Operating instruction manual OI/A02-EN Rev. C

A02
RF Capacitance Level Switch

High sensitivity RF level switch
K-TEK Level Products

Introduction

This operating instruction manual provides the following information:

Power and productivity
for a better world™

TABLE OF CONTENTS

1.0 GENERAL DESCRIPTION

1.1 KTEK's Model A02 is used to detect the presence of a material at a given level in a tank, bin, or other container. In some cases, it can be used to detect an interface between materials. For these applications, it is recommended that one material be conductive and the other nonconductive. An example would be found in an oil and water separator. Applications requiring differential switching, such as sump pump control, can be accomplished with the adjustable differential option without additional latching relays.

1.2 The Model A02 is available in both integral and remote mounted configurations. The integral version consists of a housing containing the electronics fixed directly to the sensing probe. The remote mounted version consists of a pipestand or wall mount housing containing the electronics, an interconnecting cable, and a vessel mounted sensing probe with terminating condulet (See figure 1.1).

1.3 Sensing probes can be installed in two general positions: horizontal or vertical. A horizontal mount can only be used to produce single point alarm action, but has the advantage of a much greater capacitance change per inch of level change. Vertical mounting is required for differential switching applications. Sensing probes may be bare or insulated depending on the specific application. When mounted vertically and used with conductive materials, the switching point is lowest point on a bare probe. With vertically mounted insulated probes, the switching point can be set anywhere within the probe length, regardless of the conductivity of the material.

1.4 Two or three element solid sensing probes are available. Three element probes use driven shield technology to eliminate the effects of sticky material buildup. Two element probes are more economical and are used where material buildup is not expected. Other options include extended solid probes up to 10 feet in length, flexible cable probes, and special probes for high temperature or high pressure applications. Applications assistance is available through our factory and distributors.

1.5 Remote-mounted units require a coaxial interconnecting cable between the electronics and the sensing probe (See figure 1.2). There are three types available: Low Loss, High Temperature, and Combination, where the first 10 feet of the cable is suitable for high temperature. See the specifications for these cables in Section 2.0. Cable length should be specified at purchase. Bulk lengths of 150 feet and field termination kits can also be purchased.

1.6 Integral-mounted units are equipped with a short twisted pair for three element probes or a single wire for two element probes (See figure 1.3).

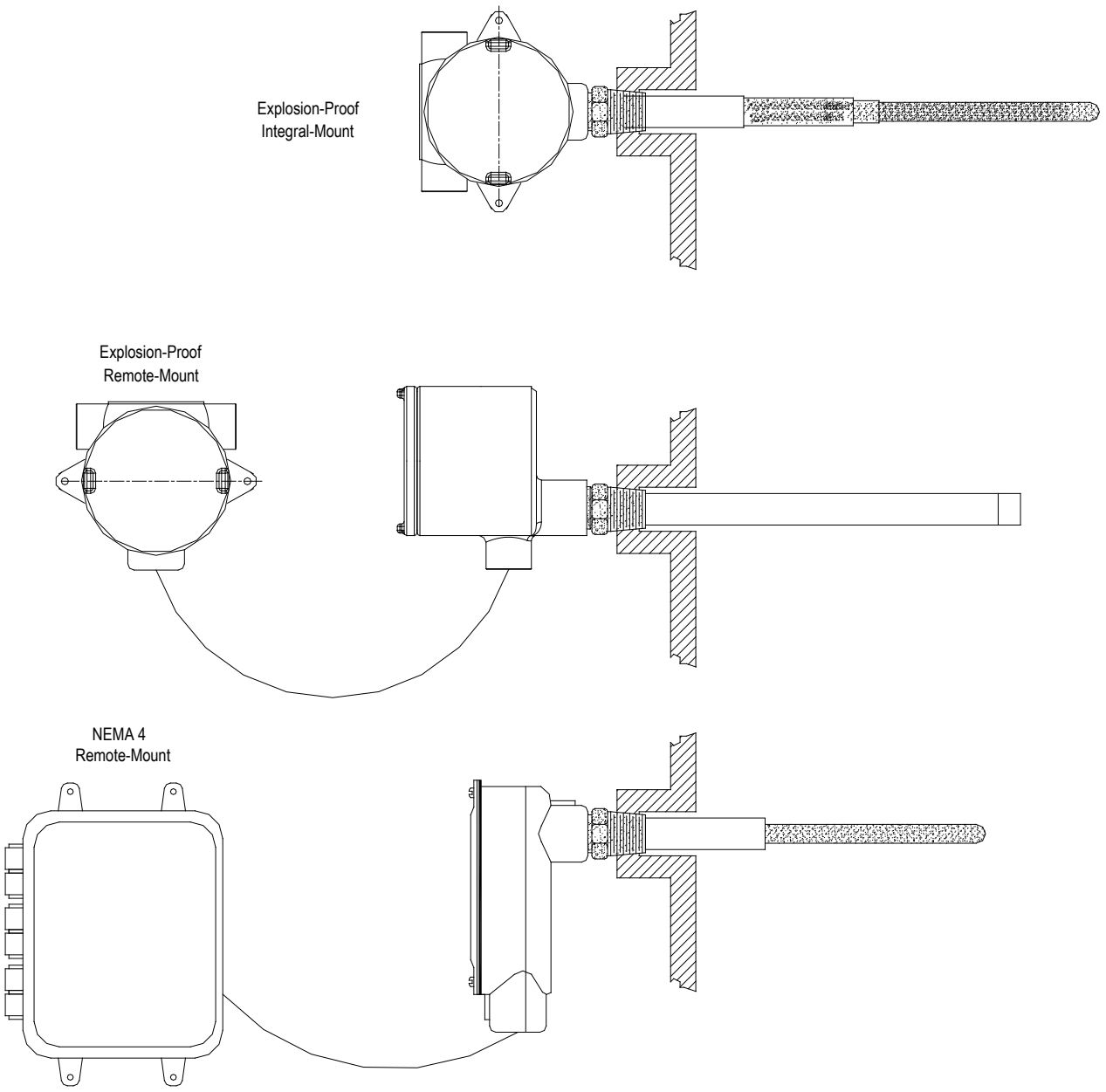
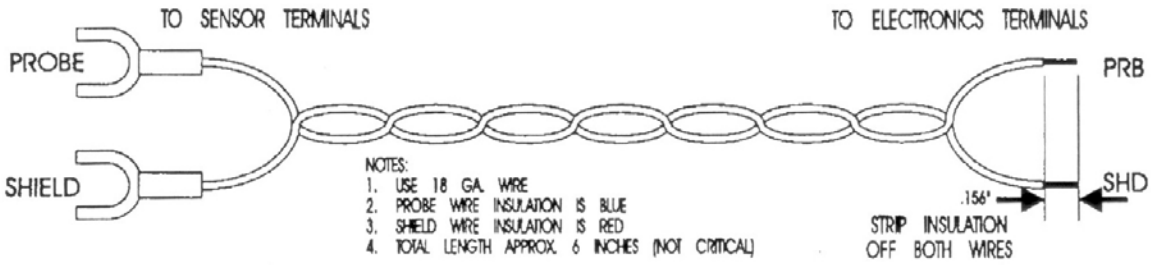

Explosion-Proof
Integral-Mount
Explosion-Proof
Remote-Mount
NEMA 4
Remote-Mount

Figure 1.1

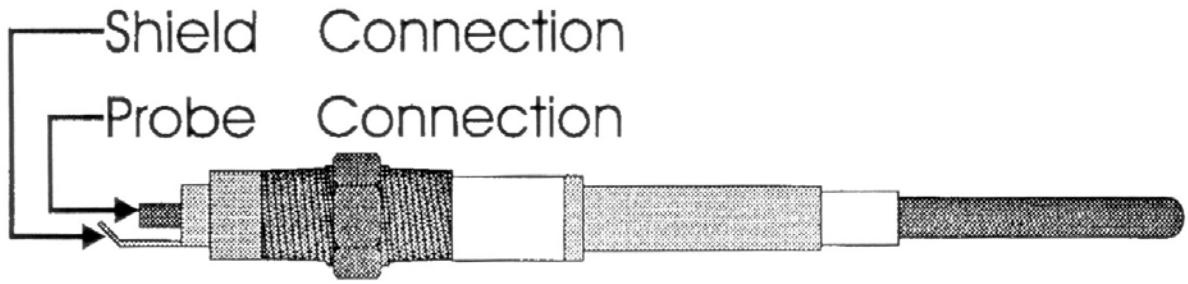


INTEGRAL-MOUNT CABLE ASSEMBLY

FOR TYPE "A" 3-ELEMENT PROBE

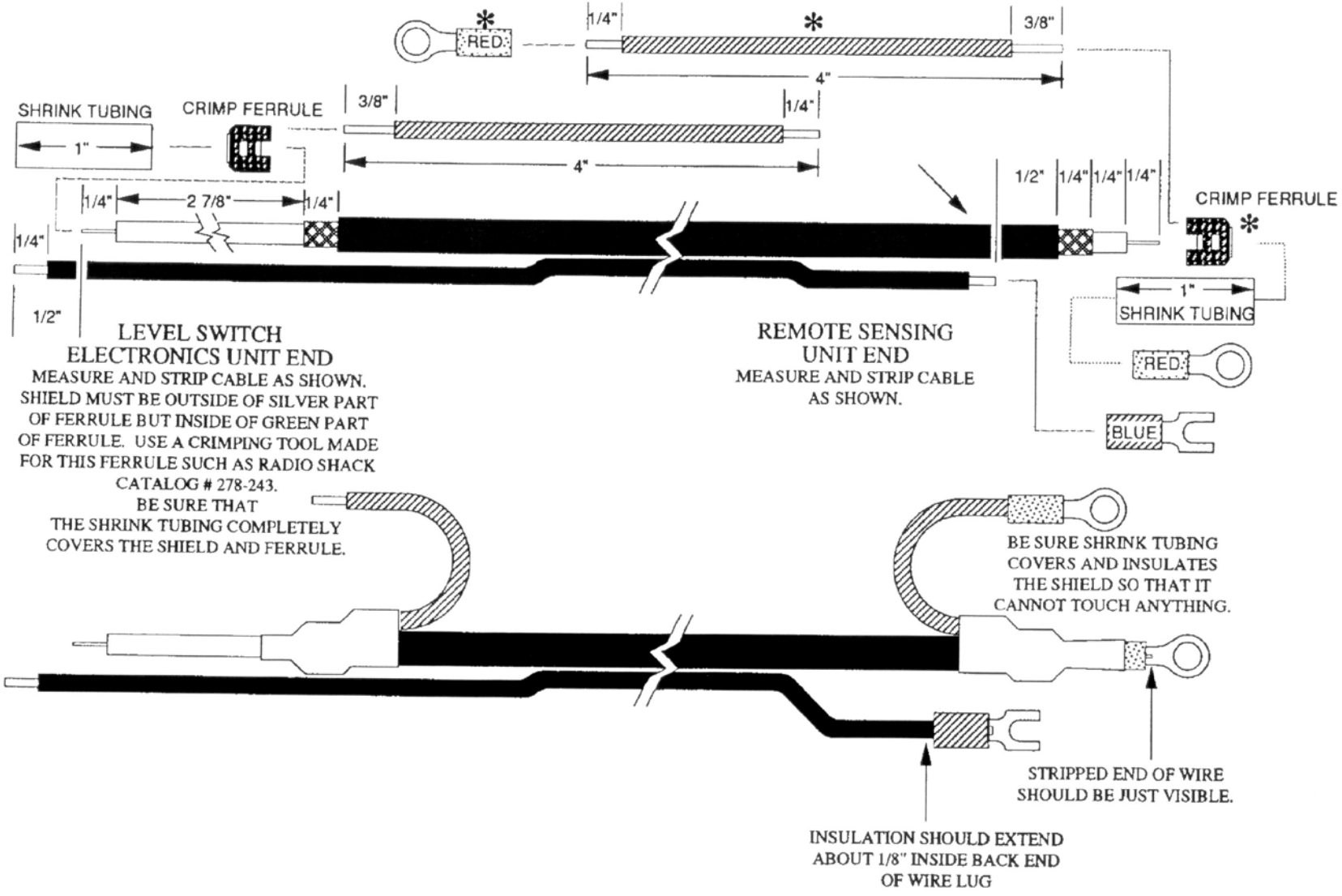
FIGURE 1.2

NOTE: When using a probe other than the type "A" 3-element a single wire to connect to the probe is all that is required.



