



Lamp measurement report – 29 Dec 2009

Led Panel Cold White

by

Saproco



Lamp measurement report – 29 Dec 2009

Summary measurement data

parameter	meas. result	remark
Color temperature	5444 K	cold white
Luminous intensity I_v	482 Cd	Measured straight underneath the lamp
Beam angle	82 deg	This lamp has symmetry over the C0-C180 and C90-C270 axis. For both these C-planes this angle is measured.
Power P	13.1 W	
Power Factor	0.93	For every 1 kWh net power consumed, there has been 0.4 kVAh for reactive power.
Luminous flux	937 Lm	
Luminous efficacy	72 Lm/W	
CRI_Ra	71	Color Rendering Index.
Coordinates chromaticity diagram	x=0.3343 and y=0.3568	
Fitting	230V	This panel is connected directly to the mains voltage.
PAR-value	4.1 $\mu\text{Mol/s/m}^2$	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	1.8	This factor indicates the amount of times more efficient the light of this light bulb is perceived under scotopic circumstances (ow environmental light level).
L x W x H external dimensions	617 x 145 x 28 mm	External dimensions of the lamp.
L x W luminous area	460 x 115 mm	Dimensions of the luminous area (used in Eulumdat file). This is equal to the surface of the plate that emits the reflected light of the leds shining sideways in it.




Lamp measurement report – 29 Dec 2009

General remarks		<p>The ambient temperature during the whole set of measurements was 23-25.5 deg C. The maximum temperature of the tube light gets about 10 degrees hotter than ambient.</p> <p>Warm up effect: during the warm up time the illuminance nor consumed power vary 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 – 29 Dec 2009

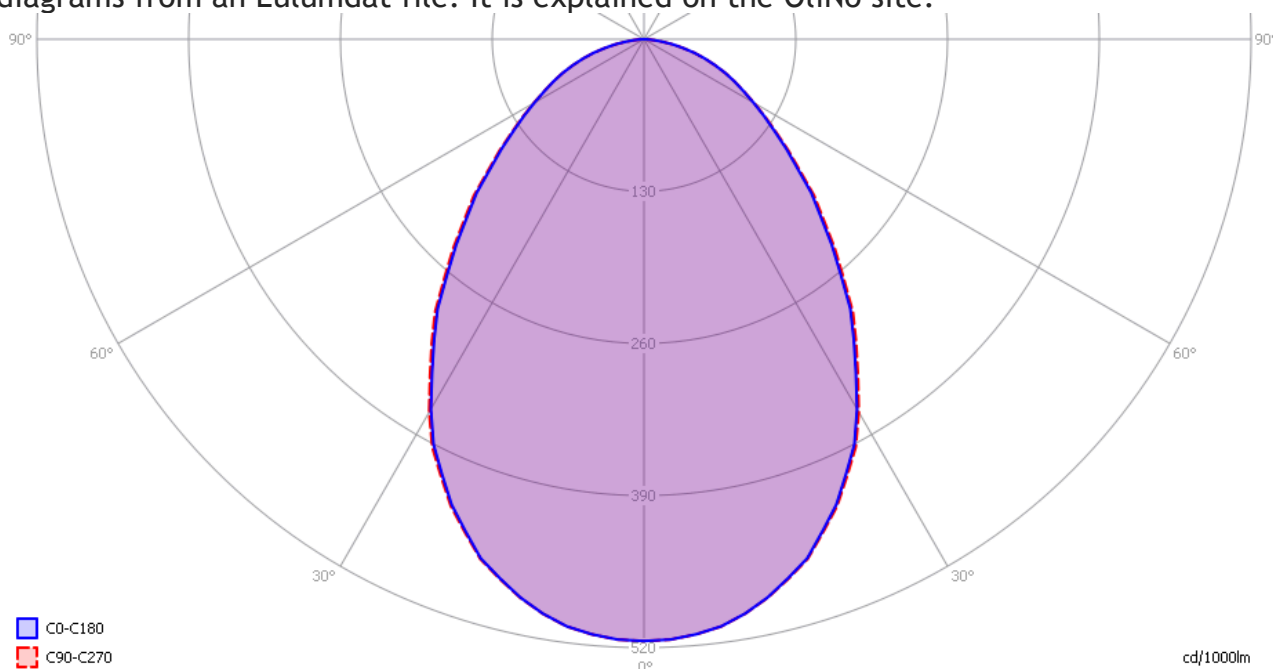
Overview table

m.	Ø 50%		CO-180: 81° C90-270: 82°	E (lux)	Luminaire Efficacy
	CO-180	C90-270			72 (lumens per Watt)
0.25	0.43	0.43		7708	Half-peak diam CO-180
0.5	0.85	0.87		1927	1.71 x diameter(m)
1	1.71	1.73		482	Half-peak diam C90-270
1.5	2.56	2.6		214	1.73 x diameter(m)
3	5.13	5.2		54	Illuminance
4	6.83	6.93		30	482 / distance ² (lux)
5	8.54	8.66		19	Total Output
					937 (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 460 mm = 2300 mm. 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.

