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LUXEON 5052 RGBW

Assembly and Handling Information

Introduction

This application brief addresses the recommended assembly and handling guidelines for LUXEON 5052 RGBW emitters. This compact 4-in-1 package makes color tuning easier. Each channel is individually addressable, enabling a large color gamut while simplifying the ability of getting just the right color point. Proper assembly, handling, and thermal management, as outlined in this application brief, ensures high optical output and reliability of these emitters.

Scope

The assembly and handling guidelines in this application brief apply to LUXEON 5052 RGBW with the following part number designation:

L 1 M C – **A A A B B C C D D E** M P 0

Where:

- **A A A** – designates color (R=Red, G=Green, B=Blue)
- **B B** – designates CCT (30=3000K)
- **C C** – designates CRI (80=80CRI)
- **D D** – designates footprint (50=5mm x 5mm)
- **E** – designates binning

In the remainder of this document the term LUXEON emitter refers to any LUXEON 5052 RGBW product as listed above.

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1. Component

1.1 Description

The LUXEON 5052 RGBW emitter (Figure 1) is a plastic molded lead-frame package with four anode pads, four cathode pads, and an electrically active thermal pad. The center thermal pad (pin 9) is electrically connected to the anode of Red LED (pin 3), as shown in Figure 1 below. 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 5052 RGBW package is ESD HBM rated at ≥2kV (Class 2, JEDEC 22A-114) and does not include a transient voltage suppressor (TVS) chip.

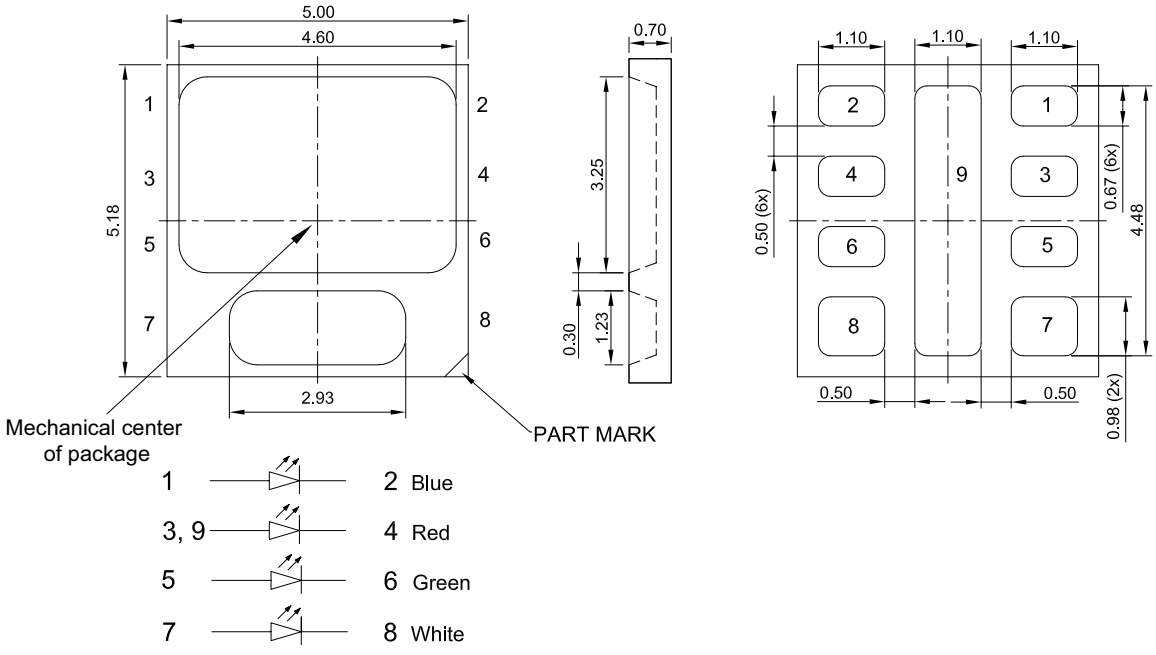


Figure 1. Mechanical Drawing of LUXEON 5052 RGBW.

1.2 Optical Raysets

Please see the optical rayset data and readme file for the reference point and optical center of each LED in the LUXEON 5052 RGBW emitter. Optical rayset data for the LUXEON emitter are available at lumileds.com.

1.3 Handling Precautions

The LUXEON 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 emitter should only be picked up from the side of the package (Figure 2).

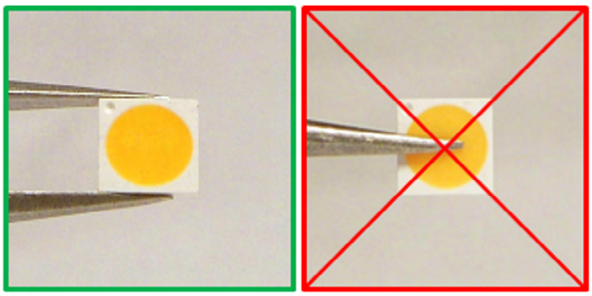


Figure 2. Illustration example of correct handling (left) and incorrect handling (right) of a representative LUXEON emitter.

