WAVELENGTH ELECTRONICS

FL591FL

FL500 Laser Diode Driver
Evalution Board

GENERAL DESCRIPTION:

Use the FL591FL Evaluation Board to rapidly prototype a laser diode control system using the cutting edge technology of the FL500 Laser Diode Driver. Onboard switches, connectors, and trimpots make configuration and operation simple. Input and output cables are included.

Operate the FL500 as two independent 250 mA channels or in parallel as one 500 mA driver. Switches set operation in either constant current (CC) or constant power (CP) mode. A trimpot sets the laser diode forward current limit. The input cables allow easy connection to your power supply and monitoring equipment while the output cables quickly connects to your laser diode and monitor photodiode.

NOTE: An external laser setpoint voltage is required to operate this product.

FEATURES:

- Operates A or B type Laser Diodes
- Configure as two independent 250 mA output channels or one 500 mA driver.
- Constant Current or Constant Power Operation
- Adjustable Current Limit
- Enable/Disable Switch, and LED status indication
- Includes Input/Output Cable Set (18”)
- FL500 is Reflow Oven Compatible

ORDERING INFORMATION:

FL591FL	WITH FL500 installed
FL591	WITHOUT FL500

Figure 1: Top View

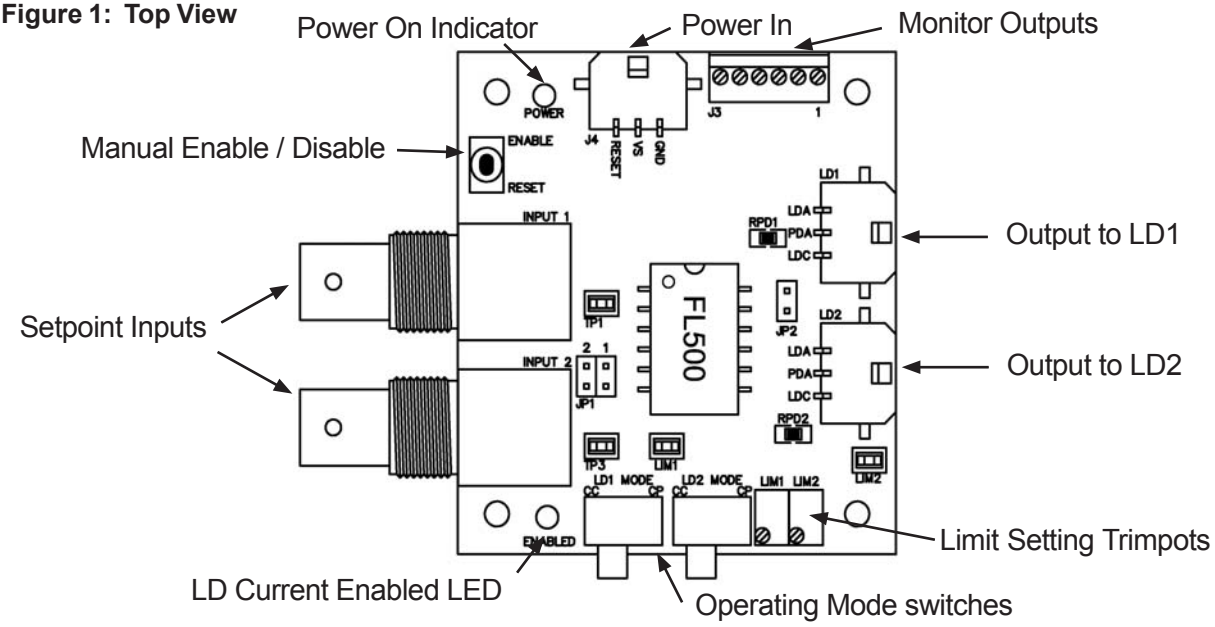
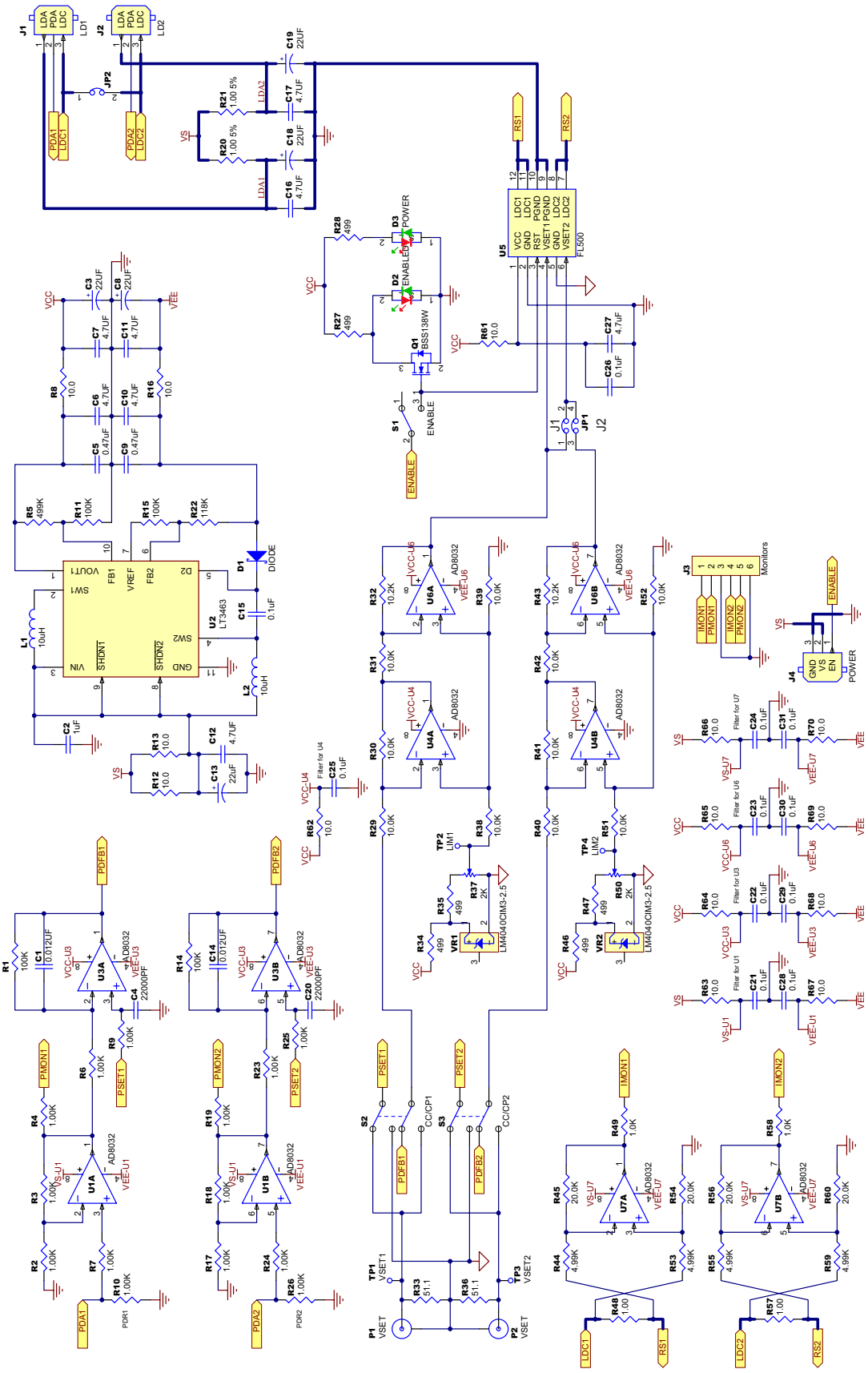


