PAL-XD

Installation and Operating Manual

PAL-XD Series
Regulatory Date/ Version: 2023.08.03
Feature version: 2023.08.31

Notice

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Caution --This manual may not be up-to-date.

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 PAL-XD system.

Table of Contents

Safety Information

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 PAL-XD to rain or moisture.

> CAUTION: TO REDUCE THE RISK OF ELECTRIC SHOCK, TURN OFF POWER BEFORE OPENING ENCLOSURE. 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

CE c UL us LISTED

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

The Network Enabled PAL-XD system consists of an electronic monitoring unit connected by jumper cable to a sensor cable. The sensor cable is continually monitored for leaks, breaks, shorts, and disconnects. The unit's status is then communicated directly through LEDs and an audible alarm on the monitoring unit, to its web page, or by communications protocols connected either through RS-485 or Ethernet.

When using the PAL-XD the following general precautions should be observed:

1. Read this manual carefully before beginning installation. Do not use alternate materials or recommended procedures. Understanding and following these instructions is essential to avoid installation problems.
2. Check packing list quantities with received items. Any shortages or damage to materials received should be reported immediately to the delivering carrier.
3. Care must be taken to store all PAL-XD components in a dry and protected area at all times. Electronic monitoring units should be wrapped and sealed with plastic.
4. Electrical work should be performed by a qualified electrician and conform to all local codes.

2. Theory of Operation

The PAL-XD Leak Detection Monitoring System is designed to monitor small areas for non-hazardous or ordinary location liquids using up to 500ft (150m) of PermAlert leak detection cable. Typical applications include unmanned equipment rooms, small, raised floor areas, and small tanks.

Using PermAlert's advanced TDR technology, the PAL-XD system continuously monitors the connected sensor cables for dielectric changes resulting from the presence of any liquid able to permeate the cable. This means that the PAL-XD can be used to monitor any number of liquids including: water, pastorium based fuels, alcohols, acids, bases, dielectric coolants, and more.

Once the presence of a liquid is detected the unit will:

1. Turn on a LED indicator on the panel
2. Switch an internal "Leak" relay to active
3. Activate a horn
4. Update the Modbus status to LEAK

After detection, the PAL-XD will return to NORMAL only once the presence of liquid is no longer detected or the user re-initializes the cable.

3. Cable Installation

Each PAL-XD system is a complete kit that includes the monitoring unit, a wall plug power supply, and an application specific length of jumper cable, and sensor cable. The lengths of sensor and jumper cables may be pre-connectorized for easy installation or be provided for field termination to allow full customization.

In a typical installation, the sensor cable is placed around the perimeter of a room, a piece of equipment, or some other space that is to be monitored for leaks. The cable should be protected from people walking on it or equipment being placed on it.

The PAL-XD system has minimum length requirements as listed below and may be provided with convenient beginning of line and end of line termination assemblies for ease of installation.

Installation notes for all PAL-XD systems

- 30ft (10m) of JMP cable before any actively monitored sensing cable.
- The end of sensor cable must have 3ft (1m) of sensing cable at the end of the system folded back and sealed.
- IMPEDANCE jumper next to leak detection terminal must be set across the “Coax” pins.

4. Monitoring Unit Installation

The panel is designed to be permanently mounted indoors, in a dry area where it will not be exposed to vibration, shock, high temperatures or humidity. The maximum ambient operating temperature is 122°F [50°C].

Install location Requirements:

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

NOTICE: The PAL-XD must be mounted so that the power connection is free of obstruction and accessible for disconnecting.

⚠ Warning: Do not mount the PAL-XD panel in a hazardous location. The panel and sensing string must be in an ordinary location.

Wall Mounting

The monitoring unit is intended to be mounted to a fixed location using the provided slots as detailed below. A third hole is provided under the cover to secure the unit on the slots. It's not necessary to remove the PCB to mount the panel.

