

FT-3400

ELECTROMAGNETIC FLOW METER Installation and Operation Guide



SAFETY INFORMATION

This meter was calibrated at the factory before shipment. To ensure correct use of the meter, please read this manual thoroughly.

Regarding this Manual:

- This manual should be passed on to the end user.
- Before use, read this manual thoroughly to comprehend its contents.
- The contents of this manual may be changed without prior notice.
- All rights reserved. No part of this manual may be reproduced in any form without ONICON's written permission.
- ONICON makes no warranty of any kind with regard to this material, including, but not limited to, implied warranties of merchantability and suitability for a particular purpose.
- All reasonable effort has been made to ensure the accuracy of the contents of this manual. However, if any errors are found, please inform ONICON.
- ONICON assumes no responsibilities for this product except as stated in the warranty.
- If the customer or any third party is harmed by the use of this product, ONICON assumes no responsibility for any such harm owing to any defects in the product which were not predictable, or for any indirect damages.

SAFETY PRECAUTIONS:

The following general safety precautions must be observed during all phases of installation, operation, service, and repair of this product. Failure to comply with these precautions or with specific WARNINGS given elsewhere in this manual violates safety standards of design, manufacture, and intended use of the product. ONICON Incorporated assumes no liability for the customer's failure to comply with these requirements. If this product is used in a manner not specified in this manual, the protection provided by this product may be impaired.

The following messages are used in this manual:

WARNING

Messages identified as "WARNING" contain information regarding the personal safety of individuals involved in the installation, operation or service of this product.

CAUTION

Messages identified as "CAUTION" contain information regarding potential damage to the product or other ancillary products.

IMPORTANT NOTE

Messages identified as "IMPORTANT NOTE" contain information critical to the proper operation of the product.

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1.3 STANDARD FEATURES AND SPECIFICATIONS

MODEL FT-3400		
PERFORMANCE	ACCURACY	±1.0% of reading from 2 - 20 ft/s ±0.02 ft/s below 2 ft/s
	MINIMUM CONDUCTIVITY	25 µS/cm
INPUT POWER	20 - 28 VDC, 400 mA at 24 VDC 20 - 28 VAC, 60 Hz, 10 VA	
I/O SIGNAL	ANALOG OUTPUT (ISOLATED)	One (1) 4-20 mA analog output, and one (1) 0-10 V or 0-5 V analog output
	FREQUENCY OUTPUT	0-15 V peak pulse, 0-500 Hz
	SCALABLE PULSE OUTPUT	Isolated solid state dry contact Contact rating: 30 V, 1.2A Pulse Duration: 0.5, 1, 2 or 6 seconds
ELECTRONICS ENCLOSURE	Weathertight NEMA 4 aluminum enclosure	
ELECTRICAL CONNECTIONS	10' or 20' of PVC jacketed cable with ½" NPT conduit connection	
FLOW RANGE	0.1 ft/s to 20 ft/s (200:1 turndown)	
SENSING METHOD	Electromagnetic sensing (no moving parts)	
PIPE SIZE RANGE	AVAILABLE OPTIONS	Standard Configuration: 3 - 72" nominal diameter
LIQUID TEMPERATURE RANGE	15°F to 250°F	
AMBIENT TEMPERATURE RANGE	-20°F to 150°F	
OPERATING PRESSURE	400 psi maximum	
PRESSURE DROP	0.1 psi at 12 ft/s in 3" pipe, decreasing as line size increases	
MATERIAL	Wetted metal components: 316 Stainless Steel Sensor head: XAREC Optional: NSF/ANSI 61/372 version	

*Specifications subject to change without notice.

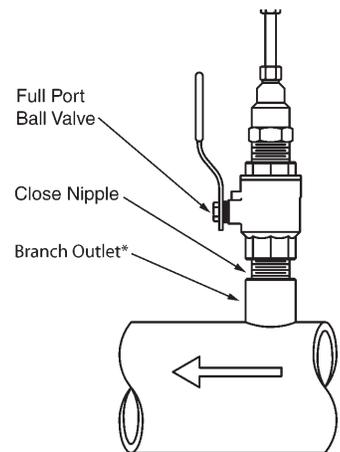
1.4 ADDITIONAL REQUIRED HARDWARE INSERTION KIT

All ONICON insertion type meters can be installed and removed via a 1" or larger full port ball valve without system shutdown. The terms "Standard" and "Hot Tap" refer to the installation method of the isolation valve kit only.

Standard Installation Hardware: For new construction or scheduled shutdown; once kit is installed, the flow meter can be installed or removed without system shutdown.

Hot Tap Installation Hardware: For applications which require the access hole in the pipe to be drilled through the valve using a wet tap drilling machine while the hydronic system is pressurized and operating.

NOTE: Installation hardware materials vary greatly based on pipe material, pipe size and standard vs. hot tap versions.



*Weld-on fitting, copper tee or saddle

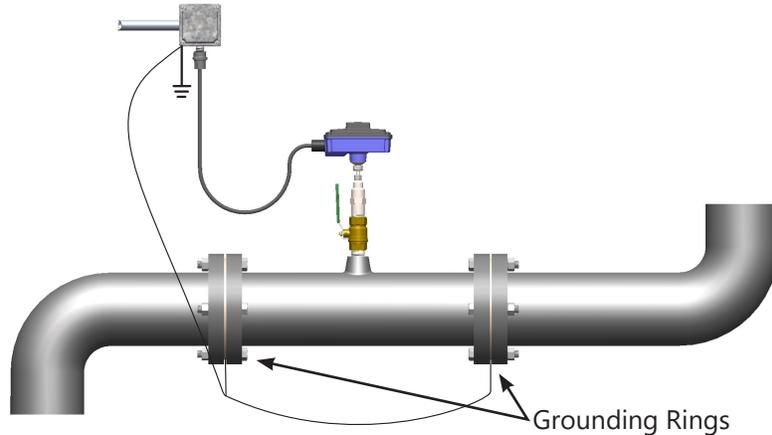
1.5 ADDITIONAL HARDWARE THAT MAY BE REQUIRED

1.5.1 Grounding Rings

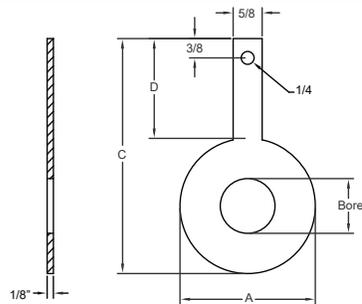
Grounding rings may be required whenever meters are installed in non-metallic or lined pipes. Grounding rings placed before and after the meter eliminate electrical noise that will interfere with the proper operation of the meter. ONICON provides grounding rings as an optional accessory. Grounding ring dimensional information and part numbers are listed below. For proper operation, grounding rings are required before and after the meter.

**Typical Installation
Non-conductive Pipe**

Note: Refer to page 21 for best earth-ground connection



GROUNDING RING DIMENSIONS



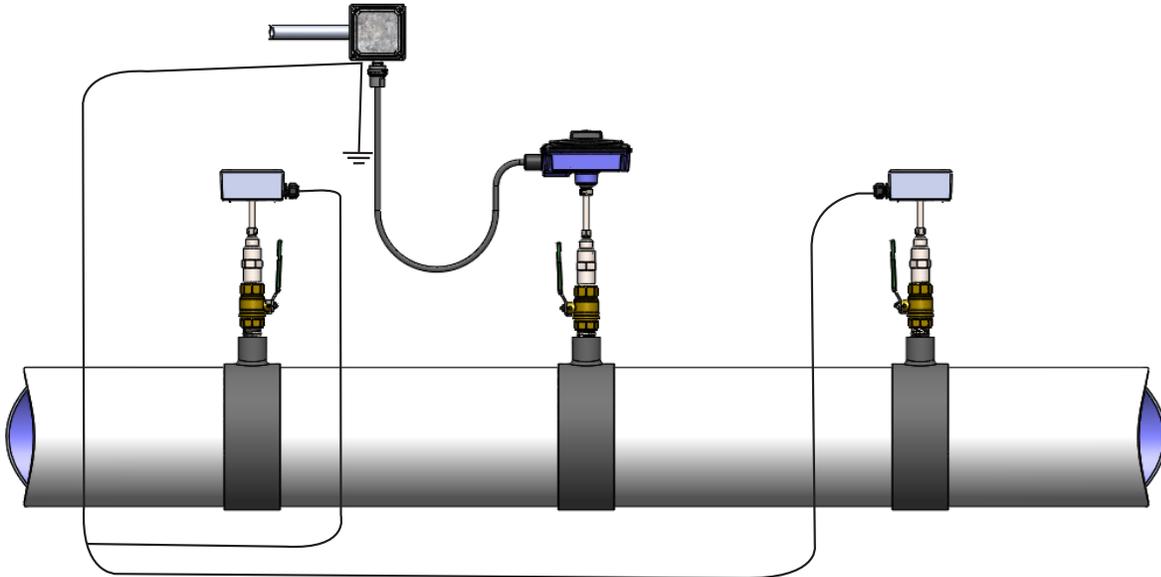
Grounding Ring Dimensions				
Nominal Size	Bore	A	C	D
1.5"	1 - 9/16	3 - 3/8	5 - 5/16	1 - 15/16
2"	2 - 1/16	4 - 1/8	6 - 1/16	1 - 15/16
3"	3 - 1/16	5 - 3/8	7 - 5/16	1 - 15/16
4"	4 - 1/16	6 - 7/8	8 - 13/16	1 - 15/16
6"	6	8 - 3/4	10 - 11/16	1 - 15/16
8"	8	11	12 - 15/16	1 - 15/16
10"	9 - 1/2	13 - 3/8	15 - 5/8	2 - 1/4
12"	11 - 9/16	16 - 1/8	18 - 9/16	2 - 7/16
14"	13 - 1/2	17 - 3/4	20 - 3/8	2 - 5/8
16"	15 - 1/4	20 - 1/4	22 - 7/8	2 - 5/8
18"	17 - 3/8	21 - 5/8	24 - 1/4	2 - 5/8
20"	19	23 - 7/8	26 - 11/16	2 - 13/16
24"	23	28 - 1/4	31 - 1/8	2 - 7/8
30"	29	34 - 3/4	38	3 - 1/2
36"	35	41 - 1/4	45 - 1/4	4
42"	41	48	52 - 1/2	4 - 1/2

GROUNDING RING ORDERING INFORMATION

ANSI Class 150 316 Stainless Steel Grounding Rings (pair)	
Nominal Size	ONICON Part Number
1.5"	19266
2"	19267
3"	19268
4"	19269
6"	19270
8"	19271
10"	19272
12"	19273
14"	19274
16"	19275
18"	19276
20"	19277
24"	19278
30"	19279
36"	19280
42"	19281

1.5.2 Grounding Probes

Grounding probes may be required whenever meters are installed in pressurized systems with non-metallic or lined pipes. Grounding probes can be hot-taped to avoid draining the system. A grounding probe is required before and after the meter to ground any electrical noise coming from any direction.



SECTION 2.0: UNPACKING

ONICON insertion electromagnetic flow meters are packed and shipped in individual cartons. All other installation hardware and peripheral devices, including Btu meters and display modules, will be packaged and shipped separately. Confirm meter is designed for the specific application. The FT-3400 has three types of sensors (hot water, chilled water, and domestic water). The configuration sheet has the type of application as well as any peripheral information attached to the meter.

Please open all packages with care to prevent damage to their contents. Carefully inspect each item for signs of damage in transit. The flow meter stem should be straight and free of blemishes or abrasions. The sensor head should have a smooth continuous surface that is free of abrasions.

