

GW704 GUIDED WAVE RADAR

INSTALLATION AND OPERATIONS MANUAL

Guided Wave Radar Level Transmitter



SOLUTIONS WITH INNOVATION

AN INNOVATIVE SENSING COMPANY

ISO 9001:2008 CERTIFIED



READ THIS MANUAL PRIOR TO INSTALLATION

This manual provides information on the **GW704 Guided Wave Radar Level Transmitter**. It is important that all instructions are read carefully and followed sequentially. The **QuickStart Installation** instructions are a brief guide to the sequence of steps for experienced technicians to follow when installing the equipment. Detailed instructions are included in the **Complete Installation** section of this manual.

Conventions Used in this Manual

Certain conventions are used in this manual to convey specific types of information. General technical material, support data and safety information are presented in narrative form. The following styles are used for notes, cautions and warnings:

Notes

Notes contain information that augments or clarifies an operating step. Notes do not normally contain actions and often follow the procedural steps to which they refer.

Cautions

Cautions alert the technician to special conditions that could injure personnel, damage equipment, or reduce a component's mechanical integrity. Cautions are also used to alert the technician of unsafe practices, the need for special protective equipment, or specific materials. In this manual, a caution indicates a potentially hazardous situation which, if not avoided, may result in minor to moderate injury.

Warnings

Warnings identify potentially dangerous situations, or serious hazards. In this manual, a warning indicates an imminently hazardous situation which, if not avoided, may result in serious injury or death.

Safety Messages

Follow all standard industry procedures for servicing electrical and computer equipment when working with, or around high voltage. Always shut off the power supply before touching any components. Although high voltage is not present in this system, it may be present in other systems.

Electrical components are sensitive to electrostatic discharge. To prevent equipment damage, observe all safety precautions when working with electrostatic-sensitive components.

WARNING!

EXPLOSION HAZARD! DO NOT CONNECT OR DISCONNECT THE TRANSMITTER UNLESS THE POWER HAS BEEN SWITCHED OFF.

Low Voltage Directive

If the equipment is used in a manner not specified by the manufacturer, protection provided by equipment may be impaired.

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All Solutions With Innovation Mechanical Level and Flow Controls are warranted free of defects in materials and workmanship for one full year from the date of the original factory shipment. If returned within the warranty period; and, upon factory inspection of the control, the cause of the claim is determined to be covered under the warranty; then, Solutions With Innovation will repair or replace the product at no cost to the purchaser (or owner) other than transportation.

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GW704 GUIDED WAVE RADAR

Level Transmitter

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1.0 QUICKSTART INSTALLATION

The QuickStart Installation procedures provide key steps for mounting, wiring and configuring the GW704 Guided Wave Radar Level Transmitter. These procedures are intended for experienced installers of electronic level measurement instruments. Refer to **Section 2.0: Complete Installation** for detailed installation instructions.

⚠ WARNING! GW704 GUIDED WAVE RADAR PROBES SHOULD BE INSTALLED WHERE THE MAXIMUM OVERFILL LEVEL IS AT A MINIMUM OF 6" (150 MM) BELOW THE PROCESS CONNECTION. THIS MAY INCLUDE UTILIZING A NOZZLE OR SPOOL PIECE TO RAISE THE PROBE. CONSULT THE MANUFACTURER TO ENSURE PROPER INSTALLATION.

1.1 GETTING STARTED

Before beginning the Quickstart Installation procedures, have the proper equipment, tools and information readily available.

1.1.1 Equipment and Tools

- Grounding Wrist Strap and ESD Workstation (*For safety usage with electronic components*)
- Open-End Wrenches or An Adjustable Wrench to Fit the Process Connection Size and Type; Coaxial Probe: 1 1/2" (38 mm), Twin Rod Probe: 1 7/8" (47 mm).
- Flat-Blade Screwdriver
- Digital Multimeter or Digital Volt/Ammeter
- 24 VDC Power Supply, 23 mA Minimum

1.1.2 Configuration Information

The GW704 requires vital information in order to calibrate the unit. Complete the following operating parameters table before beginning configuration. Refer to **Section 1.4** for calibration instructions.

DISPLAY	QUESTION	ANSWER
UNITS:	What units of measurement will be used? (Inches or Centimeters)	
	What is the distance from the probe process connection to the tank bottom?	
PROBE MODEL:	What probe model is listed on the model information? (<i>First 4 digits of probe model #</i>)	
PROBE LENGTH:	What probe length is listed on the model information?	
OFFSET:	What is the distance from the probe tip to the desired 0% level?	
DIELECTRIC (<i>Sensitivity</i>):	What is the dielectric constant of the process medium?	
SET 4.0 mA:	What is the 0% reference point for the 4.0 mA value?	
SET 20.0 mA:	What is the 100% reference point for the 20.0 mA value? (<i>The top 4" or 100 mm of Twin Rod probe is inactive.</i>)	

1.2 QUICKSTART MOUNTING

Confirm the configuration style and process connection size/type of the GW704 Guided Wave Radar Level Transmitter. Ensure it matches the requirements of the installation before proceeding.

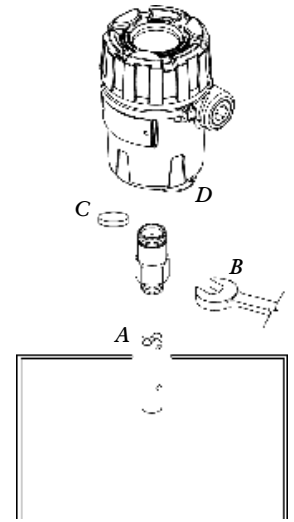
1.2.1 Probe

CAUTION! IF THE TRANSMITTER IS BEING INSTALLED AT A LATER TIME, DO NOT REMOVE THE PROTECTIVE CAP FROM THE PROBE. DO NOT USE SEALING COMPOUND OR TFE TAPE ON THE PROBE CONNECTION TO THE TRANSMITTER. THIS CONNECTION IS SEALED USING A VITON® O-RING.

- 1 Carefully, place the probe into the vessel. Align the probe connection with the threaded or flanged mounting on the vessel. Fig. A
- 2 Tighten the hex nut of the probe process connection or flange bolts. Fig. B

1.2.2 Transmitter

- 3 Remove the protective plastic caps from the top of the probe and at the bottom of the transmitter. Keep the plastic caps for future use. Fig. C
- 4 Verify that the high frequency connector (female) is clean and dry. Clean the component with isopropyl alcohol on a cotton swab, if necessary.
- 5 Place the transmitter onto the probe. Hand-tighten the connection securely. Fig. D



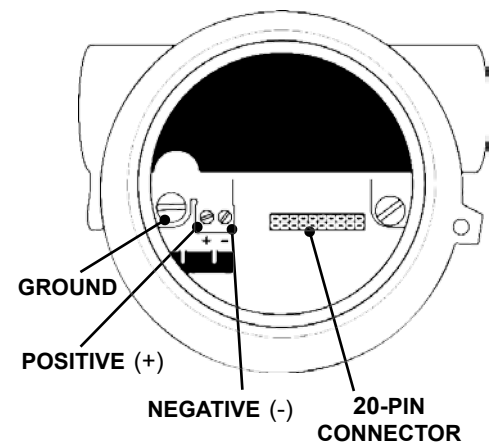
1.3 QUICKSTART WIRING

WARNING! EXPLOSION HAZARD. DO NOT CONNECT OR DISCONNECT THE EQUIPMENT UNLESS POWER TO THE DEVICE HAS BEEN TURNED OFF.

CAUTION! OBSERVE ALL APPLICABLE ELECTRICAL CODES AND PROPER WIRING PROCEDURES.

CAUTION! DO NOT APPLY MORE THAN 10 FT. LBS. TO THE CONDUIT ENTRIES ON THE VALOX HOUSING.