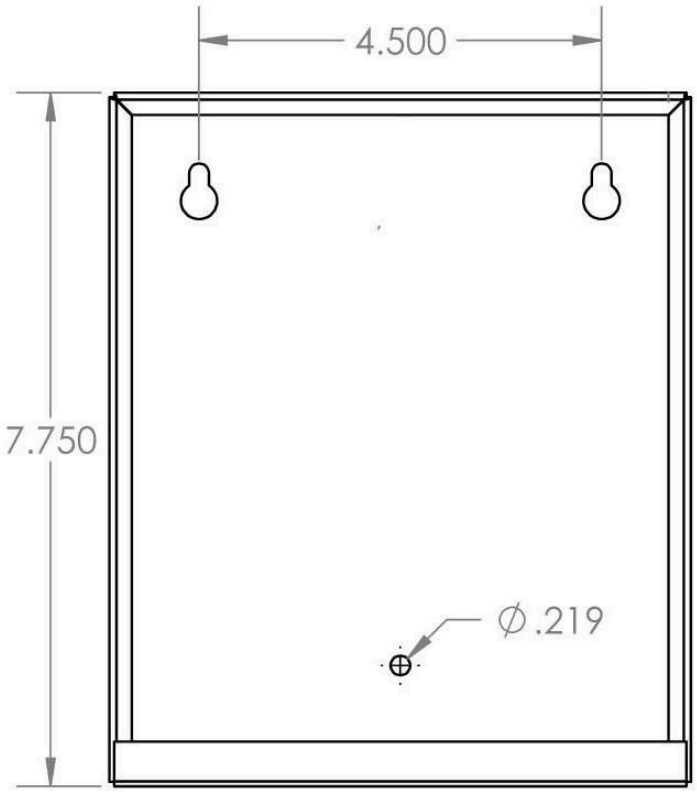


Figure 4.1 – Panel Mounting Dimensions

5. Power Requirement

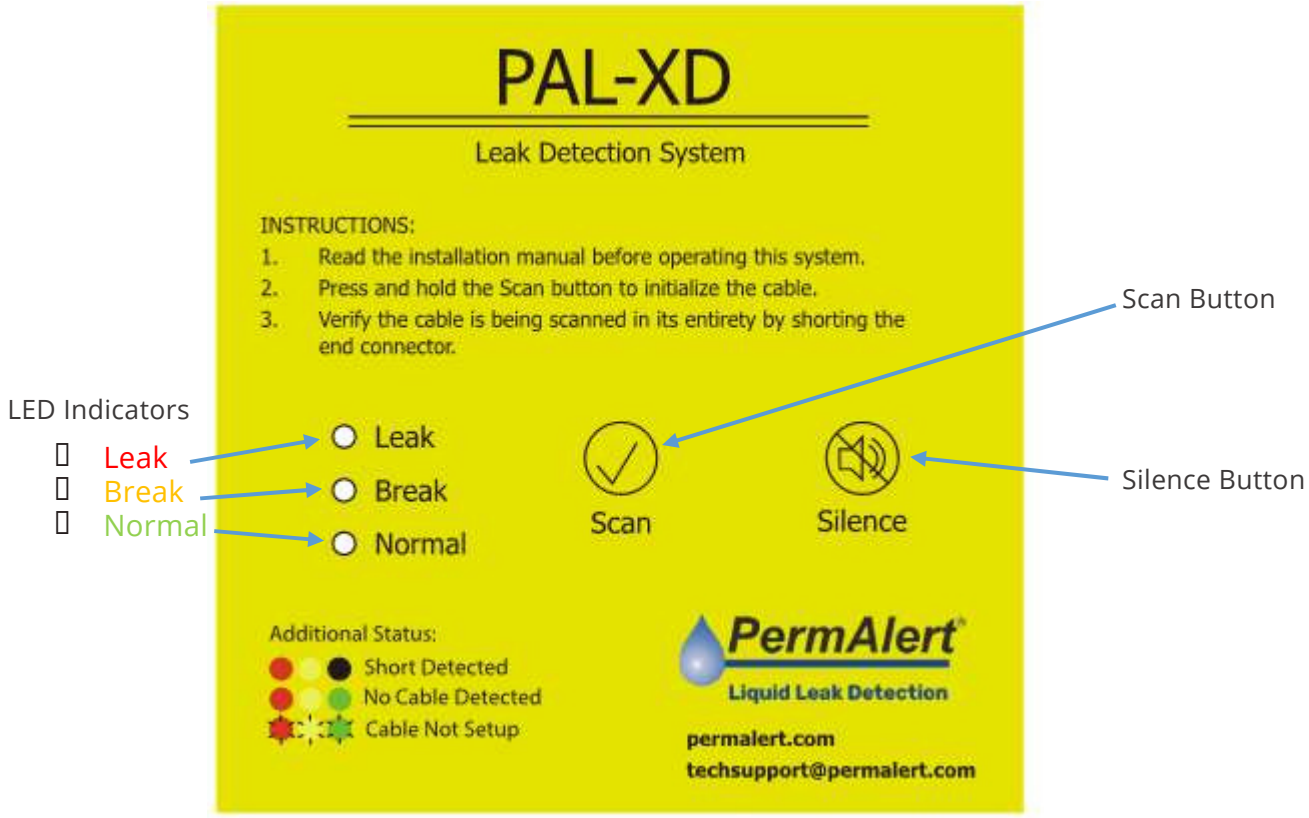
The PAL-XD requires 24VDC / 10W of power and is provided with a 24VDC wall plug style power supply with automatic current limiting. The panel has mating DC jack connection with a threaded ring for securing the connection in place. The device may also be provided with 24VDC control voltage from a centralized location if available.
Note if providing 24VDC directly without use of the provided power supply, the center pin of the provided jack is +24VDC

