SeaHawk

LD2000 USER GUIDE

LD2000

PRODUCT REGISTRATION

Product registration helps RLE Technologies inform owners of:
- Product Upgrades
- Firmware Enhancements
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TECHNICAL SUPPORT

Personal assistance is available Monday through Friday, from 8:00 a.m. to 5:00 p.m. MST.

For more information, please download the Product User Guide located on the Products/LD2000 section on our website at **www.rletech.com**,

A request for assistance may be sent to **support@rletech.com**.

Otherwise, please call us directly at: **(970) 484-6510 -** press "**2**" for technical support

The following information is located on the bottom of each LD2000 unit.
Please have this information available whenever a technical support call is placed:

Product Model Number _____

Product Serial Number _____

Product Manufacture Date _____

TABLE OF CONTENTS

LIST OF FIGURES AND TABLES

CHAPTER 1: PRODUCT OVERVIEW

1-1   DESCRIPTION

The LD2000 is a complete monitoring system that detects and reports the presence of water and other conductive liquids. The LD2000 couples the SeaHawk Leak Detection Cable (SC) with an advanced control panel. Each LD2000 monitors up to 2000 feet (609m) of SC cable. When a conductive liquid comes in contact with the SC cable, the distance to the leak is shown on the LD2000's front panel display. Alarm notifications are distributed via user-configurable Modbus (RS485 or TCP/IP), BACnet (IP), SNMP, SMTP (email), or Relay output.

1-2   OPERATION

When the LD2000'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 summary relay has one output. The LD2000 provides a webpage interface to allow users to check updates on the unit's conditions via the Internet or local area network. The LD2000 also provides Modbus outputs via RS485, twisted-pair wire, or TCP/IP.

The LD2000 is a supervised system - it continually monitors the cable for continuity. A cable break or excess contamination of the cable causes a cable break indication and activates a relay. The LD2000 sends alarm notifications to predetermined recipients when an alarm sounds. The LD2000 produces an alarm during the following conditions:

- Leak Detection
- Cable Break
- Cable Contamination

1-3   MECHANICAL DESCRIPTION

The LD2000 is built with one circuit board. The **main board** is mounted inside of the enclosure. A reset switch is provided inside of the enclosure on the board to reset the microprocessor without cycling power to the unit.

1-4   INSTALLATION

The LD2000 is a wall mounted device. Before applying power to the unit, ensure that all connections are correct and all screw terminals are secure. The LD2000 is powered by 24 VAC or 24 VDC power. **DO NOT** connect 120/230 VAC to the unit, damage will occur to the circuitry.

1-5   REFERENCE MAP

Users are advised to purchase a framed reference map (part #FM1114) for use with the LD2000 to help locate any detected leaks along the SC cable; to view sample maps, go to the SeaHawk Accessories webpage at www.rletech.com. Once all the SC 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 updated map can be remounted near the control panel.

1-6   WEB INTERFACE

The LD2000's webpage interface provides remote information updates via network communications. The interface's menu structure is as follows:

- ➢ Home
  - ▪ Alarm Status
  - ▪ Cable Length
  - ▪ Cable Current
  - ▪ Leg 1 Resistance
  - ▪ Leg 2 Resistance
  - ▪ Alarm Delay Counts
  - ▪ Last Alarm Time
  - ▪ Model
  - ▪ Flash Application
  - ▪ Flash Appl. Size
  - ▪ Bootloader Version
  - ▪ MAC Address
  - ▪ IP Address
  - ▪ Net Mask
  - ▪ Def Route
  - ▪ Current Time
  - ▪ sysUpTime

