

LUXEON 3528 RGB

Assembly and Handling Information



Introduction

This application brief addresses the recommended assembly and handling procedures for the LUXEON 3528 RGB emitter. This emitter is a compact 3-in-1 package that offers flexibility and versatility. With the ability to control individually or all at the same time the color control is precise.

Scope

The assembly and handling guidelines in this application brief apply to LUXEON 3528 RGB with the following part number designation:

L 1 M C - A A A 0 0 2 8 0 0 0 M P 0

Where:

A A A – designates designates color (R=Red, G=Green, B=Blue)

In the remainder of this document the term LUXEON emitter refers to the LUXEON 3528 RGB product as listed above.

Table of Contents

| | |
|---|----------|
| Introduction | 1 |
| Scope | 1 |
| 1. Component | 3 |
| 1.1 Description | 3 |
| 1.2 Optical Center | 3 |
| 1.3 Handling Precautions | 3 |
| 1.4 Cleaning | 3 |
| 1.5 Electrical Isolation | 4 |
| 1.6 Mechanical Files | 4 |
| 1.7 Soldering | 4 |
| 2. Printed Circuit Board Design Guidelines | 5 |
| 2.1 PCB Footprint and Land Pattern | 5 |
| 2.2 Solder Mask | 5 |
| 2.3 Surface Finishing | 5 |
| 2.4 Minimum Spacing | 5 |
| 2.5 PCB Quality and Supplier | 5 |
| 3. Assembly Process | 6 |
| 3.1 Stencil Design | 6 |
| 3.2 Solder Paste | 6 |
| 3.3 Solder Reflow Profile | 6 |
| 3.4 Pick and Place | 6 |
| 3.5 Electrostatic Discharge Protection | 7 |
| 3.6 JEDEC Moisture Sensitivity | 7 |
| 4. Thermal Managements | 9 |
| 5. Packaging Considerations - Chemical Compatibility | 9 |
| About Lumileds | 11 |

1. Component

1.1 Description

The LUXEON 3528 RGB emitter (Figure 1) is a plastic molded lead-frame package with three anode pads and three cathode pads. A chamfer on the corner of the package marks the cathode side of the emitter package. The light emitting surface (LES) is encapsulated with silicone to protect the chips. The LUXEON 3528 RGB package is ESD HBM rated at $\geq 2\text{kV}$ (Class 2, JEDEC JS-001-2012) and does not include a transient voltage suppressor (TVS) chip.

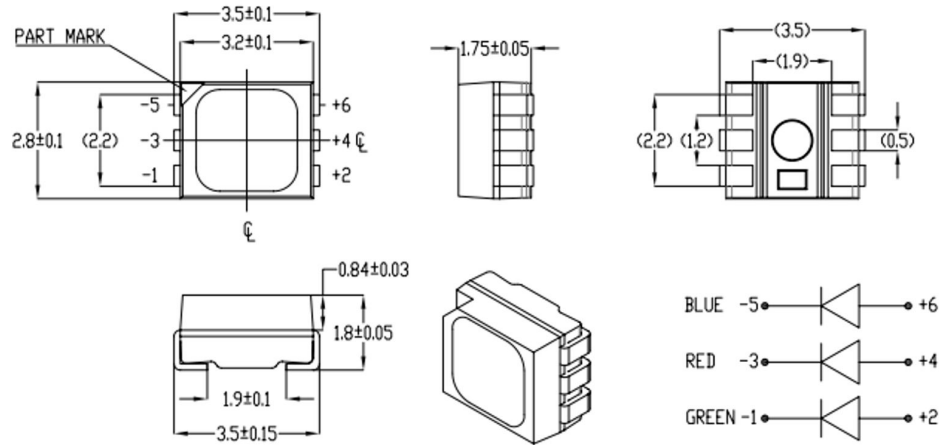


Figure 1. Mechanical Drawing of LUXEON 3528 RGB

1.2 Optical Center

The optical center coincides with the mechanical center of the LUXEON 3528 RGB emitter. Optical rayset data for the LUXEON emitter are available at lumileds.com.

1.3 Handling Precautions

The LUXEON 3528 RGB emitter is designed to maximize light output and reliability. However, improper handling of the device may damage the silicone coating and affect the overall performance and reliability. In order to minimize the risk of damage to the silicone coating during handling, the LUXEON 3528 RGB emitter should only be picked up from the side of the package.

1.4 Cleaning

The LUXEON 3528 RGB emitter should not be exposed to dust and debris. Excessive dust and debris may cause a drastic decrease in optical output. It is best to keep LEDs in their original shipping reel until actual use.

