

FMG470 Series

Municipal/Industrial Magmeter



 **OMEGA™**





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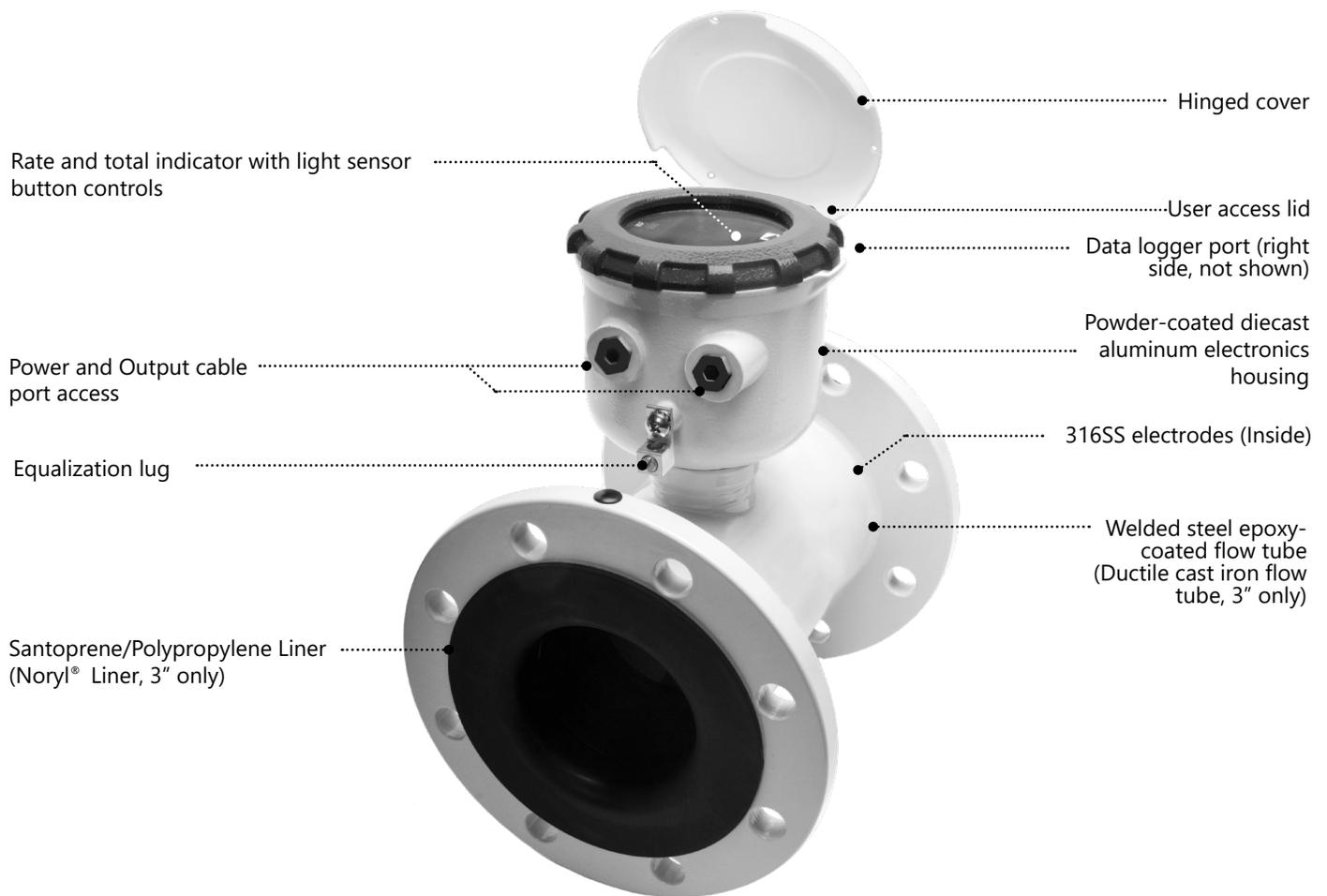
The **FMG470 Series** is the most economical flanged electromagnetic flowmeter on the market. With electrodes designed to discourage fouling, it is available in 3" to 12" pipe in municipal or industrial water, waste and reclaimed water, pump stations, and packaged plant applications. Minimal straight pipe requirements allow FMG470 Series meters to be used in piping configurations where there is little space between the meter and an elbow.

FMG470 Series meters are CE certified, certified to NSF/ANSI standard 61 and are rated IP68 for applications where the meter may be operated under water to a depth of up to 10 feet (3 meters) continuously.

Rate and total units and pulse scaling can be set via the front panel touch key pad by the user. Bidirectional flow reading is standard with totals available in forward, reverse, net flow, batch forward flow, and batch reverse flow. Built-in data logging is available as an option for secure flow logging.

A power/output cable allows outputs for use with a variety of Omega and other displays and controls for remote reading. Pulse output is standard on all models in addition to a 4-20mA passive current loop.

Features



Specifications*

Pipe Sizes	2", 3", 4", 6", 8", 10", 12"						
Flanges	150 lb. ANSI Pattern						
Pressure	150 psi (10.3 bar) line pressure						
Temperature	Operating 10° to 140° F (-12° to 60° C)						
	Storage -40° to 158° F (-40° to 70° C)						
Accuracy	±0.75% of reading (±1.0% FMG470), ±0.025% of full-scale flow from low flow cutoff to maximum flow rate of 10 m/sec						
Low Flow Cutoff	0.5% of maximum flow rate						
Material	Body (2"-12")	Welded steel, epoxy-coated					
	Liner (2" & 3")	Polyurethane/Noryl®					
	Liner (4"-12")	Santoprene flange/Polypropylene liner body					
	Electronics Housing	Powder-coated diecast aluminum					
Electrodes	316 stainless steel						
	Display	Type 128x64 dot-matrix LCD					
	Digits	5 Digit Rate			8 Digit Total		
	Units	Rate Volume Units		Rate Time Units	Total Volume Units		
	<i>Please Note: All meters are factory set for gallons per minute (GPM) rate and gallons total. If other units are required, they can be set in the field.</i>	Gallons Liters Barrels(42 gal) Cubic Feet Cubic Meters	Million Gallons ² Mega Liters ² Imperial Gallons Million Imperial Gallons ²	Second Minute Hour Day	Gallons Gallons x 10 Gallons x 100 Gallons x 1000 Million Gallons Liters Kilo Liters Mega Liters	Barrels (42 gal) Cubic Meters Cubic Meters x 1000 Cubic Feet Cubic Feet x 100 Cubic Feet x 1000 Second Foot Day Million Cubic Feet	Acre Feet Acre Inches Imperial Gallons Imperial Gallons x 1000 Million Imperial Gallons Gallons Fluid Ounces
	Bidirectional ¹	Forward Total, Reverse Total, Net Total, Batch Forward Total, Batch Reverse Total ³					
Power	DC Power	9-36 Vdc @ 250 mA max, 30 mA average					
	Battery Backup (Not for use as primary power)	DC powered units: One lithium 7.2V 'D' size battery pack, replaceable. AC powered units: One 9V alkaline battery, replaceable.					
	AC Power	85-264Vac, 50/60Hz, 0.12A					
	Battery	One lithium 7.2V 'D' size battery pack, replaceable.					
Scaled Pulse Output	Signal	Current sinking pulse, isolated, 36 Vdc at 10 mA max					
	Pulse Rates	User-scalable from 0.1 to 99,999.9 volume units/pulse. Pulse width is one-half of pulse period with minimum pulse width of 2.5 ms, 200 pulses/sec max. For battery option meters, pulse width varies with frequency, 150 pulses/sec max.					
Options	4-20mA Current Loop	Isolated, passive, 24Vdc, 650 Ω maximum current loop					
	High Speed Digital	Isolated, open collector, 24 Vdc					
	Serial Communications	Isolated, asynchronous serial RS485, Modbus® RTU protocol					
Cable	Power/Output Cable	20ft (6m) standard length polyurethane jacketed cable—for power and outputs (lengths up to 200' available).					
	Remote Display Cable	20ft (6m) standard length polyurethane jacketed cable—for connection between meter and remote display (lengths up to 200' available).					
Conductivity	> 20 microSiemens/cm						
Empty Pipe Detection	Hardware/software, conductivity-based						
Regulatory	CE (EN 61326), certified to NSF/ANSI standard 61 60°C (140°F)						
Environmental	NEMA 6P, IP68 (10ft (3m) depth, continuously)						

Modbus® is a registered trademark of Schneider Electric.

