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User's Guide

Laser Diode Current Source Modules
LDC-3916330 Series

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

70028104 June 2013

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SAFETY AND WARRANTY INFORMATION

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

Safety Information and the Manual

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



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



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



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

General Safety Considerations

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

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

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

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 2
- 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 ñ40 ×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) 556-2481

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

On the web at: . . . . . http://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 or sketch 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 LDC-3916330 Series Laser Diode Current Source Modules for use in the LDC-3908, LDC-3916, and LDC-3926 LD Controller Mainframes.

It covers model numbers LDC-3916332 500 mA Dual Current Source Module, LDC-3916334 1A Dual Current Source Module, and LDC-3916338 3A Single Current Source Module. Chapter 1 contains unpacking information, instructions on how to install and apply power, and safety considerations and instructions. It also contains some maintenance information and specifications.

WARNING

If any of the following symptoms exist, or are even suspected, remove the LDC-3916330 Series Controller Module from service. Do not use the modules 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 modules to ILX Lightwave for service and repair to ensure that safety features are maintained.

Safety Symbols and Terms

The following safety terms are used in this manual:

- The WARNING heading explains dangers that could result in personal injury or death.
- The CAUTION heading explains hazards that could damage your instrument.

- The NOTES heading gives information to the user that may be beneficial in the use of the instrument and to the devices being tested.

Product Overview

The LDC-3916330 Series Laser Diode Current Source Modules consist of two dual output current source modules and one single output current source module. The LDC-3916332 and LDC-3916334 dual modules have two independent current sources with a maximum output current of 500 mA and 1 Amp respectively while the LDC-3916338 single module has a single current source with a maximum output current of 3 Amps. Each current source provides a high stability, low noise output with fully redundant hardware current limits and multiple laser protection features such as intermittent contact protection, adjustable compliance voltage limit, slow turn-on and shorting circuits. The LDC-3916330 Series modules can be used in the LDC-3916 sixteen channel mainframe, the LDC-3908 eight channel mainframe and the LDC-3926 high power sixteen channel mainframe.

Installing the LDC-3916330 Series Laser Diode Controller Module

Installation into LDC-3916 Laser Diode Controller Mainframe

If you are receiving this new module for installation into a previously purchased LDC-3908, LDC-3916, or LDC-3926 mainframe, follow the instructions below. If your system was configured at the factory with your desired modules skip this section.

CAUTION

Static discharge can damage your new Laser Diode Controller Module. Be certain you use proper grounding procedures before you unpack and install your controller module(s) into the mainframe.

Inspect the module for any visible shipping damage that may have occurred before inserting the module into the mainframe. Pay special attention to the copper shielding material on the back edge of the module.

Be sure that the mainframe power is off before inserting your new laser diode controller module. Damage from "hot swapping" is not included under the warranty.

Unwrap the module from the anti-static bag it was packaged in.

Insert the module into the desired slot from the rear of the mainframe. Each module is supported by two plastic card guides inside of the mainframe. Insert the module, 40 pin connector first, by lining up the edges of the module frame with the appropriate card guides (one on top and one on the bottom). Carefully slide the module into the mainframe slot until the connector is seated. Push firmly to fully seat the module until the rear panel of the module is flush with the mainframe. Fasten the module to the mainframe with two screws located at the top and bottom of the module rear panel.

General Shipping Instructions

If you need to ship your LDC-3916330 Series Laser Diode Controller Module back to the factory for repair, be sure that the module is packaged in an anti-static bag and an enclosure with cushioning material to prevent damage to the module during shipment (use the original shipping containers and accessories if possible). Re-install the ESD protective caps on the rear panel over the 9-pin connectors. Shipping damage is not covered under warranty.

Attach a tag to the module identifying the owner and indicating the service or repair needed. Include the model number, serial number, and return authorization number. We suggest that you insure the shipment. See your mainframe manual for instructions on where to ship the module.

Calibration and Repair Services

You may have to return your current source module to an ILX Lightwave facility at some time for repair, calibration or service whether it is under warranty or not. 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 above information available when you call. 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.

General Shipping Instructions

If you need to ship your LDC-3916330 Series Laser Diode Current Source Module back to the factory for repair, be sure that the module is packages in an anti-static bag and an enclosure with cushioning material to prevent damage to the module during shipment (use the original shipping containers and accessories if possible). Re-install the ESD protective caps on the rear panel over the 9-pin connector. Shipping damage is not covered under warranty.

Attach to the module a copy of the completed service form (see Safety and Warranty section). We suggest that you insure the shipment.

Specifications

The following specifications are for when the modules are used in the LDC-3916 16-Channel Laser Diode Controller Mainframe or the LDC-3908 8-Channel Laser Diode Controller Mainframe. Please see the LDC-3926 16-Channel High Power Laser Diode Controller Mainframe brochure for specifications when the modules are used in the LDC-3926

MODEL NUMBER	3916332 Dual 500mA	3916334 Dual 1A	3916338 Single 3A
DRIVE CURRENT OUTPUT[1]			
Output Current Range:	0 to 500 mA	0 to 1000 mA	0 to 3000 mA
Set-Point Resolution:	10 µA	20 µA	80 µA
Set-Point Accuracy:	± 0.1% of full scale	± 0.1% of full scale	± 0.1% of full scale [2]
Compliance Voltage:	6 V maximum (adjustable voltage limit)	6 V maximum (adjustable voltage limit)	4.5 V (adjustable voltage limit)
Temperature Coefficient:	≤ 50 ppm/°C	≤ 50 ppm/°C	≤ 100 ppm/°C
Short Term Stability (1 hr.): [3]	≤ 20 ppm	≤ 20 ppm	≤ 50 ppm
Long Term Stability (24 hr.): [4]	≤ 50 ppm	≤ 50 ppm	≤ 70 ppm
Noise and Ripple: [5]			
High Bandwidth Mode:	< 10 µA rms	< 12 µA rms	< 36 µA rms
Low Bandwidth Mode:	< 5 µA rms	< 8 µA rms	< 24 µA rms
Transients:			
Operational: [6]	< 3 mA	< 3 mA	< 5 mA
1kV EFT / Surge: [7]	< 4 mA / < 8 mA	< 5 mA / < 10 mA	< 5 mA / < 10 mA
DRIVE CURRENT LIMIT SETTINGS			
Range:	0 to 500 mA	0 to 1000 mA	0 to 3000 mA
Resolution	0.2 mA	0.4 mA	1.025 mA
Accuracy:	± .7mA	± 1.4 mA	± 9 mA
Voltage Limit	0 to 6.0 V	0 to 6.0 V	0 to 7.5 V
Voltage Limit Resolution	0.2 V	0.2 V	0.2 V
PHOTODIODE FEEDBACK			
Type:	Differential 10Ω Input, Selectable Zero Bias or 5V Reverse Bias	Differential 10Ω Input, Selectable Zero Bias or 5V Reverse Bias	Differential 10Ω Input, Selectable Zero Bias or 5V Reverse Bias
PD Current Range:	0 to 5,000 µA	0 to 5,000 µA	0 to 5,000 µA
Output Stability: [8]	± 0.01%	± 0.01%	± 0.01%
Accuracy, set point (% of FS):	± 0.1%	± 0.1%	± 0.1%
EXTERNAL ANALOG MODULATION			
Input : [9]	0 to 10V, 50 Ω	0 to 10V, 50 Ω	0 to 8V, 50 Ω
Transfer Function:	50 mA / V	100 mA / V	375 mA / V ± 10%
High Bandwidth Mode, Small Signal Bandwidth: [10]	DC to 1.2 MHz	DC to 1.0 MHz	DC to 0.6 MHz
High Bandwidth Mode, Large Signal Bandwidth: [11]	DC to 1.0 MHz	DC to 1.0 MHz	DC to 0.6 MHz
Low Bandwidth Mode:	DC to 30KHz	DC to 30KHz	DC to 30 kHz
DRIVE CURRENT MEASUREMENT (DISPLAY)			
Output Current Range:	0 to 500.00 mA	0 to 1000.0 mA	0 to 3000.0 mA
Output Current Resolution:	0.01 mA	0.01 mA	0.01 mA
Output Current Accuracy (@25°C):	± 0.05% of Full Scale	± 0.05 % of Full Scale	± 0.07 % of Full Scale
Photodiode Current Range:	0 to 5,000 µA	0 to 5,000 µA	0 to 5,000 µA
PD Current Resolution:	0.1 µA	0.1 µA	0.1 µA
PD Current Accuracy (@25°C):	± 2 µA	± 2 µA	± 2 µA
PD Responsivity Range: [12]	0.00 to 1000.00 µA/ mW	0.00 to 1000.00 µA/ mW	0.00 to 1000.00 µA/ mW
PD Responsivity Resolution:	0.01 µA/ mW	0.01 µA/ mW	0.01 µA/ mW
Optical Power Range:	0.00 to 500.00 mW	0.00 to 500.00 mW	0.00 to 5000.00 mW
Optical Power Resolution:	100 µW	100 µW	100 µW
Forward Voltage Range:	0.00 to 6.0 V	0.00 to 6.0 V	0.00 to 7.5 V
Forward Voltage Resolution:	1 mV	1 mV	10 mV (1 mV GPIB)
Forward Voltage Accuracy: [13]	± 2 mV	± 2 mV	± 7 mV (±2 mV GPIB)

CURRENT SOURCE NOTES:

1. All values relate to a one-hour warm-up period.
2. Accuracy is 0.15% above 2.5 Amps after 1 hour warm up period
3. Over any 1-hour period, half-scale output.
4. Over any 24-hour period, half-scale output.
5. Measured optically, evaluating noise intensity of a laser diode into a photodetector with 150 kHz Bandwidth.
6. 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).
7. Maximum output current transient resulting from a 1000V power-line transient spike. Tested to ILX Lightwave Technical Standard #LDC-00196. Request ILX Application Note #3.
8. Maximum monitor photodiode current drift over any 30 minute period. Assumes zero drift in responsivity of photodiode.
9. Modulation input is 50 Ω terminated inside the mainframe.
10. 250 mA set point, 50 mA modulation current, 1Ω load. High bandwidth mode.
11. 50% modulation at mid-scale output, 1Ω load. High bandwidth mode.
12. Responsivity value is user-defined and is used to calculate the optical power.
13. Four wire voltage measurement. Voltage measurement accuracy while driving calibration load. Accuracy is dependent upon load and cable used.

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

CHAPTER 2

OPERATIONS

This chapter introduces you to the operation of the LDC-3916330 Series Dual LD Current Source's control functions. It offers instructions for connecting your lasers to the current sources. This chapter also contains step by step procedures that teach you how to operate your module in Constant Current Mode or Constant Power Mode. We recommend that you review the contents of this chapter at a minimum before operating your new LDC-3916330 Series modules.

Note: The LDC-3916332 and 3916334 modules each contain two fully independent laser diode current sources. The top connector on the back of the module is for the source called LAS1, and the bottom connector is for the current source called LAS2. Each of these two sources must be programmed separately before turning the respective source on.

Table 2.1 LDC-3916330 Series Controllers Default Settings

LASER CURRENT CONTROLLER
LASER output off
ISET = 50 mA
ILIM = 150 mA
VLIM = 5.0 V
Constant I, low bandwidth mode
Modulation off
PPD Set Point = 3.0 W
CAL PD = 0.0 µA/mW
PLIM = 500 mW
PD Bias off
LASER STEP value = 0. 1mA
LASER Tolerance values = 10 mA, 1.0 seconds
IPD Set Point = 100 µA

Connecting to the Laser Current Source

When connecting your laser diode or any other sensitive devices to the LDC-3916330 Series Dual Current Source Modules, we recommend that the instrument be powered up and the LASER outputs 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 outputs off.

It is also recommended that the connections to the LDC-3916330 Series module output be made using twisted wire pairs with an earth-grounded shield (see Figures 2.1 -2.4). We recommend using our CC-303 Shielded Laser Cable which is a unique twisted-pair cable with braided outer shield designed to provide the best possible rejection of most transient noise signals. 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.

Note: Experience indicates that should an inadvertent open circuit occur during laser operation (while the LASER is ON), your laser may be damaged by a momentary circuit break-and-remake before the final circuit break. Your new LDC-3916330 Series Module has circuitry designed to detect open circuits and will shut the output off under most conditions. However, we recommend that cable connections to the laser be secure enough that they won't open-circuit, should they be jostled or bumped.

Note: Use appropriately shielded cabling to reduce coupling of potentially laser damaging transients. Do not "bundle" the current source cables with other cables in your system or laboratory. See Application Note #3, "Laser Diode Protection Strategies" for more detailed discussions on connecting to your laser.

Figures 2.1 - 2.4 show the possible configurations of connecting laser diodes and photodiodes with the LDC-3916330 Series Laser Diode Controller Modules.

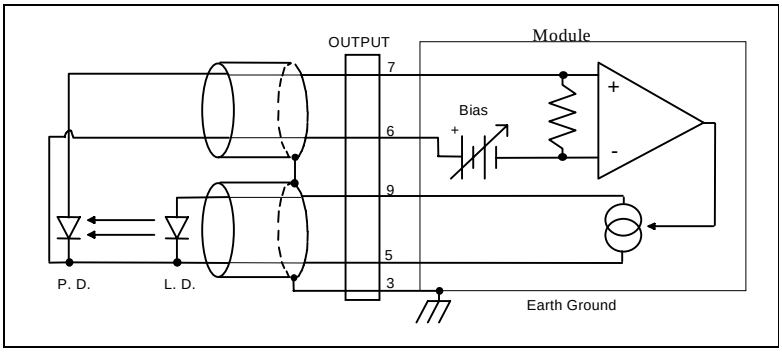


Figure 2.1 Common Laser Cathode - Photodiode Cathode

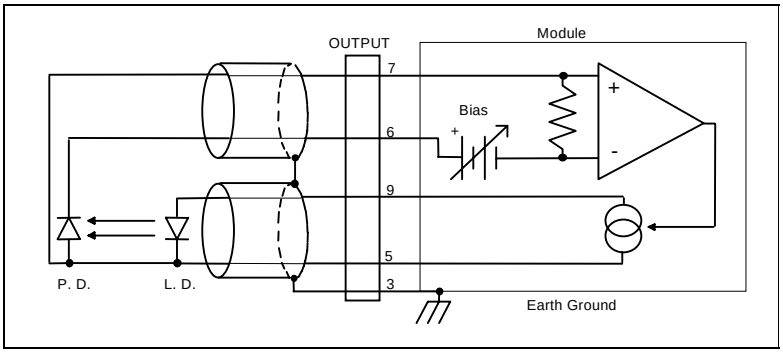


Figure 2.2 Common Laser Cathode - Photodiode Anode

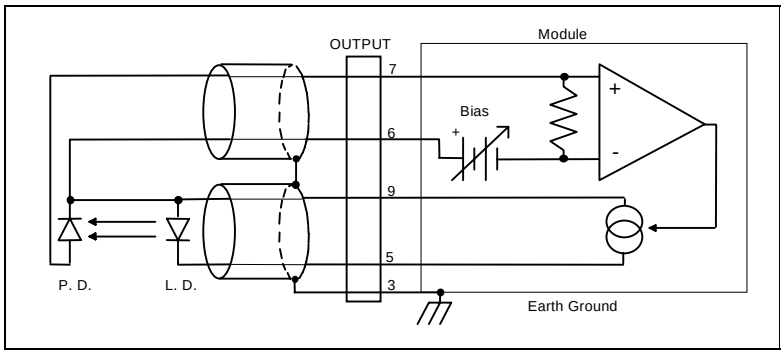


Figure 2.3 Common Laser Anode - Photodiode Cathode

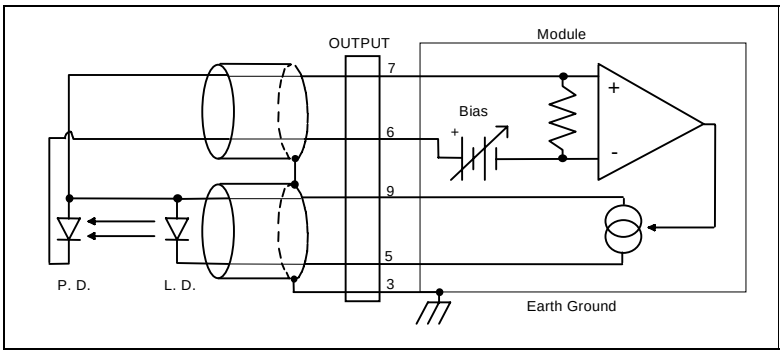


Figure 2.4 Common Laser Anode - Photodiode Anode

Connectors on the rear panel of the LDC-3916330 Series modules provide laser anode and cathode, photodiode anode and cathode, chassis ground, interlock and laser forward voltage connections. A pin-out diagram for these connectors is shown in Figure 2.2. The LDC-3916332 and LDC-3916334 modules are dual current source modules and have two 9-pin connectors, one for each laser source. The top connector is for the current source called LAS1 while the bottom connector is for the current source called LAS2.

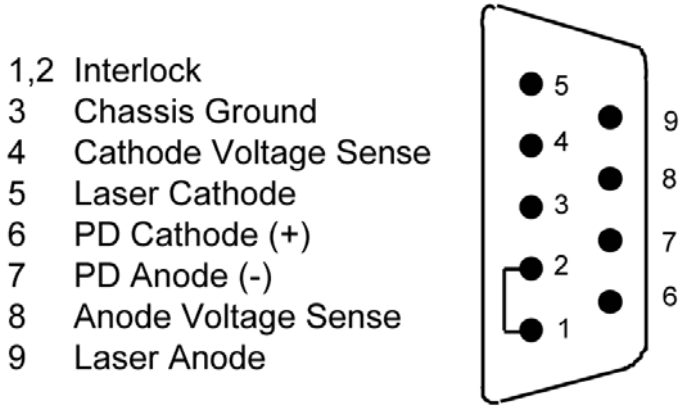


Figure 2.5 Back Panel LD Connector

Interlock Connections

In order for the laser output to be enabled, a short must exist between the Interlock pins (pins 1 and 2) of the connector. 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 and you attempt to turn on the LAS output, an error will be indicated on the display for the respective channel, on any of the Laser set up pages, or on the status screen; furthermore, the output will be turned off. The error is E401 if LAS1's interlock is disconnected, and the error is E501 if LAS2's interlock is disconnected.

CAUTION

The interlock terminals on the LASER connector, pins 1 and 2, must be kept isolated from all other connections including earth ground.

Four-Wire Voltage Sense

The LDC-3916330 Series Modules have a 4-wire voltage sense feature. The laser voltage is sensed through a pair of connections (pins 4 and 8) that is separate from the laser current drive connections (pins 5 and 9). This allows a more accurate laser voltage reading for the voltage limit feature. All four of these pins

(4,5,8,9) must be connected for the module to operate. See Tech Note #TN3916-2 for more information on 4-wire Voltage Sense.

Photodiode 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.

The photodiode and laser connections to the LDC-3916330 Series Module 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 2.1 - 2.4 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 2.1, but the common connection (between the photodiode and the laser) is optional.

Grounding Considerations

The LASER outputs of the LDC-3916330 Series Laser Diode Controller Module are isolated from chassis ground allowing either output terminal to be grounded at the user's option. Figure 2.1 shows the proper earth-ground shielding for laser diode/photodiode connections.

