TEKTROL
Technology Solutions

TEK-VOR 1300I

Insertion Vortex Flow Meter

Instruction Manual

Document Number: IM-1300I

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.

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1 Safety Instructions

1.1 Intended Use

Tek-Vor 1300I Insertion Vortex Flow Meter can predict fluid density, volumetric flow rate and mass flow rate of gas and steam applications. The meter provides reliable steam quality (steam dryness) measurement.

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 1300I Insertion 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 flowmeter remove any fluid from the flowmeter 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 1300I Insertion Vortex Flow Meters provide a reliable solution for process flow measurement. From a single entry point in the pipeline, 1300I Vortex meters offer precise measurements of mass or volumetric flow rates.

2.2 Measuring Principle

Karman Vortex Street

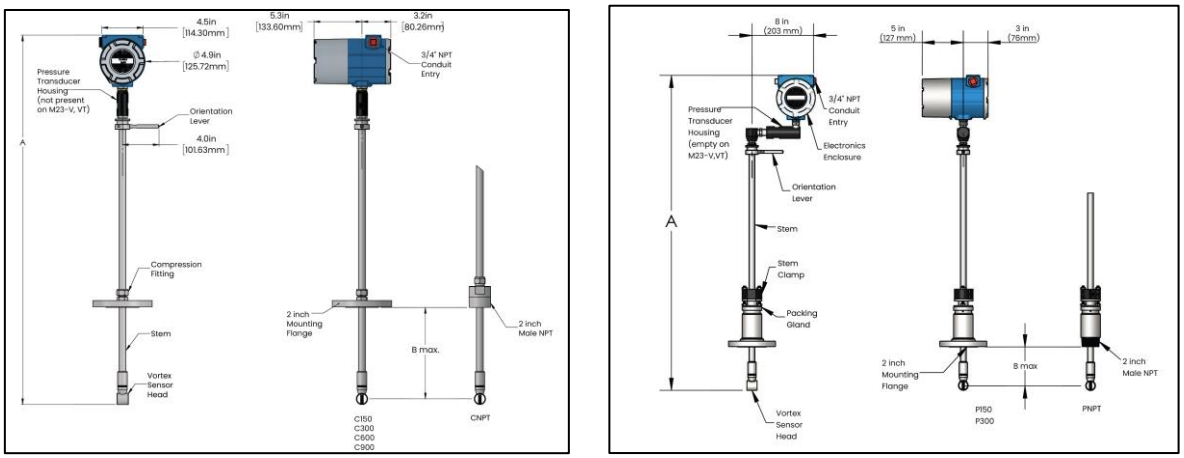
This flowmeter operates on the principle of Karman Vortex Street, any medium passing through the pipeline flows around the bluff body and sheds a series of alternating vortices on each side of the body. This phenomenon is referred to as Vortex Shedding. These vortices shed downstream of the bluff body and dissipate as they flow further. This pattern of vortices is called a Karman Vortex Street (also called a Von Karman Vortex Street).

2.3 Specifications

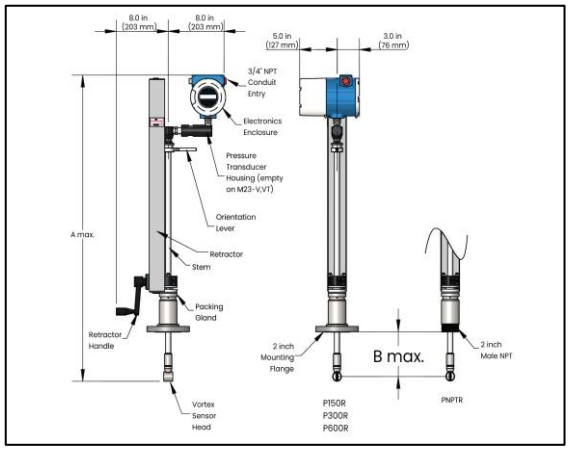
Services	Compatible with liquids, gases, and steam; 316L stainless steel; not for multiphase fluids.		
Accuracy	Process Variables	Liquids	Gas & Steam
	Volumetric Flow Rate	± 1.2% of Rate	± 1.5% of Rate
	Mass Flow Rate	± 1.5% of Rate	± 2.0% of Rate
	Temperature	± 2°F (± 1°C)	± 2°F (± 1°C)
	Pressure	± .3% of Full Scale	± .3% of Full Scale
	Density	± .3% of Reading	± .5% of Reading
Rangeability	100:1		
Temperature Range	• Process Standard Temperature: -330 to 500°F (-200 to 260°C) • Ambient Operating Temperature: -40 to 140°F (-40 to 60°C) • Ambient Storage Temperature: -40 to 140°F (-40 to 60°C		
Pressure Range	Up to 1500 psia		
Wetted Materials	316L, Stainless Steel, PTFE		
Power Supply	• DCL option: 12-36 VDC, 25mA, 1W max, loop powered (single output) • DCH option: 12-36 VDC, 300mA, 9W max, (multiple outputs) DCHPOE • option: 12-28 VDC, or Power over Ethernet, 5W max (multiple outputs) • AC option: 100-240 VAC, 50/60Hz line power, 5W (multiple outputs)		
Output Signal	4-20 mA, HART protocol communications – Standard, Modbus, BACnet communications available		
Response Time	Adjustable from 1 to 100 seconds		
Approvals	FM, FMC, ATEX, IECEx		

2.4 Dimensional Drawing

Tek-Vor 1300XP Inline Flanged Models



Tek-Vor 1300XP Inline Water Models



Tek-Vor 1300XP Reduced Bore Wafer Models

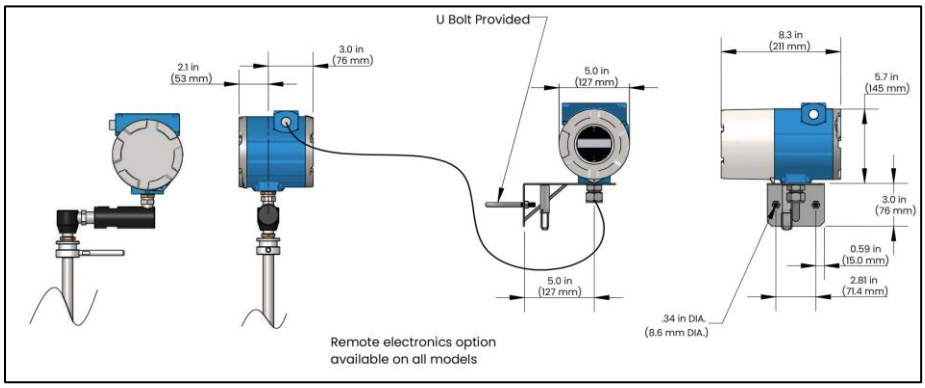


Fig 2. Dimensional Drawing

2.5 Model Chart

Example	Tek-Vor 1300I	V	20	S	A	1	S	I	1	D	LCD	Tek-Vor 1300I-V-20-S-A-1-S-I-1-D-LCD
Series	Tek-Vor 1300I											Insertion Vortex Mass Flow Meter
Type		V VT VTP										Volumetric Flow Meter for liquid, gas and steam Velocity and Temperature Sensors Velocity, Temperature and Pressure Sensors
Size			20 25 40 50 80 100 150 200 250 300									3/4" Nominal Bore 1" Nominal Bore 1 1/2" Nominal Bore 2" Nominal Bore 3" Nominal Bore 4" Nominal Bore 6" Nominal Bore 8" Nominal Bore 10" Nominal Bore 12" Nominal Bore
Probe Length				S C E								Standard Length Compact Length Extended Length
Process Connection					A B C D E F G H I J							Compression, 2 inch NPT Compression, 2 inch 150# Flange Compression, 2 inch 300# Flange Compression, 2 inch 600# Flange Compression, 2 inch 900# Flange Packing Gland, 2 inch 300# Flange Packing Gland, 2 inch NPT, Retractor Packing Gland, 2 inch 150# Flange, Retractor Packing Gland, 2 inch 300# Flange, Retractor Packing Gland, 2 inch 600# Flange, Retractor
Pressure Rating						1 2 3 4 5						Maximum 30 psia (2 bara), Proof 60 psia (4bara) Maximum 100 psia (7 bara), Proof 200 psia (14bara) 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 H					Standard Process temperature – 330 to 500°F (-200 to 260°C) High Process temperature to 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									1 2			12-36 VDC, 300mA, 9W max 100-240 VAC, 50/60 Hz line power, 5W max
Electronics Enclosure										D R		NEMA 4X, IP66 Enclosure Remote Electronics NEMA 4X, IP66, Specify cable length in parentheses
Display											LCD B	Digital Display and Programming Button No Diplay

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

Before installing the flow meter, verify the installation site allows for these considerations:

1. Line pressure and temperature will not exceed the flow meter rating.
2. The location meets the required minimum number of pipe diameters upstream and downstream of the sensor head.
3. Safe and convenient access with adequate overhead clearance for maintenance purposes.
4. Verify that the cable entry into the instrument meets the specific standard required for hazardous area installations. 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.
5. For remote installations, verify the supplied cable length is sufficient to connect the flow meter sensor to the remote electronics.

Also, before installation check your flow system for anomalies such as:

- leaks
- valves or restrictions in the flow path that could create disturbances in the flow profile that might cause unexpected flow rate indications
- avoid areas where high RF, EMI, or other electrical interference may be present. Devices such as VFD's (variable frequency devices), large AC motors, etc.

3.2 Unobstructed Flow Requirements

Select an installation site that will minimize possible distortion in the flow profile. Valves, elbows, control valves and other piping components may cause flow disturbances. Check your specific piping condition against the examples shown below. In order to achieve accurate and repeatable performance install the flow meter using the recommended number of straight run pipe diameters upstream and downstream of the sensor.

NOTE

For liquid applications in vertical pipes, avoid installing with flow in the downward direction because the pipe may not be full at all points. Choose to install the meter with flow in the upward direction if possible.

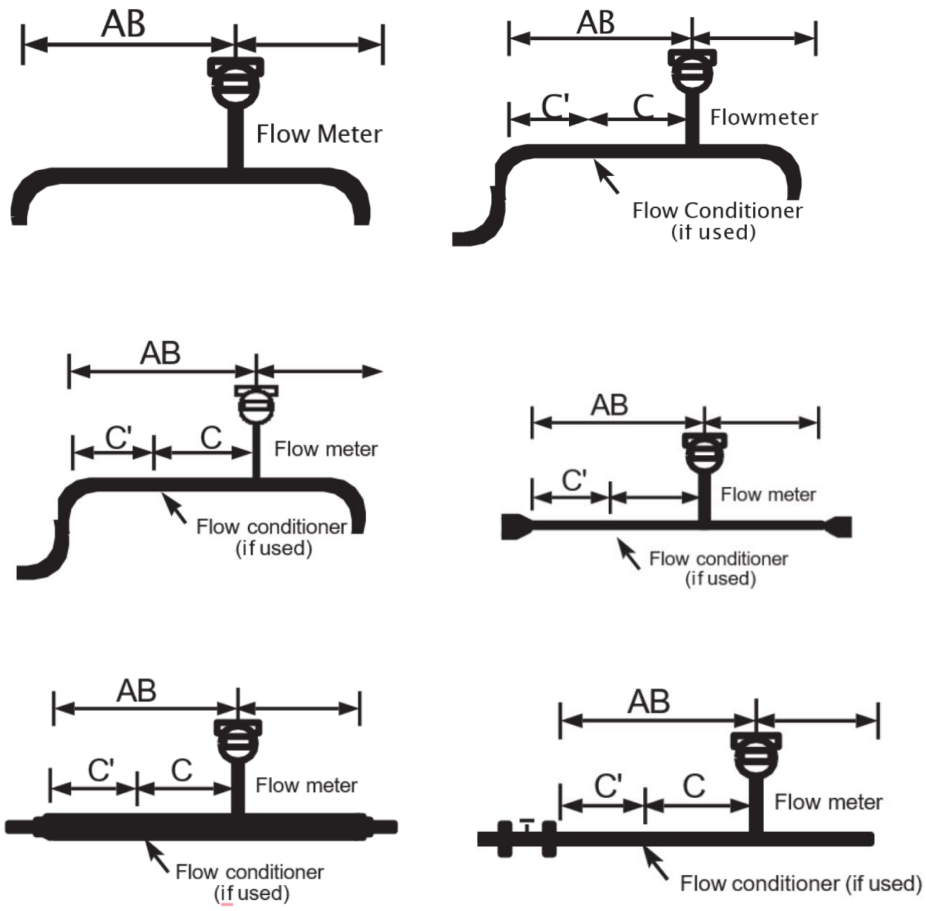


Fig 3. Unobstructed Flow Requirements

Minimum Required Upstream Diameters					Minimum Required Downstream Diameters	
	No Flow Conditioner	With Flow Conditioner			No Flow Conditioner	With Flow Conditioner
Example	A	A	C	C	B	B
1	10 D	N/A	N/A	N/A	5 D	5 D
2	15 D	10 D	5 D	5 D	5 D	5 D
3	30 D	10 D	5 D	5 D	10 D	5 D
4	10 D	10 D	5 D	5 D	5 D	5 D
5	20 D	10 D	5 D	5 D	5 D	5 D
6	30 D	10 D	5 D	5 D	10 D	5 D
D = Internal Diameter of channel N/A = Not applicable						

3.3 Recommended Meter Locations

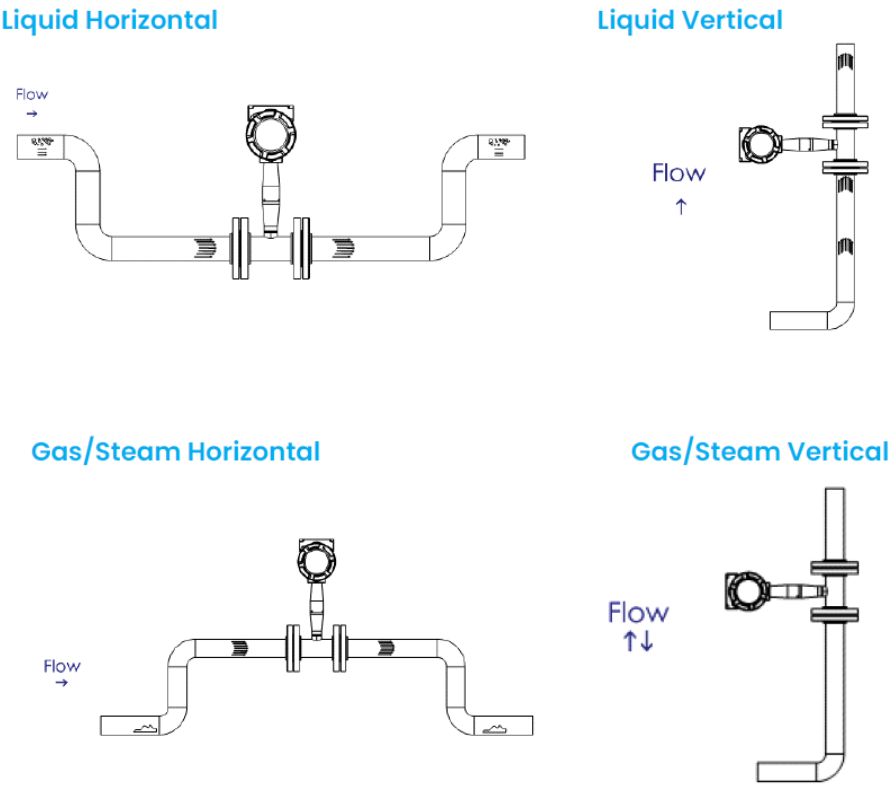


Fig 4. Recommended Meter Locations

3.4 Cold Tap Guidelines

Refer to a standard code for all pipe tapping operations. The following tapping instructions are general in nature and intended for guideline purposes only.

1. Turn off the flow of process gas, liquid or steam. Verify that the line is not pressurized.
2. Confirm that the installation site meets the minimum upstream and downstream pipe diameter requirements.
3. Use a cutting torch or sharp cutting tool to tap into the pipe. The pipe opening must be at least 1.875 inches in diameter. Do not attempt to insert the sensor probe through a smaller hole.
4. Remove all burrs from the tap. Rough edges may cause flow profile distortions that could affect flow meter accuracy. Also, obstructions could damage the sensor assembly when inserting into the pipe.
5. After cutting, measure the thickness of the cut-out and record this number for calculating the insertion depth.
6. Weld the flow meter pipe connection on the pipe. Make sure this connection is within ± 5° perpendicular to the pipe centerline.
7. Install the isolation valve (if used).
8. When welding is complete and all fittings are installed, close the isolation valve or cap the line. Run a static pressure check on the welds. If pressure loss or leaks are detected, repair the joint and re-test.
9. Connect the meter to the pipe process connection.
10. Calculate the sensor probe insertion depth and insert the sensor probe into the pipe as described on the following pages.

3.5 Hot Tap Guidelines

Refer to a standard code for all pipe tapping operations. The following tapping instructions are general in nature and intended for guideline purposes only.

1. Confirm that the installation site meets the minimum upstream and downstream pipe diameter requirements.
2. Weld a two inch mounting adapter on the pipe. Make sure the mounting adapter is within ± 5° perpendicular to the pipe centerline (see previous page). The pipe opening must be at least 1.875 inches in diameter.
3. Connect a two inch process connection on the mounting adapter.
4. Connect an isolation valve on the process connection. The valve's full open bore must be at least 1.875 inches in diameter.
5. Run a static pressure check on the welds. If pressure loss or leaks are detected, repair the joint and re-test.
6. Connect the hot tapping equipment to the isolation valve, open the isolation valve and drill at least a 1.875 inch diameter hole.
7. Retract the drill, close the isolation valve, and remove the hot tapping equipment.
8. Connect the flow meter to the isolation valve and open the isolation valve.
9. Calculate the sensor probe insertion depth and insert the sensor probe into the pipe as described on the following pages.

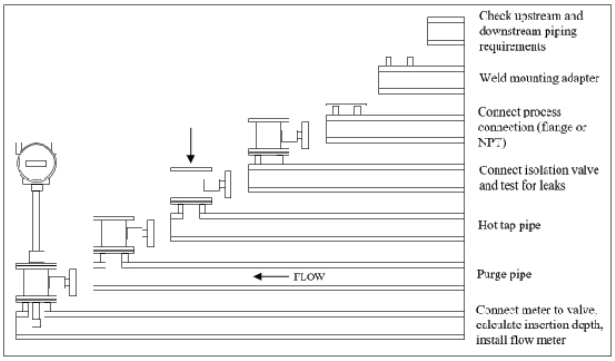


Fig 6. Hot Tap Sequence

3.6 Flow Meter Insertion

The sensor head must be properly positioned in the pipe. For this reason, it is important that insertion length calculations are carefully followed. A sensor probe inserted at the wrong depth in the pipe will result in inaccurate readings.

