

G3S GLIDER-FINAL PRODUCTION RECORD

SELECT ONE		X		1000M	350M	Schematic Rev	
CUSTOMER		Memorial		CUST. ORDER NO.		R122444-1-1	
				SPECIAL			

NOTE: FILL IN ALL REQ'D DATA, NO EMPTY SPACES, NO DITTOS.

ASSY / PART DESCRIPTION		DWG #	REV	SERIAL #
GLIDER ASSY (FILL IN) PN "GLD-XXX-NFC"		GLD-0102-D	NA	1
SHALLOW FRONT PUMP (SELECT ONE)		N/A	NA	NA
FWD SECTION ASSY (SELECT ONE)		ASSY 305685-1000	305685	B
ALTIMETER ASSY (SELECT ONE)		4457	4407	B
PAYLOAD BAY ASSY - Fill In		PLD-0100	NA	1
STACK-ON BAY - Fill In		Assy 306243-01	306243	B
AFT SECTION		A311317-NFC	A311317-NFC	1
AFT END CAP		ASSY 305654	305654	1
AFT TRAY		A311318-NFC	A311318-NFC	1
PRESSURE TRANSDUCER		ASSY G-1312	3002	C
RADOME FIN		ASSY 304376	304376	D
THRUSTER ASSY		ASSY 302409	302409	NA
Composite Hull, Fwd		ASSY G-1405-L	3135	K
Composite Hull, Aft		ASSY G-1405-L	3135	K
ASSY / PART DESCRIPTION		DWG #	VENDOR SERIAL #	
LITHIUM BATTERY, PITCH		Assy 306523	305523	130
LITHIUM BATTERY, AFT		Assy 305524	305524	118
ENERGY BAY BATTERY		Assy 305523	305523	135
BATTERY, EMERGENCY		306318-NFC	306318	NA
FREEWAVE		ASSY 301784	301784	973-9925
ASSY / PART DESCRIPTION		VENDOR SERIAL #		
IRIDIUM SIM CARD (CUSTOMER SUPPLIED)		8988169234001174002		
ARGOS ID# (CUSTOMER SUPPLIED)		Dec. 224507 Hex. 32197BE		
ASSY / PART DESCRIPTION		VERSION #		
FIRMWARE, COTS TESTING		10.07-RC03 / 4 DS 01/28/22		
HELIUM LEAK TEST				
<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL Initial: <u>AR</u> Date: <u>1/21/22</u>				
NOTES:				

Completion Date	<u>1/21/22</u>	Name (print)	<u>Adam Ritterbush</u>	Initials	<u>AR</u>
Inspection Date	<u>1/24/22</u>	Name (print)	<u>Jessica Guzman</u>	Initials	<u>JG</u>
Review Date	<u>1/28/22</u>	Name (print)	<u>JH Green</u>	Initials	<u>JG</u>



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GLIDER RELEASE RECORD

TO BE COMPLETED BEFORE FACTORY ACCEPTANCE TEST (FAT)
NOTE THESE STEPS ARE LISTED IN THEIR PREFERRED (NOT REQUIRED) ORDER

Step	Test description	Initials/Date	Pass/Fail
1	Glider Ballasting Procedure, Document #4095-GBP Spreadsheet Document #4095-GBPSH	DS 01/28/22	PASS
2	Confirm ballasting in tank (Only necessary if internal ballast was changed.)	DS 01/28/22	PASS
3	Document #4095-GVI Glider Visual Inspection	DS 01/28/22	PASS
4	Document #4095-FSI, #4095-FSI-L or #4095-FSI-L-G3S Glider Final Seal Inspection	DS 01/28/22	PASS
5	Document #301750-HLT Helium Leak Test	DS 01/28/22	PASS
6	Verify Flight Testing is Complete	DS 01/28/22	PASS

FACTORY ACCEPTANCE TEST (FAT) WITH CUSTOMER (IF REQUIRED)

1	Document #4095-FCP, #4095-FCP-L or #4095-FCP-L-G3S Functional Checkout Procedure	DS 01/28/22	PASS
2	(Optional, as requested by customer) Document #4095-CICT Customer Iridium Communications Test	NA	NA
3	Install science sensor covers. For Aanderaa optodes, be sure to fill rubber cover with water.	DS 01/28/22	PASS

COMMENTS:

FINAL APPROVAL FOR PRODUCT SHIPPING

Customer Witness (if Applicable)	Date:
TWR :	Date: 01/28/2022
QA/ Production Supervisor Review:	Date: 1/28/22

