RLE Technologies

SeaHawk LD5000

User Guide

SeaHawk

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LD5000

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CHAPTER 1: PRODUCT OVERVIEW

1-1 DESCRIPTION

The LD5000 is a complete monitoring system that detects and reports the presence of water and other conductive liquids. The LD5000 couples RLE distance read leak detection cable with an advanced control panel. Each LD5000 monitors up to 5,000 feet of leak detection cable. When a conductive liquid comes in contact with the water leak detection cable an alarm sounds and the distance to the leak is shown on the LD5000's four line display.

The LD5000 allows a single person to perform the mapping of the cable - the process of determining the relationship between a known point along the cable and the value as measured by the LD5000.

1-2 OPERATION

When the LD5000'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 leak relay and fault relay each have two outputs. An additional 4-20mA output allows the device to interface with third party management systems.

The LD5000 produces an alarm in the following conditions:

- **Leak Detected**
- **Cable Break**
- **Loss of Communication**s

The LD5000 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.

1-3 MECHANICAL DESCRIPTION

The LD5000 with LCD is built with three circuit boards:

- The **display board** is connected to the microprocessor board with a ten conductor ribbon cable. The display board is mounted on the inside of the unit's door.
- The **microprocessor board** is mounted on top of the **leak detection board**. A reset switch is provided to reset the microprocessor without cycling power to the unit.

1-4 INSTALLATION

The LD5000 with LCD is a wall mounted device. Before applying power to the unit, insure that all connections are correct and all screw terminals are secure. The EMI suppression core must be installed on the leader cable that exits the LD5000 to conform to CE standards.

1-5 FLOOR MAP

Users may purchase a water leak detection cable reference map with their LD5000. Once all the water leak detection 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 reinstalled near the control panel.

1-6 LCD USER INTERFACE

The LD5000's LCD is a 4 line by 20 character backlit display with a six button keypad. The interface's menu structure is as follows:

- Main Menu
  - Status
    - Current Cable Status
    - Cable Length
    - Cable Current
  - Setup – (Password Protected)
    - Trip Points
      - Detection Trip
      - Contamination Trip
    - Clock
    - Re-Alarm
    - Ft/M
      - Calibrate
      - FCDft
  - Log/Data
    - History
    - Trend
    - HistClr
    - TrndClr
  - System (Water Leak Detection Cable mapping)
    - View Map
    - StartMap
  - Reset
    - Reset
    - Update
    - FaultRly
    - LeakRly
  - Modbus

Navigate through the menu(s) with the **left** and **right** arrows. **Esc** cancels any action and returns to the previous menu. **Enter (↵)** selects a submenu and commits changes. The **-** (minus) and **+** (plus) keys change the values. Further LCD interface information can be found beginning on pages 13-17. If any of the LD5000's passwords are lost or misplaced, contact RLE Technologies to help reset the passwords.

Figure 1-1 LD5000 LCD Interface

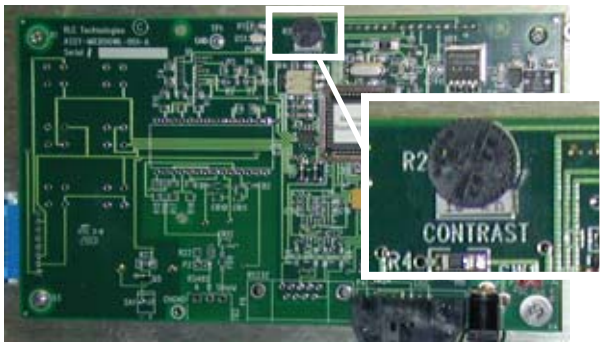


Figure 1-2 R2 Contrast Adjustment

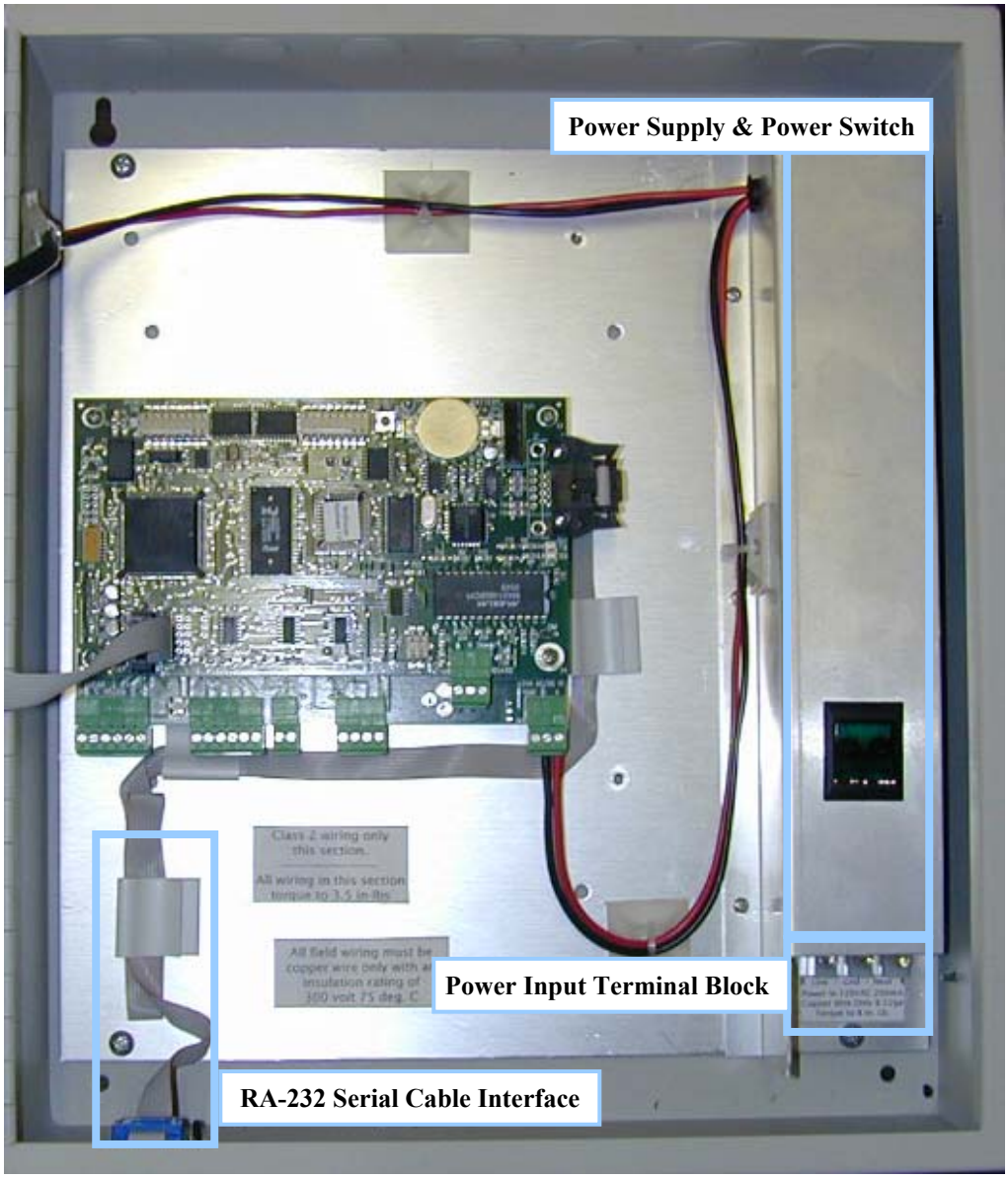


Figure 1-3 LD5000 Enclosure Interior

Warning!

- ***A dedicated circuit breaker must be provided in the building within close proximity to the RLE unit and be clearly marked as the disconnecting device for this unit.***

CHAPTER 2: CONNECTIONS AND SETTINGS

The LD5000 is comprised of three boards. All three boards are accessed when the device's front cover is opened. The display board is located on the inside of the door. The microprocessor board is stacked on top of the leak detection board. Since the leak detection board is longer than the microprocessor board, the connectors on the leak detection board extend past the end of the microprocessor board. These two boards are secured to the inside of the unit.

The connectors on the leak detection board, found at the bottom of the following photograph, are labeled TB1 through TB5. The connectors on the microprocessor board are labeled TB1 and P3. The switches on the microprocessor board are labeled SW1 through SW4.

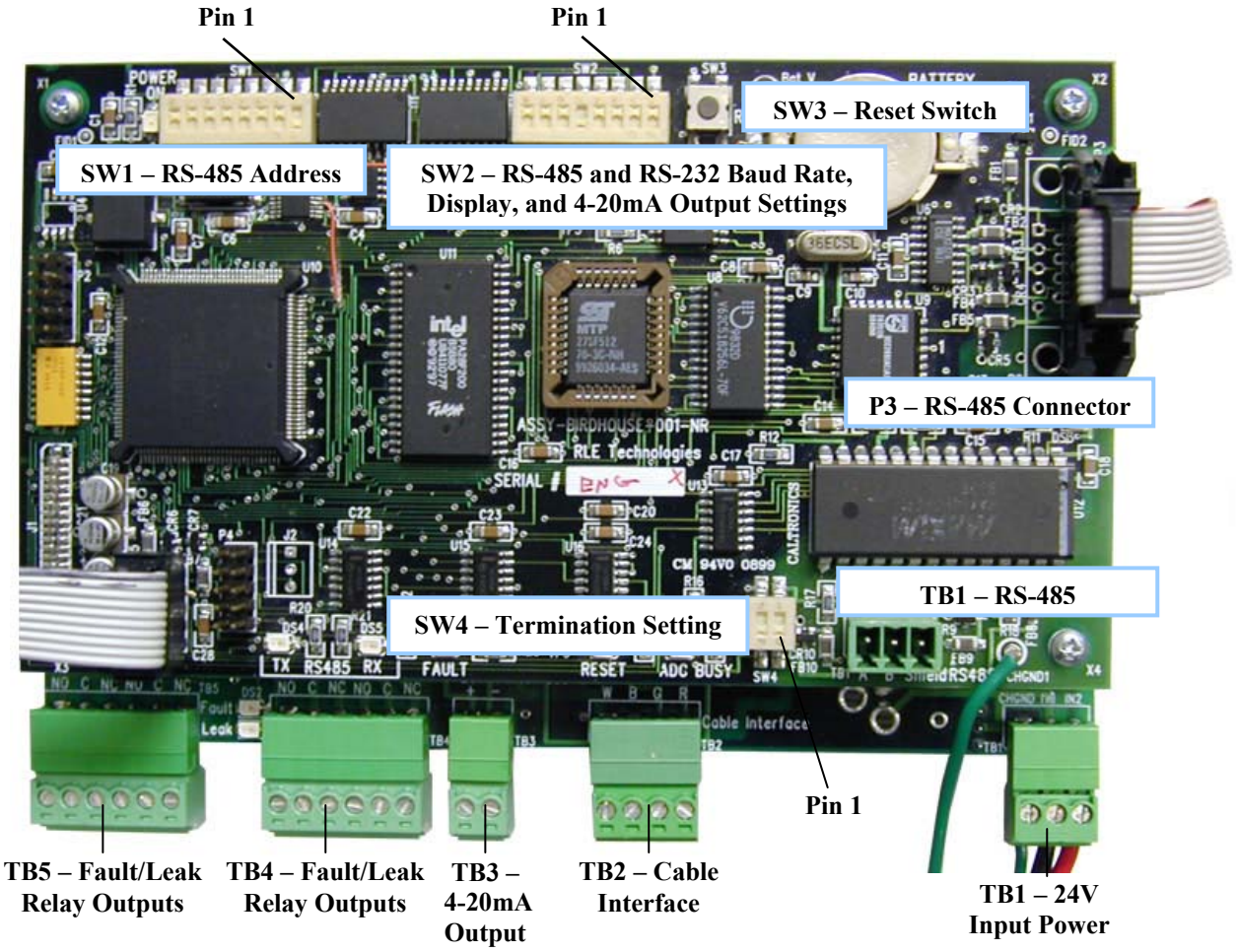


Figure 2-1 LD5000 Leak Detection Boards

2-1 DISPLAY BOARD

2-1.1 R2: Contrast

This dial adjusts the 4x20 LCD's contrast. Turn the knob clockwise or counterclockwise to adjust the contrast as necessary.

2-2 LEAK DETECTION BOARD

2-2.1 TB1: Input Power

This is a factory wired three position connector with the following connections (for reference only):

TB1-1 ground
TB1-2 24VDC negative (-)
TB1-3 24VDC positive (+)

2-2.2 TB2: Cable Interface

The Water Leak Detection Cable connects to TB2. A fifteen foot Non-Sensing cable is provided to connect the LD5000 to the Water Leak Detection 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

2-2.3 TB3: 4-20mA Output

A 4-20mA loop powered output is provided on TB3.

Four mA = no alarm
Five mA = leak at 0 distance
19mA = full scale distance specified by SW2 positions 6-8 (see page 14)
20mA = cable fault

Connect the 4-20mA wires to TB3 as follows:

TB3-1 4-20mA positive (+)
TB3-2 4-20mA negative (-)

2-2.4 TB4 & TB5: Relays

Terminals TB4 and TB5 are Form C Relay Outputs. Each terminal has two outputs. TB4 provides a connection to one of the leak alarm relay outputs and one of the fault relay outputs; TB5 provides a second set of contacts for the same leak and fault alarms.

The six contacts on TB4 and TB5 are labeled **Leak NO**, **Leak C**, **Leak NC**, **Fault NO**, Fault C, and **Fault NC**. Connect the alarm relay wires to TB4 and TB5 as follows:

TB4-1 Leak alarm normally open (NO)
TB4-2 Leak alarm common (C)
TB4-3 Leak alarm normally closed (NC)
TB4-4 Fault alarm normally open (NO)
TB4-5 Fault alarm common (C)
TB4-6 Fault alarm normally closed (NC)
TB5-1 Leak alarm normally open (NO)
TB5-2 Leak alarm common (C)

TB5-3 Leak alarm normally closed (NC)
TB5-4 Fault alarm normally open (NO)
TB5-5 Fault alarm common (C)
TB5-6 Fault alarm normally closed (NC)

Two LEDs, labeled **Fault** and **Leak**, are located between TB4 and TB5. They indicate the status of the relays. The leak detection relay is activated when a leak is detected. The cable break relay is activated when a cable fault is detected.

Both relays can be configured to be unsupervised or supervised. If the relay is set to supervised, the relays will be closed as long as no alarm condition exists. A leak, cable trouble, or power failure will cause the appropriate relay to open.

The relays can also be configured to latched or unlatched. A latched alarm requires a manual reset of the system once a leak or cable problem is no longer present.

2-3 MICROPROCESSOR BOARD

2-3.1 TB1: RS-485 Connector

TB1 connects the RS-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 RS-485 port is set to no parity, 8 databits, 1 stop bit (n, 8, 1). Connect the RS-485 wires to TB1 on the top PC board as follows:

TB1-1 A (+)
TB1-2 B (-)
TB1-3 Shield

2-4 INPUT POWER

The LD5000 mounted in the metal enclosure requires an 85-264VAC connection (2 wire & ground). Connect the 85-264VAC to the input terminal block. Connect the 85-264VAC to the input terminal block.

Warning!

Do not apply power until connections are complete.

2-5 POWER ON/OFF SWITCH

An internal power switch is used to power the unit on and off. This switch contains an integrated breaker rated at two amps.

2-6 RS-232 CONNECTOR

The RS-232 port uses only the transmit, receive, and ground pins (2, 3 and 5). The manufacturer sets the baud rate at 9600. The user may adjust the baud rate through SW2 on the microprocessor board. The RS-232 port is set to no parity, 8 databits, 1 stop bit (n, 8, 1).A straight through cable should be used to connect a terminal or PC to the LD5000.

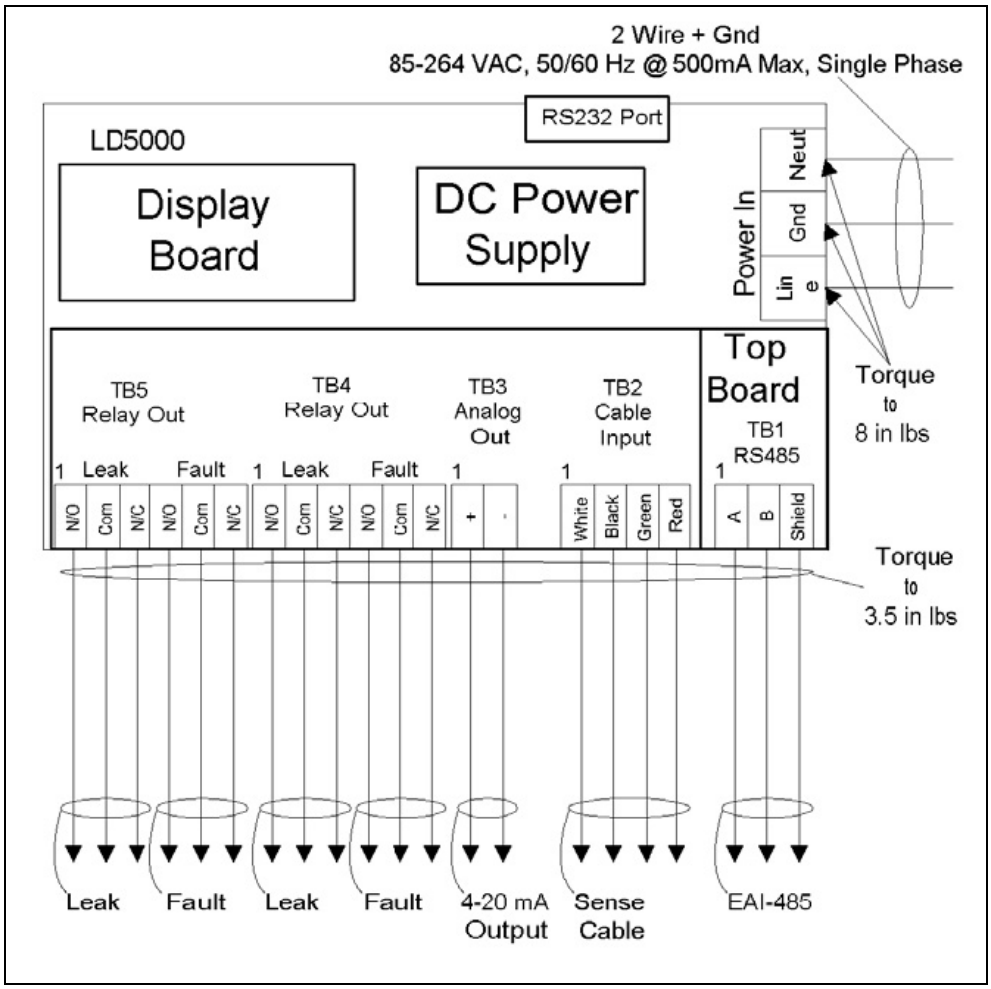
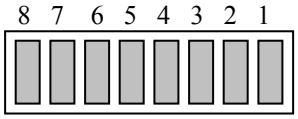


Figure 2-2 LD5000 Wiring Diagram

2-7 SWITCHES

2-7.1 SW1: Setting RS-485 Address



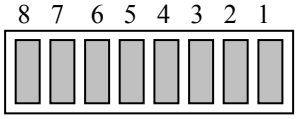
SW1, positions 1 through 8, are used to set the RS-485 address. The address can range from 00000001 to 11111111.

For All SW Settings:

1 – Switch is on.

0 – Switch is off.

2-7.2 SW2: Baud Rate Settings, LCD Display, 4-20mA Scale



Baud rate settings for the RS-232 port and the RS-485 port are both set through this dip switch. The RS-232 baud rate is set with switch positions 1 and 2. The RS-485 baud rate is set with switch positions 3 and 4.

2-7.2.1 SW2, Positions 1 & 2

The manufacturer sets the baud rate of the RS-232 connection to 9600 baud. Manipulating the positions of switches 1 and 2 adjusts the baud rate as follows:

21 (Switch position)
01 = 1200
10 = 2400
00 = 9600
11 = 19,200

2-7.2.2 SW2, Positions 3 & 4

The manufacturer sets the baud rate of the RS-485 connection to 9600 baud. Users can set the baud rate using SW2, positions 3 and 4, and manipulating them as follows:

43 (Switch position)
00 = 1200
10 = 9600
01 = 2400
11 = 19,200

2-7.2.3 SW2, Position 5

SW2, position 5 enables or disables the LCD.

0 = Disable
1 = Enable

2-7.2.4 SW2, Position 6-8

SW2, positions 6 through 8, designate the length of cable attached to the LD5000. This insures the 4-20mA output readings are correct for the LD5000 system. Without an accurate length setting, the unit would not return the proper 4-20mA reading to diagnose the condition of the cable.

Switch settings are listed below. If the length of cable falls between two amounts, use the settings for the higher of the two amounts:

876 (Switch position)
000 = 0 - 500 ft. (0 - 152.4 m)
001 = 0 - 1000 ft. (0 - 304.8 m)
010 = 0 - 1500 ft. (0 - 457.2 m)
011 = 0 - 2000 ft. (0 - 609.6 m)
100 = 0 - 2500 ft. (0 - 762.0 m)
101 = 0 - 3000 ft. (0 - 914.4 m)
110 = 0 - 4000 ft. (0 - 1219.2 m)
111 = 0 - 5000 ft. (0 - 1524.0 m)

2-7.3 SW4 - Termination Setting

SW4-1 is used to set termination on the unit. **ON** (down) indicates termination and **OFF** (up) indicates no termination.

CHAPTER 3: INSTALLATION

3-1 INSTALLING THE UNIT

The LD5000 is a wall mounted device. To secure the device to the wall, first remove the aluminum back panel and all electronics from the enclosure. There are knockouts on the top and bottom of the enclosure designed to accommodate .5" conduit. Remove as many as necessary. There are two holes in the top back of the unit spaced 10.5" apart. Use drywall anchors to secure the unit to the wall. Put two more drywall anchors through the two holes in the bottom back of the unit. Reinstall the back panel and reconnect the electronics.

3-2 CONNECTING THE WATER LEAK DETECTION CABLE

The LD5000 is packaged with a 15' length of leader cable. One end of this leader cable connects into the LD5000. This end of the cable is finished with a terminal connector. The other end features a mating connector which connects with the leak detection cable. The end of the cable is finished with a removable end terminator.

Attach (clip) the plastic EMI Suppression core to the 15' leader cable. The plastic core should slide freely once it is placed on the cable. Make sure the core is located close to the end of the leader cable that attaches to the LD5000 terminal block connection (TB2). Connect the 15' leader cable with the EMI Suppression core to the LD5000; plug the terminal connector into the cable interface terminal block TB2. From left to right, with the screws of the 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 blocks, it is ready to be connected to the leak detection cable. To do this, unscrew the end terminator from the end of the leader cable. Attach the first length of water leak detection cable to the leader cable. Route the water leak detection cable according to the cable layout diagram, if provided. Lay the cable according to the following guidelines. Secure the end terminator on the unoccupied end of the leak detection cable.

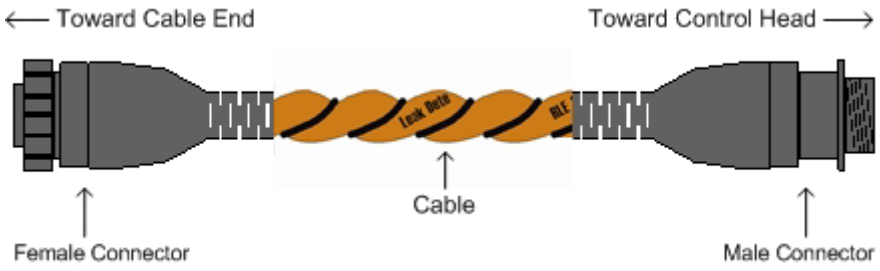


Figure 3-1 Water Leak Detection Cable

3-2.1 Securing Cable to the Floor

Secure the cable to the floor with either J-clips or one of the other approved methods shown in Figure 3-2 Cable Installation Methods. J-clips are the manufacturer's recommended installation method and can be installed as follows:

- Place one J-clip every three feet along the length of the water leak detection 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.
- Do not install the cable directly in front of an air conditioner. Allow a minimum of six feet 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 apart.

NOTE:

It is important to finish the end of the leak detection cable with the end terminator. If the end terminator is not present, a cable fault will register. Note any variances between the cable layout diagram and the actual cable installation.

3-2.1.1 Recommended Cable Installation

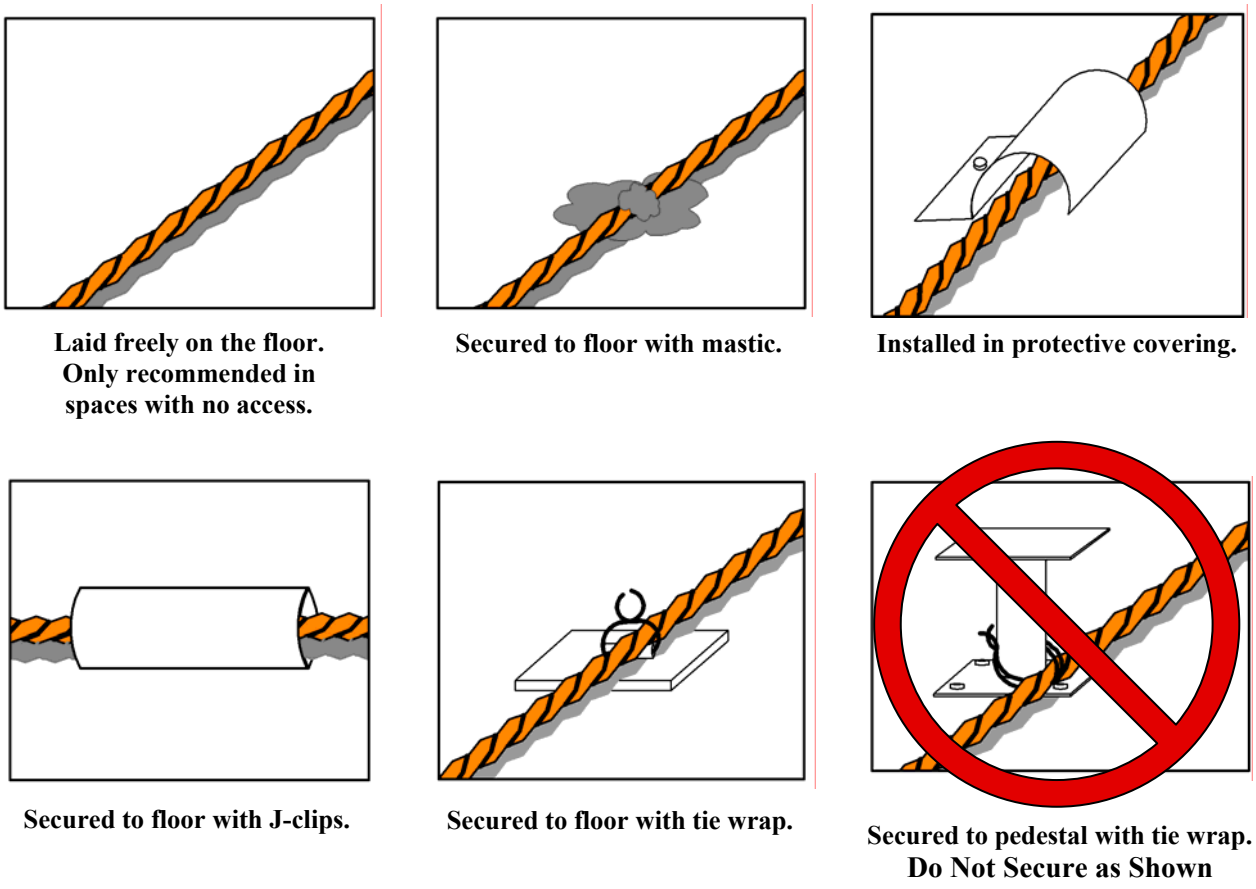


Figure 3-2 Cable Installation Methods

3-3 APPLY POWER TO THE UNIT

Once the leak detection cable is connected to the unit, power may be applied.