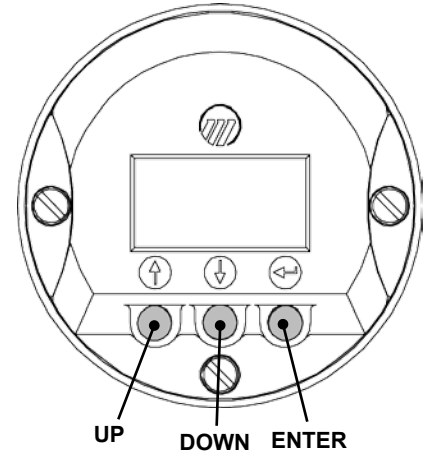
- 1 Remove the cover of the transmitter.
- 2 Install the conduit plug into the unused opening, if applicable.
- 3 Holding the display module by the flats, remove the module from the assembly.
- 4 Install a conduit fitting and pull the supply wires through.
- 5 Connect the shield to an earth ground at the power supply and at the transmitter.
- 6 Connect an earth ground wire to the green ground screw.
- 7 Connect the positive supply wire to the (+) terminal and the negative supply wire to the (-) terminal.
- 8 Carefully, reconnect the display module to the 20-pin connector.
- 9 Re-install the cover of the transmitter.



1.4 QUICKSTART CONFIGURATION

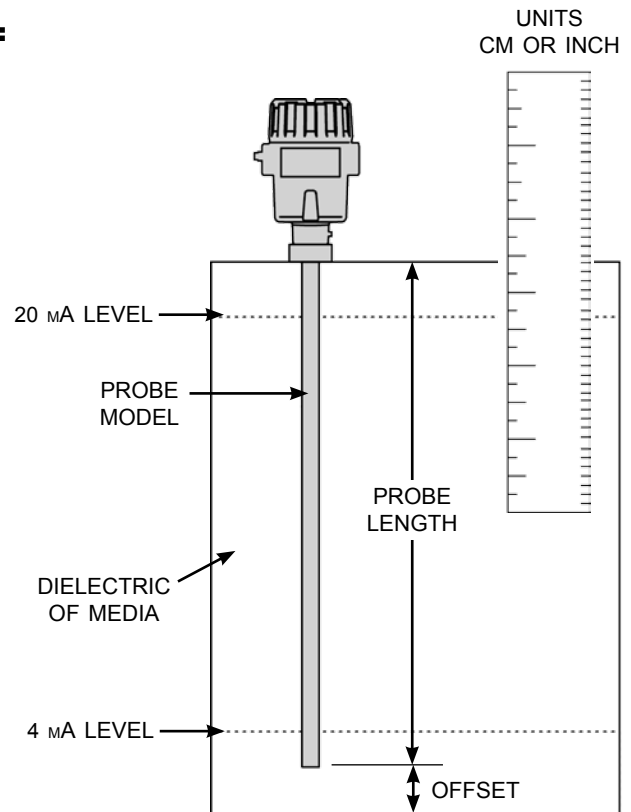
The GW704 Guided Wave Radar Level Transmitter is configured with its factory default values before leaving the manufacturer. However, the transmitter should be reconfigured to the parameters that will be used in your application. The table from Section 1.1.2 will be useful during this process.

- 1 Apply power to the transmitter. The display will change approximately every 2 seconds to show one of the three measurement values: Level, % Output and Loop Current.
- 2 Remove the cover of the transmitter.
- 3 Use the **UP** or **DOWN** arrow keys ($\uparrow\downarrow$) to move from one step of the configuration program to the next.
- 4 To change a specific parameter, press the **ENTER** arrow key (\leftarrow). The last character in the first line of the display will change to an exclamation point (!).
- 5 Use the **UP** or **DOWN** arrow keys ($\uparrow\downarrow$) to increase or decrease the value shown on the display, or to scroll through the choices.
- 6 Press the **ENTER** arrow key (\leftarrow) to set a value, then move to the next step of the configuration program.
- 7 After entering the last value, let the unit sit for at least 5 seconds before disconnecting power to the transmitter.




Minimum Entry Requirements for Configuration:

- 1 Select the **Units** of measurement for the level readout (centimeters or inches).
- 2 Select the corresponding **Probe Model** number.
- 3 Enter the **Offset** value: the distance from the probe end to the desired 0% level point. (The unit is shipped from the manufacturer with an offset value = 0. All measurements are referenced to the bottom of the probe.) Refer to Section 2.7.5 Offset Description.
- 4 Enter the **Level Trim** or distance correction to account for the mounting variations (this should be done after probe installation).
- 5 Enter the **Dielectric** range for the media (only applicable on coaxial and twin rod probes 7XA & 7XB).
- 6 Enter the minimum level value (0% point) for the **4 mA** output reading.
- 7 Enter the maximum level value (100% point) for the **20 mA** output reading.



2.0 COMPLETE INSTALLATION

This section provides detailed procedures on properly installing and configuring the GW704 Guided Wave Radar Level Transmitter.

 **CAUTION!** IF THE EQUIPMENT IS USED IN A MANNER NOT SPECIFIED BY THE MANUFACTURER, PROTECTION PROVIDED BY THE EQUIPMENT MAY BE IMPAIRED.

2.1 UNPACKING

Unpack the instrument, carefully. Make sure that all components have been removed from the packing material. Inspect all components for damage. Report any concealed damage to the carrier within 24 hours of receiving. Compare the contents with the packing slip and report any discrepancies to the factory immediately. Record the sales order number and/or serial number for future reference when ordering parts.

Before Proceeding to Installation, Complete the Following:


- Inspect all components for damage. Report any damage to the carrier within 24 hours of receiving.
- Record the model and serial numbers for future reference when ordering parts.

Model Number _____

Serial Number _____

2.2 INSTALLATION LOCATION

GW704 Guided Wave Radar Transmitters should be located within easy access for service, calibration and monitoring. Sensors should not be exposed to ambient temperatures below -40°F (-40°C) or above $+185^{\circ}\text{F}$ ($+85^{\circ}\text{C}$). Special precaution should be made to prevent exposure to corrosive atmospheres, excessive vibration, shock and physical damage.

 **CAUTION!** THIS UNIT CONTAINS ELECTRONICS WHICH MAY BE DAMAGED BY STATIC ELECTRICITY. DO NOT TOUCH ANY SEMI-CONDUCTOR DEVICES UNLESS YOU ARE PROPERLY GROUNDED.

2.3 ⚠ ELECTROSTATIC DISCHARGE (ESD) HANDLING PROCEDURE



Solutions With Innovation's electronic instruments are manufactured to the highest quality standards. These instruments use electronic components that may be damaged by static electricity present in most work environments.

THE FOLLOWING STEPS ARE RECOMMENDED TO REDUCE THE RISK OF COMPONENT FAILURE DUE TO ELECTROSTATIC DISCHARGE:



- Use a grounding wrist strap when installing and removing circuit boards. A grounded workstation is recommended.
- Handle all circuit boards *only* by their edges. Do not touch board components or connector pins.
- Make sure that all electrical connections are completely secure and none are partial or floating. Ground all equipment to a good, earth ground.

2.4 BEFORE YOU BEGIN

2.4.1 Site Preparation

- 1 Each GW704 Guided Wave Radar Level Transmitter is built to the specifications indicated during the ordering process. Make sure that the probe connection is correct for the threaded or flanged mounting on the vessel or tank where the transmitter will be placed. Refer to **Section 2.5: Mounting**.
- 2 Ensure that the wiring between the power supply and GW704 electronics are complete and appropriate for the type of installation. Refer to **Section 3.6: Specifications**.
- 3 When installing the GW704 Guided Wave Radar Level Transmitter in a general purpose or hazardous area, all local, state and federal regulations/guidelines must be observed. Refer to **Section 2.6: Wiring**.

2.4.2 Equipment and Tools

No special equipment or tools are required to install the GW704 Guided Wave Radar Level Transmitter.

The Following Are Recommended:

- Open-End Wrenches or An Adjustable Wrench to Fit the Process Connection Size and Type; Coaxial Probe: 1 1/2" (38 mm), Twin Rod Probe: 1 7/8" (47 mm).
- Flat-Blade Screwdriver
- Digital Multimeter or Digital Volt/Ammeter
- 24 VDC Power Supply, 23 mA Minimum

2.4.3 Optional Considerations

Operational specifications vary based on the probe model number. Refer to **Section 3.6: Specifications**.