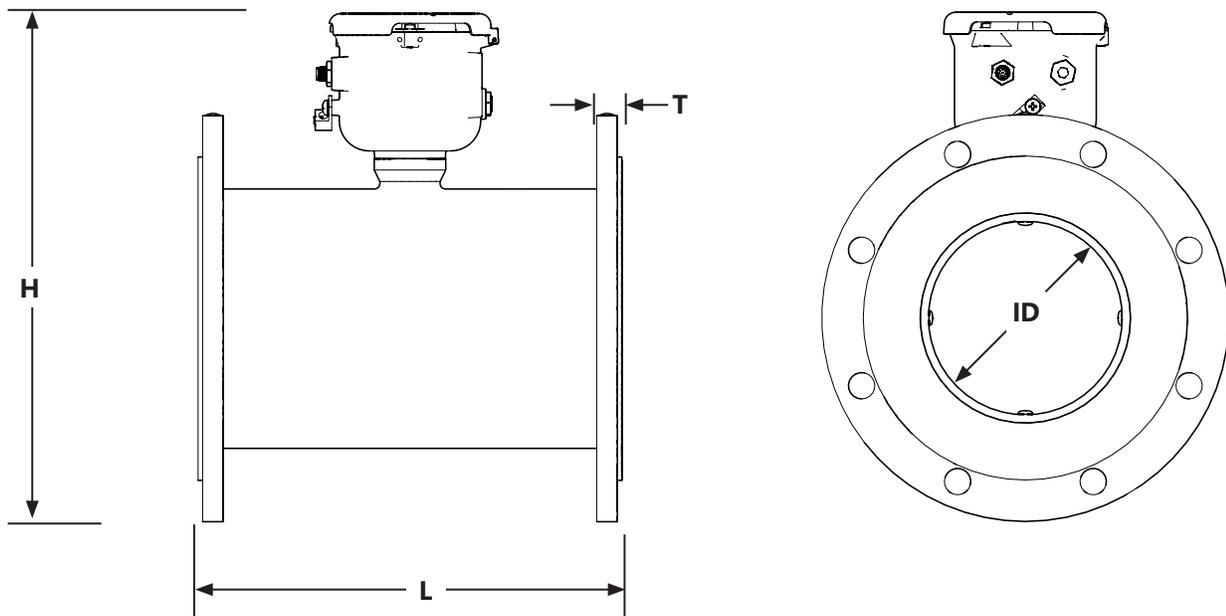
* Specifications subject to change. Please consult our website for the most current data (www.seametrics.com).

¹ If forward and reverse flow data needs to be sent to another device, either the Digital or Modbus® output is required.

² Rate Time Unit is available in Day only.

³ Forward and reverse flow totals are non-resettable. Batch forward and batch reverse totals can be reset.

Dimensions

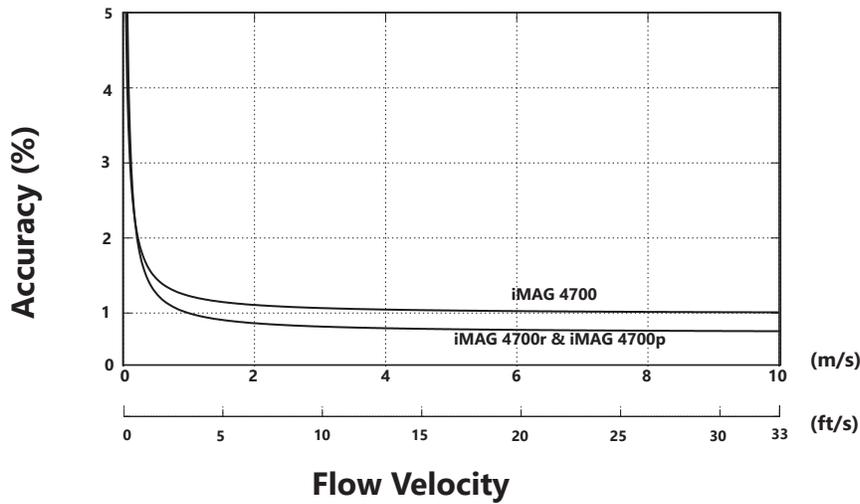


Meter Size	L		H		T		ID		Shipping Weight	
	inch	mm	inch	mm	inch	mm	inch	mm	lbs	Kg
2"	7.9	200	7.6	193	.62	15.7	1.76*	45*	25	11.3
3"	7.9	200	8.1	206	.62	15.7	2.68*	68*	30	13.6
4"	10.12	257	8.3	211	.62	15.7	3.12	79	33	15
6"	12.09	307	9.1	231	.69	17.5	5.05	128	49	22
8"	14.14	359	10.1	257	.69	17.5	6.44	164	70	32
10"	18.08	459	11.2	284	.69	17.5	8.61	219	130	59
12"	19.68	500	12.2	310	.81	20.6	10.55	268	170	77
Flanges	Standard ANSI 150 lb. drilling								Cable 1 lb.	

