

LUXEON® for Flashlight Applications

Introduction

This reference design outlines the key considerations for engineering a LUXEON® based flashlight. Although a number of designs are possible, this reference design focuses on low system cost solutions.

Additional Mechanical, Optical, Thermal, and Electrical drive circuitry recommendations are provided to assist in the rapid design and development of a low cost high performance flashlight.



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Technical Information

Mechanical Considerations

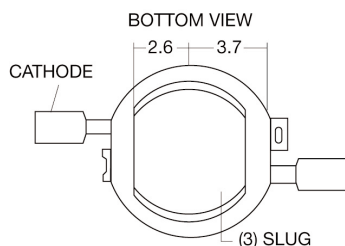
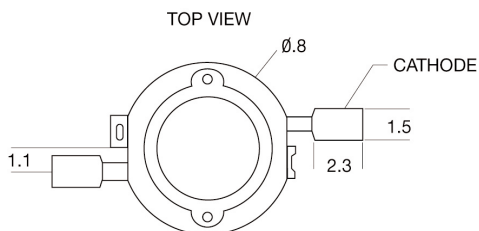
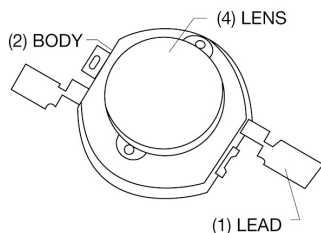
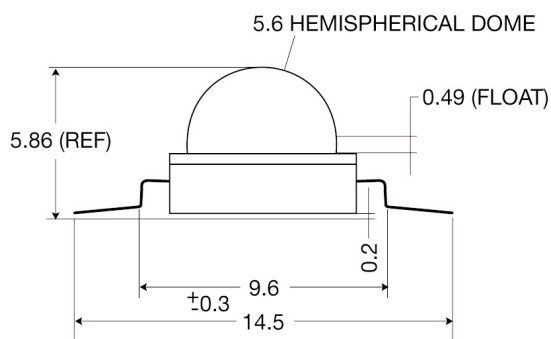
Philips Lumileds offers two base products that work very well in flashlight applications: LUXEON Emitter and LUXEON Star.

LUXEON Emitter Utilization

The emitter enables maximum design flexibility. Use of a LUXEON Emitter may require the use of a custom heat sink to ensure proper operation, safety and lifetime. Please review the LUXEON Emitter Technical Datasheet DS25.



Mechanical Dimensions

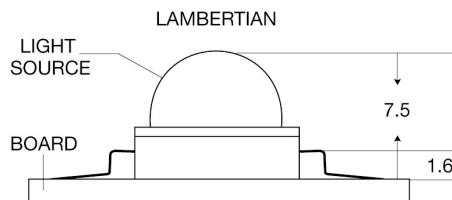
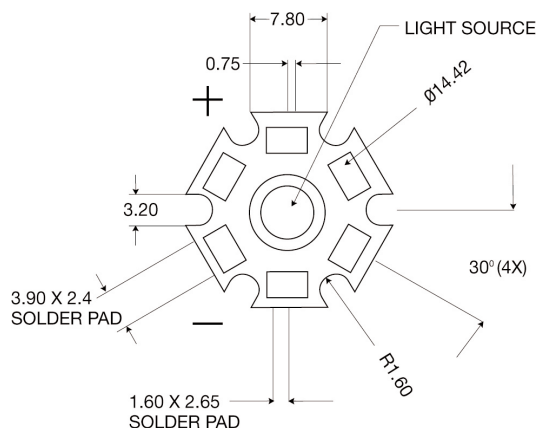


LUXEON Star Utilization

A LUXEON Star consists of an emitter mounted to a hexagonal MCP circuit board. The MCPB helps to facilitate thermal management and provides a solid base for mounting options. Mounting the LUXEON Star to the body of an aluminum flashlight will further support the heat dissipation. Please review the LUXEON Star Technical Datasheet DS23.



