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User's Guide

Precision Current Sources
LDX-3500B Series



Newport®

Newport Corporation
31950 Frontage Road Bozeman, MT, USA
www.newport.com
PHONE: 1-800-459-9459 1-406-556-2481 FAX: 1-406-586-9405 EMAIL: sales@ilxlightwave.com
Complete listings for all global office locations are available online at www.newport.com/contact

Newport Corporation, Irvine and Santa Clara, California and Franklin, Massachusetts: Evry and Beaune-La-Rolande, France: Stahnsdorf, Germany and Wuxi, China have all been certified compliant with ISO 9001 by the British Standards Institution.

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SAFETY AND WARRANTY INFORMATION

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

Safety Information and the Manual

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



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



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



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

General Safety Considerations

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

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

If necessary, return the instrument to ILX Lightwave, or authorized local ILX Lightwave distributor, for service or repair to ensure that safety features are maintained (see the contact information 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 ix 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: . . . . . www.newport.com/b/ilx-lightwave

Email. . . . . support@ilxlightwave.com

Or mail to:

MKS / Newport
31950 Frontage Road
Bozeman, Montana, U.S.A 59715

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 manual contains operation and maintenance information for the LDX-3500B Series Precision Current Sources. If you want to get started right away, read Chapter 2, which covers Operation, first.

Product Overview

The LDX-3500B Series Precision Current Sources provide a high stability output with a fully redundant current limit and multiple laser protection features.

Available Options and Accessories

Options and accessories available for the LDX-3500B Series Precision Current Sources include rack mount kits, laser diode mounting fixtures, interconnect cables, and low noise filters.

Please contact ILX sales@ilxlightwave.com or visit us online at www.newport.com/b/ilxlightwave for information on accessories and options.

Specifications: LDX-3500B Series

	LDX-3525B	LDX-3545B	LDX-3565B
CURRENT OUTPUT			
Output Current Range:	200mA / 500mA	1000mA / 3000mA	2000mA / 6000mA
Setpoint Resolution:	12 bit (100 µA / 150 µA)	12 bit (250 µA / 750 µA)	12 bit (500 µA / 1.5mA)
Setpoint Accuracy (% of FS):[2]	±0.1% (±.2mA / ±.5mA)	±0.1% (±1mA / ±3mA)	±0.15% (±2mA / ±6mA)
Compliance Voltage:	7.0 V	6.0 V [3]	5.0 V [4]
Temperature Coefficient:	<50 ppm/°C	<50 ppm/°C	<50 ppm / <100 ppm/°C
Short-Term Stability (1 hr):[5]	<20 ppm	<20 ppm	<20 ppm
Long-Term Stability (24 hr):[6]	<50 ppm	<50 ppm	<50 ppm
Noise and Ripple (rms)[7]			
High Bandwidth Mode:	<4 µA rms /<4 µA rms	<25 µA rms /<25 µA rms	<50 µA rms /<100 µA rms
CW Mode:	<2 µA rms /<2 µA rms	<15 µA rms /<15 µA rms	<15 µA rms /<30 µA rms
Transients			
Operational: [8]	<1mA / <1mA	<2mA / <5mA	<30mA / <40mA
Power-line Induced:[9]	<10mA / <10mA	<20mA / <20mA	<20mA / <40mA
DRIVE CURRENT LIMIT SETTINGS			
Range:	0– 202.0mA / 0–505.0mA	0–1010mA / 0–3030mA	0–2020mA / 0–6060mA
Resolution:	1mA / 2mA	4mA / 12mA	8mA / 24mA
Accuracy (% of FS):	±1%[14]	±1%	±1%
PHOTODIODE FEEDBACK[13]			
Type:	Differential	Differential	Differential
Reverse Bias:	0–5 V, adjustable	0–5 V, adjustable	0–5 V, adjustable
Photodiode Current Range:	0–5000 µA	5–9999 µA	0.01–25mA
Output Stability: [10]	±0.01%	±0.02%	±0.02%
Setpoint Accuracy (% of FS):[2]	±0.1% (±5 µA)	±0.1% (±5 µA)	±0.1% (±5 µA)
Power Modulation BW:	1 kHz	1 kHz	1 kHz
ANALOG MODULATION			
Input:	0–10 V, 1 kΩ	0–10 V, 1 kΩ	0–10 V, 1 kΩ
Transfer Function (±15%):	20mA/V / 50mA/V	100mA/V / 300mA/V	200mA/V / 600 mA/V
Bandwidth (3dB)[11]			
High Bandwidth Mode:	DC–500 kHz / DC–150 kHz	DC–150 kHz / DC–50 kHz	DC–100/ DC–50 kHz
CW Mode:	DC–100 Hz / DC–100 Hz	DC–100 Hz / DC–100 Hz	DC–80 Hz / DC–80 Hz
ANALOG OUTPUT			
Output Voltage:	0–10 V	0–10 V	0–10 V
Transfer Function (±15% of FS):	20mA/V / 50 mA/V	100mA/V / 300 mA/V	200mA/V / 600 mA/V
MEASUREMENT (DISPLAY)			
Display Type:	4 digit green LED	4 digit green LED	4 digit green LED
Output Current Range:	0–200.0mA / 0–500.0mA	0–999.9mA / 0–3000mA	0–2000mA / 0–6000mA
Output Current Resolution:	0.1mA /0.1mA	0.1mA / 1.0mA	1.0mA / 1.0mA
Output Current Accuracy:	±0.1% of FS	±0.1% of FS	±0.15% of FS
Photodiode Current Range:	0–5.000mA	0–9.999mA	0–25.00mA
Photodiode Current Resolution:	0.001mA	0.002mA	0.01mA
Photodiode Current Accuracy:	±0.1% of FS	±0.1% of FS	±0.1% of FS
Photodiode Resposivity Range:[12]	0.001–1.000 mA/mW	0.001–1.000 mA/mW	0.001–1.000 mA/mW
Photodiode Responsivity Resolution:	0.001 mA/mW	0.001 mA/mW	0.001 mA/mW
Optical Power Range:	0–500.0 mW	0–3000 mW	0–6000 mW
Optical Power Resolution:	0.1 mW	1 mW	1 mW

CONNECTORS

Current Source Output:	9-pin, D-sub female
PD Input:	BNC rear panel; 9-pin D-sub laser connector
Modulation Input:	BNC front panel
Analog Output:	BNC rear panel
Chassis Ground:	4 mm Banana Jack
Interlock:	9-pin D-sub laser connector

LASER DIODE PROTECTION

Output Shorting Relay:	Normally closed
Output Enable Delay:	2s (per 21CFR 1040.10)
Current Limit:	Adjustable, redundant hardware limit
AC Power Failure / Brown-out Protection	
Hardware Fault Response Time	
Current Limit:	Continuous operation
Voltage Limit	5µS
Open Circuit:	50µS
Error Monitoring / Reporting:	Current limit, voltage limit, open circuit, optical power limit, interlock

GENERAL

Power Requirements, VAC (50–60Hz):	95–125, 210–250
Remote Interface:	USB 2.0
Size (HxWxD):	88 mm x 185 mm x 304 mm 3.5"x 7.3"x12.5"
Weight (LDX-3525B and LDX-3545B):	3.5 kg (7.65 lbs)
Weight (LDX-3565B):	4.6 kg (10.15 lbs)
Operating Temperature:	10°C to 40°C
Storage Temperature:	–40°C to 70°C
Humidity:	<85% relative, noncondensing
Laser Safety:	Keyswitch, Interlock, Output Delay (meets 21 CFR 1040.10),all models
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

In keeping with our commitment to continuing improvement, ILX Lightwave reserves the right to change specifications without notice or liability for such changes.

