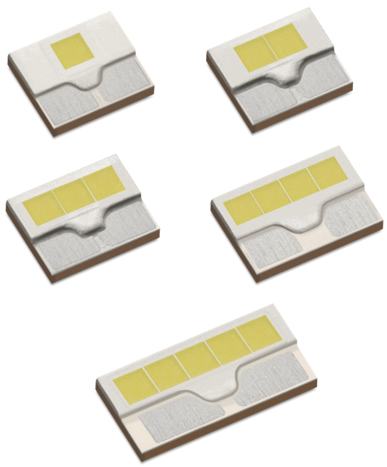
AUTOMOTIVE

LUXEON Altilon TopContact

Assembly and Handling Information



Introduction

This application brief addresses the recommended assembly and handling procedures for LUXEON Altilon TopContact LEDs. LUXEON Altilon TopContact is designed to deliver high luminous flux and efficacy in automotive exterior lighting applications. Proper assembly, handling, and thermal management, as outlined in this application brief, ensure high optical output, long-term lumen maintenance, and high reliability of LUXEON Altilon TopContact in automotive applications.

Scope

The assembly and handling guidelines in this application brief apply to the following products:

PRODUCTS
LUXEON Altilon TopContact 1x1
LUXEON Altilon TopContact 1x2
LUXEON Altilon TopContact 1x3
LUXEON Altilon TopContact 1x4
LUXEON Altilon TopContact 1x5
LUXEON Altilon TopContact 1x5L

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

Table of Contents

1. Component

1.1 Reference Document

The LUXEON Altilon TopContact datasheets are available upon request. Please contact your sales representative.

1.2 Description

Figure 1 (a) and (b) show the top view and bottom view of the LUXEON Altilon TopContact, respectively. The LUXEON Altilon TopContact consist of an array of LED chips assembled on a ceramic carrier, combined with a phosphor converter (Lumiramic) to emit white light. The electrical contacts are located at the top side of the ceramic carrier and are suitable for wire or ribbon bonding. The bottom side of the carrier has a metallized pad suitable for glue bonding. The outside of the LED array is coated with white silicone to shield the chips from the environment and to prevent light leakage to the sides (top emitter). The LUXEON Altilon TopContact LEDs include a transient voltage suppressor (TVS) to protect the emitter against electrostatic discharge (ESD).

The design features of the different LUXEON Altilon TopContact family members are shown in Table 1.

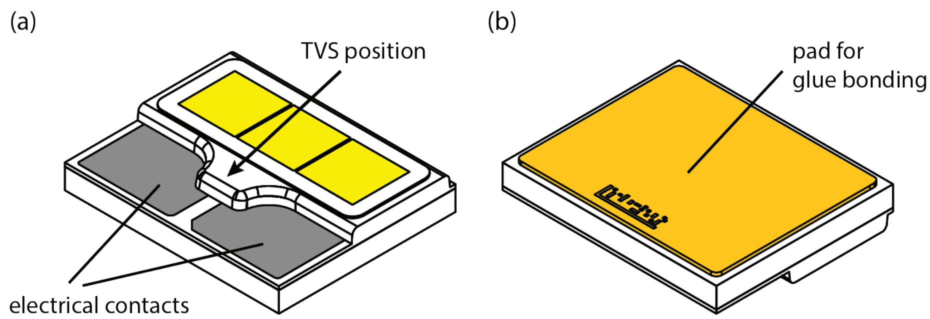
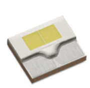
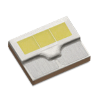


Figure 1. (a) Top view and (b) bottom view of LUXEON Altilon TopContact

Table 1. Design features of LUXEON Altilon TopContact by part number

PART DESCRIPTION		PART NUMBER	NOMINAL DRIVE CURRENT (mA)	LIGHT EMITTING AREA (mm)	NUMBER OF DIES	PACKAGE SIZE (mm)
	LUXEON Altilon TopContact 1x1	A1ST-58501xxxxxxxx	1000	1.06 x 1.06	1	3.30 x 3.70 x 0.77
	LUXEON Altilon TopContact 1x2	A1ST-58502xxxxxxxx	1000	1.06 x 1.06	2	3.30 x 3.70 x 0.77
	LUXEON Altilon TopContact 1x3	A1ST-58503xxxxxxxx	1000	1.06 x 1.06	3	3.30 x 4.00 x 0.77
	LUXEON Altilon TopContact 1x4	A1ST-58504xxxxxxxx	1000	1.06 x 1.06	4	3.30 x 5.00 x 0.77
	LUXEON Altilon TopContact 1x5	A1ST-58505xxxxxxxx	1000	1.06 x 1.06	5	3.30 x 6.10 x 0.77
	LUXEON Altilon TopContact 1x5L	A1ST-58505xxxxxxxx	1000	1.06 x 1.06	5	3.30 x 6.54 x 0.77

1.3 Form Factor

Figure 2 shows outlines of the LUXEON Altilon TopContact family members. The different outline dimensions are listed in Table 1. Please refer to the latest LUXEON Altilon TopContact datasheets for applicable tolerances.