Note: 'L' dimension is total from liner face to liner face

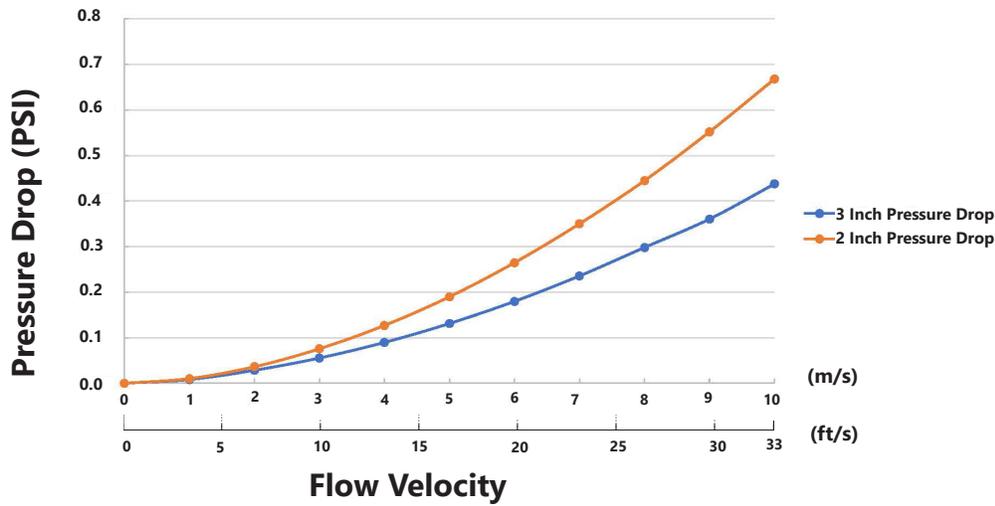
*Average ID

Accuracy



2" & 3" Pressure Drop

Note: No pressure drop in 4" - 12" meters



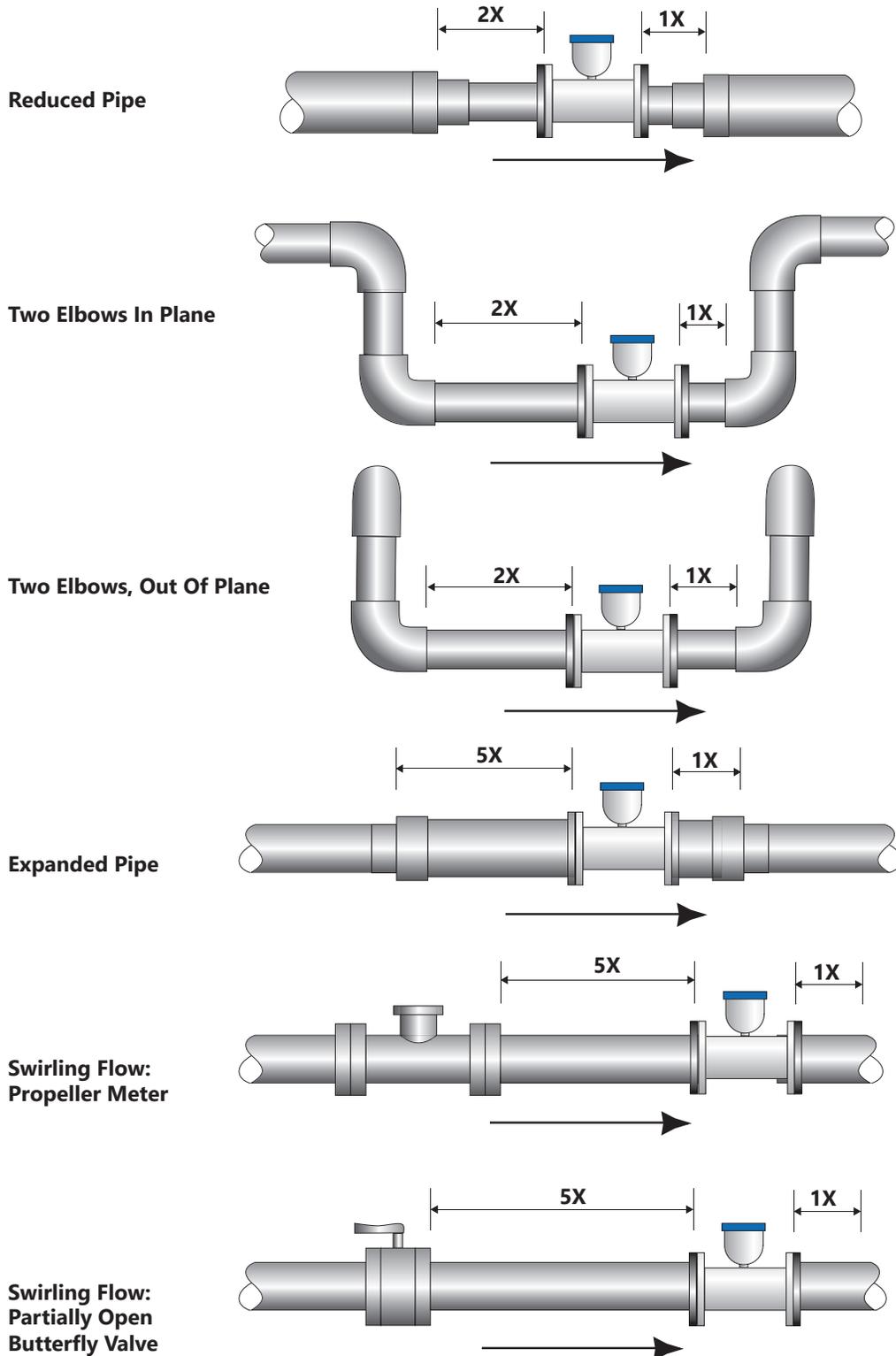
Flow Rate (2" - 12")

Pipe Size (Inches in diameter)	2"	3"	4"	6"	8"	10"	12"
Max Flow Rate (Gallons/Minute)	321	722	1285	2891	5140	8031	11565
Cut-off (min) Flow Rate (Gallons/Minute)	1.61	3.61	6.43	14.46	25.70	40.15	57.82
Max Flow Rate (Liters/Second)	20.25	46	81	182	324	507	730
Cut-off (min) Flow Rate (Liters/Second)	0.13	0.23	0.41	0.91	1.62	2.54	3.65
Max Flow Velocity (Meters/Second)	10	10	10	10	10	10	10

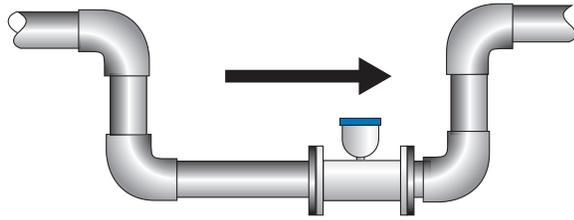
INSTALLATION

Straight Pipe Recommendations (X = diameter)

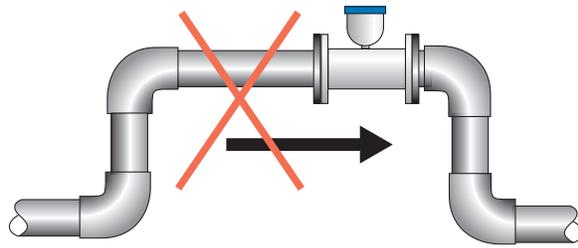
NOTE: These configurations are to be used as general guidelines and do not cover every possible installation. A combination of two or more obstructions will require additional straight pipe. If there is any concern about the length of pipe required for a specific application, please contact your local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



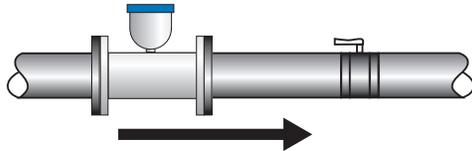
Full Pipe Recommendations



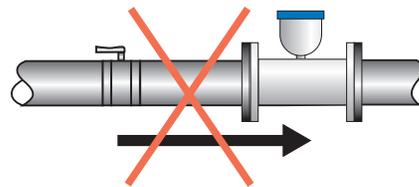
Recommended:
Keep pipe full at meter for accuracy



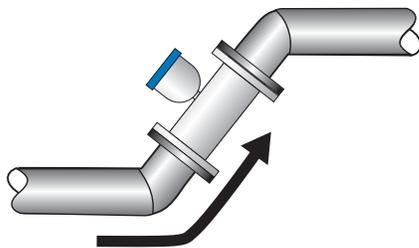
Not Ideal:
Allows air pockets to form at meter



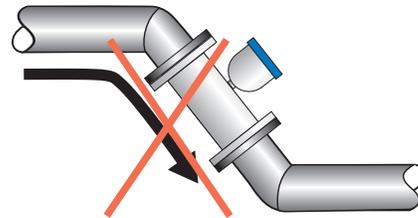
Recommended:
Keeps pipe full at meter for accuracy



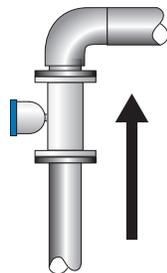
Not Ideal:
Post-valve cavitation can create air pocket



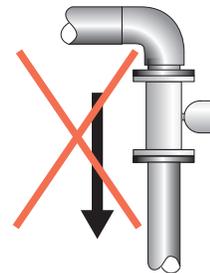
Recommended:
Allows air to bleed off



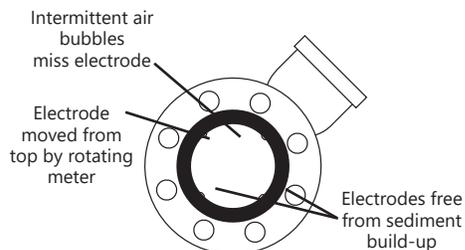
Not Ideal:
Air can be trapped



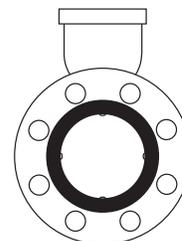
Recommended:
Allows air to bleed off



Not Ideal:
Air can be trapped



Best:
Improved accuracy results from unimpeded electrodes



Not Ideal:
If pipe contains air bubbles or sediment (may affect accuracy)

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.

These meters can be installed horizontally, vertically (with upward flow), or in any radial position. **Using a check valve on the upstream side of the meter, and/or an air vent (vacuum relief valve) in the same, unobstructed run of pipe as the meter, is required in any installation where the meter may be exposed to suction when the system is not in normal operation. Suction can cause damage to the liner. Liner damage caused by suction, without the use of a check valve and/or air vent, may void the warranty.**

Straight Pipe Recommendations. The FMG470 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 7).

