Flexible Probe Radar Monitor
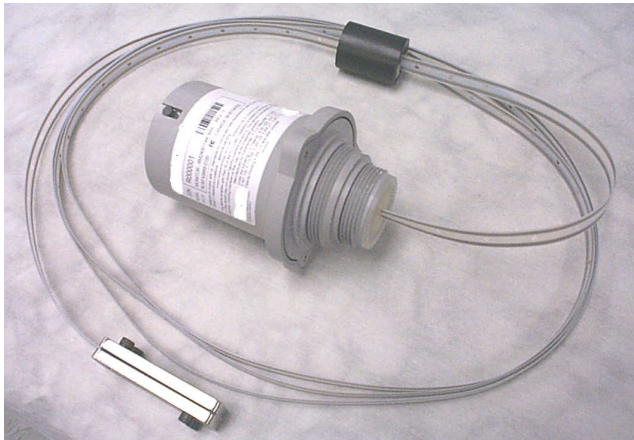# Instruction Manual

Model: G4RM Series

Document # 040070C0001

Revision B

Dated 10/06/2014

Table of Contents

1.0   Introduction

This manual describes how to install, test, and service the Flexible Probe Radar Level Monitor. The Radar Monitor is part of a Level Monitoring System that includes the Data Collection System and Gateway(s).

This guide does not describe how to install, test, maintain or troubleshoot the Gateway or Data Collection System. Refer to these products' respective instruction manuals.

The description herein is based on a standard installation.

2.0 Product Overview

2.1   Description

This Monitor detects level, temperature within the Monitor housing, battery condition, and error codes and broadcasts this information to the system's Gateway.

The Monitor is calibrated and pre-programmed at the factory with the Serial Number and Transmission Frequency. No field programming of the Monitor is required, but the Monitor can be configured by the Data Collection website.

2.2   Operation

The Radar Monitor consists of a sealed housing with external pipe threads which installs in a 1 ½" or 2" National Pipe Thread (NPT) bung. The housing protects the Monitor's electronic circuitry and supports the long flexible probe that extends down into the tank. The Radar Monitor measures liquid level by detecting the vertical position of a float that rides on the probe at the top of the liquid.   The Monitor's electronic circuitry measures the time that it takes for an electromagnetic pulse to travel to the float and back to the Monitor. Travel time for the electromagnetic pulse is proportional to distance, allowing the Monitor to calculate fluid level. This level information is transmitted to the Gateway using a radio signal. Level information transmitted by the Monitor is in tenths of an inch measured from the level output reference line on the Monitor lower housing to the surface of the fluid.

The Monitor is powered by two replaceable batteries. The battery life of the Monitor depends on how frequently the Monitor is scheduled to transmit.

2.3   Environmental Specifications

The following environmental specifications should be observed when installing the Monitor:

- Operating Temperature Range: -40°C to +80°C (-40°F to +176°F)
- The Monitor housing is designed to meet or exceed NEMA 4X/6P.
- UV life: 10 years exposure to direct sunlight.
- Shock: The unit will withstand a one-meter drop test per UL 913.
- Chemical Exposure: The Radar Monitor is designed for use in water, ethylene glycol, oil, and common hydrocarbon fuels such as gasoline, gasoline / ethanol blends, fuel oil, and diesel fuel. Wetted materials in this design include polypropylene, 316 series stainless steel, Nitrile rubber, brass, and FEP Teflon. For applications involving fluids other than those noted above contact your distributor before installation.
- Pressure: The Radar Monitor is designed for use on vented storage tanks only. The maximum pressure inside the tank must not exceed 5 PSI.

2.4   Certifications

2.4.1   FCC Notice—Radio Frequency Communications

The Monitor generates and uses radio frequency energy. If not installed and used in accordance with the manufacturer's instructions, it may cause interference to radio and television reception. The Monitor complies with the specifications in Part 15 of the FCC Rules for Class B Computing Devices.

CAUTION: Do not make field changes or modifications to any of the Level Monitoring System equipment unless they are specifically covered in this manual. All adjustments must be made at the factory under the specific guidelines set forth in the manufacturing processes. Any modification to the equipment will void the manufacturer's warranty and could void the user's authority to operate the equipment and render the equipment in violation of FCC Part 15, Subpart C, 15.247.

CAUTION: This device is required to comply with FCC RF exposure requirements for mobile transmitting devices. The FCC requires that the antenna(s) used for this transmitter must be installed to provide a separation of at least 20 cm (8 inches) from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

2.4.2   Safety and Regulatory

The Monitor is designed to comply with UL Standards for Intrinsically Safe Apparatus for use in Class I, Division 1, Group D locations. The Monitor conforms to UL 913 and has been certified to CAN/CSA Standard C22.2 No. 157 and Standard C22.2 No. 94.