Eulumat light diagram

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



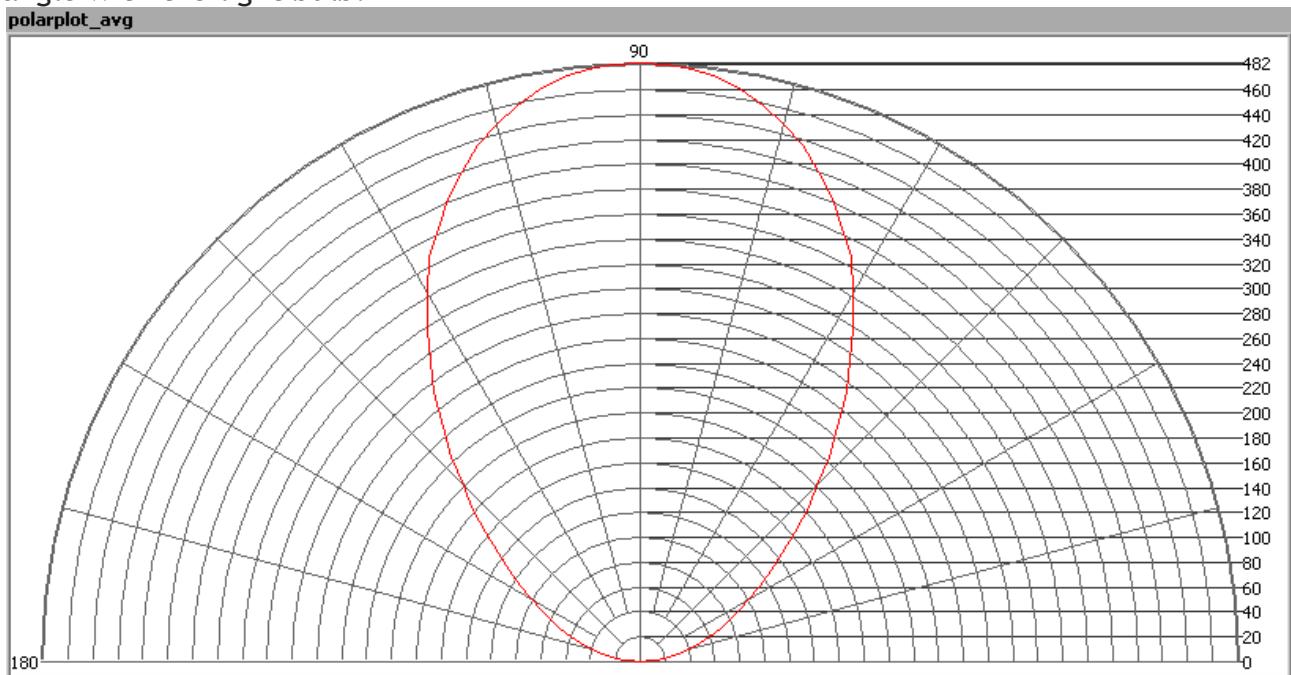
Lamp measurement report – 29 Dec 2009

The light diagram giving the radiation pattern.

It indicates the luminous intensity around the light bulb. In the length direction (C90-C270) the beam angle is the same as in the direction crossing the length direction (C0-C180).

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.

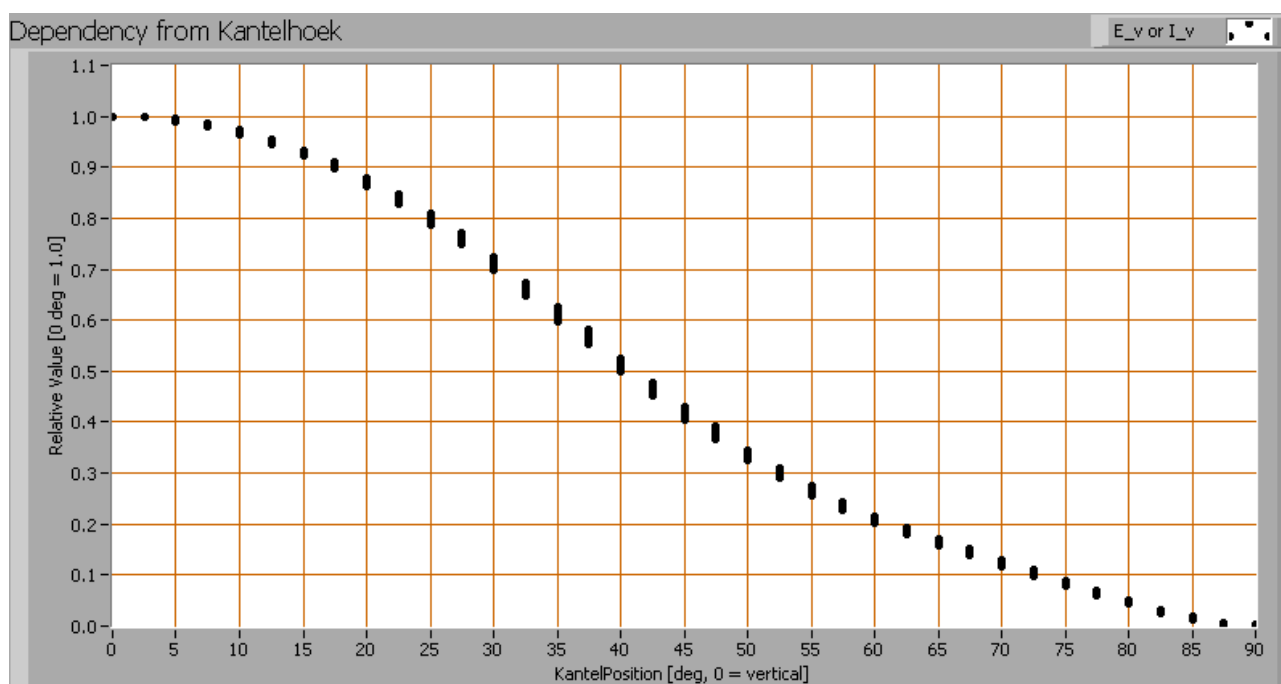


The radiation pattern of the light bulb.

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 – 29 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 82° for both C0-C180 and C90-C270 planes.

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 937 Lm.

