Lamp measurement report – 1 Sept 2010

Led Candle Light CW

by

ElektoLED

Lamp measurement report – 1 Sept 2010

Summary measurement data

parameter	meas. result	remark
Color temperature	3732 K	Warm to neutral white
Luminous intensity I_v	23 Cd	Measured straight underneath the lamp.
Illuminance modulation index	5 %	Measured straight underneath the lamp. Is a measure for the amount of flickering.
Beam angle	217 deg	217° for all C-planes since the lamp is symmetrical along its 1st axis.
Power P	3.7 W	
Power Factor	0.53	For every 1 kWh net power consumed, there has been 1.6 kVAhr for reactive power.
THD	153 %	Total Harmonic Distortion
Luminous flux	178 Lm	
Luminous efficacy	48 Lm/W	
CRI_Ra	82	Color Rendering Index.
Coordinates chromaticity diagram	x=0.3925 and y=0.3849	
Fitting	E14	This lamp is connected to the 230 V grid voltage.
PAR-value	0.2 µMol/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	0.4 µMol/s/W_e	The toal emitted number of photons by this light, divided by its consumption in W. It indicates a kind of efficacy in generating photons.
S/P ratio	1.6	This factor indicates the amount of times more efficient the light of this light bulb is perceived under scotopic circumstances (low environmental light level).

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D x H external dimensions	40 x 117 mm	External dimensions of the lamp.
D x H luminous area	15 x 15 mm	Dimensions of the luminous area (used in Eulumdat file). This is the surface of the matte part in which the led is shining. See also photo at the end of this article.
General remarks		The ambient temperature during the whole set of measurements was 23.5 deg C. The temperature of the housing with coolribs gets about 50 degrees hotter than ambient temperature. Warm up effect: during the warm up time the illuminance decreases with 9 % and the consumed power with 6 %. Voltage dependency: the power consumption and illuminance vary insignificantly, when the power voltage varies between 200-250 V.

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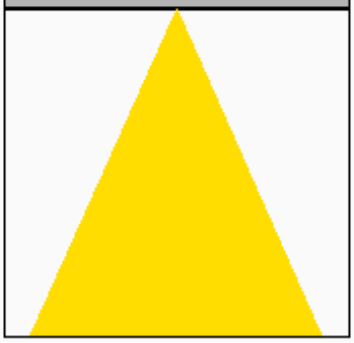
Overview table

m.	Ø 50% C0-180	Ø 50% C90-270
0.25		
0.5		
1		
1.5		
3		
4		
5		

C0-180: 217°
C90-270: 217°



E (lux)
368
92
23
10
3
1
1

Luminaire Efficacy
48 (lumens per Watt)
Half-peak diam C_{0-180}
x diameter(m)
Half-peak diam C_{90-270}
x diameter(m)
Illuminance
23 / distance² (lux)
Total Output
178 (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 15 mm ≈ 75 mm. Within this distance from the lamp, the measured lux values willl be less than the computed values in this overview as the measurements are then within the near field of the lamp.
Note II: the beamangle > 180 degrees and hence the half peak diameters and the Ø50% spot size are not defined.

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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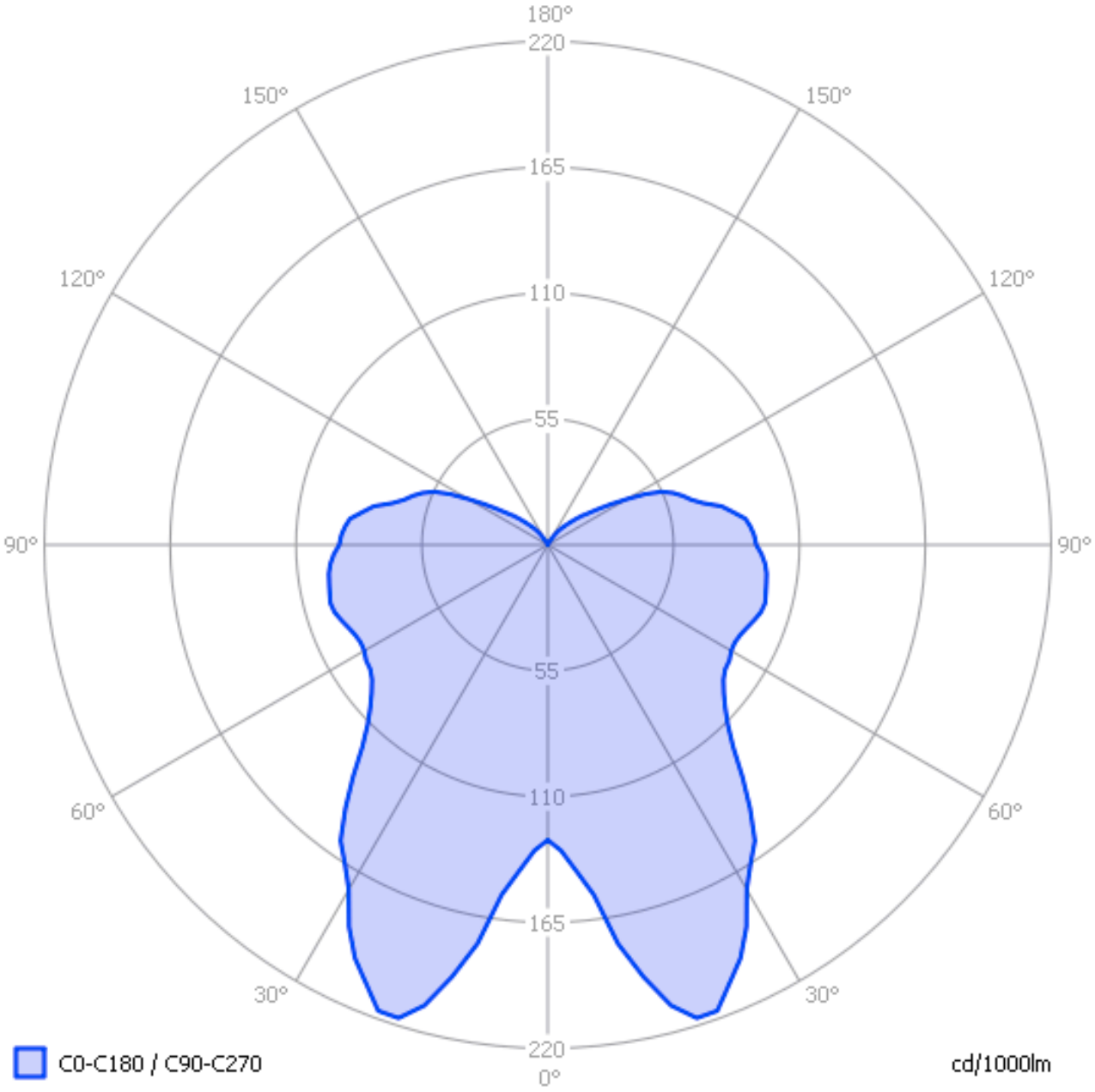

The light diagram giving the radiation pattern.

It indicates the luminous intensity around the light bulb. All the planes give (almost) the same results as the lamp is symmetrical along its 1st axis.

