TEST REPORT

IEC 62471:2006

Photobiological safety of lamps and lamp systems

Report reference No ..... :	RSZ150706552-03M1
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Date of issue ..... :	2015-07-09
Testing laboratory ..... :	Bay Area Compliance Laboratories Corp. (Dongguan)
Address ..... :	No.69 Pulong Village Puxinhu Industry Zone Tangxia,Dongguan, China.
Testing location ..... :	Same as above
Applicant ..... :	Guangzhou Hongli Opto-Electronic Co., Ltd.
Address ..... :	No.1, Xianke Yi Road, Huadong Town, Huadu District, Guangzhou, China
Standard ..... :	IEC 62471:2006
Test sample(s) received..... :	2015-07-07
Test in period..... :	2015-07-08
Procedure deviation ..... :	N.A.
Non-standard test method ..... :	N.A.

Type of test object ..... :	LED Package
Trademark ..... :	None
Model/type reference ..... :	P2016W6H4-D01-8D1A01
Multiple models..... :	P2016W1H4-D01-8D1A01, P2016W2H4-D01-8D1A01, P2016W3H4-D01-8D1A01, P2016W4H4-D01-8D1A01, P2016W5H4-D01-8D1A01

Manufacturer..... .....:	Guangzhou Hongli Opto-Electronic Co., Ltd. No.1, Xianke Yi Road, Huadong Town, Huadu District, Guangzhou, China
Rating .....:	150mA

Copy of marking plate:
N/A

Test item particulars .....:

Tested lamp.....:LED
Tested lamp system.....:N/A

Lamp classification group.....: Exempt Group
Lamp cap.....:N/A
Bulb.....:N/A
Rated of the lamp .....:N/A
Furthermore marking on the lamp.....:N.A.
Seasoning of lamps according EN standard .....:No seasoning
Used measurement instrument.....:See appendix B for details
Temperature by measurement.....:25.3°C
Information for safety use.....:N.A

Possible test case verdicts:
-test case does not apply to the test object.....:N(.A.)
-test object does meet the requirement.....:P(ass)
-test object does not meet the requirement.....:F(ail)

General remarks:
The test results presented in this report relate only to the object tested.
This report shall not be reproduced, except in full, without the written approval of the Issuing testing laboratory.
"(See Enclosure #)" refers to additional information appended to the report.
"(See appended table)" refers to a table appended to the report.
Throughout this report a point is used as the decimal separator.
List of test equipment must be kept on file and available for review.

This report consists of 18 pages and following appendices:
Appendix A EUT photos
Appendix B Test equipment list
Appendix C DECLARATION OF DIFFERENCES

Note：This report is based on RSZ150706552-03, the amendment is just change the blue light(small source) emission limits.

General product information:

Model	Input parameters	CCT
P2016W1H4-D01-8D1A01	150mA	2700K
P2016W2H4-D01-8D1A01		3000K
P2016W3H4-D01-8D1A01		4000K
P2016W4H4-D01-8D1A01		5000K
P2016W5H4-D01-8D1A01		6000K
P2016W6H4-D01-8D1A01		6500K

From above table, all models have same electrical parameters. They difference just in CCT.
6500K is the worse case,which could cover other CCT.Unless otherwise specified, the P2016W6H4-D01-8D1A01 was chosen as the representative models to perform the test.

Remarks:
The measured LED, part number P2016W6H4-D01-8D1A01, with ANSI bin 6500K, is part of the Hongli LED Package product family. The present classification is thus valid(worst case) for all Hongli LED Package P2016WxH4-D01-8D1A01 from ANSI bins equal to 6500K or lower CCT.