Warning!

- ***A dedicated circuit breaker must be provided in the building within close proximity to the RLE unit and be clearly marked as the disconnecting device for this unit.***

The LD5000 operates on 85-264VAC power. An AC power supply should be run to the location of the unit. Before applying power to the unit, make sure the AC breaker switch is turned off.

Once the power is turned off, strip the end of the AC supply so the three wires inside are exposed. Strip the end of each of the three wires and feed the end of the power supply into the LD5000 enclosure. The three wires must now be inserted into the terminal block in the lower right corner of the enclosure. As is labeled in the enclosure, the live power line is placed inside the left hand opening of the terminal block. The Earth ground line is placed into the terminal block's center station. The neutral line is placed into the opening on the right side of the terminal block.

Once all the wires are placed inside the terminal block, tighten the three screws across the bottom of the terminal block until the wires are securely held in place. Turn the AC supply back on. Flip the LD5000's power switch on to activate the unit. Wait approximately one minute. No alarm should be present.

On the LCD, enter the **Status** menu. Press **Enter** (↵) twice. The cable length is displayed. If this reading varies by more than ±5% of the actual length of cable installed, verify the installation.

Use the switch settings on page 8 to set the cable length scale for the analog 4-20mA loop. Set the clock, system name, relay configuration, feet/meters, LCD setup (re-alarm time, password), etc.

Wait at least 30 minutes before calibrating the LD5000. Calibrate the LD5000 through the front panel Setup Menu (page 14) or through the RS-232 configuration port System Configuration Menu (page 33). Auto calibration is recommended.

Map the cable per the instructions in Chapter 8: Mapping the Cable beginning on page 21.

CHAPTER 4: 4-20MA OUTPUT TESTING

The LD5000's 4-20mA output is loop powered and tested by the manufacturer. The manufacturer guarantees its performance upon delivery. Should the 4-20mA output need to be tested in the field, follow these steps. The following procedure is performed with the cable connected, unless otherwise indicated.

1. Remove the two position plug from TB3.

2. Remove any wires from the terminal and install a 200Ohm resistor to TB3-2. Then apply +24V to TB3-1 and ground of the 24V supply to the other side of the resistor.

3. Reinstall the plug on TB3.

4. With the system on and no alarms present, measure the DC voltage across the resistor. A value of 0.8VDC should register. This equates to 4mA, or normal operation.

5. Remove the water leak detection cable and wait for the unit to activate its cable trouble alarm. Measure the DC voltage across the resistor. A value of approximately 4.0VDC should be measured. This equates to 20mA, or a fault alarm. Reconnect the water leak detection cable.

6. Place water on the end of the water leak detection cable. Measure the DC voltage across the resistor. The value will be proportional to the length of cable set on the dip switches. A value of approximately 3.8V, which equates to 19mA, will be read if the length of the cable is identical to the length set by the switches. Dry the cable.

7. Place water on the start of the cable. Measure the DC voltage across the resistor. A measurement of approximately 1.2VDC, or 5mA, should be measured. This corresponds to a leak at zero distance. Dry the cable.

8. Remove the resistor from the plug and reattach any wires as necessary.

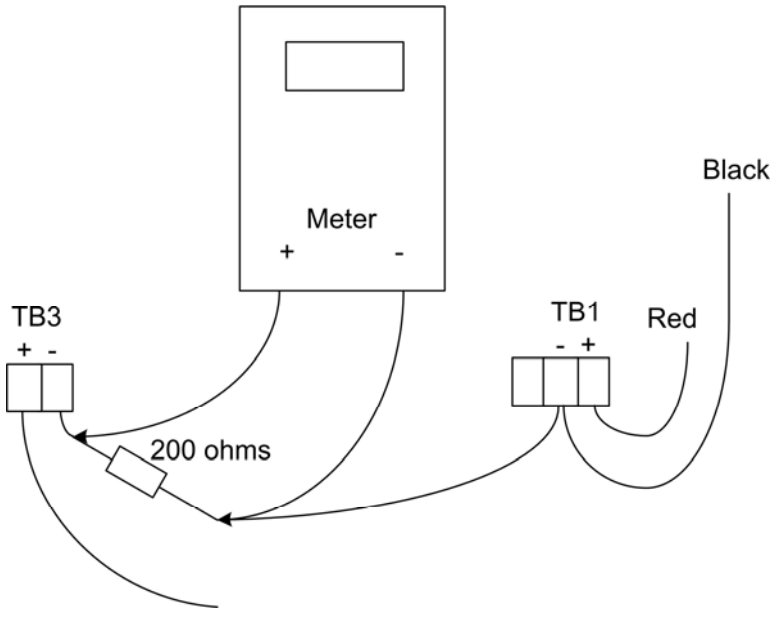
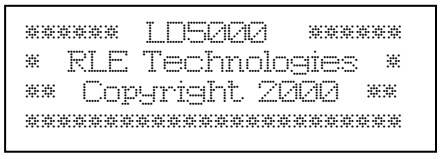


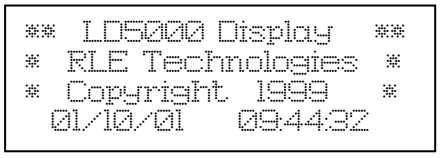
Figure 4-1 4-20mA Testing

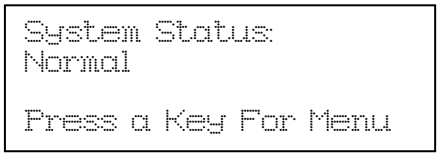
CHAPTER 5: LCD DEFAULT DISPLAY

When the LD5000 is powered up, diagnostics are performed. The boot ROM and flash program code are verified. While these diagnostics are being performed, the following text is displayed on the LCD:



Once the diagnostics are complete, the LCD alternates between the following panels:





Any time a screen within the LCD interface is left idle for more than one minute, it will return to this default display.

CHAPTER 6: LCD MAIN MENU

A limited selection of system set-up, configuration, and display functions begin in the Main Menu. For a more comprehensive selection of functions, use the RS-232 interface.

The LCD is accompanied by a six button control panel. The **-** (minus) and **+** (plus) keys are used to decrease and increase values on the display. The **left** and **right** arrow keys are used to move the cursor through the display. The **Esc** key backs the display up one menu level at a time. The **Enter (↵)** key selects an option and commits changes.

From the Main Menu, use the **left** and **right** arrow keys to position the arrow on the LCD in front of the appropriate menu choice. Press the **Enter (↵)** key to select the option.

```
***   Main Menu    ***
->Status    Setup
Log/Data    System
Reset       Comms
```

6-1 STATUS

The **Status** option displays the Cable Status Screens. The first screen of this option shows the current status of the cable. The second screen, accessed by pushing the **Enter (↵)** key when the cursor is next to the **down** option, displays the length of the cable monitored by the LD5000 and the leakage current on the cable. A threshold for the current reading can be set through the **TripPoints** option in the Setup Menu. This will help avoid false leak readings due to cable contamination. Press the **Esc** key to exit the cable status screen and return to the Main Menu.

```
**  Cable Status  **
System Normal

->Down
```

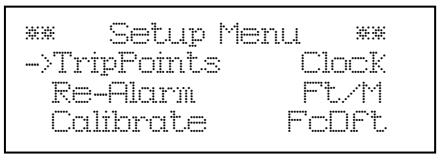
```
**  Cable Status  **
Length: 300ft
Current: 0  uA
Up          ->Down
```

```
**  Cable Status  **
Contam Dly: 0/120
Leak Delay: 0/20
->Up
```

6-2 SETUP

The **Setup** option displays the password protected Setup Menu. Use the **-** (minus) and **+** (plus) keys to enter the correct numerical values. Use the **right** and **left** arrow keys to move to the next position in the password sequence. Press the **Enter (↵)** when the password is correct. The manufacturer's default password for this menu is **1234**. To disable this feature, enter **0000** as the password in the Calibration Menu section of the RS-232 interface.

The Setup Menu allows authorized users to configure the LD5000's settings. This menu is described in greater detail in Chapter 7: LCD Setup Menu. Press the **Esc** key to exit the Setup Menu and return to the Main Menu.



6-3 LOG/DATA

The **Log/Data** option displays the Log/Data Menu. This menu provides a view of the History Log and the Trend Data and an option to clear both the History Log and the compiled Trend Data.

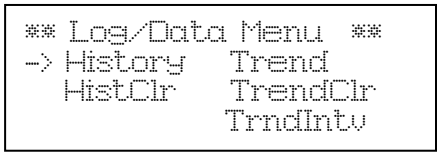
6-3.1 History Log

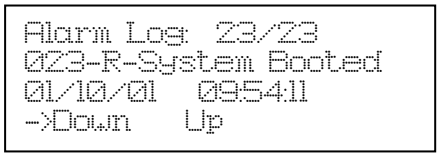
The History Log displays the most recent 100 events recorded by the unit. Events are displayed in the following manner: **Number-Status-Description**
Date Time *whereas:*

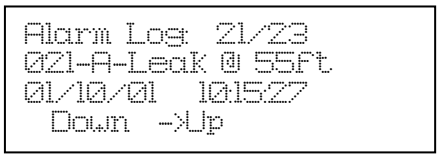
Number is a sequential event number assigned to the event.
Status is R = Returned to normal, A = Alarm, or F = Forced to Normal.
Description is a detail of the nature of the event.
Date is the date the event occurred.
Time is the time at which the event occurred.

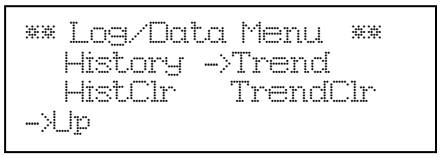
6-3.2 Trend Data

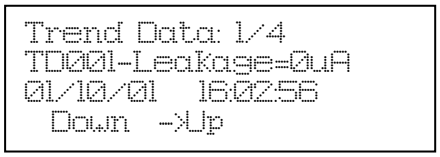
The Trend Data displays the leakage current on the cable. One measurement is taken at the user set interval (1 min - 1440 min; factory default is 1440 min (1day)). The log retains the 288 most recent entries. Analyzing the Trend Data can help determine the location of long term contamination build up (degradation), etc. on the cable. Press the **Esc** key to exit the Log/Data Menu and return to the Main Menu.

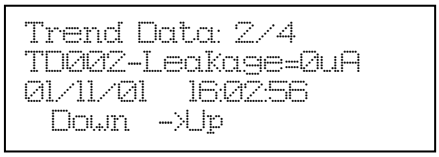


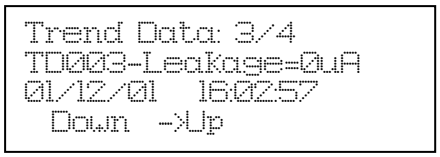


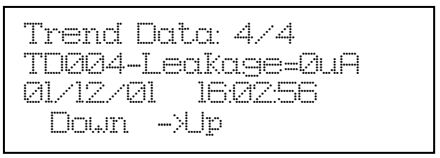


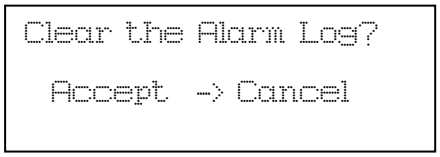


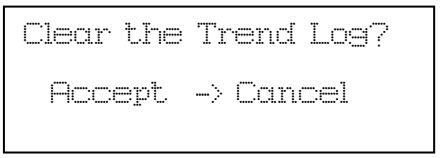












6-4 SYSTEM

The **System** option displays the System Menu. This menu allows a user to map the water leak detection cable that is attached to the LD5000. Mapping the cable is a key step in pinpointing a leak. Cable should not be mapped until it is properly installed in its intended area, and the system is calibrated for the length of cable installed. Whenever additions or adjustments are made to the water leak detection cable, the cable should be remapped.

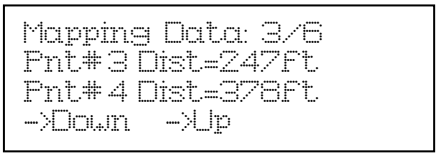
6-4.1 ViewMap

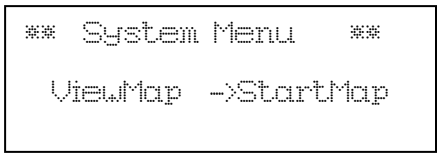
The **ViewMap** option allows the user to view the current system map.

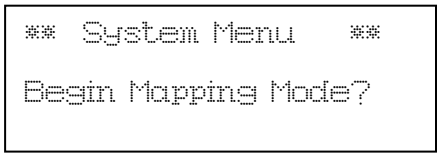
6-4.2 StartMap

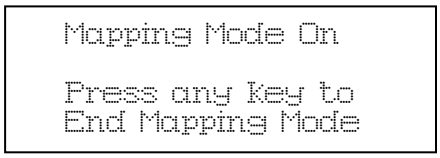
The **StartMap** option begins the mapping process:

For a complete set of LCD interface cable mapping instructions, refer to Chapter 8: Mapping the Cable. Press the **Esc** key to exit and return to the Main Menu.



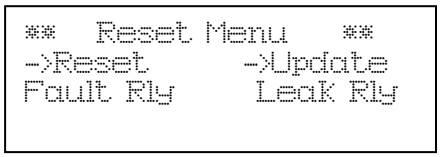






6-5 RESET

The **Reset** option displays the Reset Menu. This menu allows the operator to reset the system, reset individual relay outputs and update alarms.



6-5.1 Leak Rly

This command silences the leak relay output. A new leak will retrigger this alarm.

6-5.2 Fault Rly

This command silences the fault relay output. A new cable fault will retrigger this alarm.

6-5.3 Reset

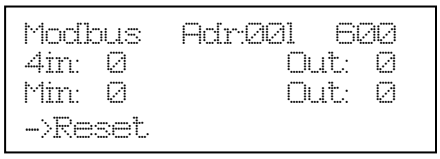
This command forces all alarms off. If an alarm condition is still present after the Reset command is executed, the alarm is reactivated. However, it will not be reentered in the Alarm History Log.

6-5.4 Update

This command updates and resets all alarms. This command forces all alarms off. If an alarm condition is still present after the Update command is executed, the alarm is reactivated and another entry is made in the Alarm History Log.

6-6 COMMS COMMAND

This command displays Modbus information like the address, baud rate, and other statistics. The information can be reset by pressing **Enter (↵)**. Press **Esc** to exit.



CHAPTER 7: LCD SETUP MENU

The Setup Menu allows authorized users to adjust the LD5000's settings. Each menu option displays a different adjustable parameter. Press **Esc** to exit the Setup Menu and return to the Main Menu.

```
**   Setup Menu   **
->TripPoints     Clock
  Re-Alarm       Ft/M
  Calibrate      FcOFt
```

7-1 TRIPPOINTS

The **TripPoints** option allows users to modify the detection and contamination trip points for the LD5000. These trip points help the system avoid false alarm readings. Throughout this menu, the user can also set the leak alarm and contamination alarm delays (20 to 3600 seconds). Press **Esc** to exit the TripPoint Menu and return to the Setup Menu.

```
** TripPoint Menu  **
->LeaK    LeaKDelay
  Contam  ContDelay
```

```
** TripPoint Menu  **
  LeaK    LeaKDelay
->Contam  ContDelay
```

```
ModiFy Detection
TripPoint: 150 uA
```

```
ModiFy Contamination
TripPoint: 050 uA
```

```
ModiFy Leak Alarm
Delay:
      20 Seconds
    +/- then (Enter)
```

```
ModiFy Contamination
Alarm Delay:
      120 Seconds
    +/- then (Enter)
```

7-2 CLOCK

The **Clock** option allows users to modify the LD5000's date and time settings. Press **Esc** to exit the Set Clock function and return to the Setup Menu.

```
Set Clock:
01/10/01 1051
^^
```

7-3 RE-ALARM

The **Re-Alarm** option allows users to determine the number of minutes between annunciations of the same alarm. Enter **000** to disable this feature. Factory default is "0" (disabled). Press **Esc** to exit and return to the Setup Menu.

```
Enter Realarm (Min):
000
^
```

7-4 FT/M

The **Ft/M** function designates whether the unit's distance readings are displayed in feet or meters. Press **Esc** to exit and return to the Setup Menu.

```
Select Feet / Meters


->Feet   Meter
```

7-5 CALIBRATE

The **Calibrate** option allows users to manually input the number of feet of cable connected to the LD5000. This automatically calibrates the system to the cable length entered. Enter the exact cable length attached to the system to ensure accurate calibration. Press the **Esc** key to exit and return to the Setup Menu.

NOTE

It may be necessary to restore the system to factory defaults before calibrating, or if the following error message is received on the LCD display:

"Error Length Not in Range Press Any Key To Return"

```
Enter Cable Length:
      1000Ft
      ^
Range (901-1101)
```

```
Leak Detected Alarm
Can't Calibrate
Press Any Key
To Return
```

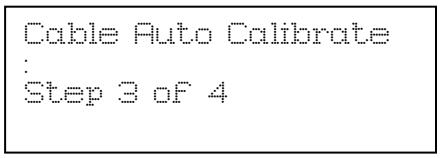
```
Cable Break Alarm
Can't Calibrate
Press Any Key
To Return
```

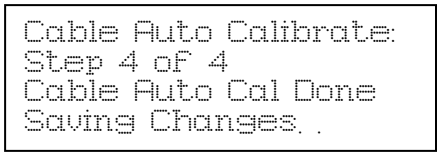
```
Error
Length Not In Range
Press Any Key
To Return
```

```
Cable Auto Calibrate

Step 1 of 4
```

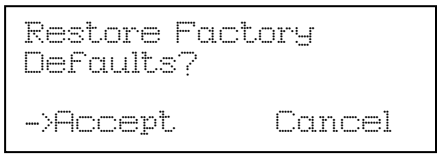
```
Cable Auto Calibrate
.
Step 2 of 4
```

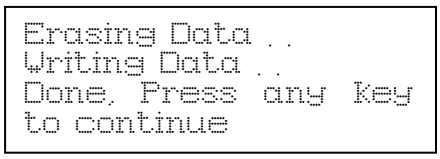




7-6 FCDFT

The **FCDFT** option will allow the user to restore the LD5000 to factory calibration default settings.





CHAPTER 8: MAPPING THE CABLE

After the water leak detection cable is laid in the desired configuration, the cable can be mapped. Mapping the cable improves the accuracy of the LD5000 and makes it easier to locate a leak.

The LD5000 computes the distance from the control panel to the leak along the length of water leak detection cable attached to the unit. In most cases, the water leak detection cable is laid in a curved or serpentine pattern. This may make it difficult to locate a leak when given a linear distance. To help alleviate this problem, identify a series of easily accessible, evenly spaced points along the cable length. Number the points, and record their locations on the leak detection reference map. Refer to the directions below and use the numbered points to map the cable. Then, when the unit detects a leak, the location of the leak can be determined by comparing the distance shown on the control panel with the known positions along the cable as recorded on the reference map.

NOTE

The system must be calibrated prior to mapping.

8-1 MAPPING DIRECTIONS

1) If a reference is not provided by RLE Technologies, create a drawing that represents the floor plan. This drawing must include the room layout (walls, doors, and other permanent structures), the water leak detection cable routing path and any jumper sections of non-sensing cable.

2) Physically identify points along the cable routing path. The points should be easily accessible and evenly spaced. Number the points and record their location on the reference map.

3) Using the front panel of the LD5000:
   - Select **System** and press **Enter (↵)**.
   - Select **StartMap** and press **Enter (↵)**.
   - Select **Accept** to start mapping and press **Enter (↵)**.

4) To test, wrap a damp paper towel or sponge around the cable at one of the previously mapped points. The LD5000 produces a short beep within approximately 30 seconds. The LCD displays the LD5000's calculated distance to the leak. Remove the paper towel and dry the cable. Within approximately 20 seconds, the LD5000 produces a long beep indicating the short is removed and the system has returned to normal.

TIP

If the individual mapping the cable is not in a position to hear the audible alarm, wait two minutes between each point. This ensures the system has had time to stabilizer.

5) Go to the next point and repeat the above steps until all points along the cable are mapped and tested.

6) When mapping is complete, press any key on the LD5000 to exit the mapping mode. This LD5000 displays **Mapping Mode Off**. Press any key again to save the map and return to the System Menu.

7) Select **ViewMap** on the LCD and record the LD5000's reading next to each point on the reference map.

8) Mount the leak detection reference map alongside to the LD5000 control panel or the remote display. When a leak or cable break occurs, refer to the map and the distance displayed on the LD5000 to determine the physical location of the leak.

Warning!

Loss of power will cause all mapping data to be lost.

CHAPTER 9: RS-232 INTERFACE STARTUP

Make sure the RS-232 port is connected to a PC or terminal with a straight through cable (see section 2-6 RS-232 Connector on page 6). Run terminal emulation software and make sure the settings match the LD5000 RS-232 port configuration. When the LD5000 is powered up, diagnostics are performed. The boot ROM and flash program code are verified. Output similar to the screen displayed below should appear on the terminal or terminal emulation software. Once the system reaches this point, press the **Enter (↵)** key to display the Main Menu.

```
RLEbh Firmware V1.1 BOOTUP - THU 03/06/03 10:58:24

uP last reset by: external signal
Diagnostics in progress
Serials: Passed
Ram:     Passed
Clock:   Passed
VPP = 5.04 Passed
Flash Blank Check:
Parm1= Has Data
Parm2= Has Data
Prgm = Has Data
Prgm Flash checksum: 6C32/6C32 Valid
Power Supplies:
24V: 22.66
15V: 15.17
Passed
Flash Code will start in 5 seconds
Press any key to abort Flash Code


LD5000 V2.3 B0   03/06/03
SYSTEM BOOTED @ 03/06/03 10:58:32
Copyright 2003, Raymond & Lae Engineering Inc.

Loading Block 2
DATA LOADED
LD5000 Diagnostics
Initializing Cable ADC: Passed

<LD5000>
```

CHAPTER 10: RS-232 MAIN MENU

Once the startup processes are complete, press the **Enter (↵)** key to access the Main Menu. All system set-up, configuration, and display functions begin in the Main Menu. Two letter commands display information requested, execute commands selected, and display submenus for additional inquiry and system configuration functions.

```
** LD5000 Help **
SC - LD5000 System Configuration
LS - Leak Status
SL - Silence Leak Relay
SF - Silence Fault Relay
SR - Silence All Relays
CA - Current Alarms
RA - Reset Alarms
UP - Update Alarms
AS - Alarm Silence (LCD)
AH - Alarm History
CH - Clear Alarm History
TD - Trend Data Table (Leakage Current)
CT - Clear Trend Data Table
TI - Display Date/Time
NS - Network Status (RS-485)
MR - Reset Modbus Status (RS-485)
ND - Network Display (RS-485)
MT - Modbus Display
EX - Exit
```

10-1 FUNCTION COMMANDS

Once the startup processes are complete, press the **Enter (↵)** key to access the Main Menu. All system set-up, configuration, and display functions begin in the Main Menu. Two letter commands display information requested, execute commands selected, and display submenus for additional inquiry and system configuration functions. These commands include:

10-1.1 SC - System Configuration

SC displays a submenu that lists all items in the System Configuration Menu. System Configuration options are discussed in further detail starting on page 33.

10-1.2 LS - Leak Status

LS displays the current leak cable status.

10-1.3 SL - Silence Leak Relay

SL silences the leak relay output. A new leak will re-trigger this alarm.

10-1.4 SF - Silence Fault Relay

SF silences the fault relay output. A new cable fault will re-trigger this alarm.

10-1.5 SR - Silence All Relays

SR silences all relay outputs.

10-1.6 CA - Current Alarms

CA displays all active alarms present on the unit.

10-1.7 RA - Reset Alarms

RA resets all alarm relays. This command forces all alarms off. If an alarm condition is still present after the **RA** command is executed, the alarm is reactivated. If an alarm is still active after the **RA** command is executed, it will not be reentered in the Alarm History Log.

10-1.8 UP - Update Alarms

UP updates and resets all alarms. This command forces all alarms off. If an alarm condition is still present after the **UP** command is executed, the alarm is reactivated and another entry is made in the Alarm History Log.

10-1.9 AS - Alarm Silence sundry

AS silences the audible alarm on the LCD.

10-1.10 AH - Alarm History

AH displays the Alarm History Log.

10-1.11 CH - Clear Alarm History

CH clears the Alarm History Log.

10-1.12 TD - Trend Data Table

TD displays the Trend Data Table, which monitors and displays leakage current.

10-1.13 CT - Clear Trend Data Table

CT clears all records from the Trend Data Table.

10-1.14 TI - Display Date/Time

TI displays the LD5000's current date and time.

10-1.15 NS - Network Status (RS-485)

NS displays the unit's RS-485 network connection status.

10-1.16 MR - Reset Modbus Status

MR clears all the RS-485/Modbus counters.

10-1.17 ND - Network Display (RS-485)

ND displays the network diagnostics and all commands, requests, and data associated with them. This feature is usually used by a service technician.

10-1.18 MT - Modbus Display

MT displays the Modbus packets.

10-1.19 EX - Exit

EX is used to enter the Bootloader command section. The unit will stop monitoring cable and allow firmware updates to be loaded. To restore normal operation after updating firmware, type **RUN** and press the **Enter (↵)** key on the keyboard, or power the unit off and then back on again.

Warning!

- ***The Bootloader section is designed for experienced technicians or users responsible for maintaining the system. Exit immediately if you are not trained in the use of the Bootloader commands.***
- ***Contact the manufacturer for more information regarding the commands in this section.***

CHAPTER 11: RS-232 FUNCTION COMMANDS

11-1 SC - SYSTEM CONFIGURATION

Please see page 33 for more information about System Configuration options.

