



MBARI WISSL G2 Detailed Design

January 2023 Update

TOPICS

- Proprietary Information
- Requirements
- Design Architecture Goal
- Point Spacing Calculations
- Old vs New Housings
- Subsea Connector
- Internal Optical Bench – Initial Designs
- Receiver Optical Design
- Scanner Detailed Design
- 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.

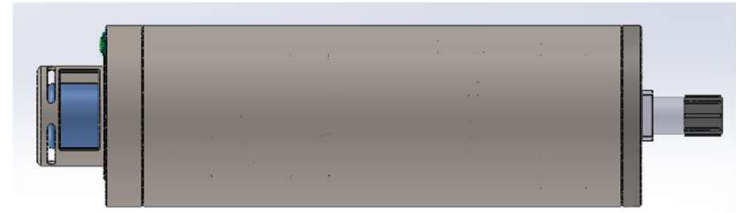
Requirements – WiSSL Gen 2

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

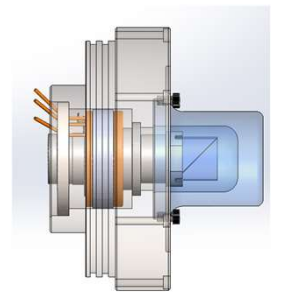
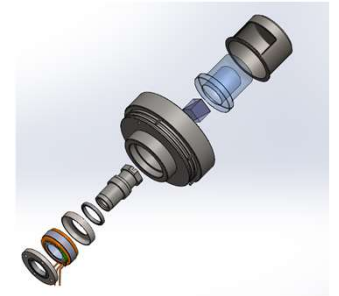
Cross Track Point Spacing = 8mm at 7m altitude

Cross Track Point Spacing = 5.7mm at 5m altitude

Cross Track Point Spacing = 3.4mm at 3m altitude

Speed = 0.3m/s

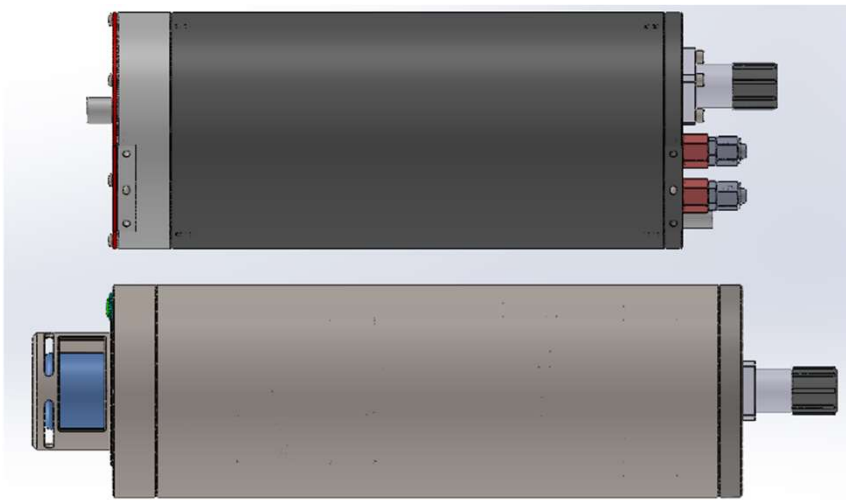
Forward Track Point Spacing = 6mm



Old vs. New Optical Bottles

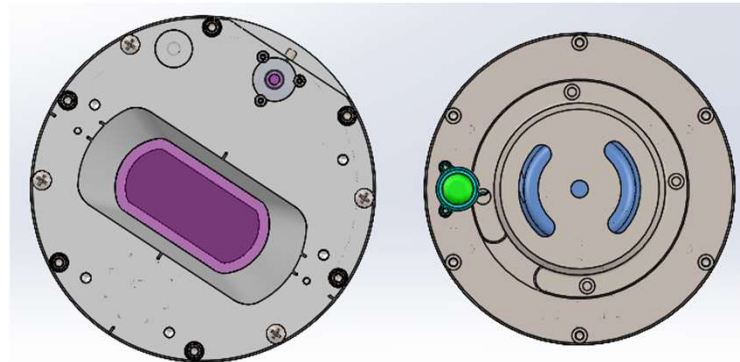
Old Optical Bottle (x2)

