



## **Photo biological safety test (IEC 62471:2006)**

**OSLON® SQUARE**

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Further explanations:





Information: The information provided in this document consists of the list of individual LED types which are considered in the respective LED family.

Document: The document has the purpose to list the individual LED types which are considered in the respective LED family with respect to the photo optical safety.

Conditions: The photo optical safety tests according to IEC 62471:2006 have been conducted using the worst case LED type of the LED family. Therefore the less critical LED types are also grouped into the respective highest risk group determined by the worst case LED types.

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<b>TEST REPORT</b> <b>IEC 62471</b> <b>Photobiological safety of lamps and lamp systems</b>	
<b>Report Reference No.</b> .....	205-15
<b>Date of issue</b> .....	17. August 2015
<b>Total number of pages</b> .....	16
<b>Testing Laboratory</b> .....	<b>Central Laboratory for Light Measurements</b>
<b>Address</b> .....	OSRAM GmbH, CI ANM CLM Berliner Allee 65; 86153 Augsburg, Germany
<b>Applicant's name</b> .....	Yeap, Sang Yee Jacqueline OS SSL AE (SSL Application Engineering)
<b>Address</b> .....	OSRAM Opto Semiconductors (MY) Sdn. Bhd. Bayan Lepas Free Industr. Zone Phase 1 - Pen 3 11900 Penang Malaysia
<b>Test specification:</b>	
Standard .....	IEC 62471:2006 (ed.1)
Test procedure .....	N/A
Non-standard test method .....	N/A
<b>Test Report Form No.</b> .....	IEC62471A
<b>TRF Originator</b> .....	<b>VDE</b> Testing and Certification Institute
<b>Master TRF</b> .....	Dated 2009-05
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<b>This report is not valid as a CB Test Report unless signed by an approved CB Testing Laboratory and appended to a CB Test Certificate issued by an NCB in accordance with IECEE 02.</b>	
<b>Test item description</b> .....	OSLON SQUARE
<b>Trade Mark</b> .....	OSRAM 
<b>Manufacturer</b> .....	OSRAM Opto Semiconductors
<b>Model/Type reference</b> .....	GW CSSRM1.PC
<b>Ratings</b> .....	1800 mA DC (max. current)

Testing procedure and testing location:	
<input checked="" type="checkbox"/> <b>Testing Laboratory:</b> Testing location/ address .....:	<b>Central Laboratory for Light Measurements</b> OSRAM GmbH, CI ANM CLM Berliner Allee 65; 86153 Augsburg, Germany  <div style="text-align: center;">   <div style="display: inline-block; font-size: 0.8em; margin-left: 10px;">             Deutsche              Akkreditierungsstelle              D-PL-17666-02-00           </div> </div> Tested by (name + signature) .....: Axel Gurel  Approved by (+ signature) .....: Dr. Werner Jordan 
<input type="checkbox"/> Testing procedure: TMP Tested by (name + signature) .....: Approved by (+ signature) .....: Testing location/ address .....:	
<input type="checkbox"/> Testing procedure: WMT Tested by (name + signature) .....: Witnessed by (+ signature) .....: Approved by (+ signature) .....: Testing location/ address .....:	
<input type="checkbox"/> Testing procedure: SMT Tested by (name + signature) .....: Approved by (+ signature) .....: Supervised by (+ signature) .....: Testing location/ address ..... :	
<input type="checkbox"/> Testing procedure: RMT Tested by (name + signature) .....: Approved by (+ signature) .....: Supervised by (+ signature) .....: Testing location/ address .....:	

**Summary of testing:****Tests performed (name of test and test clause):**

Test was performed according to clause 5  
MEASUREMENT OF LAMPS AND LAMP  
SYSTEMS of IEC 62471:2006 (ed.1)

**Testing location:**

**Central Laboratory for Light Measurements**  
OSRAM GmbH, CI ANM CLM  
Berliner Allee 65; 86153 Augsburg, Germany

Test results:

- OSRON SQUARE GW CSSRM1.PC:

- **RG1, low risk**  
@ > 0,5m at max. current
- Blue light hazard  $L_B < 10000 \text{ W} \cdot \text{m}^{-2} \cdot \text{sr}^{-1}$
- Threshold illuminance at 750lx
- RG2 @ 200mm distance

**Summary of compliance with National Differences:**

**Note:** EN Group Differences together with National Differences and Special National Conditions, if any, are in the Appendix to the main body of this TRF.

