

Lamp measurement report – 3 May 2010

Low Bay Led Lamp

by
Glo



Photo courtesy www.OliNo.org

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Summary measurement data


parameter	meas. result	remark
<u>Color temperature</u>	3309 K	Warm white
Luminous intensity I_v	2281 Cd	Measured straight underneath the lamp.
Illuminance modulation index	0 %	Measured straight underneath the lamp. Is a measure for the amount of flickering.
Beam angle	113 deg	113° for the C0-C180-plane (this crosses the longest side of the lamp) and 111° for the C90-C270 plane (crosses the smallest side of the lamp, or along the longest side of the lamp).
Power P	99.3 W	
Power Factor	0.97	For every 1 kWh net power consumed, there has been 0.2 kVAhr for reactive power.
THD	15 %	Total Harmonic Distortion
Luminous flux	5944 Lm	
Luminous efficacy	60 Lm/W	
CRI_Ra	62	Color Rendering Index.
Coordinates chromaticity diagram	x=0.4192 and y=0.4037	
Fitting	230V	This lamp is connected to their 230 V rail system.
PAR-value	17.7 $\mu\text{Mol/s/m}^2$	The number of photons seen by an average plant when it is lit by the light of this light bulb. Value valid at 1 m distance from light bulb.
PAR-photon efficacy	0.5 $\mu\text{Mol/s/W}_e$	The total emitted number of photons by this light, divided by its consumption in W. It indicates a kind of efficacy in generating photons.

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S/P ratio	1.2	This factor indicates the amount of times more efficient the light of this light bulb is perceived under scotopic circumstances (low environmental light level).
L x W x H external dimensions	360 x 290 x 115 mm	External dimensions of the lamp.
W x L luminous area	235 x 230 mm	Dimensions of the luminous area (used in Eulumdat file). This is the surface of the opening of the glassplate at the front, behind which the reflector is seated. The 235 mm length is along the external width of the lamp.
General remarks		<p>The ambient temperature during the whole set of measurements was 25-26 deg C. The temperature of the glass plate gets 22 degrees hotter, the area between the fins of the heatsink gets about 43 degrees hotter, and the side of the housing gets about 32 deg hotter than ambient.</p> <p>Warm up effect: during the warm up time the illuminance decreases with 9 % and the consumed power with 6 %.</p> <p>Voltage dependency: the power consumption and illuminance was upon request not tested in a wide range. At the end an additional photo.</p>

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Overview table

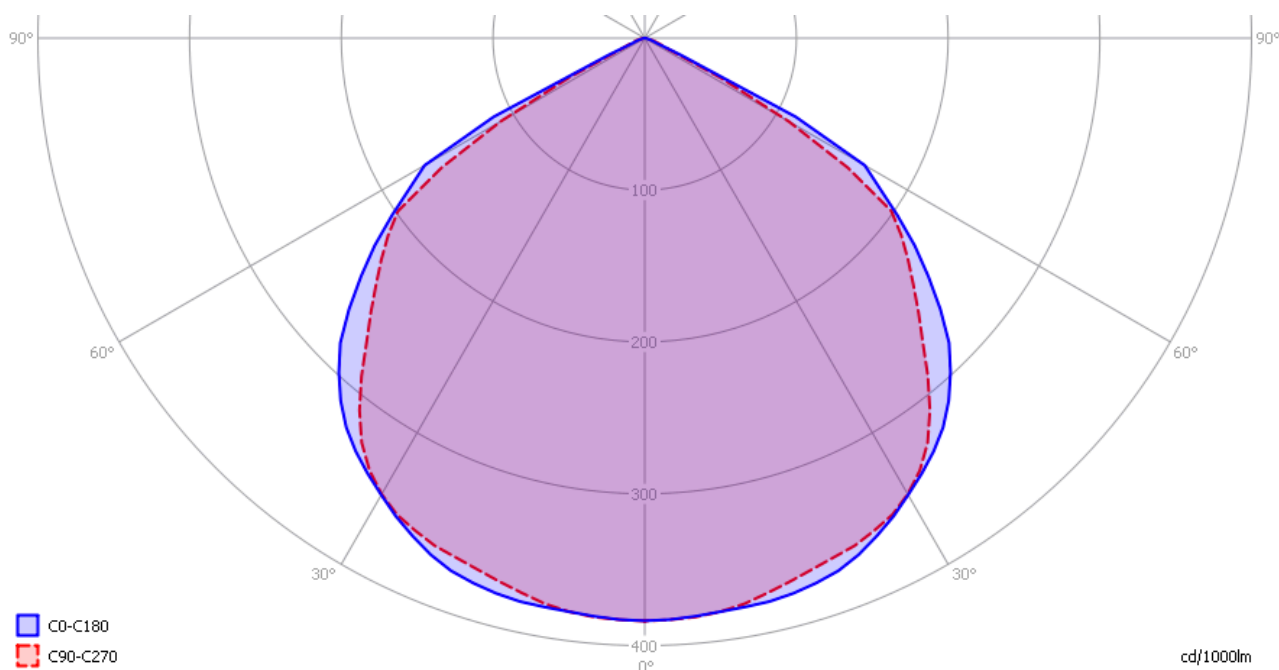
m.	Ø 50%		CO-180: 113° C90-270: 111° 	E (lux)	Luminaire Efficacy
	CO-180	C90-270			60 (lumens per Watt)
0.25	0.75	0.73		36503	Half-peak diam CO-180
0.5	1.51	1.45		9126	3.02 x diameter(m)
1	3.02	2.9		2281	Half-peak diam C90-270
1.5	4.52	4.35		1014	2.9 x diameter(m)
3	9.05	8.7		253	Illuminance
4	12.06	11.6		143	2281 / distance ² (lux)
5	15.08	14.5		91	Total Output
					5944 (lumens)

The overview table is explained on the OLiNo website. Please note that this overview table makes use of calculations, use this data with care as explained on the OLiNo site. E (lux) values are not accurate, when within 5 x 330 mm (diagonal length) ≈ 1700 mm. Within this distance from the lamp, the measured lux values will be less than the computed values in this overview as the measurements are then within the near field of the lamp.

Eulumdat light diagram

This light diagram below comes from the program Qlumedit, that extracts these diagrams from an Eulumdat file. It is explained on the OLiNo site.

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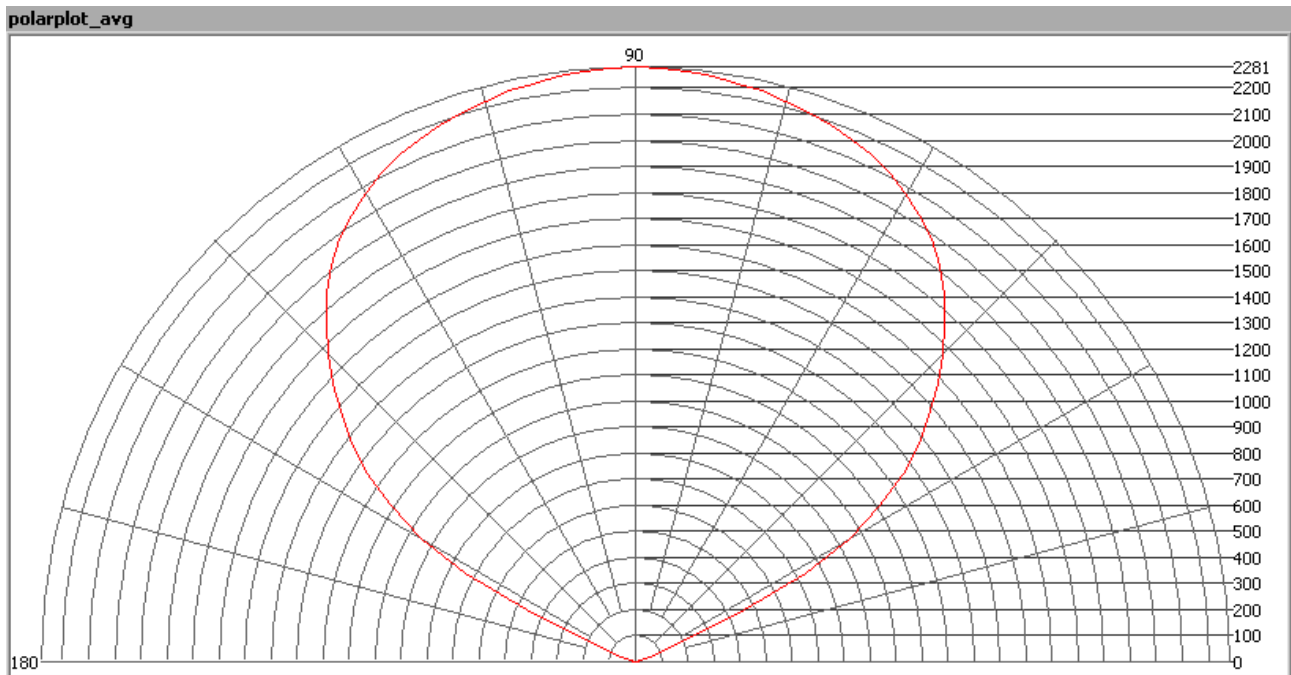
The light diagram giving the radiation pattern.

