

Xicato's XLM module: for a pure *rectangular* beam of beautiful white light

The built environment is made up square and rectangular surfaces, such as walls and ceilings. This physical environment makes for mismatch with much of the lighting industry's output: most luminaires produce a circular or oval, not a rectangular, beam. In many cases, such as downlighting applications, the effect of lighting a rectangular space with a circular beam is perfectly acceptable.

Certain professional and commercial lighting designs, however, call for a uniform rectangular beam. For instance, the walls of a corridor in a hotel or office may be beautifully and evenly washed with a series of rectangular beams from surface-mount, track-mount or recessed luminaires. Precisely positioned so that the vertical edge of one beam abuts the vertical edge of the adjacent beam, such fixtures can create the illusion of a continuous wall of light stretching into the distance. In these designs, even small variations within a beam, or between one beam and another, are highly undesirable. Uniformity and consistently high quality of light are therefore important attributes of fixtures with rectangular beams.

The most common conventional lamp used in rectangular-beam fixtures is ceramic metal halide (CMH), which provides high efficacy and a uniform, consistent beam. While efficient and consistent, the quality of the light from CMH is often lacking, dimming is not possible and the lifetime pales in comparison to what is possible with LEDs. Conversely, the conventional approach to the design of LED fixtures is to use an array of white LEDs, but this can fail to offer the required uniformity within the beam or between one beam and another.

Clearly a union that combines the best attributes of CMH and LED would fill the gap. Recognizing the need of lighting designers to have a source they can use to light rectangular surfaces and also use for asymmetric uplighting and accent lighting led Xicato to create the XLM module. Superior to CMH in its quality of light, dimmability and lifetime, the XLM offers all the advantages of CMH with none of its drawbacks.

CMH: today's popular choice

CMH, when mounted in a horizontal, not a traditional axial, orientation enables a uniform rectangular beam of white light. This lamp and orientation are popular in applications requiring a rectangular beam for a number of reasons:

- the CMH beam is uniform and consistent
- a simple reflector is the only optical device required to shape and direct a CMH beam
- the lamp and reflector system are efficient, delivering high lm/W performance. Other lamp types require lenses to shape the beam to a rectangle, leading to a loss of typically 20% or more of the lamp's light output. CMH achieves high efficacy in part because no lens is required.

CMH was popularized as a replacement for halogen in applications requiring a rectangular beam largely because of its high efficacy. Halogen-based fixtures are fondly remembered by many lighting designers because of the exceptionally high quality of light they provided, particularly the excellent color rendering and dimmability.

In professional and commercial schemes, however, the disadvantages of halogen proved impossible to overcome: its low efficiency and short lifetime resulted in excessive operating costs, and hampered building operators' ability to comply with energy efficiency regulations.

CMH decisively outperforms halogen on these parameters, typically offering efficacy of 90-100lm/W, and a lumen lifetime of 10-15,000 hours. Easy to implement from an optical point of view, CMH has become the preferred light source for manufacturers and users of fixtures providing a rectangular beam.

Light quality and dimming concerns

This has had the unfortunate drawback for lighting designers of reducing the quality of light of the rectangular beam available to them, since CMH's typical CRI Ra rating of 80 (even the very best CMH lamps can only realize an Ra of 90) falls far short of the near-natural light available from a halogen lamp (with a CRI Ra rating of 100).

The designer's ability to control the light output is also severely compromised, since CMH can only be dimmed to typically 50% of its maximum light output. This limits the designer's and operator's flexibility to alter the mood and ambience of a space by changing luminance levels, or to implement energy-saving schemes that dim lights when no person is present.

LED luminaires, by contrast, are readily dimmable, and in general provide high efficacy and long lifetime. But LED technology has not been widely used in rectangular-beam applications for a variety of reasons. .

LED luminaires that use arrays of conventional white LEDs require complex optical structures to shape the light into an acceptable rectangular beam. These are difficult to design, add to the fixture's bill-of-materials and assembly costs and cause losses in the form of internal reflection. In addition, overlaying a diffuser to mask the individual point sources of light also wastes light and reduces the lamp's efficacy.

Worse, conventional white LEDs are known to suffer from 'color shift', their color temperature varies over their lifetime (this is also common with CMH lamps). Color shift has a double drawback: across the whole scheme, the color temperature changes from that specified by the designer; and as color shift occurs at different rates in different LEDs, a set of luminaires that began life with exactly the same color temperature might begin to show visible inconsistency from one beam to another as they age.