**Copy of marking plate / product picture:**

**object no. d424**

The above label may show a draft of an artwork for making plate pending approval by National Certification Bodies and it shall not be affixed to products prior to such an approval.

<b>Test item particulars</b> .....	
Tested lamp .....	<input checked="" type="checkbox"/> continuous wave lamps <input type="checkbox"/> pulsed lamps
Tested lamp system .....	OSLON SQUARE GW CSSRM1.PC
Lamp classification group .....	<input type="checkbox"/> exempt <input checked="" type="checkbox"/> risk 1*) <input checked="" type="checkbox"/> risk 2**) <input type="checkbox"/> risk 3
Lamp cap .....	N/A
Bulb .....	N/A
Rated of the lamp .....	max. 1800mA DC
Furthermore marking on the lamp .....	N/A
Seasoning of lamps according IEC standard .....	N/A
Used measurement instrument .....	See list of measurement equipment on page 15
Temperature by measurement .....	25°C +/- 2K
Information for safety use .....	*) at a distance >0,5m (@ max. current) or at a threshold illuminance less than 750lx **) @ 200mm distance
<b>Possible test case verdicts:</b>	
– test case does not apply to the test object ..... : N/A	
– test object does meet the requirement ..... : P (Pass)	
– test object does not meet the requirement ..... : F (Fail)	
<b>Testing:</b>	
Date of receipt of test item .....	04.07.2015
Date (s) of performance of tests .....	11.08.2015
<b>General remarks:</b>	
<u>Explanatory statement:</u>	
The measurement was performed at maximum current in steady state. The measurement result for blue light hazard is $L_B = 56,7 \text{ kW} \cdot \text{m}^{-2} \cdot \text{sr}^{-1}$ at a distance of 200mm (measuring aperture 11mrad). For RG1 the distance should be more than 0,5m or at a threshold illuminance less than 750lx.	
This report represents the highest available CCT and covers the whole product family.	
(for detailed results see page 16)	
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 comma is used as the decimal separator. List of test equipment must be kept on file and available for review.	
<b>Note: EN Group Differences together with National Differences and Special National Conditions, if any, are in the Appendix to the main body of this TRF.</b>	
<b>Factory</b> (for information only)	
Name .....	OSRAM Opto Semiconductors
Address .....	Penang, Malaysia
<b>General product information:</b>	
UV- and IR radiation of visible LED products can be neglected!	



IEC 62471			
Clause	Requirement – Test	Result – Remark	Verdict
<b>4</b>	<b>EXPOSURE LIMITS</b>		
4.1	General		
	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 $10^4 \text{ cd}\cdot\text{m}^{-2}$	see clause 4.3	P
4.3	Hazard exposure limits		
4.3.1	Actinic UV hazard exposure limit for the skin and eye	No relevant radiation emission below 400 nm (white LED)	N/A
	The exposure limit for effective radiant exposure is $30 \text{ J}\cdot\text{m}^{-2}$ within any 8-hour period		N/A
	To protect against injury of the eye or skin from ultraviolet radiation exposure produced by a broadband source, the effective integrated spectral irradiance, $E_s$ , of the light source shall not exceed the levels defined by:		N/A
	$E_s \cdot t = \sum_{200}^{400} \sum_t E_{\lambda}(\lambda, t) \cdot S_{UV}(\lambda) \cdot \Delta t \cdot \Delta \lambda \leq 30 \quad \text{J}\cdot\text{m}^{-2}$		N/A
	The permissible time for exposure to ultraviolet radiation incident upon the unprotected eye or skin shall be computed by:		N/A
	$t_{\max} = \frac{30}{E_s} \quad \text{s}$		N/A
4.3.2	Near-UV hazard exposure limit for eye		
	For the spectral region 315 nm to 400 nm (UV-A) the total radiant exposure to the eye shall not exceed $10000 \text{ J}\cdot\text{m}^{-2}$ for exposure times less than 1000 s. For exposure times greater than 1000 s (approximately 16 minutes) the UV-A irradiance for the unprotected eye, $E_{\text{UVA}}$ , shall not exceed $10 \text{ W}\cdot\text{m}^{-2}$ .	No relevant radiation emission below 400 nm (white LED)	N/A
	The permissible time for exposure to ultraviolet radiation incident upon the unprotected eye for time less than 1000 s, shall be computed by:		N/A
	$t_{\max} \leq \frac{10\,000}{E_{\text{UVA}}} \quad \text{s}$		N/A
4.3.3	Retinal blue light hazard exposure limit		
	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, $B(\lambda)$ , i.e., the blue-light weighted radiance, $L_B$ , shall not exceed the levels defined by:	RG1 – low risk >0,5m @ (max. current)	P