Insertion flow meters are applicable to pipes 3 inches and larger. For pipe sizes 10 inches and smaller, the centerline of the meter's sensing head is located at the pipe's centerline. For pipe sizes larger than 10 inches, the centerline of the sensing head is located in the pipe's cross section 5 inches from the inner wall of the pipe, so its "wetted" depth from the wall to the centerline of the sensing head is 5 inches.

Insertion flow meters are available in three probe lengths:

Standard Probe configuration is used with most flow meter process connections. The length, S, of the stem is 29.47 inches.

Compact Probe configuration is used with compression fitting process connections. The length, S, of the stem is 13.1 inches.

12-Inch Extended Probe configuration is used with exceptionally lengthy flow meter process connections. The length, S, of the stem is 41.47 inches.

3.7 Installing Flow Meters with a Compression Connection

Use the following formula to determine insertion length for flow meters (NPT and flanged) with a compression process connection. The installation procedure is given on the next page.

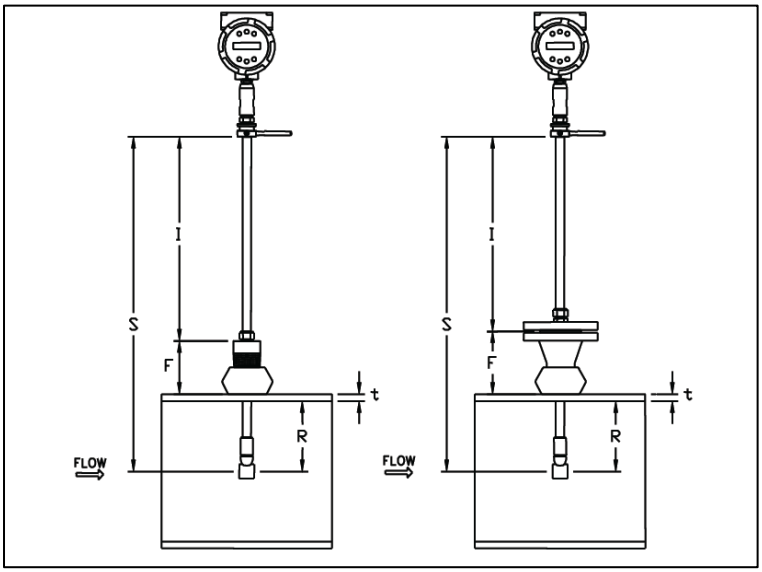


Fig 7. Insertion Calculation (Compression Type)

Isolation Valve Selection

$$I = S - F - R - t$$

Where:
I = Insertion length
S = Stem length – the distance from the center of the sensor head to the base of the enclosure adapter (S = 29.47 inches for standard probes; S = 13.1 inches for compact; S = 41.47 inches for 12-inch extended).
F = Distance from the raised face of the flange or top of NPT stem housing to the outside of the pipe wall.
R = Pipe inside diameter ÷ 2 for pipes ten inches and smaller.
R = Five inches for pipe diameters larger than ten inches.
t = Thickness of the pipe wall. Measure the disk cut-out from the tapping procedure or check a piping handbook for thickness.

Example:
To install the Tek-Vor 1300I vortex flow meter with a standard probe (S = 29.47 inches) into a 14 inch schedule 40 pipe, the following measurements are taken:
F = 3 inches
R = 5 inches
t = 0.438 inches
The insertion length for this example is 21.03 inches. Insert the stem through the fitting until an insertion length of 21.03 inches is measured with a ruler.
*All dimensions are in inches

Insertion Procedure for Meters with a Compression Connection

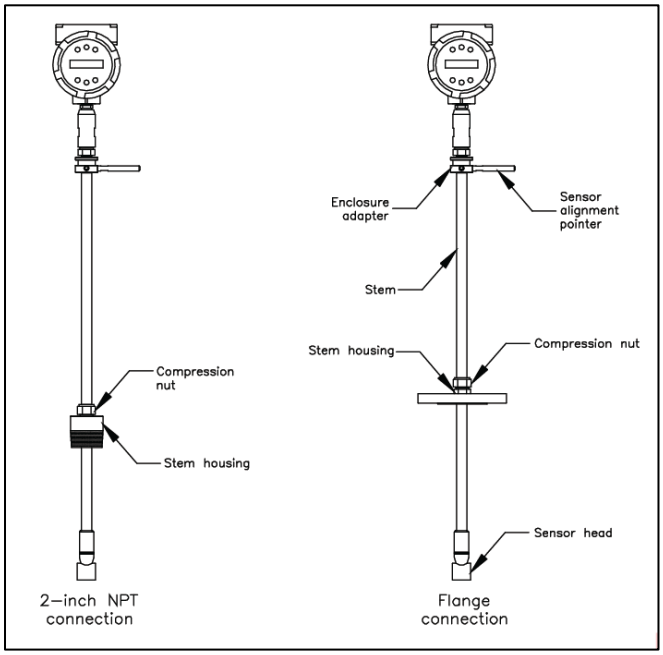


Fig 8. Flow Meter with Compression Type Fitting

1. Calculate the required sensor probe insertion length.
2. Fully retract the stem until the sensor head is touching the bottom of the stem housing. Slightly tighten the compression nut to prevent slippage.
3. Bolt or screw the flow meter assembly into the process connection. Use Teflon tape or pipe sealant to improve the seal and prevent seizing on NPT styles.
4. Hold the meter securely while loosening the compression fitting. Insert the sensor into the pipe until the calculated insertion length, I, is measured between the base of the enclosure adapter and the top of the stem housing, or to the raised face of the flanged version. Do not force the stem into the pipe.
5. Align the sensor head using the sensor alignment pointer. Adjust the alignment pointer parallel to the pipe and pointing downstream.
6. Tighten the compression fitting to lock the stem in position. When the compression fitting is tightened, the position is permanent.

3.8 Installing Flow Meters with a Packing Gland Connection

Use the formula below to determine the insertion depth for flow meters (NPT and flanged) equipped with an insertion tool. To install, see the next page for instructions for meters with a permanent insertion tool.

Insertion Length Formula

$$I = F + R - t - 1.35$$

Where:

I = Insertion length

F = Distance from the raised face of the flange or top of the process connection for NPT style meters to the top outside of the process pipe.

R = Pipe inside diameter ÷ 2 for pipes ten inches and smaller.
R = Five inches for pipe diameters larger than ten inches.
t = Thickness of the pipe wall. (Measure the disk cut-out from the tapping procedure or check a piping handbook for thickness.)

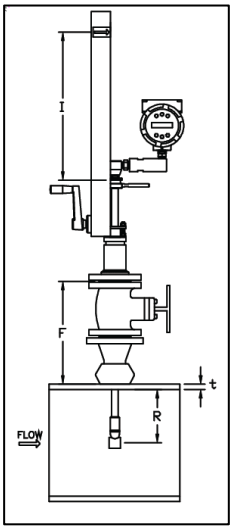


Fig 9. Insertion Calculation (Meters with Insertion Tool)

Example 1:
To install the Tek-Vor 1300I Vortex Flow Meter into a 14 inch schedule 40 pipe, the following measurements are taken:

F = 12 inches
R = 5 inches
t = 0.438 inches

The insertion length for this example is 16.09 inches.

Example 2:
The length of thread engagement on the NPT style meters is also subtracted in the equation. The length of the threaded portion of the NPT meter is 1.18 inches. Measure the thread portion still showing after the installation and subtract that amount from 1.18 inches. This gives you the thread engagement length. If this cannot be measured use .55 inch for this amount.

F = 12 inches
R = 5 inches
t = 0.438 inches

The insertion length for this example is 15.54 inches.
***All dimensions are in inches**

Insertion Procedure for Flow Meters with Permanent Insertion Tool

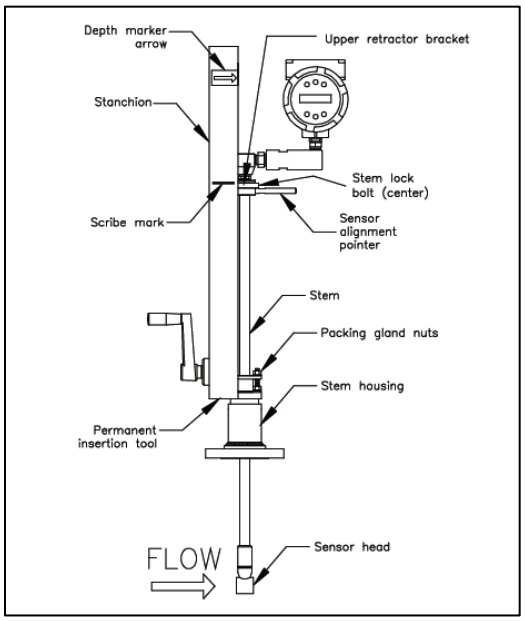


Fig 10. Flow Meter with Permanent Insertion Tool

1. Calculate the required sensor probe insertion length (see previous page). Measure from the depth marker arrow down the stanchion and scribe a mark at the calculated insertion depth.

2. Fully retract the flow meter until the sensor head is touching the bottom of the stem housing. Attach the meter assembly to the two inch full-port isolation valve, if used. Use Teflon tape or pipe sealant to improve seal and prevent seizing on NPT style.
3. Loosen the two packing gland nuts on the stem housing of the meter. Loosen the stem lock bolt adjacent to the sensor alignment pointer. Align the sensor head using the sensor alignment pointer. Adjust the alignment pointer parallel to the pipe and pointing downstream. Tighten the stem lock bolt to secure the sensor position.
4. Slowly open the isolation valve to the full open position. If necessary, slightly tighten the two packing gland nuts to reduce the leakage around the stem.
5. Turn the insertion tool handle clockwise to insert the sensor head into the pipe. Continue until the top of the upper retractor bracket aligns with the insertion length position scribed on the stanchion. Do not force the stem into the pipe.
6. Tighten the packing gland nuts to stop leakage around the stem. Do not torque over 20 ftlb.

Insertion Procedure for Flow Meters with Removable Insertion Tool

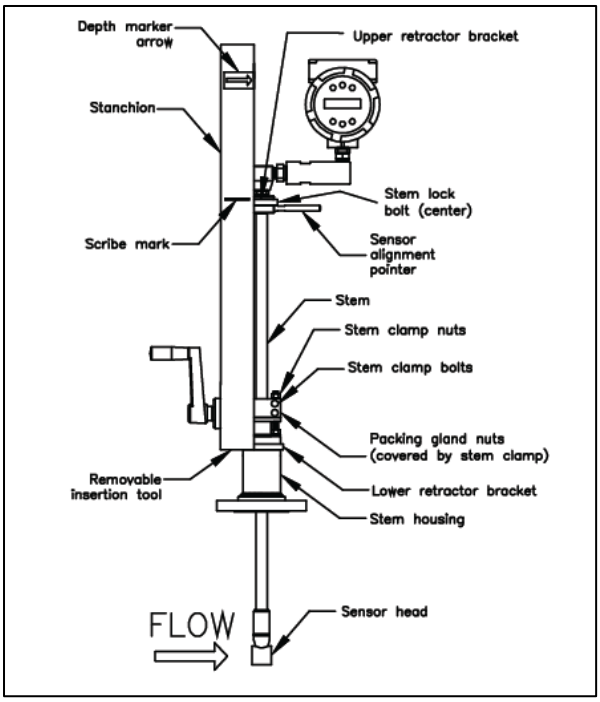


Fig 11. Flow Meter with Removable Insertion Tool

1. Calculate the required sensor probe insertion length. Measure from the depth marker arrow down the stanchion and scribe a mark at the calculated insertion depth.
2. Fully retract the flow meter until the sensor head is touching the bottom of the stem housing. Attach the meter assembly to the two inch full-port isolation valve, if used. Use Teflon tape or pipe sealant to improve seal and prevent seizing on NPT style.
3. Remove the two top stem clamp nuts and loosen two stem clamp bolts. Slide the stem clamp away to expose the packing gland nuts.
4. Loosen the two packing gland nuts. Loosen the stem lock bolt adjacent to the sensor alignment pointer. Align the sensor head using the sensor alignment pointer. Adjust the alignment pointer parallel to the pipe and pointing downstream. Tighten the stem lock bolt to secure the sensor position.
5. Slowly open the isolation valve to the full open position. If necessary, slightly tighten the two packing gland nuts to reduce the leakage around the stem.
6. Turn the insertion tool handle clockwise to insert the stem into the pipe. Continue until the top of the upper retractor bracket lines up with the insertion length mark scribed on the stanchion. Do not force the stem into the pipe.
7. Tighten the packing gland nuts to stop leakage around the stem. Do not torque over 20 ftlbs.
8. Slide the stem clamp back into position. Torque stem clamp bolts to 15 ft-lbs. Replace the stem clamp nuts and torque to 10-15 ft-lbs.
9. To separate the insertion tool from the flow meter, remove four socket head cap bolts securing the upper and lower retractor brackets. Remove the insertion tool.

3.9 Installation of Meters with Packing Gland Connection (No Insertion Tool)

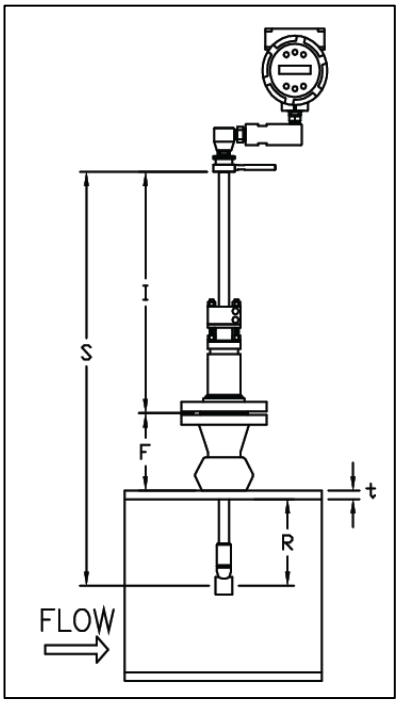


Fig 12. Insertion Calculation (Meters without Insertion Tool)

1. Calculate the required sensor probe insertion length.
2. Fully retract the stem until the sensor head is touching the bottom of the stem housing. Remove the two top stem clamp nuts and loosen two stem clamp bolts. Slide the stem clamp away to expose the packing glands nuts. Loosen the two packing gland nuts.
3. Align the sensor head using the sensor alignment pointer. Adjust the alignment pointer parallel to the pipe and pointing downstream.
4. Insert the sensor head into the pipe until insertion length, I, is achieved. Do not force the stem into the pipe.
5. Tighten the packing gland nuts to stop leakage around the stem. Do not torque over 20 ftlbs.
6. Slide the stem clamp back into position. Torque stem clamp bolts to 15 ft-lbs. Replace the stem clamp nuts and torque to 10-15 ft-lbs.

Insertion Length Formula

$$I = S - F - R - t$$

Where:
I = Insertion length
S = Stem length – the distance from the center of the sensor head to the base of the enclosure adapter (S = 29.47 inches for standard probes; S = 41.47 inches for 12 inch extended probes).

F = Distance from the raised face of the flange or top of NPT stem housing to the outside of the pipe wall.
R = Pipe inside diameter ÷ 2 for pipes ten inches and smaller.
R = Five inches for pipe diameters larger than ten inches.
t = Thickness of the pipe wall. (Measure the disk cut-out from the tapping procedure or check a piping handbook for thickness.)

Example:
To install Tek-Vor 1300I Vortex Flow Meter with a standard probe (S = 29.47) into a 14 inch schedule 40 pipe, the following measurements are taken:

F = 3 inches
R = 5 inches
t = 0.438 inches

The example insertion length is 21.03 inches.
***All dimensions are in inches.**

3.10 Adjusting Meter Orientation

Display/Keypad Adjustment

The orientation of the display/keypad may be changed in 90 degree increments for easier viewing.

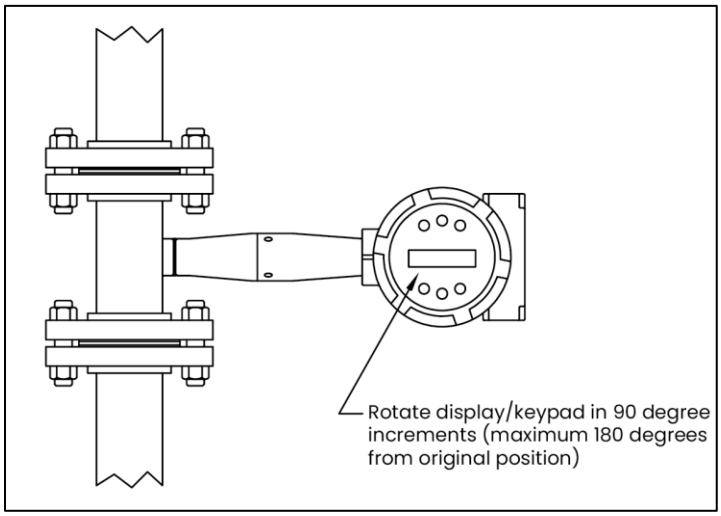


Fig 13. Display/Keypad Viewing Adjustment

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 window cover.
- Loosen the 4 captive screws on the electronic display board.
- 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.

3.11 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

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.

4.1.1 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.

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).