4	EXPOSURE LIMITS		P
4.1	General		P
	The exposure limits in this standard is not less than 0,01 ms and not more than any 8-hour period and should be used as guides in the control of exposure		P
	Detailed spectral data of a light source are generally required only if the luminance of the source exceeds 10^4 cd·m^{-2}	>10^4 cd·m^{-2}	P
4.3	Hazard exposure limits		P
4.3.1	Actinic UV hazard exposure limit for the skin and eye		P
	The exposure limit for effective radiant exposure is 30 J.m^{-2} within any 8-hour period		P
	To protect against injury of the eye or skin from ultraviolet radiation exposure produced by a broadband source, the effective integrated spectral irradiance, Es, of the light source shall not exceed the levels defined by:	Es=7.8×10^{-6}W·m^{-2}	P
	$Es \cdot t = \sum_{200}^{400} \sum_{t} E\lambda(\lambda,t) \cdot s_{uv}(\lambda) \cdot \triangle t \cdot \triangle \lambda \leq 30$ J·m^{-2}		P
	The permissible time for exposure to ultraviolet radiation incident upon the unprotected eye or skin shall be computed by:		P
	$t_{max}=30/E_s$	$t_{max}=30/(7.8\times10^{-6})=3.85\times10^6$s	P
4.3.2	Near-UV hazard exposure limit for eye		P
	For the spectral region 315 nm to 400 nm (UV-A) the total radiant exposure to the eye shall not exceed 10000 J.m^{-2} for exposure times less than 1000s. For exposure times greater than 1000 s (approximately 16 minutes) the UV-A irradiance for the unprotected eye, E_{UVA}, shall not exceed 10 W·m^{-2}	E_{UVA}=4.3×10^{-4}W·m^{-2}	P
	The permissible time for exposure to ultraviolet radiation incident upon the unprotected eye for time less than 1000 s, shall be computed by:		N
	$t_{max} \leq 10000/E_{UVA}$ s		N
4.3.3	Retinal blue light hazard exposure limit		P
	To protect against retinal photochemical injury from chronic blue-light exposure, the integrated spectral radiance of the light source weighted against the blue-light hazard function, B(_), i.e., the blue-light weighted radiance , LB, shall not exceed the levels defined by:		P
	$L_B \cdot t = \sum_{300}^{700} \sum_{t} L\lambda(\lambda,t) \cdot B(\lambda) \cdot \triangle t \cdot \triangle \lambda \leq 10^6$ J·m^{-2}·sr^{-1}		N

	$L_B = \sum_{300}^{700} L_\lambda \cdot B(\lambda) \cdot \triangle\lambda \leq 100$ W·m^{-2}·sr^{-1}	L_B=77 W·m-2·sr-1	P
4.3.4	Retinal blue light hazard exposure limit - small source	α= 0.0030 rad	P
	Thus the spectral irradiance at the eye E_, weighted against the blue-light hazard function B(_) shall not exceed the levels defined by: see table 4.2		P
	$E_B \cdot t = \sum_{300}^{700} \sum_{t} E_\lambda(\lambda,t) \cdot B(\lambda) \cdot \triangle t \cdot \triangle\lambda \leq 100$ J·m^{-2}		N
	$E_B = \sum_{300}^{700} E_\lambda \cdot B(\lambda) \cdot \triangle\lambda \leq 1$ W·m^{-2}	E_B=0.32W·m^{-2}	P
4.3.5	Retinal thermal hazard exposure limit		P
	To protect against retinal thermal injury, the integrated spectral radiance of the light source, L_, weighted by the burn hazard weighting function R(_) (from Figure 4.2 and Table 4.2), i.e., the burn hazard weighted radiance, shall not exceed the levels defined by:		P
	$L_R = \sum_{380}^{1400} L_\lambda \cdot R(\lambda) \cdot \Delta\lambda \leq \frac{50000}{\alpha \cdot t^{0,25}}$ W·m^{-2}·sr^{-1}	L_R=7.9x10^{4}W·m^{-2}·sr^{-1}	P
4.3.6	Retinal thermal hazard exposure limit – weak visual stimulus		P
	For an infrared heat lamp or any near-infrared source where a weak visual stimulus is inadequate to activate the aversion response, the near infrared (780 nm to 1400 nm) radiance, LIR, as viewed by the eye for exposure times greater than 10 s shall be limited to:		P
	$L_{IR} = \sum_{780}^{1400} L_\lambda \cdot R(\lambda) \cdot \Delta\lambda \leq \frac{6000}{\alpha}$ W·m^{-2}·sr^{-1}	L_{IR}=1.4x10^{2}W·m^{-2}·sr^{-1}	P
4.3.7	Infrared radiation hazard exposure limits for the eye		P
	The avoid thermal injury of the cornea and possible delayed effects upon the lens of the eye (cataractogenesis),ocular exposure to infrared radiation, EIR,over the wavelength range 780 nm to 3000 nm, for times less than 1000 s, shall not exceed:		N
	$E_{IR} = \sum_{780}^{3000} E_\lambda \cdot \Delta\lambda \leq 18000 \cdot t^{-0,75}$ W·m^{-2}		N
	For times greater than 1000 s the limit becomes:		P

