WAVELENGTH ELECTRONICS

LDTC0520 / LDTC1020

Combine the low noise drive current of the FL500 with the temperature stability of the WTC3243

GENERAL DESCRIPTION:

The LDTC0520 combines the FL500 500 mA, low noise laser driver and the WTC 3243 2.2 Amp temperature controller on one small board. The LDTC1020 parallels two 500 mA laser drivers to provide up to 1 Amp of laser current with the 2.2 Amp temperature controller.

The WTC3243 will control temperature using thermistors, RTDs, or linear temperature sensors such as the LM335 or the AD590. Adjust temperature using the onboard trim pot or a remote voltage input from a panel mount potentiometer, DAC, or other voltage source. A default temperature set point configuration provides fault tolerance and avoids accidental damage to system components. Adjustable trim pots configure heat and cool current limits.

The heart of the laser driver section is the FL500 500 mA Laser Driver. It maintains precision laser diode current (Constant Current mode) or stable photodiode current (Constant Power mode) using electronics compatible with Common Photodiode Cathode (Type A/B) lasers.

FEATURES, LDTC:

- Small package size
- Single supply operation possible
- Cost Effective

FEATURES, Laser Diode Driver:

- Default current range is 500 mA or 1 Amp.
- Low Noise operation
- Slow start laser diode protection
- Constant Current or Constant Power modes
- Compatible with Common Photodiode Cathode (A or B type) laser diodes
- Adjustable laser diode current limit
- Brownout protection

FEATURES, Temperature Controller:

- Drive up to 2.2 Amps of TEC current
- Internal or External set point control
- Fail safe set point default
- Ultra-stable PI control loop
- Separate Heat & Cool current limits
- Single power supply operation possible

Figure 1
Top View Pin Layout
(Pin Descriptions on Page 7)

TOP VIEW
(Actual Size)

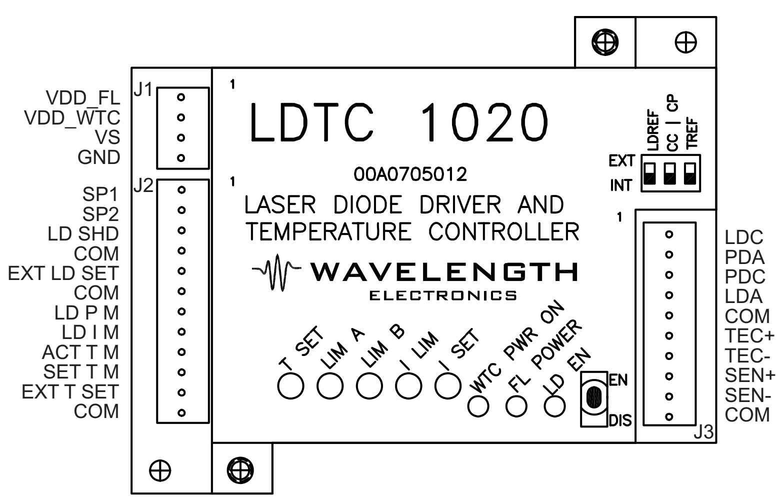


Figure 2
Schematic for FL500 connections

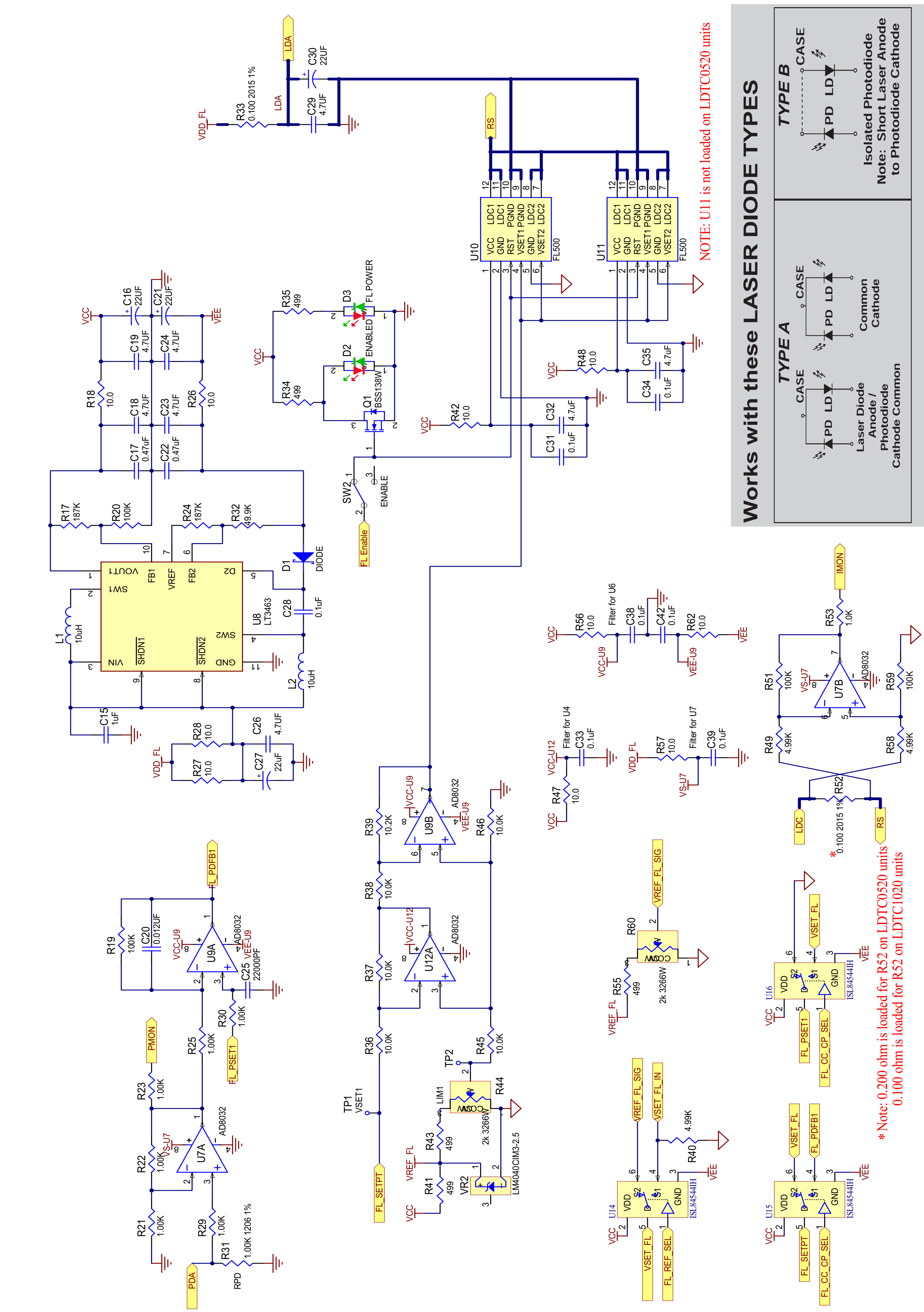
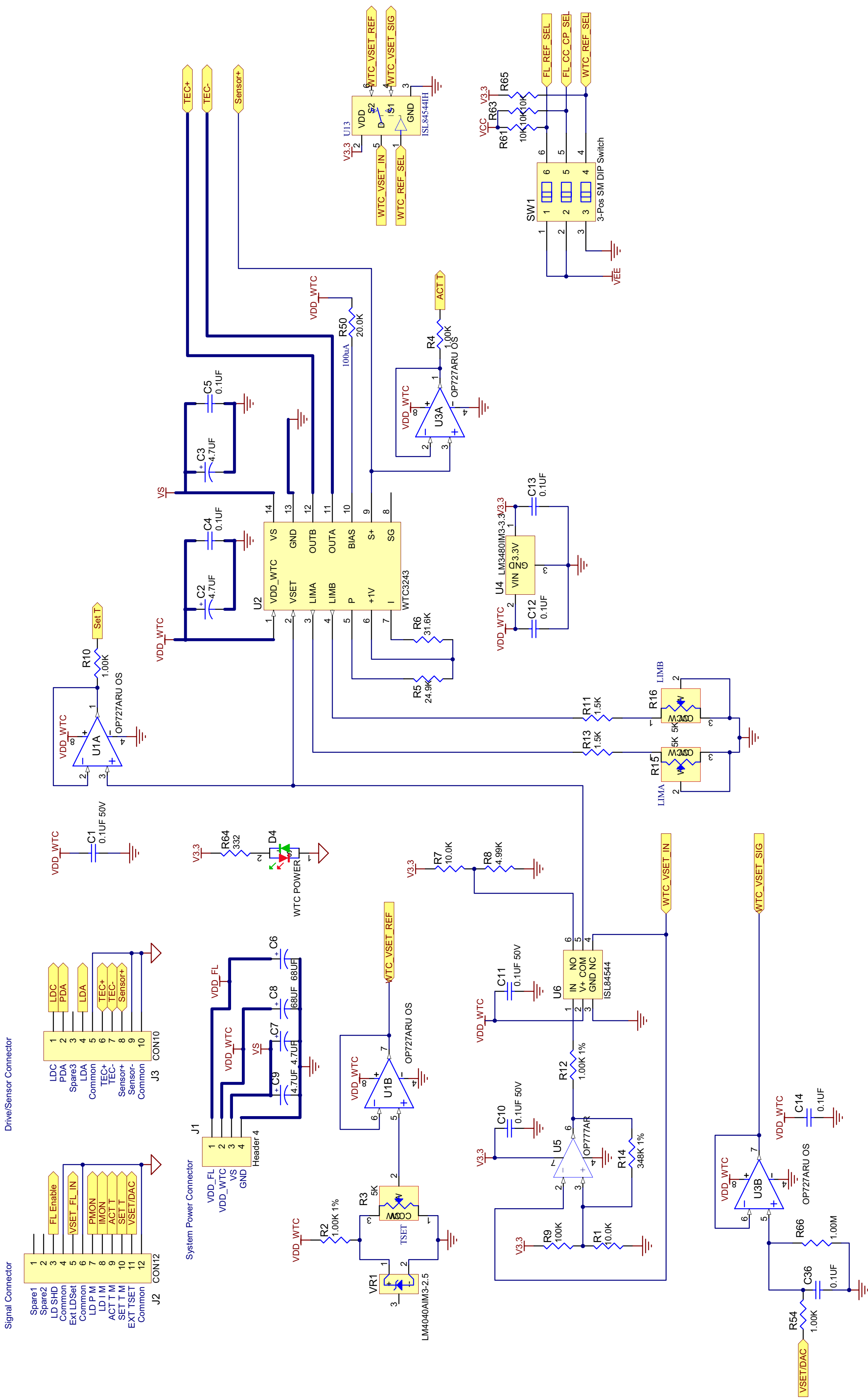


