

Diode Laser Construction Manual

by Matthew Beede

Parts

Wavelength independent parts

- Thermal Paste
- Epoxy
- Thermistor
 - Electronics shop: 98K8278 Thermistor, NTC, 10K OHM, 5%
- Thermoelectric Coolers
 - <https://www.digikey.com/en/products/detail/coherent-thermal-solutions/RC3-6-01LS/6159109>
- Mirror mounts
 - <https://www.thorlabs.com/thorproduct.cfm?partnumber=POLARIS-K1E2> (Low drift stainless steel)
 - <https://www.thorlabs.com/thorproduct.cfm?partnumber=KM100> (aluminum mount)
- Piezo
 - <https://www.thorlabs.com/thorproduct.cfm?partnumber=PA4HKW>
- Collimation tube
 - <https://www.thorlabs.com/thorproduct.cfm?partnumber=LT110P-B>

Wavelength dependent parts

- Laser Diode
- Diffraction Grating
- Mirror
- Optical Window (should be a wedged window)

Machine shop Parts

- Laser base
- Acrylic Cover
- Acrylic Lid
- Heat Transfer Plate
- Mirror Mount Modification
- Tube Holder
- Grating Holder
- Mirror Holder

Part for these schematics at the [end of manual](#)

Construction Procedure

Step 1: Wiring

The first step is to wire the D9, D15, and BNC and insert them into their places in the Laser Base part. For now leave the wires for the laser diode and piezo unattached to said parts, and just connect the TEC and Thermistor.

Step 2: TEC

To place the Thermoelectric Cooler (TEC) begin by apply a very thin layer of thermal paste to both sides and center it between the 4x 6-32 holes before placing the copper Heat Transfer Plate (HTP) over it and securing it with plastic screws (N632A in the electronics shop), being careful not to crush the TEC.

Step 3: Mirror Mount and Thermistor

Begin by placing the thermistor into the $\varnothing .14$ hole in the back piece and securing it with a set screw. Some thermal paste may need to be used to ensure good thermal conduct, keeping in mind the thicker the paste the poorer the thermal transfer. Once placed the mount can then be screwed onto the HTP, a low head socket screw (8-32 x 3/8) will be needed to accommodate the tube holder. The tube holder can then be attached to the mount as well.

Step 4: Laser Diode and Collimation

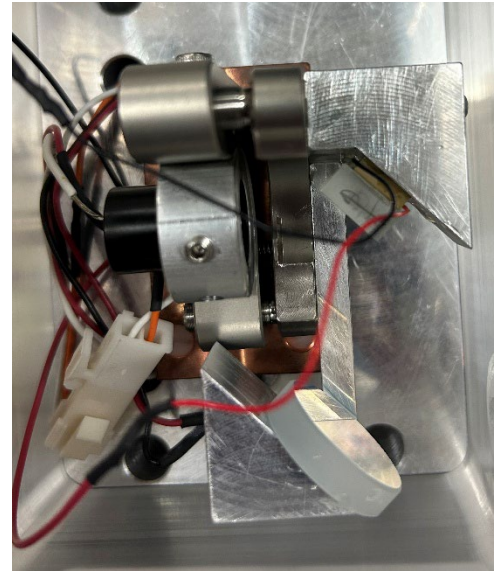
Before soldering the wires to the laser diode place the locking piece and diode holder piece that came with the collimation tube onto both wires. Once soldered together, put the diode into the collimation tube using the threaded piece ensuring the diode is sat correctly in the collar and insert the assembly into the tube holder. Rotate the collimation tube in the tube holder until the line is as close to wholly horizontal using the polarimeter (PAX1000) before locking it with the set screw. The end of the collimation tube should not extend past the end of the tube holder to ensure plenty of room for the piezo and grating.

Before continuing with the rest of the assembly the diode should be collimated. Begin by pointing the laser at a wall at least 10 feet away, preferably 20ft or more, as the further away the better collimation can be achieved. By twisting the outer lens with the appropriate lens wrench, collimate the beam so the shape and size of the beam are constant both near the exit of the diode and the far wall as well as along the length of the beam.

