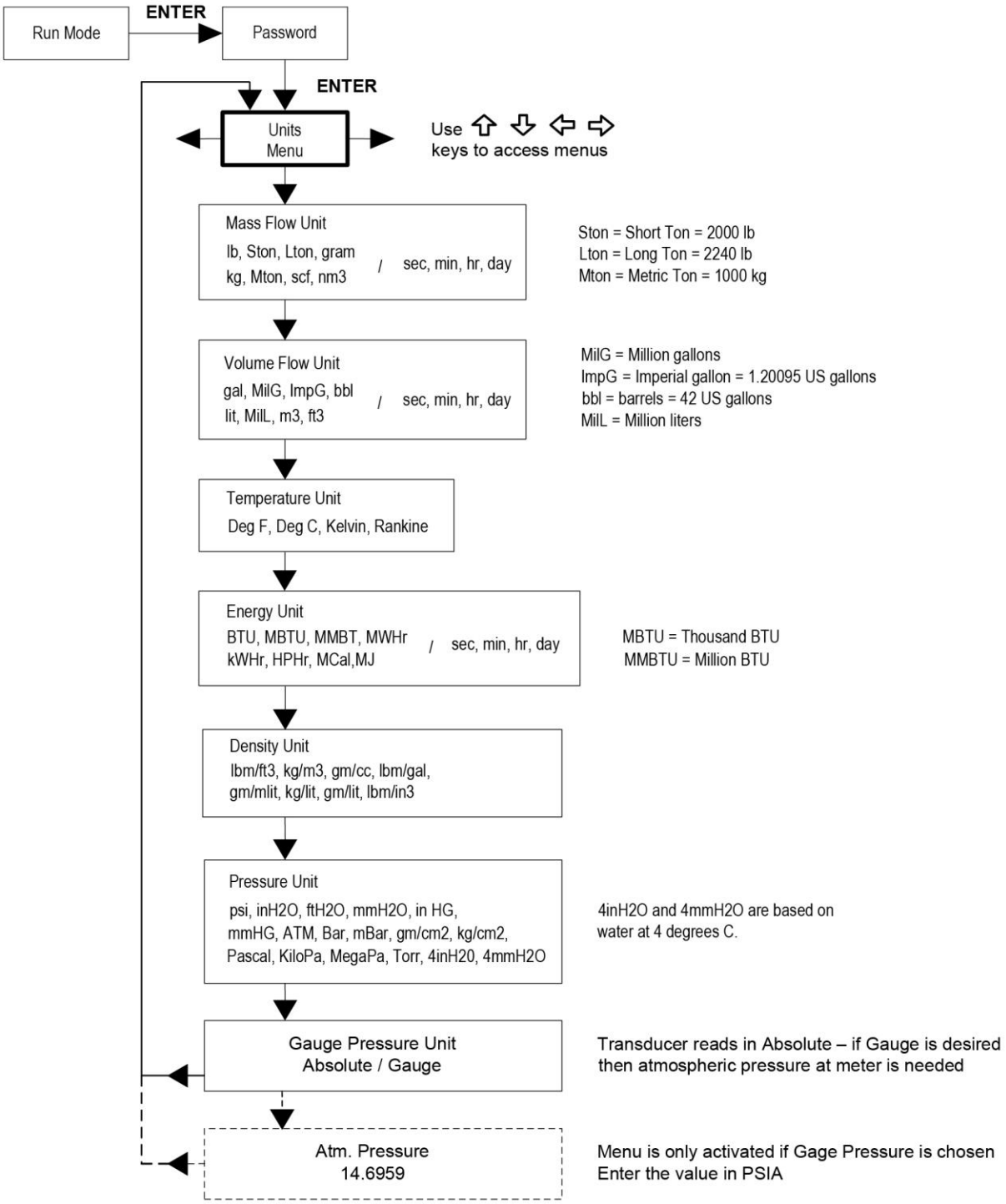
Fluid Menu



Use the Fluid Menu to configure the flow meter for use with common gases, liquids and steam. Your flow meter is pre-programmed at the factory for your application's process fluid.

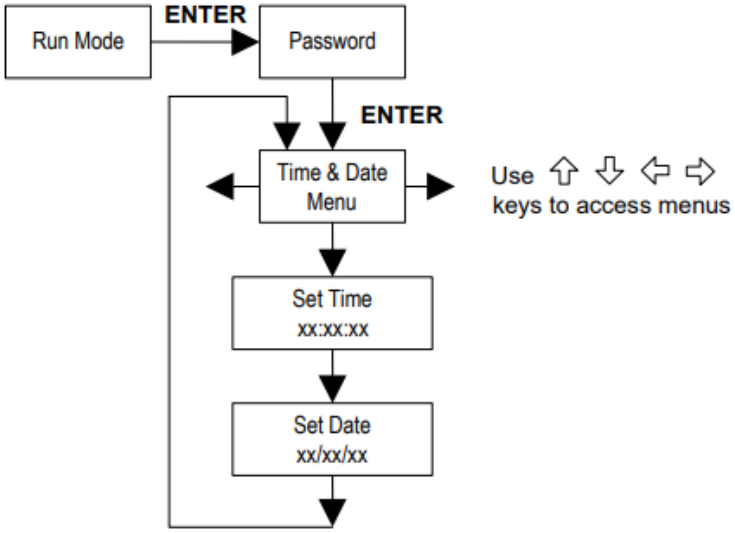
The units of measurement used in the Fluid Menu are preset and are as follows: Mole Weight = lbm/(lbm·mol), CRIT PRESS = psia, CRIT TEMP = °R, Density = lbm/ft3 and Viscosity = cP (centipoise).

6.10 Units Menu



Use the Units Menu to configure the flow meter with the desired units of measurement. These are global settings and determine what appears on all screens.

6.11 Time & Date Menu



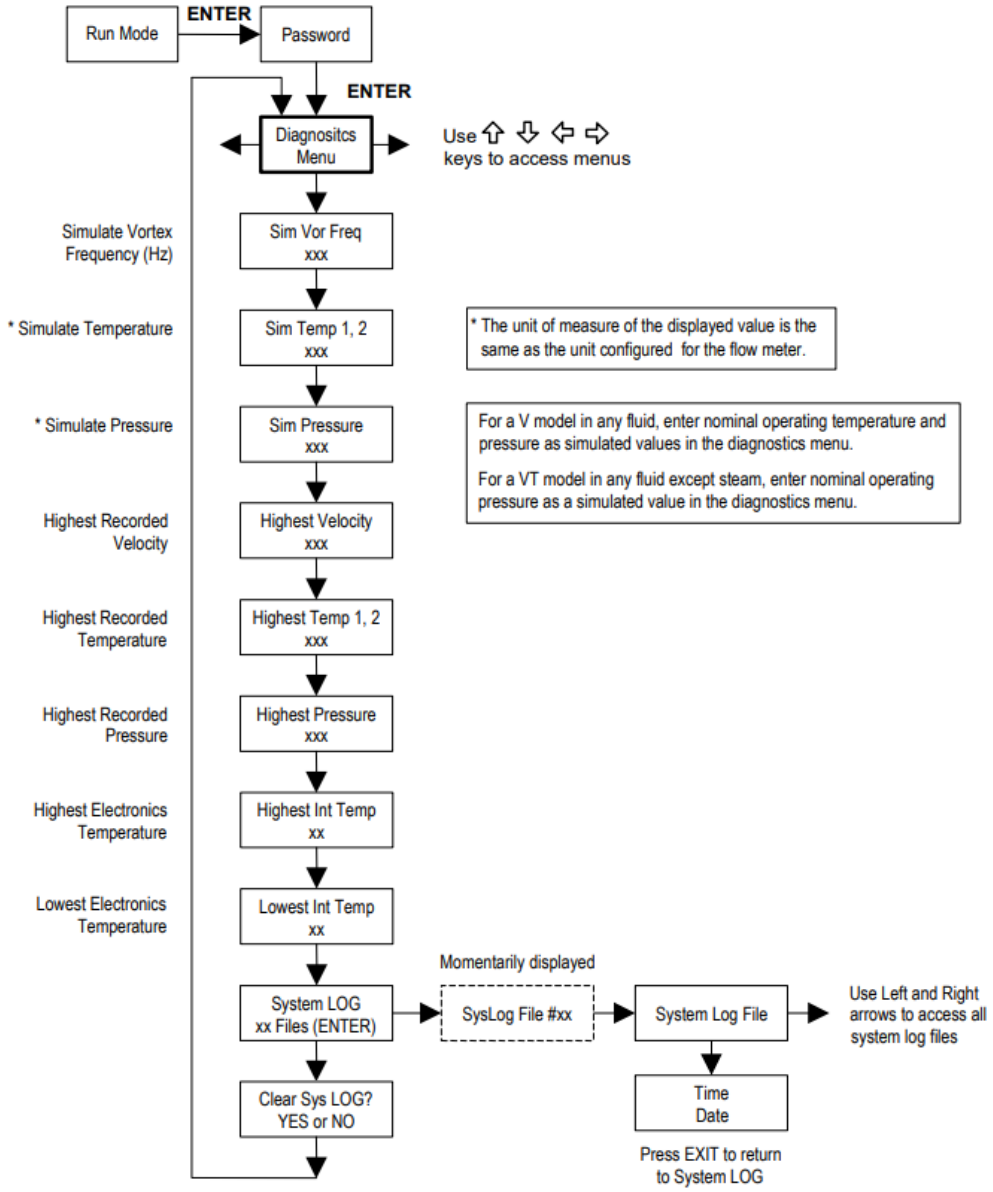
Use the Time and Date Menu to enter the correct time and date into the flow meter's memory. The parameters are used in the Run Mode and the alarm and system log files. Note: Time is displayed in AM/PM format, but military format is used to set the time. For example, 1:00 PM is entered as 13:00:00 in the Set Time menu.

