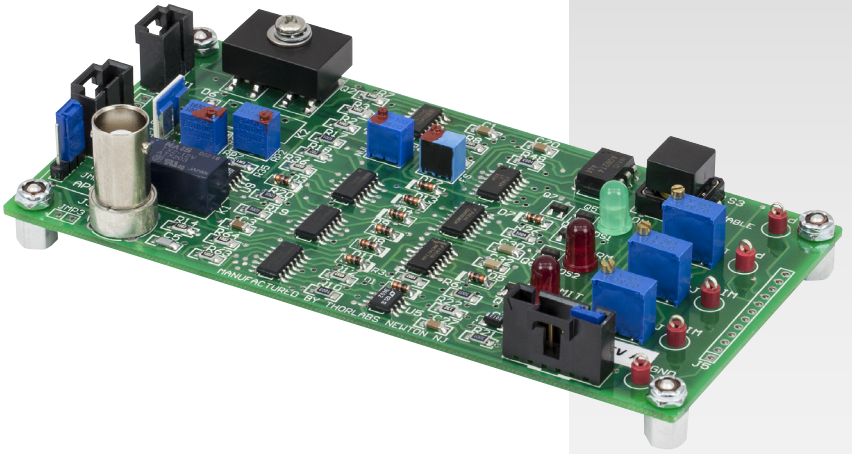
IP250-BV
250 mA Blue Laser Diode Controller

User Guide



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Chapter 1 Overview

The IP250-BV is a 250 mA (medium power), board level laser diode controller optimized for the higher operating voltages of the blue and the blue-violet laser diodes. The driver is in the form of a PCB assembly with provisions for mounting into other higher-level assemblies. It can accommodate only common cathode (cathode grounded) laser diode pin-out configurations, and it allows control of the laser by means of either constant current or constant power modes. The driver contains circuitry for complying with the various laser safety requirements, as well as protection circuitry for the laser diode.

The primary application for this product is to provide a method of precisely controlling a blue or blue-violet laser diode at the PCB board level or within the confines of a higher level assembly. In all cases, the end-user must provide DC power and the proper connections between the unit and the laser diode. In addition to this, the end-user is responsible for the proper limit settings needed for their particular laser diode and application.

1.1. Features

- 250 mA Blue Laser Diode Driver
- Also Recommended for Driving LEDs
- Input Power ±12 VDC @ 275 mA
- Control Range: 0 to ±250 mA (CC), 5 µA to 2 mA (CW)
- 0 to 10 V Analog Modulation Bandwidth: DC to 50 kHz
- Optimized for Lasers with V_{op} greater than 5 V

Chapter 2 Setup and Operation

2.1. Connections

Wiring harnesses have been provided to make the proper connections from the IP250-BV to its power source and the laser diode to be driven. One harness has a three-pin connector mate the other has a four-pin connector mate.

The wire harness made with the 3-pin connector should be connected to J1 of the IP250-BV and the ±12 V power supply. Connect to the power supply as follows:

Power Supply		
Connector	**Wire Color**	**Designation**
J1-1	Red	+12 V
J1-2	Black	Common
J1-3	Yellow	-12 V

The wire harness made with the 4-pin connector should be connected to J2 of the IP250-BV and the laser diode to be driven. Connect the laser diode as follows:

Laser Diode Connections		
Connector	**Wire Color**	**Designation**
J2-1	Blue	Laser Anode
J2-2	Black	Laser Cathode Ground
J2-3	Black	Monitor Photodiode Cathode
J2-4	Orange	Monitor Photodiode Anode

Note: Either the monitor photodiode cathode or monitor photodiode anode MUST be connected to ground somewhere in this system. Typically this is done at the laser diode package itself on a common pin. To eliminate errors due to wire losses, always return the photodiode ground connection on the wire provided. Do not use a common wire for the photodiode and laser diode ground currents.

