

ARTISAN®
TECHNOLOGY GROUP

Your **definitive** source for quality pre-owned equipment.

Artisan Technology Group
(217) 352-9330 | sales@artisantg.com | artisantg.com

Full-service, independent repair center
with experienced engineers and technicians on staff.

We buy your excess, underutilized, and idle equipment
along with credit for buybacks and trade-ins.

Custom engineering
so your equipment works exactly as you specify.

- Critical and expedited services
- In stock / Ready-to-ship
- Leasing / Rentals / Demos
- ITAR-certified secure asset solutions

Expert team | Trust guarantee | 100% satisfaction

All trademarks, brand names, and brands appearing herein are the property of their respective owners.

Visit our website - *Click HERE*

User's Guide

High Power Precision Current Source
LDX-32420



ILX Lightwave®
A Newport Corporation Brand

ILX Lightwave Corporation · 31950 Frontage Road · Bozeman, MT, U.S.A. 59715 · U.S. & Canada: 1-800-459-9459 · International Inquiries: 406-556-2481 · Fax 406-586-9405

ilx.custhelp.com · www.ilxlightwave.com

70041301 January 2010

TABLE OF CONTENTS

Safety Information and the Manual ix
General Safety Considerations ix
Safety Marking Symbols x
Comments, Suggestions, and Problems xii

Chapter 1 Introduction and Specifications

Product Overview 1
Initial Inspection 2
Installing Your LDX-32420 High Power Precision Current Source 2
Grounding Requirements 2
AC Line Power Requirements 2
GPIB Communication 3
The GPIB Address 3
USB Communication 3
Rack Mounting 4
Shipping Kit 4
Interlocks 4
Operating the LDX-32420 Precision Current Source 4
Obtaining Repair Services 6
Maintenance 6
Specifications 7
Options and Accessories 10

Chapter 2 Operation

Applying Power to Your LDX-32420 11
The Power On Sequence 11
The Power On State 12
Connecting to the Laser 12
Laser Diode Connections 13
Photodiode Connections 14
Voltage Sense 14
Interlock Connections 14
Setting the PD Bias 15
Front Panel Operation 15
Digital Display 15
Adjust Knob 15
Error Indicators 16
COMM 16
PARAMETER 17
MODE 17
RANGE 17
MOD 18
Fundamentals of Operation 19
Operating a Laser in Constant Current (I) Mode 19
Setting Up the Precision Current Source 19
Conditions That Will Automatically Shut Off the LASER OUTPUT 21
Operating a Laser in Constant Power (P) Mode 22
Entering Photodiode Responsivity Values 22

Chapter 3 Remote Operation

Changing Operation from Local to Remote 25
GPIB 26
The GPIB Address 26
Changing the GPIB Address 26
USB 27

COM PORT Settings Required 27
USB Driver Installation 27
LDX-32420 Current Source Command Set 28
Command Syntax 28
Command Paths 30
IEEE488.2 Command Commands 31
LDX-32420 Frequently Used Commands 32
Status Reporting 33
Event and Condition Registers 33
Operation Complete Definition 33
Output Off Register 35
Command Timing and Completion 37
Error Messages 38

Chapter 4 Command Reference

LDX-32420 Device-Dependent Command Reference 44

Chapter 67

Chapter 5 Functions and Features

Saving and Recalling from the Front Panel 67
Saving and Recalling Under Remote Operation 68
Using the Laser Compliance Voltage Adjustment 68
Using the LDX-32420 Current Source's Trigger Function 69
Using Interlock 2 70
Interlock 2 Usage Example 70
Modulating the Laser Current Source 70

Chapter 6 Calibration and Troubleshooting

Calibration Overview 73
Recommended Equipment 74
Calibration of the LDX-32420 Current Source 74
Current Source Calibration 75

I_{PD} Current Calibration 76
Laser Forward Voltage Measurement Calibration 77
Remote Calibration of the LDX-32420 Current Source 78
Current Source Calibration 78
I_{PD} Current Calibration 80
Laser Forward Voltage Measurement Calibration 81
Troubleshooting Guide 82
Error Messages 84

LIST OF FIGURES

Figure 1.1 LDX-32420 Front View 5
Figure 1.2 LDX-32420 Rear View 5
Figure 2.1 Back Panel LD Connector 13
Figure 3.1 LDX-32420 Command Path Structure 30
Figure 3.2 LDX-32420 Status Reporting Schematic Diagram 34
Figure 3.3 LDX-32420 Output Off Register 36
Figure 5.1 LDX-32420 Rear Panel 69

LIST OF TABLES

Table 2.1 LDX-32420 Default Settings 12

Table 2.2 LDX-32420 Error Indicators 16

Table 3.1 Substitute Parameter Names 29

Table 3.2 LDX-32420 Often Used Commands 32

Table 3.3 LDX-32420 Series Default Settings for Output Off Registers 35

Table 3.4 Error Code Classifications 38

Table 3.5 LDX-32420 Series Error Codes 38

Table 4.1 LDX-32420 Series Device-Dependent Commands 41

Table 6.1 Recommended Test Equipment 74

Table 6.2 Error Code Classifications 84

Table 6.3 LDX-32420 Series Error Codes 84

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 later in this section.)

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)
- Mains supply voltage fluctuations are not to exceed ±10% of the nominal supply voltage.
- Pollution Degree II
- Installation (overvoltage) Category II for transient overvoltages
- Maximum Relative Humidity: <80% RH, non-condensing
- Operating temperature range of 0 °C to 40 °C
- Storage and transportation temperature of –40 °C to 70 °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:

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

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

On the web at: . . . . . ilx.custhelp.com

Or mail to:

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

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

This chapter is an introduction to the LDX-32420 High Power Precision Current Source. This chapter contains first time setup information, important safety considerations, maintenance information, instrument specifications, and general LDX-32420 information.

WARNING

If any of the following symptoms exist, or are even suspected, remove the LDX-32420 from service. Do not use the LDX-32420 until trained service personnel can verify safe operation.

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

If necessary, return the LDX-32420 to ILX Lightwave for service and repair to ensure that safety features are maintained.

Product Overview

The LDX-32420 Precision High Power Laser Diode Current Source provides up to 20A of DC current with a compliance voltage of 4 Volts for testing and controlling high power single emitter laser diodes. Standard features include dual range output of 10 amps and 20 amps with a 1 mA setpoint resolution, constant current or constant optical power operating modes, laser diode forward voltage measurement, and a current modulation input.

These high current drivers offer many laser diode protection features which protect the laser diode from electrical transients and provide safeguards such as adjustable voltage and current limits and error detection and reporting. Independent interlocks are provided for further laser and operation protection.

Instrument operation is possible on the LDX-32420 through an IEEE488/GPIB or USB computer interface. All instrument control and functions are programmable for test sequence, measurements and data handling in automated test systems. Synchronization with other measurement or control instruments is possible with an output trigger function whenever the output current changes. Multiple test configurations can be stored and retrieved through Save and Recall functions from the front panel or through the computer interfaces.

Initial Inspection

When you receive your LDX-32420, verify that the following items were shipped with the instrument:

- LDX-32420 Series Instruction Manual
- Power Cord
- Shipping Kit

Verify the line voltage indicated on the rear panel is correct for your facility. Check for damage from shipping.

Installing Your LDX-32420 High Power Precision Current Source

Grounding Requirements

The LDX-32420 High Power Precision Current Source comes with a three conductor AC power cable. The power cable must either be plugged into an approved three-contact electrical outlet or used with a three-contact or two-contact adapter with the grounding wire connected to an electrical ground (safety ground). The LDX-32420's power jack and supplied power cable meet IEC safety standards.

AC Line Power Requirements

You can operate the LDX-32420 instrument from a single phase power source delivering nominal line voltages of 100 - 120 VAC and 230VAC (all values RMS), at 50/60 Hz. The line power voltage can vary ±10% but cannot exceed 250 VAC. The instrument's operational voltage is factory configurable and need not be changed before operating the instrument.

WARNING

Before connecting the LDX-32420 High Power Precision Current Source to a power source, verify that the AC power source matches the setting of the LDX-32420's voltage indicated on the rear panel of the instrument.

To avoid electrical shock hazard, connect the instrument to properly earth-grounded, 3-prong receptacles only. Failure to observe this precaution can result in severe injury or death.

GPIB Communication

The IEEE488/GPIB computer interface is located on the rear panel above and to the left of the AC power input module as shown in Figure 1.2. Attach the GPIB cable to the 24-pin connector. The connector is tapered to ensure proper orientation. Tighten the two screws on the connector finger tight.

A total of 15 devices can be connected together on the same GPIB interface bus. The cables have single male/female connectors on each end so that several cables can be stacked. This allows more than one cable to be attached to any one device. However, 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 LDX-32420 are identical. This GPIB address is read locally by pressing the GPIB LOCAL switch with the address displayed on the display. The instrument comes from the factory configured with the GPIB address set to 1. You can change the GPIB address via the front panel. A procedure for changing the address can be found in the section “Changing the GPIB Address” in Chapter 3.

USB Communication

Install the USB driver included in the shipping kit prior to connecting the USB cable to the instrument. Instructions for installing the driver are given in the USB section of Chapter 3. The USB Type B connector is located on the rear panel just to the left of the power input module as shown in Figure 1.2. Attach the USB cable to the instrument in the proper orientation. A USB cable is provided in the shipping kit.

Rack Mounting

The LDX-32420 Precision Current Source can be mounted in a standard 19” rack with the optional rack mount kits. The kits contain a rack mount flange and hardware for mounting on either side of the enclosure. All rack mount accessory kits contain mounting instructions.

Shipping Kit

The LDX-32420 Current Source comes with a shipping kit and accessories the user will find useful in getting the instrument operational. The shipping kit includes hardware for the current source output connector in the case where a custom cable is needed. The hardware includes a connector body, hood, and pins. Accessories shipped with the instrument include a USB cable and a CD with the USB drivers.

Interlocks

Two interlocks are located on the rear panel of the instrument; one is a terminal block labeled Interlock 1, the other is a BNC labeled Interlock 2.

Interlock 1 is a normally open switch which defeats the output of the instrument if left in the open state. Shorting the two terminals will satisfy the interlock circuitry and allow the current source output to be enabled. The LDX-32420 is shipped with Interlock 1 shorted.

Interlock 2 is a normally high TTL level interlock; in this condition the current source output can be enabled. A TTL low will defeat the interlock and disable the current source output.

Operating the LDX-32420 Precision Current Source

Now that the LDX-32420 High Power Precision Current Source is installed and ready for use, you can begin to learn about its operation. Figures 1.1 and 1.2 show the front and back of the instrument identifying the functional keypad groupings and back panel connectors. Use these figures to familiarize yourself with the LDX-32420. After that, use Chapter 2 for fundamentals of operating your instrument.

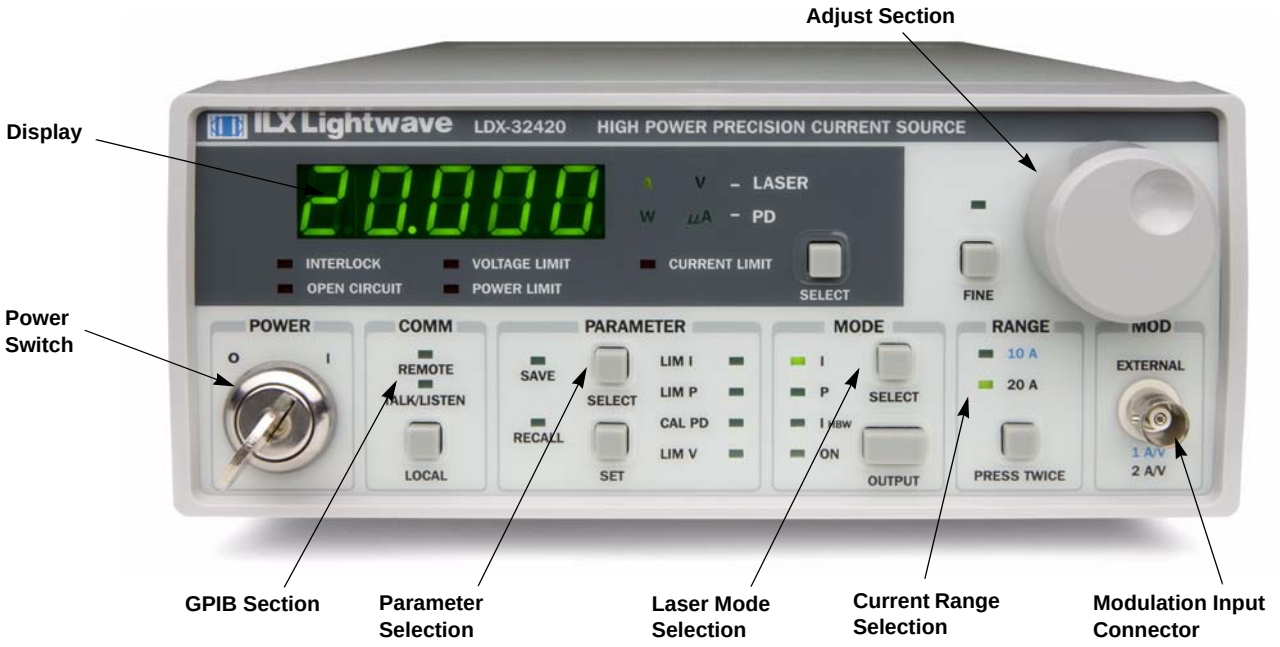


Figure 1.1 LDX-32420 Front View

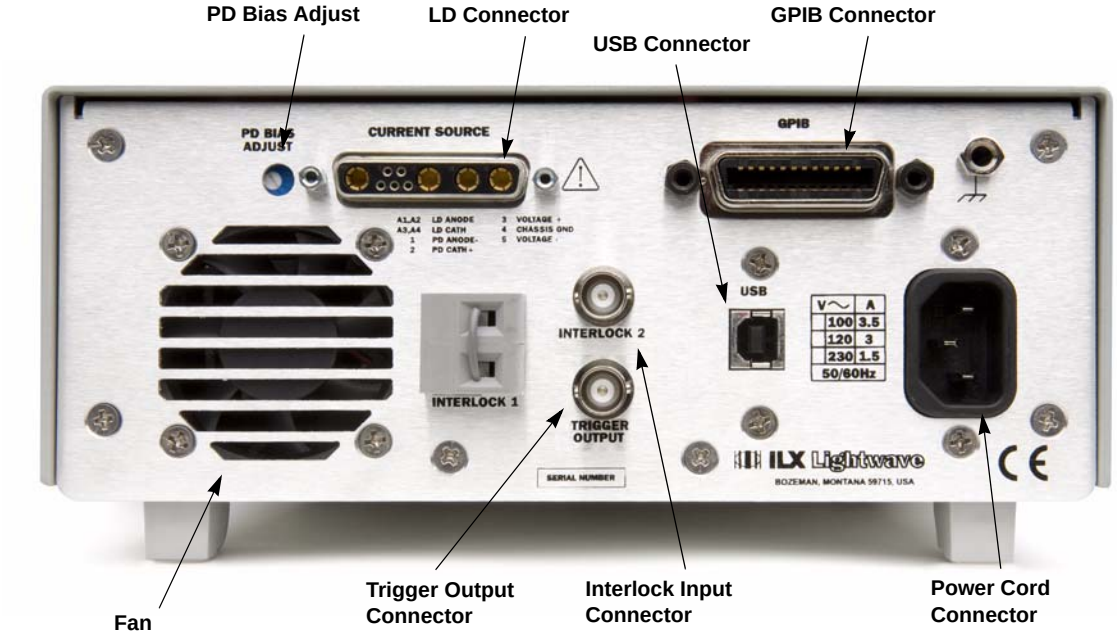


Figure 1.2 LDX-32420 Rear View

Obtaining Repair Services

You may have to return your instrument to the ILX Lightwave facility at some time for repair or service whether or not it is under warranty. There is a charge for repairs after the warranty period has expired. Contact an ILX Lightwave service representative for shipping instructions prior to returning the instrument. Have the model number, instrument serial number, and a description of the problem or request at the time of the call. All ILX Lightwave instruments are identified by a serial number located on the rear panel. The first four or five digits are the model number; the last four digits are unique to the instrument and identify your instrument specifically. A return authorization number will be given to you at the time of your request for repair or service. Please use this number in all communications concerning your instrument.

If you need to ship your LDX-32420 High Power Precision Current Source back to the factory for repair, be sure that the LDX-32420 is packaged in an enclosure with cushioning material to prevent damage to the instrument during shipment (use the original shipping containers and accessories if possible). Re-install the ESD protective caps on the rear and front panels over the connectors (9 pin D or hybrid, BNC, and GPIB). Shipping damage is not covered under warranty.

Attach a tag to the instrument identifying the owner and indicating the service or repair needed. Include the model number and serial number. We suggest that you insure the shipment.

In North America, contact ILX Lightwave for return authorization and shipping instructions. Outside of North America, contact your ILX distributor for shipping information.For more information on how to obtain repair services, see the Safety and Warranty section of this manual.

Maintenance

If cleaning is required, use a clean, dry cloth. Calibration of the instrument is recommended on an annual basis and can be performed by the user or by ILX Lightwave. Contact Customer Service for calibration information.No other maintenance is required.



Potentially lethal voltages exist within the LDX-32420 High Power Precision Current Source. To avoid electric shock, do not perform any of the maintenance on the instrument unless you are qualified to do so. Qualified service personnel are required to wear protective eyeglasses and anti-static wristbands while working on the LDX-32420's circuit boards. High voltages are present on and around the instrument's printed circuit boards.

