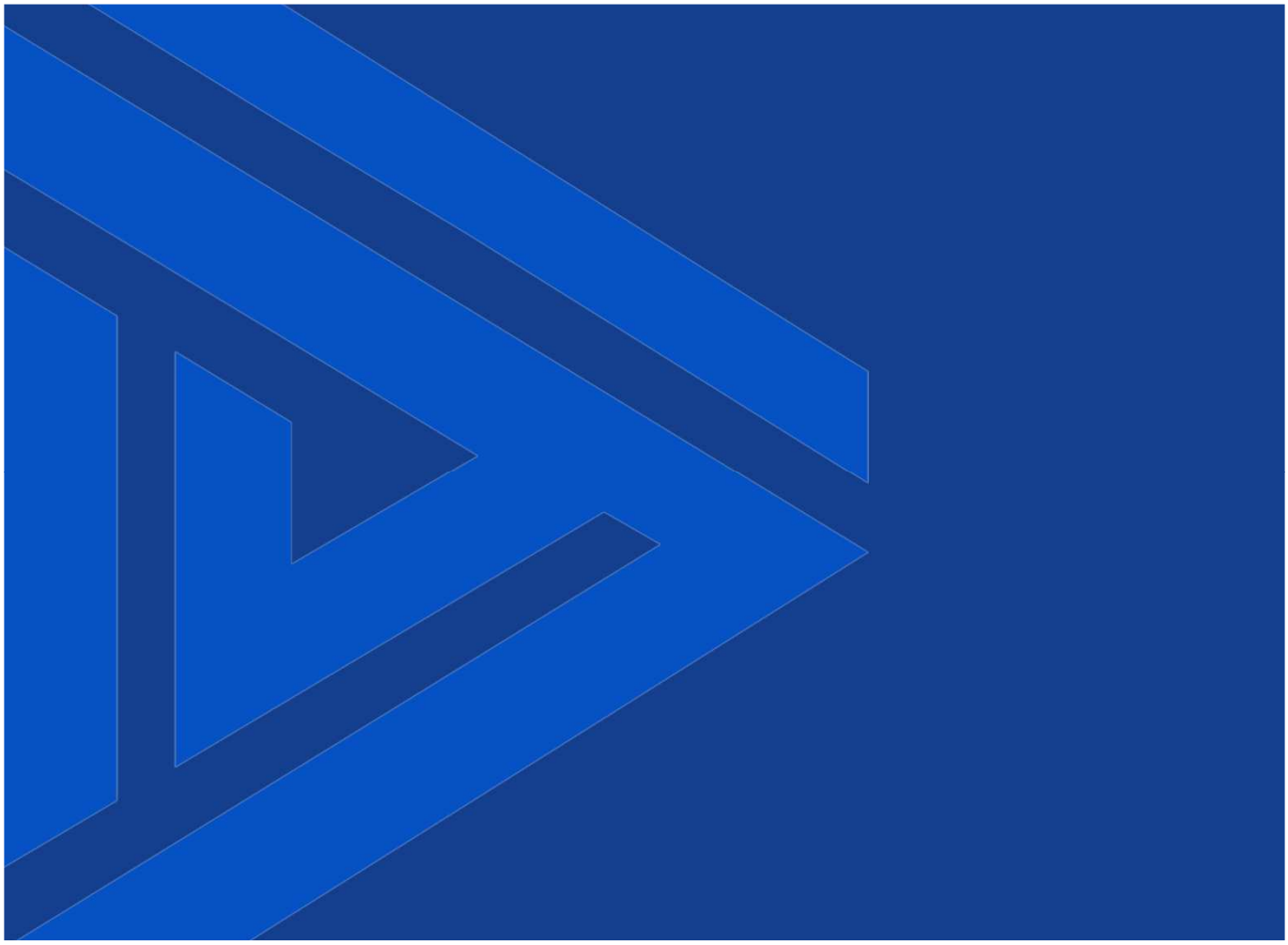
Model 107

Installation, Operation and Maintenance Manual



Delta Controls
CORPORATION

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Model 107 Electronic Probe Type Level Switch

GENERAL DESCRIPTION

Model 107 is an admittance switch for use in demanding level sensing applications. The 107 is designed to switch when material rises on the sensing probe to a preset elevation. It features high sensitivity, excellent stability, and low susceptibility to external electrical noise.

