

TLS-50

Site Prep Manual

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 Function Code: 60437
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Introduction

This manual describes the site preparation and console installation procedures for all TLS-50 Monitoring Systems. Except where noted, the procedures described herein apply to all consoles. TLS-50 is used throughout Table 1 lists the various TLS-50 consoles and options by form number. Figure 1 shows where on the top of the console you can find the information about your console's form number.

Table 1.- TLS-50 Consoles and Features

Console Form No.	Console Type
8469X0-060	TLS-50 w/keypad and display, up to 6 probes
8469X0-160	TLS-50 w/keypad and display, w/relay, up to 6 probes
8469X0-260	TLS-50 w/keypad and display, w/com and relay, up to 6 probes
8469X0-230	TLS-50C w/o keypad or display, w/com, up to 3 probes
8469X0-460	TLS-50 w/o keypad or display, w/com and relay, up to 6 probes

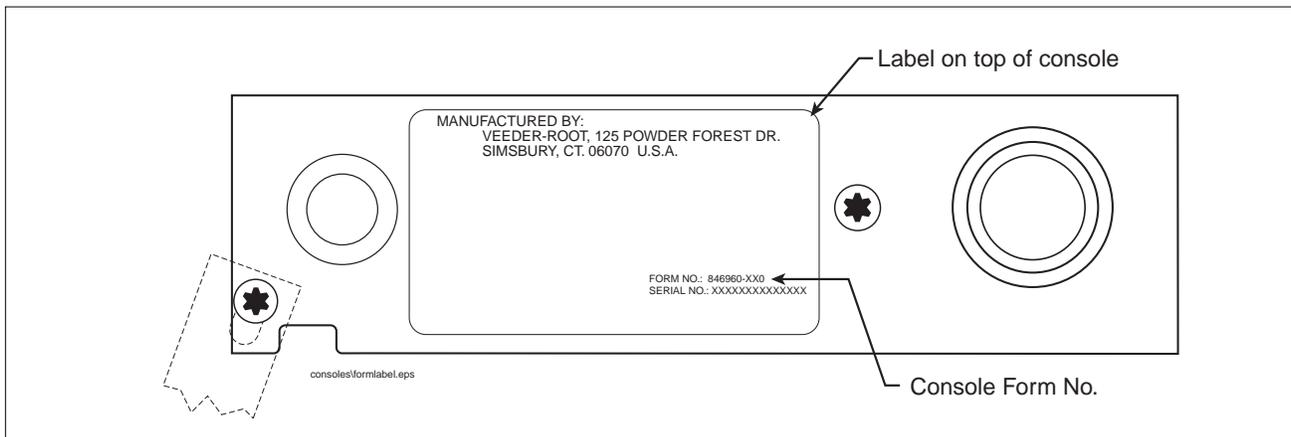


Figure 1. Locating the console form number

This manual assumes that you installing the monitoring system in a new site (before pavement is put down and with no wiring runs in place). Some of the topics covered in this manual are listed below.

- Laying out the site
- Mounting the console and connecting power wiring
- Assembling and installing probes
- Installing wiring conduit between the console and probes
- Field wiring probes
- Connecting probes to the console
- RS-232 serial communication connection requirements and available serial commands (consoles with com option)
- Troubleshooting information

- TLS-50 system specifications

After the console is wired to its power source and probes, you should program the console following the setup instructions contained in the TLS-50 Setup & Operation Manual.

Related Manuals

577013-609	TLS-50 Setup & Operation Manual
576013-635	RS-232 Serial Interface Manual
576013-859	Direct Burial Cable Installation Manual
577013-744	Mag Plus Probe Assembly Guide

Safety Symbols

The following safety symbols are used in this manual to alert you to important safety hazards and precautions.

 <p>EXPLOSIVE Fuels and their vapors are extremely explosive if ignited.</p>	 <p>FLAMMABLE Fuels and their vapors are extremely flammable.</p>
 <p>ELECTRICITY High voltage exists in, and is supplied to, the device. A potential shock hazard exists.</p>	 <p>TURN POWER OFF Live power to a device creates a potential shock hazard. Turn Off power to the device and associated accessories when servicing the unit.</p>
 <p>INJURY Careless or improper handling of materials can result in bodily injury.</p>	 <p>GLOVES Wear gloves to protect hands from irritation or injury.</p>
 <p>WEAR EYE PROTECTION Fuel spray from residual pressure in the lines can cause serious eye injuries. Always wear eye protection.</p>	 <p>READ ALL RELATED MANUALS Knowledge of all related procedures before you begin work is important. Read and understand all manuals thoroughly. If you do not understand a procedure, ask someone who does.</p>
 <p>WARNING Heed the adjacent instructions to avoid equipment damage or personal injury.</p>	 <p>STATIC SENSITIVE COMPONENTS Handling static sensitive electronic components without grounding your body can subject them to damaging voltage potentials.</p>

Site Considerations

Control Drawing

NOTE: Intrinsically safe wiring (marked **I.S.**) shall be installed in accordance with Article 504-20 of the NEC, ANSI/NFPA 70.

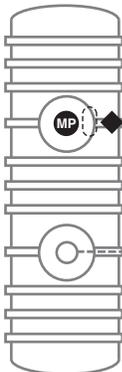
Note: conduit requirements are dependent on local electrical regulations. For probe-to-console wiring, shielded cable is required regardless of conduit requirements.



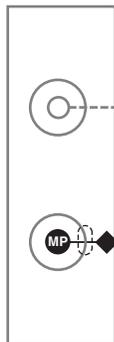
WARNING:
Substitution of components may impair intrinsic safety.

Circuitry within the TLS-50 Console barrier forms an intrinsically safe, energy-limited system. This system makes TLS-50 probes safe for use in a Class I, Group D hazardous location. TLS-50 probe wiring is intrinsically safe only when connected to Veeder-Root's TLS-50 Consoles. Reference Form Number 8469 (TLS-50/TLS-50C Consoles) and Form Number 8462, 8463, 8468, and 8473 (Probes).

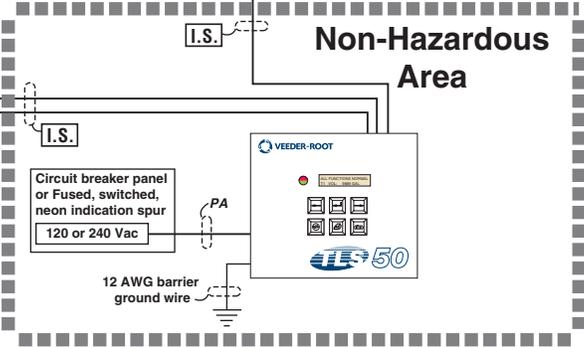
Double Wall Tank



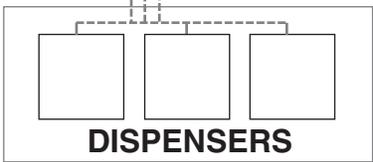
Single Wall Tank



Single Wall Tank



Hazardous Area



Hazardous Area

LEGEND	
MP	Magnetostrictive Probe
●	Epoxy Sealed Connection in a Weatherproof Junction Box
◆	Seal-Off
□	Terminal Connection
○	1/2" (12.7 mm) Rigid Conduit
I.S.	Conduit Enters Console in an Intrinsically Safe Area Knockout
PA	Conduit Enters Console in a Power Area Knockout
---	Product piping

consoles\50sysdia.eps

Figure 2. Control Drawing - Example TLS-50 System Site Layout

National Electrical Code Compliance

The following information is for general reference and is not intended to replace recommended National Electric Code (NEC) procedures. It is important for the installer to understand that electrical equipment and wiring located in Class I, Division 1 and 2 installations shall comply with the latest appropriate articles found in the National Electric Code (NFPA 70) and the Automotive and Marine Service Station Code (NFPA 30A), or other local code such as the CEC, Canadian Electrical Code.

PROBE-TO-CONSOLE WIRING

Shielded Cable or Veeder-Root Direct Burial Cable Required

To ensure the best operating systems available, Veeder-Root **REQUIRES** the use of shielded cable for all probes regardless of conduit material or application. In these installations, shielded cable must be rated less than 100 pF/foot (100 pF/304 mm) and be manufactured with a material suitable for the environment, such as Carol™ C2534 or Belden™ 88760, 8760, or 8770.

Note: Throughout this manual, when mentioning any cable being used for probe-to-console wiring, it will be referring to shielded cable.

Wire Length

Improper system operation could result in undetected potential environmental and health hazards if the probe-to-console wire runs exceed 1000 feet (304 m). Wire runs must be less than 1000 feet to meet intrinsic safety requirements.

Splices

Veeder-Root recommends that no splices be made in the wire run between a probe junction box and the console. Each splice degrades signal strength and could result in poor system performance.

Wire Gauges - Color coded

- Shielded cable must be used in all installations. Probe-to-console wires should be #14 - #18 AWG (2.5 to 0.8 mm²) stranded copper wire and installed as a Class 1 circuit. As an alternate method when approved by the local authority having jurisdiction, #22 AWG (>0.3 mm²) wires such as Belden 88761 may be suitable in installations with the following provisions:
 - Wire run is less than 750 feet (228 m)
 - Capacitance does not exceed 100 pF/foot (100 pF/304 mm)
 - Inductance does not exceed 0.2 μH/foot (0.2 μH/304 mm)
- Total cable length per installation: 22,000 feet (6700 m).

POWER WIRING

Wires carrying 120 or 240 Vac from the power panel to the console should be #14 AWG (2.5 mm²) copper wire for line, neutral and chassis ground (3); and #12 AWG (4 mm²) copper wire for barrier ground (1).

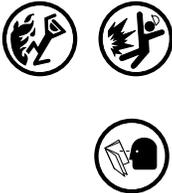
PROBE JUNCTION BOXES

Weatherproof electrical junction boxes with a gasketed cover are required on the end of each probe conduit run at the manhole location. Gasketing or sealing compound must be used at each entry to the junction box to ensure a waterproof junction. The interior volume of each junction box must be a minimum of 16 cubic inches (262 cm³).

Veeder-Root recommends the following junction box or equivalent:

- Appleton Electric Co. - JBDX junction box, JBK-B cover, and JB-GK-V gasket.
- Crouse-Hinds Co. - GRFX-139 junction box, GRF-10 cover, and GASK-643 gasket.

Probe Wiring Safety Issues

⚠ WARNING	
	<p>Probes operate in areas where flammable liquids and explosive vapors may be present.</p> <p>Improper installation may result in fire or explosion causing serious injury or death.</p> <p>Practice the following:</p> <ol style="list-style-type: none"> 1. Read thoroughly and follow the instructions shipped with each probe. 2. Probe wiring must enter the console only through their designated areas. 3. Power wires and conduit must not enter the intrinsically safe compartment of the console. 4. Substitution of components may impair intrinsic safety.

Wiring between the console and the probes is of limited electrical power so that there is insufficient energy to ignite fuel. In the console, the low power probe wiring is considered intrinsically safe because it is physically isolated from all high power wiring. To maintain the integrity of this safety feature probe wiring can not share the same conduit with power wiring. In addition, probe cables can only enter the console through the designated intrinsically safe area knockouts.

If the TLS-50 System is being retrofitted into a paved site, you can cut grooves in the pavement, run direct burial cable to the probes, and then seal over the cable grooves, subject to approval of the local authority having jurisdiction.

Before trenching, you should diagram all conduit runs between the console's intended location and its deployed probes. Your site diagram will help you calculate conduit and wiring lengths, and necessary quantities of junction boxes, sealing boxes, clamps, brackets, etc.

Throughout this planning process and in the actual installation, you must follow all latest National Electric Codes, and applicable federal, state, and local codes as regards conduit type, depth below grade, sealing, grounding, wire capacities, direct burial (if permitted), etc.

Selecting a Console Location

⚠ WARNING	
	<p>Explosive vapors or flammable liquids could be present near locations where fuels are stored or being dispensed. The TLS-50 Console is not explosion proof.</p> <p>An explosion or fire resulting in serious injury or death, property loss and equipment damage could occur if the console is installed in a volatile, combustible or explosive atmosphere (Class I, Division 1 or 2).</p> <p>Do not install this console in a volatile, combustible, or explosive atmosphere.</p>

Select a mounting location on the inside of any building. The console must be protected from severe vibration, extremes in temperature and humidity, rain, and other conditions that could harm computerized electronic equipment.

The equipment is designed to operate safely under the following range of conditions:

- Temperature range 0 to 40°C - (storage temperature range of -40 to +74°C).
- A maximum relative humidity of 95% RH (non-condensing) at temperatures up to 40°C.
- Console may be powered by either 120 or 240 Vac. A switchmode power supply automatically detects the input voltage (no jumpers required).
- Main supply voltage fluctuations not exceeding $\pm 10\%$.
- Pollution Degree Category 2.
- Installation Category II.



Important! Consoles must be installed within the interior of buildings. They are not suitable for any external location.

Ensure that the console is located where neither the console nor its associated cabling will be damaged by doors, furniture, barrows, etc. Consider the ease of routing wiring, ducting, and probe cables to the console. Check that the mounting surface is strong enough to support the console's weight of about 4 pounds.

Important! If the unit requires cleaning, do not use any liquids, wipe only with a clean, dry cloth.

Console Installation

Mounting the Console

Figure 3 illustrates recommended console mounting. Install the console fastening devices to the mounting surface using the hole pattern (6.7" x 5.7") shown in Figure 4. Mounting screws up to 3/16" diameter may be used.

Install metal conduit (1/2" I.P.S.) between the console and the power panel. Figure 4 shows the three designated knockouts (one each on top, left side, and bottom) through which power wiring can safely enter the console.

