The Ultrasonic Point Level Control produces an 8mA or 16mA current to indicate liquid presence/absence within a sensor cavity. Two piezoelectric crystals face each other across the sensor cavity. One crystal transmits an ultrasonic signal; the other crystal receives the signal.

When the sensor cavity is empty, the receiver detects a weak signal because air is a poor conductor of ultrasonic waves.

When process liquid fills the sensor cavity, the receiver detects a strong signal because liquids are good conductors of ultrasonic waves.

The wet probe switch inside the electronics housing switches between 8mA and 16mA output in the wet probe condition. Internal LEDs indicate the current output over the loop. A red LED indicates 16mA current output, and a yellow LED indicates 8mA current output.

An optional timer is available to delay the current change from 0 seconds to 10 minutes. The delay timer provides added process control, valuable for use in turbulent conditions.

NOTE: If you suspect that a product is defective, contact the factory or the SOR® Representative in your area for a return authorization number (RMA). This product should only be installed by trained and competent personnel.

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<th>Table of Contents</th>
</tr>
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</table>
**Installation**

Ultrasonic Level Sensors can be mounted by inserting the sensor through a fitting in a vessel, or the sensor may be suspended over an open sump or basin.

Keep the sensor cavity out of the direct flow of liquid fill to prevent false readings. Install a baffle to divert liquid flow if necessary.

Avoid installation of sensor in turbulent areas such as pump discharge or suction. Air pockets may be present in these areas which may cause false indication.

**WARNING**  
*DO NOT weld any part of this instrument.*

**Tank or Vessel**

Make sure that the sensor can be fully inserted and tightened without interference from obstructions inside the tank or vessel. (See A). The sensor cavity must clear the inner wall by one inch/25.4 mm. (See B)

Apply suitable sealant to the process connection to prevent process leakage. (See A)  
Use an open end wrench to tighten the sensor into the process connection.  
Do not use the sensor base as a handle to tighten the process connection.

**Horizontal Mounting**

Horizontal mounting is recommended for use in highly viscous liquids, or liquids containing sludge and debris. When tightened securely, the sensor cavity must be perpendicular to the liquid surface for optimum drainage when process liquid level drops below the sensor cavity.

An alignment mark X stamped on a wrench flat (or on the dry face of a flange below the housing) shows sensor cavity orientation. (See B)

Optimum drainage occurs when the X mark is located at 6 or 12 o’clock. The sensor must project through a tank fitting so that the sensor cavity is at least 1” beyond the inner wall of the tank. (See B)
Open Sump or Basin
Do not suspend the unit by rigid conduit installed in the electrical hub. When installing the unit over an open sump or basin, use a suitable bracket to support the instrument.

NOTE: The instrument must be positioned so that overflow does not flood electrical housing. (See C)

Remote Cable Connection
Conduit must be installed between the sensor base and the electronics housing to provide a raceway for sensor extension cables. (See D) The sensor base and the electronics housing are suitable for use in Class I Group C & D; Class II Groups E, F & G; Division 1 & 2 Hazardous Locations. All conduit and fittings used for the installation must equal or exceed this rating to maintain the explosion proof integrity of the assembly.

Fishing the sensor extension cables
Two sensor extension cables are supplied. Both ends of the cables are terminated and labeled at the factory. Use care to avoid damaging the factory installed coax connectors while fishing the sensor extension cables through the conduit. Pull cables from the electronics housing so that the free ends follow the fish through the conduit. (See D)
**Electrical Connection**

Ensure that wiring conforms to all applicable local and national electrical codes and install unit(s) according to relevant national and local safety codes.

**Sensor Coax Connections Inside Sensor Base**
Inside the sensor base, a remote interconnect board rests in a plastic holder. Slide the interconnect board up. Attach the sensor coax connectors to the interconnect board as follows:

1. Connect cable A to IN 1.
2. Connect cable T to IN 2.

Attach the extension cables to the interconnect board as follows:
3. Connect cable A to OUT 1.
4. Connect cable T to OUT 2. (See E)

Plug in Connections inside Electronics Housing Plug sensor extension cables onto the PC board as follows:
5. Connect cable A to J1.
6. Connect cable T to J2. (See H to locate J1 and J2.)

---

**Units in Hazardous Locations — Prior to calibration, make sure that the work area is declassified before removing the explosion proof cover to calibrate the unit. Failure to do so could result in severe personal injury or substantial property damage.**

**Electrical power must be disconnected from explosion proof models before the cover is removed. Failure to do so could result in severe personal injury or substantial property damage.**
Ensure that wiring conforms to all applicable local and national electrical codes and install unit(s) according to relevant national and local safety codes.

