



MBARI WISSL G2 Detailed Design

April 2023 Update

TOPICS

- Proprietary Information
- Requirements
- Design Architecture Goal
- Point Spacing Calculations
- Old vs New Housings
- Subsea Connector
- Optical Design
- Receiver Board – build and testing
- Scanner Driver Board – build and testing
- Power Board
- MBARI Feedback

PROPRIETARY INFORMATION

NOTICE: This presentation contains 3D at Depth Confidential and Proprietary information.

In order to better describe some of the design decisions and options, this presentation contains details about the internal architecture and design decisions for 3D at Depth's current 3D laser scanning products. Therefore, this information should ONLY be shared with MBARI employees who need to read and evaluate the presentation. 3D at Depth appreciates our customers taking the appropriate safety measures when distributing this information internally.

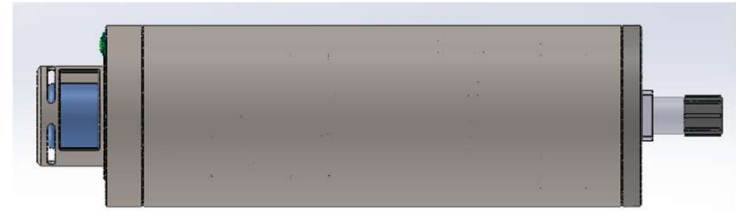
Requirements – WiSSL Gen 2

Reference WiSSL Upgrades Wishlist_R1_1.PDF

Highlighted Requirements	Must	Goal
Depth Rating	4000m	
Size	< 20" diameter, < 3ft long	6.25" diameter, < 20" long
Field of View (FoV)	80°	90° (360° possible)
Range	1-meter to 7-meter NADIR, (10-meter LOS max)	1-meter to 7-meter NADIR, (10-meter LOS max)
Range Precision	Same as Gen 1 (<3mm)	
Angular Precision	Same as Gen 1 (<100µrad)	
Electrical Interface	• 18-36VDC • Isolate all peripherals • Less than Gen 1 (~400W)	Less than 200W while scanning (Probably < 100W)
Timing Requirements	Same as Gen 1 (ZDA + PPS)	PTP – baseline PPS
Software Interface	SL3 plus updates as defined in Documentation	
Scan Rate	< 1cm spacing at 0.5m/s. Current surveys at 3m altitude and 0.2m/s	< 9mm spacing at 0.5m/s at max altitude < 5mm spacing at 0.5m/s at 3m altitude
Temperature		-2.5° C to 350° C per pulse Precision: +/-1° C

Design Architecture Goal

- Primary Design Goal
 - Single housing capable of full 90° FOV (360° possible) that includes both optical components and electronics. This bottle connects directly to the ROV/AUV.
- ROV /AUV Connection: 1x 12 pin connector
 - 18 – 36 VDC (4 wire)
 - 10/100 TCP/IP Ethernet connection (2 twisted pair)
 - 1PPS Timing connection (1PPS twisted pair)
- If can implement PTP timing then can switch to 1Gbps TCP/IP Ethernet connection with same connector
 - WiSSL Gen 2 could support PTP directly
 - Will require MBARI to convert from ZDA & PPS to PTP for WiSSL G2
 - Identified two options for generating PTP using Raspberry Pi4
 - Real time hat: <https://innoroute.com/realtimehat/>
 - Pi4 can also be used directly to measure/generate PTP <https://github.com/raspberrypi/linux/issues/4151>
 - NOT a major focus at the moment



Point Spacing Calculations

Desired

FOV = 90° (can go up to 360°)

