

Application Note – Designing for Wet Locations

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The purpose of this document is to provide customers more detailed information about designing Xicato modules into luminaires intended for wet location installation, and Ingress Protection (IP) ratings based on the International Electrotechnical Commission (IEC) 60529 standard. IP ratings have global application for outdoor lighting luminaires. Global acceptance of IP rated luminaires ensures straightforward communication of enclosure ratings, facilitating specification on a worldwide scale.

Component vs. Luminaire IP Rating

The IEC defines the standard for an IP rating. Enclosures for most consumer products or lighting components such as LED modules, drivers, cell phones, cameras, watches, etc. are tested and rated following IEC 60529 standards. Under these standards, tests are conducted under normal steady state operating conditions. Test durations range from 3 to 30 minutes depending on the IP rating.

The IEC has defined IP ratings of complete luminaires under IEC 60598 standards. Under these standards, testing conditions are tailored specifically to the technical characteristics of luminaires. In general this means testing is conducted for longer durations and conducted during non-steady state operations. In addition to water testing, a 48 hour humidity test is also conducted.

IEC 60598 requires that the luminaire reach full steady state temperature before tests begin. During the tests, AC power must be disconnected from the luminaire allowing the enclosure and internal air to cool as the test continues. The IEC's intent is to determine if the luminaire enclosure sucks in moisture or dust as the pressure drops inside the luminaire due to cooling, or if gaps in the enclosure appear as materials expand and contract with temperature.

IP Rating Code Definition

The code specifies protection against the ingress of liquids or particulate into the luminaires. The IP rating is defined by two digits. The first digit classifies the object / particulate ingress protection and the second digit defines the water ingress protection.

Xicato Module IP rating

XIM, XTM and XCA modules are IP20 rated. IP20 is protected against fingers or similar objects. XSM and XLM modules offer an IP66 rating. IP66 is dust tight and protected against powerful water jets. These LED module IP ratings conform to IEC 60529 standards, however when utilizing any of these modules, the luminaire still has to go through IP rating certification per IEC60598. The tests will assess the protection of the luminaire against ingress of solid bodies and/or liquids, varying over differing degrees of protection, depending upon the

requirements and criteria of the final product. Test labs and certification bodies can verify applicable requirements and conditions. Therefore, regardless of the IP ratings of the internal components, all luminaires must be IP rated per IEC 60598 for their intended environments.

Since the Xicato Module is not a luminaire it is not tested or rated based on IEC 60598. The module is not tested under heating and cooling cycles as required by IEC 60598. Additionally, Xicato modules are not designed for long term exposure to moisture. Long term exposure to water or moisture may corrode materials resulting in leakage of moisture into the internal electronics.

Xicato's Reliability & Environmental Testing

One of Xicato's core values is to perform rigorous reliability and environmental testing on all products. Xicato performs rigorous testing to evaluate product lifetime, as well as to study failure mode criteria under harsh environments. One important test consists of mounting the modules to a plate that is temperature controlled to 85°C, in a chamber with an elevated ambient air temperature, and 85% relative humidity. The modules are continuously cycled on and off every hour, so they experience repeated heating and cooling. It should be pointed out that since the mounting plate is controlled to 85°C, the actual Tc of each module is much higher while they are operating. This test is a very demanding accelerated test and exceeds any actual operating environment. Additionally, this test exceeds industry standard WHTOL testing which typically does not include the on/off power cycles, thus Xicato test regimen is significantly more demanding than typical WHTOL testing.

In addition to WHOTL testing, Xicato performs the below tests on all modules including XSM, XLM, XTM, & XIM. Below tests can also be applied to XCA, since XCA is part of XTM and XIM. Independent of IP rating, all modules undergo and pass these same tests. This demonstrates that these products have the same robustness levels and can thus perform in the same fixtures.

| Test | Stress Conditions | Stress Duration | XSM / XLM | XIM / XTM / XCA |
|--|---------------------------------------|-------------------|-----------|-----------------|
| Wet High Temperature Operating Life (WHTOL) – cycled bias (1hr on/off) | 85°C/85%RH, IF = max. DC | 2000 hrs. | ✓ | ✓ |
| High Temperature Operating Life (HTOL) | 90°C, IF = max. DC | 6000 - 10000 hrs. | ✓ | ✓ |
| High Temperature Operating Life (HTOL) – Accelerated test | 110°C, IF = max. DC | 6000 hrs. | ✓ | ✓ |
| Low Temperature Operating Life (LTOL) | 55°C, IF = max. DC | 6000 hours | ✓ | ✓ |
| Non-Operating Thermal Shock (TMSK) | -40°C to 125°C, 20 minutes dwell, <5s | 500 cycles | ✓ | ✓ |

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|---|---|------------|---|---|
| Non-Operating Temperature Cycle (TMCL) | -40°C to 110°C, 20 minutes dwell/15 minute transfer | 500 cycles | ✓ | ✓ |
| High Accelerated Stress Test (HAST) Non-operating | Tc = 130° R.H = 85% Non-operating | 480 hrs. | ✓ | ✓ |
| Vibration, Shock, & Drop | Sine Vibration Random Vibration 1500G, 0.5ms pulse, 5 per 6 axis | 500 cycles | ✓ | ✓ |
| ESD (HBM) | Human body model 2000V | | ✓ | ✓ |

Contact Xicato for more information about above tests.

