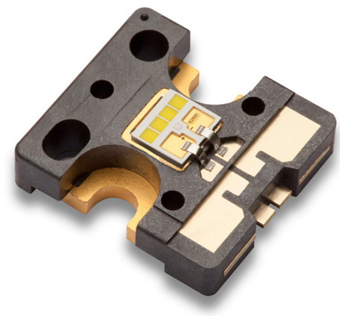
LUMILEDS

AUTOMOTIVE

LUXEON Altilon

Assembly and Handling Information



Introduction

LUXEON Altilon is the most robust and powerful LED automotive forward lighting source available, offering the highest luminance per package.

Proper assembly, handling, and thermal management are required for maximum performance and reliability.

Scope

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

• LAFL-C2S-xxxx	• LAFL-C4S-xxxx
• LAFL-C2L-xxxx	• LAFL-C4L-xxxx

Table of Contents

1. Component

1.1 Reference Document

The LUXEON Altilon DS66 datasheet is available on the Lumileds website, http://www.lumileds.com/uploads/39/DS66-pdf.

1.2 Form Factor

LUXEON Altilon comes in two mechanical configurations, with and without leads. See Figures 1a and 1b below.

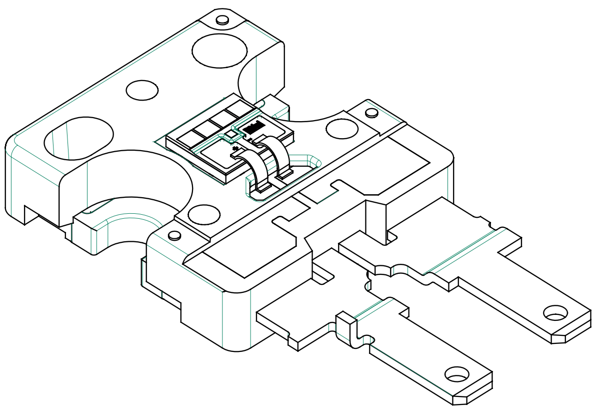


Figure 1a. Module with leads.

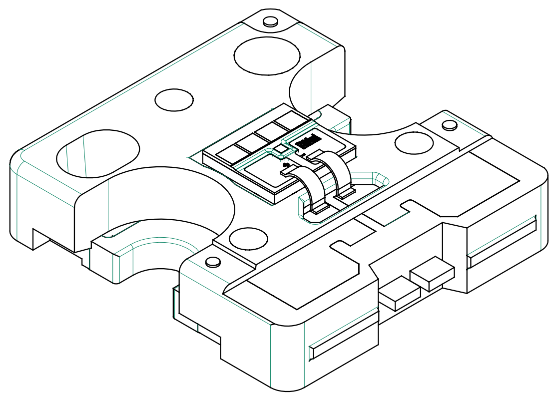


Figure 1b. Module without leads.

Key features of the LUXEON Altilon LED module assembly are noted in Figure 1c below. The leaded module uses connectors (spade lugs) while the solder module requires wires to be soldered (on solder pads, see Figure 1c) to make electrical contacts.

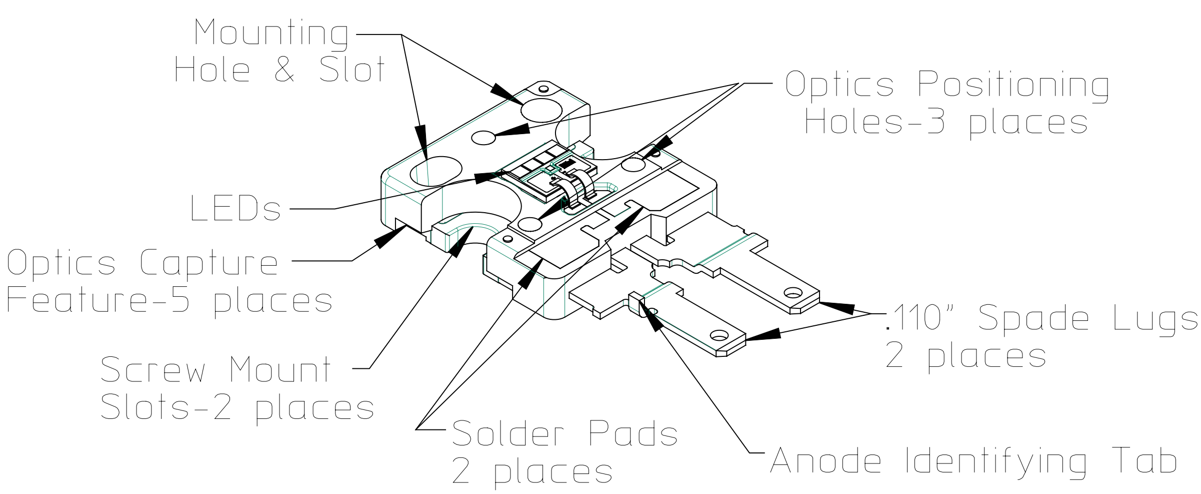


Figure 1c.

