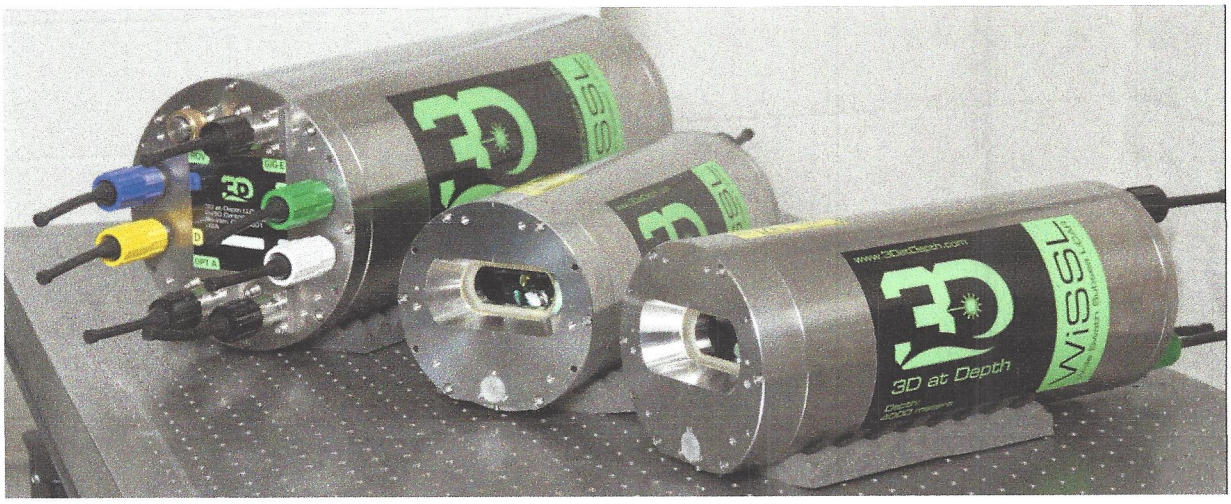
3D at Depth



Wide Swath Lidar

Factory Acceptance Test

Nov. 20-21, 2017

Rev 3.0

3D at Depth LLC
2450 Central Ave Suite J
Boulder, CO 80301

1 Purpose:

The purpose of this document is to capture all the Factory Acceptance Tests to be performed at 3D at Depth's Boulder site with MBARI personnel. A hard copy of this document with MBARI and 3D at Depth representative sign-offs will be delivered with the system.

2 Mechanical:

2.1 Depth Certification of Housings (3) and Cables

2.1.1 All three housings were certified to a maximum working depth of 4,000 MSW (5,875 PSIG) and pressured tested to 7% over working depth, 4,280 MSW (6,290 PSIG).

(SEE END OF DOCUMENT FOR PRESSURE TEST CERTIFICATE)

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2.1.2 The RF cables were pressure tested at the MBARI facility in September 2017. The cables were considered to pass. See report 3DatDepthRFCableTestReport-Sept2017.pdf. All other cables are 6000m rated. The system is being delivered with 6 calibrated RF cable pairs.

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2.2 Mounting Calibration Report

2.2.1 Mounts are rigid and will hold calibration

Validate no slop for mounting of optical heads to frame.

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2.3 Tooling, tools and support equipment

2.3.1 Provide a list of all tooling, tools and support equipment that would be used to service the system.

- See Mechanical ICD for hardware / fastener requirements for interfacing to the mount plate.
- See User's Manual for Field Power Supply (FPS) information.
- See User's Manual for laser safety warnings. One pair of laser safety glasses will be included with the deliverable.

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2.3.2 The following items will be included with the system:

Qty (3) spare Teledyne cable face-seal o-rings will be provided with the deliverable. ✓ ✓
Qty (5) spare anodes P/N M000249 will be provided with the deliverable. ✓ ✓
Qty (2) 10mL SubConn Molykote tubes will be provided with the deliverable. ✓ ✓
Qty (4) spare Handle screws and washers will be provided with the deliverable. ✓ ✓
Qty (4) spare Optical Head Safety Cover screws will be provided with the deliverable. ✓ ✓
Qty (1) Window Cleaning Kit will be provided with the deliverable. ✓ ✓
Qty (12) Total Teledyne RF cables ✓

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2.3.3 Verify shipping crates are stamped heat treated per ISPM 15.

