

LiquidWatch II

Installation and Operating Manual



Operating Manual

LW2000 Series
Regulatory Date/ Version: 2018.11.5 / 1.1
Feature version: 2019.7.23 / 1.1.00A

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Please check the PermAlert website, www.permalert.com, for the latest revision of this manual.

The manual is typically revised at least once a year. The revision date is on the back cover.

Contact techsupport@permalert.com for technical assistance with the LiquidWatch II system.

Table of Contents

Safety Information	5
Regulatory Compliance Statements	5
1. Introduction	6
1.1 Using this Manual	6
1.2 Application	6
1.3 Receiving and Handling Precautions	6
1.4 Typical System Material Supplied by PermAlert	6
1.5 Typical Installation Material Supplied by Contractor	7
1.6 LiquidWatch II Components	7
2. Alarm Panel Installation	7
2.1 Installation Overview	7
2.2 Terminals	8
2.3 Power Connection	9
2.4 Audible Alarm Wiring	9
2.5 Control Relays	9
2.6 Communications Connections	11
2.6.1 Port 1 - RS-485/RS-232	11
2.6.2 Port 2 - RS-232	11
2.6.3 Ethernet	11
2.7 Replaceable Parts	11
2.7.1 Battery	11
2.7.2 24 VDC Input and Output Fuses	12
2.8 Contrast Adjustment	12
2.9 UL	12
2.10 FCC and CE Compliance Requirements	12
3. Probe Installation	13
3.1 Probe Configuration	13
3.2 Probe Installation	14
3.3 Typical Installations	16
3.4 PHLR-LW Hydrocarbon Probe	21
3.4.1 Cleaning Sensor Elements Procedure	22
3.4.2 Testing the PHLR	22
3.4.3 Troubleshooting	23
3.4.4 Probe Tests	23

4. Operating LiquidWatch II	24
4.1 Menu Navigation	24
4.2 Initial Message Screens	24
4.3 Monitoring Screen	25
4.3.1 New Alarm or Maintenance State	25
4.4 Menus.....	26
4.4.1 Probe Setup Menu	26
4.4.2 Probe On/Off Menu	27
4.4.3 History Function	27
4.4.3.1 Viewing Logs	27
4.4.4 Display Setup Menu	28
4.4.5 Configuration Menu.....	29
4.4.5.1 Set System Clock.....	29
4.4.5.2 Change Network Settings	31
4.4.5.3 Change Serial Port Settings.....	33
4.4.5.4 Change System Address	35
4.4.5.5 Change Password.....	36
5. Connecting to LiquidWatch II	37
5.1 Modbus Communications Overview	37
5.1.1 Modbus Global Settings	37
5.1.2 Modbus Serial Communications	37
5.1.2.1 Modbus Serial Values	37
5.1.2.2 Modbus Serial Jumper Settings	37
5.1.3 Modbus TCP/IP Communications	38
5.2 BACNet Communications	38
Appendix.....	39
A.1 Supply Power	39
A.2 Modbus Data Structure	39
A.3 BACNet Data Structure	40
A.4 The probe status values.....	40
Warranty.....	41

Safety Information

Please Read This Operating Manual

Please take the time to read this operating manual carefully. It will help you operate your system properly. **Failure to follow these instructions may impair the safety of the equipment.** Please save this operating manual for future reference.

For your safety

Caution: To reduce the risk of fire or electric shock, do not expose LiquidWatch II to rain or moisture.

CAUTION: TO REDUCE THE RISK OF ELECTRIC SHOCK, TURN OFF POWER BEFORE OPENING ENCLOSURE DOOR. REFER ALL SERVICING TO QUALIFIED PERSONNEL



This symbol alerts the user to the presence of uninsulated, dangerous voltage within the system enclosure that may be of sufficient magnitude to constitute a risk of electric shock.



This symbol alerts the user to the presence of important operating and maintenance instructions in this manual.

Approvals and Certifications



Regulatory Compliance Statements

FCC Class A Notice

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions.

1. This device may not cause harmful interference, and
2. This device must accept any interference received, including interference that may cause undesired operation

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with this instruction manual, may cause harmful interference to radio communications.

Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

The party responsible for product compliance:
Perma-Pipe, Inc.,
6410 W. Howard St.,
Niles, IL 60714

1. Introduction

1.1 Using this Manual

This LiquidWatch II Installation and Operating Manual is intended for use as a general guide for installation and setup of the PermAlert LiquidWatch II Leak Detection Systems. Users and installers should read through this manual thoroughly before attempting to install or adjust the system. Additional information can be found at www.permalert.com.

1.2 Application

The LiquidWatch II system is a self-contained probe based liquid detection system. The probes are designed to suit a broad array of applications including: secondary contained piping, double wall tanks, sumps, computer room subfloors, cleanroom subfloors, or any area where liquids need to be detected.

The base system is equipped to monitor up to 8 probes and has 6 alarm output relays (see section 2.5). The system is expandable to monitor up to 64 probes with additional Remote Probe Modules (RPM-8) that can monitor up to 8 probes per module. Receiving and Handling Precautions

The following general precautions should be observed:

1. Read this manual carefully before beginning any work. **Do not use substitute materials or short cut recommended procedures.** Understanding and following this guide is essential to avoid installation problems.
2. Collect the needed quantities of all materials well in advance of scheduled work.
3. Check the packing list against received items. Report immediately any shortages or damaged materials to the delivering carrier.
4. All probes must be tested upon receipt following the probe test procedures contained in this manual. Report immediately to PermAlert any probes that fail this quality control test.
5. System drawings, provided by the designer, should indicate the extent, general location and arrangement of leak detection equipment and probes. The contractor (installer) should become familiar with all details of the installation before proceeding.
6. A qualified electrician should perform electrical work.

1.3 Typical System Material Supplied by PermAlert

Depending on application, each system may include the following items:

1. Leak detection alarm panel
2. Communication cable
3. Probe Lead wire
4. Probe adapter assembly
5. Probes
6. Watertight junction boxes conforming to NEMA 4X

Maximum No. of Cable Junctions in Enclosure	Enclosure Dimensions
4	6" x 6" x 4"
6	8" x 6" x 4"
8	10" x 8" x 4"

7. Watertight cord grips

1.4 Typical Installation Material Supplied by Contractor

Each system may require the installing contractor to supply the following items:

1. Electrical conduit, junction boxes and wiring, as required.
2. Multimeter for testing.
3. Hot air gun for shrink tube and heat shrink butt splices.

NOTE:

All probe lead and communication cable should be run in conduit to protect the cable from physical damage. In an area subject to strong electrical interference, grounded metal conduit is recommended. Contact PermAlert for additional information.

1.5 LiquidWatch II Components

The following LiquidWatch II components are available for replacement or expansion:

Model	Part No.	Description
LW2000	8027573	Monitoring Unit
RPM-8	8027636	Remote Probe Module (connects up to 8 probes)
PA-10	8027638	Probe Adapter to Interface with Non-Std. Probes
PHLR-LW	8027890	Hydrocarbon Probe Assembly
PFS-LW	8027902	Float Probe Assembly
PSTV-LW	8027903	2" Tank Well Float Probe Assembly
PWS-LW	8027904	Water Probe Assembly
PTHL-LW	8027906	Tank Overfill Probe Assembly
LW-2	8017688	Probe Lead 2 wire
LW-4	8017690	Probe Lead 4 wire
MC-15	8017692	LiquidWatch II Communication Cable

2. Alarm Panel Installation

2.1 Installation Overview

All applicable manuals must be reviewed and understood prior to installing and operating the LiquidWatch II system.

The LiquidWatch II panel is designed to be permanently mounted indoors in a dry area. The enclosure is rated NEMA Type 12 [IP52]. It must not be located in direct sunlight to prevent excessive heat buildup.

In all installations, the ambient temperature surrounding the LiquidWatch II panel must be within the limits below. The equipment is designed to be safe in the following range of environmental conditions:

1. Indoor use;
2. Altitude up to 6,560 ft. [2000 m];
3. Temperature -4°F [-20°C] to 122°F [50°C];
4. Maximum relative humidity 95%;
5. Pollution degree 2.



CAUTION - Access inside the LiquidWatch II panel should be limited to qualified personnel. Risk of electrical shock exists.

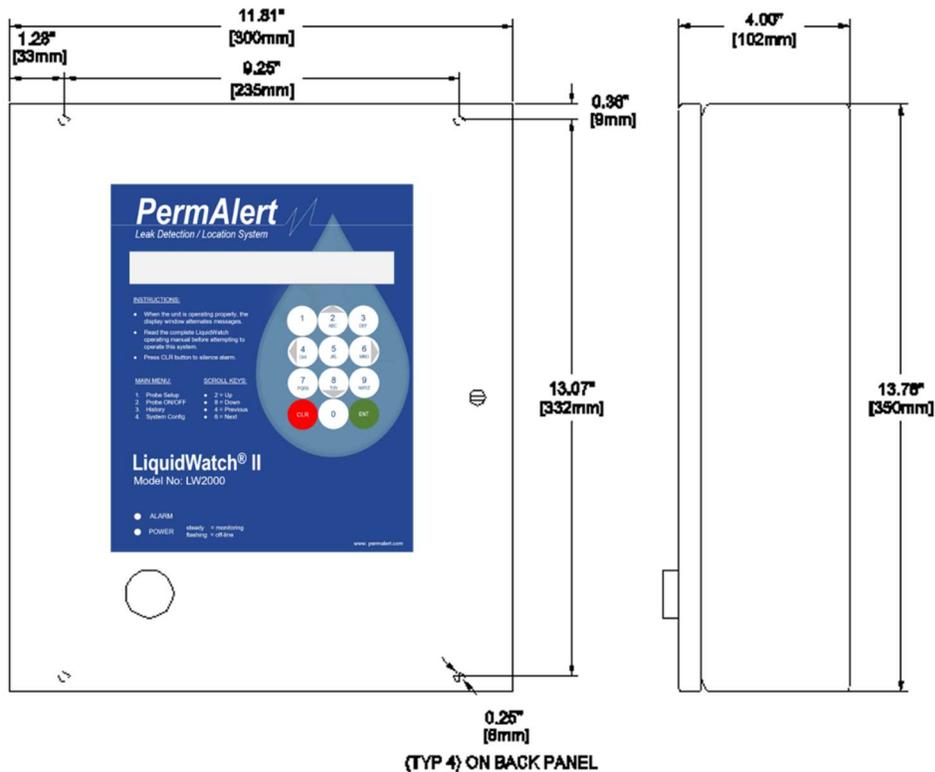


Warning: Do not mount the LiquidWatch II panel in a hazardous location. The panel must be in an ordinary location.

Mount the LiquidWatch II panel securely to a wall, using 1/4" [M6] hardware in the 4 holes on the back of the panel (see figure 2-1). If it is mounted to a typical 1/2" plasterboard wall, use 1/4" x 1 1/2" [M6 x 40mm] lag screws to secure it to the studs (nominal 2" x 4" [50mm x 100mm]). The panel can also be mounted to steel mounting channel struts using 1/4" [M6] machine screws.

The LiquidWatch II panel is connected to the probes using probe lead and communication cable (Type LW-2, LW-4 and MC-15).