1.3 Optical Center

Since there is no primary optic, the theoretical "filament" center is at the center location of the 1x4 or 1x2 LED chip arrays as shown by the red dot in Figure 2. The centering tolerance is ± 0.05 mm with respect to the datum.

LUXEON Altilon has three optic positioning holes and five optic capture/locking features (Figure 1c) to allow optics to be attached.

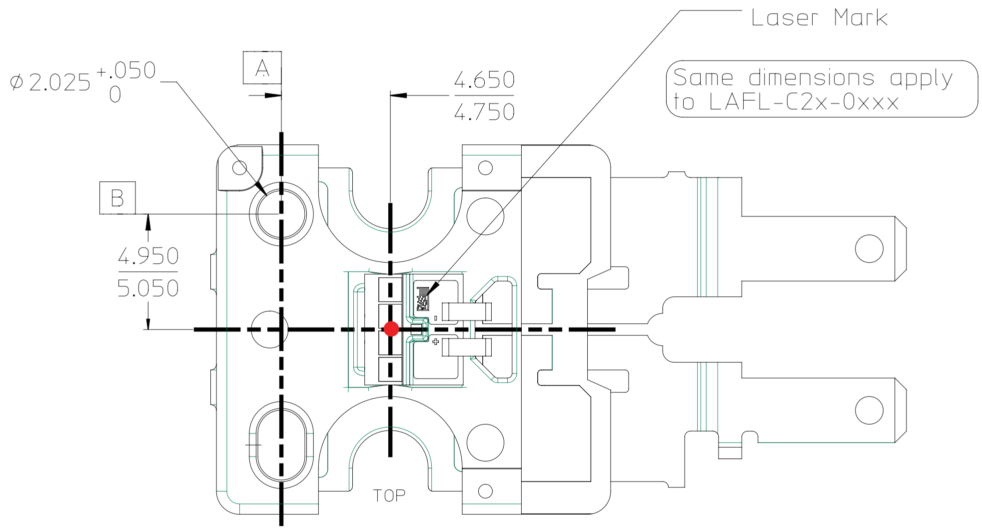


Figure 2.

1.4 Handling Precautions

Like all LEDs, there are handling precautions that need to be considered when setting up assembly procedures. For LUXEON Altilon, the following cautions are noted:

1. The Keep-Out-Zone defines an area where the LED die, phosphor, ceramic and ribbon bonds are located. Handling equipment, tools, fingers, and any other objects should avoid making contact with the module assembly in this defined area. See Figure 3a.
2. There is an undercut in the black LCP (plastic) on the bottom of the package, adjacent to the heat slug. Take care not to put unsupported pressure on the top side of the package over those areas, as the heat slug could become a fulcrum, resulting in a potential fracture stress. See Figure 3b.
3. Manual or automated tooling should not provide a side clamping force on the package exceeding 44.5 N [10 lbs] over an area smaller than 10 mm square.

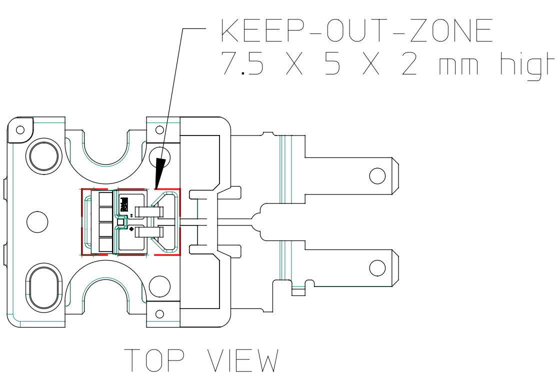


Figure 3a.

