

RLI-80

Non-Contact Radar Level Sensor

Data Sheet No. 262490 Rev. A



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1. About This Document

1.1 Function

This instruction provides the information required for mounting, connection, setup, maintenance, and resolving faults. Please read this information before installing the sensor and putting the instrument into operation and keep this manual accessible.

1.2 Target group

This operating instruction manual is directed for trained personnel. Only properly trained staff should install and/or repair this product.

1.3 Document Online Location

<https://www.gemssensors.com/docs/default-source/resource-files/product-manual/rli-80-data-sheet.pdf>



1.4 Symbols Used



INFORMATION, NOTE, TIP:

This symbol indicates helpful additional information and tips for successful work.



NOTE:

This symbol indicates notes to prevent failures, malfunctions, damage to devices or plants.



CAUTION:

Non-observance of the information marked with this symbol may result in personal injury.



WARNING:

Non-observance of the information marked with this symbol may result in serious or fatal personal injury.



DANGER:

Non-observance of the information marked with this symbol results in serious or fatal personal injury.



EX APPLICATIONS:

This symbol indicates special instructions for Ex applications.



BATTERY DISPOSAL:

This symbol indicates special information about the disposal of batteries and accumulators.

2. Safety

2.1 Authorized Personnel

All operations described in this document must be carried out by trained, and qualified personnel only. Personal protective equipment must always be worn when working with the sensor.

2.2 Appropriate Use

Gems RLI-80 is a non-contact continuous level sensor. Effective and reliable results from the sensor are only possible when used according to the specifications within this document. Individual applications must be reviewed by trained personnel to confirm the RLI-80 can be installed and used appropriately.

2.3 Incorrect Use

Incorrect or inappropriate use of this sensor can increase the likelihood of application hazards not limited to vessel overflow, damage to property, environmental contamination, and damage to the sensor itself.

3. Product Description

The RLI-80 Non-Contact Radar Level Sensor is a no-moving parts continuous level transmitter for reliable performance in challenging OEM and industrial tank level applications. RLI-80 Non-Contact Radar comes standard with 4–20 mA, MODBUS®, and Bluetooth® connectivity for configuration and setup.

The RLI-80 provides accurate level measurement in medias with a dielectric constant of 2 or greater. Constructed of chemically inert PVDF material and designed to withstand IP67 conditions, the RLI-80 withstands the harshest conditions.

The 2" NPT mounting provides adaptability to be used in tanks as large as 49.2 ft (15 m). The RLI-80 is unaffected by changes in physical properties of the application such as pressure, temperature, or vapors.

- Measuring Range up to 49.2 ft (15 m)
- Accuracy: ±0.2 in (5 mm)
- Measurement is Independent of Temperature, Pressure and Moisture Variations
- Minimum Dielectric Constant (er) > 2
- 4–20 mA and MODBUS® Outputs
- Temperature Range: –40° F to +176° F (–40° C to +80° C)
- Pressure: Full Vacuum to 43 PSI (3 bar)
- IP67 Protection
- Approvals: Intrinsically Safe, cULus, CE, ATEX/IECEX

Applications

- Water & Wastewater
- Food & Beverage Process Tanks
- Fuel Tank Farms
- Chlorination Systems
- Cooling Towers
- Water Purification

