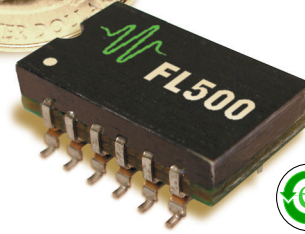




FL500

500 mA laser diode driver or two 250 mA drivers in a small SMT package that is reflow process compatible



GENERAL DESCRIPTION:

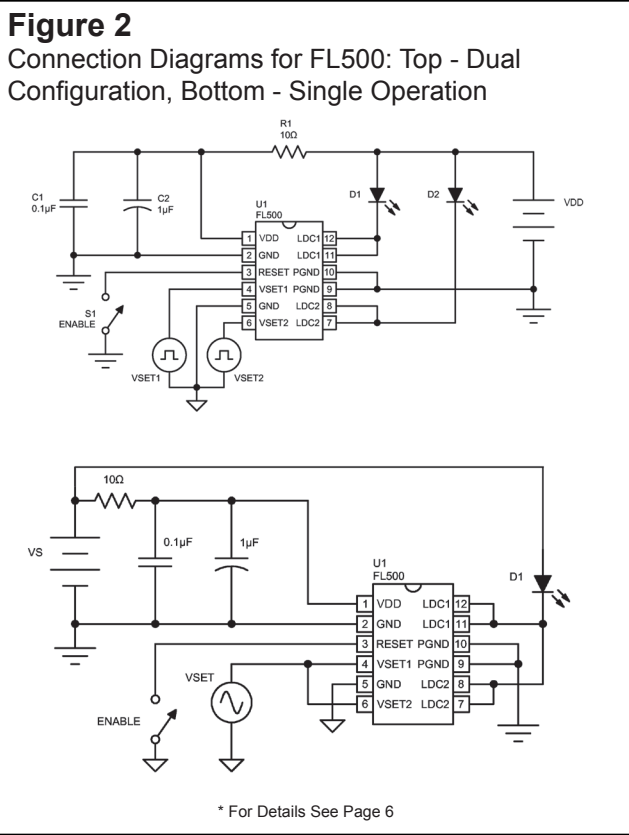
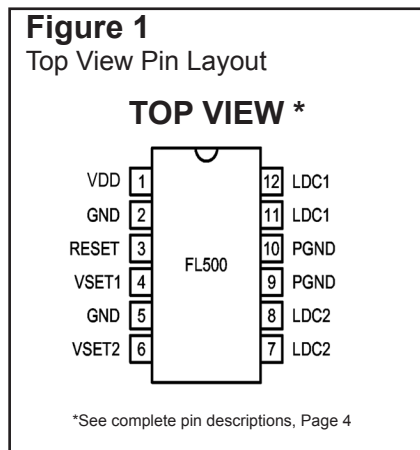
The FL500 is ideal for driving low power laser diodes. It operates from 3 to 12 V, so is compatible with Li+ battery operation. It can be configured as two totally independent 250 mA drivers or a single 500 mA driver. Compatible with Type A or B laser diodes.

The FL500 allows for quick and easy operation in Constant Current (CC) mode. For simple CC mode operation the only components that are required are a power supply, an analog control voltage, your laser and optional filtering circuitry.

