Design-in guide

Philips Lexel LED Spotlight Module (SLM) System

PHILIPS

Contents

Introduction

Dear Customer,

This is the first version of the Philips Lexel Spotlighting Module application design guide which details the specification, the benefits/ roadmap/positioning, and describes technicalities of the luminaire design. The design guide comes in a package with the 3D- and ray-set files of the Lexel SLM. Please feel free to ask for further information of the Philips sales representive.

Or visit our website at www.philips.com/OEM

The Philips Lexel LED SLM module family is a part of a family of high performance, compact, and cost effective series of products for accent lighting. These products offer long life time and energy efficient accent lighting for the Retail and Hospitality lighting segments. Consistent with all of the SLM Modules, color accuracy and future proofed systems will bring you peace of mind.

1. Specifications

1.1 Lexel SLM ordering codes

The two modules that were released end of March 2011, with flux levels of 800 Lm for the RGB, and 1100 Lm for the Tunable White (TW) version, have the following ordering codes and Commercial names:

EOC	Commerical name	12Nc
8727900 95415900	Lexel LED SLM module 1100 22W/8TW	929000620203
8727900 95416600	Lexel LED SLM module 800 25W/RGB	929000620303

Table 1.1 a Ordering codes for the Lx SLM modules

The driver for these two modules is customized to four flavors: DMX, a DMX TW version that works directly with the Philips ToBeTouched UID8530 Color Temperature DMX controller, DALI, and four button (4B). The hardware is all the same, but the control firmware varies for these four drivers. Ordering codes below, dimensions: 138, 74, 32 mm, all have 12 V output:

EOC	Commercial Name	12NC
871829112508200	Lexel LED driver 25W -DALI	929000620503
871829112509900	Lexel LED driver 25W -DMX	929000632700
871829112510500	Lexel LED driver 25W -4B	929000632800
TBD	Lexel LED driver 25W -DMX TW	929000659703

Table 1.1 b Ordering codes for the lexel led drivers

We have released two lamp-driver cables, 60 cm and 25 cm long, and a DMX&4B controller cable:

EOC	Commerical name	12Nc
8727900954200300	Lexel LED SLM Cable 60 cm	929000633203
872790095417300	Lexel LED SLM Cable 25 cm	929000620403
TBD	Lexel LED SLM DMX/4B Cable 60 cm FL	929000661303

Table 1.1 c Ordering codes for the lexel led drivers

1.2 Mechanical description of the Modules

The two modules are available in the same footprint: a ~50 mm diameter light source with in the module rim provisions for heatsink attachment (three holes of 3.4 mm at 42 mm) and in the center optical alignment at 25 mm. 2D or 3D CAD drawings are available; Fig 1.2_1 gives dimensional information.

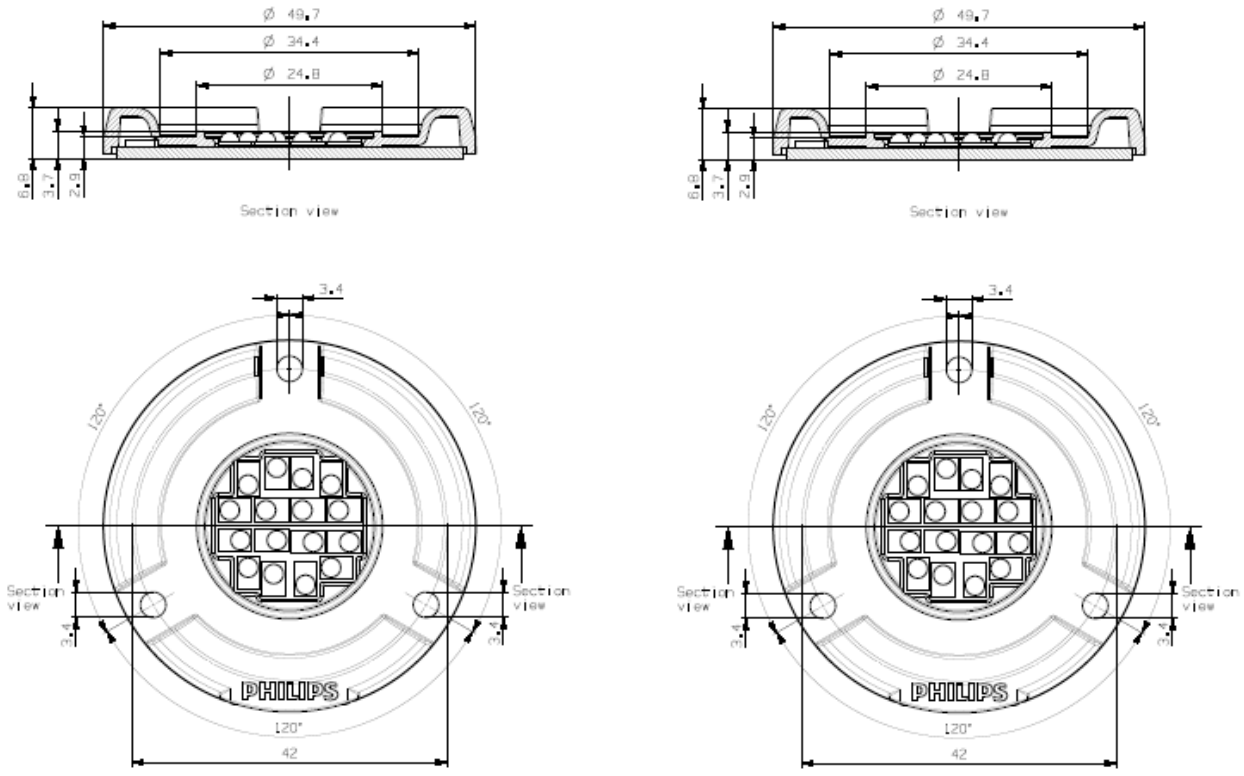


Fig 1.2 1 Mechanical Features of the Lexel SLM. RGB left, TW right

1.3 Specifications of the modules

Flux and tolerances, at Tcase derived from input power

Table 1.3_a gives specifications of the SLM modules at operating conditions (with impedances specified in thermal application note). The impedance is derived with the requirement to obtain 65° C at worst case conditions; this is 25 W input power for the RGB module at ambient of 35° C. The flux numbers indicated below have been derived with case temperatures that are 55° C for RGB and 60° C for TW as power levels at the color points indicated in the tables are lower then the MAX-value. We have derived these case Temperatures using the relation between case T and input wattage as given in Fig. 1.3_1:

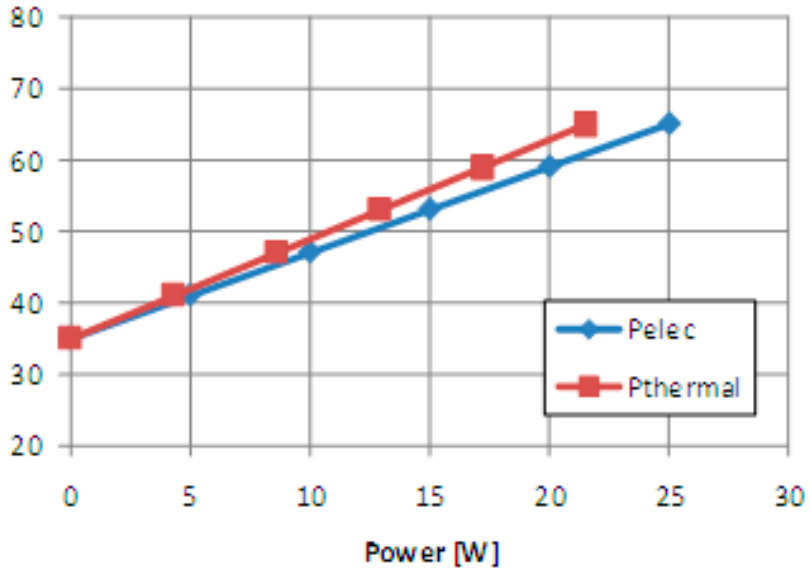


Fig 1.3 1 Case temperatures for the LX SLM modules when at the max Power setting 65° C case T is obtained. As can be seen the RGB module at 6500 K, consuming only 17 W, will arrive at a case Temperature of 55° C.

Module at:	RED	GREEN	BLUE	CCT = 6500 K
SLM Module 800 25 W/RGB Flux	250	900	350	800
Typical lamp power,	8 W	14 W	10 W	17 W
and typical thermal load	7 W	13 W	8 W	16 W
Module at:	**CCT = 3000 K**	**CCT = 3500 K**	**CCT = 4000 K**	
SLM Module 1100 22W/8TW LpW of module	60 Lm/W	65 Lm/W	65 Lm/W	
Typical lamp power,	18 W	17 W	17 W	
and typical thermal load	14 W	14 W	13 W	

Table 1.3 a Spec points for Lexel SLM modules

The fluxes for the lexel SLM RGB module are of course very dependent on the case temperature that is achieved: Fig below gives Temperature dependence of RGB and the 6500 K white setting: Again, only @ 55° C we reach the spec point of 800 Lm.

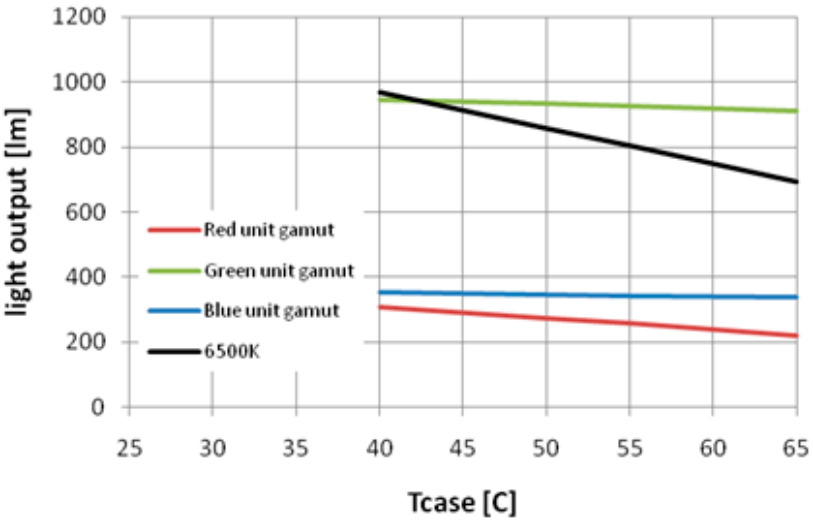


Fig 1.3 2 Temperature dependence of the LX-SLM RGB module. The temperature feed forward loop will maintain the right color setting as red shows a much steeper effect then green and blue

On top of the discussion where case temperatures determines flux, one should realize that we will have some initial flux variation from module to module. In the factory, at end of line, the Lexel SLM module flux tester will operate with the following tolerance for the RGB module:

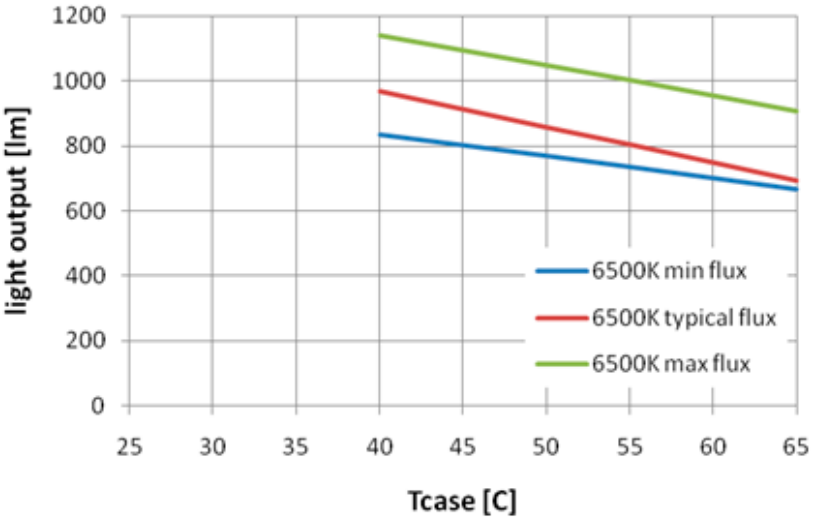


Fig 1.3 3 Maximum product-to-product flux tolerance for EOL tester for LX-SLM RGB

