THORLABS

LDM9T
Laser Mount with TEC and Controller

User Guide

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Chapter 1 Safety

All statements regarding safety of operation and technical data in this instruction manual will only apply when the unit is operated correctly.

WARNING

This unit must not be operated in explosive environments

WARNING

Avoid exposure – laser radiation emitted from apertures

Chapter 2 Description

Features

- Ø5.6 mm (TO-46) and Ø9 mm (TO-18) Laser Diodes Compatible
- Integrated TEC Controller
- Bias-T Adapter for RF Modulation of Laser Current up to 1 GHz
- TEC Element Prolongs LD Life and Stabilizes Output Power and Wavelength

The LDM9T is a laser diode mount that features an integrated thermo-electric cooler (TEC) and temperature controller to precisely regulate the operating temperature of a laser diode. This mount is designed for users who wish to temperature control laser diodes without the need for an external TEC controller. By integrating the TEC, the PID loop settings have be tuned specifically for the mount at the factory. The temperature range is limited to approximately 20 to 30 °C due to the size of the package. The TEC control circuit provides a stable, cost effective, temperature platform for laser diodes. This, combined with current control, can be used to stabilize or tune the laser diode wavelength.

The LDM9T is compatible with Thorlabs series of LDC controllers. A four pin socket accepts all Ø9 mm and Ø5.6 mm laser diodes. Easy to use polarity switches allow the laser mount to be configured for most laser pin assignments. A allows The laser can be directly modulated to >1GHz using a 50 Ω RF bias-T.

The mount's safety and protection features include reverse bias protection diodes, remote safety interlock connection, and a TEC lockout circuit that prevents enabling of the laser diode unless the temperature controller is also enabled. The TEC lockout can easily be bypassed by setting an on-board jumper.

The LDM9T mount has a compact design, with a low speed fan to increase the cooling capacity, and still offers the features typical to our other products. The mounting options include multiple #8-32 (M4-0.5 on the /M version) mounting holes, 30 mm cage system mounting holes, and SM1 threaded aperture.

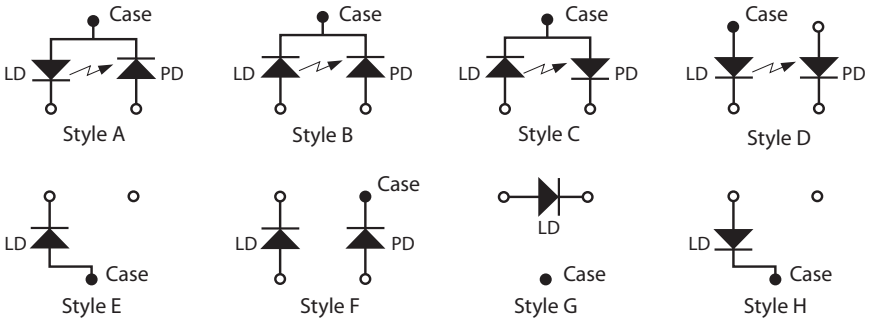


Figure 1 Supported Pin Configurations

Chapter 3 Setup

3.1. Package Contents

- LDM9T Mount
- Ø9 mm LD Flange
- Ø5.6 mm LD Flange
- Replacement Screws
- HK564 5/64" Hex Key
- Operating Manual

3.2. Setup Instructions

- Unpack the laser mount and remove the four 2-56 socket head screws from the top cover using a 5/64" hex driver.
- Remove the two 2-56 socket head screws securing the Ø9mm flange to the copper cold plate with a 5/64" hex driver.
- Determine the laser pin configuration from the laser diode manufacturer's data sheets and set the LD (Laser Diode) and PD (Photodiode) switches on the inside of the LDM9T.

