Leak Detection

LD1500 User Guide

SeaHawk

RLE Technologies

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Revision History

Part number 110068

Rev. No.	Date
2.0	June 2010
2.1	October 2010

Note: As necessary, blank pages are added to make the page count even.

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The following information is located on the bottom of each LD1500 unit. Please have this information available whenever a technical support call is placed:

Product Model Number	_____
Product Serial Number	_____
Product Manufacture Date	_____

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1

PRODUCT OVERVIEW

1.1. Description

The LD1500 is a complete monitoring system that detects and reports the presence of water and other conductive liquids. The LD1500 couples SeaHawk Leak Detection Cable (sensing cable) with an advanced control panel. Each LD1500 monitors up to 1,500 feet (457.2m) of sensing cable. When a conductive liquid comes in contact with the sensing cable, an Alarm LED is illuminated red on the front panel, the distance to the leak is shown on the LD1500's webpage, and alarm notifications are distributed via user-configurable Modbus (EIA-485 RTU or TCP/IP), BACnet (EIA-485 MS/TP or IP), or SNMP.

1.2. Operation

When the LD1500's analog circuitry measures a current in excess of the user-defined leak threshold, the unit's microprocessor computes the distance to the leak. The unit then annunciates the leak and logs the alarm in its event log. The LD1500 provides a webpage interface to allow users to get updates on the unit's conditions via the Internet or local area network. The LD1500 also provides Modbus and BACnet outputs via EIA-485, twisted-pair wire or TCP/IP.

Note The LD1500 produces an alarm in the following conditions:

- Leak detected
- Cable break (or cable fault)
- Cable contamination
- Loss of communications

The LD1500 is a supervised system; it continually monitors the cable for continuity. A cable break or excess contamination of the cable causes an Alarm indication and notification.

1.3. Mechanical Description

The LD1500 is built with one circuit board. The main board is mounted inside of the enclosure.

1.4. Installation

The LD1500 is a wall mounted device. Before applying power to the unit, ensure that all connections are correct and all screw terminals are secure. The LD1500 is powered by 24 VAC or 24 VDC power. DO NOT connect 115/230 VAC to the unit; damage will occur to the circuitry.

1.5. Reference Map

Users are advised to purchase a framed reference map (FM1114) for use with the LD1500 to aid in locating any detected leaks along the sensing cable; to view sample maps, go to the SeaHawk Accessories webpage at www.rletech.com. Once all the sensing cable is installed, compare this reference map with the actual cable installation. Note any discrepancies and return the map to the original author for correction. Keep a copy for use until the map is revised.

1.6. Web Interface

The LD1500's webpage interface provides remote information updates via network communications. The interface's menu structure is as follows:

- Home
  - Alarm Status
  - Model
  - sysUpTime
- Cable Status
  - Self-test
- Alarm Log
- Firmware
- Configuration Menu
  - Leak Settings
  - Web Settings
  - Network/IP Settings
  - SNMP
  - SNMP/Syslog Community 1

- SNMP/Syslog Community 2
- SNMP Trap Test
  - Send Test Trap
  - Send Test Trap – Cable Break
  - Send Test Trap – Contamination
- Modbus/EIA-485
  - Modbus Slave Register Display
- BACnet
  - BACnet Information
- BACnet BDT
- BACnet Alarm
- System Management
  - Exit to Bootloader
  - Restore Factory Defaults

A more detailed description of the webpage interface can be found in Chapter 4, “Web Interface” on page 25.

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CHAPTER

2

CONNECTIONS AND SETTINGS

The LD1500 contains one circuit board. All connections are accessible when the unit is inside of its enclosure. The connectors on the main board, found at the bottom of the following photograph, are labeled TB1 through TB3 and P1 through P4.

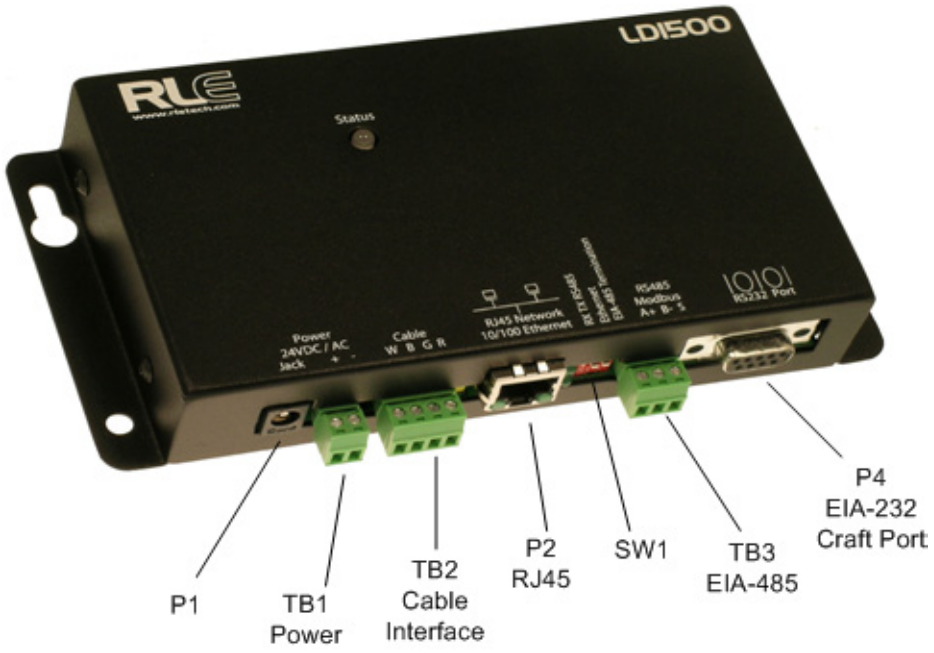

Figure 2.1 LD1500 Connections

2.1. Connections

2.1.1 P1: Input Power

This is an optional barrel connection for input power (as you may also use TB1 for input power) with the following connection:

Inside positive (+)

Outside negative (-)

Power is recommended to be supplied by a 24VDC wall adapter power supply (part #WA-DC-24), which is not included with the LD1500 and can be purchased separately. For more information on RLE power supplies, visit the Falcon Accessories webpage at www.rletech.com, or contact RLE.

2.1.2 TB1: Input Power

This is an optional two position connector (as you may also use P1 for input power) with the following connections:

TB1-1 24VDC positive (+)

TB1-2 24VDC negative (-)

Polarity suggestions are optional, as the LD1500 power inputs are connected directly to an internal bridge rectifier. 24VAC uses the same power connector as 24VDC.

2.1.3 TB2: Cable Interface

The SeaHawk Water Leak Detection Cable (sensing cable) connects to TB2. A 15 foot (4.57m) non-sensing leader cable is required (included in a leader cable kit: part #LC-KIT) to connect the LD1500 to the sensing cable. Connect the cable wires to TB2 as follows:

TB2-1 White wire

TB2-2 Black wire

TB2-3 Green wire

TB2-4 Red wire

2.1.4 P2: RJ45 Network

A 10/100 Ethernet connection is available to connect the LD1500 on a local area network. Use a crossover cable for initial connection and configuration. The default settings are as follows:

IP Address: 10.0.0.188

Subnet Mask: 255.255.255.0

2.1.5 SW1.1: Ethernet Port Configuration

Switch SW1.1, when switched DOWN, enables 10/100BASE-T Auto Negotiate. When switched UP, it locks the Ethernet port in 100BASE-T. Auto Negotiate does not work with some gigabit switches; therefore, the LD1500 ships with switch SW1.1 in the UP, 100BASE-T locked, position.