Figure 2: FL591FL Schematic

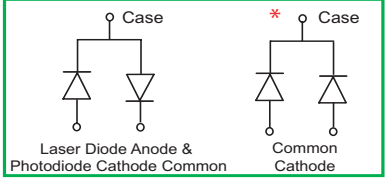


SETUP INFORMATION

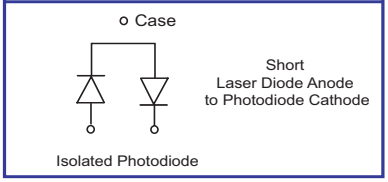
Fill in the following chart of preconfiguration and operational mode options prior to installation. Have this data available before calling technical support.

Description	Value in your application	Notes
Laser Diode Configuration	**A, B or C**	The FL 591 supports only type A or B laser diodes. See below for explanation of laser diode types.
Laser Diode Max Current		
Operating LD Current		
Operating PD Current		
Operating Mode	**CC or CP**	Constant Current (CC): Laser diode current is fixed, power varies. Constant Power (CP): Laser diode current varies. Photodiode current is fixed. Power output is fixed
Power Supply		If greater than 5V, make sure to check the SOA curve in the FL500 datasheet.

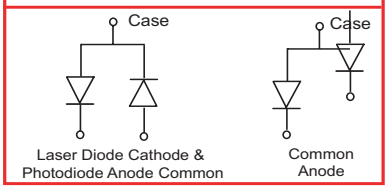
Type A Laser Diode



Type B Laser Diode



Type C Laser Diode



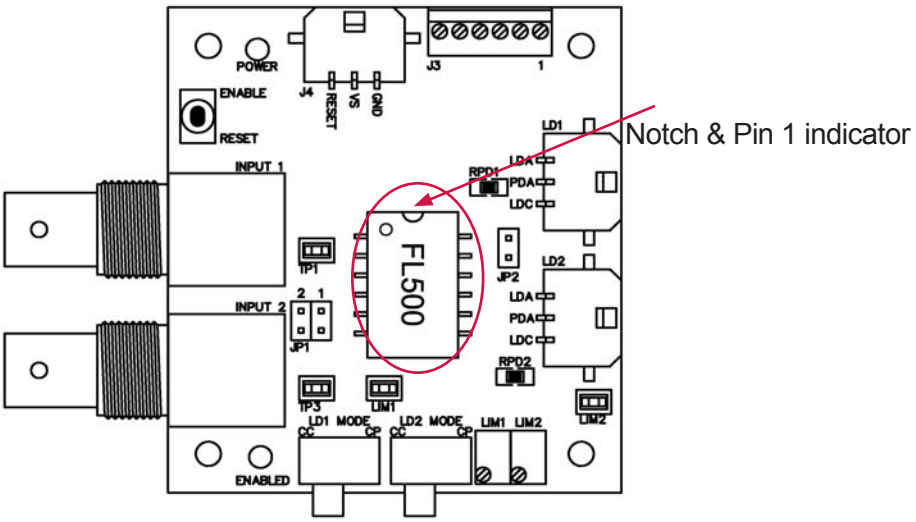
* Contact factory for common cathode configuration

Follow the next ten steps sequentially to safely operate the FL500 with your laser diode. Complete steps 1 through 4 before applying power to the board.

STEP 1: Install the FL500 on the evaluation board (if you purchased the FL500 and FL591FL separately)

Match up the notch in the FL500 with the index marker shown in Figure 3. Solder the pins making sure to take proper static sensitive precautions.

Figure 3: Orientation of FL500 on evaluation board



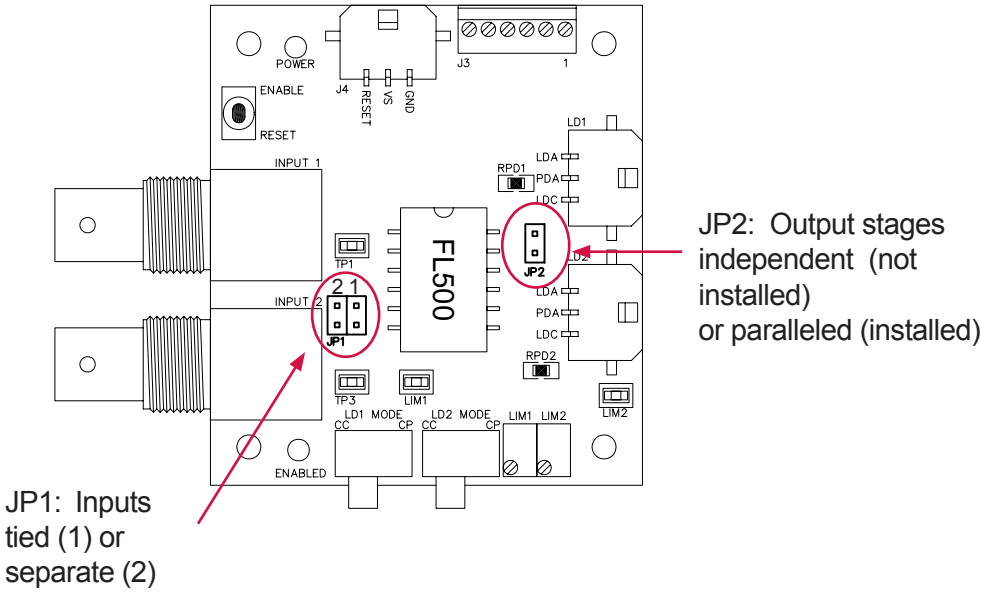
STEP 2: CONFIGURE FOR INDIVIDUAL OR PARALLEL OPERATION

The FL500 contains two 250 mA drivers. The evaluation board allows them to be operated independently or together in parallel as a 500 mA driver. Two sets of jumpers are used:

JP1 (INPUTS): Installed in position 2 (see Figure 4), each current source operates independently. Each has its own current limit circuit and constant power feedback circuit. When installed in position 1, the LD2 current source uses the same input, limit, and power feedback circuit as the LD1 current source. Outputs are not connected with the jumper in position 1.

JP2 (OUTPUT STAGE): When not installed, the LD1 and LD2 outputs operate independently. To parallel the current sources, install JP2. Use either output connector to connect to the laser diode load.