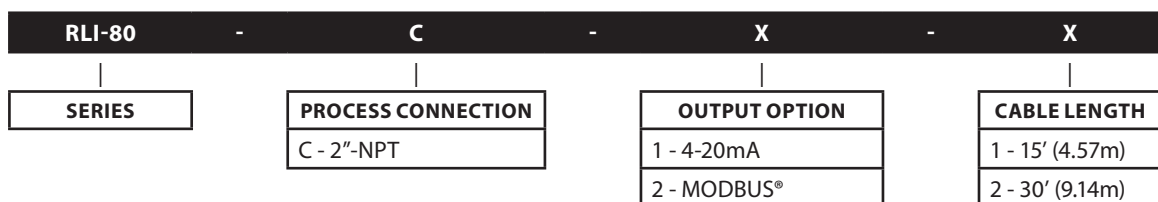
3.1 Specifications

MEDIA	Liquids
DIELECTRIC CONSTANT	Er > 2
MEASURING RANGE	49.21' (15 m)
FREQUENCY	80 GHz
OPERATING PRESSURE	Full VAC to ~43 PSI (3 bar)
OPERATING TEMPERATURE	-40° F to +176° F (-40° C to +80° C)
ACCURACY	± 0.2" (5 mm)
DEAD BAND	2.95" (75 mm)
BEAM ANGLE	8°
MATERIALS (WETTED PARTS)	PVDF (Housing), FKM (Seal)
THREADED CONNECTION	2" NPT, 1 ¼"-12 (Bracket Mounting)
PROTECTION RATING	IP67
INPUT	24-36 VDC
OUTPUT	MODBUS® (4-Wire) or 4-20 mA (2-Wire)
COMMUNICATION INTERFACE	Configurations / Diagnostics via Bluetooth®, View Tank Obstacles & Signal Strength
INDICATION / ADJUSTMENT	Via App on Smartphone or Tablet & Bluetooth®
APPROVALS	cULus, CE, ATEX/IECEX
ELECTRICAL CONNECTION	15' (4.57 m) or 30' (9.14 m) TPE Jacketed Cable

Bluetooth® is a registered trademark of Bluetooth SIG, Inc. in Kirkland, WA.

MODBUS® is a registered trademark of Schneider Electric USA, Inc. in Palatine, IL.

3.2 Part Number Nomenclature



3.3 Sensor Label

The sensor label will have the general specifications of the sensor, including but not limited to the input voltage, the output, FCC, IC information, serial number (s/n), part number (p/n), material, and approval logos. The s/n is important as it is needed to connect the sensor to the Bluetooth® App

3.4 Operating Principle

Radar technology works by sending out short microwave signals toward the liquid via the sensor. The microwave signal then hits the liquid surface and bounces back toward the sensor. The sensor utilizes the time-of-flight principle which uses the known speed of the microwave, and the time it took for the signal to return, divided by two (since it had to travel down to the liquid and then back up to the sensor) to determine the distance between the liquid level and the sensor. Since most level is based on the height of the liquid, not the height of the non-liquid (air), the air height is subtracted from the total tank depth to determine the liquid level.

3.5 Adjustment

RLI-80 comes standard with integrated Bluetooth® connectivity that allows for the application parameters (Sensor Height, Fill Height) to be adjusted via standard smartphone/tablets.

3.6 Accessories

For open tanks you may mount the sensor using the bracket p/n 261977. The device is mounted to the bracket via the 1 ¼"-12 UNF threads at the top of the sensor and the supplied jam nut.



4. Mounting

4.1 General Instructions

The instrument is suitable for standard and extended ambient conditions. It can be used indoors as well as outdoors.



NOTE: FOR SAFETY REASONS, THE INSTRUMENT MUST ONLY BE OPERATED WITHIN THE SPECIFIED PROCESS CONDITIONS NOTED IN THIS DOCUMENT. REVIEW THE WETTED MATERIALS OF THE SENSOR TO ENSURE THAT ALL PARTS OF THE INSTRUMENT EXPOSED TO THE PROCESS ARE CHEMICALLY COMPATIBLE. ENSURE THE PROCESS PRESSURE AND PROCESS TEMPERATURE DO NOT EXCEED THE LISTED SPECIFICATIONS.

4.2 Bracket Mounting

For open tanks you may mount the sensor using the bracket p/n 261977. The device is mounted to the bracket via the 1 ¼"-12 UNF threads at the top and the supplied jam nut. The bracket can be attached to the side of a wall or ceiling. Where possible keep the center of the sensor at least 8" away from the side of the tank wall.

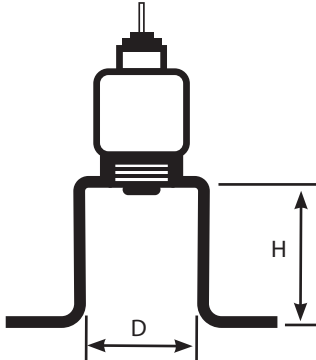
4.3 Process Connection Mounting

For sealed tanks you can use the 2" NPT process connection. For sealed tanks make sure the sealant is compatible with the PVDF housing and that no sealant is placed on the sensor face. Where possible install sensor into a plastic female bung.

