DESIGN-IN GUIDE OPTICAL LIGHT ENGINES

SLC-30

SLE-30

SLE-16

SLE-11

INTRODUCTION TO THIS GUIDE

Thank you for choosing the Soraa Optical Light Engine module. This document is intended for fixture or luminaire designers to provide information, including hints and tips, required to design this module into a luminaire. Proper integration of the module ensures best results in terms of longevity, light output and overall performance. This document helps to predict the expected performance, in line with design targets for life time.

The maximum rated drive currents given on the specification sheets are for reference only. As part of the design process, all Optical Light Engines MUST be thermally tested inside a new fixture or luminaire within its intended environmental conditions. This is to ensure the Tc temperature of the LED never exceeds 80 °C during use. Performance, lifetime, and warranty are subject to the Optical Light Engine working and storage temperature as well as the driving current.

Additional information:
On our website https://www.soraa.com/products/optical_light_engine.php you will find not only information about this module but also photometrics and an electrical compatibility guide. If you require any further information or support please consult your local Soraa representative or dealer.

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PERFORMANCE VALIDATION PROCESS

Soraa Optical Light Engines are easy to integrate. Below is a summary of the procedure to validate the performance of Soraa Optical Light Engines incorporated in a fixture. More detail on each step is provided further in this document.

Equipment needed

- Variable power supply - preset to a voltage of 35V and variable current between 0 and 700mA
- Multimeter to read out resistance between 0.5 and 50kOhm

Procedure

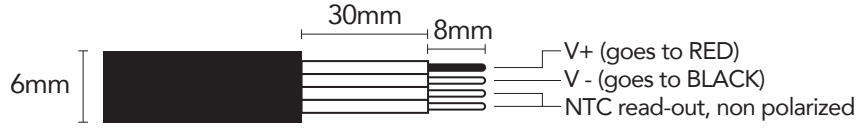
1. Determine goals for lifetime, based on color and light output maintenance
2. Incorporate Soraa Optical Light Engine into fixture and match the intended environmental conditions as closely as possible
3. Choose a current setting close to nominal
4. Allow sufficient time for thermal stabilization, then then measure LED temperature via procedure described in Thermal Integration section of this document
5. Consult the product performance tables
6. If necessary, adjust current when expectations are not met or or when temperature on the LED exceeds 80°C
7. Select driver to provide selected current

ELECTRICAL INTEGRATION

Wire information

Soraa Optical Light Engines have a 4 wire ribbon cable - 2 wires for DC power and 2 wires for NTC (thermally sensitive resistor) read-out. The wire function can be determined based on the color and location as shown on figure below.

- Wire type: 4-wire ribbon
- Wire Gauge: AWG28
- Wire tip finish: tinned
- Wire length: 430mm
- Wire harness material: transparent silicone based
- Wire-end: schematic



DRIVER SPECIFICATION

A constant current, SELV isolated, LED driver or equivalent is required. The driver shall be able to provide the specified maximum current over the entire voltage range of 20 to 35VDC. This voltage requirement is the same for all Soraa Optical Light Engines. Depending on the light engine type, the required current setting can be different. The lower end of the voltage range is related to operation at low current amplitude, for example, under current amplitude dimming.

Soraa Optical Light Engines are not designed to be driven in reverse voltage.

Light output can be varied by either Pulse Width Modulation (PWM), or amplitude variation. For uniform light output across the light beam, current amplitude of at least 20mA is recommended.

Depending on the LED driver type, good dimming compatibility can be achieved with various dimming methods, both phase cut based and 0-10V or DALI based.

Soraa recommends using one LED driver (or one driver channel in the case of a multi-channel driver) per light engine. Parallel configuration of Optical Light Engines can result in unpredictable light output and series configuration results in an increase of overall system voltage potentially beyond the design limits of the product.

Several market-available driver types have the capability to include the NTC as an input to the driver and provide thermal feedback. This can be used to ensure that the Optical Light Engine cannot exceed set temperature limits.

MECHANICAL INTEGRATION

Soraa Optical Light Engines have been developed to provide multiple options for integration into a fixture. Optical Light Engines with heatsink (part number starting with SLE) can be operated without additional heatsinking. Optical Light Engines without a heatsink (part number starting with SLC) require additional heatsinking, which can be in the form of the fixture itself.