If the photodiode is completely isolated from the laser diode, install a wire jumper into J3 of the IP250-BV to fix the ground connection to the photodiode cathode.

Refer to Figure 1 on Page 4 for the schematic diagram detailing the laser diode connections.

This driver is limited to common-cathode (cathode grounded) laser diodes.

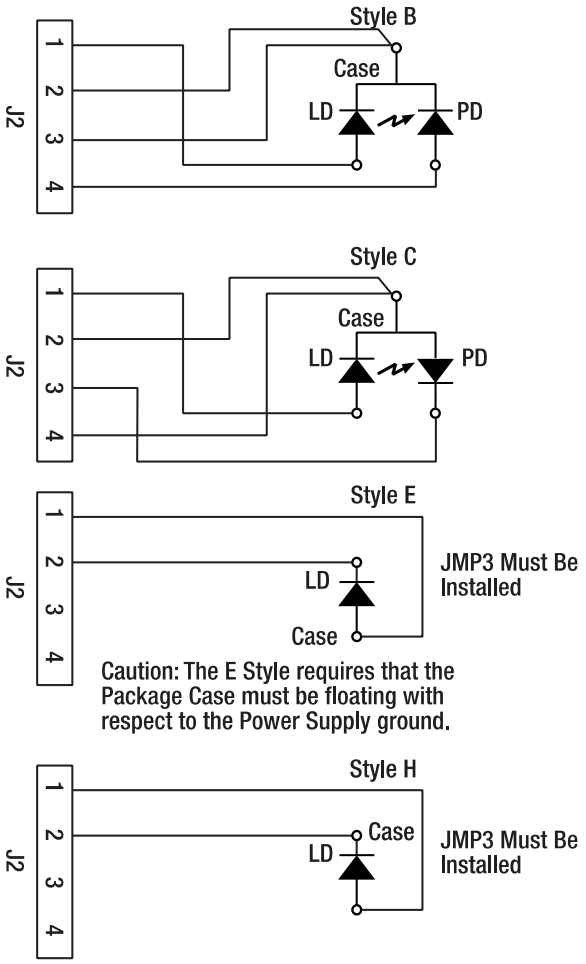

Figure 1 Laser Diode Connections

2.2. Operation

2.2.1. Automatic Constant Current Control (ACC)

1. This board will only work with laser diodes with grounded cathodes.
2. Set JMP2 to “ACC” for Constant Current operation. JMP2 is located on the left side of the unit. Always disable the laser driver prior to changing modes.
3. Refer to output current derating curves in Appendix A before proceeding.
4. Apply power to the unit.

5. Using a digital multimeter measure the ILIM Test point with respect to the TP GND Test point (all measurements will be with respect to TP GND). Adjust the ILIM ADJ potentiometer for the maximum current that the laser must be limited to. The transfer function is 1 V = 1 A, with a maximum adjustment of approximately 0.250 V or 250 mA.

6. If a monitor photodiode (MPD) is connected, measure the PLIM Test point and adjust the PLIM ADJ pot for the maximum MPD current expected. The transfer function is 1 V = 1 mA, with a maximum adjustment of 2.5 V or 2.5 mA.

   When operating in ACC the PLIM (power limit) function is still active if the MPD current reaches the limit point. This is especially helpful if the laser is to be operated at varying temperatures where the efficiency may change to the point where the operating current will overdrive the laser. The PLIM will always keep the laser in a safe operating area when properly set.

   If no MPD is connected always set the PLIM ADJ fully clockwise.

7. The P/I ADJ Pot will allow adjustment of the laser drive current from 0 mA to the ILIM set point or 250 mA max. When turning on a laser for the first time it is suggested that this pot be set fully counterclockwise.

8. Press and release the ENABLE switch.

9. The green LD ON indicator will turn on.

   NOTE: There will always be a delay until full power of approximately 2 to 3 seconds before any current can flow to the laser diode.