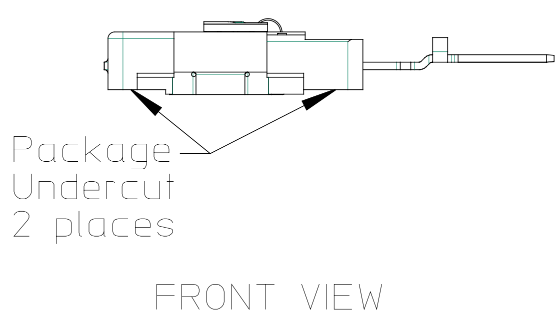


Figure 3b.

1.5 Cleaning

The surface of the LED chip array should not be exposed to dust and debris. Excessive dust and debris on the LED chip array may cause a decrease in optical output. As much as possible do not remove the units from shipping tubes until use.

In the event that the surface requires cleaning within the Keep-Out-Zone, a compressed gas duster at a distance of 6 inches away will be sufficient to remove the dust and debris or an air gun with 20 psi (at nozzle) from a distance of 6 inches. Make sure the parts are secured first.

One can also use a lint-free swab and optional isopropyl alcohol to gently swab the surface. Extra care should be taken not to disturb the two ribbon bonds and the white silicone coating around the LED chips. Ensure that the surface is free of large particles before swabbing to avoid damages to the surface.

1.6 Electrical Isolation

The heat slug of LUXEON Altilon is electrically isolated from the LED.

1.7 Mechanical 3-D

The 3-D igs and stp file formats are available upon request. Please contact your sales representatives.

1.8 Soldering

LUXEON Altilon is not designed to be soldered to a heat sink when mounting. Please refer to "Assembly Process Recommendation" section for proper procedure. Soldering is only permitted within the solder pads of LUXEON Altilon.

2. Thermal Management

2.1 Thermal Interface Material (TIM) Selection

Due to the low thermal resistance of the LUXEON Altilon assembly and its large thermal footprint (Figure 4), a wide variety of thermal interface materials can be used, including: grease, phase change materials, thermal epoxies, thermal tapes, etc. 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—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 your operating conditions.
5. Outgassing—Outgassing 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 (see "Assembly Process Recommendation" section for max screw torque).

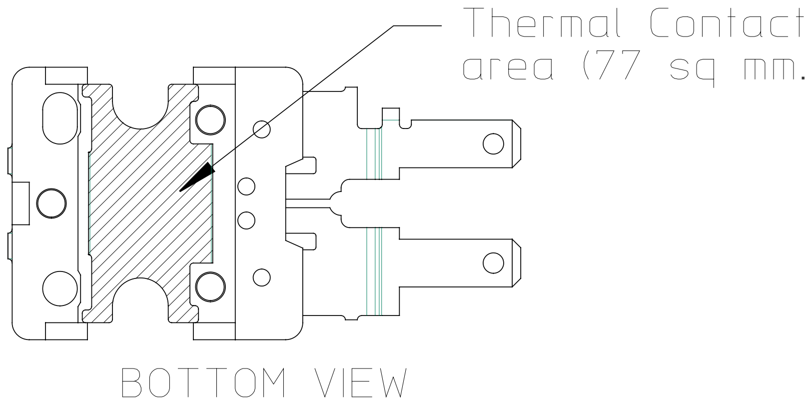


Figure 4.

Table 1 lists several TIMs that have been tested. Ultimately, a selected TIM should meet the criteria of the considerations noted above. Lumileds provides this data for informational purposes only, and does not warrant the use of, or performance of, listed TIMs.

Table 1. List of some TIMs.

MANUFACTURER	TIM
Artic Silver®	Artic Silver® #5 (epoxy)
Emerson & Cuming	Amicon CE 8500 (epoxy)
Wakefield Engineering	Type 120 series (grease)
Bergquist	Sil-Pad® series (pad)
FujiPoly	Sarcon® series (pad)

2.2 Temperature Probing and Characterization

The use of a temperature probe may be desirable to verify your overall system design model and expected thermal performance. The LUXEON Altilon datasheet specifies temperature performance based on case temperature (T_c) and not LED junction temperature. The ideal case temperature is the temperature at the center of the bottom of the heat slug (labeled as "thermal contact area") as shown in Figure 4.

For practical reasons, we recommend the following probe area as shown in Figure 5.

Using thermal simulation software, the temperature difference between the thermocouple (T_c) wire position as shown in Figure 5 and the center of the bottom of the heat slug is estimated to be about 2°C (Figure 6) when simulated at 1A, 85°C heat sink temperature. We recommend positioning the T_c wire as close as possible to the center of the heat slug via one of the two mounting screws shown in Figure 5.