General handling
To ensure optimal optical performance, it is recommended that the lens is not directly touched.

Considerations for assembly into fixtures
The 4-lead ribbon wire has a strain relief incorporated. Soraa Optical Light Engines have been burned-in for 12 hours.

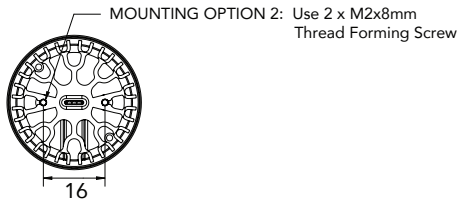
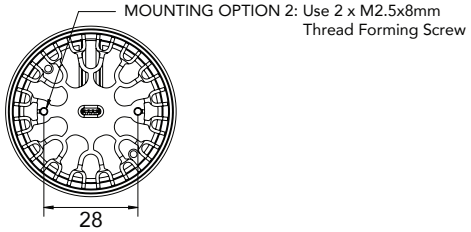
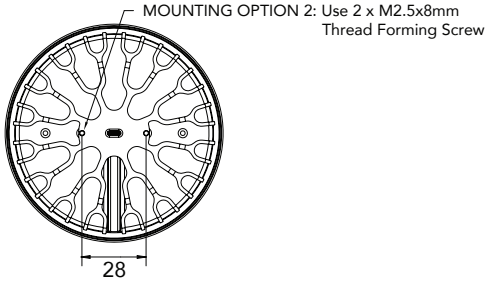
Identification
All Soraa Optical Light Engines have a manufacturing data code on the label. The date code consists of year and week of manufacture. For example: 1902 refers to the second week of 2019.

Integration of Optical Light Engine with heatsink (SLE-xx)
Optical Light Engines with heatsink, can be fixed by securing the lip at the front (mounting option 1), can be screwed onto an external surface (mounting option 2), or can be suspended by the wire.

Mounting option 1
The lip at the front of the product for mounting option 1, matches the lip definition of MR11 (SLE11-xx), MR16 (SLE16-xx) or PAR30 (SLE30-xx) lamps. Fixtures with features to hold these lamps at the lip will typically be able to hold Soraa Optical Light Engines in a similar way.

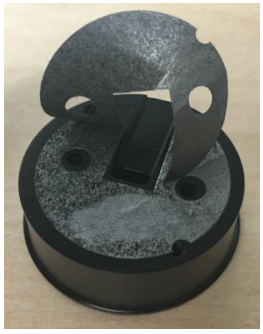
Mounting option 2
Soraa Optical Light Engines can be attached to an external surface on the back using 2 thread forming screws. Reference table below for pre-formed hole spacing and recommended screw type. Additional material for thermal transport (grease or pad material) is not required.

Table 1: Mounting hole pitch and screw dimensions

SLE11-xx	
SLE16-xx	
SLE30-xx	

Integration of Optical Light Engine without heatsink (SLC-xx)
Soraa Optical Light Engines have a unique thin form factor. Narrow spot options in SLC30 diameter size are available with a height of only 25mm. They are intended to enable very thin fixture design, when the fixture shell can perform the function of heat-sink.

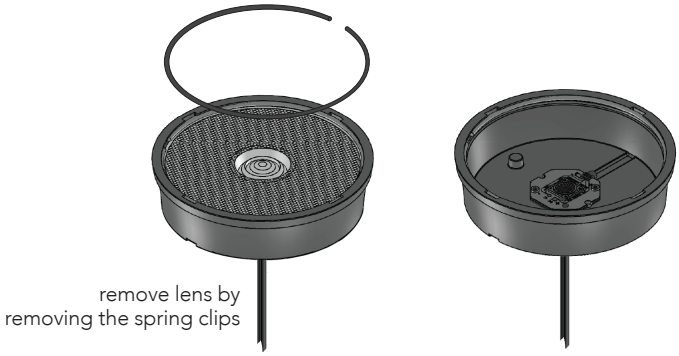
For seamless integration the wire can be routed sideways in the horizontal plane. The backside features a channel so when side mounting of the wire is chosen, flush mounting can still be achieved.


black protective liner removal

A thermal graphite pad comes standard on the backside for optimal thermal transfer. No additional thermal contact material is needed.
NOTE: The black protective liner should be removed from the thermal graphite pad prior to mounting process.