In the event that the surface requires cleaning, a compressed gas duster or an air gun with 1.4 bar (at the nozzle tip) and a distance of 15 cm will be sufficient to remove the dust and debris. Make sure that the parts are secured first, taking above handling precautions into account.

1.5 Electrical Isolation

The minimum creepage distance within the LUXEON 3528 RGB is 0.35mm between pads of different electrical potential. It is important to keep sufficient distance between the LUXEON emitter package and any other objects or neighboring LUXEON emitters to prevent any accidental shorts.

In order to avoid any electrical shocks, flashover 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. EN-IECE 62368).

1.6 Mechanical Files

Mechanical drawings for the LUXEON 3528 RGB emitter is available at [lumileds.com](https://www.lumileds.com).

1.7 Soldering

LUXEON 3528 RGB emitters are designed to be mechanically secured onto a heat sink. For detailed assembly instructions, see Section 3.

2. Printed Circuit Board Design Guidelines

2.1 PCB Footprint and Land Pattern

An example PCB footprint design for the LUXEON emitter is shown in Figure 2. In order to ensure proper heat dissipation to the PCB, it is best to extend the top copper layer of the solder pad beyond the perimeter of the LUXEON emitter as much as possible.

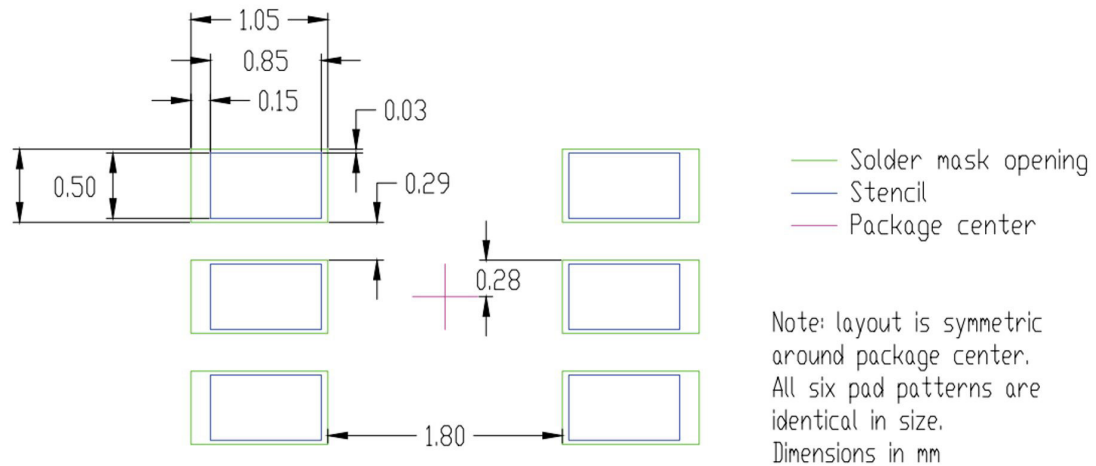


Figure 2. Recommended PCB solder pad layout for LUXEON 3528 RGB

2.2 Solder Mask

A stable white solder mask finish (typically a polymer compound with inert reflective filler) with high reflectivity in the visible spectrum will typically meet most application needs. The white finish should not discolor over time when exposed to elevated operating temperatures. Customers are encouraged to work with their PCB suppliers to determine the most suitable solder mask options which can meet their application needs.

2.3 Surface Finishing

Lumileds recommends using a high temperature organic solderability preservative (OSP) or electroless nickel immersion gold (ENIG) plating on the exposed copper pads.

2.4 Minimum Spacing

Lumileds proposes a minimum edge to edge spacing between LUXEON emitters of 0.5mm. Placing multiple LUXEON emitters too close to each other may adversely impact the ability of the PCB to dissipate the heat from the emitters.

2.5 PCB Quality and Supplier

Select PCB suppliers that are capable of delivering the required level of quality. At a minimum the PCBs must comply with IPC standard (IPC-A-600K, 2020 "Acceptability of Printed Boards").

3. Assembly Process

3.1 Stencil Design

The recommended solder stencil thickness is 5 mils (127µm).

3.2 Solder Paste

Lumileds recommends lead-free solder for the LUXEON emitter. Good results have been obtained with lead-free solders such as SAC 305 solder paste from Alpha Metals (SAC305-CVP390-M20 type 3). 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 Reflow Profile

The LUXEON emitter is compatible with standard surface-mount and lead-free reflow technologies. This greatly simplifies the manufacturing process by eliminating the need for adhesives and epoxies. The reflow step itself is the most critical step in the reflow soldering process and occurs when the boards move through the oven and the solder paste melts, forming the solder joints. To form good solder joints, the time and temperature profile throughout the reflow process must be well maintained.