NADIR = 7 meter

Speed = 0.5m/s

Desired Point Spacing = 10mm

Calculations

LOS = 10m

Swath = 14m

Number of points per Swath = 1,400

Number of Forward Track Points per Second = 50

Goal PRF = 350kHz

Given scanner implementation

Forward Track Point Spacing = 10mm

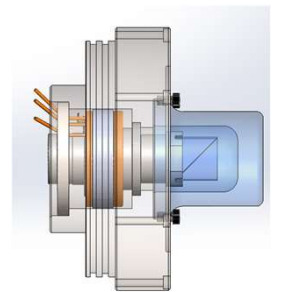
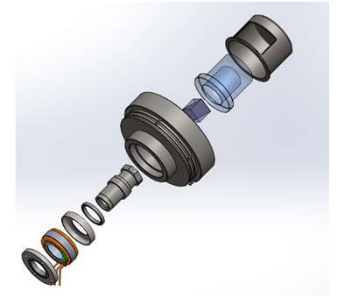
Cross Track Point Spacing = 8mm at 7m altitude

Cross Track Point Spacing = 5.7mm at 5m altitude

Cross Track Point Spacing = 3.4mm at 3m altitude

Speed = 0.3m/s

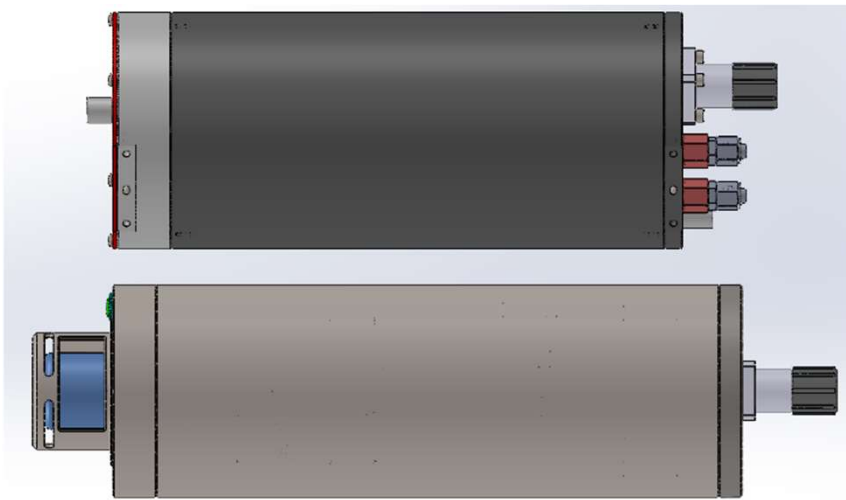
Forward Track Point Spacing = 6mm



Old vs. New Optical Bottles

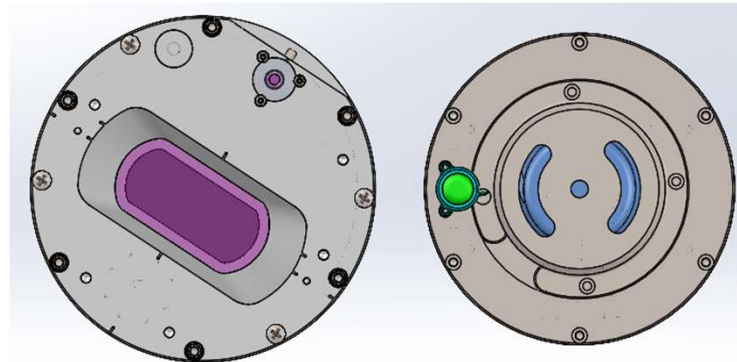
Old Optical Bottle (x2)

- OD: 6.94"
- Endcaps + Tube Length: 16.625"
- Tip-to-tip Length: 20.29"
- Weight of tube + endcaps: 42.41 pounds



New All-in-One

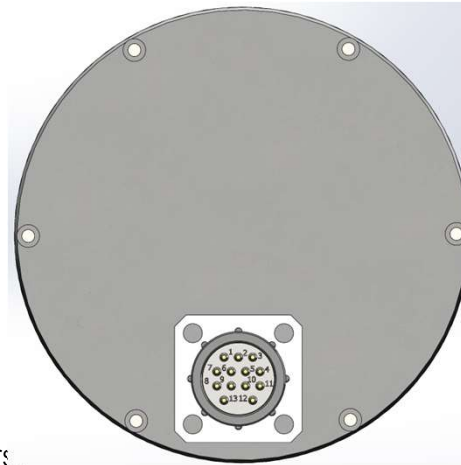
- OD: 6.25"
- Endcaps + Tube Length: 18.45"
- Tip-to-tip Length: 23.60"
- Weight of tube + endcaps: 38.67 pounds
- Tube material: TI-6AL-4V Grade 5
- Output Endcap material: 17-4 PH HH1150
- Connector Endcap material: TI-6AL-4V Grade 5



