



**InternationalLight**  
TECHNOLOGIES

# CALIBRATION CERTIFICATE

## ELECTRICAL INSTRUMENTATION CALIBRATION REPORT

This document states that the instrument described below meets or exceeds all manufacturer specifications. The calibration results published in this certificate were obtained using equipment capable of producing results that are traceable to NIST and through NIST to the International System of Units (SI). ILT is Accredited to ISO/IEC 17025:2005. Calibration conforms to ANSI/NCSI Z540.1-1994 and ANSI/NCSI Z540.3-2006.

Date: 26-Oct-18 Certificate #: 1810261401E SO#: 162182

Temp: 22 Degrees C Humidity: 18 % Procedure: TP-0113:08NOV2011

Rendered To: LOT - Quantum Design GMBH

InstrumentModel-S/N: IL1700 #330

Calibration/Repair Remarks: None

Parts (If Needed): None

As Found Tolerance In Out	As Found Readings	As Found Permissible Error	Applied Current	Adjusted Readings	Permissible Adjustment Error	As Left Tolerance In Out
<input checked="" type="checkbox"/> <input type="checkbox"/>	1.001E-3	+/- 0.5%	1.000E-3	1.000E-3	+/- 0.2%	<input checked="" type="checkbox"/> <input type="checkbox"/>
<input checked="" type="checkbox"/> <input type="checkbox"/>	1.002E-4	+/-0.5%	1.000E-4	1.000E-4	+/- 0.2%	<input checked="" type="checkbox"/> <input type="checkbox"/>
<input checked="" type="checkbox"/> <input type="checkbox"/>	1.000E-5	+/-0.7%	1.000E-5	9.99E-6	+/- 0.2%	<input checked="" type="checkbox"/> <input type="checkbox"/>
<input checked="" type="checkbox"/> <input type="checkbox"/>	1.008E-6	+/-1.0%	1.000E-6	1.000E-6	+/- 0.2%	<input checked="" type="checkbox"/> <input type="checkbox"/>
<input checked="" type="checkbox"/> <input type="checkbox"/>	1.004E-7	+/-1.0%	1.000E-7	9.99E-8	+/- 0.5%	<input checked="" type="checkbox"/> <input type="checkbox"/>
<input checked="" type="checkbox"/> <input type="checkbox"/>	1.004E-8	+/-1.0%	1.000E-8	1.002E-8	+/- 0.5%	<input checked="" type="checkbox"/> <input type="checkbox"/>
<input checked="" type="checkbox"/> <input type="checkbox"/>	9.90E-10	+/-1.0%	1.000E-9	1.000E-9	+/- 0.5%	<input checked="" type="checkbox"/> <input type="checkbox"/>
<input checked="" type="checkbox"/> <input type="checkbox"/>	9.95E-11	+/-1.5%	1.000E-10	1.005E-11	+/- 1.0%	<input type="checkbox"/> <input checked="" type="checkbox"/>

Tolerance after repair and/or calibration:  In  Out

Measurement Uncertainty: 1mA=±0.065%, 100uA=±0.062%, 10uA=±0.062%, 1uA=±0.065%, 100nA=±0.073%, 10nA=±0.079%, 1nA=±0.084%, 100pA=0.26%. Confidence Level of Uncertainty is 95% (K=2).

The above Instrument was compared to the Keithley Current Calibrator/Source Model 263 S/N 0730631 calibrated on 3/12/2018. Calibration Due: 3/12/2019

Calibrated By:   
Electrical Calibration Tech. Chris Kucy

This certificate applies only to the item identified and shall not be reproduced other than in full, without the specific written approval by International Light Technologies, Inc.





**InternationalLight**  
TECHNOLOGIES

# CALIBRATION CERTIFICATE

## ELECTRICAL INSTRUMENTATION CALIBRATION REPORT

This document states that the instrument described below meets or exceeds all manufacturer specifications. The calibration results published in this certificate were obtained using equipment capable of producing results that are traceable to NIST and through NIST to the International System of Units (SI). ILT is Accredited to ISO/IEC 17025:2005. Calibration conforms to ANSI/NCSI Z540.1-1994 and ANSI/NCSI Z540.3-2006.

