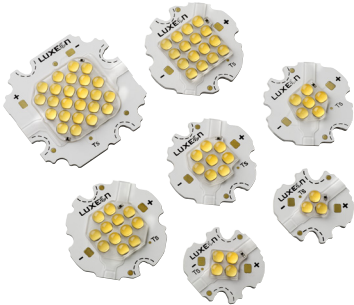


LUXEON K

Assembly and Handling Information



Introduction

This application brief covers recommended assembly and handling procedures for LUXEON® K array emitters. LUXEON K emitters are designed to deliver high luminous flux and efficacy in an easy-to-use bolt-down package that facilitates assembly in space-constrained retrofit and down-light applications. Proper assembly, handling, and thermal management, as outlined in this Application Brief, ensures high optical output and long LED lumen maintenance for LUXEON K emitters.

Scope

The assembly and handling guidelines in this Application Brief apply to the following products:

- LUXEON K 3-up (LXKx-Pxxx-0403)
- LUXEON K 4-up (LXKx-Pxxx-0004)
- LUXEON K 4-up (LXKx-Pxxx-0404)
- LUXEON K 6-up (LXKx-Pxxx-0206)
- LUXEON K 8-up (LXKx-Pxxx-0008)
- LUXEON K 12-up (LXKx-Pxxx-00012)
- LUXEON K 16-up (LXKx-Pxxx-00016)
- LUXEON K 24-up (LXKx-Pxxx-00024)

Any assembly or handling requirements that are specific to a subset of LUXEON K products is clearly marked. In the remainder of this document the term LUXEON K simply refers to any product in the LUXEON K product family.

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I. Component

I.1 Description

The LUXEON K 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 MCPCB is made out of aluminum to ensure a good thermal path between the LEDs and the heatsink on which LUXEON K is mechanically mounted. The MCPCB of the LUXEON K emitter contains 2 slots for mounting screws (marked by dashed black lines) and 2 smaller slots to feed electrical wires to the electrical pads on top of the substrate.

The LED array is overmolded with silicone to enhance light extraction and to shield the chip array from the environment. LUXEON K emitters include a transient voltage suppressor (TVS) chip under the silicone to protect the emitter against electrostatic discharge (ESD).

The backside of the MCPCB contains a serial number and a 2D barcode which is unique to each emitter.

LUXEON K emitters come in various form factors in order to meet different performance specifications. Figure I summarizes the key mechanical features for each LUXEON K emitter configuration.

I.2 Optical Center

The optical center of all LUXEON K emitters coincides with the mechanical center of the emitter.

Optical rayset data for each LUXEON K emitter are available upon request.

I.3 Handling Precautions

LUXEON K emitters are designed to maximize light output and reliability. However, improper handling of the emitter may damage the silicone overmold and affect the overall performance and reliability. In order to minimize the risk of damage to the silicone overmold during handling, LUXEON K emitters should only be picked up from the MCPCB. Excessive force on the lens may cause damage to the interior of the LUXEON K emitter.

I.4 Cleaning

LUXEON K emitters 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 K 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 lens. Do not use other solvents as they may adversely react with the LED assembly. For more information regarding chemical compatibility, see Section 4.

I.5 Electrical Isolation

The aluminum substrate of the LUXEON K emitter is electrically isolated from the LED cathode and anode.

I.6 Mechanical Files

Mechanical drawings for LUXEON K (2D and 3D) are available upon request.

I.7 Soldering

LUXEON K emitters are designed to be mechanically secured onto a heat sink. Electrical wires may have to be soldered onto the electrical pads. For detailed assembly instructions, see Section 2.

