Warning and Emergency Vehicle Lighting

DESIGNER'S GUIDE

Making LED Lighting Solutions Simple™

FUTURE
Lighting Solutions

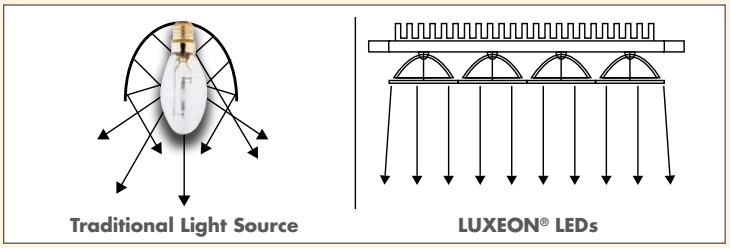
LUXEON® VALUE

LUXEON® LEDs are widely used in **emergency vehicle lighting** (police, fire, ambulance and tow & recovery), and in **warning vehicle lighting** (utility, construction, security and maintenance), providing a strong value proposition:

Visibility

Small directed light sources

- Less wasted light (reflectors can reduce light output by as much as 50%)
- More light where needed (avoid light distraction to other vehicles)



Full range of colors

- No color filters (filters can reduce light output by as much as 80%)

Flexibility

Low profile form factor

- Sleek and stealth designs (never before possible form factors and places)
- LUXEON® LEDs show no color until they are lit. Law enforcement vehicles can remain unnoticed when needed

Efficiency

1/5th of the power consumption compared to traditional light sources

- Light bars can be powered by the vehicle battery alone (the engine can be turned off)
- Significant reduction in alternator and battery replacement
- Low profile LUXEON®-based light bars and warning beacons are more aerodynamic and therefore more fuel efficient

Reliability

70% of the original light output after 50,000 hours

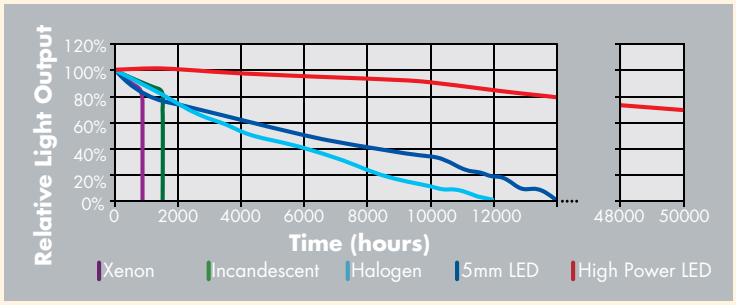
- Can be on continually for 6 years!

Rugged solid-state light source

- LUXEON® LEDs contain no filament, no gases and no moving parts. They are resilient to shock and vibration experienced in vehicles

Operating temperature range down to -40°C

- Will start in severe environments



1 LUXEON® LEDs

2 Power - Current Regulating IC

3 Power - Microcontroller

4 Optics

5 Thermal - Base used as Heatsink

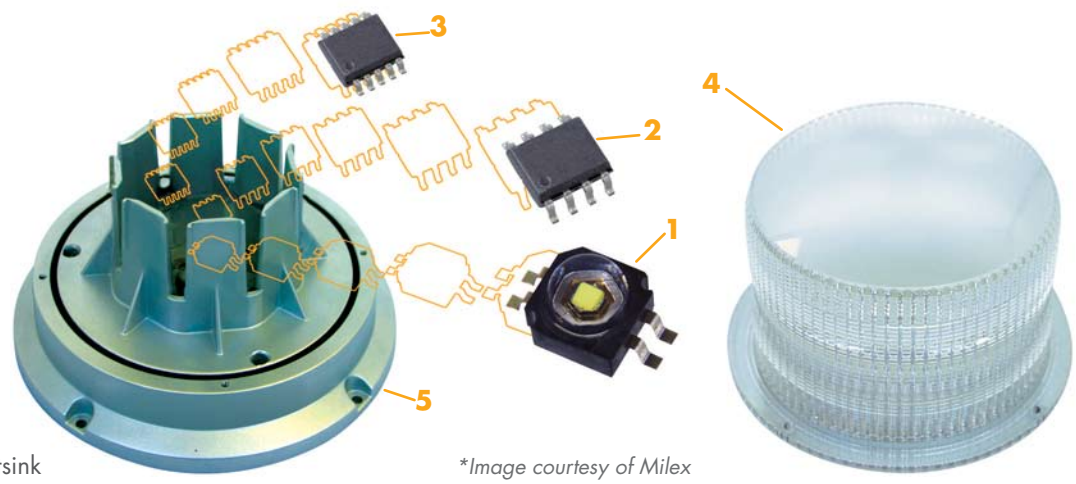
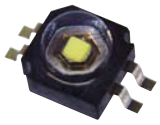