3-ELEMENT PROBE CABLE CONNECTIONS

FIGURE 1.3



CABLE PREPARATION AND
ASSEMBLY DETAILS
MODEL A02 LEVEL SWITCH
REVISION 2 9/2/94

* THE THREE ITEMS MARKED WITH AN ASTERISK ARE NOT USED WITH TWO-ELEMENT PROBES. THEY ARE USED ONLY WITH THREE-ELEMENT PROBES.

2.0 SPECIFICATIONS

ENVIRONMENTAL

Electronics

Functional -40°F to 185°F / -40°C to 85°C

Rated Accuracy -40°F to 168°F / -40°C to 70°C

Hazardous Area Classification

Electronics

Integral-Mount= Class I, Div. 1 & 2, Groups B, C,& D; Class II, Div. 1 & 2 Groups E, F, & G; Class III; NEMA 4

Remote-Mount= NEMA 4X (8”x6” box)

Probe Enclosure

E= Class I, Div. 1 & 2, Groups B, C,& D; Class II, Div. 1 & 2 Groups E, F, & G; Class III; NEMA 4

G= NEMA 4

Sensing Elements and Cable

Intrinsically Safe for Class I & II, Div. 1, Groups A -G

ELECTRICAL

Electronics

Input Power 90-130 VAC, 50-60 Hz, 7W

190-260 VAC, 50-60 Hz 7W

12-40 VDC

Output (1) DPDT Relay

Relay Contact Rating Resistive- 5 A 250 VAC; 5A 30 VDC

Inductive- 1/10 HP 125, 250 VAC

Sensitivity An increase of 0.2pF can be detected

Static Protection 100 amp Standard

RFI Protection Less than 2 Picofarads shift in operation point for unit in standard housing from a 5 watt field at 27, 150 or 450 MHz, 5 feet from exposed sensing element, cable or power lines.

Coaxial Interconnecting Cable

Type	Max. Length	Temperature Range
Low Loss	50 ft	-40°F to 160°F / -40°C to 70°C
High Temp	50 ft	-40°F to 400°F / -40°C to 200°C
Combination	50 ft	First 10 ft from probe same as High Temp. Remainder same as Combination

MECHANICAL

Process Connection 3/4” NPT Standard

(Flanged and other mountings available upon request)

See probe compatibility list, on page 5, for temperature and pressure ratings.

ORDERING INFORMATION:
A02/a/b/c/d/e:

/a Operating Voltage

/A 120 VAC /B 240 VAC /D 12 and 24 VDC

/b Probe Type

		Operating Temp.	Operating Pressure
/1	316SS Probe / 4" *Delrin® Lower Bushing	A	A
/2	316SS Probe / 4" *Teflon® Lower Bushing	C	A
/5	Fly Ash Probe / 8" 316SS Inactive Sheath	D	B
/6	PVC Covered Cable / 13" 316SS Weight	A	D
/8	PVC Covered Cable / 13" Nylon Weight	A	D
/N	*Teflon® Covered Cable / 13" *Teflon® Weight	C	D
/A	3 Terminal 316SS Probe-*Teflon® Insulator 316SS Shield	C	A
/B	Macroprobe (3/4" OD Probe *Delrin® Bushing)	A	A
/T	Macroprobe (3/4" OD Probe *Teflon® Bushing)	C	A
/K	Quick Release Clamp Probe / 4" *Teflon® Bushing	A	A
/L	Quick Release Clamp Probe / *Teflon® Sheathed Probe	A	A
/R	*Teflon® Sheathed Probe / 316SS Mounting Nipple	C	A
/S	*Teflon® Sheathed Probe / *Teflon® Mounting Nipple	C	D
/U	Flush Mount Detector – Aluminum / *Delrin®` Bushing	A	D
/W	Concentric Shield 304SS / Teflon Sheathed Probe	A	A
/X	Teflon Sheathed Probe / 316SS Inactive Sheath	A	A

/c Probe Length

/xxx Rigid Probe in Inches; Cable Probe in Feet

/d Options

/O No Options
/C Epoxy Coating Aluminum Enclosure
/F Flanged Connection
/L Stainless Steel Tags
/Z Any special option not included in above description. Includes but not limited to: Extended Lower Bushing, 10 amp DPDT Relay (Not FM approved) or Remote-Mount Connector Cable

/e Enclosure

/H Explosion Proof Note: Electronic enclosure is type H when remote mounted
/G Remote NEMA 4 electronics are selected

*Registered Trade Mark of E.I.DuPont Corp.

Operating Temperature Codes	
A	-40 to 185ºF / -40 to 85ºC
B	-40 to 320ºF / -40 to 160ºC
C	-40 to 450ºF / -40 to 230ºC
D	200 to 1400ºF / 95 to 760ºC

Operating Pressure Codes	
A	1500 psi @ 77ºF / 103 bar @ 25ºC
B	Static Head Only (Consult Factory)
C	150 psi / 10.3 bar
D	100 psi / 7 bar

