

Application specific custom LuxiGen™ LED emitters

Unique Platform for High Power Custom Built LED Emitters in a Compact Package

Key Custom Emitter Platform Options

- Wide range of light spectrum choices from 365nm to 940nm covering full spectrum from UV to IR
- Surface mount ceramic package with integrated dome shape or optically flat glass lens
- Small foot print choices – 4.4mm x 4.4mm to 12mm x 12mm
- Package options capable of handling power from 4W to 80W
- Industry lowest thermal resistance per package from 0.5°C/W to 6.0°C/W depends on package size, material option and total power rating
- Custom built emitters can be packaged on tape and reel, assembled on LED Engin MCPCB or customer designed PCBs

Applications Supported by Custom LuxiGen Emitters

- Analytical Equipment
- Architectural Lighting
- Entertainment
- General Lighting
- Horticulture
- Industrial & 3D Printers
- Image Sensors
- Machine Vision
- Medical Devices
- Security Cameras
- UV Curing

Introduction

LEDs are used as light sources in many different applications, all of which have their own requirements. Not all of them target traditional uses of light. As LEDs are incorporated in emerging technologies such as those in medical devices, sensors, machine vision, 3D printing, UV curing and other specialty applications, there is demand for different LEDs with specific attributes to be used together, sometimes in very compact designs. This requirement poses a challenge to the LED light source designers and an opportunity for LED Engin to support.

Most LED manufacturers are setup for mass assembly of standard products, typically single-die LEDs or multi-die arrays or CoBs of a certain kind. When the application requires mixed spectrum, multi-die light sources, many design considerations come into play. Multi-die arrays do not usually have a small light emitting surface (LES) while co-packaged small LES multi-die LEDs typically don't exceed 4 dies. Level 2 assemblies using packaged LEDs from different manufacturers are available but present their own complexity of design as each supplier's packaging is slightly different. All of these issues are addressed by using a single substrate, multi-die, mixed spectrum, small LES, custom emitter from LED Engin.

LED Engin's standard LED product offering includes a wide variety from 4W single-die emitters to 80W 25-die emitters with light output covering full spectrum wavelengths from 365nm to 940nm, and glass primary optics. These emitters all use the LuxiGen™ platform which leverages a multi-layer coefficient of thermal expansion (CTE) matched ceramic substrate with metal interconnects running through the ceramic layers that results in some of the lowest thermal resistance values for LED packaging. Dies from different LED manufacturers can be simultaneously mounted on this substrate - a unique offering in the industry - and covered with a robust glass primary optics. LED Engin supports customer defined, application specific LED emitters on this LuxiGen platform subject and is an experienced supplier of level 1 and level 2 LED products.

