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User's Guide

High Power Laser Diode Controller Mainframe
LDC-3926



ILX Lightwave®
A Newport Corporation Brand

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SAFETY AND WARRANTY INFORMATION

The Safety and Warranty Information section provides details about cautionary symbols used in the manual, safety markings used on the instrument, and information about the Warranty including Customer Service contact information.

Safety Information and the Manual

Throughout this manual, you will see the words *Caution* and *Warning* indicating potentially dangerous or hazardous situations which, if not avoided, could result in death, serious or minor injury, or damage to the product. Specifically:



Caution indicates a potentially hazardous situation which can result in minor or moderate injury or damage to the product or equipment.



Warning indicates a potentially dangerous situation which can result in serious injury or death.



Visible and/or invisible laser radiation. Avoid direct exposure to the beam.

General Safety Considerations

If any of the following conditions exist, or are even suspected, do not use the instrument until safe operation can be verified by trained service personnel:

- Visible damage
- Severe transport stress
- Prolonged storage under adverse conditions
- Failure to perform intended measurements or functions

If necessary, return the instrument to ILX Lightwave, or authorized local ILX Lightwave distributor, for service or repair to ensure that safety features are maintained (see the contact information on page xii).

All instruments returned to ILX Lightwave are required to have a Return Authorization Number assigned by an official representative of ILX Lightwave Corporation. See Returning an Instrument on page xi for more information.

SAFETY SYMBOLS

This section describes the safety symbols and classifications.

Technical specifications including electrical ratings and weight are included within the manual. See the Table of Contents to locate the specifications and other product information. The following classifications are standard across all ILX Lightwave products:

- Indoor use only
- Ordinary Protection: This product is NOT protected against the harmful ingress of moisture.
- Class I Equipment (grounded type)
- Pollution Degree II
- Installation (overvoltage) Category II for transient overvoltages
- Maximum Relative Humidity: <80% RH, non-condensing
- Operating temperature range of 0 ^{o}C to 40 ^{o}C
- Storage and transportation temperature of -40 ^{o}C to 70 ^{o}C
- Maximum altitude: 3000 m (9843 ft)
- This equipment is suitable for continuous operation.

Safety Marking Symbols

This section provides a description of the safety marking symbols that appear on the instrument. These symbols provide information about potentially dangerous situations which can result in death, injury, or damage to the instrument and other components.

 Caution, refer to manual	 Earth ground Terminal	 Alternating current	 Visible and/or invisible laser radiation
 Caution, risk of electric shock	 Protective Conductor Terminal	 Caution, hot surface	 Frame or chassis Terminal
 or (I) On: In position of a bistable push control. The slash (I) only denotes that mains are on.		 or (O) Off: Out position of a bistable push control. The circle (O) only denotes that mains are off.	

WARRANTY

ILX LIGHTWAVE CORPORATION warrants this instrument to be free from defects in material and workmanship for a period of one year from date of shipment. During the warranty period, ILX will repair or replace the unit, at our option, without charge.

Limitations

This warranty does not apply to fuses, lamps, defects caused by abuse, modifications, or to use of the product for which it was not intended**.**

This warranty is in lieu of all other warranties, expressed or implied, including any implied warranty of merchantability or fitness for any particular purpose. ILX Lightwave Corporation shall not be liable for any incidental, special, or consequential damages**.**

If a problem occurs, please contact ILX Lightwave Corporation with the instrument's serial number, and thoroughly describe the nature of the problem.

Returning an Instrument

If an instrument is to be shipped to ILX Lightwave for repair or service, be sure to:

1. Obtain a Return Authorization number (RA) from ILX Customer Service.
2. Attach a tag to the instrument identifying the owner and indicating the required service or repair. Include the instrument serial number from the rear panel of the instrument.
3. Attach the anti-static protective caps that were shipped with the instrument and place the instrument in a protective anti-static bag.
4. Place the instrument in the original packing container with at least 3 inches (7. 5 cm) of compressible packaging material. **Shipping damage is not covered by this warranty.**
5. Secure the packing box with fiber reinforced strapping tape or metal bands.
6. Send the instrument, transportation pre-paid, to ILX Lightwave. Clearly write the return authorization number on the outside of the box and on the shipping paperwork. ILX Lightwave recommends you insure the shipment.

If the original shipping container is not available, place your instrument in a container with at least 3 inches (7.5 cm) of compressible packaging material on all sides.

Repairs are made and the instrument returned transportation pre-paid. Repairs are warranted for the remainder of the original warranty or for 90 days, whichever is greater.

Claims for Shipping Damage

When you receive the instrument, inspect it immediately for any damage or shortages on the packing list. If the instrument is damaged, file a claim with the carrier. The factory will supply you with a quotation for estimated costs of repair. You must negotiate and settle with the carrier for the amount of damage.

Comments, Suggestions, and Problems

To ensure that you get the most out of your ILX Lightwave product, we ask that you direct any product operation or service related questions or comments to ILX Lightwave Customer Support. You may contact us in whatever way is most convenient.

In the United States:

Phone . . . . . (800) 459-9459 or (406) 586-1244

Fax . . . . . (406) 586-9405

Online: . . . . . http://ilx.custhelp.com

Email: . . . . . support@ilxlightwave.com

Or mail to:

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P. O. Box 6310
Bozeman, Montana, U.S.A 59771
www.ilxlightwave.com

In Europe:

Optical Test and Calibration Ltd.
Listerhills Science Park
Bradford, BD7 1HR United Kingdom
Phone: (44) 1274 393857
Fax: (44) 1274 393336
Online: www.otc.co.uk
Email: sales@otc.co.uk

In Japan:

Kyosai Technos
424, Shimo-Ongata-Machi
Hachioji-Shi
Tokyo, 192-0154 Japan
Phone: (81) 426 521 388
Fax: (81) 426 513 270

In China:

ETSC Technologies Co.
9/F Building 1
SBI Street
Dongxin Road
East Lake High-Tech Development Zone
Wuhan, Hubei, 430074 PRC China
Phone: (86) 27 8717 0152; (86) 27 8741 2681; (86) 27 8780 7925
Fax: (86) 27 8780 7133
Online: www.etsc-tech.com
Email: sales@etsc-tech.com

In China:

Kyosai Technos
3F Bldg G, No.21 Changjiang Road, Wuxi
National Hi-Tech Development Zone
Jiangsu, P.R. China
Phone: (86) 510 522 1707
Fax: (86) 510 522 1679
Email: ilx-service-china@kyosaitec.co.jp

When you contact us, please have the following information:

Model Number: _____

Serial Number: _____

End-user Name: _____

Company: _____

Phone: _____

Fax: _____

Description of what is connected to the ILX Lightwave instrument: _____

Description of the problem: _____

If ILX Lightwave determines that a return to the factory is necessary, you are issued a Return Authorization (RA) number. Please mark this number on the outside of the shipping box.

You or your shipping service are responsible for any shipping damage when returning the instrument to ILX Lightwave; ILX recommends you insure the shipment. If the original shipping container is not available, place your instrument in a container with at least 3 inches (7.5 cm) of compressible packaging material on all sides.

We look forward to serving you even better in the future!

CHAPTER 1

INTRODUCTION AND SPECIFICATIONS

Chapter 1 is an introduction to the LDC-3926 Laser Diode Controller. It contains unpacking information, installation instructions, and basic instruction about how to apply power. It also contains some maintenance information and specifications.

WARNING

If any of the following symptoms exist, or are even suspected, remove the LDC-3926 from service. Do not use the LDC-3926 until safe operation can be verified by trained service personnel.

Visible damage

Severe transport stress

Prolonged storage under adverse conditions

Failure to perform intended measurements or functions

If necessary, return the instrument to ILX Lightwave for service and repair to ensure that safety features are maintained.

Product Overview

The LDC-3926 Laser Diode Controller mainframe holds up to 16 modules for controlling laser diode current and temperature, with the capability of providing 6 A of current per module bay. The current-source modules provide high stability output with fully redundant current limits and multiple laser protection features. The temperature control modules are compatible with most thermistor-type temperature sensors and TEC modules to deliver precise laser temperature control over a wide range of temperatures.

The LDC-3926 accepts all LDC-3908, LDC-3916 and LDC-3926 modules.

Initial Inspection

Visually inspect the mainframe and its packaging for damage or signs of mishandling. Verify that the power cord was shipped with the mainframe.

When unpacking the instrument, make sure to save the packaging and the protective Electro Static Discharge (ESD) caps on the rear of the instrument, in case you have to return the instrument to ILX Lightwave. Shipping damage is not covered under the standard instrument warranty.

Installing the LDC-3926

This section provides information about the necessary requirements to install the LDC-3926 and how to begin operating the instrument.

Grounding Requirements

The LDC-3926 comes with a three-conductor AC power cable. The power cable must be plugged into an approved three-contact electrical outlet or used with a three-contact to two-contact adaptor with the grounding wire connected to an electrical ground (safety ground). The power cord connector and power cable meet IEC safety standards.

WARNING

The instrument must be connected to properly earth-grounded receptacles.

AC Line Power Requirements

You can operate the mainframe from a single-phase power source delivering nominal line voltages of 100, 120, 200-240 VAC (all values RMS) from 50 to 60 Hz. The line power voltage can vary ±10%. The instrument must be connected to properly earth-grounded receptacles.

The LDC-3926 is factory configured with a 20 A mains fuse for regions or locations with a nominal line voltage of 100 VAC and 15 A mains fuse for regions with nominal line voltages of 120, 200-240 VAC. The instrument must be reconfigured with the correct fusing if it is moved to a region or physical location with different nominal supply voltages than intended at shipment. Contact ILX Customer Service (see Comments, Suggestions, and Problems on page xii of the Safety and Warranty section for contact information) for more information.

CAUTION

At supply voltages below 110 volts, a fully-loaded LDC-3926 can approach 15 amps of current draw and compromise the safety limits of some AC line power sources.

Current draw increases as supply voltage drops. For example, an LDC-3926 that is fully-loaded with six-amp laser current source modules, consumes 1285 volt-amps with all modules running at 6.0 amps of output current. If line voltage is 90 volts, the instrument draws up to 14.78 amps; at 110 volts, the mainframe draws up to 11.68 amps.

RS-232 Connectors

The RS-232 interface consists of two 9-pin, D-sub connectors, located on the rear panel (see Figure 1.2 on page 4). The A connector is used to connect to the host computer with a standard straight-through cable. The B connector is not enabled at this time.

GPIB Connector

A total of 15 devices can be connected together on the same GPIB interface bus. The GPIB interface connector is located on the rear panel, to the left of the power input module (see Figure 1.2 on page 4). The 24-pin GPIB interface connector is tapered to ensure proper orientation. Finger tighten the two screws on the cable connector.

The cables have single male/female connectors on each end so that several cables can be stacked. This permits more than one cable to be attached to any one device. The maximum length of the GPIB cables must not exceed 20 meters (65 feet) total, or 2 meters (6.5 feet) per device.

The GPIB Address

The talk and listen addresses on the LDC-3926 are identical. The mainframe comes from the factory configured with the GPIB address set to 1. You can change the GPIB address locally (via the front panel). The procedure for changing the address is found in Changing the GPIB Address on page 23.

Tilt-Foot Adjustment

The LDC-3926 comes standard with folding front legs and two rear feet for use as a benchtop instrument. Extend the front legs to tilt the front panel upward, making it easier to read the vacuum fluorescent display.

Rack Mounting

The LDC-3926 can be mounted in a standard 19-inch rack with one of two available rack mounting kits. These kits contain support brackets that fasten to the inside of a rack enclosure to support the mainframe along each side. There are two kits available from ILX. Each kit comes with the necessary hardware, including fasteners and instructions for their use. Refer to the ILX Lightwave product catalogue or contact Customer Service (see page xii for contact information) for ordering information.

CAUTION

Do not rack mount instruments directly on top of one another. There must be at least a 1.75-inch (44 mm, 1 u) open space between instruments to ensure airflow for proper cooling. Make sure that all air-vents are open and free from obstruction.

Front and Back Panels

Figure 1.1 and Figure 1.2 show front and rear views of the instrument. The figures identify functional keypad groupings, rear panel connectors, and switches. Please refer to Chapter 2, Operations for operating fundamentals of the LDC-3926.

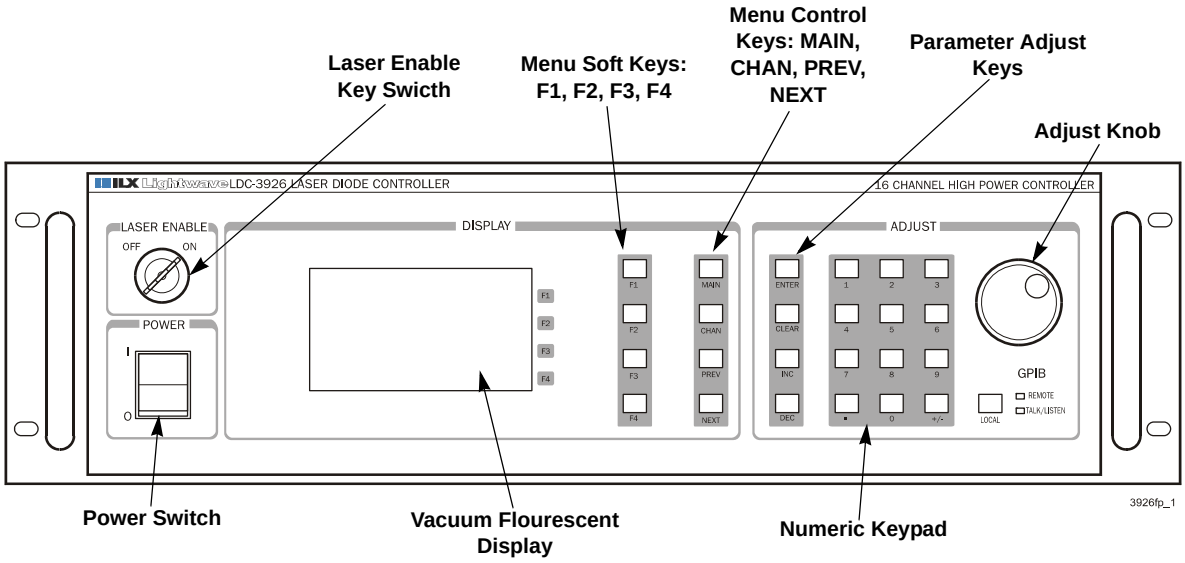


Figure 1.1 Front Panel

Only the 16 module bays are user-accessible. Do not attempt to remove the Microprocessor module or power module.