Ballasting The Slocum Glider (Spreadsheet)

Reference Ballasting Procedure 4095-GBP

1- Fill in all fields that are shaded in blue

2- Adjust weight by amount in yellow box to go from neutrally buoyant in tank to neutrally buoyant in target water

Glider Name:	Unit 971	
Ballasted by:	DS	
Date:	1/26/2022	
Glider Type:	G2 Deep (1000m)	
Add-ons (check box for each)	G1 Shallow Science Bay	1st <input type="checkbox"/> 2nd <input type="checkbox"/>
	G1 Deep/G2 Science Bay	1st <input type="checkbox"/> 2nd <input type="checkbox"/>
	G2 Extended Science/ Energy Bay (14.85")	<input checked="" type="checkbox"/>
	DVL Bay (5.75")	1st <input type="checkbox"/> 2nd <input type="checkbox"/>
	ES Science/Energy Bay (15.75")	<input type="checkbox"/>
	Mark III Aft End Cap	<input checked="" type="checkbox"/>
	Rockland Scientific Microrider	<input type="checkbox"/>
	SUNA Nitrate Sensor	<input type="checkbox"/>
	Pond Wings	
	Pinger	
Insert Glider-specific Volume Adjustment Here	11.02	
Base Glider Displacement:	46.02 Liters	
Total Glider Displacement:	72.01 Liters	

	Tank Water	Target Water	Weight Change
Temperature and	19.2860 °C	0.0000 °C	-76.1985 grams
(Density or	0.0000 g/L °C	0.0000 g/L °C	
Conductivity or	4.7216 s/m	0.0000 s/m	
Salinity)	0.0000 pss	0.0000 pss	
Calculated/given Salinity	35.0217 pss	0.0000 pss	
Calculated/given Density	1024.9656 g/L °C	1025.5000 g/L °C	38.4824 grams
Total Weight Adjustment:			-37.7161 grams

Drive Weight Material	
Configure 2 Drive Weights, Each Weighing (g)	

Battery Type:	Lithium	weight (kg)
Pitch Configuration	Lithium Pitch Pack	8.5006
Science/Energy Bay Configuration	Secondary Lithium Pitch Pack	8.506
Aft Configuration	Lithium Aft Pack	9.8542
Nose Configuration	1 pack nose	0.5886

Note: This spreadsheet consists of 3 tabs. Complete "Ballast", "Worksheet", and the tab relevant to your particular glider.

Calculating H-moment (Roll Method)

- 1- Place well-ballasted glider in tank with wings.
- 2- Add a known amount of weight (~300 g) on one wing rail
- 3- Attach a spring scale to the glider on the opposite wing rail
- 4- Measure the weight change shown on the spring scale
- 5- Measure the angle of roll that the glider undergoes due to the addition of weight. For this step you can use an inclinometer (less accurate) or have the glider on and measure compass roll before and after weight addition and measure angle difference.
- 6- Remove the added weight, measure weight, and multiply by 0.912 if using Lead weight or by 0.875 if the weight used is stainless steel. This factor accounts for buoyancy provided by water on material.

Roll Start	0.0000	radians
Roll End	0.0000	radians
Weight on Spring	0.00	grams
Weight added on wing rail	0.00	grams
Angle of Rotation	0.00	degrees
Radius of Hull + Distance to Weight	107	mm

(radius of hull: 200mm=107, 1000mm=110)

H-distance	#DIV/0!	mm
------------	---------	----

Weight of Pitch Battery	8.5006	kg
Total range of Pitch Battery (+/- in)	1.00	inches
Pitch Range	#DIV/0!	Degrees

Calculating H-moment (Pitch Battery method)

- 1- Put battery position (c_battpos) at about .25, ensure front of glider is not touching bottom of tank- adjust as necessary
- 2- Record m_pitch and m_battpos
- 3- Put battery position at 0
- 4- Record m_pitch and m_battpos

Weight of Pitch Battery	8.5006	kg
Pitch_1	0.00698	radians
Battery Position_1	-0.02303	inches
Pitch_2	-0.09075	radians
Battery Position_2	0.2744212	inches

H-Distance	8.98	mm
Total range of Pitch Battery (+/- in)	1.00	inches
Pitch Range	27.59	Degrees