WARNING: SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY.

AVERTISSEMENT: LA SUBSTITUTION DE COMPOSANTS PEUT COMPROMETTRE LA SÉCURITÉ INTRINSÈQUE.

3.0   Installation

A Quick Installation Guide, which provides an overview of the Radar Monitor installation procedure, was included with this product.

The following sections of this manual explain in detail the site selection and installation process:

3.1   Radio Installation Guidelines

The Radar Monitor contains sensitive measurement circuitry and a radio transmitter. Large metal objects such as buildings and vehicles may affect the transmission of radio signals. Electrical equipment may produce electronic noise that could adversely affect signal quality.

- Direct line of sight between the Monitor and Gateway will provide optimum radio reception.

- The Monitor and Gateway can communicate at distances up to one mile under optimum line-of-sight conditions.

- When obstructions such as walls, buildings, and vehicles exist between the Monitor and Gateway the distance between these units should be minimized.

- Multiple obstructions (such as two or more walls or a tank and a wall) between the Monitor and Gateway should be avoided, if possible.

- Electrically conductive objects such as metal buildings, concrete reinforcement rods, tanks, silos, and vehicles reflect radio signals. This reflection can be either an advantage or disadvantage to good radio reception at a particular installation site:

    1. Metal objects between the Monitor and Gateway may reflect and scatter RF energy and reduce radio signal strength at the Gateway.

2. Metal objects behind the Monitor or Gateway may increase the radio signal strength at the Gateway by reflecting radio signals toward the Gateway.

- Even small metal objects such as tank vents or toolboxes between the Monitor and Gateway can significantly reduce radio signal strength if they are within a few feet of the Monitor or Gateway. These objects can reflect radio signals and cause a RF "shadow" which may prevent radio signals from reaching the Gateway.

- Objects which are not electrically conductive such as wooden or fiberglass buildings, non-reinforced masonry, trees, plastic, and glass have less effect on radio signals than metal objects.

- Windows and wooden doors can provide radio signals access into otherwise closed metal buildings. However, "low-E" window glass may have a thin metallic coating that can reflect radio signals.

- Strong electromagnetic fields such as those found in close proximity to power lines, large electric motors, generators, electric fences, and transmitter antennas may interfere with the radio signals received by the Gateway.

- The Gateway should be mounted as high as is reasonably possible to improve its ability to receive radio signals. For example, placing the Gateway on a high shelf would be preferable to setting the unit on a floor near ground level. Installing the Gateway on the second floor of a two-story structure would be more desirable than installing it on the ground floor. Installing the Gateway in an underground basement should be avoided.

    Warning: For maximum Monitor reception, mount the Monitor as close as possible to the Gateway, avoid mounting Monitor inside a fully closed metal building, and avoid close proximity to large electrical equipment. Do not paint the Monitor or Gateway housings.

3.2   Handling Guidelines

The Radar Monitor is designed to provide many years of reliable service in demanding outdoor environments. However, the Monitor contains sensitive measurement circuitry and should be handled carefully. Do not throw or drop the Monitor. Do not pull on the probe cable. Do not kink or twist the probe cable. Do not attempt to disassemble the Monitor except as described in section 5.1 (Battery Replacement).

When removing the Monitor for storage or shipment insert the disable magnet securely in the magnet slot. Clean the probe, float, and anchor with a damp cloth. Secure the probe cable in a flat coil and pack the Monitor in a protective container.

3.3   Mounting

After the Gateway has been successfully setup, the Monitor can be mounted to the tank by following these instructions:

Warning: If the tank contains flammable liquid or vapor, extinguish all flames and smoking material before performing the Monitor installation procedure.

