

Lamp measurement report – 1 Dec 2009

Solis 9W Neutral White LED Down Lighter

by
Lioris



Photo courtesy by www.OliNo.org

Lamp measurement report – 1 Dec 2009

Summary measurement data

parameter	meas. result	remark
Color temperature	4478 K	neutral white
Luminous intensity I_v	372 Cd	Measured straight underneath the lamp
Beam angle	81 deg	Due to its symmetry over the height axis this value is valid for all cross section angles (called C-angles).
Power P	9.1 W	
Power Factor	0.88	For every 1 kWh net power consumed, there has been 0.5 kVAhr for reactive power.
Luminous flux	726 Lm	
Luminous efficacy	80 Lm/W	
CRI_Ra	64	Color Rendering Index.
Coordinates chromaticity diagram	x=0.3640 and y=0.3760	
Fitting	230V	It is connected directly to the grid. It uses an own current source driver.
PAR-value	3.0 $\mu\text{Mol/s/m}^2$	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.
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 (ow environmental light level).
D x H external dimensions	170 x 46 mm	External dimensions of the lamp.
D luminous area	124 mm	Dimensions of the luminous area (used in Eulumdat file). This is equal to the surface of the diffuse, milk white cover at the front.

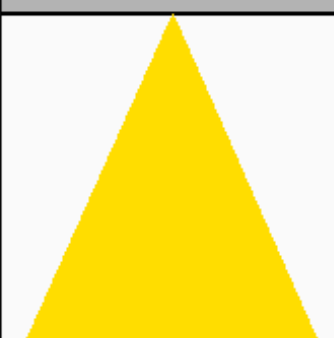


Lamp measurement report – 1 Dec 2009

General remarks		<p>The ambient temperature during the whole set of measurements was 23.5-26 deg C. The heatsink in which the leds are situated gets about 15 deg C warmer then ambient temperature.</p> <p>Warm up effect: during the warm up time the illuminance nor consumed power change significantly.</p> <p>Voltage dependency: the power consumption and illuminance do not significantly depend on the voltage when it is varied from 200 - 250 V.</p>

Lamp measurement report – 1 Dec 2009

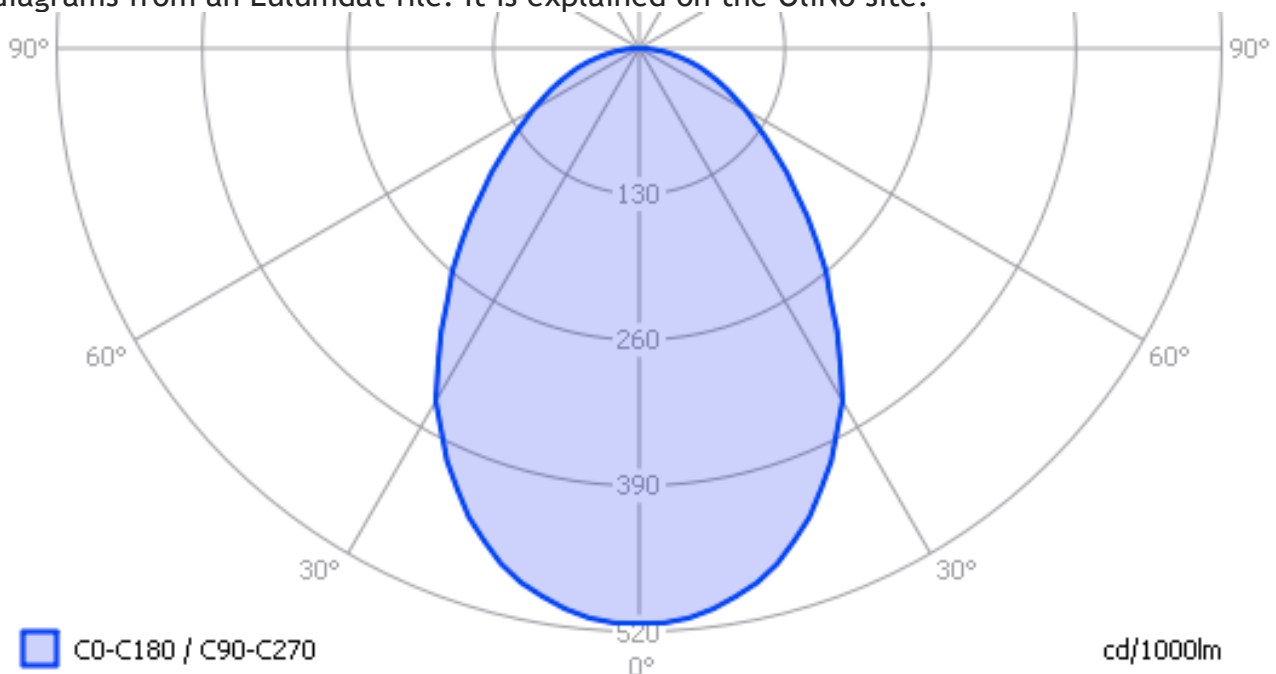
Overview table

m.	Ø 50%		CO-180: 81° C90-270: 81°	E (lux)	Luminaire Efficacy
	CO-180	C90-270			80 (lumens per Watt)
0.25	0.42	0.42		5955	Half-peak diam CO-180
0.5	0.85	0.85		1489	1.7 x diameter(m)
1	1.7	1.7		372	Half-peak diam C90-270
1.5	2.55	2.55		165	1.7 x diameter(m)
3	5.09	5.09		41	Illuminance
4	6.79	6.79		23	372 / distance ² (lux)
5	8.49	8.49		15	Total Output
					726 (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.

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.