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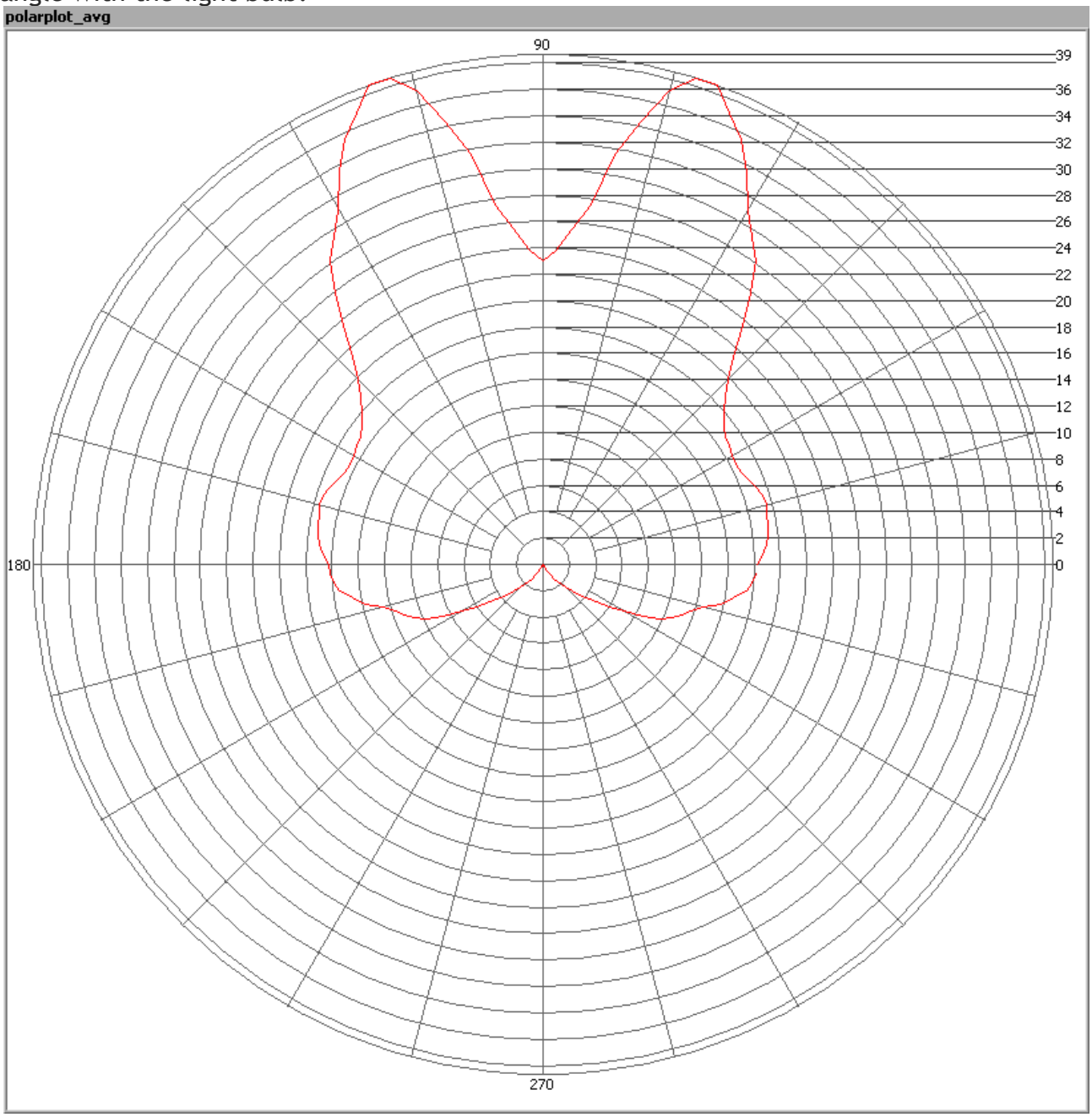
Illuminance Ev at 1 m distance, or luminous intensity Iv

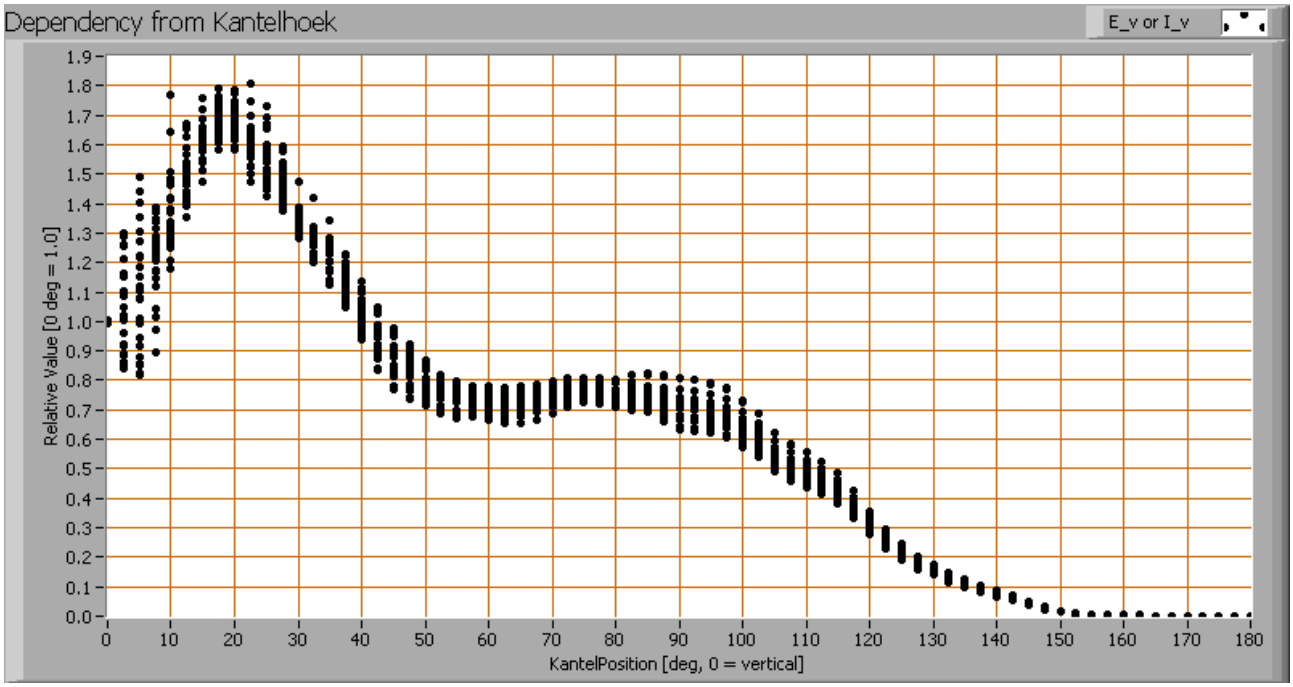
Herewith the plot of the *averaged* luminous intensity Iv as a function of the inclination angle with the light bulb.



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.



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 217° for all C-planes 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 178 Lm.