- 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

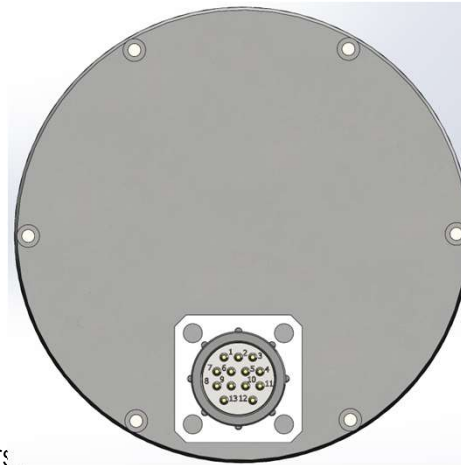


3D at Depth Confidential and Proprietary Information

Single Connector

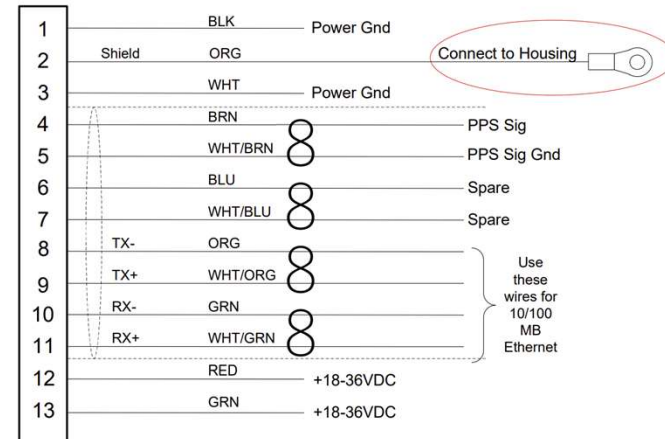
Reduction from 12 connectors across 3 bottles!!

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

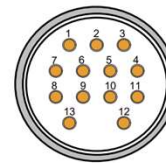


- 2x Power
- 2x Power Ground
- 4x 100Mb Ethernet (2x twisted pairs ,
- 1x PPS Signal
- 1x PPS Gnd
- 1x Cable Shield
- 2x Spare

