Manual No. 16L
Revision 0-593

MODEL 16L
MULTI-POINT
LEVEL DETECTION SWITCH

ADDENDUM FOR MODEL 16L CSA-APPROVED MULTI-POINT LEVEL DETECTION SWITCH

Installation of the Model 16L level detection switch in a Class I or Class II, Div. 1 hazardous area is only certified by CSA as explosion-proof when all of the following conditions are met:

1. A certified GLI insulated level sensor in the 4000L, 4100L, 4200L, 4300L or 4500L series must be used.

2. The power supply that provides power to the Model 16L must be located in a safe area.

3. All components of the system must be wired in accordance with GLI control drawing 1001X4N1180.

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For additional background, please refer to the following GLI literature:

- Application Note L1 — RF Level Measurement In Lined Metal Vessels With Grounded Shell
- Application Note L2 — RF Level Measurement In Plastic Vessels
- Technical Bulletin L1 — Capacitance Level Measurement

PART ONE - INTRODUCTION

SECTION 1 - GENERAL INFORMATION

1.1 Description

The Model 16L RF electronic, multi-point level detection switch can be used for level alarm and/or control of conductive and non-conductive liquids, granular materials, foams, pastes and slurries.

The Model 16L provides four independent setpoints which can be selected to operate in a "point" control or "zone" control mode. These modes are described in Part Three, Sections 3.1 and 3.2 respectively. Each of the four relays can be selected to operate in response to increasing or decreasing level. Adjustable relay time delay (selectable to delay on pull-in, drop-out or both ways) can be applied to any relay to meet application requirements. Furthermore, each relay can be independently set up to operate in a low level or high level fail-safe mode. LED's on the control panel indicate respective relay on/off status.

Calibration only requires a one-point span adjustment. A bi-color LED indicates below level, at level and above level status to simplify calibration.

The Model 16L can be used with any GLI bare or insulated level probe except Model 4400L-series driven-shield probes.

1.2 Product Identification

The serial # of your instrument is located on the electronic chassis next to the power input terminals. The matrix below lists all of the instrument options. Use it as a handy reference when re-ordering. Write the serial # in the space provided below the matrix for convenient identification when technical assistance is required.

MODEL NUMBER
16L RF electronic multi-point level detection switch with four relays/setpoints.

LINE VOLTAGE

1	115 volts, 50/60 Hz	**4**	24 VDC
2	230 volts, 50/60 Hz (single-fused)	**6**	230 volts, 50/60 Hz (dual-fused)

RESERVED CATEGORIES

N Standard Instrument
K Special Instrument

16L **A0** **Product Number** **Serial #**_____

SECTION 2 - SPECIFICATIONS

2.1 Operational

Measurement..... RF impedance

Setpoint Range..... 20 to 5000 pF

Temperature Range ..... –40 to 71°C (-40 to 160°F) electronics; probe separately rated (dependent upon materials of construction)

Protection ..... RFI, EMI, and designed to pass IEC-801-2 static discharge test

Spark Protection..... 100 amps

Power Requirements..... 100-137.5 VAC, 50/60 Hz; 195-275 VAC, 50/60 Hz available; 24 VDC available, 8.5 VA nominal

Relay Function:

Operating Modes ..... 4 Pt. (four control points) or zone control, field selectable

Output:

Relays A and D ..... DPDT, two Form C contacts, 5A resistive, @ 115/230 VAC and 30 VDC

Relays B and C ..... SPDT, two Form C contacts, 5A resistive, @ 115/230 VAC and 30 VDC

Deadband:

Relays A, B and D... Fixed at 1% of full scale

Relay C ..... Adjustable, 1-75% of full scale

Time Delay (all relays) ..... Adjustable 0 to 30 seconds, field selectable to delay on pull-in, drop-out or both ways

Fail-Safe (all relays).... High or low level, field selectable

Phasing (all relays) ..... Field selectable to operate relays in response to increasing (high phase) or decreasing (low phase) level

2.2 Performance

Sensitivity ..... 0.1% of span

Stability..... 0.1% of span per 24 hrs., non-cumulative

Temperature Drift ..... 0.03% of span per °C, maximum

Repeatability..... 0.1% of span

Response Time ..... 100 milliseconds

2.3 Mechanical

Enclosure..... Cast aluminum w/ urethane finish – NEMA 4, 7 and 9 (weatherproof, hosedown, dust and vapor explosionproof)

Net Weight..... 3.6 lbs. (1.63 kg) approximately

PART TWO - INSTALLATION

SECTION 1 - UNPACKING

After unpacking, carefully unscrew the cover from the base casting and inspect the electronic chassis for shipping damage. If there is any evidence of damage, notify your carrier immediately. Save the small plastic screwdriver and banana plug for later use.

SECTION 2 - MECHANICAL REQUIREMENTS

2.1 Location

Mounting positions for the Model 16L switch should be carefully considered. The probe may be installed vertically or angled, but should not be located where the inflow of material could contact it as this could cause false or sporadic relay actuation. Downward angle-mounted level probes allow the measured material to drain or fall from the electrode surface. Vertically mounted level probes must be clear of agitators and other obstructions within the vessel. Figure 2-1 illustrates typical mounting locations.

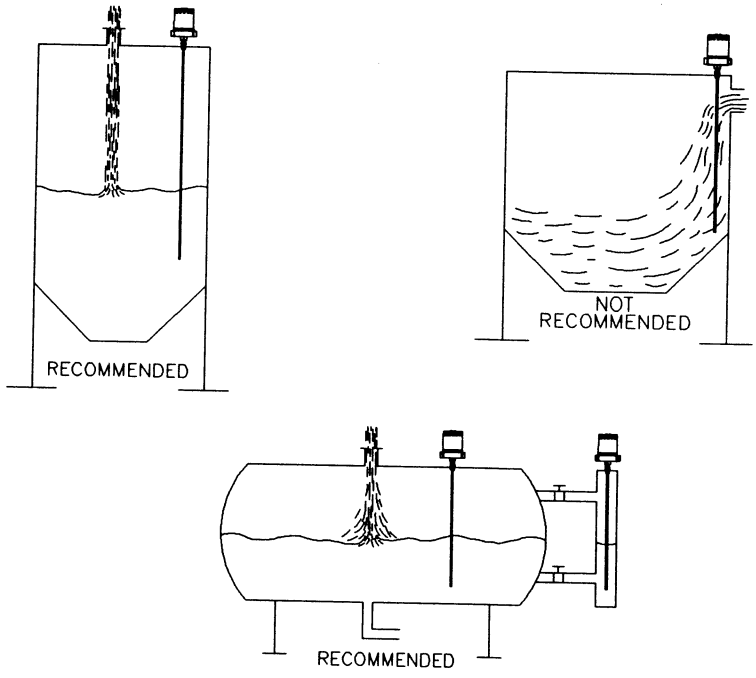


FIGURE 2-1 Typical Mounting Locations

In all cases, avoid mounting locations that would position the level probe in areas where material can build up unevenly.

Typically, buildup is caused by materials (granulars, powders or dry solids) filling into the vessel unevenly. If the level probe is contacted by uneven material buildup, the 16L will switch at this false point which is not the intended actual level trip point. The effect of uneven material buildup may be minimized by moving the probe further towards the center of the vessel. Figure 2-2 illustrates these mounting arrangements.