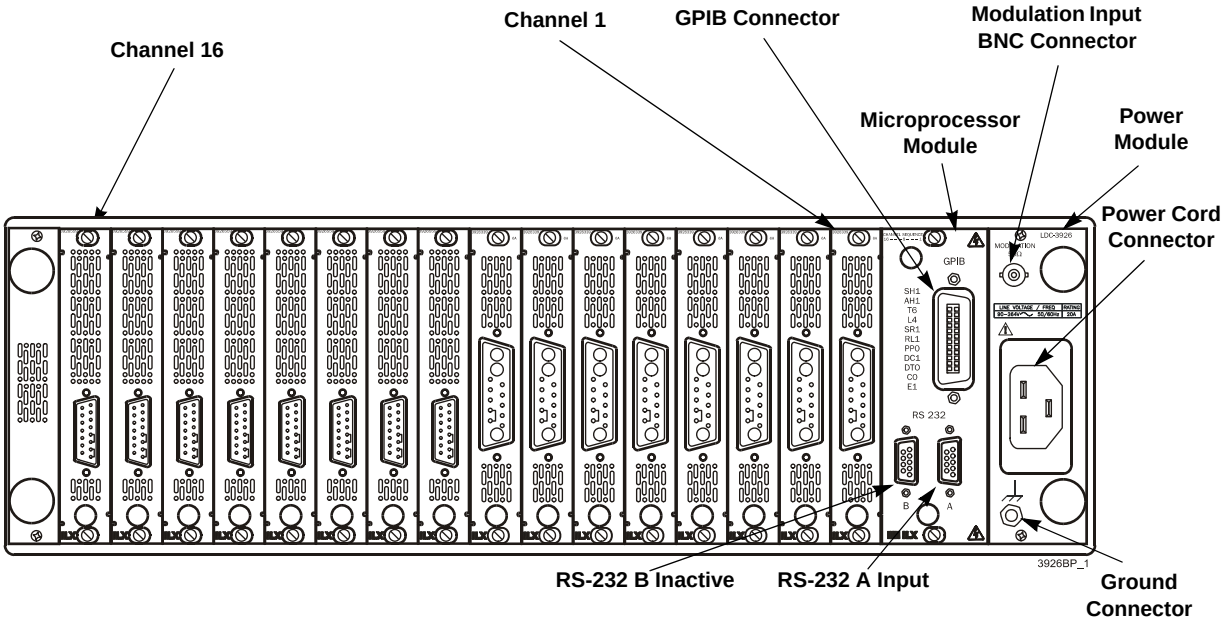


Figure 1.2 Mainframe Rear View

Specifications

The LDC-3926 is factory configured with a 20 A mains fuse for regions or locations with a nominal line voltage of 100 VAC and 15 A mains fuse for regions with nominal line voltages of 120, 200-240 VAC. The instrument must be reconfigured with the correct fusing if it is moved to a region or physical location with different nominal supply voltages than intended at shipment. Contact ILX Customer Service (see Comments, Suggestions, and Problems on page xii of the Safety and Warranty section for contact information) for more information.

WARNING

Potentially lethal voltages exist within the LDC-3926 Laser Diode Controller. To avoid electric shock, do not perform any maintenance on the instrument unless you are qualified to do so. Qualified service personnel are required to wear protective eyewear and anti-static wrist bands while working on the LDC-3926 Laser Diode Controller circuit boards. High voltages are present on and around the printed circuit boards.

Only the 16 module bays are user-accessible. Do not attempt to remove the Microprocessor module or power module.

Table 1.1 General Specifications

Specification	Description
Chassis Ground	4 mm Banana Jack
GPIB Connector	24-pin IEEE-488.2
RS-232 Interface connector	9-pin, D-connector
Power Requirements[1]	50 Hz to 60 Hz 100 VAC ±10%, 15 A 120 VAC ±10%, 12 A 200-240 VAC ±10%, 6 A
Size (H x W x D)	133 mm x 432 mm x 609 mm (5.25" x 17" x 24")
Weight (typical) Mainframe only With modules	 20 kg (44 lbs) 27 kg (59 lbs)
Operating Temperature	0 °C to 40 °C
Storage Temperature	-40 °C to +70 °C
Humidity[2]	20-85% non-condensing
Laser Safety Features	Keyswitch, Interlock, Output Delay: (Meets CDRH US21, CFR 1040.10)
Display	Vacuum Fluorescent 64 x 128 pixels 83 mm x 41 mm

1. All channels driving 6 amps.
2. Based on the vacuum fluorescent display specification.

CHAPTER 2

OPERATIONS

This chapter introduces you to the operation of the LDC-3926. It offers instructions for connecting your laser to the current source and temperature control modules and describes powering up the instrument. The chapter also provides a description of the front panel controls, including both display and adjust controls.

This chapter also provides a description of the LDC-3926 Menu Structure and has instructions about selecting each menu and performing the operations relevant to the menu selected.

Front Panel Controls

All key operating parameters for the laser and temperature control modules can be set, adjusted, and displayed through established menus. See the respective module manual for further information on each module.

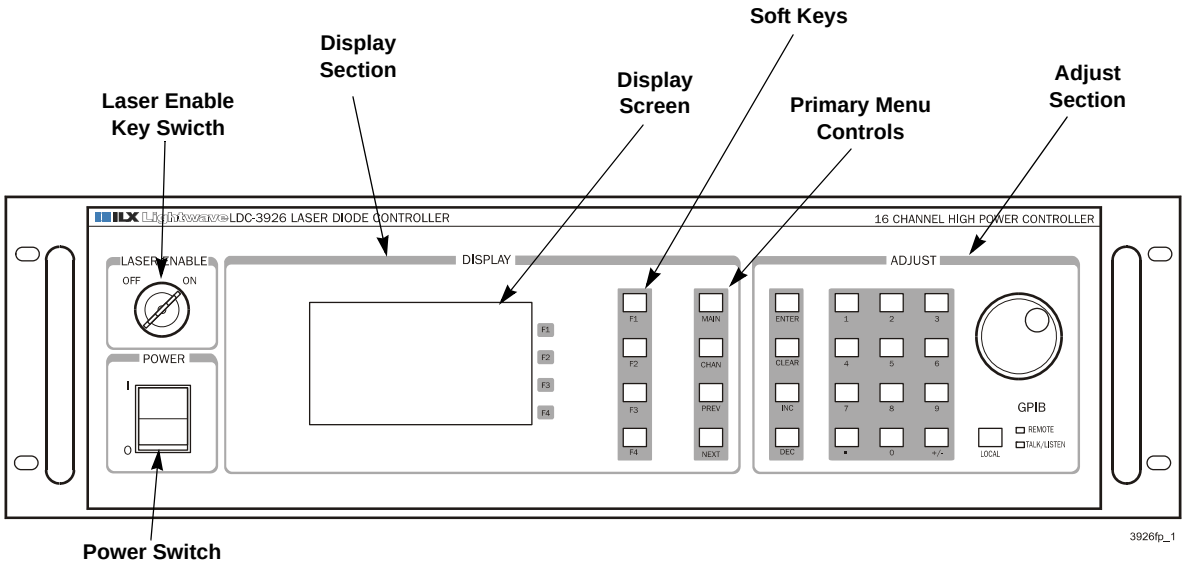


Figure 2.1 Front Panel

Display Section Controls

All key operating parameters for the LAS (laser) and TEC modules can be set, adjusted, and displayed through established menus. (See the respective module manual for further information on each module.) The menus on the display are controlled by using the keys (pushbuttons) to the right of the display box. There are two kinds of keys, the hard keys and soft keys. The hard keys have only one function, while the function of the soft keys varies with each menu on the display.

Hard Keys

Enter the menu structure using one of the primary Menu Control keys. These keys provide direct access to the Main and Channel menus as well as movement within the screens used most often for instrument control. They are located in the second column to the right of the display window. They are labeled (from top to bottom): MAIN (for Main Menu), CHAN (Channel), PREV (Previous), and NEXT. Pressing the MAIN key provides direct access to the Main Instrument screen. The CHAN key provides direct access to the Channel screen, where the instrument displays channel information about operating parameters for the laser and TEC modules. The CHAN key also allows access to complete laser and TEC configuration screens. The PREV/NEXT keys move the cursor around the screen to select operating parameters only.

Soft Keys

The four keys closest to the display window are used as soft keys. They perform menu-specific functions within each menu. When you have accessed a menu, the soft key identification for this menu appears on the right side of the display, next to the corresponding key. Soft keys can be used to initiate another menu or to change/edit a parameter. For example, in the LAS section of the CHAN menu, the word *On* designates the state of the output. Pressing the associated soft key changes the state from On to Off. If the LAS soft key is pressed, the laser setup menu appears.

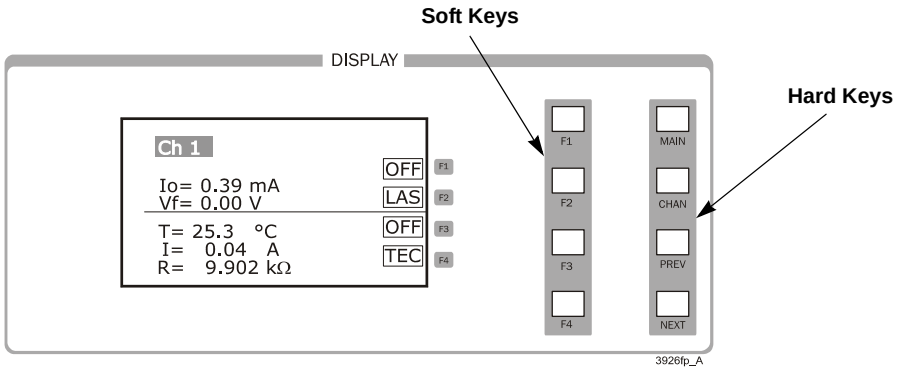


Figure 2.2 Display Section

Adjust Section Controls

The Adjust section of the front panel provides various means of entering or modifying instrument parameters. These include a 12-key numeric keypad, a rotary knob (digital encoder), and increment and decrement keys.

Numeric Keypad

The numeric keypad provides direct entry of values for set-points and numeric data. When an editable field is highlighted or selected from the menu screens, you can type the desired value using the keypad, then accept by pressing the Enter key within five seconds. If an incorrect value is entered, press the CLEAR key to reset the field to its previous value. The keypad supports decimal entry as well as negative values for some constants and temperature set-points.

Adjust Knob

When the cursor in a menu is positioned on a parameter that can be adjusted, the Adjust Knob is used to increase or decrease the parameter values. When the Adjust Knob is turned, the new values are updated automatically. The Adjust Knob can be disabled from the System Configuration menu.

Increment and Decrement Keys

The Increment and Decrement keys are used, in addition to the Adjust Knob, to adjust values on any of the screens where a numeric value is required. Holding down either of the keys increases or

decreases the number via a time-based acceleration algorithm. When the Arrow keys are pressed, the new values are updated automatically.

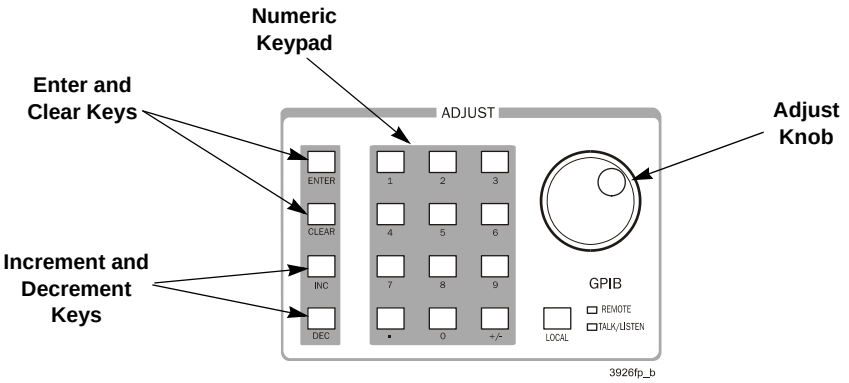


Figure 2.3 Adjust Section

Applying Power to the Mainframe

To turn on the LDC-3926, push the button in the Power section of the front panel to change the setting from zero (0) to one (1). This initiates the Power-on sequence. If the LDC-3926 does not appear to turn on, verify that it is connected to line power.

The Power On Sequence

When power is applied to the LDC-3926, the following takes place:

- The initialization screen is displayed, showing the company name and logo, the name of instrument, and firmware version.
- A self test is performed to ensure that the mainframe processor is communicating with the processor(s) of any module(s) connected to the mainframe and identifying which module model is present. After this test, the instrument is ready to operate and is configured to the state it was in when the power was last shut off.

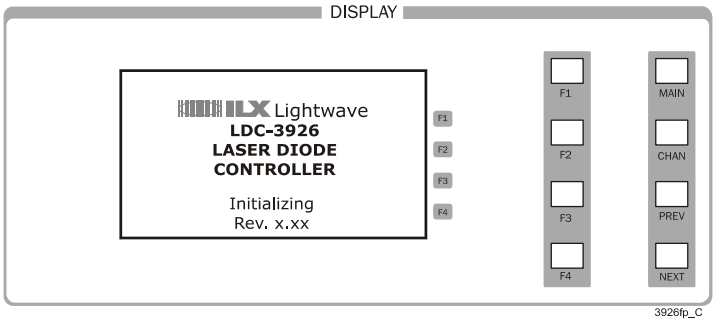


Figure 2.4 Initialization Screen

The Power On State

The controller defaults to the Channel menu and the first channel with a module when power is applied. It is configured to the state when power was last shut off, and according to the type of module in each bay. You can choose to clear the last saved state by recalling the default values. These values are stored in BINS that you can use to save or recall configurations (See Save and Recall on page 15). BIN 0 contains all of the default configurations. The default configuration information for each module is found in the each module instruction manual.