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Clause	Requirement – Test	Result – Remark	Verdict
	$L_B \cdot t = \sum_{300}^{700} \sum_t L_\lambda(\lambda, t) \cdot B(\lambda) \cdot \Delta\lambda \leq 10^6 \quad \text{J} \cdot \text{m}^{-2} \cdot \text{sr}^{-1}$	for $t \leq 10^4 \text{ s}$	P
	$L_B = \sum_{300}^{700} L_\lambda \cdot B(\lambda) \cdot \Delta\lambda \leq 100 \quad \text{W} \cdot \text{m}^{-2} \cdot \text{sr}^{-1}$	for $t > 10^4 \text{ s}$	N/A
4.3.4	Retinal blue light hazard exposure limit – small source		N/A
	Thus the spectral irradiance at the eye $E_\lambda$ , weighted against the blue-light hazard function $B(\lambda)$ shall not exceed the levels defined by:	see table 4.2	
	$E_B \cdot t = \sum_{300}^{700} \sum_t E_\lambda(\lambda, t) \cdot B(\lambda) \cdot \Delta\lambda \leq 100 \quad \text{J} \cdot \text{m}^{-2}$	for $t \leq 100 \text{ s}$	N/A
	$E_B = \sum_{300}^{700} E_\lambda \cdot B(\lambda) \cdot \Delta\lambda \leq 1 \quad \text{W} \cdot \text{m}^{-2}$	for $t > 100 \text{ s}$	N/A
4.3.5	Retinal thermal hazard exposure limit		
	To protect against retinal thermal injury, the integrated spectral radiance of the light source, $L_\lambda$ , weighted by the burn hazard weighting function $R(\lambda)$ (from Figure 4.2 and Table 4.2), i.e., the burn hazard weighted radiance, shall not exceed the levels defined by:	<i>Permissible blue light exposure time larger than 10s =&gt; retinal thermal hazard can be neglected (IEC 62471, clause 3.4.)</i>	N/A
	$L_R = \sum_{380}^{1400} L_\lambda \cdot R(\lambda) \cdot \Delta\lambda \leq \frac{50\,000}{\alpha \cdot t^{0,25}} \quad \text{W} \cdot \text{m}^{-2} \cdot \text{sr}^{-1}$	( $10 \mu\text{s} \leq t \leq 10 \text{ s}$ )	N/A
4.3.6	Retinal thermal hazard exposure limit – weak visual stimulus		
	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, $L_{IR}$ , as viewed by the eye for exposure times greater than 10 s shall be limited to:	<i>No relevant radiation emission above 780 nm (white LED)</i>	N/A
	$L_{IR} = \sum_{780}^{1400} L_\lambda \cdot R(\lambda) \cdot \Delta\lambda \leq \frac{6\,000}{\alpha} \quad \text{W} \cdot \text{m}^{-2} \cdot \text{sr}^{-1}$	$t > 10 \text{ s}$	N/A
4.3.7	Infrared radiation hazard exposure limits for the eye		
	The avoid thermal injury of the cornea and possible delayed effects upon the lens of the eye (cataractogenesis), ocular exposure to infrared radiation, $E_{IR}$ , over the wavelength range 780 nm to 3000 nm, for times less than 1000 s, shall not exceed:	<i>No relevant radiation emission above 780 nm (white LED)</i>	N/A
	$E_{IR} = \sum_{780}^{3000} E_\lambda \cdot \Delta\lambda \leq 18\,000 \cdot t^{-0,75} \quad \text{W} \cdot \text{m}^{-2}$	$t \leq 1000 \text{ s}$	N/A
	For times greater than 1000 s the limit becomes:		



