Pro-M

Electomagnetic Flow Sensor

Seametrics

ISO 9001

General Information

Installation

Connections

Configuration

Operation

Troubleshooting & Error Messages

The **Pro-M** is an electromagnetic flow meter with high pressure and temperature ratings. Using Faraday's Law of induction which allows for an unobstructed flow tube, it is available in 1" to 12" pipe sizes from Seametrics. The Pro-M is ideal for high pressure and temperature industrial processes. With minimal straight-pipe requirements, the Pro-M can be used in piping configurations where there is little space between the meter and an elbow.

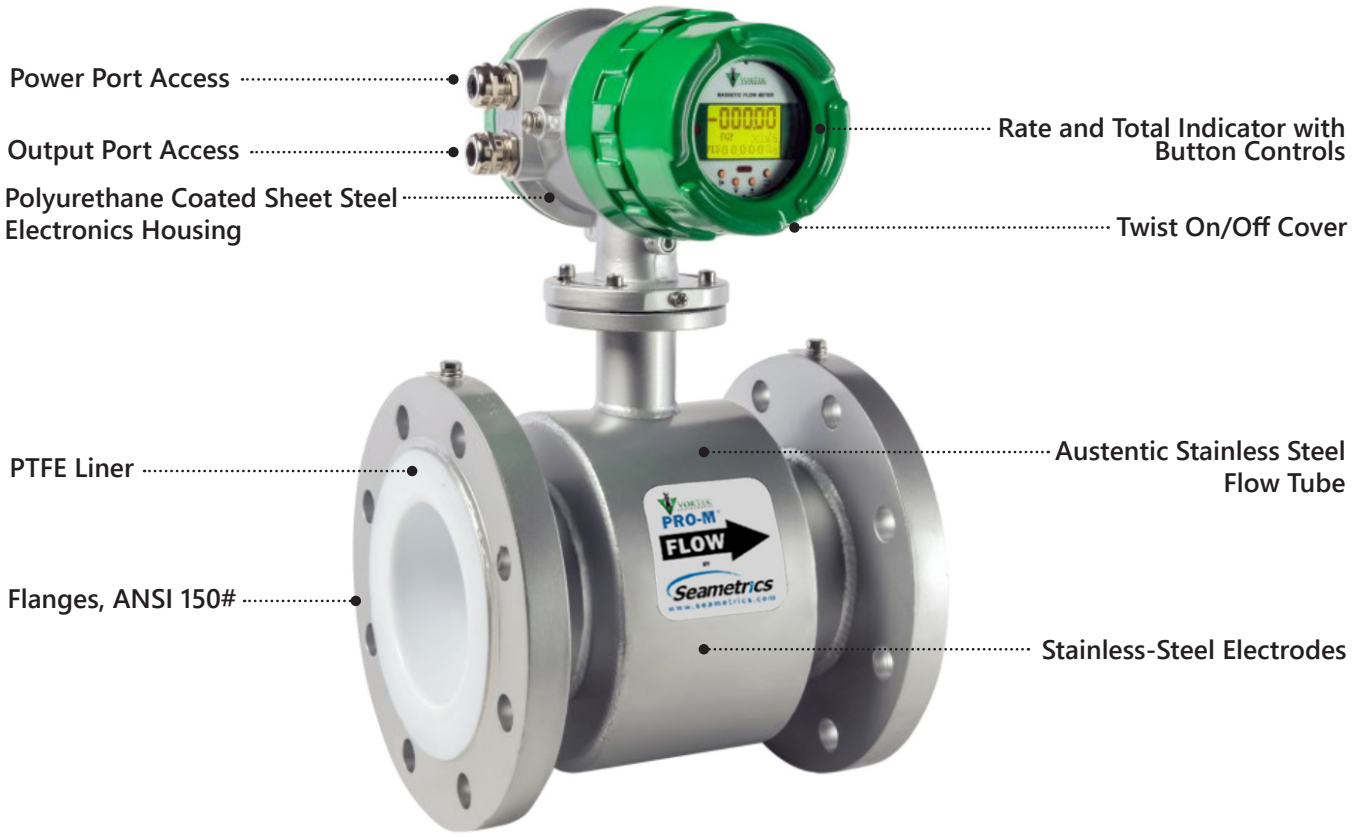
The Pro-M series meters are rated IP65, which means it is dust tight and protected against heavy seas or powerful jets of water. They are not protected against immersion.

The Pro-M measurement is not affected by changes in fluid density, viscosity, temperature, pressure, or conductivity. Due to the unobstructed flow tube, the pressure drop across the Pro-M is negligible.

The Pro-M is equipped with fully digital processing, strong anti-interference ability, reliable measurement, high precision, and a wide flow range.

Both rate and total indication are standard as well as pulse and 4-20mA output. Rate and total units can be set via the front panel by the user. Bidirectional flow reading is standard as well. Additionally, the Pro-M has standard Modbus RTU digital communication signal output and built-in self-test and a self-diagnostic functions.