> **Note:** If the instrument cannot successfully complete the power on test, that is, cannot identify a module (or modules) inserted into the mainframe, that module (or modules) are not identified in the Status Screen. Power down the instrument and check if the modules are correctly seated and fastened to the mainframe. If you continue to experience power-up problems, power down the instrument and contact an ILX Lightwave Customer Service Representative.

Laser Enable Key Switch

The LDC-3926 is equipped with a laser enable key switch. This ensures that the laser current is turned on only if the key is inserted and in the On position.

Laser current sources installed in the LDC-3926 have remote interlock capability. The interlock capability allows you to connect the interlock circuit to an external switch for safety. If the interlock is removed, the laser current output is disabled. Refer to the appropriate laser module User's Guide for details about the interlock function.

Using the Menu Structure

This section describes the menus, how they are structured, and how to navigate through them.

Main Menu

The Main menu is the primary set-up and configuration screen for the instrument. Pressing the corresponding soft keys to the right of the display leads to Channel selection, System configuration, All Channel control features, and system Status displays. It also allows a soft key path directly back to the Channel menu.

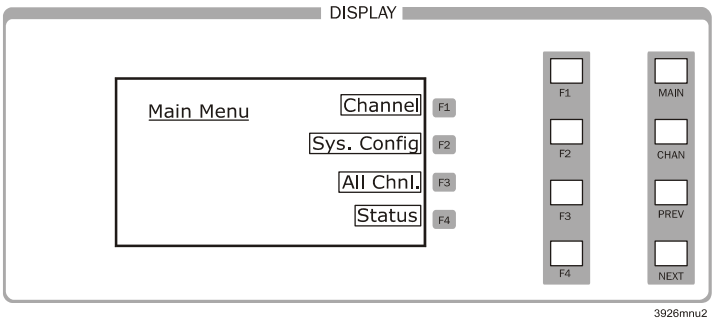


Figure 2.5 Main Menu

Channel Menu

The Channel menu provides standard user information, along with soft-key assignments for configuring a module further or for turning the output On or Off. Pressing the CHAN key allows you to jump directly to the default Channel menu. The channel number is changed by rotating the Adjust Knob or pressing the INC/DEC keys. Pressing the LAS or TEC soft key calls up the menu for editing Laser or TEC control parameters for each of the active modules.

The output state for each module is changed by pressing the associated soft key, which is accompanied by a configurable audible tone. When the output is on, the screen indicates measured laser output current and forward voltage, measured temperature, thermoelectric module current, sensor resistance, or other measurements depending on the module installed.

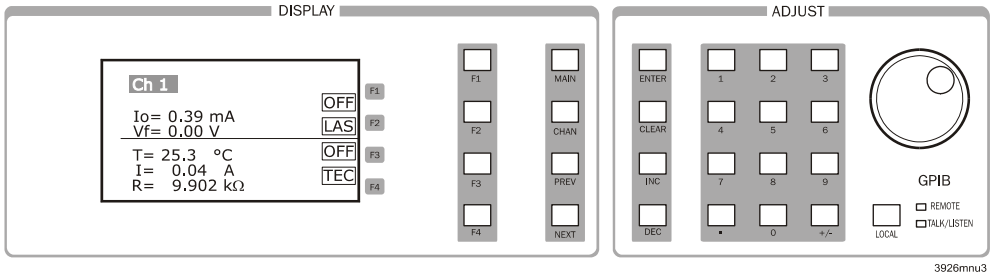


Figure 2.6 Channel Menu

System Configuration

The System Configuration menu is accessed from the Main menu. Pressing the appropriate soft key provides access to:

- The Communications Configuration menu (Comm.) for GPIB and RS-232 setup
- Display Configuration (Display) menu for interface settings
- Calibration (Cal.) menu for module calibration
- Save/Recall (Sav/Rec) menu for system-wide parameter storage and retrieval

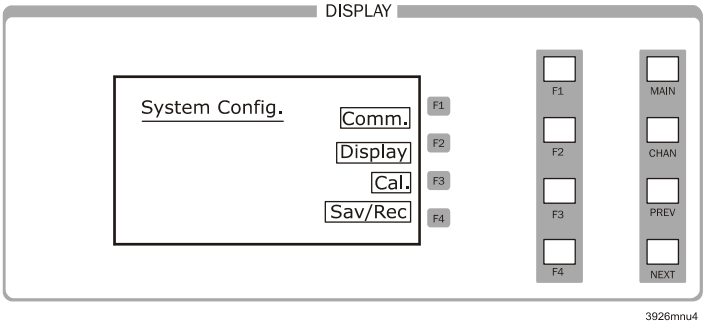


Figure 2.7 System Configuration Menu

Communications Configuration

To operate your LDC-3926 remotely, via the General Purpose Information Bus (GPIB) or through a serial RS-232 link, select **Comm.** from the System Configuration menu to access the Config. Comm menu. The Config. Comm menu allows you to view and change the GPIB address and the RS-232 baud rate. Press the Up soft key (F3) to return to the Sys. Config. menu. See Chapter 3, Remote Operations, or your module manual, for complete information on remote control operation.

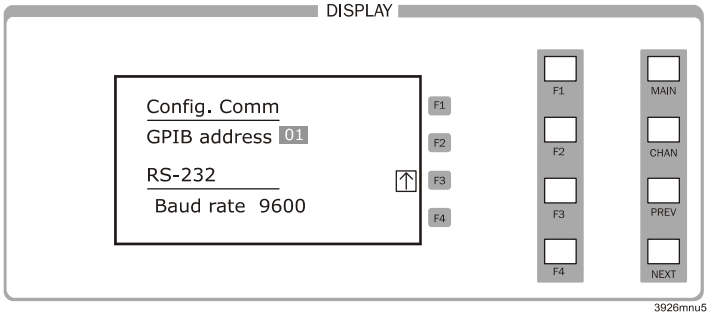


Figure 2.8 Communications Configuration Menu

Display Configuration

Selecting Display from the System Configuration menu accesses the Display Config. menu. Here, you can adjust the display brightness, initiate a display self-test, enable or disable an audible tone whenever pushbuttons are pressed, and enable or disable the Adjust Knob. Use the PREV and NEXT keys to select the desired function. Pressing the Up Arrow soft key (F3) returns you to the previous menu.

You can adjust the display brightness in four levels. A bar graph is displayed next to the Bright enunciator. One, two, three or no sections of the bar graph are back-lit, indicating the level of display brightness. You can adjust the brightness with the Adjust Knob or the INC/DEC keys. Display brightness increases from right to left. Each step increases the brightness 12.5% from minimum to maximum brightness.

If there is a problem with the graphic display, you can inititiate a display self-test from this menu using the Display Test function. Select Display Test function using the PREV/NEXT keys, then use the Adjust Knob or the INC/DEC keys to select "Yes". Press **ENTER** to activate the test. The display is instructed to light all pixels; perform a visual inspection of the display to ensure that all of the pixels are illuminated. If you find a display problem, contact the Customer Service Department of ILX Lightwave (see Comments, Suggestions, and Problems on page xii for more information). Press the MAIN or CHAN keys to return to those specific menus or press any other key to return to the previous menu.

The Audible Beep function allows you to enable or disable an audible tone when any key (either hard or soft key) is pressed or when the Adjust knob increments or decrements a value. The On or Off enunciator (depending on the current state of this function) is highlighted when selected. Use the Adjust Knob or INC/DEC keys to turn the tone on or off. You must press Enter after making the desired selection to execute the change.

You can enable or disable the Adjust Knob from the Display Configuration menu. Once the Lockout dial function is selected, the On or Off enunciator is highlighted. Use the Adjust Knob or INC/DEC

keys to turn the Adjust Knob on or off. Press **ENTER** after making the desired selection to execute the change.

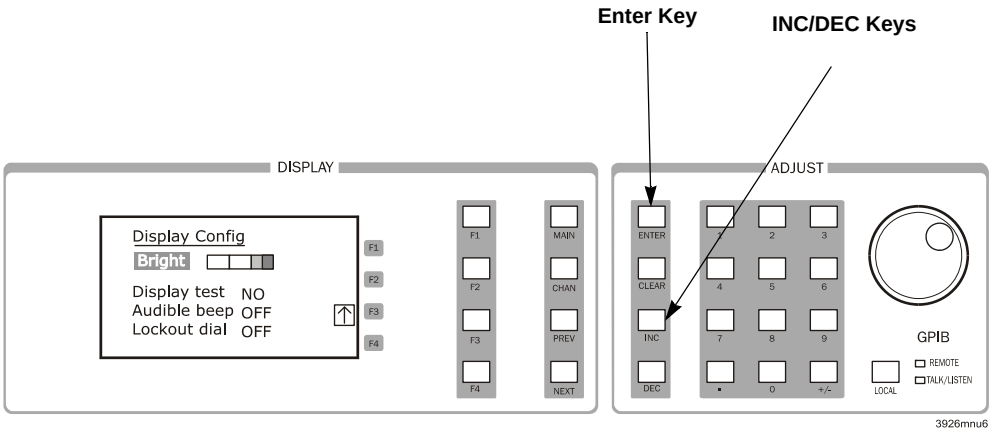


Figure 2.9 Display Configuration Menu

Calibration

The Calibration Menu allows you to calibrate, from the front panel, all Laser and TEC functions for each of the modules loaded into the LDC-3926. Remote calibration through the IEEE488.2 GPIB or serial RS-232 interface is provided as well.

ILX recommends that the modules be calibrated every 12 months, or whenever performance verification indicates that calibration is necessary, such as any difference between the displayed laser current and the actual laser current. Calibrate the modules under laboratory conditions; typically, 23 ^{o}C (±3.0 ^{o}C). If possible, calibrate the LDC-3926 at its intended use temperature (if this is within the specified operating temperature range of 0 ^{o}C to 40 ^{o}C). For specific calibration information, see the module instruction manual.

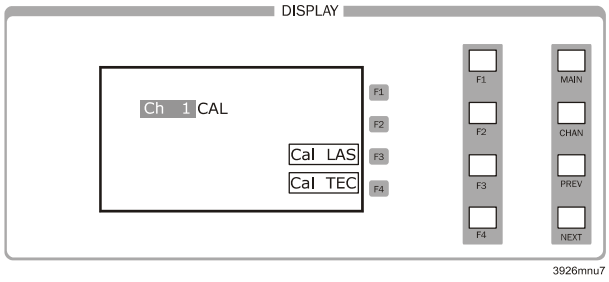


Figure 2.10 Calibration Menu

Save and Recall

The Save and Recall feature is used to alternate between particular instrument configurations. The Save feature allows you to store front panel settings for any given configuration. These settings, which are stored in one of ten memory bins, are retrieved at any time with the Recall function. This saves setup time and reduces the chance of setup error for tests that are repeated periodically. See the relevant module manual for information on instrument configuration setup.

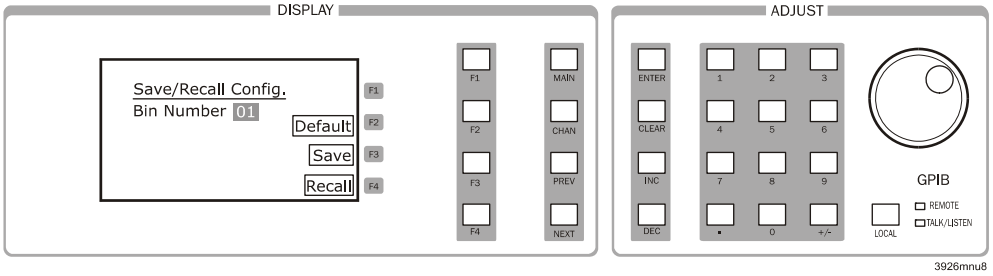


Figure 2.11 Save and Recall Configuration Menu

To save a configuration:

1. Select **Sav/Rec** from the System Configuration menu to access the Save/Recall Config. menu.
2. Select the desired bin number using the Adjust Knob or the INC/DEC keys.
3. Press the Save soft key to save the configuration.

The instrument saves/recalls up to 16 channel settings in a bin location. Each channel can be configured differently and saved or recalled from a bin for future use. A module must be present within the mainframe to save the settings. To recall a configuration:

1. Select the desired bin number using the Adjust Knob or the INC/DEC keys.
2. Press the Recall soft key.
3. To restore the factory default settings, press the **Default** soft key. Bin 0 contains the factory default settings.

   Note: A checksum from each module is used to ensure the recalled setup matches the user's expectation (in case a module was changed or fails to restore properly). A warning is displayed if a checksum error is found.

See Chapter 3, Remote Operations for remote execution of the Save and Recall functions.

All Channel Menu

The All Channel menu allows you to configure all 16 channels of the instrument (or any number of channels from 2 to 16) simultaneously. Once the modules are configured, all of the lasers and/or TEC modules can be turned on simultaneously by pressing the ON soft key. All of the modules must be the same model number for this feature to operate. See the specific module User's Guide for information about configuring the modules.

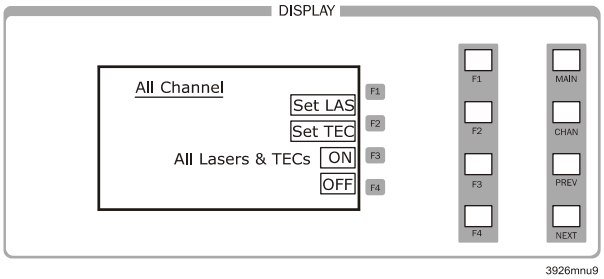


Figure 2.12 All Channel Menu

Status Menu

The Status menu allows you to view information about module status, adjust setpoints, turn on outputs and view module error codes. There are two status pages to choose from:

- The Summary status page lists all channels, up to sixteen, present in the mainframe and the condition of the output;
- The Status page lists four channels at a time, totaling up to sixteen.