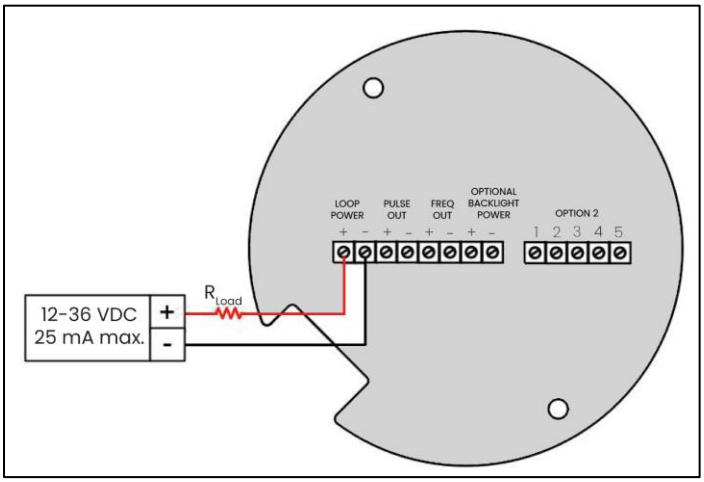


Fig 14. DC Power Connections

4.1.2 4-20 mA Output Connections

The Tek-Vor 1300I Vortex Flow 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:

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

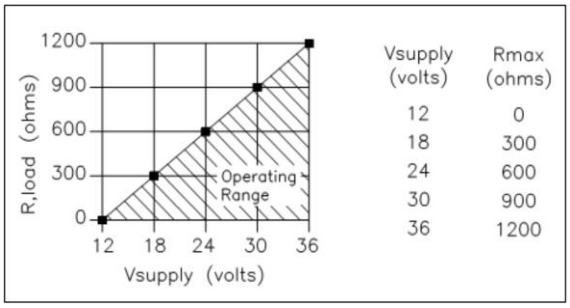


Fig 15. Load Resistance Versus Input Voltage

The current loop range is 3.8 to 20.5 mA.

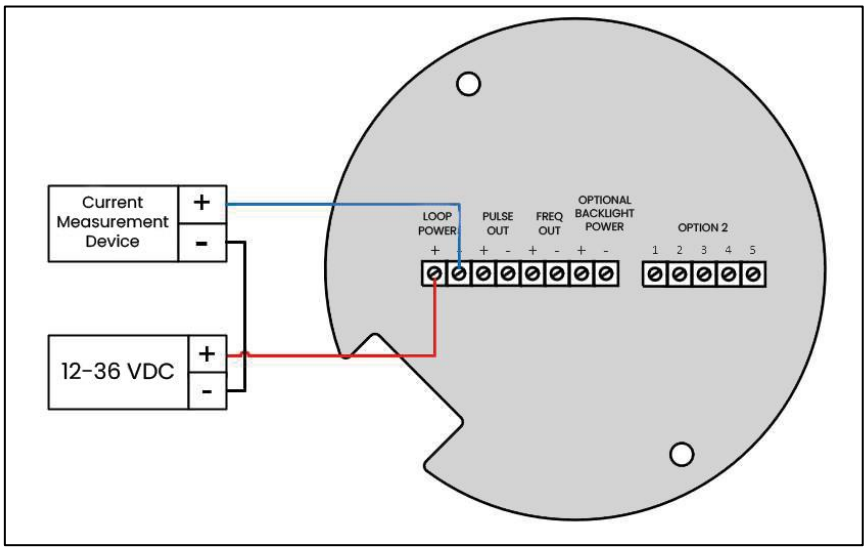


Fig 16. Loop Power 4-20 mA Wiring Diagram

4.1.3 Pulse Output Connections

The pulse output is used for a remote counter. When the preset volume or mass (defined in the totalizer settings) 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.

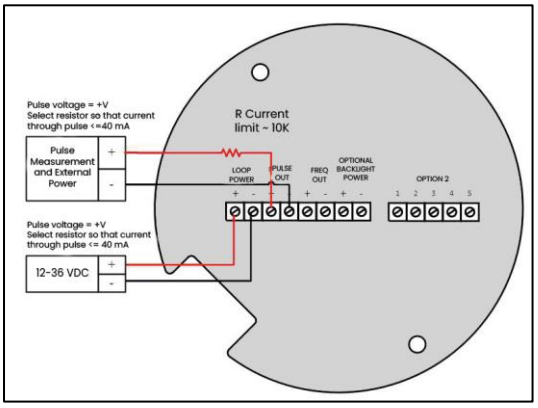


Fig 17. Isolated Pulse Output Using External Power Supply

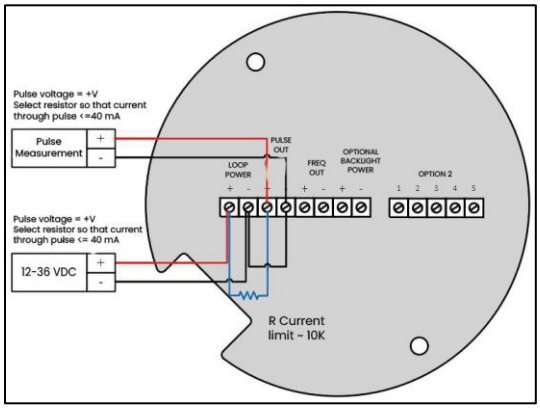


Fig 18. Non-Isolated Pulse Output Using External Power Supply

4.1.4 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. Scaled frequency will need to be set in the Output Menu.

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.

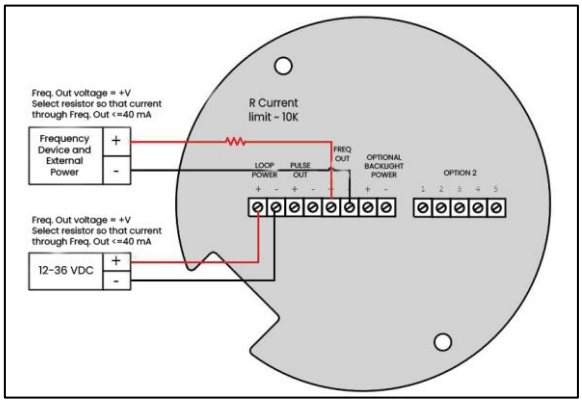


Fig 19. Isolated Frequency Output Using External Power Supply

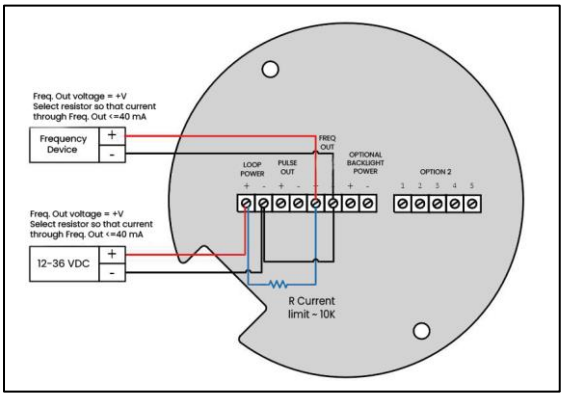


Fig 20. Non-Isolated Frequency Output Using External Power Supply

4.1.5 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.

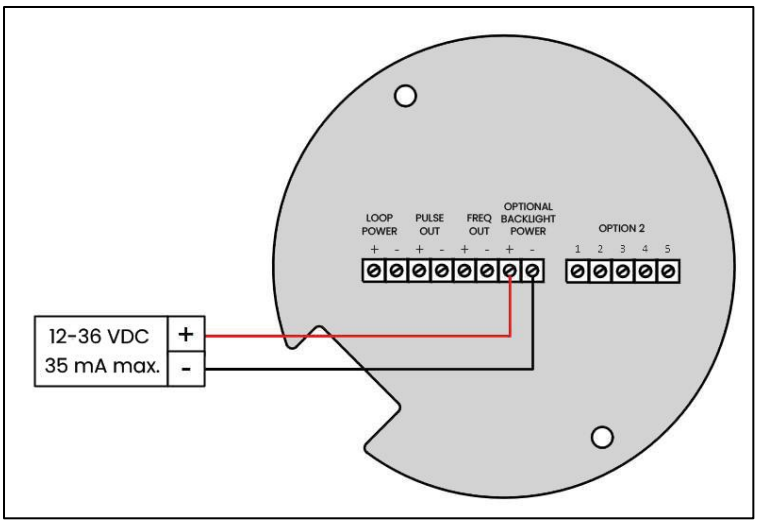


Fig 21. Backlight Using External Power Supply

4.1.6 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.

Note: Numeric code on junction box label matches wire labels.

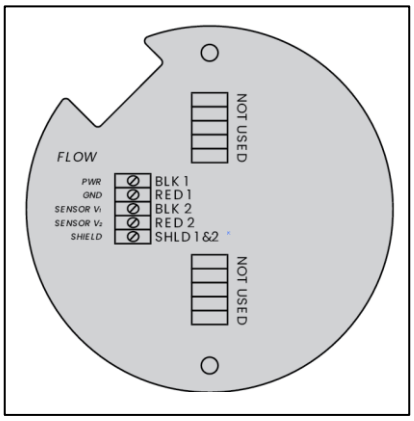


Fig 22. Loop Power Volumetric Flowmeter Junction Box Sensor Connection

Wires enter the flow connector from the left side of the connector shown above.

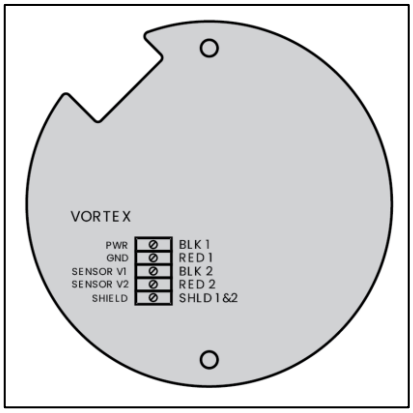


Fig 23. Loop Power Volumetric Flowmeter Junction Box Sensor Connection

Wires enter the flow connector from the right side of the connector shown above.

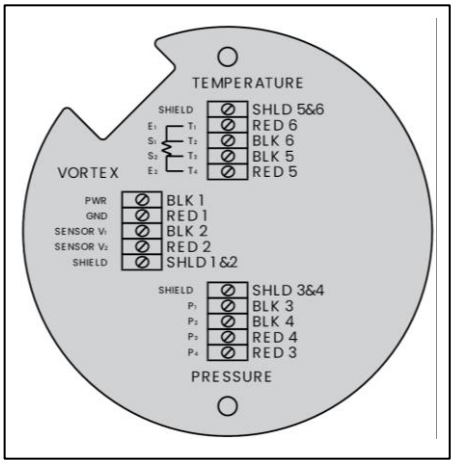


Fig 24. Loop Power Mass Flowmeter Junction Box Sensor Connection

4.2 High Power Meter 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. There are two options for powering the POE version meters: external DC Power and POE option.

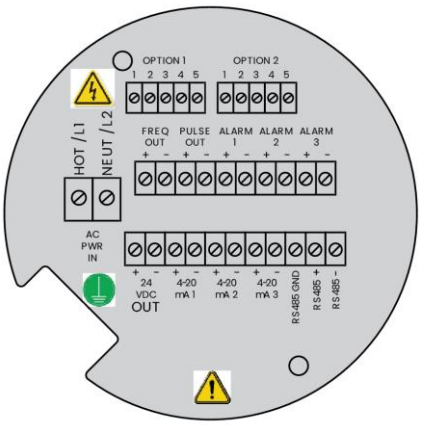


Fig 25. AC Wiring Terminals

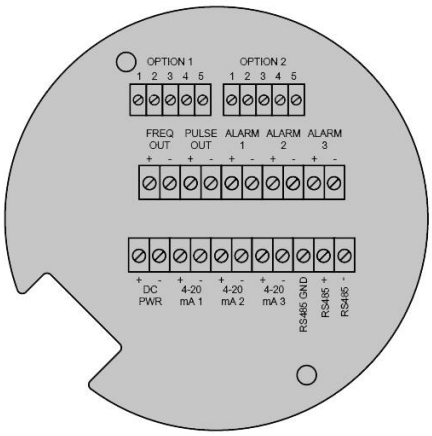


Fig 26. DC Wiring Terminals

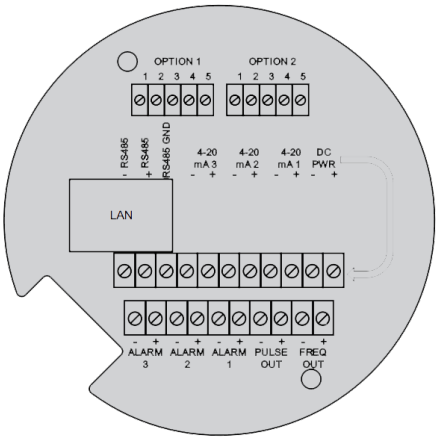


Fig 27. POE Wiring Terminals

4.2.1 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.

AC Power Wiring

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.

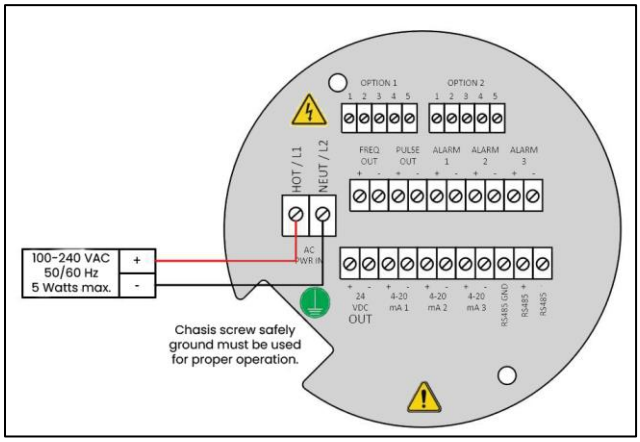


Fig 28. AC Power Connections

DC Power Wiring

The DC power wire size must be 20 to 12 AWG with the wire stripped 1/4 inch (7 mm). Connect 12 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).

Alternatively, POE injector may be used for example (TRENDnet TPE-115Gi).

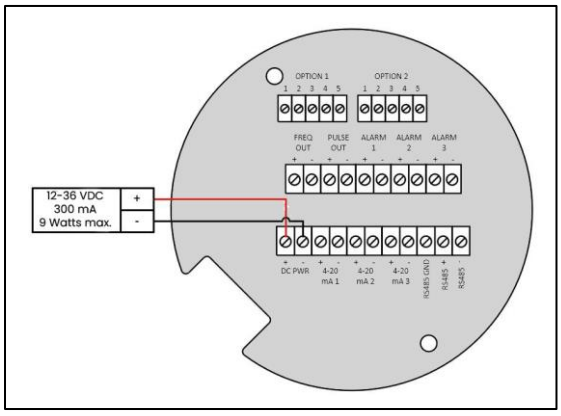


Fig 29. DC Power Connections

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 of Vortek 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 and communicating.

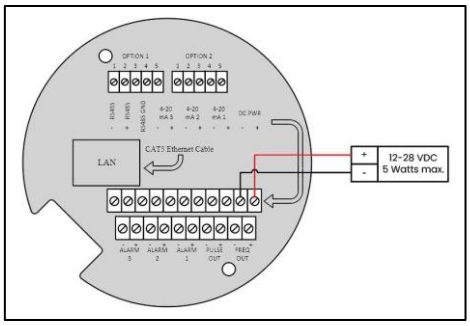


Fig 30. DC POE Power Connections

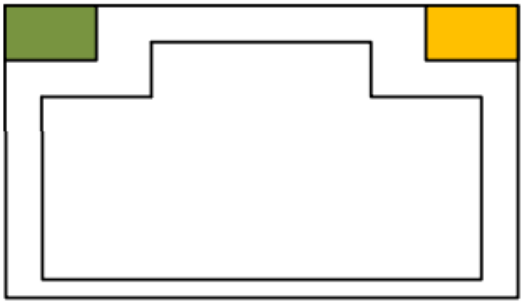


Fig 31. Front of the LAN Connector

4.2.2 4-20 mA Output Connections

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

The maximum loop resistance (load) for the current loop output is dependent upon the supply voltage. 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 $R_{load} = R_{max} = (V_{supply} - 12V) / 0.020\ A$

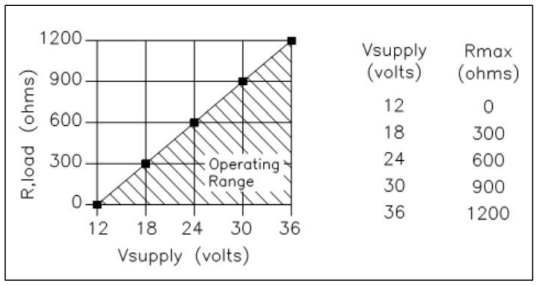


Fig 32. Load Resistance Versus Input Voltage

The current loop range is 3.8 to 20.5 mA. See Figures 2-34 through 2-37 for wiring options.

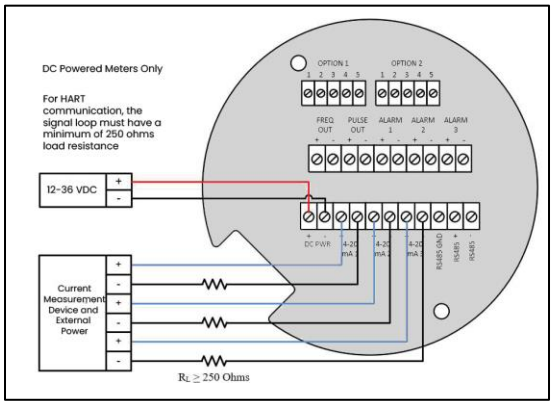


Fig 33. Isolated 4-20 mA Output Using External Power Supply

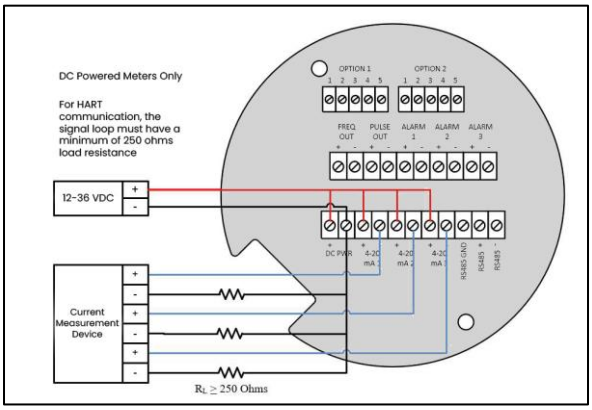


Fig 34. Non-Isolated 4-20 mA Output Using External Power Supply

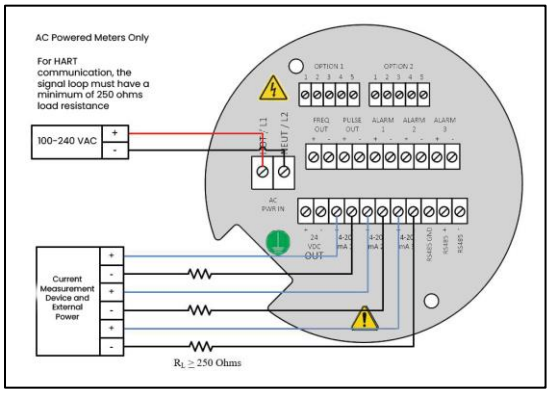


Fig 35. Isolated 4-20 mA Output Using External Power Supply

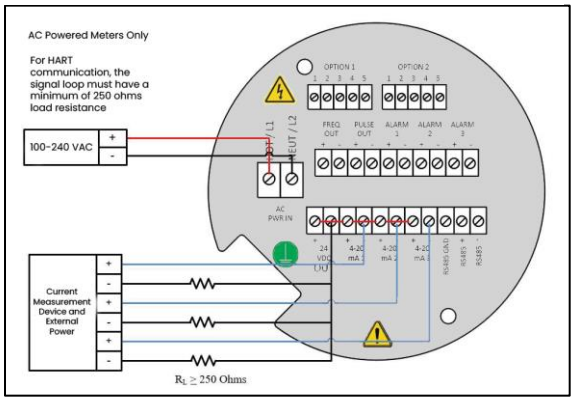


Fig 36. Isolated 4-20 mA Output Using Meter Provided Power Supply

4.2.3 Pulse Output Connections

The pulse output is used for a remote counter. When the preset volume or mass (defined in the totalizer settings) 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.