2.1.6 SW1.2:EIA-485 Termination

Switch SW1.2, when switched ON (DOWN), places a termination resistor across the + and - terminals of the EIA-485 port. This is used when the LD1500 is the last unit on an EIA-485 network.

2.1.7 TB3: EIA-485 Modbus Port

TB4 connects to an EIA-485 network. A grounded shield contact is provided for connection to shielded cable. If the shield contact is used, verify the power connector is properly grounded and there is no voltage potential between units on the network. The EIA-485 port is set to 8 data bits, no parity, and 1 stop bit (8, N, 1). Connect the EIA-485 wires to TB4 as follows:

TB3-1 A (+)

TB3-2 B (-)

TB3-3 Shield

2.1.8 P4: EIA-232 Connector

The EIA-232 uses a baud rate of 9600. The EIA-232 port is set to 8 data bits, no parity, and 1 stop bit (8, N, 1). A straight through cable should be used to connect a terminal or PC to the LD1500. This connection should only be used for Setting of the IP address, advanced diagnostics, firmware uploading, and troubleshooting only.

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3

INSTALLATION

3.1. Installing the LD1500

The LD1500 is a wall mounted device. There are four mounting holes on the sides of the unit spaced 6.6 inches (.167m) apart. Use drywall anchors if securing the unit to drywall.

3.2. Connecting the Leak Detection Cable

The LD1500 is shipped with a 15-foot (4.57m) leader cable. One end of this leader cable connects to the LD1500 controller, and the other end connects to the SeaHawk leak detection cable (sensing cable). Connect each end of the leader cable as follows:

1 With the screws of the terminal block connector on the LD1500 facing up, connect the four stripped, bare wires of the leader cable to the terminals in this order, from left to right: white, black, green, red.

Note If the terminal connector is removed from the end of the cable, make sure the wires are in this same order when the connector is reapplied.

2 Unscrew the end-of-line (EOL) terminator from the other end of the leader cable.

3 Attach the first length of leak detection cable (sensing cable) to the leader cable.

4 Route the sensing cable according to a cable layout diagram, if provided. Lay the cable according to the 5, “Secure the EOL terminator on the unoccupied end of the sensing cable.” on page 20.

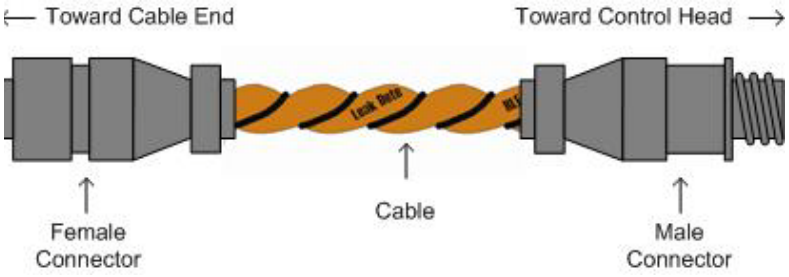

Figure 3.1 SeaHawk Leak Detection Cable (Sensing Cable)

5 Secure the EOL terminator on the unoccupied end of the sensing cable.

3.2.1 Securing Cable to the Floor

Secure the sensing cable to the floor with either J-clips (part #JC), or one of the other approved methods shown in Figure 3.2. J-clips (part #JC), available from RLE and designed specifically for use with sensing cable, are the manufacturer's recommended installation method and can be installed as follows:

- Place one J-clip every 5 to 6 feet (1.52 to 1.83m) along the length of the sensing cable and one at each turn of the cable. Use more J-clips if a “tighter” configuration is required.
- If the cable is installed over an obstruction, place a J-clip on the cable on both sides, as close to the obstruction as possible.

WARNING

Do not install the cable directly in front of an air conditioner. Allow a minimum of 4 to 6 feet (1.22 to 1.83m) between the unit and the cable. If the cable is too close to the air conditioning unit’s air stream, the moisture from the humidifier may cause false leak readings. If the cable must be installed in front of an air conditioning unit, place the J-clips 12 to 18 inches (.305 to .457m) apart.

Note It is important to finish the end of the SeaHawk Water Leak Detection Cable (sensing cable) with the end terminator (EOL). If the EOL terminator is not present, a cable fault will register. Note any variances between the cable layout diagram and the actual cable installation.

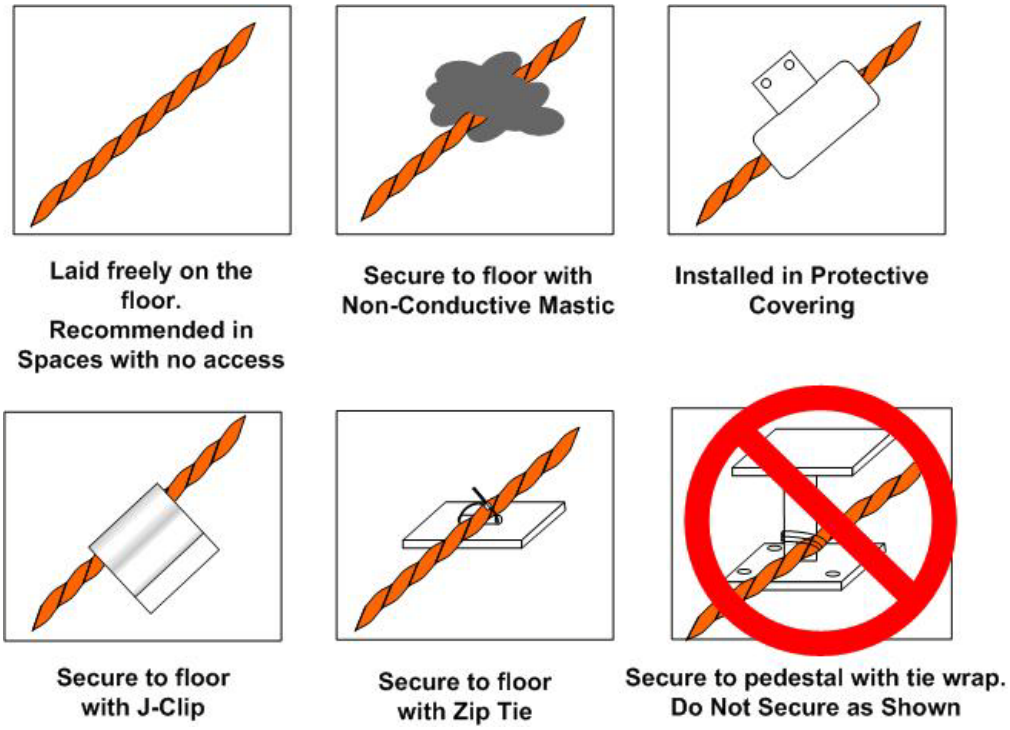

Figure 3.2 Cable Installation Methods

3.3. Applying Power to the LD1500

Once the SeaHawk leak detection cable (sensing cable) is connected to the unit, power can be applied. The LD1500 operates on 24VDC or 24VAC power. A power supply is not included with the LD1500. RLE recommends its 24VDC power supply (part #PSWA-DC-24), which can be purchased separately. For more information on RLE power supplies, visit www.rletech.com, or contact RLE.

Note RLE recommends that an **isolated power supply** be used.

Before applying power to the unit, ensure all cable and communication connections are complete. The LD1500 begins booting once power is applied. Wait approximately one minute. No alarm should be present.

On the webpage interface, under the Cable Status link, the cable length is displayed. If this reading varies by more than ±5% of the actual length of cable installed, verify the installation. The LD1500 should not require any calibration. If any calibration is required, verify that the cable current is 0 (zero) before calibrating or false and inaccurate readings will occur.

Set the system name, alarm configuration, feet/meters, etc., through the webpage submenus.

