



FL500

500 mA laser diode driver or
two 250 mA drivers
in a small SMT package

GENERAL DESCRIPTION:

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

FEATURES:

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



(TOP VIEW)

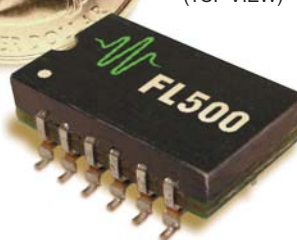
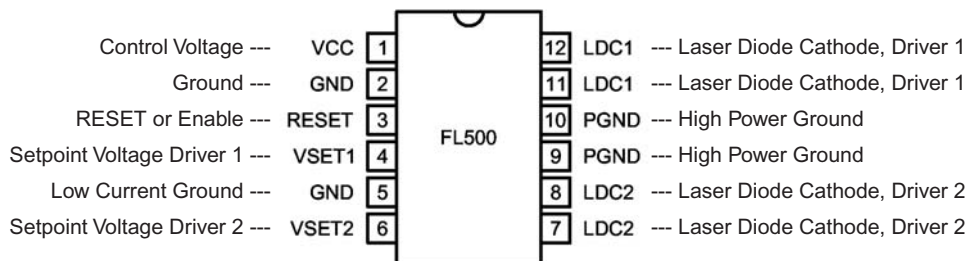