The probe lead and communication cable must be run in a separate conduit from the power supply cable. All conduit fittings must be appropriately rated and installed properly to maintain the rating of the enclosure. All electrical connections must comply with local codes. **Remove the system board from the white back panel (four #6-32 screws) before drilling holes in the enclosure for conduit openings to prevent damage and contamination from metal shavings.**



Model LW2000

Mounting Dimensions

Figure 2-1

2.2 Terminals

The terminals on the LiquidWatch II system board use a quick-connect design that provides an easy, fast and robust connection. A flat blade screwdriver, 1/8" [3.5 mm], is used to press down on the terminal lever and open the terminal for easy wire insertion. Release the lever, and the wire is tightly clamped. **The acceptable wire size for connection to any terminal, including the mains, is 28 - 12 AWG [0.08-2.5 mm²].** The terminals can accommodate solid or stranded wires. **If ferrules are used with stranded wire, the maximum wire size is 14 AWG [1.5 mm²].** Refer to the detail located at the upper right side of figures 2-2 and 2.3. **Caution: The lever only travels 1/8" [3.5 mm] to open the terminal completely, and only requires 5 - 8 lbs. [2-4 kg] force. Do not exceed these limits or the terminal will be damaged.**

2.3 Power Connection

The LiquidWatch II must be permanently wired to instrument-quality power using appropriate certified conduit, fittings, and wiring. Refer to figures 2-2. The LiquidWatch II contains a universal power supply. The power requirement is 110-240 V_{AC}, 50 / 60 Hz, 0.3 A / 50 VA.

A suitable, external, over-current protection device, such as a fuse or circuit breaker (15 A), and disconnect device is recommended. The over-current protection and disconnect devices shall be installed on all ungrounded conductors, i.e. the terminal marked hot (L) (and neutral (N) terminal if ungrounded for 240 VAC). The disconnect device shall be located near the equipment and marked with appropriate ON / OFF markings as specified by local codes. The ground conductor must be easily identifiable as green with a yellow stripe insulation. Ground should be connected to the grounding connection on the upper right corner of the back panel as shown in Figure 2.2. Installation should be performed by qualified personal in accordance with local codes and procedures.

The LiquidWatch II can also be powered by a 24 V_{DC}, 1 A / 24 VA, over-current protected power source at terminal T5. Fuse F1 on the PAL-AT system board protects the 24 V_{DC} input. It is a 2A, 250 V, time-delay, 5 x 15 mm fuse.



Caution - Before accessing the LiquidWatch II panel, the panel must be disconnected from the power source and isolated from any hazardous voltage present in the panel, e.g. relay wiring.

Three internal switches on the system board control the power source utilized by the panel (110-240 V_{AC} or 24V_{DC}). These switches are intended for use by service personnel. Before powering on the panel, ensure the AC Power Switch (SW3) and the 24 V_{DC} Power Switch (SW1) are both in the down, or "OFF" position. The input power can be set to "VAC" or "VDC" using the Input Power Select Switch (SW2), depending on the desired power source. Once selected to AC or DC, the panel's control power can be disconnected using SW3 for when on AC power or SW1 when on DC power.

2.4 Audible Alarm Wiring

An internal 90-dBA pulse horn is supplied. An optional chime alarm is available. The wiring for the horn is a 2-wire cable connected to terminal strip T6. The red wire must be connected between the "+" terminal on the horn and the "+" T6 terminal. The black wire must be connected between the "-" terminal on the horn and the "-" T6 terminal. The terminal provides 24 VDC @ 10 mA.

2.5 Control Relays

LiquidWatch II has 6 SPDT output relays rated for 250 VAC, 10 A. They are labeled "P - F Alarm", "Common Alarm", "Relay 1", "Relay 2", "Relay 3" and "Relay 4" (see figures 2-2). The relay contacts are labeled in their unpowered or "on-the-shelf" condition.

The P - F Alarm relay energizes when the panel is powered and is intended to be used to monitor for a power fault.

The common alarm relay switches state in response to any fault condition. The CLR key can be pressed to reset the common alarm relay to its normal state and deactivate the internal audible alarm for up to 96 hours. The default reset time is 12 hours.

The assignable relay(s) will activate when a fault is detected and will reset when the fault returns to normal or the probe is taken offline. The default setting is to activate for all alarms, but it is firmware selectable to activate in response to only probe active alarms.

Control devices or auxiliary equipment should be connected to the cable relay(s) so they will not be reactivated when the alarm is silenced. LiquidWatch II is shipped with the common alarm and assignable relays configured to operate in a normally de-energized mode, so they energize when the panel is in the alarm state (Refer to operating section for changing relay configuration).

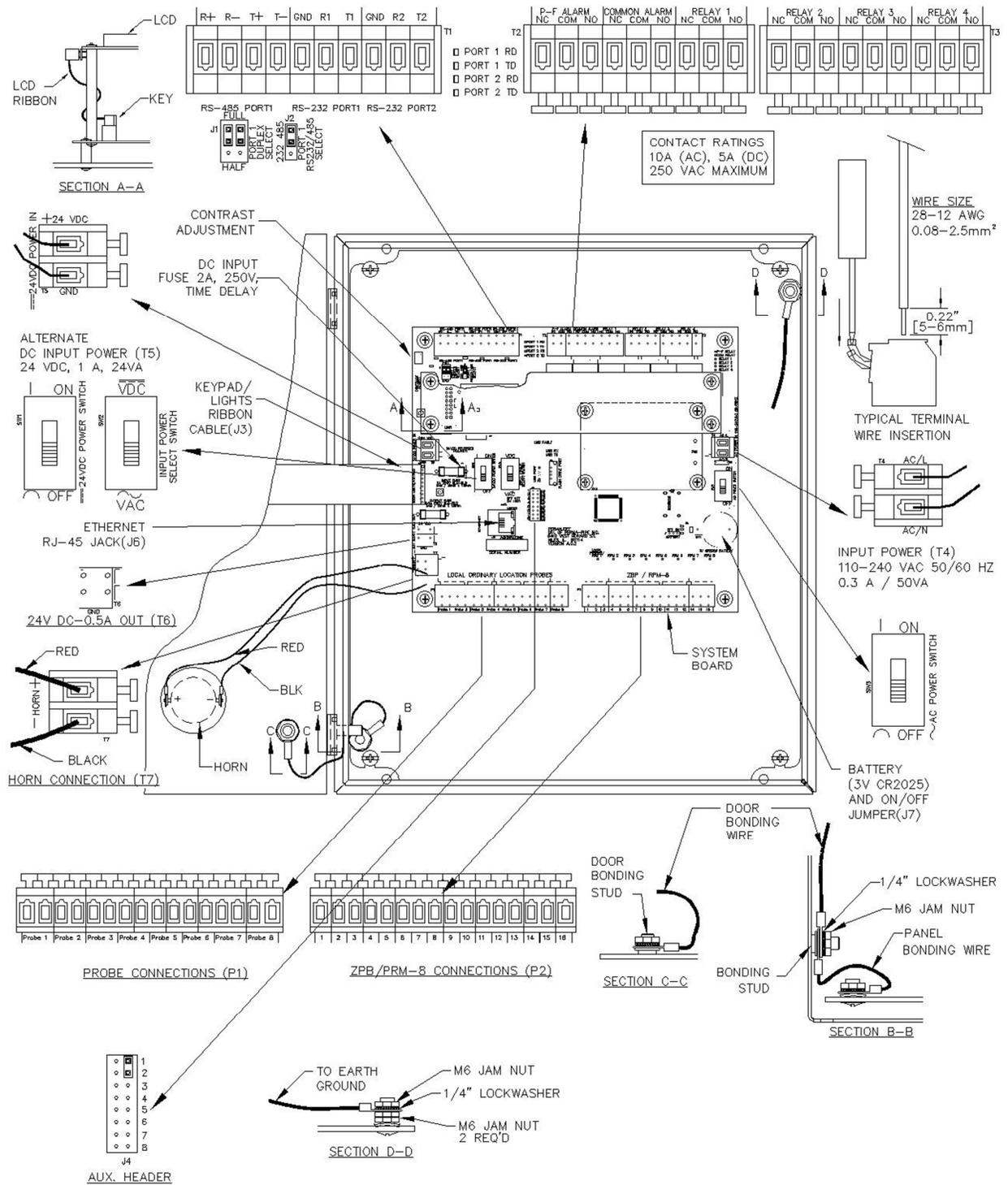


Figure 2-2 - Component Layout for LiquidWatch II Panel

2.6 Communications Connections

LiquidWatch II is provided with several options for communication. The options include:

- Port 1 – RS-485/RS-232
- Port 2 – RS-232
- Ethernet - RJ-45 connector

2.6.1 Port 1 - RS-485/RS-232

Port 1 can be configured for RS-485 or RS-232 through a jumper setting. To configure it for RS-485, jumper J2 should be placed in the top position. Then the two jumpers at J1 can be set to select either full (top positions) or half-duplex (bottom positions). The two jumpers must be oriented vertically.

Full duplex is available using two twisted-pairs connected to T1 terminals R+, R-, T+ and T-.

Half duplex, or 2-wire RS-485, requires a jumper wire connecting terminal R+ to T+ and a jumper from R- to T-. Each LiquidWatch II is a full load for the RS-485 network. A crimp ferrule is recommended to connect each incoming RS-485 lead to the corresponding jumper wire to insure a solid connection of the two wires in the T1 terminals.



All RS-485 cables in the network should be properly terminated as per EIA RS-485 recommendations. Typically, the network is a daisy-chain configuration and two 120-ohm termination resistors are installed, one at each end of the network. Shields of the network cables should be connected together and grounded at only one point.

Port 1 can be configured for RS-232 by moving J2 to the bottom position. Then a 3-conductor cable should be connected to T1 terminals GND, R1 (receive) and T1 (transmit). The baud rate is configured via the LiquidWatch II firmware.

2.6.2 Port 2 - RS-232

RS-232 communications through port 2 requires a 3-conductor cable connected to T1 terminals GND, R2 (receive) and T2 (transmit). The baud rate is configured via the LiquidWatch II firmware.

2.6.3 Ethernet

An Ethernet RJ-45 jack provides a TCP connection to the LiquidWatch II. There are several ports available to handle different protocols. Please refer to the individual protocol sections below for details on ports and protocol availability.

2.7 Replaceable Parts



Caution - Before accessing the LiquidWatch II panel, the panel must be disconnected from the power source and isolated from any hazardous voltage present in the panel, e.g. relay wiring.

2.7.1 Battery

Battery BT1 on the LiquidWatch II system board maintains the clock settings when the panel is off. Jumper J7, located left of the battery, must be set "On" (left position) to enable the battery. The battery is a 3 V lithium type.



Replace Battery with Energizer CR2025 Only as indicated. Use of Another Battery May Present a Risk of Fire or Explosion.

Caution, Battery May Explode if Mistreated. Do Not Recharge, Disassemble or Dispose of in Fire.

The battery can be obtained locally or through PermAlert. Replace the battery by pushing on the battery at the 10 o'clock position then sliding the battery down and to the right. Remove the old battery and sliding in the new one. Take care to install the battery correctly. The lettering on the battery (+) should be facing out.

2.7.2 24 VDC Input and Output Fuses

Fuse F1 on the LiquidWatch II system board protects the 24 VDC input. It is a 2 A, 250 V, time-delay, 5 x 15 mm fuse.

