Illumitex LED

Surexi and Aduro-C LED Installation and Thermal Guide

The Most Optically Advanced LEDs on the Planet
Maximum Delivered Lumens and PPF per Watt and Unsurpassed Light Quality

The Surexi and Aduro-C family of products provides light control to deliver intense and uniform light on the targeted surface without the use of additional optical elements. The fundamental package design is made to be fastener mounted to the user's heat sink/housing assembly and electrically connected using field-attached soldered wires or other suitable connection means. The Surexi and Aduro-C package is designed for:

- Enhanced thermal performance
- Square beam patterns
- Elimination of all costs and processes associated with secondary optics
- Optical beam Control
- More light on target
- Reduced glare
- Reduced energy consumption

This guide is intended to help with Surexi and Aduro-C installation in luminaires using hand soldering techniques.

Specifically, this guide is intended to help you:
- Solder to the LED package
- Mount the LED package
- Understand the thermal issues
- Maximize voltage withstand values of the assembled luminaire

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TABLE OF CONTENTS

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Product Handling

The Surexi and Aduro-C package is a robust structure using a heavy gauge (1.5mm) metal-core substrate with bonded housing and optic elements. The package will readily withstand normal handling by humans or machines. Care should be taken to keep the electrical and thermal contact surfaces clean and free of oils and other chemicals.

When picking up the devices, they should be handled by grasping the edges of the substrate or the sides of the white housing. **Do not** pick up or place the devices by the lens surfaces. The lens surfaces may be scratched if touched with hard materials such as tweezers or vacuum pick-up tools. Additionally, some of the product models have structured surfaces on the lenses that may be damaged by hard implements.

Recommended Materials and Methods:

- Recommended minimum soldering iron power is 60 Watts.
  - Always use clean freshly tinned tips for optimum heat transfer to the solder joint.
  - Warning: Excessive heat will damage the solder pad and cause it to lift off of the LED substrate.
  - Warning: Touching the lens housing or the lens with a hot soldering iron will melt the housing and the lens.
- Recommended wire is 28 gage, 200C, 250V.
  - Strip wire so that a minimum of bare wire extends beyond the solder joint area.
  - Warning: If bare wire touches the mounting screw or the board edge, the LED will short to ground.
- The following types of solder have been used successfully to solder to all Surexi and Aduro-C parts.
  - Sn60Pb40, 0.025” dia, rosin core flux.
  - Sn99.3Cu0.7, .032” dia, rosin core flux.
  - If an externally applied flux is used, such as a brush-on paste, the LED assembly must be cleaned before installation. Failures to clean off excess flux will result in very low voltage withstand values.

- For best results, solder the LEDs on thermally nonconductive fixtures (such as wood) and transfer the LED strings to the luminaire heatsink after soldering.
- For best results, the exposed metal should be potted after installation. This will improve the voltage withstand rating of the fixture and will also enhance the thermal behavior of the fixture.

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Application

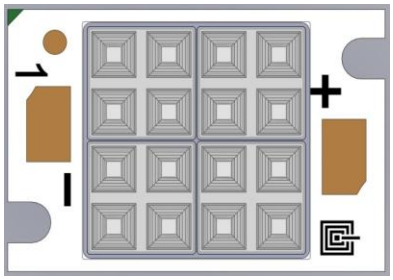
The Surexi and Aduro-C package can be hand or machine soldered using
- soldering tool
- hot plate
- hot bar soldering tool

The Surexi and Aduro-C package should NOT be soldered using
- in-line or batch oven
- hot air reflow station

The heat source can be applied to either the top side (i.e. anode and cathode pads) or the backside (aluminum base of the metal core board). The maximum temperature allowed for the heat source is 260°C and the maximum time that the board can be exposed to this temperature source is 90 seconds.
Lead-free soldering materials are recommended. Any residual fluxes should be removed after soldering. If the package will be exposed to the environment in its final installation, it is recommended to over-coat the solder connections and electrical pads with a suitable insulating material.

