BULLETIN

424

INSTALLATION & OPERATION

TrueCap® MK-1 RF Capacitance Point Level Sensor

Model MK-1

- Multiple Configurations for a wide range of Applications
- Easy 2-Step Calibration
- Rugged, Watertight Housing
- No Moving Parts to Break or Wear Out

The TrueCap® MK-1 RF Capacitance Point Level Sensor is an economical point level measurement device compatible with a wide range of dry bulk material applications as well as some liquids. The MK-1 is available in many different configurations each suited to optimize performance for particular applications.

Standard Probe: An excellent general usage probe. Its probe is 7" long and offers versatility for a variety of applications.

Base for Extensions Probe: Configured so rigid extensions can be connected as needed. The compact construction tolerates lever loads typical of top mounted extended probes. Extensions are available to create overall lengths of up to 48".

Cable Extension Probe: Provides means to sense level beyond 48" beneath the mounting point. The Teflon® coated cable provides a non-stick surface to minimize material cling. Lengths to 50' are available.

Low Profile Probe: Ideal for tight spaces or heavy materials that might otherwise damage a standard probe.

PRINCIPLE OF OPERATION

The operation of the MK-1 is based on RF Capacitance technology. A radio frequency is applied to the probe and is continually analyzed to determine the influence caused by the surrounding environment. Since all materials have relative dielectric constants and conductance values different than air, the resultant impedance seen by the radio frequency changes whenever material contacts the probe. Capacitance variances create change in impedance. The active probe of the MK-1 and the vessel's wall comprise the two "plates" of a capacitor. The probe's insulator and surrounding air make up the dielectric material. As the air (relative dielectric constant of 1.0) is substituted with any other material (relative dielectric constant >1.0), the capacitance effect is enhanced thereby changing the application's impedance. This influence is measured within the circuitry and compared to the reference established by the sensitivity setting. The placement of the sensitivity setting determines how much influence must be present before the sensor's output changes.

MONITOR

"SETTING THE STANDARD FOR SUPPLIER EXCELLENCE"

PRE-INSTALLATION CONSIDERATIONS

Choosing a Location: (see Figure 1)

1.) Material Flow - When selecting a location for the MK-1, choose a point in the vessel where the probe will be out of the direct flow of incoming and outgoing material to prevent any mechanical damage that may be caused by the pressure of the flow. If the MK-1 must be located in product flow, be sure to install a protective baffle to prevent false signals. The MK-1 must be positioned at a point where incoming material will reach and cover the probe in its normal flow, and when receding, will flow away from the probe in an even manner. For best results, choose a position where a majority of the probe, not just the tip, will be covered, especially when used to detect materials with low relative dielectric constants and low product densities. When used with these materials, the unit will not operate as a "tip sensitive" device. For extended length models, allow for at least 8 to 12" of probe coverage. In addition, avoid high vibration areas.

2.) Vessel Contact - Select an area where the probe can not contact any internal structure elements of the vessel. When using the Cable Extension Probe, consider the angle of repose of the material that will flow into and out of the vessel. Insure that the expected swing of the cable will not touch the vessel.

3.) Nozzle Mounting - Mounting the MK-1 in a nozzle can cause false output activation due to material packing between the probe and vessel connection. Do not permit the active probe to be recessed into a nozzle. Always maximize the probe's insulator protrusion.

4.) Avoid Bridging - Avoid mounting the MK-1 in locations where material can bridge between the probe and the vessel wall. Do not mount the probe at an upward angle as this allows material to become trapped at the sensor's mounting point.

5.) Multiple Probe Proximity - If more than one sensor is mounted in the vessel, do not place the sensors closer than 18" from one another.

