

# G3S GLIDER-FINAL PRODUCTION RECORD

				Schematic Rev	
SELECT ONE	1000M	X	350M	SPECIAL	
CUSTOMER	Memorial	CUST. ORDER NO.	R123614-1		

**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-0106-D	NA	1	969
SHALLOW FRONT PUMP (SELECT ONE)	USE PULL DOWN MENU	305869	A-1	645
FWD SECTION ASSY (SELECT ONE)	USE PULL DOWN MENU	305685	NA	NA
ALTIMETER ASSY (SELECT ONE)	G-1414	G-1414	C	60364594
PAYLOAD BAY ASSY - Fill In	PLD-0107	NA	1	1477
STACK-ON BAY - Fill In	306450-NFC	306450	A	816
AFT SECTION	A311317-NFC	A311317-NFC	1	1062
AFT END CAP	ASSY 305654	305654	E	211
AFT TRAY	A311318-NFC	A311318-NFC	1	1062
PRESSURE TRANSDUCER	ASSY G-1312	3002	C	129990
RADOME FIN	ASSY 304376	304376	D	1412
THRUSTER ASSY	ASSY 302409	302409	C	300
Composite Hull, Fwd	ASSY G-1405-L	3135	K	2946
Composite Hull, Aft	ASSY G-1405-L	3135	K	2950
ASSY / PART DESCRIPTION		DWG #	VENDOR SERIAL #	
LITHIUM BATTERY, PITCH	Assy 305523	305523	134	
LITHIUM BATTERY, AFT	Assy 305524	305524	114	
ENERGY BAY BATTERY	Assy 305523	305523	133	
BATTERY, EMERGENCY	306318-NFC	306318	NA	
FREEWAVE	ASSY 301784	301784	973-9676	
ASSY / PART DESCRIPTION		VENDOR SERIAL #		
IRIDIUM SIM CARD (CUSTOMER SUPPLIED)		8988169234001174010		
ARGOS ID# (CUSTOMER SUPPLIED)		Dec. 224508 Hex. 32197C7		
ASSY / PART DESCRIPTION		VERSION #		
FIRMWARE, COTS TESTING		10.04		
<b>HELIUM LEAK TEST</b>				
<input checked="" type="checkbox"/> PASS <input type="checkbox"/> FAIL Initial: <u>AR</u> Date: <u>1/15/22</u>				
NOTES: IP Address Jasco 172.20.10.97				

Completion Date	<u>1/15/22</u>	Name (print)	<u>Adam Ritterbush</u>	Initials	<u>AR</u>
Inspection Date	<u>1/15/22</u>	Name (print)	<u>Jasmin Gorman</u>	Initials	<u>J.M.</u>
Review Date	<u>1/28/22</u>	Name (print)	<u>[Signature]</u>	Initials	<u>SG</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	KB 1/18/22	Pass
2	Confirm ballasting in tank (Only necessary if internal ballast was changed.)	N/A	Pass
3	Document #4095-GVI Glider Visual Inspection	KB 1/28/22	Pass
4	Document #4095-FSI or #4095-FSI-I Glider Final Seal Inspection	KB 1/18/22	Pass
5	Document #301750-HLT Helium Leak Test	KB 1/27/22	Pass
6	Verify Flight Testing is Complete	KB 1/28/22	Pass

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

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

### COMMENTS:

### FINAL APPROVAL FOR PRODUCT SHIPPING

Customer Witness (if Applicable)

Date:

TWR :

Date:

QA/ Production Supervisor Review:

Date:

**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

<b>Glider Name:</b>	Unit 969	
<b>Ballasted by:</b>	DS	
<b>Date:</b>	1/18/2022	
<b>Glider Type:</b>	G2 Deep (1000m)	
<b>Add-ons</b> (check box for each)	G1 Shallow Science Bay	1st 2nd
	G1 Deep/G2 Science Bay	1st 2nd
	G2 Extended Science/ Energy Bay (14.85")	
	DVL Bay (5.75")	1st 2nd
	ES Science/Energy Bay (15.75")	
	Mark III Aft End Cap	
	Rockland Scientific Microrider	
	SUNA Nitrate Sensor	
	Pond Wings	
	Pinger	
Insert Glider-specific Volume Adjustment Here	1	
<b>Base Glider Displacement:</b>	46.02	Liters
<b>Total Glider Displacement:</b>	72.27	Liters