Features



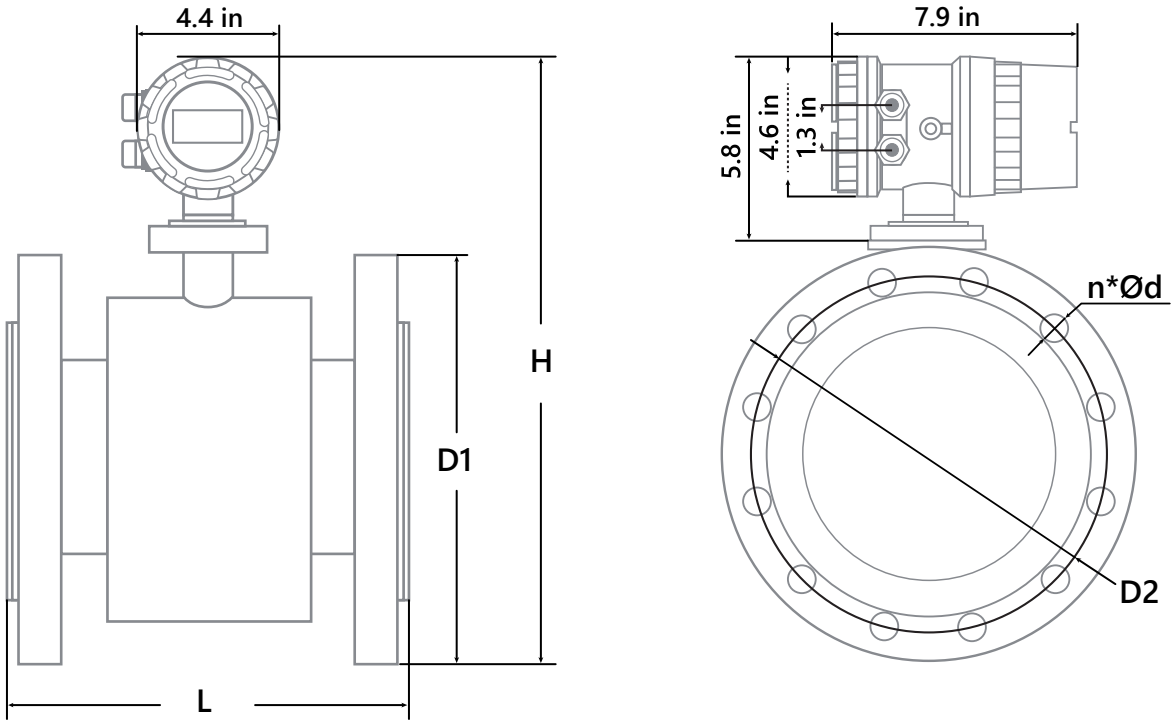
Specifications*

Pipe Sizes		1”, 1.5”, 2”, 3”, 4”, 6”, 8”, 10”, 12”		
Flanges		ANSI 150# Flange		
Pressure		270 psi (18.62 bar)		
Temperature	**Operating**	-4°F to 248°F (-20°C to 120°C)		
	Storage	-4°F to 158°F (-20°C to 70°C)		
Accuracy		± 0.5% of reading (velocity > 1.97 ft/s or ± 0.01 ft/s of reading (velocity ≤ 1.97 ft/s)		
Low Flow Cutoff		3% of maximum flow rate		
Material	**Body**	304 stainless steel		
	Liner	PTFE (optional: Hard rubber, polyurethane, PFA)		
	Electronics Housing	Sheet Steel, Polyurethane Coated		
	Electrodes	316 stainless steel (optional titanium, tantalum, Hastelloy C, Platinum-Iridium)		
Display	**Type**	Aluminum converter Housing, Alpha Numeric 3-line LCD digital display with four push buttons for full field configuration		
	Digits	5 Digit Rate		9 Digit Total
	Units *Please Note: All Pro-M meters are factory set for US GPM rate and USG total. If other units are required, they can be set in the field*	Rate Volume Units	Rate Time Units	Total Volume Units
		US Gallons UK Gallons Liters Cubic Meters	Second Minute Hour	US Gallons UK Gallons Liters Cubic Meters
	Bidirectional	Flow Velocity, Percentage, Forward Flow, Reverse Flow, Net total		
Alarms		FQH (High Flow Alarm), FQL (Low Flow Alarm), FGP (Empty Pipe), SYS (General Alarm Status)		
Power	**DC Power**	20-36Vdc, 630mA minimum		
Output	**4-20mA Current Loop**	Isolated, passive, 24Vdc, 650 Ω maximum current loop		
	Modbus RTU	Isolated, asynchronous serial RS485, Modbus® RTU protocol		
	Two Alarms	Alarm outputs for lower and higher limits Max voltage 36V Max Current 250mA		
	Pulse/Frequency	Current Sinking - Digital Pulse 1 – 100 Pulses/sec Photoelectric Isolate > 1000V 1 to 500 hz.		
Conductivity		≥ 20 µS/cm		
Empty Pipe Detection		Hardware/software, conductivity-based		
Environmental		IP65		

Modbus® is a registered trademark of Schneider Electric.

** Specifications subject to change. Please consult our website for the most current data (www.seametrics.com).*

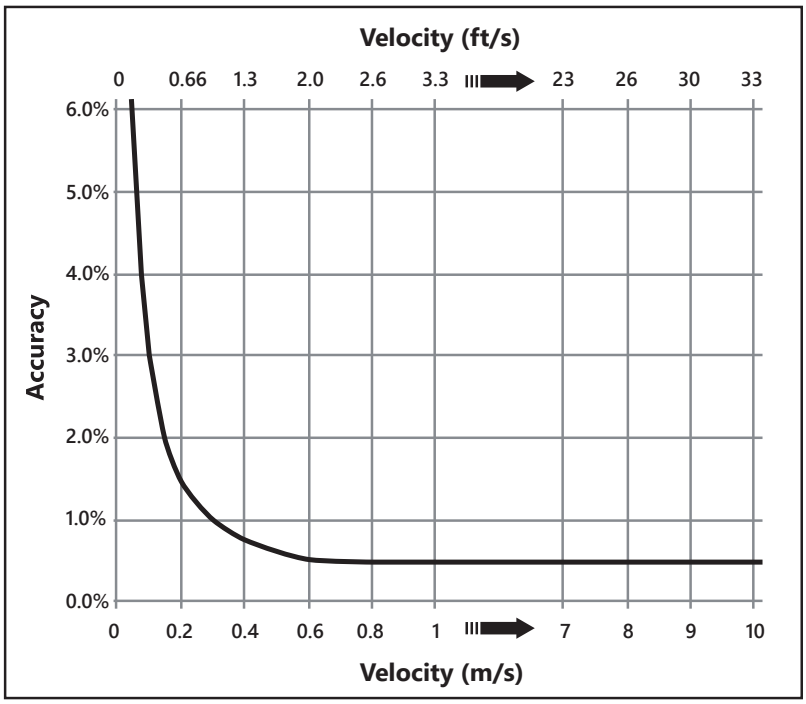
Dimensions



Pro-M Meter Size	L		H		D1		D2		Bolt Holes	Shipping Weight	
	inch	mm	inch	mm	inch	mm	inch	mm	#	lbs	Kg
1″	7.9	200	12.6	320	4.3	108	3.1	79.25	4	18	8
1.5″	7.9	200	14.0	355	5.0	127	3.9	98.6	4	22	10
2″	7.9	200	14.6	370	6	152.4	4.8	120.7	4	29	13
3″	9.8	250	16.0	405	7.5	190.5	6	152.4	4	33	15
4″	9.8	250	16.7	425	9	228.6	7.5	190.5	8	44	20
6″	11.8	300	19.3	490	11	279.4	9.5	241.3	8	84	38
8″	13.8	350	22.2	565	13.5	342.9	11.8	298.5	8	105	48
10″	17.7	450	23.6	600	16	406.4	14.3	362	12	154	70
12″	19.7	500	25.6	650	19	482.6	17	431.8	12	243	110
Flanges	Standard ANSI 150 lb. drilling									Cable 1 lb.	

Pro-M Accuracy

Vortek Accuracy
Accuracy Standard Accuracy Model:
±0.5% of reading (velocity > 1.97 ft/s) or
±0.01 ft/s of reading (velocity ≤ 1.97 ft/s)



Repeatability Volumetric Flow Rate:

±0.1% of rate

Velocity Range

Maximum velocity, liquid: 10 meters/second (32.8 feet/second)

Minimum velocity, liquid: 0.3 meters/second (0.98 feet/second)

Flow Rate (1" - 12")

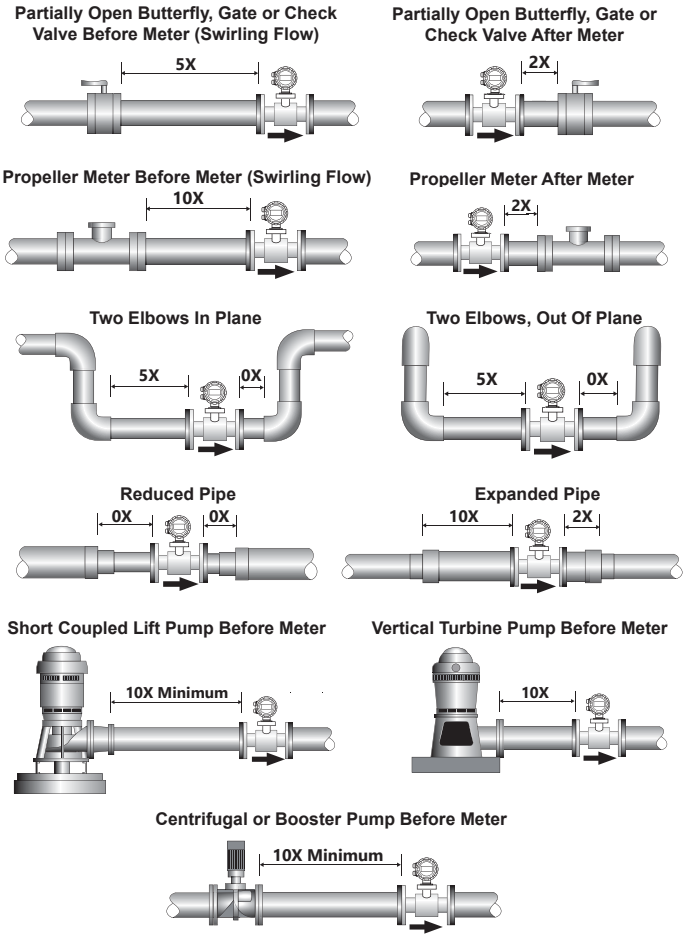
Nominal Pipe Size (Inches)	1"	1.5"	2"	3"	4"	6"	8"	10"	12"
GPM Min	2.2	4.4	8.8	22	36	88	150	234	335
GPM Max	79	198	312	796	1,246	2,800	4,979	7,779	11,205
M3/Hr Min	.5	1	2	5	8	20	34	53	76
M3/Hr Max	18	45	71	181	283	636	1,131	1,767	2,545