Luminous efficacy

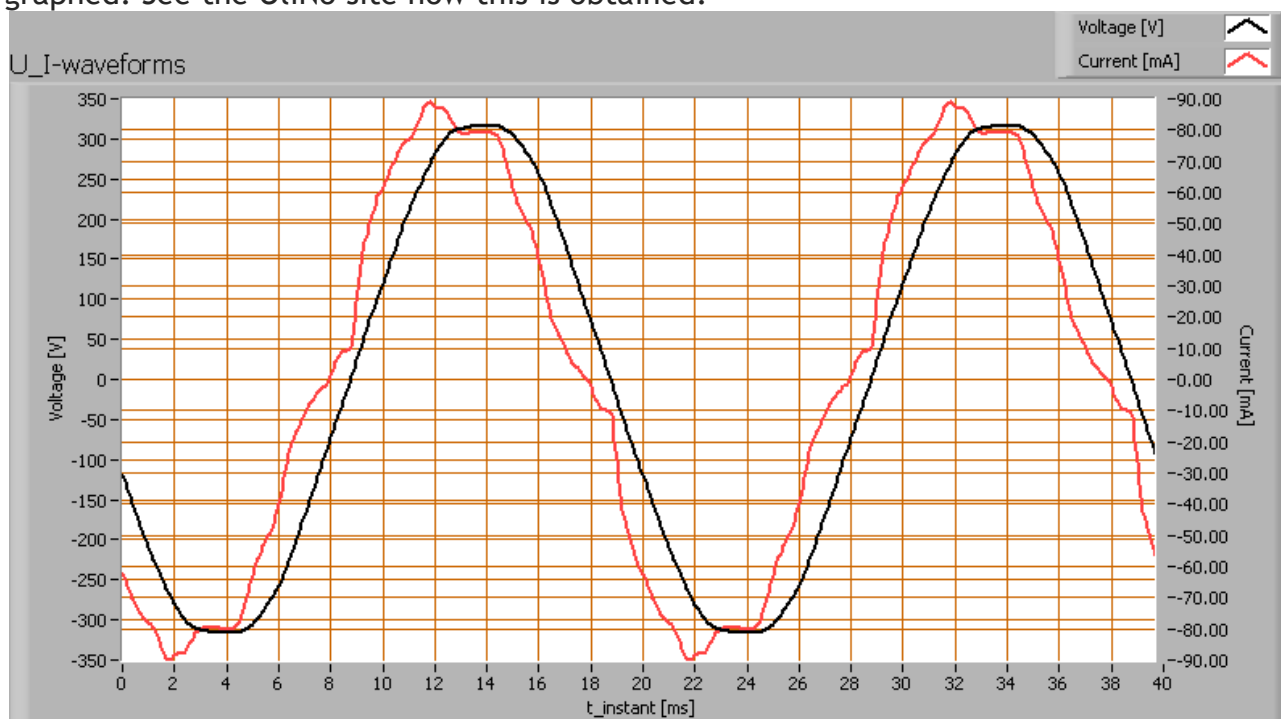
The luminous flux being 937 Lm, and the power of the light bulb being 13.1 W, yields a luminous efficacy of 72 Lm/W.

A power factor of 0.93 means that for every 1 kWh net power consumed, a reactive component of 0.4 kVAr was needed.

Lamp measurement report – 29 Dec 2009

Light bulb voltage (used on power supply!)	230 VAC
Light bulb current	61 mA
Power P	13.1 W
Apparent power S	14.1 VA
Power factor	0.93

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.

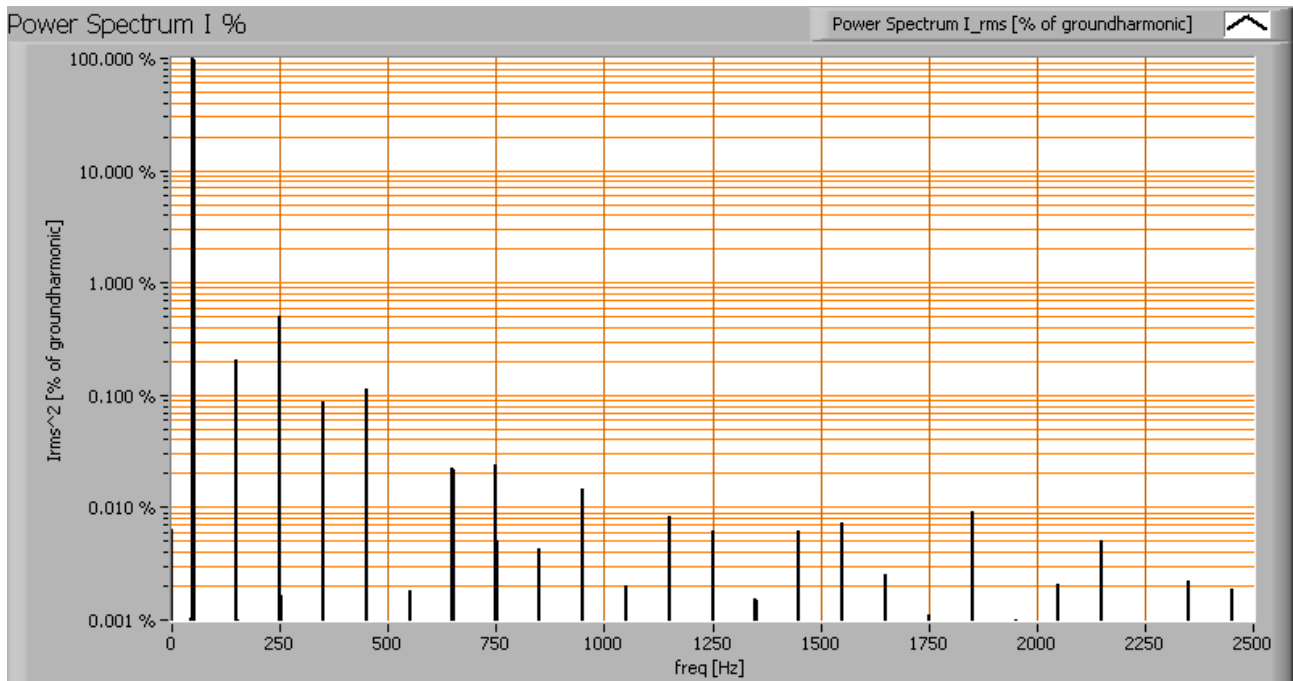


Voltage across and current through the lightbulb

The current form does look much like a sine. The current phase is a bit leading the voltage's. The powerfactor is very good with a value near 0.95.

Also the power spectrum of the current is determined.

Lamp measurement report – 29 Dec 2009



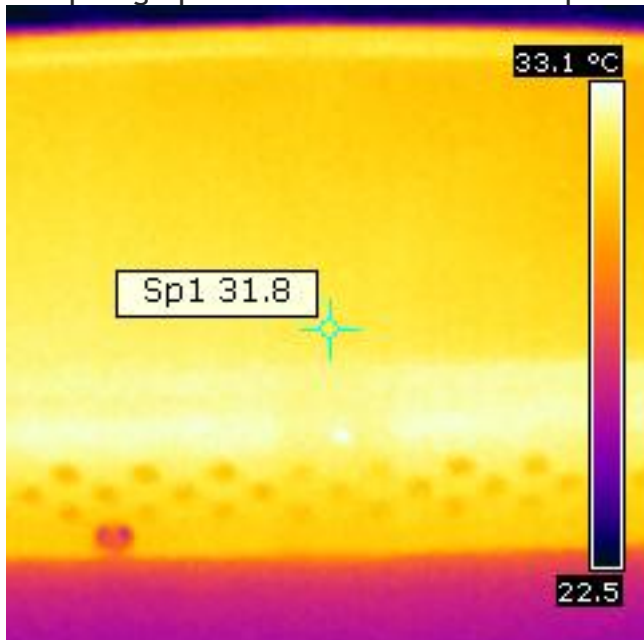
Squared amplitudes of higher harmonics related to the first harmonic (50 Hz).