Specifications

	LDX-32420	
Drive Current Output[1]		
Output Current Setpoint		
Range	0 to 10 A	0 to 20 A
Resolution	1 mA	1 mA
Accuracy (% of reading)	±0.1% + 10 mA	±0.1% + 10 mA
Compliance Voltage	4 V	4 V
Temperature Coefficient	<50 ppm/°C	<50 ppm/°C
Stability (1 hour)[2]	<100 ppm	<100 ppm
Noise and Ripple (rms)[3] High Bandwidth Mode Low Bandwidth Mode	 <5 mA <5 mA	 <5 mA <5 mA
Transient Operational[4] 1 kV EFT/Surge[5]	 <25 mA <80 mA	 <25 mA <80 mA
Compliance Voltage Adjust		
Range	0 - 4 V	0 - 4V
Resolution	100 mV	100 mV
Accuracy (% of FS)	±2.5%	±2.5%
Drive Current Limit Settings		
Range	0.1 to 10.1 A	0.2 to 20.2 A
Resolution	100 mA	100 mA
Accuracy (% of FS)	±1%	±1%
Photodiode Feedback		
Type	Differential	Differential
PD Reverse Bias	0 - 5V, adjustable	0 - 5V, adjustable
PD Current Range	0 to 5000 µA	0 to 5000 µA
Output Stability[6]	±0.02%	±0.02%
Accuracy, setpoint (% of FS)	±0.05%	±0.05%
External Analog Modulation		
Input	0 - 10 V, 1 kΩ	0 - 10 V, 1 kΩ
Transfer Function	1 A / V	2 A / V

	LDX-32420	
Bandwidth (3 dB)[7] High Bandwidth Low Bandwidth	 DC to 100 kHz DC to 20 kHz	 DC to 100 kHz DC to 20 kHz
Trigger Output		
Type	TTL	TTL
Pulse Width	14 µs	14 µs
Delay	12 ms	12 ms
Measurement (Display)		
Output Current Range[9]	0 to 10.000 A	0 to 20.000 A
Output Current Resolution	0.001 A	0.001 A
Output Current Accuracy (% of reading)	0.1% + 10 mA	0.1% + 10 mA
Photodiode Current Range	0 to 5000 µA	0 to 5000 µA
Photodiode Current Resolution	1 µA	1 µA
Photodiode Current Accuracy	±2 µA	±2 µA
PD Responsivity Range[10]	0.00 to 100.00 µA/mW	0.00 to 100.00 µA/mW
PD Responsivity Resolution	0.01 µA/mW	0.01 µA/mW
Optical Power Range	0.00 to 100.00 W	0.00 to 100.00 W
Optical Power Resolution	0.01 W	0.01 W
Forward Voltage Range	0.000 to 4.000 V	0.000 to 4.000 V
Forward Voltage Resolution	1 mV	1 mV
Forward Voltage Accuracy[11]	±5 mV	±5 mV
Laser Diode Protection		
Output Shorting Relay	Normally closed	
Output Enable Delay	2s (per 21CFR 1040.10)	
Current Limit	Adjustable, redundant hardware limit	
Voltage Limit	Adjustable	
Hardware Fault Response Time		
Current Limit	Continuous monitoring	
Voltage Limit	5 µs	
Open Circuit	50 µs	
Intermittent Contact Protection		
AC Power Failure / Brown-out Protection		
Error Monitoring / Reporting	Current limit, voltage limit open circuit, optical power limit	

Interlocks	
Interlock 1	Normally open, close to enable output
Interlock 2	Normally high, TTL input; TTL low to disable current source output
General	
Remote Interface	
GPIB	IEEE488
USB	2.0
Power Requirements	100-120 VAC ± 10% 220-240 VAC ± 10%
Maximum Current Draw	100-120 VAC: 1.5A 220-240 VAC: 0.7A
Size (H x W x D)	4” x 8.5” x 13.4”; 102 mm x 216 mm x 340 mm
Weight	12.2 lbs (5.5 kg)
Operating Temperature	0°C – 40°C
Storage Temperature	-40°C – 70°C
Humidity	<80% non-condensing
Regulatory Compliance	CE certified EN 61326-1:2006 Basic Requirements; Immunity EN 55011:2007 Radiated and Conducted Emissions EN 61010-1 Safety Requirements EN 60950 Low Voltage Directive
Connectors	
Laser Output	D-sub combination 9W4
Modulation Input	BNC, front panel
Trigger Out	BNC, rear panel
Interlock 1	Terminal block, rear panel
Interlock 2	BNC, rear panel
Ground	Banana jack

Notes
1. All values relate to a one-hour warm-up period.
2. Over any one-hour period, half-scale output.
3. Measured electrically, with a 0.5Ω load evaluating AC coupled rms value over a 1 MHz bandwidth.
4. Maximum output current transient resulting from normal operations (e.g. power on-off, current on-off), as well as accidental situations (e.g. power line plug removal).
5. Maximum output current transient resulting from a 1000V power-line transient spike per IEC 1004-4 and 1004-5.
6. Maximum monitor photodiode current drift over any 30-minute period. Assumes zero drift in photodiode responsivity.
7. 5V peak to peak modulation at mid-scale output. Higher bandwidth is possible with smaller magnitude modulation signal.
8. From start of output current change to trigger pulse.
9. Measured current through GPIB or USB command; instrument front panel displays setpoint current.
10. The responsivity value is user-defined and is used to calculate the optical power.

Options and Accessories

Options and accessories for the LDX-32420 High Power Precision Current Sources include the following:

DESCRIPTION	MODEL NUMBER
20A Interconnect Cable, 9W4 to 7W2	CC-320
20A Interconnect Cable, 9W4 to Ring Lug	CC-325
Single Rack Mount Kit	RM-139
Dual Rack Mount Kit	RM-140
C-Mount Laser Diode Mount	LDM-4409
CS Package Laser Diode Mount	LDM-4415
TO-3 and HHL Laser Diode Mount	LDM-4442
High Power Butterfly Laser Diode Mount	LDM-49840
High Power Butterfly Laser Diode Mount with Case Temperature Control	LDM-49840T
High Power 2-pin Laser Diode Mount	LDM-49860
High Power 2-pin Laser Diode Mount with Case Temperature Control	LDM-49860T

Our goal is to make the best laser diode instrumentation available anywhere. To achieve this, we need your ideas and comments on ways we can improve out products. We invite you to contact us at any time with your suggestions.

CHAPTER 2

OPERATION

This chapter introduces you to the operation of the LDX-32420 High Power Precision Current Source. It offers instructions for connecting your laser to the current source and describes powering up the instrument. This chapter also contains step by step procedures that teach you how to operate your current source in Constant Current Mode and Constant Power Mode. We recommend that you review the contents of this chapter at a minimum before operating the LDX-32420 Current Source.

Applying Power to Your LDX-32420



To turn on the LDX-32420, rotate the key in the "POWER" section of the front panel from "O" to "I". This action will initiate the power on sequence. If the LDX-32420 does not respond, verify that it is connected to line power. If line power is not the problem, remove the power cord and contact ILX Lightwave or your local distributor for troubleshooting.

The Power On Sequence

During the power-up sequence, the following takes place. For about 1.5 seconds all indicators light up, and all of the 7-segment displays indicate "8.". Then all lamps are turned off for 1.5 seconds. Next, the firmware version will be displayed. Then, a self-test is performed to ensure that the instrument's hardware and processor are communicating. 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.

Note: If the instrument cannot successfully complete the power on test, an error message of E-512 or E-513 will be displayed on the Display. See Chapter 3 for a list of error codes and actions to take when your instrument indicates these errors.

The Power On State

You can choose to "clear" the last saved state by recalling the default values. These values are stored in BINS to that you can save or recall instrument configurations (described in more detail in Chapter 5). "BIN 0" contains all of the default configurations listed in Table 2.1.

Table 2.1 LDX-32420 Default Settings

GPIB mode in LOCAL via front panel, or in REMOTE via GPIB
PARAMETERS not selected
CAL PD = 0 µA / mW
LIM I (high range) = 10 A
LIM I (low range) = 5 A
LIM V = 4 volts
LIM P = 50W
Output off
DISPLAY enabled, in I mode
Constant I, low bandwidth mode selected
I setpoint = 0 mA
I_{PD} setpoint = 0 µA
P_{PD} setpoint = 0 mW
RECALL BIN number = 0

Connecting to the Laser

When connecting your laser to the LDX-32420, we recommend that the instrument be powered up with the output off. In this condition, a low impedance shunt is active across the output terminals. When disconnecting devices, it is only necessary to turn the current source output off.

It is also recommended that the connections from the LDX-32420 current source output to the anode and cathode of the laser diode be made using stranded or solid core wire. For best performance in any of the LDX-32420's operating modes, we recommend the ILX CC-320 or CC-325 interconnect cables which connect directly to the LDX-32420 current source output connector.

The laser current and photodiode output terminals of the instrument are left floating relative to earth ground to suppress AC power on / power off transients that may occur through an earth-ground path. If the output circuit is earth-grounded at some point (such as through the laser diode package and mount), the

user must be careful to avoid multiple earth grounds in the circuit. Multiple earth grounds may provide circuit paths that induce transient currents in the cable conductors affecting the photodiode current and laser diode forward voltage measurements.

> **Note:** With high currents, connections to the cable end or the laser should be secure and tight. Avoid point contacts, maximizing surface area for connections is advisable. Increased resistance due to poor connections will cause high voltage drops and I^2R heating which could be dangerous or damaging to improperly sized conductors and/or the conductor insulation.

The 9-pin 9W4 connector marked CURRENT SOURCE on the back panel is used to connect your laser diode to the LDX-32420. There are connections provided for laser cathode and anode, photodiode cathode and anode, laser forward voltage and chassis ground. The pinout diagram for this connector is shown in Figure 2.1.

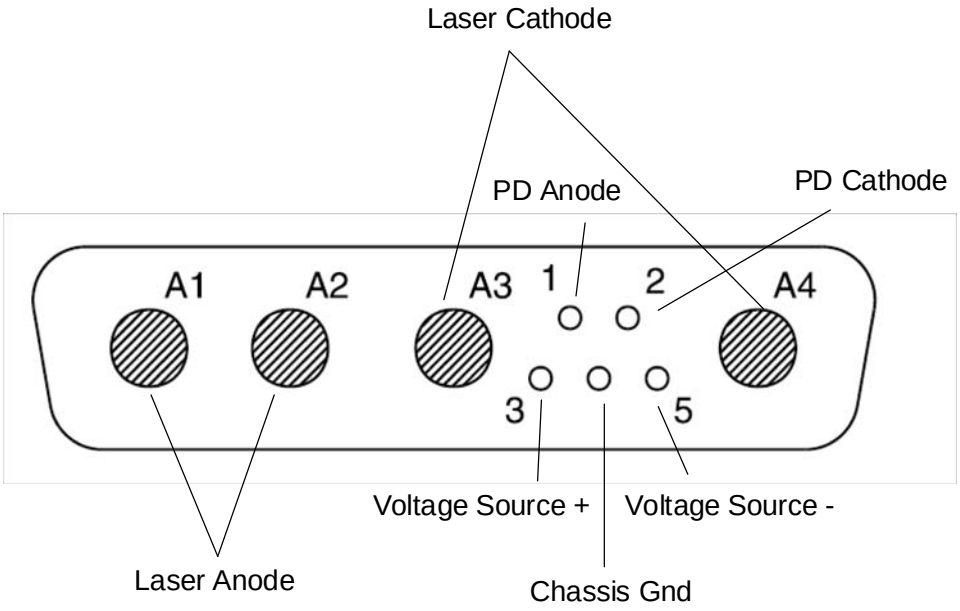


Figure 2.1 Back Panel LD Connector

Laser Diode Connections

The laser current output of the LDX-32420 is isolated from chassis ground, allowing either the laser anode or cathode to be grounded at the user's option. Two pairs of connections (A1, A2) for laser anode and (A3, A4) for laser cathode are provided through the 9W4 connector. These conductors are internally shorted so that only one pin from each pair is needed for driving the laser diode. With the ILX CC-320 and CC-325 interconnect cables, the laser conductors are un-shielded stranded 8 AWG wire.

Photodiode Connections

Some laser diode modules contain an internal photodiode that monitors the back-facet emission of the laser. the LDX-32420 measures current from a photodiode connected to pins 1 and 2 of the 9W4 connector on the back panel.

The photodiode and laser connections are electrically isolated from ground and each other. When connecting a photodiode, a twisted pair shielded cable is recommended for best signal quality. The shield should be connected to earth ground at the LDX-32420 on pin 4 as well as at the source. With the ILX CC-320 and CC-325 interconnect cables, shielded twisted pair 18 AWG conductors are used for the photodiode conductors.

Voltage Sense

The LDX-32420 measures forward voltage of the laser diode when the laser anode and cathode are connected to pins 3 and 5 respectively of the 9W4 connector of the back panel.

When connecting to the instrument, a twisted pair shielded cable is recommended for best signal quality. The shield should be connected to earth ground at the LDX-32420 on pin 4 as well as at the source. With the ILX CC-320 and CC-325 interconnect cables, shielded twisted pair 18 AWG conductors are used for the voltage sense inputs.

Interlock Connections

In order for the laser output to be enabled, a short circuit must exist between the interlock pins of Interlock 1. The short can be a direct short across the pins or a switch to prevent laser operation until the switch is closed. If a short does not exist between these two pins, the INTERLOCK LED will illuminate on the front panel and the laser output will be disabled.

Interlock 2 should be left disconnected or tied to a TTL high level signal. If this connection is shorted or connected to a TTL low signal, it will also cause the interlock LED to illuminate and disable the output.

CAUTION

The interlock terminals on Interlock 1 must be kept isolated from all other connections including earth ground.

Setting the PD Bias

The LDX-32420 provides an adjustable reverse bias of 0-5 VDC for the photodiode. To set the photodiode bias to 5 V reverse bias, turn the back panel PD BIAS ADJUST fully clockwise. To set the photodiode bias to 0 V reverse bias, turn the back panel PD BIAS ADJUST fully counter-clockwise.

Front Panel Operation



Digital Display

The 7-segment, LED display is used to show control parameters such as laser drive current (A), laser current limit (A), laser forward voltage (V), voltage limit (V), monitor photodiode current (µA), and laser optical power (W) in both setpoint and measurement modes. It will also display error codes that relate to LASER operation. Error indicators underneath the display indicate control errors and are explained in the section titled “ERROR INDICATORS”. All laser control parameters are displayed on this digital display with the appropriate enunciator illuminated. The select button toggles the display between laser current and voltage and photodiode power and current measurements.

Adjust Knob

The adjust knob in the upper right corner of the front panel is used to change instrument settings such as output current set-point and parameters such as current and voltage limits. Turn the adjust knob clockwise to increase the displayed value or counterclockwise to decrease the displayed value. When the

adjust knob is turned, the instrument automatically changes to set point mode indicated by the display mode enunciator flashing and adjusts the output current set point value. Pushing the FINE button to the left of the adjust knob decreases the rate of change of the set point adjustment and is indicated by the illumination of the LED above the push button.

Error Indicators

The LDX-32420 High Power Precision Current Sources indicate general operational error conditions. Each error condition results in an action as shown in the table below.

Table 2.2 LDX-32420 Error Indicators

Error Condition	Action
Interlock	Output off; INTERLOCK light flashes at 1 Hz
Open Circuit	Output off; OPEN CIRCUIT light flashes at 1 Hz; if this condition was caused by an excessive voltage, the VOLTAGE LIMIT light will also be illuminated.
Current Limit	CURRENT LIMIT light flashes at 1 Hz
Voltage Limit	VOLTAGE LIMIT light flashes at 1 Hz; this indicator warns that the output is within 0.25 V of LIM V setting; if the voltage limit (LIM V) is reached, the LASER output will shut off.
Power Limit	Output off; POWER LIMIT light flashes at 1 Hz

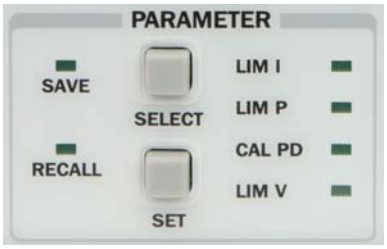
COMM

- REMOTE: indicates the unit is under remote operation
- TALK LISTEN: indicates remote communications to and from the instrument through GPIB or USB computer interfaces
- LOCAL: removes the instrument from remote operation and displays the GPIB address



PARAMETER

- SELECT: toggles front panel display between current limit (LIM I), power limit (LIM P), photodiode responsivity (CAL PD), compliance voltage limit (LIM V), and save and recall bins
- SET: when pressed allows the user to change the active parameter or recall and save bins. With the GPIB address displayed by pressing the local button; pressing and holding the set button will change the GPIB address



Parameter setting is accomplished by first pressing the select button until the parameter to be modified is selected. If the set button is pressed within this time, the parameter indicator will flash and the adjust knob may be used to adjust the value. After adjustment and the adjust knob is idle for approximately 3 seconds, the value will be stored.

MODE

- I: unit is configured for constant current bandwidth limited mode
- P: unit is configured for constant power mode
- I_{HBW}: unit is configured for constant current maximum bandwidth mode
- ON: the output is enabled; the LDX-32420 is controlling current to the laser diode
- SELECT: switches between constant current and constant power modes of operation; output must be off to change modes
- OUTPUT: enables or disables the current source output



Instrument mode setting is accomplished by pressing the select button and as indicated by the respective LED. The current source output is enabled or disabled with the output push button.

RANGE

The range button toggles between 10A and 20A ranges. The output must be off and the button must be pressed twice within one second to change ranges. Independent limits and setpoints are saved under each range. Changing the range with the output enabled will automatically disable the output.