Sign: _____

Date: _____

01/26/2022

Document #:	4095-GBPSH
Rev:	G
Date:	1/26/2022
ECO #:	0

Glider Ballast Worksheet

Glider Name: Unit 971
 Ballasting Technician: DS
 Date: 1/26/2022
 Glider Displacement (L): 72.0
 H-Moment (mm): 8.98

TANK WATER:

Temperature (°C):	19.29
Conductivity (S/m):	4.72
Salinity (psu):	35.02
Density (g/L°C):	1024.9656

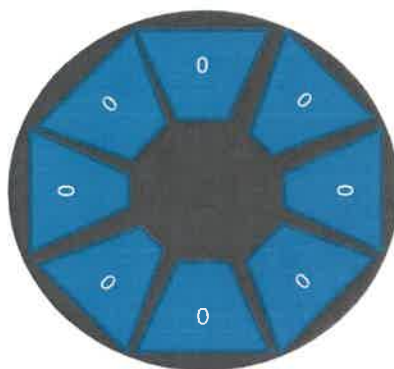
TARGET WATER

Temperature (°C):	0.00
Conductivity (S/m):	0.00
Salinity (psu):	0.00
Density (g/L°C):	1025.5000

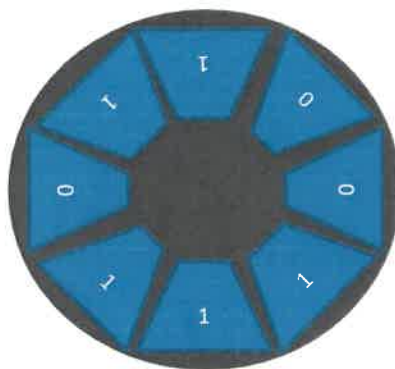
Pie Weight Locations

Pie weights can be removed or shifted around to indicate exact location. The quantity can also be changed to represent stacked pie weights.

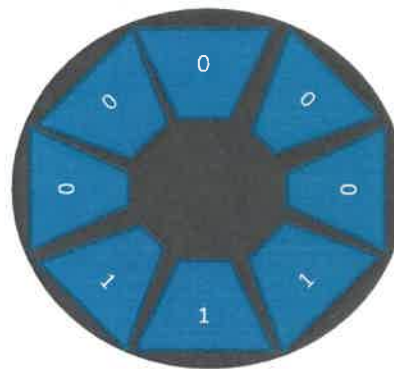
Additional Bay FWD



Science FWD



Science AFT



Wing Rail Weight Locations

Shade in the location of wing rail weights.



Final Weight Configuration As Sent to Customer

Forward	Weight (g)	Payload	Weight (g)	Aft	Weight (g)
Port Bottle	230	Top FWD		Aft Bottle STBD	50
STBD Bottle	135	Bottom FWD		Aft Bottle PORT	75
Bottom Bottle		Top AFT			
		Bottom AFT			
Desiccant	124.8	Weight Bar			

Pond Wings:	
Pinger Channel:	

Certificate no: 4831_958_00181586
Foil batch no: 1824M

Product: 4831
Calibration date: 14.02.2021

Serial no: 958
Page 1 of 2

Index	Temperature reference(°C)	[O2] Reference(μM)	Temperature raw data(mV)	Phase reading(°)
0	30.229	1.60	-102.920	59.96
1	20.144	1.15	222.387	60.96
2	10.107	0.95	546.720	61.66
3	0.864	0.83	822.940	62.29
4	0.949	21.03	820.547	59.63
5	1.023	42.83	818.467	57.08
6	1.085	63.30	816.740	54.94
7	1.133	110.00	815.353	50.75
8	1.169	151.47	814.360	47.70
9	1.203	217.99	813.407	43.73
10	1.234	323.87	812.540	39.01
11	1.250	436.82	812.080	35.36
12	1.262	540.06	811.727	32.84
13	10.810	16.50	524.507	58.68
14	10.713	34.69	527.607	55.66
15	10.641	51.52	529.847	53.26
16	10.592	86.46	531.427	49.06
17	10.565	122.86	532.293	45.58
18	10.544	172.50	532.953	41.80
19	10.531	262.60	533.340	36.83
20	10.520	341.25	533.713	33.76
21	10.499	430.12	534.353	31.13
22	20.672	13.31	205.073	57.72
23	20.613	27.49	207.020	54.46
24	20.568	41.88	208.493	51.68
25	20.534	67.66	209.580	47.56
26	20.505	95.26	210.540	44.09
27	20.482	138.17	211.293	39.90
28	20.462	204.25	211.947	35.31
29	20.450	273.72	212.320	31.95
30	20.440	344.86	212.660	29.43
31	30.402	10.82	-108.320	56.68
32	30.386	22.45	-107.827	53.20
33	30.380	34.04	-107.607	50.28
34	30.381	56.06	-107.640	45.82
35	30.385	79.35	-107.800	42.16
36	30.392	112.91	-108.000	38.15
37	30.409	167.14	-108.540	33.62
38	30.416	227.18	-108.773	30.19
39	30.422	284.31	-108.953	27.88