Protective Baffles: (see Figure 2)

Installing protective baffles over side mounted Standard or Base for Extension probes is recommended for materials that have a tendency to pack, bridge, and arch. The baffle can be created using a number of materials including angle irons, welded plates and pipe sections. It should be securely mounted to the vessel wall and should extend the full length of the probe. This structure will keep the full weight of the material from bending or breaking the probe. Applications using side mounted Base for Extension probes with extensions are particularly vulnerable and are only recommended after careful review of the mechanical stresses which apply.

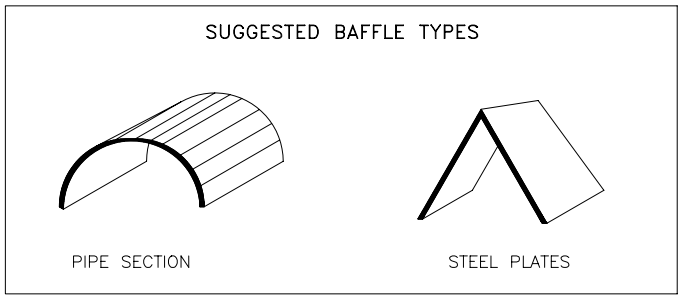


Figure 2

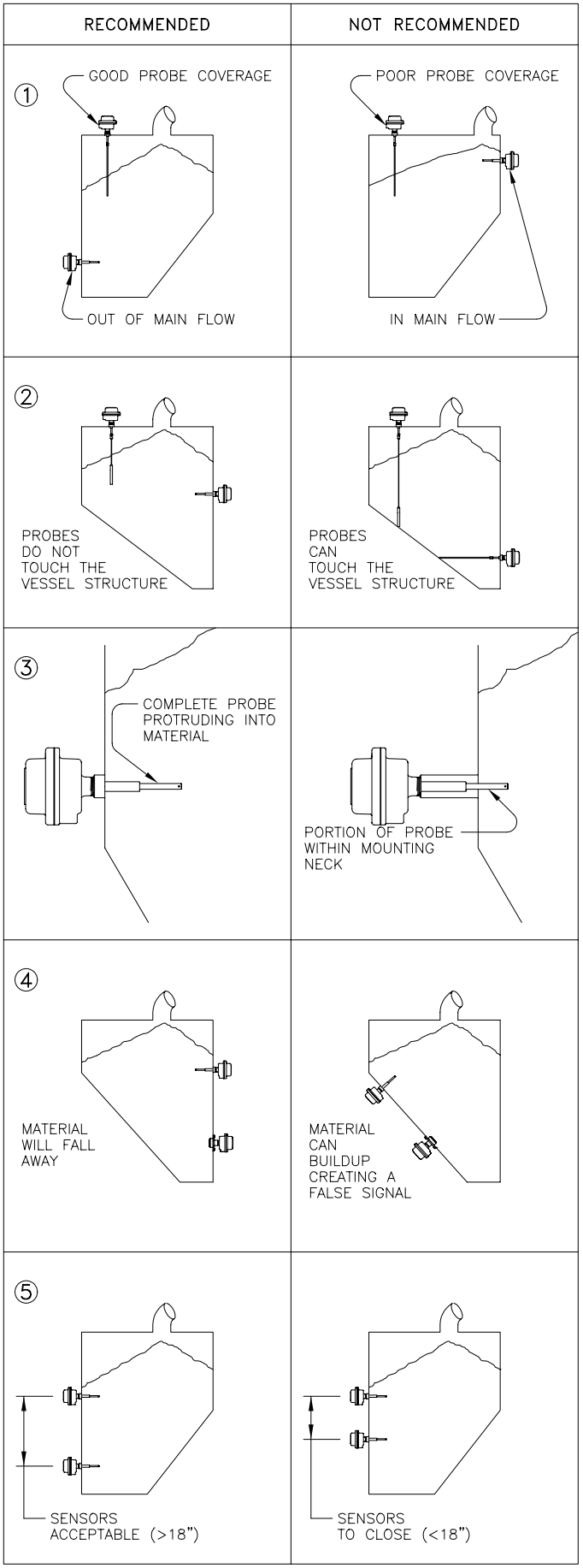


Figure 1

MECHANICAL INSTALLATION

Standard, Base for Extensions, Cable Extension Probe Mounting: (see Figures 3, 4 & 5)

1.) Select a mounting location in accordance with the Pre-Installation Recommendations.

