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USER MANUAL
MODEL 762 SEED LASER DIODE DRIVER

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Introduction

The model 762 Seed Laser Diode Driver (SLDD) is a high performance general purpose laser diode driver (LDD) with additional features to support use as a seed laser for fiber amplifiers. The driver uses a 14-pin butterfly packaged laser module with a common industry pinout (see *Table 1 – Compatible Laser Diode 14-pin Butterfly Package Pinout*).

The driver circuitry operates from a single +5 V power source. Additional voltages are generated on the board by high efficiency switching power supplies. The laser power input may be operated down to +3 V to conserve power at the expense of switching speed. Input laser power may also be increased to up to +12 V to enhance switching speed for high inductance lasers. For most applications laser power may be tied to the driver +5 V supply, or through an external switch as an additional safety interlock.

The driver also supplies a bidirectional proportional-integral-derivative (PID) thermoelectric cooler (TEC) controller with current capability of ±3 A and voltage capability of ±4 V. An on board field programmable gate array (FPGA) is programmed to handle communications, to modify adjustable features, and to provide external flags and signals to a host system. The FPGA also contains a comprehensive pulse generation system with many programmable features. See the model 762 Interface Control Document (ICD) for details of the digital system and programmable operation.

Safety

The driver does not generate or use any hazardous voltages, so high voltage precautions are not required in mounting or use. The driver is easily capable of producing enough laser light at the fiber tip to cause serious eye and skin damage. All reasonable precautions should be employed to avoid this. Keep work areas policed up of fiber fragments and off trims. Safe disposal of these is very important to avoid injury.

Mounting

Heat Sink Adapter Plate

The diode driver is normally shipped without a laser diode installed. The first step is to determine how hard the driver will be used. For all but the very lightest applications, a heat sink will be required. Determine the power dissipated in the laser, TEC, and drive FET. Most TECs cannot hold the diode temperature with a differential from die to heat sink over 45° C. Generally, that is the requirement that determines the specifications for the heat sink and any need for forced air or other active cooling method.

An adapter plate is offered to allow mounting to any flat surface. If vibration or shock of the unit is of concern, use one 0.375 inch spacer or standoff on each corner of the 762 circuit board along with the adapter plate attached to the laser and FET. This ensures the heat sink is 0.375 inches away from and parallel to the bottom of the circuit board and that the heat sink will be connected to the adapter plate and each corner of the 762. The four corners of the 762 allow for convenient mounting of the spacers or standoffs.

The adapter plate holes are not tapped. As a result, provide enough clearance to properly affix screws, nuts, and washers to mount the adapter plate and heat sink to the FET and laser diode. Alternatively, tap the heat sink mounting holes to provide for a solid fit. Should a custom integrated mounting scheme be employed, it is important to attach the laser and the FET to the same metal surface to permit the over temperature cutoff to protect both the laser and the FET. Use heat sink grease or other thermally conducting medium on all heat transfer surfaces.