Operating the Laser Current Source from the Front Panel

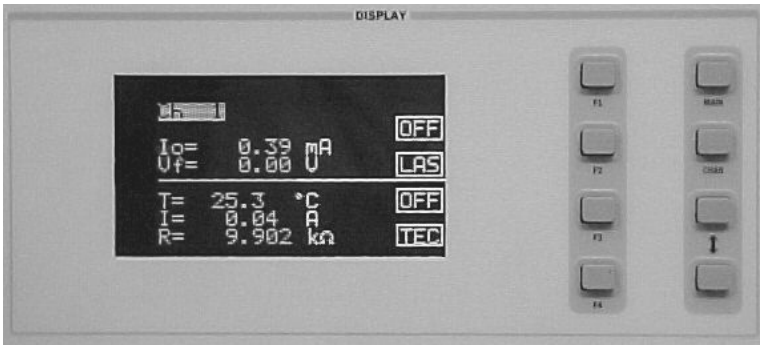
The various laser current source control parameters can be set the same for all channels via the All Chnl menu which is accessed through the MAIN menu. Alternatively, the laser source control parameters for each individual channel can be set independently via channel setup menus, which are accessed through the CHAN menu. You can move between multiple pages of any setup menu by pushing the up and down arrow soft keys (F3 and F4) while in the setup menu. Which parameter to adjust can be selected with the (DISPLAY) UP/DOWN ARROW keys. In general, the selected parameter value can be adjusted with the numeric keypad, the ADJUST knob, or the (ADJUST) UP/DOWN ARROW keys. The ENTER key must be pressed within three seconds after entering a numeric value with the keypad, or the value will revert to the previous value.

The DISPLAY is used to show both the set point and measured value of laser control parameters such as laser drive current (Iset and Io), laser current limit (Ilim), laser forward voltage (Vf), forward voltage limit (Vlim), mode of control (Mode), monitor photodiode current (Ipdset and Ipd), and laser optical power (Plim and Ppd). It will also display error codes, which relate to LASER operation. Error codes indicate control errors and are explained below in the section titled "LASER ERROR INDICATORS". The following sections describe fundamentals of single channel operation for your LDC-3916330 Series Laser Diode Current Sources in two operating modes, Constant Current (I) and Constant Power (P).

Operating a Laser in Constant Current (I) Mode

Suppose you have an LDC-3916330 Series Module and you want to run the instrument in Constant Current low bandwidth mode (Ilbw), with a set point of 150 mA, a current limit of 175 mA, and a voltage limit of 6 volts. The Ilbw mode uses a low-pass filter on the laser drive current output to significantly reduce noise. In this mode a low bandwidth modulation input may be used via the back panel MODULATION connector. Follow the instructions below, in the sequence presented, to program the current source for a single channel.

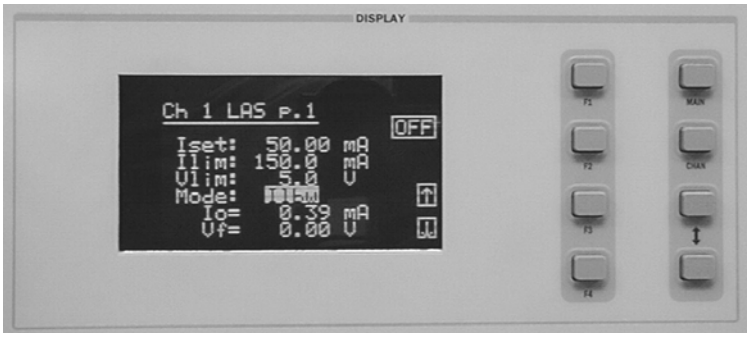
Entering the Laser Channel Setup Menu



Push the CHAN key to display the single channel menu. From this menu you can see the measured parameters, enter the LAS1 or LAS2 channel setup menus (3916332/334 modules) or the LAS setup menu (3916338), or turn the current sources on and off. Use the (ADJUST) UP/DOWN ARROW keys or the ADJUST knob to select the desired channel number highlighted at the top of the display. For the 3916332/334 modules, push the DISPLAY LAS1 soft key (F2) to enter page 1 of the laser channel setup menu. Push the LAS2 soft key (F4) to program the second current source in this module.

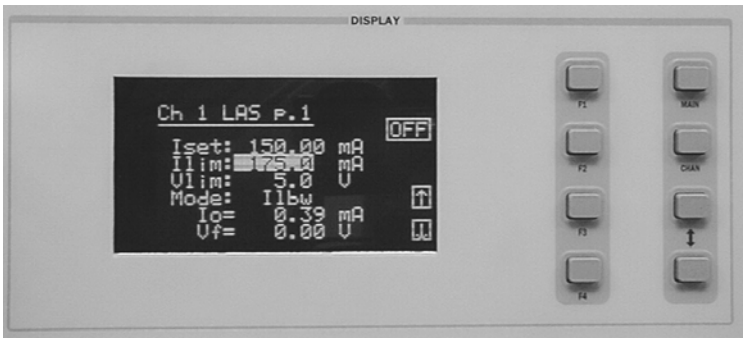
For the 3916338 module, push the display down arrow soft key (F4) to enter page 1 of the laser channel set up menu.

Setting the Mode of Control



Select the Mode parameter by pushing the (DISPLAY) UP/DOWN ARROW keys until the Mode parameter is highlighted. Repeatedly pushing the (ADJUST) UP/DOWN ARROW keys or turning the ADJUST knob will cycle through the Constant Current low bandwidth (Ilbw), Constant Optical Power (P), Constant Current high bandwidth (Ihbw), and Photodiode Current (Ipd) control modes. Set the LDC-3916330 Series Controller Modules in Constant Current low bandwidth mode by selecting the Ilbw mode.

Setting the Current Limit

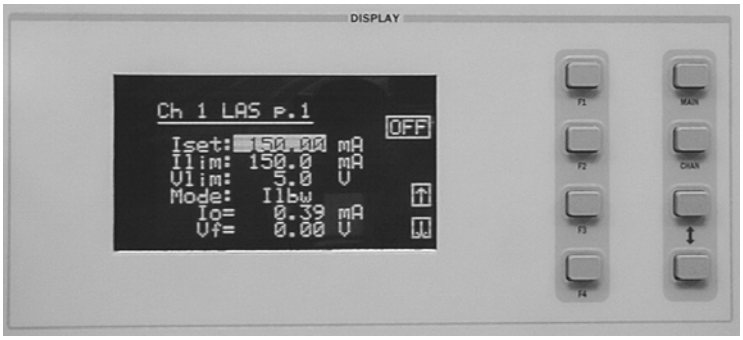


Now select the current limit (Ilim) parameter using the (DISPLAY) UP/DOWN ARROW keys. Adjust the value to 175mA. The current limit protects your laser by never allowing the laser drive current to exceed the Ilim value independent of the current set point and the controller mode (Constant Current or Constant Power).

⚠ CAUTION

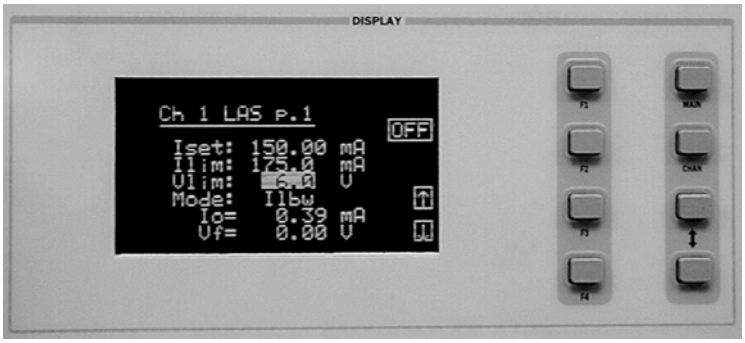
Failure to set and ensure a proper Ilim value could result in laser damage.

Setting the Constant Current Value



Next, select the Iset parameter on the setup menu using the (DISPLAY) UP/DOWN ARROW keys. This parameter sets the laser current source drive value when in Ilbw or Ihbw modes. Enter 150 mA using the numeric keypad, the ADJUST knob, or the (ADJUST) UP/DOWN ARROW keys. Push the ENTER key to store the value in memory within three seconds after entering the value using the numeric keypad, or it will revert to the old value.

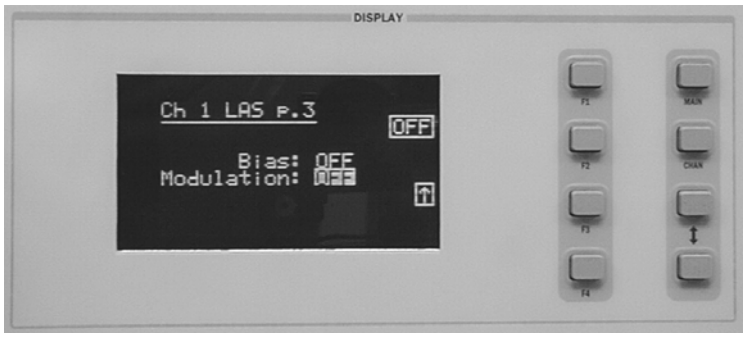
Setting the Voltage Limit



Select the voltage limit (Vlim) parameter and adjust it to 6 volts in the same manner as described above. The voltage limit also protects your laser by shutting off the source driver if the laser voltage exceeds the Vlim value. The Vlim value should be set slightly above the operating voltage of the laser diode to provide maximum protection.

Note: There is also a laser optical power limit (Plim) safety feature explained in this manual under the section titled “Operating a Laser in Constant Power (P) Mode”. The laser optical power limit can be disabled by setting the CalPD value to zero on page 2 of the laser setup menu.

Enabling the Modulation Input



Change the display to LAS p.3 of the laser setup menu to set the next parameter. Do this by pushing the DOWN soft key (F4) twice. The Modulation parameter on this page controls whether the MODULATION connector input is active or not. Select the Modulation parameter by pressing the (DISPLAY) UP/DOWN ARROW keys until the Modulation parameter is highlighted. Adjust the value to ON or OFF as desired with the (ADJUST) UP/DOWN ARROW keys or the ADJUST knob. Refer to the LDC-3916330 Series Controller Module specifications for modulation input specifications and limitations.

Turning the Laser Current Source On

Now you are ready to enable the current source output for your laser diode. The top soft key (F1) on any of the three pages of the LAS setup menu will toggle the laser current source on and off. You can also turn the current source on and off with the top soft key (F1) on the CHAN menu. The ON toggle has a two second delay before the current source is enabled in compliance with safety requirements.

Each current source can be turned on or off independently as described above, or you can turn on all the channels at the same time from the All Chnl menu. See the LDC-3908, LDC-3916 or LDC-3926 Mainframe Instruction Manual for more information on the all channel operation.

Operating a Laser in Constant Power (P) Mode

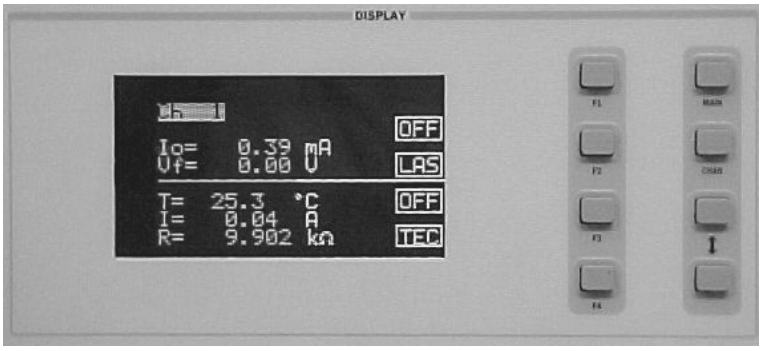
Suppose you want to operate a 3 mW laser in constant optical power at 1 mW. The LDC-3916330 Series Controller Modules allow you to operate the instrument current source drivers in Constant Optical Power (P) mode. In the "P" mode, the controller drives current to the laser to reach a set power value in mW. The control loop feedback parameter is monitor photodiode current, which the controller converts to optical power via a user defined photodiode responsivity number, CalPD. If laser power changes due to internal or environmental conditions, the controller will increase/decrease the current to the laser to maintain the power set point. The following paragraphs detail the instrument configuration in Constant Power Mode.

Calculating Photodiode Responsivity Values

The photodiode responsivity, CalPD, is used to convert between photodiode current and optical power of the laser diode. A method to calculate the responsivity is suggested below.

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

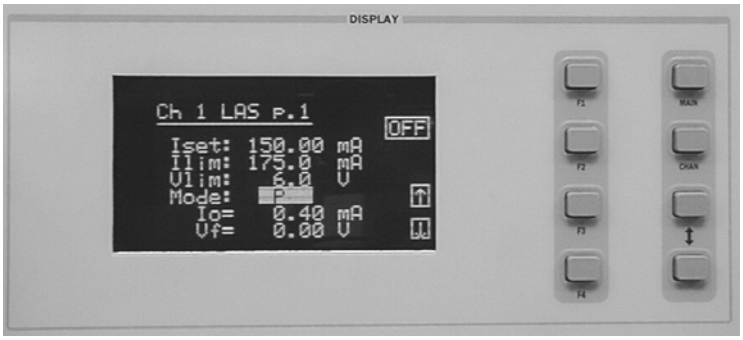
Entering the Laser Channel Setup Menu



To enter the setup menu, push the CHAN key, which displays the channel menu. Select the correct channel number at the top of the display by pushing the (ADJUST) UP/DOWN ARROW keys or turning the ADJUST knob. For the 3916332/334 modules, push the DISPLAY LAS soft key (F2) to enter page 1 of the laser setup menu. (See image above.)

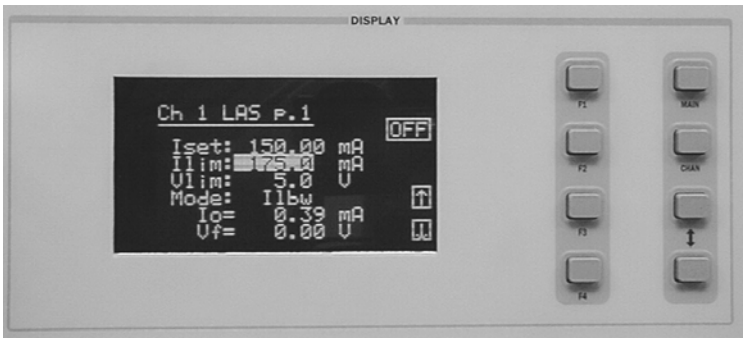
For the 3916338 module, push the display down arrow soft key (F4) to enter page 1 of the laser setup menu. (See image above.)

Selecting the Mode of Control



Select the Mode parameter by pushing the (DISPLAY) UP/DOWN ARROW keys until the Mode parameter is highlighted. Repeatedly pushing the (ADJUST) UP/DOWN ARROW keys or turning the ADJUST knob will cycle through the Constant Current low bandwidth (Ilbw), Constant Optical Power (P), Constant Current high bandwidth (Ihbw), and Photodiode Current (Ipd) control modes. Set the LDC-3916330 Series Controller Module in Constant Optical Power mode by selecting the P mode.

Setting the Current Limit

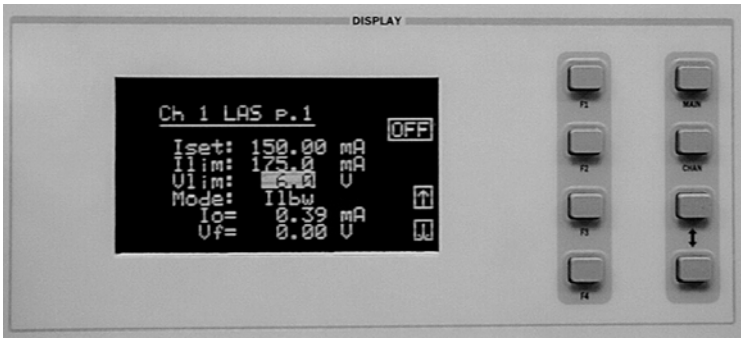


Select the laser current limit (Ilim) parameter by pushing the (DISPLAY) UP/DOWN ARROW keys until the Ilim value is highlighted with the cursor. Adjust the current limit value with the numeric keypad, the ADJUST knob, or the (ADJUST) UP/DOWN ARROW keys. If you use the numeric keypad, you mush push the ENTER key to store the value in memory within three seconds after entering the value, or it will revert to the previous value. The current limit protects your laser by never allowing the laser drive current to exceed the Ilim value independent of the current set point and the controller mode (Constant Current or Constant Power).

CAUTION

Failure to set and ensure a proper current limit value could result in laser damage.

Setting the Voltage Limit

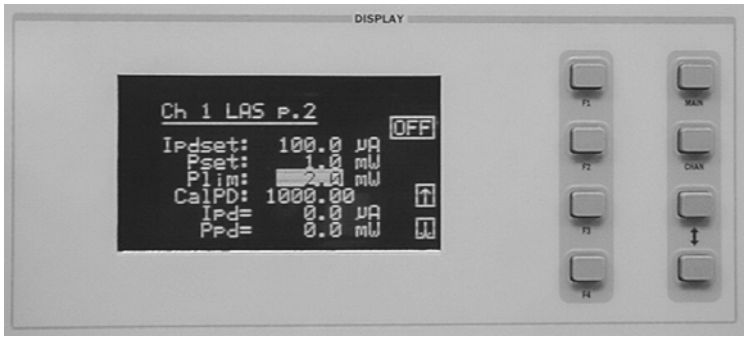


Next, select the laser voltage limit (Vlim) parameter using the (DISPLAY) UP/DOWN ARROW keys. Adjust this value to your desired laser voltage limit. The voltage limit also protects your laser by shutting off the source driver if the laser

voltage exceeds the Vlim value. The Vlim value should be set slightly above the operating voltage of the laser diode to provide maximum protection.

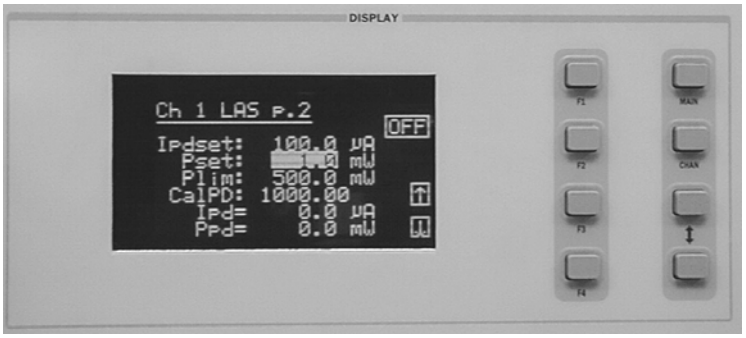
Note: Be sure to push the ENTER key within three seconds after using the keypad to adjust any numeric values in the setup menus; otherwise, the value will revert to the previous setting.

Setting the Power Limit



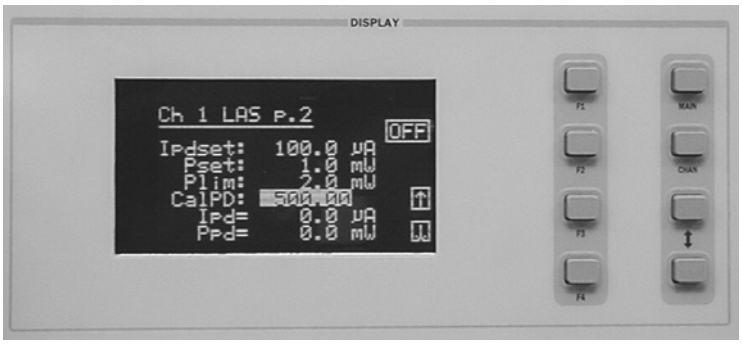
Now push the DOWN soft key (F4) to advance to LAS p.2 of the laser setup menu. Before the laser is enabled, the power limit for the laser under test should be set. To do this, push the (DISPLAY) UP/DOWN ARROW keys to select the power limit (Plim) parameter. Adjust this value to your desired laser optical power limit. The responsivity value (CalPD) must be set to the correct value for the power limit feature to work properly. This is a software limit only. The LASER output is normally turned off if this limit is reached.

Adjusting the Constant Power Setting



Use the (DISPLAY) UP/DOWN ARROW keys to select the power (Pset) parameter, and adjust the value to 1 mW. The Controller Module will divide the measured photodiode current by the CalPD value to calculate the laser optical power. The current source will automatically adjust the laser drive current to keep the calculated laser power at the Pset value.

