# E-Series G2® Ultrasonic Meters

**Lead-Free Bronze Alloy, 5/8…8 inch**



**Badger Meter**

**User Manual**

# CONTENTS

# SCOPE OF THIS MANUAL

This manual contains installation and operation procedures for the Badger Meter® E-Series G2® Ultrasonic residential (5/8…1 inch) and commercial (3…8 inch) water meters. Proper performance and reliability of the product depend upon installation in accordance with these instructions.

## Additional Resources

Go to *badgermeter.com* to find the following related manuals:

For meter programming, refer to *Product Configuration Utility for E-Series G2 Ultrasonic Meters*

For connecting meters to ORION endpoints, refer to *ORION Water Endpoints Installation*

# PRODUCT UNPACKING AND INSPECTION

To avoid damage in transit, E-Series Ultrasonic meters are shipped to the customer in special shipping containers. Upon receipt of shipment, be sure to follow these unpacking and inspection procedures:

If damage to a shipping container is evident upon receipt of a meter, request that a representative of the carrier be present when the meter is unpacked.

• Carefully open the shipping container, following any instructions that may be marked on the container. Remove all cushioning material surrounding the meter and carefully lift the meter from the container. Keep the container and all packing material for possible use in reshipment or storage.

• Visually inspect the meter and applicable accessory devices for any signs of damage such as scratches, loose or broken parts or other physical damage that may have occurred during shipment.

   **NOTE:** If damage is found, request an inspection by the carrier's agent within 48 hours of delivery. Then file a claim with the carrier. A claim for equipment damaged in transit is the responsibility of the customer.

## Rigging, Lifting and Moving Large Commercial Meters

• DO NOT lift or move a meter using the electronics, lid or cables.

• Use a crane rigged with soft straps to lift and move the meters. Place the straps around the meter body, between the flanges, on each side of the electronics.

• Use the sling-rigged method to lift large meters into a vertical position while they are still crated. Use this method to position while they are still crated. Use this method to position large meters vertically into pipelines.

• DO NOT lift a meter with a forklift by positioning the meter body on the forks with the flanges extending beyond the lift. This could dent the housing or damage the internal components. NEVER place forklift forks, rigging chains, straps, slings, hooks or other lifting devices inside or through the meter flow tube to hoist the unit. This could damage the internal components.

# SAFETY INFORMATION

The installation of the E-Series Ultrasonic meter must comply with all applicable federal, state and local rules, regulations and codes. Failure to read and follow these instructions can lead to misapplication or misuse of the meter, resulting in personal injury and damage to equipment.

# ABOUT THE E-SERIES ULTRASONIC METERS

The E-Series Ultrasonic meter uses solid-state technology in a compact, tamper protected, weatherproof and UV-resistant housing, suitable for residential and commercial applications. The registration electronics and battery are encapsulated to withstand harsh environments and protect the electronics in flooded or submerged pit applications.

Electronic water metering provides information—such as rate of flow and status and alarm indication—and data not typically available through traditional mechanical meters and registers. The ultrasonic measurement system has no moving parts, provides long-term accuracy and minimizes measurement errors due to sand, suspended particles and pressure fluctuations.

Meters can be installed using horizontal or vertical piping, with water flow in the up direction. The meter will not measure flow when an "empty pipe" condition is experienced. An empty pipe is defined as a condition that occurs when the flow sensors are not fully submerged.

## Operation

As water flows into the measuring tube, ultrasonic signals are sent consecutively in forward and reverse directions of flow. Velocity is then determined by measuring the time difference between the measurement in the forward and reverse directions. Total volume is calculated from the measured flow velocity using water temperature and pipe diameter.

The LCD screen toggles to display total volume and unit of measure, rate of flow, operating mode, firmware and alarm conditions (reverse-flow, no usage, empty pipe, exceeding max flow, suspected leak, pressure, temperature, end of life, and measurement error).

## Construction

The E-Series Ultrasonic meter features lead-free bronze alloy meter housing, ultrasonic transducers, a meter-control circuit board with associated wiring, LCD and battery. Wetted elements are limited to the pressure vessel, transducers and strainer, if equipped. The electronic components are housed and fully potted within a molded, engineered polymer enclosure, which is attached to the meter housing. The transducers extend through the housing and are sealed by O-rings, enabling turbulence-free water flow through the tube. The flow tube is designed to reduce pressure loss and provide long-term accuracy.

## Standards

E-Series Ultrasonic meters meet and exceed ANSI/AWWA C715 Standards. The lead-free bronze alloy meters comply with the lead-free provisions of the Safe Drinking Water Act and NSF/ANSI/CAN Standards 61 and 372.

## Meter Applications

Residential and commercial E-Series G2 Ultrasonic meters are available for potable water, reclaimed water and fire service applications.

E-Series Ultrasonic meters can be used in potable cold water applications or in reclaimed irrigation or raw water applications, with less than optimum water conditions, where small particles exist. E-Series Ultrasonic meters for residential and commercial fire service applications in 3/4…8 inch sizes comply with the requirements of UL Subject 327B, ultrasonic and magnetic type water meters used in fire service applications. Meters in the 3…8 inch sizes further comply with the requirements of FM 1044 for commercial fire service applications. These applications are regulated by local codes and requirements established by the Authority Having Jurisdiction (AHJ).
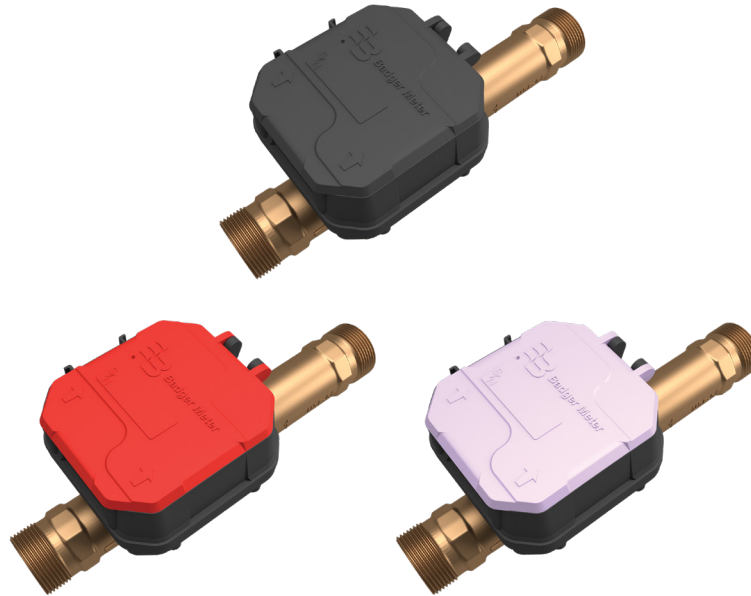


*Figure 1: Lid colors indicate application type (charcoal gray: potable and raw water; red: fire service; lavender: reclaimed water)*

| E-Series G2 Ultrasonic Water Meters | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Size (Inches)** | **5/8** | **5/8×3/4** | **3/4** | | **1** | **3** | | **4** | | **6** | | **8** |
| **Lay Length (Inches)** | 7-1/2 | 7-1/2 | 7-1/2 | 9 | 10-3/4 | 12 | 17 | 14 | 20 | 18 | 24 | 20 |
| **Fire Service** | NA | NA | UL 327B | UL 327B | UL 327B | UL 327B, FM 1044 | | | | | | |

# ENDPOINTS AND SOFTWARE

## IMPORTANT
*For proper handling of the higher reading resolution and the extended status indicator capabilities of the E-Series G2 Ultrasonic meter, we recommend ORION Cellular endpoints to support the full capabilities of the meter.*

To support *pressure, temperature,* use the following:
- BEACON® Software as a Service (SaaS)
- ORION Cellular C, HLD, CS, LTE-M, LTE-MS, HLA endpoints, ORION Mobile M endpoint, any firmware version
- ORION Cellular LTE endpoints, firmware version 1.10.1193 or newer
- ORION ME, SE endpoints, firmware version X.19 (2.19 or 3.19)
  **NOTE:** ORION ME, SE endpoints only transmit temperature and pressure alerts.

