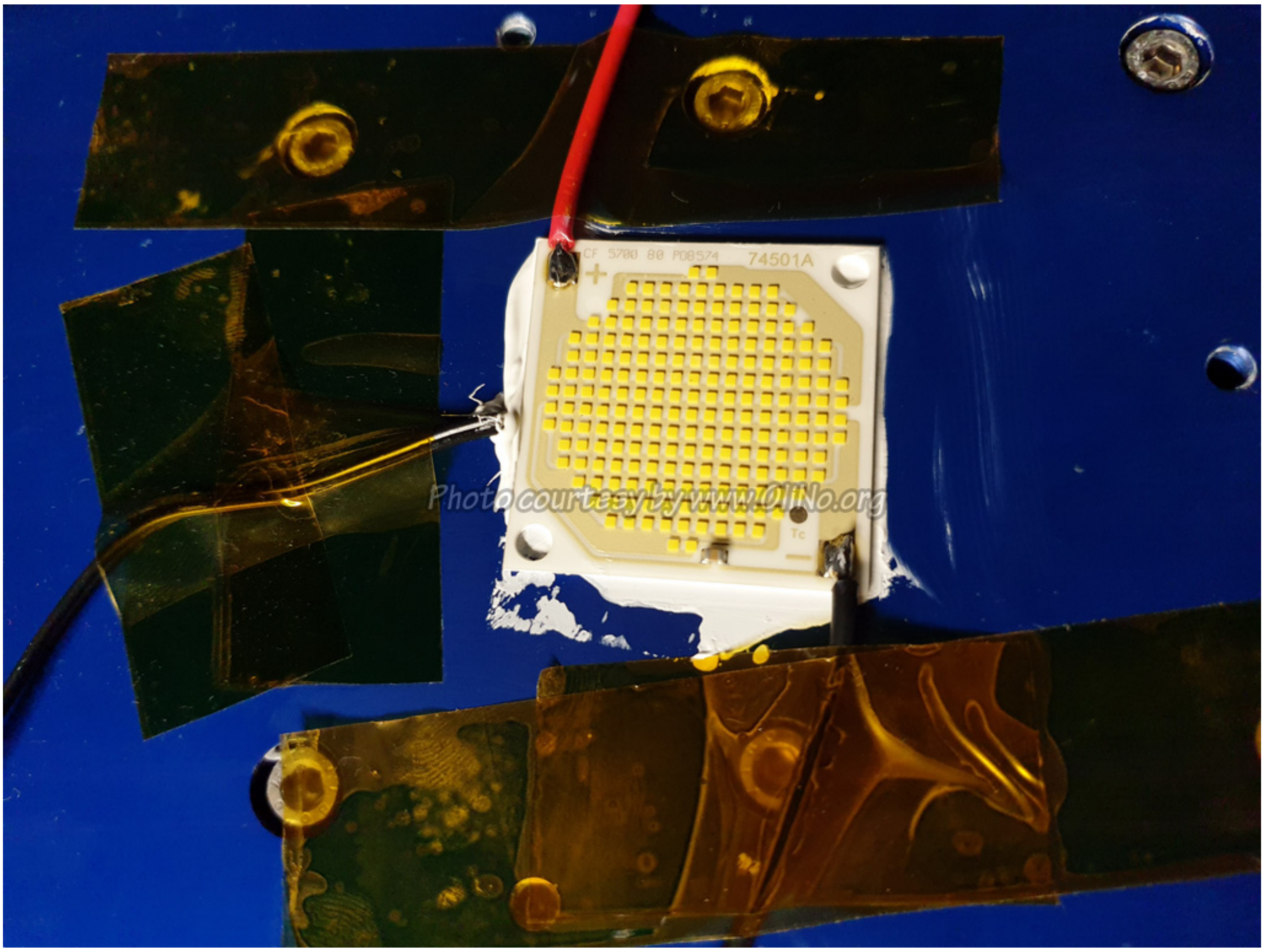
LED measurement report – Day Month Year

LEDCHIP

by

Customer



LED measurement report – Day Month Year

Summary measurement data

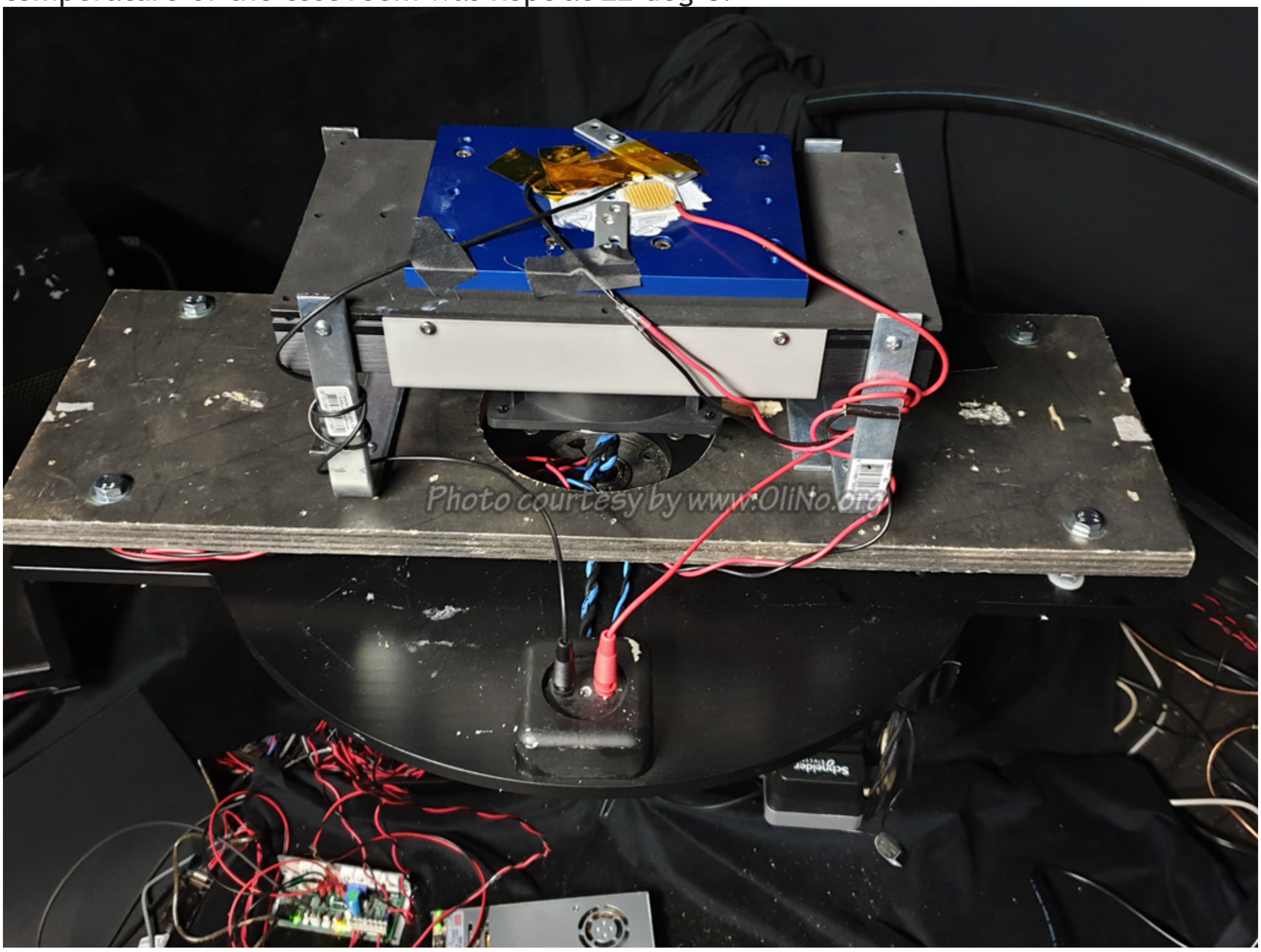
I_meas [A]	U_f [V]	Flux [lm]	P [W]	Eff [lm/W]	T_LED [C]	Remark
1.99	54.2	14.9 k	108	138	24.8	
2.75	56.0	19.7 k	154	128	24.7	
3.50	57.7	24.2 k	202	120	24.9	
4.26	59.2	28.4 k	252	113	24.7	
4.93	60.5	31.9 k	298	107	24.7	
T_amb = 22 C						