Luminous efficacy

The luminous flux being 178 Lm, and the power of the light bulb being 3.7 W, yields a

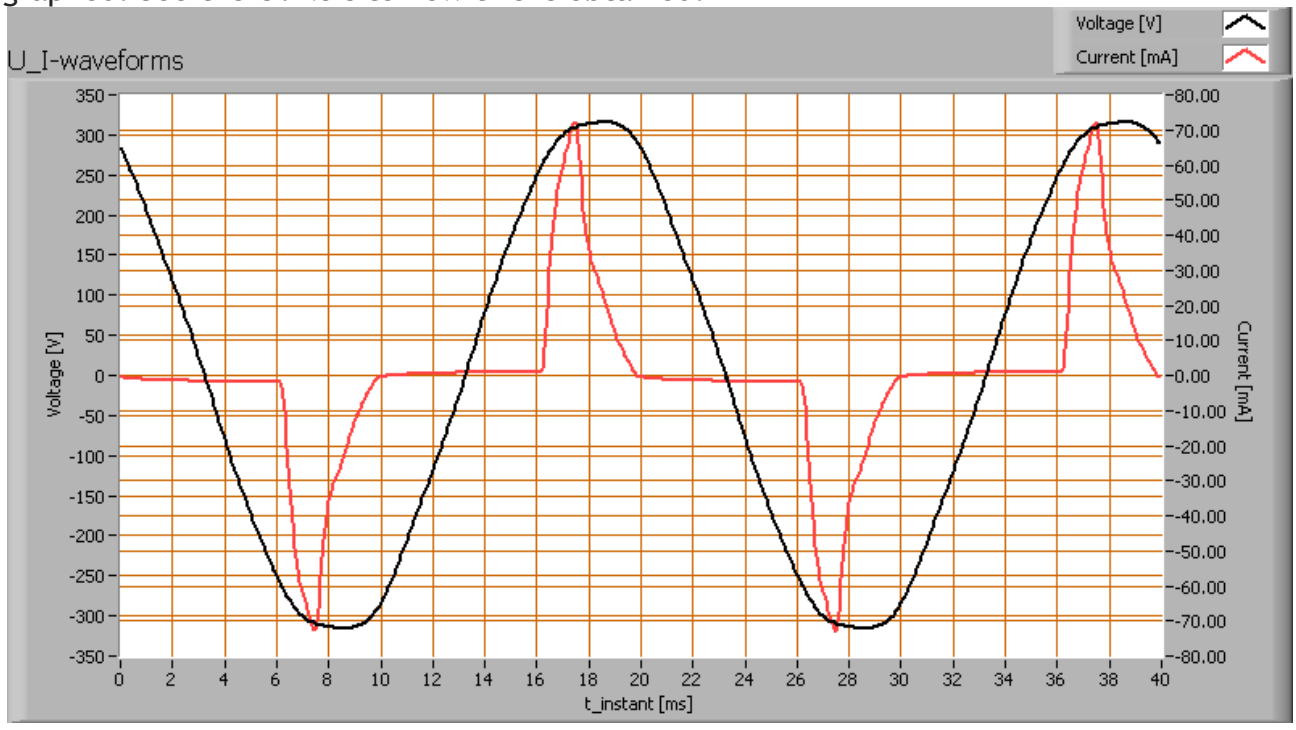
luminous efficacy of 48 Lm/W.

Electrical properties

A power factor of 0.53 means that for every 1 kWh net power consumed, a reactive component of 1.6 kVAr was needed.

Lamp voltage	230 VAC
Lamp current	30 mA
Power P	3.7 W
Apparent power S	6.9 VA
Power factor	0.53

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



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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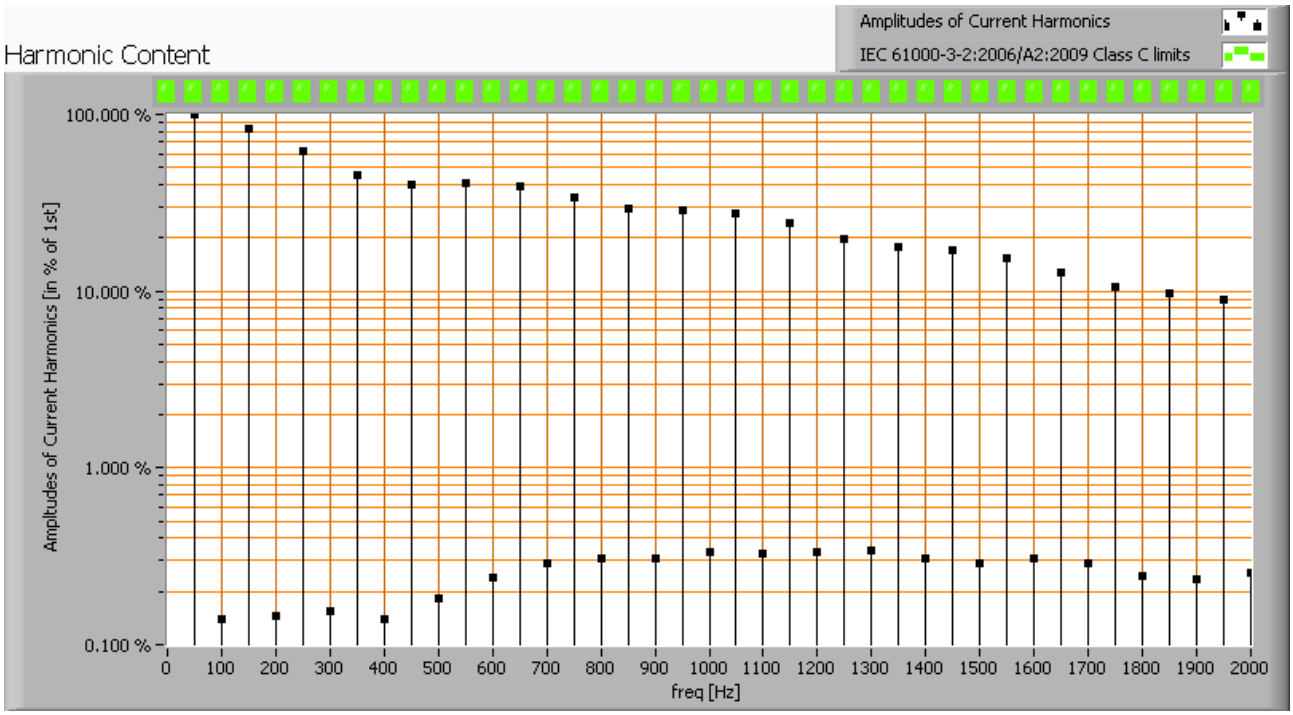

Harmonics in in the current waveform and checked against IEC61000-3-2:2006

There are no limits for the harmonics for lighting equipment <= 25 W.
The Total Harmonic Distortion of the current is computed as 153 %.