Fuse F2 on the LiquidWatch II system board limits the 24 VDC auxiliary output. It is a 0.5A, 250 V, time-delay 5 x 15 mm fuse.

Fuses can be obtained locally or through PermAlert.

2.8 Contrast Adjustment

The contrast of the LCD can be adjusted by turning the contrast adjustment screw on the system board (Figures 2-2). This may be necessary to get the best viewing angle, depending on the mounting height of the LiquidWatch II panel.

2.9 UL / CUL

LiquidWatch II is listed by Underwriters Laboratories, Inc. for installation in ordinary locations.



CAUTION - The maximum operating voltage allowed in the LiquidWatch II panel is 250 VAC. In addition, the voltage on any wires to the control relays must be limited to 250 VAC.

2.10 FCC and CE Compliance Requirements

Each LiquidWatch II system complies with FCC and CE regulations for a Class A digital device.

3. Probe Installation

3.1 Probe Configuration

The LiquidWatch II panels are designed to monitor up to 64 probes. The 64 probes are organized in 8 banks of 8 probes. The P1 terminal located in the LiquidWatch II panel (see Figure 2-2) can be wired directly to probes 1 – 8. If additional probes are monitored, remote probe modules (Model RPM-8) are required. Each RPM-8 has a bank select jumper, P3 that can be set to bank 1 through bank 8 and will monitor 8 probes as follows (Figure 3-1):

Bank	Probe Numbers
1	1-8
2	9-16
3	17-24
4	25-32
5	33-40
6	41-48
7	49-56
8	57-64

Labels are supplied to place on the circuit board next to the terminal strip P1 to renumber the probe terminals.

The RPM-8s are connected with a 15 conductor shielded communication cable. The standard communication cable supplied by PermAlert has the following color code and is connected to terminal strip P2, numbered 1 - 16 as follows:

Terminal Pin Number	Color	Function
1	Black	Probe Input #1
2	Typically Not Used	Bank #1 Select
3	White	Probe Input #2
4	Red	Bank #2 Select
5	Green	Probe Input #3
6	Orange	Bank #3 Select
7	Blue	Probe Input #4
8	White/Black	Bank #4 Select
9	Red/Black	Probe Input #5
10	Green/Black	Bank #5 Select
11	Orange/Black	Probe Input #6
12	Blue/Black	Bank #6 Select
13	Black/White	Probe Input #7
14	Red/White	Bank #7 Select
15	Green/White	Probe Input #8
16	Blue/White	Bank #8 Select

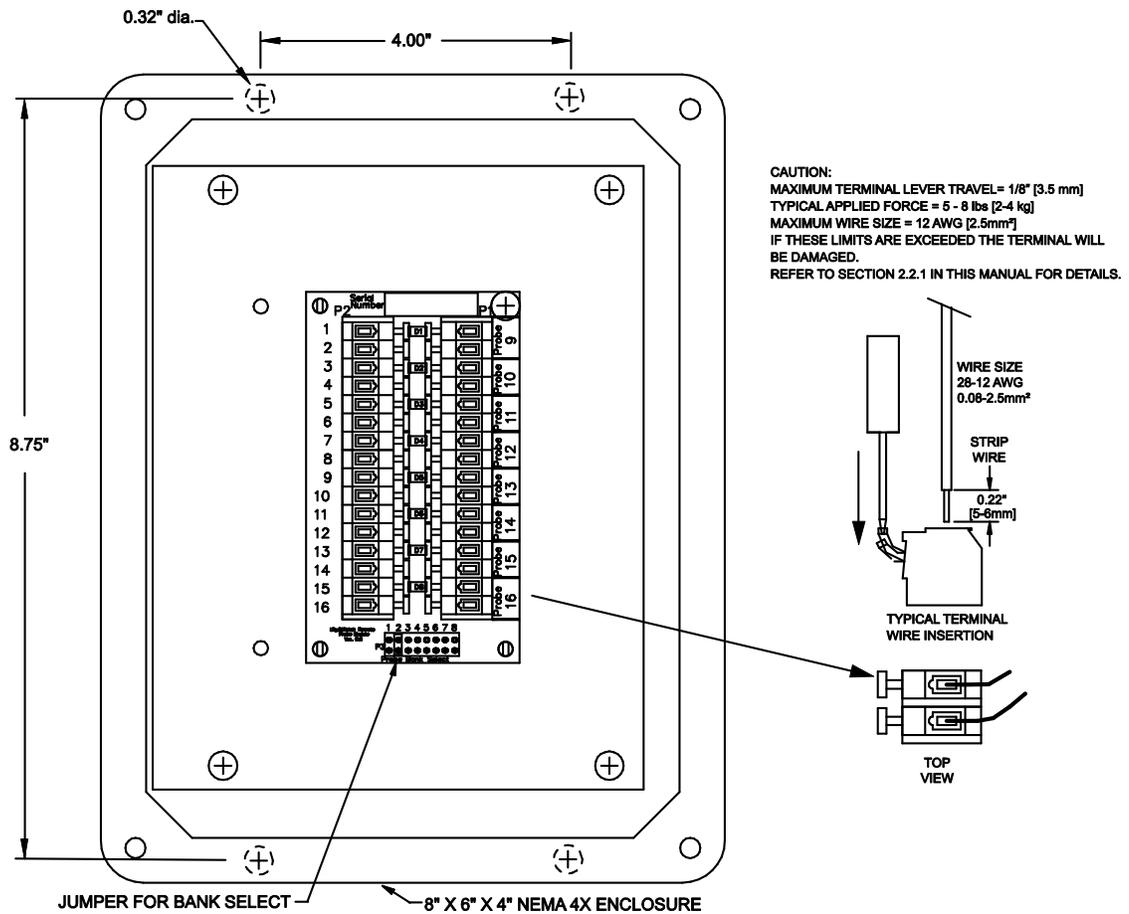


Figure 3-1 – Remote Probe Module

For normal locations the P1 terminal in the LiquidWatch II enclosure can run to Probe 1 through 8 and the communication cable runs from P2 terminal in the LiquidWatch II enclosure to the P2 terminals of the RPM-8's.

Normally each RPM-8 is set to a unique probe bank select number. The maximum distance from a probe to the main alarm panel (including communication cable) is 20,000 feet.

The communication cable can branch from one RPM-8 to 2 or 3 RPM-8's in a star pattern. This may be convenient if the probes are located in separate areas of a site. The maximum number of communication cables that can be connected together at terminal strip P2 is 4.

When 2 or more wires are going into the same terminal, it is recommended that a wire crimp ferrule be used to crimp the wires together. Then a single ferrule is inserted into each terminal pin. This will make installation easier and reduce field-wiring errors. The following is a guide for crimping 2, 3, or 4 wires together.

Number of Wires	Ferrule Size (AWG)	Crimp tool setting (mm)
2	16 or 14	1.0 or 1.5
3	14	1.5
4	14	1.5

PermAlert recommends using Eclipse Model 300-016 Wire Ferrule Crimp Tool or equivalent, available from PermAlert.

3.2 Probe Installation

Each PermAlert supplied probe is furnished with an integral probe adapter. Probe adapters are also available to connect customer supplied probes to the LiquidWatch II monitoring system. A standard 6" x

6" x 4" junction box can house several probe adapters (Figure 3-3) or several standard probe splices (Figures 3-4). (PermAlert can supply NEMA 4X junction boxes and cord grips.)

A junction box or a remote probe module should be mounted at a location close to the point being monitored for serviceability. PermAlert supplies probes with 20 feet of probe lead cable, but additional lead cable may be used if necessary.

Probes should be installed using electrical conduit and/or watertight cord grips, as necessary, to prevent water entry where the probe lead penetrates the monitored area. Figures 3-5 through 3-10 show typical probe installations.

Once the probe is installed, the probe lead should be routed to the junction box or the remote probe module. Trim the excess length of the probe lead before splicing it. Splice the leads by using the crimp connectors supplied with the probe or probe adapter. Make sure the shrink tubing on the connector covers the insulation of the wires, so no bare copper wire is exposed. Heat the splice with a heat gun to seal the adhesive-lined shrink tubing on the connector (Figures 3-3 and 3-4).

To reduce the potential for noise propagation, the shields from each communication cable and all probe cables in a junction box must be connected together at each RPM-8. The shields may only be grounded in the LiquidWatch II panel to one of the 4 mounting screws for the back plate.

Be very careful when removing the jacket of the communication cable and probe cables. Do not nick the wire insulation. If the insulation is cut, the shield may short the wire to ground. It is time-consuming to locate the damaged insulation and the resulting intermittent short after the system is installed.

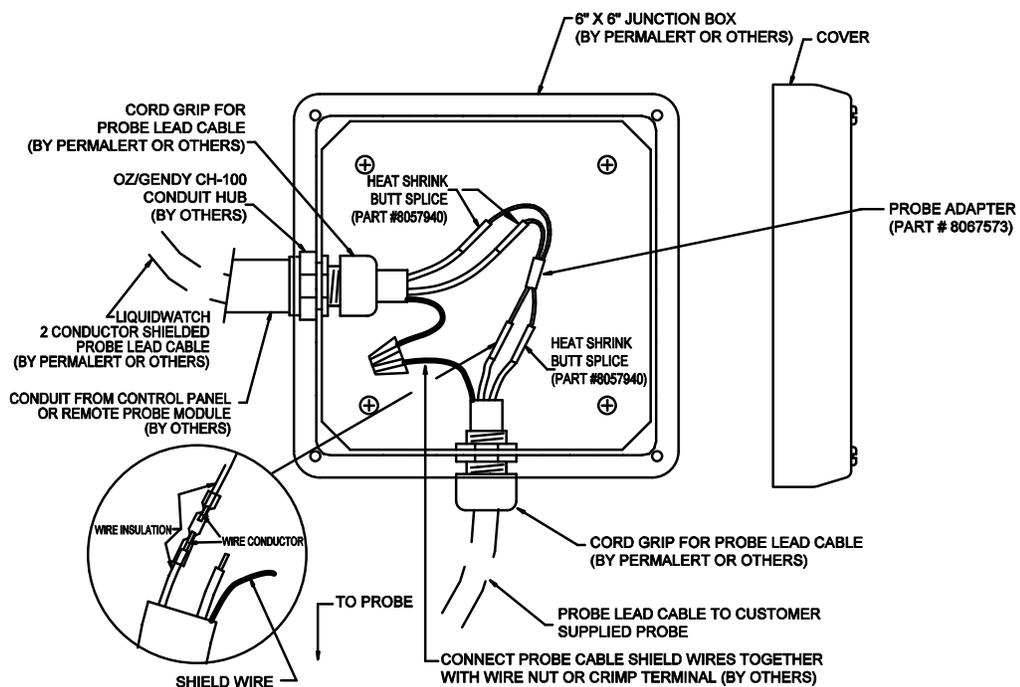


Figure 3-3 - Probe Adapter Installation

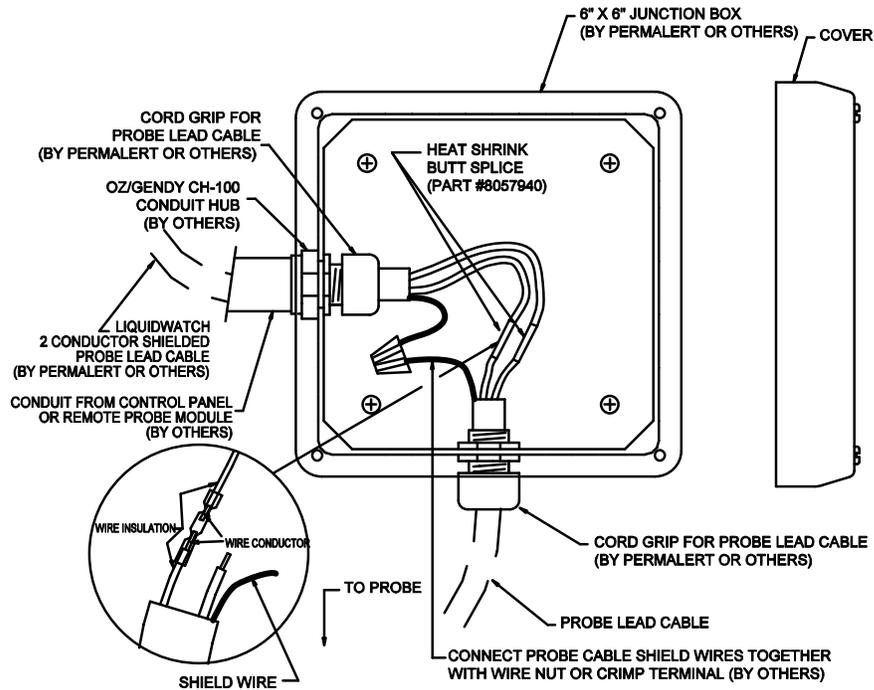


Figure 3-4 - Probe Installation

3.3 Typical Installations

Figures 3-5 through 3-10 show typical installations.