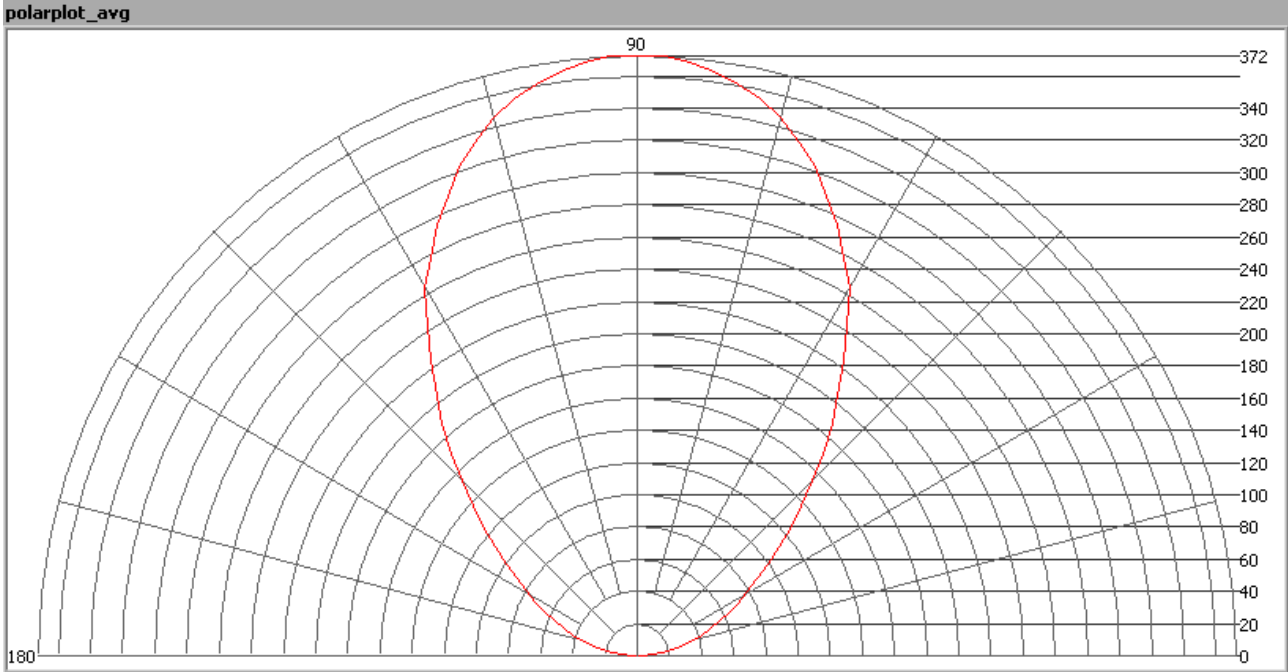
The light diagram giving the radiation pattern.

It indicates the luminous intensity around the light bulb.

Lamp measurement report – 1 Dec 2009

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.

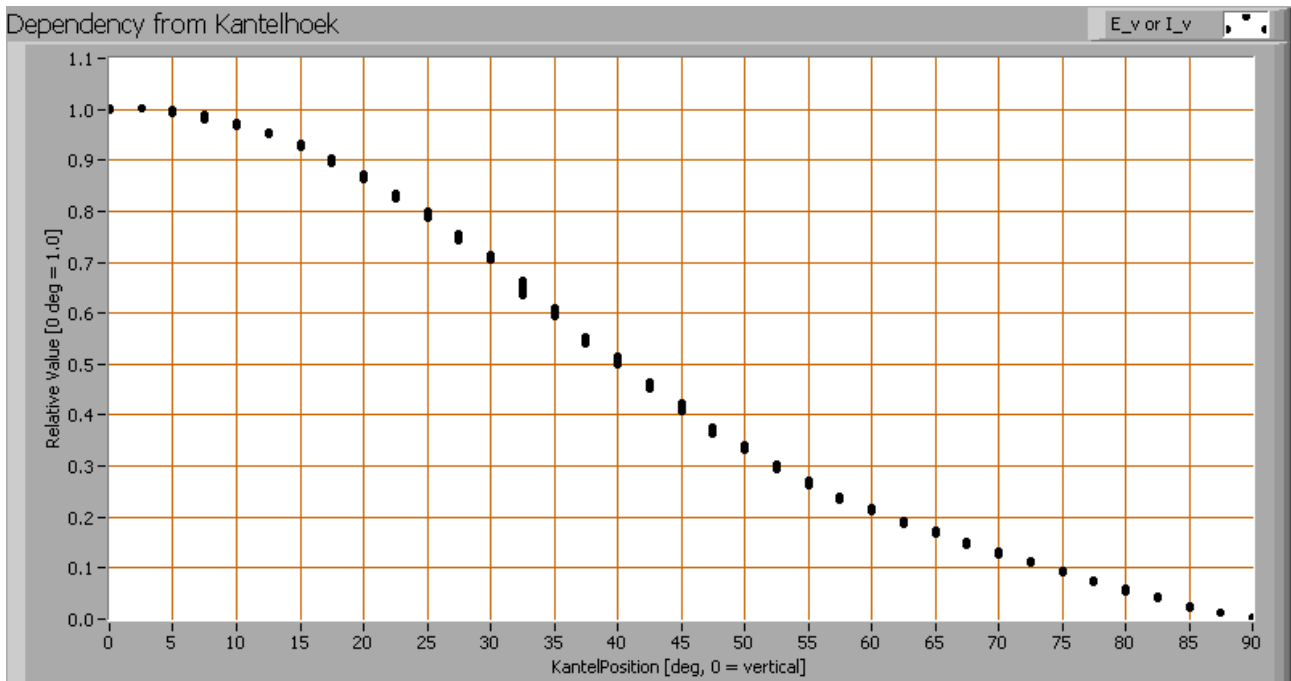


The radiation pattern of the light bulb.

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.

Lamp measurement report – 1 Dec 2009



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 81° for all C planes as there is symmetry over the height axis (the first axis).

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 726 Lm.

