Lamp measurement report – 23 Feb 2011

KLV-AMT8-151-A-test

by

KLV Ledverlichting

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Summary measurement data

parameter	meas. result	remark
Color temperature	5743 K	cold white
Luminous intensity I_v	723.6 Cd	Measured straight underneath the lamp.
Illuminance modulation index	56 %	Measured with a light sensor looking at the lamp (angle not defined). Is a measure for the amount of flickering.
Beam angle	121 deg	121 deg is the beam angle for the C0-C180-plane (perpendicular to the length direction of the lamp) and 111 deg is the beam angle for the C90-C270 plane, which is along the length direction of the lamp.
Power P	25.0 W	Follow the link for more information on electrical properties.
Power Factor	0.97	An electrical load with this power factor means that for every 1 kWh net energy consumed, there has been 0.26 kVAhr for reactive energy.
THD	10 %	Total Harmonic Distortion.
Luminous flux	2351 lm	
Luminous efficacy	94 lm/W	
EU-label classification	A	The energy class, from A (more efficient) to G (least efficient).
CRI_Ra	70	Color Rendering Index.
Coordinates chromaticity diagram	x=0.3272 en y=0.3413	
Fitting	TL	This is lamp is connected diractly to the grid voltage.
PAR-value	6.3 uMol/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.

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PAR-photon efficacy	0.8 uMol/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.
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 (low environmental light level).
L x W x H external dimensions	1500 mm x 34 mm x 34 mm	External dimensions of the lamp.
L x W x H luminous area	1462 mm x 28 mm x 13 mm	Dimensions of the luminous area (used in Eulumdat file). The light comes from the opal cap and hence its dimensions are used.
General remarks		The ambient temperature during the whole set of illuminance measurements was 23.2 – 24.4 deg C. The temperature of the housing gets maximally about 18 degrees hotter than ambient temperature. Warm up effect: during the warm up time the illuminance decreases about 12 % and the consumed power decreases about 10 %. Voltage dependency: There is no (significant) dependency of the illuminance when the power voltage varies between 200 – 250 V AC. There is no (significant) dependency of the consumed power when the power voltage varies between 200 – 250 V AC. At the end of the article an additional photo.

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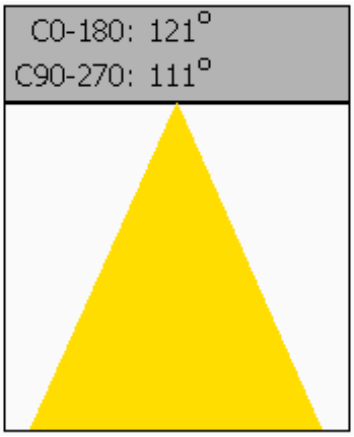
Overview table

m.	Ø 50% C0-180	Ø 50% C90-270
0.25	0.88	0.72
0.5	1.77	1.44
1	3.54	2.89
1.5	5.31	4.33
3	10.61	8.67
4	14.15	11.56
5	17.69	14.45



E (lux)
11578
2894
724
322
80
45
29

Luminaire Efficacy	
94	(lumen per Watt)
Half-peak diam C_{0-180}	
3.54	x diameter(m)
Half-peak diam C_{90-270}	
2.89	x diameter(m)
Illuminance	
724	/ distance² (lux)
Total Output	
2351	(lumen)

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 1462 mm (maximal luminous size, eventually diagonally measured)= 7310 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.

EU Energy label classification

With the measurement results of the luminous flux and the consumed power the classification on energy efficacy of this lamp is calculated. This information is requested in the EU for certain household lamps, see also the OliNo site that explains for which lamps it is requested, how the label looks like and what information it needs to contain. Herewith the labels for this lamp in color and black and white.

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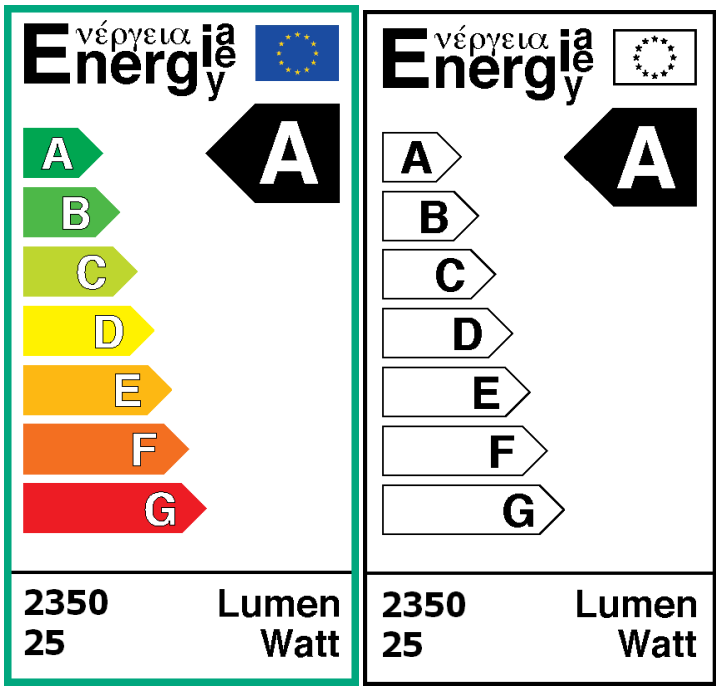
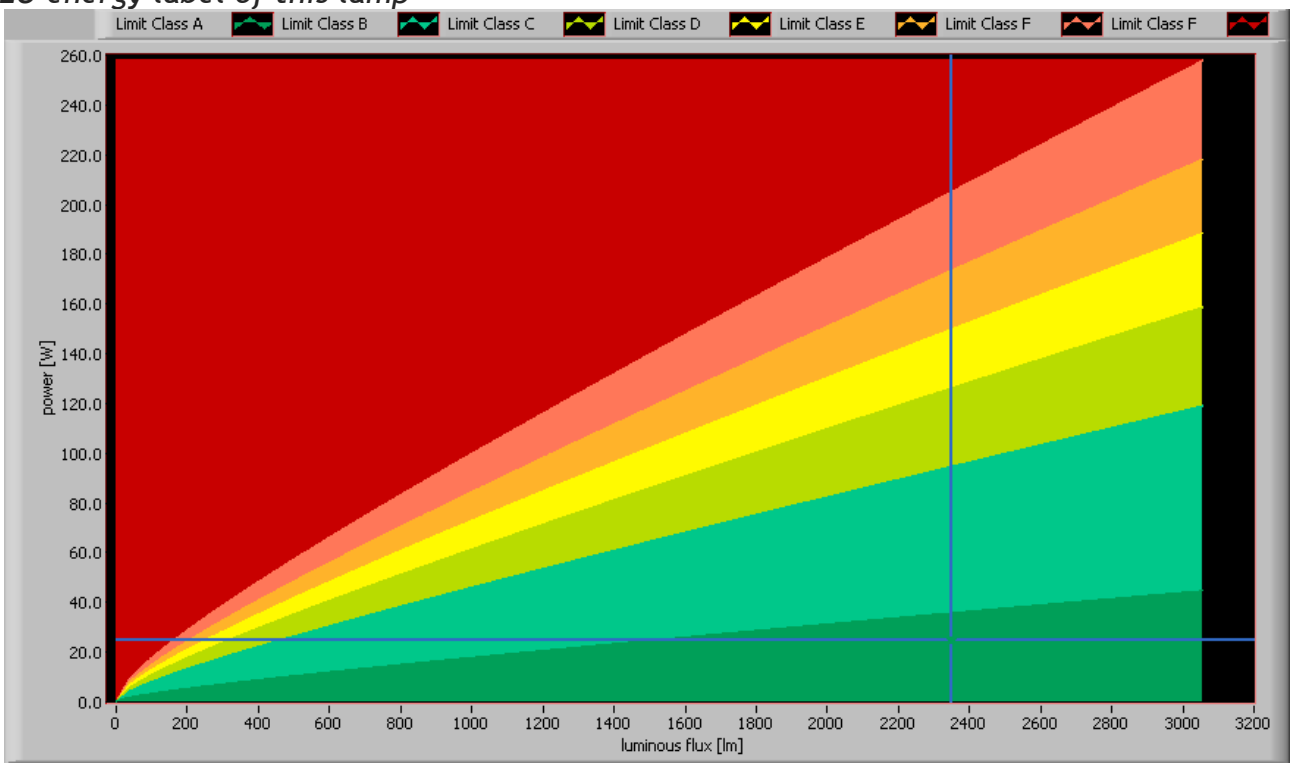