Certificate no: 4831_958_00181586
Foil batch no: 1824M

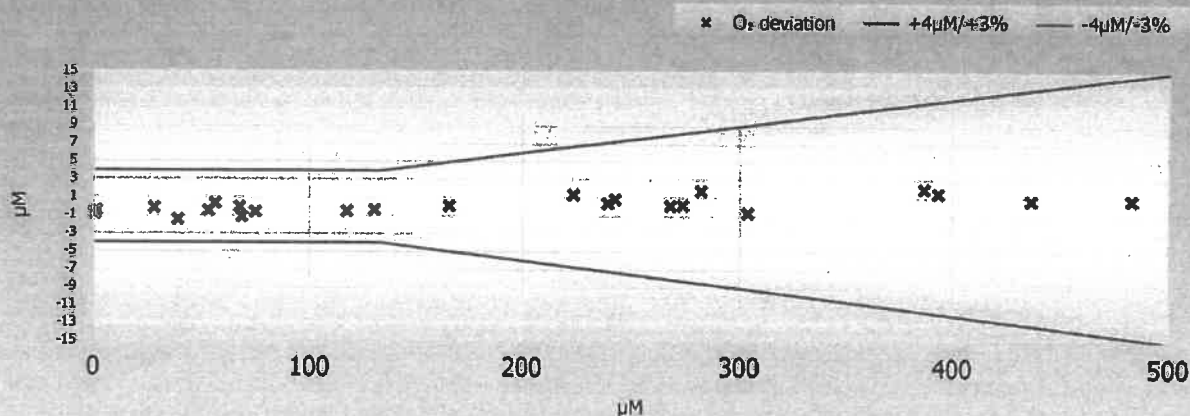
Product: 4831
Calibration date: 14.02.2021

Serial no: 958
Page 2 of 2

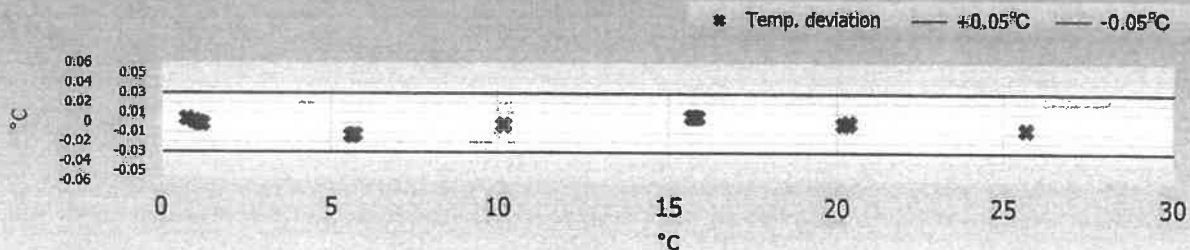
Giving these coefficients

Index	0	1	2	3	4	5	6
SVUFoilCoef	2.72340E-03	1.07222E-04	2.28628E-06	1.73503E02	-2.33249E-01	-4.40995E01	3.56786E00
TempCoef	2.69790E01	-3.12065E-02	3.13273E-06	-4.58253E-09	0.00000E00	0.00000E00	

Oxygen validation



Temperature validation



With following settings

Index	0	1	2	3
PhaseCoef	-1.42200E00	1.00000E00	0.00000E00	0.00000E00

Index	0 (Offset)	1 (Slope)
ConsCoef	0.00000E00	1.00000E00
SatSatCoef	0.00	
Firmware Version	5.3.1	

Date:14.02.2021

Tor-Ove Kvalvaag
Tor-Ove Kvalvaag, Calibration Engineer

AANDERAA

a xylem brand

PRESSURE CERTIFICATE

Form No. 667, Sept 2009

Product: Oxygen Optode 4831**Serial No:** 958**Date:** 11.02.2021**Certificate No:** 181490260958

