LLD-300

Troubleshooting Manual

LLD-300 CPU BOARD

C1 LCD1   U4   U10

le to Power
ply Board

J1

BACK   ENTER   SELECT   U11

U16
LED1   SILENT   START TEST   U14

U2   U15

Positions
actory
)   DEFAULT
(X2)
D
C
B
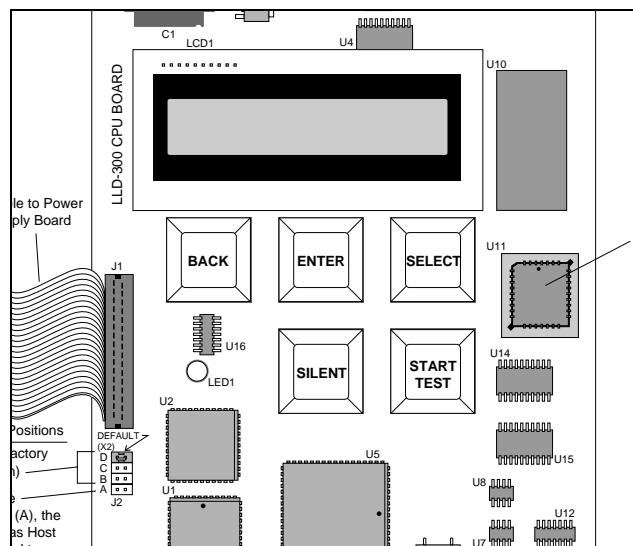A   U5   U8
U1   U12
(A), the
as Host   U7

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Environmental Products

Notice

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RS-232 Serial Interface - Optional

Glossary

Figures

Introduction

This manual contains troubleshooting information for the Veeder-Root stand-alone LLD-300 Wireless Pressurized Line Leak Detection system. Once programmed, the console can monitor and control up to four non-manifolded, fiberglass and/or steel product lines.

Inputs from the dispensers are used to schedule the leak test(s) following each dispense. Through connections to the STP contactors, the LLD-300 Console can switch on and off certain models of FE Petro™ or Red Jacket™ pumps to pressurize the line. A wireless pressure line leak sensor mounted in the STP records a set of line pressures from the time the pump is switched on. Eight seconds later the sensor transmits its pressure measurements in discrete data packets over the pump's ac wiring, where they are detected by the console.

Depending on the model and programming selections, the LLD-300 determines if a line is holding pressure, or is leaking at one of three different rates: 3 gph (gross), 0.2 gph (periodic), and 0.1 gph (annual). If the LLD-300 detects a line leak, it switches on console warning annunciators (Red light and beeper), and depending on the test type and programming selections, shuts down that line.

Veeder-Root Manual 577013-546 Required

Important ☞ This troubleshooting manual must be used in conjunction with the LLD-300 Installation, Setup, and Operation Manual (V-R manual no. 577013-546). The Service Contractor is cautioned to verify that the LLD-300 Console and WPLLD sensors are installed and wired correctly following the procedures outlined in manual 577013-546, before beginning the troubleshooting procedures contained herein. Other instructions, such as setup programming following a cold boot and adjusting sensor signal strengths are also found in that manual.

Return Shipping

All product returns, including warranty replacements, repairs, and core credits, must be returned on an RGA (Returned Goods Authorization) for proper processing. To return a product under this procedure call Customer Service at (800) 873-3313 to obtain an RGA number.

1. Address the shipment to Veeder-Root Co., 6th Avenue at Burns Crossing, Altoona, Pennsylvania 16602.

2. All warranty returns must be in accordance with Veeder-Root warranty procedures. Problem description and corrective action must be filled out in detail.

Safety Symbols

The following safety symbols may be used throughout this manual to alert you to important safety hazards and precautions.

Explosive

Fuels and their vapors are extremely explosive if ignited.

Flammable

Fuels and their vapors are extremely flammable.

Electricity

High voltage exists in, and is supplied to, the device. A potential shock hazard exists.

Turn Power Off

Live power to a device creates a potential shock hazard. Always turn power off to the device and associated accessories when servicing the unit.

No Smoking

Sparks and embers from burning cigarettes or pipes can ignite fuels and their vapors

No Open Flames

Open flames from matches, lighters, welding torches, etc. can ignite fuels and their vapors.

No Power Tools

Sparks from power tools (such as drills) can ignite fuels and their vapors.

No Vehicles

Moving vehicles in the area during service can create a potential for personal injury to you or others. Sparks from starting vehicles can ignite fuels and their vapors

No People in the Area

Unauthorized people in the area during service can create a potential for personal injury to you and them.

Use Safety Barricades

Unauthorized people or vehicles in the work area are dangerous. Always use safety cones or barricades, safety tape, and your vehicle to block the work area.

Wear Eye Protection

Fuel spray from residual pressure in the lines can cause serious eye injuries. Always wear eye protection.

Injury

Careless or improper handling of materials can result in bodily injury.

Gloves

Wear gloves to protect hands from irritation or injury.

Collect Fuel In Approved Containers

NFPA-30A, Section 2, requires use of approved containers to collect, transport and dispose of fuel.

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.

LLD-300 System

The LLD-300 System consists of the LLD-300 Console which is mounted indoors; a Wireless Pressurized Line Leak sensor which is installed in the STP (for installations with Red Jacket pumps, some models of the console will require a Veeder-Root SwiftCheck valve which is also installed in the STP).

WPLLD Sensor and SwiftCheck Valve

The WPLLD sensor and the SwiftCheck valve are not field repairable and must be replaced if faulty.

High Altitude Installation Precaution for the WPLLD Sensor

The WPLLD sensors are equipped with a vent screw to equalize internal pressure. If the site's altitude is above 2,000 feet and this vent screw was not opened prior to the sensor's installation it could be transmitting inaccurate pressure readings. Remove the sensor from the STP and open the vent screw at least two turns, but not more than three turns to vent any internal pressure (Figure 9, page 27, V-R manual no. 577013-546). Retighten the vent screw securely to prevent water from entering and replace the sensor in the pump.

LLD-300 Console Components

The console contains two removable assemblies – a Power Supply board and a CPU board.

Power Supply Board

The Power Supply Board contains the following circuitry:

❑ Controller
❑ WPLLD signal processing
❑ 8-volt switching power supply
❑ LED indicators
❑ RS-232 driver circuit
❏ Beeper
❏ Transistor output (dc switch)

Figure 1 locates various components on the Power Supply Board which is mounted in the console.
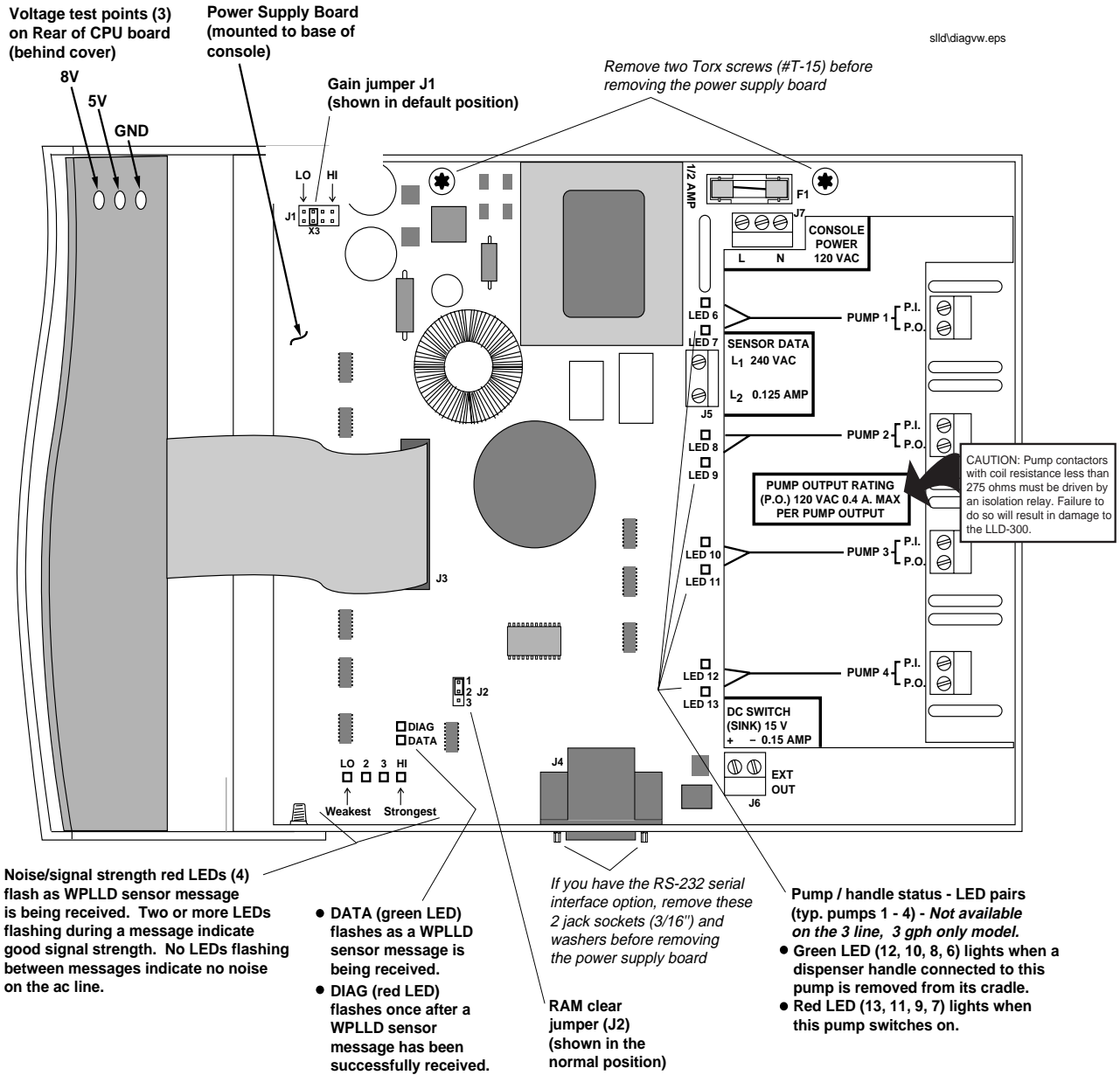