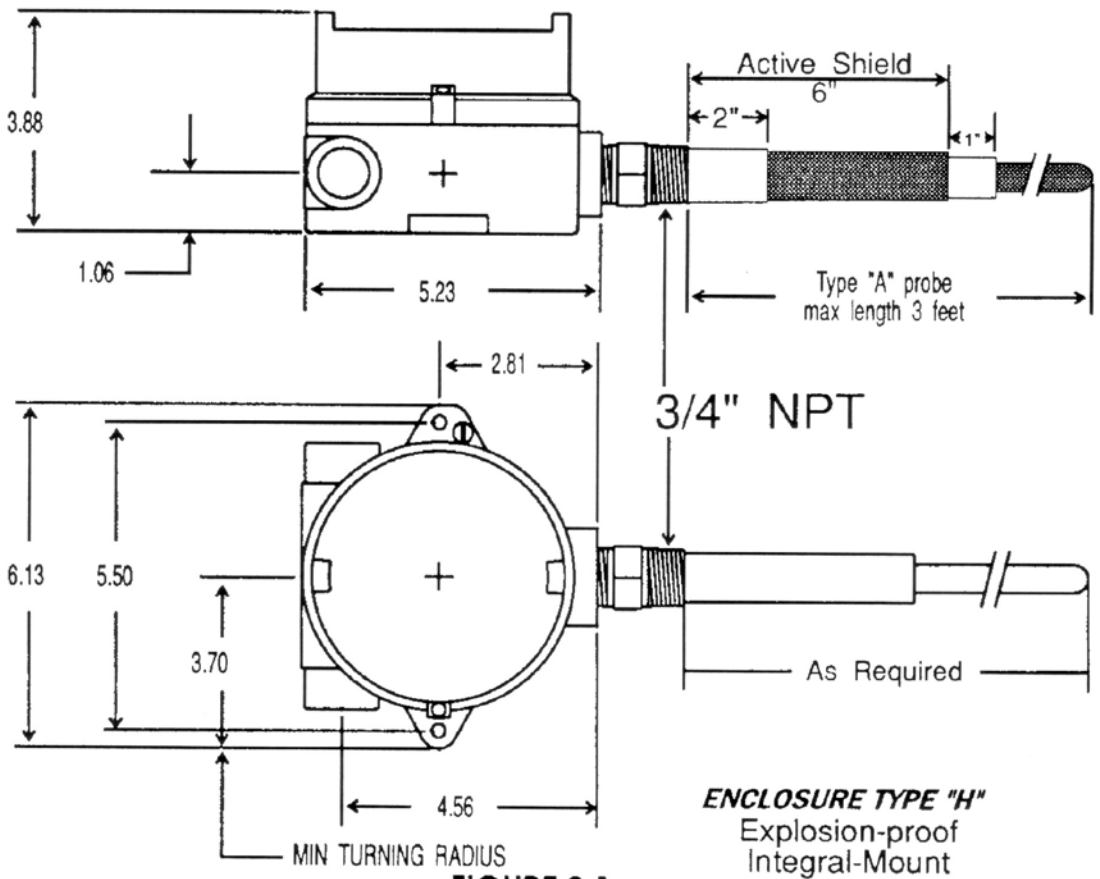


FIGURE 2.1

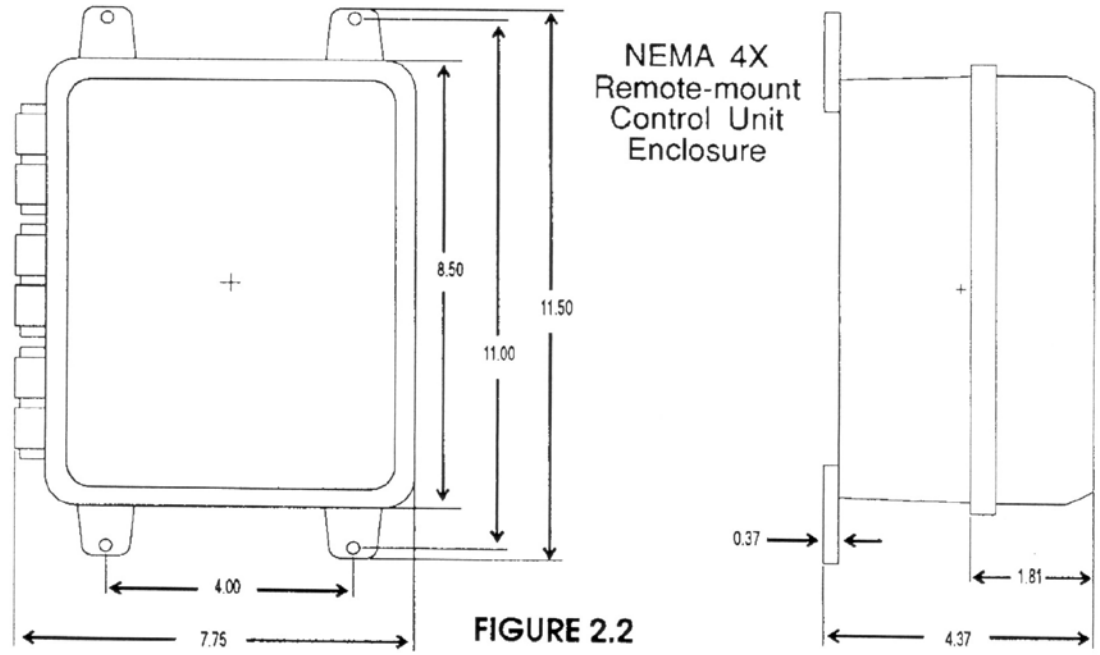


FIGURE 2.2

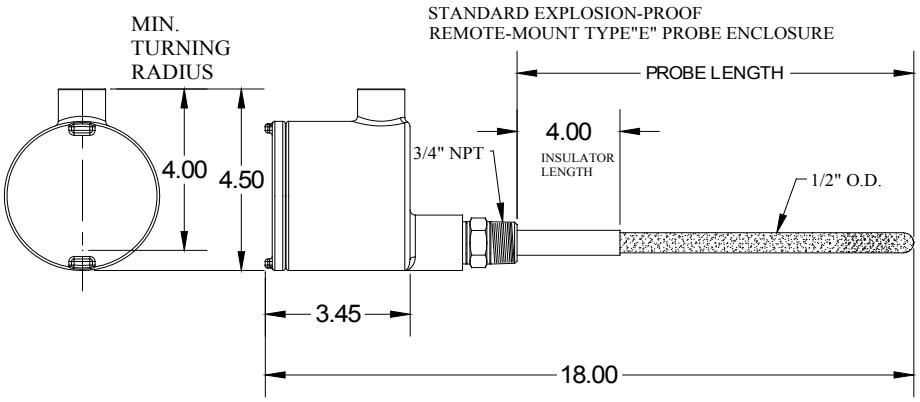


FIGURE 2.3

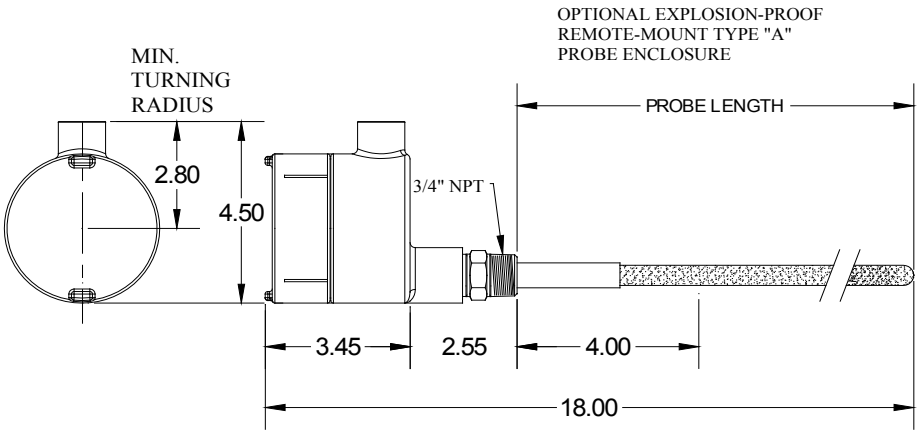


FIGURE 2.4

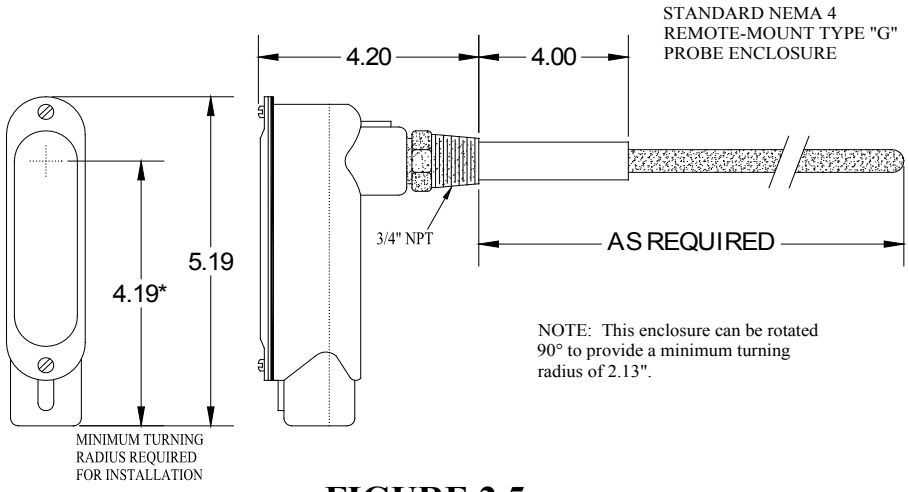


FIGURE 2.5

3.0 OPERATION

3.1 When material I n the vessel come into contact with the probe, the relay in the unit will change states. If the unit is programmed for operation in the “Fail-Safe High” mode, the relay will deenergize upon contact of the probe with the material. Since the two sets of relay contacts may be used in a number of different ways, the operator should know what to expect when a change in condition occurs and be prepared to take any action required by the system in which Model A02 is used.

3.2 The Model A02 includes driven shield technology to eliminate the effects of long interconnecting cable and allows the use of three element sensing probes to produce a high degree of coating rejection. The shield driver maintains identical voltage and phases between the center and shield elements of the sensing probe. Since no difference in potential exists between the center and shield elements, even with a conductive coating bridging the probe, no current can flow from the center element past the shield to ground (vessel wall). Therefore, only the actual material level in the vessel is detected.

3.3 The Model A02 is provided with a mode selevction jumper that allows the unit to be placed in a calibrate (CAL) mode and then returned to its normal operate (OPER) mode. This feature is most useful when the A02 is used to sense very low dielectric materials. This feature allows the unit to be critically adjusted in the CAL mode. Returning the unit to its OPER mode introduces a critically defined offset that stabilizes the unit while retaining maximum sensitivity.

3.4 An adjustable time delay with a range of 0 to 30 seconds is standard on all units. It can be used to eliminate nuisance alarms caused by sloshing or wave action within a vessel. A jumper selection is provided to set the time delay to operate on either rising (TDR) or falling (TDF) level.

For example, when the time delay is sey to actuate on rising level, the red LED will turn on instantaneously when the liquid in the vessel first touches the probe. The relay and its associated green LED will not change condition until the material has been in continuous contact with the probe for the amount of time the delay is set for. When the material falls off of the probe, the relay, its green LED and the red LED will all change condition instantaneously.

When the time delay is set to actuate on falling level, the relay, its green LED and the red LED all operate instantaneously when material first touches the probe. When material falls off of the probe, the red LED will go off instantaneously but the relay and its green LED will not change condition until the time delay has elapsed.

3.5 Adjustable switching differential (ASD), an extra cost option, is also useful in eliminating nuisance alarms. It is most commonly used to allow the Model A02 to be used as a two-point level controller. With ASD, the level must change by an amount determined during calibration before the unit will return to normal from the alarm state, The range of adjustment is 100% if probe length, independent of the zero range of the unit.

4.0 INSTALLATION AND CALIBRATION

4.1 After unpacking the unit, inspect it for any evidence of shipping damage. Any claims for damage due to shipping must be filed with the carrier who handled the package (s).

4.2 Select a mounting location in accordance with good instrument practice. Reliability will be enhanced if the location is free of excessive vibration or environmental temperatures outside the specified range. Be sure there is sufficient clearance around the mounting position to allow for the turning radius as the unit is screwed into place. Additional clearances must be allowed to enable insertion of long rigid probes into the vessel opening and removal of the housing cover. (See figure 4.1 for recommended mounting practices.)

CAUTION: WHEN MAKING CONNECTIONS TO THE VESSEL, OBSERVE ALL SAFETY REQUIREMENTS OF THE AREA WHERE THE WORK IS BEING DONE. BE ESPECIALLY CAREFUL OF PRESSURE VESSELS.

4.3 The Model A02 may not function properly if:

- The capacitance change at the probe is less than 0.2 Picofarads.
- The unit does not have an adequate ground reference.
- The probe (bare rod or cable) comes into contact with ground reference.
- The probe is located near a material inlet or outlet line.
- The housing is not properly grounded.

IF ANY OF THE ABOVE APPLY TO YOUR APPLICATION, DO NOT INSTALL THE MODEL A02 AND CONTACT YOUR LOCAL DISTRIBUTOR, REPRESENTATIVE, OR THE ABB FACTORY FOR INSTRUCTIONS.

4.4 The Model A02 may be damaged if:

- The temperature in the electronics housing exceeds -40°F to 168°F / -40°C to 70°C.
- The sensing probe rated temperature or pressure is exceeded.
- The electronics are subjected to excessive vibration ot shock.
- The probe is mounted directly in the flow of material
- The supply power is not within the ratingd for the particular unit.
- The relay contacts are subjected to a current in excess of their rating

IF ANY OF THE ABOVE APPLY OT YOUR APPLICATION, DO NOT INSTALL THE MODEL A02 UNTIL YOU CONTACT YOUR LOCAL DISTRIBUTOR, REPRESENTATIVE, OR THE ABB FACTORY FOR INSTRUCTIONS.

4.5 Mount the sensing probe using a suitable NPT fitting or flange. (See figure 4.2 for remote sensing probe wiring.) Integral sensing probes are factory wired. (See figure 1.2 for remote cable preparation.)

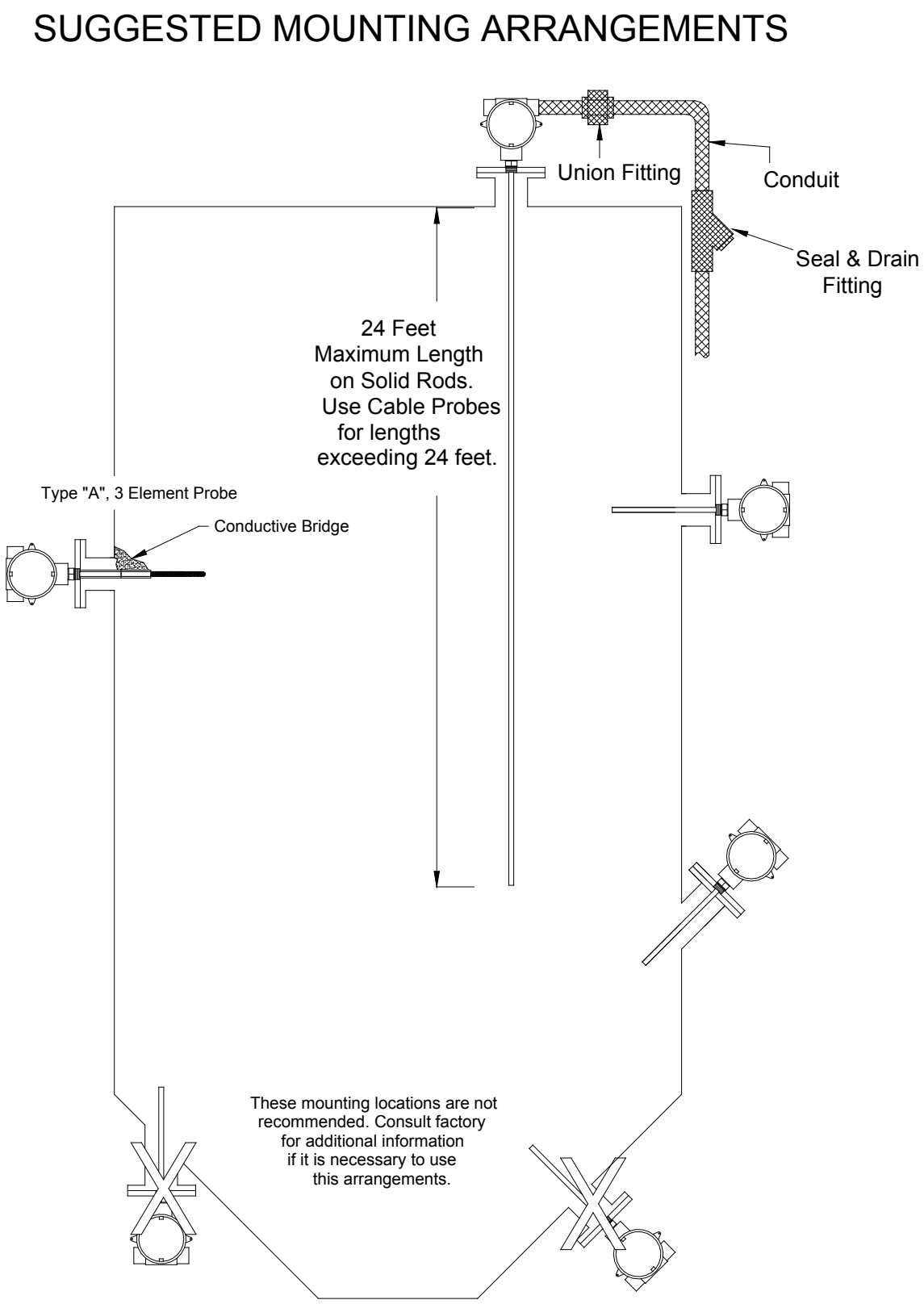
WARNING: Turn off and lock out all power before beginning installation.