4.4 Process Extension Mounting

When mounting within an extended process connection, the tank end of the bung should be smooth and burr-free. The ends should also be rounded, if possible, to not get any false signals. Process extensions should also be

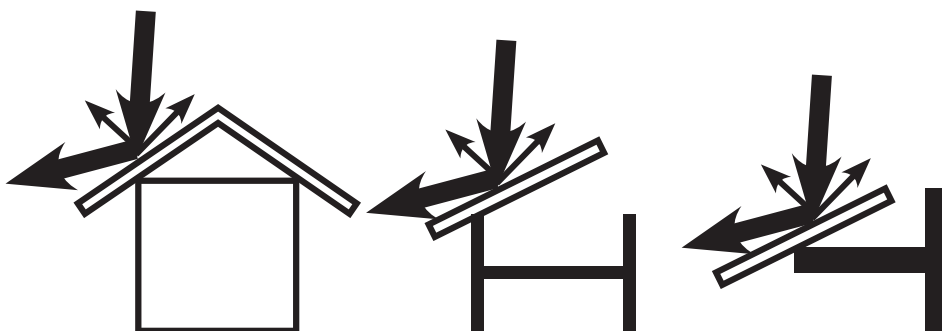
used with medias with higher dielectric constants to ensure a strong return signal. See the below recommended process extension diameters based on bung heights.



BUNG DIAMETER D		BUNG HEIGHT DIAMETER H	
1.5"	40 mm	≤ 5.9"	≤ 150 mm
2"	50 mm	≤ 7.9"	≤ 200 mm
3"	80 mm	≤ 11.8"	≤ 300 mm
4"	100 mm	≤ 15.8"	≤ 400 mm
5"	150 mm	≤ 23.6"	≤ 600 mm

4.5 Sensor Location

Mount the radar sensor in a location where no other equipment or fixtures will encounter the radar beam. Obstructions within the tank or directly outside on plastic tanks (ladders, pipes) can cause false signal returns and disrupt the correct signal from the media. When possible, install the sensor at least 8" away from the tank wall. Large obstructions creating false echoes can also be weakened by installing metal baffles above them to direct the signal away from the radar sensor.



Install the sensor as perpendicular as possible to the media surface to obtain the most accurate measurement readings. The middle of the sensor face is the beginning of the measurement range.

4.6 Sensor Dismounting

 **WARNING: PRIOR TO DISMOUNTING, PLEASE BE AWARE OF ALL DANGEROUS PROCESS CONDITIONS NOT LIMITED TO PRESSURIZED TANK OR VESSEL, HIGH TEMPERATURES, CORROSIVE OR TOXIC MEDIA AND VAPORS. FOLLOW THE DIRECTIONS OF MOUNTING AND ELECTRICAL CONNECTION IN REVERSE ORDER.**

5. Electrical Connection

5.1 Safely Connect

All electrical connections should be carried out by qualified personnel.

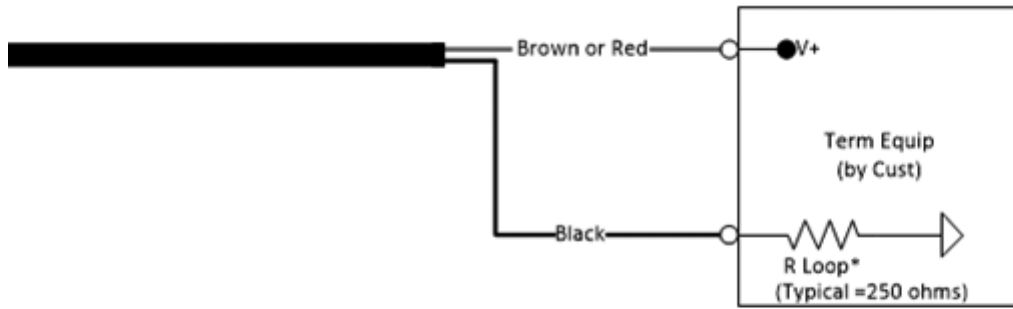
 **WARNING: ONLY CONNECT OR DISCONNECT THE SENSOR WITH THE POWER DE-ENERGIZED.**

