

Model 50 Meter-Master Flow Sensor

Operating Instructions

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Section One

INTRODUCTION

1.1 About The Meter-Master Model 50

The METER-MASTER MODEL 50 Magnetic Signal Converter is a battery-powered, portable flow monitor that converts a meter's magnetic drive signal to a digital output, which, in turn, is available for input into any standard data logger. It is compatible with almost all water meters, small enough to fit inside any meter box, and easy to set up.

The Model 50 uses a patented sensor to pick up the magnetic pulses generated by a meter's drive magnets. No electrical or mechanical connection or adapter is required for most meters (gear-driven meters, Hersey MHR meters, and Sensus Compound meters require available adapters). The square wave output has four built-in configurations options for maximum logger compatibility and maximum MM50 battery life.

Meter-Master set-up in the field is simple, requiring only velcro straps to secure the sensor in position. Typically, the sensor is placed on the side of the water meter's register with the sensor cable going straight up or down. A small number of meters have different sensor locations (see Section 2.2).

Membrane switches on the MM50 allow sufficient control over the MM50 to turn the MM50 power on and off and to check the sensor's digital output signal and the battery charge status. The front of the MM50 has a receptacle for the digital output cable to the data logger and a receptacle for the sensor cable. Four internal, user-replaceable, 1.5 volt, "AA" batteries power the unit. A total of 6 volts is required.

Meter-Master products are durably built for long, accurate service in accordance with military quality standards. Each unit is manufactured at our factory and shipped ready for operation.

F. S. Brainard & Co. reserves the right to modify its designs at any time in order to supply the best products possible. All instruments are warranted for two years from either the date of purchase or the date of manufacture (see Section 4.2). Maintenance agreements are available following the initial warranty period.

1.2 Output Cable Options

The MM50 has 4 built-in output configuration options based on the wire lead combinations shown in the table below. In all cases, the green wire is ground (common, negative). When two signal wires are indicated, both wires are to be connected to the same signal input of the data logger.

Output Options	Signal Wire(s)	Ground Wire
Internal 5 volt DC pull-up. Minimum MM50 battery life.	Red wire and White wire	Green
External 3–60 volt DC pull-up. Maximum MM50 battery life, maximum 10 milliamp load.	Red wire	Green
5 volt logic (CMOS to CMOS, no pull-up required). Moderate MM50 battery life.	Red/Black wire	Green

If you are unclear which option to choose, the first option will work as long as the logger circuit accepts a 5 volt signal. However, the first option uses the most MM50 battery power. Most loggers are equipped with pull-up capability, which, if used with the MM50, will extend MM50's battery life (but may shorten the logger's battery life if it is not AC powered). If your logger can supply 3 to 60 volts DC for pull-up, you should use the second option to maximize MM50 battery life. If your logger is battery powered and equipped to handle 5 volt logic, the third option may provide the best combined battery life option for the MM50 and data logger.

FloSearch Recorders

If you intend to use the Model 50 with Neptune/Schlumberger's FloSearch™ recorder, a pre-configured cable is available for connecting the MM50 to the FloSearch recorder.

1.3 MM50 Specifications

- **Size:** 7.0" x 4.3" x 1.5" (178mm x 108mm x 38mm).
- **Weight (including batteries):** 1.75 lbs. (.8 kg).
- **Case:** Submersible, ABS/polycarbonate blend.
- **Integral Handle:** May be used to chain unit for security and/or suspend unit above the ground.
- **Stainless Steel Threaded Connectors.**
- **Square Wave Electrical Output:** One digital pulse output for each magnetic pulse input. (Each North-South pole combination generates one pulse.)

- **3 Built-In Output Signal Configurations:** (a) internal 5 volt DC pull-up, (b) external 3 to 60 volt DC pull-up, maximum 10 milliamps load, (c) 5 volt logic (CMOS to CMOS, no pull-up). Configuration is selected according to wire lead combination.
- **Data Logger Connection:** Flying wire with tinned leads. (Customer specified connectors may be factory installed at a reasonable cost.)
- **Internal Power:** 4 user-replaceable, 1.5 volt, “AA” alkaline batteries (requires 6 volts).
- **Battery Operating Life (alkaline):** 6+ months, depending on output configuration.
- **“ON” Button and “OFF” Button.**
- **“SENSOR” Button:** Press and release. LED flashes with each digital pulse output and continues for approximately 64 pulses.
- **“BATTERY” Button:** Press and hold. LED will flash while button is pressed down. Flash speed indicates battery charge status; the faster the flash, the greater the charge.
- **Strap-On Magnetic Sensor:** Fastens to outside of meter with velcro straps provided.