This is to certify that this product has been pressure tested with the following instrument, and we confirm that no irregularities were found during the test:

Autoklav 800 bar – sn: 0210005

Pressure readings:

Pressure (Bar)	Pressure time (hour)
600	1

Date: 11 Feb 2021

Sign:

Laila A. Skålnes

Laila Skålnes, Production Engineer

Program Version: 5.3.1

Product: Oxygen Optode 4831

Serial No: 958

Visual and Mechanical Checks:

- 1.1 Soldering quality
- 1.2 Visual surface
- 1.3 Galvanic isolation between housing and electronics

Current Drain and Voltages:

2.1 Average current drain at 0.5 Hz sampling (Max.: 33 mA)	23.2	mA
2.2 CANBus Current drain at 0.5 Hz sampling (Max.: 33 mA)		mA
2.3 Current drain in sleep (Max.: 270 μ A)	236	μ A
2.4 CANBus Current drain in sleep (Max.: 180 μ A)		μ A
2.5 DSP IO voltage, J4.18 (3.3 \pm 0.15V)	3.28	V
2.6 DSP Core voltage, J4.17 (1.8 \pm 0.05 V)	1.82	V
2.7 Excitation driver voltage, C4 Analog Board (4.3 \pm 0.1 V)	4.28	V

Performance test:

	Channel:	Blue	Red
3.1 Average of Receiver readings (0 \pm 150mV)		-8.0 mV	-5.4 mV
3.2 Standard Deviation of Receiver readings (Max.: 45mV/10mV)		1.23 mV	0.27 mV
3.3 Amplitude measurement with non-fluorescence foil (<60mV/650-1200mV)		10 mV	976.5 mV
3.4 CANBus Output test			

Function test from 0 to 40°C:

	Channel:	Blue	Red
4.1 Minimum amplitude measurement (Blue: >550 mV, Red >550 mV)		740.8 mV	799.7 mV
4.2 Maximum amplitude measurement (Blue: <1600 mV, Red <1400 mV)		1113.8 mV	1220.1 mV
4.3 Minimum phase measurement (Blue: >32°, Red: >3°)		35.39 °	7.65 °
4.4 Maximum phase measurement (Blue: <45°, Red: <10°)		41.12 °	9.02 °
4.5 Maximum standard deviation of Phase measurement: (< 0.07°)		0.05 °	0.05 °
4.6 Minimum temperature raw data measurement: (<-200 mV)			-425.6 mV
4.7 Maximum temperature raw data measurement: (>450 mV)			704.1 mV

Date: 11 Feb 2021

Sign:

Laila A. Skålnes

Laila Skålnes, Production Engineer



Conductivity Calibration Certificate

RBRiegato³ C.T.D, Teledyne Webb Slocum, dry bay (1000dbar) s/n: 207975

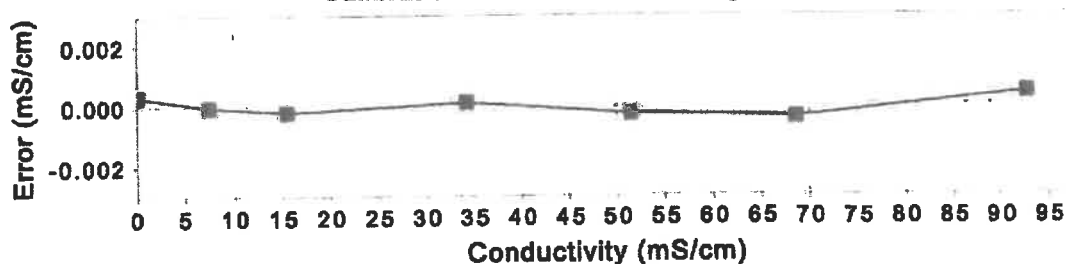
References: Autosal8400B#66289, MS-315#15506, SSW P164, RC#002