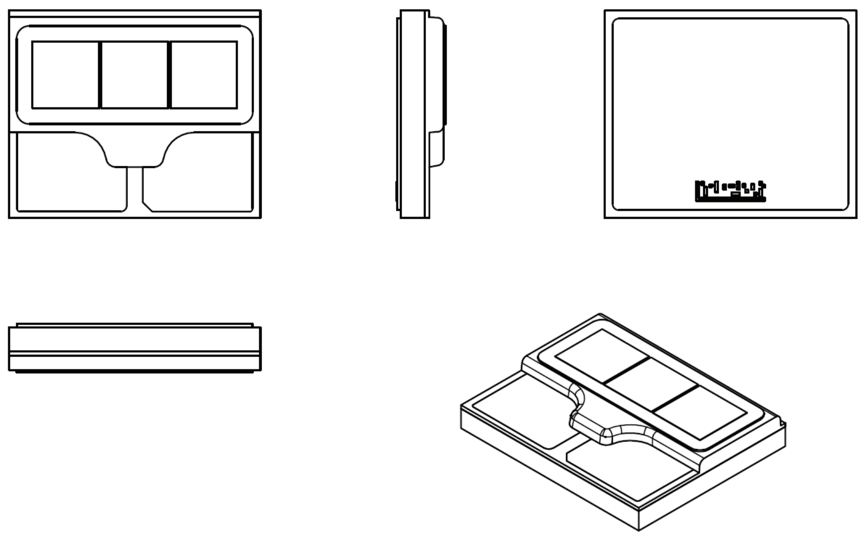


Figure 2. Outlines for LUXEON Altilon TopContact 1x3

1.4 Optical Center

The LUXEON Altilon TopContact has no lens (primary optics). The optical center and the center of the bottom metallization are located relative to each other as indicated by Figure 3. The optical center is at the center of the Lumiramic array (light-emitting area) as indicated by the green dot in Figure 3, and the center of the bottom metallized pad is indicated by the red dot. Optical rayset data of each LUXEON Altilon TopContact part are available upon request.

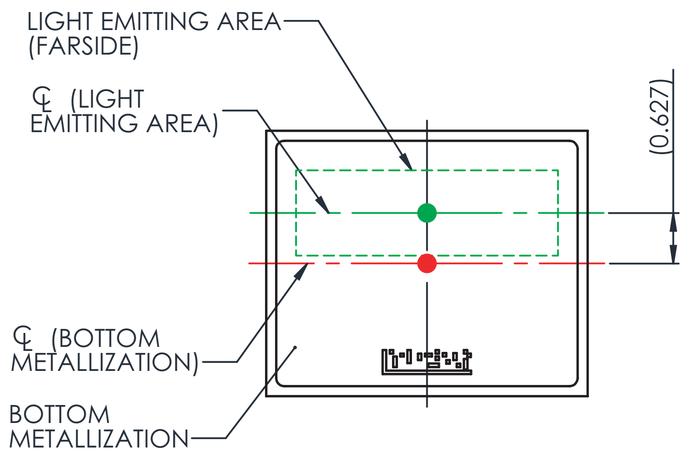


Figure 3. Theoretical optical center (green dot) and bottom-metallization pad center (red dot) for the LUXEON Altilon TopContact family members

1.5 Polarity Marking

The polarity of LUXEON Altilon TopContact is marked on the top side with a chamfered bond pad corner (see Figure 4). This chamfered corner indicates where the cathode pad is located. On the metallized bottom pad there is an alphanumeric OCR code (see Figure 4). Figure 1. (a) Top view and (b) bottom view of LUXEON Altilon TopContact, which can be used to identify the production batch for full test parameter traceability.

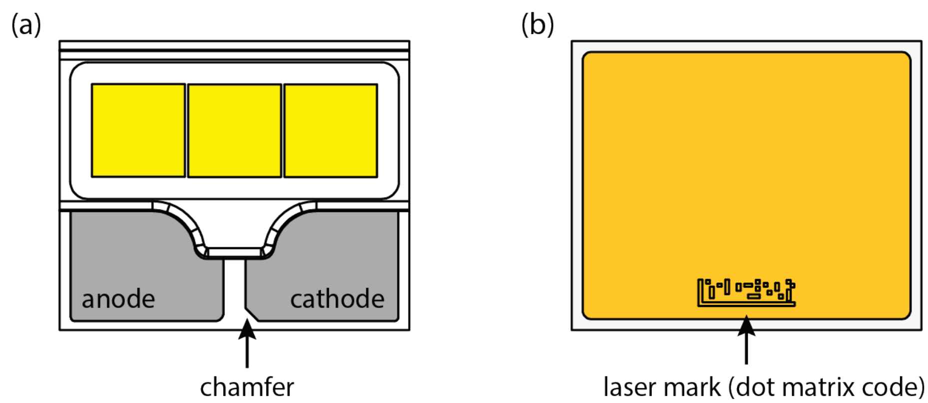


Figure 4. (a) Top-side polarity mark and (b) bottom-side laser mark of LUXEON Altilon TopContact

1.6 Mechanical Files

Mechanical drawings for LUXEON Altilon TopContact (2D and 3D) are available upon request. For details, please contact your sales representative.