Section Two

OPERATION

2.1 Installation

1. Connect Cables To MM50 And Turn Power On

Connect digital output and sensor cables to MM50. Keyways align the cable connectors with the receptacles; make sure the cables have the rubber nub on top and are seated properly in the receptacle before screwing the connector into place. Press the ON button on the membrane keypad. Before securing the sensor to the meter, you may check the sensor operation by flipping the sensor over and back after pressing the SENSOR button. Because the sensor senses the earth's magnetic field, flipping the sensor over and back creates pulses. *Make sure that the electronics have settled before checking the sensor:* wait 1 minute after attaching the sensor; wait 2 minutes after turning power on.

2. Check Battery Charge

Press the BATTERY button on the membrane keypad and hold it down long enough to view LED flash speed. LED flash speed is proportional to the battery charge: the more rapid the flashes, the greater the charge. When the batteries are fully charged, the LED will flicker rapidly. Fully charged, the batteries should last at least 6 months, depending on the output configuration selected. Change the batteries before the LED flash rate drops to one flash per second (approximately 5.1 volt battery charge level).

3. Attach Sensor To Meter

Attach the MM50 sensor to the meter with the velcro strap(s) provided (tape may also be used). The sensor is typically placed on a side of the meter register that is not over the pipe; however, the best location varies, especially for large meters. When placed on the side of the register, the sensor cable should extend either straight down or up. For more detailed information on positioning the sensor, see the section entitled, "Pointers for Positing the Sensor", and Appendix A.

4. Check Sensor Location

Check the sensor location by pressing the SENSOR button. Before pushing the button, make sure you have allowed time for the electronics to settle: if you just moved the sensor, wait 10 seconds; if you just attached the sensor cable to the MM50, wait 1 minute; if you just turned the MM50 on, wait 2 minutes. After the button is pressed, the light will flash in relationship to the amount of water passing through the meter; each flash indicates one magnetic pulse. Each pulse equals one North-South pole combination. Accordingly, each revolution of a 2-pole magnet will

create one pulse, and each revolution of a 4-pole magnet will create two pulses. If the sensor signal does not flash regularly or in proportion to the flow rate, try the sensor in other locations. For more information, see the section entitled, "Pointers for Positioning the Sensor".

5. Attach MM50 To Data Logger

The MM50 wires (green = negative/common/ground) must be attached to the data logger either directly (screw or clip connection) or after being installed into a connector. See Section 1.2 for an explanation of the output cable configuration options.

2.2 Pointers For Positioning The Sensor

BEFORE YOU BEGIN

The METER-MASTER senses the magnetic pulses generated by the magnets which couple the register of a water meter to the meter body. An adapter for gear-driven meters is available as an accessory.

Know your meters

Attaching the MM50 sensor is straightforward for most meters, especially positive displacement meters. However, it is strongly recommended that, before taking the MM50 out into the field, you bench-test the MM50 on samples of the meter makes, models, and sizes from which you plan to gather data. Appendix A describes the suggested sensor locations for almost all meters used in the U.S. Use your meter test-bench to experiment with different sensor locations. The "sweet spot" on some meters is larger than on others. By experimenting on your meter test-bench, you may avoid searching for an alternative sensor location under less favorable conditions in the field. You may also use this initial experimentation period to familiarize yourself with the MM50 operation.

Testing the sensor by itself

Even without water flowing, you can create magnetic pulses by flipping the sensor over and back again continuously with your hand which causes the MM50 to sense the earth's magnetic field.

Special adapters

Sensus SRH and SRM compound meters require the Sensus Compound Adapter. This adapter may also be used with Kent (U.S. models) and Schlumberger/Neptune turbine meters to increase the resolution of the recorded data from these meters by a factor of 12, which is significant when identifying and defining leakage rates.

In Appendix A, some Hersey turbine meters have been noted as requiring a modified gear train in order to attain compatibility with the MM50. These gear trains are available as accessories.

