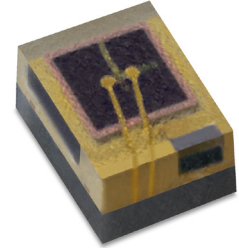


# LUXEON IR Compact Line

## Assembly and Handling Information



### Introduction

This application brief addresses the recommended assembly and handling procedures for LUXEON IR Compact Line emitters. Proper assembly, handling, and thermal management, as outlined in this application brief, ensure high optical output and long light output maintenance for LUXEON IR Compact Line.

### Scope

The assembly and handling guidelines in this application brief apply to the following products:

<b>L1IZ-0AAAXXXXXXXXXX</b>
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Where:

AAA	- designates nominal peak wavelength
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XXXXXXXX	- reserved for further customization
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In the remainder of this document the term LUXEON emitter refers to any product in the LUXEON IR Compact Line.

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# 1. Component

## 1.1 Description

The LUXEON IR Compact is an ultra-compact, surface mount, high-power infrared emitter. Each LUXEON IR Compact consists of a high brightness LED chip on a ceramic substrate. The ceramic substrate provides mechanical support and provides a thermal path from the LED chip to the bottom of the emitter. An interconnect layer electrically connects the LED chip to cathode and anode pads of equal size on the bottom of the ceramic substrate. The cathode of the LUXEON IR is marked with a small notch (see Figure 1) and the pads are gold plated.

The top of the LUXEON emitter is covered with silicone to shield the chip from the environment. Inside the silicone, there is a transient voltage suppressor (TVS) chip which protects the LED chip against electrostatic discharge (ESD) events.

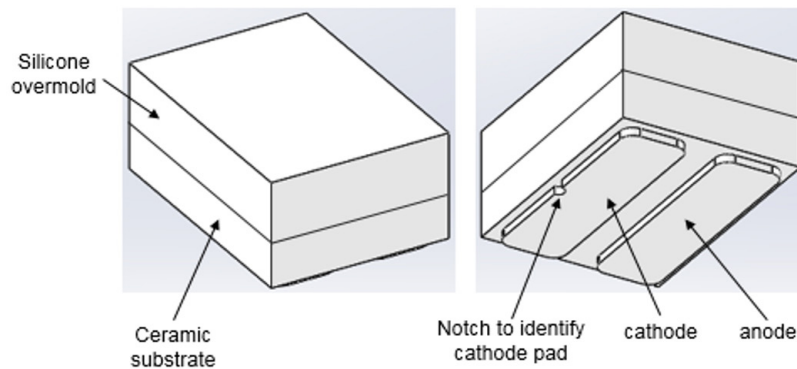


Figure 1. 3D rendition of LUXEON IR Compact emitter.

To identify the polarity orientation of LUXEON IR Compact from the top view, see Figure 2.

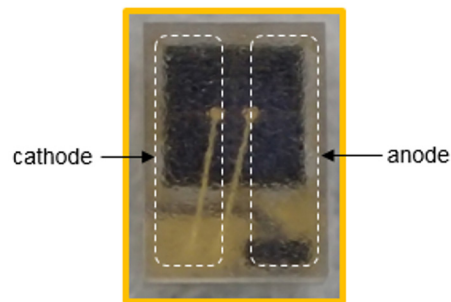


Figure 2. Polarity orientation when viewed from package top. White dashed line are the pad outlines as seen from the top.

## 1.2 Optical Center

The theoretical optical center of the LUXEON IR Compact is 0.685mm from the top and 0.685mm from the side edges of the package outline (see Figure 3). This corresponds to the center of the LED chip.

## 1.3 Handling Precautions

The LUXEON IR Compact is designed to maximize light output and reliability. However, improper handling of the emitter may damage the LED chip and affect the overall performance and reliability. In order to minimize the risk of damage to the LED chip during handling, LUXEON emitter should only be picked up manually from the side of the ceramic substrate as shown in Figure 4.

