

# LUXEON CX Plus CoBs

## Assembly and Handling Information



### Introduction

This application brief addresses the recommended assembly and handling procedures for LUXEON CX Plus CoB emitters. These emitters deliver high efficacy and quality of light for distributed light source and high lumen density applications in a compact LES Array. Proper assembly, handling, and thermal management, as outlined in this application brief, ensure high optical output and reliability of these emitters

### Scope

The assembly and handling guidelines in this Application Brief apply to the following LUXEON CX Plus CoB product lines:

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LUXEON CX Plus CoB Gen 2

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LUXEON CX Plus CoB – High Density

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LUXEON CX Plus CoB – High Density (Below BBL)

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In the remainder of this document the term LUXEON CoB emitter refers to any product in the LUXEON CX Plus CoB product lines listed above.

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# 1. Component

## 1.1 Description

The LUXEON CoB emitter consists of an array of LED chips which are mounted onto a metal-core printed circuit board (MCPCB) to facilitate assembly and handling. The substrate of MCPCB is aluminium (Figure 1) to provide mechanical support and to ensure a good thermal path between the LEDs and the heat sink on which the LUXEON CoB is mechanically mounted.

The light emitting surface (LES, Figure 1) is covered with a phosphor silicone mixture to shield the chip array from the environment. LUXEON CoB emitters include an ESD transient voltage suppressor (ESD TVS) chip.

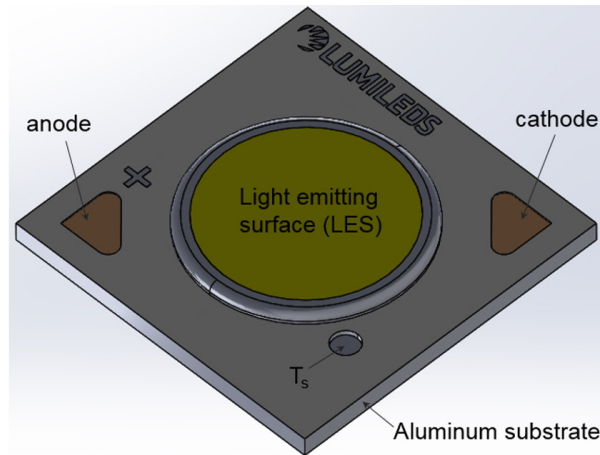


Figure 1. Package rendering of a representative LUXEON CX Plus CoBs

## 1.2 Optical Center

The optical center coincides with the mechanical center of the LUXEON CoB emitter. Optical rayset data for LUXEON CoB emitters are available on the Lumileds website at [lumileds.com](https://www.lumileds.com).

## 1.3 Handling Precautions

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

## 1.4 Cleaning

The LUXEON CoB 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 CoB 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 LES area. Do not use other solvents as they may adversely react with the LUXEON CoB package. For more information regarding chemical compatibility, see Section 5.

## 1.5 Electrical Isolation/Insulation

The LUXEON CoB emitters meet the UL8750 dielectric withstand voltage test of 500V between live parts (anode and cathode pads, Figure 1) and the top of LES area and also between live parts and the aluminium substrate of the MCPCB. To ensure safe and reliable operation at the light engine level or luminaires level in meeting relevant standards, additional electrical safety isolation may be required during the design.

As a note, the maximum working voltage for the bare LUXEON CoB is 75V as tested according to the clearance and creepage requirement of IEC 62031. When operating above 60V in final assembly, additional protection is required against electrical shock hazard.

## 1.6 Mechanical Files

Mechanical drawings for LUXEON CX Plus CoB emitters are available on the Lumileds website at [lumileds.com](https://www.lumileds.com).

