LD3000R
Constant Current Laser Diode Driver

User Guide

Table of Contents

Chapter 1 Warning Symbol Definitions

Below is a list of warning symbols you may encounter in this manual or on your device.

Symbol	Description
	Direct Current
	Alternating Current
	Both Direct and Alternating Current
	Earth Ground Terminal
	Protective Conductor Terminal
	Frame or Chassis Terminal
	Equipotentiality
	On (Supply)
	Off (Supply)
	In Position of a Bi-Stable Push Control
	Out Position of a Bi-Stable Push Control
	Caution: Risk of Electric Shock
	Caution: Hot Surface
	Caution: Risk of Danger
	Warning: Laser Radiation
	Caution: Spinning Blades May Cause Harm

Chapter 2 Description

The LD3000R was developed for operating laser diodes in a constant current mode, up to a maximum of 2.5 A. It allows the laser anode to be grounded while operating off a negative DC supply, allowing lasers whose anodes are connected to the laser case to be mounted in a grounded case for added ESD protection. The laser operating current can be set with either an on-board 12-turn trimpot or an external analog voltage (0 to 5 VDC).

The LD3000R has a quiescent laser current of 10 to 20 mA (i.e. with the laser current control turned down to a minimum, the lowest laser current could be as high as 20 mA). If your laser has an operating current of less than 100 mA, we recommend using Thorlabs' LD1255R Laser Driver, which has a lower quiescent current and will offer better current control at the lower operating currents.

Chapter 3 Setup and Operation

The LD3000R was designed to mount to a suitable heat sink. Two counter-sunk clearance holes located on 3" (76.2 mm) centers are provided for easy mounting.

WARNING

The driver dissipates a large amount of heat when driving lasers under full load. To avoid permanent damage, do not operate the driver without a heat sink.

There are two single-row connectors located on top of the unit. The 10-pin connector is used for the power supply input, the laser interface, and monitor signals. The table below lists the pin configuration of J1:

Pin #	Function
1	+V (5 to 12 VDC, 50 mA)
2	Ground
3	-V (-8 to -12 VDC, 2.5 A) **See Page 8 for Notes on Compliance Voltage**
4	External Current Control (0 to 5 VDC)
5	No Contact (Polarization Key)
6	Laser Diode Anode (Internally Connected to Pin 2 Ground)
7	Laser Diode Cathode
8	Monitor Photodiode Anode (from Laser) **See Caution Below**
9	Photo Diode Monitor Output (-1 V/mA)
10	Laser Current Monitor Output (1 V/A) **Referenced to -V**

CAUTION

The PD monitor circuit of the LD3000R only supports lasers that have an isolated PD anode. It will not work with common cathode lasers.

CONNECTING THE PHOTODIODE OF THESE LASERS TO THE LD3000R WILL DESTROY THE LASER.

The LD3000R will operate the LD portion of all common cathode lasers without issue as long as the PD anode is not connected to the driver.

The pin configuration for the 5-pin connector J2 is given in the table below.

Pin #	Function
Jump 2 to 3	Mode 1: COMMON Referenced External Current Control
Jump 4 to 5	Mode 2: Disable External Current Control
1	No Connection (Leave This Pin Floating)
5	-V (May Also Be Used for Monitoring Signals)

CAUTION

Do not operate the LD3000R without a jumper installed on J2. Your laser may be overdriven and permanently damaged.

WARNING

Direct viewing of laser diode emission may cause eye damage, especially in conjunction with collimating lenses. Extreme care must be taken to prevent any beam from being viewed directly or indirectly through external optics or mirrors.

3.1. Laser and Power Supply Connection

The LD3000R requires a clean (preferably non-switching) DC bipolar power supply for optimum operation. The positive supply is used only for biasing low-power amplifiers and only needs to supply 10 mA of current. The laser drive current is derived from the negative power supply output and should be capable of at least -2.6 A of current.

1. Attach the DC power supply to J1 according to the table on page 3.
2. Attach the laser diode to J1 according to the table on page 3.
3. Select the desired current control mode using J2 (see Section 3.2 below).
4. Turn the current control potentiometer a full 12 turns counterclockwise to ensure the laser current is at a minimum. (Note that the potentiometer will continue to turn after reaching the limits. To be safe, always turn the potentiometer at least 12 complete turns to ensure the current is at its lowest setting.)
5. Apply power to the LD3000R and slowly turn the current control potentiometer clockwise until the desired operating current is achieved. Connect a DVM from Pin 10 of J1 to Pin 3 of J1 (Pin 5 of J2 may also be used) to monitor the laser current. Note that Pin 3 is connected to the negative voltage supply. If using a DAQ card, make sure these specs will not damage it.

