FUTURE Lighting Solutions

Making LED Lighting Solutions Simple™

LIGHT BY LUXEON®

Simple Steps to Solid-State Lighting

FUTURE
Lighting Solutions
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Future Lighting Solutions is a division of Future Electronics Inc., the 3rd largest electronics distributor in the world. Future Lighting Solutions is focused on delivering world-class LUXEON® high-power LEDs, technical solutions and commercial support that facilitate developing and manufacturing "never before possible" LUXEON LED-based applications. Future Lighting Solutions brings customers unparalleled LED lighting knowledge, access to expert resources, full system solutions, global logistics support and full access to the LUXEON Lighting Network™ of Certified Solutions Partners. Future Lighting Solutions is your first and last stop for complete LUXEON lighting solutions; Making LED Lighting Solutions Simple™.

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FOR MORE INFORMATION VISIT www.FutureLightingSolutions.com

Philips Lumileds

Philips Lumileds is the global market and technology leader in power LEDs, producing the world's brightest and longest-lasting LED light sources for all types of lighting applications. The company's patented LUXEON Power Light Sources are the first to combine the light output of conventional lighting with the small size, long life, energy efficiency, and many other advantages of LEDs. LUXEON, SuperFlux, and SnapLED LEDs are used in general lighting, automotive, portable, digital imaging, display backlighting, signal and signage applications. Philips Lumileds is a pioneer in epitaxial, packaging, and phosphor technologies specifically designed to deliver the most lumens per watt, per package, and per dollar, with the widest operating range, highest reliability and industry-leading lumen maintenance.

Philips Lumileds also supplies core LED material and LED packaging, manufacturing billions of LEDs annually. Our global engineering, manufacturing, marketing, sales and support infrastructure provides outstanding service and design support to customers worldwide.

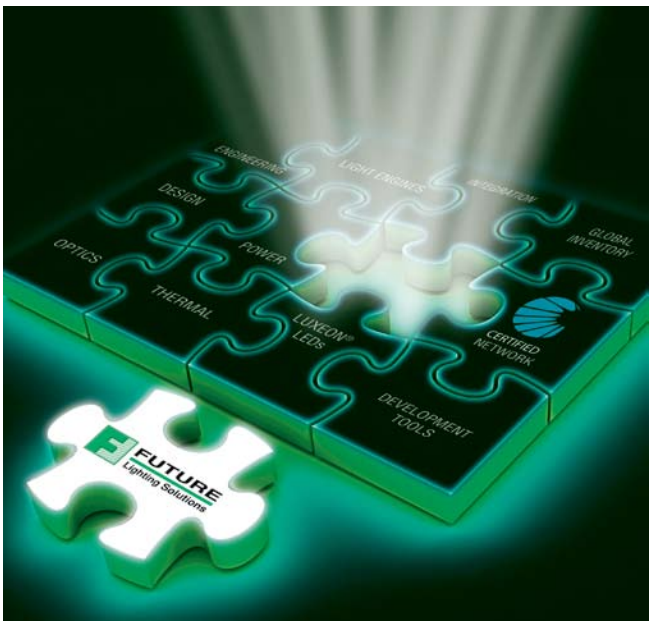
FOR MORE INFORMATION VISIT www.philipslumileds.com

Making LED Lighting Solutions Simple™

Future Lighting Solutions has created the "Simple Steps to Solid-State Lighting" Guide to facilitate your development of an efficient SSL application using the best-in-class LUXEON® Power LEDs. Following these steps can greatly simplify and accelerate your product development.