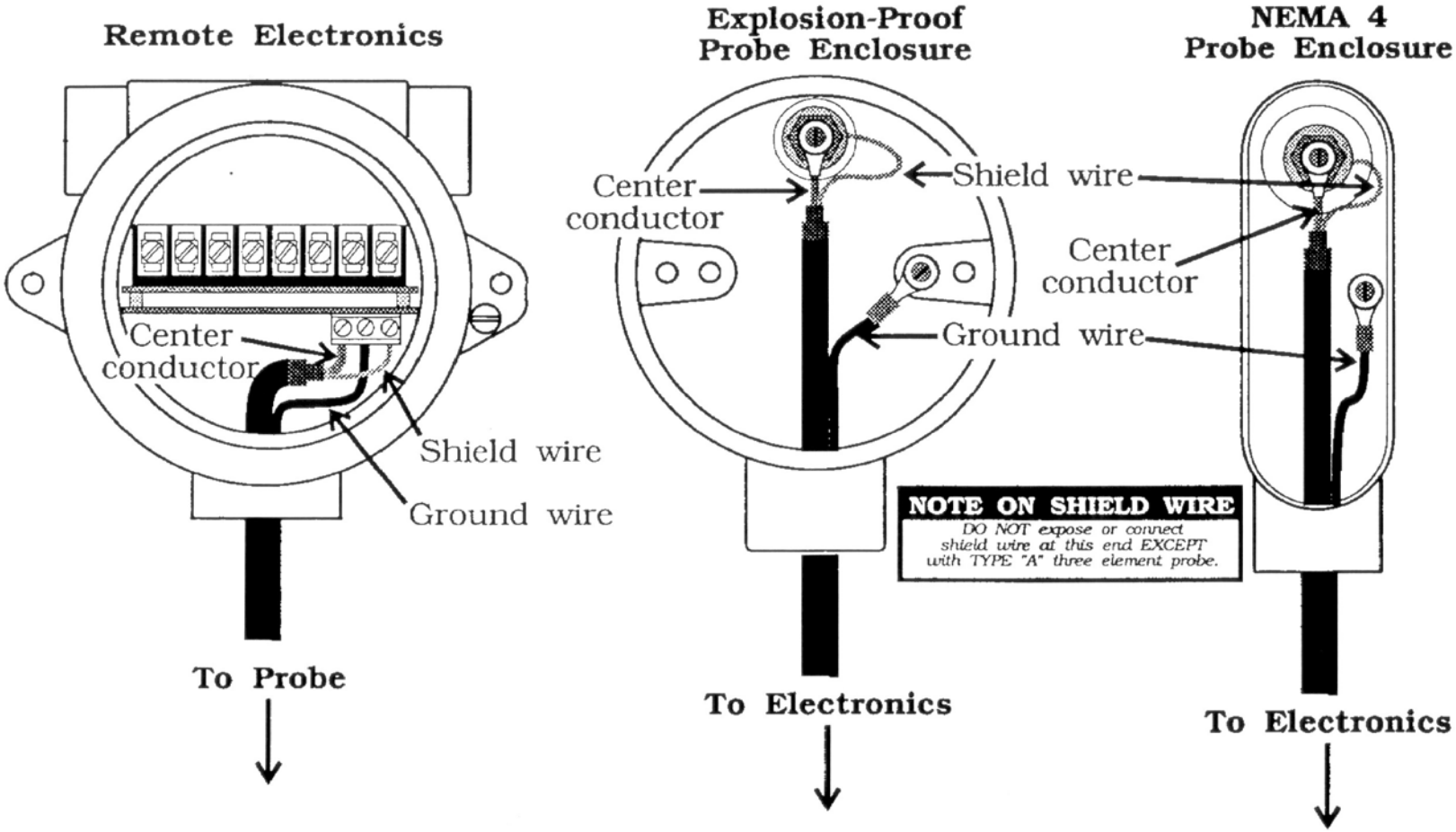
DANGER: If installing the electronics in a hazardous area, install approved conduit seal within 18 inches / .5 m of the enclosure as required by National and Canadian Electrical Codes. Serious personal injury or property damage can result if seals are not installed.

4.6 Wire the Model A02 in accordance with one of the typical wiring diagrams of figure 4.3 or 4.4 as may be required by the particular application in which the unit is used. Because of the extremely wide range of control and/or alarm applications in which the unit may be used, it is not possible to show all conceivable wiring diagrams. Contact your distributor or ABB, if assistance is required.

CAUTION: BE SURE ALL WIRING COMFORMS TO THE REQUIREMENTS OF THE NATIONAL ELECTRICAL CODE AND ANY ENFORCING AUTHORITIES OR AGENCIES HAVING JURISDICTION OVER THE INSTALLATION. INSURE THAT ANY SPECIAL CONDITIONS, SUCH AS AREA HAVING EXPLOSION HAZARDS, ARE GIVEN FULL CONSIDERATION.