Mechanical Dimensions

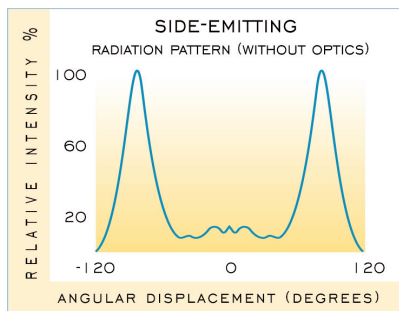


Optical Considerations and Radiation Patterns

Side Emitting Radiation Pattern

The Side Emitting radiation pattern relies heavily on the reflector design. Designers proficient in optics and the development of reflectors can take advantage of this style lens, which should lead to a shallower, more efficient reflector optic. This will enable better light management and improved control of the beam pattern.

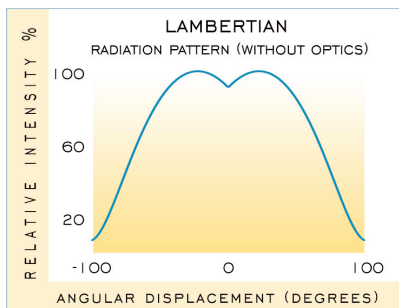
See chart below:



Lambertian Radiation Pattern

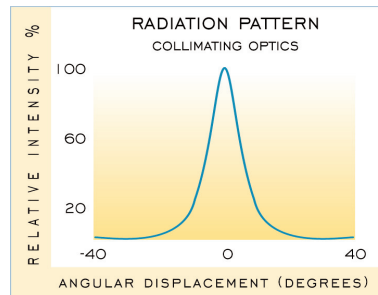
The Lambertian radiation pattern is less dependent on the quality of the reflector design. Most of the light is projected directly out of the flashlight bezel without the aid of the reflector. A deeper reflector is typically required to adequately harness and control the light. When choosing the Lambertian radiation pattern, consider using an acrylic collimating lens that is optically designed for use with LUXEON. This will enable a more efficient and compact flashlight design.

See chart below:



LUXEON Collimator Lens

A third optical option is the use of an acrylic collimating lens. Philips Lumileds offers a collimator lens, which is designed to efficiently collimate the light from a LUXEON power source into a 10-degree beam (5-degree half angle). The optical design of the collimator uses Total Internal Reflection to collimate the light with 90% efficiency utilizing a lambertian emitter. There is one limitation to the collimating lens; it does not lend itself to beam adjustment. (See Technical Data Sheet DS26)



Other Collimating Lens Vendors

Reflexite Optics
120 Darling Drive
Avon, CT 06001
www.reflexite.com

Fraen
80 New Crossing Road
Reading, MA 01867
www.fraen.com

CTP Coil
111 Buckingham Avenue
Slough, Berks SL1 PF4
www.coil.co.uk

Other optics solutions also provided by our supply chain partner: Future Electronics: 1-888-LUXEON2

For more options, please see the Resource Guide at www.lumileds.com.

Thermal Considerations

The thermal issues will depend on the material chosen to house the flashlight. When constructing an aluminum body flashlight, the MCPCB module or emitter should be in direct contact with the aluminum housing to allow the flashlight body to function as a heat sink. Plastic body flashlights will require the use of an "off-the-shelf" heat sink. A general rule of thumb suggests at least 1-square inch of aluminum per watt of LED power when the maximum ambient condition is less than 50°C.



Good thermal design will ensure that junction temperatures do not exceed the maximum value (LUXEON: $T_j \text{ max} = 120^\circ\text{C}$, or 135°C for LUXEON III). Philips Lumileds provides a detailed description of thermal management in Reference Application Brief AB05.

If space constraints do not allow for a heat sink, consider under-driving the LED to minimize heat production.

For heat sink support, see the Vendor Resource Guide at: http://www.lumileds.com/guide/vendor_guide.cfm?formSend=filterForm&specId=Heatsink

Electrical Considerations

There are numerous battery configurations used to power flashlights, therefore supply voltage and current will depend on your specific battery configuration. Since a LUXEON LED is a current regulated device, it is important to manage the current per the respective LUXEON data sheet.

