Seametrics

iMAG 4700

Municipal/Industrial Magmeter Instructions

PROUDLY MADE IN THE USA

ISO 9001:2008

General Information

Installation

Connections

Configuration

Operation

Troubleshooting & Error Messages

Warranty

Note: These instructions cover the iMAG 4700. For details on the iMAG 4700p or 4700r, see the *iMAG 4700p* or *iMAG 4700r Municipal/Industrial Magmeter Instructions*.

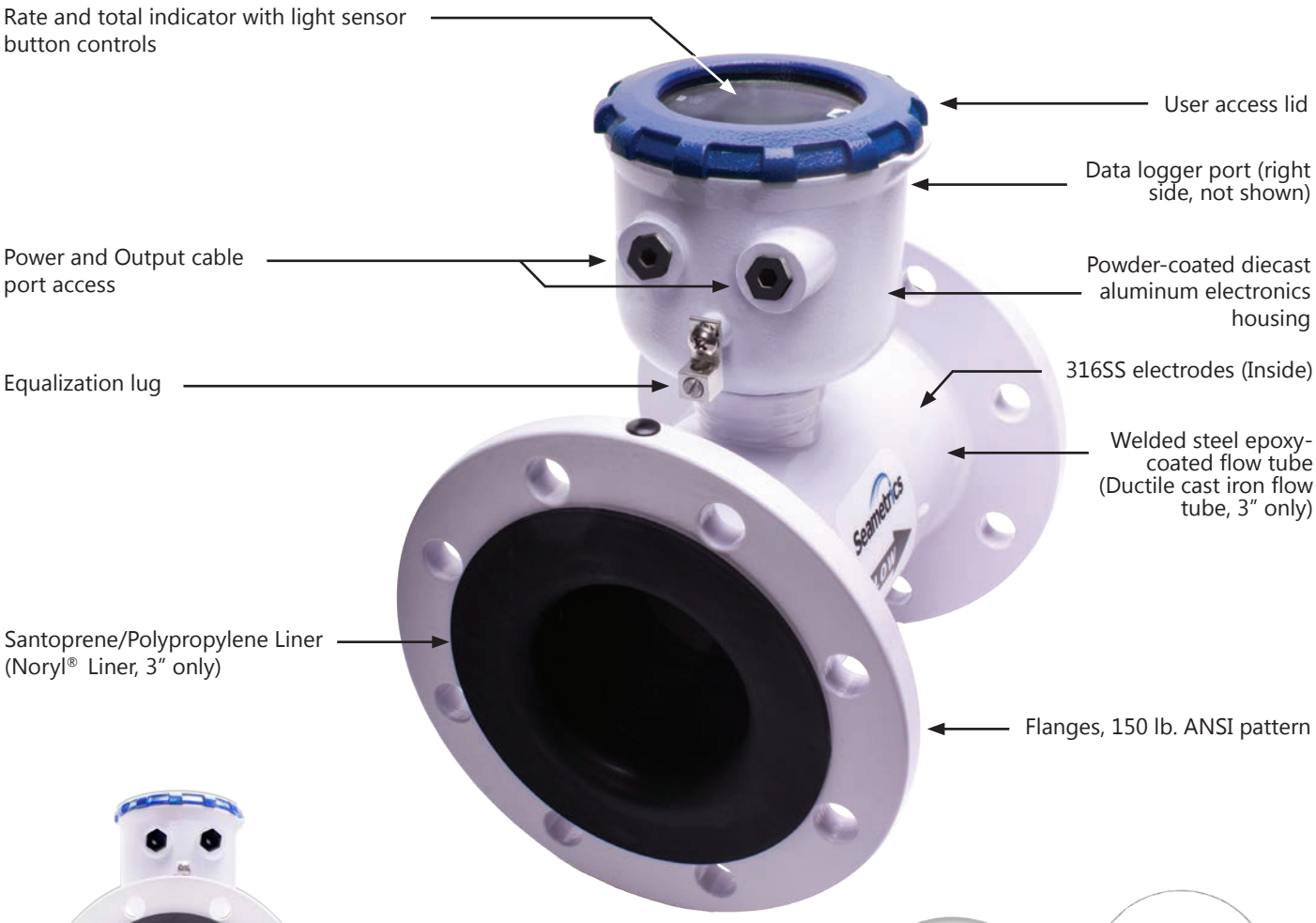
The **iMAG-Series** is the most economical flanged electromagnetic flowmeter on the market. With electrodes designed to discourage fouling, it is available in 3" to 12" pipe in municipal or industrial water, waste and reclaimed water, pump stations, and packaged plant applications. Minimal straight pipe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

iMAG-Series meters are NSF-61 approved and are rated IP68 for applications where the meter may be operated under water to a depth of at least 10 feet (3 meters) continuously.

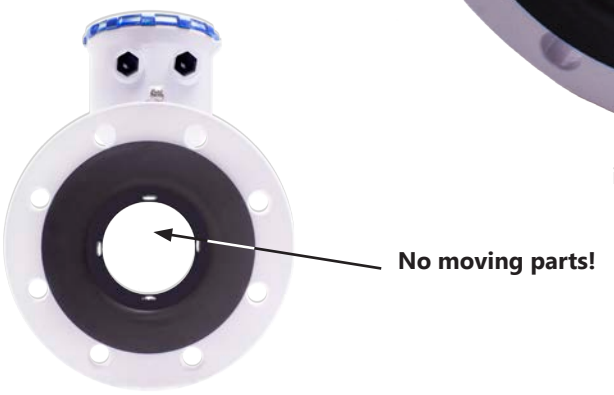
Rate and total units and pulse scaling can be set via the front panel touch key pad by the user. Bidirectional flow reading is standard with totals available in forward, reverse, net flow, batch forward flow, and batch reverse flow. Batch totals can be reset.

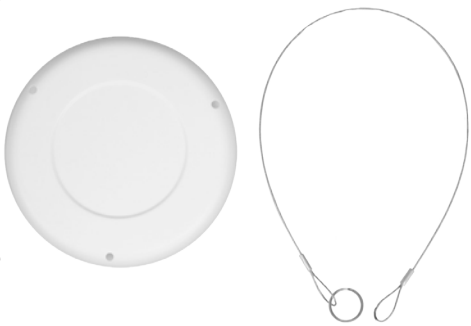
A power/output cable allows outputs for use with a variety of Seametrics and other displays and controls for remote reading and telemetry applications. Pulse output is standard on all models. In addition, 4-20mA passive current loop, HART protocol, high speed digital, and Modbus® protocol outputs are optional on the externally powered units, depending on model.

Features



iMAG 4700





Protective faceplate cover and lanyard

Specifications*

Pipe Sizes		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 on iMAG 4700p and 4700r (±1.0% iMAG 4700), ±0.025% of full-scale flow from low flow cutoff to maxi. flow rate of 10 m/sec					
Low Flow Cutoff		0.5% of maximum flow rate					
Material	**Body** *(3" only)*	Ductile cast iron, powder coated					
	Body *(4"-12")*	Welded steel, epoxy-coated					
	Liner *(3" only)*	Noryl®					
	Liner *(4"-12")*	Santoprene flange/Polypropylene liner body					
	Electronics Housing	Powder-coated diecast aluminum					
	Electrodes	316 stainless steel					
	O-ring (3" only)	EPDM					
Display	**Type**	128x64 dot-matrix LCD					
	Digits	5 Digit Rate			8 Digit Total		
	Units *Please Note: All iMAG 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.*	Rate Volume Units		Rate Time Units	Total Volume Units		
		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 1000 Second Foot Day Million Cubic Feet	Acre Feet Acre Inches Imperial Gallons Imperial Gallons x 1000 Million Imperial Gallons Fluid Ounces
	Bidirectional[1]	Forward Total, Reverse Total, Net Total, Batch Forward Total, Batch Reverse Total (Batch totals can be reset)					
Power	**DC Power**	9-36 Vdc @ 250 mA max, 30 mA average					
	Battery Backup	DC powered units: Two lithium 3.6V 'D' batteries, replaceable. AC powered units: One 9V alkaline battery, replaceable.					
	AC Power *(iMAG 4700r and 4700p only)*	85-264Vac, 50/60Hz, 0.12A					
	Battery *(iMAG 4700 only)*	Two lithium 3.6V 'D' batteries, 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, 150 pulses/sec max with battery option					
Options	**4-20mA Current Loop**	Isolated, passive, 24Vdc, 650 Ω maximum current loop					
	HART/4-20mA	HART protocol over 4-20mA line					
	High Speed Digital Output *(iMAG 4700 & 4700p only)*	Isolated, open collector, 24 Vdc					
	Serial Communications	Isolated, asynchronous serial RS485 (Reconfigurable for RS232 or 3.3V CMOS), Modbus® RTU protocol (factory selectable)					
Cable	**Power/Output Cable**	20ft (6m) standard length polyurethane jacketed cable—for power and outputs (lengths up to 200' available).					
	Remote Display Cable *(iMAG 4700r)*	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), 4"-12" NSF-61 60°C (140°F); 3" NSF-61 Cold Water 23°C (73.4°F)					
Environmental		NEMA 6P, IP68 (10ft (3m) depth, continuously)					

