OLINO
renewable energy

Lamp measurement report – 5 Nov 2010

LVS D01 GU10 3W WW dim

by

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Summary measurement data

parameter	meas. result	remark
Color temperature	2871 K	Warm white
Luminous intensity I_v	377 Cd	Measured straight underneath the lamp.
Illuminance modulation index	7 %	Measured straight underneath the lamp. Is a measure for the amount of flickering.
Beam angle	29 deg	29° for all C-planes since the lamp is symmetrical along its 1st axis.
Power P	4.2 W	
Power Factor	0.76	For every 1 kWh net power consumed, there has been 0.9 kVAhr for reactive power.
THD	82 %	Total Harmonic Distortion
Luminous flux	140 Lm	
Luminous efficacy	34 Lm/W	
EU-label classification	A	The energy class, from A (more efficient) to G (least efficient).
CRI_Ra	83	Color Rendering Index.
Coordinates chromaticity diagram	x=0.4394 and y=0.3938	
Fitting	GU10	This lamp is connected to the 230 V grid voltage.
PAR-value	3.8 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	0.3 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.

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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).
D x H external dimensions	50 x 53 mm	External dimensions of the lamp, without pins.
D luminous area	41 mm	Dimensions of the luminous area (used in Eulumdat file). This is the surface of the smalles circle around the leds at the front of the lamp.
General remarks		The ambient temperature during the whole set of illuminance measurements was 23.3-25.2 deg C. The temperature of the housing directly around the leds get about 43 degrees hotter than ambient temperature, on the ribs at the sides. Warm up effect: during the warm up time the illuminance decreases with 17 % and the consumed power with 15 %. Voltage dependency: the power consumption and illuminance vary when the power voltage varies between 200-250 V. This is understandable as the lamp is dimmable. This lamp has been tested on dim-ability and it is. The result varies depending on the dimmer type used.

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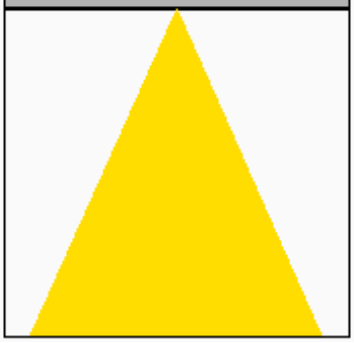
Overview table

m.	Ø 50% C0-180	Ø 50% C90-270
0.25	0.13	0.13
0.5	0.26	0.26
1	0.52	0.52
1.5	0.77	0.77
3	1.55	1.55
4	2.06	2.06
5	2.58	2.58

C0-180: 29°
C90-270: 29°



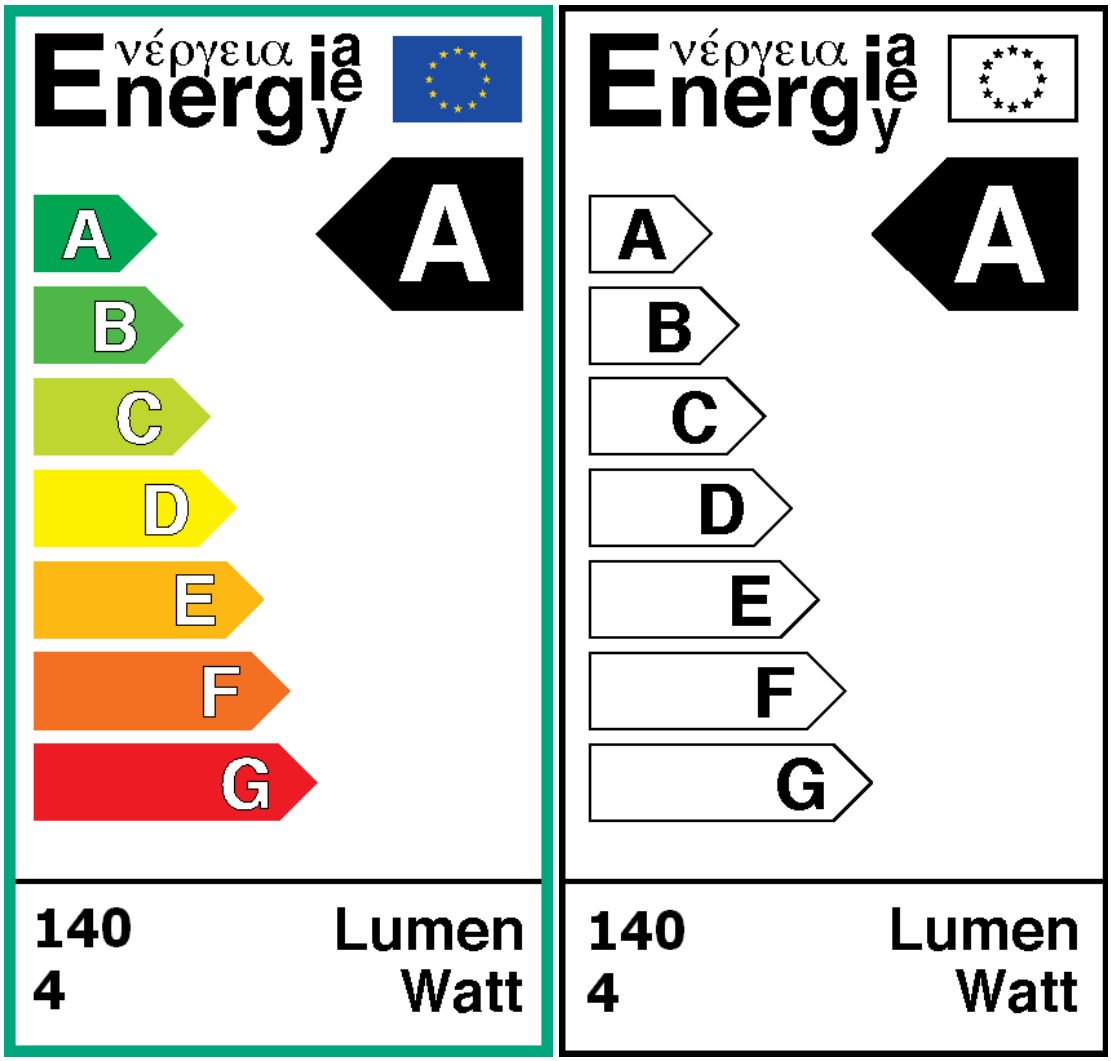
E (lux)
6039
1510
377
168
42
24
15

Luminaire Efficacy
34 (lumen per Watt)
Half-peak diam C_{0-180}
0.52 x diameter(m)
Half-peak diam C_{90-270}
0.52 x diameter(m)
Illuminance
377 / distance² (lux)
Total Output
140 (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 41 mm ≈ 210 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.

EU Energy label classfication

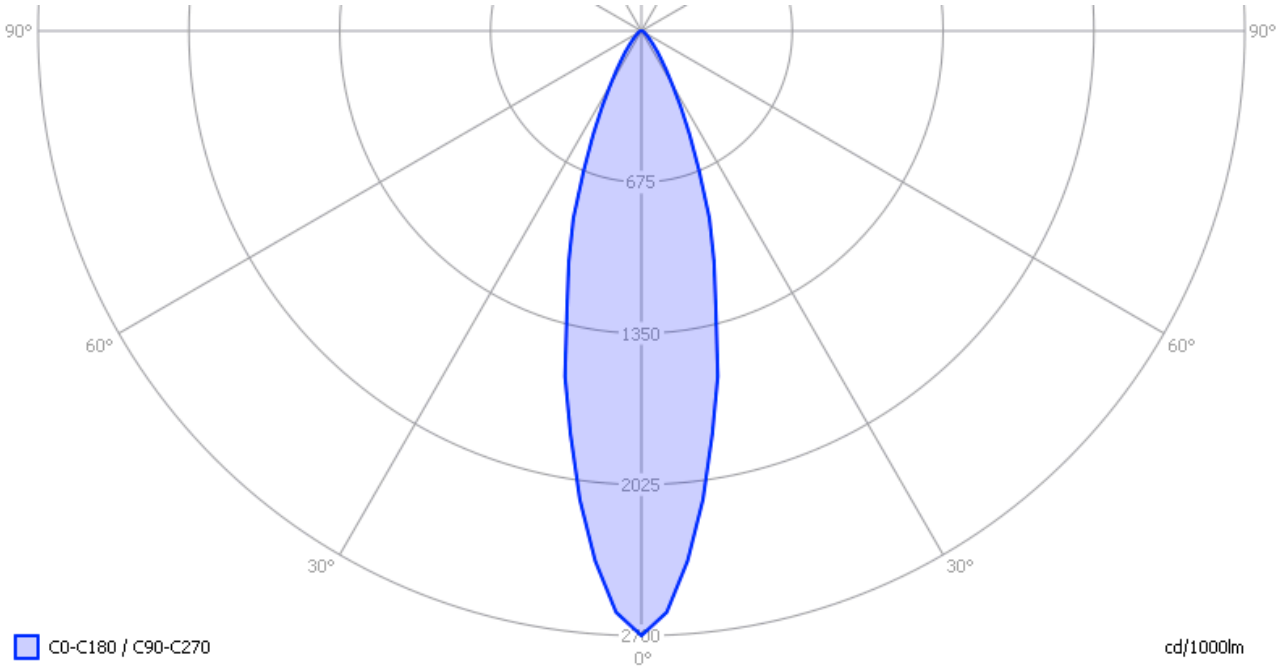
With the measurement results of the luminous flux and the consumed power the classification on energy of this lamp is calculated. This information is requested in the EU for certain household lamps, see also the OliNo site that explains for which lamps it is requested, how the label looks like and what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



EU energy label of this 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.