Step 5: Piezo and grating

To figure out where to place the piezo and grating attach the grating holder to the mirror mount and hold the piezo and grating together to the part being careful not to mar the grating

(there are destroyed/damaged gratings that can be used in place of the chosen grating for this step. Move the piezo/grating stack along the grating holder until the beam is centered on the grating and mark this position. Next remove the holder from the mount and use epoxy to attach the piezo ensuring the wired side will be towards the base when the part is attached to the main assembly. Allow the epoxy to set following the instructions on the epoxy bottles/tubes before moving on to the grating. Before epoxying the grating locate the arrow on its side and ensure when placed on the piezo it is pointed back to the laser diode as seen in the image. As before, allow the epoxy to set. With both pieces attached, solder the piezo wires to the correct wires for the piezo.



Step 6: Mirror

As with the piezo/grating, attach the mirror holder to the assembly and move the mirror along the face until the beam is centered on it and mark that position. Remove the mirror holder and epoxy the mirror to it allowing to for it to properly set before reattaching to the assembly.

Step 7: Threshold Test

Begin by setting the current of the diode driver to 35 mA and then centering the beam on the power meter and turning the vertical adjustment of the mirror mount until the power reading increases by several orders of magnitude. Once power has increased to the threshold turn the knob until the power is maximized. This step ensures single mode lasing in the device.

Step 8: Spectrum Analysis

Begin by coupling the light to a single mode fiber cable and attaching the fiber to the spectrum analyzer. Using the spectrum analyzer to read the wavelength(s) of the beam use the horizontal adjustment knob of the mirror mount until the desired wavelength is achieved. The analyzer does not need a lot of light, as such the coupling is unlikely to need to be adjusted unless large movements are needed to get the desired wavelength.

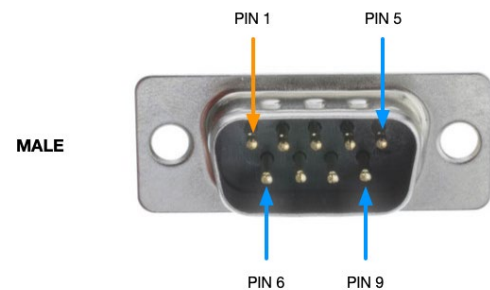
Step 9: Optical Window and Wrap Up

Place the acrylic walls onto the laser device and turn the laser on and mark the place the beam strikes the wall. Remove the beam and drill a hole that is between .0018 -.0029 inches larger than the optical window. The wedged(/slanted) side should face towards the beam/cavity, for further information reference manufacturer's part page. If the hole was drilled out to the above dimensions the window should be able to be press fit into the hole, if not epoxy may be needed to hold the piece in, being careful not to get any on the faces of the window. Finally place a Laser Safety sticker on the side of the laser wall and the laser diode will be complete.

Wiring Manual

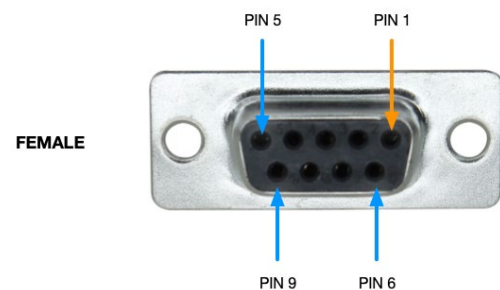
D9 wiring (Laser Diode Current):

- Pins 1/2: connected to each other
- Pins 4/5: Laser Cathode (+ red)
- Pins 8/9: Laser Anode (- white)



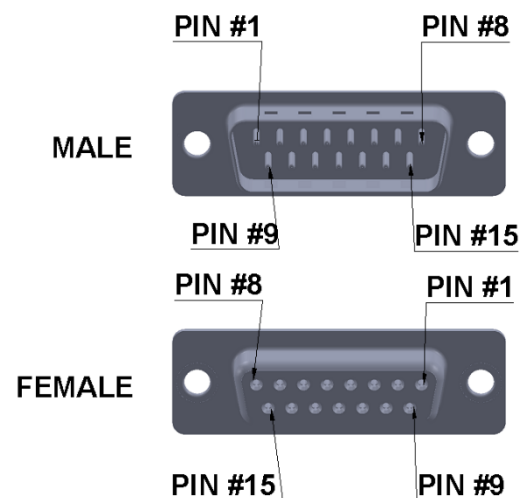
D15 wiring (TEC):

- Pin 1/2/9: TEC Cathode (+ red)
- Pin 3/4/10: TEC Anode (- black)
- Pin 7: 10k Thermistor Cathode (+ orange) slather in thermal paste
- Pin 8: 10k Thermistor Anode (- white) slather in thermal paste



BNC (Piezo):

- Center pin: Cathode (+ Red)
- Outer pin: Anode/Ground (Black)



Machining Files