6.11.1 Setting the Time

How to set the time to 12:00:00. You can check the time in the Run Mode by pressing the ▲▼ keys until the Time & Date screen appears. Note: all outputs are disabled while using the Setup Menus.

1. Use ◀ ▶ keys to move to the Time and Date Menu.
2. Press ▼ key until Set Time appears. Press ENTER.
3. Press ▼ key until 1 appears. Press ▶ key to move the underline cursor to the next digit. Press the ▼ key until 2 appears. Continue sequence until all desired parameters are entered. Press ENTER to return to the Time and Date Menu.
4. Press EXIT to return to the Run Mode.

6.12 Diagnostic Menu

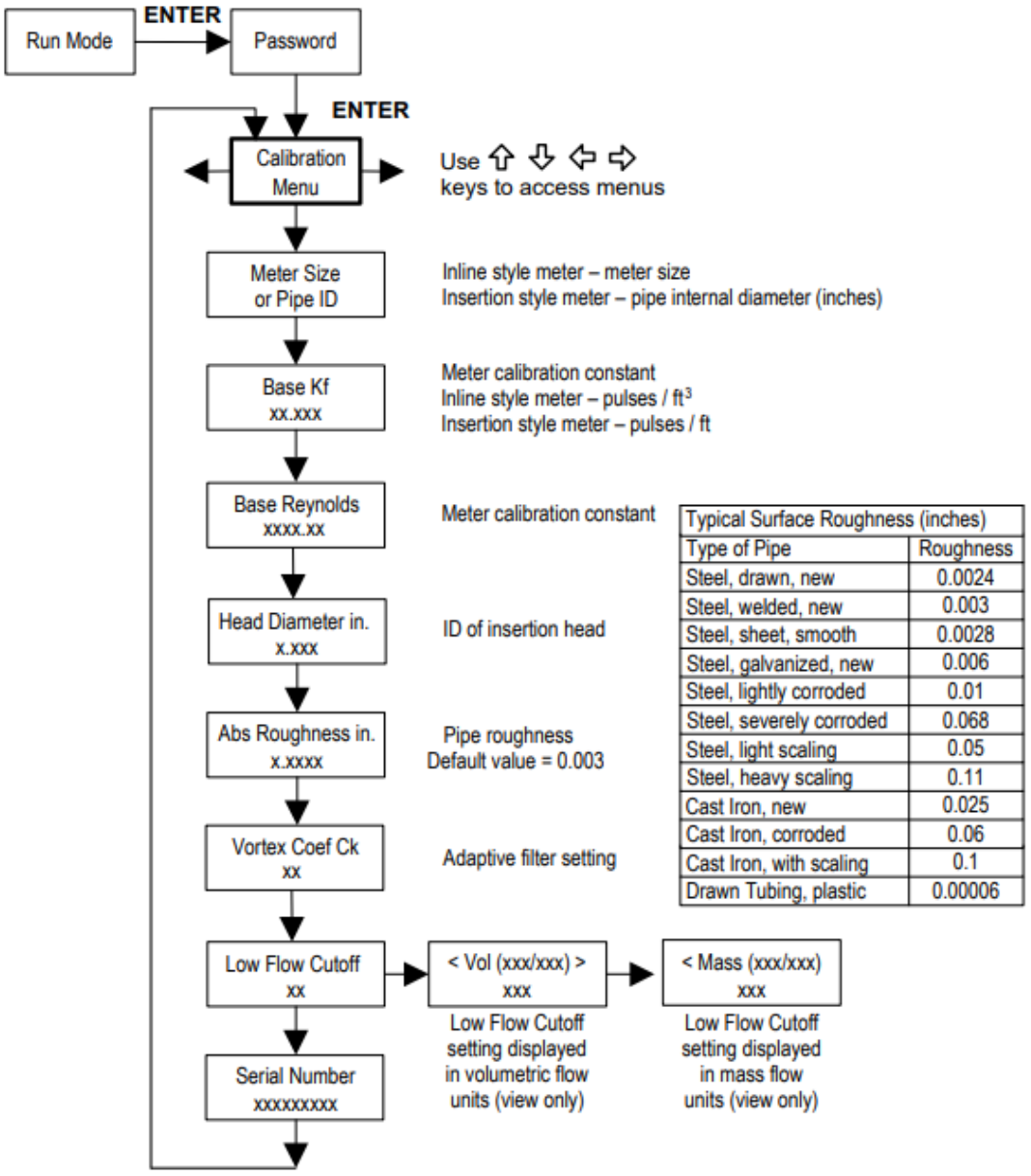


Use the Diagnostics Menu to simulate operation and review the system files. The system log files contain time/date stamped messages including: power on, power off, programming time outs, parameter faults, incorrect password entry and other various information relative to system operation and programming.

The simulated inputs are for testing the meter to verify that the programming is correct. They are also used to enter nominal operating temperature and pressure for the V only model. Simulated vortex frequency allows you to enter any value for the sensor input in Hz. The meter will calculate a flow rate based on the corresponding value and update all analogue outputs (the totalizer display and output is not affected by a simulated frequency).

The simulated pressure and temperature settings work the same way. The meter will output these new values and will use them to calculate a new density for mass flow measurement. Note: when your diagnostic work is complete, make sure to return the values to zero to allow the electronics to use the actual transducer values. For the V only model keep the temperature and pressure at nominal operating conditions.

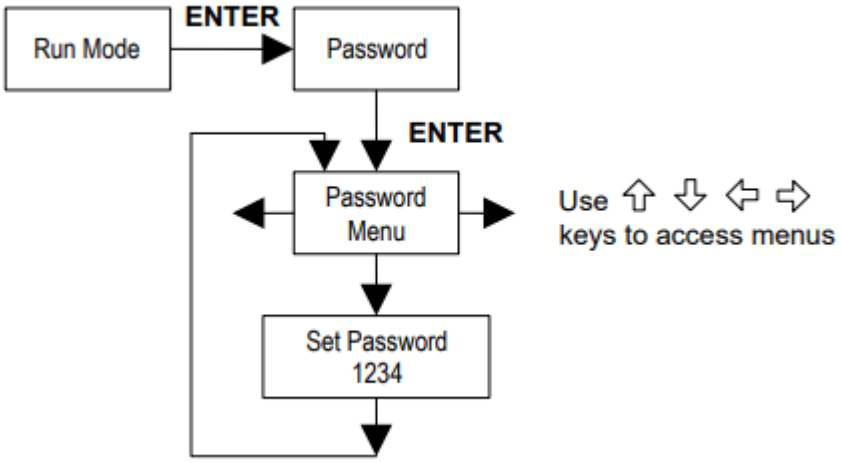
6.13 Calibration Menu



Typical Surface Roughness (inches)	
Type of Pipe	Roughness
Steel, drawn, new	0.0024
Steel, welded, new	0.003
Steel, sheet, smooth	0.0028
Steel, galvanized, new	0.006
Steel, lightly corroded	0.01
Steel, severely corroded	0.068
Steel, light scaling	0.05
Steel, heavy scaling	0.11
Cast Iron, new	0.025
Cast Iron, corroded	0.06
Cast Iron, with scaling	0.1
Drawn Tubing, plastic	0.00006

The Calibration Menu contains the calibration coefficients for the flow meter. These values should by changed only by properly trained personnel. The Vortex Ck and Low Flow Cutoff are set at the factory. Consult the factory for help with these settings if the meter is showing erratic flow rate.