2. Handling Precautions

Like all electrical components, there are handling precautions that need to be taken into account when setting up assembly procedures. The precautions for LUXEON Altilon TopContact are noted in this section.

2.1 Electrostatic Discharge Protection

Electrostatic discharge (ESD), rapid transfer of charges between two bodies due to an electric potential difference between those bodies, can cause unseen damage to electronic components. In LED devices, ESD events can result in a slow degradation of light output and/or early catastrophic failures. In order to prevent ESD from causing any damage, handling in a safe ESD protected environment is required. LUXEON Altilon TopContact devices include an transient voltage suppressor (TVS) chip in parallel to the LED chips (see Figure 5). This TVS chip provides a current path for transient overvoltages.

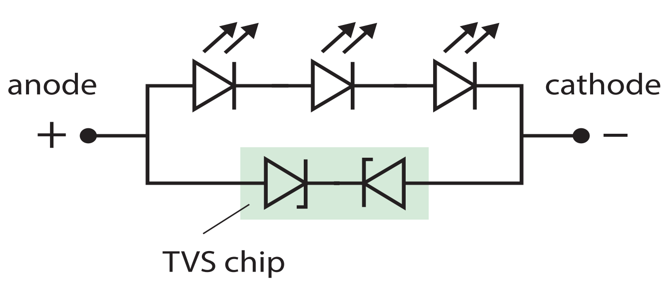


Figure 5. Electrical schematics of LUXEON Altilon TopContact

Common causes of ESD include the direct transfer of charges from the human body or from a charged conductive object to the LED component. In order to test the susceptibility of LEDs to these common causes of ESD, two different models are typically used:

- Human Body Model (HBM)
- Charged Device Model (CDM)

LUXEON Altilon TopContact LEDs have been independently verified to successfully pass ESD tests under HBM and CDM conditions. For the respective test voltages of these tests please refer to the latest LUXEON Altilon TopContact datasheets. Nevertheless, Lumileds strongly recommends that customers adopt handling precautions for LEDs similar to those which are commonly used for other electronic surface-mount components which are susceptible to ESD events. Additional external ESD protection for the LED may be needed if the LED is used in non-ESD-protected environments and/or exposed to higher ESD voltages and discharge energies, e.g. as described in ISO 10605 or IEC 61000-4-2 (severity level IV). For details please contact your sales representative.

2.2 Component Handling

Minimize all mechanical forces exerted onto the silicone package of LUXEON Altilon TopContact. The white package consists of fragile silicone material and should not be handled with tweezers that can lead to damage of the package (see Figure 6), especially not with metallic tweezers. A vacuum pen can be used instead of tweezers (see Figure 6). Make sure that the nozzle does not contaminate or damage the top side surface of the LED. Do not stick any tape, such as capton or UV-tape, on top of the light-emitting surface. A contamination of glue or its invisible constituent parts may change the LED performance. Avoid electrical testing on the bonding pads before assembly. Probe tips may scratch or dent the bond pad surface and could have impact on ribbon/wire bond quality. Avoid contact with the LED other than what is required for placement. Lumileds stongly recommends handling with automatic assembly equipment only where forces to the component can be well controlled.

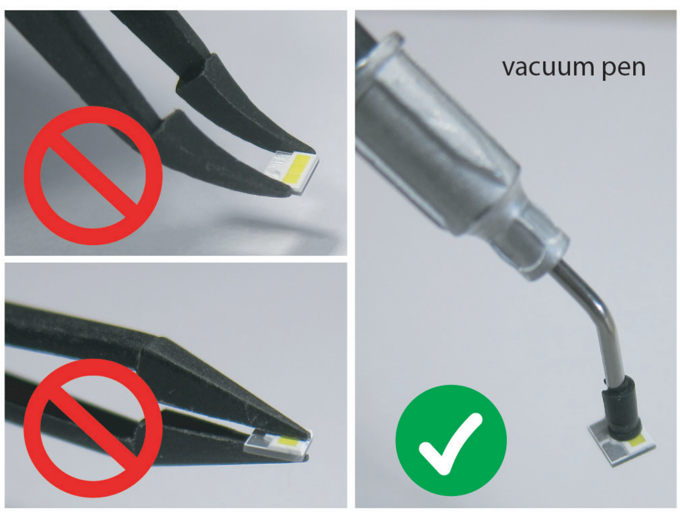


Figure 6. LED handling

Do not touch the LED top surface with fingers or apply any pressure to it when handling finished boards containing LUXEON Altilon TopContact emitters (see Figure 7). Do not stack finished boards because the LED can be damaged by the other board outlines (see Figure 7). Do not put finished boards with LUXEON Altilon TopContact emitters top-side down on any surface (see Figure 7). The surface of a workstation may be rough or contaminated and may damage the LED.