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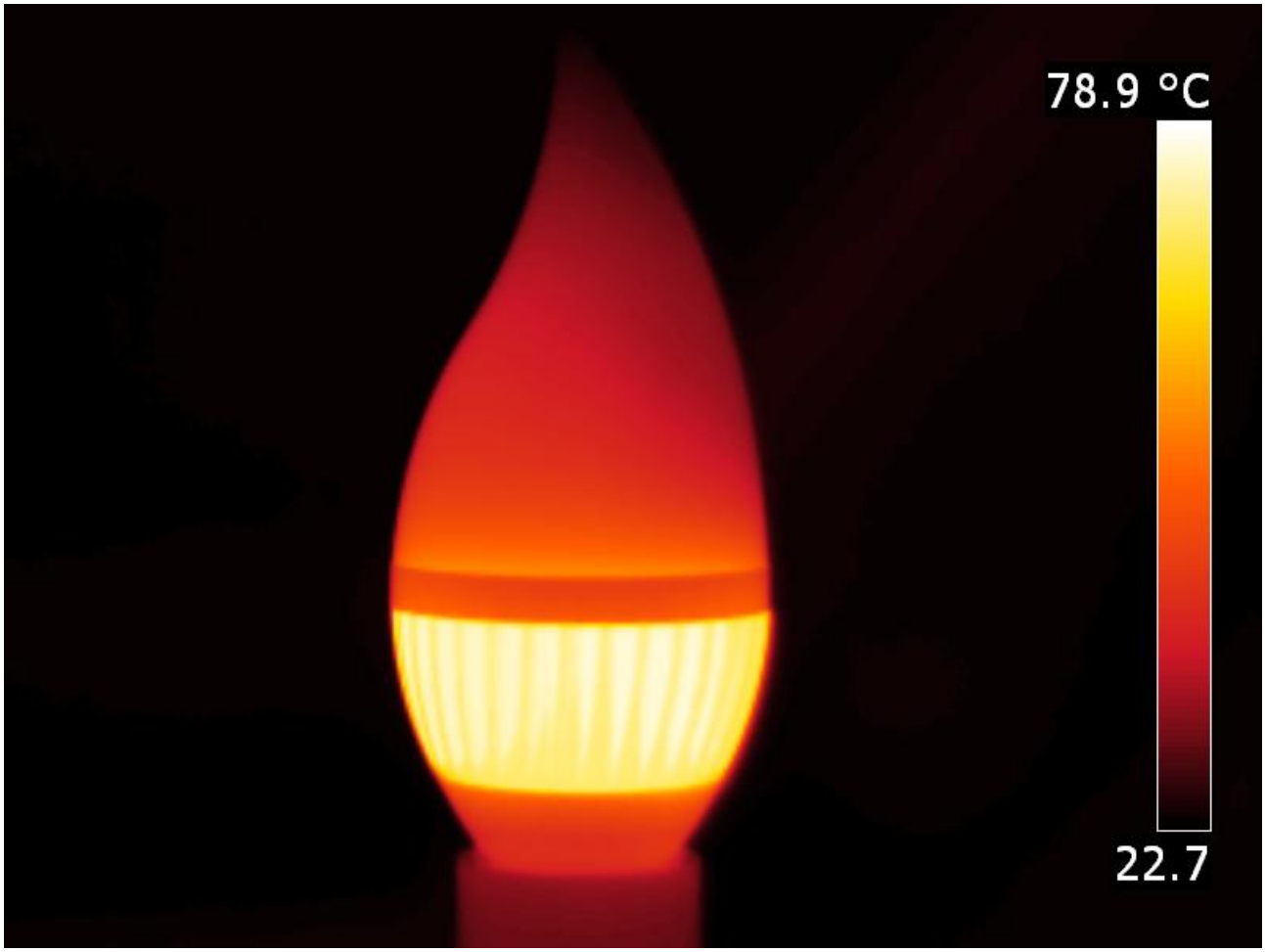
Temperature measurements lamp



Overview image

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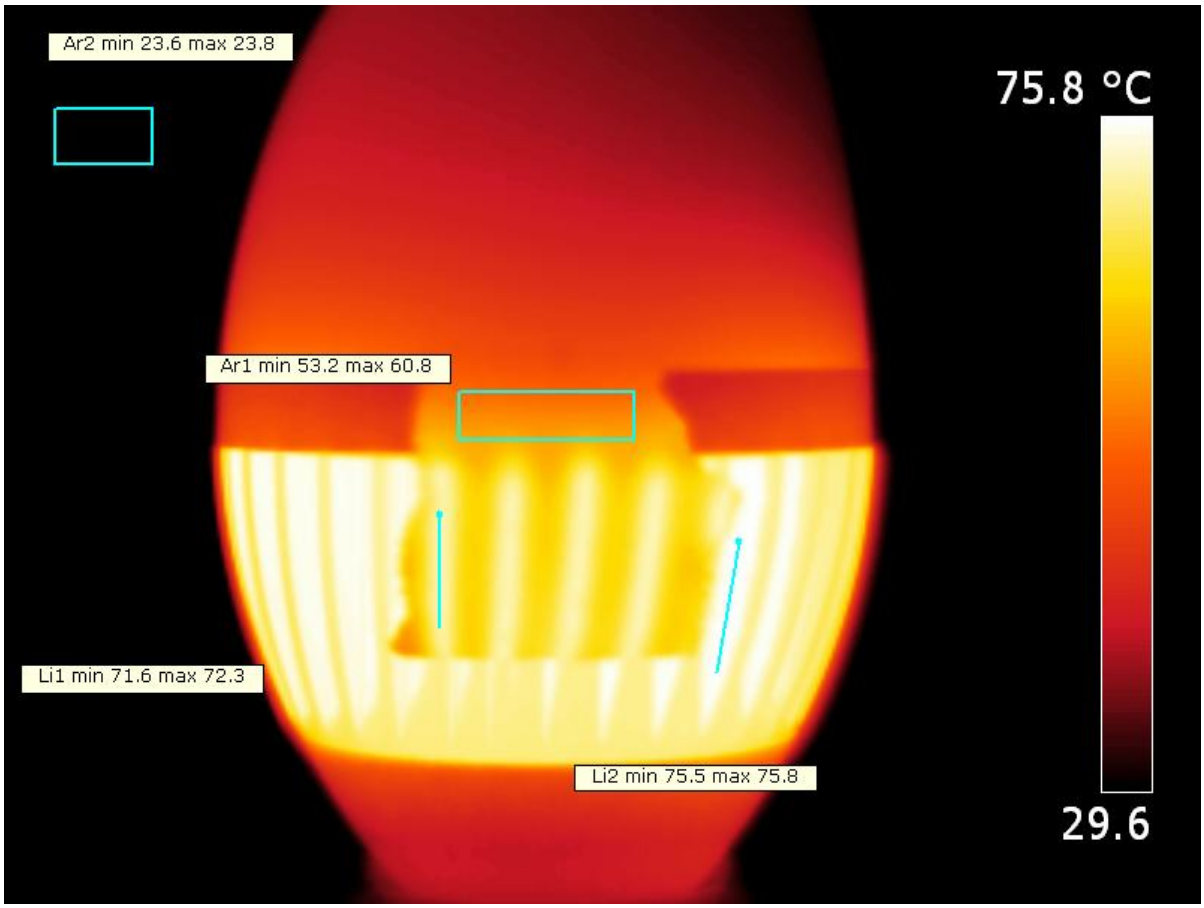


Zoomed in on sideview.

The used tape has an emissivity of about 0.95. The ribs show the same temperature when measured directly on them as with the tape. indicating the same emissivity.

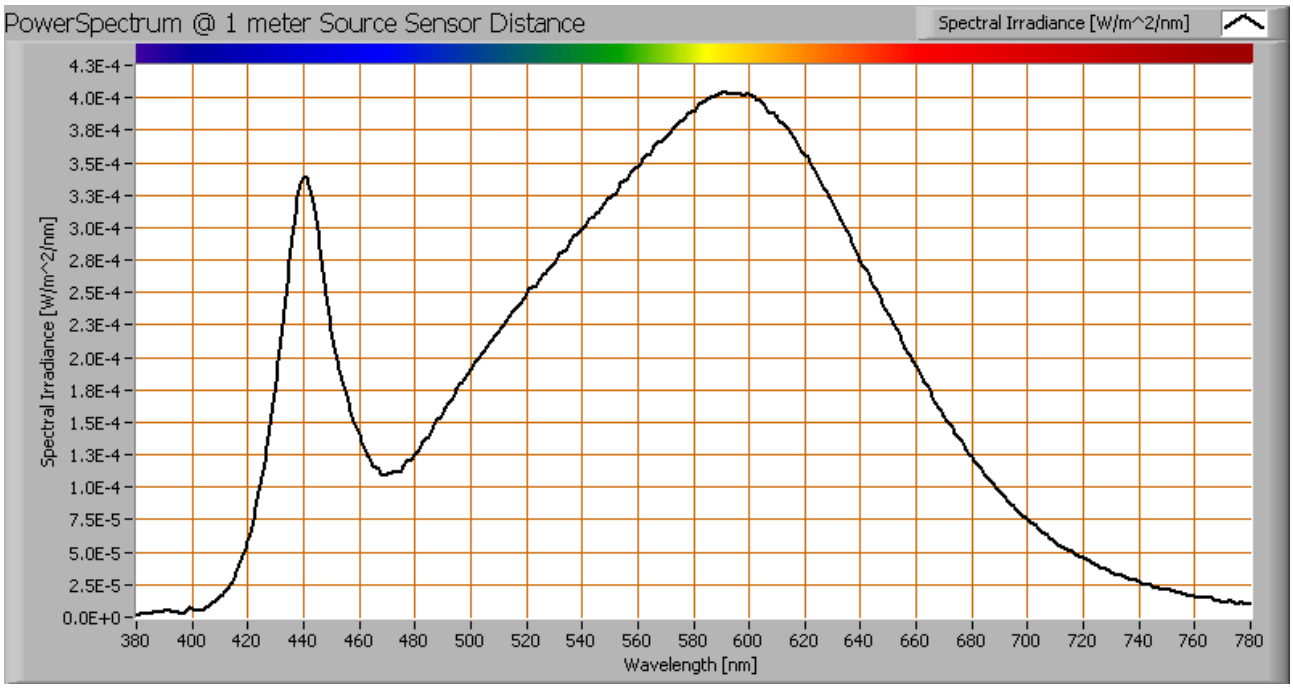
The ring above the heatsink shows a temperature of 53-60 degrees when measured on the tape.