Special Order Pipe Size (Inches)	14"	16"	18"	20"	24"	28"	32"	36"	40"
GPM Min	458	599	753	934	1,343	1,828	2,387	2,910	3,734
GPM Max	15,255	19,918	25,210	31,123	44,816	60,979	79,691	100,825	124,469
M3/Hr Min	104	136	171	212	305	415	542	662	848
M3/Hr Max	18	3,465	4,524	5,726	7,069	10,179	13,850	22,900	28,270

Straight Pipe Recommendations (X = diameter)

NOTE: These configurations are to be used as general guidelines and do not cover every possible installation. A combination of two or more obstructions will require additional straight pipe. If there is any concern about the length of pipe required for a specific application, please contact your local dealer.

Installing a meter after a pump. Most meters will be installed in systems with some sort of pump, and while the pump is unlikely to have a negative effect on meter performance, there are some situations where understanding the effect the pump has on the flow profile, and by extension on the meter will be of utmost importance.
Air vents should be installed in the same unobstructed pipe run as the meter and should be located relatively close to the meter. Constant bleed air vents are recommended because simple check type air vents will not open once the system is under pressure and an accumulation of air can build up behind them.
Significant amounts of air entrained in the flow of water, wildly erratic flow profiles and water that travels through the pipe with significant swirl will cause the meter to read erratically, sometimes very erratically, or not read at all. Therefore, the designer or installer must reduce or eliminate these issues when they are likely to occur.
Every installation is different, but we can offer some general guidelines when it comes to the placement of your pump and meter. And again, in most cases, the pump will have no, or very little effect on the meter's performance, but some care should be taken to assure your installation has the best chance for success.
Confirm there is adequate head to insure a full pipe of water through the meter (a valve downstream of the meter may be required).



Vertical Turbine Pumps drawing from deep wells, or from well under the surface of the water will generally have very little effect in the flow profile of the water by the time the water reaches the meter.

Short Coupled Lift Pumps can, but will not necessarily, cause an erratic or swirling flow profile. Care must be taken during system layout to avoid these issues. The inlet of these pumps will be located near the surface of the water supply and can both suck air from the surface and swirl the water around the pump. This swirling water itself may be a contributing factor of poor flow profile and also lower the surface of the water over the pump inlet.

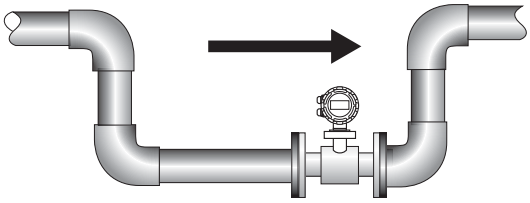
The absolute minimum depth of the inlet of the pump can be calculated using this formula,

S=D+(0.574Q/D^1.5)
Where
S=Submergence in inches
D=Pump bell diameter in inches
Q=Flowrate in gallons per minute

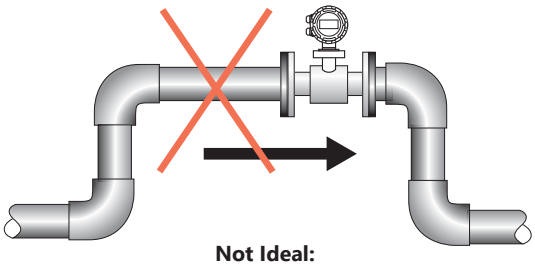
Note: to raise D to the power of 1.5 (3/2) as shown in D^1.5 Take the square root of D and cube the result.
Be sure to calculate from the minimum water level during all seasons of pump operation.
If the water supply will be located in a confined area such as canal turn out, and especially if the turnout ends in a cylindrical vault, the motion of the pump can result in significant swirl of the water being sucked through the pump and this will cause the meter to perform poorly. Be sure to take steps to keep the water from swirling or meter performance will be affected.

Booster Pumps before the meter can also cause swirl or an erratic flow profile. If a booster pump is located before the meter, it must be located far enough upstream that the flow profile has a chance to return to normal. Every case will be different, but we recommend a minimum of at least 10 pipe diameters after the booster pump and before the meter.
By the very nature of their purpose, booster pumps will also cause low pressure in the pipe upstream of the pump. If this low pressure falls low enough, it may open any air vent upstream of the pump which will cause air to enter the water stream. In this case, the entrained air will likely cause the meter to go into an empty pipe state.

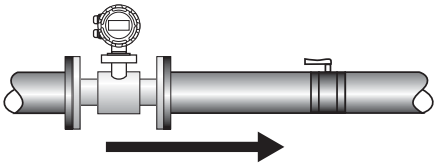
Full Pipe Recommendations



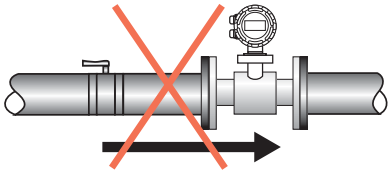
Recommended:
Keep pipe full at meter for accuracy



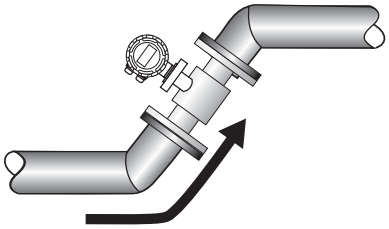
Not Ideal:
Allows air pockets to form at meter



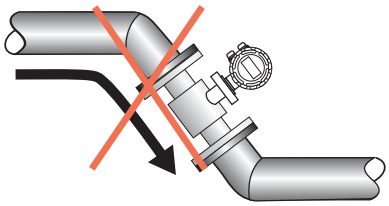
Recommended:
Keeps pipe full at meter for accuracy



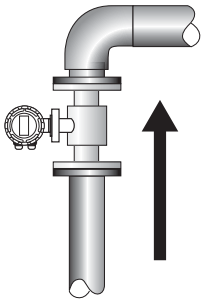
Not Ideal:
Post-valve cavitation can create air pocket



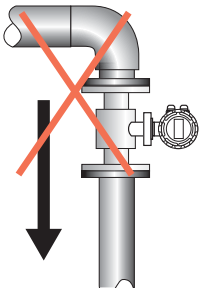
Recommended:
Allows air to bleed off



Not Ideal:
Air can be trapped

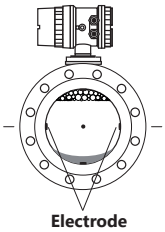


Recommended:
Allows air to bleed off

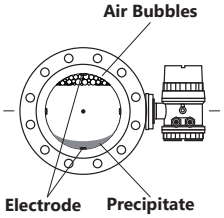


Not Ideal:
Air can be trapped

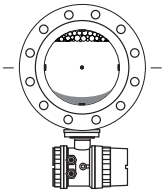
Correct:



Incorrect:



Incorrect:



Positioning the Meter

CAUTION: These flow sensors are not recommended where installation may expose the flow sensor to boiler pressure and temperature. Maximum recommended operating temperature is 140˚ F (60˚ C).

Avoid all pipe locations where the flow is pulsating, such as the outlet side of the piston or diaphragm. Likewise, avoid all pipe locations near equipment producing electrical interference such as electric motors, transformers, variable frequency drives, etc.