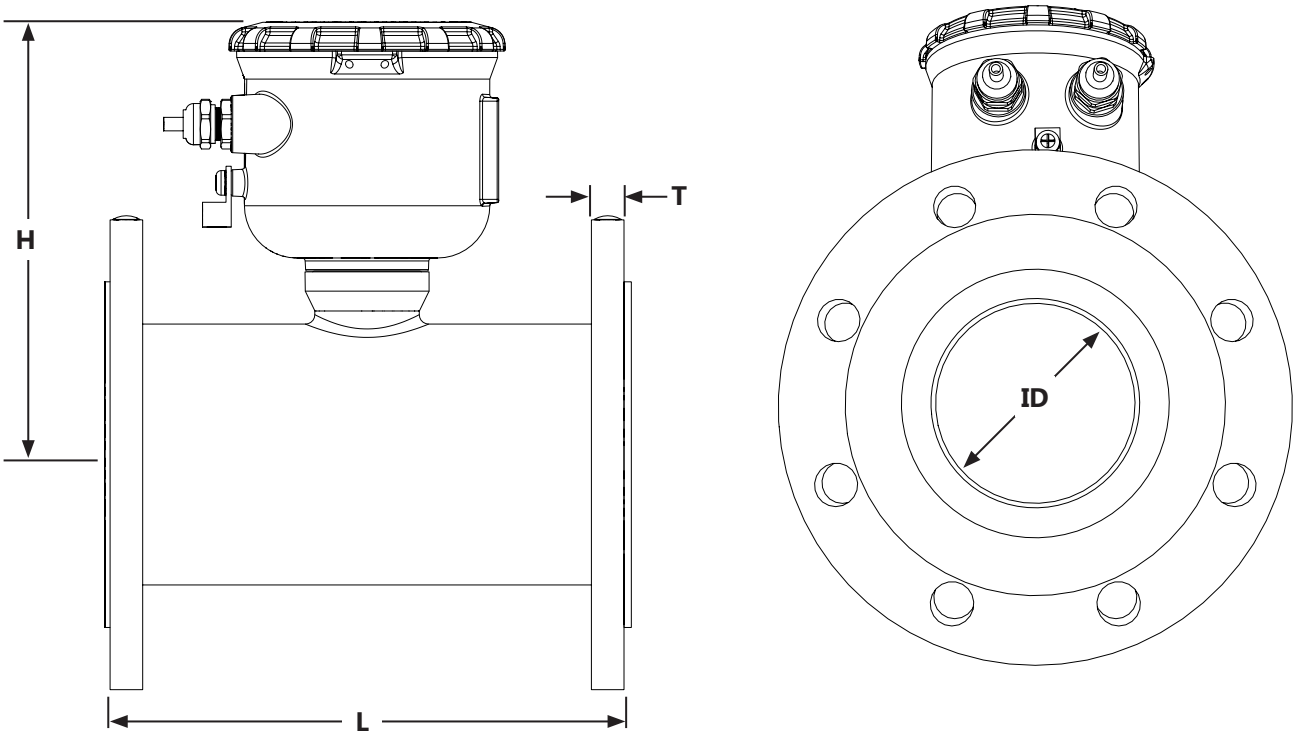
Modbus is a registered trademark of Schneider Electric.

** 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.

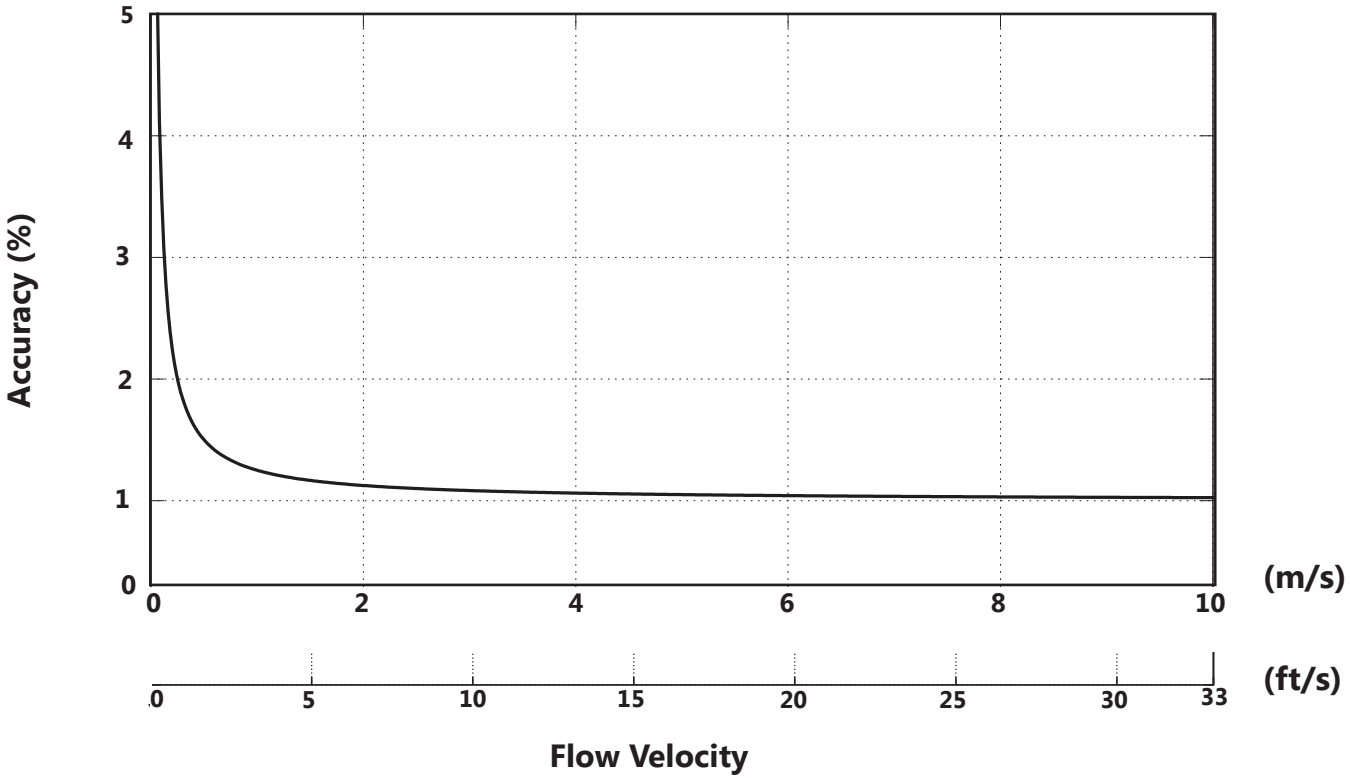
Dimensions



iMAG 4700 Meter Size	L		H		T		ID		Shipping Weight	
	inch	mm	inch	mm	inch	mm	inch	mm	lbs	Kg
3″	12.25	311.15	7.08	179.8	.68	17.25	2.6	66.04	31	14
4″	10.24	260	8.3	211	.62	15.7	3.12	79	27	12
6″	12.27	312	9.1	231	.69	17.5	5.05	128	42	19
8″	14.24	362	10.1	257	.69	17.5	6.44	164	64	29
10″	18.18	462	11.2	284	.69	17.5	8.61	219	123	56
12″	19.68	500	12.2	310	.81	20.6	10.55	268	165	75
Flanges	Standard ANSI 150 lb. drilling								Cable 1 lb.	