Model 107 can handle many applications where it is impossible, impractical, or uneconomical to use other types of switches. These electronic units are particularly advantageous when measuring interfaces, corrosive liquids, and granular solids or where a small physical size requirement is a factor. They are externally powered and do not rely on the relatively low force that is produced by liquid floatation or displacement, are insensitive to foam, tolerant of agitation, bubbles which are entrained, and work under vibration conditions.

The unit is designed to detect high or low levels of liquids, interfaces, slurries, and solids. The sensed material may be conductive (water, acid, caustic) or nonconductive (oil, wheat, gasoline). The dielectric constant of the material can be as low as 1.30 when the proper high gain probe is selected. All water-based compounds and most medium weight hydrocarbons (ammonia, crude oil, Freon, fuel oil, lube grease) require only basic probes.

The unit is designed for mounting on the top of a tank, container, or open pit. It is usually good practice for the sensing probe to extend down from the top and 6 inches below the point at which each level switching action is to occur. The unit can also be mounted such that its sensor extends in from the side of the container; however, the probe must be selected so that it is not adversely affected by material buildup, or broken off if the process material is a solid.

OPERATING PRINCIPLE

A capacitor is formed by the sensing probe and a ground plane (usually the tank wall, but can be a parallel rod or plate), and the RF Admittance of this capacitor is directly proportional to the material elevation.

A high frequency AC waveform of fixed voltage is applied to the probe, and the average current flowing into the probe is measured. The RF Admittance of the probe is calculated as the ratio of measured current to applied voltage. The measured RF Admittance is then scaled against two stable internal references to reduce the effects of temperature on the measurement circuit. The admittance of the comp coaxial cable is also measured and subtracted from the probe admittance to eliminate temperature effects on the probe coaxial cable. The measured admittance is then scaled against the calibration values entered during setup to calculate the level of material on the probe. This value of level is then compared to the relay setpoints to control the relays.

The RF Admittance is a function of the probe size, ground plane distance and the dielectric constant (Dc) of the process material. The dielectric constant of each material is specific to each material. This property can be described as the ease with which AC energy can travel through the material filling the space separating the two plates of a capacitor. Empty space (with a dielectric constant equal to 1.0) transfers the least amount of energy and is, therefore, used as a reference for other materials. The actual dielectric constant value for a specific material is a ratio of its energy transfer characteristic to that of empty space (a hard vacuum). For example, gasoline has a dielectric constant value of 2.0, which means that twice as much energy will transfer through gasoline as will through a hard vacuum. A precise value of a material's dielectric constant is not normally needed for selection,

installation, or calibration for Delta Controls Series 100 models. In general, if a material is conductive, it has a dielectric constant value high enough that the transfer effect is dominant and the actual dielectric constant value can be ignored. Gases (such as air, nitrogen, etc.) have dielectric constant values very close to 1.0; therefore, their effects can be ignored. Non-conductive materials have dielectric constant values ranging from 1.5 to 55.0 and consideration must be given to probe and range selection to ensure that an adequate signal-to-noise ratio is maintained.

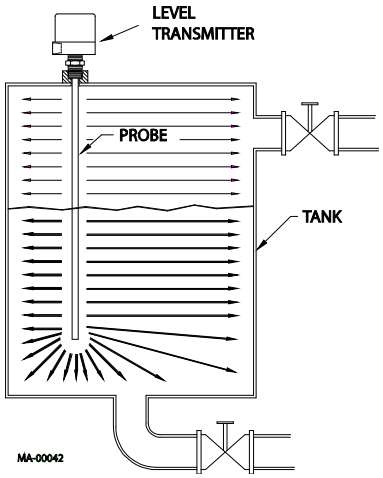

Figure 1 Capacitance Level Sensor

INSTALLATION

Mounting and Wiring

Select a mounting point and hook-up arrangement in accordance with good instrument practice. The unit must be installed in accordance with governing codes, such as the National Electric Code. The sensing portion of the probe rod should normally be vertical and should span the distance between material elevations where relay setpoints are to be established. Further, it should extend at least 3 inches both above and below these points.