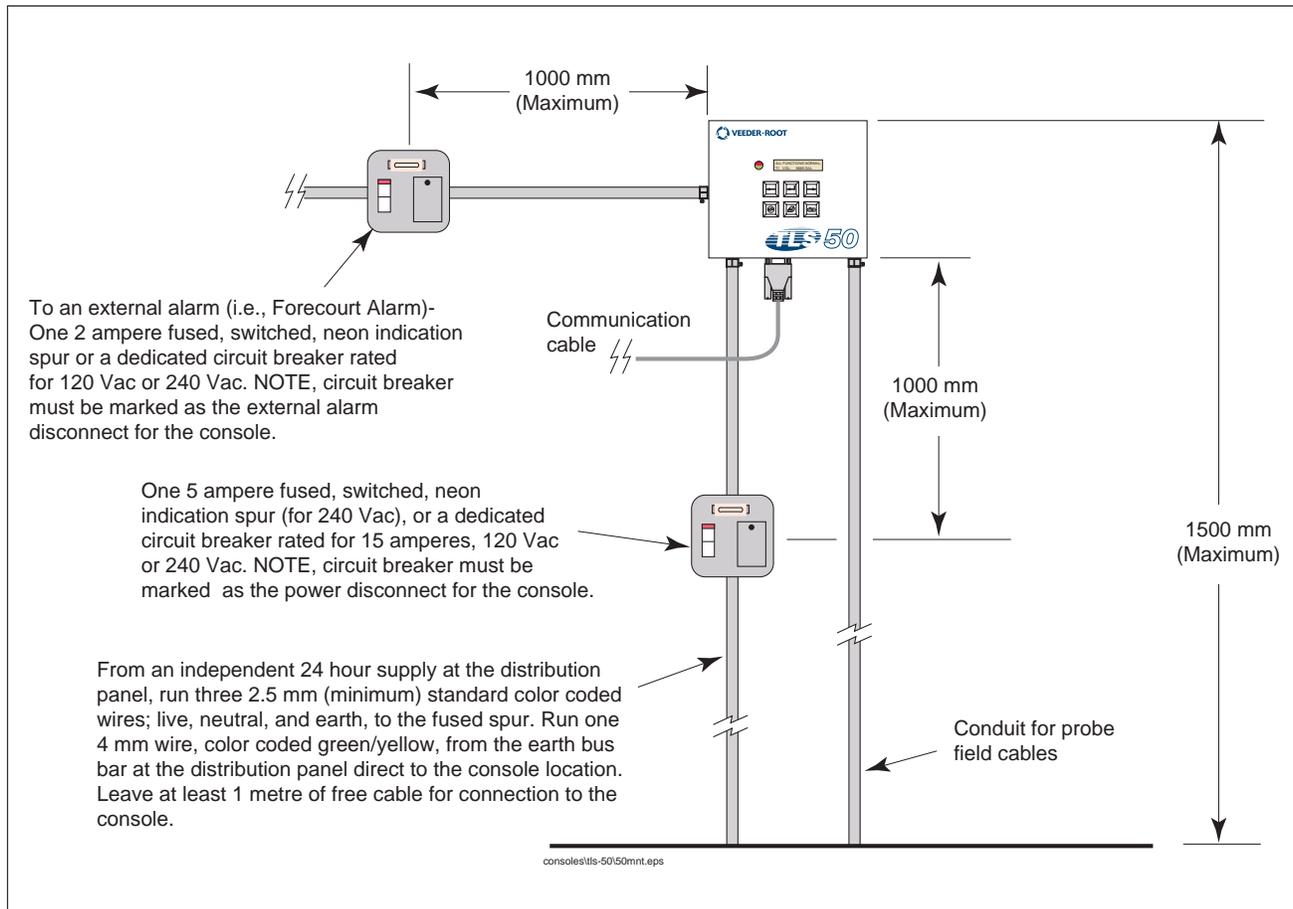


Figure 3. Recommended Mounting of Console

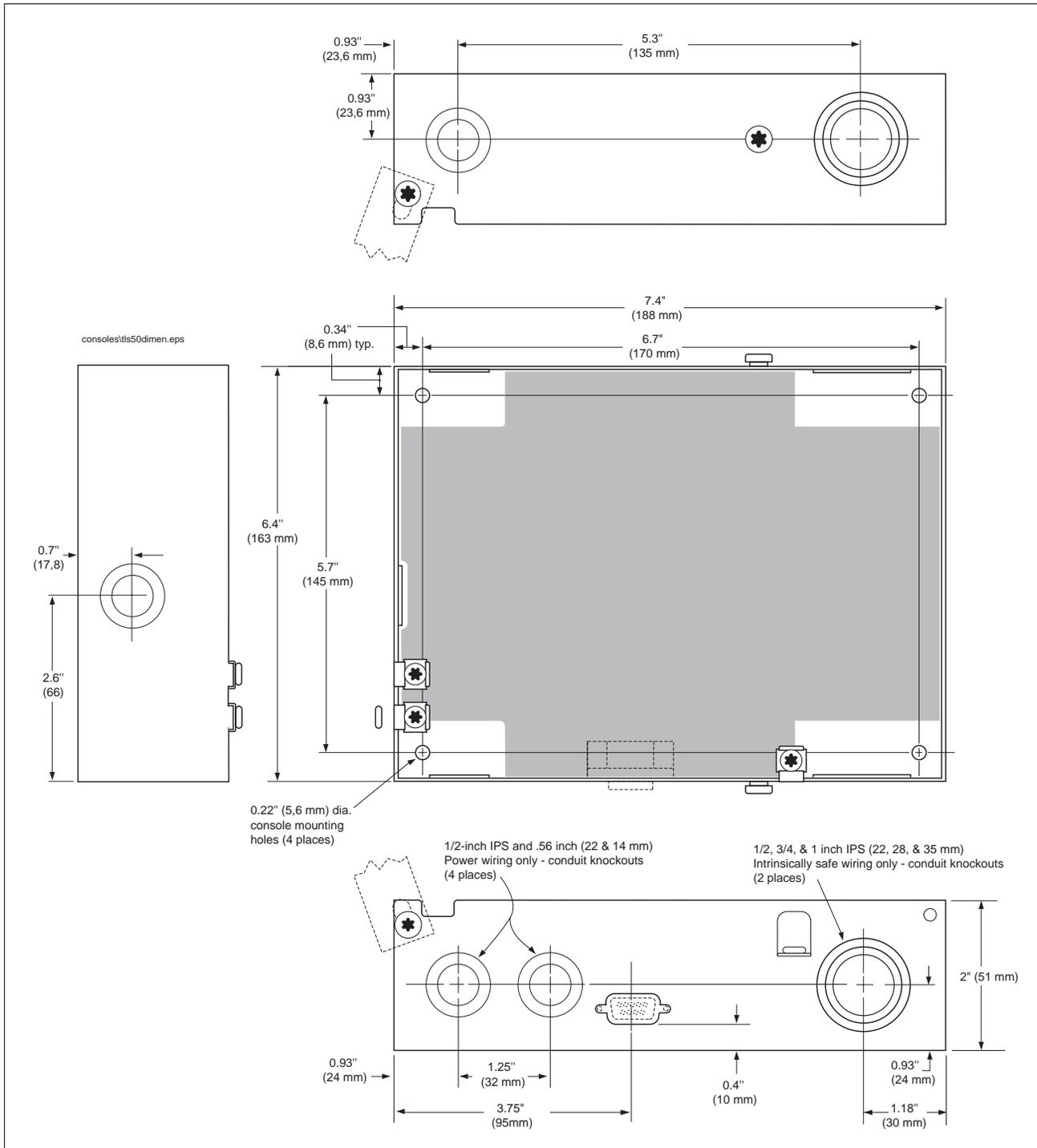


Figure 4. Console Dimensions and Designated Conduit Knockouts

Wiring the Console

⚠ WARNING



The console contains voltages which can be lethal. It is connected to devices that must be intrinsically safe.

Connecting power wires to a live circuit can cause electrical shock that may result in serious injury or death.

1. Turn power off at the circuit breaker connecting the power supply wires.
2. Attach conduit from the power panel to the console's Power Area knockouts only (1 on top and bottom, ref. Figure 4).

1. Pull four wires between the power panel and the console; three #14 AWG color-coded wires for AC line (L), AC neutral (N) and chassis ground; and one #12 AWG (4 mm²) green and yellow wire for barrier ground.

For international applications using 240 Vac, pull four wires between the power panel and a 5 A fused, switched, neon indication spur; three #14 AWG color-coded wires for AC line (L), AC neutral (N) and chassis ground; and one #12 AWG (4 mm²) green and yellow wire for barrier ground. Pull four identical wires between the spur and the console.

2. Open the right door of the console and connect the four power/ground wires as shown in [Figure 5]. Do not connect the power wires to breaker panel at this time.

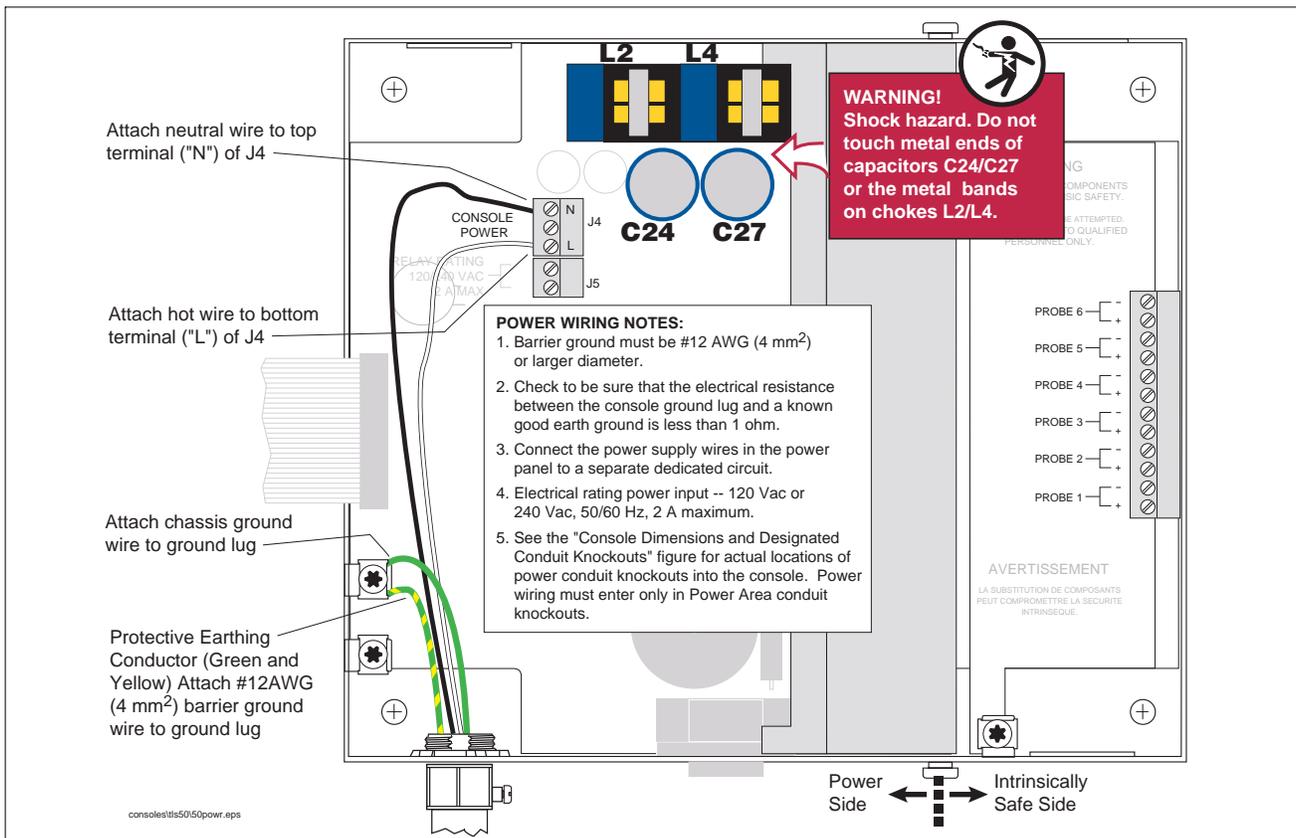


Figure 5. Wiring AC Power to the Console

Probe Installation

Probe Manhole Installation

At each underground probe location, install a 14-inch (355 mm) minimum diameter approved manhole according to the manufacturer's instructions (Note: probes should be located at least 24 inches (610 mm) from the submersible pump to avoid erroneous probe readings when the pump is running). Position the manhole so that there is necessary clearance for junction box installation and wiring.

Determining Mag Probe Length for Installation in a Dedicated Riser

1. Measure the distance from the bottom of the tank to the top of the probe manway - this is the minimum probe length (ref. Figure 6).
2. The probe canister must be within the riser pipe (minimum length of 10 inches [254mm]).

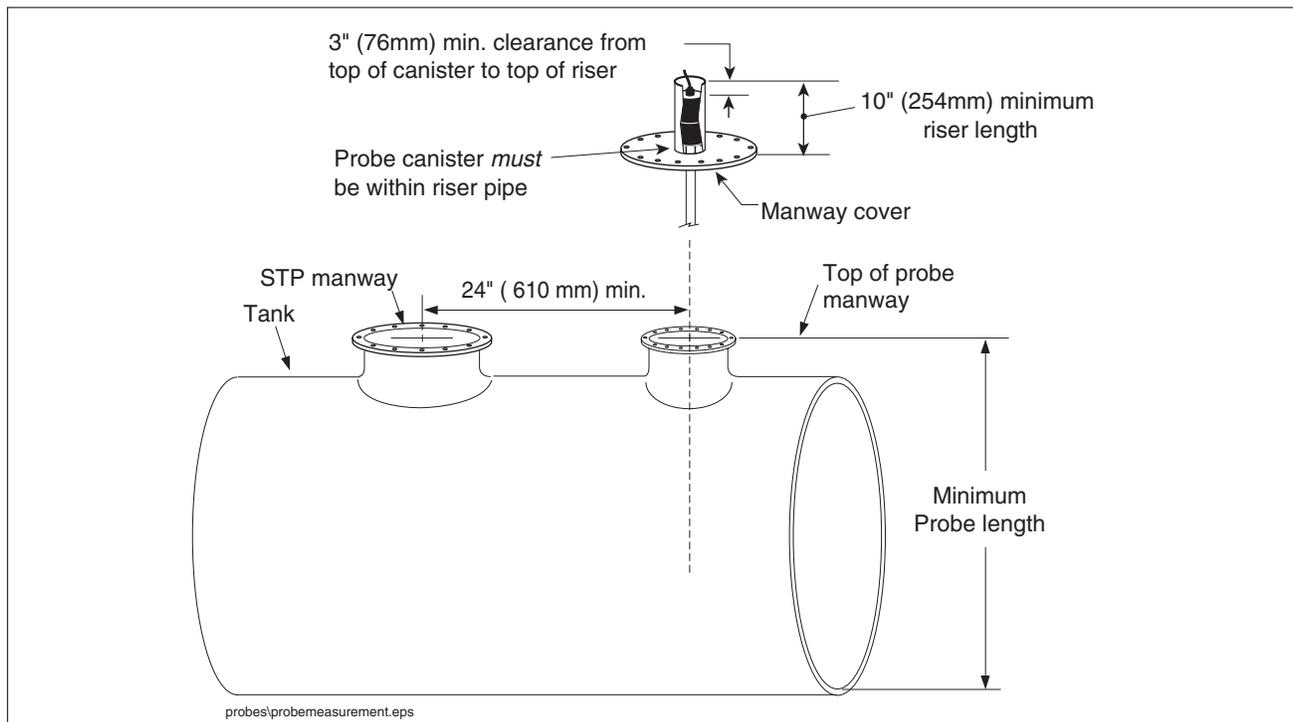


Figure 6. Determining the Minimum Mag Probe Length

Probe Installation



1. Turn OFF power to the console.
2. Remove any sludge from the bottom of the tank.
3. Check that floats, boot, and cable are assembled correctly on probe (ref. Mag Probe Assembly Manual).
4. Gently slide the float(s) to the bottom of the probe shaft before raising the probe. Carefully lower the probe into the riser pipe until the boot rests on the bottom of the tank [See Figure 7 for UST installation or Figure 8 for AST installation].

CAUTION! Handle probes carefully. Striking or dropping the probe will result in loss of calibration and could cause permanent damage.

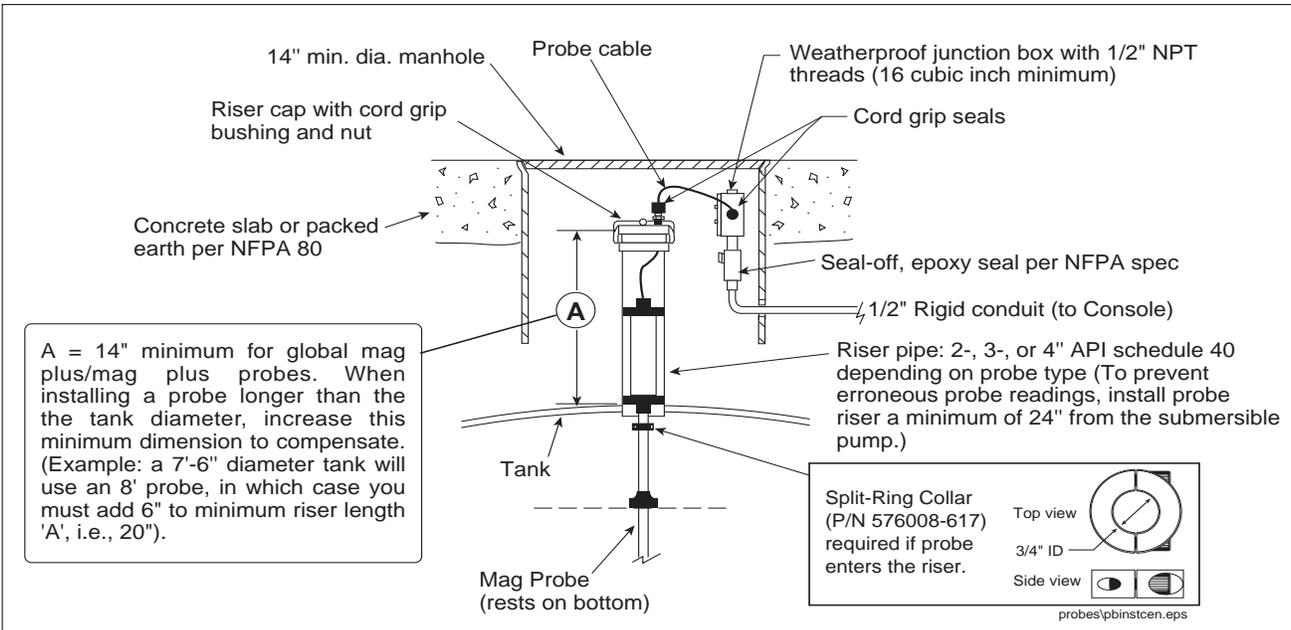


Figure 7. TLS-50 Probe Installation Example - Underground Storage Tank

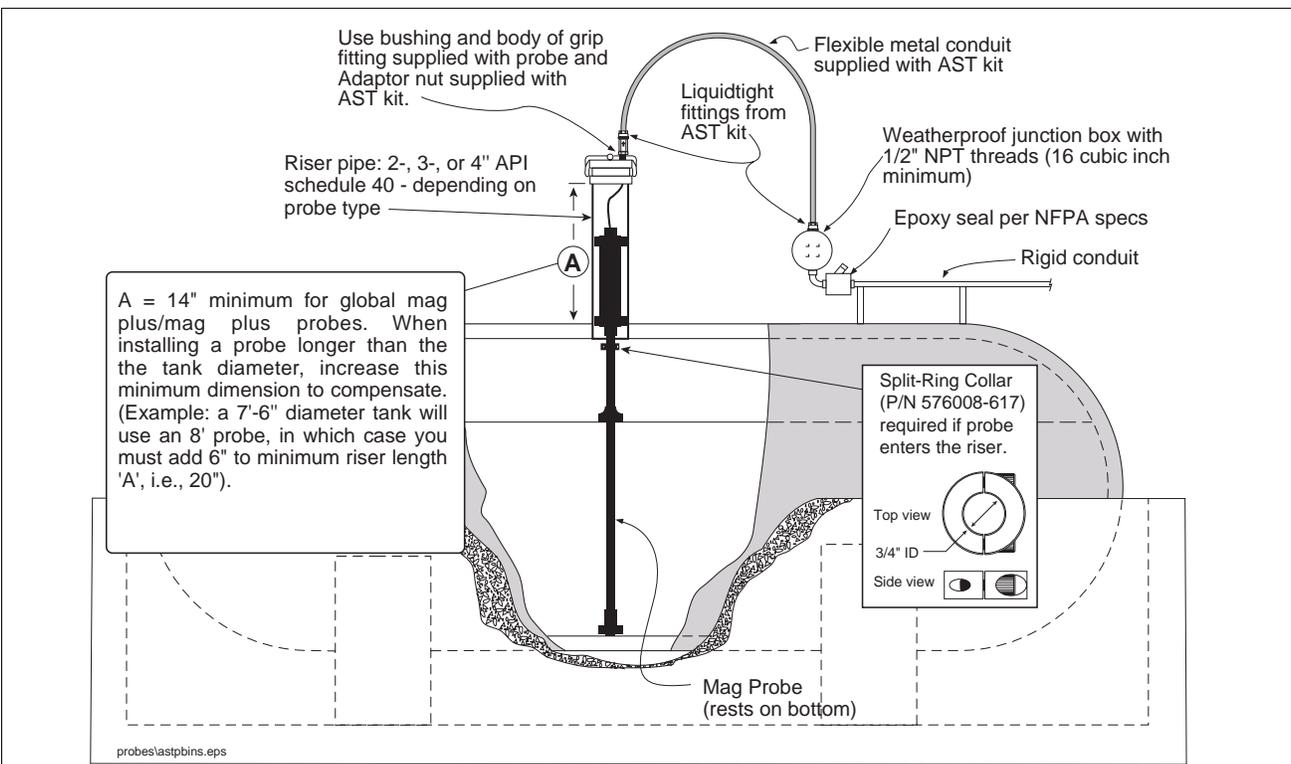


Figure 8. TLS-50 Probe Installation Example - Above ground Storage Tank

SPECIAL INSTRUCTIONS FOR UST'S WITH METAL RISER CAPS

If you are installing the metal cap and adapter ring, screw the ring onto the 4" riser until the gasket contacts the pipe, then use a pipe wrench to tighten it an additional 3/4 turn. Push the cable through the metal cap and cord grip, then clamp the cap onto the ring.