Due to some few steep edges in the current there are a few small higher harmonics.
The Total Harmonic Distortion of the current is 11 %.

Lamp measurement report – 29 Dec 2009

Temperature measurements lamp

This paragraph is the same as with the panel emitting neutral white light.



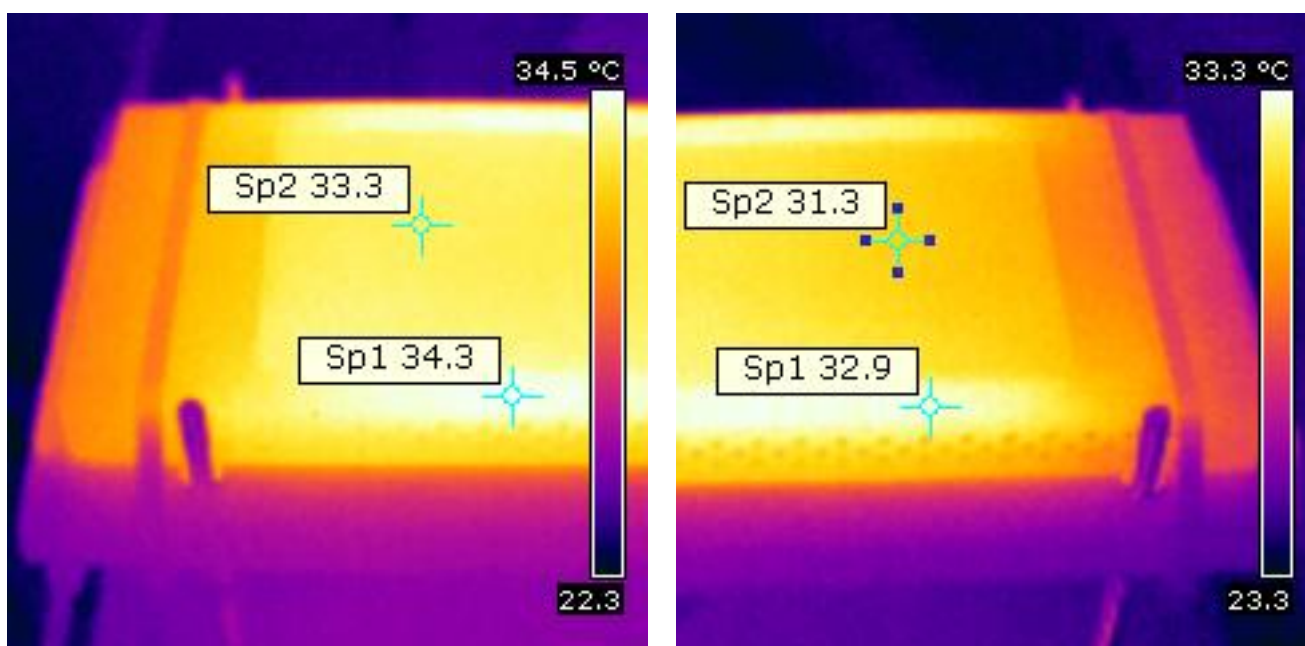
Temperature image after warm up period

status lamp	> 2 hours on
ambient temperature	23 deg C
reflected background temperature	23 deg C
camera	Flir B-CAM Western S
emissivity	0.95 ⁽¹⁾
measurement distance	0.20 m
IFOV _{geometric}	0.7 mm
NETD (thermal sensitivity)	100 mK

⁽¹⁾ The emissivity of the masking tape is used which is about 0.95.

The measured temperatures are low.

Lamp measurement report – 29 Dec 2009



Temperature images of the ends of the panel

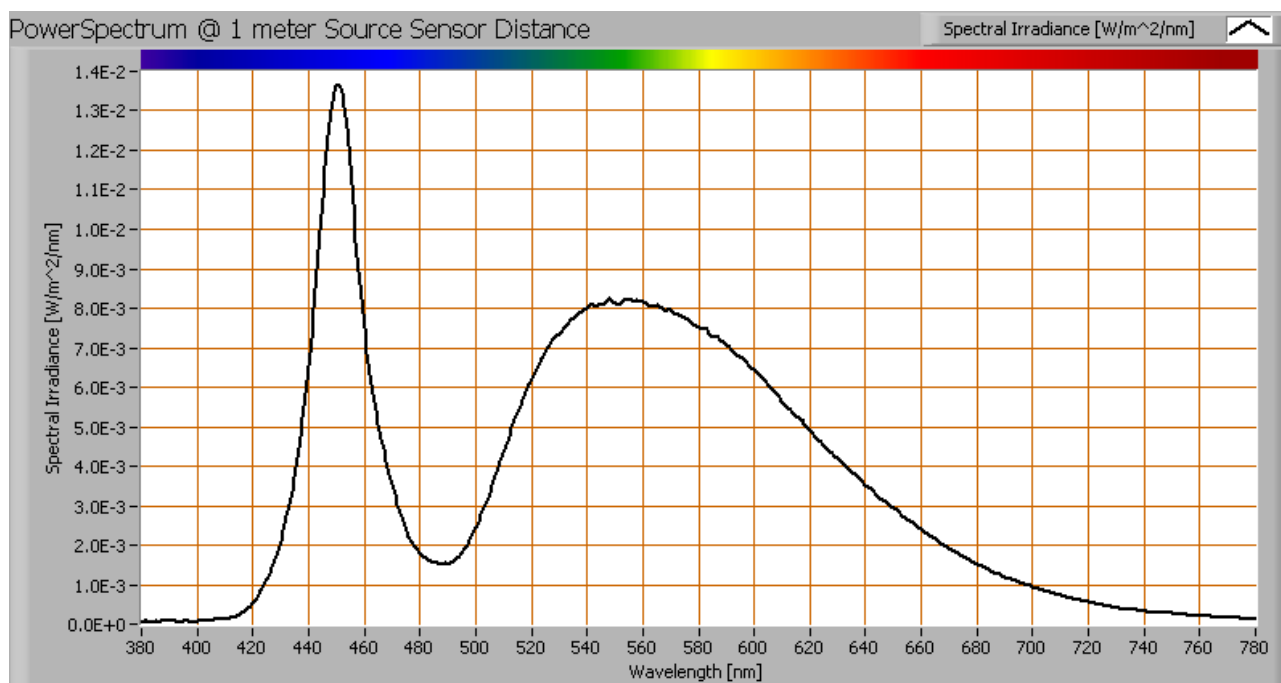
status lamp	> 2 hours on
ambient temperature	23 deg C
reflected background temperature	23 deg C
camera	Flir B-CAM Western S
emissivity	0.95 ⁽¹⁾
measurement distance	0.50 m
IFOV _{geometric}	1.9 mm
NETD (thermal sensitivity)	100 mK