2.5 MOUNTING

The GW704 Guided Wave Radar Level Transmitter is available in a variety of process connections. This device can be installed into the top of a process tank depending on the connection type. Typically, a threaded or flanged connection is used for installing the GW704.

⚠ WARNING! *GW704 GUIDED WAVE RADAR PROBES SHOULD BE INSTALLED WHERE THE MAXIMUM OVERFILL LEVEL IS AT A MINIMUM OF 6" (150 MM) BELOW THE PROCESS CONNECTION. THIS MAY INCLUDE UTILIZING A NOZZLE OR SPOOL PIECE TO RAISE THE PROBE. CONSULT THE MANUFACTURER TO ENSURE PROPER INSTALLATION.*

⚠ WARNING! *DO NOT DISASSEMBLE THE PROBE WHEN IT IS IN SERVICE AND/OR UNDER PRESSURE.*

⚡ CAUTION! *DO NOT PLACE INSULATING MATERIAL AROUND ANY PART OF THE TRANSMITTER INCLUDING THE PROBE FLANGE AS IT MAY CAUSE EXCESSIVE HEAT BUILD-UP.*

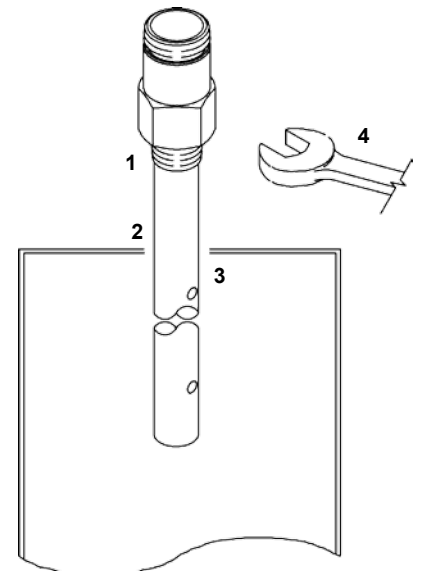
2.5.1 Coaxial Probe Installation

- Verify that the probe has adequate room for installation and has unobstructed entry to the bottom of the vessel. Refer to **Section 3.6: Specifications**.
- Ensure that the process temperature, pressure, dielectric and viscosity are within the probe's specifications for the type of installation. Refer to **Section 3.6: Specifications**.

⚡ CAUTION! *IF THE TRANSMITTER IS BEING INSTALLED AT A LATER TIME, DO NOT REMOVE THE PROTECTIVE CAP FROM THE PROBE. DO NOT USE SEALING COMPOUND OR TFE TAPE ON THE PROBE CONNECTION TO THE TRANSMITTER. THIS CONNECTION IS SEALED USING A VITON® O-RING.*

How to Install A Coaxial Probe:

- 1 Verify that the process connection is at least 3/4" NPT or a flanged mounting.
- 2 Carefully, place the probe into the vessel. Align the gasket on flanged installations.
- 3 Align the probe process connection with the threaded or flanged mounting on the vessel.
- 4 For *threaded connections*, tighten the hex nut of the probe process connection. For *flanged connections*, tighten the flange bolts.



2.5.2 Twin Rod Probe Installation

- Verify that the probe has adequate room for installation and has unobstructed entry to the bottom of the vessel. Refer to **Section 3.6: Specifications**.
- Ensure that the process temperature, pressure, dielectric and viscosity are within the probe's specifications for the type of installation. Refer to **Section 3.6: Specifications**.

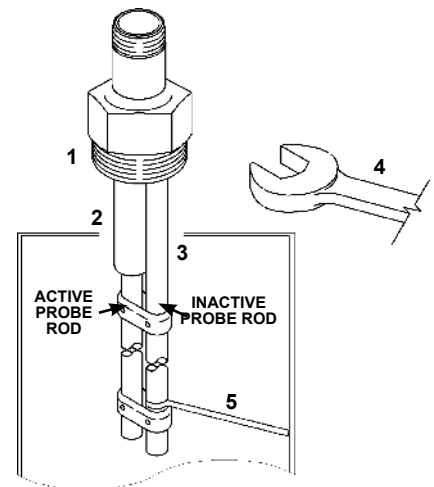
Nozzles:

- Nozzles should be at least 3" (80 mm) in diameter. For nozzles less than 3" (80 mm), the bottom of the inactive section of the probe should be at least flush with the bottom of the nozzle or extend into the vessel.
- The 7XB Twin Rod Probe should be installed so that the active rod is more than 2" (50.8 mm) from metallic objects such as pipes, ladders, etc. A bare tank wall parallel to the probe is acceptable.

CAUTION! IF THE TRANSMITTER IS BEING INSTALLED AT A LATER TIME, DO NOT REMOVE THE PROTECTIVE CAP FROM THE PROBE. DO NOT USE SEALING COMPOUND OR TFE TAPE ON THE PROBE CONNECTION TO THE TRANSMITTER. THIS CONNECTION IS SEALED USING A VITON® O-RING.

How to Install A Twin Rod Probe:

- 1 Verify that the process connection is at least 2" NPT or a flanged mounting.
- 2 Carefully, place the probe into the vessel. Align the gasket on flanged installations.
- 3 Align the probe process connection with the threaded or flanged mounting on the vessel.
- 4 For *threaded connections*, tighten the hex nut of the probe process connection. For *flanged connections*, tighten the flange bolts.
- 5 The probe can be stabilized by attaching the inactive probe rod to the vessel.



2.5.3 Transmitter Installation

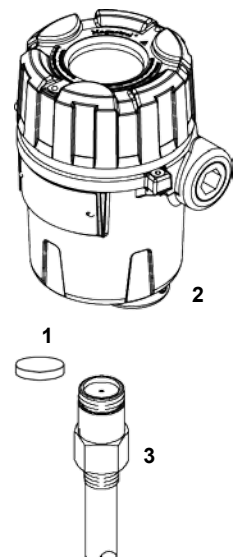
The GW704 Guided Wave Radar Level Transmitter can only be ordered for installation as an integral configuration.

CAUTION! DO NOT APPLY MORE THAN 10 FT./LBS. OF FORCE.

CAUTION! GW704 TRANSMITTERS MAY NOT SHOW AN ERROR AND INDICATE A LEVEL VALUE GREATER THAN ZERO WHEN DISCONNECTED FROM THE PROBE.

How to Install A GW704 Transmitter:

- 1 Remove the protective plastic caps from the top of the probe and at the bottom of the transmitter. Keep the plastic caps for future use.
- 2 Place the transmitter on the probe. Be careful not to bend or dirty the gold high-frequency (male) connector.
- 3 Place the transmitter onto the probe. Hand-tighten the connection securely.



2.6 WIRING

⚠ WARNING! EXPLOSION HAZARD. DO NOT CONNECT OR DISCONNECT THE EQUIPMENT UNLESS POWER TO THE DEVICE HAS BEEN TURNED OFF.

⚡ CAUTION! DO NOT APPLY MORE THAN 10 FT. LBS. TO THE CONDUIT ENTRIES ON THE VALOX HOUSING.

⚡ CAUTION! THE GW704 TRANSMITTER ELECTRONICS OPERATE AT VOLTAGES OF 12-28 VDC. A HIGHER VOLTAGE WILL DAMAGE THE TRANSMITTER. OBSERVE ALL APPLICABLE ELECTRICAL CODES & WIRING PROCEDURES.

📄 NOTE: WIRING BETWEEN THE POWER SUPPLY AND GW704 ELECTRONICS SHOULD BE MADE USING 18 - 22 AWG SHIELDED, TWISTED PAIR INSTRUMENT CABLE.

2.6.1 General Purpose or Non-Incendive (Class I, Div. II)

- A *General Purpose* installation **DOES NOT** have flammable media present.
- Areas rated *Non-Incendive* (Class I, Div. II) have flammable media present only under abnormal conditions. No special electrical connections are required.
- If flammable media is contained in the vessel, the transmitter must be installed per Class I, Div. II standards of area classification.