The light diagram giving the radiation pattern.

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

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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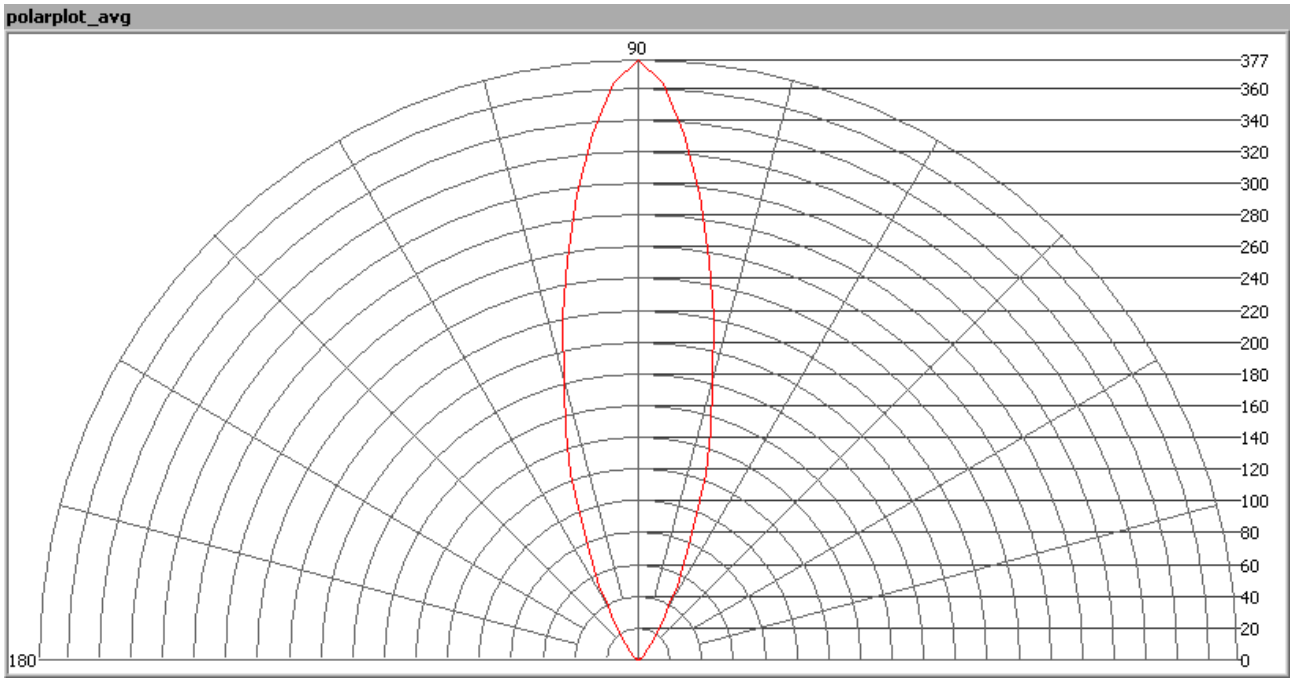
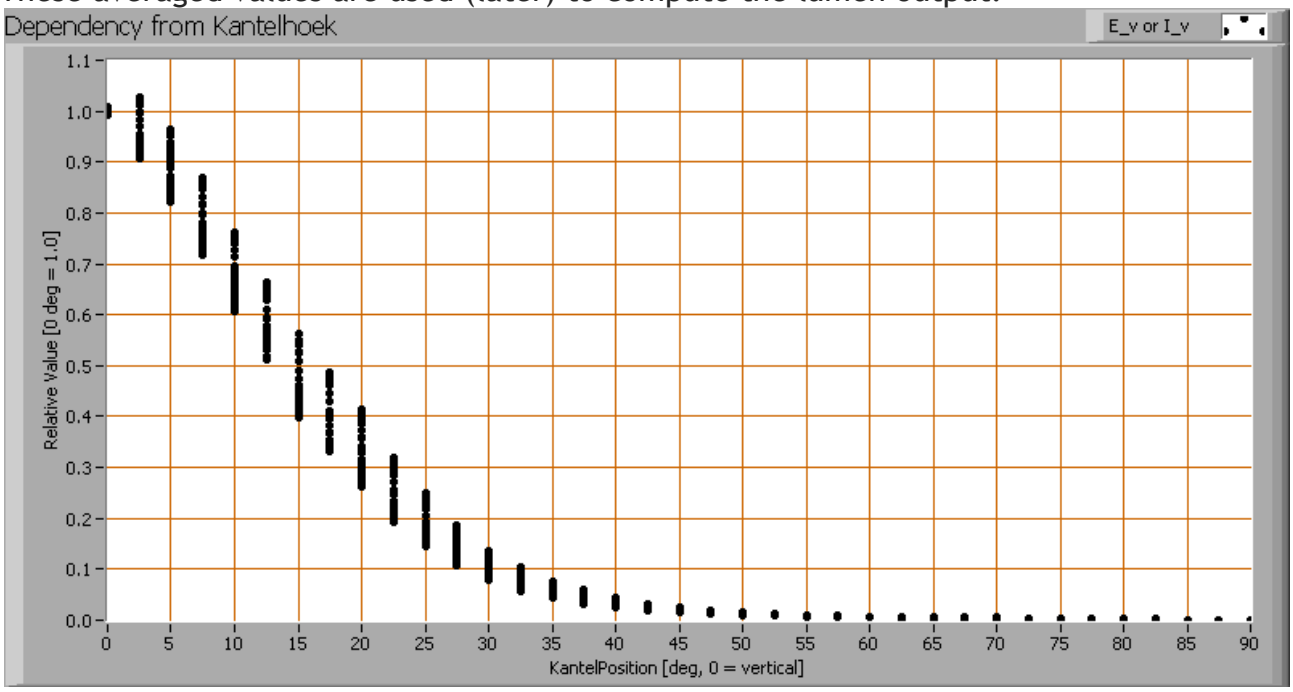


The radiation pattern of the light bulb.

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 29° 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 140 Lm.

Luminous efficacy

The luminous flux being 140 Lm, and the power of the light bulb being 4.2 W, yields a luminous efficacy of 34 Lm/W.

Electrical properties

A power factor of 0.76 means that for every 1 kWh net power consumed, a reactive component of 0.9 kVAr was needed.

Lamp voltage	230 VAC
Lamp current	24 mA
Power P	4.2 W
Apparent power S	5.5 VA
Power factor	0.76

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.