The base of the package is NOT electrically connected to the LEDs. Accordingly, it may be mounted to a grounded structure if desired.

Top View



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Hand Soldering Instructions

Choose solder tip size according to pad size to insure the quickest installation process, minimizing possible damage to LED die. For larger pad sizes use a 'chisel' type tip.

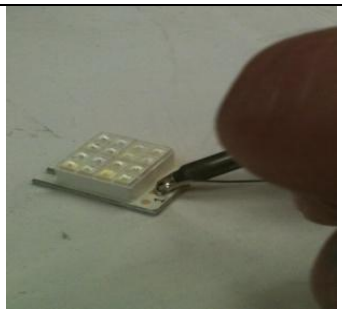
Smaller pad sizes may use a smaller tip size.

Chisel types are acceptable for either applications, but be cautious of rapid heat transfer to small pads as damage may occur.

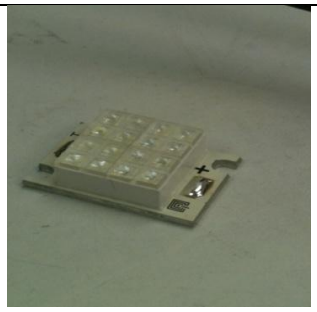
The following are steps to properly install a wire/lead onto an LED pad. (Before completing each step below, insure a clean and freshly tinned solder iron tip.)

1. Tin the LED pads:

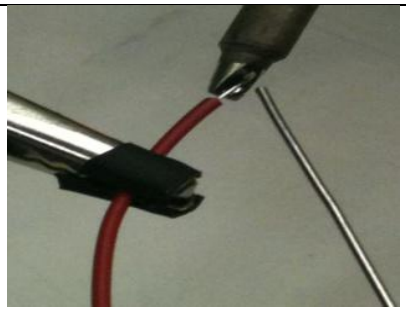
Place solder iron tip on pad to apply heat.



2. After approximately 5-8 seconds for the larger pads (3-5 seconds for the smaller pads) begin to apply solder onto the solder iron tip and pad junction.



3. Solder will wet evenly onto pad when heated sufficiently.



4. Tin the lead/wire: Heat the wire/lead with solder iron tip. After approx. 3 seconds apply solder to the wire/lead and solder iron junction, moving the solder and solder iron tip across the length of the exposed wire. Move evenly until the wire is completely tinned.

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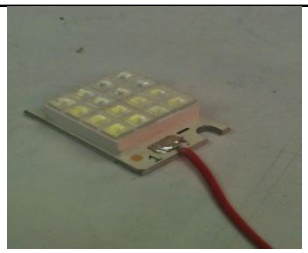

5. Installing wire onto pad:

Apply heat to pad, as the solder begins to melt, insert tinned wire into desired position. Bond is complete when the solder from the wire has melted together with the pad solder. Remove heat and hold wire into place until solder hardens.

6. Repeat these steps to complete installation process.

Tips:

- After the soldering of one side is complete, quickly continue the installation process on the opposite end. Installation time will be reduced due to the heat transfer of completed pad. CAUTION, LED will be very hot after wires are installed. Allow sufficient time to cool before handling.
- Remember to isolate the LED from any heat conductor prior to tinning or wire installation. If the LED rests on a thermally conductive material, heat will not transfer to pads efficiently, potentially causing damage to LED.
- If, LED must be positioned onto final assembly fixture during install, place a temporarily non-conductive material (i.e., a piece of thick paper or cardboard) underneath to isolate the transfer of heat to the conductor during the soldering operation.

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Product Mounting

The Surexi and Aduro-C products are mounted by means of two M2 fasteners. Fasteners must be chosen with head sizes not greater than 4.0 mm diameter. Each device should be mounted to a suitable heat sink capable of dissipating the steady-state power consumption of the device (up to 8.4 watts max per package). Thermally conductive materials should be applied between the base of the device and the heat sink to provide best thermal performance. A number of materials may be used for this.