At sites that require installation of a riser adaptor (Phil-Tite M/F 4X4 or equivalent) at the top of the riser, do so following the manufacturer's instructions. Next screw the adapter ring from the Veeder-Root kit (P/N 312020-952) onto the riser adaptor by hand until the gasket contacts the sealing surface. Then use a torque wrench attached to an appropriate strap wrench (K-D Specialty tools nylon strap oil filter wrench, or equivalent) and tighten the ring to 35 - 45 ft-lbs. Loosen the cord grip nut and push the cable through the metal cap and cord grip, then clamp the cap onto the ring (see Figure 9).

Make sure there is a minimal amount of slack between the probe and cap, then tighten the cord grip nut until the cable is held firmly. Push the end of the cable through the field J-box cord grip, then tighten that cord grip nut as well. Splice and seal the wires in the J-box as shown in Figure 12.

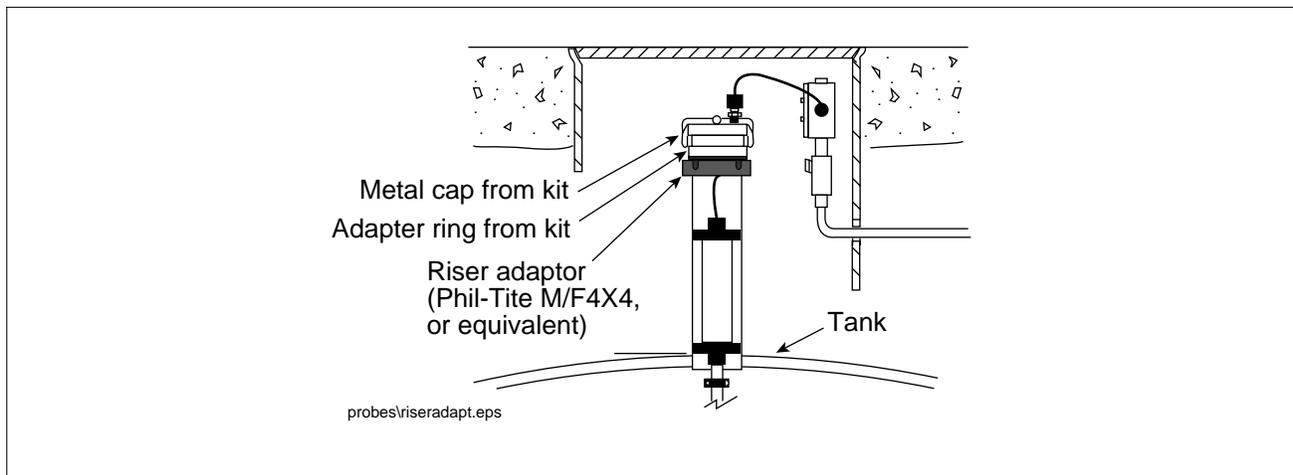


Figure 9. Installing the Riser Adapter

Installing Field Wiring from Probes to TLS-50 Console

Two wiring run methods are commonly used for probes - Shielded wiring pulled through buried, sealed 1/2" rigid conduit (discussed in the following paragraphs); or direct burial cable (discussed on page 15).

⚠ WARNING	
	<p>Probes operate in areas where flammable liquids and explosive vapors may be present. Improper installation may result in fire or explosion causing serious injury or death.</p> <p>Practice the following:</p> <ol style="list-style-type: none"> 1. Read thoroughly and follow the instructions shipped with each probe. 2. Probe wiring conduit must not contain any other wires. 3. Probe wiring and conduits must enter the console only through their designated areas (see Figure 4). 4. Power and communication wires and conduit must not enter the intrinsically safe compartment of the console. (see Figure 4).

Buried Rigid Conduit

The preferred method, especially in new sites before driveway surfaces are paved, is to pull probe wiring through buried 1/2" rigid conduit [Figure 10].

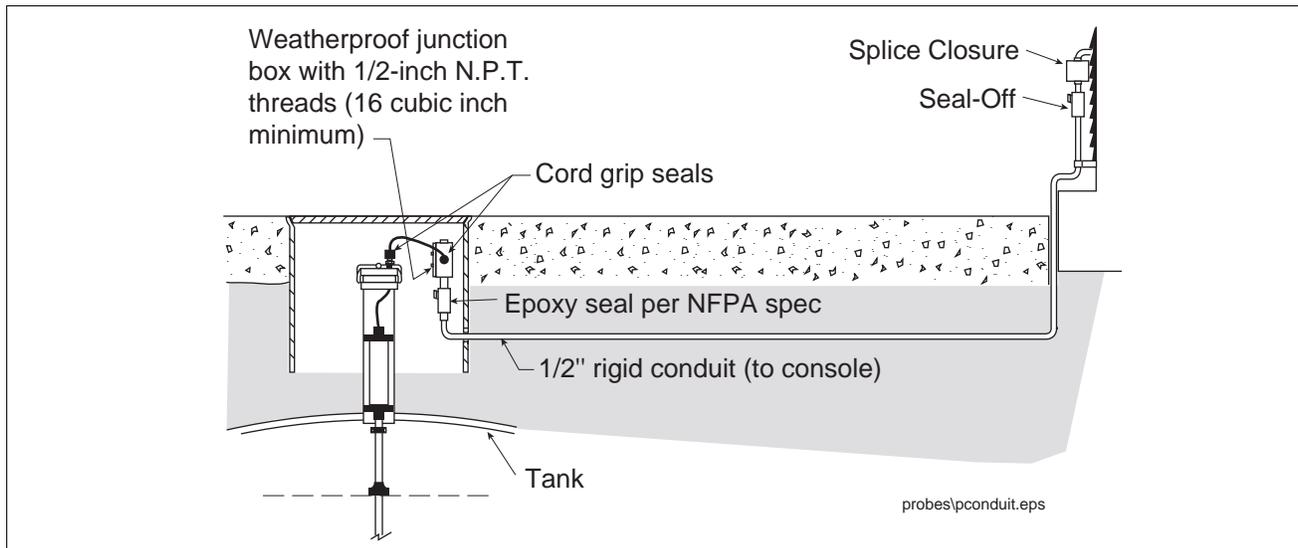


Figure 10. Example Probe Wiring Run in Buried Rigid Conduit

Pull shielded cable consisting of two conductors, color-coded #14-18 AWG stranded copper wire, between the console and the junction box at each probe location (do not gang wires together). Use single lengths of wire with no splices to ensure optimum signal strength.



IMPORTANT! Maximum probe-to-console cable length is 1000 feet (305m).

Since wires for multiple probes may enter the console through a single conduit, it is recommended that you use a different color-code for each wire or individually mark each wire to identify probe inputs. Also, if the intrinsically safe wires enter the building in a wiring trough, only intrinsically safe wires (from TLS-50/-50C probes) can be in the trough. Keep all low power (intrinsically safe) wiring physically isolated from high power wires in all wiring troughs per the NEC.

SEALING FIELD CONNECTIONS

1. Pull the wires from the probe canister into the junction box. Pull two wires from the console through the seal-off box and into the junction box.
2. Using wire nuts, connect the two wires from the probe to the two wires coming from the console. Be sure to observe color codes or tags when making these connections. Figure 11 diagrams a typical probe field wiring connection in the junction box.
3. Do NOT terminate drain wire at this location, ground drain wire at console only.
4. Seal wire nuts with epoxy sealant using one bag for two-wire nut connections (Figure 12).
5. Push the tie-wrapped, epoxy sealed bag into the junction box. Replace and tighten the junction box cover.

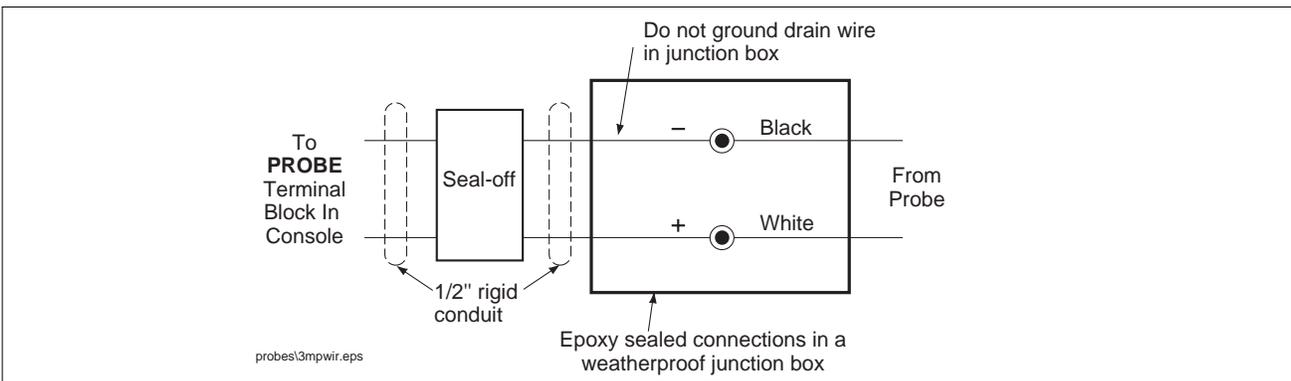
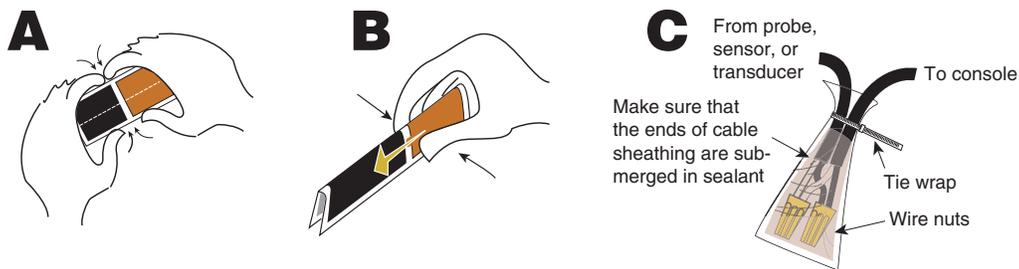


Figure 11. Probe Field Wiring Connection



Instructions:

NOTE: When temperature is below 50°F (10°C), keep resin in a warm place prior to mixing (e.g., in an inside pocket next to body).

1. Open epoxy sealant package, and remove resin pak.
2. Holding resin pak as shown in A, bend pak along long length.
3. As shown in B, firmly squeeze the RED SIDE of the resin, forcing it through the center seal and into BLACK SIDE.

4. Mix thoroughly to a uniform color by squeezing contents back and forth 25-30 times.
5. Squeeze mixed, warm resin into one end of bag and cutoff other end.
6. Slowly insert wiring connections into sealing pak until they fit snugly against the opposite end as shown in C.
7. Twist open end of bag and use tie wrap to close it off and position the tie wrapped end up until the resin jells.



CAUTION: Epoxy sealant is irritating to eyes, respiratory system, and skin. Can cause allergic skin reaction. Contains: epoxy resin and Cycloaliphatic epoxycarboxylate.

Precautions: Wear suitable protective clothing, gloves, eye, and face protection. Use only in well ventilated areas. Wash thoroughly before eating, drinking, or smoking.

consoles1epxy2w.eps

Figure 12. Epoxy Sealing Connections

Direct Burial Cable - Probe to Console Field Wiring

An alternative to trenching through existing pavement is to use direct burial cable.



IMPORTANT! Maximum probe-to-console cable length is 1000 feet (305m).

Prior to installing direct burial cable with epoxy splices, consult with the local authority having jurisdiction. Use of direct burial cable is only allowed in locations where local codes permit the use of buried cable.

The direct burial method requires grinding a 1/4" to 3/8" wide by 1-1/4" deep groove (adding 1/4" of depth for each additional cable) in the pavement surface, laying Veeder-Root supplied direct burial cable down in the bottom of the groove, laying an expanded polyethylene foam backer rod over the cable(s), and then a placing a 1/4" to 1/2" bead of Veeder-Root recommended silicone sealant over the backer rod to within a minimum of 3/8" below the pavement surface [see Figure 13].

If you decide to use the direct burial method, you should order the Veeder-Root Direct Burial Cable Preparation Kit, P/N 848100-500.

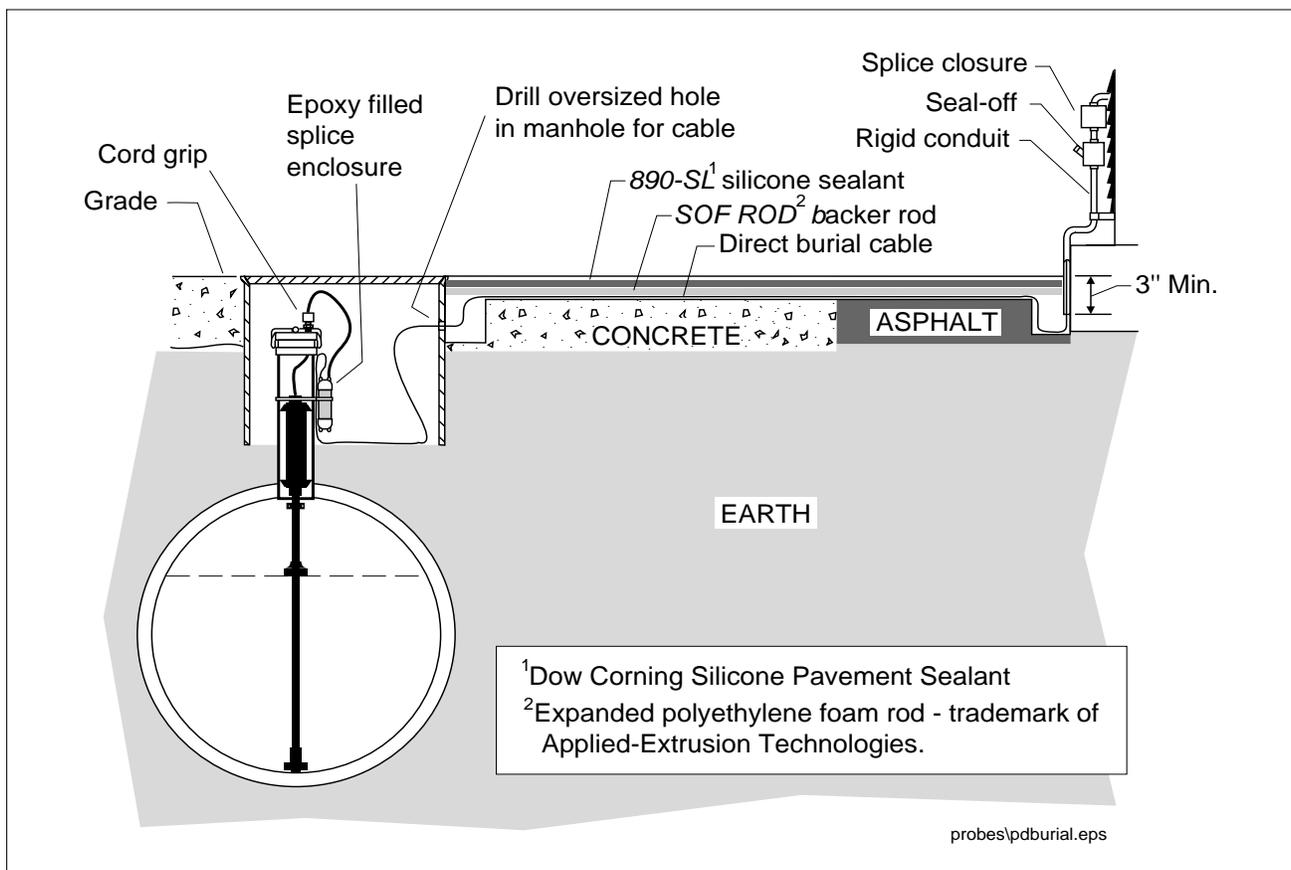


Figure 13. Example Probe Wiring Run via Direct Burial Cable

DIRECT BURIAL CABLE FIELD WIRING



When using direct burial cable for probe-to-console wiring runs, the wiring connections are the same as shown in Figure 11 on page 14, but the sealing materials and procedure is completely different. If you are using Direct Burial Cable you seal the field wiring connections as instructed in the Direct Burial Cable Installation Manual.