The key to success in Solid-State Lighting is working with the right partner. Future Lighting Solutions offers you unparalleled LED lighting knowledge, design and development tools, and access to expert resources and system solutions. Future Lighting Solutions has industry leading capabilities such as:

- ❑ Solid-State Lighting Expertise & Education
- ❑ Product Concept Development Support
- ❑ Optimal Power LED Selection Tools
- ❑ Complete System Solution Design Support
- ❑ Certified Design, Integration & Manufacturing Partners
- ❑ Product Lifecycle Inventory Management Programs

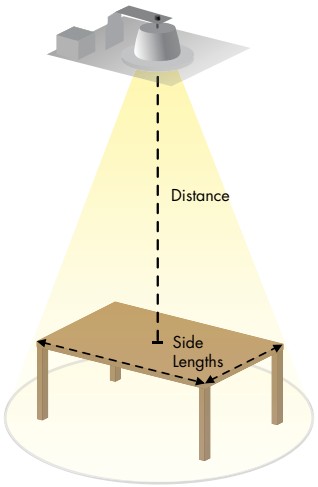


STEP 1

Define the Area

It is important to understand the area of the surface that you are intending to illuminate. Measuring the area will allow you to determine how much light and how wide of a light beam spread is required for your application.

Determine the square area of the surface to be illuminated.



Measuring the distance will help you determine how much light is required and how it should be directed. The further the light source is away from the surface, the more light will be needed.

Measure the distance between the light source and the center of the surface to be illuminated.

Approximate area: _____ square feet

Approximate distance: _____ feet

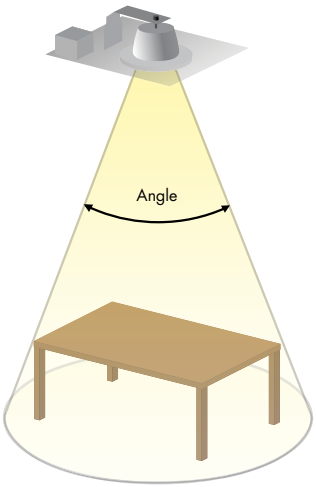
STEP 2

Select an Optic

An optic can form a narrow, medium or wide beam of light to target the appropriate surface area needed to be lit, while minimizing wasted light.

Select an optic that will help you achieve the desired light spread. Optics selection is not an exact science – you may need to try different options.

Based on the area and the distance determined in Step 1, refer to Table 2.1 to determine the beam spread needed to illuminate the surface area.



Narrow = 5° – 15°
Medium = 20° – 40°
Wide = 40° – 60°

TABLE 2.1 — OPTIC/BEAM SPREAD

Distance (feet)	Square Area (square feet)						
	1	2	4	6	9	12	16
1	Wide						
2	Medium	Wide					
3	Medium	Medium	Wide	Wide			
5	Narrow	Medium	Medium	Medium	Wide	Wide	Wide
8	Narrow	Narrow	Medium	Medium	Medium	Medium	Medium

Note: 1 foot = 0.3 meters

Optic/beam spread: _____

STEP 3

Determine the Illuminance
(footcandles)

The illuminance is the amount of light measured on a surface area measured in lux (metric) or in footcandles (imperial). Before selecting a LUXEON® LED, this must be determined to ensure the surface is adequately illuminated.

For a general idea for your illuminance requirements, refer to Table 3.1 to view the typical illumination levels for common applications.

TABLE 3.1 — LIGHTING APPLICATIONS

Application	Typical Illuminance Requirements		# of LUXEON LEDs / fixture
	footcandles	lux	
Desk Area Reading/Writing	50	500	1
Office Area	30	300	20
Conference Room	30	300	20
Lobby	10	100	8
Auditorium	10	100	8
Corridor	5	50	4


Desk Area Reading/Writing


Office Area


Conference Room


Lobby


Auditorium


Corridor

Approximate illuminance: _____ footcandles

STEP 4

Determine the Light Output
(lumens)

Light output of high-power LEDs is measured by its luminous flux (lumens). Illuminance requirements and light output needs are directly related; more illuminance will require more light output.

Based on the beam spread, distance and illuminance determined in the previous steps, refer to Tables 4.1, 4.2 or 4.3 as a general guideline to find the light output required to illuminate the surface.