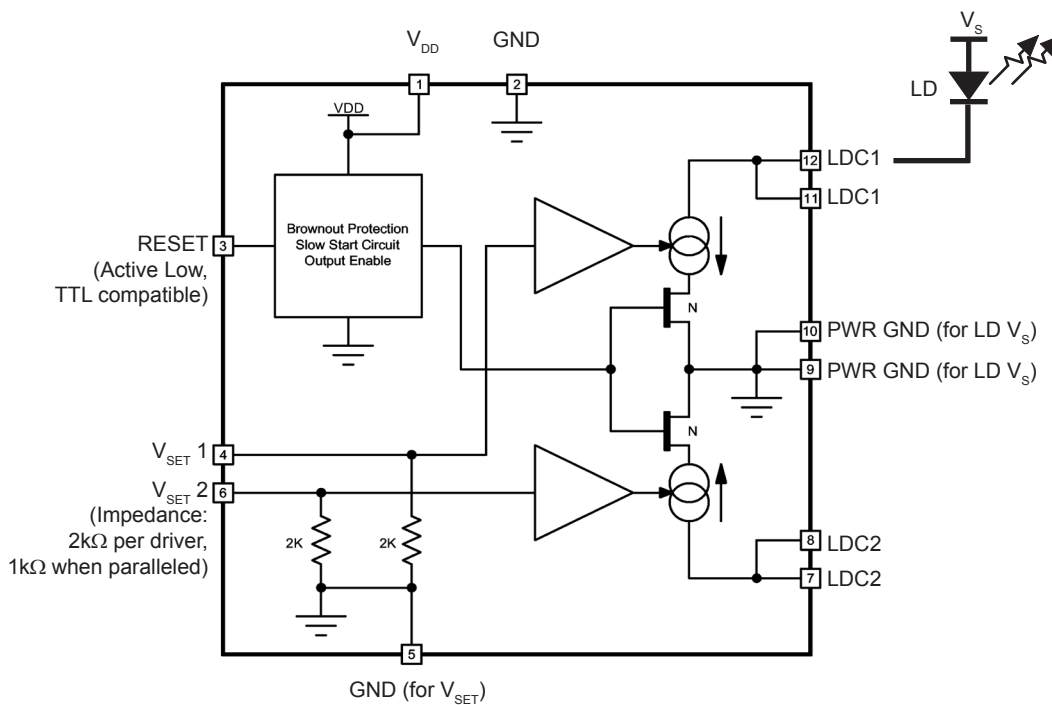
For additional features, including current limit and photodiode feedback for Constant Power operation, the FL500 can be used with the FL591 evaluation board.

FEATURES:

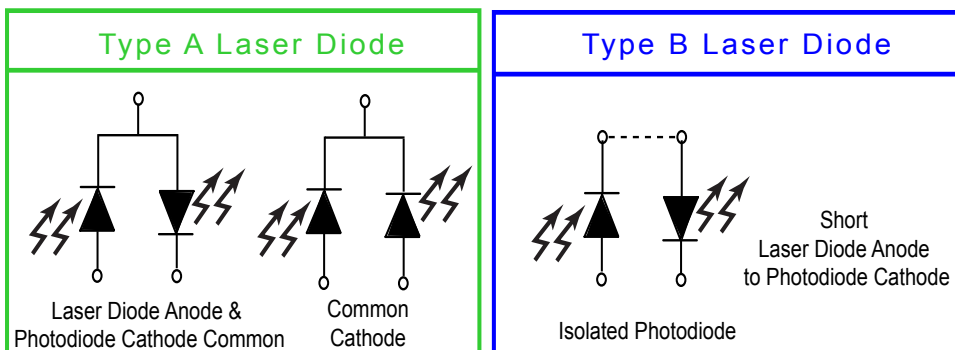
- Small Package (0.75" x 0.45" x 0.255")
• Low Cost
• Brownout Protection
• 12-pin, SMT package, Reflow Compatible
• Slow Start Laser Diode Protection
• Drive Up to 500 mA Output Current
• Can be configured as two 250 mA drivers
• Voltage Controlled Setpoint
• TTL Compatible Shutdown Pin
• Adjustable Current Limit on Eval boards
• Adjustable Current Range Output
• 500 kHz sinewave Constant Current Bandwidth (100 kHz square wave)