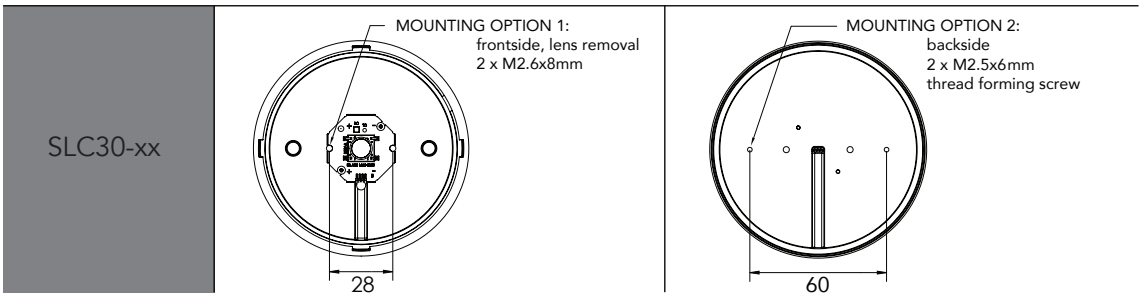
Option 1: Mounting from the topside - requires lens removal
This option requires the lens to be removed to access the inside of the Optical Light Engine cup.

Step 1: Remove the lens by removing the spring clip. Use a small plier or flat screw driver. Be careful not to scratch the lens.
Step 2: Take out the lens by tilting the Optical Light Engines over. Avoid contaminating the lens with skin oil or other debris.
Step 3: Screw in 2 screws, torque 0.5Nm. Use great care not to touch the exposed LED and its wire contacts, as this can compromise its function or reliability.
Step 4: Place back the lens and fasten it with the retaining clip.



Option 2: Mounting from the back side
By using M2.5 screws the Optical Light Engine can also be attached from the back side. Recommended torque is 0.5Nm.

Table 2: Mounting hole pitch and screw dimensions for SLC



Design Resources
Two dimensional outline drawings and 3D CAD models are available on request.

OPTICAL INTEGRATION

Soraa Optical Light Engines are directional light sources with the optic designed and optimized to unique Soraa GaN-on-GaN LED technology. Soraa designs the optics inhouse, based on in-depth understanding of the LED itself. The combination of Soraa GaN-on-GaN LED with optimized optics is referred to as Point Source Optics™. The aim in optical design is to maximize peak intensity for a given beam angle, provide very uniform color across beam and field, ensure smooth artifact-free transitions and limit wide angle light that can cause glare.

In comparison with typical LED directional lighting solutions, Soraa Optical Light Engines have a substantially smaller aperture for a given beam angle and intensity. In addition, the height of LED and optic can be less than half or a third compared to a typical LED with reflector combination of the same beam angle. Soraa Optical Light Engines provide substantially higher peak intensity (Candela) per unit of luminous flux (Lumen) for a given beam angle. The ratio of candela per lumen can be twice as high when compared to other LED solutions. The benefit of a high candela per lumen ratio is that system power can be reduced and smaller heat-sinks can be applied.

Soraa uses two types of lens optics. The first type is referred to as TIR (for Total Internal Reflection) and is used for 25 degree and 36 degree beam angles. The second type is referred to as prism optic and provides very narrow spot and spot options (9 to 15 degree beam angle). To attach SNAP System™ optical accessories a magnet has been attached in the center of the prism optic. SNAP accessories can only be used in combination with the prism optic. Optical Light Engines SLE16 can be used with SNAP accessories ACXXX. Optical Light Engines SLE/C30 are compatible with SNAP accessories AC-E-XXX. Soraa does not recommend using more than two SNAP accessories per Light Engine.

Soraa optics are designed to provide the desired beam distribution without additional reflectors or shields.

Lenses are held in place with circular spring retainer clip. In general, prism type lenses are not interchangeable with TIR type lenses.