Figure 4: Jumpers for individual or parallel operation



STEP 3: CONFIGURE FOR CONSTANT CURRENT OR CONSTANT POWER MODE

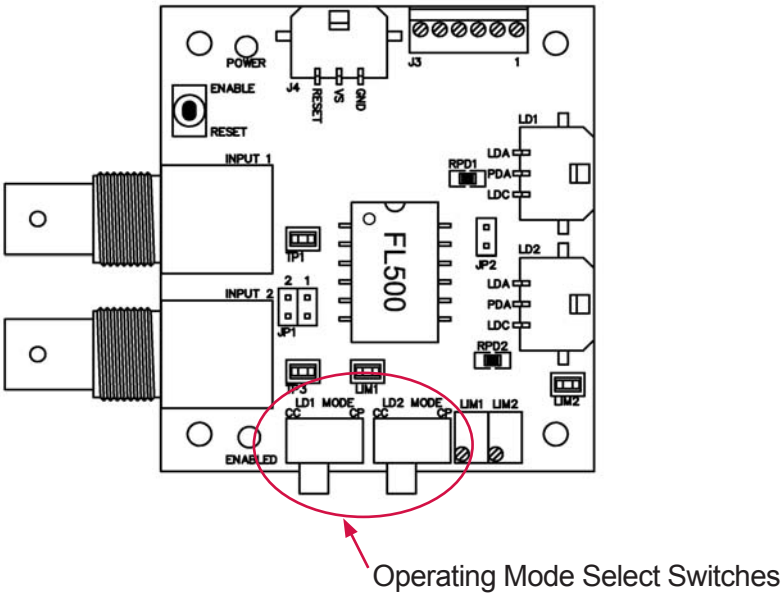
The two modes of operation supported by the FL591FL are constant current and constant power mode. Operating mode is selected by changing the position of the switches shown in Figure 5 below. **It is very important to note that the FL591FL should be configured for either constant current or constant power mode BEFORE power is applied. Changing operating mode while the FL591FL is operating can result in damage to your laser diode.** In constant current mode, V_{SET} correlates directly to the laser diode current, regardless of laser diode power intensity. In constant power mode, the FL591FL controls the laser diode using the photodiode to achieve a consistent laser power that is directly proportional to V_{SET}.

Constant Current mode ignores the laser's photodiode. The FL591FL, however, is designed to allow you to monitor the laser's photodiode while running in this mode. Monitor the voltage at pin 2 or 5 on the terminal block on the top side of the FL591FL. Before powering the unit on to operate in constant current mode, make sure that the mode select switch is in the CC position (see Figure 5).

Constant Power mode utilizes the laser's photodiode to regulate the intensity of the laser in proportion to V_{SET}. While the unit is NOT powered, make sure the mode select switch is in the CP position to configure the FL591FL for constant power mode (see Figure 5).

NOTE: If the FL591FL is configured to operate in parallel mode, make sure that both CC/CP switches are set to the same position.

Figure 5: Operating Mode Switches



STEP 4: ATTACH THE V_S POWER SUPPLY

Figure 6 demonstrates the location of the power connector for the FL591FL. Connect a DC voltage between +3 and +9 V between and V_S GND to operate the control electronics and provide power to the laser diode. Choose V_S such that the minimum current capacity is greater than the limit current setting(s), plus 2mA quiescent current for the FL500. Use GND for the power return. The signal ground pins on the monitor connector are not intended to act as a power connection return. These ground connections are strictly for the low noise ground references used to monitor driver operation.

Select V_S to be approximately (V_{LD} + (V_{SET} / 2) + 25mV), in order to minimize the power dissipation within the FL500. Use the Safe Operating Area calculations in the FL500 manual or online to verify that the FL500 is operated in a safe configuration.

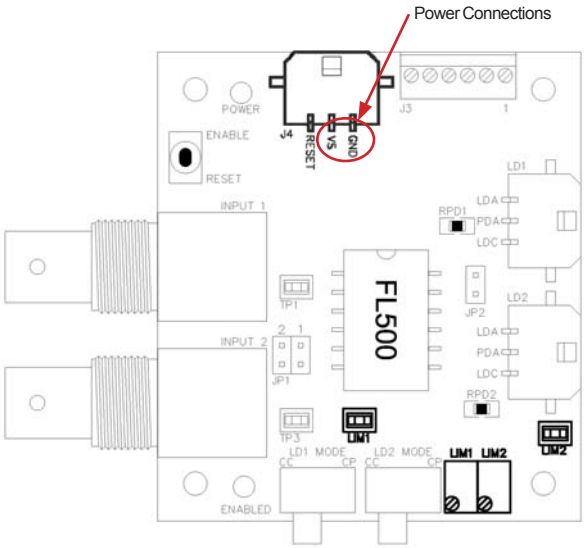
STEP 5: SET THE LASER DIODE CURRENT LIMIT

The LIM 1 and LIM 2 trimpots on the FL591FL control the maximum current setpoint. This circuit does so without overshooting or ringing at the limit point, and without saturating control elements, providing very fast recovery from limit conditions, without phase shifts or inversions. See Figure 6 for location of current limit trimpots and test points.