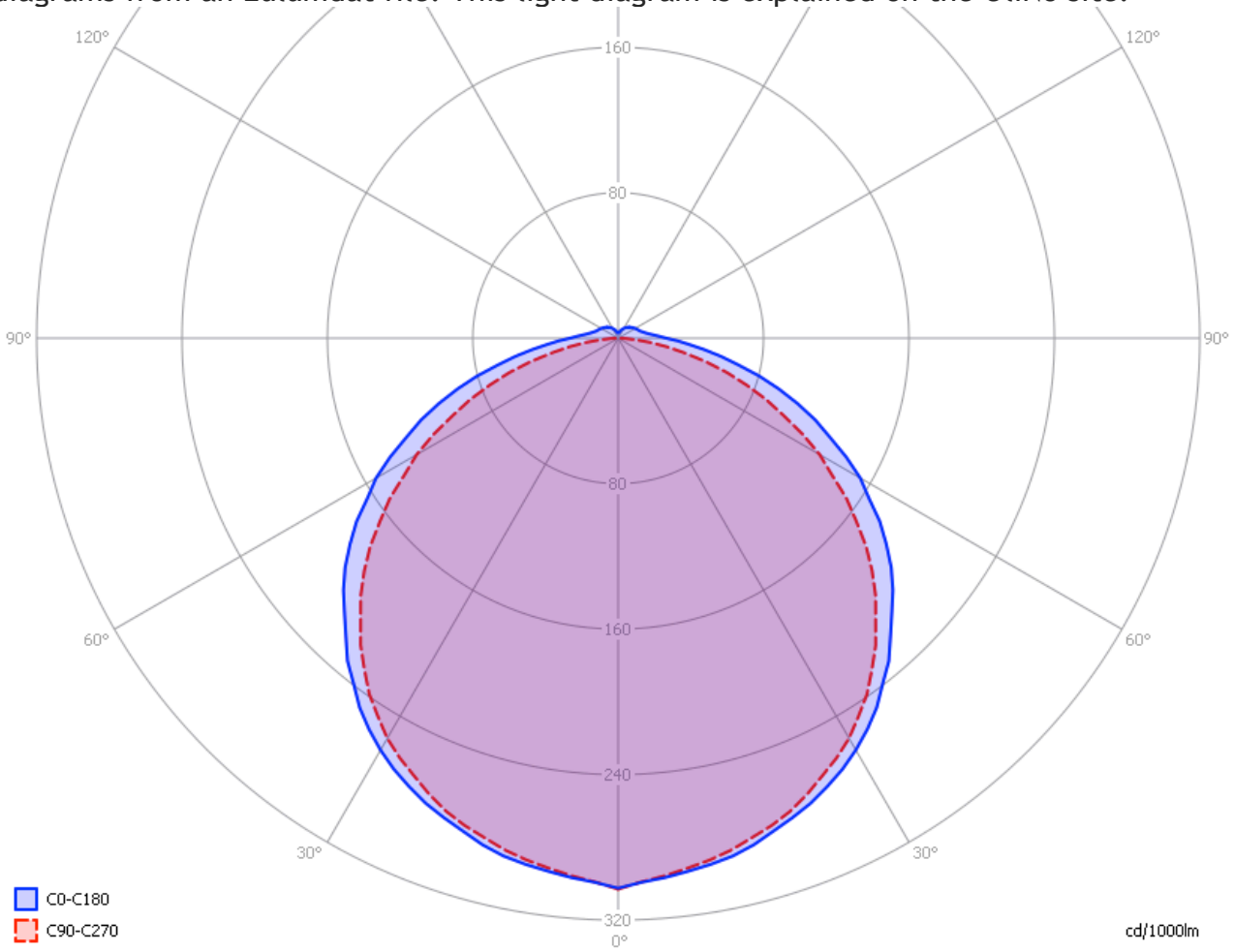
EU energy label of this lamp



The lamp's performance in the lumen-Watt field, with the energy efficacy fields indicated.

Eulumdat light diagram

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



The light diagram giving the radiation pattern.

The light diagram indicates the beam in the C0-C180 plane (perpendicular to the length direction of the lamp) and in the plane perpendicular to that, the C90-C270 plane (along the length direction of the lamp).

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.

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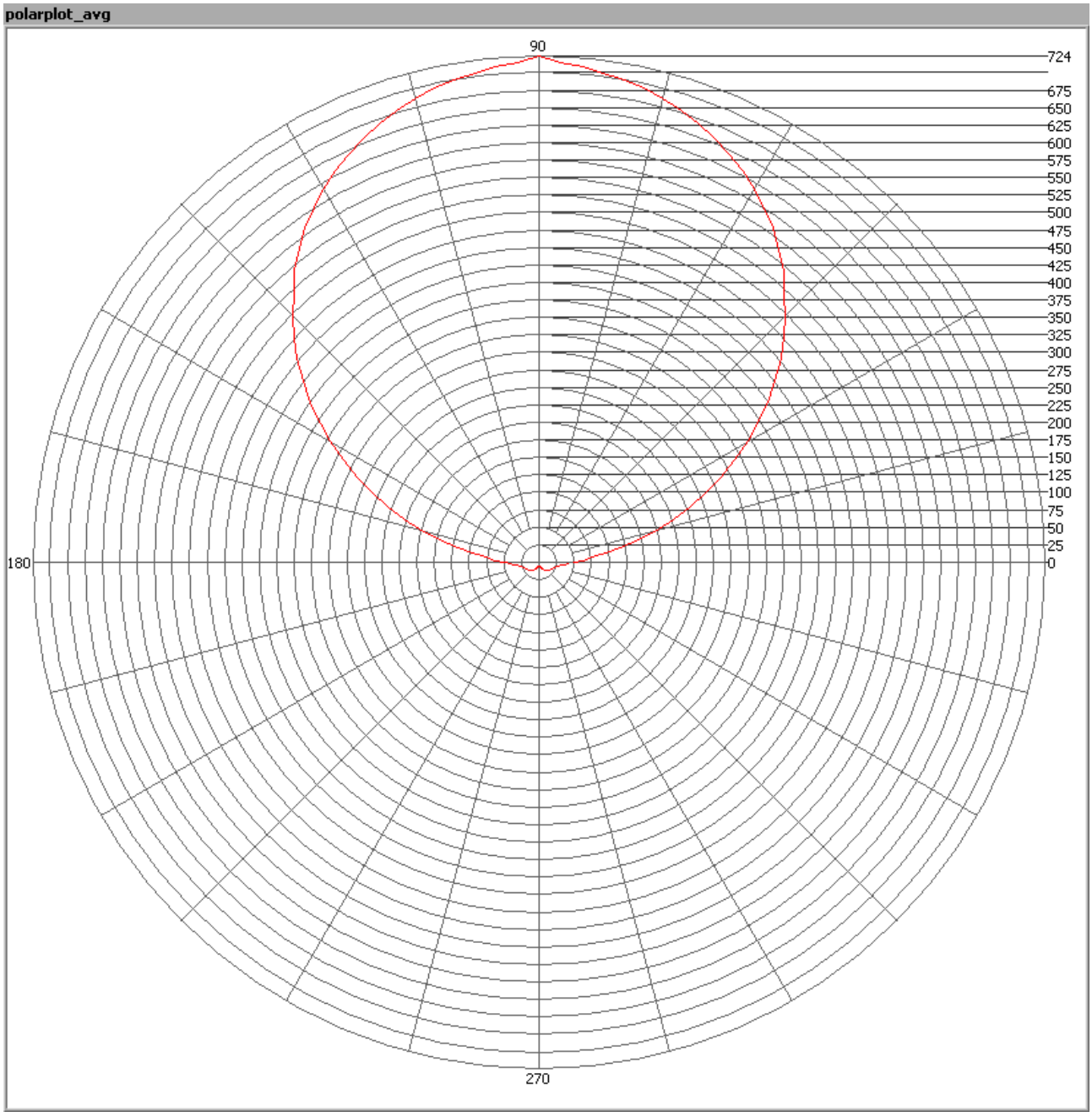
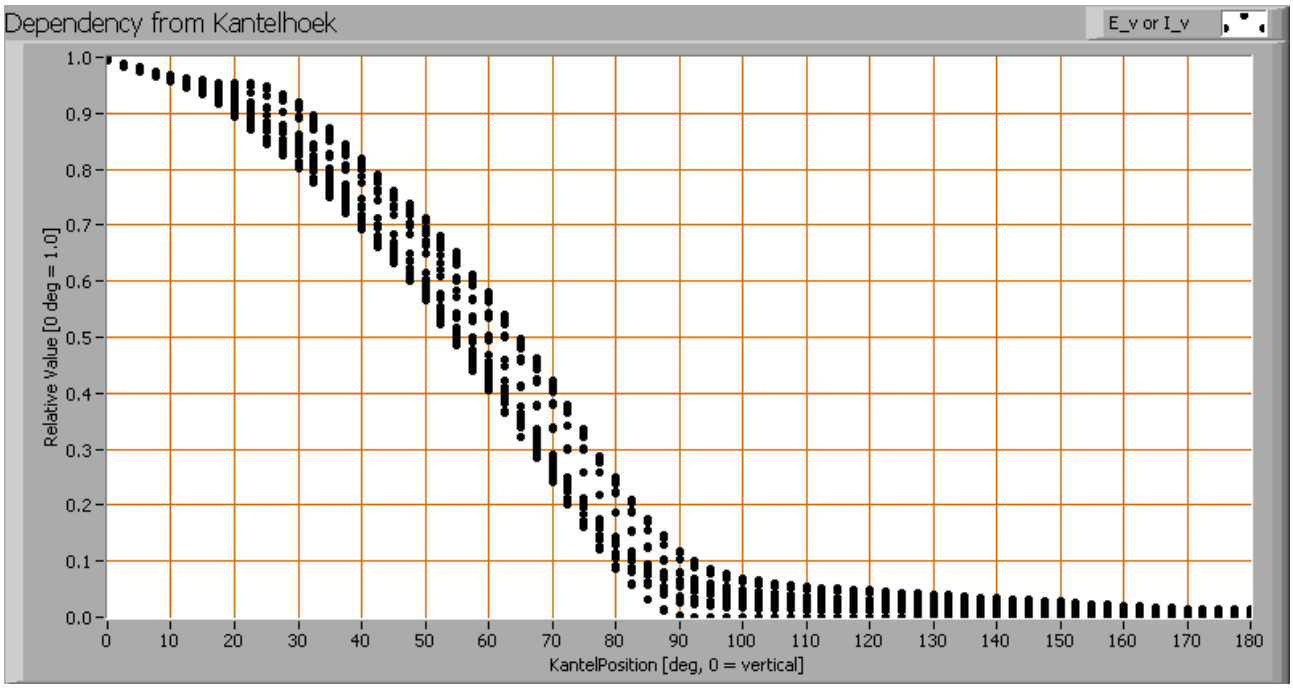