Luminous efficacy

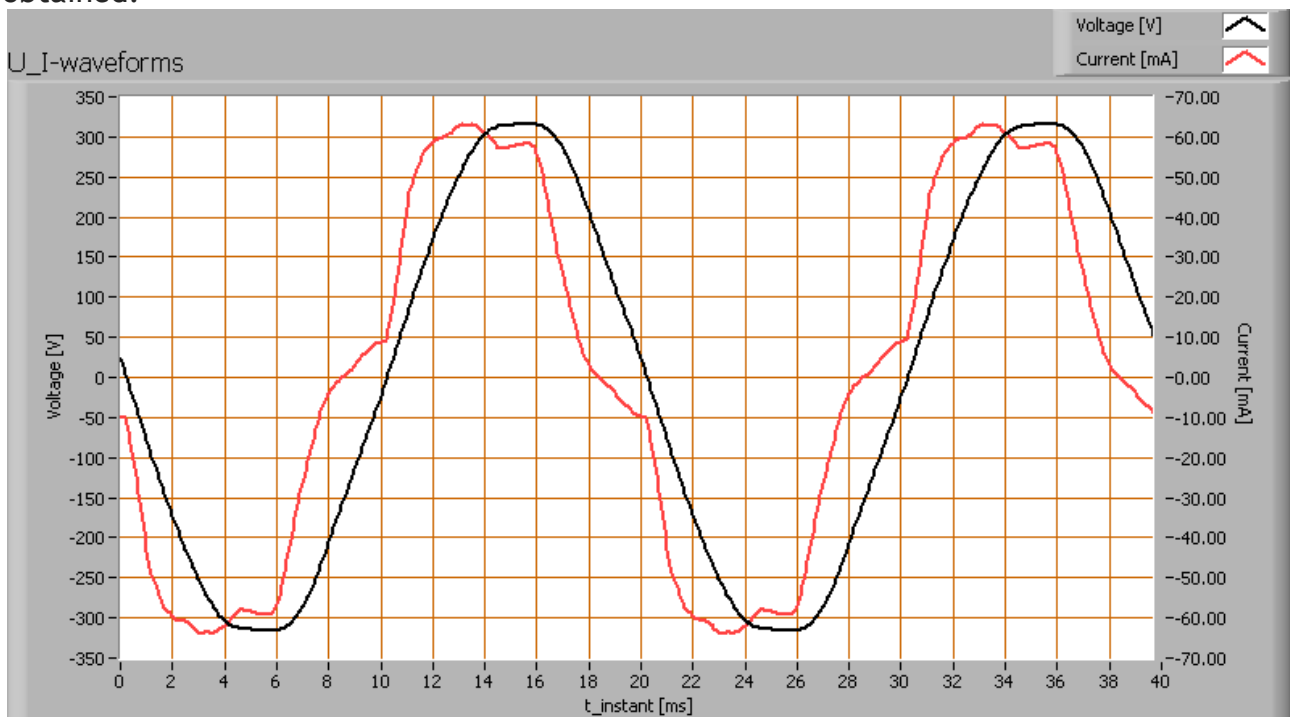
The luminous flux being 726 Lm, and the power of the light bulb being 9.1 W, yields a luminous efficacy of 80 Lm/W.

A power factor of 0.88 means that for every 1 kWh net power consumed, a reactive component of 0.5 kVAr was needed.

Lamp measurement report – 1 Dec 2009

Light bulb voltage (used on power supply!)	230 VAC
Light bulb current	45 mA
Power P	9.1 W
Apparent power S	10.4 VA
Power factor	0.88

Of this light bulb the voltage across and the resulting current through it+its constant current driver power supply are measured and graphed. See the OliNo site how this is obtained.

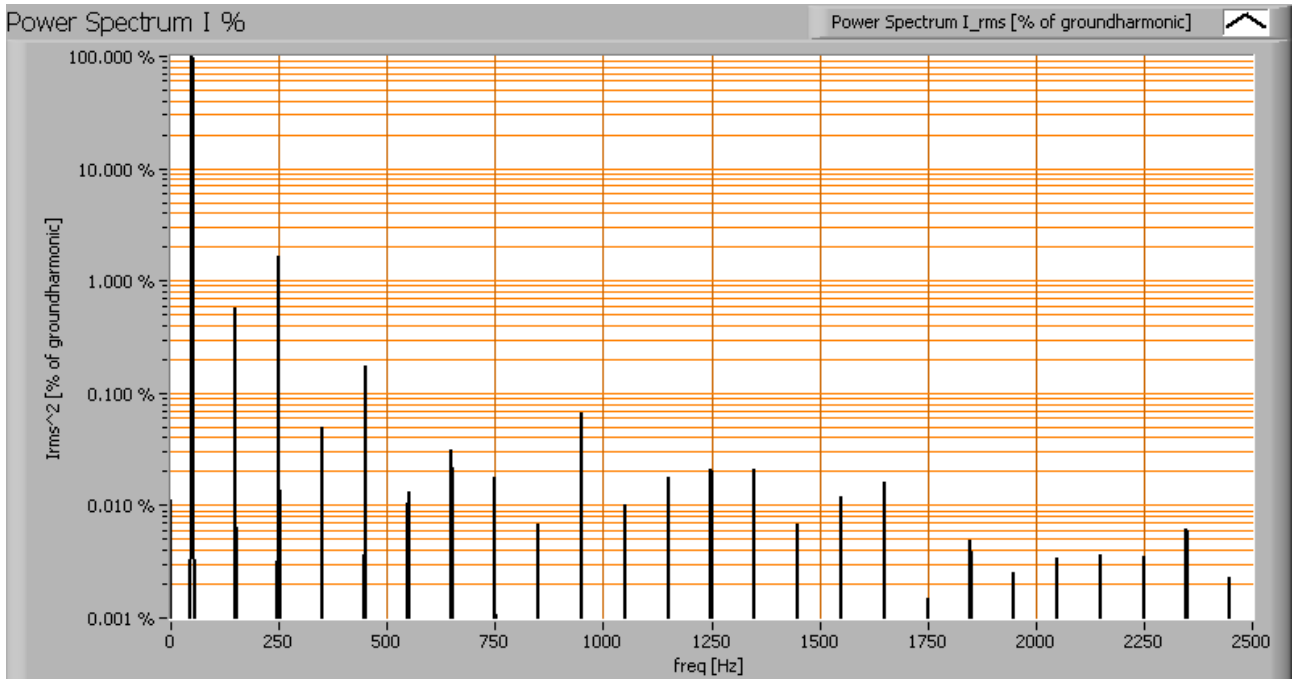


Voltage across and current through the lightbulb

The current does not look quite well like a sine. The current phase is lagging a little bit the voltage. The result is a nice powerfactor of almost 0.9.

Also the power spectrum of the current is determined.

Lamp measurement report – 1 Dec 2009

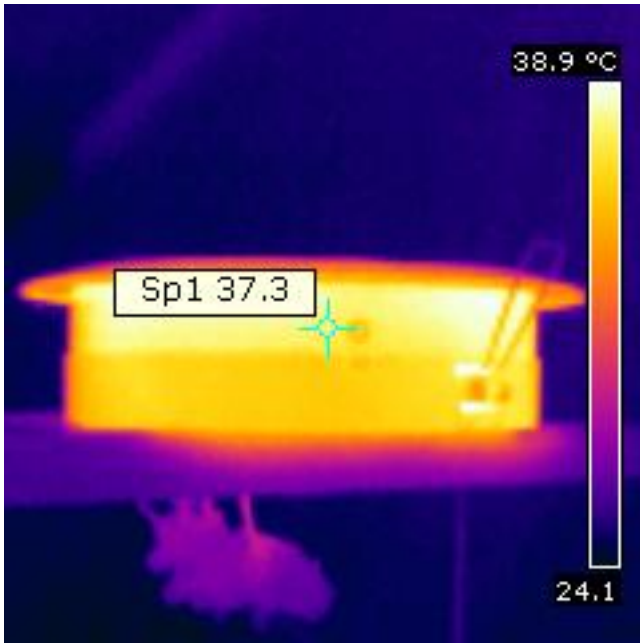


Current power spectrum in % of the first harmonic (50 Hz).