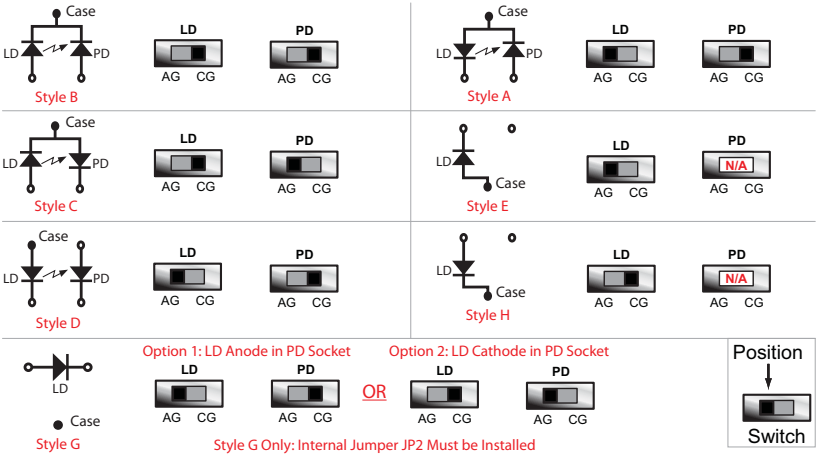


Figure 2 Polarity Switch Settings

- The four sockets comprising the laser diode connector are through hole type sockets.
- Most laser diodes are three pins with the case tied to one of the laser pins and also to one of the photodiode pins. The other laser and photodiode pin will be isolated from the case. The LDM9T was designed to operate the laser case at ground potential therefore this common pin will be inserted into either the 9 o'clock or the 3 o'clock position of the laser connector, marked G. Locate the isolated laser pin and insert it in the 6 o'clock position, marked LD. The isolated photodiode should now be in the 12 o'clock position, marked PD.

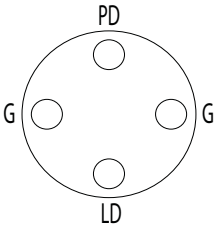


Figure 3 Laser Diode Socket

- Make sure the laser diode is flush with the cold plate. Install the appropriate mounting flange, either Ø5.6 mm or Ø9 mm, over the laser diode and secure in place using the provided screws. A spare set of screws is provided with the mount.
- Lastly, reattach the cover plate using the two 2-56 socket head screws.

WARNING

Make sure the laser diode is installed correctly and the polarity switches on the mount are set as per the laser diode pin configuration provided by the manufacturer. Connecting the LD driver to mount with incorrect installation may damage the laser diode.

3.3. Special Note for 4-pin Laser Diodes

The LDM9T also supports 4-pin laser diodes. Insert the laser into the 4-pin socket and note which laser pin is in the 6 o'clock position (laser anode or cathode). Also, note which photodiode pin is in the 12 o'clock position (anode or cathode). The mount will tie the laser and photodiode pins located at 9 o'clock and 3 o'clock together and also to ground. By noting which polarity pins are inserted in the socket, you can convert the 4-pin layout to one of the 3-pin layouts in Figure 2 on page 4. Set the LD and PD polarity switches accordingly.

3.4. Laser Diodes without a Monitor Photodiode

Laser diodes without a monitor photodioe will also work with the LDM9T. The laser diode pins must be positioned between the LD and G positions. Some 2 pin packages will not align with the laser diode socket, but 3 pin versions can be mounted.

Pin style G is a special case. To properly operate this laser diode style, the internal jumper JP2 needs to be installed. This will short the PD pin to G. The user will need to determine if they want to operate with the LD anode or cathode grounded. The laser diode needs to be oriented so that the preferred grounded LD pin is oriented to the PD pin. This will align the remaining laser diode pin into the LD socket. The laser diode pin oriented toward the PD pin will determine the switch position.

Laser Lead in PD Socket	LD Switch	PD Switch
Anode	AG	CG
Cathode	CG	AG

It should be noted that both PD pins will now be grounded giving eronious readings on controllers with photodiode measurement circuits.

