

#### 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 17025:2005. Calibration conforms to ANSI/NCSI Z540.1-1994 and ANSI/NCSI Z540.3-2006.

Date:	12-	Mar-14	Certificate #	!:	14031	21207	Æ	SO#:	145	615		
Temp:	24	Degrees C	Humidity:	23	%		P	rocedure:	TP-011	13:08NC	)V2	011
Rendere	d To	: LOT-Quant	tumDesign									
Instrume	entM	odel-S/N:	IL1700 #2338									
Calibrat	ion/F	Repair Remark	s: None									
Parts (If	Nee	ded): None					1					
As Found		As Found	As Found	Ann	aliad (	Current	Adiusts	d Dandings	Daymai	acible.	As Le	Α.
Tolerance In Ou	e	Readings	Permissible Error	App	olied (	Current	Aujuste	d Readings		ent Error	Toler In	
<b>V</b>		1.001E-3	+/- 0.5%		1.000E	-3	1.0	000E-3	+/- 0	).2%	<b>V</b>	
<b>✓</b>		1.002E-4	+/-0.5%		1.000E	-4	1.0	001E-4	+/- 0	).2%	<b>V</b>	

ance Out	Readings	Permissible Error	Applied Current	Adjusted Readings	Adjustment Error	Tolerance In Out
	1.001E-3	+/- 0.5%	1.000E-3	1.000E-3	+/- 0.2%	<b>✓</b>
	1.002E-4	+/-0.5%	1.000E-4	1.001E-4	+/- 0.2%	<b>✓</b>
	1.001E-5	+/-0.7%	1.000E-5	1.000E-5	+/- 0.2%	<b>✓</b>
	1.008E-6	+/-1.0%	1.000E-6	1.000E-6	+/- 0.2%	<b>✓</b>
	1.002E-7	+/-1.0%	1.000E-7	9.970E-8	+/- 0.5%	<b>✓</b>
	1.006E-8	+/-1.0%	1.000E-8	1.001E-8	+/- 0.5%	<b>✓</b>
	1.010E-9	+/-1.0%	1.000E-9	1.004E-9	+/- 0.5%	<b>✓</b>
	1.005E-10	+/-1.5%	1.000E-10	1.000E-10	+/- 1.0%	<b>✓</b>
	ance	Readings  1.001E-3  1.002E-4  1.001E-5  1.008E-6  1.002E-7  1.006E-8  1.010E-9	Readings Permissible Error  1.001E-3 +/- 0.5% 1.002E-4 +/-0.5% 1.001E-5 +/-0.7% 1.008E-6 +/-1.0% 1.002E-7 +/-1.0% 1.006E-8 +/-1.0% 1.010E-9 +/-1.0%	Readings	Readings	Readings Permissible Error Permissible Error Adjustment Error  1.001E-3 +/- 0.5% 1.000E-3 1.000E-3 +/- 0.2%  1.002E-4 +/-0.5% 1.000E-4 1.001E-4 +/- 0.2%  1.001E-5 +/-0.7% 1.000E-5 1.000E-5 +/- 0.2%  1.008E-6 +/-1.0% 1.000E-6 1.000E-6 +/- 0.2%  1.002E-7 +/-1.0% 1.000E-7 9.970E-8 +/- 0.5%  1.006E-8 +/-1.0% 1.000E-8 1.001E-8 +/- 0.5%  1.010E-9 +/-1.0% 1.000E-9 1.004E-9 +/- 0.5%

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%

The above Instrument was compared to the Keithley Current Calibrator/Source Model 263 S/N 0621350 on 2/2/2014 which is traceable to NIST. Calibration Due: 2/2/2015

calibrated

Calibrated By:

Poul De for

Electrical Calibration Tech. Paul DeLauri

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.

