Monitor liquids and powder bulk solids with the **Series RFC RF Capacitance Point Level Switch**. Microprocessor based Series RFC provides a 5 amp DPDT relay output for level detection. Heavy material build-up on the probe does not effect operation.

Unit is designed with integral electronics and includes one-touch calibration. Series RFC features LED indication (located inside the housing) of relay and probe status, adjustable time delay, high/low failsafe, and NEMA 4X (IP 56) enclosure.

**OPERATION**

The Series RFC responds to a change in the low energy electrical field present on the Active sensing element of the probe, the on-board relay transfers to a field selectable energized or de-energized state. This change occurs because the process material has a greater ground potential as it covers the probe. In electronic terms, this is described as a capacitance, impedance, or admittance change.

Accumulated build-up on the probe is ignored via Dwyers unique drive guard. The drive guard produces a force field over the build-up; the ground potential of the build-up is removed leaving only the process level to be detected. The guard element should protrude at least one inch into the process beyond the mounting nozzle.

Typically, ground referencing the process material is accomplished by threading the probe to a metallic tank. In effect, the tank becomes the ground reference for the process material.

Non-metallic tanks require a ground reference near the probe for optimum performance. A grounded pipe or plate can serve this purpose. Feel free to review this with Dwyer if a vessel's ground is in question.

**SPECIFICATIONS**

- **Service:** Liquids and powder bulk solids.
- **Wetted Materials:** 316 SS probe with Polyphenylene Ether and Polystyrene PPE & PS guard.
- **Temperature Limits:** Electronics: -40 to 160°F (-40 to 71°C).
- **Pressure Limits:** 650 psig (44.8 bar).
- **Enclosure:** NEMA 4X (IP56), dust tight, water resistant.
- **Switch Type:** DPDT.
- **Electrical Rating:** 5A @ 115/230 VAC non-inductive.
- **Power Requirements:** 110/220VAC.
- **Conduit Connector:** 3/4˝ female NPT.
- **Process Connector:** 3/4˝ male NPT.
- **Mounting Orientation:** Vertical.
- **Sensitivity:** Factory set @ 5 pF, adjustable to < 2 pF.
- **Fail-Safe:** Selectable high/low.
- **Time Delay:** Adjustable 50 ms to 30 seconds.
- **Weight:** 5.0 lb (2.3 kg).

The amount of capacitance generated in a given application is depended upon the dielectric constant of the process material, the distance from the sensing probe to earth ground, or a ground reference, and by the size (surface area) of the sensing probe.

Assuming that the dielectric constant of the process material is consistent, and that the sensing elements mounting location is fixed, the amount of capacitance generated is based upon the sensing elements overall size or area.

When the process material fluctuates in the vessel, the amount of capacitance generated between the sensing element and the vessel wall or ground also fluctuates.

**INSTALLATION**

**Unpacking**

Remove the Series RFC carefully from the shipping carton. Check to make certain that no damage has occurred to the electronics or to the sensing probe. If the equipment has been damaged, notify the carrier immediately.
Mounting Location

Note: Avoid mounting in the fill stream.

The Series RFC should be installed and mounted in an environment where temperatures are no less than -40°F (-40°C) and no greater than 165°F (73°C).

Normally, when installed in metallic vessels, the vessel wall serves as the ground reference. It is important to the overall operation of the system that a good connection is made between the sensing probe and the vessel. If in doubt, connect a separate ground strapping wire between the Series RFCs housing and the metal vessel.

When installed in vessels containing conductive liquids, the location of the probe in relationship to the vessel wall is not critical. When the Series RFC is used to monitor materials that have low dielectric values (non-conductive materials or materials with a dielectric value <20) special provisions should be made to locate the sensing probe within 10 inches of the vessel wall. If this cannot be accomplished, an artificial ground reference (metal pipe or rod) should be considered. This will enhance the units sensitivity and operation.

Note: Mount at least 24 inches from the other Radio Frequency (R.F.) probes that are in the same plane.

For applications where the Series RFC is being used in non-metallic vessels, i.e. plastic, fiberglass, or concrete, or in horizontally mounted vessels, an artificial ground reference that runs parallel to the sensing probe must be used. Typically, this can be accomplished by mounting a steel pipe parallel to the probe. A permanent wire connection from the ground reference to the Series RFCs housing completes the ground reference. Avoid mounting the ground reference where process material can remain bridged between the active probe element and the ground reference.

