

Putting Together a Laser Diode

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1 Parts

1.1 Aluminum Block

The aluminum block provides the foundation for the rest of the laser diode. It should include the following holes:

- On the side:
 - 1 DE-9 male connector with a 4-40 threaded hole on either side (diode driver).
 - 1 DA-15 male connector with a 4-40 threaded hole on either side (temperature controller).
 - 1 BNC female head (piezo).
- On the top:
 - Output hole for the DE-9 connector.
 - Output hole for the DA-15 connector.
 - Output hole for the BNC.
 - Four threaded holes to mount the copper plate.
 - Four unthreaded holes for mounting to the table.



1.2 Electronics

- 1 DE-9 male connector (for the diode current controller).
- 1 DA-15 male connector (for the temperature controller).
- 1 BNC isolated female head.
- 4 single-pin headers.
- 1 piezo.
- 1 thermister (Thorlabs TH10K).
- 1 temperature controller (Thorlabs TEC3-6).
- 1 laser diode (Thorlabs L785P090 for example).
- Diode driver (Newport 500B series diode driver).
- Temperature controller.
- Thermal paste.

1.3 Mirror and Grating

- Small mirror.
- Grating.
- Small mirror mount (right).
- Grating mount, 1200 grooves/mm (left).



1.4 Mount

- A mirror mount with one of the corners machined off. Holes will need to be drilled and tabbed to mount the grating and mirror. An unthreaded hole will also be needed for the thermister, a #47 drill should do the trick. The hole should be just below where the diode will sit.



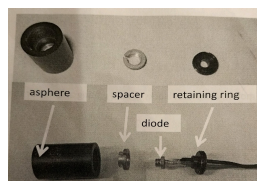
- 2 100 turn/inch actuators.



- Asphere holder.
- Asphere.



- Spacer.
- Retaining ring.



1.5 Screws

- 4 4-40's (attach connectors).
- 4 1/4-20's (attach to table).
- 1 8-32 (attach mirror mount to copper plate).
- attach copper plate to aluminum block.
- 2 () to attach mount asphere.

1.6 Miscellaneous

- Plastic box.



- copper plate.



- screws.

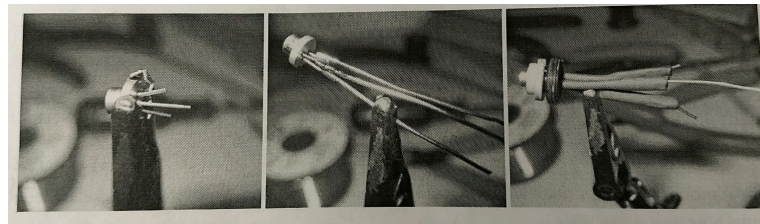
2 Real Big Tip

It will be extremely convenient to put headers on some of the electrical components instead of having plain wires. This is particularly true for the diode and piezo itself because it will make replacing them much easier.

3 Assembly

1. Attach the copper plate to the aluminum block with the plastic screws. The Peltier element should be inbetween. The screws should be tightened so that the Peltier element is in thermal contact with both the copper plate and aluminum block and is gently held in place so as not to break it. Don't forget thermal paste.
2. Attach mirror mount to copper plate.
3. Put thermister in #47 sized hole in mirror mount. Don't forget thermal paste.
4. Assemble the BNC (piezo controller), 9-pin (current controller), and 15-pin (temperature controller) connectors and attach them to the aluminum block.
5. Once the BNC and 9-pin connectors are in place, attach headers to the ends of the leads. This can be done for the 15-pin connector, but it is not as important.
6. Solder the diode. This is the most delicate part of the assembly because the laser diode is sensitive to heat and static. Therefore, static protection must be worn and exposure to the soldering iron must be kept to a minimum (and the soldering iron temperture should not be set too high). In addition to these difficulties, the leads of the diode must fit through the retaining ring. Due to the small size of the retaining ring, this is very difficult. Procedure:
 - Cut off the leads at staggered positions (left picture below). This will prevent bulging once the shrink tube is added.