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Clause	Requirement – Test	Result – Remark	Verdict
	$E_{IR} = \sum_{780}^{3000} E_{\lambda} \cdot \Delta\lambda \leq 100 \quad \text{W} \cdot \text{m}^{-2}$	$t > 1000 \text{ s}$	N/A
4.3.8	Thermal hazard exposure limit for the skin		
	Visible and infrared radiant exposure (380 nm to 3000 nm) of the skin shall be limited to:		
	$E_H \cdot t = \sum_{380}^{3000} \sum_t E_{\lambda}(\lambda, t) \cdot \Delta\lambda \leq 20\,000 \cdot t^{0,25} \quad \text{J} \cdot \text{m}^{-2}$	No relevant radiation emission to cause thermal hazard for the skin (white LED)	N/A

<b>5</b>	<b>MEASUREMENT OF LAMPS AND LAMP SYSTEMS</b>		
5.1	Measurement conditions		
	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)		
	Seasoning of lamps shall be done as stated in the appropriate IEC lamp standard.	No seasoning in appropriate LED module standards required	N/A
5.1.2	Test environment		
	For specific test conditions, see the appropriate IEC lamp standard or in absence of such standards, the appropriate national standards or manufacturer's recommendations.	Type test at 25°C +/-2K ambient temperature, according to LED module safety standard IEC 62031 Ed. 1 2008-01	P
5.1.3	Extraneous radiation		
	Careful checks should be made to ensure that extraneous sources of radiation and reflections do not add significantly to the measurement results.	The optical measurement setup is placed in special black painted housing and shielded with baffles	P
5.1.4	Lamp operation		
	Operation of the test lamp shall be provided in accordance with:		
	– the appropriate IEC lamp standard, or		N/A
	– the manufacturer's recommendation		P
5.1.5	Lamp system operation		
	The power source for operation of the test lamp shall be provided in accordance with:		
	– the appropriate IEC standard, or		N/A
	– the manufacturer's recommendation	Operation at rated current	P
5.2	Measurement procedure		
5.2.1	Irradiance measurements		
	Minimum aperture diameter 7mm.		N/A
	Maximum aperture diameter 50 mm.		N/A

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Clause	Requirement – Test	Result – Remark	Verdict
	The measurement shall be made in that position of the beam giving the maximum reading.	<i>No irradiance measurements performed</i>	<i>N/A</i>
	The measurement instrument is adequate calibrated.		<i>N/A</i>
5.2.2	Radiance measurements		
5.2.2.1	Standard method		
	The measurements made with an optical system.	<i>see equipment list</i>	<i>P</i>
	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.		<i>P</i>
5.2.2.2	Alternative method		
	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.		<i>N/A</i>
5.2.3	Measurement of source size		
	The determination of $\alpha$ , the angle subtended by a source, requires the determination of the 50% emission points of the source.	<i>See luminance image</i>	<i>P</i>
5.2.4	Pulse width measurement for pulsed sources		
	The determination of $\Delta t$ , the nominal pulse duration of a source, requires the determination of the time during which the emission is > 50% of its peak value.		<i>N/A</i>
5.3	Analysis methods		
5.3.1	Weighting curve interpolations		
	To standardize interpolated values, use linear interpolation on the log of given values to obtain intermediate points at the wavelength intervals desired.	see table 4.1	<i>P</i>
5.3.2	Calculations		
	The calculation of source hazard values shall be performed by weighting the spectral scan by the appropriate function and calculating the total weighted energy.		<i>P</i>
5.3.3	Measurement uncertainty		
	The quality of all measurement results must be quantified by an analysis of the uncertainty.	see Annex C in the norm	<i>P</i>
<b>6</b>	<b>LAMP CLASSIFICATION</b>		
	For the purposes of this standard it was decided that the values shall be reported as follows:	see table 6.1	