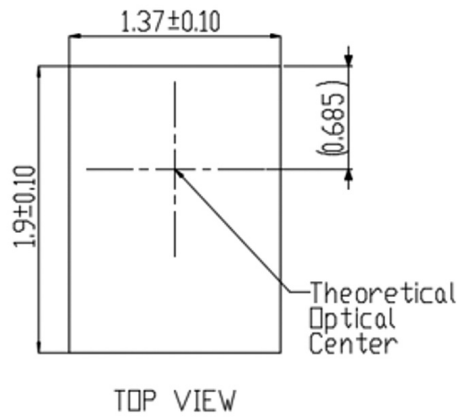


Figure 3. The optical center of LUXEON IR Compact is 0.625mm from the top and 0.650mm from the side edges.

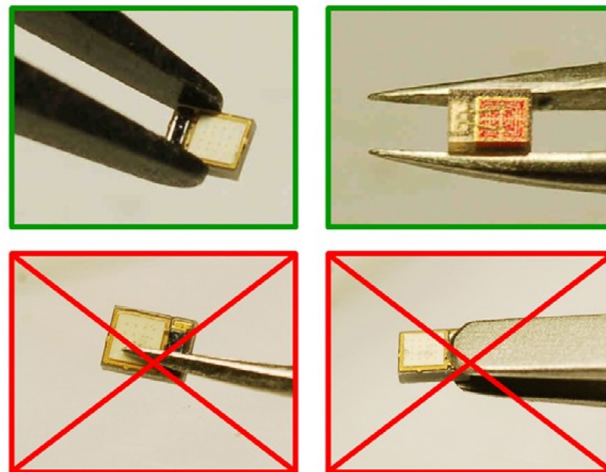


Figure 4. Illustration examples of correct handling (top) and incorrect handling (bottom) of LUXEON emitters.

When handling finished boards containing LUXEON emitters, do not touch the top surface with any fingers (see Figure 5) or apply any pressure to it. Also, do not turn over the assembled board for probing, storing or stack multiple boards on top of each other (see Figure 5). Use proper PCB carriers or racks for storage.

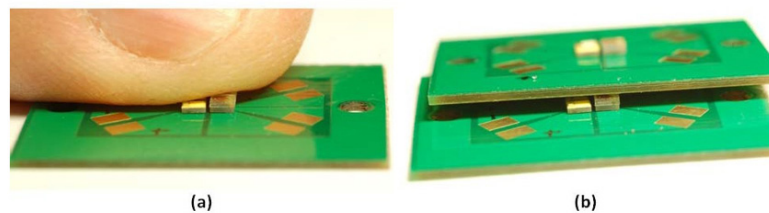


Figure 5. Do not touch the top of surface of the LUXEON emitters when handling a finished board (a) or stack boards with one or more LUXEON emitters on top of each other (b).

## 1.4 Cleaning

The LUXEON IR Compact should not be exposed to dust and debris. Excessive dust and debris may cause a drastic decrease in optical output. In the event that the surface of a LUXEON emitter requires cleaning, a compressed gas duster at a distance of 6 inches away will be sufficient to remove the dust and debris or an air gun with 20 psi (at nozzle) from a distance of 6 inches. Make sure the parts are secured first.

## 1.5 Electrical Isolation

The LUXEON IR Compact contains only two electrical pads on the bottom of the ceramic substrate with a spacing of 0.25mm between them. In order to avoid any electrical shocks and/or damage to the LUXEON emitter, each design needs to comply with the appropriate standards of safety and isolation distances, known as clearance and creepage distances, respectively (e.g. IEC60950, clause 2.10.4).

## 1.6 Mechanical Files

Mechanical drawings (3D STEP file) for LUXEON IR Compact are available at [lumileds.com](http://lumileds.com).

## 1.7 Soldering

LUXEON IR Compact are designed to be soldered onto a Printed Circuit Board (PCB). For detailed assembly instructions, see Section 2.