2.) If using a welded fitting, cut a 1-1/2" hole into the side/top of the vessel. If using a Monitor mounting plate, cut a 2-1/2" center hole and six 11/32" mounting holes (for 5/16" bolts) on a 7" bolt circle. Use mounting plate as a template.

3.) Weld fitting or attach mounting plate to the vessel wall.

4.) If applicable, attach extension to probe tip using roll pin provided. Insert probe through fitting. Grease threads with anti-seize then thread unit tightly into place by gripping and rotating housing. Teflon tape may be used to achieve pressure sealing capability if desired. Continuity between sensor mounting point and vessel wall must be maintained to assure proper probe operation.

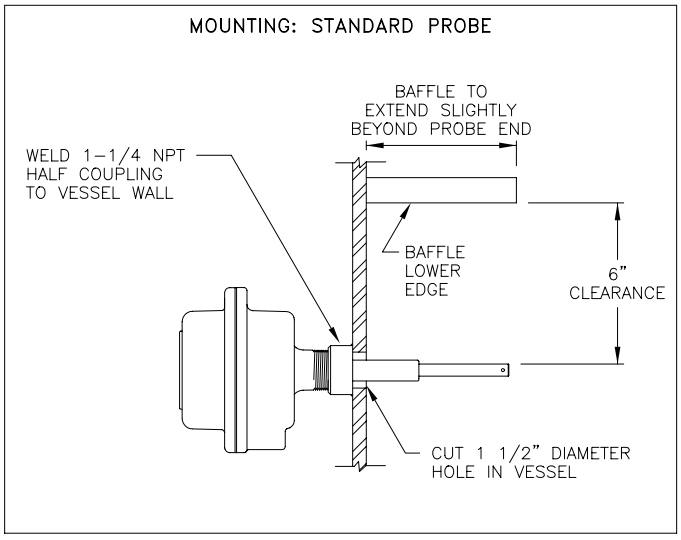


Figure 3

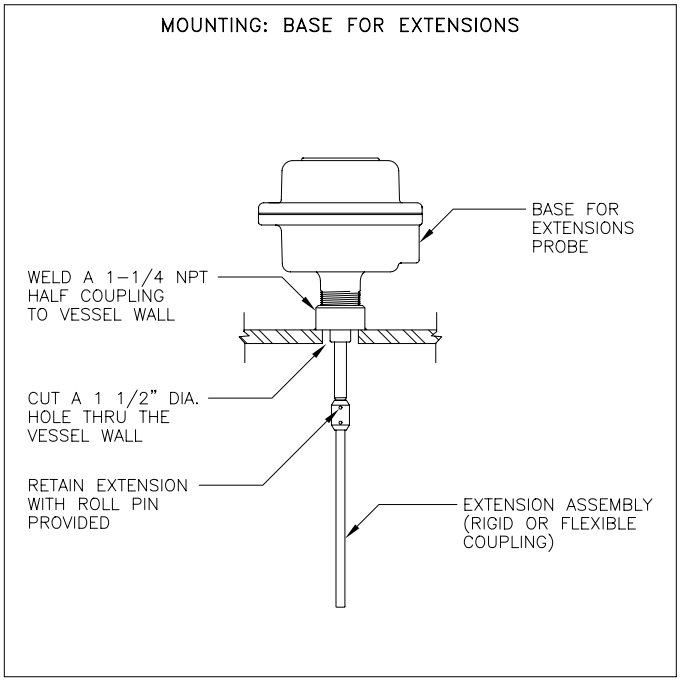


Figure 4

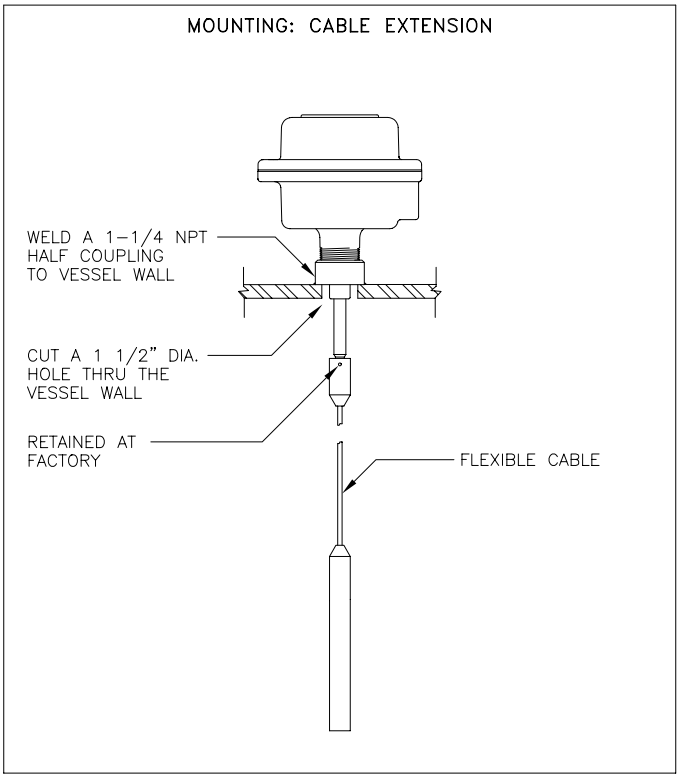


Figure 5

Low Profile Probe Mounting: (see Figure 6)

1.) Select a mounting location in accordance with the Pre-Installation Recommendations.