- Remove the Monitor from its protective packaging. Along with the Monitor, there will be two O-rings in the package, one 1.5" and the other 2" in diameter.
- Select a permanent mounting location on the top of the tank that will allow the Radar Monitor cable to hang vertically inside the tank. Verify that there is adequate clearance to prevent the float, cable, or anchor from contacting obstructions such as walls, baffles, reinforcements, and other measurement equipment inside the tank. There should be at least two inches of clearance between the probe cable and any obstructions. Remove all materials from the desired bung.
- The Monitor may be installed in a vertical standpipe if necessary. However, the standpipe must have an inside diameter of at least two inches and its length should be minimized. If the Radar Monitor is to be installed in a standpipe that is more than 6" tall, clip and remove the positive stop (wire tie) that is inserted through the probe cable about 4" below the Monitor housing. Verify that the standpipe is vertical and that the probe cable and float will not contact the sides of the pipe. If the probe cable touches the inside of a standpipe at any point because the pipe is not vertical, a Probe Centering Kit (P/N 086655A0001) should be installed.
- Measure from the top of the tank bung to the inside bottom surface of the tank. Install the float and anchor on the probe cable. Carefully slide the anchor up the cable so that it will be positioned approximately two inches above the inside bottom surface of the tank when the Monitor is installed. Tighten the cable anchor screws to approximately 10 in. lb torque and cut off any excess cable flush with the bottom of the anchor. The cable and anchor must not touch the bottom of the tank when the Monitor is installed.
- Determine the appropriate mounting O-ring to use based on the size of the tank opening. Slip the O-ring over the probe end of the Monitor and slide it past the lip at the base of the lower housing threads. Press along the O-ring circumference until it is snug.
- Lower the anchor, probe, and float into the tank while being extremely careful not to nick the cable insulation on the tank threads. Verify that no twists or kinks are allowed to remain in the cable. Imperfections in the cable such as these must be straightened by hand as the cable is lowered into the tank.
- Carefully screw the Monitor into the tank opening by hand tightening it 1/8 turn clockwise past engaging the O-ring. Assembly requires only a snug fit. Do not over-tighten.
- When installation is complete the probe cable should hang straight and vertical in the tank. The float should rest on the liquid surface and move freely on the cable.

Note: For maximum Monitor performance, adjust the tank so that the top mounting surface of the tank opening is level to within +/- 5 degrees. A bubble level may be used for this task.

Repeat these steps for additional Monitors.

3.4   Activation

After Monitor mounting, follow these steps to activate the unit(s):

- To activate the Monitor, pull the disable magnet completely out of the top of the Monitor housing. This will activate the Monitor to make measurements and burst transmissions on a factory-programmed interval.

  Note: Do not discard the magnet completely—keep it accessible for future use if needed. Do not store the magnet in the Monitor upper housing slot since this will de-activate the Monitor.

- When the disable magnet is removed from the upper housing slot the Monitor will immediately make a level measurement and transmit this information. The Gateway will flicker the green "Monitor" LED each time it successfully receives a Monitor transmission. After this initial activation routine the Monitor reverts to its factory programmed transmission interval.

Note: The installer can verify radio reception at the Gateway by watching the "Monitor" LED during the Monitor's activation sequence.

To activate multiple Monitors, repeat these steps.

4.0 Troubleshooting and Testing

This section contains procedures for testing the Radar Monitor and provides information for troubleshooting the Monitor installation.

4.1 Troubleshooting

If the Monitor is not operating properly, try to locate the solution below:

Question	Solution
Has the Monitor ever reported into the Data Collection System?	If Never: Verify that the Gateway is properly installed. Refer to the Gateway Instruction

Question	Solution
	Manual for installation verification. Perform the Monitor test in Section 4.2 with the Monitor installed. If this test is unsuccessful, perform the same test with the Monitor near the Gateway installation location. If successful only at bench testing, re-evaluate the installation site for RF interference problems and refer to Section 5.5 for technical support. If not successful at either test, continue with troubleshooting. Replace the battery by following Section 5.1 and repeat the above tests. If still having problems, refer to Section 5.5 for technical support.
Does the Monitor occasionally miss scheduled report times	If Yes: The most likely cause is RF interference problems. Re-evaluate the installation site per Section 3.1 for RF interference problems and refer to Section 5.5 for technical support.
Does the Monitor ever report a low battery status?	If Yes: Replace both batteries by following Section 5.1 and repeat the above tests. If still having problems, refer to Section 5.5 for technical support.
Does the Monitor ever report error codes?	If Yes, find the error code below: Code ER00: Indicates an EEPROM memory failure Code ER01: Indicates a RAM memory failure Code ER04: Indicates that the Monitor did

Question	Solution
	not receive a return pulse within the expected amount of time
	Code ER05: Indicates that the measured distance to the liquid surface is greater than the stored probe length
	Record the code number that is reported and refer to Section 5.5 for technical support.
Does the Monitor report significantly more or less liquid than is actually present in the tank?	If Yes: Obstructions in the tank such as baffles, reinforcing rods, other level sensors, pipes, etc. can cause the Monitor to report a false level. Obstructions can cause the float to become stuck or can cause erroneous radar reflections. Verify that the float is freely riding on the liquid surface and that the probe cable is clean, straight, and not touching any objects in the tank. If necessary, carefully clean the cable with a damp rag and straighten any kinks or twists in the cable. *Warning: Do not pull on the probe cable.*