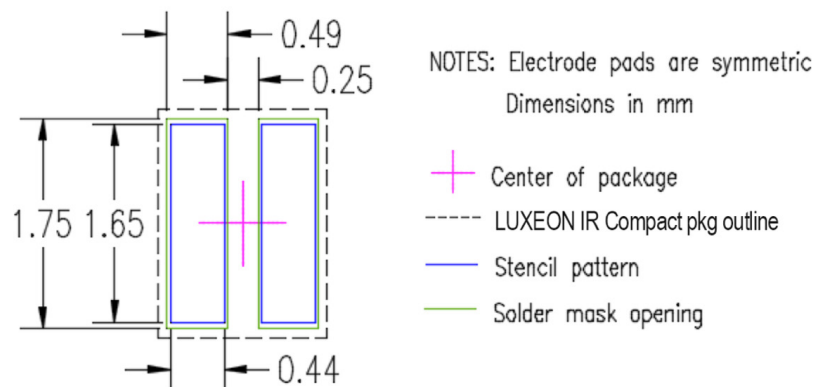


Figure 6. Recommended PCB Footprint for LUXEON IR Compact.

## 2. Printed Circuit Board Design

The LUXEON IR Compact is designed to be soldered onto a Metal Core PCB (MCPCB) or a multi-layer FR4 PCB. To ensure optimal operation of the LUXEON IR Compact, the PCB should be designed to minimize the overall thermal resistance between the LED package and the heat sink.

### 2.1 Footprint and Land Pattern

The LUXEON IR Compact has two pads that need to be soldered onto corresponding pads on a PCB to ensure proper electrical and thermal operation. Figure 6 shows the footprint design for a LUXEON IR Compact emitter.

The electrical pads of the LUXEON IR Compact also serve as thermal pads between the LED and the PCB. To enhance heat dissipation from the LUXEON emitter into the PCB, it is best to extend the copper area around each electrode approximately 4mm from the center of the LUXEON IR Compact emitter, where possible. Furthermore, it is desirable to keep the thermal resistance values of the two copper pads on the PCB underneath each LUXEON IR Compact emitter approximately equal to ensure a balanced heat transfer from the LUXEON emitter through both electrodes.

### 2.2 Surface Finishing

For small pad dimensions and pitch, Lumileds has good experience using electroless nickel immersion gold (ENIG) or high temperature organic solderability preservative (OSP) on the exposed copper PCB pads. Hot air solder leveling (HASL) should not be used, because it yields poor co-planarity (leveling) and is, therefore not suitable for fine pitch assembly. In addition, HASL may yield poor solder joints, potentially resulting in open failures.

## 2.3 Minimum Spacing

A minimum edge to edge spacing between LUXEON IR Compact of 0.2mm can generally be achieved with modern pick and place equipment. Placing multiple LUXEON emitters too close to each other may adversely impact the ability of the PCB to dissipate the heat from the emitters. Also, the light output for each LED may drop due to optical absorption by adjacent LED packages.

# 3. Assembly Process Guidelines

## 3.1 Stencil Design

The appropriate stencil design for the LUXEON IR Compact emitter is included in the PCB footprint design (see Figure 6). Lumileds has successfully evaluated a stencil thickness of 4 mils (102µm).

## 3.2 Solder Paste

Lumileds successfully tested a lead-free, no clean SAC 305 solder paste from Alpha® OM-340, type 4. However, since application environments vary widely, Lumileds recommends that customers perform their own solder paste evaluation in order to ensure it is suitable for the targeted application.

## 3.3 Solder Paste Screen Printing

In general there are three methods to align the stencil to the PCB during solder paste screen printing:

1. The stencil is manually aligned to the PCB prior to printing. No adjustments are made during printing.
2. The stencil is manually aligned to the PCB prior to printing. During printing, the machine keeps track of the PCB fiducial mark(s) and makes any necessary adjustments to maintain proper alignment with the PCB.
3. A technician performs a crude alignment of the stencil to the PCB. During printing, the machine keeps track of the PCB fiducial mark(s) and the stencil fiducial mark(s) and maintains proper alignment between the fiducials throughout the process.