5.2 Voltage Supply

 **NOTE: POWER THE SENSOR WITH 24-36 VDC AND USE AN ENERGY LIMITING CIRCUIT NOT TO EXCEED 100 WATTS.**

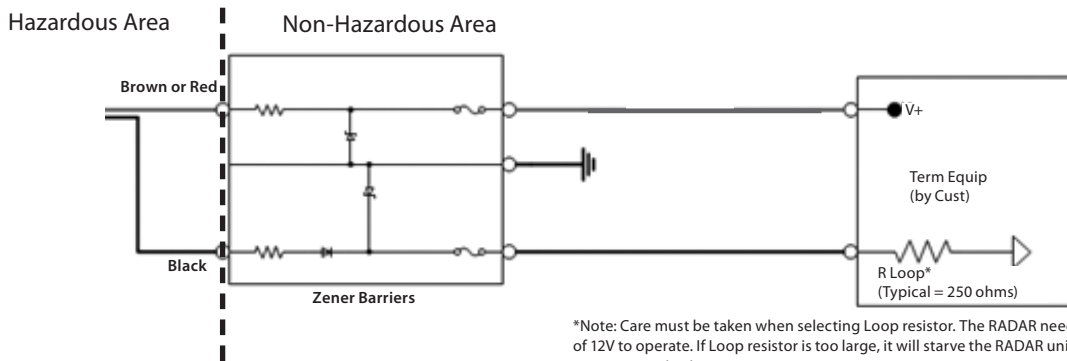
5.3 4-20mA Wiring

Non-Intrinsically Safe



*Note: Care must be taken when selecting Loop resistor. The RADAR needs a minimum of 12V to operate. If Loop resistor is too large it will starve the RADAR unit and erroneous output may occur.

Intrinsically-Safe

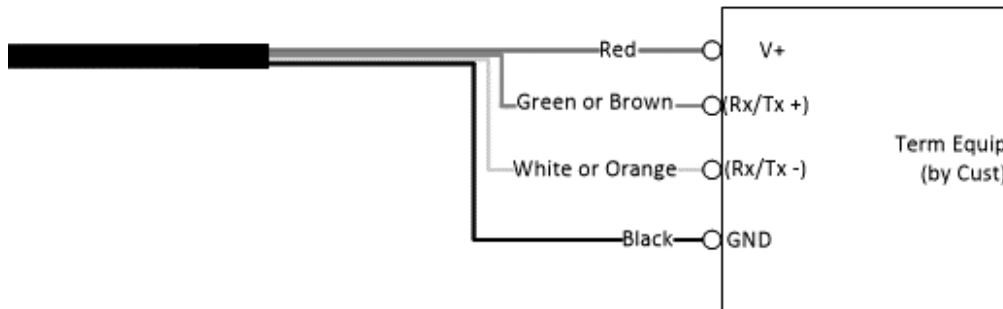


*Note: Care must be taken when selecting Loop resistor. The RADAR needs a minimum of 12V to operate. If Loop resistor is too large, it will starve the RADAR unit and erroneous output may occur.

$$R_{Loop} = R_{Supply\ Barrier} + R_{Return\ Barrier} + R_{Monitoring\ Equipment}$$

5.4 MODBUS® Wiring Diagram

Non-Intrinsically Safe



*Note: RS-485 Half-duplex communication protocol.

Intrinsically safe configuration only available with 4-20mA output.

5.5 Intrinsically Safe Barriers

When using the RLI-80 within a Hazardous Location, intrinsically safe barriers are required. The following barriers are one example that may be used with the RLI-80. Pepperl+ Fuchs Type Z787 P/N 71816.

5.6 MODBUS® Parameters

This RLI-80 uses a RS-485 physical interface to support the MODBUS RTU interface. These are the TX/RX+ and the TX/RX - connections as shown in the wiring harness diagram. The serial interface uses 8 data bits with 1 stop bit. The Baud rate and Parity may be modified by the user using the BLE configuration Application as well as the RTU device ID and other user defined parameters.

This RLI-80 supports the following baud rate options:

TABLE 1: RLI-80 MODBUS RTU BAUD RATES

BAUD
9600 (Default)
19200
38400
57600
115200
921600

This RLI-80 supports the following parity options:

TABLE 2: RLI-80 MODBUS RTU PARITY

BAUD
None
Odd
Even (Default)

Table 3 details the data available by the reading the Input registers.