The maximum temperature is found between the ribs.

status lamp	> 2 hours on
ambient temperature	23.5 deg C
reflected background temperature	23.5 deg C
camera	Flir T335
emissivity	0.95[1]
measurement distance	0.2 m
$IFOV_{geometric}$	0.3 mm
NETD (thermal sensitivity)	50 mK

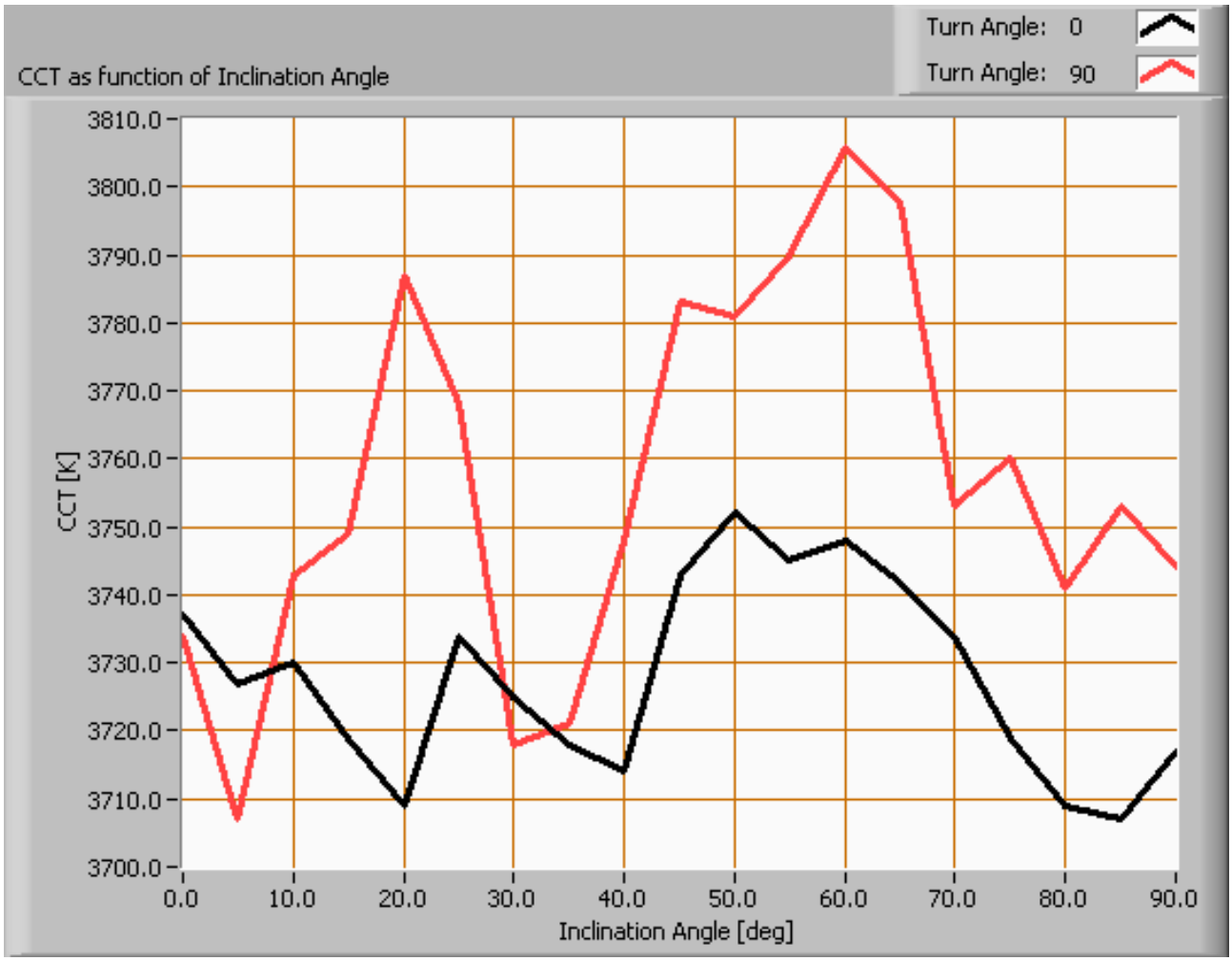
[1] The emissivity is set equal to the masking tape that is being used.

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 3750 K which is warm to neutral white. This color temperature is measured straight underneath the light bulb. Below a graph showing the color temperature for different inclination angles.



Color temperature as a function of inclination angle.

The measurement of CCT is measured for inclination angles up to 90°.
The beam angle is 217°, meaning a 108.5° inclination angle. In this area most of the light is present. The variation in correlated color temperature in the area up to 90 degrees inclination angle is about 2 %.

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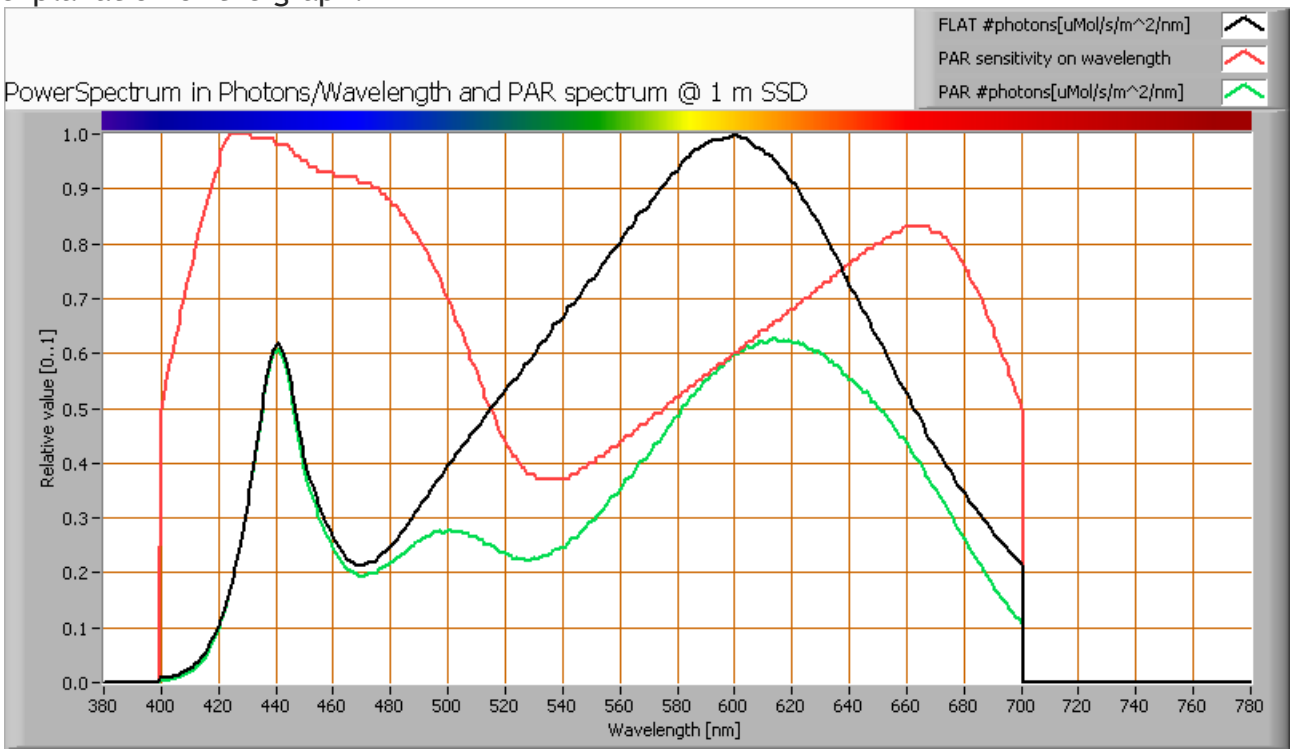
PAR value and PAR spectrum