2.) Cut a 3 3/4" hole into the side of the vessel wall which will permit passage of the probe.

3.) Drill four 3/4" diameter holes on a 4 3/4" bolt circle (matching holes in the flange) encircling the main center hole previous cut. The sensor can act as a template to simplify locating the exact placement. Place the holes so the conduit connection on the sensor points downward after sensor attachment. NOTE: The 3/4" holes are sized so a bolt and nut can secure probe to the vessel. If it is desirable to mount the sensor without placing nuts on the inside of vessel, suitable drilled and tapped holes can be created.

4.) Secure the MK-1 into position with 5/8" bolts and nuts or other applicable means.

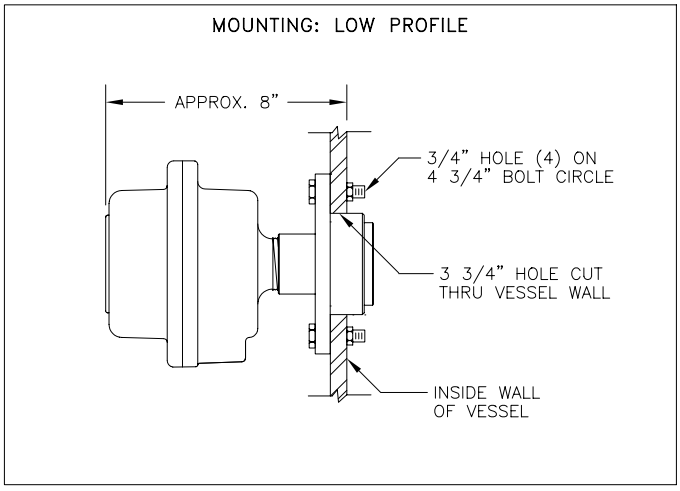


Figure 6

ELECTRONICS

The electronics are positioned within the sensor housing permitting easy access to the main terminal block. All wiring should be routed through the 3/4" NPT conduit connection on the housing.