It indicates the luminous intensity around the light bulb. The plane C90-C270 (crosses the smallest side of the lamp) has almost the same beam as the C0-C180 (crosses the longest side of the lamp).

Illuminance E_v at 1 m distance, or luminous intensity I_v

Herewith the plot of the *averaged* luminous intensity I_v as a function of the inclination angle with the light bulb.

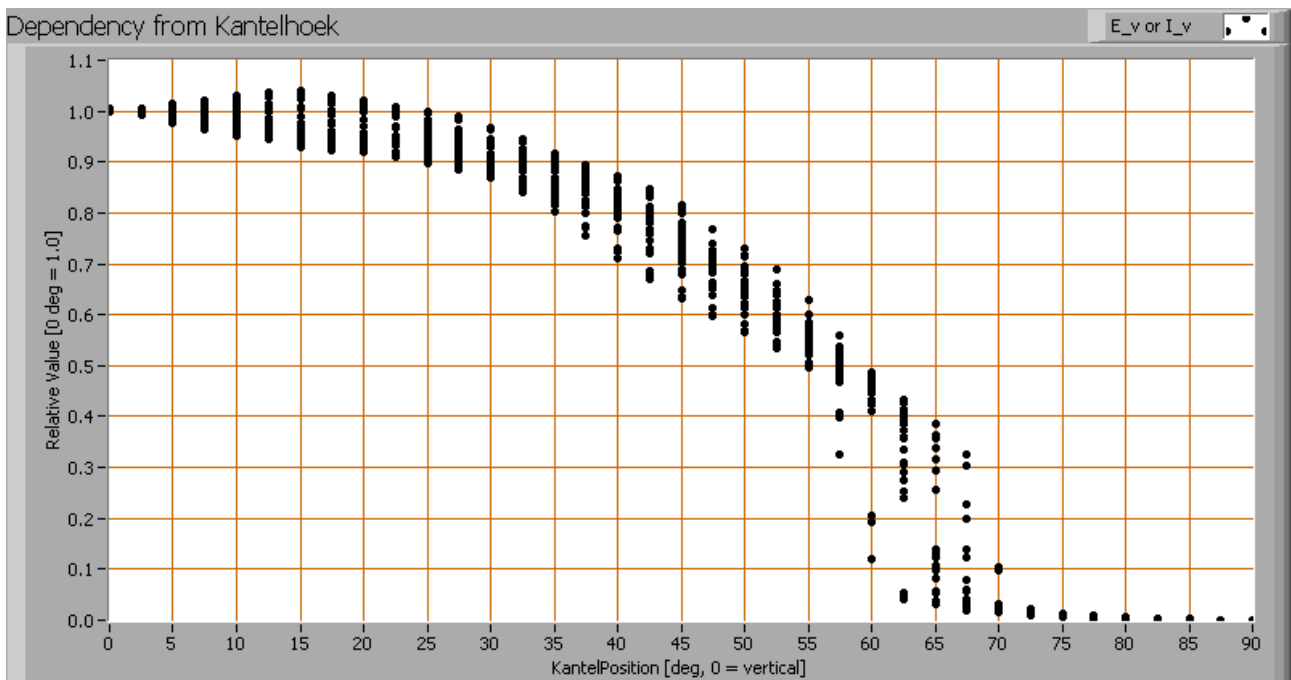
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The radiation pattern of the light bulb.

This radiation pattern is the average of the light output of the light diagram given earlier. Also, in this graph the luminous intensity is given in Cd.

These averaged values are used (later) to compute the lumen output.





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Intensity data of every measured turn angle at each inclination angle.

This plot shows per inclination angle the intensity measurement results for each turn angle at that inclination angle. There normally are differences in illuminance values for different turn angles. However for further calculations the averaged values will be used. When using the average values per inclination angle, the beam angle can be computed, being 111-113° depending on the C-plane looked at.

Luminous flux

With the averaged illuminance data at 1 m distance, taken from the graph showing the averaged radiation pattern, it is possible to compute the luminous flux. The result of this computation for this light spot is a luminous flux of 5944 Lm.

Luminous efficacy

The luminous flux being 5944 Lm, and the power of the light bulb being 99.3 W, yields a luminous efficacy of 60 Lm/W.

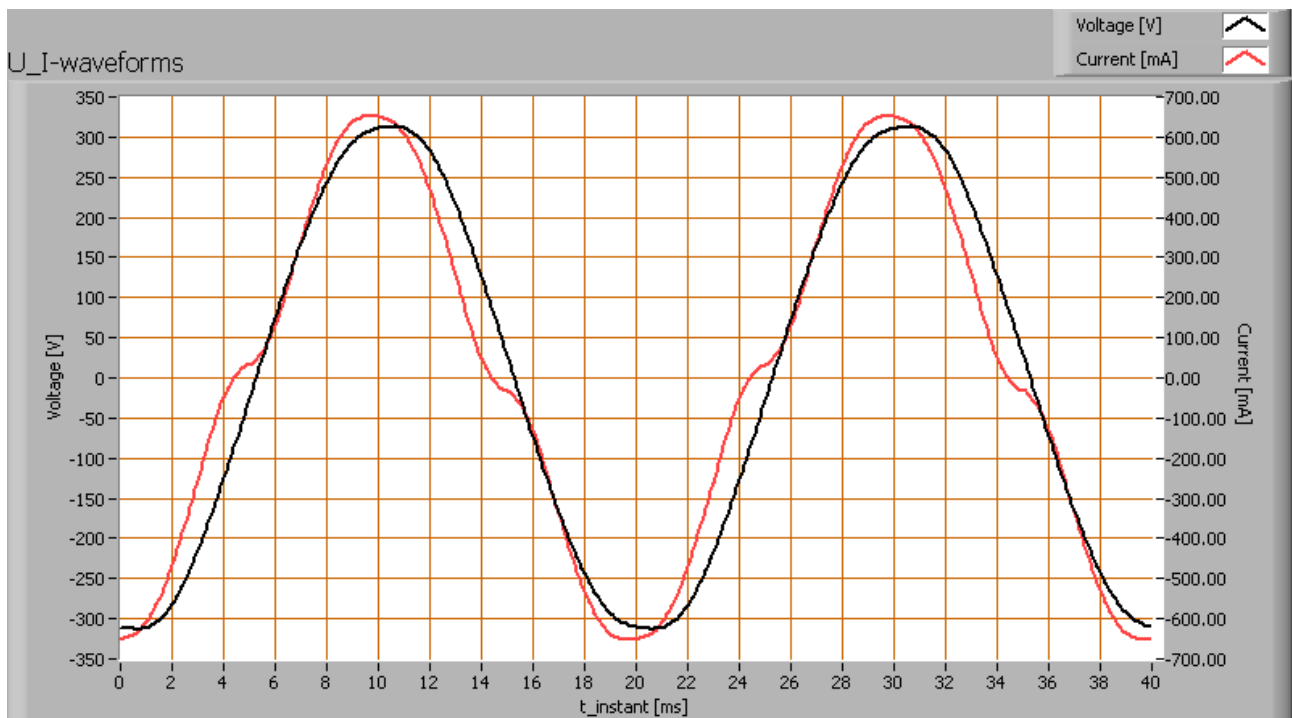
Electrical properties

A power factor of 0.97 means that for every 1 kWh net power consumed, a reactive component of 0.2 kVAr was needed.