Measurement setup

MOUNTING OF LED

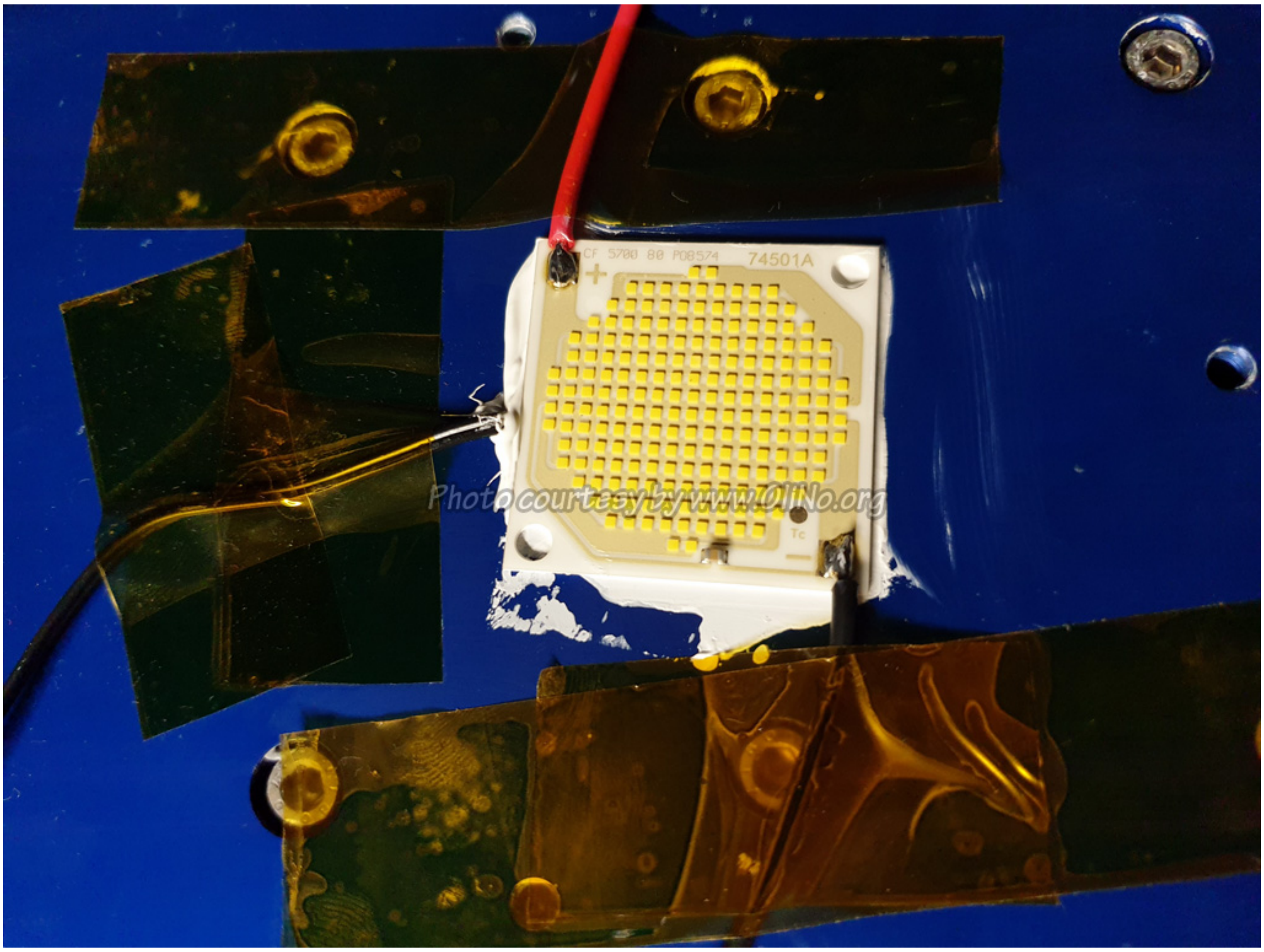
Measurements done on Thermo Electroc Cooler that can handle 160W (however distributed over all blue plate).

Mounting of the LED chip on te blue plate is done with help of thin layer of white cool paste. Connections are soldered directly on the LED chip. The temperature sensor is put next to the LED chip with Kapton tape and its setpoint was 25 deg C. The ambient temperature of the test room was kept at 22 deg C.



The image above shows the wooden mounting board on which the Thermo Electric Cooler is mount. The blue metal plate is the one on top of the Peltier modules. On top of this blue plate is the LED chip.