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Clause	Requirement – Test	Result – Remark	Verdict
	– 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		N/A
	– for all other light sources, including pulsed lamp sources, the hazard values shall be reported at a distance of 200 mm	Object classification at a distance of 200mm	P
6.1	Continuous wave lamps		
6.1.1	Except Group		
	In the except group are lamps, which does not pose any photobiological hazard. The requirement is met by any lamp that does not pose:		
	– an actinic ultraviolet hazard ( $E_S$ ) within 8-hours exposure (30000 s), nor		N/A
	– a near-UV hazard ( $E_{UVA}$ ) within 1000 s, (about 16 min), nor		N/A
	– a retinal blue-light hazard ( $L_B$ ) within 10000 s (about 2,8 h), nor		N/A
	– a retinal thermal hazard ( $L_R$ ) within 10 s, nor		N/A
	– an infrared radiation hazard for the eye ( $E_{IR}$ ) within 1000 s		N/A
6.1.2	Risk Group 1 (Low-Risk)		
	In this group are lamps, which exceeds the limits for the except group but that does not pose:		
	– an actinic ultraviolet hazard ( $E_S$ ) within 10000 s, nor		N/A
	– a near ultraviolet hazard ( $E_{UVA}$ ) within 300 s, nor		N/A
	– a retinal blue-light hazard ( $L_B$ ) within 100 s, nor		P
	– a retinal thermal hazard ( $L_R$ ) within 10 s, nor		N/A
	– an infrared radiation hazard for the eye ( $E_{IR}$ ) within 100 s		N/A
	Lamps that emit infrared radiation without a strong visual stimulus and do not pose a near-infrared retinal hazard ( $L_{IR}$ ), within 100 s are in Risk Group 1.		N/A
6.1.3	Risk Group 2 (Moderate-Risk)		
	This requirement is met by any lamp that exceeds the limits for Risk Group 1, but that does not pose:		
	– an actinic ultraviolet hazard ( $E_S$ ) within 1000 s exposure, nor		N/A
	– a near ultraviolet hazard ( $E_{UVA}$ ) within 100 s, nor		N/A
	– a retinal blue-light hazard ( $L_B$ ) within 0,25 s (aversion response), nor		P

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Clause	Requirement – Test	Result – Remark	Verdict
	– a retinal thermal hazard ( $L_R$ ) within 0,25 s (aversion response), nor		N/A
	– an infrared radiation hazard for the eye ( $E_{IR}$ ) within 10 s		N/A
	Lamps that emit infrared radiation without a strong visual stimulus and do not pose a near-infrared retinal hazard ( $L_{IR}$ ), within 10 s are in Risk Group 2.		N/A
6.1.4	Risk Group 3 (High-Risk)		
	Lamps which exceeds the limits for Risk Group 2 are in Group 3.		N/A
6.2	Pulsed lamps		
	Pulse lamp criteria shall apply to a single pulse and to any group of pulses within 0,25 s.		N/A
	A pulsed lamp shall be evaluated at the highest nominal energy loading as specified by the manufacturer.		N/A
	The risk group determination of the lamp being tested shall be made as follows:		
	– a lamp that exceeds the exposure limit shall be classified as belonging to Risk Group 3 (High-Risk)		N/A
	– 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/A
	– 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/A

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Clause	Requirement – Test	Result – Remark	Verdict

<b>Table 4.1</b>		Spectral weighting function for assessing ultraviolet hazards for skin and eye	
Wavelength <sup>1</sup> $\lambda$ , nm	UV hazard function $S_{uv}(\lambda)$	Wavelength $\lambda$ , 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
<sup>1</sup> Wavelengths chosen are representative: other values should be obtained by logarithmic interpolation at intermediate wavelengths. * Emission lines of a mercury discharge spectrum.			