The radiation pattern of the light bulb.

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.



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 121 deg for the C0-C180 plane and 111 deg for the C90-C270 plane.

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 2351 lm.

Luminous efficacy

The luminous flux being 2351 lm, and the consumed power of the lamp being 25.0 Watt, results in a luminous efficacy of 94 lm/Watt.

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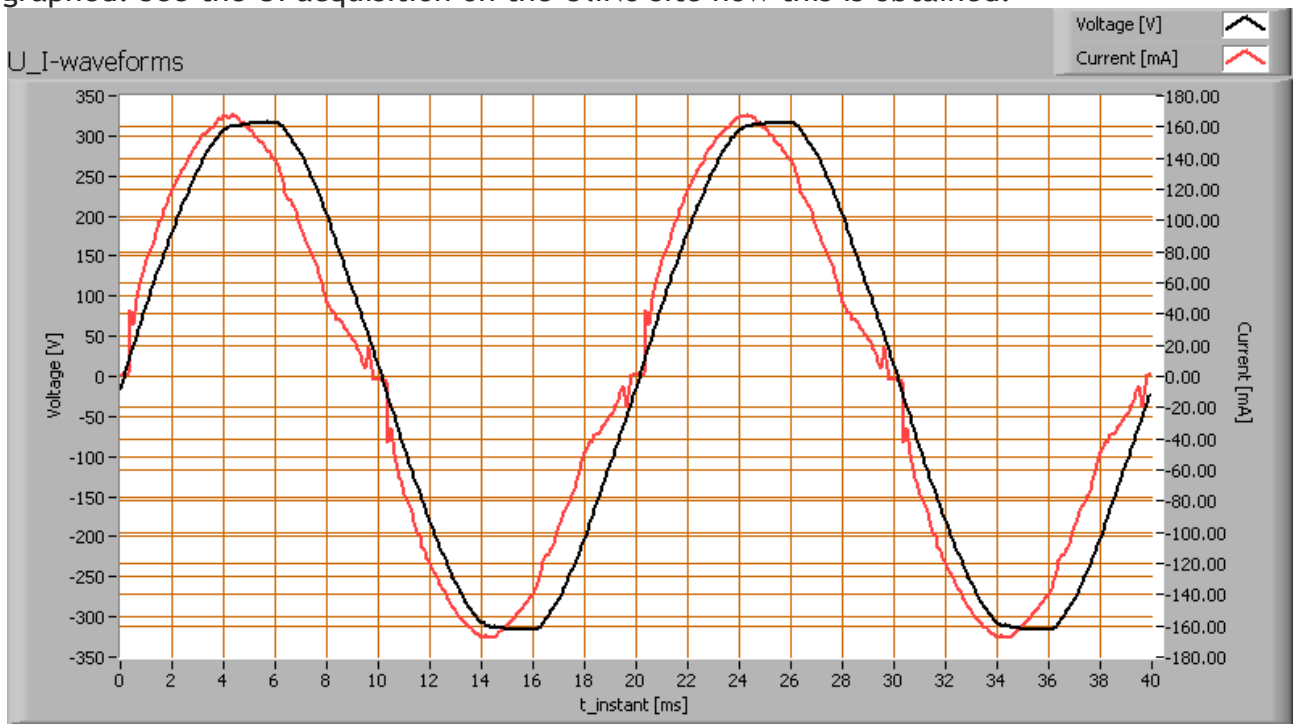
Electrical properties

The power factor is 0.97. An electrical load with this power factor means that for every 1 kWh net energy consumed, there has been 0.26 kVAhr for reactive energy.

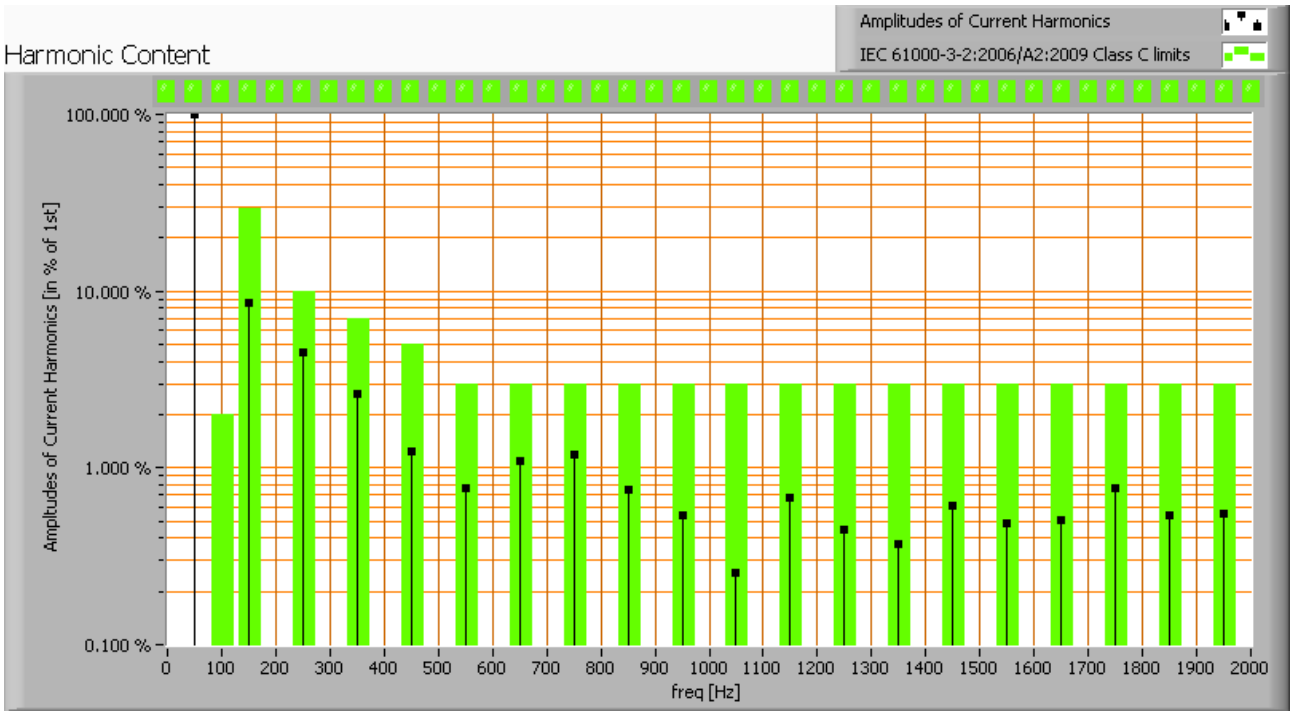
Lamp voltage	230.0 V
Lamp current	0.112 A
Power P	25.0 W
Apparent power S	25.8 VA
Power factor	0.97

Of this lamp the voltage across and the resulting current through it are measured and graphed. See the UI acquisition on the OliNo site how this is obtained.