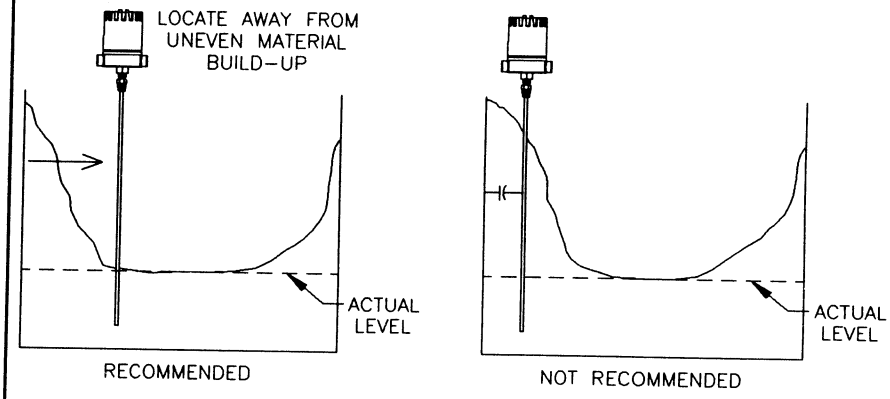


FIGURE 2-2 Probe Location Do's and Don'ts for Applications with Uneven Material Buildup

For applications involving a vessel with non-conductive walls, a ground reference plate or grounded reference electrode is required. However, if the measured material is conductive and effectively grounded in some other way, this is not necessary.

For more in-depth information on conductive material in lined metal vessels or point level measurement in plastic vessels, refer to GLI Application Notes No. L1 and No. L2, respectively. Also, the concept of capacitance level measurement is described in GLI Technical Bulletin No. L1.

2.2 Mounting

Before installing the level probe and Model 16L, it is recommended to perform the simple bench test described in Part Three, Section 2 to familiarize yourself with the instrument.

The Model 16L has a 1/2-inch NPT hole on the bottom center of the enclosure for direct mounting onto the installed level probe. Follow these steps to install the level probe and Model 16L.

1. Install level probe into vessel opening without the Model 16L mounted on it. Use a wrench on the larger, lower hex nut portion only of the two-piece fitting to tighten level probe into vessel.

   CAUTION: Do not tighten or loosen the smaller, upper hex nut portion of the two-piece fitting. This is a compression seal that could be damaged if the upper portion is turned.

NOTE: *The level probe has a 3/4 inch NPT thread for mounting to the vessel. Since this bare threaded connection provides a convenient, effective ground for conductive vessels, Teflon tape is not recommended on the threads unless leaking occurs. If tape is used, grounding of conductive vessels must be verified.*

For non-conductive vessels (fiberglass, etc.), an alternative grounding method must be used. Refer to GLI Application Notes No. L1 and L2 for guidelines.

If the level probe is welded into a mounting flange, simply bolt flange to the mating flange on the vessel.

2. Install banana plug onto back end of level probe extension by screwing it into the threaded hole.

   CAUTION: Do not tighten plug with excessive force as it can be easily twisted off.

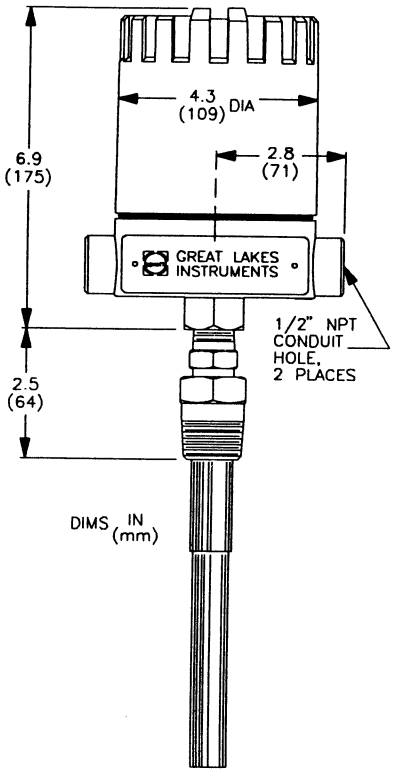


FIGURE 2-3
Model 16L Mounting Details

3. Carefully screw Model 16L enclosure onto threaded upper portion of fitting on back end of level probe. The banana plug makes the necessary electrical connection to the electronic chassis. Screw until tight, but without excessive force to avoid stripping the aluminum threads.

   NOTE: *It may be necessary to rotate the 16L to orient wiring entrances to a desired position. Use a wrench to hold the upper, smaller hex nut stationary while turning the 16L.*

SECTION 3 - ELECTRICAL CONNECTIONS

3.1 Level Probe

Connect level probe to the Model 16L via the banana plug installed onto back end of probe. The plug must be securely fastened and not damaged.

3.2 Line Power

Power requirements may be 115 VAC, 230 VAC, or 24 VDC. Check to make sure which voltage is correct for the unit being installed.

Earth Ground

Regardless of the power requirements, **the 16L must be connected to earth ground.**

1. Remove the electronic chassis from the enclosure by loosening the two side bracket screws to access the green GND SCREW (Figure 2-4).
2. Connect the ground wire to this screw. The GND SCREW, which is common with chassis ground, grounds the instrument which is mandatory for safe operation.
3. Re-install the electronic chassis with the power input terminals facing the GND SCREW.

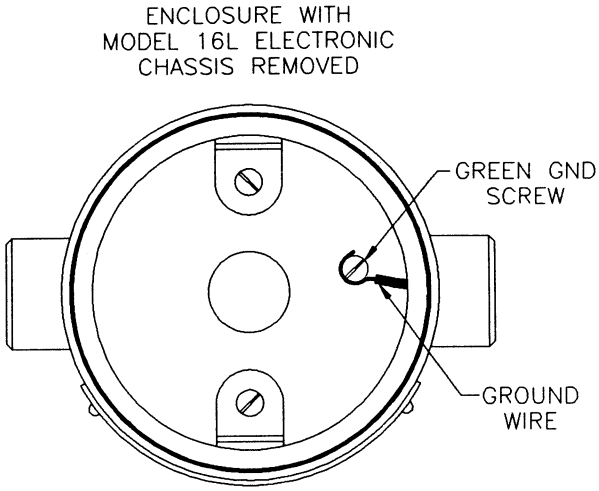


FIGURE 2-4 Electrical Chassis Grounding Details

AC-Powered Model 16L's

Connect AC line power to NEUT and HOT terminals on TB1 (Figure 2-5) which are fuse protected. Wire size of #12 AWG is recommended for primary power and control circuit wiring. Use wiring practices which conform to local codes (National Electrical Code Handbook in the U.S.A.). Use only the standard three-wire connection for AC wiring.

WARNING: FOR HAZARDOUS AREA APPLICATIONS, APPROVED WIRING SEAL FITTINGS MUST BE USED IN THE CONDUIT OPENINGS TO PRESERVE THE EXPLOSIONPROOF RATING. UNUSED CONDUIT OPENINGS MUST BE SEALED USING A SOLID PIPE PLUG.

DC-Powered Model 16L's

Connect 24 VDC to the appropriate terminals on TB1, matching polarity as indicated (Figure 2-6).

3.3 Relay Outputs

Four sets of relay outputs are provided on TB2 and TB3. **They are not powered.** A terminal is provided on TB1 to power the relay contacts if desired. This terminal, designated "HOT FOR RELAYS" or "+24 VDC FOR RELAYS", is electrically common with the power input terminal on the respectively powered unit.

NOTE: *Terminal designations are shown with relay in the de-energized state. This is important and will have an effect on control wiring depending on the fail-safe mode of operation selected (Part Three, Section 2.4).*

Always check control wiring to insure that line power will not be shorted by the switching action of the relay contacts.

CAUTION: Do not exceed the relay's contact rating of 5A 115/230 VAC. Use an adequate wire size rated for the load.