TABLE 3: RLI-80 INPUT REGISTERS (04)

ADDRESS	REGISTER	DATE TYPE	COMMENTS
0	Update Counter	Uint16	Updated for each radar measurement.
1	Output Range (Meters)	Float (IEEE-754 Format)	Output Range Value Based on latest measurement or average of selected.
2			
3	Latest Range (Meters)	Float (IEEE-754 Format)	Latest Measurement Value (IEEE-754 Format) (Meters)
4			
5	Magnitude	Float (IEEE-754 Format)	Relative Signal Magnitude Value of latest measurement.
6			
7	Percent (Range = 0-100%)	Float (IEEE-754 Format)	Percent Full Value or Percent Empty Value (if selected).
8			
9	Up Time (0.1 Minutes)	Float (IEEE-754 Format)	Up time since power-up.
10			
11	Device Temperature (°C)	Int16	Measured Internal Temperature

12	Current Operational Mode	Uint16	01 - Operational (Default) 02 - Standby (Radar Operation Suspended) 03 - Continuous
13	Error Code	Uint16	Measurement Error Code (TBD) 0 = No Errors
14	Serial Number	Uint32	Device Serial Number
15			
16	Device Name	Char[8]	User-Assigned Device Name (8 character field padded with spaces)
17			
18			
19			
20	Radar Min Range (Meters)	Float (IEEE-754 Format)	Minimum Limit for Radar Processing (User-Defined)
21			
22	Radar Max Range (Meters)	Float (IEEE-754 Format)	Maximum Limit for Radar Processing (User-Defined)
23			
24	Tank Top Range (Meters)	Float (IEEE-754 Format)	Top of Tank Range Setpoint Used for % Calculations & 4-20 Output (User-Defined)
25			
26	Tank Bottom Range (Meters)	Float (IEEE-754 Format)	Bottom of Tank Range Setpoint Used for % Calculations & 4-20 Output (User-Defined)
27			
28	Tank Inversion Mode	Int16	0 = Normal, Bottom: 0% Top: 100% 1 = Inverted, Bottom: 100% Top: 0% (User-Defined)
29	Reserved		TBD
30	Reserved		TBD
31	Reserved		TBD

Table 4 details the available control functions.

TABLE 4: RLI-80 WRITE SINGLE REGISTERS (06)

ADDRESS	REGISTER	DATE TYPE	COMMENTS
0	Operational Mode	Uint16	0 - Normal Measurements at 3 sec. Rate 1 - Standby, Measurements Suspended 2 - Continuous Measurements at 0.5 sec. Rate (Requires 60 mA)
1	Reserved		TBD
2	Reserved		TBD

6. Maintenance

6.1 Basic Maintenance

Typically, no special maintenance is necessary in normal operation. In certain applications, excessive buildup on the sensor face can affect the measurement output and should be cleaned routinely. Use cleaning medias compatible with the sensor housing and seal and use cleaning methods corresponding to the IP rating.

6.2 Basic Troubleshooting

4-20mA or MODBUS® signal missing	<ul style="list-style-type: none"> • Ensure electrical connection is tight and secure. • Ensure sensor is supplied with correct voltage supply. • Ensure the operating voltage is not too low and that the load resistance is not too high. See the wiring diagram.
Current signal less than 3.6 mA or greater than 22 mA (excluding MODBUS®)	<ul style="list-style-type: none"> • Ensure sensor is supplied with correct voltage supply.
Output measurement unchanged during filling	<ul style="list-style-type: none"> • Ensure the sensor face is projecting past the end of the threaded socket. • Remove any buildup on the sensor face. • Eliminate any large obstructions within close range that are causing false signals.
Output measurement increases toward 100% during emptying	<ul style="list-style-type: none"> • Remove any buildup on the sensor face.

6.3 Returns

Standard terms & conditions of sale apply. Refer to the document located online at <https://www.gemssensors.com/docs/default-source/resource-files/terms-conditions/gems-customer-terms>. All RA activity must go through the Gems quality services team. To initiate an RA please go to <https://ecatalog.gemssensors.com/support/ra>

7. Connectivity

7.1 Bluetooth® Access Code

The Bluetooth® access code is required to establish communication between the sensor and the smartphone/ tablet. The access code is the serial number (s/n) which is found on the label of the sensor. The access code only needs to be entered once and is stored in the application.