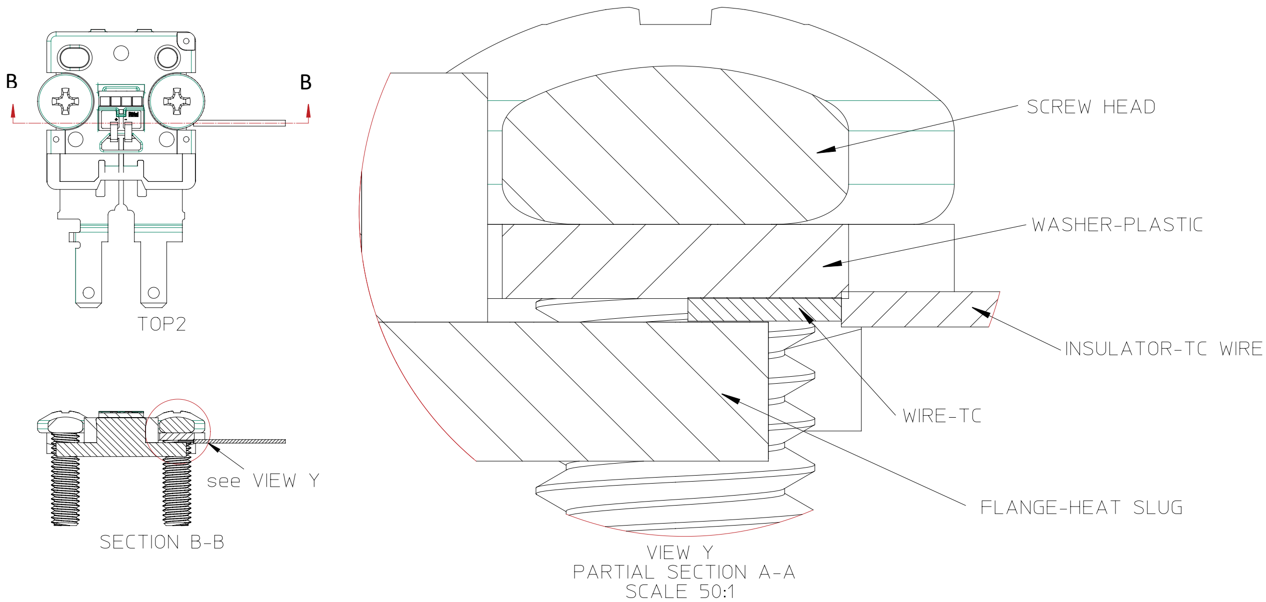


Figure 5.

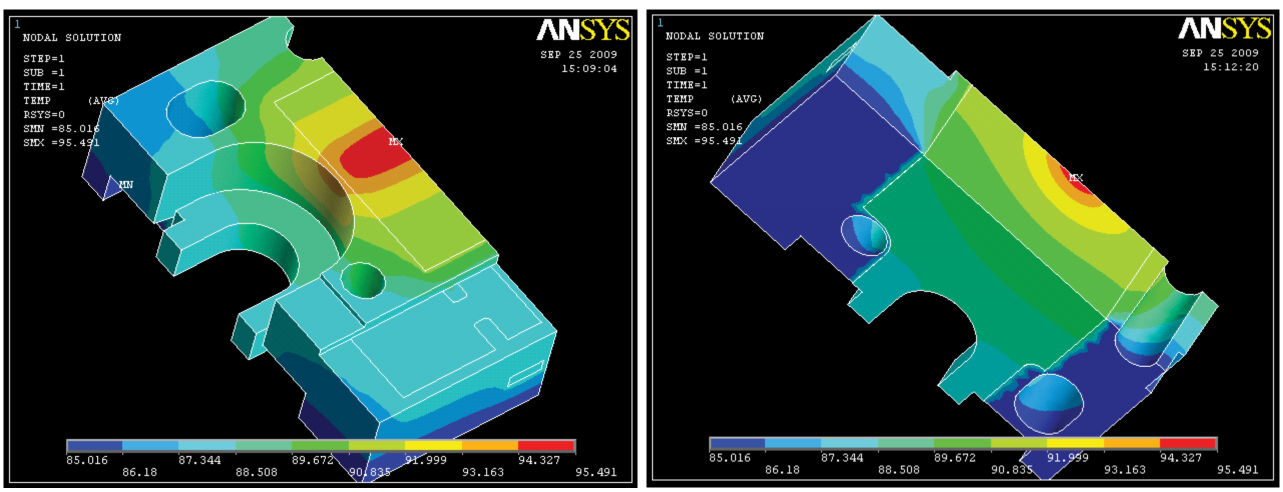


Figure 6. Thermal simulation (LAFL-C4x-0xxx, 1A, 85°C). Left diagram showing top and right diagram showing bottom of LUXEON Altilon (half model only, package symmetry).