NOTES

1 All values measured after a one hour warm-up period.
2 Measured at 25°C ambient.
3 Maximum compliance voltage of 5V @ 95VAC input
4 Maximum compliance voltage of 3.5V @ 95VAC input
5 Over any 1-hour period, half-scale output @ 25°C ambient
6 Over any 24-hour period, half-scale output @ 25°C ambient
7 Measured electrically, with a resistive load evaluating AC coupled rms value over a 100 kHz bandwidth.
8 Maximum output current transient resulting from normal operational situations (e.g., power on-off, current on-off), as well as accidental situations (e.g., power line plug removal). Tested to ILX Technical Standard #LDC-00196.
9 Maximum output current transient resulting from a 1000V power line transient spike. Tested to ILX Technical standard #LDC-00196. Request ILX Application Note #3.
10 Maximum monitor photodiode current drift over any 30-minute period. Assumes zero drift in photodiode responsivity.
11 Assumes 50% modulation depth at half-scale output into a 1Ω load.
12 The responsivity value is user-defined and is used to calculate the optical power.
13 Laser diodes which have voltages above 1.2V when the current is <0.4% of range may trigger the instrument to shut down the output in constant power mode. In order to determine if your laser will function in constant power mode, please contact ILX Lightwave.
14 ± 2% for limit settings ≤20 mA.

ORDERING INFORMATION

LDX-3525B-120V	Precision Laser Diode Driver (200/500 mA), 120V
LDX-3525B-220V	Precision Laser Diode Driver (200/500 mA), 220V
LDX-3545B-110V	Precision Laser Diode Driver (1/3 A), 120V
LDX-3545B-220V	Precision Laser Diode Driver (1/3 A), 220V
LDX-3565B-120V	Precision Laser Diode Driver (2/6 A), 120V
LDX-3565B-220V	Precision Laser Diode Driver (2/6 A), 220V
CC-305S	Current Source/Laser Diode Mount Interconnect Cable
CC-306S	Current Source/Unterminated Interconnect Cable
LNF-320	Low Noise Filter
RM-134	Single Rack Mounting Kit
RM-135	Dual Rack Mounting Kit

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 our products. We invite you to contact us at any time with your suggestions.

CHAPTER 2

INSTALLATION AND OPERATION

This chapter describes how to install, adjust, and operate the LDX-3500B Series Precision Current Sources. It is divided into sections covering installation, familiarization and adjustment, and normal operating procedures.

Later in this chapter, there is an overview of the front panel features, and it presents a guide to quickly familiarize the user with the front panel operations.

Installation

AC Power Considerations

The LDX-3500B Series Current Sources are pre-configured to operate at nominal line voltages 100, 120, 220-240 VAC. This is done at the factory and cannot be changed. Be sure that the voltage marked on the back panel of the instrument matches the power-line voltage in your area.

WARNING

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.

Rack Mounting

The LDX-3500B Series Precision Current Source may be rack mounted by installing a rack mount flange on either side of the enclosure. All rack mount accessory kits contain detailed mounting instructions. See below for applicable rack mount accessory part numbers.

Description	Model Number
Single Rack Mount Flange Kit	RM-134
Dual Rack Mount Flange Kit	RM-135

Power-Up Sequence

With the LDX-3500B Series Precision Current Source connected to an AC power source, pressing the POWER switch will supply power to the instrument and start the power-up sequence.

During the power-up sequence, the following takes place. For about two seconds all indicators light up, and all of the 7-segment displays indicate "8". Then all lamps are turned off for two seconds. After this, the firmware version number is displayed for two seconds. After this, the instrument is configured to the state it was in when the power was last shut off.

Introduction to the LDX-3500B Series Front Panel

The LDX-3500B Series Precision Current Source's front panel consists of displays and controls for the current source hardware. Each of the labeled areas on the front panel (e.g. PARAMETER, MODE) is described in this chapter.

Refer to Figure 2.1 for the following discussions of the front panel sections. The key words are in capital letters for quick identification. Although an LDX-3525B front panel is shown, Figure 2.1 may be used for front panel familiarization with the LDX-3545B and LDX-3565B.

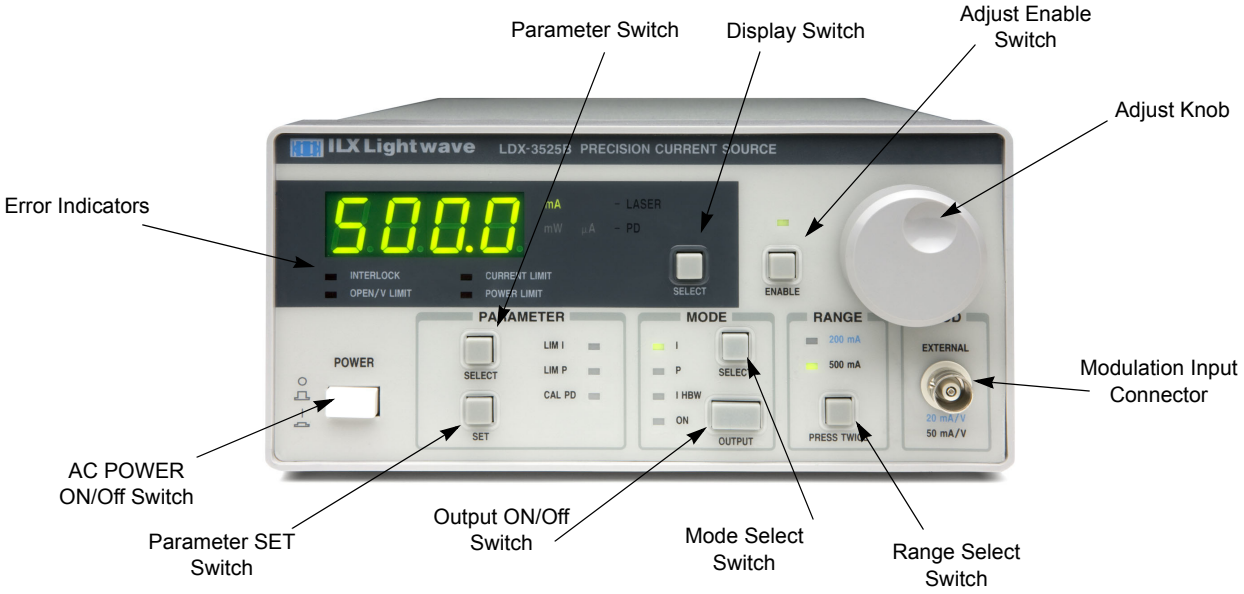


Figure 2.1 LDX-3525B Front Panel

Adjustments

The adjust section consists of the Adjust knob for entering current set point, power set point and parameter values. In order to make any set point or parameter adjustment, the ENABLE indicator must be illuminated. Pressing the ENABLE switch toggles the ENABLE indicator on or off.

Display

The four digit display is used to show current and power measurements, current and power set point, and parameter values. Whenever a set point is being displayed, the corresponding enunciator will blink.

The SELECT switch is used to select the measured current, power, uncalibrated photodiode, or the set point value. The set point type is determined by the MODE selection.

When in I or I HBW modes, the set point will be output current and the DISPLAY SELECT switch will toggle between output current measurement, power measurement, uncalibrated photodiode and output current setpoint. When in POWER mode, the set point will be laser power, and the display switch will toggle between laser power measurement, uncalibrated photodiode, laser power setpoint, and output current measurement.

Likewise, when the output is off, if the adjust knob is turned the control mode set point will be displayed for three seconds. If the set point is adjusted (by turning the adjust knob) the set point timer will be restarted. Therefore, three seconds after the set point is adjusted the display will return to the last measurement.