	Tank Water	Target Water	Weight Change
Temperature and	19.3129 °C	19.3129 °C	0.0000 grams
(Density or	0.0000 g/L °C	0.0000 g/L °C	
Conductivity or	4.6996 s/m	4.6996 s/m	
Salinity)	0.0000 pss	0.0000 pss	
Calculated/given Salinity	34.8164 pss	34.8164 pss	
Calculated/given Density	1024.8018 g/L °C	1024.8018 g/L °C	0.0000 grams
<b>Total Weight Adjustment:</b>			0.0000 grams

<b>Drive Weight Material</b>	
<b>Configure 2 Drive Weights, Each Weighing (g)</b>	

<b>Battery Type:</b>	Lithium	weight (kg)
<b>Pitch Configuration</b>	Lithium Pitch Pack	8.4856
<b>Science/Energy Bay Configuration</b>	Secondary Lithium Pitch Pack	8.4872
<b>Aft Configuration</b>	Lithium Aft Pack	9.805
<b>Nose Configuration</b>	1 pack nose	0.5882

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: 200m=107, 1000m=110)

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

Weight of Pitch Battery	8.4856	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	8.4856	kg
Pitch_1	-0.02268	radians
Battery Position_1	-0.03308	inches
Pitch_2	-0.16755	radians
Battery Position_2	0.282582	inches

H-Distance	6.37	mm
Total range of Pitch Battery (+/- in)	1.00	inches
Pitch Range	36.32	Degrees

Sign: \_\_\_\_\_

Date: \_\_\_\_\_

1-18-22



Document #:	4095-GBPSH
Rev:	G
Date:	1/18/2022
ECO #:	0

## Glider Ballast Worksheet

Glider Name: Unit 969  
Ballasting Technician: DS  
Date: 1/18/2022  
Glider Displacement (L): 72.3  
H-Moment (mm): 6.37

### TANK WATER:

Temperature (°C):	19.31
Conductivity (S/m):	4.70
Salinity (psu):	34.82
Density (g/L°C):	1024.8018

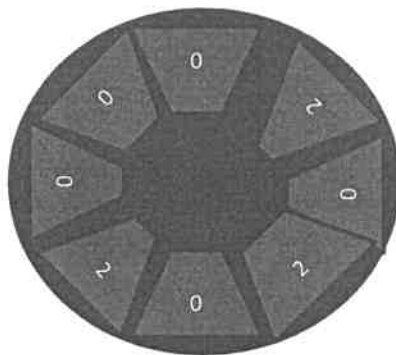
### TARGET WATER

Temperature (°C):	19.31
Conductivity (S/m):	4.70
Salinity (psu):	34.82
Density (g/L°C):	1024.8018