Due to the minor deviations from a sine, there are a few higher harmonics in the signal. The Total Harmonic Distortion (THD) is computed and is 18 %.

Lamp measurement report – 1 Dec 2009

Temperature measurements lamp



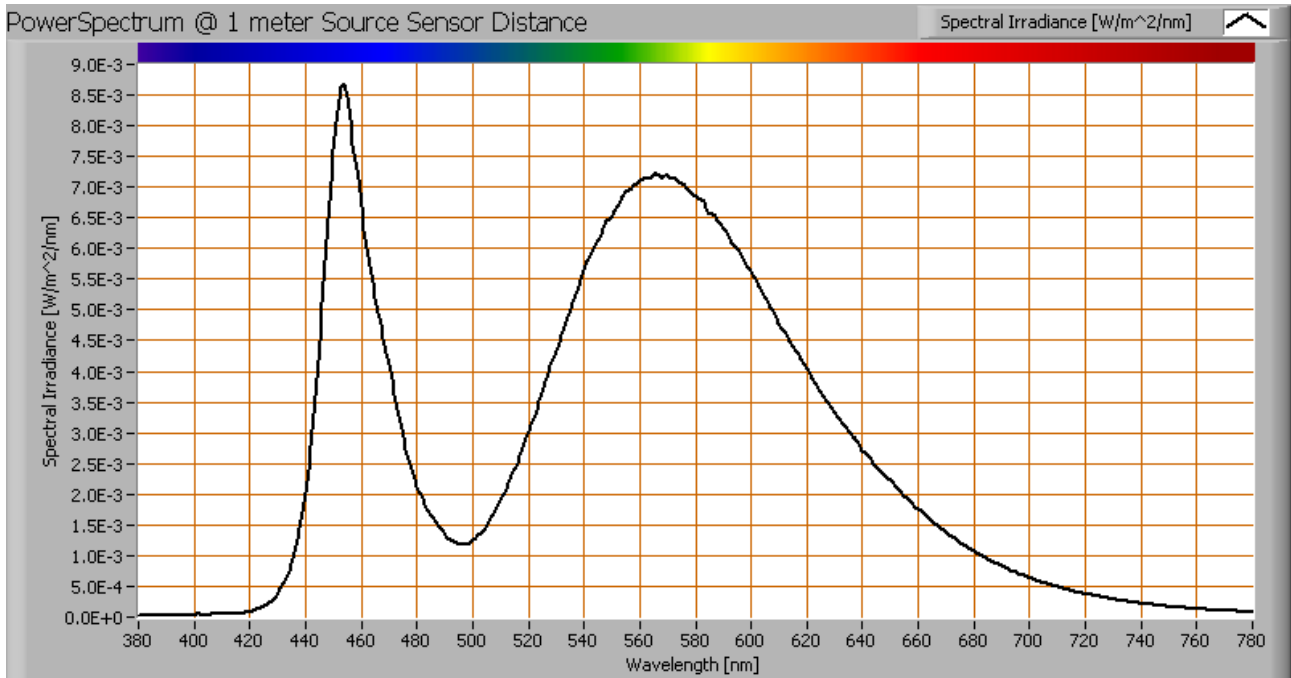
Temperature image after warm up period

status lamp	> 2 hours on
ambient temperature	22.1 deg C
reflected background temperature	22.1 deg C
camera	Flir B-CAM Western S
emissivity	0.95 ⁽¹⁾
measurement distance	0.4 m
IFOV _{geometric}	1.5 mm
NETD (thermal sensitivity)	100 mK

⁽¹⁾ The emissivity is set such that the temperature reading of the point indicated in the image corresponds to a contact measurement temperature reading.
The heat sink gets warm-to-the-touch but not more.