Full Pipe Recommendations. To prevent false readings, this meter is designed to indicate 'EMPTY PIPE' if one or more electrodes is exposed. For highest accuracy, install the meter so that the pipe will be full when there is flow. If air bubbles may be present in the pipe or sludge accumulation is an issue, rotate the meter by one flange hole to position the control housing at a 45° angle (see diagrams on page 8).

Fittings. The FMG470 Series has ANSI 150 lb. drilled flanges and will mate with any other ANSI 150 lb. flanges. See table on page 10 for flange bolt tightening torque specifications.

Calibration. The FMG470 Series is factory-calibrated before shipping. The frequency of recalibration will depend on the needs of each application and local regulatory policies.

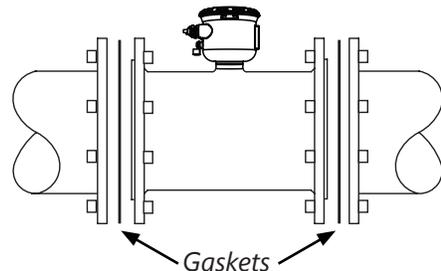
Chemical Injection. When the FMG470 Series is used in a chemical injection application, the chemical injection point must be placed downstream of the magmeter OR far enough upstream for complete mixing to occur before the fluid reaches the meter. When unmixed chemical alternates with water passing through 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.

Installing Gaskets

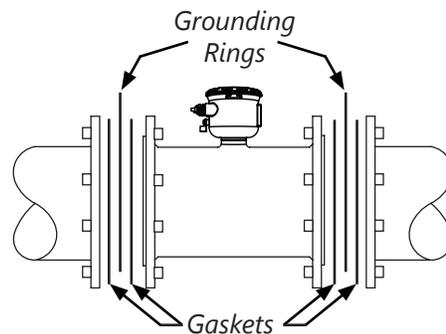


GASKETS
Gaskets are required at all junctions.

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 without grounding rings



Installation with grounding rings

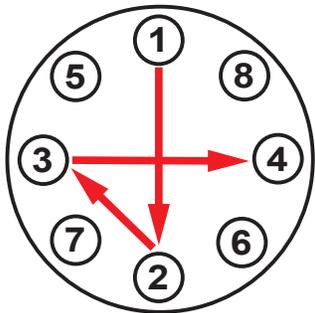


CAUTION: In chemical injection applications, install chemical injection point downstream of magmeter, or far enough upstream to allow complete mixing of fluids.

Tightening Flange Bolts

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

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



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.

SUGGESTED FLANGE BOLT TORQUE

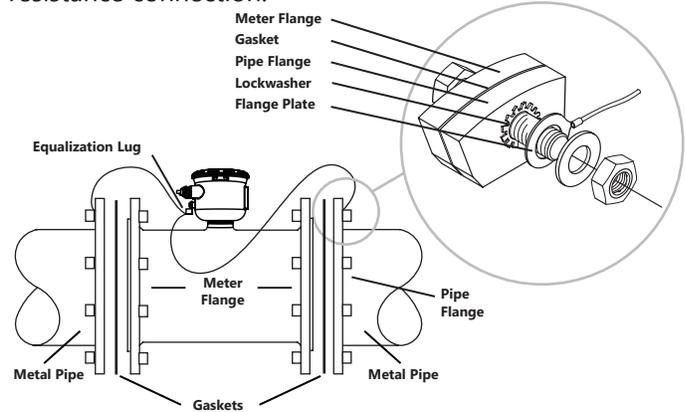
Pipe Size	Liner	
	ft-lb	Nm
2"	18	25
3"	25	34
4"	20	27
6"	42	57
8"	65	88
10"	73	99
12"	97	132

Equalization and Grounding

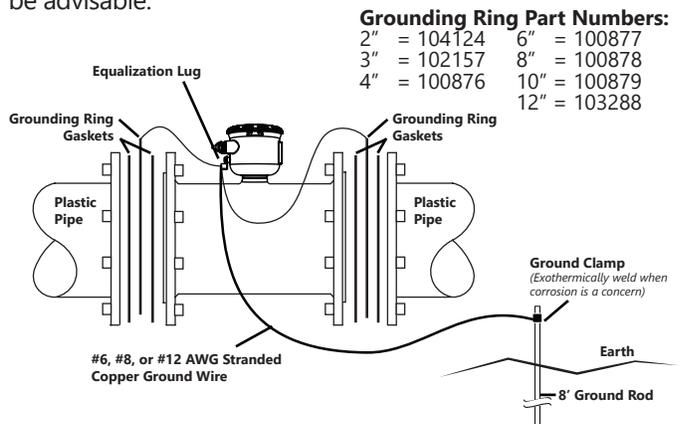


WARNING: ELECTRICAL SHOCK HAZARD
When installed in a plastic piping system, or when externally powered, the piping system must be grounded to meet national and local electrical safety codes. Failure to do so can result in electrocution.

Metal Pipe Installations. To equalize the electrical potential of the fluid, the meter, and the surrounding pipe, secure the flange plates (factory-installed on the equalization wire) to both pipe flanges at one of the bolt holes, as shown below. Be sure the lock washer fits between the pipe flange and the flange plate. For the best electrical bonding, remove rust and paint to expose clean, bare metal where the equalization flange plate lock washer contacts the pipe flange. Connection must be inspected periodically for corrosion to maintain the necessary low resistance connection.



Plastic Pipe and Electronically Noisy Installations. When installed in plastic pipe or in an electrically noisy system (near a VFD etc.), grounding rings are recommended. As shown in the diagram below, the equalization wires should be solidly connected to the grounding ring tabs instead of the flange bolts as in metal piping installations. Where lightning is a threat, or in severe electrical environments, an optional connection to a nearby equipment ground or ground rod may be advisable.

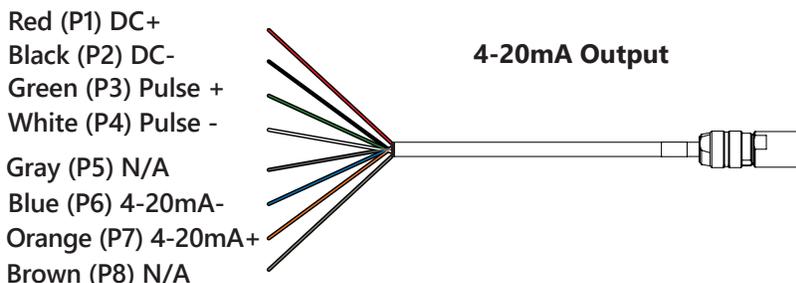
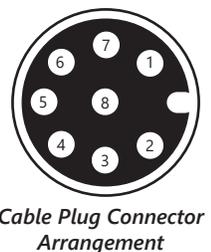
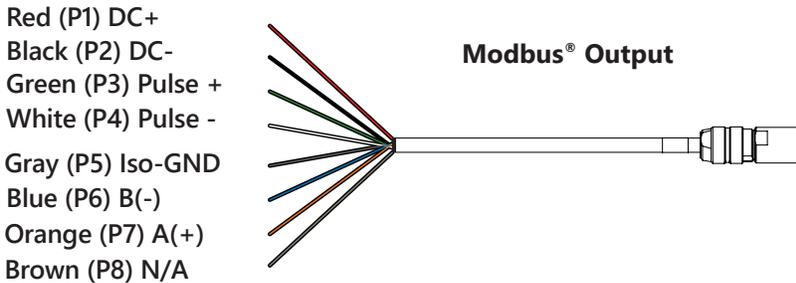
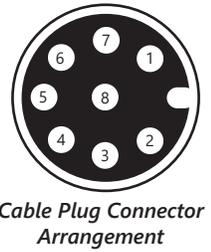
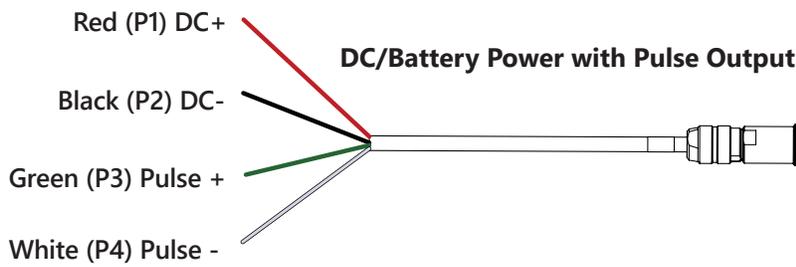
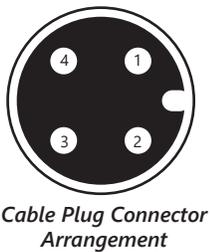
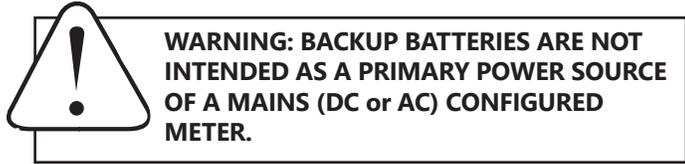