The limit current can be set while the output is disabled (recommended), by monitoring the voltage at the LIM*n* test point while adjusting the corresponding LIM*n* trimpot. The voltage range is 0-2 VDC, matching the voltage range and scale of the analog input. When the current sources are operated independently, the LIM1 trimpot adjusts the limit for INPUT1, and therefore the limit current for LD1. Likewise, LIM2 adjusts the limit for INPUT2, and therefore the current limit for LD2. The transfer function for individual operation is 125 mA/V.

When the FL500 current sources are run in parallel mode, LIM1 controls the total limit current. When operated in parallel mode, the voltage range of 0-2 VDC corresponds to a limit current ranging from 0-500 mA, giving a transfer function of 250 mA per volt.

Figure 6: Power Connections & Current Limit Trimpots and Testpoints



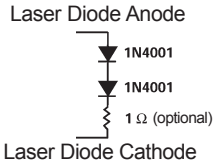
STEP 6: CONNECT THE LASER DIODE AND MONITOR PHOTODIODE

With power removed from the FL591FL board, connect the output (3 wire cable) to your laser diode. Note the silkscreen of each connector: LDA = Laser Diode Anode. PDA = Photodiode Anode. LDC = Laser Diode Cathode. The FL591FL is compatible with Type A and B laser diodes.

Note: We recommend using a simulated laser diode load for initial operation (See Figure 7 below). Simulation of the laser allows the user to become familiar with the configuration and operation of the laser driver without risking damage to an expensive laser diode. Always check the Laser Diode Driver, Safe Operating Area analysis tool to avoid excessive power dissipation in the laser driver (http://www.teamwavelength.com/tools/calculator/soa/defaultld.htm**).**

Figure 7: Simulated Laser Diode Loads

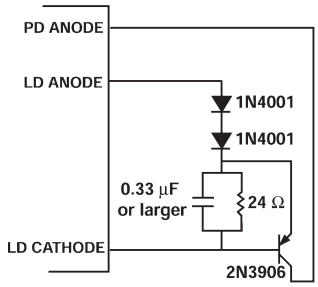
Constant Current Mode:



The 1N4001 general purpose rectifier has a forward voltage of 1.1V per diode and is suitable for simulation of drive currents less than 1 Amp.

National Semiconductor P/N 1N4001
800-272-9959
www.national.com

Constant Power Mode:

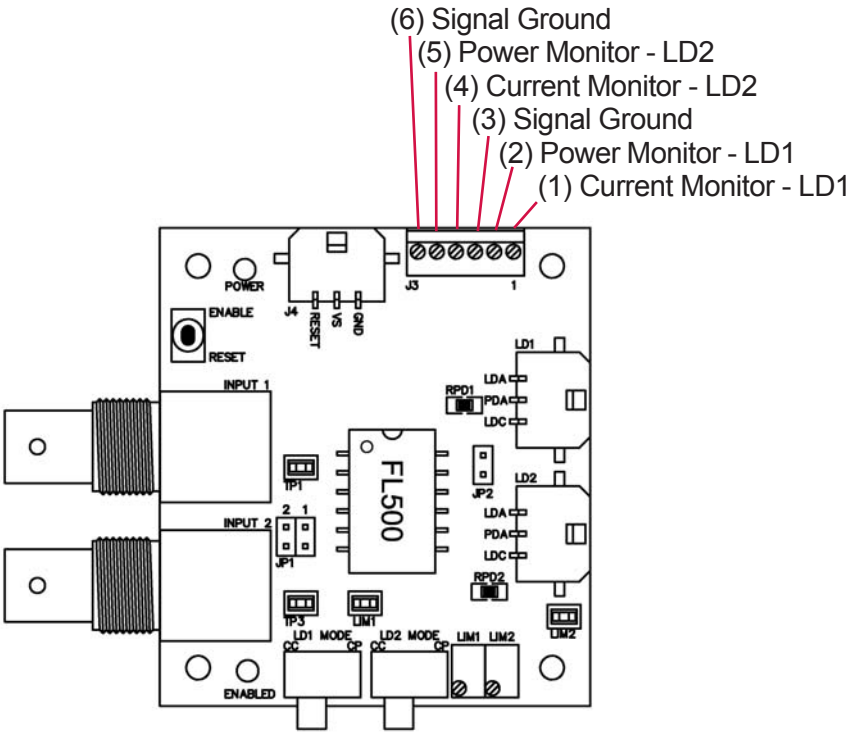


This circuit provides a fixed photodiode current. The 24 Ω resistor typically produces 30 mA of laser diode current. Vary the resistor size to change the current output.

