

## Laser diode for freely moving optogenetics

**Last update:** Mihaly Voroslakos (2023. August 23.)

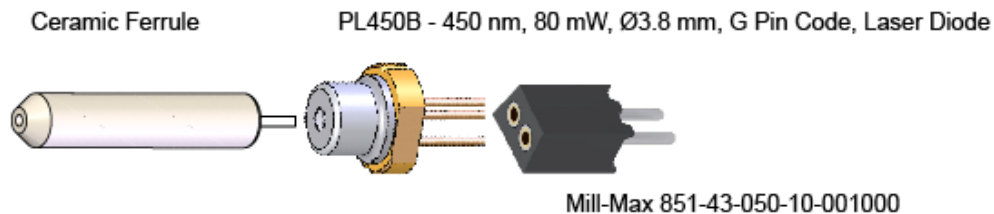
### BOM (Bill of Materials)

- Optrode
  - Silicon probe with an attached optic fiber  
(<https://www.cambridgeurotech.com/optogenetics> or <https://pubmed.ncbi.nlm.nih.gov/22496529/>)
  
- Laser diode coupled to a ferrule
  - Laser diode: PL450B - 450 nm, 80 mW, Ø3.8 mm, G Pin Code
    - <https://www.thorlabs.com/thorproduct.cfm?partnumber=PL450B>
  - Electric Connector: Mill-Max 851-43-050-10-001000
    - <https://www.mouser.com/ProductDetail/Mill-Max/851-43-050-10-001000?qs=FG09h9tFCuBy0jixipu6QA%3D%3D>
  - Ferrule: R-FOC-L200C-50NA
    - <https://www.rwdstco.com/product-item/fiber-optic-cannulae-with-ceramic-ferrule/>
  - Optical glue: Norland61
    - <https://www.edmundoptics.com/p/1-oz-application-bottle-of-noa-61/4209/>
  - Dental cement: Unifast Dental cement (GC America)
    - <https://www.dentalcity.com/product/4150/gc-america-unifast-trad-powder-100gm>
  - Epoxy: 2216 B/A (3M)
    - <https://www.grainger.com/product/3M-Epoxy-Adhesive-2216-2RUD2>
  - Header pin: SAM1067-40-ND (Digi-Key)
    - <https://www.digikey.com/products/en?keywords=SAM1067-40-ND>
  - UV curing cyanoacrylate: 4310 (Henkel Loctite)
    - <https://www.ellsworth.com/products/adhesives/cyanoacrylate/henkel-loctite-flashcure-4310-light-cure-cyanoacrylate-adhesive-1-oz-bottle>
  - 3-axis micromanipulator (RBL13D or similar)
    - <https://www.thorlabs.com/thorproduct.cfm?partnumber=RBL13D>
  
- Current controller
  - Benchtop LD Current Controller: LDC202C (Thorlabs)
    - <https://www.thorlabs.com/thorproduct.cfm?partnumber=LDC202C>
    - Triggering can be done by function generator or PulsePal

- Cyclops LED Driver (Open Ephys)
  - <https://open-ephys.org/cyclops>
- Recording neural data
  - RHD USB interface board
  - RHD 6-ft (1.8 m) ultra thin SPI interface cable
  - RHD 64-channel headstage with accelerometer
- Connecting current controller trigger output to Intan digital input
  - Any two lead insulated wires
  - BNC to wire connector (Mouser)
    - <https://www.mouser.com/ProductDetail/Gravitech/BNC-F-TERM-S?qs=unwgFEO1A6tHUOL9llhrFA%3D%3D>

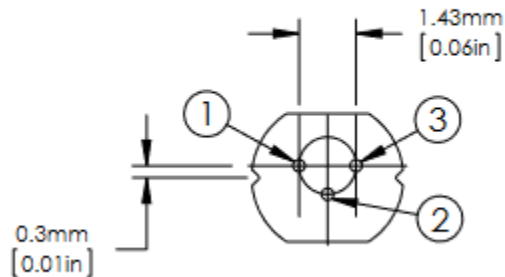
## Detailed explanations of the process

### Coupling laser diode

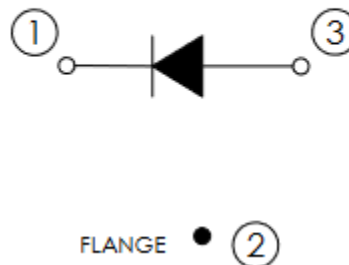


1. Identify anode and cathode on the Laser diode. (This circuit diagram is for PL450-B, check your diode's pin layout and adjust accordingly).

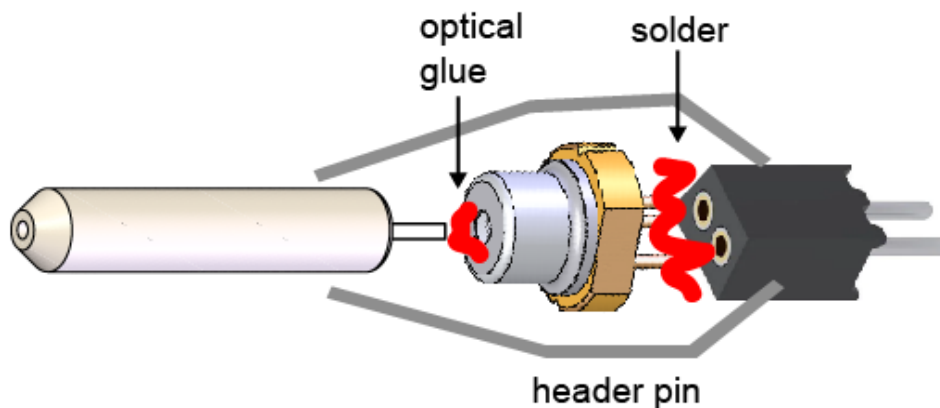
### Rear View



### PIN Code G



2. Remove pin #2. Cut pin #1 and 3 to appropriate length.
3. Solder the Mill-Max connector with the female side to the diode.
4. Mark anode (pin #1) with nail polish (or any other way; diodes are sensitive to current flow; reverse current will damage the diode immediately).
5. Attach Mill-Max to current controller.
6. Measure light power output using PM130D. It should reach the theoretical maximum (80 mW).
7. Using helping hands attached to 3-axis micromanipulator, align optic fiber with diode and measure light output through the ferrule. It should be at least 50 mW. Re-align components until coupling is good enough to produce 50 mW.
8. Apply optical glue between laser diode and optic fiber.
9. Measure light output. It should stay around 50 mW. If light output is below 30 mW, the process should be started all over (most likely you need to discard the diode).
10. After the glue dried, attach header pins between the Mill-Max connector and ferrule. This will serve as mechanical protection. Cut the pins to the appropriate length, bend them in a way not to touch the diode (prevent shorts). Glue two or three pins using UV curing cyanoacrylate. Glue to Mill-Max and ferrule.



11. Apply liquid Unifast dental cement between components. Make sure cement does not flow 'down' due to gravity.
12. After the cement is cured, cover everything with epoxy. Wait 24 hours. Make sure to leave enough space on the ferrule for the alignment sleeve.
13. Measure light output. If it is below 30 mW, discard the laser diode and build a new one (make sure **not to misalign** while glue, cement, epoxy is applied)