Single Connector

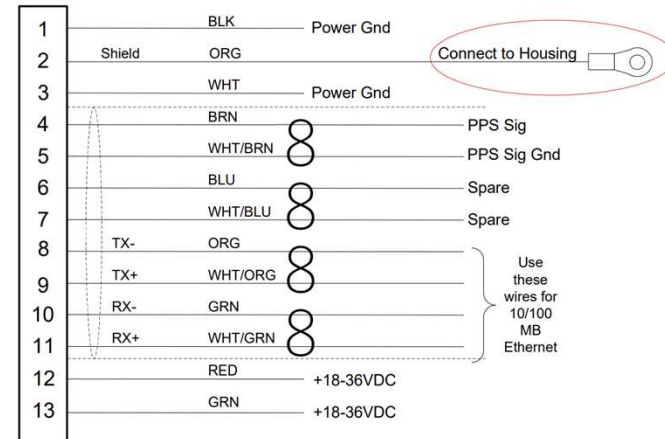
Reduction from 12 connectors across 3 bottles!!

- MacArtney Connector: DFCR2013M
- 13 pins
- Body: Chloroprene rubber
- Flange: 316 Ti

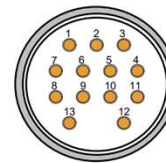


- 2x Power
- 2x Power Ground
- 4x 100Mb Ethernet (2x twisted pairs ,
- 1x PPS Signal
- 1x PPS Gnd
- 1x Cable Shield
- 2x Spare

Power/Comms



MacArtney Male
DFCR2013M
(Mates to DIL13F)



Flange-Mount Male
Mating Face View

Note that the DFCR2013M requires the LS2000-type locking sleeve installed on the cable mating end.