STEP 7: MONITOR THE LASER DIODE AND PHOTODIODE CURRENTS

The monitor connector (J3) includes onboard monitors for current and power for each of the laser diode channels, as well as signal grounds. Figure 8 indicates the function of each of the six pins on this connector.

Figure 8: Current and Power Monitor Connections



CURRENT MONITOR

The current monitor provides a voltage proportional to the measured laser diode current. This current is measured external to the FL500. The transfer function for calculating output current when operating the current sources independently is

$$I_{LDn} = V_{IMONn} * 0.25A / 2V$$

Where V_{IMONn} is the measured Current Monitor (IMON) voltage , and *n* is the LD channel number. The IMON voltage is scaled to match the transfer function of the input signal.

When operating in parallel mode, the outputs from each of the current sources are simply connected together, effectively doubling the output current. The individual current monitors will still only measure current from each individual source, not the total output current. Therefore, the total output current is calculated using the following equation:

$$I_{LD(TOTAL)} = I_{LD1} + I_{LD2}$$

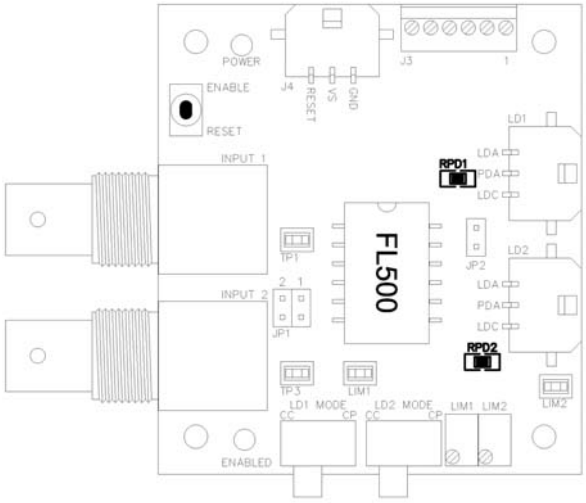
$$I_{LD(TOTAL)} = 0.25\ (V_{MON1} + V_{MON2})\ /\ 2V$$

The signal ground connections at pin 3 and pin 6 of the monitor connector are low current ground references to be used for measurement instrumentation.

POWER MONITOR

The power monitor provides a means to measure the voltage developed across the photodiode current sense resistors, R_{PD1} and R_{PD2}. These resistors are labeled in the silk screen on the top of the FL591FL evaluation board. Their locations are shown in Figure 9 below.

Figure 9: Photodiode Sense Resistor Locations



The photodiode current sense resistors have a value of 1kΩ +/- 1% when the board ships from the factory, giving a maximum photodiode range of 1mA in individual mode or 2mA in parallel mode. The 1kΩ resistors can be replaced by the user with values more suitable to the sensitivity of the photodiode being used with any 0805 sized resistor.

The photodiode current I_{PDn} can be calculated using the following equation:

$$I_{PDn} = V_{PMONn} / (2 * R_{PDn})$$

When operating either channel of the FL500 in constant power mode, the P_{MONn} voltage is used as the power feedback signal. The FL591FL's constant power circuit integrates the difference between the INPUT*n* voltage and the P_{MONn} feedback signal. Output current will not exceed the maximum current limit configured by the user, as the current limit is applied to the resulting current setpoint.

The power monitor outputs are available at all times, whether operating in constant current or constant power mode, as long as the photodiode connection is present.

STEP 8: ENABLE OR DISABLE THE OUTPUT CURRENT

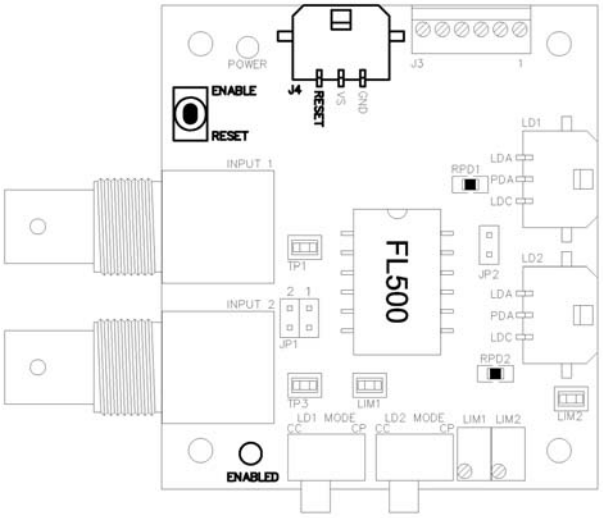
The FL591FL offers a remote electrical enable, as well as a local enable switch to enable/disable the output current to the laser diode. Under any condition where the output is enabled and can possibly drive laser diode current the ENABLED LED will be on. The FL591FL must be both remotely and locally enabled to drive current to the laser.