3.4. Communication

The LD1500 will not communicate over a user's network the first time it is connected to the network. The manufacturer programs the LD1500 with a default IP address: 10.0.0.188, subnet: 255.255.255.0 and gateway (Def Route): 10.0.0.1. These settings must be changed to IP addresses that correspond with the user's network before the LD1500 can communicate over the network.

3.4.1 Set the LD1500's IP Address

- Via the Web browser
- Via the EIA-232 interface

3.4.1.1 Set the LD1500's IP Address Using a Web Browser

1. Plug the crossover network cable that shipped with the LD1500 unit into the laptop or workstation that will be used to configure the LD1500. This cable is not intended to be connected to a network hub.
2. Write down the computer's IP address and Subnet Mask. Then change the IP address and Subnet Mask of the computer from its existing address to one that will allow it to communicate with the LD1500, such as **10.0.0.190**. It may be beneficial to set the IP address to one that is one number different from the Falcon's IP address. Consult the computer's manual or your IT Department before attempting this.
3. Connect the other end of the network cable to the Ethernet port on the LD1500. Access the LD1500 through a Web browser by typing the IP address into the location bar. Enter the LD1500 user name and password when prompted.

Note The default user name is "`ld1500`" (use all lowercase, as user name is case sensitive). There is no default password—leave the password field empty.

4. Select the **Configuration Menu** link, then select the **Network Settings** link. Change the IP address, Subnet Mask, and Def Route to ones provided by the network administrator. Press the **Submit Changes** button. The LD1500 will save the new IP address and reboot. You must now use the new IP address and reset your computer to its original IP address and Subnet Mask.
5. Change the IP address of your computer back to its original IP address. If the computer was configured as DHCP (the network domain controller assigns an IP address) return it to this state. This may require assistance from your IT Department, or you may need to consult the computer's manual
6. The computer and the LD1500 are now both configured to communicate on the network. Both should be accessible via the network. Connect the PC and the LD1500 to the network. From the PC Web browser, type in the IP address of the LD1500. Enter the user name and password as stated above to verify network access to the LD1500.

3.4.1.2 Set the LD1500's IP Address using an EIA-232 Connection

To use the EIA-232 interface:

1. Connect the EIA-232 port (P4) on the LD1500 to a terminal or PC running terminal emulation software (such as HyperTerminal) with a 9-pin male-female straight through serial cable.
2. Set the appropriate communication port to **9600 baud**, **8 data bits**, **no parity**, **1 stop bit (9600/N/8/1)**, and **no software or hardware flow command**.
3. Once the terminal emulation software starts, type **?** and press ENTER on the keyboard and the Main Menu should appear. If the Main Menu does not appear, check the communication settings and make sure the unit is powered on.
4. From the Main Menu type "**netcfg**" to select the Network Configuration Menu.
5. Enter the new IP address for the LD1500 by typing **ip xxx.xxx.xxx.xxx** where xxx.xxx.xxx.xxx is the new IP address of the unit. Separate each field with a decimal point—for example, type ip 10.0.0.50 <enter>.
6. The LD1500 will erase a memory block and copy data to Flash memory before rebooting.
7. The LD1500 IP address is now set and the LD1500 can be accessed through a Web browser using the new IP address.
8. Repeat steps 4-7 to change the Subnet Mask and Def Route, if needed, using the commands **nm xxx.xxx.xxx.xxx** to change the Subnet Mask and **dg xxx.xxx.xxx.xxx** to change the default gateway.

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WEB INTERFACE

The LD1500's network connection allows users to configure and view current information from the LD1500. When logging on to the LD1500, navigate to the unit's IP address in a Web browser. A prompt will ask for a username and password. Enter in the appropriate information.

Default Settings:

IP: 10.0.0.188

Username: ld1500

Password: *-none/blank-*

Figure 4.1 LD1500 Log In Page

4.1. Home/Main Menu

When logging into the LD1500, the first page display is the **Home** page. All vital information is displayed in the main table. From the main page, four links are available in the bottom left section: Cable Status, Alarm Log, Firmware, and Configuration Menu.

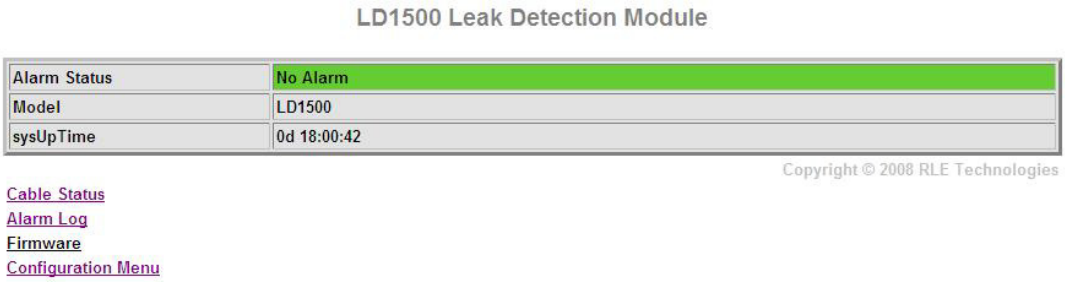


Figure 4.2 Home Page

4.2. Cable Status

The `Cable Status` page displays a table of System Alarm Status, Cable Length, Current, Leg Resistances and Alarm Delay Counts. A link to a self-test diagnostic is also available on this page. The diagnostic will connect internal precision 4.02K test resistors into the leak detection circuitry and display the results: leg resistances, zero leakage and full leakage test, and near and far leak calculations.

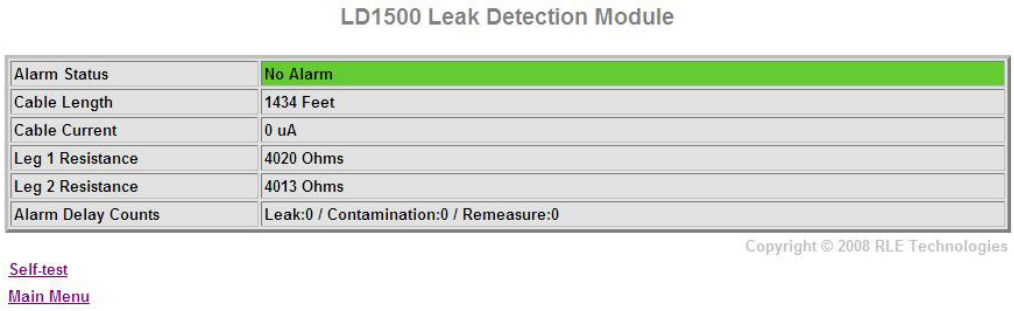


Figure 4.3 Cable Status

4.3. Alarm Log

The **Alarm Log** page displays a table of Alarm History. The Alarm History table displays Alarms and events recorded in the unit's memory log of the last 10 events. The alarms are displayed as follows:

TYPE - SYSTEM_TIME_STAMP DESCRIPTION

SYSTEM_TIME_STAMP is displayed as **xxd HH:MM:SS** format since the system was powered up where **xxd** = days, **HH**=hours (01-24), **MM**=minutes (01-60) and **SS**=seconds (01-60).

DESCRIPTION provides details about the current alarm/event (e.g. Leak, Cable Fault, etc.).