All ONICON products are shipped insured unless the customer specifically requests otherwise. Please notify the shipping company and ONICON immediately if any items are damaged in transit. Save all packing material for inspection by the shipper.

2.1 CHECKING THAT YOU HAVE RECEIVED EVERYTHING

Your FT-3400 shipment should arrive with the following items:

- FT-3400 Insertion Electromagnetic Flow Meter
- Adjustable Insertion Depth Gauge
- Optional Installation Hardware Kit, if ordered

Enclosed with each meter is a comprehensive documentation package that includes the following items:

- Quick Start Guide with Meter Configuration (hanging tag)
- Flow Meter Certificate of Calibration
- Flow Meter Configuration Sheet

Please notify the ONICON if any of these documents are missing.

SECTION 3.0: INSTALLATION, REMOVAL AND ADJUSTMENT

WARNING

Insertion flow meters may be installed in pipes which are under high pressure. Accidents with these systems can cause serious injury or death. Only persons experienced with high pressure systems and related knowledge in the heating, cooling and fluid metering fields should attempt to install, adjust, or remove the flow meter. Please read all instructions before attempting to insert or remove a flow meter.

ONICON will be happy to assist with technical recommendations and to provide guidance by telephone or e-mail. On-site field engineering, installation and service is also available at additional cost.

3.1 INSTALLATION SITE SELECTION

Install the flow meter where it will be accessible for personnel to perform necessary periodic maintenance. The clearance required for installation is typically 30-40" from the pipe wall to the nearest obstruction above the valve assembly. This clearance dimension will increase with large diameter pipes. The environment should be free of corrosive liquids/fumes, temperature extremes and heavy vibration. The diagrams on the following page should be used as a guide to the proper location for installing the meter.

GENERAL PRACTICES:

1. For best results, install the flow meter in a straight run of pipe, free of bends, tees, valves, transitions, and obstructions.
2. Straight run requirements vary based on the nature of the upstream obstruction. See the table on the following page for guidelines in determining minimum up stream straight run requirements based on the nature of the obstruction.

Note: Depending upon specific location details, more or less straight run may be required to produce a satisfactory flow profile.

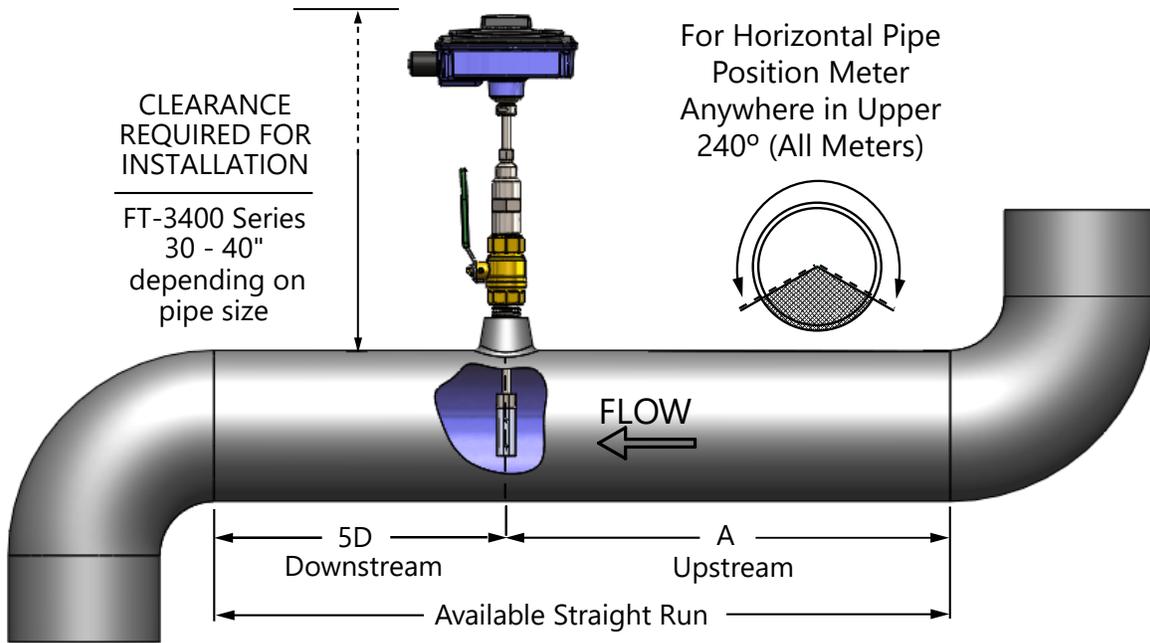
3. If there is insufficient straight run, allow 80% of the run upstream and 20% of the run downstream. If the total length of straight run is less than 70% of the recommended length, performance may seriously degrade, and consideration should be given to changing to the series FT-3000 Inline Electromagnetic Flow Meter. The FT-3400 can be installed in the supply or return line on close loop systems.

How To Determine The Available Straight Pipe Diameters:

For each application, locate the longest straight, unobstructed section of pipe (no bends, tees, valves, other insertion probes, size transitions). The longest straight pipe run in inches divided by nominal pipe size in inches equals "diameters of straight pipe." For closed loop applications, consider both the supply and return lines as possible locations.

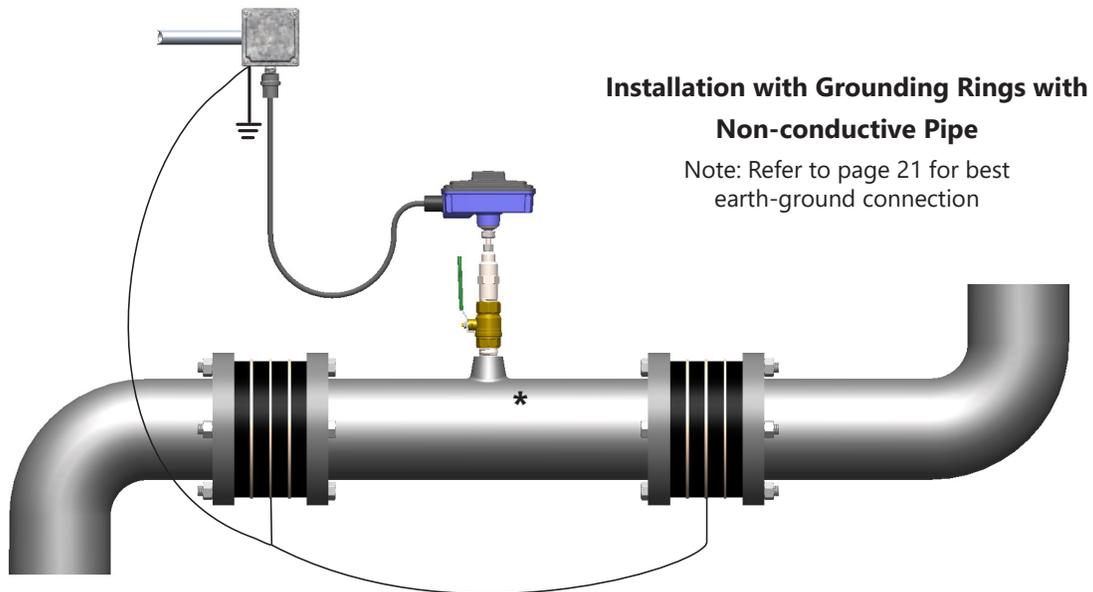
IMPORTANT NOTE

Always use the maximum available straight run. When more than the minimum required straight run is available, place the meter such that the excess straight run is upstream of the meter location.



For 3" and larger pipe diameters

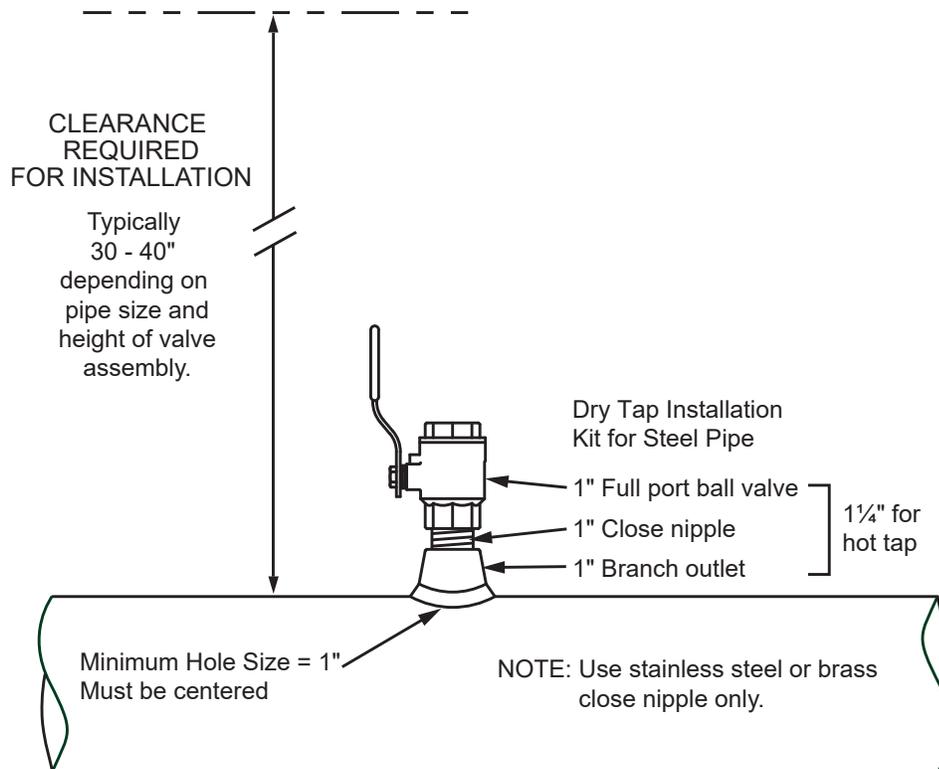
Upstream obstruction	(A) Minimum straight run required upstream of meter location
Single bend preceded by ≥ 9 diameters of straight pipe	10 Diameters
Pipe size reduction / expansion in straight pipe run	10 Diameters
Single bend preceded by ≤ 9 diameters of straight pipe	15 Diameters
Outflowing tee / Pump outflow	20 Diameters
Multiple bends out of plane	30 Diameters
Inflowing tee	30 Diameters
Control / Modulating valve	30 Diameters



* Additional straight run may be required upstream of the upstream grounding ring based on the nature of the upstream obstruction. Refer to the chart above to determine how much straight run is required.

3.2 MECHANICAL INSTALLATION

ONICON Insertion Electromagnetic Flow Meters employ a hot tap adapter design that allows for insertion and removal, when necessary, without interrupting flow and draining the pipe. To take advantage of this feature, the flow meter must be installed through an isolation valve. The installation must allow for sufficient overhead clearance to fully extract the meter, and a full 1" opening in the pipe wall is required to clear the sensor head and allow for insertion. Make sure that your valves and fittings are full port and at least 1" in actual internal diameter for dry tap installation or at least 1.25" for hot tap installations..



CAUTION

ONICON insertion style flow meters must be installed through a valve assembly. Failure to do so negates the ability to remove the meter without shutting down and draining the system. It will also result in an excessive amount of stem protruding from the pipe. Excessive stem lengths unnecessarily expose the meter to incidental damage.

IMPORTANT NOTE

Flow meters installed through oversized access holes will be subjected to undesirable turbulence that may affect the accuracy of the meter.

3.2.1 Installation Kit

ONICON offers a wide range of installation hardware kits for commonly used pipe materials. The kits are specifically designed for ONICON flow meters, and their use is recommended.