Setting the Responsivity Value (CalPD)

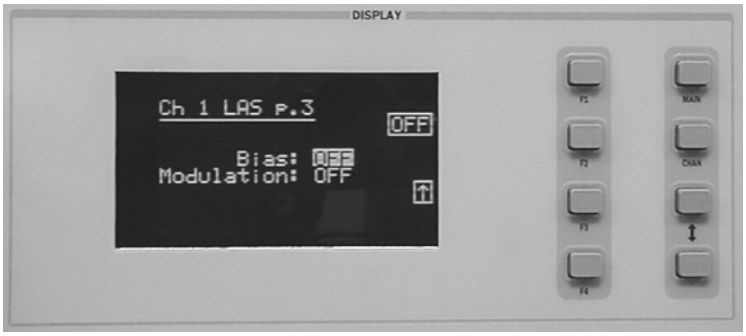


The correct responsivity value (CalPD) must be set for the constant power mode to operate properly. To do this, select the CalPD parameter, and adjust it to the correct value. The CalPD units are µA/mW.

A method to calculate the responsivity value (CalPD) is suggested here:

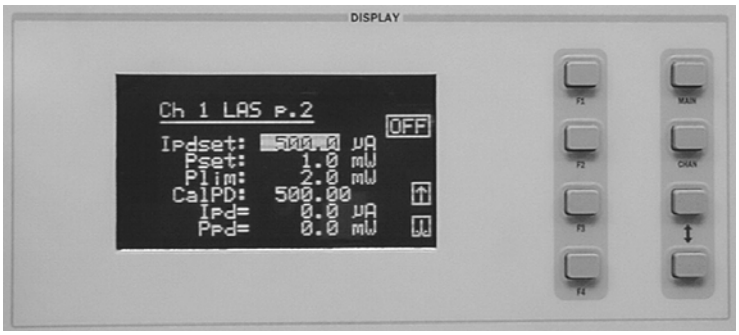
- Measure (with a calibrated detector) the output power of the laser.
- Measure the corresponding monitor photodiode current.
- Calculate the responsivity (CalPD) by dividing the photodiode current by the optical power noting the units required are µA/mW.

Setting the Photodiode Bias Voltage



Now push the DOWN soft key (F4) to display LAS p.3 of the laser setup menu. The Bias parameter setting controls whether or not a bias voltage is applied to the monitor photodiode. Select the Bias parameter and adjust it ON or OFF depending on whether you want a 5 volt reverse bias on your photodiode or not. (Many laser diode modules are tested and characterized by the manufacturer with a 5 volt reverse bias on the photodiode. This bias can decrease the response time and increase the linearity and/or saturation level of the photodiode.)

Constant Power Mode if CalPD is Unknown



If you do not know the correct photodiode responsivity (CalPD) value, the LDC-3916330 Series Modules can still drive your laser at a constant light power. The Constant Photodiode Current (Ipd) mode will control the laser drive current so the monitor photodiode current remains at a constant set point. To do this, adjust the Mode to Ipd on LAS p.1 of the laser setup menu, and set the photodiode current (Ipdset) parameter on the LAS p.2 menu to your desired value. In this case, you may want to set the power limit (Plim) value high or set CalPD to zero which will disable the power limit feature.

Turning the Laser Current Source On

Now this channel is configured to operate in Constant Power Mode. The Controller's laser current source will drive the laser to the Constant Power set point and maintain closed loop control with the monitor photodiode current measurement. You can enable this channel now or set all of the other channels first. The top soft key (F1) on any of the three pages of the LAS setup menu will toggle the laser current source on and off. You can also turn the current source on and off with the top soft key (F1) on the channel menu. The ON toggle has a two second delay before the current source is enabled in compliance with safety requirements.

Each current source can be turned on or off independently as described above, or you can turn on all 16 channel sources at the same time from the All Chnl menu. See the LDC-3908, LDC-3916 or LDC-3926 Mainframe Instruction Manual for more information on all channel operation.

Conditions Which Will Automatically Shut Off the Laser Output

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. With the laser output enabled, the channel or status displays should be indicating measured laser current. If the output won't function or an error code appears, check the conditions shown below or table 2.3 "LASER Error Indicators".

The following conditions will automatically force the laser current source to turn off:

1. LASER High Power Limit (Plim, E507)
2. LASER High Voltage Limit (Vlim, E503 or E505)
3. LASER ENABLE Interlock (E501)
4. LASER ENABLE Key Lock turned off on the front panel (E501)
5. LASER Open Circuit (E503)
6. TEC High Temperature Limit Condition (E509)

In addition, the LASER Current Limit setting (Ilim) will clip the laser drive current at the Ilim set point when the signal is being modulated. When the LASER current limit (Ilim) is reached, an ILIM warning will appear on the CHAN menu display. The current limit setting is independent of the voltage drop of the device connected to the LASER output. 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 active.

The LDC-3916330 Series Modules' response to sensing the various limits can be controlled via the GPIB interface. Most high limit responses can be set to either turn off the source or just give a limit warning through the GPIB interface. See the "LAS:ENAB:OUTOFF" command in Chapter 4 of this manual for more information.

Laser Error Indicators

The LDC-3916330 Series Laser Diode Current Source Controllers indicate general LASER operational error conditions. When an error occurs, the Error Indicator Code will appear on the status page, the Chan page, or the LAS setup pages for the respective current source. Laser error indicator codes are summarized in Table 2.2. The error indicator code will clear if you exit any page that it appears on after the error has been corrected. The output drive will shut off when and laser error code occurs. Error codes that start with “E4” are for the LAS1 current source. Error codes that start with “E5” are for the LAS2 current source.

Table 2.2 LASER Error Indicators

Error Code			Description	Probable Cause
LDC-3916332/334		LDC-3916338		
LAS1	LAS2	LAS		
E401	E501	E501	Interlock	Interlock pins not connected properly or LASER ENABLE key lock turned off on front panel
E403	E503	E503	Voltage Limit or Open Circuit	The laser current source pins are open, or some condition caused the laser voltage to exceed the voltage limit setting.
E404	E504	E504	Current Limit	The current limit was reached. This condition will cause an error indicator code and shut down the current source only when enabled through the GPIB interface; otherwise, a current limit will only limit the drive current at the limit value and indicate ILIM on the display.
E405	E505	E505	Voltage Limit Warning	The voltage on the laser current source is approaching the limit value. This condition will cause an error indicator code and shut down the current source only when enabled through the GPIB interface.
E407	E507	E507	Output Power Limit	Software calculated optical output power limit was detected
E408	E508	E508	TEC is off	A TEC source, such as a 3916558 which has been programmed to control this channel’s laser module has turned off. This condition will shut down the laser source only when enabled through the GPIB interface.
E409	E509	E509	TEC Temperature Limit	A TEC source, such as a 3916558 which has been programmed to control this channel’s laser module has turned off due to a temperature limit condition. This condition will shut down the laser source only when enabled through the GPIB interface.
E410	E520	E520	Tolerance Event	Out of tolerance status forces LAS output off.
E411	E511	E511	Hardware error	Firmware has detected a hardware error.
E429	E529	E529	Output off when controller detects on	The laser source is off without hardware or firmware indication.
E435	E535	E535	Mode changed while output enabled	Operating mode of the module was changed while the laser output enabled.

CHAPTER 3

REMOTE OPERATIONS

Everything you can do from the front panel can also be done remotely and in some cases with more flexibility. For example, in remote mode, you can enable or disable conditions that will cause the laser current source or the TEC controller to automatically shut off. The following sections show you the fundamentals of operating your LDC-3916330 Series module remotely through the GPIB and RS-232 interfaces.

Remote Configuration

Refer to the LDC-3916 Instruction Manual Chapter 3, "Operating in Remote Control" for information concerning setup of GPIB or RS-232 remote communications. That section also describes the use of IEEE 488.2 common commands, LDC-3916 mainframe commands, and syntax.

LDC-3916330 Series Laser Diode Controller Command Set

The LDC-3916330 Series module utilizes its own module-specific commands, as well as the commands for the LDC-3916 mainframe (see LDC-3916 User's Manual Chapter 3 "Operating in Remote Control"). Figure 3.1 shows all of the commands which are usable by the LDC-3916 in conjunction with the LDC-3916330 Series modules.

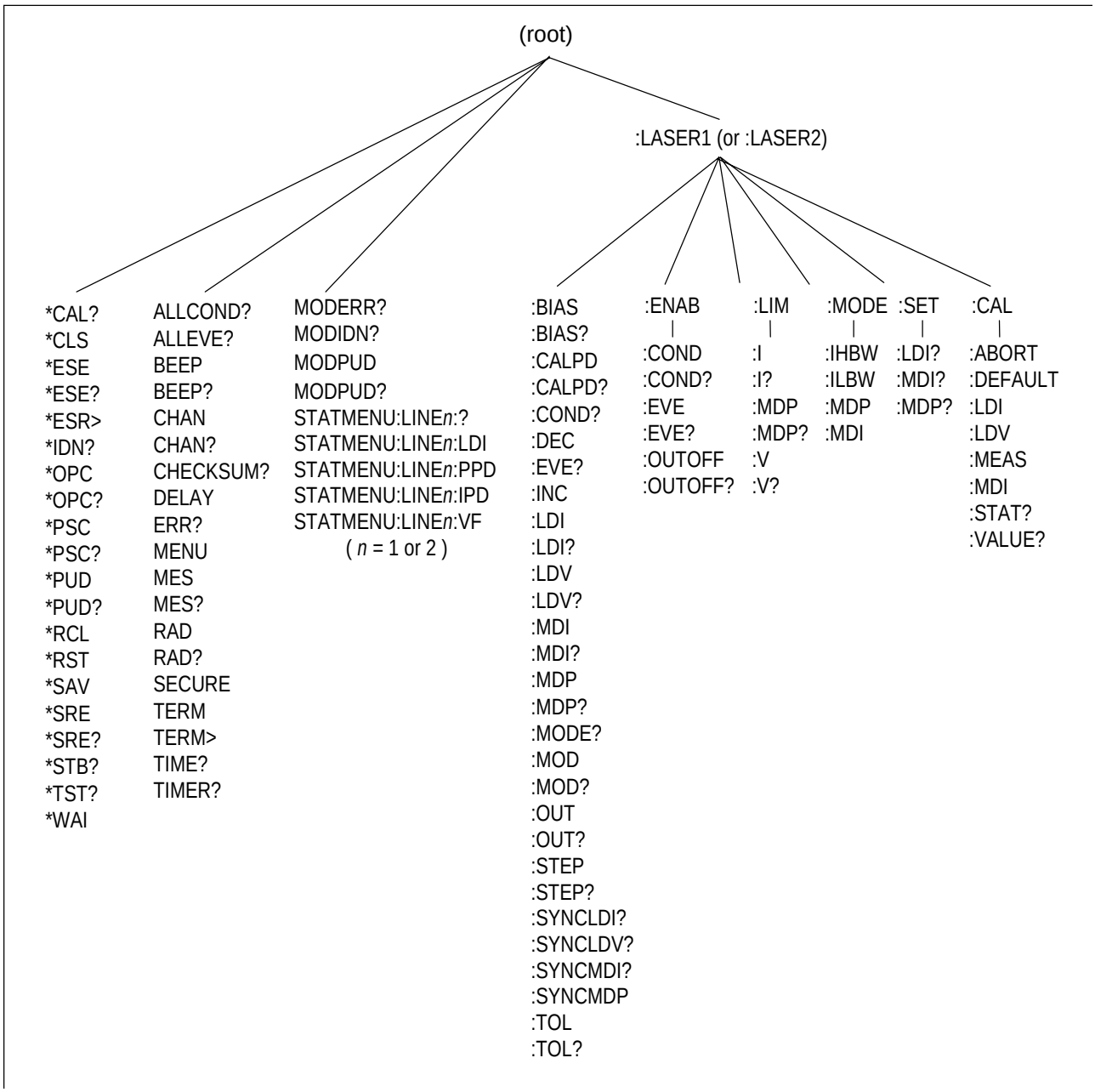


Figure 3.1 LDC-3916 and LDC-3916330 Series Command Path Structure

LDC-3916330 Series Laser Diode Controller Often Used Commands

Table 3.1 LDC-3916330 Series Often Used Commands

NAME	PARAMETERS	FUNCTION
CHAN	1	Sets the channel (or ALL channels) for further commands.
ERR?	NONE	Returns "Mainframe" errors generated since the last query, followed by a binary representation of existing module errors.
MODERR?	NONE	Returns module errors generated since the last error query (to that module).
LASERn:		
LASERn:CALPD	1	Sets the monitor photodiode responsivity for Power mode use[1].
LASERn:LDI	1	Sets the constant current source set point.
LASERn:LDI?	NONE	Returns the measured output current.
LASERn:LDV?	NONE	Returns the measured laser voltage.
LASERn:LIM:I	1	Sets the current source limit.
LASERn:LIM:MDP	1	Sets the constant optical power (from monitor PD) limit.
LASERn:LIM:V	1	Sets the current source voltage limit.
LASERn:MDI?	1	Returns the measured monitor PD current.
LASERn:MDP	1	Sets the constant optical power set point.
LASERn:MDP?	NONE	Returns the measured optical power.
LASERn:MODE:IHBW	NONE	Sets the mode to constant current, high bandwidth mode.
LASERn:MODE:ILBW	NONE	Sets the mode to constant current low bandwidth mode.
LASERn:MODE:MDI	NONE	Sets the mode to constant photodiode current mode.
LASERn:MODE:MDP	NONE	Sets the mode to constant optical power mode.
LASERn:OUT	1	Used to turn the current source output on or off.
LASERn:OUT?	NONE	Returns the current source output status.

Command Timing and Completion

All commands for the LDC-3916330 Series modules are sequential, except for the "LAS:OUT ON", "LAS:INC", and "LAS:DEC" commands. The "LAS:OUT ON" command is overlapped to allow the user to abort it with the "LAS:OUT OFF" command during a two second interval after the output is told to be on. The "LAS:INC" and "LAS:DEC" commands are overlapped to allow the user to monitor the other functions while in an automatic ramping mode.

For more information on the use of operation complete commands, such as *WAI and *OPC, refer to the LDC-3916 User's Manual, Chapter 3.

Status Reporting

Refer to the LDC-3916 Laser Diode Controller Instruction Manual, Chapter 3 "Operating in Remote Control" for information on standard status structures, mainframe-related commands, and for understanding the Operation Complete definition.

The following sections discuss the LDC-3916330 Series module-dependent aspects of the status reporting, including the "OUTOFF" commands and queries. The Output Off Register section also contains information on specifying some of the conditions that will force the laser current source and/or TEC output off.

Status Registers

The LDC-3916330 Series modules provide status registers which are summarized in the LDC-3916 mainframe. These summaries are accessed by the "ALLCOND?" and "ALLEVE?" remote queries. Refer to the LDC-3916 Instruction Manual for details on remote status reporting.

Each channel of the LDC-3916 may contribute to the "ALLCOND" and "ALLEVE" registers. For the LDC-3916330 Series modules, the enabled conditions of both the LAS and TEC functions are logically ORed, and the summary is passed to the appropriate bit of the ALLCOND register (see Figure 3.2). Likewise, the enabled events of both the LAS and TEC functions are logically ORed, and the summary is passed to the appropriate bit of the ALLEVE register (see Figure 3.3).

For example, you may wish to have the LDC-3916 create an interrupt to the host PC in the event of the TEC output shutting off. To do this you would first enable the event with the "TEC:ENAB:EVE 1024" command. This would allow the event to be passed to the ALLEVE register on the 3916 mainframe. The ALLEVE status can be read by the "ALLEVE?" query and the summary can be monitored with the "*STB?" query. To generate the SRQ (interrupt) for our example, you must also set the Service Request Enable Register, e.g. "*SRE 1", to allow the ALLEVE summary to generate the interrupt. See the LDC-3916 Instruction Manual, Chapter 3, for details on status structures.

> **Note:** When the laser voltage reaches the voltage limit setting (LAS:LIM:V), the hardware will always shut the laser off. The “Laser Voltage Limit” referred to in the Event, Condition, and Output Off Registers occurs when the voltage is about 0.25 volts less than the voltage limit setting. This feature can be used for a warning before the actual voltage limit is reached.