Date: 26-Oct-18 Certificate #: 1810261402E SO#: 162182

Temp: 22 Degrees C Humidity: 17 % Procedure: TP-0113:08NOV2011

Rendered To: LOT - Quantum Design GMBH

InstrumentModel-S/N: IL1700 #2338

Calibration/Repair Remarks: None

Parts (If Needed): None

As Found Tolerance In Out	As Found Readings	As Found Permissible Error	Applied Current	Adjusted Readings	Permissible Adjustment Error	As Left Tolerance In Out
<input checked="" type="checkbox"/> <input type="checkbox"/>	1.000E-3	+/- 0.5%	1.000E-3	1.000E-3	+/- 0.2%	<input checked="" type="checkbox"/> <input type="checkbox"/>
<input checked="" type="checkbox"/> <input type="checkbox"/>	1.001E-4	+/-0.5%	1.000E-4	1.001E-4	+/- 0.2%	<input checked="" type="checkbox"/> <input type="checkbox"/>
<input checked="" type="checkbox"/> <input type="checkbox"/>	1.000E-5	+/-0.7%	1.000E-5	1.000E-5	+/- 0.2%	<input checked="" type="checkbox"/> <input type="checkbox"/>
<input checked="" type="checkbox"/> <input type="checkbox"/>	1.002E-6	+/-1.0%	1.000E-6	1.000E-6	+/- 0.2%	<input checked="" type="checkbox"/> <input type="checkbox"/>
<input checked="" type="checkbox"/> <input type="checkbox"/>	9.98E-8	+/-1.0%	1.000E-7	9.98E-8	+/- 0.5%	<input checked="" type="checkbox"/> <input type="checkbox"/>
<input checked="" type="checkbox"/> <input type="checkbox"/>	1.000E-8	+/-1.0%	1.000E-8	1.000E-8	+/- 0.5%	<input checked="" type="checkbox"/> <input type="checkbox"/>
<input checked="" type="checkbox"/> <input type="checkbox"/>	1.000E-9	+/-1.0%	1.000E-9	1.000E-9	+/- 0.5%	<input checked="" type="checkbox"/> <input type="checkbox"/>
<input checked="" type="checkbox"/> <input type="checkbox"/>	9.92E-11	+/-1.5%	1.000E-10	1.000E-10	+/- 1.0%	<input checked="" type="checkbox"/> <input type="checkbox"/>

Tolerance after repair and/or calibration:  In  Out

Measurement Uncertainty: 1mA=±0.065%, 100uA=±0.062%, 10uA=±0.062%, 1uA=±0.065%, 100nA=±0.073%, 10nA=±0.079%, 1nA=±0.084%, 100pA=0.26%. Confidence Level of Uncertainty is 95% (K=2).

The above Instrument was compared to the Keithley Current Calibrator/Source Model 6430 S/N 4080572 calibrated on 12/6/2017. Calibration Due: 12/6/2018

Calibrated By:   
Electrical Calibration Tech. Chris Kucy

This certificate applies only to the item identified and shall not be reproduced other than in full, without the specific written approval by International Light Technologies, Inc.





**OPTICAL CALIBRATION CERTIFICATE**

International Light Technologies certifies that the calibration results published in this certificate were obtained using equipment capable of producing results that are traceable to NIST and through NIST to the International System of Units (SI). ILT is Accredited to ISO/IEC 17025:2005. Calibration conforms to ANSI/NCSI Z540.1-1994 and ANSI/NCSI Z540.3-2006.

Rendered-to: LOT-QUANTUMDESIGN GMBH

Detector: SED240 #5676 Input Optic: W #7743

Filter: ACT5 #23008 Misc.: N/A #

Calibrated With: IL1700 #2338 +5V Bias On

(PIR) PEAK IRRADIANCE RESPONSE SENSITIVITY FACTOR AS CALIBRATED ON: 29-Oct-2018

4.11E-4 (A)(cm2)(eff W-1) assuming monochromatic irradiance at 270nm

5.38% \*Change In Sensitivity From Previous Calibration Dated: 07-May-2014

Tolerance As Found:  In  Out Tolerance As Left:  In  Out

Unit will read directly in effective watts per square centimeter when used with the sensitivity factor above.

REFERENCE PLANE Groove ONE formed by filter or diffuser elements and next element, counted from front surface of assembly.

\*difference includes intrinsic detector change, NIST recertification updates, lab experimental error or modifications to the hardware adjustments.