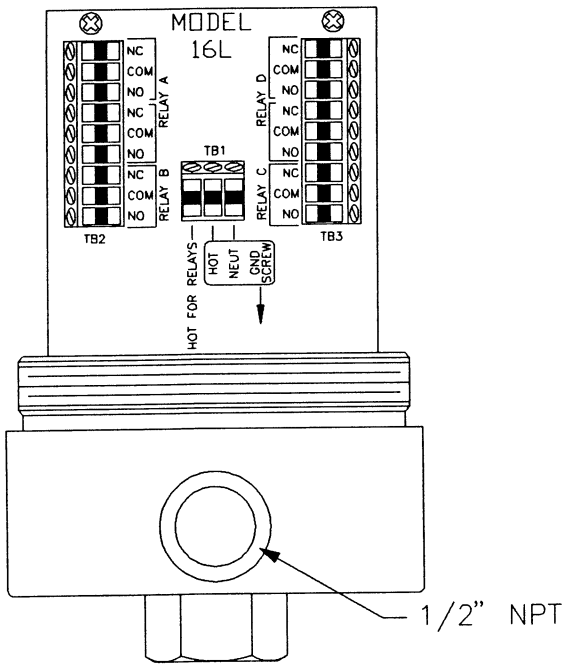


FIGURE 2-5 Hook-up Details For Relay Outputs And AC Line Power

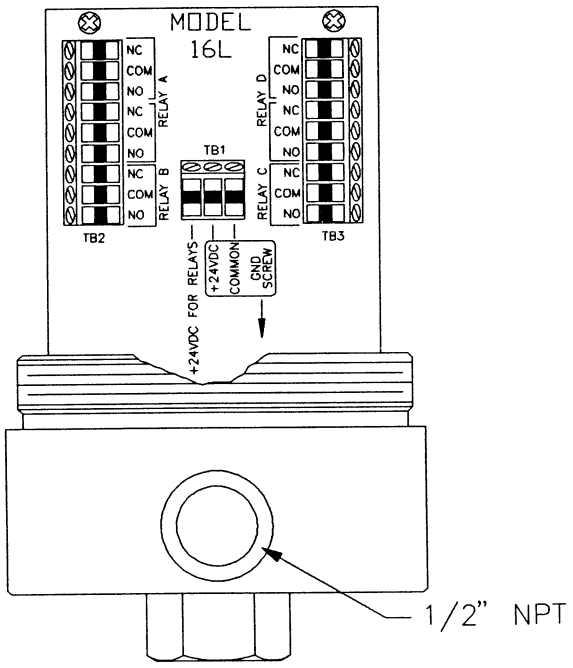


FIGURE 2-6 Hook-up Details For Relay Outputs And DC Line Power

PART THREE - OPERATION

SECTION 1 - OPERATING CONTROLS

All operating controls are marked and accessed by unscrewing the top cover from the enclosure. Use the small plastic screwdriver provided to make control adjustments. Do not force any control past its adjustment stops to avoid breakage.

1. **COARSE SPAN** switch (Figure 3-1)

   Selects the maximum level setpoint range. Positions 0 through 6 progressively select a wider overall instrument span. This switch is used in combination with **FINE SPAN** control (item 2) to calibrate the instrument.

2. **FINE SPAN** control (Figure 3-2)

   Sets the exact high calibration point. This control precisely calibrates the instrument after the **COARSE SPAN** control has been set to select the range. The range of adjustrment is 20 complete turns.

3. **CAL INDICATOR** (bi-color LED, Figure 3-2)

   Aids during calibration by indicating level status relationship with selected instrument span. Lights green when level is within calibration range. Lights orange when level exceeds present **FINE SPAN** control setting.

4. **MODE SELECTOR** switch (Figure 3-2)

   4 PT. position — Selects all four relays for individual set up anywhere along the level probe length.

   ZONE position — Selects setpoints for RELAY B and RELAY C to be dedicated to establishing a user-defined "zone" which can be from 1% to 100% of the probe's calibrated span. These setpoint controls operate a single relay (RELAY B). The remaining **SET POINT A** and **D** controls operate separate relays and are available to establish control/alarm points anywhere along the level probe length.

5. **SET POINT A, B, C** and **D** controls (Figure 3-2)

   Sets the level point anywhere within the calibration range setting at which the respective relay transfers. The range of adjustment is 20 complete turns.

6. **CONTROL ACTION A, B, C** and **D** switches (Figure 3-2)

   DIR position — Selects respective relay to operate in response to increasing measured level.

   REV position — Selects respective relay to operate in response to decreasing measured level.

   NOTE: *Any preset deadband (fixed at 1% of span for Relays A, B and D and user-adjustable for Relay C) will occur on decreasing level for "DIR" setpoints and increasing level for "REV" setpoints.*

7. **DEAD BAND** control (Figure 3-2)

   Sets the deadband for RELAY C from 1% to 75% of the probe's calibrated span. The deadband represents a distance on the probe which must be passed by the process level before a relay transfer recovery, after a trip, can occur. The range of adjustment is 20 complete turns.

8. **HI** and **LO DELAY A, B, C** and **D** switches (Figure 3-2)

   These switches, in conjunction with respective **DELAY ADJ** controls (item 9), may be used to provide relay time delay to prevent contact chattering or sporadic operation in turbulent materials.

   NONE (on/left) position — Selects respective relay to operate without time delay.

   ADJ (off/right) position — Selects respective relay to operate with a time delay. With **HI DELAY** switch in this

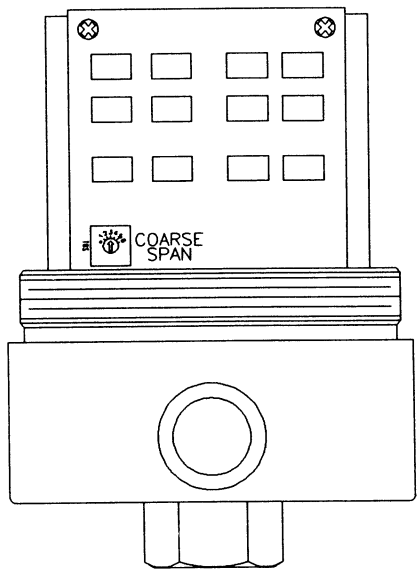


*FIGURE 3-1 Location of **COARSE SPAN** Switch*

position, DIR. relay action will occur a preset time after level rises above the level setpoint. With **LO DELAY** switch in this position, DIR. relay action will occur a preset time after level falls below the level setpoint. With both switches set to **ADJ** position, delay will occur both on rising and falling level. The delay time (0-30 seconds), preset with the **DELAY ADJ** control (item 9), is the same for both delay modes.

NOTE: *Underlined actions indicate low level fail-safe mode of operation. Opposite relay operation occurs when a high level fail safe mode is selected with* ***FAIL-SAFE MODE SELECT*** *switch (item 10).*

9. **DELAY ADJ A, B, C** and **D** controls (Figure 3-2)

   Adjusts relay delay time from 0 to 30 seconds when **HI DELAY** and/or **LO DELAY** switch is in **ADJ** (off/right) position.