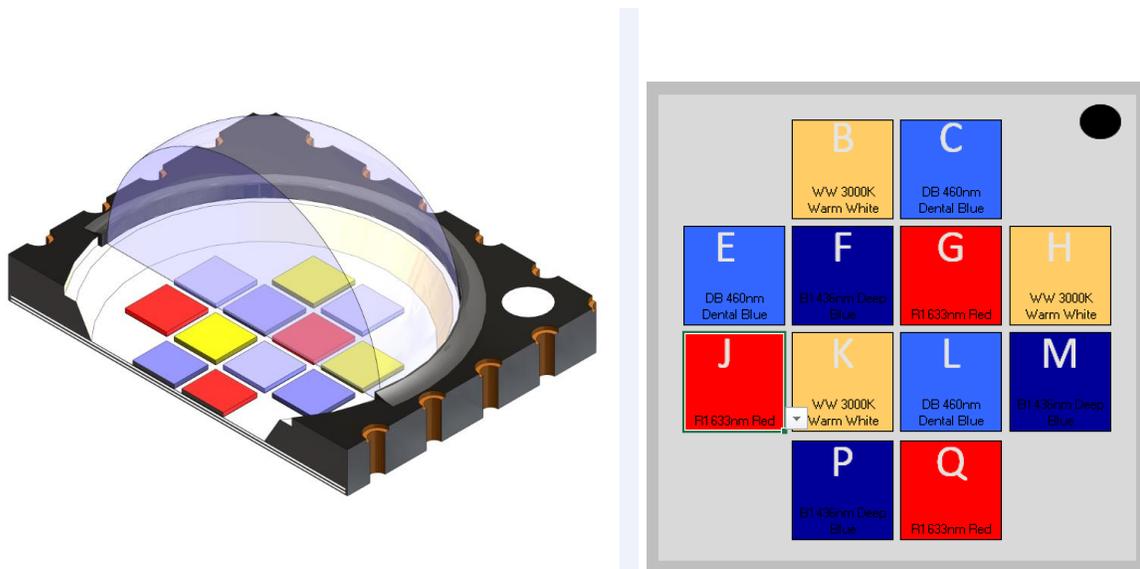


Fig. 1. LuxiGen™ emitter cross-section and customizable die combination in a LZC emitter

Advantages of the LuxiGen™ Emitter Platform

The biggest benefit of the LuxiGen platform is that it can help luminaire designers develop directional lighting fixtures which are small in size, support narrow beam angles, yet are high in light output, all of which translates into longer distances illuminated. This advantage stems from the high thermal conductivity or low thermal resistance of the substrate across the various different LZx emitters. At a system level, this implies that a fixture designed with LuxiGen emitters can either have a smaller heatsink for the same light output as a fixture designed with LEDs from another LED supplier or provide a higher light output for the same size of heatsink in comparison.

Another advantage of the LuxiGen platform is that LEDs of different wavelengths can be integrated into a single small foot print package. This mechanical arrangement can reduce the complexity of the secondary optical system, as the primary optics directs the light output in a unified direction with almost identical light beam field of view (FOV) angle. So beam forming, color mixing, beam directional control and zooming can all be accomplished by using the same optical components for all the wavelengths. This usually results in a more compact optical system and resulting fixture .

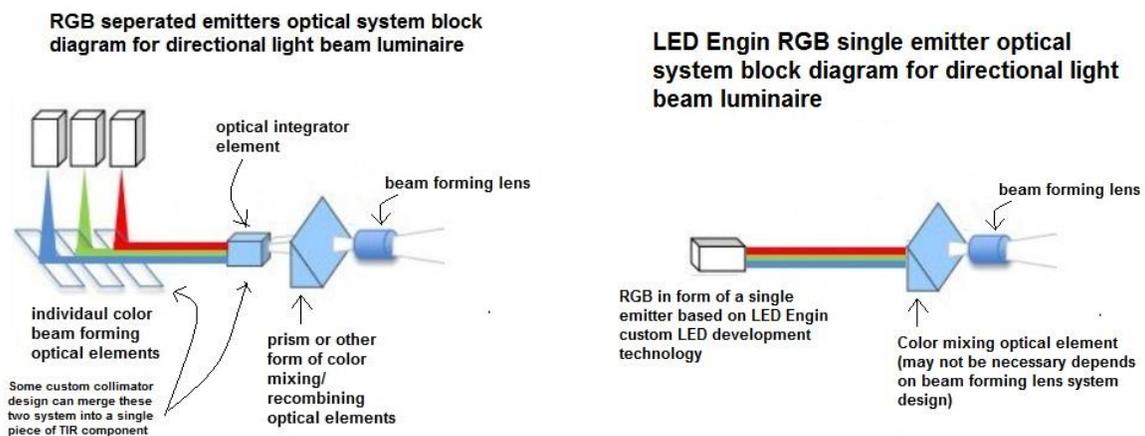


Fig. 2. Simplicity of optical design when co-locating LEDs of different wavelengths in a single package

A third advantage is that depending on the substrate design selected, individual dies or string of LEDs are independently addressable. As an example, the 12 dies in one of the LZC substrates or the 7-dies in a LZ7 substrate are all individually addressable. The 4 strings of dies in a RGBW emitter are also individually addressable whether in a LZ4 4-die substrate or a LZP 25-die substrate. Light sources, whether in traditional lighting applications or otherwise, all need control and dimming using some standard protocols. The ability to address dies and strings uniquely adds to design freedom.