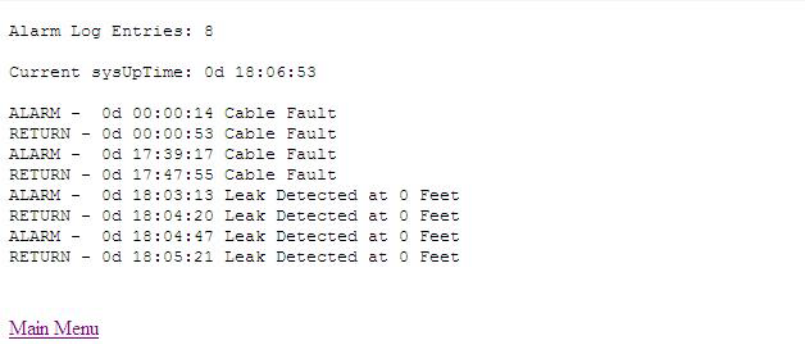


Figure 4.4 Alarm Log Page

4.4. Firmware

The **Firmware** page displays the Flash application name, version and size in bytes, and the Bootloader name and version.

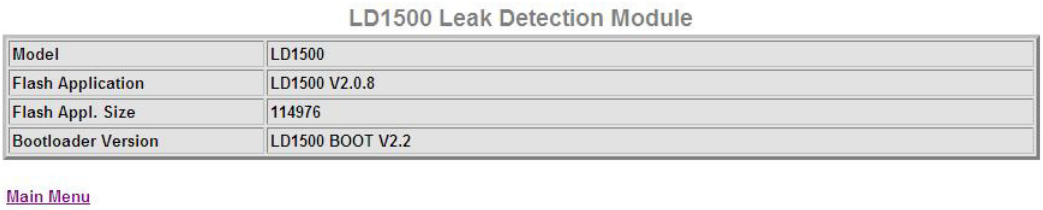


Figure 4.5 Firmware Page

4.5. Configuration

The **Configuration** page provides access to a menu of available settings.

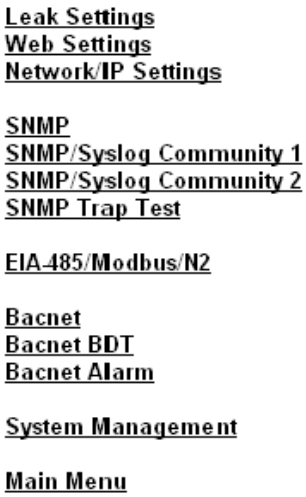


Figure 4.6 Configuration Menu

4.5.1 Leak Settings

The **Leak Settings** menu displays all current leak and cable settings.

Table 4.1 Leak Settings Menu

Setting	Description	
Leak Trip Point	The amount of current leakage required to detect a leak. Default setting is 150uA. Adjust this number to adjust the sensitivity of the leak detection cable to leaks (higher = less sensitive, lower = more sensitive).	
Contamination Trip Point	The amount of current leakage required to detect cable contamination. Default setting is 50uA. Adjust this number to adjust the sensitivity of the leak detection cable to contamination (higher = less sensitive, lower = more sensitive).	
	Leak Alarm Delay	The amount of time required to pass once the Leak Trip Point has been reached before declaring a leak alarm. Default setting is 20 seconds. The Leak Trip Point must be exceeded for the duration of the delay.
	Contamination Alarm Delay	The amount of time required to pass once the Contamination Trip Point has been reached before declaring a contamination alarm. Default setting is 120 seconds. The Contamination Trip Point must be exceeded for the duration of the delay.

Table 4.1 Leak Settings Menu (continued)

Setting	Description	
	Resistance Per Foot	The resistance per foot (or meter) of cable determines the unit's ability to accurately detect the sensing cable length installed and calculate distances to leaks. The default setting is 2.800 ohms and should not be changed for any RLE cable; parts SC-10, SC-25, SC-50, and SC-100 are all built to specifications of 2.8 ohms per foot.
	Measurement Display	Select either feet or meters to calibrate the LD1500 to the preferred unit of measure.

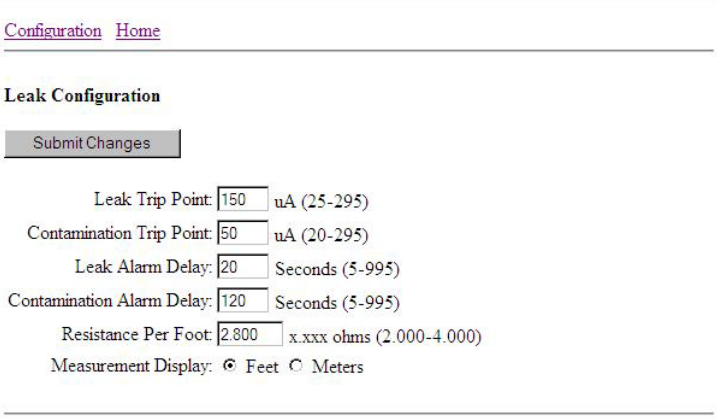


Figure 4.7 Leak Configuration Page

4.5.2 Web Settings

The **Web Settings** menu allows users to set two different security level passwords on the LD1500. A Read-Only level password allows users to only view the information and settings of the LD1500. No settings or changes may be submitted to the unit. The Read/Write level password allows users to change settings and configurations on the LD1500 as well as view all information in the unit. The Web refresh rate changes the interval that the Home page refreshes automatically when left open in an Internet browser.

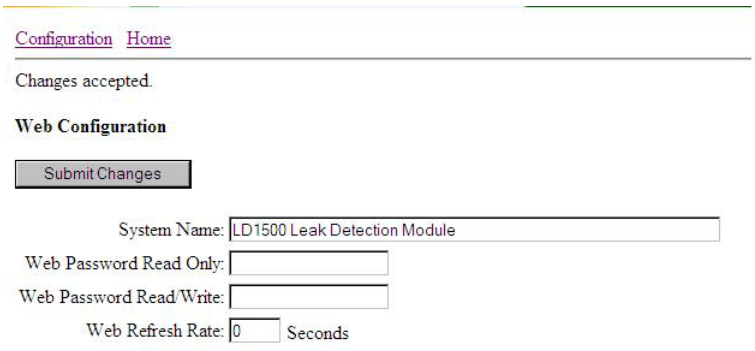


Figure 4.8 Web Configuration

4.5.3 Network/IP Settings

The **Network** settings allow users to change the network configuration of the LD1500. IP address, Subnet Mask, and Default Route (Gateway) may be changed from this menu.

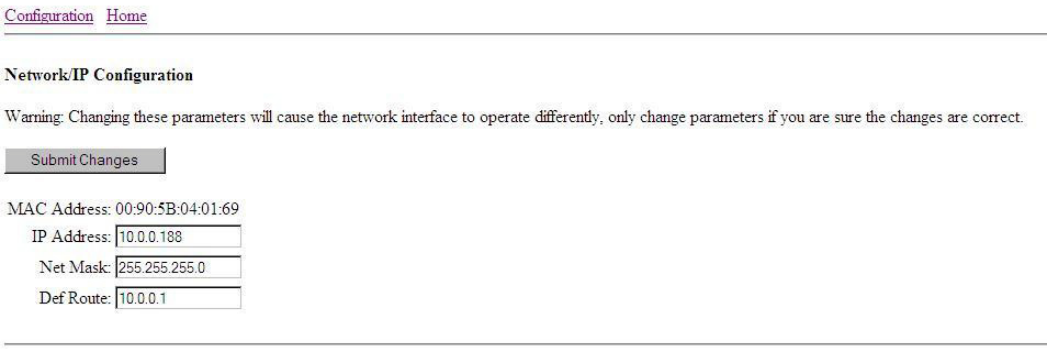


Figure 4.9 Network/IP Settings

4.5.4 SNMP

The SNMP Configuration page allows users to configure SNMP notification options. See definitions below:

Table 4.2 SNMP Menu Options

Menu Option	Description
System Name	Appears on the LD1500 Main Menu and is included as part of email notifications.
System Contact	Lists the individual responsible for the LD1500. The System Contact is only available through SNMP Gets and is not included in email or SNMP Trap notifications.
System Location	Lists the location of the LD1500. The System Location is not included in email or SNMP Trap notifications.
SNMP Trap Type	Selects the type of trap/inform (V1 or V2C) that the LD1500 will send for SNMP Trap notifications.
Max Inform Retries	Specifies the number of times the LD1500 will attempt to send an Inform. An entry of zero (0) means that the LD1500 will attempt to send the Inform indefinitely.
Inform Interval	Specifies the interval in minutes between Inform attempts.