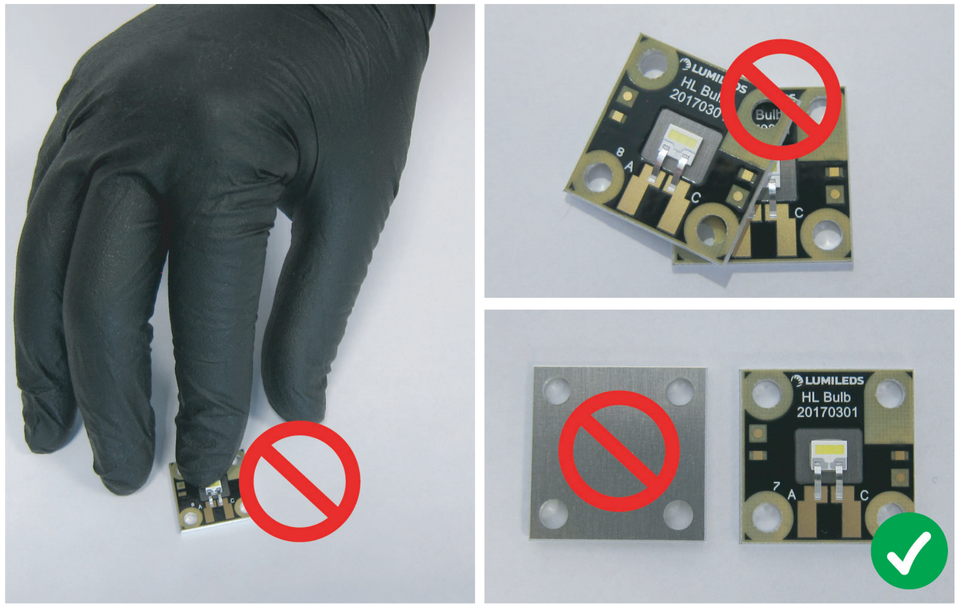


Figure 7. Board handling

2.3 Cleaning

The surface of the LUXEON Altilon TopContact emitter should not be exposed to dust and debris. Excessive dust and debris on the LED chip array may cause a decrease in light output and modified optical behavior. It is best to keep LUXEON Altilon TopContact LEDs in their original shipping reel until actual use.

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

One can also rinse with isopropyl alcohol (IPA). Do not use the solvents listed in Table 8, as they may adversely react with the LED assembly. Extra care should be taken not to destroy the white silicone coating around the LED chips. Lumileds does not recommend ultrasonic-supported cleaning for LUXEON Altilon TopContact.

3. Heat Sink Integration

The LUXEON Altilon TopContact can be glued on a printed circuit board (PCB) or directly on a heat sink (see Figure 8). To ensure optimal operation of the LUXEON Altilon TopContact, the thermal path between the LED package and the heat sink should be optimized according to the application requirements. The electrical contact pads on the PCB should be optimized for the applicable electrical interconnect.

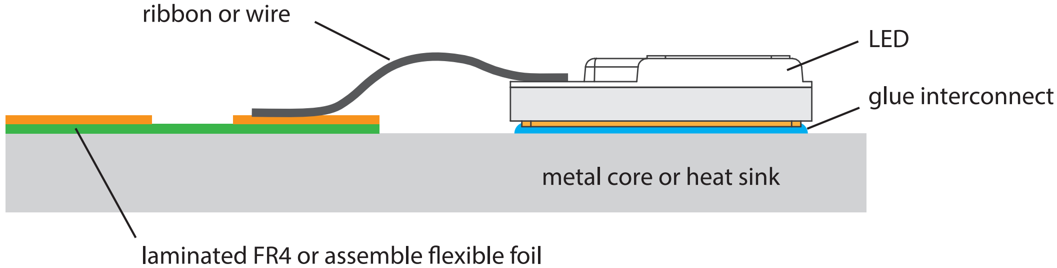


Figure 8. Mounting concept for LUXEON Altilon TopContact

Please ensure that the PCB assembly complies to the applicable IPC standards as listed in Table 2.

Table 2. General PCB standards

STANDARD	DESCRIPTION
IPC A-600K	Acceptability of Printed Boards
IPC A-610G	Acceptability of Electronic Assemblies
IPC 2221B	General Standard on Printed Board Design
IPC 7093A	Design and Assembly Process Implementation for Bottom Termination Components

4. Thermal Management

4.1 Thermal Resistance of the Glue Layer

The thermal resistance of the glue interconnect of the LUXEON Altilon TopContact to the heat sink $R_{th,glue}$ can be easily estimated assuming a one-dimensional approximation of the heat flow through the glue layer. It is then

$$R_{th,glue} \approx 1/k_{glue}\ d_{glue}/A_{pad}\,,$$

where k_{glue} denotes the thermal conductivity of the glue material, d_{glue} denotes the thickness of the glue layer, and A_{pad} denotes the cross-sectional area, which is defined as the size of the bottom pad of the LED (cf. Figure 2).