3.5. Mount Power and TEC Control

- Locate the included power supply module and the supplied line cord. Install the line cord into the power supply and plug into an appropriate wall socket.
- Plug the power supply output plug into the LDM9T power input receptacle located on the side of the unit.
- Power the mount using the slide switch located on the top of the unit. The fan should immediately turn on and the Power LED should light.
- As soon as the unit is powered on the temperature will start stabilizing to the setpoint determined by the “TEMP ADJ” knob. Allow a couple of minutes for the temperature to stabilize whenever the unit is powered up or the laser diode average power level is changed.
- To adjust the temperature setpoint simply adjust the Temp Adj knob located on the top of the mount.

3.6. Thorlabs LDC Series Laser Controller Connection

- The LDM9T is compatible with all Thorlabs LDC laser diode controllers. Thorlabs' ITC series combination controllers (LD and TEC) may also be used however the TEC control provided will not be used. It may be necessary to adjust the protection settings to allow operation without the TEC protection provided by the ITC. Appropriate cables are included with our controllers and ensure that the controllers cannot be connected incorrectly.
- The nomenclature for the Laser Diode polarity switch on the LDC40xx and ITC40xx drivers and the LDM9T are consistent with each other. For example, if the laser polarity on the driver is set to "AG" (anode grounded), then the LD polarity switch on the LDM9T should also be set to AG.
- The nomenclature for the Photo Diode polarity switch on the LDC40xx/80xx and ITC series drivers and the LDM9T is as follows: The photodiode polarity switch on the LDM9T must always be set to "CG". The photodiode polarity should be set with the internal Laser controller switch only. For more information on how to set Polarity settings on the Laser controller, please refer to the appropriate Laser Controller manual.

Note: The LDC and ITC series controllers can be used to monitor the photodiode current "I_{PD}". If the sign of the photodiode current "I_{PD}" is negative, the photodiode is reversed. Please double check the laser diode pin configuration and polarity switches before turning on the unit.

3.7. 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 the table below for laser connections.

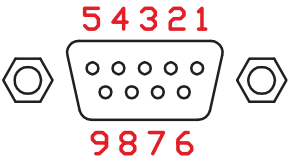


Figure 4 LD Controller DB9 Connection

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' LDC controllers, no external circuitry is required. To use these features with third-party controllers, please see page 8.
5	Interlock and Status Return	This pin is the return side of the Status and Interlock circuitry.
7	Laser Diode Cathode	This pin is connected to the 6 o'clock pin on the laser socket when the LD polarity switch is set to AG (anode ground). Otherwise it is floating.
8	Laser Diode Anode	This pin is connected to the 6 o'clock pin on the laser socket when the LD polarity switch is set to CG (cathode ground). Otherwise it is floating.
3	Laser Ground (Case)	This pin is connected to the 9 o'clock and 3 o'clock pins on the laser socket and corresponds to the settings of the LD and PD polarity switches. i.e., If the LD and PD switches are set to AG, then this pin grounds the anode of the laser diode and photodiode.
2	Photodiode Cathode	This pin is connected to the 12 o'clock pin on the laser socket when the PD polarity switch is set to AG (anode grounded). It is attached to ground and the 9 o'clock and 3 o'clock pins on the laser socket when the PD polarity switch is set to CG (cathode grounded).
4	Photodiode Anode	This pin is connected to the 12 o'clock pin on the laser socket when the PD polarity switch is set to CG (cathode grounded). It is attached to ground and the 9 o'clock and 3 o'clock pins on the laser socket when the PD polarity switch is set to AG (anode grounded).
6, 9	NC	These pins are typically used to monitor LD voltage when used with the Thorlabs LDC series controllers. This mount does not support this feature.

Chapter 4 Operation

4.1. General

Once the laser diode is mounted in the LDM9T and a Laser Diode Current Controller is connected, the device is ready to operate. Please refer to the operating instructions for the laser controller for specific operating instructions.

The LDM9T may be modulated at low bandwidth through the laser controller. This mount includes a high bandwidth bias T circuit that allows RF modulatied signals to be added to the laser controller signal. See RF Modulation below for more details.

The TEC control circuit is always active when powered. The cold plate temperature will stabilize to the setpoint temperature indicated on the TEMP ADJ knob. There is no tuning of PID setting for this system as long as the unit is operated within the safe operating area as described in Section 0.