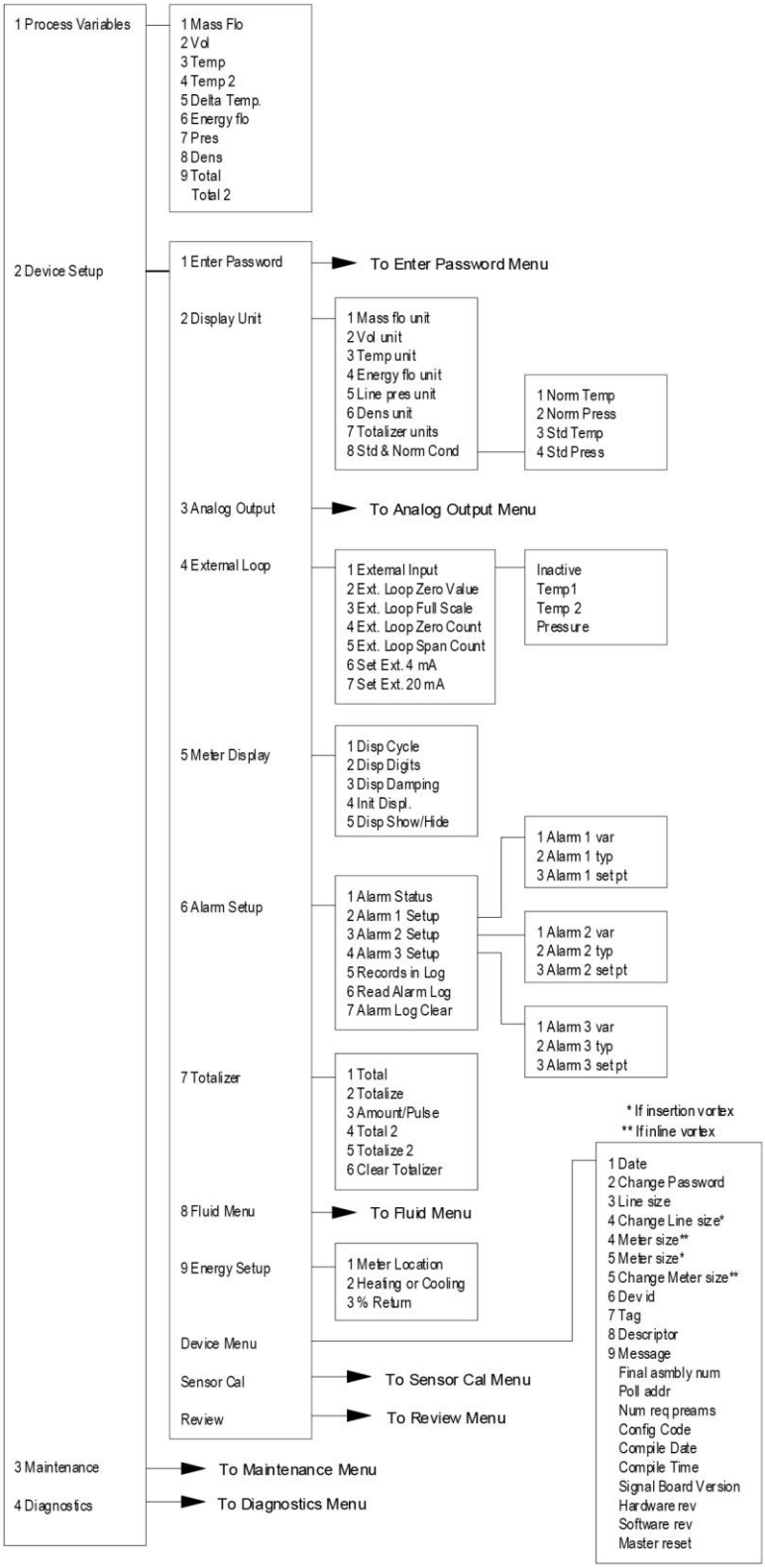
6.14 Password Menu



Use the Password Menu to set or change the system password. The factory-set password is 1234.