MOD

The LDX-32420 allows a modulated voltage signal to be superimposed on the current source output. The input for this signal is a BNC located in the MOD section labeled External. This port is configured as a differential input allowing the shell to be grounded through the connecting instrument. The input impedance is 1 KΩ. The voltage to current transfer function depends on the range of the instrument and is specified just below the BNC connector as shown.



Fundamentals of Operation

This section describes fundamentals of operation for your LDX-32420 in two operating modes: Constant Current (I) and Constant Power (P).

- [square brackets]: the equivalent remote commands for the front panel instructions listed. Refer to Chapter 4 for more information.

Operating a Laser in Constant Current (I) Mode

Suppose you want to run the instrument in Constant Current, low bandwidth mode, with a setpoint of 7.5 A and a current limit of 8 A. This particular mode uses a low-pass filter on the laser drive current output to reduce noise. In this mode a modulation input of up to 10 kHz may be used via the front panel MOD EXTERNAL connector. Follow the instructions below in the sequence presented.

Setting Up the Precision Current Source



Set the LDX-32420 in Constant Current, low bandwidth mode by selecting I in the MODE section of the front panel [LASer:MODE:ILBW]. Do this by toggling the SELECT push button until the I indicator is illuminated. Repeatedly pressing the (MODE) SELECT switch cycles through the current (I) [LASer:MODE:ILBW], photodiode power (P) [LASer:MODE:MDP], or high bandwidth current (I_{HBW}) [LASer:MODE:IHBW] control modes.



Next, in the RANGE section set the current source range by selecting the 10 A range indicated by the accompanying LED [LASer:RANge LOW]. You will need to press the SELECT push button twice to change the range. It must be pressed twice quickly (within less than 1 second) to switch between ranges, and the LASER output must be off [LASer:OUTput OFF] in order to change ranges.

Configure the display so that it reads laser current in A [LASer:DISplay:LDI]. Press and release the SELECT switch in the DISPLAY section of the front panel until the A enunciator is lit. The (DISPLAY) SELECT switch is also used to select the I_{PD} (PD current, µA) [LAS:DIS:MDI], P_{PD} (laser power, mW) [LAS:DIS:MDP], or V (forward voltage, V) measurement [LAS:DIS:LDV] or setpoint [LAS:DIS:SET] display modes. When the setpoint mode is active, the corresponding enunciator will flash to indicate setpoint mode. The display defaults to the measurement mode.

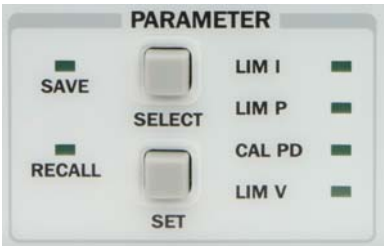
To view the setpoint, press and hold down the display SELECT switch for two or more seconds. When the SELECT switch is released the measurement mode will be restored.

At this point the LDX-32420 is in Constant Current Mode, (I), in the 10A range, and the display is reading in A. Next, we need to adjust the setpoint of the laser current source.

To adjust the setpoint of the current source to 7.5 A, turn the adjust knob clockwise to increase the setpoint; counterclockwise to decrease the value [LAS:LDI: 7.5]. When the adjust knob is turned, the LDX-32420 automatically changes to setpoint mode indicated by the flashing annunciator. Adjust the setpoint to 7.5 A. After an adjustment has been made, and the adjust knob is released, the setpoint mode will time out in three seconds. The current set point value will be updated and the display will revert to the original measurement display mode (I, I_{PD}, V, or P_{PD}).

The instrument is still not ready to turn on the laser. One of the laser protection features our precision current sources offer is a fully independent hardware current limit. The current limit protects your laser by never allowing the laser drive current to exceed the limit independent of the setpoint and the output control mode (Constant Current or Constant Power).

To set the current source limit, use the SELECT push button in the PARAMETER section of the front panel to select LIM I. Press the (PARAMETER) SET push button and rotate the adjust knob to vary the limit setpoint value. Set the limit to 8 A [LASer:LIMit:ILOW 8]. After three seconds, the new limit value is stored in non-volatile memory.



When the LASER current limit is reached, the CURRENT LIMIT error indicator flashes. The current limit setting is independent of the voltage drop of the device connected to the LASER output, and therefore, no dummy load is required for precise adjustment of the current limit. Furthermore, since the current limit circuitry is fully independent of the main current control, the current limit can be adjusted safely, even while the LASER output is enabled.

An additional feature of the LDX-32420 instrument is an adjustable voltage limit. This allows an extra level of laser protection in the event of an intermittent open circuit.



To set the LASER voltage limit, use the SELECT push button in the PARAMETER section of the front panel to select LIM V and then press the (PARAMETER) SET push button. Adjust the voltage limit using the adjust knob. [LASer:LIMit:LDV]

Now you are ready to enable the current source output for your laser diode.

In the MODE section of the front panel, press the push button labeled OUTPUT [LASer:OUTput ON]. The accompanying LED labeled ON will illuminate, indicating that the laser current source's output is enabled. The instrument will drive the current source to the value set by the corresponding MODE setpoint. The OUTPUT switch has a toggling action. Pressing the switch again will disable the current source output [LASer:OUTput OFF] and the ON LED will not be illuminated. When the LASER output is off, an internal short is placed across the LASER output. The default condition for the current source output is off when the instrument is first powered up.

Conditions That Will Automatically Shut Off the LASER OUTPUT

The following conditions will automatically cause the instrument to disable the current source output [LASer:EVEnt?]:

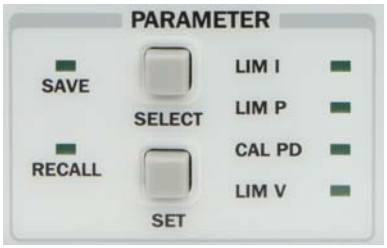
- LASER High Power Limit (Laser Event Bit 3)
- LASER Interlock 1 or Interlock 2 Activated
- LASER Open Circuit or Voltage Limit (Laser Event Bit 6 or Bit 7)

Operating a Laser in Constant Power (P) Mode

Suppose you want to operate a laser diode at a constant 10 W level. The LDX-32420 allows you to operate the laser current source driver in a Constant Optical Power mode. In this mode, the LDX-32420 drives current to the laser to reach a setpoint power value (in W). The control loop feedback parameter is photodiode current which the LDX-32420 converts to optical power via a user-defined photodiode responsivity number. If laser power changes due to internal or environmental conditions, the LDX-32420 will increase/decrease the current to the laser to maintain the power setpoint. The following paragraphs detail the instrument configuration in Constant Power Mode.

To set the LDX-32420 in Constant Power mode, select P in the MODE section of the front panel by toggling the SELECT push button [LASer:MODE:MDP]. Repeatedly pressing the (MODE) SELECT switch cycles through the current (I) [LAS:MODE:ILBW], photodiode power (P) [LAS:MODE:MDP], or high bandwidth current (I_{HBW}) [LAS:MODE:IHBW] control modes. The LED indicator shows the selected mode.

Entering Photodiode Responsivity Values



The photodiode responsivity, CAL PD, is used to convert between photodiode current and optical power of the laser diode. To enter the CAL photodiode parameter [LAS:CALMD XX], select CAL PD with the (PARAMETER) SELECT push button by toggling down past LIM P. The indicator becomes lit when CAL PD is selected and the display indicates the responsivity parameter in µA/mW (not enunciated). Press the set button then rotate the adjust knob to enter a new value for responsivity. When the correct value is displayed, the number will be stored after 3 seconds.

A method to calculate the responsivity is suggested below.

1. Measure (with a calibrated detector) the output power of the device.
2. Measure the corresponding photodiode current.
3. Calculate the responsivity by dividing the photodiode current by the optical power noting the units required are µA/mW.

Note: The LDX-32420 High Power Precision Current Source can be put into a special mode with the CAL PD parameter set to zero. When the CAL PD value is zero, the LASER output will be controlled to a current setpoint value (I_{PD}) in micro amps (µA). Therefore, the instrument is in Constant I_{PD} mode. The display will indicate µA for photodiode measured current and "-.-" for power measurement.

Next, configure the display by pressing and releasing the (DISPLAY) SELECT switch until the W annunciator is lit. [LASer:DISplay:MDP]

Adjust the Constant Power setpoint of the LDX-32420 to 10 W. [LASer:MDP 10] To do this, turn the adjust knob to vary the setpoint. When the adjust knob is turned, the LDX-3232 automatically changes to setpoint mode as indicated by the flashing annunciator. Adjust the setpoint to 10 W. After an adjustment has been made, and the adjust knob is released, the setpoint mode will time out in three seconds and the display will return to the measurement display mode.

Before the laser output is enabled, the power limit for the laser under test should be set. In Constant Power mode, this is accomplished by setting a Power limit, LIM P value [LASer:LIMit:MDP]. The LDX-32420 uses the responsivity value entered to calculate a power limit as a function of monitor current (I_{PD}). This is a software limit only.

To set the Constant Power limit, use the SELECT push button in the PARAMETER section to select LIM P. When the LIM P is indicated by the accompanying LED, the display will indicate the limit setpoint in W. Press the (PARAMETER) SET push button and then rotate the adjust knob to set the limit to 15 W.

The LIM P is the absolute limit of optical power, as detected by the instrument via the monitor photodiode feedback loop. In order for this limit to be meaningful, the monitor photodiode responsivity (CAL PD) must be adjusted correctly. The LASER output is normally turned off if this limit is reached (See LASer:ENABle:OUTOFF command in Chapter 4 for instructions on disabling this function). The maximum LIM P value is 100 W.

Also, in constant power mode the LASER current limit and voltage limit values are in effect. Be sure they are set correctly corresponding to the laser under test. Setting of these limits is described previously in “Operating a Laser in Constant Current (I) Mode”.

Now the instrument is configured to operate in Constant Power Mode. In the MODE section, enable the output of the laser current source by depressing the OUTPUT push button once [LASer:OUTput ON]. The accompanying LED labeled ON will illuminate indicating that the laser output is on and current is being driven to the laser. The LDX-32420 current source will drive the laser to the Constant Power setpoint and maintain closed loop control.

CHAPTER 3

REMOTE OPERATION

Everything you learned to 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, such as commands that will increment (INC) and decrement (DEC) the current set point by a pre-defined step value. The following sections show you the fundamentals of operating your LDX-32420 remotely through the GPIB or USB computer interfaces.

Changing Operation from Local to Remote



Sending a command over the GPIB or USB bus will automatically put the instrument in remote mode. The REMOTE indicator will identify when the current source is in remote operation mode. When the instrument is in remote mode, pressing the LOCAL switch returns 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. Local lockout disables all front panel switches until this condition is changed by the host computer. In this condition, the REMOTE indicator will flash at a 1 Hz rate. The TALK/LISTEN indicator is illuminated when the instrument is communicating over the GPIB or USB bus.

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

GPIB

The GPIB Address

Before you can operate the LDX-32420 instrument remotely, you need to know its GPIB address. The talk and listen addresses on the LDX-32420 current source are identical. Every device on the GPIB bus must have a unique address.

The GPIB address is read by pressing the (GPIB) LOCAL push button; the address will be displayed on the LED display in the format “Adr XX”. The default address from the factory is Address 1. The GPIB address can be changed via the front panel as described in the next section.

Changing the GPIB Address

If it is necessary to change the address, press and hold in the (PARAMETER) SET switch while displaying the GPIB address. Turn the ADJUST knob until the desired address value is displayed, then release the SET switch. The new GPIB address will then be stored in non-volatile memory. The allowable address range is 0 - 30 for primary GPIB addressing. Extended GPIB addressing is not implemented on the LDX-32420 at this time.

USB

To begin using the USB port on the LDX-32420 Precision Current Source, please install the Virtual Com Port Driver which is available on the companion CD or from our website (www.ilxlightwave.com). A standard USB “A/B” cable is necessary to connect the instrument to a PC and is included in the shipping kit. Once connected, the **ILX Virtual COM Port** driver provides a simple programmable interface to the USB port.

COM PORT Settings Required

BAUD: 19200
DATA BITS: 8
PARITY: NONE
STOP BITS: 1
FLOW CONTOL: NONE

USB Driver Installation

Insert the companion CD into the PC. This CD is included with the LDX-32420 shipment. The **ILX Virtual COM Port Installer** should run automatically but if it does not, the executable can be found at *[CD-ROM Drive]:\ILX USB Installer.exe*. Follow the instructions of the installer to complete the installation.

LDX-32420 Current Source Command Set

For the most efficient and effective remote control of your LDX-32420 High Power Precision Current Source, we recommend you study the following sections. You will learn about command syntax, IEEE488 Command Commands and the most used device dependent commands. Later in this chapter you will be introduced to the error and status registers.

This information is for sending instrument commands through the GPIB or USB computer interfaces.

Command Syntax

Any command or command query must contain all of the letters that are shown in the LDX-32420 Command Path Structure, Figure 3.1. However, the Current Source's command parser is NOT CASE SENSITIVE so upper or lower case may be used in any combination. The lower case letters shown with the Device Dependent commands in Chapter 4 are optional letters and may be used for clarity. For example, the following commands are equal:

- `LAS:DIS 1`
- `LAS:Dis 1`
- `LAS:DISPLAY 1`

In this example, only the first three letters "DIS" are required, while the other letters, "play" are optional. These optional letters must be used in the proper sequence as shown.

The syntax of the commands follows the rules laid out in the GPIB-IEEE488 standard. Colons (:) indicate the start of a new command path, while semicolons (;) indicate a separation of commands within a command string. A leading colon on a command may be used to return the LDX-32420 command parser to the command path root (see Figure 3.1).

Spaces or white space may be used to separate commands and/or data (after the command header or query question mark). Spaces or white space must be used to separate the command (header) from the first parameter (or program data). The following examples show valid syntax for commands:

- `LAS:display:ldi`
- `Laser:limit:ldi 400`
- `LAS:DIS 1; las:set:ldi?`
- `Las:MODE:Mdp; LAS:OUT 1`

The following are examples of invalid syntax. These command strings would produce an erroneous result, as explained:

`LAS:MODE MDP`	Missing colon, MODE? expected
`LAS:MODE:ILBW 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

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 should be separated with commas:

```
LAS:INC 100,50
```

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

```
LAS:LDI?
```

When sending commands through the GPIB bus, the LDX-32420 uses a terminator of <NL><^END> (new line with EOI). For users whose GPIB driver defaults expect a carriage return in the terminator, <CR><NL><^END>, the `TERM` command may be used for convenience (see `TERM` command in Chapter 4). For more information, refer to your GPIB driver configuration manual.

Commands sent through the USB bus must always be terminated with new line, <n1>.

Command Paths

The LDX-32420 device-dependent commands are structured into a tree format (see Figure 3.1). Each of the legal paths is listed below, followed by its list of path options, each of that is followed by the commands themselves. It is recommended that the first-time user begin learning the commands by using the full path notation. Once you are familiar with the commands, you may wish to take advantage of the shortcuts allowed for command paths.

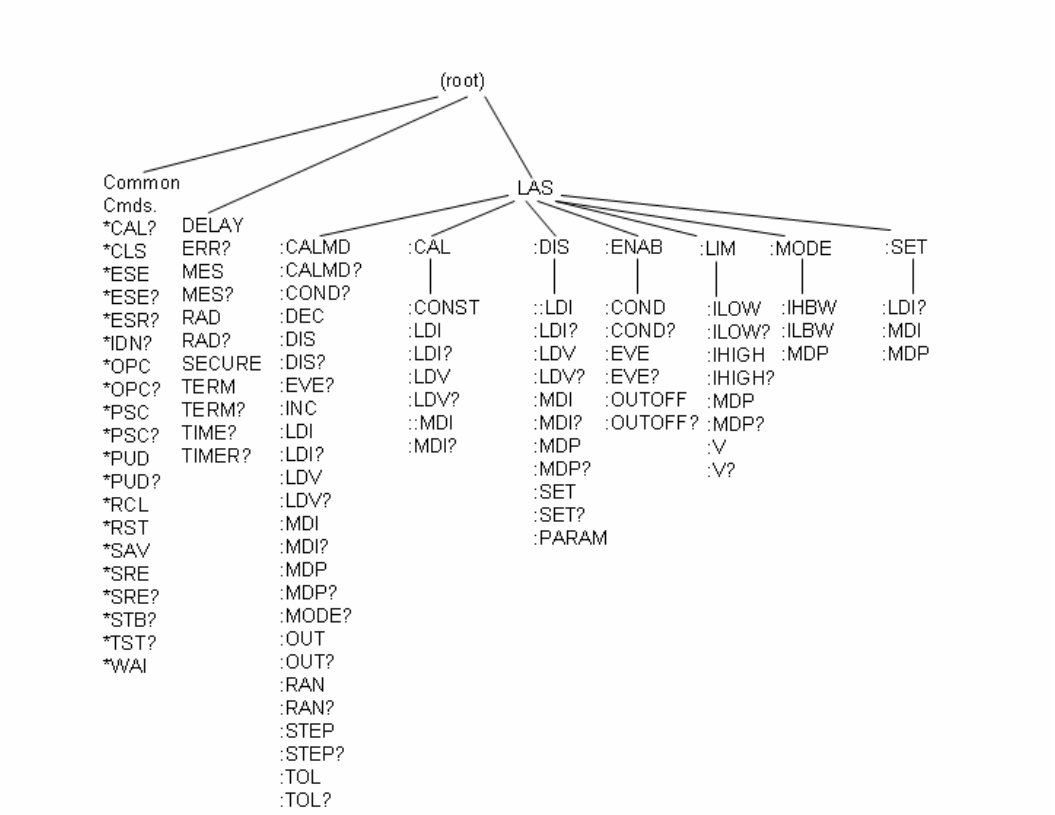
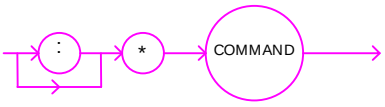


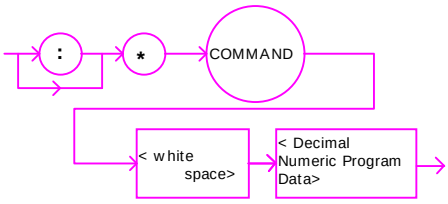
Figure 3.1 LDX-32420 Command Path Structure

IEEE488.2 Command Commands

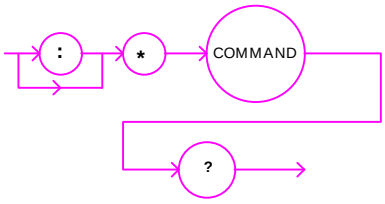
The IEEE488.2 Common Commands and Queries are distinguished by the " * " that begins each mnemonic. The diagrams below show the syntax structure for common commands, common commands with numeric data required, and common command queries.



