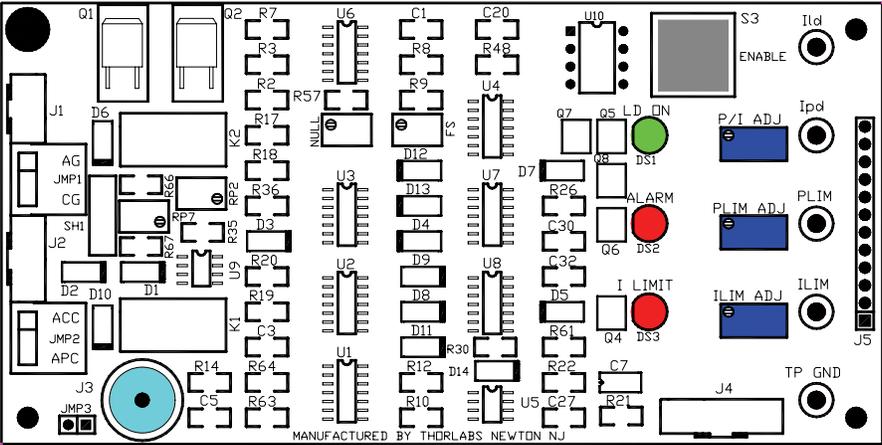


IP500

500mA Laser Diode Controller

Operating Manual



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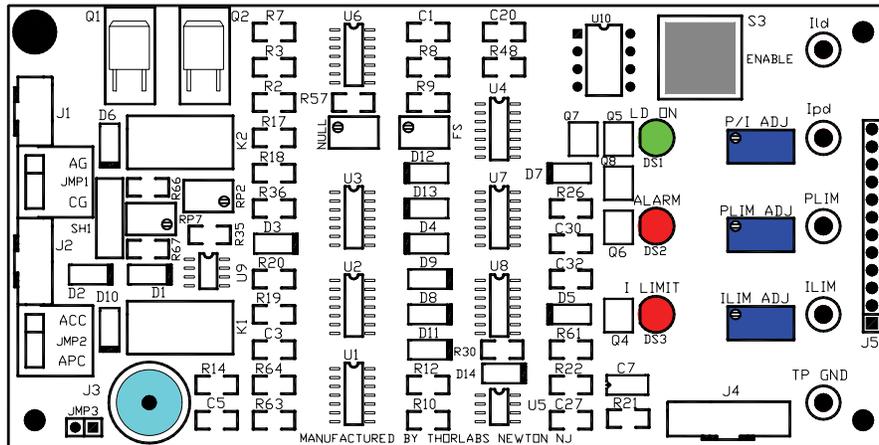


Figure 1 - Front View of IP500 Laser Controller

Overview

- The IP500 is a universal laser diode controller capable of supporting all pin configurations in either constant current mode or constant power mode.
- The IP500 is optimized for 500mA maximum injection current.
- Accepts photodiode feedback currents of up to 2.0mA.
- Pin configurations and operating modes are easily set using on board jumpers.
- Current and Power limits are set using individual 25-turn potentiometers.
- Current or Power is adjusted using a 25-turn potentiometer.
- Easily accessible test points allow analog monitoring of the injection current and photodiode feedback current as well as the current and power limit settings.
- Laser diode inputs are shorted during idle operation to protect the device.
- Three indicators display whether the laser is enabled, operating at current limit, or in an alarm shutdown condition.
- Automatic alarmed shutdown when laser connection is open or reversed.
- Operates from $\pm 5\text{VDC}$.
- Analog modulation up to 50kHz.
- Separate ENABLE switch turns laser on and off, no need to power down the entire unit.

Specifications

(unless otherwise stated all specs are $\pm 1\%$)

- Input Power:
 - ± 5 VDC @ 600mADC Nominal
 - (+4.75 to +5.25V and -4.75 to -5.25V)

- Output Power:
 - 3.3V Max @ 500mADC Max

- Constant Current Mode (ACC):

Control Range	0 to ± 500 mA
Setting Accuracy	± 0.5 mA
Compliance Voltage	>3.0VDC
Ripple and Noise (10 Hz to 10 MHz)	<10 μ A rms
Short-time fluctuations (<15s, <10Hz)	<50 μ A
Temperature Coefficient	<100 ppm/ $^{\circ}$ C
Drift (30 min, <10 Hz)	<100 μ A
Limit Adjust Range	0 to 500mA
Limit Accuracy	$\pm 1\%$ of Limit Setpoint

- Constant Power Mode (APC):

Control Range Photodiode Current	5 μ A to 2mA
Setting Accuracy	± 2 μ A
Drift (30 min, <10 Hz)	<1 μ A
Limit Adjust Range	0 to >2.5mA
Limit Accuracy	± 2 μ A

- Analog Modulation/Control Voltage:

Input Resistance	10k Ω
Bandwidth	DC to 50KHz
Transfer Function (ACC Mode)	50mA/V
Input Range	0 to 10V

- Analog Monitor Outputs:

Note: All analog outputs are single ended with respect to ground.