Power Input: (see Figure 7)
The MK-1 sensors are designed to accept either 115VAC or 230VAC line voltage. Distinct terminals are provided for wiring each voltage. Improper wiring of the power input will prevent proper operation and may damage to unit. An earth ground screw is provided at the conduit connection area for protective grounding purposes.

Output Relay Contacts:
The MK-1 is equipped with a set of isolated contacts (SPDT). These can be connected to any type of control device, provided ratings are observed (see specifications). The designations on the circuit board relate to the contact status when the material is not sensed and the fail-safe is in the "low" mode. When available use an independent voltage source to operate the load. Insure all electrical codes are followed and proper wiring gauge size is used to support the load current.

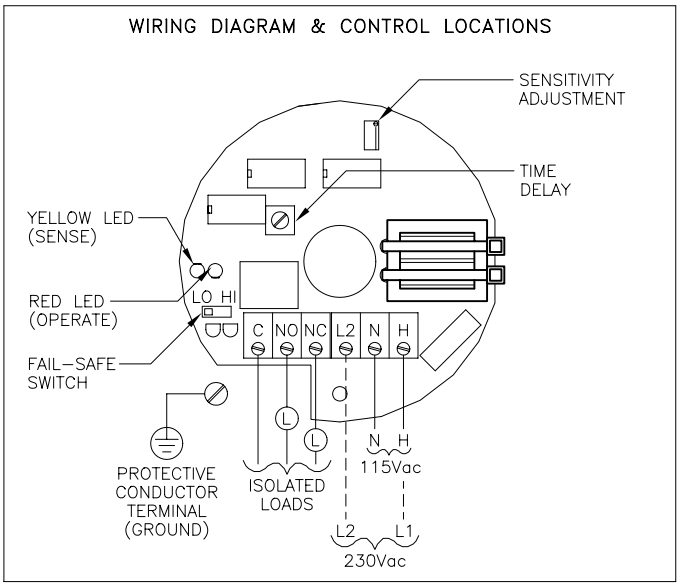


Figure 7

CALIBRATION

Sensitivity: (see Figure 7)
A 20-turn potentiometer adjusts the sensitivity of the MK-1 to the material being sensed. Rotating the adjustment in a clockwise direction will increase the sensitivity making the material easier to "sense". There are two different procedures which can be used in the calibration process. Both utilize the simple "2-Step Calibration" procedure. One procedure sets the sensitivity with the probe exposed to the material, while the second procedure exposes the probe to free air only. Since the capacitance being measured is directly related to the material being sensed, the best results will be achieved by setting the calibration while the probe is exposed to the application material.

2-Step Calibration - Probe exposed to material
1.) While the probe is not covered with material, rotate the sensitivity adjustment clockwise until the "SEN" (yellow) LED illuminates.
2.) Permit the application material to cover the probe. While counting the number of revolutions, rotate the sensitivity adjustment counter-clockwise until the "SEN" (yellow) LED turns off. Reposition the sensitivity adjustment at the halfway point between the LED on and LED off settings. (e.g. If after inserting the probe into the material, if it takes 4 counter-clockwise turns of the sensitivity adjustment for the "SEN" (yellow) LED to turn off, then sensitivity adjustment should be repositioned 2 clockwise turns.)

2-Step Calibration- Probe exposed to free air only
1.) Rotate the sensitivity adjustment clockwise until the "SEN" (yellow) LED illuminates.
2.) Reposition sensitivity adjustment a number of turns counter-clockwise with respect to the three described sensitivities below (see Figure 8). It is desirable to reposition the sensitivity adjustment in accordance to "2-Step Calibration- probe exposed to material" once material can cover the probe. Materials with high dielectric constants or conductivity, require the sensitivity adjustment further counter-clockwise than the those applications sensing materials with low dielectric constants. When setting the MK-1 to detect the interface between two materials (neither of them air), set the sensitivity adjustment to ignore the material with the lower dielectric constant. The material with the higher dielectric will then be sensed.