Common Command



Common Command with Numeric Data



Common Command Query

Numeric data is required with *PSC (1=on, 0=off), *RCL (0 to 10, see front panel RECALL function), *SAV (1 to 10, see front panel SAVE function), *ESE (0 to 255, see Figure 3.2), *SRE (0 to 255, see Figure 3.2), and *PUD (used at factory only).

A list of all of the GPIB-IEEE488 Common Commands supported by the LDX-32420 follows:

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

For more information on these commands, refer to an ANSI/IEEE 488-1987 standards reference.

Note: Care should be taken to set the GPIB time-out appropriately for use with the *WAI, DELAY, or *OPC? Commands. If the time for a response after one of these commands exceed the GPIB time-out period, a bus (time out) error will occur. Usually, after this time out error, the LDX-32420 Series Instrument will generate a query error (E302). This error code is reported via the ERR? Query.

LDX-32420 Frequently Used Commands

The LDX-32420 High Power Precision Current Source's complete command set contains over 60 commands that allow you to operate the current source for a variety of applications. Within the command set, however, is a smaller subset of commands that will meet most of your needs. These commands are listed in Table 3.2.

Table 3.2 LDX-32420 Often Used Commands

Name	Parameters	Function
ERR?	NONE	Returns errors generated since the last query
LAS:CALMD	1	Used to set the CAL PD (monitor responsivity) constant
LAS:LDI	1	Used to set the current source setpoint value
LAS:LDI?	NONE	Used to return the constant current source measured value
LAS:LDV?	NONE	Used to return the measured laser voltage value
LAS:LIM:ILOW	1	Used to set the low range current limit
LAS:LIM:IHIGH	1	Used to set the high range current limit
LAS:LIM:MDP	1	Used to set the constant optical power (from monitor photodiode) limit value
LAS:LIM:V	1	Used to set the current source compliance voltage limit value (LIM V)
LAS:MDP	1	Used to set the constant optical power setpoint
LAS:MDP?	NONE	Returns the actual monitor photodiode power value
LAS:MODE?	NONE	Returns the mode, ILBW, IHBW, or MDP (optical power)
LAS:MODE:IHBW	NONE	Sets the mode to constant current, high bandwidth mode
LAS:MODE:ILBW	NONE	Sets the mode to constant current, low bandwidth mode
LAS:MODE:MDP	NONE	Sets the mode to constant optical power mode
LAS:OUT	1	Used to enable/disable the current source output
LAS:OUT?	NONE	Returns the current source output status
LAS:RAN	1	Sets the laser current output range

Status Reporting

This section contains information that is relevant 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 on setting some of the conditions that will force the laser current source output 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 GPIB-IEEE488 status reporting structures, the LDX-32420 remote interface provides Event and Condition Registers for LASER operations. The Event Registers are used to report events that occur during instrument operation. Events differ from conditions in that events signal an occurrence once, and are not reset until the Event Register is queried, the status cleared by the `*CLS` command, or the instrument is powered off. Conditions reflect the current state of the instrument and therefore may change many times during operation. Querying a Condition Register does not change its contents.

Figure 3.3 shows the status reporting scheme of the LDX-32420. Each of the registers that may be accessed by a command or query has the appropriate command or query written above or below the register representation. For example, the LASER Condition Register may be queried via the `LASer:COND?` query.

The condition or event registers are logically ANDed with their respective enable registers. These bits are then logically ORed to form a summary message in the status byte for that particular register.

Operation Complete Definition

Note that Bit 0 of the Standard Event Status Register contains the status of the Operation Complete flag. Enabling this bit via the `*ESE` command allows the user 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 (bus) signal will be generated upon completion of the currently processed commands. This bus signal (SRQ) may be used to initiate service request routines that depend on the completion of all previous commands.

For example, the user may enable the current source output (`LAS:OUT 1`), enable an SRQ on Operation Complete (set `*ESE 1` and `*SRE 5`), and have an SRQ handling routine in the user's software, that reads a new measurement after the output on state has been reached. This allows the use of the operation complete features of the LDX-32420, without the need for program looping or polling that can tie up the communication bus. Operation Complete on the LDX-32420 is defined as:

1. No operations to the LASER current source hardware are pending.
2. No EEPROM (non-volatile) memory write cycles are in progress.

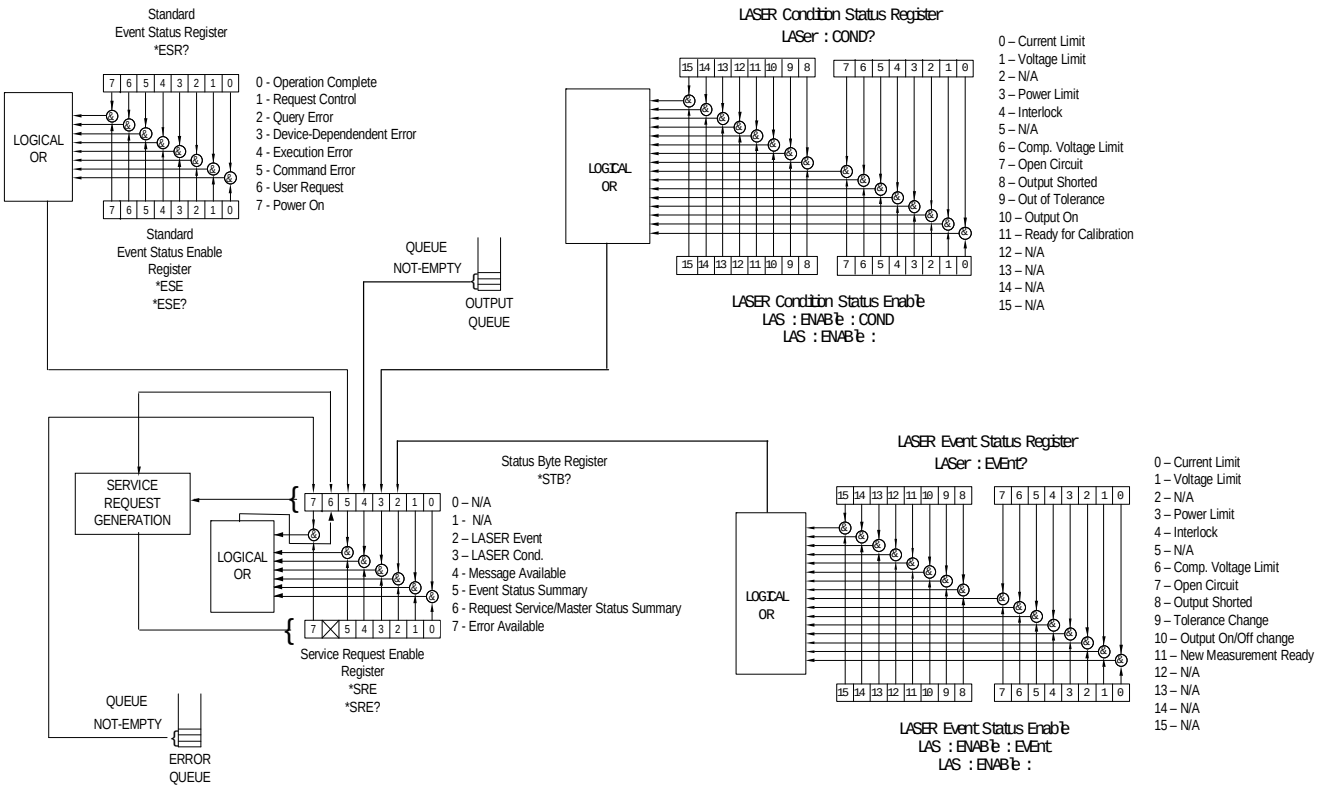


Figure 3.2 LDX-32420 Status Reporting Schematic Diagram

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

The `*OPC`, `*OPC?` and `*WAI` commands should not be used inside a calibration routine.

Output Off Register

The Output Off Enable Register allows you to determine that conditions and events in the LDX-32420 High Power Precision Current Source can cause the current source output to be turned off. This register is configured in a manner similar to the status reporting registers. However, the register output is not reported in the Status Byte Register. Rather, it sets the hardware that controls the output switching. The events and conditions that may be set to cause the current source output to be turned off are shown in Figure 3.3.

The default (factory) settings for this register are shown in Table 3.3. These settings are not affected by the *PSC (Power-On Status Clear) command.

Table 3.3 LDX-32420 Series Default Settings for Output Off Registers

0 - disabled	8 - N/A
1 - disabled	9 - disabled
2 - N/A	10 - N/A
3 - enabled	11 - N/A
4 - N/A	12 - N/A
5 - N/A	13 - N/A
6 - N/A	14 - N/A
7 - N/A	15 - N/A

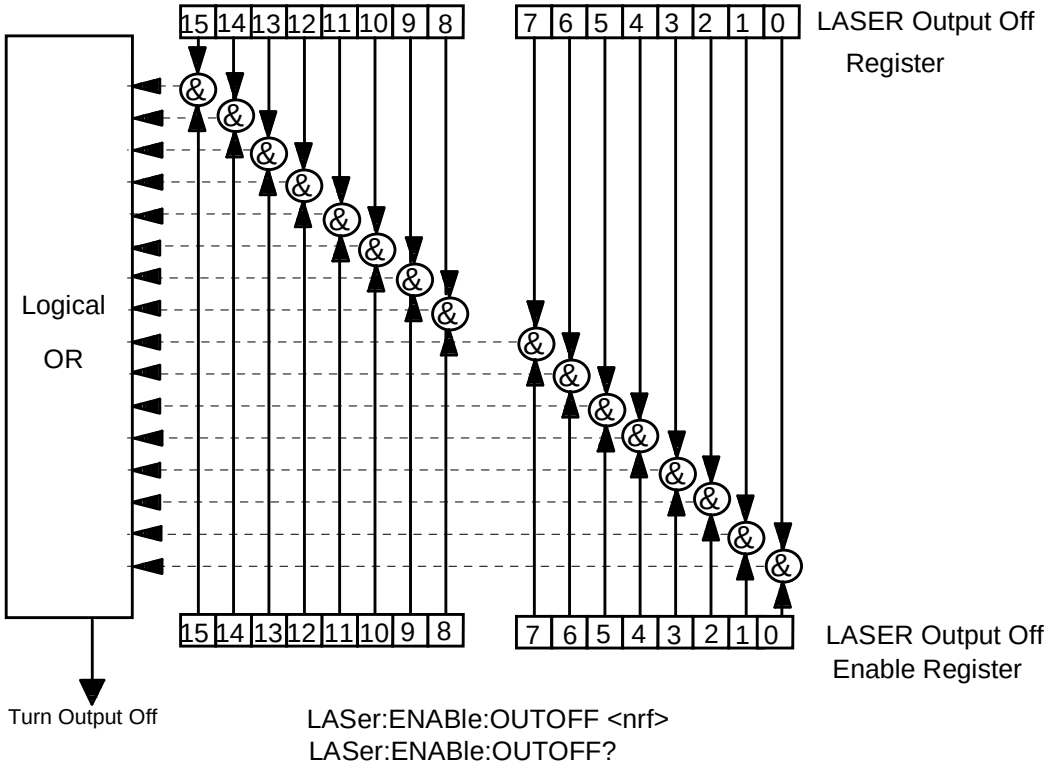


Figure 3.3 LDX-32420 Output Off Register

0 - LASER Current Limit	8 - N/A
1 - LASER Voltage Limit	9 - LASER Output Changed to be Out of Tolerance
2 - N/A	10 - N/A
3 - LASER Power Limit (output on)	11 - High Temperature Limit Condition
4 - N/A	12 - N/A
5 - N/A	13 - N/A
6 - N/A	14 - N/A
7 - N/A	15 - N/A

Command Timing and Completion

This section describes, for each device-dependent command, whether that command is performed in an overlapped or sequential manner. In other words, it states whether the next command may begin while the current command is being executed, or if the next command must wait until the current command is completed before its execution begins. The conditions for setting the operation complete flag are given in the Chapter 3 section titled Operation Complete Definition.

All LDX-32420 device-dependent commands are executed in an overlapped manner, except the `DELAY` command. 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 that 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 that 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 is done to ensure that the OPC flag is never set prematurely.

Whenever there is any output (response) data in the Output Queue, bit 4 is set in the Status Byte Register. Whenever there is any error message in the Error Queue, bit 7 is set in the Status Byte Register.

Error Messages

In the event of a hardware error condition, error messages will be displayed on the display. In most cases, the error message will appear for three seconds. In some cases the error code display will remain until the user changes display modes. In the case of multiple error messages, the display may sequentially show each message for three seconds. In addition to the hardware errors, remote command errors may be read via the ERR? query. Table 3.4 lists the numerical error ranges by function. Table 3.5 contains all of the error messages that may be generated. Not all of these messages may appear on the front panel displays. Some refer to remote operation activities only.

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

Table 3.4 Error Code Classifications

Error Code Range	Area of Operation
E-001 to E-099	Internal Program Errors
E-100 to E-199	Parser Errors
E-200 to E-299	Execution Control Errors
E-300 to E-399	Communication Errors
E-500 to E-599	LASER Control Errors

Table 3.5 LDX-32420 Series Error Codes

Error Code	Explanation
E-001	Memory allocation failure
E-103	<DEFINITE LENGTH ARBITRARY BLOCK PROGRAM DATA> length too long
E-104	<NON-DECIMAL NUMERIC PROGRAM DATA> type not defined
E-105	<DECIMAL PROGRAM DATA> exponent not valid
E-106	<DECIMAL PROGRAM DATA> digit expected
E-123	Command not found
E-124	<program mnemonic> Lookup, failed because query/command type match failed
E-126	Too few or too many program data elements
E-201	<PROGRAM DATA> value out of range
E-202	<PROGRAM DATA> will not convert to valid type
E-203	Security violation, command is not available without clearance

Error Code	Explanation
E-205	<PROGRAM DATA> is not a Boolean value or word
E-207	<PROGRAM DATA> will not convert to an unsigned 16-bit value
E-209	<PROGRAM DATA> will not convert to an unsigned 32-bit value
E-210	<PROGRAM DATA> will not convert to a floating point value
E-211	<PROGRAM DATA> will not convert to a character value
E-213	<PROGRAM DATA> is incorrect block data length
E-214	<PROGRAM DATA> length exceeds maximum
E-302	Query error; device was addressed to talk, but GPIB controller failed to read all of the <RESPONSE MESSAGE>
E-501	LASER interlock disabled output
E-503	LASER open circuit disabled output
E-504	LASER current limit disabled output
E-505	LASER voltage limit disabled output
E-507	LASER power limit disabled output
E-510	LASER out of tolerance disabled output
E-511	LASER control error disabled output
E-512	Analog section status is all 1's or all 0's (power down)
E-513	Serial EEPROM checksum error
E-515	Laser output must be off to change ranges
E-516	Incorrect configuration for calibration sequence to start
E-519	Setting a measurement is only valid during the calibration phase for that measurement; user has tried to calibrate a measurement without first entering the required calibration mode.

CHAPTER 4

COMMAND REFERENCE

This chapter is a guide to all of the device-dependent commands for the LDX-32420 High Power Precision Current Source. It is divided into two parts; a command list and a command reference. Table 4.1 lists all of the device dependent commands. The remainder of the chapter describes each command in alphabetical order with the command name, path, parameters and examples.