Install security seal during installation if regulations require.

iMAG Accuracy

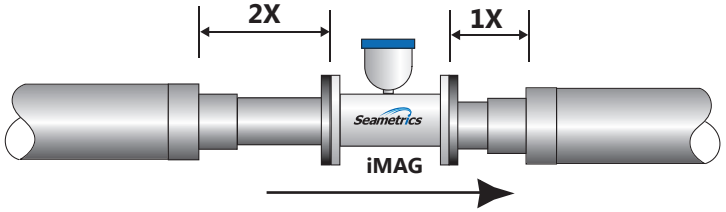


Flow Rate (3" - 12")

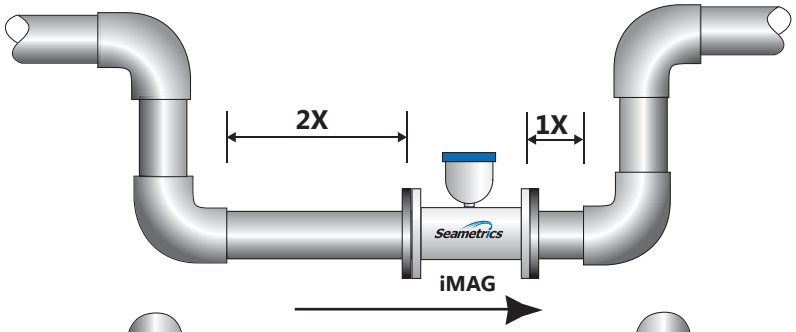
Pipe Size *(Inches in diameter)*	**3"**	**4"**	**6"**	**8"**	**10"**	**12"**
Max Flow Rate *(Gallons/Minute)*	723	1285	2891	5140	8031	11565
Cut-off (min) Flow Rate *(Gallons/Minute)*	3.62	6.43	14.46	25.70	40.15	57.82
Max Flow Rate *(Liters/Second)*	46	81	182	324	507	730
Cut-off (min) Flow Rate *(Liters/Second)*	0.23	0.41	0.91	1.62	2.54	3.65
Max Flow Velocity *(Meters/Second)*	10	10	10	10	10	10

Straight Pipe Recommendations (X = diameter)

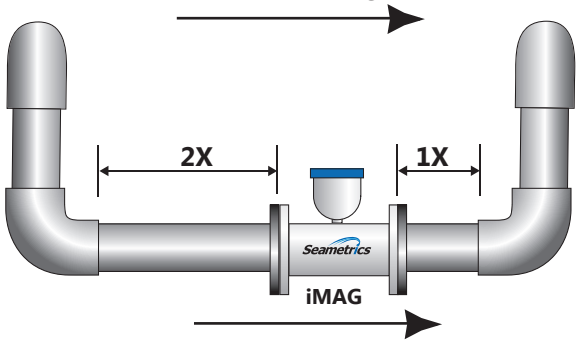
Reduced Pipe



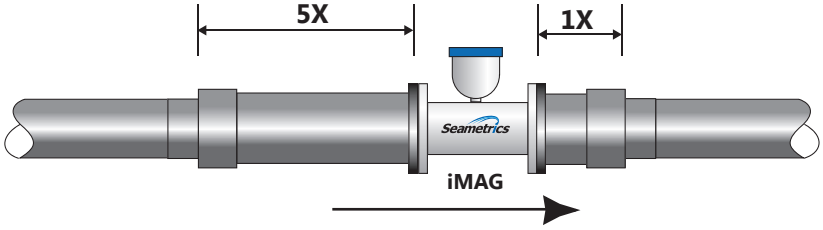
Two Elbows In Plane



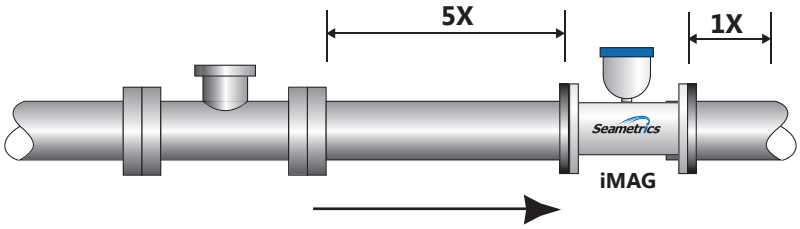
Two Elbows, Out Of Plane



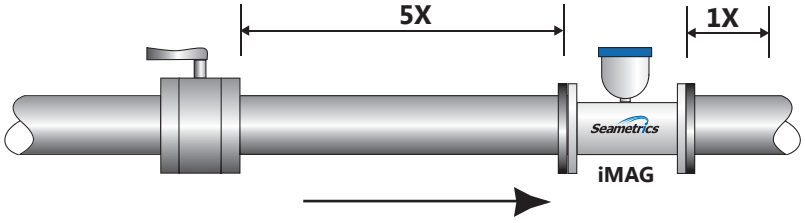
Expanded Pipe



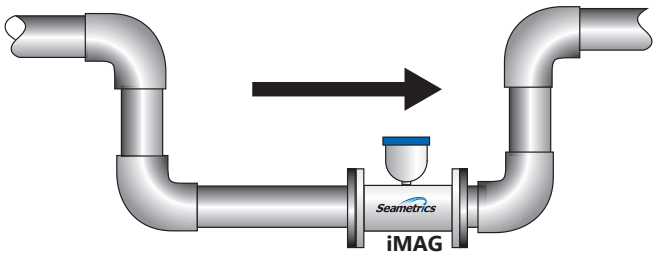
Swirling Flow: Propeller Meter



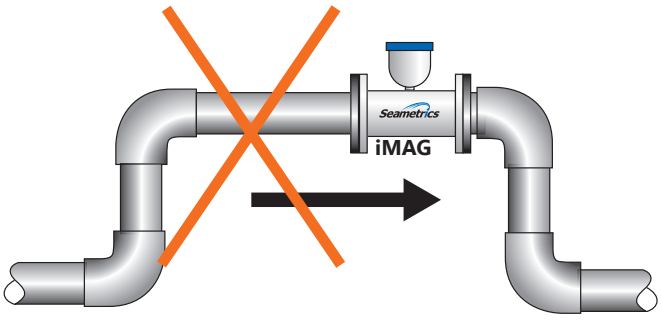
Swirling Flow: Partially Open Butterfly Valve



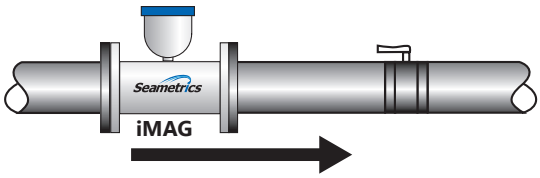
Full Pipe Recommendations



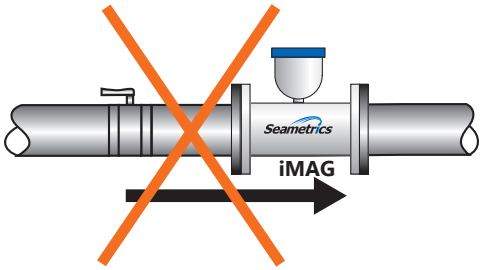
Recommended:
Keep pipe full at meter for accuracy



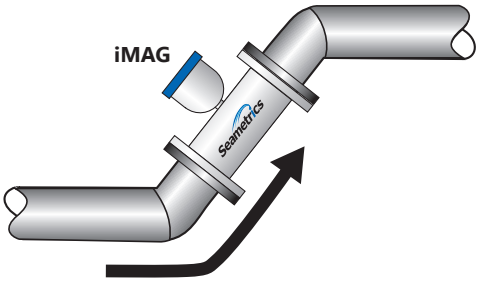
Not Ideal:
Allows air pockets to form at meter



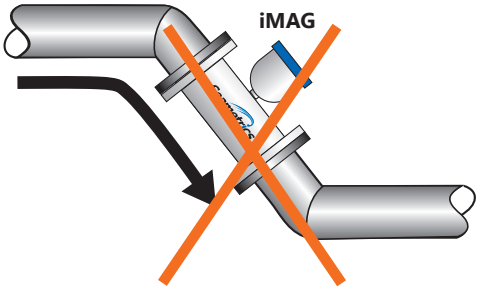
Recommended:
Keeps pipe full at meter for accuracy



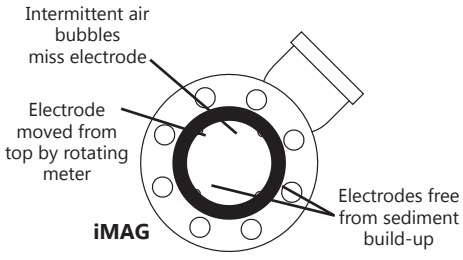
Not Ideal:
Post-valve cavitation can create air pocket



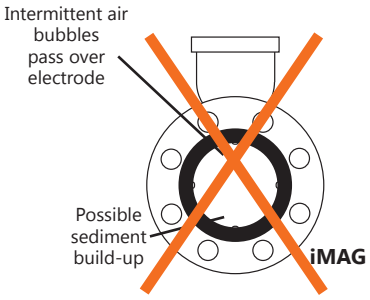
Recommended:
Allows air to bleed off



Not Ideal:
Air can be trapped



Recommended:
Improved accuracy results from unimpeded electrodes



Not Ideal:
Air bubbles and sediment on the electrodes can 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 130˚ 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 iMAG 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 iMAG 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 iMAG is factory-calibrated before shipping. The frequency of recalibration will depend on the needs of each application and local regulatory policies.