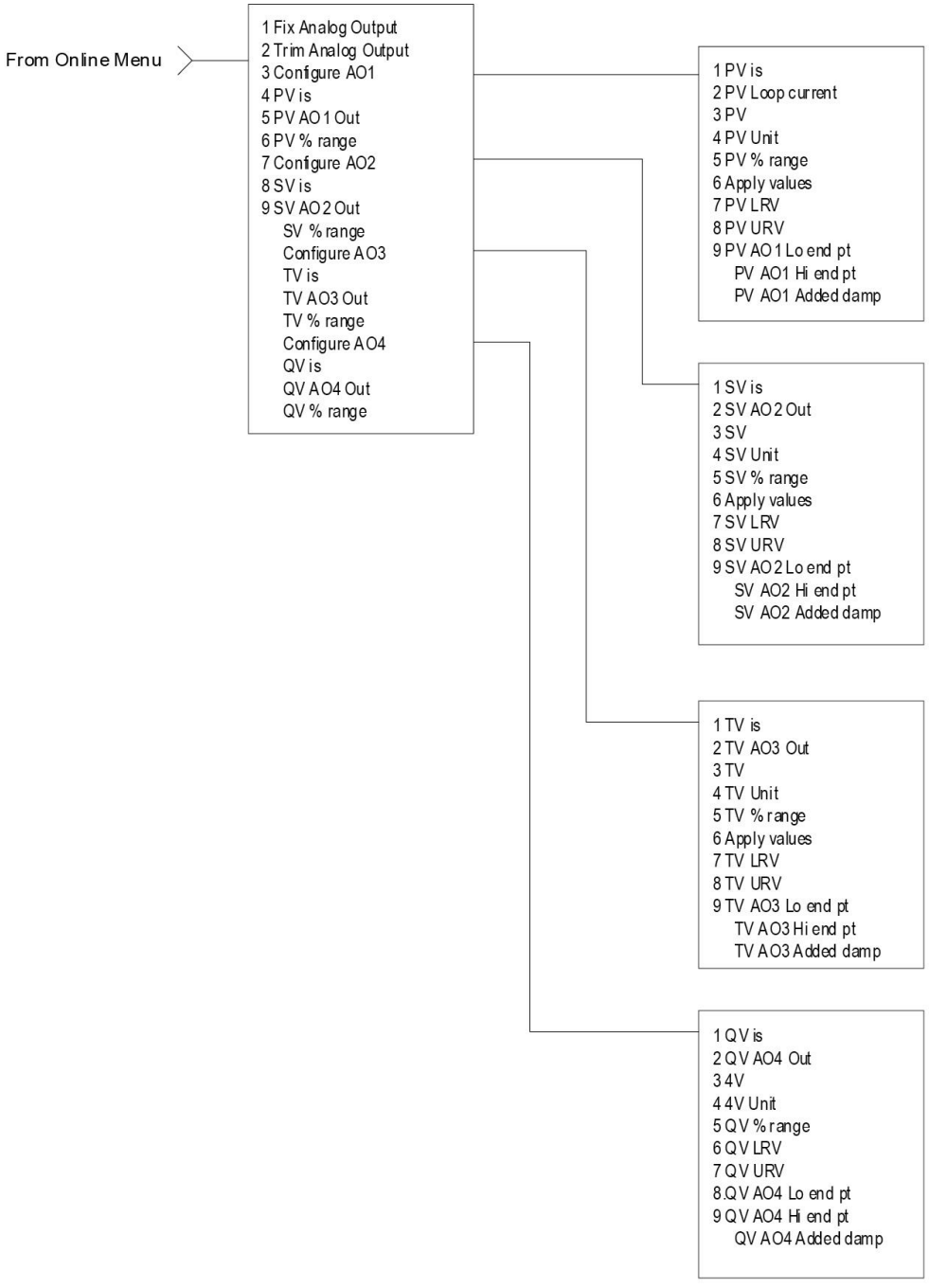
6.15 HART Commands with the DD Menu

Online Menu



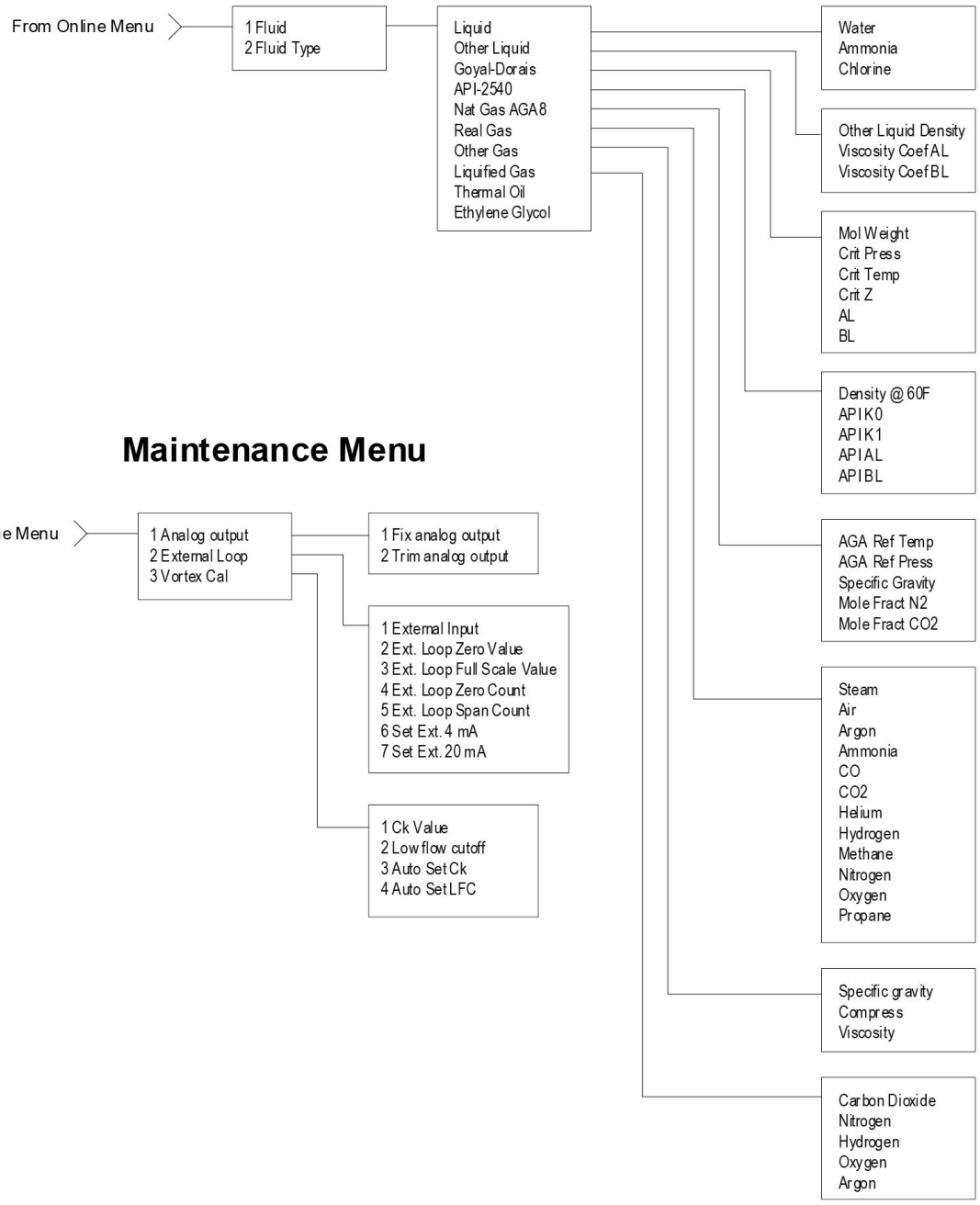
HART Commands with the DD Menu Continued....

Analog Output Menu



HART Commands with the DD Menu Continued....

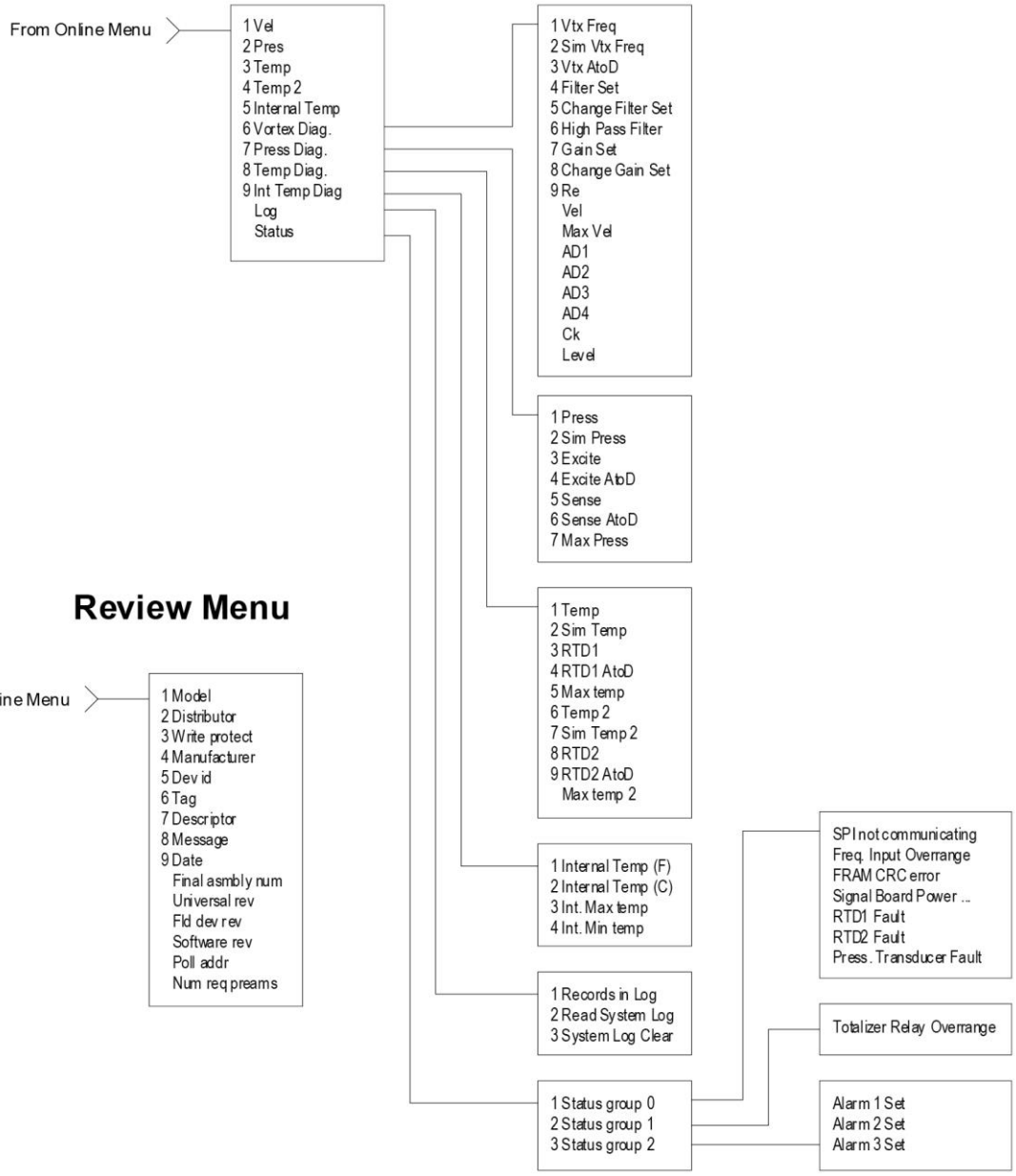
Fluid Menu



Maintenance Menu

HART Commands with the DD Menu Continued....