There are three connection options for the pulse output – the first with a separate power supply, the second using the flow meter power supply (DC powered units only), and the third using the internal 24 VDC power supply (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 pulse 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 pulse 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 pulse output is the same as the voltage supplied to the circuit.

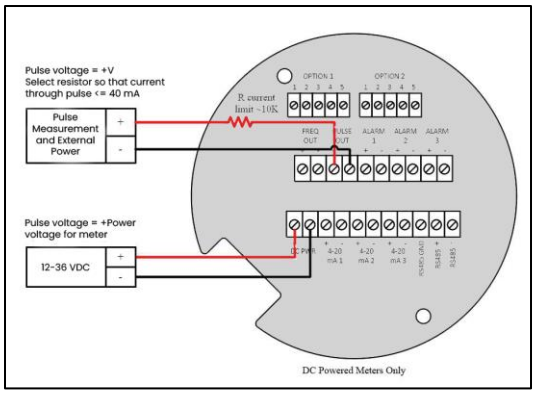


Fig 37. Isolated Pulse Output using External Power Supply

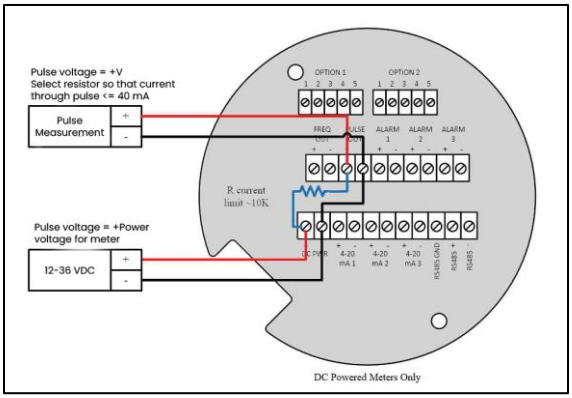


Fig 38. Non-Isolated Pulse Output using Input Power Supply

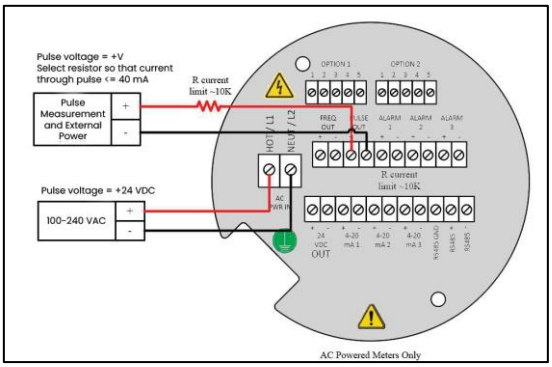


Fig 39. Isolated Pulse Output using External Power Supply

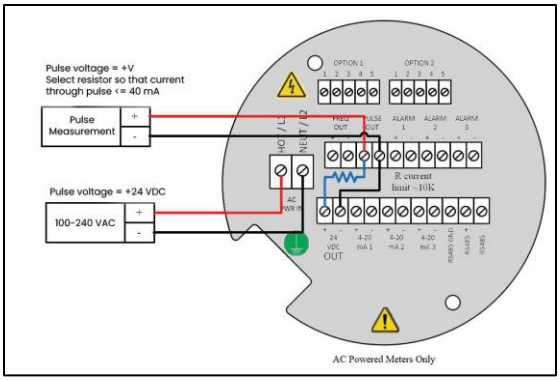


Fig 40. Isolated Pulse Output using Meter Provided Power Supply

4.2.4 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. Scaled frequency will need to be set in the Output Menu.

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, the second using the flow meter power supply (DC powered units only), and the third using the internal 24 VDC power supply (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.

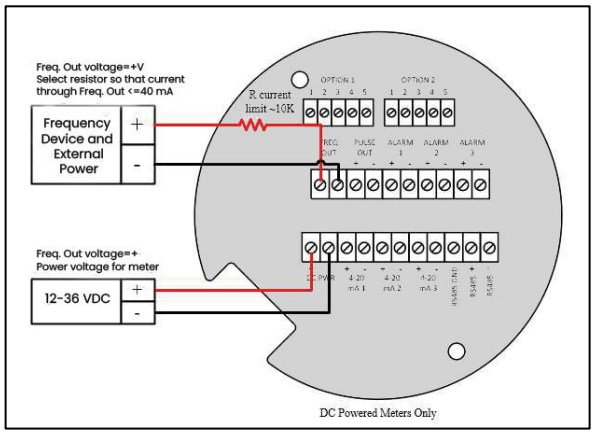


Fig 41. Isolated Frequency Output Using External Power Supply

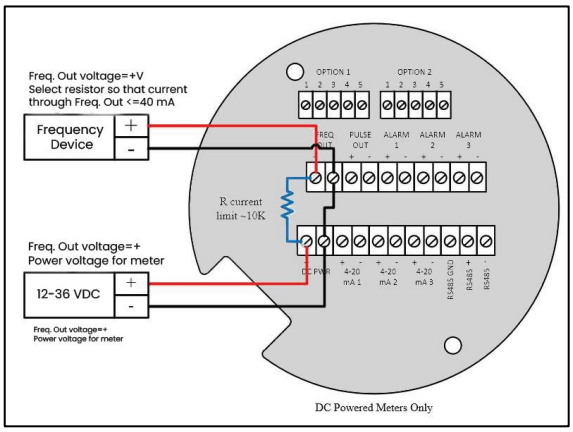


Fig 42. Non-Isolated Frequency Output Using Input Power Supply

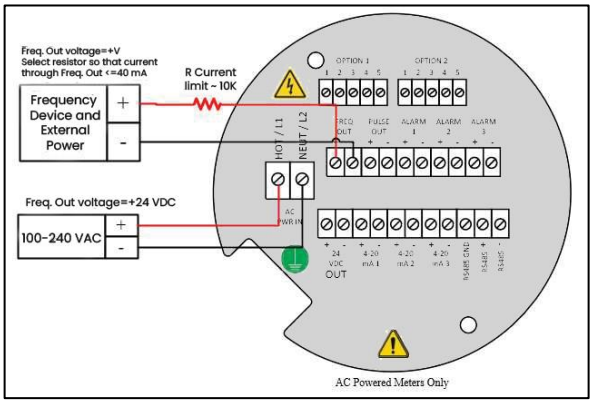


Fig 43. Isolated Frequency Output Using External Power Supply

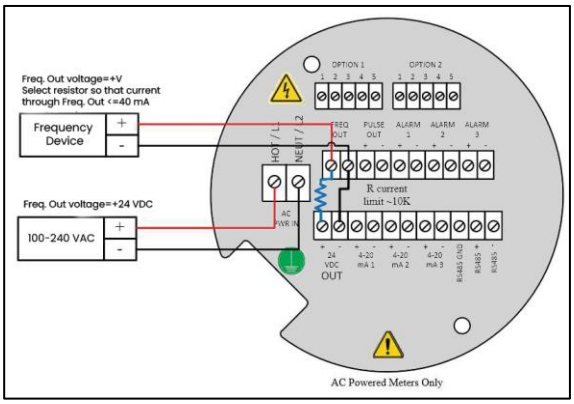


Fig 44. Non-Isolated Frequency Output Using Meter Provided Power Supply

4.2.5 Alarm Output Connections

One alarm output (Alarm 1) is included on the standard Tek-Vor 1300I Vortex 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 Rload appropriately.

There are three connection options for the alarm output–the first with a separate power supply, the second using the flow meter power supply (DC powered units only) and the third with the meter provided power supply (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

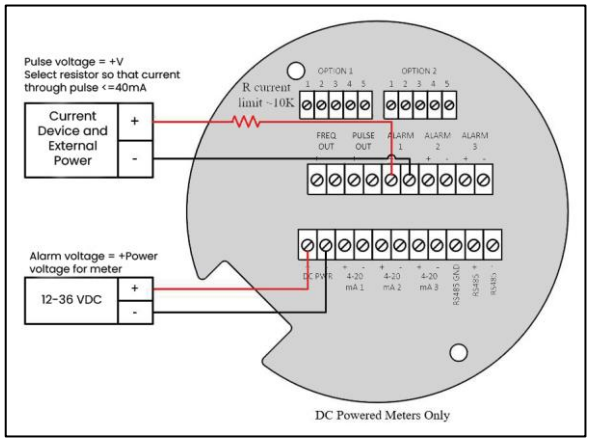


Fig 45. Isolated Alarm Output Using External Power Supply

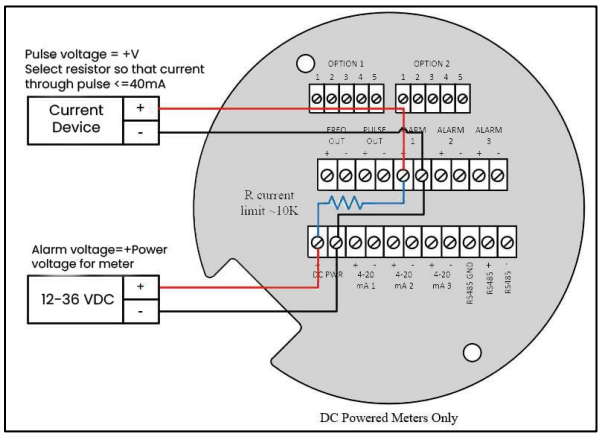


Fig 46. Non-Isolated Frequency Output Using Internal Power Supply

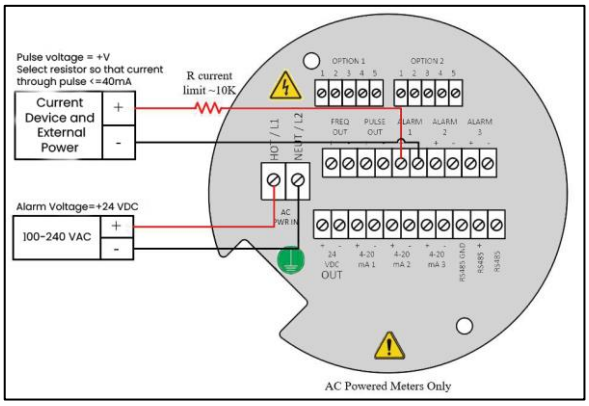


Fig 47. Isolated Alarm Output Using External Power Supply

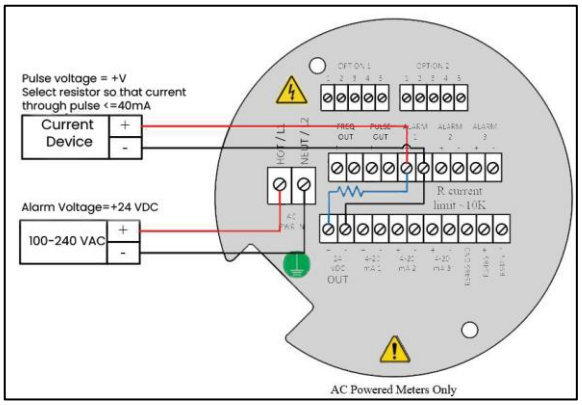


Fig 48. Non-Isolated Alarm Output Using Meter Provided Power Supply

4.2.6 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.

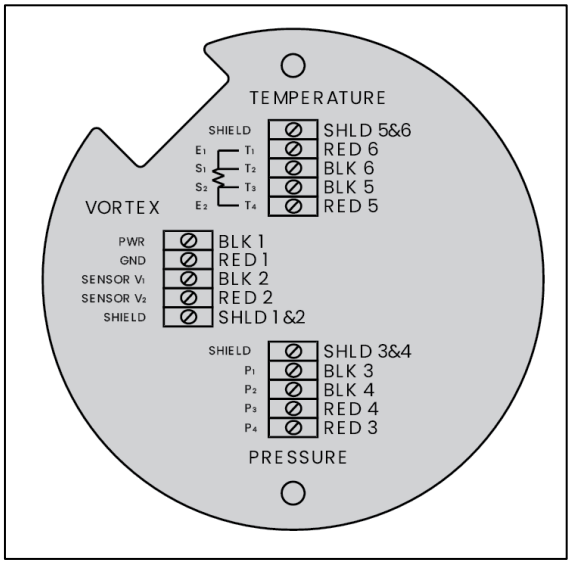


Fig 49. High Power Flowmeter Junction Box Sensor Connection

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

4.3 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.

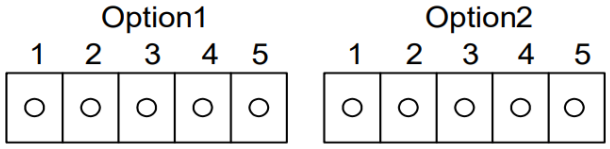


Fig 50. Optional Energy EMS RTD Input Wiring

4.3.1 Optional Energy EMS RTD Input Wiring

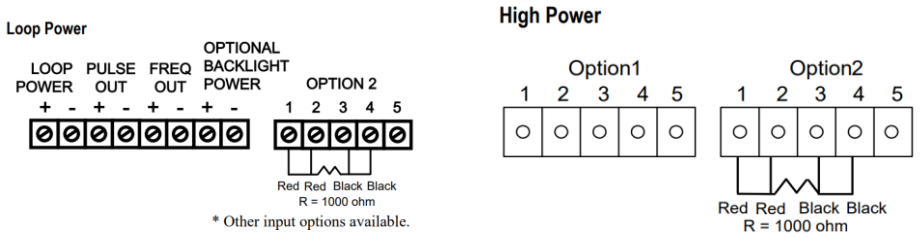


Fig 51. Optional Energy EMS RTD Input Wiring

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.

4.3.2 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.

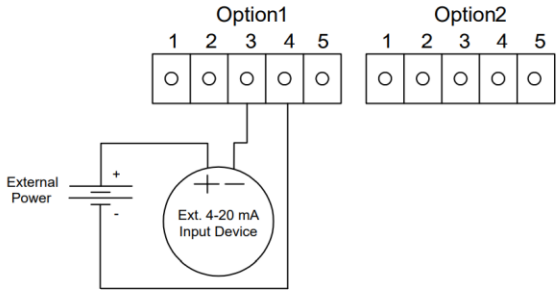


Fig 52. External 4-20 mA Input Wiring - External Power Supply

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

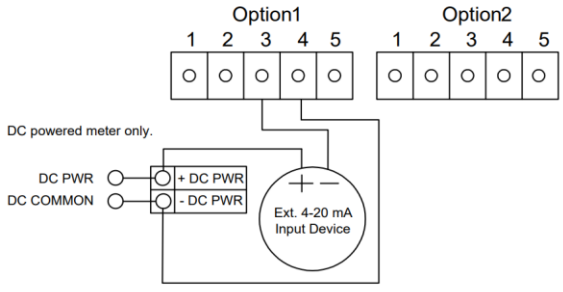


Fig 53. External 4-20 mA Input Wiring - DC Powered Meter

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.

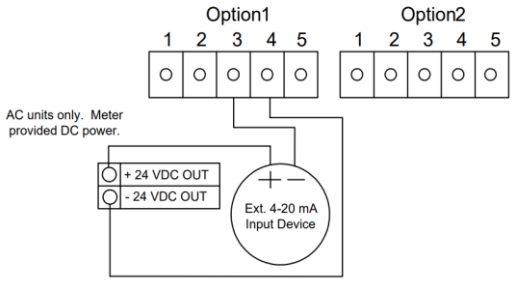


Fig 54. External 4-20 mA Input Wiring - AC Powered Meter

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.

4.3.3 Optional External 4-20 mA Input and RTD Wiring

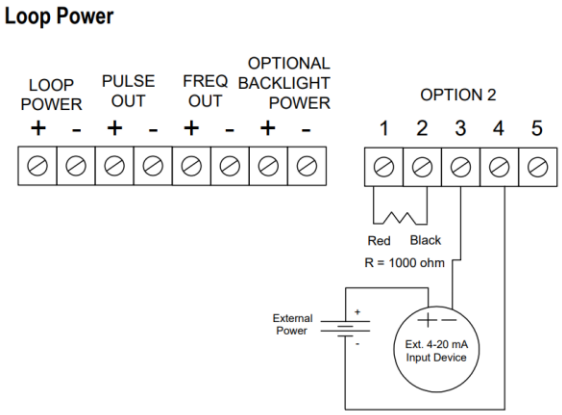


Fig 55. External 4-20 mA Input and RTD Wiring – Loop Power

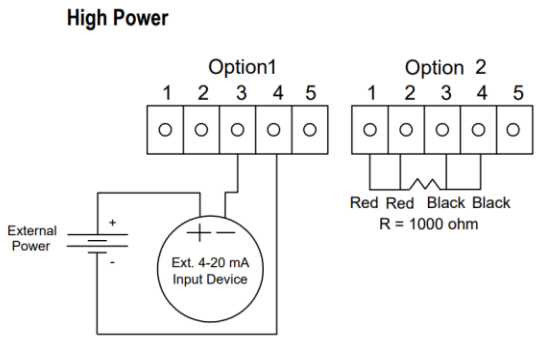


Fig 56. External 4-20 mA Input and RTD Wiring – High Power

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

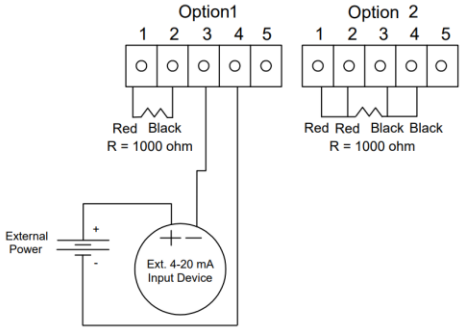


Fig 57. Energy EMS External 4-20 mA Input and RTD Wiring – High Power

4.3.5 Optional External Contact Closure Input Wiring

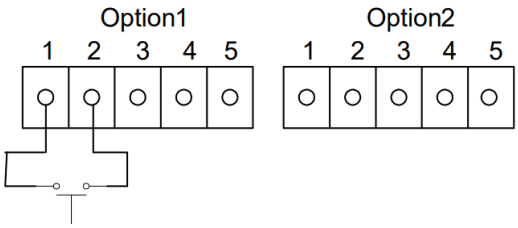


Fig 58. Optional External Contact Closure Input Wiring

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.