11-2 LS - LEAK STATUS

Menu selection **LS** displays the current leak status.

```
** LD5000 Help **
SC - LD5000 System Configuration
LS - Leak Status
SL -
SF -
SR -
CA -
RA -
UP -
AS -
AH -
CH -
TD - Trend Data Table (Leakage Current)
CT - Clear Trend Data Table
TI - Display Date/Time
NS - Network Status (RS-485/Modbus)
MR - Reset Modbus Status (RS-485)
ND - Network Display (RS-485)
MT - Modbus Display
EX - Exit
```

```
LS

Cable Length:  4995ft
Sense Cable Current:  0uA
No Leak!

<LD5000>
```

11-3 CA - CURRENT ALARMS

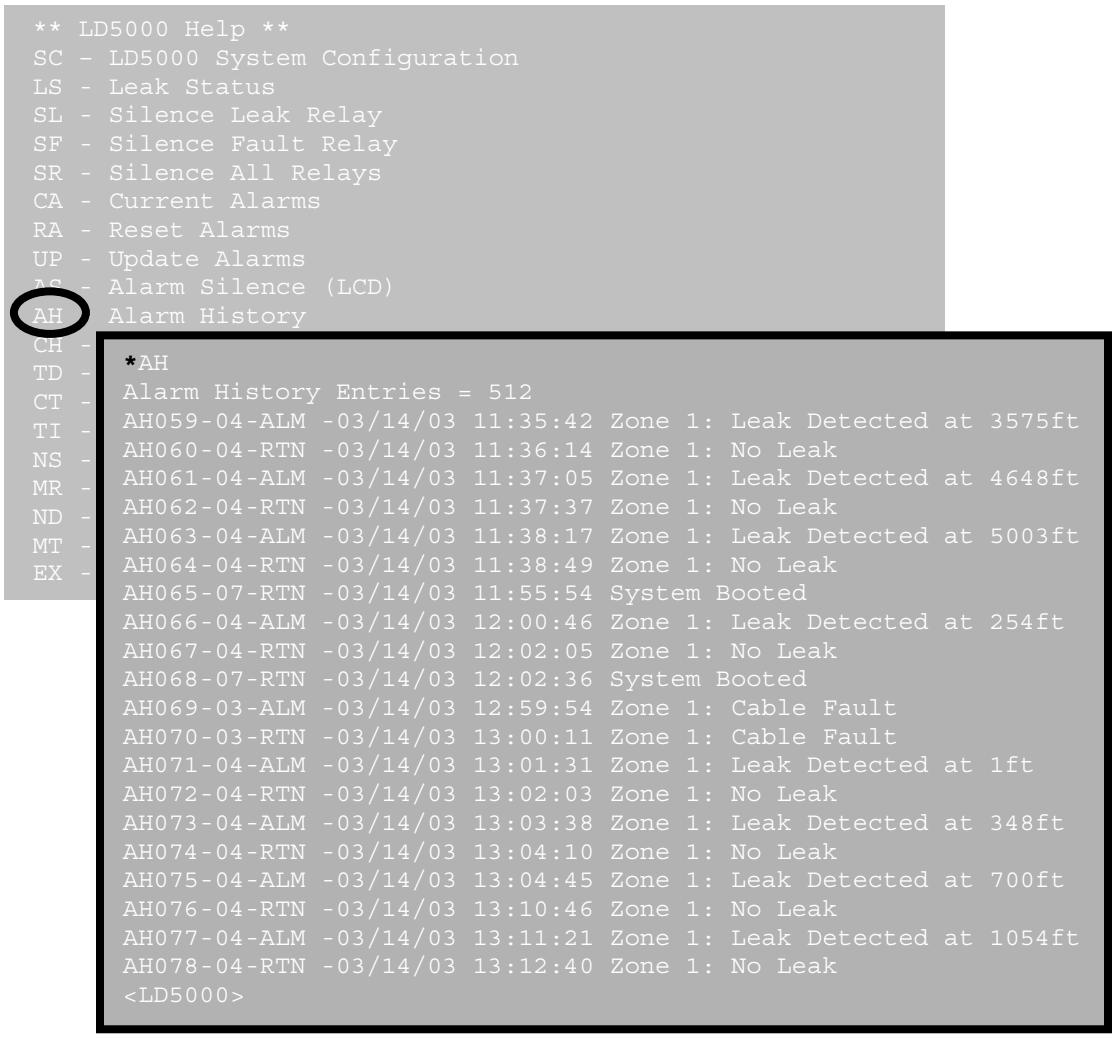
Menu selection **CA** displays the current alarm status.

```
** LD5000 Help **
SC - LD5000 System Configuration
LS - Leak Status
SL - Silence Leak Relay
SF - Silence Fault Relay
SR - Silence All Relays
CA - Current Alarms
RA -
UP -
AS -
AH -
CH -
TD -
CT - Clear Trend Data Table
TI - Display Date/Time
NS - Network Status (RS-485/Modbus)
MR - Reset Modbus Status (RS-485)
ND - Network Display (RS-485)
MT - Modbus Display
EX - Exit
```

```
CA
LD5000
03/14/05 14:02:30 Leak Detected at 701ft
<LD5000>
```

11-4 AH - ALARM HISTORY

Menu selection **AH** displays the alarm history log of the last 512 events. The oldest alarm is listed at the top of the list. The most recent alarm is listed at the bottom of the list.



***Note**: The Alarm History Log displayed above has been shortened for the purpose of this user guide.*

11-5 CH - CLEAR ALARM HISTORY

Menu selection **CH** clears the alarm history log. Type **Yes**, **Y**, or **y** to clear the log. Type **No**, **N**, or **n** to exit this option without clearing the log.

```
** LD5000 Help **
SC - LD5000 System Configuration
LS - Leak Status
SL - Silence Leak Relay
SF - Silence Fault Relay
SR - Silence All Relays
CA - Current Alarms
RA - Reset Alarms
UP - Update Alarms
AS - Alarm Silence (LCD)
AH - Alarm History
CH - Clear Alarm History
TD -
CT -
TI -
NS -
MR -
ND -
MT - Modbus Display
EX - Exit
```

```
CH
Are you sure (yes or no)? >y
ok

<LD5000>
```

11-6 TD - TREND DATA TABLE (LEAKAGE CURRENT)

Menu selection **TD** displays the trend log data for the cable (leakage current). Data is logged by the trend interval set by the user (default is 24 hours). The oldest trend entry is listed first. The most recent trend entry is listed last. Analyzing the Trend data can help determine the location of long term contamination build up (degradation), etc. on the cable.

```
** LD5000 Help **
SC - LD5000 System Configuration
LS - Leak Status
SL - Silence Leak Relay
SF - Silence Fault Relay
SR - Silence All Relays
CA - Current Alarms
RA - Reset Alarms
UP - Update Alarms
AS - Alarm Silence (LCD)
AH - Alarm History
CH - Clear Alarm History
TD - Trend Data Table (Leakage Current)
CT -
TI -
NS -
MR -
ND -
MT -
EX -
```

```
TD1
Cable Leakage Current Trend Data Table Entries = 3
TD001-03/06/03 15:37:31 Leakage=0uA
TD002-03/07/03 15:37:28 Leakage=0uA
TD003-03/08/03 15:37:30 Leakage=0uA
<LD5000>
```

11-7 CT - CLEAR TREND DATA TABLE

Menu selection **CT** clears the trend data table. Type **Yes**, **Y**, or **y** to clear the data. Type **No**, **N**, or **n** to exit this option without clearing the table.

```
** LD5000 Help **
SC - LD5000 System Configuration
LS - Leak Status
SL - Silence Leak Relay
SF - Silence Fault Relay
SR - Silence All Relays
CA - Current Alarms
RA - Reset Alarms
UP - Update Alarms
AS - Alarm Silence (LCD)
AH - Alarm History
CH - Clear Alarm History
TD - Trend Data Table (Leakage Current)
CT - Clear Trend Data Table
TI -
NS -
MR -
ND -
MT -
EX - Exit
```

```
CT
Are you sure (yes or no)? >y
ok
<LD5000>
```

11-8 TI - DISPLAY DATE/TIME

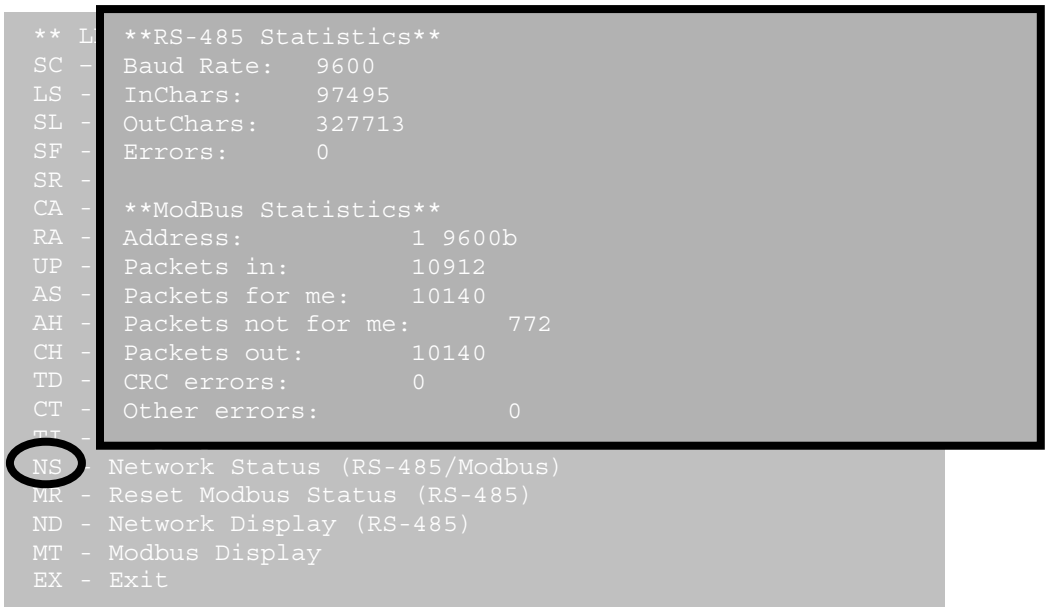
Menu selection **TI** displays the date and time as measured by the LD5000.

```
** LD5000 Help **
SC - LD5000 System Configuration
LS - Leak Status
SL - Silence Leak Relay
SF - Silence Fault Relay
SR - Silence All Relays
CA - Current Alarms
RA - Reset Alarms
UP - Update Alarms
AS - Alarm Silence (LCD)
AH - Alarm History
CH - Clear Alarm History
TD - Trend Data Table (Leakage Current)
CT - Clear Trend Data Table
TI - Display Date/Time
NS -
MR -
ND -
MT -
EX -
```

```
TI
03/18/03 14:38:10
<LD5000>
```

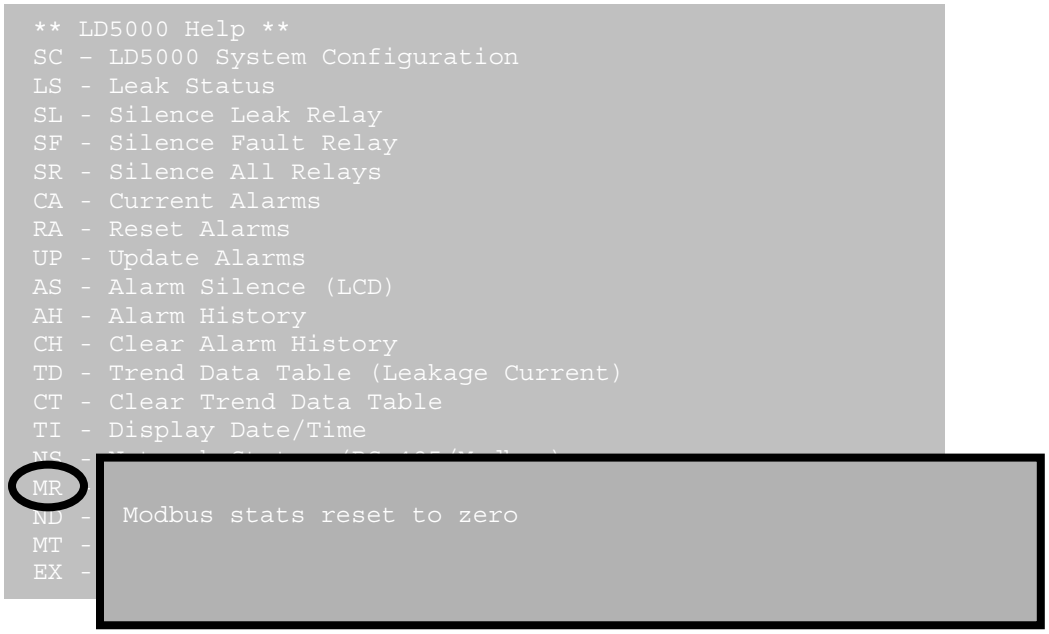
11-9 NS - NETWORK STATUS (RS-485)

Menu selection **NS** displays the LD5000's network status.



11-10 MR - RESET MODBUS STATUS COUNTERS

Type **MR<CR>** from the RS-232 configuration port to clear all the 485/Modbus counters.



11-11 ND - NETWORK DISPLAY (RS-485)

Menu selection **ND** displays the LD5000's network diagnostic. This shows all commands, requests, and data passed through the RS-485 connection. A service technician may use this feature for diagnostic purposes.

Press any key to turn the display off.

```
** LD5000 Help **
SC - LD5000 System Configuration
LS - Leak Status
SL -
SF -
SR -
CA -
RA -
UP -
AS -
AH -
CH -
TD -
CT -
TI -
NS -
MR -
ND -
MT - Modbus Display
EX - Exit
```

```
ND
ok
RS-485 Monitor on <press any key to turn off!>
<LD5000>
{02} {04} {00} {00} {00} {03} {B0} {38} Modbus wakeup
{A3} {02} {04} {00} {00} {00} {03} {B0} {38} Modbus wakeup
{A3} {02} {04} {00} {00} {00} {03} {B0} {38} Modbus wakeup
{A3} {02} {04} {00} {00} {00} {03} {B0} {38} Modbus wakeup
{A3} {02} {04} {00} {00} {00} {03} {B0} {38} Modbus wakeup
{A3} {02} {04} {00} {00} {00} {03} {B0} {38} Modbus wakeup
{A3} {02} {04} {00} {00} {00} {03} {B0} {38} Modbus wakeup
{A3} {02} {04} {00} {00} {00} {03} {B0} {38} Modbus wakeup
{A3}
```

11-12 MT – MODBUS DISPLAY (TRACE)

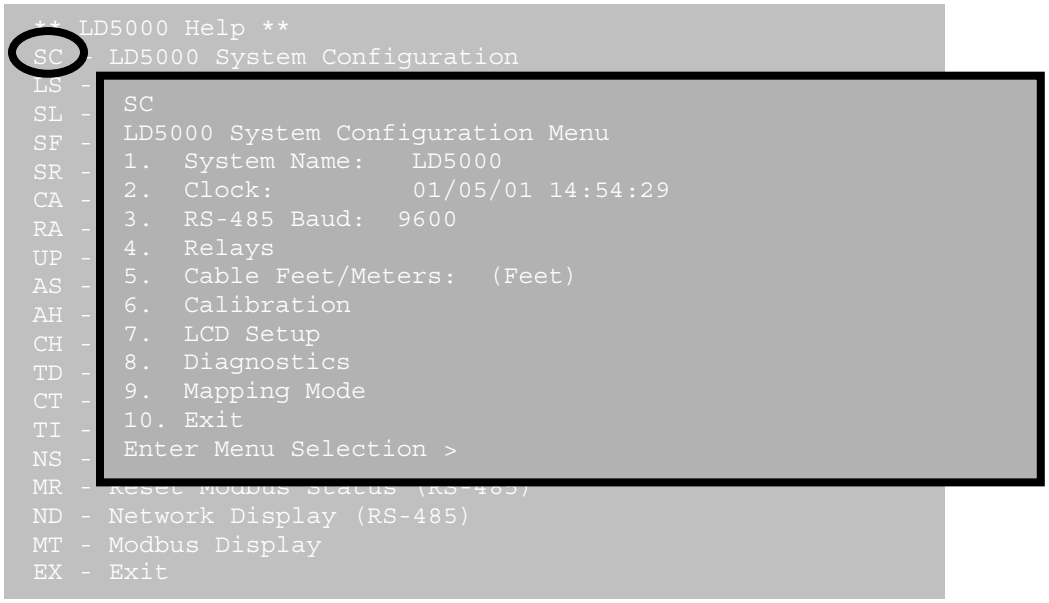
Type **MT** <CR> from the RS-232 configuration port to display the Modbus packets.

```
** LD5000 Help **
SC - LD5000 System Configuration
LS - Leak Status
SL - Silence Leak Relay
SF -
SR -
CA -
RA -
UP -
AS -
AH -
CH -
TD -
CT -
TI -
NS -
MR -
ND -
MT -
EX -
```

```
MT
Modbus trace/display is on <press any key to turn off!>
<LD5000>
ins:  02 04 00 00 00 03 B0 38
mbreg matches:  3
Outs:  02 04 06 00 00 00 00 00 01 B5 A3
ins:  02 04 00 00 00 03 B0 38
mbreg matches:  3
Outs:  02 04 06 00 00 00 00 00 01 B5 A3
ins:  02 04 00 00 00 03 B0 38
mbreg matches:  3
Outs:  02 04 06 00 00 00 00 00 01 B5 A3
ins:  02 04 00 00 00 03 B0 38
mbreg matches:  3
Outs:  02 04 06 00 00 00 00 00 01 B5 A3
ins:  02 04 00 00 00 03 B0 38
mbreg matches:  3
Outs:  02 04 06 00 00 00 00 00 01 B5 A3
```

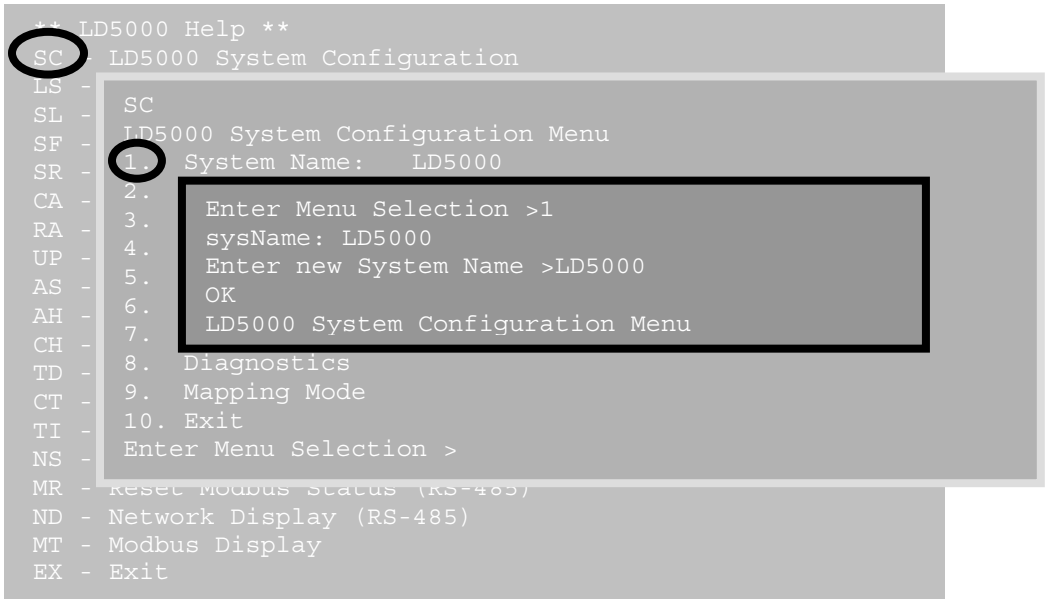
CHAPTER 12: SYSTEM CONFIGURATION

The System Configuration Menu displays a submenu that lists all the items for the system setup and configuration.



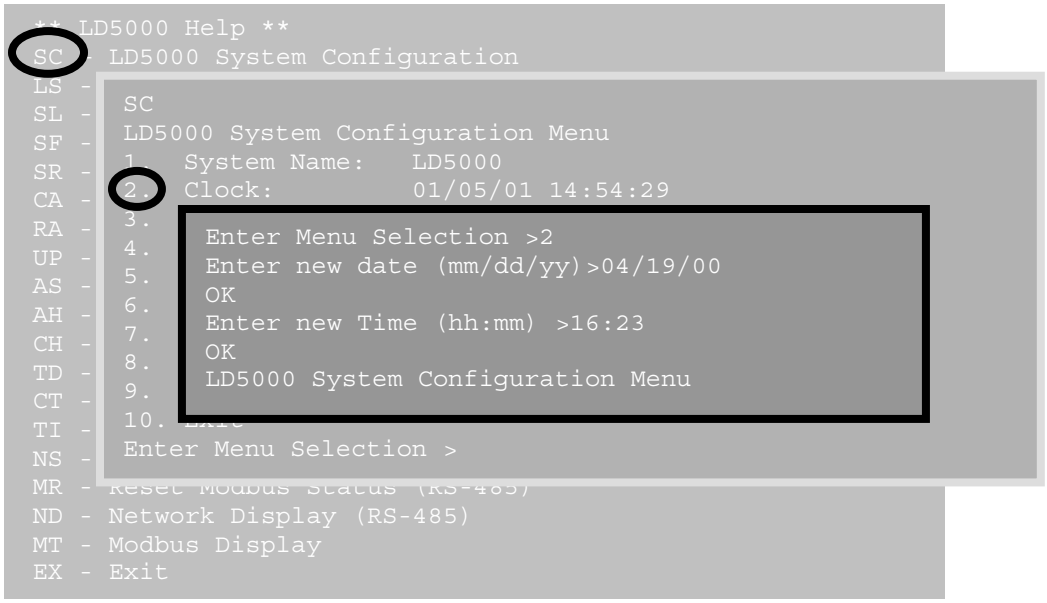
12-1 SYSTEM NAME - 1

Menu selection **1** allows a user to enter a descriptive name for the system up to a maximum of 64 characters.



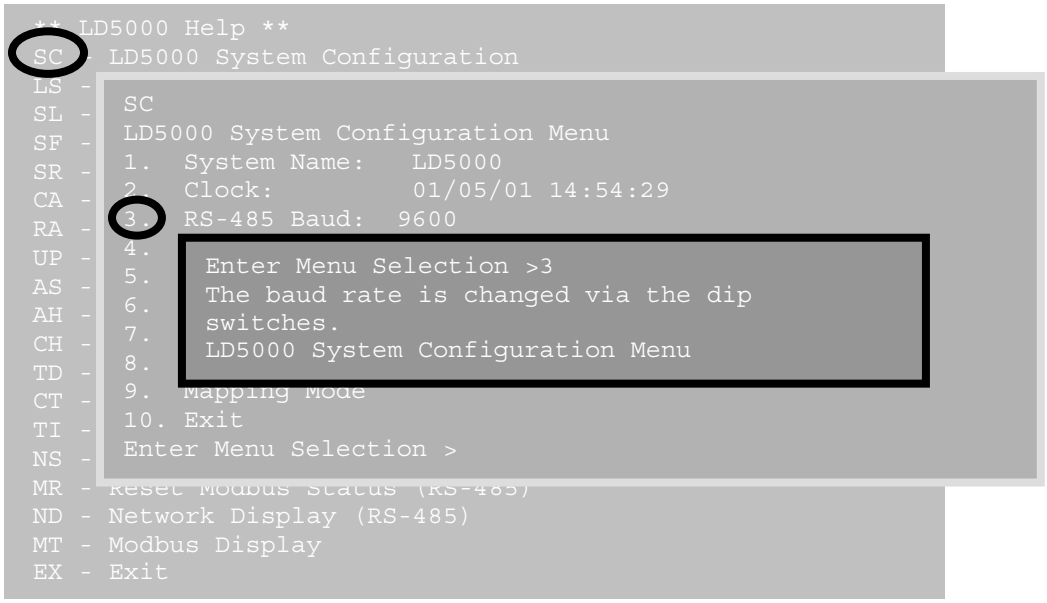
12-2 CLOCK - 2

Option **2** allows a user to change the device's date and time. Date is in mm/dd/yy format; time is maintained in a 24-hour format. Type the date and press **Enter (↵)**. Type the time and press **Enter (↵)**



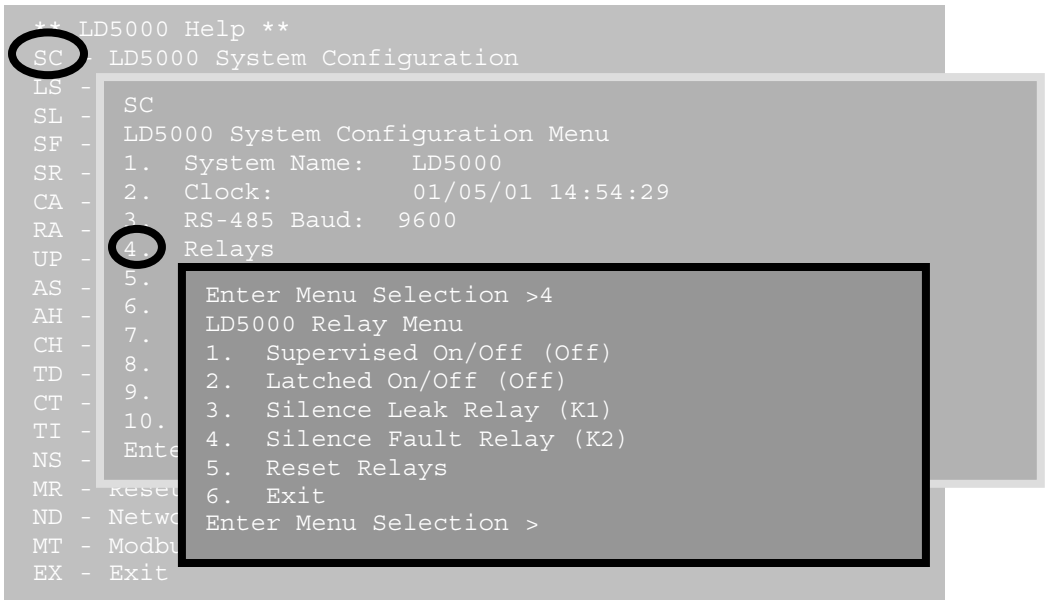
12-3 RS-485 BAUD - 3

Option **3** allows the user to view the RS-485 port's baud rate.



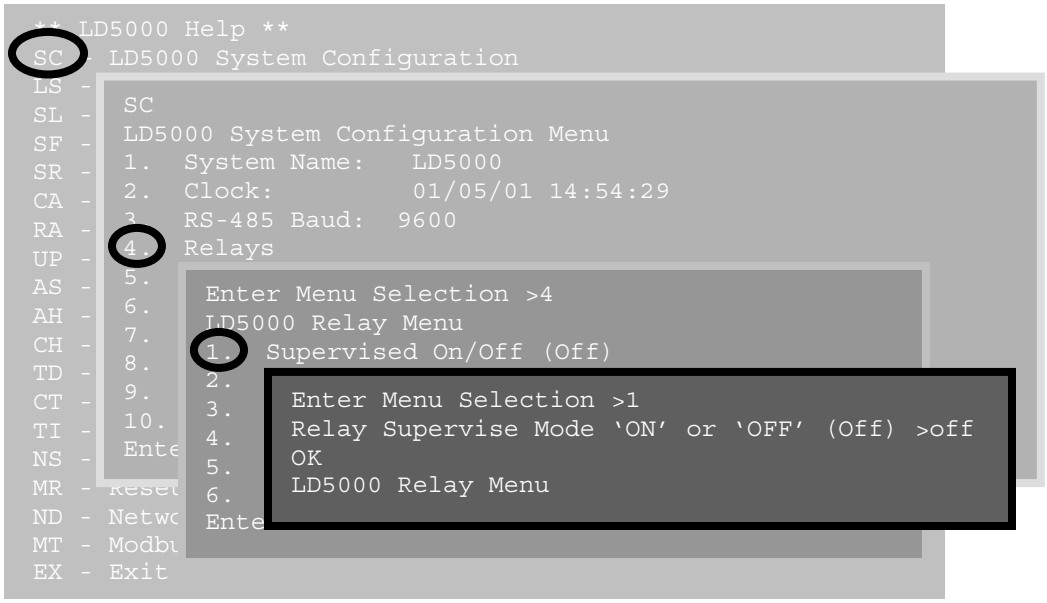
12-4 RELAYS - 4

Menu selection **4** displays the Relay Configuration Menu. Output relays are configured from this menu.