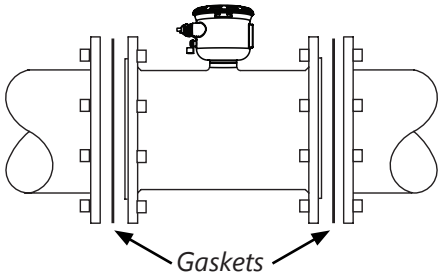
Chemical Injection. When the iMAG is used in a chemical injection application, the chemical injection point must be placed downstream of the magmeter OR far enough upstream for complete mixing to occur before the fluid reaches the meter. When unmixed chemical alternates with water passing through the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

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

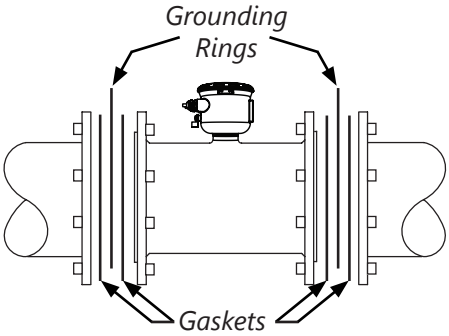
Installing Gaskets

GASKETS
Gaskets are required at all junctions.

1. Select a suitable full-face gasket.
   - Only use flat compressible gaskets (either pliable or hard fiber will work).
   - Use a material compatible with the fluid you will be using.
   - Thickness should be 1/8" - 1/4" (3 - 6 mm), depending on the flatness of the pipe flange surface.
   - Inner diameter must be larger than opening in flow meter.
2. Be sure all mating surfaces are smooth and free of debris.
3. Install gaskets on each end of meter as shown in diagrams below. If using grounding rings, install one gasket on each side of the grounding ring.



Installation without grounding rings

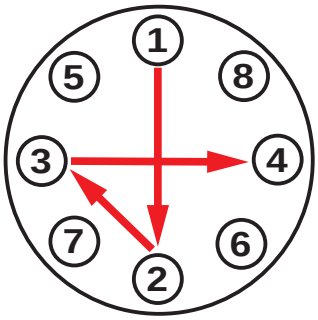


Installation with grounding rings

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.

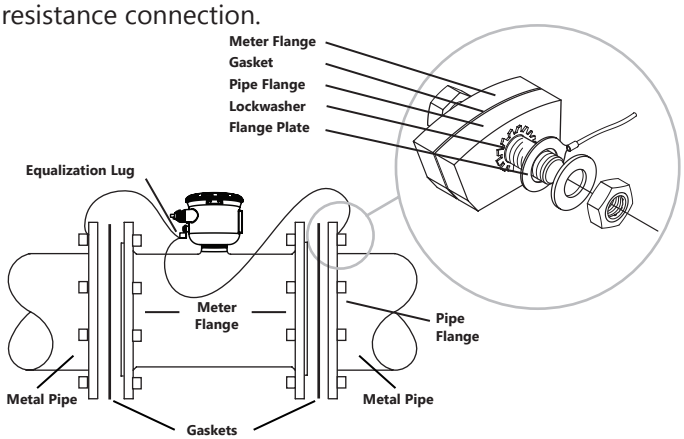
SUGGESTED FLANGE BOLT TORQUE

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

Equalization and Grounding

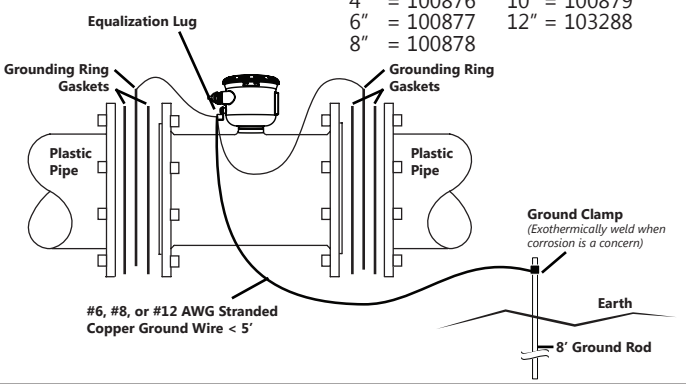
WARNING: ELECTRICAL SHOCK HAZARD
When the iMAG is installed in a plastic piping system, or when externally powered, the piping system must be grounded to meet national and local electrical safety codes. Failure to do so can result in electrocution.

Metal Pipe Installations. To equalize the electrical potential of the fluid, the iMAG 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.



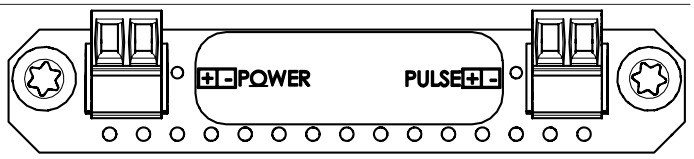
Plastic Pipe Installations. When the iMAG is installed in a plastic piping system, grounding rings are recommended, especially in the presence of electrical interference sources such as VFD pump drives. As shown in the diagram below, the equalization wires should then be connected to the grounding ring 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:
4″ = 100876 10″ = 100879
6″ = 100877 12″ = 103288
8″ = 100878

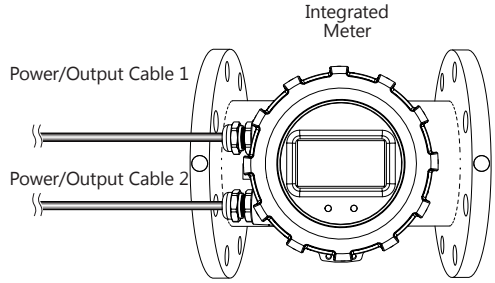


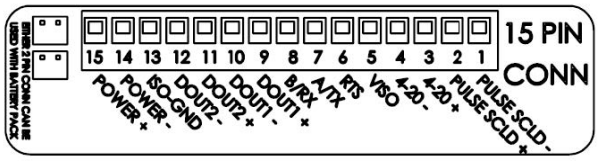
General Cable Information

In the iMAG 4700 meter, there are a maximum of two Power/Output cables that can be installed. These cables contain the wires for DC power and for any output (scaled pulse, 4-20mA, Modbus®, HART, and high speed digital). (See Sample Cable Wiring Diagrams and Cable Wiring Table.) It is up to the user to decide how to best organize the wiring for the application.



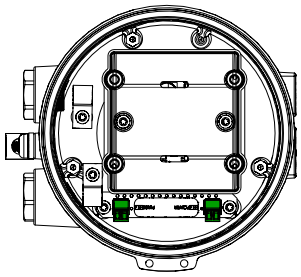
Two 2-pin Connectors for iMAG 4700 Battery Version



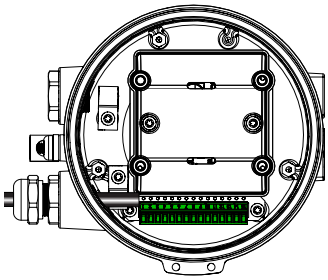


15 Pin Connector for iMAG 4700 DC Versions

The iMAG 4700 is available in either Battery or external DC versions.