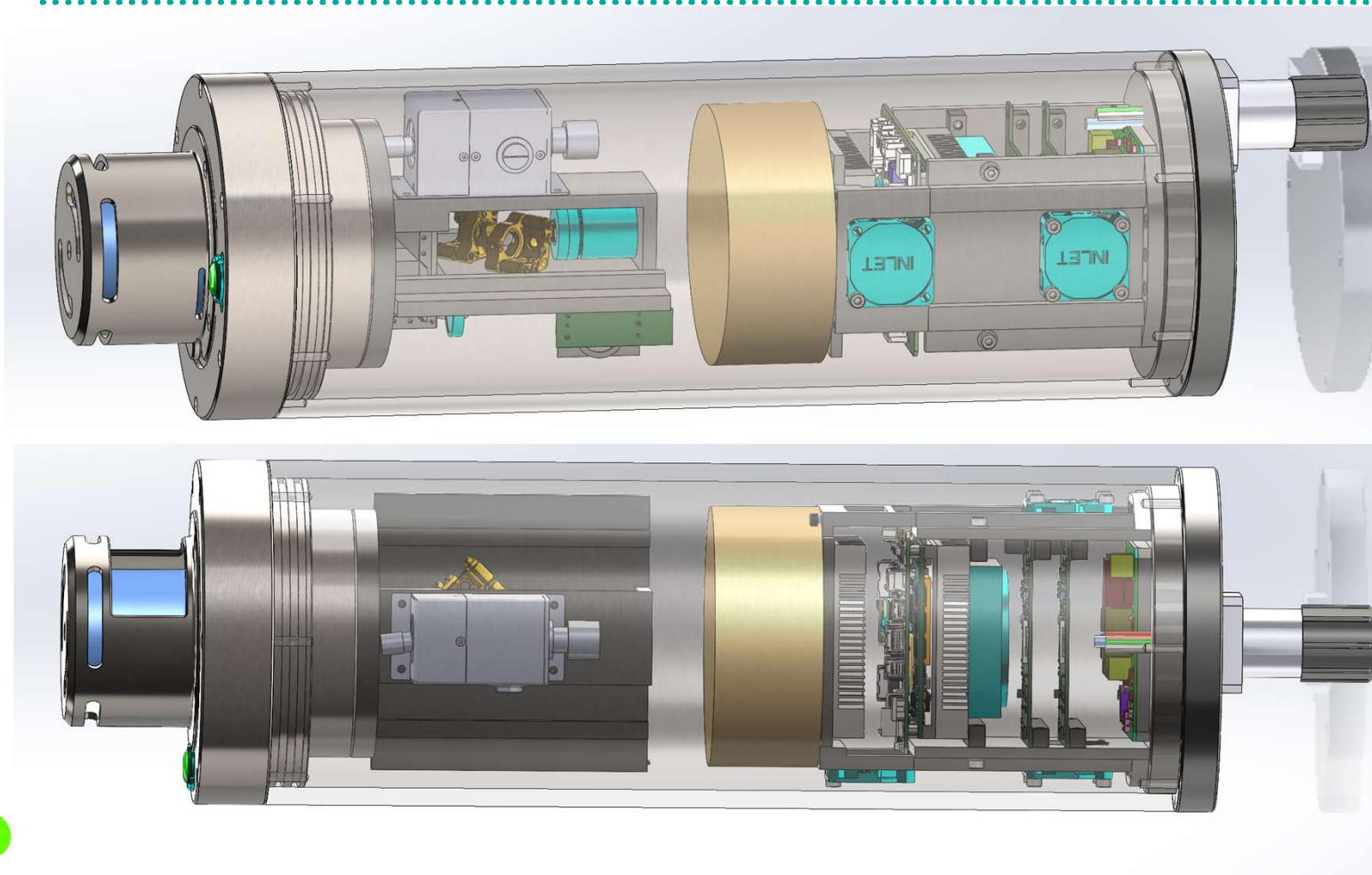
MBARI-22 Electronics Connections
13-Pin MacArtney