You should install the meter with enough room for future access for maintenance purposes. Keep in mind that you will need to twist off the meter head cover to make any configuration changes, and that will require room to take off fully.

The meter's liner, whether it is PTFE or rubber, is not intended to be used as a gasket. Standard gaskets (not provided) should be installed to ensure a proper hydraulic seal. When installing the gaskets, make sure they are properly centered to avoid flow restriction or turbulence. Do not use graphite or any electrically conductive sealing compound to hold the gaskets in place during installation. This could affect the reading accuracy of the measuring signal.

Straight Pipe Recommendations. The Pro-M series requires straight pipe before and after the meter for best accuracy. However, the ability of electromagnetic meters to average the flow across the entire pipe allows for shorter straight pipe recommendations than most mechanical meters (see page 8).

Full Pipe Recommendations. To prevent false readings, this meter is equipped with a parameter MTP, which will give you a ratio of emptiness. To view this reading, you can follow the instructions on page 16. .

Fittings. The Vortek Pro-M series meter is equipped with ANSI 150# flange, and will mate with any other ANSI 150# flange..

Calibration. The Vortek Pro-M is factory calibrated. The frequency of calibration will depend on the needs of each application and local regulatory policies.

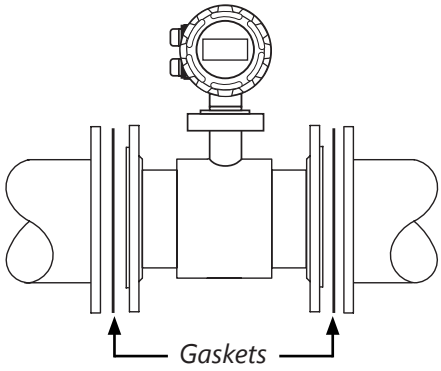
Chemical Injection. When the Vortek Pro-M is used in a chemical injection application, the chemical injection point must be placed downstream of the magmeter, OR far enough upstream for complete mixing to occur before the fluid reaches the magmeter. When unmixed chemicals alternates with water passing through the meter, the rapid changes in conductivity may cause sudden spikes and drops in the meter's reading, resulting in inaccurate measurement. The magmeter will re-stabilize, however, with a steady flow of fluid of uniform conductivity.

NOTICE: Do not install a magmeter downstream of a pressure or proportional control valve.

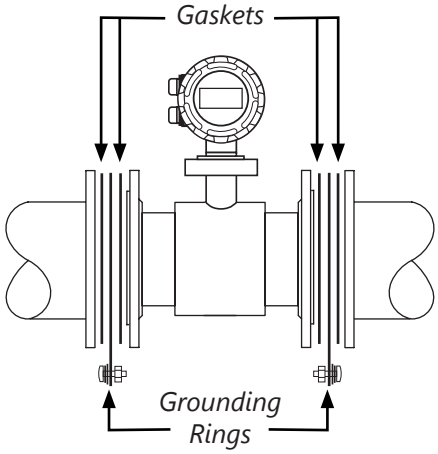
Installing Gaskets

NOTICE: Gaskets are required at all junctions.

1. Be sure all mating surfaces are smooth and free of debris.
2. Install Seametrics provided gaskets, or equivalent, on each end of meter as shown in diagrams below. If using grounding rings, install one gasket on each side of the grounding ring.
3. **Failure to install gaskets will void warranty.**



Installation <u>without</u> grounding rings

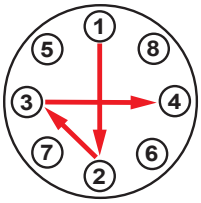


Installation <u>with</u> grounding rings

Tightening Flange Bolts

NOTE: Mating pipe flanges must be ANSI 150# full face (FF) and/or raised face (RT).

1. Tighten flange bolts in an alternating pattern.
   - Tighten left flange bolt-1 to 20% recommended torque.
   - Tighten right flange bolt-1 to 20% of recommended torque.
   - Repeat steps a and b for each bolt in an alternating order, such as shown at right, tightening to 40%, then 60%, then 80%, and then 100%.
2. Test for leaks.
3. If needed, tighten further in 10% increments until leaking stops. **DO NOT over-tighten. Over-tightening can cause serious damage to the flow meter.**
4. Recheck after 24 hours, adjusting if needed.



Suggested Tightening Sequence

SUGGESTED FLANGE BOLT TORQUE

Pipe Size	Liner	
	ft-lb	Nm
1"	5	7
1.5"	7	9
2"	18	25
3"	25	34
4"	20	27
6"	42	57
8"	65	88
10"	73	99
12"	97	132

CAUTION: Improper tightening sequence can cause serious damage to the flow meter.
- Do not tighten one side at a time.
- Do not tighten each bolt completely at one time.

The Vortek Pro-M series meter is available in only a DC configuration. The meter will not ship with a power cord. The meter is equipped with screw terminals, that will allow you to easily wire DC power to the meter with your own cables.

Wiring. A 22-gauge wire is the minimum that is needed to provide power and utilize the outputs on the Vortek Pro-M series meter. The Vortek Pro-M comes with a pulse/frequency output, 4-20 analog, 2 alarms and modbus.

Vortek Pro-M has standard DC power.

Grounding

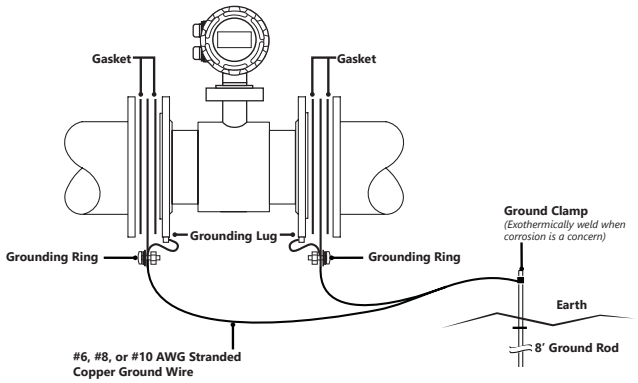
WARNING: ELECTRICAL SHOCK HAZARD
When the iMAG is installed in a plastic piping system, or when externally powered, the piping system must be grounded to meet national and local electrical safety codes. Failure to do so can result in electrocution.

In this section, the term "grounding" will be defined as: the arrangement of process wetted metal materials (piping, ground rings, and ground electrodes), cabling (ground straps and ground wires), and connections to stable references (often, but not always earth ground) required to achieve satisfactory operation of a magnetic flowmeter. As such, it applies to the instrumentation aspect of grounding, rather than to "safety grounding".

NOTE: Connections must be inspected periodically for corrosion to maintain the necessary low resistance connection.

Proper installation and grounding of magnetic flowmeters is important for accuracy, reliable measurement performances and deterring stray AC or DC currents through the fluids and other instruments. Although grounding rings will not be necessary on all installations adding grounding rings to any meter at the time of installation will make the diagnosis and elimination of excessive noise or transient voltages much easier if found during normal operation of the meter site.

Adding a 5/8" x 8' independent ground rod dedicated to the meter, a ground rod clamp, and connecting them with at least 10 GA ground wire may be necessary when electrical noise is present, but unlike grounding rings, ground rods are easy to add after the fact although installing these during meter installation adds insurance that a meter will encounter less noise and will help protect against large electrical spikes.