3.2. Selecting External Current Control Mode

The current can also be externally controlled by a voltage source applied to J1 pin 4 (function generator, DAQ output, etc.). The external current control voltage must be referenced to the common output of the power supply. The total drive current is determined by the sum of the manual set point and the external current control voltage.

CAUTION

One of the following operating modes must be selected BEFORE turning the LD3000R on. Otherwise, the laser will be overdriven and damaged.

Mode 1

COMMON referenced external current control voltage (i.e. 0 to 5 V). An internal level shifter allows the negatively biased laser to be controlled by a COMMON referenced control voltage. To enable this mode jumper pin 2 to 3 on J2.

In Mode 1, the laser current is:

$$I_{LD} = 0.5\left(\frac{A}{V}\right)V_{PIN4}$$

Mode 2

If the External Current Control is not to be used, disable by jumpering pins 4 and 5 on J2.

3.3. Laser Current Monitor

The laser drive current can be monitored from pin 10 of J1. This output is referenced to the negative supply (J1 Pin 3 or J2 pin 5) and has the following transfer function:

$$V_{PIN10} = V + I_{LD}(1\ \Omega)$$

Using a DVM, the laser current can be read without having to compensate for the negative voltage offset by attaching the (-) lead to J1 Pin 3 and the (+) lead to J1 pin 10.

3.4. Photodiode Current Monitor

CAUTION

The LD3000R has a photodiode monitor circuit that only supports lasers having the laser anode attached to the photodiode cathode. The use of the monitor input with common cathode lasers will cause damage to the laser. However, the LD3000R can be used safely with common cathode lasers as long as the photodiode is not connected to the driver.

An on-board transimpedance amplifier is provided for lasers with internal monitor photodiodes that are supported by the LD3000R (see caution above). The amplifier converts the photodiode current to a voltage that can be measured on J1 Pin 9 for monitoring the relative laser output power. The output of pin 9 has the following transfer function:

$$V_{PIN9} = -1000 I_{PD}(V)$$

If the exact monitor current is known for a given laser power, this output can be converted to laser power as follows:

$$P = \alpha \left(\frac{V_{PIN9}}{-1000\Omega} \right)$$

Where α is the monitor photodiode conversion factor (mW/mA).

CAUTION

The LD3000R operates diode lasers only in a constant current mode. Caution must be used to avoid overdriving the laser when operating the laser over widely varying temperatures. Diode lasers become more efficient as their operating temperature decreases. It is possible to overdrive the laser when operating the laser near the maximum drive current if the laser temperature is lowered. Please consult the laser manufacturer's data sheets.

3.5. Important Note About Compliance Voltage and Power Supply Voltages

The LD3000R is a power module and will dissipate a fair amount of heat under normal operation. However, it is imperative that the driver be mounted to an adequate heat sink to avoid damaging the internal components. Also, please read the following section on compliance voltage to keep the excess heating to a minimum.

One of the most important specs of a constant current source is its compliance voltage. This is the maximum voltage a current source can supply to a given load at a given current. The higher the load impedance is, the higher the compliance voltage must be to operate as a constant current source. Because of the LD3000R's internal impedances, this compliance voltage depends on the operating current and decreases as the current increases. The compliance voltage can be easily calculated as follows:

$$V_{COMP} = V_{SS} - [(1\Omega)I_{LD} + V_{CE} + V_{LD}]$$

Where:

V_{COMP} = compliance voltage
V_{SS} = the negative supply voltage (this is the input power for the LD3000R)
I_{LD} = the operating current of the laser
V_{CE} = minimum output transistor voltage (set this to 1.8 V to solve equation)
V_{LD} = the forward operating voltage of the laser diode. (Typically 2 to 3 V)

A couple of important points:

1. V_{COMP} must be positive.
2. As V_{ss} increases, the compliance voltage increases.
3. If V_{ss} is too high, the LD3000R will dissipate the excess energy as heat.

Example 1

I_{LD} = 1 A (laser operating current)

V_{LD} = 2 V (laser forward voltage)

V_{ss} = 12 V

$$V_{COMP} = 12\,V - [(1\Omega)1\,A + 1.8\,V + 2\,V] = 7.2\,V$$

The compliance voltage should be limited as much as possible since the excess compliance voltage results in unnecessary heating:

$$P_{DIS} = V_{COMP}(I_{LD})$$

$$P_{DIS} = 7.2\,V(1\,A) = 7.2\,W \text{ of Heat}$$

A better way to approach the question is to calculate the minimum negative supply voltage necessary to operate the laser. This will keep the excess heat build up to

a minimum. (Note that the circuitry requires a minimum supply voltage of 8 V to operate properly. See the supply voltage specification.)