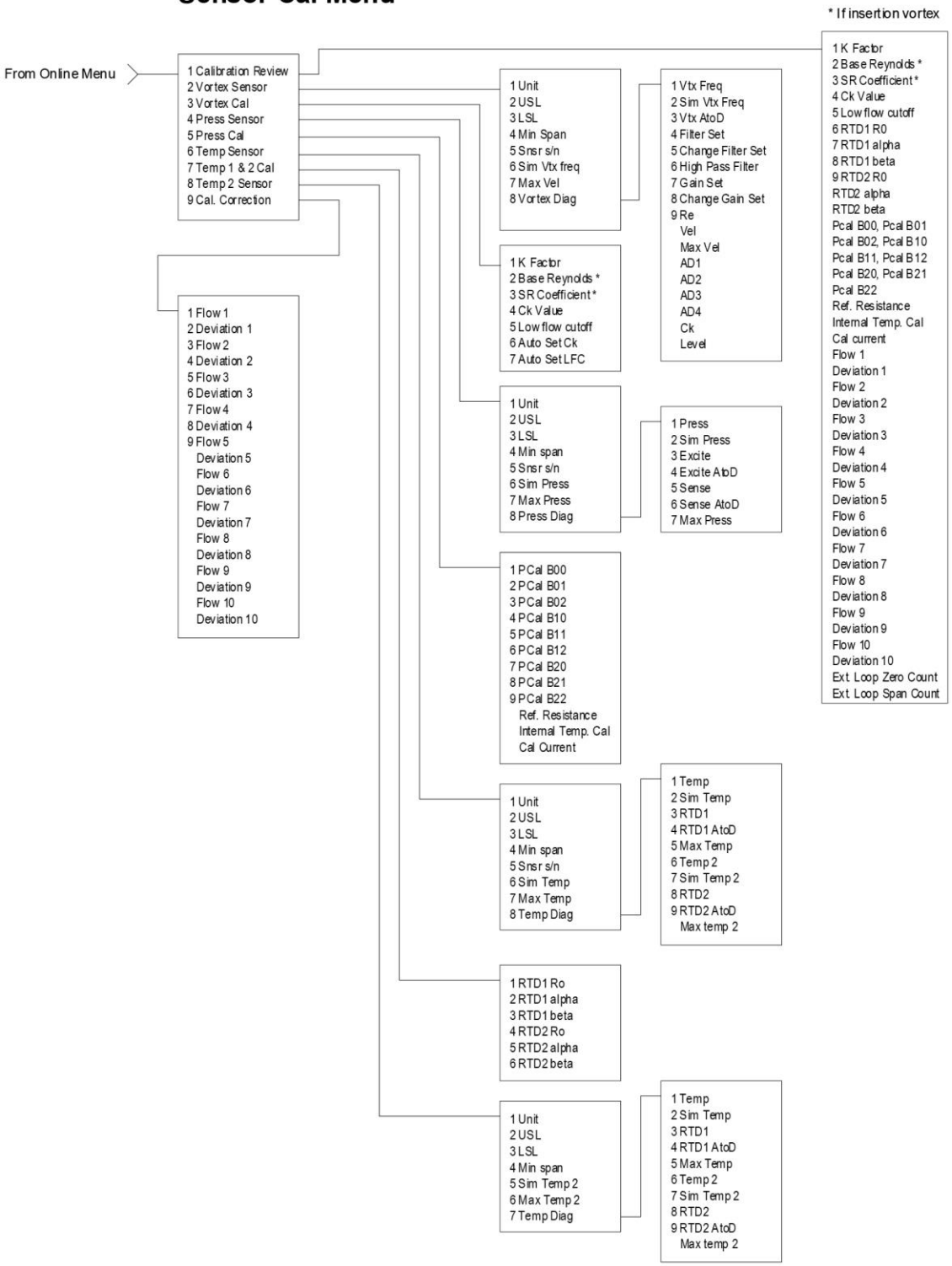
Diagnostics Menu



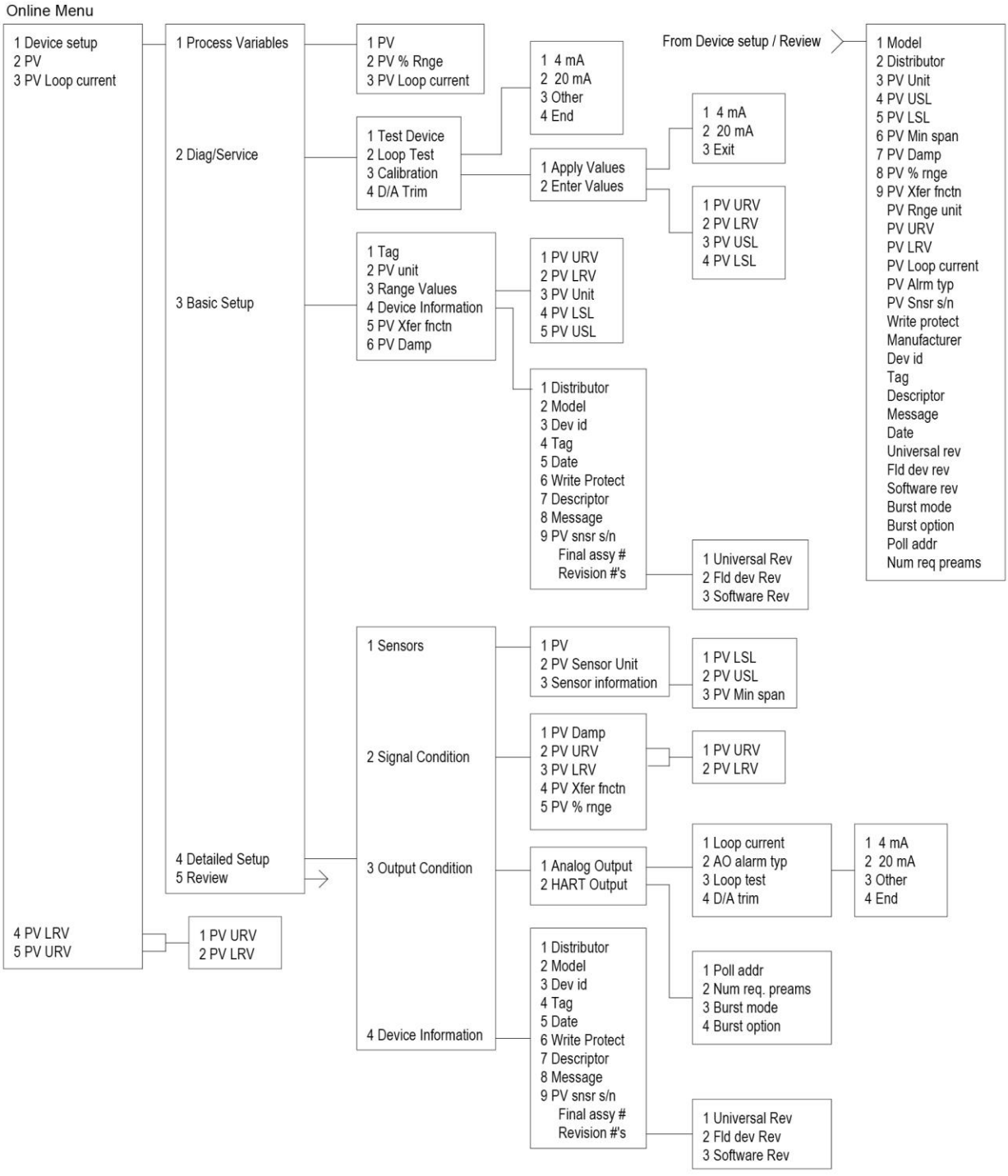
Review Menu

HART Commands with the DD Menu Continued....

Sensor Cal Menu



6.16 HART Commands with Generic DD Menu



7 Error Responses

If an error is detected in the message received by the unit, the function code in the response is the received function code with the most significant bit set, and the data field will contain the exception code byte, as follows:

7.1 Control Register Definitions

The only writeable registers in this implementation are the Reset Exception Status, Reset Meter and Reset Totalizer functions, which are implemented as "coils" which may be written with the Write Single Coil command (function code 05) to address 7 through 9, respectively, (register #00008 through #00010). The value sent with this command must be either 0x0000 or 0xff00, or the meter will respond with an error message; the totalizer will be reset or exception status cleared only with a value of 0xff00.

7.2 Error Responses

If an error is detected in the message received by the unit, the function code in the response is the received function code with the most significant bit set, and the data field will contain the exception code byte, as follows:

Exception Code	Description
01	Invalid function code — function code not supported by device
02	Invalid data address — address defined by the start address and number of registers is out of range
03	Invalid data value — number of registers = 0 or >125 or incorrect data with the Write Single Coil command

If the first byte of a message is not equal to the unit's Modbus address, if the unit detects a parity error in any character in the received message (with even or odd parity enabled), or if the message CRC is incorrect, the unit will not respond.

7.3 Command Message Format

The start address is equal to the desired first register number minus one. The addresses derived from the start address and the number of registers must all be mapped to valid defined registers, or an invalid data address exception will occur.

Device Address 8 bits, 1…247	Function Code 8 bits	Start Address 16 bits, 0…9998	N = Number of Registers 16 bits, 1…125	CRC 16 bits

7.3.1 Normal Response Message Format

Device Address 8 bits, 1…247	Function Code 8 bits	Byte Count = 2 x N 8 bits	Data (N) 16-bit registers	CRC 16 bits

7.3.2 Exception Response Message Format

Device Address 8 bits, 1...247	Function Code + 0x80 8 bits	Exception Code 8 bits	CRC 16 bits

Examples
Read the exception status byte from the device with address 1:

01 07 41 E2

01 Device address
07 Function code, 07 = read exception status
41 E2 CRC

A typical response from the device is as follows:

01 07 03 62 31

01 Device address
07 Function code
03 Exception status byte
62 31 CRC

Request the first 12 registers from device with address 1:

01 04 00 00 00 0C F0 0F

01 Device address 04 Function code,
04 = read input register
00 00 Starting address
00 0C Number of registers = 12
F0 0F CRC

A typical response from the device is as follows: *note these are the older register definitions

01 04 18 00 00 03 E8 00 00 7A 02 6C 62 00 00 41 BA 87 F2 3E BF FC 6F 42 12 EC 8B 4D D1

01 Device address
04 Function code
18 Number of data bytes = 24
00 00 03 E8 Serial number = 1000 (unsigned long)
00 00 7A 02 Totalizer = 31234 lbm (unsigned long)
6C 62 00 00 Totalizer units = "lb" (string, unused characters are 0)

41 BA 87 F2 Mass flow rate = 23.3164 lbm/sec (float)
3E BF FC 6F Volume flow rate = 0.3750 ft 3 /sec (float)
42 12 EC 8B Pressure = 36.731 psia (float)
4D D1 CRC

An attempt to read register(s) that don't exist

01 04 00 00 00 50 F1 D2

01 Device address
04 Function code 4 = read input register
00 00 Starting address
00 50 Number of registers = 80
F0 36 CRC

results in an error response as follows:

01 84 02 C2 C1

01 Device address
84 Function code with most significant bit set indicates error response
02 Exception code 2 = invalid data address
C2 C1 CRC

Request the state all three alarms:

01 02 00 00 00 03 38 0B

01 Device address
02 Function code 2 = read discrete inputs
00 00 Starting address
00 03 Number of inputs = 3
38 0B CRC

and the unit responds with:

01 02 01 02 20 49

01 Device address
02 Function code
01 Number of data bytes = 1
02 Alarm #2 on, alarms #1 and #3 off
20 49 CRC

To reset the totalizer:

01 05 00 00 FF 00 8C 3A

01 Device address
05 Function code 5 = write single coil
00 09 Coil address = 9
FF 00 Data to reset totalizer
5C 38 CRC

The unit responds with an identical message to that transmitted, and the totalizer is reset. If the "coil" is turned off as in the following message, the response is also identical to the transmitted message, but the totalizer is not affected.

