



# **LM14S2**

## **Butterfly Laser**

## **Diode Mount**

### **User Guide**



















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# Chapter 1 Warning Symbol Definitions

Below is a list of warning symbols you may encounter in this manual or on your device.

Symbol	Description
	Direct Current
	Alternating Current
	Both Direct and Alternating Current
	Earth Ground Terminal
	Protective Conductor Terminal
	Frame or Chassis Terminal
	Equipotentiality
	On (Supply)
	Off (Supply)
	In Position of a Bi-Stable Push Control
	Out Position of a Bi-Stable Push Control
	Caution: Risk of Electric Shock
	Caution: Hot Surface
	Caution: Risk of Danger
	Warning: Laser Radiation
	Caution: ESD Sensitive Components

## Chapter 2 Safety



### WARNING



Always observe proper laser safety when operating this unit.

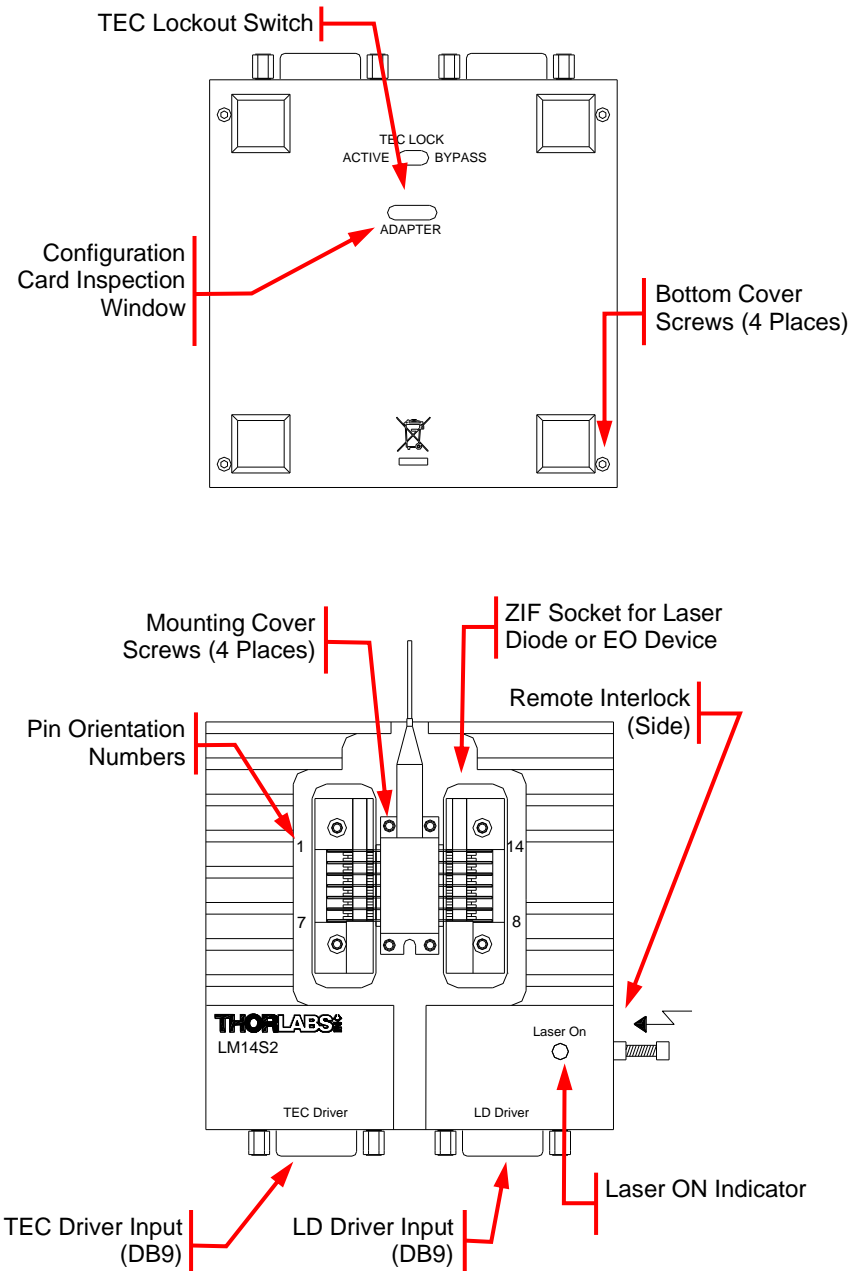
## **Chapter 3 Description**

The LM14S2 is a universal laser diode mount specifically designed for 14-pin butterfly laser diodes that have integrated Thermal Electric Coolers (TECs) and Thermistor sensors. When used with Thorlabs LDC Series Laser Controllers and TED Series TEC Controllers, a laser diode can be operated with precise temperature control for wavelength stability and temperature tuning. A zero insertion force (ZIF) socket accepts all standard 14-pin butterfly laser diode packages. Easy to use configuration cards allow the laser mount to be configured for all possible laser pin assignments.