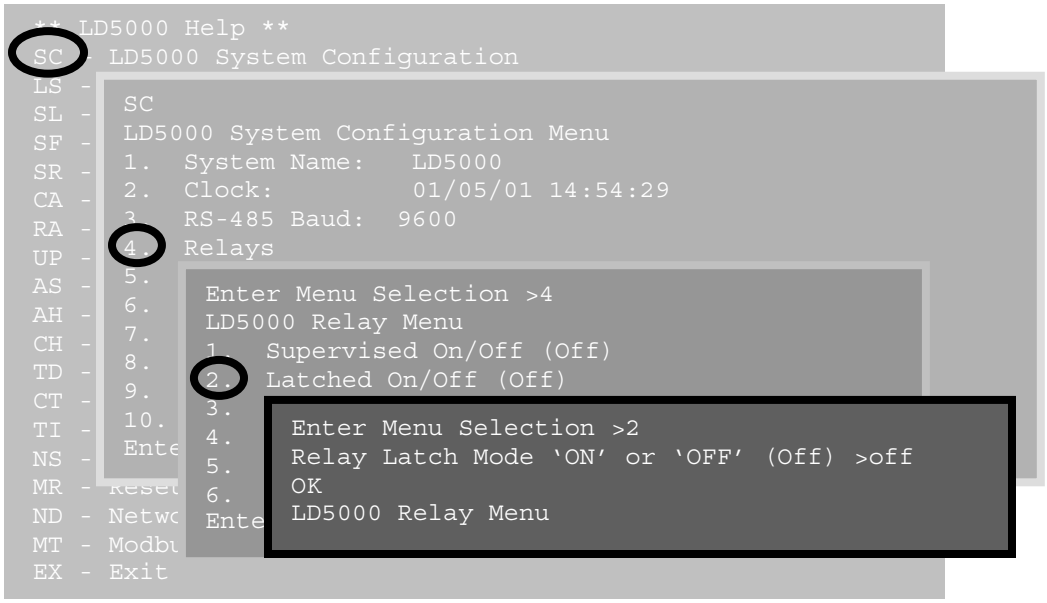
12-4.1 Supervised On/Off - 1

Option **1** allows a user to turn the relay supervision on or off. If the relay is set as supervised, the relay will be closed as long as no alarm condition exists. A leak, cable trouble, or a power failure will cause the relay to open. Set the relay to unsupervised (normally open - NO).



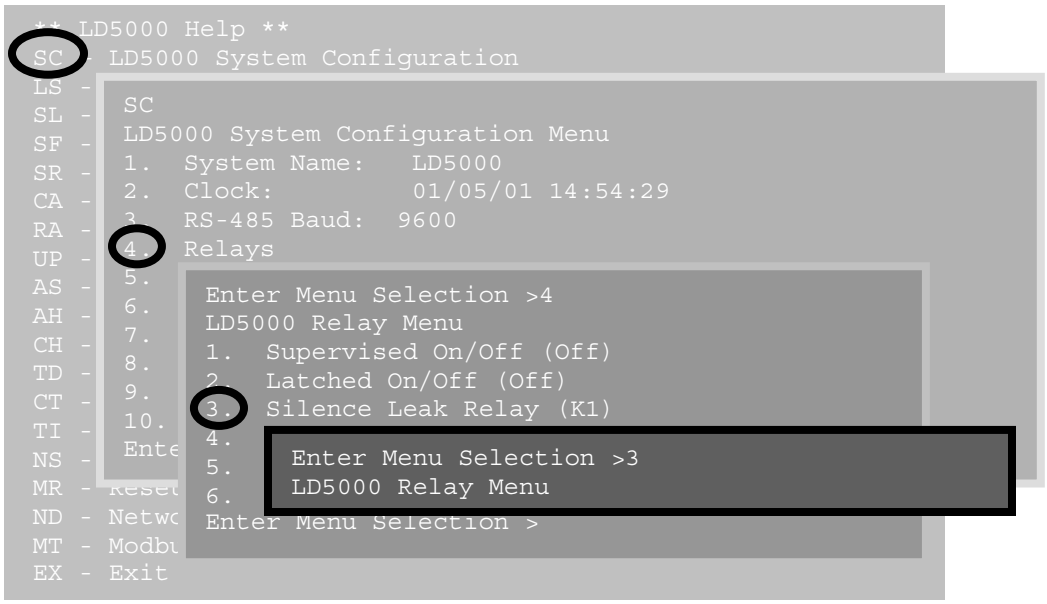
12-4.2 Latched On/Off - 2

Option **2** allows the relay to be set as latching or non-latching. A latched alarm requires a manual reset of the system once a leak or cable problem is no longer present. Set the relay to non-latching.



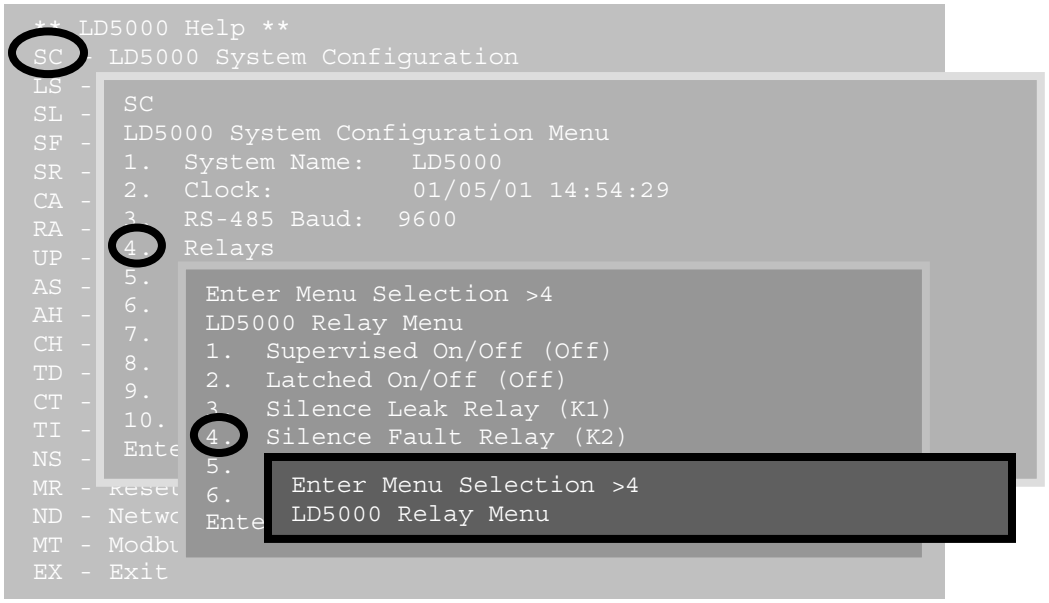
12-4.3 Silence Leak Relay -3

Press **3** to silence the leak relay.



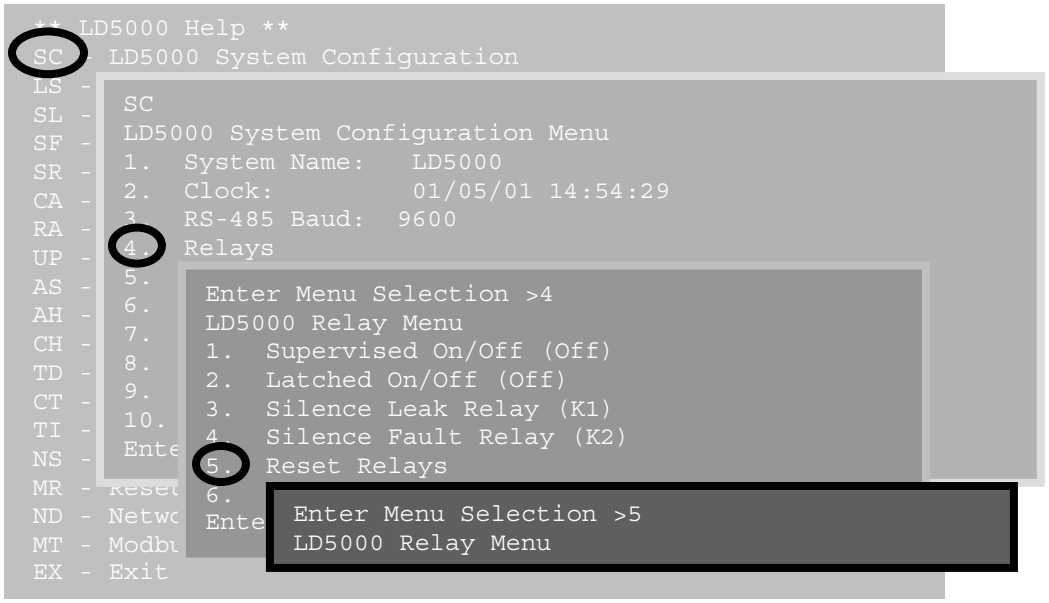
12-4.4 Silence Fault Relay - 4

Press **4** to silence the fault relay.



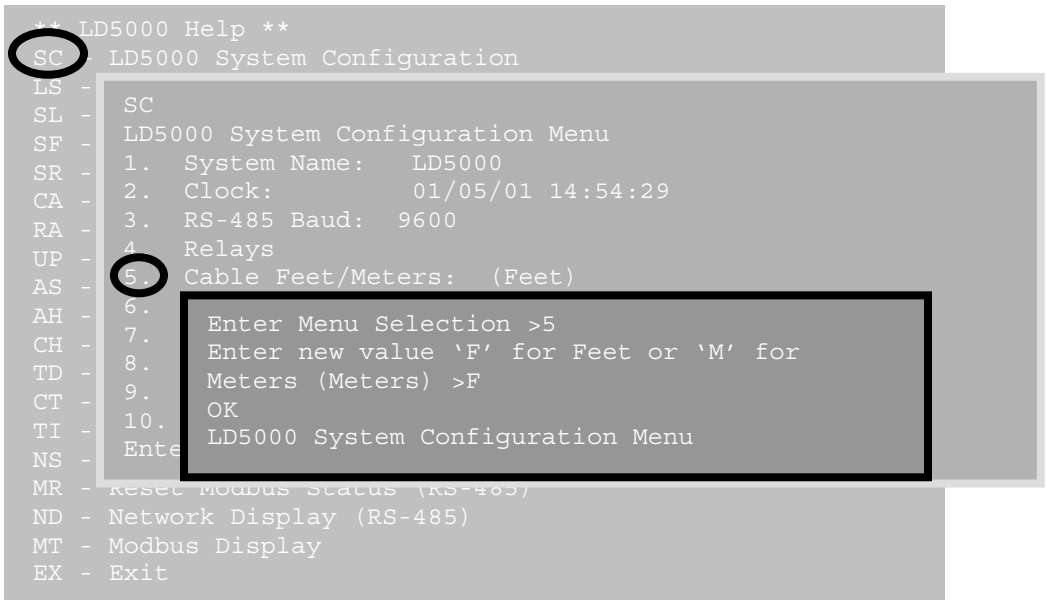
12-4.5 Reset Relays - 5

Press **5** to reset both the leak and the fault relays.



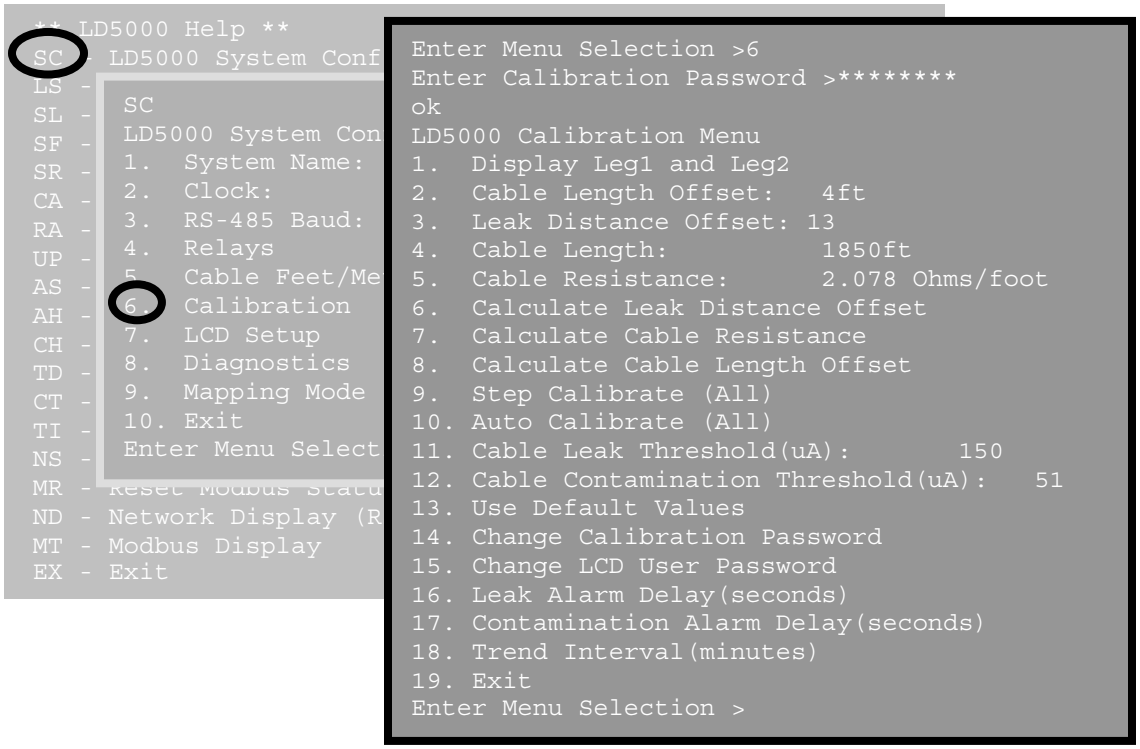
12-5 CABLE FEET/METERS - 5

System Configuration menu selection **5** allows the user to specify whether cable length is calculated and displayed in feet or meters.



12-6 CALIBRATION - 6

Option **6** displays the Calibration Menu. A password is needed to access this menu. The factory default password is**: RLE2TECH** - typed in all capital letters. The leak detection cable is calibrated from this menu. The Calibration Menu is described in greater detail on page 44.



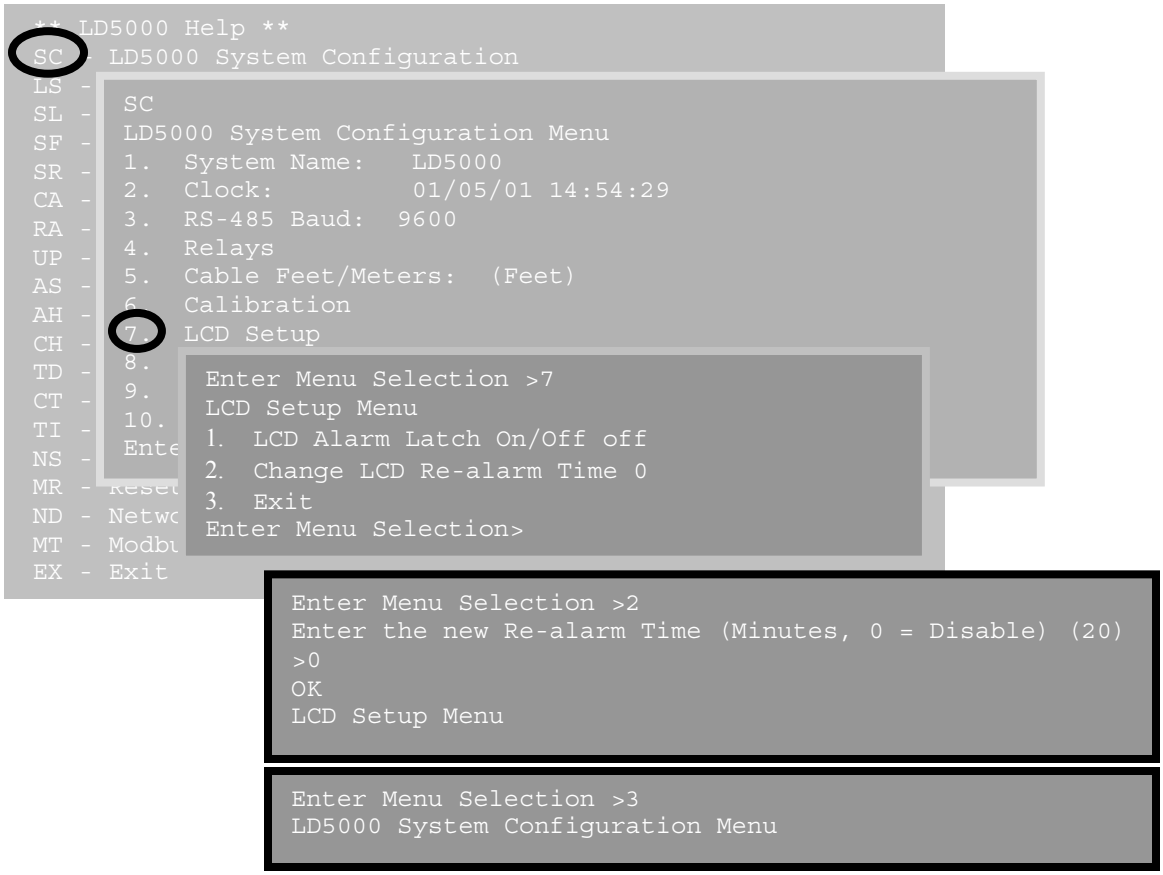
12-7 LCD SETUP -7

Option **7** accesses the LCD Setup Menu. This section is applicable only if the unit has an LCD.

On the submenu, option **1** allows the alarm to be set as latched or unlatched. A latched alarm will display on the interface until it is manually cleared (audible alarm silenced). An unlatched alarm will disappear from the display as soon as the alarm condition is gone.

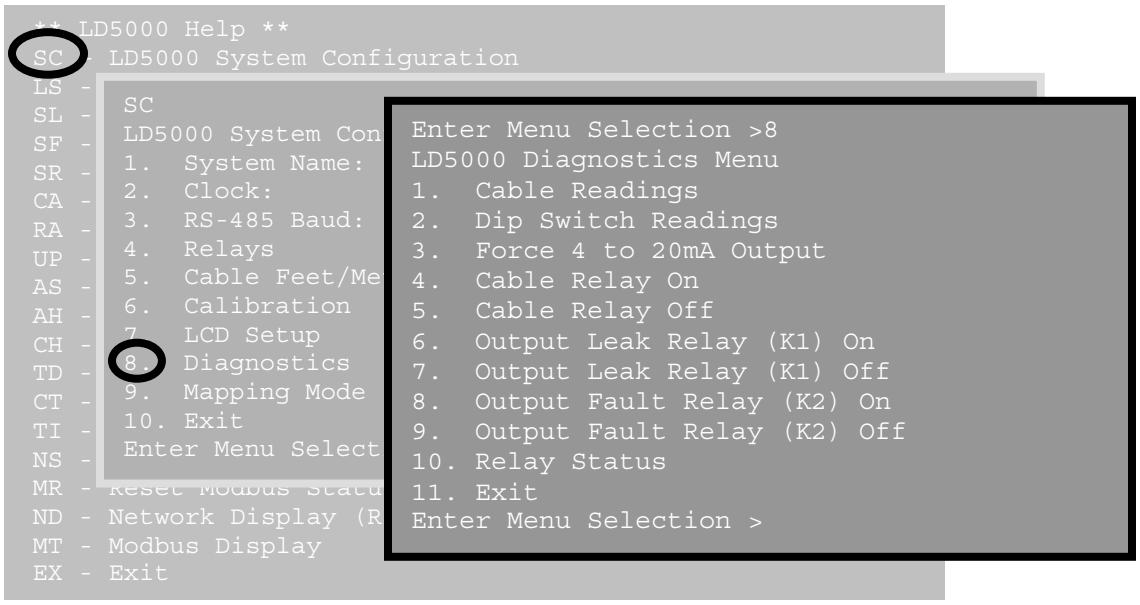
Option **2** on the submenu allows a user to set a re-alarm time. This is the amount of time that elapses between annunciations of the same alarm. If the re-alarm time is set at five minutes, the unit will alarm every five minutes as long as the alarm condition is present. The factory default value is "0" (disabled).

Option **3** exits the LCD Setup Menu and returns the user to the System Configuration Menu.



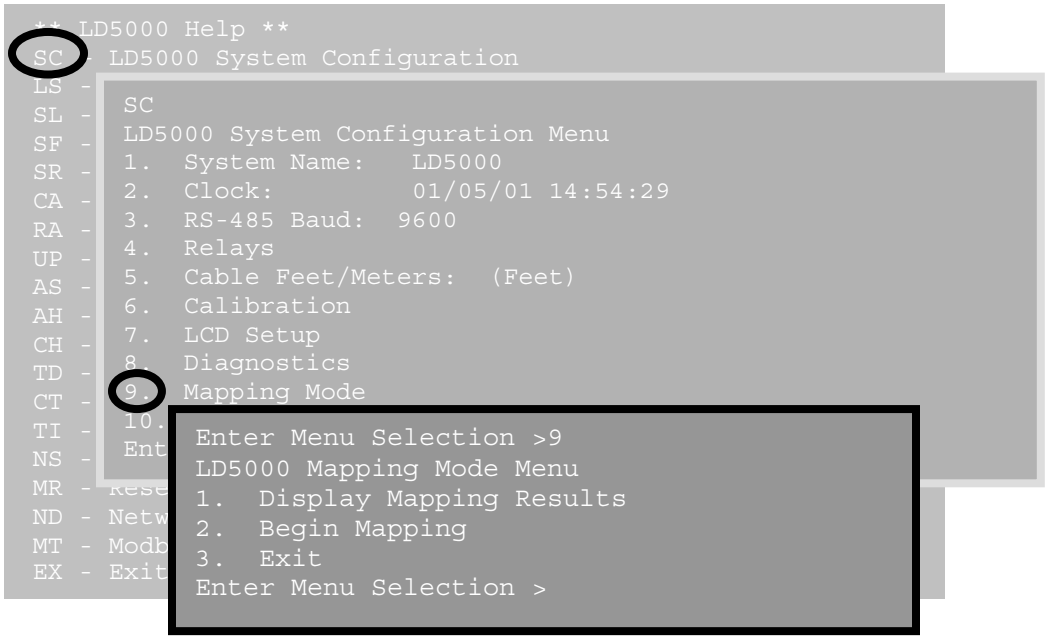
12-8 DIAGNOSTICS - 8

Menu selection **8** displays the LD5000 Diagnostics Menu. This menu is primarily used for troubleshooting and system testing. The Diagnostics Menu is described in greater detail on page 64.



12-9 MAPPING MODE - 9

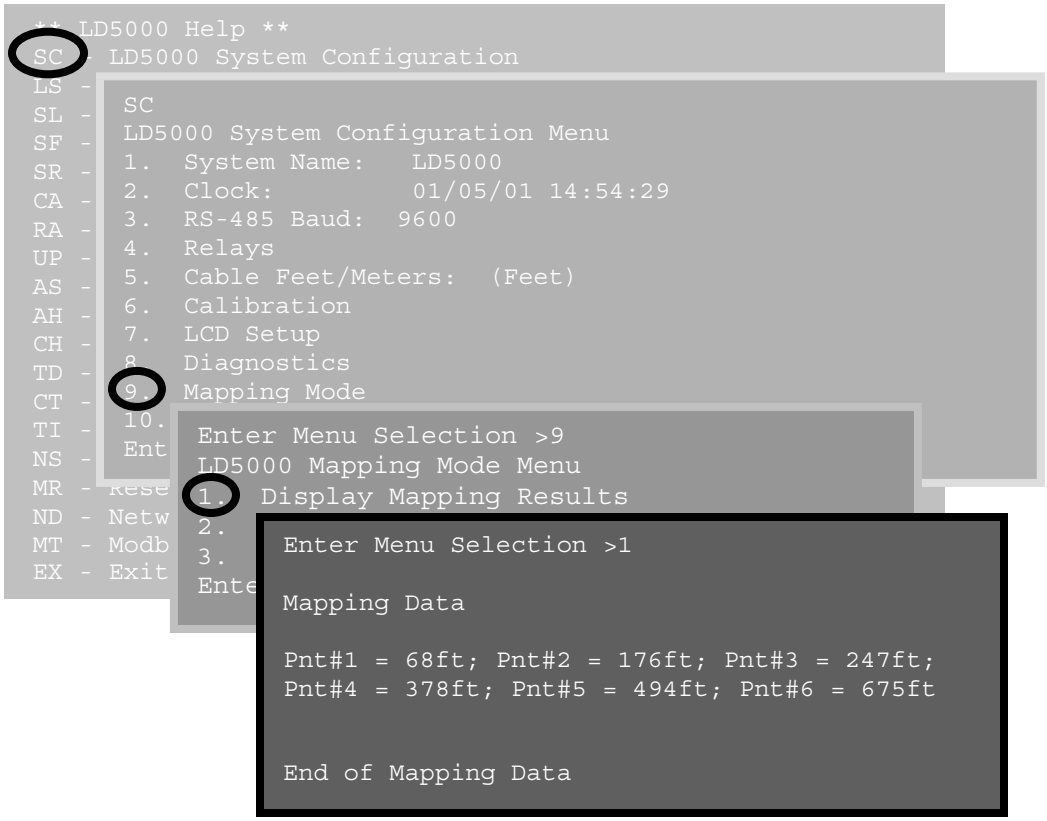
Option **9** displays the LD5000 Mapping Mode Menu. The mapping mode establishes a relationship between a known physical location, such as a position on a floor map, and a distance reading as displayed by the LD5000. Mapping is performed after all the cable is installed, the system is calibrated, and the cable's end-of-line-terminator is in place. Mapping makes locating a leak annunciated by the LD5000 much easier.



> **NOTE:**
>
> ***When additional cable is added to the system or if cable is replaced, the system should always be checked and remapped if necessary.***

12-9.1 Display Mapping Results - 1

Option **1** displays the existing map.

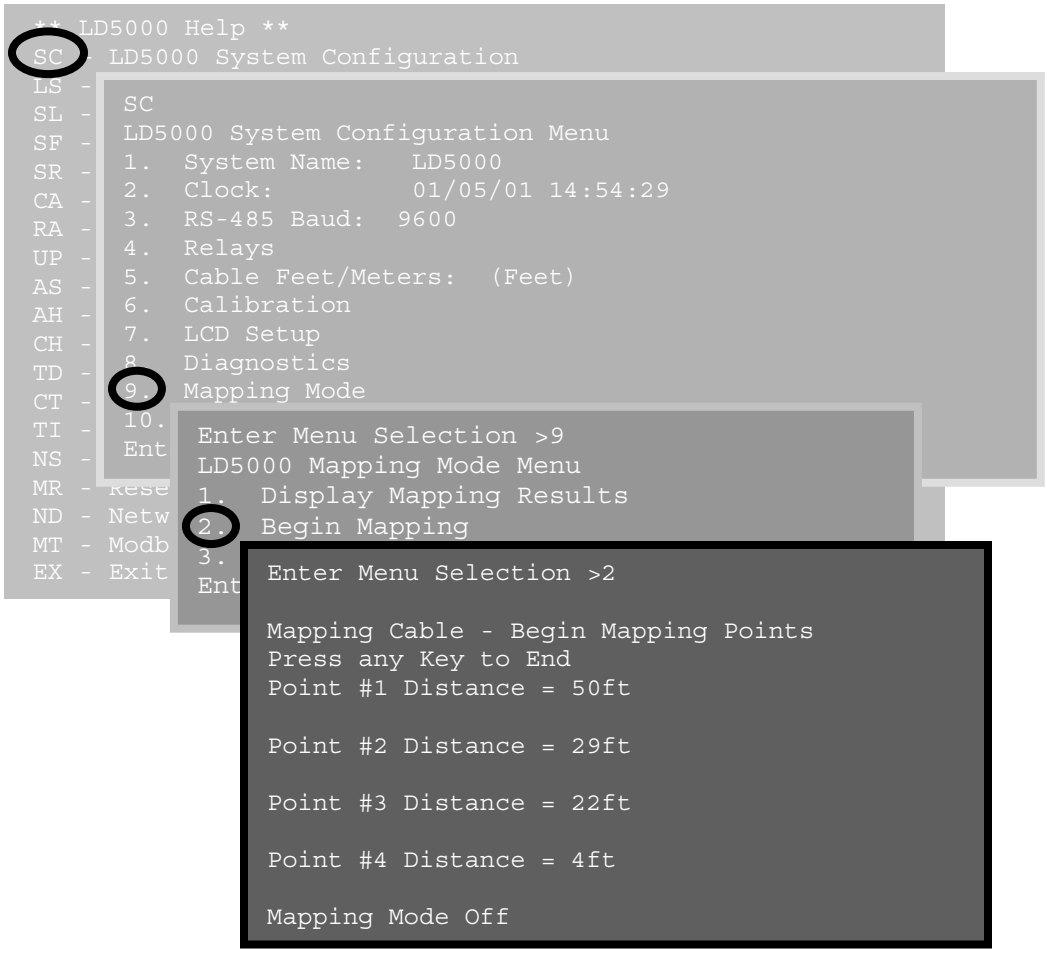


12-9.2 Begin Mapping - 2

Menu selection **2** begins the mapping process. Physically identify and mark points on the floor map. The points should be easily accessible and somewhat evenly spaced. Number the points and record their location (their distance from the control panel) on the reference map.