How To Install General Purpose or Non-Incendive Wiring:

- 1 Remove the cover of the transmitter.
- 2 Install the conduit plug into the unused opening, if applicable.
- 3 Holding the display module by the flats, remove the module from the assembly. Fig. 1
- 4 Install a conduit fitting and pull the supply wires through.
- 5 Connect the shield to an earth ground at the power supply and at the transmitter.
- 6 Connect an earth ground wire to the green ground screw.
- 7 Connect the positive supply wire to the (+) terminal and the negative supply wire to the (-) terminal.
- 8 Carefully, reconnect the display module to the 20-pin connector.
- 9 Re-install the cover of the transmitter.

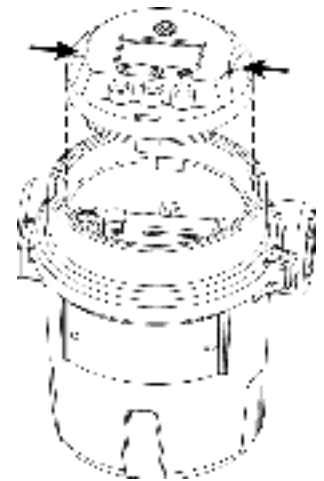
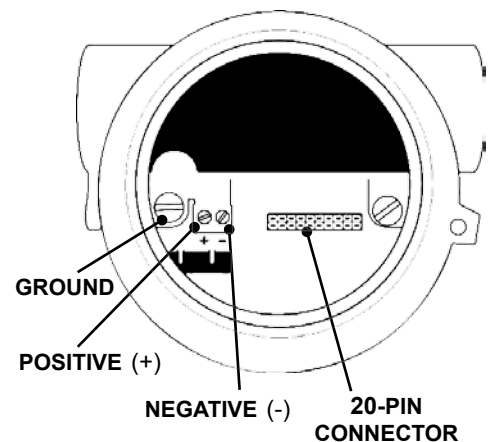


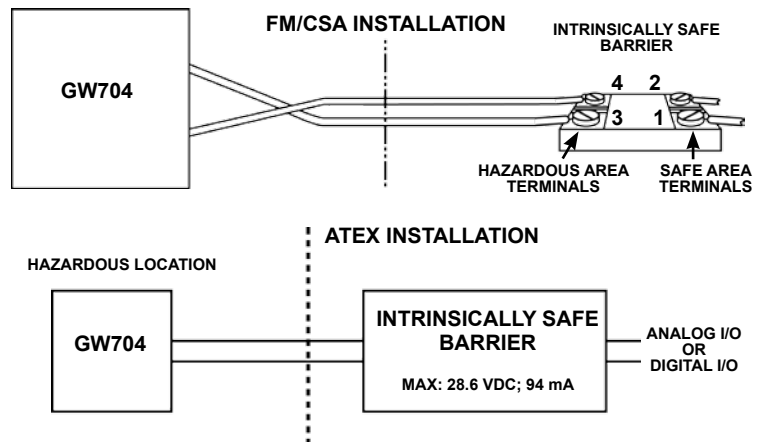
Fig. 1

2.6.2 Intrinsically Safe

- An *Intrinsically Safe* installation **DOES** have potentially flammable media present.
- An approved intrinsically safe barrier must be installed in the non-hazardous (safe) area.

How To Install Intrinsically Safe Wiring:

- 1 Verify that the intrinsically safe barrier is properly installed in the safe area. Then, complete the wiring from the barrier to the transmitter.
- 2 Remove the cover of the transmitter. Install the conduit plug into the unused opening, if applicable.
- 3 Holding the display module by the flats, remove the module from the assembly.
- 4 Install a conduit fitting and pull the supply wires through.
- 5 Connect the shield to an earth ground at the power supply and at the transmitter.
- 6 Connect an earth ground wire to the green ground screw.
- 7 Connect the positive supply wire to the (+) terminal and the negative supply wire to the (-) terminal.
- 8 Carefully, reconnect the display module to the 20-pin connector.
- 9 Re-install the cover of the transmitter.

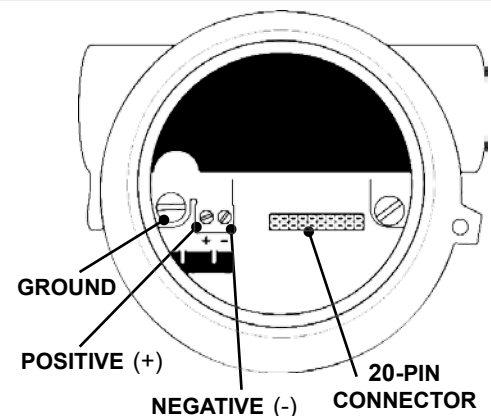


2.6.3 Explosion-Proof

- An *Explosion-Proof* installation **DOES** have flammable gases and/or vapors present in quantities sufficient to produce explosive or ignitable mixtures.
- The transmitter wiring must be contained in an explosion-proof conduit extending into the safe area.
- An explosion-proof conduit fitting (EY seal) is not required within 18" of the transmitter. However, the conduit fitting is required between the hazardous and safe areas.

How To Install Explosion-Proof Wiring:

- 1 Install the explosion-proof conduit from the safe area to the conduit connection of the transmitter.
- 2 Remove the cover of the transmitter. Holding the display module by the flats, remove the module from the assembly.
- 3 Connect the shield to an earth ground at the power supply and at the transmitter.
- 4 Connect an earth ground wire to the green ground screw.
- 5 Connect the positive supply wire to the (+) terminal and the negative supply wire to the (-) terminal.
- 6 Carefully, reconnect the display module to the 20-pin connector.
- 7 Re-install the cover of the transmitter.



2.7 CONFIGURING THE TRANSMITTER

The GW704 Guided Wave Radar Level Transmitter is configured with its factory default values before leaving the manufacturer. However, the transmitter should be reconfigured to the parameters that will be used in your application. Bench configuration provides a convenient and efficient way to set up the transmitter before traveling to the tank site to complete the installation. Before configuring the GW704, refer to the parameters listed in Section 1.1.2. Apply power to the transmitter and follow the steps according to the menu-driven transmitter display.

2.7.1 Operating Parameters

Some information is needed to calibrate the transmitter. Refer to the information table in Section 1.1.2.

2.7.2 Setting Up for Bench Configuration

The GW704 Guided Wave Radar Level Transmitter can be configured on a test bench prior to installation.

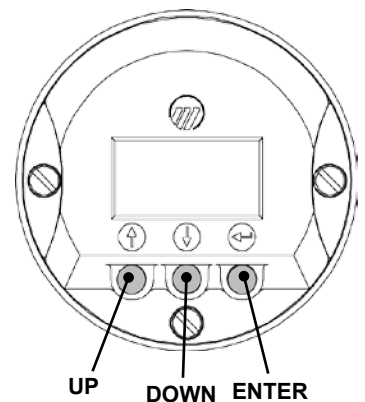
- 1 Connect a 24 VDC power supply directly to the transmitter terminals. Attach the red (+) positive lead from the power supply to the (+) positive terminal on the device. Then, attach the black (-) negative lead from the power supply to the (-) negative terminal on the device.
- 2 If necessary, connect a digital multimeter to show the current outputs of the transmitter.
- 3 The transmitter can be configured without the probe. Disregard the error message due to the unattached probe (the transmitter may not show an error message and indicate a level value greater than zero when it is disconnected from the probe).
- 4 After entering the last value, allow five seconds before disconnecting power to the transmitter. This will allow the transmitter to store the new values.

2.7.3 Transmitter Display and Keyboard

The GW704 Guided Wave Radar Level Transmitter has a liquid crystal display (LCD) capable of showing two lines with eight characters each. The transmitter's measurements and configuration menu are displayed on the LCD screen.

The transmitter default display is the measurement screen. The display changes every 2 to 5 seconds to show one of the three values: Level, % Output and Loop Current. The transmitter will default to this display after 5 minutes have elapsed without keystrokes.

The keypad utilizes three arrows to scroll through the display options and to calibrate the transmitter. The **UP** and **DOWN** arrow keys (↑↓) and the **ENTER** arrow key (↵) are the main keypad selection tools during the programming process.