4.2 Thermal Resistance of the Glue Layer

The use of a temperature probe may be desirable to verify the overall system design model and expected thermal performance. Depending on the required temperature measurement accuracy, different methods are possible to determine the LED temperature in terms of case temperature (T_c), junction temperature (T_j), or phosphor temperature (T_{ph}). Table 3 lists three methods along with the expected asurement accuracy. The more accurate the measurement is, the closer T_c can T_j can be designed to the maximum allowable values specified in the LUXEON Altilon TopContact datasheets. Figure 9 schematically shows the LED glued on a PCB, including the relevant temperatures as defined for specific positions in the setup.

Table 3. Temperature measurement methods

METHOD	ACCURACY (°C)	EFFORT	EQUIPMENT COST
Thermocouple (e.g. thin wire thermocouple)	± 2.0 to ± 5.0 [1]	Low	Low
Forward voltage measurement	± 0.5	High	High
Infrared thermal imaging	± 2.0 to ± 10.0 [2]	Medium	High

Notes for Table 3:
- See section "Temperature Probing by Thermo Sensor" for parameters determining the measurement accuracy.
- See section "Temperature Measurement by Infrared Thermal Imaging" for parameters determining the measurement accuracy.

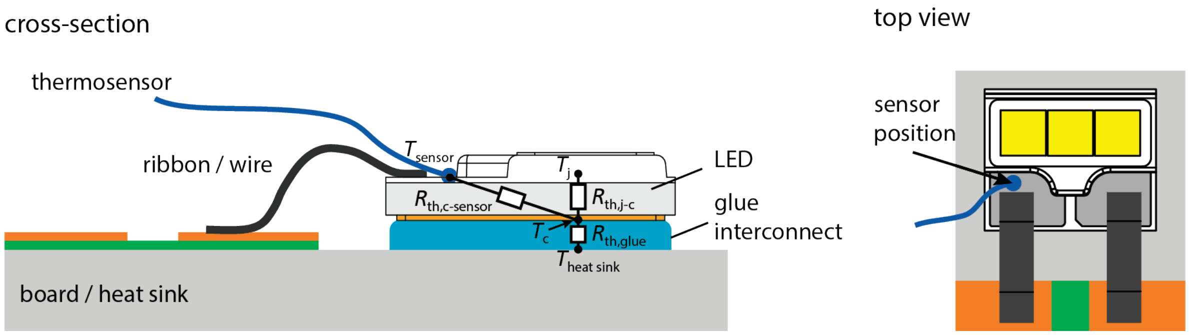


Figure 9. Temperature probing (schematically)

Temperature Probing by Thermo Sensor

A practical way to verify the case temperature Tc is to measure the temperature Tsensor at one of the electrical contact pads of the LED as sketched in Figure 9. The case temperature Tc can then be calculated according to the following equations:

$$T_c = T_{sensor} + R_{th,c\text{-}sensor,el} \cdot P_{el},$$

$$T_c = T_{sensor} + R_{th,c\text{-}sensor,real} \cdot P_{th}.$$

In these equations, $R_{th,c\text{-}sensor,el}$ is the thermal resistance from case to sensor based on the electrical input power P_{el} and $R_{th,c\text{-}sensor,real}$ is the thermal resistance from case to sensor based on the thermal input power Pth. The thermal resistances $R_{th,c\text{-}sensor,el}$ can be calculated from $R_{th,c\text{-}sensor,real}$ as $R_{th,j\text{-}sensor,el} = R_{th,j\text{-}sensor,real}$*(1–WPE), where WPE denotes the wall plug efficiency. Note that the WPE is not constant and depends on drive condition and flux binning class. The thermal resistances Rth,c-sensor,el and $R_{th,c\text{-}sensor,real}$ depend on the type of LED attach and the heat sink material and can be determined with help of thermal simulations and measurements. The accuracy of the measurement is determined by the type of LED attach, the heat sink material, the measurement accuracy of the thermocouple, and the mounting position. The typical $R_{th,c\text{-}sensor}$ values for an Al substrate and the glue interconnect as described in section 5.1 are listed in Table 4.

Table 4. Typical $R_{th,c\text{-}sensor}$ values

INTERCONNECT AND TEST BOARD	$R_{th,c\text{-}sensor,el}$	$R_{th,c\text{-}sensor,real}$
Dow Corning DA-6534, 30 µm thickness, on Al substrate	0.2 K/W	0.3 K/W

Temperature Probing by Forward Voltage Measurement

The forward voltage measurement uses the temperature dependence of the LED's forward voltage. In a first step, the LED system is heated up by operating the LED at the targeted current. Then, the forward voltage change after switching off the thermally stabilized system is measured and analyzed, yielding information on the LED junction temperature. By using a thermal model of LUXEON Altilon TopContact or the LED junction-to-case thermal resistance as indicated in the datasheets, the case temperature Tc can be estimated. To ensure high accuracy, a precise and fast voltage measurement system is needed. In addition, the relationship between forward voltage and temperature needs to be properly characterized for each individual LED. Please contact your sales representatives for further support in this topic.

