LUXEON 3735 RGB

Assembly and Handling Information

Introduction

This application brief addresses the recommended assembly and handling procedures for the LUXEON 3735 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 3735 RGB with the following part number designation:

L 1 M C – **A A A** 0 0 3 5 0 0 0 M P 0

Where:

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

In the remainder of this document the term LUXEON emitter refers to any product in the LUXEON 3735 RGB product as listed above.

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1. Component

1.1 Description

The LUXEON 3735 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 3735 RGB package is ESD HBM rated at ≥2kV (Class 2, JEDEC JS-001-2012) and does not include a transient voltage suppressor (TVS) chip.

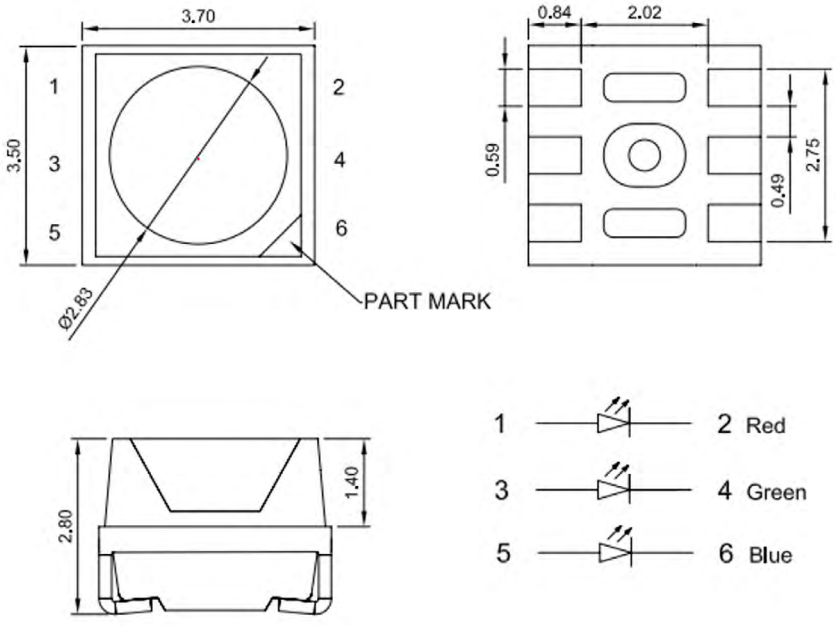

Figure 1. Mechanical Drawing of LUXEON 3735 RGB.

1.2 Optical Center

The optical center coincides with the mechanical center of the LUXEON 3735 RGB emitter. Optical rayset data for the LUXEON emitter are available at lumileds.com.

1.3 Handling Precautions

The LUXEON 3735 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 3735 RGB emitter should only be picked up from the side of the package.

1.4 Cleaning

The LUXEON 3735 RGB emitter should not be exposed to dust and debris. Excessive dust and debris may cause a drastic decrease in optical output. In the event that a LUXEON 3735 RGB emitter requires cleaning, first try a gentle swabbing using a lint-free swab. If needed, a lint-free swab and isopropyl alcohol (IPA) can be used to gently remove dirt from the silicone coating. Do not use other solvents as they may adversely react with the package of the LUXEON emitter. For more information regarding chemical compatibility, see Section 5.

1.5 Electrical Isolation

The minimum creepage distance within the LUXEON 3735 RGB is 0.48mm 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 3735 RGB emitter are available on the website at lumileds.com.

1.7 Soldering

LUXEON 3735 RGB emitters are designed to be mechanically secured onto a heat sink. For detailed assembly instructions, see Section 3.

2. PCB 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.

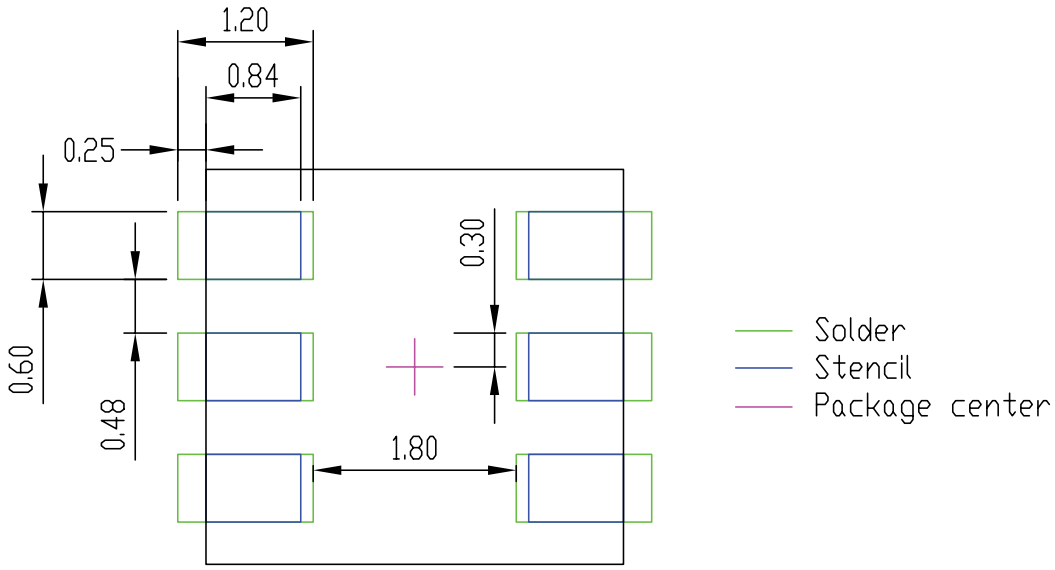

Figure 2. Recommended PCB solder pad layout for LUXEON 3735 RGB.