$$V_{SS} = (1\Omega)I_{LD} + V_{CE} + V_{LD}$$

Example 2

Using the same values as in the previous example:

$$V_{SS} = (1\Omega)1\ A + 1.8 + 2 = 4.8\ V$$

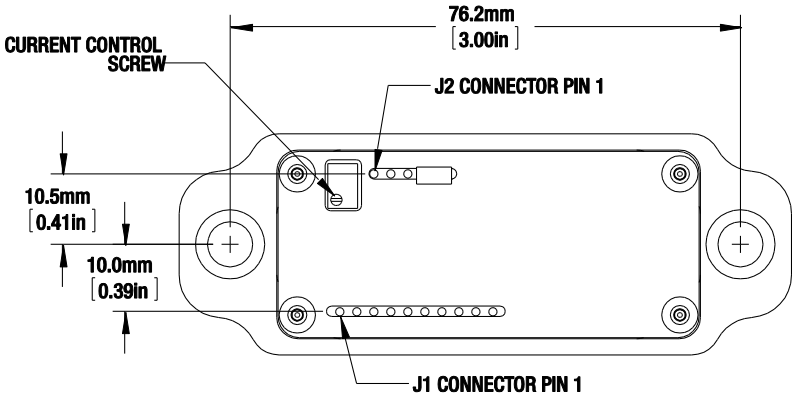
$$P_{DIS} = (8\ V - 4.8\ V)(1\ A) = 3.2\ W \text{ of Heat}$$

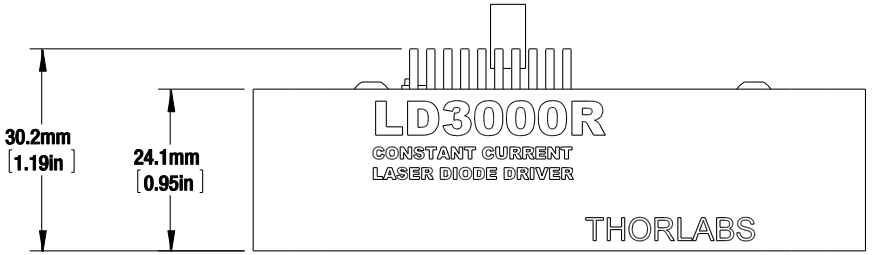
Remember, a minimum supply voltage of 8 V must be used.

Chapter 4 Specifications

LD3000R	
Output Current	0.02 - 2.5 A
Operating Mode	Constant Current
Internal Current Control	12-Turn On-Board Potentiometer
External Current Control	0 - 5 V Analog Input Voltage (J1 Pin 4)
Signal Bandwidth	1.1 kHz
Operating Voltage	±8 to 12 V
Dimensions	3.6” Length x 1.3” Height
Monitor Photodiode	
Transimpedance Gain	1000 V/A (See Section 3.4 for Related Cautions)
Operating Temperature	10 to 30 °C
Storage Temperature	-20 to 50 °C
Warmup Time	30 Min (Recommended)

Chapter 5 Drawings

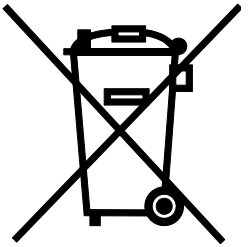




Chapter 6 Regulatory

As required by the WEEE (Waste Electrical and Electronic Equipment Directive) of the European Community and the corresponding national laws, Thorlabs offers all end users in the EC the possibility to return “end of life” units without incurring disposal charges.

- This offer is valid for Thorlabs electrical and electronic equipment:
- Sold after August 13, 2005
- Marked correspondingly with the crossed out “wheelie bin” logo (see right)
- Sold to a company or institute within the EC
- Currently owned by a company or institute within the EC
- Still complete, not disassembled and not contaminated



Wheelie Bin Logo

As the WEEE directive applies to self contained operational electrical and electronic products, this end of life take back service does not refer to other Thorlabs products, such as:

- Pure OEM products, that means assemblies to be built into a unit by the user (e.g. OEM laser driver cards)
- Components
- Mechanics and optics
- Left over parts of units disassembled by the user (PCB’s, housings etc.).

If you wish to return a Thorlabs unit for waste recovery, please contact Thorlabs or your nearest dealer for further information.

Waste Treatment is Your Own Responsibility

If you do not return an “end of life” unit to Thorlabs, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

Ecological Background

It is well known that WEEE pollutes the environment by releasing toxic products during decomposition. The aim of the European RoHS directive is to reduce the content of toxic substances in electronic products in the future.

The intent of the WEEE directive is to enforce the recycling of WEEE. A controlled recycling of end of life products will thereby avoid negative impacts on the environment.

Chapter 7 Thorlabs Worldwide Contacts

For technical support or sales inquiries, please visit us at
www.thorlabs.com/contact for our most up-to-date contact information.

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