DWG NO

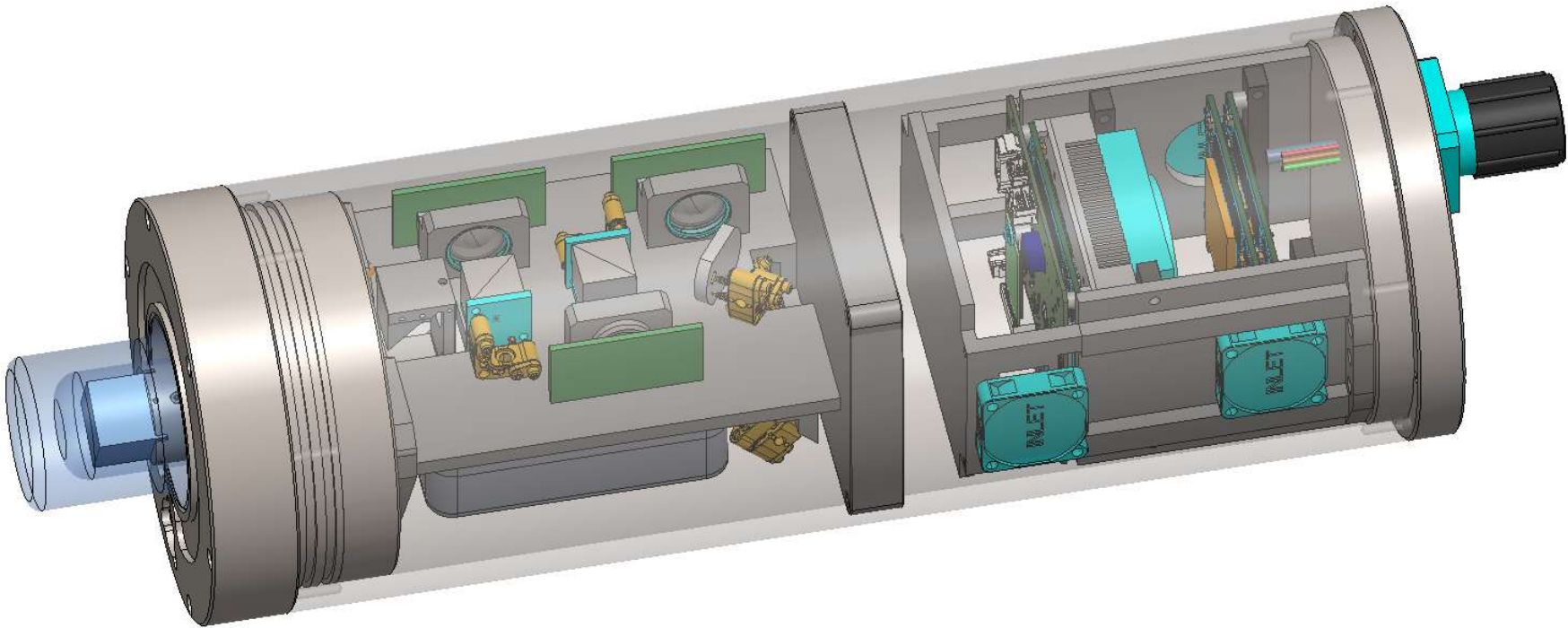
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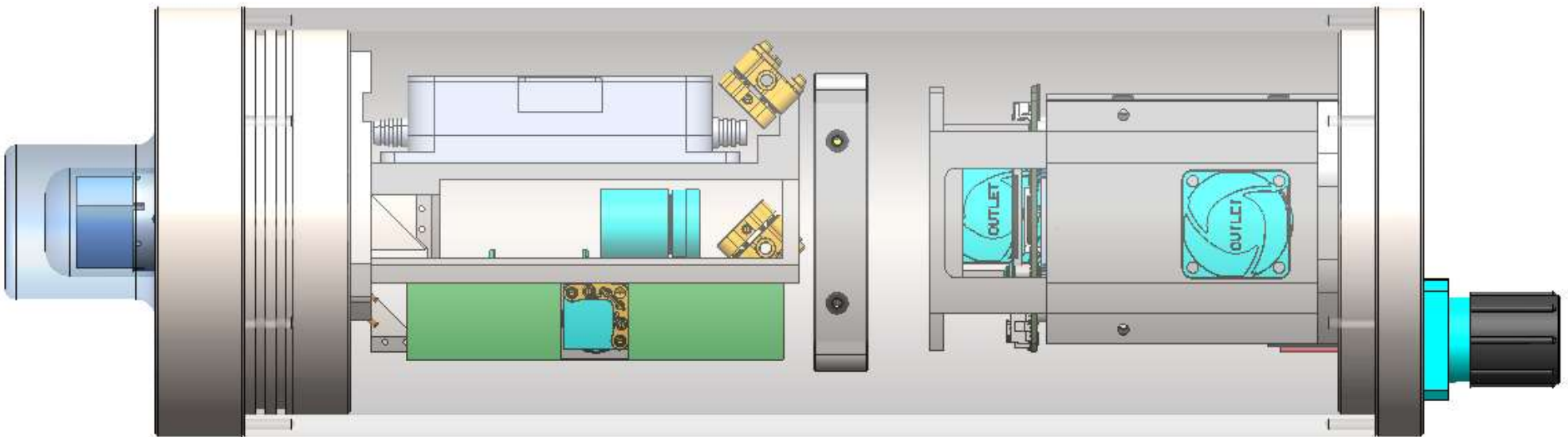
Screenshots of Internals – Initial Designs with Attenuator – Design 1