Figure 1. Power Supply Board Component Locations

CPU Board

The CPU board contains the following circuitry:

❑ EEPROM

❑ PROM (replaced for software upgrades)

❑ RAM

❑ 16-character display

❑ LED indicator

❑ Processor

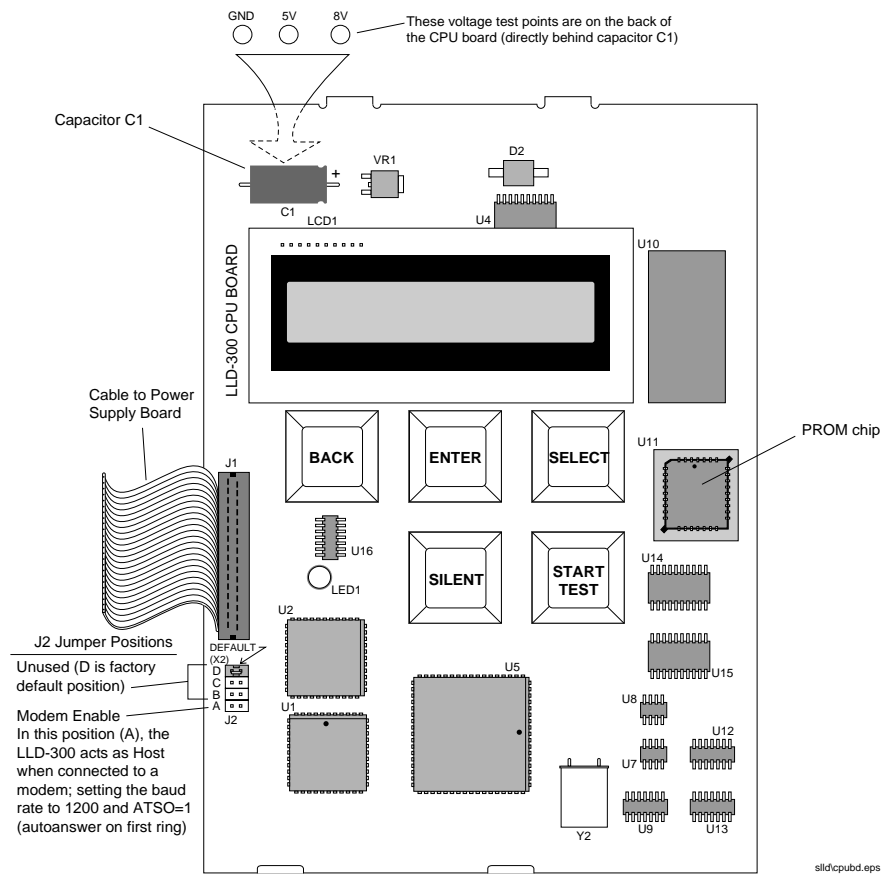Figure 2 shows various components on the CPU board which is located in the door of the LLD-300 Console.

Figure 2.　CPU Board Components

Line Leak Tests

Line leak tests are controlled by the LLD-300 software and are determined passed or failed after analyzing two sets of pressure measurements recorded by, and transmitted from, the WPLLD sensor.

Each time a sensor is powered up, it records and transmits a number of pressure readings spaced over a fixed amount of time. In pump-off tests, the first pressure reading from each measurement set is used. In pump-on tests 2 pressure readings from each measurement set are used (the software calculates which two, based upon line length and type entered during setup, and whether a 0.2 or 0.1 gph test is being run).

3 gph Leak Test

The 3 gph (gross) leak test is a pump-off test that is run after every dispense. The total time required for this test is approximately 45 seconds.

Two pump-off pressure measurements are used in this test. The 3 gph test fails if the second measurement is not within 5 psi of the first, or if the pressure readings are less than 10 psi. If a 3 gph test fails it is rerun, and if it fails again, the line is shutdown.

0.2 gph Leak Test

The 0.2 gph (periodic) leak test is a pump-on test that can be programmed to run monthly or continuously, or it can be started manually. All 0.2 gph tests are automatically preceded by a 3 gph test (there is a 15 minute delay between the 3 gph and 0.2 gph tests).

The 0.2gph test involves multiple pump on and pressure measurement periods of less than 1 minute spaced 15 minutes apart.

The minimum time required for the 0.2 gph test to run is approximately 30 minutes (2 cycles). The maximum time is indefinite (thermal dependent).

However after the first pump cycle, the system runs a mid-range test that can detect leaks in the range of about 0.8 gph or larger. The test fails if the second measurement is not within 5 psi of the first. The total time required for this test is approximately 65-70 seconds.

If the mid-range test fails, both a 3 gph and a 0.2 gph test failure are posted.

The method used to pass or fail a 0.2 gph test is more involved than that used in the 3 gph or mid-range tests. In the 3 gph tests, the software compares the first pressure reading in two sets of measurements and looks for a 5 psi difference between them. In the 0.2 gph test the software is looking for a very small difference between two pressures from each set of measurements, plus the rate of change between the two pressures from each set.

When the first set of measurements are received, the software stores the values of the two pressures it will use in the test and calculates a pressure decay rate (Ramp) in psi/second (i.e., rate of change of pressure in the two pressures, divided by the time between them).

When the second set of measurements are received, the software calculates a Ramp value of these latest two pressures and compares it to the stored Ramp value from the previous measurement. At least two measurements are required.

If the current and stored Ramp values are not within allowable limits, this indicates that the line is still thermally active, and and additional test cycles are scheduled. This continues until a satisfactory level of thermal stability is achieved.

When the current and stored Ramp values are within allowable limits, the difference between the two pressures is used to determine the leak rate.

The line will shut down after a failed 0.2 gph test if programmed to do so.

0.1 gph Leak Test

The 0.1 gph (annual) leak test is a pump-on test that is manually started. A 0.1 gph test will always be preceded by a 3 gph and a 0.2 gph test. The 0.1 gph test looks for a leak equivalent to six drops of liquid every 10 seconds.

The minimum time required for the 0.1 gph test to run is approximately 45 minutes. The maximum time is indefinite (thermal dependent).

Where the 0.2 gph test looks at two pressure readings a certain time apart in each set of measurements, the 0.1 gph looks at two pressure readings a longer time apart. Otherwise, the software determines if a 0.1 gph test passes or fails exactly the same way as it does a 0.2 gph test.

The line will shut down after a failed 0.1 gph test if programmed to do so.

Troubleshooting

Warm Boot Messages

Every time power to the LLD-300 is switched off and on, the software runs self-diagnostics and then displays the results of the tests:

Test Passed	Test Failed	Action (If Failed)
RAM TEST - OK	RAM FAIL	Replace CPU board
ROM TEST - OK	ROM FAIL	" " "
WARM BOOT		
STARTUP COMPLETE		

When the warm boot completes the system returns to the Main Screen (MM/DD/YY HH:MM or All LINES NORMAL depending on which LLD-300 model you have).

Alarm Messages

LLD-300 Alarms	Result	Refer To Troubleshooting Chart
3 FAIL	Flashing Red LED, beeper starts, will shut down line	page 10
2 FAIL	Flashing Red LED, beeper starts, will shut down line if programmed to do so	page 12
1 FAIL	Flashing Red LED, beeper starts, will shut down line if programmed to do so	page 12
COMM ALARM	Flashing Red LED, beeper, will shut down line	page 10
CONT PMP ALM	Flashing Red LED, beeper starts	page 11
MONTHLY WARN	Red LED lights	page 11
SHUTDOWN (not displayed	RS-232 output - posted when one of the above alarms occurs	n/a

Alarm Message Troubleshooting Chart

Table 1 lists LLD-300 alarm messages and some suggested corrective procedures.

Important ☞ When measuring the pressure in the line for comparison with pressure transducer readings, always install the pressure gauge DOWNSTREAM of the Check Valve (for example, at the dispenser emergency shut-off valve). DO NOT measure pressure at the pump head.