BLOCK DIAGRAM



SUPPORTS A & B LASER DIODE PACKAGE STYLES



* Contact factory for common cathode configuration

ELECTRICAL AND OPERATING SPECIFICATIONS

ABSOLUTE MAXIMUM RATINGS						
RATING	SYMBOL	VALUE	UNIT			
Supply Voltage (Voltage on Pin 1)	V _{DD}	+3 to +12 **	Volts DC			
Output Current (See SOA Chart)	I _{OUT}	500	mA			
Power Dissipation, T _{AMBIENT} = +25°C [1]	P _{MAX}	2	Watts			
Operating Temperature, case	T _{OPR}	- 40 to + 85	°C			
Storage Temperature	T _{STG}	- 55 to +125	°C			
Weight	FL500	0.08	oz			
PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNITS
CONSTANT CURRENT CONTROL						
Short Term Stability, 1 hour	T _{AMBIENT} = 25°C			35	40	ppm
Long Term Stability, 24 hours	T _{AMBIENT} = 25°C		50		75	ppm
CONSTANT POWER CONTROL						
Short Term Stability, 1 hour [3]				0.019		%
Long Term Stability, 24 hours [3]				0.011		%
OUTPUT [2]						
Current, peak, see SOA chart	Per channel		245	250	252	mA
Current, peak, see SOA chart	Two channels operated in parallel		495	500	505	mA
Compliance Voltage, Laser Diode Load	Full Temp. Range, I _{OUT} = 500 mA		V _{DD} - (0.5 x V _{set})			Volts
Rise Time	I _{OUT} = 500 mA			300		nsec
Fall Time	I _{OUT} = 500 mA			300		nsec
Bandwidth	Constant Current, Sine Wave			500		kHz
Bandwidth	Constant Current, Square Wave			100		kHz
Delayed start			100			msec
Slow Start ramp rate				15		mA / msec
Depth of Modulation	100 kHz sine wave			99		%
Transfer Function - V _{SET} to I _{OUT}	Configured as two 250 mA drivers			0.125		A / V
Transfer Function - V _{SET} to I _{OUT}	Configured as one 500 mA driver			0.25		A / V
POWER SUPPLY						
Voltage, V _{DD}			3		12**	Volts
Current, V _{DD} supply, quiescent			2.2	2.7	4.6	mA
V _S , Maximum to LD Anode					20**	Volts
INPUT						
Offset Voltage, initial, I _{mon}	Pin 2, T _{AMBIENT} = 25°C, V _{CM} = 0 V			2		mV
Bias Current (based on input Res of op amp)	Pin 2, T _{AMBIENT} = 25°C, V _{CM} = 0 V			10	15	nA
Common Mode Range	Pin 2, Full Temp. Range		0		V _{DD}	V
Common Mode Rejection, Set point	Full Temperature Range		-16	64		dB
Power Supply Rejection	Full Temperature Range		60			dB
THERMAL						
Heatspreader Temperature Rise	T _{AMBIENT} = 25°C			43		°C / W
Pin Solderability	Solder temp @260°C			10		Sec
NOISE						
Noise & Ripple (Rms)	I _{OUT} = 100 mA, 100 kHz bandwidth			3		μA
Leakage Current	V _{SET} = 0 V			50		μA
(when using the FL591 circuitry)	V _{SET} = 1 V			100		μA
	V _{SET} = 2 V			150		μA

**The FL591 Evaluation Board revision A or B limits the input voltage to 9 V.
Revision C allows full range operation from +3 V to +12 V.

PIN DESCRIPTIONS

Pin	Pin #	Name	Function
VDD	1	Control Electronics Power	Power supply input for the FL500's internal control electronics. Supply range input for this pin is +3 to +12 Volts DC. It is compatible with Li+ batteries.
GND	2	Control Electronics Ground	Return path for control electronics. Connect ground for V _{DD} power supply here. Do not use for high current ground return.
RESET	3	Enable / RESET Control	TTL compatible. LO = laser diode current on FLOAT or HI = laser diode current attenuated to ~10 μ A (~20 μ A if drivers are paralleled to produce 500 mA)
VSET1	4	Setpoint for LDC1 control	2 k Ω input impedance. 0 to 2 V range. There is no internal clamping, so higher voltage here will produce more current through the laser diode. Not recommended above 2 V.
GND	5	Ground for setpoint inputs	Low Current, Low Noise ground for use with VSET1 & VSET2.
VSET2	6	Setpoint for LDC2 control	2 k Ω input impedance. 0 to 2 V range. There is no internal clamping, so higher voltage here will produce more current through the laser diode. Not recommended above 2 V.
LDC2	7	Laser Diode Cathode, Driver 2	Tie to laser diode cathode for individual drive operation (250 mA max). Tie to LDC1 for parallel operation up to 500 mA. Tie to pin 8 (also LDC2) if laser diode current exceeds 125 mA. Actual pin capacity is greater, but higher current produces offsets and higher noise.
LDC2	8		
PGND	9	Power Ground for VS connection	Use for ground connection of VS power supply. Tie to pin 10 (also PGND) if laser diode current exceeds 125 mA.
PGND	10		
LDC1	11	Laser Diode Cathode, Driver 1	Tie to laser diode cathode for individual drive operation (250 mA max). Tie to LDC2 for parallel operation up to 500 mA. Tie to pin 12 (also LDC1) if laser diode current exceeds 125 mA. Actual pin capacity is greater, but higher current produces offsets and higher noise.
LDC1	12		

Note [1]. Maximum Power Dissipation is 1 Watt per channel. When configured as one driver, maximum power dissipation is 2 W.