⁽¹⁾ The emissivity of the masking tape is used which is about 0.95. The paint used on the panel has generally the same emissivity, as the tape itself is not visible.

The images show the panel in mounted position for measuring. One end gets slightly hotter than the other side, maybe indicating that there is the power supply behind. However the measured temperatures are low.

Lamp measurement report – 29 Dec 2009

Color temperature and Spectral power distribution

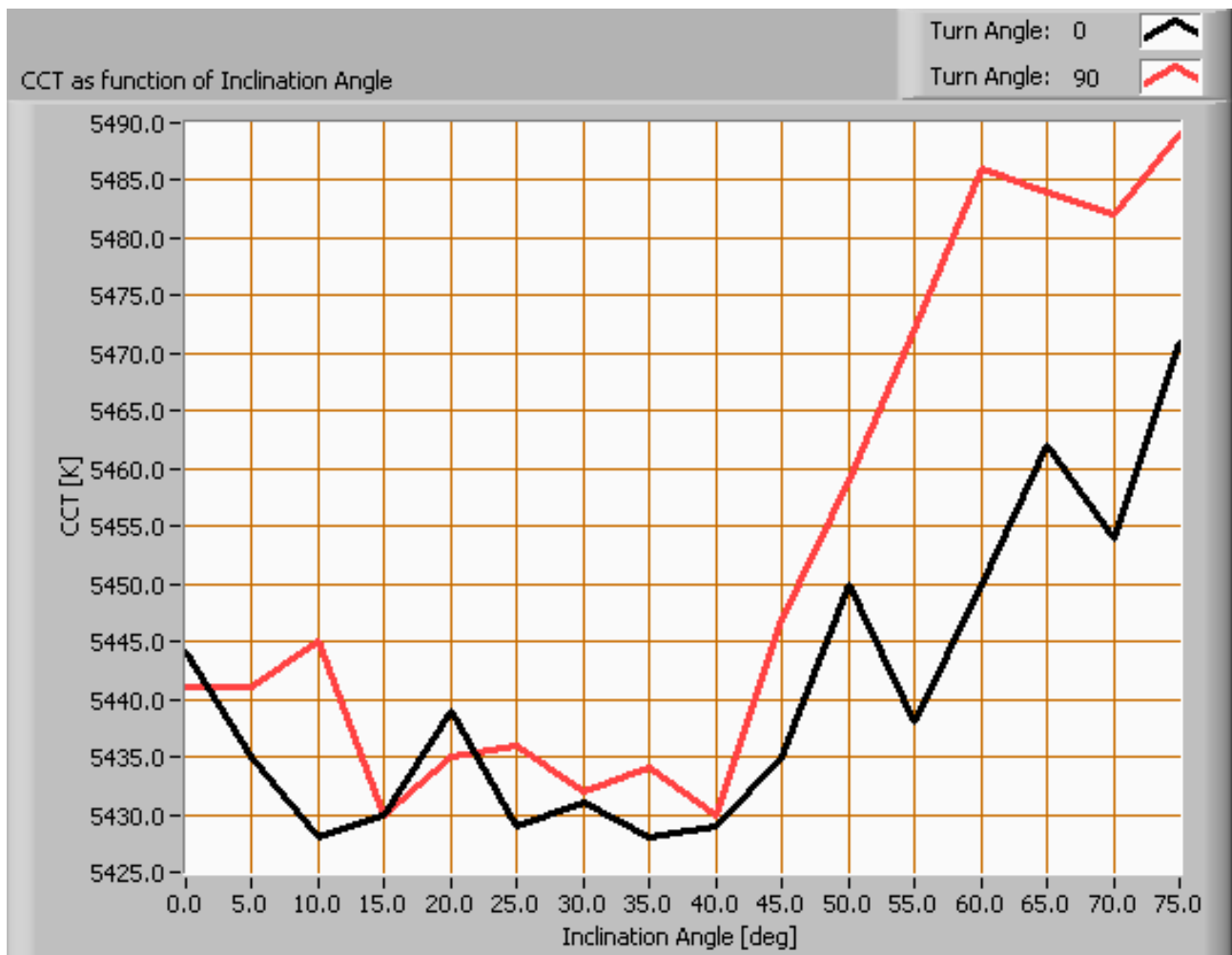


The spectral power distribution of this light bulb, energies on y-axis valid at 1 m distance.

The measured color temperature is about 5450 K which is cold 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 – 29 Dec 2009



Color temperature as a function of inclination angle.