	$E_{IR} = \sum_{780}^{3000} E_\lambda \cdot \Delta\lambda \le 100$ W·m^{-2}	E_{IR}=0 W·m^{-2}	P
4.3.8	Thermal hazard exposure limit for the skin		P
	Visible and infrared radiant exposure (380 nm to 3000 nm) of the skin shall be limited to:		P
	$E_H \cdot t = \sum_{380}^{3000} \sum_{t} E_\lambda(\lambda,t) \cdot \Delta t \cdot \Delta\lambda \le 20000 \cdot t^{0,25}$ J·m^{-2}	E_H= 0 J·m^{-2}	P

5	MEASUREMENT OF LAMPS AND LAMP SYSTEMS		P
5.1	Measurement conditions		P
	Measurement conditions shall be reported as part of the evaluation against the exposure limits and the assignment of risk classification.		P
5.1.1	Lamp ageing (seasoning)		N
	Seasoning of lamps shall be done as stated in the Appropriate EN lamp standard.		N
5.1.2	Test environment	25.3℃	-
	For specific test conditions, see the appropriate EN lamp standard or in absence of such standards, the appropriate national standards or manufacturer's recommendations.		-
5.1.3	Extraneous radiation		P
	Careful checks should be made to ensure that extraneous sources of radiation and reflections do not add significantly to the measurement results.		P
5.1.4	Lamp operation		P
	Operation of the test lamp shall be provided in accordance with:		P
	– the appropriate EN lamp standard, or		N
	– the manufacturer' s recommendation		P
5.1.5	Lamp system operation		N
	The power source for operation of the test lamp shall be provided in accordance with:		N
	– the appropriate EN standard, or		N
	– the manufacturer' s recommendation		N
5.2	Measurement procedure		P
5.2.1	Irradiance measurements		P
	Minimum aperture diameter 7mm.		P
	Maximum aperture diameter 50 mm.		P
	The measurement shall be made in that position of the beam giving the maximum reading.		P

	The measurement instrument is adequate calibrated.	See appendix B	P
5.2.2	Radiance measurements		P
5.2.2.1	Standard method		P
	The measurements made with an optical system.		P
	The instrument shall be calibrated to read in absolute radiant power per unit receiving area and per unit solid angle to acceptance averaged over the field of view of the instrument.		P
5.2.2.2	Alternative method		N
	Alternatively to an imaging radiance set-up, an irradiance measurement set-up with a circular field stop placed at the source can be used to perform radiance measurements.		N
5.2.3	Measurement of source size		P
	The determination of α, the angle subtended by a source, requires the determination of the 50% emission points of the source.		P
5.2.4	Pulse width measurement for pulsed sources		N
	The determination of △t, the nominal pulse duration of a source, requires the determination of the time during which the emission is > 50% of its peak value.		N
5.3	Analysis methods		P
5.3.1	Weighting curve interpolations		N
	To standardize interpolated values, use linear interpolation on the log of given values to obtain intermediate points at the wavelength intervals desired.		N
5.3.2	Calculations		P
	The calculation of source hazard values shall be performed by weighting the spectral scan by the appropriate function and calculating the total weighted energy.		P
5.3.3	Measurement uncertainty		P
	The quality of all measurement results must be quantified by an analysis of the uncertainty.		P