Note [2]. Limit is fixed at 500 mA (250 mA per channel). The Evaluation Board circuitry adds a variable limit circuit.

Note [3]. Constant Power Control is available when the FL500 is used with FL591 and FL593 as well as the LDTC0520/1020 combination boards.

OPERATION

1. RESET / ENABLE FUNCTION

This control pin is common to both sources. When active, this pin attenuates the output current amplitude to near zero ($\sim 10 \mu\text{A}$ when configured for 250 mA max.) Current still flows through the laser diode. The pin is active LO. LO = LD current flowing to setpoint. FLOAT or HI = LD current attenuated. The input is TTL compatible.

2. DELAYED / SLOW START

Once power is applied, current at the attenuated level will flow ($\sim 10 \mu\text{A}$ when configured for 250 mA max). After 100 msec, current will rise to the level dictated by the setpoint voltage at the rate of about 15 mA / msec. This delay ensures that all control electronics are functioning before significant current flows to the laser diode. The delay time is set with internal components. [It can be increased - please request a custom modification through Sales.] Refer to Figure 3 for a typical sequence.

3. BROWN OUT PROTECTION

If V_{DD} drops below 2.7 V, the RESET circuit is triggered immediately (on the order of 100 μsec), reducing current through the laser diode to attenuated levels ($\sim 10 \mu\text{A}$).

4. V_S & V_{DD}

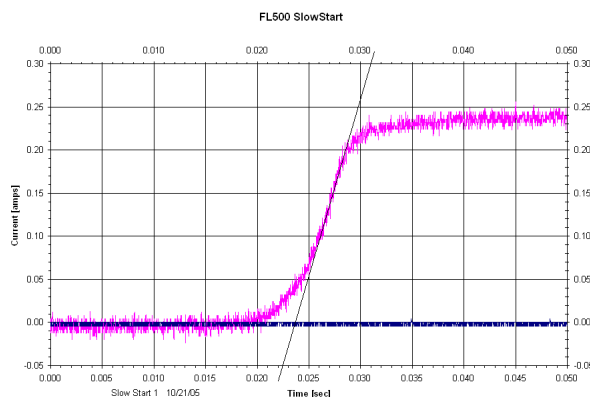
V_{DD} powers the control electronics. V_S powers the laser diode current source.

- To power the laser diode from V_{DD} , connect V_{DD} where V_S is shown. For lower noise operation, separate V_{DD} from V_S .
- V_S can be up to 20 V. At this level, however, too much power can be dissipated in the FL500 causing permanent damage. Calculate the power dissipated in the FL500 using the Safe Operating Area (SOA) Calculator online prior to using a V_S more than 2 V greater than the voltage dropped over the laser diode.

A maximum power dissipation of 1 W per source (2 W for paralleled operation) must not be exceeded.

- The minimum V_S is determined by the voltage drop across the laser diode and half the setpoint voltage. $V_{S\text{MIN}} = V_{LD} + V_{SET}/2 + 25 \text{ mV}$ (across FET). Ground this power supply at pins 9 and 10 (PGND). **Using pin 2 could damage the FL500.**

Figure 3
Typical Delayed / Slow Start



Example $V_{S\text{MIN}}$:

$$\begin{aligned}
 V_{LD} &= 1.2 \text{ V} \\
 V_{SET} &= 1.5 \text{ V} \\
 V_{S\text{MIN}} &= 1.2\text{V} + (1.5 / 2) + 0.025 = 1.975 \text{ V}
 \end{aligned}$$