CHAPTER 2: CONNECTIONS AND SETTINGS

The LD2000 is comprised of one board. All connections are accessible when the unit is inside of its enclosure. The connectors on the main board, found at the bottom of Figure: 2-1, are labeled TB1 through TB4 and P1 through P4.
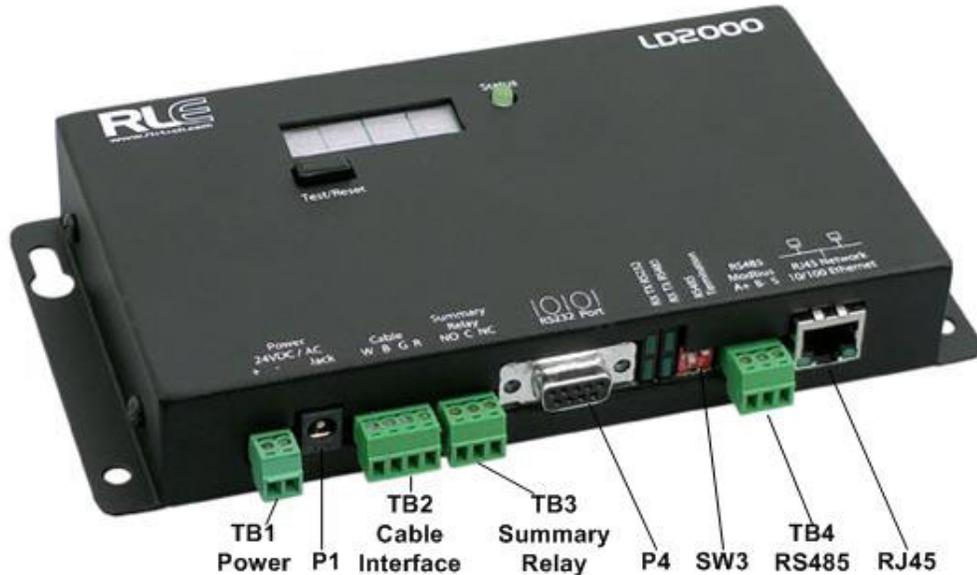
Figure 2-1: LD2000 Connections

2-1   RESET

When held this button will reset the unit and clear any alarms. The LD2000 will then recheck for any alarm conditions.

2-2   CONNECTIONS

2-2.1   TB1: Input Power

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

> TB1-1 24VDC negative (-)
> TB1-2 24VDC positive (+)

2-2.2   P1: Input Power

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

> Inside Positive (+)
> Outside Positive (-)

Power is recommended to be supplied by a 24VDC wall adapter power supply (part #WA-DC-24-ST), which is not included with the LD2000 and can be purchased separately. For more information on RLE power supplies, visit the SeaHawk Accessories webpage at www.rletech.com, or contact RLE.

2-2.3   TB2: Cable Interface

The SeaHawk Water Leak Detection Cable (SC) connects to TB2. A 15 foot (4.57m) non-sensing leader cable is required to connect the LD2000 to the SC cable. The non-sensing cable is included in a leader cable kit (part #LC-KIT; *purchased separately*). Connect the cable wires to TB2 as follows:

> TB2-1 White wire
> TB2-2 Black wire
> TB2-3 Green wire
> TB2-4 Red wire

2-2.4   TB3: Summary Relay

Terminal TB3 is a Form C Relay Output. This relay provides alarm notification when a **leak** is detected, a cable **fault** is detected, or a cable **contamination** is detected.

The three contacts on TB3 are labeled **NO**, **C**, and **NC**. Connect the alarm relay wires to TB3 as follows:

> TB3-1 Leak alarm normally open (NO)
> TB3-2 Leak alarm common (C)
> TB3-3 Leak alarm normally closed (NC)

Both relays (all alarms) can be configured to be latched or unlatched. A latched alarm requires a manual reset of the system once a leak or cable problem is no longer present; *see section 4-3.1, pg. 10 for configuration instructions*.

2-2.5   P4: RS232 Connector

The RS232 uses a baud rate of 9600. The RS232 port is set to 8 databits, no parity, and 1 stop bit (8, N, 1). A straight through cable should be used to connect a terminal or PC to the LD2000. This connection should only be used for setting the IP address, advanced diagnostics, uploading firmware, and troubleshooting.

2-2.6   SW3: RS485 Termination

Switch SW3, when switched on (down position), places a termination resistor across the + and – terminals of the RS485 port. This is used when the LD2000 is the last unit on a RS485 network.

2-2.7   TB4: RS485 Modbus Port

TB4 connects to a RS485 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 RS485 port is set to 8 databits, no parity, and 1 stop bit (8, N, 1). Connect the RS485 wires to TB4 as follows:

> TB3-1 A (+)
> TB3-2 B (-)
> TB3-3 Shield

2-2.8   P3: RJ45 Network

A 10/100 BaseT Ethernet connection is available to connect the LD2000 on a local area network. Use a crossover cable (shipped with the LD2000; blue cable with yellow ends) for initial connection and configuration. The default settings are as follows:

> IP Address: 10.0.0.188
> Subnet Mask: 255.255.255.0

CHAPTER 3: INSTALLATION

3-1   INSTALLING THE UNIT

The LD2000 is a wall mounted device. There are four mounting holes on the sides of the unit spaced 7.5 inches (.19m) apart. Use drywall anchors if securing the unit to drywall.