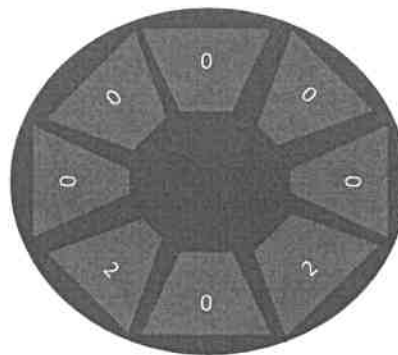
### Pie Weight Locations

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

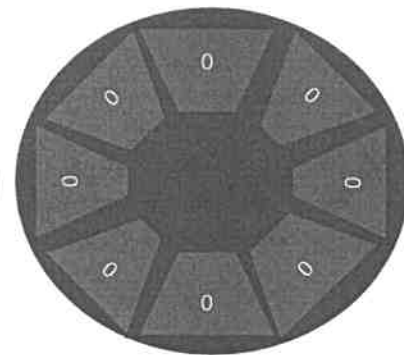
Additional Bay FWD



Science FWD

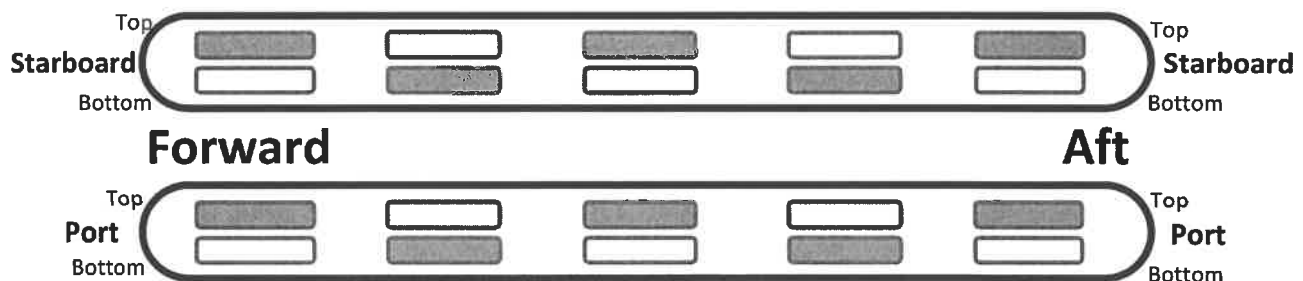


Science AFT



### 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	127	Top FWD		Aft Bottle Port	158
STBD Bottle	127	Bottom FWD	800	Aft Bottle STBD	158
Bottom Bottle		Add Bay Top FWD	400		
		Add Bay Bottom FWD	800		
Desiccant	125	Weight Bar			

Pond Wings:	
Pinger Channel:	

# RBR

## Conductivity Calibration Certificate

RBRlegato<sup>3</sup> C.T.D, Teledyne Webb Slocum, dry bay (1000dbar) s/n: 207968

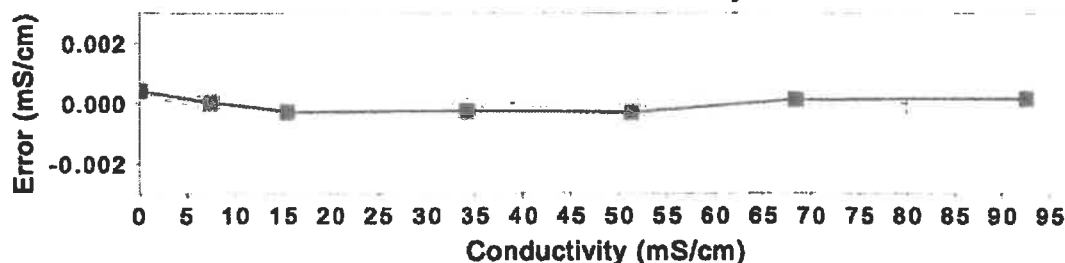
References: Autosal8400B#66289, MS-315#15506, SSW P164, RC#002

Reference Resistance (ohm)	Reference Conductivity (mS/cm)	Voltage Ratio, V	Measured Conductivity (mS/cm)	Calibration Error (mS/cm)	Coefficients	
open	0.0000	-0.000137	0.0004	0.0004	C0:	26.457904E-3
694.042	7.4024	0.038920	7.4024	0.0000	C1:	189.51392
331.926	15.4780	0.081531	15.4777	-0.0003	(K) C2:	1.001942
150.019	34.2460	0.180563	34.2457	-0.0002	X0:	538.5284E-6
100.016	51.3675	0.270907	51.3672	-0.0003	X1:	-12.133374E-6
75.023	68.4793	0.361203	68.4794	0.0001	X2:	0.0
55.520	92.5358	0.488141	92.5360	0.0002	X3:	0.0
					X4:	0.0
					X5:	14.863837
					X6:	10
Bath	Voltage Ratio	Temperature (ITS-90)	Salinity (PSS-78)	Conductivity (mS/cm)		
T15S35	0.2255738	14.86384	34.9928	42.7758		
T25S35	0.2788079	24.80848	34.9958	52.8655		