The plus and minus leads are directly soldered onto the LED chip. The temperature sensor is next to it, held on its place by Kapton tape.



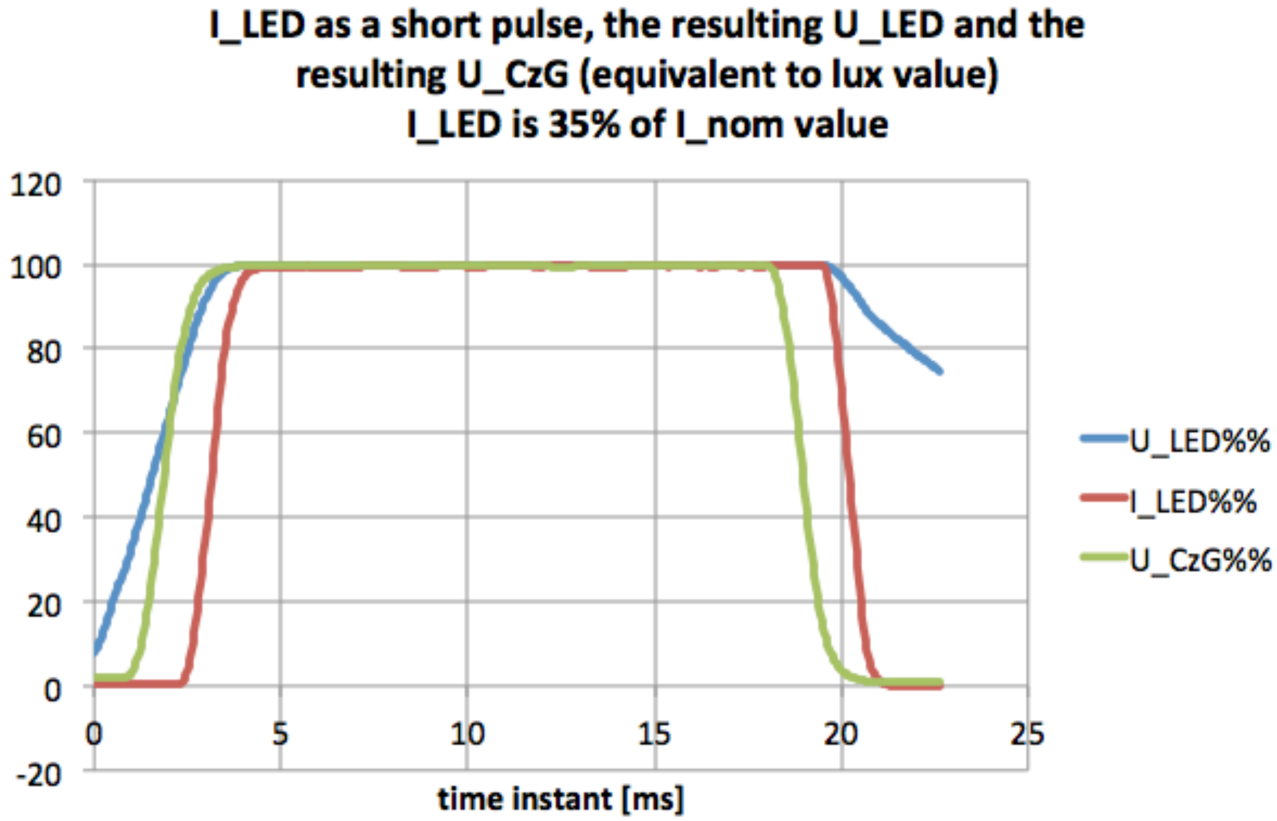
The controller has been set to maintain 25 deg C at the temperature sensor. The ambient temperature (in the test room) at 1 m distance of the test setup is controlled at 22 deg C.