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 Guidelines

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 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.

3.5 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 65ºC, +/-5 ºC for 24 hours. The oven door should not be opened frequently during the baking process.

Table 1. JEDEC Moisture sensitivity levels for LUXEON 3735 RGB.

LEVEL	FLOOR LIFE		SOAK REQUIREMENTS STANDARD	
	TIME	CONDITIONS	TIME	CONDITIONS
5a	24 Hours	≤30°C / 60% RH	48 Hours +2/-0	30°C / 60% RH

4. Thermal Measurement Guidelines

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 $R\theta_{j\text{-}s}$ between the sensor pad (Ts position in Figure 3) and the junction of the LUXEON 3735 RGB emitter was experimentally determined. Table 2 summarizes the typical thermal resistance values for each LUXEON 3735 RGB emitter configuration.

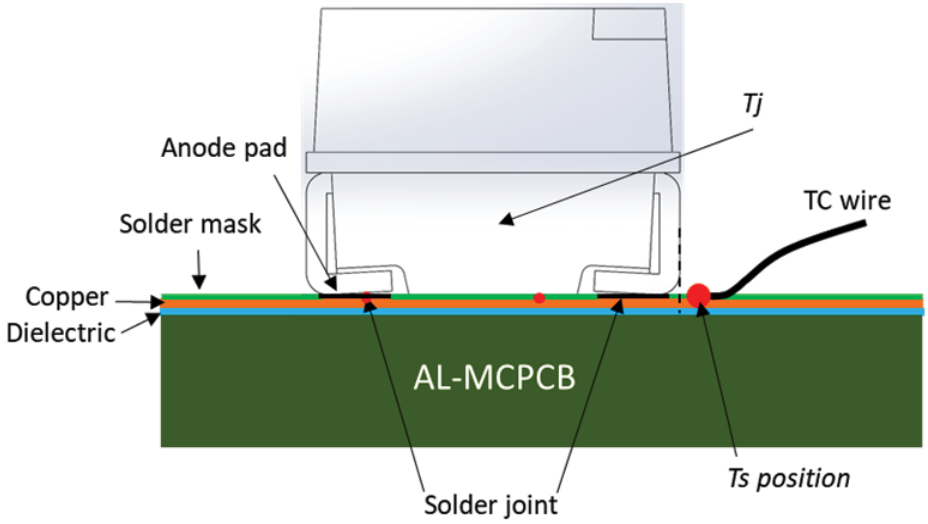

Figure 3. Cross sectional view of LUXEON 3735 Color on Al-MCPCB and the corresponding temperature location. Actual mounting of thermocouple wire closest to the Cathode pad of the LUXEON 3735 Color package on Al-MCPCB.

Table 2. Typical thermal resistance from junction to Ts point of LUXEON 3735 RGB.

PRODUCT	COLOR	TYPICAL $R\theta_{j\text{-}Ts}$ [K/W]
L1MC-RGB0035000MP0	Red	75
	Green	120
	Blue	85

5. Packaging Considerations—Chemical Compatibility

The LUXEON 3735 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 3735 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 3735 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 3 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 3 are typically not directly used in the final products that are built around LUXEON 3735 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 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 3. List of commonly used chemicals that will damage the silicone overcoat of LUXEON 3735 RGB. Avoid using any of these chemicals in the housing that contains the LED package.

CHEMICAL NAME	NORMALLY USED AS
Acetic Acid	Acid
Hydrochloric Acid	Acid
Nitric Acid	Acid
Sulfuric Acid	Acid
Ammonia	Alkali
Potassium Hydroxide	Alkali
Sodium Hydroxide	Alkali
Benzene	Solvent
Dichloromethane	Solvent
Gasoline	Solvent
MEK (Methyl Ethly Ketone)	Solvent
MIBK (Methyl Isobutyl Ketone)	Solvent
Mineral Spirits (Turpentine)	Solvent
Tetracholorometane	Solvent
Toluene	Solvent
Xylene	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 [1]
Acrylic Tape	Adhesive

Note for Table 3:
1. Other than the use of no-clean solder paste qualified by customer. Avoid secondary solder flux, for example when manually soldering wires close to LUXEON emitter, the solder flux should not spit onto the LUXEON emitter surface or leaving excessive secondary solder flux residue onto the PCB when operating LEDs in an air tight enclosure or poorly ventilated enclosure.

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 better, safer, more beautiful—with light.

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