

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 000273

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 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.



C-OPS

Serial Number: 000273

Date of Certificate 4/6/2017

Optical Channels, Radiance (LuZ) Calibration

Acquisition Rate 5 Hz
Internal Temperature (Max) 23.749 °C
Internal Temperature (Min) 22.895 °C
Aggregator Vin (Avg) 6.52 V
Aggregator Iin (Avg) 98.6 mA
Aggregator Internal Temperature (Avg) 26.2 °C
Aggregator Internal Pressure (Avg) 5.9 psi
Date of Calibration 4/4/2017
Calibration Engineer TC
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 ¹	Calibrated Units
LuZ305	305	A	v:2.003 03/04/11 3Gain	0.011	0.236	0.235	669.73	0.5574	2.59766	$\mu\text{W}/(\text{sr cm}^2 \text{ nm})$
LuZ320	320	B	v:2.003 03/04/11 3Gain	-0.318	-0.197	-0.198	948.58	0.5598	3.25012	$\mu\text{W}/(\text{sr cm}^2 \text{ nm})$
LuZ340	340	C	v:2.003 03/04/11 3Gain	-0.140	-0.008	-0.008	1554.24	0.5624	2.91571	$\mu\text{W}/(\text{sr cm}^2 \text{ nm})$
LuZ380	380	D	v:2.003 03/04/11 3Gain	-0.034	0.079	0.079	853.24	0.5665	0.70721	$\mu\text{W}/(\text{sr cm}^2 \text{ nm})$
LuZ395	395	E	v:2.003 03/04/11 3Gain	-0.107	0.047	0.046	3826.07	0.5677	2.43275	$\mu\text{W}/(\text{sr cm}^2 \text{ nm})$
LuZ412	412	F	v:2.003 03/04/11 3Gain	-0.225	-0.027	-0.028	4079.86	0.5689	2.34432	$\mu\text{W}/(\text{sr cm}^2 \text{ nm})$
LuZ443	443	G	v:2.003 03/04/11 3Gain	-0.168	-0.025	-0.025	4942.74	0.5707	3.31615	$\mu\text{W}/(\text{sr cm}^2 \text{ nm})$
LuZ465	465	H	v:2.003 03/04/11 3Gain	-0.253	-0.081	-0.082	4937.97	0.5719	2.29844	$\mu\text{W}/(\text{sr cm}^2 \text{ nm})$
LuZ490	490	I	v:2.003 03/04/11 3Gain	-0.249	-0.111	-0.111	6515.46	0.5730	5.88940	$\mu\text{W}/(\text{sr cm}^2 \text{ nm})$
LuZ510	510	J	v:2.003 03/04/11 3Gain	-0.325	0.067	0.066	5736.65	0.5737	3.16656	$\mu\text{W}/(\text{sr cm}^2 \text{ nm})$
LuZ532	532	K	v:2.003 03/04/11 3Gain	-0.082	0.072	0.071	6203.73	0.5745	5.91590	$\mu\text{W}/(\text{sr cm}^2 \text{ nm})$
LuZ555	555	L	v:2.003 03/04/11 3Gain	-0.247	-0.087	-0.087	6042.15	0.5752	7.14785	$\mu\text{W}/(\text{sr cm}^2 \text{ nm})$
LuZ565	565	M	v:2.003 03/04/11 3Gain	-0.060	0.078	0.077	6405.40	0.5755	6.07926	$\mu\text{W}/(\text{sr cm}^2 \text{ nm})$
LuZ625	625	N	v:2.003 03/04/11 3Gain	-0.132	-0.024	-0.025	6289.71	0.5770	10.36425	$\mu\text{W}/(\text{sr cm}^2 \text{ nm})$
LuZ665	665	O	v:2.003 03/04/11 3Gain	-0.052	0.106	0.106	6716.82	0.5778	13.94775	$\mu\text{W}/(\text{sr cm}^2 \text{ nm})$
LuZ683	683	P	v:2.003 03/04/11 3Gain	-0.303	-0.138	-0.139	6388.11	0.5781	10.47178	$\mu\text{W}/(\text{sr cm}^2 \text{ nm})$
LuZ710	710	Q	v:2.003 03/04/11 3Gain	0.068	0.010	0.010	5847.41	0.5786	14.39026	$\mu\text{W}/(\text{sr cm}^2 \text{ nm})$
LuZ780	780	R	v:2.003 03/04/11 3Gain	-0.287	-0.100	-0.101	5798.77	0.5795	11.02904	$\mu\text{W}/(\text{sr cm}^2 \text{ nm})$
LuZchl	27 FWHM	S	v:2.003 03/04/11 3Gain	-0.016	0.027	0.026				$\text{nE}/(\text{sr m}^2 \text{ s})$

1. Volts/Calibrated Units



C-OPS

Serial Number: 000273

Date of Certificate 4/6/2017

Optical Channels, Radiance (LuZ) Calibration

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

Date of Calibration 4/4/2017
Calibration Engineer TC

Model Number uRV2:3G

Firmware Version v:2.003 03/04/11 3Gain

Adc Rate Rate_125_Hz

Adc Buffer Enabled False

Adc Channel Type Primary/Input

Adc Gain Gain_1

Ranging Mode Auto

Ranging Delay High 3

Ranging Delay Medium 3

Ranging Delay Low 3

Switch Point High 31000

Switch Point Low 7782400



C-OPS Serial Number: 000273		Date of Certificate 4/6/2017	
Pressure Channel Date of Calibration Calibration Engineer		Temperature Channel Date of Calibration Calibration Engineer	
Slope (Sensitivity) Offset (High/Low) Reference Sensor Pressure Depth Relationship Reference Offset Psi/Decibars R ² Test Depth (Min) Test Depth (Max) Gain Ratio Ranging Mode Adc Gain Channel Type Observations Offset	-0.011997933 8143837 Paroscientific 1.00806 14.67 0.6894757 0.99999400 61.15757 120.19051 1 HighGain Gain_32 Depth 723 -0.11952	volts/meter counts dbar/meter psi meter meter volts volts	
Note: decibars/meter at 30 degree latitude, temp=0C, salinity=35, 500 decibars pressure			