Grounding Ring Part Numbers:
 2" = 104124 6" = 100877
 3" = 102157 8" = 100878
 4" = 100876 10" = 100879
 12" = 103288

General Cable Information

The meter has two power/output cables that can be installed. The 4-pin cable contains the wires for DC power and pulse output. The 8-pin cable contains the wires for DC power and pulse, 4-20 mA or Modbus® output options when ordered. See diagrams below for details.

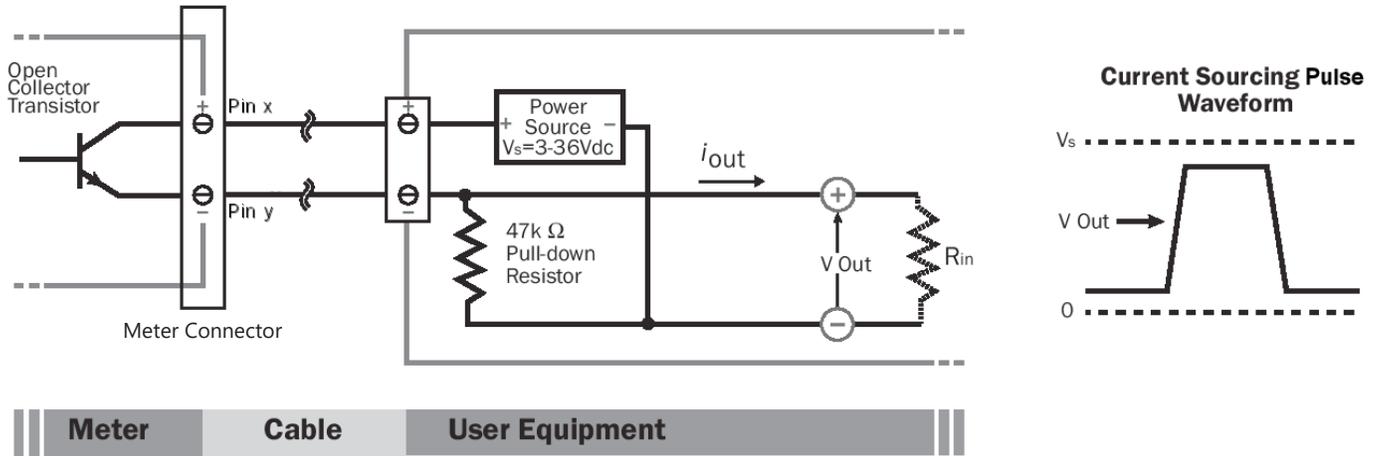
Available in either Battery or external DC versions.



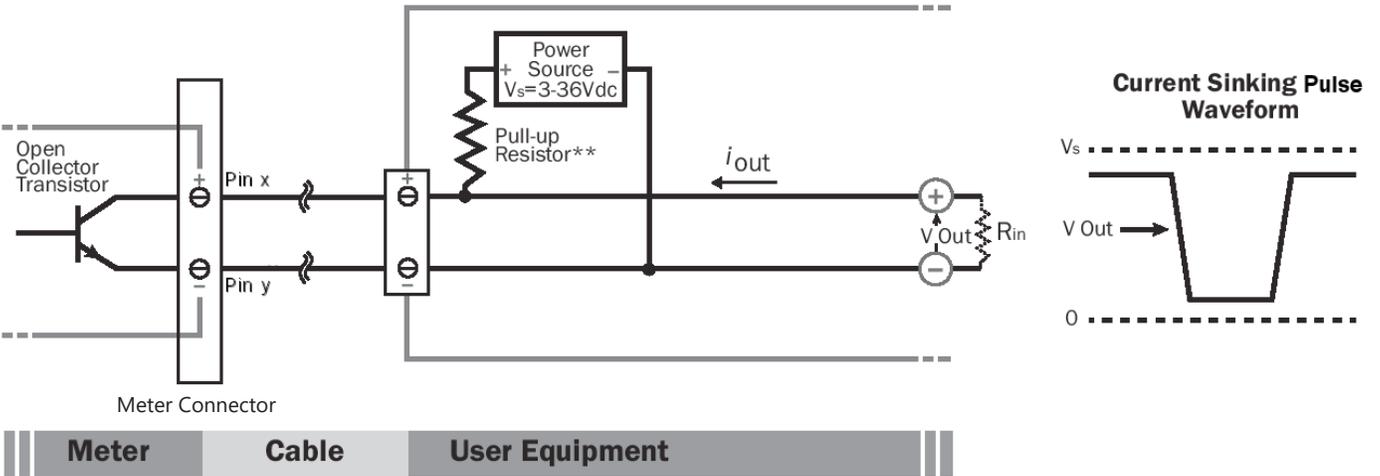
Option IDs

O ID	POWER SOURCE / OUTPUT(S)
BXX	= BATTERY POWER / PULSE SCALED
BXS	= BATTERY POWER / PULSE SCALED / MODBUS®
D1X/D2X	= DC POWER / PULSE SCALED
D1L/D2L	= DC POWER / PULSE SCALED AND 4-20mA
D1S/D2S	= DC POWER / PULSE SCALED AND MODBUS®

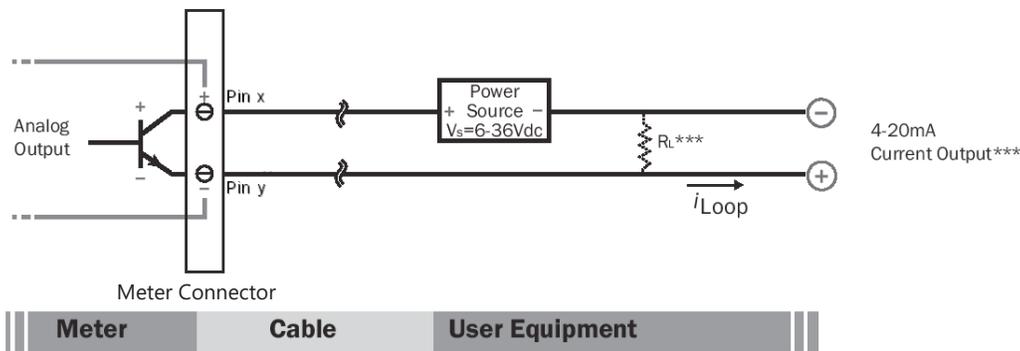
Pulse or Digital Output Application - Sourcing Mode (Recommended for $R_{in} < 30k\Omega$)



Pulse or Digital Output Application - Sinking Mode (Recommended for $R_{in} > 30k\Omega$)



Analog (4-20mA Current Loop) Output Application



** Minimum resistor value is $(100 \times V_s)$ ohms. Higher resistances maybe used depending on frequency and cable length. Longer cables and high frequencies require lower resistance.

*** Resistor R_L converts 4-20mA current to voltage for voltage input only devices.

Cable Shield. In general, the cable shield and its bare drain wire should be left unconnected at the user equipment end of the cable to minimize “ground loop” problems.