# 2. Assembly Guidelines

## 2.1 Introduction

A typical assembly with LUXEON CoB emitter consists of a LUXEON CoB mounted onto a heat sink with screws through a use of a suitable CoB holder (Figure 2). A thermal interface material (TIM) is applied between the LUXEON CoB and the heat sink to improve thermal conductivity. Secondary optics typically can be added to the LED module and secured via the holder. The holder also acts as a conduit for making electrical connections to LUXEON CoB, also known as connector. Lumileds does not recommend soldering wires to the LUXEON CoB electrode pads.

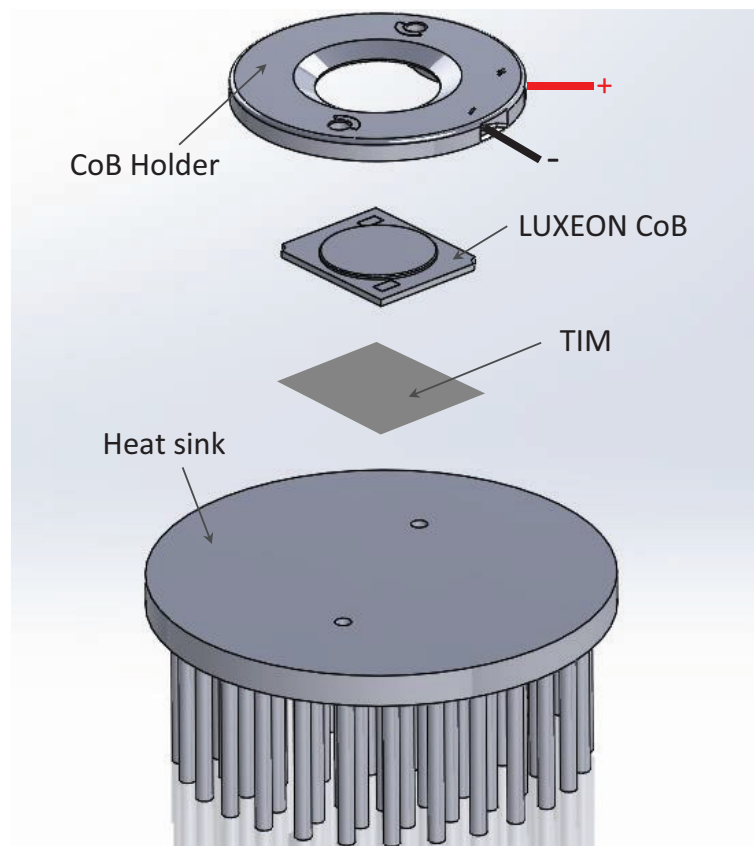


Figure 2. A typical LUXEON CoB assembly.

## 2.2 CoB Holders and Connectors

There are many CoB holders or connectors in the market. Table 1 provides a list of some of the holders that are compatible with LUXEON CX Plus CoB emitters. For additional information, please visit respective supplier's website. Note that the list below may be subject to change and may be updated by manufacturer from time to time.

**Table 1. LUXEON CX Plus CoB emitters' compatible CoB holder model numbers.**

LUXEON CX PLUS COB PART NUMBERS	BENDER + WIRTH	BJB	IDEAL	KANG RONG	MOLEX	TE CONNECTIVITY
L2C4-xxxxxS0xxxxxx (13.35mm x 13.35mm)	448 634c	47.319.6120.50	50-2000CR		180555-0002	2-2154857-2
L2C4-xxxxxM0xxxxxx (15.85mm x 15.85mm)	441 641a	47.319.6101.50	50-2001CR	K905A	180560-0001	2-2154857-2 5-2154874-2
L2C4-xxxxxL0xxxxxx (17.85mm x 17.85mm)	437 637a	47.319.2130.50	50-3001CR 50-2101CR	K905C K905R		2-2154857-2

## 2.3 Heat Sinks

A suitably rated heat sink (cooling capacity) should be selected and evaluated to allow the operation of LUXEON CoB to be operated below the maximum rated junction temperature under a wide range of operating conditions (can be influenced by installation and environment). An example of a supplier that provides a wide range of heat sinks for LUXEON CoB is from [MechaTronix](#).