01 05 00 09 00 00 1D C8

01 Device address
05 Function code 5 = write single coil
00 09 Coil address = 9 00 00 Data to "turn off coil" does not reset totalizer
1D C8 CRC

8 Troubleshooting

WARNING

Make sure the line is not pressurized before trying any flow meter repairs. Prior to removing any component of the mass flow meter, always turn off the main power. If necessary, take measures in hazardous areas. Use electrostatic discharge precautions when handling static-sensitive electronics. .

8.1 Hidden Diagnostics Menus

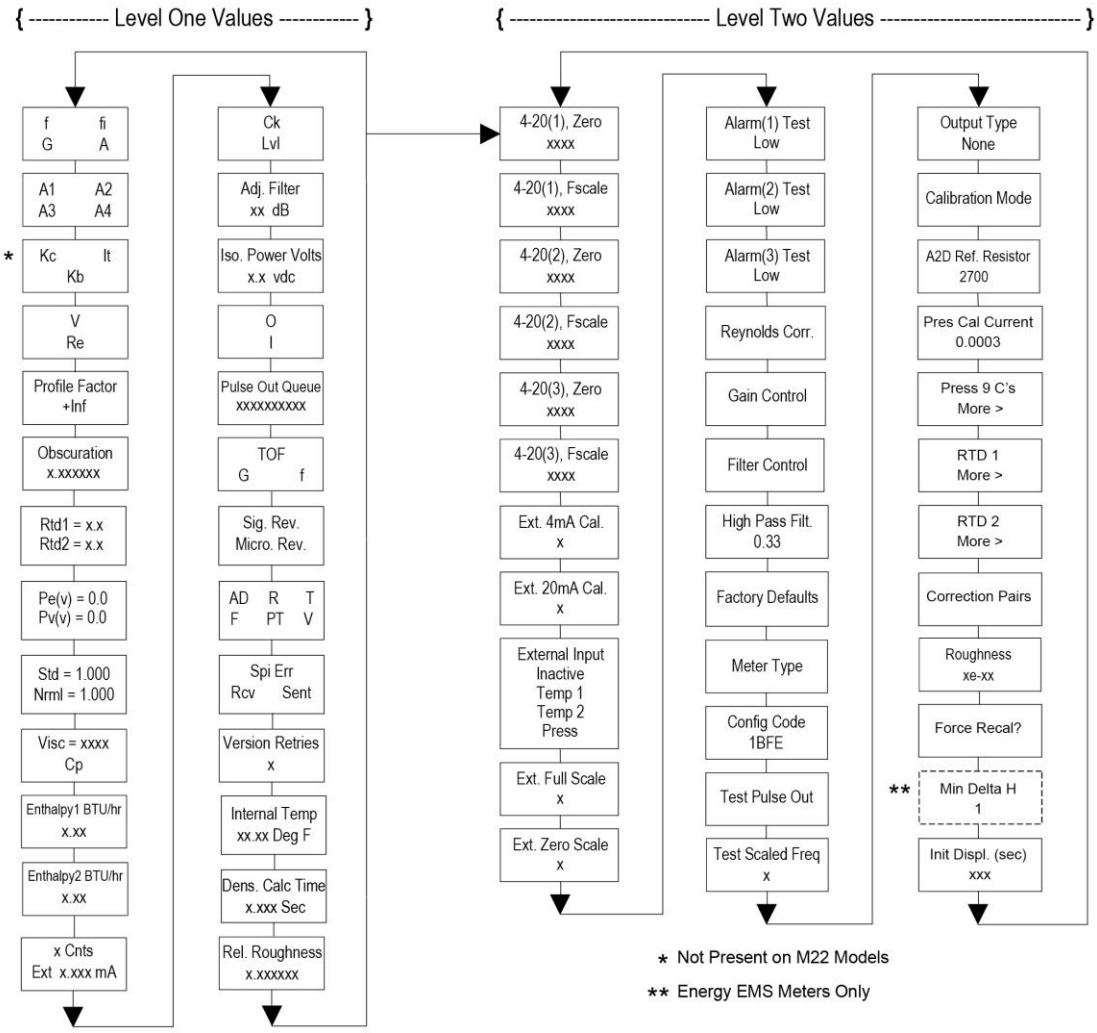
The menus shown on the following page can be accessed using the password 16363, then moving to the display that reads "Diagnostics Menu" and pressing ENTER (rather than one of the arrow keys).

Use the right arrow key to move to the second level. Press EXIT to move from the second level back to the first, press EXIT while in the first level to return to the setup menus.

Caution: password 16363 will allow full access to the configuration and should be used carefully to avoid changes that can adversely alter the function of the meter.

Each of the menus on the following page will first be defined followed by specific troubleshooting steps.

Hidden Diagnostics Menus



8.2 Level One Hidden Diagnostics Values

- **f** = Vortex shedding frequency (Hz).
- **fi** = Adaptive filter – should be approximately 25% higher than the vortex shedding frequency, this is a low-pass filter. If the meter is using the Filter Control (see below) in the manual mode, **fi** will be displayed as **fm**.
- **G** = Gain (applied to vortex signal amplitude). Gain defaults to 1.0 and can be changed using the Gain Control (see below).
- **A** = Amplitude of vortex signal in Volts rms.
- **A1, A2, A3, A4** = A/D counts representing the vortex signal amplitude. Each stage (A1-A4) cannot exceed 512. Beginning with stage A1, the A/D counts increase as the flow increases. When stage A1 reaches 512, it will shift to stage A2. This will continue as the flow rate increases until all 4 stages read 512 at high flow rates. Higher flow rates (stronger signal strength) will result in more stages reading 512.
- **Kc, It, Kb** = Profile equation (factory use only).
- **V** = Calculated average pipe velocity (ft/sec).
- **Re** = Calculated Reynolds number.

- **Profile Factor** = Factory use only.
- **Obscuration** = Factory use only.
- **RTD1** = Resistance value of integral RTD in ohms.
- **RTD2** = Optional RTD resistance value in ohms.
- **Pe(v)** = Pressure transducer excitation voltage
- **Pv(v)** = Pressure transducer sense voltage.
- **Stnd** = Density of fluid at standard conditions.
- **Nrml** = Density of fluid at normal conditions.
- **Viscosity** = Calculated viscosity of flowing fluid.
- **Enthalpy1 BTU/hr** = Factory use only.
- **Enthalpy2 BTU/hr** = Factory use only.
- **x Cnts** = A/D counts from the external 4-20 mA input.
- **Ext x.xxx mA** = Calculated external 4-20 mA input from the digital counts.
- **Ck** = Calculated Ck at current operating conditions. Ck is a variable in the equation that relates signal strength, density, and velocity for a given application. It is used for noise rejection purposes. Ck directly controls the fi value (see above). If the Ck is set too low (in the calibration menu), then the fi value will be too low and the vortex signal will be rejected resulting in zero flow rate being displayed. The calculated Ck value in this menu can be compared to the actual Ck setting in the calibration menu to help determine if the Ck setting is correct.
- **Lvl** = Threshold level. If the Low Flow Cutoff in the calibration menu is set above this value, the meter will read zero flow. The Lvl level can be checked at no flow. At no flow, the Lvl must be below the Low Flow Cutoff setting or the meter will have an output at no flow.
- **Adj. Flilter** = Adjustable filter. Displays the filtering in decibels. Normally reads zero. If this value is consistently -5 or -10, for example, the Ck or density setting may be wrong.
- **Iso. Power Volts** = Nominally 2.7 VDC, if less than this check the flow meter input power.
- **O,I** = Factory use only.
- **Pulse Out Queue** = Pulse output queue. This value will accumulate if the totalizer is accumulating faster than the pulse output hardware can function. The queue will allow the pulses to “catch up” later if the flow rate decreases. A better practice is to slow down the totalizer pulse by increasing the value in the (unit)/pulse setting in the totalizer menu.
- **TOF, G, f** = Factory use only.
- **Sig. Rev** = Signal board hardware and firmware revision.
- **Miro Rev** = Microprocessor board hardware and firmware revision.
- **AD, R, T, F, PT, V** = Factory use only.
- **SPI Err, Rcv, Sent** = Factory use only.
- **Version Retries** = Factory use only.
- **Internal Temperature** = Electronics temperature.
- **Dens. Calc Time** = Factory use only.
- **Rel. Roughness** = Factory use only.