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.



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	0.2	µMol/s/m²
PAR-photon current	1.6	µMol/s
PAR-photon efficacy	0.4	µMol/s/W

The PAR efficiency is 64 % (valid for the PAR wave length range of 400 – 700 nm). So maximally 64 % 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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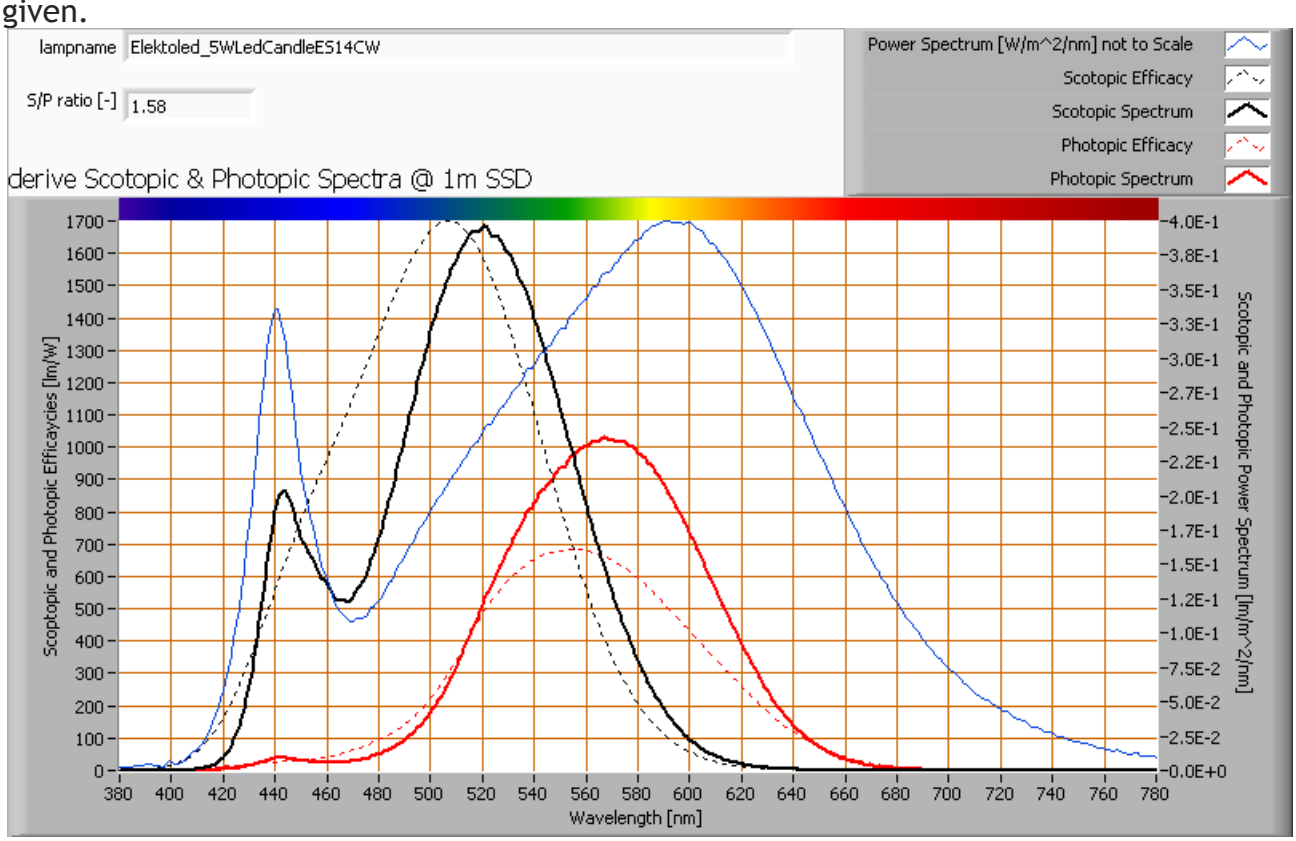
S/P ratio

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 1.6.
More info on S/P ratio can be found on the OliNo website.

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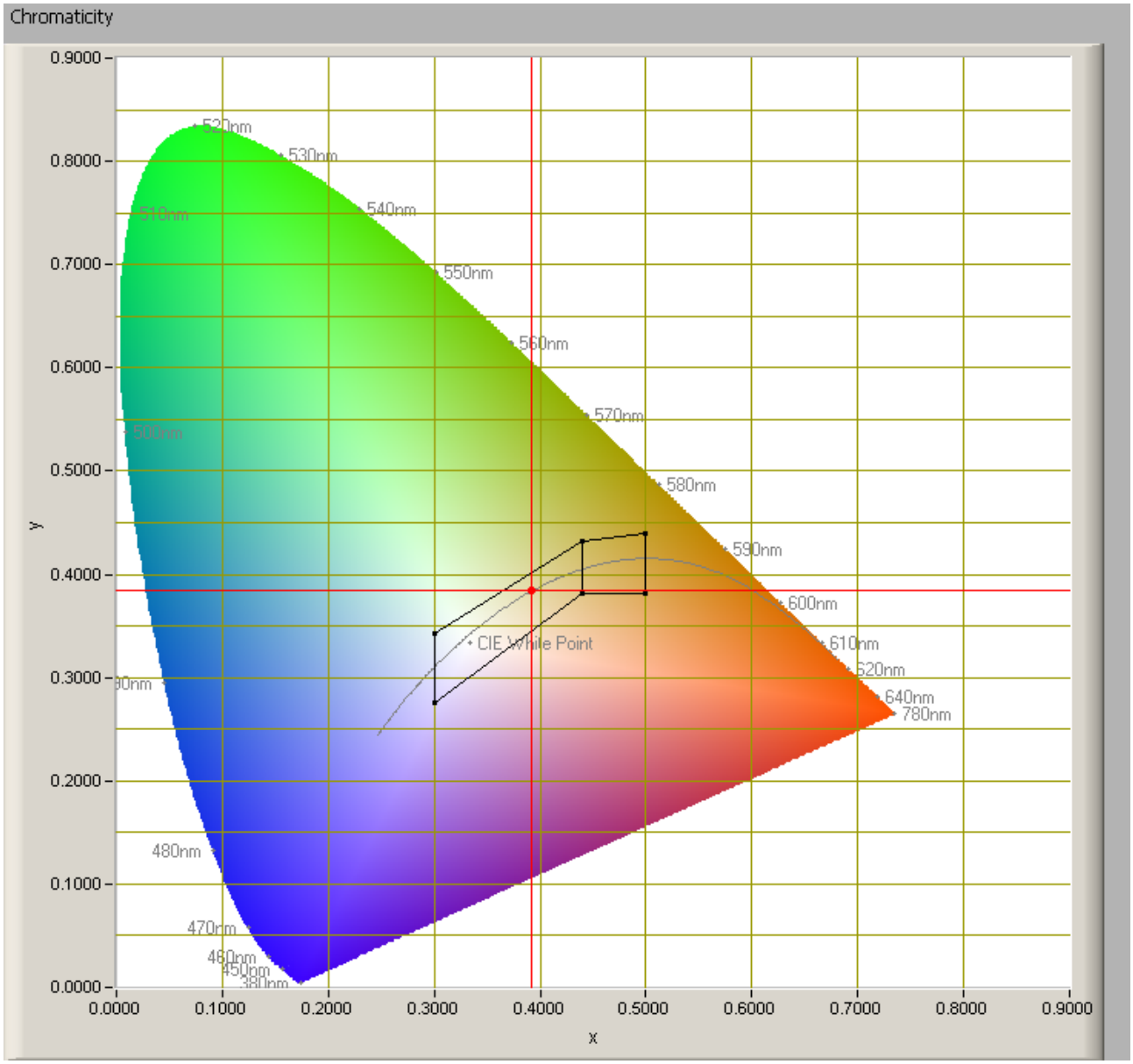
Chromaticity diagram