Ilim	0 to 500mV = 0 to ± 500 mA
Ild	0 to ± 500 mV = 0 to ± 500 mA
Ipd	0 to 2.0V = 0 to 2.0mA
Plim	0 to 2.5V = 0 to 2.5mA

- Physical Specifications (size, packaging...)

Length	5.0"
Width	2.5"
Height	0.8"
Weight	<0.5 lb.

- Operating / Storage Temperatures:

Operating	0 to +40°C
Storage	-40°C to +70°C

Set-up and Operation

1) Connections

- Wiring harnesses have been provided to make the proper connections from the IP500 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 IP500 and the $\pm 5V$ power supply. Connect to the power supply as follows:
 - **J1-1** RED +5V
 - **J1-2** BLACK Return (Common)
 - **J1-3** YELLOW -5V
- The wire harness made with the 4-pin connector should be connected to J2 of the IP500 and the Laser Diode to be driven. Connect the Laser Diode as follows:
 - **J2-1** BLUE Laser Cathode of Anode Grounded Diode
or Laser Anode of Cathode Grounded Diode
 - **J2-2** BLACK Laser Anode Ground or Laser Cathode Ground
 - **J2-3** BLACK Monitor Photodiode Cathode
 - **J2-4** ORANGE Monitor Photodiode Anode

Special 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 IP500 to fix the ground connection to the Photodiode Cathode.

Refer to Figure 2 for the schematic diagram detailing the laser diode connections and the correct setting for the JMP1 ground jumper.

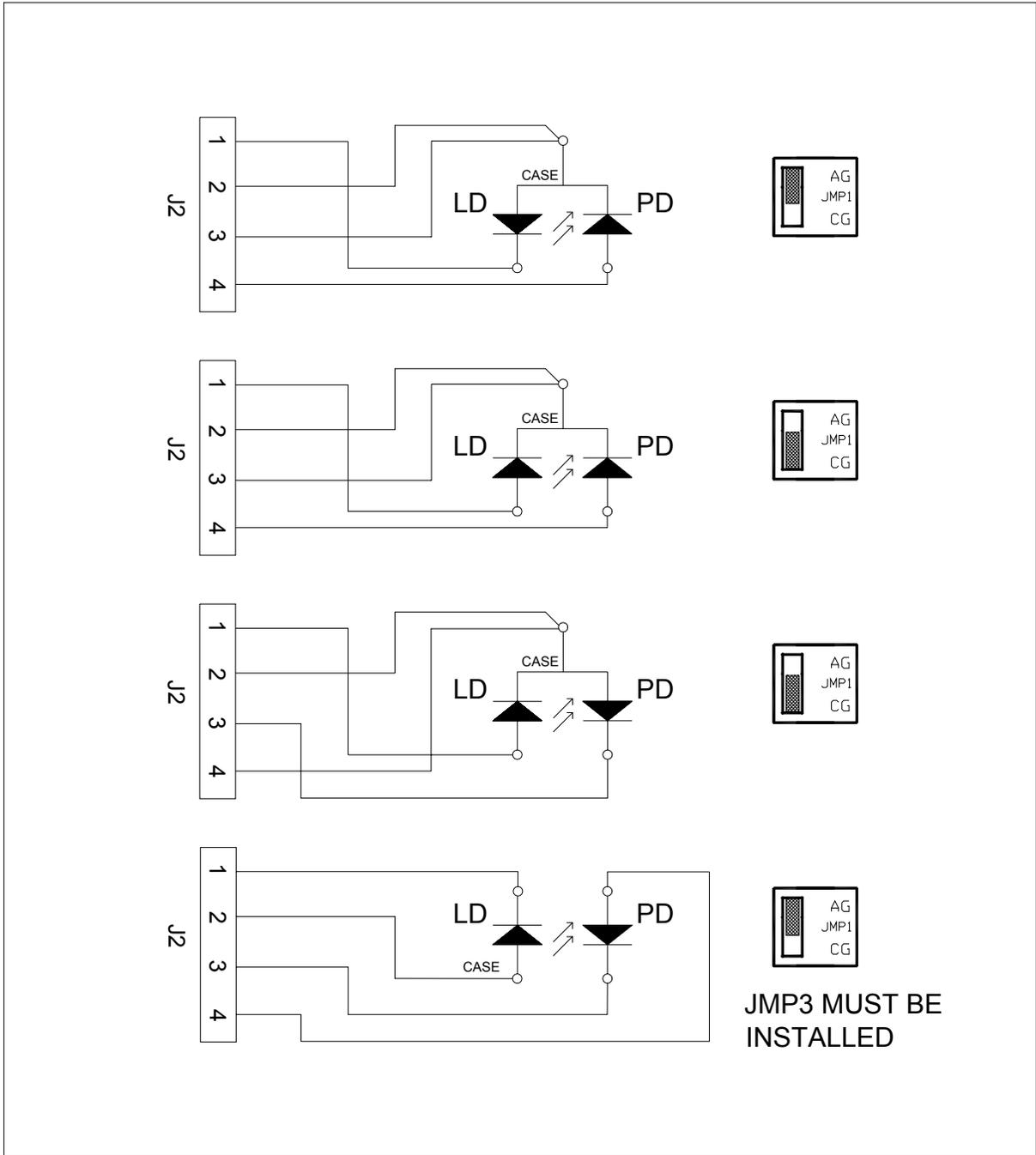


Figure 2 - Typical Laser Diode Connections

2) Operation

Automatic Constant Current Control (ACC):