To support *maximum flow rate measurement*, use the following:
- BEACON® Software as a Service (SaaS)
- ORION Cellular C, HLD, CS, HLA endpoints, any firmware version
- ORION® Cellular LTE-M or LTE-MS, firmware version 2.0.445
  **NOTE:** ORION Cellular LTE endpoints do not support maximum flow rate measurement.

# BEACON FIRST TIME SETUP

For meters connected to ORION endpoints, perform these steps to make sure the E-Series Ultrasonic meter Sensor information is accessible in BEACON. See *"Endpoints and Software"* above on this page for detailed endpoint information.

1. In BEACON, select **Utility Settings> General Settings** from the menu on the left.
2. Scroll down to the *Monitor Page Settings* section, click *Select Filters* and find the *Sensors* section.
3. Select the **Water Pressure** and/or **Water Temperature** check boxes to turn on reporting for the temperature and/or pressure meter sensors.
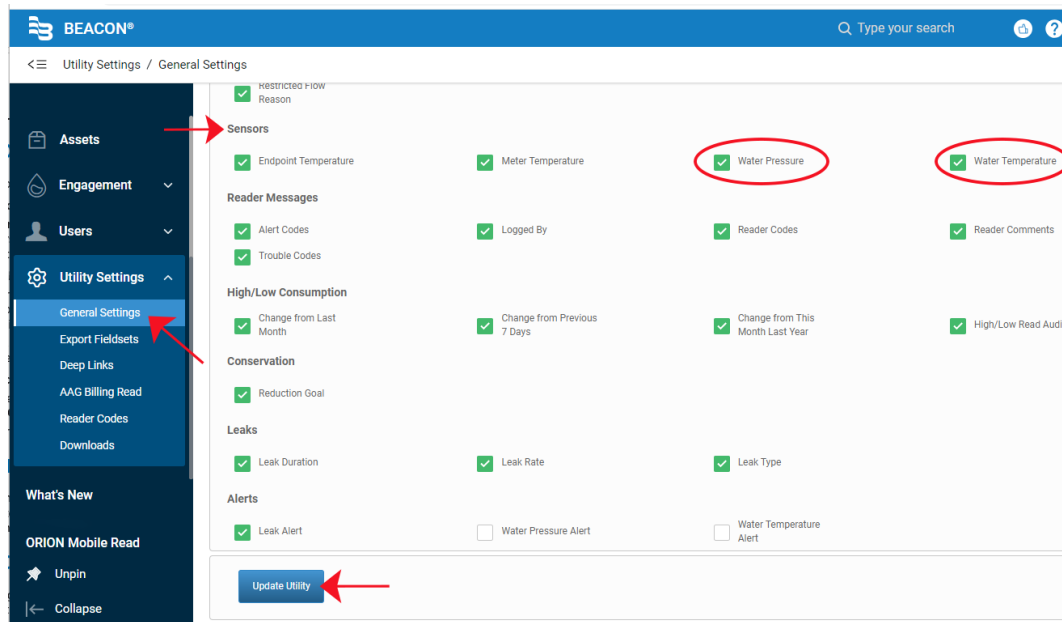


*Figure 2: BEACON Utility Settings, Monitor Page Filters*

4. Select **Update Utility** at the bottom of the page to save your changes.



*Figure 3: Select to save changes*

5.  Select **At A Glance** from the menu on the left.

6.  Select **Add/Remove** on the top right side.

    *On the window that opens, select* **Add** *for System Water Temperature and/or System Water Pressure. Then select* **Done***.*
    *The System Water Pressure and/or System Water Temperature modules display, as selected, on the At A Glance page.*
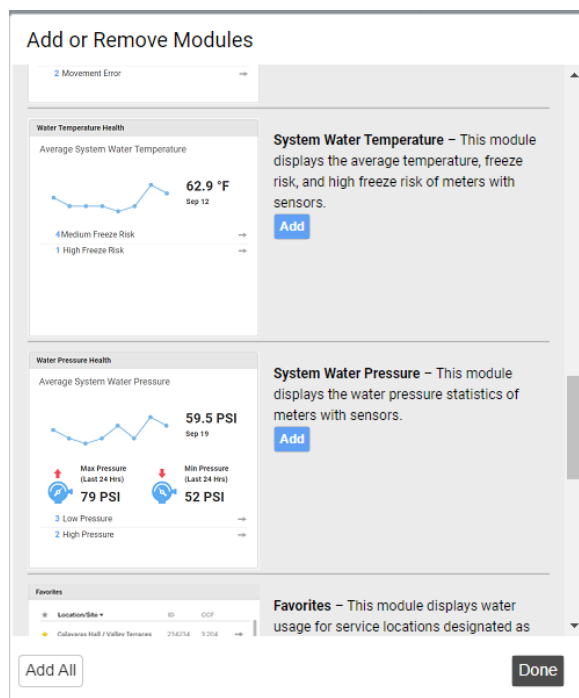


*Figure 4:  Add/Remove modules for At A Glance*

BEACON setup is complete.

# METER OPERATING MODES

The E-Series Ultrasonic meter automatically moves through storage and transition mode into active mode based on water flow:

*   **Storage Mode**

    E-Series Ultrasonic meters are delivered in storage mode so that a meter alarm is not triggered. In storage mode, the meter LCD displays the empty pipe icon ⚠ on the consumption screen, an empty pipe code on the alarm screen (but no alarm code is sent to the endpoint) and **– – – F** (or **– – – C**) on the temperature screen.

*   **Transition Mode**

    When the meter senses water in the pipe, it moves into transition mode. In transition mode, the meter displays water consumption and sends a reading to the endpoint, if connected. After sensing a full pipe for 24 hours, the meter transitions to active mode.

    **NOTE:**   If a meter senses an empty pipe in transition mode, the meter goes back into storage mode until water triggers the process to start again.

*   **Active Mode**

    Meter is operating normally. If the meter is in active mode and detects an empty pipe, water temperature displays **ErrF** (or **ErrC**).

For more information see *"Temperature Screen*" on page 16 and "Alarm and Operating Mode Screen" on page 17* .

# REMOVING A METER

> ⚠ **WARNING**
>
> *DEPRESSURIZE THE LINE BEFORE STARTING ANY DISASSEMBLY OPERATION. REMOVING A METER THAT IS UNDER LINE PRESSURE CAN RESULT IN COMPONENTS BECOMING PROJECTILES, CAPABLE OF CAUSING PERSONAL INJURY.*

# INSTALLATION

## Outdoor Installations

When installed outdoors in a meter box, the E-Series Ultrasonic meter should have a 2…3 inch clearance to avoid damage or strain to the service piping or meter and to accommodate any settling that may occur after installation.

Make sure the service pipe in the meter box is properly bedded so that it is not axially misaligned and that it lays evenly on the bottom of the pipe trench. Place the backfill material covering the pipe appropriately to maintain pipe alignment in the event of eventual ground shifts. This will prevent damage to the pipe.

Protect the service lines and the water meter from freezing. The earth covering the service line must be adequate to prevent frost penetration. Due to the smaller volume of water, service line pipes will freeze sooner than the main distribution line.

Excavate the meter box pit below the frost line. Even though the meter itself may be positioned above the frost line, the warmer air rising from the earth below the frost line will reduce the possibility of freezing.

## Indoor Installations

As a precautionary measure when working with metallic pipes, check indoor settings for electrical continuity through the service pipe before you remove or service a meter. American Water Works Association (AWWA) policy specifies that service pipes must not be used as an electrical ground.

Check your local codes and practices. You must use a permanent ground strap or metal setter if electrical grounding to water services is required in your community. See *Figure 5*.

To prevent floor damage, close the valve downstream from the meter before installing or removing a meter.