Table 4.1 LDX-32420 Series Device-Dependent Commands

Name	Parameters	Function
DELAY	1	Used to create a delay in the execution of further commands
ERR?	NONE	Returns errors generated since the last query
LAS:CALMD	1	Used to set the CAL PD (monitor responsivity) constant
LAS:CALMD?	NONE	Returns the CAL PD (monitor responsivity) constant
LAS:CAL:LDI	NONE	Used to enter the laser current calibration mode
LAS:CAL:LDI?	NONE	Returns the ready state for entering the laser current calibration value
LAS:CAL:LDV	NONE	Used to enter the laser voltage calibration mode
LAS:CAL:LDV?	NONE	Returns the ready state for entering the laser voltage calibration mode
LAS:CAL:MDI	NONE	Used to enter the monitor photodiode current calibration mode
LAS:CAL:MDI?	NONE	Returns the ready state for entering the monitor photodiode current calibration value
LAS:COND?	NONE	Returns the value of the LASER condition register
LAS:DEC	0, 1 or 2	Used to decrease the laser current setpoint value by one or more steps
LAS:DIS	1	Turns the LASER display on or off
LAS:DIS?	NONE	Returns the LASER display value
LAS:DIS:LDI	NONE	Turn on/off LASER display to show laser output current

Name	Parameters	Function
LAS:DIS:LDI?	NONE	Returns status of laser output current display, on/off
LAS:DIS:LDV	NONE	Turn on/off LASER display to show laser output voltage
LAS:DIS:LDV?	NONE	Returns status of laser output voltage display, on/off
LAS:DIS:MDI	NONE	Turn on/off LASER display to show photodiode monitor current
LAS:DIS:MDI?	NONE	Returns status of photo diode monitor current display, on/off
LAS:DIS:MDP	NONE	Turns on/off LASER display to show photodiode monitor power
LAS:DIS:MDP?	NONE	Returns status of photodiode monitor power display, on/off
LAS:DIS:PARAM	NONE	Enables LASER display to show parameter values
LAS:DIS:SET	NONE	Shows the LASER display setpoint corresponding to mode
LAS:DIS:SET?	NONE	Returns status of LASER setpoint display, on/off
LAS:ENAB:COND	1	Sets the enable register for LASER conditions
LAS:ENAB:COND?	NONE	Returns the value of the LAS conditions enable register
LAS:ENAB:EVE	1	Sets the enable register for LAS events
LAS:ENAB:EVE?	NONE	Returns the value of the LAS event enable register
LAS:ENAB:OUTOFF	1	Sets the enable register for LAS conditions, that turn the LAS output off
LAS:ENAB:OUTOFF?	NONE	Returns the value of the LAS outoff enable register
LAS:EVENT?	NONE	Returns the value of the LAS event register
LAS:LDI	1	Used to set the LASER constant current source setpoint value
LAS:LDI?	NONE	Used to return the constant current source measured value
LAS:INC	0, 1, or 2	Used to increment the LASER setpoint value by one or more steps
LAS:LDV	1	Used to set the laser voltage value for calibration
LAS:LDV?	NONE	Returns the measured laser voltage value
LAS:LIM:ILOW	1	Used to set the LASER low range current source limit
LAS:LIM:ILOW?	NONE	Returns the LASER low range current source limit
LAS:LIM:IHIGH	1	Used to set the LASER high range current source limit
LAS:LIM:IHIGH?	NONE	Returns the LASER high range current source limit
LAS:LIM:MDP	1	Used to set the constant optical power (from monitor photodiode) limit value
LAS:LIM:MDP?	NONE	Used to return the optical power (from monitor photodiode) limit value

Name	Parameters	Function
LAS:LIM:V	1	Used to set the LASER compliance voltage limit value
LAS:LIM:V?	NONE	Used to return the LASER compliance voltage limit value
LAS:MDI	1	Used to set the constant optical power setpoint, if photodiode responsivity is 0
LAS:MDI?	NONE	Used to return the monitor photodiode current measured value
LAS:MDP	1	Used to set the constant optical power setpoint
LAS:MDP?	NONE	Returns the actual monitor photodiode power value
LAS:MODE?	NONE	Returns the mode, I (current), IHBW (high bandwidth), or P (optical power)
LAS:MODE:IHBW	NONE	Sets the mode to constant current, high bandwidth
LAS:MODE:ILBW	NONE	Sets the mode to constant current, low bandwidth
LAS:MODE:MDP	NONE	Sets the mode to constant optical power mode
LAS:OUT	1	Used to enable/disable the current source output
LAS:OUT?	NONE	Returns the current source output status
LAS:RAN	1	Sets the laser current output range
LAS:RAN?	NONE	Returns the laser current output range
LAS:SET:LDI?	NONE	Returns the laser constant I (current) setpoint
LAS:SET:MDI?	NONE	Returns the laser constant optical power setpoint
LAS:SET:MDP?	NONE	Returns the constant P (optical power) setpoint
LAS:STEP	1	Used to set the LASER setpoint step value
LAS:STEP?	NONE	Returns the LASER setpoint step value
LAS:TOL	2	Used to set the LASER setpoint tolerance value and time period value
LAS:TOL?	NONE	Used to return the LASER setpoint tolerance value and time period value
MES	1	Used to enter a string message of up to 16 bits
MES?	NONE	Returns a previously stored ASCII message
RAD	1	Sets the radix type for numerical data; decimal, binary, octal or hexadecimal
RAD?	NONE	Used to return the radix type for numerical data
TERM	1	Used to add 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

LDX-32420 Device-Dependent Command Reference

This section contains all of device-dependent commands for the LDX-32420 High Power Precision Current Source, listed in alphabetical order. Sub-sections for each path are presented, listing the commands that are legal for that path. See Figure 3.1 for command path tree structure. Figure 4.1 shows the format for the device command descriptions. The commands that emulate local (front panel) operation are denoted by “Front Panel” in bold text at the upper right hand corner of the command description.

The following pages contain a reference for the device-dependent commands. This reference serves as useful information for both local and remote operation. References to the front panel switch labels are capitalized in the following reference pages (as is done throughout this manual). For example, a reference to the LOCAL switch is meant to signify the switch labeled “LOCAL” on the front panel.

In some references, parentheses are used to signify the section label for a particular switch or LED indicator on the front panel. For example, (PARAMETER) SET refers to the switch labeled “SET” in the PARAMETER section of the front panel.

DELAY <nrf value>

FRONT PANEL
REMOTE

The DELAY command causes the execution of commands to be delayed by a user-defined time. 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> that represents the delay time in milliseconds.
Notes	The Operation-Complete flag is held false until the delay period elapses, but the *OPC? query will not execute until the delay period has elapsed. This command is useful for creating delays that don't require a lot of program code and don't tie up the communication bus during execution. The delay time is approximate, with an error of about ±10%.
Examples	"DELAY 500" - action: Further commands and queries are not executed until about 0.5 seconds have elapsed from the time this command is executed.

Note: Care should be taken to set the GPIB time-out appropriately for use with the Delay command.

Note: When using the USB interface, queries requested before the delay command will not return the result of the query until after the delay.

ERRors?

FRONT PANEL
REMOTE

The ERRors? query returns a list of command and device errors that have occurred since the last query. These errors are notated by a number that corresponds to the type of error that occurred. See Chapter 3 for more information regarding error handling.

Parameters	None
Notes	The response data will be a list of the current errors. The errors are represented by numbers and are separated by commas. A response of 0 indicates that no errors were reported. The response data is sent as character data. Up to 10 error codes are stored between error queries.
Examples	"ERR?" - response: 0, means no errors reported. "ERRors?" - response: 201, means that the <PROGRAM DATA> (parameter) value out of range error was reported since the last ERR? query.

LASer:CALMD <responsivity>
LASer:CALMD?

FRONT PANEL
REMOTE

The LASer:CALMD command sets the laser's photodiode feedback responsivity, the CAL PD parameter.

The LASer:CALMD? query returns this setting.

Parameters: Responsivity:, in μA/mW. The range is 0.01 to 100.00.

Notes: If the parameter is set to 0, the LDX-32420 will operate in a constant I_{PD} mode, when Constant P (MDP) mode is selected.

The parameter should be set to 0 for I_{PD} operation modes. Otherwise, the value of this parameter is used to convert between I_{PD} and P_{PD} values. The units of this parameter are μA/mW.

If this value is 0, the front panel P_{PD} will display "-.-" and no P_{PD} value can be calculated.

Examples: "LAS:CALMD 0.1" - action: sets the CAL PD parameter to 0.1. Therefore, a measured PD current of 100 μA will equate to an optical power of 1000 mW (1W).

"LASER:CALMD?" - response: 0, means the LDX-32420 is set for operation in constant I_{PD} mode (if P mode is also selected).

LASer:CAL:LDI
LASer:CAL:LDI?

FRONT PANEL
REMOTE

The LASer:CAL:LDI command is used to enter the LASER current setpoint, measurement, and limit calibration mode.

The LASer:CAL:LDI? query is used to determine that the LDX-32420 is ready for a value to be entered during the calibration cycle of the LASer:CAL:LDI mode.

Notes: Since the limit circuit is the same for both high and low bandwidth modes, it is only calibrated when low bandwidth mode is selected.

After LASer:CAL:LDI is issued, the LDX-32420 will allow calibration of the current setpoint, measurement, and limit (if low bandwidth mode is selected). This procedure is outlined in Chapter 6.

The calibration defaults to the selected bandwidth setting. Therefore, it is necessary to select the desired bandwidth (I or I_{HBW}) and turn the LASER output on before performing the calibration for that bandwidth.

Calibration is performed at the current setpoint, wherever it is set. If the LASER output is not on, E516 is displayed.

Examples: "Las:CAL:LdI" - action: the LDX-32420 enters calibration mode for LASER current.

LASer:CAL:LDI?" - response: 1, means the LDX-32420 is ready for the user to enter a current value via the LASer:LDI command.

LASer:CAL:LDV
LASer:CAL:LDV?

FRONT PANEL
REMOTE

The LASer:CAL:LDV command is used to enter the LASER voltage measurement calibration mode.

The LASer:CAL:LDV? query is used to determine that the LDX-32420 is ready for a value to be entered during the calibration cycle of the LASer:CAL:LDV mode.

Notes — After LASer:CAL:LDV is issued, the LDX-32420 will allow calibration of the laser voltage measurement. This procedure is outlined in Chapter 6.

Examples — "Las:CAL:Ldv" - action: the LDX-32420 enters calibration mode for LASER voltage.

"LASer:CAL:LDV?" - response: 1, means the LDX-32420 is ready for the user to enter a voltage value via the LASer:LDV command.

LASer:CAL:MDI
LASer:CAL:MDI?

FRONT PANEL
REMOTE

The LASer:CAL:MDI command is used to enter the LASER photodiode current calibration mode.

The LASer:CAL:MDI? query is used to determine that the LDX-32420 is ready for a value to be entered during the calibration cycle of the LASer:CAL:MDI mode.

Notes — After LASer:CAL:MDI is issued, the LDX-32420 will automatically enter the LASER photodiode current calibration mode. When the LDX-32420 is ready, the user should enter the measured value. This procedure is outlined in Chapter 6.

If the LASER output is not ON or if the P mode is not selected, error code E-516 will be generated.

Examples — "Las:CAL:MDI" - action: the LDX-32420 enters the LASER photodiode current calibration mode.

LAS:CAL:MDI?" - response: 1, means the LDX-32420 is ready for the user to enter a photodiode current value via the LASer:MDI command

LASer:COND?

FRONT PANEL
REMOTE

The LASer:COND? query returns the value of the status condition register of the LASER operations.

-where the response is the sum of the following:

1	LASER Current Limit	256	Output is shorted
2	LASER Voltage Limit	512	Output is outside tolerance limit
4	N/A	1024	Output on/off state
8	Power limit	2048	Ready for calibration data state
16	Interlock disabled	4096	N/A
32	N/A	8192	N/A
64	Compliance Voltage Limit	16384	N/A
128	Open circuit	32768	N/A

Notes

The LASER conditions that are reported to the status byte are set via the LASer:ENABle:COND command.

The Open circuit condition is only present while the LASER output is on, and when the hardware detects this condition, it will turn the LASER output off. Therefore, the Open Circuit condition is fleeting and may be missed via the LAS:COND? query. Therefore, the user should test for the Open Circuit Event via the LAS:EVEnt? query.

The LASER condition status is constantly changing, while the event status is only cleared when the event status is read or the *CLS command is issued.

Examples

"LAS:COND?" - response: 513, means that the LASER limit current and out of tolerance LASER conditions currently exist.

"Radix Hex; Laser:Cond?" - response: #H108, means that the LASER Output shorted and Power limit conditions currently exist.

LASer:DEC [<steps[,<delay>]]

FRONT PANEL
REMOTE

The LASer:DEC command decrements the selected laser control mode setpoint by one or more steps. Optional parameters allow multiple steps to be decremented and the time (in milliseconds) between decrements to be set, respectively. This is an overlapped command. Other commands may be executed while this function is in progress.

Parameters
Steps: optional parameter indicating number of steps
Delay: optional parameter specifying the number of milliseconds between steps.

Notes
The default step amount is one step. The step size can be edited via the LAS:STEP command. LDX-32420 default values are 0.001 A, 0.01 W, or 1 µA (if CALMD = 0).

If the step parameter is specified, but not the delay parameter, the user may decrement the LASER setpoint by a multiple of the LAS:STEP size, without changing the LAS:STEP size.

If both parameters are used, the user may create an automated stepping ramp function for the LASER output.

If the first parameter is entered as zero, "LAS:DEC 0", the command will do nothing.

The minimum time to complete one decrement is about 20 ms. Therefore, values for the second optional parameter (time between decrements) have a practical minimum of 20.

Examples
"LAS:MODE:I; LAS:STEP 3; LAS:DEC" - action: The laser source current setpoint is decremented by 0.003 A.

"LAS:MODE:I; LAS:STEP 3; LAS:DEC 3" - action: The laser source current setpoint is decremented by three times the amount described in the first example.

"LAS:MODE:I; LAS:STEP 3; LAS:DEC 3,5000" - action: The laser source current setpoint is decremented by the amount described in the first example, three times, with five seconds between decremental steps.

LASer:DISplay {ON, OFF}
LASer:DISplay?

FRONT PANEL
REMOTE

The LASer:DISplay command enables or disables (turns off) the display and some LEDs

The LASer:DISplay? query returns the value shown on the display.

Notes
Turning the display and LEDs off means that a message of all blank spaces is sent to the display, and most of the LEDs will be turned off.

LASer:DISplay? returns the actual (6-character) string from the output buffer to the display. If the display is disabled, it returns " .".

Examples
"las:dis 1" - action: turns the LASER display on and enables the LASER indicator LEDs.

"LAS:DIS?" - response: "- 99.9", means the LASER display shows "- 99.9".

LASer:DISplay:LDI
LASer:DISplay:LDI?

FRONT PANEL
REMOTE

The LASer:DISplay:LDI command sets the laser display to show the constant current measurement value.

The LASer:DISplay:LDI? query returns the status of the LDI measurement display mode.

- where the response is 0 or 1.

Notes

The LDI measurement display mode is turned off automatically when another display selection is enabled.

In local operation, the status of the LDI measurement display mode is indicated by the enunciator next to the display (A will be illuminated and not blinking when the display is in LDI measurement mode).

Examples

"LAS:DIS:LDI" - action: enables the display for laser current values.

“LAS:DIS:LDI?" - response: 0, means that the LDI measurement is not displayed.

LASer:DISplay:LDV
LASer:DISplay:LDV?

FRONT PANEL
REMOTE

The LASer:DISplay:LDV command sets the laser display to show the laser forward voltage measurement.

The LASer:DISplay:LDV? query returns the status of the LDV (laser diode voltage) measurement display mode.

- where the response is 0 or 1.

Notes

The LDV measurement mode is turned off automatically when another display selection is enabled.

In local operation, the status of the LDV measurement mode is indicated by the enunciator next to the display (V will be illuminated when the display is in LDV measurement mode).

Examples

"LAS:DIS:LDV" - action: enables the display for LDV measurement mode.

“LAS:DIS:LDV?" - response: 0, means that laser voltage measurement is not displayed.

LASer:DISplay:MDI
LASer:DISplay:MDI?

FRONT PANEL
REMOTE

The LASer:DISplay:MDI command sets the laser display to show the monitor photodiode current measurement.

The LASer:DISplay:MDI? query returns the status of the (LASER DISPLAY) I_{PD} switch.

- where the response is 0 or 1

Parameters: None

Notes: The MDI measurement display is turned off automatically when another display selection is enabled.

In local operation, the status of the MDI measurement mode is indicated by the enunciator next to the display (µA will be illuminated and not blinking when the display is in MDI measurement mode).

Examples: "LAS:DIS:MDI" - action: enables the display for photodiode current measurement values.

"LAS:DIS:MDI?" - response: 0, means that the laser photodiode monitor current measurement is not displayed.

LASer:DISplay:MDP
LASer:DISplay:MDP?

FRONT PANEL
REMOTE

The LASer:DISplay:MDP command sets the display to show the monitor photodiode power measurement.

The LASer:DISplay:MDP? query returns the status of the MDP (monitor diode power) measurement display mode.

- where the response is 0 or 1.

Parameters: None

Notes: The MDP measurement display is turned off automatically when another display selection is enabled.

In local operation, the status of the MDP measurement mode is indicated by the enunciator next to the display (W will be illuminated and not blinking when the display is in MDP measurement mode).

Examples: "Las:Display:MDp" - action: enables the display for photodiode power measurement values.

"LAS:DISp:MDp?" - response: 0, means that the MDP measurement is not displayed.

LASer:DISplay:PARAM

FRONT PANEL
REMOTE

The LASer:DISplay:PARAM command enables the display to show the parameter values.

Parameters: None

Notes: This command has the same effect as pressing the (PARAMETER) SELECT switch. The selected parameter will be displayed for three seconds. The actual LASER PARAM display is turned off automatically when a display selection is enabled.

Each time the command is issued, the next LASER parameter will be selected, see Chapter 2 for more information.

Examples: "Laser:Display:Param" - action: selects a parameter and displays its value.

LASer:DISplay:SET
LASer:DISplay:SET?

FRONT PANEL
REMOTE

The LASer:DISplay:SET command sets the display to show the setpoint of the selected display mode.

The LASer:DISplay:SET? query returns the status of the setpoint display mode.

- where the response is 0 or 1.

Notes: LASer:DISplay:SET has the same effect as physically holding the (DISPLAY) SELECT switch down continuously.

The setpoint display will not time out when REMOTE operation is used. (It will be continuously displayed.)

Examples: "Las:Dis:Set" - action: enables the display for the setpoint of the selected mode: LDI, MDI (I_{PD}) or MDP (P_{PD})

"LAS:DISPLAY:SET?" - response: 0, means the setpoint is not shown on the display.