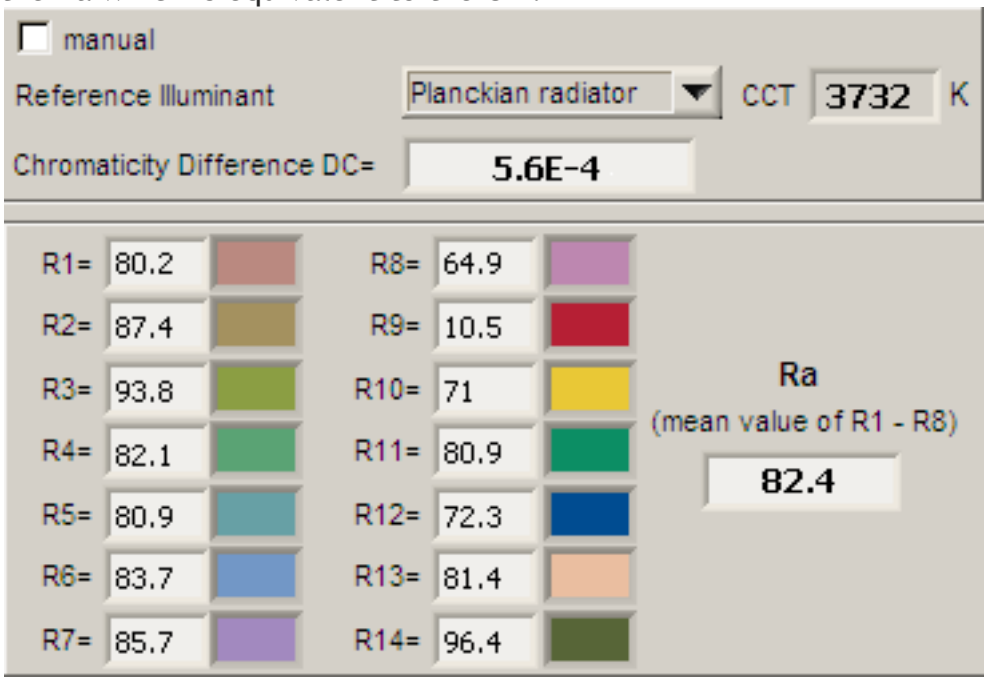


The chromaticity space and the position of the lamp's color coordinates in it.

The light coming from this lamp is in the area of class A. This is an area defined for signal lamps, see also the OliNo website.
Its coordinates are x=0.3925 and y=0.3849.

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 Rx, and the first 8 indexes (R1 .. R8) are averaged to compute the Ra which is equivalent to the CRI.



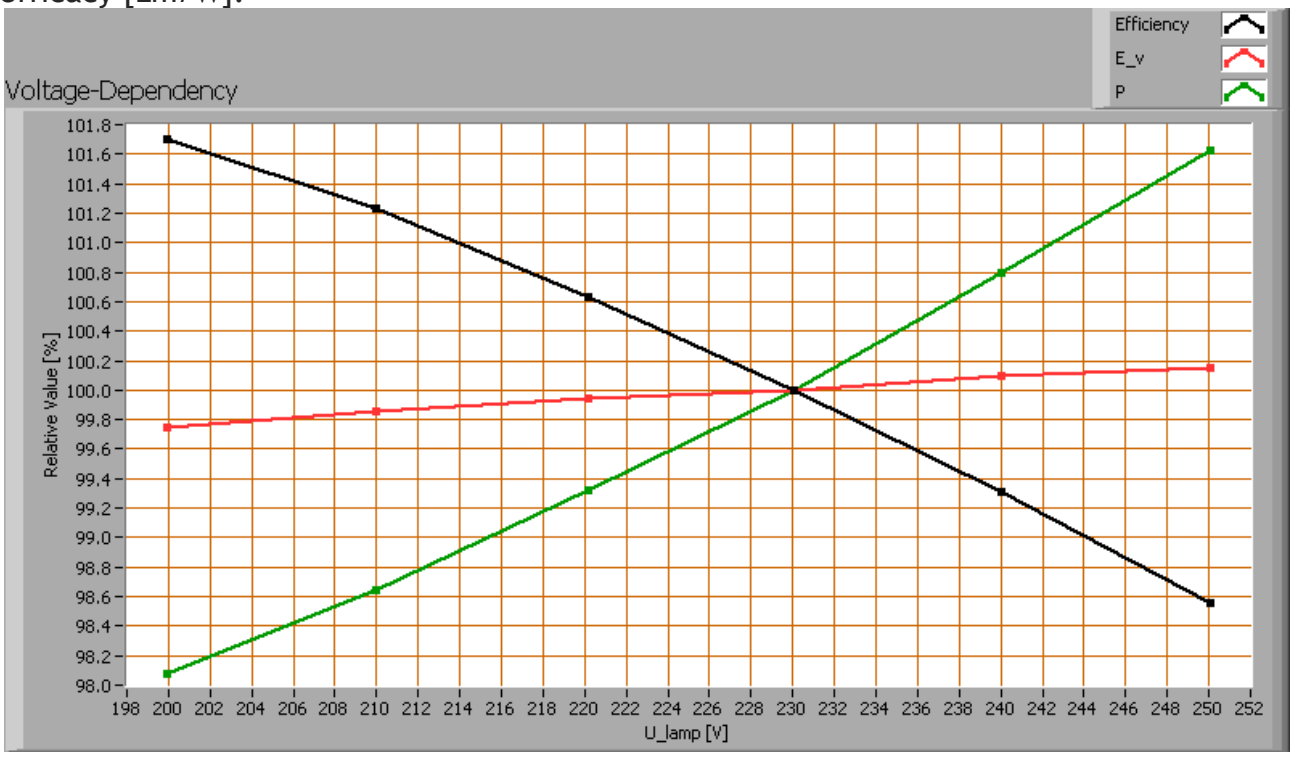
CRI of the light of this lightbulb.

The value of 82 is higher than 80 which is considered a minimum value for indoor usage. Note: the chromaticity difference is 0.0006 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 determined. For this, the lamp voltage has been varied and its effect on the following light bulb parameters measured: illuminance E_v [lx], the lamppower P [W] and the luminous

efficacy [Lm/W].