Parameters

The 3500B Series Precision Current Source allows adjustment of the following parameters, LIM I (output current limit), LIM P (laser power limit) and CAL PD (monitor photodiode responsivity).

When the LIM I is set, the hardware will limit the output current to the LIM I value, regardless of the set point or control mode.

When the LIM P is set and the user is in POWER mode, the LIM P will NOT limit the output current. If the power limit is reached in power mode, the power limit error indicator will blink as a warning.

The CAL PD parameter is used to convert monitor diode (back facet) current measurements to light power. The range of this parameter is 0.001 to 1.000 mA/mW. Setting CAL PD to 0.000 allows the user to measure the monitor diode current directly in μA.

Parameter Setup

The parameter SELECT switch is used to view and edit the parameters. Repeatedly pressing the parameter SELECT switch will cycle through the parameters.

When a parameter is selected for viewing, its value will remain on the display for three seconds. If an adjustment is made to the parameter (by pressing the parameter SET switch and turning the adjust knob) the three second timer will be restarted. Three seconds after the parameter adjustment is done, the display will revert to the last measurement mode.

Mode and Current Output

The MODE section contains the OUTPUT switch and indicator. The ON indicator is lit whenever the output is on. Pressing the ON switch will toggle the current output on or off.

Before the output turns on, the ON indicator will blink at a rate of 3Hz for two seconds. The output will then turn on.

Conditions Which Will Automatically Shut Off the OUTPUT

- 1. Interlock/ENABLE Key Lock State open
- 2. Open Circuit (While Output On)
- 3. Switching Ranges or Modes (While Output On)
- 4. Internal Overheating Sense Switch (LDX-3565 only)

Control Mode and Current Range

The mode SELECT switch is used to select the output control mode. Repeatedly pressing the SELECT switch cycles through the current, light power (P), and high bandwidth current (I HBW) control modes. The LED indicators show the selected mode. Changing the control mode forces the output off.

The RANGE switch is used to switch between the high and low laser current output ranges. Pressing the RANGE switch twice will change the output current range.

Modulation

The MOD-EXTERNAL connector (BNC) allows a modulation signal to be applied to the output. The bandwidth depends on the selected current range and bandwidth mode (see Specifications). Bandwidth specifications are measured across a 1Ω load. The modulation port input impedance is 10 kΩ. The transfer functions (mA/V) in Figure 2.1 is shown for the LDX-3525B. This transfer function varies by model and output current range and is summarized in Table 2.1.

Model	Low Range	High Range
LDX-3525B	20 mA/V	50 mA/V
LDX-3545B	100 mA/V	300 mA/V
LDX-3565B	200 mA/V	600 mA/V

Table 2.1 Modulation Transfer Functions

Error Indicators

Error indicators become lit when the corresponding conditions occur. The INTLK/ENBL light comes on whenever the back panel ENABLE switch or the interlock connections (pins 1 and 2 of the 9-pin connector) are open.

The OPEN/V LIM indicator becomes lit whenever an open circuit (or a high impedance condition) occurs on the output when the output is on. When the OPEN/V LIM condition occurs, the output will be shut off and the indicator will remain on until the problem is resolved and the output is turned on again. The OPEN/V LIM indicator blinks at 1 Hz whenever the output voltage is near its compliance limit. If this occurs, the impedance of the output load is too high and may cause the output to shut off if the output current is increased.

On the LDX-3565B, the OPEN/V LIM indicator also becomes lit whenever the internal overheating sense circuit senses an internal overheating condition and shuts the output off.

The current LIMIT indicator will blink at 1 Hz whenever the output current tries to exceed the LIM I value. A circuit is used to sense this condition, and the actual output current is limited to the LIM I value, regardless of operating mode.

The power LIMIT indicator blinks at 1 Hz whenever the output (laser) power exceeds the LIM P value while in the constant P mode. This indicator is just a warning device. There is no actual hardware limiting to a LIM P value. Therefore, the user should set LIM I appropriately to protect the laser.

Back Panel Controls and Connections

Refer to Figure 2.2 for the following discussions of back panel controls and connectors. For fuse replacement, please refer to Chapter 4, Maintenance.

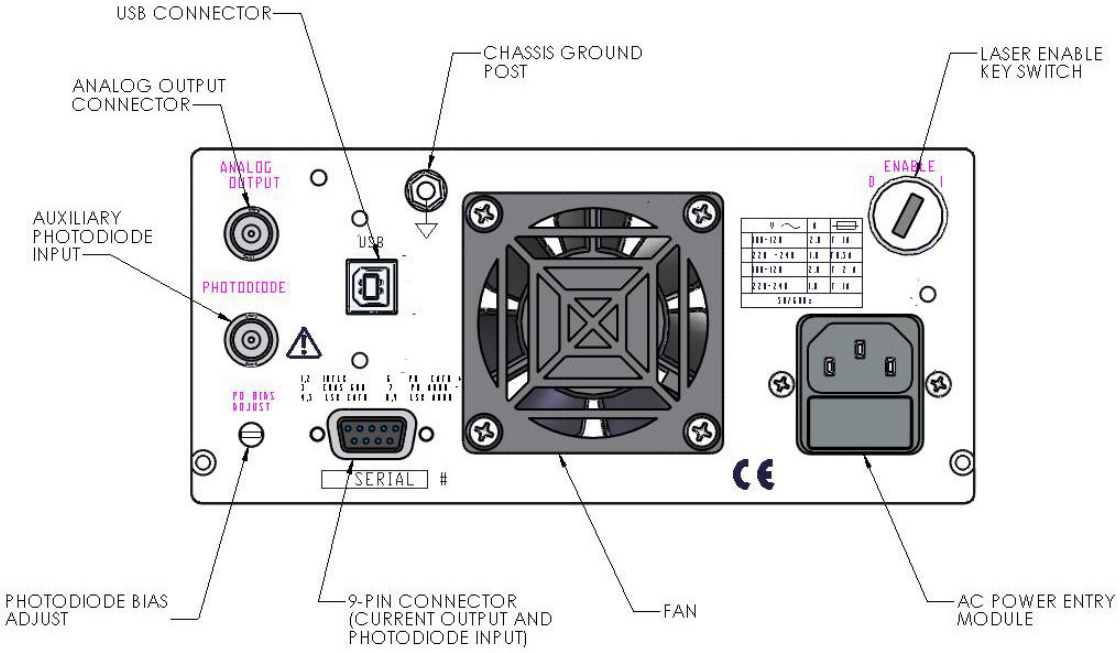


Figure 2.2 LDX-3500B Series Back Panel

The Laser Connectors

Near the bottom left corner of the back panel is the 9-pin D-sub connector for the laser diode connections. The pinout diagram for this connector is shown in Figure 2.3.

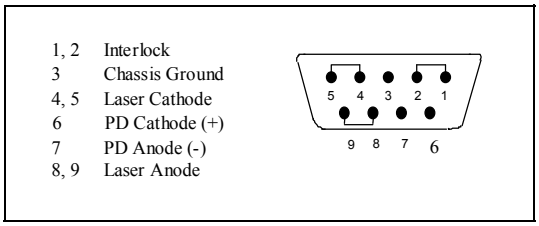


Figure 2.3 Back Panel LD Controller

The Interlock pins must be shorted in order to turn the LDX-3500B Series Precision Current Source output on.

The Photodiode BNC connector may also be used instead of pins 6 and 7 of the D-sub connector. The PD Cathode (+) is on the center connection to the BNC, and the PD Anode (-) is on the outer connection to the BNC.