LASer:ENABle:COND <flags>
LASer:ENABle:COND?

FRONT PANEL
REMOTE

The LASer:ENABle:COND command sets the condition status enable register of the LASER operations for summary (in bit 3 of the status byte) and generation of service requests.

The LASer:ENABle:COND? query returns the value of the status condition enable register of the LASer operations.

Parameters — Flags: an integer whose sum represents the enabled bits:

1	LASER Current Limit	256	Output is shorted
2	LASER Voltage Limit	512	Output is outside tolerance limit
4	N/A	1024	Output on/off state
8	Power limit	2048	Ready for calibration data state
16	Interlock disabled	4096	N/A
32	N/A	8192	N/A
64	Compliance Voltage Limit	16384	N/A
128	Open circuit	32768	N/A

Notes — If any of the enabled LASER conditions are true, bit 3 of the status byte register will be set.

The enable registers normally retain their values at power-up (as they were at power-down) unless the power-on status clear flag is set true (for more information see the *PSC definition, in the GPIB-IEEE488 specification).

Examples — "LAS:ENAB:COND 129" - action: enables the LASER status condition register so that the Open circuit and LASER current limit conditions will be summarized in the status byte (bit 3).

"LAS:ENAB:COND?" - response: 17, means that the Laser Current Limit and Interlock disabled LASER conditions will be reported (in summarized form) to the status byte (bit 3).

LASer:ENABle:EVEnt <flags>
LASer:ENABle:EVEnt?

FRONT PANEL
REMOTE

The LASer:ENABle:EVEnt command sets the status event enable register of the LASER operations. These events are summarized in bit 2 of the status byte register.

The LASer:ENABle:EVEnt? query returns the value of the status event enable register of the LASER operation.

Parameters — An <nrf value> whose sum represents the bits that are enabled:

1	LASER Current Limit	256	Output is shorted
2	LASER Voltage Limit	512	Output changed to be in/out of tolerance
4	N/A	1024	Output on/off state changed
8	Power limit	2048	New measurements taken
16	Interlock changed state	4096	N/A
32	N/A	8192	N/A
64	Compliance Voltage Limit	16384	N/A
128	Open circuit	32768	N/A

Notes — The enable registers normally retain their values at power-up (as they were at power-down) unless the power-on status clear flag is set true (for more information see the *PSC definition, in the GPIB-IEEE488 specification).

Examples — "LAS:ENAB:EVENT 136" - action: enables the LASER status event register so that the Open circuit and Power limit events will be reported (in summarized form) to the status byte (bit 2).

"LAS:ENAB:EVE?" - response: 1040, means that the Output on/off state change and Interlock changed LASER events will be reported (in summarized form) to the status byte register (bit 2).

LASer:ENABle:OUTOFF <flags>
LASer:ENABle:OUTOFF?

FRONT PANEL
REMOTE

The LASer:ENABle:OUTOFF command sets the status outoff enable register of the LASER operations (things that will turn the LASER output off).

The LASer:ENABle:OUTOFF? query returns the value of the status outoff enable register of the LASER operations.

Parameters — Flags: an integer whose sum represents the enabled bits:

1	LASER Current Limit	256	N/A
2	LASER Voltage Limit	512	Output is out of tolerance*
4	N/A	1024	N/A
8	Power limit (with output on)	2048	N/A
16	N/A	4096	N/A
32	N/A	8192	N/A
64	N/A	16384	N/A
128	N/A	32768	N/A

Notes — The enable registers normally retain their values at power-up (as they were at power-down) unless the power-on status clear flag is set true (for more information see the *PSC definition, in the GPIB-IEEE488 specification).

The factory default value for this register is #B0000100000001000, #H808, or 2056 decimal.

Examples — "LAS:ENAB:OUTOFF 9" - action: enables the LASER status outoff register so that Power limit and LASER current limit conditions will cause the LASER output to be turned off.

"LAS:ENAB:OUTOFF?" - response: 1, means that Current Limit Condition will cause the LASER output to be turned off.

LASer:EVEnt?

FRONT PANEL
REMOTE

The LASer:EVEnt? query returns the value of the status event register of the LASER operations.

- where the response is the sum of the following:

1	LASER Current Limit	256	Output is shorted
2	LASER Voltage Limit	512	Output changed to be in/out of tolerance
4	N/A	1024	Output on/off state changed
8	Power limit	2048	Measurement ready
16	Interlock disabled	4096	N/A
32	N/A	8192	N/A
64	Compliance Voltage Limit	16384	N/A
128	Open circuit	32768	N/A

Notes

The LASER conditions that are reported in the status byte can be set by using the LASer:ENABle:EVEnt command.

The LASER event status is only cleared when the event status is read or by the *CLS command while the condition status is constantly changing.

Examples

"LAS:EVE?" - response: 513, means that the LASER output tolerance changed and current limit events have occurred since the last LASer:EVEnt? query.

"Radix Hex; Laser:Event?" - response: #H88, means that the LASER Power limit and Open circuit events have occurred since the last LASer:EVEnt? query.

LASer:INC [<steps>[,<delay>]]

FRONT PANEL
REMOTE

The LASer:INC command increments the selected laser control mode setpoint by one or more steps. Optional parameters allow multiple steps to be incremented and the time (in ms) between increments to be set, respectively. This is an overlapped command. Other commands may be executed while this function is in progress.

Parameters

Steps: optional parameter indicating how many times to step
Delay: optional parameter specifying the number of milliseconds between steps.

Notes

The default step amount is one. The step size can be edited via the LAS:STEP command. LDX-32420 default values are 0.001 A, 0.01 W, or 1 µA.

If the step parameter is specified, but not the delay, the LASER setpoint is incremented by a multiple of the LAS:STEP size without changing the LAS:STEP size. The delay is the time, in ms, between steps.

If both parameters are used, the user may create an automated stepping ramp function for the LASER output.

If the steps is entered as zero, “LAS:INC 0”, the command will do nothing.

The minimum time to complete one increment is about 20 ms. Therefore, values for the second optional parameter (time between increments) have a practical minimum of 20.

This command should not be overlapped with “LAS:DEC” or other “LAS:INC” commands.

Examples

“LAS:MODE:I; LAS:STEP 3; LAS:INC” -action: The laser source current setpoint is incremented by 0.003 A.

“LAS:MODE:I; LAS:STEP 3; LAS:INC 3” -action: The laser source current setpoint is incremented by three times the amount described in the first example.

“LAS:MODE:I; LAS:STEP 3; LAS:INC 3,5000” - action: The laser source current setpoint is incremented by the amount described in the first example, three times, with five seconds between incremental steps.

“LAS:STEP 1; LAS:Mode:P; Las:INC” - action: The power setpoint is incremented by 0.01 W.

LASer:LDI <Amps>
LASer:LDI?

FRONT PANEL
REMOTE

The LASer:LDI command sets the laser control current setpoint.

The LASer:LDI? query returns the value of the measured laser current.

- where the response is the most recent laser current measurement.

Parameters

Amps: represents the (laser) output current setpoint in A.

Notes

Setpoint is the same for both low and high bandwidth output modes.

Response is the measured laser output current for either low or high bandwidth modes. This measurement is updated approximately once every 600 ms.

Examples

"Las:LDI 4" - action: sets the laser output current setpoint to 4.00 A.

"LAS:ldi?" - response: 15.0, means the measured laser output current is 15.0 A.

LASer:LDV <Volts>
LASer:LDV?

FRONT PANEL
REMOTE

The LASer:LDV command sets the laser voltage for calibration of the laser voltage measurement.

The LASer:LDV? query returns the value of the measured laser voltage.

- where the response is the measured laser output voltage for either low or high bandwidth modes.

Parameters: Volts: represents the (laser) output voltage, in volts.

The LASer:LDV? measurement is updated approximately once every 600 ms.

Notes: The setpoint is the same for both low and high bandwidth output modes and is entered only for LDV calibration.

Examples: "Las:LDV 4" - action: enters a value of 4.000 V.

"LAS:ldv?" - response: 3.03, means the measured laser output voltage is 3.03 V.

LASer:LIMit:ILOW <Amps>
LASer:LIMit:ILOW?

FRONT PANEL
REMOTE

The LASer:LIMit:ILOW command sets the LASER current limit value for the 10 A range on the LDX-32420.

The LASer:LIMit:ILOW? query returns the value of the LASER current limit for the 10 A range on the LDX-32420.

Parameters: Amps: represents the LASER limit current, in A.

Notes: The current limit is in effect in all modes of operation (ILBW, IHBW, or P). The current limit in use depends on the LASER output range selection.

Examples: "LAS:LIM:ILOW 8" - action: the LASER current limit is set to 8 A.

"LAS:LIM:ILOW 4.5?" - response: 4.5, means the laser current limit is 4.5 A.

LASer:LIMit:IHIGH <Amps>
LASer:LIMit:IHIGH?

FRONT PANEL
REMOTE

The LASer:LIMit:IHIGH command sets the LASER current limit value for the 20 A range on the LDX-32420.

The LASer:LIMit:IHIGH? query returns the value of the LASER current limit for the 20 A on the LDX-32420.

Parameters: Amps: represents the LASER limit current, in A.

Notes: The current limit is in effect in all modes of operation (ILBW, IHBW, or P). The current limit in use depends on the LASER output range selection.

Examples: "LAS:LIM:IHIGH 15.5" - action: the LASER current limit is set to 15.5 A.

"LAS:LIM:IHIGH?" - response: 12, means the laser current limit is 12 A.

LASer:LIMit:MDP <Watts>
LASer:LIMit:MDP?

FRONT PANEL
REMOTE

The LASer:LIMit:MDP command sets the laser monitor photodiode power limit value.

The LASer:LIMit:MDP? query returns the value of the laser monitor photodiode power limit.

Parameters: Watts: represents the laser monitor photodiode power limit in W.

Notes: When constant MDP mode is used, the output level is limited only by the LIM I value. Exceeding the power limit will either cause the output to shut off (default) or generate a warning (see LAS:ENAB:OUTOFF command).

The (LASER) MDP limit is in effect for both laser output current ranges.

The MDP limit is not in effect when CALMD=0. In this case, the monitor current measurement is not converted to power.

Examples: "LAS:LIM:MDP 10" - action: sets the laser output power limit to a value that corresponds to producing 10.00 W of photodiode feedback (optical) power.

"LAS:LIM:MDP?" - response: 3.0, means the monitor photodiode power limit is set to 3.0 W.

LASer:LIMit:V <Volts>
LASer:LIMIT:V?

FRONT PANEL
REMOTE

The LASer:LIMit:V command sets the LASER compliance voltage limit value.

The LASer:LIMit:V? query returns the value of the LASER compliance voltage limit setting.

Parameters: Volts: represents the LASER limit voltage, in volts.

Notes: The voltage limit setting is useful for laser protection. This limit is internal to the LDX-32420, therefore cable and connection losses must be added in addition to the laser forward voltage. If the laser is accidentally disconnected, the current source will quickly sense the over-voltage and shut off.

The voltage limit is valid for all modes of Laser operation.

Examples: "LAS:LIM:V 4.0" - action: the LASER compliance voltage limit is set to 4.0 V.

"LAS:LIM:V?" - response: 3.5, means the laser compliance voltage limit is 3.5 V.

LASer:MDI <µAmps>
LASer:MDI?

FRONT PANEL
REMOTE

The LASer:MDI command sets the value of the optical power setpoint, in µA, if the CALMD (CAL PD) responsivity is 0.

The LASer:MDI? query returns the value of the laser photodetector current measurement in µA.

Parameters µAmps: represents the photodiode feedback current, in µA.

Notes If the CALMD (CAL PD) parameter is not set to 0, the LAS:MDI value will not be used. In this case, the measured MDI would be converted to MDP (P_{PD}, by the CAL PD factor), and the MDP (P_{PD}) setpoint would be used.

The response is in µA. The response is valid, even when the unit is not in constant P mode.

This measurement is updated approximately once every 600 ms.

Examples "Las:Mdi 40" - action: The LASER output is controlled so that the photodiode feedback current remains constant at 40 µA.

"Las:Mode:MDP; Las:Calmd 0; Las:MDi?" - response: 100.0, means 100 µA of photodetector current. This feedback is controlling the laser current output.

LASer:MDP <Watts>
LASer:MDP?

FRONT PANEL
REMOTE

The LASer:MDP command sets the value of the optical power setpoint in W if the CALMD (CAL PD) responsivity is greater than 0.

The LASer:MDP? query returns the value of the laser photodetector power measurement in W.

Parameters Watts: represents the photodiode feedback power in W.

Notes If the CALMD (CAL PD) parameter is set to 0, the LAS:MDP value will not be used. In this case, the measured MDP would be invalid, and the MDI (I_{PD}) setpoint would be used.

The response is in W. The response is valid, even when the unit is not in constant P mode. This measurement is updated approximately once every 600 ms.

Examples "Las:Mdp 40" - action: The LASER output is controlled so that the photodiode feedback power remains constant at 40 W.

"Las:Mode:MDP; Las:Calmd 46; Las:MDp?" - response: 20, means 20 W of photodetector power. This feedback is controlling the laser current output.

LASer:MODE?

FRONT PANEL
REMOTE

The LASer:MODE? query returns the selected laser control mode.

Notes I_{HBW} mode is the same as I mode (low bandwidth), except that the output low bandpass filter is disabled in I_{HBW} mode.

Examples "LAS:MODE?" - response: ILBW, means that constant I (current) mode is in effect for the laser output.

LASer:MODE:IHBW

FRONT PANEL
REMOTE

The LASer:MODE:IHBW command selects laser high bandwidth constant current mode.

Notes — This mode of operation is constant I mode with the output low pass filter disabled.

Examples — "LAS:Mode:Ihbw" - action: enables the laser high bandwidth constant current mode.

LASer:MODE:ILBW

FRONT PANEL
REMOTE

The LASer:MODE:ILBW command selects laser constant current mode.

Notes — Constant I mode (low bandwidth) enables the output low bandpass filter.

Examples — "LAS:MODE:ILBW" - action: sets the laser output for constant I mode (low bandwidth).

LASer:MODE:MDP

FRONT PANEL
REMOTE

The LASer:MODE:MDP command selects laser constant power mode.

Notes — This mode of laser operation requires the laser's monitor photodiode feedback to maintain constant optical power or constant monitor current.

In this mode, the displayed parameter will be either I_{PD} (if CALMD=0) in µA, or P_{PD} (if CALMD>0) in W.

Examples — "LAS:MODE:MDP" - action: sets the laser output mode of operation to constant optical power mode.

LASer:OUTput <0,1,ON,OFF>
LASer:OUTput?

FRONT PANEL
REMOTE

The LASer:OUTput command turns the laser output on or off.

The LASer:OUTput? query returns the status of the laser output switch.

Parameters
1, ON = current source is on

0, OFF = current source is off; shorting protection enabled

Notes
There is a two-second delay after the output is turned on before the output shorting relay is opened. Following this, the output current ramps up to the current setpoint slowly to protect the laser. Therefore, the time to turn the output on and reach the setpoint current varies from two to about three seconds.

After the output is turned on, it may be useful to wait until the output is stable (within tolerance) before performing further operations.

When the LASER output is off, an internal short is placed across the output terminals; it is safe to connect or disconnect devices to the LASER output terminals.

Although the status of the switch is on, the output may not have reached the setpoint value.

Examples
"LAS:I 2; LAS:OUT ON" - action: sets the laser output current to 2 A and then enables the output.

"Las:OUT?" - response: 0, means that the output switch is disabled.

LASer:RANge <HIGH,LOW>
LASer:RANge?

FRONT PANEL
REMOTE

The LASer:RANge command selects the laser's drive current output range.

The LASer:RANge? query returns the value of the Laser Drive Current range.

Parameters
HIGH, LOW: represent the laser current output range.

HIGH = 20A range; LOW = 10A range

Notes
This range setting effects the Laser Drive Current output current range only. The Laser Drive Current output should be “off” when this command is issued. If the Laser Diode Current output is “on” when this command is issued, the LDX-32420 will generate error E515, and the range will not be changed.

The resolution and accuracy of the laser limit current are dependent on the Laser Drive Current output range.

Examples
"LAS:RAN HIGH" - action: sets the laser output drive current range to 20 A.

"LAS:RAN?" -response: LOW, means that the Laser Drive Current range is 10 A.

LASer:SET:LDI?

FRONT PANEL
REMOTE

The LASer:SET:LDI? query returns the constant current setpoint value that is used for both output ranges and both bandwidths.

- where the response is the constant I setpoint value, in A.

Examples "LAS:SET:LDI?" - response: 5.000, means the laser output current setpoint value is 5.000 A.

LASer:SET:MDI?

FRONT PANEL
REMOTE

The LASer:SET:MDI? query returns the laser monitor photodiode current setpoint value (when CALPD=0), in µA.

Notes The monitor photodiode current is directly proportional to the laser optical output power. Therefore, the MDI (I_{PD}) setpoint may be used to control optical output of the laser.

Examples "las:set:mdi?" - response: 30.0, means the laser monitor photodiode current is setpoint is 30 µA, for use in constant P mode with CALPD = 0.

LASer:SET:MDP?

FRONT PANEL
REMOTE

The LASer:SET:MDP? query returns the laser monitor photodiode power setpoint value (when CALMD [CAL PD] is not zero), in mW.

- where the response is the constant P_{PD} setpoint, in mW.

Examples "LAS:Set:MDP?" - response: 10.0, means the laser monitor photodiode feedback setpoint is 10.0 W (CALPD>0).

LASer:STEP <step size>
LASer:STEP?