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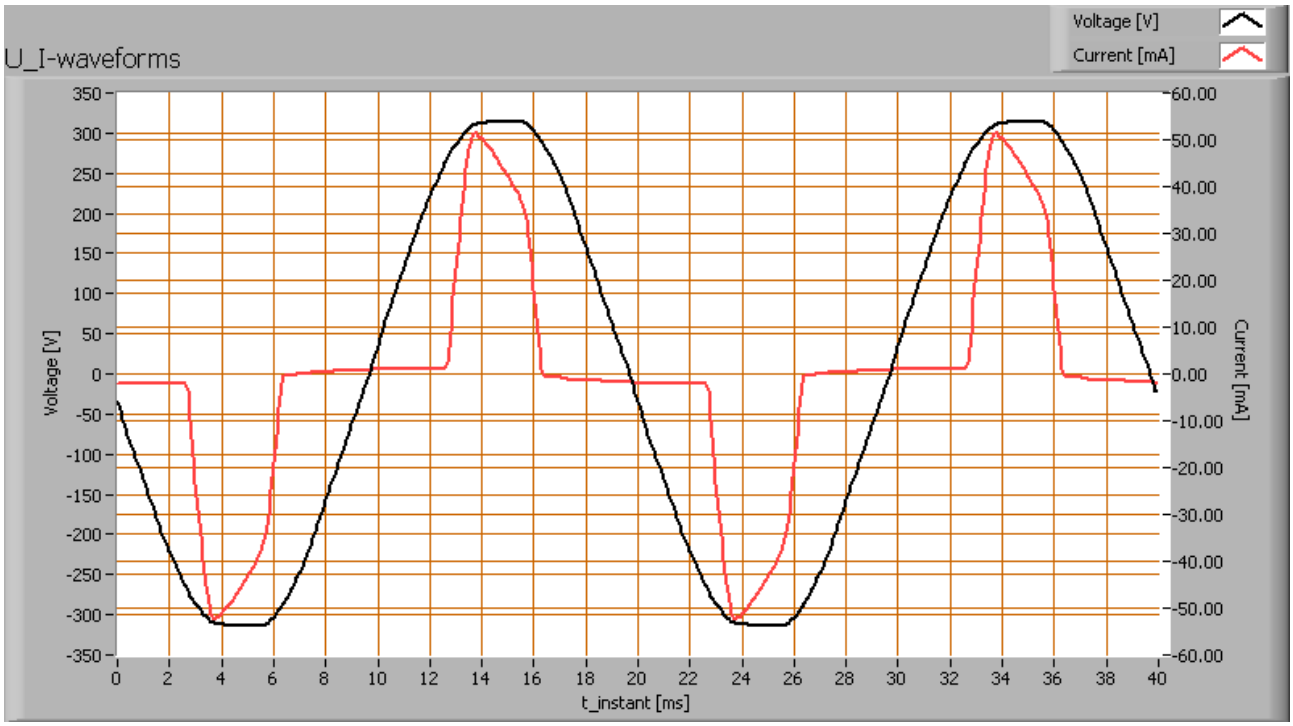
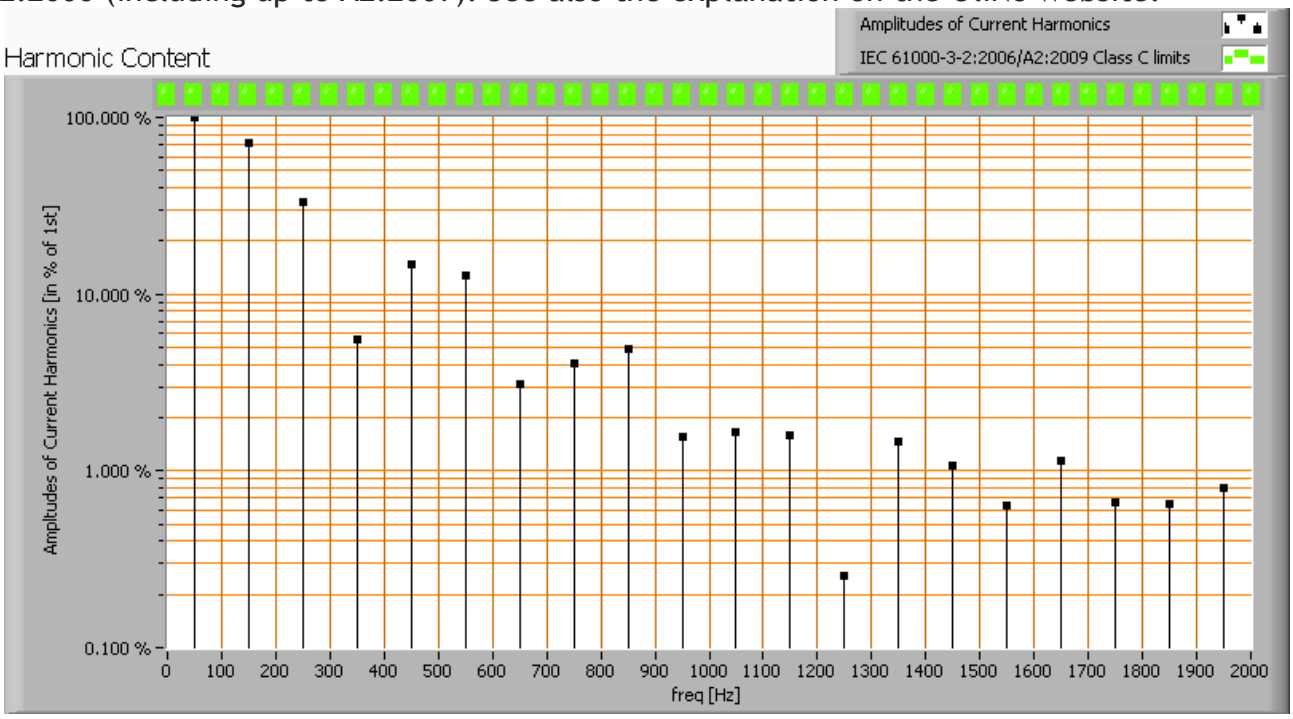


Voltage across and current through the lightbulb

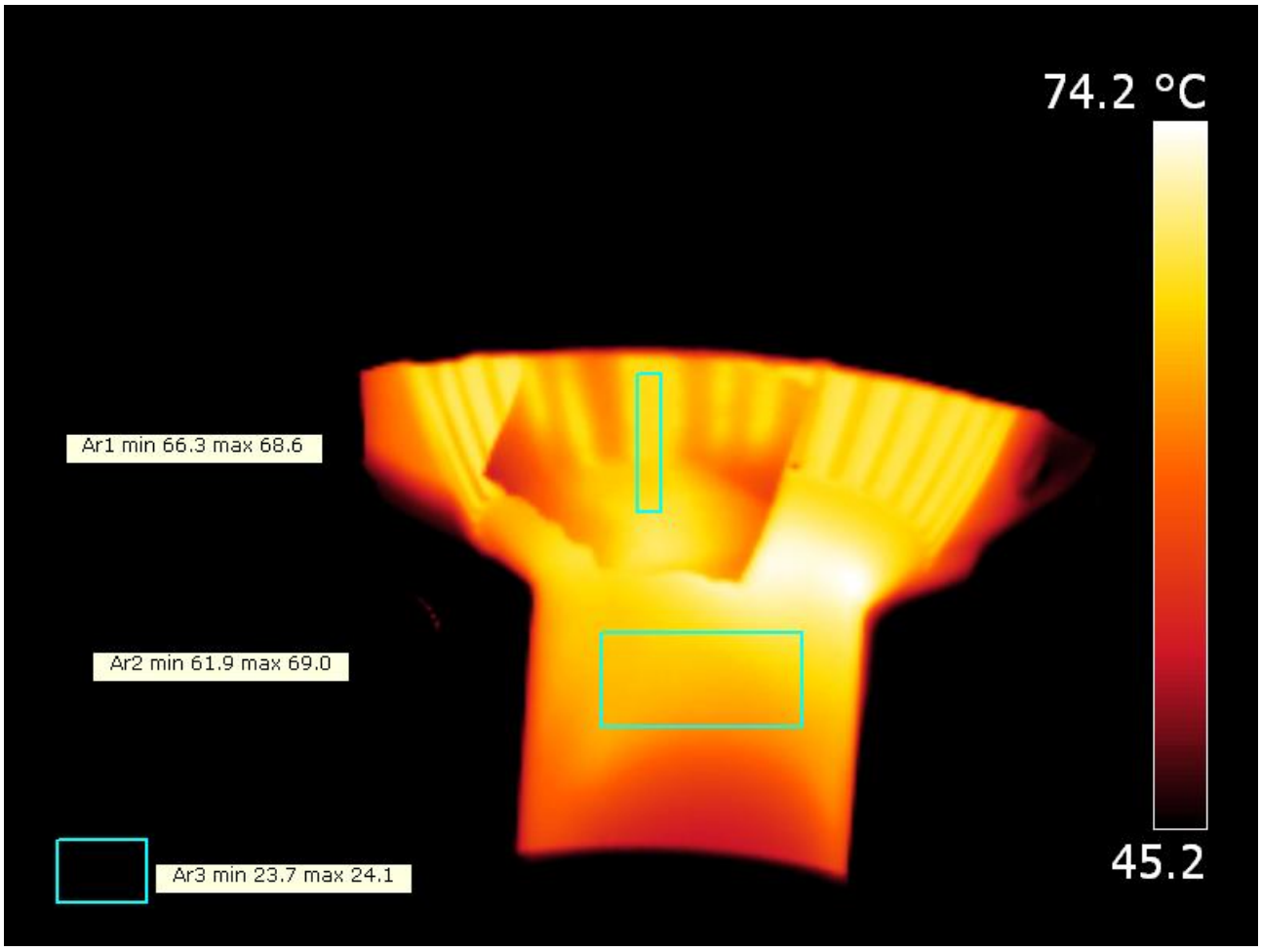
This waveforms have been checked on requirements posed by the norm IEC 61000-3-2:2006 (including up to A2:2009). See also the explanation on the OliNo website.



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 82 %.

Temperature measurements lamp



IR image from the side of the lamp

The used tape has an emissivity of about 0.95. The metal on the side has a comparable emissivity (same color on this IR photo) and the white material on the base also has a (comparable) high emissivity.