Lamp voltage	230 VAC
Lamp current	443 mA
Power P	99.3 W
Apparent power S	102 VA
Power factor	0.97

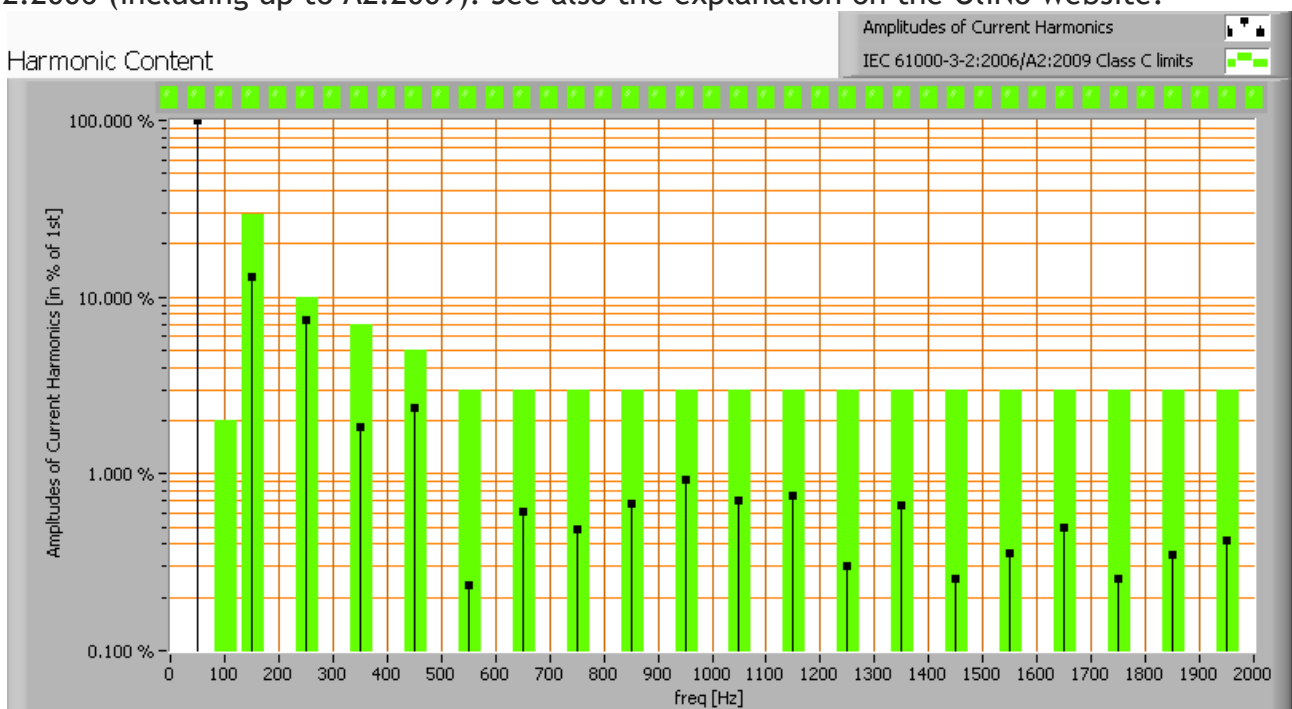
Of this light bulb the voltage across and the resulting current through it are measured and graphed. See the OLiNo site how this is obtained.

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Voltage across and current through the lightbulb

This waveforms have been checked on requirements posed by the norm IEC 61000-3-2:2006 (including up to A2:2009). See also the explanation on the OLiNo website.



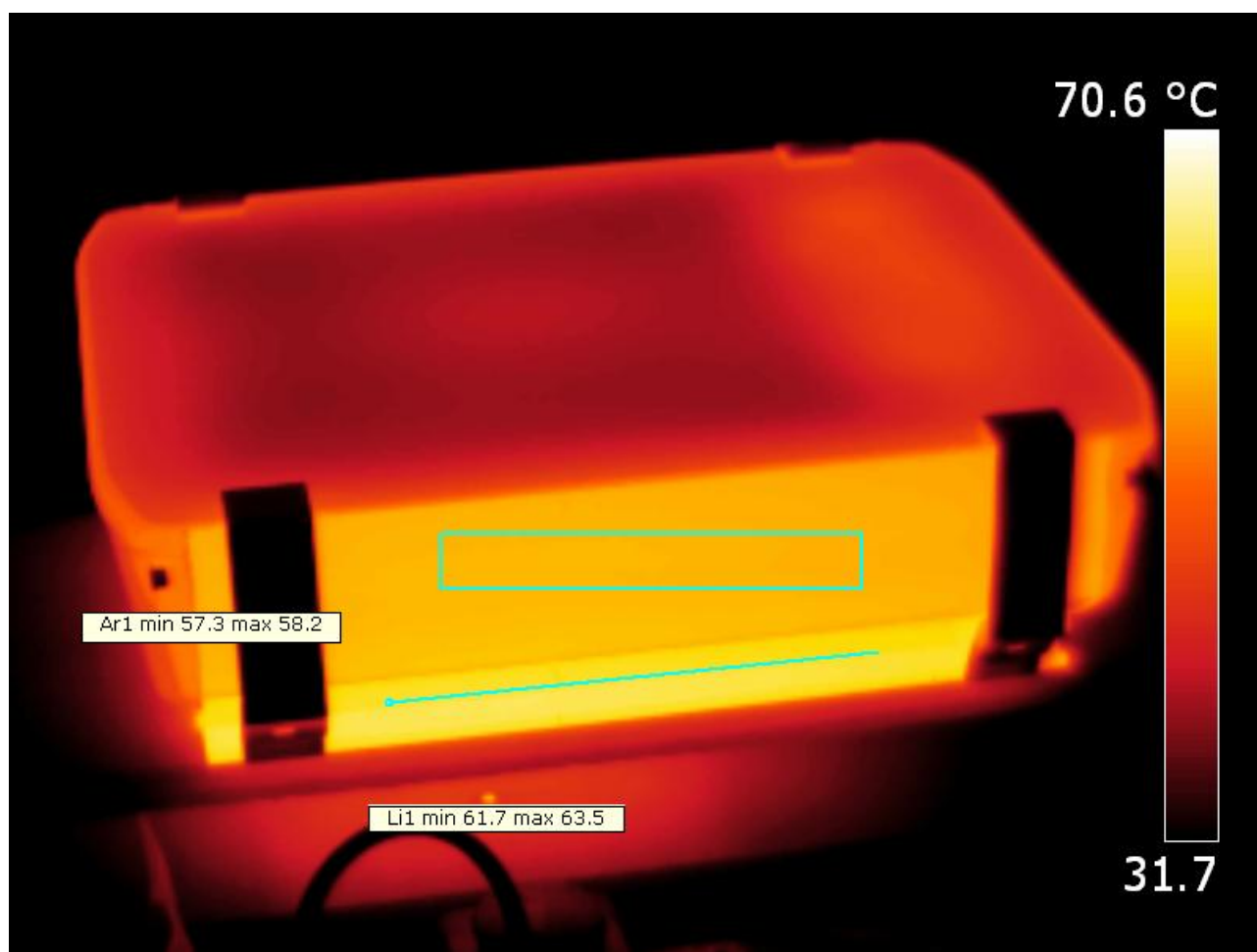
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Harmonics in the current waveform and checked against IEC61000-3-2:2006

There are limits for the harmonics for lighting equipment > 25 W and these limits are fulfilled.