OPERATION

5. OPERATION AS TWO INDEPENDENT DRIVERS

The FL500 contains circuitry for two 250 mA drivers. VS1 does not need to be tied to VS2. The transfer function for VSET is 0.125 A / V, the RESET minimum current is 10 μ A, and leakage current is less than 1 mA. The FL500 has a known leakage current when disabled equal to the following magnitude:

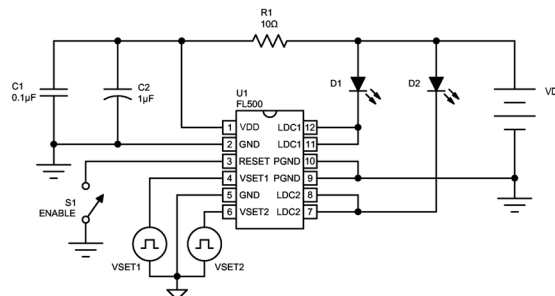
$$I_{\text{OUT(LEAK)}} = \frac{V_{\text{IN}}}{20 \text{ k}\Omega}$$

This is well below 1 mA, and usual leakage expected is 100 μ A.

See Figure 4 for typical operating schematic.

Figure 4

Operation as two independent drivers using single supply voltage ($V_S = V_{DD}$).



6. OPERATION IN PARALLEL AS ONE DRIVER.

The FL500 contains circuitry for two 250 mA drivers. They can be run in parallel to deliver 500 mA to one laser diode. Tie LDC1 & LDC2 together. VSET1 and VSET2 can be tied together or one can be used to set a DC bias while the other is used for an additive modulation signal. Only one VS can be used. The transfer function for tied VSETs is 0.25 A / V.

The transfer function for independent VSETs is 0.125 A / V. The RESET minimum current is 20 μ A, and leakage current is 2 mA. Note that if VSETs are tied together, input impedance becomes two 2 k Ω in parallel or 1 k Ω . The FL500 has a known leakage current when disabled equal to the following magnitude:

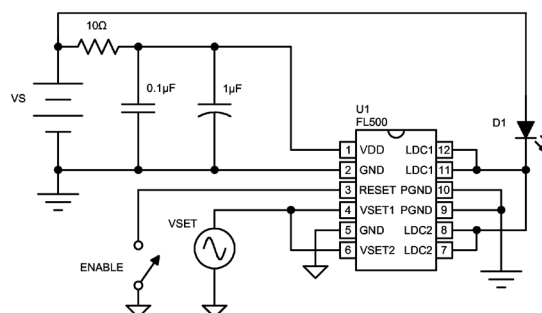
$$I_{\text{OUT(LEAK)}} = \frac{V_{\text{IN}}}{20 \text{ k}\Omega}$$

This is well below 1 mA, and usual leakage expected is 100 μ A.

See Figure 5 for typical operating schematic.

Figure 5

Operation in parallel as one driver.



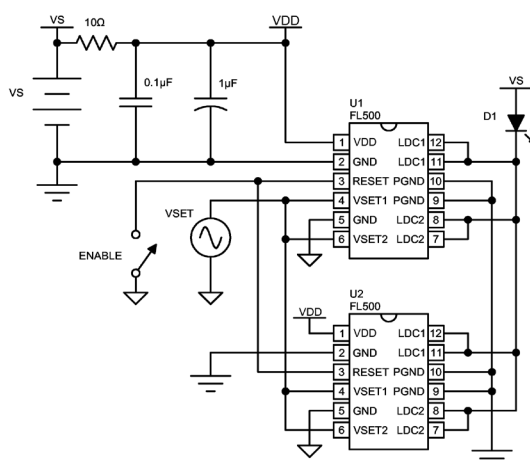
OPERATION

7. MULTIPLE FL500s IN PARALLEL

Multiple FL500s can be used in parallel for 1 A, 1.5 A, etc. operation: Note input impedance on VSET drops. For two FL500s configured for 500 mA each and used in parallel, the input impedance drops to 500 Ω . See Figure 6 for typical operating schematic.

Figure 6

Multiple units in parallel



Caution:

Do not exceed the Safe Operating Area (SOA). Exceeding the SOA voids the warranty.

To determine if the operating parameters fall within the SOA of the device, the maximum voltage drop across the driver and the maximum current must be plotted on the SOA curves.