Refer to Figure 2 for proper connections.

*****WARNING***** Do not incorrectly wire the unit, provide incorrect supply power, or wire AC supply power across a relay contact to ground.

Integrally Mounted Electronics Units

In integrally mounted units, where the electronics housing is mounted directly on the probe head, the probe is connected to the "Probe" terminal with a short wire. The "Compensation" terminal is not used in integrally mounted units.

Remoted Electronics Units

The electronics unit may be located up to 50 feet away from the sensing probe. The capacitance of the interconnecting cable is 14pF per foot of length. This capacitance is added to the probe capacitance. It may be necessary to use a higher range setting (See RANGE setup parameter) when the unit is located a long way from the probe.

Remotely mounting the electronics is usually done for one of the following reasons:

(1) Remove the electronics unit from a harsh environment such as high temperature, low temperature, high radiation or high vibration levels.
(2) Move the electronics unit to ground level from the top of a tank for ease of installation, testing and maintenance.
(3) Move the electronics unit out of an area that is unsafe or potentially hazardous to maintenance and inspection personnel.

The sensing probe is connected to "Probe" and "Shield" terminals using RG-62U coaxial cable. An identical length of RG-62U is connected to the "Compensation" and "Shield" terminals. Put a water tight insulating seal on the opposite end of the “Compensation” cable. Install both lengths of coax, side by side, in the same conduit.

The "Compensation" coax acts to cancel changes due to temperature, etc. that occur in the "Probe" coax. Model 107 will operate without the "Compensation" coax, but switch points will drift and erratic operation may occur from time to time.

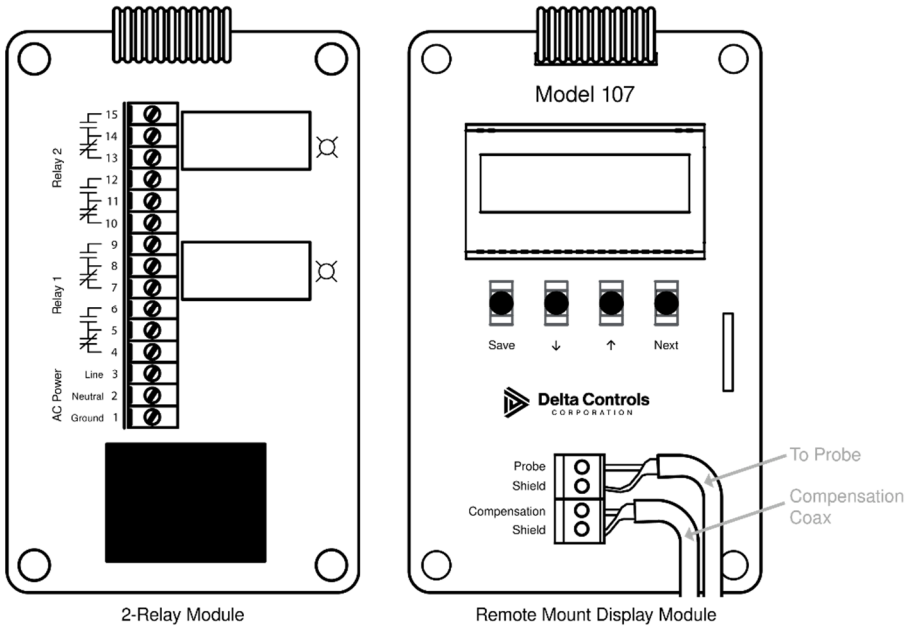

Figure 2 Model 107 Layout and Wiring

OPERATION INSTRUCTIONS

Pushbuttons used to operate Model 107:

1) **SAVE** Pressing this button saves all setpoint and calibration values. The display message will read "Saving..." while values are being saved.
2) ↓ Pressing this button causes the value displayed to be decremented. Holding the button causes the value to continue downward at an increasing rate.
3) ↑ Pressing this button causes the value displayed to be incremented. Holding the button causes the value to continue upward at an increasing rate.
4) **NEXT** Pressing this button shifts the display to the next setup parameter.