General Cable Information

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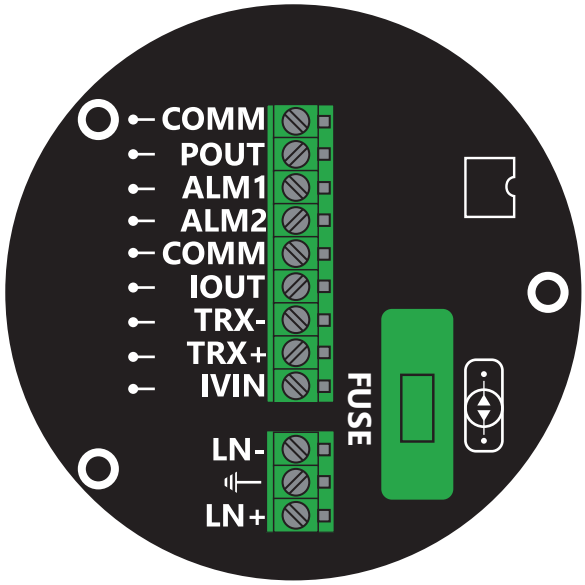
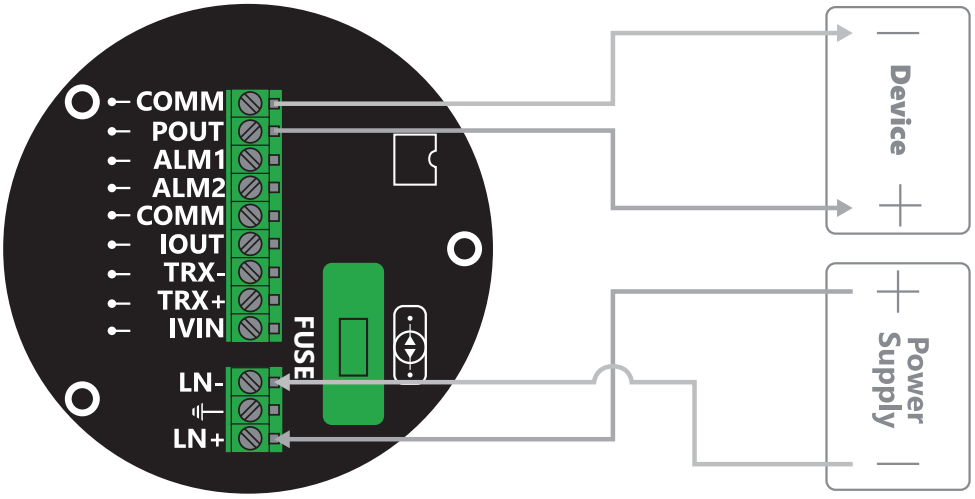
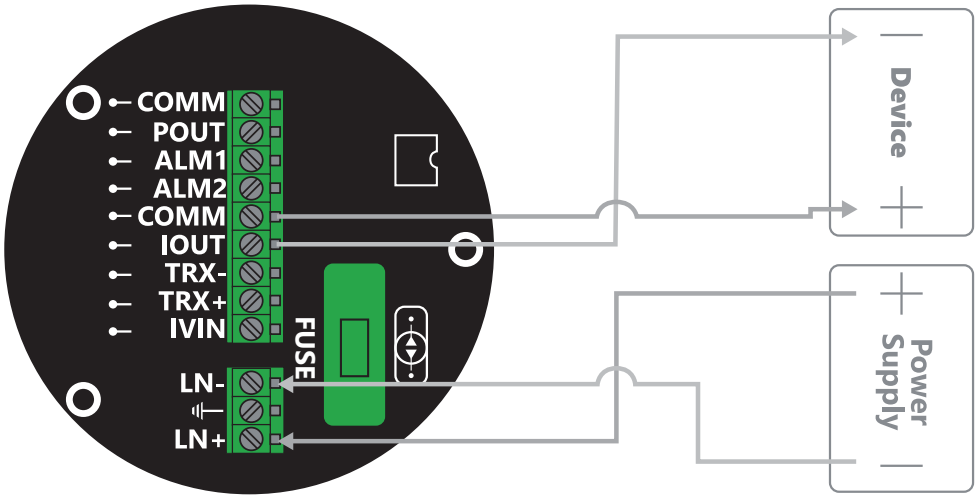


Terminal Configuration	
Terminal	**Meaning**
LN +	Live Wire: AC version 110/220 or DC version + 24Vdc
LN -	Naught Wire: AC version 110/220 or DC version -24Vdc
⏚	Earth Ground
IVIN	24 DC Power Supply for 2 wire 4-20 Output
TRX +	+ RS485 Communication
TRX -	- RS485 Communication
IOUT	Current Output of Flow Rate
COMM	Frequency, Pulse and Current Common (GND)
ALM2	Alarm Output for Lower Limit
ALM1	Alarm Output for Higher Limit
POUT	Frequency (Pulse) Output for Bi-Directional Flow
COMM	Frequency, Pulse, and Current Common (GND)

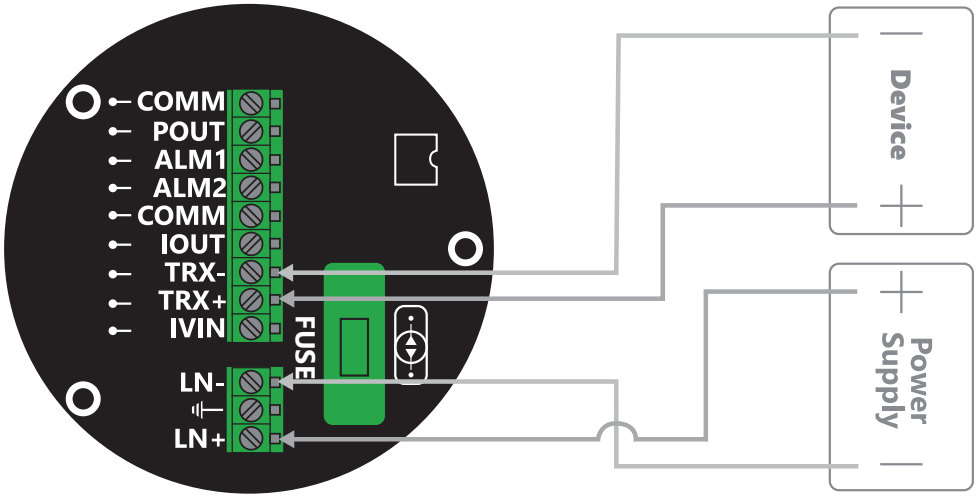
Pulse Output Current Sinking Sourcing Wiring



4-20mA



Modbus



Home Screen and General Navigation

The home screen as pictured shows flowrate, total, and alarm symbol and messages. There are four buttons which are used for accessing various settings. If the meter is ever in any setting or menu, 3 minutes of inactivity will bring the display back to measuring mode.

Alarm Code	Meaning
FQH	High Flow Alarm
FQL	Low Flow Alarm
FGP	Empty Pipe
SYS	General Alarm Status

Key	Meaning/Reference
▶|	Forward Key – Used in combination with other keys to access settings and menu
↵	Enter – Allows for return to main measuring screen. Used in combination with other keys to access settings.
▲	Up Key – Used to change parameters in the upward direction on the main screen. Utilized to select menus. Used in combination with other keys to change settings and select.
▼	Down Key - Used to change parameters in the downward direction on the main screen. Utilized to select menus. Used in combination with other keys to change settings and select.

Key Combinations	Meaning/Reference
▶| + ↵	From the home screen allows entry to get into menu, clear total option and quick view settings.
▶| + ▲ (or) ▶| + ▼	To move cursor to the right, and to move cursor to the left.

Changing Flow Meter Settings

Home Screen and General Navigation

The HOME Screen displays flow volume, direction of the flow total, and flow rate. The home screen also shows the alarm conditions, and the units for both the volume and flow rate.

Changing Total Direction

To change the total direction that is displayed on the home screen, press the ▲ button to cycle through totalizer display options. ∑+ indicates positive flow (in the direction of the arrow on the flow body. ∑- indicates negative flow (in the opposite direction of the arrow on the flow body). ∑D represents the net flow ((Σ+)-(Σ-)).