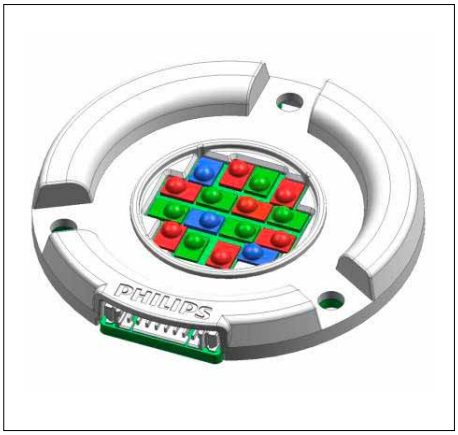


Fig. 1.3 5 The positions of rebel LEDs for Lexel SLM (RGB left, and TW right)

1.4 The lifetime of the module

The flux and spectrum of the modules will have the following lifetime specs:

Product Type	Lifetime B50L70	CCT accuracy, initial	Lifetime CCT accuracy	CRI
SLM TW	50,000 h	< 5 SDCM	50 kHrs	> 80
SLM RGB	50,000 h	< 5 SDCM	25 kHrs	NA

Table 1.3 b Lifetime specs of the SLM modules

The Lexel SLM uses Philips Lumileds Rebel LEDs which offer superb lifetime, high flux at operating conditions, and tight color control & stability. The position of the LEDs are indicated in Figure on the left:

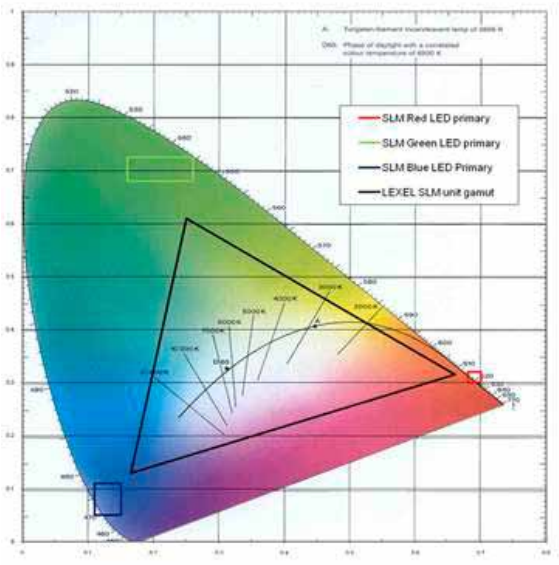
1.5 The gamut of the module

Besides the above indicated flux/lifetime/CRI specs for a given set of color points, the Lexel SLM can be used to create a huge variety of colors and white shades. The unit gamut of the LX-SLM RGB indicates which color points can be achieved:

	X	Y
Red	0.660	0.315
Green	0.250	0.610
Blue	0.165	0.130

Table 1.3 c Unit gamut of the Lexel SLM RGB product

The figure below shows unit gamut of RGB and white shades for TW.



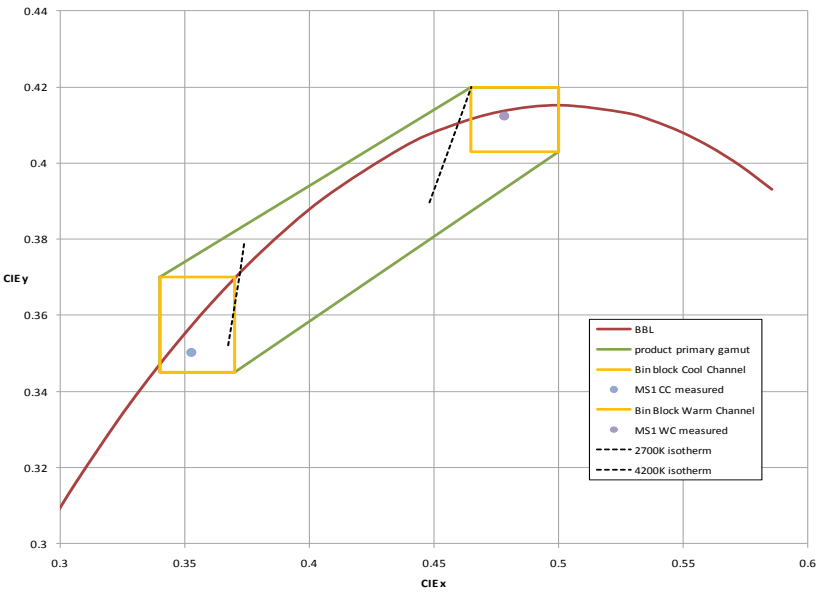


Figure 1.3 4 Color points within unit gamut of the Lx SLM RGB and TW products

* * Initial color accuracy is 4 MacAdam ellipses (Standard Deviation in Color Match, SDCM); Philips utilizes LEDs that have a maximum drift of one ellipse over lifetime.

1.6 Environmental Compliance

Photobiological Safety

Measurements on the Lexel LED SLM TW and RGB yielded the following results:

Hazard Category

LB	Exempt
LR	Exempt
LIR	Exempt
ES	Exempt
EUVA	Exempt
EB	Exempt
EIR	Exempt

IEC recommendations

The general recommendations for luminaire design given by the IEC (IEC 60598) and the national safety regulations are also applicable to LED-based luminaires. Please consult us if you wish to deviate from the design rules described in this application guide.