Figure 3
Schematic for WTC3243 connections



ELECTRICAL AND OPERATING SPECIFICATIONS

ABSOLUTE MAXIMUM RATINGS	SYMBOL	VALUE	UNIT
Operating Temperature, case	T_{OPR}	- 40 to + 85	˚C
Storage Temperature	T_{STG}	- 55 to +125	˚C
Weight	LDTC0520	3.04	oz
Weight	LDTC1020	3.13	oz
FL500 Laser Diode Driver Rating			
Supply Voltage (Voltage on Pin 1)	V_{DD-FL}	+3 to +12	Volts DC
Output Current (See SOA Chart), LDTC0520 (Single FL500)	I_{LD}	500	mA
LDTC1020 (Dual FL500s)	I_{LD}	1000	mA
Power Dissipation, $T_{AMBIENT}$ = +25˚C, LDTC0520 (1)	P_{MAX}	2	Watts
LDTC1020	P_{MAX}	4	Watts
WTC3243 Temperature Controller Rating			
Supply Voltage 1 (Voltage on Pin 1)	V_{DD-WTC}	+4.5 to +12	Volts DC
Supply Voltage 2 (Voltage on Pin 14)	V_S	+4.5 to +30	Volts DC
Output Current (See SOA Chart)	I_{OUT}	±2.2	Amps
Power Dissipation, $T_{AMBIENT}$ = +25˚C (See SOA Chart) (with fan and heat sink)	P_{MAX}	9	Watts

(1) Derate above 25°C by 34 mW/°C. For the LDTC1020 with dual FL500 chips, derating should be applied to both chips for a total of 68 mW/°C

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	$T_{AMBIENT}$ = 25˚C		0.019		%
Long Term Stability, 24 hours	$T_{AMBIENT}$ = 25˚C		0.011		%
OUTPUT					
Current, peak, see SOA chart	Single FL500 driver	495	500	505	mA
Compliance Voltage, Laser Diode Load	Full Temp Range, I_{LD}= 500 mA	V_{DD-FL} - (.5 x V_{Set})			Volts
Rise Time	I_{LD}= 500 mA		300		nsec
Fall Time	I_{LD}= 500 mA		300		nsec
Bandwidth	Constant Current, Sine Wave		500		kHz
Bandwidth	Constant Power	Depends on PD BW			Volts
Delayed Start		100			msec
Slow Start Ramp Rate			15		mA/msec
Depth of Modulation	100kHz sine wave		99%		
Transfer Function	LDTC0520		250		mA/V
	LDTC1020		500		mA/V
POWER SUPPLY					
Voltage, V_{DD-FL}		3		12	Volts
Current, V_{DD} supply, quiescent	LDTC0520	2.2	2.7	4.6	mA
	LDTC1020	4.4	5.4	9.2	mA
V_{DD-FL} (Voltage at LD Anode)		V_{DD-FL}		20	V
INPUT					
Input Impedence			2		kΩ
Offset Voltage, initial, I_{mon}	$T_{AMBIENT}$ = 25˚C, V_{CM} = 0V		10	15	mV
Bias Current (based on input Res of op amp)	$T_{AMBIENT}$ = 25˚C, V_{CM} = 0V		450	2000	nA
Common Mode Range	Full Temp. Range	0		V_{DD-FL}	V
Common Mode Rejection, Set point	Full Temperature Range	46	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 and Ripple (RMS)	I_{LD}= 100 mA		13		uA
Leakage Current	Vset = 0, Reset = 0			1	mA
	Vset = 0, Reset = 1			0.2	mA
	Vset = 2, Reset = 1			0.3	mA

ELECTRICAL AND OPERATING SPECIFICATIONS, continued
Temperature Controller

PARAMETER	TEST CONDITIONS	MIN	TYP	MAX	UNITS
TEMPERATURE CONTROL					
Short Term Stability, 1 hour	TSET = 25˚C using 10 kΩ thermistor	0.001	0.005	0.010	˚C
Long Term Stability, 24 hour	TSET = 25˚C using 10 kΩ thermistor	0.003	0.008	0.010	˚C
Control Loop		P		PI	
P (Proportional Gain)		18	20	22	A/V
I (Integrator Time Constant)		2	3	4.5	Sec.
Setpoint vs. Actual T Accuracy	TSET = 25˚C using 10 kΩ thermistor	0.1	2	4	mV
OUTPUT					
Current, peak, see SOA Chart		±1.8	±2.0	± 2.2	Amps
Compliance Voltage, TEC	Full Temp. Range, I_{OUT} = 100 mA	$\vert V_S - 0.7 \vert$	$\vert V_S - 0.5 \vert$		Volts
Compliance Voltage, TEC	Full Temp. Range, I_{OUT} = 1 Amp	$\vert V_S - 1.2 \vert$	$\vert V_S - 1.0 \vert$		Volts
Compliance Voltage, TEC	Full Temp. Range, I_{OUT} = 1.5 Amps	$\vert V_S - 1.6 \vert$	$\vert V_S - 1.4 \vert$		Volts
Compliance Voltage, TEC	Full Temp. Range, I_{OUT} = 2.0 Amps	$\vert V_S - 1.8 \vert$	$\vert V_S - 1.6 \vert$		Volts
Compliance Voltage, Resistive Heater	Full Temp. Range, I_{OUT} = 2.0 Amps	$\vert V_S - 1.7 \vert$	$\vert V_S - 1.6 \vert$		Volts
POWER SUPPLY					
Voltage, V_{DD-FL}		4.5		12	Volts
Current, V_{DD} supply, quiescent			55	105	mA
Voltage, V_{S-WTC}		4.5		28	Volts
Current, Vs supply, quiescent		20	50	100	mA
INPUT					
Offset Voltage, initial	Pins 2 and 9 of U2		1	2	mV
Bias Current	Pins 2 and 9, of U2 $T_{AMBIENT}$ = 25˚C		20	50	nA
Offset Current	Pins 2 and 9 of U2, $T_{AMBIENT}$ = 25˚C		2	10	nA
Common Mode Range (2)	Pins 2 and 9 of U2, Full Temp. Range	0	$V_{DD-WTC-2}$		V
Common Mode Rejection	Full Temperature Range	60	85		dB
Power Supply Rejection	Full Temperature Range	60	80		dB
Input Impedance			500		kΩ
Input voltage range (2)		GND	$V_{DD-WTC-2}$		Volts