Pulse Output Configuration. A pulse output is standard on all models. Since this is an isolated output, the external equipment must include a DC power source to regenerate the pulse from the open-collector output (transistor equivalent of a contact closure). A pull-up or pull-down resistor may be needed if not included in the user equipment as shown in the diagrams. Both the power source and resistor may be supplied internally in some types of control and monitoring devices. If not, as for most PLC discrete input modules, they must be added externally at the module input terminals. The pulse output rate in volume units/pulse can be set by the user via the SETP tab on the meter’s setup menus.

Because the pulse output is set by the user, care must be taken to assure the output pulses do not exceed the maximum frequency of the meter while also ensuring a reasonable resolution.

K-factor: Remember that SETP is expressed in units totaled per output pulse (G/P if using gallons) while K-factors are expressed in pulses per gallon (P/G.) To determine K-factor from SETP, divide 1 by SETP (if SETP is expressed in gallons.) Conversely, 1 divided by the K-factor equals SETP

FMG470 Series meters that were initially configured as battery powered units have a maximum output frequency of 150 Hz. Those that were initially configured as powered units have a maximum output frequency of 200 Hz.

Because all pulse outputs (SETP) are configured in (rate) units totaled per pulse, all sizes of meters can be configured with the same SETP values. For example, if your rate is chosen as gallons per minute (GPM) the table below applies.

Pulse Units. The units of measure of SETP are independently selectable and are not tied to rate or total. Upon change of the SETP unit, the pulse output may take up to 10 seconds, or the duration of one pulse (whichever is longer) to take effect.

If Pulse Output is Inconsistent. The PDAMP filter may need to be increased.

Pulse Width Timing. The unit and value of SETP must be chosen to keep the duration between meter pulse outputs to less than 500 seconds.

Pulse Timing in Battery Powered Units. The output pulse width in battery powered units is short and varies with pulse frequency. (See table)

SETP	Flow Rate at 1 Hz (GPM)	Flow Rate at 200 Hz (GPM) Powered Meters	Flow Rate at 150 Hz (GPM) Battery Powered Meters
0.1	6	1200	900
0.2	12	2400	1800
0.3	18	3600	2700
0.4	24	4800	3600
0.5	30	6000	4500
0.6	36	7200	5400
0.7	42	8400	6300
0.8	48	9600	7200
0.9	54	10800	8100
1.0	60	12000	9000

Lower frequency output pulses (1 pulse for some particular number of gallons) can also be set.

Any output frequency can be determined by:

$$\text{Rate (units/minute)} \div \text{SETP (units/pulse)} = \text{pulse/minute}$$

$$\text{Hz} = \text{pulse/minute} \div 60 \text{ seconds / minutes}$$

For reference/comparison only

K-factors and the equivalent SETP values for old style WMX units are shown below.

WMX	4"	6"	8"	10"	12"
K-Factor	16.36	6.31	3.34	2.15	1.53
SETP	0.06*	0.16	0.30	0.47	0.65

**Note that you would need to choose a SETP value of 0.1 for the 4".*

Output Pulse Width of Battery Powered Units		
Output Pulse Frequency	Output Pulse Width as a Percentage of the Pulse Period (Pulse period = 1000 milliseconds/frequency)	
Zero to 1 Hz	Multiply the pulse period by 0.01	= Output Pulse Width (ms)
1 to 20 Hz	Multiply the pulse period by 0.05	= Output Pulse Width (ms)
20 to 100 Hz	Multiply the pulse period by 0.1	= Output Pulse Width (ms)
100 to 150 Hz	Multiply the pulse period by 0.15	= Output Pulse Width (ms)

Example: If frequency = 20 Hz then the pulse period = 50 milliseconds and pulse width = (.05 x 50 milliseconds) = 2.5 ms

Analog Output (4-20mA) Configuration.

(Not available on battery only units.)

Since the meter's analog output is isolated and passive, loop power must be supplied externally as shown previously. (In addition, an external resistor R_L will be needed to convert the loop current to voltage for voltage-only input devices.)

The meter's loop transmitter minimum voltage drop is 6Vdc which, with wiring resistance and loop power supply voltage, will determine the maximum resistance for R_L .

The flow rates corresponding to 4 and 20mA can be set by the user via the SET 4 and SET20 tabs on the meter's setup menus.

Note: As configured by the factory, any alarm state will force 22.8mA on the loop.

This can be changed to 3.2mA - see Technical Bulletin, 'iMAG4700/AG3000: Changing the 4-20mA Alarm'

Modbus® Serial Communication Configuration (factory configured).

These connections provide a half-duplex, isolated, RS485 serial communications port using the Modbus® messaging protocol. The TXD connection is the transmitted data output from the meter and RXD is the received data input to the meter. See Modbus® Interface Description, LT-103393 (available at omega.com) for supported Modbus® message protocol and electrical interface specifications.

A 120-ohm termination resistor is built into the Modbus® option board but is shipped in the unused position. To engage the termination resistor, move the jumper on JP1 from position 3-4 to position 1-2.

Changing Flow Meter Settings

Home Screen and General Navigation

The HOME Screen displays flow volume, direction of the flow total and flow RATE along with status conditions such as Empty Pipe. Two buttons below the LCD display are used to access menu screens for viewing and changing meter setup parameters.



These two buttons are light sensors which can detect when a finger is covering them and activate upon release. Only three button touch actions are needed to control navigation through the menus, settings changes and back to the home screen.

HORIZONTAL SCROLLING:

Tap right button to scroll horizontally through menu tabs or move horizontally within a tab dialog when applicable.



SELECT:

Tap left button to change a highlighted item within a tab dialog.



ENTER/EXIT:

Hold left button while tapping right button once to enter or exit a tab dialog or to navigate between the HOME and other menu screens (continue to hold the left button until after the right button is released.).



Changing Total Direction/Resetting Batch Totalizers

On the Main screen, hold right button and tap left button 7 times to scroll through the total direction options. Release right button to select a total direction.



Once BATCH FORWARD or BATCH REVERSE is selected, tap right button four times to reset batch totalizer.

Entering Menu System

To enter the Menu System, perform the hold and tap sequence. The Passcode entry screen will display. The default passcode is 000000. If a different passcode has previously been set, use the up and right buttons to enter that passcode. In either case, hold and tap again to move into the menu system. (If you enter the wrong passcode, hold and tap again to return to the previous screen. See page 21 for information on how to change a passcode.)



Making Selections

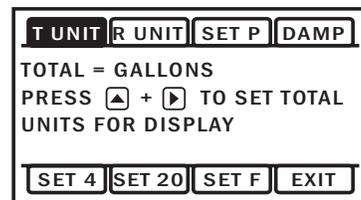
Once in the Menu System, move from tab to tab by tapping the right button. (See the next page for details on the various available tabs.)



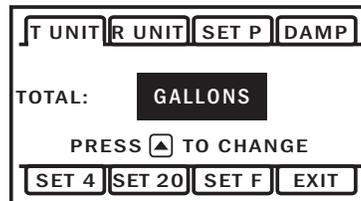
Select the parameter. In the screen for the highlighted tab, you will see the current parameter value for that tab. Tapping the right button, move to the tab for the parameter you want to change.



In this example, the first line indicates that the current unit for the TOTAL is GALLONS. The next two lines tell you what to do next.



If you would like to change the TOTAL units, just perform the hold and tap sequence to bring up a screen to change the setting.



Select a new setting. Select the new setting by scrolling through a list of selections as in the screen illustration below by tapping the left button to find a different TOTAL unit.



Accept changes. To accept any changes you have made, perform the hold and tap sequence.



When finished making changes. When you are finished making changes, move to the EXIT tab using the right button.



To return to the HOME screen, perform the hold and tap sequence.