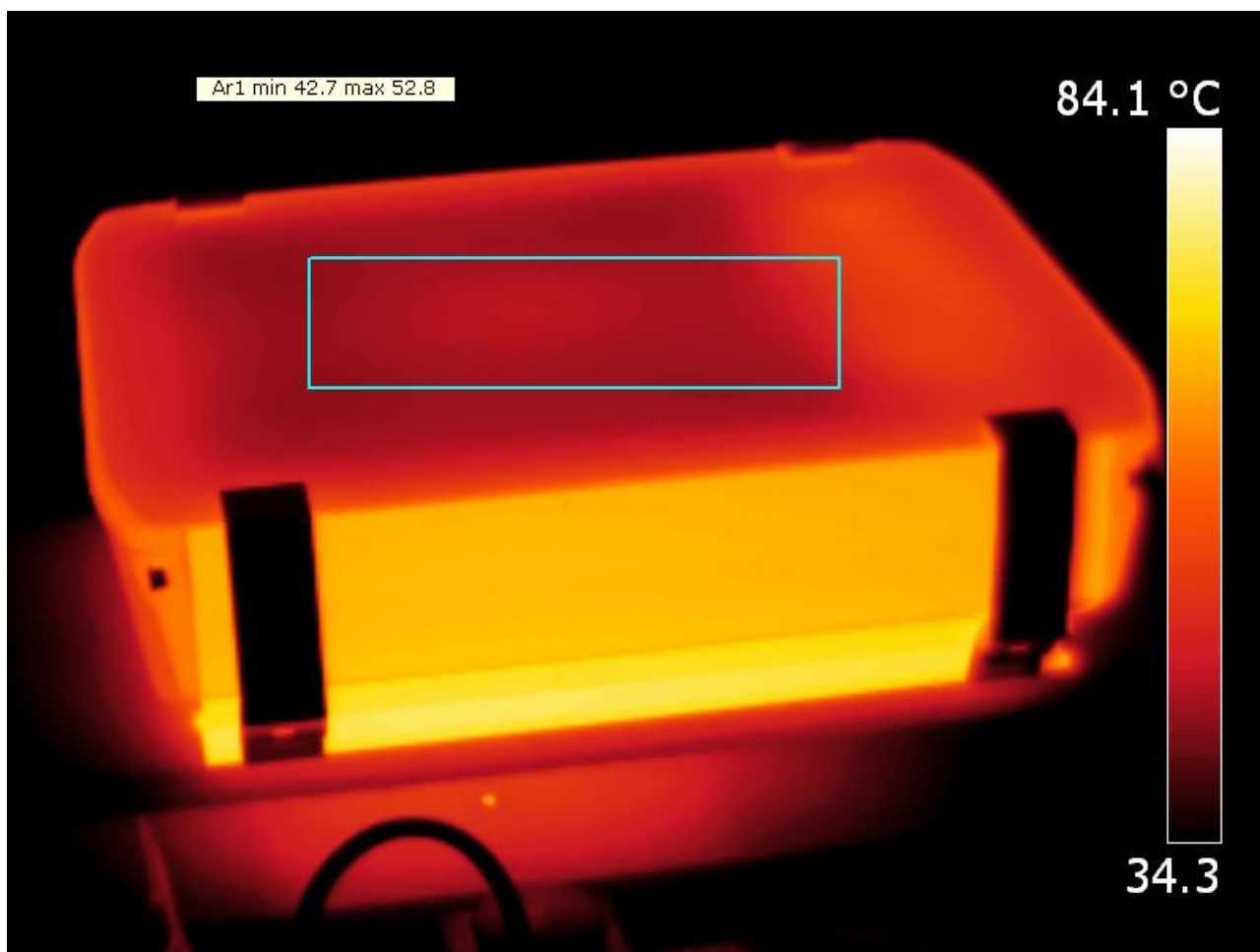
The Total Harmonic Distortion of the current is computed as 15 %.

Temperature measurements lamp



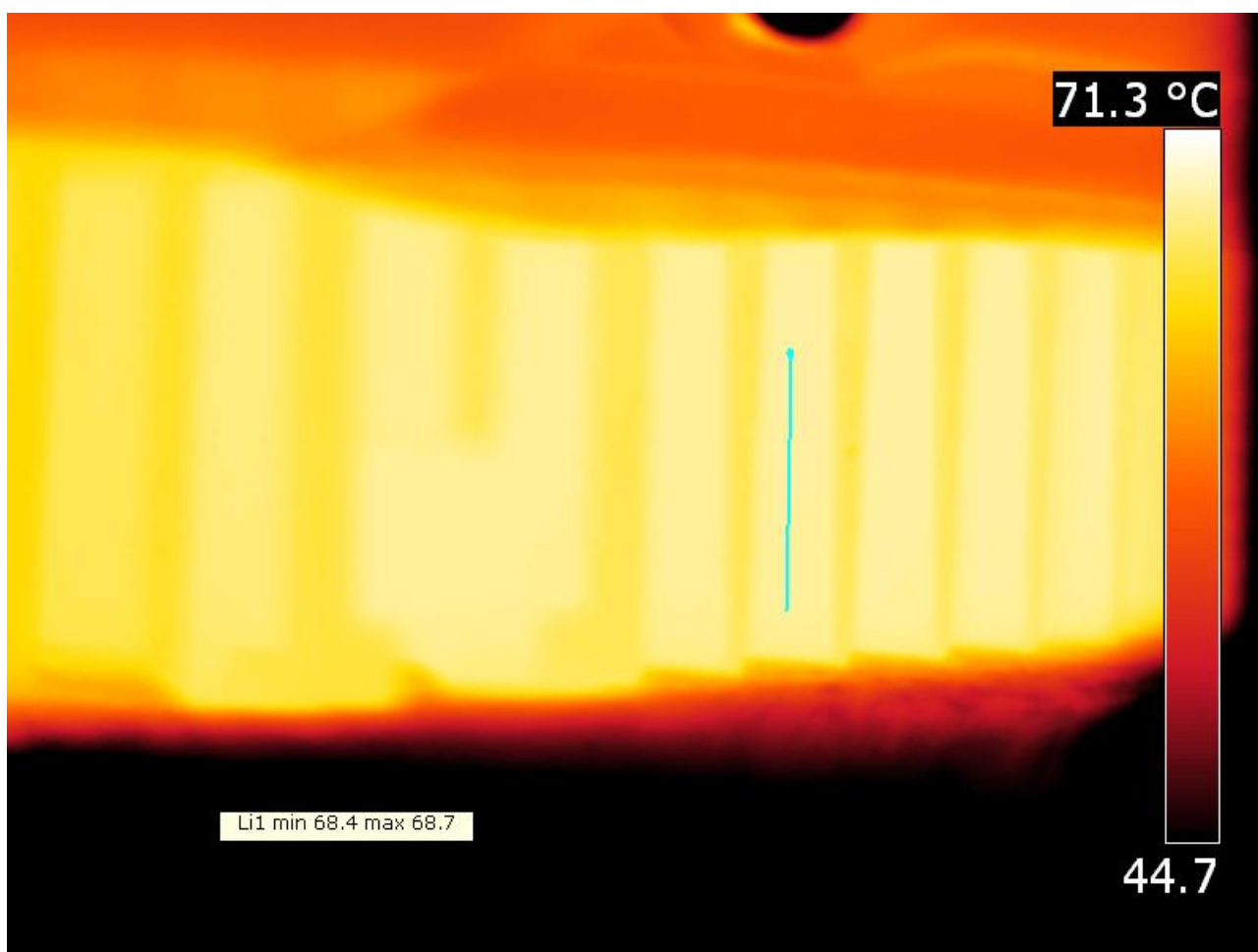
The resulting temperature image of the side of the housing and the heatsink fins from outside (ambient was 25 deg C).