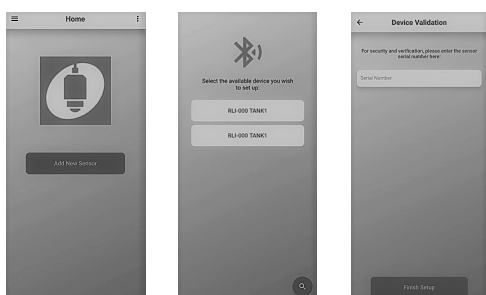
7.2 System Requirements

The smartphone/tablet should have the below operating systems to connect to the sensor correctly.

- - iOS 8 or newer
- - Android 5.1 or newer
- - Bluetooth® 4.0 LE or newer

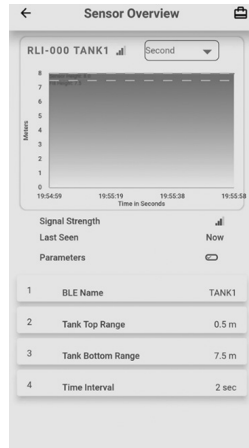
7.3 Connecting

Open the Bluetooth® app and select the “Add New Sensor” option. The smartphone or tablet will search for any Bluetooth® devices in the area. Click on the radar sensor that you would like to set up. Connecting the sensor for the first time will require an authentication code, which is the serial number (s/n). The s/n is located on the sensor label. After the sensor is connected to the app the tank adjustment menu will be displayed.



7.4 Tank Adjustment

Enter the following parameters into the application to set your configuration.



SENSOR HEIGHT:

Distance between the process connection and the minimum level (empty height) (0%).

FULL HEIGHT:

Distance between minimum level (empty height, 0%) and maximum level (fill height, 100%).

LOOP FAIL-SAFE:

Select 4mA, 20mA, or 22mA as your loop fail-safe value. This is the output value that will be sent out if the radar signal is lost.

TANK NAME:

Enter the name of the tank the sensor is installed in. Tank name is limited to 8 characters.

After those parameters are entered, you may exit the setup menu and the configuration will be saved. Your tank parameters can be viewed below the measurement graph.

7.5 Advanced Parameter Settings

The following advanced parameters may be adjusted within the application but are not required.

7.5.1 Scan Start Range

Defines the starting range for radar level processing. Must be less than Scan End Range.

Range: 0.0 – 20.0 meters **Default:** 0.05 meters

7.5.2 Scan Edge Range

Defines the ending range for radar level processing. Must be greater than Scan Start Range.

Range: 0.0 - 20.0 meters **Default:** 3.1 meters

7.5.3 Tank Invert

Sets the output used for 4-20 mA and MODBUS® to report % Empty versus % Full.

Selections: On (% Empty) or Off (% Full) **Default:** Off (% Full)

7.5.4 Average Length

Sets the number of measurements used for range averaging for use in output reporting via 4-20mA or MODBUS®.

Range: 1-16 **Default:** 1 (none)

7.5.5 Sample Period

Sets the time between radar measurements in seconds.

Range: 2-60 seconds **Default:** 2 seconds

7.5.6 History Interval

Sets the number of measurements intervals between each update to the history archive.

Range: 1 (Every Measurement) – 32767 (History Updated Every 32767 Measurements) **Default:** 1

7.5.7 4-20 Error Selection

Sets the loop fail-safe output value that will be sent out if the radar signal is lost.

Selections: 4mA, 20mA, 22mA **Default:** 4mA

7.5.8 MODBUS® Enable

Enables/Disables the MODBUS® RTU interface over RS-485 connection.

Selections: Off, On-Normal (2s Sampling), On-Continuous (500ms Sampling) **Default:** On-Normal

7.5.9 MODBUS® RTU Address

Selects the slave address for communications to the RLI-80 device over MODBUS® RTU protocol.

Range: 1-254 **Default:** 1

7.5.10 MODBUS® Baud Rate Selection

Selects the serial baud rate used for communications to the RLI-80 device over MODBUS® RTU protocol.