Designed primarily for Laser Diodes, the LM14S2 can also be used with many two port Electro-optic devices that are in 14-pin butterfly packages.

A Bias-T adapter is also included allowing the laser to be directly modulated up to 500 MHz. This adapter is intended for use only with butterfly lasers that have integrated RF modulation components (i.e. blocking inductor and 25  $\Omega$  input impedance).

Additional safety and protection features include an on board reverse bias protection diode, remote safety interlock connection, and the TEC Lockout circuit that prevents enabling of the laser diode unless the temperature controller is also enabled. Designed to work with our LDC and TED controllers, the TEC Lockout can easily be bypassed by setting a switch.



**Figure 1 Location of Features**

## Chapter 4 Setup

### 4.1. Setup Instructions

Note: The following procedure applies to installing and using a butterfly laser diode with the LM14S2. For information regarding electro-optic devices other than laser diodes, please refer to Section 10.2 AFTER reviewing these instructions for configuration card and device installation.

1. Place the unit on a solid, dry working surface.
2. Remove the bottom cover from the unit by removing the four 4-40 screws from the bottom cover.
3. Determine the type of laser you are using, Type 1 Pump, Type 2 Telcom, or Other (refer to Section 4.2.1). Install the appropriate configuration card into the 24-pin header located on the now exposed bottom side of the main PCB:
  - a. If you are using a Type 1 laser, install the Type 1 / Type 2 configuration card into the 24-pin header with the text "TYPE 1" facing towards the connector side of the unit.
  - b. If you are using a Type 2 laser, install the Type 1 / Type 2 configuration card into the 24-pin header with the text "TYPE 2" facing towards the connector side of the unit.
  - c. If your laser does not match either a Type 1 or Type 2 pin-out, then you must use the custom configuration card. See Section 4.2 for more information on wiring this card.

Make sure the socket on the configuration card is properly aligned with the 24-pin header.

4. Replace the bottom cover to the unit and secure it with the four 4-40 screws previously removed. The cover must be oriented to allow the TEC LOCK switch to pass through it. When installed properly, the configuration card can be identified through the inspection window in the bottom cover.
5. Connect the laser driver to the DB9 female connector labeled LD Driver. This connector is pin-for-pin compatible with all Thorlabs LDC series laser diode controllers. If using other controllers, refer to Table 2 for the pin-outs for the LD driver connector.
6. Connect the TEC controller to the DB9 male connector labeled TEC Driver. This connector is pin-for-pin compatible with the Thorlabs TEC controllers. If using other controllers, refer to Table 2 for the pin-outs for the TEC driver connector.
7. Install the butterfly laser diode into the Zero Insertion Force (ZIF) sockets as follows:
  - a. Press the latching mechanisms on each ZIF socket away from the pin clamps to release the clamps.

- b. Swing the pin clamps forward to expose the contacts on each socket.
- c. Remove the four 2-56 cap head screws mounted between the two ZIF sockets using a 5/64" ball driver or suitable tool.
- d. Apply a thin layer of thermal grease to the bottom of the butterfly laser diode (optional, but recommended).
- e. Carefully lay the butterfly laser diode onto the ZIF sockets. The output fiber of the laser must exit towards the front of the mount, *opposite* the DB9 connectors. The pin orientation of the socket is marked on the sides of the ZIF sockets. Align the pins into the slots for each contact.
- f. Install the four 2-56 cap head screws into the four mounting holes on the butterfly package, securing the laser to the mount. Tighten the screws in a crisscross pattern to ensure equal force across the device. A torque of 10~20 oz-in (0.07~0.14N·m) is recommended for securing the screws.
- g. Swing the pin clamps back onto the ZIF socket, taking care that all of the laser diode pins are still aligned onto the correct contacts.
- h. Press the latching mechanism forward onto the pin clamps until they snap into place, latching the pin clamps onto the pins and contacts.

## 4.2. Configuration Cards

The LM14S2 is shipped with two configuration cards needed to program the unit for the proper pin-outs for the type of laser being installed in the mount. In most cases, the dual Type 1 / Type 2 Configuration Card can be used to route the DB9 input signals to the mounted laser diode. Refer to Section 4.2.1 for specifics on which side of the configuration card to use.

For non-standard devices that do not use the pin-out conventions described on the next page, we have included a custom configuration card. This card is designed to allow you to easily configure the mount to any pin configuration by soldering wires between the appropriate points on the card. For convenience, the outline of the butterfly package is shown on both sides of the card, in its proper top and bottom views. In addition, an extra set of holes is provided to allow multiple connections to one node.

Ideally a solid 26 – 30 AWG insulated wire can be used for the various connections, but any suitable wire can be used.

Refer to Tables Table 1 and Table 2 for signal nomenclatures shown in bold type.