Form F-094B Rev F

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Gilway echnical Lamp

International Light



### ELECTRICAL INSTRUMENTATION CALIBRATION REPORT

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ate:	12-Mar-14	Certificate	#: 1403121208	BE SO#:	145615	
emp:	24 Degree	s C Humidity:	23 %	Procedure:	TP-0113:08No	OV2011
endered	l To: LOT-Qu	antumDesign				
strume	ntModel-S/N:	IL1700 #330				
alibrati	on/Repair Rema	arks: Main display	failing intermitte	ently and has been	n replaced.	
(IC:	NT 1 1 N N C 1	1' 1				
arts (If	Needed): Main	display.				
arts (If)	Needed): Main	display.				
As Found Tolerance In Out	As Found Readings	As Found Permissible Error	Applied Current	Adjusted Readings	Permissible Adjustment Error	As Left Tolerance In Out
As Found Tolerance	As Found Readings	As Found	Applied Current	Adjusted Readings 1.000E-3		Tolerance
As Found Tolerance In Out	As Found Readings	As Found Permissible Error			Adjustment Error	Tolerance In Out
As Found Tolerance In Out	As Found Readings	As Found Permissible Error +/- 0.5%	1.000E-3	1.000E-3	Adjustment Error +/- 0.2%	Tolerance In Out
As Found Tolerance In Out	As Found Readings 1.002E-3 1.003E-4	As Found Permissible Error +/- 0.5% +/-0.5%	1.000E-3 1.000E-4	1.000E-3 1.001E-4	+/- 0.2% +/- 0.2%	Tolerance In Out
As Found Tolerance In Out	As Found Readings  1.002E-3  1.003E-4  1.001E-5	As Found Permissible Error +/- 0.5% +/-0.5% +/-0.7%	1.000E-3 1.000E-4 1.000E-5	1.000E-3 1.001E-4 1.000E-5	+/- 0.2% +/- 0.2% +/- 0.2%	Tolerance In Out
As Found Tolerance In Out	As Found Readings  1.002E-3  1.003E-4  1.001E-5  1.003E-6  1.008E-7	As Found Permissible Error +/- 0.5% +/-0.5% +/-0.7% +/-1.0%	1.000E-3 1.000E-4 1.000E-5 1.000E-6	1.000E-3 1.001E-4 1.000E-5 1.000E-6	+/- 0.2% +/- 0.2% +/- 0.2% +/- 0.2%	Tolerance In Out
As Found Tolerance In Out	As Found Readings  1.002E-3  1.003E-4  1.001E-5  1.003E-6  1.008E-7  1.017E-8	As Found Permissible Error  +/- 0.5% +/-0.5% +/-0.7% +/-1.0%	1.000E-3 1.000E-4 1.000E-5 1.000E-6 1.000E-7	1.000E-3 1.001E-4 1.000E-5 1.000E-6 9.950E-8	+/- 0.2% +/- 0.2% +/- 0.2% +/- 0.2% +/- 0.5%	Tolerance In Out

Calibrated By:

Flectrical Calibration Tech. Paul DeLauri

2/2/2014 which is traceable to NIST. Calibration Due:

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The above Instrument was compared to the Keithley Current Calibrator/Source Model 263 S/N 0621350

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calibrated







#### **OPTICAL CALIBRATION CERTIFICATE**

Rendered-to: <u>LOT-QUANTUMDESIGN</u>	
Detector: SED240 #5676	Input Optic W #10237
Filter: UVB-1 #23781	Misc.: N/A #
Calibrated With: <u>IL1700 #2338</u>	+5V Bias <u>On</u>
	•
(PIR) PEAK IRRADIANCE RESPONSE SENSITIVITY FACTO	R AS CALIBRATED ON: 07-May-2014
1.383E-5 (A)(cm2)(W-1) assuming monochromat	tic irradiance at 290nm
21.42% *Change In Sensitivity From Previous Calib	oration Dated: 03-Dec-2001
Tolerance As Found: ☐ In ✓ Out	Tolerance As Left: ✓ In Out
Unit will read directly in watts per square centimeter when used w	ith an IL1700
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 recertificatio adjustments.	n updates, lab experimental error or modifications to the hardware
PRIMARY STANDARD: U.S. National Institute of Standards and I219 - November 2005 - NIST Test No. 844/272521-05 : U1023 January 1997 - NIST Test No. 844/257423-96/1	
INTERNATIONAL LIGHT TECHNOLOGIES PRIMARY TRAN	NSFER STANDARDS:
U522 U1023 N/A	
ILT Transfer Uncertainty to Customer = $\pm \frac{1}{2}$ plus NIST Un	ncertainty of:
LIGHT SOURCE: 19J Hg-Xe	LAMP OUTPUT: 7.00E-3 W/cm2
INSTRUMENTATION: #1029/SCS280/W	PROCEDURE: <u>OP-0007</u>
	HUMIDITY: 25%
CALIBRATED BY:	
Calibration Technician: Cathy Olson	NOT BE DEPOSITIONED EVOCATING IN A MITHOUT TO SECURE
THIS CERTIFICATE APPLIES ONLY TO THE ITEMS IDENTIFIED AND SHAI WRITTEN APPROVAL BY INTERNATIONAL LIGHT TECHNOLOGIES, INC.	LL NOT BE REPRODUCED EXCEPT IN FULL, WITHOUT THE SPECIFIC
Calibration Date: <u>5/7/2014</u> Certificate No: <u>405074721</u>	Sales Order #: 145615