Analog Output

An analog output signal is available at the ANALOG OUTPUT connector (BNC) on the back panel. This signal is a voltage between 0 - 10 volts which is proportional to the output current. For example, an analog output signal of 5 volts would represent an output current of about 50% of full scale.

Connecting to Your Laser

When connecting laser diodes and other sensitive devices to the LDX-3500B Series Precision Current Source, we recommend that the instrument be powered up and the LASER output be off. In this condition, a low impedance shunt is active across the output terminals. When disconnecting devices, it is only necessary to turn the LASER Output off.

Key Switch

The back panel ENABLE key switch is used to enable/disable the current output. The key must be turned clockwise for the laser output current to turn on. If this switch is in the off position, the front panel INTERLOCK error indicator will be lit.

Laser Diode Connections and Shielding

WARNING

Before connecting the laser diode to the LDX-3500B Series Precision Current Source, be sure that the front panel (OUTPUT) ON switch is in the OFF position. Before turning on the LASER output, be sure that the current limit has been correctly set.

The interlock pins (1 and 2) on the LASER connector must be shorted in order to turn on the LASER output current.

Figures 2.4 - 2.7 show the possible configuration of connecting laser diodes and photodiodes with the LDX-3500B Series Precision Current Sources.

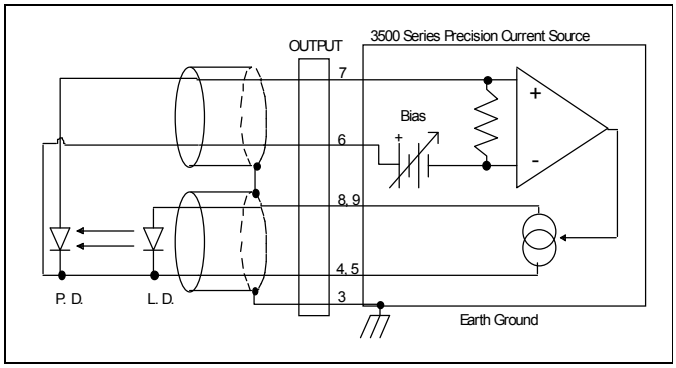


Figure 2.4 Common Laser Cathode - Photodiode Cathode

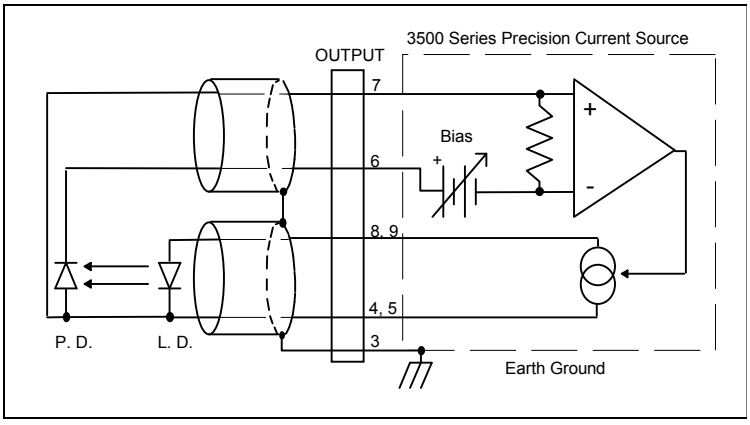


Figure 2.5 Common Laser Cathode - Photodiode Anode

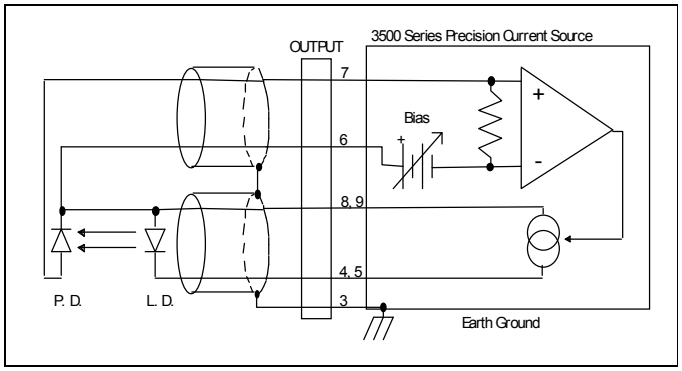


Figure 2.6 Common Laser Anode - Photodiode Cathode

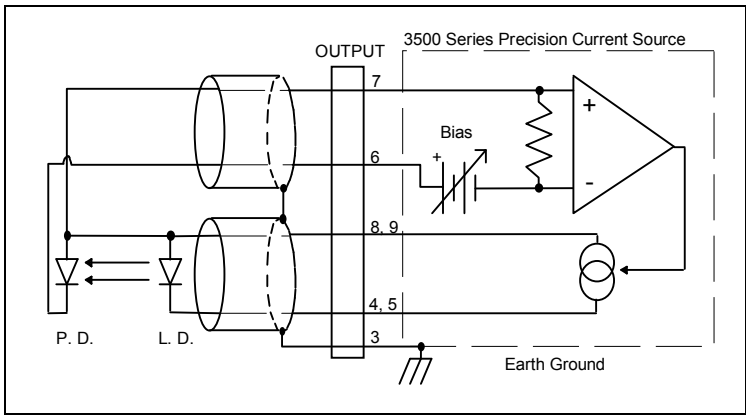


Figure 2.7 Common Laser Anode - Photodiode Anode

WARNING

The cable connections to the laser must be secure enough that they won't open-circuit, should they be jostled or bumped. Should an open circuit occur during laser operation, the LASER output will be turned off automatically.

Experience indicates that should an open circuit occur during laser operation (while the LASER is on, the laser may be damaged by a momentary circuit break-and-remake before the final circuit break. Therefore, although the LDX-3500B Series Precision Current Source provides a proprietary debounce protection circuit for LASER output, secure cabling is important.

It is recommended that the connections to the LDX-3500B Series Precision Current Source output be made using twisted wire pairs with an earth-grounded shield (see Figures 2.4 - 2.7). The 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 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 spurious currents in the photodiode feedback circuit and output leads.

Photodiode Feedback Connections

Many laser diode modules contain an internal photodiode that monitors the back-facet emission of the laser. Usually, this photodiode is internally connected to either the laser anode or cathode. Figures 2.4 - 2.7 show the recommended connections and shielding for the various configurations of laser diode modules and photodiode feedback schemes.

The photodiode current is input at the 9-pin D-sub connector at pins 6 and 7 or the BNC connector labeled photodiode (see Figure 2.3). The LDX-3500B Series Precision Current Source provides an adjustable reverse bias of 0 - 5 V for the photodiode. To set the photodiode bias to 5 volts reverse bias, turn the PHOTODIODE BIAS ADJUST fully clockwise. To set the photodiode bias to 0 volts reverse bias, turn the back panel PHOTODIODE BIAS ADJUST fully counter-clockwise.

The photodiode and laser inputs of the LDX-3500B Series Precision Current Source are electrically isolated from ground and each other. So, if a 4-pin connection is made (no common connections) no additional jumpers are required. Figures 2.4 - 2.7 show the recommended connections and shielding for 3-pin lasers (where the common connection is internal to the device). A 4-pin laser should be connected with the same shielding as shown in Figure 2.4, but the common connection (between the photodiode and the laser) is optional.

Grounding Considerations

The LASER outputs of the LDX-3500B Series Precision Current Source are isolated from chassis ground allowing either output terminal to be grounded at the user's option. Figure 2.4 shows the proper earth-ground shielding for laser diode/photodiode connections.

General Operating Procedures

The following sections present some guidelines for operation, as well as some common operating procedures.