4.2   Monitor Test

The Monitor is designed to wake up, take a measurement, and transmit RF data every time that it is activated. The Monitor is activated by inserting and then removing the disable magnet. At the same time that the Monitor transmits its RF data, the Gateway will acknowledge receipt of the transmission by blinking the green "Monitor" LED. If the Gateway has never received data from this particular Monitor (this is the case during initial installation or after the Gateway has been reset), it will then initiate a call to the Data Collection System to report a "new Monitor" and request configuration data. With this in mind, use the following steps to verify installation and troubleshoot system communication problems.

1.   Insert the disable magnet into the slot of the Monitor's upper housing until snug.

2.   Activate the Monitor by completely removing the disable magnet from the upper housing. The Monitor will immediately make one transmission.

3.   Verify that the Gateway successfully receives RF transmissions from the Monitor by watching the green "Monitor" LED flicker.

Repeat the above test as necessary, using the guidance of Section 4.0 to determine the cause of communication problems.

5.0 Servicing

5.1   Battery Replacement

If it becomes necessary to replace both batteries in the Monitor, follow these steps:

WARNING: TO PREVENT IGNITION OF A HAZARDOUS ATMOSPHERE, THE BATTERY MUST ONLY BE CHANGED IN AN AREA KNOWN TO BE NONHAZARDOUS.

AVERTISSEMENT: AFIN DE PRÉVENIR L'INFLAMMATION D'ATMOSPHÈRES DANGEREUSES, NE CHANGER LE BATTERIE QUE DANS DES EMPLACEMENTS DÉSIGNÉS NON-DANGEREUX.

Caution: When performing this procedure be extremely careful not to disturb the two wires that connect the probe to the circuit board.

Warning: Use Duracell DL123A batteries (quantity 2) only.

Warning: If the tank contains flammable liquid or vapor, extinguish all flames and smoking material before performing the battery replacement procedure.

1.   Carefully remove Monitor from the tank by reversing the mounting procedure (see section 3.3 of this manual). Transport the monitor out of the hazardous area before proceeding with the battery replacement procedure.

2.   Ground yourself by either wearing an anti-static wrist strap or by touching a grounded metal object (such as a copper water pipe).

3.   Remove the Monitor's upper housing by removing the 3 Phillips head screws and carefully lifting the upper housing off of the lower housing.

4.   Avoid contact with circuit board components, if possible. Hands should be clean and dry. Handle circuit board only by the edges.

5. Cut and discard the wire tie that secures the old batteries.

6. Remove **BOTH** old batteries.

7. Insert a new battery in BT2 holder (observing polarity markings molded into the battery holder).

8. Insert a new battery in BT1 holder (observing polarity markings molded into the battery holder).

9. Carefully install a new wire tie through the circuit board slots and secure it around the battery. Trim the free end of the wire tie leaving at least ¼" of un-trimmed material.

10. Ensure that the housing O-ring is properly positioned on the lower housing O-ring shelf. For a good seal, the O-ring must be intact and properly placed, and the lid must be fully sealed.

11. Firmly reinstall the Monitor's upper housing.

    Note: The mounting screws are not evenly spaced around the upper housing in order to ensure that the housing will only fit in the proper orientation.

12. Using a Phillips screwdriver, gently tighten the 3 screws on the Monitor housing to 10+/- 2 inch pounds. Do not over tighten.

13. Reinstall the Monitor on the tank (refer to section 3.3 of this manual).

14. Follow the battery manufacturer's safety and disposal guidelines.

5.2   Warranty

Please refer to the Warranty section of the General Terms and Conditions of Sale provided with order confirmation.

5.3   Unit Disposal

The plastic parts of the Monitor housing are marked for recycling purposes. An approved battery recycling center must dispose of the batteries.

5.4   Service Parts List

Part Number	Description	Quantity
039912A0001	Upper Housing Screw	3
039911A0001	Battery	2
496KA003-04	Wire Tie (To Retain Battery)	1
086607A0001	Disable Magnet Assembly	1
036240N0039	Upper Housing O-ring	1
036240N0229	2" Mounting O-Ring	1
036240N0225	1 ½" Mounting O-Ring	1
086655A0001	Probe Centering Block Kit	1

5.5   Service and Technical Support

For service and technical support, contact your Distributor using the phone number provided on the Monitor or Gateway label.