3-2   CONNECTING THE SEAHAWK WATER LEAK DETECTION CABLE (SC)

The LD2000 requires a leader cable kit (part #LC-KIT, *purchased separately*) which includes a 15 foot (4.57m) leader cable. One end of this leader cable connects into the LD2000. This end of the cable has four stripped, bare wires. The other end features a mating connector which connects with the SeaHawk Leak Detection Cable (SC). The end of the cable is finished with a removable end terminator (EOL).

> **NOTE:**
> **A Leader Cable Kit (part #LC-KIT) is required to connect the LD2000 to SeaHawk Leak Detection Cable (SC). The kits are not included with the LD2000, and can be purchased separately.**

Connect the 15 foot (4.57m) leader cable to the LD2000. From left to right, with the screws of the terminal block connector facing up, the wires that screw into the terminal connector should be colored white, black, green, and red. 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.

Once the leader cable is plugged into the terminal block, it is ready to be connected to the SC cable. To do this, unscrew the end EOL from the end of the leader cable. Attach the first length of the SC cable to the leader cable. Route the SC cable according to a cable layout diagram, if provided. Lay the cable according to the Securing Cable guidelines on page 6. Secure the EOL terminator on the unoccupied end of the SC cable.
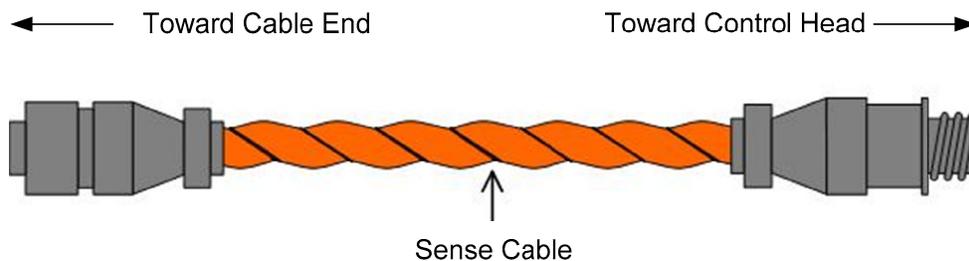
Figure 3-1: SeaHawk Water Leak Detection Cable (SC)

3-2.1   <u>**Securing Cable to the Floor**</u>

Secure the SC cable to the floor with either J-clips (part #JC), or one of the other approved methods shown in Figure: 3-2, page 7. Available from RLE and designed specifically for use with SC cable, J-clips (part #JC) are the manufacturer's recommended installation method and can be installed as follows:

- Place one J-clip every 3 feet (.914m) along the length of the SC cable and one at each turn of the cable.

- If the cable is installed over an obstruction, clip 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 6 feet (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 Leak Detection Cable (SC) 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.

Laid freely on the floor. Only recommended in spaces with no access.

Secured to floor with mastic.

Installed in protective covering.

Secured to floor with J-clips.

Secured to floor with tie wrap.