3. Assembly Process Recommendation

3.1 Mounting

Once the TIM is applied, the LUXEON Altilon assembly is now ready to be placed onto the heat sink. As noted in Figure 7b, optional locating pins can be incorporated into the heat sink for module positioning. The locating hole and slot in the package are located relative to the LED die axis, x and y. When interfacing to the locating hole and slot with pins, the can be accurately positioned relative to remote optics, such as reflectors. A benefit of using pins is they prevent axial torque to the package when screwing down.

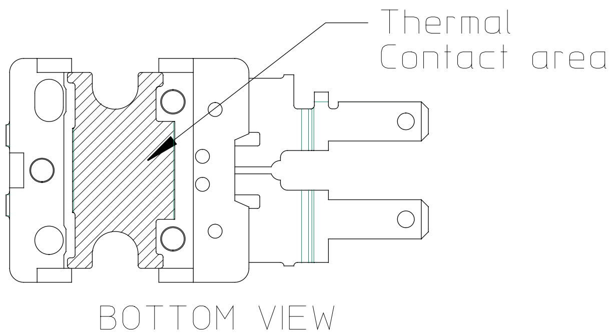


Figure 7a.

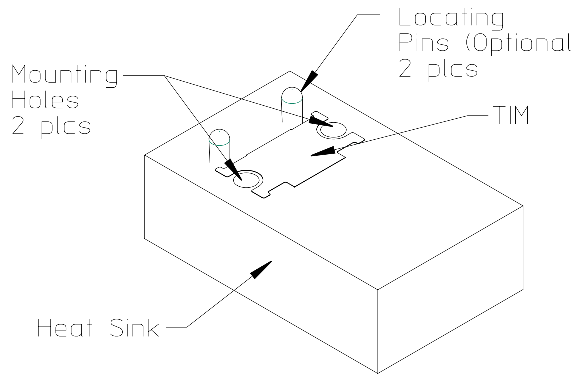


Figure 7b.

The LUXEON Altilon module assembly is designed to be screwed down with 3 mm Pan Head Screws in two places (Figure 8). Tighten each screw to 6-12N.cm [5-10 lb.in] of torque using a calibrated torque screw tool, which will translate into 113-191kg [250-420lbs] of downward force/screw. Caution: The surface here is gold and if bolted down with excessive force it can easily damage the heat slug. The use of Pan Head Screws will ensure the screws do not extend above the optical plane of the LED die and phosphor.

CAUTION: Excessive torque in an aluminum heat sink may cause stripping of the thread! To minimize the potential for thread stripping, a thread engagement of 6mm [0.236in] minimum is recommended.

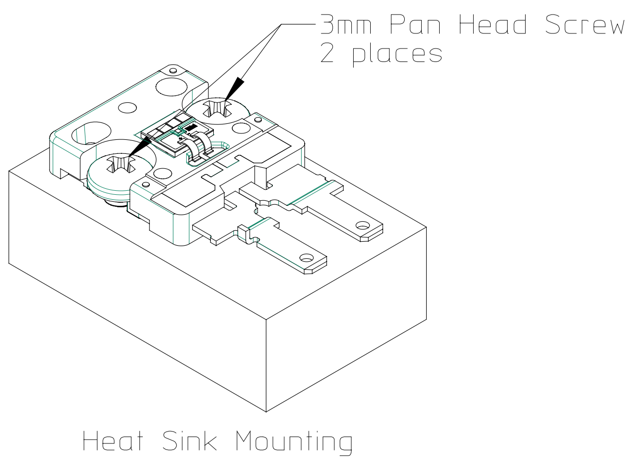


Figure 8.

3.2 Connector Assembly (Leaded Module Only)

Assembly of connectors, or individual spade lug terminals, should be performed with as little side-to-side and up and down motion as possible to avoid package damage. Spade lug terminals are readily available through several manufacturers and suppliers. The LUXEON Altilon package has two 0.110in wide spade lugs extending from the front of the package, except "S" type modules. These spade lugs are designed per Tyco industry standards to ensure mating to standard terminals.