> ⚠ **CAUTION**
>
> - *DO NOT ATTEMPT TO USE ANY METER AS A LEVER OR CROWBAR TO STRAIGHTEN A MISALIGNED METER POSITION. THIS COULD DAMAGE THE METER.*
>
> - *TO AVOID POTENTIAL PROBLEMS, CORRECT ANY IRREGULARITIES IN PIPE SPACING AND MISALIGNMENT BEFORE PLACING THE METER INTO ITS POSITION.*
>
> - *METERS MUST OPERATE IN A COMPLETELY FILLED LINE AT ALL TIMES. THE DOWNSTREAM PIPING MUST ALWAYS BE ARRANGED TO PROVIDE SUFFICIENT BACK PRESSURE TO MAINTAIN A FULL LINE AT THE METER. BY ELIMINATING AIR IN THE LINE, AS WELL AS SUDDEN FLOW SURGES, INACCURATE REGISTRATION AND DAMAGE TO THE METER CAN BE AVOIDED.*
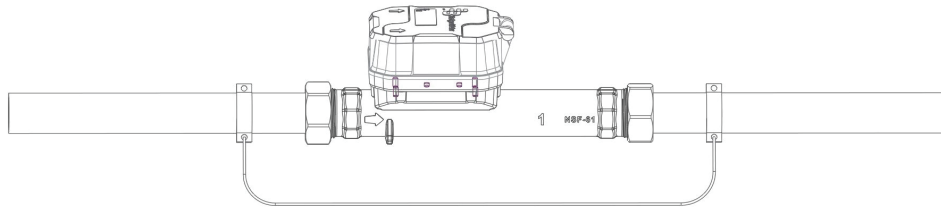
# INSTALLATION: RESIDENTIAL METERS



*Figure 5:  Recommended residential meter installation*

## Special Fittings and Accessories for Residential Meters

To accommodate 5/8…1 inch residential meter installations, special fittings and accessories may be needed. Metal meter setters, re-setters, horns and meter yokes are available for holding the service pipe in proper alignment to the meter and laying length spacing. Metal setters and meter yokes can provide an electrical continuity to protect meters and consumers from electrical shocks.

## Pre-Installation

*Consider the following before you begin a residential E-Series Ultrasonic meter installation:*

- Inspect the piping around the meter for suitable conditions. The service line, valves, connections and meter must be watertight. Repair the piping system if pipes are corroded or damaged.

- Install the meter in the pipeline in a horizontal or vertical position so that the flow arrow on the meter housing points in the same direction as water flow. Registration should be upright and protected from damage, freezing and tampering.

- Verify meters are correctly programmed.

- Position the meter so it is accessible for installation, reading and removal.

- The line opening for the meter should match the lay length of the meter, allowing slight additional space for coupling gaskets. The inlet and outlet sides of the meter should be axially aligned to the pipe.

- The installed meter must not be an obstacle or a hazard to the customer or interfere with public safety.

- To avoid cavitation, always install control valves downstream of the meter. Never install the meter on a pump suction side.

- Consider maximum flow rates when sizing and selecting the appropriate meter for the application.

- Pump discharge should never be installed in proximity of the meter.

- Externally weighted check valves and pressure reducing devices should not be located in proximity of the meter.

## Residential Meter Installation Instructions

1. Begin at this step when cutting in for new service. When cutting in is not required, begin at **step 2**.
    - Close the curb (shutoff) valve to relieve water pressure in the line before starting the cutting operation. Provide a high-quality upstream shutoff valve with a low pressure drop.
    - Flush the pipe to clear chips, pipe dope or other plumbing residue.
2. Close the meter inlet-side valve.
3. Open a faucet and wait until water flow stops to depressurize the system. Do not remove the meter until the flow stops.

**⚠ WARNING**

*DEPRESSURIZE THE LINE BEFORE STARTING ANY DISASSEMBLY OPERATION. REMOVING A METER THAT IS UNDER LINE PRESSURE CAN RESULT IN COMPONENTS BECOMING PROJECTILES, CAPABLE OF CAUSING PERSONAL INJURY.*

4. Check valves and make necessary repairs to the curb (shutoff) valve or inlet side valve if necessary.

5. Before installing or removing a meter, close the outlet-side valve to relieve pressure. Protect the area around the meter against potential spills or leaks that could occur.

6. To replace an existing meter continue with **step 7**. To install a new meter skip to **step 9**.

7. Loosen the meter coupling nuts or flange bolts, and remove the meter and old gaskets.

8. Clean the coupling nuts or flange bolts, removing any pipe dope or dirt.

9. Check the existing position for proper alignment and spacing. Correct any misalignment or spacing issues.

10. Place the connection gaskets inside the connection coupling nuts.

11. Install the meter in the pipeline in a horizontal or vertical position with the ***flow arrow on the meter pointing in the direction of flow***. Registration should be upright.

    **For 5/8…1 in. Threaded Ends**

    • Start the coupling nuts at the threaded meter ends. Verify that the nuts are properly aligned to avoid cross-threading or damage to the meter ends.

    • An effective method for starting a coupling nut is:
        a. Position the nut squarely against the meter's spud end.
        b. Turn the nut counterclockwise (in reverse) while holding the nut against the meter spud end. When the first threads on both the nut and the spud end coincide, you will hear a slight click and feel the nut move into the starting position.
        c. Tighten the nut by hand until it is tight.
        d. With an open-end wrench, apply a partial turn. Do not over tighten. For plastic swivel connections, a one-quarter turn beyond hand-tight is usually sufficient.

12. After the meter is installed, slowly open the inlet shutoff valve until the meter is full of water and make sure there are no leaks. (The more flow you allow through the meter, appropriate for the meter size, the better.)

    **⚠CAUTION**  Take caution when opening the inlet valve to avoid damage to the pressure sensor due to extreme water hammer.

13. Slowly open the outlet valve until air is out of the meter and service line.

14. Slowly open a service valve downstream of the meter and verify that no foreign debris in the water obstructs the operation of the system.

15. Check the read on the meter to make sure it is registering a positive number. If it is not, make sure the meter is installed in the correct direction.

    • The meter is shipped in storage mode so that customers do not experience alarms during shipment or installation. After properly purged of air, and the meter senses a full pipe, it may take up to 30 seconds to begin measurement.

    • The meter itself does not require a quantity of flow to begin measurement. The meter just requires that the pipe is cleared of air and filled with water. If attempting to purge the meter at low flow rates, it would likely be more difficult and take longer.

16. Meter installation is complete. When the meter starts recording positive flow, note the reading for your records.

**NOTE:** To complete the assembly, you can attach the meter encoder to an endpoint (optional). Refer to the *ORION Water Endpoints Installation Manual*, available at *badgermeter.com*, for endpoint installation information.
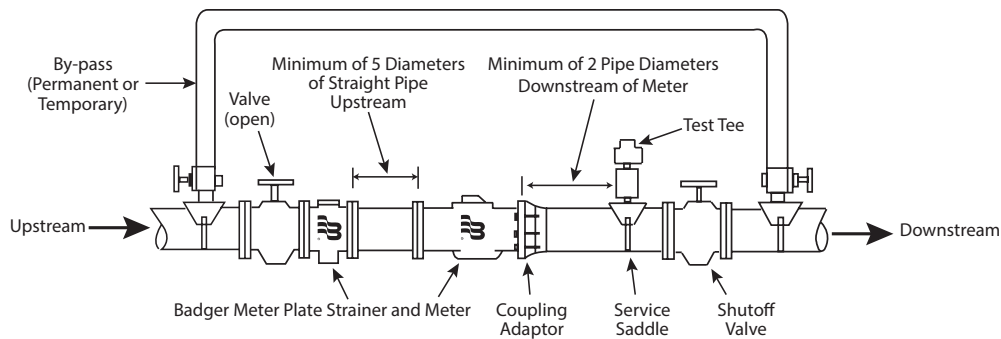
# INSTALLATION: COMMERCIAL METERS



*Figure 6:  Recommended commercial meter installation*

## Pre-Installation

*Consider the following before you begin a commercial E-Series Ultrasonic meter installation:*