ARROWS	DISPLAY MODE FUNCTIONS	CONFIGURATION MODE FUNCTIONS
UP ↑ & DOWN ↓	Moves forward and backward in the configuration program from one display to another.	Increases or decreases the value displayed on the screen, or moves to another choice. <i>Hold down the arrow key for rapid scrolling.</i>
ENTER ↵	Enters the configuration mode (noted by ! as the last character in top display line).	Accepts a value.

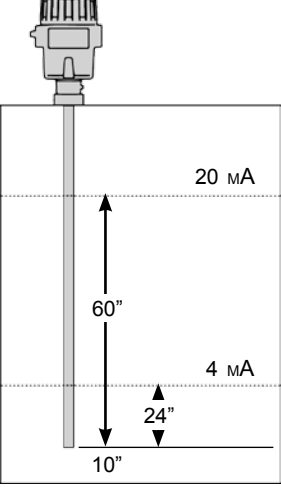
2.7.4 Menu: Step By Step Procedure

The following table provides a complete explanation of the software menus displayed by the GW704 Guided Wave Radar Level Transmitter. Use this table as a step-by-step guide to configure the device. The first column represents the menus in the order they are shown on the transmitter display. The second column lists the actions needed to configure the transmitter. Additional information is provided in the third column.

DISPLAY	ACTION	COMMENT
Level %Output Loop	Transmitter Display	Transmitter Default: Level, % Output and Loop values cycle every 2 to 5 seconds.
Level xxx.x cm	Transmitter Display	Transmitter Display: Level Measurement in cm or inches.
%Output xx.x%	Transmitter Display	Transmitter Display: % Output measurement as derived from the 20 mA span.
Loop xx.xx mA	Transmitter Display	Transmitter Display: Loop value (mA).
Units (select)	SELECT Units for Level Measurement	cm or inches
PrbModel (select)	SELECT the Type of Probe Used	Select from dual element probes: 7xA-x , 7xB-x or 7xR
Probe Ln xxx.x	ENTER the Exact Length of the Probe	The probe length is printed on the nameplate and order information. It is the last three digits of the probe model number.
Offset xxx.x	ENTER the Offset Value	Offset is the distance from the probe tip to the desired 0% level point (-10" to 192" or -25 cm to 488 cm).
Lvl Trim xxx.x	ENTER the Level Trim Value	Level Trim may be necessary to account for installation variances.
Dielctrc (select)	ENTER the Dielectric Range Value of Media	1.7 - 10; 10 - 100 (For Dual Element Probes)
Set 4mA xxx.x	ENTER the Level Value of 4 mA Point	A small transition zone (0 to 6") may exist at the top/bottom of the probe.
Set 20mA xxx.x	ENTER the Level Value of 20 mA Point	A small transition zone (0 to 6") may exist at the top/bottom of the probe. The top 4" (100 mm) of the 7XB Twin Rod Probe is inactive.
Damping xx sec	ENTER the Damping Factor	A Damping Factor (0 to 10 seconds) may be added to smooth a noisy display and/or output due to turbulence.
Fault (select)	ENTER the Fault Value	Select 3.6 mA , 22 mA or HOLD (last value).
Deadband xx.x	ENTER the Deadband Value	The Deadband may have to be adjusted for installation variances.
Poll ADR xx	<i>Disregard this Setting</i>	
Trim 4 xxxx	Fine Tune the 4 mA Point	Attach a mA meter to the output. If the output does not equal 4.0 mA, adjust the value on the display until the meter reads 4.00 mA.
Trim 20 xxxx	Fine Tune the 20 mA Point	Attach a mA meter to the output. If the output does not equal 20.0 mA, adjust the value on the display until the meter reads 20.00 mA.
Loop Tst xx.x mA	ENTER a mA Output Value	Set the mA Output to any given value to perform the loop test.
Fid Tick	<i>None, DO NOT ADJUST</i>	Diagnostic, Factory Setting
Conv Fct xx.xxx	<i>None, DO NOT ADJUST</i>	Diagnostic, Factory Setting
Scl Offs xx.x	<i>None, DO NOT ADJUST</i>	Diagnostic, Factory Setting
# Ticks xxxx	<i>None, DO NOT ADJUST</i>	Diagnostic, Factory Setting
Threshld (select)	SELECT the Type of Threshold	Unit default CFD . Only select Fixed in an application with a low dielectric media over a higher dielectric media and the level output is incorrect, i.e. oil over water. Select Dielectric Range of the upper material. Adjustment of Lvl Trim may be necessary when the threshold is changed.
Model 704 Ver xx.xx	<i>None, DO NOT ADJUST</i>	Diagnostic, Factory Setting (Ver refers to the software version)

2.7.5 Offset Description

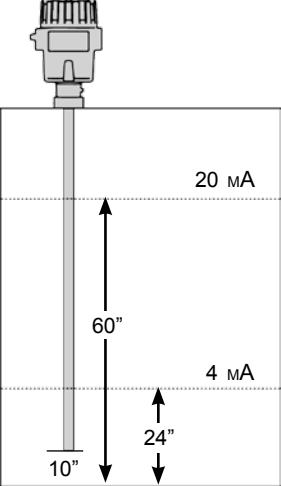
The parameter referred to as the “Offset” in the GW704 transmitter menu is the distance from the bottom of the probe to the desired 0% level point. The unit is shipped from the manufacturer with the offset value set to zero. In this configuration, all measurements are referenced from the bottom of the probe.



Example 1:

The application calls for a 72” NPT coaxial probe in water with the bottom of the probe 10” above the tank. The user wants the 4 mA point at 24” and the 20 mA point at 60”, as referenced from the bottom of the probe.

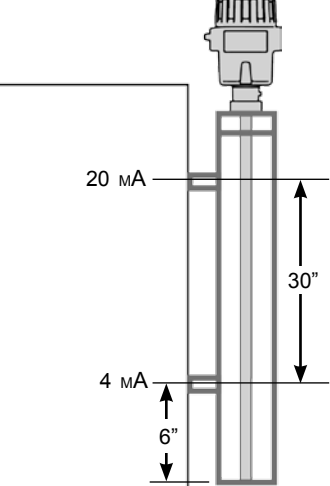
In applications where it is desired to reference all measurements from the bottom of the vessel, the value of the offset should be changed to the distance between the bottom of the probe and the bottom of the vessel. Refer to Example 2.



Example 2:

The application calls for a 72” NPT coaxial probe in water with the bottom of the probe 10” above the bottom of the tank. The user wants the 4 mA point at 24” and the 20 mA point at 60”, as referenced from the bottom of the tank.

When the transmitter is mounted in a chamber/bridle, it is usually recommended to configure the unit with the 4 mA (0%) point at the lower process connection and the 20 mA (100%) point at the upper process connection. This way, the span is the center-to-center dimension and a negative offset would need to be centered. To achieve this, all measurements are referenced at a point up on the probe. Refer to Example 3.



Example 3:

The application calls for a 48” NPT coaxial flanged probe measuring water in a chamber with the bottom of the probe 6” below the lower process connection. The user wants the 4 mA point to be 0” at the bottom process connection and the 20 mA point to be 30” at the top process connection.

3.0 PREVENTATIVE MAINTENANCE

Periodic inspections are necessary to maintain the proper functionality of the GW704 Guided Wave Radar Level Transmitter. The transmitter is a safety device that protects the equipment it serves. A systematic program of preventative maintenance should be implemented at the time of installation. If the following instructions are completed routinely, the switch will provide continuous, reliable protection.

3.1 MAINTENANCE PROCEDURES

3.1.1 Inspect Unit Periodically

Verify that there are no cracks or defective surfaces on the unit. Should the probe or transmitter components become damaged, obtain a replacement immediately.

3.1.2 Inspect Transmitter Connections Monthly

GW704 Guided Wave Radar Level Transmitters may be vulnerable to extreme heat and excessive moisture. Under these conditions, the electrical wire insulation can periodically break or peel away. As a result, the units should be inspected monthly.

- Inspect the housing to electrical connections to ensure tightness.
- Inspect the wiring connections to ensure tightness.

