

# Cree® XLamp® CXA1512 LED Retail Track Light Reference Design



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## INTRODUCTION

This application note details the design of a 25-watt equivalent retail track light using Cree’s XLamp CXA1512 LED. The CXA1512 is optimized to simplify designs and lower system cost and can enable system-level performance of 800 to over 1600 lumens. The XLamp CXA1512 LED delivers high lumen output and high efficacy in a single, easy-to-use package that eliminates the need for reflow soldering.

The XLamp CXA1512 LED highlighted in this reference design is optimized to enable applications that traditionally use halogen, ceramic metal halide (CMH) and compact fluorescent lamp (CFL) technology. The goal of the design is to enable a retail track light with a narrow beam, based on a single XLamp CXA1512 LED, delivering performance equivalent to a 25-watt CMH lamp.

## DESIGN APPROACH/OBJECTIVES

In the “LED Luminaire Design Guide” application note, Cree advocates a 6-step framework for creating LED luminaires.<sup>1</sup> All Cree reference designs use this framework, and the design guide’s summary table is reproduced in Table 1.

Step	Explanation
1. Define lighting requirements	<ul style="list-style-type: none"> <li>The design goals can be based either on an existing fixture or on the application’s lighting requirements.</li> </ul>
2. Define design goals	<ul style="list-style-type: none"> <li>Specify design goals, which will be based on the application’s lighting requirements.</li> <li>Specify any other goals that will influence the design, such as special optical or environmental requirements.</li> </ul>
3. Estimate efficiencies of the optical, thermal & electrical systems	<ul style="list-style-type: none"> <li>Design goals will place constraints on the optical, thermal and electrical systems.</li> <li>Good estimations of efficiencies of each system can be made based on these constraints.</li> <li>The combination of lighting goals and system efficiencies will drive the number of LEDs needed in the luminaire.</li> </ul>
4. Calculate the number of LEDs needed	<ul style="list-style-type: none"> <li>Based on the design goals and estimated losses, the designer can calculate the number of LEDs to meet the design goals.</li> </ul>
5. Consider all design possibilities and choose the best	<ul style="list-style-type: none"> <li>With any design, there are many ways to achieve the goals.</li> <li>LED lighting is a new field; assumptions that work for conventional lighting sources may not apply.</li> </ul>
6. Complete final steps	<ul style="list-style-type: none"> <li>Complete circuit board layout.</li> <li>Test design choices by building a prototype luminaire.</li> <li>Make sure the design achieves all the design goals.</li> <li>Use the prototype to further refine the luminaire design.</li> <li>Record observations and ideas for improvement.</li> </ul>

**Table 1: Cree 6-step framework**

## THE 6-STEP METHODOLOGY

The goal for this project is to demonstrate an easy-to-implement, high-output lamp that can better the performance of 25-W CMH lamps currently on the market, showing that a narrow-beam 25-watt equivalent retail track light is possible using a single XLamp CXA1512 LED.<sup>2</sup>

### 1. DEFINE LIGHTING REQUIREMENTS

Table 2 shows a ranked list of desirable characteristics to address in a track light.

Importance	Characteristics	Units
Critical	Luminous flux	lumens (lm)
	Light intensity - center beam candle power (CBCP)	candelas (cd)
	Beam angle - full width half maximum (FWHM)	degrees (°)
	Luminaire efficacy	lm/W
	Electrical power	watts (W)
Important	Lifetime	hours
	Operating temperatures	°C
	Correlated color temperature (CCT)	K
	Color rendering index (CRI)	100-point scale
	Power factor	

**Table 2: Ranked design criteria for a track light**

1 LED Luminaire Design Guide, Application Note AP15, [www.cree.com/xlamp\\_app\\_notes/luminaire\\_design\\_guide](http://www.cree.com/xlamp_app_notes/luminaire_design_guide)  
 2 Production and cost-optimized implementations are beyond the scope of this document.

Table 3 and Table 4 summarize the ENERGY STAR® requirements for directional commercial and residential luminaires.<sup>3</sup>

Luminaire Type	ENERGY STAR REQUIREMENTS		
	Luminaire Efficacy (Initial)	Luminaire Minimum Light Output (Initial)	Luminaire Zonal Lumen Density Requirement
Accent Lights <ul style="list-style-type: none"> <li>• includes line voltage track heads</li> <li>• includes directional ceiling fan light kits</li> </ul>	35 lm/W	Luminaire shall deliver a minimum of 200 lumens per head.	Luminaire shall deliver a minimum of 80% of total initial lumens within the 0-40° zone (axially symmetric about the center of the beam).