POSITIONING THE SENSOR

Appendix A describes the location of the sensor for almost all meters used in the U.S. and can be used as a guide for other meters with similar construction (meters with “similar construction” have their drive magnets in similar locations). Refer to the pictorial representations of the suggested sensor locations located at the end of Appendix A.

In general, the four most important points in positioning the sensor are:

Sensor
attachment

1. Position Sensor At Meter’s Sweet Spot.

- **Positive Displacement Meters:** Place the sensor on a side of the meter register that is not over the pipe, unless otherwise indicated in Appendix A and the sensor location diagrams in this manual.
- **Turbine Meters:** Check the sensor location diagrams in this manual for a meter of similar construction to the current one and try the indicated location first. If that location proves unsatisfactory, try other locations. Move the sensor to the other side of the meter, place the sensor flat on top of the register, etc. When you move the sensor, remember to wait ten seconds to allow the electronics to settle before initiating a sensor test.
- **Shielded Registers:** If no signal is detected when the sensor is placed on the side of the register because of shielding on the side of the register, place the sensor flat on top of the register. Note that when the sensor is placed flat on top of the register, a 4-pole magnet will typically generate a 2-pole signal (half as many pulses).
- **Drive Magnets Integral To Turbine Rotor:** If the meter’s drive magnet is integral to the turbine rotor (e.g., Sensus Turbo), place the sensor on the side of the meter body with the cable extending in a *horizontal* direction. (See sensor location diagrams.)
- **Compound Meters With Two Registers:** Position the sensors on the sides of both registers such that the sensors are physically located as far away from the other register as possible. In the case of a Schlumberger/Neptune TRU/FLO compound, place the sensor on the PD (small) side and flat on top of the register.
- **Insulated Meters:** Because it is not necessary for the MM20 sensor to make direct contact with the meter housing, it may not be necessary to remove insulation when it covers a meter. Test the sensor pick-up from the outside of the insulation before removing any meter insulation.

2. Do Not Cock Sensor Or Sensor Cable.

The sensor itself should be positioned flat against the meter casing or register with the velcro on the outside, away from the meter. It is not necessary for the sensor to touch the meter. If the sensor is on the side of the register, position the sensor such that the sensor cable extends straight up or straight down toward the ground. If the sensor is on the side of the meter body (Sensus Turbos, Hersey MHR 2”-3”, and Badger Recordall Compounds—turbine side), position the sensor such that the cable extends in a horizontal direction.

3. Secure The Sensor As Tightly As Possible.

Velcro straps come with the Meter-Master. The straps will stretch slightly over time, so test each attachment to ensure that the sensor will resist any effort to move it. The velcro is provided in 2 lengths which may be secured together to create one extended length. If desired, tape can also be used to keep the sensor in place.

4. Wait For The Electronics To Settle Before Checking The Pulse Rate.

If you have just moved the sensor, attached the sensor cable, or turned on the power to the MM20, make sure you have allowed sufficient time for the electronics to settle before checking the sensor location. The circuit takes 10 seconds to stabilize when the sensor is moved, 1 minute when the sensor is connected, and 2 minutes when power is initially applied to the MM20.

UNDERSTANDING THE SENSOR LED SIGNAL

The sensor LED flashes once for every pulse picked up by the sensor. The flash rate is thus proportional to the flow rate.

The internal magnet and gearing configurations vary from one meter manufacturer to the next, and some magnets spin much faster than others. Accordingly, the same size meters from different manufacturers rarely generate the same number of magnetic pulses per unit of liquid measure. Moreover, some meters have 4-pole magnets, which generate 2 pulses per magnet revolution, and others have 2-pole magnets, which generate 1 pulse per magnet revolution. However, note that the sensor typically detects a 2-pole signal from a 4-pole magnet when the sensor is placed flat on top of the register. A 2-pole magnet will always generate a 2-pole signal.

Positive displacement meters should always provide a high frequency output signal as long as there is water flowing and the equipment is working properly. Turbine meters vary greatly in pulse frequency. In order to correlate the digital output with the flow rate of large meters, it is strongly recommended that you contact a meter manufacturer for information about magnet revolutions per unit of liquid measure as well as the number of poles on the magnet. Alternatively, contact us for meter pulse factors for individual meters.