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Clause	Requirement – Test	Result – Remark	Verdict

<b>Table 4.2</b>	Spectral weighting functions for assessing retinal hazards from broadband optical sources		
Wavelength nm	Blue-light hazard function B ( $\lambda$ )	Burn hazard function R ( $\lambda$ )	
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		$10^{[(700-\lambda)/500]}$	
1050-1150		0,2	
1150-1200		$0,2 \cdot 10^{0,02(1150-\lambda)}$	
1200-1400		0,02	



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Clause	Requirement – Test	Result – Remark	Verdict

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

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

IEC 62471			
Clause	Requirement – Test	Result – Remark	Verdict

Table 6.1		Emission limits for risk groups of continuous wave lamps							
Risk	Action spectrum	Symbol	Units	Emission Measurement					
				Exempt		Low risk		Mod risk	
				Limit	Result	Limit	Result	Limit	Result
Actinic UV	$S_{UV}(\lambda)$	$E_s$	$W \cdot m^{-2}$	0,001	N/A	0,003	N/A	0,03	N/A
Near UV		$E_{UVA}$	$W \cdot m^{-2}$	10	N/A	33	N/A	100	N/A
Blue light	$B(\lambda)$	$L_B$	$W \cdot m^{-2} \cdot sr^{-1}$	100	N/A	10000	< 10 000 @ > 0,5m	4000000	56 700 @ 200 mm
Blue light, small source	$B(\lambda)$	$E_B$	$W \cdot m^{-2}$	1,0*	N/A	1,0	N/A	400	N/A
Retinal thermal	$R(\lambda)$	$L_R$	$W \cdot m^{-2} \cdot sr^{-1}$	28000/ $\alpha$	N/A	28000/ $\alpha$	N/A	71000/ $\alpha$	N/A
Retinal thermal, weak visual stimulus**	$R(\lambda)$	$L_{IR}$	$W \cdot m^{-2} \cdot sr^{-1}$	6000/ $\alpha$	N/A	6000/ $\alpha$	N/A	6000/ $\alpha$	N/A
IR radiation, eye		$E_{IR}$	$W \cdot m^{-2}$	100	N/A	570	N/A	3200	N/A
* Small source defined as one with $\alpha < 0,011$ radian. Averaging field of view at 10000 s is 0,1 radian. ** Involves evaluation of non-GLS source									

**Furthermore remarks:**

- List of measurement equipment

<b>Manufacturer</b>	<b>Type</b>	<b>Serial no.</b>	<b>Calib.valid</b>
Gigahertz	FEL 1000W spectral irradiance tungsten halogen lamp	BN-9101-263	6/16
OSRAM	Wi 17G spectral radiance tungsten ribbon lamp	81-02-1	6/16
Instrument Systems	Compact Array Spectrometer - CAS 140 CT	44314208	*)
Instrument Systems	Radiance setup - TOP 200	01420108	*)
Instrument Systems	Compact Array Spectrometer - CAS 140 CT	1628142	*)
Instrument Systems	Irradiance setup - EOP 7mm entrance aperture	1628142E1	*)
TechnoTeam	Radiance camera - LMK	DXM2141	*)
Gigahertz Op-tic	Photometer head PD-9304-1_PD-93VL	16792	*)
Keithley	Digital-Multimeter 2000	1110633	8/16
Keithley	Digital-Multimeter 2000	0947882	8/16
Burster	1282 – High Precision Shunt Resistor 100 mΩ	351077	11/15
Testo	Temperature Data Logger 177-H1	00850609/307	2/16
BMI	Steel measuring tape 20mx13mm GKI.:2	38	7/16

\*) instruments calibrated by standard lamps (see above)

All standard lamps are traceable to the German NMI: Physikalisch Technische Bundesanstalt

## Central Laboratory for Light Measurements



enclosure 1 to report 205-15

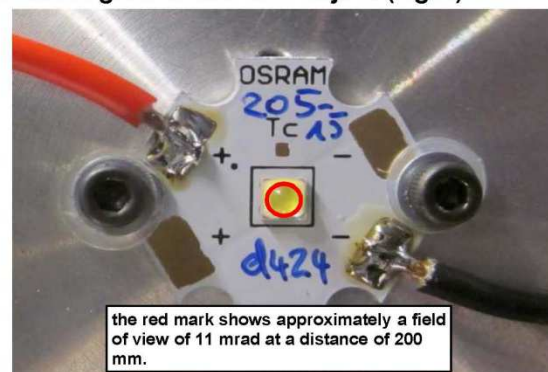
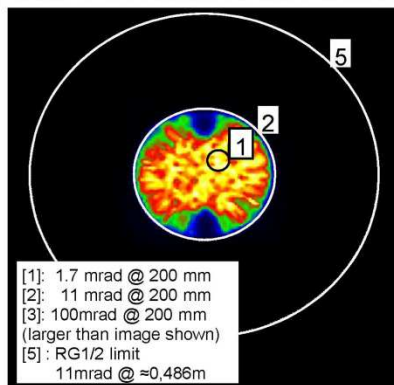
## Blue Light / Retinal Thermal Hazard classification of OSLO SQUARE no. d424