Figure 1

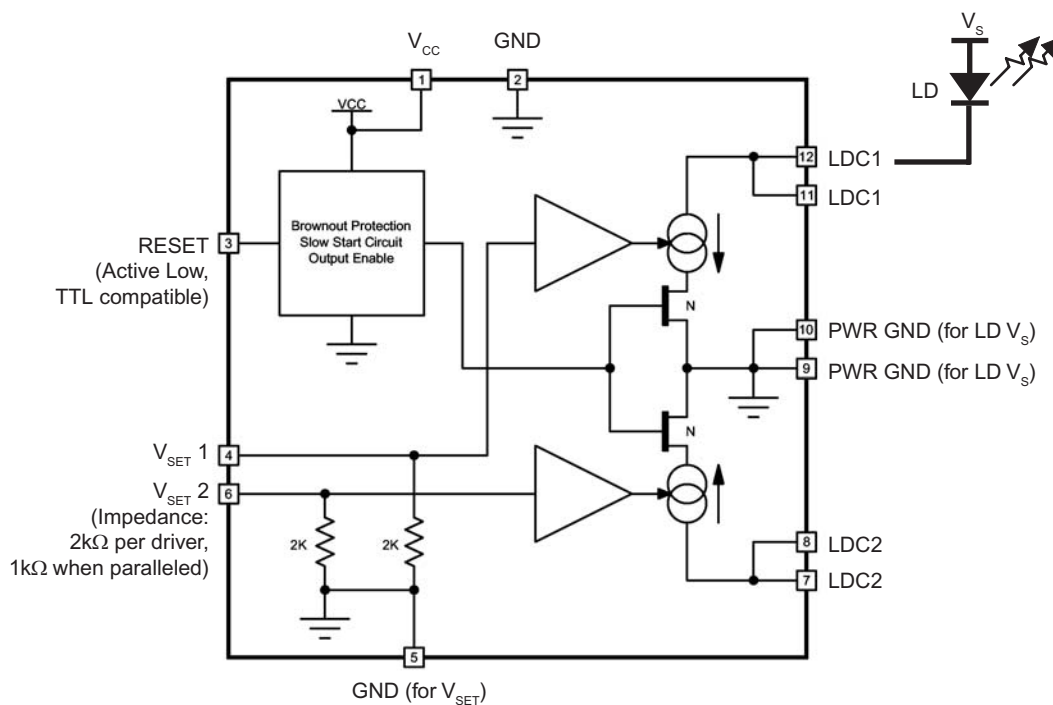
Top View Pin Layout
and Descriptions

TOP VIEW *

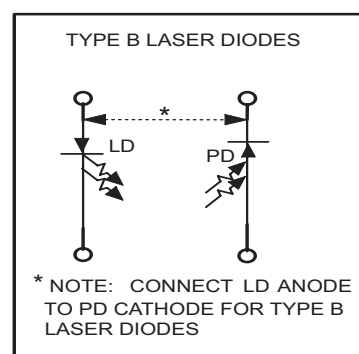
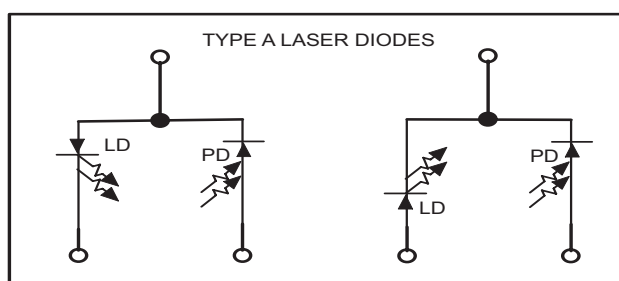


* See complete pin descriptions, Page 4

BLOCK DIAGRAM



SUPPORTS A & B LASER DIODE PACKAGE STYLES



ELECTRICAL AND OPERATING SPECIFICATIONS

ABSOLUTE MAXIMUM RATINGS						
RATING	SYMBOL	VALUE	UNIT			
Supply Voltage (Voltage on Pin 1)	V _{CC}	+3 to +12 **	Volts DC			
Output Current (See SOA Chart)	I _{LD}	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	.08	oz			
PARAMETER	TEST CONDITIONS		MIN	TYP	MAX	UNITS
CONSTANT CURRENT CONTROL						
Short Term Stability, 1 hour	T _{AMBIENT} = 25°C			200	250	ppm
Long Term Stability, 24 hours	T _{AMBIENT} = 25°C			50	75	ppm
CONSTANT POWER CONTROL						
Short Term Stability, 1 hour [3]				.019		%
Long Term Stability, 24 hours [3]				.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 _{LD} = 500 mA		V _{CC} - (0.5 x Vset)			Volts
Rise Time	I _{LD} = 500 mA			300		nsec
Fall Time	I _{LD} = 500 mA			300		nsec
Bandwidth	Constant Current, Sine Wave			2.0		MHz
Bandwidth	Constant Current, Square Wave			100		kHz
Bandwidth (with external circuitry)	Constant Power (Depends on PD BW)					
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 _{LD}	Configured as two 250 mA drivers			0.125		A / V
Transfer Function - V _{SET} to I _{LD}	Configured as one 500 mA driver			0.25		A / V
POWER SUPPLY						
Voltage, V _{CC}			3		12**	Volts
Current, V _{CC} 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} = 0V			2		mV
Bias Current (based on input Res of op amp)	Pin 2, T _{AMBIENT} = 25°C, V _{CM} = 0V			10	15	nA
Common Mode Range	Pin 2, Full Temp. Range		0		V _{CC}	V
Common Mode Rejection, Set point	Full Temperature Range		-16	64		dB
Power Supply Rejection	Full Temperature Range		60	TBD		dB
THERMAL						
Heatspreader Temperature Rise	T _{AMBIENT} = 25°C			43		°C/W
Pin Solderability	Solder temp @260°C			10		Sec
NOISE						
Noise & Ripple	I _{LD} = 100uA			13		Rms
Leakage Current	Vset = 0, Reset = 0				1	mA
	Vset = 0, Reset = 1				0.2	mA
	Vset = 2, Reset = 1				0.3	mA

PIN DESCRIPTIONS

Pin	Pin #	Name	Function
VCC	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 _{CC} 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 500mA)
VSET1	4	Setpoint for LDC1 control	2k 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 2V.
GND	5	Ground for setpoint inputs	Low Current, Low Noise ground for use with VSET1 & VSET2.
VSET2	6	Setpoint for LDC2 control	2k 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 2V.
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 500mA. Tie to pin 8 (also LDC2) if laser diode current exceeds 125mA. 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 500mA. Tie to pin 12 (also LDC1) if laser diode current exceeds 125mA. 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.