LEDs with superior quality of light

Luminaire manufacturers that use the XLM module realize the lifetime and efficiency of LED technology, the optical simplicity and consistency of CMH and the light quality of halogen. Xicato's XLM modules provide:

- beautiful white light (CRI Ra of as much as 98 and excellent rendering of saturated colors)
- consistent color temperature and light output over the lifetime of the module
- the high efficiency and long (50,000 hours) lifetime for which LEDs are renowned

- a rectangular beam that only requires a simple reflector in wall-washing, accent lighting and downlighting applications
- High light output, up to 4000 lumens
- A range of correlated color temperatures from 2700K to 4000K
- Dimming to 0.1% of peak output

	Ra	R1	R2	R3	R4	R5	R6	R7	R8	R9	R10	R11	R12	R13	R14	R15
Xicato 80 Series	81	80	85	89	81	78	80	86	66	16	64	79	58	81	93	75
Xicato Artist Series	98	98	99	98	98	98	97	98	98	96	99	98	88	98	98	98
Typical IR coated Halogen Dichroic	98	98	99	99	99	98	98	99	97	92	97	98	97	98	99	97
Typical Compact Metal Halide	82	90	94	69	82	81	81	87	71	27	59	62	55	93	78	88
Typical Compact Fluorescent	87	91	93	86	91	89	90	88	70	17	76	91	81	93	92	81

Independent measurements by University College, London.

Fig. 1: CRI ratings for Xicato modules and other popular light sources

The Standard Series XLM is specified with a CRI Ra rating of ≥ 80 ; the Artist Series XLM carries a CRI Ra rating of ≥ 95 (see Figure 1). It is common to evaluate or report only the first 8 of the 15 samples; this is often presented as Ra. This leaves out saturated and skin tone colors, however, and can lead to an inaccurate evaluation of a light source.

Xicato evaluates all 15 reference samples for its 80 Series and Artist Series modules, providing a complete understanding of CRI with respect to quality of light. In the case of the Artist Series modules, the results for the deep red R9 and other samples put these modules on a par with halogen lamps.

Thus in a wall-washing application for instance, fixtures using the XLM module can enable efficient rectangular beams of light which offer total consistency of color temperature between one fixture and another, over the entire (50,000 hours) lifetime of the fixtures. In addition, each fixture will provide a uniform beam, with no dark spots and negligible gradient across the beam.

For lighting designers and specifiers, a luminaire based on an XLM module offers:

- a light source that enables them to realize their vision. The Artist Series XLM modules provide color rendering performance matching that of halogen light sources. Dimmability to 0.1% provides for total control of light output. A precisely specified CCT (to within 1 x 2 Macadam ellipses) guarantees the color temperature of the light output, which is consistent over the lifetime of the fixture.
- high lifetime value, with performance and lifetime guaranteed for a minimum 50,000 hours of operation. XLM modules provide ‘fit and forget’ reliability, eliminating the maintenance and replacement costs associated with halogen and CMH light sources.
- compliance with the latest energy-efficiency requirements

Lighting designers and specifiers anywhere in the world can choose from a wide range of off-the-shelf luminaires suitable for applications such as wall washing and accent lighting. These are listed at www.xicato.com/luminaires-gallery.

For lighting equipment manufacturers (OEMs), the XLM module offers a unique solution that meets the demands of lighting designers and specifiers for an LED source of light that offers beautiful, consistent white light. XLM thus gives manufacturers an edge over competitors producing lamps based on CMH or on white LEDs.

In addition, Xicato provides the tools and simulation models required to make system development easy. These tools include:

- an online tool for selecting from a wide range of dedicated optical solutions for accent and ambient lighting, supplied by top optics companies. This includes a choice of rectangular reflectors.
- similar selection tools for off-the-shelf drivers and for heat sinks. The driver tool includes information about safety certifications and compliance, dimming controls and dimensions
- CAD files, application notes, raysets and safety certifications for off-the-shelf optical and thermal solutions compatible with the XLM modules

Xicato also offers to test every customer's design before it goes into production. If thermally validated for performance within the specifications of Xicato's Corrected Cold Phosphor Technology, Xicato will offer OEMs a full five-year color and lumen maintenance warranty on the performance of the XLM module in their product.

Conclusion

CMH is a tried and tested technology that provides a simple way to implement a fixture that produces an efficient, rectangular beam. But while CMH is relatively high efficacy, and offers adequate quality of light, it has now been surpassed by superior and unique LED technology developed by Xicato.

Modules with rectangular light emitting surfaces, such as the XLM, have all the advantages of LEDs, including long lifetime and high efficacy. But because of the unique design of the XLM modules, using Corrected Cold Phosphor Technology, they also provide outstanding consistency and quality of light, including CRI Ra ratings as high as ≥ 95 , and CCT values specified to within 1 x 2 Macadam ellipses, guaranteed for the lifetime of the module.

Lighting designers and luminaire manufacturers alike have the ability to meet ever increasing demands for consistent, efficient and controllable high quality light that optimizes the look and feel of different spaces. Combining the quality of light of halogen with the efficacy of CMH and the long lifetime of LEDs, rectangular modules, like the XLM from Xicato are now the best light source for these demanding applications.