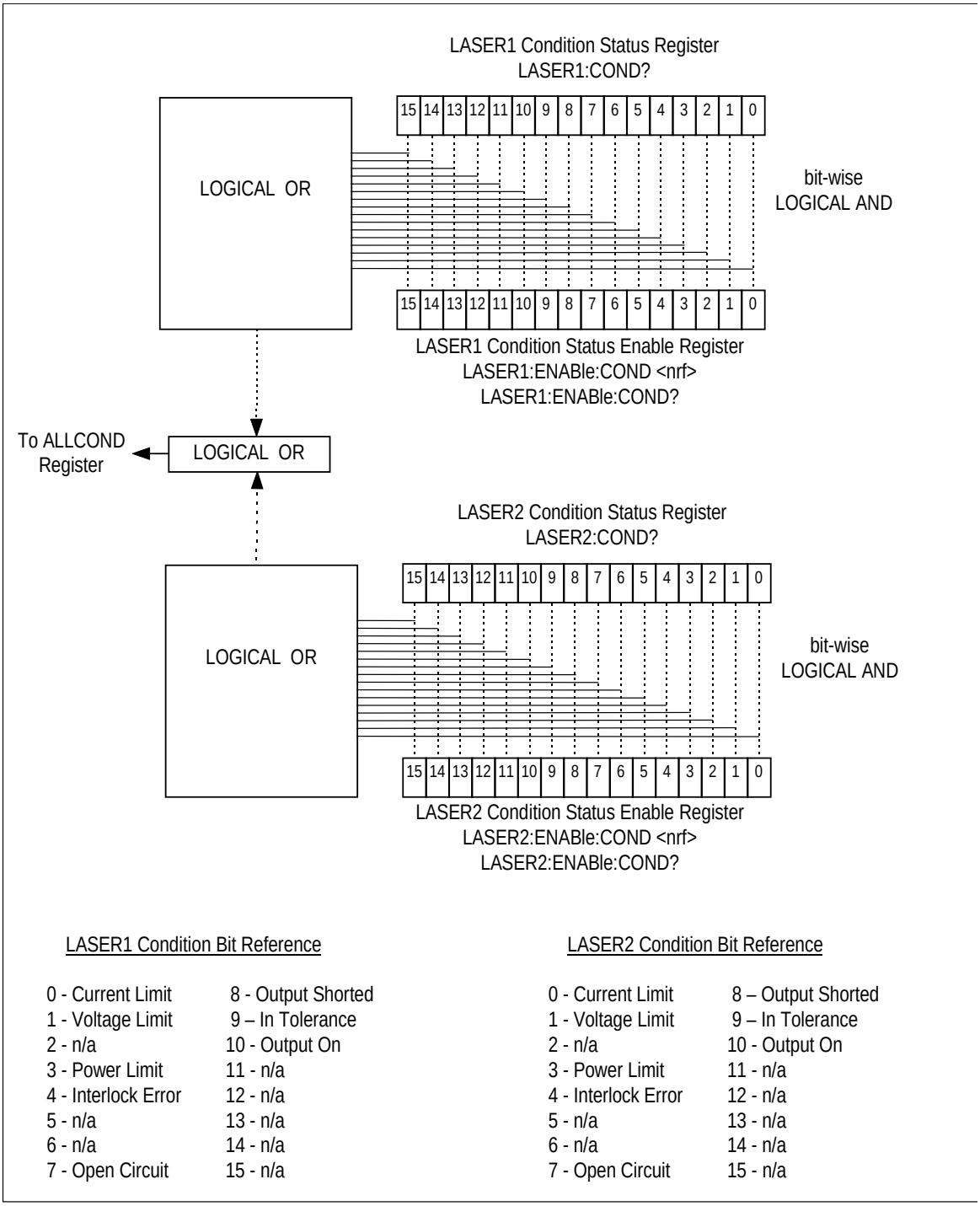


Figure 3.2 LDC-3916330 Series Condition Registers

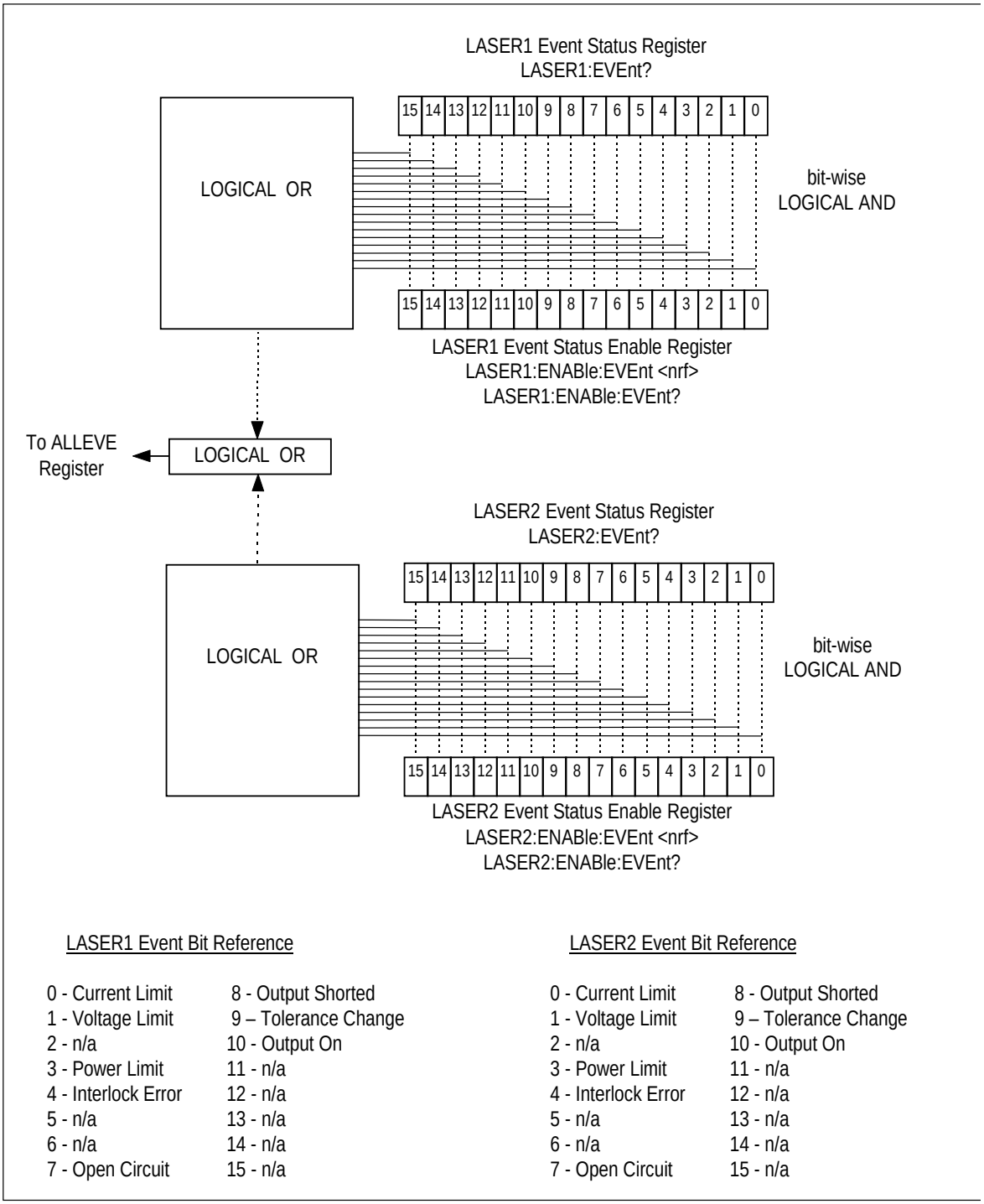


Figure 3.3 LDC-3916330 Series Event Registers

Output Off Registers

The Output Off Enable Registers allow you to determine which conditions and events in the TEC and LASER controllers can cause their outputs to be turned off. These registers are configured in a manner which is similar to the status reporting registers. However, their values are not reported in the Status Byte Register. These registers are used by the firmware to control the output enable for that function (LASER or TEC). The events and conditions which may be set to cause the TEC and LASER outputs to be turned off are shown in Figures 3.4 and 3.5.

The default settings for these registers for an LDC-3916330 Series module are shown in Table 3.2. The registers take on these values at power-up, as the result of a *RST command, or when you choose "Default" from the Save/Recall menu. These settings are not affected by the *PSC (Power-On Status Clear) command.

Table 3.2 LDC-3916330 Series Default Settings for Output Off Registers

LASER Output Off Register			**TEC Output Off Register**		
Bit	Name	State	Bit	Name	State
0	Current Limit	Disabled	0	Current Limit	Disabled
1	Voltage Limit	Disabled	1	Voltage Limit	Disabled
2	N/A		2	N/A	
3	Power Limit	Enabled	3	High Temperature Limit	Enabled
4	N/A		4	N/A	
5	N/A		5	N/A	
6	N/A		6	Sensor Open	Enabled
7	N/A (see Note 1 below)		7	TE Module Open Circuit	Enabled
8	N/A		8	Sensor Type changed	Enabled
9	Out of Tolerance	Disabled	9	Out of Tolerance	Disabled
10	TEC Output Off	Disabled	10	Sensor Shorted	Enabled
11	TEC High Temp Limit	Enabled	11	N/A	
12	N/A		12	N/A	
13	N/A		13	N/A	
14	N/A		14	N/A	
15	N/A		15	N/A	

Note: Bit 7 is Laser Open Circuit in the Laser Condition and Event registers. It is not available to disable in the Output Off Enable register because it is always active in the hardware.

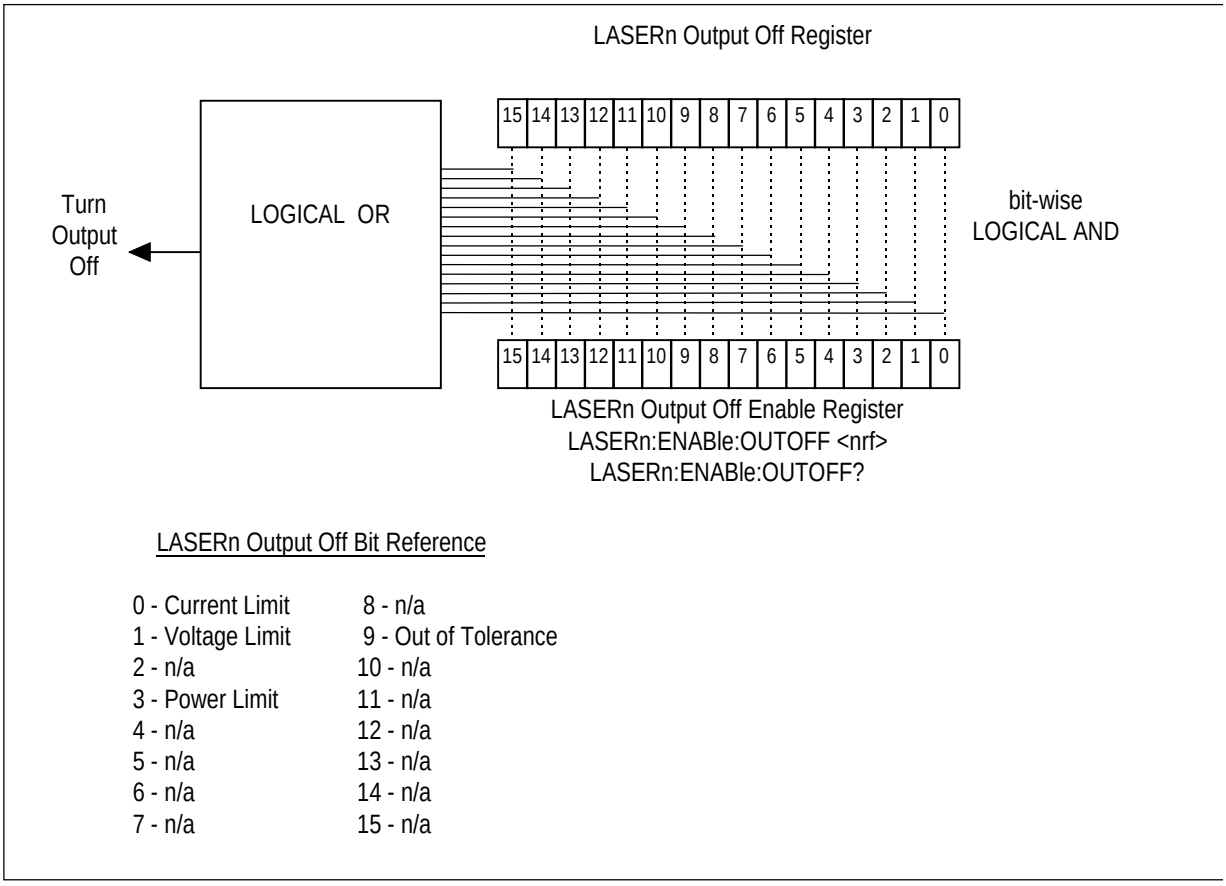


Figure 3.4 LDC-3916330 Series Laser Diode Controller LASER Output Off Register

Error Messages

This section contains descriptions of the errors which are specific to the LDC-3916330 Series modules. These are the error codes that are returned from the "MODERR?" query. Refer to the LDC-3916 Laser Diode Controller Instruction Manual, Chapter 3, for a list of LDC-3916 mainframe error codes and descriptions (the codes returned from the "ERR?" query).

During remote operation, the recommended method for error testing is as follows. First read the system errors and module error summary with the "ERR?" query. This allows you to error check the LDC-3916 as a whole. If any module errors are present, the corresponding bit of the error summary will be set. For example, if the "ERR?" query returns "0,0001000000100000" there are errors on channels 13 and 6. Then read the module errors using the "MODERR?" query. For example, "Chan 13;Moderr?" and "Chan 6;Moderr?" queries could be sent. For more information on LDC-3916 mainframe errors, refer to Chapter 3 of the LDC-3916 Instruction Manual.

Table 3.3 LDC-3916330 Series Error Message Codes

Error Code	Explanation
E-103	Length of arbitrary block is different from expected length.
E-104	Parameter is an undefined numeric type.
E-105	Parameter has an invalid exponent.
E-106	A digit was expected in the parameter but was not found.
E-114	Specified arbitrary block length is invalid.
E-123	Command is not found.
E-126	Wrong number of parameters for command.
E-201	Parameter value out of range.
E-202	Error in conversion of parameter type.
E-203	Command is a "secure" command, but secure commands are disabled.
E-204	Suffix is invalid.
E-205	Expected Boolean parameter is invalid.
E-206	Error in conversion to signed 16-bit integer.
E-207	Error in conversion to unsigned 16-bit integer.
E-208	Error in conversion to signed 32-bit integer.
E-209	Error in conversion to unsigned 32-bit integer.
E-210	Error in conversion to floating-point number.
E-211	Error in conversion to character pointer.
E-212	Error in conversion to byte pointer.
E-214	Response is too long to output.
E-222	Set value is over range.
E-223	Set value is under range.
E-226	Error in arbitrary block specification.

Error Code	Explanation
E-401	Interlock Open forces Laser 1 output off.
E-403	Laser 1 Voltage Limit forces output off. "Open Circuit" error.
E-404	Laser 1 Current Limit forces output off.
E-405	Laser 1 Voltage Limit forces output off.
E-407	Laser 1 Monitor Diode Power Limit forces output off.
E-408	External TEC Output Off Status forces LAS1 output off.
E-409	External TEC Temperature Limit forces LAS1 output off.
E-410	Out of Tolerance status forced LAS1 output off.
E-411	Laser 1 Hardware Error forces output off. (e.g. low power line voltage).
E-429	Laser 1 Output is off, but Laser 1 Status thought it was on.
E-435	Laser 1 Mode changed while output on.
E-501	Interlock Open forces Laser 2 output off.
E-503	Laser 2 Voltage limit forces output off. "Open Circuit" error.
E-504	Laser 2 Current Limit forces output off.
E-505	Laser 2 Voltage Limit forces output off.
E-507	Laser 2 Monitor Diode Power Limit forces output off.
E-508	External TEC Output Off Status forces LAS2 output off.
E-509	External TEC Temperature Limit forces LAS2 output off.
E-510	Out of Tolerance status forced LAS2 output off.
E-511	Laser 2 Hardware Error forces output off. (e.g. low power line voltage).
E-529	Laser 2 Output is off, but Laser 2 status thought it was on.
E-535	Laser 2 Mode changed while output on.
E-601	Internal error: recalled bin has incorrect checksum. (Settings do not match bin).
E-602	Internal error: task synchronization error.
E-620	Internal error: resource unavailable.
E-621	Internal error: message undeliverable to task.
E-622	Internal error: could not send message to mainframe.
E-710	Internal error: AC power low error detected
E-711	Internal error: AC power low error detected
E-712	Internal error: Over-temperature error detected on internal sensor
E-713	Internal error: Power brown-out error detected
E-714	Internal error: Writing to display
E-802	Calibration error: measurement entered before calibration was ready.

CHAPTER 4

COMMAND REFERENCE

This chapter is a guide to all of the device-dependent commands for the LDC-3916330 Series Dual LASER Diode Controller module. The first part contains an overview of the remote commands used by the LDC-3916330 Series. The second part contains all of the LDC-3916330 Series commands in alphabetical order.

Table 4.1 lists the commands for the LDC-3916330 Series modules. It uses the nomenclature “LASER” in places to indicate that a command can be sent either to the LASER1 current source or to the LASER2 current source. To send a command to LASER1, replace “LASERn” with “LASER1”; “LASER2” will cause a command to go to LASER2.

Table 4.1 GPIB Command Summary Reference List

Name	Parameters	Function
LAS:BIAS	1	Enables or disables the -5 volt photodiode bias
LAS:BIAS?	NONE	Returns the status of the photodiode bias control
LAS:CALPD	1	Used to set the CAL PD (monitor responsivity) constant
LAS:CALPD?	NONE	Returns the CAL PD (monitor responsivity) constant
LAS:CAL:ABORT	NONE	Aborts a calibration
LAS:CAL:DEFAULT	NONE	Restores all calibration values to their defaults
LAS:CAL:LDI	NONE	Enters the LASER current calibration mode
LAS:CAL:LDV	NONE	Enters the LASER voltage calibration mode
LAS:CAL:MDI	NONE	Enters the monitor photodiode current calibration mode
LAS:CAL:MEAS	1	Enters a calibration value
LAS:CAL:STAT?	NONE	Returns a value which represents the calibration status
LAS:CAL:VALUE?	1	Used for factory calibration testing only
LAS:COND?	NONE	Returns the value of the LASER condition register
LAS:DEC	2	Decreases the LASER set point value by one or more steps with user-programmable delay between steps
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 which turn the LAS output off
LAS:ENAB:OUTOFF?	NONE	Returns the value of the LAS outoff enable register
LAS:EVE?	NONE	Returns the value of the LAS event register
LAS:LDI	1	Sets the LASER constant current source set point value
LAS:LDI?	NONE	Returns the constant current source measured value
LAS:INC	2	Increases the LASER set point value by one or more steps with user-programmable delay between steps
LAS:LDV?	NONE	Returns the measured LASER voltage value
LAS:LIM:I	1	Sets the LASER current source limit
LAS:LIM:I?	NONE	Returns the LASER current source limit
LAS:LIM:MDP	1	Sets the constant optical power (from monitor PD) limit value
LAS:LIM:MDP?	NONE	Returns the optical power (from monitor PD) limit value
LAS:LIM:V	1	Sets the LASER compliance voltage limit value
LAS:LIM:V?	NONE	Returns the LASER compliance voltage limit value
LAS:MDI	1	Sets the monitor current set point
LAS:MDI?	NONE	Returns the monitor PD current measured value
LAS:MDP	1	Sets the constant optical power set point
LAS:MDP?	NONE	Returns the actual monitor PD power value

Table 4.1 GPIB Command Summary Reference List

Name	Parameters	Function
LAS:MODE?	NONE	Returns the mode, I (current), IHBW (high bandwidth), P (optical power) or MDI (constant monitor current)
LAS:MODE:IHBW	NONE	Sets the mode to constant current, high bandwidth.
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:MOD	1	Enables or disables the channel's modulation output
LAS:MOD?	NONE	Returns the status of the channel's modulation output
LAS:OUT	1	Enables/disables the current source output
LAS:OUT?	NONE	Returns the current source output status
LAS:SET:LDI?	NONE	Returns the LASER constant I (current) set point
LAS:SET:MDI?	NONE	Returns the LASER constant optical power set point
LAS:SET:MDP?	NONE	Returns the constant P (optical power) set point
LAS:STEP	1	Sets the LASER set point step value
LAS:STEP?	NONE	Returns the LASER set point step value
LAS:SYNCLDI?	NONE	Synchronized measurement; returns the LASER current in mA
LAS:SYNCLDV?	NONE	Synchronized measurement; returns the LASER voltage in volts
LAS:SYNCMDI?	NONE	Synchronized measurement; returns the monitor photodiode current in μA
LAS:SYNCMDP?	NONE	Synchronized measurement; returns the optical power
LAS:TOL	2	Sets the LASER set point tolerance value and time period value
LAS:TOL?	NONE	Returns the LASER set point tolerance value and time period value
MODERR?	NONE	Returns the error codes (up to 10) from the module
MODIDN?	NONE	Returns identification data from the module
MODPUD	1	Used at factory to set calibration information
MODPUD?	NONE	Returns factory set calibration information
STATMENU:LINE*n*?	NONE	Returns the name of the measurement that is displayed on line *n* of the status menu (*n* can be either 1 or 2)
STATMENU:LINE*n*:LDI	NONE	Sets line *n* of the status menu to display LASER current
STATMENU:LINE*n*:VF	NONE	Sets line *n* of the status menu to display LASER forward voltage
STATMENU:LINE*n*:IPD	NONE	Sets line *n* of the status menu to display photodiode current
STATMENU:LINE*n*:PPD	NONE	Sets line *n* of the status menu to display optical power

LDC-3916330 Series Device-Dependent Command Reference

This section contains all of the device-dependent commands for the LDC-3916330 Series Laser Current Source Modules, listed in alphabetical order. Sub-sections for each path are presented, listing the commands which are legal for that path. See Chapter 3, Figure 3.1, for command path tree structure.
The following pages contain a reference for the device-dependent commands. Contained is useful information for the remote operation of the modules. The pages also contain the commands for only the LASERn current source. The commands for the LASERn are identical; merely replace “LASER1” with “LASER2”.

Note: For 3916338 modules, the n in LASERn is not required.

LASERn :

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn: command path is used to get to the LDC-3916330 Series Laser Diode Current Source’s laser current source commands. The following command paths may be reached from the LASER: command path.

LASERn:CAL:	LASERn:MODE:
LASERn:ENABle:	LASERn:SET:
LASERn:LIMit:	

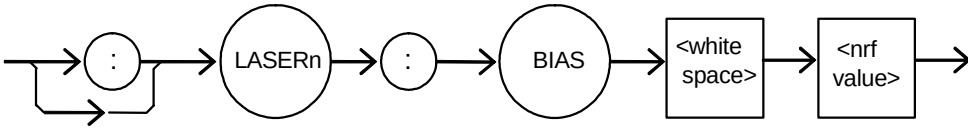
The following commands may be reach directly from the LASER1: command path.

LASERn:BIAS	LASERn:LDV?	LASERn:STEP
LASERn:BIAS?	LASERn:MDI	LASERn:STEP?
LASERn:CALPD	LASERn:MDI?	LASERn:SYNCLDI?
LASERn:CALPD?	LASERn:MDP	LASERn:SYNCLDV?
LASERn:COND?	LASERn:MDP?	LASERn:SYNCMDI?
LASERn:DEC	LASERn:MODE?	LASERn:SYNCMDP?
LASERn:EVEnt?	LASERn:MODulation	LASERn:TOL
LASERn:INC	LASERn:MODulation?	LASERn:TOL?
LASERn:LDI	LASERn:OUTput	
LASERn:LDI?	LASERn:OUTput?	