8.3 Level Two Hidden Diagnostics Values

- **4-20(1) Zero** = Analog counts to calibrate zero on analog output 1.
- **4-20(1) FScale** = Analog counts to cal. full scale on analog output 1.
- **4-20(2) Zero** = Analog counts to calibrate zero on analog output 2.
- **4-20(2) FScale** = Analog counts to cal. full scale on analog output 2.
- **4-20(3) Zero** = Analog counts to calibrate zero on analog output 3.
- **4-20(3) FScale** = Analog counts to cal. full scale on analog output 3.
- **Ext. 4 mA Cal.** = Enter 0 for auto calibration or enter factory supplied A/D counts. Note: You must connect a known 4.00 mA input if you are going to calibrate the unit.
- **Ext. 20 mA Cal.** = Enter 0 for auto-calibration or enter factory supplied A/D counts. Note: You must connect a known 20.00 mA input if you are going to calibrate the unit.
- **External Input** = Enter what the external 4-20 mA input represents, i.e. Temperature 1, Temperature 2, or Pressure. The meter will use this for its internal calculations.
- **Ext. Full Scale** = Enter the full scale units that correlate to the 20 mA point. Note: It must be in the units for the selected input type such as Deg F, Deg C, PSIA, Bar A, etc.
- **Ext. Zero Scale** = Same as above but for the 4 mA point.
- **Alarm (1) Test** = Used as a test to verify that the alarm circuit is functioning. When low is selected the alarm will initiate a low alarm on the output. When High is selected it will give a high alarm on the output.
- **Alarm (2) Test** = Used as a test to verify that the alarm circuit is functioning. When low is selected the alarm will initiate a low alarm on the output. When High is selected it will give a high alarm on the output.
- **Alarm (3) Test** = Used as a test to verify that the alarm circuit is functioning. When low is selected the alarm will initiate a low alarm on the output. When High is selected it will give a high alarm on the output.
- **Reynolds Corr**. = Reynolds number correction for the flow profile. Set to Enable for M23 insertion and set to Disable for M22/M24 inline.
- **Gain Control** = Manual gain control (factory use only). Leave set at 1.
- **Filter control** = Manual filter control. This value can be changed to any number to force the fi value to a constant. A value of zero activates the automatic filter control which sets fi at a level that floats above the f value.
- **High Pass Filter** = Filter setting – Factory use only
- **Factory Defaults** = Reset factory defaults. If you change this to Yes and press Enter, all the factory configuration is lost and you must reconfigure the entire program. Consult the factory before performing this process, it is required only in very rare cases.
- **Meter Type** = Insertion (M23) or Inline (M22/M24) meter.
- **Config Code** = Factory use only.
- **Test Pulse Out** = Force totalizer pulse. Set to Yes and press enter to send one pulse. Very useful to test totalizer counting equipment.
- **Test Scaled Freq** = Enter a frequency value in order to test the scaled frequency output. Return to 0 to stop the test.
- **Output Type** = Factory use only.
- **Calibration Mode** = Factory use only.
- **A2D Ref. Resistor** = Factory use only.

- **Pressure Cal Current** = Calibration value for the electronics and pressure transducer combination. Consult Factory for value.
- **Pressure 9Cs** = Nine pressure coefficients unique to the pressure transducer. Use the RIGHT ARROW to access all nine coefficients.
    - o Press. Max psi = Based on installed sensor.
    - o Press. Min psi = 0 psia
- **RTD1. Press the RIGHT ARROW to access**:
    - o Ro = RTD resistance at 0°C (1000 ohms).
    - o A = RTD coefficient A (.0039083).
    - o B = RTD coefficient B (-5.775e-07).
    - o RTD1 Max Deg. F = 500 o RTD1 Min Deg. F = -330
- **RTD2** = Second RTD configuration, for special applications only.
- **Correction Pairs**
    - o ft3/sec (1 through 10)
    - o %Dev. (1 through 10)
- **Roughness** = Factory use only.
- **Force Recal?** = Factory use only.
- **Min. Delta H** – Energy EMS meters only. Sets the deadband for totalization to begin. Must be greater than this number (1 default) to initiate the totalizer.
- **Init Displ. (sec)** = Enter a value in seconds to initialize the display every xxx seconds. Enter a value of 0 to disable initializing the display.

8.4 Analog Output Calibration

To check the 4–20 mA circuit, connect a DVM in series with the output loop. Select zero or full scale (from the second level of the hidden diagnostics) and then actuate the enter key twice. This action will cause the meter to output its 4 mA or 20 mA condition. If the DVM indicates a current greater than ± 0.006 mA from 4 or 20, adjust the setting up or down until the output is calibrated. Note: these settings are not for adjusting the output zero and span to match a flow range, that function is located in the Output Menu.

8.5 Display Contrast Adjustment

The flow meter display contrast is set at the factory but if the display characters appear too dark or too light proceed as follows:

1. Hold down the “Exit” button on the front panel for 5 to 10 seconds. “Setting Contrast” will appear.
2. Push the “Up” arrow to darken the display or the “Down” arrow to lighten it.
3. Push the “Enter” button to save the contrast setting.

8.6 Troubleshooting the Flow Meter

WARNING

Before attempting any flow meter repair, verify that the line is not pressurized. Always remove main power before disassembling any part of the mass flow meter. Use hazardous area precautions if applicable. Static sensitive electronics - use electro-static discharge precautions.

First Check Items:

- ☐ Installation Direction Correct
- ☐ Installation Depth Correct (Insertion style meter)
- ☐ Power and Wiring Correct
- ☐ Application Fluid Correct
  Please record what the fluid is _____

- ☐ Meter Range Correct for the Application
- ☐ Meter Configuration Correct
- ☐ Describe Installation Geometry i.e. upstream diameters, valve position, downstream diameters, etc.

Record Values:

Record the following values from the Run Menu with the meter installed in order to determine the operating state of the flow meter:

	With Flow	**With No Flow (if possible)**
Flow =		
Temperature =		
Pressure =		
Density =		
Error Messages? =		

Record the following values from the Hidden Diagnostics Menu with the meter installed: (Use password 16363 to access.)

	With Flow	**With No Flow (if possible)**
f =		
fi =		
A =		
A1 =		
A2 =		
A3 =		
A4 =		
V =		
Ck =		
Lvl =		
Adj. Filter =		
Iso. Power Volts =		

Record the following values from the Calibration Menu.

Meter Size / Pipe ID =	
Meter Factor =	
Vortex Coef Ck =	
Low Flow Cutoff =	
Serial Number =	

8.6.1 Determine the Fault

Symptom: Output at no Flow

1. The low flow cutoff is set too low. At no flow, go to the first level of the hidden diagnostics menu and record the Lvl value. The low flow cutoff must be set above this value.
2. Example: at no flow , Lvl = 25. Set the low flow cutoff in the Calibration Menu to approximately 28 and the meter will no longer read a flow rate at no flow.

Symptom: Erratic Output

1. The flow rate may be too low, just at the cutoff of the meter range, and the flow cycles above and below the cutoff making an erratic output. Consult the factory if necessary to confirm the meter range based on current operating conditions. It may be possible to lower the low flow cutoff to increase the meter range. See the example above for output at no flow, only this time the low flow cutoff is set too high. You can lower this value to increase the meter range as long as you do not create the output at no flow condition previously described.
2. Mechanical installation may be incorrect. Verify the straight run is adequate as described in Chapter 2. For in-line meters, make sure the meter is not installed backwards and there are no gaskets protruding into the flow stream. For insertion meters, verify the insertion depth and flow direction.
3. The meter may be reacting to actual changes in the flow stream. The output can be smoothed using a time constant. The displayed values can be smoothed using the time constant in the Display Menu. The analog outputs can be smoothed using the time constant in the Output Menu. A time constant of 1 will result in the change in value reaching 63% of its final value in one second. A time constant of 4 is 22%, 10 is 9.5% and 50 is 1.9% of the final value in one second. The time constant equation is shown below (TC = Time Constant).

$$\%Change\ to\ final\ value\ in\ one\ second = 100(1 - e^{\left(-\frac{1}{TC}\right)})$$

4. The vortex coefficient Ck may be incorrectly set. The Ck is a value in the equation used to determine if a frequency represents a valid vortex signal given the fluid density and signal amplitude. In practice, the Ck value controls the adaptive filter, fi, setting. During flow, view the f and fi values in the first level of the hidden diagnostics. The fi value should be approximately 10-20 % higher than the f value.