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The glassplate has an emissivity of 0.7, hence the same image but now the emissivity set to a value only correct for the glassplate.

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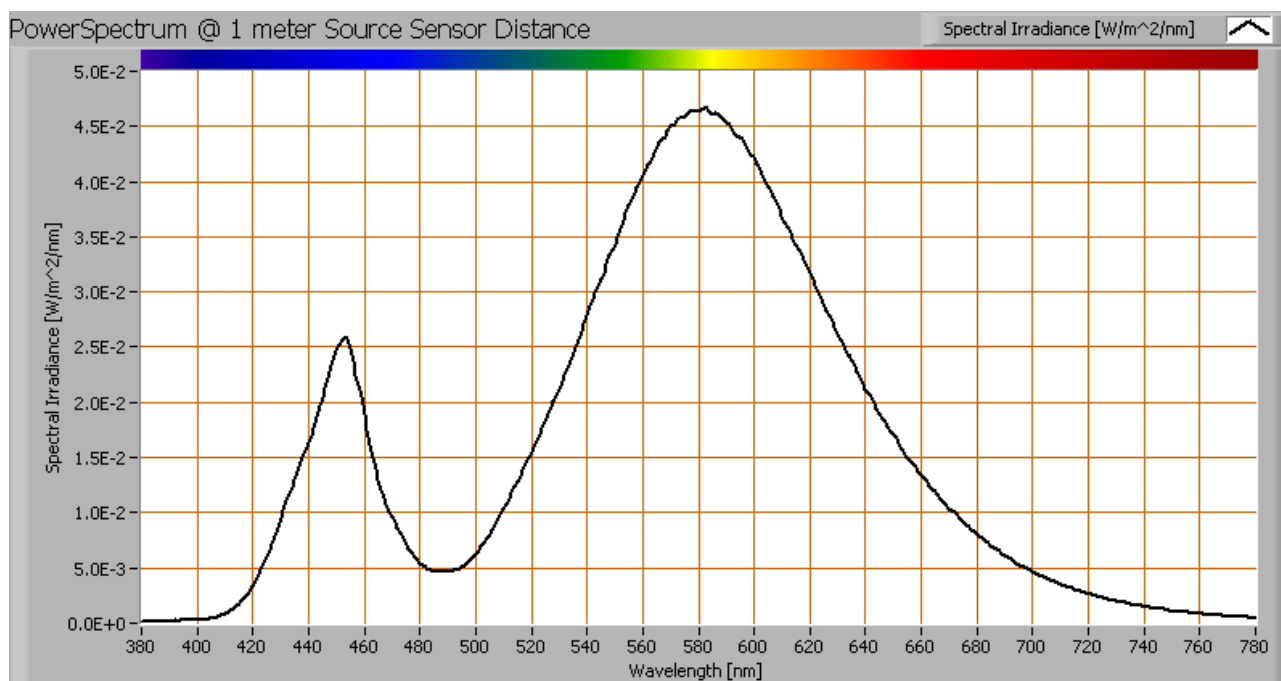
Temperature image between the fins of the heatsink. The emissivity of the black material of the heatsink is close to 0.98. This is the maximum temperature seen.

status lamp	> 2 hours on
ambient temperature	25 deg C
reflected background temperature	25 deg C
camera	Flir T335
emissivity	0.7 (glassplate) and 0.95
measurement distance	0.2 m (heatsink)
IFOV _{geometric}	0.3 mm
NETD (thermal sensitivity)	50 mK

The hottest temperature on the lamp is at the heatsink, between the blades.

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Color temperature and Spectral power distribution

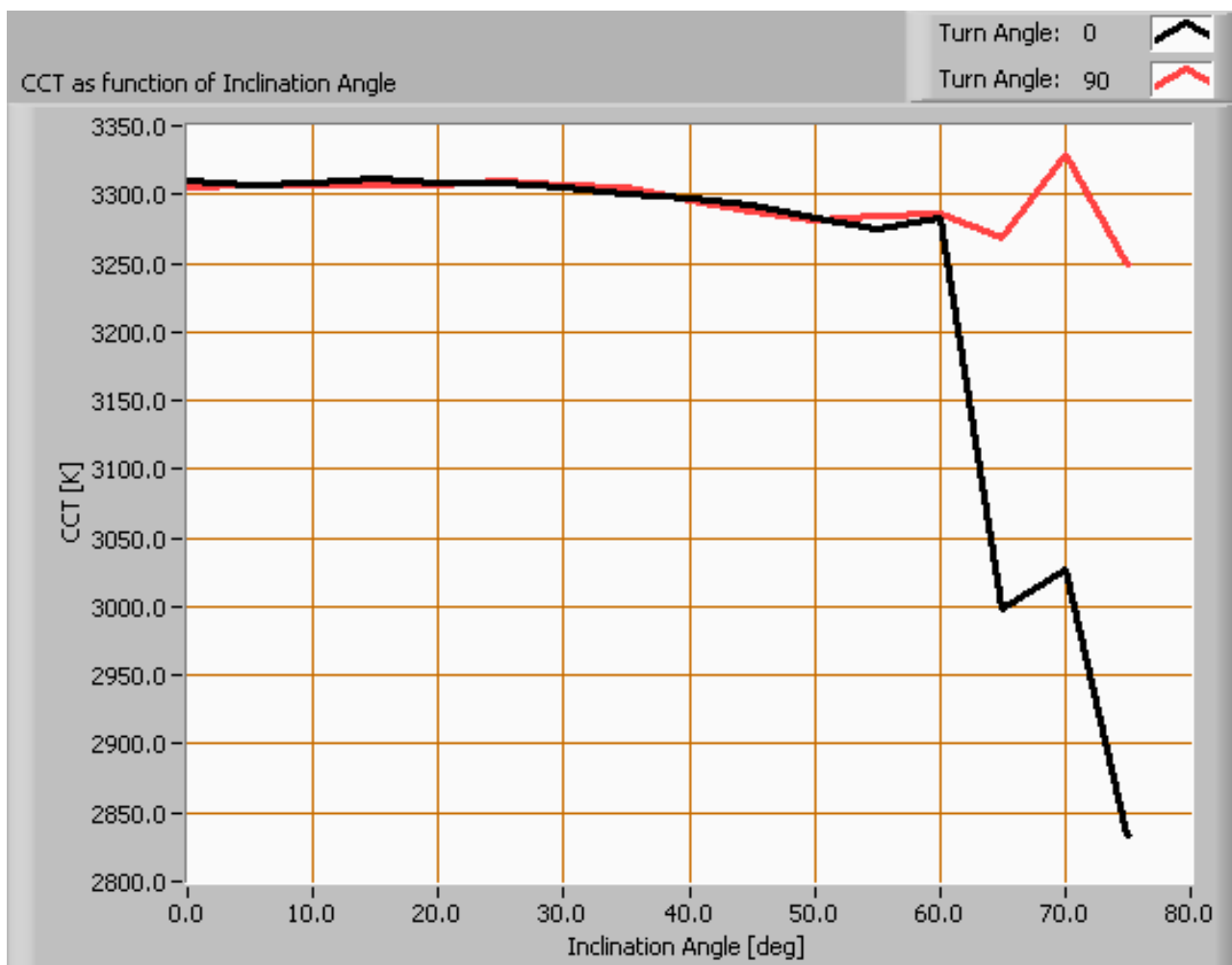


The spectral power distribution of this light bulb, energies on y-axis valid at 1 m distance.

The measured color temperature is about 3300 K which is warm white.

This color temperature is measured straight underneath the light bulb. Below a graph showing the color temperature for different inclination angles.

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Color temperature as a function of inclination angle.