Screenshots of Internals – Design 2

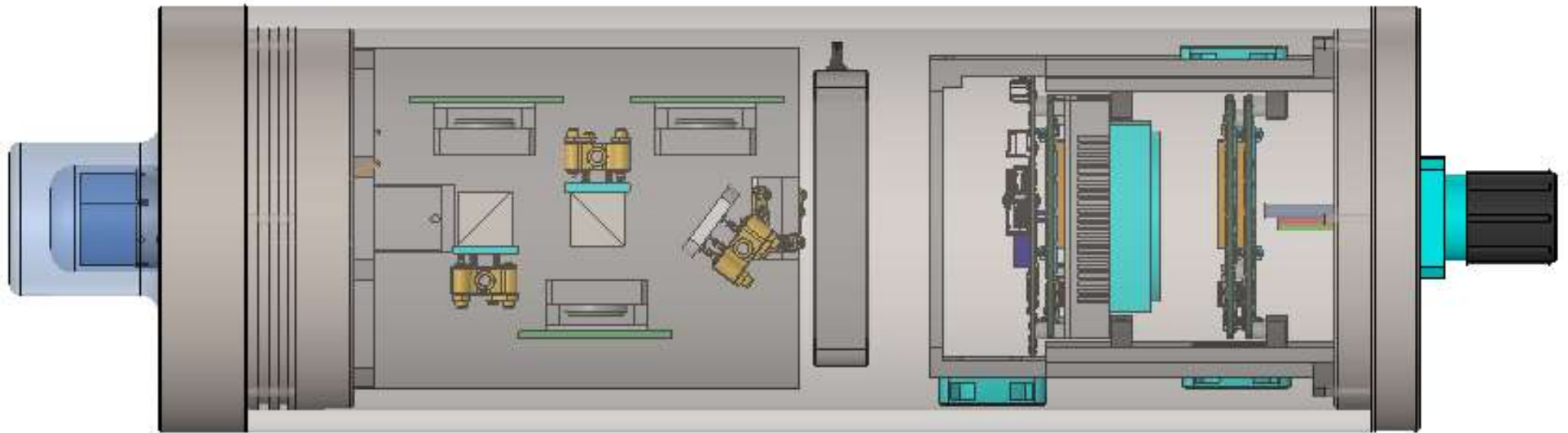


Screenshots of Internals – Design 2



Screenshots of Internals – Design 2

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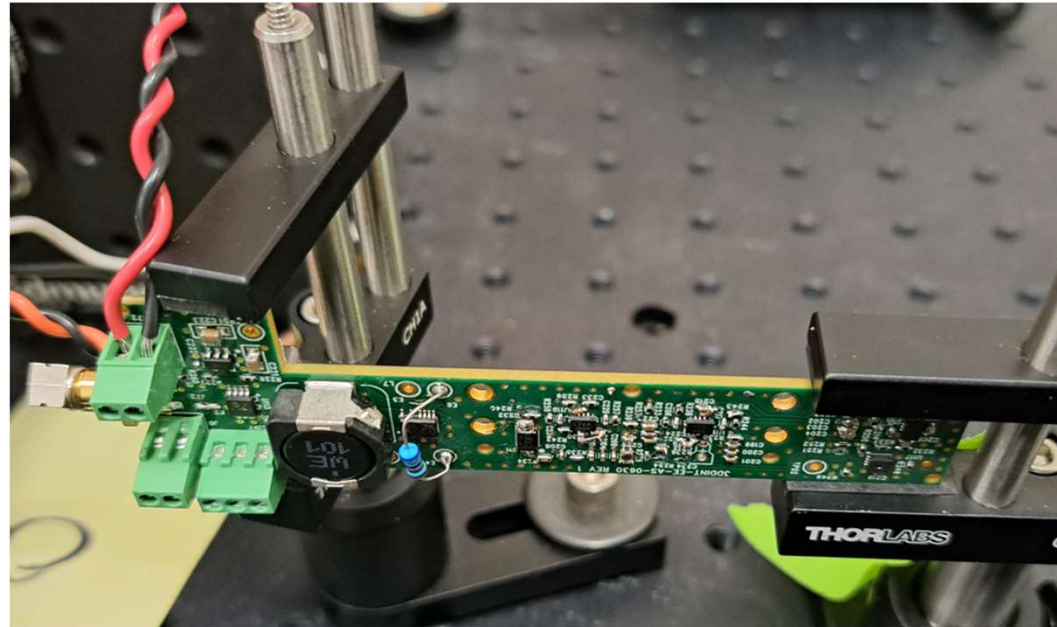
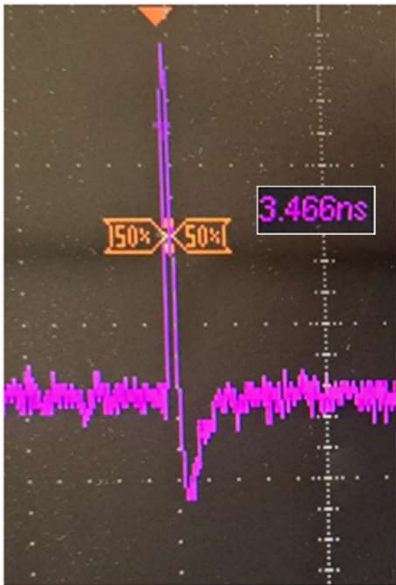