6. The PAL-XD Alarm Panel

The PAL-XD alarm panel is designed to be a fully independent device. It can be quickly installed, initialized, and indicate cable status out of the box with only power and a sensor cable connected. The supported communications protocols and relays connections are not necessary for monitoring for leaks but are provided for additional information and remote monitoring.

The alarm panel will alert any time a cable status other than “Normal” is detected, as determined when the cable initialized. The panel will continue to alarm until the event causing the status change is corrected.

For setup and status indication at the panel, the PAL-XD has a set of 2 buttons, 3 LEDs, and an audible alarm as described below. For convenience, Leak, Break, and Normal status have dedicated LEDs, all other status are indicated by combinations of LEDs and blinking. A status key is included directly on the label for reference.



6.1 Alarm Panel Buttons

- Scan Button – The scan button is used to initialize the cable or re-initialize the cable to accept changes. Section 8 for more information.
- Silence Button – Press the Silence button to silence the audible alarm for 24 hours. A change in cable status will re-activate the audible alarm

6.2 Alarm Panel LED Indicators

The Alarm panel has three LEDs indicators that change according to the status of the cable. The most prevalent states of Leak, Break, and Normal have their own LEDs. The other states such as Not Setup, Short, and No Cable detected use a combination of these LEDs for indication. There is a convenient reference directly on the PAL-XD monitoring panel for these states. The below table summarizes the various LED states.

LED Behavior

LED Name	Not Setup	Initializing Cable	Normal	Leak	Break	Short	No Cable Detected
Leak	Toggling	Off	Off	On	Off	On	On
Break	Toggling	Off	Off	Off	On	On	On
Normal	Toggling	Toggling	On	Off	Off	Off	On

6.3 Alarm Panel Audible Alarm

The Audible alarm will sound whenever the PAL-XD is not in the Normal monitoring state. This alarm is temporarily silenced by pressing the Silence button. It will remain silenced for 24 hours. Once silenced the alarm will reactivate on any status change other than a return to the Normal monitoring state.

6.4 Ethernet Connection

On initial startup, the PAL-XD Ethernet port will be set to a standard IP Address and Netmask. The initial IP address settings are detailed below. To access the device's settings page, the user must use a PC or laptop with a standard web browser (E.g. Microsoft Edge, Google Chrome, Mozilla Firefox) and either directly connect to the panel or thought the same Ethernet switch. The setup page can be accessed by entering the devices IP address directly into a standard browser.

Initial Wired Ethernet Settings:

IP Address: 192.168.0.100
Netmask: 255.255.0.0
Setup Page URL: http://192.168.0.100

In order to ensure connection, the User's PC or Laptop must be on the same subnet as the PAL-XD. The below example gives a typical IP address and netmask setting for the User's machine.

Suggested IP settings for connecting PC:

IP Type: Static
IP Address: 192.168.0.101

Netmask: 255.255.0.0

Refer to additional sections below for detailed information on settings.

6.5 Factory Reset

The PAL-XD panel can be reset to factory defaults to re-establish connection to a device where connection settings or credentials are unknown. Factory reset is initiated by holding the User button (see Figure 9.1 below) while powering on the unit. Alternatively, press and release the Reset button while holding down the User button. Factory reset will reset the following: IP Address, Subnet Mask, Gateway, DNS, Username, Password, Modbus ID, Serial Port settings.