4.2. RF Modulation

The LDM9T has an RF input for modulating the laser with an external RF source from 200 kHz to 1 GHz. This is a 50 Ω input that is AC-coupled directly to the laser through the Bias-T network. 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 calculations:

RF Voltage = (Laser Diode Modulating Current) x 50 Ω

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 input with care to avoid damaging your laser or mount.

4.3. Status and Interlocks

This unit is equipped with a remote interlock circuit, a temperature lockout interlock circuit 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. These circuits do not directly interface with the laser diode control lines. They are meant to provide a fault to the laser diode controller, which will then safely shut down laser diode operations.

If third-party controllers are used to drive the laser diode, these features may not be used. In this case the onboard interlocking features will not be active and the laser controllers interlocking features must be implemented to provide the required safety protocols. Below is a schematic of the interlock feature.

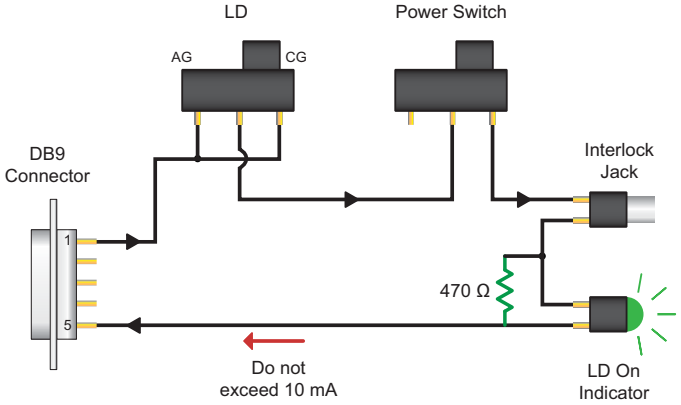


Figure 5 Interlock Connection Schematic

If you wish to make full use of all of the Status and Interlock features with your third-party drivers, please contact Thorlabs and an engineer will help you determine if this is possible and how to implement these features.

4.4. Active Cooling System

The LDM9T incorporates a fan in the heatsink to improve the heating/cooling capacity of the mount. The fan speed is actively controlled to provide the best overall performance when high power loads are installed and to keep noise and vibration to a minimum when light loads are applied. Do not block the fan or prevent it from spinning. This will cause the mount to possibly overheat and go into a thermal runaway condition.

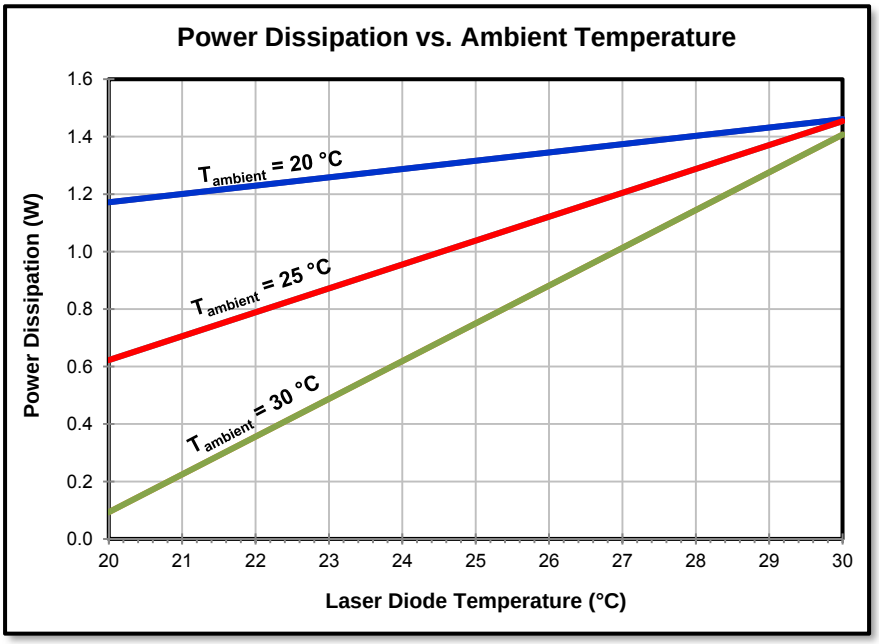
4.5. Safe Operating Area (SOA)

The safe operating area for the mount is basically the area at which the thermal power of the laser diode can be removed and dissipated by the LDM9T. How much power the mount can dissipate depends on a number of factors, ambient temperature and setpoint temperature being the most important. The graph below can be used to determine how much power the mount can efficiently remove and maintaine proper stabilization. Most low and medium power laser diodes will fall within this curve.