PRIMARY STANDARD: U.S. National Institute of Standards and Technology Detector Response

I219 - December 3, 2015 - NIST Test No. 685/287304-15/2 : D204 - December 2, 2015 - NIST Test No. 685/287304-15/1

INTERNATIONAL LIGHT TECHNOLOGIES PRIMARY TRANSFER STANDARDS:

U1023 U522 N/A

ILT Transfer Uncertainty to Customer = +/- 4.5% plus NIST Uncertainty of: +/- 1% Confidence Level of Uncertainty is 95% (k=2)

LIGHT SOURCE: SpectroPro1500/1000W Xe LAMP OUTPUT: 5.83E-7 W/cm2

INSTRUMENTATION: SED240 #3355 PROCEDURE: OP-0018

TEMPERATURE: 22.2 degrees C HUMIDITY: 33%

CALIBRATED BY: Cathy Olson

Calibration Technician: Cathy Olson

THIS CERTIFICATE APPLIES ONLY TO THE ITEMS IDENTIFIED AND SHALL NOT BE REPRODUCED EXCEPT IN FULL, WITHOUT THE SPECIFIC WRITTEN APPROVAL BY INTERNATIONAL LIGHT TECHNOLOGIES, INC.

Calibration Date: 10/29/2018 Certificate No: 810299714 Sales Order #: 162182





**OPTICAL CALIBRATION CERTIFICATE**

International Light Technologies certifies that the calibration results published in this certificate were obtained using equipment capable of producing results that are traceable to NIST and through NIST to the International System of Units (SI). ILT is Accredited to ISO/IEC 17025:2005. Calibration conforms to ANSI/NCSI Z540.1-1994 and ANSI/NCSI Z540.3-2006.

Rendered-to: LOT-QUANTUMDESIGN GMBH

Detector: SED240 #5676 Input Optic: W #7743

Filter: UVB-1 #23781 Misc.: N/A #

Calibrated With: IL1700 #2338 +5V Bias On

(PIR) PEAK IRRADIANCE RESPONSE SENSITIVITY FACTOR AS CALIBRATED ON: 29-Oct-2018

1.420E-5 (A)(cm2)(W-1) assuming monochromatic irradiance at 290nm

1.420E-08 (A)(cm2)(mW-1) assuming monochromatic irradiance at 290nm

Unit will read directly in watts per square centimeter or milliWatts per square centimeter when used with the sensitivity factor above. PREVIOUSLY CALIBRATED WITH W #10237

REFERENCE PLANE Groove ONE formed by filter or diffuser elements and next element, counted from front surface of assembly,

PRIMARY STANDARD: U.S. National Institute of Standards and Technology Detector Response

I219 - December 3, 2015 - NIST Test No. 685/287304-15/2 : D204 - December 2, 2015 - NIST Test No. 685/287304-15/1

INTERNATIONAL LIGHT TECHNOLOGIES PRIMARY TRANSFER STANDARDS:

U522 U1023 N/A

ILT Transfer Uncertainty to Customer = +/- 5.5% plus NIST Uncertainty of: +/- 1.25 Confidence Level of Uncertainty is 95% (k=2)

LIGHT SOURCE: 19P Hg-Xe LAMP OUTPUT: 7.29E-3 W/cm2

INSTRUMENTATION: #1029/SCS280/W PROCEDURE: OP-0007

TEMPERATURE: 22.2 degrees C HUMIDITY: 33%

CALIBRATED BY: *Cathy Olson*

Calibration Technician: Cathy Olson

THIS CERTIFICATE APPLIES ONLY TO THE ITEMS IDENTIFIED AND SHALL NOT BE REPRODUCED EXCEPT IN FULL, WITHOUT THE SPECIFIC WRITTEN APPROVAL BY INTERNATIONAL LIGHT TECHNOLOGIES, INC.

Calibration Date: 10/29/2018 Certificate No: 810299713 Sales Order #: 162182





**OPTICAL CALIBRATION CERTIFICATE**

International Light Technologies certifies that the calibration results published in this certificate were obtained using equipment capable of producing results that are traceable to NIST and through NIST to the International System of Units (SI). ILT is Accredited to ISO/IEC 17025:2005. Calibration conforms to ANSI/NCSI Z540.1-1994 and ANSI/NCSI Z540.3-2006.