Lamp measurement report – 1 Dec 2009

Color temperature and Spectral power distribution

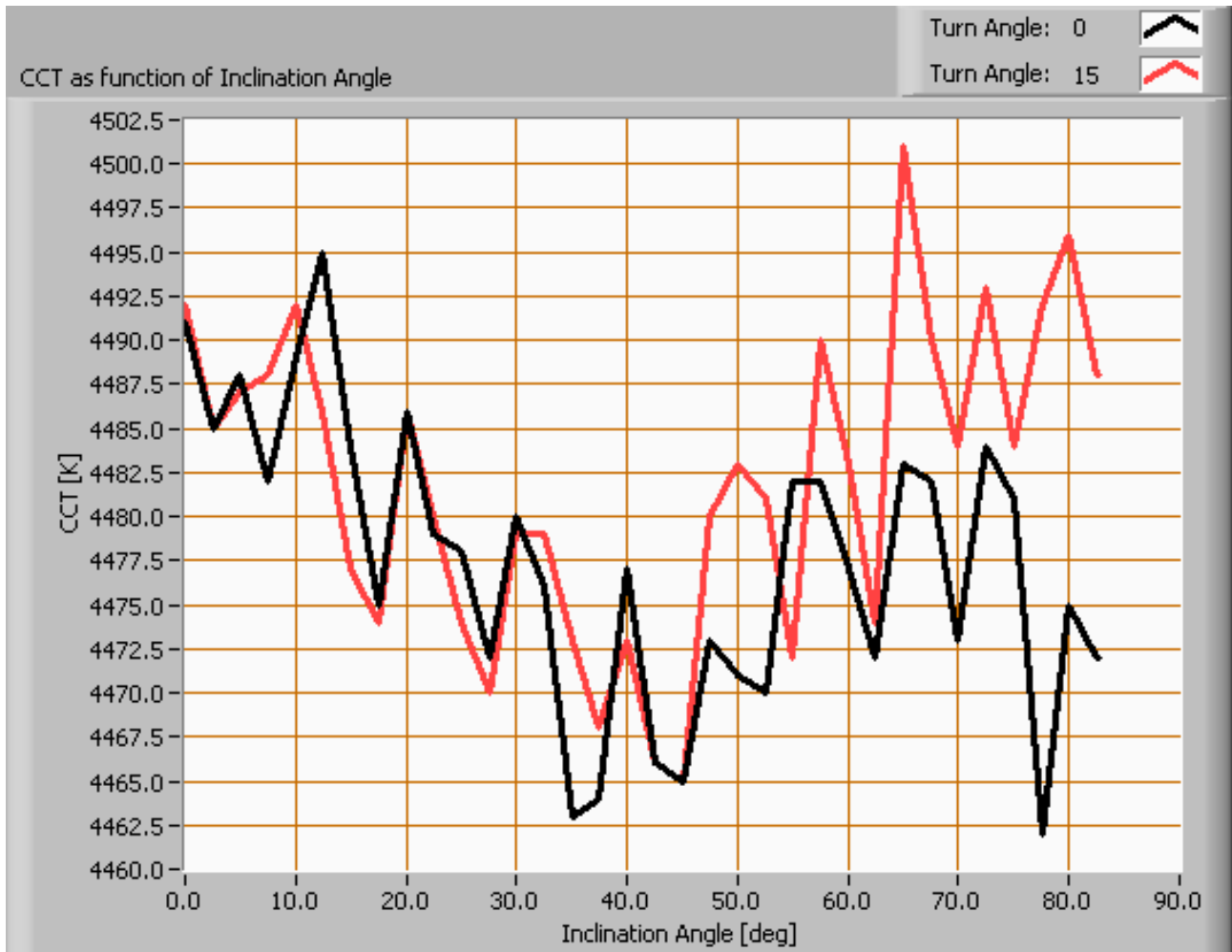


The spectral power distribution of this light bulb, energies on y-axis valid at 1 m distance.

The measured color temperature is about 4475 K which is neutral white.

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

Lamp measurement report – 1 Dec 2009



Color temperature as a function of inclination angle.

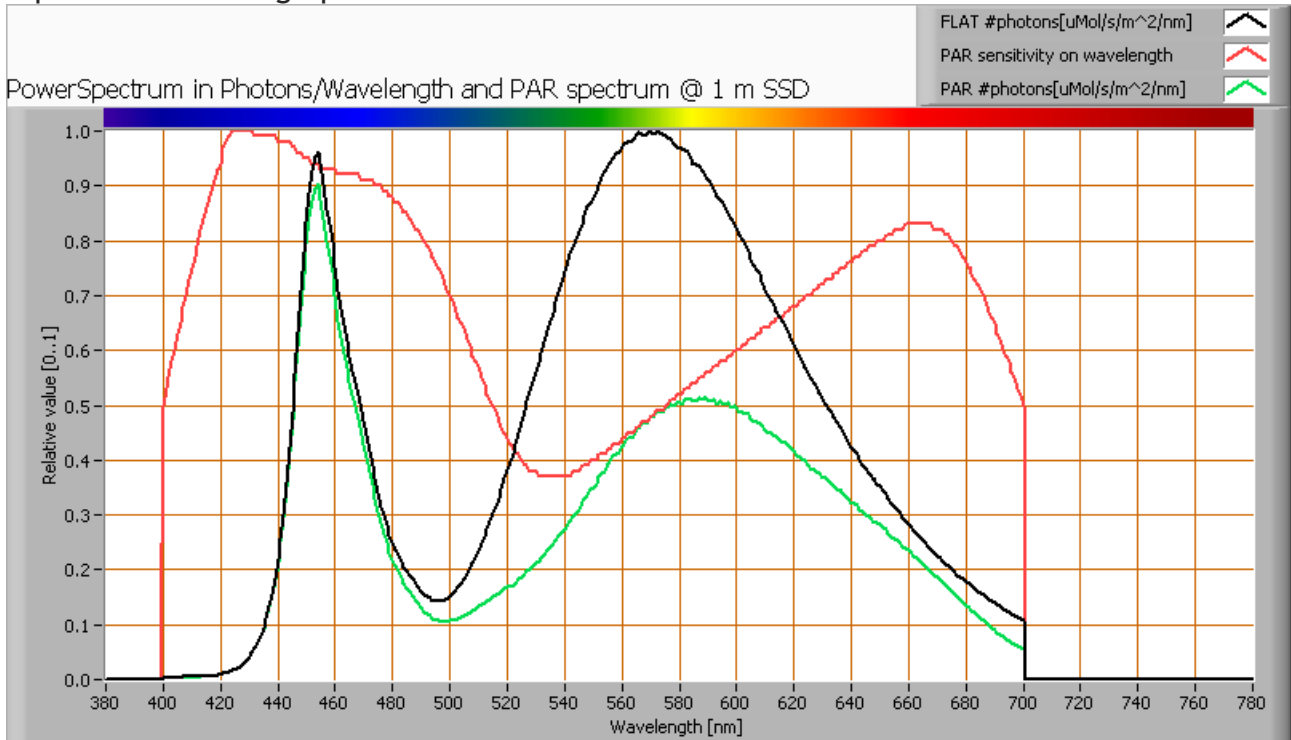
The measurement of CCT has been stopped when the inclination angle was 82.5 as the illuminance value was decreased to very low values there (< 5 lux).

The beam angle is 81°, meaning an inclination angle of max 40.5°. Almost all light falls within this angle. The variation of the color temperature within this angle is about 1 %.