## 2.4 Thermal Interface Materials (TIM)

To improve thermal conductivity from the bottom of LUXEON CoB to the top of the heat sink, a TIM material is applied between these two contact surfaces. The TIM selection should be made with the following considerations:

1. Pump out—Some TIMs will move out of the thermal path during extreme temperature excursions and create voids in the thermal path. These materials should not be used.
2. TIM thickness—Excessive thickness of some TIMs will present an unacceptable thermal resistance.
3. Surface roughness—In order to fill the air gaps between adjacent surfaces, choose the appropriate TIM that minimizes the interfacial contact resistance.
4. Operating temperature—Some TIMs perform poorly at elevated temperatures. Care should be exercised to select a TIM that will perform well under the anticipated operating conditions.
5. Out-gassing—Out-gassing of some TIMs at design temperatures may produce undesirable optical or appearance qualities (e.g. fogging) in a sealed system. Special consideration must be given to limit this effect.
6. Clamping force—TIMs such as thermal tape or pads perform better when the right (high) uniform pressure is applied. Typically the screw torque range as specified by the CoB holder/connector is sufficient.

Table 2 lists several TIMs that have been tested with LUXEON CoB. This data is provided for informational purposes only. Lumileds cannot guarantee the performance of the listed TIMs since LED operating conditions and long-term performance specification may vary with the application design.

**Table 2. List of TIM materials that meet the TIM considerations outlined in this section.**

MANUFACTURER	TIM
Arctic Silver	Arctic Silver® #5
GrafTech	Graphite Sheet 1205
Thermalloy Inc.	Thermal Joint Compound (white)

## 2.5 Mounting

The mounting or assembly of LUXEON CoB emitters (Figure 2 and Figure 3) consists of the following four steps: heat sink preparation, TIM application, LUXEON CoB holder and wire attachment.

1. Select the pre-drilled heat sink that matches with the CoB holder screw locations. Check that the surface of the heat sink is clean of any particles, contamination or obvious surface roughness/unevenness (see supplier heat sink specification, if any). Likewise, check the bottom of the LUXEON CoB for any foreign particles. If the heat sink does not come with pre-drilled holes for the screws, perform drilling and the heat sink surface must then be cleaned thoroughly to remove any trace of lubricants and metal shavings
2. TIM be should be applied to the back of the LUXEON CoB emitter or to the heat sink in preparation for the next step. Application method is dependent upon the type of TIM selected. Follow the TIM manufacturer operating procedure. For more details regarding suitable TIMs, see section 2.4.
3. Mounting of the LUXEON CoB is dependent upon the various holder manufacturers. Some holder allows the LUXEON CoB to be first snapped into place before placing the assembly onto the heat sink. Other types may require the LUXEON CoB to be placed onto the heat sink, align and drop the holder into place. In both cases, install the mounting screws to the torque as specified by the holder manufacturer.
4. The final step is to install wire leads to the holders/connectors as recommended by the manufacturer and power up the device to test the connections.

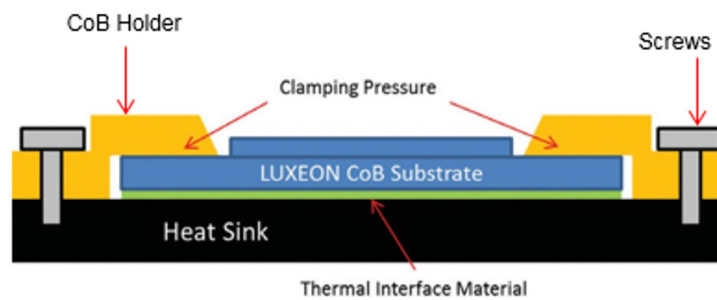


Figure 3. Cross section of the various assembly components.