Figure 4.1: Suggested Mounting Arrangements





Remote Sensing Probe Wiring

FIGURE 4.2

FIGURE 4.3 - AC Powered Unit

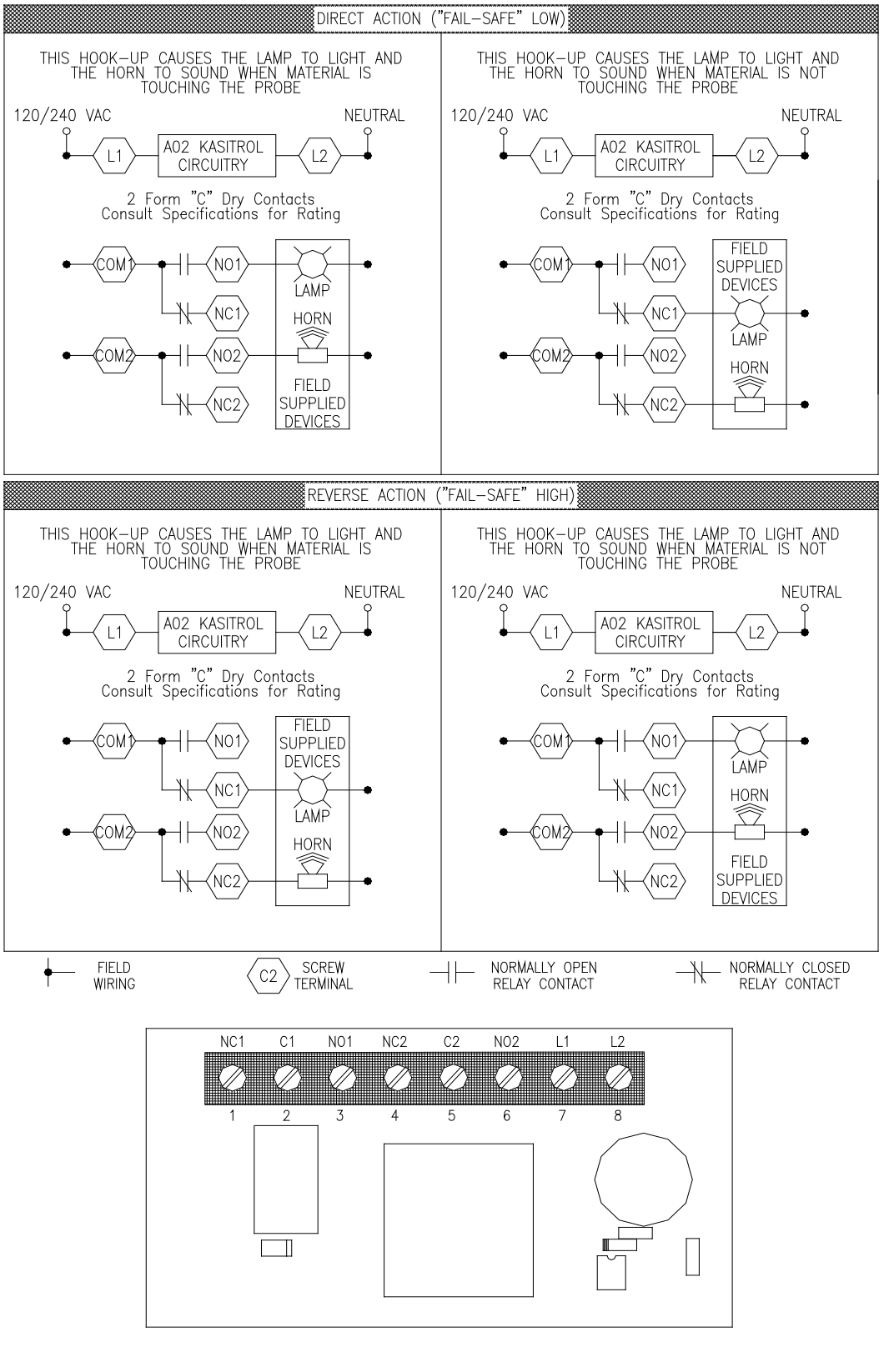
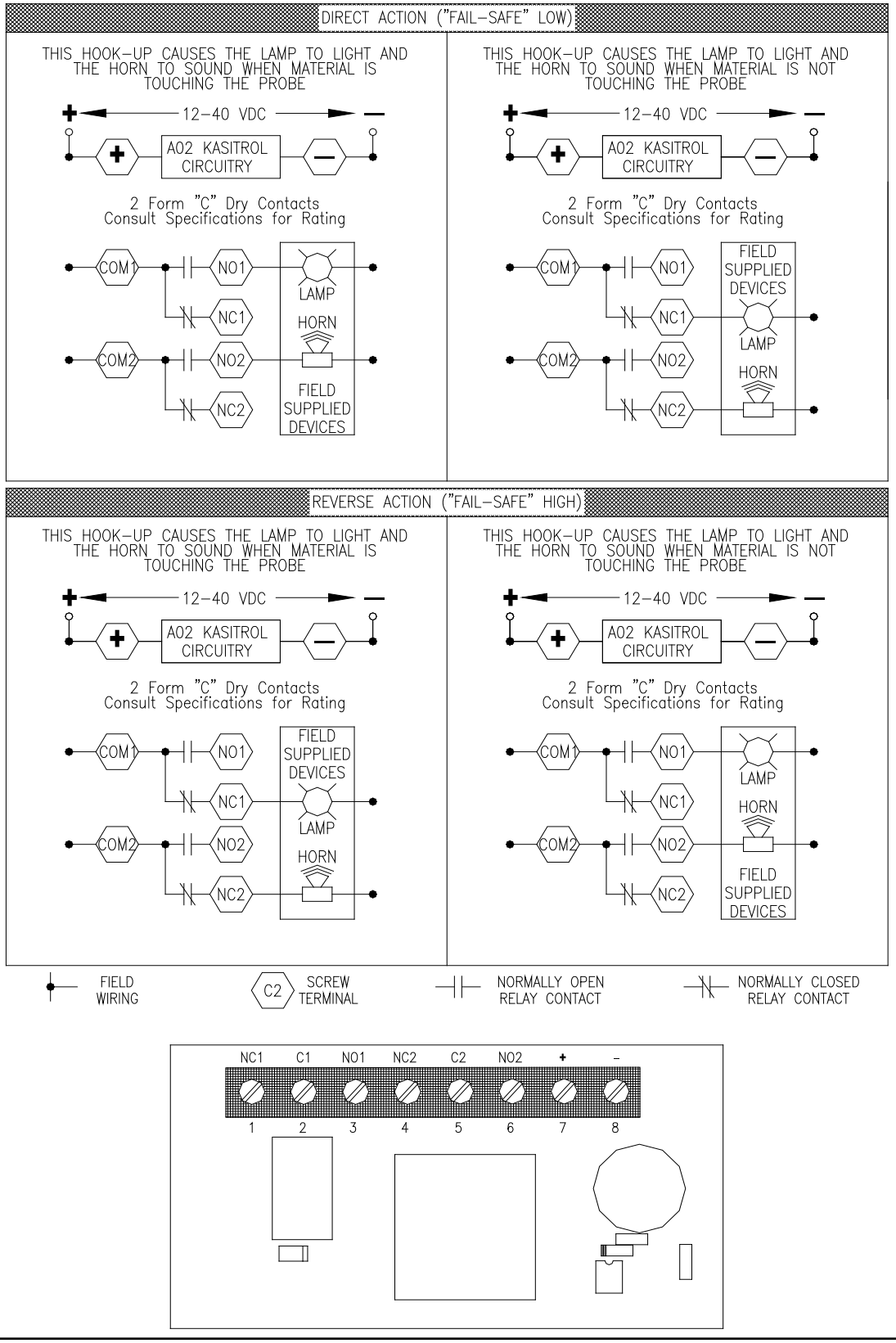
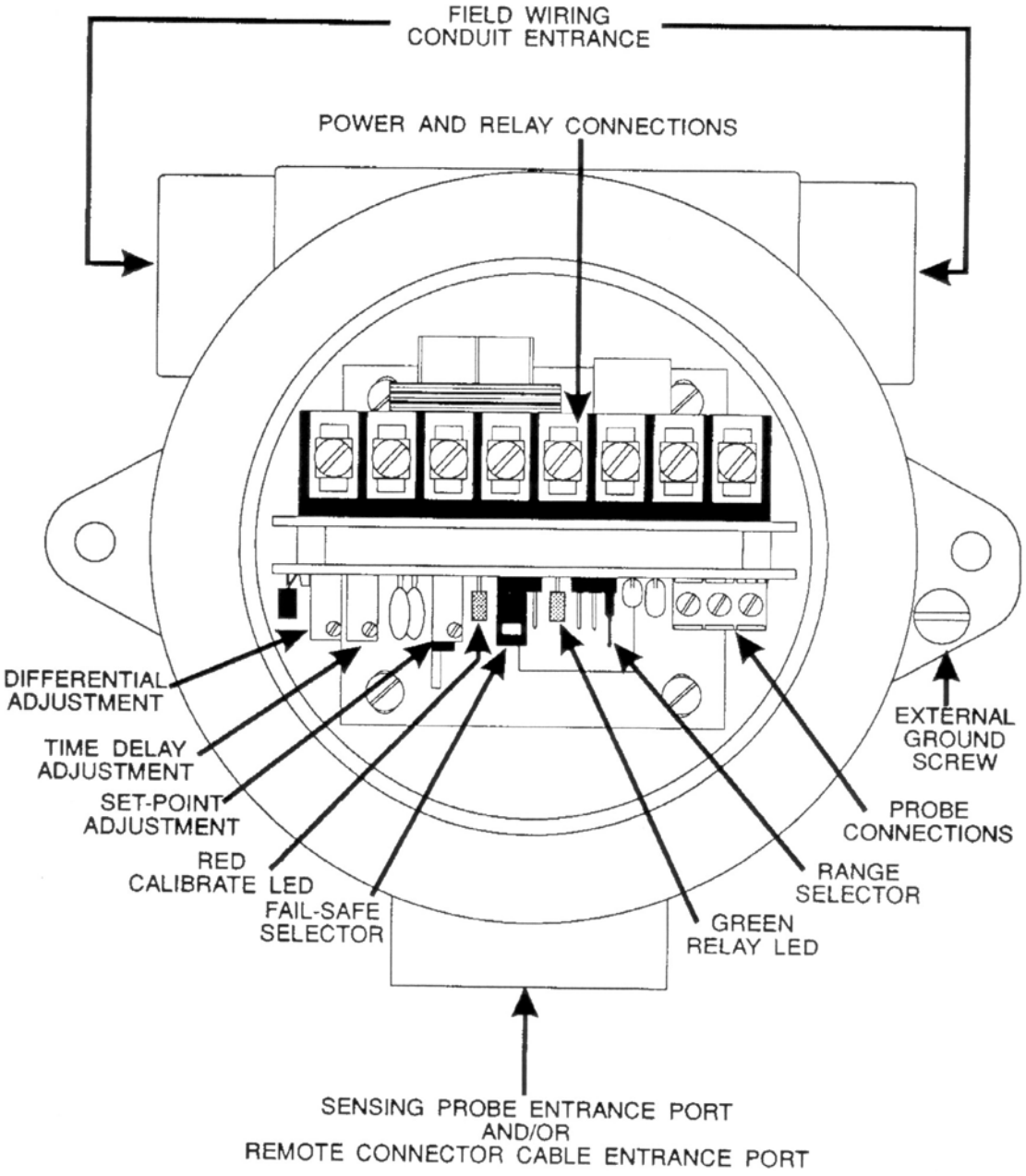


FIGURE 4.4 - DC Powered Unit





Location of Controls and Adjustments

FIGURE 4.5

4.0 INSTALLATION AND CALIBRATION (Continued)

4.7 Calibrate the unit using the procedures that follow. See figure 4.5 and 4.6 for location of adjustments and controls.

1. The “Fail-Safe” selector is used to determine the mode of operation of the relay. If the selector is placed in the HI position, the relay will be energized until the material in the vessel touches the sensing probe, at which time the relay will de-energize. If the selector is placed in the LO position, the relay will be de-energized until the material in the vessel touches the sensing probe at which time the relay will energize. There are no devices which are absolutely “Fail-Safe”. “Fail-Safe” means that, in the event of the loss of power and some component failures, the instrument will indicate an alarm condition. If your application needs absolute Fail-Safe, a backup instrument or redundant system must be installed.

2. The RANGE jumper sets the maximum allowed capacitance for the unit. For most applications, RANGE 3 will be correct. For some applications, such as very long sensing probes, interface detection, or sensing elements mounted very close to the wall of the tank, selection of another range may be necessary. This is accomplished by moving the RANGE jumper on the printed circuit board. If after rotating the set-point potentiometer through its complete travel switch action, switch action cannot be achieved in the highest range, set the jumper to the next lower range and repeat the calibration steps. Continue to move to the lower ranges necessary to achieve switch operation.

3. The calibration potentiometer sets the Model A02 to a particular installation. Once set, no readjustment should be required unless the installation is changed or the unit is moves to a different location.

4. Two indicator lights are used to determine the proper setting of the calibration potentiometer and indicate the state of the control relay. The “RLY” (relay) LED is on when the relay is energized and off when the relay is de-energized. Once properly calibrated, the red “CAL” (calibrate) LED is ON when material is touching the probe and OFF when material is not touching the probe.

5. The CAL/OPER jumper is used to aid the sometimes critical calibration of the unit for use with very low dielectric materials. Materials in this category are usually dry powders or light hydrocarbons. See the special calibration procedure for this purpose. For materials that do not fall into this category, place the CAL/OPER jumper in the OPER position and leave it there.

6. The TDR/TDF jumper is used to select the mode of operation for the time delay. To introduce a delay from the time material touches the probe until the relay changes state, place the jumper in the TDR (time delay rising) position. To introduce a delay from the time material falls below the probe until the relay changes stae, place the jumper in the TDF (time delay falling) position. If the time delay function is not used, the position of this jumper does not matter.

7. READ ALL STEPS BEFORE BEGINNING:

   NOTE: STEPS 1 and 2 are to be performed regardless of the mounting plane of the sensing probe.

   STEP 1: Rotate the SETPOINT (S/P), TIME DELAY (T/D) and DIFFERENTIAL (DIFF) adjustments fully counterclockwise (CCW) at least 20 turns or until a click is heard for every complete rotation.

   STEP 2: Set the RANGE jumper in position 3.

   HORIZONTALLY MOUNTED SENSING PROBE

   STEP 3: See that material is not touching the sensing probe.

   STEP 4: Rotate the SETPOINT adjustment slowly clockwise (CW) until the read “CAL” LED just goes off. If switch action has not occurred after 20 turns of the SETPOINT pot, move the RANGE jumper to the next lower setting and repeat steps 3 and 4.

4.0 INSTALLATION AND CALIBRATION (Continued)

STEP 5: Mentally note the position of the adjustment potentiometer.

STEP 6: Increase the material level until it is well above the sensing probe. Switch action will occur and the red “CAL” LED will turn on.

STEP 7: Counting the number of turns, turn the adjustment potentiometer slowly CW until the red “CAL” LED once again turns off, but no more than 15 turns.

STEP 8: Turn the adjustment back CCW 1/2 the number of turns that were counted in Step 7 above. The red “CAL” LED should be on.

STEP 9: Calibration is now complete.

VERTICALLY MOUNTED SENSING PROBE

NOTE: When detecting an interface, such as that between oil and water, the tank is considered to be “empty” for calibration purposes when the heavier material (water) is not touching the sensing probe. During STEPS 1-4, the lighter material (oil) must be covering the sensing probe so that it may be calibrated out.

CALIBRATING for VERY LOW DIELECTRIC MATERIALS

Calibrating for materials with a very low dielectric constant can be somewhat more demanding than for materials that are easier to detect. Using the CAL/OPER jumper can be a significant aid in setting the unit to operate reliably in this type of application. Use this method ONLY if you have trouble using either of the preceding methods.