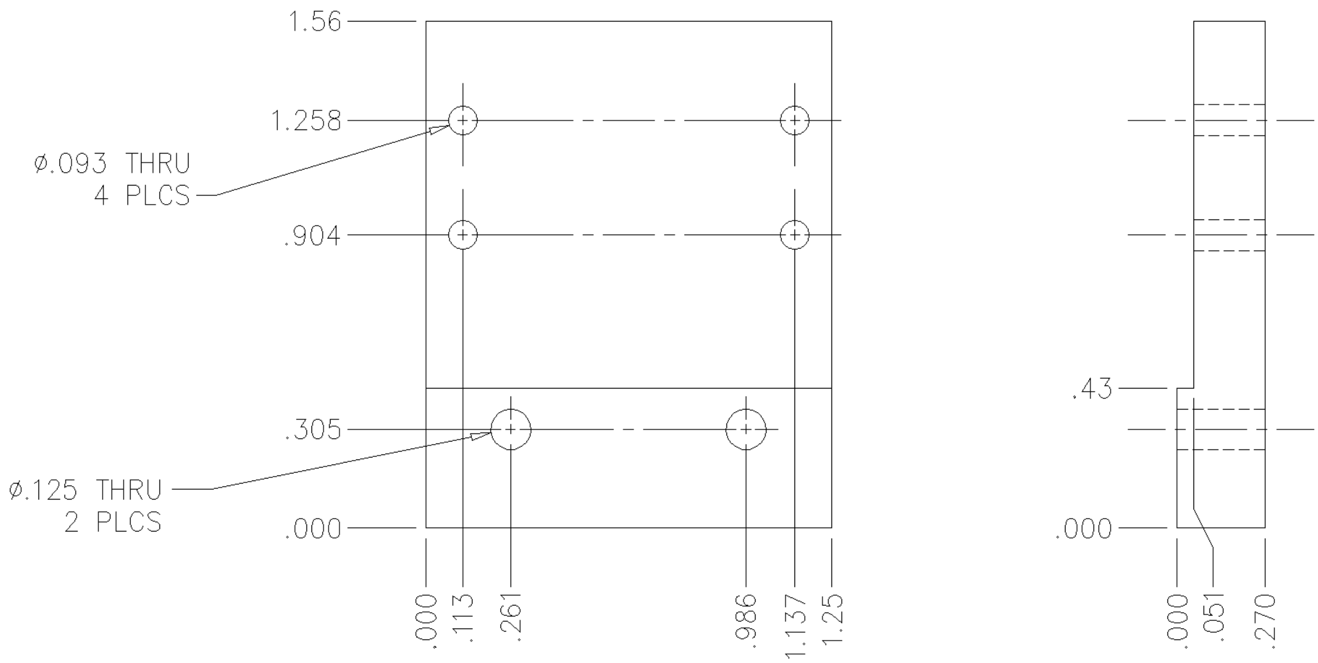

Figure 1 – Heat Sink Adapter Plate Outline and Dimensions

Mounting the Laser

Follow the instructions below for mounting a laser to the 762. Refer to *Table 1 – Compatible Laser Diode 14-pin Butterfly Package Pinout* for a compatible pinout

1. Coat mounting surface of adapter plate, if used, on the heat sink side with heat transfer material.
2. Place adapter on heat sink surface. Align mounting holes.
3. Coat bottom of FET with heat transfer material.
4. Screw the FET to the heat sink. Do not tighten at this time.
5. If the board is being mounted with standoffs, screw to heat sink. Do not tighten at this time.
6. Place the laser through the cutout in the board, and insert the mounting screws in two opposing corners. Do not tighten at this time.
7. Move the board around as needed to align the laser pins with the solder pads. Tighten the FET mounting screws, and, if used, tighten the board mounting screws.
8. Carefully trim the laser pins to fit on the pads. Removing the laser from the PCB may make this easier.
9. When the pins have been trimmed and passed a trial fit, coat the bottom of the laser with heat transfer material. Screw down the laser diode to the heat sink using all four mounting holes.
10. Solder the laser leads to the pads.

Pin	Signal	Pin	Signal
1	TEC (+)	8	No Connect
2	Thermistor	9	No Connect
3	Back Facet Monitor Anode	10	Laser Diode Anode
4	Back Facet Monitor Cathode	11	Laser Diode Cathode
5	Thermistor	12	No Connect
6	No Connect	13	Case Ground
7	No Connect	14	TEC (-)

Table 1 – Compatible Laser Diode 14-pin Butterfly Package Pinout

Before Power Up

Review *Table 2 – Factory Settings of Potentiometer Adjustable Parameters* against the specifications for the laser diode being installed. Should any adjustments need to be made prior to powering on the device, refer to *Figure 3 – Adjustment Potentiometers and Measurement* Points for the potentiometer locations. Most adjustments must be made with the power on, so to be safe turn the control potentiometer in the direction indicated in *Table 2* at least five turns.

Adjustment	Factory Setting	Potentiometer Designator	Turn Direction to Lower Setting	Voltage at Measurement Point
Laser Fire Threshold	+1.5 V	R139	CCW	+1.5 V at R138, pin 1
TEC Maximum Current	+2.2 A	R145	CW	+0.44 V at R145, pin 1
TEC Maximum Voltage	+3.0 V	R177	CCW	+0.75 V at R51, pin 2
TEC Set Point Temperature	+25º C	R46	CCW	+0.75 V at R46, pin 2 (Increases as temp. decreases)
Laser Diode Current	+1.5 A	R124	CCW	+1.5 V at R124, pin 2
Current Limit	+1.75 A	R150	CCW	+0.219 V at R150, pin 2
Laser Diode Bias Current	+8 mA	R129	CCW	0 V at TP4 (preliminary) +0.001 V at E1 (final)

Table 2 – Factory Settings of Potentiometer Adjustable Parameters

Electrical Interface

Input/Output and Power Connectors

The connectors shown in Figure 2 – Input/Output and Power Connectors below are described in the sections to follow.