Table 1. LLD-300 Troubleshooting

Alarm Message/ Indicator*	Description	Possible Causes	Suggested Actions
3 FAIL	3 gph line leak test failure: line leak greater than 3 gph; dispensing halts while alarm is active.	Valve leakage or leak in pipeline or dispenser.	• Inspect all visible areas of pipeline, dispenser piping, and submersible pump for leakage. • Retest line to confirm failure, then close line shut-off valve (if present) and retest: If it passes, open line shut-off valve and close all dispenser emergency shut-off ("crash") valves. If it then fails, the line may be leaking. If it passes, open the shut-off valves, one at a time, and continue testing until leakage recurs. This will identify suspect dispenser. Check dispenser piping and fueling solenoid valve; repair/replace as required. If it fails with line shut-off valve closed, either there is a line leak between the ball valve and check valve or the check valve is leaking. Replace check valve as required. • Check submersible pump pressure using a pressure gauge to verify that pump is working.
		Failed dispenser switch.	Verify that all dispenser switches, when actuated, are recognized by lifting dispenser handles while watching Pump-In green LEDs # 6, 8,10, & 12 flash (Figure 1)*. (see Missing Pump-In Signal Note on page 12.)
		Leaking solenoid valve in dispenser.	Close shut-off valve on each dispenser to isolate leaking valve. Replace valve.
		Contactor sticking, stuck on.	Replace Contactor.
COMM ALARM Before alarm is issued, condition must exist for one hour after last passed 3 gph test on this line.	*Alarm on one line only.* Line is disabled; no test can be run until communications are restored.	Failed/sticking pump contactor.	• Check that Pump/handle status - LED pairs on Power Supply board, turn on as described in Figure 1.* • Check pump contactor. • Check submersible pump pressure using a pressure gauge.
		Contactor for STP does not pull in when test is started; pump does not switch on.	Turn on the STP contactor box relay switch. Check for 120 Vac on P.O. (pump output) control wire of questionable pump and/or watch Pump-On red LEDs # 7,9,11, or 13 flash (Figure 1)* after corresponding Pump-In green LED flashes. Check power across Sensor Data terminals L_1 and L_2 (240 Vac) of terminal block J5 on Power Supply board. Replace relay; pump contactor has failed. Verify correct wiring to LLD-300 Console. Replace Power Supply board.
		Contactor for STP pulls in when test is started; pump does not switch on.	Check the 240 Vac circuit breaker for this line's STP. If there is 240 Vac power leaving the pump contactor, check the field wiring.
		Contactor for STP pulls in when test is started and pump switches on, but individual line leak sensor will not communicate.	• Pump contactor sticks; replace contactor. • Check wiring of WPLLD sensor at the submersible pump. • Replace WPLLD sensor.
		Contactor on continuously.	Replace Contactor.

*Pump In/Out LEDs not available on 3 line, 3 gph model.

Table 1. LLD-300 Troubleshooting (Continued)

Alarm Message/ Indicator*	Description	Possible Causes	Suggested Actions
COMM ALARM (continued)	*Alarm on more than one line.* Lines are disabled; no tests can be run until communications are restored.	Contactors for STPs do not pull in when test is started; pumps do not switch on.	• Check console power for 120 Vac across terminals Ll and N of J7 on Power Supply board. • Check fuse F1 on Power Supply Board.
		Contactors for STPs pull in when test is started; pumps do not switch on.	• Verify that all breakers are switched on. • Check to see if emergency stop is engaged.
		Contactors for STPs pull in when test starts and pumps switch on, but none of the noise/ signal LEDs on the power supply board are lit.	• Check power across Sensor Data terminals L_1 and L_2 (240 Vac) of terminal block J5 on Power Supply board. • Check pump control wiring in the "Wiring Pumps to the Console" section of the *LLD-300 Installation and Operation Manual*.
		Contactor for STP pulls in when test starts and pump switches on, but less than two of the noise/ signal strength LEDs on the power supply board are lit.	• Refer to the procedure under "Verifying WPLLD Communications" in the *LLD-300 Installation and Operation Manual*. • Replace Power Supply board.
		Pump control works correctly and LLD-300 Console shows good signal strength.	• Check programming of console (refer to *LLD-300 Site Preparation and Installation Manual*).
		Pump control works correctly, LLD-300 Console receives data.	• During a test, verify that the DATA (green) LED on the Power Supply board flashes as described in Figure 1. If not, replace the Power Supply board.
CONT PMP ALM	A dispense request signal is continuously active for a period exceeding 8 hours.	Failed dispenser switch	• Check dispensers for switch that always shows dispenser on. Repair as required.
MONTHLY WARN	The system failed to perform a periodic (0.2 gph) test in the programmed number of days. Dispensing halts if programmed to do so.	Not enough idle time to complete 0.2 gph test.	Check test history to determine if periodic tests are failing; if they are, follow procedures outlined below for 2 Fail alarms.
		Tests aborted due to pressure readings below 22 psi with pump on.	Verify that pump is producing more than 22 psi by checking pressure reading with pump on. If possible, adjust check valve pressure to 20-25 psi. Replace pump if necessary.
		Failed dispenser switch.	Repair as required.

Table 1. LLD-300 Troubleshooting (Continued)

Alarm Message/ Indicator*	Description	Possible Causes	Suggested Actions
2 FAIL	0.2 gph line leak test failure: line leak greater than 0.2 gph; dispensing halts while alarm is active only if pro-grammed to shut down for 0.2 gph leak.	Valve leakage or leak in pipeline or dispenser.	• Inspect all visible areas of pipeline, dispenser piping, and submersible pump for leakage. • Check pump circuit breaker, and relay box switch (if used). • Retest line to confirm failure: If it fails, close all dispenser emergency shut-off ("crash") valves. If it still fails, the line may be leaking. If it passes, open the shut-off valves, one at a time, and continue testing until leakage recurs. This will identify suspect dispenser. Check dispenser piping and fueling solenoid valve; repair/ replace as required. If the line passes when retested, the cause of 0.2 gph line failures may be difficult to isolate. Consult Technical Support for further assistance.
		Leaking solenoid valve in dis-penser.	Close impact valve on each dispenser to isolate leaking valve.
1 FAIL	0.1 gph line leak test fail	Tests aborted due to pressure readings below 22 psi with pump on.	Verify that pump is producing more than 22 psi by checking pressure reading with pump on.
		Valve leakage or leak in pipeline or dispenser.	• Inspect all visible areas of pipeline, dispenser piping, and submersible pump for leakage. • Check pump circuit breaker and relay box switch (if used). • Retest line to confirm failure: If it fails, close all dispenser emergency shut-off ("crash") valves. If it still fails, the line may be leaking. If it passes, open the shut-off valves, one at a time, and continue testing until leakage recurs. This will identify suspect dispenser. Check dispenser piping and fueling solenoid valve; repair/ replace as required. If the line passes when retested, the cause of 0.1 gph line failures may be difficult to isolate. Consult Technical Support for further assistance.
		Leaking solenoid valve in dis-penser.	Close impact valve on each dispenser to isolate leaking valve.

Missing Pump-In Signal Note:

PROBLEM: Dispensers use a variety of methods, including mechanical switches, to generate the pump handle signal. Over time, dispenser switch contacts may limit voltage required to activate the pump-in circuit. When this happens, the LLD-300 pump-in circuit, which was designed to draw very little current, no longer draws enough to sense when the dispenser switches on.

Power up the system and activate the suspect dispenser's handle. With a DVM, measure the AC voltage between that dispenser's pump-in signal (P.I.) terminal and the Console Power neutral (N) terminal. Under normal conditions, the reading is between 105 and 125 Vac. If the measurement is between 70 and 95 Vac, the problem may be caused by switch contacts.

SOLUTION: Connect a spare pump relay to the pump-in signal circuit. The spare pump relay creates a larger load, draws more current through the dispenser switch, and provides the pump-in circuit with a handle-on signal of sufficient voltage to activate the STP.

The pump relay must be mounted in a suitable enclosure. Connect one side of each pump relay coil to each P.I. signal terminal. Connect the other side of the each relay coil to neutral. The spare relay contacts are not used.

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. Disconnect the CPU board cable from the Power Supply board. Remove the CPU board following the instructions in "CPU Board" on page 6.

3. Locate the PROM chip on the board [Figure 2].

4. Remove the PROM chip following instructions in Figure 5.

5. Replace the PROM chip following instructions in Figure 6.

6. Replace the CPU board in the front door of the LLD-300. Connect the CPU board cable to J3 on the Power Supply board.

7. Follow the instructions in "Cold Boot Procedure".

Chip socket

Removable chip

Chip removal slots

Chip Removal Tool
(Part No. 576036-022,
or equivalent)

Incorrect
Angle

Correct
Angle

Chip socket

INCORRECT
ANGLE

CORRECT
ANGLE

Tool

Tool

Cutaway of
chip in socket

Hook down too
far and rests in
socket indent

Hook in correct
position under chip

When you rotate
tool, you will crack
the chip socket.

When you rotate tool,
you will lift the corner
of the chip out of the
socket (alternate
between two chip
removal slots)

consoles\h8remov1.eps

Chip Removal Tool
(Digikey Part No. K293-ND,
or equivalent)

Lifting hooks

Chip socket

lifting hooks
go down in
slots and under
chip until tool
rests on socket

As you squeeze
the sides of the
removal tool with
your hand, the
hooks will lift the
chip out of the
socket.

Lift up chip when
it is free from
socket.