STEP 1: Rotate the SETPOINT (S/P), TIME DELAY (T/D) and Differential (DIFF) potentimeters fully counter-clockwise (CCW)

STEP 2: Ste the RANGE jumper in position 3, the CAL/OPER jumper in the CAL position and the FS-HI/FS-LO jumper to the desired position. If the time delay function is to be used, place the TDR/TDF jumper in the desired position.

STEP 3: See that the material is not touching the sensing probe.

STEP 4: Rotate the S/P potentionmeter clockwise (CW) until the red DET LED just goes off. It is essential that this adjustment is as close as possible to the exact point where the red LED just goes out. In order to do this, it may be helpful to swing back and forth through this point a couple of times. Be sure that the final adjustment is made in the CW direction.

STEP 5: Move the CAL/OPER jumper to the OPER position. The red LED should remain off.

STEP 6: To confirm that the calibration is correct, raise the material level in the vessel until it is in contact with the probe. The red LED should turn on. With a vertically mounted probe, it may be necessary to cover several inches of the probe in order to detect the material. Lower the material level in the vessel until material is no longer touching the probe. The red LED should go off.

STEP 7: Calibration is now complete.

CALIBRATING for VERY LOW DIELECTRIC MATERIALS

Adjustable switching differential can be specified as an option on the Model A02. When configured for this option, the differential amount of level change required between the “ON” and “OFF” points of the control relay is adjustable from 0 to 100% of the vertical probe length. It is typically used for pump control - either to keep a tank full or to keep it pumped out by transferring process material.

STEP 1: Rotate the SETPOINT (S/P), TIME DELAY (T/D) and DIFFERENTIAL (DIFF) adjustments full counterclockwise (CCW) 20 turns or until a click is heard for every complete rotation. The red “CAL” LED should be on.

STEP 2: Set the material level to the highest desired operating point on the probe. Set the RANGE jumper to position 3.

STEP 3: Rotate the STEPOINT pot clockwise (CW) until the red “CAL” LED just goes off, then back counterclockwise (CCW) until the red “CAL”LED just comes back on. If the switch action has not occurred after 20 turns of the SETPOINT pot, select the next lower RANGE jumper setting and repeat Steps 1 and 2.

STEP 4: Rotate the DIFFERENTIAL (DIFF) adjustment fully clockwise (CW). Set the material level to the lowest desired operating point on the probe.

STEP 5: Slowly rotate the DIFFERENTIAL (DIFF) adjustment CCW until the red “CAL” LED just goes off.

STEP 6: Calibration is not complete.

TIME DELAY ADJUSTMENT

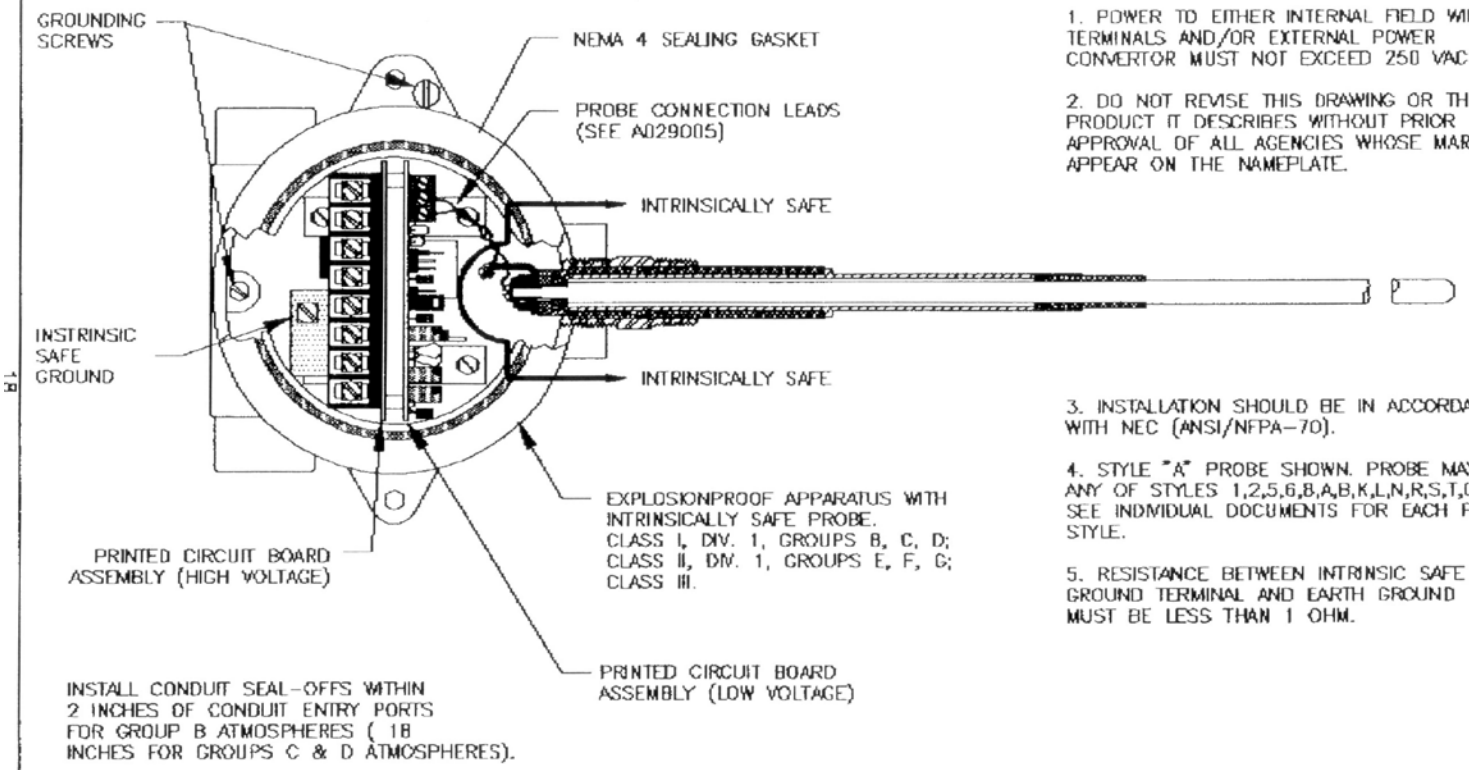
The TIME DELAY potentiometer is used to adjust the length of time that a given level condition must exist before a relay and its associated green LED will change state. This adjustment has 20 turns and slips or freewheels without damage at either end of its travel. The unit is shipped with the time delay set to its minimum time of approximately 0.1 second (potentiometer turned fully counterclockwise). Each clockwise turn of the potentiometer will add approximately 1.5 seconds to the time delay.

The time delay may be programmed to any of three different modes of operation. These are time delay on rising level, time delay on falling level, and time delay on both rising and falling level.

Time delay rising causes a delay beginning when the material in the vessel touches and remains in continuous contact with the probe for the length of the time delay setting. Ay the end of the time delay, the relay will change its state based upon the position of the fail-safe jumper. When material touches the probe, the relay will change instantly back to its original state.

Time delay on both rising and falling level causes a delay in both directions. Use of this feature would be very rare and should not be attempted without a complete understanding of how this mode will affect the operation of the unit. Please consult ABB if you have any doubt about using this mode of operation.

FIGURE 4.6



NOTES:

1. POWER TO EITHER INTERNAL FIELD WIRING TERMINALS AND/OR EXTERNAL POWER CONVERTOR MUST NOT EXCEED 250 VAC.

2. DO NOT REVISE THIS DRAWING OR THE PRODUCT IT DESCRIBES WITHOUT PRIOR APPROVAL OF ALL AGENCIES WHOSE MARKS APPEAR ON THE NAMEPLATE.

3. INSTALLATION SHOULD BE IN ACCORDANCE WITH NEC (ANSI/NFPA-70).

4. STYLE "A" PROBE SHOWN. PROBE MAY BE ANY OF STYLES 1,2,5,6,B,A,B,K,L,N,R,S,T,OR U. SEE INDIVIDUAL DOCUMENTS FOR EACH PROBE STYLE.

5. RESISTANCE BETWEEN INTRINSIC SAFE GROUND TERMINAL AND EARTH GROUND MUST BE LESS THAN 1 OHM.

INSTALL CONDUIT SEAL-OFFS WITHIN 2 INCHES OF CONDUIT ENTRY PORTS FOR GROUP B ATMOSPHERES (18 INCHES FOR GROUPS C & D ATMOSPHERES).

ECO NO.	DATE	REV	DESCRIPTION
A02-004	1-31-94	02	CONVERTED FROM A023003 TO A023202 SHEET #2 FOR FM APPROVAL

CONTROL DRAWING
MODEL A02 LEVEL SWITCH
DC POWERED WITH INTEGRAL SENSING PROBE

DRWN BY IJN	DATE 1-31-94	CHKD BY	DATE
LE NONE	SHEET 2 OF 3	DRWG NO. A023202	A023003

18321 Swamp Road
Prairieville, Louisiana 70769 USA
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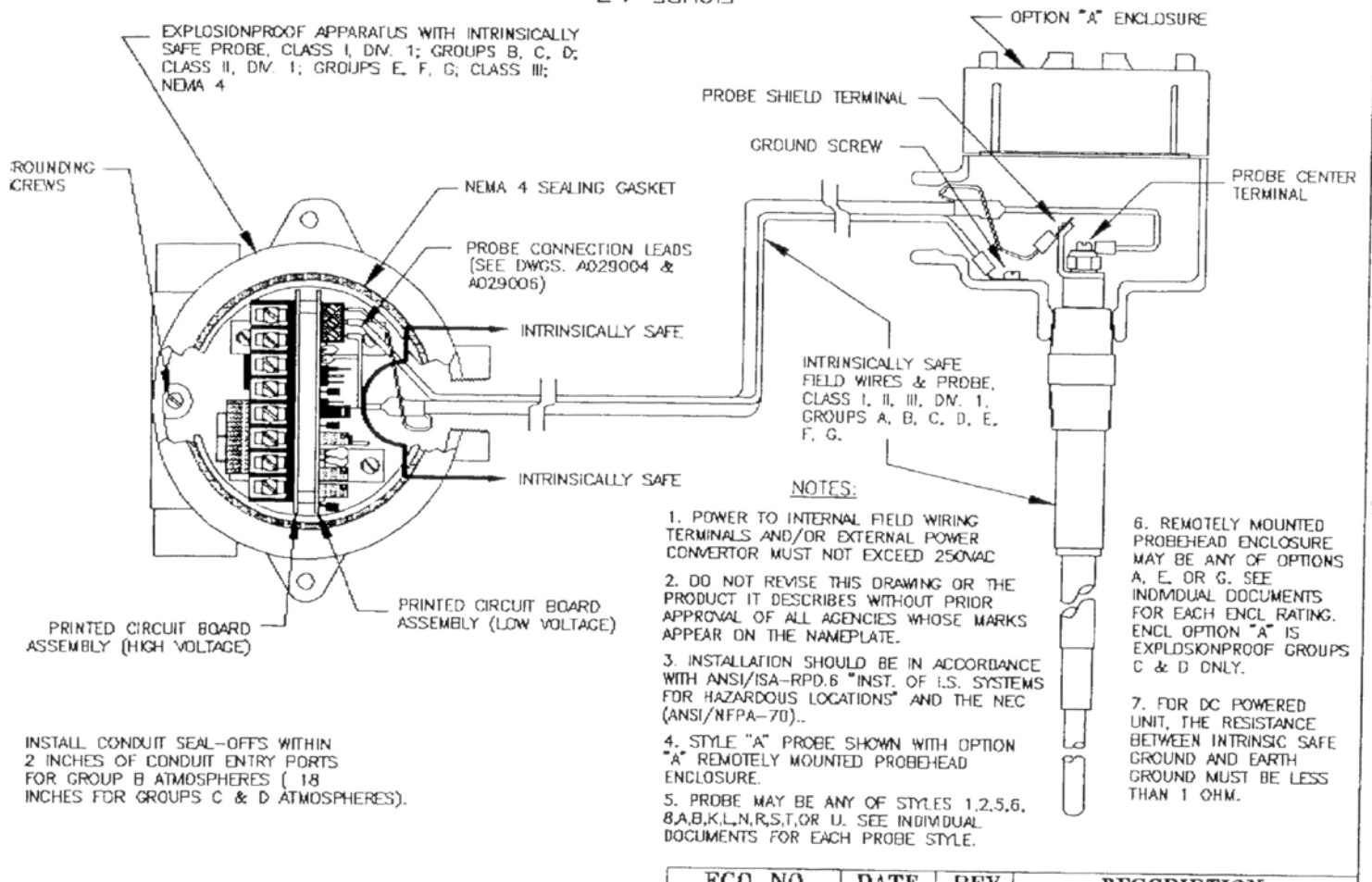
FIGURE 4.7