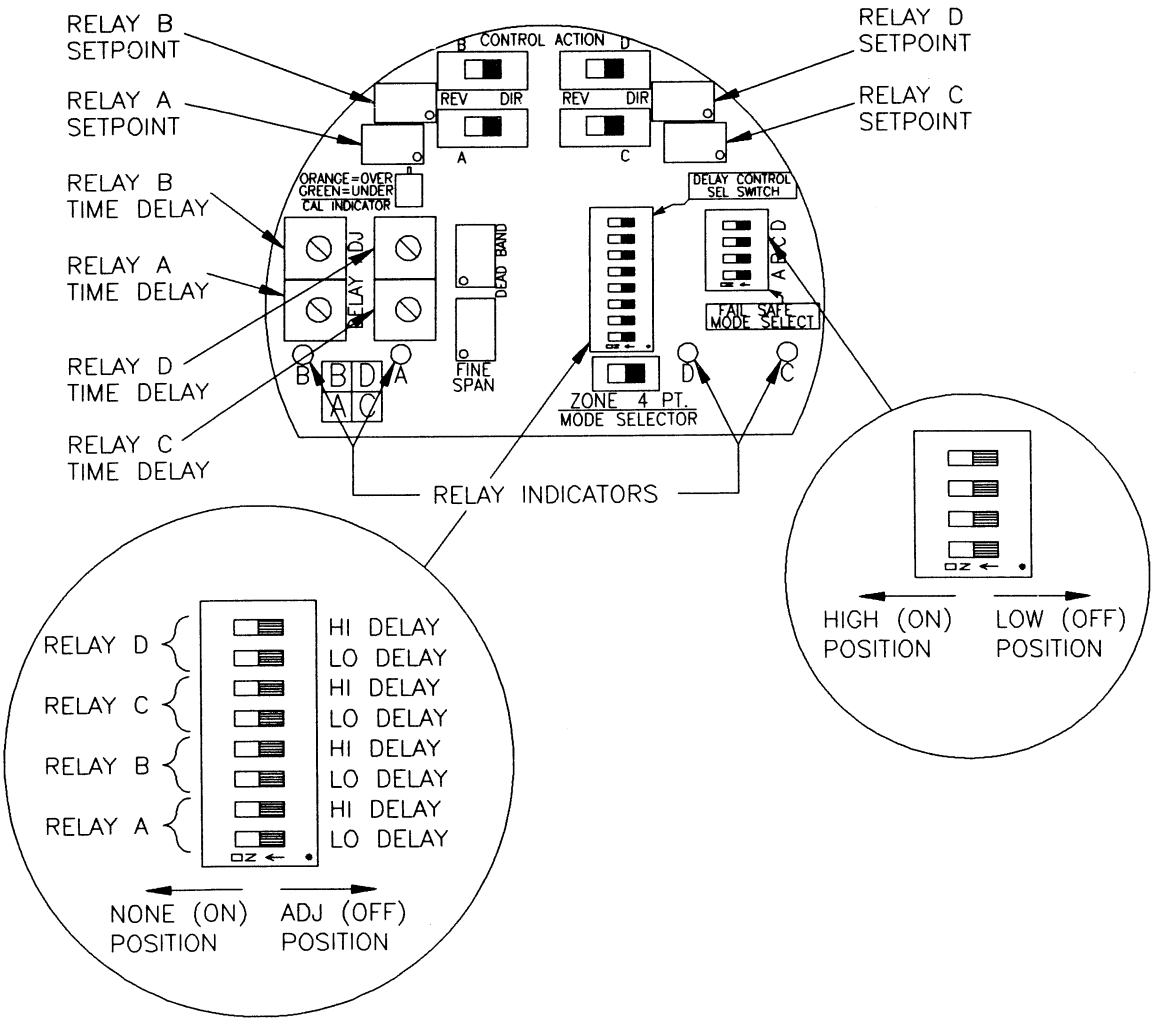


FIGURE 3-2 Control Panel Layout

10. **FAIL-SAFE MODE SELECT A, B, C and D** switches (Figure 3-2)

    HIGH (on/left) position — Selects respective relay to be energized when the level is below the setpoint on the level probe. The relay de-energizes when the level rises above the level setpoint.

    NOTE: *In the event of power failure or most component failures, the relay would naturally be in the de-energized state. The system, therefore, fails safely. For additional safety, the control contacts of the relay should be wired to a separate power source. Note that the position of the* ***CONTROL ACTION*** *switches (item 6) could also affect the resultant relay control logic.*

    LOW (off/right) position — Selects respective relay to be energized when the level rises above the setpoint on the level probe for a direct acting relay.

11. **A, B, C** and **D** indicators (red, Figure 3-2)

    Indicates that the respective relay is in the energized state.

SECTION 2 - INSTRUMENT STARTUP (BENCH TEST)

It is recommended to become familiar with the Model 16L before actual installation. Performing these simple steps will accomplish this purpose and, at the same time, test the instrument.

The procedure must be done with the level probe connected to the Model 16L. Make sure the banana plug is installed onto the back end of the level probe extension to make electrical contact with the unit.

WARNING: IN HAZARDOUS AREA LOCATIONS, IT IS NECESSARY TO OBTAIN PLANT SAFETY DEPARTMENT APPROVAL BEFORE OPENING THE ENCLOSURE CASTING WHILE CIRCUITS ARE POWERED.

2.1 Initial Setup

1. Support the instrument, with insulated level probe connected, in a metal or plastic pail with enough tap water to cover no less than approximately 1 foot of the probe length (the more the better). Do not touch the insulated probe. Hold the system by the instrument enclosure base if necessary. Run a bare wire from the instrument enclosure ground into the water in the pail.

NOTE: *It is critical that both the water and the instrument be grounded for this test to succeed. If available, it is recommended to use a conductive material pail such as steel rather than plastic.*

If a bare level probe is used with the 16L, a non-conductive material such as oil must be used instead of tap water. Also, the ground wire must be connected to a metal pail which contains the oil rather than just placing the wire in the oil. Conductive tap water would short the bare probe to the grounded metal pail on contact.

2. Place the following controls and switches to these settings:

Control	Setting
COARSE SPAN switch	**"0"**
FINE SPAN control	Fully counterclockwise*
MODE SELECTOR switch	**"4-PT."**
CONTROL ACTION A, B, C and D switches	**"DIR"**
SET POINT A, B, C and D switches	Fully counterclockwise*
DELAY ADJ A, B, C and D controls	Fully counterclockwise
DEAD BAND control	Fully counterclockwise*
HI and **LO DELAY A, B, C** and **D** switches	**"NONE"** (on/left)
FAIL-SAFE MODE SELECT A, B, C and **D** switches	**"LOW"** (off/right)

*Twenty complete turns to the left.

3. Connect power to appropriately marked terminals. It is not necessary to connect a load to the relay terminals for this test.

4. Turn **COARSE SPAN** switch (Figure 3-1) clockwise from **"0"** position until **CAL INDICATOR** turns off or lights green.

5. Turn **FINE SPAN** control slowly clockwise until **CAL INDICATOR** is off. If setting is too high, **CAL INDICATOR** lights orange. If setting is too low, **CAL INDICATOR** lights green.

6. After the span is calibrated, raise level probe out of the water by about 50% of the previously submerged portion and support the system at that position. (Do not touch insulated probe). The **CAL INDICATOR** will light green to indicate that the instrument is within the calibration span.

7. Turn **SET POINT C** control clockwise until RELAY C indicator turns off. Now adjust **SET POINT C** control slowly counterclockwise until RELAY C indicator lights. Best accuracy is achieved when the setpoint control is adjusted to the point where the relay indicator just turns on.

8. Lower and raise the level probe, holding the instrument by the enclosure base, past the setpoint and note the action of Relay C.

NOTE: *Steps 7 and 8 may be repeated using* ***SET POINT A, B and D*** *controls if desired.*

# # #

2.2 Adding Relay Time Delay

To add time delay to the relay action:

1. Set **HI DELAY C** switch to **ADJ** (off/right) position and turn **DELAY ADJ C** control a few degrees clockwise. Repeat step 8 in Section 2.1 and notice that relay action does not occur until a specific time elapses after the probe setpoint is submerged below the liquid level.