Warm-Up and Environmental Considerations

Operate the LDX-3500B Series Precision Current Source at an ambient temperature in the range of 10 to +40 °C. Storage temperatures should be in the range of -40 to +70 °C. To achieve rated accuracy, let the instrument warm up for about 1 hour before use.

Current Mode Operation

You can operate the LASER current source portion of the LDX-3500B in several modes, constant I CW, constant I HBW, or constant POWER. This example is for constant I CW or I HBW mode. Refer later in this chapter for POWER mode operation.

- Plug the current source into an AC power source supplying the correct voltage and frequency for your unit (refer to the back panel for the correct ratings).
- Turn on the current source. The OUTPUT stage will be off at power-up and the instrument will automatically configure its parameters to the state which existed when the power was last shut off.
- For front panel operation, make sure the ENABLE indicator is lit (adjustment enabled). Press the MODE switch until the I CW or I HBW (high bandwidth) mode is selected. Press the RANGE switch until the desired current range is selected.
- Press the parameter SELECT switch and check the setting of I LIMIT to insure that it is compatible with the laser you are using. If not, press SET and turn the adjust knob until the current limit is correct.
- Press the display SELECT switch and check the set point (operating) current. If it requires changing, turn the adjust knob until the desired value is displayed.
- Turn the current output on by pressing the mode OUTPUT switch. The instrument will automatically drive the laser to the set point current.

  In I CW or I HBW mode the output may also be modulated via the MODULATION input.

  During operation, the adjust knob may be disabled by pressing the ENABLE switch. The LED indicator will be unlit when the adjust knob is disabled.
- When the instrument is powered off, the state of the instrument at power-down is saved in non-volatile memory.

Power Mode Operation

CAUTION

The constant power mode of the LDX-3500B instruments is designed to function at a range of operating current levels and operating voltages for typical laser diodes. However, some laser diodes will not function appropriately if they have a low threshold current. If you are having trouble running a laser diode in constant power mode, please contact ILX Lightwave for support.

You can operate the LASER current source portion of the LDX-3500B in constant POWER. This example is for constant POWER mode. Refer to page 15 for constant I CW or I HBW mode operation.

- Press the MODE switch until the P mode is selected.
- Press the PARAMETER SELECT switch and check the setting of I LIMIT to insure that it is compatible with the laser you are using. If not, press SET and turn the adjust knob until the current limit is correct.

  Press the PARAMETER SELECT switch again and check the setting of P LIMIT to ensure that it is as desired. If not, press SET and turn the adjust knob until the power limit is correct.

  Press the PARAMETER SELECT switch again and check the setting of CAL PD to ensure that it is as desired. If not, press SET and turn the adjust knob until the CAL PD value matches the responsivity of your monitor photodiode.
- Turn the adjust knob until the desired power value is displayed.
- Turn the current output on by pressing the ON switch (in the MODE section). The unit will automatically drive the laser to the set point power. If the laser power exceeds the P LIMIT setting, the P LIMIT indicator will blink.

  If necessary, adjust the PHOTODIODE BIAS on the back panel, as needed.

  In POWER mode the output may also be modulated via the MODULATION input. When modulating in POWER mode the user should take special care to set I LIMIT properly. Since the monitor diode current (feedback) controls the drive current in this mode, the modulation bandwidth is limited and the response time of the control feedback (monitor current) greatly affects the drive current operation.

  During operation, the adjust knob may be disabled by pressing the ENABLE switch. The LED indicator will be unlit when the adjust knob is disabled.
- When the instrument is powered off, the state of the instrument at power-down is saved in non-volatile memory.

CHAPTER 3

REMOTE OPERATION

The LDX-3500B Series Precision Current Sources provides a USB interface for remote control of the instrument. The following sections detail the fundamentals of operating the LDX-3500B Series Precision Current Source remotely through the USB interface.

To begin using the USB port on the LDX-3500B Series Precision Current Source, please install the Virtual Com Port Driver which is available on the companion CD or from our website. A standard USB "A/B" cable is necessary to connect the instrument to a PC and is included in the shipping kit.

COM Port Settings

Baud: 19,200
Data Bits: 8
Parity: None
Stop Bits: 1
Flow Control: None

USB Driver Installation

Insert the companion CD into the PC. This CD is included with the LDX-3500B Series Precision Current Source shipment. The ILX Virtual COM Port and Virtual Front Panel Installer should run automatically but if it does not, the executable can be found at [CD-ROM Drive]:\LDX-3500B Installer.exe. Follow the instructions of the installer to complete the installation.

Once the driver has been installed, connect the LDX-3500B to your computer with the supplied USB cable. The Windows Found New Hardware Wizard will be started. When the prompt on the screen asks to connect to Microsoft to search for an appropriate driver, select “No, not this time”. Click NEXT. Ensure the radio checkbox next to “Allow Windows to install the appropriate driver” is checked. Click NEXT. The wizard will install the correct driver to communicate with the

instrument. If Windows requires authorization to allow the driver to be installed, click CONTINUE.

Command Syntax

This section details the syntax of the commands as expected by the LDX-3500B.

Letters

Any remote command or query must contain all of the letters of the command. The LDX-3500B does not distinguish between capital and lower case letters.

White Space

Spaces or white space may be used to separate data but may not be used as a separation between command and query question mark. Spaces or white space must be used to separate the command from the first parameter.

Command Termination

Each USB command or query must always be terminated with the new line character: '\n' or 0x0A.

Boolean Parameter Values

Boolean values (0 and 1) are used to represent On/Off or True/False.

Table 3.1 lists all of LDX-3500B Series Precision Current Source's commands and a brief explanation of its usage.

Command Timing and Completion

All commands are executed in a sequential manner.

Error Messages

The LDX-3500B Series Precision Current Source has two error messages. "E123" indicates that the instrument received an invalid command or query. "E100" indicates that the instrument received an invalid parameter, such as a value after the question mark in the query. Instrumentation errors such as Interlock Error are can be queried over USB.

Command Reference

This section is a guide to all of the commands for the LDX-3500B Series Precision Current Source. This chapter is divided into two parts. The first part contains an overview of the remote commands used by the LDX-3500B Series Precision Current Source. The second part contains all of the LDX-3500B commands in alphabetical order.

Remote Command Reference Summary

This section contains all of the commands for the LDX-3500B Series Precision Current Source, listed in alphabetical order. Sub-sections for each path are presented.

Name	Parameters	Function
*IDN?	NONE	Returns the device identification string
CAL:P	1	Used to set the monitor PD current calibration value
CAL:P?	NONE	Returns the monitor PD current calibration value
I_LIM?	NONE	Returns the status of the I (current) limit error
INTLCK?	NONE	Returns the status of the interlock error
LDI	1	Used to set the laser current set point value
LDI?	NONE	Returns the measured laser diode current
LIM:I1	1	Used to set the current limit for low range mode
LIM:I1?	NONE	Returns the current limit set point for low range mode
LIM:I2	1	Used to set the current limit for high range mode
LIM:I2?	NONE	Returns the current limit set point for high range mode
LIM:P	1	Used to set the power limit for power mode
LIM:P?	NONE	Returns the power limit set point for power mode
MODE?	NONE	Returns the laser diode mode of operation
MODE:IHBW	NONE	Set the mode to constant current, high bandwidth
MODE:ILBW	NONE	Sets the mode to constant current, low bandwidth mode
MODE:P	NONE	Sets the mode to constant optical power mode
OPEN?	NONE	Returns the status of the Open/V limit error
OUT	1	Used to enable/disable the current source output
OUT?	NONE	Returns the current source output status
P	1	Used to set the power set point value
P?	NONE	Returns the laser diode power measurement calculated from photodiode current
P_LIM?	NONE	Returns the status of the P (optical power) limit error
RAN	1	Sets the laser current output range
RAN?	NONE	Returns the laser current output range
SET:LDI?	NONE	Returns the laser constant I (current) set point
SET:P?	NONE	Returns the constant P (optical power) set point

The following pages contain a reference for the device-dependent commands of the LDX-3500B Series Precision Current Source. This reference contains useful information for remote operation of the LDX-3500B.