NOTES:

1. POWER TO INTERNAL FIELD WIRING TERMINALS AND/OR EXTERNAL POWER CONVERTOR MUST NOT EXCEED 250VAC
2. DO NOT REVISE THIS DRAWING OR THE PRODUCT IT DESCRIBES WITHOUT PRIOR APPROVAL OF ALL AGENCIES WHOSE MARKS APPEAR ON THE NAMEPLATE.
3. INSTALLATION SHOULD BE IN ACCORDANCE WITH ANSI/ISA-RPD.6 "INST. OF I.S. SYSTEMS FOR HAZARDOUS LOCATIONS" AND THE NEC (ANSI/NFPA-70)..
4. STYLE "A" PROBE SHOWN WITH OPTION "A" REMOTELY MOUNTED PROBEHEAD ENCLOSURE.
5. PROBE MAY BE ANY OF STYLES 1,2,5,6, 8,A,B,K,L,N,R,S,T,OR U. SEE INDIVIDUAL DOCUMENTS FOR EACH PROBE STYLE.
6. REMOTELY MOUNTED PROBEHEAD ENCLOSURE MAY BE ANY OF OPTIONS A, E, OR G. SEE INDIVIDUAL DOCUMENTS FOR EACH ENCL RATING. ENCL OPTION "A" IS EXPLOSIONPROOF GROUPS C & D ONLY.
7. FOR DC POWERED UNIT, THE RESISTANCE BETWEEN INTRINSIC SAFE GROUND AND EARTH GROUND MUST BE LESS THAN 1 OHM.

INSTALL CONDUIT SEAL-OFFS WITHIN 2 INCHES OF CONDUIT ENTRY PORTS FOR GROUP B ATMOSPHERES (18 INCHES FOR GROUPS C & D ATMOSPHERES).

ECO NO.	DATE	REV	DESCRIPTION
A02-004	1-31-94	02	NOTE CHNGS. FOR FM APPROVAL

CONTROL DRAWING
MODEL A02 LEVEL SWITCH
AC OR DC POWERED WITH REMOTE SENSING PROBE ASSEMBLY

DRWN BY IJN	DATE 1-31-94	CHKD BY	DATE
S F NONE	SHEET 3 OF 3	DRWG NO. A023202 (A023004)	

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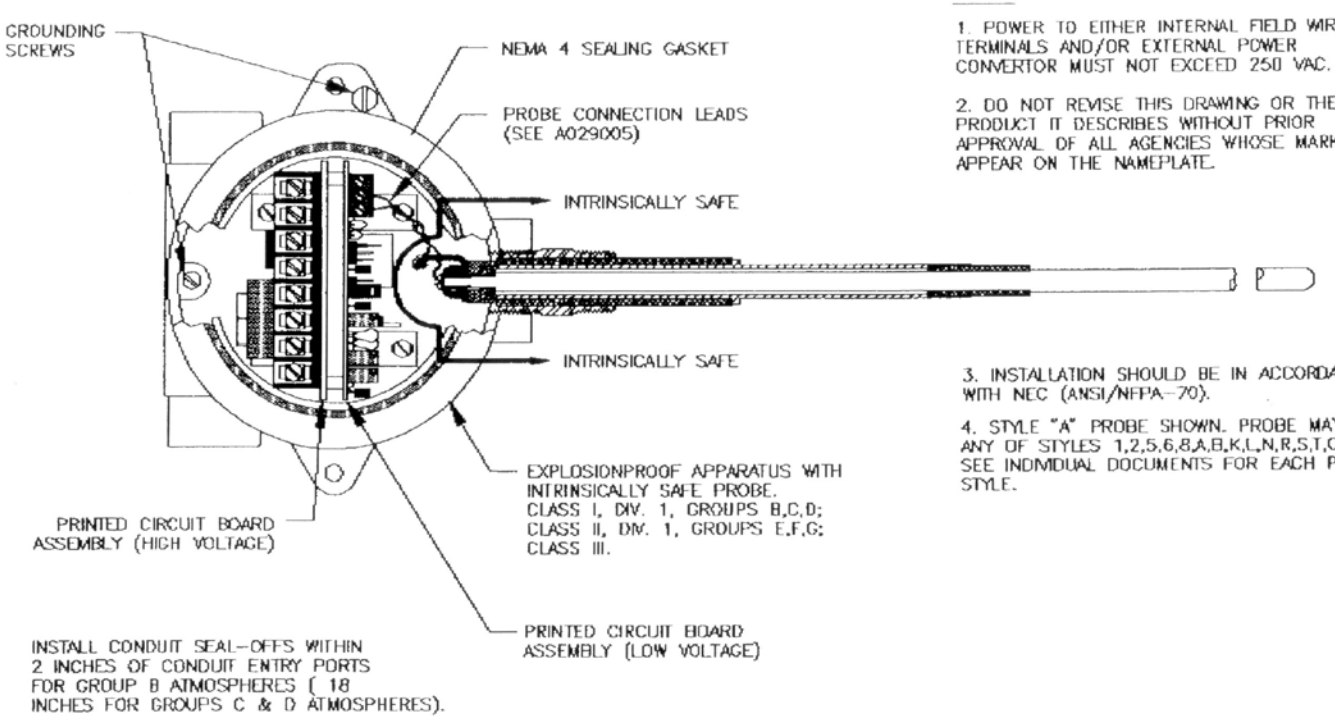
FIGURE 4.8



NOTES:

1. POWER TO EITHER INTERNAL FIELD WIRING TERMINALS AND/OR EXTERNAL POWER CONVERTOR MUST NOT EXCEED 250 VAC.

2. DO NOT REVISE THIS DRAWING OR THE PRODUCT IT DESCRIBES WITHOUT PRIOR APPROVAL OF ALL AGENCIES WHOSE MARKS APPEAR ON THE NAMEPLATE.

3. INSTALLATION SHOULD BE IN ACCORDANCE WITH NEC (ANSI/NFPA-70).

4. STYLE "A" PROBE SHOWN. PROBE MAY BE ANY OF STYLES 1,2,5,6,8,A,B,K,L,N,R,S,T,OR U. SEE INDIVIDUAL DOCUMENTS FOR EACH PROBE STYLE.

ECO NO.	DATE	REV	DESCRIPTION
A02-004	1-31-94	02	NOTE CHNGS. FOR FM APPROVAL
A02-003	12-06-93	01	UPDATE TO REFLECT CURRENT REVISION LEVEL APPEARANCE

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CONTROL DRAWING
MODEL A02 LEVEL SWITCH
AC POWERED WITH INTEGRAL SENSING PROBE

DRWN BY IJN	DATE 1-31-94	CHKD BY	DATE
SCALE NONE	SHEET 1 OF 3	DRWG NO. A023202	

5.0 THEORY OF OPERATION

5.1 Gases have low dielectric constant values; most are essentially 1.0. At ambient temperature and pressure, their low dielectric value is negligible in liquid level measurement and can usually be ignored. Nonconductive materials have intermediate values; most of them between 1.5 and 10.0. Careful consideration of dielectric constant is a necessity . Changes in moisture content, bulk density, etc. must be considered. Conductive materials can be considered to have extremely high dielectric constants making them the easiest products to detect.

5.2 The Model A02 consists of an oscillator circuit, a detector circuit, a sensing probe, a setpoint adjustment, a comparator circuit, a shield driver circuit, an indicator light, and a relay. See the block diagram, Figure 5.1. The unit also includes a power supply which is not shown on the block diagram.

5.3 The oscillator produces a 100 KHz signal that is coupled to the sensing probe through a resistance-capacitance network. The impedance of this network forms a voltage divider with the capacitive reactance of the sensing probe. A measure of the change in voltage across the divider is proportional to the change of capacitance at the probe.

5.4 The sensing probe forms one “plate” of a capacitor. The other “plate” is usually formed by the wall of the vessel in which the unit is mounted. Since neither the spacing between these two “plates” nor their area is allowed to vary, a difference in the dielectric constant of the material between the “plates” is the variable responsible for the capacitance change.

5.5 The detector output is a DC voltage that is inversely proportional to capacitance change. Low capacitance (low tank level) produces larger DC voltage, high capacitance (high tank level) produces smaller DC voltage. This voltage can be read with a voltmeter at pin Test Point (TP) 2 on the control board.

5.6 The comparator monitors the voltages from the Setpoint Adjustment potentiometer and the Detector circuit. When coincidence is detected, the comparator output toggles. This action turns on the red “CAL” LED, and the relay driver energizes or de-energizes the relay and green “RLY” LED as required for the failsafe mode selected. Once calibrated, the red “CAL” LED shows the presence or absence of product at the setpoint level on the sensing probe (LED on = product present; LED off = product absent).

5.7 The relay provides the means by which the Model A02 can control other devices such as lamps, small motors, motor starters, etc. It can be programmed either to energize when material contacts the sensing probe or to de-energize when material contacts the sensing probe. It should be noted that the green “RLY” LED indicates the state of the relay (LED on = relay energized; LED off = relay de-energized).

6.0 MAINTENANCE AND TROUBLESHOOTING

No routine maintenance is required other than keeping the interior of the unit clear of moisture and other contaminents. The A02 consists of three main sub-assemblies: the electronics boards, the sensing probe, and the sensor interconnecting cable. The following troubleshooting guide will assist in identifying the problem source.

NOTE: The following procedures require power to be applied to the unit with the cover removed. Do not perform this procedure unless the area is know to be non-hazardous. Energizing circuits with the cover removed can cause ignition of flammable gases or vapors, resulting in serious personal injury or property damage. Extreme care should be used when working around exposed live circuits to avoid personal injury or death due to electrical shock. Always insure that the unit is properly grounded.