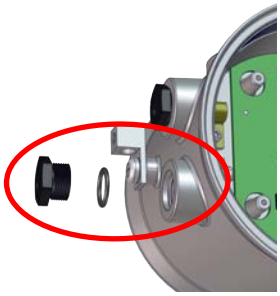
Battery version with two 2-pin connectors



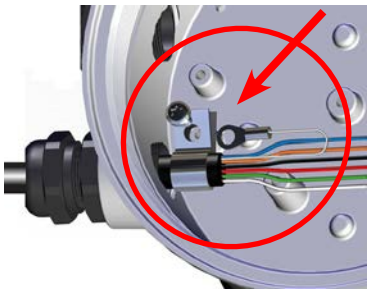
DC version with a 15-pin connector. (Your meter may have one or two cable glands, depending on configuration.)

Cable Gland Opening and Sealing

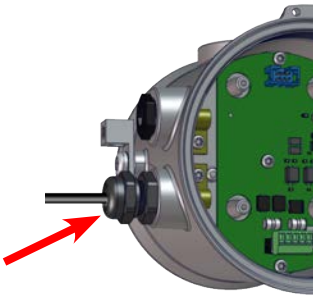
WARNING: Improper sealing of glands or cables will invalidate any warranty.



Remove plug & o-ring. Insert cable gland/strain relief. Feed cable through cable gland.



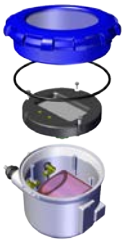
Clamp cable with strain relief clips. Attach drain wire lug to bracket post.



CRITICAL!
Torque cable gland sealing nut to 22 in-lbs.

Cable Installation

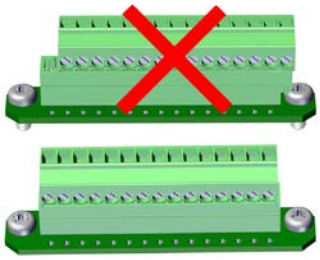
DC Version or Battery Only Version with external pulse output.



1. Unscrew the display lid and remove it.
2. Remove the 3 screws holding the display assembly and remove it from the meter exposing the internal connectors. Be sure to **NOT** undo any connections to the display assembly as you remove it.
3. The DC version comes with a 15 pin screw connector. Remove this from its bag. (On the battery version, there are two 2-pin connectors already installed.)
4. Remove the plug and o-ring from the cable port(s) where you want to insert the cable(s).
5. Install cable gland(s) and insert cable end(s).
6. Strip cable jacket and conductors and install the wires into the connectors in their respective locations for your options, Modbus®, pulse, HART, etc. (See Cable Wiring Table for details.)
7. If using the 15 pin screw connector, plug it into its socket. **Be sure all pins align properly and that the connector has not slipped to one side.**

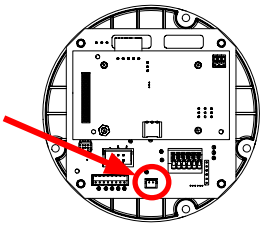
Improper alignment

Proper alignment



8. **Plug the backup battery cable into the circuit board, as shown.** *(DC Version only - Battery version has battery already connected.)*

Battery connection



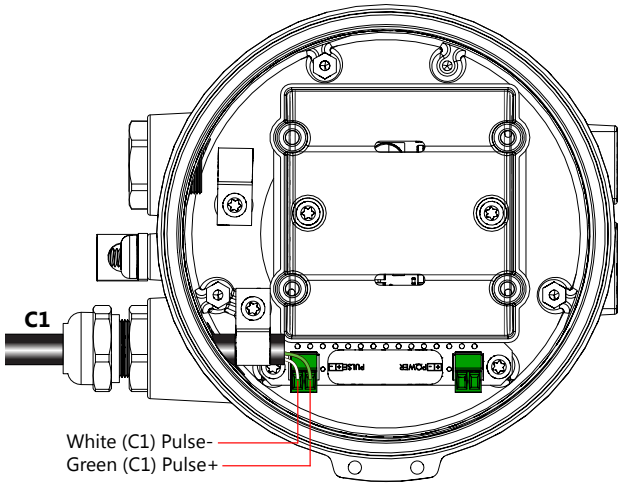
9. Secure the cables inside the internal strain relief clip and tighten the cable gland sealing nut securely. (torque nut to 22 in-lbs.). A loose nut could cause moisture ingress and compromise the meter head's IP68 rating, voiding the warranty.
10. Remount the display assembly, being careful to not pinch any wires, and install the display assembly screws.
11. Reinstall the display lid, being sure to avoid cross-threading the lid.

Battery Only Version with no external pulse output

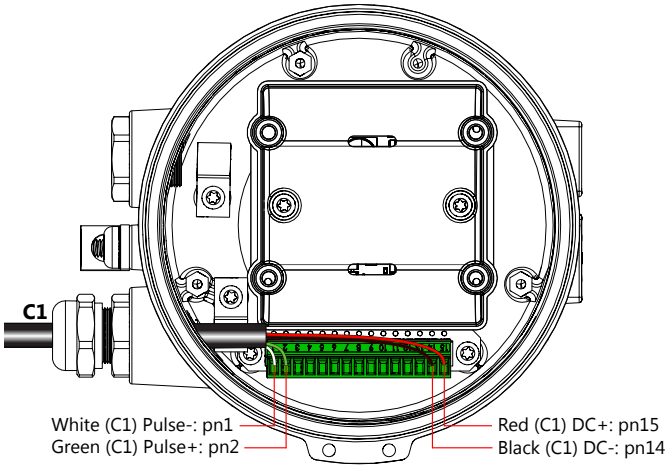
No wiring is needed.

Wiring Diagrams

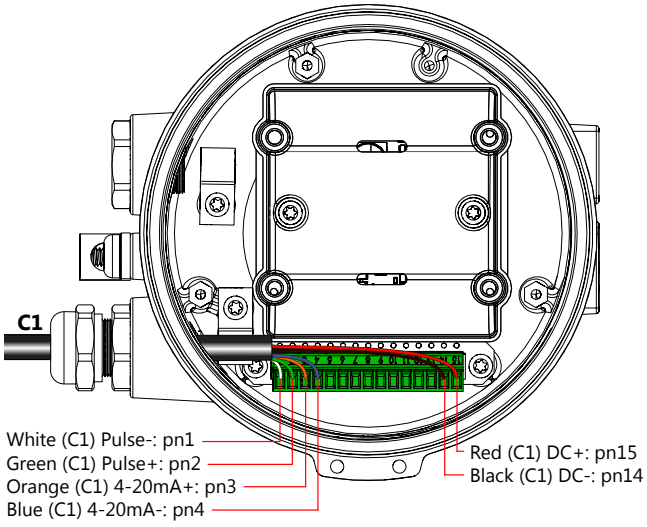
Unscrew the display lid and remove it. Remove the 3 screws holding the display assembly and remove it from the meter. Remove the 15 pin screw connector from its bag. Install the wires through the cable glands into the 15 pin screw connector in their respective locations. Plug the 15 pin screw connector into its socket. *(C1 = power/output cable, C2 = power/output cable 2)*



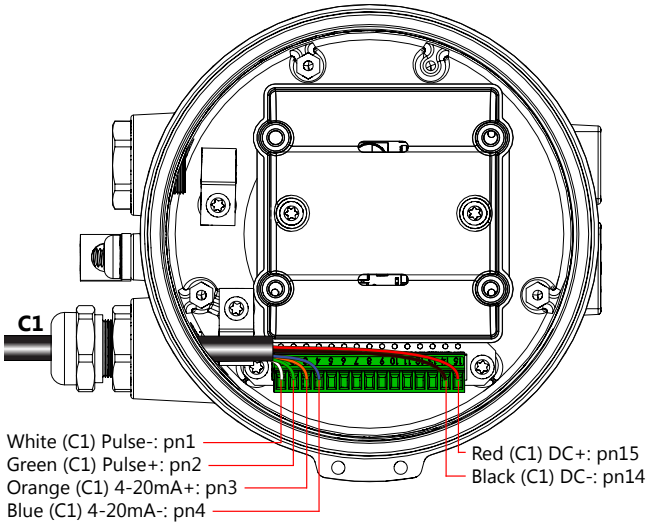
Battery Power with Pulse (BXX)



DC Power with Pulse (D1X/D2X)