---

* IDN?

FRONT PANEL
REMOTE

Action	Requests the instrument to identify itself.
Response	Returns a comma delimited standard format ASCII identification string, from information stored in the instrument during manufacturing.

CAL:P

FRONT PANEL
REMOTE

	The CAL:P command sets the laser's photodiode feedback responsivity (the CAL PD parameter)
Parameters	An <nrf value>, in mA/mW. The range is 0.001 to 1.000.
Notes	If the parameter is set to 1, the LDX-3500B Series Precision Current Source will operate in constant MDI mode where the monitor PD power set point corresponds directly to monitor PD current.
Examples	"CAL:P 0.25" - action: sets the CAL PD parameter to 0.25 mA/mW.

CAL:P?

FRONT PANEL
REMOTE

	The CAL:P? query returns the value of the laser's photodiode feedback responsivity (CAL PD parameter) setting.
Notes	If this value is 1, the LDX-3500B Series Precision Current Source's power set point corresponds directly to monitor PD current.
Examples	"CAL:P?" - response: 0.450, means the responsivity is set to 0.450 mA/mW.

I_LIM?

FRONT PANEL
REMOTE

	The I_LIM? query returns the status of the Current Limit Error displayed on the front panel.
Notes	This error is reported in all modes of operation. The response is "0" for false, and "1" for true.
Examples	"i_lim?" - response:0, means that the instrument is not in current limit error. "I_LIM?" - response:1, means that the instrument is in current limit and the output is being clamped by the current set point.

INTLCK?

FRONT PANEL
REMOTE

The INTLCK? query returns the status of the interlock error displayed on the front panel.

Notes: This error is reported in all modes of operation. The response is “0” for false, and “1” for true.

Examples: “intlck?” - response:0, means that the instrument does not have an interlock error.

“INTLCK?” - response: 1, means that the instrument currently has an interlock error caused by a disconnected output or the key-switch enable on the back panel.

LDI

FRONT PANEL
REMOTE

The LDI command sets the laser control current.

Parameters: An <nrf value> which represents the (laser) output current, in mA.

Notes: Set point is the same for both low and high bandwidth output modes. The laser set point can be set in increments of 0.1mA (LDX-3525B) or increments of 1mA (LDX-3545B or LDX-3565B)

Examples: “LDI 100.2” - action: sets the laser output current to 100.2 mA.

“ldi 1450” - action: sets the laser output current to 1450 mA.

LDI?

FRONT PANEL
REMOTE

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

Notes: Response is the measured laser output current, for either low or high bandwidth modes. This measurement is updated approximately once every 71 msec.

Examples: “ldi?” - response: 30.0, means the measured laser output current is 30.0 mA.

LIM:I1

FRONT PANEL
REMOTE

The LIM:I1command sets the laser current limit value for the low range mode of operation.

Parameters: An <nrf value> which represents the (laser) limit current, in mA.

Notes: The current limit in effect in all modes of operation of the laser output with respect to the output range (low/high).

Examples: “LIM:i1 100” - action: the laser current limit is set to 100 mA.

“LIM:I1 1450” - action: the laser current limit is set to 1450 mA.

LIM:I1?

FRONT PANEL
REMOTE

The LIM:I1? query returns the value of the laser current limit for the low range mode.

Notes: The current limit is valid for all modes of laser operation.

Examples: “LIM:I1?” - response: 30, means the laser current limit is 30 mA.

“LIM:I1 1450” - response: 1450, means the laser current limit is 1450 mA.

LIM:I2

FRONT PANEL
REMOTE

The LIM:I2 command sets the laser current limit value for the high range mode of operation.

Parameters: An <nrf value. which represents the (laser) limit current, in mA.

Notes: The current limit is in effect in all modes of operation of the laser output with respect to the output range (low/high).

Examples: “LIM:i2 200’ - action: the laser current limit is set to 200 mA.
“LIM:I2 3000” - action: the laser current limit is set to 3000 mA.

LIM:I2?

FRONT PANEL
REMOTE

The LIM:I2? query returns the value of the laser current limit for the high range mode.

Notes: The current limit is valid for all modes of laser operation.

Examples: “LIM:I2?” - response:30, means the laser current limit is 30 mA.
“lim:i2?” - response: 1450, means the laser current limit is 1450 mA.

LIM:P

FRONT PANEL
REMOTE

The LIM:P command sets the laser monitor PD power limit value.

Parameters: An <nrf value> which represents the laser monitor photodiode power limit, in mW.

Notes: When constant power mode is used, the output is limited only by the LIM I value.

Examples: “LIM:P 200.0” - action: sets the laser output power to 200.0 mW (LDX-3525B only).
“LIM:P 1000” - action: sets the laser output power to 1000 mW (all instruments).

LIM:P?

FRONT PANEL
REMOTE

The LIM:P? query returns the value of the laser monitor PD power limit.

Notes: The laser MDP limit is in effect for both laser output current ranges.

Examples: “LIM:P?” - response: 40, means the laser monitor PD power limit is 40 mW.
“lim:P?” - response: 1450, means the laser monitor PD power limit is 1450 mW.

MODE?

FRONT PANEL
REMOTE

The 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 — "MODE?" - response: I, means that constant I (current) low bandwidth mode is in effect for the laser output.

"Mode?" - response: IHBW, means that constant I (current) high bandwidth mode is in effect for the laser output.

"MoDE?" - response: P, means that constant P (power) mode is in effect for the laser output.

MODE:IHBW

FRONT PANEL
REMOTE

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

Parameters — None.

Notes — The mode of operation is constant I mode with the output lowpass filter disabled.

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

MODE:ILBW

FRONT PANEL
REMOTE

The MODE:ILBW command selects laser low bandwidth constant current mode.

Parameters — None.

Notes — This mode of operation is constant I mode with the output lowpass filter enabled.

Examples — "Mode:ILbw" - action: enables the laser low bandwidth constant current mode.

MODE:P

FRONT PANEL
REMOTE

The MODE:P command selects laser constant power mode.

Parameters — None.

Notes — This mode of laser operation requires the laser's monitor PD feedback to maintain constant monitor current.

Examples — "Mode:P" - action: sets the laser output mode of operation to constant optical power mode.

OPEN?

FRONT PANEL
REMOTE

The OPEN? query returns the status of the OPEN/V-LIM error displayed on the front panel.

Notes — This error is reported in all modes of operation. The response is “0” for false, and “1” for true. the instrument does not differentiate between an open output or a voltage limit. The error will remain on until the output has been turned back on.

Examples — “open?” - response:1. If the output is still on this means that the instrument is in voltage limit. If the output is turned off then this means that the output was shut off due to an open condition or an over voltage limit condition. The error will remain on until the output is turned on.

OUT

FRONT PANEL
REMOTE

The OUT command turns the laser output on or off.

Parameters — An <nrf value>; 1 = on, 0 = off.

Notes — There is a 2-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 set point slowly to protect the laser. Therefore, the time to turn the output on and reach the set point current varies from 2 to about 3 seconds.

After the output is turned on, it may be useful to wait until the output is stable (within tolerance) before performing further operations, but it is not necessary.

When the laser output is off, an internal short is placed across the output terminals.

Examples — “OUT 1” - action: turns on the laser output.

OUT?