## Test information and classification

measured system voltage	3,12 V DC
measured current	1,80 A
measured system power	5,62 W
temperature 25°C	thermally stabilized
burning position	as depicted
CCT	9845 K
BLH (11 mrad @ 200 mm)	56,7 kW/(m²sr)
BLH (100 mrad @ 200mm)	0,75 kW/(m²sr)
emission limits according to EN 62471	
BLH emission limit RG2	4.0 MW/m²sr
risk group classification	RG 0 RG 1 RG 2 RG 3
	x
RG1 for a distance larger than 500mm	



## Local BLH radiance distribution (left) and relevant region of the test object (right)

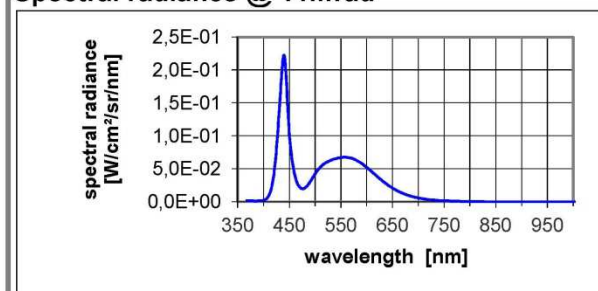


The corresponding blue light/retinal thermal effective radiance values and exposure limits are given below.  
 maximum permissible BLH dose (EN 62471): 1 MJ/(m²sr)

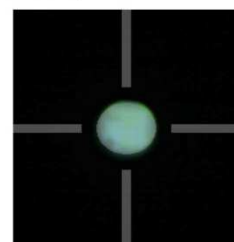
region no. and field of view $\alpha$	distance d	condition	diameter D	luminance $L_v$	blue light radiance $L_B$	exp. limit $t_{max}$
[1]: 1,7 mrad @ 200 mm			0,34 mm	52,9 Mcd/m²	87,7 kW/m²sr	11 s
[2]: 11 mrad @ 200 mm			2,2 mm	42,0 Mcd/m²	56,7 kW/m²sr	18 s
[3]: 100 mrad @ 200 mm			20 mm	0,57 Mcd/m²	0,75 kW/m²sr	1335 s
[5]: RG1/2 limit 11 mrad @	≈ 0,486 m	$E_{thr} = 767 \text{ lx}$	5,3 mm	7,7 Mcd/m²	10,0 kW/m²sr	100 s

RTH: The maximum exposure time in 1,7 mrad (region [1]) is longer than 10 s. The retinal thermal hazard is negligible.

## Spectral radiance @ 11mrad



position of the spectral measurement:  
 (see crosshairs)



OSLO SQUARE GW CSSRM1 PC i=1800mA 200mm.xlsx

**LED Family:**  
**OSLON® SQUARE**  
**Corresponding photo biological safety report:**  
**205-15**

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LED	Test Status	Highest Brightness	Exempt Group	Risk Group 1	Risk Group 2
GW CSSRM1.PC	Tested Device	359lm			x
GW CSSRM1.PM	Covered Device	359lm			x
GW CSSRM1.EC	Covered Device	280lm			x
GW CSSRM1.CC	Covered Device	240lm			x
GW CSHPM1.EM	Covered Device	140lm			x
GW CSHPM1.CM	Covered Device	112lm			x
GW CS8PM1.EM	Covered Device	140lm			x
GW CS8PM1.CM	Covered Device	112lm			x
GW CSSRM1.BM	Covered Device	224lm			X
GW CSSRM2.PM	Covered Device	330lm			x
GW CSSRM3.PM	Covered Device	360lm			x

This Risk group assessment shall only be used in combination with the eye safety report according to IEC 62471:2006.

**END OF DOCUMENT**