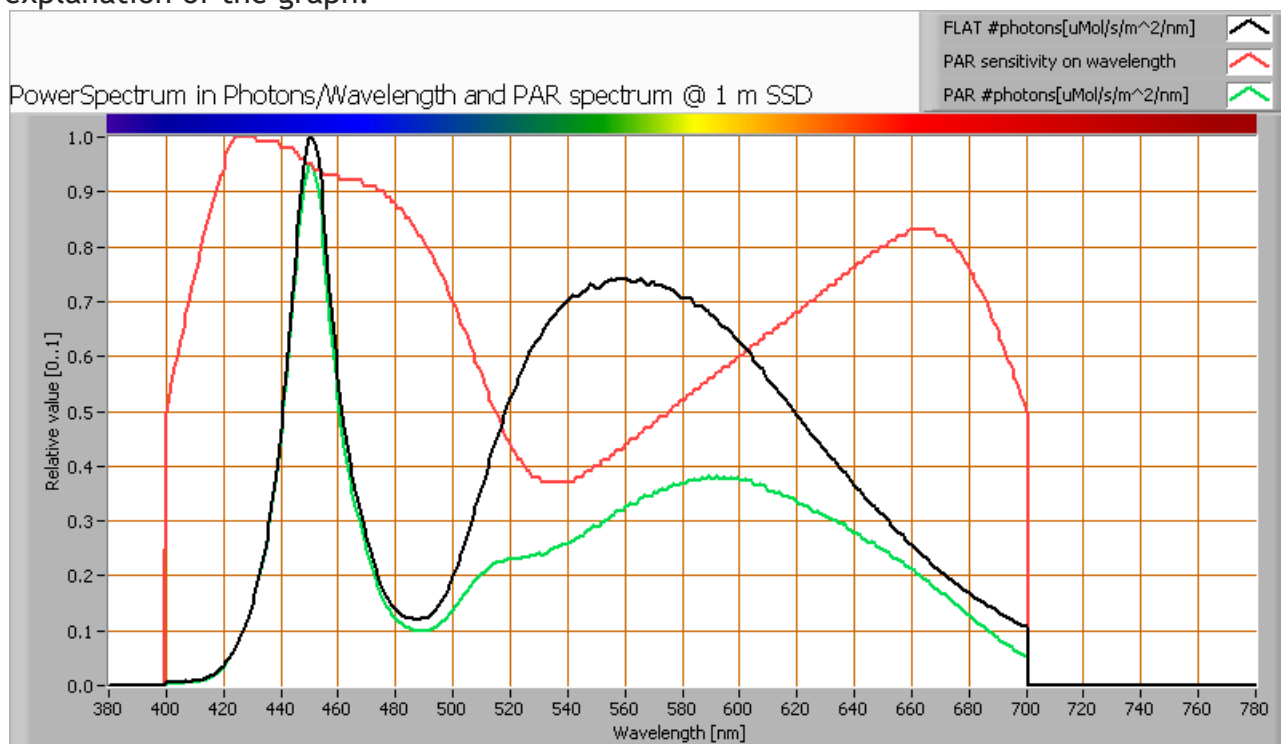
The measurement of CCT is measured for inclination angles up to 75° since then the illuminance value was decreased to very low values (< 5 lux).

The beam angle is maximally 82°, meaning a 41° inclination angle. In this area the majority of the light is present. The variation in correlated color temperature in this area is about 1 %.

Lamp measurement report – 29 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

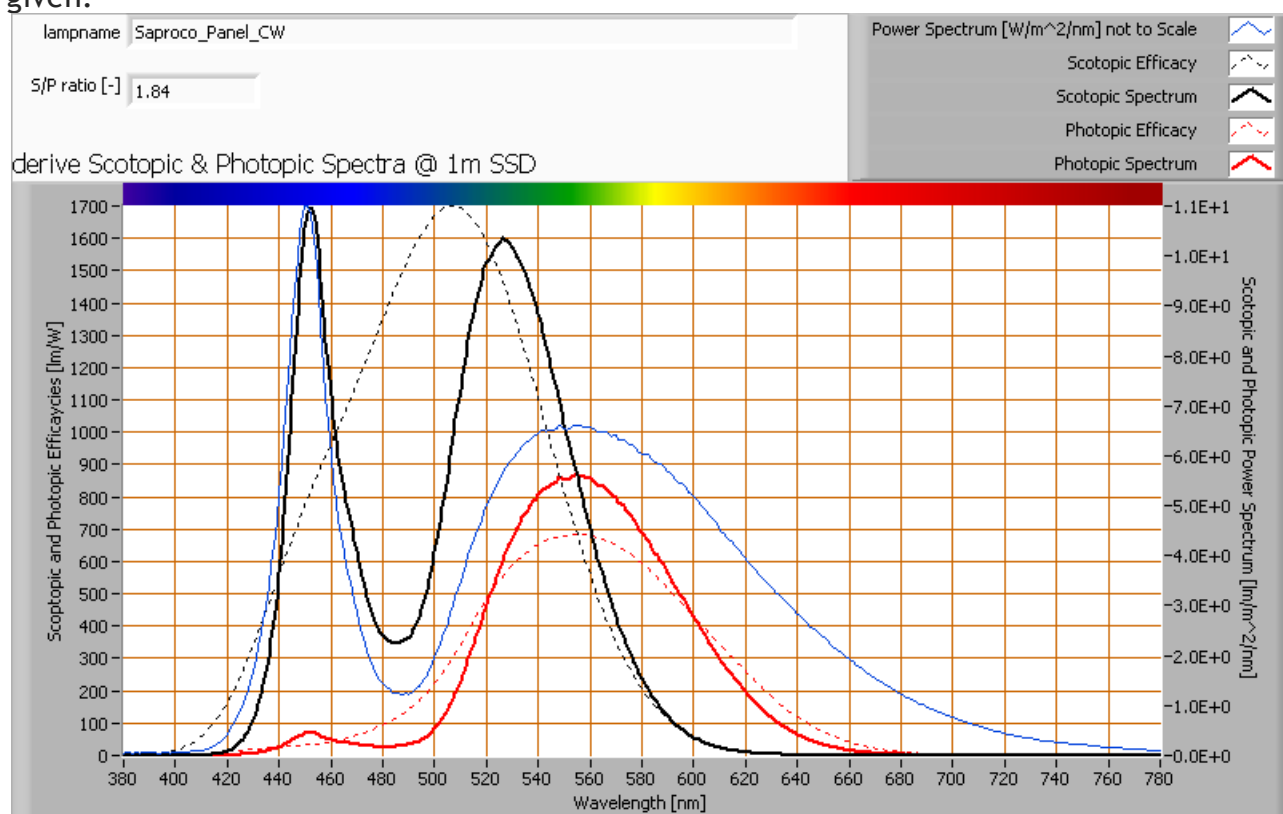
parameter	value	unit
PAR-number	4.1	$\mu\text{Mol/s/m}^2$

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 %).