Optical design resources
IES files are available for download at www.soraa.com. It is recommended to generate optical design files at the fixture level as the integration into the fixture might impact the light distribution and depending on the current and temperature conditions the actual output can differ from what is provided in Soraa's IES files.

THERMAL INTEGRATION

LED temperature has a strong correlation to the expected life of the product, as defined by customer criteria on acceptable color stability and light output maintenance. Soraa Optical Light Engines make it very easy to measure the reference temperature with the Optical Light Engine incorporated in the fixture.

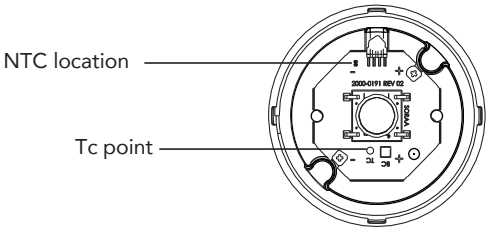
Temperature Measurement
Temperature can be assessed through an NTC resistor component that is mounted on the circuit board inside the Optical Light Engine. Its temperature is representative of the temperature at the Tc point on the board. The advantage of using the NTC is that it becomes very easy to do in-situ measurement with basic equipment like a standard multi-meter through two wires of the four wire ribbon cable. The resistance values measured from the NTC can be translated to temperature with the Table 3 below. Light Engines MUST be thermally tested inside its application and environmental conditions. To ensure a desired lifetime, Tc point on the LED may NEVER exceed 80˚C at any time in life. An applied thermal sensitive label will turn black when the maximum temperature is exceeded.
Keeping a record of the Tc compliance testing must be kept for future reference.

Table 3: NTC measured resistance values vs. temperature

WARNING: Tc of LED may NEVER exceed 80˚C

Tc	-20 °C	-10 °C	0 °C	10 °C	20 °C	30 °C	40 °C	50 °C	60 °C	70 °C	80 °C	90 °C	100 °C	110 °C	120 °C
RESISTANCE (KOHM)	480	271	158	95	59	38	25	16	11	7.8	5.6	4.0	2.9	2.2	1.7

Notes:
1. Tolerance: +/- 5°C
2. Temperature can be assessed with an NTC next to the LED on the mounting board inside the Light Engine.



Typically, it will take 20 to 50 minutes for the Optical Light Engine itself to reach a stable operating temperature. Depending on the total system configuration it can take up to a few hours for the total system to reach stable operating temperature. Temperature measurements must be recorded at thermal equilibrium.

In most cases, it is expected that ambient temperature fluctuations outside the fixture translate directly to reference temperature changes in the Optical Light Engine by the same amount.

Soraa's color and lumen maintenance predictions presented in this document are all based on reference temperature measurements through the NTC.

LIFE TIME ESTIMATES FOR VARIABLE DRIVE CONDITIONS

Soraa defines the life of its products based on the deviation over time from its initial performance. This includes reduction in light output over time and change in color over time. The same predictions apply for different CCT and CRI options, as well as beam angle options. Life predictions apply to the entire product and include the stability of the lens.

Life predictions are based on 10,000 hours of life testing that is conducted according to LM-80 by an accredited external lab across a range of temperature and current conditions. Projections shared in this document are averages. Two sets of predictions are given. One for Optical Light Engines starting with part numbers starting with SLExx-06 (can be SL11-06 and SLE16-06), and one with part number SLExx-08 (can be SLE16-08 and SLE30-08)

Color stability over time
Soraa GaN-on-GaN LEDs provide consistent color over time, thanks to the combination of violet primary LED emission and red, green and blue phosphors that create white light. To provide insight in how an installation would appear over time, color stability is presented in two separate parts.

The first part of color stability is color spread. This indicates how much color difference can be expected within a group of Optical Light Engines in an installation. The second part is color drift over time. This indicates how much color change the Optical Light Engines exhibit as a group. While a group as a whole can drift in color, if the spreading is minimal, the lighting installation can keep its uniform appearance as time passes. The effect of drift would become visible in comparison with a new Optical Light Engine.