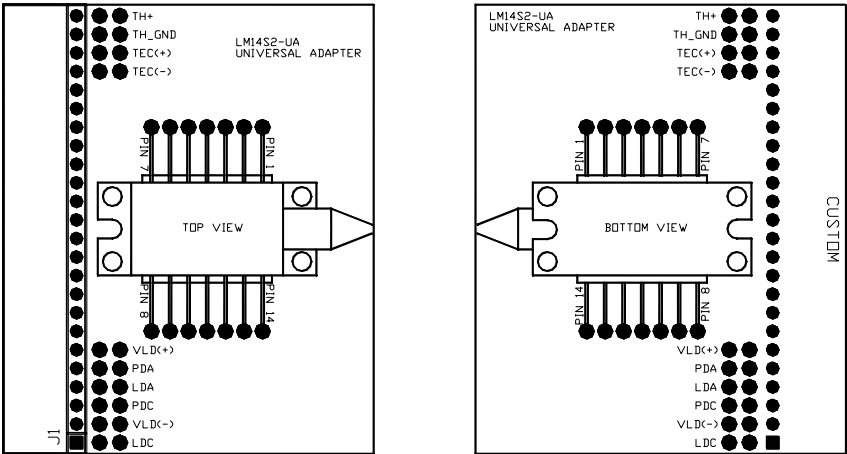


Figure 2 Custom Configuration Card

4.2.1. Configuration Card Pin-Outs

Refer to the following diagrams to determine which type of configuration card to use with your laser diode.

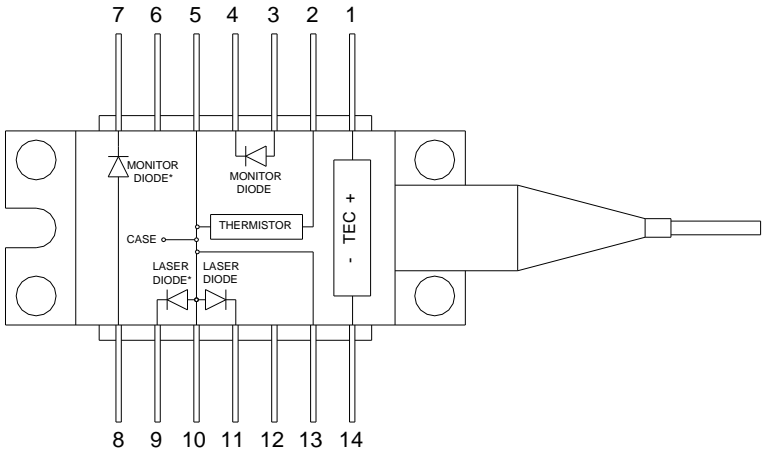
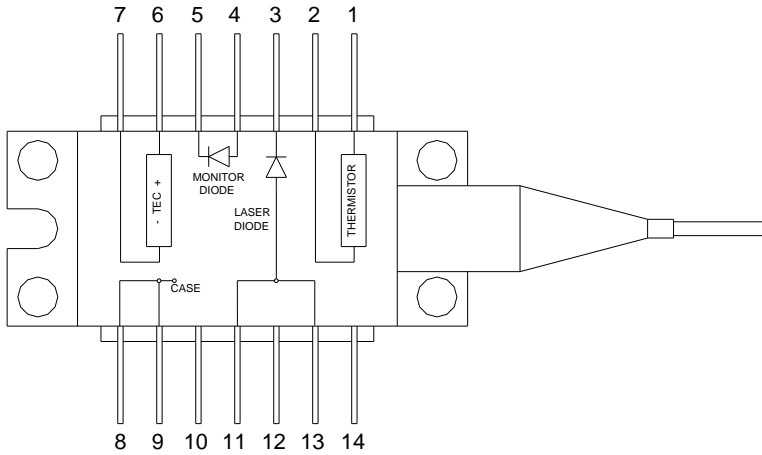
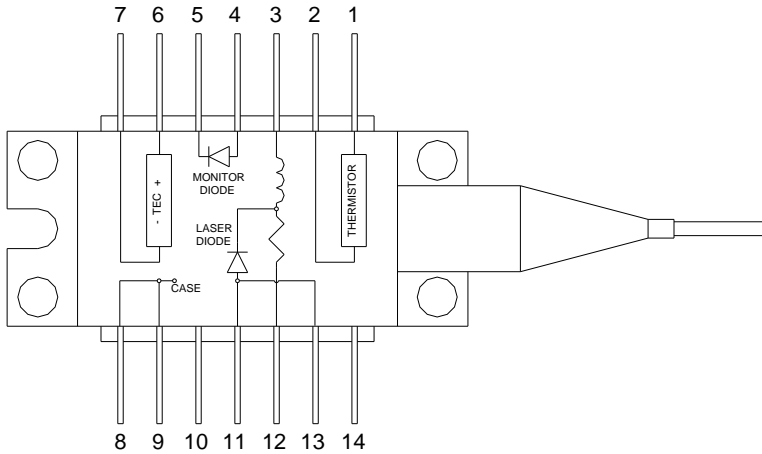


Figure 3 Type 1 Pump Laser Diode (View shows alternate locations for monitor and laser diodes.)