Types of thermal interface materials that may be used:
- Thermal grease
- Thermal films/pads
- Thermal phase-change materials

The Surexi and Aduro-C products are not electrically connected to the base material. Any thermal compound may be used.

Electrical insulation is not a requirement. It is suggested that thermal interface materials have thermal impedance (R_{if}) values (as installed) of less than 0.5 °C-in^2/W. With normal package mounting using two screws, package contact pressures will be greater than 344 KP (50 PSI).

Thermal materials should be chosen to provide a substantially flat interface. Care must be taken to prevent distortion/bending of the substrate base metal during tightening of the fasteners. If a thin thermal material is used (e.g. grease or film less than 125 um (.005")), there is little concern. For thicker films, care must be taken to tighten the fasteners evenly and to correct torque levels to prevent bending of the substrate.

The Surexi and Aduro-C package is designed for mounting on a heat sink with two M2 screws. The recommended head diameter for these screws is 3.8 mm to 4.0 mm. The dimensions of the bolt hole pattern are shown in the figure below:

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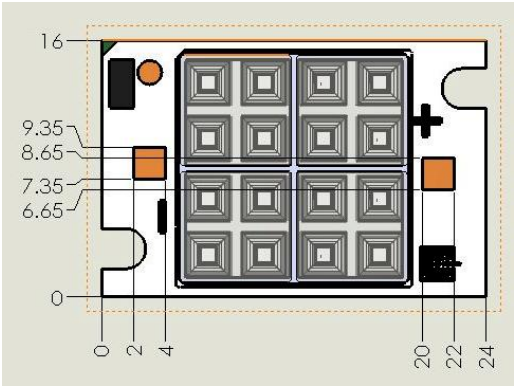
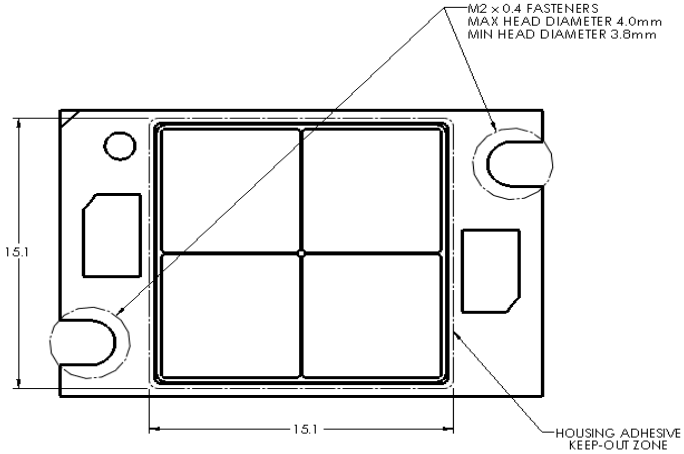
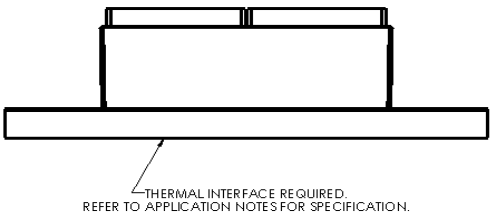
Product Mounting (continued)

(All dimensions in mm)







The housing mounting adhesive may squeeze out from the housing onto the MCPCB. This, if observed, is normal. The keep out zone that allows for adhesive squeeze out is specified on the drawings above.

Package Thermal Performance

The Surexi and Aduro-C line has a thermal resistance of 2°C/W from the junction of the LED die to the metal base of the substrate (R_{jb}). This means that for every watt of power passed through the device, the junction temperature will increase by 2 °C over the temperature of the base metal.

For a typical Surexi and Aduro-C, the nominal power at 500mA drive current and 10 Volts = 10 watts.

Amperes x Volts = Watts
0.5 X 110 = 5 Watts.