ELECTROMAGNETIC INTERFERENCE (EMI)

Place the sensor farthest from and aim the sensor away from any nearby equipment which may generate electromagnetic interference (EMI). Typical examples are motors, burglar alarms, and generators. Because the MM60 is designed to pick up the magnetic signal generated by a water meter, you may encounter a circumstance in which the location of the meter is so close to other electromagnetic sources that the light flashes extremely quickly or stays solid when no flow is occurring. Unless you can deactivate or shield the source of EMI, an accurate record may not be possible.

2.3 Replacing The Batteries

The batteries should last at least 6 months, depending on the output configuration. With new batteries, the BATTERY button LED flickers rapidly. Replace the batteries before the LED flashes are spaced one second apart.

TO CHANGE THE BATTERIES:

1. Remove The 6 Screws On The Back Of The Case

2. Carefully Remove The Back Cover

Make sure not to damage the O-ring.

3. Replace The Batteries

The MM50 uses four standard 1.5 volt “AA” batteries.

4. Make Sure The O-Ring Is Clean And Properly Seated

Important

Make sure that the O-ring is very clean and that the groove in which the O-ring is located is also very clean prior to reassembling the instrument. This is essential for the unit to operate properly while submersed.

5. Replace Cover And 6 Screws

Section Three

TROUBLESHOOTING

3.1 List Of Topics

GENERAL

- (1) Insulated Meter
- (2) No Response To BATTERY Button Press
- (3) Sensor Does Not Seem To Be Working

SENSOR TEST

- (1) No Sensor LED Signal At All
- (2) Sensor LED Signal Is On Solid
- (3) Sensor LED Flashes Erratically
- (4) Sensor LED Flashes Regularly But Not At The Expected Rate

NOTES ON SPECIFIC METERS

- (1) Dual Register Compound Meters
- (2) Compound & Turbine Meters With Change Gears
- (3) Sensus (Rockwell): SR; Turbo (W-3500, W-5500); Compound (SRH, SRM)
- (4) Schlumberger (Neptune): T-8 & T-10 (5/8", 3/4", 1"); Turbine; TRU/FLO
- (5) Badger: Recordall Turbo; RCDL-Turbo (older version)
- (6) Hersey: MHR (4"-10"); MVR; MCT & MFM
- (7) ABB (Kent): Turbine
- (8) Precision: All Models
- (9) Water Specialties: ML & TM
- (10) Master Meter: All Models

3.2 Recommended Action

GENERAL

- (1) **Insulated Meter**
 - Sensor does not need to be touching meter and can be located on outside of insulation if distance from magnets does not result in too weak a signal.
- (2) **No Response To BATTERY Button Press**
 - Make sure MM50 is on by pressing ON button.
 - Note if there is any battery power at all by pressing SENSOR button and flipping sensor with hand to create pulses from earth's magnetic field. Even after battery LED stops responding, there is usually enough charge left in batteries to operate the sensor in this manner for a short time. Before pressing the SENSOR button, make sure you have allowed sufficient time for the electronics to settle: at least 1 minute after attaching the sensor cable, and at least 2 minutes after turning the power on.
 - Batteries may be discharged. (To change batteries, see Section 2.3).
 - If still no response after battery replacement; return unit to factory (call first for RMA#).
- (3) **Sensor Does Not Seem To Be Working**
 - Make sure MM50 is on and battery power is adequate by pressing BATTERY button.
 - Check sensor cable connection to MM50. There should be no bent pins, and the plug should thread all the way into receptacle. If connection appears okay:
 - Press SENSOR button and repeatedly turn sensor over and back again (flip like a pancake) to cause sensing of earth's magnetic field. Flipping sensor over and back will create pulses.
 - Alternatively, attach sensor to a PD meter with active flow and check sensor operation.

SENSOR TEST

- (4) **No Sensor LED Signal At All**
 - Make sure MM50 is on and battery power is adequate by pressing BATTERY button.
 - Make sure that there is adequate flow to cause flashes.
 - Make sure sensor is in correct location for current meter.
 - Make sure sensor is working (see above).
- (5) **Sensor LED Signal Is On Solid**

- Normal for many PD meters and some turbines at medium and high flow rates.
- May indicate an electromagnetic noise interference area. To test for magnetic interference, remove the sensor from the meter and check the signal in various locations around the meter (wait 10 seconds before initiating a test). Check for switching equipment, transformers, motors, alarm systems, generators, etc. in close proximity. If you determine that there is magnetic interference, try moving the sensor to the side of the meter away from the noise source; try aiming the sensor in a slightly different direction. Test may not be possible at this location.