These values are used for the example SOA determination:

$V_S = 5$ volts

$V_{Load} = 2.5$ volts

$I_{Load} = 100$ mA

} These values are determined from the specifications of the laser diode.

Follow these steps:

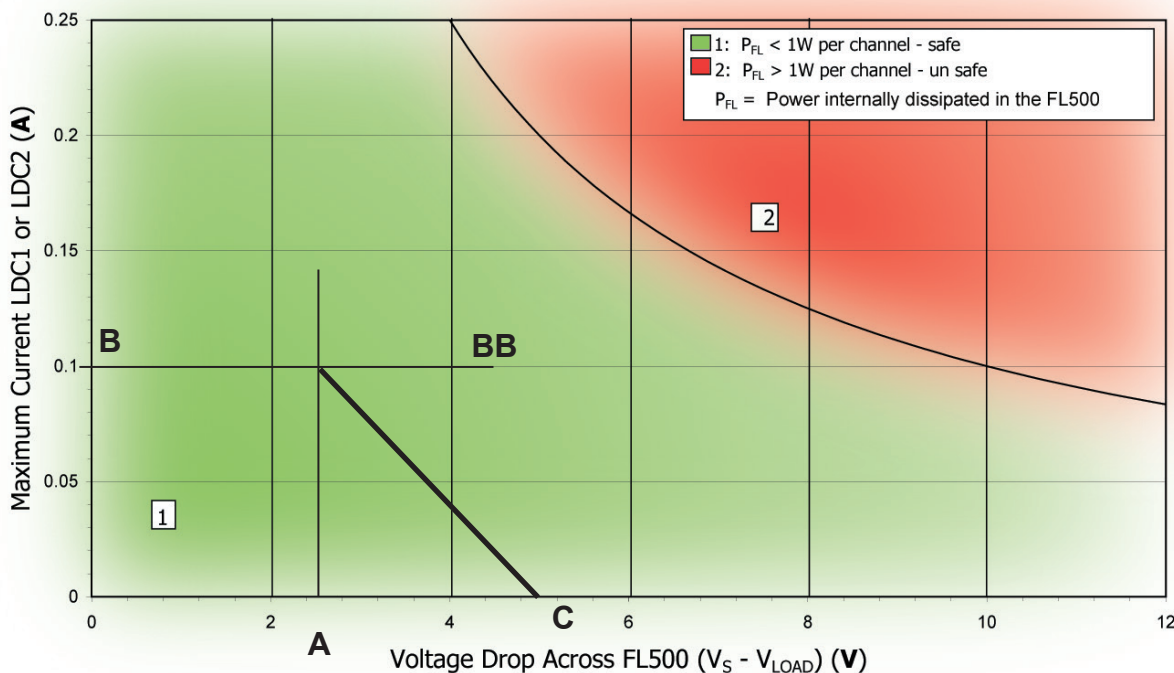
1. Determine the maximum voltage drop across the driver, $V_S - V_{Load}$, and mark on the X axis.
Example: 5 volts - 2.5 volts = 2.5 volts, Point A)
2. Determine the maximum current, I_{Load} , through the driver and mark on the Y axis:
(100 mA, Point B)
3. Draw a horizontal line through Point B across the chart. (Line BB)
4. Draw a vertical line from Point A to the maximum current line indicated by Line BB.
5. Mark V_S on the X axis. (Point C)
6. Draw the Load Line from where the vertical line from point A intersects Line BB down to Point C.

Refer to the chart shown below and note that the Load Line is in the Safe Operating Area. Note the first chart is for the independent channels. The second, on the following page, is for dual channels configured as a single 500 mA driver.

An online tool for calculating your load line is at <http://www.teamwavelength.com/support/calculator/soa/soald.php>.

FL500 Safe Operating Area
Independent Channels 1 W, 250 mA max

Graphs assume:
25°C Ambient
35°C Case



Caution:

Do not exceed the Safe Operating Area (SOA). Exceeding the SOA voids the warranty.

To determine if the operating parameters fall within the SOA of the device, the maximum voltage drop across the driver and the maximum current must be plotted on the SOA curves.