NOTE: Factory Reset WILL NOT affect the cable setup.

7. Setup Monitoring

The PAL-XD is designed to be easy to setup and requires only a single button push. The below initialization can be performed for periodic calibration, or to initialize a different length of cable.

7.1 Initializing the Sensor Cable

Once the PAL-XD monitoring panel is installed, and the desired leak detection cable is connected, the unit may be powered up. Follow the below instructions to initialize or re-initialize the cable. The user can re-initialize the cable and save the new cable information at any time. This should be done with a level of attention, as breaks or shorts on the cable might result in a shorter cable being monitored or a failure of the device to complete calibration. If such a scenario arises, simply repair or replace the cable and recalibrate.

1. On first power up, the PAL-XD monitoring panel will sound an alarm indicating it is not setup and blink all three indicator LEDs.
   Note: If the monitoring panel was pre-calibrated prior to shipping, the alarm panel may show a different status. If this is the case, the below steps should still be followed to ensure the device is ready for monitoring at the installed location.
2. If needed, silence the horn by pressing the “Silence” button.
3. To initialize the cable, press and hold the “Scan” button for 5 seconds, until only the “Normal” LED begins to blink.
4. The Monitoring unit will automatically scan the end of the cable and take an initial reading before going into monitoring mode, indicated by a “Normal” status indication.
5. To test that the entire cable is being monitored:
   a. If there is an open connector at the end, short the open-end connection using any metallic object and verify the panel indicates “Short”.
   b. If there is a heat shrink booted termination, dip the end of the cable into water to verify it goes into leak.

7.2 Testing the Sensor Cable

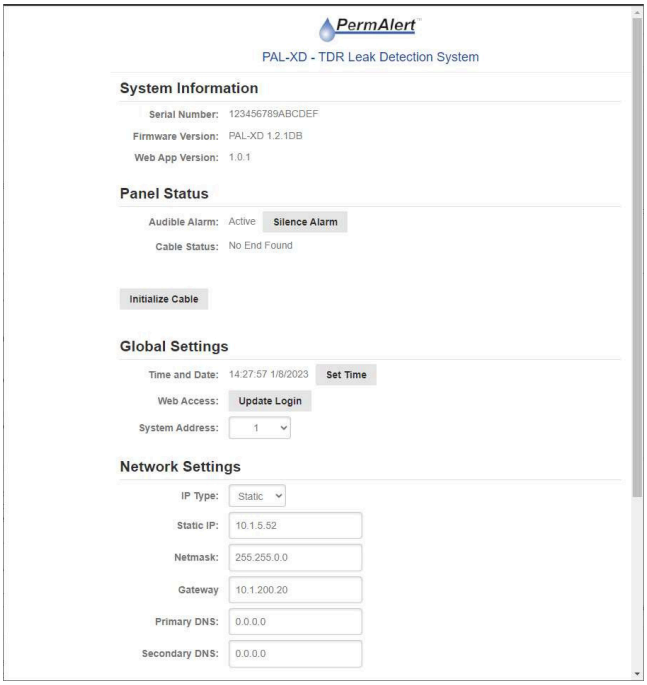
The PAL-XD may be checked periodically to verify sensitivity by shorting the end of the line or dip the end of the cable into water to verify it goes into leak as described in Section 7.1 point 5. However, this is not necessary to maintain reliable monitoring.

8. System Configuration

The PAL-XD has additional configuration options available for communicating and monitoring. Setup of the additional options are done through an ethernet connection

8.1 PAL-XD Web Page

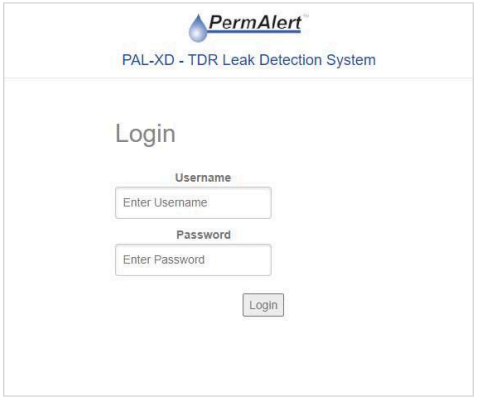
Communications settings are performed via the PAL-XD's built in web page using a standard browser. Below details the settings and information available on the web page.