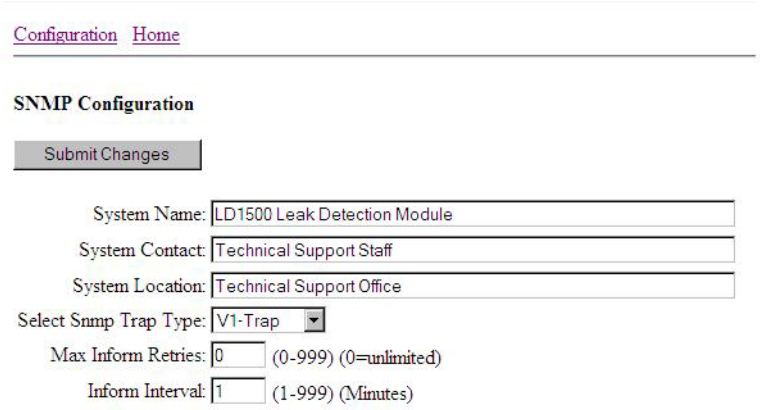


Figure 4.10 SNMP Configuration Page

4.5.5 SNMP/Syslog Communities 1 & 2

The **SNMP/Syslog Communities Configuration** pages identify devices that receive SNMP Traps and/or Syslog messages from the LD1500 and interact with the LD1500 over the network. To add a device to the Communities list, select a community number posted as "empty." Enter the receiving device's IP Address and a string that identifies the device. An IP Address of 0.0.0.0 in this field allows any device to access the LD1500 through an MIB browser. Select "Write" if the device will have Read/Write network access. This allows the LD1500 to be configured over the network. Select "Traps" if the device will receive Traps from the LD1500. Select "Syslog" if the device will receive Syslog messages from the LD1500.

Figure 4.11 SNMP/Syslog Communities Configuration

4.5.6 SNMP Trap Test

The **SNMP Trap Test** page contains three pushbuttons that allow the user to send SNMP Traps out the Ethernet port, simulating an alarm event. Pushbuttons are available for Leak Detected, Cable Break, and Contamination.

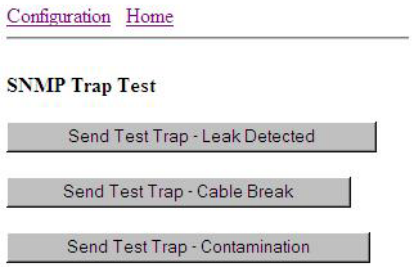


Figure 4.12 SNMP Trap Test

4.5.7 Modbus

The Modbus/EIA-485 Configuration page allows users to configure Modbus (EIA-485 and/or TCP/IP) options. See definitions below:

Table 4.3 Modbus Menu Options

Menu Option	Description
Modbus/TCP/UDP Slave Unit Identifier	Specify the slave address used on the LD1500's IP port (1-254).
Select EIA-485 Port Function	Sets the EIA-485 port for Modbus-Slave, BACnet MS/TP-Slave, or Modbus N2.
EIA-485 Slave Address	Set the EIA-485 Port's slave address (1-254). Each device on the EIA-485 Modbus network must have a unique address.
EIA-485 Baud Rate	Sets the EIA-485 Port to 1200, 2400, 9600, 19200, or 38400 baud. All the devices connected to the Modbus network must be set to operate at the same Baud rate.
EIA-485 Parity	Sets the EIA-485 Port to None, Even or Odd Parity. All the devices connected to the Modbus network must be set to operate at the same parity.
Modbus Slave Register Display	Displays the contents of the Modbus Slave Registers. See Table 5.3, “Output Registers” on page 41 and Table 5.5, “Input Registers” on page 42 for descriptions of the register contents.
N2 Register Display Log/Statistics	Displays the contents of the Modbus N2 registers and statistics.

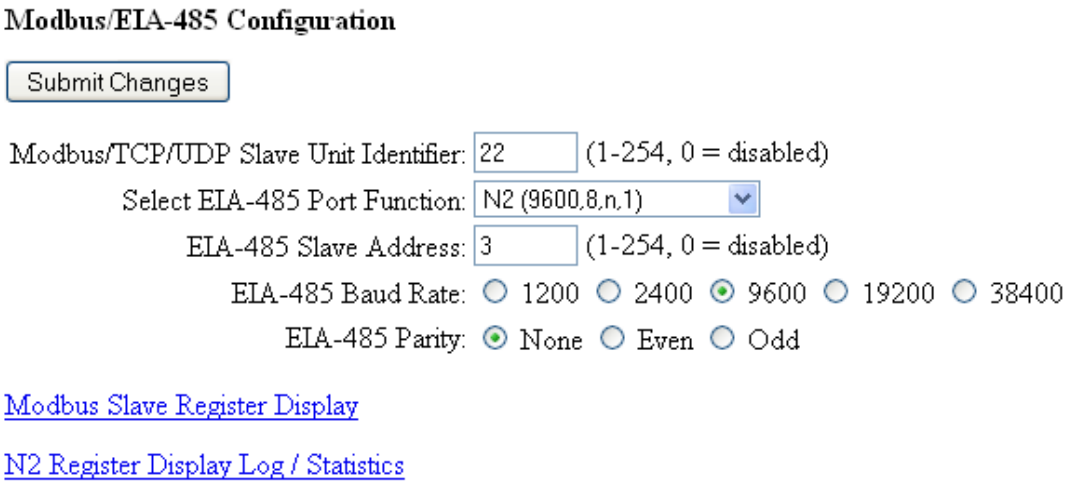


Figure 4.13 Modbus/EIA-485 Configuration Page

4.5.8 BACnet

The **BACnet Configuration** page allows the user to enable the LD1500 for BACnet slave configuration.

Table 4.4 BACnet Configuration Menu Options

Menu Option	Description
BACnet Device Name	The name of the LD1500 as it will appear on the BACnet network.
BACnet Device ID	The unique identifier for the LD1500 on the BACnet network.
BACnet Description	The description of the LD1500 as it will appear on the BACnet network.
BACnet UDP Port	The port to which the LD1500 will respond to BACnet requests. The default number of zero in this field will configure the LD1500 to listen on the standard BACnet port of 47808, see the BACnet standard for more information.
BACnet MSTP Max Master	The highest allowable address for master nodes on the MSTP network.
BACnet Information	Displays the status of the BACnet interface, including Alarm flag status, BACnet Objects, BACnet Property Identifiers, and BACnet Device Objects.