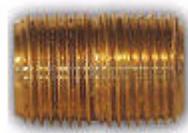
The use of ONICON installation hardware kits accomplishes two important objectives. First, it ensures that the proper hardware is used. Second, it simplifies order processing by standardizing the dimensions of the installation hardware. ONICON must have an accurate measurement of the overall height of the installation hardware as measured from the outside wall of the pipe to the top of the valve in order to determine the correct stem length when assembling the meter in our factory. ONICON documents refer to this dimension as the stack height.

ONICON installation hardware kits consist of three separate component parts:

A threaded branch outlet



A threaded close nipple



A full port isolation valve



Different pipe materials require different branch outlets and may include additional bushings, like those shown below, to properly size the opening.



3.2.2 ONICON Standard Installation Hardware Kit

Standard installation hardware kits are designed to be installed on piping systems that are drained and at atmospheric pressure. The access hole is drilled (1" minimum) prior to installation of the branch outlet with 1" NPT threads, close nipple and full port ball valve. Once the isolation valve is installed, the piping system can be flushed, filled and pressurized. The flow meter may now be inserted or removed by hand without having to drain the system. Please read all instructions before proceeding with meter insertion.

3.2.3 ONICON Hot Tap Installation Hardware Kit

ONICON offers an alternative installation hardware kit when it is not practical to relieve pressure and drain the system. In this case, a 1 1/4" branch outlet, close nipple and 1 1/4" full port ball valve are installed first. Then, a hot tap drilling apparatus is used to drill a 1" diameter hole through the valve. This eliminates the need to shut down and drain the pipe. Please read all instructions before proceeding with meter insertion.

3.2.4 Customer Supplied Installation Hardware

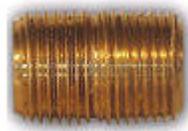
There are occasions where circumstances require that the customer provide the installation hardware or that the flow meter must be installed through existing hardware. In these cases, it is important to confirm that the installation hardware is suitable for use with the flow meter provided by ONICON before it is installed. The installation must allow for sufficient overhead clearance to fully extract the meter and a full 1" opening in the pipe wall is required to clear the sensor head and allow for insertion. Make sure that your valves and fittings are full port and at least 1" in actual internal diameter.

Installation hardware generally consists of three separate component parts:

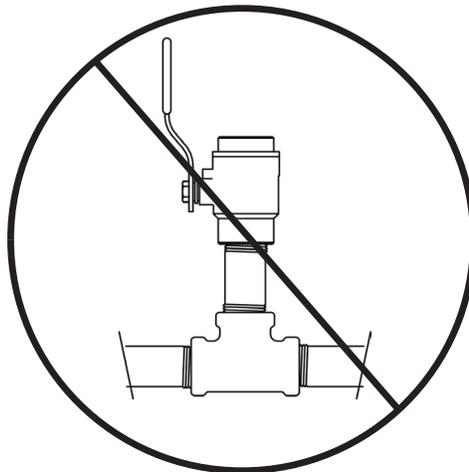
A threaded branch outlet



A threaded close nipple



A full port isolation valve



CAUTION

Do not use threaded steel or slip PVC tees to provide the 1" opening in the pipe. Tees of this type will cause significant errors in the flow measurement.

CAUTION

In order to provide the flow meter with the correct stem length, ONICON must know the overall height of the installation hardware as measured from the outside wall of the pipe to the top of the valve where the meter is installed.

CAUTION

Use stainless steel or brass nipple only.

3.2.5 Confirming the Stack Height

ONICON insertion flow meter stem lengths vary according to the pipe diameter and the height of the installation hardware stack. ONICON records the stack height dimension provided by the customer at the time of order entry, and the information is used to size the stem. For standard configuration meters, the dimension of the stack height and the depth gauge is shown on the tag attached to the meter.



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DO NOT REMOVE TAG

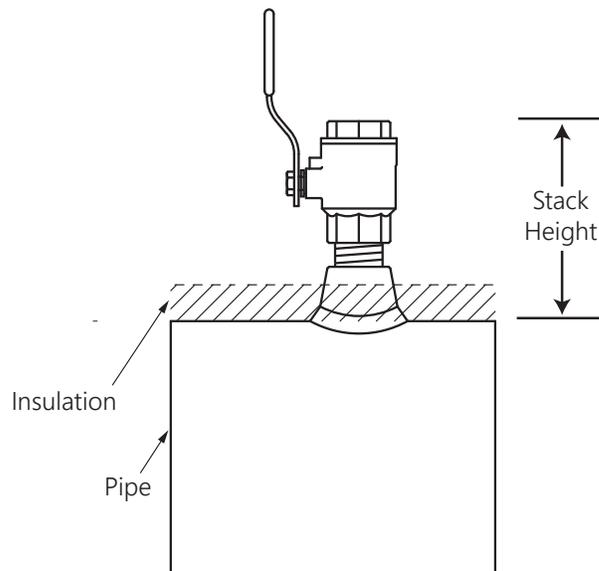
Meter Tag:	FT - 3400
Model No:	FT-3400-12-A
S/N:	1132525
Stack Height:	5.625"
Gage Length:	15.325"
Pipe Data:	8 inch PVC Schedule 40
Analog Output Type:	4-20 mA/ 0-5V
Analog Output Range:	Full Scale
Max Frequency:	1000
Meter Factor:	45451
Scaled Pulse Output:	100 Gal/Pulse
Peripheral Equipment:	-----

Calibrated By: Sadhu Moka
Date: September 20, 2023

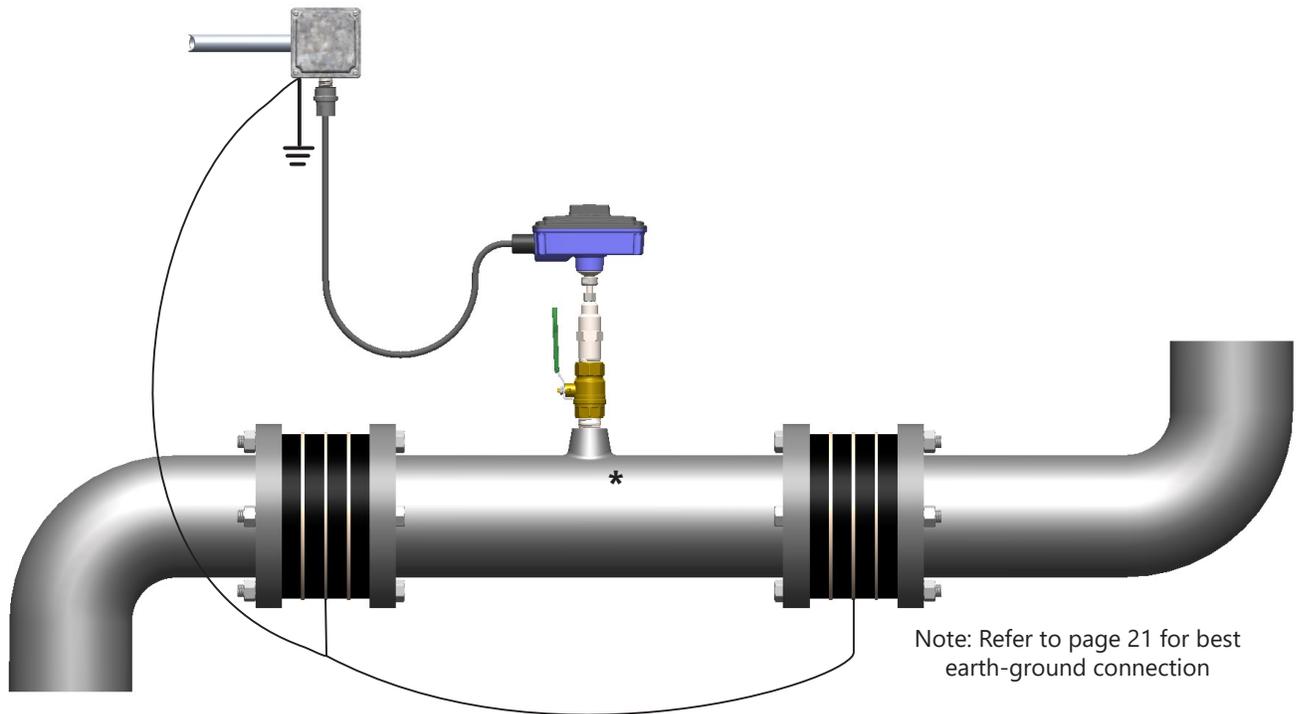
	Wire Color	Description	Notes
POWER / GROUND	Red	(+) 24V Supply voltage	Connect to power supply (+) DC (+) or AC (line) 22-26VDC, 1.2A, 25Watts or 20-28VAC, 30VA, 60hz
	Black	(-) Isolated supply voltage common	
	Green / Yellow	Earth ground connection	Required for meter operation
FREQUENCY OUT	Green	(+) Isolated frequency output	Required when connecting to ONICON display or STU meter
	Yellow	(-) Frequency output common	
ANALOG OUT	Blue	(+) Isolated 4-20mA analog output	2mA = Master Alarm
	White	(+) Isolated 2-10V or 1-5V analog output	Configurable via PC app TV = Master Alarm for 2-10V or 0.5V = Master Alarm for 1-5V
	Brown	(-) Isolated analog output common	
DRY CONTACT (Scaled Pulse or Alarm)	Orange / Black	Dry Contact 1	Pulse scaled output for totalization. Example: 1 pulse per 10 gal / 1 pulse per 100 gal
	White / Black		
	Gray / Black	Dry Contact 2	Master Alarm Contact
	Violet / Black		
	Gray	Dry Contact 3	Bidirectional Contact (only available on the FT-3400-2)
Violet			

Small Pipe Configuration meters use an insertion depth collar to properly set the insertion depth.

Prior to installing the meter, confirm that the stack height recorded on the tag is close to the actual stack height. Flow meter stems are intentionally over sized to allow for variations of at least 2" in the stack height. Contact ONICON prior to installation if there is any question regarding stack height or stem length. This way ONICON can offer you credit for your meter if you decide to exchange the meter for one with a different stem length. Returns may be subject to a restocking fee.



3.2.6 Installing Grounding Rings and Grounding Probes

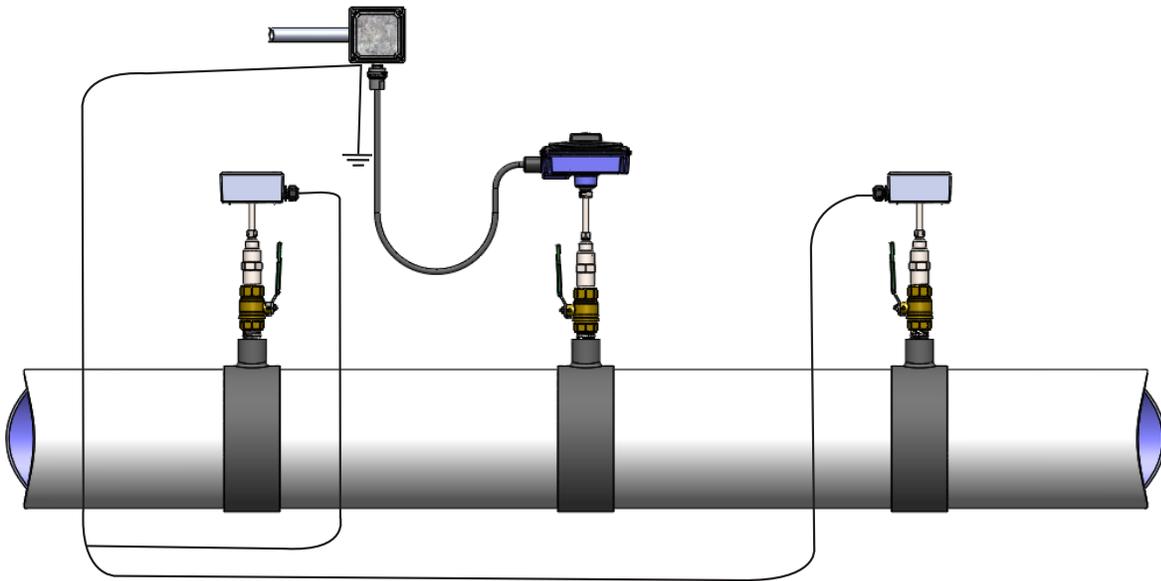


*** Additional straight run may be required upstream of the upstream grounding ring based on the nature of the upstream obstruction. Refer to the chart in Section 3.1 on page 8 of this manual to determine how much straight run is required.**

Grounding rings are used to suppress electrical interference at the installation location for electromagnetic flow meters. They are provided in pairs and are installed upstream and downstream of the flow meter. The use of grounding rings significantly reduces electrical noise and may be necessary for proper operation of flow meters installed in lined or non-conductive pipes.