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

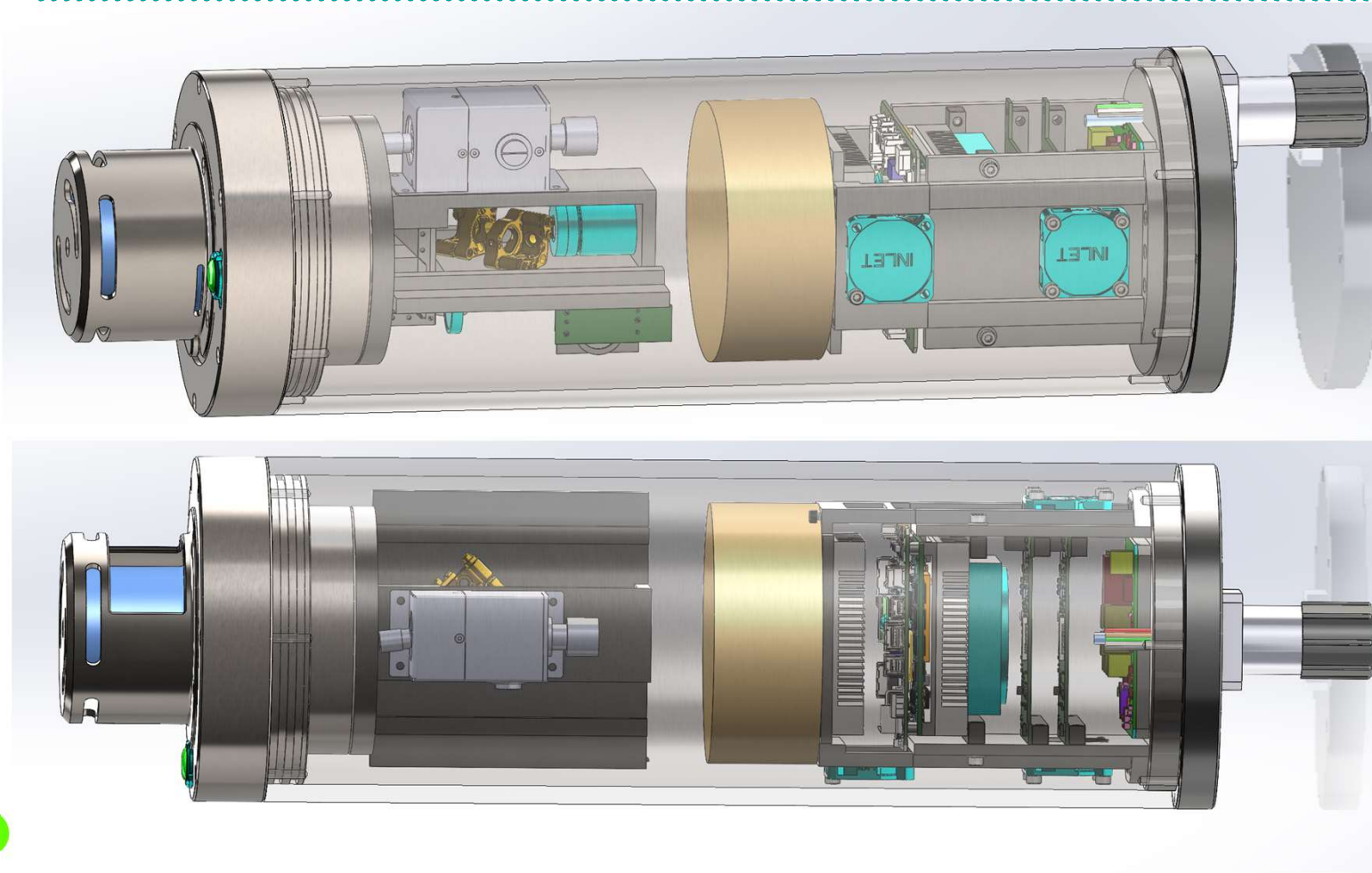
DWG NO

EW0050

REV

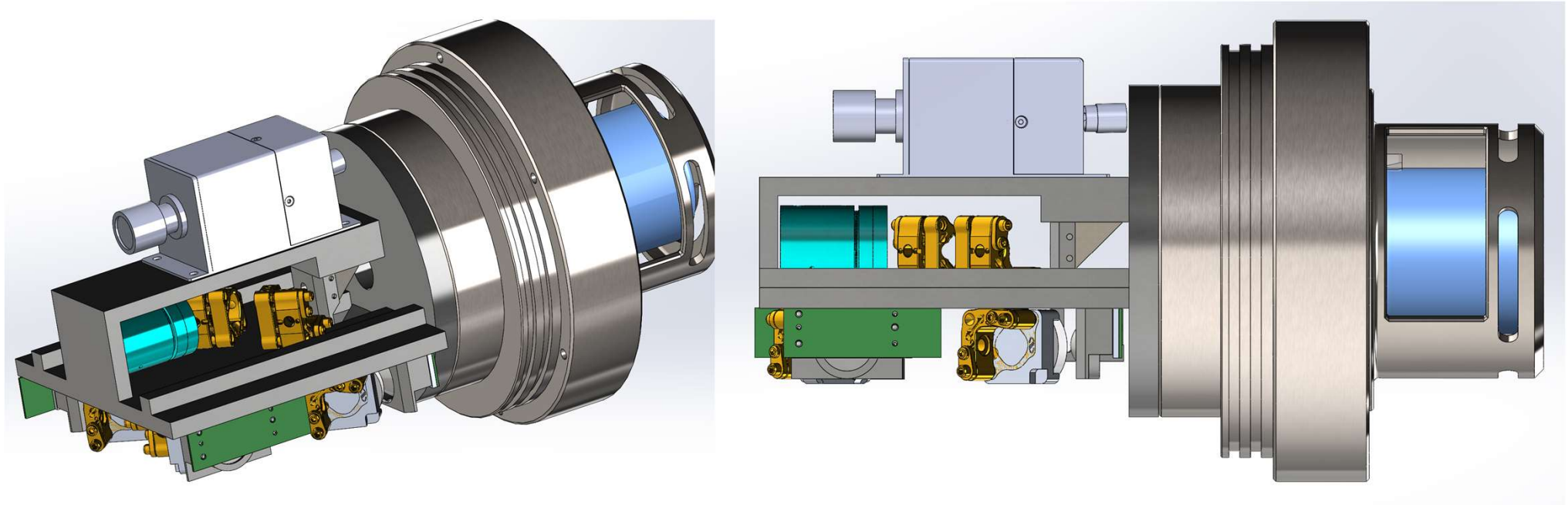
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Screenshots of Internals – Initial Designs with Attenuator