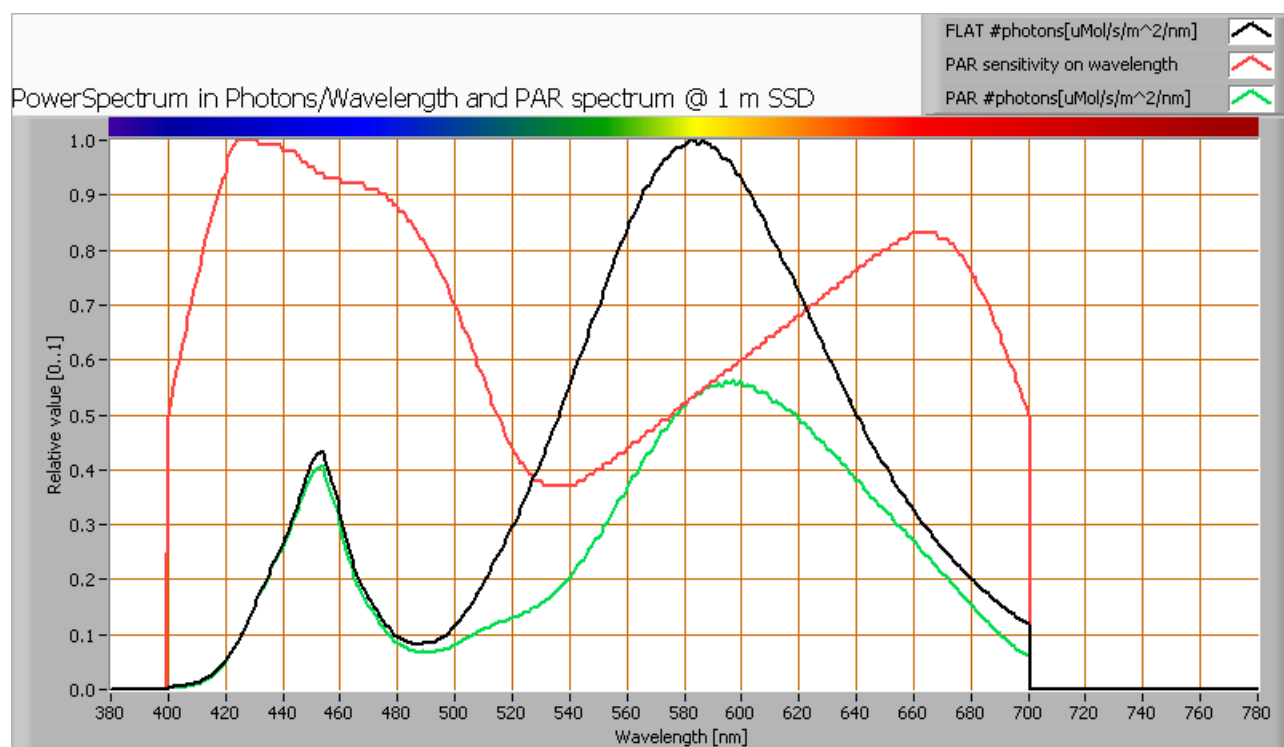
The measurement of CCT is measured for inclination angles up to 75° and beyond the illuminance value gets very low (< 5 lux).

The maximum beam angle is 113°, meaning a 56.5° inclination angle. In this area most of the light is present. The variation in correlated color temperature in this area is less than 1 %.

PAR value and PAR spectrum

To make a statement how well the light of this light bulb is for growing plants, the PAR-area needs to be determined. See the OLiNo website how this all is determined and the explanation of the graph.

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The photon spectrum, then the sensitivity curve and as result the final PAR spectrum of the light of this light bulb

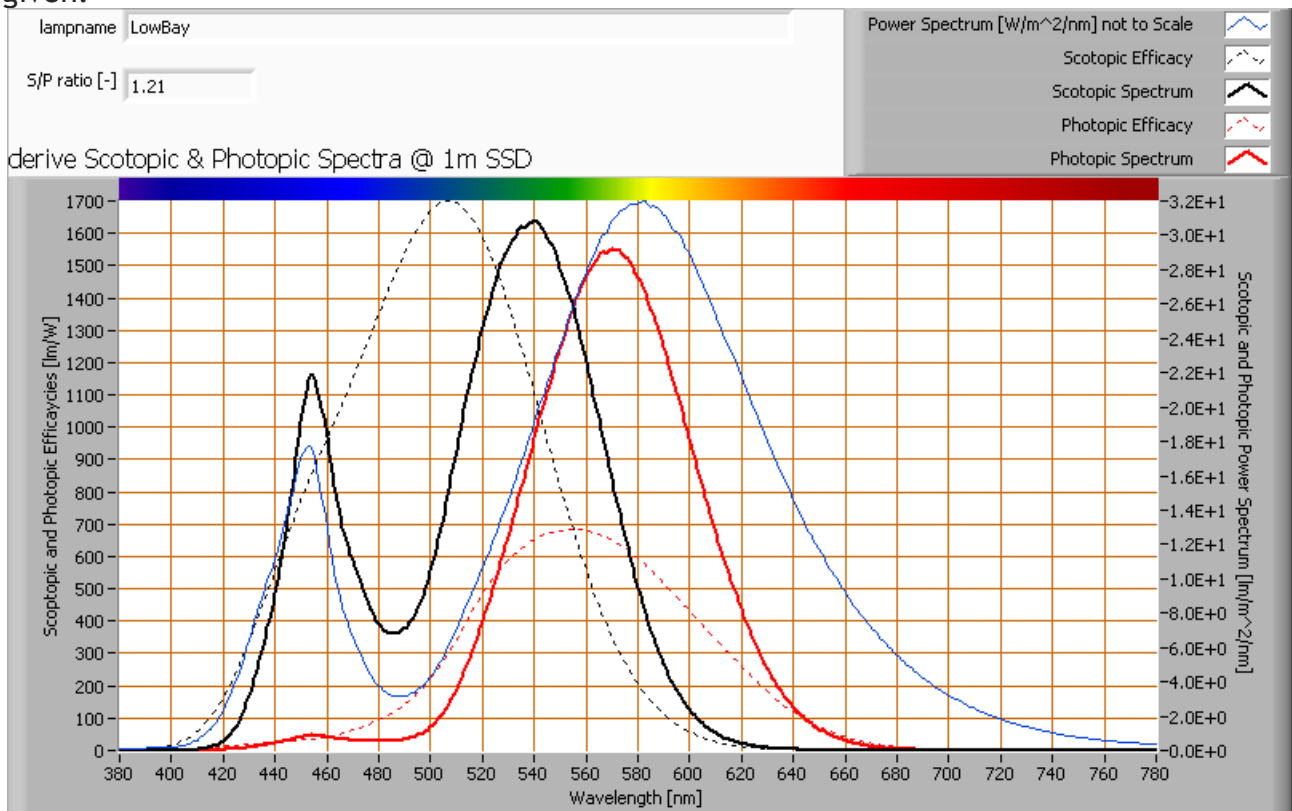
parameter	value	unit
PAR-number	46.2	μMol/s/m ²
PAR-photon current	17.7	μMol/s
PAR-photon efficacy	0.5	μMol/s/W

The PAR efficiency is 62 % (valid for the PAR wave length range of 400 - 700 nm). So maximally 62 % of the total of photons in the light is effectively used by the average plant (since the plant might not take 100 % of the photons at the frequency where its relative sensitivity is 100 %).

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S/P ratio

The S/P ratio and measurement is explained on the OliNo website. Here the results are given.