Probe Number	TANK Number & Product
PROBE 1	IN TANK _____
PROBE 2	IN TANK _____
PROBE 3	IN TANK _____
PROBE 4	IN TANK _____
PROBE 5	IN TANK _____
PROBE 6	IN TANK _____

consoles\tls50\prbrnk.eps

Figure 14. Probe Installation Directory

Grounding Probe Shields and Drain Wires

Connect probe cable shields and drain wires to ground in the console only, not at the field junction boxes. Do not ground both ends of the shield.

CONNECTING PROBES TO THE CONSOLE - OBSERVE POLARITY

Connect the two color-coded/marked wires from the each probe to the appropriate terminals of the Probe Terminal Block as shown in Figure 15.

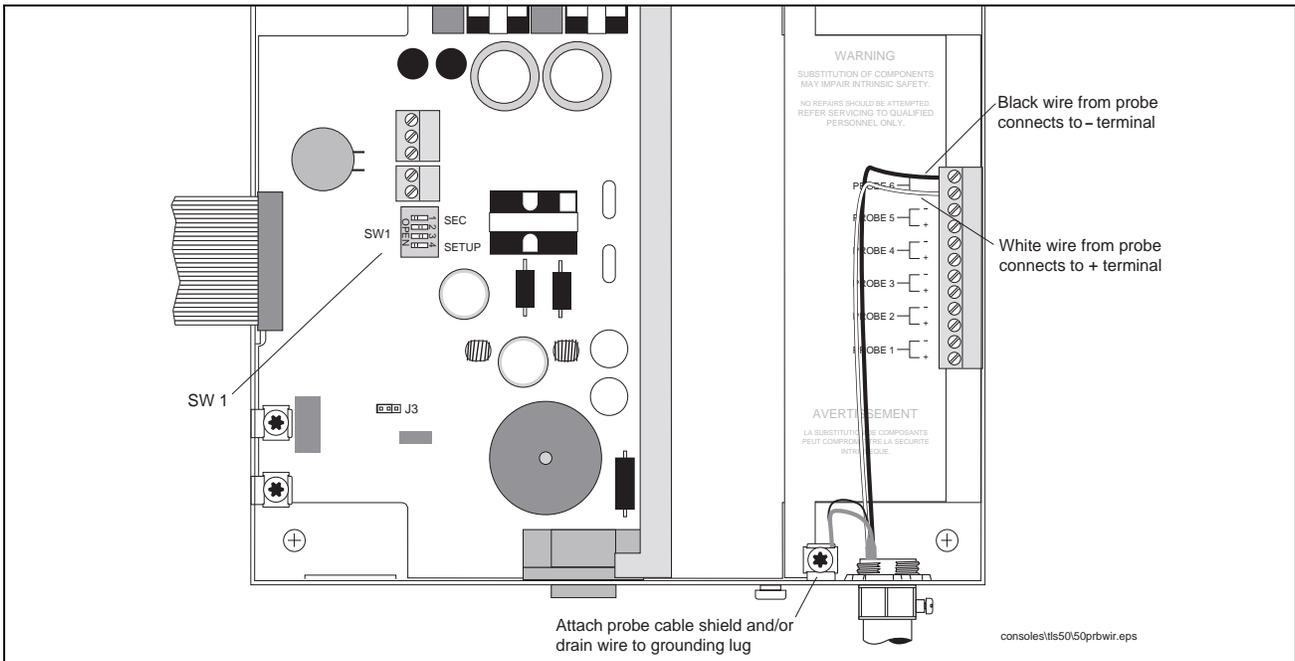


Figure 15. Connecting Probe Wiring to Console (TLS-50C has 3 probe inputs only)

System Setup Security

To protect against unauthorized access to system operation DIP switch 4 of SW1 on the Power Supply board lets you lockout setup and diagnostic menus after making initial programming (for consoles w/display only). Consoles are shipped from the factory with this switch in the open (disabled) position.

See Figure 15 for location of this switch. Figure 16 shows the switch in the closed position, enabling setup lockout. Switch 2 and Switch 3 are not used and can be in any position.

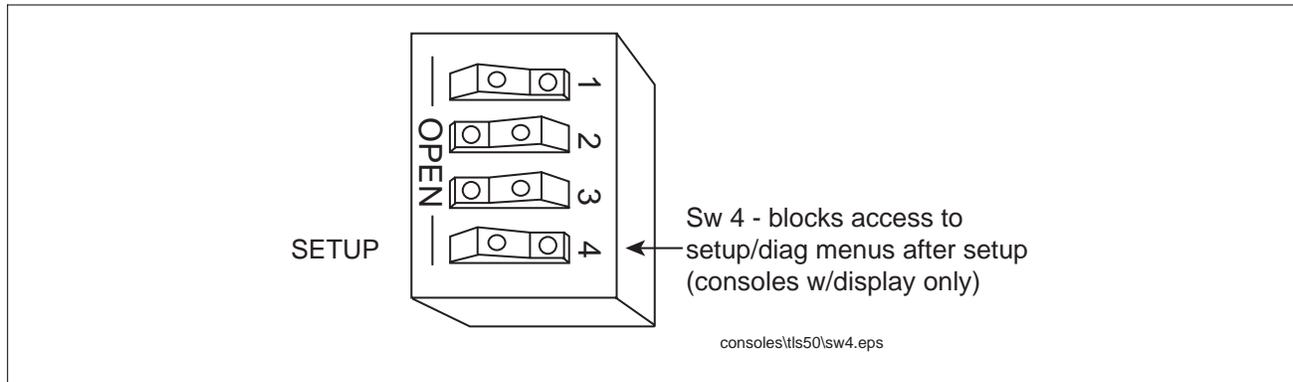


Figure 16. DIP switch 4 in closed position to enable menu lockout

Overfill Alarm Relay

All consoles except those having form numbers 8469X0-060 and 8469X0-230 have one dry contact relay output that closes when an overfill alarm is activated. You can connect an external audible/visual warning device to this relay.



Important! Note these Output Relay Connection Restrictions:

1. Do not connect output relays to a device that draws more than 2 amperes of current. Output power: output relay contact, resistive load - 120/240 Vac, 2 A max.
2. Alarm relays cannot be used for flow control. Alarm relays provide only a momentary closure and cannot actuate flow control devices such as valves and pump motor relays for extended periods of time.



With power to the console turned Off, connect the two wires from the external warning device to the either of the two overfill relay terminals (J5) [see Figure 17].

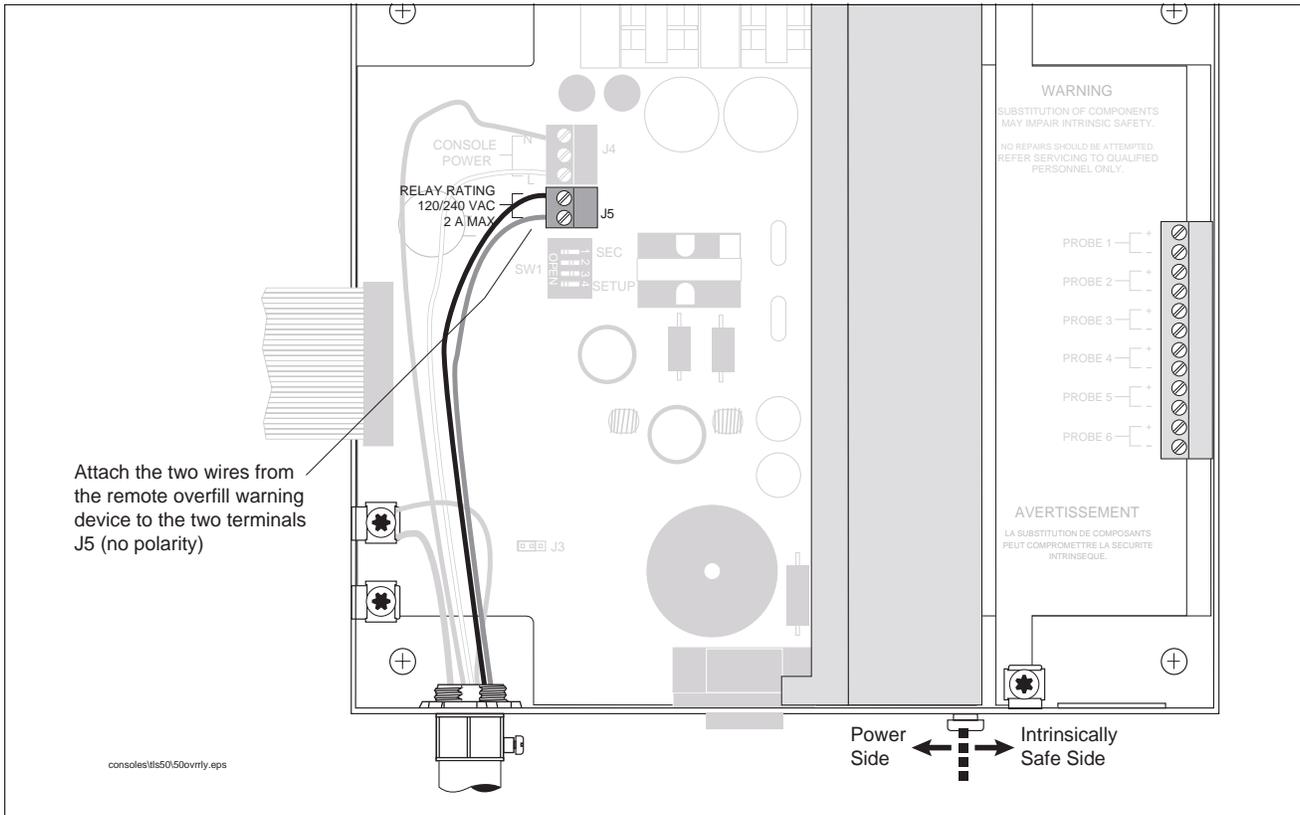


Figure 17. Connecting I/O Devices to Console

Applying Power to System

Cold Boot - Initial Power Up (Consoles w/Display)

Once all devices are connected to the console, attach the console power wires to the appropriate power panel connections. Close the front panel of the console. Switch on the AC power breaker. The system will automatically run a cold boot self-diagnostic program when you power up the console for the first time:

<u>Test Passed</u>	<u>Test Failed</u>	<u>Action (If Failed)</u>
RAM TEST - OK	RAM FAIL	Replace CPU board
ROM TEST - OK	ROM FAIL	“ “ “
COLD BOOT		
EEPROM TEST - OK	EEPROM FAIL	“ “ “
STARTUP COMPLETE		

Following a cold boot the display will read:

NO TANKS CONFIGURED

Follow the Setup instructions in the TLS-50 Setup and Operation Manual to program the system.

Cold Boot - Initial Power Up (Consoles w/o Display)

Once all devices are connected to the console, attach the console power wires to the appropriate power panel connections. Close the front panel of the console. Switch on the AC power breaker. The system will automatically run a cold boot self-diagnostic program when you power up the console for the first time. Wait 30 seconds and then follow the Setup instructions in the TLS-50 Setup and Operation Manual to program the system.

<u>Test Failed</u>	<u>Action (If Failed)</u>
--------------------	---------------------------

Unit fails to communicate	Check “RS-232 Serial Communication Setup” on page 24. If comm settings are correct, replace CPU board.
---------------------------	--

Cold Boot - RAM Clear



If the system has previously been setup, a cold boot can be initiated and the system reset (such as for a software upgrade) as follows:

CONSOLES WITH DISPLAY

Move the RAM clear jumper (J3 in Figure 5) off of pins 1 and 2 and onto pins 2 and 3. The display will acknowledge the RAM clear request with the message: **RAM CLEAR**, then turn the power Off. Move the jumper back onto pins 1 and 2.

CONSOLES WITHOUT DISPLAY

Turn off the power to the unit, move the RAM clear jumper (J3 in Figure 5) off of pins 1 and 2 and onto pins 2 and 3. Turn on the power for 5 seconds, then turn the power off. Move the jumper back onto pins 1 and 2.

Warm Boot

CONSOLES WITH DISPLAY

Once the system is setup, every time power to consoles is switched Off and On, the software will run a self-diagnostic warm boot program and display the test results:

<u>Test Passed</u>	<u>Test Failed</u>	<u>Action (If Failed)</u>
RAM TEST - OK	RAM FAIL	Replace CPU board
ROM TEST - OK	ROM FAIL	“ “ “
WARM BOOT		
STARTUP COMPLETE		

If a fault is detected an error message will be displayed and the system will halt. When the warm boot completes the display returns to the top level status message.

CONSOLES WITHOUT DISPLAY

Once the system is setup, every time power to the console is switched Off and On, the software will run a self-diagnostic warm boot program. Wait 30 seconds and the system should return to normal operation with previous setups intact.

RS-232 Communications

The RS-232 port, provided with consoles having form numbers 8469X0-260, -230, and -460, connects to a user-selected serial printer, modem or terminal.

RS-232 Peripheral Equipment Requirements

Any peripheral equipment connected to an RS-232 serial port must meet the following criteria:

1. Peripheral equipment must be UL listed.
2. The equipment must have an EIA standard RS-232C or RS-232D communications protocol.
3. The equipment must NOT be installed over or in a hazardous location.

RS-232 Connections

TO A DEVICE LESS THAN 50 FEET FROM THE CONSOLE

Veeder-Root recommends that you use a null-modem cable no longer than 50 feet for direct connections between the console and a remote device. Cable runs longer than 50 feet can result in data errors, component damage, or both.

TO A DEVICE MORE THAN 50 FEET FROM THE CONSOLE

If cable runs longer than 50 feet are needed, two short-haul modems should be used, one at the console and one at the remote device. We recommend an asynchronous short-haul modem, Black Box model ME800A, or equivalent at the console and at the remote device. For more information, you can contact Black Box by phone: 724-746-5500, Fax: 724-746-0746, or web: <http://www.blackbox.com>

Figure 18 illustrates how to connect two short-haul modems between the console RS-232 Interface Module's or Auxiliary RS-232 Interface Module's DB-25 connector and the remote device.