2. Return **HI DELAY C** switch to **NONE** and set **LO DELAY C** switch to **ADJ.** Repeat step 8 in Section 2.1 and notice that relay action does not occur until a specific time elapses after the probe setpoint is raised above the liquid level.

3. Set both **HI** and **LO DELAY C** switches to **ADJ** position and repeat step 8 in Section 2.1. Notice that delay action occurs in both directions.

4. Increase delay time by turning **DELAY ADJ C** control clockwise. The maximum delay is approximately 30 seconds.

5. Reset **HI** and **LO DELAY C** switches to **NONE** and return **DELAY ADJ C** control to a fully counterclockwise setting.

2.3 Setting Relay Direct/ Reverse Operation

Set **CONTROL ACTION C** switch to **REV** position and repeat step 8 in Section 2.1. Notice that relay operation is reversed — off when liquid level is above the setpoint and on when liquid level is below the setpoint. Return **CONTROL ACTION C** switch to **DIR** for normal operation.

2.4 Testing Fail Safe Operation

Set **FAIL-SAFE MODE SELECT C** switch to **HIGH** position and repeat step 8 in Section 2.1. Notice that the relay logic has reversed: off when liquid level is above the setpoint and on when the liquid level is below the setpoint. Return **FAIL-SAFE MODE SELECT C** switch to **LOW** position.

NOTE: *It seems that the relay operation described in this section is identical to the relay operation described in*

*Section 2.3. These are, in fact, separate relay functions which will be shown later to allow complete configuration flexibility in logic control of setpoints. In applications requiring combinations of different high and low alarms, these two separate relay functions — instead of just one — allows relay contact consistency in fail-safe logic operation. Lastly, the fail-safe mode does not affect the position of the relay deadbands, whereas the **CONTROL ACTION** switch positions do. Refer to Section 5 for a complete explanation.*

2.5 Setting RELAY C Deadband

Unlike the other relays, RELAY C has an adjustable deadband control which may be used to create a dead zone on the probe to delay relay recovery transfer after a trip. The deadband can be best described as a distance the measured material must travel past the setpoint on the probe before the relay resets after a trip. The deadband feature is useful in many simple pumping operations. Remember that the deadband will always occur below a high alarm (direct acting relay) or above a low alarm (reverse acting relay).

1. Turn **DEAD BAND** control 5 complete turns clockwise. Repeat step 8 in Section 2.1. Notice that relay on and relay off do not occur in the same position on the level probe. Specifically, the relay on condition always occurs at the same point, but the relay off position has been moved to a lower point on the probe. The region between these two points is known as the deadband of RELAY C.
2. Increase the deadband effect by turning the **DEAD BAND** control 5 more complete turns clockwise and repeat step 8 in Section 2.1. The deadband will increase. Deadband can be adjusted to a maximum of 75% of the calibrated span length on the probe, or until the deadband forces the relay de-energize point off the tip of the probe.
3. Return **DEAD BAND** control to a fully counterclockwise setting.

SECTION 3 - DECIDING WHICH 16L MODE TO USE

Before calibrating the 16L, the user should first determine which operating mode best suits the specific application. If you are unsure which operating mode is best, read this section which explains the 4-PT. and ZONE operating modes.

3.1 The 4-PT. Operating Mode

In the 4-PT. mode, all four relays are available for individual alarm/control setup anywhere along the level probe length.

Each relay can be individually selected to operate in response to increasing or decreasing level. An adjustable deadband feature — for RELAY C only — can be useful in many simple pumping operations by providing a simple differential style control scheme. This deadband can be adjusted anywhere from 1% to 75% of the probe's calibrated span. The limitation of the deadband control in the 4-PT. operating mode is that only simple control schemes can be handled. For example, suppose the user desires to use the deadband control for RELAY C in a pumping operation. The 16L must first be calibrated and then the **SETPOINT C** control must be set at the desired high level where the pump is to turn on. As the level pumps down to a lower point on the probe, the pump is desired to shut off and allow the tank to refill on its own. As a result, the **DEAD BAND** control is adjusted to hold the energized relay in until the level drops to this lower probe point. At this point, the relay releases and the pump shuts off. When the level rises to the upper setpoint the whole cycle begins again. If, after viewing this control scheme for several cycles, the user decides that the upper setpoint must be moved, the lower reset point will also be moved - simultaneously. It may take several cycles to tune this type of control to be acceptable. In extremely large vessels, expensive processes, or critical active processes, this constant fill-empty procedure for instrument tuning may not be possible. In these applications, the ZONE operating mode will optimize the instrument set up time.

3.2 The ZONE Operating Mode

In the ZONE mode, two of the 16L's setpoint controls (RELAY B and C) are dedicated to defining a "zone" which can be from 1% to 100% of the probe's calibrated span. These two setpoints then operate a single relay (RELAY B). The remaining two setpoints (RELAY A and D) operate separate relays and are available for establishing control/alarm points anywhere along the calibrated level probe length. This ZONE feature is similar to the deadband feature discussed in Section 3.1 with two important exceptions:

- The ZONE operating mode offers true differential control. Therefore, the two setpoint controls are independent of each other. One established setpoint can be moved after tuning without affecting the other.
- The ZONE operating mode offers a differential adjustment anywhere from 0 to 100% of the probe's calibrated span. This is a tradeoff since the ZONE mode forfeits one relay (RELAY C) for an added amount of control in true differential applications. The ZONE operating mode is ideal for true pump control applications and still allows two additional setpoints,

such as high alarm/low alarm, to be used to monitor adverse conditions.

SECTION 4 - CALIBRATION

4.1 Setting The Probe Span

The following procedure is used to set the span on the level probe.

1. Disconnect relay outputs to prevent actuation of final control elements.
2. Place the following controls and switches to these settings:

Control	Setting
COARSE SPAN switch	**"0"**
FINE SPAN control	Fully counterclockwise*
MODE SELECTOR switch	**"4-PT."**
CONTROL ACTION A, B, C and D switches	**"DIR"**
SET POINT A, B, C and D controls	Fully counterclockwise*
DELAY ADJ A, B, C and D controls	Fully counterclockwise
DEAD BAND control	Fully counterclockwise*
HI and LO DELAY A, B, C and D switches	**"NONE"** (on/left)
FAIL-SAFE MODE SELECT A, B, C and D switches	**"LOW"** (off/right)

*Twenty complete turns to the left.

3. Connect power and ground to appropriate marked terminals.
4. Apply power to the instrument.
5. Manually raise the material level in the vessel to the highest point attainable on the probe (no higher than 2 inches from the bottom of the probe gland). It is recommended that the level height be slightly higher than the highest setpoint which will be set.
6. Turn **COARSE SPAN** switch (Figure 3-1) clockwise from **"0"** position until **CAL INDICATOR** turns off or lights green.
7. Turn **FINE SPAN** control slowly clockwise until **CAL INDICATOR** is off. If setting is too high, **CAL INDICATOR** lights orange. If setting is too low, **CAL INDICATOR** lights green.

# # #

4.2 Establishing Relay Setpoints

1. Determine if your setpoints will be high alarms or low alarms. If a high alarm is desired, that specific relay will energize (as indicated by its lit LED) as the level rises above the setpoint on the probe. If a low alarm is desired, that specific relay will energize as the level falls below the setpoint on the probe. For all high alarm relays, place respective **CONTROL ACTION** switches to **DIR** position. For all low alarm relays, place respective switches to **REV**. If you are unsure about high or low alarms, place respective switches to the **DIR** position. When all four relays are used, it may be helpful to sketch your control scheme before proceeding. Also, refer to Section 5.1 or 5.2 for application examples which are intended to provide you with guidelines in relay setup.
2. After the span is calibrated, manually lower (or raise) the material level in the vessel to the position on the probe where the highest setpoint (high point for RELAY D) will be established.
3. Turn **SET POINT D** control clockwise until RELAY D indicator changes state. If the LED turns off, slowly adjust **SET POINT D** control counterclockwise until RELAY D indicator just turns on.