Voltage across and current through the lightbulb

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



Harmonics in the current waveform and checked against IEC61000-3-2:2006 and A2:2009

When the consumed power is > 25 W there are limits for the harmonics and those are fulfilled.
The Total Harmonic Distortion of the current is computed and its value is 10 %.

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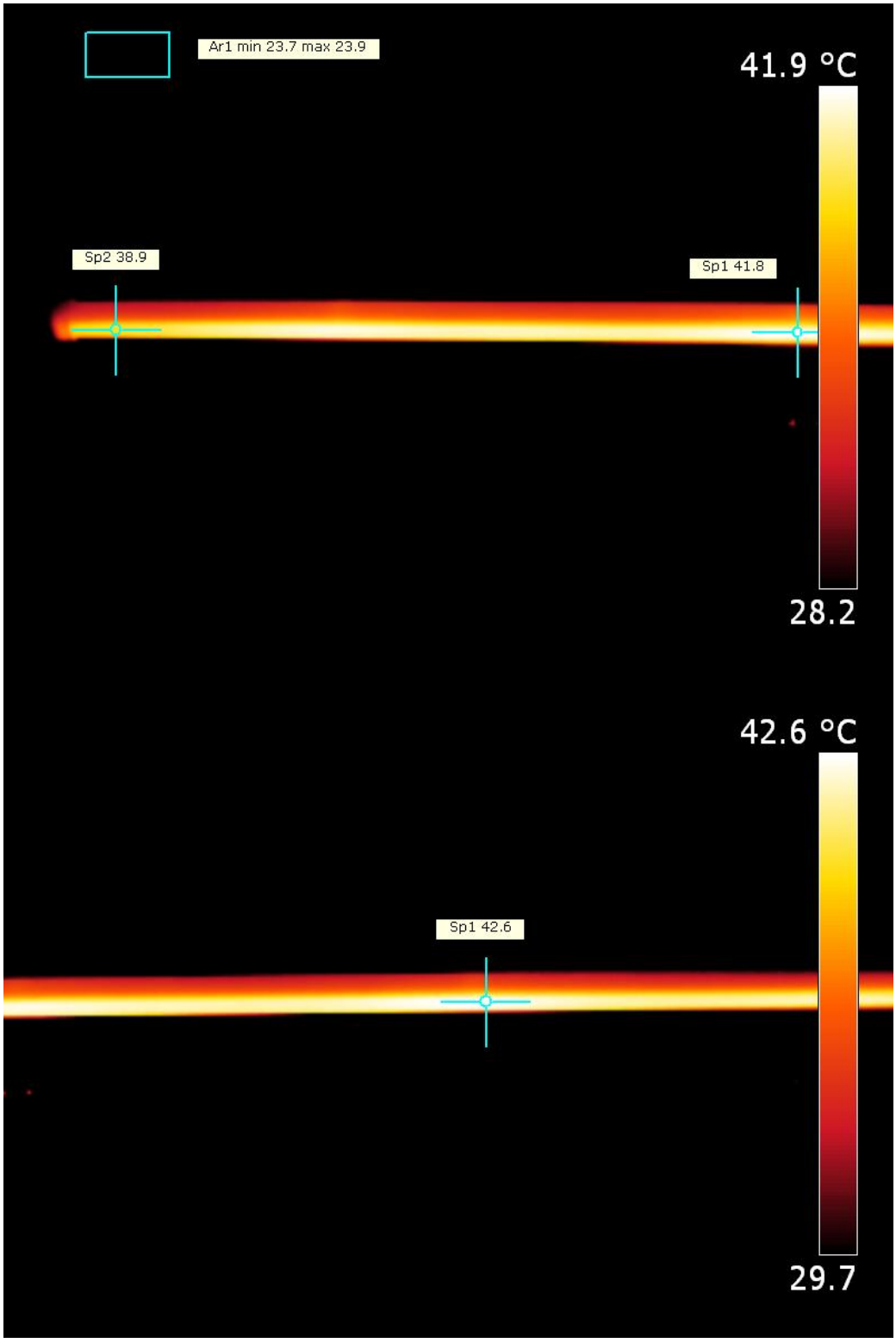
Temperature measurements lamp



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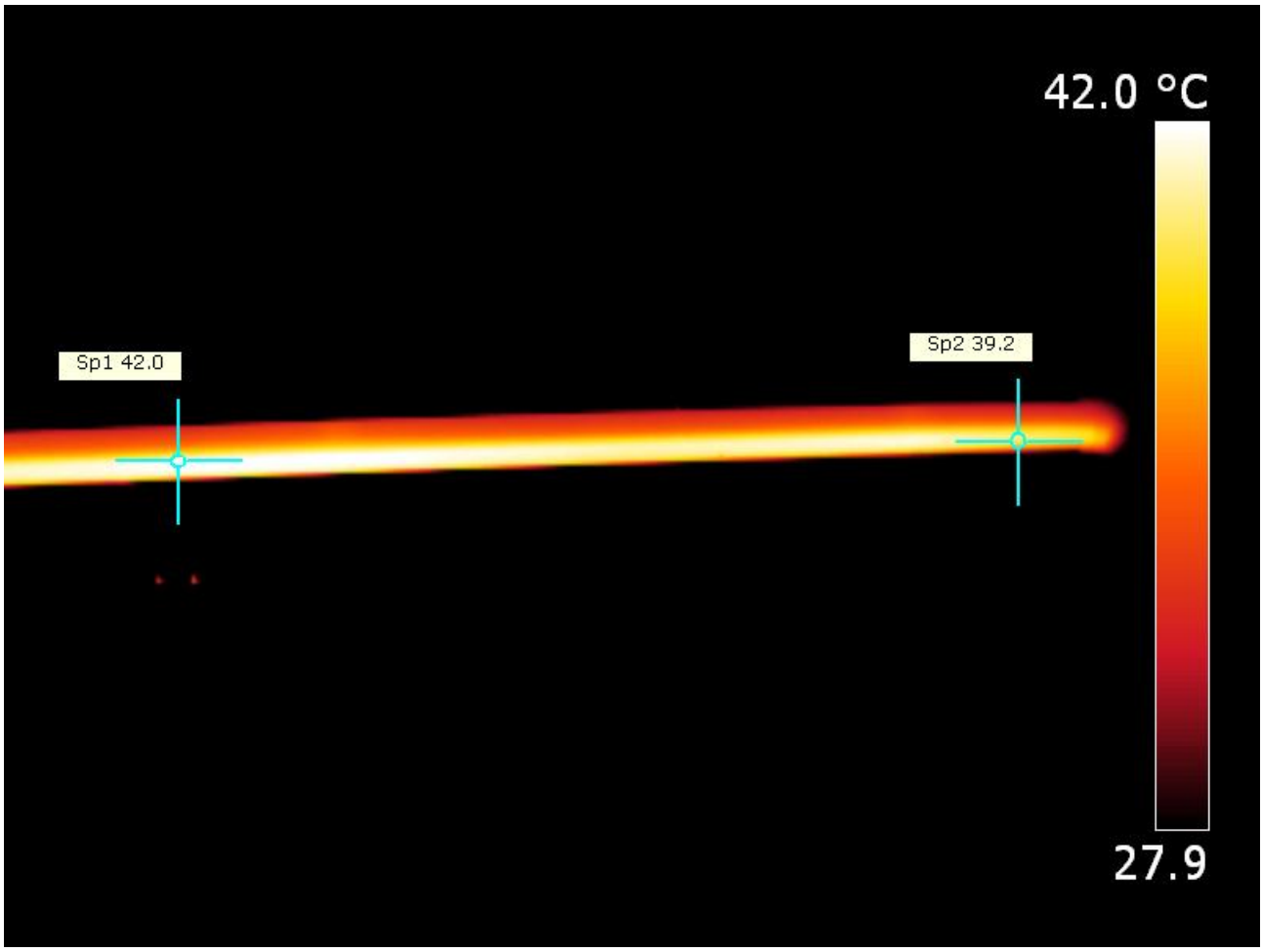