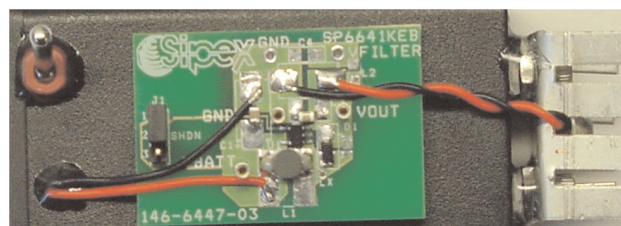
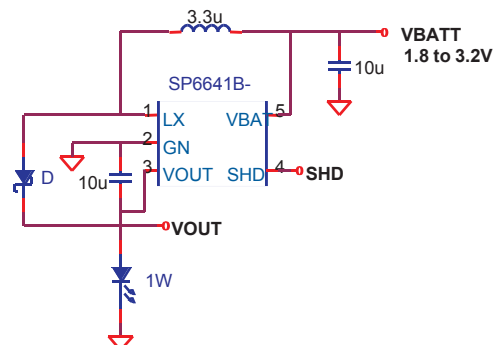
Cost effective Regulated Circuit

To achieve optimal performance Philips Lumileds recommends the use of various Step-Up or Step-Down controllers to supply and control the LUXEON LED device.

Future Electronics offers a selection of driver solutions ranging from a simple cost-effective on/off function, to feature rich microcontroller designs.

The solution below illustrates a low cost current regulating circuit designed by Sipex. Components for this solution are listed at the bottom of this page. All components are available through Future Electronics.

SP6641B 5V for 2 Cell to Luxeon I



Alternative Driver Methods

Passive Circuit

A low cost solution to regulating current involves the use of a resistor in series with the batteries. Although this lowers overall system performance, it reduces the overall cost of the flashlight. See Application Brief AB12 page 13 to understand how to calculate resistor values.

Direct to Battery

Depending on the battery configuration, it may be possible to drive the LUXEON directly from the batteries. This design provides an unregulated current to the LED and may damage or shorten the lifetime of the LUXEON LED if the current exceeds the maximum recommended current specified in the data sheet. Again, the overall system performance is compromised as well as the lifetime of the LED.

Other circuit solutions also provided by our supply chain partner: Future Electronics: 1-888-LUXEON2

For alternative sources, please see the Resource Vendor Guide at: http://www.lumileds.com/guide/vendor_guide.cfm

Ref Designation	Qty	Manufacturer	Part Number	Description	Size	Vendor
U1	1	Sipex Corp.	SP6641BEK-5.0	1A 5V out Boost DC/DC Regulator	SOT23-5	www.sipex.com
L1	1	Coilcraft	DO1608C-332	Inductor 3.3uH 0.08ohms 2.0A	1210 (1.55mm ht)	www.coilcraft.com
D1	1	On-Semi	MBR0520	0.5A DC Schottky Diode	SOD-223	www.onsemi.com
C1, C2	2	TDK	C2012X5R0J100K	10uF X5R ceramic	0805	www.tdk.com

Summary

This document has outlined the various design issues that should be considered when designing a LUXEON based flashlight. Philips Lumileds LUXEON LEDs are an ideal light source for flashlights in terms of durability, efficiency, life cycle, and light output. Our broad product selection of various radiation patterns, colors, and light intensities offers great flexibility for flashlight designers. This enables new and creative approaches to flashlight design.



Company Information

LUXEON® is developed, manufactured and marketed by Philips Lumileds Lighting Company. Philips Lumileds is a world-class supplier of Light Emitting Diodes (LEDs) producing billions of LEDs annually. Philips Lumileds is a fully integrated supplier, producing core LED material in all three base colors (Red, Green, Blue) and White. Philips Lumileds has R&D centers in San Jose, California and in The Netherlands and production capabilities in San Jose and Penang, Malaysia. Founded in 1999, Philips Lumileds is the high-flux LED technology leader and is dedicated to bridging the gap between solid-state LED technology and the lighting world. Philips Lumileds technology, LEDs and systems are enabling new applications and markets in the lighting world.

Philips Lumileds may make process or materials changes affecting the performance or other characteristics of our products. These products supplied after such changes will continue to meet published specifications, but may not be identical to products supplied as samples or under prior orders.



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