SENSITIVITY SETTING OF THE MK–1

SENSITIVITY DESCRIPTION	NO. OF ADJ TURNS	MATERIAL DIELECTRICS	TYPICAL APPLICATIONS
HIGH	0–2	1.5–3.0	PLASTICS, SOAP, OILS, RUBBER, CEMENT
MED	2–5	3.0–9.0	GRAINS, FERTILIZERS, FEED, SALT
LOW	> 5	> 9.0	WASTEWATER, SLURRIES, ANY WATER BASED SOLUTIONS

Figure 8

Delay:
A single-turn potentiometer is provided for setting the time delay between the time the material is sensed (yellow LED on) and the time the relay contact output changes (red LED on). A clockwise rotation will increase the delay from .25 to 15 seconds. This adjustment minimizes false signals associated with temporary material shifts. The delay between the time material is "not sensed" (yellow LED off) and the time the relay contact output changes (red LED off) is fixed at .25 seconds.

PCB Indicators:
1.) Yellow LED - Its status describes the "sensing" condition of the MK-1. Illumination indicates that the amount of capacitance established by the sensitivity adjustment has been detected. Its status is not affected by the time delay setting.
2.) Red LED - Its status describes the "operate/output" condition of the MK-1. Illumination indicates the relay output is in the "operate/material sensed" condition. Its state is influenced by the time delay setting but not by the fail-safe setting.

Fail-safe: (see Figure 9)
The term fail-safe refers to the output signal condition which occurs with a loss of power to the probe. A switch permits selection of either low or high fail-safe.

High Fail-Safe: The relay will de-energize with high level sensing or with power loss.

Low Fail-Safe: The relay will de-energize with low level sensing or with power loss.

Note the designations on the electronics PCB refer to the relay contact status when no material is sensed and low fail-safe is selected (Relay is in normal de-energized mode). The designations are reversed when no material is sensed and high fail-safe is selected (Relay is energized).

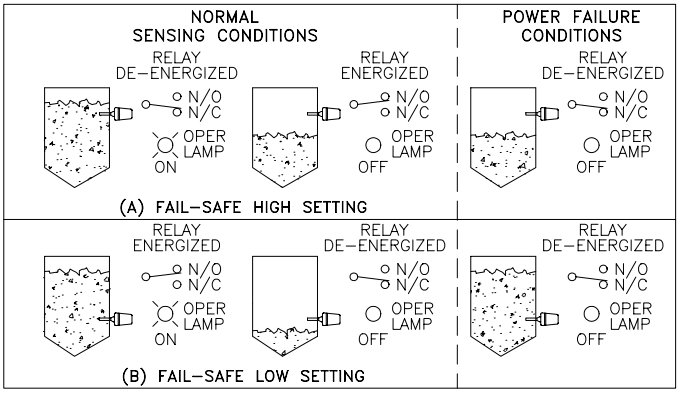


Figure 9

TROUBLESHOOTING

PROBLEM: Sensor will not sense material

CAUSE/SOLUTION:

1.) Verify power is applied to sensor.

2.) Verify sensitivity setting. Reposition sensitivity adjustment clockwise therefore making the probe more sensitive to "difficult to sense" materials.

3.) Verify probe coverage when sensing is expected. The sensor is not designed to be "tip sensitive". Permit significant probe coverage before expecting sensing.

4.) Verify continuity between probe mount and vessel wall. If no continuity, connect a ground strap between the housing and vessel wall.

5.) Verify connection of the electronics to the probe.

PROBLEM: Sensor remains in "SENSE" mode even when material is absent.

CAUSE/SOLUTION:

1.) Verify the active probe is not in direct contact with any internal vessel structure. If so reposition sensor.

2.) Verify sensitivity setting. Reposition sensitivity adjustment counter-clockwise therefore making the probe less sensitive to "easy to sense" materials.