Conditions for using LED Module and LED Driver

- DMX control inputs to the Luminaire must be isolated from the AC mains by an insulation at least equal to “double” or “reinforced” insulation.
- These components are designed to be mounted inside a Lighting fixture.
- These components do NOT have an IP rating.
- These components are designed for indoor use.
- These components are designed for dry location only.
- These components are not serviceable by the end user.
- The pins of the connectors found on the LED driver support single wire connection. If additional connections are required, a single crimp pin in the OEM’s cable assembly must be used.
- These components are to be installed according to international and local safety standards. The suitability of the mounting means shall be determined during the end product evaluation.
- Proper heat sinking of these components must be provided, by the OEM, for correct functioning of the system.
- Temperature tests shall be considered in the end product evaluation, and the specified maximum case temperature (Tc) points shall not be exceeded.
- The Lexel LED driver has a SELV rated output but it’s housing is rated Class 1; therefore the LED driver housing must be connected to protective earth according to the applicable safety standards.

2. System specifications

2.1 System (Module + Driver) specifications

2.1.1 Lumen per watt performance of the Lamp + Gear at operating conditions

Table 2.1.1_a gives system performances:

RGB	(W)	Module P (W)	Driver P (W)	lm/W
Max system Power	34	24.5	9.5	35.3
D65	24	17.3	6.7	33.3
R	15	10.8	4.2	
G	22	15.8	6.2	
B	18	13.0	5.0	

TW	(W)	Module P (W)	Driver P (W)	lm/W
Max system Power	30	21.6	8.4	36.7
Warm channel	26	18.7	7.3	42.3
Cold channel	23	16.6	6.4	47.8

Table 2.1.1 a System performances

2.1.2 Lifetime statements of the system

The lifetime specs of the Philips Lexel SLM system involves lumen depreciation separate from catastrophic failures. The latter involves all e.g. solder-joint failures of Lamp and Gear, the first involves lumen output degradation of the LED including shorted die area. Taking all these failure modes into account, Philips arrived at Table 2.1.2_b which gives lifetime specifications for Lexel SLM systems.

Average Lumen Depreciation after 50,000 h at 65° C case and 35° C ambient	Average Catastrophic Failure Rate at 65° C case and 35° C ambient with one switching cycle typically per day after 50,000 h
>L70	10%

Table 2.1.1 b System lifetime

Table 1.1.2 a Lifetime specifations for Lexel SLM TW and RGB systems.

Lumen depreciation curves are given in Fig. 2.1.1_1. 1n case situations where better lifetime numbers are needed, the reduction of the temperature ratings brings great improvements (e.g. in number of switching cycles).

Fig. 2.1.1 1 gives system lumen depreciation.

As can be seen the dispersion is TIGHT, allowing the fair prediction of End Of Life lumen output for LUX calculations.

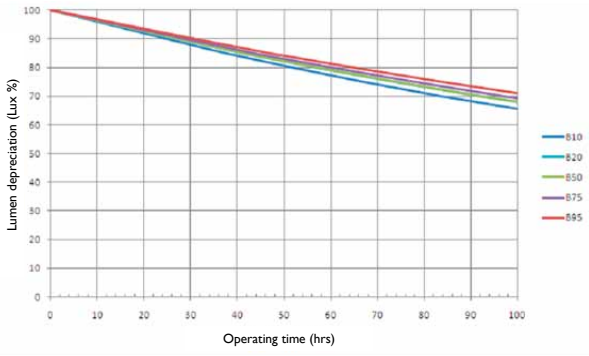


Table 2.1.1 1 System lumen depreciation

2.2 Why Philips Lexel SLM

The following features of the Fortimo SLM can be derived from the above specifications:

Features	Benefits
Breakthrough design for energy efficiency	LED Product suitable for general accent lighting
High flux output from small light source at high efficiency	Enables energy breakthrough for directional beams from recessed and track fixtures suitable for accent lighting
Efficient power conversion in the Xitanium LED drivers	Efficient system solution enabling energy code requirements
Various control protocols (DMX, DALI, 4B)	Value added & Efficient lighting design enabled by scene setting and reduction of energy consumption when lower lux levels are acceptable
Superior quality white light	Enables to enter accent lighting with LEDs
CRI > 80 for TW modules	Meets the norm for general lighting
Mixed and matched white LED binning	Consistent color quality and lumen output
Comprehensive portfolio (to be released: CRI90 & Tunable products)	One luminaire design allows core, performance, and statement quality lighting designs
Future Proof System design	Follow LED roadmap without any investment costs
Fixed form factor	Less tooling costs
Consistent output (800 & 1100 Lm, Zhaga compliant)	One optic metric for a lighting designer
Upgrades of the design with improved LEDs get automatically the right current setting	Drive cost down as quickly as possible
Upper limit heat load for future products	One heatsink design
Ecosystem of complementary partners around the module	Faster time to market, economy of scale on cost of components
Fixed Optical and thermal interface	Faster time to market, design rules can be verified from deep understanding of LED physics
Long life time	Zero maintenance, reduced cost
Driver ripple current minimized	Low Lumen depreciation & small heatsink possible
Very good thermal conduction to heat spreader	Low Lumen depreciation & small heatsink possible
Driver output dimmed when NTC indicates overheating.	Low failure rate (catastrophic)

3. How to design a luminaire?

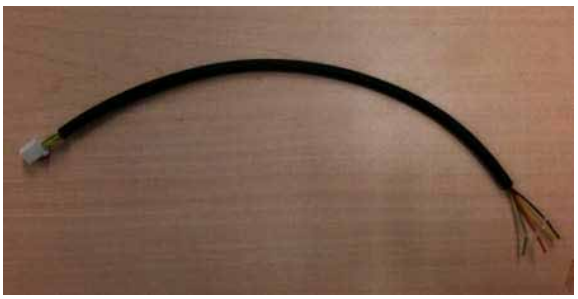
Separate on our website we have published the thermal and optical application note. This chapter discusses cables and controls: Between Lamp and driver we will have 60 cm and 25 cm cable according to the following details:

X2	Signal	Description	Colour coding of cable	RGB	TW
X2-1	C1	Cathode string 1	White	Blue channel -	Cool channel -
X2-2	A3	Anode string 3	Black	Red channel +	
X2-3	C2	Cathode string 2	Yellow	Green channel -	Warm channel -
X2-4	A2	Anode string 2	Red	Green channel +	Warm channel +
X2-5	C3	Cathode string 3	Blue	Red channel -	
X2-6	A1	Anode string 1	Orange	Blue channel +	Cool channel +
X2-7	DIG	Digital Module Interface	Green		
X2-8	SGND	Signal ground	Brown		

To create scenes, some control means should be connected: Wiring safety requirements:

- DALI is considered an Extra Low Voltage (ELV) circuit as defined in the standards IEC62386-101 Clause 4.2 and IEC61347-2-3 Cause 15.5. The appropriate insulation depends on the final luminaire design.
- DALI control inputs to the luminaire must be isolated from the AC mains by insulation at least equal to basic insulation.
- DALI control inputs in the luminaire must be isolated from SELV circuits by at least equal to double or reinforced insulation.
- DMX should be considered to be a SELV circuit (equivalent to Class 2 circuits) and the appropriate insulation will depend on the final luminaire design. Of course, double isolation to the mains wires going into the driver should of course be organized carefully.

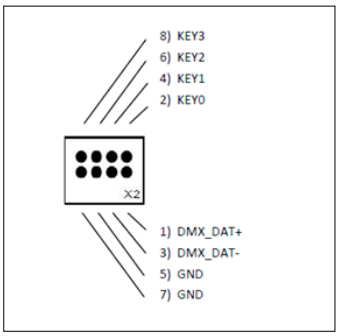
Between controller and driver two connectors can be used.



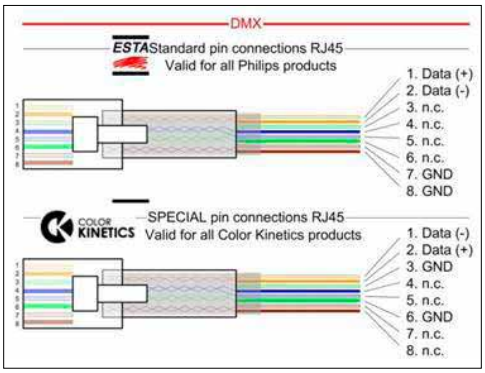
3.1 The DMX input connector

First we describe the so called DMX connector (12NC : 2422 025 21485 SOC : B08B-PUDSS-1 (LF)(SN)) which can be used with a 4B and DMX controller. To operate through this input slot, we have organized the following standard cable:

- DMX connector: JST PUDP-08V-S
- Wire diameter AWG 24-26, (UTP Ethernet cabling)
- Cable Length: 60 cm
- Loose end striped (see pictures)



DMX/4B connector on Lexel LED driver



Coloring of the RG45 plug of the DMX/4B cable

Pin 1 – Data (+) → white/orange
Pin 2 – Key0 → orange
Pin 3 – Data (-) → white/blue
Pin 4 – Key1 → blue
Pin 5 – GND → white/green
Pin 6 – Key2 → green
Pin 7 – GND → white/brown
Pin 8 – Key3 → Brown

Loose end pre-strip (see pictures). The ground-planes on 5) and 7) are connected.

Please be aware that the Philips CK control products have Data+ and Data- swapped, standard DMX controllers (including the 2BeTouched Philips controlers) operate well with our cable.

Out of the box, the LX-SLM TW system works compatible to the 2BeTouched controller, with DMX address 423 and 424 intensity and color T.

If an RGB lamp is connected to the driver, it will listen to DMX addres 1,2,3 for RGB values. So out of the box it will work with ToBeTouched UID8540 Color DMX (see appendix 3 for ordering code).
To change the DMX start address RDM can be used through e.g. a Philips Smart Jack Pro using the Quickplay Pro software which can be downloaded through **www.colorkinetics.com/support/addressing**.
The basic steps are: connect the components as indicated in Fig below:

Then run fixture configuration, click discover, and enter NEW DMX address. Steps are indicated in attachment 3.

DMX intensities are created using the following inputs:

RGB SLM

Personality xyY:

DMX x data [0 – 255]	:	x = data * 0.0032
DMX y data [0 – 255]	:	y = data * 0.0032
DMX Y data [0 – 255]	:	0 = 0%, 255=100%, linear in between: Y = intensity = 100*data/255

Personality RGB:

DMX R data [0 – 255]	:	
DMX G data [0 – 255]	:	
DMX B data [0 – 255]	:	

Intensity = 100*(MAX(DMX R data, DMX G data, DMX B data))/255 (linear)

TW SLM

Colour points primaries family Gamut (x,y) – the values are read from SLM module

Cool white	:	0.3720, 0.3710 (4200 K, Mirek 238)
Warm white	:	0.4600, 0.4110 (2700 K, Mirek 370)

Personality CCT_REL:

DMX CCT data [0 – 255]	:	Mirek = 238 + data * (370-238)/255
DMX intensity data [0 – 255]	:	0=0%, 255=100%, linear in between: 100*data/255

Personality CCT_ABS:

DMX CCT data [0 – 255]	:	Mirek = data * 5
DMX intensity data [0 – 255]	:	0=0%, 255=100%, linear in between: 100*data/255

CCT (Kelvin)	Bytes Value (0-255)	CCT (Kelvin)	Bytes Value (0-255)
2700	217 - 255	4600	63
2700	216	4700	59
2800	203	4800	54
2900	191	4900	50
3000	179	5000	46
3100	169	5100	42
3200	159	5200	38
3300	149	5300	35
3400	140	5400	31
3500	132	5500	28
3600	124	5600	25
3700	116	5700	21
3800	109	5800	18
3900	102	5900	15
4000	96	6000	13
4100	90	6100	10
4200	84	6200	7
4300	79	6300	5
4400	73	6400	2
4500	68	6500	0