6	LAMP CLASSIFICATION		P
	For the purposes of this standard it was decided that the values shall be reported as follows:		P
	– for lamps intended for general lighting service, the hazard values shall be reported as either irradiance or radiance values at a distance which produces an illuminance of 500 lux, but not at a distance less than 200 mm	LED light for general lighting: 200 mm	P
	– for all other light sources, including pulsed lamp sources, the hazard values shall be reported at a distance of 200 mm		N
6.1	Continuous wave lamps		P
6.1.1	Exempt Group		P

	In the except group are lamps, which does not pose any photobiological hazard. The requirement is met by any lamp that does not pose:		P
	– an actinic ultraviolet hazard (ES) within 8-hours exposure (30000 s), nor		P
	– a near-UV hazard (EUVA) within 1000 s, (about 16 min), nor		P
	– a retinal blue-light hazard (LB) within 10000 s (about 2,8 h), nor		P
	– a retinal thermal hazard (LR) within 10 s, nor		P
	– an infrared radiation hazard for the eye (EIR) within 1000 s		P
6.1.2	Risk Group 1 (Low-Risk)		N
	In this group are lamps, which exceeds the limits for the except group but that does not pose:		N
	– an actinic ultraviolet hazard (ES) within 10000 s, nor		N
	– a near ultraviolet hazard (EUVA) within 300 s, nor		N
	– a retinal blue-light hazard (LB) within 100 s, nor		N
	– a retinal thermal hazard (LR) within 10 s, nor		N
	– an infrared radiation hazard for the eye (EIR) within 100 s		N
	Lamps that emit infrared radiation without a strong visual stimulus and do not pose a near-infrared retinal hazard (LIR), within 100 s are in Risk Group 1.		N
6.1.3	Risk Group 2 (Moderate-Risk)		N
	This requirement is met by any lamp that exceeds the limits for Risk Group 1, but that does not pose:		N
	– an actinic ultraviolet hazard (ES) within 1000 s exposure, nor		N
	– a near ultraviolet hazard (EUVA) within 100 s, nor		N
	– a retinal blue-light hazard (LB) within 0,25 s (aversion response), nor		N
	– a retinal thermal hazard (LR) within 0,25 s (aversion response), nor		N
	– an infrared radiation hazard for the eye (EIR) within 10 s		N
	Lamps that emit infrared radiation without a strong visual stimulus and do not pose a near-infrared retinal hazard (LIR), within 10 s are in Risk Group 2.		N
6.1.4	Risk Group 3 (High-Risk)		N
	Lamps which exceed the limits for Risk Group 2 are in Group 3.		N
6.2	Pulsed lamps		N
	Pulse lamp criteria shall apply to a single pulse and to any group of pulses within 0,25 s.		N
	A pulsed lamp shall be evaluated at the highest nominal energy loading as specified by the manufacturer.		N

	The risk group determination of the lamp being tested shall be made as follows:		N
	– a lamp that exceeds the exposure limit shall be classified as belonging to Risk Group 3 (High-Risk)		N
	– for single pulsed lamps, a lamp whose weighted radiant exposure or weighted radiance does is below the EL shall be classified as belonging to the Exempt Group		N
	– for repetitively pulsed lamps, a lamp whose weighted radiant exposure or weighted radiance dose is below the EL, shall be evaluated using the continuous wave risk criteria discussed in clause 6.1, using time averaged values of the pulsed emission		N

Table 4.1	Spectral weighting function for assessing ultraviolet hazards for skin and eye	-

Wavelength[1] λ, nm	UV hazard function $S_{uv}(\lambda)$	Wavelength λ, nm	UV hazard function $S_{uv}(\lambda)$
200	0,030	313*	0,006
205	0,051	315	0,003
210	0,075	316	0,0024
215	0,095	317	0,0020
220	0,120	318	0,0016
225	0,150	319	0,0012
230	0,190	320	0,0010
235	0,240	322	0,00067
240	0,300	323	0,00054
245	0,360	325	0,00050
250	0,430	328	0,00044
254*	0,500	330	0,00041
255	0,520	333*	0,00037
260	0,650	335	0,00034
265	0,810	340	0,00028
270	1,000	345	0,00024
275	0,960	350	0,00020
280*	0,880	355	0,00016
285	0,770	360	0,00013
290	0,640	365*	0,00011
295	0,540	370	0,000093
297*	0,460	375	0,000077
300	0,300	380	0,000064
303*	0,120	385	0,000053
305	0,060	390	0,000044
308	0,026	395	0,000036
310	0,015	400	0,000030

[1] Wavelengths chosen are representative: other values should be obtained by logarithmic interpolation at intermediate wavelengths.
* Emission lines of a mercury discharge spectrum.