The local enable switch is shown in bold in Figure 10 below. This switch must be set to the enable position to allow current to flow to the laser diode.

The RESET pin on J4 can be used to remotely enable the laser output. The RESET pin is an active-low, TTL-compatible input. To enable output current, this pin must be tied to a TTL-compatible logic low, or tied to ground. If this pin is left floating, the output will be disabled. The FL591FL requires that the user tie this to a known logic 0 state before the output will enable.

When disabled, the FL591FL can have up to 1 mA of leakage current. Typically it is less than 500 μA.

Figure 10: Remote and Local Enable



STEP 9: ADJUST THE SETPOINT VOLTAGE

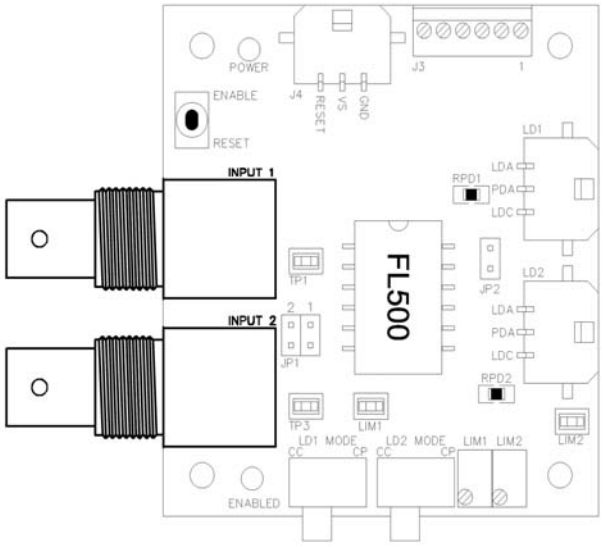
Figure 11 shows the location of the laser diode setpoint inputs. INPUT1 sets the operating current for LD1. INPUT2 sets the operating current for LD2. Maximum voltage for these inputs is 2V. Input impedence is 51.1Ω. For additional specifications see the FL500 manual (http://www.teamwavelength.com/downloads/fl500.pdf)

In constant current mode, when operated independently, the transfer function is 250 mA / 2 V (or 125 mA/V). When operated in parallel, the transfer function is 500 mA / 2 V (or 250 mA / V).

In constant power mode, the input voltage/photodiode current transfer function can be adjusted by changing the R_{PD} resistor. The default R_{PD} resistors installed at the factory are 1kΩ for a default photodiode range of 1mA.