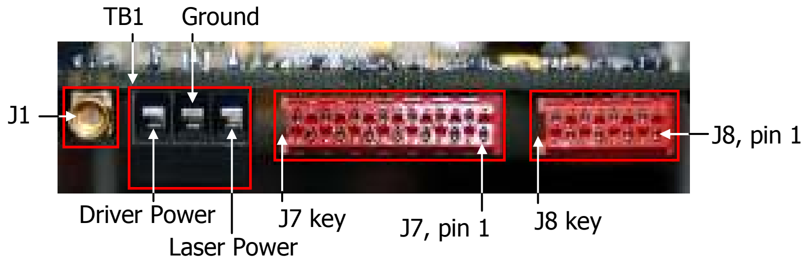

Figure 2 – Input/Output and Power Connectors

J1 – MMCX Jack

J1 is a miniature 50 Ω MMCX jack that mates with a straight or right angle MMCX plug and 50 Ω coaxial cable assembly. The signal transmitted is the analog back facet monitor (BFM) output that must be terminated with 50 Ω when a coaxial cable is connected to J1. No termination is required if no coaxial cable is connected.

TB1 – Input Power Screw Terminal Block

The screw terminal block accepts between 16 AWG and 28 AWG wire for driver power, ground, and laser power supplies. All connection locations are shown in *Figure 2 – Input/Output and Power Connectors*.

J7 – 14-pin MicroMatch Receptacle

J7 mates with a keyed 14-pin MicroMatch IDC style header (Tyco Electronics / AMP part number 8-215083-4) connected to 14-position, 28 AWG ribbon cable. The J7 pin descriptions and locations can be found below in *Table 3 – J7 Pin Description*. Also, refer to *Figure 2 – Input/Output and Power Connectors* for further clarification.

Pin	Description
1	Enable (active low)
2	Ground
3	Control voltage (not connected by default)
4	Monitor Gain MSB
5	Monitor Gain LSB
6	Ground
7	Trigger / PW
8	Ground
9	Trigger / PW (active low)
10	Ground
11	I2C Clock / Asynchronous Transmit
12	I2C Data / Asynchronous Receive
13	Ground
14	Serial Select

Table 3 – J7 Pin Description

J8 – 8-pin MicroMatch Receptacle

J8 mates with a keyed 8-pin MicroMatch IDC style header (Tyco Electronics / AMP part number 7-215083-8) connected to 8-position, 28 AWG ribbon cable. The J8 pin descriptions and locations can be found in *Table 4 – J8 Pin Description*. Also, refer to *Figure 2 – Input/Output and Power Connectors* for further clarification.

Pin	Description
1	Current Fault (active low)
2	Temperature Fault (active low)
3	Ground
4	Digital Laser Fire Output
5	Ground
6	Amplifier Synchronization 1
7	Ground
8	Amplifier Synchronization 2

Table 4 – J8 Pin Description

Power Signal Descriptions

Driver Power

Driver power should be +5.0 V (±5%), up to 3A for maximum TEC current and voltage settings and worst case conditions. Voltage levels apply at the board input terminals under minimum to maximum loads.

Ground

Ground is the return line for both the driver current and the laser current. Size wiring run accordingly.

Laser Power

Laser power is a +3.0 V to +12.0 V input that services the laser anode only. Current on the line is equal to the average laser current. Normally, the input is tied to the same supply as the driver power. If speed is not important, lowering the laser input voltage can reduce power consumption. If a high inductance laser is mounted, the driver speed can be recovered by increasing the input voltage.

Input/Output Signal Descriptions

General Information

All digital inputs are high impedance with on board 4.75 kΩ pull up resistors to +5.0 V. They are compatible with open drain or collector outputs, TTL and +5.0 V CMOS. The host system can obtain +3.3 V CMOS compatibility by installing a 6.82 kΩ resistor from each input to ground.