Optical Design

- Received custom spinning prism quote from multiple suppliers: Preferred vendor is \$1,350ea for Qty (5) or \$788ea for Qty (10)
- Received custom corrector lens quote from multiple suppliers: Preferred vendor is \$684ea for Qty (5) or \$610ea for Qty (10)
- Received single quote for custom T/R optic – too high, searching for other suppliers
- Investigating use of Fresnel lens for corrector lens – still under investigation, but back-burner as we have another solution already
- Still investigating laser suppliers
 - Original selection will fit, but supplier is flaky
 - Found two other potentials. One requires a slightly larger package. Still working with their engineering

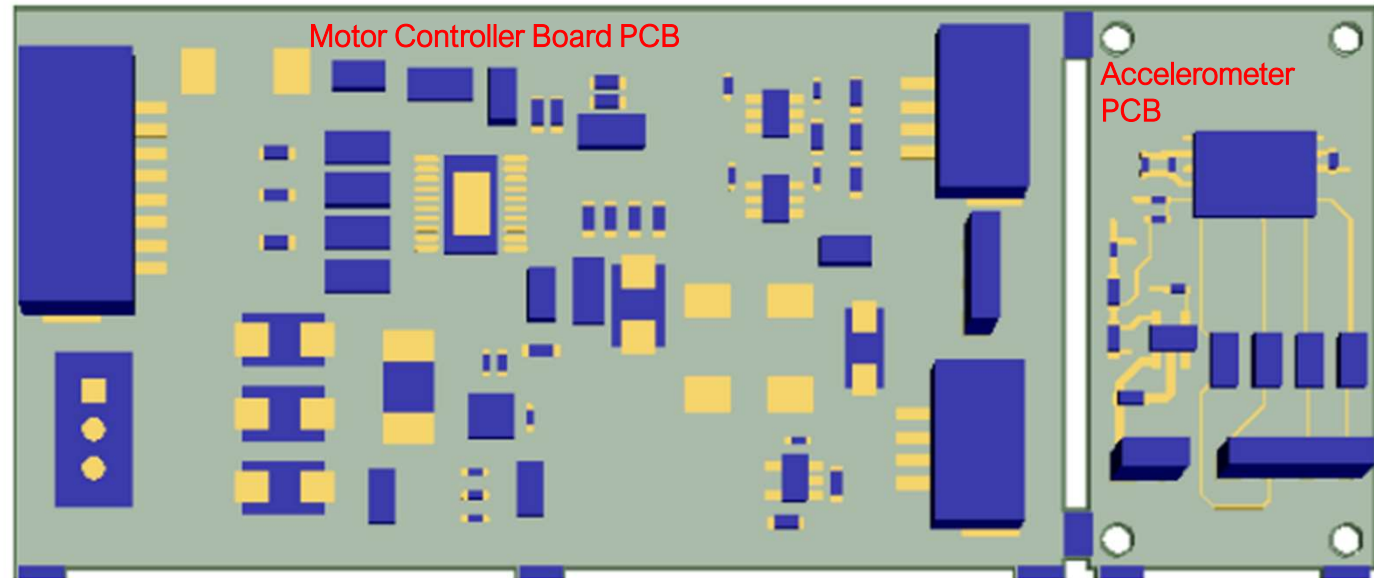
Receiver Board – Design, Build, Test

- Prototype Receiver Board in house; Functioning but optimizing for Bandwidth through simulation and component selection