- Inspect the piping around the meter for suitable conditions. The service line, valves, connections and meter must be watertight. Repair the piping system if pipes are corroded or damaged.
- Install the meter in the pipeline in a horizontal or vertical position so that the flow arrow on the meter housing points in the same direction as water flow. Registration should be upright and protected from damage, freezing and tampering.
- Verify meters are correctly programmed.
- Position the meter so it is accessible for installation, reading and removal.
- The line opening for the meter should match the lay length of the meter, allowing slight additional space for coupling gaskets. The inlet and outlet sides of the meter should be axially aligned to the pipe.
- The installed meter must not be an obstacle or a hazard to the customer or interfere with public safety.
- To avoid cavitation, always install control valves downstream of the meter. Never install the meter on a pump suction side.
- Consider maximum flow rates when sizing and selecting the appropriate meter for the application.
- A minimum of five pipe diameters of straight, unobstructed pipe is recommended upstream of the meter.
- Pump discharge should never be installed in proximity of the meter.
- Externally weighted check valves and pressure reducing devices should not be located in proximity of the meter.
- Do not install check valves or pressure reducing devices within five pipe diameters upstream of the meter.
- Only fully open gate or ball valves should be used immediately upstream of the meter. Butterfly valves must be five pipe diameters or more upstream of the meter. Fully open gate, ball or butterfly valves can be used downstream.
    - **NOTE:** A partially opened gate or ball valve, or butterfly valve installed immediately upstream of the meter could adversely affect meter accuracy.
- A service saddle (or reducing tee) should be at least two pipe diameters downstream of the meter outlet flange.
- Unweighted check valves should not be located closer than three pipe diameters downstream of the meter.
- Pump discharge should be installed at least five pipe diameters upstream of the meter.
- Externally weighted check valves and pressure reducing devices should be located no closer than five pipe diameters of the meter.
- The meter is designed so that a strainer is not required. If installing a strainer, it is recommended that it be installed a minimum of five pipe diameters upstream of the meter in order to maximize the accuracy of your measurements.
- During meter replacement, if there is already a strainer installed immediately upstream, to attain the highest accuracy capabilities, consider moving the strainer downstream of the meter or further upstream.

- If you are using a strainer that is a size smaller than the pipe installation, five diameters of pipe is required in order to reduce the effect of jetting caused by the increase in flow velocity. Additional length is required if a sharp contraction or an eccentric reducer is used, rather than a concentric, tapered reducer.

- To allow for the dampening of velocity profile distortions, elbow (90°) configurations should be installed a minimum of five pipe diameters upstream the meter and/or downstream the meter. Where spiral flows are created by three-dimensional elbows or rotary pumps, additional downstream distance is beneficial to dampen the effect.

## Commercial Meter Installation Instructions

1. Begin at this step when cutting in for new service. When cutting in is not required, begin at **step 2**.

    - Close the curb (shutoff) valve to relieve water pressure in the line before starting the cutting operation. Provide a high-quality upstream shutoff valve with a low pressure drop.

    - Flush the pipe to clear chips, pipe dope or other plumbing residue.

2. Close the meter inlet-side valve.

3. Open a faucet and wait until water flow stops to depressurize the system. Do not remove the meter until the flow stops.

> ⚠ **WARNING**
>
> *DEPRESSURIZE THE LINE BEFORE STARTING ANY DISASSEMBLY OPERATION. REMOVING A METER THAT IS UNDER LINE PRESSURE CAN RESULT IN COMPONENTS BECOMING PROJECTILES, CAPABLE OF CAUSING PERSONAL INJURY.*

4. Check valves and make necessary repairs to the curb (shutoff) valve or inlet side valve if necessary.

5. Before installing or removing a meter, close the outlet-side valve to relieve pressure. Protect the area around the meter against potential spills or leaks that could occur.

6. To replace an existing meter continue with **step 7**. To install a new meter skip to **step 9**.

7. Loosen the meter coupling nuts or flange bolts, and remove the meter and old gaskets.

8. Clean the coupling nuts or flange bolts, removing any pipe dope or dirt.

9. Check the existing position for proper alignment and spacing. Correct any misalignment or spacing issues.

10. Install the meter in the pipeline in a horizontal or vertical position with the ***flow arrow on the meter pointing in the direction of flow***. Registration should be upright. A cross star torque pattern is recommended when installing the flange bolts.

11. After the meter is installed, slowly open the inlet shutoff valve until the meter is full of water and make sure there are no leaks. (The more flow you allow through the meter, appropriate for the meter size, the better.)

    ⚠ **CAUTION**  Use caution when opening the inlet valve to avoid damage to the pressure sensor due to extreme water hammer.

12. Slowly open the outlet valve until air is out of the meter and service line.

13. Slowly open a service valve downstream of the meter and verify that no foreign debris in the water obstructs the operation of the system.

14. Check the read on the meter to make sure it is registering a positive number. If it is not, make sure the meter is installed in the correct direction.

    - The meter is shipped in storage mode so that customers do not experience alarms during shipment or installation. After properly purged of air, and the meter senses a full pipe, it may take up to 30 seconds to begin measurement.

    - The meter itself does not require a quantity of flow to begin measurement. The meter just requires that the pipe is cleared of air and filled with water. If attempting to purge the meter at low flow rates, it would likely be more difficult and take longer.

15. Installation is complete. When the meter starts recording positive flow, note the reading for your records.

**NOTE:** To complete the assembly, you can attach the meter encoder to an endpoint (optional). Refer to the *ORION Water Endpoints Installation Manual*, available at *badgermeter.com*, for endpoint installation information.

## Commercial Meter Accuracy Test

The E-Series Ultrasonic meters are accuracy tested at the factory before shipment. However, the meters can be tested for accuracy in the field using appropriate connections by running output flow through the NPT test port, if so equipped. Refer to the *Portable Large Meter Tester application data sheet* (TST-AS-01297-EN), available at *badgermeter.com*, for accuracy testing instructions using a test meter.

When sealing the test plug, hand tighten plus 7/8 to 1-1/2 turns. If further sealing is needed, tighten incrementally, but use caution to avoid over-tightening which may result in damage to the test port.

### ⚠ WARNING

*IF THE TEST PORT IS TO BE USED, SHUT OFF FLUID SUPPLY AND RELEASE PRESSURE BEFORE SERVICING OR MAKING A PLUMBING CONNECTION. FAILURE TO DO SO CAN LEAD TO PLUG BEING EJECTED FROM HOUSING, CAUSING PERSONAL INJURY AND/OR PROPERTY DAMAGE.*

# OPERATIONS

## Display

E-Series Ultrasonic meters use a 9-digit Liquid Crystal Display (LCD) that toggles to show consumption, rate of flow, temperature,* pressure,* alarm and operating mode, and firmware version. Indicator and alarm icons appear in the display as symbols that illuminate when the condition is active. See *"Meter Alarms" on page 21* for alarm duration. Additional display screens can be programmed, including: six-digit display, reverse total flow and programmed date.
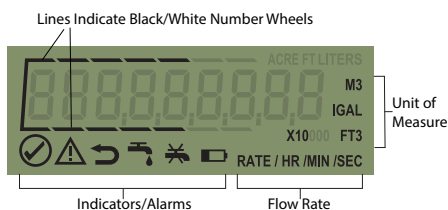


*Figure 7: E-Series Ultrasonic Meter LCD*

*Pressure monitoring is available when meter is equipped with the optional integrated pressure sensor. Pressure alarms, and temperature and pressure data, are sent as part of the encoder message and surfaced in BEACON SaaS when meter is used with applicable ORION endpoints. See *"Endpoints and Software" on page 6* for complete endpoint information.

## Activating the Display

The E-Series Ultrasonic meter display illuminates when the register cover is opened. You can change the display screen by touching the optical communication port in the center of the register face or by closing and opening the meter lid. The display reverts to sleep mode after a period of inactivity.