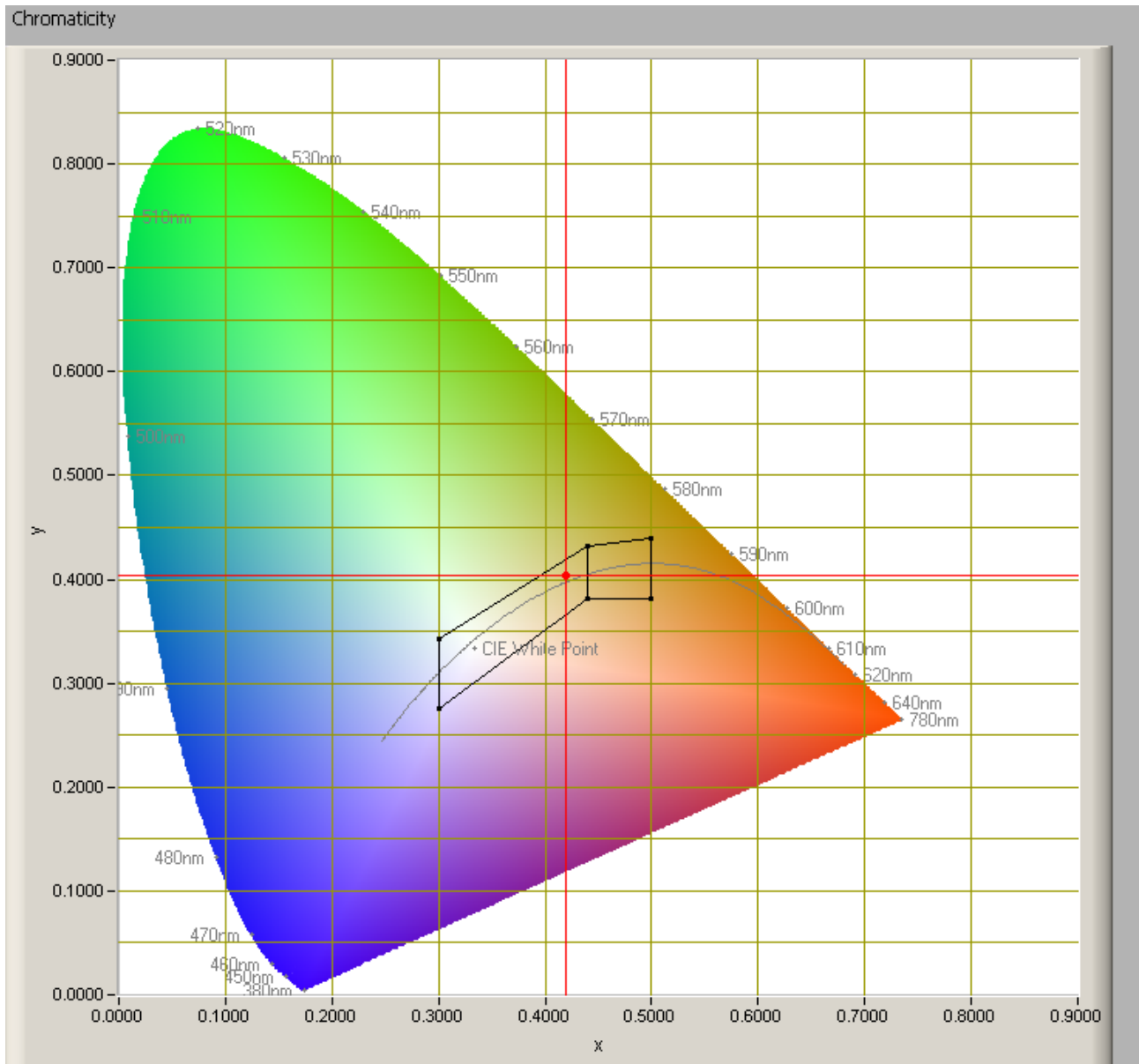
The power spectrum, sensitivity curves and resulting scotopic and photopic spectra (spectra energy content defined at 1 m distance).

The S/P ratio is 1.2.

More info on S/P ratio can be found on the OliNo website.

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Chromaticity diagram



The chromaticity space and the position of the lamp's color coordinates in it.

The light coming from this lamp is inside the area designated with class A. This class A is an area that is defined for signal lamps, see also the OLiNo website.
Its coordinates are $x=0.4192$ and $y=0.4037$.

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Color Rendering Index (CRI) or also Ra















Herewith the image showing the CRI as well as how well different colors are represented (rendered). The higher the number, the better the resemblance with the color when a black body radiator would have been used (the sun, or an incandescent lamp). Practical information and also some critics about the CRI can be found on the OliNo website.

Each color has an index R_x , and the first 8 indexes ($R_1 \dots R_8$) are averaged to compute the R_a which is equivalent to the CRI.

☐ manual

Reference Illuminant: Planckian radiator CCT: 3309 K

Chromaticity Difference DC= 2.8E-3

R1= 55.4		R8= 33.6	
R2= 73.9		R9= -66.4	
R3= 88.5		R10= 38.9	
R4= 54		R11= 41.3	
R5= 53.9		R12= 28.1	
R6= 60.5		R13= 58.3	
R7= 75		R14= 93.3	

Ra
(mean value of $R_1 - R_8$)
61.8

CRI of the light of this lightbulb.

The value of 62 is lower than 80 which is considered a minimum value for indoor usage. Note: the chromaticity difference is 0.0028 indicates the distance to the Planckian Locus. There is no norm yet that states what the max deviation from white light is allowed to be. A reference with signal lights as a reference is given in the chromaticity diagram.

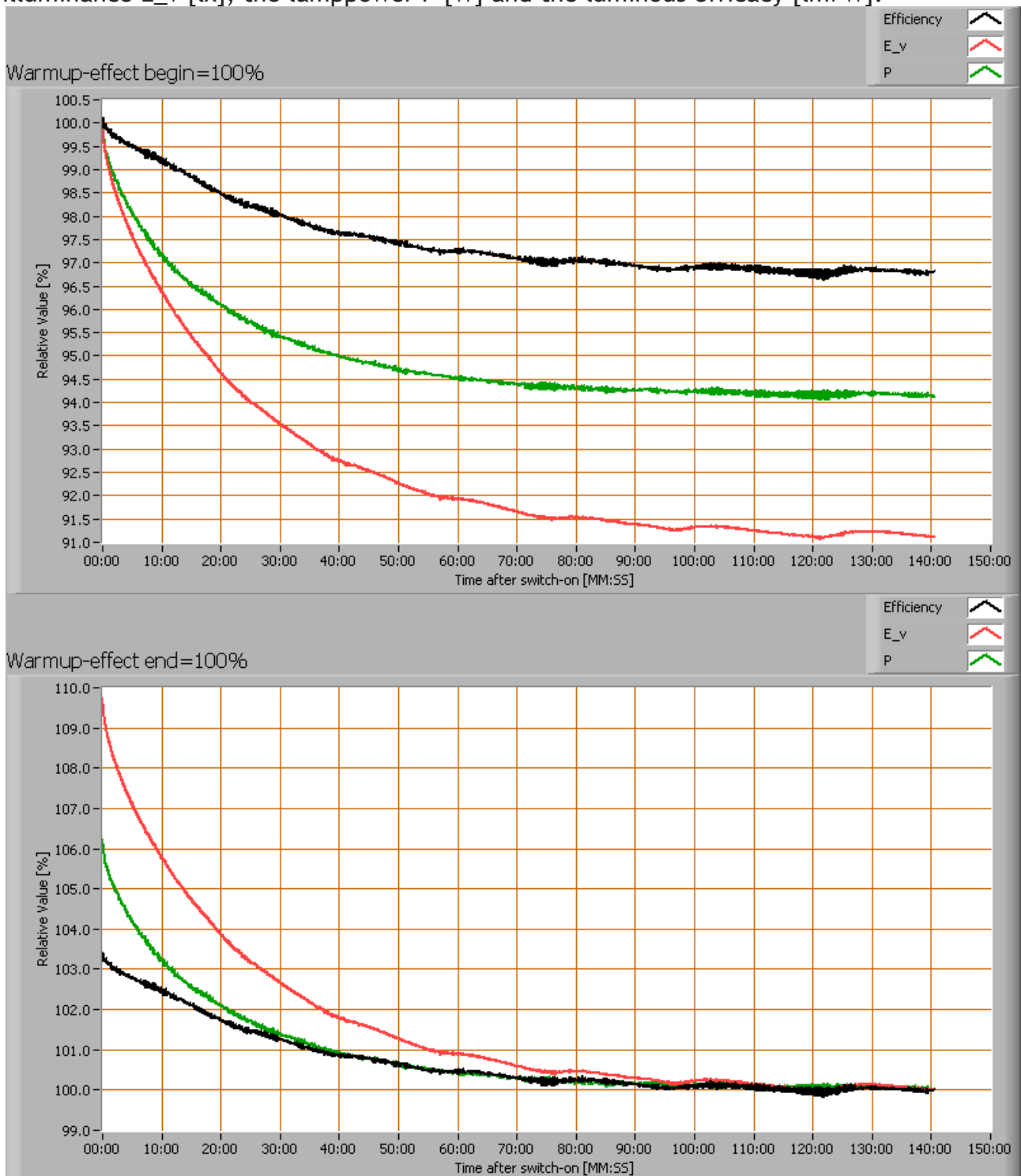
Voltage dependency

The dependency of a number of lamp parameters on the lamp voltage is not determined.