CCT values of the DMX - CCT mode and corresponding byte values

Secondly, the DMX-connector can be used to run scenes through a 4B input device. Scenes are pre-programmed and can be changed (see appendix 4). Standard settings are:

1	COLOUR_TYPE_XY,	/* R */
2	COLOUR_TYPE_XY,	/* G */
3	COLOUR_TYPE_XY,	/* B */
4	COLOUR_TYPE_XY,	/* RG */
5	COLOUR_TYPE_XY,	/* GB */
6	COLOUR_TYPE_XY,	/* BR */
7	COLOUR_TYPE_MIREK,	/* 6500K */
8	COLOUR_TYPE_MIREK,	/* 5000K */
9	COLOUR_TYPE_MIREK,	/* 4000K */
10	COLOUR_TYPE_MIREK,	/* 3500K */
11	COLOUR_TYPE_MIREK,	/* 3000K */
12	COLOUR_TYPE_MIREK,	/* 2700K */

3.2 The DALI input connector

We have also implemented a DALI input connector and run version 209 of DALI color: (DALI =IEC 62386-209, 01.06.2010 DIGITAL ADDRESSABLE LIGHTING INTERFACE -Part 209: PARTICULAR REQUIREMENTS FOR CONTROL GEAR - COLOUR CONTROL (DEVICE TYPE 8)). One precaution should be made: Do not disconnect the module from the driver when power is on, the driver will not detect that the lamp is not there.

4. Appendices

Appendix 1

ToBeTouched TW controller that works directly with the DMX-TW driver:

Packaging data

Type	Box dimensions	Qty	Material	Weight (Kg)	
	(mm)			net	gross
UID8530 Color Temperature DMX	113 x 113 x 61	1	Card board	0.108	0.193

Ordering data

Type	MOQ	Ordering number	EAN code level 1	EAN code level 3	EOC
UID8530 Color Temperature DMX	1	9137 003 35403	8727900 873504	8727900 873511	87350400
UID8550 ToBe Touched PSU	1	9137 003 38603	8727900 886832	8727900 886849	88683200

ToBeTouched RGB controller that works directly with DMX driver:

Packaging data

Type	Box dimensions	Qty	Material	Weight (Kg)	
	(mm)			net	gross
UID8540 COLOR DMX	113 x 113 x 61	1	Card board	0.108	0.193

Ordering data

Type	MOQ	Ordering number	EAN code level 1	EAN code level 3	EOC
UID8540 COLOR DMX	1	9137 003 35503	8727900 873528	8727900 873535	7352800
UID8550 ToBe Touched PSU	1	9137 003 38603	8727900 886832	8727900 886849	88683200

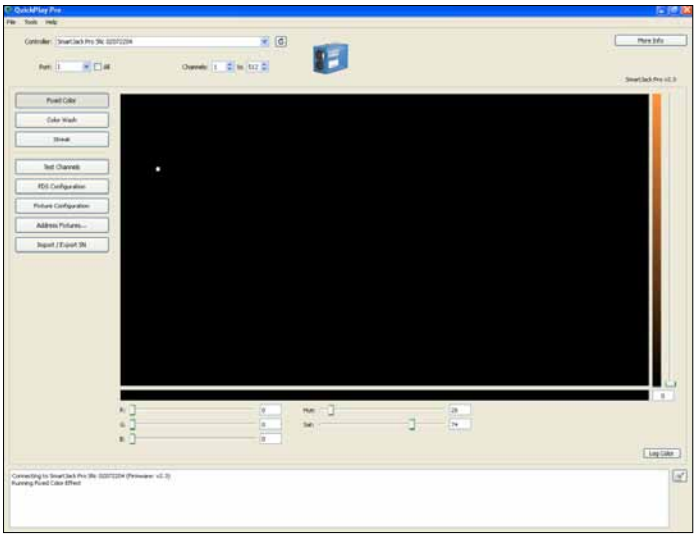
Appendix 2

Driver details: Lexel LED driver 25 W

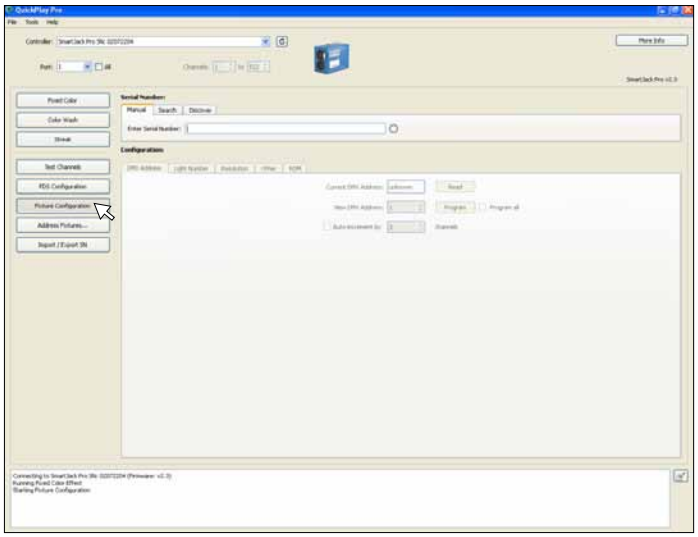
Product name	Lexel LED driver 25 W
Rated voltage range (V)	200-264
Output current (A)	350-700
Output voltage range (Vdc)	18- 28
Type of dimming	DMX/DALI/4B
12V output	Yes
Isolation classification	SELV
Ripple current	< 25%
Efficiency range (300-700mA)	70-75%
Power factor range (200 – 700mA)	0.9
Hot wiring	no
T ambient	50
Tc max (°C)	65
Life time (hrs)	50,000
Warranty (years)	5 years