Table 4.2	Spectral weighting functions for assessing retinal hazards from broadband optical sources	-

Wavelength nm	Blue-light hazard function B( )	Burn hazard function R( )
300	0,01	-
305	0,01	-
310	0,01	-
315	0,01	-
320	0,01	-
325	0,01	-
330	0,01	-
335	0,01	-
340	0,01	-
345	0,01	-
350	0,01	-
355	0,01	-
360	0,01	-
365	0,01	-
370	0,01	-
375	0,01	-
380	0,01	0,1
385	0,013	0,13
390	0,025	0,25
395	0,05	0,5
400	0,10	1,0
405	0,20	2,0
410	0,40	4,0
415	0,80	8,0
420	0,90	9,0
425	0,95	9,5
430	0,98	9,8
435	1,00	10,0
440	1,00	10,0
445	0,97	9,7
450	0,94	9,4
455	0,90	9,0
460	0,80	8,0
465	0,70	7,0

470	0,62	6,2
475	0,55	5,5
480	0,45	4,5
485	0,40	4,0
490	0,22	2,2
495	0,16	1,6
500-600	$10^{[(450-\lambda)/50]}$	1,0
600-700	0,001	1,0
700-1050	0,013	$10^{[(700-\lambda)/500]}$
1050-1150	0,025	0,2
1150-1200	0,05	$0,2.^{100.02(1150-\lambda)}$
1200-1400	0,10	0,02

* 1 Wavelengths chosen are representative: other values should be obtained by logarithmic interpolation at intermediate wavelengths.
* Emission lines of a mercury discharge spectrum.

Table 5.4	Summary of the ELs for the surface of the skin or cornea (irradiance based values)				-
Hazard Name	**Relevant equation**	**Wavelength Range nm**	**Explosure aperture rad(deg)**	**Limiting aperture rad(deg)**	**EL in items of constant irradiance $W.m^{-2}$**
Actinic UV skin & eye	$E_S = \sum E_\lambda \bullet S(\lambda) \bullet \Delta\lambda$	200 – 400	< 30000	1,4 (80)	30/t
Eye UV-A	$E_{UVA} = \sum E_\lambda \bullet \Delta\lambda$	315 – 400	≤1000 >1000	1,4 (80)	10000/t 10
Blue-light small source	$E_B = \sum E_\lambda \bullet B(\lambda) \bullet \Delta\lambda$	300 – 700	≤100 >100	< 0,011	100/t 1,0
Eye IR	$E_{IR} = \sum E_\lambda \bullet \Delta\lambda$	780 –3000	≤1000 >1000	1,4 (80)	$18000/t^{0,75}$ 100
Skin thermal	$E_H = \sum E_\lambda \bullet \Delta\lambda$	380 – 3000	< 10	2π sr	$20000/t^{0,75}$