Galvanic corrosion consideration needs to be evaluated when dissimilar metals are used when making physical connection.

Some standard, catalogue available terminals are shown in Table 2.

Table 2. Terminal Connectors.

MANUFACTURER P/N	MANUFACTURER	DESCRIPTION
640923-1	AMP/TYCO	PEDG receptacle 22-18 AWG, Faston Terminal, 0.110in
72F-110-20-P	3M	FML DISC 16-14, Insulated Terminal, 0.110in

A Monolithic connector (Figure 9) has been custom designed for the LUXEON Altilon, utilizing Positive Lock Terminals for maximum retention and is available through Tyco Electronics with P/N's as shown in Table 3.

Table 3. Connector Receptacles.

TYCO P/N	DESCRIPTION
1969227-1	Receptacle, Positive Lock, 110 Series
175411-5	Receptacle Contact, Positive Lock, 110 Series

During insertion or withdrawal of monolithic connector, the maximum amount of twist (torque in direction of the leads) should not be more than 0.45 N.m (4 lb.in) to avoid package damage. There is only one orientation for a monolithic connector to be inserted (Figure 10).

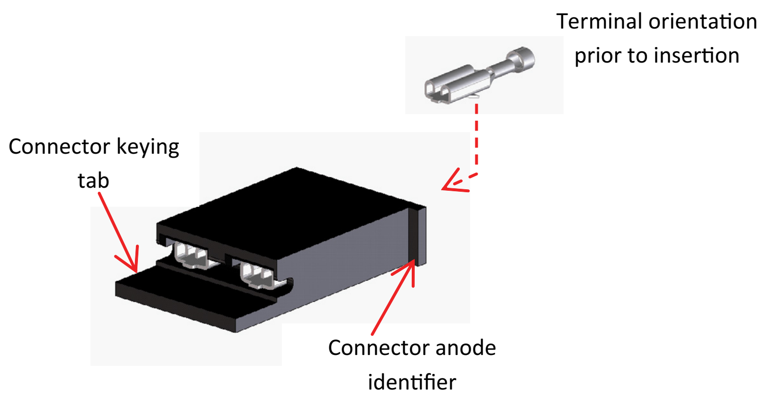


Figure 9. Connector insertion orientation.

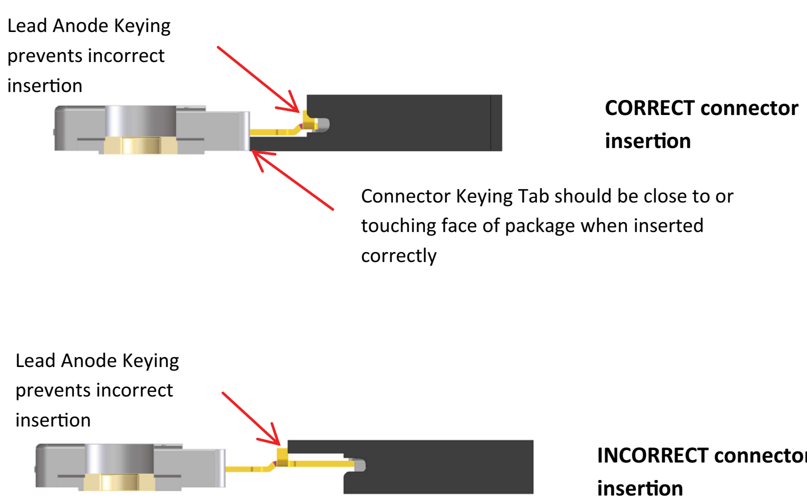


Figure 10. Connector insertion orientation.

3.3 Lead Bending (Leaded Module Only)

LUXEON Altilon has two 0.110in wide spade lugs extending from the front of the package, except "S" type modules. In bending or forming the leads, care should be taken to properly clamp the leads during the forming process to ensure the integrity of the package.

To facilitate an easy method to identify the anode lead, a bent tab was added to the anode lead. The bent tab also serves to prevent incorrect connector insertion. Also, the leads have a slight dog-leg (Figure 11c) kick up to facilitate clearance for a monolithic connector insertion when the package is mounted to a heat sink (Figure 11a). Figure 11b is a close up view of the anode identifying bent tab.