Designing XIM, XTM or XCA Into An Enclosed Outdoor Luminaire

If the XIM, XTM or XCA are to be designed into an outdoor or wet location luminaire, it must be appropriately IP rated per IEC 60598. When the luminaire is installed and subjected to certain environmental conditions, condensation may form on the inside of the luminaire due to inherent moisture content in the trapped air within the luminaire.

In this case, the concern for product failure would be the electrical connection between the XIM or XTM connector and the XCA. The XTM and XIM both consist of a XCA which includes the patented Corrected Cold Phosphor technology and four electrical pads, and a means of mechanically and electrically connecting the module housings to the XCA by way of specialized connector assemblies and electronics. If electrical connection between the XIM or XTM holder and the XCA were to lose its electrical conductivity by way of corrosion, etc., the module would cease to light up.

Examining that joint more closely, the XTM holder spring finger contacts are copper alloy with nickel under-plate and gold plating. The contact finish on the spring fingers has a very low risk of corrosion. In case of XIM, there are soldered connections and no mating surfaces. Therefore XTM and XIM have a very low risk of corrosion and are highly reliable for use in outdoor applications.

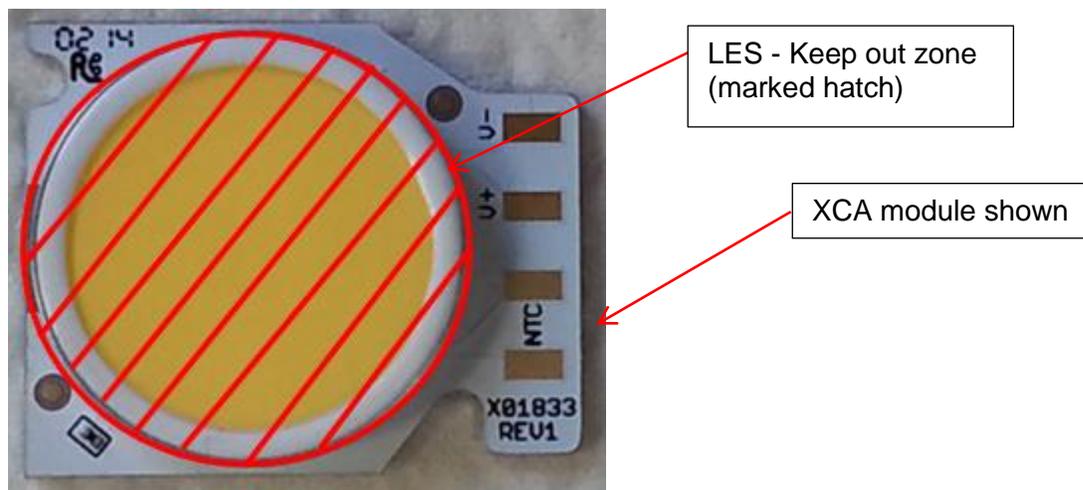
The XCA electrical pads are copper with Electroless Nickel / Electroless Palladium / Immersion Gold (ENEPIG) finish. This material construct has a very low risk for corrosion unless the thin layer of ENEPIG is removed and the copper layer is exposed. However, there is no mechanism for rubbing, wear, or movement between the spring finger and XCA electrical pad once the two parts are mated, thus there is very low risk that the copper layer will become exposed during normal usage.

During Xicato's rigorous reliability and environmental testing program no corrosion on the electrical pads or spring fingers has been observed and thus there is no reason to believe that there is a significant risk of corrosion or catastrophic failure of the XIM, XTM or XCA when enclosed in the sealed fixture.

XIM and XTM have a physically and optically future proof form factor, but the XCA is not physically future proof – meaning that it's basic size and dimensions may change in the future. It is Xicato's recommendation to design in with the XIM or XTM.

If a customer cannot accommodate XIM or XTM due to design constraints or other reasons and has to utilize XCA with soldered wire leads, common conformal coating can be brushed onto the post-soldered contacts as an additional layer of protection. Conformal coating material is applied to the electronic circuit to act as protection against moisture, dust, corrosion and harsh environments.

For more information on chemicals to avoid using on Xicato modules, refer to Xicato Application Note on "Module Chemical Compatibility". Also during this conformal coating, care should be taken to ensure that the coating does not come into contact with any part of the Light Emitting Surface (LES) or surrounding metal ring where the Tc location is defined on the XCA Module Interface drawing. Below is picture representing "keep out zones".



References

International Electrotechnical Commission (IEC), *IEC 60529: Degrees of protection provided by enclosures (IP Code), Edition 2.1 2001*

International Electrotechnical Commission (IEC), *IEC 60598-1: Luminaires – Part 1: General Requirements and Tests, 2008*

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Xicato Outdoor Luminaire Gallery

Please visit <http://www.xicato.com/luminaires-gallery> for a partial list of outdoor luminaires featuring Xicato modules. Please contact Xicato if you're looking for a solution and that is not represented in our gallery.