Temperature images.

status lamp	> 2 hours on
ambient temperature	24 deg C
reflected background temperature	24 deg C
camera	Flir T335
emissivity	0.95
measurement distance	1.5 m
$IFOV_{geometric}$	0.136 mm per 0.1 m distance
NETD (thermal sensitivity)	50 mK

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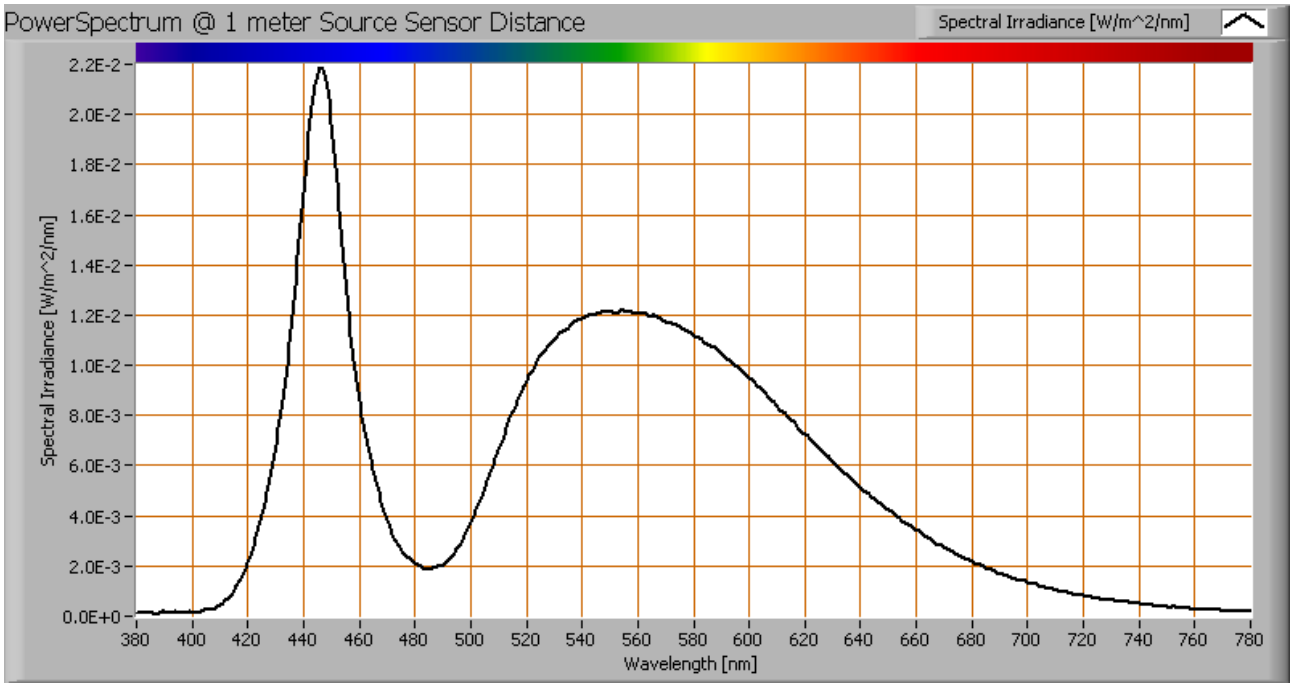
Color temperature and Spectral power distribution



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

The measured color temperature is 5743 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.

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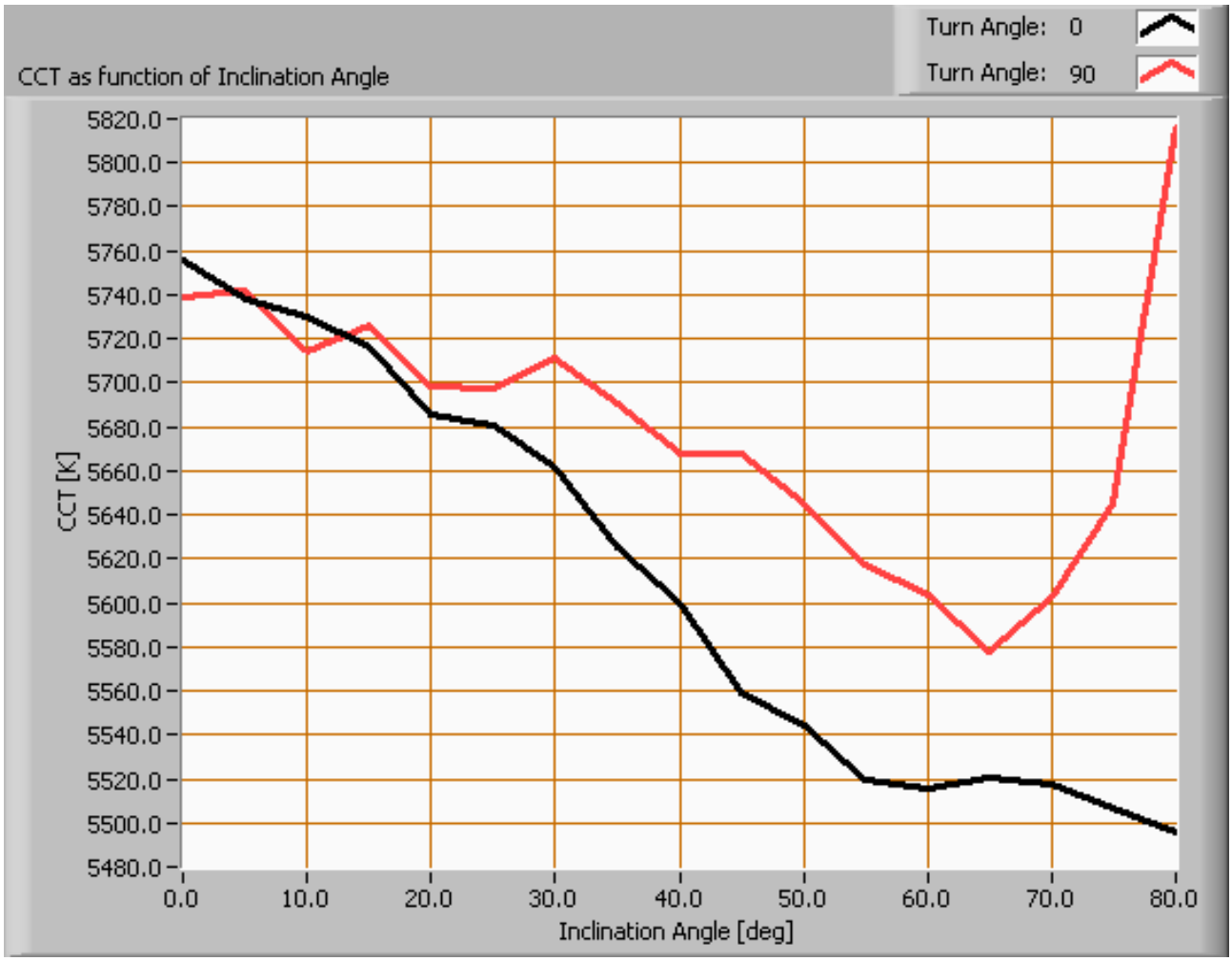

Color temperature as a function of inclination angle.

The color temperature is given for inclination angles up to 80 deg. Beyond that value the illuminance is so low (< 5 lux) that it has not been used for color determination of the light.

For the C0-C180 plane: the beam angle of 121 deg is equivalent to 60.5 deg inclination angle,which is the area where most of the light falls within. The maximum variation of color temperature in this inclination area is about 2 %.

For the C90-C270 plane: the beam angle of 111 deg is equivalent to 55.3 deg inclination angle,which is the area where most of the light falls within. The maximum variation of color temperature in this inclination area is about 4 %.