1. Make sure the power source is turned off.
2. Remove the housing cover.
3. Pull power and signal wires through the conduit connection and into the control housing.
4. Locate TB1 on the control board. (See F) Terminals are labeled “+” and “-“. Connect power leads to the proper terminals.
5. Do not exceed the maximum loop resistance for the circuit. (See G)
Calibration and Functional Test

**Units in Hazardous Locations — Prior to calibration, make sure that the work area is declassified before removing the explosion proof cover to calibrate the unit. Failure to do so could result in severe personal injury or substantial property damage.**

No calibration is needed. Units are calibrated at the factory. No user adjustments are required.

Functional test may be done with or without a current meter. See [F] for wiring configuration. See Figure 8 for component location.

1. Connect power to the circuit board as shown in [F].
2. With a dry sensor, move the Wet Probe Switch (see [H]) to 8mA position. The red LED will light. The current meter will read 16mA (±1 mA).
3. Apply process liquid to the sensor. The red LED will turn off, and the yellow LED will light. The current meter will read 8mA (±1 mA).
4. With liquid still applied to the sensor, move the Wet Probe Switch to the 16mA position. The yellow LED will turn off, and the red LED will light. The current meter will read 16mA (±1 mA).
5. Remove the liquid from the sensor. The red LED will turn off, and the yellow LED will light. The current meter will read 8mA (±1 mA).

**Delay Timer Operation (DT accessory)**

<table>
<thead>
<tr>
<th>Yellow LED (Dry)</th>
<th>Red LED (Wet)</th>
<th>Current Meter (+ 1mA)</th>
<th>Sensor Status</th>
<th>Wet Probe Switch Position</th>
</tr>
</thead>
<tbody>
<tr>
<td>○</td>
<td>●</td>
<td>8mA</td>
<td>Wet</td>
<td>8mA</td>
</tr>
<tr>
<td>●</td>
<td>○</td>
<td>16mA</td>
<td>Dry</td>
<td>8mA</td>
</tr>
<tr>
<td>●</td>
<td>●</td>
<td>16mA</td>
<td>Wet</td>
<td>16mA</td>
</tr>
<tr>
<td>○</td>
<td>○</td>
<td>8mA</td>
<td>Dry</td>
<td>16mA</td>
</tr>
</tbody>
</table>
The delay timer is present in units which contain a DT near the end of the model number. Time delays are available as shown in the Time Delay Switch Settings chart below. Two sets of switches located inside the electronics housing control the delay timer. (See)

On Delay = sensor dry → sensor wet
Off Delay = sensor wet → sensor dry

1. Remove the housing cover.
2. Locate off and on delay switches. (See)
3. Set the on and off delay timers by moving the switches according to the chart below.

### Time Delay Switch Settings

<table>
<thead>
<tr>
<th>Delay (seconds)</th>
<th>Position 1</th>
<th>Position 2</th>
<th>Position 3</th>
<th>Position 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>1</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>2</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>5</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>10</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>15</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>20</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>30</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>45</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>60</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>90</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>OFF</td>
</tr>
<tr>
<td>120</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>180</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>240</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>300</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
<td>ON</td>
</tr>
<tr>
<td>600</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
<td>OFF</td>
</tr>
</tbody>
</table>
### Troubleshooting

<table>
<thead>
<tr>
<th>Symptom/Problem</th>
<th>Possible Cause</th>
<th>Corrective Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>No current in the loop</td>
<td>1. Power supply turned off. 2. Improperly wired terminal block TB1. 3. Broken power supply wire.</td>
<td>1. Check power supply source. 2. Check terminal block wiring per F. 3. Check loop wire integrity.</td>
</tr>
<tr>
<td>No LEDs lit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Current is greater than 20mA</td>
<td>1. Incorrectly wired circuit</td>
<td>1. Check current loop wiring per F.</td>
</tr>
<tr>
<td>Current is 8mA when 16mA is expected or current is 16mA when 8mA is expected.</td>
<td>1. Wet probe switch is in the wrong position. 2. Time Delay has not timed out (units with DT accessory only).</td>
<td>1. Set wet probe switch to proper position. 2. Check time delay switches and wait for timeout or set new timeout or cycle power (turn off power then turn it back on.)</td>
</tr>
</tbody>
</table>

If corrective action is not effective, please consult the factory.

*NOTE: Agency certified units, (FM, CSA, IEC) must be returned to SOR for repairs.*

### Sensor Replacement

1. Disconnect power to the unit.  
2. Remove the housing cover.  
3. Slide out PC board to expose the sensor connections J1 and J2. (See H)  
4. Disconnect the sensor wires from J1 and J2.  
5. Unscrew the sensor from the housing.  
6. Apply thread sealant to the male threads of the new sensor.  
7. Thread the new sensor into the bottom of the housing.  
8. Connect one sensor wire into the J2 mini-phono jack on the circuit board.  
9. Connect the other sensor wire into the J1 miniphone jack on the circuit board.  
10. Slide the PC board into the grooves in the plastic ring inside the housing.  
11. Reconnect power and replace the housing cover.