FRONT PANEL
REMOTE

The OUT? query returns the status of the laser output switch.

Notes — Although the status of the switch is on, the output may not have reached the set point value.

Examples — “out?” - response:0, means that the output switch is disabled. Devices may be safely disconnected or connected at the laser output terminals.

“OUT?” - response:1, means that the laser output switch is enabled, laser output is present.

P

FRONT PANEL
REMOTE

The P command sets the value of the optical power set point, in mW.\

Parameters: An <nrf value> which represents the photodiode feedback power, in mW.

Notes: If CAL PD parameter is set to 1, the P value corresponds directly to MDI.

Examples: “P 40.00” - action: the laser output is controlled so that the photodiode feedback power remains constant at 40.00 mW.

“P 200.0” - action: the laser output is controlled so that the photodiode feedback power remains constant at 200.0 mW.

P?

FRONT PANEL
REMOTE

The P? query returns the value of the laser photodetector power measurement, in mW.

Notes: Response is in mW. The response is valid, even when the unit is not in constant P mode.

Examples: “P?” - response: 30.0, means 30.0 mW of photodetector power.

P_LIM?

FRONT PANEL
REMOTE

The P_LIM? query returns the status of the Power Limit Error displayed on the front panel.

Notes: This error is reported in constant monitor PD power mode of operation. The response is “0” for false, and “1” for true. The LDX-3500B does not clamp, the output based on power limit.

Examples: “P_LIM?” - response:0, means that the instrument is not in Power Limit error.

“I_LIM?” - response: 1, means that the instrument is in Power Limit.

RAN

FRONT PANEL
REMOTE

The RAN command selects the laser’s drive current output range.

Parameters: An <nrf value> which represents the laser current output range. For all LDX-3500B instruments 1 = low range, 0 = high range.

Notes: This range setting effects the laser drive current output current range only. When issuing this command the output will automatically shut off the laser output.

Examples: “RAN 1” - action: sets the laser output drive current range to low range mode.

“ran 0” - action: sets the laser output drive current to high range mode.

RAN?

FRONT PANEL
REMOTE

The RAN? query returns the value of the laser drive current range.

Notes — The resolution and accuracy of the laser limit current are dependent on the laser drive current output range.

Examples — “RAN?” - response: 1, means that the laser drive current range is low range mode.

“ran?” - response: 0, means that the laser drive current range is high range mode.

SET:LDI?

FRONT PANEL
REMOTE

The SET:LDI? query returns the constant I value which is used for both output ranges and both bandwidths.

Notes — In local operation, the constant I set point is read by cycling through the display options. The last option (after MDI display) is the set point view.

Examples — “SET:ldi?” - response: 50.0 means the laser output current set point value is 50.0 mA.

“set:LDI?” - response: 1200, means the laser output current set point value is 1200 mA.

SET:P?:

FRONT PANEL
REMOTE

The SET:P? query returns the laser monitor PD power set point value.

Notes — This set point is used in constant MDP mode only.

Examples — “SET:P?” - response: 250.0, means the laser monitor PD feedback set point value is 250.0 mW.

“set:p?” - response: 1200, means the laser monitor PD feedback set point value is 1200 mW.

CHAPTER 4

MAINTENANCE

This chapter describes how to maintain the LDX-3500B Series Precision Current Source. Included are sections covering calibration and fuse replacement.

WARNING

Potentially lethal voltages exist within the LDX-3500B Series Precision Current Source. To avoid electric shock, do not perform any of the procedures described in this chapter unless you are qualified to do so.

Qualified service personnel are required to wear protective eyeglasses and anti-static wrist bands while working on the LDX-3500B Series Precision Current Source circuit boards.

CAUTION

High voltages are present on and around the printed circuit boards of the LDX-3500B Current Sources.

Calibration Overview

The LDX-3500B Series Precision Current Source should be calibrated every 12 months or whenever performance verification indicates that calibration is necessary.

All calibrations can be done with the case closed. The instrument is calibrated by changing the internally stored digital calibration constants.

Recommended Equipment

Recommended test equipment for calibrating the LDX-3500B Series Precision Current Source is listed in Table 3.1. Equipment other than that sown in the table may be used if the specifications meet or exceed those listed.

Description	Manufacturing/Model	Specification
DMM	HP-3457A	DC Amps (@ 1.0 A): ±0.02 % Resistance (@ 10); ±0.02% 0.1 µA or 0.1 mV resolution
Resistors	High Power	1Ω, 20 W, low TCR, (LDX-3545) 0.5 Ω, 20 W, low TCR (LDX-3565) for current calibration
I_{PD} Calibration		
Resistors	Metal Film High-Power	49 Ω, 100 Ω, 1.0 MΩ, 1%, 1/4 W 10 Ω, 5 W, low TCR (LDX-3525) 5 Ω, 10 W, low TCR (LDX-3545) 5 Ω, 10W, low TCR (LDX-3565)
Optical Isolator		TIL117 or equivalent, 6-pin
Battery		9 V battery
Connector	D-sub	9-pin male

Table 4.1 Recommended Test Equipment

Environmental Conditions

Calibrate this instrument under laboratory conditions. We recommend calibration at 23 °C ± 1.0 °C. When necessary, however, the LDX-3500B Series Precision Current Source may be calibrated at its intended use temperature if this is within the specified operating temperature range of 0 to 40 °C.

Warm-Up

The LDX-3500B should be allowed to warm up for at least 1 hour before calibration.

Calibration Adjustments

There are two calibration adjustments that need to be made for the LDX-3500B Series Precision Current Source. They are calibration of the constant current source for both bandwidths and ranges, and calibration of the constant power (I_{PD}) feedback circuits for both ranges.

The LDX-3500B implements a two-point calibration. Two currents are applied to a load, and the resulting measured currents are fed back (by the user) to the LDX-3500B Precision Current Source. The LDX-3500B calibration program uses the two sets of data to calculate calibration constants that it will thereafter use to set current.

If a problem arises during calibration which prevents its normal completion, the calibration may be aborted with no ill effects by simply turning the power off. Then, at power-up, the old calibration values will be initialized and the user may re-calibrate. This is possible because the calibration values are not saved to non-volatile memory until the last step of calibration.

If an open-circuit condition occurs during calibration, the calibration mode will abort automatically, with no ill effect to the calibration data.

Current Source Calibration

The following procedure is for calibrating the output current measurement and set point. This procedure calibrates the circuits for the constant current modes. When the calibration set point values are reached and are stable, the user enters the actual value of the current, as measured by an external DMM. The LDX-3500B Series Precision Current Source then automatically calibrates the current limit circuits.

- Set the current limit (LIM I) to 90% of full scale (e.g., 900 mA for 1000 mA range on the LDX-3545B), set the mode to I CW, set the output range as desired, and current set point to 80% of full scale (i. e. 800 mA for 1000 mA range on LDX-3545B).

  Disconnect any laser from the output. Connect a calibrated DMM across the LASER output terminals and measure the current directly.

  OR - Connect a 1 Ω, 20 W, (LDX-3525B or LDX-3545B) or 5 Ω, 20 W, (LDX-3565B) resistor across the LASER output terminals and use a calibrated DMM to measure the voltage across the resistor.

  Calculate the current in the following steps by using Ohm's Law:

  I = E / R

  -where E is the accurately measured voltage across the resistor, and R is the accurately measured load resistance. (A 4-point probe resistance measurement is recommended.)