A temperature profile consists of three primary phases:

1. Preheat: the board enters the reflow oven and is warmed up to a temperature lower than the melting point of the solder alloy.
2. Reflow: the board is heated to a peak temperature above the melting point of the solder, but below the temperature that would damage the components or the board.
3. Cool down: the board is cooled down rapidly, allowing the solder to freeze, before the board exits the oven. As a point of reference, the melting temperature for SAC 305 is 217°C.

3.4 Pick and Place

The LUXEON emitter is packaged and shipped in tape-and-reel which is compatible with standard automated pick-and-place equipment to ensure the best placement accuracy. Note that pick and place nozzles are customer specific and are typically machined to fit specific pick and place tools. Lumileds advises customers to take the following general pick and place guidelines into account:

- a. The nozzle tip should be clean and free of any particles since they may interact with the top surface of the silicone encapsulation of the LUXEON emitter package.
- b. During setup and the first initial production runs, it is good practice to inspect the top surface of the LUXEON emitters under a microscope to ensure that the emitters are not accidentally damaged by the pick and place nozzle.

In selecting a suitable nozzle size for picking up these LUXEON emitters, there are two important factors to consider:

1. The nozzle outer diameter or size should not be larger than the opening of the reel pocket tape otherwise it may interfere with the pocket tape cavity during the pick-up process.
2. The nozzle outer diameter or size should also not be smaller than the silicone encapsulant surface otherwise this may allow the nozzle tip to be in full contact with the encapsulant area and may cause damage to the surface or cause pick-up/release issues. Note that the encapsulant is typically recessed below the white plastic housing and assuming a nozzle tip that is planar, the nozzle tip is able to rest on the edge of the white plastic housing and not in full contact with the encapsulant.

See Figure 3 for the dimensions to be considered in nozzle design. There is no constraint on the nozzle inner size as long as there is sufficient vacuum to hold the LED emitter during pick and place process.

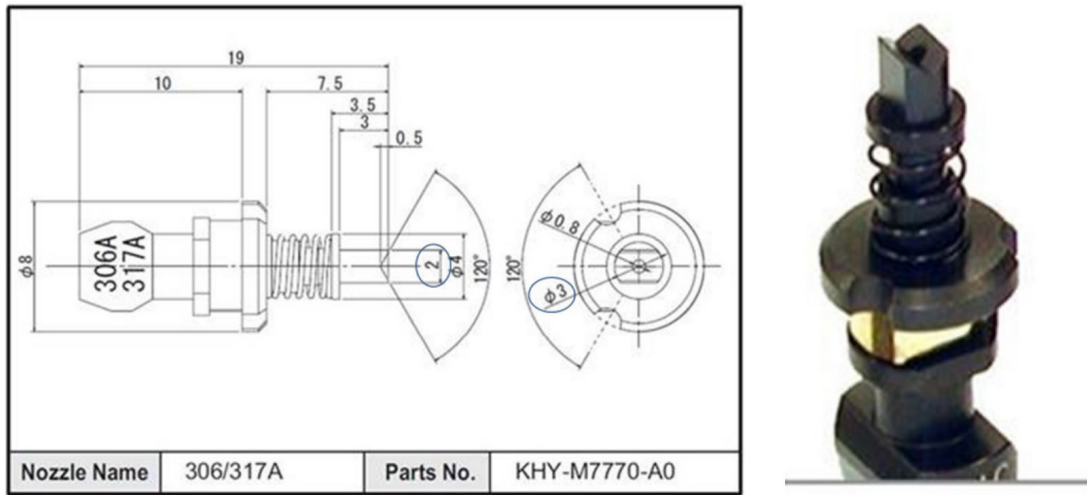


Figure 3. An example of a nozzle with outer size of 2mm x 3mm as shown on the left drawing. See the circled dimensions. Right image is the actual nozzle tip. Dimensions in mm

An example of an off-the-shelf nozzle from Yamaha that may be suitable as a starting point to evaluate pick and place of LUXEON 3528 RGB is shown in Figure 3.

3.5 Electrostatic Discharge Protection

The LUXEON emitter does not include any transient voltage suppressor (TVS) chip to protect against electrostatic discharges (ESD). Therefore, Lumileds recommends observing the following precautions when handling the LUXEON emitter:

- During manual handling always use a conductive wrist band or ankle straps when positioned on a grounded conductive mat.
- All equipment, machinery, work tables, and storage racks that may get in contact with the LUXEON emitter should be properly grounded.
- Use an ion blower to neutralize the static discharge that may build up on the surface and lens of the plastic housing of the LUXEON emitter during storage and handling.