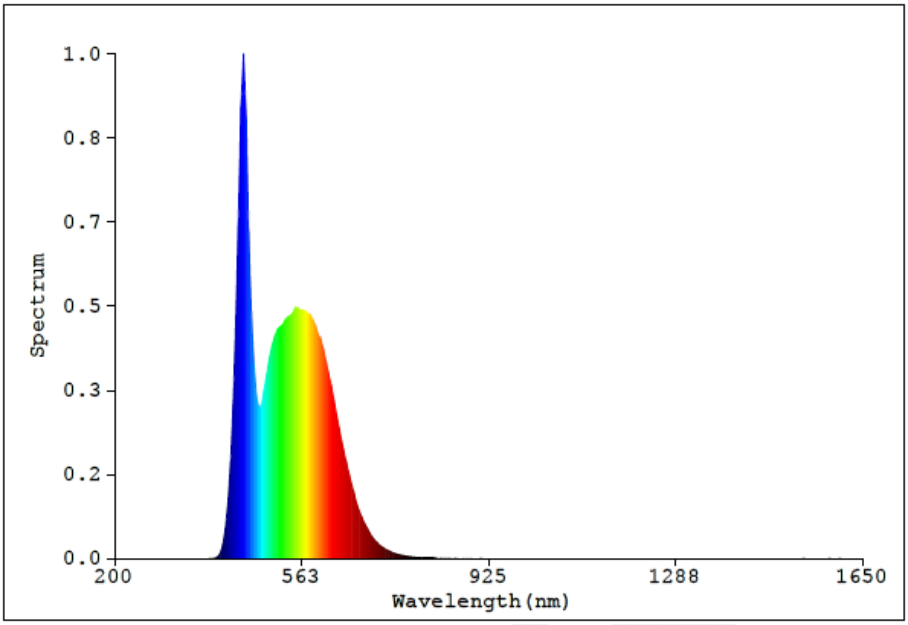
Table 5.5	Summary of the ELs for the retina (radiance based values)				**-**
Hazard Name	**Relevant equation**	**Wavelength Range nm**	**Explosure duration Sec**	**Field of view radians**	**EL in terms of constant radiance $W.m^{-2}.sr^{-1}$)**
Blue light	$L_B = \sum L_\lambda \bullet B(\lambda) \bullet \Delta\lambda$	300 – 700	0,25 – 10 10-100 100-10000 ≥ 10000	$0,011\bullet\sqrt{(t/10)}$ 0,011 $0,0011\bullet\sqrt{t}$ 0,1	$10^6/t$ $10^6/t$ $10^6/t$ 100
Retinal thermal	$L_R = \sum L_\lambda \bullet R(\lambda) \bullet \Delta\lambda$	380 – 1400	< 0,25 0,25 – 10	0,0017 $0,011\bullet\sqrt{(t/10)}$	$50000/(\alpha\bullet t^{0,25})$ $50000/(\alpha\bullet t^{0,25})$
Retinal thermal (weak visual stimulus)	$L_{IR} = \sum L_\lambda \bullet R(\lambda) \bullet \Delta\lambda$	780 – 1400	> 10	0,011	6000/α

Table 6.1	Emission limits for risk groups of continuous wave lamps base on Directive(2006/25/EC)								P
Risk	Action spectrum	Units	Symbol	Exempt		Low risk		Mod risk	
				Limit	Result	Limit	Result	Limit	Result
Actinic UV	Suv(λ)	$W.m^{-2}$	E_S	0.001	7.8×10^{-6}	0.003	-	0.03	-
Near UV		$W.m^{-2}$	E_{UVA}	10	4.3×10^{-4}	33	-	100	-
Blue light	B(λ)	$W.m^{-2}.sr^{-1}$	L_B	100	77	10000	-	4000000	-
Blue light,small source	B(λ)	$W.m^{-2}$	E_B	1*	0.32	1	-	400	-
Retinal thermal	R(λ)	$W.m^{-2}.sr^{-1}$	L_R	28000/α α=0.0030	$7.9x10^4$	28000/α α=0.0030	-	71000/α α=0.0030	-
Retinal thermal, Weak visual stimulus**	R(λ)	$W.m^{-2}.sr^{-1}$	L_{IR}	6000/α α=0.0030	1.4×10^2	6000/α α=0.0030	-	28000/α α=0.0030	-
IR radiation Eye		$W.m^{-2}$	E_{IR}	100	0	570	-	3200	-

* Small source defined as one withα< 0,011 radian. Averaging field of view at 10000 s is 0,1 radian.
** Involves evaluation of non-GLS source