All digital outputs are open drain with pull up resistors to +5.0 V; the value for each will be given in the individual signal descriptions. As with all passive pull up outputs the rise time is a function of both the pull up resistor and the local capacitance. If necessary the rise time can be shortened by lowering the pull up resistance. Should this technique be employed, the total pull up resistance should not be less than 200 Ω. As for the inputs +3.3 V CMOS compatibility can be achieved by dividing down the logic high voltage to less than +3.3 V.

Analog Back Facet Monitor Output

The back facet monitor is an analog signal with 0 V to +3.7 V range. The amplifier has four selectable gains corresponding to 10, 20, 30, and 37dB to cover a back facet monitor range of from less than +0.1 mA to greater than +10 mA. The BFM signal will contain some remnants of the input current pulse and the laser inductance ring. These signals are coupled internally in the laser module and cannot be separated from the optical signal. As a safety precaution, the BFM should always be terminated into 50 Ω to prevent the buffer from oscillating and overheating when a coaxial cable assembly is attached. No termination is necessary if no coaxial cable assembly is attached. Since the digital laser fire output signal is derived from the BFM output, a buffer oscillation or overheat condition may cause the digital laser fire indicator to malfunction.

Enable (active low)

The enable is an active low input that serves two purposes. First the enable line must be low for the driver to pass any current to the laser. The second purpose is to clear a current fault when a current fault is triggered by an over current condition. The enable line must be cycled high and then back low to clear the flag and resume operation. The enable line should not be pulled low during power up. Maintaining a disabled state will prevent any undesirable transients from producing laser current. Furthermore, it is recommended the laser be disabled when performing any adjustments for which it is not necessary to operate the laser.

Control Voltage

In a standard configuration 762 driver the control voltage line is not connected to any internal function. As a factory installed option, this line may be configured as an analog input. When installed the control voltage has an input impedance of 50 Ω and has direct control of the laser current; potentiometer and digital control of the laser current are disabled. This option is included for customers who require agile control of the laser current, or wish to drive the laser with unusual waveforms, pulses with variable rise/fall times, or modified pulse flatness. There are two normal operating modes for the input, but combinations are also possible. The analog calibration of the input is 1 A/V. In the first case, the pulse input is set up for CW operation. The current modulation is then input on the control voltage line. Any waveform is possible within the limits of the driver bandwidth, clipping at 0, and tripping the over current latch if the current goes too high. In the other mode, on board or externally generated pulses are applied as usual, and the voltage at the control input controls the pulse amplitude.

Monitor Gain MSB and Monitor Gain LSB

These digital inputs control the gain of the back facet monitor amplifier for the analog output. See *Table 5 – Monitor Gain Parameters – Amplifier Gain and Scaling Values* below for settings and corresponding gains and monitor current scaling.

Monitor Gain	Amplifier Gain	BFM Current Scale
00	10 dB	105 mV/mA
01	20 dB	332 mV/mA
10	30 dB	1.05 V/mA
11	37 dB	2.35 V/mA

Table 5 – Monitor Gain Parameters – Amplifier Gain and Scaling Values

Trigger/PW and Trigger/PW (active low)

These digital inputs control the production of current pulses. They have multiple modes of operation. This discussion will deal with the mode that is not under control of the gate array. For information on those modes refer to the model 762 Interface Control document. The Trigger/PW and Trigger/PW (active low) can be driven in three ways. First, Trigger/PW (active low) can be held low, and Trigger/PW can be driven by positive pulses. Second, Trigger/PW and Trigger/PW (active low) can be held high, and Trigger/PW (active low) can be driven with negative pulses. Finally, the two inputs can be driven differentially. Regardless of mode, the current pulse begins with the leading edge of the pulse plus the driver delay and will be the same pulse width as the incoming pulse. For CW operation, hold Trigger/PW high and Trigger/PW (active low) low.

I2C Clock/Asynchronous Transmit, I2C Data/Asynchronous Receive, and Serial Select

These three lines form the communications interface with the 762 so that multiple functions can be placed under digital control. Please refer to the model 762 Interface Control Document (ICD) for information on how to interface serially with the 762. By default, the driver is fully under analog control.