**Replacement Sensors**  
See Form 973 Ultrasonic Catalog for replacement sensor model numbers.
**Circuit Board Replacement**

1. Disconnect power to the unit.
2. Remove the housing cover.
3. Slide out PC board.
4. Disconnect power wiring and sensor plugs J1 and J2. (See [Illustration]) Remove the ground screw in the housing bottom.
5. Slide the ring terminal over the ground screw and replace it into the housing bottom.
6. Slide the new board into the control housing.
7. Connect the sensor plugs to the new board. One sensor wire plugs into J2. The other sensor wire plugs into J1.
8. Reconnect power and replace the housing cover.

**Replacement Circuit Boards**

Match the characters of your model number with those shown below to select the proper replacement board part number. Accessory designators are located at the end of the model number in no particular order.

<table>
<thead>
<tr>
<th>Accessory Designator</th>
<th>Model Number with DT</th>
<th>Model Number without DT</th>
</tr>
</thead>
<tbody>
<tr>
<td>701 □ 4-U-P9-C</td>
<td>38-123</td>
<td>38-125</td>
</tr>
</tbody>
</table>

**Cable Shielding**

In order to achieve the stated accuracy of +/-1mA, a shielded cable, cable gland and shielded beads must be used. SOR recommends using a shielded cable made of PVC insulation around a tinned copper braid shield (Offlex CY cable or equivalent). Refer to illustrations below for installation of shield beads.

**Probe Wire Shield Bead**

- Short/Fat Bead

**Power Wire Shield Bead**

- Install end of bead as close to cable gland as possible
- 2 loops
- Positive (+)
- Negative (-)
- Long/Slender Bead

2 loops
Dimensions

Remote Unit Electronics Housing

Dimensions are for reference only. Contact the factory for certified drawings for a particular model number.

Integral Unit or Remote Unit Sensor Housing

Linear = mm/inches

Drawing 0390529

Linear = mm/inches

Drawing 0390415
Control Drawing

SENSOR/ELECTRONICS COMBINATIONS

<table>
<thead>
<tr>
<th>ELECTRONICS</th>
<th>SENSOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>701</td>
<td>371U</td>
</tr>
<tr>
<td>711</td>
<td>371N</td>
</tr>
<tr>
<td>721</td>
<td>371N</td>
</tr>
<tr>
<td>712</td>
<td>372N</td>
</tr>
<tr>
<td>722</td>
<td>372N</td>
</tr>
</tbody>
</table>

NOTE:
1. ONLY THOSE FMRC APPROVED SENSOR/ELECTRONICS COMBINATIONS LISTED ABOVE ARE VALID.
2. SENSOR/ELECTRONICS COMBINATION IS CERTIFIED FOR THE LESSER HAZARDOUS LOCATION RATING OF THE SENSOR OR THE ELECTRONICS HOUSING. FOR EXAMPLE THE ASSEMBLY OF A GROUP B SENSOR WITH A GROUP C HOUSING IS CERTIFIED FOR GROUP C.
3. WIRING SHALL BE INSTALLED IN COMPLIANCE WITH THE NATIONAL ELECTRIC CODE FOR HAZARDOUS (CLASSIFIED) LOCATIONS. SUITABLE LISTED SEAL FITTINGS SHALL BE INSTALLED WITHIN 18" OF EACH ENCLOSURE ENTRANCE.
4. A MINIMUM OF 5 FULL THREAD ENGAGEMENT FOR ALL NPT THREAD JOINTS AND BETWEEN PROBE AND HOUSING CONNECTIONS IS REQUIRED PER NEC.

THIS DRAWING NOT TO BE CHANGED WITHOUT FM APPROVAL.
SERIES 700 TRANSMITTER
FM APPROVED
INTRINSICALLY SAFE (ENTITY)

CLASS I, II, III, DIVISION 1, GROUP C, D, E, F, G
HAZARDOUS LOCATION
SERIES 7XXX-X-P9-X-FI

NON-HAZARDOUS LOCATION
INTRINSIC SAFETY BARRIER

4-20 mA SIGNAL LEADS
GROUND

SERIES 371-XXXX-XXX-FI
SENSING ELEMENT

HAZARDOUS AREA TERMINALS
NON-HAZARDOUS AREA TERMINALS

ENTITY PARAMETERS
V_{\text{max}} = 30V
C_i = 12\mu F
L_i = 1600\mu H
I_{\text{max}} = 100mA (GP C-6)