5 Operation

After installing the Tek-Vor 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

The flow meter's digital electronics allow you to set, adjust and monitor system parameters and performance. A full range of commands are available through the display/keypad. The LCD display gives 2 x 16 characters for flow monitoring and programming. The six pushbuttons can be operated with the enclosure cover removed, or the explosion-proof cover can remain in place and the keypad operated with a hand-held magnet positioned at the side of the enclosure as shown in the illustration at the left.

To secure the enclosure cover use a 1/16" hex key wrench to tighten the 6-32 x 1/4 cup point socket set locking screw.

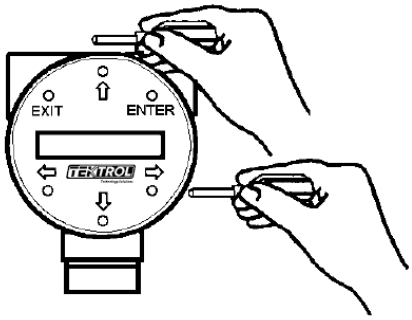


Fig 60. Display

From the 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. To set new parameters, 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. The keys advance through each screen of the current menu. When changing a system parameter, all keys are available to enter new parameters.

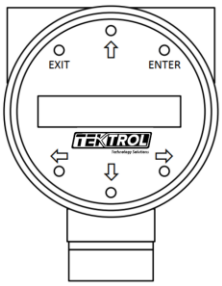


Fig 59. Display Configuration

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.

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.

NOTE: The meter will come from the factory preprogrammed for your application.

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:

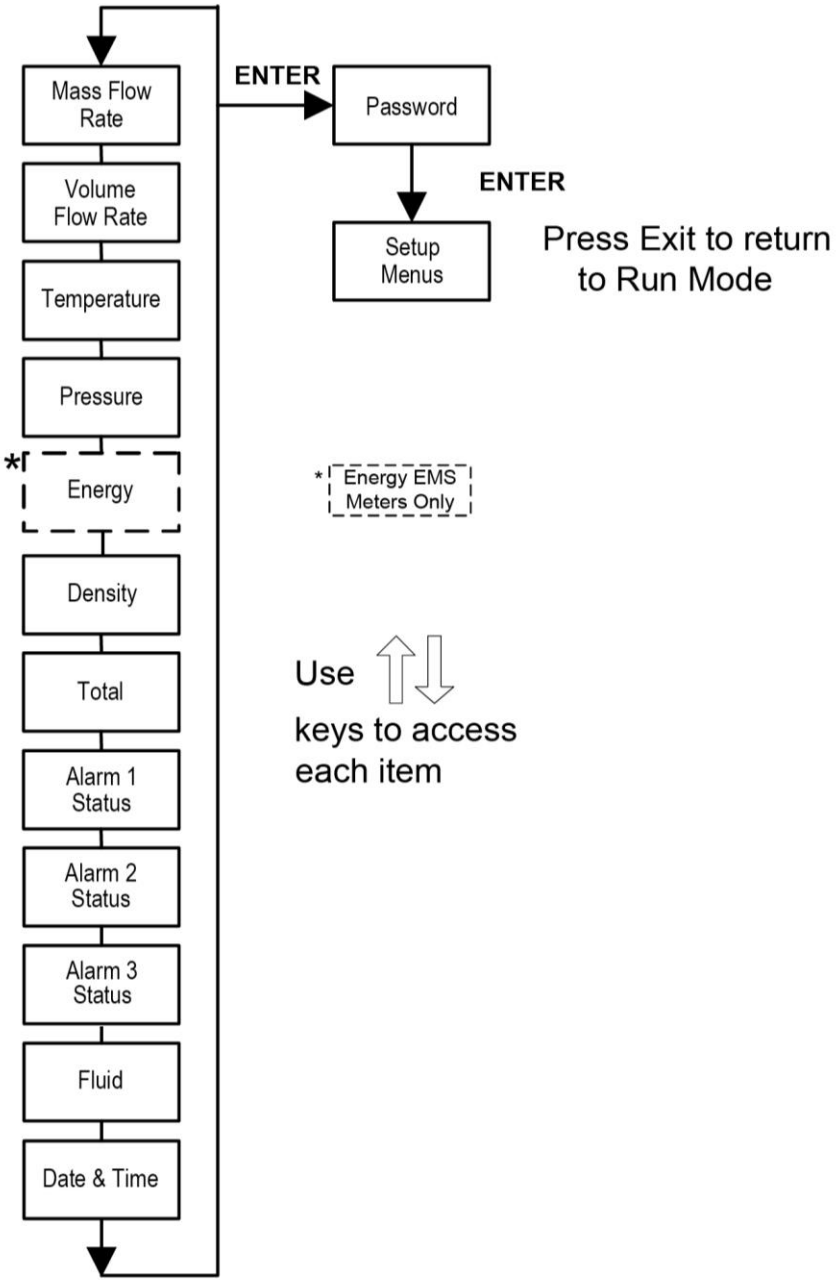
1. Use ◀ ▶ keys to move to the Units Menu.
2. Press ▼ key until Mass Flow Unit appears. Press ENTER.
3. Press ▼ key until lb appears in the numerator. Press ▶ key to move the underline cursor to the denominator. Press the ▼ key until hr appears in the denominator. Press ENTER to select.
4. Press ▲ key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

Second, set the analog output:

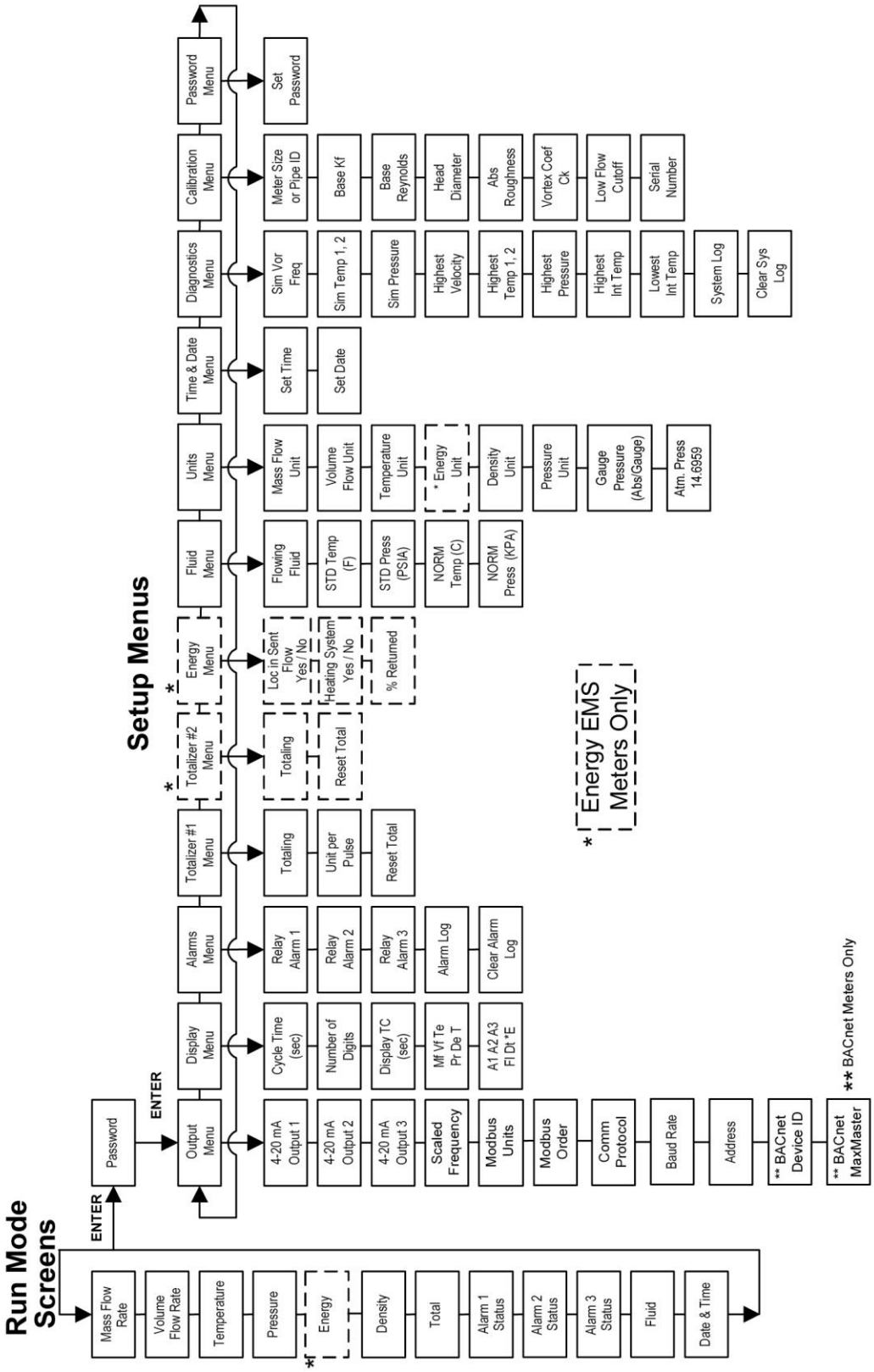
1. Use ◀ ▶ keys to move to the Output Menu.
2. Press the ▼ key until 4-20 mA Output 1 appears.
3. Press ▶ key to access Measure selections. Press ENTER and press the ∫ key to select Mass. Press ENTER.
4. Press ▶ key to set the 4 mA point in the units you have selected for mass of lb/hr. Press ENTER and 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

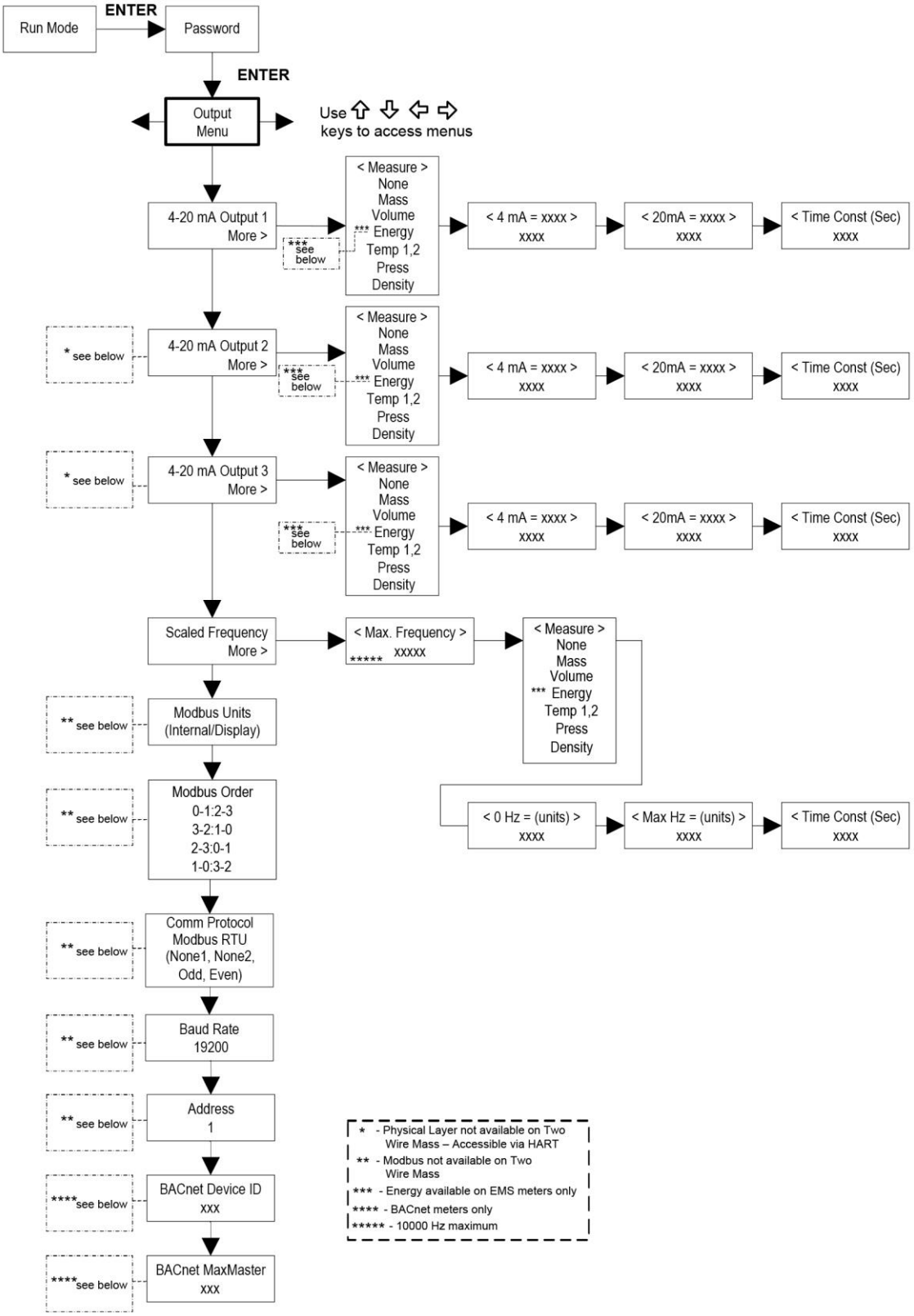
6.1 Run Mode Screens



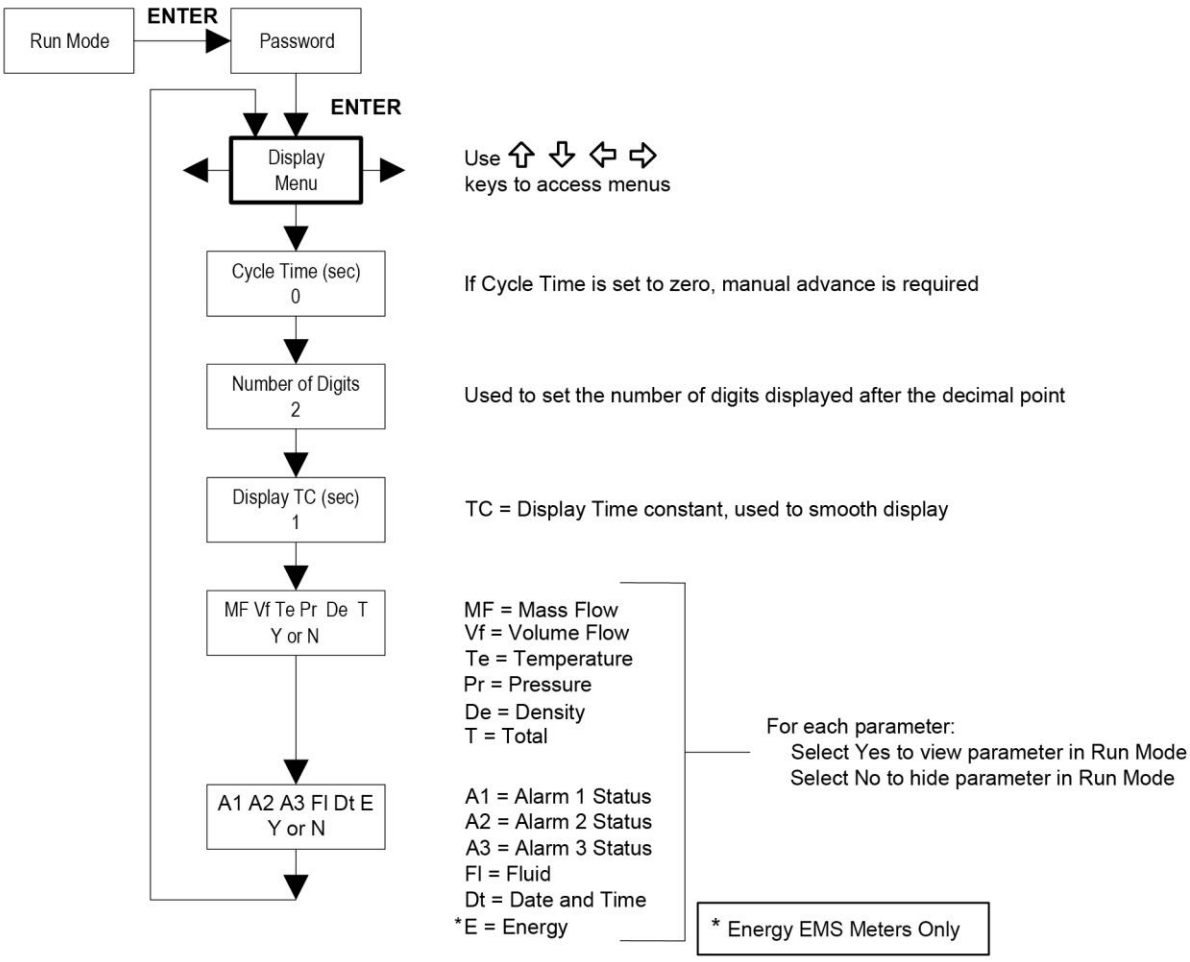
6.2 Set Up Menus



6.3 Output Menus



6.4 Display Menus



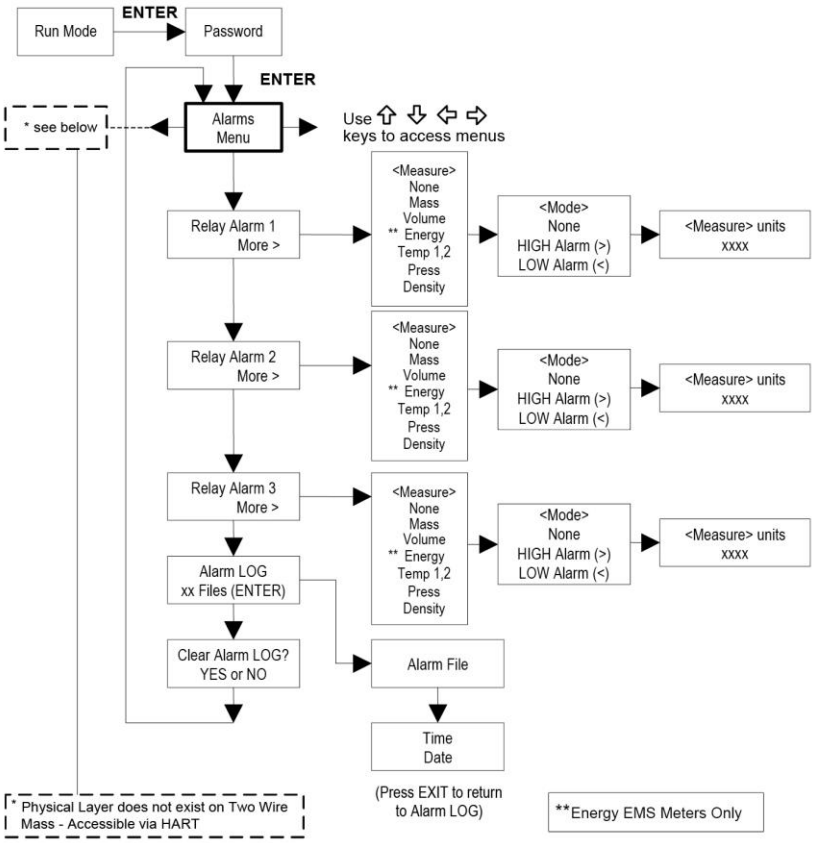
Use the Display Menu to set the cycle time for automatic screen sequencing used in the Run Mode, change the precision of displayed values, smooth the values or enable or disable each item displayed in the Run Mode screens.