Figure 5. Removing PROM Chip

LLD-300 CPU BOARD

C1   LCD1
VR1
D2
U4
U10
U11
BACK   ENTER   SELECT
J1
U16
LED1
SILENT   START TEST
U2
U14
DEFAULT (X2)
D
C
B
A
J2
U1
U5
U15
U8
U12
U7
Y2
U9   U13

1) Orient PROM so that the small indented dot on top of the chip is on the same side with the small triangle embossed in the socket's base; or,
2) If the chip is covered with a label you can also orient the chip correctly if you insert the chip in the socket with its angled corner in the same angled corner of the socket.
3) Carefully align the chip's pins with the socket's pins. (If you have the pins aligned correctly, the chip will seem to drop into the socket.) Then push down firmly and evenly on the chip until it snaps into the socket.
4) Check to see that all pins are in place and none are bent.

slld\cpuprm.eps
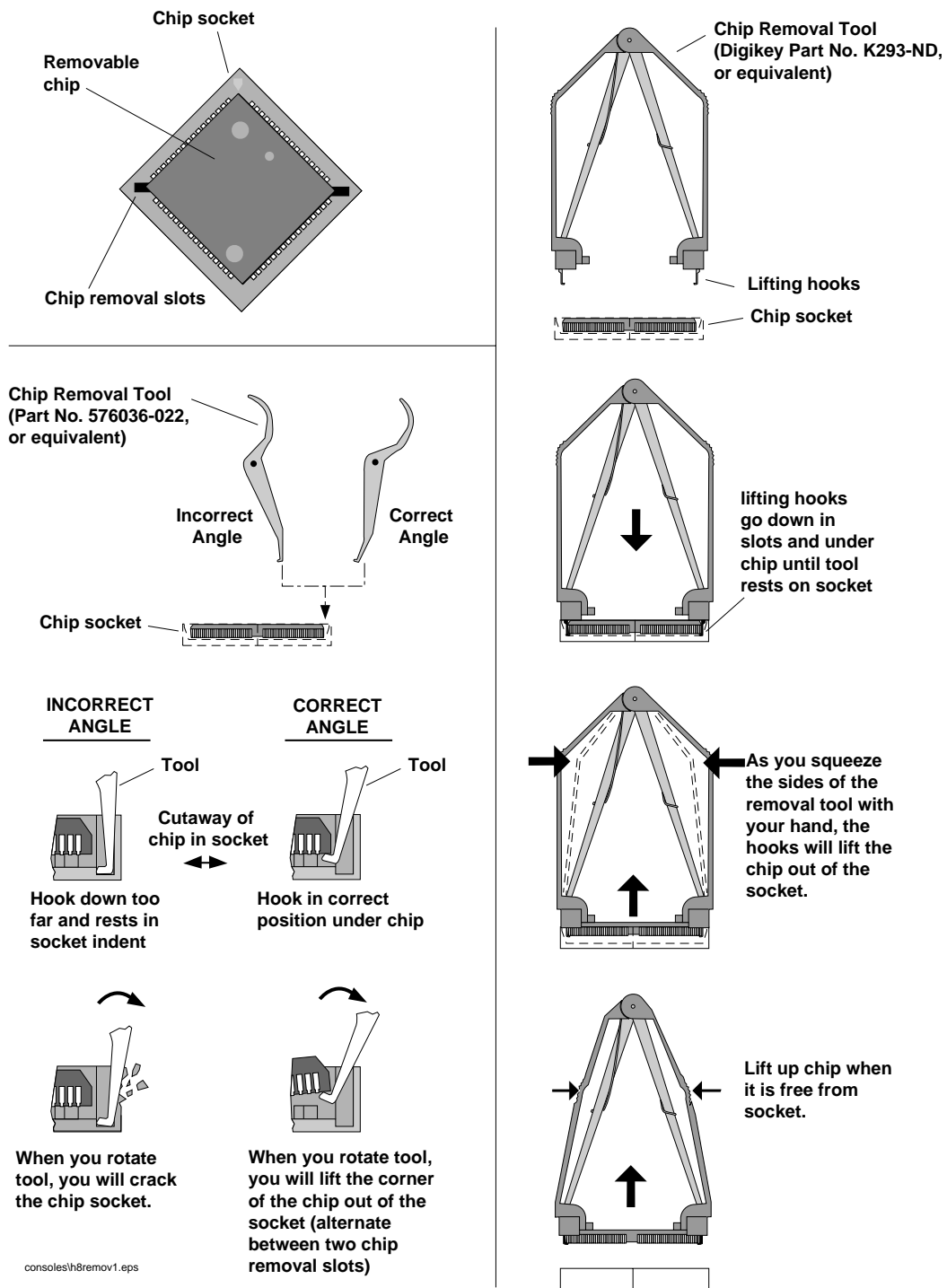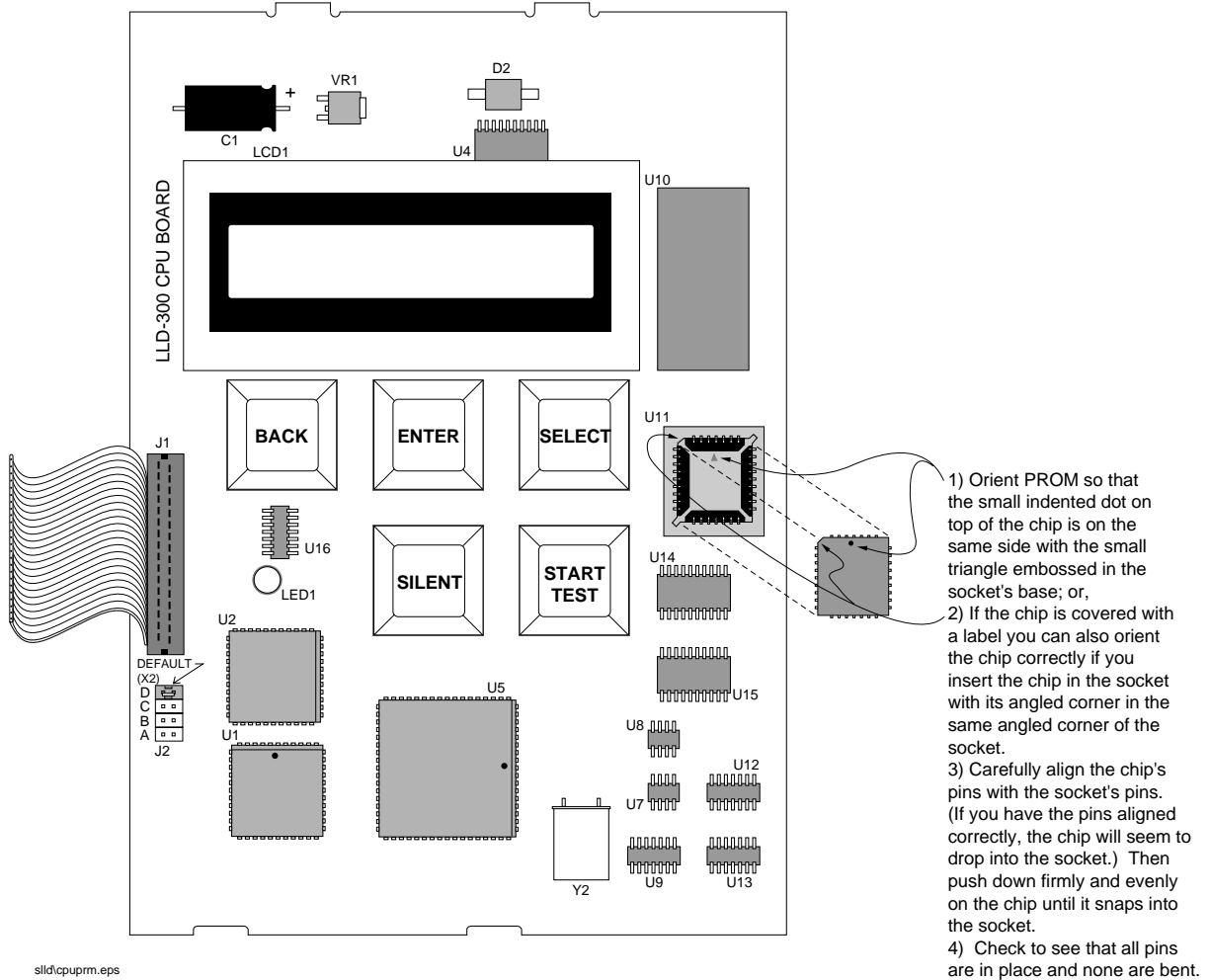
Figure 6. Replacing PROM Chip

Replacing the CPU Board

The CPU board must be replaced if:

❑ If one of the system self-tests fails during a warm boot [page 9] or a cold boot;

❑ The display contains garbled messages and the voltage between the GND and 8V test points [Figure 2] on the back of the CPU board is within 7 - 9 Vdc; or,

❑ The voltage between the GND and 5V test points [Figure 2] on the back of the CPU board is not within 4.75 - 5.25 Vdc.

1. Turn off power to the system. Disconnect the CPU cable from the Power Supply board.

2. 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.

3. Replace the CPU board reversing the above steps.

4. Perform a cold boot of the system.

Cold Boot Procedure

A cold boot of the system is required after installing a software upgrade, after replacing the CPU board, or if you want to clear console historical data or setup parameters.

Turn off power to the console. Open the console front door and locate the RAM clear jumper J2 [Figure 1]. Move the jumper to pins 2 and 3. Turn on power to the console. The display will read RAM CLEAR, then begin a cold boot while displaying these status messages:

Test Passed	Test Failed	Action (If Failed)
RAM TEST - OK	RAM FAIL	Replace CPU board
ROM TEST - OK	ROM FAIL	" " "
COLD BOOT		
EEPROM TEST - OK	EEPROM FAIL	" " "
CALCLK - OK*	CALCLK FAIL	" " "
NVRAM TEST - OK*	NVRAM FAIL	" " "
STARTUP COMPLETE		

*These self-tests occur in 0.2 and 0.1 gph models only

If you leave the jumper in position 2-3, the console will continue to cycle through the RAM CLEAR and cold boot messages. Turn off power to the console. Move Jumper (J2) back to the 1-2 position. Turn on power to the console. The console will run the

cold boot procedure and return to the Main Screen (MM/DD/YY HH:MM or All LINES NORMAL depending on which LLD-300 model you have).

Reprogram the system following the setup procedure in the LLD-300 Installation, Setup, and Operation Manual (V-R No. 5776013-546).

Important ☞ **When you finish the setup procedure, a 3 gph test must be run on each line before the system becomes operational and the site can pump fuel.**

Return to the Main Screen and press the START TEST to button to initiate the line leak tests. A 3 gph test will automatically run on all of the lines. If the LLD-300 model has the 0.2 gph option, a 0.2 gph test will automatically follow the 3 gph test. If the LLD-300 model has the 0.1 gph option, and you press and hold the START TEST key for 3 seconds (you will hear the beeper), the 0.2 gph test will be followed by a 0.1 gph test.