Rendered-to: LOT-QUANTUMDESIGN GMBH

Detector: SED033 #7059 Input Optic: W7 #00119

Filter: UVA #23821 Misc.: N/A #

Calibrated With: IL1700 #2338 +5V Bias Off

(PIR) PEAK IRRADIANCE RESPONSE SENSITIVITY FACTOR AS CALIBRATED ON: 29-Oct-2018

6.45E-3 (A)(cm2)(W-1) assuming monochromatic irradiance at 360nm

6.450E-06 (A)(cm2)(mW-1) assuming monochromatic irradiance at 360nm

Unit will read directly in watts per square centimeter or milliWatts per square centimeter when used with the sensitivity factor above. PREVIOUSLY CALIBRATED WITH W #10237.

REFERENCE PLANE Groove ONE formed by filter or diffuser elements and next element, counted from front surface of assembly.

PRIMARY STANDARD: U.S. National Institute of Standards and Technology Detector Response

I219 - December 3, 2015 - NIST Test No. 685/287304-15/2 : D204 - December 2, 2015 - NIST Test No. 685/287304-15/1

INTERNATIONAL LIGHT TECHNOLOGIES PRIMARY TRANSFER STANDARDS:

SED400 #139 SED400 #1490 IL #01

ILT Transfer Uncertainty to Customer = +/- 4.5% plus NIST Uncertainty of: +/- 1.16 Confidence Level of Uncertainty is 95% (k=2)

LIGHT SOURCE: 19P Hg-Xe LAMP OUTPUT: 3.02E-3 W/cm2

INSTRUMENTATION: SED033 #4544/UVA/W PROCEDURE: OP-0007

TEMPERATURE: 22.2 degrees C HUMIDITY: 33%

CALIBRATED BY: Cathy Olson

Calibration Technician: Cathy Olson

THIS CERTIFICATE APPLIES ONLY TO THE ITEMS IDENTIFIED AND SHALL NOT BE REPRODUCED EXCEPT IN FULL, WITHOUT THE SPECIFIC WRITTEN APPROVAL BY INTERNATIONAL LIGHT TECHNOLOGIES, INC.

Calibration Date: 10/29/2018 Certificate No: 810299712 Sales Order #: 162182







OPTICAL CALIBRATION CERTIFICATE

International Light Technologies certifies that the calibration results published in this certificate were obtained using equipment capable of producing results that are traceable to NIST and through NIST to the International System of Units (SI). ILT is Accredited to ISO/IEC 17025:2005. Calibration conforms to ANSI/NCSI Z540.1-1994 and ANSI/NCSI Z540.3-2006.

Rendered-to: LOT-QUANTUMDESIGN GMBH

Detector: SED033 #4776 Input Optic: W #5599

Filter: F #16702 Misc.: N/A #

Calibrated With: IL1700 #2338 +5V Bias Off

(PIR) PEAK IRRADIANCE RESPONSE SENSITIVITY FACTOR AS CALIBRATED ON: 29-Oct-2018

1.233E-2 (A)(cm2)(W-1) assuming monochromatic irradiance at 600nm

1.233E-05 (A)(cm2)(mW-1) assuming monochromatic irradiance at 600nm

10.09% \*Change In Sensitivity From Previous Calibration Dated: 07-May-2014

Tolerance As Found:  In  Out Tolerance As Left:  In  Out

Unit will read directly in watts per square centimeter or milliWatts per square centimeter when used with the sensitivity factor above.

REFERENCE PLANE Groove ONE formed by filter or diffuser elements and next element, counted from front surface of assembly.

\*difference includes intrinsic detector change, NIST recertification updates, lab experimental error or modifications to the hardware adjustments.