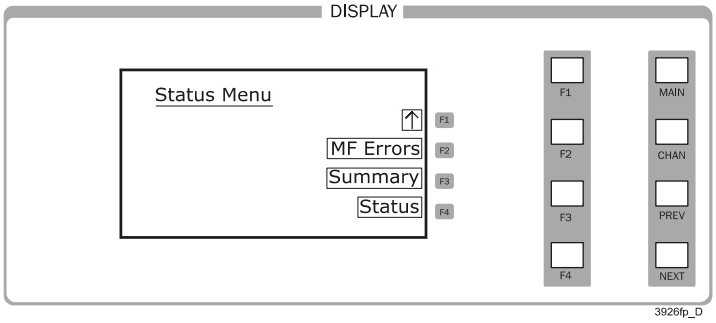


Figure 2.13 Status Menu

Displaying the Summary Screen

From the Status menu, press the Summary soft key (F3) to display the Summary page. Next to each channel number is a channel designation LAS or TEC, depending on the module. If the designation is highlighted, the output is turned on for that respective channel. Blanks indicate that there is no module present in that bay.

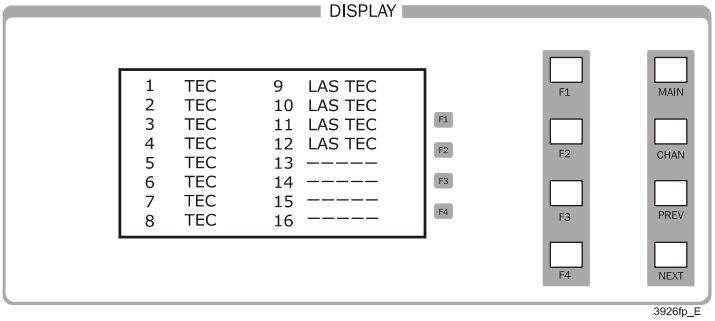


Figure 2.14 Summary Screen

Displaying the Status Screen

The Status screen provides instant access to multiple channel status information. You can also change laser and TEC setpoints and turn on the laser or TEC from the status screen.

1 Press the Status soft key (F4) from the Status menu. Multiple channel status information is displayed.

Note: With the PREV/NEXT keys, you can scroll through all of the modules loaded, one channel at a time.

2 To change the laser or TEC setpoint:

2a Press **F1** to highlight the top line and change it from measurement to setpoint.

Pressing F1 cycles through the values.

2b Adjust the setpoint using the Adjust Knob or numeric keypad.

3 Press **F1** again to highlight and change the second line from measurement to setpoint.

4 Adjust the setpoint using the Adjust Knob or numeric keypad.

5 Press **F1** again to highlight first-line Off or On. Use the Adjust Knob or INC/DEC keys to turn the channel output On or Off.

6 Press **F1** again to highlight and adjust the next the next value (if applicable to the module).

7 Press the corresponding softkeys (F2, F3, and F4) to adjust the other displayed channels.

8 Press **MAIN** or **CHAN** to exit the Status screen.

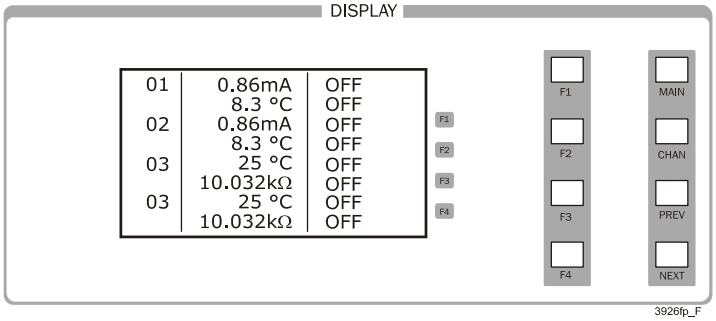


Figure 2.15 Status Screen

The default measurements shown on the Status Screen are configureable by sending a GPIB command. These two lines can be configured to display any laser or TEC measurement by sending the appropriate GPIB command. For example, sending the command STATMENU:LINE2:IPD displays the photodiode monitor current on the second line. See the Command Reference chapter of the module User's Guide for more information.

Modulating the Laser Current Sources

The LDC-3926 allows a modulated signal to be superimposed on the laser current of any or all current source modules. The modulation connector (BNC) on the back panel is the input for the modulated signal.

Note: The modulation input is terminated into 50 Ω.

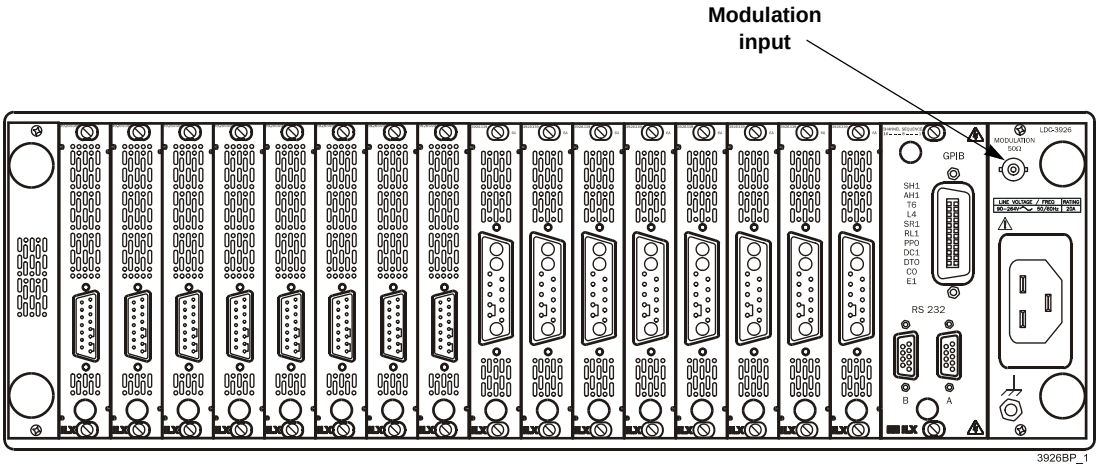


Figure 2.16 LDC-3926 Back Panel

Each module uses an instrumentation amplifier to buffer the modulation signal. This signal may be applied to more than one module (channel) at a time.

Laser protection is assured, even while modulating, via the current limit parameter set on each individual module. Refer to the appropriate module manual for details on current limit settings and laser diode protection.

The allowable bandwidth of the modulated signal, defined as the 3 dB roll-off point, depends on the current source module used and the mode (constant current: low bandwidth, high bandwidth). See the laser current source specifications in the appropriate module User's Guide for external analog modulation bandwidth specifications.

Modulation Setup

1. Press **CHAN** or press the Channel soft key from the Main menu to view the channel menu.
2. Press the LAS softkey to view the laser setup screen.
3. Press **F4**, the down arrow softkey, until LAS p.3 (laser page 3) is displayed.
4. Press PREV or NEXT to highlight the modulation toggle.
5. Using the the Adjust knob or INC/DEC keys, turn on or turn off the modulation.

CHAPTER 3

REMOTE OPERATIONS

GPIB (General Purpose Interface Bus) is the common name for *ANSI/IEEE Standard 488.2-1987*, an industry standard for interconnecting test instruments in a system. Everything you can do from the front panel can also be done remotely, and in some cases, with more flexibility. For instance, in remote mode you have access to commands for functions not found on the front panel. The following sections show you the fundamentals of operating your LDC-3926 Laser Diode Controller remotely through the General Purpose Interface Bus (GPIB) and RS-232 interfaces.

GPIB Configuration

Before you can operate the LDC-3926 from a remote location with the GPIB, you need to know its GPIB address. The following sections describe reading and changing the GPIB address of the LDC-3926.

Data and Interface Messages

GPIB devices communicate with each other by sending data and interface messages. Data contains device-specific information such as programming instructions, measurement results, and instrument status. Each device has an address number, and ignores all data traffic not addressed to it. Depending on its content, data is often called a "device dependent message" or a "device dependent command". Interface messages manage the bus, with functions such as initializing the bus and addressing or unaddressing devices. In addition, some individual bus lines are designated for this purpose.

Talkers, Listeners, and Controllers

Every GPIB system consists of one or more "talkers" and "listeners", and at least one controller. Talkers supply data. Listeners accept data. A system can consist of simply a talker and listener, for example a meter connected to a datalogger or chart recorder. Controllers designate talkers and listeners. A controller is necessary when the active talkers or listeners must be changed. When the controller is a computer, it often also designates itself as a listener so it can collect data from designated talkers.

If there is more than one controller, only one is the Controller In Charge (CIC). Control is passed from one controller to another. In a multiple controller system, there can be one System Controller capable of asserting control (becoming CIC).

GPIB Cable Connections

Standard GPIB connectors can be linked together (daisy-chained), allowing you to configure the system linearly or in a star configuration.

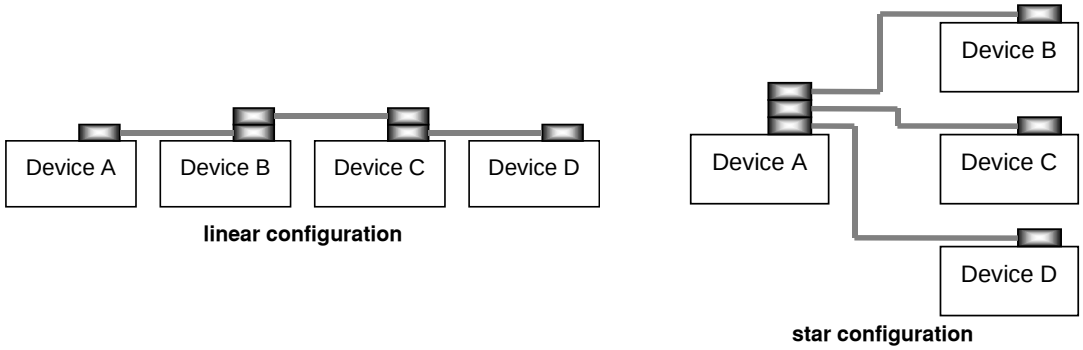


Figure 3.1 GPIB Connections

The GPIB Connector

The standard GPIB connector consists of 16 signal lines in a 24-pin stackable connector. The extra pins are used for some twisted-pair wires. There are eight data input/output (IO) lines, three handshake lines, and five interface management lines.

Eight data input/output (DIO) lines carry both data (including device dependent commands) and interface messages. The ATN interface management line determines whether these lines contain data or interface messages.

Three handshake lines ensure that all data and messages are reliably transferred:

- NRFD (not ready for data) indicates whether a device can receive the next byte of data or message.
- NDAC (not data accepted) indicates whether a receiving device has accepted a byte of data or message.
- DAV (data valid) indicates that the signal levels on the data lines are stable and available for the receiving device(s) to accept.

Five interface management lines control the flow of information:

- ATN (attention) is set by the controller in charge to define the I/O lines for data or interface messages.
- IFC (interface clear) is set by the system controller to initialize the bus and assert itself as controller in charge.
- REN (remote enable) is set by the controller to place addressed devices into remote or local (front panel) control mode.
- SRQ (service request) can be set by any device in the system to request service from the controller.
- EOI (end or identify) is used by talkers to identify the end of a message.

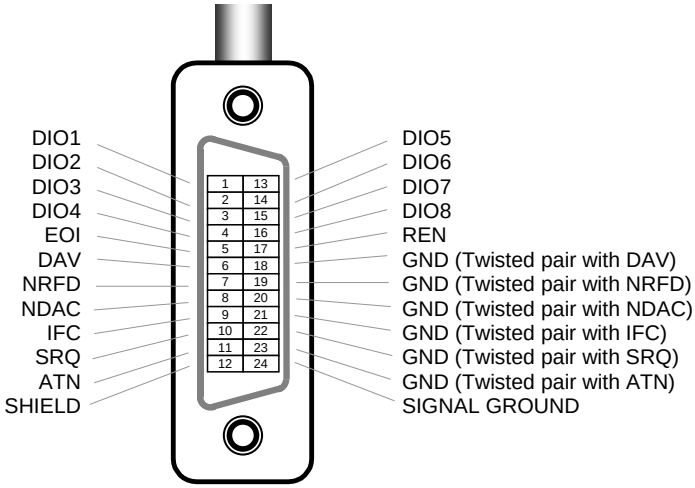


Figure 3.2 GPIB Connector Diagram

Reading the GPIB Address

1. Press **MAIN** from the front panel to recall the Main Menu.
2. Press the **Sys. Config** soft key, to reach the System Configuration menu.
3. Press the **Comm.** soft key to access the Config. Comm menu. The mainframe displays the GPIB Address on the Config. Comm menu.

Changing the GPIB Address

Every device on the GPIB bus must have a unique address. The default address from the factory is address "01".

1. Press **Main** from the front panel to recall the Main Menu.
2. Press the **Sys. Config** soft key, to reach the System Config. menu.
3. Using the PREV/NEXT keys, highlight **GPIB Address**.
4. Select the desired address using the Adjust Knob.

The new GPIB address is stored in non-volatile memory. The allowable address range is 0-30 for primary GPIB addressing. Extended GPIB addressing is not implemented on the LDC-3926 at this time.

RS-232 Configuration

The baud rate setting must match the baud rate used by the serial RS-232 interface, which is typically a serial COMM port on your PC. This section describes reading and changing the baud rate of the LDC-3926.

The RS-232 is configured for 8-bit, no parity. This is not adjustable. Only the baud rate may be altered.

Reading the Baud Rate

1. Press **Main** from the front panel to recall the Main Menu.
2. Press the **Sys. Config** soft key, to reach the System Config. menu.
3. Press the Comm. soft key to access the Config. Comm. menu. The instrument displays the baud rate on the Config. Comm. menu.

Changing the Baud Rate

The factory default baud rate is 19200.

1. Press **Main** from the front panel to recall the Main Menu.
2. Press the **Sys. Config** soft key, to reach the System Config. menu.
3. Using the PREV/NEXT keys, highlight **Baud rate**.
4. Select the desired baud rate using the Adjust Knob.