Illustrations of Custom LED Emitters by Application

Following are some examples of custom designs that can be achieved with the LuxiGen emitter platform. With the exception of 365nm UV, all the different LEDs listed in the wavelengths table can be combined in a single emitter substrate. In addition to the well-known warm white-cool white combinations for white light LEDs, the possibilities are many and limited only by business potential.

Example 1: W-IR for Surveillance Camera

A LuxiGen emitter with a White LED and IR LED in the same package is a versatile light source for surveillance camera application. With a small form factor and high flux integrated emitter, a camera designer can simplify their light source optical design and keep the camera unit small. Different visible spectrum image sensors may have different optical sensitivity in the IR range. LED Engin allows the customer to pick the right IR wavelength band to optimize the response of their image sensor technology so that there is maximum light output while keeping the IR light emitted as “invisible” as possible.

Example 2: RGB-UV for Industrial Inspection/ Machine Vision

The rate of absorption of light incident on a surface depends on the wavelength of the light and the surface material. Conventional white light may not be the best light source to render the mechanical shapes and edges of objects precisely if the material absorbs such light. RGB-UV light from a LuxiGen emitter is one combination used in a furniture manufacturing environment for inspecting and measuring the final dimension and surface finish quality of furniture. The machine controls the light spectrum output depending on the material, shape, and surface finish of the object it is inspecting. In this example, the UV radiation is used to reveal details by interacting with certain paints, varnishes or other materials that cannot be well revealed by light of other wavelength.

Example 3: RGB-Amber/-pc-Lime/-UV for Commercial Photography & Videography

In commercial photography and movie production, full spectrum “white” light is not necessarily the best light source for all situations. Color filters are used in most of the works of photographers or movie makers. RGB with some other special spectrum light like Amber, phosphor converted Lime (pc-L), Violet or even near UV can help emphasize appearance in photography or moviemaking. RGBA creates a pleasing warm tone, and is used for façade lighting of red brick buildings for instance, as it enhances the red colors better than RGB or RGBW. pc-L makes cool colored objects appear more vibrant. Most fabrics appear much more saturated in color in near UV than when illuminated with standard white light only. LuxiGen emitters such as RGB-A, RGB-pc-L, RGB-UV are supported custom options.

Example 4: RGB-IR for Retinal Image Capturing

Monochromatic light of certain colors illuminates biological tissues or structures better than others, resulting in improved clarity. Traditionally, retinal scanners use green light as the illuminating source for imaging the retinal network of blood vessels. A RGB-IR device using a LuxiGen emitter can be used in a retinal image capturing tool to acquire additional details about other types of tissues in the human eye, besides blood vessels, during the same scanning operation.

Example 5: Aquarium Lighting

Aquarium lighting is a niche application where the right light depends on whether the aquarium is freshwater or marine, what plants, fish or other aquatic creatures are illuminated and whether there are spectrum requirements for photosynthetic aquatic life to flourish. A custom LuxiGen emitter for aquarium lighting could include UV for black light effects on coral and fish, as well as more blue, or more Deep Red depending on the spectral needs of water, flora and fauna.

Custom Emitter Platform Options

The following are some of the options available while designing a custom LuxiGen emitter

1. Packaging Options

- a. Emitter footprint: 4.4mm x 4.4mm, 7mm x 7mm, 9mm x 9mm, 12mm x 12mm
- b. Dies per emitter: 1, 4, 7, 9, 12 and 24/25 dies
- c. Substrate material: Alumina, Aluminum Nitride

Aluminum Nitride (AlN) is the industry's highest thermal conductivity LED substrate material and is available for the following LED Engin emitters

- 4.4mm x 4.4mm, 1 die
- 7mm x 7mm, 4 die
- 7mm x 7mm, 7 dies
- 9mm x 9mm, 12 die