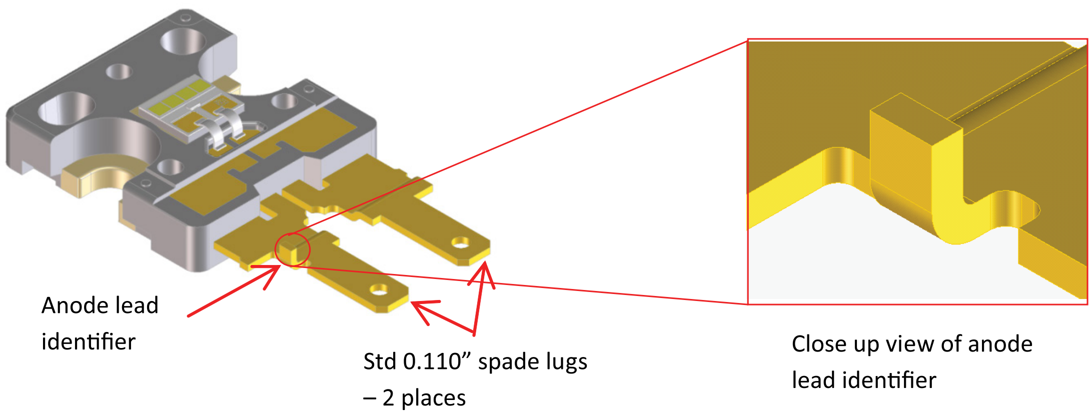


Figure 11a.

Figure 11b.

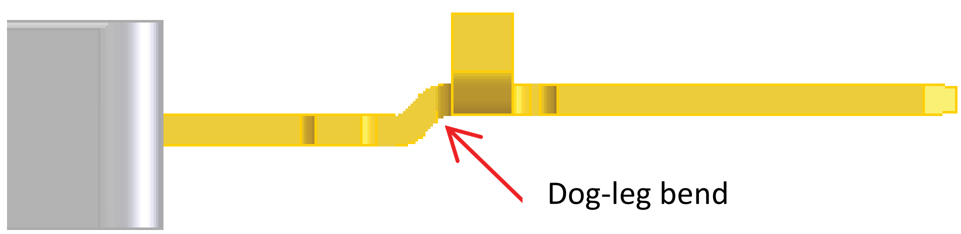


Figure 11c.

The leads are made of tin brass, which is a popular material for connector leads and tabs, having good bending qualities. Any tooling used to form the leads must provide clearance for the anode tab. Care must be taken to ensure the dog-leg bend is not disturbed, as re-bending may work harden the metal bend and make it fragile. Bends up to 45° are easily facilitated with this lead configuration. The tooling is simple and can open straight up or down as needed. Bends >45° present a greater challenge from a tooling perspective as the parts must necessarily be ejected from the tool sideways.

An example of a lead bending tool for 0–45° can be seen in Figure 12.

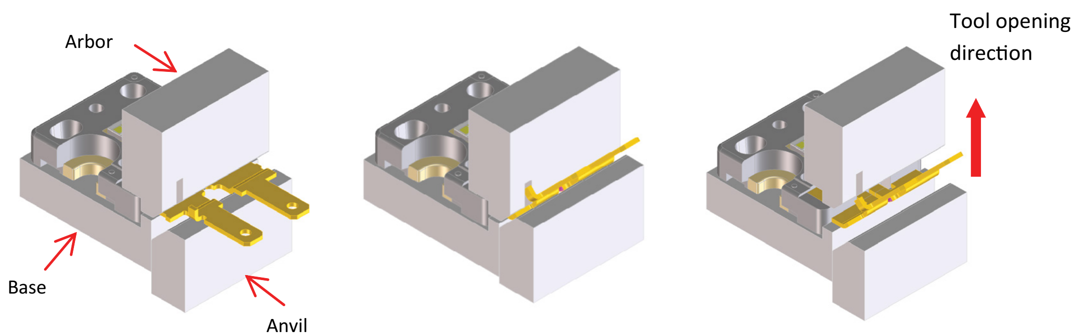


Figure 12. LUXEON Altilon in bending tool.

For bends >45°, special considerations need to be made to accommodate bending and extraction of the parts from the tool, as shown in Figure 13 below.

