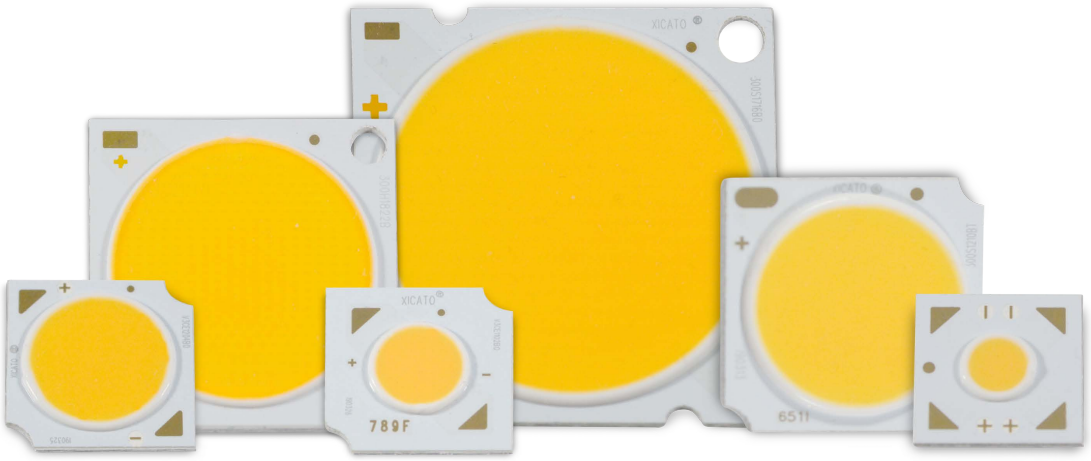
XOB Application Note

HANDLING AND ASSEMBLY GUIDE



Xicato designs and delivers one of the broadest portfolio spot and linear light sources and electronics that enable architects, designers and building managers to create beautiful, smart spaces in which people love to live and work. With thousands of installations around the globe, Xicato continues to be a leading supplier of high quality lighting solutions. Xicato is defining the future of intelligent light sources by integrating electronics, software and connectivity. Founded in 2007, Xicato's headquarters is based in Silicon Valley and the company has offices in China, Europe and the US.

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INTRODUCTION

The purpose of this application note is to provide general guidance on assembling Xicato XOB LED arrays into luminaire assemblies. This document presents several methods for mechanical, thermal, and electrical connections within a luminaire.

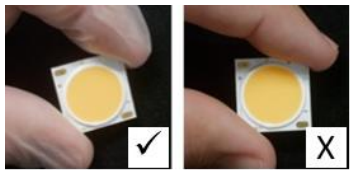
HANDLING THE XOB

Removal From Tray

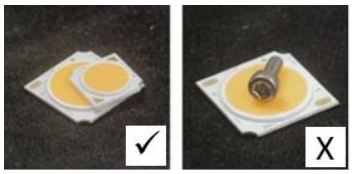
The packaging for XOB arrays is designed to be stackable without contacting and applying pressure to the top surface of the LED. Packaging trays should be opened on a flat surface inside a clean environment to minimize risk of contaminates adhering to the sensitive top surface of the XOBs.

General Handling

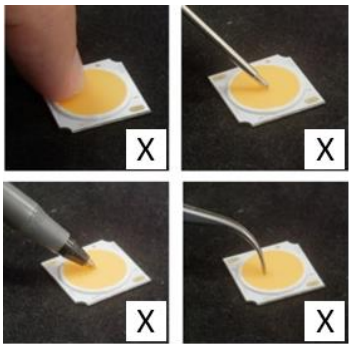
It is important to hold the edges of the PCB when manually handling the XOB. Avoid touching the phosphor coating on top of the LED array. The light emitting surface (LES) and white dam area are sensitive to scratches, contamination, and debris which may decrease module performance. If any dust or debris accumulates on the phosphor coating, clean the surface by blowing on it with clean air or gently wipe the surface clean with isopropyl alcohol.



Use of clean lint-free antistatic gloves is strongly recommended to prevent dirt and other debris from adhering to the phosphor area. Avoid handling the XOB with bare fingers.



Do not stack XOBs on top of each other or allow objects to rest on top of the LES.



Do not apply pressure on the LES or white dam area with your finger or any sharp object. Any rubbing, stress on, or pressure to these sensitive areas may negatively affect the performance and reliability of the XOB.