POWERING OF LED

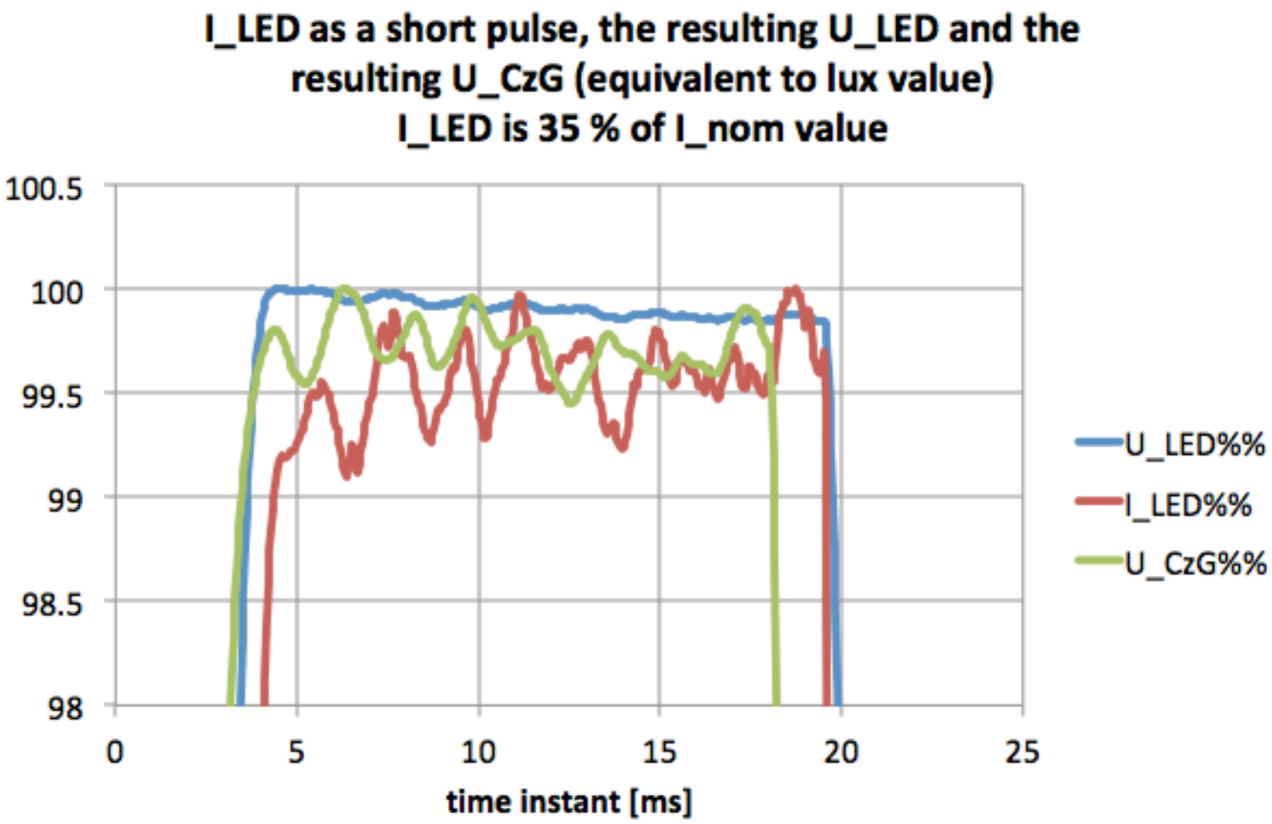
The current to the LED is given by a fast DC power supply, capable of sending a short (20 ms) current pulse through the LED. This results in a short light pulse coming from the LED. The light sensor used is very fast (bandwidth at least 10 kHz) so changes in amount of light during ms can easily be followed.

Since this pulse is very short, as a result the LED barely heats up during this pulse. However at nominal and higher currents even during the 20 ms there has been seen a small decrease in amount of light coming from the LED (generally a 1 to 2 % decline relative to the max value) so that the max value of light is extracted from the measurement (after averaging over 1 ms wide in order not to be too sensitive to small peaks).

Here an example of a pulse measurement on a pulse far lower than Inominal:



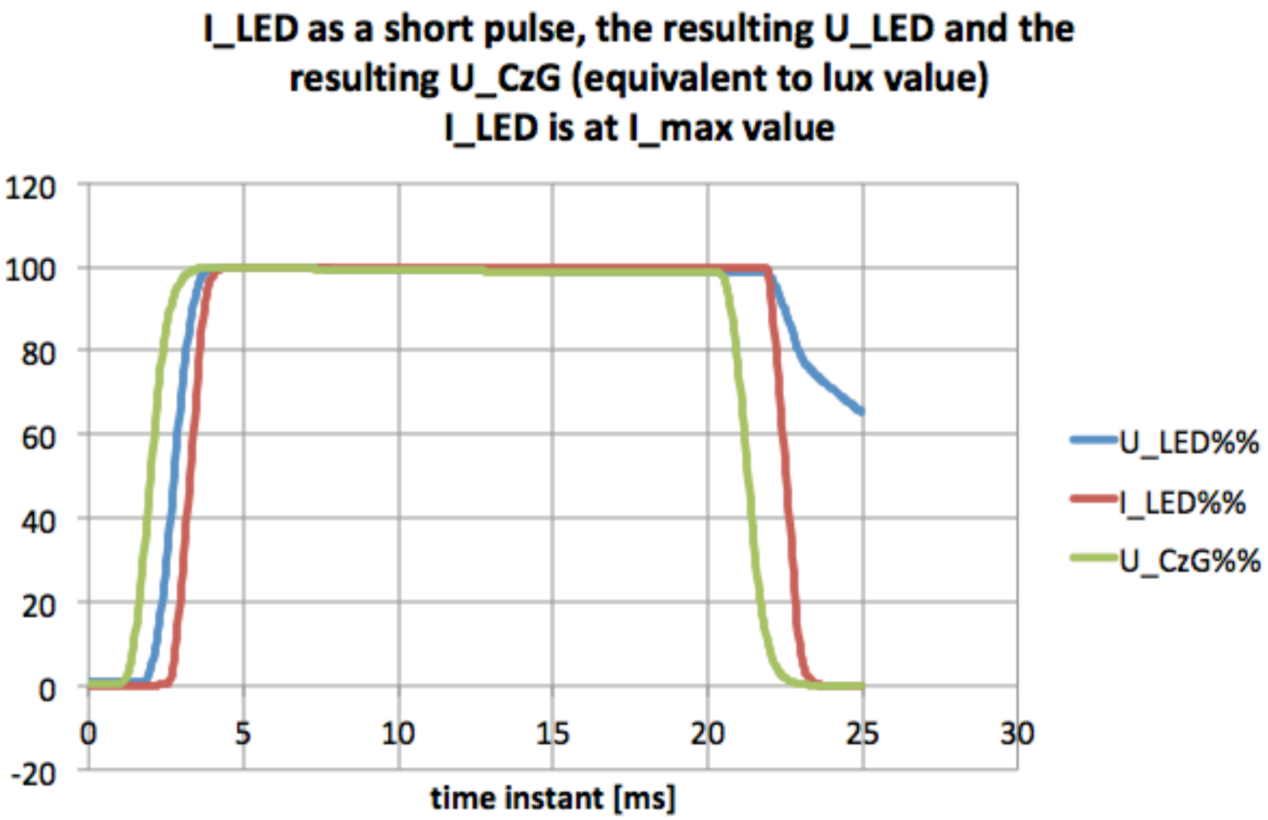
The current pulse is less than 20 ms wide. All curves look straight at the 100 % level but let's zoom in:



When zoomed in, we can see that the current is relatively constant at around 99.5 % of its max value. Then the voltage is slowly decreasing in value from 100 % to 99.85 % and the lux value (U_CzG) is effectively constant over de 12 ms that the pulse is wide.