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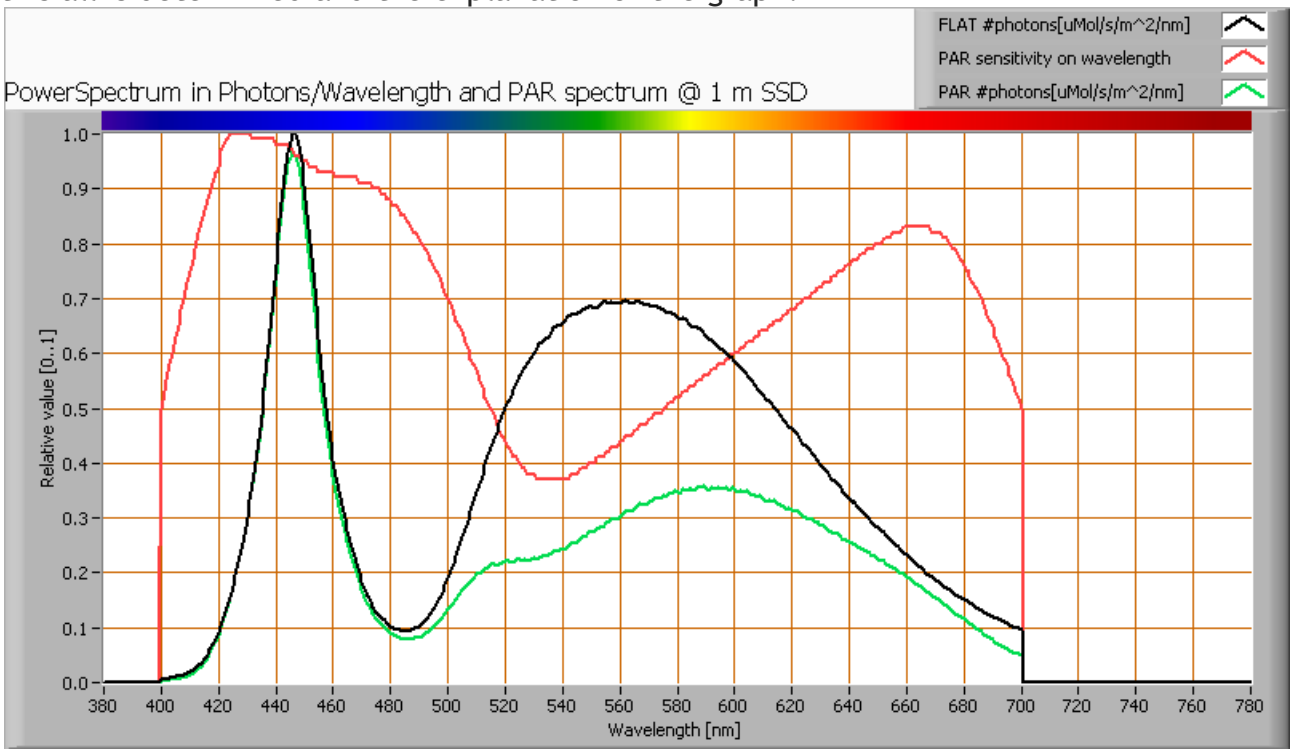
PAR value and PAR spectrum

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 explanation about PAR on the OliNo website how this all is determined and the explanation of the graph.



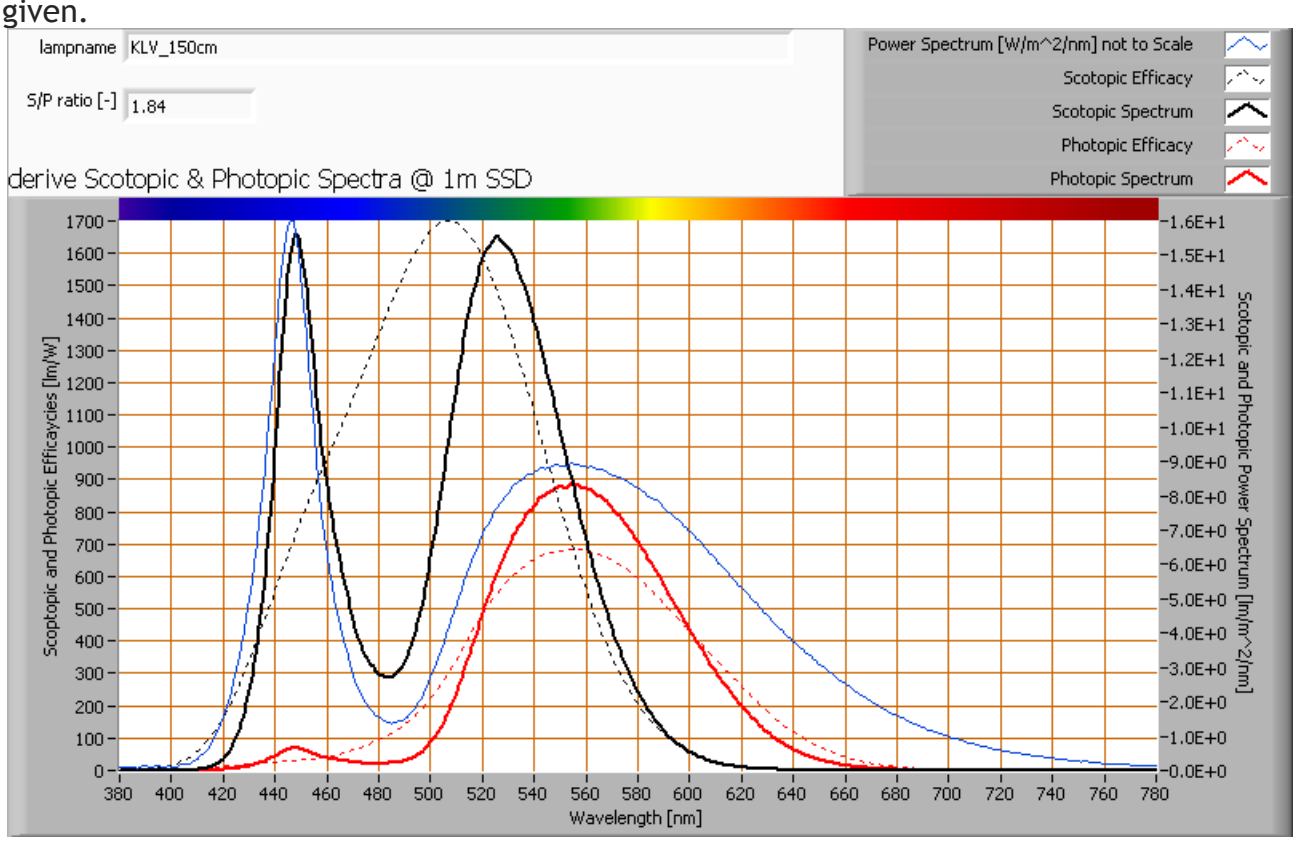
The photon spectrum, then the sensitivity curve and as result the final PAR spectrum of the light of this light bulb

parameter	value	unit
PAR-number	6.3	uMol/s/m^2
PAR-photon current	20.4	uMol/s
PAR-photon efficacy	0.8	uMol/s/W

The PAR efficiency is 65 % (valid for the PAR wave length range of 400 – 700 nm). This is the maximum percentage of the total of photons in the light that 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 %).

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 of the light coming from this lamp is 1.8.
More info on S/P ratio can be found on the OliNo website.