These values are used for the example SOA determination:

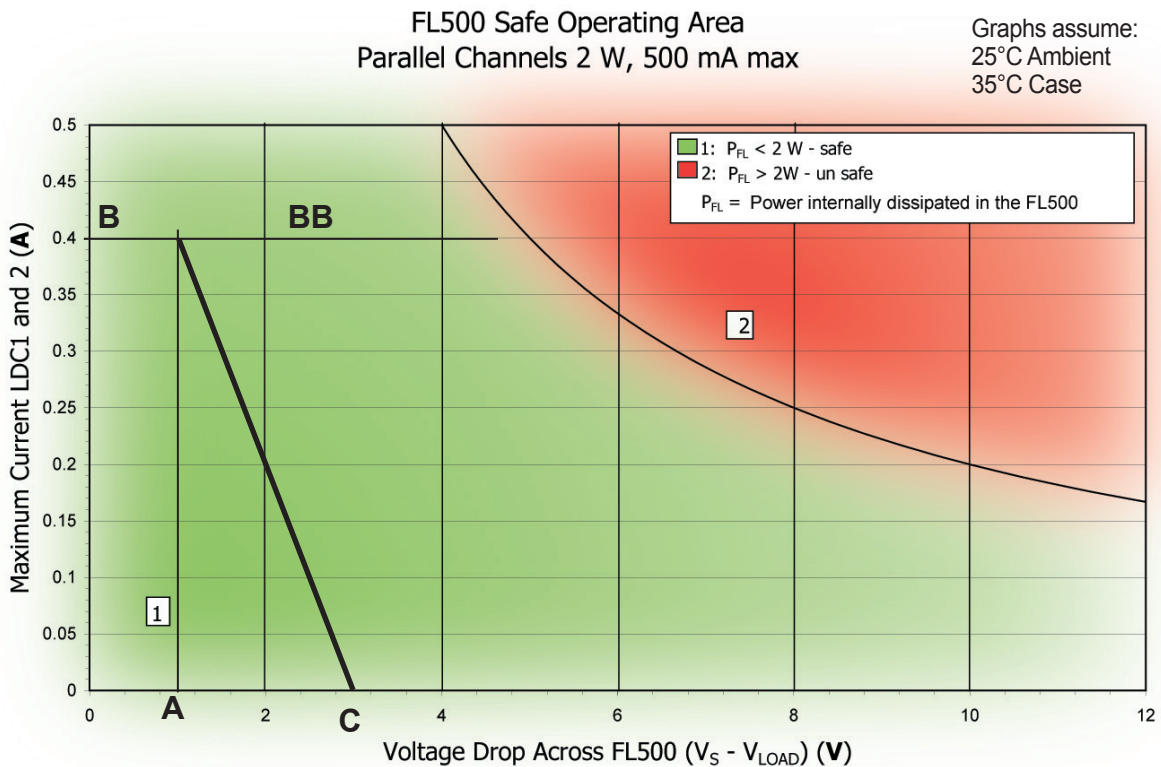
$$\left. \begin{matrix} V_S = 3 \text{ volts} \\ V_{Load} = 2 \text{ volts} \\ I_{Load} = 400 \text{ mA} \end{matrix} \right\} \text{These values are determined from the specifications of the laser diode.}$$

Follow these steps:

1. Determine the maximum voltage drop across the driver, $V_S - V_{Load}$, and mark on the X axis.
Example: 3 volts - 2 volts = 1 volts, Point A)
2. Determine the maximum current, I_{Load} , through the driver and mark on the Y axis:
(400 mA, Point B)
3. Draw a horizontal line through Point B across the chart. (Line BB)
4. Draw a vertical line from Point A to the maximum current line indicated by Line BB.
5. Mark V_S on the X axis. (Point C)
6. Draw the Load Line from where the vertical line from point A intersects Line BB down to Point C.