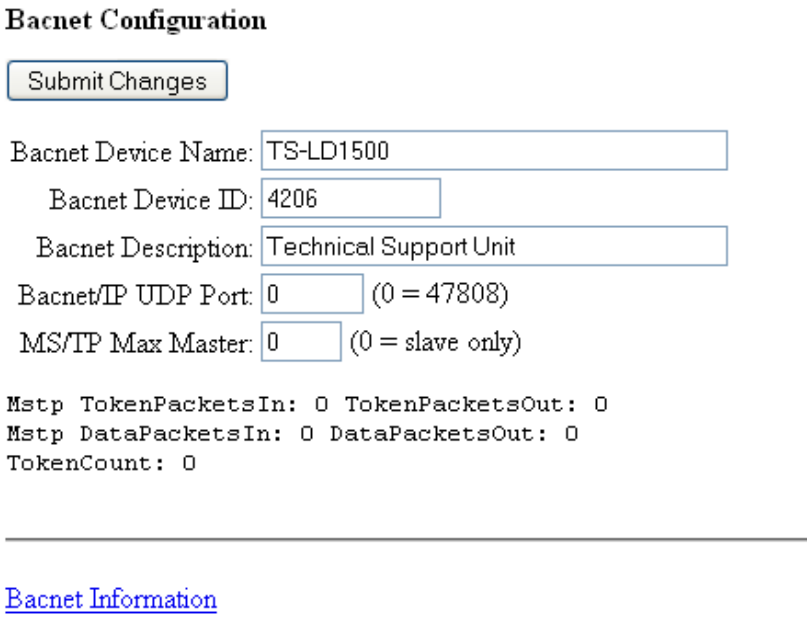


Figure 4.14 BACnet Configuration

4.5.9 BACnet BDT

The BACnet BDT Configuration page allows the user to review and edit the BACnet Broadcast Distribution Table. The following information is given on the webpage.

- **BACnet BBMD-BDT, LD1500 IP Address**
- **#1 IP Address, Port, Mask**
- **#2 IP Address, Port, Mask**
- **#3 IP Address, Port, Mask**
- **#4 IP Address, Port, Mask**

These fields *DO NOT* need to be configured by the user. If the LD1500 is acting as a BACnet router, these fields will automatically be populated by the BACnet network controller.

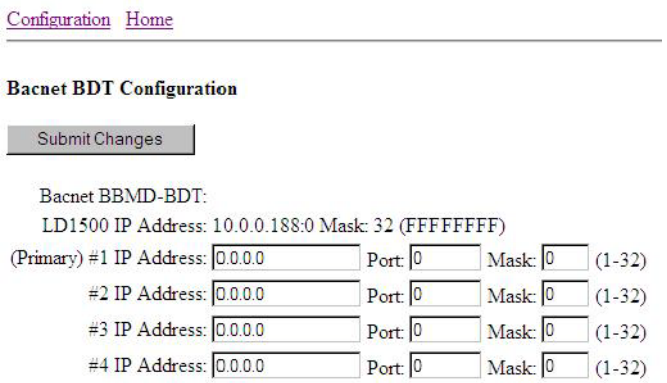


Figure 4.15 BACnet BDT Configuration

4.5.10 BACnet Alarm

The BACnet Alarm Configuration page allows the user to configure the BACnet alarm settings.

- **Recipient #1 IP Address, PID**
- **Notification Type:** Unconfirmed or Confirmed
- **Notification Class, Priority**
- **Leak Detected Alarms:** Analog or Binary
- **APDU Timeout:** in seconds
- **Number of APDU retries**

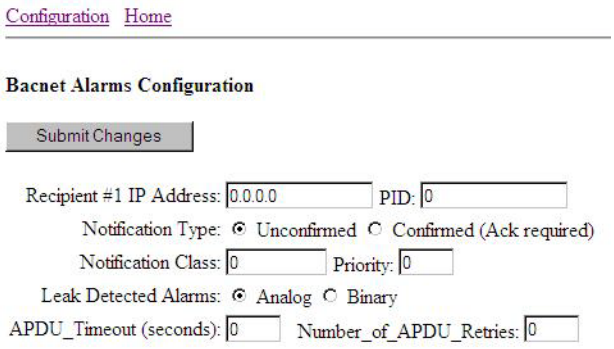


Figure 4.16 BACnet Alarm

4.5.11 System Management

The **System Management** page allows users to restore the unit to factory default settings and upload firmware.

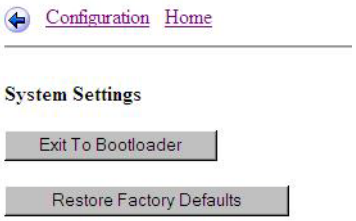
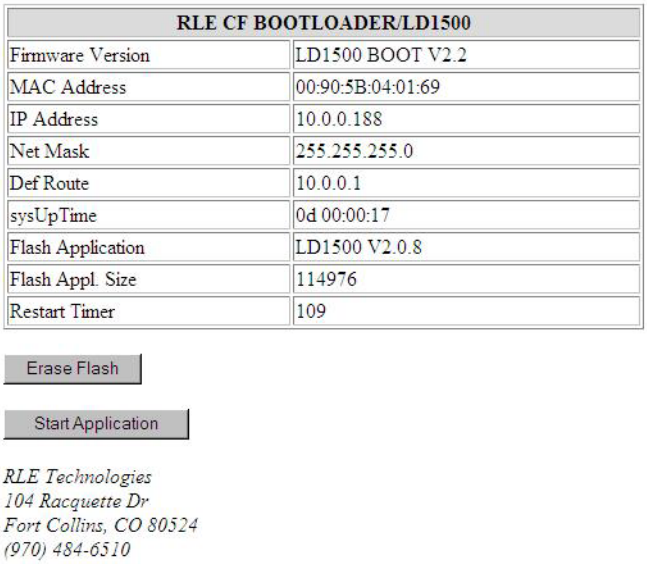


Figure 4.17 System Management Page

Table 4.5 System Management Pushbuttons

Pushbutton	Description
Exit to Bootloader	Forces the unit to stop running flash application to allow for firmware updates; for more information see Appendix A, “Firmware Updates” on page 45.
Restore Factory Defaults	Resets the configuration and settings on the unit to all factory defaults.



RLE CF BOOTLOADER/LD1500	
Firmware Version	LD1500 BOOT V2.2
MAC Address	00:90:5B:04:01:69
IP Address	10.0.0.188
Net Mask	255.255.255.0
Def Route	10.0.0.1
sysUpTime	0d 00:00:17
Flash Application	LD1500 V2.0.8
Flash Appl. Size	114976
Restart Timer	109

Figure 4.18 Exit to Bootloader Page

Notes:

CHAPTER

5

MODBUS COMMUNICATION

This document describes the Modbus communications protocol as supported by the LD1500 Distance Read System. It includes details and information on how to configure the LD1500 for communications via Modbus network.

5.1. Implementation Basics

The LD1500 is capable of communicating via the half-duplex EIA-485 serial communication standard. The LD1500 is configured to act as a slave device on a common network. The EIA-485 medium allows for multiple devices on a multi-drop network. The LD1500 is a slave only device and will never initiate a communications sequence.

5.1.1 Modes of Transmission

The Modbus protocol uses ASCII and RTU modes of transmission. The LD1500 supports only the RTU mode of transmission, with 8 data bits, no parity and 1 stop bit. Every Modbus packet consists of four fields:

- Slave Address Field
- Function Field
- Data Field
- Error Check Field (Checksum)

5.1.1.1 Slave Address Field

The slave address field is one byte in length and identifies the slave device involved in the transaction. The valid address range is between 1 and 254. The slave address is set from the **Modbus/EIA-485 Configuration** webpage (see 4.5.7, “Modbus” on page 32).

5.1.1.2 Function Field

The function field is one byte in length and tells the LD1500 which function to perform. The supported functions are 03 (Read 4xxxx output registers), 04 (Read 3xxxx input registers), 06 (Preset single register) and 16 (Preset multiple registers).

5.1.1.3 Data Field

The data field of the request is a variable length depending on the function. The data fields for the LD1500 are 16-bit registers, transmitted high order byte first (big-endian).

5.1.1.4 Error Check (Checksum) Field

The checksum field lets the receiving device determine if the packet has transmission errors. The LD1500 RTU mode uses a 16-bit cyclic redundancy check (CRC-16).