Screenshots of Internals – Initial Designs

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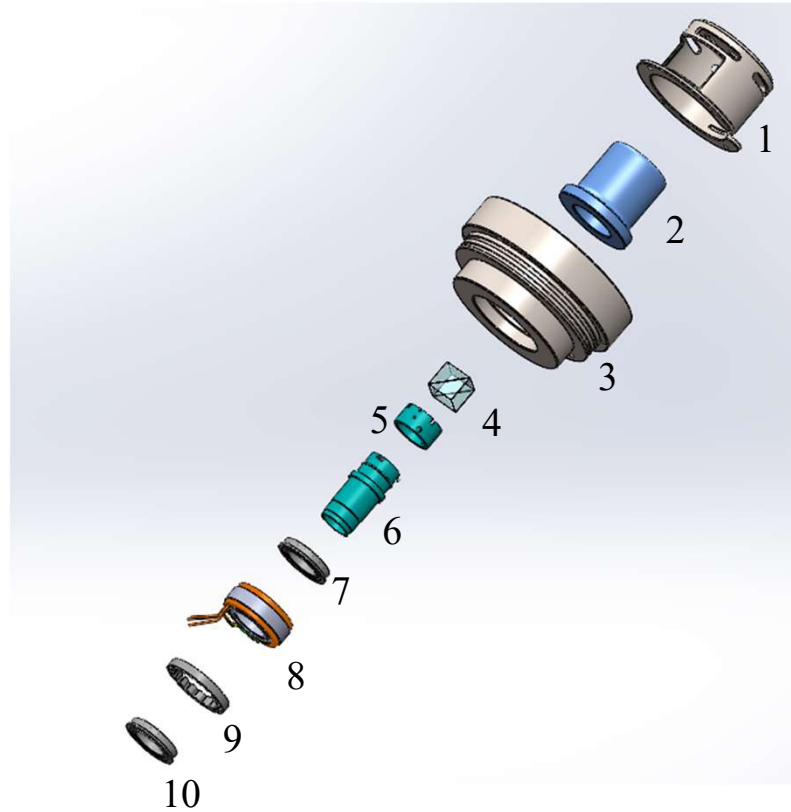