To calculate the thermal power of the installed laser diode two factors need to be known, forward operating voltage (V_F) and the operating current (I_{op}). Both are typically published in all laser diode spec sheets.

$$P_{thermal} = (V_F)(I_{op})$$

Blue and violet laser diodes tend to have much higher forward voltage drops meaning they produce more thermal power that needs to be dissipated than a standard laser diode.



4.6. Maintaining the LDM9T

There are no serviceable parts in the LDM9T. The housing may be cleaned by wiping with a soft, damp cloth. If you suspect a problem with your LDM9T, please call Thorlabs and an engineer will be happy to assist you.

Chapter 5 Making Safety Interlock Connections

The LDM9T is equipped with a Remote Interlock connector located on the side panel. In order to enable the laser source, 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 feature does not directly control the laser connections. It only effects the interlock lines on pins 1 and 5 for the laser controller connection. An appropriate laser controller with interlocking support must be used for this feature to operate.

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
Short Circuit Current	~8 mA DC
Connector Polarity	Tip is +5 V, 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

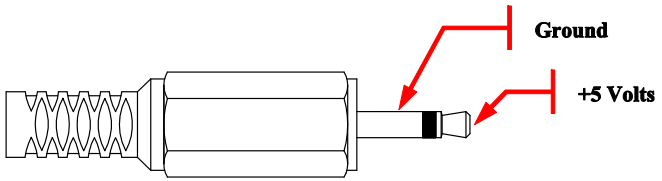


Figure 6 Remote Interlock Connector

Chapter 6 Troubleshooting

Laser Driver Will Not Enable

If you are using Thorlabs' Laser controller with your LDM9T:

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 LDM9T. If you have a remote interlock switch connected to this REMOTE INTRLK connector, it must be in a closed position.
The LDM9T is powered off	The power must be enabled to allow the laser to operate. The power is only supplied to operate the TEC controller, however an internal TEC Lockout will prevent the laser diode form operating when there is no active TEC control.

Laser Wavelength or Power is Unstable.

Possible Solution	Directions
LD is not fully seated	Make sure your laser diode is fully inserted into the LDM9T laser socket and its body is in full contact with the copper cold plate.
LD is mode hopping	The laser diode may be operating on a mode transition. Try adjusting the temperature to shift the laser diode to a more stable operating point.
Mount is set outside safe operation area	Verify the thermal power of the laser diode is operating within the SOA as described in Section 4.4.

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

Possible Solution	Directions
LD and PD polarity switch settings are incorrect	Refer to Figure 2 on page 4 and the data sheet for your specific diode to ensure the proper settings. The LD polarity switch setting on the mount must match the LD polarity switch setting on the rear panel of your LDC series laser diode controller.
LD orientation may be incorrect in the socket	Refer to Figure 3 on page 5 and the laser diode data sheet for you specific diode to ensure proper orientation.

If you still have problems or questions regarding the operation of your LDM9T, please feel free to call Thorlabs and ask for Technical Support.