FRONT PANEL
REMOTE

The LASer:STEP command is used to increment or decrement the selected laser control mode setpoint by the given amount, when used with the LASer:INC or LASer:DEC command.

The LASer:STEP? query is used to read back the LASer STEP value.

Parameters Step size: an integer value in the range 1 to 9999 that is multiplied by resolution to determine the step size.

Notes The step of one corresponds to the smallest display resolution for the mode. For example, a step of one means 0.001 A, 0.01 W, or 1 µA.

Examples "Las:Mode:i; Las:Idi 5; Las:Step 100; Las:Inc; Las:set:Idi?" -action: sets the step to 0.100 A, so the Las:set:Idi? query will return a value of 5.100 A.

"Las:Mode:LDI; Las:Step?" - response: 1 means the step size is 0.001 A, since Const Current mode is in effect.

LASer:TOLerance <Amps>,<Time>
LASer:TOLerance?

FRONT PANEL
REMOTE

The LASer:TOLerance command allows the programmer to determine the LASER current tolerance and time window for it to occur, in order that the operation complete flag be set after a "LASer:OUTput 1" command is issued or the LASER setpoint is changed.

The LASer:TOLerance? query allows the programmer to determine how the LASER current tolerance is set.

- the response consists of two values, the first is the current tolerance in A and the second is the time window, in seconds.

Parameters: Amps: represents the LASER current tolerance in A with a range of 0.001 to 1.000 A.

Time: represents the time window, in seconds, with a range of 0.001 to 50.000 seconds.

Notes: The LDX-32420 defaults to a tolerance of 0.010 A for three seconds, unless changed by the LASer:TOLerance command.

If the LDX-32420 is operated in P mode, the current tolerance parameter is not used. Instead a fixed value of 50 µA is used for the I_{PD} current. A fixed value of 0.1 W is used for P_{PD} power, and only the time window parameter may be adjusted.

The tolerance of the LDX-32420 LASER current may be used to delay programming after an "LASer:OUTput 1" command is issued or the setpoint is changed.

A change of the output into or out of tolerance flag sets a flag in the LASER status event register and so entering or exiting LASER current tolerance may be used to generate service requests.

Note: If the tolerance is set too tight it may never be achieved. This is due to the calibration of the setpoint and measurement values.

Examples: "Las:Tol 0.005,10" - action: the LDX-32420's LASER current source will be in tolerance when the LASER current is within 0.005 A for 10.000 seconds.

"Las:Tol?" - response: "0.002,5.0", means the LDX-32420 has a LASER current tolerance setting of 0.002 A with a time window of 5.000 seconds.

MESsage <string>
MESsage?

FRONT PANEL
REMOTE

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

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

Parameters: String: 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 terminate the string.

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

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

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

RADix {DEC,BIN,HEX,OCT}
RADix?

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.

The RADix? query allows the programmer to determine that radix type is currently selected.

- where the character response data of DEC means decimal, BIN means binary, HEX means hexadecimal, and OCT means octal.

Parameters

DEC = Decimal (default)

BIN = Binary

HEX = Hexadecimal

OCT = Octal

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.

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.

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 dec" - action: the decimal radix is selected.

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

TERM <0,1,FALSE,TRUE>
TERM?

FRONT PANEL
REMOTE

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

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

- where the response is 0 or 1.

Parameters: 0, FALSE =uses <NL><^END> termination

1, TRUE = uses <NR><NL><^END> termination

Notes: An altered terminator will be in the form <CR><NL><^END>. This technically takes the LDX-32420 out of GPIB/IEEE488 specification, but may be done for convenience when using non standard GPIB controllers. This termination will be sent with all output until the "TERM 0" command is sent or the LDX-32420 is powered off.

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 LDX-32420 is powered off. This command has no affect over USB.

Examples: "Term 1" - temporarily sets <CR><NL><^END> as the output terminator.

"Term?" - response: 1, means that the <CR><NL><^END> terminator is temporarily being used.

TIME?

FRONT PANEL
REMOTE

The TIME? query allows the programmer to determine how much time has passed since the LDX-32420 was last powered up.

- where the response is character data in the form: hours:minutes:seconds.

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

Examples: "Time?" - response: 1:02.36, means that one minute and 2.36 seconds have passed since the LDX-32420 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.

- where the response is character data that represents 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.

The timer counter is initially set at power-up, the same as the TIME? counter. So the first time the TIMER? is issued its response will be the same as if a TIME? query's response.

Examples: "Timer?" -response: 00:02:00.31, means the LDX-32420 has been on for two minutes and 0.31 seconds since the last TIMER? query was issued.

CHAPTER 5

FUNCTIONS AND FEATURES

This chapter introduces you to the LDX-32420 High Power Precision Current Source functions and operating features such as event triggering, analog modulation of laser injection current, and Save and Recall.

Saving and Recalling from the Front Panel

For applications where you might need to alternate between particular instrument configurations, the LDX-32420 Current Source offers a unique SAVE and RECALL feature. The SAVE feature allows you to easily store all front panel settings for any given instrument configuration. These settings, that are stored in one of ten memory bins, can be retrieved at any time with the RECALL function. This saves setup time, and it reduces the chance of setup error for tests that are periodically repeated. For example, using the configuration described in Chapter 2 where the Current Source is operating in Constant Current mode, the instrument parameters saved by using the SAVE function would be Constant Current Mode, 10A range, a limit setpoint of 8A, a laser current setpoint of 7.5A, and Display Mode I. Once this setup is saved, the LDX-32420 Current Source may be configured for another unique setup. You can recall the original setup for the first experiment any time using the RECALL function.

To enter the SAVE/RECALL mode, press the SELECT switch in the PARAMETER section until the SAVE indicator LED becomes lit and the unit displays the SAVE "bin" on the display. If another bin number is desired, press the SET switch and rotate the adjust knob until the desired bin number is displayed. Releasing the SET knob for three seconds completes the SAVE operation and all of the instrument parameters are saved to the indicated bin number as they appear on the front panel.

To recall a previously saved instrument setup, press the SELECT switch until the RECALL indicator led becomes lit. The instrument will display a RECALL "bin" number on the display. If you desire to change the RECALL bin, press the SET switch then rotate the adjust knob until the desired bin number is displayed.

Releasing the knob for three seconds completes the RECALL operation. The instrument is restarted and the front panel parameters are reconfigured to the new parameters saved under that bin number.

The factory default values for front panel parameters may be restored by recalling "bin" zero (0). See Table 2.1 for the default settings.

Saving and Recalling Under Remote Operation

For saving under remote operation, use the command *SAV *x*, where *x* is the desired "bin" number (1-10). For a recall under remote operation, use the command *RCL *x*, where *x* is the desired "bin" number (0 - 10).

Using the Laser Compliance Voltage Adjustment

For applications where you need to have critical protection of the laser, we recommend the following. Using a resistor or other non-critical load, set the LASER voltage limit as described in Chapter 2.

Then with the LASER output on, slowly increase the LASER current and watch the LASER voltage measurement. Press the (DISPLAY) SELECT push button to see the voltage. At about 0.25 V below the LASER voltage limit value, the VOLTAGE LIMIT warning indicator will become lit on the display. Continue to adjust the current upwards until the voltage limit is reached and the output is shut off. Record the voltage at the value that the LASER output shuts off. It should be within the specification of the LASER voltage limit accuracy. However, there is typically some offset error. For example, if the LASER voltage limit is set to 4.0 V, the actual voltage where it shuts off may be 3.9 V. This error term of 0.1 V should be considered when setting the LASER compliance voltage limit.

The closer the LASER voltage limit shut off point is to the operating voltage of your laser, the faster the circuit will work in the event of an open circuit. Some experimentation may be necessary for optimum results.

Using the LDX-32420 Current Source's Trigger Function

For applications where you need to synchronously initiate a measurement task from a remote instrument with the LDX-32420 Current Source, the Current Source offers a trigger output signal. The TTL pulse is initiated with any remote change in setpoint of the laser current source. A typical application for utilization of this feature is laser characterization tasks where an L-I curve is generated. For a programmed step in laser current, a measurement can be triggered for each step in laser current. The trigger output is enabled automatically in remote mode.

The trigger output is available via a standard BNC connector on the rear panel of the LDX-32420 Current Source. See Figure 5.1. The TTL pulse is approximately 13 μs wide and has a delay time of about 10-12 ms after the current setpoint is changed via remote command. This delay does not include transmission time. The time for any command to be sent depends on the interface hardware and software control. The current setpoint may be changed by the LAS:LDI, LAS:INC, or LAS:DEC commands.

Note: The minimum step change time required for a corresponding trigger pulse is 20 ms. Care should be used with respect to the timing of any setpoint commands in relation to the actual hardware function. The INC and DEC commands have a minimum step time of about 20 ms that allows for the hardware initiation of a setpoint change and the settling of the output. The LAS:LDI command does not have any fixed delay for settling. With this command, some trigger pulses may be missed if the program step time is less than the 20 ms minimum.

A one shot trigger pulse will occur on power up of the instrument due to the states of the processor I/O.



Figure 5.1 LDX-32420 Rear Panel

Using Interlock 2

The Interlock 2 connection is designed to allow an external emergency input signal to turn the current output off. The interlock is TTL compatible and configured to be normally high. The BNC interlock connection, when left unconnected, is pulled to a logic high with a 100 kΩ resistor. High values (+5 V) will keep the current source in the operational state, while low values (0 V) forces the output off. Once the BNC interlock is low, the output will stay off until the interlock is high again, and you re-enable the output.

Interlock 2 Usage Example

When using the LDX-32420 Current Source to drive a temperature controlled laser diode, Interlock 2 can be used to accept an error signal from the laser diode temperature controller unit. Linking the LDX-32420 Current Source to a temperature controller* with the ability to signal when its temperature control has gone outside of some tolerance window will allow the LDX-32420 to safely disable the current source output before thermal damage occurs to the laser diode.

*The ILX Lightwave LDT-5900 series of temperature controllers include an output BNC connector that is compatible with the BNC interlock feature of the LDX-32420. The output BNC connector of the LDT-5900 has a TTL compatible output signal that will signal when the temperature control has gone outside of a programmable temperature window. For more information about the LDT-5900 series of temperature controllers, go to www.ilxlightwave.com.

Modulating the Laser Current Source

The LDX-32420 Current Source allows a modulated signal to be superimposed on the source output current. The allowable bandwidth of the modulated analog signal, defined as the 3 dB roll off point, is dependent on the output current range and the mode (constant current low/high bandwidth). See the section, LASER CURRENT SOURCE SPECIFICATIONS, in Chapter 1 for external analog modulation bandwidth specifications.



Setting up the Current Source for a modulated laser injection current is easy. The (MOD) EXTERNAL connector (BNC) on the front panel is the input for the modulated signal. Connect a modulating voltage signal from a standard function generator, for example, to this connector. The modulation port input impedance is 1 kΩ. The transfer function for the low and high current ranges of the LDX-32420 are 1A/V and 2 A/V.



Set the LDX-32420 in Constant Current High Bandwidth Mode by selecting I_{HBW} in the MODE section of the front panel. Do this by toggling the (MODE) SELECT push button until the I_{HBW} indicator is illuminated. Repeatedly pressing the (MODE) SELECT switch cycles through the current (I), optical power (P), or high bandwidth current (I_{HBW}) control modes.



Next, set the current source range by selecting the 10A range indicated by the accompanying LED. You will need to press the select push button twice to change the range. It must be pressed twice quickly (within less than one second) to switch between modes, and the current source output must be off (MODE ON indicator unlit) in order to change ranges.

The limit clamp function for DC output current applies to the modulated current as well protecting your laser in any mode. To accomplish setting the current source limit, use the (PARAMETER) SELECT push button LIM I. Press the (PARAMETER) SET pushbutton then rotate the adjust knob. Set the limit to 7.5A. After three seconds, the new parameter value is stored in non-volatile memory.

When the laser current limit is reached, the CURRENT LIMIT error indicator flashes. The current limit setting is independent of the voltage drop of the device connected to the laser output, and therefore, no dummy load is required for precise adjustment of the current limit. Furthermore, since the current limit circuitry is fully independent of the main current control, the current limit can be adjusted safely, even while the current source output is active.

Now you are ready to modulate the laser injection current. To enable the Current Source output, press the push button labeled (MODE) OUTPUT. The accompanying LED labeled ON will illuminate indicating that the laser current source's output is enabled. The instrument will drive the current source to the

value set by the corresponding MODE setpoint. Turn on the function generator (modulation source) to inject the modulation signal.

To disable the output, press the OUTPUT push button again. When the LDX-32420 current output is off, an internal short is placed across the output. This short will prevent the modulation signal from reaching the LED. Thus, it is safe to disconnect the test device when the LDX-32420's output is off, regardless of the presence of the modulation signal.

CHAPTER 6

CALIBRATION AND TROUBLESHOOTING

This chapter describes calibration of your LDX-32420 Series Current Source. Descriptions of the required test instruments, calibration conditions, and the detailed procedures for calibration of the instrument's Laser Diode Current Source are included. A troubleshooting guide is also offered for some of the more common failure symptoms.

Calibration Overview

There are several calibrations to be performed to completely calibrate your LDX-32420 Current Source. The calibration consists of calibrating the current source in both ranges and both modes (low and high bandwidth), calibrating the photodiode monitor current measurement and finally the forward voltage measurement. The current limits are calibrated internally by the instrument as part of the calibration process.

Your LDX-32420 Current Source can be calibrated with the case closed. Calibration is recommended every 12 months. Calibrate the instrument under laboratory conditions. We recommend calibration at 23°C ± 1.0°C. When necessary, however, the LDX-32420 Current Source may be calibrated at its intended use temperature if this is within the specified operating temperature range of 0 to 40°C.

Finally, the LDX-32420 Current Source should be allowed to warm up for at least one hour before calibration.

Recommended Equipment

Recommended test equipment for calibrating the LDX-32420 Current Source is listed in Table 6.1. Equipment other than that shown in the table may be used if the specifications meet or exceed those listed.

Table 6.1 Recommended Test Equipment

Description	Manufacturer/Model	Specification
DMM	Agilent 3458A	DC Amps 0.5 μA @ 5 mA DC Volts 500 μV @ 5V
Current Transducer	LEM IT 150-S	Accuracy 0.0043%
DC Power Supply	Agilent E3631	±15 V, 250 mA

The DC power supply is necessary to power the current transducer. The current transducer is used to reduce the current down to acceptable measurement ranges for the DMM. For most of the tests, the Laser Anode and Cathode connections are looped through the IT 150-S twice to increase the measurement sensitivity. In this configuration, the current from the transducer is 1/375th the current from the LDX-32420.

Calibration of the LDX-32420 Current Source

There are three calibration adjustments required for the current source. They are calibration of the constant current source for both bandwidths and ranges, calibration of the laser voltage measurement, and calibration of the constant light power (I_{PD}) feedback circuits.

The LDX-32420 Current Source implements a two-point calibration for the Laser current source. Two current levels (approximately 80% and 20% of FS) are applied to a test load, and the resulting current measurements are fed back (by the user) to the Current Source. The Laser Current Source calibration program uses the two sets of data to calculate new calibration constants. These calibration constants are used to set the actual current output of the current source.

Current Source Calibration

The following procedure is for calibrating each range of the current source. Calibration must be performed on both bandwidth modes. A total of four calibrations will be performed on the current source. Start with the low range, low bandwidth mode. Configure the Laser Current Source in the following state:

Function	State
MODE	I (constant current low bandwidth)
RANGE	LOW
CURRENT LIMIT	90% of FS (full scale of range)
SETPOINT	80% of FS

a. Connect the secondary current from the transducer to the DMM to measure current.

b. Configure the multimeter to measure current. You will be calculating the actual laser current by the relationship:

$I_{actual} = I_{measured}$ x CTR / N

- where CTR is the current transfer ratio of the transducer and N is the number of times the current from the LDX-32420 passes through the transducer.

c. Press the (MODE) ON switch to turn the current source output on. The output must be on in order to enter the LASER I calibration mode.

d. Enter the LASER I calibration mode by pushing the (GPIB) LOCAL and (DISPLAY) SELECT switches at the same time. The display will blank and the Current Source will drive the current output to the setpoint and the Display will indicate output current in mA.

e. Calculate the actual current through the transducer as described in step b. Press and hold in the (PARAMETER) SET switch and turn the adjust knob until the display indicates the calculated actual current.

f. Release the (PARAMETER) SET switch. After the (PARAMETER) SET switch is released, the Current Source will drive the current output to about 25% of the first calibration setpoint.

g. Calculate the measured current again through the transducer.

h. Press and hold in the (PARAMETER) SET switch and turn the adjust knob until the display indicates the actual current as calculated in step g.

i. Release the (PARAMETER) SET switch to accept the second calibration point. After the (PARAMETER) SET switch is released, the Current Source will calculate the calibration constants and store them to nonvolatile memory. In low bandwidth calibration mode, the LDX-32420 Series Current Source will also perform current limit calibration, indicated by the CURRENT LIMIT LED flashing.

j. Turn the current source output off. Change the Mode to I_{HBW} (high bandwidth constant current mode). Repeat the calibration procedure as described above.

k. Change the output range to high range and repeat the calibration procedure as described above.

I_{PD} Current Calibration

The following procedure is for calibrating the LASER I_{PD} (PD monitor) setpoint and measurement. This procedure calibrates the feedback circuits for constant I_{PD} and constant P_{PD} modes. When these values are reached and are stable, the user enters the actual value of the monitor current, measured with a DMM. The LDX-32420 Series Current Source then automatically calibrates the current measurement circuits.