Temperature Probing by Infrared Thermal Imaging

Infrared (IR) thermal imaging can be used to measure the surface temperature/phosphor temperature of the LED or the heat sink temperature. For an accurate determination of the absolute temperature, the determination of the exact emissivity value is crucial. The emissivity generally depends on material, surface properties, and temperature. It can be determined by heating up the unbiased device to a defined temperature that can be, for example, measured with a thermocouple. Then, an IR measurement can be taken of this setup, and the emissivity setting of the material of interest (typcially the phosphor or the heat sink surface) can be adjusted to match the thermocouple reading. The obtained emissivity value can be used to evaluate the IR image of the device in operation to determine the temperature of interest. For low-emissivity materials, e.g. bare metal, the accuracy of the so-determined temperatures can become low. It is therefore recommended to locally enlarge the emissivity at the measurement point to ensure an accurate interpretation of the IR temperature readings at this location. These emissivity modifications need to be confined to a small region not to change the thermal behaviour of the system essentially.

The temperature at which the emissivity value is determined should be similar to the temperature in operation that is to be measured. During IR imaging, make sure that the recorded image is not disturbed by unwanted background reflections. Due to the small dimensions of the LUXEON Altilon TopContact, an imaging system with high magnification should be used in order to get a sufficient resolution of the LED in the IR image.

Note that due to losses in the phosphor converter layer, the phosphor temperature of the LUXEON Altilon TopContact is typically higher than the LED junction temperature and that the absolute temperature difference depends on the drive current.

5. Assembly Process Recommendations and Parameters

5.1 Mechanical and Thermal Interconnect

5.1.1 General Requirements

Grease, oil or other foreign material should be removed from the heat sink or board prior to mounting LUXEON Altilon TopContact LEDs.

The surface roughness of the LED attach area should be defined. Lumileds evaluated a surface roughness range from 0.25 μm to 1.25 μm without any significant impact on the mechanical strength of the glue interconnect. The surface of the applicable heat sink area should also be free from burrs and scratches.

5.1.2 Thermal Glue Material

Lumileds has tested Dow Corning DA-6534, which is a silver-filled silicone-based thermal conductive adhesive.

5.1.3 Dispensing Pattern and Volume

Lumileds dispenses the adhesive in a diagonal cross pattern with a ratio of 80% at the center of the footprint of the LED as shown in Figure 10). This cross pattern is recommended to minimize the void level in the glue layer.

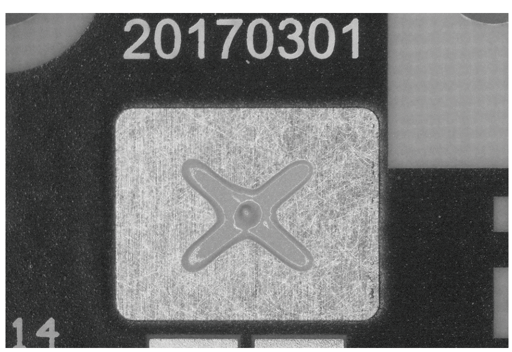


Figure10. Dispense pattern

5.1.4 Pick and Place Nozzle

The LUXEON Altilon TopContact is packed in a tape and reel with the light-emitting surface facing upwards. Automated pick and place equipment provides the best handling and placement accuracy for LUXEON Altilon TopContact emitters.

Lumileds recommends to take the following general pick and place guidelines into account:

1. The pick-up area, for a full area nozzle, is defined in Figure 11.
2. The nozzle tip should be clean and free of any particles since this may interact with the top surface coating of the LUXEON Altilon TopContact during pick and place.
3. During setup and the first initial production run, it is good practice to inspect the top surface of LUXEON Altilon TopContact emitters under a microscope to ensure that the emitters are not accidentally damaged by the pick and place nozzle.
4. To avoid LED damage, it is recommended to lower the z-axis velocity when the device is picked or placed.

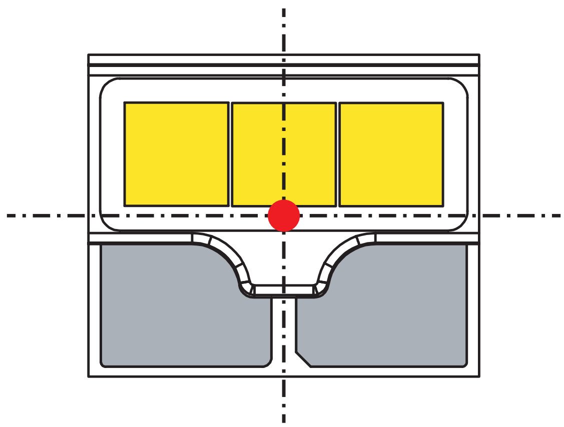


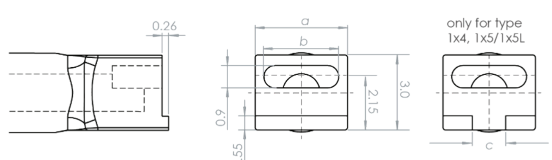
Figure 11. Pick-up area for LUXEON Altilon TopContact

Since LUXEON Altilon TopContact has no primary optics or lens which can act as a mechanical enclosure protection for the LED chip, the pick-up and placement force applied to the top of the package should be minimized and kept well controlled.