LASERn:BIAS

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:BIAS command turns the selected channel's laser photodiode bias on or off.



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

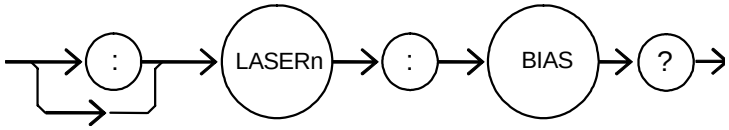
Notes When the BIAS is on, a bias of -5 volts is placed across the photodiode terminals.

Examples "LASER1:BIAS ON" - action: sets Laser1 photodiode bias output on.
"LASER:BIAS ON" - action: sets the laser photodiode bias on (LDC-3916338 only).

LASERn:BIAS?

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:BIAS? query returns the status of the selected module's photodiode bias selection.



Parameters None. The response is an <nrf value>.

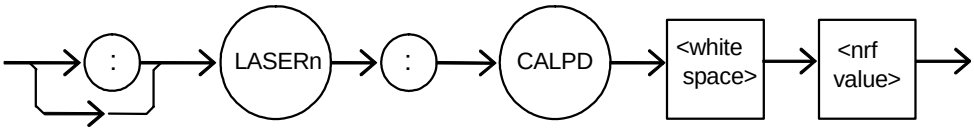
Notes Photodiode bias is turned off when a *RST command is issued.

Examples "Laser1:BIAS?" - response: 0, means that the selected module's Laser1 photodiode bias is off.

LASERn:CALPD

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:CALPD command sets the selected module's laser photodiode feedback responsivity (the CAL PD parameter)



Parameters An <nrf value>, in microamps/milliwatt (μA/MW).

Notes The module calculates optical power by dividing the monitor feedback current by its CALPD value. Photodiode (PD) responsivity is frequently provided by manufacturers of packaged lasers with built-in power monitors, and is typically called "Monitor Detector Responsivity." The monitor produces a current when the laser illuminates it, and this current will increase with increasing laser optical power. Manufacturers of laser modules with integrated monitors may specify the responsivity of the monitor in terms of the laser optical power and the resulting monitor current. Fox example, a responsivity may be specified as 5 μA/mW, meaning that to produce a monitor current or 5 μA, the laser optical power must be 1 mW. Typically, the specified responsivity is entered into the current source as CalPD, using the LASERn:CALPD command.

If this parameter is set to 0, the module will not calculate the optical power. It will display "-----" on the front panel, and GPIB queries of the optical power, using the "LASERn:MDP?" query, will return -1.0.

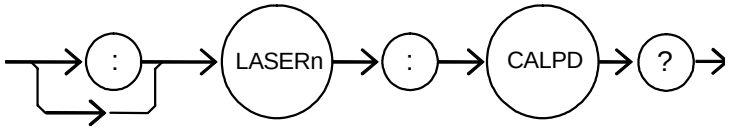
Examples "LASER1:CALPD 0" - action: sets the CAL PD parameter to 0.

"Laser1:Calpd 10.0" - action: sets the CAL PD parameter to 10.0 microamp/milliwatt. A photodiode feedback current of 10 μA will cause the measured optical power to be 1 milliwatt.

LASERn:CALPD?

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:CALPD? query returns the value of the selected module's laser photodiode feedback responsivity (CalPD parameter) setting.



Parameters None. The response is an <nrf value>.

Notes If this value is 0, the front panel Ppd will display "----", and measured optical power (read with GPIB using the "Laser1:mdp?" query) will be -1.0.

Examples "LASER1:CALPD?" - response: 1.1, means the selected module's Laser1 CalPD is set to 1.10 μA/mW: a photodiode feedback current of 2.2 μA represents 2 mW of optical power.

LASERn:CAL:

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:CAL: command path is used to get to the selected module's laser calibration commands.

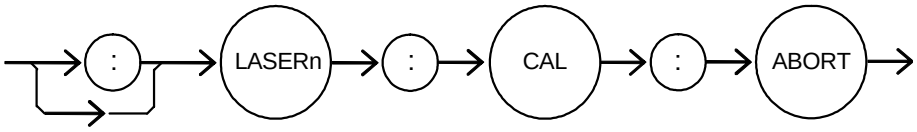
The following commands may be reached directly from the LASER:CAL: command path.

LASERn:CAL:ABORT	LASERn:CAL:DEFAULT	LASERn:CAL:LDI
LASERn:CAL:LDV	LASERn:CAL:MDI	LASERn:CAL:MEAS
LASERn:CAL:STATUS?	LASERn:CAL:VALUE?	

LASERn:CAL:ABORT

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:CAL:ABORT command is used to exit the selected module's laser calibration procedure without changing the calibration values.



Parameters None.

Notes If this command is issued while the LDC-3916330 Series Dual Laser Diode Current Source is in a laser calibration, the calibration will be terminated and the module will operate with the same calibration values as before the calibration mode was started.

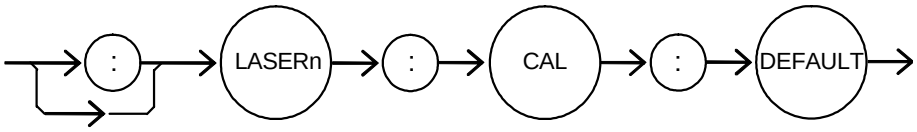
This command is intended for use after a false or invalid calibration is entered, or to exit calibration mode before any values have been entered.

Examples "Laser1:CAL:ABORT" - action: module exits calibration mode.

LASERn:CAL:DEFAULT

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:CAL:DEFAULT command sets all of the selected module's laser calibration constants to default values.



Parameters None.

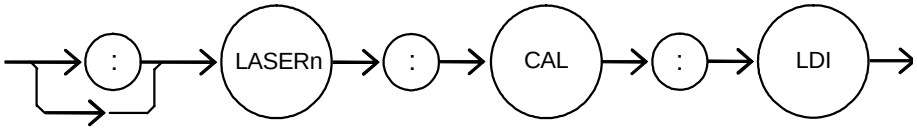
Notes This command should only be used in the case in which the calibration has become corrupted and circumstances make calibration impossible. Measurements and setpoints on the laser current source are not guaranteed to meet accuracy specifications after this command is issued. Accuracy will remain unspecified until calibration is performed on the module.

Examples "Laser1:CAL:Default" - action: the selected module sets all of its Laser1 calibration constants to default values.

LASERn:CAL:LDI

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:CAL:LDI command is used to initiate the calibration procedure for the selected module's laser current setpoint, measurement, and current limit.



Parameters None.

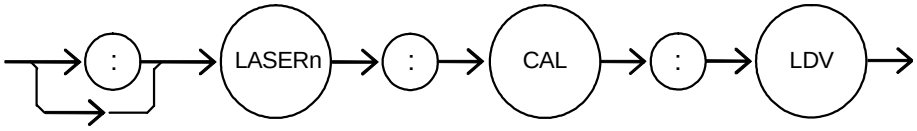
Notes Both low and high bandwidth modes, along with current limit, are calibrated during this procedure. See the Service Reference portion of this manual for complete calibration instructions.

Examples "Laser1:CAL:LdI" -action: the selected module enters calibration mode for Laser1 current.

LASERn:CAL:LDV

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:CAL:LDV command is used to initiate the calibration procedure for the selected module's laser voltage measurement.



Parameters None.

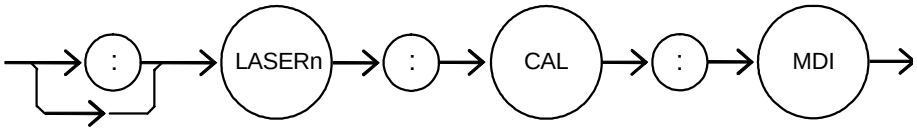
Notes See the Service Reference portion of this manual for complete calibration instructions.

Examples "Laser1:CAL:Ldv" -action: the selected module enters calibration mode for Laser1 voltage measurement.

LASERn:CAL:MDI

COMMON
DEVICE DEPENDENT
FRONT PANEL

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



Parameters None.

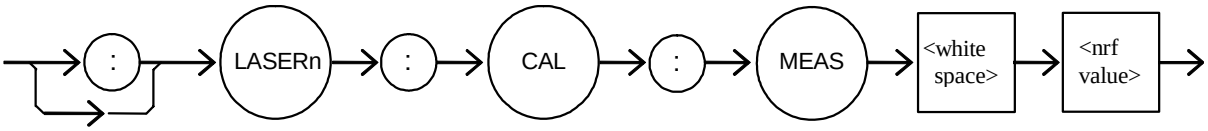
Notes See the Service Reference portion of this manual for complete calibration instructions.

Examples "Laser1:CAL:MDI" -action: the selected module enters the Laser1 photodiode current calibration mode.

LASERn:CAL:MEAS

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:CAL:MEAS command is used to enter measured values during the selected module's laser calibration procedure.



Parameters An <nrf value> which represents the measured value expected for the present Laser1 calibration state.

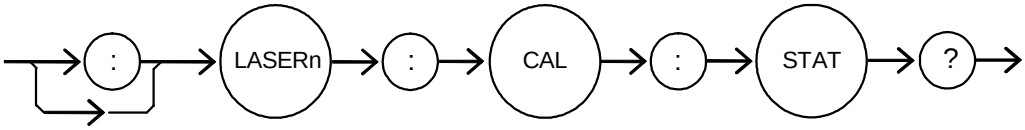
Notes See the Service Reference portion of this manual for compete calibration instructions.

Examples "Laser1:CAL:MEAS 4.95" - action: the module uses the value 4.95 for the required measurement value.

LASERn:CAL:STATus?

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:CAL:STATus? query is to determine whether the unit is ready for a calibration value and whether it is in a laser calibration mode.



Parameters None. The response will be an <nrf value>; 0 = not ready for measurement; 1 = ready for measurement; 2 = calibration completed; 3 = calibration aborted

Notes If the calibration is aborted, the status value will remain "3" until the calibration is started again.

Examples "LASER1:CAL:STAT?" - response: 1, means the module is ready for a calibration measurement to be entered using the "LASER1:CAL:MEAS" command.

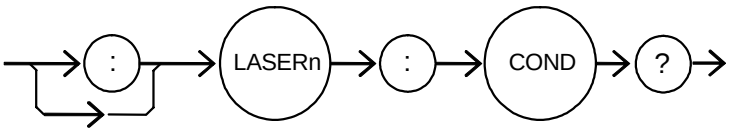
"LASER1:CAL:STAT?" - response: 2, means the module has completed calibration.

"LAser1:Cal:Stat?" - response: 0, means the module is not yet ready for the LASER1 calibration measurement value to be entered.

LASERn : COND?

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:COND? query returns the contents of the selected module's laser condition status register.



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

1 - Current Limit	256 - Output is Shorted
2 - Voltage Limit	512 - Output in Tolerance
4 - N/A	1024 - Output On
8 - Power Limit	2048 - N/A
16 - Interlock Disabled	4096 - N/A
32 - N/A	8192 - N/A
64 - N/A	16384 - N/A
128 - Open Circuit	32768 - N/A

Notes — The conditions which are reported to the 3916 status byte are set using the LASERn:ENABle:COND command (for each channel). See the Status Reporting section of the 3916 manual for more complete information.

The open circuit condition can only be present while a laser output is on; when the hardware detects this condition, it will turn that laser output off. Therefore, the open circuit condition is fleeting and may be missed with the LASERn:COND? query. The user should test for the open circuit event using the LASERn:EVEnt? query.

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

NOTE: The voltage limit condition occurs as a warning when the laser diode voltage is about 0.25 volts below the VLim setting. The open circuit condition occurs when the laser diode voltage is equal to or exceeds the VLim setting.

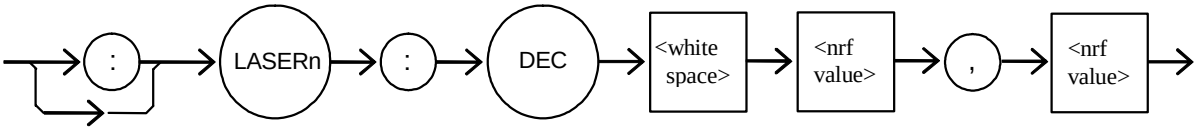
Examples — "LASER1:COND?" - response: 1027, means that the Laser1 output is on (1024), it is in voltage limit (2), and it is in current limit (1).

"LASER1:COND?" - response: 272, means that the Laser 1 output is shorted (turned off - 256) and its interlock pins are not connected (16).

LASERn:DEC

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:DEC command decrements the selected module's laser constant current set point by one or more steps. Parameters allow multiple steps to be decremented and the time (in milliseconds) between decrements to be set, respectively.



Parameters — Two <nrf values> are required. The first one represents the number of steps, and the second is the number of milliseconds between steps.

Notes — The step size can be edited via the LASERn:STEP command. Its default value is 1.0 mA.

The first parameter (number of steps) must be an integer between 1 and 50000.

The minimum time to complete one decrement is about 10 to 20 msec. Therefore, values for the second parameter (time between decrements) have a practical minimum of 20. The maximum number of msec is 65535.

Only the LASERn:LDI set point is decremented via this command regardless of mode setting or output status.

Examples — "LASER1:STEP 0.3; LASER1:DEC 1,100" - action: the Laser1 constant current setpoint is decremented by 0.3 mA.

"LASER1:STEP 0.5; LASER1:DEC 4,100" - action: the step size is set to 0.5 mA, the setpoint is decremented by 4 steps of 0.5 mA, separated in time by 100 msec, for a total decrement of 2.0 mA.

"laser1:step 1.0; laser1:dec 10,1000" - action: the step size is set to 1.0 mA, the setpoint is decremented by 1.0 mA, 10 times, with 1 second between decrement steps. The Laser1 output is decremented a total of 10 mA over a period of 10 seconds.

LASERn:ENABle

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:ENABle: command path is used to get to the selected module's laser status enable commands and queries.

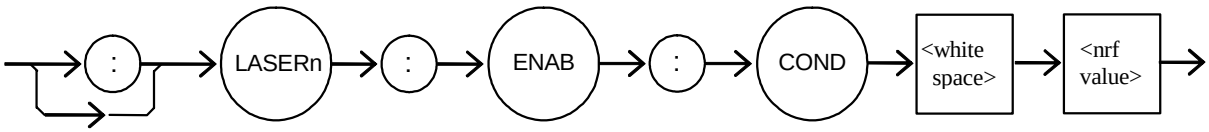
The following commands may be reached directly from the LASER1:ENABle: command path.

LASERn:ENABle:COND
LASERn:ENABle:COND?
LASERn:ENABle:EVEnt
LASERn:ENABle:EVEnt?
LASERn:ENABle:OUTOFF
LASERn:ENABle:OUTOFF?

LASERn:ENABle:COND

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:ENABle:COND command sets the selected module's laser condition status enable register. The bits in this register determine which bits in the Laser1 condition status register are summarized in the 3916 status byte.



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

1 - Current Limit	256 - Output Shorted
2 - Voltage Limit	512 - Output In Tolerance
4 - N/A	1024 - Output On
8 - Power Limit	2048 - N/A
16 - Interlock Disabled	4096 - N/A
32 - N/A	8192 - N/A
64 - N/A	16384 - N/A
128 - Open Circuit	32768 - N/A

Notes This register can be read using the LASERn:ENABle:COND? query.

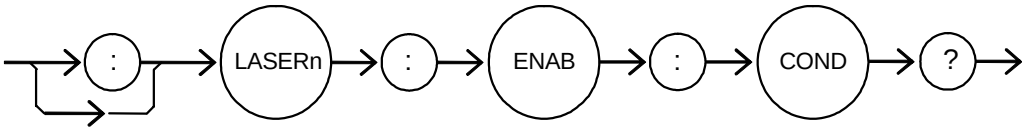
See the Status Reporting section of the 3916 manual for more information regarding condition reporting.

Examples "LASER1:ENAB:COND 9" -action: the only conditions from the selected module that will be reported to the 3916 status byte are the power limit (8) and current limit (1) conditions.

LASERn:ENABle:COND?

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:ENABle:COND? query returns the value of the selected module's laser condition status enable register.



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

1 - Current Limit	256 - Output Shorted
2 - Voltage Limit	512 - Output In Tolerance
4 - N/A	1024 - Output On
8 - Power Limit	2048 - N/A
16 - Interlock Disabled	4096 - N/A
32 - N/A	8192 - N/A
64 - N/A	16384 - N/A
128 - Open Circuit	32768 - N/A

Notes The selected module's enabled laser conditions can be set by using the LASERn:ENABle:COND command.

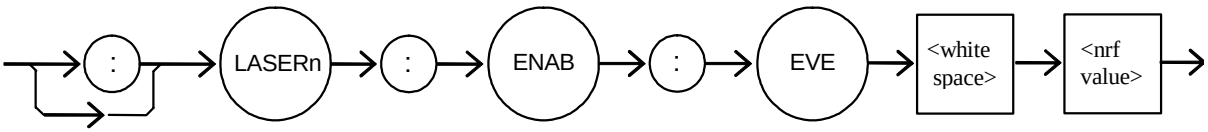
The laser condition status can be monitored by the LASERn:COND? query.

Examples "LASER1:ENAB:COND?" - response: 258, means that only the following two conditions will be reported (in summarized form) to the 3916's status byte: output shorted (256) and voltage limit (2). Note that the output shorted condition is the same as output off.

LASERn:ENABle:EVEnt

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:ENABle:EVEnt command sets the selected module's laser event status enable register. The bits in this register determine which bits in the laser event status register are summarized in the 3916 status byte.



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

1 - Current Limit Changed State	256 - Output Shorted Changed State
2 - Voltage Limit Changed State	512 - Output Changed Tolerance State
4 - N/A	1024 - Output On Changed State
8 - Power Limit Changed State	2048 - N/A
16 - Interlock Changed State	4096 - N/A
32 - N/A	8192 - N/A
64 - N/A	16384 - N/A
128 - Open Circuit Changed State	32768 - N/A

Notes The register is read with the LASERn:ENABle:EVEnt? query. The selected module's laser event status can be monitored by the LASERn:EVEnt? query.

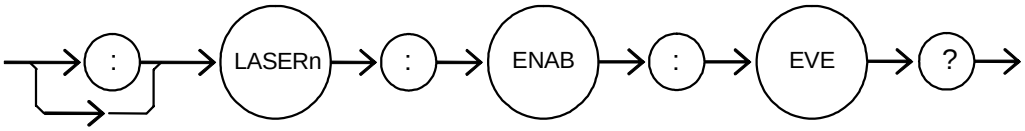
See the Status Reporting section of the 3916 manual for more information regarding condition reporting.

Examples "LASER1:ENAB:EVENT 136" -action: only the open circuit changed state (128) and power limit changed state (8) events will be reported (in summarized form) to the 3916's status byte.

LASERn:ENABle:EVEnt?

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:ENABle:EVEnt? query returns the contents of the selected module's laser event status enable register.



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

1 - Current Limit Changed State	256 - Output Shorted Changed State
2 - Voltage Limit Changed State	512 - Output Changed Tolerance State
4 - N/A	1024 - Output On Changed State
8 - Power Limit Changed State	2048 - N/A
16 - Interlock Changed State	4096 - N/A
32 - N/A	8192 - N/A
64 - N/A	16384 - N/A
128 - Open Circuit Changed State	32768 - N/A

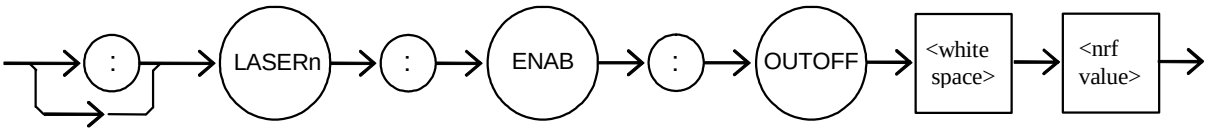
Notes The register is set using the LASERn:ENABle:EVEnt command. The selected module's laser event status can be monitored by the LASERn:EVEnt? query.