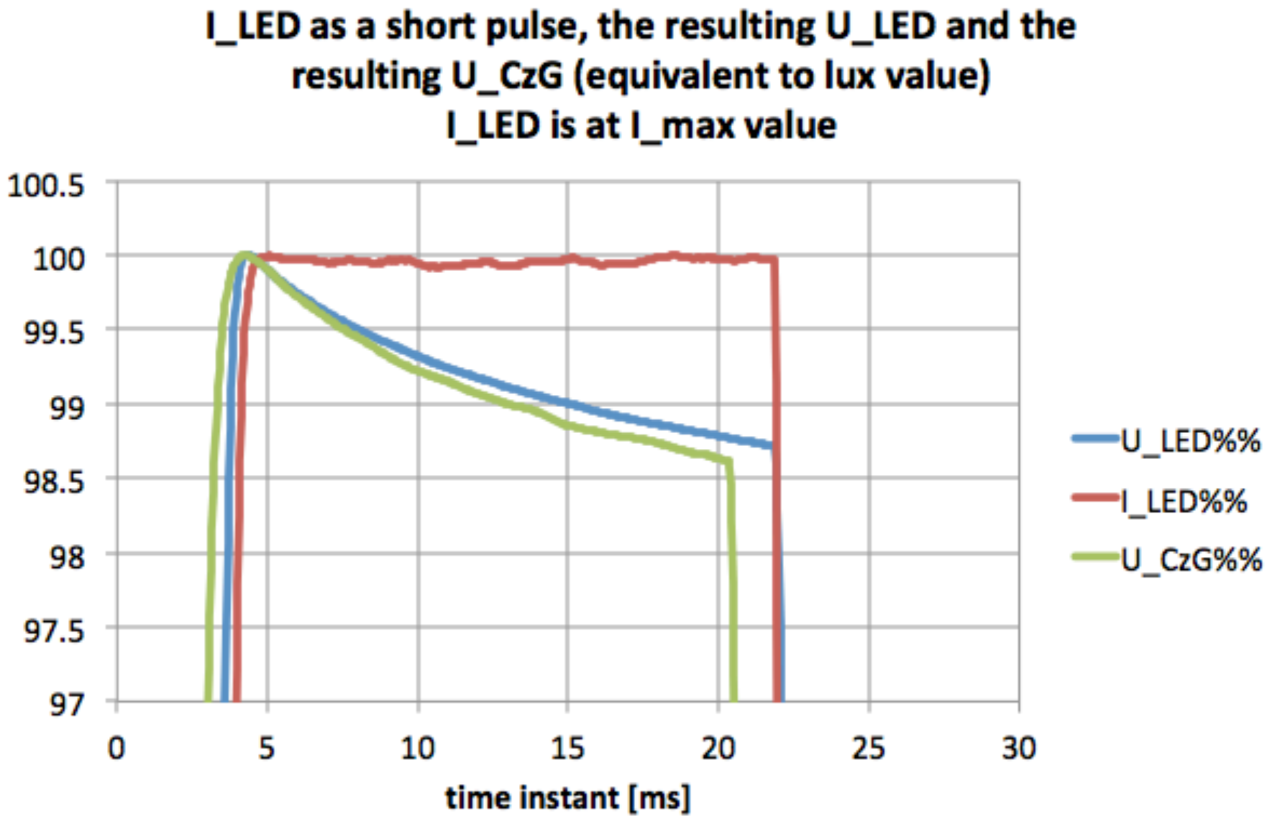
This way, we could define a lowest level above which we consider the values to be averaged to get the results for current, voltage and lux value.

However, here an example of a pulse measurement on a pulse at Imax:



The current pulse is less than 20 ms wide. All curves look at first sight straight however one can see that the U_CzG is decreasing over de pulse width towards the end of it. So let’s zoom in:

LED measurement report – Day Month Year



This way we can easily see (1) that both the voltage and the lux value (U_CzG) are decreasing notably over the length of the current pulse. And (2) that the current value remains well constant. Note that for these graphs n averaging filter of 1 ms period has been used.

The amount of light falls to about 1.5 % less than its maximum value. Therefore, after the averaging, we decided to take the max value as the required value.

It is important that the metal plate of which the LED is mount, is kept at a constant temperature. Measurements done show a variation between 24.7 – 25.3 deg C.

When doing several times the pulse measurement, there is a small variation in the value of the max lux value. This value varies over a range of 0.5 %.

Measurements and calculations

Find U_CzG max during pulse

First the pulse measurements are done. Short current pulses are applied to the LED while the LED is on a temperature controlled metal plate. During the pulse, the current, voltage and sensor amplifier voltage are measured. This last value is a value that indicates the lux value however is measured in volts (not yet in lux).

First the interesting part of the pulse is taken, in this case all values that are higher than 97 % of the max value measured. This is for all three signals.

Then a averaging filter of 1 ms period time is used to flatten the signals. After all, the max value of U_LED and U_CzG (equivalent to lux) are taken and the average value of I_LED.

Find relation U_CzG to lux

After the pulse measurement, a measurement that lasts a several seconds, is done where the LED is powered with the same current and while being powered, every 100 ms the average U_CzG is measured but at the same period the lux value is retrieved digitally from the lux sensor amplifier. This way we have a lux value and a voltage value that can be related. A number of 100 ms cycles of the last part of the total measurement period are used to determine a stable average value of the factor to go from U_CzG to real lux value.