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3 Electrical:

3.1 Measure DC current draw at 48V while idle: 6.00A measured with TCP312A Current Probe. Initial in-rush measured at 3.0A. – July 18, 2017

Performed with MBARI provided 600W power supply: LCC600-48U-9P

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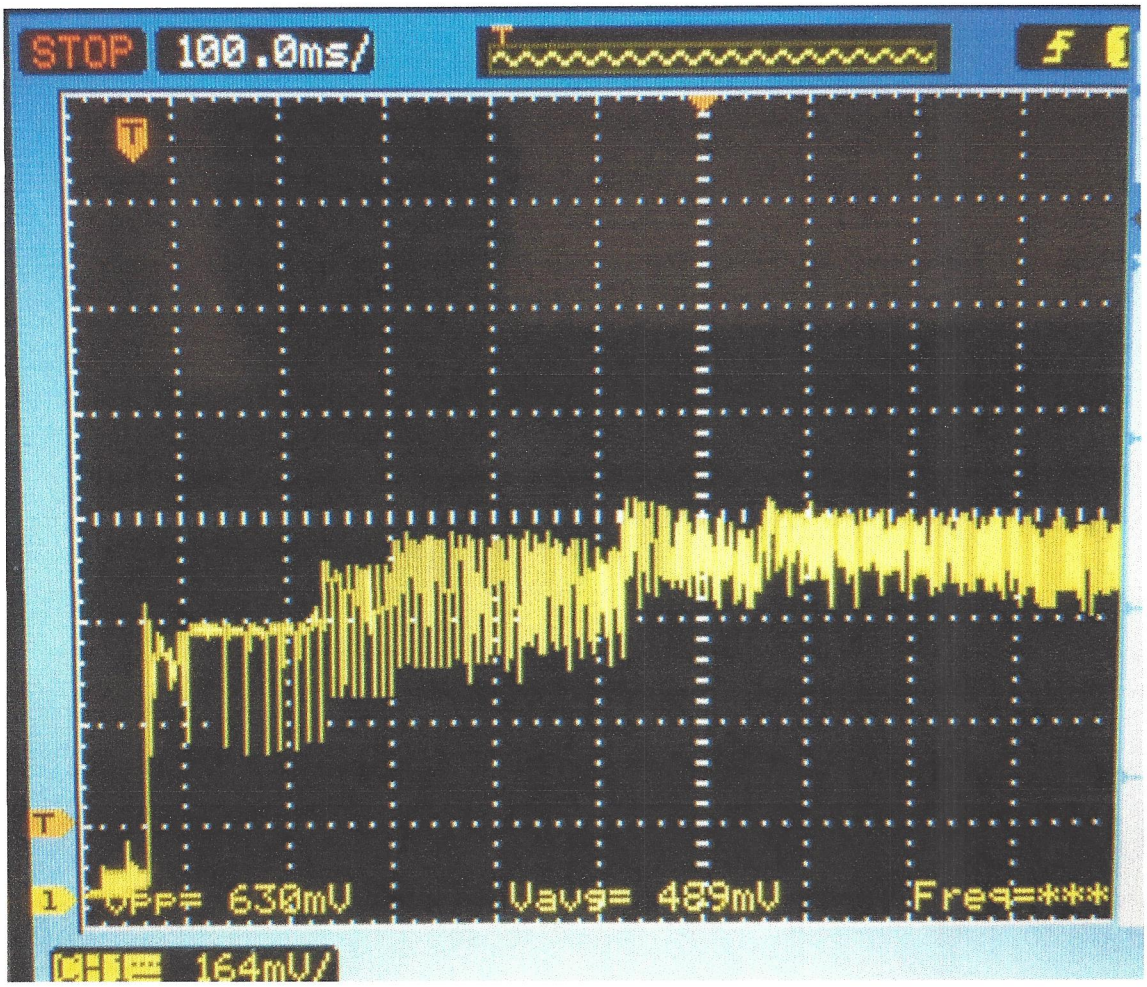

Figure 1. Volts to Amps conversion 10A/Volt.

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3.2 Measure DC current draw at 48V while both heads are scanning:
8.0A measured with same probe. – July 18, 2017

Performed with MBARI-provided 600W power supply: LCC600-48U-9P

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3.3 Let system soak in 1.6ºC salt water (~32 PSU) for approximately 30 minutes to reach thermal stability of 10ºC digitizer temp. Then power on system and perform scans to demonstrate normal operation. Test conducted on July 18, 2017.

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3.4 Measure time that system can operate out of water in idle condition after Test 3.3 before reaching temperature limits: 40 minutes. July 18, 2017 .

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3.5 Pin Isolation

3.5.1 Test system has no faults to case from wet connector contacts. Measured 30uA of AC current b/w electronic bottle and power supply return. Measured 30uA of AC current b/w optical head and power supply return. Nov. 20, 2017

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3.5.2 Demonstrate successful isolation of 1PPS/ZDA input

ZDA input is via Ethernet, therefore is isolated by design.