Lamp measurement report – 1 Dec 2009

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

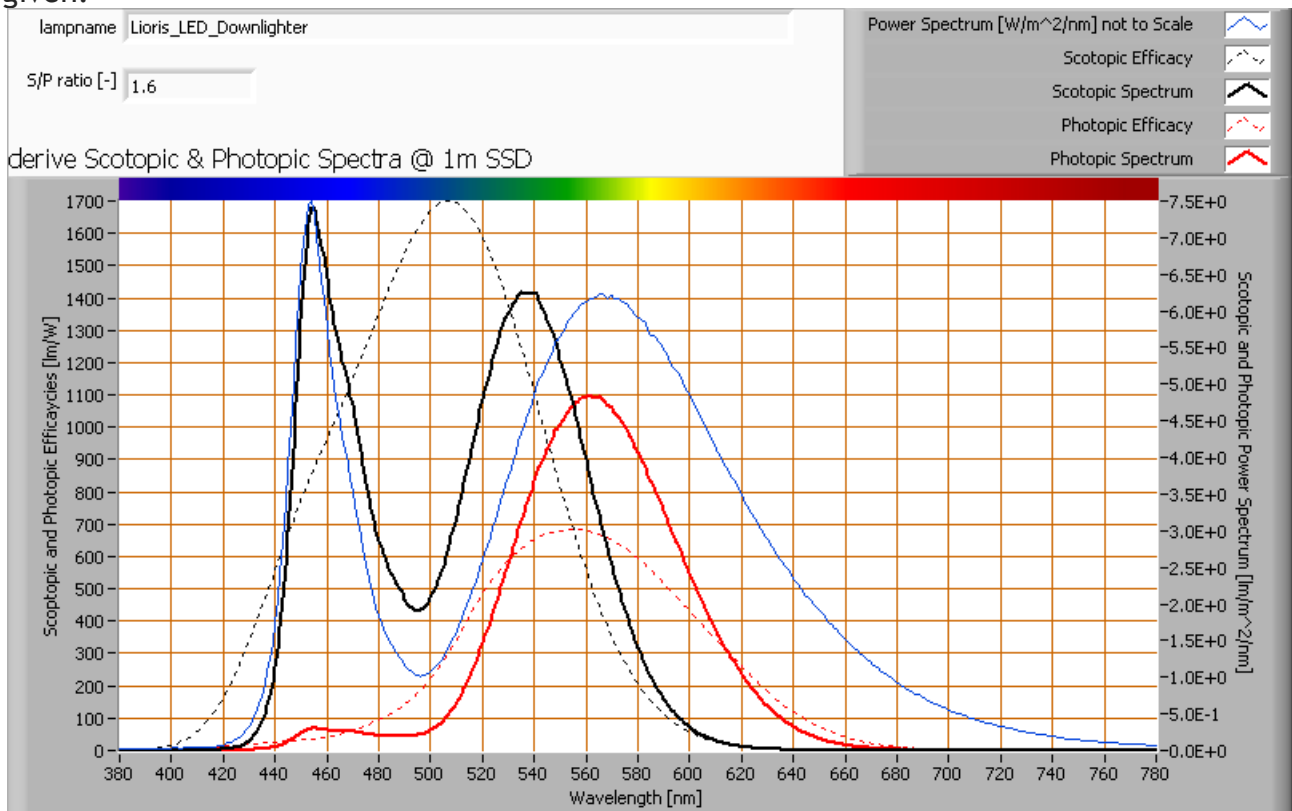
The PAR number for this light results in $3.0 \mu\text{Mol/s/m}^2$. This value is valid at 1 m distance from the light bulb and valid roughly inside its beam angle.

The PAR efficiency is 63 % (valid for the PAR wave length range of 400 - 725 nm). So maximally 63 % 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 %).

Lamp measurement report – 1 Dec 2009

S/P ratio

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



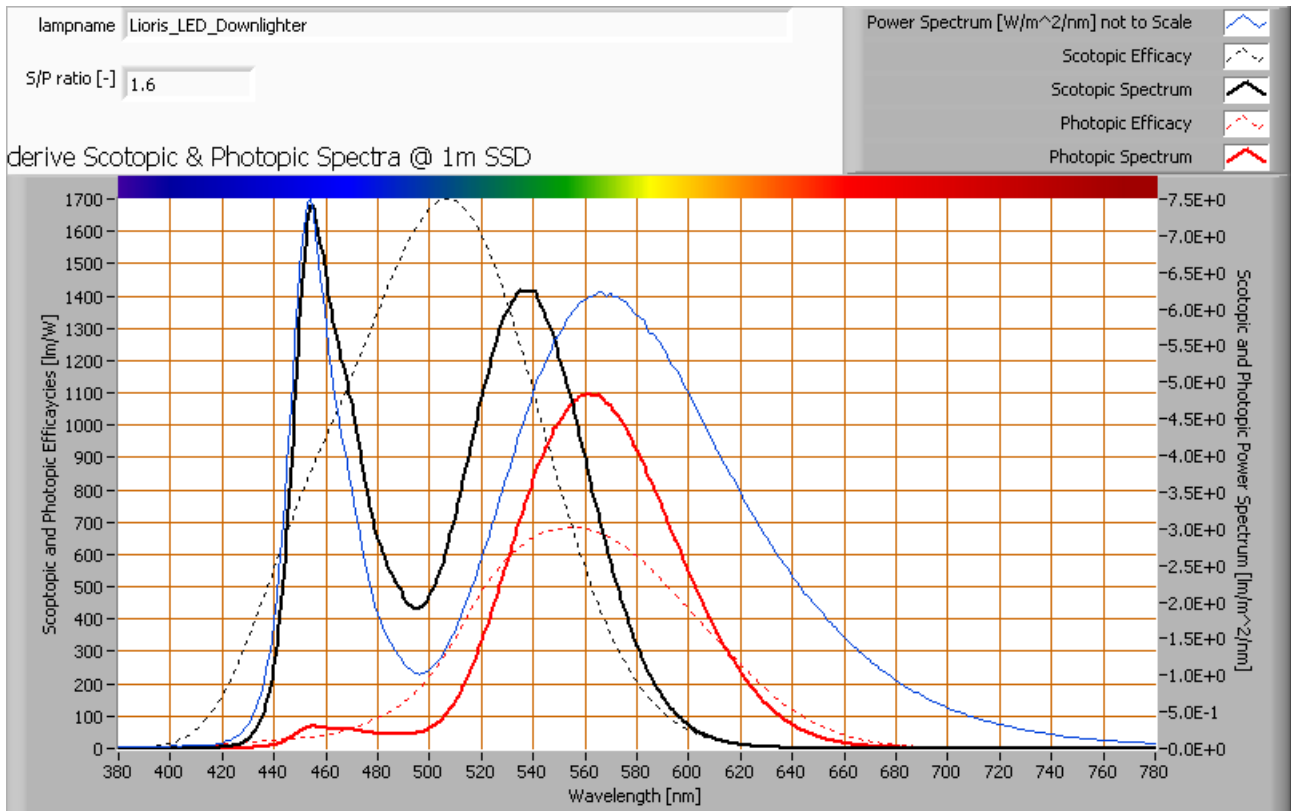
The power spectrum, sensitivity curves and resulting scotopic and photopic spectra (spectra energy content defined at 1 m distance).

The S/P ratio is 1.6.

More info will come in a separate article.

Lamp measurement report – 1 Dec 2009

Chromaticity diagram



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

The light coming from this lamp is at a distance from the Planckian Locus (the black path in the graph).

Its coordinates are $x=0.3640$ and $y=0.3760$.