Grounding Ring Installation Instructions

1. Install the rings upstream and downstream of the meter as shown above.
(Please note that the straight run requirements shown above are only for locating the grounding rings with respect to the FT-3400 flow meter. The complete straight run requirements for this meter are found in Section 3.1 on page 9 of this manual.)
2. Install each grounding ring sandwiched between (2) ANSI Class 150 flanges and (2) gaskets.
3. Center each gasket on the grounding ring surface. Do not allow the gasket to protrude into the flow stream.
4. Use the torque specifications provided with the gaskets when tightening the flange bolts.
5. Wire the two grounding rings together as shown and connect them to the flow meter earth wire. Connect this to a known good earth connection. See Section 3.5.2 of this manual on page 21 for additional information on identifying an acceptable earth connection.



Hot Tap Grounding Probes Installation Instructions

This kit can be installed on a pressurized pipe. A hot tap drilling machine must be used to create $\frac{7}{8}$ " openings in the pipe wall in a pressurized pipe. Once installed, this kit allows for the insertion and removal of the probes without a system shutdown.

1. Identify an appropriate location for each probe.
2. Weld the branch outlets onto the pipe or install pipe saddles as per the manufacturer's instructions.
3. Install the close nipples and ball valves as shown on the image. Use a paste type thread sealant.
4. Use a hot tap drilling machine with a $\frac{7}{8}$ " hole saw to drill the access hole.
5. Remove the drill and flush all debris out of the valve before installing the probes.
6. Install the grounding probes according to the instructions attached to each probe.

3.2.7 Installing the Flow Meter

WARNING

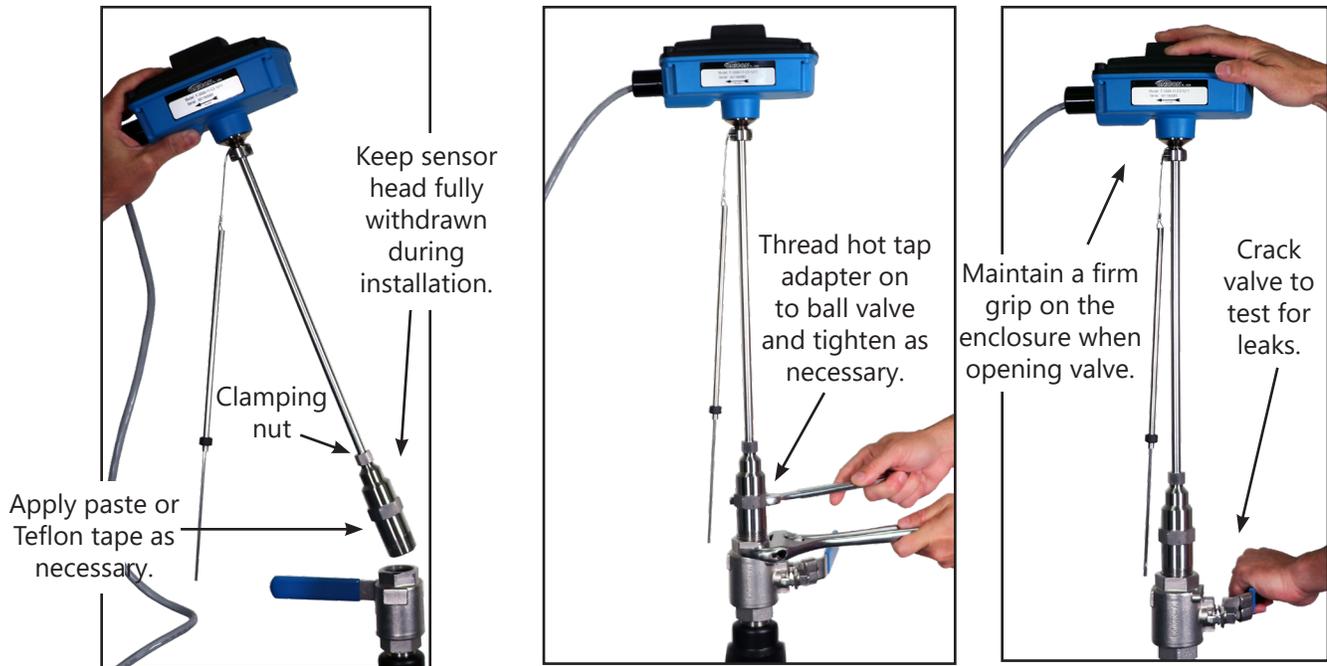
When you are ready to refill the system, make sure that all lines are filled with water before inserting the meter into the flow stream. If the lines are not filled and this is a hot water system, some water may flash to steam and exceed the high temperature limit for the sensor head assembly. This flash over could also exceed the pressure ratings of the meter and the assembly could fail allowing steam and hot water to escape causing serious injury.

Tools needed for standard installation:

- 1 5/16" wrench or adjustable wrench
- 5/8" wrench or small adjustable wrench
- Pipe wrench (to hold valve in place)
- Pipe thread sealant



Flush, fill and pressure test the piping system prior to installing the meter. Loosen clamping nut to facilitate installation.



CAUTION

If there are any leaks around the clamping nut or stem, DO NOT ATTEMPT TO STOP THE LEAKAGE BY OVERTIGHTENING THE CLAMPING NUT. Damage to this nut or the clamping ring under the nut may prevent the assembly from properly holding the meter in the pipe. The clamping nut is not part of the sealing mechanism. Any leaks in this area indicate that the "O" ring is not sealing properly and you must contact ONICON for assistance.

3.3 INSERTION OF THE METER

WARNING

SYSTEM MAY BE UNDER HIGH PRESSURE. When adjusting the meter position or removing it, be sure to hold the electronics enclosure firmly by hand before SLOWLY loosening the positioning clamping nut. Failure to do this will allow the pressure to suddenly and rapidly force the meter from the pipe causing serious injury. The meter could also be damaged or break apart causing a break in the water seal with the resultant loss of large amounts of water. The hand effort required to hold the meter will be 0.11 times the pipe pressure.

Begin by calculating the effort that will be required to hold the meter. Establish adequate footing for this task, taking extra caution when working from a ladder or platform. Use the following formula:

$$E = 0.11 \times P \quad \text{Where: } E = \text{effort in pounds}$$

$$P = \text{system pressure in pounds per square inch}$$

Example: In a 300 PSI system, 33 pounds of effort is required to insert the meter into the pipe.

3.3.1 Inserting Standard Configuration Flow Meters

Step 1: Maintain a firm grip on the enclosure to counteract the effects of the pressure in the pipe.

Step 2: Slowly open the valve to the full open position.

Step 3: Use the end of the depth gage to pierce any insulation that may be present and rest the gage on the outside wall of the pipe.

Step 4: Orient the enclosure to parallel with the pipe and in alignment with the flow direction arrow.

Step 5: Slowly push down on the flow meter until the bottom of the enclosure rests on the top of the depth gage.

Step 6: Carefully tighten the clamping nut. DO NOT OVERTIGHTEN.

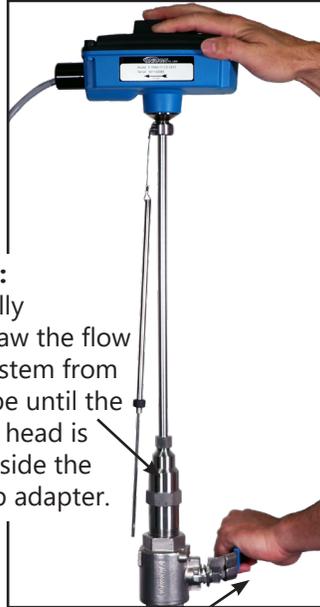
3.4 REMOVAL OF THE METER

WARNING

SYSTEM MAY BE UNDER HIGH PRESSURE. When removing the flow meter, be sure to hold the electronics enclosure firmly by hand before slowly loosening the positioning clamping nut. Failure to do this will allow the pressure in the pipe to suddenly and rapidly force the meter from the pipe causing serious injury. The meter could also be damaged or break apart causing a break in the water seal with the resultant loss of large amounts of water. The hand effort required to hold the meter will be 0.11 times the pipe pressure.



Step 1:
Slowly loosen the position clamping nut while maintaining a firm grip on the enclosure to counteract the effect of pressure in the pipe.



Step 2:
Carefully withdraw the flow meter stem from the pipe until the sensor head is fully inside the hot tap adapter.



Step 3:
After the meter is completely withdrawn, slowly close the valve to isolate flow.

Step 4:
After the valve is completely closed, unscrew the hot tap adapter from the valve. For hot water meters, partially unscrew the adapter to vent pressure before fully removing the meter.

NOTE:
The hot tap adapter will contain a small amount of water.

IMPORTANT NOTE

Removal of the meter is the same for small pipe configuration meter installations. The clamping nut can be accessed with the alignment tool installed.

CAUTION

The main cause of damage to meters comes from accidentally closing the valve on the sensor head. To avoid this, gently rotate the meter by twisting the electronics enclosure back and forth (twist the stem, do not bend it) while you slowly close the valve. If the valve touches any part of the meter, you will feel it as you are twisting the meter. If the valve touches anything, it means the meter is not fully withdrawn. Usually a gentle twisting motion while withdrawing the meter will clear any obstruction and permit the meter to withdraw completely. (Excessive build-up on the stem may require the hot tap "O" ring to be lubricated with silicone.)

WARNING

In hot water systems, even a small amount of water can cause serious personal injury. Use extra caution when working with hot water meters.

3.5 WIRING CONNECTIONS

Make all connections to the attached 10 ft or 25 ft cable.

The most common causes of electronic failures are mis-wired connections during installation. When adding additional cable, record and carefully document any substitution of wire colors. Additional cable may be purchased from ONICON that will allow you to maintain the existing color coding.

All electrical connections to the FT-3400 must be made through the 10 ft or 25 ft cable provided with the meter. This cable is not designed to be removed in the field, and any attempt to do so will compromise the weather tight integrity of the enclosure. Special care is required to ensure that the FT-3400 is connected to earth through the green/yellow earth wire. This connection is required to prevent random electrical noise from interfering with the operation of the meter. (See section 3.5.2 for details.)