PPS & PPS ground pins will be validated against housing and all other connector pins.

July 18, 2017.

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4 Software:

4.1 Demonstrate successful real time data collection at maximum acquisition rates. Tested Nov 20, 2017.

Show profile and waterfall graphs while moving objects during scan. ✓ ✓

Show presence of archived data. ✓ ✓

Show scan rates. ✓ ✓

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4.2 Demonstrate CTD input, PPS/ZDA input functions properly

PPS/ZDA demonstrated with in-house GPS, 3D at Depth test software, and visual inspection of both sensor clock synchronized. Tested Nov 20, 2017. ✓ ✓

Demonstrate CTD auto-update across Ethernet with 3D at Depth test SW. Visual inspection of sensor GUI to show updates. Tested Nov 20, 2017. ✓ ✓

Visual inspection of status LEDs on GUI. Tested Nov 20, 2017. ✓ ✓

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4.3 Demonstrate system functions through both Ethernet cables:

Validate 100Mbps communications through primary cable. Tested Nov 20, 2017. ✓ ✓

Validate 1Gbps communications through dedicated Gb connection. Tested Nov 20, 2017. ✓ ✓

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4.4 Demonstrate that topside software can be installed on new topside machine (in case of field failure of acquisition machine)

Documentation of how to perform this ~~will be~~ provided prior to open water trial. Tested July 19, 2017.

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4.5 Step through all GUI operations, functions, and safety features. Tested Nov 20, 2017.

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5 Documentation.

User's Manual document. ✓✓

Hardware Reference Manual document. ✓✓

Installation instructions. ✓✓

Scanner resolution performance table. ✓✓

File RAA format description. ✓✓

Mechanical ICD validation. ✓✓

Solid Model delivered. ✓✓

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6 Performance:

6.1 Qualify swath width of final assembly.

Measure distance to wall and measure scan width on wall. Compare to trig calculation. Tested July 19, 2017.

nWater	1.34
nSapphire	1.76

Measured		
	Sensor Perspective	**Overhead Perspective**
Pointing angle		22.08
Angle in air	38.97817129	61.05817129
Angle in sapphire	20.940616	
Angle if water	27.99672506	
Water Half Swath		50.07672506
Total Swath		100.1534501

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MBARI

11/21/2017

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7 Shipping Manifest

Optical Crate

ITEM	Quantity
Wide Swath Dual Optical Head Assembly	1
Teledyne RF pressure caps (installed)	4
MacArtney 13-pin dummy plug (installed)	2

Electronics Crate

ITEM	Quantity
Wide Swath Electronics Assembly	1
Bottle carry handles (installed)	4
Teledyne RF pressure caps (installed)	4
MacArtney 13-pin dummy plug (installed)	2
Teledyne 12-pin dummy plug (installed)	1
MacArtney 8-pin dummy plug (installed)	1
Signal Processor case (see case checklist below)	1
Wide Swath FPS	1
Teledyne RF cables 5m set w/ dust caps (installed)	6
MacArtney 13-pin cable 5m (right angle)	2
Teledyne 12-pin cable 15m	1
MacArtney 8-pin cable 5m	1
Laser Safety Glasses	1
Laser Safety Documentation	1
Window Cleaning Kit	1
SubConn Molykote tubes 10mL w/ datasheet	2
Spare Teledyne Impulse connector o-rings 5-273	3
Spare Teledyne RF cable o-ring 2-013	10
Spare Teledyne RF backup o-ring 2-012	10
Spare Teledyne RF backup o-ring retainer	5
Spare Teledyne RF cable dust caps	5
Spare handle screws & washers (4/ea)	4
Spare safety cover screws	4
Spare anodes (¼-20)	5

Signal Processor Case

ITEM	Quantity
Signal Processor	1
Signal Processor Sleeve	1
Signal Processor Power Supply	1
Mouse (wired)	1

3D at Depth

MBARI 11/21/2017

DeepSea Power & Light, Inc.
4033 Ruffin Rd.
San Diego, CA 92123-1813
Tel: 858-576-1261, Fax: 858-576-0219

Packlist ID: **DL141985**
CO Number: **DO137483**
Date: 10/11/2017
Page: 1

PACKING LIST

SOLD TO	SHIP TO
3D AT DEPTH 2450 CENTRAL AVE SUITE J BOULDER, CO 80301 Tel: 720-313-0762 Fax:	3D AT DEPTH 2450 CENTRAL AVE SUITE J BOULDER, CO 80301