PRIMARY STANDARD: U.S. National Institute of Standards and Technology Detector Response

I219 - December 3, 2015 - NIST Test No. 685/287304-15/2 : D204 - December 2, 2015 - NIST Test No. 685/287304-15/1

INTERNATIONAL LIGHT TECHNOLOGIES PRIMARY TRANSFER STANDARDS:

IL #01 IL #02 SED033 #3275

ILT Transfer Uncertainty to Customer = +/- 3% plus NIST Uncertainty of: +/- 0.31 Confidence Level of Uncertainty is 95% (k=2)

LIGHT SOURCE: 1G 1000W QTH LAMP OUTPUT: 3.02E-5 W/cm2

INSTRUMENTATION: SED033 #6400 PROCEDURE: OP-0029

TEMPERATURE: 22.2 degrees C HUMIDITY: 33%

CALIBRATED BY: [Signature]

Calibration Technician: Cathy Olson

THIS CERTIFICATE APPLIES ONLY TO THE ITEMS IDENTIFIED AND SHALL NOT BE REPRODUCED EXCEPT IN FULL, WITHOUT THE SPECIFIC WRITTEN APPROVAL BY INTERNATIONAL LIGHT TECHNOLOGIES, INC.

Calibration Date: 10/29/2018 Certificate No: 810299711 Sales Order #: 162182





OPTICAL CALIBRATION CERTIFICATE

International Light Technologies certifies that the calibration results published in this certificate were obtained using equipment capable of producing results that are traceable to NIST and through NIST to the International System of Units (SI). ILT is Accredited to ISO/IEC 17025:2005. Calibration conforms to ANSI/NCSI Z540.1-1994 and ANSI/NCSI Z540.3-2006.

Rendered-to: LOT-QUANTUMDESIGN GMBH

Detector: SED033 #4776 Input Optic: R #415

Filter: F #16702 Misc.: N/A #

Calibrated With: IL1700 #2338 +5V Bias Off

(PRR) PEAK RADIANCE RESPONSE SENSITIVITY FACTOR AS CALIBRATED ON: 29-Oct-2018

8.87E-4 (A)(cm2)(sr)(W-1) assuming monochromatic radiance at 600nm

-1.22% \*Change In Sensitivity From Previous Calibration Dated: 07-May-2014

Tolerance As Found:  In  Out Tolerance As Left:  In  Out

Unit will read directly in watts per square centimeter per steradian when used with the sensitivity factor above.

REFERENCE PLANE Average F.O.V. +/-0.75 Degrees

\*difference includes intrinsic detector change, NIST recertification updates, lab experimental error or modifications to the hardware adjustments.

PRIMARY STANDARD: U.S. National Institute of Standards and Technology Detector Response

I219 - December 3, 2015 - NIST Test No. 685/287304-15/2 : D204 - December 2, 2015 - NIST Test No. 685/287304-15/1

INTERNATIONAL LIGHT TECHNOLOGIES PRIMARY TRANSFER STANDARDS:

IL #01 IL #02 SED033 #3275

ILT Transfer Uncertainty to Customer = +/- 3% plus NIST Uncertainty of: +/- 0.31 Confidence Level of Uncertainty is 95% (k=2)

LIGHT SOURCE: 1G 1000W QTH/Reflectance Tablet LAMP OUTPUT: 9.26E-6 W/cm2/sr

INSTRUMENTATION: SED033 #6400 PROCEDURE: OP-0041

TEMPERATURE: 22.2 degrees C HUMIDITY: 33%

CALIBRATED BY: Cathy Olson

Calibration Technician: Cathy Olson

THIS CERTIFICATE APPLIES ONLY TO THE ITEMS IDENTIFIED AND SHALL NOT BE REPRODUCED EXCEPT IN FULL, WITHOUT THE SPECIFIC WRITTEN APPROVAL BY INTERNATIONAL LIGHT TECHNOLOGIES, INC.

Calibration Date: 10/29/2018 Certificate No: 810299710 Sales Order #: 162182





OPTICAL CALIBRATION CERTIFICATE

International Light Technologies certifies that the calibration results published in this certificate were obtained using equipment capable of producing results that are traceable to NIST and through NIST to the International System of Units (SI). ILT is Accredited to ISO/IEC 17025:2005. Calibration conforms to ANSI/NCSI Z540.1-1994 and ANSI/NCSI Z540.3-2006.

Rendered-to: LOT-QUANTUMDESIGN GMBH

Detector: SED038 #1386 Input Optic: W #3728

Filter: Y #5485 Misc.: N/A #

Calibrated With: IL1700 #330 +5V Bias Off

(VIS)PHOTOPIC ILLUMINANCE RESPONSE SENSITIVITY FACTOR AS CALIBRATED ON: 29-Oct-2018

3.68E-8 (A)(ft<sup>2</sup>)(lm-1) assuming 3215 K Color Temperature

3.419E-09 (A)(lux-1) assuming 3215 K Color Temperature

0.27% \*Change In Sensitivity From Previous Calibration Dated: 07-May-2014

Tolerance As Found:  In  Out Tolerance As Left:  In  Out

Unit will read directly in lumens per square foot (footcandles) or lux when used with the sensitivity factor above.