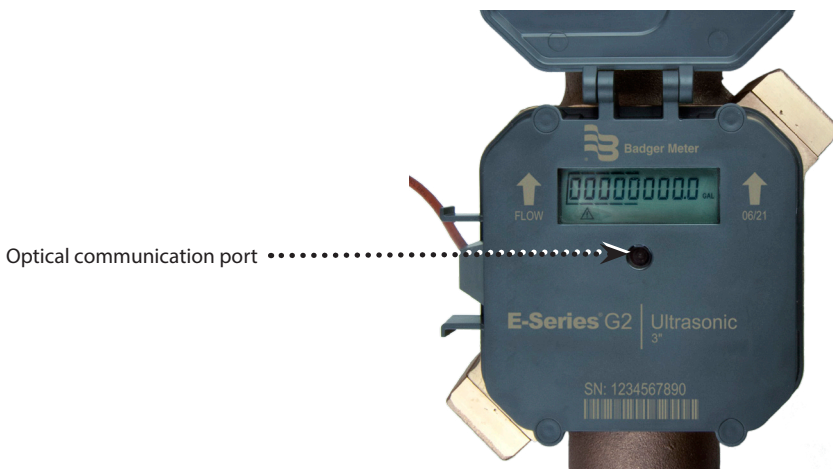See *"Display Screens" on page 14* for Information about each screen.



*Figure 8: Meter, lid open, showing optical communication port*

The direction of water flow is noted on the face of the electronics housing and cast into the meter housing.

## Display Screens

The total consumption screen shows all nine digits, including leading zeroes and a decimal point.

The displayed value is the sum of the forward flow minus the reverse flow. The display also includes indicator lines above and below the digits to represent the typical utility meter reading (electronic equivalent of white and black number wheels on mechanical registers).

Unit of measure and resolution are factory programmed for the meter. The examples show typical displays for the three different units of measure.

### Total Consumption Screen: Residential Meters

Totalized flow displays up to 10 million gallons with a resolution of 0.01 gallons, 1 million cubic feet with a resolution of 0.001 cubic feet, or one thousand cubic meters with a resolution of 0.0001 cubic meters.

| 5/8, 5/8 × 3/4, 3/4, 1 inch |
|---|

**Gallons**

123456789 GAL

Meter reading to the nearest?

| | | |
|---|---|---|
| 100th gallon = | 1234567.89 | |
| 10th gallon = | 1234567.8 | |
| 1 gallons = | 1234567 | |
| 10 gallons = | 123456 | |
| 100 gallons = | 12345 | |
| Typical Billing Units ⟶ 1000 gallons = | 1234 | |

**Cubic Feet**

123456.789 FT3

Meter reading to the nearest?

| | |
|---|---|
| 1000th ft³ = | 123456.789 |
| 100th ft³ = | 123456.78 |
| 10 ft³ = | 123456.7 |
| 1 ft³ = | 123456 |
| 10 ft³ = | 12345 |
| Typical Billing Units ⟶ 100 ft³ | 1234 |

**Cubic Meters**

123456789 M3

Meter reading to the nearest?

| | |
|---|---|
| 10000th m³ = | 12345.6789 |
| 1000th m³ = | 12345.678 |
| 100th m³ = | 12345.67 |
| 10th m³ = | 12345.6 |
| Typical Billing Units ⟶ 1 m³ = | 12345 |
| 10 m³ | 1234 |

## Total Consumption Screen: Commercial Meters

**3, 4 inch meters**: Totalized flow displays up to 100 million gallons with a resolution of 0.1 gallons, 10 million cubic feet with a resolution of 0.01 cubic feet, or one million cubic meters with a resolution of 0.001 cubic meter.

**6, 8 inch meters**: Totalized flow displays up to 1 billion gallons with a resolution of 1 gallon; 100 million cubic feet with a resolution of 0.1 cubic feet; or 10 million cubic meters with a resolution of 0.01 cubic meter.

| 3, 4 inch | 6, 8 inch |
|-----------|-----------|

### Gallons



Meter reading to the nearest?

|  |  |
|---|---|
| 10th gallon = | 12345678.9 |
| 1 gallon = | 12345678 |
| 10 gallons = | 1234567 |
| 100 gallons = | 123456 |
| Typical Billing Units → 1000 gallons = | 12345 |



Meter reading to the nearest?

|  |  |
|---|---|
| 1 gallon = | 123456789 |
| 10 gallons = | 12345678 |
| 100 gallons = | 1234567 |
| Typical Billing Units → 1000 gallons = | 123456 |

### Cubic Feet



Meter reading to the nearest?

|  |  |
|---|---|
| 100th ft³ = | 1234567.89 |
| 10th ft³ = | 1234567.8 |
| 1 ft³ = | 1234567 |
| 10 ft³ = | 123456 |
| Typical Billing Units → 100 ft³ = | 12345 |



Meter reading to the nearest?

|  |  |
|---|---|
| 10th ft³ = | 12345678.9 |
| 1 ft³ = | 12345678 |
| 10 ft³ = | 1234567 |
| Typical Billing Units → 100 ft³ = | 123456 |

### Cubic Meters



Meter reading to the nearest?

|  |  |
|---|---|
| 1000th m³ = | 123456.789 |
| 100th m³ = | 123456.78 |
| 10th m³ = | 123456.7 |
| Typical Billing Units → 1 m³ = | 123456 |
| 10 m³ = | 12345 |



Meter reading to the nearest?

|  |  |
|---|---|
| 100th m³ = | 1234567.89 |
| 10th m³ = | 1234567.8 |
| 1 m³ = | 1234567 |
| Typical Billing Units → 1 m³ = | 1234567 |
| 10 m³ = | 123456 |

## Rate of Flow Screen

Rate of flow is factory programmed in gallons per minute. The LCD shows both the unit of measure and rate of flow. The rate of flow screen also serves as the flow indicator. The rate of flow display is shown without leading zeros. When the rate of flow screen is displayed, it is updated every two seconds.



*Figure 9: Rate of flow screen*

## Pressure Screen*

Displays current water pressure. The pressure sensor is rated to a maximum psi of 150. If the maximum operating pressure is exceeded, **P 999 PSI** (or **P 99.9 bAr**) displays until pressure is back within the specified range. If the pressure sensor is damaged, **P Err PSI** (or **P Err bAr**) will display.

**NOTE:** Meters operating above 175 psi are operating outside approved specifications.

*When meter is equipped with optional integrated pressure sensor and used in conjunction with applicable ORION endpoints, pressure data and alarms are sent as part of the encoder message and surfaced in BEACON SaaS. See *"Endpoints and Software" on page 6* for complete endpoint information.



*Figure 10: Pressure screen*

## Temperature Screen*

Displays current water and ambient temperature. If the meter is in active mode and detects an empty pipe, water temperature displays **ErrF** (or **ErrC**). If the meter is in storage mode and detects an empty pipe, water temperature displays **– – – F** (or **– – – C**). Ambient temperature is displayed in all modes. Water temperature is not reported in storage mode. Temperature data begins reporting in transition mode when there is a full pipe.

*When used in conjunction with applicable ORION endpoints, temperature data is sent as part of the encoder message and surfaced in BEACON SaaS. See *"Endpoints and Software" on page 6* for complete endpoint information.
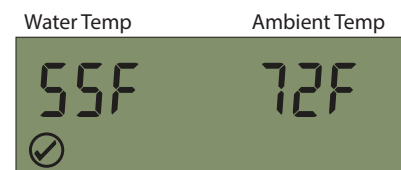
Water Temp          Ambient Temp



*Figure 11: Temperature screen*

## Alarm and Operating Mode Screen

Displays alarm condition and meter operating mode. This screen is only visible in active mode if an alarm is detected. Screen is always visible in storage and transition mode.

Display format: **ErXXX.YYY.Z**

| | | |
|---|---|---|
| **XXX** | **Position 1** | First set of 3 characters displays an alarm code that has occurred. See duration of each individual alarm in alarms chart on *page 20*. |
| **YYY** | **Position 2** | Second set of 3 characters displays an alarm code that is currently active. The alarm is stored in this position until reported to the endpoint. |

- Up to 15 min with ORION Cellular
- Up to 1 hr with ORION SE/ME
- Up to 35 days if not connected to an ORION endpoint

Alarm code reappears if condition is still present or reoccurs and resends message to endpoint.

| | | |
|---|---|---|
| **Z** | **Position 3** | The character in the last position is the code for the meter operating mode. The meter has three operating modes: storage (*Figure 12*), transition (*Figure 13*) and active mode (*Figure 14*). |

**5** Storage     **Γ** Transition     **A** Active

Also see *"Meter Operating Modes" on page 7*.