During the tests the display will read TEST L: 1 2 3 4. As tests for a line are completed, that line's number will disappear from the screen. When all tests are complete, the display will either return to the Main Screen or display a test failed alarm.

Overriding the Automatic 0.2 gph Test

The time required to run a 3 gph test is approximately 45 seconds. The time required to run a 0.2 gph test is at least 30 minutes (the time required to run a 0.1 gph test is at least 30 minutes also). If there is an urgent need to get the site up and running, you can run the mandatory 3 gph test on all lines and then manually override the 0.2 gph test on the lines.

In this discussion, the LLD-300 is assumed to be monitoring 4 lines and have at least 0.2 gph test capability.

1. Perform the cold boot [page 40] and programming procedures[page 44] in the LLD-300 Installation, Setup, and Operation Manual (V-R No. 5776013-546).

2. With the Main Screen displayed, press the START TEST key. The display will read TEST L: 1 2 3 4. Within 8 seconds all lines will have started the 3 gph test and within another 45 seconds, all lines should have passed their 3 gph tests.

3. Press ENTER once then press SELECT until the display reads L1 DIAGNOSTICS; press ENTER and the display reads L1 E1 T2 P0 (or P1) H0. T2 indicates the test underway is a 0.2 gph test and E1 indicates the line is enabled (the 3 gph test passed). Ensuring that the dispenser handles are in their cradles (H0), press START TEST to turn off the 0.2 gph test in progress on Line 1 (the display will now read L1 E1 T0 P0 (or P1) H0.

4. Press BACK and the display reads L1 DIAGNOSTICS. Press SELECT and the display reads L2 DIAGNOSTICS. Following the procedure in steps 3 and 4, to abort the 0.2 gph tests on the remaining lines.

5. Now that all lines have been enabled (E1), you can return to the Main Screen.

The Override test procedure can also be used to abort any 0.2 gph or 0.1 gph test in progress (T2 or T1). Just go to step 3 above, press SELECT until the particular line's diagnostic screen is displayed, press ENTER then START TEST to stop the test (T0).

Replacing the Power Supply Board

The Power Supply board must be replaced when:

❑ WPLLD sensor data is not being processed

❑ Dispenser inputs are received but not processed

❑ Pump contactors are not being turned on

❑ The voltage between the GND and 8V test points [Figure 2] 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 wiring inputs to the Power Supply board.

4. The Power Supply board is supported on the bottom of the board by two tabs that are inserted into slots in the bottom of the console, and supported on its two sides by detents that extend out from the sides of the console, and on the top by two PEM studs attached to the base of the console.

   The board is secured by two T-15 Torx screws on either side of the transformer which screw into the two PEM studs. If the LLD-300 has the optional RS-232 serial interface, the two screw locks which go through the bottom of the console into the DB9 connector must be taken out before removing the board.

   After removing the Torx screws (and screw locks), slowly lift up on the board holding the transformer, 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.Follow the instructions in "Powering Up The System", beginning on page 40 of the Installation, Seetup, and Operation manual (V-R no. 577013-546).

Fuse F1

If the 120 Vac console power circuit breaker is on, but the display doesn't come on, check console fuse F1 [Figure 1]. Turn off power, test fuse, replace if necessary.

Visually Checking System Operation

You can visually check various LEDs on the Power Supply board to see if the system is correctly processing, dispenser inputs, pump commands, sensor messages, and scheduling tests.

1. Turn off power to the system. Check that all wiring connections are correct between the sensors, dispensers, and console and that the system setup procedure was performed (ref. V-R manual 577013-546).

2. Open the console front door. Locate the Pump/handle status LED pairs for each line (LED 6 handle & LED 7 pump on for pump 1, etc. - these LEDs not available on 3 line, 3 gph only model). Locate the Noise/signal strength red LEDs (4). Locate the DATA and DIAG LEDs.

3. Turn on power to the system.

4. **3 Line, 3 gph only model**

    Have an assistant go to any dispenser on line 1. Have the assistant lift the handle. In about 10 seconds that pump's sensor will transmit its first message (approximately 0.5 seconds long), causing some or all of the Noise/signal strength red LEDs and the green DATA LED to flash as the message is received. The red DIAG LED flashes once if messagewas successfully received by the software.

    All other Models

    Have an assistant go to any dispenser on line 1. While watching line 1's Pump/handle status LEDs, have the assistant lift the handle. The green handle status (P.I.) LED (LED 6) will turn on, followed within 2 seconds by the red Pump- on (P.O.) LED (LED 7) turning on. Eight seconds later that pump's sensor will transmit its first message (approximately 0.5 seconds long), causing some or all of the Noise/signal strength red LEDs and the green DATA LED to flash as the message is received. The red DIAG LED flashes once if messagewas successfully received by the software.

5. You can repeat this same procedure for each of the lines to visually observe the proper operation of the entire system.

Using the Diagnostic Menu

The Diagnostic Menu is accessed from the front panel of the console. From the Top Level menu press SELECT until the display reads DIAGNOSTICS [Figure 7].

Units of measurement shown Figure 7 are in U.S. units. Metric equivalents (e.g., kPa instead of psi) will appear if metric units are selected during system setup.

DIAGNOSTICS

Line status where:
E = 0 (line disabled), E= 1 (line enabled),
T = test in progress (0 = none, 3, 2, 1),
P = 0 (pump off), = 1 (pump on),
H = 0 (handle off), = 1 (handle on).

LX E1 T0 P1 H1

From this screen you can press START TEST to stop tests on this line, or press START TEST to initiate tests on this line

Software I.D.

349768-001-A

ENTER

Feature set of Console
NUM L = # of lines (3 or 4); T = line tests
available always 3, 0.2 [2] & 0.1 [1] optional.
(0.2 & 0.1 gph tests not available for Flex lines.)

NUM L-3 T- 3 2 1

SELECT

LX DISPENSING

Test Activity Messages

DISPENSING = Current line's activity
PENDING   = Waiting to start a test
PRESSURIZE = Line is being pressurized
DECAY = Waiting for pressure measurement
MEASUREMENT = Pump on, sensor is recording/
                            transmitting messages

L1 DIAGNOSTICS

SELECT

Last 3 gph test P1, P2 pressures
in psi (kPa if metric) for this line

SELECT

LX 3 +XXX +XXX

ENTER

Last 0.2 gph test P1, P2 pressures
in psi for this line -
(Date/Time Models only)

L2 DIAGNOSTICS

SELECT

SELECT

LX 2 +XXX +XXX

Last 0.1 gph test P1, P2 pressures
in psi for this line - (Date/Time Models
with 0.1 gph option)

ENTER

SELECT

LX 1 +XXX +XXX

L3 DIAGNOSTICS

SELECT

Last MID test P1, P2 pressures
in psi for this line

ENTER

SELECT

LX M +XXX +XXX

L4 DIAGNOSTICS

SELECT

Ramp rates (DP/DTime)(10^3) in psi/sec
of current test for this line; first one is
the most recent.

ENTER

SELECT

LX R +XXX +XXX

DIAGNOSTICS

SELECT

Serial number of the
WPLLD sensor
for this line

Press SELECT until
you return to the
Main Screen

SELECT

LX SER NO XXXXXX

Total number of sensor messages
received for this line

SELECT

LX CNT XXXXXX

Total number of sensor messages
rejected by Cyclic Redundancy
Checks (CRC) for this line

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LX DIAGNOSTICS
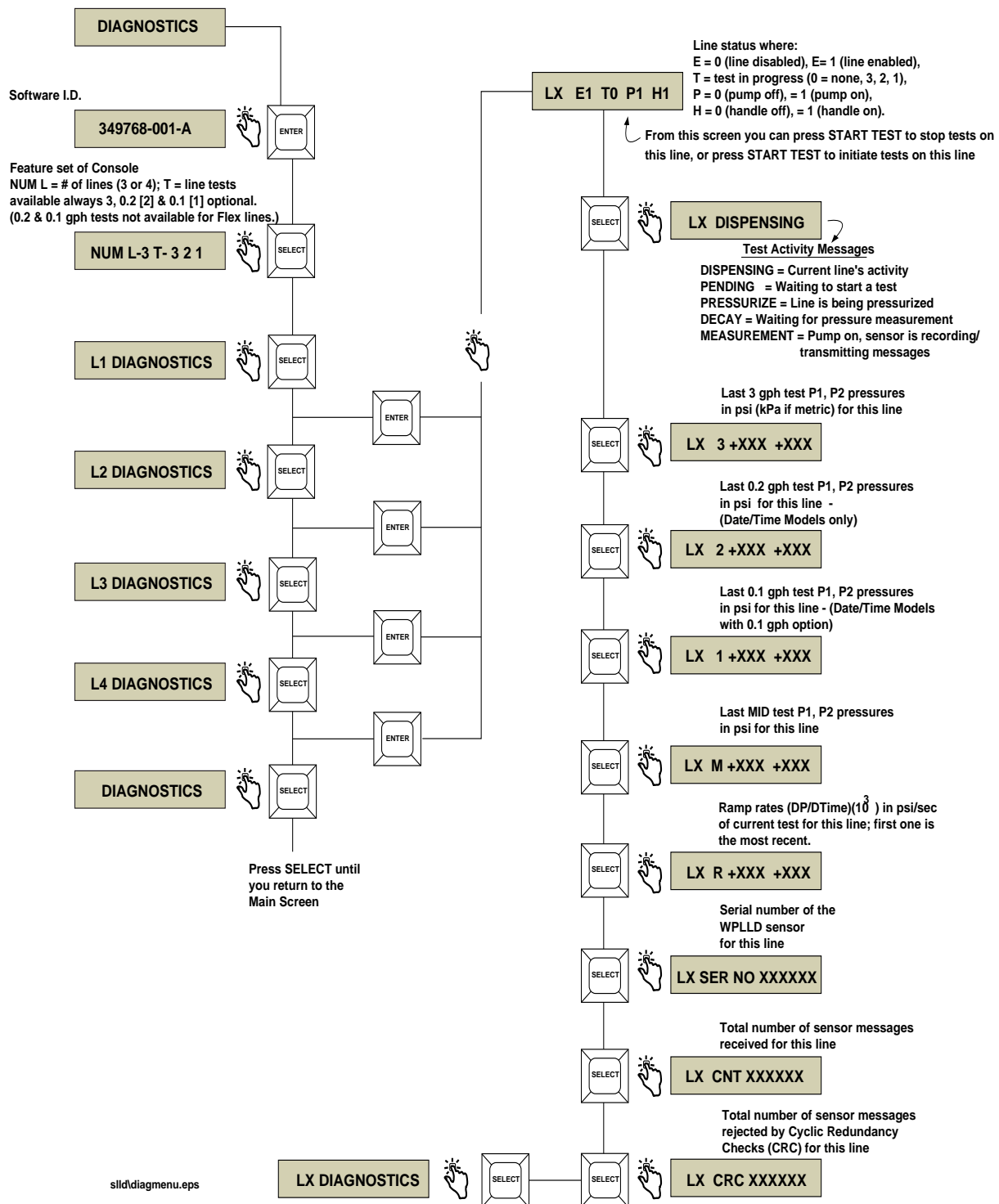
SELECT