   NOTE: *For all of the setpoints, best accuracy will be achieved when the setpoint is established where the relay just turns on. This places the relay dead-band in the proper position.*
4. Manually lower the material level in the vessel to the position on the probe where the next highest setpoint (high point for RELAY C) will be established.
5. Adjust **SET POINT C** control in a similar manner as described in step 3.
6. Continue to lower the material level and adjust **SET POINT B** and **SET POINT A** controls as described in steps 3 and 4.
7. Set **FAIL-SAFE MODE SELECT A, B, C** and **D** switches to desired positions.
8. Reconnect final control elements to the relay outputs.

SECTION 5 - RELAY APPLICATION EXAMPLES

5.1 Setup In The 4-PT. Mode

The following relay application setup example is intended to illustrate the 16L being used in the 4-PT. operating mode. This example, shown in Figure 3-3, involves two high alarms (RELAYS C and D) and two low alarms (RELAYS A and B). The

underlined words in the instructions will have an opposite meaning if the **CONTROL ACTION** switch positions are set oppositely from those that are described.

1. Place the following controls and switches to these settings:

Control	Setting
MODE SELECTOR switch	**"4-PT."**
CONTROL ACTION A and B switches	**"REV"**
CONTROL ACTION C and D switches	**"DIR"**
SET POINT A, B, C and D controls	Fully counterclockwise*
DELAY ADJ A, B, C and D controls	Fully counterclockwise
DEAD BAND control	Fully counterclockwise*
HI and LO DELAY A, B, C and D switches	**"NONE"** (on/left)
FAIL-SAFE MODE SELECT A, B, C and D switches	**"LOW"** (off/right)

*Twenty complete turns to the left.

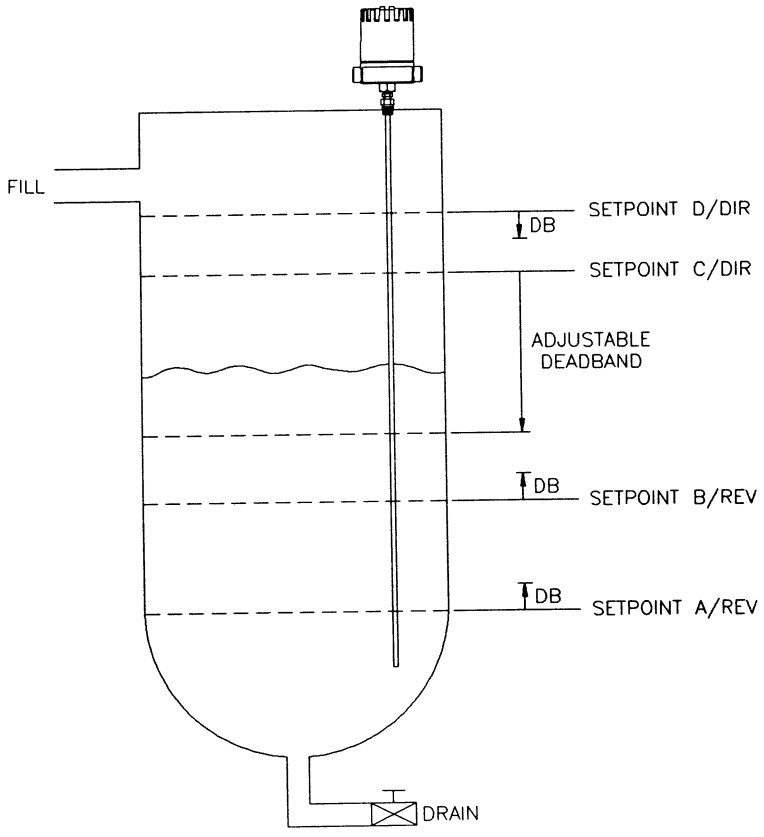


FIGURE 3-3 4-PT. Mode Relay Application Setup Example

2. After the span is calibrated, manually lower the material level in the vessel to the position on the probe where the first setpoint (high point for RELAY D) will be established.

3. Turn **SET POINT D** control clockwise until RELAY D indicator turns off. Now slowly adjust **SET POINT D** control counterclockwise until RELAY D indicator just turns on.

   NOTE: *For all of the setpoints, best accuracy will be achieved when the setpoint is established where the relay just turns on.*

4. Manually lower the material level in the vessel to the position on the probe where the next setpoint (high point for Relay C) will be established.

5. Turn **SET POINT C** control clockwise until RELAY C indicator turns off. Now slowly adjust **SET POINT C** control counterclockwise until RELAY C indicator just turns on.

6. Manually lower the material level in the vessel to the position on the probe where the next setpoint (low point for Relay B) will be established.

7. Turn **SET POINT B** control clockwise until RELAY B indicator just turns on.

8. Lower the material level in the vessel to the position on the probe where the next setpoint (low point for RELAY A) will be established.

9. Turn **SET POINT A** control clockwise until RELAY A indicator just turns on.

NOTE: *Notice that when the material level returns to the static level, no alarms or LED indications are present. In this example, the 16L will have all relays de-energized at this point (low fail-safe) and all LED's will be off. Also, take note that if high fail-safe was selected for each relay, all relay logic would be reversed (all relays energized and all LED's lit). This illustrates the usefulness of having separate **CONTROL ACTION** and **FAIL-SAFE MODE SELECT** switches to establish control for each relay. These two features allow the uniformity of the alarm condition for all relays to be established very simply. Also, notice where the deadband is positioned for each relay in Figure 3-3. Fail-safe mode selection does not affect relay deadband positions, but the **CONTROL ACTION** switches do.*

# # #

5.2 Setup In The ZONE Mode

The following relay application setup example is intended to illustrate the 16L being used in the ZONE operating mode. This example, shown in Figure 3-4, involves one high alarm (RELAY D), one low alarm (RELAY A), and the zone. The underlined words in the instructions will have an opposite meaning if the **CONTROL ACTION** switch positions are set oppositely from those that are described.

1. Place the following controls and switches to these settings:

Control	Setting
MODE SELECTOR switch	**"4-PT."**
CONTROL ACTION A switch . . .	**"REV"**
CONTROL ACTION B, C and **D** switches.	**"DIR"**
SET POINT A, B, C and **D** controls	Fully counterclockwise*
DELAY ADJ A, B, C and **D** controls	Fully counterclockwise
DEAD BAND control.	Fully counterclockwise*
HI and **LO DELAY A, B, C** and **D** switches.	**"NONE"** (on/left)
FAIL-SAFE MODE SELECT A, B, C and **D** switches	**"LOW"** (off/right)

*Twenty complete turns to the left.

2. After the span is calibrated, manually lower the material level in the vessel to the position on the probe where the first single high setpoint (RELAY D) will be established.

3. Turn **SET POINT D** control clockwise until RELAY D indicator turns off. Now slowly adjust **SET POINT D** control counterclockwise until RELAY D indicator just turns on.

   NOTE: *For all of the setpoints, best accuracy will be achieved when the setpoint is established where the relay just turns on.*

4. Manually lower the material level in the vessel to the position on the probe where the high setpoint of the "zone" will be established.

5. Turn **SET POINT C** control clockwise until RELAY C indicator turns off. Now slowly adjust **SET POINT C** control counterclockwise until RELAY C indicator just turns on.

6. Manually lower the material level in the vessel to the position on the probe where the low setpoint of the "zone" will be established.