Additionally, in the same location, you can cycle through and view current flow speed (FLS), percentage of full scale flow (FQP), and the ratio of emptiness (MTP).

Entering Menu System

To navigate from the HOME Screen, press both ▶ + ↵ keys to be taken to the FIRST SUBMENU.

FIRST SUBMENU

To cycle between options here, press the ▲ to cycle through the following screens: “Parameters Set”, “Clr Total Rec”, and “Fact Modif Rec”. To enter any of them, press ↵ (the Enter Key). The meter will prompt you for a passcode to enter the “Parameters Set” menu and the “Clr Total Rec” menu.

To enter the “Parameters Set” menu, enter the Grade 4 passcode: 07206. To navigate the passcode entry, press ▲ to increase the number, and press ▼ to decrease the number. To move to the next digit in the passcode, press ▶ + ▲ , and to move to the previous digit, press ▶ + ▼. Once the passcode has been entered in, then you must press ▶ + ↵ to enter the passcode. If successful, the screen should transition.

Parameter Set Menu

The first parameter that is visible in the “Parameter Set” menu is “Language”. This is a full list of all parameters that are available in this menu:

Parameter Function Table

NOTE: TO ACCESS THE PARAMETER SET MENU, YOU MUST ENTER THE PASSCODE 07206

No.	Function	Setting/Description
Language		
M1	Language	Switch meter language to other available options. Default is English
RS485 Communication		
M2	Comm Address	Value: Integer 01 to 99 Device Address for RS485
M3	Baud Rate	Selectable: 300, 600, 1200, 2400, 4800, 9600, 19200, 38400
Sensor Diameter		
M4	Sensor Size	Select the sensor size

No.	Function	Setting/Description
Flow Parameters		
M5	Flow Unit	Selectable: L/s, L/m, L/h, m3/s, m3/m, m3/h, UKG, USG
M6	Flow Range	Value: 0000.0-9999.9 (This parameter represents the maximum flow rate of the meter)
		Changing this value will affect M10 and current output value. The value this is set to will represent the 20mA output. 0mA output will always by 0 flow.
M7	Flow Rspns	Damping time/time constant – default value: 3 seconds
		Setting a large value for this parameter can enhance the stability of the flow display and digital output, which is suitable for the totalizer. A smaller value means a faster response rate, which is suitable for production control.
M8	Flow Direct	Selectable: Forward/Reverse
		Define polarity of flow direction. Forwards: Following the direction of the arrow on the measuring sensor. Reverse: Opposing the direction of the arrow on the measuring sensor.
M9	Flow Zero	Zero Calibration
		First Row: FS-new zero calibration value Second row: Zero-point correction value To ensure the flow meter's accuracy, FS should be 0 Note: Only perform "Flow Zero" when pipe is full, and fluid is static.
M10	Flow Cutoff	Sets output value for all outputs to 0
		For example: Flow cutoff = 20% Then the minimum flow rate = 20% of maximum flow rate. Note: This function is ONLY effective if M11 is enabled.
M11	Cutoff Enable	Selectable: Enable/Disable
M12	Total Unit	Selectable: 0.001 L, 0.01 L, 0.1 L, 1.0 L, 0.001 m3, 0.01 m3, 0.1 m3, 1 m3, 0.001 UKG, 0.01 UKG, 0.1 UKG, 1.0 UKG, 0.001 USG, 0.01 USG, 0.1 USG, 1.0 USG
Outputs		
M13	SegmaN Ena	Selectable: Enable/Disable The switch to control current or pulse outputs of reverse flow.
		Note: The output function is only effective for reverse flow if M13 is enabled.
M14	Analog Type	Selectable: 4-20 mA
M15	Pulse Type	Selectable: Frequency / Pulse Frequency: Frequency Output Pulse: Scaled Pulse Output
M16	Pulse Fact	Selectable: 0.001 L, 0.01 L, 0.1 L, 1.0 L, 0.001 m3, 0.01 m3, 0.1 m3, 1.0 m3, 0.001 UKG, 0.01 UKG, 0.1 UKG, 1.0 UKG, 0.001 USG, 0.01 USG, 0.1 USG, 1.0 USG
		The Pulse Fact value is only effective if M15 is selected as "Pulse". Example: If M16 = "0.1 G", each pulse represents 0.1 Gallons. Maximum pulse output: 100 pulses/sec
M17	Frequency Max	Value: 1-9999 Hz
		Maximum frequency corresponds to M6

No.	Function	Setting/Description
Alarms		
M18	Mtsnsr Enable	Selectable: Enable/Disable Empty pipe detection is only valid if M18 is enabled
M19	Mtsnsr Trip	First row: Measured Conductivity Value (V1) (Same as MTP value). Second row: The value (V2) which can trigger the Empty Pipe Alarm. Generally, set V2 as 3-5 times the value of V1. Flow indication, pulse output, and current output are 0 when the alarm is triggered. Note: Perform the parameter set when the pipe is fully filled with liquid.
M20	Alm Hi Ena	Selectable: Enable/Disable Upper flow limit alarm is only valid if M20 is enabled.
M21	Alm Hi Val	Value: 0% - 599.99% (The value to trigger the Upper Flow Limit Alarm)
		Upper flow limit alarm is only triggered when M20 is enabled and the flow rate > M21*M6
M22	Alm Low Ena	Selectable: Enable/Disable Lower flow limit alarm is only valid if M22 is enabled
M23	Alm Low Val	Value: 0% to 599.99% (The value to trigger the Low Flow Limit Alarm)
		Lower flow limit alarm is only triggered when M22 is enabled and the flow rate < M10*M6
M24	Sys Alm Ena	Selectable: Enable/Disable System exciting alarm is only valid if M24 is enabled
Reset Totalizer Password		
M25	Clr Sum Key	The password is used to reset the totalizer
Sensor		
M26	Snsr Code 1	User can set the sensor production date in M26 to track whether the sensor factor is correct
M27	Snsr Code 2	Sensor Serial Number
M28	Field Type	Selectable: Type 1 (1/16); Type 2 (1/20); Type 3 (1/25) Three types of excitation frequency Usually, 1/16 for smaller sized sensors, and the other two for larger sized sensors
M29	Sensor Fact	Input measuring sensor constant: GK User can get this factor from the calibration certificate
Linearity Correction		
M30	Line Crc Ena	Selectable: Enable/Disable
		This parameter is used to control the linearity correction function
M31	Lineary CRC 1	Correction Point 1: Velocity of Point 1
M32	Lineary Fact 1	Linear Fact 1: Correction Factor of Point 1
M33	Lineary CRC 2	Correction Point 2: Velocity of Point 2
M34	Lineary Fact 2	Linear Fact 2: Correction Factor of Point 2
M35	Lineary CRC 3	Correction Point 3: Velocity of Point 3
M36	Lineary Fact 3	Linear Fact 3: Correction Factor of Point 3
M37	Lineary CRC 4	Correction Point 4: Velocity of Point 4
M38	Lineary Fact 4	Linear Fact 4: Correction Factor of Point 4