CUSTOMER ID	CUSTOMER PO	CUSTOMER TAX ID	PAYMENT TERMS/FREIGHT TERMS
3DA001	2017-715		NET 30 DAYS/Freight Collect
SALES REP ID	**SHIPPING METHOD**	**F.O.B.**	**SHIP DATE**
	DeepSea to SouthWest Airlines	Factory	10/18/2017

Line #	QUANTITY				PART NUMBER	DESCRIPTION
	ORD	SHP	BCK	UOM		
1	3					20" Chamber Pressure Test Hourly Rate 20" Chamber Pressure Test Hourly Rate Line provides sufficient estimated time to perform 2 iterations of test profile: 3 cycle 6,285psi 10 min. hold in 20" chamber.
3	1					SHIPMENT PICKUP FROM AIRPORT
4	1					SHIPMENT DROP OFF TO AIRPORT

DEEPSEA Power & Light
4033 Ruffin Road
San Diego, CA 92123
(858) 576-1261

20-INCH PRESSURE LOG

Logbook: 20-17-01
Page: 084

* with Teledyne RP adapter / connectors

Unit Serial #:
Unit Description: W155L
Technician: CFerran
Customer: 3D@DEPTH
Sales Order: DO137783

Test Date: 10 / 11 / 17
Gauge S/N: CM99457TC
Gauge Rated Pressure: 20000
Gauge Last Cal: 10 / 19 / 16
Gauge Next Cal: 10 / 19 / 17

Cycle Number	Time In (24 hr time)	Time Out (24 hr time)	Elapsed Time (minutes)	Start Pressure (PSI)	End Pressure (PSI)	Tech Initials	Comments
1	7:38	7:51	13	0	6285	CF	
	7:51	8:02	11	6285	6285	CF	
	8:02	8:15	13	6285	0	CF	
	8:15	8:18	3	0	0	CF	
2	8:18	8:31	13	0	6285	CF	
	8:31	8:42	11	6285	6285	CF	
	8:42	8:55	13	6285	0	CF	
	8:55	8:58	3	0	0	CF	
3	8:58	9:11	13	0	6285	CF	
	9:11	10:13	62	6285	6285	CF	
	10:13	10:26	13	6285	0	CF	
	10:26	10:28	2	0	0	CF	

NOTES:

☐ Check this box if test is continued on next page. →

W155L - EXCEEDS SCALE THRESHOLD

"A" - 20008.9g 20034.3g
"B" - 20024.1g 20017.9g

~20g Δ is because B had anode attached, A did not.

As the testing technician, I certify that the unit(s):

☑ were tested according to the profile listed above. *(Applicable to Outside Customer Tests)*

☐ (___ Passed) (___ Failed) these tests. *(Applicable to Deep Sea Power & Light Products Only)*

Signature: CF Date of Test 10 / 11 / 17

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2450 Central Ave Suite J
Boulder, CO 80301

DEEPSEA Power & Light
4033 Ruffin Road
San Diego, CA 92123
(858) 576-1261

20-INCH PRESSURE LOG

Logbook: 20-17-01

Page: 010

Unit Serial #: See NOTES
Unit Description: 3 cylinders
Technician: CFERRELL
Customer: 3D at DEPTH
Sales Order: 136946

Test Date: 2 / 21 / 17
Gauge S/N: CM 99957TC
Gauge Rated Pressure: 20000
Gauge Last Cal: 10 / 19 / 16
Gauge Next Cal: 10 / 19 / 17

Cycle Number	Time In (24 hr time)	Time Out (24 hr time)	Elapsed Time (minutes)	Start Pressure (PSI)	End Presssure (PSI)	Tech Initials	Comments
	8:01	8:14	13	0	6290	CF	
	8:14	8:25	11	6290	6290	CF	
	8:25	8:39	14	6290	0	CF	
	8:41	8:55	14	0	6290	CF	
	8:55	9:06	11	6290	6290	CF	
	9:06	9:19	13	6290	0	CF	
	9:22	9:35	13	0	6290	CF	
	9:35	10:36	61	6290	6270	CF	
	10:36	10:50	14	6270	0	CF	

NOTES:

	BEFORE	AFTER
E Bottle	94.35 lbs	94.40 lbs
"B"	44.25 lbs	99.30 lbs
"A"	44.25 lbs	99.30 lbs

☐ Check this box if test is continued on next page. →

As the testing technician, I certify that the unit(s):

☑ were tested according to the profile listed above. *(Applicable to Outside Customer Tests)*

☐ (___Passed) (___Failed) these tests. *(Applicable to Deep Sea Power & Light Products Only)*

Signature: CFerrell Date of Test 2 / 21 / 17