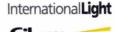
### **OPTICAL CALIBRATION CERTIFICATE**

Rendered-to: <u>LOT-QUANTUMDESIGN</u>	
Detector: SED240 #5676	Input Optic W #7743
Filter: ACT5 #23008	Misc.: N/A #
Calibrated With: IL1700 #2338	+5V Bias On
	•
	OD AS CAMPBATTED ON 107 M 2014
(PIR) PEAK IRRADIANCE RESPONSE SENSITIVITY FACTO	DR AS CALIBRATED ON: 07-may-2014
3.90E-4 (A)(cm2)(eff W-1) assuming monochro	omatic irradiance at 270nm
Unit will read directly in effective watts per square centimeter wh	en used with an IL1700_
DEEEDENCE DI ANE. Croove ONE formed by filter or diffusor	alamonts and next alamont, counted from front aurices of accombly
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	
I219 - November 2005 - NIST Test No. 844/272521-05 : U102 January 1997 - NIST Test No. 844/257423-96/1	23 - January 1997 - NIST Test No. 844/257423-96/2 : D204 -
INTERNATIONAL LIGHT TECHNOLOGIES PRIMARY TRA	NSFER STANDARDS:
U1023 U522 N/A	
ILT Transfer Uncertainty to Customer = $\pm \frac{4.5\%}{1.00}$ plus NIST U	Incertainty of: +/- 1%
LIGHT SOURCE: SpectroPro1500/1000W Xe	LAMP OUTPUT: 9.64E-7 W/cm2
INSTRUMENTATION: SED240 #3355	PROCEDURE: <u>LP-0041 Rev B</u>
TEMPERATURE: 22.8 degrees C	HUMIDITY:25%
CALIBRATED BY:	-
Calibration Technician: Cathy Olson	
THIS CERTIFICATE APPLIES ONLY TO THE ITEMS IDENTIFIED AND SHA WRITTEN APPROVAL BY INTERNATIONAL LIGHT TECHNOLOGIES, INC.	
Calibration Date: <u>5/7/2014</u> Certificate No: <u>405074720</u>	Sales Order #: 145615



#### **OPTICAL CALIBRATION CERTIFICATE**

Rendered-to: <u>LOT-QUANTUMDESIGN</u>				
Detector: SED033 #7059	Input Optic W #10237			
Filter: UVA #23821	Misc.: N/A #			
Calibrated With: IL1700 #2338	+5V Bias Off			
	•			
(PIR) PEAK IRRADIANCE RESPONSE SENSITIVITY FACTO	R AS CALIBRATED ON: 07-May-2014			
7.20E-3 (A)(cm2)(W-1) assuming monochromat	tic irradiance at 360nm			
-2.70% *Change In Sensitivity From Previous Calib	oration Dated: 03-Dec-2001			
Tolerance As Found: ✓ In Out	Tolerance As Left: ✓ In Out			
Unit will read directly in watts per square centimeter when used w	ith an IL1700			
*difference includes intrinsic detector change, NIST recertificatio adjustments.	elements and next element, counted from front surface of assembly.  In updates, lab experimental error or modifications to the hardware			
PRIMARY STANDARD: U.S. National Institute of Standards and I219 - November 2005 - NIST Test No. 844/272521-05: U1023 January 1997 - NIST Test No. 844/257423-96/1				
INTERNATIONAL LIGHT TECHNOLOGIES PRIMARY TRAN	NSFER STANDARDS:			
SED400 #139 SED400 #1490 IL #01				
ILT Transfer Uncertainty to Customer = $\pm \frac{-4.5\%}{}$ plus NIST Un	ncertainty of: <u>+/- 1%</u>			
LIGHT SOURCE: 19J Hg-Xe	LAMP OUTPUT: 2.73E-3 W/cm2			
INSTRUMENTATION: #4544/UVA/W	PROCEDURE: <u>OP-0007</u>			
TEMPERATURE: 22.8 degrees C	HUMIDITY:25%			
CALIBRATED BY:				
Calibration Technician: Cathy Olson				
THIS CERTIFICATE APPLIES ONLY TO THE ITEMS IDENTIFIED AND SHAI WRITTEN APPROVAL BY INTERNATIONAL LIGHT TECHNOLOGIES, INC.	LL NOT BE REPRODUCED EXCEPT IN FULL, WITHOUT THE SPECIFIC			
Calibration Date: _5/7/2014 Certificate No: 405074719	Sales Order #: 145615			