## Firmware Version Screen

Displays current meter firmware version.



*Figure 12: Alarm and operating mode screen in storage mode*



*Figure 13: Alarm and operating mode screen in transition mode*



*Figure 14: Alarm and operating mode screen in active mode*



*Figure 15: Firmware version screen*

# OUTPUT

## Encoder Output

Programmed to the industry standard ASCII encoder protocol, E-Series Ultrasonic meters have the ability to transmit meter status indicators to applicable ORION endpoints as part of the extended encoder/meter reading message. The details can also be read through an IR interface.

### Endpoint Reading Resolution

The standard electronic encoder output resolution of the E-Series Ultrasonic meter is 9 digits. Though the meter output is 9-digit resolution, the reading resolution sent to the reading software is dependent on the endpoint that the meter is connected to. Readings reported from the endpoints are the left-most significant digits of the encoder reading.

| Endpoint Technology | Reading Resolution Reported to Reading Software |
|---|---|
| ORION Cellular, ORION Mobile M | 9-digit reading, plus the extended message capability |
| ORION ME/ORION SE | 8-digit reading, plus the extended message capability |
| ORION CE | 7-digit reading |
| GALAXY | 6-digit reading |

### Wire Connections

The E-Series Ultrasonic meter is available with a connector for easy connection and installation to AMR/AMI endpoints. It is also available with a flying lead for field splice connection. The inline connector is recommended for pit applications.

## Dual Output

The E-Series Ultrasonic meter is also available with dual outputs. The following dual output options are available:

- Encoder and encoder
- Encoder and scaled/unscaled
- Encoder and 4-20 mA
- Scaled/unscaled and 4-20 mA

### 4-20 mA Set Point Screen

Displays for meters with 4-20 mA output. The default display value is equal to the safe maximum operating condition flow rate which is dependent on the size of the meter.


*Figure 16: Analog output screen*

### Scaled Pulse Set Point Screen

Displays for meters with scaled pulse output. The display resolution presents the pulse weight for a given unit of measure. See the default pulse weight for each unit of measure in *Table 1*.

The unscaled pulse output does not have a dedicated display screen. Default values are shown in *Table 2*.


*Figure 17: Scaled pulse screen*

## Scaled Output

- Scaled output is a switch closure output defined as: **red** wire = positive, **black** wire = negative.
- Scaled output from the register has a default resolution 1/10th of the register test circle (resolution may vary in some cases).
- The nominal pulse output width is programmable from 30…100 msec.
- This pulse output is compatible with most totalizers and batch controllers.

## Unscaled Output

- Unscaled output is a switch closure output defined as: **green** wire = positive, **black** wire = negative
- This pulse output is compatible with most totalizers and batch controllers.

## Analog Output

- The flow rate measurement is converted to a standard 4-20 mA control signal.
- This signal is proportional to the flow of fluid passing through the flow meter.
- The 4-20 mA output is isolated when paired with scaled/unscaled output.
- Power for the device can be obtained from a 9…50V DC control loop.

| Meter Size (in.) | Pulse Weight | | | | | |
| | Scaled (units/pulse) | | | Unscaled (units/pulse) | | |
| | gal | ft3 | m3 | gal | ft3 | m3 |
|---|---|---|---|---|---|---|
| 5/8 | 1 | 0.1 | 0.01 | 0.02 | 0.002 | 0.00005 |
| 5/8 x 3/4 | 1 | 0.1 | 0.01 | 0.02 | 0.002 | 0.00005 |
| 3/4 x 7-1/2 | 1 | 0.1 | 0.01 | 0.02 | 0.0025 | 0.0001 |
| 3/4 x 9 | 1 | 0.1 | 0.01 | 0.02 | 0.0025 | 0.0001 |
| 1 | 1 | 0.1 | 0.01 | 0.025 | 0.004 | 0.0001 |
| 3 in. | 10 | 1 | 0.1 | 0.250 | 0.05 | 0.001 |
| 4 in. | 10 | 1 | 0.1 | 0.500 | 0.1 | 0.002 |
| 6 in. | 100 | 10 | 1 | 1.000 | 0.1 | 0.005 |
| 8 in. | 100 | 10 | 1 | 2.000 | 0.2 | 0.005 |

*Table 1: Default pulse weights*

| Meter Size (in.) | Measurement Resolution | | | | | | |
| | Scaled (pulse/unit) | | | Unscaled (pulse/unit) | | | Analog Output |
| | gal | ft3 | m3 | gal | ft3 | m3 | 20 mA Set point (gpm) |
|---|---|---|---|---|---|---|---|
| 5/8 | 1 | 10 | 100 | 50 | 500 | 20000 | 30 |
| 5/8 x 3/4 | 1 | 10 | 100 | 50 | 500 | 20000 | 30 |
| 3/4 x 7-1/2 | 1 | 10 | 100 | 50 | 400 | 10000 | 40 |
| 3/4 x 9 | 1 | 10 | 100 | 50 | 400 | 10000 | 40 |
| 1 | 1 | 10 | 100 | 40 | 250 | 10000 | 64 |
| 3 in. | 0.10 | 1 | 10.0 | 4 | 20 | 1000 | 560 |
| 4 in. | 0.10 | 1 | 10.0 | 2 | 10 | 500 | 1100 |
| 6 in. | 0.01 | 0.1 | 1 | 1 | 10 | 200 | 2000 |
| 8 in. | 0.01 | 0.1 | 1 | 0.5 | 5 | 200 | 3500 |

*Table 2: Measurement resolution*

## Wiring Connections
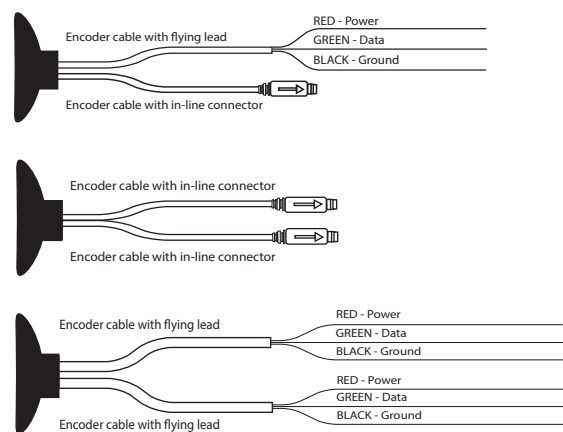
### Encoder and Encoder



*Figure 18: Encoder and encoder wiring options*

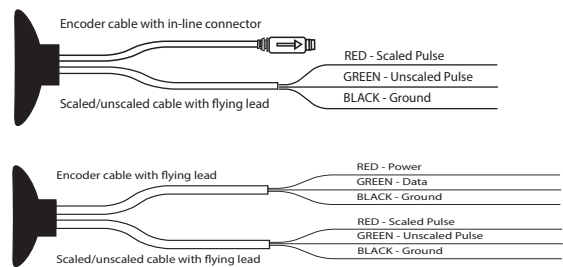### Encoder and Scaled Unscaled



*Figure 19: Encoder and scaled/unscaled output wiring options*
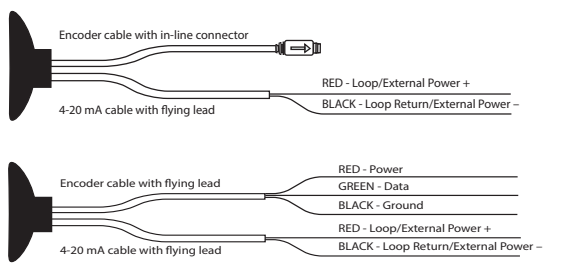
### Encoder and 4-20



*Figure 20: Encoder and 4-20 mA wiring options*
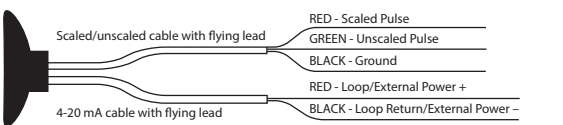
### Scaled/Unscaled and 4-20 mA



*Figure 21: Scaled/unscaled and 4-20 mA wiring option*

# METER ALARMS

E-Series Ultrasonic meter alarms appear on the display as icons that illuminate when the condition occurs. Alarms are displayed for the number of days listed in the table below. Alarms also appear as 3-character codes on the alarm and operating mode screen. See *"Alarm and Operating Mode Screen" on page 17* and *"Alarm Codes" on page 22*.