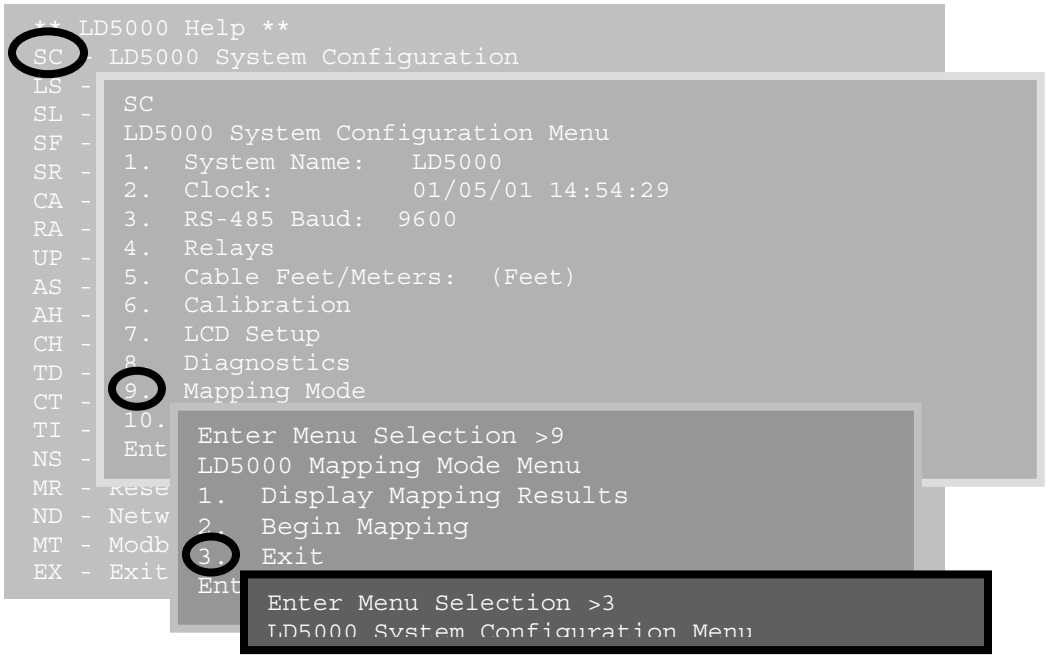
Short the cable at these points using a damp paper towel or sponge. Once you short a point, wait for the leak to be detected - annunciated by a long (3 second) beep. Remove the short and wait for the all clear signal - annunciated by a short (1 second) beep.

Mark the points on the reference map with the distances as measured by the LD5000. Once the cable is mapped, select option **1** from the Mapping Mode Menu to view the new map.



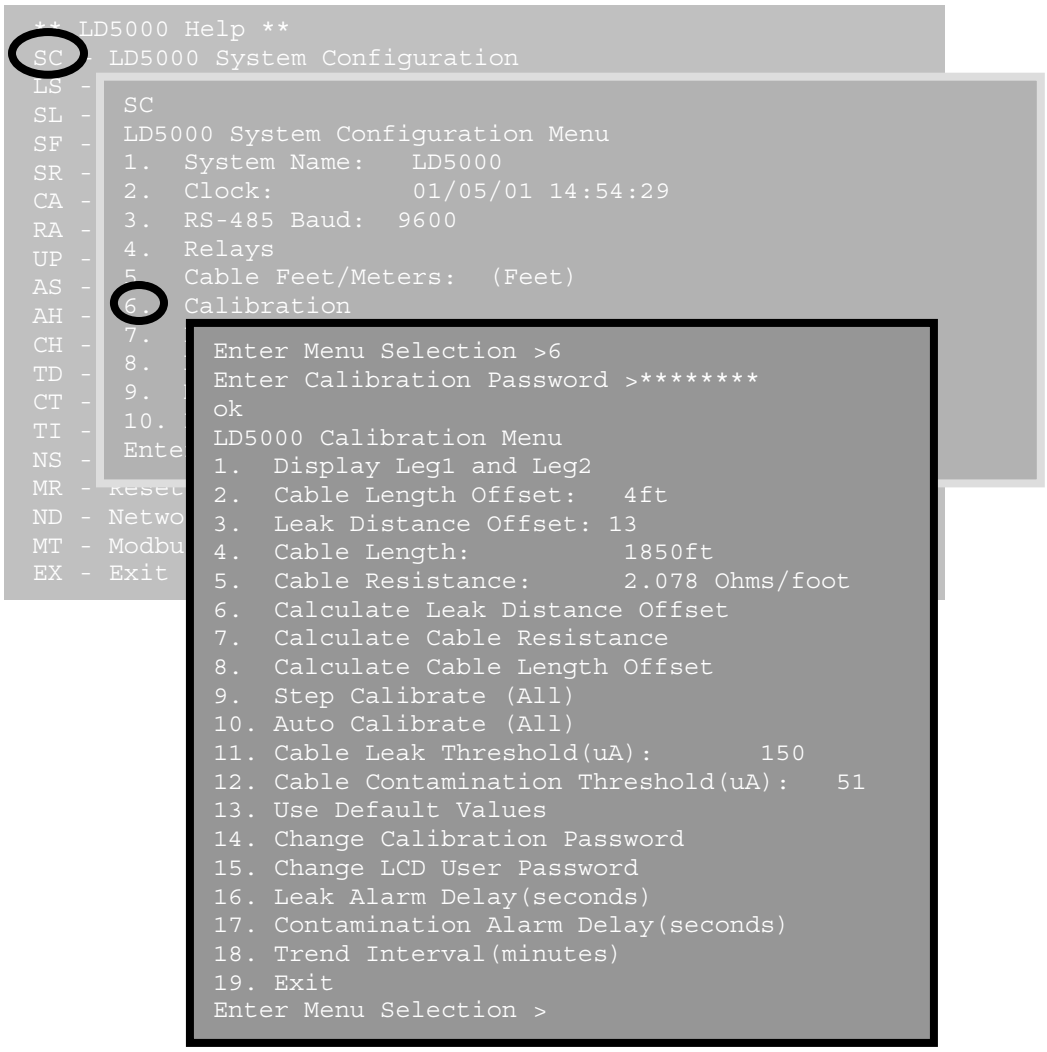
12-9.3 Exit - 3

Option **3** exits the LD5000 Mapping Mode Menu and returns to the System Configuration Menu.



CHAPTER 13: CALIBRATION MENU

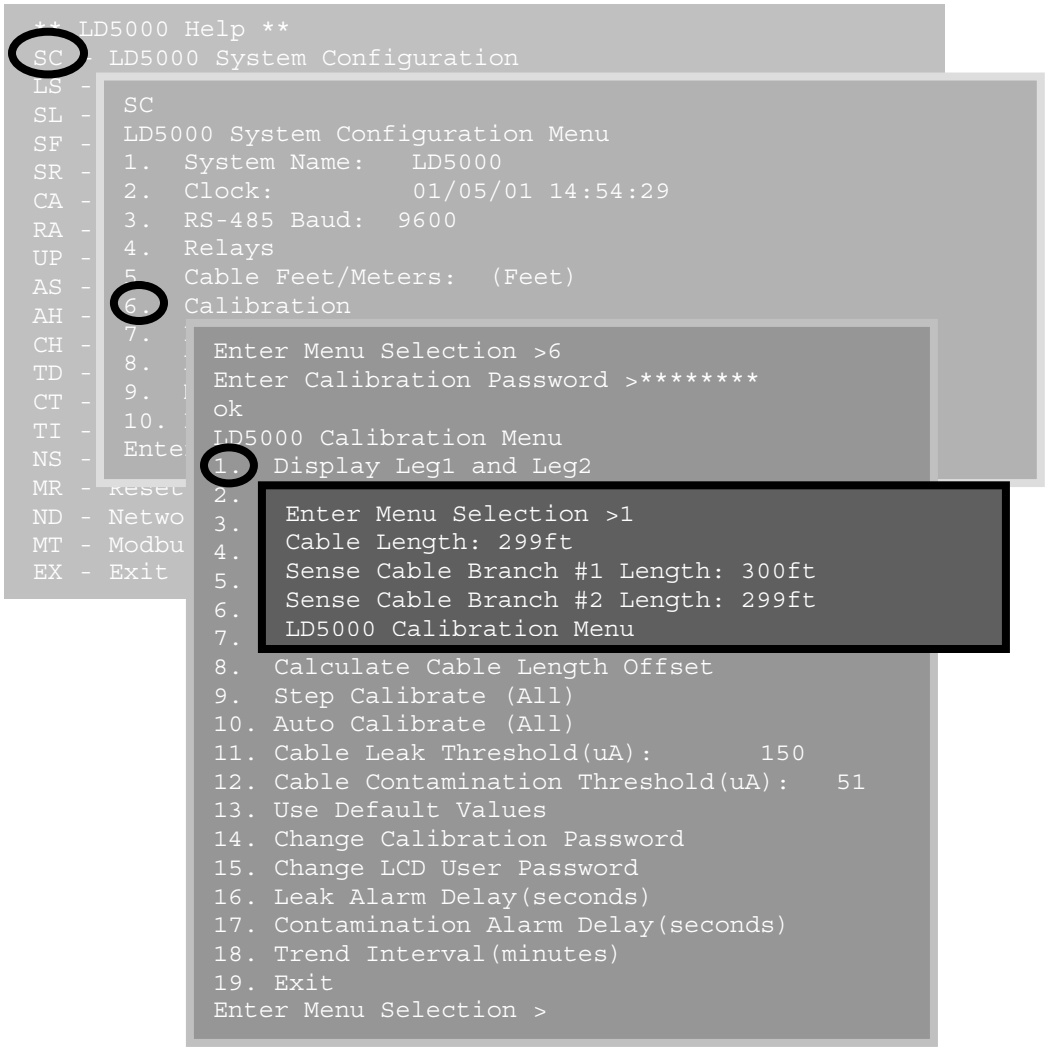
Option **6** of the System Configuration Menu displays the Calibration Menu. A password is needed to access this menu. The factory default password is: **RLE2TECH** - typed in all capital letters. The water leak detection cable is calibrated from this menu.



13-1 DISPLAY LEG1 AND LEG2 - 1

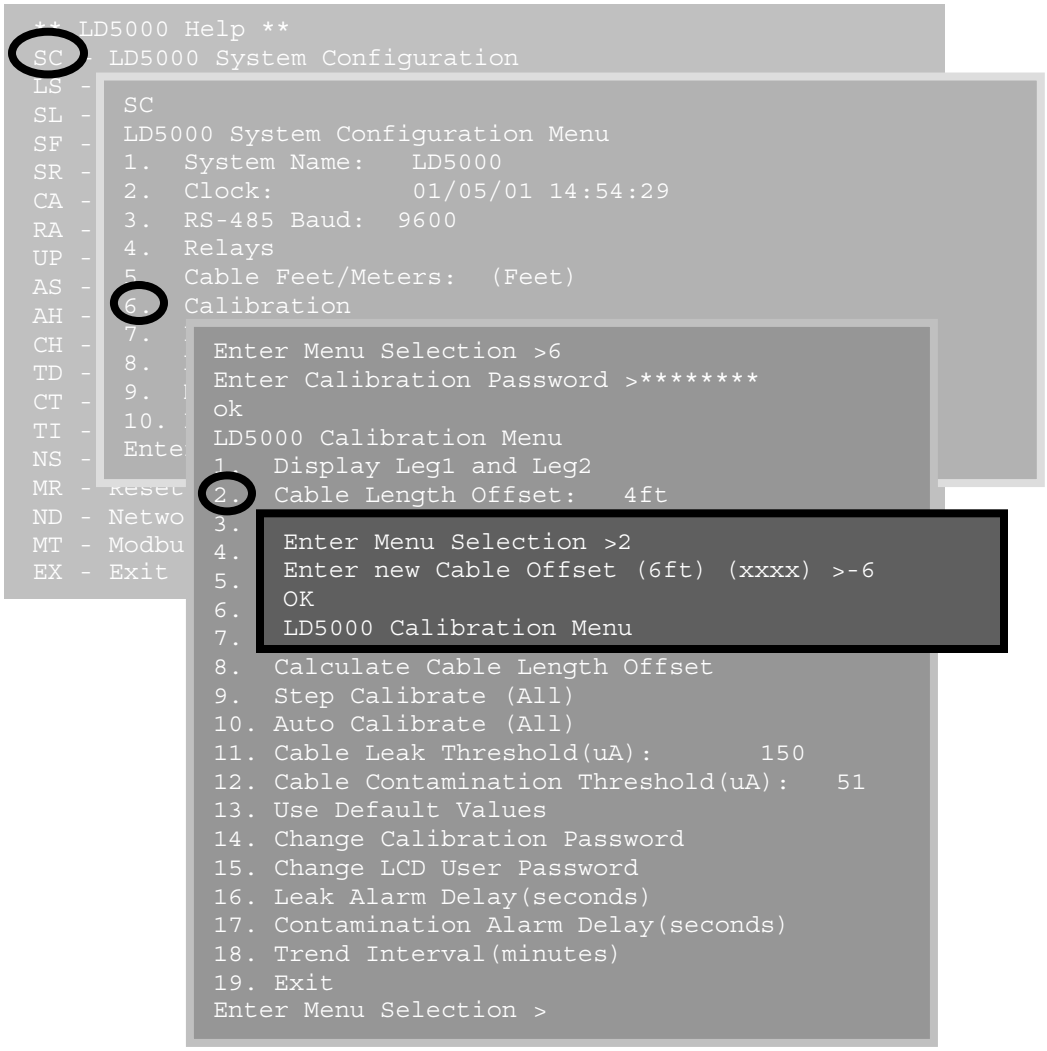
Menu selection **1** displays the status of leg1 (TB2 pins 1 and 2) and leg2 (TB2 pins 3 and 4). This selection is particularly useful when troubleshooting the system.

Executing this option produces two cable length values. These values should be close to each other. If the two cable length readings are significantly different from each other, there may be problems with TB2 wiring.



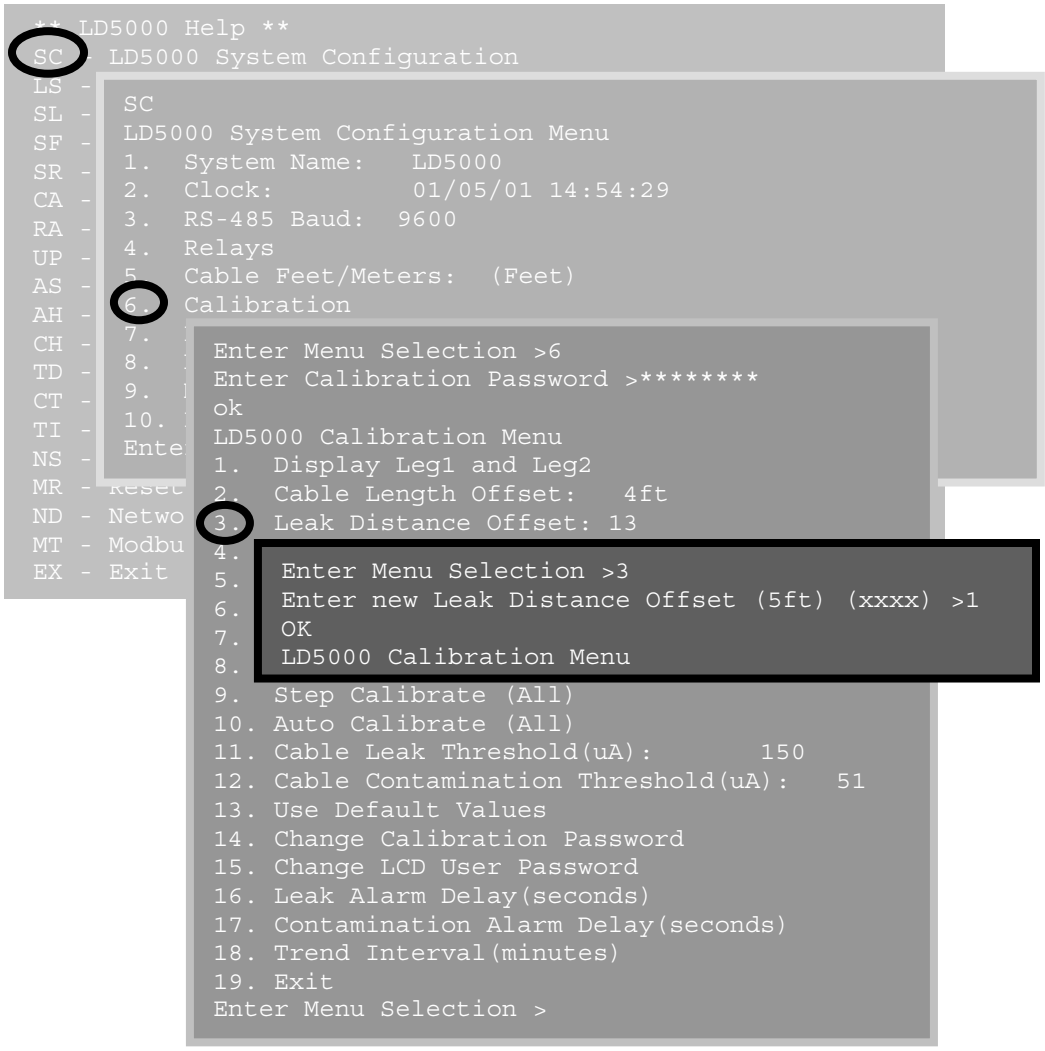
13-2 CABLE LENGTH OFFSET - 2

Option **2** displays the cable length offset. This parameter is calibrated by the LD5000 and should not be changed by the end user. Cable Length Offset is used by the system for the displayed cable length calculation which is accessed through the LCD, RS-232 and RS-485 interfaces (Status Menu, etc.). This is a parameter set during calibration and should not be changed by the end user unless he/she is technically qualified. If there are any questions regarding the cable length offset, consult the manufacturer.



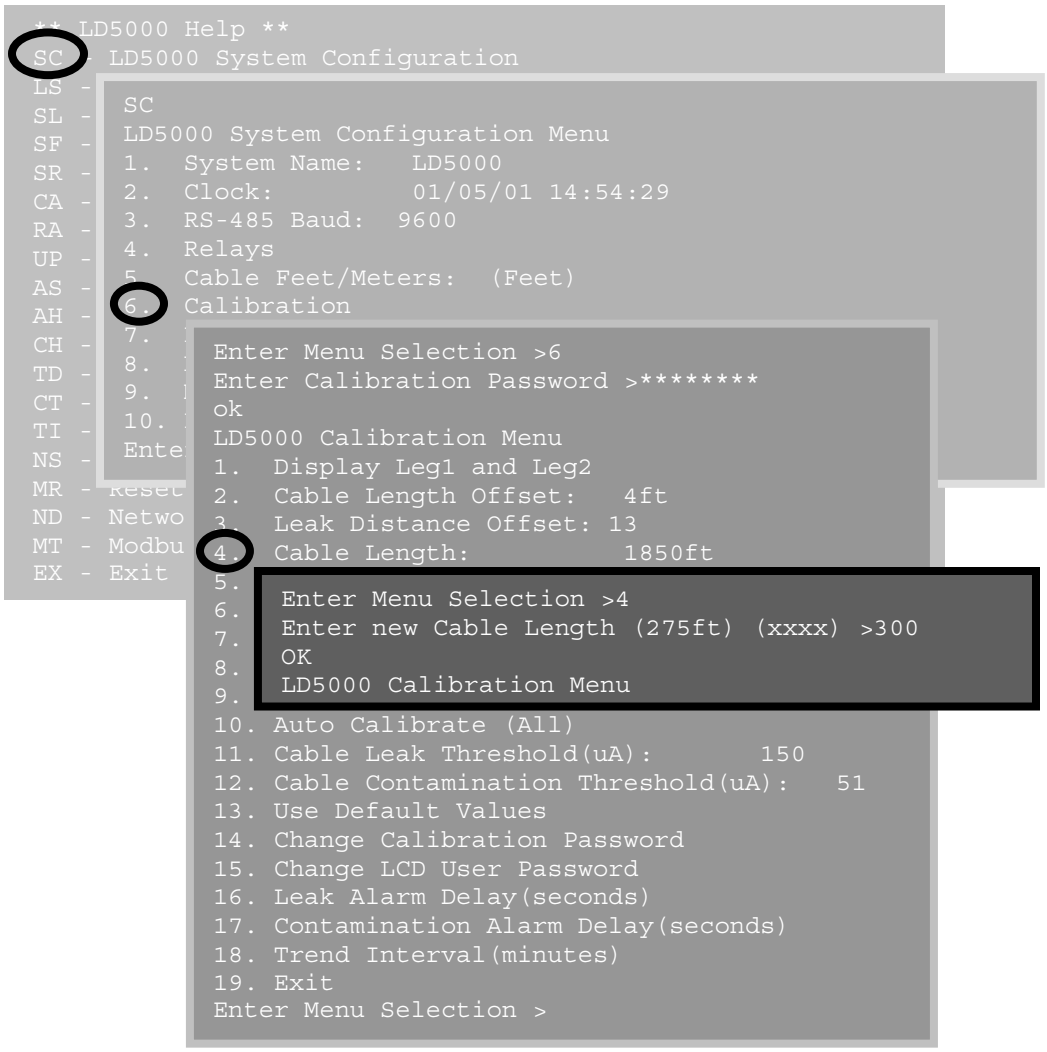
13-3 LEAK DISTANCE OFFSET - 3

Option **3** displays the cable distance offset. This parameter is calibrated by the LD5000 and should not be changed by the end user. Distance Offset is used by the system to calculate the Leak Distance when in alarm which is accessed through the LCD, RS-232 and RS-485 interfaces (Status menu, etc.). This is a parameter set during calibration and should not be changed by the end user unless he/she is technically qualified. If there are any questions regarding the cable distance offset, consult the manufacturer.



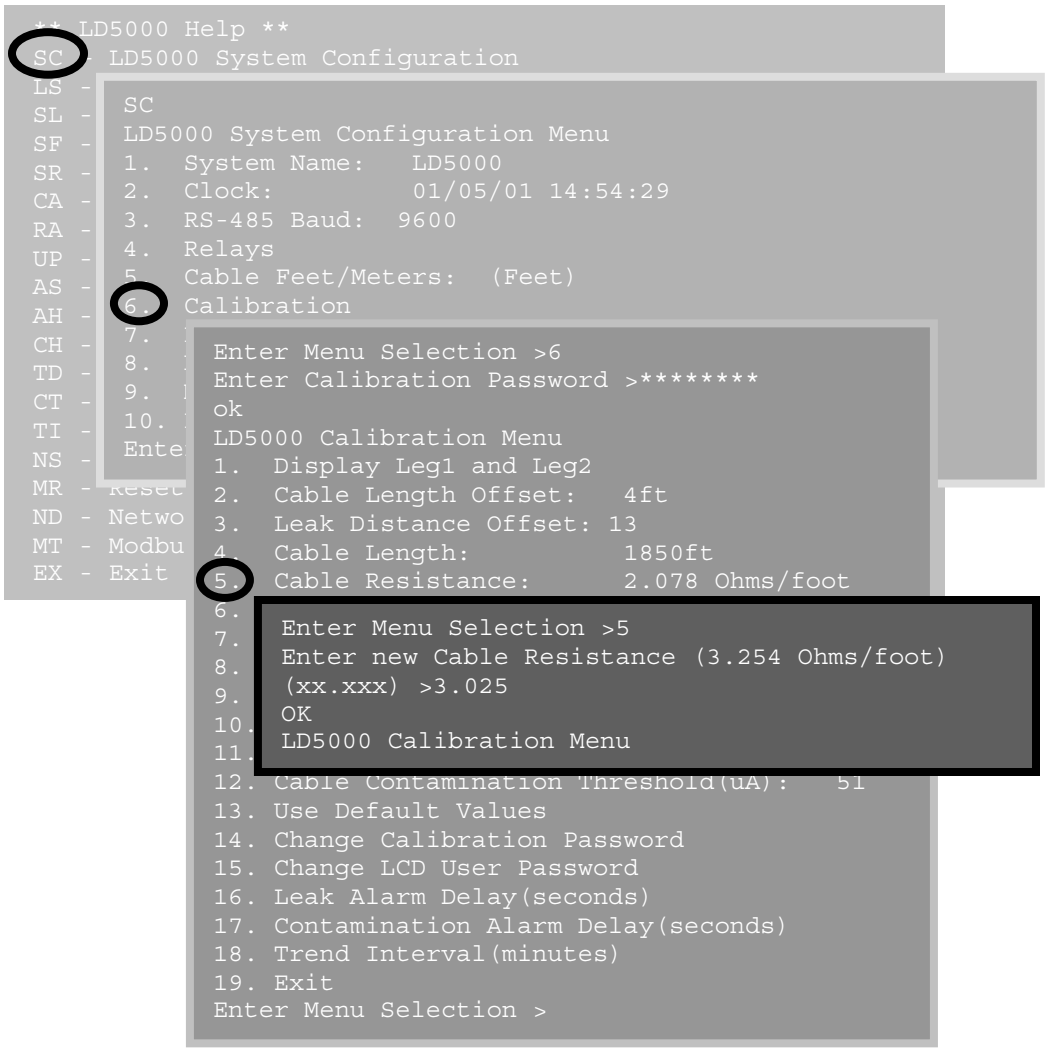
13-4 CABLE LENGTH - 4

Option **4** allows a user to manually enter the length of the cable connected to the LD5000.