**Figure 4 Type 2 Telcom Laser Diode**



**Figure 5 Type 2 Laser with Integrated Bias-T**

### **4.3. Using the TEC / Laser Lockout Feature**

The TEC / Laser Lockout feature provides an added level of protection for your butterfly laser diode. By monitoring a status signal from the TEC controller, the laser driver can only be enabled if the TEC controller is also enabled. This feature is activated by setting the TEC LOCK switch located on the bottom of the unit to the proper position. Set this to "Active" to use this feature, or to "Bypass" to disable the feature. Designed for direct compatibility with the Thorlabs LDC and TEC controllers, no additional wiring is required when used in conjunction with these drivers.

### **4.4. Operating the Butterfly Laser Diode**

Once the butterfly laser diode is properly mounted in the LM14S2, set the operating temperature using the TEC controller. Once the set temperature has been reached, enable the laser diode, set the drive current or power level, and control as you normally would.

### **4.5. Laser Controller Connection**

#### **4.5.1. Using the Thorlabs LDC Series Laser Controllers**

The LM14S2 is best used with the Thorlabs LDC Series Laser Controllers. The LDC series drivers are shipped with a mating DB9 cable that plugs directly into the controller and laser head. Using the cable supplied with the LDC, the controller cannot be connected incorrectly. Also, the LDC has built-in protection circuitry that protects the laser when not in use. Simply connect the DB9 cable included with the LDC to the laser mount and to the controller.

### 4.5.2. Using a Third-Party Laser Controller

When using a third-party controller, a custom cable will have to be made to properly interface to the laser mount. Please refer to Table 1 for laser connections.

Pin	Signal	Description
1	Interlock and Status Pin (LDC Specific)	This pin is the input to the LD Status Indicator and Interlock Circuits. When using Thorlabs LDCs, no external circuitry is required. To use these features with third-party controllers please refer Section 5.2 of this manual.
5	Interlock and Status Return	This pin is the return side of the Status and Interlock circuitry.
7	Laser Diode Cathode <b>LDC</b>	Use this pin for the laser diode cathode connection. This pin must always be driven more negative than Pin 3 (laser anode), otherwise a reverse bias protection diode will clamp this pin to Pin 3.
8	-	Not Used
3	Laser Diode Anode <b>LDA</b>	Use this pin for the laser diode anode connection. This pin must always be driven more positive than Pin 7 (laser cathode), otherwise a reverse bias protection diode will clamp this pin to Pin 7.
2	Photodiode Cathode <b>PDC</b>	Use this pin to connect to the integral monitor photodiode cathode of your laser diode.
4	Photodiode Anode <b>PDA</b>	Use this pin to connect to the integral monitor photodiode anode of your laser diode.
6	Laser Diode Voltage (-) <b>VLD(-)</b>	This pin can be used to measure the voltage at the laser diode cathode. There is a 499 $\Omega$ resistor between this pin and the LD cathode.
9	Laser Diode Voltage (+) <b>VLD(+)</b>	This pin can be used to measure the voltage at the laser diode anode. There is a 499 $\Omega$ resistor between this pin and the LD anode.

**Table 1 Laser Diode Connector Pin Functions**

## 4.6. TEC Controller Connection

### 4.6.1. Using the Thorlabs TED200C Controller

The LM14S2 is best used with Thorlabs TED200C or related TEC controllers. The TED200C is shipped with a mating DB9 cable that plugs directly into the controller and laser mount. Using the cable supplied with the TED200C, the controller cannot be connected incorrectly. Simply connect the cable included with the TED200C to the laser mount and to the controller.

### 4.6.2. Using a Third-Party TEC Controller

When using a third-party controller, a custom cable will have to be made to properly interface to the laser mount. Please refer to Table 2 for laser connections.

Pin	Signal	Description
4	TEC(+)	This pin is connected to the positive terminal of the TEC element integrated in the laser diode.
5	TEC(-) and TEC Lockout (-)	This pin is connected to the negative terminal of the TEC element, and also is common to the cathode of the photo-relay of the TEC Lockout circuit - refer to the Status and Interlock section of this manual.
1	TEC Lockout (+)	This pin is connected to the anode of the photo-relay side of the TEC Lockout circuit. When using Thorlabs TECs, no external circuitry is required. To use these features with third-party controllers please refer to the Status and Interlock section of this manual.
2	+Thermistor TH+	This pin is connected to the Thermistor integrated in the laser diode.
3	-Thermistor TH_GND	The Thermistor return pin. See Grounding Jumpers below.
7	-	Not Used
9	-	Not Used
6	-	Not Used
8	-	Not Used

**Table 2 TEC Connector Pin Functions**

## 4.7. Grounding

Two jumpers, JMP1 and JMP2, are located on the main PCB, accessible by removing the bottom cover.

JMP1 allows you to connect the anode circuit on the main PCB to the shield connection of the LD Driver DB9 cable, in most cases making it common to the chassis of the LD driver and Earth. To completely float the circuit, simply disconnect this jumper. The jumper can be placed on one of the other header pins for safe keeping. The unit is shipped with JMP1 NOT installed.