It is important to split color change into spread and drift because just looking at color change in du'v' does not provide sufficient insight in how an installation will appear over time. For example, two light sources can have a small amount of color shift but if they shift in opposite directions (for example one towards green tint and the other one towards pink tint), the effect will be clearly visible. In the context of this example, these light sources may not move as a group, but show considerable color spread. In the case of this example, because of their color shift in opposite directions, the spreading between the sources is actually twice their individual shift.

Soraa has found negligible color spread in its LM80 test data. The color "cloud" of parts was observed to be stable over the 10,000h test duration, across different temperature and current test conditions. Because of the absence of spreading in test data, no color spreading predictions could be generated and predictive data is not presented in this document. It is expected that color spreading will be very minimal over the life of a group of products.

Product performance at reference conditions

Table 4: Product performance parameters SLx30

Reference Number	CCT (K)	CRI	Beam angle	Field angle	MAX. Drive Current (mA)	Peak Intensity (Cd)	Nominal power consumption (W)	Luminous Flux (lm)	SNAP compatible
SLE30									
SLE30-08-009D-927-03-01	2700K	95	9	16	580	20900	16.1	950	YES
SLE30-08-025D-927-03-01	2700K	95	25	40	580	5510	16.1	950	
SLE30-08-036D-927-03-01	2700K	95	36	60	580	2660	16.1	950	
SLE30-08-009D-930-03-01	3000K	95	9	16	580	22000	16.1	1000	YES
SLE30-08-025D-930-03-01	3000K	95	25	40	580	5800	16.1	1000	
SLE30-08-036D-930-03-01	3000K	95	36	60	580	2800	16.1	1000	
SLE30-08-009D-940-03-01	4000K	95	9	16	580	23100	16.1	1050	YES
SLC30									
SLC30-08-009D-927-03-00	2700K	95	9	16	580	20900	16.1	950	YES
SLC30-08-009D-930-03-00	3000K	95	9	16	580	22000	16.1	1000	YES
SLC30-08-009D-940-03-00	4000K	95	9	16	580	23100	16.1	1050	YES

Notes:

1. The maximum rated drive currents are for reference only and may NEVER be exceeded. Light Engines MUST be thermally tested inside its application and environmental conditions. To ensure a desired lifetime, Tc point on the LED may NEVER exceed 80˚C at any time in life. Performance, lifetime and warranty are subject to the engine's working and storage temperature, and driving current.
2. Beam angle defined at 50% of peak intensity
3. Field angle defined at 10% of peak intensity

Table 5: Product performance parameters SLx16

Reference Number	CCT (K)	CRI	Beam angle	Field angle	MAX. Drive Current (mA)	Peak Intensity (Cd)	Nominal power consumption (W)	Luminous Flux (lm)	SNAP compatible	
SLE16										
SLE16-06-010D-927-03-01	2700K	95	10	20	290	6370	8.1	435	YES	
SLE16-08-015D-927-03-01	2700K	95	15	30	440	5940	12.2	680	YES	
SLE16-08-025D-927-03-01	2700K	95	25	40	440	3960	12.2	680		
SLE16-08-036D-927-03-01	2700K	95	36	60	440	1900	12.2	680		
SLE16-06-010D-930-03-01	3000K	95	10	20	290	6710	8.1	460	YES	
SLE16-08-015D-930-03-01	3000K	95	15	30	440	6260	12.2	720	YES	
SLE16-08-025D-930-03-01	3000K	95	25	40	440	4170	12.2	720		
SLE16-08-036D-930-03-01	3000K	95	36	60	440	2010	12.2	720		
SLE16-08-015D-940-03-01	4000K	95	15	30	440	6570	12.2	755	YES	

Notes:

1. The maximum rated drive currents are for reference only and may NEVER be exceeded. Light Engines MUST be thermally tested inside its application and environmental conditions. To ensure a desired lifetime, Tc point on the LED may NEVER exceed 80˚C at any time in life. Performance, lifetime and warranty are subject to the engine's working and storage temperature, and driving current.
2. Beam angle defined at 50% of peak intensity
3. Field angle defined at 10% of peak intensity