Contained Pipe

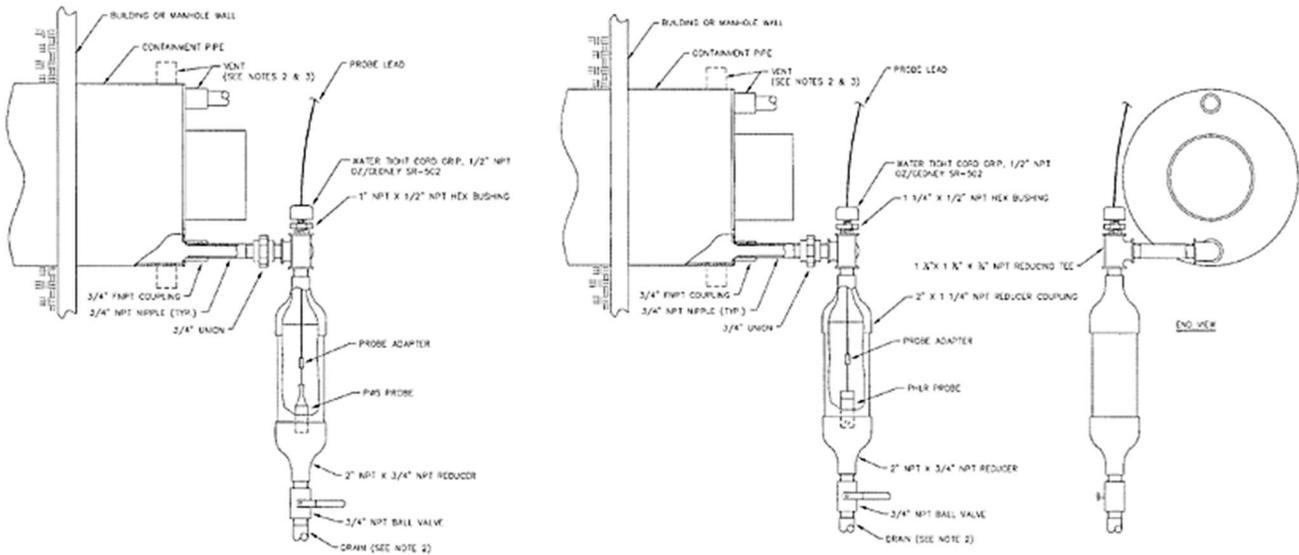


Figure 3-5 - Typical PWS-LW, and PHLR-LW Probe Installations at End Seal

Pressurized Contained Pipe

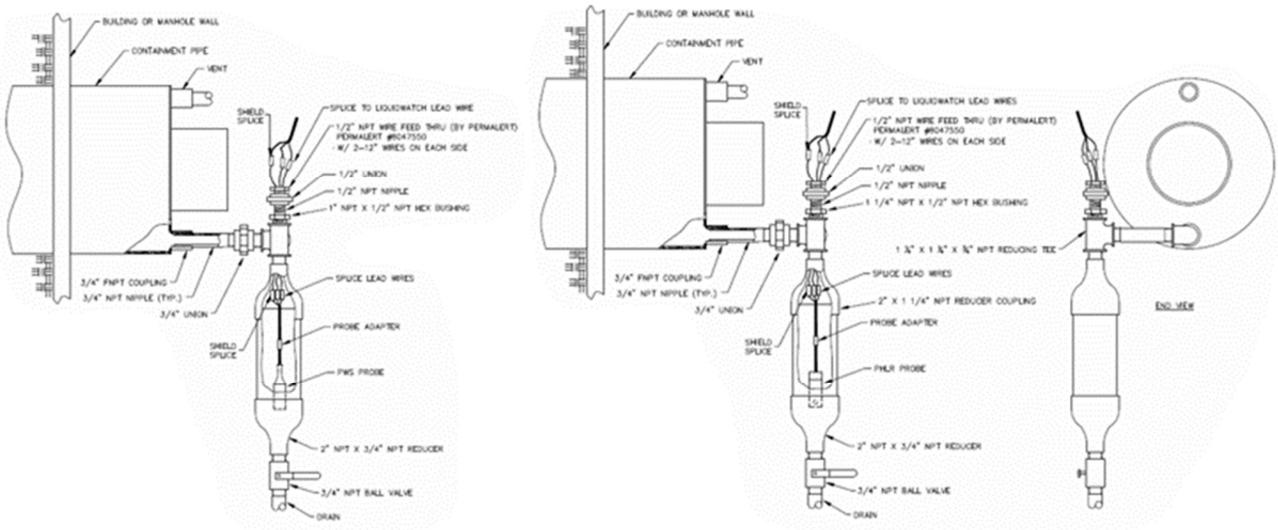


Figure 3-6 - Typical PWS-LW, and PHLR-P-LW Probe Installations at End Seal

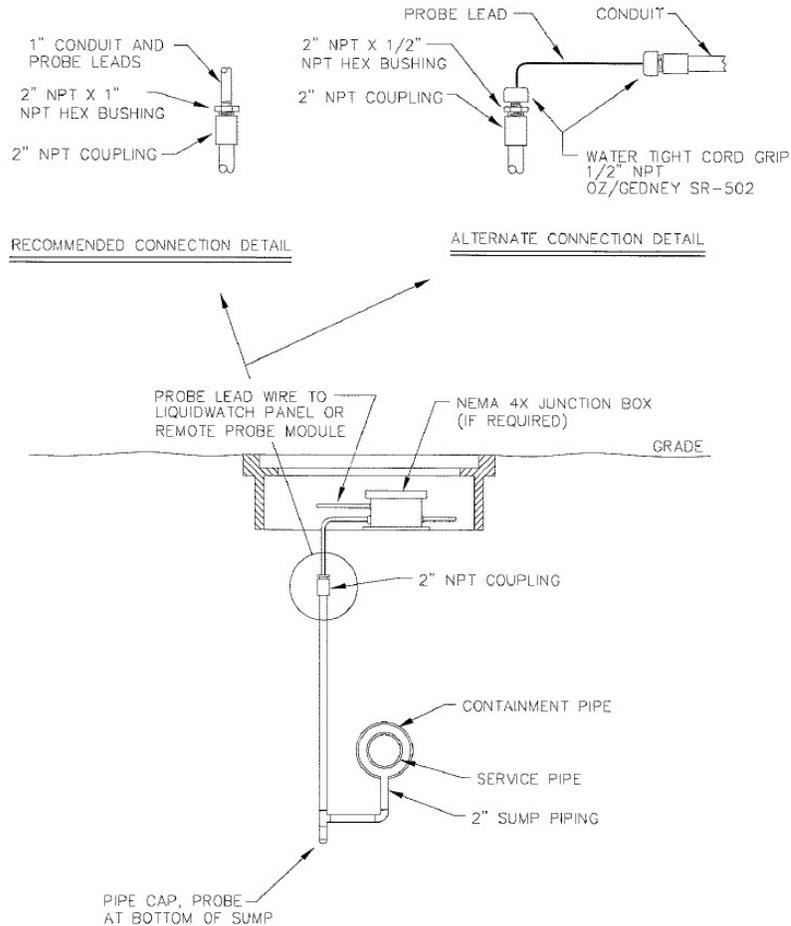


Figure 3-7 - Containment Sump

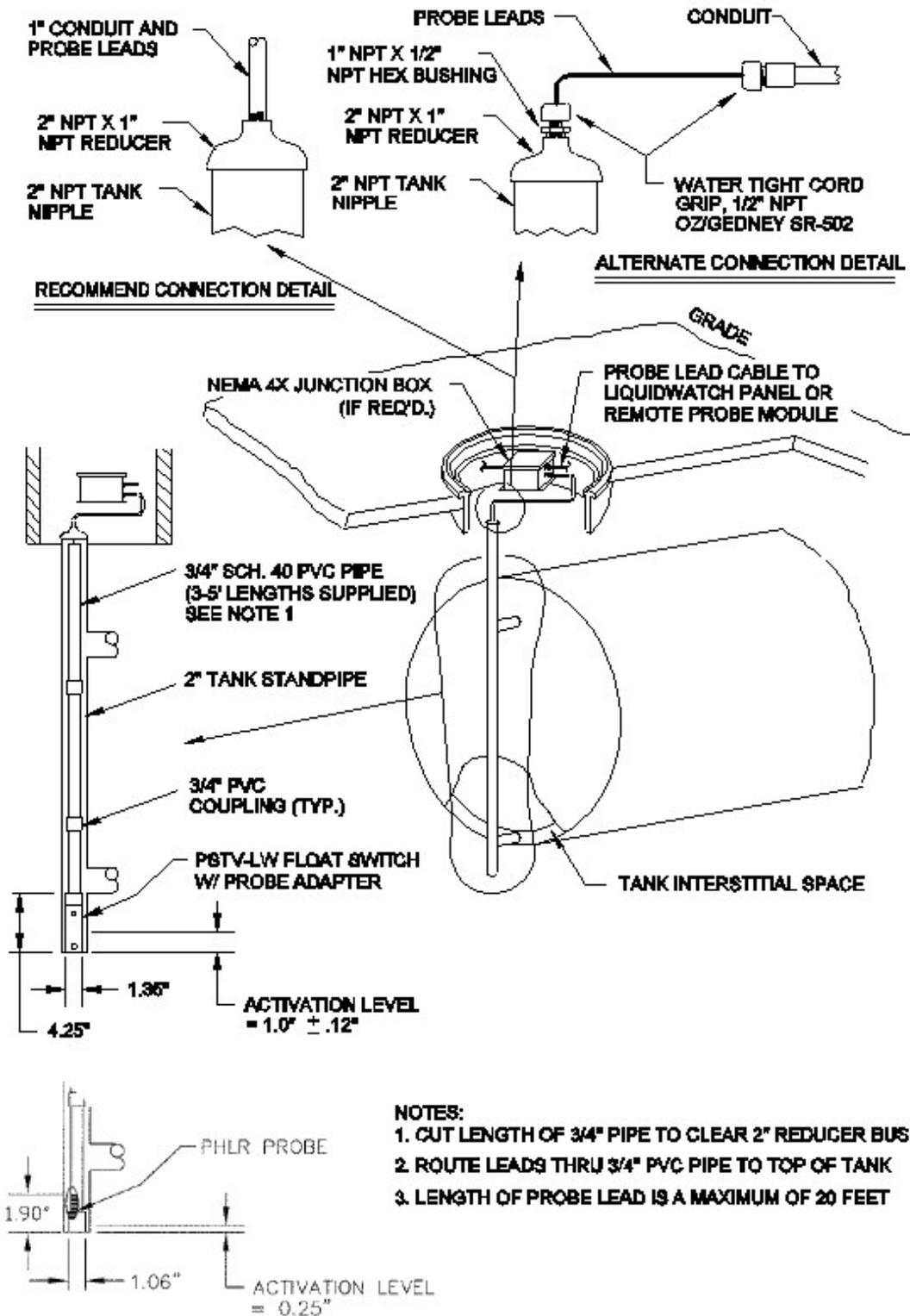


Figure 3-8
Typical PSTV-LW Tank Float Switch and PHLR-LW Installation

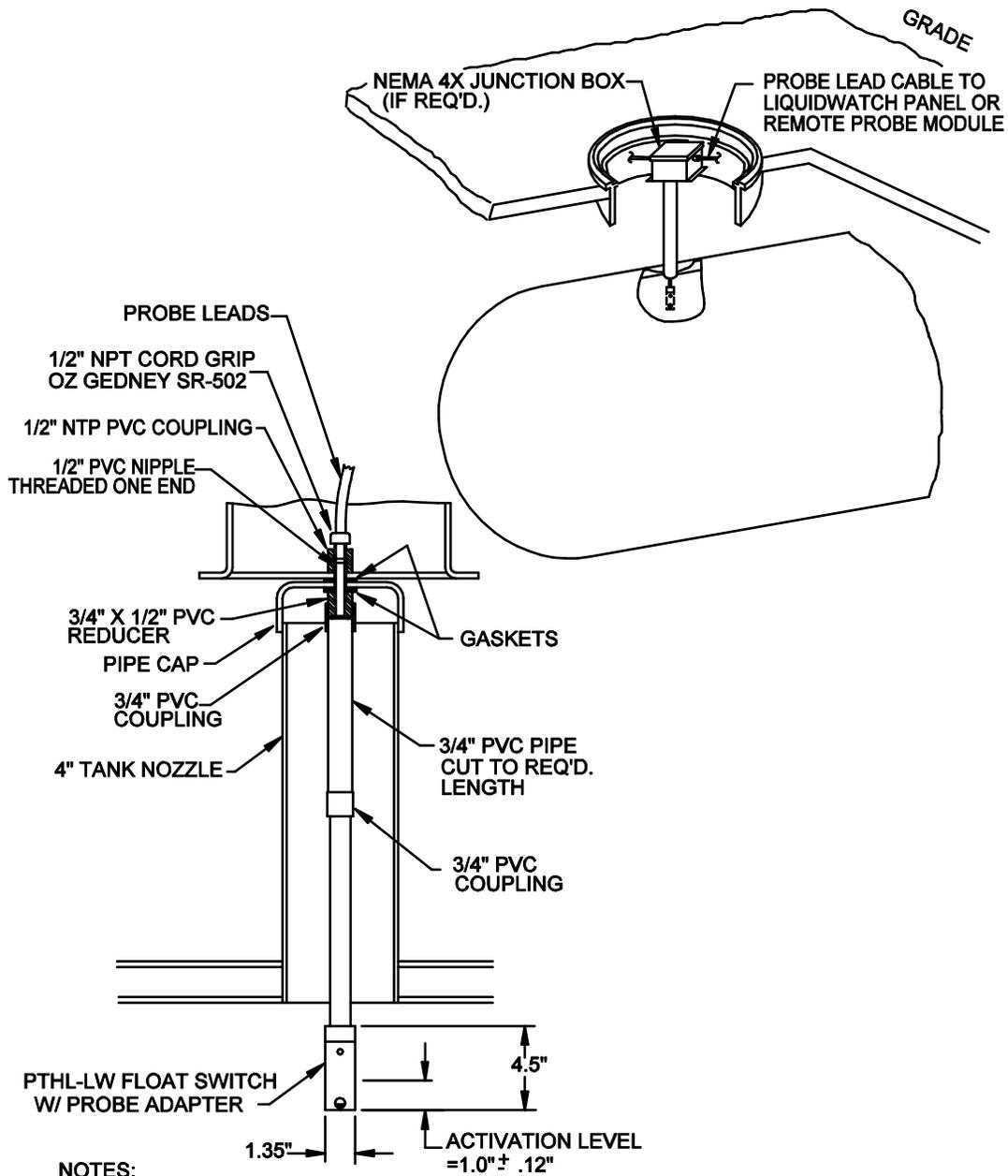
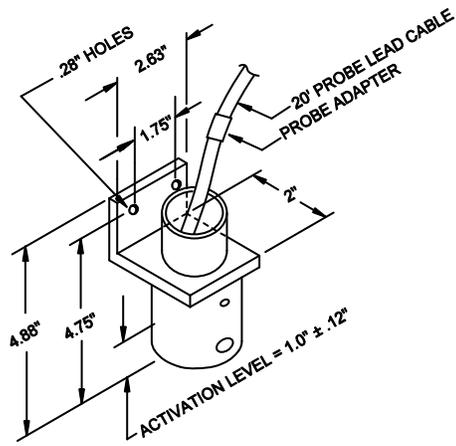
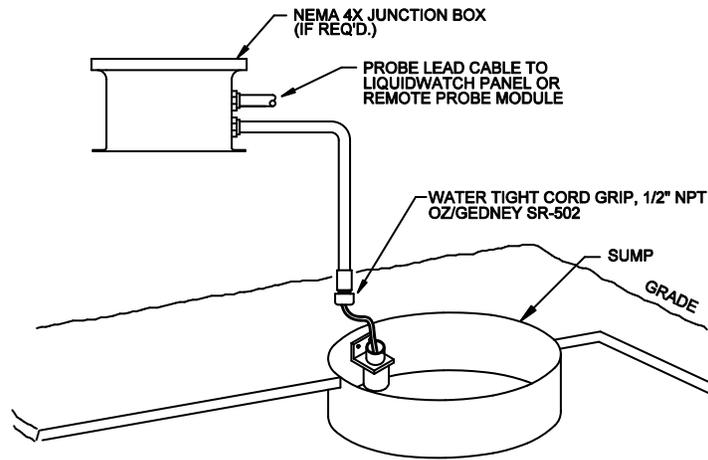


Figure 3-9 - Typical PTHL-LW Float Switch Installation



PFS FLOAT SWITCH W/ MOUNTING BRACKET

Figure 3-10 - Typical PFS-LW Installation

3.4 PHLR-LW Hydrocarbon Probe

The PHLR-LW series is a reusable hydrocarbon probe that detects hydrocarbon liquids in sumps, interstitial spaces of pipes and any other areas where hydrocarbon liquids can accumulate to a depth of ¼". The probe is designed to detect fuels (gasoline, diesel fuel, jet fuel, crude oil, etc.) and many hydrocarbon solvents. The probe is reusable by cleaning or replacing the sensor elements. There are 2 models of the PHLR-LW probe available:

The standard PHLR-LW is designed for non-pressurized locations such as sumps, manholes, and non-pressurized containments. The PHLR can be installed in any orientation – vertical or horizontal.

The PHLR-P-LW is designed for pressurized containment applications. This model is ideal for typical sealed, containment piping systems that are maintained under pressure with a nitrogen or air blanket. The PHLR-P-LW should be installed in a vertical orientation. **The PHLR-P has vent holes that must not be submerged in a liquid before the containment is pressurized** (see Figure 3-6).

An extension to the probe housing can easily be added with standard ¾" Schedule 40 PVC pipe to accommodate installation requirements.

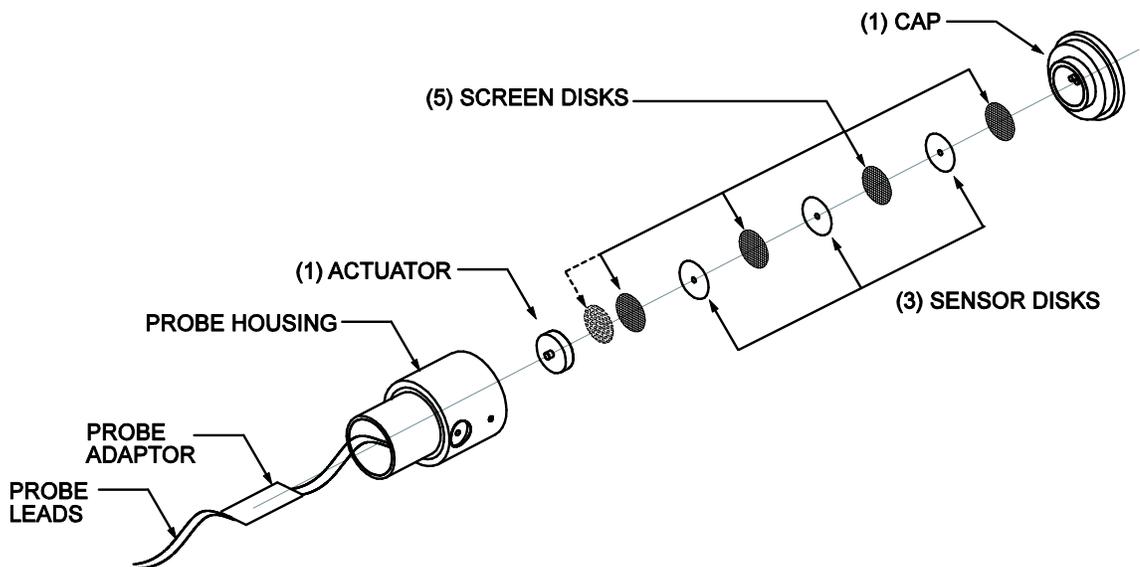


Figure 3-11
PHLR Sensor Package

3.4.1 Cleaning Sensor Elements Procedure

The replacement sensor package consists of 8 disks: 5 screen disks and 3 sensor disks as shown in Figure 3-11. The replacement package includes all removable parts: probe cap, sensor elements, and actuator. Replacement sensor elements can also be purchased on their own.