(2) The bias source has a compliance up to VDD - 2.0 V. In normal operation this limits the sensor voltage range to 0.25V to VDD - 2.0V. While voltages up to +/- 5V outside this range on the Vset pin will not damage the unit, it will not provide proper control under these conditions.

NOTE: Operation higher than 5V on VDD (i.e. 12V) requires close evaluation of the SOA curves and current limit settings. Damage to the FL or WTC will occur if they are operated outside their Safe Operating Area (SOA). Contact the factory if you plan to use higher than 5V. See our online SOA calculator for the WTC and FL at http://www.teamwavelength.com/tools/tools.asp.

PIN DESCRIPTIONS

Connector 1 (J1)

Pin	Pin #	Name	Function
VDD_FL	1	Supply Voltage to Laser Driver Control Electronics and Laser Diode	Connect +3 to +12 V between pins 1 & 4 to power the control electronics and the output drive to the Laser Diode. Use the online Safe Operating Area calculator to make sure maximum internal power dissipation in the FL is not exceeded.
VDD_WTC	2	Supply Voltage for Temperature Controller Electronics	Connect +5 to +28 V between pins 2 & 4 to power the control electronics of the WTC.
VS	3	Supply Voltage to Output TEC Drive	Connect +5 to +28 V between pins 3 & 4 to drive the TEC output stage. Use the online Safe Operating Area calculator to make sure maximum internal power dissipation in the WTC is not exceeded.
GND	4	Power Supply Ground	High Current Return / Ground

Connector 2 (J2)

Pin	Pin #	Name	Function
SP1	1	Spare 1	Spare connection for your use - test point, etc.
SP2	2	Spare 2	Spare connection for your use - test point, etc.
LD SHD	3	LD Shutdown / Interlock	GND = Enable Laser Diode Current Input >3 V = Disable Laser Diode Current
COM	4	Common	Low current GND for monitors, DACs, External VSET, etc.
EXT LDSET	5	Remote Laser Diode Setpoint	Voltage Input range is 0 to 2 V. The transfer function is given on page 19.
COM	6	Common	Low current GND for monitors, DACs, External VSET, etc.
LD P M	7	Photodiode Monitor	Monitor the laser diode power. The Photodiode Current Monitor indicates a voltage proportional to the current produced by the monitor photodiode. The transfer function is given on page 18.
LD I M	8	LD Current Monitor	Monitor the laser diode forward current. The Laser Diode Current Monitor indicates a voltage proportional to the current flowing through the laser diode. The transfer function is given on page 18.
ACT T M	9	Actual Temp Monitor	Monitor the actual voltage produced by the temperature sensor. The voltage produced and transfer function correlating to temperature are determined by the sensor being utilized.
SET T M	10	Setpoint Monitor	Monitor the temperature setpoint voltage. The voltage produced and transfer function correlating to temperature are determined by the sensor being utilized.
EXT T SET	11	Remote Temperature Setpoint	Connect a voltage source between Pin 11 (EXT T SET) and Pin 12 (GND) to control the temperature setting remotely. A default value of 1 V (about room temperature with 10 kΩ thermistor) will be seen by the WTC if the voltage at this pin drops below 0.3 V.
COM	12	Common	Low current GND for monitors, DACs, External VSET, etc.

Connector 3 (J3)

Pin	Pin #	Name	Function
LDC	1	Laser Diode Cathode	
PDA	2	Photodiode Anode	
PDC	3	Photodiode Cathode	
LDA	4	Laser Diode Anode	
COM	5	Common	
TEC+	6	TEC + connection	Cooling current flows from this pin when using an NTC sensor.
TEC-	7	TEC - connection	Heating current flows from this pin when using an NTC sensor.
SEN+	8	Temperature Sensor +	Temperature sensor + Voltage
SEN-	9	Temperature Sensor -	Temperature Sensor return path
COM	10	Common	Low current GND for monitors, DACs, External VSET, etc.

TYPICAL PERFORMANCE GRAPH FOR SINGLE FL500 (2 Watt, 500 mA)

Caution:

Do not exceed the Safe Operating Area (SOA) of the FL500. Exceeding the SOA voids the warranty.

To determine if the operating parameters fall within the SOA of the device, the load line for your configuration must be plotted on the SOA curves.

The values used for this example SOA determination are:

V_{DD-FL} = 3 Volts
V_{Load} = 2 Volts
I_{Load} = 400 mA

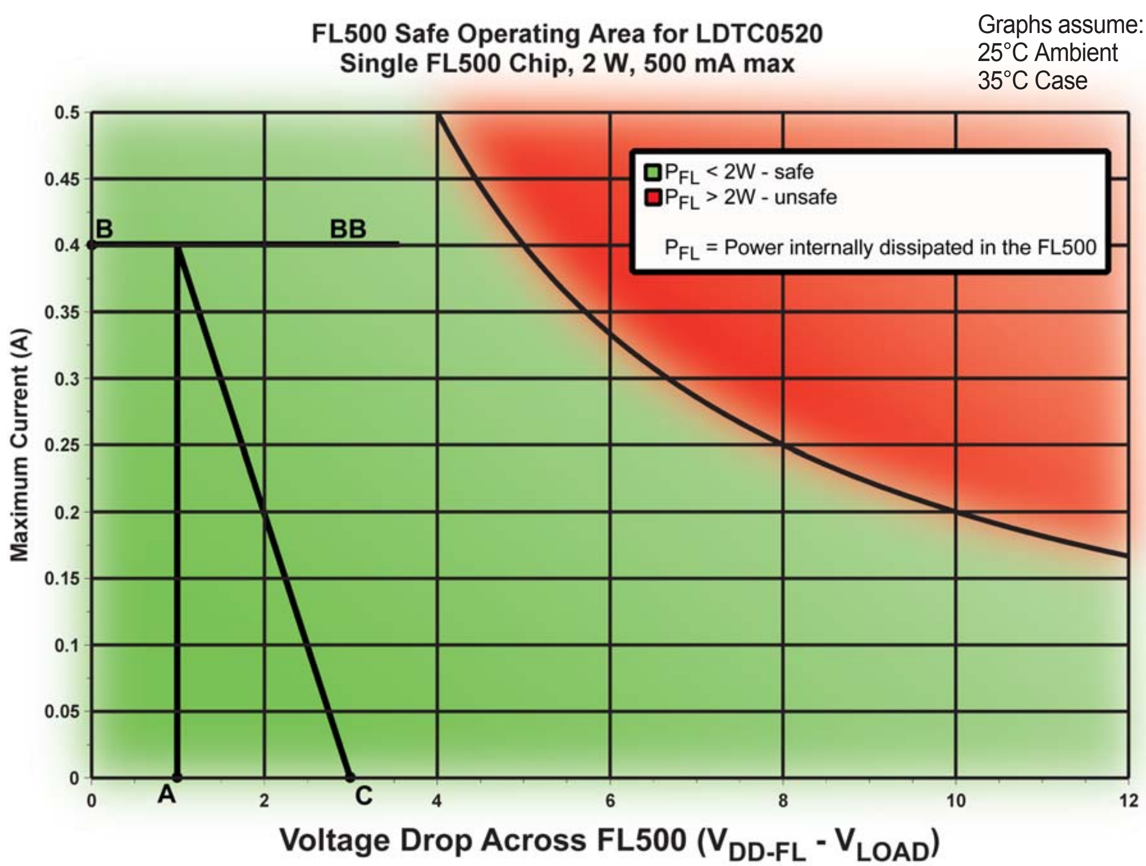
} These values are determined from the specifications of the laser diode.