REFERENCE PLANE Groove ONE formed by filter or diffuser elements and next element, counted from front surface of assembly.

\*difference includes intrinsic detector change, NIST recertification updates, lab experimental error or modifications to the hardware adjustments.

PRIMARY STANDARD: U.S. National Institute of Standards and Technology Detector Response

SED033 #4528 / Y #16218 - November 5, 2015 - NIST Test No.: 685/287261-15/1 - Calibration Due: November 5, 2025

ILT Transfer Uncertainty to Customer = +/- 4.3% plus NIST Uncertainty of: +/- 0.5% Confidence Level of Uncertainty is 95% (k=2)

LIGHT SOURCE: 1G 1000W QTH LAMP OUTPUT: 226 lm/ft<sup>2</sup>

INSTRUMENTATION: #6400/Y PROCEDURE: OP-0070

TEMPERATURE: 22.2 degrees C HUMIDITY: 33%

CALIBRATED BY: [Signature]

Calibration Technician: Cathy Olson

THIS CERTIFICATE APPLIES ONLY TO THE ITEMS IDENTIFIED AND SHALL NOT BE REPRODUCED EXCEPT IN FULL, WITHOUT THE SPECIFIC WRITTEN APPROVAL BY INTERNATIONAL LIGHT TECHNOLOGIES, INC.

Calibration Date: 10/29/2018 Certificate No: 810299708 Sales Order #: 162182







## OPTICAL CALIBRATION CERTIFICATE

International Light Technologies certifies that the calibration results published in this certificate were obtained using equipment capable of producing results that are traceable to NIST and through NIST to the International System of Units (SI). ILT is Accredited to ISO/IEC 17025:2005. Calibration conforms to ANSI/NCSI Z540.1-1994 and ANSI/NCSI Z540.3-2006.

Rendered-to: LOT-QUANTUMDESIGN GMBH

Detector: SED038 #1386 Input Optic: R #172

Filter: Y #5485 Misc.: N/A #

Calibrated With: IL1700 #330 +5V Bias Off

(YLS) PHOTOPIC LUMINANCE RESPONSE SENSITIVITY FACTOR AS CALIBRATED ON: 29-Oct-2018

6.00E-10 (A)(fL-1) assuming 3215 K Color Temperature

1.751E-10 (A)(m2)(cd-1) assuming 3215 K Color Temperature

0.50% \*Change In Sensitivity From Previous Calibration Dated: 07-May-2014

Tolerance As Found:  In  Out Tolerance As Left:  In  Out

Unit will read directly in foot-Lamberts when used with the sensitivity factor above.

REFERENCE PLANE Average F.O.V. +/-0.75 Degrees

\*difference includes intrinsic detector change, NIST recertification updates, lab experimental error or modifications to the hardware adjustments.

PRIMARY STANDARD: U.S. National Institute of Standards and Technology Detector Response

SED033#4528/Y#16218 - November 5, 2015 - NIST Test No.: 685/287261-15/1 - Calibration Due: November 5, 2025

ILT Transfer Uncertainty to Customer = +/- 4.3% plus NIST Uncertainty of: +/- 0.5% Confidence Level of Uncertainty is 95% (k=2)

LIGHT SOURCE: 1G 1000W QTH/Reflectance Tablet LAMP OUTPUT: 218 fL

INSTRUMENTATION: #6400/Y PROCEDURE: OP-0071

TEMPERATURE: 22.2 degrees C HUMIDITY: 33%

CALIBRATED BY: *Cathy Olson*

Calibration Technician: Cathy Olson

THIS CERTIFICATE APPLIES ONLY TO THE ITEMS IDENTIFIED AND SHALL NOT BE REPRODUCED EXCEPT IN FULL, WITHOUT THE SPECIFIC WRITTEN APPROVAL BY INTERNATIONAL LIGHT TECHNOLOGIES, INC.

Calibration Date: 10/29/2018 Certificate No: 810299709 Sales Order #: 162182