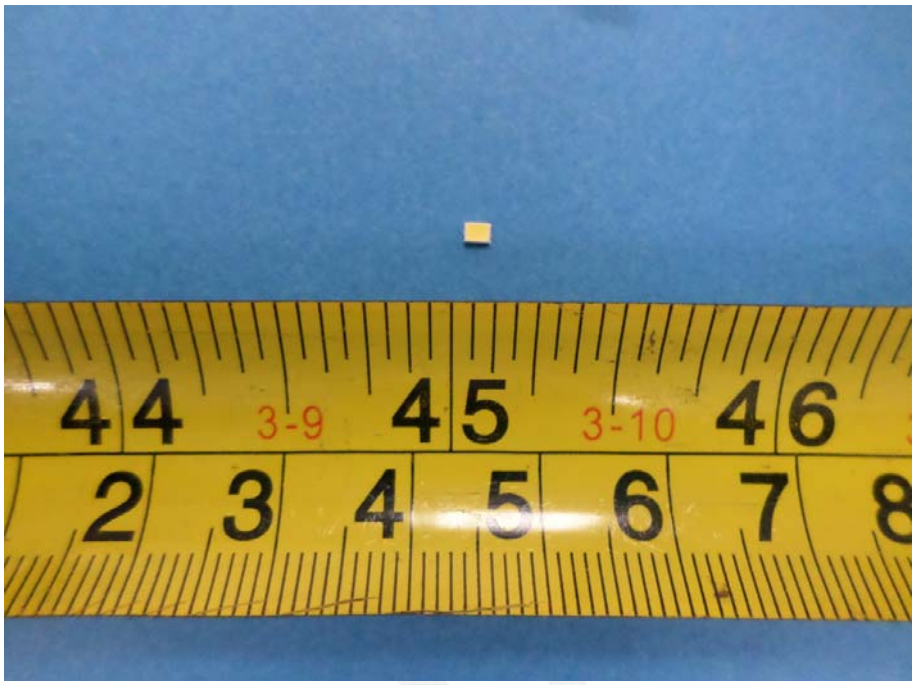
Appendix I Figure of Spectral distribution

Spectral distribution of P2016W6H4-D01-8D1A01



Appendix A - EUT Photos

1. General view of P2016W6H4-D01-8D1A01



Appendix B Test equipment list

Equipment Description	Model No	BACL#	Manufacturer	Last Cal	Cal Due
UV light leakage spectrum of biological safety systems	PMS-300	T-08-EE042	EVERFINE	2015-3-25	2016-3-24
Standard power spectral UV radiation-specific	UVS-8003	T-08-EE048	EVERFINE	2014-8-2	2015-8-2
80mm sample integrating sphere	SMS-300	T-08-EE055	EVERFINE	2015-3-25	2016-3-24
Radio meter	RD-2000	T-08-EE056	EVERFINE	2015-3-25	2016-3-24
high-accuracy digital photometer head	HAAS-2000	T-08-EE058	EVERFINE	2015-3-25	2016-3-24
Hygrothermograph	PWS280	T-08-QA026	N/A	2013-4-1	2016-3-30
Steel tape	HILOCK-19	T-08-SF100	TAJIMA	2013-4-18	2018-4-17

Appendix C DECLARATION OF DIFFERENCES

HONGLI 鸿利光电

广州市鸿利光电股份有限公司

Difference Declaration

We, Guangzhou Hongli Opto-Electronic Co.,Ltd., hereby declare that products: P2016W1H4-D01-8D1A01、P2016W2H4-D01-8D1A01、P2016W3H4-D01-8D1A01、P2016W4H4-D01-8D1A01、P2016W5H4-D01-8D1A01 are electrically identical with the same PCB LAYOUT and circuit as model: P2016W6H4-D01-8D1A01 tested by BACL, the only differences between those models are the Model Name, and CCT.

All the family model numbers and differences are listed as below:

Model Number	CCT
P2016W1H4-D01-8D1A01	2700
P2016W2H4-D01-8D1A01	3000
P2016W3H4-D01-8D1A01	4000
P2016W4H4-D01-8D1A01	5000
P2016W5H4-D01-8D1A01	6000
P2016W6H4-D01-8D1A01	6500

Thank you!

July 01, 2015

Sincerely,

Signature: Becky.Yang

Printed name: Becky. Yang

Title: System supervisor

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