Follow these steps:

1. Determine the maximum voltage drop across the driver, V_{DD-FL}-V_{Load}, and mark on the X axis.
   Example: 3 volts - 2 volts = 1 Volt, (Point A)
2. Determine the maximum current 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_{DD-FL} 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 that this chart is for the LDTC0520 which contains a single 500 mA driver. The following page contains the performance graph for two parallel FL500 chips as used in the LDTC1020.

An online tool for calculating your load line is at http://www.teamwavelength.com/tools/calculator/soa/defaultld.htm.



TYPICAL PERFORMANCE GRAPH FOR DUAL FL500 (4 Watt, 1A)

Caution:

Do not exceed the Safe Operating Area (SOA) of the FL500. Exceeding the SOA voids the warranty.

To determine if the operating parameters fall within the SOA of the device, the load line for your configuration must be plotted on the SOA curves.

The values used for this example SOA determination are:

V_{DD-FL} = 5 Volts
V_{Load} = 2 Volts
I_{Load} = 750 mA

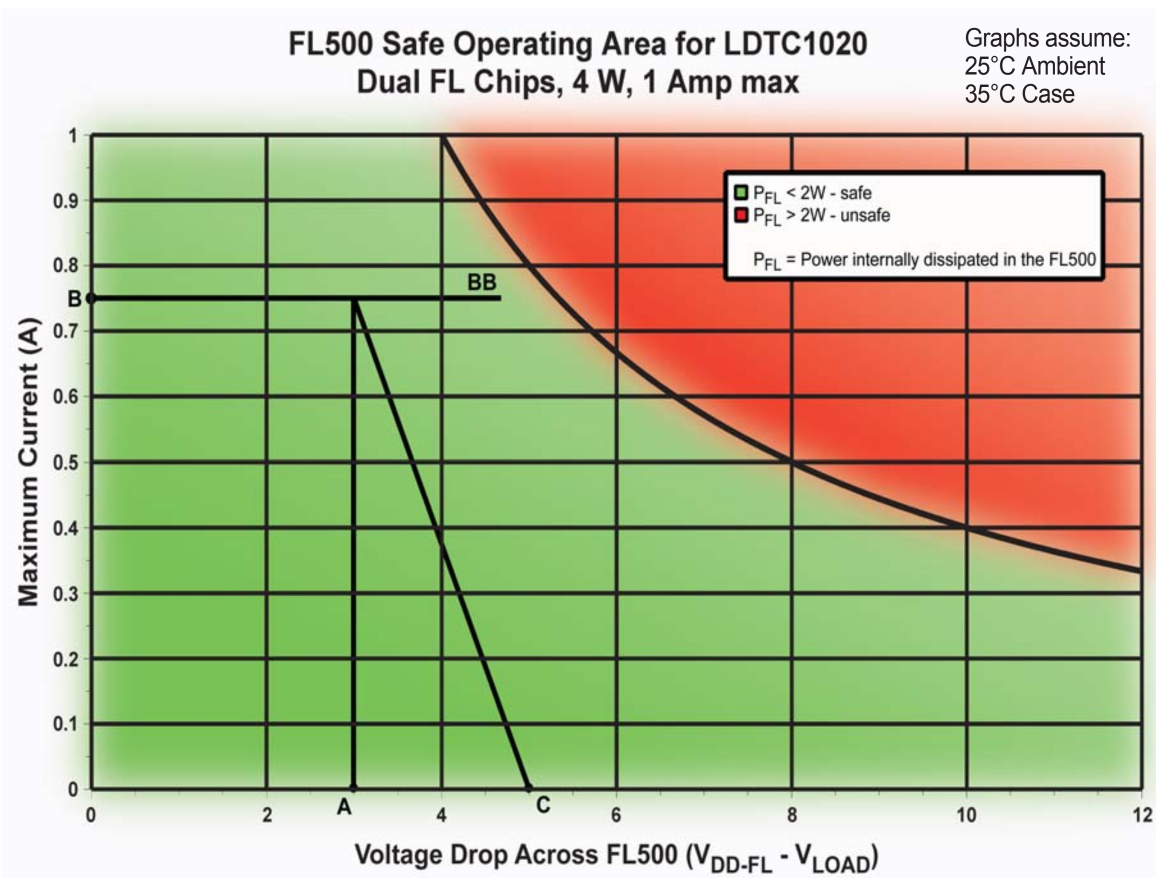
} These values are determined from the specifications of the laser diode.

Follow these steps:

1. Determine the maximum voltage drop across the driver, V_{DD-FL}-V_{Load}, and mark on the X axis. Example: 5 Volts - 2 Volts = 3 Volts, (Point A)
2. Determine the maximum current, I_{Load}, through the driver and mark on the Y axis: (750 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_{DD-FL} 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 the LDTC1020 which contains dual 500 mA drivers. The previous page contains the performance graph for a single FL500 chip as used in the LDTC0520

An online tool for calculating your load line is at http://www.teamwavelength.com/tools/calculator/soa/defaultld.htm.



TYPICAL PERFORMANCE GRAPHS - WTC

Caution:

Do not exceed the Maximum Internal Power Dissipation of the FL500 or WTC.
Safe Operating Area (SOA) tools are provided online to make your design easier. Exceeding the Maximum Internal Power Dissipation voids the warranty.

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

These values are used for the example SOA determination for a WTC:

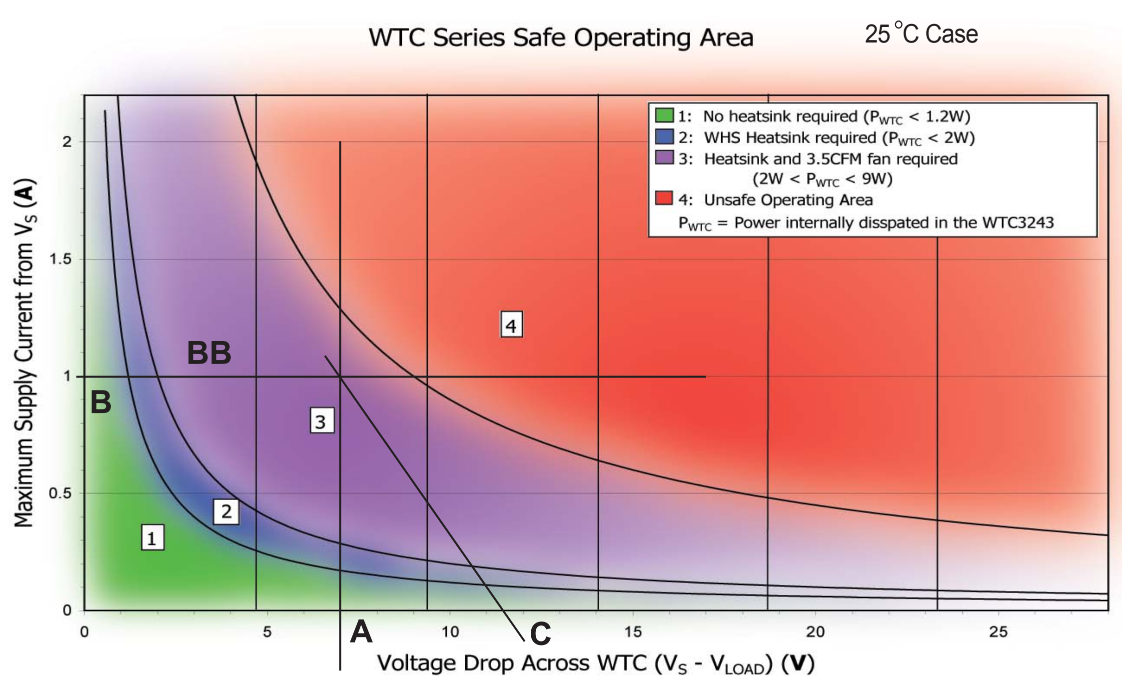
Vs= 12 Volts
Vload = 5 Volts
ILoad = 1 Amp

Follow these steps:

1. Determine the maximum voltage drop across the controller ,Vs-Vload, and mark on the X axis. (12 Volts - 5 Volts = 7 Volts, Point A)
2. Determine the maximum current through the controller and mark on the Y axis: (1 Amp, 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 Vs 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 outside the Safe Operating Areas for use with no heatsink (1) or the heatsink alone (2), but is within the Safe Operating Area for use with heatsink and fan (3).