TABLE 4.1 —
NARROW BEAM OPTICS

Distance (feet)	Illuminance Requirements (footcandles)		
	5	10	30
	Flux Requirements* (lumens)		
1	0.2	0.4	1.2
2	0.7	1.5	4
3	1.5	3	9
5	4	8	24
8	11	22	66
10	17	34	102

Note: 1 foot = 0.3 meters
1 footcandle = 10.76 lux

TABLE 4.2 —
MEDIUM BEAM OPTICS

Distance (feet)	Illuminance Requirements (footcandles)		
	5	10	30
	Flux Requirements* (lumens)		
1	1.5	3	9
2	6.5	13	39
3	15	30	90
5	40	80	240
8	105	210	630
10	160	320	960

Note: 1 foot = 0.3 meters
1 footcandle = 10.76 lux

TABLE 4.3 —
WIDE BEAM OPTICS

Distance (feet)	Illuminance Requirements (footcandles)		
	5	10	30
	Flux Requirements* (lumens)		
1	5	10	30
2	20	39	117
3	44	88	265
5	122	245	732

Note: 1 foot = 0.3 meters
1 footcandle = 10.76 lux

*Assuming 70% system efficiency

Approximate flux requirements: _____ lumens

STEP 5

Select Your LUXEON® LED

Selecting a LUXEON LED is an application specific process. Multiple LEDs in an array may be used or the LEDs can be driven at a higher drive current to achieve the light output requirements.

With the flux requirements determined in Step 3, refer to Table 5.1 to choose a LUXEON LED that has the best lumen output characteristics to match your lighting criteria.

TABLE 5.1 — LUXEON LEDS

LED	Part Number	Test Forward Current	Minimum Flux (lumens)
LUXEON Rebel Neutral White	LXML-PWC1-0040	350mA	40
	LXML-PWC1-0050		50
	LXML-PWC1-0070		70
	LXML-PWC1-0080		80
LUXEON Rebel Cool White	LXML-PWC1-0040	350mA	40
	LXML-PWC1-0050		50
	LXML-PWC1-0070		70
	LXML-PWC1-0080		80
	LXML-PWC1-0090		90
	LXML-PWC1-0100		100
LUXEON K2 Warm White	LXK2-PWW4-T00	1000mA	68
	LXK2-PWW4-U00		88
LUXEON K2 Neutral White	LXK2-PWN4-T00	1000mA	68
	LXK2-PWN4-U00		88
	LXK2-PWN4-V00		114
LUXEON K2 with TFFC Cool White	LXK2-PWC4-0160	1000mA	160
	LXK2-PWC4-0180		180
	LXK2-PWC4-0200		200

LUXEON LEDs are also available in a full range of colors as well as Warm White and Neutral White variations.

For the full range of LUXEON products, please visit www.FutureLightingSolutions.com and download our *All in 1 Plug & Play Guide* for our complete line of products.

LUXEON LED: _____

# of LUXEON LEDs: _____

STEP 6

Select Your Power Solution

LUXEON® LEDs need to be driven at a constant current. There are a number of off-the-shelf drivers designed to work with LUXEON LEDs to ensure that they are operating within their specified range. Standard transformers will not work as they are not designed to operate at a constant current.

To choose a Power Solution, you must first determine the following:

Input voltage (120Vac or 230Vac) : _____

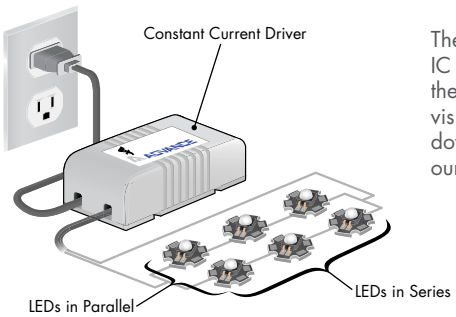
Number of LEDs per fixture : _____

Configuration of the LEDs (series and/or parallel branches) : _____

Refer to Table 6.1 for a selection of power solutions that will fit the criteria determined above.