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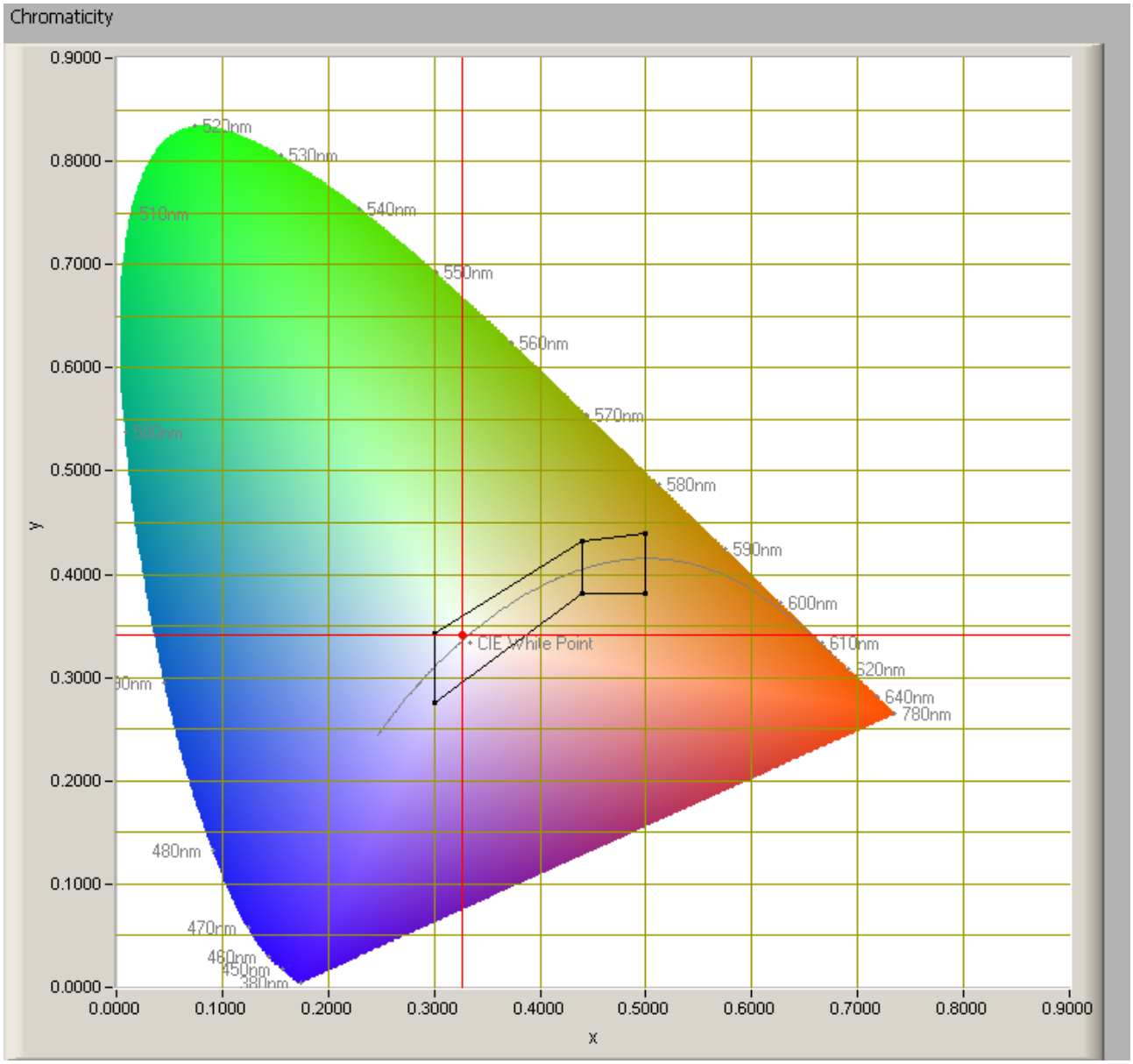
Chromaticity diagram



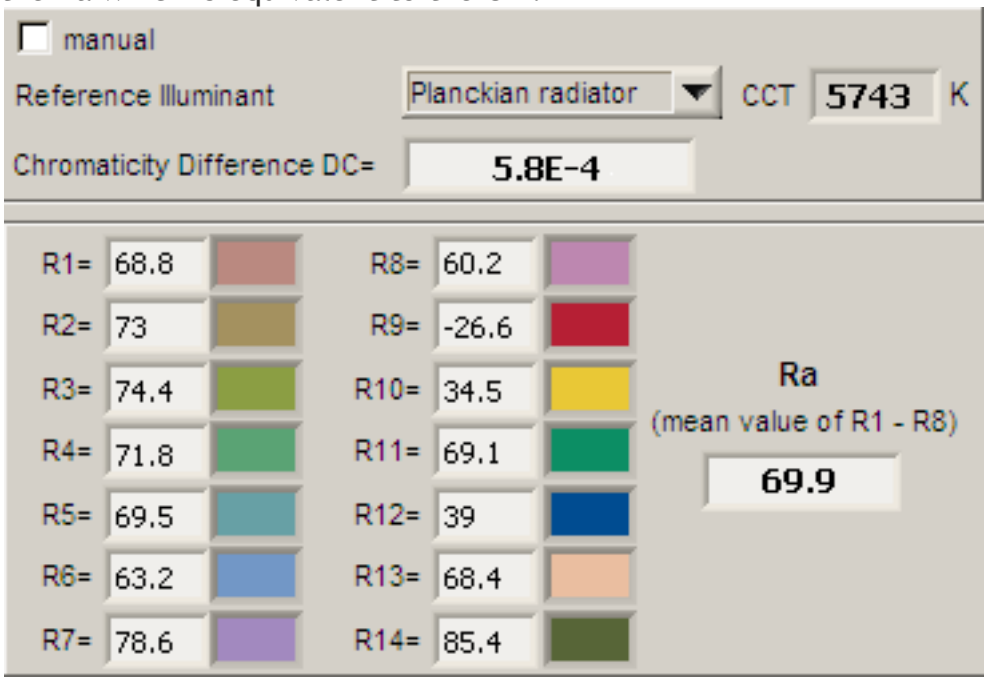
The chromaticity space and the position of the lamp's color coordinates in it.

The point of the light in this diagram is inside the area indicated with class A. This area indicates an area for signal lamps, see also the article on signal lamps and color areas on the OliNo website.

The color coordinates are x=0.3272 and y=0.3413.

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.

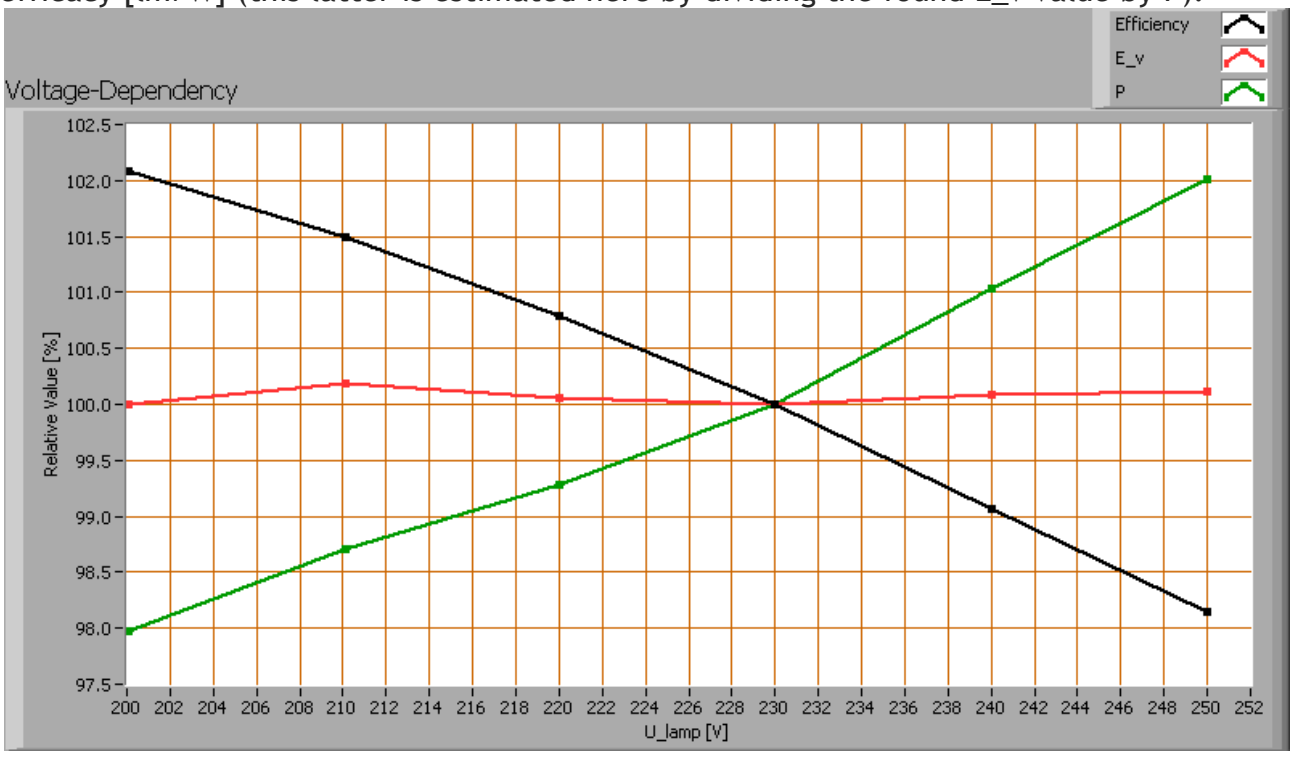


CRI of the light of this lightbulb.