#### **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: <u>LOT-QUANTUMDESIGN</u>	
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  8.98E-4 (A)(cm2)(sr)(W-1) assuming monochro	•
(A)(cm2)(st)(w-1) assuming monocine	matic radiance at oboinin
1.35% *Change In Sensitivity From Previous Calib	pration Dated: 26-May-2010
Tolerance As Found: ✓ In Out	Tolerance As Left: ✓ In Out
Unit will read directly in watts per square centimeter per steradian	when used with an IL1700
REFERENCE PLANE: Average F.O.V. +/-0.75 Degrees  *difference includes intrinsic detector change, NIST recertificatio adjustments.  PRIMARY STANDARD: U.S. National Institute of Standards and	on updates, lab experimental error or modifications to the hardware
I219 - November 2005 - NIST Test No. 844/272521-05 : U102: January 1997 - NIST Test No. 844/257423-96/1	
INTERNATIONAL LIGHT TECHNOLOGIES PRIMARY TRAI	NSFER STANDARDS:
IL #01 IL #02 SED033 #3275	
ILT Transfer Uncertainty to Customer =plus NIST Un	ncertainty of: <u>+/- 0.31%</u>
LIGHT SOURCE: 1L 1000W QTH/Reflectance Tablet	LAMP OUTPUT: 9.17E-6 W/cm2/sr
INSTRUMENTATION: #6400	PROCEDURE: <u>OP-0041</u>
TEMPERATURE: 22.8 degrees C	HUMIDITY:25%
CALIBRATED BY: Calibration Technician Cathy Olean	
Calibration Technician: Cathy Olson THIS CERTIFICATE APPLIES ONLY TO THE ITEMS IDENTIFIED AND SHA	LL NOT BE REPRODUCED EXCEPT IN FULL. WITHOUT THE SPECIFIC
WRITTEN APPROVAL BY INTERNATIONAL LIGHT TECHNOLOGIES, INC.	
Calibration Date: 5/7/2014 Certificate No: 405074718	Sales Order #: <u>145615</u>



10 Technology Drive, Peabody, MA 01960 USA 978-818-6180 / 978-818-6181 *fax* intl-lighttech.com

Form F-074 (Rev H)



#### OPTICAL CALIBRATION CERTIFICATE

Rendered-to: <u>LOT-QUANTUMDESIGN</u>	
Detector: SED033 #4776	Input Optic W #5599
Filter: F #16702	Misc.: N/A #
Calibrated With: IL1700 #2338	+5V Bias <u>Off</u>
(DID) DE AV IDD ADIANCE DECRONEE CENCITIVITY FACTOR	OD AS CALIDRATED ON: 07 May 2014
(PIR) PEAK IRRADIANCE RESPONSE SENSITIVITY FACTO	OR AS CALIBRATED ON: 07-May-2014
1.120E-2(A)(cm2)(W-1) assuming monochroma	tic irradiance at 600nm
-1.50% *Change In Sensitivity From Previous Calif	bration Dated: 26-May-2010
Tolerance As Found: ✓ In Out	Tolerance As Left: ✓ In Out
Unit will read directly in watts per square centimeter when used w	vith an IL1700
•	
INTERNATIONAL LIGHT TECHNOLOGIES PRIMARY TRA	NSFER STANDARDS:
	Not EK STANDARDS.
IL #01 IL #02 SED033 #3275	200 1 0 210V
ILT Transfer Uncertainty to Customer = +/- 3% plus NIST U	
LIGHT SOURCE: <u>IL 1000W QTH</u>	LAMP OUTPUT: 2.95E-5 W/cm2
INSTRUMENTATION; #6400	PROCEDURE: <u>OP-0029</u>
TEMPERATURE: 22.8 degrees C CALIBRATED BY:	HUMIDITY: 25%
Calibration Technician: Cathy Olson	
THIS CERTIFICATE APPLIES ONLY TO THE ITEMS IDENTIFIED AND SHA WRITTEN APPROVAL BY INTERNATIONAL LIGHT TECHNOLOGIES, INC.	ALL NOT BE REPRODUCED EXCEPT IN FULL, WITHOUT THE SPECIFIC
Calibration Date: _5/7/2014 Certificate No: 405074717	Sales Order #:145615