1.4 Cleaning

The LUXEON 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 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 6.

1.5 Electrical Isolation

The minimum creepage distance within the LUXEON 5052 RGBW is 0.5mm 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. IEC60950, clause 2.10.4).

1.6 Mechanical Files

Mechanical drawing (3D STEP) for LUXEON 5052 RGBW is available on the website at lumileds.com.

2. PCB Design Guidelines for the LUXEON Emitter

The LUXEON emitter is designed to be soldered onto a Printed Circuit Board (PCB). To ensure optimal operation, the PCB should be designed to minimize the overall thermal resistance between the LED package and the heat sink.

2.1 PCB Footprint and Land Pattern

An example PCB footprint design for the LUXEON emitter is shown in Figure 3a. Dimensions of the footprint design are shown in Figures 3b and 3c. In order to ensure proper heat dissipation to the PCB, it is best to extend the top copper layer of the center thermal pad beyond the perimeter of the LUXEON emitter as much as possible (see Section 3). In Figures 3a-c, the thermal pad is connected to the anode of the Red LED.

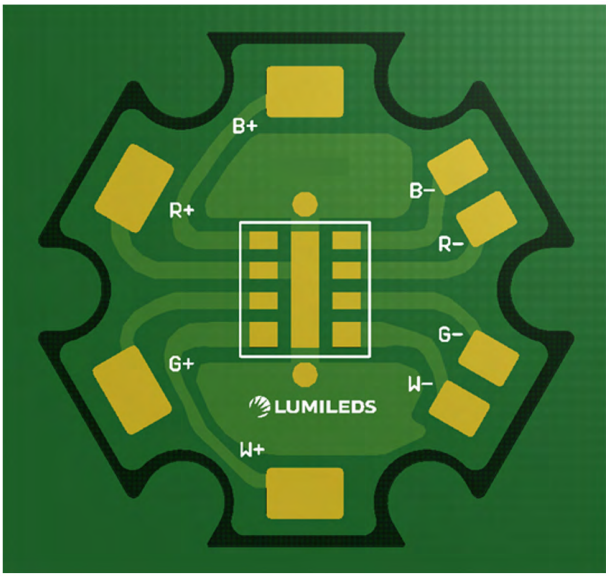


Figure 3a. Example PCB footprint design for LUXEON 5052 RGBW.

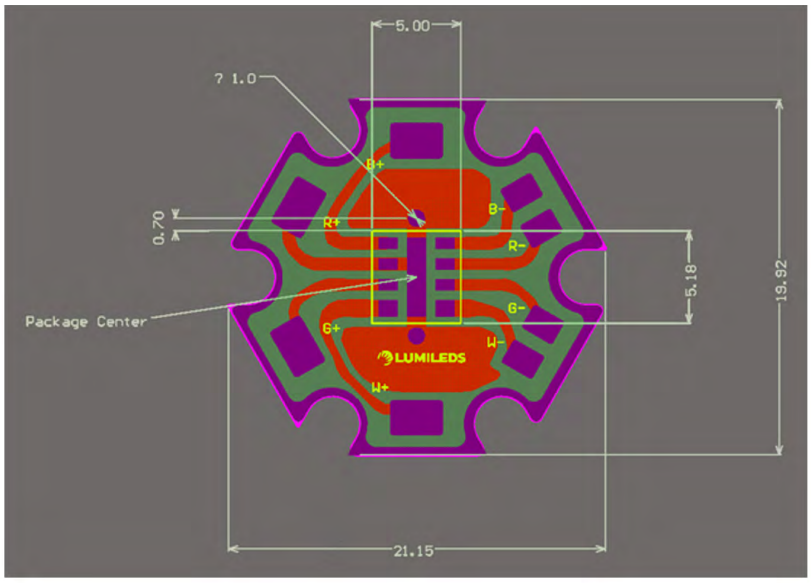


Figure 3b. Overall dimensions of example PCB footprint design for LUXEON 5052 RGBW. Dimensions in mm.