Find relation lux straight in front of LED to luminous flux

Once this all is determined, then at nominal current the LED is set to and then it is allowed to stabilize. Once the LED output in lux and in power consumption is stable, then a goniometric measurement is done. Note that the LED is still on the temperature controlled plate and as long as the total consumed power of the LED is not too high (less than 80 Watts), then the plate can still be kept at a 25 deg C temperature. The junction temperature of the LED will be higher though, but the intent here is to find a relation between the lux value measured straight in front of the LED and its related luminous flux.

Comparisons and results

First we can compare the lux value at the max value during the pulse with the lux value after the LED has been stable when powered for a longer time with a constant current. This shows in how much more the LED will give when the junction temperature is at 24.8-25.2 deg C, compared to a situation where the base plate on which the LED is mounted is at 25 deg C and the LEDs junction temperature is somewhat hogher (and unknown).

Finally, we get to the desired luminous flux value for a junction temperature of 25 deg C when we compute:

Flux_maxPulse = E_v_maxPulse / E_v_stablePowered * Flux_stable_powered

Relation Ev and Luminous Flux

Current measurement done at 400mA. This means that the cooling plate can easily keep temp of cooling plate at 25 deg C as the power drawn by the LED is very low. The only interest is to get the relation between Ev straight underneath the LED and the luminous flux. This relation is the same for all subsequent measurements at higher currents.

Ev_straight underneath the LED: 1036.70 lux

Luminous flux calculated: 3317.5 lm

For information: stable measurement done at 400 mA gives P = 19.54 W and hence efficacy = 169.8 lm/W.

The factor to be used to go from Ev to luminous flux is 3317.5 /1036.70 = 3.2001

1990 mA (pulse meas)

Pulse measurements:

	m1	m2	m3		avg	
Ev [lx]	4653.183	4649.175	4650.555		4651.0	
T_LED[C]	24.79	24.83	24.65		24.8	
U_LED[V]	54.222	54.198	54.203		54.21	
I_LED[mA]	1990	1990	1990		1990	
P_avg	107.9					

The factor to be used to go from Ev to luminous flux is 3.2001

So luminoux flux = 3.2001* 4651.0= 14884 lm.

Efficacy= 14884/107.9 = 137.9 lm/W

LED measurement report – Day Month Year

2745 mA (pulse meas)

Pulse measurements:

	m1	m2	m3		avg	
Ev [lx]	6157.468	6159.151	6159.4		6158.7	
T_LED[C]	24.84	24.69	24.67		24.7	
U_LED[V]	56.034	56.034	56.032		56.032	
I_LED[mA]	2745	2745	2745		2745	
P_avg	153.8					

The factor to be used to go from Ev to luminous flux is 3.2001

So luminoux flux = 3.2001 * 6158.7= 19708 lm.

Efficacy= 19708/153.8 = 128 lm/W

LED measurement report – Day Month Year

3500 mA (pulse meas)

Pulse measurements:

	m1	m2	m3		avg	
Ev [lx]	7553.336	7546.781	7545.721		7548.6	
T_LED[C]	25.05	24.69	24.92		24.9	
U_LED[V]	57.752	57.732	57.697		57.73	
I_LED[mA]	3500	3500	3500		3500	
P_avg	202.0					

The factor to be used to go from Ev to luminous flux is 3.2001

So luminoux flux = 3.2001 * 7548.6= 24156 lm.

Efficacy= 24156/202.0 = 119.6 lm/W

4256 mA (pulse meas)

Pulse measurements:

	m1	m2	m3		avg	
Ev [lx]	8860.437	8866.366	8865.502		8864.1	
T_LED[C]	24.67	24.65	24.81		24.7	
U_LED[V]	59.252	59.221	59.198		59.22	
I_LED[mA]	4256	4256	4256		4256	
P_avg	252.0					

The factor to be used to go from Ev to luminous flux is 3.2001

So luminoux flux = 3.2001 * 8864.1 = 28366 lm.

Efficacy= 28366/252.0 = 112.6 lm/W

4932 mA (pulse meas)

Pulse measurements:

	m1	m2	m3		avg	
Ev [lx]	9978.822	9984.660	9984.604		9982.7	
T_LED[C]	24.72	24.78	24.70		24.7	
U_LED[V]	60.53	60.498	60.480		60.50	
I_LED[mA]	4932	4933	4932		4932	
P_avg	298.4					

The factor to be used to go from Ev to luminous flux is 3.2001

So luminoux flux = 3.2001 * 9982.7 = 31946 lm.

Efficacy= 31946/298.4 = 107.1 lm/W