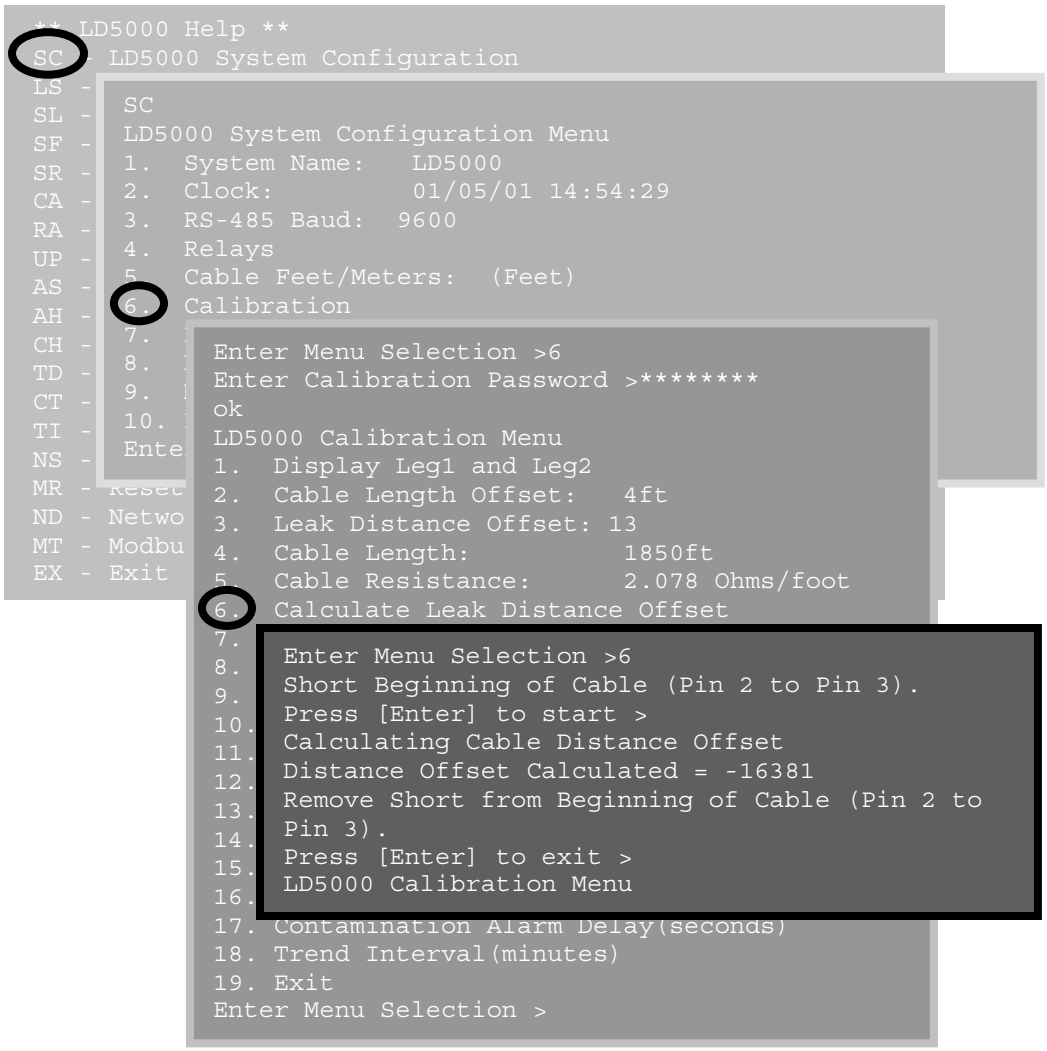
13-5 CABLE RESISTANCE - 5

Option **5** enables the manual entry of the cable resistivity. This value is calculated in ohms per foot and is automatically calculated in the Step or Auto Calibrate modes.



13-6 CALCULATE LEAK DISTANCE OFFSET - 6

Press **6** to calculate the leak distance offset. This calculation is made when the operator shorts the beginning of the leak detection cable.

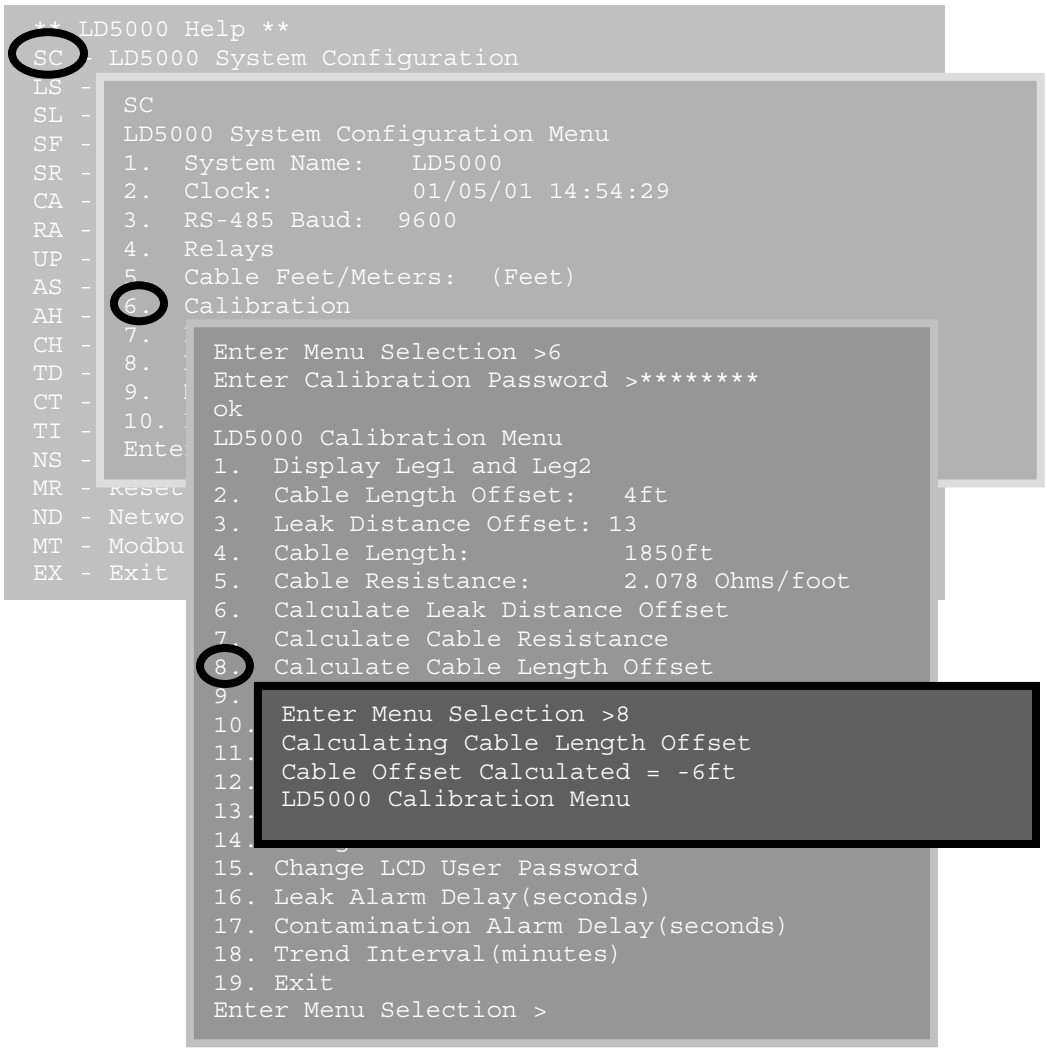


13-7 CALCULATE CABLE RESISTANCE - 7

Menu selection **7** calculates the cable resistivity. This value is calculated when the operator shorts pins 1, 2, 3, and 4 at the end of the water leak detection cable.

13-8 CALCULATE CABLE LENGTH OFFSET - 8

Option **8** calculates the cable length offset. This calculation is made with the end-of-line-terminator connected to the water leak detection cable, and may take a couple minutes to complete.

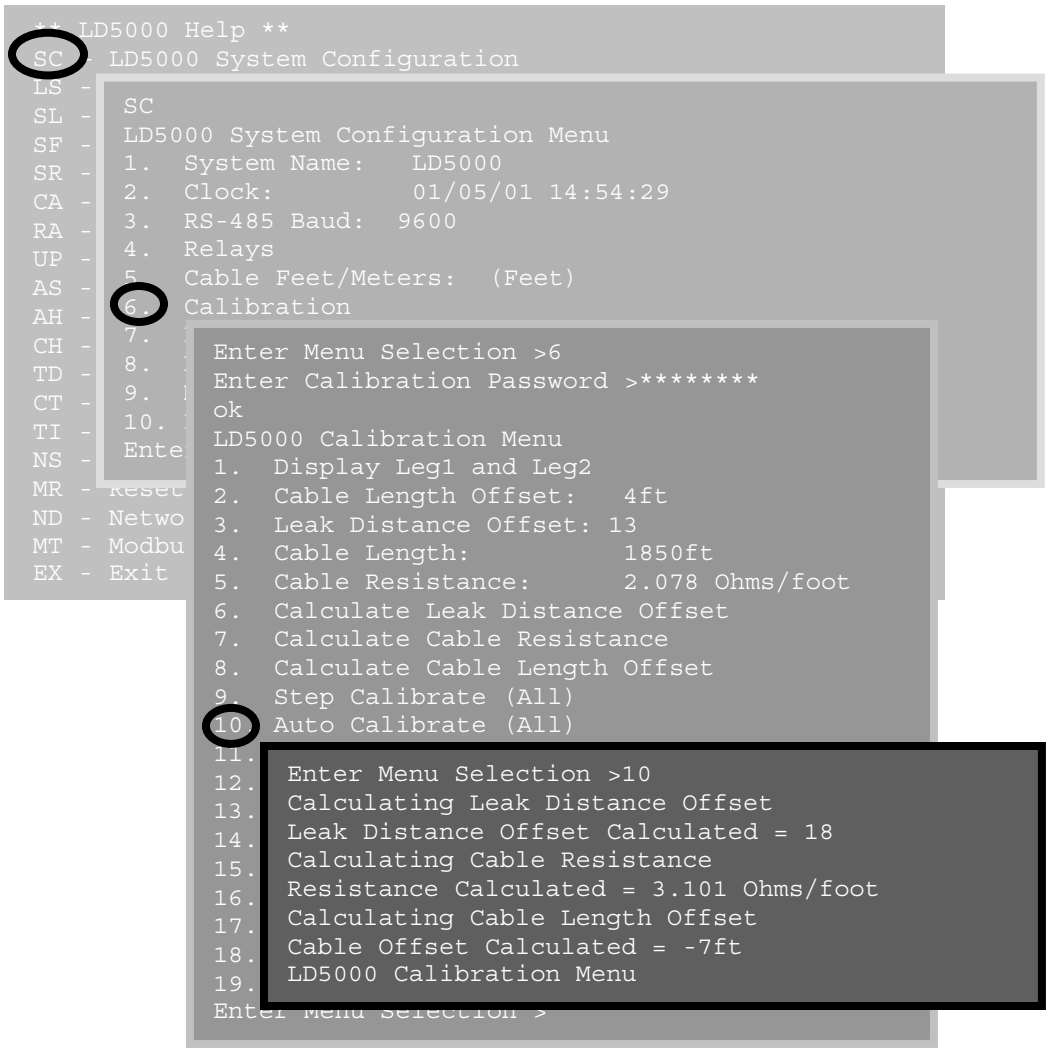


13-9 STEP CALIBRATE - 9

Option **9** manually steps the user through menu selections 6, 7 and 8. A calibration fixture is required to perform this operation. Contact the manufacturer to obtain the fixture.

13-10 AUTO CALIBRATE - 10

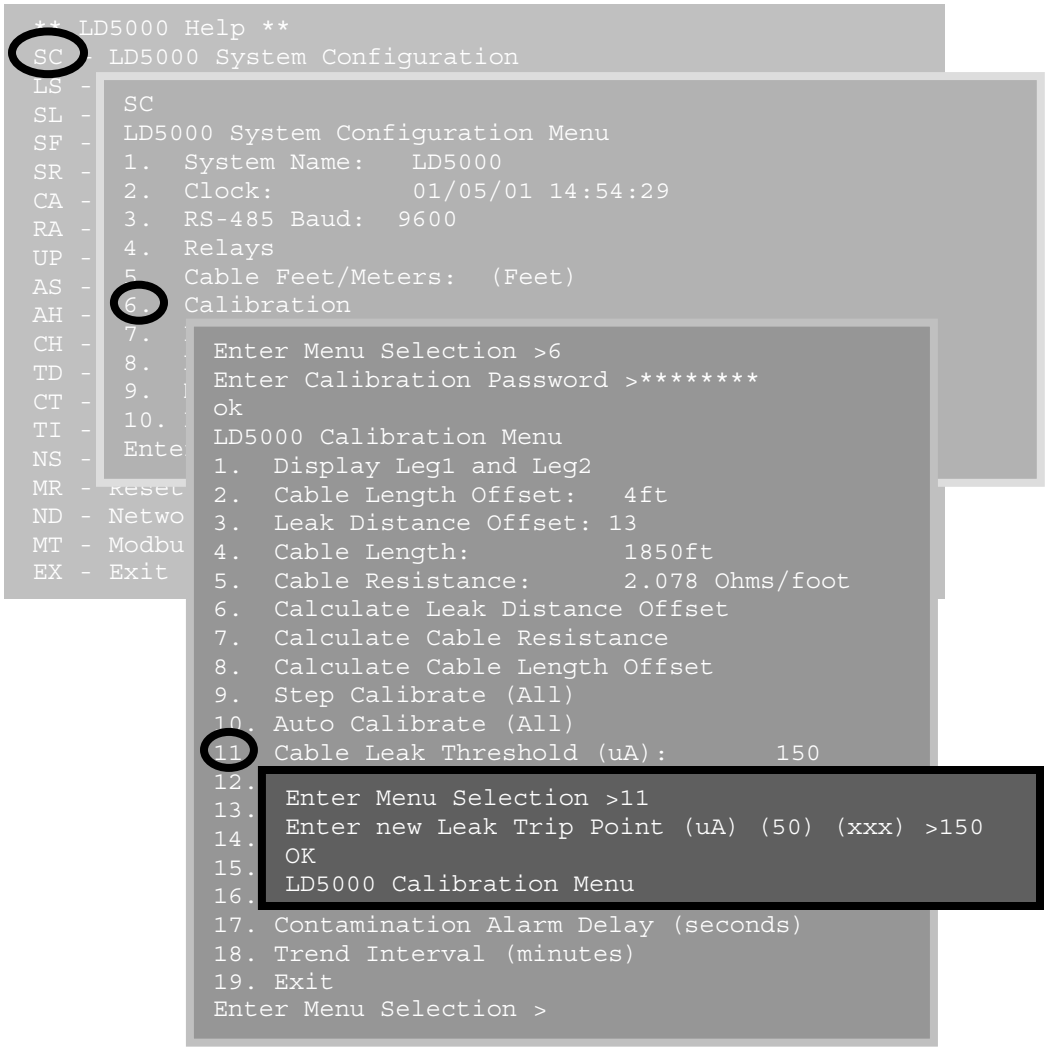
Option **10** automatically calibrates the device based on its dip switch settings. This method does not require a calibration fixture, and is the recommended calibration method. Note: It may be necessary to restore the system to factory defaults (use default values) before calibrating.



13-11 CABLE LEAK THRESHOLD - 11

Option **11** establishes the threshold for a leak alarm. Once the measured leak surpasses this threshold, the leak alarm relay activates.

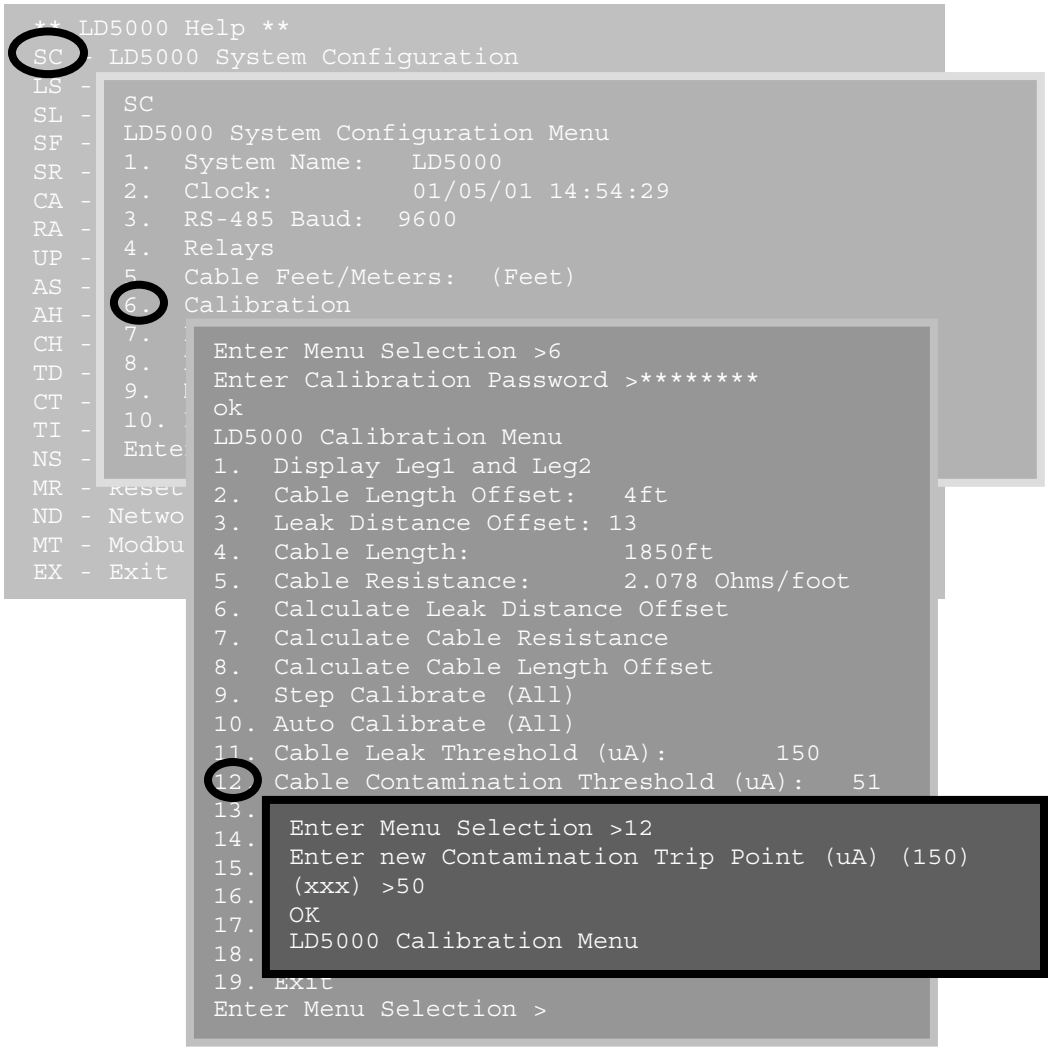
The manufacturer recommends setting the Leak Trip Point between 150uA and 200uA.



13-12 CABLE CONTAMINATION THRESHOLD - 12

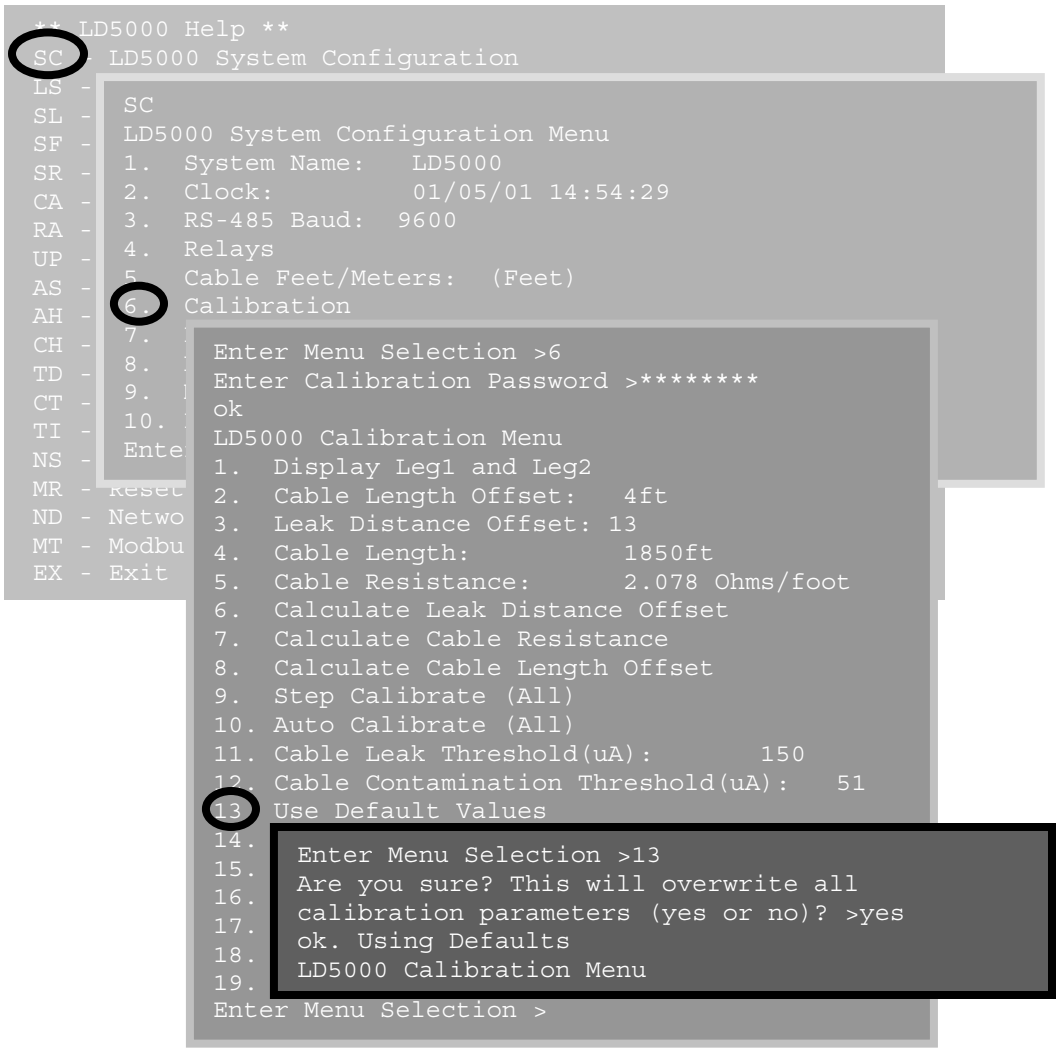
Option **12** establishes the threshold for cable contamination. Once the measured cable contamination surpasses this threshold, the cable alarm relay activates.

The manufacturer recommends setting the Contamination Trip Point less than 50uA.



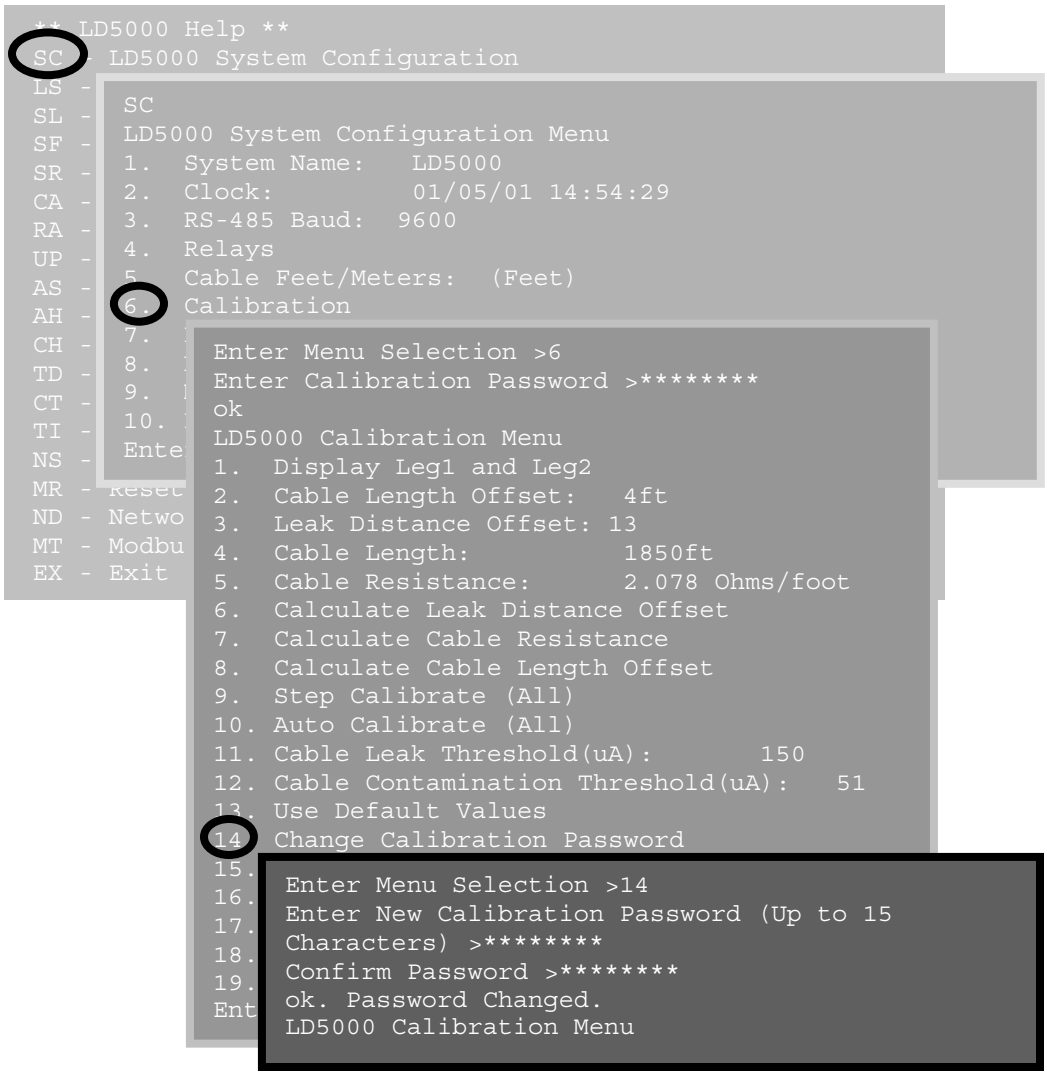
13-13 USE DEFAULT VALUES - 13

Option **13** resets all calibration values to the factory default settings.



13-14 CHANGE CALIBRATION PASSWORD - 14

Option **14** allows a user to change the calibration password.

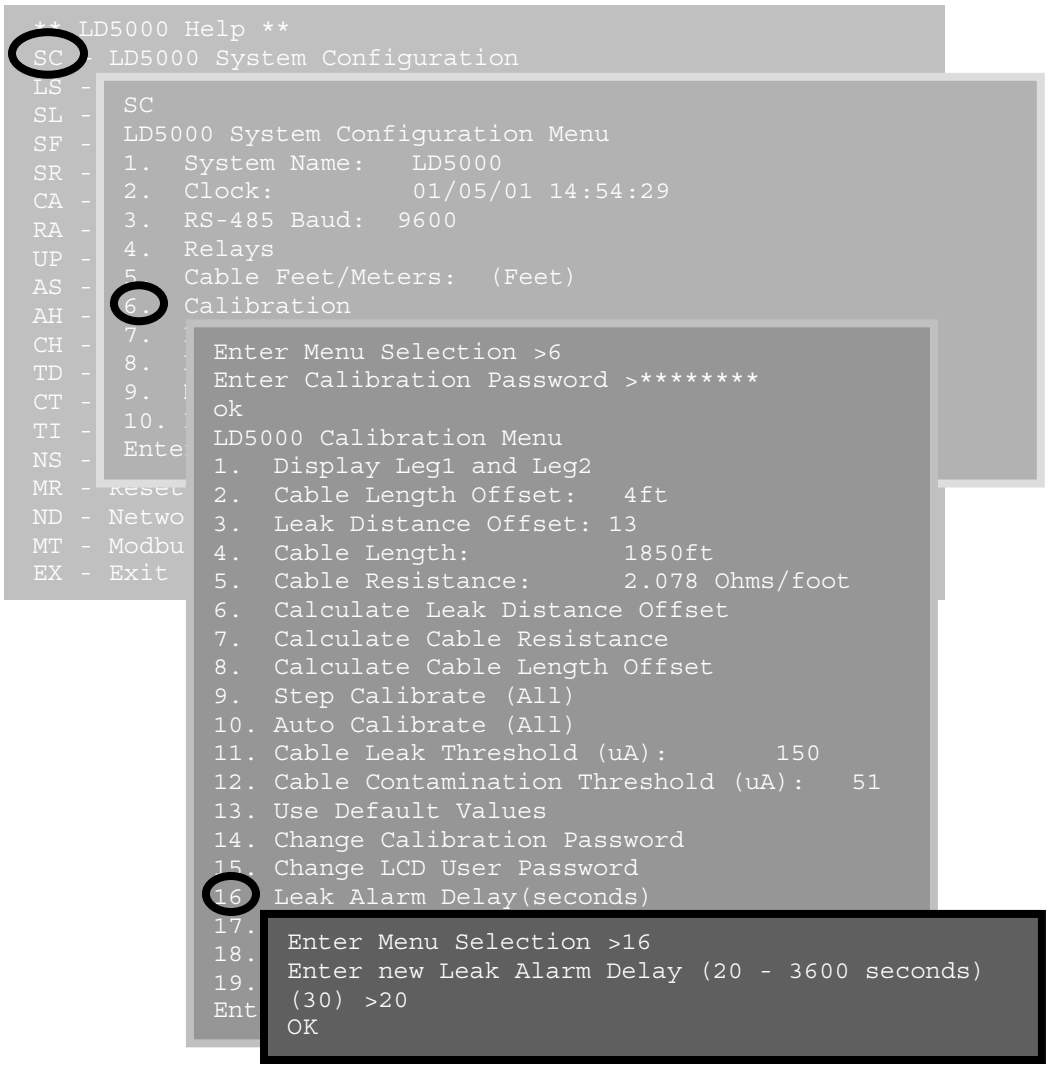


13-15 CHANGE LCD USER PASSWORD - 15

Option **15** allows a user to change the password used to access the set-up menu through the LCD.