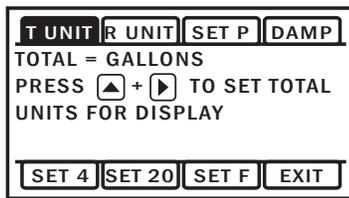


Standard Menu Options

Note: Available options will depend on specific meter configuration. Not all options are available on all meters. **Options not ordered with your meter will not appear on the meter menu.**

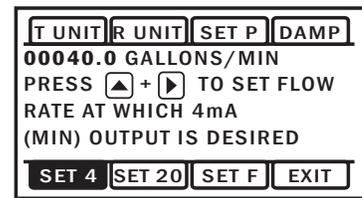
T UNIT

View or change TOTAL volume units



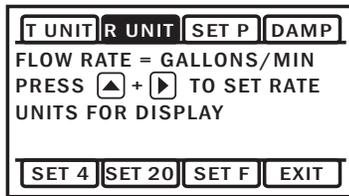
SET 4

View or change flow rate corresponding to 4mA. *(Externally powered units only)*



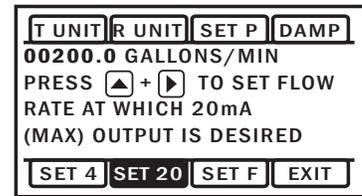
R UNIT

View or change flow RATE units



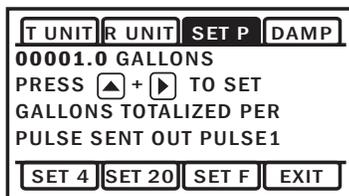
SET 20

View or change flow rate corresponding to 20mA. *(Externally powered units only)*



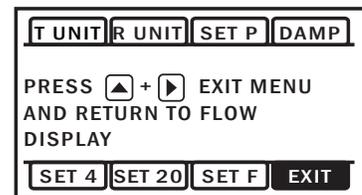
SET P

View or change pulse output scaling



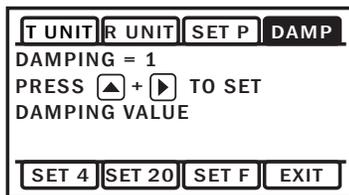
EXIT

Return to HOME SCREEN or enter SUBMENU



DAMP

View or change # of samples for rolling average.



Special SUBMENU for Further Options

The EXIT tab in the MAIN MENU has a second function. If, instead of using the hold and tap sequence to return to the HOME screen, you tap [Up] seven times, you will be redirected to a SUBMENU screen from which you can access several more options.

INFO: Meter model number, serial number, and firmware version.

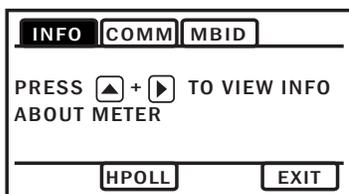
COMM: Modbus® baud rate and parity.

MBID: Modbus® address

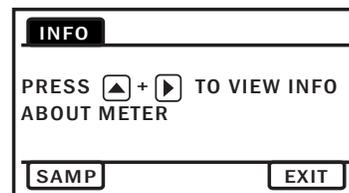
SAMP: Sample rate *(Battery powered version only.)*

EXIT: Return to MAIN MENU or enter next submenu.

Navigation in this SUBMENU is the same as for the MAIN MENU. Whenever you wish, go to the EXIT tab in the SUBMENU and perform the hold and tap sequence to return to the MAIN MENU.



Sub-Menu



Sub-Menu - Battery Only Version

To Change a Passcode and Decimal Places

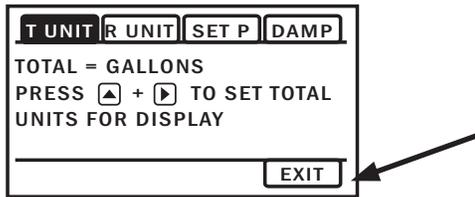
The AG3000 has a passcode system for restricting access to the menus. The AG3000 comes from the factory with the passcode set to 000000. When a user attempts to enter the menu system (see details on page 16), the passcode entry screen will be displayed.



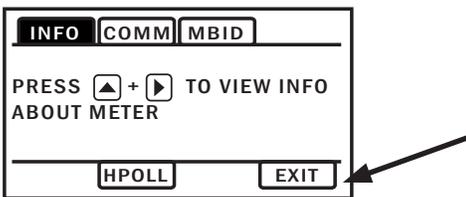
The default passcode is 000000. If a different passcode has previously been set, then the user must enter that passcode at this time. After entering the passcode, or leaving it at 000000 if using the default passcode, the user does the tap and hold sequence to move into the menu system.

To change the passcode, you must use the THIRD MENU screen. Access the THIRD MENU screen as follows:

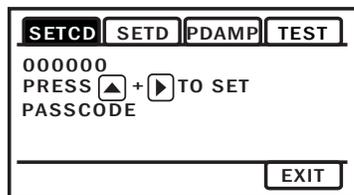
- Enter the main menu system, as described above.



- On the main menu, tab over to the EXIT tab and tap the up arrow five times. A SUBMENU screen will display.



- On the SUBMENU screen tab over to the EXIT tab and tap [up arrow] five times. The THIRD MENU screen will display.



- To set the PASSCODE, hold and tap on SETCD and then use the [up arrow] and [right arrow] to enter the new code.
- Hold and tap again to return to the THIRD MENU screen.
- Tab to EXIT, and then hold and tap to return to the SUBMENU.

To change the number of decimal places in the total

- To set the decimal point, hold and tap on SETD and then use the [right arrow] to move the decimal point.
- Hold and tap again to return to the THIRD MENU screen.
- Tab to EXIT, and then hold and tap to return to the SUBMENU.

PDAMP

PDAMP is used to view or change the number of samples for rolling average of pulse output.

TEST

TEST allows the user to initiate a fully functional, artificial flow rate for the purpose of testing other connected equipment. When TEST is applied, all features of the meter will function at the stated flow rate (in gallons per second).

For TEST to function, the meter must be filled (not EMPTY PIPE).

To enter a value into the TEST feature, navigate to the TEST tab and enter a flow rate value in the VAL screen (in gallons per second only,) then [right arrow] to the VAL box and [up arrow] to the ON screen. This will initiate the TEST feature. The next [up arrow] would bring you to the OFF screen, but you can 'hold and tap' the arrows to return you to the sub menu while the feature operates.

After use, the TEST feature must be turned OFF. If the TEST feature is not turned OFF, the stated static flow rate (in gallons per second) will be shown any time the meter is full or in a flowing condition. Flow values recorded by the meter while the TEST feature is operating are permanently recorded in the displayed TOTAL. It may be useful to note that these values are only written to permanent memory every 15 minutes and cycling all power within this 15 minute time frame will return the meter to its previous total.

OPERATION

Power Indicators

A power indicator is displayed in the lower left of the main display window.

Any meter powered from an external power source will display a power plug icon when running on external power. If the connection to external power is lost, the meter will switch to the backup battery and the power icon will switch to a battery symbol.

OK on the battery indicator means battery voltage is above 6.4 volts.

LO on the battery indicator means the battery is low and should be replaced soon.



Being powered by external DC or AC



Being powered by battery - voltage is sufficient



Being powered by battery - voltage is low



If display reads, 'BATT END' replace battery immediately.

Battery Powered Units

To 'wake up' a battery powered meter, you may need to hold the up arrow for 5 seconds and release. If the meter does not wake up on the first attempt, repeat the 5 second hold.

The meter can come configured with one 7.2V 'D' size replaceable battery pack. In this configuration, the only option/output is the scaled pulse output which comes standard. The scaled output for the battery powered option has a maximum pulse rate of 150 pulses/second. Be sure to set your P value such that the meter will function properly over the flow range in your application. The sample rate of the meter is user selectable through the SAMP tab in the meter's sub-menu. Sample periods of 1/5, 1/3, 1, 3, 5, 15, 30, and 60 seconds can be selected. (A sample period of 5 seconds—5 year battery life—is the default.)

Larger sample periods will yield longer battery life but slower response time. Care must be taken to select a sample period that is suitable for your application. See the table below for the expected battery life as a function of sample period.