2. Wavelength Options

Spectrum Range	LED Die Options Available
UV/Violet (peak wavelength)	365nm, 385nm, 395nm, 405nm
Visible Spectrum (dominant wavelength)	Blue 457nm, Dental Blue 460nm, Green 523nm, Red 623nm, Deep Red 660nm, Far Red 740nm, Cool White 6500K, 5500K Neutral White 4000K Gallery White 3000K Warm White 2200K
Near IR and IR (peak wavelength)	IR 850nm, IR 940nm
Special Color Spectrum (peak wavelength)	Amber 590nm, Cyan 497nm, pc-Lime, pc-Amber

3. Primary Optics Options

- a. Glass, domed, with silicone under the glass
- b. Glass, optically flat, with air-gap under the glass

4. MCPCB Options by Substrates & Channels

Substrate	Substrate Dimension	Dies/channel	# of Channels	MCPCB Channel Options	~ Thermal Load @Tc ≤125°C
LZP	12mm x 12mm	4 x 6dies + 1 x 1die	5	5	80W – 90W
		4 x 6 dies	4	4	
LZC	9mm x 9mm	2 x 6dies	2	2	30W – 80W
		3 x 4dies	3	3	
		12 x 1die	12	12	
LZ9	7mm x 7mm	1 x 9dies	1	1	30W – 80W
		3 x 3dies	3	3	
LZ7	7mm x 7mm	7 x 1die	7	7	25W – 60W
LZ4	7mm x 7mm	1 x 4dies	1	1	20W – 40W
		4 x 1die	4	4	
LZ1	4.4mm x 4.4mm	1 x 1die	1	1	4W – 10W

- a. Depending on the emitter and rated drive current, LED Engin offers aluminum (Al) and copper (Cu) MCPCB options, with a unique pedestal design for excellent heat conduction
- b. LED Engin also supports customer designed PCB (FR4, MCPCB etc.) for Level 2 designs and can coordinate customer designed PCB fabrications with our contract manufacturer for assembling custom LuxiGen emitters on to customer designed PCB as finished product.

Application Support for Custom Emitters

1. Problem Scoping – Solution Mapping

Initial contact is to determine whether LED Engin can support the specific customer application/product. LED Engin Sales and Application Engineering typically gather information from the customer regarding business potential and product requirements at this stage. Where possible, LED Engin will propose configurations that might work for the customer’s application.

2. Product Definition

In the next stage, LED Engin Application Engineering would use the information gathered from customer to generate a Preliminary Custom Emitter Datasheet. This datasheet is provided for customer review together with a quotation from LED Engin Sales. Sample orders are not processed without this datasheet approval.

3. Design & Build

Once customer agrees with the preliminary specification, estimated delivery, cost of NRE/samples, customer typically places an order for samples. The data from the sample builds is used to revise the preliminary datasheet as needed and a final Custom Emitter Datasheet is submitted for customer’s final review and signoff. High volume orders are not processed without this approval.

About LED Engin

LED Engin, an OSRAM business based in California's Silicon Valley, develops, manufactures, and sells advanced LED emitters, optics and light engines to create uncompromised lighting experiences for a wide range of entertainment, architectural, general lighting and specialty applications. LuxiGen™ multi-die emitter and secondary lens combinations reliably deliver industry-leading flux density, upwards of 5000 quality lumens to a target, in a wide spectrum of colors including whites, tunable whites, multi-color and UV LEDs in a unique patented compact ceramic package. Our LuxiTune™ series of tunable white lighting modules leverage our LuxiGen emitters and lenses to deliver quality, control, freedom and high density tunable white light solutions for a broad range of new recessed and downlighting applications. The small size, yet remarkably powerful beam output and superior in-source color mixing, allows for a previously unobtainable freedom of design wherever high-flux density, directional light is required. LED Engin is committed to providing products that conserve natural resources and reduce greenhouse emissions; and reserves the right to make changes to improve performance without notice.

For more information, please contact LEDE-Sales@osram.com or visit us at www.osram.us/ledengin