Appendix 3

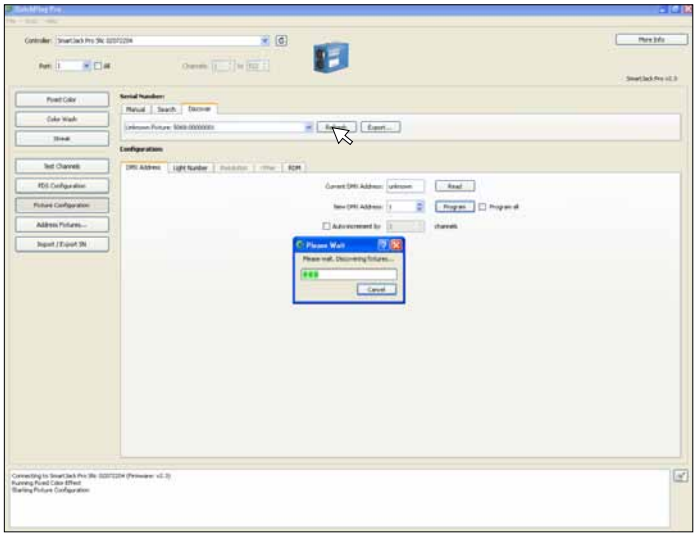
How to change DMX start address using smart Jack Pro:
Run Fixed Color (screen shot 1), start Fixture Configuration (screen shot 2), and press Refresh to discover Fixtures (screen shot 3).



screen shot 1

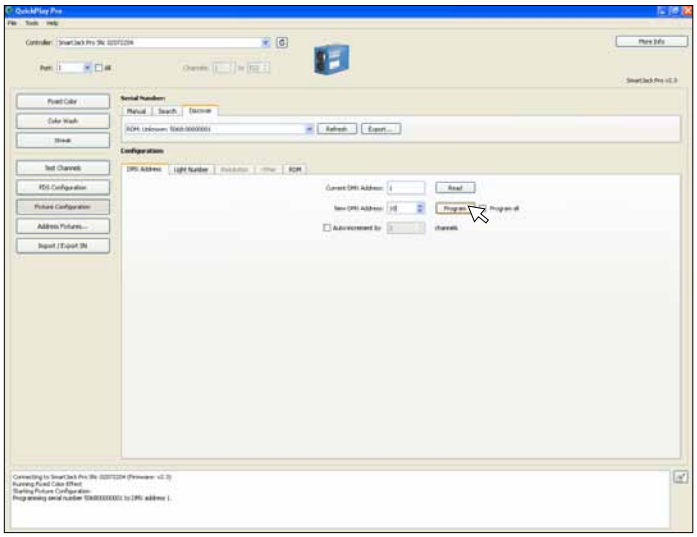


screen shot 2

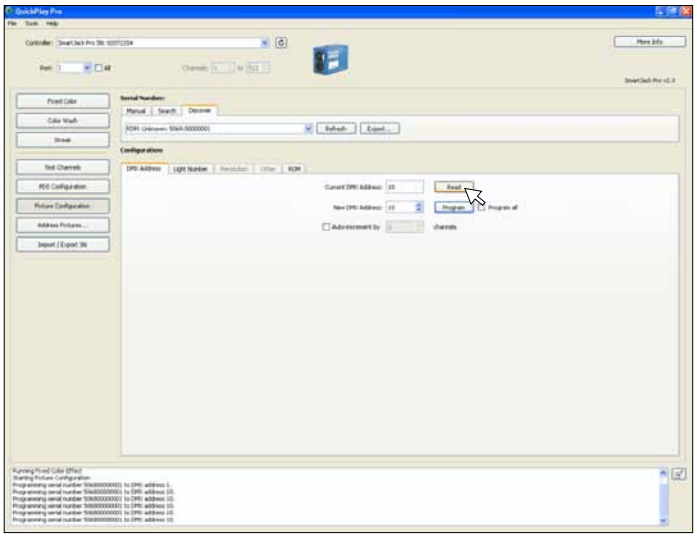


screen shot 3

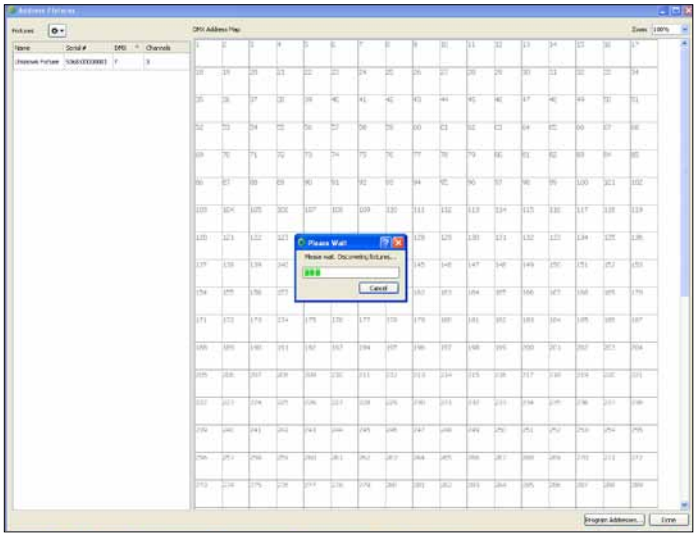
Select new DMX address (e.g. 10, see screen shot 4), then read DMX address 10 (screen shot 5), then DMX address map appears (screen shot 6).