10. Adjust the P/I ADJ potentiometer clockwise to increase the injection current of the laser diode. The Ild Test point provides an analog read back of the actual laser current, 1 V = 1 A. The Ipd Test point provides an analog read back of the Photodiode monitor current, 1 V = 1 mA and can be used to gauge the relative output power of the laser.

11. Pressing the ENABLE switch while the laser is operating will turn off the laser current.

If the ALARM indicator turns ON see “Alarms and Troubleshooting” below.

NOTE: If the ILIM setting is below approximately 10 mA the I LIMIT LED will be ON, this is normal.

If the current is adjusted to its maximum limit then the I LIMIT indicator will turn ON. This indicator is active when the injection current is approximately 95% of the maximum limit.

If the photodiode is connected and the PLIM is set to a value requiring less than the maximum current set by ILIM, the I LIMIT indicator will NOT turn ON and the unit will operate in constant power at the power limit level set by PLIM.

While operating in APC Mode, if the power is adjusted to its maximum limit then the injection current will not increase even though the potentiometer has more adjustment.

2.2.2. Automatic Constant Power Control (APC)

Photodiode feedback current is required in APC Mode.

1. Set JMP2 to “APC” for constant current operation. JMP2 is located on the left side of the unit. Always disable the laser driver prior to changing modes.
2. Apply power to the unit.
3. Using a digital multimeter measure the ILIM Test point with respect to the TP GND Test point (all measurements will be with respect to TP GND). Adjust the ILIM ADJ potentiometer to the maximum laser current limit. The transfer function is 1 V = 1 A, with a maximum adjustment of approximately 0.250 V or 250 mA.

   When operating in APC the ILIM (current limit) function is still active if the laser current reaches the limit point.
4. Measure the PLIM Test point and adjust the PLIM ADJ pot for the maximum MPD current expected. The transfer function is 1 V= 1 mA, with a maximum adjustment of 2.5 V or 2.5 mA.
5. The P/I ADJ Pot will allow adjustment of the monitor photodiode current from 5 uA to the PLIM set point or 2 mA max. When turning on a laser for the first time it is suggested that this pot be set fully counterclockwise.
6. Press and release the ENABLE switch.
7. The green LD ON indicator will turn ON. If the ALARM indicator turns ON see “Alarms and Troubleshooting” below. If the I LIMIT indicator turns ON immediately press the ENABLE switch and refer to “Alarms and Troubleshooting”.
8. Adjust the P/I ADJ potentiometer clockwise to increase the MPD current. The IPD Test point provides an analog read back of the actual MPD current, 1 V = 1 mA.
9. Pressing the ENABLE switch while the laser is operating will turn off the laser current.

While operating in APC Mode, if the power is adjusted to its maximum limit then the injection current will not increase even though the potentiometer has more adjustment.

If the PLIM is set to a value that requires a higher level of drive current than ILIM is set to, the I LIMIT indicator will turn ON and the unit will operate in constant current at the current limit level.

If the Photodiode is connected incorrectly or the connection is opened, the I LIMIT indicator will turn ON and the unit will operate in constant current at the current limit level.

2.2.3. Analog Modulation

The amplitude of the laser injection current can be varied over time by connecting a signal generator to the BNC connector J3 on the IP250-BV. It is recommended that the unit be configured to operate in ACC mode whenever analog modulation is used.

J3 can also be used as a remote analog input, allowing the user to program the laser injection current from 0 to 250 mA by applying a 0 to 10 VDC signal. The transfer function being 25 mA per 1 V.

The P/I ADJ pot must be set fully counterclockwise prior to using this input.

For 100% depth of modulation set the P/I ADJ pot fully counterclockwise and apply a sine wave input to J3. The peak-to-peak amplitude must equal ILIM / 0.025 and a DC offset equal to 0.5 of the amplitude must be applied (the signal should always be above 0 V).