Examples "LASER1:ENAB:EVE?" -response: 256, means that the selected module's Laser1 output shorted changed state event is the only event that will be reported to the 3916 status byte.

LASERn:ENABle:OUTOFF

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:ENABle:OUTOFF command sets the selected module's laser output off enable register. The bits in this register specify the conditions that will cause the Laser1 current source to automatically turn off.



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

1 - Current Limit	256 - N/A
2 - Voltage Limit	512 - Output Out of Tolerance
4 - N/A	1024 - N/A
8 - Power Limit	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 This register is read using the LASERn:ENABle:OUTOFF? query.

The factory default value for this register is 8: only power limit will shut off the output.

Enabling voltage limit will cause the output to shut off when the laser diode voltage reaches a level that is about 0.25 volts below the VLim setpoint. Regardless of how this register is set, the current source will shut off when the laser diode voltage exceeds the VLim setpoint: this is an open circuit error.

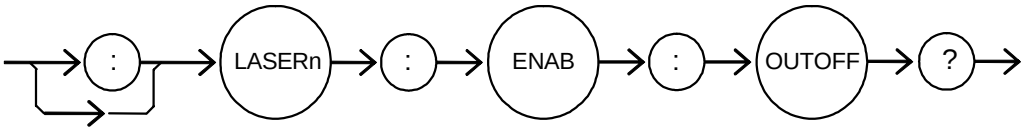
Examples "LASER1:ENAB:OUTOFF 9" - action: sets the selected module's LASER1 output off enable register so that either a power limit or a current limit condition will cause the LASER1 output to be turned off.

NOTE: Open circuit or interlock open conditions will always turn off the current source. They are not included in the output off enable register because they cannot be disabled.

LASERn:ENABle:OUTOFF?

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:ENABle:OUTOFF? query returns the contents of the selected module's laser output off enable register.



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

1 - Current Limit	256 - N/A
2 - Voltage Limit	512 - Output Out of Tolerance
4 - N/A	1024 - N/A
8 - Power Limit	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

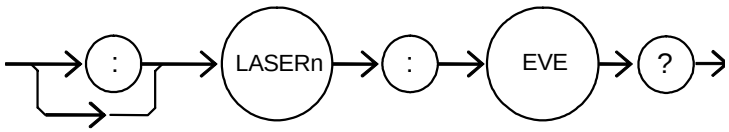
Notes The register can be set by using the LASERn:ENABle:OUTOFF command. The selected module's laser output status can be monitored by the LASERn:EVEnt? query.

Examples "LASER1:ENAB:OUTOFF?" - response: 8, means that the selected module's power limit condition will cause the selected module's Laser1 output to be turned off.

LASERn:EVEnt?

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:EVEnt? query returns the contents of the selected module's laser event status register.



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

1 - Current Limit Changed State	256 - Output Shorted Changed State
2 - Voltage Limit Changed State	512 - Output Changed Tolerance State
4 - N/A	1024 - Output On Changed State
8 - Power Limit Changed State	2048 - N/A
16 - Interlock Changed State	4096 - N/A
32 - N/A	8192 - N/A
64 - N/A	16384 - N/A
128 - Open Circuit Changed State	32768 - N/A

Notes The events in this register will not be reported to the 3916's status byte unless they are selected using the LASERn:ENABle:EVEnt command.

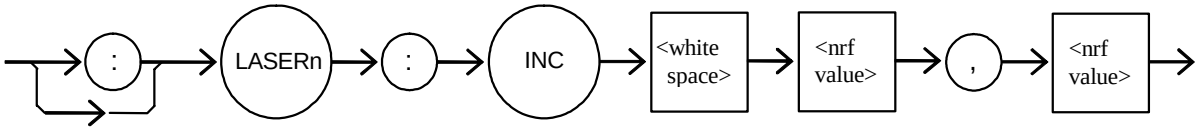
The event status register is only cleared when it is read or by the *CLS command; the condition status, however, is constantly changing.

Examples "LASER1:EVE?" -response: 131, means that an open circuit changed state event (128), a voltage limit changed state event (2), and a current limit changed state event (1) have occurred since the last LASER1:EVEnt? query.

LASERn:INC

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:INC command increments he selected module's laser constant current set point by one or more steps. A second parameter allows the time (in milliseconds) between increments to be set.



Parameters — Two <nrf values> are required. The first represents the number of steps, and the second is the time in milliseconds between steps.

Notes — The step size can be set using the LASERn:STEP command. Its default value is 1.0 mA.

The first parameter (number of steps) must be an integer between 1 and 50000.

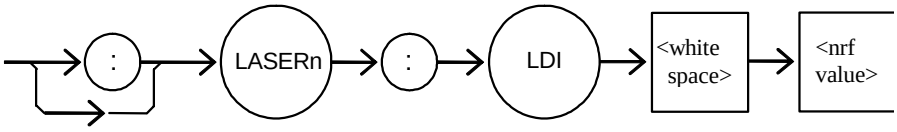
The minimum time to complete one increment is about 10 to 20 msec. Therefore, values for the second parameter (time between increments) have a practical minimum of 20. The maximum number of msec is 65535.

Examples — "LASER1:STEP 0.5; LASER1:INC 10,50" - action: the step size is set to 0.5 mA, and the set point is incremented by 0.5 mA ten times, each increment being separated by 50 msec.

LASERn:LDI

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:LDI command sets the selected module's laser constant current setpoint.



Parameters — An <nrf value> which represents the setpoint, in mA.

Notes — The setpoint is the same for both low and high bandwidth output modes.

The setpoint is read using the LASERn:SET:LDI? query.

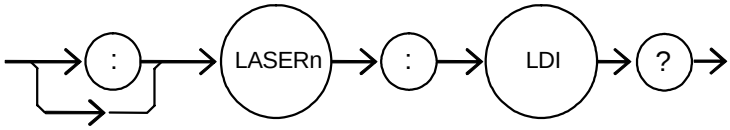
Examples — "Las:LDI 400" -action: sets the selected module's Laser1 output current to 400.00 mA.

"LASER1:ldi 100" - action: sets the selected module's Laser1 output current to 100.00 mA.

LASERn:LDI?

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:LDI? query returns the value of the selected module's measured laser current



Parameters None. The response is an <nrf value>.

Notes Response is the selected module's measured LASERn output current, regardless of control mode. This measurement is updated approximately once every 600 msec.

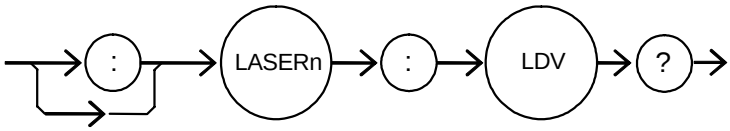
Examples "LASER1:ldi?" -response: 30.0, means the selected module's measured Laser1 output current is 30.0 mA.

"LASER1:LDI?" -response: 149.6, means the selected module's measured Laser1 output current is 149.6 mA.

LASERn:LDV?

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:LDV? query returns the value of the selected module's measured laser voltage.



Parameters None. The response is an <nrf value>.

Notes Response is the selected module's measured laser output voltage, regardless of control mode. This measurement is updated approximately once every 600 msec.

Examples "LASER1:ldv?" -response: 3.03, means the measured Laser1 output voltage is 3.03 volts.

"LASER1:LDV?" -response: 1.0, means the measured Laser1 output voltage is 1.00 volts.

LASERn:LIMIT:

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:LIMit: command path is used to access the selected module's limit commands.

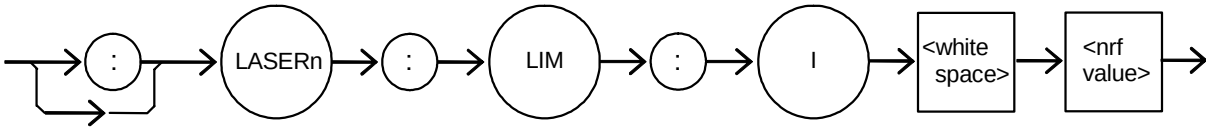
The following commands may be reached directly from the LASERn:LIMit: command path.

LASERn:LIMit:I	LASERn:LIMit:MDP	LASERn:LIMit:V
LASERn:LIMit:I?	LASERn:LIMit:MDP?	LASERn:LIMit:V?

LASERn:LIMit:I

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:LIMit:I command sets the selected module's laser current limit value.



Parameters An <nrf value> which represents the selected module's laser limit current, in mA.

Notes The current limit is in effect in all modes of operation.

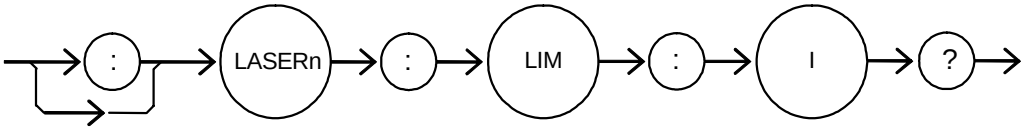
Examples "LASER1:LIM:I 80" -action: the selected module's Laser1 current limit is set to 80 mA.

":Laser1:Limit:I 160" -action: the selected module's Laser1 current limit is set to 160 mA.

LASERn:LIMit:I?

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:LIMit:I? query returns the value of the selected module's laser current limit.



Parameters None. The response in an <nrf value>.

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

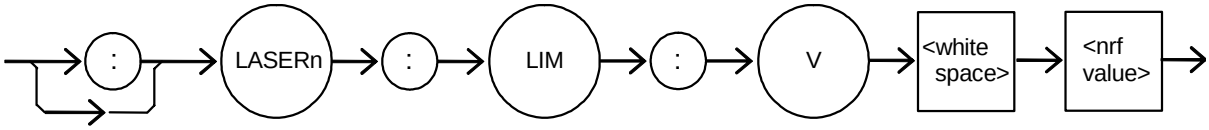
Examples "LASER1:LIM:I?" - response: 40, means the selected module's Laser1 current limit is 40 mA.

"Laser1:LIM:I?" - response: 300, means the selected module's Laser1 current limit is 300 mA

LASERn:LIMit:V

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:LIMit:V command sets the selected module's laser voltage limit (VLim) value. If the laser diode voltage exceeds this value, the output will automatically turn off, and an open circuit error will be generated.



Parameters An <nrf value> which represents the selected module's laser limit voltage, in volts.

Notes Voltage limit is in effect in all modes of operation. If the laser diode voltage exceeds this value, the current source will automatically turn off and generate an open circuit error.

The range for the voltage limit is 0.1 to 7.5 volts.

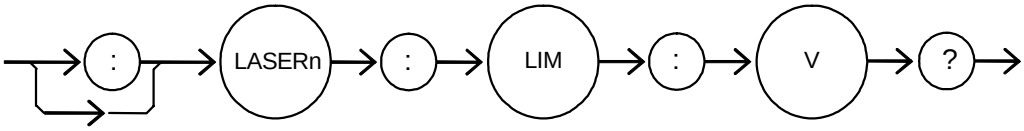
Examples "LASER1:LIM:V 4.6" - action: the selected module's Laser1 voltage limit is set to 4.6 volts.

":Laser1:Limit:v 6.1" - action: the selected module's Laser1 voltage limit is set to 6.1 volts.

LASERn:LIMit:V?

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:LIMit:V? query returns the value of the selected module's laser voltage limit setpoint.



Parameters None. The response is an <nrf value>.

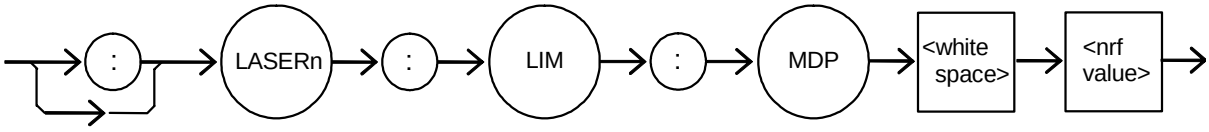
Notes The selected module's voltage limit is valid for all modes of operation.

Examples "LASER1:LIM:V?" -response: 4.0, means the selected module's Laser1 voltage limit is 4.0 volts.

LASERn:LIMit:MDP

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:LIMit:MDP command sets the laser optical power limit. If the measured optical power exceeds this value, the current source output will be shut off, and a power limit error will be generated.



Parameters — An <nrf value> which represents the selected module's laser monitor photodiode power limit, in mW.

Notes — The monitor photodiode power limit condition normally shuts the output off, but this can be disabled using the LASERn:ENABle:OUTOFF command.

The laser optical power is a calculated value. The module derives the optical power by dividing the monitor diode current (MDI) by CalPD.

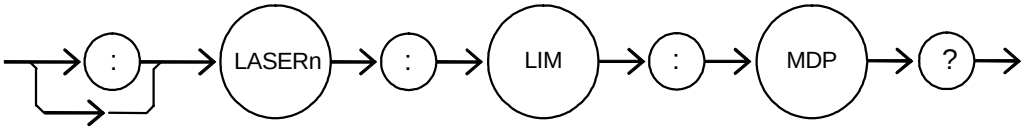
The optical power limit is in effect for all operating modes with the following exceptions: if CalPD is set to 0.0, the power is not calculated and the limit test is not performed. The limit test is also not performed during calibration.

Examples — "LASER1:LIM:MDP 200" - action: sets the selected module's Laser1 monitor photodiode power (optical power) limit to 200 mW.

LASERn:LIMit:MDP?

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:LIMit:MDP? query returns the value of the selected module's laser optical power limit setpoint.



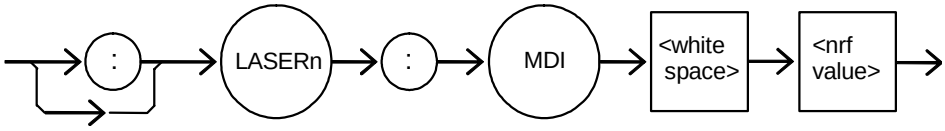
Parameters — None. The response is an <nrf value>.

Examples — "LASER1:LIM:MDP?" - response: 300.0, means the selected module's monitor PD power limit is set to 300.0 mW.

LASERn:MDI

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:MDI commands sets the selected module's laser monitor photodiode current (MDI) setpoint.



Parameters An <nrf value> which represents the selected module's photodiode current setpoint, in μA.

Notes In constant monitor diode current (MDI) mode, the output current is controlled so that the monitor diode current remains constant at the MDI setpoint. See the "LASERn:Mode" command for more information.

Monitor diode current is sometimes referred to as "photodiode feedback current". On the front panel, monitor diode current is referred to as IPD.

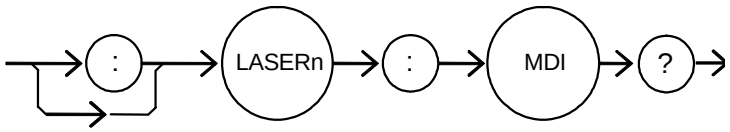
Examples "Laser1:Mdi 40" - action: the selected module's Laser1monitor photodiode current setpoint is set to 40 μA.

"Laser1:MDI 200.5" - action: the selected module's Laser1 constant-monitor photodiode current setpoint is set to 200.5 μA.

LASERn:MDI?

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:MDI? query returns the value of the selected module's laser photodetector (monitor photodiode) current measurement, in μA.



Parameters None. The response is an <nrf value>.

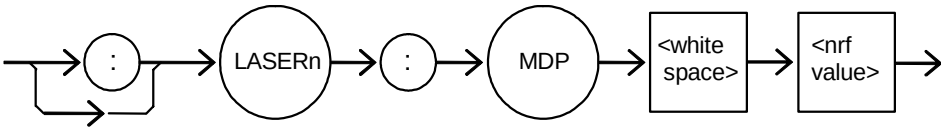
Notes The response is in μA, and is valid even when the unit is not in MDI mode. This measurement is updated approximately once every 600 msec.

Examples "Laser1:MDi?" - response: 57.3, means 57.3 μA of photodetector current was measured in the selected module's Laser1 monitor photodiode circuit.

LASERn:MDP

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:MDP command sets the value of the selected module's laser optical power set point, in mW.



Parameters An <nrf value> which represents the selected module's optical power setpoint, in mW.

Notes In constant optical power (MDP) mode, the output current is controlled so that the optical power remains constant at the MDP setpoint. See the "LASERn:Mode" command for more information.

If CALPD is 0, the actual MDP set point will be approximately 0.

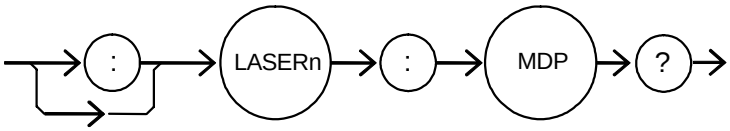
On the front panel, the monitor photodetector power is referred to as PPD.

Examples "Laser1:Mdp 40" - action: the selected module's Laser1 power setpoint is set to 40 mW.

LASERn:MDP?

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:MDP? query returns the value of the selected module's laser photodetector power measurement, in mW.



Parameters None. The response is an <nrf value>.

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

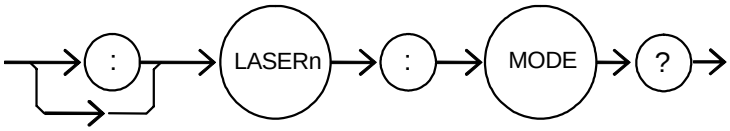
This measurement is derived from the monitor photodiode current (MDI): it is calculated by dividing MDI by CalPD. If CalPD is 0, this query returns a -1.0. This measurement is updated approximately once every 600 msec.

Examples "Laser1:MDp?" - response: 100.0: means Laser1's optical power is calculated to be 100 mW.

LASERn:MODE?

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:MODE? query returns the selected module's laser control mode.



Parameters: None. The response is character data (which represents the LAS operating mode).

Notes: IHBW mode is the same as ILBW mode (low bandwidth), except that the output low bandpass filter is disabled in IHBW mode.

Examples: "LASER1:MODE?" - response: ILBW, means that constant current, low bandwidth mode is in effect for the selected module's Laser1 output.

":Laser1:Mode?" - response: MDP, means that constant optical power is in effect for the selected module's Laser1 output.

"Laser1:Mode?" - response: MDI, means that constant monitor current mode is in effect for the selected module's Laser1 output.

":Laser1:MODE?" - response: IHBW, means that constant current, high bandwidth mode is in effect for the selected module's Laser1 output.

LASERn:MODE:

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:MODE: command path is used access the selected module's laser mode selection commands.

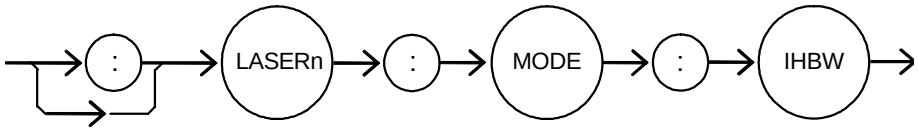
The following commands may be reached directly from the LASERn:MODE: command path.

LASERn:MODE:IHBW	LASERn:MODE:ILBW
LASERn:MODE:MDI	LASERn:MODE:MDP

LASERn:MODE:IHBW

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:MODE:IHBW command selects high bandwidth constant current mode for the selected module's laser current source.



Parameters None.

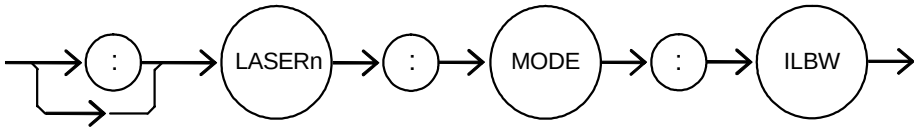
Notes In high bandwidth mode the modulation bandwidth is increased.

Examples "Laser1:mode:ihbw" - action: enables the high bandwidth constant current mode for the selected module's Laser1 current source.

LASERn:MODE:ILBW

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:MODE:ILBW command selects low-bandwidth constant current mode for the selected module's laser current source.