Lamp voltage dependencies of certain light bulb parameters, where the value at 230 V is taken as 100 %.

The illuminance and consumed power vary insignificantly when the voltage is varied. When the voltage at 230 V varies with + and – 5 V, then the illuminance varies < 0.1 %, so when abrupt voltage changes occur this effect is not visible in the illuminance output.

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 lamppower P [W] and the luminous efficacy [lm/W].

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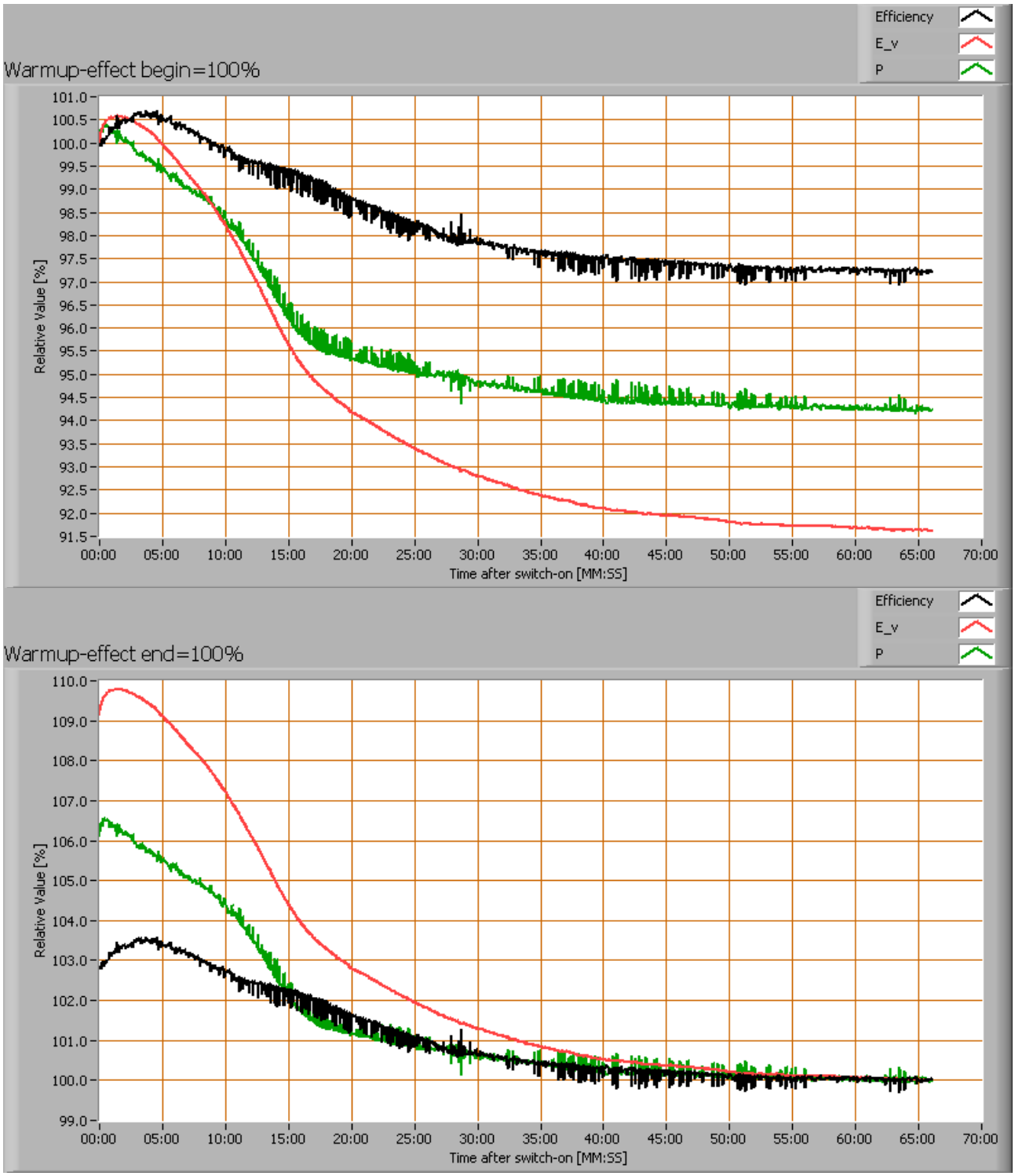
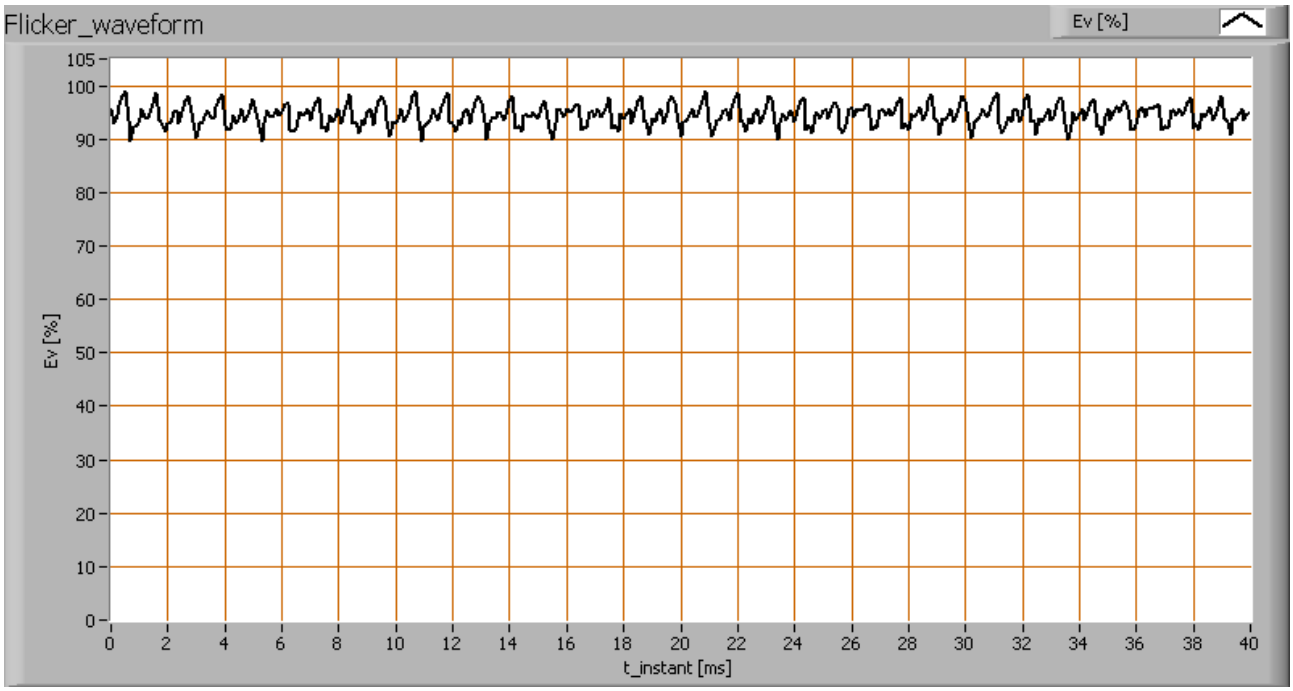


Effect of warming up on different light bulb parameters. At top the 100 % level is put at begin, and at bottom at the end.

The warm up time is about 45 minutes during which 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 variartion of the light of the light bulb

parameter	value	unit
Flicker frequency	882	Hz
Illuminance modulation index	5	%

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

Extra photo

The matte part in which the led is shining

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