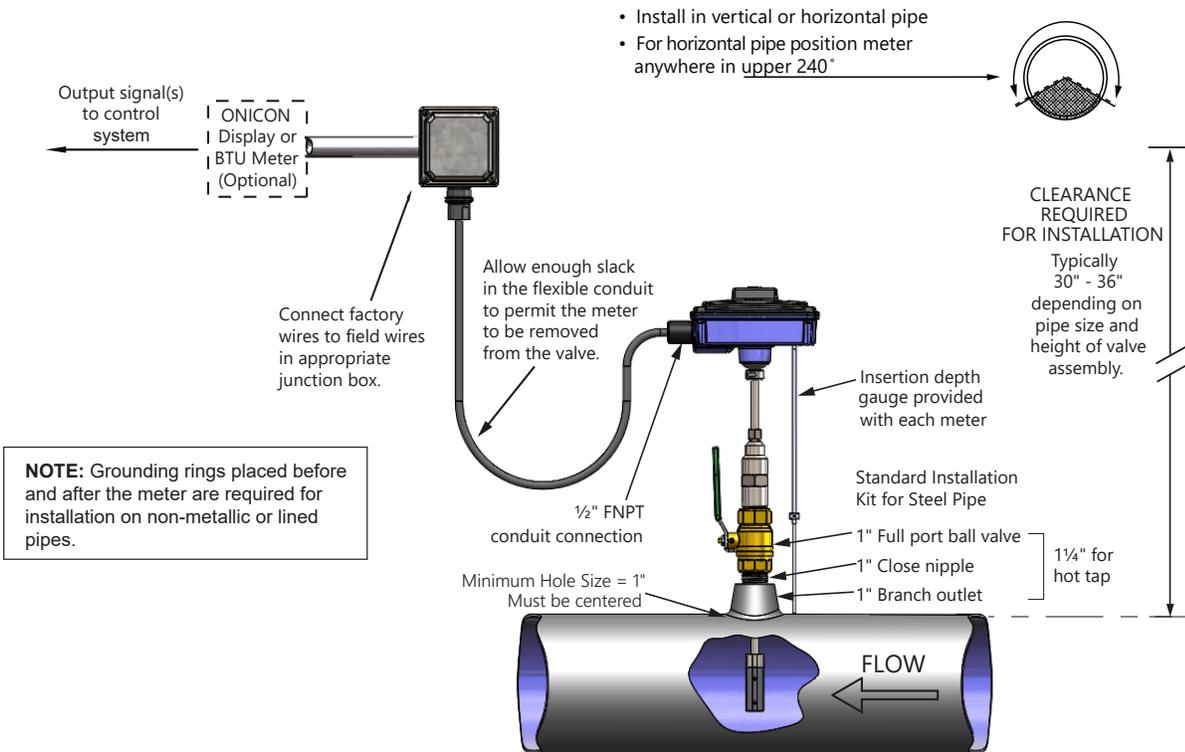
CAUTION

Do not attempt to remove the existing cable or to remove the factory installed connection fitting. Doing so will compromise the weather tight integrity of the enclosure and may void the warranty.

CAUTION

Only qualified personnel should attempt to make electrical connections to the FT-3400. Failure to properly connect the FT-3400 power, signal or earth connections may result in damage to the FT-3400 and/or to associated peripheral equipment.

3.5.1 Signal and Power Wiring Connections



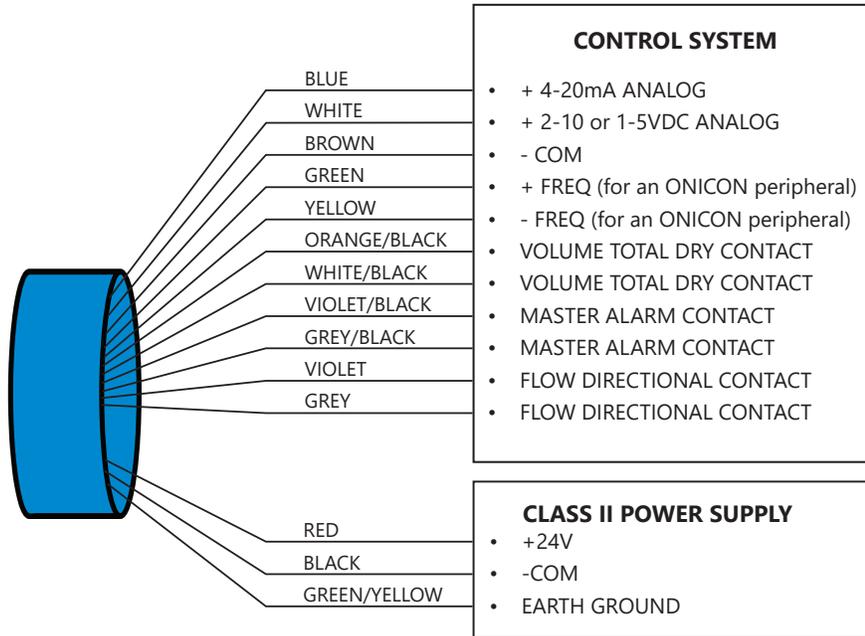
- Install in vertical or horizontal pipe
- For horizontal pipe position meter anywhere in upper 240°

NOTE: Grounding rings placed before and after the meter are required for installation on non-metallic or lined pipes.

Note: Installation kits vary based on pipe material and application. For installations in pressurized (live) systems, use "Hot tap" 1 1/4 inch installation kit and drill hole using a 1 inch wet tap drill.

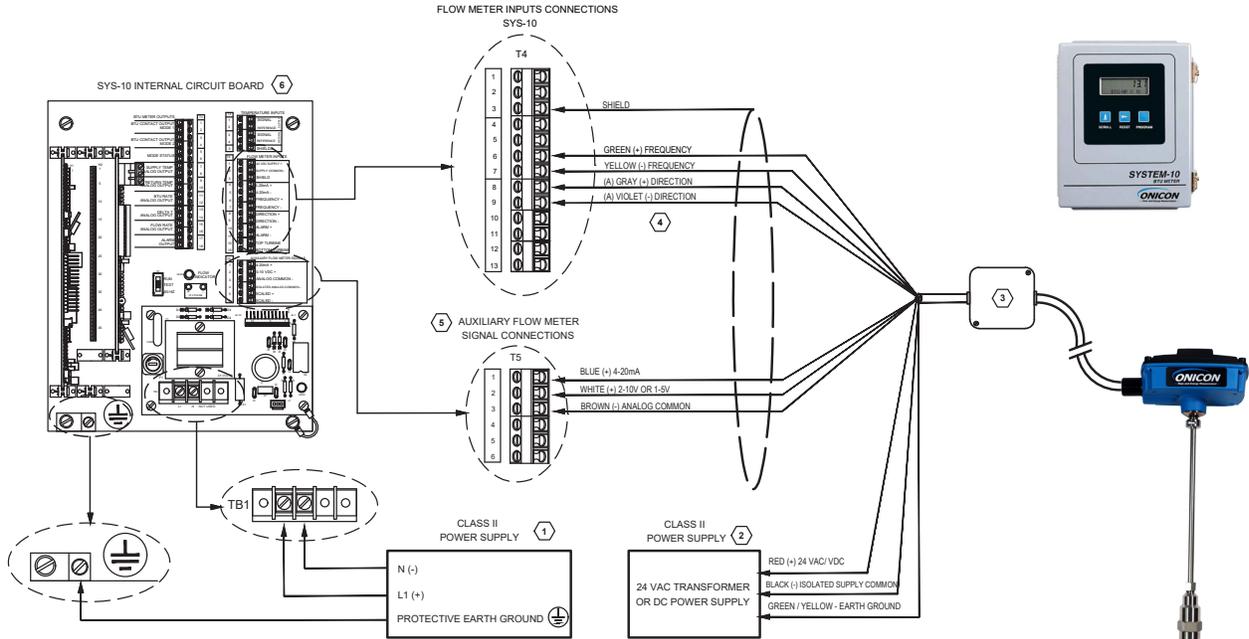
Install meter as shown using flex conduit and junction box. Leave sufficient slack in flex conduit to allow the meter to be removed without disconnecting cable. Run factory installed meter cable to junction box through flex conduit making connection to field wires at this point.

Wire Color	Description	Note
Power / Ground		
Red	(+) Supply voltage	Connect to power supply: (+)24VDC or (+)24VAC (line)
Black	(-) Isolated supply voltage common	Connect to power supply: (-)DC or (-)AC (neutral)
Green / Yellow	Earth ground connection	Required to operate the meter
Frequency Output		
Green	(+) Isolated frequency output	Required when connecting to ONICON display or BTU meter
Yellow	(-) Frequency output common	
Analog Output		
Blue	(+) Isolated 4-20mA analog output	DO NOT POWER THE LOOP. Meter is provided with 4-20mA active output. 2mA = alarm condition.
White	(+) Isolated 2-10 V or 1-5 V analog output	1 V = alarm condition for the 2-10V analog output configuration. 0.5 = alarm condition for the 1-5V analog output configuration. 0-10V or 0-5V can be reconfigured via diagnostic GUI
Brown	(-) Isolated Analog output common	
Dry Contact (Scaled Pulse or Alarm)		
Orange / Black	Dry Contact 1	Pulse scaled output for totalization. Examples: 1 pulse per 10 gal. 1 pulse per 100 gal.
White / Black		
Gray / Black	Dry Contact 2	Master Alarm Contact
Violet / Black		
Gray	Dry Contact 3	Bidirectional Contact
Violet		



- Notes
- Do not power the analog output
 - Flow directional contact is only available for the FT-3400-2
 - Frequency output is used for ONICON peripherals
 - 2 mA = Alarm in the 4-20mA signal
 - 1 V = Alarm in the 2-10V signal
 - 0.5V = Alarm in the 1-5V signal
 - Provide a power supply with enough VA or W to power the flow meter.
The minimum input power is: 20-28 VDC, 400 mA at 24 VDC or 20-28 VAC, 60 Hz, 10 VA

SYSTEM-10 AND FT-3400 WIRING DIAGRAM



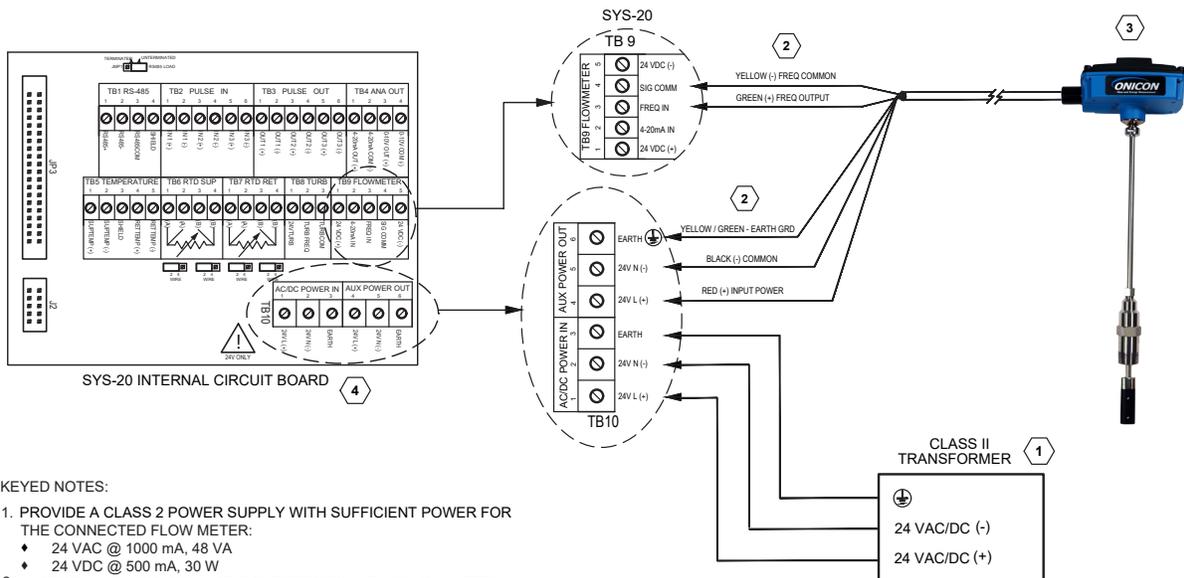
KEYED NOTES:

- POWER SUPPLY (CLASS 2 POWER SUPPLY FOR 24 VAC) REQUIREMENT (INPUT VOLTAGE IS NOT FIELD SELECTABLE):
 - 24 VAC: 20-28 VAC, 50/60 Hz, 12 VA
 - 120 VAC: 108-132 VAC, 50/60 Hz, 15 VA (112 VAC MINIMUM FOR VERSIONS WITH IP COMMS + 4 CHANNEL ANALOG CARD)
 - 240 VAC: 207-253 VAC, 50/60 Hz, 15 VA (220 VAC MINIMUM FOR VERSIONS WITH IP COMMS + 4 CHANNEL ANALOG CARD)
- THE SYSTEM-10 DOES NOT PROVIDE POWER TO THE F-3500 FLOW METERS. INPUT POWER FOR THE FLOW METERS MUST BE PROVIDED SEPARATELY. REFER TO FT-3400 IOM FOR ADDITIONAL WIRING INFORMATION. FOR 24 VAC VERSION, IT IS ACCEPTABLE TO POWER THE FT-3400 FLOW METERS FROM THE SYS-10 MAINS TERMINALS (TB1).
- 24 VAC: 20-28 VAC, 50/60 Hz, 30 VA TO POWER BOTH FT-3400 AND SYS-10
- CONNECT FT-3400 FACTORY WIRES TO FIELD WIRES IN APPROPRIATE JUNCTION BOX. DO NOT REMOVE FACTORY WIRES.
- CONNECTIONS SHOWN WITH (A) ARE USED WITH BI-DIRECTIONAL (FT-3400-2) MODELS ONLY. FACTORY WIRE COLORS ARE SHOWN FROM FLOW METER CABLE OR ADDITIONAL CABLE PROVIDED BY ONICON. FIELD WIRE COLORS MAY CHANGE FROM JUNCTION BOX.
- AUXILIARY FLOW METER CONNECTIONS ARE NOT USED BY THE BTU METER. BOTH INCOMING AND OUTGOING CONNECTIONS ARE MADE TO THE SAME TERMINAL.
- REFER TO SYS-10 IOM FOR ADDITIONAL WIRING INFORMATION.

SYSTEM-20 AND FT-3400 WIRING DIAGRAM



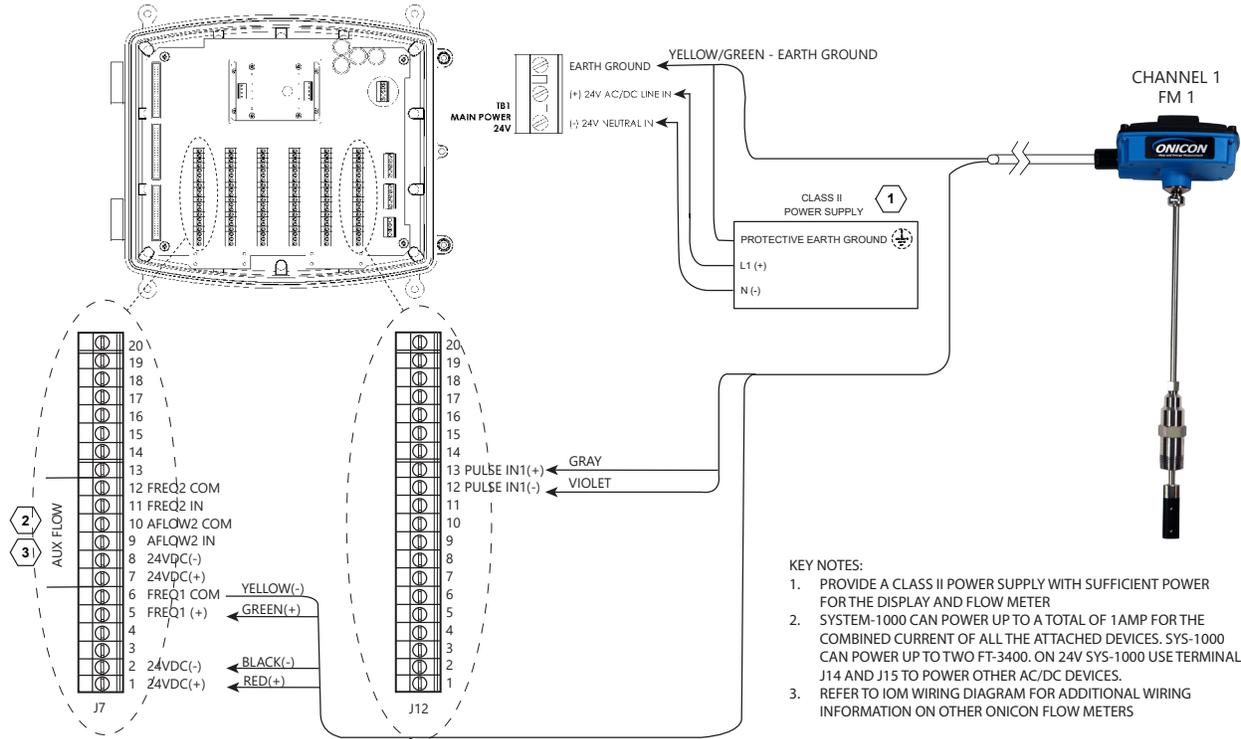
FLOW METER SIGNAL CONNECTIONS



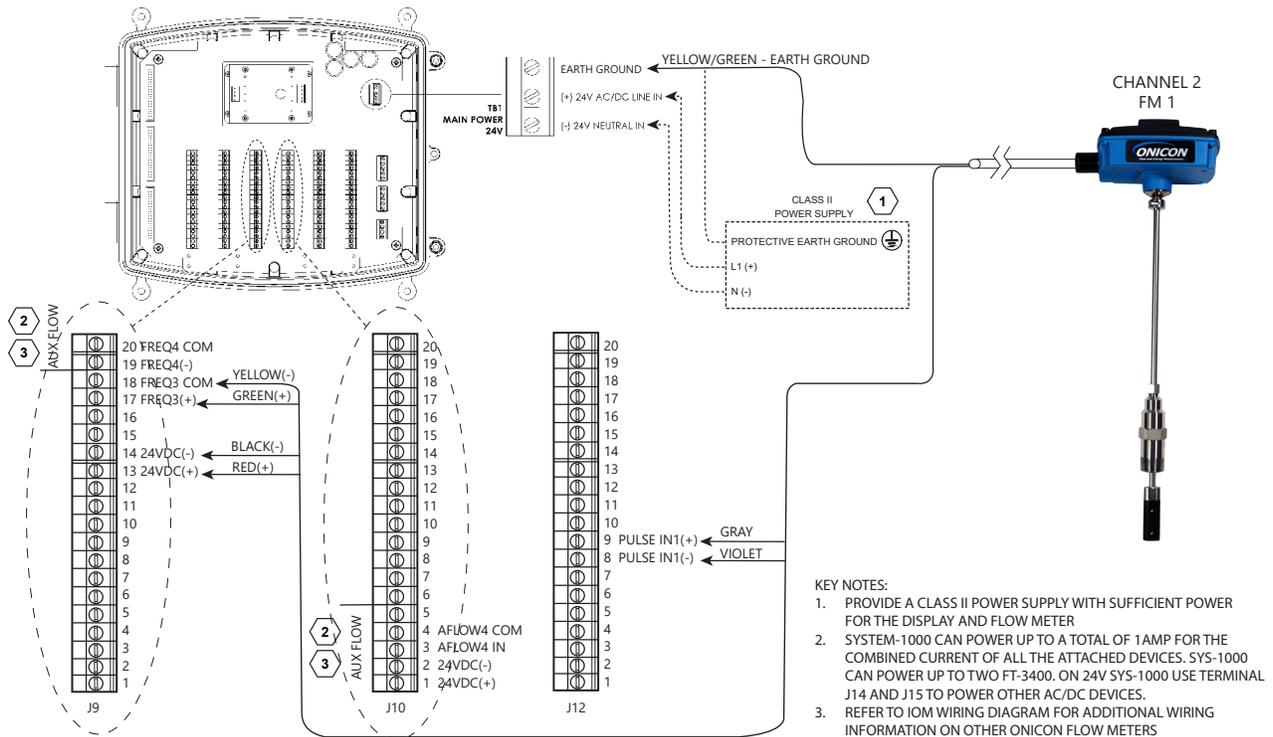
KEYED NOTES:

- PROVIDE A CLASS 2 POWER SUPPLY WITH SUFFICIENT POWER FOR THE CONNECTED FLOW METER:
 - 24 VAC @ 1000 mA, 48 VA
 - 24 VDC @ 500 mA, 30 W
- FACTORY WIRE COLORS ARE IDENTIFIED FROM THE FLOW METER. DO NOT REMOVE FACTORY CABLE.
- REFER TO FT-3400 SERIES IOM FOR ADDITIONAL WIRING INFORMATION.
- REFER TO SYS-20 IOM FOR ADDITIONAL WIRING INFORMATION.

SYSTEM-1000 AND FT-3400 WIRING DIAGRAM



SYSTEM-1000 AND FT-3400 WIRING DIAGRAM



CAUTION

Failure to provide a proper earth connection to the meter may result in excessive electrical noise that will interfere with the operation of the meter.

3.5.2 Earth Connection

FT-3400 Electromagnetic Flow Meters are designed to detect microvolt signal levels at the electrodes located on the sensor head. These signals are generated as conductive fluids flow through the magnetic field generated by the meter. If enough random electrical noise is present at the electrodes, it can interfere with the flow measurement. Care must be taken during installation to minimize the effects of electrical noise on the flow meter.

The most effective way to minimize the effects of electrical noise is to make sure that the pipe, the fluid and the flow meter body are all connected to earth ground. This accomplishes two important goals. First, it ensures that the pipe, fluid and flow meter are all at the same electrical potential, and second, it ensures that this electrical potential is the same as earth ground.

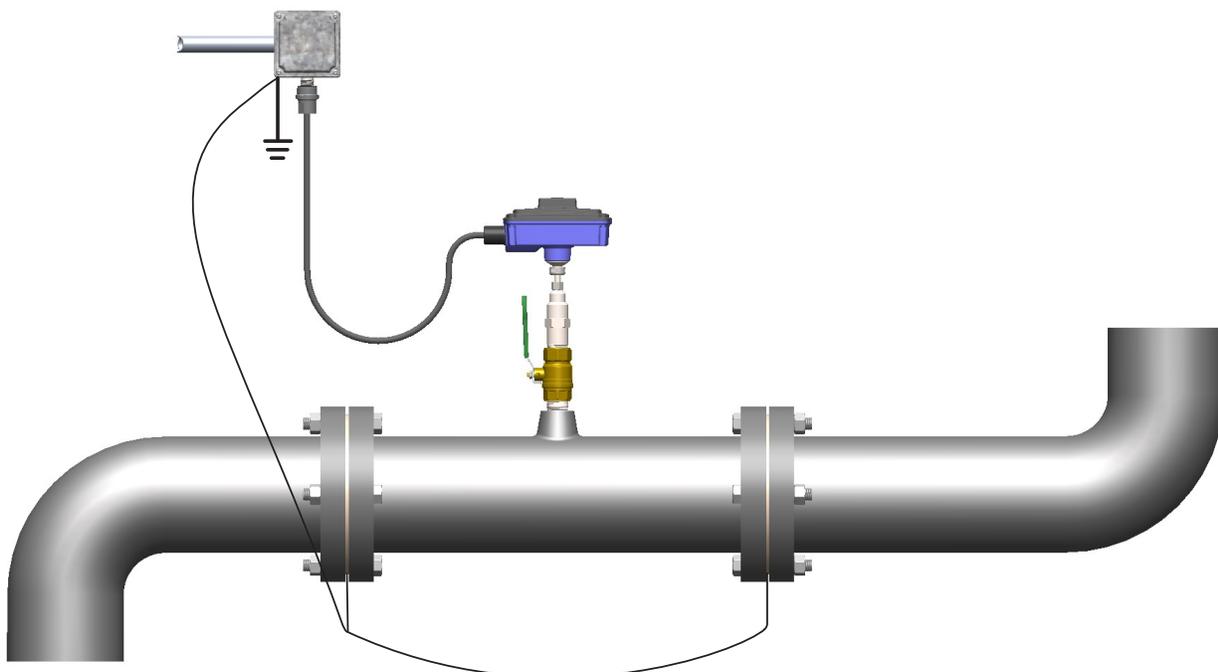
In order to be certain that the meter is properly connected to earth, the flow meter earth cable should be run directly to a known earth connection. The length of this earth cable should be as short as practically possible, preferably ≤ 25 feet in length. The table below lists earth connections from best to worst. If necessary, a separate earth cable should be connected to the metal pipe near the meter.