The following procedure is a general guideline to follow to clean the probe and sensor elements after exposure to hydrocarbon liquids. **Caution: It is the user's responsibility to determine safety precautions and the suitability of exposing personnel to the hydrocarbon liquid on the probes and various cleaning solvents suggested.**

The sensor disks swell after exposure to fuels and solvents. The swelling forces the actuator to move and operate a low-force sealed switch. Volatile hydrocarbon liquids, such as gasoline, will eventually evaporate resulting in the sensor disks returning to their original size. This allows the switch to return to the normal position. A faster resetting process is to disassemble the probe to speed the evaporation of the liquid. Other liquids such as diesel fuel and jet fuel, which do not evaporate, must be flushed with a solvent to remove the contamination. Disassemble and clean the probe as follows:

1. Remove excess hydrocarbon contamination from the exterior of the probe.
2. Hold the switch in a vertical position with the cap downward and unscrew the cap. It is suggested to do this over a table so the small parts are not lost if they are dropped. **Be very careful not to lose the sensor disks.** They are very similar to contact lenses in size and texture.
3. Place the actuator, screens, cap, and sensor disks into a small container of solvent. Coleman Camp Fuel, which is naphtha, works well and evaporates very quickly. Other solvents that evaporate quickly and completely are also suitable.
4. Soak the components for a minute or two and then remove them.
5. Let the solvent evaporate until the disks return to the original diameter and fit into the cap easily. If the sensor disks do not slip easily into the circular holder in the cap, repeat the cleaning process. The disks should be about 0.5" diameter when dry.
6. Reassemble the switch. Carefully alternate the 4 screens and 3 sensor disks in the cap as shown in Figure 3-11. Place the actuator on top of the top screen. The actuator has a small point in the center of one side that must face the probe housing as shown. Hold the probe housing vertically and screw the cap finger-tight into the bottom of the housing.
7. If response time is over 5 minutes for diesel fuel at room temperature, insert the optional 5th screen next to the actuator. Make sure the extra screen does not activate the probe when it is tightened. If so, remove the extra screen. The extra screen accommodates manufacturing tolerances and reduces the amount of swelling of the sensor disks that is required before the probe activates.

3.4.2 Testing the PHLR

The assembled probe can be easily tested with an ohmmeter and a small paperclip.

1. Connect the ohmmeter leads to the probe leads.
2. The reading should be 8k-10k ohms.
3. Insert the paper clip into one the center hole of the cap and press gently (1-2 oz. of force) into the switch.
4. The ohmmeter should read 150k-160k ohms.
5. Remove the paper clip and the reading should return to the original low reading.
6. Disconnect the ohmmeter.

3.4.3 Troubleshooting

If the test results are not as expected, the following checks should help determine the problem.

If the original reading is 150k-160k ohms, then

1. Check that the sensor disks and screens are installed correctly. They must be flat, not folded over.
2. Verify that the diameter has returned to the original size. Clean again if needed.
3. If the optional 5th screen adjacent to the actuator is installed, it should be removed.

If the ohmmeter reading is not 150k-160k ohms when the paperclip is inserted, then

4. Check that the meter leads or probe wires are not shorted together.
5. Disassemble the probe and make sure the actuator point is oriented properly to press into the center of the switch in the probe housing.

3.4.4 Probe Tests

All LiquidWatch II probes change resistance when switched from the normal “Good” state to the “Active” state. The probe leads can be removed from the terminal strip and a probe tested with an ohmmeter according to the “resistance” columns in the following table:

PROBE READING WITH PROBE ADAPTER INSTALLED				
	NORMAL		ACTIVE	
	Resistance (Ω)	A/D Reading	Resistance (Ω)	A/D Reading
PHLR-LW	8K – 10K	2900 – 3400	150K – 160K	800 - 1200
PHLR-P-LW	8K – 10K	2900 – 3400	150K – 160K	800 - 1200
PWS-LW	150K – 160K	800 - 1200	8K – 35K*	1300 – 3400
PSTV-LW	8K – 10K	2900 – 3400	150K – 160K	800 - 1200
PFS-LW	8K – 10K	2900 – 3400	150K – 160K	800 - 1200
PTHL-LW	8K – 10K	2900 – 3400	150K – 160K	800 - 1200
Normally-Closed Contact	8K – 10K	2900 – 3400	150K – 160K	800 - 1200
Normally-Open Contact	150K – 160K	800 - 1200	8K – 10K	2900 – 3400

**Note: The PWS-LW probe active resistance range is an initial reading when an ohmmeter is connected. The value will increase after a second or two. Reverse the meter leads to obtain a new reading.*

The probes and connecting wiring can also be tested without removing them from the circuit. This is described in Display Setup Menu, Section 4.4.4 of this manual. If the probe is not “Good” as determined from the “A/D Reading” columns, check the probe and wiring and correct the problem.

4. Operating LiquidWatch II

The LiquidWatch II panel interface consists of 5 menus as listed on the keypad label. The interface has been designed to provide prompts whenever possible to assist the user during setup and operation. Read the display carefully. LiquidWatch II prompts for the information it needs. The LiquidWatch II label has an integral 12-digit keypad to enter 0-9, CLR and ENT.

LiquidWatch II has a password protection system to prevent unauthorized access. LiquidWatch II requests a password whenever the user attempts to access a setup menu. After user access is granted, the access will remain active until the user exits out of the menu and back to the main screen or timeout after inactivity for 2 minutes. The LiquidWatch II will automatically return to normal functionality on password timeout and any unsaved information will be lost.

Functions are access by pressing the keys as described in the table below from the Monitor Idle screen.

Main Functions	
Key	Function
1	Probe Setup
2	Probe ON/OFF
3	History
4	Display Setup
5	Configuration

4.1 Menu Navigation

Navigation is performed by using the ▲ and ▼ keys (2 and 8) to move to the previous or next menu or option. In menus where devices are presented, the ◀ and ▶ keys (4 and 6) are used to scroll to the previous and next device respectively. The enter key, ENT, is used to select, to proceed, or to confirm options, and the clear key, CLR, is used to cancel or exit a menu.

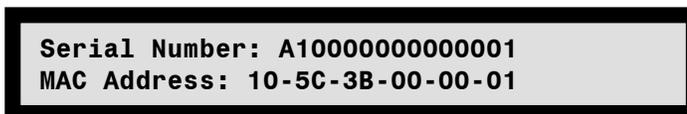
4.2 Initial Message Screens

During startup, the LiquidWatch II panel will display the firmware version as shown below.



**LIQUIDWATCH VERSION #.##.###
PermAlert A DIVISION OF PERMA-PIPE**

The display will the briefly show the Serial Number and MAC Address of the panel. For reference, the Serial Number is also included on a label inside the panel.



**Serial Number: A1000000000001
MAC Address: 10-5C-3B-00-00-01**

4.3 Monitoring Screen

The monitoring screen is the main screen of the LiquidWatch II panel while in monitoring state. The screen consists of 4 informational areas as labeled below



- **Probe Bank** – Display the bank number being actively monitored. Corresponds to probes and state display below.
- **Probe & State** – Cycles through probes that are not in the normal state (i.e. without short, break, or leak state). Indicates probe number and current alarm or maintenance state. Probes that are not in an alarm or maintenance state will not be shown.
- **Current Time** – Shows the 24-hour system time, in 1 second resolution as set in the “Configuration” menu.
- **Current Date** – Shows the current system date as set in the “Configuration” menu in YYYY-MM-DD format.

During normal operation, when no changes are detected, the monitoring screen will display probes and states in sequential order from lowest to highest number. When a bank has no alarms, the monitoring screen will indicate “all probes normal”.

4.3.1 Normal State

Below is an example a bank in monitoring state with no maintenance or alarms.



4.3.2 New Alarm or Maintenance State

Upon first detection of a leak or maintenance state, the monitor function will drop out of the cyclical display process and prioritize the newly detected alarm before returning to the cyclical display.

New Alarm State



New Maintenance State



4.3.3 Silence Alarm

In the event of an alarm, the audible alarm can be silenced and common alarm relay reset for two hours by pressing CLR from the Monitor Idle screen. The Alarm LED on the panel’s face will blink to indicate the alarms have been manually silenced.

4.4 Menus

Top level menu options are indicated on the panel keypad label. To enter a menu function, simply press the key of the desired menu. If a password is required, the system will prompt for password entry before allowing access to protected menus.

4.4.1 Probe Setup Menu

The probe setup menu is used to setup probes, assign relays to probes, and set the initial state of the probe to online or offline. The steps below detail how to setup a probe.

1. Press "1" key to enter the "Setup" menu
2. When prompted for password, enter the password
3. Press ENT to continue to probe settings

**DO YOU WANT TO CHANGE PROBE SETTINGS?
PRESS CLR TO CANCEL ENT TO CONTINUE**

4. Enter the probe number to be setup or changed (1 to 64). When finished, press ENT to continue.

**ENTER PROBE NUMBER CLR CANCEL ENT ACCEPT
PROBE _**

5. Select the probe type. Use the ▲ and ▼ keys to change scroll to the correct probe type press ENT to confirm selection.

**SELECT TYPE 2 AND 8 TO SCROLL ENT ACPT
PROBE 2 TYPE: WATER**

6. Assign a relay. Use the ▲ and ▼ keys to set or remove the assigned relay.

**ASSIGN RELAY 2 AND 8 SCROLL ENT ACCEPT
PROBE 2 ASSIGN REALY: 4**

7. Set Online / Offline state. Use the ▲ and ▼ keys to set the state. The state can also be changed in the Probe ON/OFF menu once the probe is setup. Press ENT to continue.

**SET STATE 2 AND 8 SCROLL ENT ACCEPT
PROBE 2 STATE: ONLINE**

8. Setup another probe as required. When prompted to setup another probe, press ENT to continue back to step 4 and setup additional probes, or CLR to continue to the save prompt.

**WOULD YOU LIKE TO SETUP ANOTHER PROBE?
PRESS CLR TO CANCEL ENT TO CONTINUE**

9. Save Probe Setup. Press ENT to save the updated probe setup and have them available at the next power cycle or CLR to discard changes.

**WOULD YOU LIKE TO SAVE YOUR CHANGES?
PRESS CLR TO CANCEL ENT TO CONTINUE**

10. The panel will indicate whether the probe settings were saved or discarded and return to Idle/Monitor mode.

4.4.2 Probe On/Off Menu

The Probe ON/OFF Menu is used as a quick access menu to enable or disable probes as necessary. This menu allows the user to change the probe state without going into the full probe setup function. This is useful, for example, to quickly shut off a probe for maintenance, or disable an alarming probe for investigation.

1. Press “2” key to enter the “Probe ON/OFF” menu
2. If prompted, enter the password
3. Select the probe to change. Use the ◀ and ▶ keys to scroll to the previous or next probe. Once the correct probe number is displayed, use the ▲ and ▼ keys to change the state.

**SET STATE 2 AND 8 SCROLL ENT ACCPT
PROBE 2 STATE: OFFLINE**

4. Save Probe Setup. Press ENT to save the updated probe setup and have them available at the next power cycle or CLR to discard changes.

**WOULD YOU LIKE TO SAVE YOUR CHANGES?
PRESS CLR TO CANCEL ENT TO CONTINUE**

5. The panel will indicate whether the probe settings were saved or discarded and return to monitoring mode.

SETTINGS SAVED

4.4.3 History Function

The History function gives the user quick access to the log history of the device. The history log display is made up of 3 sections as labeled and described below.

The screenshot shows a rectangular display box with a black border. Inside, the text is arranged as follows: the date '2018-01-01' is on the left, the time '15:50:04' is on the right, and the message 'PROBE 1 LEAK DETECTED' is centered below the date. Three arrows point to these elements: one from the left labeled 'Date of log' points to the date; one from the left labeled 'Log message' points to the message; and one from the right labeled 'Time of log' points to the time.