Locking – To prevent accidental changes to the instrument setup, some parameters require an unlocking procedure before changes are allowed. If you try to change a parameter while it is locked, you will get a 'LOCKED' message on the display.

To unlock the unit:

Press and hold the NEXT button.
While holding NEXT, press and release the DOWN button.
Release the Next button.

Setup Parameters

LEVEL	The level on the probe
RELAY #1 ON	Relay #1 ON setpoint
RELAY #1 OFF	Relay #1 OFF setpoint
RELAY #2 ON	Relay #2 ON setpoint
RELAY #2 OFF	Relay #2 OFF setpoint
RELAY #3 ON *	Relay #3 ON setpoint*
RELAY #3 OFF*	Relay #3 OFF setpoint*
RELAY #4 ON *	Relay #4 ON setpoint*
RELAY #4 OFF*	Relay #4 OFF setpoint*
DELAY	Minimum number of seconds between relay operations. (0-120 sec)
RANGE	Maximum probe capacitance measurement, refer to chart below. There are three ranges: 0-2.

Range	Maximum Capacitance
0	800 pF
1	2400 pF
2	8000 pF

Most applications will use the most sensitive range, range 0. If you have a probe that is more than 12 feet long and is measuring a conductive material, like water, you may have to use range 1 or even 2. If the capacitance being measured exceeds the maximum value for the range selected, the display will alternate between its normal reading and "OVER RANGE!". In this case, set the range to the next higher value.

NOTE: After changing range parameter, re-check unit calibration.

TIME CONSTANT	1-20; time constant for smoothing measurement.
CAL PT 1	Calibration point number 1
CAL PT 2	Calibration point number 2

Calibration Procedure

1. Measure the level of material in the tank or set the level in the tank to a known level. Press the NEXT button until CAL PT 1 is displayed. Press the ↑ or ↓ buttons until the level in the tank is displayed. Then press SAVE.
2. Change the level of material in the tank to another known level. The amount of change is not critical, however the farther apart the two calibration points are, the more accurate will be the calibration. Press the NEXT button until CAL PT 2 is displayed. Press the ↑ or ↓ buttons until the new level in the tank is displayed. Then press SAVE.
3. The unit is now calibrated to read level. Press the NEXT button until LEVEL is displayed.

Relay Setpoint Setup

To set up the relays, Press the NEXT button until the desired setpoint is displayed. Press the ↑ or ↓ buttons until the setpoint is reached. Then press SAVE. Repeat for the next setpoint.

* Relays 3 and 4 are only displayed on the Model 107 4 relay configuration.

NOTE: If a relay's "On" switchpoint is set greater than or equal to its "Off" switchpoint, the relay will energize when the level is above the "On" switch point and de-energize when the level drops below the "Off" switch point. This action is commonly known as "Direct Action".

If a relay's "On" switchpoint is set less than its "Off" switchpoint, the relay will energize when the level is below the "On" switch point and de-energize when the level rises above the "Off" switch point. This action is commonly known as "Reverse Action".

MAINTENANCE

No periodic or scheduled maintenance is required for Model 107.

SPECIFICATIONS

Level range:	Switching at any point along the length of the probe selected. Equivalent capacitance settable range 0-8000 pF.
Differential:	Adjustable to any point within the range.
Relay Contacts:	5 A at 250 ACV DPDT
Time Delay:	Adjustable 1 to 120 seconds
Supply Voltage:	80-305 ACV 50/60 Hz plus or minus 10 percent
Operating Temperature:	-40 °F to +180 °F (-40 °C to +82 °C)
Temperature Effect	0 °F to +150 °F (-17 °C to +65 °C): ±0.25 pF; less than 1/10 inch in water.
Electronics Module:	Potted for high reliability.
Housing:	NEMA 4X, explosionproof optional, aluminum or stainless steel.