The new baud rate is stored in non-volatile memory. The allowable baud rates are 1200, 2400, 4800, 9600, and 19200. Refer to the serial port configuration of your PC (if used) for the appropriate baud rate.

Changing Operation from Local to Remote

Sending a command over the GPIB or RS-232 interface automatically puts the instrument in Remote mode. The Remote indicator on the lower right of the front panel illuminates when the controller is in remote operation mode.

When the instrument is in Remote mode, press the Local button from the front panel to return the instrument to Local Control mode unless a Local Lockout state has been activated by the low level GPIB command LLO from the host computer (GPIB only). Local Lockout disables all LDC-3926 front panel operations until it is changed from the host computer. In this condition, the REMOTE indicator will flash at a 1 Hz rate. Menu changes are allowed by using the soft keys in Remote mode. Changing channels is allowed by using the Adjust Knob or Increment/Decrement keys. Other items in menus such as setpoint adjustments, mode changes, cursor movements or turning the TEC/laser on or off are not allowed.

The Talk/Listen indicator on the front panel illuminates when the instrument is communicating over the GPIB or RS-232 interface.

For more information on low level commands such as LLO, refer to the IEEE488.1 specification.

GPIB vs. RS-232 Communications

The LDC-3926 must not be run remotely via GPIB and RS-232 at the same time. When using the RS-232 interface, the remote GPIB command set is fully operable. Command syntax does not vary between GPIB and RS-232 usage. However, the commands which affect GPIB hardware operation will not be useful. For example, the user could send the "*SRE" command via RS-232. However, any service request (SRQ) via GPIB would not be visible since RS-232 has no hardware to support it. This is because SRQ is a function of the GPIB interface hardware and is not available via RS-232.

Mainframe Command Set

This section contains information about the LDC-3926 mainframe command set, command syntax, as well as error and status registers. For module-specific commands, refer to the module's User's Guide.

Command Syntax

This section describes command syntax and structure. You need this information to effectively write GPIB control programs. The syntax of GPIB commands follow the rules defined in the ANSI/IEEE 488.2-1987 standard.

Letters

Any GPIB command or query must contain all of the letters that are shown in upper case in the command definition. Some of the device dependent commands include additional optional letters shown in lower case in the command reference (Chapter 4, Command Reference). Upper or lower case does not matter, it is used in this manual to identify optional letters; although, the optional letters must be in the correct sequence. Some examples of what does, and does not, work:

Okay	Not Okay
`DIS`	`DS`
`Disp`	`dsp`
`Displ`	`dply`
`Displa`	`DSPLY`
`Display`	`disply`

White Space

White space is normally the space character (space bar). A single white space must separate a command from its parameters or data. For example:

Okay	Not Okay
`DELAY 500`	`DELAY500`

To enhance readability, you can use one or more white spaces before a comma, semicolon, or terminator. Since a computer normally puts the terminator at the end of each command string (line), an extra space character at the end of the command line does not affect the command string.

A query has no space between the mnemonic and the question mark. For example:

Okay	Not Okay
`TIMER?`	`TIMER ?`

Note: Too many consecutive white spaces can overflow the 80-byte data I/O buffer.

Terminators

A program message terminator identifies the end of a command string. These are the valid terminator sequences:

- <NL>
- <^END>
- <NL><^END>

Many computers terminate with <CR><NL><^END> (Carriage Return - New Line - EOI). A carriage return (<CR>)is read as a white space.

The LDC-3926 terminates its responses with <CR><NL><^END>, unless you use the TERM command to change it. See TERM on page 50 for more information.

If you encounter problems with GPIB communications, the terminator string can sometimes be the cause.

Command Separators

You can put more than one command on the same line (same command string) if you separate them with a semicolon.

Note: The semicolon can be preceded by one or more spaces. Examples:

```
TEC:DIS 1; tec:set:t?;
TEC:MODE:t ; TEC:T 25 ; TEC:Const 1, 2, 3.5 ; TEC:OUT
```

Parameters

Some commands require a parameter. The parameter must be separated from the command by at least one space.

The syntax symbol `<nrf value>` refers to the flexible numeric representation defined by the GPIB standard. It means that you can represent numbers in integer or floating point form, or in engineering/scientific notation. The IEEE-488.2 standard uses the names NR1, NR2, and NR3 respectively to denote "integer", "floating point", and "scientific notation". For example the number "twenty" may be represented by any of the following ASCII strings:

Integer	20	+20	NR1
Floating point	20.0	+20.0	NR2
Scientific notation	2.0E+1 2.0e+1	+2.0E+1 +2.0e+1	NR3

There are no default values for omitted parameters. If a command is expecting a parameter and none is entered, an error is generated.

For further clarity in programming, the (Boolean) values of one (1) and zero (0) may be used or their names as indicated in the following table.

Table 3.1 Substitute Parameter Names

SUBSTITUTE NAME	VALUE
ON	1
OFF	0
OLD	1
NEW	0
TRUE	1
FALSE	0
SET	1
RESET	0

If multiple parameters are expected, they must be separated with commas. For example, to set the Steinhart-Hart constants (C1, C2, and C3) on a TEC module, the following command may be sent:

```
TEC:CONST 1.111, 2.004, 0.456
```

Figure 4.1 lists the LDC-3926 device-dependent commands, with the full path shown for each command and a brief explanation of its usage. Device-dependent commands for each module are listed in the module's instruction manual.

Command Tree Structure

The LDC-3926 commands require the full path notation.

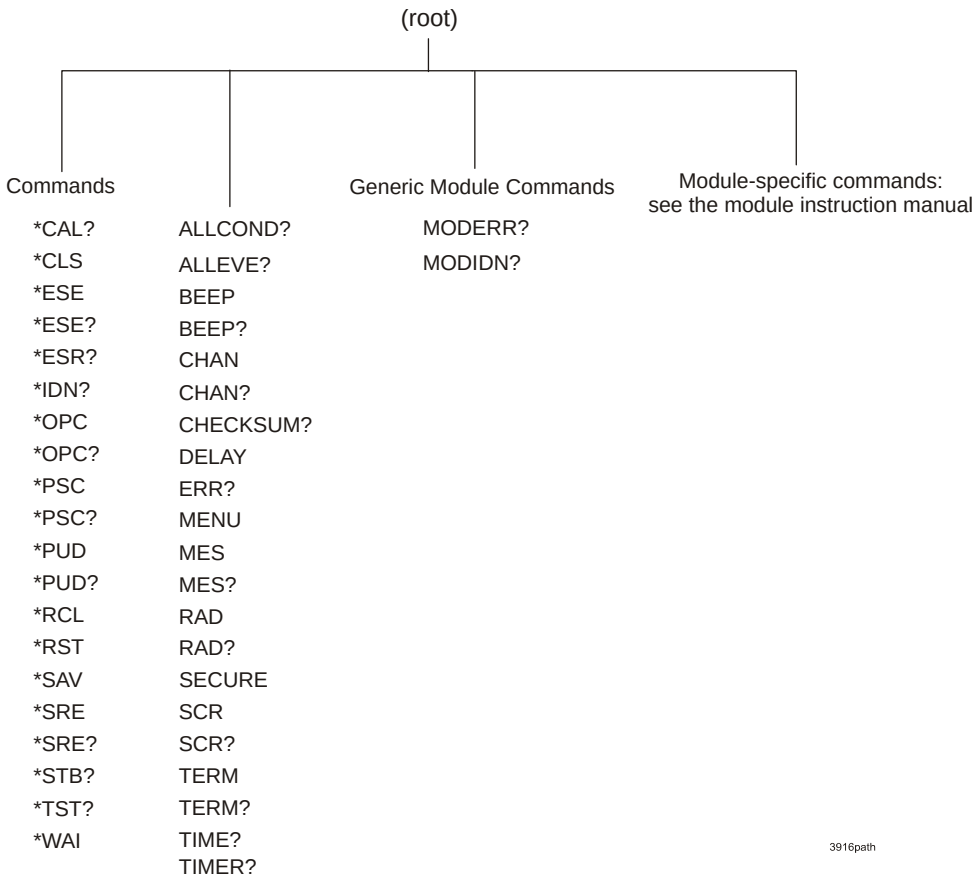


Figure 3.3 Command Path Structure

Syntax Summary

GPIB commands must contain all of the letters shown in upper case in the command definition. Optional letters shown in lower case for some device dependent commands in the command reference are useful for clarity, but must be in the correct sequence.

A single white space must separate a command from its parameters or data. White space is normally the space character (space bar). Other control characters are also interpreted as white space. Do not use white space before the question mark in a query command.

If you encounter problems with GPIB communications, the terminator string can be the cause. Refer to your GPIB interface (controller) manual. The instrument accepts <NL>, or <^END>, or <NL><^END> as a command line terminator. Many computers terminate with <CR> <NL> <^END> (Carriage Return - New Line - EOI). The instrument ignores the <CR> (Carriage Return) and treats it as white space. The LDC-3926 terminates its responses with <CR><NL><^END>, unless you use the TERM command to change it.

You can put more than one command on the same line (same command string) if you separate them with a semicolon.

GPIB uses a flexible representation for numeric parameters: integer, floating point, or engineering/scientific notation. There are no default values for omitted parameters.

Some device-dependent GPIB commands are compound commands, in which the first mnemonic opens a path to a set of commands relating to that path. The second mnemonic then defines the actual command.

Table 3.2 shows examples of invalid syntax command strings that produce errors:

Table 3.2 Invalid Syntax Command Strings

COMMAND	COMMENT
`TEC:MODE T`	Missing colon, MODE? expected.
`TEC:MODE:R DEC`	Missing semicolon, DEC command generates an error.
`LAS:DIS ?`	Space not allowed before question mark, DIS command expected.
`Las:LDI33;dis?`	Space missing between LDI command and the parameter value, 33.

IEEE 488.2 Common Commands

IEEE 488.2 Common Commands and Queries are distinguished by the "*" which begins each mnemonic. The diagrams below show the syntax structure for common commands, common command queries, and common commands with numeric data required.

Numeric data is required with *PSC (1 = on, 0 = off), *RCL (0 to 10, see Save and Recall on page 15), *SAV (1 to 10, see Save and Recall on page 15), *ESE (0 to 255, see Table 3.3 on page 28), *SRE (0 to 255, see Table 3.3 on page 28), and *PUD (used at factory only).

The *CAL? query returns "1" if all LDC-3926 modules' self-calibration routines are completed properly, otherwise "0" is returned.

The *TST? query returns "1" if all LDC-3926 modules that were working at power-up (or at the time of the last *TST? query) have responded to the LDC-3926 mainframe within the past 15 seconds. If any modules fail to respond to the mainframe, *TST? returns "0", and those modules are no longer recognized by the system.

A list of all of the IEEE 488.2 Common Commands supported by the LDC-3926 follows.

`*CAL?`	`*CLS`	`*ESE`
`*ESE?`	`*ESR?`	`*IDN?`
`*OPC`	`*OPC?`	`*PSC`
`*PSC?`	`*PUD`	`*PUD?`
`*RCL`	`*RST`	`*SAV`
`*SRE?`	`*SRE`	`*STB?`
`*TST?`	`*WAI`	

The IEEE 488.2 common commands and LDC-3926 mainframe commands are documented in Chapter 4, Command Reference.

LDC-3926 Mainframe Specific Commands

The LDC-3926 command set can be divided into three categories: IEEE 488.2 common commands, LDC-3926 mainframe commands, and module-dependent commands. The IEEE 488.2 common commands and LDC-3926 mainframe commands are documented in this manual. The commands that apply to each module are found in that module's instruction manual.

Status Reporting

This section contains information for understanding instrument error and status reporting. It also contains information regarding the use of the instrument status for generating interrupts for interrupt-driven programs or subroutines. Understanding the Operation Complete definition for the instrument is useful for programming synchronization. The Output Off Register section also contains information about setting some of the conditions that force the laser current source and/or TEC output to turn off.

The following sections describe the Event and Condition registers, Operation Complete flag, Output Off registers, and Error Messages.

Event and Condition Registers

In addition to the required IEEE 488.2 status reporting structures, the LDC-3926 remote interface provides Event and Condition registers for module operations. The ALLEVE register is used to report events that occur during the operation of the LDC-3926 and that are enabled to be passed to the status byte. The ALLEVE register contains summary bits from each of the sixteen modules.

Likewise, the ALLCOND register is used to report conditions which occur during the operation of the LDC-3926, and are enabled to be passed on to the status byte. The ALLCOND register contains summary bits from each of the sixteen modules.

The bits in the ALLCOND and ALLEVE registers are logically ORed to form a summary message in the status byte for that particular register.

Events are different from conditions. Events signal one-time occurrences and are not reset until either the corresponding module's Event Register(s) is queried, the *CLS command is issued, or the LDC-3926 is powered off. Conditions reflect the current state of the device and therefore may change many times during operation.

Figure 3.4 on page 31 shows the status reporting scheme of the LDC-3926 Laser Diode Controller.

Operation Complete Definition

Bit 0 of the Standard Event Status register contains the status of the Operation Complete flag. Enabling this bit via the *ESE command allows you to update Bit 5 of the status byte. Then, if the SRE mask has bit 5 set, and the user issues an *OPC command, the SRQ signal is generated upon completion of the currently processed commands. This is used to initiate service request routines that depend on the completion of all previous commands.

The LDC-3926 defines operation completeness as the state when all sequential and overlapped commands are completed. Most commands are sequential; only a few are overlapped. See Sequential/Overlapped Commands on page 32 and refer to the module manual for a list of overlapped commands.

