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 000411

NIST-traceable Optical Calibrations:

The instrument was calibrated using a 1000 Watt FEL lamp with serial number V-039. This lamp was calibrated on 7/20/16 against the NIST Standard of Spectral Irradiance F-616. 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: 000411

Date of Certificate 6/12/2018

Optical Channels, Irradiance (Ed0) Calibration

Acquisition Rate 5 Hz

Aggregator Vin (Avg) 6.1 V

Aggregator Iin (Avg) 92.2 mA

Date of Calibration 6/12/2018

Calibration Engineer TPC

Internal Temperature (Max) 26.652 °C

Internal Temperature (Min) 25.798 °C

Aggregator Internal Temperature (Avg) 27.0 °C

Aggregator Internal Pressure (Avg) 5.85 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 Air	Units
Ed0320	320	A	v:2.003 03/04/11 3Gain	-0.113	-0.008	-0.008	1845.78	-	0.17997	μW/(cm² nm)
Ed0340	340	B	v:2.003 03/04/11 3Gain	-0.404	-0.284	-0.284	2153.38	-	0.14560	μW/(cm² nm)
Ed0380	380	C	v:2.003 03/04/11 3Gain	-0.070	0.052	0.051	2060.08	-	0.04994	μW/(cm² nm)
Ed0395	395	D	v:2.003 03/04/11 3Gain	-0.015	0.120	0.120	2807.11	-	0.21316	μW/(cm² nm)
Ed0412	412	E	v:2.003 03/04/11 3Gain	-0.070	0.045	0.045	2914.96	-	0.38724	μW/(cm² nm)
Ed0443	443	F	v:2.003 03/04/11 3Gain	-0.086	-0.176	-0.176	2923.32	-	0.25442	μW/(cm² nm)
Ed0465	465	G	v:2.003 03/04/11 3Gain	-0.195	-0.077	-0.078	2936.74	-	0.25615	μW/(cm² nm)
Ed0490	490	H	v:2.003 03/04/11 3Gain	0.002	0.121	0.122	2559.14	-	0.60919	μW/(cm² nm)
Ed0510	510	I	v:2.003 03/04/11 3Gain	-0.056	0.066	0.065	2916.46	-	0.70215	μW/(cm² nm)
Ed0532	532	J	v:2.003 03/04/11 3Gain	-0.245	-0.117	-0.118	3184.90	-	0.67971	μW/(cm² nm)
Ed0555	555	K	v:2.003 03/04/11 3Gain	-0.180	-0.058	-0.058	2991.62	-	1.33535	μW/(cm² nm)
Ed0560	560	L	v:2.003 03/04/11 3Gain	-0.132	-0.006	-0.006	2735.27	-	0.79871	μW/(cm² nm)
Ed0625	625	M	v:2.003 03/04/11 3Gain	-0.235	-0.109	-0.109	3016.56	-	1.56949	μW/(cm² nm)

Ed0665	665	N	v:2.003 03/04/11 3Gain	-0.198	-0.058	-0.058	3045.45	-	1.70070	μW/(cm² nm)
Ed0670	670	O	v:2.003 03/04/11 3Gain	0.000	0.113	0.113	3110.97	-	0.53202	μW/(cm² nm)
Ed0683	683	P	v:2.003 03/04/11 3Gain	-0.121	0.002	0.001	3048.48	-	2.06399	μW/(cm² nm)
Ed0710	710	Q	v:2.003 03/04/11 3Gain	0.013	0.122	0.122	3009.24	-	2.24872	μW/(cm² nm)
Ed0780	780	R	v:2.003 03/04/11 3Gain	-0.048	0.074	0.074	3084.45	-	2.06128	μW/(cm² nm)
Ed0PAR	400-700	S	v:2.003 03/04/11 3Gain	-0.359	-0.237	-0.238	3022.74	-	17535.71851	μE/(cm² s)

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Optical Channels, Irradiance (Ed0) Calibration

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

Date of Calibration 6/12/2018

Calibration Engineer

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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Serial Number: 000411

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Angle Channels, Irradiance (Ed0) Calibration

Date of Calibration 6/11/2018

Pitch and roll sensors zeroed according to manufacturer's specifications.

Calibration Engineer