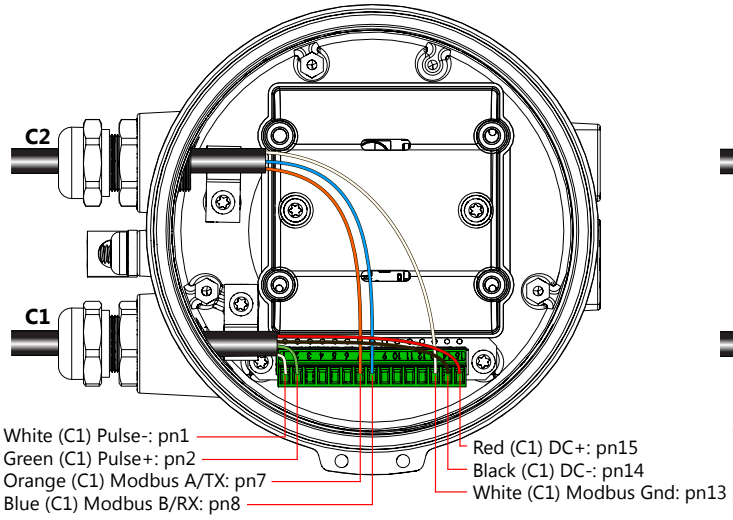
DC Power with Pulse and 4-20mA (D1L/D2L)



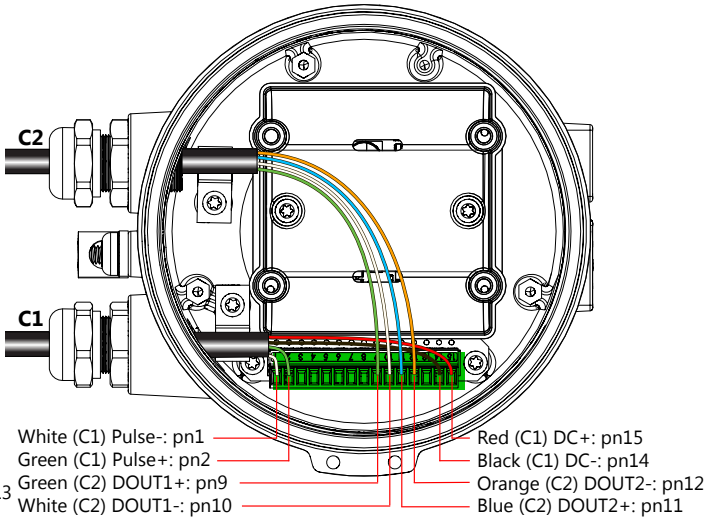
DC Power with Pulse and HART/4-20mA (D1H/D2H)

Wiring Diagrams (continued)

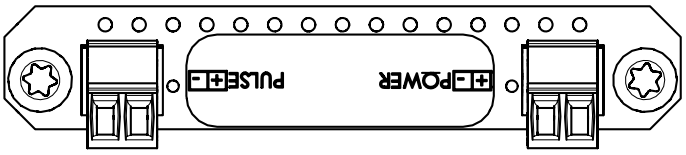
Unscrew the display lid and remove it. Remove the 3 screws holding the display assembly and remove it from the meter. Remove the 15 pin screw connector from its bag. Install the wires through the cable glands into the 15 pin screw connector in their respective locations. Plug the 15 pin screw connector into its socket. *(C1 = power/output cable, C2 = power/output cable 2)*



DC Power with Pulse and Modbus® (D1S/D2S)

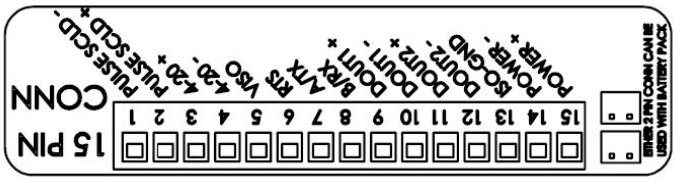


DC Power with Pulse and Digital (D1G/D2G)



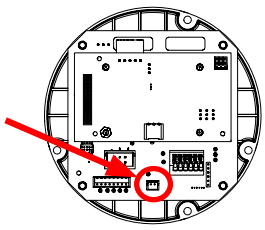
Two 2-pin Connectors for iMAG 4700 Battery Version

Note that when viewing the connectors from the front of the meter, the labels will be upside down, as shown here, with numbering going from left to right.



15 Pin Connector for iMAG 4700 DC Versions

Plug the backup battery cable into the circuit board



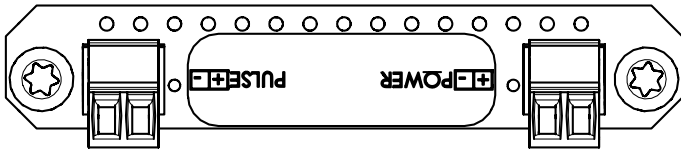
Cable Wiring Table

PIN	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
O ID	**PWR+**	**PWR-**	**ISO-GND**	**DOUT 2-**	**DOUT 2+**	**DOUT 1-**	**DOUT 1+**	**B/RX**	**A/TX**	**RTS**	**VISO**	**4-20 -**	**4-20 +**	**PULSE SCLD+**	**PULSE SCLD-**
BXX														GREEN C1	WHITE C1
D1X/ D2X	RED C1	BLACK C1												GREEN C1	WHITE C1
D1L/ D2L	RED C1	BLACK C1										BLUE C1	ORNG C1	GREEN C1	WHITE C1
D1H/ D2H	RED C1	BLACK C1										BLUE C1	ORNG C1	GREEN C1	WHITE C1
D1S/ D2S	RED C1	BLACK C1	WHITE C2					BLUE C2	ORNG C2					GREEN C1	WHITE C1
D1G/ D2G	RED C1	BLACK C1		ORNG C2	BLUE C2	WHITE C2	GREEN C2							GREEN C1	WHITE C1

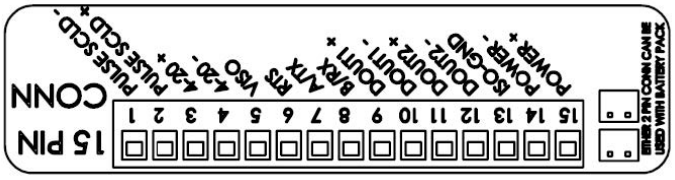
(C1 = power/output cable 1 C2 = power/output cable 2)

Option IDs

O ID		POWER SOURCE / OUTPUT(S)
BXX	=	BATTERY POWER / PULSE SCALED
D1X/D2X	=	DC POWER / PULSE SCALED
D1L/D2L	=	DC POWER / PULSE SCALED AND 4-20mA
D1H/D2H	=	DC POWER / PULSE SCALED AND HART/4-20mA
D1S/D2S	=	DC POWER / PULSE SCALED AND MODBUS®
D1G/D2G	=	DC POWER / PULSE SCALED AND DIGITAL



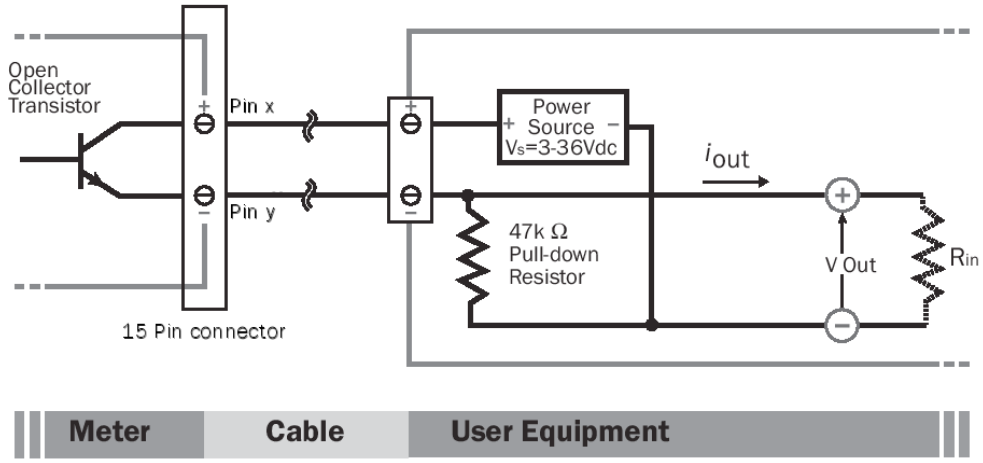
Two 2-pin Connectors for iMAG 4700 Battery Version