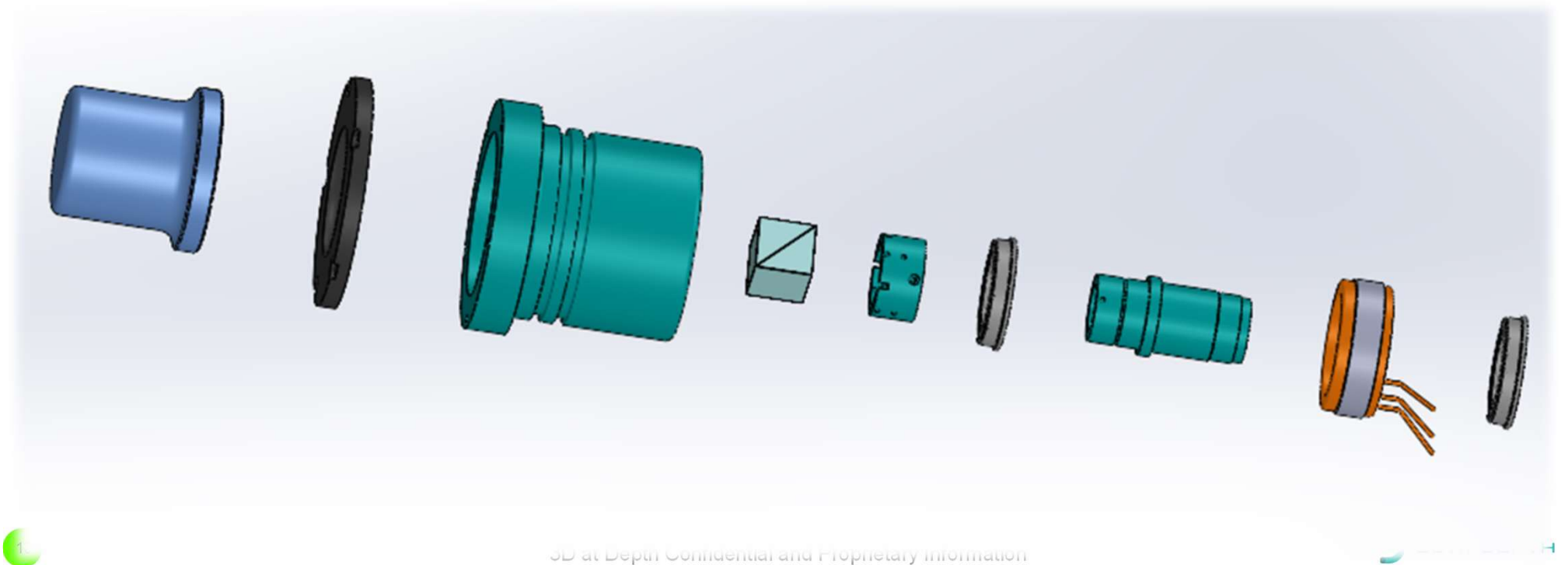
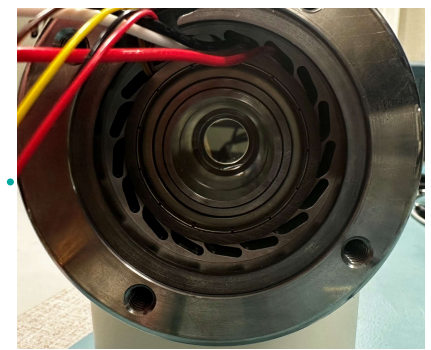
Optical Design

- Sending custom spinning optic out for quotes
- Sending custom corrector lens out for quotes
- Investigating use of Fresnel lens for corrector lens and getting quotes
- Starting layout for temperature receiver system