Secured to pedestal with tie wrap. Do Not Secure as Shown
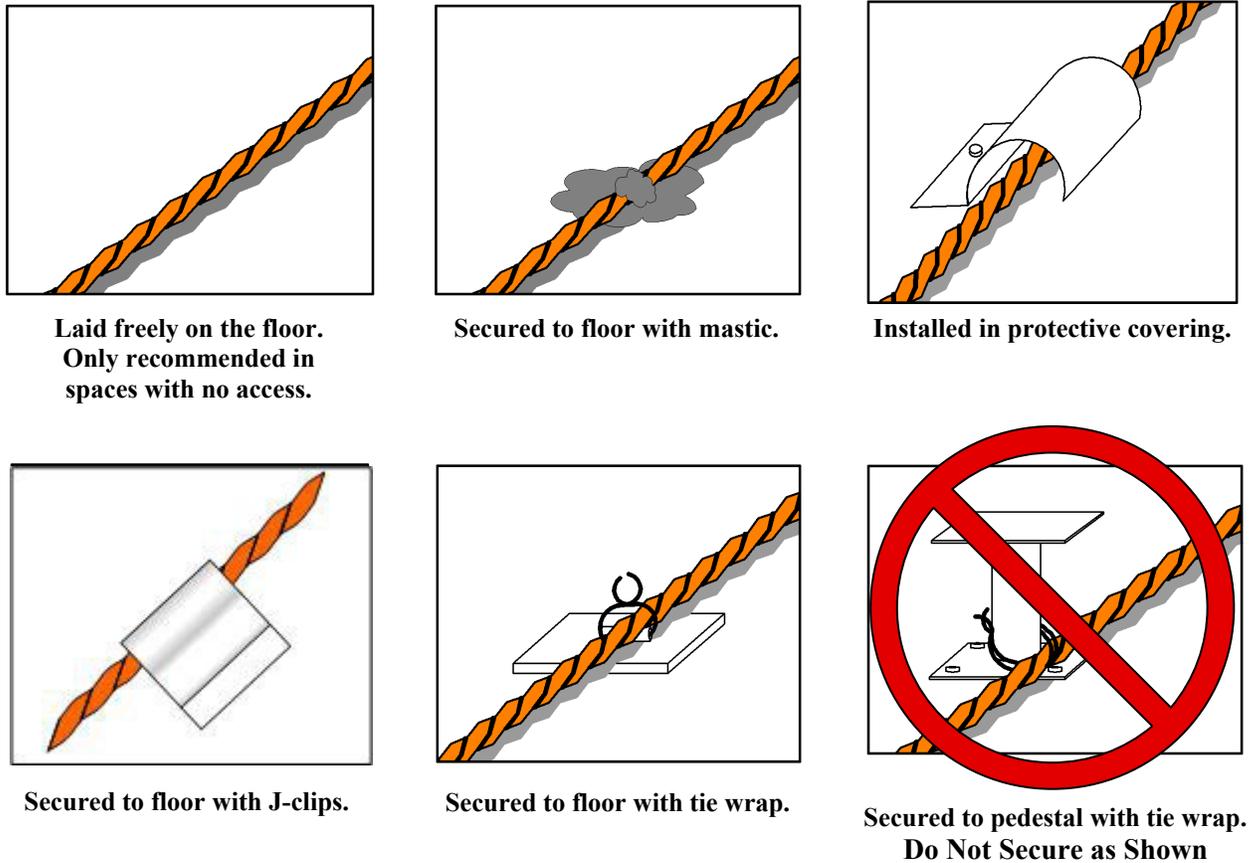
Figure 3-2: Cable Installation Methods

3-3   APPLY POWER TO THE UNIT

Once the SC cable is connected to the unit, power may be applied. The LD2000 operates on 24VDC or 24VAC power. RLE recommends that power be supplied by a 24VDC wall adapter power supply (part #WA-DC-24-ST).

> **NOTE:**
>
> **A power supply is not included with the LD2000. The recommended 24VDC power supply (part #WA-DC-24-ST) can be purchased separately. For more information on RLE power supplies, visit the SeaHawk Accessories webpage at www.rletech.com, or contact RLE directly at 970 484-6510.**

A power supply should be run to the location of the unit. Before applying power to the unit, make sure all cable and communication connections are complete. The LD2000 should begin booting upon power. Wait approximately one minute. No alarm should be present.

On the webpage interface, the cable length is displayed. If this reading varies by more than ±5% of the actual length of cable installed, verify the installation. The LD2000 should not require any calibration. If any calibration is required, verify that the cable current is zero before calibrating or false, inaccurate readings will occur.

Through the webpage submenus, you may set the clock, system name, alarm configuration, feet/meters, etc.

3-4   COMMUNICATION

The LD2000 will not communicate over a user's network the first time it is connected to the network. The manufacturer programs the LD2000 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 LD2000 can communicate over the network.

3-4.1   <u>Set The LD2000's IP Address</u>

- ▪ Via the Web browser
- ▪ Via the RS232 interface

3-4.1.1 Set the LD2000's IP Address Using a Web Browser

1. Plug the crossover network cable that shipped with the LD2000 unit into the laptop or workstation that will be used to configure the LD2000. This cable is not intended to be connected to a network hub.