Chapter 7 Specifications

Performance Specifications	
Lasers Supported	Ø5.6mm and Ø9mm Laser Diodes
Max Laser Current	200 mA ($T_{ambient}$ = 25 °C, VLD = 3 V)
Laser Diode Compliance Voltage	7.5 V
Laser Pin Configurations	All LD Packages Except Style "F"
LDC Modulation Frequency	DC to 200 kHz
RF Modulation Frequency*	200 kHz to 1 GHz
RF Input Impedance	50 Ω
Maximum RF Power	250 mW
Maximum TEC Current	1 A (Internally Regulated)
TEC Heating/Cooling Capacity	0.5 W ($T_{ambient}$ = 25 °C, TLD = 20 °C) See SOA Curve, page 11
Typical Temperature Range	20 to 30 °C
Temperature Stability	<0.02 °C (1 hour) <0.05 °C (24 hour)
Typical Settling Time	<2 min heating, <3 min cooling
Temperature Sensors	10 kΩ Thermistor ±2% @ 25 °C, NTC
Operating Temperature	10 to 30 °C
Storage Temperature	-20 to 70 °C

**Modulate Low Frequencies Through LD Controller*

Power Supply Specifications	
TEC Power Supply	Desktop Switching Supply
Supply Input	12 W
Supply Voltage Output	5 VDC

Physical Specifications	
Laser Polarity Select	Internal Slide Switches
Laser Interface	DB9 Female
Power Supply Connector	2.5mm Power Jack
RF Input Connector	SMA Jack
Interlock Connector	2.5 mm Phono Jack
Indicators	LD Enabled Green LED, Power On Green LED
Size (L x W x H)	3.09" x 2.89" x 1.79" (78.4 mm x 73.3 mm x 45.5 mm)
Weight	0.56 lbs. (1.55 lbs. ship weight)
Mounting Threads	3x #8-32 (3x M4-0.5 for LDM9T/M)