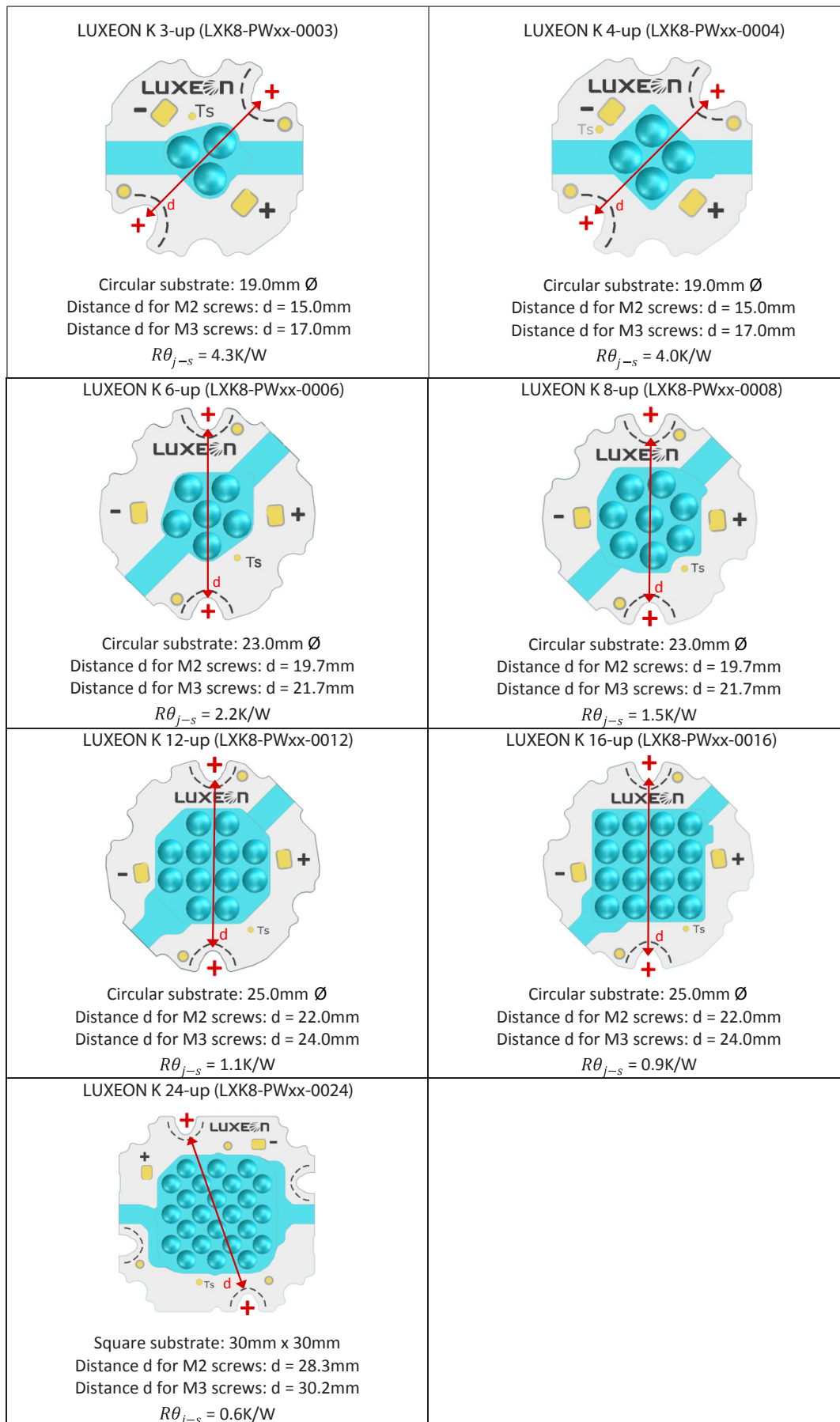


Figure I. Mechanical and thermal characteristics by LUXEON K emitter configuration.