2. **Consult the computer's manual or your IT Department before attempting this.** 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 LD2000, 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. Connect the other end of the network cable to the Ethernet port on the LD2000. Access the LD2000 through a Web browser by typing the IP address into the location bar. Enter the LD2000 user name and password when prompted.

> ### NOTE:
> **The default user name is "ld2000". The user name is case sensitive so be sure to use all lowercase letters. There is no default password. Leave the password field empty.**

3. 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 LD2000 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.

4. 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.

5. The computer and the LD2000 are now both configured to communicate on the network. Both should be accessible via the network. Connect the PC and the LD2000 to the network. From the PC Web browser, type in the IP address of the LD2000. Enter the user name and password as stated above to verify network access to the LD2000.

3-4.1.2 Set the LD2000's IP Address using an RS232 Connection

To use the RS232 interface:

1. Connect the RS232 port (P4) on the LD2000 to a terminal or PC running terminal emulation software (HyperTerminal) with a 9-pin male-female straight through serial cable.

2. Set the appropriate communication port to **9600 baud, NO parity, 8 data bits, 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 LD2000 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 LD2000 will erase a memory block and copy data to Flash memory before rebooting.

7. The LD2000 IP address is now set and the LD2000 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.

CHAPTER 4:WEB INTERFACE

The LD2000's network connection allows users to configure and view current information from the LD2000. When logging on to the LD2000, 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: ld2000
> Password: *-none/blank-*

4-1   HOME

When logging into the LD2000, the first page display is the **Home page**. All vital information is display in the main table. From the main page, four links are available in the top right section: Refresh, Home, Historical Data, and Configuration. Refresh allows the user to refresh the webpage and update all data in the table. **Home** is a link to the Home page currently being viewed. **Historical Data** and **Configuration** are links to their appropriate webpages.

4-2   HISTORICAL DATA

The **Historical Data** page displays a table of Alarm History and also provides a link to the Trend Log (located in the upper right). The Alarm History table displays Alarms and events recorded in the unit's memory log. The alarms are displayed as follows:

> **AHxxx-yy-zzz –DATE TIME DESCRIPTION**
> **xxx** is the log entry number for the alarm/event.
> **yy** is the event code and varies depending on the event (03 – Cable Fault, 04 – Leak Detected, 05 – Contamination Detected, 06 – Reset/Power Up)
> **DATE** and **TIME** are displayed as MM/DD/YY and HH:MM:SS (24 hour) format.
> **DESCRIPTION** provides details about the current alarm/event.

4-2.1   Trend Log

The Trend Log option provides a trending list of logged current leakage. This provides assistance in troubleshooting leaks and inaccurate readings.

4-3   CONFIGURATION

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

4-3.1   Leak Settings

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

> **Leak Trip Point**: The amount of current leakage required to detect a leak. Default setting is 200uA. 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. The Leak Trip Point must also 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. The Contamination Trip Point must also be exceeded for the duration of the delay.

Resistance Per Foot: The resistance per foot (or meter) of cable determines the unit's ability to accurately detect the 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/meter.

Measurement Display: The type of units that are displayed on the LD2000. Select either feet or meters to calibrate the unit to the preferred unit of measure.

Latching Alarms: This option selects the latching ability for the alarm notifications of the unit. Latching alarms will hold the unit in an alarm state, even after the condition has been cleared, until someone presses the Reset button, located on the front of the physical LD2000 unit.

4-3.2   Zone Settings

The Zone Settings menu allows users to set zones along particular lengths of cable. These zones will display in the descriptions of any leak alarm when detected in the appropriate cable range. Labeling zone descriptions increase the speed in which a leak is physically discovered. For example, a section of cable located in the "Room A" might be labeled "Rm. A". Because the description refers to a familiar location rather than cable distance, the alarm can be located faster. Each zone begins with previous zone's end distance and ends with its own. Zone 1 begins at zero.

4-3.3   Network Settings

The Network settings allow users to change the network configuration of the LD2000. IP address, Subnet Mask, and Default Route (Gateway) may be changed from this menu.

4-3.4   Web Settings

The Web Settings menu allows users to set two different security level passwords on the LD2000. A Read-Only level password allows users to view *only* the information and settings of the LD2000. No settings or changes may be submitted to the unit.