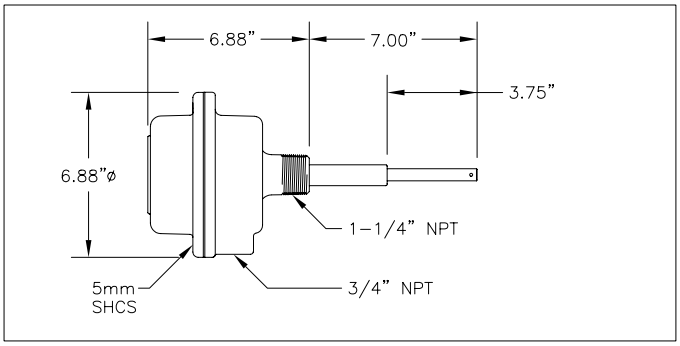
3.) Verify material buildup on probe. Excessive product buildup between the active probe and vessel wall can create false detection. Clean probe if necessary.

PROBLEM: Output contacts perform opposite of designations (N/O, N/C).

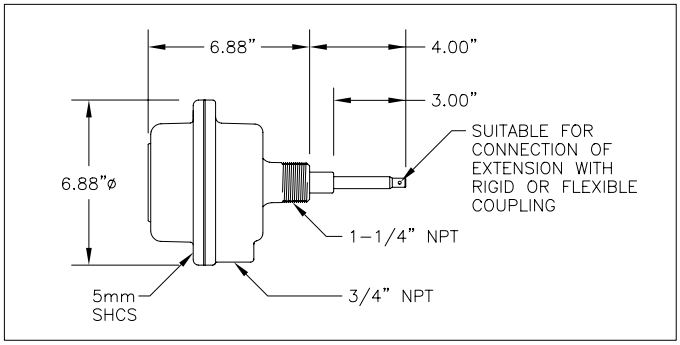
CAUSE/SOLUTION:

1.) Designations on PCB relate to relay status when in "Fail-safe Low" mode and when no material is sensed. If "Fail-safe High" mode is used, the designations are reversed.