SELECT

LX CRC XXXXXX

Figure 7. Diagnostic Menu

LLD-300 System Specifications

Physical Specifications

Console
- ❑ Width (door closed): 7.62" (door open 9.62")
- ❑ Height: 6.75"
- ❑ Depth (door closed): 2.62" (door open 9")
- ❑ Weight: 3.5 lbs.
- ❑ Two PC boards in console: CPU (in door) and Power Supply (in unit)

WPLLD Sensor
- ❑ Pressure range: 0 - 70 psig
- ❑ Output: 4-20 mA
- ❑ Repeatability: ±0.5% F.S., at constant temperature and pressure: includes hysteresis
- ❑ Accuracy: ±0.5 psi, ±5% of reading at room temperature
- ❑ Operating Temperature: -40 to +150°F
- ❑ Storage Temperature: -40 to +165°F
- ❑ Humidity: 100% RH, non-condensing
- ❑ Proof Pressure: 200 psi
- ❑ Burst Pressure: 250 psi
- ❑ Immersion: 8 feet of water or gasoline

SwiftCheck Valve (if used)
- ❑ Operating Pressure: 0 - 50 psig
- ❑ Proof pressure: 100 psig
- ❑ Burst pressure: 250 psig

Environmental Specifications
- ❑ Console storage and operation: indoor, climate controlled

Electrical Specifications
- ❑ Console operating voltage: 120 Vac, 2 A max.

Software Specifications

❑ Four system interface modes, via front panel keys: Operating (Top Level), History, Setup, Diagnostic

❑ System, test, and alarm messages posted to front panel display and to optional RS-232 serial interface connector

❑ System, test, and alarm messages and all histories (0.2 gph and 0.1 gph models) are stored in battery-backed RAM

❑ System Setup information and line test pass/fail status are stored in EEPROM

❑ System software in a snap-in PROM chip

❑ RAM clear jumper

RS-232 Serial Interface (Optional)

❑ Connector: DB9

❑ Settings: 1200 baud, 7 data bits, Odd parity, 1 stop bit

❑ Veeder-Root RS-232 command protocol format (includes some RS-232 serial commands that are only for the LLD-300)

❑ The complete compliance and diagnostic history lists will be available through the RS-232 serial interface.

Signal Input Specifications

❑ Pump In (P.I.): 120 Vac, 0.1 A max. (from dispenser)

❑ Sensor Data: 240 Vac, 0.125 A (pump ac)

Signal Output Specifications

❑ Pump Output (P.O.): 120 Vac, 0.4 A (to pump contactor)

CAUTION: Pump contactors with coil resistance of less than 275 ohms must be driven by an isolation relay. Failure to do so will result in damage to the LLD-300.

❑ Ext. Out DC Switch: rating 5-15 Vdc, 0.15 A

Front Panel User Interface

❑ 16-character, single line, LCD display

❑ Visible annunciator (bi-color LED)

    ❑ Green - all functions normal

    ❑ Flashing red - line leak alarm active

❑ Steady red - warning
❑ Push buttons
  ❑ SELECT
  ❑ ENTER
  ❑ BACK
  ❑ SILENCE
  ❑ START TEST
❑ Audible annunciator: internal beeper

Leak Testing

❑ Tests performed: 3 gph (gross), optional 0.2 gph (periodic), and optional 0.1 gph (annual)
❑ Tests initiated automatically or manually
❑ Single line tests only (tests on dual or manifolded lines not supported)
❑ Line type: steel or fiberglass
❑ Line length: steel 30 - 499 feet; glass 30 - 350 feet

RS-232 Serial Interface - Optional

Interfacing the LLD-300 Console by RS-232 serial communication is done through the DB9 connector on the bottom of the unit. For more information on the command format, consult Veeder-Root's Serial Interface Manual (Part No. 576013-635).

DB9 Connector Pin-Outs

Pin layout to connect the LLD-300's Serial Interface DB9 connector to a 25-pin computer terminal connector are shown in Figure 8. These connections are standard for "AT" style modem cables..

	LLD-300 (DB-9 Connector)			Computer Terminal (DB-25 Connector)	
N/C	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

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Figure 8.   DB-9, RS-232 Pin-Outs

RS-232 Serial Interface Port Settings

Transmission rate and data frame structure required for RS-232 communication with the LLD-300 are:

❑ 1200 baud

❑ 7 data bits

❑ Odd parity

❑ 1 stop bit

RS-232 Serial Commands

Control Functions

Operational Reports

Setup Commands

Diagnostic Commands

RS-232 Serial Command Formats

Function Code: **001**
Function Type: System Reset

Command Format:
Display: `<SOH>S00100`
Computer: `<SOH>s00100`

Typical Response Message, Display Format:

```
<SOH>
S00100
MAR 27, 1997 4:47 PM
<ETX>
```

Typical Response Message, Computer Format:

`<SOH>s00100YYMMDDHHmm&&CCCC<ETX>`

Notes:

1. `YYMMDDHHmm` - current date and time
2. `&&` - data termination flag
3. `CCCC` - message checksum

Function Code: 083 *Version 10*
Function Type: Start WPLLD Line Leak Test

Command Format:
Display: `<SOH>S083LL149`
Computer: `<SOH>s083LL149`

Notes:
1. 149 = verification code that must be sent to confirm the command

Typical Response Message, Display Format:

```
<SOH>
S083LL
MAR 27, 1997 3:47 PM

L 1:
STATUS: TEST PENDING
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>s083LLYYMMDDHHmmLLtt...
                    LLtt&&CCCC<ETX>
```

Notes:
1. `YYMMDDHHmm` - current date and time
2. `LL` - WPLLD line leak sensor number (decimal, 00 = all)
3. `tt` - test status
       `00` = test complete
       `01` = dispensing
       `02` = test 3
       `03` = test 2
       `04` = test aborted
       `05` = unused
       `06` = disable alarm
       `07` = test pending
       `08` = test delay
       `09` = test 1
4. `&&` - data termination flag
5. `CCCC` - message checksum

Function Code: 084
Function Type: Stop WPLLD Line Leak Test

Command Format:
Display: `<SOH>S084LL149`
Computer: `<SOH>s084LL149`

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

Typical Response Message, Display Format:

```
<SOH>
S084LL
MAR 27, 1997 3:48 PM

L 1:
STATUS: TEST ABORTED
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>s084LLYYMMDDHHmmLLtt...
                    LLtt&&CCCC<ETX>
```

Notes:

1.   `YYMMDDHHmm` - current date and time
2.   `LL` - WPLLD line leak sensor number (decimal, 00 = all)
3.   `tt` - test status
        `00` = test complete
        `01` = dispensing
        `02` = test 3
        `03` = test 2
        `04` = test aborted
        `05` = unused
        `06` = disable alarm
        `07` = test pending
        `08` = test delay
        `09` = test 1
4.   `&&` - data termination flag
5.   `CCCC` - message checksum

Function Code: 38A
Function Type: Monthly Line Test Report

Command Format:
Display: `<SOH>I38ALL`
Computer: `<SOH>i38ALL`

Typical Response Message, Display Format:

```
<SOH>
I38A00
JAN 14, 1997 8:27 AM

MONTHLY LINE TEST REPORT

L 1

DATE/          TIME        RESULT DATE CHANGE
JAN  1, 1997 4:12  PM  PASS   NO
DEC  3, 1996 11:22 PM  PASS   NO
NOV  2, 1996 1:38  AM  PASS   NO
OCT  1, 1996 3:47  AM  PASS   NO
SEP  2, 1996 5:01  AM  PASS   NO
AUG  3, 1996 10:53 PM  PASS   NO
JUL  3, 1996 11:22 PM  PASS   NO
JUN  2, 1996 1:38  AM  PASS   NO
MAY  1, 1996 3:47  AM  PASS   NO
APR  2, 1996 5:01  AM  PASS   NO
MAR  3, 1996 10:53 PM  PASS   NO
FEB  1, 1996 4:12  PM  PASS   NO
```

Typical Response Message, Computer Format:

```
<SOH>i38AQQYYMMDDHHmmLLCCYYMMDDHHmmRRSS...
                     LLCCYYMMDDHHmmRRSS&&CCCC<EXT>
```