8.2 Web Page Login

The PAL-XD web site requires a user name and password to access. Enter the below credentials and click "Login" to get to the PAL-XD setup page.

- Username: admin
- Password: admin



8.3 System Settings and Status Page

From the web page, a user can see the current system status and edit any required communications settings for the specific application and environment. To the right is an image of the PAL-XD web page as well as a brief description of each setting and information field organized by group.

Once changes are made on the web page the user must click “Save” at the bottom of the page to apply the changes.

8.4 System Information

This group is a list of information pertaining to the software and Device ID

- Serial Number: Globally unique serial number of the PAL-XD monitoring panel
- Firmware Version: Software version currently running on the PAL-XD monitoring panel
- Web App Version: Version of the website being used to access the device. This can be useful to determine if the web browser has loaded the current version of the website or is using a cached copy.

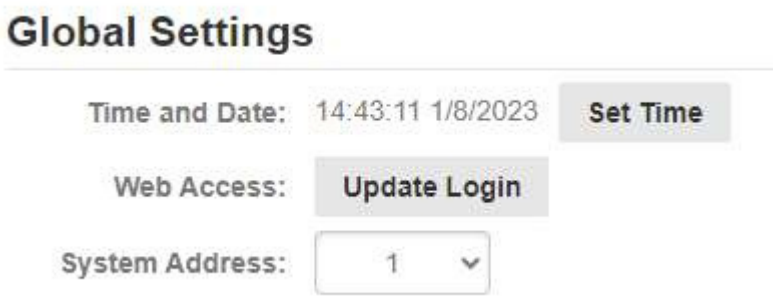
8.5 Panel Status

This group gives the user a display of the current monitoring status and remote access for initializing the cable

- Audible Alarm: The current status of the audible alarm as Active, Off or Silenced. When active, the “Silence Alarm” button will appear to allow remotely silencing the audible alarm through he web page. Cable Status: The current cable status
- (OK, Leak, Break, Short, No End, Not Setup)
- Initialize Cable: The “Initialize Cable” button will rescan the cable and save the results for monitoring. Care should be taken when re-initializing the cable. Once started, the initialization process will update the length of cable being monitored, and clear any issues that are present on the cable.

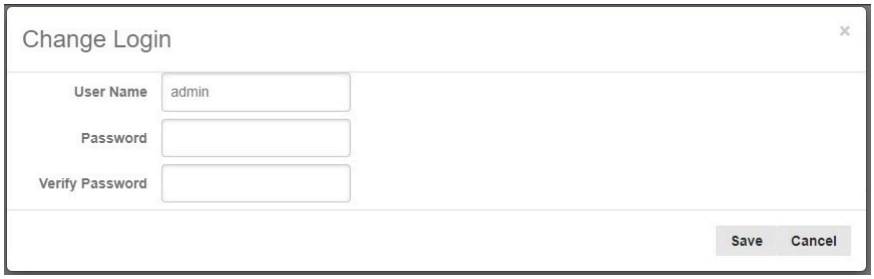
8.6 Global Settings

The Global Settings group has general settings that effect the communications and setup of the device.



- Set Time: The “Set Time” button will pop up a window, shown below, to set the time on the device.

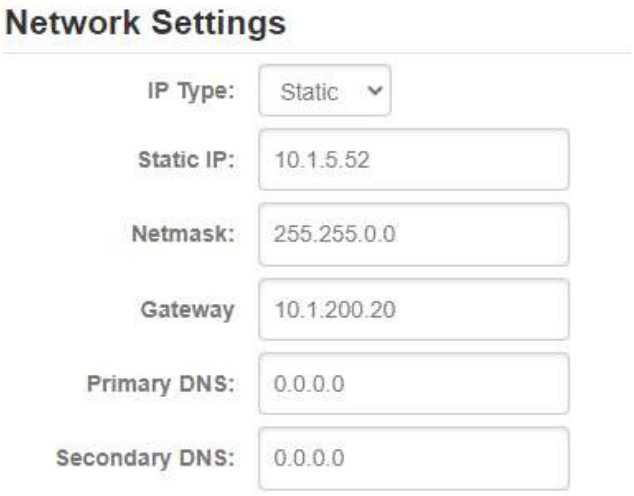
- Change Login: The username and password is changed under the resulting window through a typical User Name and Password dialog box with password verification.