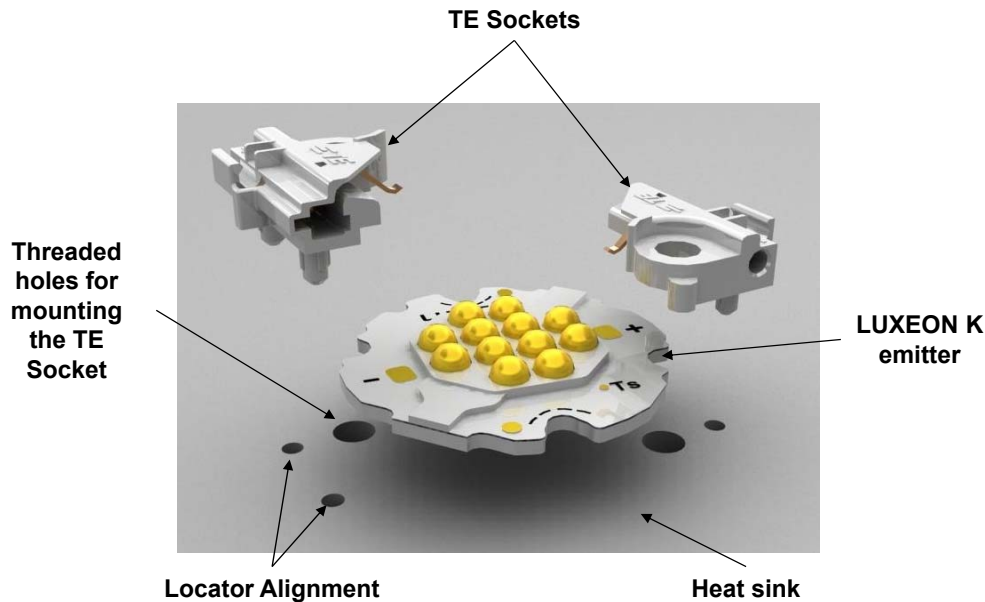


Figure 2. The TE Connectivity Solderless LED Holder (Type LK 2173470-1).

2. Assembly Process

2.1 Mounting LUXEON K Onto a Heat Sink

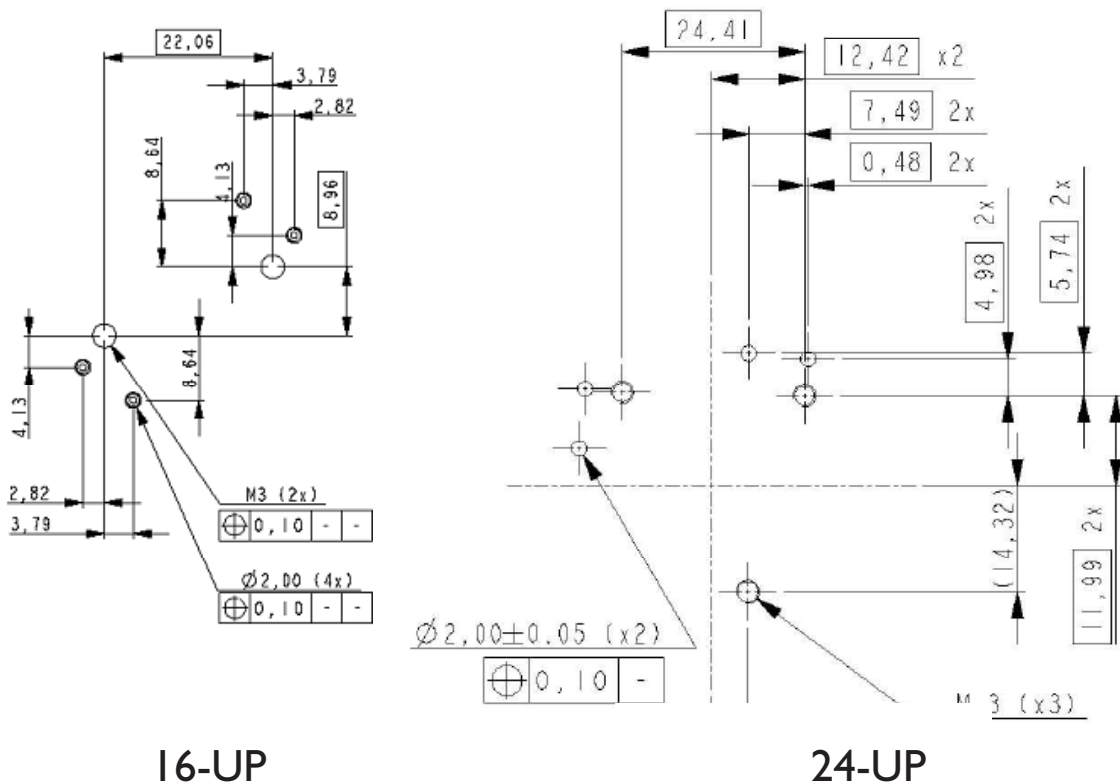
LUXEON K emitters are designed to be mechanically mounted onto a heat sink with screws, facilitating the design and assembly of retrofit and down-light applications. TE Connectivity¹ offers a special LUXEON K solderless LED Socket from, which can be used to electrically, mechanically and thermally secure a LUXEON K emitter onto a heat sink, see Figure 2. Alternatively, a LUXEON K emitter can be directly mounted onto a heat sink with M2/M3 screws and electrical wires can be soldered onto the electrical pads. The remainder of this section provides detailed instructions on how to mount the LUXEON K emitter onto a heat sink.