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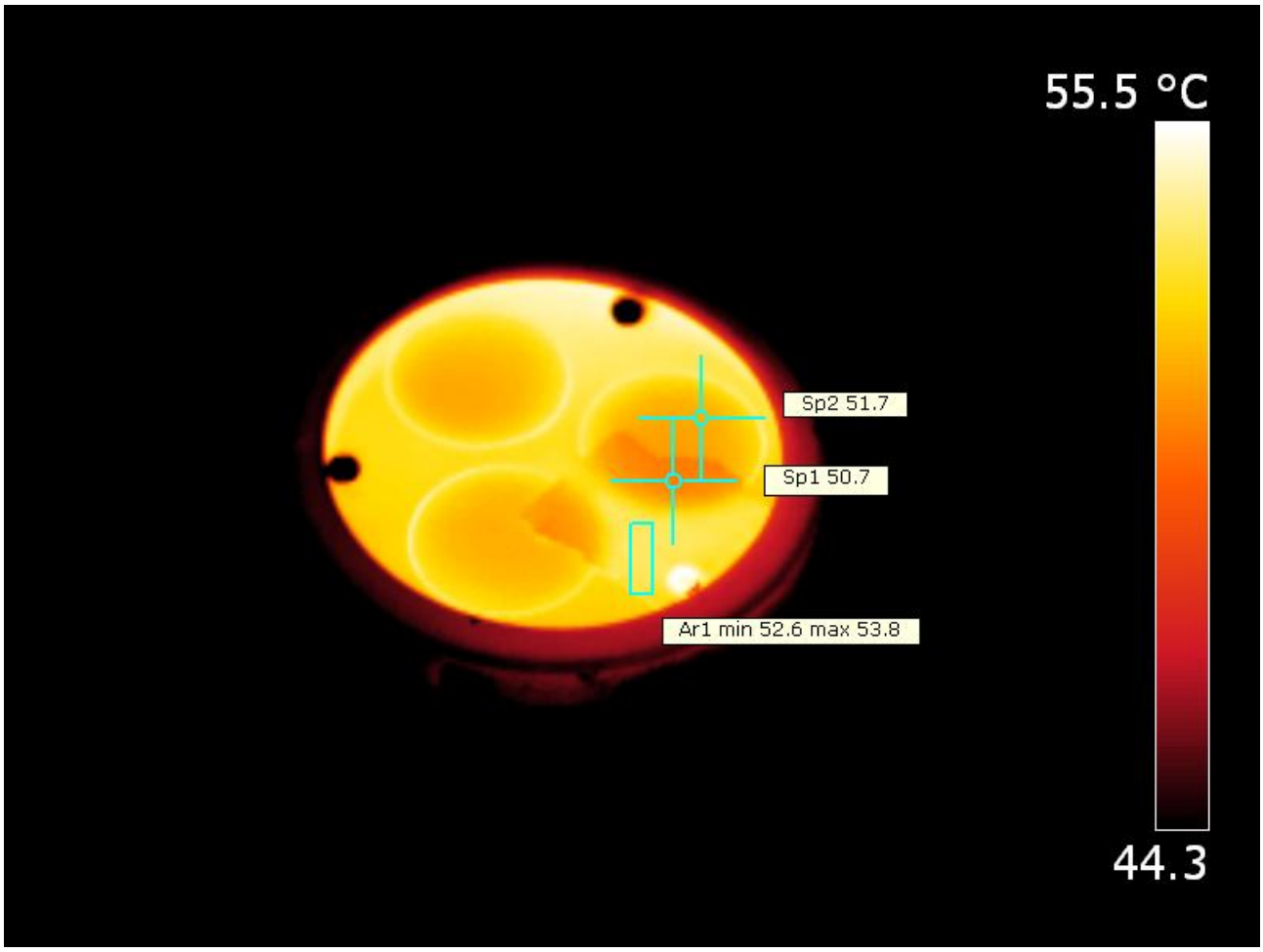


The top of the lamp.

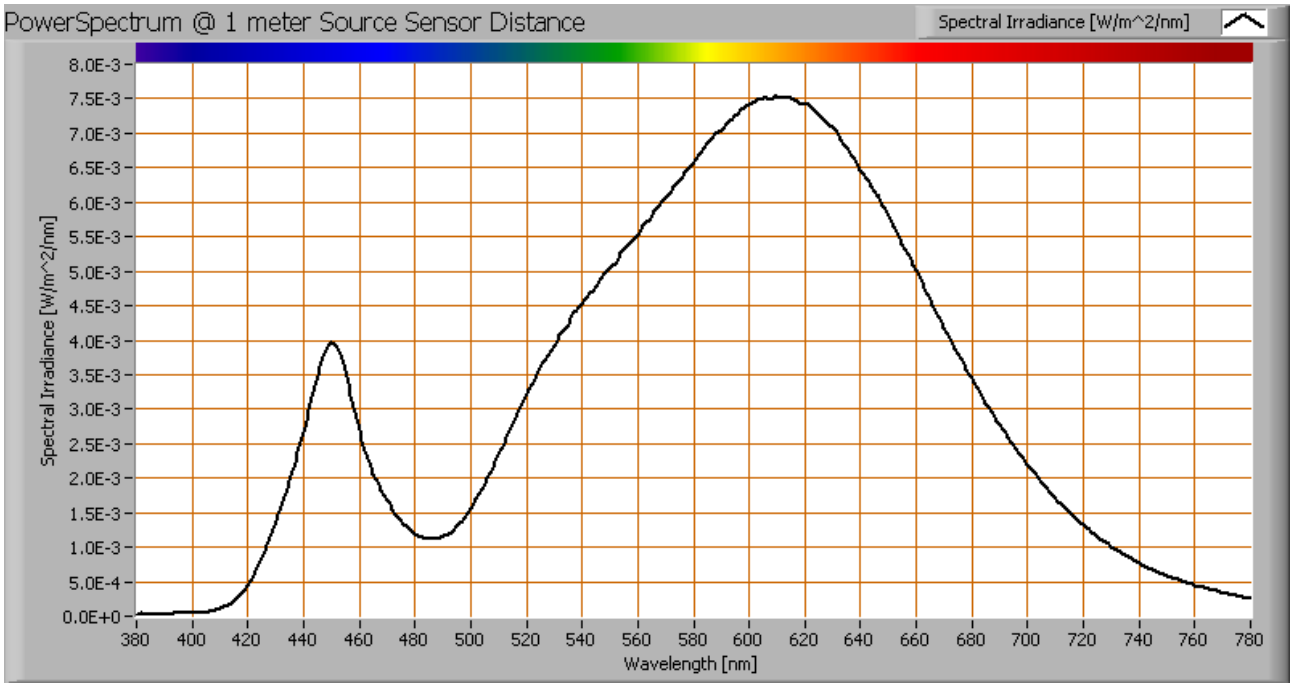
Tape has been used to not have an issue with reflections of temperature of the surroundings. The i photo shows little temperature difference between the taped parts and the tempertaure of the parts directly measured. While the temperature is significantly higher than ambient, this almost equal temperature shows the same emissivity.

status lamp	> 2 hours on
ambient temperature	24 deg C
reflected background temperature	24 deg C
camera	Flir T335
emissivity	0.95(1)
measurement distance	0.2 m
$IFOV_{geometric}$	0.3 mm

NETD (thermal sensitivity)	50 mK

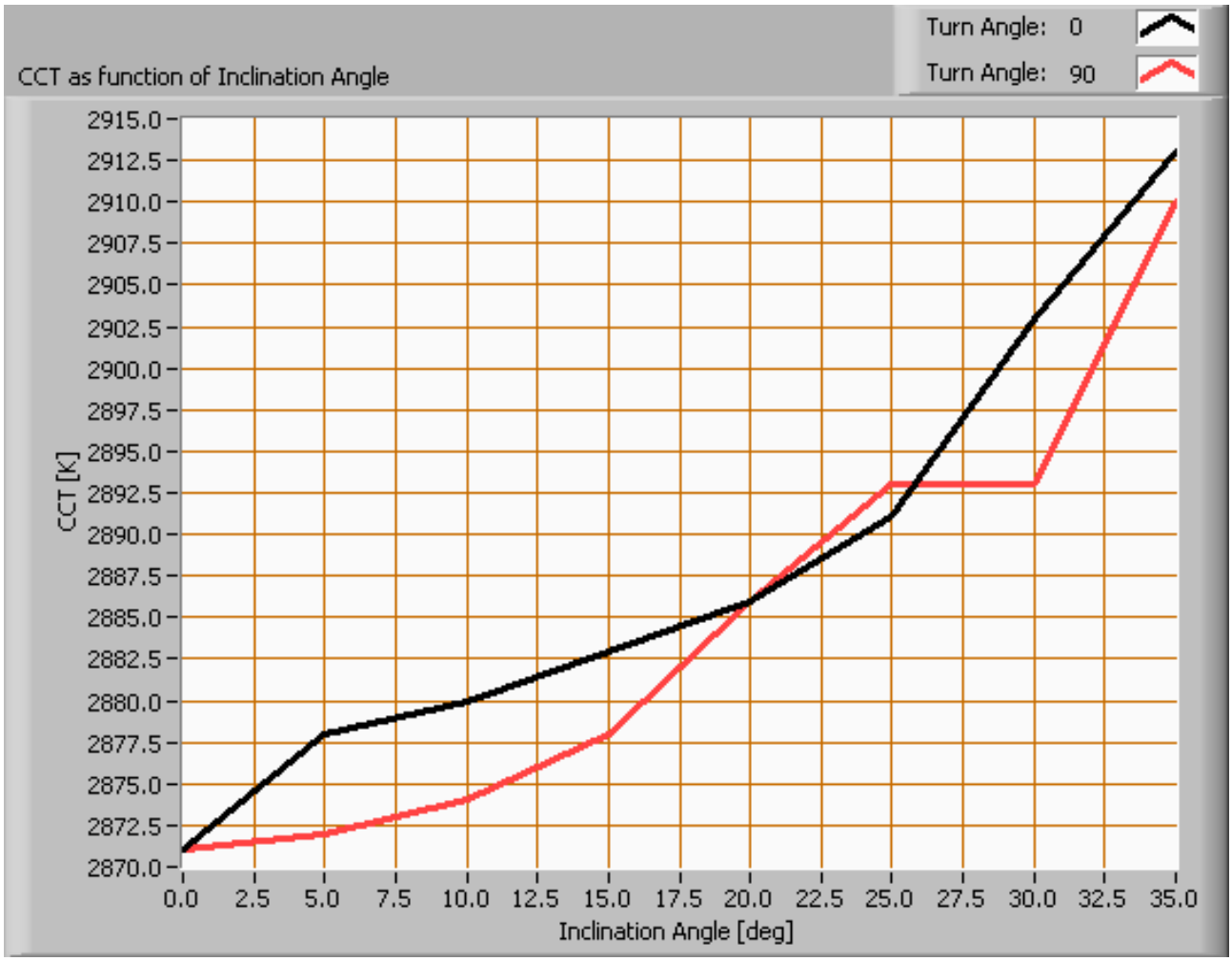
(1) See text for explanation.