ELECTRICAL CONNECTIONS

Gold plated contacts for soldering or spring finger contact connection are provided on XOB arrays for power delivery.

Soldering

When soldering wire leads to contact pads, Xicato recommends using Alpha HF-850 no-clean solder wire and a temperature-controlled soldering iron such as a Metcal MX Series soldering system with an STTC-117 chisel tip. Since there is variability in available solder alloys and solder guns/irons, Xicato cannot make a specific soldering recommendation; therefore, the following general processes should be practiced.

1. Uniformly cover contact pad with solder.

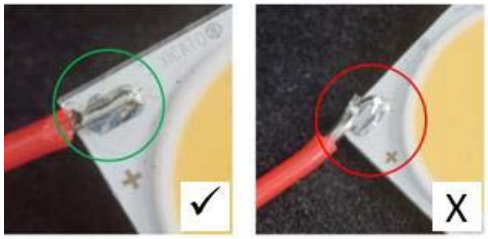
2. Solder tin wires prior to soldering them to XOB contacts. Angle of soldered wire with respect to the XOB board should be greater than 10°. Soldering duration should be no longer than 5 seconds per connection.

3. Strain relief wires soldered to XOB to further protect solder joints and allow XOB to return to room temperature prior to handling.

The quality of the solder joint should comply with the following standards governing wire soldering:

IPC J-STD-001	Requirements for Soldered Electrical and Electronic Assemblies
IPC/EIA J-STD-002	Solderability Tests for Component Leads, Terminals and Wires
J-STD-004	Requirements for Soldering Fluxes

Appearance of Soldering Lead Wire



Wires should not protrude beyond solder pads to minimize the potential to damage the LES or create a short around the PCB.

Excessive solder flux should be cleaned with IPA.

Caution

- Damage to the gold contact pads on the XOB or to wire insulation can occur when exposed to excessive heat for an extended period of time. Reworking of solder should be avoided if possible, as repetitive soldering can cause long term degradation caused by solder flux building up around the solder pads.
- Be mindful of the XOB LES while soldering. Damage to LES can occur if hot solder or soldering iron makes contact with surface.
- An electrical short can occur if wire lead insulation is not trimmed properly. Ensure wire insulation is trimmed such that bare wire does not contact edge of PCB.

Electrical Connection to LED Driver

LED modules are susceptible to failure from electrical over stress. The failure results in a module that is either electrically open or shorted. In both cases, the result will commonly be complete catastrophic failure (no light). A common source of this stress is "hot plugging" an LED module into a driver or power supply while the power source or driver is energized. This leads to brief, but powerful current spikes. These current spikes that often take place in less than a millisecond can result in a non-operative module in as little as one over stress event.

Constant current LED drivers and adjustable bench top power supplies are commonly utilized for powering XOB arrays during factory test and field installation. Constant current sources are typically designed to have the LED array connected prior to applying power to constant current source. In many cases, connecting an XOB to a constant current source after the source has been powered on will result in an over current condition.

The only safe method of connecting an XOB to a constant current source is to:

1. Turn off the constant current output of the power source. With a bench top power supply, this is generally accomplished by pushing a button. With an LED driver, the AC mains will need to be unplugged or disconnected and the operator/installer will need to wait as much as 60 seconds for the driver to discharge its internal capacitors. Please follow your LED driver manufacturer's recommendations for the duration of this waiting period.
2. Attach the XOB to the constant current output of the power source.
3. Turn on the power source.