- System Address: The System Address is used to identify the device to Modbus RTU networks. Once the System Address is updated, the “Save Settings” button will save it to the device.

8.7 Network Settings

By default, the IP address of the PAL-XD is 192.168.0.100 /24. Changes to the IP address for connecting to the web page or Modbus over Ethernet (Modbus TCP / RTU over TCP) are done here. Once the Network Settings are changed, the “Save Settings” button will save the settings to the device.



- IP Type: The IP Type can be selected as Static (default) or DHCP if desired. The static setup fields will automatically hid when selected to DHCP
- Static IP: This should be set to the desired IP of the device for web page connection and communications over Ethernet
- Netmask: This should be set to the desired Netmask

- Gateway: This may be set to the desired gateway for the connected network if required
- DNS (x2): These may be set to the desired Domain Name Server IP addresses

8.8 Port Settings group

Changes to the serial port settings are made under Port Settings. There are two serial two RS-485 connections internal to the PAL-XD alarm panel providing Modbus RTU connection. Each serial port has a separate group of independent communication settings.

- Baud Rate: This field allows setting connection rates of 9600, 14400, 19200, 38400, 57600 or 115200 bits per second (Default 57600)
- Parity: This field allows setting a parity of None, Odd, or Even (Default None)
- Stop Bits: This field allows setting of One or Two stop bits (Default One)

9. Field Wiring

Field wiring is directly to the board through the provided terminal blocks. The terminal blocks are quick release and support 0.14 to 1.5mm2 [24 to 16 AGW] wire without a ferrule. To insert simply depress the spring release with a small flathead screwdriver and push the wire securely into the terminal. To release, depress the spring release and gently pull the wire free. Ferrules may be used on wires up to 0.75 mm2 for insulated ferrules or up to 1.5mm2 uninsulated. When ferrules are used, the wire may be pushed into the terminal without depressing the spring release.

⚠ Power to the unit should be turned off when connecting any internal wiring to the monitoring unit to avoid damage.