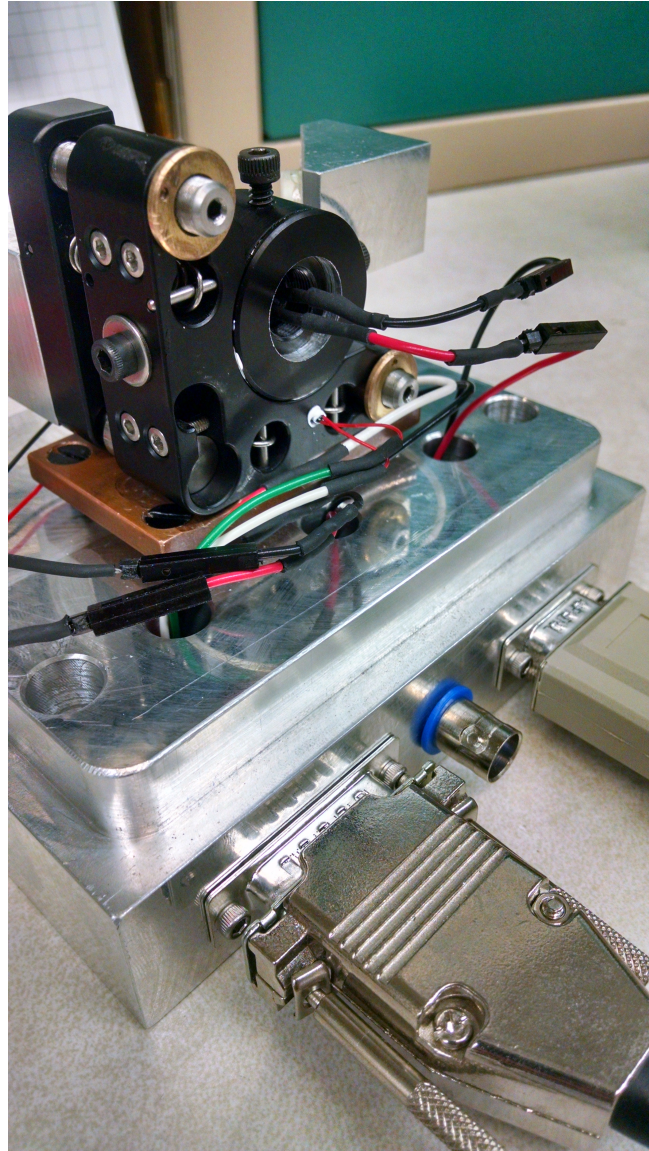
- Solder about an inch and a half of bare, solid wire to each lead in order to extend them (middle). Remember not to get the diode too hot.
- Put 3/4 inch of the thinnest shrink tube available over the leads and slide the retaining ring on (right).
- Add some insulated wire with a header at the end to each of the extended leads.



- Put the diode into the spacer and then screw the retaining ring into the asphere. Put the asphere into the asphere holder and attach it to the mirror mount.
- Glue the piezo to the piezo mount and let the glue dry. Then, glue the grating to the piezo.
- Solder a BNC connector the the piezo leads. Be careful about which lead is ground because the piezo will get damaged if a negative votlage is applied across it.
- Connect all connectors.
- Attach the piezo mount to the (large) mirror mount.
- Attach the small mirror mount to the (large) mirror mount. Mark where the beam hits the small mirror mount to determine where to put the small mirror.
- Glue on the small mirror.
- Adjusting the beam:
 - Collimation: Adjust the asphere using the spanner to collimate the beam.
 - Polarization: Rotate the cylinder containing the diode and asphere so that the long axis of the oblong beam output is vertical. This will ensure the proper polarization is being used for the grating feedback system.
 - Grating feedback: Preform the threshold test:
 - Turn the diode current way down to 20-30 mA. The power output should be around 50-100 μ W.
 - Slowly increase the current noting that the power output is also slowly increasing.

- At a certain current, the output power will begin to rapidly increase. Reset the current to just below this point.
- Adjust the grating angle (top mirror mount actuator) slowly until you see a spike.
- Repeat these steps to hone in on the threshold.

This should ensure the laser output is single mode.



A Diode and Diode Driver Pinout

The laser diode, with its three pins, is controlled by a current driver with a 9-pin output. In practice though, only two of the diode's pins, the cathode and anode, will end up being connected. These diode leads are connected to the DE-9 male connector. Pins 4 and 5 of the 9-pin connector go to the laser cathode and pins 8 and 9 go to the laser anode. None of the other pins are used. The spec sheet for the Thorlabs L785P090 laser diode and the current controller used here can be found on the wiki.

B Temperature Controller Pinout

The DA-15 male connector of the temperature controller attaches to the thermister and Peltier element. Pins 1 and 2 of the 15-pin connector go to the TE+ lead and pins 3 and 4 go to the TE- lead. Pin 7 goes to the Peltier+ lead (called sensor+ in the temperature controller manual) and pin 8 goes to the Peltier- lead. All other pins are not used. See the manuals on the wiki for more info.