2.2 LUXEON K Solderless LED Socket

The TE Connectivity Solderless LED Socket (Type LK 2173470-1) is designed to scale with all sizes and models of the LUXEON K emitter. A LUXEON K emitter can be mechanically secured onto a heat sink with two TE Connectivity LED Sockets. The square LUXEON K 24-up emitter requires one additional M3 screw to ensure good mechanical contact between the emitter and the heat sink. Each Solderless LED socket includes a metal spring connector, which is designed to establish a reliable electrical contact between the Socket and one of the electrical pads on the LUXEON K emitter, and an easy-to-use poke-in wire termination, which is compatible with 22-24 AWG wires. Figure 3 provides relevant reference dimensions for the TE Connectivity Solderless LED Socket. Figure 4 and Figure 5 provide reference layouts and dimensions for the holes that need to be drilled into the heat sink to align and secure a LUXEON K emitter onto a heat sink with the Solderless LED Sockets.

The Solderless LED Socket (Type LK 2173470-1) is designed and manufactured by TE Connectivity and may be subject to change without notice. The assembly information for the Solderless LED Socket discussed in this document is for reference only. For the latest up-to-date information on the Solderless LED Socket, visit <http://www.te.com/catalog/pn/en/2173470-1>. Philips Lumileds provides no warranty of any kind with respect to the Solderless LED Socket.

¹ TE Connectivity, TE Connectivity (logo) and TE (logo) are trademarks of the TE Connectivity Ltd family of companies.



16-UP

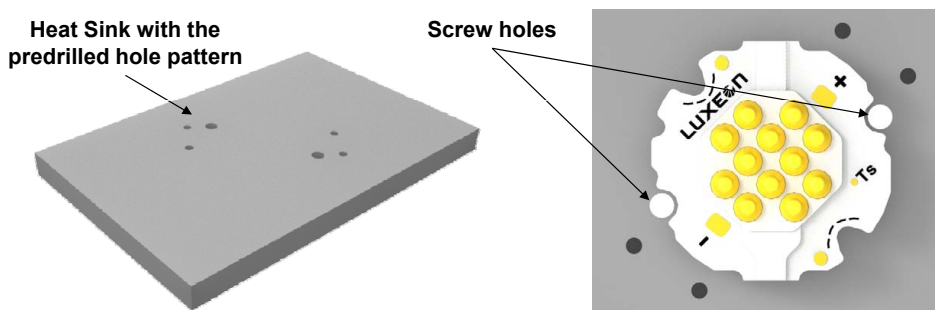
24-UP

Figure 5. Reference layout and dimensions of the holes that need to be drilled into the heat sink to align and secure the LUXEON K 16-up, and 24-up emitter with the Solderless LED Holder (Type LK 2173470-1). All dimensions are in mm.

Follow these steps to mount the LUXEON K emitter on a heat sink with the Solderless LED Socket (Type LK 2173470-1) from TE Connectivity:

1. Prepare the heat sink
 - a. Ensure that the heat sink surface is clean and flat ($\leq 25\mu\text{m}$, with no crowns or peaks in the mounting area).
 - b. Drill and tap the holes as per Figure 4 or Figure 5 and wipe the heat sink surface clean with isopropyl alcohol (IPA).
 - c. Apply a thermal interface material (TIM) on the LED area. For more details regarding suitable TIMs, see Section 3.1.
2. Align the semi-circular cutouts in the LUXEON K board, which are closest to the electrical pads, with the pre-drilled screw holes in the heat sink (see Figure 6).

Figure 6. Align the LUXEON K emitter with respect to the tapped screw holes on the heat sink.