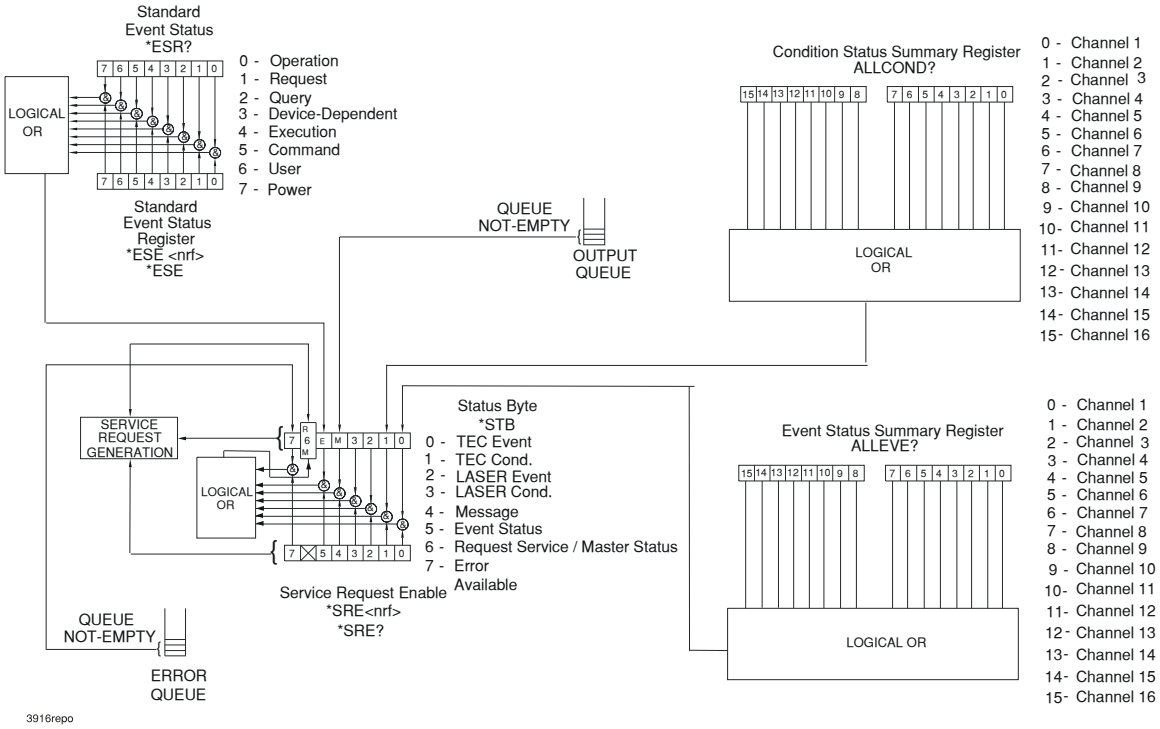


Figure 3.4 Status Reporting Schematic Diagram

Care must be taken when using the *OPC, *OPC?, and *WAI commands with the LAS:OUT ON command, due to the two-second turn-on delay. In some cases operation completion can far exceed the standard GPIB time-out setting.

If the GPIB times out while waiting for a response, either set the GPIB time-out to be longer, or use SRQ-generated interrupts in your program. See your GPIB manual for time-out configuration or SRQ programming setup.

Command Timing

This section describes, for each device-dependent command, whether that command is performed in an overlapped or sequential manner. Command timing states whether the next command can begin while another command is being executed, or if the next command must wait until this command is completed before its execution begins. See Operation Complete Definition on page 30 for conditions about setting the operation complete flag.

Sequential/Overlapped Commands

All device-dependent commands are executed in an overlapped manner: subsequent commands can begin before the current command is completed. Some common commands are sequential; the next command must wait until this command is completed. All device-dependent commands are executed in an overlapped manner, except the "DELAY" command which is sequential. The operation complete flag is set after the conditions outlined in the Operation Complete Definition have been satisfied.

The *WAI (common command) is an example of a sequential command which forces the next command to wait until the no-operation-pending flag is true. This is essentially the same as waiting for the OPC flag to become true, because the no-operations-pending flag is used to set the OPC flag (bit 0 of the Standard Event Status Register).

Commands which change the status of the instrument limits, or change its mode or current range, step value, or status enable registers, will not have their OPC flag set until all current writing to non-volatile memory has been completed. This ensures the OPC flag is never set prematurely.

Query Response Timing

Query responses are evaluated at the time the query request is parsed, and not at the time the response message is sent. In most cases this does not create a problem since the time between parsing a query and sending its response is small.

Error Messages

In the event of a hardware error condition, error messages are displayed on the channel menu screens. In addition to mainframe errors, GPIB errors from the channel (module) may be read via the MODERR? query. Mainframe Errors and a binary representation of channel errors may be read over GPIB using the ERR? query. For example, a response from ERR? might look like:

0,0000000010001000

This indicates that there are no Mainframe Errors, and that channel 4 and channel 8 both have errors. Read those error codes by sending:

```
CHAN 4;ERR?;CHAN 8;ERR?
```

Table 3.3 lists the numerical error ranges by function. Table 3.4 on page 33 contains all of the error messages which may be generated. Not all of these messages may appear on the front panel displays. Some refer to GPIB activities only.

In remote operation, the errors can be read by issuing the ERR? query. When this is done, all of the error messages which are resident in the error queue are returned (up to 10 may be stored). Reading the error queue via GPIB clears the error queue.

Note: Errors codes not listed are reserved for future design use.

Table 3.3 Mainframe Error Code Classifications

Error Code Range	Area of Operation
E-100 to E-199	Parser Errors
E-200 to E-299	Execution Control Errors
E-300 to E-399	GPIB Errors
E-700 to E-799	Mainframe Errors
E-900 to E-999	Mainframe-to-Module Communication Errors

Table 3.4 Mainframe Error Codes

Error Code	Explanation
E-124	Command not recognized by mainframe.
E-125	Common command not recognized by mainframe.
E-126	Too few or too many program data elements.
E-201	<PROGRAM DATA> ó Value out of range.
E-202	<PROGRAM DATA> ó Will not convert to valid type.
E-203	Security violation; command is not available without clearance.
E-225	No modules are present.
E-226	Arbitrary Block data header not valid.
E-227	Invalid channel selection.
E-228	String delimiter not found.
E-229	"Channel All" command not valid; all modules in mainframe must be the same model.
E-301	A <RESPONSE MESSAGE> was ready, but the mainframe failed to address the device to talk.
E-302	Device was addressed to talk, but mainframe failed to read all of the message.
E-710	AC Power Low Error detected.
E-711	AC Power Low Error detected.
E-712	Over-Temperature Error detected on internal sensor.
E-713	Power Brown-out Error detected.
E-714	Internal error waiting to display
E-9xx	Internal communications warnings.

CHAPTER 4

COMMAND REFERENCE

This chapter is a reference to all of the GPIB commands for the LDC-3926 Laser Diode Controller. It contains an overview of the remote commands used by the LDC-3926, as shown in Table 4.1, and it contains the command descriptions, listed in alphabetical order.

GPIB Commands

Table 4.1 GPIB Command Summary Reference List

Name	Parameters	Function
ALLCOND?	NONE	Returns the summary of all 16 channels' condition bits which are further summarized in the Status Byte.
ALLEVE?	NONE	Returns the summary of all 16 channels' event bits which are further summarized in the Status Byte.
BEEP	1	Enables the beeper, or beeps once.
BEEP?	NONE	Returns the enable status of the beeper.
*CAL?	NONE	Used for the A/D calibration procedure.
CHAN	1	Selects a channel (or all channels) for further commands.
CHAN?	NONE	Returns the selected channel.
CHECKSUM?	NONE	Returns a value which is the checksum of the 3926 setup parameters.
*CLS	NONE	Resets the Standard Event Register, Status Byte and Error Queue to zero.
DELAY	1	Used to create a delay in the execution of further commands.
ERR?	NONE	Returns errors generated since the last query.
*ESE	1	Used to load the Standard Event Status Enable Register.
*ESE?	NONE	Returns the value of hte STANDARD EVENT STATUS ENABLE REGISTER
*ESR?	NONE	Returns the value of the **STANDARD EVENT REGISTER**.
*IDN?	NONE	Returns the **DEVICE IDENTIFICATION** string.
MENU	1	Selects a menu for the front panel display.
MES	1	Enters a string message of up to 16 bits.
MES?	NONE	Returns a previously stored ASCII message.
MODERR?	NONE	Returns the error codes of the selected channel(s).

Table 4.1 GPIB Command Summary Reference List

Name	Parameters	Function
MODIDN?	NONE	Returns the model number, serial number, and firmware version of the selected channel(s).
*OPC	NONE	Generates the **OPERATION COMPLETE** message in the Standard Event Status Register .
*OPC?	NONE	Places an ASCII character 1 into the Output Queue.
*PSC	1	Used to avoid any undesirable service requests.
*PSC?	NONE	Queries the power-on-status-clear flag.
*PUD	1	Stores data unique to the instrument.
*PUD?	NONE	Retrieves the contents of the *PUD storage area.
RAD	1	Sets the radix for integer data. Decimal, binary, octal, or hexadecimal.
RAD?	NONE	Returns the radix type for numerical data.
*RCL	1	Recall a stored setup configuration
*RST	NONE	Performs a device reset.
*SAV	1	Save the current setup configuration
SECURE	1	Used to gain access to protected data.
SCR	1	Enables or disables auto-scrolling in the status menu.
SCR?	NONE	Returns the status of the auto-scrolling feature.
*SRE	NONE	Sets the Service Request Enable Register bits to allow generation of the user-selectable service requests.
*SRE?	NONE	Determines the current contents of the Service Request Enable Register.
*STB?	NONE	Reads the Status Byte.
TERM	1	Adds a carriage return to the device terminator.
TERM?	NONE	Returns the status of the TERM command.
TIME?	NONE	Returns the elapsed time since the instrument was last powered up.
TIMER?	NONE	Returns the elapsed time since the timer was last reset.
*TST?	NONE	Initiates an internal self-test and returns a response when complete.
*WAI	NONE	Prevents executing any further commands until the No-Operation-Pending flag is true.

Command Reference

This section presents the mainframe commands for both local and remote operation of the LDC-3926, listed in alphabetical order. Also included in this section are the descriptions of the Generic Module Commands, see Figure 3.3 on page 28. Refer to the appropriate module manual for details on each specific module. Sub-sections for each path are presented, listing the commands which are legal for that path.

ALLCOND?

COMMON
FRONT PANEL
REMOTE

The ALLCOND? query returns the status summary of enabled conditions from each channel of the LDC-3926 Laser Diode Controller.

Parameters — None. The response is the sum of the following:

1 - Channel 1 conditions	256 - Channel 9 conditions
2 - Channel 2 conditions	512 - Channel 10 conditions
4 - Channel 3 conditions	1024 - Channel 11 conditions
8 - Channel 4 conditions	2048 - Channel 12 conditions
16 - Channel 5 conditions	4096 - Channel 13 conditions
32 - Channel 6 conditions	8192 - Channel 14 conditions
64 - Channel 7 conditions	16384 - Channel 15 conditions
128 - Channel 8 conditions	32768 - Channel 16 conditions

Notes — Each channel's conditions that are summarized here represent that channel's contribution to the Status Byte Register. All of the "bits" of the ALLCOND register are logically ORed to set or clear bit 0 of the Status Byte Register.

The value of the ALLCOND register is not cleared until it is read using the ALLCOND? query. Thus, if an SRQ is generated from any of the condition "bits" of the ALLCOND register, it is necessary to use the ALLCOND? query in the user's interrupt service routine to reset the interrupt-enabled condition. Otherwise, multiple interrupts would occur.

Typical use of the ALLCOND? query would be in conjunction with the *STB? query. For example, if you first read the status byte with *STB? and find bit 0 is set, then you can read the ALLCOND? to find out which channel(s) generated the change. If more information is still required, then you can query the contributing channel(s) for the appropriate conditions (e.g. "CHAN 3;LAS:COND?" or "CHAN 12;TEC:COND?", etc.). For more information, see the appropriate condition-enable commands, e.g. "LAS:ENAB:COND" or "TEC:ENAB:COND". Refer to the appropriate module instruction manual for details on each specific module.

Examples — ALLCOND?óresponse: 0, means the no channels have any enabled conditions to pass to the Status Byte register.

ALLCOND?óresponse: 9, means that channels 1 and 4 have enabled conditions. Bit 0 of the Status Byte register is set.

RAD BIN;ALLCOND?óresponse: #B10001, means that channels 1 and 5 have enabled conditions. Bit 0 of the Status Byte register is set.

ALLEVE?

COMMON
FRONT PANEL
REMOTE

The ALLEVE? query returns the status summary of enabled events from each channel of the LDC-3926 Laser Diode Controller.

Parameters — None. The response is the sum of the following:

1 - Channel 1 events	256 - Channel 9 events
2 - Channel 2 events	512 - Channel 10 events
4 - Channel 3 events	1024 - Channel 11 events
8 - Channel 4 events	2048 - Channel 12 events
16 - Channel 5 events	4096 - Channel 13 events
32 - Channel 6 events	8192 - Channel 14 events
64 - Channel 7 events	16384 - Channel 15 events
128 - Channel 8 events	32768 - Channel 16 events

Notes — Each channel's events which are summarized here represent that channel's contribution to the Status Byte Register. All of the "bits" of the ALLEVE register are logically ORed to set or clear bit 1 of the Status Byte Register.

The value of the ALLEVE register is not cleared until it is read using the ALLEVE? query. Thus, if an SRQ is generated from any of the event "bits" of the ALLEVE register, it is necessary to use the ALLEVE? query in the user's interrupt service routine to reset the interrupt-enabled condition. Otherwise, multiple interrupts would occur.

Typical use of the ALLEVE? query would be in conjunction with the *STB? query. For example, if you first read the Status Byte with *STB? and find that bit 1 is set, then you can read the ALLEVE? to find out which channel(s) generated the change. If more information is required, then you can query the contributing channel(s) for the appropriate events (i.e. "CHAN 11;LAS:EVE?" or "CHAN 3;TEC:EVE?", etc.). For more information, see the appropriate event-enable commands,e.g. "LAS:ENAB:EVE" or "TEC:ENAB:EVE".

Examples — ALLEVE? - response: 0, means the no channels have any enabled events to pass to the Status Byte register.