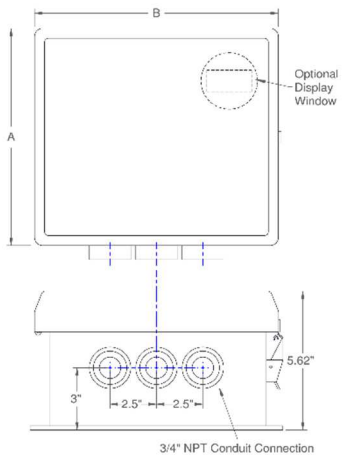

Figure 3 Remote Electronics Housing

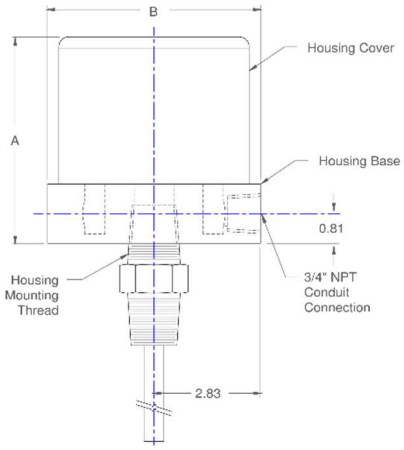

Figure 2 7X Housing

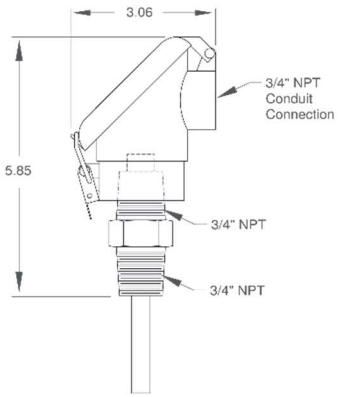

Figure 5 Optional Remote Probe Head Housing

MODEL NUMBER SYSTEM

BASIC TYPE	-	SUPPLY VOLTAGE	-	HOUSING & RATING	-	MOUNTING LOCATION	-	OPTIONS	
MODEL EXAMPLE 107C	-	1	-	4XR	-	10'P	-	AA	ELECTRONICS UNIT; (ORDER PROBE SEPARATELY)

BASIC TYPE	
M/N	DESCRIPTION
107C	2 RELAYS
107D	4 RELAYS

RELAYS ARE 5 AMPS @ 125/250 VAC, DPDT

MOUNTING LOCATION	
M/N	DESCRIPTION
AA	NONE, INTEGRAL
#'P	REMOTE, POLY JACKETED CABLE, 160ºF MAXIMUM
#'D	REMOTE, PTFE JACKETED CABLE, 450ºF MAXIMUM

REPLACE # WITH TOTAL LENGTH OF CABLE REQUIRED, IN FEET

OPTIONS	
M/N	DESCRIPTION
AA	NONE
PSM	2" PIPESTAND OR SURFACE MOUNTING BRACKET FOR "7W" REMOTE ELECTRONICS HOUSING
DW	DISPLAY WINDOW FOR "4X" HOSEPROOF
ZZ	SPECIAL CONFIGURATION OR FEATURE

SUPPLY POWER	
M/N	DESCRIPTION
1	120 VAC 50/60 HZ
2	240 VAC 50/60 HZ

HOUSING & RATING			
M/N	MATERIAL	DESCRIPTION	M/N
4XR	FIBERGLASS	4X HOSEPROOF	107C
		REMOTE MOUNT ONLY	107D
7WI 7WR	ALUMINUM	EXPLOSION PROOF CLASS 1, DIV 1, GRPS B,C,D,E,F,G ; ALSO 4 HOSEPROOF	107C
		FOR "I" INTEGRAL OR "R" REMOTE MOUNT	107D
7TI	300 SS	SAME; EXCEPT ALL 300 SS	107

HOUSINGS ARE THIRD PARTY LISTED