Selections: 9600, 19200, 38400, 57600, 115200, 921600 **Default:** 9600

7.5.11 MODBUS® Parity Selection

Selects the serial parity bit used for communications to the RLI-80 device over MODBUS® RTU protocol.

Selections: None, Odd, Even **Default:** Even

7.5.12 BLE Name

Allows customization of the tank name the RLI-80 device is installed on. For example: the default name is "TANK1", so resulting name is "RLI-*nnn* TANK1" where "*nnn*" is the last 3 digits of the RLI-80 serial number.

Selection: Text Entry up to 8 Characters **Default:** TANK1 (Resulting Name: RLI-*nnn* TANK1)

7.5.13 4-20 mA Adjustments

Allows fine tuning of the 4-20mA output. Updates to these values should be done via a process that forces the device into a forced 0% (4mA) or 100% (20mA) mode.

4 mA Adjustment:

Allows fine tuning of the 4mA output level to adapt to different supply and load resistor configurations.

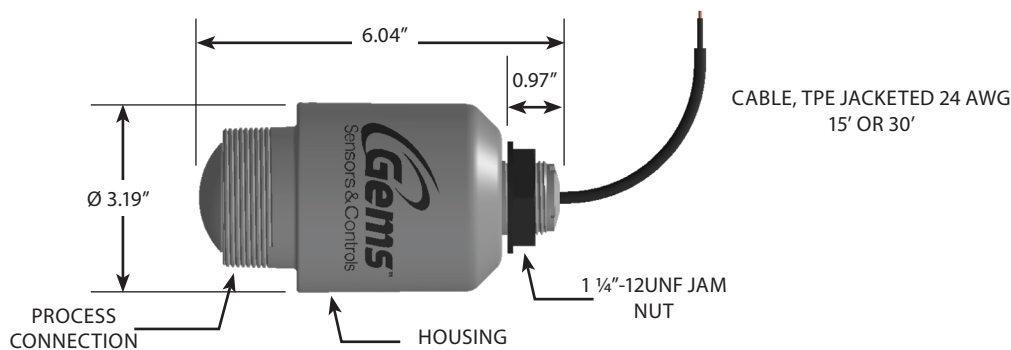
Range: -150 to +150 **Default:** 0

20 mA Adjustment:

Allows fine tuning of the 20mA output level to adapt to different supply and load resistor configurations.

Range: -150 to +150 **Default:** 0

8. Dimensions



9. Certificates & Approvals

9.1 Radio Licenses

1) FCC Interference Statement (Part 15.105 (b))

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

2) FCC Part 15 Clause 15.21:

“Changes or modifications not expressly approved by the party responsible for compliance could void the user’s authority to operate the equipment”

3) FCC Part 15.19(a) [interference compliance statement], unless the following statement is already provided on the device label:

“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.”

4) ISED RSS-Gen Notice (in English and French):

“This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada’s licence-exempt RSS(s). Operation is subject to the following two conditions:

- This device may not cause interference.
- This device must accept any interference, including interference that may cause undesired operation of the device. .”

“L’émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d’Innovation, Sciences et Développement économique Canada applicables aux appareils radio exempts de licence. L’exploitation est autorisée aux deux conditions suivantes :

- L’appareil ne doit pas produire de brouillage;
- L’appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d’en compromettre le fonctionnement. .”

5) ISED Canada ICES-003 Compliance Label (CAN BE PROVIDED ON LABEL OR in MANUAL):

“CAN ICES-3 (B)/NMB-3(B)”

9.2 Hazardous Location Approvals

This device has the following Intrinsically Safe approvals. UL/c-UL for Class I, Division 1, Groups A, B, C, and D; Class II, Division 1, Groups E, F, and G; Class III, Division 1; Zone 0, Group IIC, AEx/Ex ia IIC T4 Ga; and ATEX/IECEx/UKEx Zone 0, Group IIC, II 1G Ex ia IIC T4 Ga

9.3 EU Conformity

The device satisfies the legal requirements of the applicable EU directives. The CE marking confirms the conformity of the Radar sensor with these directives.

10. Contact Information

Toll Free: 1-855-877-9666

Outside the US: 860-747-3000

Contact Email: is@gemssensors.com