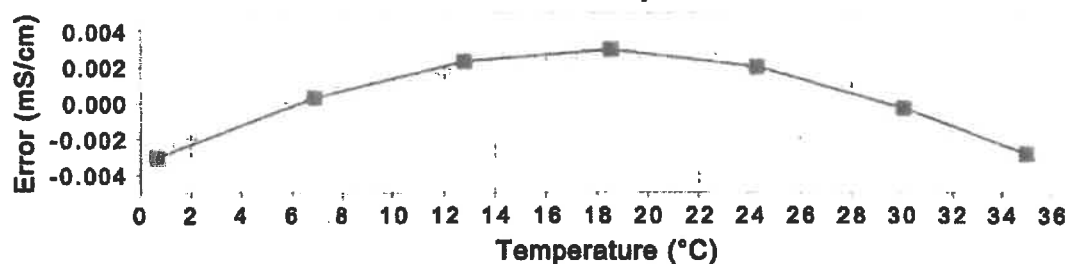
Cell Constant @T15S35 = 5.13754 1/cm

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

Calibration error vs. Conductivity



Calibration error vs. Temperature



Calibration Date: 2021-08-18

Issue Date: 2021-08-18

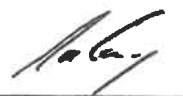
File Name: 207968\_20210818\_1521C.rsk

Operator:



jwang

Approver:



kmalorny

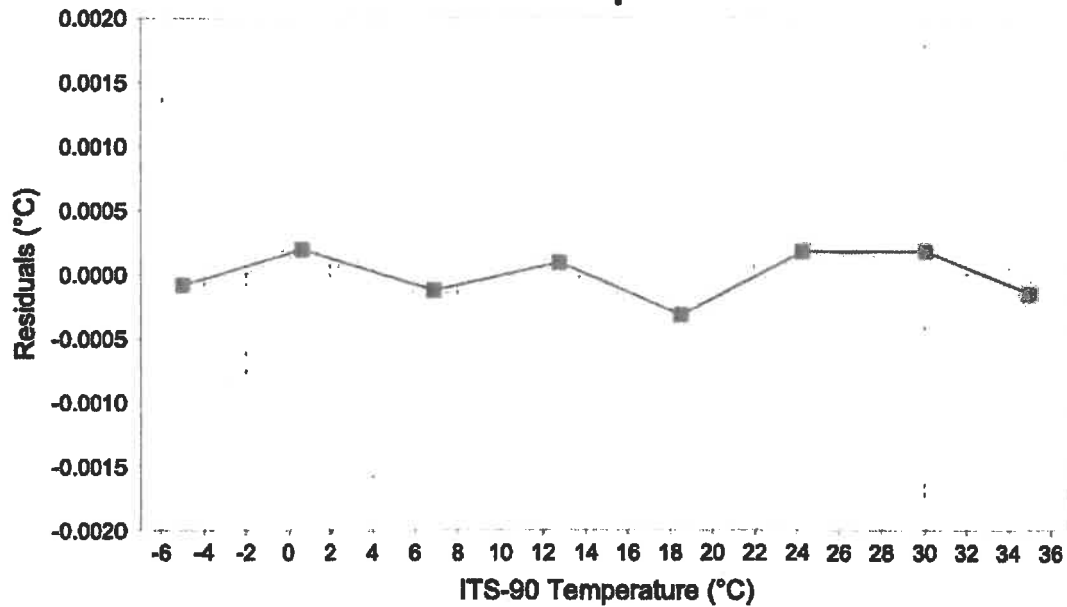


## Temperature Calibration Certificate

Logger ID: RBRlegato<sup>3</sup> Serial No: 207968 Channel No: 2

Reference Temperature, ITS-90	Voltage ratio, V	Measured Temperature, ITS-90	Calibration error	Coefficients	
-4.97361	0.683896	-4.97369	-0.00008	C0:	3.5320197E-3
0.66592	0.615894	0.66612	0.00020	C1:	-253.05226E-6
6.88648	0.538339	6.88636	-0.00012	C2:	2.5934678E-6
12.79196	0.465618	12.79205	0.00010	C3:	-78.98605E-9
18.56121	0.398294	18.56089	-0.00031		
24.30635	0.336903	24.30653	0.00018		
30.10444	0.281863	30.10462	0.00018		
34.99447	0.241164	34.99433	-0.00014		