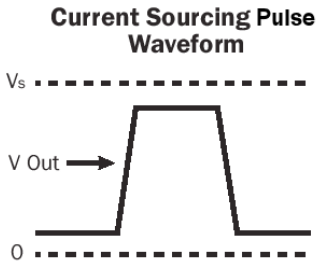


15 Pin Connector for iMAG 4700 DC Versions

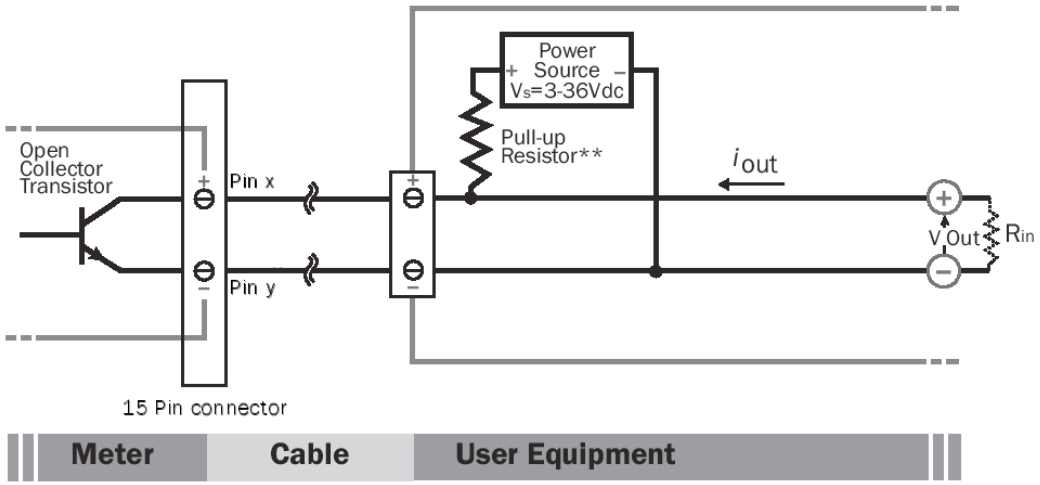
Note that when viewing the connectors from the front of the meter, the labels will be upside down, as shown above, with numbering going from left to right.

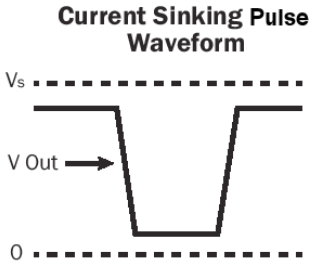
Pulse or Digital Output Application - Sourcing Mode (Recommended for Rin < 30kΩ)



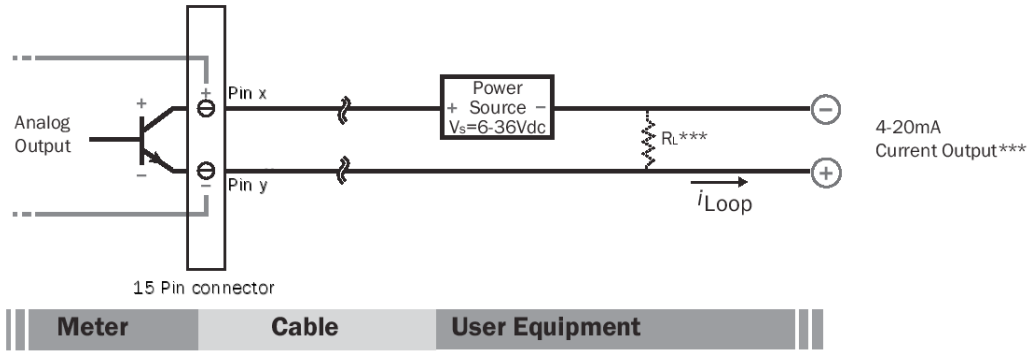


Pulse or Digital Output Application - Sinking Mode (Recommended for Rin > 30kΩ)





Analog (4-20mA Current Loop) Output Application



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

**** Resistor RL 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 of an iMAG 4700 meter 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

iMAG 4700 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. If your rate is different, simply use your rate label in place of (GPM.) The numerical values will remain the same.

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 DAMP 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:

Rate (units/minute) ÷ SETP (units/pulse) = pulse/minute
Hz = pulse/minute ÷ 60 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 on the iMAG 4700 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 (8Vdc with HART) 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'.

HART Configuration. *(Not available on battery only units.)* The HART protocol, rev.7.5, allows for a Polling address between 0 and 63. The default value in the iMAG is 0. To change the Polling address, use iMAG menu HPOLL to set the Polling address.

To get to this menu, move to the EXIT tab and tap the left button 4 times. This will bring up the SUBMENU page. Navigate to the HPOLL tab. Use the left button to select the Polling address.

To enter SUBMENU

To select address

(See Changing Flow Meter Settings later in these instructions for details in using the menu system.)

A minimum of 250 ohms of loop resistance must be present in order for the HART modem to correctly and reliably demodulate FSK voltage. With this in mind, the maximum loop resistance* for the iMAG HART interface cannot be exceeded in order to assure correct operation.

The iMAG HART interface is HART compatible. All the commands have been implemented in accordance with the HART Protocol Specification published by HART Foundation. A HART Communicator can be used with the iMAG, even in the absence of DD files, by taking advantage of the Generic Online Menu capability of a Communicator. This means that a generic menu is automatically available when DD files are not present.

The following information from the iMAG HART can be displayed on the Communicator using the generic menu:

PV	Flowrate in units selected for iMAG
PV Loop Current	Loop current in mA
PV LRV	Lower range value of PV in units selected for iMAG
PV URV	Upper range of PV in units selected for iMAG

**4-20 mA loop has maximum loop resistance of 650ohms and requires a 24Vdc power supply.*

Modbus® Serial Communication Configuration (factory configured). *(Not available on battery only units.)* These connections provide a half-duplex, isolated, RS485 serial communications port using the Modbus messaging protocol. The port is reconfigurable by internal jumper settings to full-duplex RS232 or 3.3V CMOS. The TXD connection is the transmitted data output from the meter and RXD is the received data input to the meter. See Seametric's Modbus Interface Description, LT-103393 (available at www.seametrics.com) for supported Modbus message protocol and electrical interface specifications.

Digital Output (High Frequency) Configuration. *(Not available on battery only units.)* These outputs are electrically similar to the Pulse Output described above except they are capable of output frequencies up to 10kHz. The frequency output scaling can be set by the user via the SETF tab on the meter's setup menus. Selections are: 500Hz and 1, 2, 5 and 10 KHz at maximum flow rate.

DOUT1 Pulses in forward direction

DOUT2 Pulses in reverse direction

K-Factors for High Speed Digital Output (High Frequency)

	SETF (Hz)				
Size	**500**	**1K**	**2K**	**5K**	**10K**
3"	41.55	83.10	166.2	415.51	831.02
4"	23.35	46.69	93.39	233.5	466.9
6"	10.38	20.75	41.51	103.8	207.5
8"	5.837	11.67	23.35	58.37	116.7
10"	3.736	7.471	14.94	37.36	74.71
12"	2.594	5.188	10.38	25.94	51.88

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. 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.

Changing Total Direction/Resetting Totalizers

On the Main screen, tap ▲ to select the direction of the total display. To reset BATCH FWD or BATCH REV, select with ▲ and then tap ▶ four times.

Entering Menu System

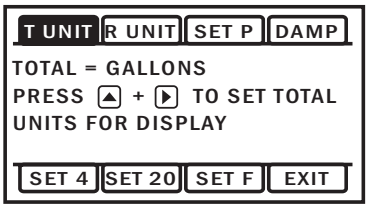
To enter the Menu System perform the hold and tap sequence. The Passcode entry screen will display. The default passcode is 000000. If a different passcode has previously been set, use the ▲ and ▶ to enter that passcode. In either case, hold and tap again to move into the menu system. (*If you enter 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

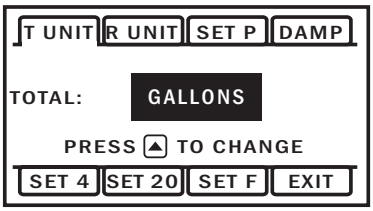
Once in the Menu System, move from tab to tab by tapping the right button. (See the next page for details on the various available tabs.)

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.

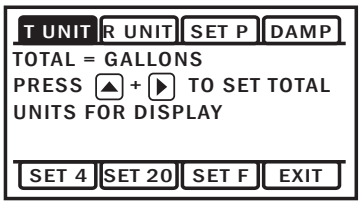
When finished making changes. When you are finished making changes, move to the EXIT tab using the right button.