#### **OPTICAL CALIBRATION CERTIFICATE**

Rendered-to: <u>LOT-QUANTUMDESIGN</u>	
Detector: SED038 #1386	Input Optic W #3728
Filter: Y #5485	Misc.: N/A #
Calibrated With: IL1700 #330	+5V Bias Off
	,
(YIS) PHOTOPIC ILLUMINANCE RESPONSE SENSITIVITY	FACTOR AS CALIBRATED ON: 07-May-2014
3.67E-8(A)(ft2)(lm-1) assuming 3215 K Color	Temperature
3.410E-09(A)(lux-1) assuming 3215 K Color Temper	rature
-0.54% *Change In Sensitivity From Previous Cali	bration Dated: 27-May-2010
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 an IL1700
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 adjustments.	on updates, lab experimental error or modifications to the hardware
PRIMARY STANDARD: U.S. National Institute of Standards an SED033 #4528 / Y #16218 - December 8, 2005 - NIST Test No	
ILT Transfer Uncertainty to Customer = $\pm \frac{1}{4.3\%}$ plus NIST U	Incertainty of: _+/- 0.5%
LIGHT SOURCE: 1L 1000W QTH	LAMP OUTPUT: 224 lm/ft2
INSTRUMENTATION: #6400/Y	PROCEDURE: <u>OP-0070</u>
TEMPERATURE: 22.8 degrees C	HUMIDITY: 25%
CALIBRATED BY:	
Calibration Technician: Cathy Olson	
THIS CERTIFICATE APPLIES ONLY TO THE ITEMS IDENTIFIED AND SHAWRITTEN APPROVAL BY INTERNATIONAL LIGHT TECHNOLOGIES, INC.	
Calibration Date: <u>5/7/2014</u> Certificate No: <u>405074716</u>	Sales Order #: 145615



#### **OPTICAL CALIBRATION CERTIFICATE**

Rendered-to: <u>LOT-QUANTUMDESIGN</u>	
Detector: SED038 #1386	Input Optic R #172
Filter: Y #5485	Misc.: N/A #
Calibrated With: IL1700 #330	+5V Bias <u>Off</u>
(YLS) PHOTOPIC LUMINANCE RESPONSE SENSITIVITY	
	•
-1.49% *Change In Sensitivity From Previous Cal	ibration Dated: 27-May-2010
Tolerance As Found: ✓ In Out	Tolerance As Left: ✓ In Out
Unit will read directly in foot-Lamberts when used with an IL170	00
REFERENCE PLANE: Average F.O.V. +/-0.75 Degrees  *difference includes intrinsic detector change, NIST recertificati adjustments.  PRIMARY STANDARD: U.S. National Institute of Standards ar SED033#4528/Y#16218/R#204 - December 14, 2005 - N	
ILT Transfer Uncertainty to Customer = +/- 4.3% plus NIST U	Uncertainty of: _+/- 0.5%
LIGHT SOURCE: 1L 1000W QTH/Reflectance Tablet	
INSTRUMENTATION: #6400/Y	PROCEDURE: OP-0071
TEMPERATURE: 22.8 degrees C	HUMIDITY:25%
CALIBRATED BY:  Calibration Technician: Cathy Olson	
THIS CERTIFICATE APPLIES ONLY TO THE ITEMS IDENTIFIED AND SH WRITTEN APPROVAL BY INTERNATIONAL LIGHT TECHNOLOGIES, INC	IALL NOT BE REPRODUCED EXCEPT IN FULL, WITHOUT THE SPECIFIC
Calibration Date: 5/7/2014 Certificate No: 405074715	Sales Order #: 145615