Earth Connections (stranded wire 14 – 18 AWG)	
Best	Earth grounding rod driven into the ground
	Earth wire connected directly to the building electrical service panel.
Worst	Earth wire connection inside an electrical outlet near the meter.

IMPORTANT NOTE

Under certain circumstances, connecting the meter to earth through the green/yellow earth wire may increase the amount of electrical noise present at the meter. Contact ONICON for technical assistance if you experience increased noise levels with the earth wire connected to earth.

Earth wiring connections for use with grounding rings



SECTION 4.0: START-UP & COMMISSIONING FOR ONICON INSERTION ELECTROMAGNETIC FLOW METERS



4.1 HELPFUL HINTS FOR START-UP AND COMMISSIONING

A step-by-step procedure and companion worksheet are located on the next two pages. Please read all installation instructions carefully before proceeding with installation, start-up and commissioning.

Please read these helpful hints before proceeding with the start-up and commissioning procedure on the next page.

1. ONICON flow meters are individually calibrated for a particular application. Be sure to verify the pipe size and location.
2. The electronic flow sensing systems will not work in air.
3. When measuring analog output signals, remember that current (mA) must be measured in series, while voltage is measured in parallel. If the 4-20 mA signal is already connected to a control system, you must break the connection and measure the signal in series.
4. When measuring frequency outputs in Hz, take your multimeter out of "auto-range mode" and manually set the range for a voltage level above 15 VDC. This will prevent false readings when signal is not present.
5. All wiring connections should be made at the end of the factory cable. Do not attempt to remove the factory installed cable or change the orientation of the electronics enclosure.
6. Never connect power to analog or frequency output signal wires. ONICON FT-3400 Flow meters are not "loop powered" devices.

4.2 START-UP AND COMMISSIONING

Please read the entire procedure before proceeding. A worksheet for checking off the following steps and recording measured values is located on the next page.

1.	Confirm flow meter location. Confirm adequate straight pipe run to achieve desired results.	Is the meter located in the correct location as required by the plans? Compare actual straight pipe upstream and downstream of the meter location to recommended distances identified in this manual. Contact ONICON's technical support department to discuss specifics of your application. If straight pipe run is very short, consult factory PRIOR to installing the meter to discuss possibility of upgrade to an FT-3000 series inline meter for closed-loop systems, the FT-3400 can be installed in the supply or return line.
2.	Confirm pipe size.	Confirm that the meter is tagged for the pipe size in which it is installed. When in doubt, measure the circumference of the pipe. Pipe O.D. = (circumference / 3.14) – (insulation thickness x 2).
3.	Confirm insertion depth and orientation.	Standard configuration meters come with an insertion depth gauge and instruction tag. Small pipe configuration meters come with an insertion depth tool. Ensure that the meter is inserted to the correct depth and that the electronics enclosure is parallel with the pipe with the arrow in the direction of flow.
4.	Confirm control system programming.	Confirm that the control system input point is properly configured for the analog range (or scale factor) identified on the calibration tag & certificate.
5.	Confirm connection to correct ONICON display or Btu meter (if ordered).	Confirm that the peripheral meter serial number matches the ONICON display or Btu meter serial number in the configuration sheet provided with the flow meter (when ordered together).
6.	Verify wiring before connecting power.	Prior to connecting the power, verify that the wiring is correct as shown in this manual and/or the additional wiring diagram provided with ONICON display or Btu meter. If in doubt, contact ONICON for assistance before proceeding further.
7.	Confirm correct supply voltage.	Verify that 24 (±4) V is available.
8.	Connect power.	Wait approximately 3 minutes after power-on before proceeding further.
The following steps require flow in the pipe. Flow signal readings should be taken while holding the flow rate constant, if possible. Otherwise, take the various output readings as quickly as possible.		
9.	Confirm any alarm or error	Confirm the contact on the gray/black and violet/black wires are not closed. If it is closed contact. Refer to page 30.
10.	Measure and record frequency output.	The frequency output signal is a 0-15 VDC pulsed output ranging up to 200 Hz and must be measured with a multimeter. Measure DC frequency (Hz) from GREEN(+) to YELLOW(-). Also measure DC volts on same wires. Five to 7 VDC is normal for a pulsating output. Zero VDC indicates no output. $\text{GPM} = \frac{\text{frequency in Hz} \times 60}{\text{meter factor in ppg}}$ (Refer to calibration tag for meter factor.)
11.	Measure and record analog or pulse outputs. Current Output: Voltage Output: Scaled Output:	Refer to flow meter wiring diagram for wire colors for the various outputs available, based on your particular flow meter model. Use the following formulas to calculate flow rate from measured analog signals: $\text{GPM} = \frac{(\text{measured current in mA} - 4) \times \text{Full Scale Analog Flow Rate}}{16}$ $\text{GPM} = \frac{\text{measured VDC} \times \text{Full Scale Analog Flow Rate}}{10}$ Each contact closure = unit volume identified as "Scale Factor" (measure and record time interval between contact closures)
12.	Compare various output signals to each other and to the flow rate displayed by the control system.	Compare the flow rates calculated in steps 9 and 10 to each other and to the flow rate indicated by the control system. Refer to troubleshooting guide when readings are inconsistent.
End of standard start-up and commissioning. Please contact ONICON at +1 (727) 447-6140 with any questions.		

4.3 START-UP AND COMMISSIONING WORKSHEET

Please read all installation instructions carefully prior to proceeding with these steps. Use the following worksheet for checking off the commissioning steps and recording measured values. The following steps require flow in the pipe. Flow signal readings should be taken while holding the flow rate constant, if possible. Otherwise, take the various output readings as quickly as possible.

STEP	TEST/MEASUREMENT	S/N: _____	S/N: _____	S/N: _____	S/N: _____
1.	Meter location:				
2.	Confirm pipe size:	_____	_____	_____	_____
3.	Insertion depth and orientation:				
4.	Control system programming:				
5.	Match display or Btu meter serial number (S/N) if ordered:	_____	_____	_____	_____
6.	Signal connections verified:				
7.	Supply voltage verified:	_____	_____	_____	_____
8.	Connect power:				
The following steps require flow in the pipe. Flow signal readings should be taken while holding the flow rate constant if possible, otherwise, take the various output readings as quickly as possible.					
9.	Frequency output(s): Avg = green Average frequency (Hz): Average frequency (VDC): Calculated flow rate:	_____ Hz _____ VDC _____ GPM	_____ Hz _____ VDC _____ GPM	_____ Hz _____ VDC _____ GPM	_____ Hz _____ VDC _____ GPM
10.	Analog or pulse output(s) 4-20 mA signal: 1-5 / 2-10 V signal: Scaled output interval: Calculated flow rate:	_____ mA _____ VDC _____ GPM	_____ mA _____ VDC _____ GPM	_____ mA _____ VDC _____ GPM	_____ mA _____ VDC _____ GPM
11.	Flow rate displayed by control system:	_____ GPM	_____ GPM	_____ GPM	_____ GPM

4.4 TROUBLESHOOTING GUIDE

NOTE: Also refer to the START-UP AND COMMISSIONING GUIDE located on page 25.

REPORTED PROBLEM	POSSIBLE SOLUTIONS
No signal	<ul style="list-style-type: none"> • Verify that the meter is properly inserted into the pipe. • Verify that the electronics enclosure is parallel with the pipe. • Verify 24 V supply voltage. • Verify correct wiring to control system (see wiring diagram). • Verify that there is flow in the pipe. • Verify that the meter earth cable is connected to earth. • Check to see if the alarm contact closure output is closed (orange & white wires). A closed contact could indicate either an empty pipe or excessive electrical noise, possibly due to a poor earth ground. • Low conductivity water ($\leq 20 \mu\text{siemens}$) may activate the empty pipe detector and/or increase the potential for electrical noise problems.
Reading is too high or low	<ul style="list-style-type: none"> • Verify pipe size. Contact ONICON if pipe size is different from calibration tag. • Verify that the meter is properly inserted into the pipe. • Verify that the electronics enclosure is parallel with the pipe. • Verify correct wiring to control system (see wiring diagram). • Confirm that the output signals are consistent with each other (frequency vs. analog, etc). • Confirm that the control system is programmed for correct flow range or scale factor. • Verify that the meter earth cable is connected to earth. A poor earth connection can lead to excessive noise that can affect the flow reading.
Analog signal seems high or low and does not correspond to frequency output	<ul style="list-style-type: none"> • Check for ground loop or offset voltage: • Disconnect analog signal input from control system and measure analog output directly from the flow meter. Reconnect signal input to control system and measure the analog signals again. Any difference between these readings indicates a potential ground loop or offset voltage. Please contact ONICON for further assistance.
Control system displays flow rate, but no flow rate is indicated on the local display module or Btu meter	<ul style="list-style-type: none"> • Verify that all wires from the flow meter are connected to the display module or Btu meter. • The frequency output wires (green and yellow) must be connected for any ONICON display or Btu meter.

4.4.1 Earth Connections & Electrical Noise Reduction

FT-3400 electromagnetic flow meters are designed to detect microvolt signal levels at the electrodes located on the sensor head. These signals are generated as conductive fluids flow through the magnetic field generated by the meter. If enough random electrical noise is present at the electrodes, it can interfere with the flow signal measurement. Care must be taken during installation to minimize the effects of electrical noise on the flow meter.

Minimizing Electrical Noise

The most effective way to minimize the effects of electrical noise is to make sure that the pipe, the fluid and the flow meter body are all connected to earth ground. This accomplishes two important goals. First, it ensures that the pipe, fluid and flow meter are all at the same electrical potential. Second, it ensures that this electrical potential is the same as earth ground.

In order to be certain that the meter is properly connected to earth, the flow meter earth cable should be run directly to a known earth connection. The length of this earth cable should be as short as practically possible, preferably ≤ 25 feet in length. The table below lists earth connections from best to worst. If necessary, a separate earth cable should be connected to the metal pipe near the meter.

IMPORTANT NOTE

Non-metallic pipes are more susceptible to electrical noise. Grounding rings installed upstream and downstream of the meter location to reduce the electrical noise present in the pipe may be required for proper operation. Refer to section 1.5.1 and section 3.1 of this manual for additional information on the use of grounding rings.

Earth Connections (stranded wire 14 - 18 AWG)	
Best	Earth grounding rod driven into the ground to the depth of the water table.
	Earth wire connected directly to the building electrical service panel.
Worst	Earth wire connection inside an electrical outlet near the meter.