Powering Multiple XOBs

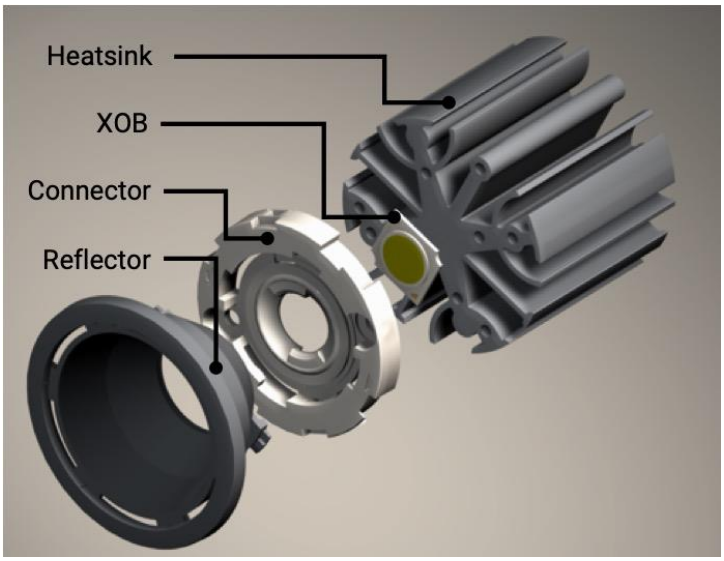
When two or more XOBs are present in a circuit, Xicato does not recommend connecting modules in parallel due to forward voltage (VF) variations from one module to another. While XOBs with closely matched forward voltages should behave similarly, VF differences between modules in parallel may cause XOBs to exhibit noticeable intensity differences and result in unequal performance. Connecting modules in series is recommended as long as the driver provides the appropriate voltage range and power to operate all modules in the circuit.

MECHANICAL ASSEMBLY

Typical Assembly

XOBs are typically attached to a heatsink and separate wires are used to deliver electrical power to the XOB. Wires can be directly soldered to the XOB or attached through a mechanical holder.

Thermal Considerations



The performance and life expectancy of Xicato light sources are directly attributed to how well the LEDs and phosphors are thermally managed. When LED and phosphor temperatures rise beyond their designed temperature limit, XOB lifespan decreases and the color properties and luminous flux of the light may shift. Therefore, effective cooling is essential in luminaires designed to accommodate XOBs lifespan decreases and the color properties and luminous flux of the light may shift. Therefore, effective cooling is essential in luminaires designed to accommodate XOBs.

Xicato correlates the performance of its light sources to the case temperature (TC), which must remain below 90°C at steady state under all conditions. There are countless luminaire design parameters that can affect module thermal performance. Examples include:

- Heatsink size, material, coating, & fin structure
- Housing material and mechanical interfaces (TIM)
- Luminaire style (track, recessed, pendant, etc.)
- Air flow conditions (ambient air temperature, forced or natural convection, venting ability, etc.)

It is the responsibility of the luminaire designer to understand the parameters above and use appropriate cooling solutions that will effectively limit the module case temperature to below 90°C in free air.

Heatsinks

Heatsinks should be sized based on the drive current of the XOB and on the conditions in which the luminaire is installed. Any heatsink or housing solution is acceptable as long as the XOB case temperature (TC) does not exceed the maximum published temperature limit (typically 90°C) in the installed environment. For effective thermal management, Xicato recommends that the heatsink have a surface flatness ≤ 0.1mm and no holes, recesses, burrs, or flashes present.

Thermal Interface Material

When mounting an XOB onto a heatsink, thermal interface material (TIM) must be inserted between the heatsink and XOB to fill any voids between the two surfaces. TIM comes in a variety of materials and forms (adhesives, compounds, gap pad fillers, gels, and phase change materials); each have their own advantages and drawbacks. Some adhesives are good thermal conductors but do not offer reworkability. Thermal grease or compounds have good reworkability but applying the compound can create a messy environment. It is important to understand how all the characteristics of the TIM work together to decide which is most important for each specific application. Regardless of which TIM is chosen for the XOB assembly, the interface material should be applied as uniformly as possible across the entire contact surface of the XOB.

Refer to the table below for some brands of thermally conductive gap pads and adhesives.

Manufacturer	TIM Type	Part Number
Dexerials	Gap Filler Sheet	UX3002D
Fujipoly	Gap Filler Pad	SARCON® GR454-00-50GY SARCON® GR80A-08H-50GY
	Thermal Silicon Compound	SARCON® SPG-30B
3M	Gap Pad Sheet	5590H
ThreeBond Co.	Thermal Adhesive	2955 Series

Attachment Using Fasteners

All XOBs, with exception of the XOB04 family, can be mounted directly to the heatsink using M3 screws.

Using a calibrated torque driver, torque fasteners to 5.3in·lbs (0.6N·m). Take caution not to exceed these values as this may damage the XOB. Xicato recommends using a spring lock washer with a flat washer to reduce the likelihood that the fasteners will loosen under shock, vibration, or thermal cycling.

Connectors

To simplify integration of secondary optics, XOBs can be used in conjunction with holders or connectors to align the LES with the optic and provide appropriate clamping force to the XOB.