## 3. Thermal Measurement Guidelines

To calculate the average LUXEON CoB junction temperature, use a small gauge (AWG 40 or AWG 36) thermocouple (TC) wire and attach it to the  $T_s$  point as shown in Figure 4. Note that  $T_s$  location and value are identical to  $t_c$  as defined in IEC 62031 standard. A recommended thermal adhesive glue such as Artic Silver AATA-5G (two component epoxy) is used to secure the TC wire to the  $T_s$  point. Apply sufficient amount of adhesive to hold the TC wire in place but not excessive to allow proper attachment of the CoB holder. Note that to route the TC wire to the outside of the holder, a small modification to the holder may need to be made first (Figure 5). Power-up the LED module system under the desired operating condition and installation setup, allow enough time for the system to reach thermal equilibrium and record the max  $T_s$  temperature.

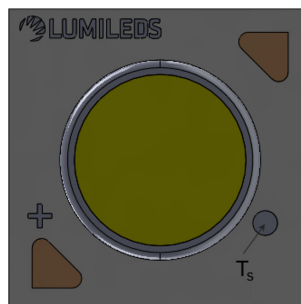


Figure 4.  $T_s$  point of LUXEON CX Plus CoB. The tip of TC wire is secured here.

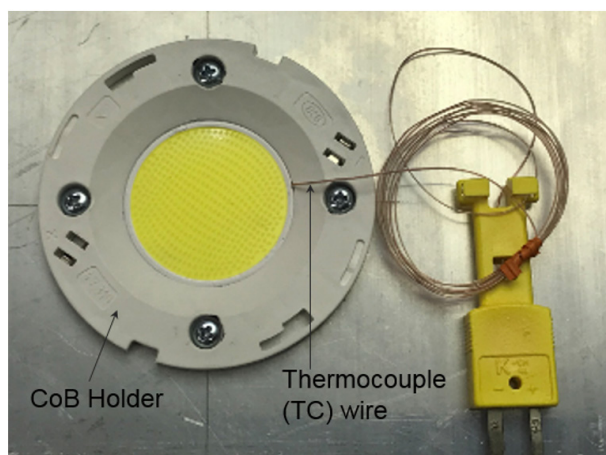


Figure 5. A representative CoB package with an actual TC wire routed from the  $T_s$  point on CoB package to outside of the CoB holder to allow  $T_s$  temperature measurement.

Use the equation below to calculate the junction temperature ( $T_j$ ). The  $P_{\text{electrical}}$  is the electrical power going into the LUXEON CoB emitter and  $R\theta_{j-Ts}$  is the thermal resistance from junction to  $T_s$  point.

$$T_j = T_c + R\theta_{j-Ts} \cdot P_{\text{electrical}}$$

The thermal resistance  $R\theta_{j-Ts}$  was experimentally determined and is shown in Table 3 below.

Table 3. Typical thermal resistance from junction to  $T_s$  point of LUXEON CX Plus CoBs.

MODEL	TYPICAL $R\theta_{j-Ts}$ (K/W)
LUXEON CX Plus CoB S01	2.57
LUXEON CX Plus CoB M02	1.31
LUXEON CX Plus CoB M03	0.94
LUXEON CX Plus CoB L04	0.80
LUXEON CX Plus CoB L05	0.56
LUXEON CX Plus CoB L08	0.51
LUXEON CX Plus CoB – HD S01H4	2.35
LUXEON CX Plus CoB – HD S02H4	2.27
LUXEON CX Plus CoB – HD S01H6	2.18
LUXEON CX Plus CoB – HD S02H6L	2.18
LUXEON CX Plus CoB – HD S02H6	1.00
LUXEON CX Plus CoB – HD S04H9	0.84

## 4. Electrical Design Guidelines

LUXEON CoBs are not protected against supply over-voltages, over-currents, overloads or short-circuit currents other than ESD (JEDEC ESD HBM Class 3B). Consideration in selecting appropriate LED drivers should include such protections or if the LED drivers are missing any of these protection circuits, include them in the LED circuit. There are regulatory electrical testing standards for lamp system or luminaires. These standards vary by regions. For example in US, the Energy Star Program Requirements for Luminaires includes transient protection testing according to ANSI/IEEE C62.41.1-2002 standard or in Europe and most of the rest of the world, according to IEC61000-4-5 Surge Immunity Test standard.