- Enter calibration mode by pushing the OUTPUT and ENABLE switches at the same time for one second. The display will blank for two seconds and then turn the output on (if it is not already on) and indicate output current in mA.
- Let the current settle for about two minutes until the measurement indicates that it is stable to five digits. Then, press and hold in the ENABLE switch and turn the ADJUST knob until the display indicates the same current as measured on the DMM or as calculated in Step a (if a voltage measurement is made).
- Release the ENABLE switch to accept the first calibration point. After the ENABLE switch is released, the LDX-3500B Series Precision Current Source will apply the second calibration current, approximately one-fourth of the original current. (For example, if the first calibration set point was 800 mA, the second set point will be about 200 mA.)
- If a voltage measurement is used, calculate the second current as in Step a.
- Press and hold in the ENABLE switch and turn the ADJUST knob until the LASER display indicates the same current as shown on the DMM or calculated in Step e (if a voltage measurement is used).
- Release the ENABLE switch to accept the second calibration point. After the ENABLE switch is released, the LDX-3500B Series Precision Current Source will calculate the calibration constants

  Then, the LDX-3500B Series Precision Current Source will automatically perform a current limit calibration, which takes about 10 seconds (for IHBW mode) or 20 seconds (I mode). During this calibration the output will be driven to about 80% and then 20% of full scale. No user input is required for the limit calibration.

  After the limit is calibrated, the LDX-3500B Series Precision Current Source will store all the calibration constants into non-volatile memory and then return to its former (before calibration) state. The output remains on after calibration.

- Repeat this procedure with the high bandwidth (I HBW), and then repeat it all with other range (four combinations are possible).

Monitor Current (Power Mode) Calibration

The following procedure is for calibrating the I_{PD} measurement and power set point. This procedure calibrates the feedback circuits for constant power mode. When the calibration set point values are reached and are stable, the user enters the actual value of the current, as measured by an external DMM.

- With the LASER output off, connect a calibrated ammeter to the PD Anode output of the LDX-3500B Series Precision Current Source, and connect the circuit of Figure 3.1 to the laser and PD outputs (R3 = 5 Ω, LDX-3565B; 5 Ω, LDX-3545B; or 10 Ω, LDX-3525B).

  If a calibrated ammeter (with 0.1 mA resolution) is not available, use a zero-Ohm jumper in place of the ammeter. Then, place a calibrated DMM (with 0.1 mV resolution) to measure the voltage across the resistor, R1, as shown in Figure 3.1.

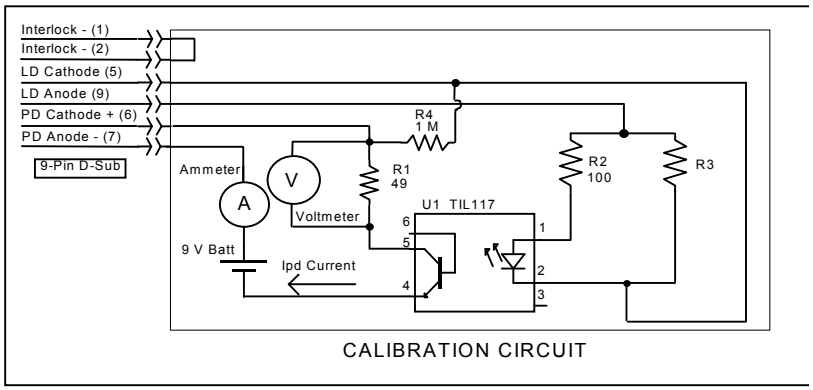


Figure 4.1 IPD Calibration Circuit

Calculate the current in the following steps by using Ohm's Law:

I = E / R

-where E is the accurately measured voltage across the resistor, and R is the accurately measured load resistance. (A 4-point probe resistance measurement is recommended.)

- Set the LDX-3500B Series Laser Diode Current Source's mode to P. Set the current range to the lower output range. Set the current limit (LIM I) to 80% of full scale. Set the P LIMIT to 100% of full scale (Power limit may be ignored during calibration). Set the power set point to 4.000 mW (LDX- 3525B) or 8.000 mW (LDX-3545B) or 40.00 mW (LDX-3565B), and set the CAL PD parameter to 1.000 (mA/mW).

  This puts the LDX-3500B Series Precision Current Source into a mode in which the measured monitor current is equivalent to the power.

- Press the ON switch to turn the output on. Verify proper operation, i.e., the power set point should be close, and the unit should not be in current limit.

- Press the ON and ENABLE switches at the same time (for one second) to place the LDX-3500B Series Precision Current Source in its calibration mode.

  The display will blank for two seconds. Then the output will come on (if it wasn't already) and the display will show the power set point value.

- After the value on the display is stable (has not changed by more than one digit for several seconds) the LDX-3500B Series Precision Current Source is ready for the actual I_{PD} value to be entered.

  Press and hold in the ENABLE switch and turn the ADJUST knob until the display shows the correct value, as shown on the calibrated ammeter (or the calculated monitor current value from Step a).

- Release the ENABLE switch to store the first calibration value. The LDX-3500B Series Precision Current Source will then set the second calibration current (power), approximately one-fourth of the original current. (For example, if the first calibration set point was 4.000 mW (mA), the second set point will be about 1.000 mW (mA). Calculate the second calibration current as in Step a.

  After the value on the display is stable (has not changed by more than one digit for several seconds) the LDX-3500B Series Precision Current Source is ready for the second actual I_{PD} value to be entered.

  When it the set point value is stable, press and hold in the ENABLE switch and turn the ADJUST knob until the display indicates the same current as calculated in Step f.

- Release the ENABLE switch to accept the second calibration point. After the ENABLE switch is released, the LDX-3500B Series Precision Current Source will calculate the calibration constants. After this, the LDX-3500B Series Precision Current Source will store all the calibration constants into non-volatile memory and then return to its former (before calibration) state. The output remains on after calibration. Repeat this procedure for the higher output current range.

Fuse Replacement

The fuses are accessible from the back panel of the LDX-3500B, above the power entry AC socket module. Before replacing the fuses, turn the power off and disconnect the AC line cord. Use only the fuses indicated on the rear panel diagram of the instrument, marked by the ILX production team. Failure to remove and replace the fuse drawer properly, or using the incorrect rated fuses, may cause damage to the instrument. Contact ILX Lightwave for more details.

APPENDIX A

TROUBLESHOOTING

This appendix is a guide to troubleshooting the LDX-3500B Series Precision Current Source. 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 which apply. If you encounter problems which are beyond the scope of this guide, contact your ILX Lightwave representative.

SYMPTOM	CORRECTIVE ACTION
LDX-3500B Series unit will not power up	Check AC power line voltage and power cord connection Check the fuses for integrity and proper rating
Power on, but display is frozen, switches don't work	This may occur if the unit loses power (AC line) briefly. Turn the power switch off and on again to restart
Power on, but no current output	Check the Interlock and back panel ENABLE key switch If OPEN / V LIMIT indicator is lit, check the load connections and then try again Check the OUTPUT ON switch, the LED should be lit
Unable to adjust output	Check the ENABLE LED; the indicator must be lit for any adjustments to be made Check the I LIMIT parameter; see that it is set above 0 mA
Output current at limit; cannot be lowered	If POWER mode is used, check the monitor diode (feedback) connections. Try reversing the polarity of the monitor photodiode. Check the photodiode bias adjustment on the back panel If I of I HBW mode, check the current set point and LIM I setting. Setting the output below the limit may require several turns of the adjust know if the set point 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.
Power Mode operation has high output current, but little or no power is 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
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 set point
Power Limit Indicator does not work in I or IHBW modes	Power limit is not detected in the constant current modes
Open Circuit Error occurs during calibration	Check load connections
Calibration is aborted unintentionally	Calibration modes will be aborted if an open circuit is detected
OPEN / V LIMIT indicator blinks	This indicates a voltage limit error; check laser connections; a higher impedance may cause this condition

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