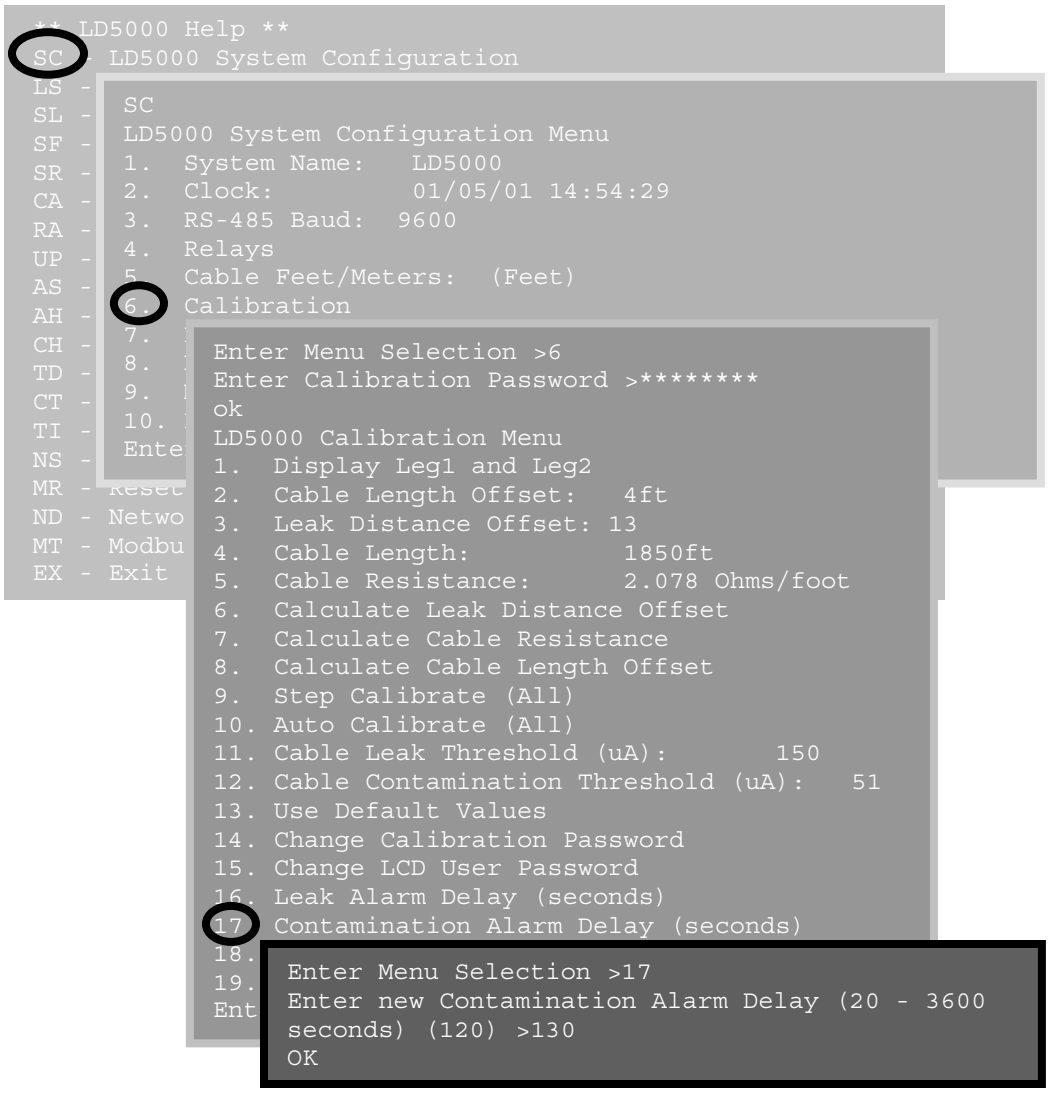
13-16 LEAK ALARM DELAY (SECONDS) - 16

Option **16** allows the user to set the length of time (20 - 3600 seconds) a leak must be present to create an alarm condition. The factory default setting is 20 seconds



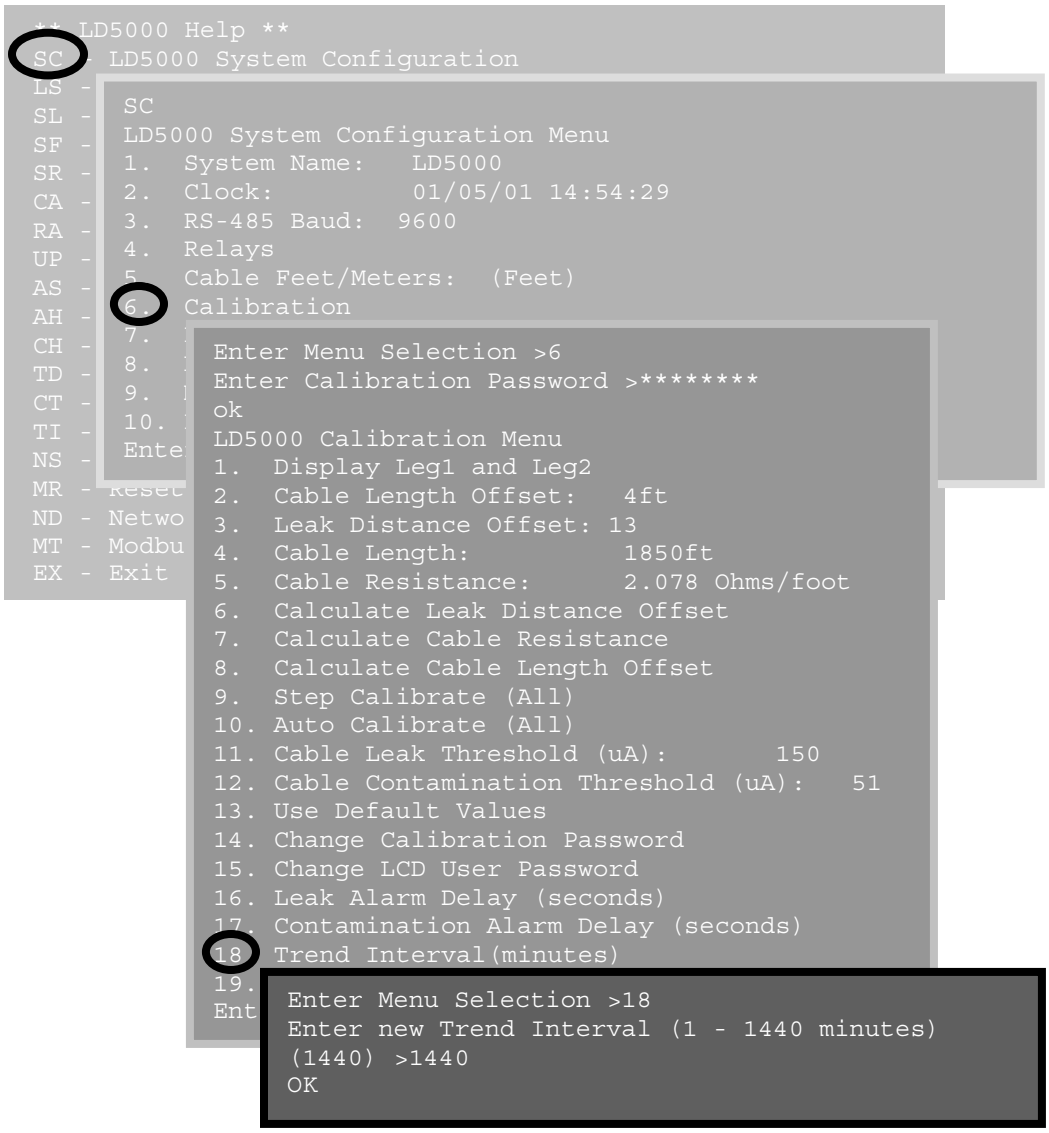
13-17 CONTAMINATION ALARM DELAY (SECONDS) - 17

Option **17** allows the user to set the length of time (20-3600 seconds) contamination must be present to create an alarm condition. The factory default setting is 120 seconds.



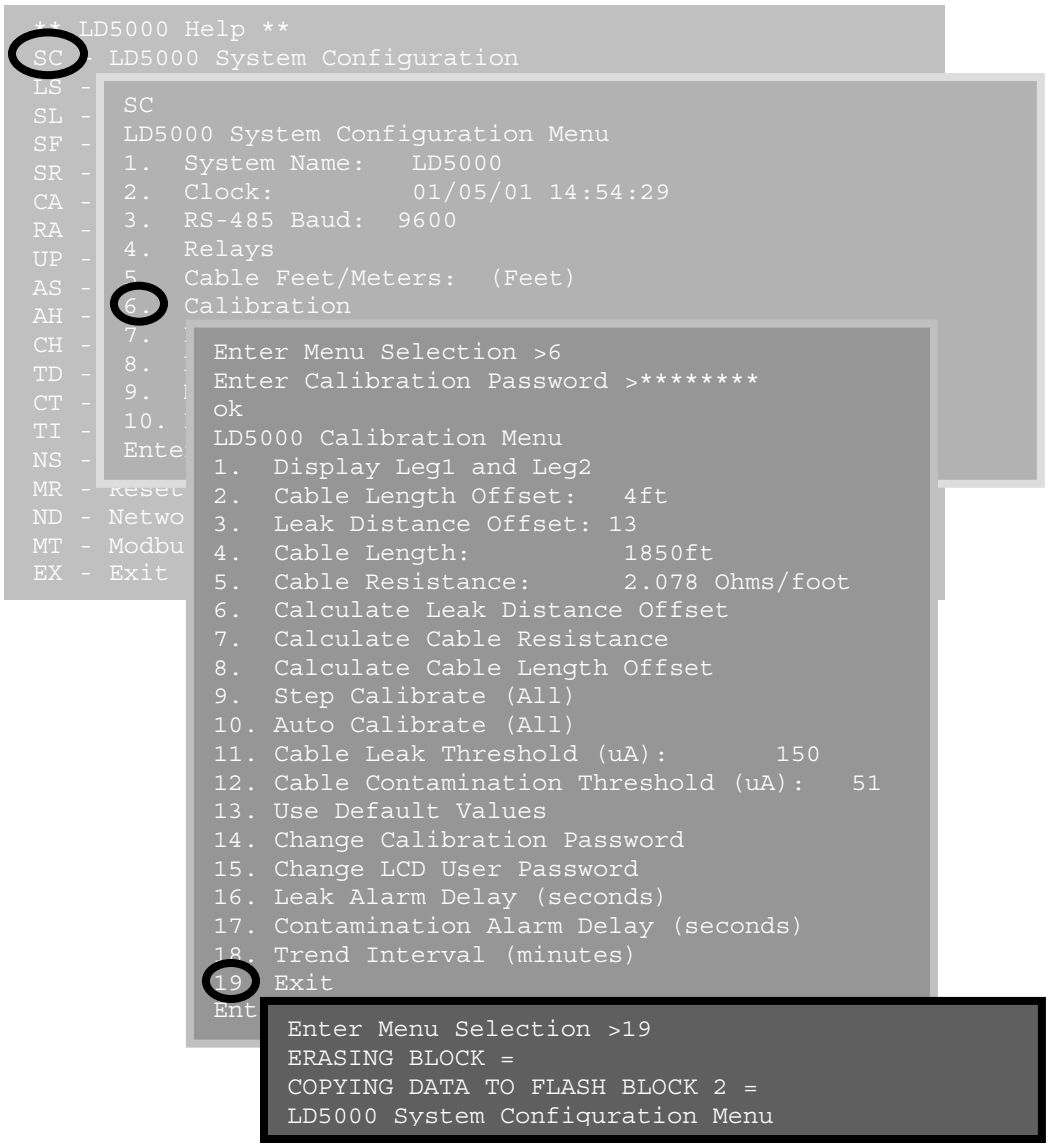
13-18 TREND INTERVAL (MINUTES) - 18

Option **18** allows the user to set the trend log acquisition time interval (1-1440 minutes), which is the time period between each measurement. The trend log will record up to 288 entries. The factory default setting is 1440 minutes.



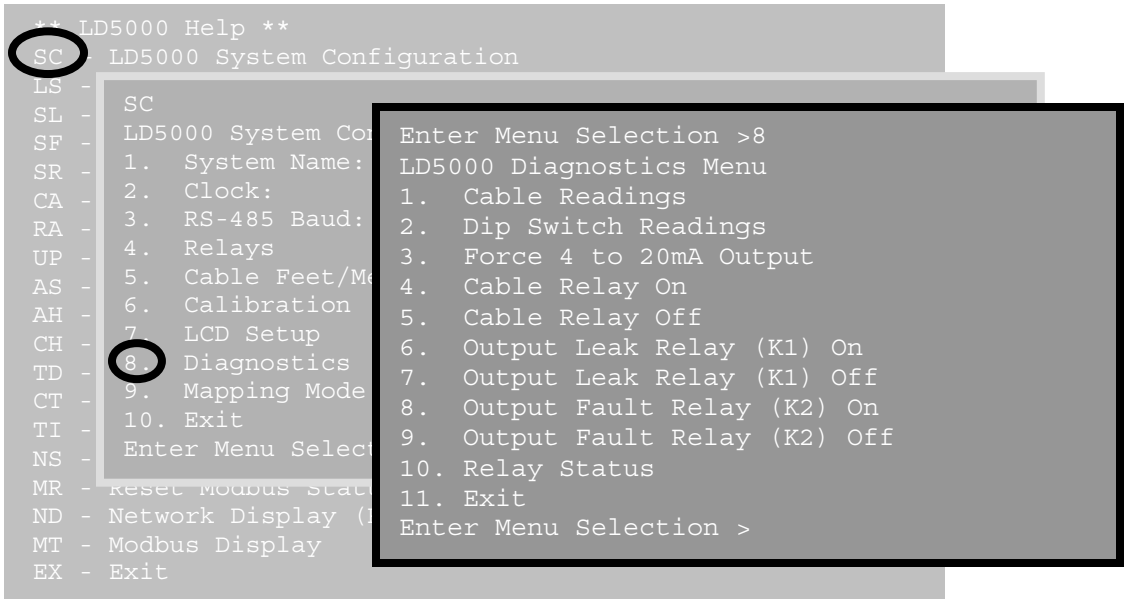
13-19 EXIT - 19

Option **19** exits the Calibration Menu and returns to the System Configuration Menu.



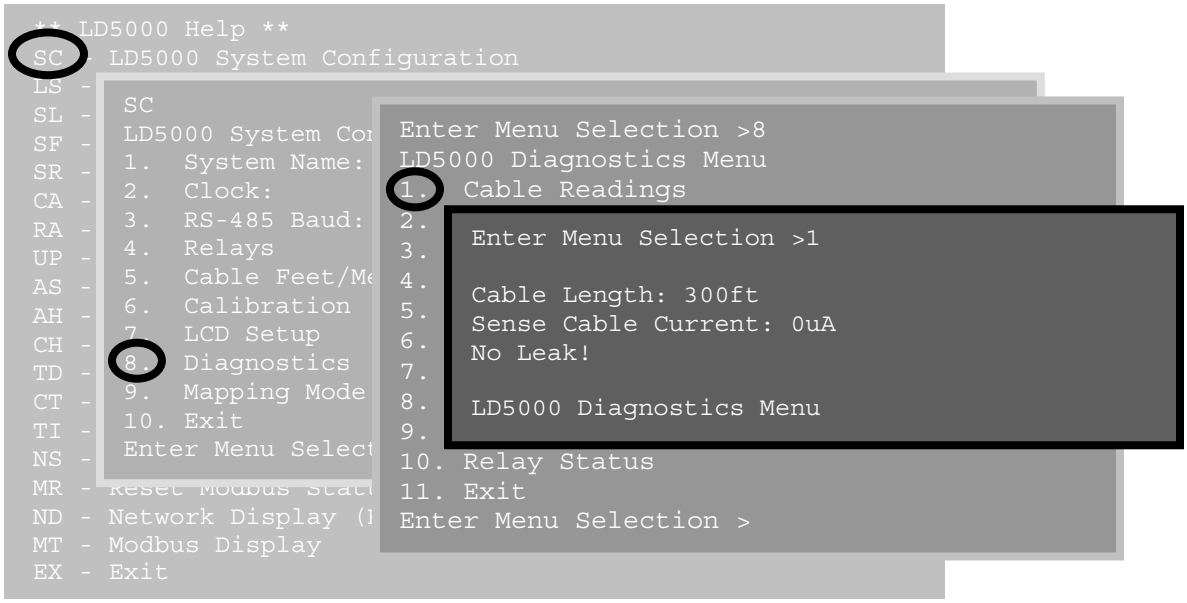
CHAPTER 14: DIAGNOSTICS MENU

Option **8** on the System Configuration Menu displays the LD5000 Diagnostics Menu. This menu is primarily used for troubleshooting and system testing.



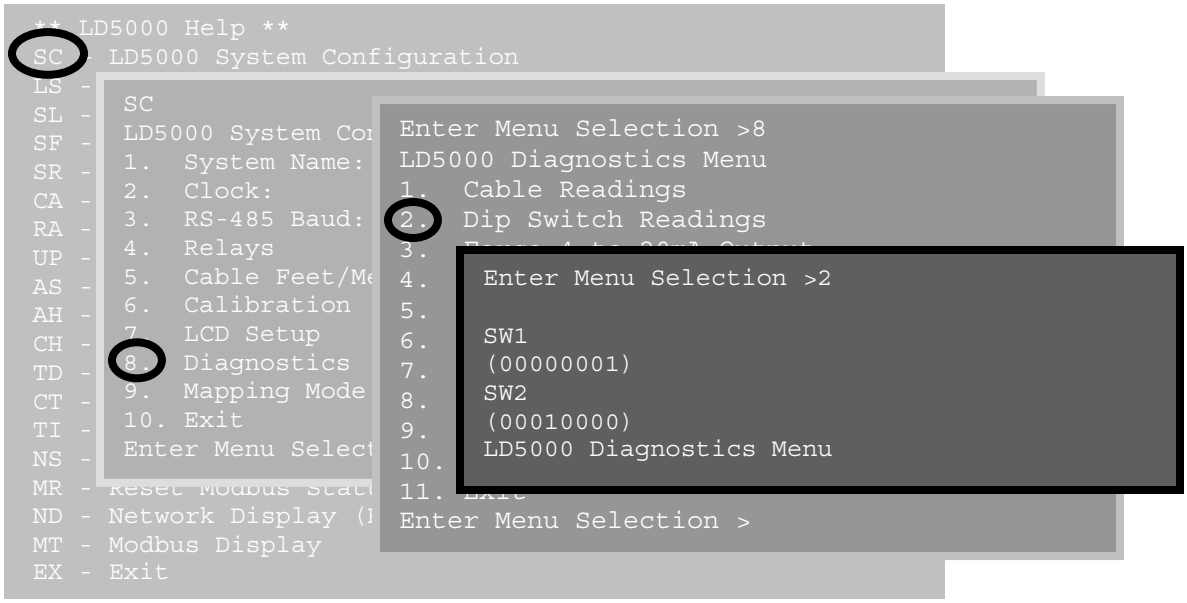
14-1 CABLE READINGS - 1

Option **1** reads the current cable status.



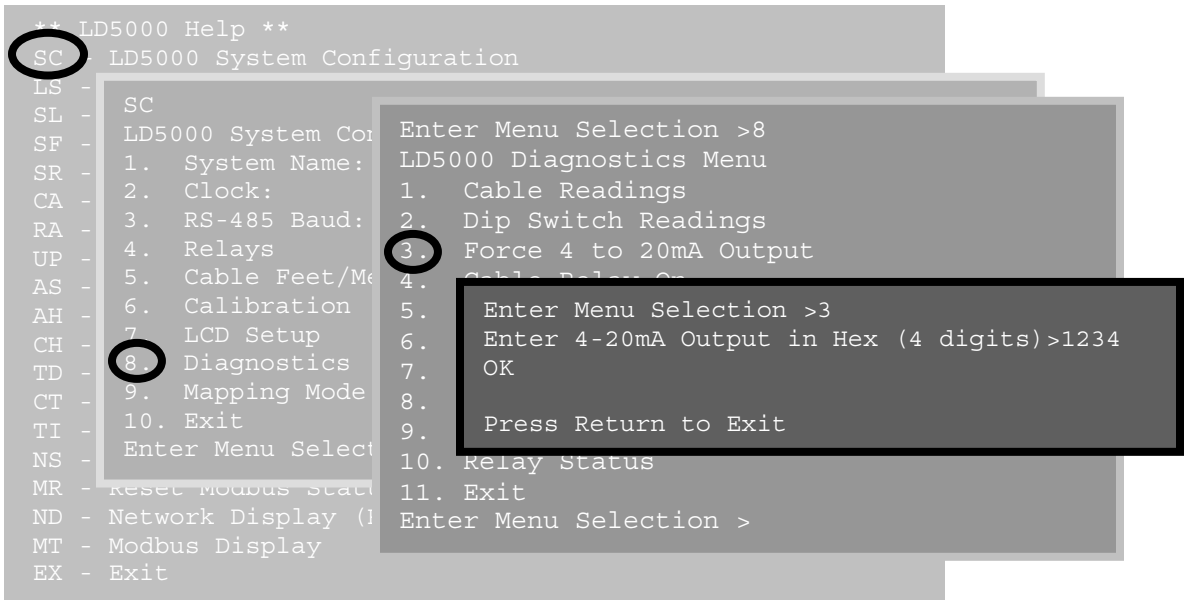
14-2 DIP SWITCH READINGS - 2

Option **2** reads the dip switch settings - SW1 and SW2, positions 1 through 8.



14-3 FORCE 4 TO 20MA OUTPUT - 3

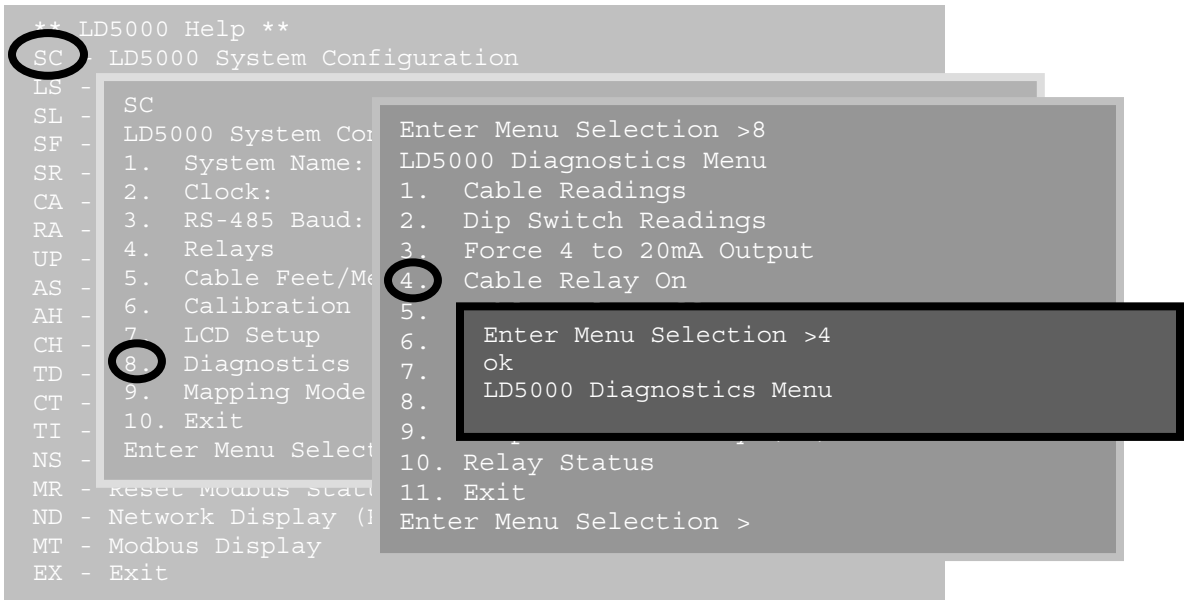
Option **3** forces the 4-20mA output to a specific value, which in turn allows a user to verify the 4-20 mA output. See the table below for specific hex values and the corresponding 4-20mA output values.



Hex Value	4-20mA Output	Hex Value	4-20mA Output
0000	4.0	87FF	12.5
07FF	4.5	8FFF	13.0
0FFF	5.0	97FF	13.5
17FF	5.5	9FFF	14.0
1FFF	6.0	A7FF	14.5
27FF	6.5	AFFF	15.0
2FFF	7.0	B7FF	15.5
37FF	7.5	BFFF	16.0
3FFF	8.0	C7FF	16.5
47FF	8.5	CFFF	17.0
4FFF	9.0	D7FF	17.5
57FF	9.5	DFFF	18.0
5FFF	10.0	E7FF	18.5
67FF	10.5	EFFF	19.0
6FFF	11.0	F7FF	19.5
77FF	115	FFFF	20.0
7FFF	12.0		

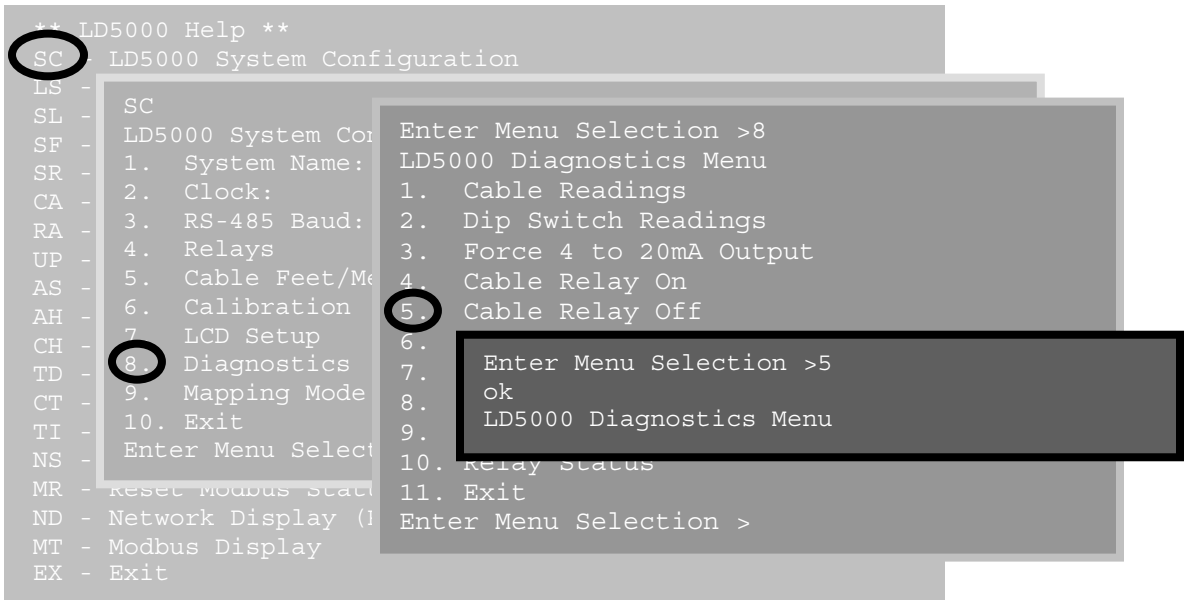
14-4 CABLE RELAY ON - 4

Option **4** turns on the disconnect cable and uses the internal test circuit.