(6) Sensor LED Flashes Erratically

- When you move the sensor, make sure you wait ten seconds to allow the electronics to settle before initiating a sensor test.
- The pulses may not be evenly spaced around the dial; however, each dial revolution should provide the correct number of flashes.
- Make sure sensor is properly positioned for meter and not cocked (see Section 2.2 and Appendix A). When the sensor is not cocked, the sensor cable will extend straight down or straight up (or horizontally for some turbine meters).
- With some turbine meters, the sensor may pick up an irregular pulse count because the register magnet is not coupling smoothly with the drive magnet. This condition is indicated by excessive LED flashes or flashes of longer than usual duration. If this occurs, move the sensor away from the magnetic coupling area, e.g., slide the sensor further up the register if Appendix A indicates a register location.
- Try the sensor in other locations until the signal becomes regular.

(7) Sensor LED Flashes Regularly But Not At The Expected Rate

(E.g., two of the same type of meter give a different pulse rate per equal register volumes.)

- Meters with change gears may have discrepancies of as much as 15%.
- On certain meters, the MM50 may sense either a 2-pole or a 4-pole signal, depending on variations in the manufacture of the meters themselves (2-pole vs. 4-pole magnet) or on sensor location. Data is accurate.
- In some cases, the meter's own magnetic coupling may not be smooth causing a phase differential and additional (false) pulses. Find a better sensor location by sliding sensor away from area where magnets couple.
- If LED is flashing more than 3 times too quickly, there may be electromagnetic interference. Check for switching equipment, transformers, motors, alarm systems, generators, etc. in close proximity. Try moving sensor to side of meter away from noise source. Test may not be possible at this location.
- The signal may simply be weak where the sensor is located due to peculiar magnet characteristics, location of magnets within the meter, or shielding material in the meter. Try the sensor in other locations.

NOTES ON SPECIFIC METERS (SEE ALSO APPENDIX A)

In general, PD meters are easy; some turbine meters require special attention.

(8) Dual Register Compound Meters

- Position the sensors on the sides of both registers such that the sensors are physically located as far away from the other register as possible. See special instructions for Neptune/Schlumberger TRU/FLO compound below.

(9) Compound & Turbine Meters With Change Gears

- Some large meters (e.g., Neptune Trident turbine and Hersey MCT, MFM, MCTII, MFMII, and MHR) use change gears for calibration. Various change gear combinations will cause variations (typically less than 15%) in the volume per pulse.

(10) Sensus (Rockwell)

- *SR*: If the sensor pick-up appears weak, place the sensor directly on top of the register.
- *Turbo (W-3500, W-5500)*: Accurate positioning of sensor is more critical than with smaller Sensus turbos due to distance from magnets.
- *Compound (SRH, SRM)*: Sensus Compound Adapter required. Call your sales representative.

(11) Schlumberger (Neptune)

- *T-8 & T-10 (5/8", 3/4", 1"; including TRU/FLO PD side)*. Place the sensor flat on top of the register. In the case of small Neptune meters, a sensor located close to the same plane as the meter's magnetic coupling area will frequently generate half as many pulses (2-pole signal) as a sensor placed toward the top of the register (4-pole signal); moreover, a 4-pole signal can convert to a 2-pole signal during high flow periods. The sensor position on top of the register assures a reliable 2-pole signal at all flow rates.
- *Turbine (including TRU/FLO & Protectus)*: Because the magnets sometimes do not couple smoothly in these meters, the slight phase differential may create additional (false) pulses. If too many flashes are seen or flashes are long in duration, move the sensor further up the register for a cleaner signal. The phase differential can cause as much as a 300% error. The Sensus Compound Adapter may be used to increase the pulse frequency and resultant data resolution by a factor of 12. For example, without the Sensus Compound Adapter, each pulse generated by a 6" Trident turbine equals 43.1 U.S. gallons; with the adapter, each pulse equals 3.6 U.S. gallons.
- *TRU/FLO*: Because the registers are close together on a TRU/FLO meter, it is possible for the magnetic field generated by one register to interfere with the signal generated by the other. Should you experience this problem, you can locate a spacer (wood, plastic, etc.) between sensor(s) and register(s) to increase physical separation.