3.1.3 Keep Unit Clean

Periodic cleanings of the unit to remove any film or deposits will ensure the continual, uninterrupted transmission of the radar waves. If the process liquid is highly-dielectric such as water, a coating can build up on the probe and spacers separating the probe elements. Media that is viscous, easily solidifies or carries particles at the fluid level can create a clog or bridge on the probe as well. Objects and debris may cause systematic interruptions and a loss in equipment functionality. To avoid decreased performance and possible errors, clean the probe routinely.

3.2 WHAT TO AVOID



NEVER LEAVE THE TRANSMITTER'S COVER OFF EXPOSING THE CIRCUIT TO THE ELEMENTS.

4.0 REFERENCE INFORMATION

This section illustrates an overview of the GW704 Guided Wave Radar Level Transmitter, as well as information on troubleshooting common problems, agency approval listings, and detailed physical, functional and performance specifications.

4.1 DESCRIPTION

The GW704 Guided Wave Radar Level Transmitter is a 24 VDC, two-wire loop-powered level transmitting device designed to detect the fluid levels in various extreme applications. By utilizing guided wave radar technology, the GW704 is capable of performing reliable level indication in turbulent locations or areas with hazardous ratings. The GW704 features a two-line LCD screen with a three-button keypad for easy configuration and quick adjustments. Its 316 stainless steel probe is available in a coaxial or twin-rod design with lengths up to 16'. Additional options include a cast aluminum or Valox electronic housing, a variety of threaded or flanged connection sizes and specialty probe materials.

4.2 THEORY OF OPERATION

4.2.1 Micro-Power Impulse Radar

The process of guided wave radar combines time domain reflectometry, equivalent time sampling and modern low-power circuitry together to provide a high-speed radar circuit. Electromagnetic pulses are emitted from a waveguide and produce a system that is more efficient than through-air radar.

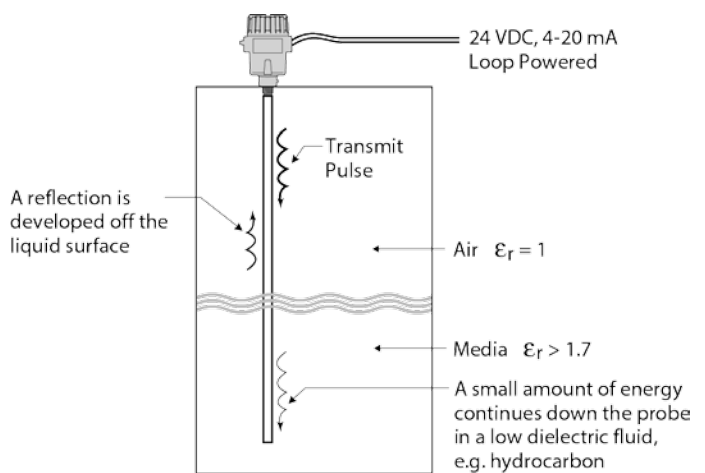
4.2.2 Time Domain Reflectometry

Time Domain Reflectometry (TDR) utilizes electromagnetic energy pulses to measure distances and levels. When a pulse reaches a dielectric discontinuity created by the media surface, part of the energy is reflected. The greater the dielectric distance is, the greater the amplitude or strength of the reflection.

In the GW704, an air-resistant waveguide is used as a probe. When part of the probe is submerged in the application media, the increase in dielectric lowers its resistance. The electromagnetic pulse moves down the probe and is reflected once it meets the dielectric gap.

4.2.3 Equivalent Time Sampling

Equivalent Time Sampling (ETS) is used to measure the high-speed, low-power electromagnetic energy. The process of ETS involves scanning the waveguide and collecting thousands of samples (approximately eight scans per second). It is a critical component in relating Time Domain Reflectometry to vessel level measurement because high-speed electromagnetic energy is difficult to measure over distances and at the resolution required by the process industry. During the scan, ETS captures the electromagnetic signal in real time (nanoseconds) and converts it to equivalent time (milliseconds) for easy measurement with today's technology.



4.3 TROUBLESHOOTING

The GW704 Guided Wave Radar Level Transmitter is designed and manufactured for trouble-free operation over a wide range of operating conditions. Common problems are discussed in terms of their symptoms and recommended corrective actions.

⚠ WARNING! EXPLOSION HAZARD. DO NOT CONNECT OR DISCONNECT THE EQUIPMENT UNLESS POWER TO THE DEVICE HAS BEEN TURNED OFF.

4.3.1 System Problems

SYMPTOM	PROBLEM	SOLUTION
THE LEVEL, % OUTPUT AND LOOP VALUES ARE INACCURATE.	BASIC CONFIGURATION AND DATA IS QUESTIONABLE.	RECONFIGURE THE PROBE MODEL, PROBE LENGTH, OR OFFSET. ENSURE THE LEVEL IS ACCURATE. VERIFY THE 4 mA AND 20 mA LOOP VALUES.
THE LEVEL READINGS ARE CONSISTENT, BUT HIGH OR LOW FROM THE ACTUAL READING BY A FIXED AMOUNT.	CONFIGURATION DATA DOES NOT ACCURATELY MATCH THE PROBE LENGTH OR TANK HEIGHT.	ENSURE THE PROPER PROBE MODEL AND PROBE LENGTH ARE INPUT.
	INSTALLATION VARIANCE.	ADJUST THE LEVEL TRIM.
THE LEVEL, % OUTPUT AND LOOP VALUES FLUCTUATE.	TURBULENCE IS PRESENT.	INCREASE THE DAMPING FACTOR UNTIL THE READING STABILIZE.
	HIGH-FREQUENCY CONNECTION.	CHECK THE FID TICKS. IT SHOULD BE STABLE WITHIN ± 10 COUNTS.
THE LEVEL, % OUTPUT AND LOOP VALUES ARE LOW VERSUS ACTUAL.	LOWER DIELECTRIC MATERIAL OVER HIGHER DIELECTRIC MATERIAL, I.E. OIL OVER WATER.	SELECT FIXED THRESHOLD OPTION.
	COATING, CLUMPING OR BUILDUP ON PROBE.	EXPECTED INACCURACIES ARE DUE TO THE EFFECT ON PULSE PROPAGATION.
	DENSE, WATER-BASED FOAM IS PRESENT.	EXPECTED INACCURACIES ARE DUE TO THE EFFECT ON PULSE PROPAGATION.
THE LEVEL READING ON THE DISPLAY IS CORRECT, BUT THE LOOP IS STUCK ON 4 mA.	BASIC CONFIGURATION AND DATA IS QUESTIONABLE.	SET POLL ADR TO 0.
THE LEVEL READING ON THE DISPLAY IS STUCK AT FULL SCALE AND LOOP IS STUCK AT 20.5 mA.	THE SOFTWARE BELIEVES THE PROBE IS FLOODED. THE LEVEL IS NEAR THE VERY TOP OF THE PROBE.	VERIFY THE ACTUAL LEVEL. IF THE PROBE IS NOT FLOODED, CHECK FOR OBSTRUCTIONS OR BUILDUP NEAR THE TOP OF THE PROBE. SELECT A HIGHER DIELECTRIC RANGE OR SET THE SENSITIVITY TO LOW.
THE LEVEL, % OUTPUT AND LOOP VALUES ARE AT MAXIMUM LEVELS.	POSSIBLE CONFIGURATION ISSUE.	INCREASE THE DEADBAND. DECREASE THE SENSITIVITY.
THE LEVEL, % OUTPUT AND LOOP VALUES ARE ALL HIGH VERSUS THEIR ACTUAL VALUES.	POSSIBLE OBSTRUCTION IN TANK.	REDUCE THE SENSITIVITY UNTIL THE OBSTRUCTION IS IGNORED. RELOCATE THE PROBE AWAY FROM THE OBSTRUCTION.
THE LEVEL VALUE READING IS HIGH WHEN IT SHOULD BE ZERO.	THE TRANSMITTER IS LOOSE OR DISCONNECTED FROM THE PROBE.	ENSURE THE TRANSMITTER IS CONNECTED SECURELY TO THE PROBE.
	INSTALLATION VARIANCE.	ADJUST THE LEVEL TRIM.







If you are still in doubt about the condition or performance of your device, consult the factory for further instructions.