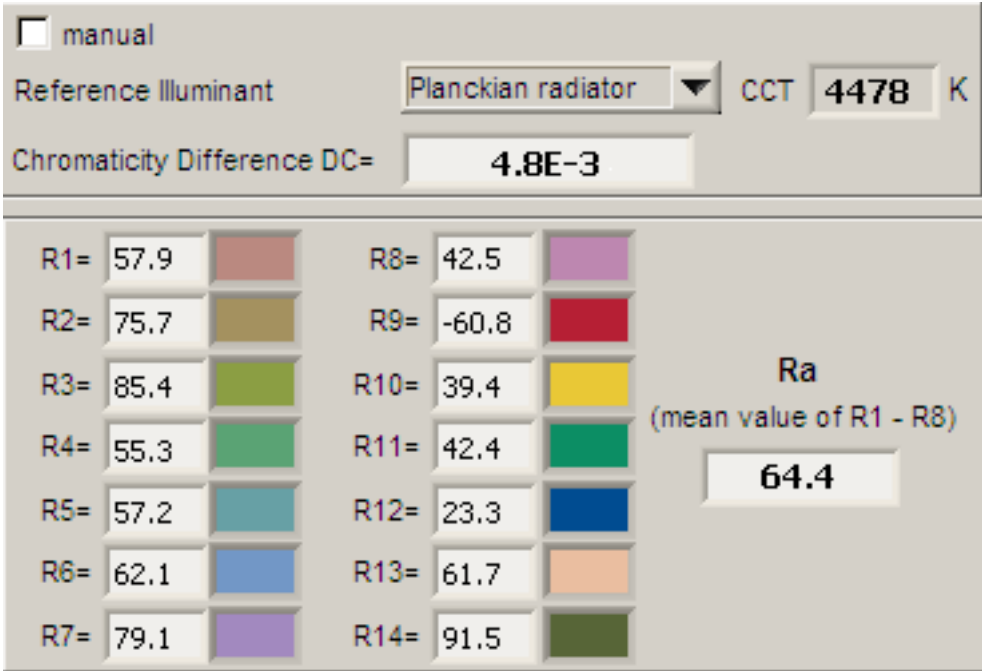
Color Rendering Index (CRI) or also Ra

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).

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



Lamp measurement report – 1 Dec 2009



CRI of the light of this lightbulb.

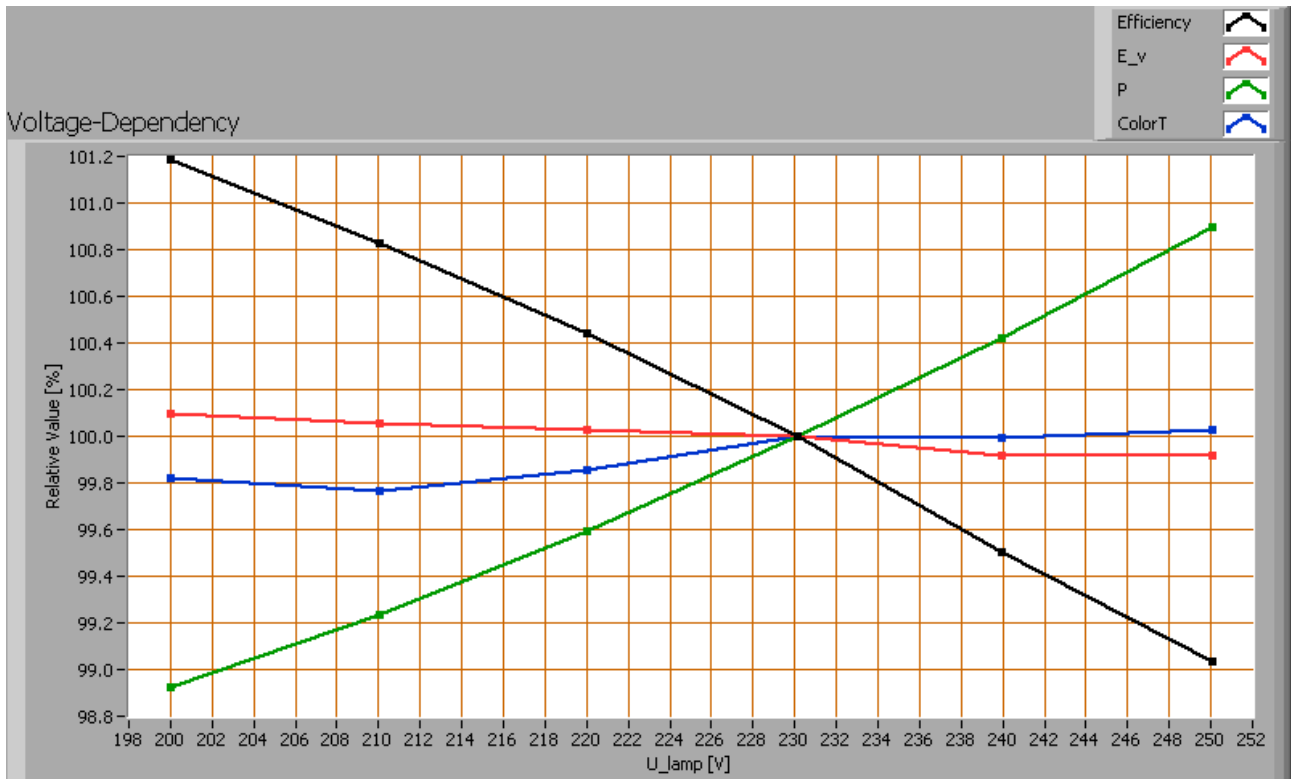
The value of 64 is smaller than 80 which is considered a minimum value for indoor usage.

Note: the chromaticity difference is 0.0048 indicates the distance to the Planckian Locus. Its value is lower than 0.0054, which means that the calculated CRI result is meaningful.

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 lamp power P [W], the (Correlated) Color Temperature [K] and the luminous efficacy [Lm/W].