An online tool for calculating your load line is at http://www.teamwavelength.com/tools/calculator/soa/defaulttc.htm.



Proper heat dissipation from the WTC is critical to longevity of the LDTC. The heat spreader of the WTC3243 is positioned to use your chassis for heat dissipation. Be sure to add thermally conductive paste to all relevant surfaces that need to dissipate heat.

WTC OPERATION

Recommended order of setup:
First complete the WTC temperature control section THEN configure the laser diode driver. Use a simulated laser diode load until you are comfortable with the laser driver operation.

CAUTION:
Operate the LDTC with loads attached - if you short either the LD or TC output connections during setup, current will flow and possibly overheat/damage the laser diode driver or temperature controller.

1. CONFIGURING HEATING AND COOLING CURRENT LIMITS

The LDTC has two trimpots that independently set the heating and cooling current limits: LIM A & LIM B. These are 12-turn 5 kΩ trimpots. Full current (~2.2 A) is at full Clockwise (CW) position. Table 1 shows the meaning of the trimpots with various sensors and actuators. Note that PTC sensors include 100 Ω platinum RTDs, the LM335, and the AD590.

Table 1
Trimpot function vs. Sensor & Load Type

Sensor Type	Load Type	LIM A Limits:	LIM B Limits:
Thermistor	Thermoelectric	Cool Current	Heat Current
PTC	Thermoelectric	Heat Current	Cool Current
Thermistor	Resistive Heater	OFF = Fully CCW	Heat Current
PTC	Resistive Heater	Heat Current	OFF = Fully CCW

2. WIRE OUTPUT CONNECTION

Use Table 2 to determine the connection from the LDTC to your thermoelectric or resistive heater.

Table 2
Wiring for Sensor & Load Type

Sensor Type	Load Type	TEC+ Connector 3, Pin 6	TEC- Connector 3, Pin 7
Thermistor	Thermoelectric	Thermoelectric positive wire	Thermoelectric negative wire
PTC	Thermoelectric	Thermoelectric negative wire	Thermoelectric positive wire
Thermistor	Resistive Heater	**Quick Connect:** Connect the Resistive Heater leads to TEC+ & TEC- (polarity doesn't matter). Adjust the Cooling Current Limit A trimpot to zero - fully CW. **Max V Connect:** Connect one side of the resistive heater to TEC- and the other side to the voltage source V_S. LIM A trimpot setting is then irrelevant.	
PTC	Resistive Heater	**Quick Connect:** Connect the Resistive Heater leads to TEC+ & TEC- (polarity doesn't matter). Adjust the Cooling Current Limit B trimpot to zero - fully CW. **Max V Connect:** Connect one side of the resistive heater to TEC- and the other side to the voltage source V_S. LIM B trimpot setting is then irrelevant.	

3. CONNECT TEMPERATURE SENSOR

The standard LDTC is configured to operate a 10 kΩ thermistor with a 100 µA bias current. If your application requires a different sensor, see page 12 for details. Wire the thermistor between Pin 8 (SENS+) and Pin 9 (SENS-) on Connector J3. Operating without a temperature sensor will drive maximum current through the WTC, potentially damaging it.

WTC OPERATION, continued

Configuration of the LDTC for Alternate Temperature Sensors

The standard LDTC configuration is for Thermistor temperature sensors with 100 μA bias current. The LDTC can be easily modified to operate with other sensors and bias currents using the following instructions. Resistive temperature sensors are covered on this page while LM335 and AD590 sensors are covered on the following page.

Resistive Temperature Sensors
(Thermistors and RTDs)

Figure 4 shows the location of resistor R_{Bias}, which sets the sensor bias current. R_{Bias} can be replaced with a 1206 sized resistor to modify the current to the desired value. Table 3 lists the suggested resistor values for R_{Bias} and RS (shorting jumper mentioned below) versus the range of resistances of the resistive temperature sensor.

The following equation demonstrates how to calculate a value of R_{Bias} given a desired sensor bias current, I_{BIAS}.

$$R_{BIAS} = \frac{2}{I_{BIAS}} \quad [\Omega]$$

Sensor Gain
If a temperature sensor voltage becomes too low (below 250 mV), the temperature controller may have a difficult time achieving high levels of precision and stability. The sensor voltage may be amplified by a factor of 10 by placing a jumper between Pin 8 (Sensor +) and Pin 13 (GND) on the WTC3243 Temperature Controller (please refer to Figure 5). Note that the set point voltage must also reflect this amplified voltage level for proper control. For example, in a system that utilizes a 100 Ω RTD sensor, with a desired operating point of about 25° C, the expected sensor voltage would be approximately 110 mV, with a 1 mA bias current. By adding the jumper, the temperature controller will "see" an approximate sensor voltage of 1.10 V at 25° C. Therefore the set point voltage will have to be set to 1.10 V to account for the sensor voltage amplification and to properly control the system at the desired set point of 25°C.

Figure 4
Location of Sensor Bias Resistor

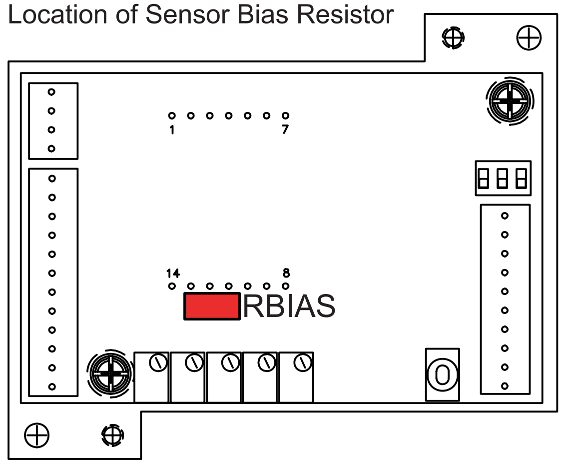
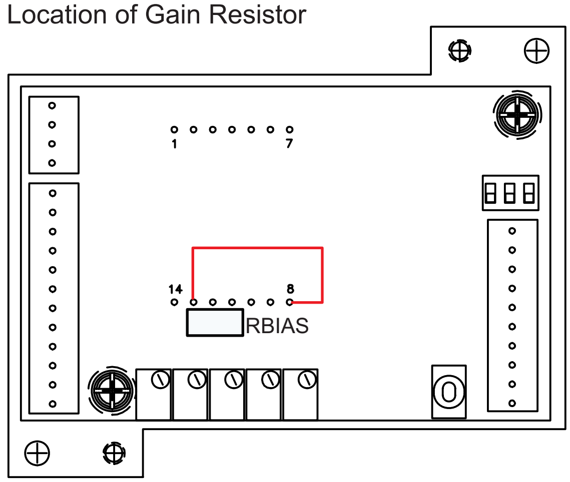


Table 3
Sensor Gain Resistor R_S vs Resistance Temperature Sensor

Sensor Resistance Range	Sensor Bias Resistor, R_{BIAS}	Sensor Bias Current	Sensor Gain Resistor, R_S	Sensor Gain
35Ω to 350Ω	2 kΩ	1mA	SHORT	10
350Ω to 3.5kΩ	2 kΩ	1mA	OPEN	1
3.5kΩ to 35kΩ	20 kΩ	100μA	OPEN	1
35kΩ to 350kΩ	200 kΩ	10μA	OPEN	1

Figure 5
Location of Gain Resistor



WTC OPERATION, continued

Configuration of the LDTC for Alternate Sensors, continued

LM335

To use a National Semiconductor, LM335 temperature sensor with the LDTC, attach the LM335 cathode to Sensor+ and the LM335 anode to Sensor-. R_{BIAS}, shown in Figure 4 should be changed to 2 kΩ for a bias current of 1 mA through the sensor.