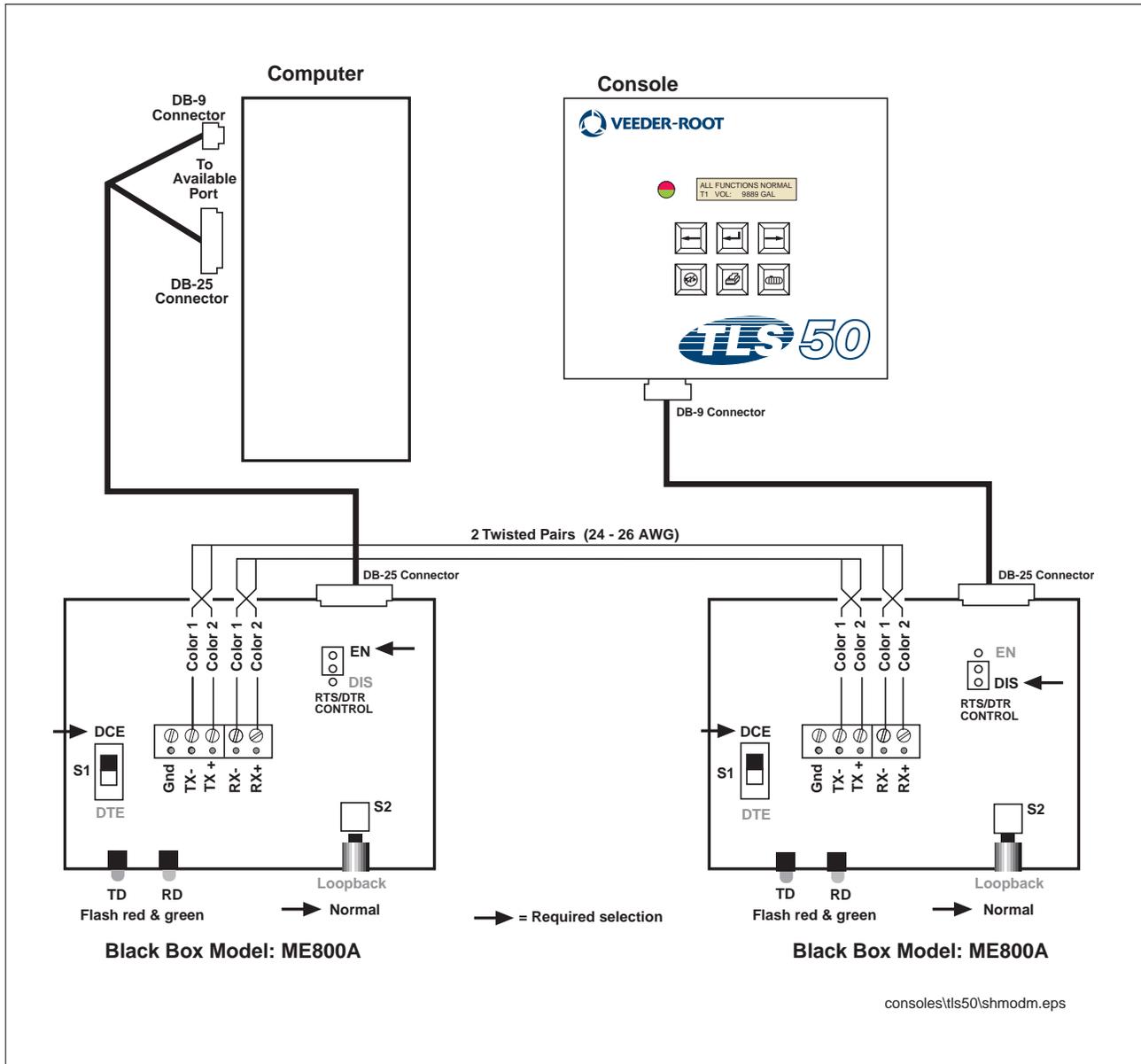


Figure 18. Console Connected to a Remote Device via Short-Haul Modem

Surge Protection for Communication Devices

In locations that are subject to high levels of noise and power surges, the use of a surge protector is recommended. The following models are available from B&B Electronics by phone: 1-815- 433-5100, or web: <http://www.bb-elec.com>:

- Telephone Line Surge Protector, model TLSP
- RS-232 Surge Protector, model 232DSP

System Serial Security

To protect against unauthorized access to system operation DIP switch 1 of SW1 on the Power Supply board lets you enter a 6-digit security code before the system will respond to a serial command (only applies to consoles having form numbers 8469X0-260, 230, & -460). If enabled, the default serial security code is 000000. The security code itself can be changed with a serial command (see "Function Code: 504" on page 31). Consoles are shipped from the factory with this switch in the open (disabled) position.

See Figure 15 on page 17 for location of this switch. Figure 19 shows the switch in the closed position, enabling the security feature.

Switch 2 and Switch 3 are not used and can be in any position.

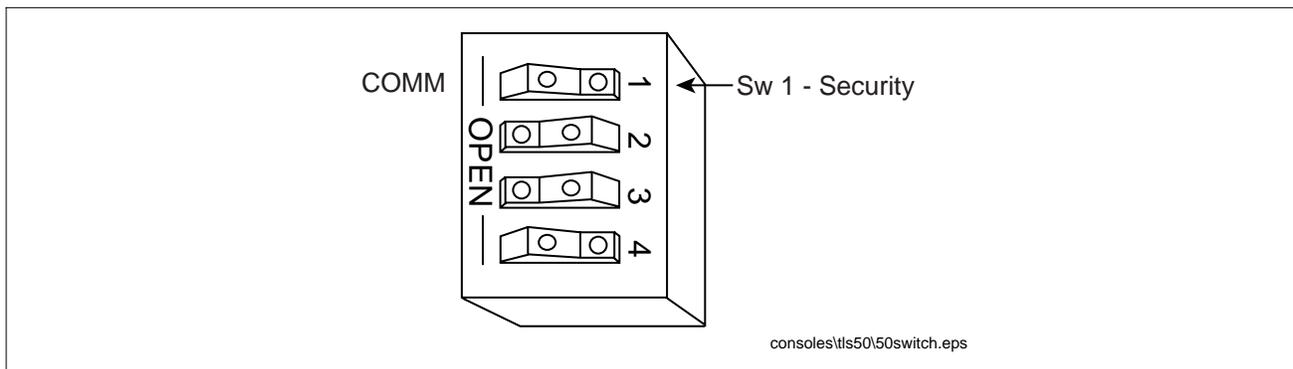


Figure 19. Console Dip Switch Settings

RS-232 Serial Communication Setup

Table 2 shows the available RS-232 setup options and defaults by console form number.

Table 2.- RS-232 Setup Options and Defaults

Setup	Options	Console Form Numbers	Default
Interface mode type	Printer, modem, or serial	8469X0-260	Printer
		8469X0-230, -460	Serial
Baud rate	300, 600, 1200, 2400, 4800, or 9600	8469X0-260, -460	9600
		8469X0-230	2400
Parity	None, odd, or Even	8469X0-260, -460	None
		8469X0-230	Even
Data length	8 or 7	8469X0-260, -460	8
		8469X0-230	7
Stop bits	1 or 2	8469X0-230, -260, -460	1

Table 2.- RS-232 Setup Options and Defaults

Setup	Options	Console Form Numbers	Default
Handshaking	None, XON/XOFF, or hardware	8469X0-260	XON/XOFF
		8469X0-230, -460	None
Printer page eject	Yes or no	8469X0-260	No
		8469X0-230, -460	N/A
Answer on options	0 to 9	8469X0-260	No
		8469X0-230, -460	N/A
Serial language	English, French, Spanish, or Portuguese	8469X0-230, -260, -460	English

DB-9 Connector Pin-Outs

Communicating with the Console from a remote computer is done through a RS-232 serial port (DB-9 connector) on the bottom of the console.

Pin layout to connect the Console's Serial Interface DB-9 connector to a 25-pin computer terminal connector are shown in Figure 20. These connections are standard for "AT" style modem cables.

Console (DB-9 Connector)		Computer Terminal (DB-25 Connector)	
CD	1	8	DCD
RXD	2	2	TXD
TXD	3	3	RXD
DTR	4	20	DTR
GND	5	7	GND
DSR	6	6	DSR
RTS	7	4	RTS
CTS	8	5	CTS
N/C	9	22	Ring Indicator

console\lts50\rs-232.eps

Figure 20. DB9, RS-232 Pin-Outs

RS-232 Commands

001	System Reset	page 27
003	Remote Alarm Reset	page 28
201	In-Tank Inventory Report.	page 29
205	In-Tank Status Report.	page 30
504	Set RS-232 Security Code.	page 31
50C	Set Printer Page Eject Enable.	page 32
50D	Set Temperature Compensation Volume Display Enable.	page 33
50E	Set Temperature Compensation Value.	page 34
517	Set Units of Measurement and Language (ext. lang. set).	page 35
601	Set Tank Configuration	page 36
604	Set Tank 1-Point (Full Height) Volume	page 37
605	Set Tank 4-Point (Full, 3/4, 1/2, & 1/4) Volume.	page 38
606	Set Tank 20 Point Full, 95%, 90%,... Volumes	page 39
607	Set Tank Diameter	page 40
608	Set Tank Tilt	page 41
609	Set Tank Thermal Coefficient of Expansion Volume	page 42
60A	Set Tank Linear Calculated Full Volume.	page 43
621	Set Tank Low Level Limit.	page 44
624	Set Tank High Water Level Limit.	page 45
628	Set Tank Maximum Volume Limit.	page 46
638	Set Tank Overfill Limit	page 47
881	Set Communication Port Data	page 48
882	Initialize Communication Port Data.	page 49
883	Set Communication Port Language	page 50
884	Set Serial Port Handshaking.	page 51
902	System Revision Level Report	page 52
A01	Probe Type and Serial Number.	page 53
A02	Probe Calibration Values.	page 54
A10	Probe Last Sample Buffers.	page 55
A11	Probe Fast Average Buffers	page 56
A12	Probe Standard Average Buffers	page 57

Function Code: 003

Function Type: Remote Alarm Reset

Version 1

Command Format:

Display: <SOH>S00300

Computer: <SOH>s00300

Typical Response Message, Display Format:<SOH>
S00300
<ETX>**Typical Response Message, Computer Format:**

<SOH>s003000000000000&&CCCC<ETX>

Notes:

1. 0000000000 - Not Used
2. && - Data Termination Flag
3. CCCC - Message Checksum

Function Code: 201

Function Type: In-Tank Inventory Report

Version 1

Command Format:

Display: <SOH>I201TT

Computer: <SOH>i201TT

Typical Response Message, Display Format:

```

<SOH>
I201TT
          TANK   VOLUME  TC VOLUME  HEIGHT  WATER  TEMP
          1      5329      5413      48.9    0.0    37.3
<ETX>

```

Typical Response Message, Computer Format:

```

<SOH>i201TT0000000000TT0sssssNNFFFFFFFF...
          TTpssssNNFFFFFFFF...&&CCCC<ETX>

```

Notes:

1. 0000000000 - Unused
2. TT - Tank Number (Decimal, 00 = all)
3. 0 - Unused
4. ssss - Tank Status Bits:
 - Bit 1 - (LSB) Unused
 - Bit 2 - Unused
 - Bit 3 - Invalid Fuel Height Alarm (MAG Probes Only)
 - Bit 4-16 - Unused
5. NN - Number of eight character Data Fields to follow (Hex)
6. FFFFFFFF - ASCII Hex IEEE float:
 1. Volume
 2. TC Volume
 3. Ullage
 4. Height
 5. Water
 6. Temperature
 7. Water Volume
7. && - Data Termination Flag
8. CCCC - Message Checksum

Function Code: 205

Function Type: In-Tank Status Report

Version 1

Command Format:

Display: <SOH>I205TT

Computer: <SOH>i205TT

Typical Response Message, Display Format:

```
<SOH>
I205TT
TANK    STATUS
1       ALL FUNCTIONS NORMAL
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>i205TT0000000000TTnnAA...
                TTnnAA&&CCCC<ETX>
```

Notes:

1. 0000000000 - Unused
2. TT - Tank Number (Decimal, 00 = all)
3. nn - Number of alarms active for tank (Hex, 00 = none)
4. AA - Active tank alarm type:
 - 01 = Unused
 - 02 = Unused
 - 03 = Tank High Water Alarm
 - 04 = Tank Overfill Alarm
 - 05 = Tank Low Product Alarm
 - 06 = Unused
 - 07 = Unused
 - 08 = Tank Invalid Height Alarm
 - 09 = Tank Probe Out Alarm
 - 10 = Unused
 - 11 = Unused
 - 12 = Tank Maximum Level Alarm
 - 13 through 26 = Unused
 - 27 = Tank Low Temperature Warning
5. && - Data Termination Flag
6. CCCC - Message Checksum

Function Code: 504**Function Type:** Set System (RS-232) Security Code

Version 1

Command Format:

<u>Set:</u>	<u>Inquire:</u>
Display: <SOH>S50400aaaaaa	Display: <SOH>I50400
Computer: <SOH>s50400aaaaaa	Computer: <SOH>i50400

Typical Response Message, Display Format:

```
<SOH>
I50400
aaaaaa
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>i50400000000000000aaaaaa&&CCCC<ETX>
```

Notes:

1. 0000000000 - Not Used.
2. aaaaaa - Current Security Code (6 ASCII characters from 20 Hex - 7E Hex)
3. && - Data Termination Flag
4. CCCC - Message Checksum

Function Code: 50C**Function Type:** Set Remote Printer Page Eject Flag

Version 1

Command Format:

Set:
Display: <SOH>S50C00f
Computer: <SOH>s50C00f

Inquire:
Display: <SOH>I50C00
Computer: <SOH>i50C00

Typical Response Message, Display Format:

<SOH>
I50C00
f
<ETX>

Typical Response Message, Computer Format:

<SOH>i50C00000000000000f&&CCCC<ETX>

Notes:

1. 0000000000 - Not Used
2. f - Page Eject Flag:
0 = Disabled
1 = Enabled
3. && - Data Termination Flag
4. CCCC - Message Checksum

Function Code: 50D**Function Type:** Set Print Temperature Compensation Flag

Version 1

Command Format:

<u>Set:</u>	<u>Inquire:</u>
Display: <SOH>S50D00f	Display: <SOH>I50D00
Computer: <SOH>s50D00f	Computer: <SOH>i50D00

Typical Response Message, Display Format:

```
<SOH>
I50D00
f
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>i50D00000000000000f&&CCCC<ETX>
```

Notes:

1. 0000000000 - Not Used
2. f - Print Temperature Compensation Flag
0 = Disable
1 = Enable
3. && - Data Termination Flag
4. CCCC - Message Checksum

Function Code: 50E**Function Type:** Set Temperature Compensation Value

Version 1

Command Format:

<u>Set:</u>	<u>Inquire:</u>
Display: <SOH>S50E00TTT.T	Display: <SOH>I50E00
Computer: <SOH>s50E00FFFFFFFF	Computer: <SOH>i50E00

Notes:

1. TTT.T - Compensation Temperature, Degrees and tenths (Decimal)
2. FFFFFFFF - Compensation Temperature, Degrees (ASCII Hex IEEE float)

Typical Response Message, Display Format:

```
<SOH>  
I50E00  
TTT.T  
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>i50E00000000000000FFFFFFFF&&CCCC<ETX>
```

Notes:

1. 0000000000 - Not Used.
2. FFFFFFFF - Compensation Temperature, Degrees (ASCII Hex IEEE float)
3. && - Data Termination Flag
4. CCCC - Message Checksum

Function Code: 517

Function Type: Set System Type & Language Flags

Version 1

Command Format:

Set:
Display: <SOH>S51700ULL
Computer: <SOH>s51700ULL

Inquire:
Display: <SOH>I51700
Computer: <SOH>i51700

Typical Response Message, Display Format:

```
<SOH>
I51700
U
LL
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>i5170000000000000ULL&&CCCC<ETX>
```

Notes:

1. 0000000000 - Not Used.
2. U - System Units:
 - 1 = U.S
 - 2 = Metric
3. LL - System Language:
 - 1 = English
 - 2 = French
 - 3 = Spanish
 - 4 = Not Used
 - 5 = Portuguese
 - 6 = Not Used
 - 7 = Not Used
 - 8 = Not Used
 - 9 = Not Used
 - 10 = Not Used
 - 11 = Not Used
 - 12 = Chinese
4. && - Data Termination Flag
5. CCCC - Message Checksum

Function Code: 601

Function Type: Set Tank Configuration

Version 1

Command Format:

Set:
Display: <SOH>S601TTf
Computer: <SOH>s601TTf

Inquire:
Display: <SOH>I601TT
Computer: <SOH>i601TT

Typical Response Message, Display Format:

<SOH>
I601TT
f
<ETX>

Typical Response Message, Computer Format:

<SOH>i601TT0000000000TTf...
TTf&&CCCC<ETX>

Notes:

1. 0000000000 - Not Used
2. TT - Tank Number (Decimal, 00 = all)
3. f - Tank Configuration Flag:
0 = Off
1 = On
4. && - Data Termination Flag
5. CCCC - Message Checksum

Function Code: 604**Function Type:** Set Tank 1 Point (Full Height Volume)

Version 1

Command Format:

Set:	Inquire:
Display: <SOH>S604TTVVVVVV	Display: <SOH>I604TT
Computer: <SOH>s604TTFFFFFFFF	Computer: <SOH>i604TT

Notes:

1. TT - Tank Number (Decimal, 00 = all)
2. VVVVVV - Full Height Volume, (Decimal)
3. FFFFFFFF - Full Height Volume, (ASCII Hex IEEE float)

Typical Response Message, Display Format:

```
<SOH>
I604TT
TT P VVVVVV
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>i604TT0000000000TFFFFFFFFF...
                TFFFFFFFFF&&CCCC<ETX>
```

Notes:

1. 0000000000 - Not Used.
2. TT - Tank Number (Decimal, 00 = all)
3. FFFFFFFF - Full Height Volume, (ASCII Hex IEEE float)
5. && - Data Termination Flag
6. CCCC - Message Checksum

Function Code: 605

Function Type: Set Tank 4-Point (Full, 3/4, 1/2, & 1/4 Height) Volumes Version 1

Command Format:

Set:	Inquire:
Display: <SOH>S605TTGGGGGGggggggGGGGGGgggggg	Display: <SOH>I605TT
or: <SOH>S605TTGGGG,gggg,GGGG,ggg	
Computer: <SOH>s605TTFFFFFFFFffffffffFFFFFFFFffffffff	Computer: <SOH>i605TT

Notes:

1. TT - Tank Number (Decimal, 00 = all)
2. GGGGGG - Full Height Volume, Gallons (Decimal)
3. gggggg - 3/4 Height Volume, Gallons (Decimal)
4. GGGGGG - 1/2 Height Volume, Gallons (Decimal)
5. gggggg - 1/4 Height Volume, Gallons (Decimal)
6. FFFFFFFF - Full Height Volume, Gallons (ASCII Hex IEEE float)
7. ffffffff - 3/4 Height Volume, Gallons (ASCII Hex IEEE float)
8. FFFFFFFF - 1/2 Height Volume, Gallons (ASCII Hex IEEE float)
9. ffffffff - 1/4 Height Volume, Gallons (ASCII Hex IEEE float)

Typical Response Message, Display Format:

```
<SOH>
I605TT
1 9728 7296 4864 2432
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>i605TT0000000000TTFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF...
TTFFFFFFFFFFFFFFFF&&CCCC<ETX>
```

Notes:

1. 0000000000 - Not Used.
2. TT - Tank Number (Decimal, 00 = all)
3. FFFFFFFF - Full Height Volume, Gallons (ASCII Hex IEEE float)
4. ffffffff - 3/4 Height Volume, Gallons (ASCII Hex IEEE float)
5. FFFFFFFF - 1/2 Height Volume, Gallons (ASCII Hex IEEE float)
6. ffffffff - 1/4 Height Volume, Gallons (ASCII Hex IEEE float)
7. && - Data Termination Flag
8. CCCC - Message Checksum

Function Code: 606

Function Type: Set Tank 20 Point Full, 95%, 90%,... Volumes Version 1

Command Format:

Set:	Inquire:
Display: <SOH>S606TTGGGGGGggggggGGGGGGgggggg...	Display: <SOH>I606TT
or: <SOH>S606TTGGGG,gggg,GGGG,...	
Computer: <SOH>s606TFFFFFFFFF...	Computer: <SOH>i606TT

Notes:

1. TT - Tank Number (Decimal, 00=all)
2. GGGGGGgggggg - Series of 20 Volumes, Gallons (Decimal)
3. FFFFFFFF - Series of 20 Volumes, Gallons (ASCII Hex IEEE float)

Typical Response Message, Display Format:

```
<SOH>
I606TT
JAN 22, 1996 3:16 PM
```

TANK 20 POINT VOLUMES

TANK	PRODUCT LABEL	GALLONS			
1	REGULAR UNLEADED	9720	9234	8748	8262
		7776	7290	6804	6318
		5832	5346	4860	4372
		3888	3402	2916	2430
		1944	1458	972	486

<ETX>

Typical Response Message, Computer Format:

```
<SOH>i606TT0000000000TFFFFFFFFF...
                TFFFFFFFFF&&CCCC<ETX>
```

Notes:

1. 0000000000 - Not Used.
2. TT - Tank Number (Decimal, 00 = all)
3. FFFFFFFF - Series of 20 Volumes, Gallons (ASCII Hex IEEE float)
4. && - Data Termination Flag
5. CCCC - Message Checksum

Function Code: 607

Function Type: Set Tank Diameter

Version 1

Command Format:

Set:	Inquire:
Display: <SOH>S607TTHHH.HH	Display: <SOH>I607TT
Computer: <SOH>s607TTFFFFFFFF	Computer: <SOH>i607TT

Notes:

1. TT - Tank Number (Decimal, 00 = all)
2. HHH.HH - Tank Diameter (Decimal)
3. FFFFFFFF - Tank Diameter (ASCII Hex IEEE float)

Typical Response Message, Display Format:

```
<SOH>
I607TT
TT HHH.HH
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>i607TT0000000000TFFFFFFFFF...
                TFFFFFFFFF&&CCCC<ETX>
```

Notes:

1. 0000000000 - Not Used.
2. TT - Tank Number (Decimal, 00 = all)
3. FFFFFFFF - Tank Diameter, (ASCII Hex IEEE float)
4. && - Data Termination Flag
5. CCCC - Message Checksum

Function Code: 608

Function Type: Set Tank Tilt

Version 1

Command Format:

Set:	Inquire:
Display: <SOH>S608TTHH.HH	Display: <SOH>I608TT
Computer: <SOH>s608TTFFFFFFF	Computer: <SOH>i608TT

Notes:

1. TT - Tank Number (Decimal, 00 = all)
2. HH.HH - Tank Tilt, (Decimal)
3. FFFFFFFF - Tank Tilt, (ASCII Hex IEEE float)

Typical Response Message, Display Format:

```
<SOH>
I608TT
TT HH.HH
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>i608TT0000000000TFFFFFFF...
          TFFFFFFF&&CCCC<ETX>
```

Notes:

1. 0000000000 - Not Used.
2. TT - Tank Number (Decimal, 00 = all)
3. FFFFFFFF - Tank Tilt, (ASCII Hex IEEE float)
4. && - Data Termination Flag
5. CCCC - Message Checksum

Function Code: 609

Function Type: Set Tank Thermal Expansion Coefficient

Version 1

Command Format:

Set:	Inquire:
Display: <SOH>S609TTc.cccccc	Display: <SOH>I609TT
Computer: <SOH>s609TTFFFFFFFF	Computer: <SOH>i609TT

Notes:

1. TT - Tank Number (Decimal, 00 = all)
2. c.cccccc - Thermal Expansion Coefficient (decimal)
3. FFFFFFFF - Thermal Expansion Coefficient (ASCII Hex IEEE float)

Typical Response Message, Display Format:

```
<SOH>
I609TT
TT c.cccccc
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>i609TT0000000000TFFFFFFFFF...
                TFFFFFFFFF&&CCCC<ETX>
```

Notes:

1. 0000000000 - Not Used.
2. TT - Tank Number (Decimal, 00 = all)
3. FFFFFFFF - Thermal Expansion Coefficient (ASCII Hex IEEE float)
4. && - Data Termination Flag
5. CCCC - Message Checksum

Function Code: 60A

Function Type: Set Tank Linear Calculated Full Volume

Version 1

Command Format:

Set:	Inquire:
Display: <SOH>S60ATTVVVVVV	Display: <SOH>I60ATT
Computer: <SOH>s60ATTFEEEEEE	Computer: <SOH>i60ATT

Notes:

1. TT - Tank Number (Decimal, 00 = all)
2. VVVVVV - Full Height Volume, (Decimal)
3. FFFFFFFF - Full Height Volume, (ASCII Hex IEEE float)

Typical Response Message, Display Format:

```
<SOH>
I60ATT
TT P VVVVVV
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>i60ATT0000000000TTFEEEEEE
TTFEEEEEE&&CCCC<ETX>
```

Notes:

1. 0000000000 - Not Used.
2. TT - Tank Number (Decimal, 00 = all)
3. FFFFFFFF - Full height volume (ASCII Hex IEEE float)
4. && - Data Termination Flag
5. CCCC - Message Checksum

Function Code: 621

Function Type: Set Tank Low Level Limit

Version 1

Command Format:

Set:	Inquire:
Display: <SOH>S621TTVVVVVV	Display: <SOH>I621TT
Computer: <SOH>s621TTFFFFFFFF	Computer: <SOH>i621TT

Notes:

1. TT - Tank Number (Decimal, 00 = all)
2. VVVVVV - Low Level Limit, (Decimal)
3. FFFFFFFF - Low Level Limit, (ASCII Hex IEEE float)

Typical Response Message, Display Format:

```
<SOH>
I621TT
TT VVVVVV
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>i621TT0000000000TFFFFFFFFF...
          TFFFFFFFFF&&CCCC<ETX>
```

Notes:

1. 0000000000 - Not Used.
2. TT - Tank Number (Decimal, 00 = all)
3. FFFFFFFF - Low Level Limit, (ASCII Hex IEEE float)
4. && - Data Termination Flag
5. CCCC - Message Checksum

Function Code: 624

Function Type: Set Tank High Water Level Limit

Version 1

Command Format:

Set:		Inquire:	
Display:	<SOH>S624TTH.H	Display:	<SOH>I624TT
Computer:	<SOH>s624TTFFFFFFFF	Computer:	<SOH>i624TT

Notes:

1. TT - Tank Number (Decimal, 00 = all)
2. HH.H - High Water Level Limit, (Decimal)
3. FFFFFFFF - High Water Level Limit, (ASCII Hex IEEE float)

Typical Response Message, Display Format:

```
<SOH>
I624TT
TT HH.H
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>i624TT0000000000TFFFFFFFF...
                TFFFFFFFF&&CCCC<ETX>
```

Notes:

1. 0000000000 - Not Used.
2. TT - Tank Number (Decimal, 00 = all)
3. FFFFFFFF - High Water Level Limit, (ASCII Hex IEEE float)
4. && - Data Termination Flag
5. CCCC - Message Checksum

Function Code: 628

Function Type: Set Tank Max Volume Limit

Version 1

Command Format:

Set:	Inquire:
Display: <SOH>S628TTVVVVVV	Display: <SOH>I628TT
Computer: <SOH>s628TTFFFFFFFF	Computer: <SOH>i628TT

Notes:

1. TT - Tank Number (Decimal, 00 = all)
2. VVVVVV - Max Volume Limit, (Decimal)
3. FFFFFFFF - Max Volume Limit, (ASCII Hex IEEE float)

Typical Response Message, Display Format:

```
<SOH>
I628TT
TT VVVVVV
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>i628TT0000000000TFFFFFFFFF...
                TFFFFFFFFF&&CCCC<ETX>
```

Notes:

1. 0000000000 - Not Used.
2. TT - Tank Number (Decimal, 00 = all)
3. FFFFFFFF - Max Product Limit, (ASCII Hex IEEE float)
4. && - Data Termination Flag
5. CCCC - Message Checksum

Function Code: 638

Function Type: Set Tank Overfill Level Limit

Version 1

Command Format:

Set:		Inquire:	
Display:	<SOH>S638TTDDD	Display:	<SOH>I638TT
Computer:	<SOH>s638TTDDD	Computer:	<SOH>i638TT

Notes:

1. TT - Tank Number (Decimal, 00 = all)
2. DDD - Overfill Level Limit, (Decimal 0-100%)

Typical Response Message, Display Format:

```
<SOH>
I638TT
TT DDD
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>i638TT0000000000TTDDD...
TTDDD&&CCCC<ETX>
```

Notes:

1. 0000000000 - Not Used
2. TT - Tank Number (Decimal, 00 = all)
3. DDD - Overfill Level Limit percent, (DECIMAL)
4. && - Data Termination Flag
5. CCCC - Message Checksum

Function Code: 881

Function Type: Set Communication Port Data

Version 1

Command Format:

Set:
Display: <SOH>S881CCBBBBBPSDTAA
Computer: <SOH>s881CCBBBBBPSDTAA

Inquire:
Display: <SOH>I881CC
Computer: <SOH>i881CC

Typical Response Message, Display Format:

```
<SOH>
I881CC
CC BBBB P S D T AA
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>i881CC0000000000CCBBBBBPSD0AA&&CCCC<ETX>
```

Notes:

1. 0000000000 - Not Used
2. CC - Communication Port Number (1)
3. BBBB - Baud Rate (Decimal)
4. P - Parity (Decimal; 0=None, 1 or 2)
5. S - Stop Bit (Decimal; 1 or 2)
6. D - Data Bit (Decimal; 7 or 8)
7. 0 - Not Used
8. AA - Number of Rings before Answer (Decimal, 0 - 9)
9. && - Data Termination Flag
10. CCCC - Message Checksum

Function Code: 882**Function Type:** Initialize Communication Port Data

Version 1

Command Format:

Set:	Inquire:
Display: <SOH>S882CC149	Display: <SOH>I882CC
Computer: <SOH>s882CC149	Computer: <SOH>i882CC

Notes:

1. 149 - This verification code must be sent to confirm the command

Typical Response Message, Display Format:

```
<SOH>
I882CC
CC BBBB P S D T AA
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>i882CC000000000000CCBBBBBPSD0AA&&CCCC<ETX>
```

Notes:

1. 0000000000 - Not Used.
2. CC - Communication Port Number (1)
3. BBBB - Baud Rate (Decimal)
4. P - Parity (Decimal; 0= None, 1 or 2)
5. S - Stop Bit (Decimal; 1 or 2)
6. D - Data Bit (Decimal; 7 or 8)
7. 0 - Not Used
8. AA - Number of Rings before Answer (Decimal)
9. && - Data Termination Flag
10. CCCC - Message Checksum

Function Code: 883

Function Type: Set Serial Communication Language

Version 1

Command Format:

Set:
Display: <SOH>S88300LL
Computer: <SOH>s88300LL

Inquire:
Display: <SOH>I88300
Computer: <SOH>i88300

Typical Response Message, Display Format:

<SOH>
I88300
LL
<ETX>

Typical Response Message, Computer Format:

<SOH>i88300000000000000LL&&CCCC<ETX>

Notes:

1. 0000000000 - Not Used
3. LL - System Language:
 - 1 = English
 - 2 = French
 - 3 = Spanish
 - 4 = Not Used
 - 5 = Portuguese
 - 6 = Not Used
 - 7 = Not Used
 - 8 = Not Used
 - 9 = Not Used
 - 10 = Not Used
 - 11 = Not Used
 - 12 = Not Used
4. && - Data Termination Flag
5. CCCC - Message Checksum

Function Code: 884

Function Type: Set Serial Handshaking

Version 1

Command Format:

Set:
Display: <SOH>S88400f
Computer: <SOH>s88400f

Inquire:
Display: <SOH>I88400
Computer: <SOH>i88400

Typical Response Message, Display Format:

<SOH>
I88400
f
<ETX>

Typical Response Message, Computer Format:

<SOH>i88400000000000000f&&CCCC<ETX>

Notes:

1. 0000000000 - Not Used
2. f - Handshaking method:
 - 0 = Disabled
 - 1 = Hardware
 - 2 = XON/XOFF
3. && - Data Termination Flag
4. CCCC - Message Checksum

Function Code: 902**Function Type:** System Revision Level Report

Version 1

Command Format:**Display:** <SOH>I90200**Computer:** <SOH>i90200**Typical Response Message, Display Format:**

```
<SOH>
I90200
SOFTWARE# 349771-vvv-rrr A B
CREATED - YY.MM.DD.HH.mm
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>i902000000000000SOFTWARE# 349771-vvv-rrrCREATED - YY.MM.DD.HH.mm&&CCCC<ETX>
```

Notes:

1. 0000000000 - Not Used
2. vvv - Software version number (ASCII text string)
3. rrr - Software revision level (ASCII text string)
4. YY.MM.DD.HH.mm - Date and time of software creation
5. && - Data Termination Flag
6. CCCC - Message Checksum
7. A = 1 - Alarm Package option installed
8. B = 2 - Serial Package option installed

Function Code: A01

Function Type: Probe Type and Serial Number

Version 1

Command Format:

Display: <SOH>IA01TT

Computer: <SOH>iA01TT

Typical Response Message, Display Format:

```
<SOH>
IA01TT
TT PP KKKK LLLL.LL SSSSSS cccc
<ETX>
```

Notes:

1. TT - Tank Number (Decimal, 00 = all)
2. PP - Probe Type: - MAG1
3. LLLL.LL - Probe Length (Decimal)
4. SSSSSS - Probe Serial Number (Decimal)
5. cccc - Probe Date Code (Hex)

Typical Response Message, Computer Format:

```
<SOH>iA01TT0000000000TT0PPKKKKFFFFFFFFSSSSSScccc...
TT0PPKKKKFFFFFFFFSSSSSScccc&&CCCC<ETX>
```

Notes:

1. 0000000000 - Not Used.
2. TT - Tank Number (Decimal, 00 = all)
3. 0 - Not used
4. PP - Probe Type: 03 = MAG1
5. KKKK - Circuit Code (Hex)
6. FFFFFFFF - Probe Length (ASCII Hex IEEE float)
7. SSSSSS - Probe Serial Number (Decimal)
8. cccc - Probe Date Code (Hex)
9. && - Data Termination Flag
10. CCCC - Message Checksum

Function Code: A02**Function Type:** Probe Factory Dry Calibration Values

Version 1

Command Format:**Display:** <SOH>IA02TT**Computer:** <SOH>iA02TT**Typical Response Message, Display Format:**

```

<SOH>
IA02TT
TT PP CCC.CCCC
<ETX>

```

Notes:

1. TT - Tank Number (Decimal, 00 = all)
2. PP - Probe Type: 03 = MAG1
3. CCC.CCCC - Probe Data (Decimal)

Typical Response Message, Computer Format:

```

<SOH>iA02TT0000000000TT0PPNNFFFFFFFF...
TT0PPNNFFFFFFFF...&&CCCC<ETX>

```

Notes:

1. 0000000000 - Not Used.
2. TT - Tank Number (Decimal, 00 = all)
3. 0 - Not used
4. PP - Probe Type: 03 = MAG1
5. NN - Number of eight character Data Fields to follow (Hex)
6. FFFFFFFF - Calibration Value (ASCII Hex IEEE float)
7. && - Data Termination Flag
8. CCCC - Message Checksum