Reference Resistance (ohm)	Reference Conductivity (mS/cm)	Voltage Ratio, V	Measured Conductivity (mS/cm)	Calibration Error (mS/cm)	Coefficients
open	0.0000	-0.000107	0.0003	0.0003	C0: 20.67835E-3
694.042	7.4181	0.038943	7.4181	-0.0000	C1: 189.95688
331.926	15.5109	0.081545	15.5107	-0.0002	(X) C2: 1.001942
150.019	34.3189	0.180559	34.3190	0.0001	X0: 439.17712E-6
100.016	51.4769	0.270882	51.4766	-0.0003	X1: 16.191501E-6
75.023	68.6251	0.361156	68.6247	-0.0004	X2: 0.0
55.520	92.7329	0.488072	92.7333	0.0004	X3: 0.0
					X4: 0.0
					X5: 14.877615
					X6: 10
Bath	Voltage Ratio	Temperature (ITS-90)	Salinity (PSS-78)	Conductivity (mS/cm)	
T15835	0.2251495	14.87761	34.9928	42.7894	
T25835	0.2780405	24.77027	34.9943	52.8236	

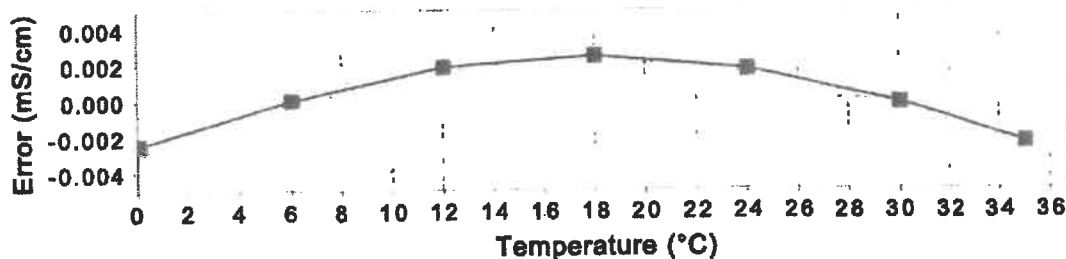
Cell Constant @T15835 = 5.14848 1/cm

$$C_c = \frac{C_0 + C_1 * C_2 * V - X_0 * (T - X_5)}{1 + X_1 * (T - X_5) + X_2 * (P - X_6) + X_3 * (P - X_6)^2 + X_4 * (P - X_6)^3}$$

Calibration error vs. Conductivity



Calibration error vs. Temperature



Calibration Date: 2021-08-19
Issue Date: 2021-08-19
File Name: 207975_20210819_1715C.rsk

Operator:

jwang

Approver:

kmalorny

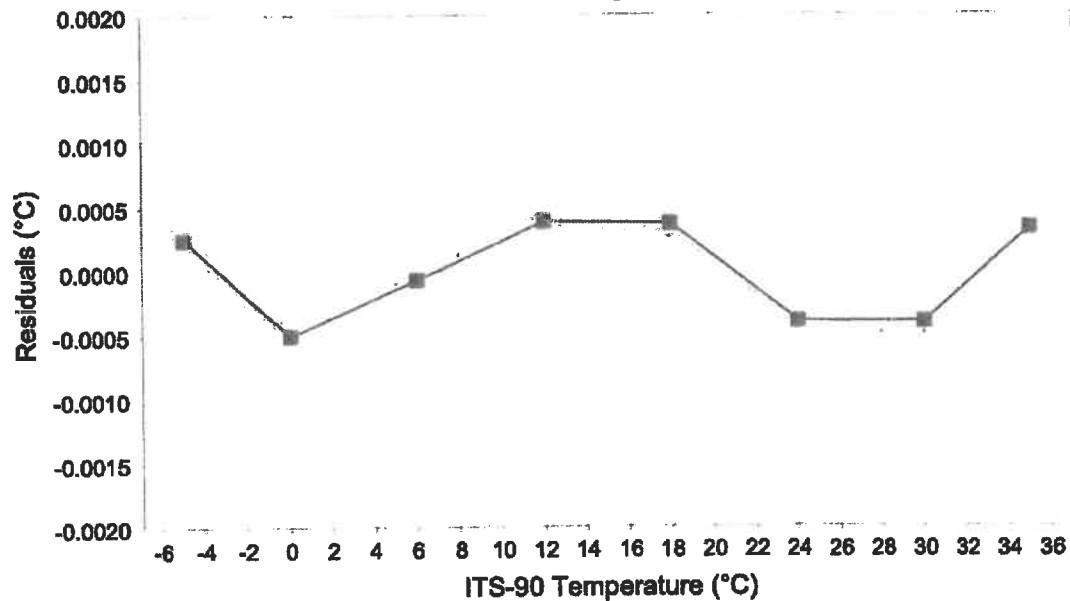


Temperature Calibration Certificate

Logger ID: RBRlegato³ Serial No: 207975 Channel No: 2

Reference Temperature, ITS-90	Voltage ratio, V	Measured Temperature, ITS-90	Calibration error	Coefficients
-4.94847	0.687946	-4.94822	0.00026	C0: 3.5256033E-3
0.05090	0.628595	0.05040	-0.00050	C1: -254.68363E-6
6.04798	0.554716	6.04791	-0.00006	C2: 2.4773692E-6
12.04477	0.481116	12.04517	0.00039	C3: -99.149815E-9
18.03538	0.410960	18.03575	0.00037	
24.03039	0.346478	24.03000	-0.00039	
30.03218	0.289074	30.03178	-0.00040	
35.02841	0.247161	35.02875	0.00034	

Residuals vs. Temperature



Calibration Date: 2021-08-12
Issue Date: 2021-08-13
Calibration ID: 48282

Operator:

dluong

Approver:

jwang

RBR

Pressure Calibration Certificate

RBRlegato® C.T.D, Teledyne Webb Slocum, dry bay (1000dbar) s/n: 207975

Instrument rating: 1,000 dbar s/n: N009858

Nominal accuracy: 0.05%FS (0.5 dbar)

Reference Instrument: Mensor CPC6050 s/n: 41000CAM

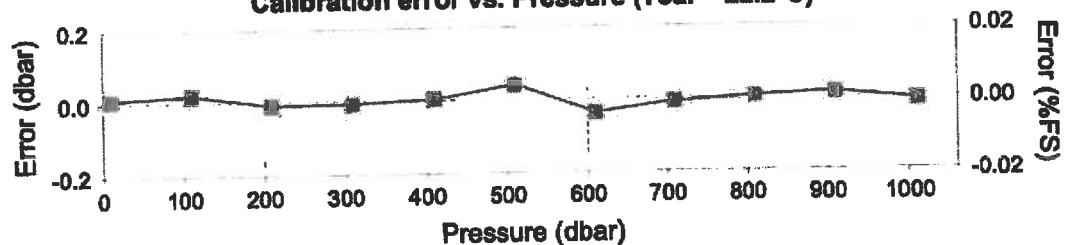
Applied pressure, P_{app} (dbar)	Voltage ratio, V	Measured pressure, P_c (dbar)	Calibration error (dbar)	Coefficients
10.118	0.022187	10.1287	0.0104	C0: -41.794617
110.000	0.064648	110.0215	0.0215	C1: 2.349637E3
209.999	0.107092	209.9914	-0.0076	C2: 37.66334
309.997	0.149507	309.9915	-0.0055	C3: -31.705196
409.999	0.191891	410.0032	0.0042	X0: 10.1183
509.999	0.234256	510.0409	0.0419	X1: 102.54835E-3
609.998	0.276547	609.9603	-0.0377	X2: 57.502715E-6
709.997	0.318868	709.9883	-0.0087	X3: -209.46332E-9
810.004	0.361172	810.0074	0.0034	X4: -108.39445E-6
910.001	0.403467	910.0146	0.0136	X5: 22.182997
1010.000	0.445750	1009.9928	-0.0072	

$$P_c = X_0 + \frac{P_m - X_0 - X_1(T - X_5) - X_2(T - X_5)^2 - X_3(T - X_5)^3}{1 + X_4(T - X_5)}$$

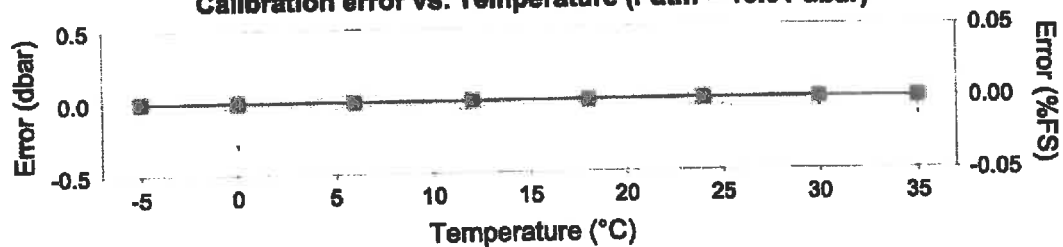
Head (mm) = 239

$$P_m = C_0 + C_1V + C_2V^2 + C_3V^3$$

Calibration error vs. Pressure (Tcal = 22.2°C)



Calibration error vs. Temperature (Patm = 10.01 dbar)