**Image courtesy of Milex*

1. LUXEON® LEDs

		LUXEON® I	LUXEON® III	LUXEON® K2	
LUXEON®					
RED-ORANGE					
Typical Flux	(lm)	55	190	100	
Drive Current	(mA)	350	1400	700	
Max Junction Temperature	(°C)	135	135	150	
Thermal Resistance	(°C/W)	15	6	9	
Size	(mm)	14.5 x 8.0 x 5.9	14.5 x 8.0 x 5.9	11.7 x 7.3 x 5.8	
Part #		LXHL-PH01	LXHL-PH09	LXK2-PH12 – S00	
RED					
Typical Flux	(lm)	44	140	100	
Drive Current	(mA)	350	1400	700	
Max Junction Temperature	(°C)	135	135	150	
Thermal Resistance	(°C/W)	15	6	9	
Size	(mm)	14.5 x 8.0 x 5.9	14.5 x 8.0 x 5.9	11.7 x 7.3 x 5.8	
Part #		LXHL-PD01	LXHL-PD09	LXK2-PD12 – S00	
BLUE					
Typical Flux	(lm)	16	23	35	46
Drive Current	(mA)	350	700	1000	1500
Max Junction Temperature	(°C)	135	135	185	185
Thermal Resistance	(°C/W)	15	13	9	9
Size	(mm)	14.5 x 8.0 x 5.9	14.5 x 8.0 x 5.9	11.7 x 7.3 x 5.8	11.7 x 7.3 x 5.8
Part #		LXHL-PB01	LXHL-PB09	LXK2-PB14 – Q00	LXK2-PB14 – Q00
AMBER					
Typical Flux	(lm)	42	110	75	
Drive Current	(mA)	350	1400	700	
Max Junction Temperature	(°C)	135	135	150	
Thermal Resistance	(°C/W)	15	6	9	
Size	(mm)	14.5 x 8.0 x 5.9	14.5 x 8.0 x 5.9	11.7 x 7.3 x 5.8	
Part #		LXHL-PL01	LXHL-PL09	LXK2-PL12 – R00	
GREEN					
Typical Flux	(lm)	53	64	100	130
Drive Current	(mA)	350	700	1000	1500
Max Junction Temperature	(°C)	135	135	185	185
Thermal Resistance	(°C/W)	15	13	9	9
Size	(mm)	14.5 x 8.0 x 5.9	14.5 x 8.0 x 5.9	11.7 x 7.3 x 5.8	11.7 x 7.3 x 5.8
Part #		LXHL-PM01	LXHL-PM09	LXK2-PM14 – U00	LXK2-PM14 – U00
WHITE					
Typical Flux	(lm)	45	65	120	140
Drive Current	(mA)	350	700	1000	1500
Max Junction Temperature	(°C)	135	135	150	150
Thermal Resistance	(°C/W)	15	13	9	9
Size	(mm)	14.5 x 8.0 x 5.9	14.5 x 8.0 x 5.9	11.7 x 7.3 x 5.8	11.7 x 7.3 x 5.8
Part #		LXHL-PW01	LXHL-PW09	LXK2-PW14-V00	LXK2-PW14-V00

Notes:
1. Minimum luminous flux or radiometric power performance guaranteed within published operating conditions. Philips Lumileds maintains a tolerance of ± 10% on flux and power measurements.
2. Typical luminous flux or radiometric power performance when device is operated within published operating conditions.