The increase in temperature of the junction is calculated as:

Watts x R_{jb} = temperature rise.
5 X 2.0 = 10 °C temperature rise over base.

The maximum allowed junction temperature of the Surexi and Aduro-C (T_j) from the specification sheet is 115°C.

Thus the maximum allowed package base temperature is calculated as:

$T_b Max = T_j Max – 10$
$T_b Max = 115\text{-}10 = 105°C$

Some of the Surexi and Aduro-C packages provide a pad for attachment of a thermocouple/thermistor for monitoring package base temperature. The temperature that is indicated by this method will be somewhat lower than the actual package base temperature at the hottest locations. This is unavoidable in design. To prevent overheating of the package, as a guideline, estimate of the package base temperature should be at least 2°C above the temperature indicated by this method.

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Complete assembly thermal performance

In the final customer configuration, a number of elements determine the final operating temperature of the device. The following is a partial list of contributing factors.

1. Device internal thermal impedance (from the data sheet)
2. Performance of the thermal coupling material
3. Heat spreading of the heat sink
4. Air circulation around the product
5. Thermal loads from other sources (e.g. direct sunlight, electric motors, other lights)
6. Ambient temperature
7. Heat from drive electronics

A good guideline is to mount the LED to a heat sink that is far enough from other heat sources to prevent significant temperature rise from those sources. For example, mount drive electronics separately from the LED.

Evaluation of the performance of the entire assembly is beyond the scope of this document because there are so many variables.

A good starting point is to make some assumptions about the environment the device is operating in and work through an example for a device mounted to a heat sink.

Our starting assumption is that the device is mounted to a heat sink using a thermal attachment material having a thermal impedance of 0.25°C-in^2/W. It is assumed that the ambient air temperature is 25°C (T_a), still air and that the heat sink designed for a temperature rise of 3°C per watt (RHS) when mounted in still air (natural convection). Our Surexi and Aduro-C package size is 16mm x 24mm.

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Complete assembly thermal performance (continued)

The total thermal resistance path looks like this:

Heat sink resistance + Thermal material resistance + Device package resistance

We will assume that the device power use is 7.3 watts. The total temperature rise will then be:

[heat sink resistance X power] + [thermal material resistance X power /contact area] + [package resistance X power]

[3 X 7.3] + [0.25 X 7.3/{(16 X 24)/ (25.4 X 25.4)}] + [2 X 7.3] = temperature rise
[21.9] +[3.06] + [14.6] = 39.56 °C

Finally, we calculate the device junction temperature to be sure that is below the maximum rating.

T JUNCTION = TAMBIENT + TRISE
T JUNCTION = 25 + 39.56 = 64.56 °C

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Voltage Withstand Testing

IEC60598-1 Section 10 requires electric strength or voltage withstand testing at the luminaire level. Table 10.2 details test levels *a*, *b*, *c*, and *d* for a number of different types of luminaires and insulations. The Surexi and Aduro-C parts should pass at level *a* (500 V) as long as the parts are clean after installation into the luminaire. If there is a residual flux on the soldermask or any other ionic contaminant, the parts will fail the test due to leakage currents through these ionic contaminants.

Passing at levels *b* and *c* (2U + 1000 V) requires potting or otherwise insulating the exposed metal of the LED after wires are soldered in place. The part will also need to be free from ionic contaminants and attention should be paid to wire routing so that wires are not too close to sharp grounded edges such as the edge of the board or the mounting screw.

Passing at level *d* (4U + 2000 V) is beyond the design intent of the Surexi and Aduro-C product.

Safety

Hand soldering LEDs involves operator exposure to high temperatures, molten metals, and vapors. Follow your company's safety guidelines for hot work.

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1. Details in this document are subject to change at the discretion of Illumitex at any time.

2. Typical and max ratings are shown as reference only. Illumitex will inform customers of both typical and max ratings at the time of inquiry.

3. For quotes of product outlined in this data sheets or any other inquires, please contact sales@illumitex.com

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