The table below shows model numbers for compatible connectors available from 3rd party manufacturers. Xicato recommends following the manufacturer's recommendations for both the amount of torque to apply to the connector and the TIM thickness.

XOB	CONNECTOR MODEL NUMBER		
	LEDiL	BJB	Bender + Wirth
XOB04	F15956_HEKLA-SOCKET-J F15957_HEKLA-J	47.319.6060.50 47.319.6295.50 47.360.1020.50 47.319.6294.50	434
XOB06			
XOB09	F15255+HEKLA-SOCKET-C FP15501_HEKLA-C	47.319.6060.50 47.319.6295.50 47.360.1020.50	
XOB14	F15859_HEKLA-SOCKET-I FP15949_HEKLA-I C16791_CLAMP-Z45-A C112691_LENA-STD-BASE-CLL030	47.319.2023.50 47.319.2021.50 47.319.2026.50 47.319.6024.50 47.319.2025.50 47.360.1010.50	433
XOB23	C112691_LENA-STD-BASE-CLL040	47.319.2314.50 47.319.2315 47.319.2033	431
XOB32		47.319.4160	458

CHEMICAL SAFETY

The following chemicals should be avoided, even in small quantities, with the XOB:

Hydrochloric Acid
Sulfuric Acid
Nitric Acid
Acetic Acid
Sodium Hydroxide
Potassium Hydroxide
Ammonia
Sulfur (Used in Rubber Processing)
MEK (Methyl Ethyl Ketone)
MIBK (Methyl Isobutyl Ketone)
Toluene
Xylene
Benzene
Gasoline
Mineral Spirits
Tetracholoromethane (Carbon tetrachloride – CCl4)
Dichloromethane
Rosin Flux Solder
Castor Oil
Lard Oil
Linseed Oil
Petroleum Oil
Silicone Oil
Halogenated Hydrocarbons (Containing F, Cl, or Br

T_c MEASUREMENT

Each XOB array has a T_C measurement location where a thermocouple can be attached in order to verify that the XOB is running below its maximum design temperature limit.

The thermocouple bead must make direct, reliable contact with the surface of the XOB; otherwise, unknown thermal impedance between the surface and the thermocouple appears. This could result in lower temperature readings. It is the responsibility of the test engineer or test party to ensure the thermocouple bead is properly attached to the T_C point. Xicato recommends attaching the thermocouple using the following method accepted by UL1598-2008, Section 19.7.4, Rev January 11, 2010. 1.

1. Verify that the intended T_C location on the XOB is clean, dry, and free from debris. Any debris between the surface and the thermocouple bead may add thermal resistance to the test and could deliver erroneous results.

2. Apply cyanoacrylate adhesive sparingly to the surface of the thermocouple bead. Press surface of bead to the T_C location immediately. Hold in place until bond sets per manufacturer's instructions. Do not reposition.

3. In a separate mixing container, add recommended ratio of two-part thermally conductive adhesive and blend per adhesive manufacturer's instructions. Avoid high mixing speeds which could entrap excessive amounts of air or cause overheating of the mixture resulting in reduced working life.

4. Apply the adhesive around the surfaces of the bonded thermocouple bead such that the bead is fully contained within the adhesive. Let the adhesive fully cure per the manufacturer's instructions. If possible, stress relief the thermocouple wire to further protect the joint.

5. Xicato recommends inspecting the T_C joint between thermal tests to ensure it is still attached properly.

> ⚠ Quick-drying adhesives or cyanoacrylate adhesive, popularly known as superglue, should not be used in any luminaire design or for long term testing. These adhesives are known to be destructive to LED components over time.

Luminaire Case Temperature Measurement

After the thermocouple is properly attached at the XOB's T_C location, the XOB can then be installed into the luminaire. For best results, the luminaire should be installed in its intended environment or in an environment which will result in the highest recorded temperature. Use tape or adhesive to strain relief the thermocouple. When securing the thermocouple, it is important that the thermocouple does not get in the optical path of the light emitted from the XOB.

Turn on the luminaire and allow the assembly to reach thermal equilibrium which may take several hours, depending on the design of the luminaire. After thermal equilibrium is achieved, record both the ambient temperature of the environment and XOB case temperature. There is no need to calculate for T_J inside the XOB LED package; All XOBs are designed to perform to a maximum published T_C limit.