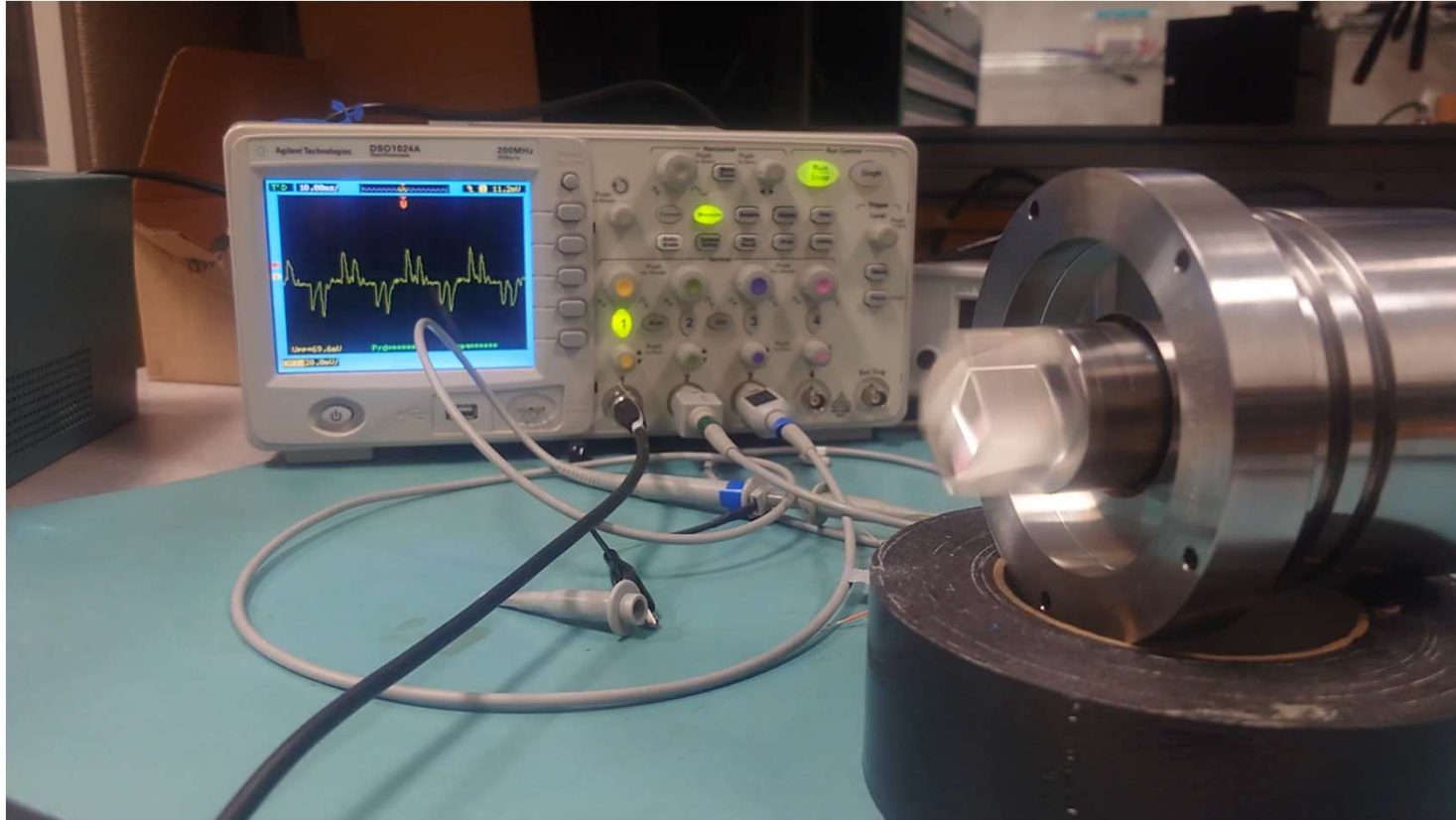
Exploded View – Scanner Assembly

1. Shroud
2. Window
3. Output Endcap
4. Prism
5. Shaft part 1
6. Shaft part 2
7. Ball bearing
8. Motor
9. Deflection reduction
10. Ball bearing