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 2875 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.



Color temperature as a function of inclination angle.

The measurement of CCT is measured for inclination angles up to 35°. Beyond that angle the illuminance was very low (< 5 lux).
The beam angle is 29°, meaning a 14.5° inclination angle. In this area most of the light is present. The variation in correlated color temperature in this area is about 1 %.

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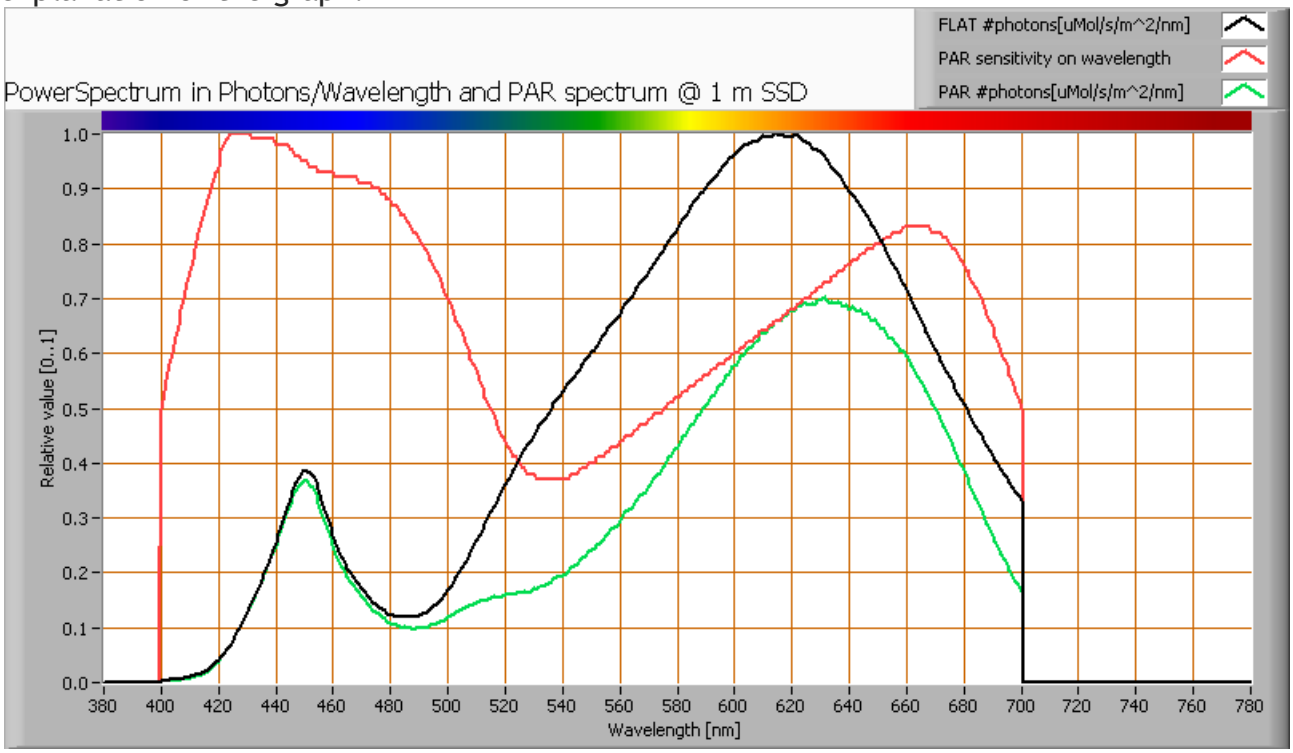
PAR value and PAR spectrum

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.



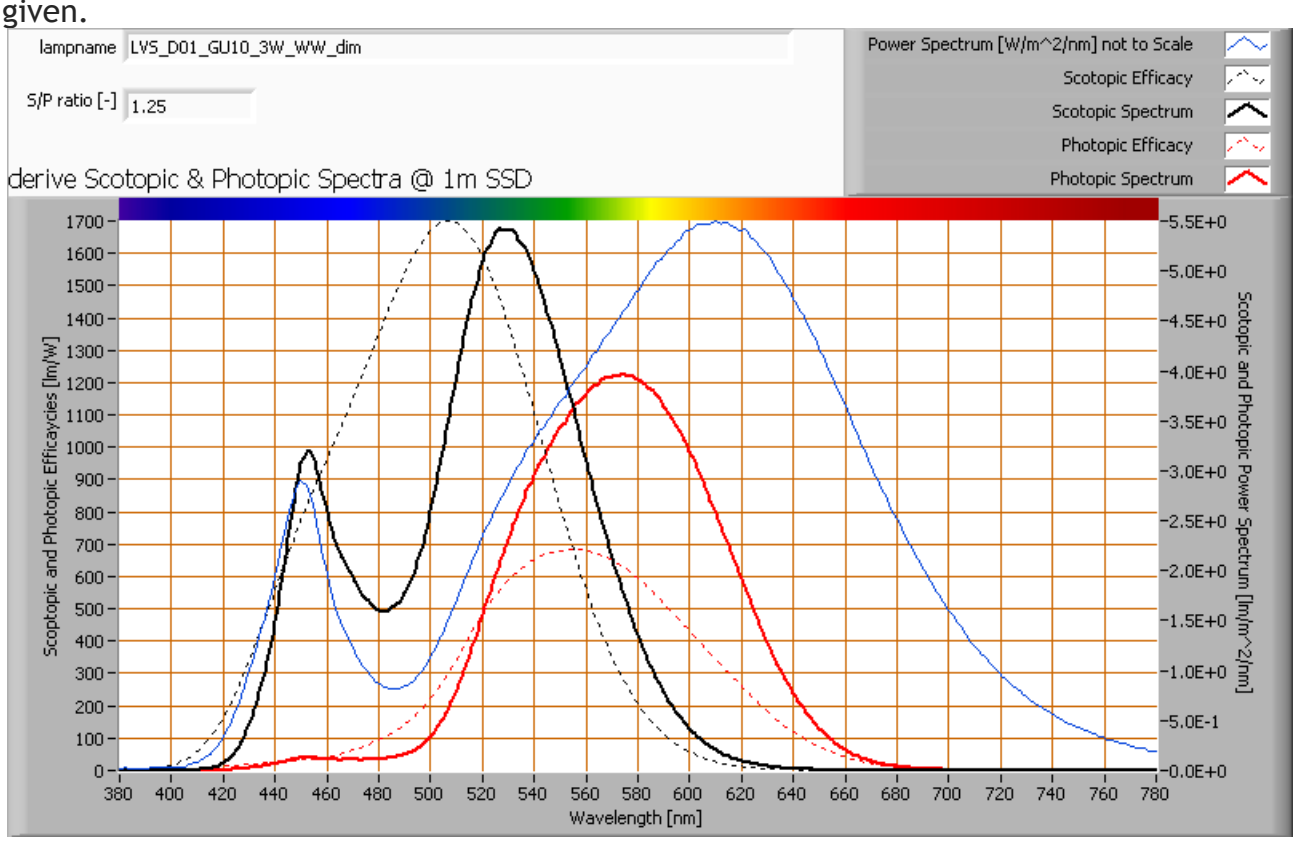
The photon spectrum, then the sensitivity curve and as result the final PAR spectrum of the light of this light bulb

parameter	value	unit
PAR-number	3.8	µMol/s/m²
PAR-photon current	1.4	µMol/s
PAR-photon efficacy	0.3	µMol/s/W

The PAR efficiency is 65 % (valid for the PAR wave length range of 400 – 700 nm). So maximally 65 % 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 %).