NOTES
1. FMRC ENTITY APPROVED BARRIER, USED IN AN APPROVED CONFIGURATION WHERE BARRIER V_{oc} OR V_1 DOES NOT EXCEED TRANSMITTER V_{\text{max}} AND BARRIER I_{sc} OR I_1 DOES NOT EXCEED TRANSMITTER I_{\text{max}}. CI OF TRANSMITTER PLUS CAPACITANCE OF INTERCONNECTING WIRING MAY NOT EXCEED BARRIER C_i. LI OF TRANSMITTER PLUS INDUCTANCE OF INTERCONNECTING WIRING MAY NOT EXCEED BARRIER L_i.

2. CONTROL ROOM EQUIPMENT SHALL NOT USE OR GENERATE OVER 250 VOLTS.

3. INSTALL IN ACCORDANCE WITH THE NATIONAL ELECTRICAL CODE (NFPA 70)

4. FOR INTRINSICALLY SAFE CLASS II AND III DIV 1, GP E, F AND G INSTALLATIONS WHERE CONDUIT IS NOT USED, INSTALL CABLE GLAND FITTING WHICH IS LISTED FOR CLASS II AND III HAZARDOUS (CLASSIFIED) LOCATIONS.

5. INSTALL INTRINSIC SAFETY BARRIER PER BARRIER MANUFACTURER’S INSTRUCTIONS.

THIS DRAWING NOT TO BE CHANGED WITHOUT FACTORY MUTUAL APPROVAL
Control Drawing

NOTE:
1. ONLY THOSE SENSOR/ELECTRONICS COMBINATIONS LISTED ABOVE ARE VALID.
2. SENSOR/ELECTRONICS COMBINATION IS CERTIFIED FOR THE LESSER HAZARDOUS LOCATION RATING OF THE SENSOR OR THE ELECTRONICS HOUSING. FOR EXAMPLE, THE ASSEMBLY OF A GROUP B SENSOR WITH A GROUP C HOUSING IS CERTIFIED FOR GROUP C.
3. WIRING SHALL BE INSTALLED IN COMPLIANCE WITH APPLICABLE CSA EXPLOSION PROOF STANDARDS FOR HAZARDOUS LOCATIONS.

SENSOR/ELECTRONICS COMBINATIONS

<table>
<thead>
<tr>
<th>ELECTRONICS</th>
<th>SENSOR</th>
</tr>
</thead>
<tbody>
<tr>
<td>701</td>
<td>371U</td>
</tr>
<tr>
<td>711</td>
<td>371N OR 371G</td>
</tr>
<tr>
<td>721</td>
<td>371N OR 371G</td>
</tr>
<tr>
<td>712</td>
<td>372N</td>
</tr>
<tr>
<td>722</td>
<td>372N</td>
</tr>
</tbody>
</table>

CONDUIT ADAPTER SUPPLIED WITH HOUSING

701 L3, K3
711 L3, K3
712 L3, K3
721 L3, K3
722 L3, K3

701 K1
711 K1

721 K2
721 R2

701 R4

701 R3
722 R3

712 R3

701 R1
711 R1

USE ADAPTER SUPPLIED WITH HOUSING

(TIP TYPE)
HAZARDOUS AREA
SERIES 700 P9 TRANSMITTER

SAFE AREA
BARRIER
11-28VDC POWER SUPPLY

GROUND

ENTITY PARAMETERS
V_{max} = 28V
I_{max} = 100 mA
C_i = 12 nF
L_i = 1600 μH

371 SERIES SENSOR

GROUNDED BUS BAR

EACH GROUND LEAD SHOWN MUST BE
1 OHM OR LESS TO EARTH GROUND

1. BARRIERS MUST BE INSTALLED IN ACCORDANCE WITH MANUFACTURERS INSTRUCTIONS.

2. BARRIER PARAMETERS MUST MEET THE FOLLOWING REQUIREMENTS:
   V_{oc} \leq V_{max}
   C_a \geq C_i + C_{cable}
   I_{sc} \leq I_{max}
   L_a \geq L_i + L_{cable}

3. MAXIMUM NON-HAZARDOUS AREA VOLTAGE MUST NOT EXCEED 250 V.

4. INSTALL IN ACCORDANCE WITH CANADIAN ELECTRICAL CODE, PART I.

Exia INTRINSICALLY SAFE/SECURITE INTRINSEQU
WARNING: SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY.
ADVERTISSEMENT: LA SUBSTITUTION DE COMPOSANTS PEUT COMPROMETTRE LA SECURITE INTRINSEQU

THIS DRAWING NOT TO BE CHANGED WITHOUT CSA APPROVAL.