- Set **JMP1** to either “**AG**” for Laser Diodes with Grounded Anodes or “**CG**” for Laser Diodes with Grounded Cathodes. JMP1 is located on the left side of the unit. **Always disable the laser driver prior to changing modes.**
- 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.**
- Apply power to the unit.
- 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 1V=1A, with a maximum adjustment of approximately 0.500V or 500mA.
- 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 1V=1mA, with a maximum adjustment of 2.5V or 2.5mA.

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.

- The P/I ADJ Pot will allow adjustment of the laser drive current from 0 mA to the ILIM set point or 500mA maximum. When turning on a laser for the first time it is suggested that this pot be set fully counter-clockwise.
- Press and release the ENABLE switch.
- The green LD ON indicator will turn ON. NOTE: There will always be a delay of approximately 2-3 seconds before any current can flow to the laser diode.
- 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, 1V=1A. The Ipd Test point provides an analog read back of the Photodiode monitor current, 1V=1mA and can be used to gauge the relative output power of the laser. If the ALARM indicator turns ON see “Alarms and

Troubleshooting” below. If the ILIM setting is below approx. 10mA the I LIMIT LED will be ON, this is normal.

- While operating in ACC Mode, 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.
- 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.
- Pressing the ENABLE switch while the laser is operating will turn off the laser injection current.

Automatic Constant Power Control (APC):

Photodiode feedback current is required in APC Mode.

- Set **JMP1** to either “**AG**” for Laser Diodes with Grounded Anodes or “**CG**” for Laser Diodes with Grounded Cathodes. JMP1 is located on the left side of the unit. **Always disable the laser driver prior to changing modes.**
- 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.**
- Apply power to the unit.
- 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 $1V=1A$, with a maximum adjustment of approximately 0.500V or 500mA.

When operating in APC the ILIM (current limit) function is still active if the laser injection current reaches the limit point.

- Measure the PLIM Test point and adjust the PLIM ADJ pot for the maximum MPD current expected. The transfer function is 1V=1mA, with a maximum adjustment of 2.5V or 2.5mA.
- The P/I ADJ Pot will allow adjustment of the Monitor Photodiode current from 5uA to the PLIM set point or 2mA maximum. When turning on a laser for the first time it is suggested that this pot be set fully counter-clockwise.
- Press and release the ENABLE switch.
- 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”.
- 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, 1V=1mA.
- 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.
- Pressing the ENABLE switch while the laser is operating will turn off the laser injection current.

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 IP500. 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 500mA by applying a 0 to 10VDC signal. The transfer function being

50mA / Volt

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

- For 100% depth of modulation set the P/I ADJ pot fully counter-clockwise and apply a sinewave input to J3. The peak to peak amplitude must equal

ILIM / 0.05

and a DC offset equal to $\frac{1}{2}$ of the amplitude must be applied (the signal should always be above zero volts).

- 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.

Remote Control Inputs

- In addition to the automatic shutdown features, the IP500 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, Inc. should you decided to incorporate these features (refer to Accessories for more information):

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 of the unit. Leave unconnected when not using.

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.

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).

3) Alarms and Troubleshooting

This unit contains circuitry that will automatically shutdown 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 (V_{op}) of the laser exceeds approximately 3.3V.

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 IP500 will also shutdown (or not allow ENABLE) if any of the following conditions exist or occur:

- The Key lock Inputs (J4-3 & J4-4) are shorted together.
- The Remote Interlock Inputs (J4-5 & J4-6) are open circuit.
- The $-5V$ power supply is below approximately $-4V$.

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 Volts at the IPD Test point.
- The Photodiode is short-circuited (in PMODE operation). Identified by 0 Volts at the IPD Test point.
- The ILIM pot is set full CCW (minimal).

4) Remote Monitoring

J5 has been reserved as an I/O port for specialized applications incorporating the IP500. Refer to the attached Engineering Support Drawing and contact a Thorlabs, Inc. engineer for more specific information on using these connections.

5) Accessories

The IP500 is shipped with the wire harness mates for J1 and J2. You may purchase spare or replacement harnesses from Thorlabs, Inc. as well as a suitable wire harness for J4. The part numbers are listed below:

J1	DC Input Wires	P/N IP500-ASSY3
J2	LD Wire Harness	P/N IP500-ASSY2
J4	Status Wire Harness	P/N TCM1000T-ASSY4