Picking the component out of the carrier tape should be performed from a defined height position and should not apply forces to the component and carrier tape, as this may damage the component. The LUXEON Altilon TopContact is packed in a recess of the carrier tape, and the nozzle geometry must be selected accordingly not to get in contact with carrier tape.

Typical nozzle

It is important to place the LED plane parallel to the board. The top side of the LED is not flat. It is recommended to use a nozzle with a step to avoid tilting of the LED during placement. The width of the nozzle should be adapted to the width of the applicable LUXEON Altilon TopContact LED. The typical design is shown in Figure 12. Precaution needs to be taken to avoid scratches on the bond-pad surface.



Type	*a* [mm]	*b* [mm]	*c* [mm]
1x1, 1x2	3.4	2.7	n.a.
1x3	3.7	3.0	n.a.
1x4	4.7	4.0	2.0
1x5, 1x5L	5.8	5.1	2.0

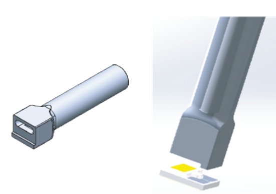


Figure 12. Recommended nozzle geometry for pick-and-place of the LUXEON Altilon TopContact

5.1.5 Placement Force

The To achieve a reliable glue joint it is important to maintain the recommended bond line thickness. The placement force and placement time are key process parameters. With the dispense pattern mentioned in section 5.1.2 (diagonal cross pattern with 80% ratio) Lumileds achieved a typical bond line thickness of 30 μm ± 10 μm by using a placement force of 1.5 N and a hold time of 1 s. The bond line thickness of 30 μm is a good compromise with respect to reliability, thermal resistance and cost. Besides the bond line thickness also the wetting area is important. A pratical way of testing the wetting area is to record an X-ray image of the assembly (see Figure 13). Structured process evaluation should define the final acceptance/reject requirements for the specific application.

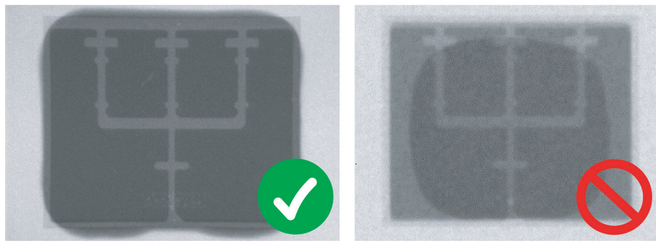


Figure 13. X-ray image shwoing the wetting area

5.1.6 Curing Profile

LUXEON Altilon TopContact is released for a maximum curing temperature of 210°C with 30 minutes curing time as stated in the LED datasheet. Lower curing temperatures combined with longer curing time can be used as necessary depending on process boundary conditions and glue specifications.

It is the responsibility of the user of the LED to verify the combination of glue, curing temperature, and curing time by analyzing for example shear forces after curing. Figure 14 is a guideline for possible combinations of curing temperatures and time. Please consult the glue supplier for glue specific recommendations.

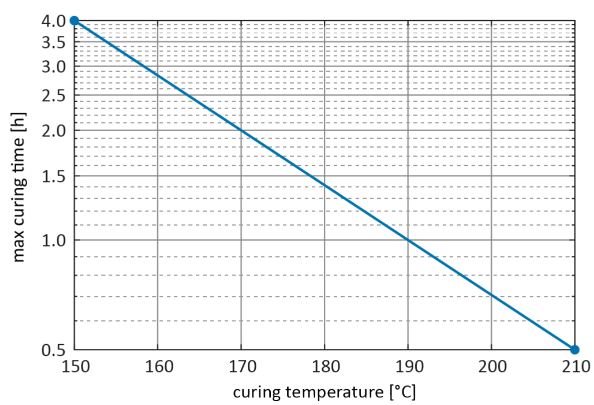


Figure 14. Curing time versus curing temperature

For example, the recommended heat curing profile of the Dow Corning DA-6534 glue is 150 °C for 120 minutes (see datasheet of glue). Lumileds used a preheated oven and the parameter settings given in Table 5 to verify the curing process. The curing time should start when the aluminum board/the heat sink has reached the required temperature. Large heat sinks need more time to heat up than small ones.

Table 5. Curing settings

TEMPERATURE	TIME
145°C - 155°C	120 min 150 min

5.1.7 Position Accuracy

TLumileds recommends using topside pattern recognition of the light-emitting area during the pick and placement step. This method Will guarantee the most accurate positioning of the light emitting area to the reference features. Typical tolerances from LEA to references on the board or heat sink of ±50 μm can easily be achieved. Lumileds does not recommend pattern recognition of the LED outline due to the additional tile sawing tolerance.