When LED package failed because of surge transient (uncontrollable event), the common symptom is a presence of burnt-mark in the LED package even though the LED system is designed to operate within the LED datasheet specification. Uncontrolled surge transient can be caused by several factors such as lighting strike or interruption in the line supply to the LED driver. A well-designed LED driver can absorb most of the energy surges but pass through very little energy to the LEDs. For example, a SELV (Europe) isolated LED driver or UL Class 2 (US) LED driver typically provide both a safe and reliable surge protection due to the use of an isolating transformer that can attenuate surge transient more than a non-isolated LED driver. However, in all the cases the surge transient testing should still be performed to assess the adequacy of the electrical design.

## 5. Packaging Considerations—Chemical Compatibility

The LUXEON CoB 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 in LUXEON CoB LES area is gas permeable. Consequently, oxygen and volatile organic compound (VOC) gas molecules can diffuse into the silicone encapsulant. 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 CoB 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 4 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 4 are typically not directly used in the final products that are built around LUXEON CoB 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 4.** List of commonly used chemicals that will damage the silicone overcoat of the LUXEON emitter. 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
Roisin Flux	Solder Flux <sup>[1]</sup>
Acrylic Tape	Adhesive
Cyanoacrylate	Adhesive

**Note for Table 4:**

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, 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.

# 6. Photobiological Safety

The threshold illuminance ( $E_{thr}$ , IEC TR 62778) is given in the table below:

LUXEON CX Plus CoB – High Density Series

MODEL NO.	DRIVE CURRENT (mA)/PERCENT OF MAX CURRENT (%)	$E_{thr}$ BY NOMINAL CCT (lx)					
		2700K	3000K	3500K	4000K	5000K	5700K
L2C4 - aabbcs01F04gg	350 / 100%	1036	1036	1036	1036	1036	1036
	175 / 50%	N/A	N/A	1144	1144	1144	1144
	88 / 25%	N/A	N/A	1191	1191	1191	1191
L2C4 - aabbcs01FH6gg	350 / 100%	1036	1036	1036	1036	1036	1036
	175 / 50%	N/A	N/A	1144	1144	1144	1144
	88 / 25%	N/A	N/A	1191	1191	1191	1191
L2C4 - aabbcs02F06gg	700 / 100%	1036	1036	1036	1036	1036	1036
	350 / 50%	N/A	N/A	1144	1144	1144	1144
	175 / 25%	N/A	N/A	1191	1191	1191	1191
L2C4 - aabbcs04F09gg	1400 / 100%	1036	1036	1036	1036	1036	1036
	700 / 50%	N/A	N/A	1144	1144	1144	1144
	350 / 25%	N/A	N/A	1191	1191	1191	1191
L2C4 - aabbcs02F04gg	350 / 100%	1036	1036	1036	1036	-	-
	175 / 50%	N/A	N/A	1144	1144	-	-
	88 / 25%	N/A	N/A	1191	1191	-	-
L2C4 - aabbcs02FH6gg	350 / 100%	1036	1036	1036	1036	-	-
	175 / 50%	N/A	N/A	1144	1144	-	-
	88 / 25%	N/A	N/A	1191	1191	-	-

LUXEON CX Plus CoB (Gen 2)

MODEL NO.	$E_{thr}$ BY NOMINAL CCT (lx)	
	4000K	5000K
L2C4-aabbcl08F14gg	1287	1287
All other models other than L2C4-aabbcl08F14gg	1062	1062

Note: see respective product datasheets for the detail of model nomenclature

## About Lumileds

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