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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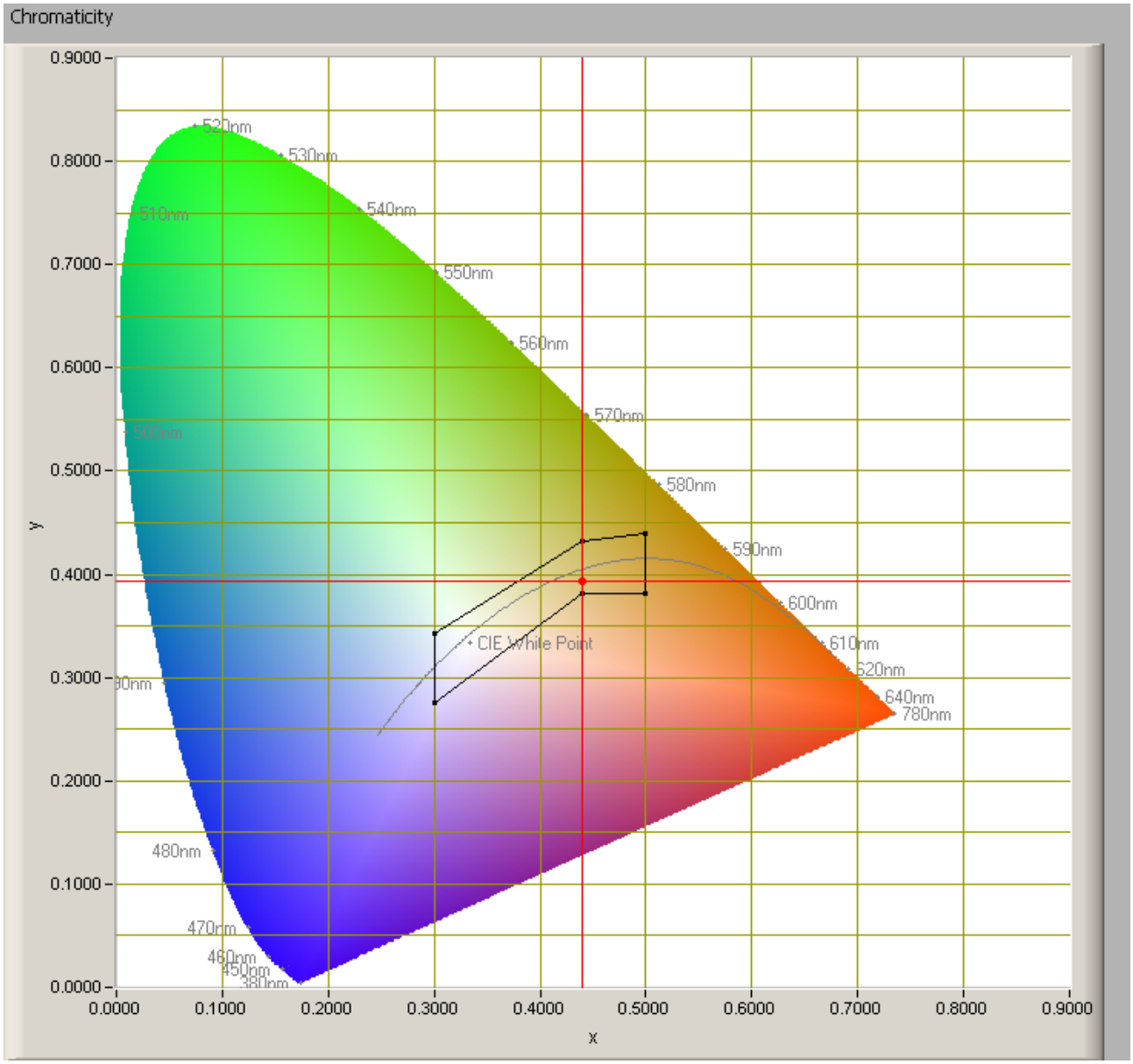
Chromaticity diagram

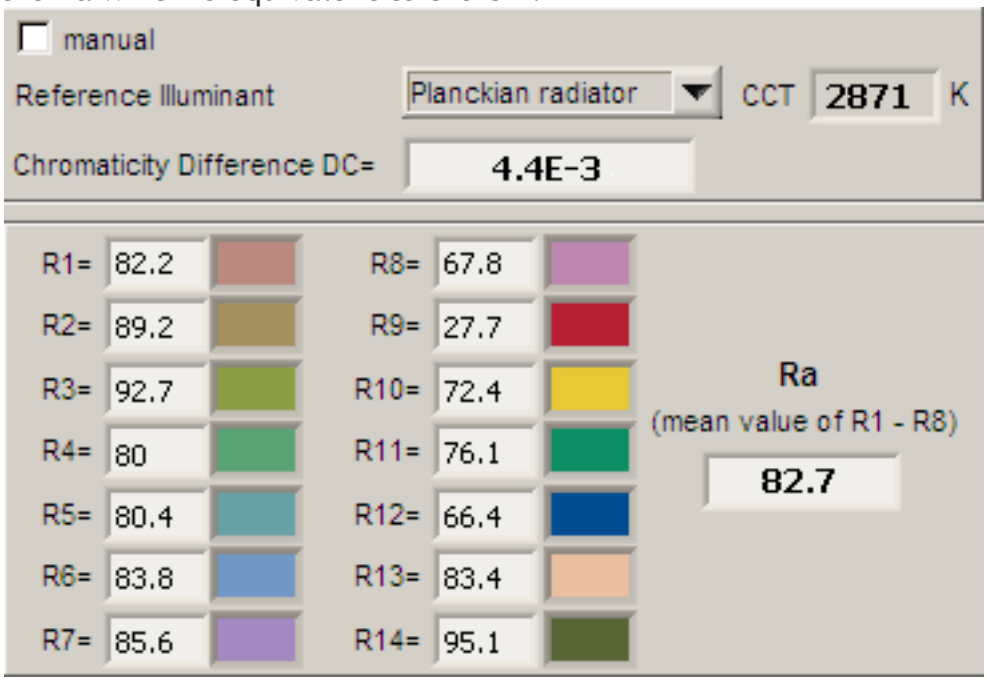


The chromaticity space and the position of the lamp's color coordinates in it.

The light coming from this lamp is at the border of areas of class A and B. These classes indicate areas that are defined for signal lamps, see also the OliNo website.
Its coordinates are x=0.4394 and y=0.3938.

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.



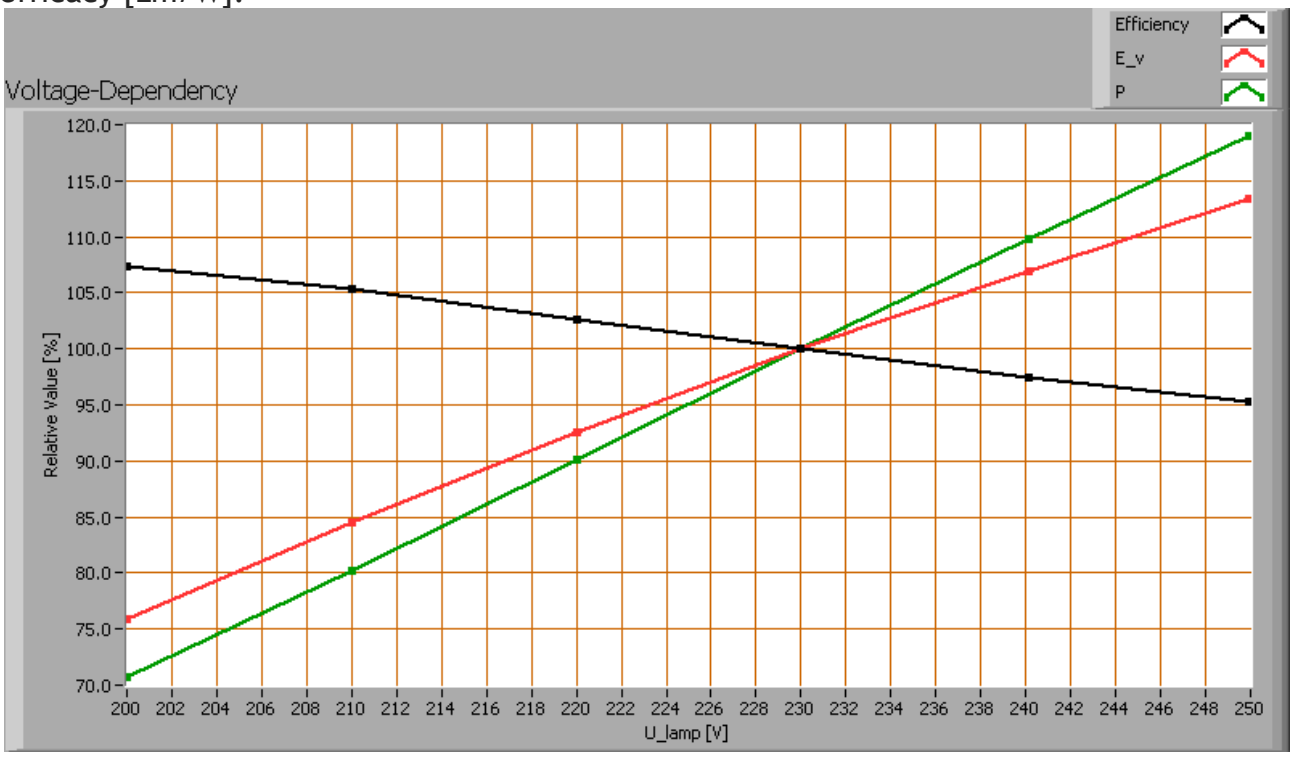
CRI of the light of this lightbulb.