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

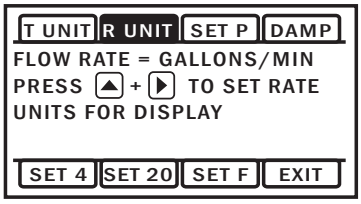
Standard Menu Options

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.**

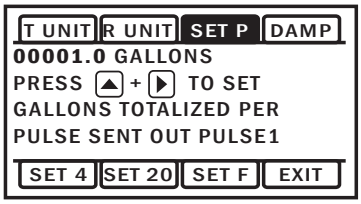
T UNIT
View or change TOTAL volume units



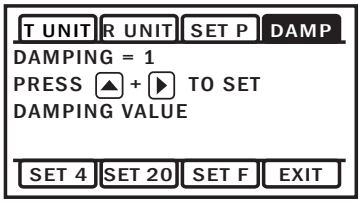
R UNIT
View or change flow RATE units



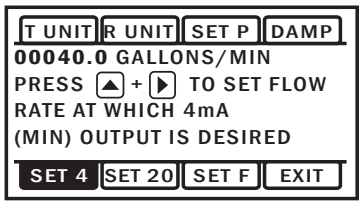
SET P
View or change pulse output scaling



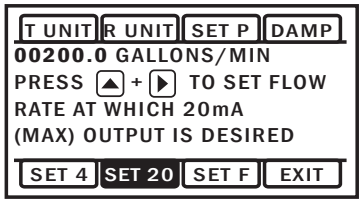
DAMP
View or change # of seconds for rolling average.*
(0=1 second, 1=2 seconds, etc.)



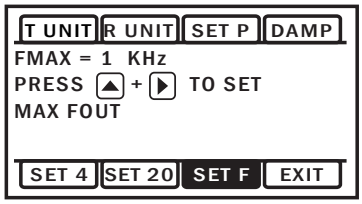
SET 4
View or change flow rate corresponding to 4mA. *(Externally powered units only)*



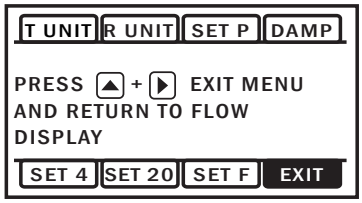
SET 20
View or change flow rate corresponding to 20mA. *(Externally powered units only)*



SET F
View or change high frequency output scaling. *(Externally powered units only)*



EXIT
Return to HOME SCREEN or enter SUBMENU



** See DAMP Settings for Battery Units on 23.*

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 ▲ five times, you will be redirected to a SUBMENU screen from which you can access several more options.

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.

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

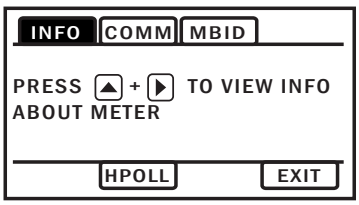
COMM: Modbus® baud rate and parity. *(Not available on battery only units.)*

MBID: Modbus® address *(Not available on battery only units.)*

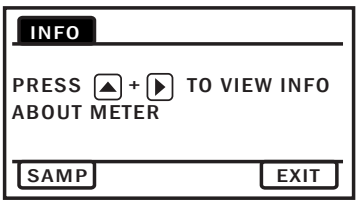
SAMP: Sample rate *(Battery powered version only.)*

HPOLL: HART Address *(Not available on battery only units.)*

EXIT: Return to MAIN MENU.



Sub-Menu



Sub-Menu - Battery Only Version

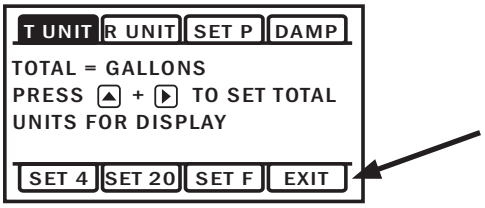
To Change a Passcode and Decimal Places

The iMAG has a passcode system for restricting access to the menus. The iMAG comes from the factory with the passcode set to 000000. When a user attempts to enter the menu system (see details on page 19), the passcode entry screen will be displayed.

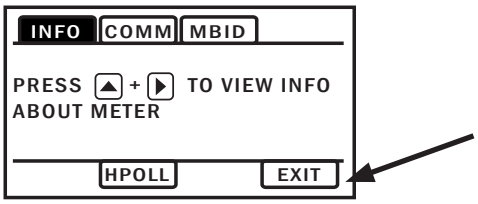
The default passcode is 000000. If a different passcode has previously been set, then the user must enter that passcode at this time. After entering the passcode, or leaving it at 000000 if using the default passcode, the user does the tap and hold sequence to move into the menu system.

To change the passcode, you must use the Set Passcode/ Decimal screen. Access the Set Passcode/Decimal Place screen as follows:

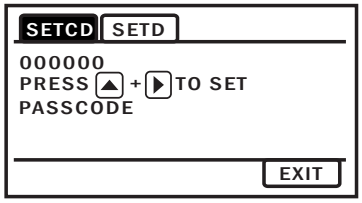
- Enter the main menu system, as described above.



- 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 the up arrow five times. The Set Passcode/ Decimal Place screen will display.



- To set the code, hold and tap on SETCD and then use the ▲ and ▶ to enter the new code.
- Hold and tap again to return to the Set Passcode/ Decimal 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 ▶ to move the decimal point.
- Hold and tap again to return to the Set Passcode/ Decimal Place screen.
- Tab to EXIT, and then hold and tap to return to the SUBMENU.

Power Indicators

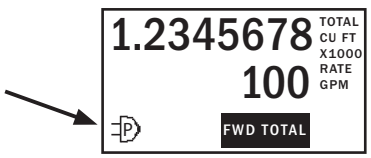
A power indicator is displayed in the lower left of the main display window.

When powered by external DC or internal AC, a power plug will display.

When powered by battery (or if external DC or internal AC power fails) a battery icon will display.

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 internal AC

Being powered by battery - voltage is sufficient

Being powered by battery - voltage is low

Battery Powered Units

The iMAG 4700 meter can come configured with two replaceable 3.6V lithium 'D' batteries. 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, with a fixed pulse width of 2.5ms. 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 to the right 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 when starting with an EMPTY PIPE it may take at least 30 seconds to register any flow.

Battery Life/Sample Period

Sensor sample period(s) (Seconds)	Expected battery life*
1/5 (0.2)	1 year
1/3 (0.33)	1.5 years
1	2.5 years
3	4 years
5	5 years
15	5.5 years
30	6 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.

Troubleshooting

Problem	Probable Causes	Things to try...
Blank Display	Faulty wiring from power source to meter	Check for incorrect wiring. Measure voltage with DMM where red and black wires connect to terminal block TB2 inside meter display head. Verify correct polarity and confirm that voltage is steady and between 9Vdc and 32Vdc
	Battery has not been plugged in	Plug in the battery
	Dead 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	Eliminate or minimize causes of flow disturbances or increase meter damping
	Pipe not full	Provide back pressure or other means to ensure pipe is filled
	Pulsing flow due to combining multiple upstream flow sources	Move connection point further upstream
	Insufficient mixing of upstream chemicals	Move chemical injection downstream from meter
	Low fluid conductivity < 20 µS/cm	Replace with different type of meter
	Noisy electrical environment	Improve grounding at meter and nearby potentially noisy electrical equipment. Increase distance between meter and electrical noise sources.
	Defective or noisy AC switching power supply	Replace power supply
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.
	Wrong type of cable	Use only twisted pair cable and ensure both signal wires are on same twisted pair
	Grounding problem	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

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c. Buyer will prepay all freight charges to return any products to Seametrics' factory, or another repair facility. as designated by Seametrics.
d. Defective products, or parts thereof, which are returned to Seametrics and proved to be defective upon inspection, will be repaired to factory specifications.
e. Seametrics will deliver repaired products or replacements for defective products to the buyer (ground freight prepaid) to the destination provided in the original order.
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    iv. Alterations to the product, purposeful or accidental
    v. Electrical current fluctuations
    vi. Corrosion due to aggressive materials not approved for your specific product
    vii. Mishandling, or misapplication of Seametrics products
    viii. Products or parts that are typically consumed during normal operation
    ix. Use of parts or supplies (other than those sold by Seametrics) which cause damage to the products, or cause abnormally frequent service calls or service problems
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