The Read/Write level password allows users to change settings and configurations on the LD2000 and 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. The link URL allows a user to link a file of a reference map to the webpage interface. Use a file common to all users, such as a .jpg or .pdf.

4-3.5   Email/DNS

The Email page allows users to configure the LD2000 to send notification via email when the unit is in an alarm state. The LD2000 will send one email message per alarm instance to a maximum of four email recipients.

Access Type: Specifies whether to send the message through a local network connection or disable the email feature (none).

Email Contamination Alarms: Specifies whether to send email alarm notification upon a cable contamination alarm. Users may want to disable this feature if false alarms are often detected.

DNS Servers: Information provided by your ISP; needed to deliver the email message.

Mail (SMTP) Server: Specifies the email server used to receive and send mail.

Mail Sender Address: The address displayed in the "From" field of the email message.

Mail Subject: Displayed in the subject field of the received email messages.

Mail Recipient (1) - Mail Recipient (4): Enter the addresses of up to four email recipients.

SMTP Authentication: Used for ESMTP; use the recommended default setting unless instructed differently by your IT Department.

SMTP User Name: Used for ESMTP; use the recommended default setting unless instructed differently by your IT Department.

SMTP Password: Used for ESMTP; use the recommended default setting unless instructed differently by your IT Department.

4-3.6   NTP (Network Time Protocol)

Network Time Protocol (NTP) is widely used in the Internet to synchronize computer clocks to national standard time or Coordinated Universal Time (UTC). It synchronizes the time of a computer or server (in this case, the LD2000) to another server or reference time source. NTP is important in maintaining a high level of accuracy and reliability in time stamped events. This page allows users to configure the LD2000's NTP feature.

Network Time (NTP) Server: The IP address or hostname of the Network Time Protocol Server with which the LD2000 will synchronize. Examples of public NTP Servers include "us.pool.ntp.org" and "time.nist.gov".

Update Interval: The time, in minutes, the LD2000 will take to request time updates from the NTP Server. This can be set from 5-1440 minutes. Enter 0 to disable.

Retry Interval: The time in seconds the LD2000 waits before retrying a failed connection to the NTP Server. This can be set from 10-120 seconds.

Select Time Zone: Enter the time zone in which the LD2000 resides.

Daylight Savings Time: Select the hour Daylight Savings Time occurs. Typically, this is 2:00 A.M. local time.

DST Begin Date: Enter the date Daylight Savings Time will begin.

DST End Date: Enter the date Daylight Savings Time will end.

4-3.7   SNMP/Syslog

SNMP/Syslog allows users to configure SNMP notification options.

System Name: Appears on the LD2000 Main Menu and is included as part of email notifications.

System Contact: Lists the individual responsible for the LD2000. 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 LD2000. The System Location is *not* included in email or SNMP Trap notifications.

Communities: Identifies devices that receive SNMP Traps and/or Syslog messages from the LD2000 and interacts with the LD2000 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 LD2000 through an MIB browser. Select "Write" if the device will have Read/Write network access. This allows the LD2000 to be configured over the network. Select "Traps" if the device will receive Traps from the LD2000. Select "Syslog" if the device will receive Syslog messages from the LD2000.

4-3.8   Modbus

Modbus Configuration allows users to configure Modbus (RS485 and/or TCP/IP) options.

Modbus/TCP Slave Unit Identifier: Specify the slave address used on the LD2000's IP port (1-254).

EIA-485 Baud Rate: Sets the RS485 Port to 1200, 2400 or 9600 Baud. All the devices connected to the Modbus network must be set to operate at the same Baud rate.

EIA-485 Parity: Sets the RS485 Port to None, Even or Odd Parity. All the devices connected to the Modbus network must be set to operate at the same parity.

EIA-485 Slave Address: Set the RS485 Port's slave address (1-254). Each device on the RS485 Modbus network must have a unique address.

4-3.9   BACnet

The BACnet Configuration page allows the user to enable the LD2000 for BACnet slave configuration.

BACnet Device Name: The name of the LD2000 as it will appear on the BACnet network.

BACnet Device ID: The unique identifier for the LD2000 on the BACnet network.

BACnet Description: The description of the LD2000 as it will appear on the BACnet network.