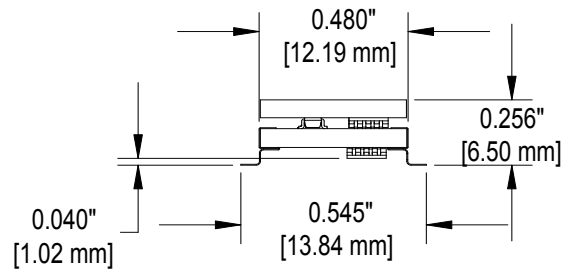
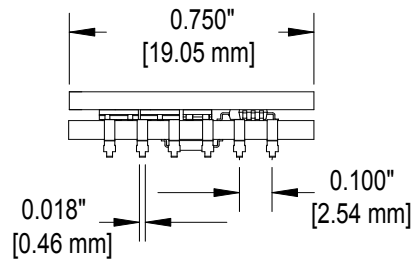
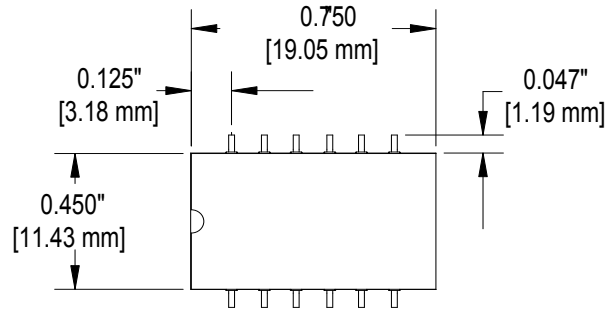
Refer to the chart shown below and note that the Load Line is in the Safe Operating Area. Note this chart is for dual channels configured as a single 500 mA driver. The first, on the previous page, is for independent channels configured for 250 mA max.

An online tool for calculating your load line is at <http://www.teamwavelength.com/support/calculator/soa/soald.php>.

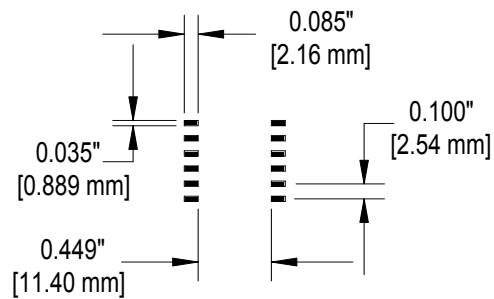


MECHANICAL SPECIFICATIONS

FL500 is reflow process compatible.



PCB FOOTPRINT



All dimension tolerances are $\pm 5\%$.

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 one (1) year 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:

The warranty shall not apply to defects resulting from improper use or misuse of the product or operation outside published specifications.

No other warranty is expressed or implied. Wavelength specifically disclaims the implied warranties of merchantability and fitness for a particular purpose.

EXCLUSIVE REMEDIES:

The remedies provided herein are the Buyer's sole and exclusive remedies. Wavelength shall not be liable for any direct, indirect, special, incidental, or consequential damages, whether based on contract, tort, or any other legal theory.

REVERSE ENGINEERING PROHIBITED:

Buyer, End-User, or Third-Party Reseller are expressly prohibited from reverse engineering, decompiling, or disassembling this product.

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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.

LIFE SUPPORT POLICY:

As a general policy, Wavelength Electronics, Inc. does not recommend the use of any of its products in life support applications where the failure or malfunction of the Wavelength product can be reasonably expected to cause failure of the life support device or to significantly affect its safety or effectiveness. Wavelength will not knowingly sell its products for use in such applications unless it receives written assurances satisfactory to Wavelength that the risks of injury or damage have been minimized, the customer assumes all such risks, and there is no product liability for Wavelength. Examples of devices considered to be life support devices are neonatal oxygen analyzers, nerve stimulators (for any use), auto transfusion devices, blood pumps, defibrillators, arrhythmia detectors and alarms, pacemakers, hemodialysis systems, peritoneal dialysis systems, ventilators of all types, and infusion pumps as well as other devices designated as "critical" by the FDA. The above are representative examples only and are not intended to be conclusive or exclusive of any other life support device.

REVISION HISTORY		
REVISION	DATE	NOTES
REV. F	24-Feb-09	Updated to include FL500 Reflow Oven compatibility
REV. G	25-Sep-09	Updated to reflect RoHS Status
REV. H	6-June-13	Updated Noise & Ripple specification
REV. I	26-Mar-14	Clarified reflow compatibility
REV. J	15-Dec-14	Updated to fully reflow compatible
REV. K	Nov. 2015	Updated leakage current spec