5.1.2 Exception Responses

If a Modbus master sends an invalid command to the LD1500 or attempts to read an invalid register, an exception response is generated. The response packet will have the high order bit of the function code set to one. The data field of the exception response contains the exception error code.

Table 5.1 Exception Codes

Code	Name	Description
01	Illegal Function	The function code is not supported
02	Illegal Data Address	Attempt to access an invalid address
03	Illegal Data Value	Attempt to set a variable to an invalid value

5.2. Packet Communications for the LD1500

5.2.1 Function 03: Read Output Registers

To read the LD1500 parameter values, the master must send a Read Output Registers request packet.The Read Output Registers request packet specifies a start register and the number of registers to read. The start register is numbered from zero (40001 = zero, 40002 = one, etc).

Table 5.2 Read Output Registers Packet Structure

Read Registers Request Packet	Read Registers Response Packet
Slave Address (1 byte)	Slave Address (1 byte)
03 (Function code) (1 byte)	03 (Function code) (1 byte)
Start Register (2 bytes)	Byte count (1 byte)
# of registers to read (2 bytes)	First register (2 bytes)
CRC Checksum (2 bytes)	Second register (2 bytes)
	…
	CRC Checksum (2 bytes)

Table 5.3 Output Registers

Register	Name	Description	Range, Units	Range
40001	Leak Threshold	Trip current for leak alarm	25-295 μAmps	0-65535
40002	Contamination Threshold	Trip current for contamination alarm	20-295 μAmps	0-65535
40003	Spare			0-65535
40004	Spare			0-65535
40005	Spare			0-65535
40006	Spare			0-65535
40007	Spare			0-65535
40008	Spare			0-65535
40009	Spare			0-65535
40010	Spare			0-65535
40011	Spare			0-65535
40012	Spare			0-65535
40013	Spare			0-65535
40014	Spare			0-65535
40015	Spare			0-65535
40016	Leak Alarm Delay	Leak Alarm Delay	5-995 seconds	0-65535
40017	Contamination Alarm Delay	Contamination Alarm Delay	5-995 seconds	0-65535

5.2.2 Function 04: Read Input Registers

To read the LD1500 input values, the master must send a Read Input Registers request packet.

The Read Input Registers request packet specifies a start register and the number of registers to read. The start register is numbered from zero (30001 = zero, 30002 = one, etc).

Table 5.4 Read Input Registers Packet Structure

Read Registers Request Packet	Read Registers Response Packet
Slave Address (1 byte)	Slave Address (1 byte)
04 (Function code) (1 byte)	04 (Function code) (1 byte)
Start Register (2 bytes)	Byte count (1 byte)
# of registers to read (2 bytes)	First register (2 bytes)
CRC Checksum (2 bytes)	Second register (2 bytes)
	…
	CRC Checksum (2 bytes)

Table 5.5 Input Registers

Register	Name	Description	Units	Range
30001	Status	Bit Level Status	None	0-65535
30002	Leak Distance	Location of Leak	Ft/Meters	0-65535
30003	Units	Unit of Measure	1=Ft 0=Meters	0-65535
30004	Leak Current	Leakage current on cable	μAmps	0-65535
30005	Cable Length	Installed Cable Length	Ft/Meters	0-65535
30006	Loop1 Res	Resistance of cable	Ohms	0-65535
30007	Loop2 Res	Resistance of cable	Ohms	0-65535
30008	Res/Ft	Resistance of cable	Ohms x1000	0-65535
30009	Version	Firmware version	xx.xx X 100	0-65535

Table 5.6 Status Flags (Register 30001)

Bit	Description
00	1 = Leak is Detected
01	1 = Cable Break Alarm
02	1 = Contamination is detected

Table 5.6 Status Flags (Register 30001) (continued)

Bit	Description
03	1 = Summary Alarm
04-15	Spare

5.2.3 Function 06: Preset Single Register

To set a LD1500 parameter value, the master must send a Preset Single Register request packet. The Preset Single Register request packet specifies a register and the data to write to that register. The register is numbered from zero (40001 = zero, 40002 = one, etc).

Table 5.7 Preset Single Register Packet Structure

Preset Register Request Packet	Preset Register Response Packet
Slave Address (1 byte)	Slave Address (1 byte)
06 (Function code) (1 byte)	06 (Function code) (1 byte)
Register (2 bytes)	Register (2 byte)
Data (2 bytes)	Data (2 bytes)
CRC Checksum (2 bytes)	CRC Checksum (2 bytes)

5.2.4 Function 16: Preset Multiple Registers

To set multiple LD1500 parameter values, the master must send a Preset Multiple Registers request packet. The Preset Multiple Register request packet specifies a starting register, the number of registers, a byte count and the data to write to the registers. The register is numbered from zero (40001 = zero, 40002 = one, etc).

Table 5.8 Preset Multiple Registers Packet Structure

Preset Registers Request Packet	Preset Registers Response Packet
Slave Address (1 byte)	Slave Address (1 byte)
16 (Function code) (1 byte)	16 (Function code) (1 byte)
Start Register (2 bytes)	Start Register (2 bytes)
# of registers to write (2 bytes)	# of registers (2 bytes)
Byte Count (1 byte)	CRC Checksum (2 bytes)
Data (2 bytes)	
…	
…	
CRC Checksum (2 bytes)	

5.3. RTU Framing

The example below shows a typical Query/Response from a LD1500 module.

Table 5.9 Response Sample

Slave Address	Function Code	Count Bytes of Data	Register Data MSB LSB	Register Data MSB LSB	Register Data MSB LSB	CRC16 LSB	CRC16 MSB
02	04	06	00 00	00 00	00 01	B5	A3

Slave address 2 responds to Function Code 4 with 6 bytes of hexadecimal data and ends with CRC16 checksum.

Register Values:

40001 = 0000 (hex)

40002 = 0000 (hex)

40003 = 0001 (hex)

APPENDIX

A

FIRMWARE UPDATES

Firmware updates are available on the Documentation/Files section of the LD1500 webpage at www.rletech.com. Download the appropriate firmware to an accessible location on a PC connected to the same Local Area Network (LAN) as the LD1500.

A.1. Updating the Flash Firmware Via Web Interface/ TFTP

Uploading firmware via TFTP requires a TFTP Client. It may be possible to download a free license TFTP Client from the Internet.Consult your IT department to determine a compatible client program.

Before updating the firmware, the firmware Flash application must be exited and then erased.

1. Navigate to the LD1500's **System Management** menu.
2. From the **System Management** menu, click on the "**Exit to Bootloader**" button. You must have write access to the unit in order to do this. The LD1500 will exit the application and display a **Bootloader** webpage.
3. 3. Click on the "**Erase Flash**" button. You will be prompted for a username and password. After entering the username and password, the Flash application will be erased.

Note To erase the flash, a special username and password are required. The username is ld1500 (the "l" and "d" are lowercase), and the password is rle2tech.

4. Verify that your PC and the LD1500 are on the same subnetwork (LAN).
5. Open your TFTP client. Configure the client as follows.
   a. **Host** = LD1500 IP Address (10.0.0.188, for example)
   b. **Port** = 69
   c. **Block Size** = 64, 128, 256, 512, or 1024
   d. **Note:** The file must be sent in binary format (not ASCII).

6 From the TFTP client, **Send** or **PUT** the firmware file to the LD1500. It may take up to 30 seconds to complete the firmware upload.

7 After one minute, refresh the LD1500 webpage. Notice that the Flash field now contains the name of latest firmware. Click the "**Start Application**" button to reboot the unit.