No.	Function	Setting/Description
Set Value for Total Flow For Flow Meter maintenance or replacement, the previous flow total might need to be set		
M39	FwdTotal Lo	Set value: 00000 – 99999
		Low byte of positive total flow (OOOOXX.XXX where X represents the digits that M39 can change)
M40	FwdTotal Hi	Set Value: 0000 – 9999
		High byte of positive total flow (XXXXOO.OOO where X represents the digits that M40 can change)
M41	RevTotal Lo	Set Value: 00000 – 99999
		Low byte of reverse (or negative) total flow (OOOOXX.XXX where X represents the digits that M41 can change)
M42	RevTotal Hi	Set Value: 0000 – 9999
		High byte of reverse (or negative) total flow (XXXXOO.OOO where X represents the digits that M42 can change)
Peak Suppression Function		
M43	PlsntLmtEna	Selectable: Enable/Disable The switch for peak suppression
M44	PlsntLmtVal	This parameter determines the change rate of peak interference, based on the percentage of flow velocity in ten grades: Grade 1 – 0.010 m/s, 0.020 m/s, 0.030 m/s, 0.050 m/s, 0.080 m/s, 0.100 m/s, 0.200 m/s, 0.300 m/s, 0.500 m/s, 0.8 m/s – Grade 10 The sensitivity of peak suppression is highest for Grade 1
M45	Plsnt Delay	This parameter can determine the width of time to restrain peak interference in ms
		If the duration of one signal is less than the value of M45, this signal can be determined as peak interference and will be suppressed; otherwise it will be determined as normal signal.
Password Management		
M46	PassWord1	Please contact the factory to alter these parameters. The password provided in this manual is a Grade 4 Password (07206). Passwords can only be changed with a Grade 5 Password, which will only be provided by the factory.
M47	PassWord2	
M48	PassWord3	
M49	PassWord4	
Factory Use ONLY		
M50	Analog Zero	Zero-point calibration for current output to make sure the zero point is 0 mA / 4mA
M51	Anlg Range	Full scale calibration for current output to make sure the full scale is 10 mA / 20 mA
M52	Meter Fact	Factory Use ONLY
M53	MeterCode1	Converter Production Date
M54	MeterCode 2	Converter Serial Number

Changing Flow Meter Settings (Continued)

Accepting Changes

The Grade 4 Password that is provided in this manual will allow you to Read parameters M1-M54, and Edit parameters M1-M38. To accept any changes that you make to the parameters, simply make the changes and then press the enter key to save the changes. You will be brought back to the parameter scroll screen.

Returning to Home Screen

To return to the home screen, hold down the enter key for approximately 5 seconds until the home screen is displayed.

Modbus

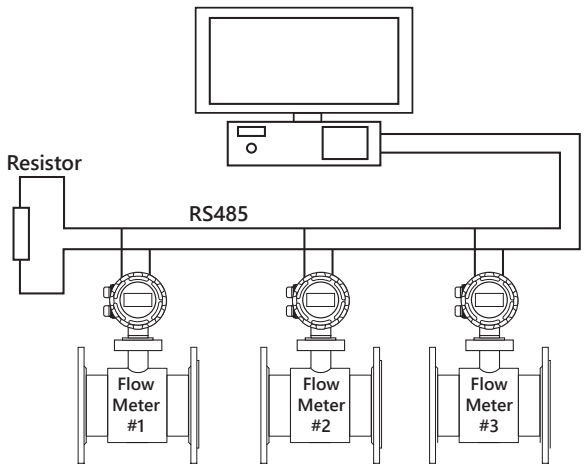
Pro-M Electromagnetic flowmeter MODBUS communication port uses electric isolation in the physical structure. The isolation voltage is 1500V and it has ESD protection. It can overcome various interferences from the industrial scene to ensure the reliable service of communications.

Supported Baud Rates
1200
2400
4800
9600
19200

Serial Port Parameters:
Data Bits = 8
Start Bit = 1
Stop Bit = 1
Parity = None

Network Structure and Wiring

Pro-M electromagnetic flowmeter's standard MODBUS communication network is a bus network. At the farthest device in the network, it usually requires a 120 **Ω** matched termination resistor to connect the two ports of communication wired in parallel. The standard communication connection media is shielded twisted pair. The figure below depicts where communication wiring is shown in detail.



Modbus (Continued)

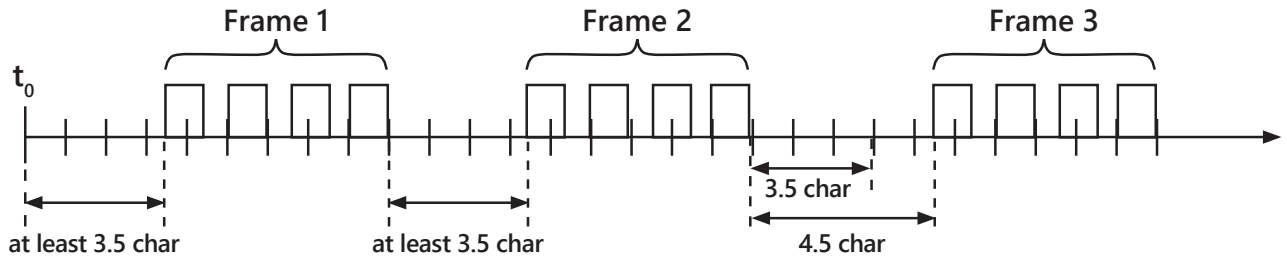
RTU Frame Format

Pro-M electromagnetic flowmeter uses the MODBUS RTU frame format (hexadecimal format). Its frame format is shown in the following tables.

Master RTU Message Frame						
Start	Device Address	Function Code	Register Address	Register Length	CRC	Stop
T1-T2-T3-T4	8 Bits	8 Bits	16 Bits	16 Bits	16 Bits	T1-T2-T3-T4

Slave RTU Message Frame						
Start	Device Address	Function Code	Data	CRC	Stop	Stop
T1-T2-T3-T4	8 Bits	8 Bits	N 8 Bits	16 Bits	T1-T2-T3-T4	T1-T2-T3-T4

T1-T2-T3-T4 is start or stop frame. MODBUS protocol sets that every two frames must have 3.5 char delay at least as shown in the figure below.



***Device address:** Pro-M electromagnetic flowmeter's communication address. Device address needs to be unique within the network trunk.*

Function Codes: Pro-M electromagnetic flowmeter uses Function code 4, read Input Register.
MODBUS Code Definitions are shown in the table below.

Function Code	Name	Function
01	Read coil status	Reservation
02	Read input status	Reservation
03	Read holding registers	Reservation
04	Read input register	Read Electromagnetic Flowmeter real-time information
05	Strong set single coil	Reservation
06	Preset single register	Reservation
07	Read abnormal status	Reservation
08	Loopback diagnostic check	Reservation
09	Program (only used for 484)	Reservation
10	Control exercise (only used for 484)	Reservation
11	Read events count	Reservation
12	Read communication events record	Reservation
13	Program (184/384 484 584)	Reservation
14	Inquire (184)384 484 584)	Reservation
15	Strong multi-coil set	Reservation

Modbus (Continued)

Registers: Below table shows the available data registers that are available from the Pro-M electromagnetic flowmeter.

MODBUS Registers			
Protocol Addresses (Decimal)	Protocol Addresses (HEX)	Data Format	Resister Definition
4112	0x1010	Float Inverse	Instantaneous Flow
4114	0x1012	Float Inverse	Instantaneous Velocity
4116	0x1014	Float Inverse	Flow Percentage
4118	0x1016	Float Inverse	Fluid Conductivity Ratio
4120	0x1018	Long Inverse	Integer part of cumulative Forward Total
4122	0x101A	Float Inverse	Decimal part of the cumulative Forward Total
4124	0x101C	Long Inverse	Integer part of the cumulative Reverse Total
4126	0x101E	Float Inverse	Decimal part of the cumulative Reverse Total
4128	0x1020	Unsigned Short	Instantaneous Flow Unit
4129	0x1021	Unsigned Short	Total Units
4130	0x1022	Unsigned Short	Upper limit alarm
4131	0x1023	Unsigned Short	Lower limit alarm
4132	0x1024	Unsigned Short	Empty pipe alarm
4133	0x1025	Unsigned Short	System alarm

If there isn't a function code setting option when configuring a PLC, add 3 in front of the register address when using function code 04. If PLC register address's basic address is from 1, add 1 to the original address when configuring register address.
Example: Pro-M electromagnetic flowmeter MODBUS register address is 4112 (0x1010) and MODBUS function code is 4. The PLC register address is 34113.