DAMP Settings for Battery Units

If SAMP (sample period) is set to less than one second, the DAMP value represents the number of seconds (plus one) used in the rolling average for the display. For example, if DAMP is set to four, then when the meter begins to show a flow rate, the rate displayed is the average of all the readings taken in seconds one through five (4 plus 1).

If SAMP (sample period) is set to one second or longer, the DAMP value represents the number of sample periods (plus one) used in the rolling average for the display. For example, if SAMP is set at three seconds and DAMP is set to four, then when the meter begins to show a flow rate, the rate displayed is the average of samples one through five (4 plus 1). Note that depending on the settings selected,

it may take up to a minute for the displayed rate to take full advantage of the DAMP filter. When starting with an EMPTY PIPE it may take at least 30 seconds to register any flow.

Battery Life/Sample Period

For battery (BX) powered meters only.

Sensor sample period(s) (Seconds)	Expected battery life*
1/5 (0.2)	7 months
1/3 (0.33)	1 year
1	2.25 years
3	4 years
5	5 years
15	6 years
30	6.25 years
60	6.5 years

*Based on 75% battery capacity at room temperature with no option cards installed.

NOTE: If a large percentage of the meter's life will be spent below 0.5 meters/second and above cutoff, battery life will be reduced.



BATTERY LIFE WITH MODBUS® OPTION!
IN THIS CONFIGURATION THE METER COMES STANDARD WITH PULSE OUTPUT. WHEN ORDERED WITH THE MODBUS® OUTPUT OPTION, BATTERY LIFE WILL BE REDUCED TO 1 YEAR, OR GREATER, BASED ON USAGE. REDUCE POLLING FREQUENCY AND MINIMIZE DATA COLLECTED IN ORDER TO MAXIMIZE BATTERY LIFE.

Troubleshooting

Problem	Probable Causes	Things to try...
Blank Display	Faulty wiring from power source to meter Backup battery has not been plugged in Dead backup battery	Check for incorrect wiring. Measure voltage with DMM where red and black wires connect to terminal block TB1 on back side of display. Verify correct polarity and confirm that voltage is steady and between 9Vdc and 32Vdc Plug in the battery Replace battery
Flow rate reading fluctuates excessively when flow is unchanging	Excessively turbulent or unsteady flow due to partially closed valves or other flow obstructions Pipe not full Pulsing flow due to combining multiple upstream flow sources Insufficient mixing of upstream chemicals Low fluid conductivity < 20 μ S/cm Noisy electrical environment Defective or noisy AC switching power supply	Eliminate or minimize causes of flow disturbances or increase meter damping Provide back pressure or other means to ensure pipe is filled Move connection point further upstream Move chemical injection downstream from meter Replace with different type of meter Improve grounding at meter and nearby potentially noisy electrical equipment. Increase distance between meter and electrical noise sources. Replace power supply
Flow Rate appears correct but pulse/ frequency output is low, erratic or absent	Wiring incorrect External device input impedance too low Cable too long	Compare wiring with appropriate wiring recommendations Use sourcing rather than sinking interface connection 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 Wrong type of cable Grounding problem	Isolate, remove or reduce noise sources. Move meter control cable away from noise sources. Increase pulse damp setting (PDAMP) Use only twisted pair cable and ensure both signal wires are on same twisted pair Improve or try different grounding method

Error Messages

Under certain conditions an error message may be displayed.

Message	Description	Notes
INIT	Initialization is occurring during power up.	
EMPTY PIPE	Fluid is not detected between the sensing electrodes.	Loop output = 22.8mA
LO in battery icon	Battery is getting low, replace soon. Meter still functions.	Above 6.4V, OK appears in icon
BATT END	Battery is very low (approx. 6.1V). Totalizer stops updating.	Loop output = 4mA
LOW VOLT	Incoming external power is very low and backup battery is dead or not connected	Loop output = 4mA
COIL FAIL	Coil current too high or too low (short or open).	Loop output = 22.8mA
COMM FAIL	Communication between transmitter and sensor board fails.	Loop output = 22.8mA
OVER RANGE	Rate exceeds number of digits that can be displayed. Adjust units.	Loop output = 4mA

WARRANTY/DISCLAIMER

OMEGA ENGINEERING, INC. warrants this unit to be free of defects in materials and workmanship for a period of **13 months** from date of purchase. OMEGA's WARRANTY adds an additional one (1) month grace period to the normal **one (1) year product warranty** to cover handling and shipping time. This ensures that OMEGA's customers receive maximum coverage on each product.

If the unit malfunctions, it must be returned to the factory for evaluation. OMEGA's Customer Service Department will issue an Authorized Return (AR) number immediately upon phone or written request. Upon examination by OMEGA, if the unit is found to be defective, it will be repaired or replaced at no charge. OMEGA's WARRANTY does not apply to defects resulting from any action of the purchaser, including but not limited to mishandling, improper interfacing, operation outside of design limits, improper repair, or unauthorized modification. This WARRANTY is VOID if the unit shows evidence of having been tampered with or shows evidence of having been damaged as a result of excessive corrosion; or current, heat, moisture or vibration; improper specification; misapplication; misuse or other operating conditions outside of OMEGA's control. Components in which wear is not warranted, include but are not limited to contact points, fuses, and triacs.

OMEGA is pleased to offer suggestions on the use of its various products. However, OMEGA neither assumes responsibility for any omissions or errors nor assumes liability for any damages that result from the use of its products in accordance with information provided by OMEGA, either verbal or written. OMEGA warrants only that the parts manufactured by the company will be as specified and free of defects. OMEGA MAKES NO OTHER WARRANTIES OR REPRESENTATIONS OF ANY KIND WHATSOEVER, EXPRESSED OR IMPLIED, EXCEPT THAT OF TITLE, AND ALL IMPLIED WARRANTIES INCLUDING ANY WARRANTY OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE HEREBY DISCLAIMED. LIMITATION OF LIABILITY: The remedies of purchaser set forth herein are exclusive, and the total liability of OMEGA with respect to this order, whether based on contract, warranty, negligence, indemnification, strict liability or otherwise, shall not exceed the purchase price of the component upon which liability is based. In no event shall OMEGA be liable for consequential, incidental or special damages.

CONDITIONS: Equipment sold by OMEGA is not intended to be used, nor shall it be used: (1) as a "Basic Component" under 10 CFR 21 (NRC), used in or with any nuclear installation or activity; or (2) in medical applications or used on humans. Should any Product(s) be used in or with any nuclear installation or activity, medical application, used on humans, or misused in any way, OMEGA assumes no responsibility as set forth in our basic WARRANTY/DISCLAIMER language, and, additionally, purchaser will indemnify OMEGA and hold OMEGA harmless from any liability or damage whatsoever arising out of the use of the Product(s) in such a manner.

RETURN REQUESTS/INQUIRIES

Direct all warranty and repair requests/inquiries to the OMEGA Customer Service Department. BEFORE RETURNING ANY PRODUCT(S) TO OMEGA, PURCHASER MUST OBTAIN AN AUTHORIZED RETURN (AR) NUMBER FROM OMEGA'S CUSTOMER SERVICE DEPARTMENT (IN ORDER TO AVOID PROCESSING DELAYS). The assigned AR number should then be marked on the outside of the return package and on any correspondence.

The purchaser is responsible for shipping charges, freight, insurance and proper packaging to prevent breakage in transit.

FOR **WARRANTY** RETURNS, please have the following information available BEFORE contacting OMEGA:

1. Purchase Order number under which the product was PURCHASED,
2. Model and serial number of the product under warranty, and
3. Repair instructions and/or specific problems relative to the product.

FOR **NON-WARRANTY** REPAIRS, consult OMEGA for current repair charges. Have the following information available BEFORE contacting OMEGA:

1. Purchase Order number to cover the COST of the repair,
2. Model and serial number of the product, and
3. Repair instructions and/or specific problems relative to the product.

OMEGA's policy is to make running changes, not model changes, whenever an improvement is possible. This affords our customers the latest in technology and engineering.

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