Installation Procedure

Note: The probe equipped with the Series RFC is a sealed gland. Do not separate the probe bushing during installation or removal.

1. Insert the entire probe assembly into the vessel and torque using a wrench on the smaller hex bushing. Max. torque: 120 ft/lb. Pipe dope or plumbers tape is recommended.

2. Conduit requirements are 3/4” NPT. To prevent accumulation of moisture in the housing, conduits should enter from a lower point of elevation.

Wiring Procedure

WARNING: Do not attempt to wire the unit with live power. Remove power until connections are complete. Power and relay wiring should comply with NEC (National Electrical Code) standards and specifications. When selecting wire for power relay connections use a light gauge, 14 to 22 AWG insulated wire.

Power Wiring

1. Make certain power is disconnected.
2. Run power wires through conduit.
3. When using 110/220 VAC, connect the hot wire to the appropriate terminal, 110 VAC to #1, 220 VAC to #3. Connect neutral to terminal #2. Connect an earth ground to the supplied ground screw attached to the housing.

Wiring Terminal

Relay Wiring

The relay contacts on 110/220 VAC unit are form C Dry Contacts. Power must be supplied to the relay contacts, typically, by using a jumper between the power terminal and the common terminal on the relay. See Wiring Terminal for relay terminal designation.

Relay Wiring Truth Tables

Fail-safe relay connections can be determined by the following truth tables.

JUMPER JP5 “BRIDGED” = Low Fail-Safe Position

<table>
<thead>
<tr>
<th></th>
<th>Probe Covered</th>
<th>Probe Exposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>RED LED</td>
<td>ON</td>
<td>OFF</td>
</tr>
<tr>
<td>RELAY</td>
<td>ENERGIZED</td>
<td>DE-ENERGIZED</td>
</tr>
<tr>
<td>RELAY N.C.</td>
<td>OPEN</td>
<td>CLOSED</td>
</tr>
<tr>
<td>RELAY N.O.</td>
<td>CLOSED</td>
<td>OPEN</td>
</tr>
</tbody>
</table>

JUMPER JP “NOT BRIDGED” = High Fail-Safe Operation

<table>
<thead>
<tr>
<th></th>
<th>Probe Covered</th>
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<tr>
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<td>CLOSED</td>
</tr>
</tbody>
</table>

Adjustment Controls

Component Description

Refer to Board Layout at right for the location of the components.

Output Status:
Red LED: Illuminates when the relay is energized. Relay remains in fail-safe selection during fault detection.

System Status:
Orange LED: This LED stays illuminated through entire detection process. LED flashes for broken probe wire.
**Calibration Status:**
Yellow LED: This LED flashes five times during calibration and stays illuminated through entire detection process.

**Black “CAL” Button: (TOP)**
This push button initializes calibration when material is at least six inches below the probe. When the button is depressed for at least two seconds, the probe conditions are stored in memory.

**White “CAL” Button: (BOTTOM)**
This push button initializes calibration when material is covering the probe. When the button is depressed for at least two seconds, the probe conditions are stored in memory.

**Fail-Safe Jumper (JP5):**
Fail-safe high or fail-safe low does not indicate the physical location of the sensor installed in the vessel. However, the fail-safe jumper determines if the relay is de-energized when the product is above (fail-safe high, bridged) or below (fail-safe low, not bridged) the operation point.

**Time Delay:**
This single turn potentiometer will delay the relay up to 30 seconds after detection occurs. Delay acts on both presence and absence of the process level.

**CALIBRATION**
All Series RFC's are shipped factory calibrated and should not require further adjustment. However, some applications may require calibration after installation.

There are three calibration procedures available depending on your application. We have labeled them Factory Setting, One-Button, and Two-Button below. Identify your application in the chart and follow the corresponding calibration procedure.

**Board Layout**
![Board Layout Diagram]

NOTE: To reset the unit to factory settings, hold both “CAL” buttons down for approximately five seconds. The Yellow and Orange LED’s will flash five times and the unit will default to the original Factory Settings.