The voltage output of the LM335 is 10 mV/K.

AD590

To use an Analog Devices AD590 temperature sensor with the LDTC, first remove R_{BIAS} shown in Figure 4.

Connect the positive lead of the AD590 to a voltage supply ≥ 8 V and the negative lead to the Sensor+ pin on the LDTC. The AD590 produces a current of 1 μA per degree Kelvin, giving a transfer function of 10 mV/K with a 10 kΩ resistor connected between Sensor+ and ground.

WTC OPERATION, continued

4. PROPORTIONAL GAIN AND INTEGRATOR TIME CONSTANT - PI TERMS

The default settings of the LDTC are configured to the mid-range positions appropriate for most laser diode loads. To adjust these parameters to optimize the temperature control system time to temperature or stability, contact Wavelength.

5. Attaching VDD_WTC and VS Power Supplies

The V_{DD_WTC} input supplies voltage to the control electronics of the WTC only. Separate inputs are provided for both the FL500 control electronics and the output stage of the WTC.

The supply should be capable of providing at least 200 mA of current in applications that use separate V_S and $V_{DD\text{-}FL}$ supplies in the temperature control implementation. Temperature control applications that tie the three supply inputs together require current capacity that equals the sum of the maximum TEC or resistive heater current, plus the maximum laser diode current, plus approximately 200 mA for the control electronics of the WTC3243 Temperature Controller and the FL500 Laser Driver, plus current to an optional fan. The maximum current required by the LDTC will be 3.5 amps or less.

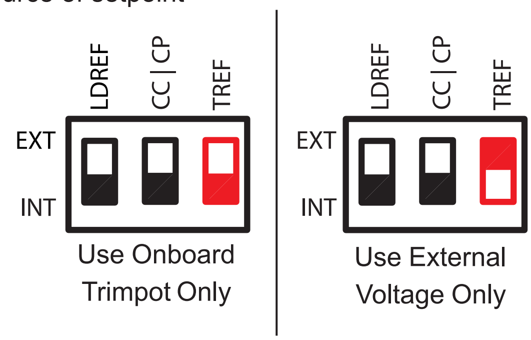
V_S is the voltage that is applied to the TEC or resistive heater. This voltage should be high enough to supply the voltage required by the TEC or resistive heater plus the voltage drop across the WTC. The voltage available to the TEC will be from between 0.5 to 1.8 V lower than V_S, depending on the output current. To minimize power dissipation in the WTC, keep V_S as low as possible.

6. TEMPERATURE SETPOINT

The temperature setpoint can be either remotely or locally controlled. An on-board trimpot (TSET) will adjust the voltage from 0.3 V to 2.5 V. Additionally, Pin 11 (EXT T SET) & 12 (COM) of Connector 2 will accept an external voltage (from 0.3 to 2.5 V). The "Failsafe Setpoint" will default the setpoint to 1V (~25°C for a 10 kΩ thermistor) if the chosen signal (from potentiometer or remote setpoint) falls below 0.3 V. There is about 100 mV of hysteresis built into the default voltage.

A dip switch set lets you choose to use only the on-board potentiometer or the external voltage.

Figure 6
Source of setpoint



Position 3 on the switchbank above J3 configures the Remote Temperature Setpoint choice.

The input impedance of the EXT T SET is greater than 20 kΩ and is fully buffered.

If you use a different sensor or would prefer a different default voltage, contact Wavelength.

CAUTION: An online Safe Operating Area (SOA) calculator is available for the WTC3243. Calculate the maximum power dissipation of your design at

http://www.teamwavelength.com/toolscalculator/soa/defaulttc.htm

before applying power to the LDTC.

WTC OPERATION, continued

7. MONITOR ACTUAL TEMP AND SETPOINT

Pins 9 and 10 of Connector 2 are the ACT T Monitor and SET T Monitor respectively. The ACT T Monitor indicates the actual temperature sensor voltage and can be measured across Pin 9 and Pin 12 (COM). The SET T Monitor indicates the total setpoint voltage set using the onboard potentiometer or remote temperature setpoint and can be measured across Pin 10 (SET T M) and Pin 12 (COM).

The standard LDTC is configured to operate with a 10 kΩ thermistor and a 100 μA bias current. The resistance of the thermistor can be calculated using the following equation.

$$R = V_{J3pin8} / 100\ \mu A$$

For other sensor configurations, see page 12.

8. ENABLE CURRENT TO TEC

Output current is supplied to the load as soon as power is applied to the controller. The Power LED indicator will light GREEN when power is applied.

FL500 OPERATION

Recommended order of setup:
Complete the WTC temperature control section, THEN the FL500 laser diode driver. Use a simulated laser diode load until you are comfortable with the FL500 operation.

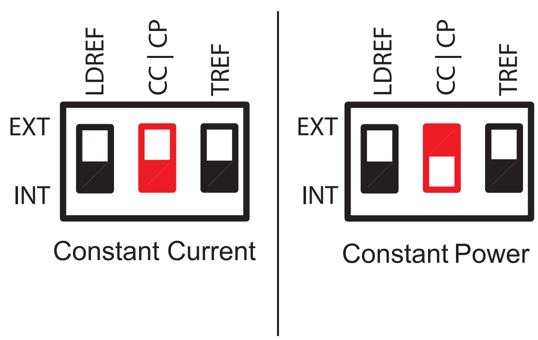
1. SELECT MODE OF OPERATION

The two modes of operation supported by the LDTC are Constant Current (CC) and Constant Power (CP). **It is very important to note that the LDTC operating mode should be configured BEFORE applying power. Changing operation mode while the LDTC is operating can result in damage to your laser diode.**

In Constant Current mode, the setpoint voltage input correlates directly to the laser diode current, regardless of laser diode optical power intensity. In Constant Power mode, the LDTC controls the laser diode using the photodiode to achieve a laser light intensity that is directly proportional to the setpoint voltage.

Select the mode of operation by setting the **CC | CP** switch to the OFF position (INT) for Constant Current mode or the ON position (EXT) for Constant Power mode. See Figure 7 for switch setting details.

Figure 7
Constant Current / Constant Power Switch



2. ATTACH THE FL500 POWER SUPPLY

The control electronics for the FL500(s) as well as the laser diode current are supplied by the V_{DD_FL} power supply. The V_{DD_FL} power supply connection is Pin 1 of the J1 power supply connector. This voltage should be between +3 and +12 Volts. The V_{DD_FL} supply should be capable of supplying at least 1.5 amps of current in applications that use separate V_{DD_WTC} and V_S supplies. For applications that tie the three power supplies together, use a power supply that is capable of providing at least 3.5 amps of current.

Performance of the laser driver is dependent upon the operational characteristics of the power supply. The LDTC provides minimal power supply filtering and noise suppression. Care should be taken to select a power supply with sufficiently low noise and ripple specs for your application.

CAUTION: Online Safe Operating Area (SOA) calculators are available for the FL500. Calculate the maximum power dissipation of your design at
http://www.teamwavelength.com/tools/calculator/soa/defaultld.htm
before applying power to the LDTC.

FL500 OPERATION, continued

3. SET THE LASER DIODE CURRENT LIMIT

The maximum laser diode current that can be output to the laser diode is configured using the ILIM potentiometer. The ILIM circuit provides current limiting 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 8 for location of current limit trimpot and test point.

The limit current can be set while the output is disabled (recommended), by monitoring the voltage at the test point while adjusting the ILIM trimpot. The voltage range is 0-2 VDC, matching the voltage range and scale of the laser diode setpoint voltage.

The transfer function for the limit current voltage, measured at the limit set point is 250 mA/V for the LDTC0520. The transfer function for the LDTC1020 is 500 mA/V.