4.4.3.1 Viewing Logs

1. Press “3” key to enter the “History” menu
2. Read instruction message. Press any key to continue to the logs.

**USE 2 & 8 TO SCROLL CLR TO EXIT
PRESS ANY KEY TO CONTINUE**

3. Use the ▼ key to go to the next oldest log. Use the ▲ key to go to the next newest log. The scroll keys can be pressed and held to auto scroll.
4. Press CLR to exit

4.4.4 Display Setup Menu

The display setup menu allows the user to view the current state of the probes only. The Display Setup Menu is separated into 5 information sections as detailed below.



1. Press "4" key to enter the Display Setup Menu
2. Use ▲ and ▼ keys to cycle through the probes and view the information.
3. Press CLR or ENT to exit and return to Monitor Idle state.

4.4.5 Configuration Menu

The configuration menu covers all system configuration with exception of the probe setup. The configuration menu is separated into sub menus according to the type of values being set. This includes Network Settings, Clock Settings, Serial Port Settings, System Address, and Password Settings. The below sections detail each sub menu and the information settings within. The Configuration menu is designed to allow the user to edit multiple settings in succession. Once a submenu task is completed, the system will automatically return to the top level configuration menu to allow selection of the next setting.

4.4.5.1 Set System Clock

The LiquidWatch II panel is designed to track and log probe events. The system has a battery backed internal clock capable of keeping track of the time and date, even while the system does not have power. In order to ensure proper logging, it is important that the system time is accurate to either the local time zone or to an agreed upon, application specific, reference time zone. (Please note: The LiquidWatch II does not automatically adjust for daylight savings time. This must be done through the clock setting by the user if required). The instruction below details steps to set the clock.

1. Press “5” key to enter the “Configuration” menu
2. If prompted, enter in the password
3. Use the ▲ and ▼ to scroll through the submenus until the “Set System Clock” submenu is displayed as shown below.

**2 AND 8 TO SCROLL CLR BACK ENT CONTINUE
SET SYSTEM CLOCK**

4. Press the ENT key to proceed into the sub menu
5. The system will prompt to continue to setting the clock as shown below. Note that once the clock setting function is entered, the user must finish setting the clock to return to the main Configuration Menu. Press ENT to continue or CLR to cancel.

**DO YOU WANT TO SET THE CLCOK?
PRESS CLR TO CANCEL ENT TO CONTINUE**

6. Select between 12 or 24-hour clock using ▲ and ▼. This setting will affect how t time is displayed by the system. Press ENT to continue.

**SET 12/24 2 AND 8 TO SCROLL ENT ENTER
12 HOUR**

7. Set the Hour using ▲ and ▼ to adjust the value. If a 12-hour clock was selected in the previous step, the system will automatically limit setting from 1 – 12. Update the AM/PM label as the user scrolls past 12. The AM/PM label is visible only if a 12-hour clock has been selected. If the 24-hour clock has been selected, the system will allow 1 – 23 hours as valid settings. Press ENT to continue.

**SET HOUR 2 AND 8 TO SCROLL ENT ACCEPT
10: AM**

8. Set the Minute using ▲ and ▼ to adjust the value. Press ENT to continue.

**SET MINUTE 2 AND 8 TO SCROLL ENT ACCEPT
:42 AM**

9. Set the Year using ▲ and ▼ to adjust the value. Press ENT to continue.

**SET YEAR 2 AND 8 TO SCROLL ENT ACCEPT
2018**

10. Set the Month using ▲ and ▼ to adjust the value. Press ENT to continue.

**SET MONTH 2 AND 8 TO SCROLL ENT ACCEPT
SEPTEMBER**

11. Set the Day using ▲ and ▼ to adjust the value. Press ENT to finish setting the clock.

**SET DAY 2 AND 8 TO SCROLL ENT ACCEPT
10**

12. The panel will display the updated time before returning to the Configuration Menu.

**TIME SET: 10:42:00 AM
2018-09-10**

13. Press CLR from the Configuration menu to return to the main Monitoring screen.

4.4.5.2 Change Network Settings

The IP Address, Subnet Mask, Gateway, and Domain Name Servers (x2) can be adjusted under the Change Network Settings submenu. LiquidWatch II can be configured with either a static IP address, or can be set to auto negotiate an IP using DHCP. The instruction below details steps to setting up the network.

1. Press “5” key to enter the “Configuration” menu
2. If prompted, enter in the password
3. Use the ▲ and ▼ to scroll through the submenus until the “Change Network Settings” submenu is displayed as shown below.

**2 AND 8 TO SCROLL CLR BACK ENT CONTINUE
CHANGE NETWORK SETTINGS**

4. Press the ENT key to proceed into the sub menu
5. The system will prompt to continue to network settings as shown below. Note that once the network settings submenu is entered, the user must finish the setup process to return to the main Configuration Menu. Press ENT to continue or CLR to cancel.

**DO YOU WANT TO CHANGE NETWORK SETTINGS?
PRESS CLR TO CANCEL ENT TO CONTINUE**

6. Select between Static IP and DHCP using ▲ and ▼. If DHCP is selected, the user setup process is complete. The system will automatically save the DHCP flag and return to the main Configuration Menu once ENT is pressed. The remaining instructions will detail setting a STATIC IP address. Press ENT to continue.

**SET DHCP OR STATIC IP ADDRESS
STATIC IP**

7. View the Static IP. The panel will display the current IP address and prompt the user to press CLR to edit or ENT to continue on to the next settings. Press CLR to edit.

**PRESS CLR TO EDIT ENT TO CONTINUE
CURRENT IP: 0.0.0.0**

8. Set the IP address in xxx.xxx.xxx.xxx format. Use CLR to enter “.” and moves to the next byte. ENT saves the IP address and moves to the next setting. To set the below address, the user types the following on the keypad: 192<CLR>168<CLR>1<CLR>5. Press ENT to continue to the next setting.

**ENTER IP – USE CLR FOR “.” ENT ACCEPT
192.168.1.5**

9. View the Subnet Mask. The panel will display the current SUBNET MASK and prompt the user to press CLR to edit or ENT to continue on to the next settings. Press CLR to edit.

**PRESS CLR TO EDIT ENT TO CONTINUE
CURRENT NETMASK: 0.0.0.0**

10. Set the Subnet Mask in xxx.xxx.xxx.xxx format. Use CLR to enter “.” and moves to the next byte. ENT saves the Subnet Mask address and moves to the next setting.

**ENTER NETMASK USE CLR FOR “.” ENT ACCEPT
255.255.0.0**

11. View the Gateway. The panel will display the current GATEWAY and prompt the user to press CLR to edit or ENT to continue on to the next settings. Press CLR to edit.

**PRESS CLR TO EDIT ENT TO CONTINUE
CURRENT GATEWAY: 0.0.0.0**

12. Set the Gateway in xxx.xxx.xxx.xxx format. Use CLR to enter “.” and moves to the next byte. ENT saves the Subnet Mask and moves on to the next setting.

**ENTER GATEWAY USE CLR FOR “.” ENT ACCEPT
192.168.1.1**

13. View the Primary DNS. The panel will display the current Primary (PRI) DNS and prompt the user to press CLR to edit or ENT to continue on to the next setting. Press CLR to edit.

**PRESS CLR TO EDIT ENT TO CONTINUE
CURRENT PRI DNS: 0.0.0.0**

14. Set the Primary DNS in xxx.xxx.xxx.xxx format. Use CLR to enter “.” and moves to the next byte. ENT saves the Primary DNS and moves on to the next setting.

**ENTER PRI DNS USE CLR FOR “.” ENT ACCEPT
192.168.1.2**

15. View the Secondary DNS. The panel will display the current Secondary (SEC) DNS and prompt the user to press CLR to edit or ENT to continue on to the next setting. Press CLR to edit.

**PRESS CLR TO EDIT ENT TO CONTINUE
CURRENT SEC DNS: 0.0.0.0**

16. Set the Secondary DNS in xxx.xxx.xxx.xxx format. Use CLR to enter “.” and moves to the next byte. ENT saves the Secondary DNS and moves on to the next setting.

**ENTER SEC DNS USE CLR FOR “.” ENT ACCEPT
192.168.1.3**

17. Following the Secondary DNS entry, the system will save the network settings, prompt the user that the settings have been saved (shown below), and return to the Configuration Menu.

NETWORK SETTINGS UPDATED

4.4.5.3 Change Serial Port Settings

The LiquidWatch II has two serial ports with selectable Baud rate, Parity and Stop Bits. The selectable settings allow the user to adjust the communication settings to accommodate a broad array of serial ports. The Serial Port Settings menu is designed to allow the user to setup one or both serial ports with a single access into the menu. The below instruction set gives detailed information on setting up the serial ports.

1. Press "5" key to enter the "Configuration" menu
2. If prompted, enter in the password
3. Use the ▲ and ▼ to scroll through the submenus until the "Change Serial Port Settings" submenu is displayed as shown below.

**2 AND 8 TO SCROLL CLR BACK ENT CONTINUE
CHANGE SERIAL PORT SETTINGS**

4. Press the ENT key to proceed into the sub menu
5. The system will prompt to continue to serial port setup as shown below. Press ENT to continue or CLR to cancel and return to the Configuration Menu.

**DO YOU WANT TO CHANGE SEIAL PORT SETUP?
PRESS CLR TO CANCEL ENT TO CONTINUE**

6. When prompted, use the ▲ and ▼ to scroll to the desired port to setup. Press ENT to continue to the port's settings.

**SELECT PORT 2 AND 8 SCROLL END ACCEPT
PORT 1**

7. Set the Baud Rate. Use the ▲ and ▼ to scroll to the desired baud rate. The system allows standard baud rate settings of 9600, 14400, 19200, 38400, 57600, and 115200 bits per second. Once the desired baud rate is displayed, press ENT to continue.

**SET BAUD 2 AND 8 SCROLL ENT ACCEPT
PORT 1 BAUD RATE: 115200**

8. Set the Parity. Use the ▲ and ▼ to scroll to the desired Parity. The system allows Even, Odd or no parity. Once the desired parity is displayed, press ENT to continue.

**SET PARITY 2 AND 8 SCROLL ENT ACCPT
PORT 1 PARITY: NONE**

9. Set the Stop Bits. Use the ▲ and ▼ to scroll to the desired stop bits. The system allows for one (1) or two (2) stop bits. Once the desired number of stop bits is displayed, press ENT to continue.

**SET STOP BITS 2 AND 8 SCROLL ENT ACCPT
PORT 1 STOP BITS: 1**

10. Set Protocol. Use the ▲ and ▼ to scroll to the desired protocol, and press ENT to continue.

**SET PROTOCOL 2 AND 8 SCROLL ENT ACCPT
PORT 1 PROTOCOL: MODBUS**

11. Save the changes. The system will prompt the user to save the settings by pressing ENT or discard the settings by pressing CLR. Press ENT to save.

**WOULD YOU LIKE TO SAVE YOUR CHANGES?
PRESS CLR TO CANCEL ENT TO SAVE**

12. Settings Saved. The system will display settings saved message.

SETTINGS SAVED

13. Setup additional port or continue. The system will ask the user if they would like to continue to setup additional ports. Press CLR to return to the Configuration Menu, or press ENT return to step 6 above.