<table>
<thead>
<tr>
<th>Calibration Procedure</th>
<th>Typical Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Factory-Setting</td>
<td>Bulk solids with a moisture content of 16% or greater and that have a bulk density of at least 40 lbs/ft³. Conductive liquids with dielectric values greater than 30. Covers 75% of all applications.</td>
</tr>
<tr>
<td>One-Button</td>
<td>Dry bulk powders from 15 to 40 lbs/ft³. Liquids that have a dielectric constant greater than 5 but less than 30. Covers 95% of applications.</td>
</tr>
<tr>
<td>Two-Button</td>
<td>Dry bulk powders from 8 to 15 lbs/ft³. Non-conductive liquids that have a dielectric constant of 5 or less. Covers 99%+ of all applications.</td>
</tr>
</tbody>
</table>

**“Factory” Calibration Procedures**
This calibration procedure uses the factory settings for sensitivity and therefore requires only two steps to calibrate.

**Step 1** - Determine the fail-safe mode required for your application. The fail-safe jumper position determines if the relay is energized when the product is above or below the operating point.

<table>
<thead>
<tr>
<th>Fail-safe</th>
<th>Relay De-energized</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Level</td>
<td>Material covers the probe, JP5 “bridged”.</td>
</tr>
<tr>
<td>Low Level</td>
<td>Material is below the probe, JP5 “not bridged”.</td>
</tr>
</tbody>
</table>

**Step 2** - Verify operation. Red LED and output should transfer at the desired detection point.

**CALIBRATION COMPLETE**

**“One-Button” Calibration Procedure**
Step 1 - Determine the fail-safe jumper position determines if the relay is energized when the product is above or below the operating point.

**Step 2** - Determine if you will calibrate the unit with the probe covered or uncovered by the process material. To calibrate with the probe covered, move to Step 3. For uncovered calibration, lower the level to a point where the process material is at least 6 inches below the probe. Hold the Black “CAL” button (uncovered) down until the Yellow LED begins to flash. The Yellow LED will flash five times. Proceed to Step 4.

**Step 3** - Hold the White “CAL” button (covered) down until the Yellow LED begins to flash. The Yellow LED will flash five times.

**Step 4** - Verify operation. The Yellow LED should remain illuminated through the entire “No Fault” operation. The Red LED and output should transfer at the desired detection point.

**CALIBRATION COMPLETE**

**“Two-Button” Calibration Procedure**
Step 1 - Determine the fail-safe mode required for your application. The fail-safe jumper position determines if the relay is energized when the product is above or below the operating point.

**Step 2** - Lower the level to a point where the process material is at least 6 inches below the probe. With the probe uncovered, hold the Black “CAL” button (uncovered) down until the Yellow LED begins to flash. The Yellow LED will flash five times.

**Step 3** - Raise the level to a point where the probe is completely covered by the process material. With the probe covered, hold the White “CAL” button (covered) down until the Yellow LED begins to flash. The Yellow LED will flash five times.
Step 4 - Verify operation. The Yellow LED should remain illuminated through the entire “No Fault” operation. Red LED and output should transfer at the desired detection point.

CALIBRATION COMPLETE

TROUBLESHOOTING

Electronics Test:
Step 1 - Remove the banana plug from the sensing probe. Make sure the banana plug is exposed to air.

Step 2 - Hold the Black “CAL” button down until the Yellow LED begins to flash. The Yellow LED will flash five times.

Step 3 - Grab the active section of the banana plug. The Red LED should change state. If the Red LED does not change state, repeat Step 2 while holding the active section of the banana plug and pressing the White “CAL” button.

Probe Test:
The probe equipped with the Series RFC has three steel elements. Each element is insulated from the other.

- **Ground**: is the bushing that provides the process connection.
- **Guard**: is the shorter probe element connected to the electronics by a quick disconnect lug.
- **Active**: is the center rod, longest element connected to the electronics by a banana connector.

Step 1 - Remove Power.

Step 2 - Unplug the quick disconnects from the guard and the banana plug from the Active probe element.

Step 3 - Connect an Ohmmeter to the Guard and the Active elements of the probe. Polarity does not matter. A non-covered or a probe in non-conductive material should have a resistance reading greater than 10 meg Ohms.

Step 4 - Check resistance between the Guard and the Ground. (A reading greater than 10 meg Ohms indicates the probe is operating properly.)

MAINTENANCE

No routine maintenance is required. The Series RFC RF Capacitance Point Level Switch is not field serviceable and should be returned if repair is needed (field repair should not be attempted and may void warranty). Be sure to include a brief description of the problem plus any relevant application notes. Contact customer service to receive a return goods authorization number before shipping.