**FL591 evaluation board limits the input voltage to 9V.

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:

$$V_S = 5 \text{ volts}$$

$$V_{\text{Load}} = 2.5 \text{ volts}$$

$$I_{\text{Load}} = 100 \text{ mA}$$

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

Follow these steps:

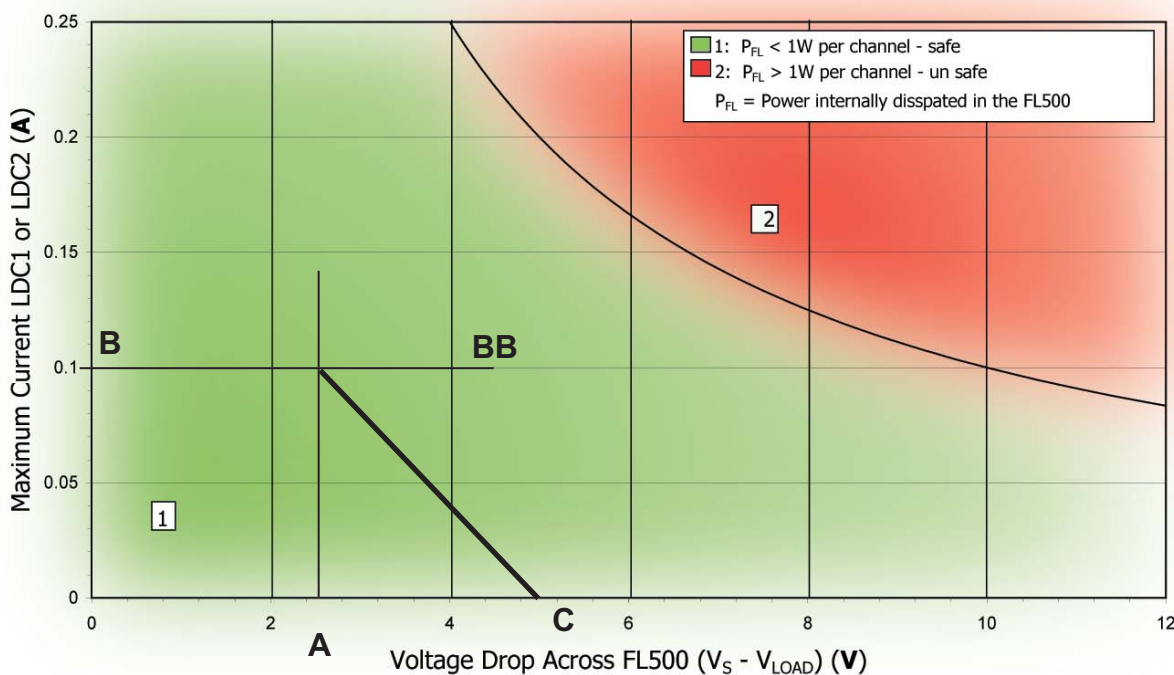
1. Determine the maximum voltage drop across the driver, $V_S - V_{\text{Load}}$, and mark on the X axis.
Example: 5 volts - 2.5 volts = 2.5 volts, Point A)
2. Determine the maximum current, I_{Load} , through the driver and mark on the Y axis:
(100 mA, Point B)
3. Draw a horizontal line through Point 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/tools/calculator/soa/defaultld.htm>.

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:

$$V_S = 3 \text{ volts}$$

$$V_{\text{Load}} = 2 \text{ volts}$$

$$I_{\text{Load}} = 400 \text{ mA}$$

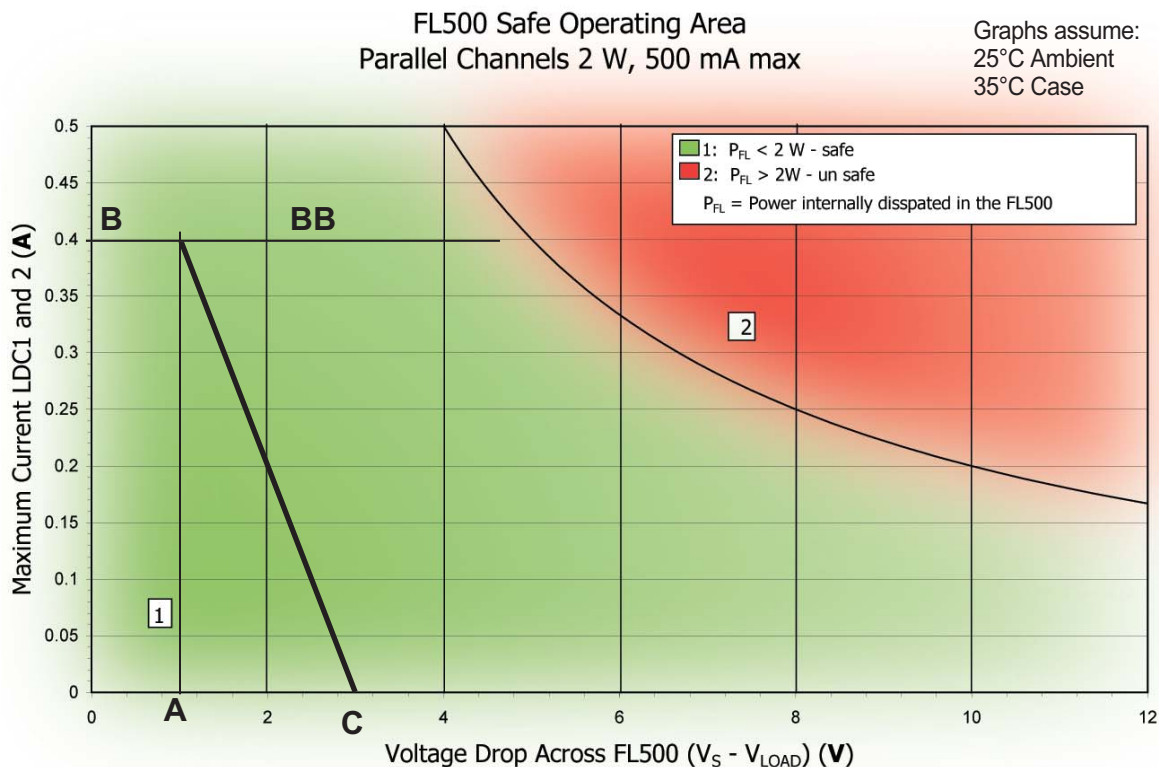
} These values are determined from the specifications of the laser diode.

Follow these steps:

1. Determine the maximum voltage drop across the driver, $V_S - V_{\text{Load}}$, 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/tools/calculator/soa/defaultld.htm>.



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 assures 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 2 for a typical sequence.

3. BROWN OUT PROTECTION

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

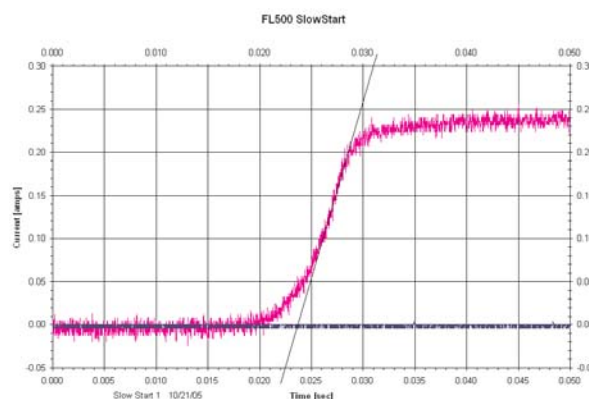
4. V_s & V_{cc}

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

- To power the laser diode from V_{CC} , connect V_{CC} where V_S is shown. For lower noise operation, separate V_{CC} from V_S .
- V_S can be up to 20V. 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) Calculators online prior to using a V_S more than 2V greater than the voltage dropped over the laser diode. A maximum power dissipation of 1W per source (2W 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. $V_{SMIN} = V_{LD} + V_{SET}/2 + 25\text{mV}$ (across FET). Ground this power supply at pins 9, and 10 (PGND). Using pin 2 could damage the FL500.