BACnet UDP Port: The port to which the LD2000 will respond to BACnet requests. The default number of zero in this field will configure the LD2000 to listen on the standard BACnet port of 47808, see the BACnet standard for more information.

BACnet BBMD-BDT, LD2000 IP Address, #1 IP Address, #2 IP Address, #3 IP Address, #4 IP Address: These fields give the user a reference and edit capabilities of the BACnet Broadcast Distribution Table. These fields DO NOT need to be configured by the user. If the LD2000 is acting as a BACnet router, these fields will automatically be populated by the BACnet network controller.

4-3.10   Clock

The Clock Configuration page allows users to set the date and time on the LD2000's internal clock.

- Enter the date using a MM/DD/YY format, where MM is a two digit month, DD is a two digit day, and YY is a two digit year.
- Enter the time using a HH/MM/SS format, where HH is a two digit hour (1-24), MM is a two digit minute (1-60), and SS is a two digit second (1-60).

4-3.11   Alarm Management

The Alarm Management page allows users to acknowledge, reset, and clear alarms.

Acknowledge Snmp Informs: Acknowledges Snmp Informs and ceases Informs from being sent out for the current alarm condition.

Reset Leak Alarm: Resets the current leak alarm and causes the unit to recheck the current cable conditions. This will clear the alarm condition if the cable registers that the leak threshold is within an accepted range.

Clear Alarm History: Clears the alarm history table of all previous alarms.

4-3.12 <u>System Management</u>

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

Exit to Bootloader: Forces the unit to stop running flash application to allow for firmware updates; *see Appendix A: Updating Firmware, pg. 19, for more information.*

Restore Factory Defaults: Resets the configurations and settings on the unit to all factory defaults.

CHAPTER 5: MODBUS COMMUNICATION

This chapter describes the Modbus communication protocol as supported by the LD2000 Distance Read System. The content includes details and information on how to configure the LD2000 for communications via Modbus network.

5-1   IMPLEMENTATION BASICS

The LD2000 is capable of communicating via the half-duplex RS485 serial communication standard. The LD2000 is configured to act as a slave device on a common network. The RS485 medium allows for multiple devices on a multi-drop network. The LD2000 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 LD2000 supports only the RTU mode of transmission, with 8 data bits, no parity and one 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. A valid address range is between 1 and 254. Dip Switch #1 sets the address. The firmware program constantly reads dip Switch #1. Any changes are updated on the fly. Close the SW1 positions that correspond to the binary number of the address.

5-1.1.2   Function Field

The function field is one byte in length and tells the LD2000 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 LD2000 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 LD2000 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 LD2000 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 LD2000

This section covers the registers with the name and a brief description of each.

5-2.1   Function 03: Read Output Registers

To read the LD2000 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	Units	Range
40001	Leak Threshold	Trip current for leak alarm	uAmps	0-65535
40002	Contamination Threshold	Trip current for contamination alarm	uAmps	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	Seconds	Leak Alarm Delay	20-3600	0-65535
40017	Seconds	Contamination Alarm Delay	20-3600	0-65535

5-2.2   Function 04: Read Input Registers

To read the LD2000 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	uAmps	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
03	1 = Summary Alarm
04-15	Spare

5-2.3 Function 06: Preset Single Register

To set a LD2000 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 LD2000 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 LD2000 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		CRC 16 "Lsb"	CRC 16"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:

$$40001 = 0000 \text{ (hex)}$$
$$40002 = 0000 \text{ (hex)}$$
$$40003 = 0001 \text{ (hex)}$$

APPENDIX A: UPDATING FIRMWARE

Firmware updates are available on the Documentation/Files section of the LD2000 webpage at www.rletech.com. Download appropriate firmware to an accessible place to upload via TFTP through a LAN connection.

A-1   UPDATING THE FLASH FIRMWARE VIA WEB INTERFACE/TFTP

Before updating the firmware, the firmware flash application must be exited and then erased. To do this, navigate to the LD2000's System Management menu. Once here, click on the "Exited to Bootloader" button (you must have write access to the unit in order to accomplish this task). Once exited, you will get a bootloader webpage at the IP address of the unit. Next, click on the "Erase Flash" button. The Flash application will be erased.

NOTE:

In order to erase the flash, a special username and password is required:
Username: LD2000
Password: RLE2TECH

1. 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.