4.3.2 Error Messages

SYMPTOM	PROBLEM	SOLUTION
NO FIDUCIAL (HART ERROR CODE: 0X80)	POOR CIRCUIT BOARD/CABLE/PROBE CONNECTION OR MALFUNCTIONING CABLE BETWEEN ELECTRONICS AND PROBE.	CHECK ALL OF THE CONNECTIONS FROM THE ELECTRONICS TO THE PROBE.
NO LEVEL SIGNAL (HART ERROR CODE: 0X40)	DIELECTRIC TOO LOW.	INCREASE SENSITIVITY.
	LEVEL WITHIN DEADBAND.	DECREASE LEVEL.
	MOUNTED TOO CLOSE TO CONCRETE WALL.	MOUNT PROBE > 12" FROM CONCRETE WALL.
	MALFUNCTIONING ANALOG BOARD.	REPLACE ELECTRONIC MODULE.
BAD CAL PARAMTRS (HART ERROR CODE: 0X20)	POSSIBLE NOZZLE ISSUES, DEADBAND TOO SMALL.	INCREASE DEADBAND.
	TANK OBSTRUCTION TOO CLOSE TO PROBE.	DECREASE SENSITIVITY.
	INCORRECT PROBE LENGTH ENTERED.	RECONFIGURE PROPER PROBE LENGTH.
CORRUPT PARAMTRS (HART ERROR CODE: 0X10)	INTERNAL PARAMETERS CORRUPTED.	CHECK ALL CONFIGURATION PARAMETERS.
		VERIFY PROBE TYPE AND PROBE LENGTH.
	DISPLAYED WHEN AT LEAST ONE PARAMETER HAS BEEN MODIFIED AFTER CORRUPTION.	CONSULT THE FACTORY - RECALIBRATION MAY BE REQUIRED.

4.4 AGENCY APPROVALS

AGENCY	APPROVED MODEL(S)	METHOD	AREA CLASSIFICATION
FM 	704-5XXX-14X	INTRINSICALLY SAFE	CLASS I, DIV. 1, GROUPS A, B, C & D CLASS II, DIV. 1, GROUPS E, F & G CLASS III, IP67 ENTITY
	704-5XXX-54X	EXPLOSION-PROOF	CLASS I, DIV. 1, GROUPS C & D CLASS II, DIV. 1, GROUPS E, F & G CLASS III, IP67
	704-5XXX-14X 704-5XXX-54X	NON-INCENDIVE	CLASS I, DIV. 2, GROUPS A, B, C & D CLASS II, DIV. 2, GROUPS F & G CLASS III, IP67
CSA 	704-5XXX-14X	INTRINSICALLY SAFE*	CLASS I, DIV. 1, GROUPS A, B, C & D CLASS II, DIV. 1, GROUP G CLASS III, IP67 ENTITY
	704-5XXX-54X	EXPLOSION-PROOF	CLASS I, DIV. 1, GROUPS C & D CLASS II, DIV. 1, GROUPS E, F & G CLASS III, IP67
	704-5XXX-14X 704-5XXX-54X	NON-INCENDIVE	CLASS I, DIV. 2, GROUPS A, B, C & D CLASS II, DIV. 2, GROUPS E, F & G CLASS III, IP67
ATEX 	704-5XXX-A4X	INTRINSICALLY SAFE*	II 1G, EEx ia IIC T4**
CE 0344 	704-5XXX-14X 704-5XXX-54X	EXPLOSION-PROOF	EMC DIRECTIVE: 89/336/EEC EN 61000-6-2/2001 EN 61000-6-4/2001 DIRECTIVE 94/9/EC FOR EQUIPMENT OR PROTECTIVE SYSTEM FOR USE IN POTENTIALLY EXPLOSIVE ATMOSPHERES (8TH DIGIT "A" ONLY)

**Measured media inside vessel must be non-flammable only.*

***Special conditions for safe use:*

Materials marked as Category 1 equipment and used in hazardous areas requiring this category shall be installed in such a way that, even in the event of rare incidents, the aluminum enclosure cannot be an ignition source due to impact or friction.