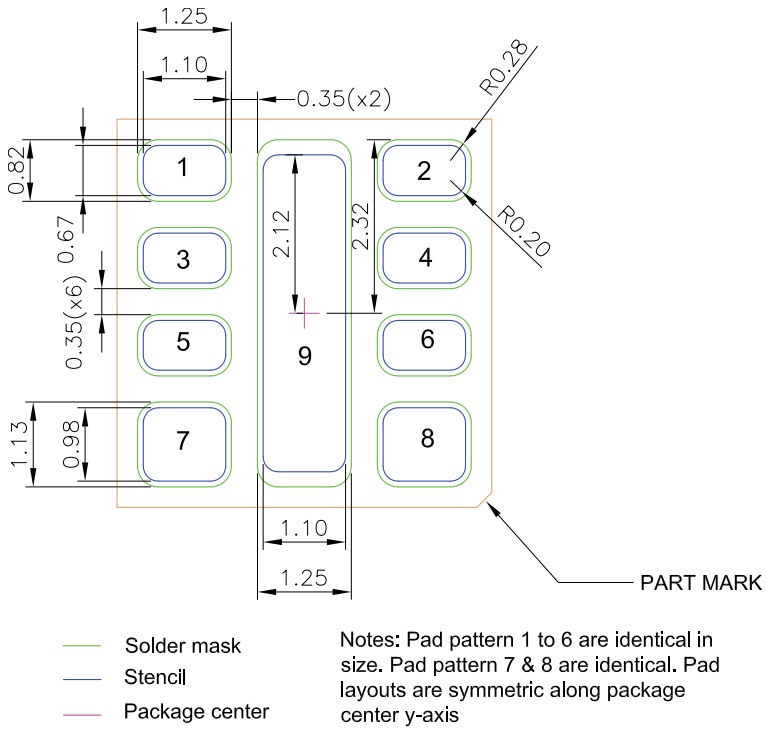


Figure 3c. Recommended PCB solder pad layout for LUXEON 5052 RGBW.

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-600H, 2010 "Acceptability of Printed Boards").

3. Thermal Management

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.

4. Thermal Measurement Guidelines

The typical thermal resistance $R\theta_{j\text{-}substrate}$ between the junction and the substrate of the LUXEON emitters are provided in the datasheet. The $R\theta_{j\text{-}substrate}$ was measured with each LED on by itself. These values are listed in Table 1 below.

Table 1. Typical thermal resistance from junction to substrate of LUXEON 5052 RGBW.

MODEL	RECOMMENDED $R\theta_{J\text{-}SUBSTRATE}$ [K/W]
LUXEON 5052 RGBW Blue	25
LUXEON 5052 RGBW Red	20
LUXEON 5052 RGBW Green	55
LUXEON 5052 RGBW White	28

5. Assembly Process Guidelines

5.1 Stencil Design

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

5.2 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.

5.3 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.

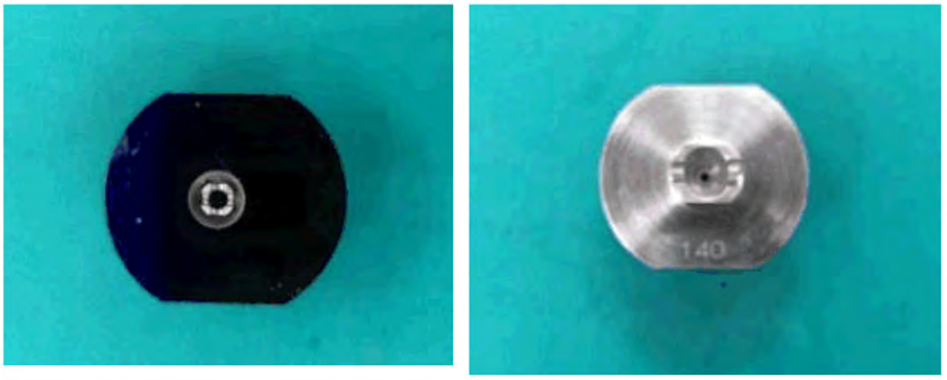
As a point of reference, the melting temperature for SAC 305 is 217°C.

5.4 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 customer to take the following general pick and place guidelines into account:

a. The nozzle tip should be clean and free of any particles since it 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 a good practice to inspect the top surface of the LUXEON emitters after reflow under a microscope to ensure that the emitters are not accidentally damaged by the pick and place nozzle.

An evaluated nozzle is shown in Figure 4. This Panasonic 140 Nozzle was tested using the Panasonic NPM-W2 machine. Please run your own tests to evaluate other nozzles.



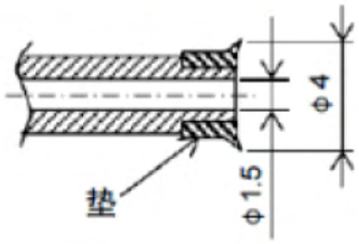
No.	形　状 (单位: mm)	对象元件 (代表例)
140 140N		TAN-D Al 电解-D SOP, SOJ PLCC, CSP

Figure 4. Example of tested nozzle: Panasonic 140 Nozzle.

5.5 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.

5.6 JEDEC Moisture Sensitivity

The JEDEC Moisture sensitivity level (MSL) for this LUXEON emitter is rated as level 3. Proper storage, handling and/or baking guidelines must be observed to prevent damage to the LUXEON emitter during reflow (see Table 2).

Table 2. JEDEC Moisture sensitivity levels for LUXEON 5052 RGBW.

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

6. Packaging Considerations—Chemical Compatibility

The LUXEON 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 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 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. Under heat and "blue" light, VOCs captured inside the silicone 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 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 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 of the LUXEON emitter. 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
Acetone	Solvent
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
Cyanoacrylate	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

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