Low Drop-Out regulators (LDOs) are low cost solutions, used in systems where the input voltage is slightly greater than the LED voltage. They produce minimal EMI.

Buck regulators are used in systems where the input voltage is significantly greater than the LED forward voltage. In these instances, they are more efficient than LDOs.

2. CURRENT REGULATING ICs FOR VEHICLES

	LDO		
	National Semiconductor	ON	Sipex
Iout (max) (A)	1500	400	1000
Vin (min) (V)	3	8	4
Vin (max) (V)	40	30	16
Vout (max) (V)	37	28	15
Part #	LM317	NUD4001	SPX2941
Line	LUXEON® I, LUXEON® III, LUXEON® K2	LUXEON® I, LUXEON® K2	LUXEON® I, LUXEON® III, LUXEON® K2
	BUCK REGULATOR		**BUCK REGULATOR + CONTROLLER**
	Melexis	ON	freescale semiconductor
Iout (max) (A)	1500+	3000	4 x 700
Vin (min) (V)	6	2.5	8
Vin (max) (V)	32	40	16
Vout (max) (V)	32	40	8
Part #	MLX10803	NCP3163	MM908E625
Line	LUXEON® I, LUXEON® III, LUXEON® K2	LUXEON® I, LUXEON® III, LUXEON® K2	LUXEON® I, LUXEON® III, LUXEON® K2

Programmable ICs are often required to enable Flashing and Strobing features.

3. MICROCONTROLLERS FOR VEHICLES

	MICROCONTROLLER		PSOC	
	freescale semiconductor		CYPRESS PERFORM	
Vin (min) (V)	3	1.8	2.4	2.4
Vin (max) (V)	5	3.6	5.25	5.25
Flash Memory (KB)	4	4	4	4-8
ADC (bit)	10	10	14	10
Part #	MC68HC908Qx	MC9S08QG4	CY8C24x	CY8C21x
Features	PWM, sequences	PWM, sequences	PWM, sequences	PWM, sequences

4. OPTICS

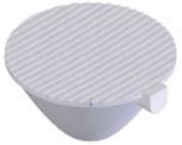
Through Future Lighting Solutions, you have access to a wide range of optical solutions – ranging from custom optics, optics design services and standard 'off-the-shelf' optics. Many of these applications require custom optics.

Contact Future Lighting Solutions for more information, or visit

http://www.lumiledsfuture.com/products/optics.cfm

Designed by
Breault Research Organization*

**Illustration courtesy of Milex*



Designed by
CRS Electonics

COMPLIANCE

LUXEON® LEDs are tested and binned for color, voltage and light output. Future Lighting Solutions offers a custom bin sorting service to help meet color specifications.

Binning and labeling is the process of separating LEDs based on their various characteristics (flux, forward voltage and color) and assigning them a specific bin code. LEDs with the same characteristics (and therefore suffix, or bin code) are placed on a reel.

When designing vehicle-based emergency or warning systems, color binning can be an important consideration. While some applications and some regions are not tightly regulated and can take advantage of all bins, others are tightly specified by regulatory bodies such as SAE, NFPA, CE. Future Lighting Solutions' bin sorting capabilities can assist in meeting these requirements, without the use of light-blocking filters and inefficient diffusers.

Below is a select list of bins, all of which can be used to develop products that will meet applicable standards. Future Lighting Solutions can assist with the selection of a range of bins that will meet specification and be readily available over time.