Configure the Current Source in the following manner for the I_{PD} Current calibration:

Function	State
MODE	P (constant power)
RANGE	LOW
CAL PD	set equal to zero
CURRENT LIMIT	90% of FS (full scale of range)
I_{PD} SETPOINT *	80% of FS

* For this test, it is recommended that the current through the transducer primary only passes through once.

a. With the LASER output off, connect the secondary of the current transducer such that it first passes through the ammeter portion of the DMM and then into the PD anode. Connect PD cathode to transducer common. The DMM will now be able to directly measure PD current.

b. Press the (MODE) ON switch to turn the current source output on. Verify proper operation, i.e. the I_{PD} measurement (via DMM) and setpoint should be close, and the unit should not be in current limit.

c. Press the (GPIB) LOCAL and FINE switches at the same time to place the Current Source in its I_{PD} Current Calibration mode.

After a few seconds the display will show the I_{PD} setpoint value.

d. After the value on the display is stable (has not changed by more than one digit for several seconds) the LDX-32420 Current Source is ready for the actual I_{PD} value to be entered.

Press and hold in the (PARAMETER) SET switch and turn the adjust knob until the display shows the actual monitor current, as shown on the DMM (or the calculated I_{PD} value from Step a).

e. Release the (PARAMETER) SET switch to store the first calibration value. The Current Source will then set the second calibration current, approximately one-fourth (1/4) of the original current. (For example, if the first calibration setpoint was 4000 µA, the second setpoint will be about 1000 µA.)

f. Press and hold in the (PARAMETER) SET switch and turn the adjust knob until the display indicates the actual current as measured by the ammeter or as calculated.

g. Release the (PARAMETER) SET switch to accept the second calibration point. After the (PARAMETER) SET switch is released, the LDX-32420 Series Current Source will calculate the calibration constants and store them to nonvolatile memory.

Laser Forward Voltage Measurement Calibration

The following procedure is for calibrating the LASER voltage measurement.

Configure the Current Source in the following manner for the Laser Current Source Voltage calibration:

Function	State
LASER MODE	I (constant current low bandwidth)
RANGE	10A
CURRENT LIMIT	Set to FS (full scale of range)
I SETPOINT	8A

a. Connect a resistor in series with the secondary current from the transducer such that approximately 4V will be developed across the resistor with 10A of current from the LDX-32420. Connect the voltage sense wires from D-sub on the 32420 and the voltage sense lines from the voltmeter such that they measure voltage across the resistor.

b. Press the (MODE) ON switch to turn the current source output on. The current source output must be on in order to enter the LDV calibration mode.

c. Enter the LASER V calibration mode by pushing the (GPIB) LOCAL and RANGE switches at the same time. The display will blank and the Current Source will drive the LASER current output to the respective setpoint and the display will indicate forward voltage in Volts.

d. Enter the measured voltage (in volts). Press and hold in the (PARAMETER) SET switch and turn the adjust knob until the display indicates the measured voltage.

e. Once the actual voltage value is entered, the Current Source will set the current to approximately one-fourth (1/4) of the original value. It will then expect the second calibration voltage point.

f. Input the second actual (measured) LASER forward voltage as in Step d.

g. Once the second actual voltage value is entered, the Current Source will store the new calibration constants.

This ends the section on front panel calibration of your LDX-32420 Current Source. The next section discusses calibration through the GPIB/IEEE488 interface.

Remote Calibration of the LDX-32420 Current Source

The LDX-32420 Current Sources can be calibrated remotely. All of the required calibration commands are listed in Table 4.1 in Chapter 4. The procedures below are general guidelines for writing a program to calibrate your instrument.

Note: The operation complete flag (bit 0 of the Standard Event Status Register) may be used to trigger a service request. This type of interrupt is enabled by setting bit 0 of the Service Request Enable register (via the `*ESE` command) and bit 5 of the Service Request Enable register (via the `*SRE` command). Service request (SRQ) handling depends on your GPIB hardware. Refer to your GPIB user's manual for details.

After a calibration value is entered, the `*OPC?` query may be used to determine when the calibration sequence is done. However, the `*OPC`, `*WAI` command, or `*OPC?` query should not be issued until after the expected calibration value is entered, or the system will "hang". This happens because the LDX-32420 Current Source will wait indefinitely for an input, yet not allow any input until the calibration is finished.

Current Source Calibration

There are three calibration adjustments required for the LDX-32420 Current Source. They are calibration of the constant current source for both bandwidths and ranges, calibration of the laser voltage measurement, and calibration of the constant light power (I_{PD}) feedback circuits.

The LDX-32420 Current Source implements a two-point calibration for the current source. Two currents (approximately 20% and 80% of FS) are applied to a test load, and the resulting actual currents are fed back (by the user) to the current source. The laser current source calibration program uses the two sets of data to calculate new calibration constants. These calibration constants are used to set the actual current of the current source.

The following procedure is for calibrating each range of the current source. Start with the low range. After calibration is complete in this range, switch to the high range and repeat the procedure.

Configure the current source in the following manner for the laser current source calibration:

Function	State	COMMAND
LASER MODE	I (constant current low bandwidth)	`LAS:MODE:ILBW`
RANGE	Low (lowest per instrument model)	`LAS:RAN x`
LIMIT	90% of FS (full scale of range)	`LAS:LIM:Ix`
SETPOINT	80% of FS	`LAS:LDI`

a. Connect the secondary current from the transducer to the DMM to measure current.

b. Configure the multimeter to measure current. You will be calculating the actual laser current by the relationship:

$I_{actual} = I_{measured}$ x CTR / N

- where CTR is the current transfer ratio of the transducer and N is the number of times the current from the LDX-32420 passes through the transducer.

c. The current source output must be on in order to enter the LASER I calibration mode. Enter the `LAS:OUTPUT ON` command to turn the current source output on.

d. Enter the LASER I calibration mode by issuing the `LAS:CAL:LDI` command. The display will indicate a current in mA.

e. Input the first actual (measured) output current (as an `<nrf value>`) via the `LAS:LDI <nrf value>` command.

If this value is to be measured and entered remotely via a remote controlled DMM, for example, the measured value of the current should not be entered until the LDX-32420 Current Source is ready to receive it. The Current Source will be ready to receive the new measured value when, after a `LAS:CAL:LDI?` query is sent, the response from the Current Source is "1".

f. Once the newly measured I value is entered via the `LAS:LDI` command, the Current Source will apply a new current equal to about 25% of the previous set current.

g. Input the second actual (measured) output current (as an `<nrf value>`) as in Step e.

h. Once the second actual I value is entered via the `LAS:LDI` command, the new calibration constants will be calculated and stored into non-volatile memory. In low bandwidth calibration mode, the LDX-32420 Current Source will also perform current limit calibration as indicated by the CURRENT LIMIT LED flashing. The `OPC?` query may be used (after the `LAS:LDI` value is sent) to determine when the calibration is completed. Or, wait about two seconds before continuing with other commands.

i. Turn the current source output off. Change the Mode to I_{HBW} (high bandwidth constant current mode) with the `LAS:IHBW` command. Repeat the calibration procedure as described above.

I_{PD} Current Calibration

The following procedure is for calibration the LASER I_{PD} constant current source. This procedure calibrates the feedback circuits for constant I_{PD} and constant P_{PD} modes. When these values are reached and are stable, the user enters the actual value of the current, as measured by an external DMM. The LDX-32420 Current Source then automatically calibrates the current measurement circuits.

Configure the current source in the following manner for the I_{PD} current calibration:

Function	State	COMMAND
LASER MODE	P (constant power)	`LAS:MODE:MDP`
RANGE	Low (lowest per instrument model)	`LAS:RAN LOW`
LIMIT	90% of FS (full scale of range)	`LAS:LIM:ILOW`
I_{PD} SETPOINT *	80% of FS	`LAS:MDI`

* For this calibration, it is recommended that the current from the LDX-32420 only passes the primary of the current transducer once.

a. With the LASER output off, connect the secondary of the current transducer such that is first passes through the ammeter portion of the DMM and then into the PD anode. Connect PD cathode to transducer common. The DMM will now be able to directly measure PD current.

b. Enter the `LAS:OUT ON` command to turn the LASER output on. Verify proper operation, i.e. the IPD output should be close to the setpoint, and the unit should not be in current limit (read the limit status via the `LAS:COND?` query, bit 0).

c. Enter the `LAS:CAL:MDI` command to place the Current Source in its I_{PD} Current Calibration mode. The Current Source will increase the laser current output until the current at the PD monitor (I_{PD}) inputs equals the targeted setpoint.

d. After a few seconds, the Current Source will be ready for the actual I_{PD} current to be entered via the `LAS:MDI <nrf value>` command. The measured value of the current should not be entered until the Current Source is ready to receive it. The Current Source will be ready to receive the current value when, after a `LAS:CAL:MDI?` query is sent, the response from the Current Source is "1".

e. Once the actual I_{PD} value is entered via the `LAS:MDI <nrf value>` command, the Current Source will store the new calibration value. It will then set the output to approximately one-fourth (1/4) of the original current. (For example, if the first calibration setpoint was 4000 µA, the second setpoint will be 1000 µA.) Then, it will be ready to receive the second calibration value.

f. Input the second actual (measured) monitor diode current (as an `<nrf value>`) as in Step d.

g. Once the second actual IPD value is entered via the `LAS:MDI` command, the new calibration constants will be calculated and stored into non-volatile memory. The `OPC?` query may be used (after the `LAS:MDI` value is sent) to determine when the calibration is completed. Or, wait about two seconds before continuing with other GPIB commands.

Laser Forward Voltage Measurement Calibration

The following procedure is for calibrating the LASER voltage measurement.

Configure the current source in the following manner for the laser current source voltage calibration:

Function	State	Command
LASER MODE	I (constant current low bandwidth)	`LAS:MODE:ILBW`
RANGE	10A	`LAS:RANGE:LOW`
CURRENT LIMIT	Set to FS (full scale of range)	`LAS:LIM:ILOW 10`
I SETPOINT	8A	`LAS:LDI 8`

a. Connect a resistor in series with the secondary current from the transducer such that approximately 4V will be developed across this resistor with 10A of current from the LDX-32420. Connect the voltage sense wires from the D-sub on the 32420 and the voltage sense lines from the voltmeter such that they measure voltage across the resistor.

b. The current source output must be on in order to enter the LDV calibration mode. Enter the `LAS:OUT ON` command to turn the current source output on.

c. Enter the `LAS:CAL:LDV` command to place the Current Source in its LASER Voltage Calibration mode.

d. Enter the measured voltage (in volts) via the `LAS:LDV <nrf value>` command. The measured value of the voltage should not be entered until the LDX-32420 Current Source is ready to receive it. The current source will be ready to receive the voltage value when, after a `LAS:CAL:LDV?` query is sent, the response from the Current Source is "1".

e. Once the actual voltage value is entered via the `LAS:LDV <nrf value>` command, the Current Source will set the current to approximately one-fourth (1/4) of the original value. It will then expect the second calibration voltage point.

f. Input the second actual (measured) LASER forward voltage (as an `<nrf value>`) as in Step d.

g. Once the second actual voltage value is entered via the `LAS:LDV` command, the Current Source will store the new calibration constants. The `OPC?` query may be used (after the `LAS:LDV` value is sent) to determine when the calibration is completed. Or, wait about two seconds before continuing with other GPIB commands.

Troubleshooting Guide

This section is a guide to troubleshooting the LDX-32420 Current Sources. Some of the more common symptoms are listed here, and the appropriate troubleshooting actions are given. We recommend that the user start at the beginning of this guide. Read the symptom descriptions, and follow the steps for the corrective actions that apply. If you encounter problems that are beyond the scope of this guide, contact your ILX Lightwave customer service representative.

Symptom	Corrective Actions
GENERAL	
LDX-32420 unit will not power up	Check AC power line voltage and power cord connection.
Power on, but display is frozen and switches don't operate	This may occur if the instrument loses power (AC line) briefly. turn the power switch off and on again to restart.
Displays E514 on power up on display	Hold (COM) LOCAL button, RANGE button and FINE button as you are powering up the instrument. This clears the laser board EEPROM, LLLLL will be displayed on the display; the laser current source must be recalibrated.
Instrument resets at power up or any LASER mode change	Hold (COM) LOCAL button, RANGE button and FINE button as you are powering up the instrument. This clears the laser board EEPROM, LLLLL will be displayed on the display; the laser current source must be recalibrated.
LASER CURRENT SOURCE	
Power on, but no current output	Check interlock pins on the instrument rear panel; Interlock 1 must be shorted either directly or though a switch; Interlock 2 must be open or pulled TTL High. If OPEN CIRCUIT indicator is lit, check the load connections and then try again. Check the OUTPUT ON switch, the corresponding LED should be lit.
Output current at limit; can't be lowered	If POWER mode is used, check the monitor diode (feedback) connections; try reversing the polarity of the monitor photodiode; also check the photodiode bias adjustment on the rear panel. If in I or I_{HBW} mode, check the current setpoint and I LIMIT setting; setting the output below the limit may require several turns of the adjust know if the setpoint is much greater than the desired limit setting.
Output goes off intermittently	Check the interlock circuit; an intermittent interlock will turn the output off. Check that the AC power cord connection is secure; power line drop-outs may reset the unit and when power is restored, the output will be off.

Symptom	Corrective Actions
Unable to adjust output	Check the I LIMIT parameter for the output range in use, see that it is set above 0 A.
Power mode operation has high output current, but little or no power measured	Check back panel PD BIAS; if set too low, may act as an open feedback loop; if in doubt, set the PD BIAS to mid range (2.5 V)
Output exceeds power limit	The “power limit” is not a hardware limit. It only serves as a warning that the power measurement has exceeded the limit setpoint. Normally this limit will cause the output to shut off. This feature can be defeated via the LAS:ENABLE:OUTOFF command.
Open circuit error occurs during calibration	Check load connections; check that measuring meter does not auto-range (use non-auto-ranging modes).
Calibration is aborted unintentionally	Calibration modes will be aborted if an open circuit is detected.
VOLTAGE LIMIT indicator blinks	This indicates a voltage limit error; check laser connections. A high impedance may cause this condition.
Open circuit error E503 or voltage limit error E505 prevents output from reaching desired value	The LDX-32420 instruments have an adjustable laser compliance voltage. Check to see if the LASER voltage limit setting is too low (Chapter 2); check laser connections.

Error Messages

In the event of a hardware error condition, error messages will be displayed on the display. In most cases, the error message will appear for three seconds. In some cases the error code display will remain until the user changes display modes. In the case of multiple error messages, the display may sequentially show each message for three seconds. In addition to the hardware errors, errors may be read via the ERR? query. Table 6.2 lists the numerical error ranges by function. Table 6.3 contains all of the error messages that may be generated. Not all of these messages may appear on the front panel displays. Some refer to remote activities only.

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

Table 6.2 Error Code Classifications

Error Code Range	Area of Operation
E-001 to E-099	Internal Program Errors
E-100 to E-199	Parser Errors
E-200 to E-299	Execution Control Errors
E-300 to E-399	Communication Errors
E-500 to E-599	LASER Control Errors

Table 6.3 LDX-32420 Series Error Codes

Error Code	Explanation
E-001	Memory allocation failure
E-103	<DEFINITE LENGTH ARBITRARY BLOCK PROGRAM DATA> length too long
E-104	<NON-DECIMAL NUMERIC PROGRAM DATA> type not defined
E-105	<DECIMAL PROGRAM DATA> exponent not valid
E-106	<DECIMAL PROGRAM DATA> digit expected
E-123	Command not found
E-124	<program mnemonic> Lookup, failed because query/command type match failed
E-126	Too few or too many program data elements
E-201	<PROGRAM DATA> value out of range
E-202	<PROGRAM DATA> will not convert to valid type
Error Code	**Explanation**

E-203	Security violation, command is not available without clearance
E-205	<PROGRAM DATA> is not a Boolean value or word
E-207	<PROGRAM DATA> will not convert to an unsigned 16-bit value
E-209	<PROGRAM DATA> will not convert to an unsigned 32-bit value
E-210	<PROGRAM DATA> will not convert to a floating point value
E-211	<PROGRAM DATA> will not convert to a character value
E-213	<PROGRAM DATA> is incorrect block data length
E-214	<PROGRAM DATA> length exceeds maximum
E-302	Query error; device was addressed to talk, but GPIB controller failed to read all of the <RESPONSE MESSAGE>
E-501	LASER interlock disabled output
E-503	LASER open circuit disabled output
E-504	LASER current limit disabled output
E-505	LASER voltage limit disabled output
E-507	LASER power limit disabled output
E-510	LASER out of tolerance disabled output
E-511	LASER control error disabled output
E-512	Analog section status is all 1’s or all 0’s (power down)
E-513	Serial EEPROM checksum error
E-515	Laser output must be off to change ranges
E-516	Incorrect configuration for calibration sequence to start
E-519	Setting a measurement is only valid during the calibration phase for that measurement; user has tried to calibrate a measurement without first entering the required calibration mode.

Artisan Technology Group is an independent supplier of quality pre-owned equipment

Gold-standard solutions

Extend the life of your critical industrial, commercial, and military systems with our superior service and support.

We buy equipment

Planning to upgrade your current equipment? Have surplus equipment taking up shelf space? We'll give it a new home.

Learn more!

Visit us at **artisantg.com** for more info on price quotes, drivers, technical specifications, manuals, and documentation.

Artisan Scientific Corporation dba Artisan Technology Group is not an affiliate, representative, or authorized distributor for any manufacturer listed herein.

We're here to make your life easier. How can we help you today?

(217) 352-9330 | sales@artisantg.com | artisantg.com

ARTISAN® TECHNOLOGY GROUP