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.

1. Use ◀ ▶ keys to move to the Display Menu.
2. Press ▼ key until Mf Vf Pr Te De T appears.
3. Press ENTER to select. Press ▶ key until the cursor is positioned below Te.
4. Press ▼ key until N appears. Press ENTER to select.
5. 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:

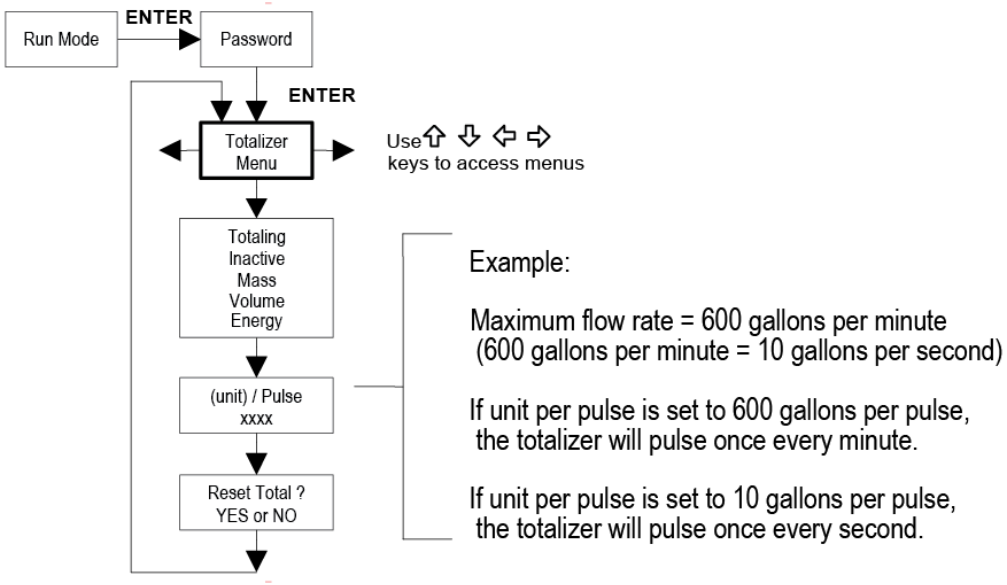
1. Use ◀ ▶ keys to move to the Units Menu.
2. Press ▼ key until Mass Flow Unit appears. Press ENTER.
3. Press ▼ key until lb appears in the numerator. Press □ key to move the underline cursor to the denominator. Press the ▼ key until hr appears in the denominator. Press ENTER to select.
4. Press ▲ key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

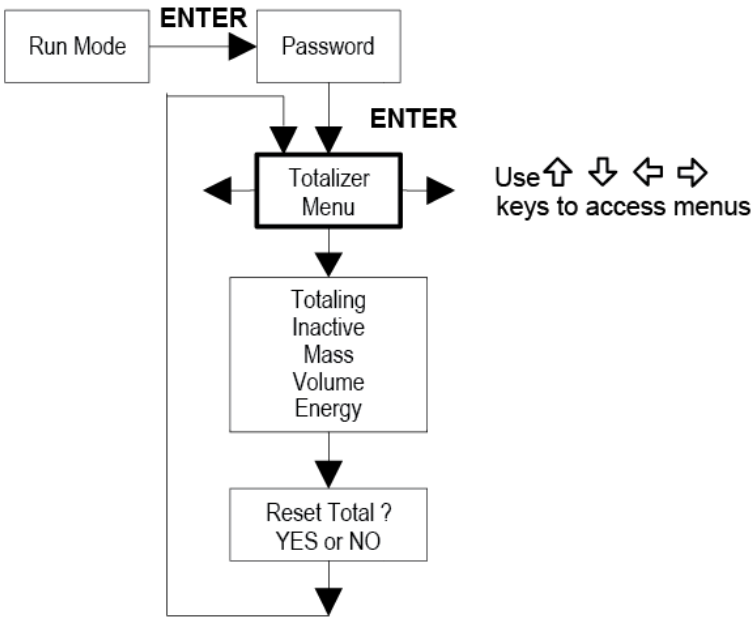
1. Use ◀ ▶ keys to move to the Units Men
2. Press ▼ key until Mass Flow Unit appears. Press ENTER.
3. Press ▼ key until kg appears in the numerator. Press ▶ key to move the underline cursor to the denominator. Press the ▼ key until sec appears in the denominator. Press ENTER to select.

4. Press ▲ key until Units Menu appears.

Second, set the pulse output:

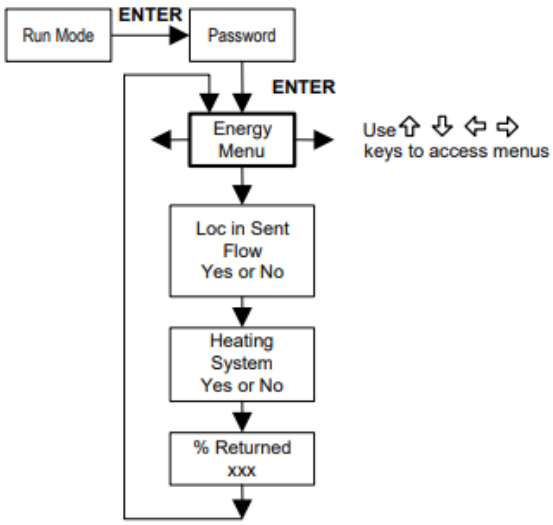
1. Use ◄ ► keys to move to the Totalizer Menu.
2. Press the ▼ key until Totaling appears.
3. Press ENTER and press the ▼ key to select Mass. Press ENTER.
4. Press ▼ key to set the pulse output in the units you have selected for mass flow of kg/sec. Press ENTER and use ▲ ▼ ◄ ► keys to set the pulse value 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.

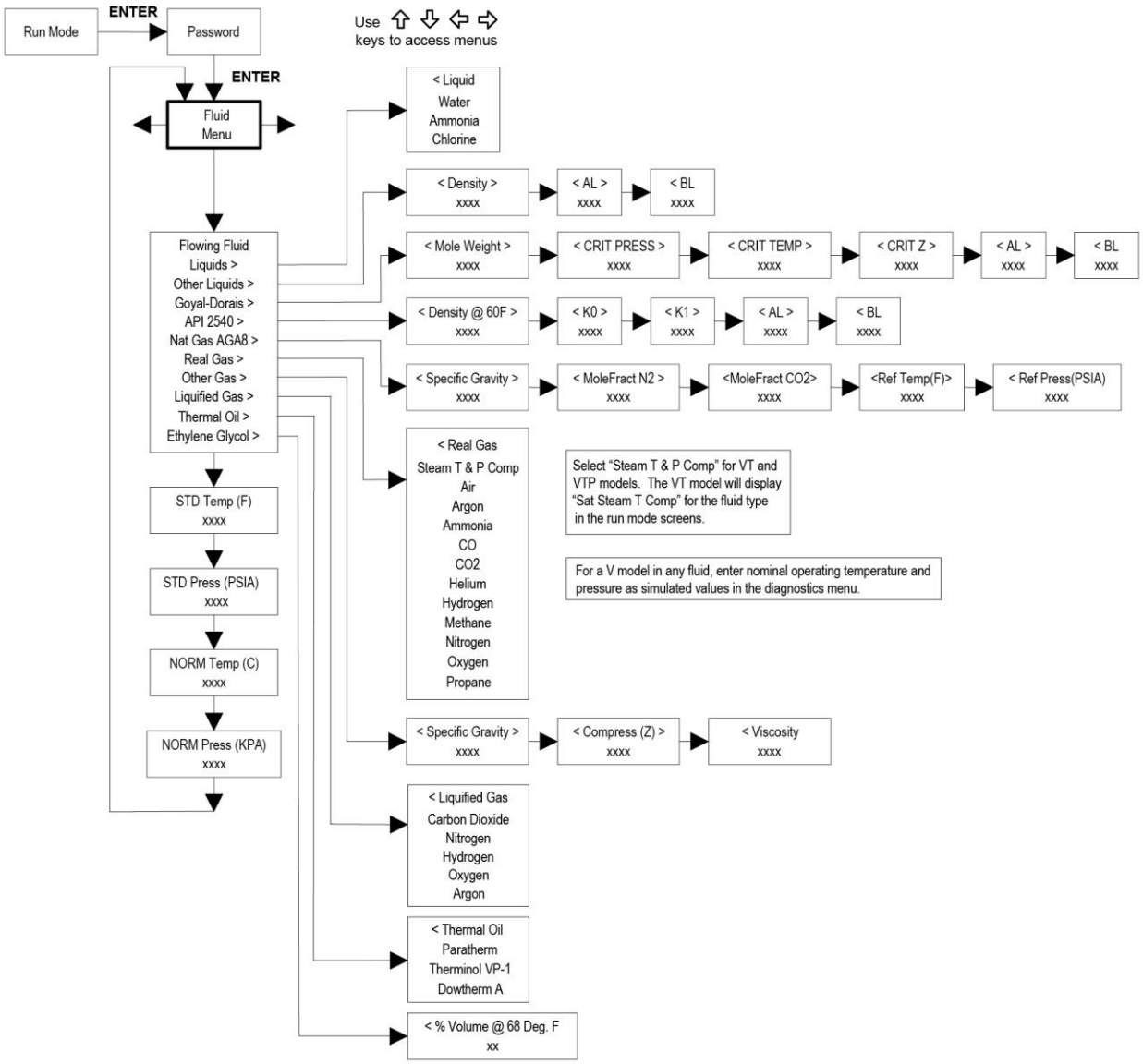
Fluid	Meter Location	Second RTD	Measurement
Water	"Sent" Flow Line	"Return Flow Line	Change in Energy
Water	"Return" Flow Line	"Sent" Flow Line	Change in Energy
Water	"Sent" Flow Line	None	Outgoing Energy
Steam	"Sent" Flow Line	"Return" Flow Line (condensate)	Change in Energy
Steam	"Sent" Flow Line	None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

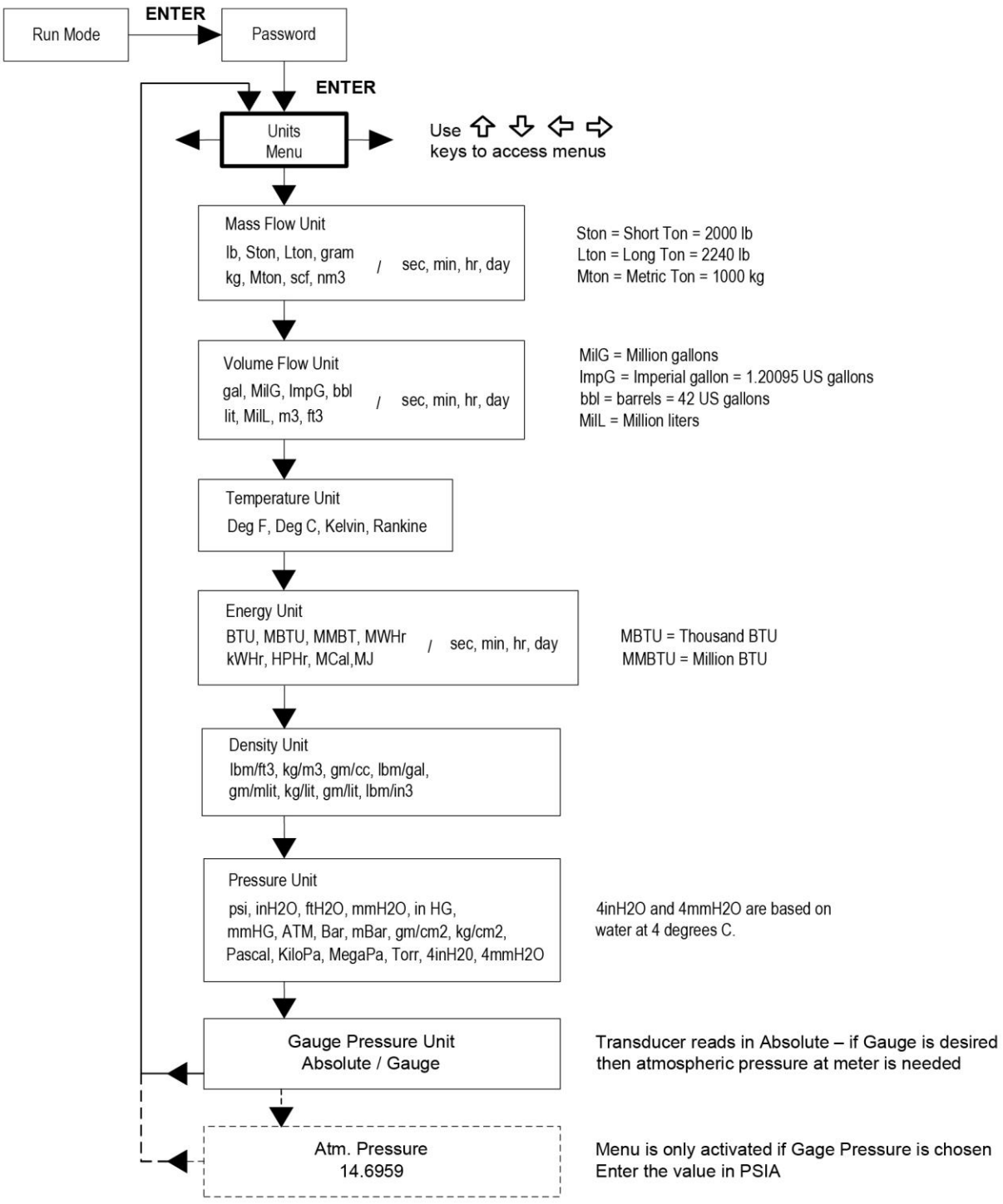
6.9 Fluid Menu



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.

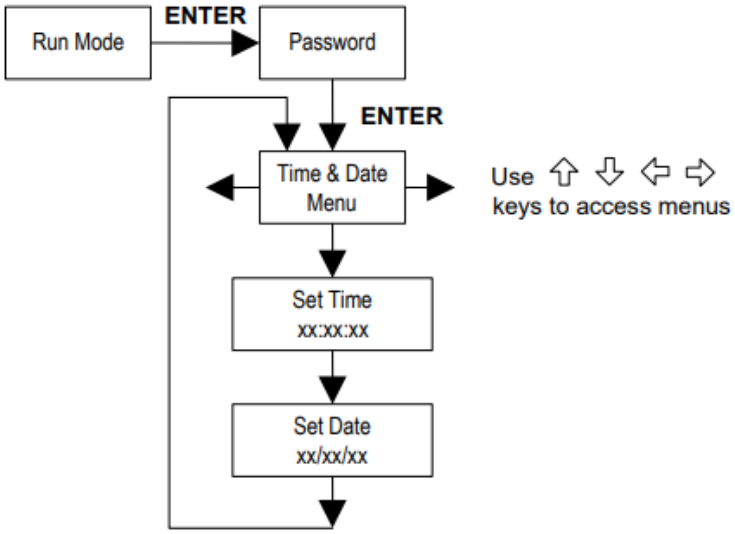
The units of measurement used in the Fluid Menu are preset and are as follows: Mole Weight = lbm/(lbm·mol), CRIT PRESS = psia, CRIT TEMP = °R, Density = lbm/ft3 and Viscosity = cP (centipoise).