Color	Bin #	Wavelength Range (nm)			Chromaticity Coordinates Range x			y		
Red-Orange	2	613.5	-	620.5	0.676	-	0.692	0.307	-	0.324
Red	4	620.5	-	631	0.692	-	0.709	0.291	-	0.307
	5	631	-	645	0.709	-	0.723	0.277	-	0.291
Blue	1	460	-	465	0.136	-	0.144	0.030	-	0.040
	2	465	-	470	0.124	-	0.136	0.040	-	0.058
	3	470	-	475	0.110	-	0.124	0.058	-	0.087
	4	475	-	480	0.091	-	0.110	0.087	-	0.133
Amber	5	480	-	485	0.069	-	0.091	0.133	-	0.201
	2	587	-	589.5	0.557	-	0.572	0.427	-	0.442
	4	589.5	-	592	0.572	-	0.587	0.413	-	0.427
	6	592	-	594.5	0.587	-	0.600	0.399	-	0.413
Green	1	520	-	525	0.074	-	0.114	0.826	-	0.834
	2	525	-	530	0.114	-	0.155	0.806	-	0.826
	3	530	-	535	0.155	-	0.193	0.782	-	0.806
	4	535	-	540	0.193	-	0.230	0.754	-	0.782
	5	540	-	545	0.230	-	0.266	0.724	-	0.754
	6	545	-	550	0.266	-	0.302	0.692	-	0.724

For complete list of all available bins or any additional information, please visit http://www.lumileds.com/pdfs/AB21.pdf

TYPICAL APPLICATIONS

DESIGN AND MANUFACTURING ASSISTANCE

Future Lighting Solutions can assist in the design and manufacture of your fixture. Through a network of Certified Solutions Partners, Future Lighting Solutions utilizes a wealth of experience in LUXEON® LED, Power, Thermal and Optics design and integration anywhere around the world.

This network of Certified Solutions Partners, titled the LUXEON® Lighting Network, exists to provide the confidence of predictable performance of LUXEON®-based lighting systems.

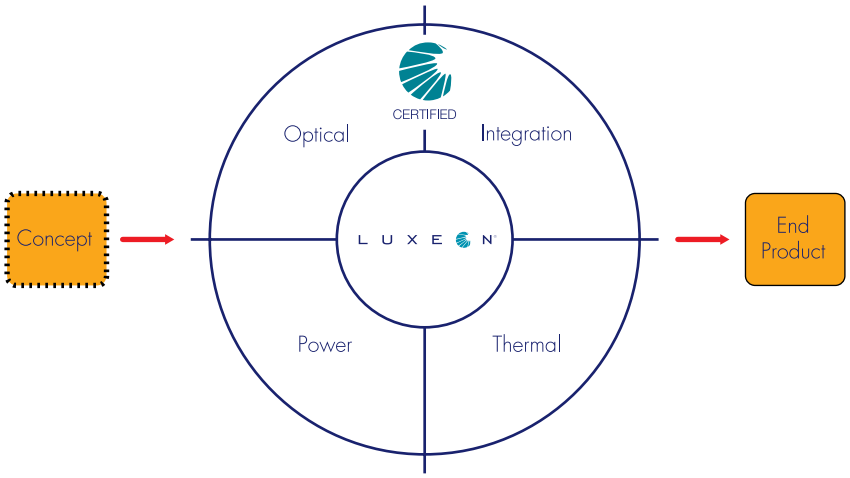
When you work with a Certified Solutions Partner, you are guaranteed that you are dealing with an expert who has been trained and certified to enable LUXEON® solutions.

CERTIFIED

Our Certified Solutions Partners are the most qualified to assist you.

Find out more about the LUXEON® Lighting Network™ and our Certified Solutions Partners here:

www.lumiledsfuture.com/luxeonlightingnetwork/



FUTURE
Lighting Solutions
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ABOUT FUTURE LIGHTING SOLUTIONS

A division of Future Electronics, the third largest electronic components distributor in the world, Future Lighting Solutions (FLS) is dedicated to the LED lighting industry. With more than 6 years of power LED experience, FLS is the pioneer in delivering the most comprehensive worldwide LED lighting solutions support structure in the industry. FLS offers customers LED Lighting knowledge, resources, programs, partners, solutions and logistics support, focused on enabling the adoption of LUXEON®-based solid state lighting technology.

Future Lighting Solutions' innovative approach is built around its team of world class LED lighting experts, its highly specialized and experienced partners, and its exclusive worldwide relationship with Philips Lumileds Lighting Company.

Future Lighting Solutions; **Making LED lighting solutions simple™.**

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