Residuals vs. Temperature



Calibration Date: 2021-08-15  
Issue Date: 2021-08-16  
Calibration ID: 48368

Operator:   
dluong

Approver:   
kmalorny

# RBR

## Pressure Calibration Certificate

RBRlegato<sup>3</sup> C.T.D, Teledyne Webb Slocum, dry bay (1000dbar) s/n: 207968

Instrument rating: 1,000 dbar s/n: N009851

Nominal accuracy: 0.05%FS (0.5 dbar)

Reference instrument: Mensor CPC6000 s/n: 612676

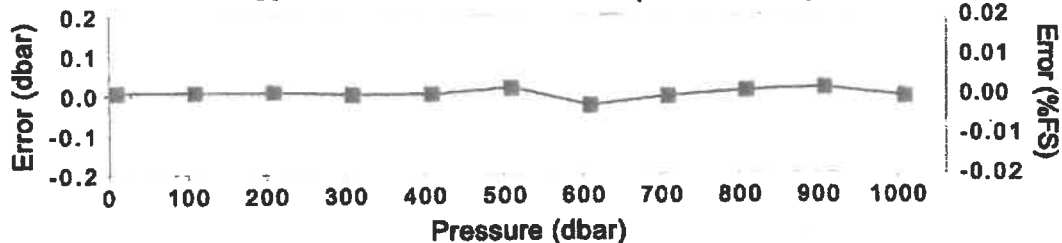
Applied pressure, $P_{app}$ (dbar)	Voltage ratio, V	Measured pressure, $P_c$ (dbar)	Calibration error (dbar)	Coefficients
10.110	0.019401	10.1193	0.0089	C0: -34.557392
110.000	0.062521	110.0087	0.0087	C1: 2.3136807E3
209.999	0.105639	210.0075	0.0085	C2: 36.9867
309.999	0.148711	310.0016	0.0026	C3: -30.144094
409.998	0.191748	410.0007	0.0027	X0: 10.1104
509.998	0.234760	510.0158	0.0178	X1: 79.48717E-3
609.998	0.277720	609.9706	-0.0274	X2: 7.0892575E-6
709.996	0.320690	709.9917	-0.0043	X3: -736.2426E-9
809.996	0.363643	810.0056	0.0096	X4: -119.37886E-6
909.997	0.406588	910.0133	0.0163	X5: 21.74662
1010.010	0.449525	1010.0046	-0.0054	

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

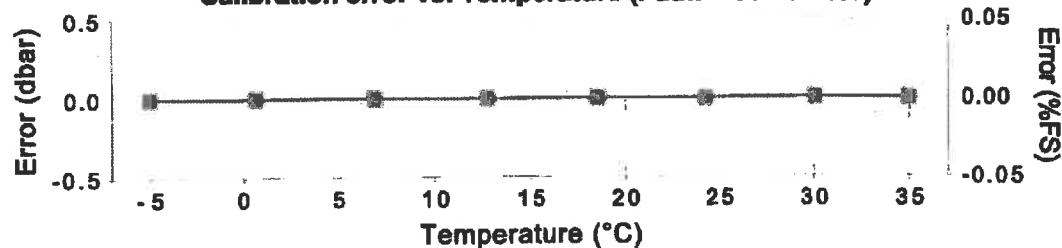
Head (mm) = 234

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

Calibration error vs. Pressure (Tcal = 21.7°C)



Calibration error vs. Temperature (Patm = 10.16 dbar)



Calibration Date: 2021-08-17

Issue Date: 2021-08-18

File Name: 207968\_20210818\_0807P.rsk

Operator:

*Adam Falicki*

afalicki

Approver:

*K. Malorny*

kmalorny



Program Version: 5.3.1

Product: Oxygen Optode 4831IW

Serial No: 951

## 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)	22.4	mA
2.2 CANBus Current drain at 0.5 Hz sampling (Max.: 33 mA)		mA
2.3 Current drain in sleep (Max.: 270 $\mu$ A)	262	$\mu$ A
2.4 CANBus Current drain in sleep (Max.: 180 $\mu$ A)		$\mu$ A
2.5 DSP IO voltage, J4.18 ( $3.3 \pm 0.15$ V)	3.29	V
2.6 DSP Core voltage, J4.17 ( $1.8 \pm 0.05$ V)	1.80	V
2.7 Excitation driver voltage, C4 Analog Board ( $4.3 \pm 0.1$ V)	4.32	V

## Performance test:

	Channel:	Blue	Red
3.1 Average of Receiver readings ( $0 \pm 150$ mV)		-14.8 mV	-10.8 mV
3.2 Standard Deviation of Receiver readings (Max.: 45mV/10mV)		1.89 mV	0.38 mV
3.3 Amplitude measurement with non-fluorescence foil (<60mV/650-1200mV)		8.8 mV	798 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)		706.6 mV	667.8 mV
4.2 Maximum amplitude measurement (Blue: <1600 mV, Red <1400 mV)		1087 mV	1047.4 mV
4.3 Minimum phase measurement (Blue: >32°, Red: >3°)		34.13 °	6.88 °
4.4 Maximum phase measurement (Blue: <45°, Red: <10°)		40.04 °	8.21 °
4.5 Maximum standard deviation of Phase measurement: (<0.07°)		0.05 °	0.05 °
4.6 Minimum temperature raw data measurement: (<-200 mV)			-368.3 mV
4.7 Maximum temperature raw data measurement: (>450 mV)			785.6 mV

Date: 11 Feb 2021

Sign:

Laila A. Skålnes

Laila Skålnes, Production Engineer

**AANDERAA**

a xylem brand

# PRESSURE CERTIFICATE

Form No. 667, Sept 2009

**Product:** Oxygen Optode 4831IW**Serial No:** 951**Date:** 11.02.2021**Certificate No:** 181483260951

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)
300	1

**Date:** 11 Feb 2021**Sign:**

Laila A. Skålnes

**Laila Skålnes, Production Engineer**

Certificate no: 4831\_951\_00181649  
Foil batch no: 1824M

Product: 4831  
Calibration date: 17.02.2021

Serial no: 951  
Page 1 of 2

Index	Temperature reference(°C)	[O2] Reference(µM)	Temperature raw data(mV)	Phase reading(°)
0	30.289	1.43	-29.580	60.10
1	20.346	1.15	291.660	61.05
2	10.193	0.90	614.420	61.86
3	0.844	0.73	884.073	62.54
4	0.897	20.81	882.660	59.82
5	0.944	42.15	881.393	57.19
6	0.979	63.00	880.447	54.91
7	1.010	106.55	879.607	50.80
8	1.033	147.09	878.987	47.64
9	1.052	215.44	878.480	43.31
10	1.070	320.86	878.000	38.39
11	1.085	425.63	877.587	34.85
12	1.098	533.37	877.253	32.10
13	10.755	15.66	597.173	58.78
14	10.649	34.05	600.407	55.59
15	10.582	50.46	602.467	53.12
16	10.523	84.50	604.273	48.80
17	10.476	117.64	605.713	45.40
18	10.434	168.54	607.020	41.25
19	10.400	257.33	608.053	36.06
20	10.369	335.85	609.000	32.85
21	10.354	417.61	609.467	30.31
22	20.552	12.52	284.933	57.73
23	20.487	27.40	287.060	54.16
24	20.442	40.68	288.513	51.45
25	20.405	67.65	289.700	46.89
26	20.378	94.82	290.593	43.27
27	20.351	134.91	291.487	39.13
28	20.326	200.70	292.287	34.32
29	20.307	270.03	292.880	30.84
30	20.294	339.43	293.327	28.31
31	30.359	10.22	-31.793	56.73
32	30.352	22.54	-31.600	52.83
33	30.352	33.44	-31.587	49.92
34	30.353	54.51	-31.600	45.32
35	30.352	76.75	-31.587	41.56
36	30.361	110.49	-31.840	37.25
37	30.379	165.33	-32.400	32.45
38	30.379	218.57	-32.400	29.27
39	30.381	277.57	-32.473	26.77