Table 6: Product performance parameters SLx11

Reference Number	CCT (K)	CRI	Beam angle	Field angle	MAX. Drive Current (mA)	Peak Intensity (Cd)	Nominal power consumption (W)	Luminous Flux (lm)	SNAP compatible	
SLE11										
SLE11-06-025D-927-03-01	2700K	95	25	40	240	2360	6.7	405		
SLE11-06-036D-927-03-01	2700K	95	36	60	240	1140	6.7	405		
SLE11-06-025D-930-03-01	3000K	95	25	40	240	2490	6.7	430		
SLE11-06-036D-930-03-01	3000K	95	36	60	240	1200	6.7	430		

Notes:

1. The maximum rated drive currents are for reference only and may NEVER be exceeded. Light Engines MUST be thermally tested inside its application and environmental conditions. To ensure a desired lifetime, Tc point on the LED may NEVER exceed 80˚C at any time in life. Performance, lifetime and warranty are subject to the engine's working and storage temperature, and driving current.
2. Beam angle defined at 50% of peak intensity
3. Field angle defined at 10% of peak intensity

Life expectation tables

Predictions for color spreading, color drift and lumen maintenance are given for up to 50,000h operation. In addition, the relative light output is given for current and temperature conditions. An estimate of the light output can be obtained for a given Optical Light Engine by multiplying the % number from the tables below with the reference luminous flux or peak intensities given in the Table 4-6. Only highlighted values are under Soraa warranty conditions for 25,000hrs or 3 year operation. The given maximum input currents and Tc temperature ratings may NEVER be exceeded. Tc point of the LED may NEVER exceed 80˚C.

Table 7: Lumen and color maintenance predictions SLExx-06-xx

	Hours of evaluation	50000										
	Degrees Celsius	50	55	60	65	70	75	80	85	90	95	100
	Degrees Fahrenheit	122	131	140	149	158	167	176	185	194	203	212
If mA	NTC readout (kOhm)	16.4	13.5	11.2	9.35	7.82	6.57	5.55	4.70	4.00	3.42	2.94
175	du'v' color drift	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002
	Lumen maintenance	94%	92%	91%	89%	86%	84%	81%	79%	75%	72%	69%
	Relative light-output at T_0	63%	62%	62%	62%	62%	61%	61%	60%	60%	60%	59%
225	du'v' color drift	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002
	Lumen maintenance	89%	87%	84%	81%	78%	75%	71%	67%	63%	58%	54%
	Relative light-output at T_0	79%	79%	78%	78%	77%	77%	76%	76%	75%	75%	74%
250	du'v' color drift	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.003
	Lumen maintenance	86%	84%	81%	77%	74%	70%	66%	61%	56%	52%	47%
	Relative light-output at T_0	87%	87%	86%	86%	85%	85%	84%	83%	83%	82%	82%
275	du'v' color drift	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.003	0.003
	Lumen maintenance	84%	80%	77%	73%	69%	65%	60%	55%	50%	45%	40%
	Relative light-output at T_0	95%	94%	94%	93%	93%	92%	91%	91%	90%	89%	89%
300	du'v' color drift	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.003	0.003	0.003
	Lumen maintenance	81%	77%	73%	69%	64%	60%	55%	49%	44%	39%	34%
	Relative light-output at T_0	102%	102%	101%	101%	100%	99%	99%	98%	97%	96%	96%

Only highlighted values fall under Soraa warranty conditions.