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



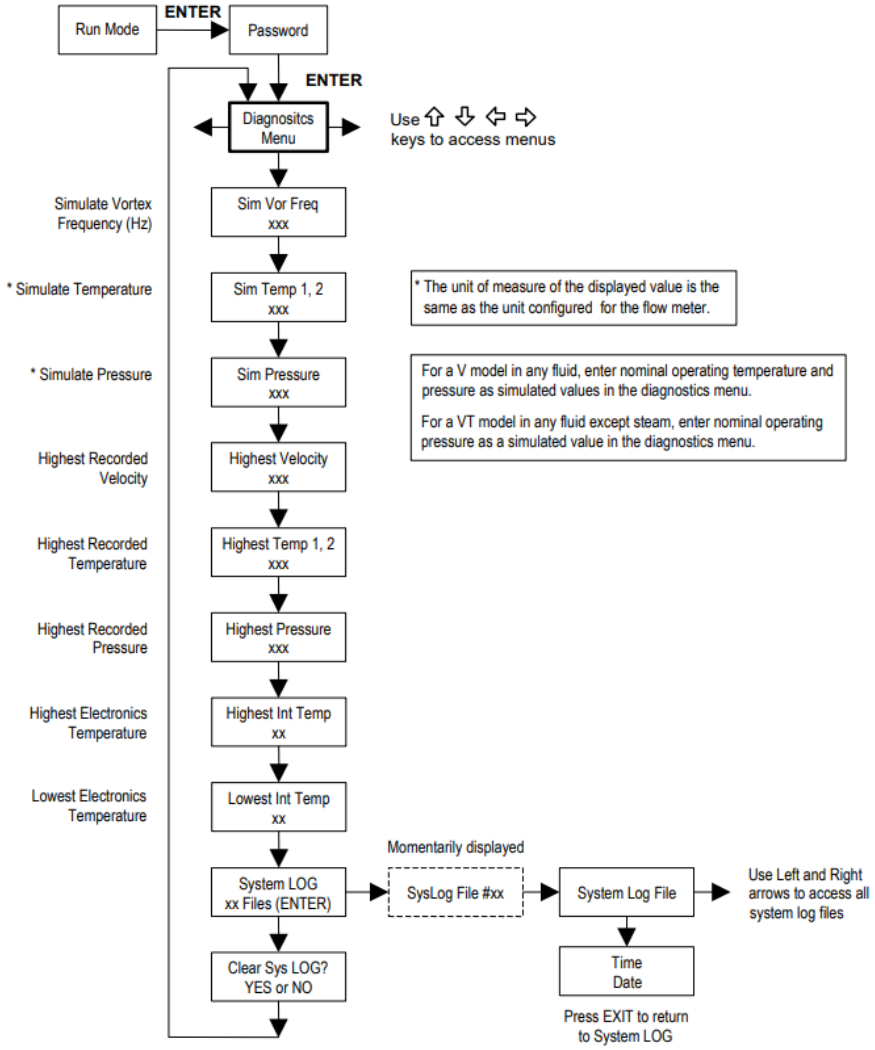
Use the Time and Date Menu to enter the correct time and date into the flow meter's memory. The parameters are used in the Run Mode and the alarm and system log files. Note: Time is displayed in AM/PM format, but military format is used to set the time. For example, 1:00 PM is entered as 13:00:00 in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

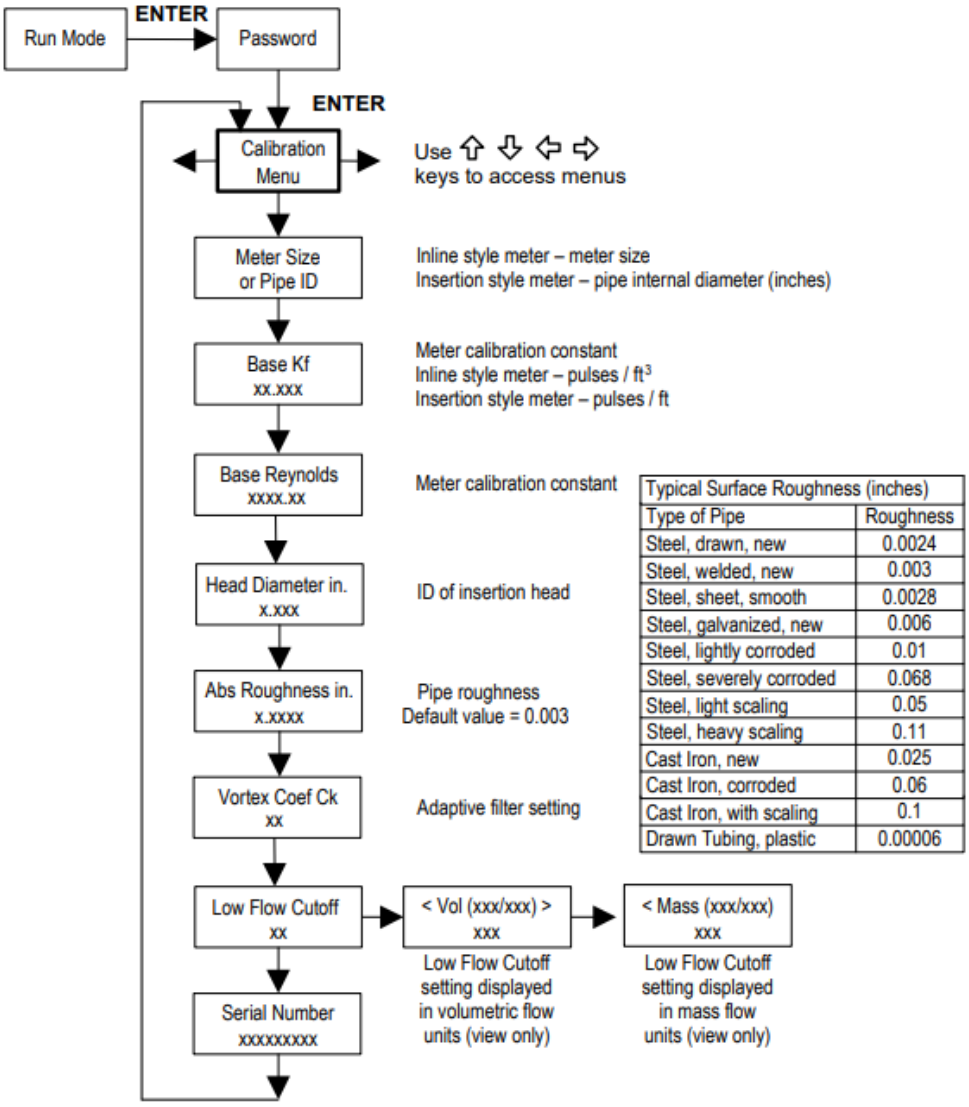
The simulated inputs are for testing the meter to verify that the programming is correct. They are also used to enter nominal operating temperature and pressure for the V only model. Simulated vortex frequency allows you to enter any value for the sensor input in Hz. The meter will calculate a flow rate 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.

If the meter display indicates a temperature or pressure fault, a substitute value can be entered to allow flow calculations to continue at a fixed value until the source of the fault is identified and corrected. The units of measure of the displayed values are the same as the units configured for the flow meter.

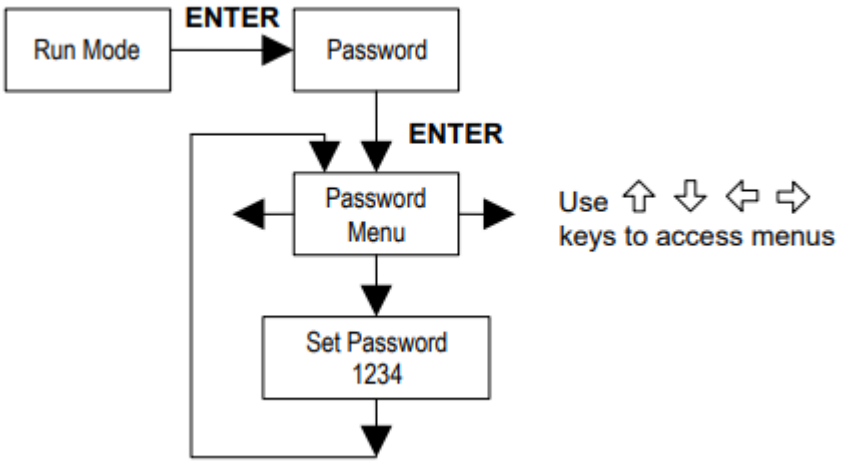
6.13 Calibration Menu



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.

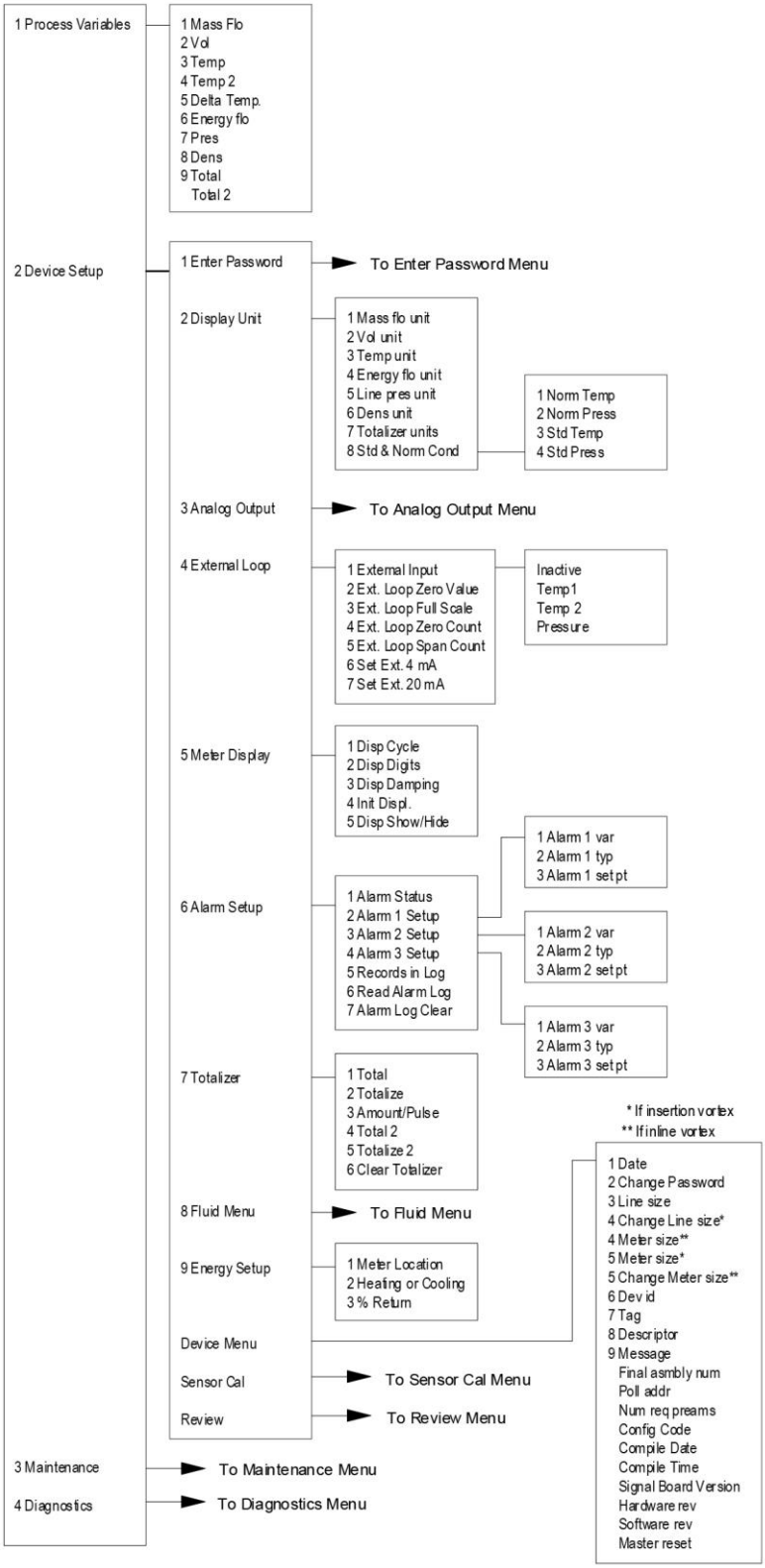
6.14 Password Menu



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

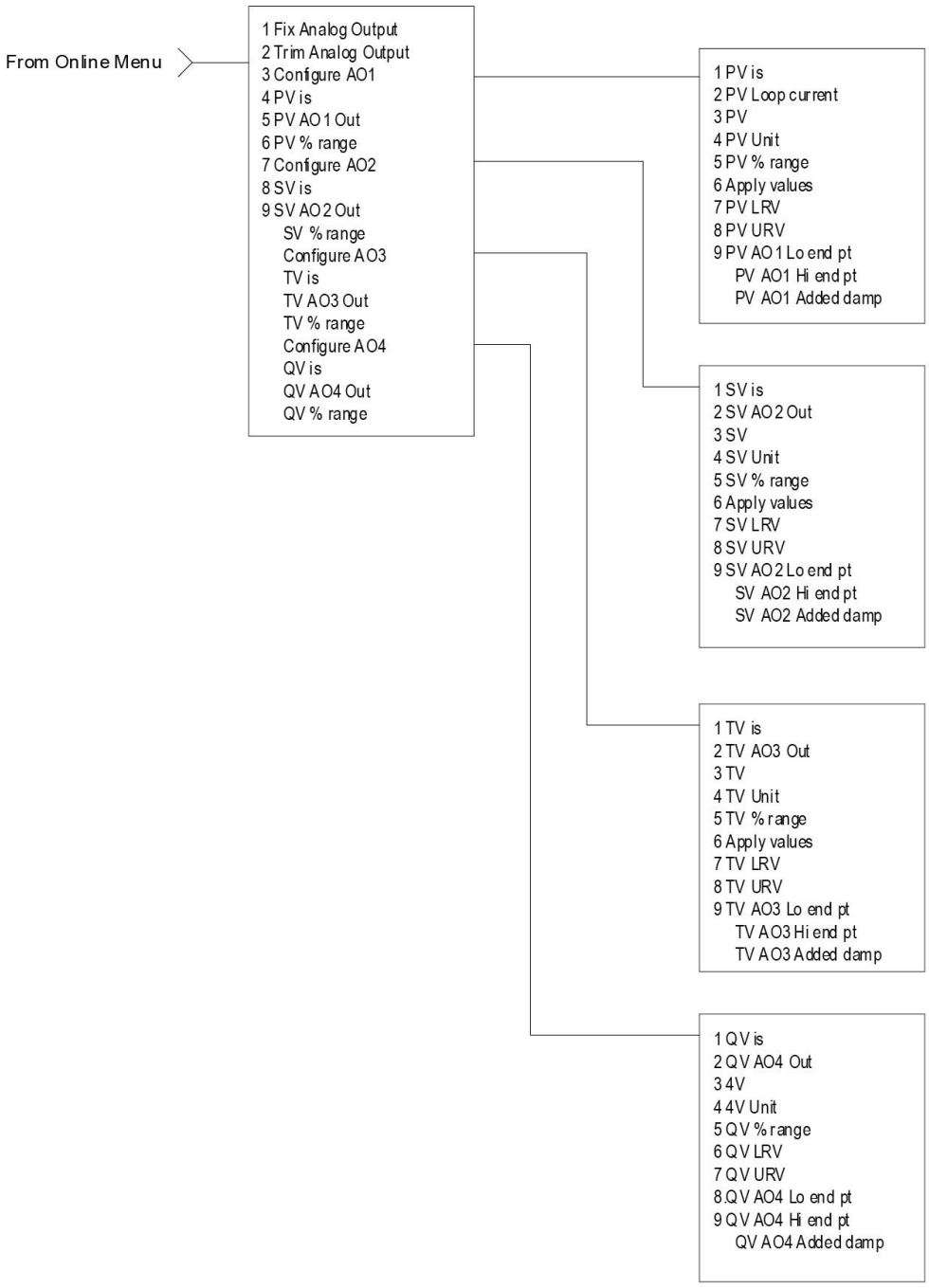
6.15 HART Commands with the DD Menu

Online Menu



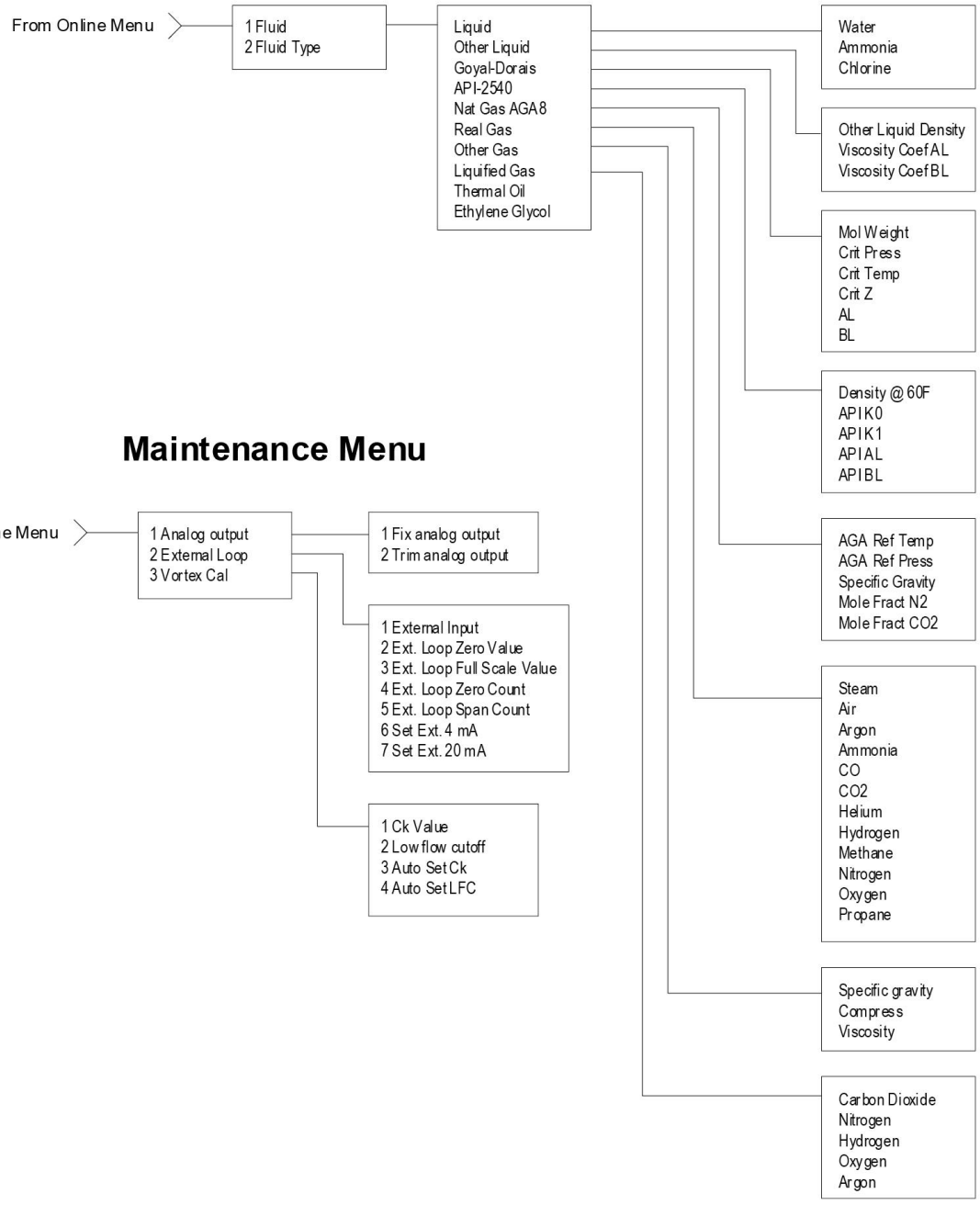
HART Commands with the DD Menu Continued....