ALLEVE? - response: 19, means that channels 1, 2, and 5 have enabled conditions. Bit 0 of the Status Byte register is set.

RAD BIN;ALLEVE? - response: #B100001, means that channels 1 and 6 have enabled events. Bit 0 of the Status Byte register is set.

BEEP

COMMON
FRONT PANEL
REMOTE

The BEEP command controls the LDC-3926 Laser Diode Controller's beeper. The beeper can be used to signal error or warning conditions.

Parameters — An <nrf value>, 0 = Off (totally disabled); 1 = On, enabled for normal operation; and 2 = beep once.

Notes — Disabling the BEEP will prevent the audible beeper signal from working during front panel operation, including calibration signals. The parameter must be a numeric value (0, 1, or 2), and not a character data substitute (such as On or Off).

Examples — BEEP 0 - action: The beeper is disabled.

BEEP 1 - action: The beeper is enabled for normal operation.

BEEP 2 - action: The beeper is beeped once.

BEEP?

COMMON
FRONT PANEL
REMOTE

The BEEP? query returns the enable status of the LDC-3926 Laser Diode Controller's beeper.

Parameters: None. A response of 0 = Off (totally disabled); 1 = On, enabled for normal operation.

Notes: Disabling the BEEP will prevent the audible beeper signal from working during front panel operation, including calibration signals.

The beeper is normally enabled, unless it is specifically disabled via the "BEEP 0" remote command.

Examples: BEEP? - response: 0, means the beeper is disabled.

BEEP? - response: 1, means the beeper is enabled for normal operation.

*CAL?

COMMON
DEVICE DEPENDENT
FRONT PANEL

Action: Adjusts the internal analog to digital (A/D) converter to reference points, then reports results.

Results: Zero = OK

Non-zero = calibration error

Note: A/D referencing is performed each 10 minutes of inactive time.

Example: *CAL?

CHANnel

COMMON
FRONT PANEL
REMOTE

The CHANnel command selects the modules that will receive subsequent channel-based commands.

Parameters: An <nrf value>, a list of comma-separated <nrf values>, or "ALL".

-where the <nrf value> (1 - 16) represents an LDC-3926 channel number.

Notes: The modules in the selected channels will receive all channel-based commands until the next "channel" command.

Selecting a channel remotely does not affect the front panel display. To change the front panel display remotely, see "Menu" command.

If an invalid (missing) module is selected, an "E227" error will be generated, and the channel will not be changed.

Examples: CHAN 1 - action: selects the module in channel 1 for further channel-based commands (assuming a module exists in the channel).

CHAN 1,3,4,8 - action: selects the modules in channels 1, 3, 4,and 8 for further channel-based commands.

CHANnel ALL - action: selects all available modules for further channel-based commands

CHANnel?

COMMON
FRONT PANEL
REMOTE

The CHANnel? query returns the channel numbers of the modules that have been selected to receive channel-based commands.

Parameters: None. The response will be the channel numbers of the selected modules.

Notes: If no channels are found by the mainframe, the response will be 0.

Examples: CHAN? - response: "12", means the module in channel 12 is selected for channel-based commands.

:CHAN? - response: "3;4;16", means the modules in channels 3, 4, and 16 are selected for channel-based commands.

CHANnel? - response: "ALL", means that channel-based commands will be sent to all available modules.

CHECKSUM?

COMMON
FRONT PANEL
REMOTE

The CHECKSUM? query returns an integer value which is the summation of all pertinent parameters of the present configuration.

Parameters: None. The response consists of an integer value.

Notes: The response value may be stored and compared at a later time to verify that the present configuration of the instrument is the same as expected. This feature works well with the *RCL (recall) command as a means of verifying a stored setup.

The checksum does not test the functionality of the instrument or which modules are present.

Examples: CHECKSUM? - response: 3812, is the checksum of the present configuration of parameters on the instrument.

*CLS

COMMON
DEVICE DEPENDENT
FRONT PANEL

Action: Clears status event registers: Event Status, Event Status Enable, and Error Queue.

Note: Useful to clear registers before enabling service requests (SRQ).

Example: *CLS

DELAY

COMMON
FRONT PANEL
REMOTE

The DELAY command causes the execution of commands to be delayed by a user-defined time interval. This command is similar to the *WAI common command, except that execution resumes after the specified number of milliseconds, instead of waiting for the Operation-Complete flag to be set.

Parameters — An <nrf value> which represents the delay time, in milliseconds.

Notes — Further commands are held off until the delay period elapses.

This command is useful for creating delays which do not require very much program code and do not tie up the GPIB during execution.

Examples — DELAY 500 - action: Further commands and queries are not executed until 0.5 second has elapsed from the time this command is executed.

Tec:T 22;Delay 2000;Tec:T? - actions: The TEC is set to 22.0°C, then the LDC-3926 Laser Diode Controller waits for about 2.0 seconds before displaying the measured temperature.

ERRors?

COMMON
FRONT PANEL
REMOTE

The "ERRors?" query returns a list of "mainframe" device and command errors, followed by a binary representation of the occurrence of "module" device and command errors. The "mainframe" errors are those which have occurred since the last "ERR?" query. The "module" errors are not cleared until the "MODERR?" query is sent to each module which reports an error. The errors are notated by a number (code) which corresponds to the type of error which occurred. See Chapter 3, Error Messages, for information regarding error handling.

Parameters — None. The response consists of one or more "mainframe" error code values, separated by commas and a 16-bit binary representation of errors which exist on each channel.

Notes — A response of 0,0000000000000000 indicates that no errors were reported. The first zero indicates no "mainframe" errors, and the second (16-bit) zero indicates no "module" errors. The response data is sent as character data.

Examples — ERR? - response: 0,0000000000000001 means no "mainframe" errors reported, but channel #1 has an error. Use "CHAN 1;MODERR?" to retrieve the error code(s) from channel 1.

ERRors? - response: 219,1111111100000000, means that the LDC-3926 was unable to restore the setup parameters (at power-up) because of a change in modules. Also, there are errors present on channels 9 - 16.

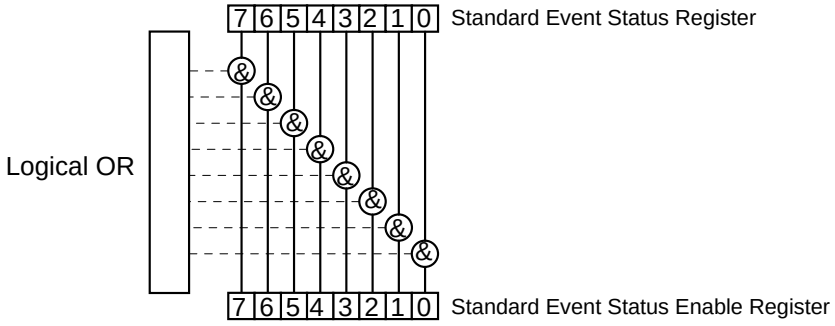
*ESE <nrf value>

Event Status Enable

COMMON
DEVICE DEPENDENT
FRONT PANEL

Action — Enables bits in the standard event status enable register.

Response — The value must be between 0 and 255.



Bit Reference

0- Operation Complete	4- Execution Error
1- N/A	5- Command Error
2- Query Error	6- User Request
3- Device Dependent Error	7- Power On

Notes — Bit 5 of the status byte register is set if any enabled conditions are true.

Setting bit 0 allows you to generate service requests from overlapped commands as previous operations complete. This may be useful for ensuring that an operation is complete before starting a measurement.

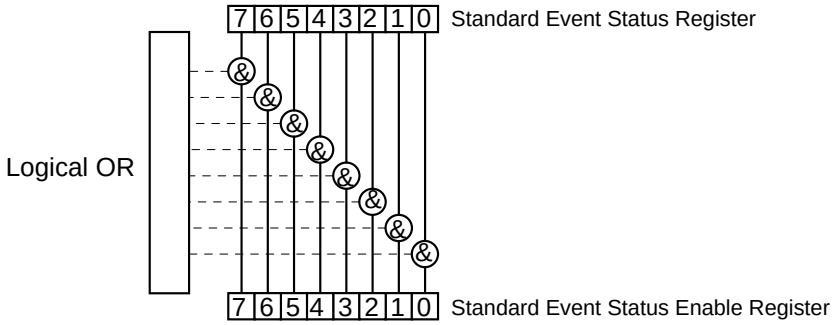
*ESE?

Event Status Enable?

COMMON
DEVICE DEPENDENT
FRONT PANEL

Action Requests the value in the standard event status enable register.

Response The value must be between 0 and 255.



Bit Reference

0- Operation Complete	4- Execution Error
1- N/A	5- Command Error
2- Query Error	6- User Request
3- Device Dependent Error	7- Power On

Notes Bit 5 of the status byte register is set if any enabled conditions are true.
Response is the sum of the enabled bits.

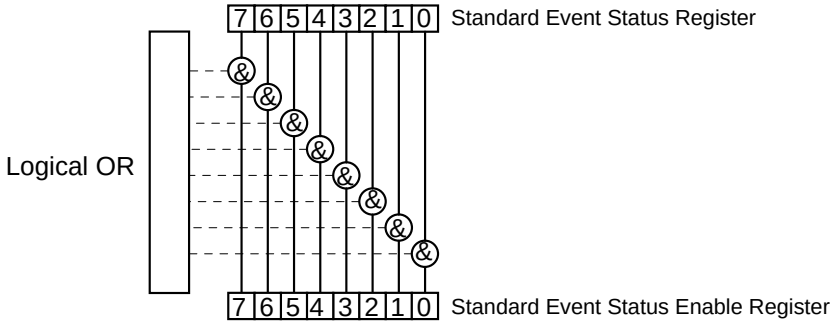
*ESR?

Standard Event Status Register?

COMMON
DEVICE DEPENDENT
FRONT PANEL

Action — Requests the value in the standard event status register.

Response — The value must be between 0 and 255.



Bit Reference

0- Operation Complete	4- Execution Error
1- N/A	5- Command Error
2- Query Error	6- User Request
3- Device Dependent Error	7- Power On

Notes — Response is the sum of the enabled bits.

This command allows you to determine which type of error has occurred.

*IDN?

COMMON
DEVICE DEPENDENT
FRONT PANEL

Action — Requests the instrument to identify itself.

Response — Returns a comma delimited standard format ASCII identification string, from information stored in the instrument during manufacture.

MENU

COMMON
FRONT PANEL
REMOTE

The MENU command changes the displayed menu on the front panel.

Parameters — An <nrf value> which represents the front panel menu selections. 1 = Channel Menu, 2 = Status Menu, or 3 = Summary Menu.

Notes — This command is useful for visually monitoring activity from the front panel while in remote operation.

The channel used (when the parameter is 1) is the remotely selected channel, not the last front panel selected channel (see CHANnel on page 39).

Examples — MENU 1 - action: sets the front panel display to the remotely selected channel's main menu.

MENU 2 - action: sets the front panel display to the Status menu.

MESsage

COMMON
FRONT PANEL
REMOTE

The MESsage command allows the user to enter an ASCII string of up to 16 non-zero characters. This command may be useful for storing messages which relate to a test or configuration.

Parameters: An ASCII string that is 1 - 16 bytes in length.

Notes: The message may contain any ASCII character but will be terminated when a "NULL" terminator character is received. If the message has less than 16 bytes, the software will fill the remaining message space with the space character. After 16 bytes have been entered, the software will null-terminate the string.

Examples: MESSAGE This is a test. - action: The string, "This is a test. ", will be stored in non-volatile memory.

MES Test 3 - action: The string, "Test 3", will be stored in non-volatile memory.

MESsage?

COMMON
FRONT PANEL
REMOTE

The MESsage? query returns the previously stored message. This message will always be 16 bytes long and enclosed in quotes. The message is entered via the MESsage command.

Parameters: None. The response is a 16-byte-long character string.

Notes: The response data will be a 16-byte-long string. If there is no previously stored message, the response will be " ", all spaces.

Examples: MES? - response: "Test 3", means the previously stored message was "Test 3".

Message? - response: "This is a test. ", means the previously stored message was, "This is a test."

MODERR?

COMMON
FRONT PANEL
REMOTE

The MODERR? query returns a list of "module" device and command errors. The "module" errors are those which have occurred since the last "MODERR?" query. The errors are notated by a number (code) which corresponds to the type of error which occurred. See the appropriate module instruction manual for information regarding error handling for each specific module.

Parameters: None. The response consists of one or more "module" error code values, separated by commas.

Notes: A response of (0) indicates that no errors were reported. The response data is sent as character data.

Examples: MODERR? - response: 0 means no "module" errors reported.

MODERR? - response: 501, means that the module has a LASER interlock error which prevented the LAS output from being turned on.

MODIDN?

COMMON
FRONT PANEL
REMOTE

The MODIDN? query returns the module model name and serial number.

Parameters: None. The response consists of the module's model number, serial number, and version number, separated by commas.

Notes: The serial number may also be found by removing the module from the mainframe and viewing the serial number information on the side of the module.

Examples: MODIDN? - response: "3926374,03740001,v1.00", for example.

*OPC

Operation Complete

COMMON
DEVICE DEPENDENT
FRONT PANEL

Sets the operation complete bit in the Event Status Register when all pending overlapped commands have been completed.

Response: None.

Example: *OPC

*OPC?

Operation Complete Query

COMMON
DEVICE DEPENDENT
FRONT PANEL

Places an ASCII character 1 into the Output Queue when all pending operations have been finished.

Response: 1 - when all overlapped commands are complete.

Example: *OPC?

*PSC <nrf value>

Power-on Status Clear

COMMON
DEVICE DEPENDENT
FRONT PANEL

Sets automatic power-on clearing of the enable registers.

Values: 0 = disable power-on clearing
1 = enable power-on clearing

Notes: Any non-zero value is interpreted as 1.

Registers affected:
Condition Status Enable — Service Request Enable
Event Status Enable — Standard Event Status Enable
Factory default condition: disabled.

In the disabled state, the values of the enable registers are saved through power OFF/ON. The power-on status clear flag (see PSC?) is set false, disallowing service request interrupts after power-on.