Table 8: Lumen and color maintenance predictions SLExx-08-xx

	Hours of evaluation	50000										
	Degrees Celsius	50	55	60	65	70	75	80	85	90	95	100
	Degrees Fahrenheit	122	131	140	149	158	167	176	185	194	203	212
If mA	NTC readout (kOhm)	16.4	13.5	11.2	9.35	7.82	6.57	5.55	4.70	4.00	3.42	2.94
350	du'v' color drift	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002
	Lumen maintenance	93%	92%	90%	88%	85%	83%	80%	77%	74%	71%	67%
	Relative light-output at T_0	63%	63%	62%	62%	62%	61%	61%	61%	60%	60%	59%
400	du'v' color drift	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002
	Lumen maintenance	90%	88%	86%	84%	81%	78%	75%	71%	67%	63%	59%
	Relative light-output at T_0	71%	71%	71%	70%	70%	69%	69%	68%	68%	67%	67%
450	du'v' color drift	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.002
	Lumen maintenance	88%	85%	82%	79%	76%	72%	69%	64%	60%	56%	51%
	Relative light-output at T_0	79%	79%	78%	78%	78%	77%	77%	76%	76%	75%	74%
500	du'v' color drift	0.001	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.003
	Lumen maintenance	84%	82%	78%	75%	71%	67%	62%	58%	53%	48%	43%
	Relative light-output at T_0	87%	87%	86%	86%	85%	85%	84%	84%	83%	82%	82%
550	du'v' color drift	0.001	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.003	0.003
	Lumen maintenance	81%	78%	74%	70%	66%	61%	56%	51%	46%	41%	36%
	Relative light-output at T_0	95%	94%	94%	93%	93%	92%	91%	91%	90%	89%	89%
600	du'v' color drift	0.001	0.001	0.001	0.001	0.002	0.002	0.002	0.002	0.003	0.003	0.003
	Lumen maintenance	78%	74%	70%	65%	60%	55%	50%	45%	40%	35%	30%
	Relative light-output at T_0	102%	102%	101%	101%	100%	99%	99%	98%	97%	96%	96%

Only highlighted values fall under Soraa warranty conditions.

Light depreciation tables

In addition to the tables for up to 50,000h performance extrapolations, tables are given to estimate the time to light output maintenance of 70%. Soraa extrapolates up to 6 times the tested time of 10,000 hours. Light output maintenance can be applied to both peak intensity and luminous flux. Similar to the 50,000h prediction tables, a separate table is given for SLExx-06 and SLExx-08 type Optical Light Engines. Only highlighted values are under Soraa warranty conditions. Given input currents and Tc temperature ratings may never be exceeded. Tc point of the LED may NEVER exceed 80˚C.

Table 10: Time to lumen maintenance SLExx-06-xx

	Lumen maintenance	70%										
	Degrees Celsius	50	55	60	65	70	75	80	85	90	95	100
	Degrees Fahrenheit	122	131	140	149	158	167	176	185	194	203	212
If mA	NTC readout (kOhm)	16.4	13.5	11.2	9.35	7.82	6.57	5.55	4.70	4.00	3.42	2.94
175		>60,000	>60,000	>60,000	>60,000	>60,000	>60,000	>60,000	>60,000	>60,000	54,000	47,000
200		>60,000	>60,000	>60,000	>60,000	>60,000	>60,000	>60,000	56,000	48,000	42,000	36,000
225		>60,000	>60,000	>60,000	>60,000	>60,000	60,000	51,000	44,000	38,000	33,000	29,000
250		>60,000	>60,000	>60,000	>60,000	57,000	49,000	42,000	36,000	31,000	27,000	24,000
275		>60,000	>60,000	>60,000	56,000	48,000	41,000	35,000	30,000	26,000	23,000	20,000
300		>60,000	>60,000	56,000	48,000	40,000	35,000	30,000	25,000	22,000	19,000	17,000

Only highlighted values fall under Soraa warranty conditions.

Table 11: Time to lumen maintenance SLExx-08-xx

	Lumen maintenance	70%										
	Degrees Celsius	50	55	60	65	70	75	80	85	90	95	100
	Degrees Fahrenheit	122	131	140	149	158	167	176	185	194	203	212
If mA	NTC readout (kOhm)	16.4	13.5	11.2	9.35	7.82	6.57	5.55	4.70	4.00	3.42	2.94
350		>60,000	>60,000	>60,000	>60,000	>60,000	>60,000	>60,000	>60,000	59,000	51,000	45,000
400		>60,000	>60,000	>60,000	>60,000	>60,000	>60,000	60,000	52,000	45,000	39,000	34,000
450		>60,000	>60,000	>60,000	>60,000	>60,000	54,000	47,000	41,000	35,000	31,000	27,000
500		>60,000	>60,000	>60,000	60,000	51,000	44,000	38,000	33,000	28,000	25,000	22,000
550		>60,000	>60,000	58,000	49,000	42,000	36,000	31,000	27,000	23,000	20,000	18,000
600		>60,000	58,000	49,000	41,000	35,000	30,000	26,000	22,000	19,000	17,000	15,000

Only highlighted values fall under Soraa warranty conditions.