7. Turn **SET POINT B** control clockwise until RELAY B indicator turns off. Now slowly adjust **SET POINT B** control counterclockwise until RELAY B indicator just turns on. The "zone" has now been established between setpoints B and C.

   NOTE: *This example uses the RELAY C controls to establish the high setpoint and RELAY B controls to establish the low setpoint of the differential.*

8. Manually lower the material level in the vessel to the position on the probe where the last single low setpoint (RELAY A) will be established.

9. Turn **SET POINT A** control clockwise until RELAY A indicator just turns on.

10. Place **MODE SELECTOR** switch to **ZONE** position. This selects RELAY B to energize at the high endpoint of the

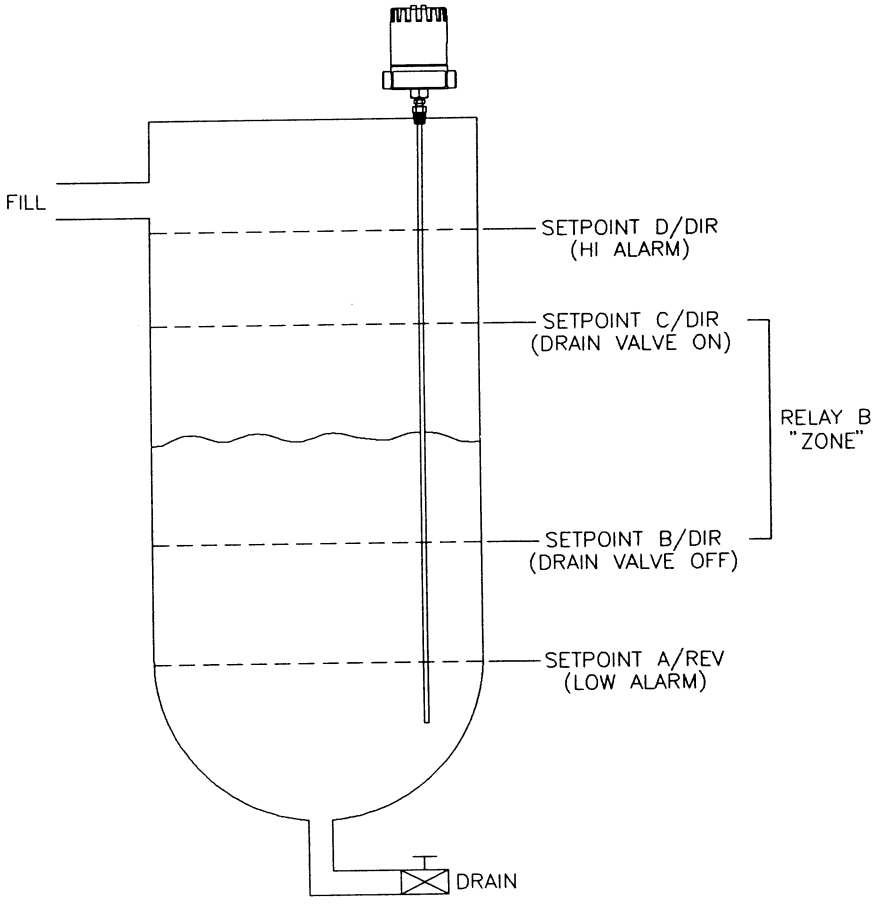


FIGURE 3-4 ZONE Mode Relay Application Setup Example

zone (RELAY C setpoint) and remain energized until the level falls to the low endpoint of the zone (RELAY B setpoint).

The control logic of RELAY B can easily be reversed (energizes at low endpoint and de-energizes at high endpoint of the zone) by doing one of the following:

- Selecting a "high" fail-safe operating mode for RELAY B.
- Positioning the setpoint for RELAY B above the setpoint for RELAY C and then placing both **CONTROL ACTION B** and **C** switches to **REV**.

PART FOUR - PRINCIPLE OF OPERATION

See Figure 4-1 for a simplified schematic diagram pertaining to these descriptions:

1. The power supply section (not shown) converts line power to appropriate voltages for circuit operation.
2. The "admittance measurement" section produces a variable amplitude A.C. signal proportional to the level probe's generated capacitance. This section is calibrated to produce a known maximum output for the application material height.
3. The "coating rejection" section removes the effect of conductive coating materials by compensating for the increase in dielectric conductance of the coating. After removing the coating effect, the signal is rectified to produce a D.C. value that is sent to the output sections.
4. The "ZONE/4-PT." operating mode section interconnects the logical operation of Relay B and Relay C when selected for ZONE operation. This mode causes the setpoints for these relays to operate Relay B. When the 4-PT. mode is

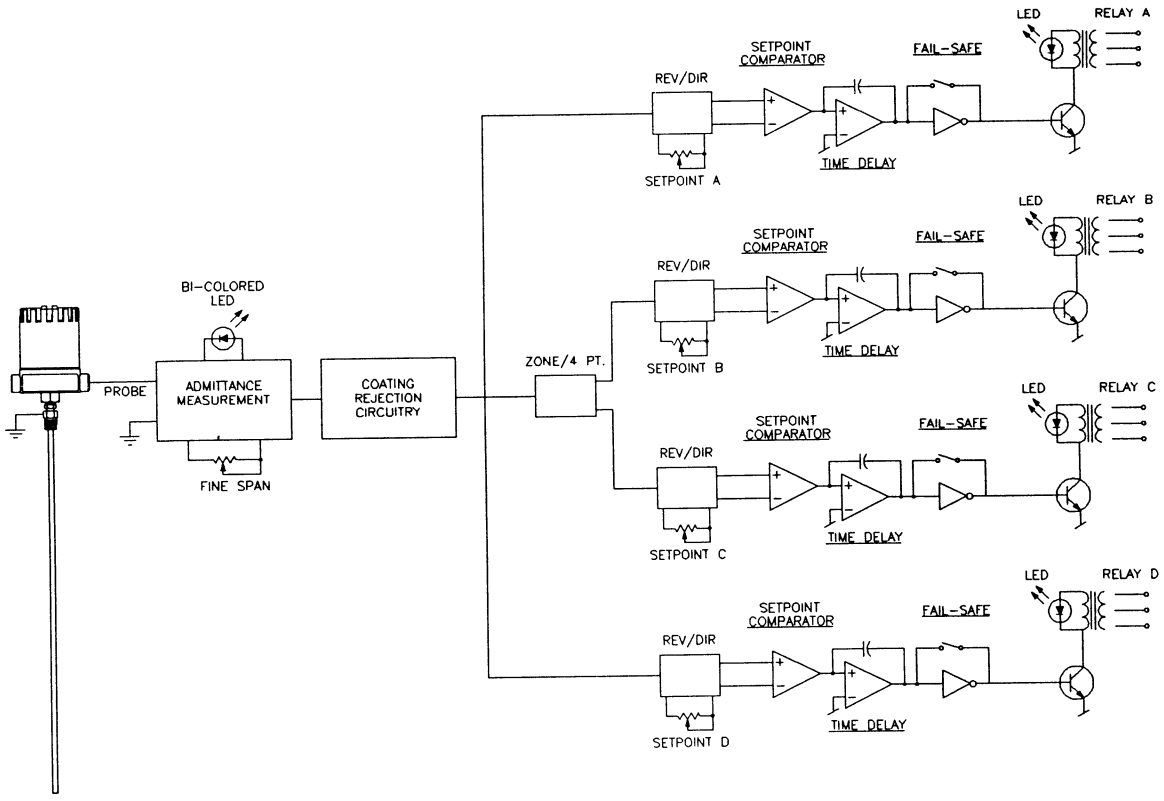


FIGURE 4-1 Instrument Operations Block Diagram

selected, this section is bypassed and all relays resume their normal operation.