Notes:

1. `YYMMDDHHmm` - current time of day
2. `LL` - WPLLD line leak sensor number (decimal)
3. `CC` - number of test 2 results (14 character groups) to follow (hex)
4. `YYMMDDHHmm` - test date and time
5. `RR` - test result [0 = pass, 1 = fail (decimal)]
7. `SS` - date change status [0 = no, 1 = yes (decimal)]
8. `&&` - data termination flag
9. `CCCC` - message checksum

Function Code: **38B**
Function Type: Line Leak Last Tests

Command Format:
Display: `<SOH>I38BLL`
Computer: `<SOH>i38BLL`

Typical Response Message, Display Format:

```
<SOH>
I38B00
JAN 14, 1997 8:27 AM

Line Leak Last Tests

L 1

TEST  DATE/TIME              RESULT DATE CHANGE
 3    JAN  1, 1997 4:12 PM   PASS   NO
 2    JAN  1, 1997 4:12 PM   PASS   NO
 1    JAN  1, 1997 4:12 PM   PASS   NO
```

Typical Response Message, Computer Format:

```
<SOH>i38BLLYYMMDDHHmmLLYYMMDDHHmmRRSSYYMMDDHHmmRRSSYYMMDDHHmmRRSS...
          LLYYMMDDHHmmRRSSYYMMDDHHmmRRSSYYMMDDHHmmRRSS&&CCCC<EXT
```

Notes:

1. `YYMMDDHHmm` - current time of day
2. `LL` - WPLLD line leak sensor number (decimal)
3. `YYMMDDHHmm` - test 3 date and time
4. `RR` - test result [0 = pass, 1 = fail (decimal)]
5. `SS` - date change status [0 = no, 1 = yes (decimal)]
6. `YYMMDDHHmm` - test 2 date and time
7. `RR` - test result [0 = pass, 1 = fail (decimal)]
8. `SS` - date change status [0 = no, 1 = yes (decimal)]
9. `YYMMDDHHmm` - test 1 date and time
10. `RR` - test result [0 = pass, 1 = fail (decimal)]
11. `SS` - date change status [0 = no, 1 = yes (decimal)]
12. `&&` - data termination flag
13. `CCCC` - message checksum

Function Code: **38C**
Function Type: WPLLD Line Leak Status

Command Format:
Display: `<SOH>I38CLL`
Computer: `<SOH>i38CLL`

Typical Response Message, Display Format:

```
<SOH>
I386LL
JAN 24, 1997 2:52 PM

WPLLD LINE LEAK STATUS

LINE    DISPENSING   TEST STATUS     PUMP  HANDLE
 L 1:  ENABLED      TESTING TEST 2  OFF   OFF

ACTIVE ALARMS:
PERIODIC WARN
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>i38CLLYYMMDDHHmmLLSSSSttNNaaaa...
                    LLSSSSttNNaaaa&&CCCC<ETX>
```

Notes:
1. `YYMMDDHHmm` - current date and time
2. `LL` - WPLLD line leak sensor number (decimal, 00 = all)
3. `SSSS` - status bits:
    `1` - least significant bit = dispensing enabled flag (0 = disabled, 1 = enabled)
    `2` - pump power (0 = pump off, 1 = pump on)
    `3` - dispenser handle (0 = handle off, 1 = handle on)
    `4-16` - unused
4. `tt` - Test status
    `00` = test complete
    `01` = dispensing
    `02` = test 3
    `03` = test 2
    `04` = test aborted
    `05` = line lockout
    `06` = disable alarm
    `07` = test pending
    `08` = test delay
    `09` = test 1
5. `NN` - number of active alarms to follow (hex)
6. `aaaa` - type of alarm:
    `0001` = shutdown alarm
    `0002` = test 3 line fail
    `0003` = test 2 line fail
    `0004` = test 1 line fail
    `0005` = comm alarm
    `0006` = continuous pump on alarm
    `0007` = test 2 warning
7. `&&` - data termination flag
8. `CCCC` - message checksum

Function Code: **38D**
Function Type: WPLLD Line Leak Alarm History Report

Command Format:
Display: `<SOH>I38DLL`
Computer: `<SOH>i38DLL`

Typical Response Message, Display Format:

```
<SOH>
I38D00
DEC 12, 1996  3:15 PM

WPLLD LINE LEAK ALARM HISTORY REPORT

L1:
2 FAIL     DEC 12, 1996   2:43:18  PM CLEAR
SHUTDOWN   DEC 12, 1996   2:43:18  PM CLEAR
SHUTDOWN   DEC 12, 1996   2:16:53  PM ALARM
2 FAIL     DEC 12, 1996   2:16:53  PM ALARM
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>i38DLLYYMMDDHHmmLLNNyymmddhhmmaaaaSS...
                    LLNNyymmddhhmmaaaaSS&&CCCC<ETX>
```

Notes:

1. `YYMMDDHHmm` - current date and time
2. `LL` - WPLLD line leak sensor number (decimal, 00 = all)
3. `NN` - number of alarms to follow (hex)
4. `yymmddhhmm` - date and time that the alarm occurred
5. `aaaa` - type of alarm:
      `0001` = shutdown alarm
      `0002` = test 3 line fail
      `0003` = test 2 line fail
      `0004` = test 1 line fail
      `0005` = comm alarm
      `0006` = continuous pump on alarm
      `0007` = test 2 warning
6. `SS` - active alarm state (00 = clear, 01 = alarm)
7. `&&` - data termination flag
8. `CCCC` - message checksum

Function Code: **501**
Function Type: Set Time of day

Command Format: Inquire:
Display: `<SOH>S50100YYMMDDHHmm`   `<SOH>I50100`
Computer: `<SOH>s50100YYMMDDHHmm`   `<SOH>i50100`

Typical Response Message, Display Format:

```
<SOH>
I50100
JAN 22, 1997 3:11 PM

SYSTEM DATE AND TIME
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>i50100YYMMDDHHmmYYMMDDHHmm&&CCCC<ETX>
```

Notes:

1. `YYMMDDHHmm` - current date and time
2. `YYMMDDHHmm` - year, month, day, hour and minute
3. `&&` - data termination flag
4. `CCCC` - message checksum

Function Code: **505** *Version 1*
Function Type: Set System Type & Language Flags

Command Format:		Inquire:
Display:	`<SOH>S50500UL`	`<SOH>I50500`
Computer:	`<SOH>s50500UL`	`<SOH>i50500`

Typical Response Message, Display Format:

```
<SOH>
I50500
JAN 22, 1997 3:12 PM

SYSTEM TYPE AND LANGUAGE FLAG

SYSTEM UNITS
U.S
SYSTEM LANGUAGE
ENGLISH
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>i50500YYMMDDHHmmUL&&CCCC<ETX>
```

Notes:

1. `YYMMDDHHmm` - current date and time
2. `U` - system units:
     1 = U.S.
     2 = metric
3. `L` - system language:
     1 = English
     2 = French
     3 = Spanish
4. `&&` - data termination flag
5. `CCCC` - message checksum

Function Code: **7A0**
Function Type: WPLLD Line Leak General Setup

Command Format:
Display: `<SOH>I7A0LL`
Computer: Computer format is not supported for this command

Typical Response Message, Display Format:

```
<SOH>
I7A0LL
JAN 24, 1997 2:54 PM

WPLLD LINE LEAK SETUP

L 1:REGULAR UNLEADED

PIPE TYPE:        GLASS
LINE LENGTH:      200 FEET
TEST 2 SCHEDULE:  MONTHLY
TEST 2:           ENABLED
TEST 1:           ENABLED
SHUTDOWN RATE:    3
<ETX>
```

Function Code: **7A4**
Function Type: WPLLD Line Leak Minimum Shutdown Rate

Command Format: Inquire:
Display: `<SOH>S7A4LLrr`   `<SOH>I7A4LL`
Computer: `<SOH>s7A4LLrr`   `<SOH>i7A4LL`

Typical Response Message, Display Format:

```
<SOH>
I7A4LL
JAN 24, 1997 2:55 PM

WPLLD LINE LEAK SHUTDOWN RATE

LINE    SHUTDOWN RATE
L 1     3
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>i7A4LLYYMMDDHHmmLLrr...
                    LLrr&&CCCC<ETX>
```

Notes:

1. `YYMMDDHHmm` - current date and time
2. `LL` - WPLLD line leak sensor number (decimal, 00 = all)
3. `rr` - shutdown rate
    `01` = test 2
    `02` = test 3
    `03` = test 1
4. `&&` - data termination flag
5. `CCCC` - message checksum

Function Code: **7A8**
Function Type: Set WPLLD Line Leak Pipe Type

Command Format: Inquire:
Display: `<SOH>S7A8LLzz`   `<SOH>I7A8LL`
Computer: `<SOH>s7A8LLzz`   `<SOH>i7A8LL`

Typical Response Message, Display Format:

```
<SOH>
I7A8LL
JAN 24, 1997 2:55 PM

WPLLD LINE LEAK PIPE TYPE

LINE    PIPE TYPE
L 1:    GLASS
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>s7A8LLYYMMDDHHmmLLzz...
                    LLzz&&CCCC<ETX>
```

Notes:

1. `YYMMDDHHmm` - current date and time
2. `LL` - WPLLD line leak sensor number (decimal, 00 = all)
3. `zz` - pipe type:
   `00` = none
   `01` = glass
   `02` = steel
4. `&&` - data termination flag
5. `CCCC` - message checksum

Function Code: 7A9
Function Type: Set WPLLD Line Leak Pipe Length

Command Format: Inquire:
Display: `<SOH>S7A9LLllll`   `<SOH>I7A9LL`
Computer: `<SOH>s7A9LLFFFFFFFF`   `<SOH>i7A9LL`

Notes:
1. `LL` - line leak device number (decimal, 00 = all)
2. `llll` - pipe length, feet or meters (decimal)
3. `FFFFFFFF` - pipe length, feet or meters (ASCII hex IEEE float)
4. Glass line length range - 30 to 350 feet.
5. Steel line length range - 30 to 499 feet.