2. Verify that your PC and the LD2000 are on the same subnetwork (LAN).

3. Open your TFTP client. Configure the client as follows.
   a) **Host** = LD2000 IP Address
   b) **Port** = 69
   c) **Block Size** = 64, 128, 256, 512, or 1024
   d) **NOTE:** The file must be sent in BINARY (not ASCII).

4. Send or PUT the firmware file to the LD2000. It may take ~10 seconds for the firmware upload to begin. This will put the new firmware into effect.

5. After one minute, refresh the LD2000 webpage. Notice that the Flash field now contains the 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 on the control panel.

3. Compare the distance reading on the LD2000 to a reference map (if available) to verify that the LD2000 displays the correct leak location.

4. Dry the cable and verify that the LD2000 returns to normal.

5. Remove the end-of-line terminator.

6. Verify the Cable Break alarm on the control panel.

7. Reinstall the end-of-line terminator.

8. Verify that the LD2000 returns to normal.

Monitor the cable current monthly to verify that the cable is not being contaminated. The LD2000 will alarm on cable contamination if the contamination is excessive.

▪ From the LD2000 Web interface, verify that the Cable Current is less than 25uA. If the cable current is greater than 25uA, it is recommended to troubleshoot the cables to determine which cable is contaminated. The contaminated cable should be removed, cleaned, retested and reinstalled.

APPENDIX C: TROUBLESHOOTING

Trouble	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 LD2000. If no voltage is present at terminal block, check the circuit (breaker) or power supply the LD2000 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 LED's are illuminated, contact RLE Technologies for further troubleshooting.
Cable Break Alarm	1. Verify that the leader cable from the SC 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 SC 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 SC cable. Start moving the EOL terminator to the end of each section of SC 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.
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 SC cable. Locate the first section of SC cable from the LD2000 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 SC 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 SC cable. If the leak is calculated correctly, remove the EOL terminator; reconnect the SC 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 LD2000 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 LD2000 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

Power		24VAC Isolated @ 600mA max, 50/60Hz; requires power supply (not included)
		24VDC@ 600mA max; requires power supply: WA-DC-24-ST (not included)
Inputs		
Water Leak Detection Cable		Compatible with SeaHawk SC Cable (not included)
Cable Input		Requires SeaHawk LC-KIT: 15ft (4.57m) leader cable and EOL (LC-KIT not included)
Recommended Maximum Length		2,000ft (609m)
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		5-990sec, software adjustable in 5sec increments; ±2sec
Outputs		
Relay		Summary Relay; 1A @ 24VDC, 0.5A resistive @ 120VAC
Communications Ports		
Ethernet		10/100 BaseT, RJ45 connector; 500VAC RMS isolation
RS-232		DB9 female connector; 9600 baud; No parity, 8 data bits, 1 stop bit
RS-485		1200, 2400, 9600 or 19200 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, Traps
SMTP (Email)		Supports Client Authentication (plain and login); compatible with ESMTP Servers
Modbus (RS-485)		Slave; RTU Mode; Supports function codes 03, 04, 06 and 16
Modbus TCP/IP		Modbus Slave; TCP/IP transmission protocol
BACnet/IP		Conformance Level 1
Terminal Emulation (RS-232)		VT100 compatible
Alarm Notification		
Visual Alarm		Red, 4-digit; 7 Segment LED Display; Bi-color status LED
Email (Ethernet)		4 Email recipients; email sent on Alarm and Return to Normal; each Alarm can notify any or all of the email recipients
SNMP Traps (Ethernet)		4 Community Strings
Logging Capabilities		
Event Log		Last 100 events
Trend Log		Cable current level every day, for the last 288 days
Login Security		
Web Browser Access (Ethernet)		1 Web password Read Only; 1 Web password Read/Write
Terminal Emulation Access		None
Front Panel Interface		
Display		Red, 4-digit; 7 Segment LED Display; Bi-color status LED
Push Buttons		Test/Rest: 1
LED Indicators		Power/Status: 1 tri-color (Power On: green; Alarm: red; Cable Fault: yellow)
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		8.0"W x 4.25"H x 1.25"D (203mmW x 108mmH x31.75mmD)
Weight		1.5 lbs. (680g)
Mounting		Vertical wall mount, or din rail mount (kit required): DIN-KIT (kit not included)
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