Method 1 has the worst accuracy and repeatability of the three methods discussed. Method 2 offers the same accuracy as method 1 but ensures better repeatability. Method 3 has the best accuracy and best repeatability of the 3 methods discussed.

Depending on what screen printing method is used, the size of the anode and cathode solder mask openings on the PCB may have to be enlarged to compensate for any misalignments between the stencil and the PCB panel. Note that any enlargement in the solder mask opening for anode and cathode pads may reduce the solder reflow placement accuracy.

In order to ensure proper alignment between the stencil and the PCB as well as reliable transfer of solder paste onto the PCB, all PCB panels should be rigidly supported during solder paste printing. Instead of placing the PCB panel on multiple support pins, it is best to place the PCB panel on a single solid plate. This is particularly important for PCB panels which contain v-scores or perforated holes for de-panel purposes.

Figure 7 shows the outcome of a well-controlled stencil printing process according to method 3 above. In this example, the recommended stencil pattern of Figure 5 was used in combination with a stencil thickness of 4 mils and a solder paste from Alpha® OM-340. Also the stencil aperture wall used should be smooth to aid smooth release of solder paste.



Figure 7. An example of a good stencil printing on PCB.

### 3.4 Pick-and-Place

Automated pick and place equipment provides the best handling and placement accuracy for LUXEON IR Compact. Samsung CN065 and Juki 503 pick and place machines and their corresponding nozzle designs and machine settings were successfully used to pick and place LUXEON IR Compact (Figure 8 and Figure 9). Note that pick and place nozzles are customer specific and are typically machined to fit specific pick and place tools.

General guidelines:

1. The nozzle tip should be clean and free of any particles since this may interact with the silicone coating of the LUXEON emitter during pick and place.
2. During setup and any initial production runs, it is a good practice to inspect the top surface of the LUXEON emitters under a microscope to ensure the emitters are not accidentally damaged by the pick and place nozzle.



Samsung off-the-shelf nozzle model: CN065  
 Nozzle tip material: ceramic (zirconia)  
 Nozzle inner diameter: 0.65 mm  
 Nozzle outer diameter: 1.20 mm

Table 1a. Samsung CN065 pick and mount settings.

PICK AND MOUNT INFORMATION		VISION INFORMATION	
Pick Height	-0.2 mm	Camera No	Fly Cam4
Mount Height	0.0 mm	Side	0
Delay – Pick Up	30 ms	Outer	4
Delay – Place	30 ms		
Delay – Vac Off	0		
Delay – Blow On	0		
Speed – XY	1		
Speed – Z Pick Down	1		
Speed – Z Pick Up	1		
Speed – R	1		
Speed – Z Place Down	1		
Speed – Z Place Up	1		
Z Align Speed	1		
Soft Touch	Not use		

Figure 8. Standard off-the-shelf nozzle from Samsung and corresponding machine settings for Samsung CN065.



Juki off-the-shelf nozzle model: "503"  
 Nozzle tip material: ceramic (zirconia)  
 Nozzle inner diameter: 0.6 mm  
 Nozzle outer diameter: 1.0 mm

Table 1b. Juki "503" pick and mount settings.

PICK AND MOUNT INFORMATION	
XY speed	Fast 2
Picking stroke	0.2 mm
Picking Z down	Fast 2
Picking Z up	Fast 2
Placing stroke	0 mm
Placing Z down	Fast 2
Placing Z up	Fast 2
Laser Position	-0.73

VISION INFORMATION	
Centering method	Laser
Comp shape	Corner Square

Figure 9. Standard off-the-shelf nozzle from Juki and corresponding machine settings for Juki "503."