In the enabled state, the enable registers are cleared during power ON. The power-on status clear flag (see PSC?) is set true, allowing service request interrupts after power-on.

Examples: *PSC 0 - Disable automatic power-on clearing of the enable registers.

*PSC 1 - Enable automatic power-on clearing of the enable registers.

*PSC?

COMMON
DEVICE DEPENDENT
FRONT PANEL

Power-on Status Clear?

Action	Requests the state of the power-on status clear flag.
Response	0óThe enable registers are saved through power OFF/ON. 1óThe enable registers are cleared during power ON. Registers affected: Condition Status Enable: Service Request Enable Event Status Enable: Standard Event Status Enable See Chapter Three for more information on register structure.
Example	*PSC? - Request state of power-on status clear flag.

*PUD

COMMON
DEVICE DEPENDENT
FRONT PANEL

Action	Stores data unique to the instrument, such as calibration date and serial number. This data is protected from change by the "SECURE <nrf>" command and is usually entered by the factory.
Notes	The arbitrary block program data is exactly 25 bytes long.

*PUD?

COMMON
DEVICE DEPENDENT
FRONT PANEL

Action	Requests the stored identification string.

RADix

COMMON
FRONT PANEL
REMOTE

The RADix command allows the programmer to select the radix type for status, condition, and event query response data. Decimal, binary, hexadecimal, and octal are allowed.

Parameters	Character program data is expected, as shown above.
Notes	DECimal is the default type. Only the first three letters of the words decimal, hexadecimal, binary, or octal are required. When the RADIX is selected, all status, condition, and event queries will return values in the new radix. In cases where the radix is not DECimal, the flexible numeric type <nrf value> (as shown in the Command Reference diagrams) will be replaced by HEX, BIN, or OCT representation. All of the above radixes may be used to enter program data at any time, without the need for issuing the RADix command. The proper prefix must also be used with Hex (#H), binary (#B), or octal (#Q). This command may be useful for setting up status reporting blocks. The bit-wise status representation may be more easily read in BIN, HEX, or OCT.
Examples	RAD dec - action: the decimal radix is selected. RAD HEX; *ESR? - action: the hexadecimal radix is selected; -response: #H80, means power-on was detected.

RADix?

COMMON
FRONT PANEL
REMOTE

The RADix? query allows the programmer to determine which radix type for status, condition, and event query response data is currently selected. Decimal, binary, octal, and hexadecimal are allowed.

Parameters: None. The response will be character data. A response of DEC means decimal, BIN means binary, HEX means hexadecimal, and OCT means octal.

Notes: DEC is the default type. The LDC-3926 Laser Diode Controller defaults to this radix at power-up.

The RADix command is used to select the desired radix. Once it is changed, the new radix will remain in effect until the power is shut off or a new RADix command is issued.

Examples: RAD? - response: Dec, means the selected radix is decimal.

RAD? - response: Hex, means the selected radix is hexadecimal.

RADIX? - response: Oct, means the selected radix is octal.

*RCL <nrf value>

Recall

COMMON
DEVICE DEPENDENT
FRONT PANEL

Action: Recalls a stored setup configuration from memory.

Value range: 0 through 10

Notes: Setup 0 has a factory-set default configuration.

If you use GPIB to recall setup 0 (*RCL 0), GPIB mode is set to REMOTE. If you recall setup "0" by the front panel, GPIB mode is set to LOCAL.

Same function as RECALL on the front panel.

Use *SAV to store various setup configurations for convenient recall.

The current setup is automatically stored and recalled at next power-ON, unless you use *PSC to tell the instrument not to do so.

Example: *RCL 0 - Recall the factory default setup.

*RST

Reset

COMMON
DEVICE DEPENDENT
FRONT PANEL

Action: Performs a device reset and the following:

Sets OCIS state

Sets OQIS state

Notes: OCIS = Operation-complete Command Idle State. This is the same state as after *OPC: no further operations to complete.

OQIS = Operation-complete Query Idle State. This is the same state as after *OPC?: no further operations to complete.

These idle states allow the mainframe to complete its reset process (no operations pending) before con-tinuing with other operations.

Example: *RST

*SAV <nrf value>

Save

COMMON
DEVICE DEPENDENT
FRONT PANEL

Action	Saves the current setup configuration in memory.
Value range	1 through 10
Notes	Configuration 0 is reserved for a factory-set default configuration. See *RCL.
	It is normally not necessary to save the current setup for next power-ON. The current setup is automatically stored for recall at next power-ON unless you use *PSC not to do so.
Example	*SAV 2 - Save the current setup configuration as #2.

SCRoll

COMMON
FRONT PANEL
REMOTE

	The SCRoll command enables or disables the auto-scrolling feature of the ALL status screen.
Parameters	A Boolean value, 0 = FALSE (disabled), 1 = TRUE (enabled).
Notes	This command affects the Status screen only.
	The scrolling rate is not adjustable.
	When the auto-scrolling feature is enabled it is in effect until it is disabled or the LDC-3926 is powered off.
Examples	SCR 1 - Enables the auto-scrolling feature of the Status screen.
	SCRol 0 - Disables the auto-scrolling feature of the Status screen.

SCRoll?

COMMON
FRONT PANEL
REMOTE

	The SCRoll? query allows the programmer to determine the status of the auto-scrolling feature for the Status Menu.
Parameters	None. The response is an <nrf value>, 1 = TRUE (enabled), 0 = FALSE (disabled).
Notes	In local operation, the user must select the Status screen in order to determine if the auto-scrolling feature is in use.
Examples	SCRoll? - response: 1, means that auto-scrolling is enabled for the Status screen.
	SCR? - response: 0, means that auto-scrolling is disabled for the Status screen.

*SRE <nrf value>

Service Request Enable

COMMON
DEVICE DEPENDENT
FRONT PANEL

	Enables bits in the service request enable register.
Notes	Response is the sum of the enabled bits.
Example	*SRE 136 - Enable the service request enable register condition summary and error message bits (8 + 128 = 136).

*SRE?

COMMON
DEVICE DEPENDENT
FRONT PANEL

Service Request Enabled?

Requests the value in the service request enable register.

Notes — Response is the sum of the enabled bits.
See Chapter Three for more information about register structure.

Example — *SRE? - Response 136 means the service request enable register condition summary and error message bits are enabled (8 + 128 = 136).

*STB?

COMMON
DEVICE DEPENDENT
FRONT PANEL

Status Byte?

Requests the value in the status byte register.

Notes — Response is the sum of the enabled bits.
See Chapter Three for more information about register structure.

Example — *STB? - Response 200 means the status byte condition and master status summary bits, and error message bits, are enabled. (8 + 64 + 128 = 200)

TERM

COMMON
FRONT PANEL
REMOTE

The TERM command allows the programmer to change the default (IEEE488.2 standard) terminator to include the carriage return.

Parameters — An <nrf value>, 0 = FALSE, 1 = TRUE

Notes — An altered terminator will be in the form <CR><NL><^END>. Technically this takes the LDC-3926 out of IEEE488.2 specification, but this command may be used for convenience when using non-standard GPIB controllers. This termination issent with all output until the TERM 0 command is sent or the LDC-3926 is powered off.

Examples — TERM 1 - temporarily sets <CR><NL><^END> as the output terminator.

TERM?

COMMON
FRONT PANEL
REMOTE

The TERM? query allows the programmer to determine whether the default (IEEE488.2 standard) terminator has been altered to include a carriage return.

Parameters — None. The response is an <nrf value>, 1 = TRUE, 0 = FALSE.

Notes — An altered terminator will be in the form <CR><NL><^END>. This termination will be sent with all output until the "TERM 0" command is sent or the LDC-3926 Laser Diode Controller is powered off.

Examples — TERM? - response: 1, means that the <CR><NL><^END> terminator is temporarily being used.
TERM? - response: 0, means that the <NL><^END> terminator (IEEE 488.2 standard) is being used.

TIME?

COMMON
FRONT PANEL
REMOTE

The TIME? query allows the programmer to determine how much time has passed since the LDC-3926 Laser Diode Controller was last powered up.

Parameters: None. The response is character data in the form: hours:minutes:seconds.

Notes: The TIME clock is independent of the TIMER clock.

Examples: TIME? - response: 00:01:02.36, means that 1 minute, 2.36 seconds have passed since the LDC-3926 Laser Diode Controller was powered up.

TIME? - response: 00:32:00.76, means that 32 minutes, 0.76 second have passed since the LDC-3926 Laser Diode Controller was powered up.

TIMER?

FRONT PANEL
REMOTE

The TIMER? query allows the programmer to determine how much time has passed since the last TIMER? query was issued.

Parameters: None. The response is character data in the form: hours:minutes:seconds.

Notes: Each time the TIMER? query is issued, the timer is reset to 0, and the elapsed time since the last TIMER? query is returned.

Examples: TIMER? - response: 00:02:00.31, means the LDC-3926 Laser Diode Controller has been on for 2 minutes, 0.31 seconds since the last TIMER? query was issued.

TIMER? - response: 00:00:12.03, means the LDC-3926 Laser Diode Controller has been on for 12.03 seconds since the last TIMER? query was issued.

*TST?

Test?

COMMON
DEVICE DEPENDENT
FRONT PANEL

Performs internal self-test, then reports results.

Response: 0 = test completed with no errors.
Non-zero = test not completed, or was completed with errors.

Example: TST?

*WAI

Wait to Continue

COMMON
DEVICE DEPENDENT
FRONT PANEL

Prevents the instrument from executing any further commands until OPC (operation complete) status is true.

Note: This command can be used to make the instrument wait until an operation is complete before continuing.

Care should be taken to set the GPIB time-out appropriately for use with the *WAI command. After this command (or the Delay) command is sent, the controller may receive up to 20 more commands before the wait period is over. If more than 20 commands are sent before the delay or wait period is over, the additional commands will be ignored and an error E220 will be generated.

Example: *WAI - Wait until OPC status is true.

CHAPTER 5

TROUBLESHOOTING

This chapter is to help you resolve problems quickly. If you need help, contact ILX Lightwave Customer Service. See page xii for contact information.

ILX Lightwave Corporation provides in-house and on-site calibration services for ILX instruments. Although the LDC-3926 does not require calibration, most ILX instruments require yearly calibration to ensure performance to published specifications. ILX factory calibrations employ NIST traceable measurement instrumentation, and our calibration engineers and technicians use automated test equipment to accurately and efficiently capture and record calibration data. An original certificate of calibration authenticity is provided with all instrument calibrations, and a detailed report showing any pre-calibration out-of-tolerance conditions is available upon request. Calibration turn-times are normally five business days or less. On-site calibrations can be performed around your production schedule, night or day, seven days a week. Please contact ILX Customer Support (see Comments, Suggestions, and Problems on page xii for contact information) for additional calibration information.

For further assistance with technical solutions and troubleshooting, visit the www.ilxlightwave.com Support page (www.ilxlightwave.com/support/index.html), and the Library page (www.ilxlightwave.com/library/index.html) for Application Notes and Technical Notes.

Troubleshooting Guide

This section is a guide to troubleshooting the LDC-3926. Some of the more common symptoms are listed here, and the appropriate troubleshooting actions are given. If problems persist, contact ILX Customer Service (see page xii for contact information). Also check the www.ilxlightwave.com Support page, and the Library page for Application Notes and Technical Notes.

Table 5.1 Troubleshooting

Symptom	Corrective Action
LDC-3926 will not power up	• Check AC Power line voltage and power cord connection. • There maybe a problem with the internal fusing. Contact ILX Customer Service
Power on, but outputs have been shut off. Instrument is locked up or instrument resets itself.	• This may occur if the instrument loses power (AC line) briefly or line voltage drops below specification. If the instrument is locked-up, cycle the power.

Error Messages

In the event of a mainframe error condition, error messages are displayed on the channel menu screens. Refer to the module User's Guide for information about module-specific errors.

Testing for Errors in Remote Operation

This section contains error codes that the LDC-3926 reports in response to the ERR? query. For more information about specific GPIB commands, see Chapter 4.

1 Send the query `ERR?` to read the system errors and module error summary.

This allows you to error-check the LDC-3926 as a whole. If any module errors are present, the corresponding bit of the module error summary is set. For example, suppose the mainframe responds to an ERR? query with the string 0,0000000001100000. The zero to the left of the comma indicates that there are no mainframe errors, and the binary representation to the right of the comma indicates that there are errors on channels 7 and 6. (Module 16 is on the left, module 1 is on the right).

2 Send the query `MODERR?` to read the module errors.

For example, type `CHAN 7;MODERR?` to return the errors in module 7, and `CHAN 6;MODERR?` returns any errors in module 6. For more information about module errors, refer to the module's User's Guide.

Note: Errors codes not listed are reserved for future design use.

Table 5.2 Mainframe Error Code Classifications

Error Code Range	Area of Operation
E-100 to E-199	Parser Errors
E-200 to E-299	Execution Control Errors
E-300 to E-399	GPIB Errors
E-700 to E-799	Mainframe Errors
E-900 to E-999	Mainframe-to-Module Communication Errors

Table 5.3 Mainframe Error Codes

Error Code	Explanation
E-124	Command not recognized by mainframe.
E-125	Common command not recognized by mainframe.
E-126	Too few or too many program data elements.
E-201	<PROGRAM DATA> ó Value out of range.
E-202	<PROGRAM DATA> ó Will not convert to valid type.
E-203	Security violation; command is not available without clearance.
E-225	No modules are present.
E-226	Arbitrary Block data header not valid.
E-227	Invalid channel selection.
E-228	String delimiter not found.
E-229	"Channel All" command not valid; all modules in mainframe must be the same model.
E-301	A <RESPONSE MESSAGE> was ready, but the mainframe failed to address the device to talk.
E-302	Device was addressed to talk, but mainframe failed to read all of the message.
E-710	AC Power Low Error detected.
E-711	AC Power Low Error detected.
E-712	Over-Temperature Error detected on internal sensor.
E-713	Power Brown-out Error detected.
E-714	Internal error waiting to display
E-9xx	Internal communications warnings.

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