screen shot 4

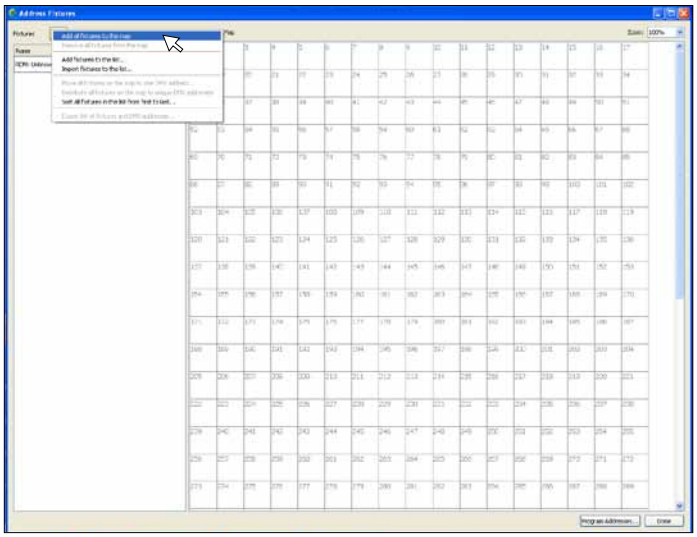


screen shot 5

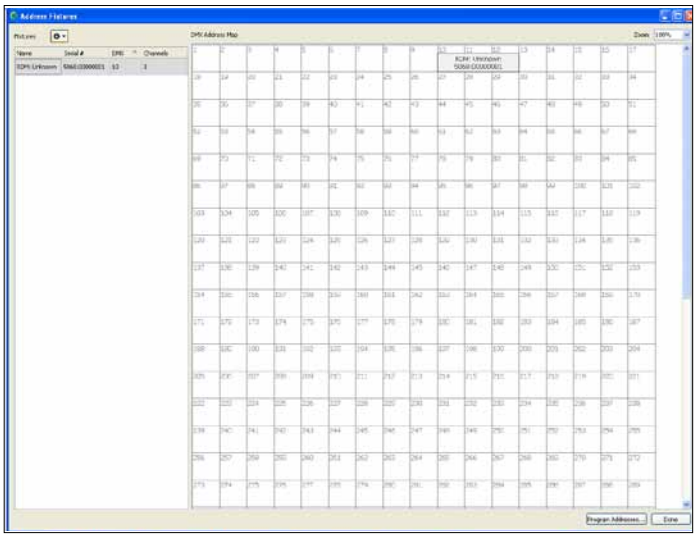


screen shot 6

Then add all fixtures to the map (screen shot 7) and a 3 Channel device appears at start address 10 (screen shot 8).



screen shot 7

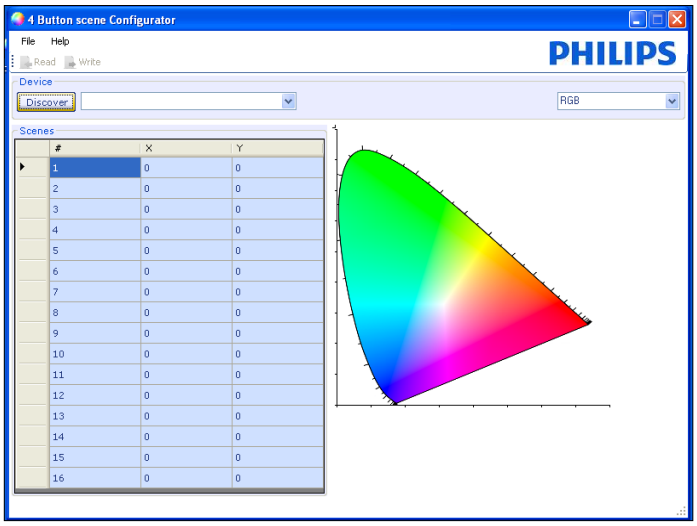


screen shot 8

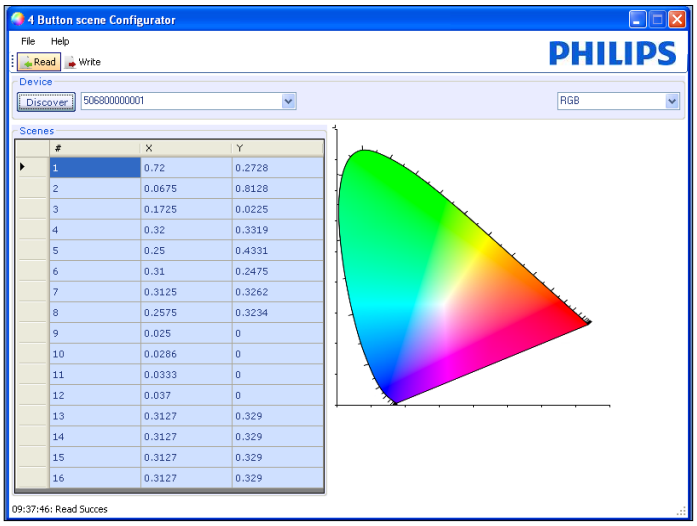
Appendix 4

Scene creator for the 4B driver.

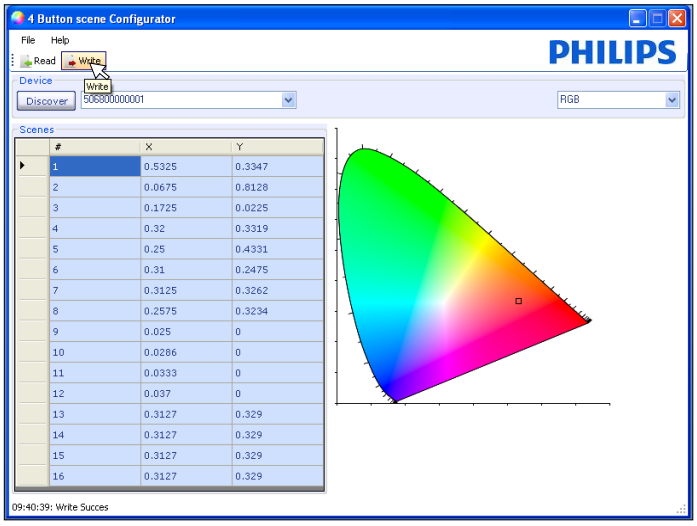
First discover the driver and then read the standard settings in the driver (screen shot 1 & 2), then select target settings, write (screen shot 3) and exit.



screen shot 1



screen shot 2



screen shot 3

5. Index of visuals

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