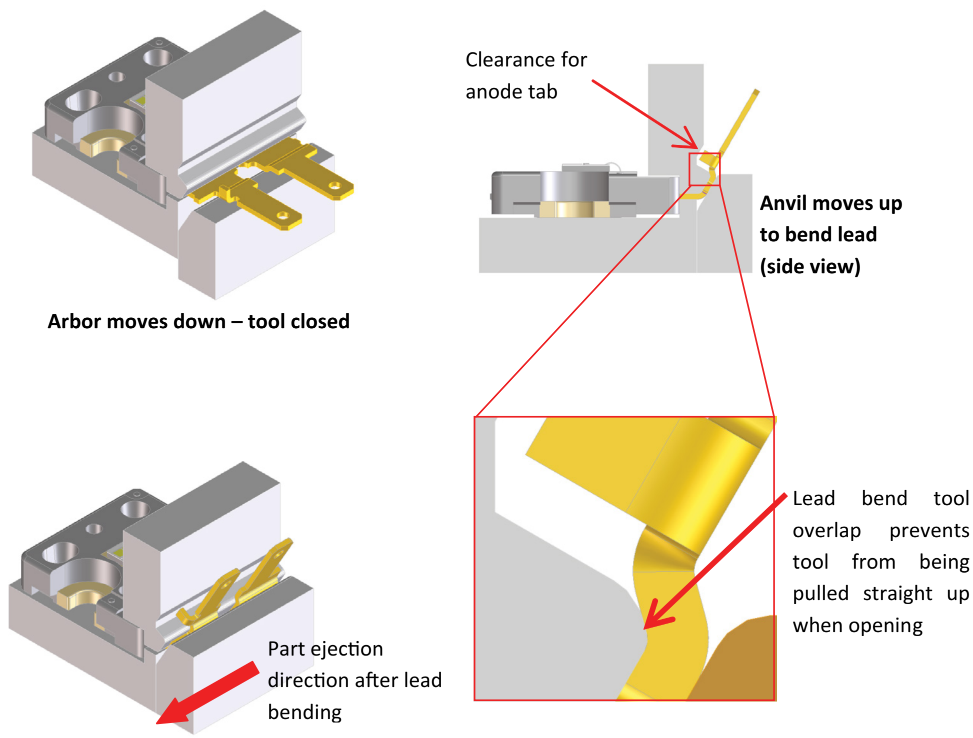


Figure 13. Lead bending process for angle greater than 45°.

3.4 Soldering (Solder Module Only)

The solder pads must be kept clean to ensure good wetting action during soldering.

The maximum allowable solder pad temperature is 270°C for not more than 30 seconds. Any higher temperature for a longer period time may deform the black plastic body.

To achieve good wetting, the solder tip or hot bar temperature setting is determined by several factors such as overall thermal mass (e.g. flexboard and solder), power rating, and thermal contact resistance (geometry and pressure). This temperature may be higher than the maximum solder pad temperature.

Some examples of electrical connections are via flexboards and wires. Employing automated hot bar soldering process helps to minimize process variation.

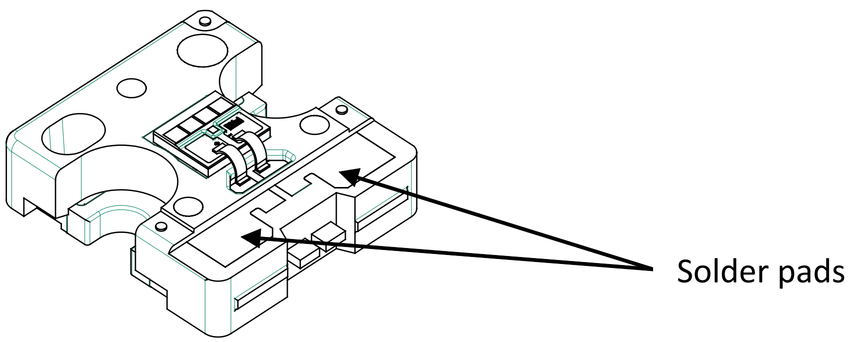


Figure 14.

4. Packaging Considerations—Chemical Compatibility

The LUXEON Altilon package contains silicone layers 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 layers in LUXEON Altilon are gas permeable. Consequently, oxygen and volatile organic compound (VOC) gas molecules can diffuse into the silicone layers. 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. Oils are often used for machining parts, such as heatsinks, and need to be thoroughly removed prior to mounting the LUXEON Altilon package.

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 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 layer. Under heat and "blue" light, the VOCs inside the silicone layer 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).

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 Altilon LEDs. However, some of these chemicals may be used in intermediate manufacturing steps (e.g. cleaning agents, metal cutting oil/cooling fluid, Thermal Interphase Materials).

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 may damage the silicone overcoat of LUXEON Altilon.

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
Tetracholorometane	solvent
Mineral oils	oil
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

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