4. CONNECT THE LASER DIODE AND MONITOR PHOTODIODE

With power removed from the LDTC connect the output connector (J3) to your laser diode. See Figure 1 for proper pin connections. The FL500 is compatible with Type A and B laser package configurations.

Note: We recommend using a simulated laser diode load for initial operation (See Figure 9). 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 8
Limit Current Trimpot and Testpoint

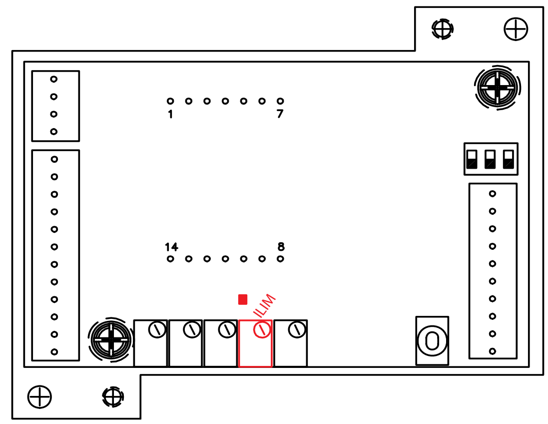
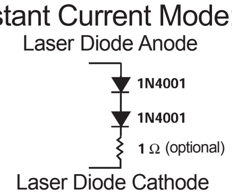


Figure 9
Simulated Laser Diode Loads

Constant Current Mode:



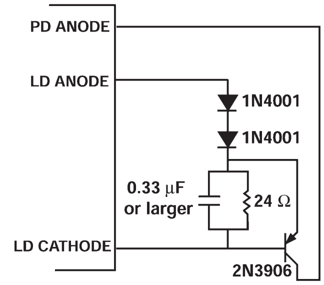
NOTE: If the actual current needs to be measured, a dummy load with a 1 Ω resistor in series is recommended. Use a meter across the resistor to measure the voltage.

PLACING AN AMMETER IN SERIES WITH THE LOAD MAY CAUSE THE CONTROL LOOP TO BECOME UNSTABLE.

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

National Semiconductor P/N 1N4001

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.

FL500 OPERATION, continued

5. MONITOR THE LASER DIODE AND PHOTODIODE CURRENTS

The monitor connector (J2) includes onboard monitors for current and power for the laser diode. Pin 8, LD I M, provides the current monitor, while Pin 7, LD P M, provides the power (photodiode current) monitor.

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 of the LDTC0520 is

$$I_{LD} = V_{LD\,I\,M} * 250 \text{ mA/V}$$

and the transfer function for the LDTC1020 is

$$I_{LD} = V_{LD\,I\,M} * 500 \text{ mA/V}$$

The signal ground connections at Pin 4 and Pin 6 of the monitor connector are low current ground references to be used for measurement.

POWER MONITOR

LD P M on Pin 7 of J2, provides the power monitor for the unit. The power monitor provides a means to measure the voltage developed across the photodiode current sense resistor, RPD. This resistor is labeled on the silk screen on the chassis side of the LDTC Circuit Board.

The photodiode current sense resistor has a value of 1 kΩ +/- 1% when the board ships from the factory, giving a maximum photodiode range of 2 mA for the LDTC. The 1206-sized 1 kΩ resistor can be replaced by the user with a value more suitable to the sensitivity of the photodiode being used.

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

$$I_{PD} = V_{LD\,P\,M} / (2 * R_{PD})$$

When operating the FL500 in constant power mode, the LD P M voltage is used as the power feedback signal. Output laser diode 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.

FL500 OPERATION, continued

6. DISABLING THE OUTPUT CURRENT

The output current can be enabled and disabled using the on-board toggle switch.

A remote voltage signal can be used to control the output status of the laser driver. Connect a zero volt signal to the "LD SHD" (Pin 3 on Connector J2) to ENABLE output current to the laser diode. A voltage level greater than 3 V, but less than 5 V, will DISABLE output current to the laser diode. This input was designed for TTL inputs.

Both the LD SHD voltage and the on-board toggle switch must be enabled before the LDTC can drive current.

NOTE:
Do not insert or remove the laser diode from the FL500 circuit with power applied to the unit.

In Constant Current Mode, the transfer function between the total input voltage and the laser diode current for the LDTC0520 is

$$I_{LD} = 250 \text{ mA/V}$$

where I_{LD} is the current through the laser diode. The transfer function for the LDTC1020 is

$$I_{LD} = 500 \text{ mA/V}$$

In Constant Power Mode, the transfer function between the input voltage and photodiode current is

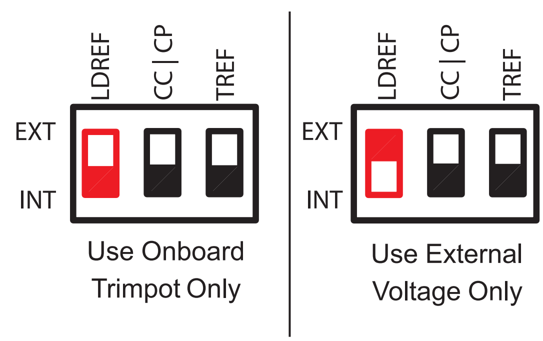
$$I_{PD} = 1 \text{ mA/V}$$

7. LASER DIODE SETPOINT AND MODULATION

The laser diode set point voltage determines the amount of current that is delivered to the laser. In Constant Current mode, the set point voltage is directly proportional to the laser diode current. In Constant Power mode, the set point voltage is directly proportional to the photodiode current, allowing for control of the optical power of the light emitted by the laser diode.

The set point voltage can be adjusted either by using the onboard ISET trim pot, or by applying an external set point voltage. The voltage range of either the external set point voltage or the voltage created with the onboard ISET trim pot can be from zero to 2.5 volts. A dip switch set lets you choose to use only the on-board potentiometer or the external voltage. Figure 10 shows how to set Switch 1 position 1 to select the voltage source.

Figure 10
Source of LD set point voltage



OPERATION NOTES:

Modulation caution - if operating with V_{DD-FL} at 12V, the final setpoint voltage (onboard voltage plus external voltage) must not exceed 12V, or the FL500 may be damaged.

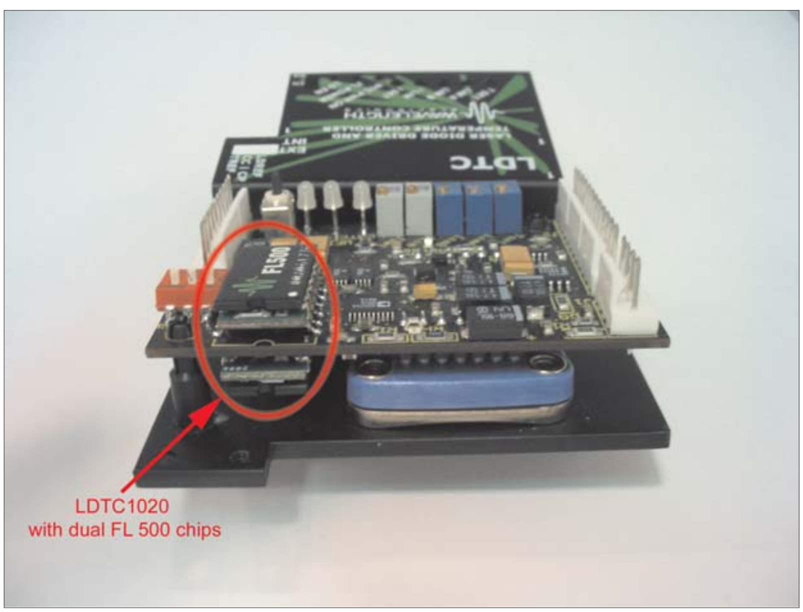
WARNING:
The LDTC does not support laser diode packages that incorporate a built in temperature sensor that is connected to or common with the laser case ground.