Calibration Date: 2021-08-18

Issue Date: 2021-08-18

File Name: 207975_20210818_1222P.rsk

Operator:

Duong
duong

Approver:

Kmalorny
kmalorny



PRESSURE TRANSDUCER CALIBRATION DATA

<i>Customer</i>	<i>Date</i>
TELEDYNE BENTHOS	17 AUG 21
<i>Model Number</i>	<i>Serial Number</i>
141698-2000A	130012

<i>Diaphragm Materials</i>	<i>Excitation</i>	<i>Pressure Range</i>	<i>Excitation Type</i>
TITANIUM	5 VDC	2000 PSIA	Constant Voltage

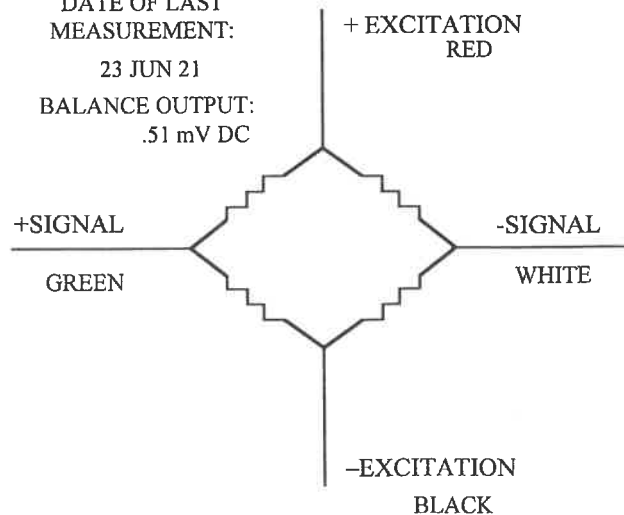
Pressure Calibration Data all readings are in mV DC						<i>Date of Pressure Calibration</i>
						19 JUN 21
Pressure	Increase	Decrease	Ideal	Linearity (%FS)	Hysteresis (%FS)	<i>STATIC ERROR BAND</i> ± .06% FS BFSL
0 PSIA	.53	.49	.53		.04%	
1000 PSIA	53.14	53.05	53.01	.12%	.09%	
2000 PSIA	105.49		105.49			
SENSITIVITY	104.96					

Thermal Calibration Data all readings are in mV DC						<i>Date of Thermal Calibration</i>
						16 JUN 21
	Low Temp.	Ambient	High Temp	Temperature Range	Thermal Balance Shift	Thermal Sensitivity Shift
Temperature	35°F	75°F	75°F			
0 PSIA	.72	.51	.47	35°F to 75°F	-.20%FS	.83%FS
2000 PSIA	104.85	105.51	105.45	75°F to 75°F	-.04%FS	-.02%FS
Sensitivity	104.13	105.00	104.98	AVERAGE	± .003% FS/°F	± .010% FS/°F

Notes

DATE OF LAST
MEASUREMENT:
23 JUN 21

BALANCE OUTPUT:
.51 mV DC



INPUT RESISTANCE 1654 Ohms
OUTPUT RESISTANCE 787 Ohms

<i>Data Entered and Reviewed By</i>	<i>Date Data Entered</i>
THARIN THAV	17 August 2021



**TELEDYNE
WEBB RESEARCH**
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A business unit of Teledyne Instruments, Inc.
49 Edgerton Drive
North Falmouth, MA 02556
P: +1 508.563.1000 F: +1 508.563.6444

CERTIFICATE OF COMPLIANCE

Sales Order No. R122444

This is to certify that the materials & services used for:

Customer Memorial University of N. F.

Purchase Order No. P0164707

conform to the drawings, specifications and conditions called for in the above Customer Purchase Order Number and Teledyne standards.

Country of Origin – Assembled in the United States of America with U.S. & foreign components.

<u>Model No.</u>	<u>REV</u>	<u>QTY</u>	<u>Product Description</u>	<u>Serial Number(s)</u>
<u>GLD-0102-D</u>	<u>1</u>	<u>1</u>	<u>G3S, Memorial University of</u>	<u>971</u>
<u></u>	<u></u>	<u></u>	<u>Newfoundland Lithium ION ASSY</u>	<u></u>
<u></u>	<u></u>	<u></u>	<u>306186-E</u>	<u></u>
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<u></u>	<u></u>	<u></u>	<u></u>	<u></u>

Authorized By: _____

Shawn Green
Name (print)


Signature

01/28/22
Date