If you raise the Ck setting in the Calibration Menu, then the fi value will increase. The fi is a low pass filter, so by increasing it or lowering it, you can alter the range of frequencies that the meter will accept. If the vortex signal is strong, the fi value will increase to a large number – this is correct.

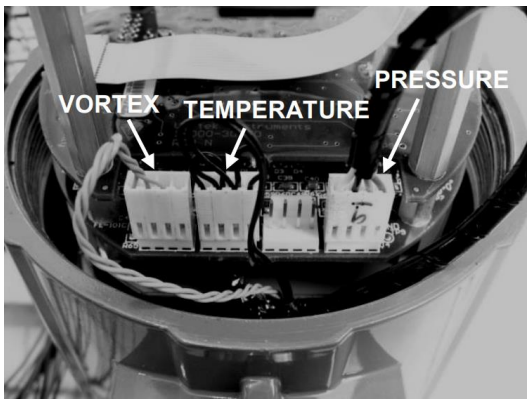


Fig 56. Electronics Stack Sensor Connections

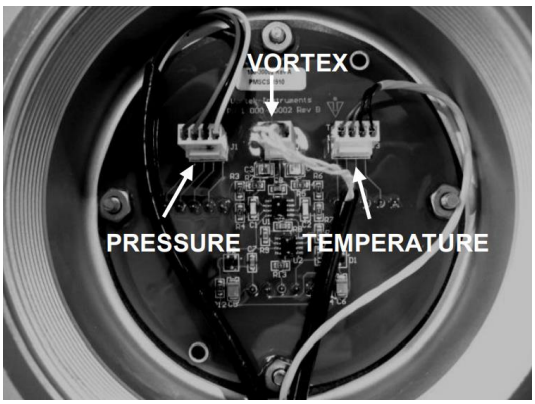


Fig 57. Remote Feed Through Board Sensor Connections

Symptom: No Output

1. For remote mounted electronics, carefully check all the wiring connections in the remote mount junction box. There are 18 connections that must be correct, verify each color (black and red), shield, and wire number.
2. Turn on the pressure and temperature display in the Display Menu and verify that the pressure and temperature are correct.
3. Using ESD precautions and hazardous area precautions, remove the electronics enclosure window cover. Disconnect the vortex sensor from the electronics stack or remote feed through board. Measure the resistance from each outside pin to the meter ground - each should be open. Measure the resistance from the center pin to the meter ground – this should be grounded to the meter. With the sensor still disconnected, go to the first level of the hidden diagnostics and display the vortex shedding frequency, f. Hold a finger on the three exposed pins on the analog board. The meter should read electrical noise, 60 Hz for example. If all readings are correct, re-install vortex sensor wires.
4. Verify all meter configuration and troubleshooting steps previously described.
5. There are many possible causes of this problem, consult factory if necessary.

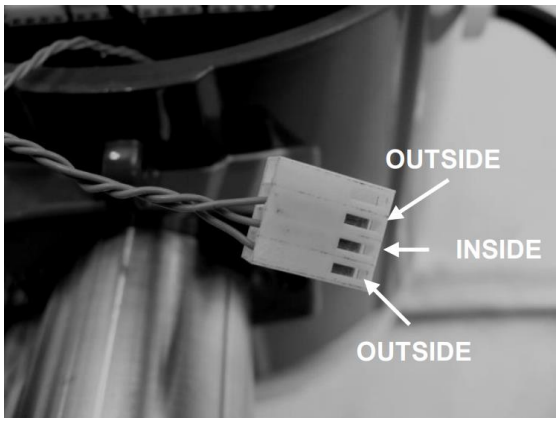


Fig 58. Vortex Sensor Connector

Symptom: Meter Displays Temperature Fault

1. For remote mounted electronics, carefully check all the wiring connections in the remote mount junction box. There are 15 connections that must be correct, verify each color (black and red), shield, and wire number.
2. Go to the first level of the hidden diagnostics and check the resistance of the rtd1. It should be about 1080 ohms at room temperature.
3. Using ESD precautions and hazardous area precautions, remove the electronics enclosure window cover. Disconnect the temperature sensor from the electronics stack or the remote feed through board. Measure the resistance across the outside pins of the temperature sensor connector. It should read approximately 1080 ohms at room temperature (higher resistance at higher temperatures). Measure the resistance across the inside pins, they should read the same.
4. Measure the resistance from one of the outside pins to case ground then from one of the inside pins to case ground. They should read open.
5. Consult the factory with the findings

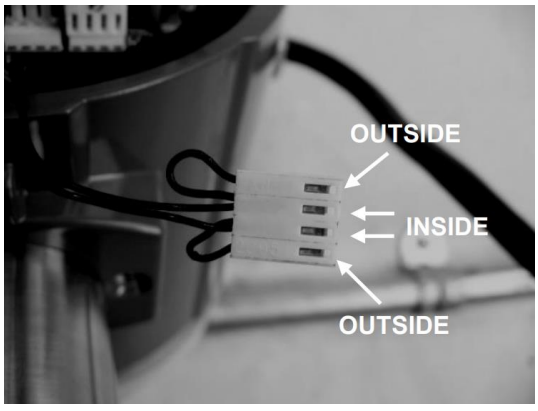


Fig 59. Temperature Sensor Connector

Symptom: Meter Displays Pressure Fault

1. For remote mounted electronics, carefully check all the wiring connections in the remote mount junction box. There are 15 connections that must be correct, verify each color (black and red), shield, and wire number.
2. Using ESD precautions and hazardous area precautions, remove the electronics enclosure window cover. Disconnect the pressure sensor from the electronics stack or the remote feed through board. Measure the resistance across the outside pins of the pressure sensor connector, then across the inside pins. Both readings should be approximately 4400 ohms.

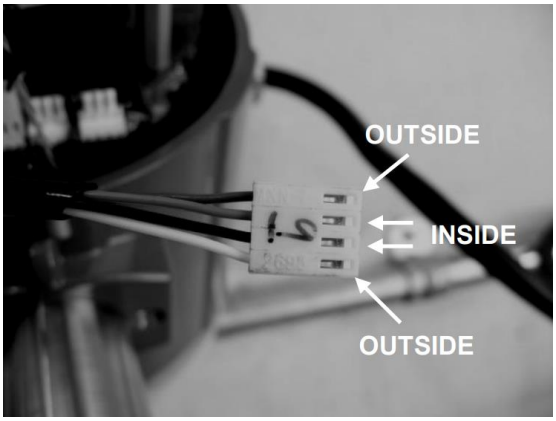


Fig 60. Pressure Sensor Connector

3. Measure the resistance from one of the outside pins to case ground then from one of the inside pins to case ground. They should read open.
4. Go to the first level of the hidden diagnostics and record the Pe(V) and Pv(V) values and consult the factory with findings.

8.7 Electronics Assembly Replacement (All Meters)

WARNING

Before attempting any flow meter repair, verify that the line is not pressurized. Always remove main power before disassembling any part of the mass flow meter.

The electronics boards are electrostatically sensitive. Wear a grounding wrist strap and make sure to observe proper handling precautions required for static-sensitive components.

1. Turn off power to the unit.
2. Locate and loosen the small set screw which locks the larger enclosure cover in place. Unscrew the cover to expose the electronics stack.
3. Locate the sensor harnesses which come up from the neck of the flow meter and attaches to the circuit boards. Make note of the location of each sensor connection.

Refer to figures 55 and 56. The vortex sensor connection is on the left, the temperature sensor connection (if present) is second form the left, and the pressure sensor connection (if present) is the right most connector. Use small pliers to pull the sensor wiring connectors off of the circuit boards.

4. Locate and loosen the small set screw which locks the smaller enclosure cover in place. Unscrew the cover to expose the field wiring strip. Tag and remove the field wires.
5. Remove the screws that hold the black wiring label in place, remove the label.
6. Locate the 4 Phillips head screws which are spaced at 90- degrees around the terminal board. These screws hold the electronics stack in the enclosure. Loosen these screws **(Note: that these are captive screws, they will stay inside the enclosure).**
7. Carefully remove the electronics stack from the opposite side of the enclosure. If the electronics stack will not come out, gently tap the terminal strip with the screw driver handle. This will loosen the rubber sealing gasket on the other side of the enclosure wall. Be careful that the stack does not hang up on the loose sensor harnesses.
8. Repeat steps 1 through 6 in reverse order to install the new electronics stack.

8.8 Pressure Sensor Replacement

1. For local mounted electronics, remove the electronics stack as previously described. For remote mount electronics, remove all wires and sensor connectors from the remote feed-through board in the junction box at the meter.
2. Loosen the three set screws at the centre of the adapter between the meter and the enclosure.
3. Remove the top half of the adapter to expose the pressure transducer.
4. Remove the transducer and replace it with the new one using appropriate thread sealant.
5. Reassemble in reverse order.

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Flow | Level | Temperature | Pressure | Valves | Analyzers | Accessories | TekValSys