Lamp measurement report – 29 Dec 2009

S/P ratio

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



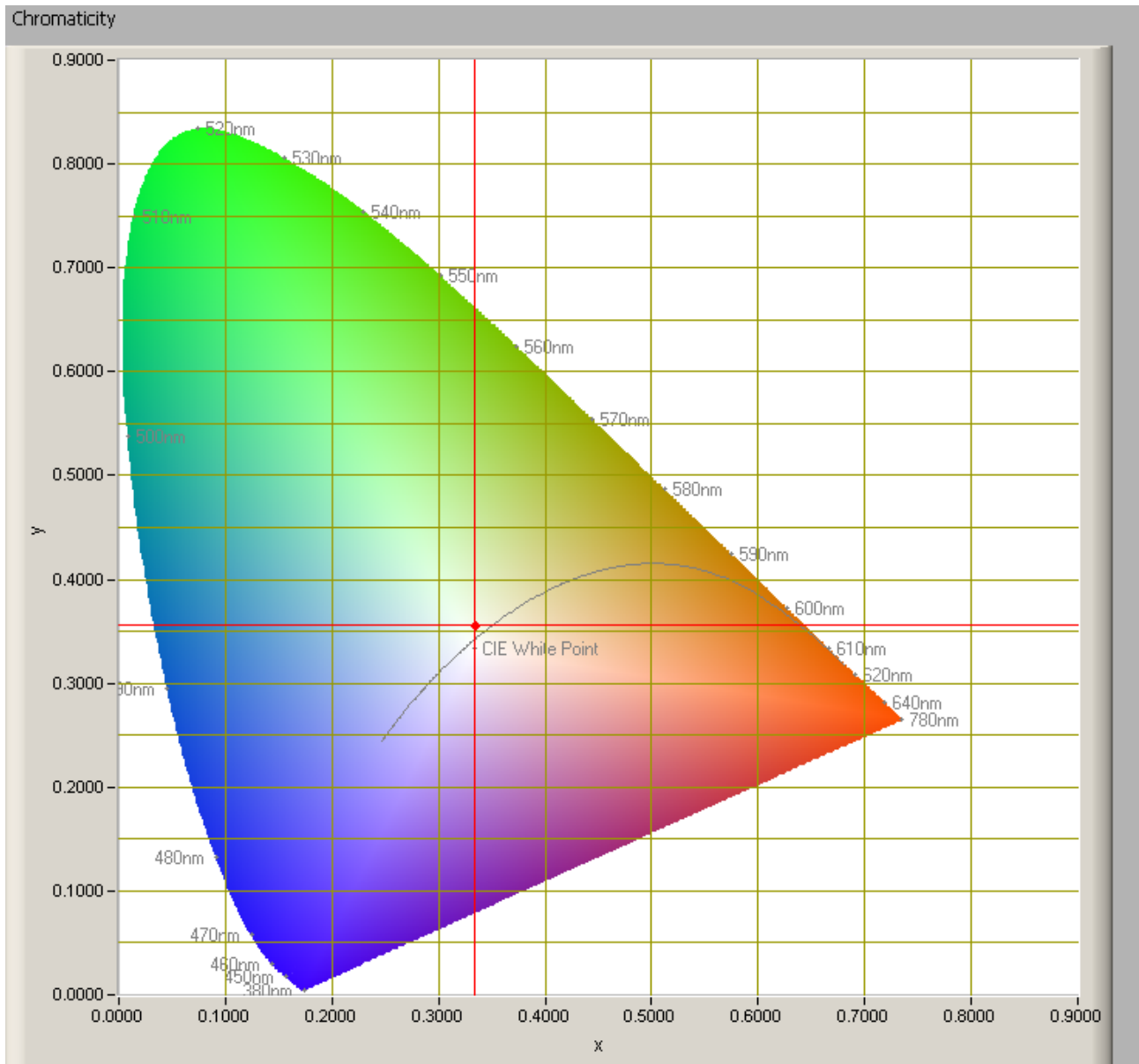
The power spectrum, sensitivity curves and resulting scotopic and photopic spectra (spectra energy content defined at 1 m distance).

The S/P ratio is 1.8

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

Lamp measurement report – 29 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 close to the Planckian Locus (the black path in the graph).

Its coordinates are $x=0.3343$ and $y=0.3568$.

Lamp measurement report – 29 Dec 2009

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.

☐ manual

Reference Illuminant Planckian radiator CCT 5444 K

Chromaticity Difference DC= 4.0E-3

R1= 67		R8= 57.4	
R2= 75		R9= -32.2	
R3= 79.4		R10= 39.4	
R4= 70.7		R11= 65.4	
R5= 67.8		R12= 35	
R6= 65.3		R13= 68	
R7= 82.2		R14= 88.3	

Ra
 (mean value of R1 - R8)
70.6

CRI of the light of this lightbulb.