Lamp measurement report – 1 Dec 2009



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

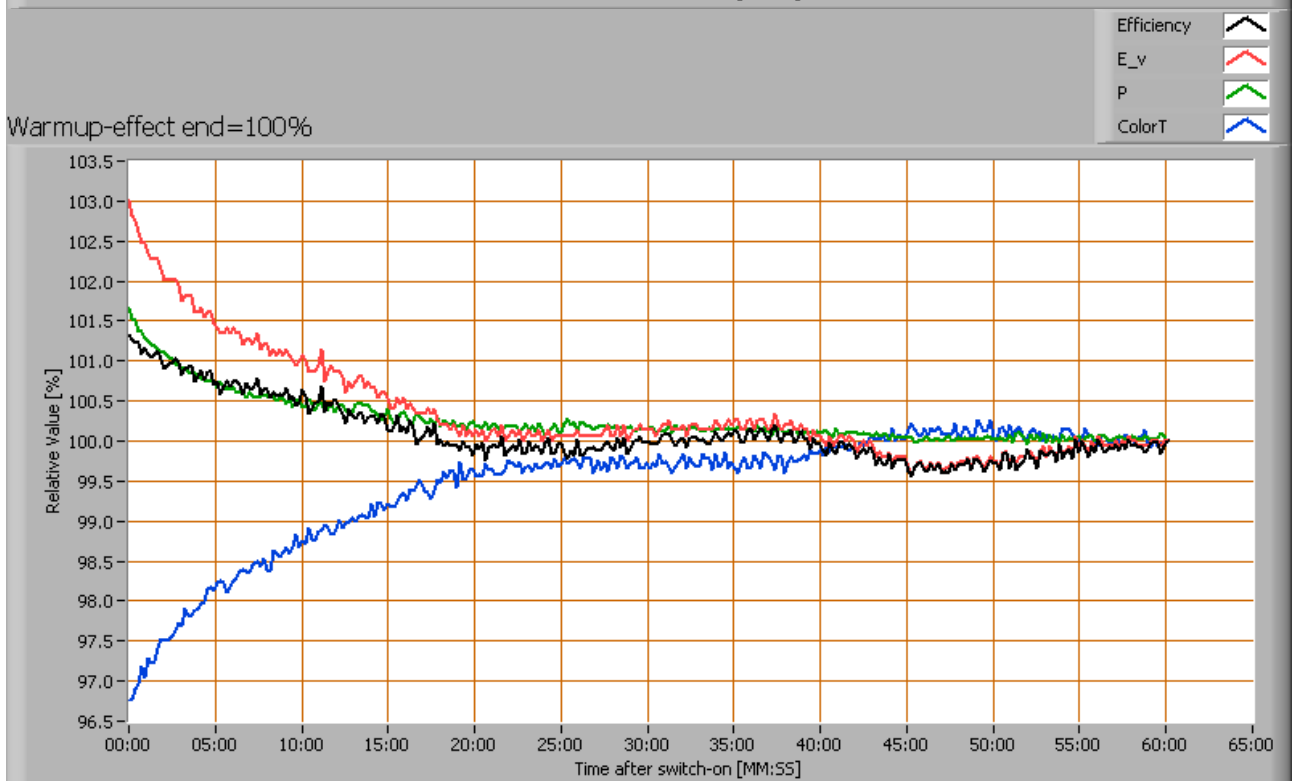
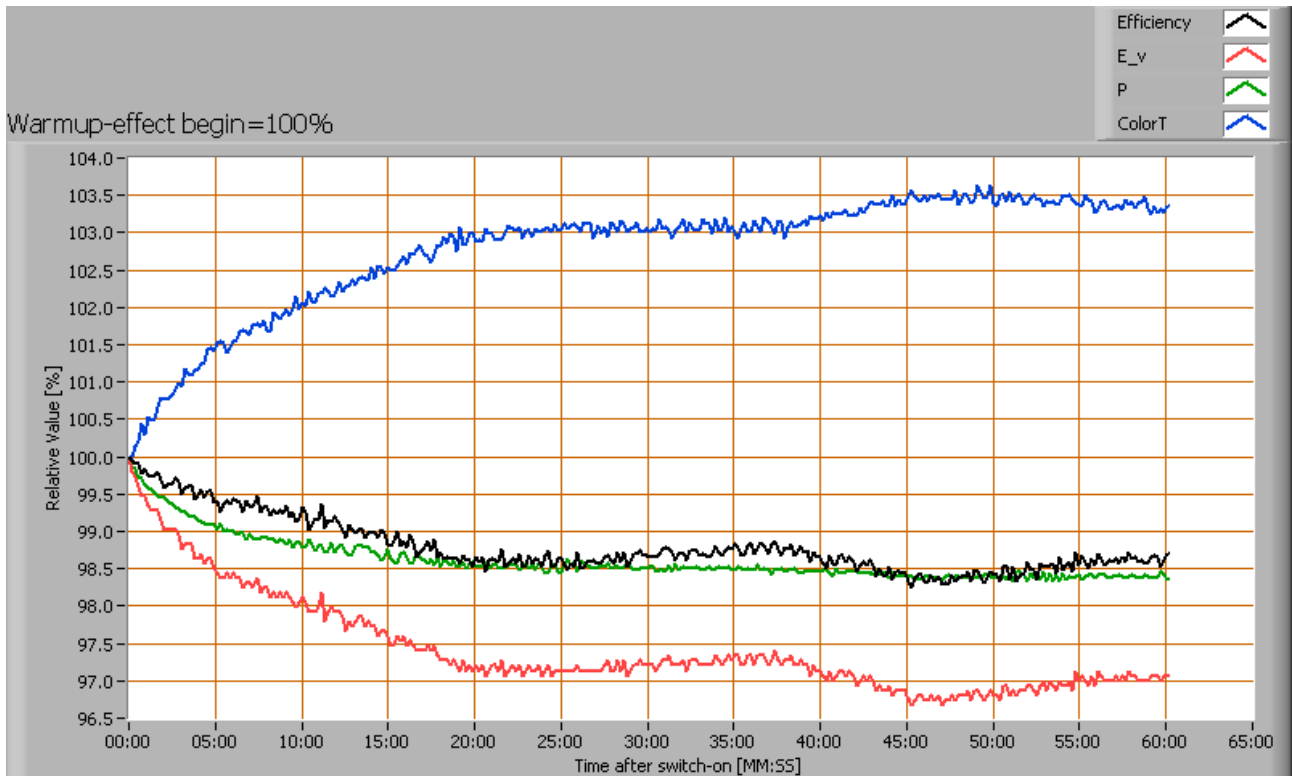
The illuminance and consumed power do not vary significantly when the voltage is varied.

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], color temperature CT or correlated color temperature CCT [K], the lamp power P [W] and the luminous efficacy [lm/W].

Lamp measurement report – 1 Dec 2009



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



Lamp measurement report – 1 Dec 2009

The warm up time is about 20 minutes. During that time the illuminance nor the consumed power vary significantly.

Disclaimer

The information in this OLiNo report is created with the utmost care. Despite of this the information can have inaccuracies. OLiNo cannot be held liable for the content of the information in this report nor for the consequences of its use. The data in this report is not legally binding.