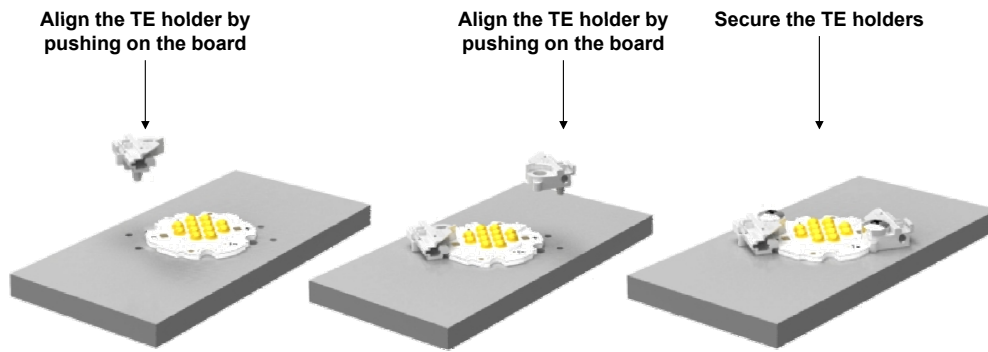


Figure 7. LUXEON K emitters are secured onto a heat sink with two Solderless LED Holders. Alignment pins on the Solderless LED Holders are designed to mate with the alignment holes in the heat sink.

3. Secure the LUXEON K emitter with two TE Solderless LED Sockets (see Figure 7).
 - a. Place the Solderless LED Sockets over the LUXEON K emitter such that the alignment pins of the Solderless LED Sockets mate with the alignment holes in the heat sink.
 - b. Secure each TE Solderless LED Socket onto the heat sink with an M3 screw. The screw down torque should not exceed 4.0 inch lbs.
 - c. In addition to the two TE Solderless LED Sockets, a LUXEON K 24-up emitter should be secured with a third M3 screw in the pre-drilled hole in the heat sink.
4. Terminate the wires (see Figure 8).
 - a. Prepare the trip length of the wire. This should be 6.95mm long.
 - b. Insert one of the 22/24 AWG UL1007 style wires into the opening of the connector.
 - c. The Solderless LED Socket is designed to accept standard stranded wires. However; a stranded wire may not always reach the correct depth in the Socket. In those cases, gently push down the insertion feature on the side of the Solderless LED socket with a small screwdriver to facilitate the insertion of the stranded wire into the Socket (see Figure 9).
 - d. Verify that the wires are inserted to the correct depth.
 - e. Lead the wires to an appropriate LED Driver.
 - f. If desired, one or both wires can be tucked into the wire guide feature on the respective Solderless LED Socket.
 - g. The LUXEON K emitter is now ready for operation.

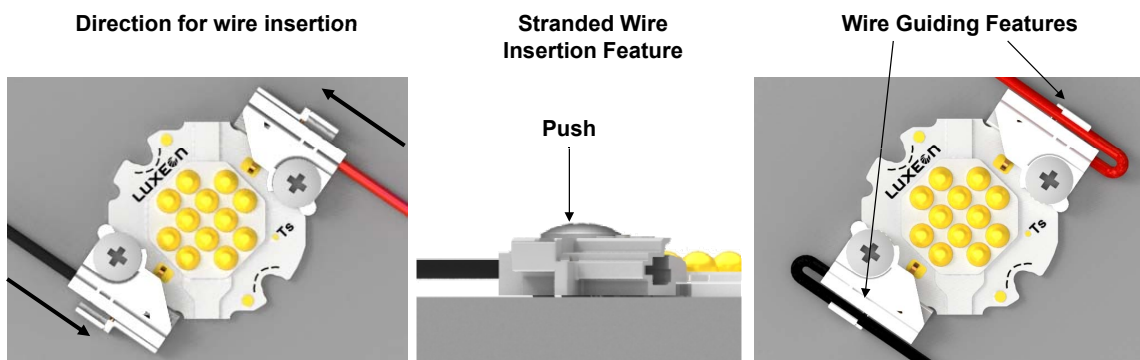


Figure 8. 22/24 AWG UL1007 style wires can be inserted into the Solderless LED Holder to establish an electrical connection with the LUXEON K emitter.

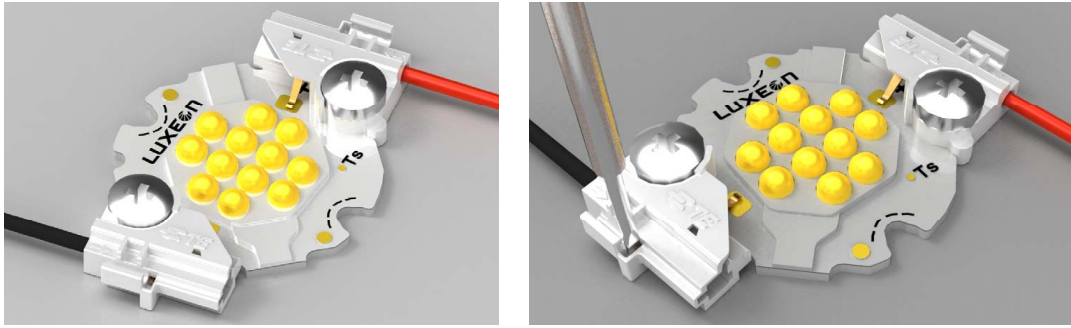


Figure 9. The Solderless LED Socket is designed to accept standard stranded wires. However, a stranded wire may not always reach the correct depth in the Socket. In those cases, gently push down the insertion feature on the side of the Solderless LED socket with a small screwdriver to facilitate the insertion of the stranded wire into the Socket.