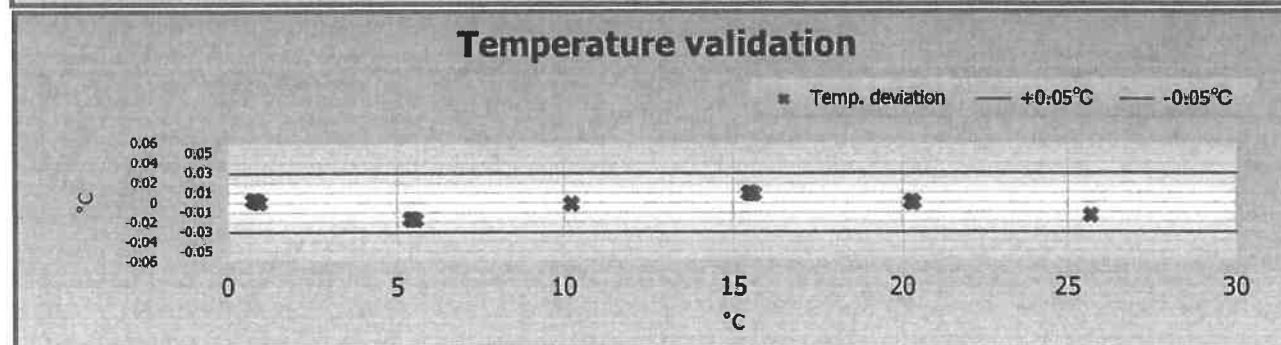
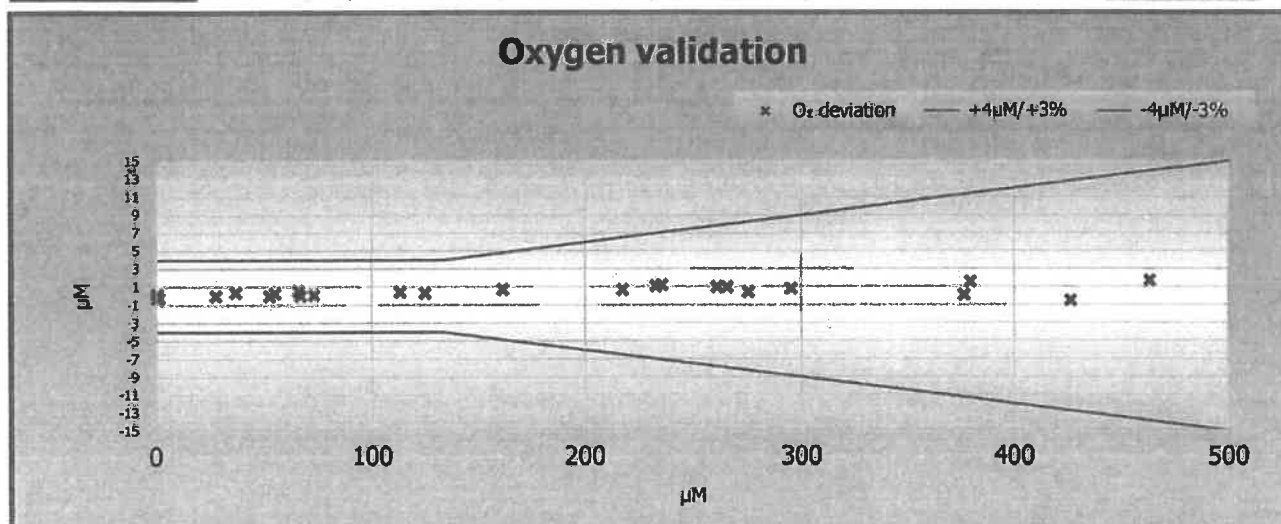
Certificate no: 4831\_951\_00181649  
Foil batch no: 1824M