Typical Temperature Response Times

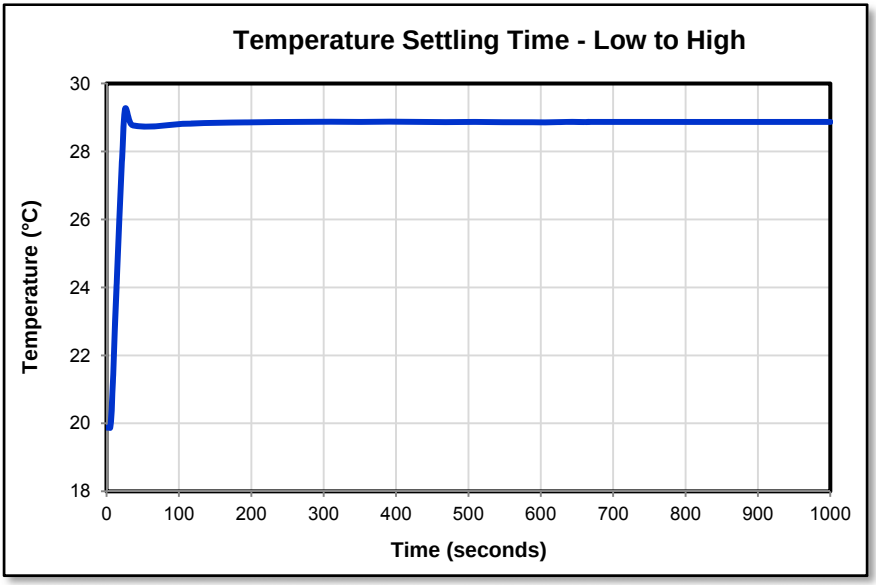


Figure 7 Typical Heating Response

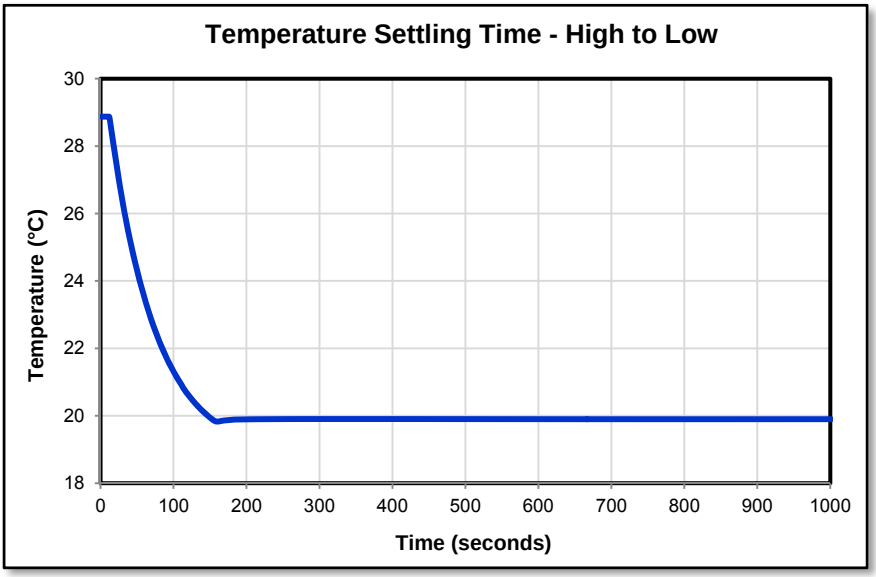


Figure 8 Typical Cooling Response

RF Modulation

RF modulation can be accomplished in one of two ways. For low frequencies (below ~200 kHz), the RF modulator should be connected to the LD controller. Figure Figure 9 shows the performance using the LDC202C. Above 200 kHz, the modulator should be connected to the mounts's SMA connector. The mount has been tested up to 1 GHz, (see Figure Figure 10 below).