Function Code: A10**Function Type:** Probe Last Sample Buffers

Version 1

Command Format:**Display:** <SOH>IA10TT**Computer:** <SOH>iA10TT**Typical Response Message, Display Format:**

```

<SOH>
IA10TT
TT PP nnnnn
ssss.sss ssss.sss ssss.sss ssss.sss ssss.sss ssss.sss ssss.sss ssss.sss
ssss.sss ssss.sss ssss.sss ssss.sss ssss.sss ssss.sss ssss.sss ssss.sss
ssss.sss ssss.sss ssss.sss ssss.sss ssss.sss ssss.sss ssss.sss ssss.sss
ssss.sss ssss.sss
<ETX>

```

Notes:

1. TT - Tank Number (Decimal, 00 = all)
2. PP - Probe Type:03 - MAG1
3. nnnnn - Sample Number (Decimal)
4. ssss.sss - Probe Data (Decimal)

Typical Response Message, Computer Format:

```

<SOH>iA10TT0000000000TT0PPSSSSNNFFFFFFFF...
                TT0PPSSSSNNFFFFFFFF...&&CCCC<ETX>

```

Notes:

1. 0000000000 - Not Used
2. TT - Tank Number (Decimal, 00 = all)
3. 0 - Not used
4. PP - Probe Type: 03 - MAG1
5. SSSS - Sample Number (Hex)
6. NN - Number of eight character Data Fields to follow (Hex)
7. FFFFFFFF - Probe Data (ASCII Hex IEEE float)
8. && - Data Termination Flag
9. CCCC - Message Checksum

Function Code: A11

Function Type: Probe Fast Average Buffers

Version 1

Command Format:

Display: <SOH>IA11TT

Computer: <SOH>iA11TT

Typical Response Message, Display Format:

```

<SOH>
IA11TT
TT PP nnnnn
ssss.sss  ssss.sss  ssss.sss  ssss.sss  ssss.sss  ssss.sss  ssss.sss  ssss.sss
ssss.sss  ssss.sss  ssss.sss  ssss.sss  ssss.sss  ssss.sss  ssss.sss  ssss.sss
ssss.sss  ssss.sss  ssss.sss  ssss.sss  ssss.sss  ssss.sss  ssss.sss  ssss.sss
ssss.sss  ssss.sss
<ETX>

```

Notes:

1. TT - Tank Number (Decimal, 00 = all)
2. PP - Probe Type: 03 - MAG1
3. nnnnn - Sample Number (Decimal)
4. ssss.sss - Probe Data (Decimal)

Typical Response Message, Computer Format:

```

<SOH>iA11TT0000000000TT0PPSSSSNNFFFFFFFF...
                TT0PPSSSSNNFFFFFFFF...&&CCCC<ETX>

```

Notes:

1. 0000000000 - Not Used
2. TT - Tank Number (Decimal, 00 = all)
3. 0 - Not used
4. PP - Probe Type: 03 - MAG1
5. SSSS - Number of Samples (Hex)
6. NN - Number of eight character Data Fields to follow (Hex)
7. FFFFFFFF - Probe Data (ASCII Hex IEEE float)
8. && - Data Termination Flag
9. CCCC - Message Checksum

Function Code: A12**Function Type:** Probe Standard Average Buffers

Version 1

Command Format:**Display:** <SOH>IA12TT**Computer:** <SOH>iA12TT**Typical Response Message, Display Format:**

```

<SOH>
IA12TT
TT PP nnnnn
ssss.sss  ssss.sss  ssss.sss  ssss.sss  ssss.sss  ssss.sss  ssss.sss  ssss.sss
ssss.sss  ssss.sss  ssss.sss  ssss.sss  ssss.sss  ssss.sss  ssss.sss  ssss.sss
ssss.sss  ssss.sss  ssss.sss  ssss.sss  ssss.sss  ssss.sss  ssss.sss  ssss.sss
ssss.sss  ssss.sss
<ETX>

```

Notes:

1. TT - Tank Number (Decimal, 00 = all)
2. PP - Probe Type: 03 - MAG1
3. nnnnn - Sample Number (Decimal)
4. ssss.sss - Probe Data (Decimal)

Typical Response Message, Computer Format:

```

<SOH>iA12TT0000000000TT0PPSSSSNNFFFFFFFF...
                TT0PPSSSSNNFFFFFFFF...&&CCCC<ETX>

```

Notes:

1. 0000000000 - Not Used
2. TT - Tank Number (Decimal, 00 = all)
3. 0 - Not used
4. PP - Probe Type: 03 - MAG1
5. SSSS - Number of Samples (Hex)
6. NN - Number of eight character Data Fields to follow (Hex)
7. FFFFFFFF - Probe Data (ASCII Hex IEEE float)
8. && - Data Termination Flag
9. CCCC - Message Checksum

Troubleshooting

This section contains information to help diagnose system problems.

- Probe troubleshooting
- CPU/Power board replacement
- System specifications
- System compatible probes

Dual-Function Front Panel Keys (consoles w/Keypads Only)

Two of the six front panel keys have dual functions [Figure 21].

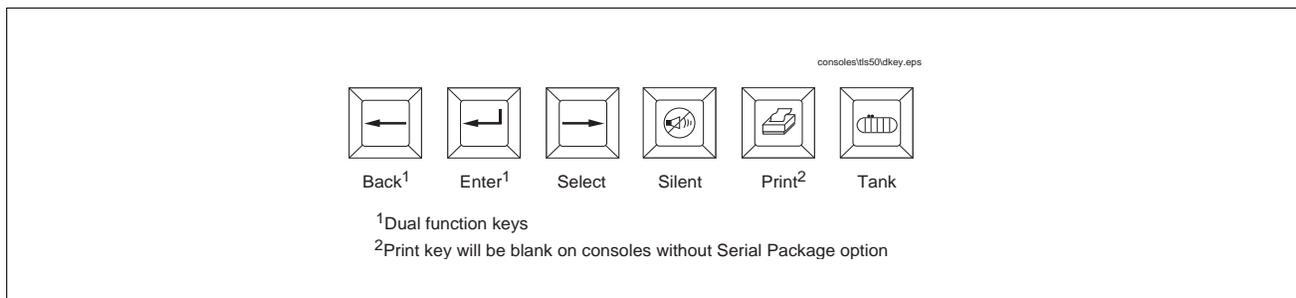


Figure 21. Dual-Function Keys

Pressing the Enter key down for an extended period (longer than 2 seconds) will change the system language to the next available language queued in software. Repeat this procedure until the desired language is displayed.

Pressing the Back key down for at least 2 seconds will change the system setup units. Repeat this procedure until the desired units are displayed.

A short beep from the console beeper will inform the operator that these keys have been held in long enough to select the alternate function. When the operator is ready to return to the originally programmed language and/or units, switch the console power off and then back on. The system will perform a warm boot and return to the originally programmed language and units.

Probe Troubleshooting

CONSOLES W/O DISPLAY

Probe troubleshooting can be performed using the appropriate RS-232 serial commands (see appropriate section in this manual).

CONSOLES W/DISPLAY

The Diagnostic Menu is accessed from the front panel of the console. From the Top Level menu press the Select key until the display reads **DIAGNOSTICS**, then follow the key presses shown in Figure 22. Figure 23 contains an general explanation of the diagnostic displays.

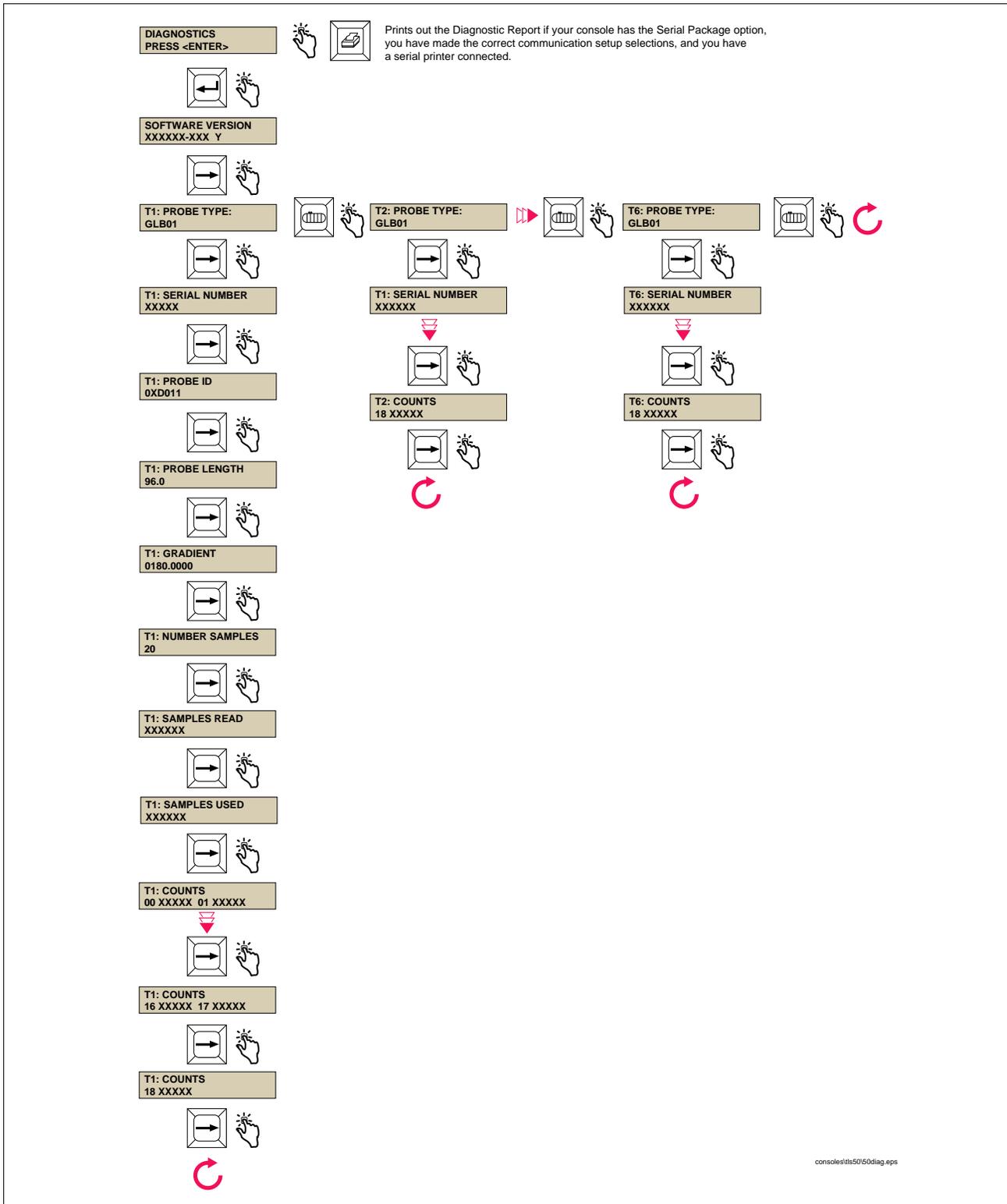


Figure 22. Diagnostic Menu - Overview

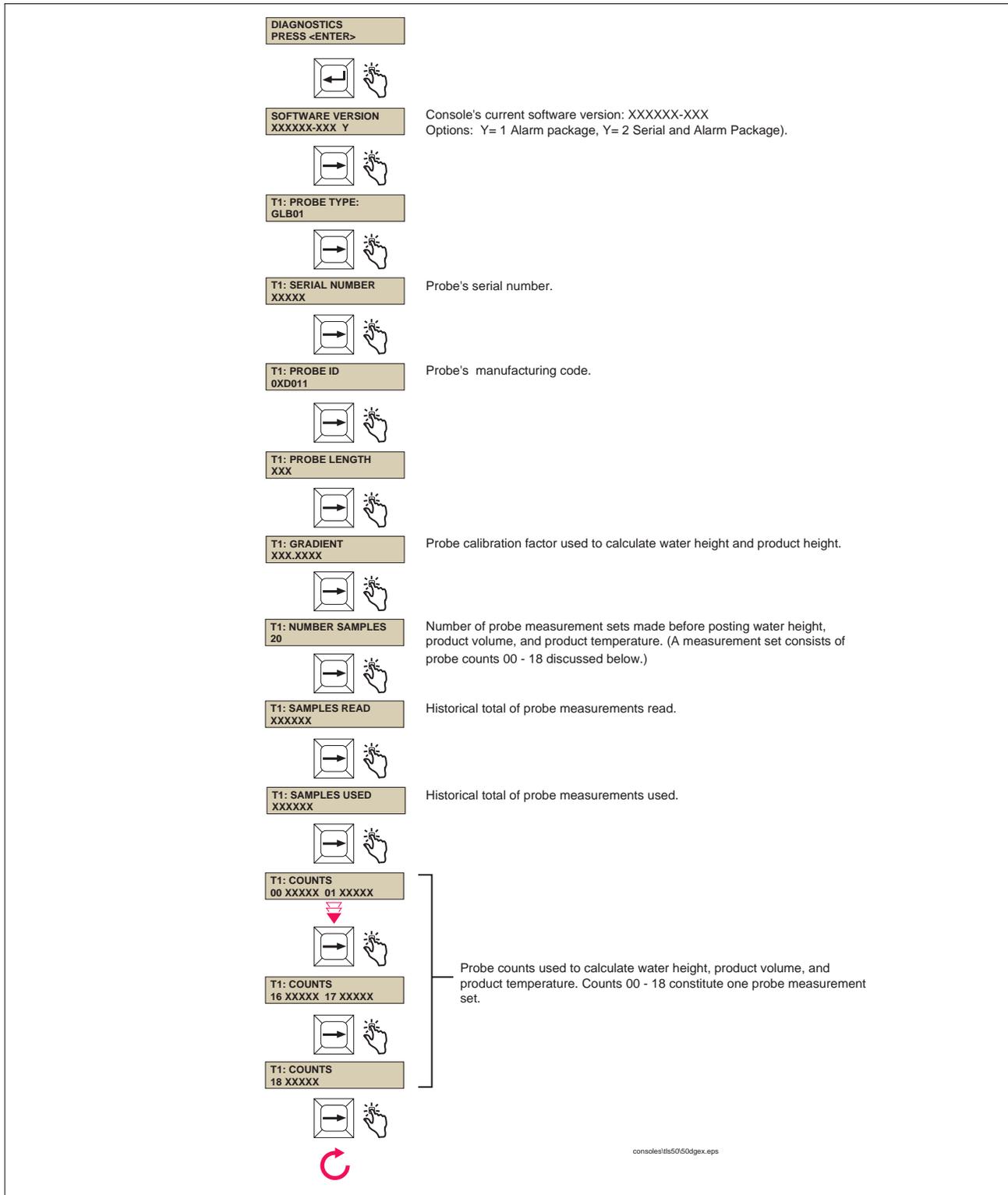


Figure 23. Diagnostic Menu - Explanation

Probe Diagnostic Report

The Diagnostic Report example below is a printout of probe information, for all tanks. The probe functions are discussed in Figure 23.

DIAGNOSTICS

SOFTWARE VERSION 349771-001-A

TANK	:	1	2	3
PROBE TYPE	:	GLB8	GLB8	GLB8
SERIAL NUMBER	:	123001	123002	123003
PROBE ID	:	D021	D021	D021
PROBE LENGTH	:	96.0	96.0	96.0
GRADIENT	:	350.00	350.00	350.00
NUMBER SAMPLES	:	20	20	20
SAMPLES READ	:	xxxxxx	xxxxxx	xxxxxx
SAMPLES USED	:	xxxxxx	xxxxxx	xxxxxx
COUNTS 00	:	xxxxx	xxxxx	xxxxx
01	:	xxxxx	xxxxx	xxxxx
02	:	xxxxx	xxxxx	xxxxx
03	:	xxxxx	xxxxx	xxxxx
04	:	xxxxx	xxxxx	xxxxx
05	:	xxxxx	xxxxx	xxxxx
06	:	xxxxx	xxxxx	xxxxx
07	:	xxxxx	xxxxx	xxxxx
08	:	xxxxx	xxxxx	xxxxx
09	:	xxxxx	xxxxx	xxxxx
10	:	xxxxx	xxxxx	xxxxx
11	:	xxxxx	xxxxx	xxxxx
12	:	xxxxx	xxxxx	xxxxx
13	:	xxxxx	xxxxx	xxxxx
14	:	xxxxx	xxxxx	xxxxx
14	:	xxxxx	xxxxx	xxxxx
15	:	xxxxx	xxxxx	xxxxx
16	:	xxxxx	xxxxx	xxxxx
17	:	xxxxx	xxxxx	xxxxx
18	:	xxxxx	xxxxx	xxxxx

Replacing the CPU Board

The CPU board in the console must be replaced when:

- A system self-test failure occurs during a warm or cold boot, or
- The display (on certain models) contains garbled messages and/or the voltage between the GND and 8V test points on the back of the CPU board is within 7 - 9 Vdc; or,
- The voltage between the GND and 5V test points [Figure 24] on the back of the CPU board is not within 4.75 - 5.25 Vdc.