Alarms are sent as part of the encoder message to AMR/AMI systems that are capable of receiving an extended message, such as ORION Cellular, Mobile M, Fixed Network (SE) and ME endpoints. The details can also be read through an IR interface.

**NOTE:** Meters are delivered in storage mode so that an alarm is not triggered. In storage mode, the meter LCD displays an empty pipe icon, but no error code is sent to the endpoint. For alarms reported within BEACON, refer to BEACON Help at *beaconama.net*.

| Alarms | Icon | Alarm Description | Number of Days Icon Displays | High Resolution with ORION Cellular, ORION Mobile M, ORION SE or ORION ME |
|---|---|---|---|---|
| Normal Meter Operation | ✔ | Meter operating correctly | NA | NA |
| Temperature | ⚠ | Temperature outside limits: above 140° F or below 34° F. Meter continues to operate but is outside specified range. | Alarm clears after 35 days unless condition continues | Meter sends consumption and alarm to the endpoint once per occurrence |
| Pressure* | | Pressure sensor is damaged, or pressure is outside specified threshold limits: above 130 psi or below 35 psi. If maximum operating pressure is exceeded, **P 999 PSI** (or **P 99.9 bAr**) displays until pressure is back within the specified range. If the pressure sensor is damaged, **P Err PSI** (or **P Err bAr**) will display. | Alarm clears after 35 days unless condition continues | |
| Empty Pipe | | Empty or partially filled pipe. Last known good read is displayed. If the meter is active and detects an empty pipe, water temperature displays **ErrF** (or **ErrC**). If meter is in storage mode and detects an empty pipe, water temperature displays **– – – F** (or **– – – C**). | Alarm clears when pipe is filled | |
| Measurement Error | | Interference of ultrasonic signal. Meter is not measuring properly. Meter continues to operate unless sensors are damaged. | Alarm clears after 35 days unless condition continues | |
| Exceeding Max Flow | ⚠ ✔ | Maximum flow rate exceeded. Meter continues to accumulate consumption outside of specified range. | Alarm clears after 35 days unless condition continues | Meter sends consumption and alarm to the endpoint once per occurrence |
| Reverse Flow | ⬅ | Meter detects reverse water flow (**one (1) gal** residential; **ten (10) gal** commercial), triggers the reverse flow alarm icon on the display and sends alarm message to the endpoint. Also see, *"Continuous Flow Alarm" on page 25*. | Alarm clears after 35 days unless condition continues | Meter detects reverse flow and sends alarm to the endpoint once per occurrence |
| No Usage | 🚱 | Flow rate less than the low flow operating rate for 30 days. | Alarm clears automatically once flow occurs | Meter detects no usage and sends alarm to the endpoint once per occurrence |
| Suspected Leak | 🚰 | Flow rate more than the low flow operating rate for 24 hours. Also see, *"Continuous Flow Alarm" on page 25*. | Alarm clears automatically when flow rate drops below low flow operating rate | Meter detects suspected leak and sends alarm to the endpoint once per occurrence |
| End of Life | 🔋 | Battery nearing end of life. | Alarm is activated after 19 years (14 years for scaled/unscaled dual output meters) and does not clear | Meter sends alarm message to the endpoint once per occurrence |
| Program Alert | NA | Meter has been programmed in last 35 days. | NA | Meter sends alarm message to the endpoint once per occurrence |

*Pressure alarms are available with meters equipped with the integrated pressure sensor.

*When used in conjunction with applicable ORION endpoints, pressure data and alarms are sent as part of the encoder message and surfaced in BEACON SaaS. See *"Endpoints and Software" on page 6* for complete endpoint information.

## Alarm Codes

Alarm codes are shown on the alarm and operating mode screen. See *"Alarm and Operating Mode Screen" on page 17*. Contact Badger Meter *"Technical Support"* for any codes not listed here.

**NOTE:** For alarms reported within BEACON, refer to BEACON Help at *beaconama.net*.

| | | | | | |
|---|---|---|---|---|---|
| **001** | Empty pipe | **010** | Reverse flow | **083** | Empty pipe, Temperature, Measurement error |
| **002** | Temperature | **011** | Empty pipe, Reverse flow | **089** | Empty pipe, No usage, Measurement error |
| **003** | Empty pipe, Temperature | **012** | Temperature, Reverse flow | **0C0** | Program alert, Measurement error |
| **004** | End of life | **013** | Empty pipe, Temperature, Reverse flow | **100** | Pressure |
| **008** | No usage | **018** | No usage, Reverse flow | **101** | Empty pipe, Pressure |
| **009** | Empty pipe, No usage | **020** | Suspected leak | **140** | Program alert, Pressure |
| **00A** | Temperature, No usage | **040** | Program alert | **150** | Reverse flow, Program alert, Pressure |
| **00B** | Empty pipe, Temperature, No usage | **080** | Measurement error | **200** | Exceeding max flow |
| **00C** | End of life, No usage | **081** | Empty pipe, Measurement error | **202** | Temperature, Exceeding max flow |
| **00D** | Empty pipe, End of life, No usage | **082** | Temperature, Measurement error | **204** | End of life, Exceeding max flow |
| | | | | **300** | Pressure, Exceeding max flow |