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Warm up effects

After switch on of a cold lamp, the effect of heating up of the lamp is measured on illuminance E_v [lx], the lamp power P [W] and the luminous efficacy [lm/W].





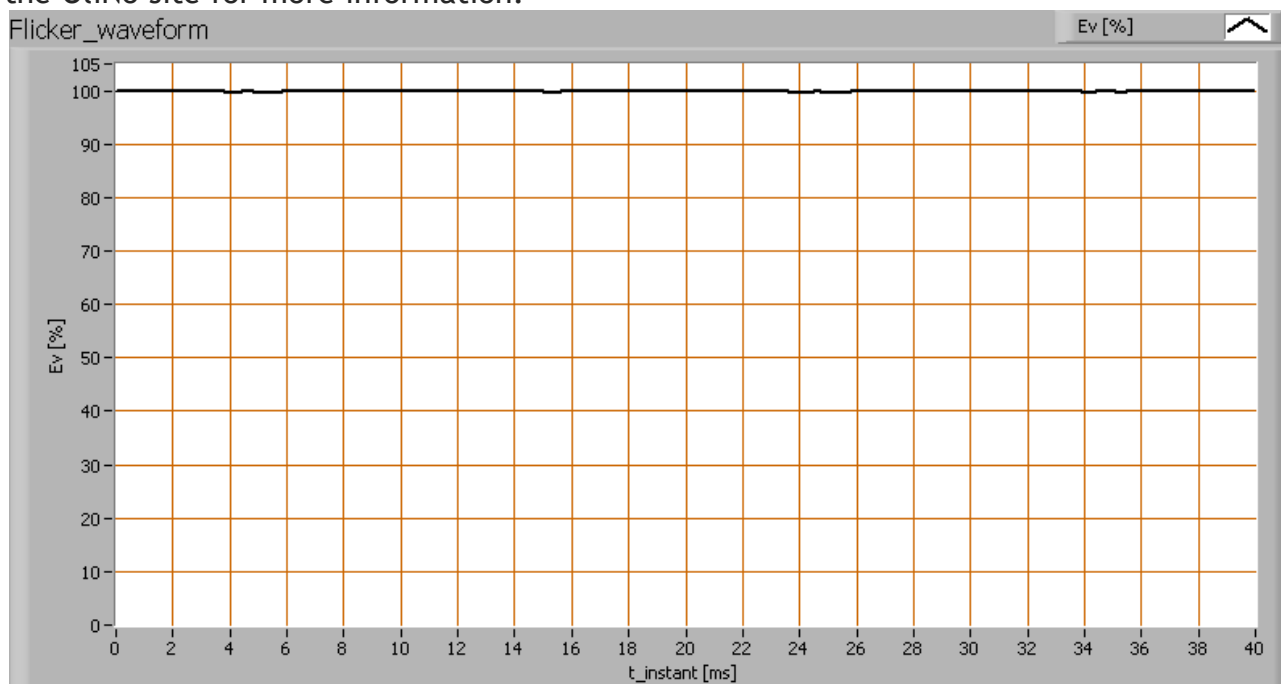
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Effect of warming up on different light bulb parameters. At top the 100 % level is put at begin, and at bottom at the end.

The warm up time is about 70 minutes. During that time the illuminance decreases with 9 % and the consumed power with 6 %.

Measure of flickering

An analysis is done on the measure of flickering of the light output by this light bulb. See the OliNo site for more information.



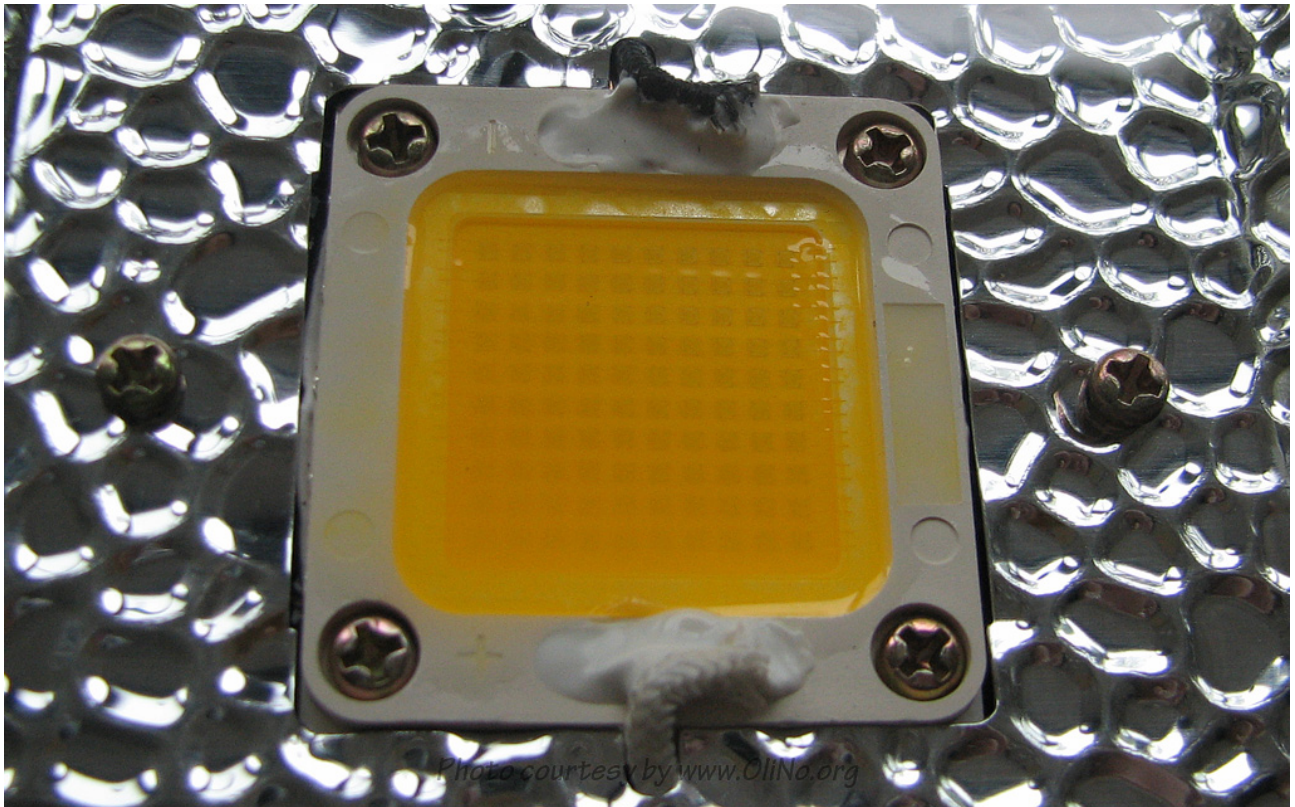
The measure of fast illuminance variation of the light of the light bulb

parameter	waarde	eenheid
Flicker frequency	n.a.	Hz
Illuminance modulation index	0	%

The illuminance modulation index is computed as: $(\max_Ev - \min_Ev) / (\max_Ev + \min_Ev)$.

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Additional photo



Close up of the led chip.

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