$$I_{PDn} = V_{SET} / (2 * R_{PDn})$$

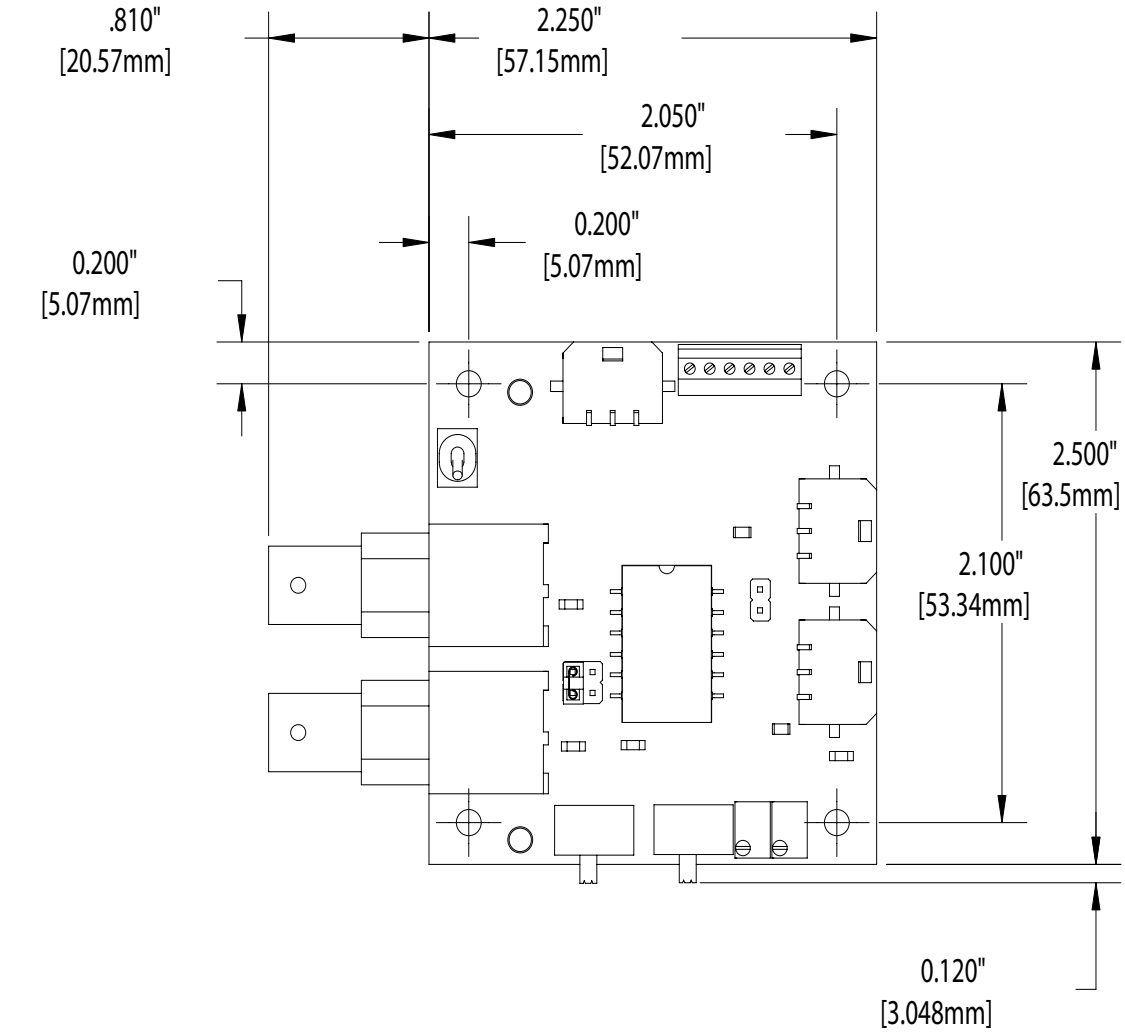
Figure 11: Input Connectors

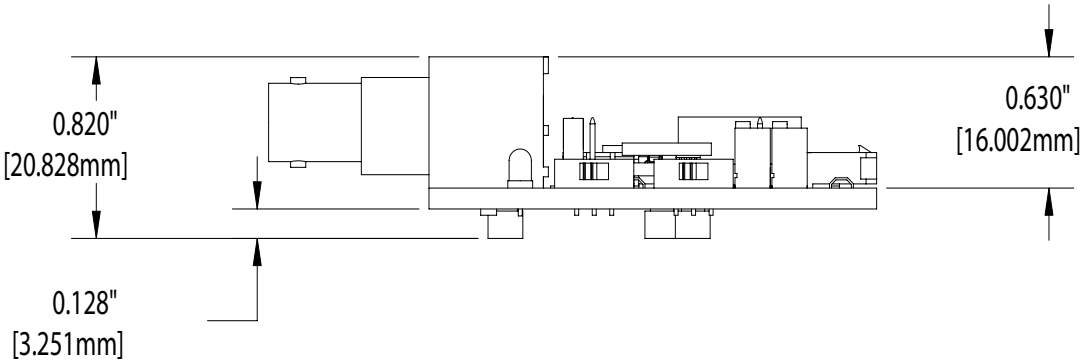


MECHANICAL SPECIFICATIONS

FL500 is reflow oven compatible

TOP VIEW (inches)





All dimension tolerances are ±5%.

CERTIFICATION AND WARRANTY

CERTIFICATION:
Wavelength Electronics (Wavelength) certifies that this product met it's published specifications at the time of shipment. Wavelength further certifies that its calibration measurements are traceable to the United States National Institute of Standards and Technology, to the extent allowed by that organization's calibration facilities, and to the calibration facilities of other International Standards Organization members.

WARRANTY:
This Wavelength product is warranted against defects in materials and workmanship for a period of 90 days from date of shipment. During the warranty period, Wavelength will, at its option, either repair or replace products which prove to be defective.

WARRANTY SERVICE:
For warranty service or repair, this product must be returned to the factory. An RMA is required for products returned to Wavelength for warranty service. The Buyer shall prepay shipping charges to Wavelength and Wavelength shall pay shipping charges to return the product to the Buyer upon determination of defective materials or workmanship. However, the Buyer shall pay all shipping charges, duties, and taxes for products returned to Wavelength from another country.

LIMITATIONS OF WARRANTY:
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SAFETY:
There are no user serviceable parts inside this product. Return the product to Wavelength Electronics for service and repair to ensure that safety features are maintained.

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REVISION HISTORY

REVISION	DATE	NOTES
REV. B	Jul-06	Initial release
REV. C	17-Feb-09	Updated to include FL500 Reflow Oven compatibility

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