# SPECIFICATIONS: RESIDENTIAL METERS

| E-Series G2 Ultrasonic Meter Sizes | 5/8 in. | 5/8 x 3/4 in. | 3/4 in. (7-1/2 in.) | 3/4 in. (9 in.) | 1 in. |
|---|---|---|---|---|---|
| **Normal Test Flow Limits** | 0.08…30 gpm (0.02…6.81 m³/hr) | 0.08…30 gpm (0.02…6.81 m³/hr) | 0.1…35 gpm (0.02…7.95 m³/hr) | 0.1…35 gpm (0.02…7.95 m³/hr) | 0.16…62 gpm (0.04…14.08 m³/hr) |
| **Minimum Test Flow Limits** | 0.04 gpm (0.009 m³/hr) | 0.04 gpm (0.009 m³/hr) | 0.04 gpm (0.009 m³/hr) | 0.04 gpm (0.009 m³/hr) | 0.075 gpm (0.017 m³/hr) |
| **Safe Maximum Operating Condition (SMOC)** | 30 gpm (6.81 m³/hr) | 30 gpm (6.81 m³/hr) | 35 gpm (7.95 m³/hr) | 35 gpm (7.95 m³/hr) | 62 gpm (14.08 m³/hr) |
| **Typical Pressure Loss** | TBD | 2.6 psi @ 15 gpm (0.18 bar @ 3.4 m³/hr) | 4.2 psi @ 25 gpm (0.29 bar @ 5.7 m³/hr) | 4.2 psi @ 25 gpm (0.29 bar @ 5.7 m³/hr) | 4.1 psi @ 40 gpm (0.28 bar @ 9.1 m³/hr) |
| **UL Approval for Residential Fire Service Meters - File No. EX15653** | NA | NA | UL 327B | UL 327B | UL 327B |
| **UL Test Flow Limits (at ±1.5% accuracy)** | NA | NA | 2…30 gpm (0.45…6.81 m³/hr) | 2…30 gpm (0.45…6.81 m³/hr) | 2…50 gpm (0.45…11.36 m³/hr) |
| **Typical UL Pressure Loss** | NA | NA | 4.2 psi @ 25 gpm (0.29 bar @ 5.7 m³/hr) | 4.2 psi @ 25 gpm (0.29 bar @ 5.7 m³/hr) | 4.1 psi @ 40 gpm (0.28 bar @ 9.1 m³/hr) |
| **Totalization Display Resolution** | • Gallons: 0.01 | | • Cubic feet: 0.001 | | • Cubic meters: 0.0001 |
| **Operating Performance** | In the normal temperature range of 45…122 °F (7…50 °C), new meter consumption measurement is accurate to: 100% ±1.5% over the normal test flow limits, 100% ±3.0% for the minimum test flow limits | | | | |
| **Storage Temperature** | – 40…140° F (– 40…60° C) | | | | |
| **Maximum Ambient Storage (Storage for One Hour)** | 150° F (66° C) | | | | |
| **Measured Fluid Temperature Range** | 34…140° F (1…60° C) | | | | |
| **Humidity** | 0…100% condensing; meter is capable of operating in fully submerged environments | | | | |
| **Maximum Working Pressure of Meter Housing** | 175 psi (12 bar) | | | | |
| **Maximum Operating Pressure of Pressure Sensor** | 175 psi (12 bar) | | | | |
| **Pressure Sensor Accuracy** | ±2% of full scale pressure, up to 175 psi (12 bar) | | | | |
| **Register Type** | Straight reading, permanently sealed electronic LCD; digits are 0.28 in. (7 mm) high | | | | |
| **Register Display** | • Total consumption (nine digits)<br>• Rate of flow<br>• Temperature<br>• Pressure *(Optional: for meters ordered with integrated pressure sensor)* | | • Alarm and operating mode<br>• Firmware version<br>• Alarm indicators<br>• Unit of measure (factory programmed for gallons, cubic feet and cubic meters) | | |
| **Scaled/Unscaled Output*** | Solid-state relay and Open Collector | | | | |
| Max. Voltage | 30V DC | | | | |
| Current | 10 mA | | | | |
| Pulse Width | 50 ms (programmable 25…100 ms) | | | | |
| **Analog 4-20 mA Output*** | Two-wire/passive flow rate measurement | | | | |
| Input Voltage Range | 9…50V DC supply | | | | |
| Current | 4…20 mA | | | | |
| Max. Load Resistance (Ohms) | (50 Ohms + 50 Ohms) × (Supply Voltage - 9V) | | | | |
| **Battery** | 3.6-volt lithium thionyl chloride; battery is fully encapsulated within the register housing and is not replaceable; 20-year battery life; 15-year battery life for dual output meters | | | | |

*Applicable to meters with dual output options.

# SPECIFICATIONS: COMMERCIAL METERS

| E-Series G2 Ultrasonic Meter Sizes | 3 in. | | 4 in. | | 6 in. | | 8 in. |
|---|---|---|---|---|---|---|---|
| | 3 × 12 in. (76 × 305 mm) | 3 × 17 in. (76 × 432 mm) | 4 × 14 in. (102 × 356 mm) | 4 × 20 in. (102 × 508 mm) | 6 × 18 in. (152 × 457 mm) | 6 × 24 in. (152 × 610 mm) | 8 × 20 in. (203 × 508 mm) |
| Normal Test Flow Limits | 0.75…560 gpm | | 1.5…1100 gpm | | 2.2…2000 gpm | | 4…3500 gpm |
| Minimum Test Flow Limits | 0.37 gpm | | 0.75 gpm | | 1.1 gpm | | 2.0 gpm |
| Safe Maximum Operating Condition (SMOC) | 560 gpm | | 1100 gpm | | 2000 gpm | | 3500 gpm |
| Typical Pressure Loss | 2.6 psi @ 350 gpm | | 2.1 psi @ 630 gpm | | 1.5 psi @ 1400 gpm | 1.8 psi @ 1400 gpm | 2.4 psi @ 2800 gpm |
| Totalization Display Resolution | *3 in. and 4 in. meters*<br>• Gallons: 0.1<br>• Cubic feet: 0.01<br>• Cubic meters: 0.001 | | | | *6 in. and 8 in. meters*<br>• Gallons: 1.0<br>• Cubic feet: 0.1<br>• Cubic meters: 0.01 | | |
| Operating Performance | In normal temperature range of 45…122 °F (7…50 °C), new meter consumption measurement is accurate to: 100% ±1.5% over the normal test flow limits, 100% ±3.0% for the minimum test flow limits | | | | | | |
| Storage Temperature | – 40…140° F (– 40…60° C) | | | | | | |
| Maximum Ambient Storage (Storage for One Hour) | 150° F (66° C) | | | | | | |
| Measured Fluid Temperature Range | 34…140° F (1…60° C) | | | | | | |
| Humidity | 0…100% condensing; meter is capable of operating in fully submerged environments | | | | | | |
| Maximum Working Pressure of Meter Housing | 175 psi (12 bar) | | | | | | |
| Maximum Operating Pressure of Pressure Sensor | 175 psi (12 bar) | | | | | | |
| Pressure Sensor Accuracy | ±2% of full scale pressure, up to 175 psi (12 bar) | | | | | | |
| Register Type | Straight reading, permanently sealed electronic LCD; digits are 0.28 in. (7 mm) high | | | | | | |
| Register Display | • Consumption (up to nine digits)<br>• Rate of flow<br>• Alarms<br>• Pressure | | | • Temperature<br>• Firmware version<br>• Unit of measure factory programmed for gallons, cubic feet and cubic meters | | | |
| Scaled/Unscaled Output* | Solid-state relay with 4-20mA output; open drain MOSFET with encoder output | | | | | | |
| Max. Voltage | 30V DC | | | | | | |
| Current | 100 mA | | | | | | |
| Pulse Width | 50 ms (programmable 25…100 ms) | | | | | | |
| Analog 4-20 mA Output* | Two-wire/passive | | | | | | |
| Input Voltage Range | 9…50V DC supply | | | | | | |
| Current | 4…20 mA | | | | | | |
| Max. Load Resistance (Ohms) | 50 Ohms + 50 Ohms (supply voltage - 9V) | | | | | | |
| Battery | 3.6-volt lithium thionyl chloride battery is fully encapsulated within the register housing and is not replaceable. 20-year battery life; 15-year battery life for dual output meters | | | | | | |

*Applicable to meters with dual output options.

# TROUBLESHOOTING

## Continuous Flow Alarm

If the meter LCD screen displays a *continuous flow alarm* for either forward or reverse flow, follow the troubleshooting steps below. A *continuous flow alarm* can be either a Reverse Flow alarm or Suspected Leak alarm. See *"Meter Alarms" on page 21*.

**NOTE:** Some **reverse flow** may be expected depending on the installation site.

1. Verify the meter is installed correctly per installation instructions in this user manual.

    - If the meter is installed correctly, continue to step 2.

    - If the meter is not installed correctly, then reinstall per instructions in this user manual. See *"Installation" on page 8*.

        a. If the LCD screen stops displaying a continuous flow alarm, then the meter is operating normally. Discontinue this procedure.

        b. If the LCD screen continues to display a continuous flow alarm, then continue to step 2.

2. Turn off the valves upstream and downstream from the meter and verify the main water supply is turned off.

3. View the meter's LCD screen.

    - If the flow rate is zero (0), the meter is operating normally and there is no indication of a leak, discontinue this procedure.

        **NOTE:** The continuous flow alarm may take up to 30 minutes to clear after the water is turned off. It is important to view the actual flow rate on the screen and not just check the alarm icons.

    - If the meter registers flow with the valves closed, then the meter should be removed. Continue to step 4.

4. Follow the instructions for removing the meter in this user manual.

5. During removal, observe if water is flowing out of the upstream pipe.

    - If water is flowing, then the shutoff valve is not actually shutting off the flow.

6. Replace the shutoff valve. Once the valve is replaced, reinstall the meter per instructions in this user manual.

7. Once the meter is reinstalled, turn the shutoff valve off and note the meter reading.

    - If the flow rate is zero (0) with the valve off, the previous flow issue was most likely due to the shutoff valve. Discontinue this procedure.

    - If the meter display shows flow in either direction with the valve turned off, contact Technical Support.

# TECHNICAL SUPPORT

For further assistance, contact Badger Meter Technical Support at 800-616-3837.

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