ORDERING INFORMATION:

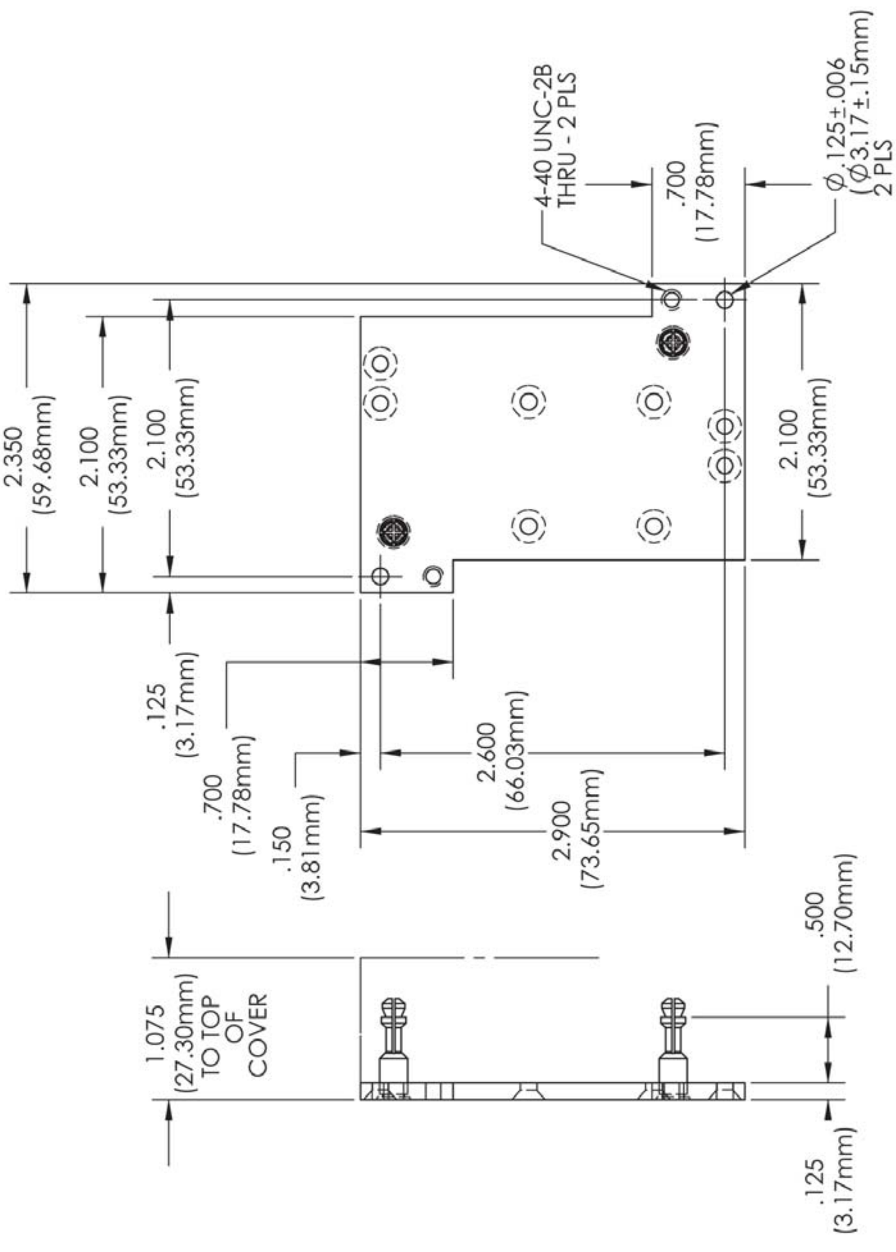
LDTC0520	Comes with board, one FL500 Laser Driver, WTC3243 Temperature Controller, base plate, enclosure, and unterminated power, input and output cables
LDTC1020	Comes with board, Dual FL500 Laser Drivers, WTC3243 Temperature Controller, base plate, enclosure, and unterminated power, input and output cables

MODEL INFORMATION

To determine which model of the LDTC0520/1020 you have when the cover has been removed, please reference the following picture. The LDTC1020 will contain both FL500 chips as shown in the picture, whereas the FL500 will be absent from the LDTC0520 on the bottom of the board.

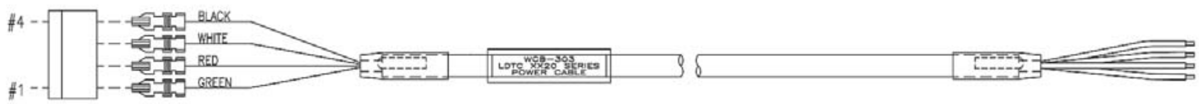


MECHANICAL SPECIFICATIONS



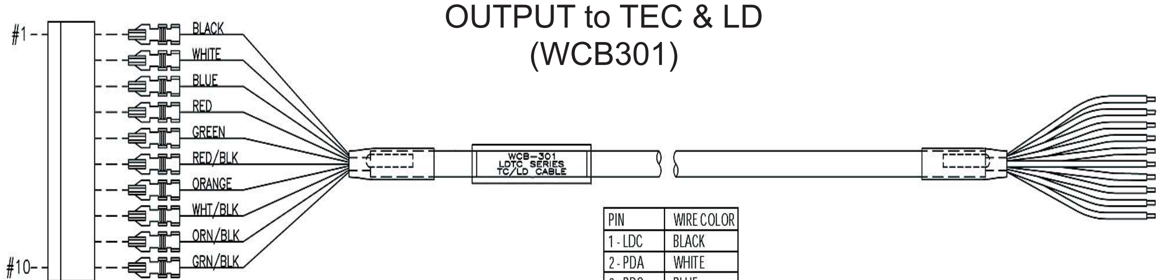
CABLE DIAGRAMS

POWER CABLE (WCB303)



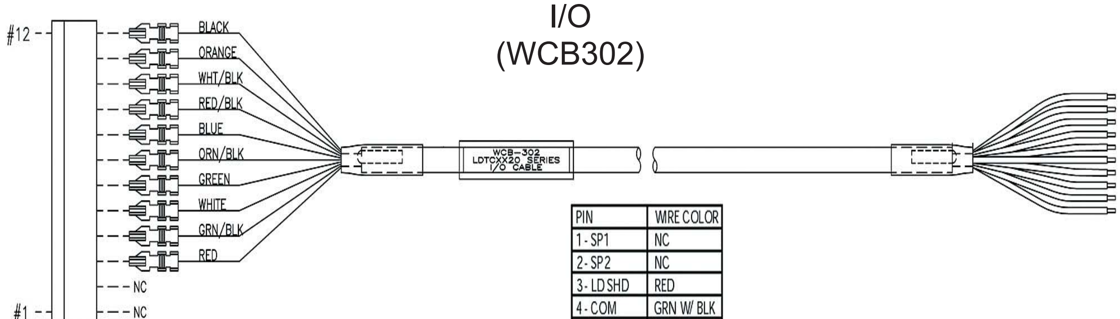
PIN	WIRE COLOR
1 - VDD_FL	GREEN
2 - VDD_WTC	RED
3 - VS	WHITE
4 - GND	BLACK

OUTPUT to TEC & LD (WCB301)



PIN	WIRE COLOR
1 - LDC	BLACK
2 - PDA	WHITE
3 - PDC	BLUE
4 - LDA	RED
5 - COM	GREEN
6 - TEC+	RED W/ BLK
7 - TEC-	ORANGE
8 - SEN+	WHT W/ BLK
9 - SEN-	ORG W/ BLK
10 - COM	GRN W/ BLK

I/O (WCB302)



PIN	WIRE COLOR
1 - SP1	NC
2 - SP2	NC
3 - LD SHD	RED
4 - COM	GRN W/ BLK
5 - R LDSET	WHITE
6 - COM	GREEN
7 - LD P M	ORG W/ BLK
8 - LD I M	BLUE
9 - ACT T M	RED W/ BLK
10 - SET T M	WHT W/ BLK
11 - R TCSET	ORANGE
12 - COM	BLACK

CERTIFICATION AND WARRANTY

CERTIFICATION:
Wavelength Electronics (WEI) 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. However, the Buyer shall pay all shipping charges, duties, and taxes for products returned to Wavelength from another country.

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