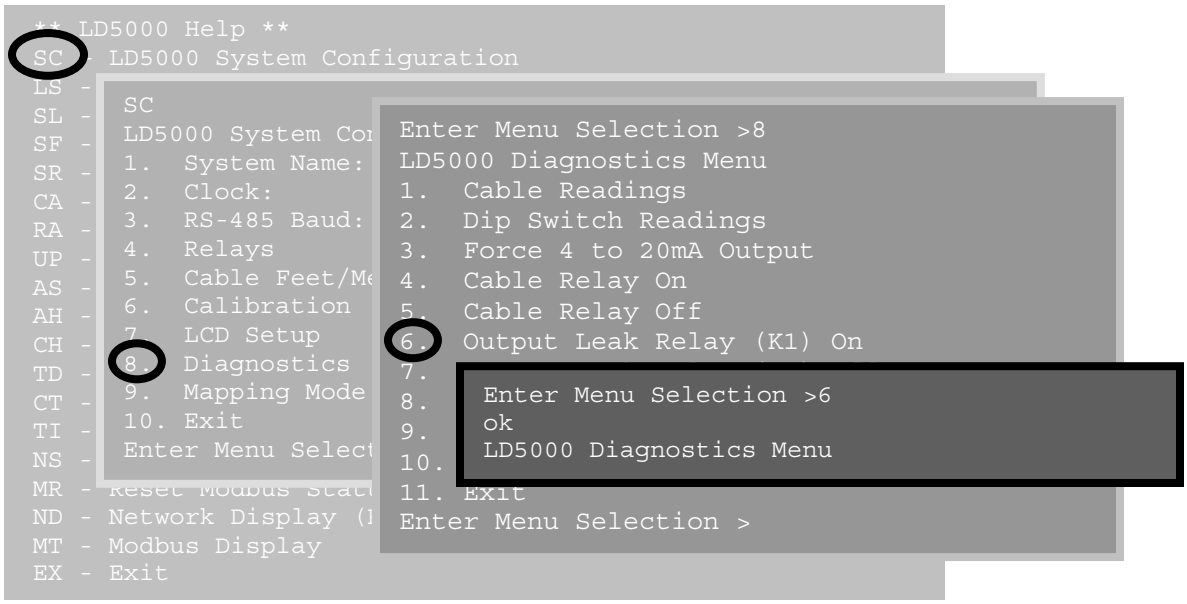
14-5 CABLE RELAY OFF - 5

Option **5** turns off the connect cable.



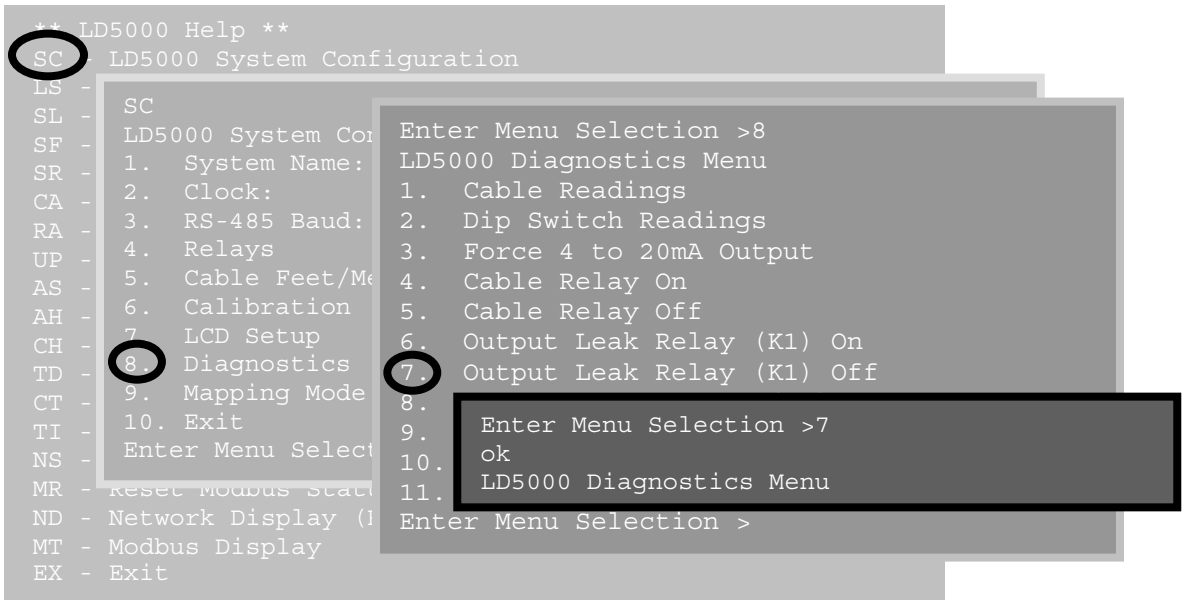
14-6 OUTPUT LEAK RELAY (K1) ON - 6

Option **6** turns on the leak relay.



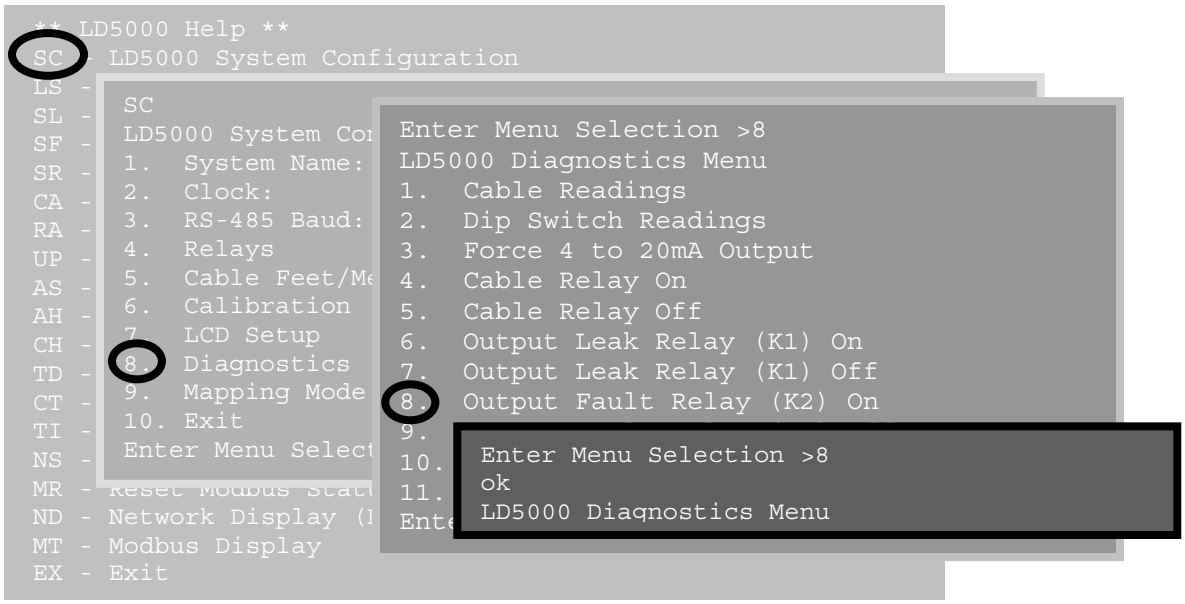
14-7 OUTPUT LEAK RELAY (K1) OFF - 7

Option **7** turns off the leak relay.



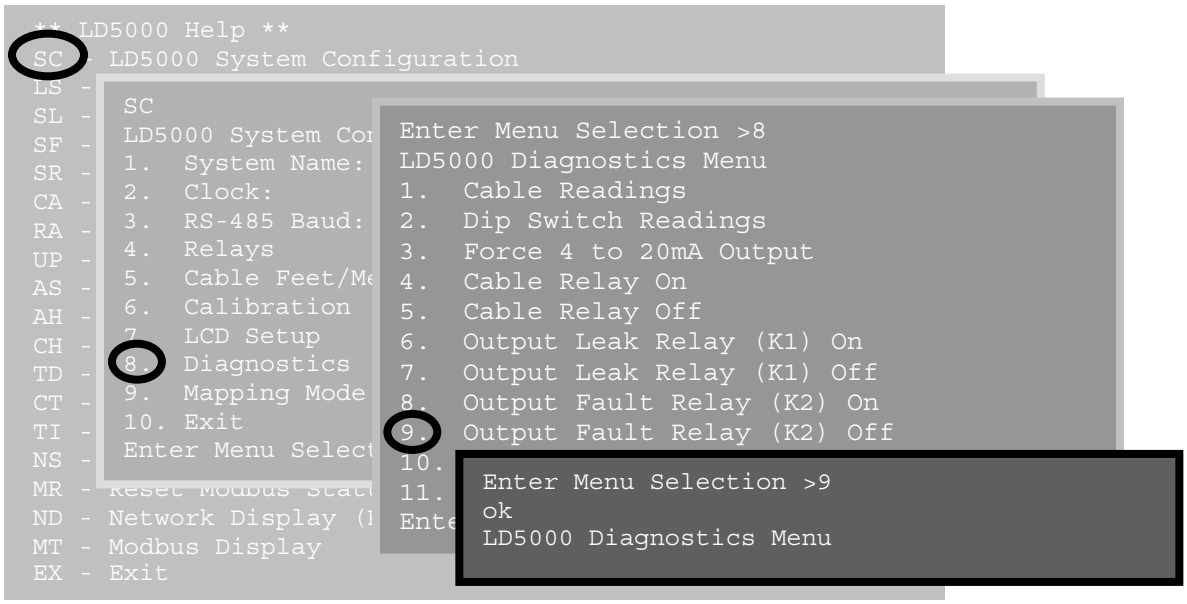
14-8 OUTPUT FAULT RELAY (K2) ON - 8

Option **8** turns the cable break relay on.



14-9 OUTPUT FAULT RELAY (K2) OFF - 9

Option **9** turns the cable break relay off.



APPENDIX A: MODBUS COMMUNICATION

This document describes the Modbus communications protocol as supported by the LD5000 Water Leak Detection System. It includes details and information on how to configure the LD5000 for communications via Modbus network.

A-1 IMPLEMENTATION BASICS

The LD5000 is capable of communicating via the half-duplex RS-485 serial communication standard. The LD5000 is configured to act as a slave device on a common network. The RS-485 medium allows for multiple devices on a multi-drop network. The LD5000 is a slave only device and will never initiate a communications sequence.

A-1.1 Modes of Transmission

The Modbus protocol uses ASCII and RTU modes of transmission. The LD5000 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)

A-1.1.1 Slave Address Field

The slave address field is one byte in length and identifies the slave device involved in the transaction. 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.

A-1.1.2 Function Field

The function field is one byte in length and tells the LD5000 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).

A-1.1.3 Data Field

The data field of the request is a variable length depending on the function. The data fields for the LD5000 are 16-bit registers, transmitted high order byte first (big-endian).

A-1.1.4 Error Check (Checksum) Field

The checksum field lets the receiving device determine if the packet has transmission errors. The LD5000 RTU mode uses a 16-bit cyclic redundancy check (CRC-16).

A-1.2 Exception Responses

If a Modbus master sends an invalid command to the LD5000 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 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

A-2 PACKET COMMUNICATIONS FOR THE LD5000

A-2.1 Function 03: Read Output Registers

To read the LD5000 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 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 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	Re-Alarm	Re-Alarm delay	Minutes	0-65535
40004	Latched Alarm	Latching Alarms	0=No 1=Yes	0-65535
40005	Silence Alarm	Set to 1 to silence audible alarm	1=Silence	0-65535
40006	Reset Alarm	Set to 1 to reset alarms	1=Reset Alarm	0-65535
40007	Spare			0-65535
40008	Spare			0-65535
40009	Spare			0-65535
40010	Month	Clock	1-12	0-65535
40011	Day	Clock	1-31	0-65535
40012	Year	Clock	00-99	0-65535
40013	Hour	Clock	0-23	0-65535
40014	Minutes	Clock	0-59	0-65535
40015	Seconds	Clock	0-59	0-65535
40016	Seconds	Leak Alarm Delay	20-3600	0-65535
40017	Seconds	Contamination Alarm Delay	20-3600	0-65535

A-2.2 Function 04: Read Input Registers

To read the LD5000 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 (40001 = zero, 40002 = one, etc).

Table 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: 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 6: Status Flags (Register 30001):

Bit	Description
00	1 = Leak is Detected
01	1 = Cable Break Alarm
02	1 = Contamination is detected
03-15	Spare

A-2.3 Function 06: Preset Single Register

To set a LD5000 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 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)

A-2.4 Function 16: Preset Multiple Registers

To set multiple LD5000 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 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)	

A-3 MODBUS DIP SWITCH SETTINGS FOR THE LD5000

Table 9: Baud rate

Baud Rate	SW2 – 5	SW2- 6
1200	Off	Off
2400	Off	On
9600	On	Off
19200	On	On

Table 10: Modbus Slave Address

Address	SW2 (8..1)	Address	SW2 (8..1)	Address	SW2 (8..1)	Address	SW2 (8..1)
0	00000000	16	00010000	32	00100000	48	00110000
1	00000001	17	00010001	33	00100001	49	00110001
2	00000010	18	00010010	34	00100010	50	00110010
3	00000011	19	00010011	35	00100011	51	00110011
4	00000100	20	00010100	36	00100100	52	00110100
5	00000101	21	00010101	37	00100101	53	00110101
6	00000110	22	00010110	38	00100110	54	00110110
7	00000111	23	00010111	39	00100111	55	00110111
8	00001000	24	00011000	40	00101000	56	00111000
9	00001001	25	00011001	41	00101001	57	00111001
10	00001010	26	00011010	42	00101010	58	00111010
11	00001011	27	00011011	43	00101011	59	00111011
12	00001100	28	00011100	44	00101100	60	00111100
13	00001101	29	00011101	45	00101101	61	00111101
14	00001110	30	00011110	46	00101110	62	00111110
15	00001111	31	00011111	47	00101111	63	00111111

- For address's 64 –127, set sw1 # 7 to on then subtract 64 from the address and use the table.
- For address's 128 –191, set sw1 #7 off, # 8 to on then subtract 128 from the address and use the table.
- For address's 192 –254, set sw1 #7 &. 8 to on then subtract 192 from the address and use the above table.

A-4 RTU FRAMING

The example below shows a typical Query/Response from a LD5000 module.

Table 11: Query 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

Table 12: Response Sample

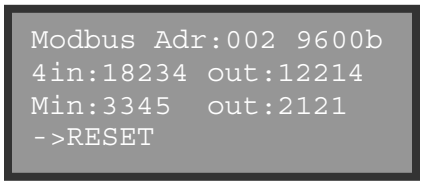
Slave Address	Function Code	Count Bytes of Data	Register Data Msb Lsb	Register Data Msb Lsb	Register Data Msb Lsb	CRC 16 "Lsb"	CRC 16"Msb"
02	04	06	00 00	00 00	00 01	B5	A3

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

Register Values:

40001 = 0000 (hex)
40002 = 0000 (hex)
40003 = 0001 (hex)

A-5 LD5000 LCD MODBUS STATUS SCREEN (COMMS)



Adr:xxx - The Modbus slave address set by the dip switch #1

9600b - The current baud rate of the Modbus RS-485 port

4in:xxxxx out:xxxxx - The number of RS-485 bytes received and transmitted

Min:xxxxx out:xxxxx - The number of Modbus packets received and transmitted

RESET - Press the **Enter (↵)** key to reset the Modbus counters

A-6 LD5000 LCD MODBUS STATUS RS-232

A-6.1 Menu Options

```
** LD5000 Help **
SC - LD5000 System Configuration
LS - Leak Status
SL - Silence Leak Relay
SF - Silence Fault Relay
SR - Silence All Relays
CA - Current Alarms
RA - Reset Alarms
UP - Update Alarms
AS - Alarm Silence (LCD)
AH - Alarm History
CH - Clear Alarm History
TD - Trend Data Table (Leakage Current)
CT - Clear Trend Data Table
TI - Display Date/Time
NS - Network Status (RS485/Modbus)
MR - Reset Modbus Status (RS485/Modbus)
ND - Network Display (RS485)
MT - Modbus Display
EX - Exit
```

A-6.2 Network Status

```
NS
** EIA-485 Statistics **
Baud Rate: 9600
InChars:   3315799
OutChars:  10647122
Errors:    14

** ModBus Statistics **
Address:            2
Packets in:         368422
Packets for me:     368422
Packets not for me: 0
Packets out:        368422
CRC errors:         366
Other Errors:       0
```

A-6.3 Reset Modbus Status Counters

Type **MR**<CR> from the RS-232 configuration port to clear all the 485/Modbus counters.

A-6.4 Network Display (Trace)

Type **ND**<CR> from the RS-232 configuration port to display the RS-485 traffic.

```
ND
ok
RS485 Monitor On <press any key to turn off!>
<LD5000>
{02}{04}{00}{00}{00}{03}{B0}{38}Modbus wakeup
{A3}{02}{04}{00}{00}{00}{03}{B0}{38}Modbus wakeup
{A3}{02}{04}{00}{00}{00}{03}{B0}{38}Modbus wakeup
{A3}{02}{04}{00}{00}{00}{03}{B0}{38}Modbus wakeup
{A3}{02}{04}{00}{00}{00}{03}{B0}{38}Modbus wakeup
{A3}{02}{04}{00}{00}{00}{03}{B0}{38}Modbus wakeup
{A3}{02}{04}{00}{00}{00}{03}{B0}{38}Modbus wakeup
{A3}{02}{04}{00}{00}{00}{03}{B0}{38}Modbus wakeup
{A3}
```

A-6.5 Modbus Display (Trace)

Type **MT**<CR> from the RS-232 configuration port to display the Modbus packets.

```
MT
Modbus trace/display is on <press any key to turn
off!>
<LD5000>
ins: 02 04 00 00 00 03 B0 38
mbreg matches: 3
Outs: 02 04 06 00 00 00 00 00 01 B5 A3
ins: 02 04 00 00 00 03 B0 38
mbreg matches: 3
Outs: 02 04 06 00 00 00 00 00 01 B5 A3
ins: 02 04 00 00 00 03 B0 38
mbreg matches: 3
Outs: 02 04 06 00 00 00 00 00 01 B5 A3
ins: 02 04 00 00 00 03 B0 38
mbreg matches: 3
Outs: 02 04 06 00 00 00 00 00 01 B5 A3
ins: 02 04 00 00 00 03 B0 38
mbreg matches: 3
Outs: 02 04 06 00 00 00 00 00 01 B5 A3
```

APPENDIX B: BOOTLOADER FIRMWARE V1.2

The LD5000 Bootloader firmware resides in EPROM and provides three basic services (a permanent code, diagnostic commands and the ability to update firmware).

B-1 PERMANENT CODE

The Bootloader firmware provides the LD5000 with a permanent start up code that cannot be erased.

B-2 DIAGNOSTIC COMMANDS

It also provides some basic diagnostics for the hardware.

- **CLOCK** - Displays the Clocks Date & Time for 5 seconds
- **TIME** - Displays the Time; May be set with "TIME HH:MM"
- **DATE** - Displays the Date; May be set with "DATE MM/DD/YY"
- **ERASE PRGM** - Erases the Flash Main Program
- **LOAD PRGM** - Loads the Flash Main Program – ASCII transfer
- **LOAD XMODEM** - Loads the Flash Main Program – Xmodem-1k transfer
- **RUN** - Runs the Flash Main Program
- **BLANK** - Blank checks the Flash Memory
- **ID** - Displays the Flash Main Program Revision
- **VPP** - Displays the Measured Flash Programming Voltage
- **VPP ON** - Turns on the Flash Programming Voltage
- **VPP OFF** - Turns off the Flash Programming Voltage
- **NET ON** - Turns the 485 Network On
- **NET OFF** - Turns the 485 Network Off
- **DIAG** - Starts the Diagnostic Test
- **TST DSW** - Returns the State of the Dip Switches
- **DISP485** - Diagnostic that Displays the RS-485 Port Communications
- **CLS** - Clears the Terminal Screen
- **WD** - Stops the Internal Watchdog
- **"?"** - Displays the List of Valid Commands

B-3 UPDATING THE FLASH FIRMWARE.

The Bootloader firmware is used to update the Flash firmware. Firmware updates can be uploaded via the RS-232 configuration port at 9600 baud (N, 8, 1). Connect a terminal emulator to the configuration port at 9600, N, 8, 1.

To start the update process, wait for the ten second delay window during power up and press any key to stop the Flash Main Program from executing. Or if the Flash Main Program is already running, type "**EX**" to exit.

The Flash Main Program must be erased before an upload can be preformed. To erase the code, type the "**ERASE PRGM**" command. After a second or so, the screen will display "**OK**".

Next, type the "**LOAD XMODEM**" command. This will upload the new firmware file using X-Modem-1k protocol. The file must be binary with a .bin extension.

After the file has been uploaded, enter the "**RUN**" command, or power down the LD5000 and then turn it back on.

APPENDIX C: 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 LD5000 LCD to the reference map to verify that the LD5000 displays the correct leak location.
4) Dry the cable and verify that the LD5000 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 LD5000 returns to normal.

Monitor the cable current monthly to verify that the cable is not being contaminated. The LD5000 will alarm on cable contamination if the contamination is excessive.

1) From the LD5000 display, press the **"Enter"** key until the cable current is displayed.
2) Be sure the cable current is less than 25uA. If the cable current is greater than 25uA, RLE recommends troubleshooting the cable to determine which cable is contaminated. The contaminated cable should be removed, cleaned, retested and reinstalled.

APPENDIX D: TROUBLESHOOTING

Trouble	Action
Control Panel will not Power Up	1) First verify the power on switch is in the on position. 2) Check with a DVOM (multi-meter) for AC input power on the lower right and terminal block. Voltage should between 110VAC and 120VAC. If no AC power is present at terminal block, check the circuit (breaker) the LD5000 control panel is powered by. If voltage is present, go to step 3. 3) Check for 24 VDC at terminal block TB1 pins 2 and 3. If no voltage is present across these pins, the internal power supply has failed. Contact RLE Technologies for replacement. If voltage is present and no LED's are illuminated, contact RLE Technologies for further troubleshooting.
Unit Powers Up without Displaying Characters on LCD	1) Open the front door and verify that the red/black supply wires are connected to TB1 on the display board (LCD panel). 2) Check the R2 contrast Potentiometer located on the top middle section of the display board. The dial should be turned clockwise until bottomed out. If the display is still not working, go to step 3. 3) Check the power on LED located to the left of the R2 contrast Potentiometer. If the DS1 power LED is illuminated but no read out is on the LCD, contact RLE Technologies for further support. If the DS1 power on LED Is not illuminated check for power with a DVM at TB1 pins 2 and 3. Voltage should be 24VDC +/- 3 VDC. If no voltage is present there may be damage to the control wiring, contact RLE Technologies for further support. If voltage is present at terminal block, contact RLE Technologies for a replacement board.
Cable Break Alarm	1) Power down the control panel and verify that the leader cable from the water leak detection cable run is plugged into terminal block TB2. 2) Verify that the end-of-line terminator is installed on the end of the orange sense cable run. If present at the end of the cable run, go to step 3. 3) Remove the end-of-line 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 water leak detection cable. Start moving the end-of-line terminator to the end of each section of water leak detection 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 TB2 from the logic control board. Remove the four conductors from the leader cable wire going into the four pin 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 TB2. Wiring color code should be as follows from left to right: White, Black, Green and Red. 2) Go into calibrate in the setup menu on the LCD display. Enter the total footage of sense cable (orange) on the system and calibrate. 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 from the end of the sense cable. Disconnect the first section of cable from the LD5000 control panel, where it joins to the second section of cable. Install the End-of-Line terminator at the end of the first section of sense 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 sense cable. If the leak is calculated correctly, remove the end-of-line terminator; reconnect the sense 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, please contact RLE Technologies for support.
Cable Contamination Alarm Unit Displays: "Cable Contaminated @ XXXX Ft"	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 LD5000 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 E: TECHNICAL SPECIFICATIONS

Power	85-264VAC @ 500mA max, 50/60Hz
Inputs	
Water Leak Detection Cable	Supplied with 15’ (4.57m) leader cable
Maximum Length	5,000’ (1,524m)
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	20-3600sec, software adjustable in 10sec increments; ±2sec
Outputs	
Analog	4-20mA Loop Powered, 18-36VDC, R_L = 500Ω max.
Relay	2 Form C Leak Relays, 2 Form C Cable Break Relays; 1A @ 24VDC, 0.5A resistive @ 120VAC; configurable for supervised or non-supervised, latched or non-latched
Communications Ports	
RS-232	1200, 2400, 9600 or 19200 baud (selectable); No parity, 8 data bits, 1 stop bit
RS-485	1200, 2400, 9600 or 19200 baud (selectable); No parity, 8 data bits, 1 stop bit
Protocols	
Terminal Emulation (RS-232)	VT100 compatible
Modbus (RS-485)	Slave; RTU Mode; Supports function codes 03, 04, 06 and 16
Alarm Notification	
Audible Alarm	85DBA @ 2’ (0.6m); re-sound 0-999min
Logging Capabilities	
Event Log	Last 512 events
Trend Log	Cable current level every day, for the last 288 days
Login Security	
Terminal Emulation Access	1 Administrator (password for configuration)
Display Access	1 Administrator (password for configuration, no password required to view panel status)
Front Panel Interface	
Display	Text, 4x20 character backlit LCD, 0.60” (15.24mm) character height, contrast adjustment
Push Buttons	+, -, right, left, enter, escape
LED Indicators	1 bi-color Power/Status (green=power on, red=alarm)
Operating Environment	
Temperature	32° to 122°F (0° to 50°C)
Humidity	5% to 95% RH, non-condensing
Altitude	10,000’ (3,048 meters) max.
Storage Environment	-4° to 158°F (-20° to 70°C)
Dimensions	12.0”W x 14.0”H x 4.0”D (305mmW x 356mmH x 101mmD)
Weight	12 lbs. (5.45kg)
Mounting	Vertical wall mount or Vertical flush mount (kit optional)
Certifications	CE; ETL listed: conforms to UL STD 61010A-1, EN STD 61010-1; CAN/CSA C22.2 STD NO. 1010-02

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