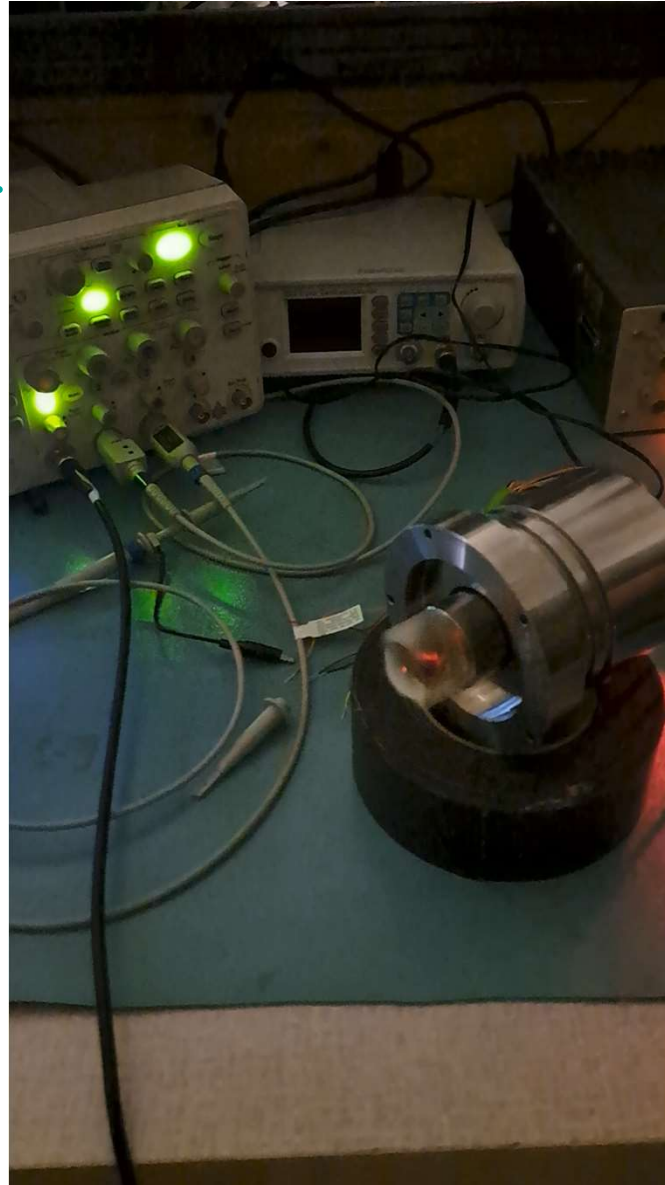




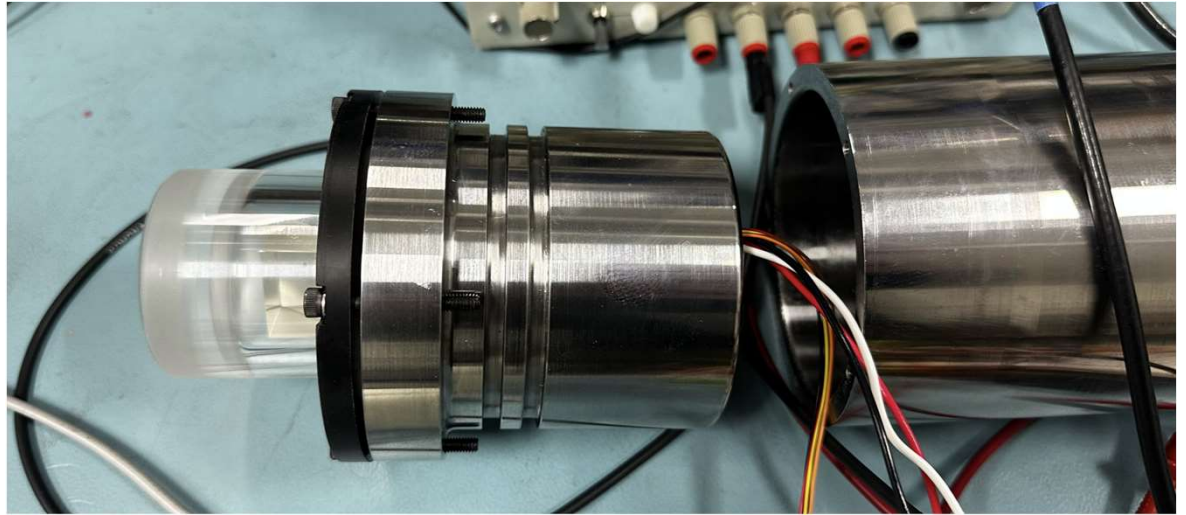
Scanner Assembly



With Laser



Scanner Assembly + Tube



Pressure Testing Results

1. Pressure test at 3,000m
 1. Two 10-minute holds and one 1hour hold
2. Pressure test at 4,000m
 1. Two 10-minute holds and one 1hour hold
3. Pressure test at 10,000psi
 1. Two 10-minute holds and one 1hour hold
4. Pressure test with motor running
 1. No increase in motor torque at 10.5 ksi
 2. See table



Pressure (PSI)	Motor Current (mA)	Notes
0	0.42	
1,000	0.41	
2,000	0.42	
3,000	0.42	
4,000	0.42	
5,000	0.41	
6,000	0.41	
7,000	0.42	
8,000	0.42	
9,000	0.41	
10,000	0.41	Initial
10,000	0.40	After 30-minute hold
10,500	0.40	Initial
10,500	0.40	After 30-minute hold
0	0.41	After de-pressure
0	0.41	After removed from vessel

MBARI Feedback

1. Changed to SubConn 13 pin flange SS connector
2. PPS baseline – will not work on PTP for now.



Questions ?

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