The depth of modulation can be decreased by increasing the P/I ADJ pot to provide a DC current offset, and then adjusting the peak-to-peak amplitude to stay within the ILIM range. The ILIM circuit will limit the average current to the ILIM setting and the I LIMIT indicator will turn on when the average current exceeds the ILIM setting.

The ILD Test point will provide the average current level when modulating.

2.2.4. Remote Control Inputs

In addition to the automatic shutdown features, the IP250-BV also has a number of remote enable and lockout functions accessible on J4 of the unit. The standard unit provides a shunt jumper installed in J4 Pins 5-6. This is the remote lockout input and must be shorted in order for the unit to be ENABLED. A summary of the J4 functions is provided for reference. A mating wire harness is available from Thorlabs should you decide to incorporate these features (refer to Accessories for more information):

Pin	Description
J4-1	Remote Enable Input
J4-2	Remote Enable Return (common to ground)

Momentarily connecting J4-1 to J4-2 will allow remote enable and disable the unit. Leave unconnected when not using.

Pin	Description
J4-3	Key lock Input
J4-4	Key Lock Return (common to ground)

A closed connection across J4-3 to J4-4 will prevent the unit from being ENABLED. Leave unconnected when not using.

Pin	Description
J4-5	Remote Interlock Input
J4-6	Remote Interlock Return (common to ground)

An open connection across J4-5 to J4-6 will prevent the unit from being ENABLED. These two points must be connected for unit to operate.

All connections to J4 must be made using isolated or dry contacts (i.e. switches or relays with no potentials on the contacts).

2.3. Alarms and Troubleshooting

This unit contains circuitry that will automatically shut down the laser driver if any of the following conditions are met:

- The laser diode anode and cathode connections are reversed.
- The laser diode connection is broken or an open circuit exists.
- The operating voltage (Vop) of the laser exceeds approximately 8 V.

If an alarm shutdown occurs the ALARM indicator will turn ON and the LD ON indicator will turn OFF, remove power from the unit, correct the problem, and reapply power to the unit. Pressing the ENABLE switch once will turn the ALARM indicator OFF. Pressing it again will re-enable the unit.

In addition to the alarm shutdown, the IP25-BV will also shutdown (or not allow ENABLE) if any of the following conditions exist or occur:

- The Key lock Inputs (J4-3 and J4-4) are shorted together.
- The Remote Interlock Inputs (J4-5 and J4-6) are open circuit.
- The -12 V power supply is below approximately -10.8 V (-3.6 V typical).

As mentioned above, the I LIMIT indicator will turn ON when the laser injection current exceeds 95% of the ILIM setting. This could be due to a number of conditions summarized here:

- The current or power has been adjusted to a point that requires an injection current of greater than 95% of the current limit setting.
- The photodiode is reverse connected (in PMODE operation).
- Identified by a negative level at the IPD Test point.
- The photodiode is not connected (in PMODE operation).
- Identified by 0 V at the IPD Test point.
- The photodiode is short-circuited (in PMODE operation).
- Identified by 0 V at the IPD Test point.
- The ILIM pot is set full CCW (minimal).

2.4. Remote Monitoring

J5 has been reserved as an I/O port for specialized applications incorporating the IP250-BV. Refer to the attached engineering support drawing and contact a Thorlabs engineer for more specific information on using these connections.

2.5. Accessories

The IP250-BV is shipped with the wire harness mates for J1 and J2. You may purchase spare or replacement harnesses from Thorlabs as well as a suitable wire harness for J4. The part numbers are listed below:

Wire Harness Descriptions		
Jumper	**Description**	**Connector Description**
J1	DC Input Wires	Molex 70543-0002
J2	LD Wire Harness	Molex 70543-0003
J3	Modulation Input	BNC
J4	Status Wire Harness	Molex 70543-0005
J5	Test Points	Standard 0.1” Spaced Header