Parameters None.

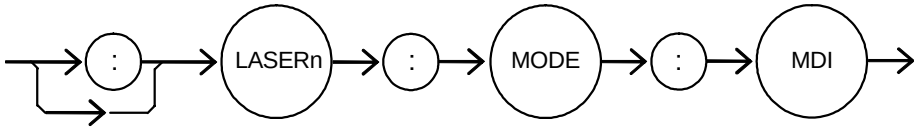
Notes Constant ILBW mode (low bandwidth) enables the selected module's output low bandpass filter.

Examples "Laser1:mode:ilbw" - action: enables the low bandwidth constant current mode for the selected module's Laser1 current source.

LASERn:MODE:MDI

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:MODE:MDI command selects constant monitor diode current (MDI) mode for the selected module's laser current source.



Parameters None.

Notes On the front panel, constant monitor diode current mode is referred to as IPD mode.

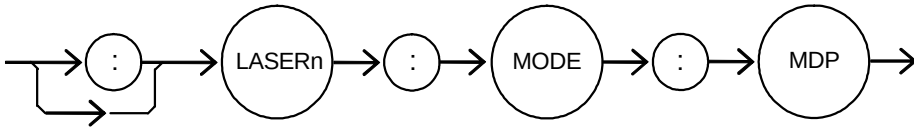
In this mode, the control set point is entered with the LASn:MDI command.

Examples "Laser1:Mode:MDi" - action: sets the selected module's LASER1 operating mode to constant monitor diode current mode.

LASERn:MODE:MDP

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:MODE:MDP command selects constant optical power mode (MDP) for the selected module's laser current source.



Parameters None.

Notes On the front panel, photodetector power mode is referred to as P mode.

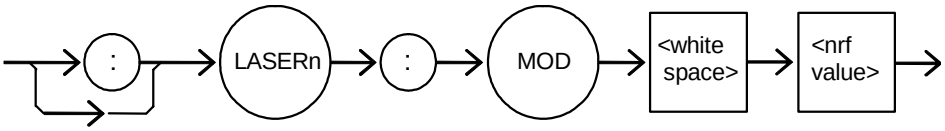
This mode of operation uses the monitor photodiode feedback to maintain constant laser optical power. The actual set point will be a monitor photodiode current value calculated with the CALPD conversion factor. Therefore, in this mode the set point is only as accurate as the user's CALPD value.

Examples "LASER1:MODE:MDP" - action: sets the selected module's Laser1 operating mode to constant optical power mode.

LASERn:MODulation

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:MODulation command turns the selected module's laser modulation switch on or off.



Parameters: An <nrf value>; 1 = on (enabled); 0 = off (disabled).

Notes: When the modulation switch is enabled for a channel, the laser current may be modulated by connecting a modulation signal onto the back panel "MODULATION" connector (BNC).

The modulation bandwidth depends on the operating mode and the module used. Refer to Chapter 1, Specifications, for more information on bandwidth specification.

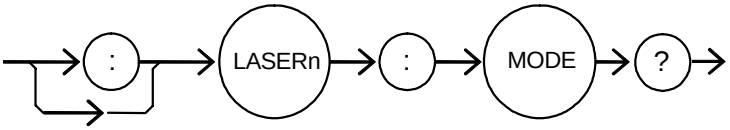
Examples: "LASER1:LDI 20; LASER1:MOD ON" - action: sets the selected module's Laser1 output current to 20 mA and then turns the selected module's Laser1 modulation switch on.

"Laser1:Mod 0" - action: disables modulation of the selected module's Laser1 current source.

LASERn:MODulation?

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:MODulation? query returns the status of the selected module's laser modulation switch.



Parameters: None. The response is an <nrf value>, 1 = on (enabled); 0 = off (disabled).

Notes: More than one channel at a time may be modulated via the modulation signal, if desired.

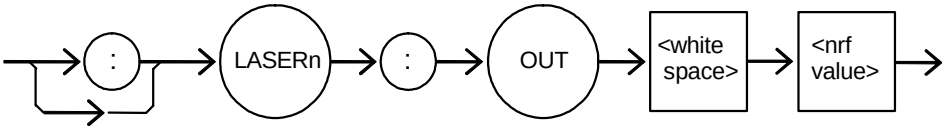
Examples: "Laser1:MODULATION?" - response: 0, means that the selected module's Laser1 modulation switch is disabled.

"LASER1:MOD?" - response: 1, means that the selected module's Laser1 modulation switch is enabled. A signal applied to the back panel modulation connector will modulate the selected module's Laser1 current.

LASERn:OUTput

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:OUTput command turns the selected module's laser output on or off.



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

Notes — After the selected module's laser output is turned on, it may be useful to wait until the output is fully on before performing further operations, but it is not necessary. When the output is turned on, there is a two second delay before the output is actually enabled. This delay is a safety requirement.

When a current source output is off, an internal short is placed across the output terminals.

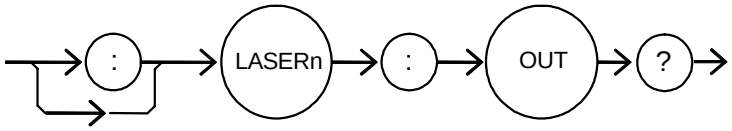
Examples — "LASER1:LDI 20; Laser1:out on" - action: sets the selected module's Laser1 output current to 20 mA and then turns the selected module's Laser1 output on.

"Laser1:Out 0" - action: turns off the selected module's Laser1 current source.

LASERn:OUTput?

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:OUTput? query returns the status of the selected module's laser output switch.



Parameters — None. The response is an <nrf value>.

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

Examples — "Laser1:OUT?" -response: 0, means that the selected module's Laser1 output switch is disabled; devices may be safely disconnected or connected at the selected module's Laser1 output terminal.

"LASER1:OUT?" - response: 1, means that the selected module's Laser1 output switch is enabled.

LASERn:SET:

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:SET: command path is used to access the selected module's laser set point queries.

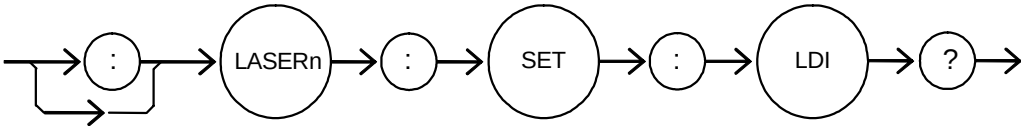
The following commands may be reached directly from the LASERn:SET: command path.

LASERn:SET:LDI? LASERn:SET:MDI? LASERn:SET:MDP?

LASERn:SET:LDI?

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:SET:LDI? query returns the selected module's laser constant-current setpoint. This value is used for both bandwidth modes (IHBW and ILBW).



Parameters None. The response is an <nrf value> which represents the selected module's constant I set point value, in mA.

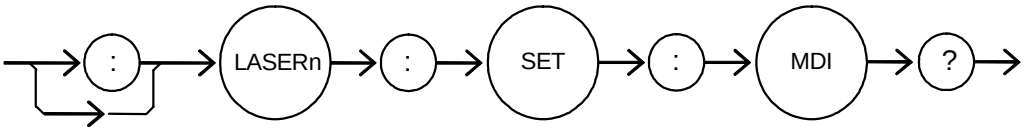
Notes The LDI set point is only in effect when the operating mode is IHBW or ILBW.

Examples "LASER1:SET:LDI?" -response: 50.0, means the selected module's LASERn output current set point value is 50.0 mA.

LASERn:SET:MDI?

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:SET:MDI? query returns the selected module's photodiode current setpoint value.



Parameters None. The response is an <nrf value> which represents the selected module's constant MDI set point, in μA.

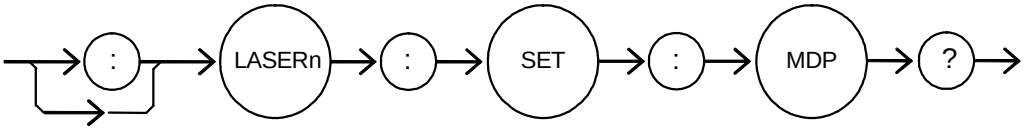
Notes The monitor photodiode current is dependent on the laser optical output power. Therefore, the MDI set point may be used to control optical output of the laser.

Examples "Laser1:set:mdi?" - response: 30.0, means the selected module's LASERn monitor photodiode current setpoint is 30 μA, for use in constant MDI mode.

LASERn:SET:MDP?

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:SET:MDP? query returns the selected module's monitor PD power set point value.



Parameters — None. The response is an <nrf value> which represents the constant power set point, in mW.

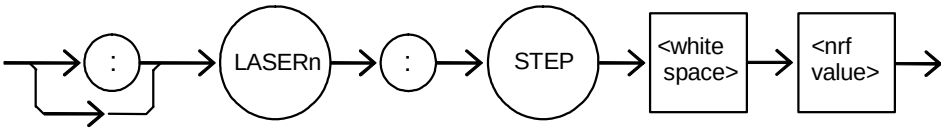
Notes — This set point is used in constant MDP (P) mode only.

Examples — "LASER1:Set:MDP?" -response: 10.0, means the selected module's laser monitor PD feedback set point is 10.0 mW.

LASERn:STEP

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:STEP command specifies the amount the selected module's laser constant current setpoint will change when the LASERn:Inc or Lasern:Dec command is issued.



Parameters — An <nrf value> representing the step amount in mA, in the range 0.1 to 100.0.

Notes — The step applies to the constant-current (ILBW or IHBW mode) setpoint.

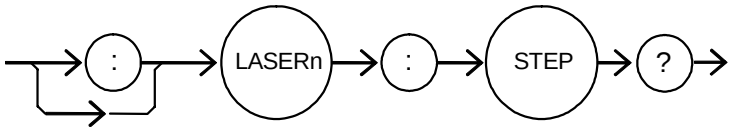
Examples — "LASER1:STEP 10" - action: sets the selected module's Laser1 step size to 10.0 mA.

"Laser1:Idi 20; Laser1:Step 10.0; Laser1:Inc 2,50" - action: sets the selected module's Laser1 setpoint to 20 mA, sets the step size to 10 mA, and performs two increments, separated by 50 mSec. After the increments, the setpoint is 40 mA.

LASERn:STEP?

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:STEP? query is used to read back the selected module's laser setpoint step size. This value is the amount the setpoint will change in response to a LASERn:Inc or LASERn:Dec command.



Parameters None. The response is an <nrf value> of the selected module's step amount.

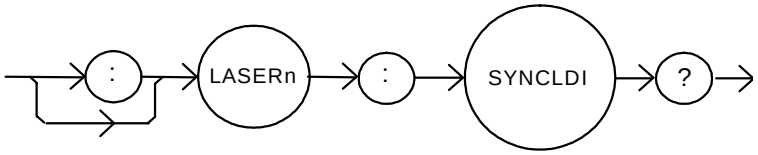
Notes The step of 1 corresponds to 1.0 mA.

Examples "Laser1:Step?" - response: 1.0, means the selected module's Laser1 step size is 1.0 mA.

LASERn:SYNCLDI?

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:SYNCLDI? query returns the value of the selected channel's measured laser current, in mA.



Parameters None. The response is an <nrf value> representing current in mA.

Notes This is a "synchronized" measurement: the measurement system is connected to the current measure signal when this query is received. A current measurement is made, and the result is returned as the response. After the measurement is made, the measurement system returns to its normal function, switching between the various signals and measuring them.

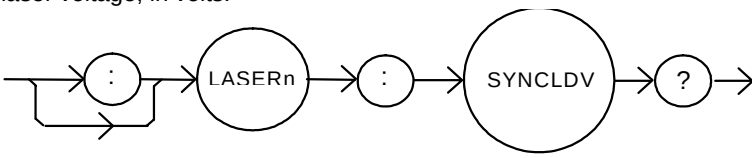
The response time to this query is from 200 msec to 250 msec, but the measurement is made as soon as the query is received. In contrast, the laser:ldi? query returns immediately, but the measurement can be up to 600 msec old.

Examples "LASER1:syncldi?" - response: 54.1, means the measured LASER current is 54.1 mA.

LASERn:SYNCLDV?

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:SYNCLDV? query returns the value of the selected channel's measured laser voltage, in volts.



Parameters None. The response is an <nrf value> representing voltage in volts.

Notes This is a "synchronized" measurement: the measurement system is connected to the voltage measurement signal when this query is received. A voltage measurement is made, and the result is returned as the response. After the measurement is made, the measurement system returns to its normal function, switching between the various signals and measuring them.

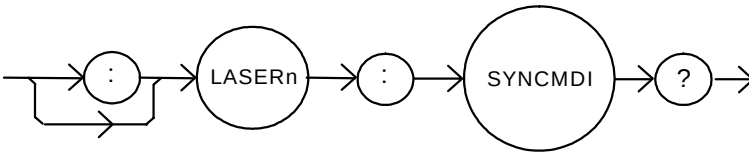
The response time to this query is from 200 msec to 250 msec, but the measurement is made as soon as the query is received. In contrast, the laser:ldv? query returns immediately, but the measurement can be up to 600 msec old.

Examples "LASER1:syncldv?" - response: 3.03, means the measured LASER output voltage is 3.03 volts.

LASERn:SYNCMDI?

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:SYNCMDI? query returns the value of the selected channel's measured monitor photodiode current in μA.



Parameters None. The response is an <nrf value> representing current in μA.

Notes This is a "synchronized" measurement: the measurement system is connected to the monitor current measure signal when this query is received. The photodiode current measurement is made, and the result is returned as the response. After the measurement is made, the measurement system returns to its normal function, switching between the various signals and measuring them.

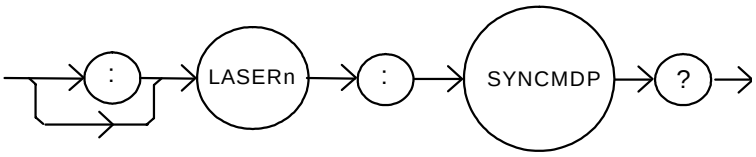
The response time to this query is from 200 msec to 250 msec, but the measurement is made as soon as the query is received. In contrast, the LASER:mdi? query returns immediately, but the measurement can be up to 600 msec old.

Examples "LASER1:syncmdi?" - response: 145.5, means the measured photodiode current is 145.5 μA.

LASERn:SYNCMDP?

COMMON
DEVICE DEPENDENT
FRONT PANEL

The LASERn:SYNCMDP? query returns the value of the selected channel's measured optical power, in mW.



Parameters: None. The response is an <nrf value> representing optical power in mW.

Notes: Optical power is derived from photodiode current. Optical power is defined as photodiode current divided by CalPD, the photodiode responsivity.

This is a "synchronized" measurement: the measurement system is connected to the monitor current measure signal when this query is received. The photodiode current measurement is made, optical power is calculated, and the result is returned as the response. After the measurement is made, the measurement system returns to its normal function, switching between the various signals and measuring them.

The response time to this query is from 200 msec to 250 msec, but the measurement is made as soon as the query is received. In contrast, the LASER:mdp? query returns immediately, but the measurement can be up to 600 msec old.

Examples: "LASER1:syncmdp?" - response: 5.5, means the calculated optical power is 5.5 mW.

STATMENU:LINE*n*:

COMMON
DEVICE DEPENDENT
FRONT PANEL

The STATMENU:LINE*n*: command path is used to get to the selected channel's status menu display selection commands. (*n* can be either 1 or 2). Line 1 only displays measurement from laser source 1 and line 2 displays measurements from laser source 2.

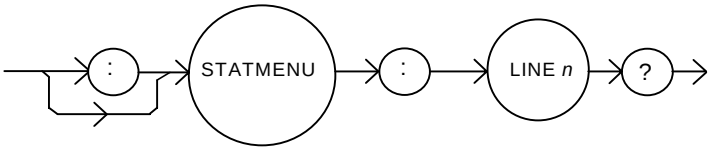
The following commands may be reached directly from the STATMENU:LINE*n*: command path.

STATMENU:LINE*n*:IPD	STATMENU:LINE*n*:LDI
STATMENU:LINE*n*:PPD	STATMENU:LINE*n*:VF

STATMENU:LINE*n*?

COMMON
DEVICE DEPENDENT
FRONT PANEL

The STATMENU:LINE*n*? query returns the name of the measurement that is currently being displayed on line *n* of the status menu. (*n* can be either 1 or 2).



Parameters — None. The response is character data which represents the measurement that is currently being displayed on line 1 of the selected channel's portion of the status menu.

Notes — The possible responses are:

1: "LDI" LASER diode current

2: "IPD" photodiode current

3: "PPD" optical power

4: "VF" LASER diode forward voltage

The default condition of the status menu displays laser diode current 1 (LDI) on line 1 and laser diode current 2 (LDI) on line 2.

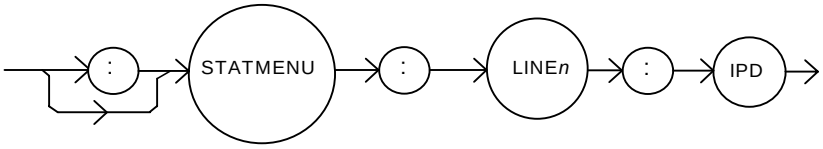
Examples — "STATMENU:LINE1?" - response: "PPD", means that optical power from laser 1 is selected to be displayed on line 1.

"STATMENU:LINE2?" - response: "PPD", means that optical power from laser 2 is selected to be displayed on line 2.

STATMENU:LINE*n*:IPD

COMMON
DEVICE DEPENDENT
FRONT PANEL

The STATMENU:LINE*n*:IPD command sets the measurement that is to be displayed on line *n* of the status menu to photodiode current (IPD).



Parameters — None.

Notes — The default condition of the status menu displays laser diode current 1 (LDI) on line 1 and laser diode current 2 (LDI) on line 2.

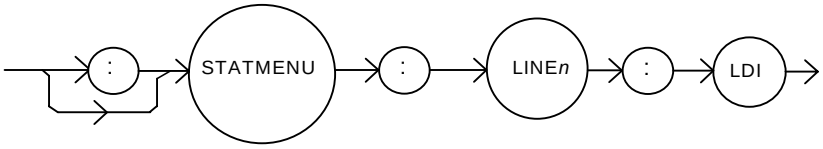
Examples — "STATMENU:LINE1:IPD" - response: photodiode current of laser 1 is displayed on line 1 of the status menu.

"STATMENU:LINE2:IPD" - response: photodiode current of laser 2 is displayed on line 2 of the status menu.

STATMENU:LINE*n*:LDI

COMMON
DEVICE DEPENDENT
FRONT PANEL

The STATMENU:LINE*n*:LDI command sets the measurement that is to be displayed on line *n* of the status menu to LASER diode current (LDI).



Parameters None.

Notes The default condition of the status menu displays laser diode current 1 (LDI) on line 1 and laser diode current (LDI) on line 2.

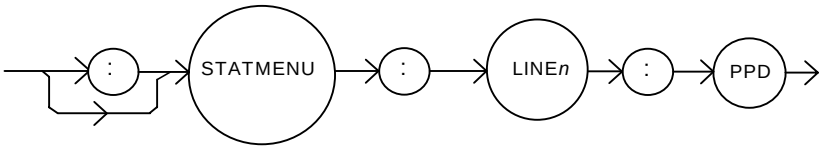
Examples “STATMENU:LINE1:LDI” - response: laser diode current of laser 1 is displayed on line 1 of the status menu.

"STATMENU:LINE2:LDI” - response: laser diode current of laser 2 is displayed on line 2 of the status menu.

STATMENU:LINE*n*:PPD

COMMON
DEVICE DEPENDENT
FRONT PANEL

The STATMENU:LINE*n*:PPD command sets the measurement that is to be displayed on line *n* of the status menu to optical power (PPD).



Parameters None.

Notes Photodetector power is calculated via the CALPD conversion factor. The measurement is only as accurate as the user’s CALPD value.