Float Format

Pro-M electromagnetic flowmeter MODBUS uses IEEE754 which is 32 bits float format. Its structure is shown as follows: (Instantaneous Flow exampled below)

0x1010 (34113)		0x1011 (34114)	
BYTE1	BYTE2	BYTE3	BYTE4
S EEEEEEE	E MMMMMMM	MMMMMMMM	MMMMMMMM

S	Mantissa Symbol	E	Exponent; expressed by the difference with decimal number 127
1	Negative	M	Mantissa; low 23 bits and the decimal part
0	Positive	When not all of the E is "0" and "1", the conversion formula between float and the decimal number is $V = (-1)^S \times 2^{(E-127)} \times (1+M)$	

Modbus (Continued)

Instantaneous Flow Unit					
Code	Unit	Code	Unit	Code	Unit
0	L/S	3	M3/S	6	UKG
1	L/M	4	M3/M	7	GPM
2	L/H	5	M3/H		

Total Flow Unit				
Code	0	1	2	3
Cumulative Unit	L	M3	T	USG

Alarm: Upper limit alarm, lower limit alarm, empty pipe alarm, system alarm.
0 = No Alarm
1 = Alarm

Communication Data Analysis

Instantaneous flow, instantaneous velocity, flow percentage, fluid conductivity ratio, decimal part of positive and reverse total, format conversion of float, integer part of the cumulative positive and reverse flow, transmission of long.

Read Instantaneous Flow

Master sends command (hexadecimal number)

01	04	10	10	00	02	74	CE
Device Address	Function Code	Register high address	Register high address	Register high length	Register low length	CRC high	CRC low

Data that master receives

01	04	04	C4	1C	60	00	2F	72
Device Address	Function code	Data length	4 bytes float (instantaneous flow)			CRC high	CRC low	

Float

C4	1C	60	00
1100 0100	0001 1100	0110 0000	0000 0000
Float byte 1	Float byte 2	Float byte 3	Float byte 4

S = 1 : if mantissa symbol is 1, it is negative. E = 10001000: Exponent is 136

M = 001 1100 0110 0000 0000 0000,

The mantissa is:

$V = (-1)^1 \times 2^{(136-127)} \times (1 + 1/8 + 1/16 + 1/32 + 1/512 + 1/1024)$

Modbus (Continued)

Read Instantaneous Velocity

Master sends command (hexadecimal number)

01	04	10	12	00	02	D5	0E
Device address	Function code	Register high address	Register high address	Register high length	Register low length	CRC high	CRC low

Data that master receives

01	04	04	C1	B0	80	00	A6	5F
Device address	Function code	Data length	4 bytes float (instantaneous velocity)				CRC high	CRC low

Float

C1	B0	80	00
1100 0001	1011 0000	1111 1000	0000 0000

S = 1

E = 10000011

M = 011 0000 1111 1000 0000 0000

$V = (-1)^1 \times 2^{(131-127)} (1+ 1/4 + 1/8 + 1/256)$

Read Total Flow

To express the 9 bits cumulative value of electromagnetic flowmeter total, integer part and decimal part of total flow are expressed respectively. The integer part uses long variable, and the decimal uses float variable. Cumulative flow is 1578m3.

Master sends commands to collect the integer value of cumulative flow.

01	04	10	18	00	02	F5	0C
Device address	Function code	Register high address	Register high address	Register high length	Register low length	CRC high	CRC low

Data that master receives

01	04	04	00	00	70	71	1E	60
Device address	Function code	Data length	4 bytes float (integer value of cumulative flow)				CRC high	CRC low

Integer value of cumulative flow is 28785

Master sends command to collect the decimal value of cumulative flow

01	04	10	1A	00	02	54	CC
Device address	Function code	Register high address	Register high address	Register high length	Register low length	CRC high	CRC low

Data that master receives

01	04	04	3F	00	00	00	3B	90
Device address	Function code	Data length	4 bytes float (decimal value of cumulative flow)				CRC high	CRC low

Modbus (Continued)

Float

3F	00	00	00
0011 1111	0000 0000	0000 0000	0000 0000

S = 0

E = 0111111 126

M = 000 0000 0000 0000 0000 0000

$V = (-1)^1 \times 2^{(126-127)} = 0.5$

Read Instantaneous Flow Unit

Master sends 8 bytes command to read instantaneous flow unit

01	04	10	20	00	01	34	C0
Device address	Function code	Register high address	Register high address	Register high length	Register low length	CRC high	CRC low

7 bytes data that master receives from slave

01	04	02	00	05	79	33
Device address	Function code	Data length	2 bytes integer (instantaneous flow unit)		CRC high	CRC low

The flow unit is M3/H from Instantaneous Flow Unit table above.

Read the unit of the total flow

Master sends 8 bytes command to read instantaneous flow unit

01	04	10	21	00	01	65	00
Device Address	Function Code	Register high address	Register high address	Register high length	Register low length	CRC high	CRC low

7 bytes data that master receives from slave

01	04	02	00	01	78	F0
Device address	Function code	Data length	2 bytes integer (cumulative flow unit)		CRC high	CRC low

Flow unit is M^3 from Total flow unit table.

Read Instantaneous Flow Unit

Master sends 8 bytes command to read instantaneous flow unit

01	04	10	24	00	01	75	01
Device Address	Function Code	Register high address	Register high address	Register high length	Register low length	CRC high	CRC low

7 bytes data that master receives from slave

01	04	02	00	01	78	F0
Device address	Function code	Data length	2 bytes integer (alarm)		CRC high	CRC low

Empty pipe is in alarm status if status is 1. Other alarm status is the same and so on.

Problem	Probable Causes	Things to try...
Measurement is not accurate	Parameters input incorrectly	Check the parameters programmed (Transmitter, K-Factor, and size).
	Pipe is not fully filled	Provide back pressure or other means to ensure pipe is filled.
Flow rate indication is unstable	Grounding issue	Make sure meter is properly grounded to a good earth ground. Use grounding rings when pipe is not conductive.
	Air	Make sure fluid does not contain air bubbles.
	Noisy Electrical Environment	Improve grounding at meter and nearby potentially noisy electrical equipment. Increase distance between meter and electrical noise sources.
	Low fluid conductivity < 20 µS/cm	Replace with different type of meter
	Excessively turbulent or unsteady flow due to partially closed valves or other flow obstructions	Eliminate or minimize causes of flow disturbances, or increase meter damping.
No display	No power	Apply correct power.
	Incorrect power	Check the power supply.
	Bad wiring connection	Check power input / output connections.
	Blown fuse	Replace the fuse.
	Contrast of LCD is too low	Increase the contrast.
Empty pipe alarm	Fluid does not fully fill the pipe	Increase the flow rate.
	Electrode has been fouled	Clean the electrodes.
	Low fluid conductivity < 20 µS/cm	Replace with different type of meter.
Flow rate appears correct, but pulse / frequency output is low, erratic, or absent	Wiring incorrect	Compare wiring with appropriate wiring recommendations.
	External device input impedance too low	Use sourcing rather than sinking interface connection.
	Cable too long	Reduce interface pull-up resistance.
Flow rate appears correct, but pulse / frequency output is erratic and / or too high	Electrical noise sources interfering with pulse frequency signal	Isolate, remove, or reduce noise sources. Move meter control cable away from noise sources. Increase pulse damping setting (Flow Rspns).
	Wrong type of cable	Replace cable.
	Grounding problem	Improve or try different grounding method.