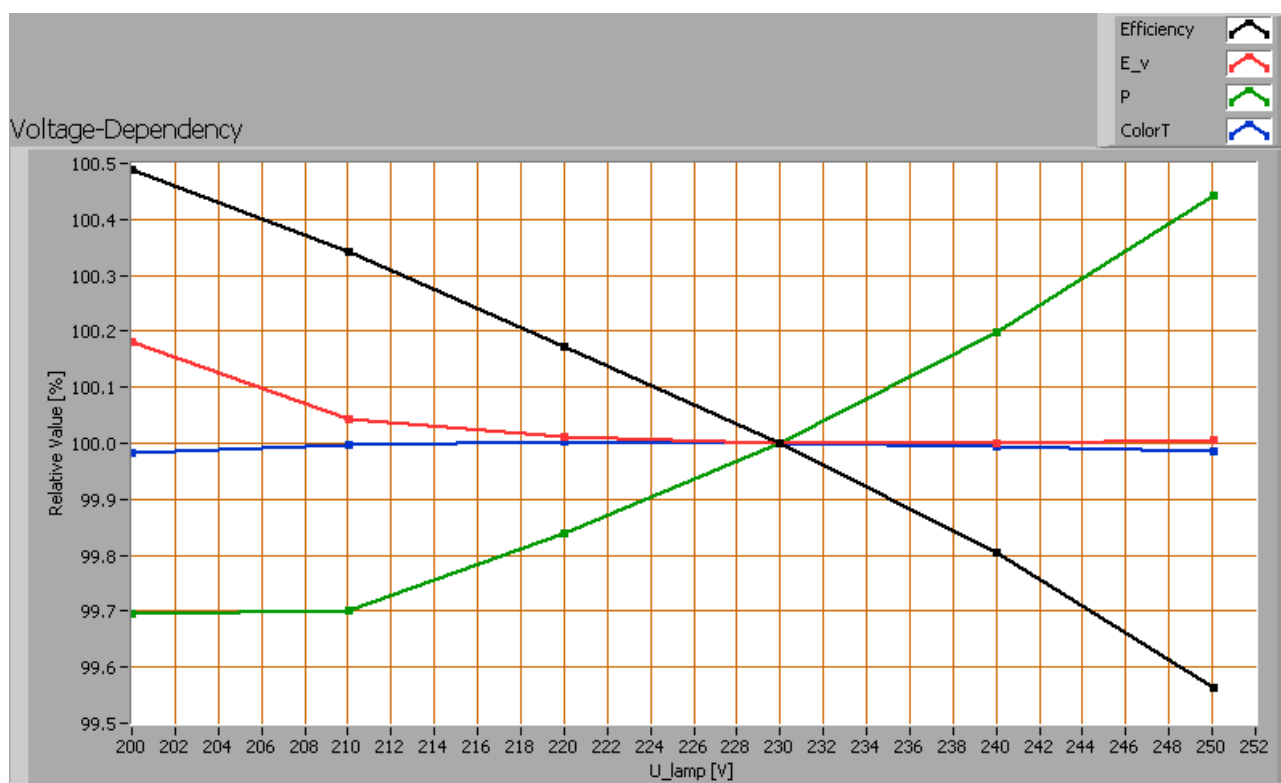
The value of 71 is lower than 80 which is considered a minimum value for indoor usage.

Note: the chromaticity difference is 0.004 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 – 29 Dec 2009



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

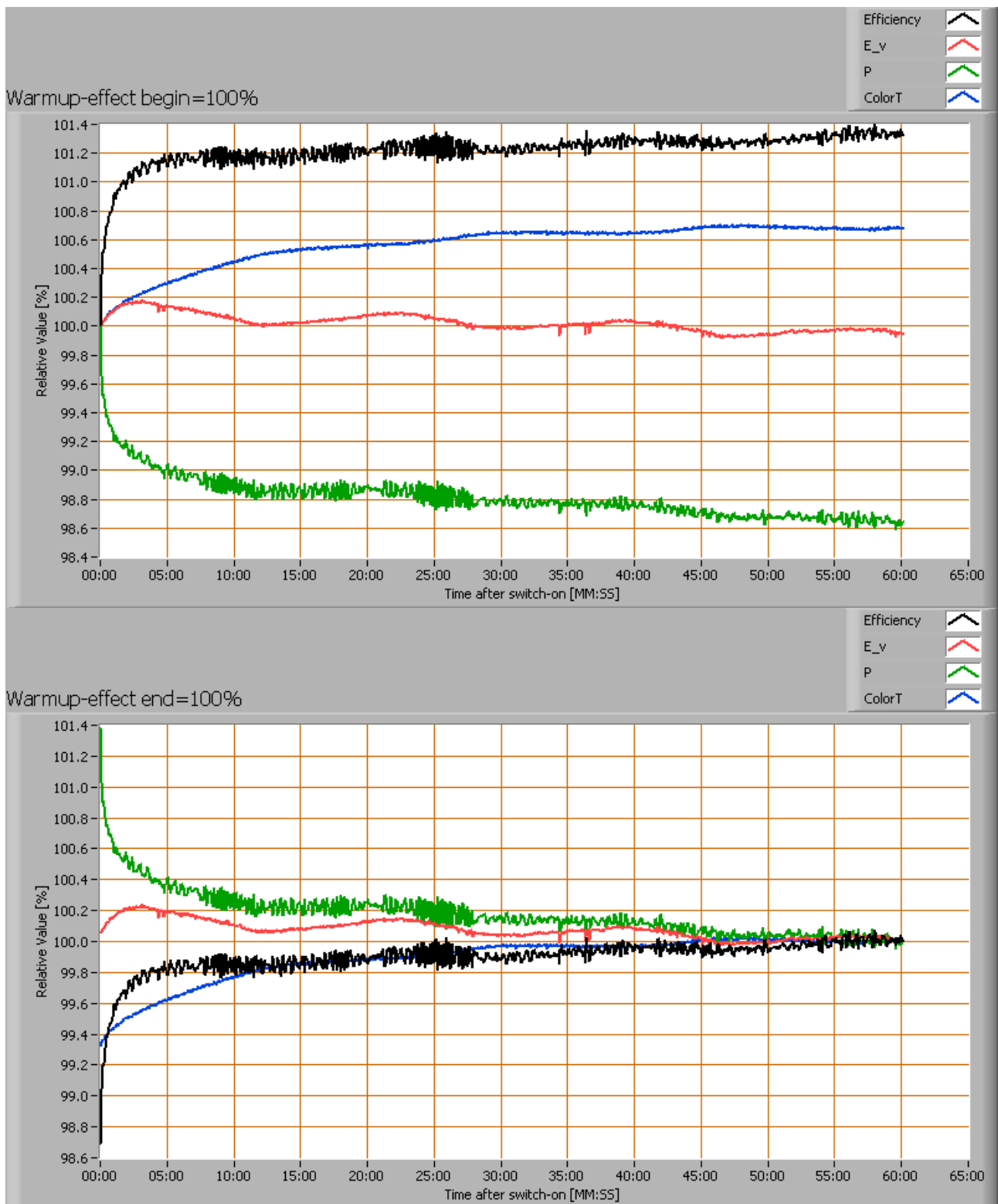
The illuminance and consumed power do not vary significantly when the voltage is varied.

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 – 29 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 – 29 Dec 2009

The warm up time is about 25 minutes. During that time the illuminance nor 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.