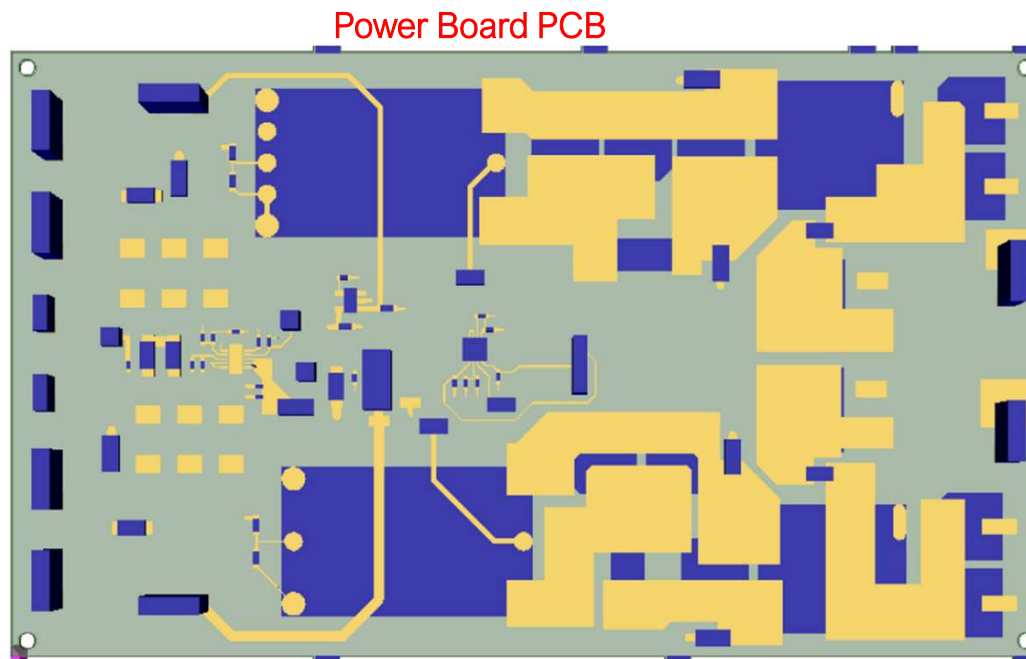
Scanner Driver Board – Test and Design

- Motor Controller Evaluation Board – Functioning with Actual Motor
- Board Design in Progress – Approximately 80% Complete – updating Motor controller
- Accelerometer – MBARI would like to include.



Power Board

- Power Board Approximately 70% Complete; to review Motor Power requirements Voltage requirement TBD – in progress
- Internal Requirements and Design Review to Continue prior to order; ensure sufficient power for new Laser



Input Voltage 18 –36 Volts

1. 12V; <200W General Purpose
2. 5V; <150W – Not to be stuffed
3. 5V; Rx Amps
4. 35V; 22W –TBD Motor
(to add DC/DC for motor TBD)
5. Temp Sensor added w/ 3V

MBARI Feedback

1. Changed to SubConn 13 pin flange SS connector. **Change to Ti connector for Ti endcap**
2. PPS baseline – will not work on PTP for now.
3. An accelerometer attached to the optical bench is useful. Include if easy as a debug device.
4. Mounting / integration points / features need to be defined
5. Define FAT
6. June works for a visit for Phase 2 presentation Late June (after 15th)
7. Need to build schedule / timeline for build stage



Questions ?

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