**WOULD YOU LIKE TO SET ANOTHER PORT?
PRESS CLR TO CANCEL ENT TO CONTINUE**

14. Press CLR from the Configuration Menu to return to the main monitoring screen.

4.4.5.4 Change System Address

The LiquidWatch II has a system address that it uses to communicate on Modbus networks. This address is set globally for all Modbus interfaces.

1. Press “5” key to enter the “Configuration” menu.
2. If prompted, enter in the password.
3. Use the ▲ and ▼ to scroll through the submenus until the “Change System Address” submenu is displayed as shown below.



2 AND 8 TO SCROLL CLR BACK ENT CONTINUE
CHANGE SYSTEM ADDRESS

4. Press the ENT key to proceed into the sub menu.
5. The system will display the current address and prompt the user to press CLR to edit the current address or ENT to continue and accept the current address. Press CLR to edit.



CURRENT ID: 1
PRESS CLR TO EDIT ENT TO CONTINUE

6. Use the number keys (0-9) to enter a new address and press ENT to save the ID.



ENTER ID (1 TO 254) ENT TO CONTINUE
123

7. Once finished, the system will navigate back to the configuration menu.

4.4.5.5 Change Password

The LiquidWatch II has a password protection security system for some menus. The default password is "12345". The password can be changed to any 0 to 20-digit number entered by built in keypad. The instruction below details steps to setup or change password.

1. Press "5" key to enter the "Configuration" menu
2. If prompted, enter in the password
3. Use the ▲ and ▼ to scroll through the submenus until the "Change Password" submenu is visible as shown below.

ENTER CURRENT PASSWORD AND PRESS ENT

4. Use the number keys to enter the current password. The CLR key will reset the entry in case of a mistype. For security the password is hidden and displayed as asterisks. Press ENT key to continue to enter the new password.

ENTER CURRENT PASSWORD AND PRESS ENT

5. Use the number keys to enter the NEW password. The CLR key will reset the entry in case of a mistype. For security the password is hidden and displayed as asterisks. Press ENT key to continue to enter the new password a second time.

ENTER NEW PASSWORD AND PRESS ENT

6. Use the number keys to re-enter the NEW password. The CLR key will reset the entry in case of a mistype. Press ENT to finish password.

RE-ENTER NEW PASSWORD AND PRESS ENT

7. Once finished, the system will navigate back to the configuration menu.

5. Connecting to LiquidWatch II

The LiquidWatch II panel provides several different ways to get the status of its probes via both serial and network connection. The details of these protocols can be found in the individual sections below.

5.1 Modbus Communications Overview

The LiquidWatch II panel provides probe status and probe A/D value via a standard Modbus interface. These statuses can be read using the “READ HOLDING REGISTER” (0x03). Valid registers start at address 40001 up to and including address 40129. Note that holding register values start at an offset of 1 per Modbus convention. Reading above these registers or attempting to use any other commands will result in a corresponding Modbus error status code. To allow different system architectures and communication methods, the Modbus interface can be accessed by both serial connection, through ports 1 or 2, Ethernet connection, through standard TCP/IP packets, or a combination of both. Details for each connection type are provided below. Full details on the register values can be found in Appendix A.2 at the end of the document.

5.1.1 Modbus Global Settings

The only Modbus global setting required for connecting to any of the Modbus interface types below is the System Address. The System Address is used for the Modbus protocol as the Modbus ID. A newly installed panel will have an initialized address of 1. This must be set to the desired address, if other than 1, for proper communications from the panel.

5.1.2 Modbus Serial Communications

The LiquidWatch II provides Modbus RTU connectivity to systems requiring RS232 (Port 1 or Port 2) or RS485 (Port 1 only) interfaces. To ensure proper connection, the serial ports must be setup correctly for the controlling system. Below is the list of settings that are required to be set to connect to LiquidWatch II's Modbus interface via serial port. These settings will differ depending on the requirements of the system being connected.

5.1.2.1 Modbus Serial Values

For proper connection, the following values should be checked and adjusted under the serial port settings configuration menu. See section 4.4.5.3 for more information.

- Baud Rate
- Parity
- Stop bits
- Protocol

5.1.2.2 Modbus Serial Jumper Settings

If connecting to Modbus serially via port 1, the jumper settings must be verified and set to the proper connection and duplex type. For information on the Port 1 jumper settings, refer to Section 2.6.1.

5.1.3 Modbus TCP/IP Communications

The LiquidWatch II provides both Modbus RTU over TCP/IP and Modbus TCP/IP connections via its Ethernet interface. Each connection has its own port as detailed below.

Port	Protocol
502	Modbus TCP/IP
1050	Modbus RTU over TCP/IP

To use the Modbus interface over TCP/IP connection, the IP address of the device will need to be set according to the controlling system requirements. The Modbus TCP/IP service is automatically started when the system is powered on.

5.2 BACNet Communications

The LiquidWatch II panel supports BACNet over TCP/IP on port 47808. The BACNet interface provides 64 Analog Inputs and 64 Multi-State inputs as detailed in Appendix A.3.

Port	Protocol
47808	BACNet

To use the BACNet interface, the IP address of the device will need to be set according to the controlling system requirements. The BACNet service is automatically started when the system is powered on.

Appendix

A.1 Supply Power

Supply Power shall be provided by a UL Recognized Power Supply Cat No PS-35-24, manufactured by Meanwell Enterprises, or a Listed Class 2 Power Supply.

A.2 Modbus Data Structure

Function code 3 is used to retrieve the probe status values from the Leak LiquidWatch II Unit. All values are integer. All data will be referenced to the start holding register address of 40001 in the following manner. The "Probe x Status" value is defined in section A.4 below.

40001 LiquidWatch II communications status (Legacy will always return 0)

40002 Probe 1 status

40003 Probe 1 diagnostic A/D value

40004 Probe 2 status

40005 Probe 2 diagnostic A/D value

40006 Probe 3 status

40007 Probe 3 diagnostic A/D value

40008 Probe 4 status

40009 Probe 4 diagnostic A/D value

40010 Probe 5 status

40011 Probe 5 diagnostic A/D value

40012 Probe 6 status

40013 Probe 6 diagnostic A/D value

40014 Probe 7 status

40015 Probe 7 diagnostic A/D value

40016 Probe 8 status

40017 Probe 8 diagnostic A/D value

...

40128 Probe 64 status

40129 Probe 64 diagnostic A/D value

A.3 BACNet Data Structure

The LiquidWatch II BACNet data consists of 64 analog Inputs for the probe value and 64 Multi-State inputs for probe status as detailed below. All data The “Probe x Status” value is defined in section A.4 below.

Analog Inputs:

Analog Input 0 – Probe 1 A/D value

Analog Input 1 – Probe 2 A/D value

Analog Input 2 – Probe 3 A/D value

Analog Input 3 – Probe 4 A/D value

Analog Input 4 – Probe 5 A/D value

Analog Input 5 – Probe 6 A/D value

Analog Input 6 – Probe 7 A/D value

Analog Input 7 – Probe 8 A/D value

Analog Input 8 – Probe 9 A/D value

...

Analog Input 63 – Probe 64 A/D value

Analog Input 63 – Probe 64 A/D value

Multi-State Inputs:

Multi-State Input 0 – Probe 1 Status

Multi-State Input 1 – Probe 2 Status

Multi-State Input 2 – Probe 3 Status

Multi-State Input 3 – Probe 4 Status

Multi-State Input 4 – Probe 5 Status

Multi-State Input 5 – Probe 6 Status

Multi-State Input 6 – Probe 7 Status

Multi-State Input 7 – Probe 8 Status

Multi-State Input 8 – Probe 9 Status

...

Multi-State Input 63 – Probe 64 Status

A.4 The probe status values

0 Probe Active

1 Break

2 Short

3 Normal

4 Off-Line

5 N/A

Warranty

Seller warrants that the PermAlert Leak Detection System (the "System") will be free from defects in materials and workmanship for a period of twelve (12) months from the date of first use of the System or eighteen (18) months from the date of shipment by Seller to Buyer of the System; whichever is earlier. Seller is not responsible for damage to the System occurring in transit or arising from the installation, alteration or repair of the System by persons other than Seller's employees, or from any abnormal or improper use of, negligence with respect to or accident affecting the System. Seller's sole obligation and liability, and Buyer's sole remedy, under this warranty shall be the repair or replacement, at Seller's election, by Seller of any defective materials or workmanship covered by this warranty, without the charge to Buyer. Repaired or replacement materials shall be delivered to Buyer f.o.b. Seller's plant or f.o.b. such other location as Seller shall designate. Seller shall not be responsible for any product returned to Seller without Seller's prior express consent. Buyer shall be responsible for returning the defective or non-conforming product(s) to Seller at Buyer's expense. No claim shall be permitted under the warranty contained herein unless Buyer notifies Seller in writing within ten (10) days after Buyer first hears of facts giving rise to any such claim and unless notice is given within the warranty period as provided above. In order to be valid, any notice sent to Seller in connection with said claim under this warranty must reasonably specify the defect which is the subject of such claim. Buyer shall be responsible for testing and inspecting the System promptly after receipt and thereafter at such intervals as are reasonably prudent so as to inform Seller of any defects which exist in the System. Notwithstanding the filing of a claim hereunder, this warranty shall expire after the warranty period in respect to materials and workmanship which are not then the subject of a proper claim.

To the maximum extent permitted by law, Buyer irrevocably waives all claims against Seller for money damages relating to the condition, use and performance of the goods sold pursuant hereto, including claims based upon tort, strict liability, negligence and product liability. Notwithstanding the provisions of the preceding sentence, if money damages are assessed against Seller, in no event shall Seller's liability for such damages exceed the purchase price of products sold by Seller.

IN NO EVENT, WHETHER BECAUSE OF A BREACH OF WARRANTY OR REPRESENTATION OR ANY OTHER CAUSE, WHETHER BASED UPON CONTRACT, TORT, WARRANTY OR OTHERWISE, ARISING OUT OF THE PERFORMANCE OR NON-PERFORMANCE BY SELLER OF ITS OBLIGATIONS UNDER THIS AGREEMENT OR WITH RESPECT TO THE PRODUCTS SOLD PURSUANT HERETO SHALL SELLER BE LIABLE FOR LOST EARNINGS, INCOME OR PROFITS OR INDIRECT, INCIDENTAL CONSEQUENTIAL DAMAGES.

THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE AND, EXCEPT AS SPECIFICALLY SET FORTH HEREIN, ALL OTHER WARRANTIES AND REPRESENTATIONS, EXPRESS OR IMPLIED, ARE HEREBY DISCLAIMED AND EXCLUDED. NOTHING SHALL BE CONSTRUED AS AN ADDITIONAL WARRANTY UNLESS SPECIFICALLY DESIGNATED AS SUCH IN WRITING AND SIGNED BY THE SELLER, IN WHICH CASE SUCH ADDITIONAL WARRANTY SHALL BE SUBJECT TO THE PROVISIONS OF THE APPROPRIATE PARAGRAPHS HEREIN AS TO DURATION AND LIMITATION OF REMEDY UNLESS SUCH ADDITIONAL WARRANTY EXPRESSLY VARIES SUCH PROVISIONS.

Extended warranty period may be available. Contact PermAlert for more information.