Figure 2

Typical Delayed / Slow Start



Example V_{SMIN} :

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

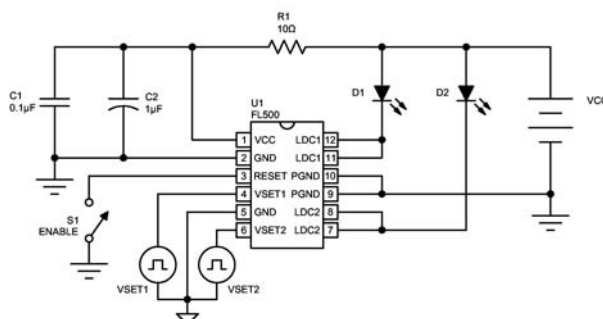
OPERATION

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. See Figure 3 for typical operating schematic.

Figure 3

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

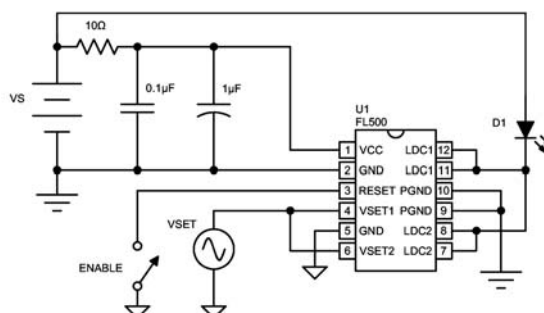


6. OPERATION IN PARALLEL AS ONE DRIVER.

The FL500 contains circuitry for two 250mA 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 VSET'S 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 . Refer to Figure 4 for typical operating schematic.

Figure 4

Operation in parallel as one driver.



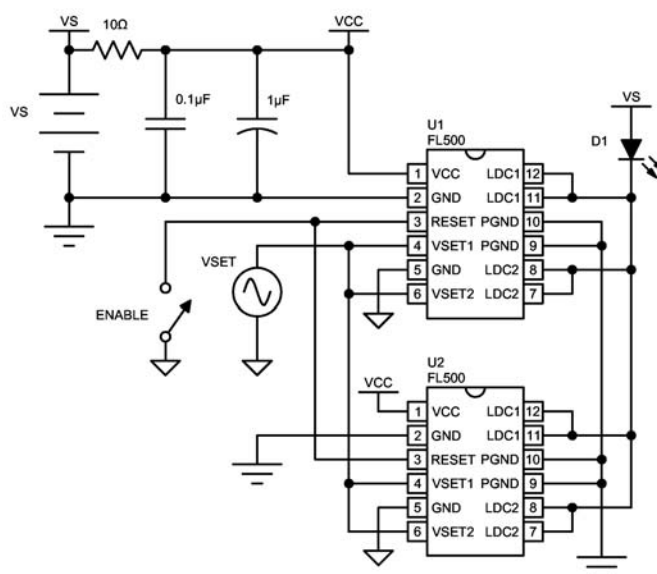
OPERATION

7. MULTIPLE FL500s IN PARALLEL

Multiple FL500s can be used in parallel for 1A, 1.5A, 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 5 for typical operating schematic.

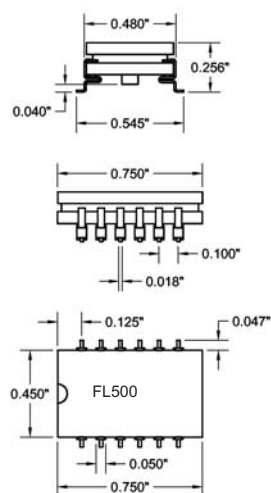
Figure 5

Multiple units in parallel



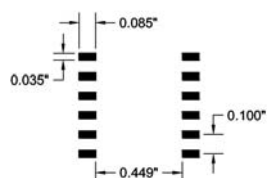
MECHANICAL SPECIFICATIONS

Mechanical Details



PCB FOOTPRINT

Recommended Footprint



The FL500 is not presently qualified as SMT reflow compatible.

The FL500 is not presently RoHS compliant.

CERTIFICATION AND WARRANTY

CERTIFICATION:

Wavelength Electronics (WEI) certifies that this product met its published specifications at the time of shipment. Wavelength further certifies that its calibration measurements are traceable to the United States National Institute of Standard 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. 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. 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 instrument 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.

NOTICE:

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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 assure that safety features are maintained.

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