Diagnosing Electrical Noise Problems

When diagnosing electrical noise problems, it is important to understand that one of four possible conditions are likely to exist. They are as listed in the table below. In order to minimize the effects of noise, it is helpful to understand which of the following conditions are present.

Earth Connection at Flow Meter	Pipe / Fluid Earth Connection	Expected Noise Level	Possible Remedies
Good earth connection ≤ 25 feet from flow meter	Pipe & fluid are connected to earth	Low	None required
Good earth connection ≤ 25 feet from flow meter	Pipe & fluid are not connected to earth	Moderate	A separate earth connection can be made directly to the metal pipe or to the fluid. Non-metallic pipes may require grounding rings installed upstream and downstream of the meter location.
Poor earth connection	Pipe & fluid are connected to earth	Moderate	Removing the earth connection at the flow meter may reduce the noise level. If this is a long wire run, break the connection where the wire connects to the cable coming out of the flow meter. If noise level is still too high, locate a better earth connection for the flow meter.
Poor earth connection	Pipe & fluid are not connected to earth	High	Locate a better earth connection for the flow meter. If noise level is still too high, locate a better earth connection for the pipe or fluid.

4.5 WARNINGS, ALARMS & ERRORS

The FT-3400 microprocessor board is equipped with diagnostic LEDs located within the electronics enclosure. These LEDs serve as a valuable tool for monitoring the status of the meter without the need for external equipment. Additionally, the meter provides analog and digital outputs that respond to warning, alarm, or error conditions.

Alarm or Errors via Analog Output:

For 4-20mA mode, the analog output will drop to 2mA when an alarm or error condition is detected.

In 2-10V mode, the analog output will decrease to 1V when an alarm or error is present.

In 2-5V mode, the analog output will reduce to 0.5V when an alarm or error condition is detected.

Alarm or Errors via Digital Output:

Digital output 2, identified by wires colored gray/black and violet/black, will close when an alarm or error condition is detected.

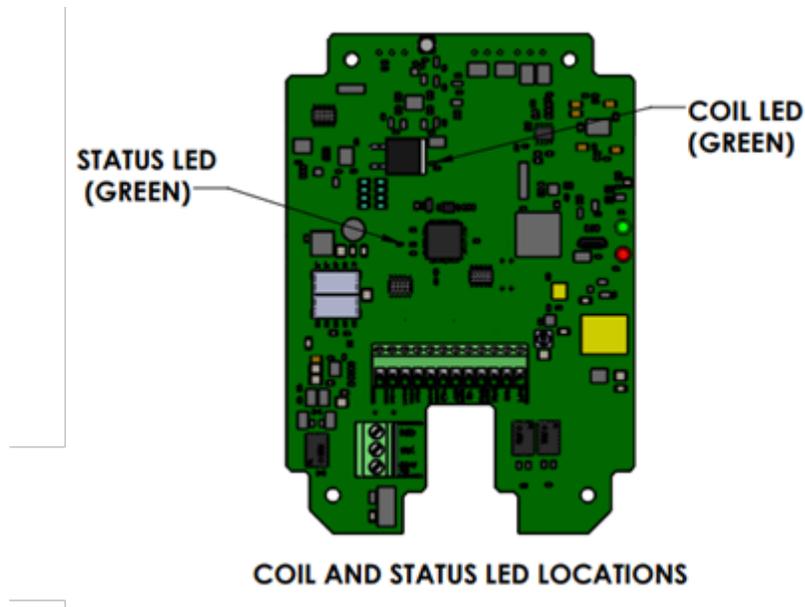
Warning, Alarm, or Errors via LED Status:

The FT-3400 will provide visual indications of the current alarm status:

One Blink - A single blink of the LED indicates that at least one warning is currently active. Although warnings are less critical than alarms, they should still be reviewed and addressed to ensure optimal performance.

Two Blinks - When you observe two blinks, it signifies that at least one alarm condition is currently active. It is crucial to investigate and address the underlying issue causing the alarm.

Three Blinks - This indicates that at least one error is currently active, requiring immediate attention and diagnostic action.



Warning, Alarm, or Errors via PC App:

For comprehensive information about the specific warnings, alarms, or errors and their meanings, we recommend connecting the meter to the PC App. Within the PC App, navigate to the “Warnings, Alarms, and Errors” tab to access detailed information regarding the status of the meter. This additional resource will help you gain a deeper understanding of any issues and guide you in taking the appropriate actions to maintain the meter’s functionality and accuracy.

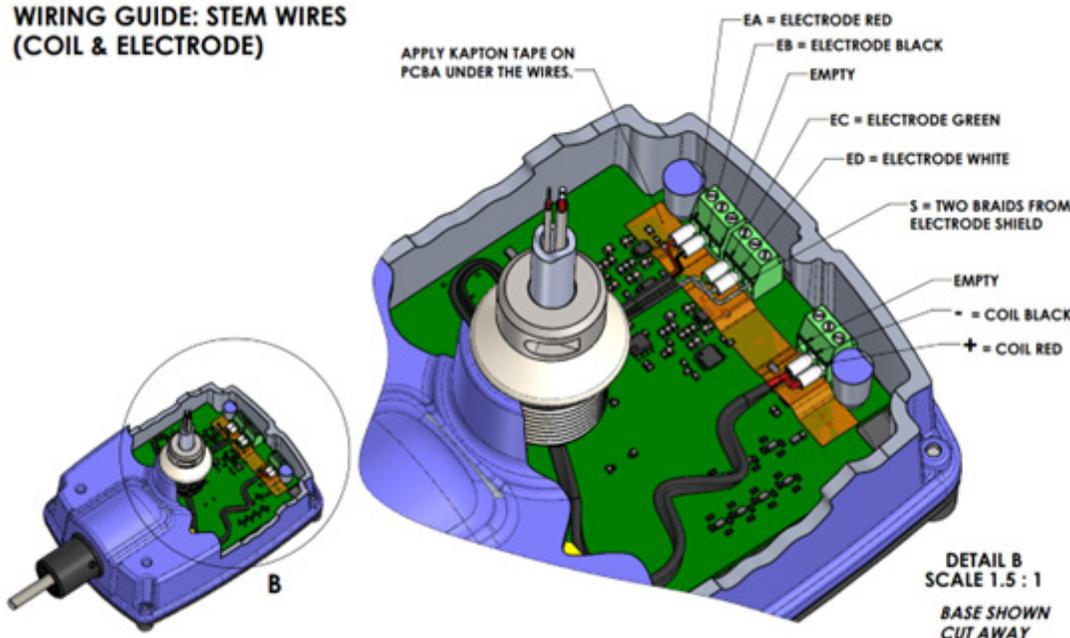


Please note that prompt attention to alarms, errors, and warnings is essential to ensure the reliable and accurate operation of the FT-3400 meter.

TROUBLESHOOTING

ERRORS		
STATUS	POTENTIAL ISSUE	POSSIBLE SOLUTIONS
Error Elec 1 Bad DC Offset	Possible electrode 1 disconnected	<ul style="list-style-type: none"> Power off the unit Carefully remove the electronic and check electrode wires are connected as per the image below. Power on the unit and the error should disappear. Contact ONICON if the error is still present. RMA Needed.
Error Elec 2 Bad DC Offset	Possible electrode 2 disconnected	<ul style="list-style-type: none"> Power off the unit Carefully remove the electronic and check electrode wires are connected as per the image below. Power on the unit and the error should disappear. Contact ONICON if the error is still present. RMA Needed.
Error Elec 1/2 Diff Outrange	Possible electrode 1 or 2 disconnected	<ul style="list-style-type: none"> Power off the unit Carefully remove the electronic and check electrode wires are connected as per the image below. Power on the unit and the error should disappear. Contact ONICON if the error is still present. RMA Needed.
Error Coil Fail	No measurement from the Coil	<ul style="list-style-type: none"> Open the enclosure and check the DS1 LED light is ON. If the DS1 LED light is off, power off the unit and carefully remove the electronics and check coil wires are connected as per the image on page 29. Power on the unit and error should disappear. Contact ONICON if the error is still present. RMA needed
Error Cfg Corrupt	Incorrect voltage to velocity table loaded	Contact ONICON. RMA needed
Error Empty Pipe Init Fail	Empty Pipe was unable to initialize due to disconnected electrode 1	<ul style="list-style-type: none"> Power off the unit Carefully remove the electronic and check electrode wires are connected as per the image below. Power on the unit and the error should disappear. Contact ONICON if the error is still present. RMA Needed.

WIRING GUIDE: STEM WIRES (COIL & ELECTRODE)



TURN POWER OFF BEFORE REMOVING THE BOARD.

DO NOT CONNECT OR DISCONNECT WIRES WITH THE POWER ON.

ALARMS		
STATUS	POTENTIAL ISSUE	POSSIBLE SOLUTIONS
Alarm High Flow	The actual flow is greater than the volumetric flow rate at 20 ft/s	Nonideal flow rate condition. Contact ONICON if a short high flow rate test is needed.
Alarm AOUT High Flow	Flow is higher than the Analog Output Full Scale	<ul style="list-style-type: none"> Confirm the analog output full scale is equal to or greater than the design max flow of the system. Use the PC App to adjust the full scale of the meter
Alarm Frequency High Flow	Flow is higher than the Max Frequency	<ul style="list-style-type: none"> Confirm the maximum frequency and flow at max frequency is equal to or greater than the design max flow of the system. Use the PC App to adjust the maximum frequency output and flow at max frequency.
Alarm Reverse Flow	The flow meter orientation does not match the flow direction	<ul style="list-style-type: none"> Check the orientation of the meter and flow direction arrow. Rotate the meter to match the flow direction.
Alarm Empty Pipe	The pipe is not full or the meter is grounded	Confirm the pipe is full of water and the meter is properly ground according to section 3.5.
Alarm Warm-Up Delay	The alarm is only present for the first 3 minutes or less after the meter is powered up. Meter electronics are initializing.	<ul style="list-style-type: none"> If 3 min have passed, power cycle the unit and wait 3 more min for the alarm to clear off. Contact ONICON if the alarm is still present. RMA needed.
Alarm Pulse 1 Overrun	This alarm is present whenever the volume flow rate causes the incremental volume total to accumulate at a rate that is too fast.	<ul style="list-style-type: none"> Confirm the flow rate data and pipe diameter data on the tag attached to the meter corresponds with the actual flow and actual pipe diameter. Any mismatch between the calibrated and actual flow rates or the calibrated and actual pipe diameter will cause this alarm message to appear. Contact ONICON for assistance in correcting this condition.
Alarm Pulse 2 Overrun		
Alarm Pulse 3 Overrun		

WARNINGS		
STATUS	POTENTIAL ISSUE	POSSIBLE SOLUTIONS
Warn Reverse Flow	Not an actual issue present. The warning is present as a message when the flow is going in the opposite direction for bidirectional meters.	
Warn Low Flow	Flow is below low flow cut-off in FPS	The meter cut-off is 0.1 ft/sec. Increased flow and warning will clear.
Warn AOUT Low Flow	Flow is below 5% of analog output full-scale	Increased flow and warning will clear.
Warn AOUT High Flow	Flow is between 95% to 100% of analog output full scale	Decrease flow and warning will clear.
Warn Freq. High Flow	Flow is between 95% to 100% of the maximum frequency output	Decrease flow and warning will clear.
Warn Flow Sample Overrun 1	Sampling not optimal	Contact ONICON.
Warn Flow Sample Overrun 2		
Warn Flow Sample Transient E		
Warn Flow Sample Near Full		