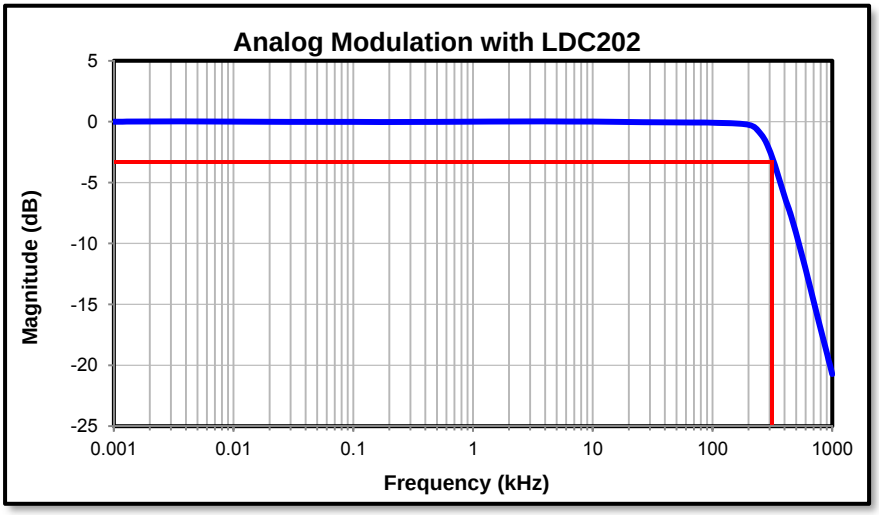


Figure 9 Low Frequency Modulation Through LD Controller

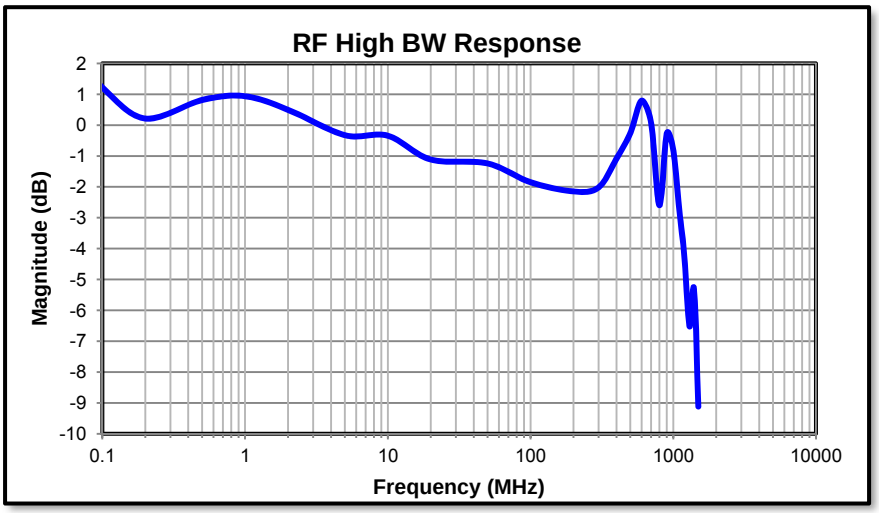
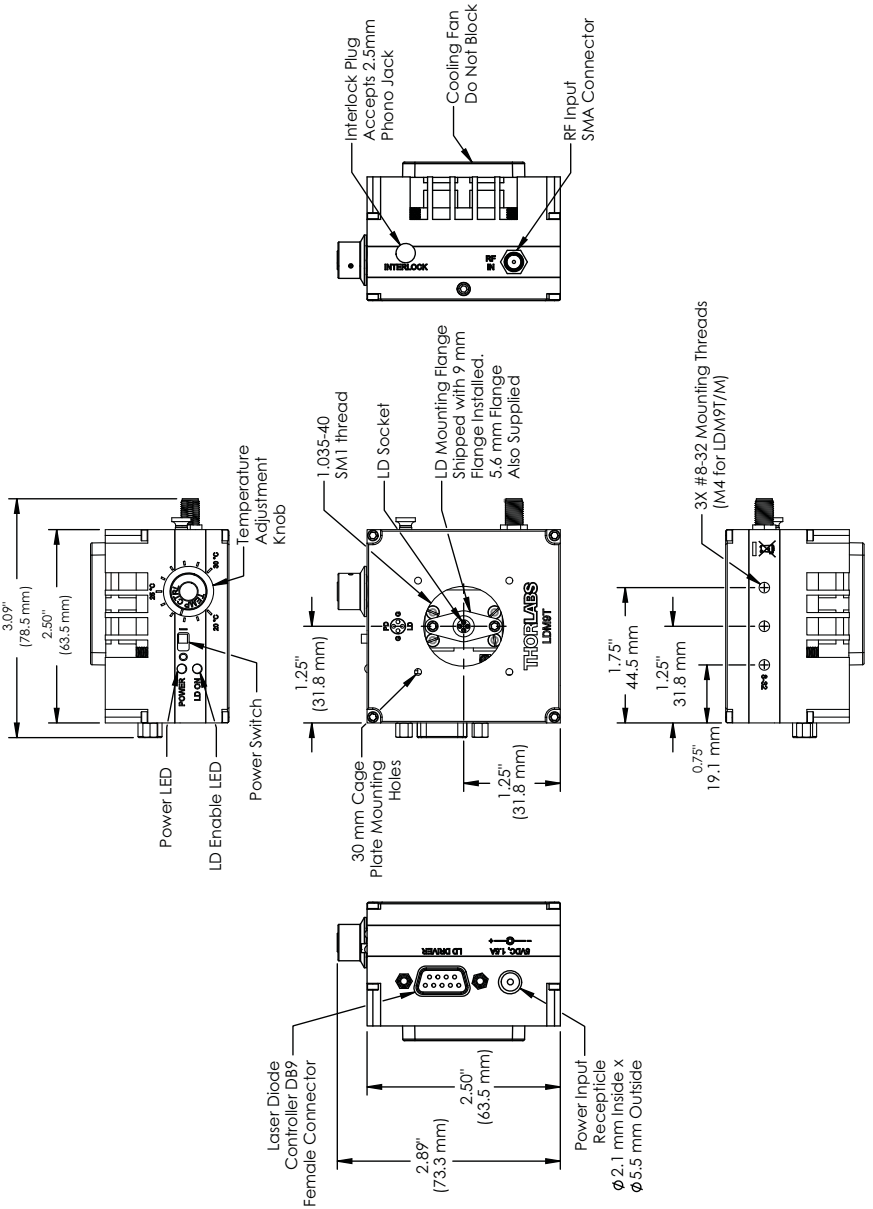


Figure 10RF Modulation Through SMA Connector on LM9LP

Chapter 8 Mechanical Drawing



Chapter 9 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.

9.1. 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.

9.2. 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.

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