TABLE 6.1 — EXAMPLES OF POWER SOLUTIONS DRIVEN AT 350mA

Input Voltage	Supplier	Part Number	Iout Max (mA)	Optimal # LEDs in Series	Optimal # Parallel Branches	Maximum # LEDs in System	LED Configurations
Offline AC-DC (120Vac)	Advance	LED-120A-350C-28F	350	7	1	7	
		LED-120A-0700C-24F	700	6	2	12	
		LED-120A-0024V-10F	1050	6	3	18	
Offline AC-DC (110 - 240 + Vac)		LED-UNIA-0350C-12F	350	3	1	3	
		LED-UNIA-0700C-12F	700	3	2	6	
	Dialight Lumidrives	MDU4-SC-35	350	4	1	4	
		MDU9-SC-35/70	700	8	2	16	



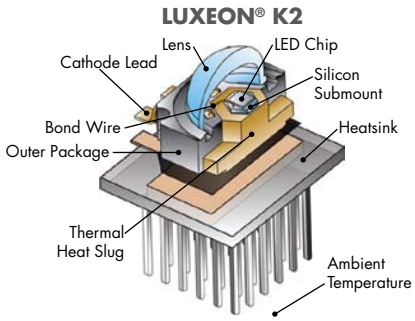
There are also a number of DC-DC and IC driver solutions for powering LEDs. For the full range of driver products, please visit www.FutureLightingSolutions.com and download our *All in 1 Plug & Play Guide* for our complete line of products.

Power solution: _____

STEP 7

Select Your Thermal Solution

Heat emitted from the back of the LUXEON LED needs to be dissipated to ensure maximum efficiency. Inadequate thermal management will lead to a shift in color, lower light output and in some cases premature failure.



The following should be considered when designing a fixture:

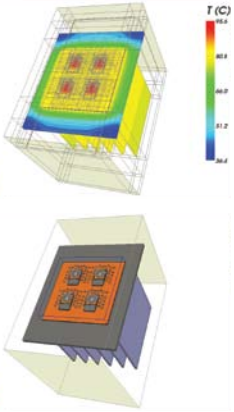
- Ambient temperature
- Airflow
- Heatsink material

For an optimal thermal design, a custom solution is necessary. For finished product designs, the actual body of the fixture can be used as a heatsink.

Future Lighting Solutions offers QLED, a thermal design software that allows lighting designers and engineers to perform real time thermal simulations using LUXEON LEDs. QLED will help developers:

- Minimize the number of design cycles
- Reduce development costs
- Decrease time to market

For a free trial evaluation or to purchase QLED please visit www.FutureLightingSolutions.com/QLED



Based on the drive current determined in Step 6, refer to Table 7.1 to select a heatsink to get started.

TABLE 7.1 – EXAMPLES OF THERMAL SOLUTIONS

Supplier	Part Number	Length (mm)	Width (mm)	Height (mm)	Thermal Resistance (°C/W)	Approx.# of LEDs @ 350mA*
Aavid Thermalloy	374124B00035	27	27	18	20.3°C/W	2-3
	374724B00032	35	35	18	15.3°C/W	3-4
	375024B0032	40	40	18	12.2°C/W	4
	500400B00000	46	46	32	5.0°C/W	7-8

*Assuming 30°C Ambient Temperature, 4°C/W Board Thermal Resistance, Maximum Forward Voltage