Chapter 3 Specifications

Specification	Value
Input Power	±12 VDC @ 275 mA
Constant Current Mode	
Control Range	0 to ±250 mA
Setting Accuracy	±0.5 mA
Compliance Voltage	>8.0 VDC
Ripple and Noise (10 Hz - 10 MHz)	<10 µA RMS
Short-time Fluctuations	<50 µA
Temperature Coefficient	<100 ppm/°C
Drift (30 min. <10 Hz)	<100 µA
Limit Adjust Range	0 to 250 mA
Limit Accuracy	±1% of Limit Setpoint
Constant Power Mode	
Control Range Photo Diode Current	5 µA to 2 mA
Setting Accuracy	±2 µA
Drift (30 min. <10 Hz)	<1 µA
Limit Adjust Range	0 to >2.5 mA
Limit Accuracy	±2 µA
Analog Modulation / Control Voltage	
Input Resistance	10 kΩ
Bandwidth	DC to 50 kHz
Transfer Function (ACC Mode)	25 mA/V
Input Range	0 to 10 V
Analog Monitor Outputs (Note: All outputs are single ended with respect to ground)	
I_{lim}	0 to 250 mV = 0 to ±250 mA
I_{LD}	0 to 250 mV = 0 to ±250 mA
I_{PD}	0 to 2.0 V = 0 to 2.0 mA
P_{lim}	0 to 2.5 V = 0to 2.5 mA
Physical Specifications	
Dimensions (L x W x H)	5.0" x 2.5" x 0.8" (127 mm x 63.5 mm x 20.3 mm)
Weight	<1.5 lbs (0.68 kg)

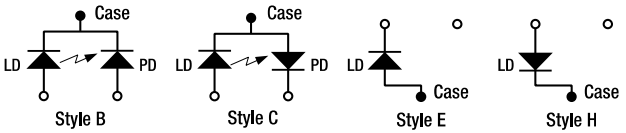

Figure 2 IP250 Laser Diode Pin Codes. Caution: The E Style requires that the Package Case must be floating with respect to the Power Supply Ground.