5. The **CONTROL ACTION** switches send either a direct or reverse (inverted) level signal to the setpoint comparator. The orientation determines whether the relay transfers on increasing or decreasing level.

6. The output of the comparator is sent to the time delay stage. This stage is a selectable integrator (delay high, delay low, or both) which ramps up or down to a trip level when the output of the preceding section goes "high." The ramp time is established by the **DELAY ADJ** control which regulates the integration rate (delay time).

7. The fail-safe section establishes the relay logic for switching. The **FAIL-SAFE** switch selects the relay control signal to be sent directly to the relay or through an inverter stage and then to the relay.

PART FIVE - SERVICE AND MAINTENANCE

SECTION 1 - GENERAL

The electronic chassis assembly is held into the enclosure with two screws in brackets on the sides of the assembly.

Replacement of circuit board components should be performed by a qualified technician. Otherwise, return the entire chassis assembly to the factory after obtaining a return authorization. If possible, include a brief description of the trouble symptoms.

In some applications it may be necessary to clean the probe periodically.

1.1 Replacing the Fuse(s)

If the Model 16L does not respond to calibration and cannot be operated to transfer a relay (using the **FAIL-SAFE MODE SELECT** switches) the line fuse(s) may be open. To replace:

1. Disconnect line power. Remove electronics module from enclosure base by loosening the two side bracket screws.
2. Once module has been removed, gently pull the upper control board assembly from its pin connectors.
3. Unfasten eight Phillips head screws to disassemble module. Once removed, separate the power supply board (board with terminal strips) from the RF board.
4. Unsolder open fuse (F01 or F02) from component side of power supply board. Replace fuse(s) with equivalent (GLI p/n 99X1F5002).
5. Re-assemble module in reverse order and replace into enclosure base.

# # #

1.2 Replacing Defective Relay(s)

1. Disconnect line power. Remove electronics module from enclosure base by loosening the two side bracket screws.
2. Once module has been removed, gently pull the upper control board assembly from its pin connectors.
3. Unfasten eight Phillips head screws to disassemble module. Once removed, separate the power supply board (board with terminal strips) from the RF board.
4. Unsolder relay (K01, K02, K03 or K04) from component

side of power supply board. Replace relay with equivalent relay (GLI p/n 99X2T1032).

5. Re-assemble module in reverse order and replace into enclosure base.

SECTION 2 - TROUBLESHOOTING

2.1 System Checkout

If the Model 16L is not thought to be operating properly, perform the following simple checks to verify operation:

1. Perform the "bench test" described in Part Three, Section 2 to fully test the instrument.
2. Recalibrate the 16L using the procedure in Part Three, Section 4.1.

If these checks are accomplished, the 16L is probably okay but the level probe may be defective. Perform the following checks to find common problems with the level probe:

- Check that the banana plug on the back of the level probe is installed and not damaged. This requires removing the probe from the 16L enclosure.
- Check that the probe's mounting gland is sealed together properly and that there is no moisture in the gland which could cause a short circuit.
- Check that the level probe is not shorted to the mounting gland (resistance should be greater than 1 megohm).
- If the probe is an insulated type, check for nicks in the insulation and that the weld at the probe tip is intact.

NOTE: *Do not use Teflon tape or any other pipe sealant on the 1/2-inch NPT threaded lower portion of the mounting gland. This connection must provide a good ground. If tape is used, an alternative grounding method must be used.*

2.2 Common Problems

The following table lists symptoms and their typical causes to aid in correcting common problems:

Table A - TROUBLESHOOTING COMMON PROBLEMS

Symptom	Typical Cause	Solution
CAL INDICATOR will not light orange or green, regardless of the position of the **COARSE SPAN** switch.	No instrument power.	Check supply to instrument.
	Line fuse(s) blown.	Perform bench test in Section 2 to check instrument operation. If faulty fusing is verified, replace as described in Part Five, Section 1.1.
CAL INDICATOR will not turn off or light green during calibration, but always stays orange.	Input capacitance from level probe is too high.	Recalibrate system with material in vessel at a lower level, or use a level probe that has a lower gain.
CAL INDICATOR is always green while attempting to calibrate the system.	Banana plug missing from probe.	Remove probe to install banana plug and re-attach probe.
	Probe not firmly attached.	Verify firm probe connection into enclosure base.
	Poor ground reference established in vessel.	Verify reference ground in the application. Consult GLI Application Note L2 for proper grounding techniques.
	Material level was not actually contacting probe while calibration took place.	Recalibrate with material level contacting the probe.
Unable to set a relay setpoint.	Setpoint is outside the calibrated span on the level probe.	Lower material height in vessel until **CAL INDICATOR** lights green. Re-attempt to set the setpoint.
	Time delay is set too high, causing relay to appear non-functional.	Disable time delay while establishing the relay setpoint.
	If setpoint is for Relay B or C, the deadband is set too high or **MODE SELECTOR** switch is set improperly.	Turn Relay C deadband fully counterclockwise before establishing the setpoint. Set **MODE SELECTOR** switch to **4-PT.** position (always do this before establishing setpoints).
	Attempting to establish the setpoint off of the level probe.	Move material level in vessel up onto probe and then set the setpoint.
Relay trips but will not reset.	Time delay is set too high.	Decrease or disable time delay.
	MODE SELECTOR switch is set to **ZONE** position when relays are being used in a 4-PT. application.	When using Relays B and C as individual setpoints, set **MODE SELECTOR** switch to **4-PT.** position.

2.3 Customer Assistance

Should service, parts or assistance in troubleshooting or repair be required, please contact your GLI representative or the GLI Customer Service Department:

GLI International, Inc.

Phone: (800) 454-0263
Fax: (970) 461-3919
E-mail: info@gliint.com

— SERVICE HOURS —

	Eastern Std. Time	Central Std. Time	Mountain Std. Time	Pacific Std. Time
Monday through Thursday	9:00 a.m. to 5:30 p.m.	8:00 a.m. to 4:30 p.m.	7:00 a.m. to 3:30 p.m.	6:00 a.m. to 2:30 p.m.
Friday	9:00 a.m. to 2:00 p.m.	8:00 a.m. to 1:00 p.m.	7:00 a.m. to 12:00 p.m.	6:00 a.m. to 11:00 a.m.

When ordering spare or replacement board assemblies, be sure to use the **complete** assembly part number.

All instrument or board assemblies returned for repair, freight prepaid, should also include the following information:

1. A clearly written description of the malfunction.
2. Name of person to contact and the phone number where they can be reached.
3. Proper return address for shipping instrument(s) back. Include preferred shipping method (UPS, Federal Express, etc.) if applicable.
4. A purchase order if instrument(s) or board assemblies are out of warranty to cover costs of repair.

NOTE: *If the instrument or board assemblies are damaged during return shipment as a result of inadequate packaging, the customer assumes responsibility for repair costs. It is recommended to use the original GLI shipping carton or an equivalent. Also, GLI will not accept instruments returned for repair unless they are thoroughly cleaned and all process material is removed.*

PART SIX - SPARE PARTS AND ACCESSORIES

	Description	Part Number
Miscellaneous Parts	Fuse, 1/4 amp. (p.c. board mount type)	99X1F5002
	Relay, 5A contacts, 12 VDC Coil	99X2T1032
	Spare Banana Plug Connector For Level Probe	99X3K1104
Electronic Chassis Assemblies (excludes enclosure and level probe)	115 VAC Operation	16M4G1005-114
	230 VAC Operation (single-fuse)	16M4G1005-214
	230 VAC Operation (dual-fused)	16M4G1005-224
	24 VDC Operation	16M4G1005-014