This value of 70 indicates how well the light of this lamp can render well a set of reference colors, this in comparison with the light of a reference source (for color temperatures < 5000K a black radiator is used as reference and for color temperatures > 5000K the sun or the light outside during the day).
The value of 70 is smaller than the value of 80 that is considered as a minimum for working areas in general.
Note: the chromaticity difference is 0.0006 and 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] (this latter is estimated here by dividing the found E_v value by P).



Lamp voltage dependencies of certain light bulb parameters

There is no (significant) dependency of the illuminance when the power voltage varies between 200 – 250 V AC. There is no (significant) dependency of the consumed power when the power voltage varies between 200 – 250 V AC.
When the voltage varies abruptly with + or – 5 V AC then this results in a variation of the illuminance of maximally 0.0 %. This difference in illuminance is not visible (when it occurs abruptly).

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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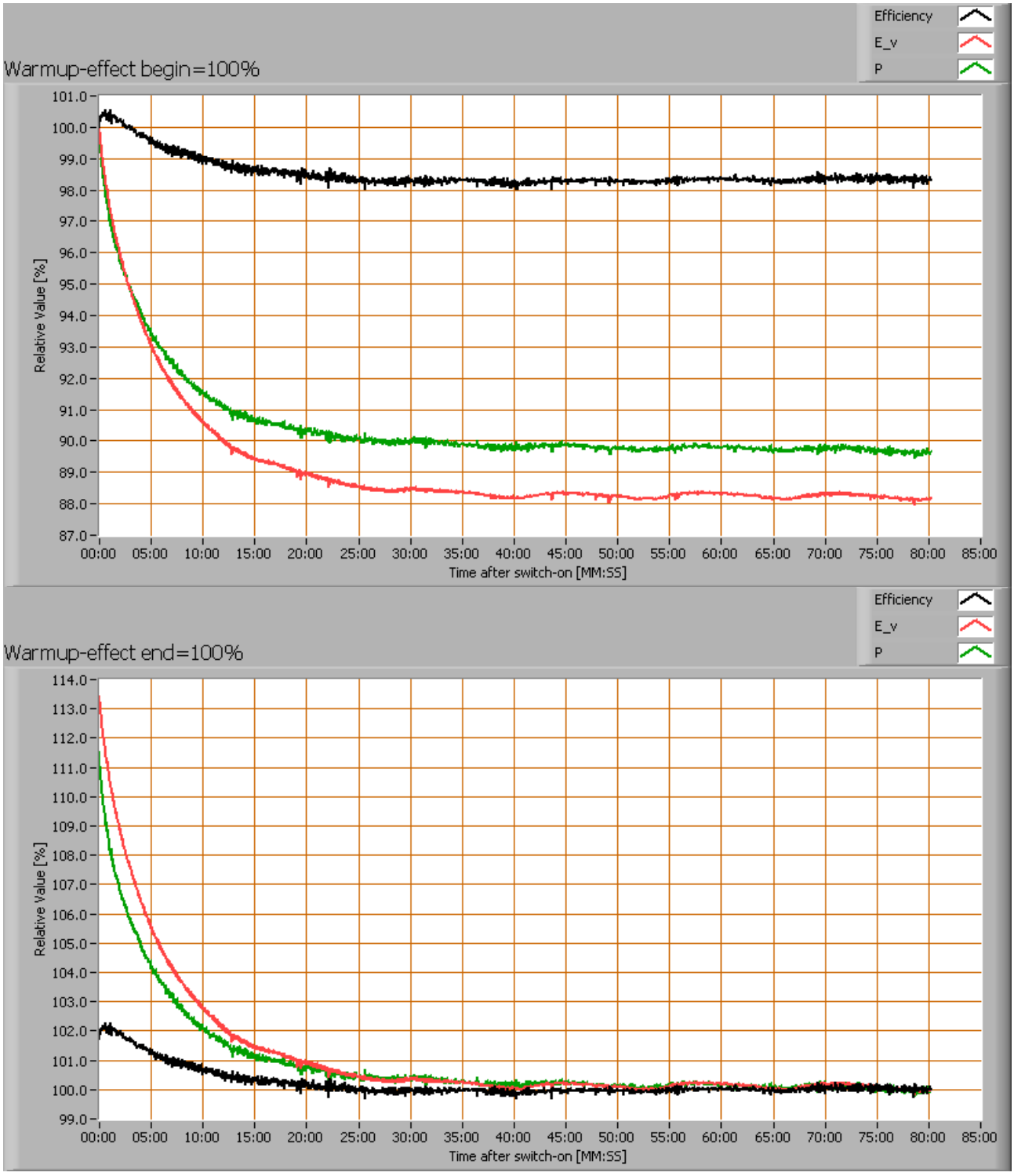
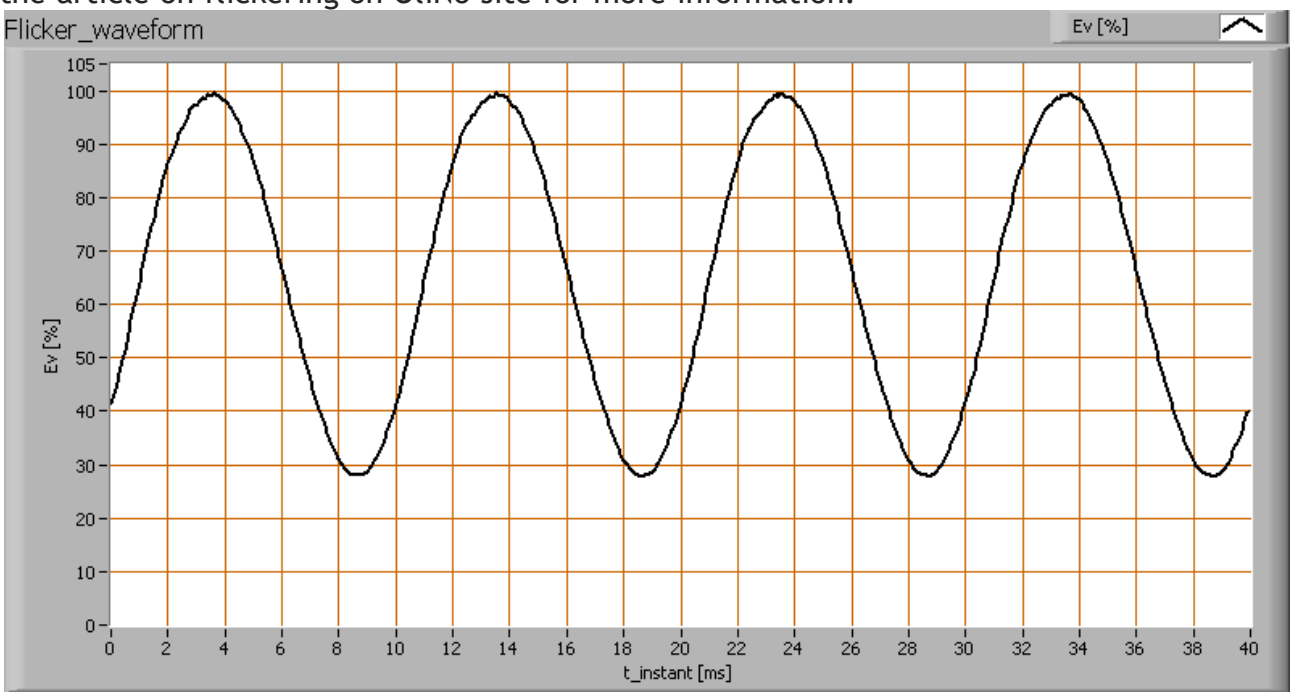


Effect of warming up on different light bulb parameters. In the first graph the 100 % level is put at begin, and in the last graph the 100 % level is put at the end.

The warmup time is about 20 minutes during which the illuminance decreases with 12 % and the consumed power decreases with 10 %.

Measure of flickering

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



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

parameter	value	unit
Flicker frequency	100.1	Hz
Illuminance modulation index	56	%

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

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