Current Fault (active low)

The current fault indicator is an active low output that is asserted if the laser current exceeds the current limit. At the same time that the indicator is asserted the driver is disabled and the condition is latched. To clear the latch and re-enable the driver, the active low enable input must be cycled high and then low. The output is pulled up using a 4.75 kΩ resistor.

Temperature Fault (active low)

The temperature fault indicator is an active low output that is asserted when the TEC controller cannot maintain the laser diode temperature at the set level. When a temperature fault is active, the driver is disabled. When temperature control has been restored, the flag will be cleared and the driver re-enabled automatically. This is the most effective method of protecting both the power FET and the laser from over heating. It is important to note that both the laser and the FET be mounted on the same heat sink to extend the protection to the FET. The output is pulled up using a 4.75 kΩ resistor.

Digital Laser Fire Output

This active high output is asserted when the back facet monitor output exceeds a preset threshold. The output pulse width is driven high for at least 1 µs for laser pulse widths of 1 µs or shorter. For longer pulses the output pulse width will equal the laser pulse width. If the pulse repetition rate is greater than 1 MHz, the output will remain continuously high. Note, if the monitor gain is too low, the digital laser fire output signal may not be active. The output is pulled up using a 4.75 kΩ resistor.

Amplifier Synchronization 1 and Amplifier Synchronization 2

These digital outputs are for use in synchronizing external fiber amplifier operation to the driver. These signals are inhibited in the high state until output is enabled using digital control. Pull up resistors on both outputs are 475 Ω.

Settings and Adjustments

Refer to *Table 2 – Factory Settings of Potentiometer Adjustable Parameters* to see default factory set adjustments. This section will focus on adjustments made by potentiometers. See *Table 6 – Adjustable Parameters and Method of Adjustment* for a list of both analog and digital adjustable parameters. Refer to
Figure 3 – Adjustment Potentiometers and Measurement Points to see the measurement point locations superimposed on an image of a 762 unit.

Adjustable Parameters	Method of Adjustment
Laser Fire Threshold	Potentiometer R139, digital, monitor gain setting
TEC Maximum Current	Potentiometer R150, digital
TEC Maximum Voltage	Potentiometer R177, digital
TEC Set Point Generator	Potentiometer R46, digital
Laser Diode Current	Potentiometer R124, digital, control voltage (if installed)
Current Limit	Potentiometer R150, digital
Laser Diode Bias Current (Offset Adjustment)	Potentiometer R129, digital
Monitor Gain	Monitor gain MSB and LSB inputs, digital
Laser Pulse Width	Trigger/PW inputs, digital, control voltage (if installed)
Pulse Rate Frequency	Trigger/PW inputs, digital, control voltage (if installed)
Current Waveform Shape	Control voltage (if installed)
TEC Shutdown	Digital
Amplifier Synchronization 1 and 2	Digital
Serial Select	Serial select input, digital
Enable (active low)	Enable input, digital