Thermal solution: _____

Glossary

AMPERE (A)	The unit of measurement of current.
AMBIENT TEMPERATURE	The air temperature of any given environment where the LED will be operating.
COLLIMATOR	A *Secondary Optic*, often a Lens, which collimates the light.
DC-DC	DC to DC converters regulate (raise or lower) the voltage level from a battery source to the LUXEON® LED.
DRIVE CURRENT	The constant current provided to the LED by the *Driver*.
DRIVER	A circuit that provides current to the LED. Constant current drivers are suitable for LUXEON LEDs.
ELECTRICAL MODULE	A ready-to-use power solution, ideal for testing and prototyping the LEDs. Little to no electronics knowledge is required.
HEATSINK	A component designed to lower the temperature of the electronic device to which it is connected by dissipating excess heat generated. It is often finned, and made from aluminum.
IC	See *Integrated Circuit*
ILLUMINANCE	The luminous power incident per unit area of a surface. It is measured in either lux or footcandles. One lumen per square meter in one lux. One lumen per square foot is one footcandle.
INTEGRATED CIRCUIT	An electronic circuit built on a semiconductor silicon substrate. The circuit is sealed and has leads. It is often referred to as a "chip".
INPUT VOLTAGE	The voltage applied to the driver circuit.
LENS	A *Secondary Optic* that collimates the light. For white LEDs the beam angle can be 10, 30 or 45 degrees.
LUMEN (LM)	The unit of measurement of *Luminous Flux*.
LUMINOUS FLUX	A measure to the sensitivity of the eye to the rate of flow of light per time at the given color. The unit of measurement is the *Lumen*.
MEDIUM BEAM OPTICS	Medium beam optics are defined by a beam angle between 20° and 40°.
NARROW BEAM OPTICS	Narrow beam optics are defined by a beam angle between 5° and 15°.
OFFLINE AC-DC	An electrical drive circuit that converts from wall current and voltage to a constant DC current, suitable for driving all LUXEON LEDs.
OPTIC	see *Secondary Optic*.
OUTPUT CURRENT	The current supplied to the LED from the output of the driver. It is measured in *Amperes*.
OUTPUT VOLTAGE	The voltage available to the LED from the output of the driver.
POWER CONSUMPTION	A measure of the power consumed by the system. It can be calculated by multiplying the *Forward Voltage* by the *Drive Current*. The unit of measurement is the *Watt*.
SECONDARY OPTIC	A device connected to the LED for purposes of manipulating the light output. Common secondary optics include a *Lens* and a *Reflector*.
SOLID-STATE LIGHTING	Lighting that uses solid-state devices, that is to say, high power LEDs, such as the LUXEON.
THERMAL RESISTANCE	The measurement of how difficult it is for heat to traverse an object. It is defined as the temperature difference across an object when a unit of heat energy flows through it in unit time. The lower the thermal resistance, the better the object *Heatsink* is at dissipating heat. The unit of measurement is degrees Celsius per Watt (°C/W).
VIEWING ANGLE	The angle through which the light may be satisfactorily viewed. Note: as the viewing angle decreases, the intensity generally increases.
WIDE BEAM OPTICS	Wide beam optics are defined by a beam angle between 40° and 60°.

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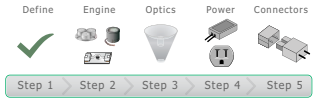
ALL IN 1 PLUG & PLAY GUIDE

Detailed overview of Philips Lumileds products portfolio and complementary power, optical and thermal solutions. Use this as your convenient All-in-One Guide when designing your solid-state lighting application.

www.FutureLightingSolutions.com/pdf/PlugPlay.pdf

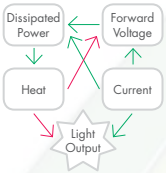
LED LIGHT ENGINES



This web-based tool brings users to within 5 easy steps of a solid-state lighting system by offering a broad range of off-the-shelf LUXEON® LED Light Engines.

www.FutureLightingSolutions.com/lightengines

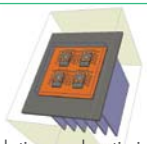
USABLE LIGHT TOOL



The purpose of this tool is to provide a true "real world" evaluation and comparison of high-power LEDs by taking into account the effects of 7 critical relationships.

www.FutureLightingSolutions.com/ult

QLED



QLED is a powerful simulation and optimization software that allows engineers to perform real time thermal design of electronic systems using LUXEON power LEDs.

www.FutureLightingSolutions.com/qled

CERTIFIED SOLUTIONS PARTNERS

CERTIFIED

Assistance Where You Need It Most
Whether you are looking to retrofit an existing fixture or design a completely new one, our Certified Solutions Partners are the most qualified to assist you.

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These and other designer guides are available for download in the *Documentation* section of the Future Lighting Solutions website.

www.FutureLightingSolutions.com

MARCH 2008