2.3 Mounting LUXEON K Directly Onto a Heat Sink

Follow these steps to mount a LUXEON K emitter directly onto a heat sink:

1. Prepare the heat sink
 - a. Ensure that the heat sink surface is clean and flat ($\leq 25\mu\text{m}$), with no crowns or peaks in the mounting area; crowns or peaks on the heat sink surface may adversely impact the thermal conductance between the LUXEON K emitter and the heat sink.
 - b. Drill and tap two M2 or M3 screw holes according to the distances d indicated in Figure 1. (The LUXEON K 24-up emitter should be secured with four screws.)
 - c. Wipe the heat sink surface clean with isopropyl alcohol (IPA).
 - d. Apply a thermal interface material (TIM) onto the heatsink. If a graphite sheet is used as TIM, cut the sheet to size such that it covers the whole footprint of the LUXEON K emitter. For more details regarding suitable TIMs, see Section 3.1.
2. Place the LUXEON K emitter onto the heat sink and align the screw slots in the substrate with the tapped screw holes in the heat sink.
3. Secure the LUXEON K emitter to the heat sink with two M2 or M3 screws (four screws are recommended for the LUXEON K 24-up emitter). The screw down torque should not exceed 2 pound inches (lb-in).

The substrate of each LUXEON K emitters contains several smaller slots near the electrical pads. These slots allow electrical wires to be fed through the heat sink to the LUXEON K emitter.

The electrical pads on the LUXEON K emitter are gold plated to facilitate electrical contact through spring contacts in a mechanical clamp. In the absence of a mechanical clamp with spring contacts, wires can be directly soldered onto the LUXEON K emitter. The following supplies are needed to do so:

- Grounded soldering iron, capable of reaching 350°C
- Stranded or solid copper wire – 24 gauge or larger
- Low-flux Sn96Ag4 solder wire
- Hot-plate, capable of reaching 100°C/212°F (optional)

Follow these steps to attach the electrical wires to the LUXEON K emitter:

1. Prepare the electrical wires:
 - a. Cut the wires to size.
 - b. Strip a few millimeters of insulating material from the ends of the wires.
 - c. Pre-tin the wires with a small amount of solder.
2. Prepare the LUXEON K emitter:
 - a. Clean the electrical pads of the LUXEON K emitter with a lint-free swab and isopropyl alcohol to remove any debris or particles.
 - b. The substrate of the LUXEON K emitter is designed to dissipate heat quickly. This may make it difficult to get the temperature of the electrical pads to a point where the solder will reflow. Therefore it is important to place the LUXEON K emitter on a thermally insulating surface. Alternatively, place the LUXEON K emitter on a pre-heated hot plate set to 100°C/212°F.
 - c. Place the tip of the soldering iron on the electrical pad, apply solder and allow it to wet the electrical pad. Do not place the soldering iron on the electrical pad for more than 3 seconds to prevent any damage to the LUXEON K emitter.
3. Solder the pre-tinned wires to the pre-tinned electrical pads:
 - a. Place the pre-tinned LUXEON K emitter on a thermally insulating surface. Alternatively, place the LUXEON K emitter on a pre-heated hot plate set to 100°C/212°F.
 - b. Place the pre-tinned wire on the pre-tinned electrical pad.
 - c. Place the tip of the soldering iron on the electrical pad and allow the solder to reflow around the wire. Do not place the soldering iron on the electrical pad for more than 3 seconds to prevent any damage to the LUXEON K emitter. If a solder joint cannot be established within this time, allow the LUXEON K emitter to cool before reapplying the heat.
 - d. Remove the soldering iron and allow the solder to joint to cool.