### CAUTION



**If your laser driver has a grounded anode drive signal, removing JMP1 will not float the circuit, it will simply disconnect it from the cable shield. In fact, when using a driver that does have a grounded anode connection, it may be beneficial to remove JMP1 to prevent a ground loop from forming.**

JMP2 allows you to connect the - Thermistor (TH\_GND) signal to the laser diode anode on the main PCB. In some cases, certain butterfly packages make this connection at the laser itself. The unit is shipped with JMP2 NOT installed.

Note: The Type 2 Configuration Card ties the laser diode Pin 8, Pin 9, Pin 11, and Pin 13 together, making the anode of the LD common to the case of the device. Refer to Figure 4 for details.

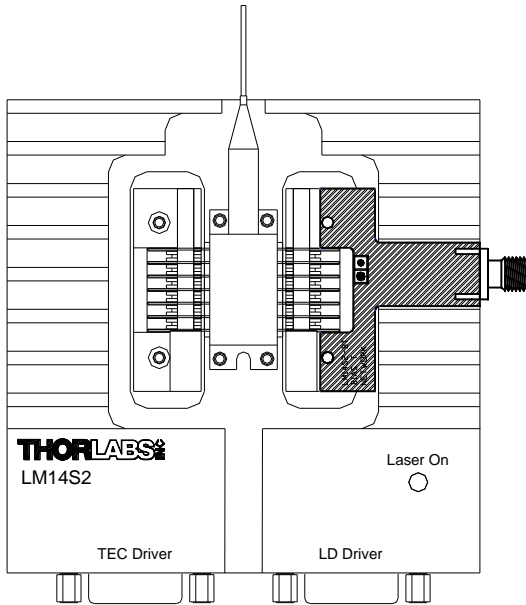
## Chapter 5 Operation

### 5.1. RF Modulation

The LM14S2 has a Bias-T adapter to provide an RF input for modulating the laser with an external RF source up to 500 MHz. The adapter has a 25  $\Omega$  input that is AC-coupled directly to the laser through a Bias-T network. This adapter will only work with butterfly lasers specifically designed with an integrated blocking inductor and an additional 25  $\Omega$  of input impedance (see *Figure Figure 6* below). The adapter makes its RF connection to Pin 12 of the laser diode (typically an anode connection), and the return connection is made at Pin 13. This is a Type 2 laser, therefore the TYPE 2 configuration option should be installed (see Section 4.1). The DC input to this type of laser is applied to Pin 3 of the laser diode.

Install the Bias-T adapter as follows:

1. Install the laser diode as described in Step 7 of Section 4.1. Do not clamp the right side ZIF socket.
2. Remove the two black cap head screws on the right side ZIF socket. The socket will stay in place as it is soldered to the main PCB below.
3. Orient the Bias-T adapter over the right side of the mount with the component side facing down.
4. Carefully place the adapter into the opening in the heat sink fins on the right side, orienting the two pins of the adapter onto Pins 12 and 13 of the laser diode.
5. Install the two stainless steel cap head screws provided in the Bias-T kit. Do not over-tighten.
6. Clamp the ZIF socket down onto the remaining laser diode pins.
7. If the Bias-T adapter is removed, reinstall the black cap head screws removed in Step 2. Do not install the stainless steel screws as they will interfere with the configuration card.



**Figure 6 Installing the Bias-T Adapter**

To calculate the desired RF power to modulate the laser, determine the amount of modulating current needed from the laser manufacturer's data sheets and use the following calculation:

$$RF \text{ Voltage} = (\text{Laser Diode Modulating Current}) \times 50\Omega$$

It is strongly recommended that you start off conservatively by a factor of 10 below the calculated modulating voltage and slowly bring the RF power up until the desired depth of modulation is reached.

Use the laser controller to establish the DC operating point of the laser.



### WARNING



The RF input is directly coupled to the laser. Any excessive transients or noise will be coupled into the laser, and may cause the laser to be overdriven. Also, the laser can be easily overdriven if excessive RF power is applied to this input. Use the RF modulation with care to avoid damaging your laser.



## 5.2. Status and Interlocks

This unit is equipped with two interlock circuits and an LED that indicates if the laser diode is enabled. All three circuits are designed to interface with Thorlabs' laser and TEC controllers with no external circuitry.

If third-party controllers are used to drive the laser diode or TEC elements then **ONLY** the LD ON indicator can be used. To prevent damage to the Status and Interlock circuits, the following external connections should be followed:

1. Install the shorting device into the REMOTE INTRLK connector that was shipped with the LM14S2.
2. Set the TEC Lock switch on the bottom of the unit to "Bypass".
3. Connect a resistor to LD Interface DB9 Pin 1 that is appropriately sized to limit the current into Pin 1 to between 5 and 10 mA.
4. The "driver" side of this resistor should be connected to a DC signal that, when high, indicates that the laser diode is being driven.

If you have any questions regarding these connections, or if you wish to make full use of all the Status and Interlock features with your third party drivers, please contact Thorlabs Tech Support.