Table 6 – Adjustable Parameters and Method of Adjustment

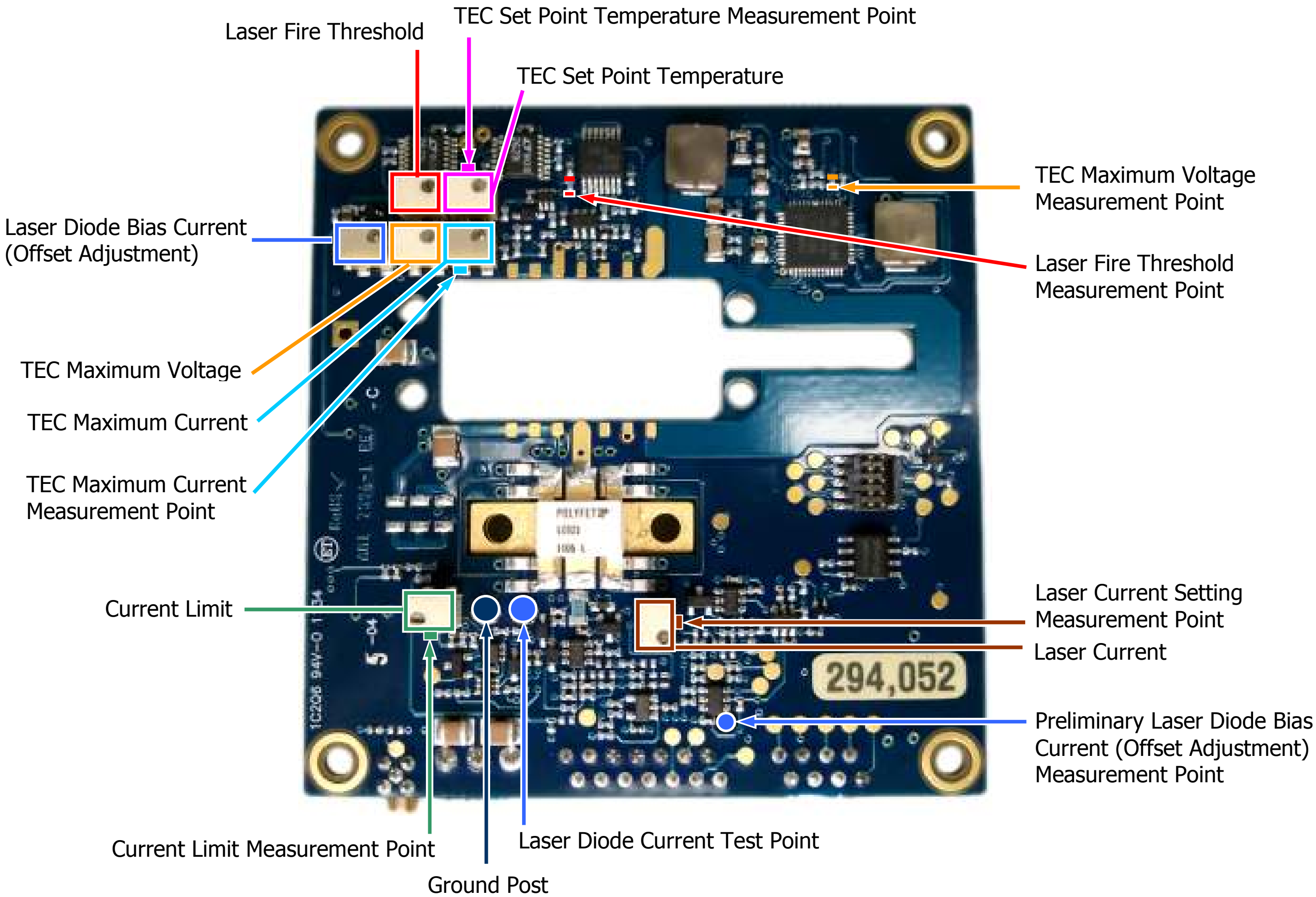

Figure 3 – Adjustment Potentiometers and Measurement Points

Laser Fire Threshold

Due to large variances in the back facet photo diode output with laser current and also variations in the laser operating conditions, a simple setting cannot be provided. If the intended application does not require the laser fire signal, skip this section. If the laser operation will be at various currents as opposed to a single drive level, the first procedure will attempt to obtain a laser fire signal across the operating range without having to change the amplifier gain or the threshold setting when changing laser current. Pulse the unit at the maximum current that will be used. If the analog back facet monitor output will not be used, set the gain to maximum (0b11 on input). Otherwise, connect an oscilloscope to the analog output and be sure to terminate into 50 Ω. Adjust the gain setting for the largest signal possible that does not saturate the amplifier. Without changing the amplifier gain, set to the lowest current pulses that will be used. Adjust the oscilloscope as required for a good display, and then measure the voltage at the 50% point of the waveform. Connect the voltmeter to the measurement point and set to the voltage measured on the oscilloscope. If only one level is to be used, set to the midpoint of the oscilloscope signal with that input.

TEC Maximum Current

Multiply the desired maximum TEC current by 0.20. Set the voltage at the measurement point to the calculated value.

TEC Maximum Voltage

The voltage at the test point is 0.25 times the TEC maximum voltage. Adjust for 0.25 of desired setting.

TEC Set Point Temperature

Different laser manufacturers use different thermistors in their products. Although 10 kΩ resistance at +25° C is the most common value and is what the controller circuitry is designed for, the thermistor curves are not identical. To assure accurate temperature settings, a chart of resistance vs. temperature is needed for the thermistor in question. Look up the value at the desired operating temperature and use the formula below to determine the measurement point voltage for that thermistor resistance. Adjust the measured voltage to the calculated value.

$$Voltage = \frac{1.5 \cdot R_{th}}{10{,}000 + R_{th}}$$

Equation 1 – Thermistor Resistance to Voltage

Laser Diode Current

Adjust the voltage in volts at the measurement point to the same numeric value as the desired pulse current (that is +1 V/A).