Product: 4831  
Calibration date: 17.02.2021

Serial no: 951  
Page 2 of 2

### Giving these coefficients

Index	0	1	2	3	4	5	6
SVUFoilCoef	2.79543E-03	1.18071E-04	2.34446E-06	1.47304E02	-2.10486E-01	-3.39037E01	2.93287E00
TempCoef	2.93530E01	-3.15198E-02	3.65313E-06	-5.06113E-09	0.00000E00	0.00000E00	



### With following settings

Index	0	1	2	3
PhaseCoef	-9.64000E-01	1.00000E00	0.00000E00	0.00000E00

Index	0 (Offset)	1 (Slope)
ConcCoef	0.00000E00	1.00000E00
Salinity	0.00	
Firmware Version	5.3.1	

Date:17.02.2021

*Tor-Ove Kvalvaag*  
Tor-Ove Kvalvaag, Calibration Engineer



## PRESSURE TRANSDUCER CALIBRATION DATA

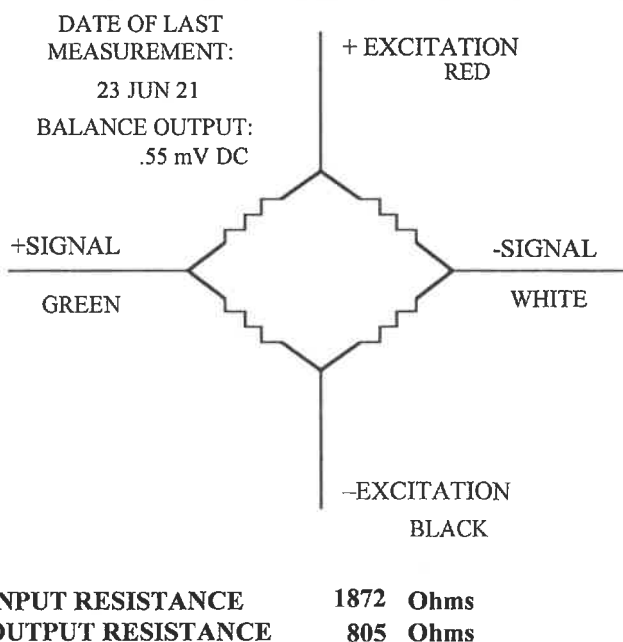
<i>Customer</i> TELEDYNE BENTHOS	<i>Date</i> 9 JUL 21
<i>Model Number</i> 141698-2000A	<i>Serial Number</i> 129990

<i>Diaphragm Materials</i> TITANIUM	<i>Excitation</i> 5 VDC	<i>Pressure Range</i> 2000 PSIA	<i>Excitation Type</i> Constant Voltage
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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)	STATIC ERROR BAND ± .06% FS BFSL
0 PSIA	.53	.49	.53		.04%	
1000 PSIA	52.74	52.69	52.61	.13%	.05%	
2000 PSIA	104.68		104.68			
SENSITIVITY	104.15					

Thermal Calibration Data    all readings are in mV DC						<i>Date of Thermal Calibration</i> 19 JUN 21
	Low Temp.	Ambient	High Temp	Temperature Range	Thermal Balance Shift	Thermal Sensitivity Shift
Temperature	35 °F	75 °F	75 °F			
0 PSIA	.49	.49	.49	35°F to 75°F	0.00%FS	.97%FS
2000 PSIA	103.66	104.67	104.67	75°F to 75°F	0.00%FS	0.00%FS
Sensitivity	103.17	104.18	104.18	AVERAGE	± 0.000% FS/°F	± .012% FS/°F

### Notes



<i>Data Entered and Reviewed By</i> THARIN THAV	<i>Date Data Entered</i> 1 July 2021
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## CERTIFICATE OF COMPLIANCE

Sales Order No. R123614

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

Customer Memorial University of N. F.

Purchase Order No. P0165278

*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.*

Model No.	REV	QTY	Product Description	Serial Number(s)
GLD-0106-D	1	1	G3S, Memorial 350M, RBR CTD,	969
			Optode, Jasco, Endurance Bay,	
			ASSY 306450 Extended Lithium	
			Recharg Extended Crate	

Authorized By:

Shawn Green  
Name (print)

  
Signature

01/28/22  
Date