## 5.3. Maintaining the LM14S2

There are no serviceable parts in the LM142. The housing may be cleaned by wiping with a soft damp cloth. If you suspect a problem with your LM14S2, please call Thorlabs Tech Support and an engineer will be happy to assist you.

## Chapter 6 Safety Interlock Connections

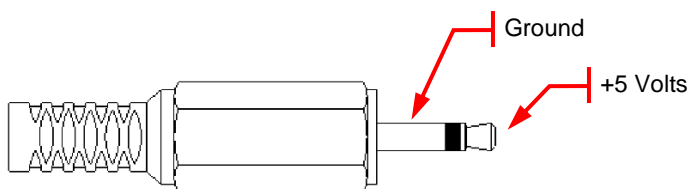
The LM14S2 is equipped with a Remote Interlock Connector located on the side panel. In order to enable the laser driver, a short circuit must be applied across the terminals of the Remote Interlock Connector. In practice, this connection is made available to allow the user to connect a remote actuated switch to the connector (*i.e.* an open door indicator). The switch (which must be normally open) has to be closed in order for the unit to be enabled. Once the switch is in an open state, the laser diode must automatically shut down.

All units shipped from Thorlabs are configured with a shorting device installed in the interlock connector. If you are not going to use this feature then you can leave the shorting device installed and the unit will operate normally as described in the procedures in this manual. If you wish to make use of the interlock feature, you will need to acquire the appropriate connector mate and wire it to your remote interlock switch. Next, remove the shorting device by unscrewing it from the input and install the connector into the interlock input.

The interlock input only accepts a **2.5 mm mono phono jack**. This connector is readily available at most electronics stores (Radio Shack, Digikey, Mouser, Allied, etc.).

The electrical specifications for the interlock input are as follows:

Specification	Value
Type of Mating Connector	2.5 mm Mono Phono Jack
Open Circuit Voltage	+5 VDC with Respect to Chassis Ground (when used in conjunction with Thorlabs drivers)
Short Circuit Current	10 mA DC (Typical)
Connector Polarity	Tip is Positive, Barrel is Ground
Interlock Switch Requirements	Must be N.O. Dry Contacts. Under no circumstances should any external voltages be applied to the Interlock Input



**Figure 7 Remote Interlock Connector**

# Chapter 7 Troubleshooting

## Laser Driver Will Not Enable

If you are using Thorlabs Laser and TEC controllers with your LM14S2:

Possible Solution	Directions
Remote interlock is open	Make sure that either the shorting device is installed in the REMOTE INTRLK connector on the side of the LM14S2. If you have a remote interlock switch connected to this REMOTE INTRLK connector, it must be in a closed position.
TEC element is not active	The internal TEC Lockout is preventing the laser diode from operating. Make sure the TEC control is active.

## Laser Wavelength or Power is Unstable Even Though the TEC Controller Shows Stable Temperature

Possible Solution	Directions
LD is not fully seated	Make sure your laser diode is fully inserted into the LM14S2 laser mount and its body is in full contact with the heat sink base, and the four securing screws are tightened.

## The LDC Series Laser Driver Indicates an “Open Circuit” Alarm When You Try to Enable the Laser

Possible Solution	Directions
LD polarity switch may be incorrect on the driver	In most cases your butterfly laser will operate with an anode grounded polarity. Therefore, set the LD polarity switch on the back of your LDC series driver to AG.

## My Laser Diode Does Not Turn On at All

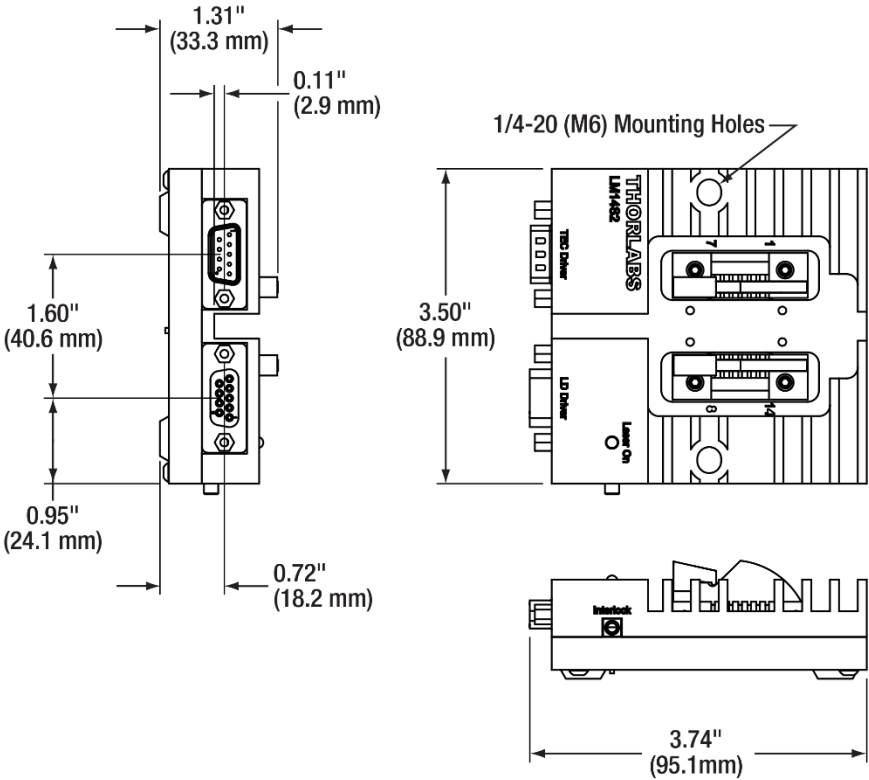
Possible Solution	Directions
The configuration card may be installed incorrectly	Make sure you have the correct configuration card installed and that it is seated in the 24-pin header properly. This is easily checked by turning the unit over and reading the card type in the adapter inspection window (see Figure 1)

