Biospherical Instruments Inc.

System Calibration Certificate

THE INSTRUMENTS REFERENCED BELOW WERE FACTORY TESTED AND CALIBRATED BY

BIOSPHERICAL INSTRUMENTS INC.
5340 Riley Street
San Diego, California 92110 USA

Instrument: C-OPS S/N 000413

Pressure Testing:

The housing for this instrument has been tested to 125 meters.

NIST-traceable Optical Calibrations:

The instrument was calibrated using a 1000 Watt FEL lamp with serial number V-039. This lamp was calibrated on 7/20/2016 5:38:00 PM against the NIST Standard of Spectral Irradiance F-616;NIST certificate spline-interpolated with w=0.001. Traceability of lamps, the calibration set up (e.g., shunts, voltmeters, power supplies) and calibration procedures follow recommendations published by the National Bureau of Standards (US), specifically "NBS Special Publication 250-20 Spectral Irradiance Calibrations (1987)" and "NBS Publication 594–13 Optical Radiation Measurements: The 1973 Scale of Spectral Irradiance (1977)."

All calibration information provided on the following pages is a subset of calibration information stored internally in the instrument.

Biospherical Instruments Inc.

C-OPS
Serial Number: 000413

Date of Certificate 6/12/2018

Optical Channels, Radiance (LuZ) Calibration

Acquisition Rate 10 Hz

Aggregator Vin (Avg) 6.3 V

Aggregator Iin (Avg) 101.0 mA

Date of Calibration 6/12/2018

Calibration Engineer TC

Internal Temperature (Max) 25.371 °C

Internal Temperature (Min) 24.091 °C

Aggregator Internal Temperature (Avg) 26.1 °C

Aggregator Internal Pressure (Avg) 5.6 psi

Standard of Spectral Irradiance V-039

Channel	Wavelength (nm)	Tag	Firmware Version	Offset High Gain (mV)	Offset Medium Gain (mV)	Offset Low Gain (mV)	Signal/Noise Ratio	Immersion Coefficient	Responsivity in Water	Units
LuZ320	320	A	v:2.003 03/04/11 3Gain	0.070	-0.032	-0.035	811.98	0.5598	3.24587	μW/(sr cm² nm)
LuZ340	340	B	v:2.003 03/04/11 3Gain	-0.201	-0.047	-0.048	1015.34	0.5624	2.39193	μW/(sr cm² nm)
LuZ380	380	C	v:2.003 03/04/11 3Gain	-0.211	-0.126	-0.127	831.73	0.5665	0.80217	μW/(sr cm² nm)
LuZ395	395	D	v:2.003 03/04/11 3Gain	-0.127	-0.039	-0.040	2345.67	0.5677	2.58645	μW/(sr cm² nm)
LuZ412	412	E	v:2.003 03/04/11 3Gain	-0.132	0.013	0.012	3058.98	0.5689	4.72764	μW/(sr cm² nm)
LuZ443	443	F	v:2.003 03/04/11 3Gain	0.006	0.067	0.066	2976.01	0.5707	3.04084	μW/(sr cm² nm)
LuZ465	465	G	v:2.003 03/04/11 3Gain	0.485	0.272	0.273	2974.94	0.5719	2.06665	μW/(sr cm² nm)
LuZ490	490	H	v:2.003 03/04/11 3Gain	-0.074	-0.003	-0.004	3309.46	0.5730	5.62418	μW/(sr cm² nm)
LuZ510	510	I	v:2.003 03/04/11 3Gain	-0.186	-0.174	-0.174	3367.90	0.5737	5.84197	μW/(sr cm² nm)
LuZ532	532	J	v:2.003 03/04/11 3Gain	-0.236	-0.156	-0.157	3414.13	0.5745	5.32205	μW/(sr cm² nm)
LuZ555	555	K	v:2.003 03/04/11 3Gain	3.939	-0.040	-0.021	2438.49	0.5752	9.65923	μW/(sr cm² nm)
LuZ560	560	L	v:2.003 03/04/11 3Gain	0.358	0.311	0.311	3424.98	0.5754	6.14981	μW/(sr cm² nm)
LuZ625	625	M	v:2.003 03/04/11 3Gain	-0.059	0.026	0.026	3408.76	0.5770	10.11555	μW/(sr cm² nm)

LuZ665	665	N	v:2.003 03/04/11 3Gain	-0.034	0.052	0.051	3474.39	0.5778	11.80485	µW/(sr cm² nm)
LuZ670	670	O	v:2.003 03/04/11 3Gain	0.186	0.015	0.015	3424.16	0.5779	6.53730	µW/(sr cm² nm)
LuZ683	683	P	v:2.003 03/04/11 3Gain	0.219	0.200	0.200	3356.27	0.5781	13.06384	µW/(sr cm² nm)
LuZ710	710	Q	v:2.003 03/04/11 3Gain	-0.553	-0.189	-0.191	2923.01	0.5786	13.75675	µW/(sr cm² nm)
LuZ780	780	R	v:2.003 03/04/11 3Gain	-0.160	-0.142	-0.142	2855.62	0.5795	12.53905	µW/(sr cm² nm)
LuZChl	27 FWHM	S	v:2.003 03/04/11 3Gain	0.067	0.066	0.066	1988.09	-	0.00955	nE/(sr m² s)

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Optical Channels, Radiance (LuZ) Calibration

The values listed in the section below are common for all optical microradiometers

Date of Calibration 6/12/2018

Calibration Engineer TC

Model Number	uRv2:3G	**Adc Rate**	Rate_125_Hz	**Ranging Mode**	Auto	**Switch Point High**	31000
Firmware Version	v:2.003 03/04/11 3Gain	**Adc Buffer Enabled**	False			**Switch Point Low**	7782400
		Adc Channel Type	PrimaryInput	**Ranging Delay High**	3		
		Adc Gain	Gain_1	**Ranging Delay Medium**	3		
				Ranging Delay Low	3		

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Pressure Channel

Date of Calibration	6/15/2015	
Calibration Engineer	TPC	
Slope (Sensitivity)	-0.012002596	volts/meter
Offset (High/Low)	8153157	counts
Reference Sensor	Paroscientific	
Pressure Depth Relationship	1.00806	dbar/meter
Reference Offset	14.67	psi
Psi/Decibars	0.6894757	
R^2	0.99999851	
Test Depth (Min)	-0.41947	meter
Test Depth (Max)	195.23889	meter
Gain Ratio	1	
Ranging Mode	HighGain	
Adc Gain	Gain_32	
Channel Type	Depth	

Temperature Channel

Date of Calibration	6/15/2015	
Calibration Engineer	TPC	
Slope (Sensitivity)	-0.016591918	volts/°C
Offset (High/Low)	7462321	counts
R^2	0.99998682	
Test Temperature (Min)	-0.47560	°C
Test Temperature (Max)	33.26534	°C
Gain Ratio	1	
Ranging Mode	HighGain	
Adc Gain	Gain_128	
Channel Type	Temp	
Observations	2751	
Offset	-0.45229	volts

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Observations	2924	
Offset	-0.11497	volts

Note: decibars/meter at 30 degree latitude, temp=0C, salinity=35, 500 decibars pressure