3. Thermal Management

3.1 Thermal Interface Materials (TIM) Selection

Due to the low thermal resistance of the LUXEON K emitter and its large thermal footprint, a variety of thermal interface materials can be used to thermally connect the emitter to the heat sink (e.g. phase change materials, thermal tapes, graphite sheets). However, 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 even though the thermal conductivity may be high.
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 pressure is applied.

Table 1 lists several TIMs that have been tested with LUXEON K. This data is provided for informational purposes only. Philips Lumileds cannot guarantee the performance of the listed TIMs since LED operating conditions will vary with the application design.

Table 1. List of TIM materials that meet the TIM considerations outlined in this section.

Note, though, that the actual performance of these TIM materials will depend on the final application.

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

Table 2. Measured LUXEON K junction temperatures for various drive currents and heat sink configurations.

LUXEON K Configuration	Heat Sink Information	TIM	T _a [°C]	I _f [mA]	T _s [°C]	V _f [V]	T _j [°C]
3-up	Ohmite SA-LED-113E R _{th} = 5.33°C/W	GrafTech Graphite Sheet	24.3	87.5	43.5	33.1	56
				125	51.0	33.2	69
				175	61.0	33.3	86
4-up ^[1]	Ohmite SA-LED-113E R _{th} = 5.33°C/W	GrafTech Graphite Sheet	25.4	350	44.1	11.5	60
				500	52.8	11.7	76
				700	62.6	11.8	96
6-up	Ohmite SA-LED-113E R _{th} = 5.33°C/W	GrafTech Graphite Sheet	24.3	175	55.0	32.7	67
				250	66.8	32.7	84
				350	82.3	32.7	107
8-up	Ohmite SA-LED-113E R _{th} = 5.33°C/W	GrafTech Graphite Sheet	23.7	350	61.9	22.1	74
				500	78.4	22.0	95
				700	98.1	22.4	122
12-up	Ohmite SA-LED-151E R _{th} = 3.2°C/W	GrafTech Graphite Sheet	23.9	350	52.4	33.1	65
				500	63.3	33.4	82
				700	86.9	33.8	113
16-up	Ohmite SA-LED-151E R _{th} = 3.2°C/W	GrafTech Graphite Sheet	24.8	350	60.6	43.6	74
				500	74.6	43.9	94
				700	94.1	44.1	122
24-up	Custom R _{th} ≈ 2°C/W	GrafTech Graphite Sheet	25.6	350	64.7	65.3	78
				500	79.8	65.7	100
				700	102.8	66.0	131

Note for Table 2:

1. A LUXEON K 4-up device of single junction configuration was used to derive the results shown in this table. No major deviations are expected for the multi-junction configured version.

3.2 Heat Sink

LUXEON K emitters must be mounted onto a properly sized heat sink in order to keep the junction temperature below the maximum acceptable junction temperature specified in the datasheet. For reference, Table 2 summarizes the approximate junction temperature which was measured for each LUXEON K emitter at multiple drive currents on the specified heat sink.

3.3 Temperature Probing and Characterization

The typical thermal resistance $R\theta_{(j-c)}$ between the junction and case for the different LUXEON K emitter configurations are published in the datasheet. With this information, the junction temperature T_j can be calculated according to the following equation:

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

In this equation T_c is the case temperature at the bottom of the LUXEON K emitter and $P_{\text{electrical}}$ is the electrical power going into the LUXEON K emitter.

In typical applications it may be difficult to measure the case temperature T_c directly. Therefore, a practical way to determine the junction temperature of a LUXEON K emitter is by measuring the temperature T_s of a predetermined sensor pad with a thermocouple. Each LUXEON K emitter has a sensor pad area, marked with T_s , on the top of the board, see Figure 1.

The thermal resistance $R\theta_{j-s}$ between the sensor pad and the junction of the LUXEON K emitter was experimentally determined. Figure 1 summarizes the typical thermal resistance values for each LUXEON K emitter configuration.

3.4 Thermal Measurements

This section describes in detail how to mount a thermocouple onto the LUXEON K emitter in order to determine the junction temperature T_j .