### 3.5 Pneumatic Feeder

For smoother and stable action of the feeder that holds, moves and peels the tape reel of LUXEON IR Compact, this can be achieved by using a smaller indexing gear pitch. On these specific Samsung SM421 and Juki KE2080L studied, in both machines reducing the 4mm indexing gear pitch to 2mm indexing gear pitch allows a much more stable and smoother action of the feeder as shown in Figure 10 and Figure 11.

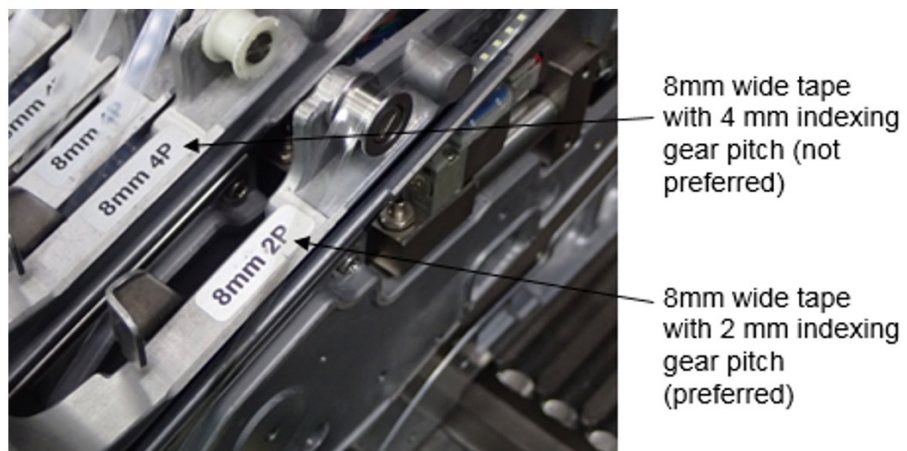


Figure 10. An example of Samsung SM421 feeder.

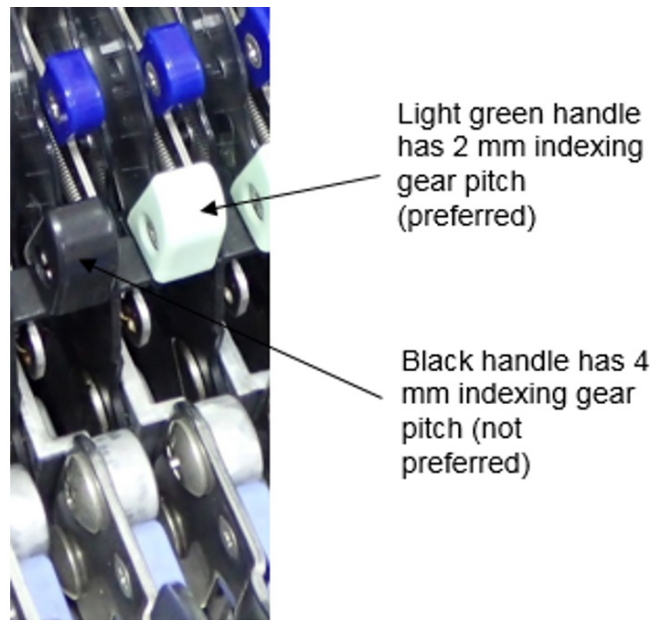


Figure 11. An example of Juki KE2080L feeder.

### 3.6 Reflow Accuracy

Using the solder pad footprint and stencil pattern layout as shown in Figure 5 with solder paste print as shown in Figure 6 and without any obstruction from nearby silkscreen (ink) print feature, LUXEON IR Compact parts can self-align to the nominal position during reflow process.

## 4 Packaging Considerations—Chemical Compatibility

The LUXEON IR Compact package contains a silicone overcoat to protect the LED chip. As with most silicones used in LED optics, care must be taken to prevent any incompatible chemicals from directly or indirectly reacting with the silicone.