Typical Response Message, Display Format:

```
<SOH>
I7A9LL
JAN 24, 1997 2:55 PM

WPLLD LINE LEAK LINE LENGTH

LINE   LINE LENGTH
L 1:   200 FEET
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>s7A8LLYYMMDDHHmmLLFFFFFFFF...
                  LLFFFFFFFF&&CCCC<ETX>
```

Notes:

1. `YYMMDDHHmm` - current date and time
2. `LL` - WPLLD line leak sensor number
3. `FFFFFFFF` - pipe length, feet (ASCII hex IEEE float)
4. `&&` - data termination flag
5. `CCCC` - message checksum

Function Code: **7AB**
Function Type: Set Test 2 Schedule

Command Format: Inquire:
Display: `<SOH>S7A300f`   `<SOH>I7A300`
Computer: `<SOH>s7A300f`   `<SOH>i7A300`

Typical Response Message, Display Format:

```
<SOH>
I7A300
JAN 24, 1997 2:54 PM

2 GPH TEST SCHEDULE

MONTHLY
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>i7A300YYMMDDHHmmf&&CCCC<ETX>
```

Notes:

1. `YYMMDDHHmm` - current date and time
2. `f` - test schedule flag
         `1` = monthly
         `2` = continuous
         `3` = manual
3. `&&` - data termination flag
4. `CCCC` - message checksum

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

Command Format:
Display: `<SOH>I90200`
Computer: `<SOH>i90200`

Typical Response Message, Display Format:

```
<SOH>
I90200
JAN 22, 1997 3:24 PM
SOFTWARE REVISION LEVEL
SOFTWARE# 349768-001-A
CREATED - YY.MM.DD.HH.MM

SYSTEM FEATURES:
TEST 3 2 1
NUM LINES 4
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>i90200YYMMDDHHmmSOFTWARE# 349768-vvv-rrr
     CREATED-YY.MM.DD.HH.mm&&CCCC<ETX>
```

Notes:

1. `YYMMDDHHmm` - current date and time
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

Function Code: 909
Function Type: Software Revision Level

Command Format:
Display: `<SOH>I909LL`
Computer: `<SOH>i909LL`

Typical Response Message, Display Format:

```
<SOH>
I90900
JAN 24, 1997 2:52 PM

SOFTWARE REVISION LEVEL

SOFTWARE# 349768-001-AX1
CREATED - 97.12.13.10.15

SYSTEM FEATURES:
TEST 3 2 1
NUM LINES 4
<ETX>
```

Typical Response Message, Computer Format:

```
<SOH>i90200YYMMDDHHmmSOFTWARE# ssssss-vvv-rrr
     CREATED-YY.MM.DD.HH.mmnnAAMMLLL&&CCCC<ETX>
```

Notes:

1. `YYMMDDHHmm` - current date and time
2. `ssssss` - software product number
3. `vvv` - software version number (ASCII text string)
4. `rrr` - software revision level (ASCII text string)
5. `YY.MM.DD.HH.mm` - date and time of software creation
6. `nn` - number of 2 byte values to follow
7. `AA` - test 1 feature (00 = disable, 01 = enable)
8. `MM` - test 2 feature (00 = disable, 01 = enable)
9. `LL` - number of lines
10. `&&` - data termination flag
11. `CCCC` - message checksum

Function Code: **B85**
Function Type: Line Leak Test 1 Diagnostic

Command Format:
Display: `<SOH>IB85LL`
Computer: `<SOH>iB85LL`

Typical Response Message, Display Format:

```
<SOH>
IB8500
JAN 14, 1997 8:27 AM

Line Leak Test 1 Diagnostic

L 1

DATE/TIME               RESULT   DATE CHANGE
JAN  1, 1997 4:12  PM   PASS     NO
JAN  1, 1997 8:12  PM   PASS     NO
JAN  1, 1997 10:12 PM   PASS     NO
```

Typical Response Message, Computer Format:

```
<SOH>iB85LLYYMMDDHHmmLLCCYYMMDDHHmmRRSS...
                    LLCCYYMMDDHHmmRRSS&&CCCC<EXT>
```

Notes:

1. `YYMMDDHHmm` - current time of day
2. `LL` - WPLLD line leak sensor number (decimal)
3. `CC` - number of test 1 histories to follow (hex)
4. `YYMMDDHHmm` - test 1 date and time
5. `RR` - test result [0 = pass, 1 = fail (decimal)]
7. `SS` - date change status [0 = no, 1 = yes (decimal)]
8. `&&` - data termination flag
9. `CCCC` - message checksum

Function Code: **B86**
Function Type: Line Leak Test 2 Diagnostic

Command Format:
Display: `<SOH>IB86LL`
Computer: `<SOH>iB86LL`

Typical Response Message, Display Format:

```
<SOH>
B8600
JAN 14, 1997 8:27 AM

Line Leak Test 2 Diagnostic

L 1

DATE/TIME              RESULT DATE CHANGE
JAN  1, 1997 4:12 PM   PASS   NO
JAN  1, 1997 8:12 PM   PASS   NO
JAN  1, 1997 10:12 PM  PASS   NO
```

Typical Response Message, Computer Format:

```
<SOH>iB86QQYYMMDDHHmmLLCCYYMMDDHHmmRRSS...
                    LLCCYYMMDDHHmmRRSS&&CCCC<EXT>
```

Notes:

1. `YYMMDDHHmm` - current time of day
2. `LL` - WPLLD line leak sensor number (decimal)
3. `CC` - number of test 2 histories to follow (hex)
4. `YYMMDDHHmm` - test 2 date and time
5. `RR` - test result [0 = pass, 1 = fail (decimal)]
7. `SS` - date change status [0 = no, 1 = yes (decimal)]
8. `&&` - data termination flag
9. `CCCC` - message checksum

Glossary

ASC	Authorized Service Contractor
AST	Aboveground Storage Tank
AWG	American Wire Gauge
asynchronous	A mode of data transmission in which the time occurrence of the bits within each character or block of characters relates to a fixed time frame, but the start of each character or block of characters is not related to this fixed time frame.
baud	A unit of signaling speed equal to the number of discrete signal conditions or events per second. This refers to the physical symbols/second used within a transmission channel. For two devices to communicate they must be set to transmit/receive at the same baud rate.
bit rate	The speed at which data bits are transmitted over a communication path, usually expressed in bits per second. A 9600 bps terminal is a 2400 baud system with 4 bits/baud.
board	A printed circuit board, such as the CPU
CPU board	Central Processing Unit printed circuit board
chip	Another term for an integrated circuit (see IC)
communications	Data transmissions between two or more pieces of equipment
component	Any resistor, capacitor, IC, etc., soldered onto a printed circuit board.
configuration	Relative arrangement of parts of a system
data	Information collected by the console.
default parameter setting	A system set-up parameter that is preset by the factory.
diagnostics	Indicators of the current conditions in the system
dispenser	Dispenses fuel through a nozzle, typically to a motor vehicle
dispenser pan	An enclosure used to contain dispenser piping to prevent release of product into the environment.
double wall tank (DW tank)	A tank with a secondary wall to prevent leakage of product into the environment.
EIA	Electronic Industries Association. The EIA is a voluntary standards organization in the U.S.A., mainly representing the manufacturers of electronic equipment, specializing in the electrical and functional characteristics of interface equipment.
EIA-RS-232	EIA Recommended Standard 232 that defines the "interface between data terminal equipment and data communications equipment employing serial binary data interchange", and consists of three parts: electrical signal characteristics, interface mechanical characteristics, and a functional description of the interchange circuits. A letter suffix to the 232, such as C or D, indicates the applicable revision level of the standard.
EEPROM	Electrically Erasable Programmable Read Only Memory
external output	Field wiring locations where devices can be connected to the system, such as overfill alarms and warning lights.

IC	Integrated Circuit; refers to circuits, such as microprocessors, which are etched on single crystals, ceramics or other semiconductor layers and hermetically sealed.
I.P.S.	International Pipe Standard
LED	Light Emitting Diode
MTBE	tert.- Butyl Methyl Ether; mixed with unleaded gasoline for various gasohol blends.
NEC	National Electrical Code; a nationally accepted guide for the safe installation of electrical conductors and equipment.
NFPA	National Fire Protection Association; a nonprofit organization dedicated to protecting lives and property from the hazards of fire. NFPA publishes over 270 nationally recognized codes and standards, including the National Electrical Code.
N.P.T.	National Pipe Threads
PROM	Programmable Read Only Memory
RAM	Random Access Memory
ROM	Read Only Memory
seal-off	An enclosure that is filled with an approved sealing compound to minimize the passage of gases and vapors, and to prevent the passage of flames through conduit.
sensor	A device that responds to a physical stimulus (e.g., pressure, magnetism, or a particular motion) and transmits a resulting impulse (as for measurement or operating a control).
STP	Submersible Turbine Pump
surface-mount board	A printed circuit board which has component leads soldered on its surface (face).
through-hole mount board	A printed circuit board which has component leads going through holes in the board for soldering on the back side.
UL	Underwriter's Laboratories
vapor	A substance in the gaseous state as distinguished from the liquid or solid state.
WPLLD	Wireless Pressurized Line Leak Detection

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