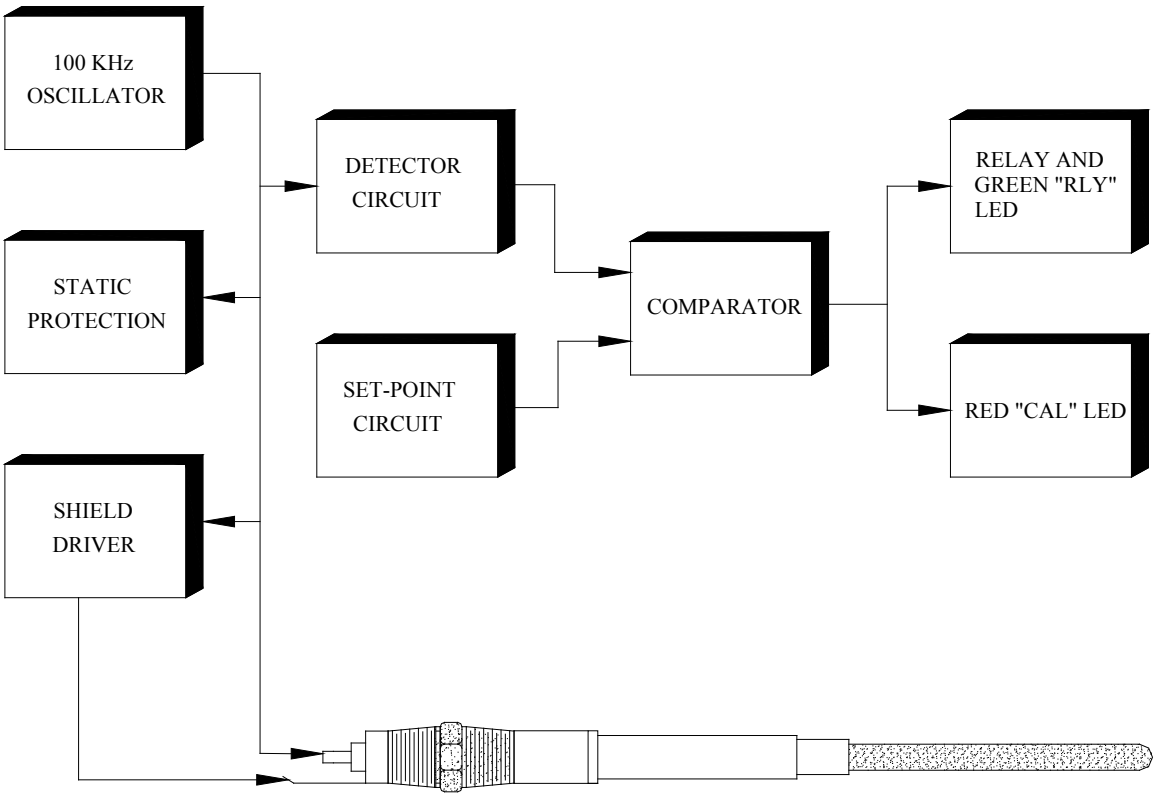

FIGURE 5.1 - Block Diagram

6.0 MAINTENANCE AND TROUBLESHOOTING

6.1 FUNCTIONAL CHECK

Disconnect the wiring between the sensing probe and the electronics boards. Do not disconnect the power supply wiring. If the RANGE shunt jumper is not in position 3, note its present position and move it to position 3. Turn the SETPOINT, TIME DELAY and DIFFERENTIAL adjustment potentiometers fully counterclockwise and note the state of the green “RLY” LED.

Find the switch point by rotating the SETPOINT potentiometer clockwise until the green “RLY” LED just changes states. Rotate the SETPOINT adjustment back and forth, observing the amount of rotation necessary to achieve switch action. At switch point, less than 1/8 turn should be required. If the unit works correctly during the test above, but not in service, it is possible that the RANGE shunt jumper was incorrectly set for the application. Positions 1 and 2 are usually needed only with very long sensing elements, or where the switch point is several feet up from the end of the sensing probe.

6.2 RELAY CHECK

An ohmmeter can be used to test the continuity of the contacts of the double-pole, double-throw (DPDT) control relay. Operational problems frequently are traced to errors in wiring to the relay. Commonly, the difficulty arises form misunderstanding of the Normally open/Normally closed terminology or a belief that power will be supplied from the relay contacts. Standard relay terminology refers to the “shelf”, that is, unpowered condition of the relay. When the relay is unpowered, continuity exists between the Normally closed and Common terminals. When the relay is energized, continuity exists between the Normally open and Common terminals and no continuity exists between the Normally closed and Common terminals.

NOTE: The relay is simply an electrically operated switch- opening or closing contacts. Power is not supplied by the relay, but it controls power that is provided by field wiring.

6.3 SENSING PROBES

Operational problems can often be traced to improper or incorrect installation of the sensing probe. The use of large quantities of TEFLON® thread tape is not recommended. Care should be taken to insure integrity between the electronics and the vessel or other ground reference plane.

The following test can be performed using an analog (non-digital) ohmmeter to measure the resistance between the sensing probe element and ground. Disconnect all sensing probe wire at the three point terminal strip on the electronics module. See Figure 4.5 for location of the terminal strip.

6.3.1 INTEGRAL MOUNTED 2-ELEMENT PROBE

Lower the level of material in the vessel until it is below the sensing probe. Measure the resistance between the sensing probe wire and electronics housing. Measured resistance should be infinite. Resistance measurements of less than 1 Megohm usually indicate presence of moisture or product in the probe insulation. Consult the factory or your distributor.

6.3.2 INTEGRAL MOUNTED 3-ELEMENT PROBE, WITHOUT COATING

Lower the level of material in the vessel until it is below the sensing probe. Measure the resistance between the sensing probe wire and the electronics housing. Measure the resistance between the shield electrode and the sensing probe. Resistance measurements of less than 1 Megaohm usually indicate the presence of moisture or product in the probe insulation. Consult the factory or your distributor.

6.2.3 INTEGRAL MOUNTED 3-ELEMENT PROBE, WITH COATING

Lower the level of material in the vessel until it is below the sensing probe. Measure the resistance between the sensing probe wire and the electronics housing. Measure the resistance between the shield electrode wire and the electronics housing. Measure the resistance between the shield probe and the sensing probe. The measured value should not be less than those listed below.

6.4 POSSIBLE PROBLEMS AND SOLUTIONS

PROBLEM	POSSIBLE CAUSE	SOLUTION
Instrument always indicates and alarm	No power to unit	Check for correct supply voltage at terminals 7 & 8. See Section 2.0.
	Excessive conductive build-up on sensing probe (HLFS)	Longer shield length required. Consult distributor.
	Sensing probe connecting cable defective.	Check for shorts between conductors of cable.
	Improper calibration	See Section 4.0
	Bad electronic unit	See Section 6.0
Instrument never indicates an alarm	Excessive conductive build-up	Longer shield length required. Consult distributor.
	Sensing probe connecting cable defective	Check for open circuit in connecting cable.
	Improper calibration	See Section 4.0
	Bad electronic unit	See Section 6.0
Unit will not stay in calibration	Sensing probe connecting cable defective	Check for open circuit in connecting cable
	Poor integrity between electronics and vessel/reference ground.	Secure ground connection
Poor sensitivity	Improper RANGE jumper setting	See Section 4.5

6.5 TROUBLESHOOTING VOLTAGE CHECKS

TP1	100 KHz Square Wave
TP2	Detector Output (Value dependent upon probe capacitance)
TP3	Setpoint Voltage
TP4	+12 VDC ±.5 VDC
TP5	Common (Ground)

7.0 WARRANTY

5 YEAR WARRANTY FOR:
KM26 Magnetic Liquid Level Gauges; MagWave Dual Chamber System; LS Series Mechanical Level Switches (LS500, LS550, LS600, LS700, LS800 & LS900); EC External Chambers and ST95 Seal Pots.

3 YEAR WARRANTY FOR:
KCAP300 & KCAP400 capacitance switches.

2 YEAR WARRANTY FOR:
AT100, AT100S and AT200 series transmitters; VF20 and VF30 vibrating fork switches; RLT100 and RLT200 reed switch level transmitters; TX, TS, TQ, IX and IM thermal dispersion switches; IR10 and PP10 External Relays; MT2000 radar level transmitters; RI100 Repeat Indicator; KP paddle switches; A02, A75 & A77 RF capacitance level switches and A38 RF capacitance level transmitters; Buoyancy Level Switches (MS50, MS10, MS8D & MS8F); Magnetic Level Switches (MS30, MS40, MS41, PS35 & PS45).

1 YEAR WARRANTY FOR:
KM50 gauging device; AT500 and AT600 series transmitters; LaserMeter and SureShot series laser transmitters; LPM200 digital indicator; DPM100 digital indicators; APM100 analog indicators; KVIEW series digital indicators and controllers; SF50 and SF60 vibrating fork switches, KB Electro-Mechanical Continuous Measuring Devices, KSONIK ultrasonic level switches, transmitters & transducers.

SPECIAL WARRANTY CONSIDERATIONS:
ABB does not honor OEM warranties for items not manufactured by ABB (i.e. Palm Pilots). These claims should be handled directly with the OEM.

ABB will repair or replace, at ABB's election, defective items which are returned to ABB by the original purchaser within the period specified above from the shipment date of the item and which is found, upon examination by ABB, to its satisfaction, to contain defects in materials or workmanship which arose only under normal use and service and which were not the result of either alterations, misuse, abuse, improper or inadequate adjustments, applications or servicing of the product. ABB's warranty does not include onsite repair or services. Field service rates can be supplied on request.

If a product is believed to be defective, the original purchaser shall notify ABB and request a Returned Material Authorization before returning the material to ABB, with transportation prepaid by the purchaser. (Request door to door delivery via New Orleans International Airport located in Louisiana, USA.) The product, with repaired or replaced parts, shall be returned to the purchaser at any point in the world with transportation prepaid by ABB for best-way transportation only. ABB is not responsible for expedited shipping charges. If the product is shipped to ABB freight collect, then it will be returned to the customer freight collect.

If inspection by ABB does not disclose any defects in material or workmanship, ABB's normal charges for repair and shipment shall apply (minimum 250.00 USD).

The materials of construction for all ABB products are clearly specified and it is the responsibility of the purchaser to determine the compatibility of the materials for the application.

THE FOREGOING WARRANTY IS ABB'S SOLE WARRANTY AND ALL OTHER WARRANTIES EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OF FITNESS FOR A PARTICULAR PURPOSE, ARE EXCLUDED AND NEGATED TO THE MAXIMUM EXTENT PERMITTED BY LAW. NO PERSON OR REPRESENTATIVE IS AUTHORIZED TO EXTEND ANY OTHER WARRANTY OR CREATE FOR ABB ANY OTHER LIABILITY IN CONNECTION WITH THE SALE OF ABB'S PRODUCTS. THE REMEDIES SET FORTH IN THIS WARRANTY ARE EXCLUSIVE OF ALL OTHER REMEDIES AGAINST ABB. ABB SHALL NOT BE LIABLE FOR ANY CONSEQUENTIAL, INCIDENTAL, OR SPECIAL DAMAGES OF ANY KIND. ABB'S SOLE OBLIGATION SHALL BE TO REPAIR OR REPLACE PARTS (FOUND TO BE DEFECTIVE IN MATERIALS OR WORKMANSHIP) WHICH ARE RETURNED BY THE PURCHASER TO ABB.

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