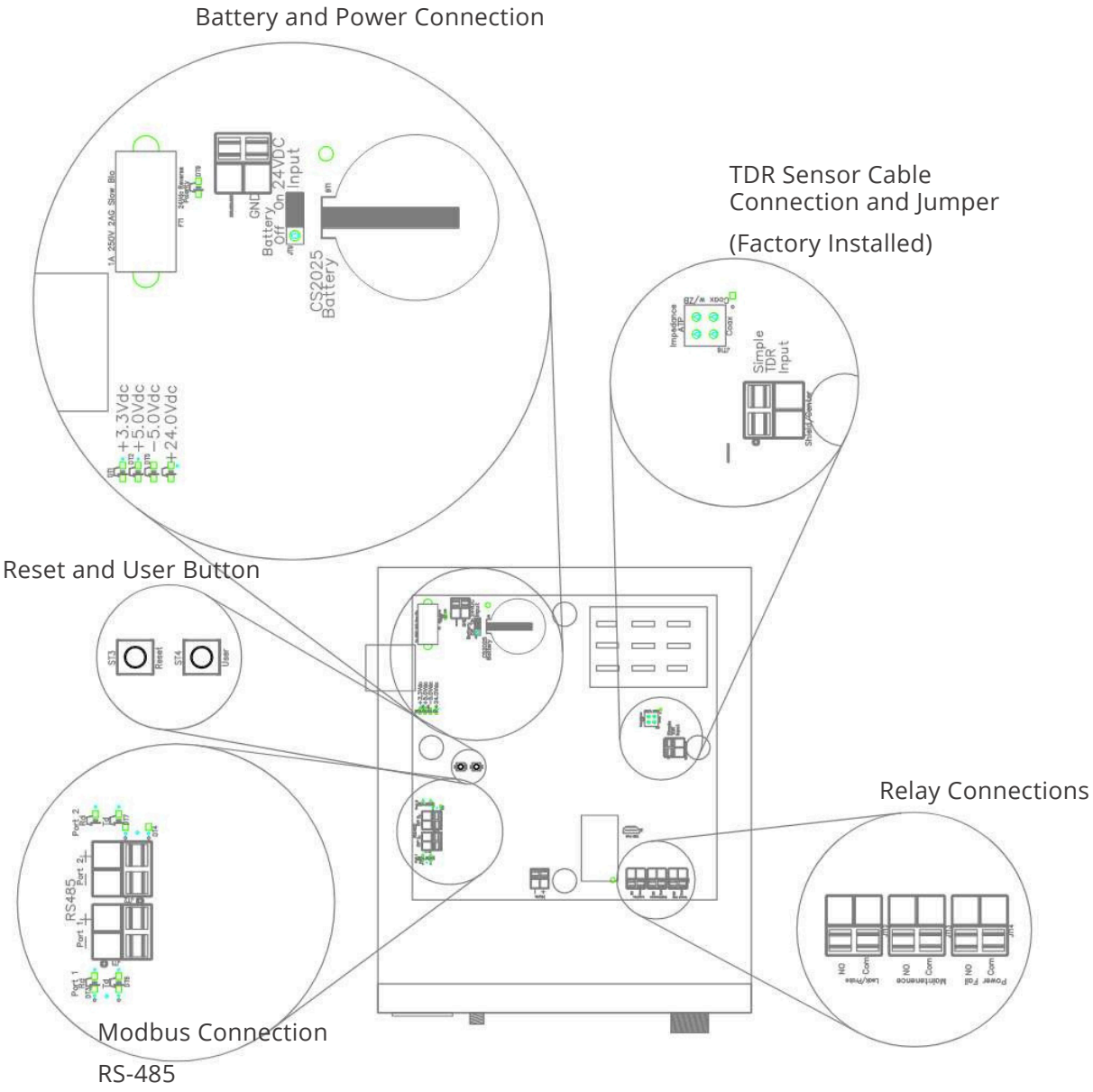


Figure 9.1 – Internal Connection Detail

10. Communicating with PAL-XD

The PAL-XD panel provides Modbus and BACnet communications for control and integration. Connections can be made either through 2 wire RS-485 connection for Modbus RTU or TCP/IP socket connection for Modbus TCP, Modbus RTU over TCP, and BACnet..

10.1 Modbus TCP / RTU Over TCP

The PAL-XD allows connection via Modbus TCP or Modbus RTU over TCP. Both these protocols are active by default.

- Modbus TCP Port: 502
- Modbus RTU over TCP Port: 1050

10.2 Modbus RTU over RS-485 Serial

The PAL-XD supports two concurrent RS-485 serial connections. Both ports are two wire connections made internally to the panel. See the section on Field Wiring for location details.

Default Serial Settings

- Baud Rate: 57600
- Parity: None
- Stop Bits: One

10.3 Modbus Read Registers Function 3

The PAL-XD supports the Read Multiple Registers (Modbus function 3). Valid registers are listed below. See the Cable Status section below for how to interpret the cables status value.

Modbus Register Map

Register Address	Description	Values
40001	Cable Status	See Cable Status section below

10.4 BACnet Connection

The PAL-XD panel provides BACnet communications over TCP on port 47808 (typical). The device supports a single Multistate Input to communicate the cable status. .

10.5 Cable Status

The cable status register gives the live status of the monitored leak detection cable. The values for this register are detailed below.

Cable Status Values

Register Value	Status

0x02	Cable OK – Normal State
0x03	Liquid Detected
0x04	Cable Break Detected
0x05	Cable Short Detected
0x09	No Cable Detected Cable is disconnected or broken within the initial jumper section
0x0ff	Cable Uninitialized

11. Relay Connections

There are three SPST Solid State output relays on the system board. The relays are rated for 60V 0.5A. Relays are normally open until energized. All three relays are connected via an internal terminal block and are labeled with the names in the table below. See the section on Field Wiring for relay wiring location details. Refer to the table below for quantity and behavior of relays.

Relay Behavior

Name	Quantity	Behavior					
		OK	Not Setup	Leak	Break	Short	No Cable Detected
Leak / Probe	1	Closed	Toggling	Open	Closed	Open	Open
Maintenance	1	Closed	Toggling	Closed	Open	Open	Open
Power Fail*	1	Closed	Closed	Closed	Closed	Closed	Closed

*Note, the Power Fail relay is active while the device has power.

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. Expendable service parts, such as probes, are not warranted by Seller. 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. 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.

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