(12) Badger

- *Recordall Turbo (current version)*: Some sensor locations on the side of the register may provide a better signal than others.
- *RCDL-Turbo (older version)*: If it is a large turbine, readings may be difficult due to size and location of magnet in the rotor.

(13) Hersey

- *MHR (4"-10")*: Modified gear train is required. Call your sales representative. (Gear train part numbers: P/N B0600 for 4" and 8"; P/N B0610 for 6"; P/N B0620 for 10".)
- *MVR*: Some sensor locations on/beside the register may provide a better signal than others.
- *MCT & MFM (Mag 1)*: A minority of MCT and MFM turbine meters require a modified gear train (P/N B3100) for pickup due to location and size of magnet. MCTII & MFMII (Mag 2) never require a modified gear train. Some Mag 1 meters use 2-pole magnets and some use 4-pole magnets.

(14) ABB (Kent)

- *Turbine*: Because these turbines typically do not have gears in the register (direct drive), two pulses are expected per dial revolution (4-pole magnet). Because of the large registers (U.S. version), slow magnet speed, and poor pulse resolution, it is sometimes difficult to verify that the MM50 is recording accurately. If the meter does have gears in the register, the LED will flash significantly more than twice per revolution (e.g., 20 times). It is highly recommended that the Sensus Compound Adapter be used with Kent turbines (U.S. version) in order to enhance the data resolution by a factor of 12.

(15) Precision

- *All Models*: There is a magnetic shield on the side of some registers. The sensor may have to be located flat on top of the register.

(16) Water Specialties

- *ML & TM*: According to the manufacturer, meters with rate-of-flow indicators as registers require the addition of a magnet on the gear-drive vertical shaft. Do not use the indicator drive magnet because it will not be accurate.

(17) Master Meter

- *All Models*: Because the magnet is very small in all Master Meter models, the Meter-Master must be modified to the high-sensitivity version. In all cases, center the sensor flat on top of the register.

Section Four

SERVICE AND SUPPORT

4.1 Customer Service

Should you experience any problems with your Meter-Master product, fax or call our Customer Service Department between 8 A.M. and 5 P.M. (Eastern U.S. Time). Phone and fax numbers are shown on the front page of these instructions. Explain the problem, and we may be able to solve it on the telephone or via fax. If not, we will provide a Return Material Authorization Number (RMA#). Be sure to include: a packing slip with the RMA#, the serial number of the unit, a description of the problem, and a contact person including phone number and address. Pack the equipment in a solid cardboard box secured with adequate packing material. Ship prepaid and insured to the address shown on the cover of this manual.

4.2 Two Year Limited Warranty

F. S. Brainard & Co. (FSBCO) warrants to the original consumer purchaser that this Meter-Master product shall be free from defects in materials and workmanship for a period of two years from either the date of purchase, provided a proof-of-purchase is presented, or alternatively, if proof-of-purchase is not presented, the date of manufacture. During the two year warranty period, liability shall be limited to replacing or repairing, at FSBCO's option, any defective product. Product which has been subjected to abuse, misuse, accident, alteration, neglect, unauthorized repair or installation is not covered by this warranty. FSBCO shall have the right of final determination as to the existence and cause of defect. As to product repaired or replaced, the warranty shall continue in effect for the remainder of the warranty period, or for ninety (90) days following date of shipment by FSBCO of the repaired or replaced product, whichever period is longer.

No liability is assumed for expendable items such as batteries. No warranty is made with respect to custom equipment or products produced to buyer's specification, except as specifically stated in writing by FSBCO and contained in the contract. FSBCO liability arising out of its warranty shall be limited to a refund of the purchase price. In no event shall FSBCO be liable for costs of procurement of substitute products or services, loss of profits, or for any consequential, incidental, indirect, and/or other damages of any kind however caused and on any theory of liability, arising out of this warranty. Other products, not manufactured by FSBCO but distributed by FSBCO, such as computers, software, and accessories, are offered as third party products. As such, these products are not warranted by FSBCO. Requests for warranty or nonwarranty repairs of third party

products should be addressed directly to the manufacturers of such products. Should your FSBCO product require nonwarranty repair, please contact FSBCO for available repair information.

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