Current Limit

Multiply 0.125 times the desired current limit set point. Adjust the voltage at the measurement point to the calculated value.

Laser Diode Bias Current (Offset Adjustment)

Begin with a preliminary adjustment by adjusting to 0 volts at the preliminary measurement point. The final settings must be made with the laser enabled. The current calibration at the laser diode current test point is +8 mA/mV. Adjust for the desired DC bias current. Should the desired current be 0, approach the final setting from a few mV positive and stop turning as soon as the voltage at the test point stops moving. The voltage can’t be reduced at the test point any further, but if the adjustment is turned more negative, the current pulse will be clipped, and will not reach its full value.

Board Outline and Dimensions

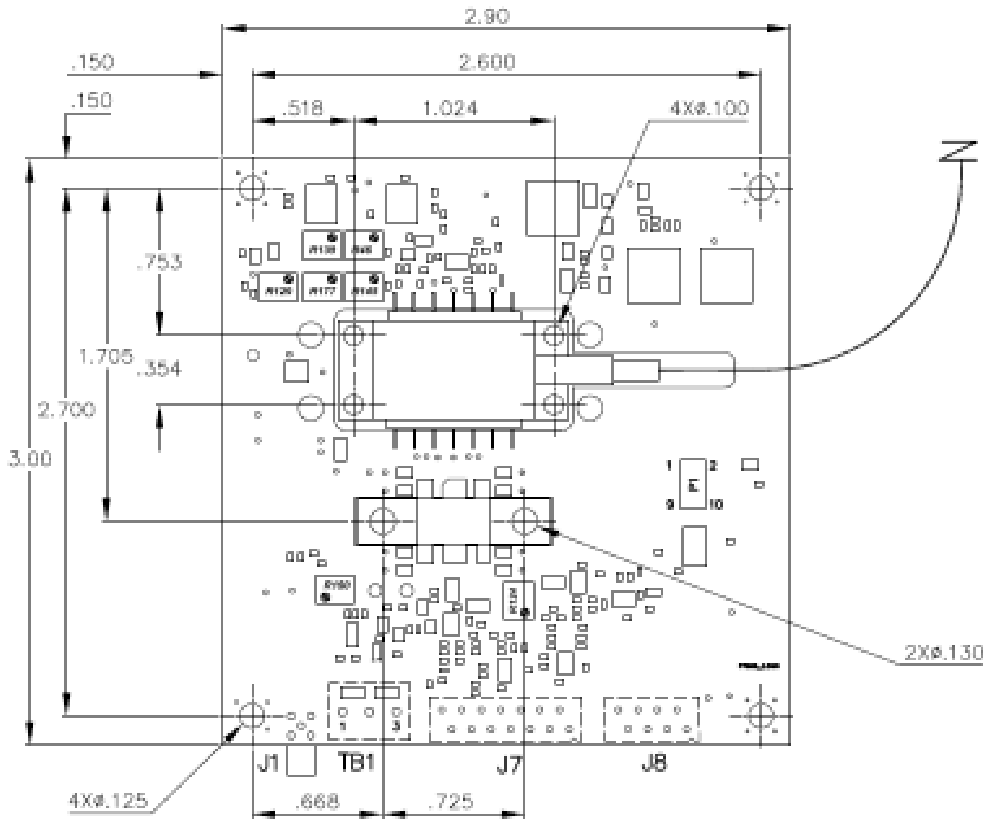

Figure 4 – Board Outline and Dimensions, Top View

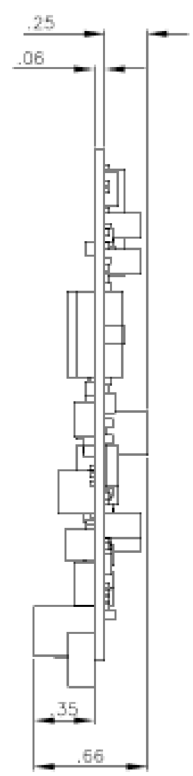

Figure 5 – Board Outline and Dimensions, Side View