## Chapter 8 Specifications

Performance Specifications	
Laser Specifications	
Lasers Supported	14 Pin-Butterfly
Maximum Laser Current	5 A
Laser Pin Configurations	User Configurable
RF Modulation Frequency	100 kHz to 500 MHz
RF Input Connection	SMA
RF Input Impedance	25 $\Omega$ (On Bias-T Adapter)
Maximum RF Power	200 mW or Limit of Laser Diode
Laser Polarity	Anode Grounded (See Section 4.7)
TEC Specifications	
Maximum TEC Current	5 A
Maximum TEC Voltage	Laser Specific
TEC Heating / Cooling Capacity	Laser Specific
Typical Temperature Range (LD Dependent)	0 to 70 °C
Temperature Sensors	Laser Specific

Physical Specifications	
Size (Not Including Ports)	3.5" x 3.5" x 1.25" (88.9 mm x 88.9 mm x 31.75 mm)
Weight	0.6 lb (0.27 kg)

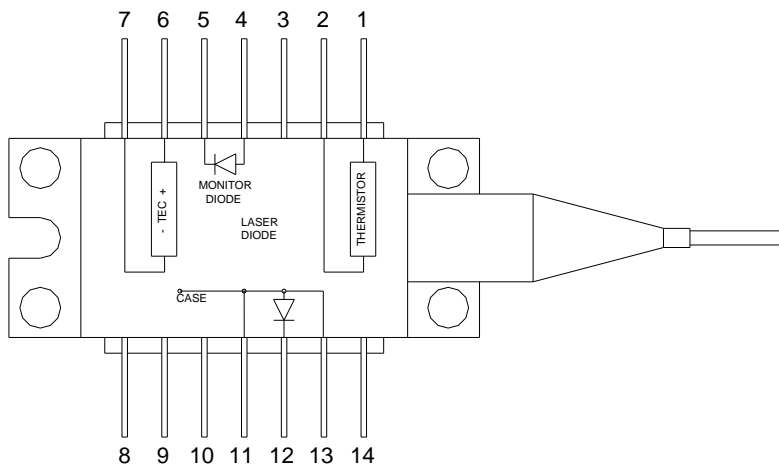
# Chapter 9 Mechanical Drawing



## Chapter 10 Appendix

### 10.1. NEL Module Type STB

The NEL laser diode shown in Figure 8 differs slightly from a standard Type 2 Telcom laser in that the laser diode cathode connection is presented on Pin 3 instead of Pin 3.



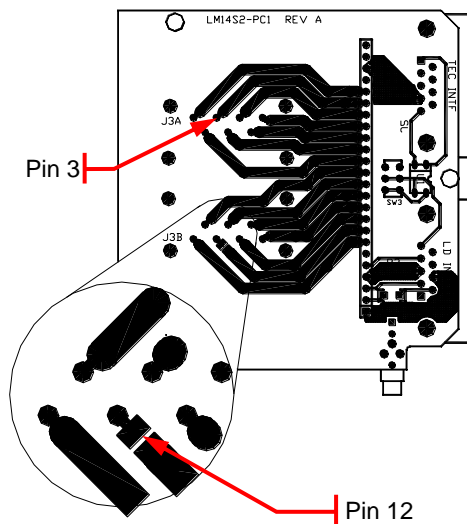
**Figure 8 NEL Type STB Laser**

In its normal configuration, the LM14S2 has an open connection to Pin 12 of the laser diode ZIF socket. This is done to prevent conflicts while using the Bias-T adapter on Type 2 laser diodes with internal Bias-T components (see Figure 5).

To operate this type of NEL laser diode in a CW mode, the following modification can be easily made to the LM14S2 that will connect Pin 12 to the laser diode cathode circuit internal to the mount:

1. Remove the bottom plate and any adapter cards that may be installed, exposing the bottom of the main PCB of the LM14S2.
2. Pin 12 is identified by two adjacent pads with a narrow slit between them (see Figure 9).
3. If you have a Revision A Type 1 / Type 2 adapter card (Rev marking is located next to the "TYPE 1" text), carefully install a wire connecting Pin 12 of the ZIF socket to Pin 3.