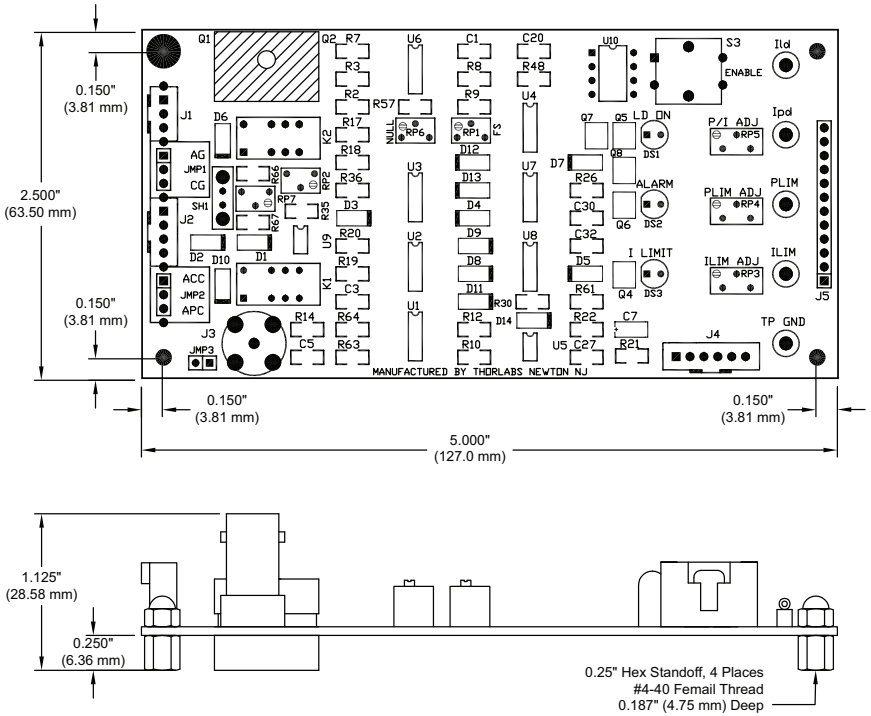

Figure 3 Mechanical Drawing

Pin	Description	Pin	Description
J1-1	+12 VDC In	**J5-1**	TP Ground
J1-2	Common	**J5-2**	ILIM Test Point (TP)
J1-3	-12 VDC In	**J5-3**	ILIM Adjust
J2-1	LDA(+) or LDC(-)	**J5-4**	IALARM
J2-2	Ground LDC(+) or LDA(-)	**J5-5**	PLIM Test Point (TP)
J2-3	PD Cathode	**J5-6**	PLIM Adjust
J2-4	PD Anode	**J5-7**	Alarm
J3	0 – 10 VDC Modulate In	**J5-8**	PMON Test Point (TP)
J4-1	Enable	**J5-9**	P/I Adjust
J4-2	Ground	**J5-10**	Enable
J4-3	Keylock	**J5-11**	IMON Test Point (TP)
J4-4	Ground	**J5-12**	2.5 V_{ref}
J4-5	Inhibit	**JMP3-1**	Ground
J4-6	Ground	**JMP3-2**	PD Cathode

Chapter 4 Output Derating Curves

Since the IP250 is intended for use with blue or blue – violet laser diodes it is optimized to operate with lasers that develop >5 V of load voltage (V_{OP}). The power dissipation of the main laser drive transistor is rated at 1.75 W. This rating is maintained at full output current (250 mA) for any load voltage above 5 V when powering the unit from a ±12 V power supply.

It is possible to operate with lasers with less than 5 V V_{OP}, but the output current must be derated to maintain a safe operating area for the drive transistor.

To determine the power dissipation of the drive transistor use the following formula:

$$P = I_{output}(V_{in} - V_{OP})$$

Where:

V_{in} is the positive input voltage to the driver (typically 10 to 12 V).

V_{OP} is the operating voltage of the laser diode.

I_{output} is the output current to the laser.

The following curve is provided for quick reference.

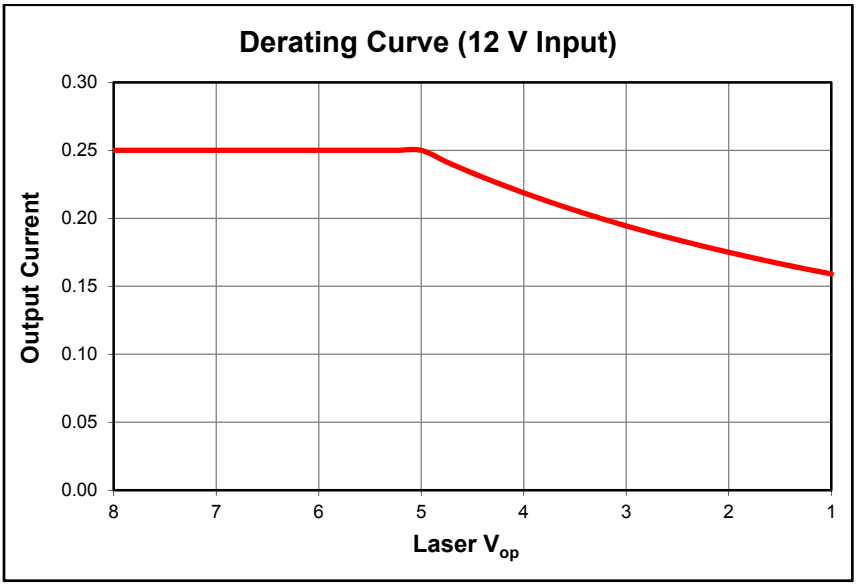

Figure 4 Derating Curve

Chapter 5 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.

5.1. 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.

5.2. 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 6 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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