Supplies and Equipment

Below is a list of supplies and equipment that is needed for T_j measurements:

- Type T precision fine wire (0.003" gauge diameter) thermal couple from Omega Engineering Inc. (part number: 5SRTC-TT-T-40-36)
- Eccobond one component, low temperature curing, thermal conductive epoxy adhesive from Emerson and Cuming (part number: E 3503-1) or Arctic Alumina Thermal Adhesive compound from Arctic Silver Inc. (part number: AATA-5G)
- Disposable 3CC barrel syringe from EFD Inc. (part number 5109LL-B)
- Disposable 0.016" inner diameter fine needle tip from EFC Inc. (part number:5122-B)
- Kapton tape
- Convection oven (for curing of Eccobond epoxy)
- Thermometer
- Magnifying glass or low power microscope (e.g. 5x to 30x)

Thermocouple Mounting Procedure

1. Familiarize yourself with the manufacturer's Material Safety Data Sheet (MSDS) and preparation procedures for the epoxy or adhesive compound.
2. Place the thermocouple tip on the sensor pad area T_s (see Figure 1). The thermocouple must touch the substrate of the LUXEON K emitter to ensure an accurate reading.
3. Use Kapton tape to secure the thermocouple wire onto the LUXEON K emitter.
4. Follow step a or b below depending on the compound or adhesive that is used to thermally connect the thermocouple to the LUXEON K emitter:
 - a. Eccobond Thermal Adhesive Epoxy
 - i. Thaw the thermal conductive epoxy per manufacturer's recommendations.
 - ii. Dispense sufficient epoxy into the 3CC barrel syringe with the fine needle tip. Store the balance per manufacturer's recommendations.
 - iii. Drop a small amount of thermal conductive epoxy just enough to cover the thermocouple tip.
 - iv. Cure the epoxy per the manufacturer's recommendations. Make sure that the oven temperature does not exceed the maximum rated temperature of the LUXEON K emitter.
 - v. Let the board cool down to room temperature before starting any measurements.
 - b. Arctic Alumina Thermal Adhesive compound
 - i. Since this is a two part epoxy system with an approximate pot-life at room temperature after mixing of 3-4 minutes, make sure that proper setup is done to ensure that the epoxy can be dispensed within the pot-life span.
 - ii. After mixing, put the epoxy immediately into the 3CC barrel syringe with the fine needle tip and dispense onto the thermocouple tip. Close to the end of the pot-life, it becomes difficult to dispense.
 - iii. Alternatively, you can dip the fine needle tip into the epoxy mix and then "touch" the thermocouple tip to dispense the epoxy via surface tension.
 - iv. Cure the epoxy at room temperature (25°C) for at least two hours.
5. Once the epoxy/compound has hardened, the LUXEON K emitter can be mechanically mounted onto the heat sink as explained in Section 2.
6. Plug in the thermocouple connector to the thermometer. The thermocouple now measures the temperature T_s .
7. Connect the power supply to the LUXEON K emitter and power up the emitter with a drive current that corresponds to normal operating conditions. If possible, attach all fixtures (e.g. heat sink, lens and any cover) to closely simulate the actual application environment.
8. Record the temperature T_s once the LUXEON K emitter stabilizes. This may take several minutes or more depending on the overall design and thermal mass.
9. The junction temperature can then be estimated as follows:

$$T_j = T_s + R\theta_{j-s} \cdot P_{\text{electrical}}$$

4. Product Packaging Considerations—Chemical Compatibility

The LUXEON K package contains a silicone overcoat and dome to protect the LED chips 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 in LUXEON K 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 K emitters are enclosed in an “air tight” environment or not. In an “air tight” environment, some VOCs that are 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 are discolored in an 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 Philips 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 K 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. Philips 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 K. 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

Company Information

Philips Lumileds is a leading provider of LEDs for everyday lighting applications. The company's records for light output, efficacy and thermal management are direct results of the ongoing commitment to advancing solid-state lighting technology and enabling lighting solutions that are more environmentally friendly, help reduce CO2 emissions and reduce the need for power plant expansion. Philips Lumileds LUXEON® LEDs are enabling never before possible applications in outdoor lighting, shop lighting, home lighting, digital imaging, display and automotive lighting.

Philips Lumileds is a fully integrated supplier, producing core LED material in all three base colors, (Red, Green, Blue) and white. Philips Lumileds has R&D centers in San Jose, California and in the Netherlands, and production capabilities in San Jose, Singapore and Penang, Malaysia. Founded in 1999, Philips Lumileds is the high flux LED technology leader and is dedicated to bridging the gap between solid-state technology and the lighting world. More information about the company's LUXEON LED products and solid-state lighting technologies can be found at www.philipslumileds.com.

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