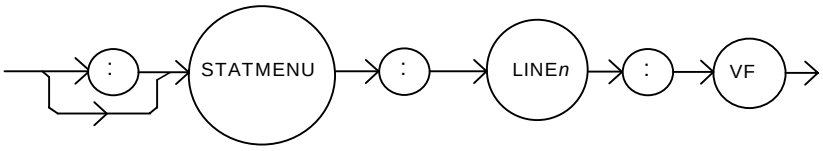
Examples "STATMENU:LINE1:PPD” - response: optical power is displayed on line 1 of the status menu.

“STATMENU:LINE2:PPD” - response: optical power is displayed on line 2 of the status menu.

STATMENU:LINE*n*:VF

COMMON
DEVICE DEPENDENT
FRONT PANEL

The STATMENU:LINE*n*:VF command sets the measurement that is to be displayed on line *n* of the status menu to laser diode forward voltage (VF).



Parameters None.

Examples "STATMENU:LINE1:VF" - response: laser diode forward voltage of laser 1 is displayed on line 1 of the status menu.

"STATMENU:LINE2:VF" - response: laser diode forward voltage of laser 2 is displayed on line 2 of the status menu.

CHAPTER 5

TROUBLESHOOTING

This chapter describes calibration of your LDC-3916330 Series Dual Laser Diode Controller Module. Descriptions of the required test instruments, calibration conditions, and the detailed procedures for calibration of the instrument's Temperature Controller and the Laser Diode Current Source are included. A troubleshooting guide is also offered for some of the more common failure symptoms. This chapter is divided into three major sections: Local (front panel) calibration, remote (through the GPIB Interface) calibration, and a troubleshooting guide.

Calibration Overview

There are several calibrations to be performed on each of the two current sources to completely calibrate the 3916330 Series Module. The calibration for each source consists of calibrating the current source, the photodiode monitor feedback ammeter, and the forward voltage measurement. The current limits are calibrated internally by the instrument, using measurements supplied by the user, as part of the calibration process.

Your 3916330 Series Module can be calibrated while installed in the 3908, 3916 or 3926 mainframe with the case closed. It should be calibrated every 12 months or whenever performance verification indicates that calibration is necessary, such as differences between set point and measurement display values which exceed the accuracy specification. Calibrate the instrument under laboratory conditions. We recommend calibration at $23^{o}C \pm 1.0^{o}C$. When necessary, however, the 3916330 Series Module may be calibrated at its intended use temperature if this is within the specified operating temperature range of 0 to $40^{o}C$.

Recommended Equipment

Recommended test equipment for calibrating the 3916330 Series Laser Diode Controller module is listed in Table 5.1. Equipment other than that shown in the

table may be used if the specifications meet or exceed those listed.

Table 5.1 Recommended Test Equipment

Description	Mfg./Model	Specification
DMM	HP 3457A	DC Amps (@ 1.0A): ±0.02% Resistance (@10Ω): 0.02% 0.1 μA or 0.1 mV resolution

It will be necessary to connect various loads and circuits to the outputs of the module for the calibration procedure. The devices required for most of the calibration loads are listed in Table 5.2. A schematic is shown in Figure 5.1 for the photodiode calibration circuit, with the required components listed in Table 5.3.

Table 5.2 Required Calibration Components

LASER CURRENT SOURCE CALIBRATION	
Current Source Calibration	1Ω 20W resistor, low TCR
Voltage Measurement Calibration (3916332/334)	15Ω 20W resistor, low TCR
Voltage Measurement Calibration (3916338)	5Ω 50W resistor, low TCR
PHOTODIODE MONITOR CALIBRATION	
See schematic in Figure 5.1	

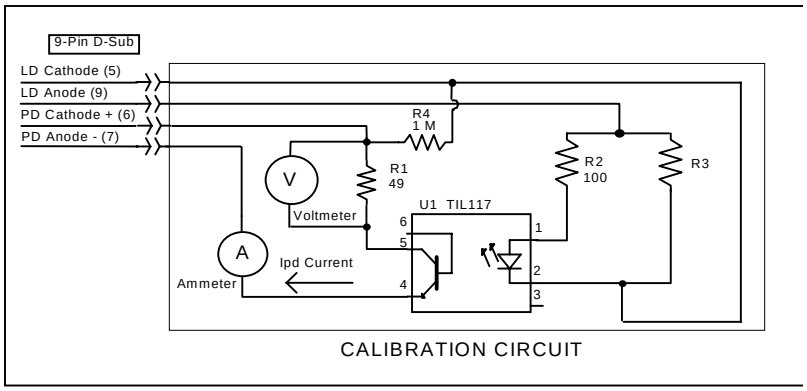


Figure 5.1 I_{PD} Calibration Circuit

Table 5.3 Components for I_{PD} Calibration Circuit

COMPONENTS FOR PHOTODIODE CURRENT (I_{PD}) CALIBRATION CIRCUIT	
R1	49Ω resistor, 1% 1/4W
R2	100Ω resistor, 1% 1/4W
R4	1.0 MΩ resistor, 1% 1/4W
R3	5Ω resistor, 1% 5W
U1	TIL 117 opto isolator
Battery	9V battery
Connector	9-pin D-sub, male

Local Calibration of the Laser Current Source

There are three calibration adjustments for each current source of the 3916330 Series Current Source Module. They are: calibration of the constant current (LDI) source, calibration of the constant light power (I_{PD}) feedback circuit, and calibration of the laser forward voltage (LDV) measurement.

Current Source Calibration

The following procedure is for calibrating the laser current source. The internal calibration procedure sets the current to two values. You must enter the exact Laser Diode current that you measure at both of these points. The internal procedure will then use this information to calibrate the current source.

1. With the output off, connect a 1Ω, 20 W resistor across the LASER output terminals (Laser Anode, pin 9, and Laser Cathode, pin 5). Current will flow from the anode to the cathode. The top 9-pin connector on the back of the module is for LAS1, and the bottom 9-pin connector is for LAS2.

2. Connect a calibrated DMM across the load resistor. You will be calculating laser current (LDI) in the following manner 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). I is the calculated current in Amps.

   Note: We recommend that the load resistor be temperature-controlled during the calibration.

   Alternatively, the current may be measured directly using an ammeter with a range of at least 2 A, and accurate to ±0.001 mA. If you use the ammeter approach, you should connect the ammeter in series with a load resistor with a nominal value of 1Ω.

3. Enter the LDI calibration mode by pushing the (DISPLAY) MAIN front panel button, then the SYS CONFIG soft key, then the CAL soft key. For the 3916332 or 3916334 modules, press Cal LAS1 or Cal LAS2 to choose which source to calibrate on the dual current source modules or Cal LAS for the 3916338 module (single current source module). Then press the LDI Cal soft key, the module's LDI calibration screen will appear.

4. Press the Start soft key. The internal calibration procedure will turn on the output and drive the LD current to approximately 25% of full range. Allow the current to settle for at least 10 seconds.

5. Calculate or measure the actual current through the load resistor, enter that value (in mA) into the highlighted "IReal" adjust field on the screen, and press (ADJUST) ENTER. Do not enter more than eight characters, including the decimal point.

6. The internal cal procedure will then set the LD current to approximately 75% of full range. Allow the current to settle for at least 10 seconds.

7. Measure the actual current, and enter that value into the IREAL adjust field.

After you have entered the second value, the internal cal procedure calibrates the LD current measurement circuit, the LD current source for both low and high bandwidths, and the LD current limit circuit.

IPD Current Calibration

The following procedure is for calibrating the LASER I_{PD} (photodiode monitor) measurement circuits. The internal calibration procedure sets the current to two values. You must enter the resulting I_{PD} (photodiode monitor) current that you measure at both of these points. The internal procedure will then use this information to calibrate the I_{PD} measurement circuit.

1. With the output off, connect the IPD calibration circuit, Figure 5.1, to the appropriate laser connector.
2. Connect an ammeter with at least 5000 μA range and at least ±0.1 μA accuracy as shown in Figure 5.1. This ammeter is in series with the Photodiode Anode input to the module, and directly measures the photodiode current.
3. Enter the LDI calibration mode by pushing the (DISPLAY) MAIN front panel button, then the SYS CONFIG soft key, then the CAL soft key. For the 3916332 or 3916334 modules, press Cal LAS1 or Cal LAS2 to choose which source to calibrate on the dual current source modules or Cal LAS for the 3916338 module (single current source module). Then press the IPD Cal soft key, the module's IPD calibration screen will appear.
4. Press the Start soft key. The internal calibration procedure will turn on the output and drive the LD current to approximately 15% of full range. Allow the current to settle for at least 10 seconds.
5. Use the ammeter and measure the actual photodiode current, enter that value (in μA) into the highlighted "IPDReal" adjust field on the screen, and press (ADJUST) ENTER. Do not enter more than seven characters, including the decimal point.
6. The internal calibration procedure will then drive the LD current to approximately 65% of full range. Allow the current to settle for at least 10 seconds.
7. Measure the actual photodiode current, enter that value (in μA) into the highlighted "IPDReal" adjust field on the screen, and press (ADJUST) ENTER.

After you have entered the second value, the internal cal procedure calibrates the IPD current measurement circuit and displays a "Completed" message on the screen.

Laser Forward Voltage Measurement Calibration

The following procedure is for calibrating the LASER forward voltage (LDV) measurement circuits. The internal calibration procedure sets the current to two values. You must enter the resulting forward voltage that you measure at both of these points. The internal procedure will then use this information to calibrate the LDV measurement circuit.

1. With the output off, connect the specified load resistor (see Table 5.2) to the LASER output terminals (Laser Anode, Pin 9, and Laser Cathode, pin 5).
2. Connect a voltmeter with at least a 15V range and an accuracy of at least ±0.01V across the load resistor.
3. Enter the LDV calibration mode by pushing the (DISPLAY) MAIN front panel button, then the SYS CONFIG soft key, then the CAL soft key. For the 3916332 or 3916334 modules, press Cal LAS1 or Cal LAS2 to choose which source to calibrate on the dual current source modules or Cal LAS for the 3916338 module (single current source module). Then press the LDV Cal soft key, the module's LDV calibration screen will appear.
4. Press the START soft key. The internal calibration procedure will turn on the output and drive the LD current to approximately 25% of full range. Allow the current to settle for at least 10 seconds.
5. Then measure the voltage across the load resistor, enter that value (in Volts) into the highlighted "VReal" adjust field on the screen, and press (ADJUST) ENTER. Do not enter more than seven characters, including the decimal point.
6. The internal calibration procedure will then drive the LD current to approximately 75% of full range. Allow the current to settle for at least 10 seconds.
7. Measure the actual voltage across the load resistor, enter that value (in Volts) into the highlighted "VReal" adjust field on the screen, and press (ADJUST) ENTER.

After you have entered the second value, the internal cal procedure calibrates the laser forward voltage measurement circuit and displays a "Completed" message on the screen.

Be sure to calibrate both sources, LAS1 and LAS2, for each module. This ends the section on front panel (local) calibration of your current source. The next section discusses calibration through the IEEE488.2 GPIB interface.

Remote Calibration of the LDC-3916330 Dual Current Source Module

The 3916330 Controller Modules can be calibrated remotely via the GPIB Interface. 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.

Laser Current Source Calibration

There are three calibration adjustments for each current source of the 3916330 Series Module. They are: calibration of the constant current (LDI) source, calibration of the laser forward voltage (LDV) measurement, and calibration of the constant light power (I_{PD}) feedback circuit.

LDI Calibration

The following procedure is for remotely calibrating the laser current sources. The module's internal calibration procedure sets the current to two values. You must measure and enter the exact Laser Diode current at both of these points. The module's internal cal procedure will then use this information to calibrate the current source.

1. With the output off, connect a 1Ω, 20 W resistor across the LASER output terminals (Laser Anode, pin 9, and Laser Cathode, pin 5). The top 9-pin connector on the back of the module is for LAS1, and the bottom 9-pin connector is for LAS2.

2. Connect a calibrated DMM across the load resistor. You will be calculating laser current (LDI) in the following manner 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). I is the calculated current in Amps.

   Note: We recommend that the load resistor be temperature-controlled during the calibration. Alternatively, the current may be measured directly using an ammeter with a range of at least 2 A, and accurate to ±0.001 mA. If you use the ammeter approach, you should connect the ammeter in series with a load resistor with a nominal value of 1Ω.

3. Enter the Laser Current Source calibration mode by sending the following command over GPIB:

   LASERn:CAL:LDI

4. The internal cal procedure will begin by setting the Laser output current to approximately 25% of its full range. Allow the current to settle for at least 10 seconds.

If this calibration value is to be measured and entered remotely via a GPIB controlled DMM, for example, the actual value of the current should not be entered until the LDC-3916 controller is ready to receive it.

5 Check to see if the internal cal procedure is ready for the measurement. Send the following query to the module:

LASERn:CAL:STATUS?

The cal procedure is ready for a measurement if it returns the value "1". Query the status until the value that is returned is "1".

6 Enter the measured current in mA by sending the following command:
LASERn:CAL:MEAS (current in mA) e.g. LASER1:CAL:MEAS 267.878

Note: The internal cal procedure will store this value and briefly change its measurement status to "0" to indicate that it is not yet ready for another measurement. This will occur after each time a new measurement is entered.

7 The cal procedure will set the output current to approximately 75% of its output range. Allow the current to settle for at least 10 seconds.

8 Check to see if the internal cal procedure is ready for the measurement. Send the following query to the module:

LASERn:CAL:STATUS?

The cal procedure is ready for a measurement if it returns the value "1". Query the status until the value that is returned is "1".

9 Enter the second measured current in mA by sending the following command:

LASERn:CAL:MEAS (current in mA) e.g. LASER1:CAL:MEAS 527.986

After you have entered the second measured current, the internal calibration procedure will perform the calibration for the laser current setpoint, current measurement, and current limit circuits. The cal procedure will then set the status to the value "2" to indicate that it has finished.

IPD Current Calibration

The following procedure is for remotely calibrating the LASER I_{PD} (photodiode monitor) measurement circuit. The module's internal calibration procedure sets the current to two values. You must enter the resulting I_{PD} (photodiode monitor) current that you measure at both of these points. The module's internal cal procedure will then use this information to calibrate the I_{PD} measurement circuit. The GPIB commands use the nomenclature “MDI”, which means “Monitor Diode Current”, and is synonymous with “IPD”.

1. With the output off, connect the IPD calibration circuit, Figure 5.1, to the appropriate laser connector.
2. Connect an ammeter with at least 5000 μA range and at least ±0.1 μA accuracy as shown in the figure. This ammeter is in series with the Photodiode Anode input to the module, and directly measures the photodiode current.
3. Enter the Laser Current Source calibration mode by sending the following command over GPIB:

   LASERn:CAL:MDI
4. The internal cal procedure will turn on the output and drive the laser current until the PD current is approximately 15% of full range. Allow the current to settle for at least 10 seconds.

   If this calibration value is to be measured and entered remotely via a GPIB controlled DMM, for example, the actual value of the current should not be entered until the cal procedure is ready to receive it.
5. Check to see if the internal cal procedure is ready for the measurement. Send the following query to the module:

   LASERn:CAL:STATUS?

   The cal procedure is ready for a measurement if it returns the value "1". Query the status until the value that is returned is "1".
6. Enter the measured current in μA by sending the following command:

   LASERn:CAL:MEAS (current in μA) e.g. LASER1:CAL:MEAS 745.321
7. The controller will drive the laser current until the PD current to approximately 65% of full range. Allow the current to settle for at least 10 seconds.
8. Check to see if the internal cal procedure is ready for the measurement. Send the following query to the module:

   LASERn:CAL:STATUS?

   The cal procedure is ready for a measurement if it returns the value "1". Query the status until the value that is returned is "1".

9 Enter the measured current in μA by sending the following command:

LAS:CAL:MEAS (current in μA) e.g. LAS:CAL:MEAS 3573.344

After you have entered the second measured photodiode current, the internal calibration procedure will perform the calibration for the photodiode current measurement circuit. The cal procedure will then set the status to the value "2" to indicate that it has finished.

Laser Forward Voltage Measurement Calibration

The following procedure is for remotely calibrating the laser forward voltage measurement circuit. The module's internal calibration procedure sets the current to two values. You must measure and enter the forward voltage at both of these points. The module's internal cal procedure will then use this information to calibrate the voltage measurement system.

1. With the output off, connect the specified load resistor (see Table 5.2) across the LASER output (Laser Anode, pin 9, and Laser Cathode, pin 5).
2. Connect a calibrated voltmeter across the load resistor ("plus" lead to Anode).
3. Enter the Laser voltage measurement calibration mode by sending the following command over GPIB:

   LASERn:CAL:LDV
4. The internal cal procedure will begin by setting the Laser output current to approximately 25% of its full range. Allow the current to settle for at least 10 seconds.

   If this calibration value is to be measured and entered remotely via a GPIB controlled DMM, for example, the actual value of the current should not be entered until the cal procedure is ready to receive it.
5. Check to see if the internal cal procedure is ready for the measurement. Send the following query:

   LASERn:CAL:STATUS?

   The cal procedure is ready for a measurement if it returns the value "1". Query the status until the value that is returned is "1".
6. Enter the measured voltage in Volts by sending the following command:

   LASERn:CAL:MEAS (voltage in Volts) e.g. LASER1:CAL:MEAS 3.76
7. The cal procedure will set the output current to approximately 75% of its output range. Allow the current to settle for at least 10 seconds.
8. Check to see if the internal cal procedure is ready for the measurement. Send the following query to the module:

   LASERn:CAL:STATUS?

   The cal procedure is ready for a measurement if it returns the value "1". Query the status until the value that is returned is "1".
9. Enter the second measured voltage in Volts by sending the following command:

   LASERn:CAL:MEAS (voltage in Volts) e.g. LASER1:CAL:MEAS 11.24

After you have entered the second measured voltage, the internal calibration procedure will perform the calibration for the laser forward voltage measurement circuit. The cal procedure will then set the status to the value "2" to indicate that it has finished.

Troubleshooting Guide

This section is a guide to troubleshooting the 3916330 Series Controller Modules. 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 ILX Lightwave Customer Service.

SYMPTOM	CORRECTIVE ACTIONS
GENERAL	
LDC-3916 Series instrument will not power up	Check AC power line voltage and power word connection
Power on, but outputs have been shut off. Instrument may be “locked up” or instrument resets itself.	This may occur if the instrument loses power (AC line) briefly or line voltage drops below specification. If instrument is “locked up”, power it off and then on to restart.
LASER CURRENT SOURCE	
Power on, but no current output	Check interlock pins on LASER input connector on instrument rear panel. These pins must be shorted either directly or through a switch. The front-panel Laser Enable switch should also be on. If Open Circuit is indicated (E503), check the load connections and cable and then try again. Be sure the cable connector is securely fastened to the back of the module(s). Also check that the Voltage Limit setting is above the laser’s operating voltage.
Unable to adjust output	Check the OUTPUT ON soft key. It should read ON. Check the instrument mode, the channel number, and the laser current limit.
Output current at limit, can’t be lowered	If IPD or PPD mode is used, check the monitor diode (feedback) connections. Try reversing the polarity of the monitor photodiode. Also check if the photodiode bias is off. If in I_{LBW} or I_{HBW} mode, check the current set point and I LIMIT setting. Setting the output below the limit may require several turns of the adjust knob 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.

Unable to adjust output	Make sure that the ISET adjust parameter is highlighted. Check the ILIMIT parameter; it should be set above 0 and above the laser operating current. Check the VLIMIT parameter; it should be set above the voltage condition of your laser load.
Power Mode operation has high output current, but little or no power is measured	Check the photodiode bias. If it is off, the circuit may act as an open feedback loop. Set the bias to on (5V).
Output exceeds power limit	It is possible via GPIB to disable turning off the output when the power limit is exceeded. Ensure that this is not the case. Default at power up is to enable this safety feature. The “Power Limit” is not a hardware limit. It serves as a warning that the power measurement has exceeded the limit set point.
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 or if entered measurements are invalid.

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