5.2 Electrical Interconnect

5.2.1 General Requirements

The electrical pads on the top side of the LUXEON Altilon TopContact consist of an aluminium layer of about 3 μm thickness and can be used for ultrasonic bonding of heavy Al wires or Al ribbons. The use of Au bond wires would also be possible. However, Lumileds did not test this type of interconnect. Lumileds used Al ribbons as electrical interconnect due to the handling robustness of ribbons.

The properties of the glue and the curing process used to attach the LED on the board/heat sink will influence the required settings for the ultrasonic bonding. Different types of glue interconnect might require different ultrasonic bonding frequencies. Lumileds used an ultrasonic bond frequency of 120 kHz based on the used glue. For further recommendations, please consult your Lumileds sales representative.

5.2.2 Protection of the Bond

Touching the bond wires or ribbons in subsequent manufacturing and handling step must not happen. For integrity of the bond, glob top protection is not required since heavy Al-wires or ribbons are robust enough to withstand vibration and shock stresses in an automotive headlamp environment.

When using thin bonding wires, Lumileds recommends protecting the bonding area and wires with a glob top layer. However, Lumileds did not test and verify such a setup.

6. Glue Interconnect Reliability

The interconnect reliability under thermal cycling and thermal shock condition is mainly determined by the thermal expansion of the used materials. The typical heat sink material is aluminium with a CTE of 23 ppm. The CTE of the Altilon TopContact LED package is about 4 ppm due to AlN used as package carrier material.

Table 6 shows the recommended parameters to pass JEDEC standard J-ESD22-A104E: Condition G -40/+125 °C, 10 s transition, 30 min dwell.

Table 6. Interconnect reliability performance

CONDITION	LED CONFIGURATION	HEAT SINK MATERIAL	GLUE MATERIAL	BOND LINE THICKNESS	CURING TEMPERATURE	CURING TIME	THERMAL CYCLING PERFORMANCE
1	1x1, 1x2, 1x3, 1x4, 1x5, 1x5L	Aluminium	DA-6534	30 μm	150 °C	120 min	>1000 cycles
2	1x1, 1x2, 1x3, 1x4, 1x5, 1x5L	Aluminium	DA-6534	30 μm	210 °C	30 min	>1000 cycles

7. JEDEC Moisture Sensitivity Level

The LUXEON Altilon TopContact has a JEDEC moisture sensitivity level of 1. This is the highest level offered in the industry and the highest level within the JEDEC J-STD-020E standard. This provides customers with ease of assembly, since they no longer need to be concerned about bake out times and floor life. No bake out time is required for a moisture sensitivity level of 1.

Moisture sensitivity level 1 allows the device to be cured up to three times under the specifications as described in the LUXEON Altilon TopContact datasheet.

JEDEC has defined eight levels for moisture sensitivity, as shown in Table 7.

Figure 7. The JEDEC Moisture Sensitivity Level

LEVEL			SOAK REQUIREMENTS			
	FLOOR LIFE		STANDARD		ACCELERATED EQUIVALENT 1	
	TIME	CONDITIONS	TIME	CONDITIONS	TIME	CONDITIONS
1	unlimited	≤ 30 °C / 85% RH*	168 hours +5/-0	85°C / 85% RH	NA	NA
2	1 year	≤ 30 °C / 60% RH	168 hours +5/-0	85°C / 60% RH	NA	NA
2a	4 weeks	≤ 30 °C / 60% RH	696 hours +5/-0	30°C / 60% RH	120 hours +1/-0	60°C / 60% RH
3	168 hours	≤ 30 °C / 60% RH	192 hours +5/-0	30°C / 60% RH	40 hours +1/-0	60°C / 60% RH
4	72 hours	≤ 30 °C / 60% RH	96 hours +2/-0	30°C / 60% RH	20 hours +5/-0	60°C / 60% RH
5	48 hours	≤ 30 °C / 60% RH	72 hours +2/-0	30°C / 60% RH	15 hours +5/-0	60°C / 60% RH
5a	24 hours	≤ 30 °C / 60% RH	48 hours +2/-0	30°C / 60% RH	10 hours +5/-0	60°C / 60% RH
6	time on label (TOL)	≤ 30 °C / 60% RH	TOL	30°C / 60% RH	NA	NA

* RH - relative humidity

8. Packaging Considerations—Chemical Compatibility

The LUXEON Altilon TopContact 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 in LUXEON Altilon TopContact 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 Altilon TopContact 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 overcoat. Under heat and “blue” light, the VOCs inside the silicone overcoat 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 overcoat 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 8 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 8 are typically not directly used in the final products that are built around LUXEON Altilon TopContact 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. Lumileds therefore recommends the following precautions when designing your application:

1. 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.
2. 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 8. List of commonly used chemicals that may damage the silicone encapsulant of LUXEON Altilon SMD DT

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
Tetrachloromethane	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

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.

To learn more about our lighting solutions, visit lumileds.com.

LUMILEDS

lumileds.com