4.5 SPECIFICATIONS

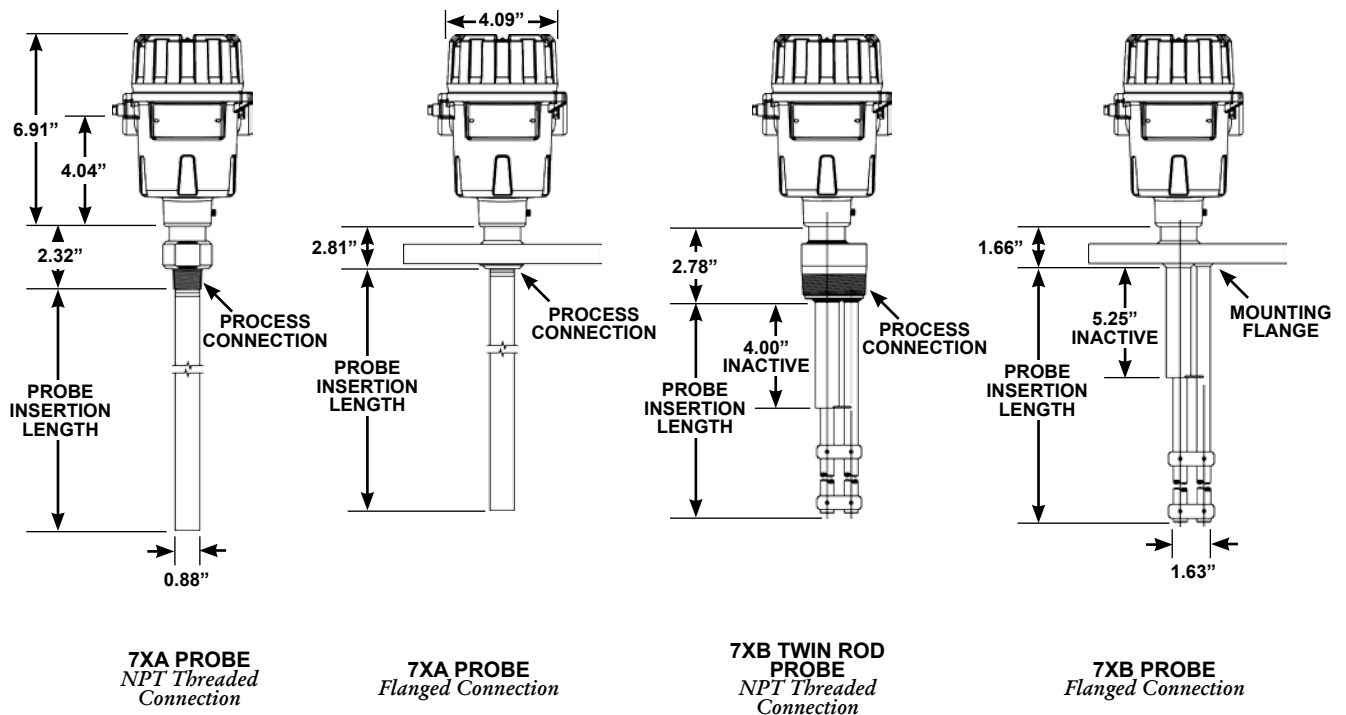
4.5.1 Functional Specifications

INPUT	
MEASUREMENT PRINCIPLE:	Guided Time-of-Flight Via Time Domain Reflectometry
MEASURED VARIABLE:	Level, Determined By the Time-of-Flight of A Guided Wave Radar Pulse From Transmitter to Product Surface and Back.
RANGE:	6" to 192" (15 cm to 488 cm)
POWER:	12 to 28.6 VDC (Pi = 0.67W, Ii = 94 mA)
OUTPUT	
SIGNAL:	4-20 mA (Analog)
RANGE:	Analog: 3.8 to 20.5 mA <i>Usable</i> Digital: 0" to 192" (0 cm to 488 cm)
RESOLUTION:	Analog: 0.01 mA Digital: 0.1" or 0.1 cm
LOOP RESISTANCE:	GP/IS/XP - 550 Ω at 24 VDC (20.5 mA)
DIAGNOSTIC ALARM:	Adjustable 3.6 mA, 22 mA, HOLD
DAMPING:	0 to 10 Seconds
ENVIRONMENTAL	
OPERATING TEMPERATURE:	Aluminum Housing: -40° to +175° F (-40° to +80° C) Aluminum Housing ATEX EExia: -40° to +160° F (-40° to +70° C) Valox Housing: -40° to +160° F (-40° to +70° C)
DISPLAY OPERATING TEMPERATURE:	-5° to +160° F (-20° to +70° C)
STORAGE TEMPERATURE:	-50° to +175° F (-45° to +80° C)
PROCESS PRESSURE:	<i>See Process Conditions</i>
HUMIDITY:	0 to 99%, Non-Condensing
AMBIENT TEMPERATURE EFFECT:	Approximately +0.03% of Probe Length/° C
SHOCK CLASS:	ANSI/ISA-S71.03 Class SA1
VIBRATION CLASS:	ANSI/ISA-S71.03 Class VC2
USER INTERFACE	
KEYPAD:	(3) Push-Button Menu-Driven Data Entry
INDICATION:	2-Line x 8-Character Display
DIGITAL COMMUNICATION:	HART Version 5.x Compatible (Sold Separately)
PERFORMANCE	
LINEARITY:	Coaxial: ± 0.25" Twin Rod: ± 0.50"
RESOLUTION:	± 0.15"
REPEATABILITY:	Less Than 0.15"
HYSTERESIS:	Less Than 0.15"
RESPONSE TIME:	Less Than 1 Second
WARM-UP TIME:	Less Than 5 Seconds
PROCESS DIELECTRIC EFFECT:	Less Than 0.5" Within Selected Range
ELECTROMAGNETIC COMPATIBILITY:	Meets CE Requirements (EN 61000-6-2/2001, EN 61000-6-4/2001) <i>Twin Rod Probes Must Be Used In Metallic Vessel or Still Well to Maintain CE Requirement</i>

4.5.2 Material Specifications

HOUSING		
MATERIAL:	Aluminum A356T6 (< 0.2% Copper) or Valox	
CABLE ENTRY:	3/4" NPT, M20	
PROBE	COAXIAL (7XA, 7XR)	TWIN ROD (7XB)
MATERIALS:	316/316L Stainless Steel, Hastelloy C or Monel with TFE Spacers and Viton® O-Rings	
DIAMETER:	0.3125" (8 mm) Rod 0.875" (10 mm) Tube	Two, 0.5" (13 mm) Rods 0.375" Clearance Between Rods
PROCESS CONNECTION:	3/4" NPT, 1" BSP, ANSI or DIN Flanges	2" NPT, ANSI or DIN Flanges
TRANSITION ZONE (TOP):	1" (25 mm) ϵ_r at = 2.0 6" (150 mm) ϵ_r at = 80.0	1" (25 mm) (+4" Inactive) $\epsilon_r > 10$ 7" (178 mm) (+4" Inactive) $\epsilon_r < 10$
TRANSITION ZONE (BOTTOM):	6" (150 mm) ϵ_r at = 2.0 1" (25 mm) ϵ_r at = 80.0	
MAXIMUM PROCESS TEMPERATURE:	+400° F (+200° C)	+400° F (+200° C)
MAXIMUM PROCESS PRESSURE:	1000 PSIG (70 bar)	750 PSIG (50 bar)
MAXIMUM VISCOSITY:	500 cp	1500 cp
DIELECTRIC RANGE:	≥ 1.7	≥ 2.5

4.5.3 Dimensional Specifications



3.7 MODEL CONFIGURATOR

3.7.1 GW704 Transmitter

TECHNOLOGY		MODEL		POWER		OUTPUT		LANGUAGE		ACCESSORIES		MOUNT/CLASS.		HOUSING		CONDUIT	
GW	Guided Wave Radar	704	Version	5	24 VDC, Two-Wire	0	4-20 mA	1	English	0	None	1	Integral, General Purpose & Intrinsically Safe (FM & CSA), Non-Incendive (Class I, Div. 2)	3	Valox	0	3/4" NPT
								2	Spanish	A	Digital Display and Keypad	5	Integral, Explosion-Proof (FM & CSA)	4	Cast Aluminum	1	M20
								3	French			A	Integral, General Purpose & Intrinsically Safe (ATEX EEx ia IIC T4)				
								4	German								

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**For additional mounting options, consult the manufacturer.*

3.7.2 GW704 Probe

MODEL		CONFIG.	MATERIAL	MOUNTING		O-RING		LENGTH			
7E	GWR Probe Customary Units	A	Coaxial 3/4" or Larger	A	316/316L SS	11	3/4" NPT	0	Viton GFLT	XXX	Inches (024")
7M	GWR Probe Metric Units	B	Twin Rod 2" NPT or 3" Flanged or Larger	B	Hastelloy C	22	1" BSP	1	EPDM		
		P	Coaxial High Pressure 3/4" or Larger	C	Monel	41	2" NPT	2	Kalrez 4079		
		R	Coaxial Overfill 3/4" or Larger			42	2" BSP	8	Aegis PF128		
						23	1" #150 ANSI Flange	N	None		
						24	1" #300 ANSI Flange				
						33	1 1/2" #150 ANSI Flange				
						34	1 1/2" #300 ANSI Flange				
						43	2" #150 ANSI Flange				
						44	2" #300 ANSI Flange				
						53	3" #150 ANSI Flange				
						54	3" #300 ANSI Flange				
						63	4" #150 ANSI Flange				
						64	4" #300 ANSI Flange				
						4P	2" Sanitary Flange				
						5P	3" Sanitary Flange				
						6P	4" Sanitary Flange				
						BA	DN 25 PN 16 DIN 2527 Form B Flange				
						BB	DN 25 PN 25/40 DIN 2527 Form B Flange				
						CA	DN 40 PN 16 DIN 2527 Form B Flange				
						CB	DN 40 PN 25/40 DIN 2527 Form B Flange				
						DA	DN 50 PN 16 DIN 2527 Form B Flange				
						DB	DN 50 PN 25/40 DIN 2527 Form B Flange				
						EA	DN 80 PN 16 DIN 2527 Form B Flange				
						EB	DN 80 PN 25/40 DIN 2527 Form B Flange				
						FA	DN 100 PN 16 DIN 2527 Form B Flange				
						FB	DN 100 PN 25/40 DIN 2527 Form B Flange				

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4.6 NOTES

4.6 NOTES (CONTINUED)

ASSURED QUALITY & SERVICE COST LESS

Service Policy

Owners of Solutions With Innovation products may request a return of the product, or any part of the product for complete rebuilding or replacement. Units will be rebuilt or replaced promptly. Products returned under the SWI Service Policy must be returned by prepaid transportation. Solutions With Innovation will repair or replace the product at no cost to the purchaser (or owner) other than transportation if:

- 1 Returned within the warranty period; and
- 2 Factory Inspection finds the cause of the claim to be covered under the warranty.

If the problem is due to circumstances beyond Solutions With Innovation's liability, or is NOT covered by the warranty, there will be charges for labor in addition to the parts required to rebuild or replace the equipment.

In rare cases, it may be expedient to ship replacement parts; or in extreme cases, an entire product before the damaged product is returned. If a quick replacement service is necessary, notify the manufacturer of the damaged product's model and serial number. In such cases, credit for the returned materials will be determined on the applicability of the warranty.

No claims for misapplication, labor, direct or consequential damage will be allowed.

Return Material Procedure

In order to efficiently process any returned materials, it is essential that a *Return Material Authorization* (RMA) number be obtained from the manufacturer prior to an item's return. RMA's can be issued through local representatives, or by contacting the factory directly.

Please supply the following information:

- 1 The Company's Name
- 2 Description of the Material
- 3 Product Serial Number
- 4 Reason for Return
- 5 Product's Application

Used units must be properly cleaned in accordance with OSHA standards before it is returned to the manufacturer. A *Material Safety Data Sheet* (MSDS) must accompany units or materials that were used in any type of media. All return shipments to the factory must be by done via prepaid transportation. All product replacements will be shipped F.O.B. manufacturer.



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