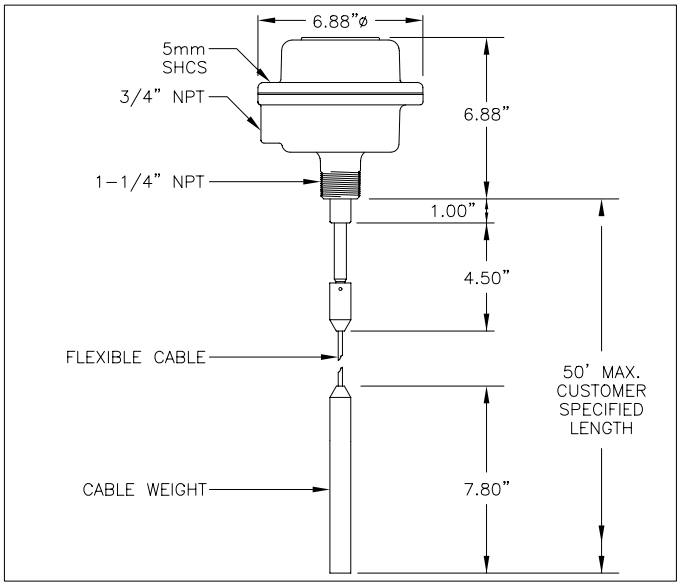
MECHANICALS



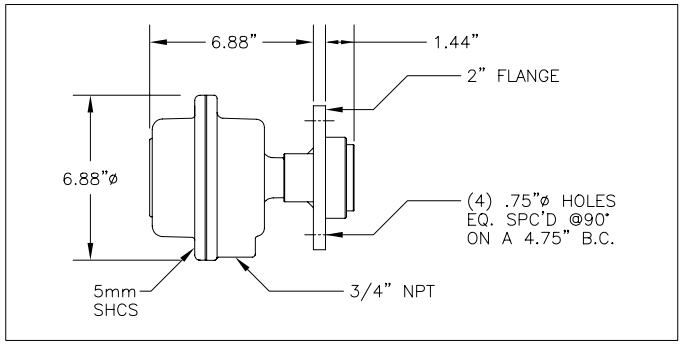
STANDARD PROBE



BASE FOR EXTENSIONS PROBE



CABLE EXTENSION PROBE



LOW PROFILE PROBE

BULLETIN 424

Model MK-1

MAINTENANCE

The MK-1 is a maintenance free product and should be serviced by Monitor Technologies LLC only. If operation appears inappropriate, refer to troubleshooting section of this bulletin. If proper operation is not achievable, consult the factory.

SAFETY

Electrical Shock Caution:

The MK-1 is powered with HIGH VOLTAGE. Extreme care shall be taken if the unit's cover is removed and live electrical terminations are exposed. To avoid electrical shock, do not contact any exposed electrical connections. Each unit is provided with a "protective ground" connection which shall be terminated to earth ground potential This terminal shall be used to reduce shock hazard in the unlikely event of internal insulation breakdown.

WARRANTY

Monitor Technologies LLC warrants each MK-1 to be free from defects in material and workmanship under normal use and service within two (2) years from the date of purchase within North America, and within one (1) year from date of purchase outside of North America. The purchaser must give notice of an defect to Monitor within the warranty period, return the product intact and prepay transportation charges. The obligation of Monitor Technologies LLC under this warranty is limited to repair or replacement at its factory. This warranty shall not apply to any product which is repaired or altered outside of the Monitor Technologies LLC factory, or which has been subject to misuse, negligence, accident, incorrect wiring by others or improper installation.

Monitor Technologies LLC reserves the right to change the design and/or specifications without prior notice.

SPECIFICATIONS

Power Requirements:	115/230 VAC, ±15%, 50/60 Hz, field selectable
Temperature:	-40°F to 160° F operating
Output Relay:	SPDT Isolated relay contacts; 5 amps @ 250 VAC or 30 VDC; 1/10 HP @ 120 VAC
Indicators:	"Sense" yellow LED illuminates when material sensed "Operate" red LED illuminates to indicate output switching after selected time delay period
Sensitivity:	Multi-turn adjustment, 0.5pF to 250pF
Stability:	±0.025pf per degree F @ 0.5pf setting
Time Delay:	.25 - 15 second delay to activate (hold-off), single turn adjustable
Fail-Safe:	Switch selectable -HI/LO
Enclosure:	Cast aluminum, bolt-on cover, as cast surface
Conduit:	(1) 3/4" NPT
Approvals:	FM: Ordinary Locations $CSA_{NRTL/C}$: Ordinary Locations NEMA 4/Type 4 enclosure, IP66
Standard Probe	
Mounting:	1-1/4" NPT aluminum
Insulator Material:	poly-acetal (Delrin®)
Probe Material:	1/2" diameter, 316ss
Probe length:	7" aluminum mount
Temperature (probe only):	+176° F max
Pressure:	50 psi maximum
Base for Extensions Probe	
Mounting:	1-1/4" NPT aluminum
Insulator Material:	poly-acetal (Delrin®)
Probe Material:	1/2" diameter, 316ss
Probe length:	Suitable for solid or flex extensions to 48"
Temperature (probe only):	+176° F max
Pressure:	50 psi maximum
Cable Extension Probe	
Mounting:	1-1/4" NPT aluminum
Insulator Material:	poly-acetal (Delrin®)
Probe Material:	1/8" diameter, 316ss Teflon® jacketed cable, 316ss weight
Probe length:	50' from mounting
Temperature (probe only):	+176° F max
Pressure:	50 psi maximum
Low Profile Probe	
Mounting:	2" pipe flange, anodized aluminum
Insulator Material:	poly-acetal (Delrin®)
Probe Material:	2-3/4" diameter, 316ss
Temperature (probe only):	+176° F max
Pressure:	150 psi maximum

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MONITOR

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