The silicone overcoat in LUXEON IR Compact is gas permeable. Consequently, oxygen and volatile organic compound (VOC) gas molecules can diffuse into the silicone overcoat. VOCs may originate from adhesives, solder fluxes, conformal coating materials, potting materials and even some of the inks that are used to print the PCBs.

Some VOCs and chemicals react with silicone and produce discoloration and surface damage. Other VOCs do not chemically react with the silicone material directly but diffuse into the silicone and oxidize during the presence of heat or light. Regardless of the physical mechanism, both cases may affect the total LED light output. Since silicone permeability increases with temperature, more VOCs may diffuse into and/or evaporate out from the silicone.

Careful consideration must be given to whether LUXEON IR Compact are enclosed in an “air tight” environment or not. In an “air tight” environment, some VOCs that were introduced during assembly may permeate and remain in the silicone overcoat. Under high temperature operation, the VOCs inside the silicone overcoat may partially oxidize and create a silicone discoloration. In an air rich or “open” air environment, VOCs have a chance to leave the area (driven by the normal air flow). Transferring the devices which were discolored in the enclosed environment back to “open” air may allow the oxidized VOCs to diffuse out of the silicone overcoat and may restore the original optical properties of the LED.

Determining suitable threshold limits for the presence of VOCs is very difficult since these limits depend on the type of enclosure used to house the LEDs and the operating temperatures.

Table 2 provides a list of commonly used chemicals that should be avoided as they may react with the silicone material. Note that Lumileds does not warrant that this list is exhaustive since it is impossible to determine all chemicals that may affect LED performance.

The chemicals in Table 2 are typically not directly used in the final products that are built around LUXEON IR Compact LEDs. However, some of these chemicals may be used in intermediate manufacturing steps (e.g. cleaning agents). Consequently, trace amounts of these chemicals may remain on (sub)components, such as heat sinks. Lumileds, therefore, recommends the following precautions when designing your application:

- When designing secondary lenses to be used over an LED, provide a sufficiently large air-pocket and allow for "ventilation" of this air away from the immediate vicinity of the LED.
- Use mechanical means of attaching lenses and circuit boards. When using adhesives, potting compounds and coatings, carefully analyze its material composition and do thorough testing of the entire fixture under High Temperature Operating Life (HTOL) test conditions.

**Table 2. List of commonly used chemicals that will damage the silicone overcoat of LUXEON IR Compact. Avoid using any of these chemicals in the housing that contains the LED package.**

CHEMICAL NAME	NORMALLY USED AS
Hydrochloric Acid	Acid
Sulfuric Acid	Acid
Nitric Acid	Acid
Acetic Acid	Acid
Sodium Hydroxide	Alkali
Potassium Hydroxide	Alkali
Ammonia	Alkali
MEK (Methyl Ethyl Ketone)	Solvent
MIBK (Methyl Isobutyl Ketone)	Solvent
Toluene	Solvent
Xylene	Solvent
Benzene	Solvent
Gasoline	Solvent
Mineral spirits	Solvent
Dichloromethane	Solvent
Tetrachlorometane	Solvent
Castor Oil	Oil
Lard	Oil
Linseed Oil	Oil
Petroleum	Oil
Silicone Oil	Oil
Halogenated Hydrocarbons (containing F, Cl, Br elements)	Misc.
Rosin Flux	Solder Flux
Acrylic Tape	Adhesive

## About Lumileds

Companies developing automotive, mobile, IoT and illumination lighting applications need a partner who can collaborate with them to push the boundaries of light. With over 100 years of inventions and industry firsts, Lumileds is a global lighting solutions company that helps customers around the world deliver differentiated solutions to gain and maintain a competitive edge. As the inventor of Xenon technology, a pioneer in halogen lighting and the leader in high performance LEDs, Lumileds builds innovation, quality and reliability into its technology, products and every customer engagement. Together with its customers, Lumileds is making the world safer, better and more beautiful—with light.

To learn more about our lighting solutions, visit [lumileds.com](http://lumileds.com).

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