APPENDIX

B

PREVENTIVE MAINTENANCE

Follow these steps monthly to test the system and ensure that the control panel is functioning properly:

1. Place water on the cable.
2. Verify the Leak Detected alarm through the Web interface or BMS.
3. Compare the distance reading on the LD1500 to a reference map (if available) to verify that the LD1500 displays the correct leak location.
4. Dry the cable and verify that the LD1500 returns to normal.
5. Remove the End-of-Line terminator (EOL).
6. Verify the Cable Break alarm through the Web interface.
7. Reinstall the EOL.
8. Verify that the LD1500 returns to normal.

Monitor the cable current monthly to verify that the cable is not being contaminated. The LD1500 will alarm on cable contamination if the contamination is excessive.

- From the LD1500 Web interface, verify that the Cable Current is less than 25μA. If the cable current is greater than 25μA, it is recommended to troubleshoot the cables to determine which cable is contaminated. The contaminated cable should be removed, cleaned, retested and reinstalled.

Notes:

APPENDIX

C

TROUBLESHOOTING

Table C.1 Troubleshooting Problems with the LD1500

Problem	Action
Control Panel will not Power Up	1 Check with a DVOM (multi-meter) for AC or DC input power on the lower left hand terminal block on the LD1500. If no voltage is present at terminal block, check the circuit (breaker) or power supply the LD1500 control panel is powered by. If voltage is present, go to step 2. 2 Contact RLE Technologies for unit replacement and/or evaluation. If voltage is present and no LEDs are illuminated, contact RLE Technologies for further troubleshooting.
Cable Break Alarm	1 Verify that the leader cable from the SeaHawk Water Leak Detection Cable (sensing cable) run is plugged into terminal block marked “Cable.” 2 Verify that the End-of-Line terminator (EOL) is installed on the end of the orange sensing cable run. If present at the end of the cable run, go to step 3. 3 Remove the EOL terminator from the end of the cable run and install it onto the end of the leader cable coming from the control panel. If the condition clears, there is a damaged/faulty section of sensing cable. Start moving the EOL terminator to the end of each section of sensing cable to isolate the faulty section. If the condition does not clear, go to step 4. 4 Power down (shut off) the control panel. Remove terminal block marked “Cable” from the unit. Remove the four conductors from the leader cable wire going into the four position terminal block. Install a jumper wire between pins 1 and 2 and another jumper wire between pins 3 and 4. Reinstall the terminal block back into TB2. If the cable break condition clears, there is a problem with the leader cable. If the condition does not clear, contact RLE Technologies for further support.

Table C.1 Troubleshooting Problems with the LD1500 (continued)

Problem	Action
Control Panel not Calculating Proper Length of Cable	1 First verify the proper wiring order into terminal block marked “Cable.” Wiring color code should be as follows from left to right: white, black, green, and red. 2 Calibrate your cable. To do this, adjust the Resistance per Foot (Configuration menu via the Web Interface). If the condition does not change, please contact RLE Technologies. The control panel is pre-calibrated from the factory. The overall footage should be within 5% of actual installed length.
Control Panel not Calculating Proper Leak Distance	1 Check the distance on the cable run to verify that the control panel is monitoring. Verify there is no water along the cable run. Check to see if multiple leaks are present on the cable. The first leak should be read and latched by the system; however, if the system is updated or simultaneous leaks occur (2 or more) within 30 seconds of the initial leak, the system may display the average distance (distance of the first leak + distance of the second leak / 2). If no water is present, go to step 2. 2 Power down (shut off) the control panel and remove the End-of-Line terminator (EOL) from the end of the sensing cable. Locate the first section of sensing cable from the LD1500 control panel. Where it joins to the second section of cable, disconnect and install the EOL terminator at the end of the first section of sensing cable. Turn power back on at control panel. Once the control panel runs for five to ten minutes, use a damp cloth, rag or paper towel and place it on the end of the orange sensing cable. If the leak is calculated correctly, remove the EOL terminator; reconnect the sensing cable and move down to the next section of cable. Repeat this process until a faulty reading is obtained. If the reading is off at the first section of cable, there may be miscalculations from the LD1500 unit, please contact RLE Technologies for support.
Cable Contamination Alarm	1 To clear a contamination alarm, the cable must be removed and cleaned. Usually the cable can be cleaned by pulling it through a clean damp rag. 2 If the cable is contaminated by oil, glycol or chemicals, the cable can be washed. Use a mild detergent solution of 1 capful to 2 gallons lukewarm water (<105°F). Agitate the cable in a suitable container, rinse with clear lukewarm water and wipe dry with a clean towel. The cable may also be cleaned by wiping it down with Isopropyl Alcohol. 3 Retest the cable by connecting it to the LD1500 before reinstalling it under the floor.

Note Contamination and/or physical damage to the cable is not covered under warranty. For all other troubleshooting concerns and questions regarding this product, contact RLE Technologies.

APPENDIX

D

TECHNICAL SPECIFICATIONS

Table D.1 Technical Specifications

Power		24VAC Isolated @ 600mA max, 50/60Hz; requires power supply (not included) 24VDC@ 600mA max; requires power supply: PSWA-DC-24-ST (not included)
Inputs		
	Water Leak Detection Cable	Compatible with SeaHawk sensing cable (not included)
	Cable Input	Requires SeaHawk LC-KIT: 15ft (4.57m) leader cable and EOL
	Recommended Maximum Length	1,500ft (457.2m)
	Detection Accuracy	± 2ft (0.6m)+/- 0.5% of the cable length
	Detection Repeatability	± 2ft (0.6m) +/- 0.25% of the cable length
	Detection Response Time	5-995sec, software adjustable in 5sec increments; ±2sec
Communications Ports		
	Ethernet	10/100BASE-T, RJ45 connector; 500VAC RMS isolation
	EIA-232	DB9 female connector; 9600 baud; 8 data bits, no parity, 1 stop bit
	EIA-485	1200, 2400, 9600, 19200 or 38400 baud (selectable); Parity: none, even or odd, 8 data bits, 1 stop bit
Protocols		
	TCP/IP, HTML, TFTP	IPv4.0; webpages comply with Rehabilitation Act of 1973, sections 504 and 508, US Dept of Education (website accessibility for computer users with disabilities)
	SNMP	V1: V2C MIB-2 compliant; NMS Manageable with Get, Set, Trap/Inform
	Modbus (EIA-485)	Slave; RTU Mode; Supports function codes 03, 04, 06 and 16; Johnson N2
	Modbus TCP/IP, UDP/IP	Modbus Slave; TCP/IP, UDP/IP transmission protocol
	BACnet/IP	Conformance Level 1
	BACnet (EIA-485)	Slave; MS/TP

Table D.1 Technical Specifications (continued)

	Terminal Emulation (EIA-232)	VT100 compatible
Alarm Notification		
	Visual Alarm	Bi-color status LED
	SNMP Traps (Ethernet)	2 Community Strings
Logging Capabilities		
	Event Log	Last 10 events
Login Security		
	Web Browser Access (Ethernet)	1 Web password Read Only; 1 Web password Read/Write
	Terminal Emulation Access	None
Front Panel Interface		
	LED Indicators	Power/Status: 1 bi-color (Power On: green; Alarm / Cable Fault / Cable Contamination: red)
Operating Environment		
	Temperature	32° to 122°F (0° to 50°C)
	Humidity	5% to 95% RH, non-condensing
	Altitude	15,000ft (4,572m) max.
Storage Environment		-4° to 185°F (-20° to 85°C)
Dimensions		7.075"W x 3.625"H x 1.25"D (179.7mmW x 92.07mmH x31.75mmD)
Weight		1.5 lbs. (680g)
Mounting		Vertical wall mount
Certifications		CE; ETL listed: conforms to UL STD 61010-1, EN STD 61010-1; certified to CSA C22.2 STD NO. 61010-1; RoHS compliant