Analog Output Menu



HART Commands with the DD Menu Continued....

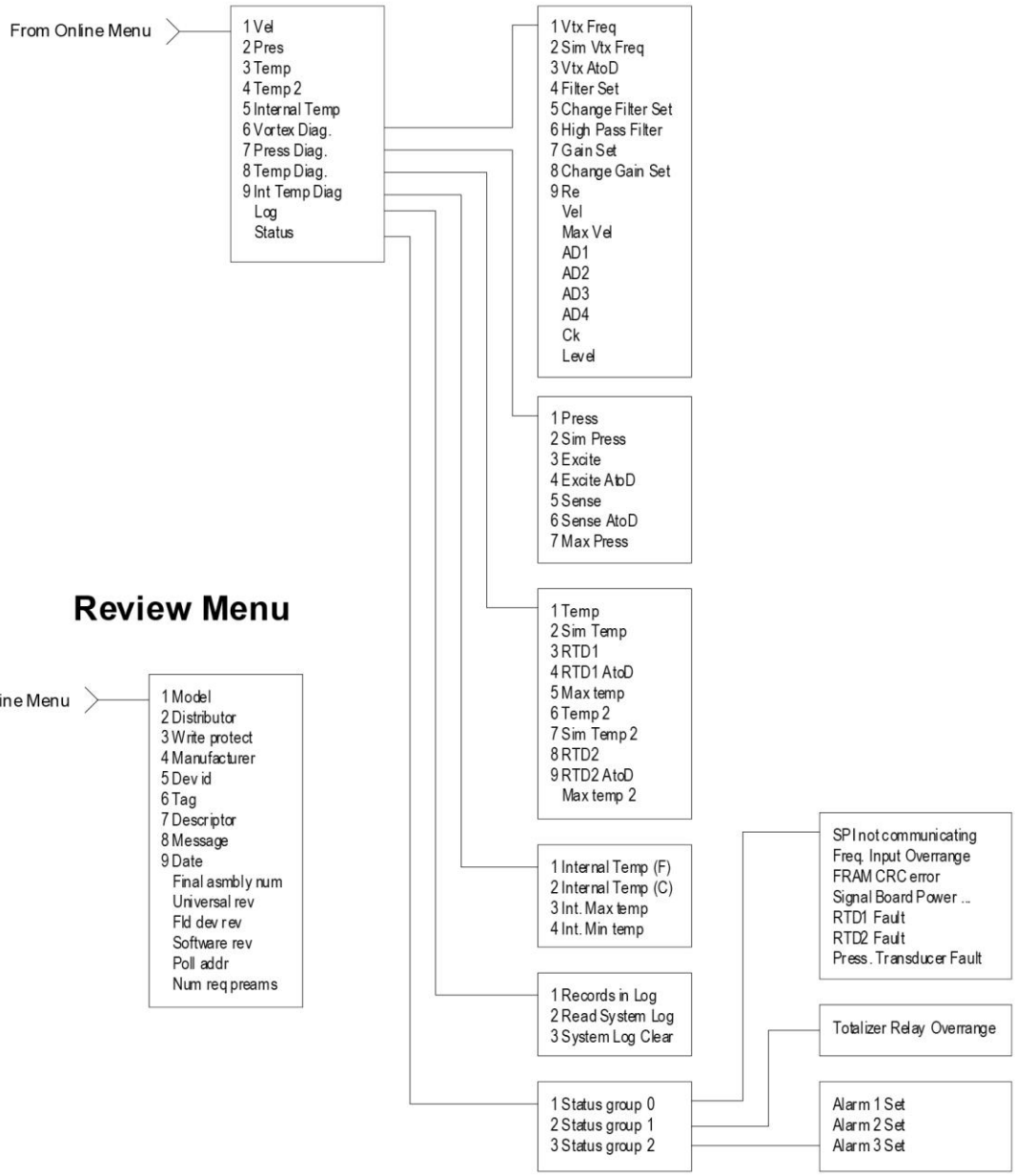
Fluid Menu



Maintenance Menu

HART Commands with the DD Menu Continued....

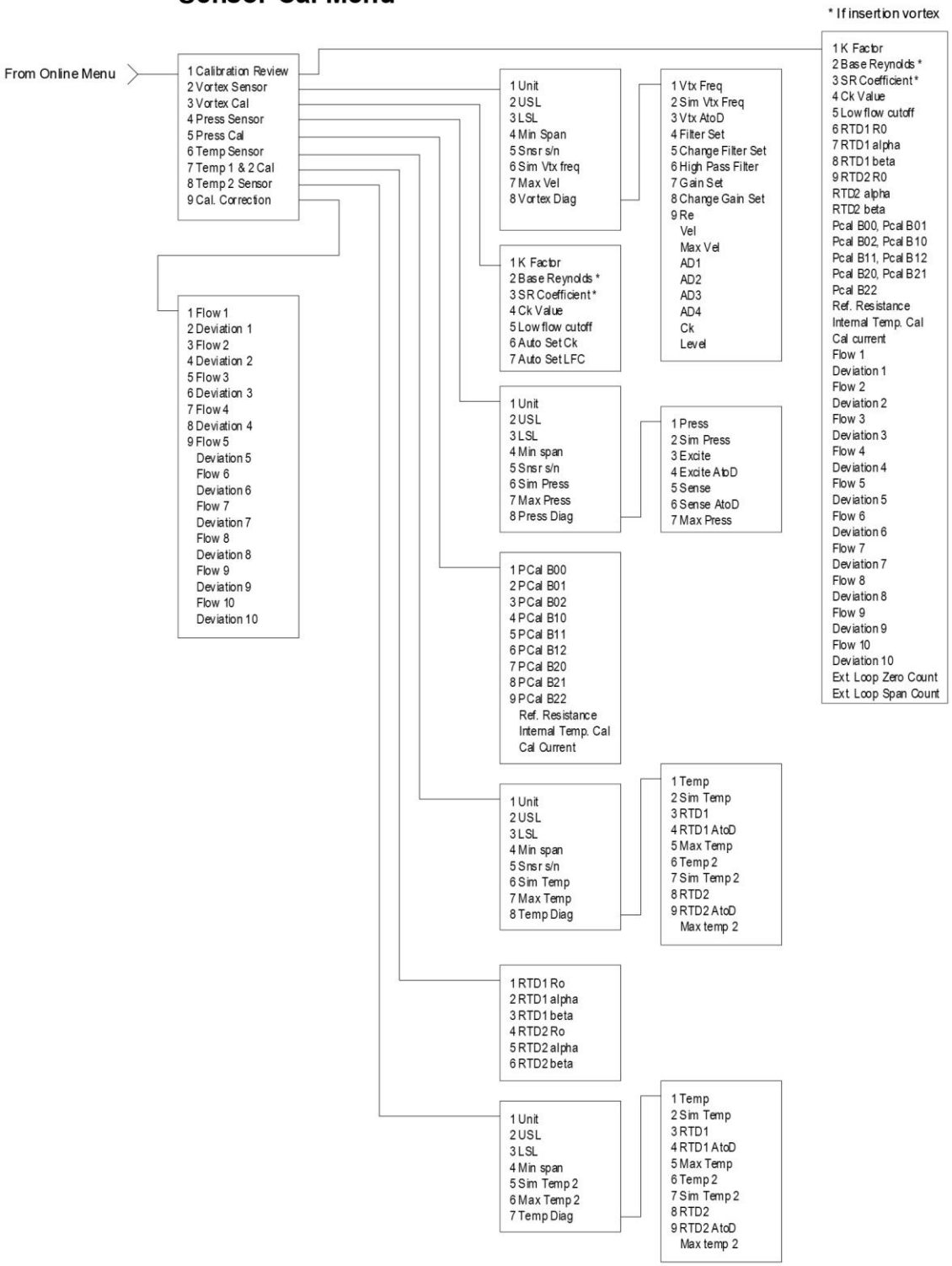
Diagnostics Menu



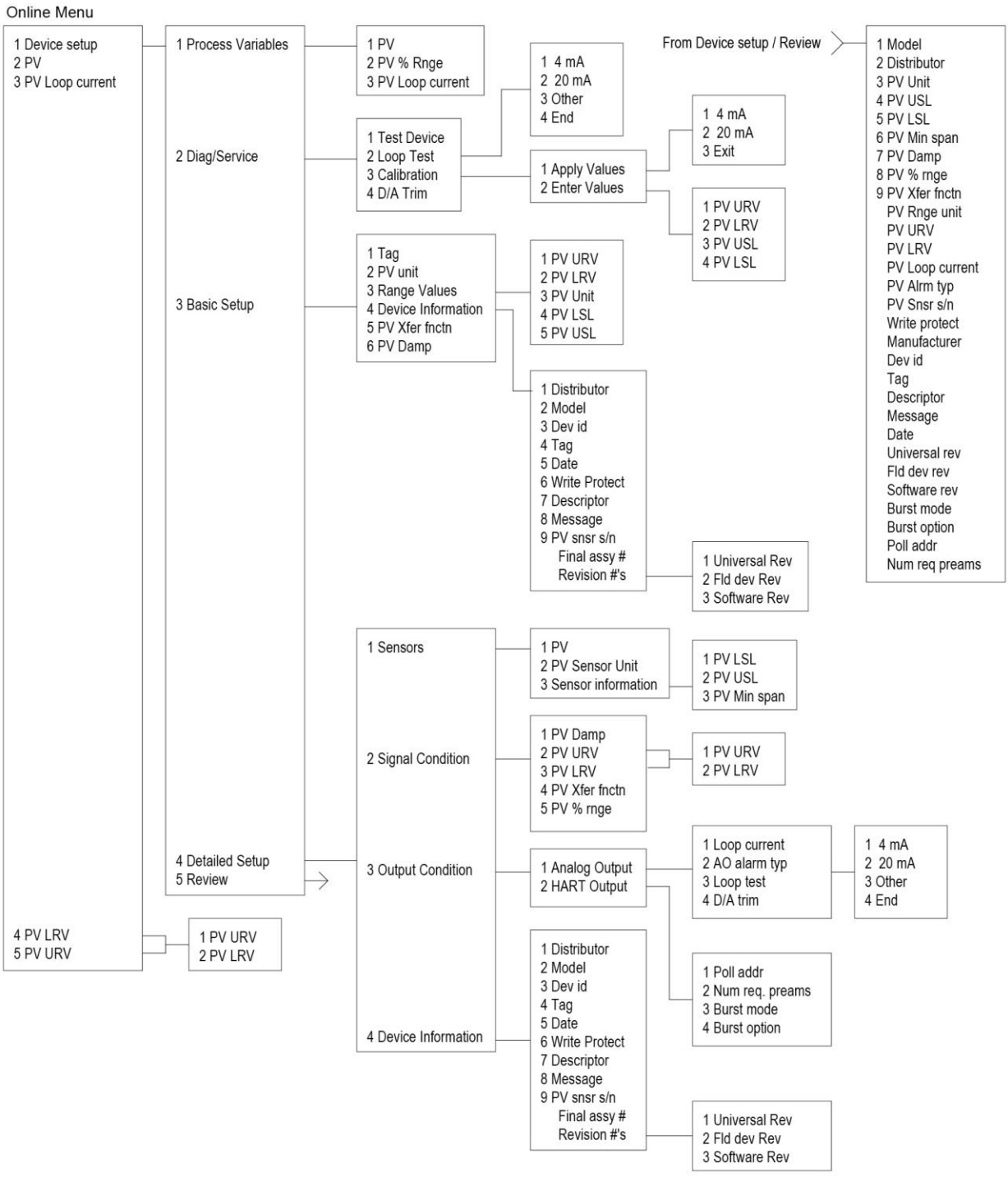
Review Menu

HART Commands with the DD Menu Continued....

Sensor Cal Menu



6.16 HART Commands with Generic DD Menu



7 Error Responses

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

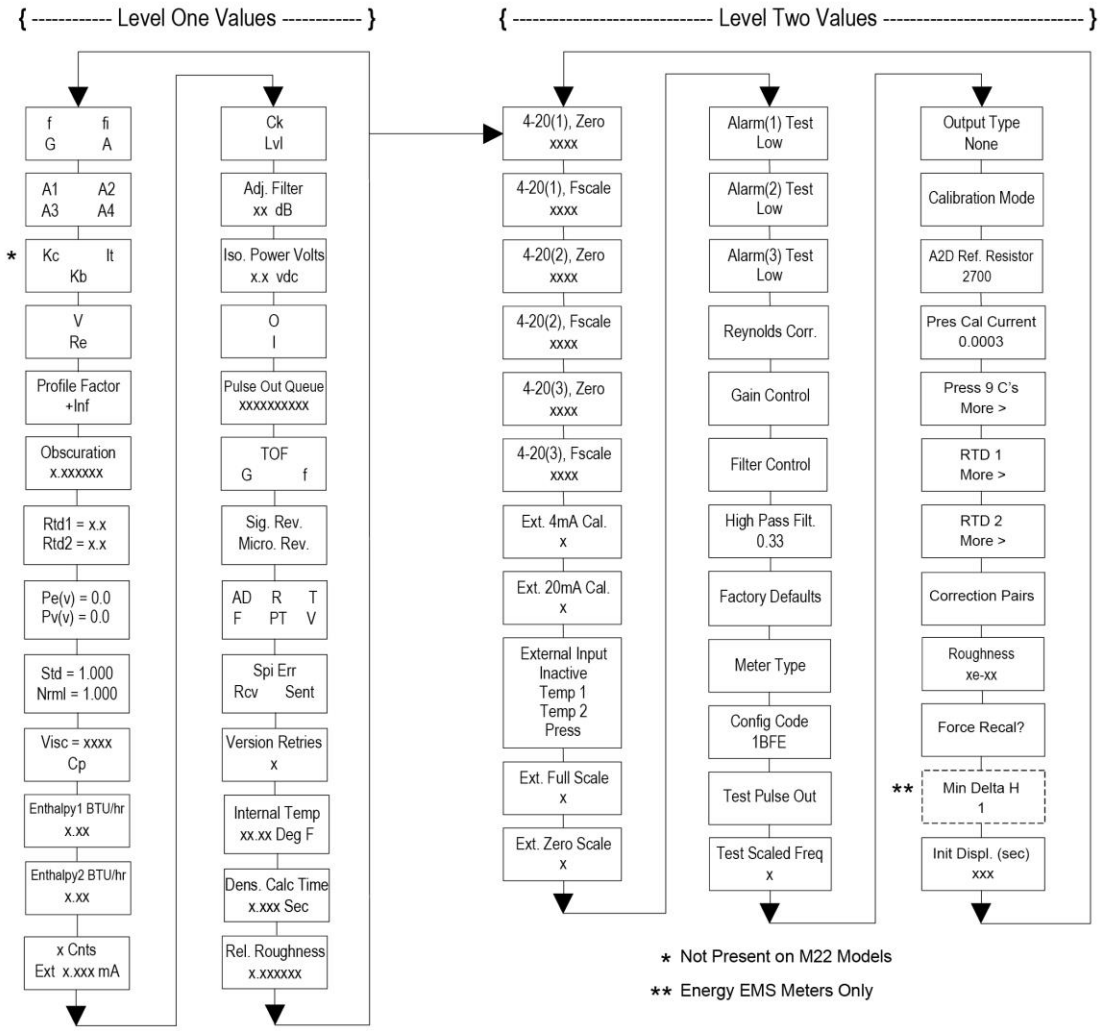
The menus shown on the following page can be accessed using the password 16363, then moving to the display that reads “Diagnostics Menu” and pressing ENTER (rather than one of the arrow keys).

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. Fliilter** = 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 =		

Record values – Hidden Diagnostics Menu continued

	With Flow	With No Flow (if possible)
Ck =		
Lvl =		
Adj. Filter =		
Iso. Power Volts =		
Config. Code =		

Note: The Config. Code is in Hidden Diagnostics Level 2

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

If the Low Flow Cutoff is less than Lvl and there is an output at no flow, then 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 the Lvl value. Increase the Low Flow Cutoff until the meter no longer gives an output at no flow.

Example: No flow and 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

The flow rate may be too low, just at the cutoff of the meter range, and the flow cycles above and below the cutoff causing an erratic output. Consult the factory if necessary to confirm the meter range based on current operating conditions

Mechanical installation may be incorrect. Verify the straight run is adequate. For inline 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.

The meter may be reacting to actual changes in the flow stream. 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. Increasing the time constant will average out the flow rate data over a longer period of time, resulting in a smoother reading.

Symptom: No Output

The Vortex Coefficient Ck may need to be adjusted. 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. The Calibration Menu Ck and the Hidden Diagnostics Ck should be close to the same value. If the Calibration Menu Ck value is significantly lower than the Hidden Diagnostics Ck value, this may cause the vortex signal to be rejected resulting in zero flow being displayed. If you raise the Ck setting in the Calibration Menu, then the fi value will increase and the Ck values should be closer to each other. 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 should increase to a large number.

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.

Turn on the pressure and temperature display in the Display Menu and verify that the pressure and temperature are correct.

Using ESD precautions and hazardous area precautions, remove the electronics enclosure window cover. Disconnect all sensors and gently wiggle on sensor wires. In some cases, loose wires can affect readings. If wires pop out, simply place the crimped metal end back into the white Molex connectors. There will be a small click once the sensor wire is correctly in place. Cycle power and note measurements.

Symptom: Meter Displays Temperature Fault

The recorded RTD values are resistance values that should correspond to the process temperature. 1000 ohm platinum RTD's are used. Please consult a resistance versus temperature table to check the temperature value. They are approximately 1080 ohms at room temperature. If the temperature is in error, the RTD may be checked as described in the Check Sensors section below. RTD2 is used for energy flow meter models.

Symptom: Meter Displays Pressure Fault

If the recorded value for pressure (Pe(V) or Pv(V)) are in error or the meter displays a pressure faults, the pressure sensor may be checked as described in the Check Sensors section below.

8.7 Electronics Assembly Replacement (All Meters)

8.8 Pressure Sensor Replacement

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