4. If you have a Revision B or higher adapter card, carefully flow a small bead of solder across the slit at Pin 12, bridging the two pads.
5. Install the TYPE 1 / TYPE 2 adapter card with the TYPE 2 connector mating with the main PCB of the LM14S2.



**Figure 9 Adapter Card Detail**

## 10.2. Two Port Electro-Optic Devices

The LM14S2 allows for mounting a two port, fiber-coupled, electro-optic (EO) device. Typically these devices will have ports on opposite sides of their packages with fiber-optic cables extending from each port. In some cases, they may contain an integrated thermos-electric cooler or require some form of current input to operate the device. The LM14S2 can accommodate most devices of this type.

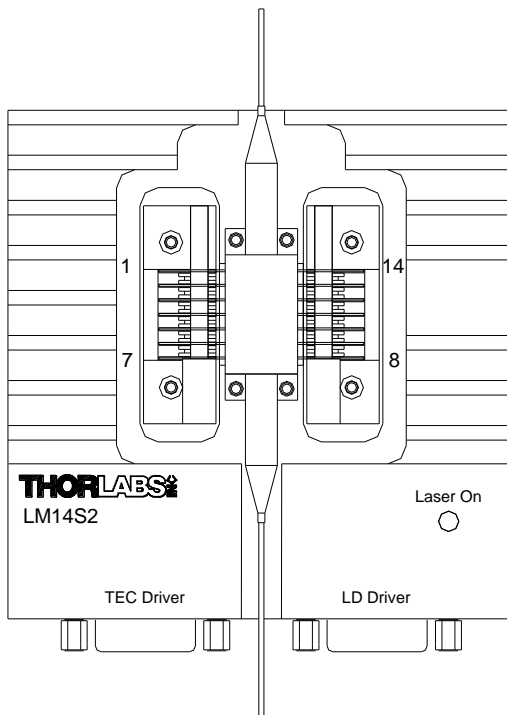
In order to make the necessary connections between the DB9 input connectors and the ZIF socket, you will need to use the Custom Configuration Card provided with the LM14S2. Please review Sections 4.1 and 4.2

When installing the EO device, please observe proper device polarity by orienting the device's pins with the pins on the ZIF sockets according to the pin designations printed to the side of each ZIF socket.

The nomenclature for the custom configuration card applies to laser diode functions, but can easily be adapted to most EO device functions. Please refer to Tables Table 1 and Table 2 for specifics on the connections. If you have problems working out the configuration, please feel free to contact Tech Support for assistance.

**CAUTION**

The LM14S2 is intended for use with negative driven current sources connected to the LDC connection with respect to the LDA input. That is to say, the LDA connection will be grounded and the LDC connection will have a negative potential. The LM14S2 incorporates a diode clamp across the LDA/LDC connections at the DB9 connector. Therefore, if the LDC input is driven positive, the diode will conduct and shunt current directly to the LDA input, bypassing the EO device entirely.



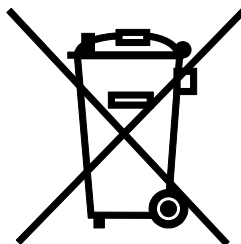
**Figure 10 The LM14S2 with a Two-Port Electro-Optic Device**



## Chapter 11 Regulatory

As required by the WEEE (Waste Electrical and Electronic Equipment Directive) of the European Community and the corresponding national laws, Thorlabs offers all end users in the EC the possibility to return “end of life” units without incurring disposal charges.

- This offer is valid for Thorlabs electrical and electronic equipment:
- Sold after August 13, 2005
- Marked correspondingly with the crossed out “wheelie bin” logo (see right)
- Sold to a company or institute within the EC
- Currently owned by a company or institute within the EC
- Still complete, not disassembled and not contaminated



**Wheelie Bin Logo**

As the WEEE directive applies to self contained operational electrical and electronic products, this end of life take back service does not refer to other Thorlabs products, such as:

- Pure OEM products, that means assemblies to be built into a unit by the user (e.g. OEM laser driver cards)
- Components
- Mechanics and optics
- Left over parts of units disassembled by the user (PCB's, housings etc.).

If you wish to return a Thorlabs unit for waste recovery, please contact Thorlabs or your nearest dealer for further information.

### ***Waste Treatment is Your Own Responsibility***

If you do not return an “end of life” unit to Thorlabs, you must hand it to a company specialized in waste recovery. Do not dispose of the unit in a litter bin or at a public waste disposal site.

### ***Ecological Background***

It is well known that WEEE pollutes the environment by releasing toxic products during decomposition. The aim of the European RoHS directive is to reduce the content of toxic substances in electronic products in the future.

The intent of the WEEE directive is to enforce the recycling of WEEE. A controlled recycling of end of life products will thereby avoid negative impacts on the environment.

## Chapter 12 Thorlabs Worldwide Contacts

For technical support or sales inquiries, please visit us at [www.thorlabs.com/contact](http://www.thorlabs.com/contact) for our most up-to-date contact information.



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