1. Turn Off power to the system.



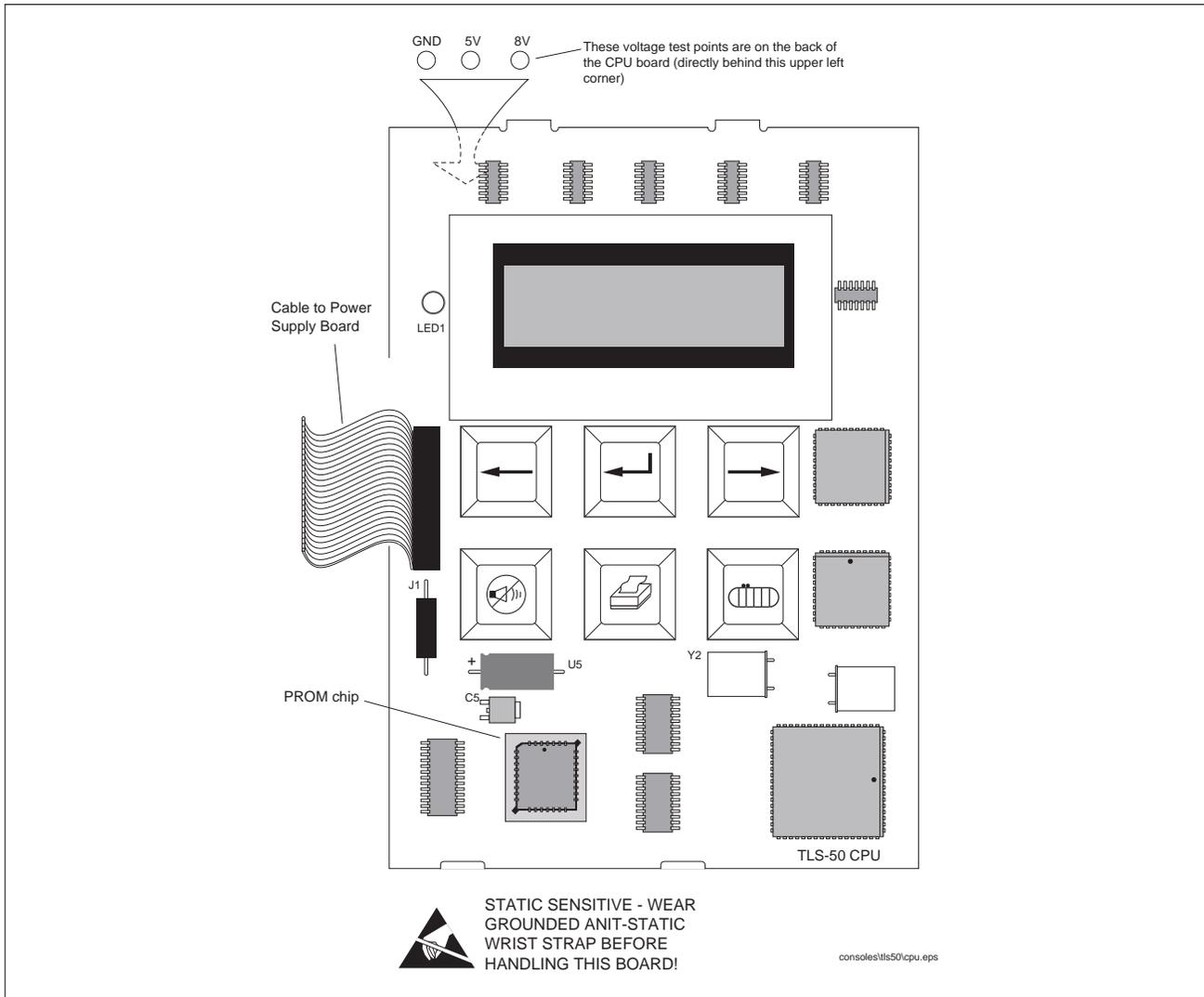


Figure 24. CPU Board Voltage Test Points (Keypad/Display version shown)

2. Attach the anti-static strap to your wrist and to a good ground.
3. Disconnect the CPU cable from the Power Supply board.
4. The CPU board snaps securely into place in the door of the console without the use of screws. There are two tabs on the top of the board that fit into two slots in the top edge of the door. The bottom of the CPU board snaps in place between two pairs of detents protruding from the bottom edge of the door. The CPU board is removed by inserting a straight-slot screwdriver into one of the two indents on the bottom of the board and then gently prying against the door until the board clears the upper detents, then rotating the board up slightly and toward you to clear the top tabs from the slots in the door.
5. Replace the CPU board reversing the above steps.
6. Follow the cold boot instructions beginning on page 20.

PROM Chip Replacement (Software Upgrade)

The PROM chip is replaced when a software upgrade is installed. This procedure requires that you perform a RAM clear.



1. If possible, record the current setup information. Turn off power to the system.
2. Open the front door of the console. The CPU board is installed in the door.
3. Attach anti-static strap to your wrist and to a good ground.
4. Disconnect the CPU board cable from the Power Supply board. Remove the CPU board following the instructions in "Replacing the CPU Board" on page 61.
5. Locate the PROM chip on the board [Figure 24].
6. Remove the PROM chip following instructions in Figure 25.
7. Replace the PROM chip following instructions in Figure 26.
8. Replace the CPU board in the front door of the TLS-50. Connect the CPU board cable to J1 on the Power Supply board.
9. Follow the cold boot instructions for your console type beginning on page 20.

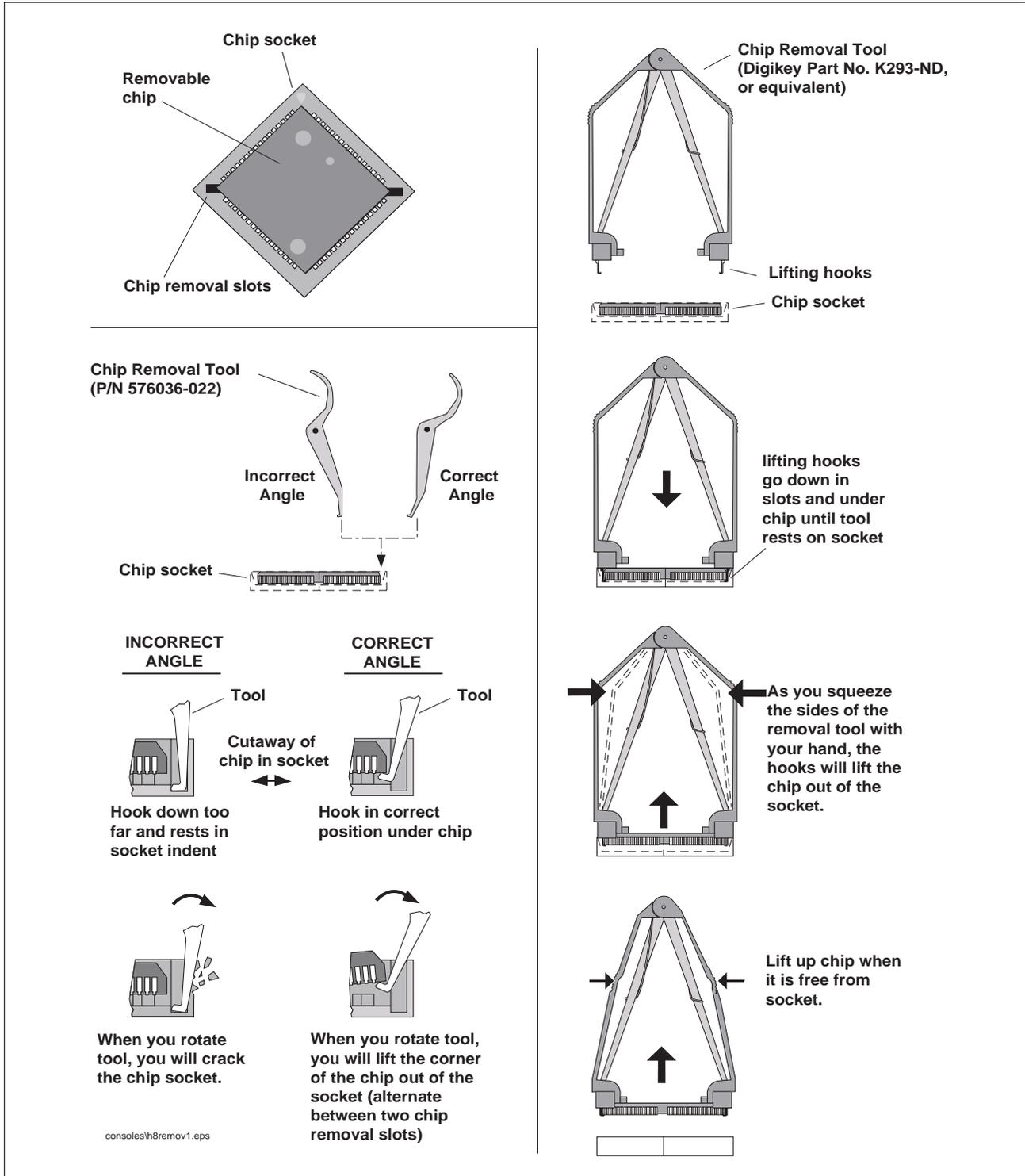


Figure 25. Removing PROM Chip

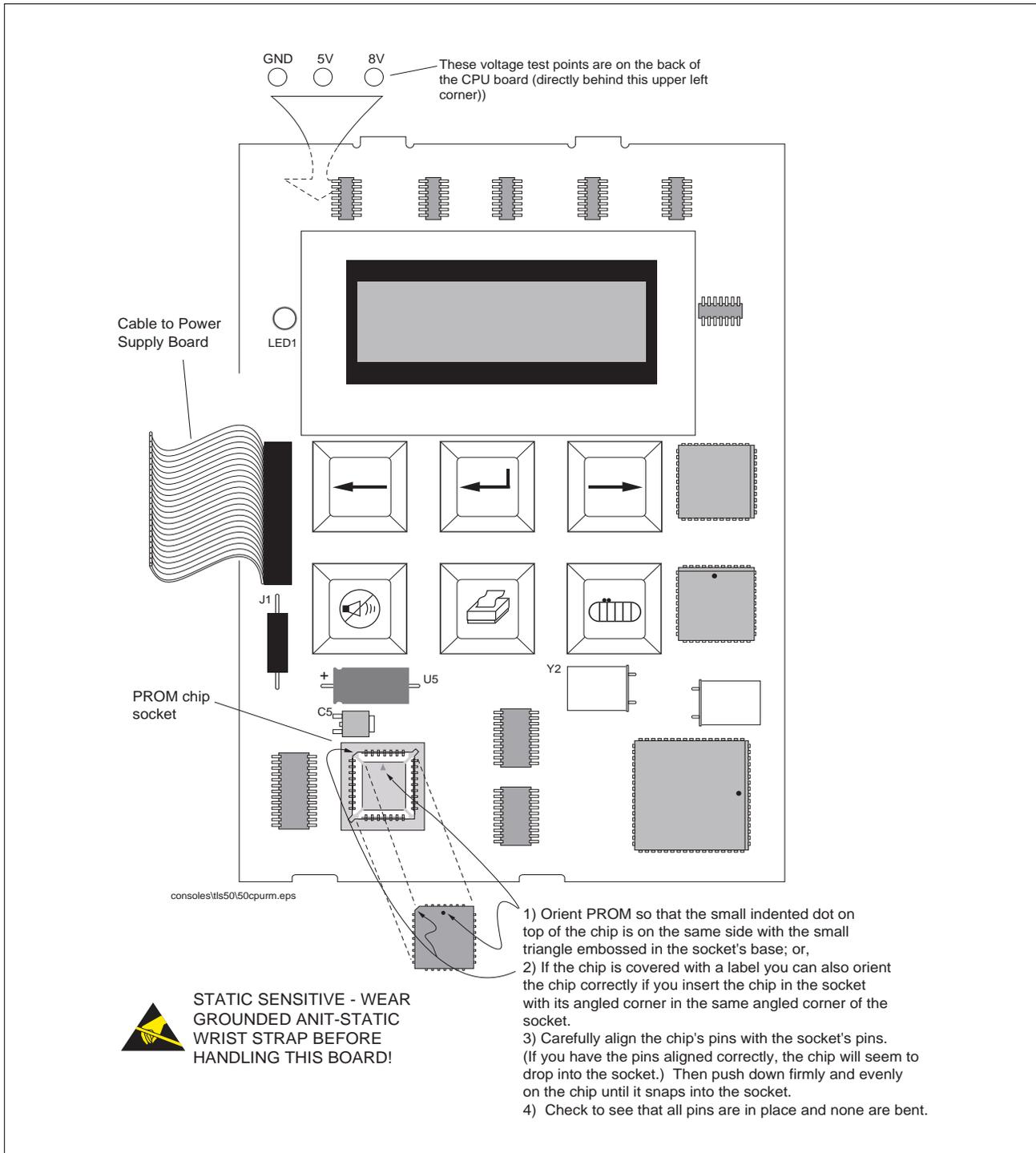


Figure 26. Replacing PROM Chip (Keypad/Display version shown)

Replacing the Power Supply Board

The Power Supply board must be replaced when:

- Probe data is not being processed, or
- The voltage between the GND and 8V test points [Figure 24] on the back of the CPU board is less than 7 Vdc.



1. Turn Off power to the system.
2. Disconnect the CPU cable from the Power Supply board.
3. Tag and disconnect probe, power, and overflow alarm relay wiring to the Power Supply board.
4. The Power Supply board is secured by two T-15 Torx screws in the top of the board. For consoles with the com option (see Table 1 on page 1), the two screw locks which go through the bottom of the console into the DB-9 connector must also be removed before you can lift out the board.

After removing the Torx screws (and screw locks), slowly lift up on the board until the lower tabs on the board clear the slots in the bottom of the console, then continue to lift the board out.

5. Replace the board by reversing the above steps.
6. Turn on power to the system. The system will perform a warm boot procedure [page 21] and the display will return to the top level status screen. You do not have to reprogram the console after replacing the Power Supply board.

Console Specifications

PHYSICAL SPECIFICATIONS

- Width (door closed): 7.6", open 9.6") Depth (door closed 2.6", open 9")
- Height: 6.7" Weight: 3.5 lbs.
- Two PC boards in console: CPU (in door) and Power Supply (in unit)

ENVIRONMENTAL SPECIFICATIONS

- Console storage and operation: indoor, climate controlled.

ELECTRICAL SPECIFICATIONS

- Console operating voltage: 120/240 Vac, 2 A max.
- The Power Supply board fuses F1 and F2 are **NOT** field replaceable The rating for both fuses is 2 A, Type T [Time Lag].

SIGNAL INPUT SPECIFICATIONS

- Up to 6 probes monitored with TLS-50, or 3 probes monitored with TLS-50C
- Probe data: 0.15 A at 12 volts

SIGNAL OUTPUT SPECIFICATIONS

- One dry contact Relay Output: 120 Vac, 2 A

FRONT PANEL USER INTERFACE (CONSOLES W/DISPLAY)

- Two line, graphic LCD display
- Visible annunciator (bi-color LED)
 - Green - all functions normal
 - Flashing red - alarm active
- Push keys
 - Select
 - Enter
 - Print (optional)
 - Back
 - Silence
 - Tank
- Audible annunciator: internal beeper

Probe Circuit Codes

Table 2 lists the probes that can be used with various TLS-50 Console Form Nos. Probe Form Nos. 8990 are only compatible with Console Form Nos. 846910-XXX.

Table 2.- Probe Circuit Codes

Circuit Code	Probe Form	Probe Type	Probe Description	Water Float Type	Temperature Measurement	No. of Floats
D021	846891-199	GLB8	---	Gasoline	Yes	2
D021	846891-299	GLB8	---	Diesel	Yes	2
D021	846891-399	GLB8	---	Light Oil	Yes	2
D022	846891-499	GLB9	---	Gasoline	No	2
D022	846891-599	GLB9	---	Diesel	No	2
D022	846891-699	GLB9	---	Light Oil	No	2
D023	846891-799	GLB10	---	None	Yes	1
D024	846891-899	GLB11	---	None	No	1
D026	899021-2XX	Mag Plus	0.2 GPH - Gasoline	---	Yes	2
D026	899031-2XX	Mag Plus	0.2 GPH - Diesel	---	Yes	2
D027	899021-3XX	Mag Plus	Inv. Only - Gasoline	---	Yes	2
D027	899031-3XX	Mag Plus	Inv. Only - Diesel	---	Yes	2

All 8990 probes are Nepsi approved. The standard configuration for an 8990 probe is stainless steel with a 5-foot (1.524 m) cable.

Appendix A: TLS-50 and TLS-50C Safety Instructions

1. Refer to Veeder-Root Descriptive System Document 331940-003 for system installation requirements. This drawing can be found on the Veeder-Root Tech Docs CD-ROM shipped with your console.
2. Refer to the site preparation procedures in this manual for general instructions on safe installation, use, and replacement.
3. The TLS-50 and TLS-50C systems do not require periodic maintenance or calibration.
4. The TLS-50 and TLS-50C systems are serviceable. If a failure occurs, the unit should be repaired in accordance with the requirements in the Troubleshooting section of this manual. Note: There are no replaceable components within the encapsulated protective circuits. If a protective circuit fails, it must be replaced in its entirety.