The value of 83 is higher than 80 which is considered a minimum value for indoor usage. Note: the chromaticity difference is 0.0044 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 do vary on a linear manner when the voltage is varied. This is to be expected when the lamp is dimmable.
When the voltage at 230 V varies with + and - 5 V, then the illuminance varies about 5 %, 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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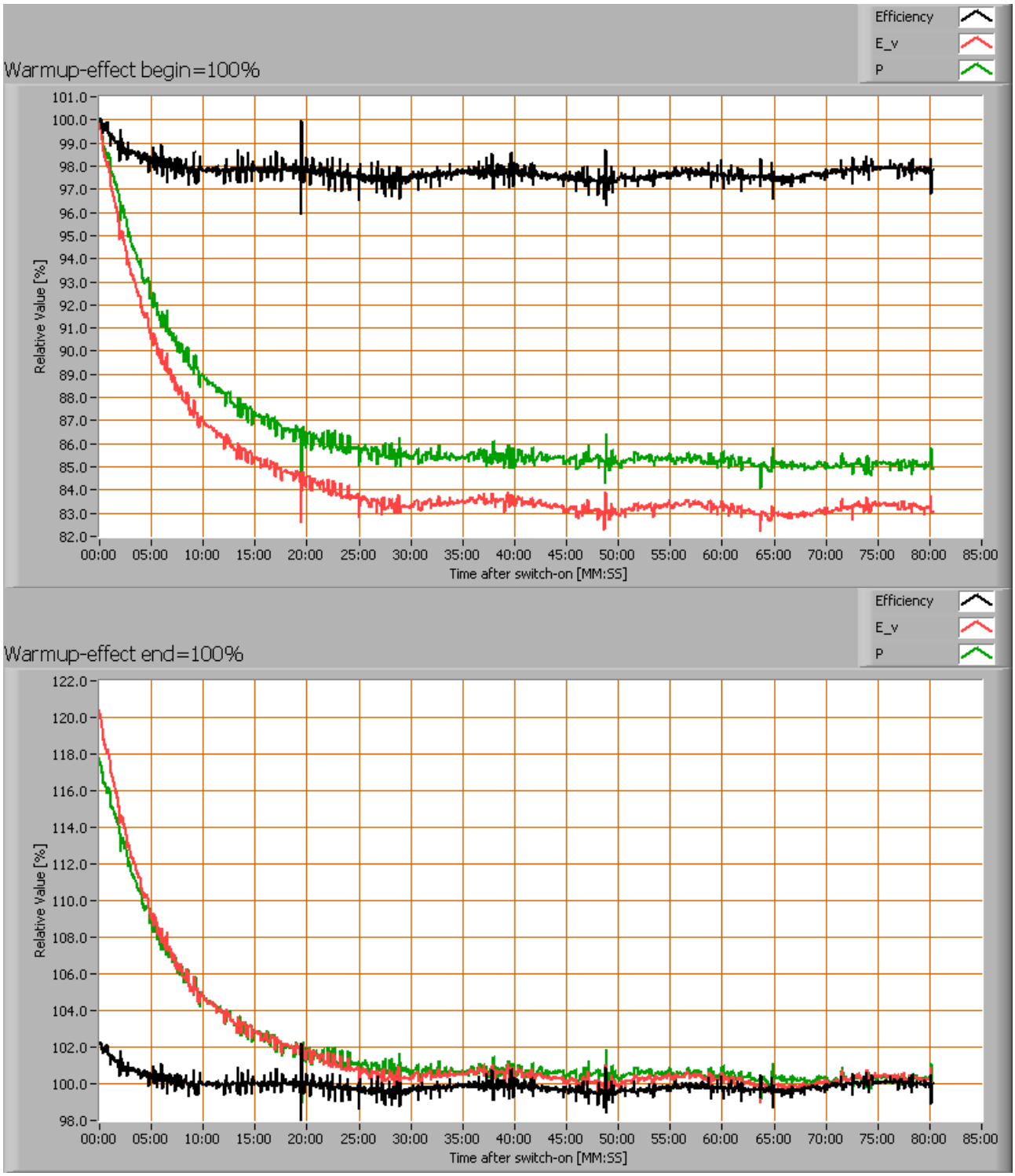
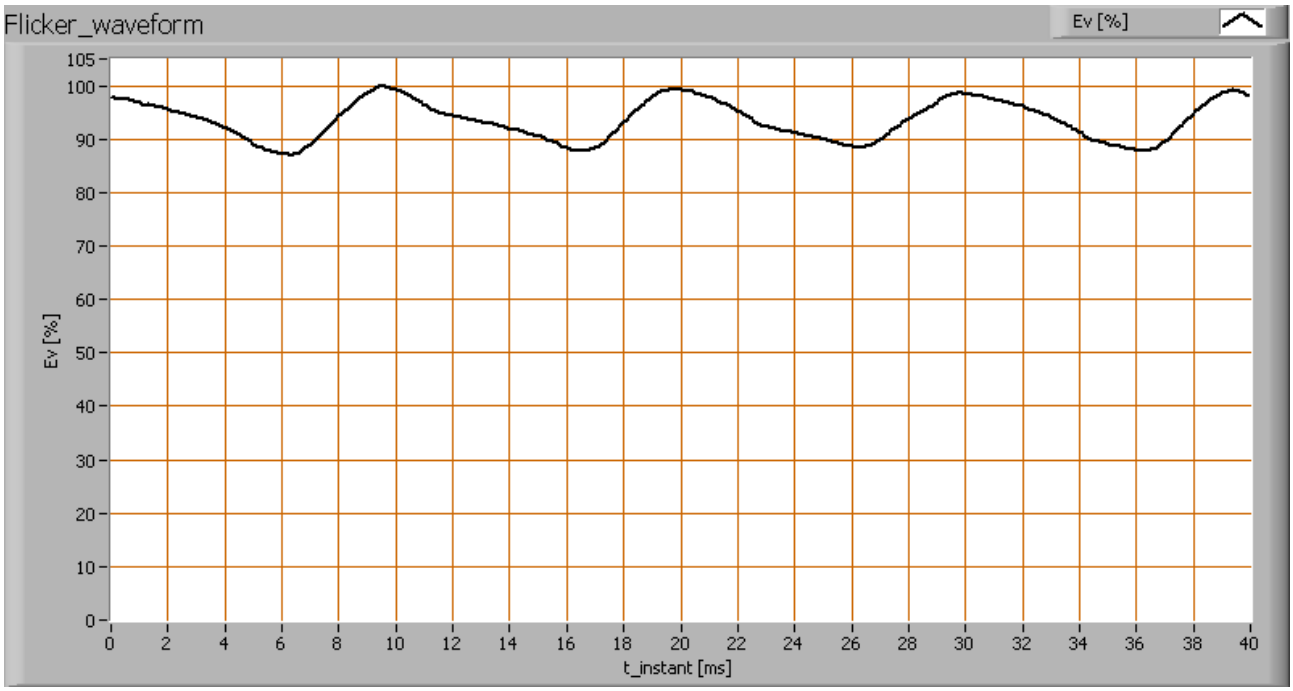


Effect of warming up on different light bulb parameters. At top the 100 % level is put at begin, and at bottom at the end.

The warm up time is about 25 minutes, during which the illuminance decreases with 17 % and the consumed power with 15 %.

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

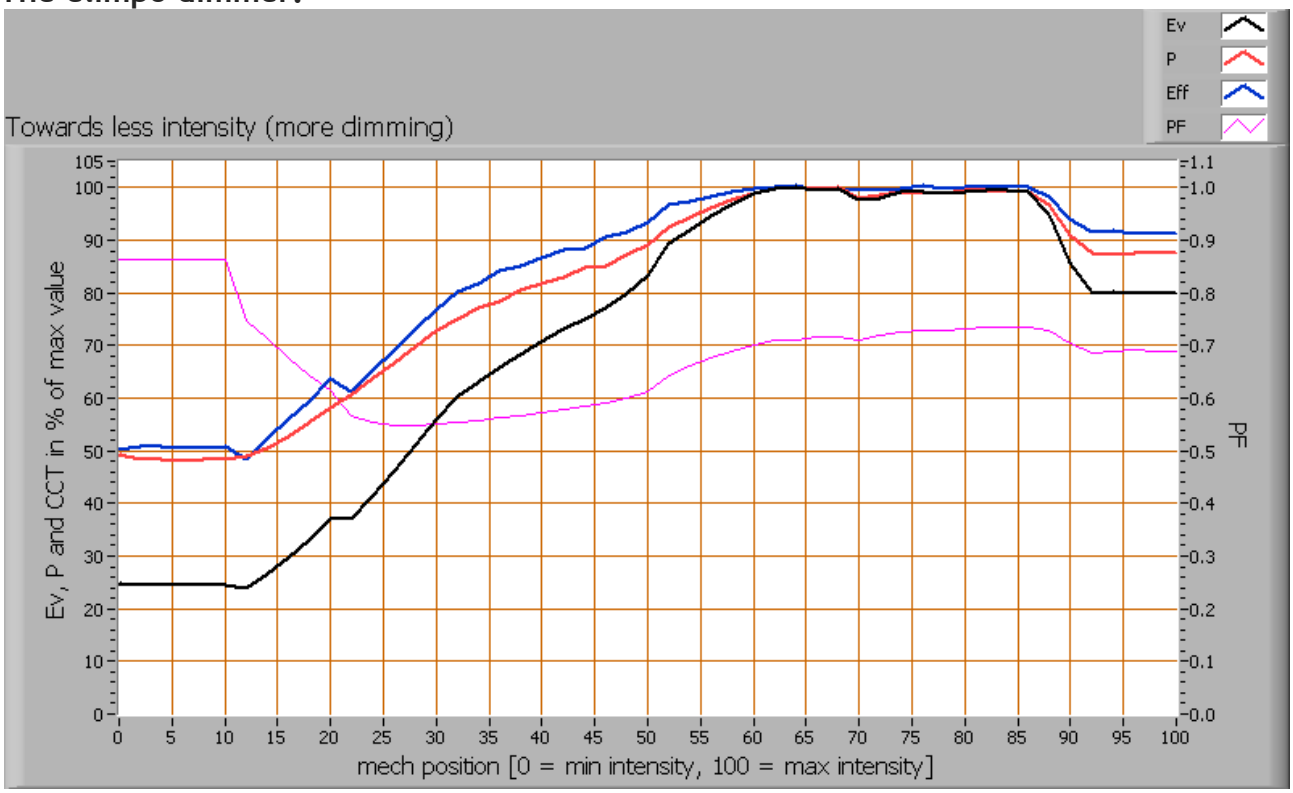
parameter	waarde	eenheid
Flicker frequency	100	Hz
Illuminance modulation index	7	%

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

Dim-ability

The lamp is dimmable with the following dimmers: the elimpo, Gira RL and the low power LRC dimmer. See for the dimmers and their spec a practical article on the dimmers on the OliNo website.