LUXEON emitters which are damaged by ESD may not light up at low currents and/or may exhibit abnormal performance characteristics such as a high reverse leakage current, and a low forward voltage (leaky diode). It is also important to take note that ESD can also cause latent failure, i.e. failure or symptoms as described above may not show up immediately but until after use. Hence continuous ESD protection is needed during assembly.

3.6 JEDEC Moisture Sensitivity

The JEDEC Moisture sensitivity level (MSL) for this LUXEON emitter is rated as level 5a. Proper storage, handling and/or baking guidelines must be observed to prevent damage to the LUXEON emitter during reflow (see Table 1).

Baking information:

Baking is required before SMT when any of the following condition occur:

1. The shelf life is more than one year.
2. The vacuum-sealed bag has an air leak.
3. The humidity indication card has color change at 30% RH at the time of opening the vacuum sealed bag.
4. The vacuum-sealed bag has been opened and exceeded the MSL lever floor time.

Baking method:

The SMD LED should not be baked within the packaging bag. The baking condition is 65°C, +/-5 °C for 24 hours. The oven door should not be opened frequently during the baking process.

Table 1. JEDEC Moisture sensitivity levels for LUXEON 3528 RGB.

| LEVEL | FLOOR LIFE | | SOAK REQUIREMENTS STANDARD | |
|-------|------------|----------------|----------------------------|----------------|
| | TIME | CONDITIONS | TIME | CONDITIONS |
| 3 | 168 Hours | ≤30°C / 60% RH | 192 Hours +5 / -0 | ≤85°C / 60% RH |

4. Thermal Managements

The overall thermal resistance between a LUXEON emitter and the heat sink is strongly affected by the design and material of the PCB on which the emitter is soldered. Al-MCPCBs have been historically used in the LED industry for their low thermal resistance and rigidity.

The thermal resistance $R\theta_{j-s}$ between the sensor pad (T_s position in Figure 4) and the junction of the LUXEON 3528 RGB emitter was experimentally determined.

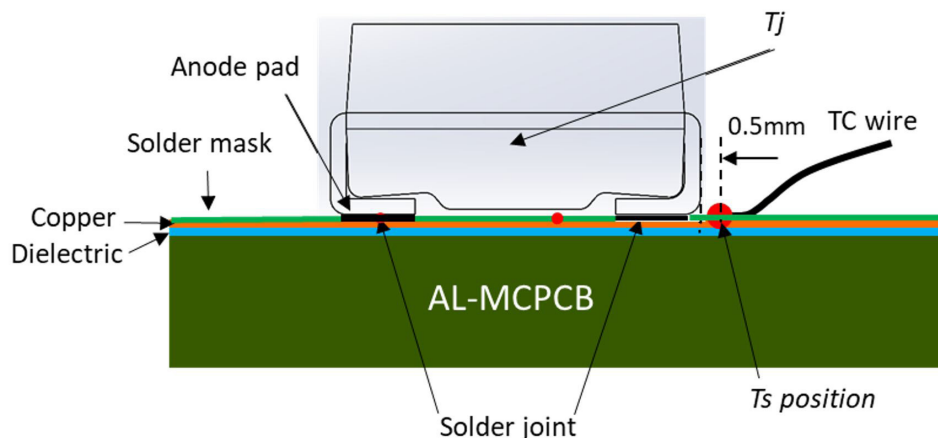


Figure 4. Cross sectional view of LUXEON 3735 Color on Al-MCPCB and the corresponding temperature location. Actual mounting of thermocouple wire closest to the Cathode pad of the LUXEON 3735 Color package on Al-MCPCB.

5. Packaging Considerations - Chemical Compatibility

The LUXEON 3528 RGB emitter package contains a silicone overcoat to protect the LED chip and extract the maximum amount of light. 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 used in the LUXEON 3528 RGB emitter 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 3528 RGB emitters 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 dome. Under heat and “blue” light, the VOCs inside the dome may partially oxidize and create a silicone discoloration, particularly on the surface of the LED where the flux energy is the highest. 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 dome 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. Also, some VOCs can photo-degrade over time.

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 3528 RGB emitters. 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 as much as possible. When using adhesives, potting compounds and coatings, carefully analyze its material composition and do thorough testing of the entire fixture under High Temperature over Life (HTOL) conditions.

Table 2. List of commonly used chemicals that may damage the silicone overcoat of LUXEON 3528 RGB.

| CHEMICAL NAME | TYPICAL USE |
|--|-------------|
| 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

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