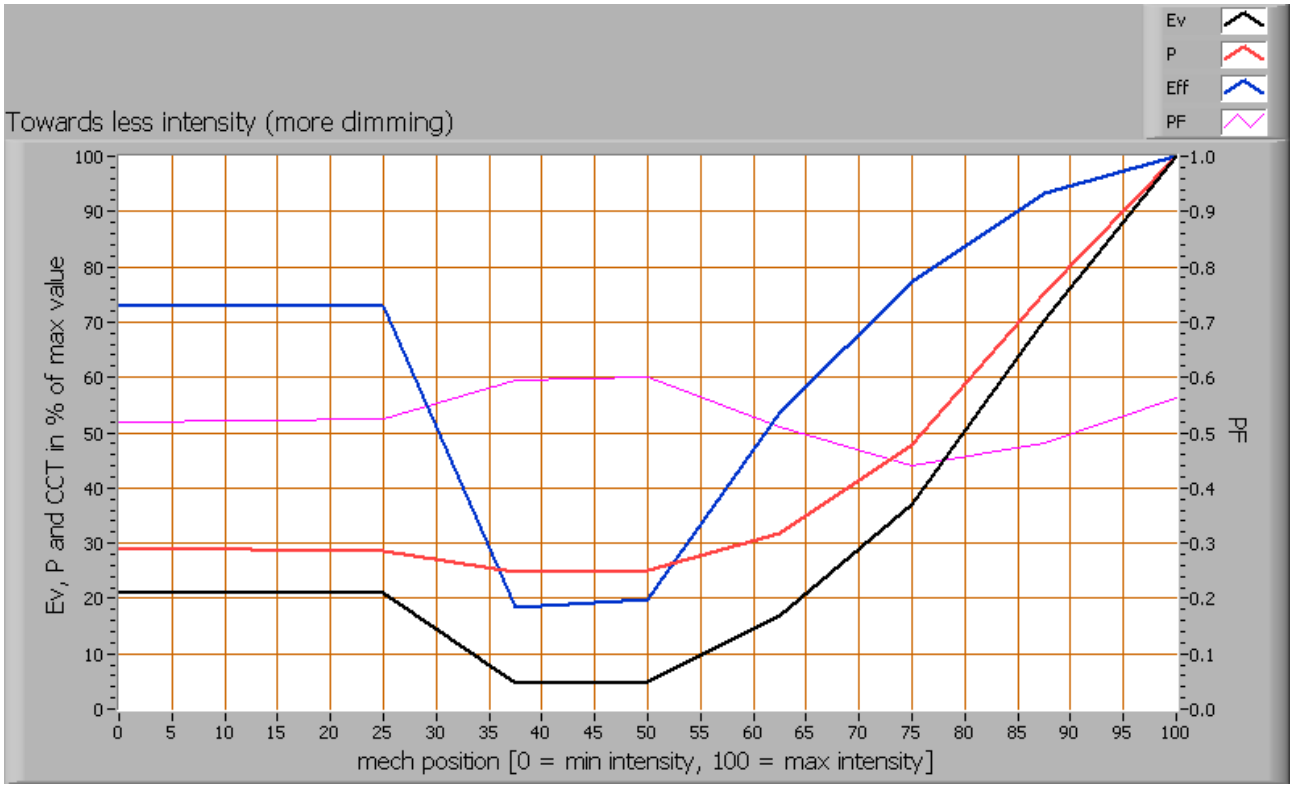
The elimpo dimmer.



Dimming with the elimpo dimmer.

Intensity: dimmable in mechanical area between 25 – 80 %.
The consumed power decreases slowly and somewhat less fast as the illuminance decreases, resulting in a decreasing efficacy.
The variation possible in illuminance is between 25 – 100 %.
The decrease of illuminance when the dimmer is inserted and put in its mechanical position with max output (80%), is 10 %.

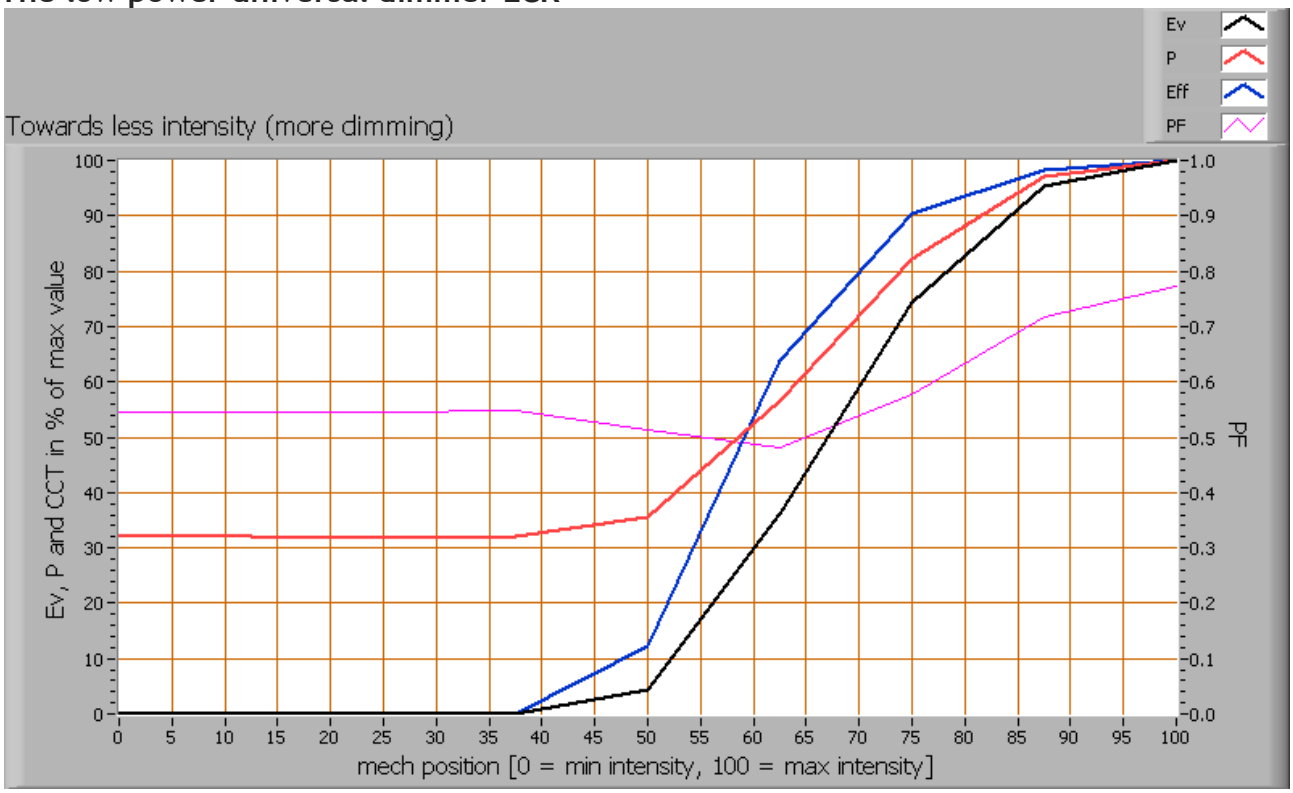
The GIRA LR dimmer



Dimming with the Gira LR dimmer

Intensity: dimmable in mechanical area between 50 – 100 %.
The consumed power decreases slowly and somewhat less fast as the illuminance decreases, resulting in a decreasing efficacy.
The variation possible in illuminance is between 5 – 100 %. Illuminance increases at very high dimming.
The decrease of illuminance when the dimmer is inserted and put in its mechanical position with max output (100%), is 20 %.

The low power universal dimmer LCR



Dimming with the universal dimmer for low powers

Intensity: dimmable in mechanical area between 50 – 100 %.
The consumed power decreases slowly and somewhat less fast as the illuminance decreases, resulting in a decreasing efficacy.
The variation possible in illuminance is between 0 – 100 %.
The decrease of illuminance when the dimmer is inserted and put in its mechanical position with max output (100%), is 20 %.

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