**Table 3: ENERGY STAR luminous efficacy, output and zonal lumen density requirements**

Characteristic	Requirements
Light source life requirements: all luminaires	<p>The LED package(s) / LED module(s) / LED array(s), including those incorporated into LED light engines or GU24 based integrated LED lamps, shall meet the following L70 lumen maintenance life values (refer to Lumen Maintenance Requirements in the next section):</p> <ul style="list-style-type: none"> <li>• 25,000 hours for residential grade indoor luminaires</li> <li>• 35,000 hours for residential grade outdoor luminaires</li> <li>• 35,000 hours for commercial grade luminaires</li> </ul> <p>Lumen maintenance life projection claims in excess of the above requirements shall be substantiated with a TM-21 lumen maintenance life projection report.</p>
Lumen maintenance requirements: directional and non-directional luminaires	<p>The LED package(s) / module(s) / array(s), including those incorporated into LED light engines or GU24 based integrated LED lamps, shall meet the following <math>L_{70}(6k)</math> rated lumen maintenance life values, in situ:</p> <ul style="list-style-type: none"> <li>• <math>L_{70}(6k) \geq 25,000</math> hours for residential indoor</li> <li>• <math>L_{70}(6k) \geq 35,000</math> hours for residential outdoor, or commercial</li> </ul> <p>Compliance with the above shall be documented with a TM-21 lumen maintenance life projection report as detailed in TM-21, section 7. The report shall be generated using data from the LM-80 test report for the employed LED package/module/array model ("device"), the forward drive current applied to each device, and the in situ <math>TMP_{LED}</math> temperature of the hottest LED in the luminaire. In addition to LM-80 reporting requirements, the following information shall be reported:</p> <ul style="list-style-type: none"> <li>• sampling method and sample size (per LM-80 section 4.3)</li> <li>• test results for each <math>T_c</math> and drive current combination</li> <li>• description of device including model number and whether device is an LED package, module or array (see Definitions)</li> <li>• ANSI target, and calculated CCT value(s) for each device in sample set</li> <li>• <math>\Delta u'v'</math> chromaticity shift value on the CIE 1976 diagram for each device in sample set</li> <li>• a detailed rationale, with supporting data, for application of results to other devices (e.g. LED packages with other CCTs)</li> </ul> <p>Access to the <math>TMP_{LED}</math> for the hottest LED may be accomplished via a minimally sized hole in the luminaire housing, tightly resealed with a suitable sealant if created for purposes of testing.</p> <p>All thermocouple attachments and intrusions to luminaire housing shall be photographed.</p>
CCT requirements: all indoor luminaires	<p>The luminaire (directional luminaires), or replaceable LED light engine or GU24 based integrated LED lamp (non-directional luminaires) shall have one of the following nominal CCTs:</p> <ul style="list-style-type: none"> <li>• 2700 Kelvin</li> <li>• 3000 Kelvin</li> <li>• 3500 Kelvin</li> <li>• 4000 Kelvin</li> <li>• 5000 Kelvin (commercial only)</li> </ul> <p>The luminaire, LED light engine or GU24 based integrated LED lamp shall also fall within the corresponding 7-step chromaticity quadrangles as defined in ANSI/NEMA/ANSI C78.377-2008.</p>
Color rendering requirements: all indoor luminaires	<p>The luminaire (directional luminaires), or replaceable LED light engine or GU24 based integrated LED lamp (non-directional luminaires) shall meet or exceed <math>R_a \geq 80</math>.</p>
Color angular uniformity requirements: directional solid state indoor luminaires	<p>Throughout the zonal lumen density angles detailed above, and five degrees beyond, the variation of chromaticity shall be within 0.004 from the weighted average point on the CIE 1976 (<math>u',v'</math>) diagram.</p>

<sup>3</sup> ENERGY STAR Program Requirements, Product Specification for Luminaires (Light Fixtures), Eligibility Criteria, Version 1.2, [www.energystar.gov/ia/partners/product\\_specs/program\\_reqs/Final\\_Luminaires\\_V1\\_2.pdf?7b7d-2473](http://www.energystar.gov/ia/partners/product_specs/program_reqs/Final_Luminaires_V1_2.pdf?7b7d-2473)

Characteristic	Requirements
Color maintenance requirements: solid state indoor luminaires only	The change of chromaticity over the first 6,000 hours of luminaire operation shall be within 0.007 on the CIE 1976 (u',v') diagram, as demonstrated by either: <ul style="list-style-type: none"> <li>the IES LM-80 test report for the employed LED package/array/module model, or</li> <li>as demonstrated by a comparison of luminaire chromaticity data in LM-79 reports at zero and 6,000 hours, or</li> <li>as demonstrated by a comparison of LED light engine or GU24 based integrated LED lamp chromaticity data in LM-82 reports at zero and 6,000 hours.</li> </ul>
Source start time requirement: directional and non-directional luminaires	Light source shall remain continuously illuminated within one second of application of electrical power.
Dimming requirements	The luminaire and its components shall provide continuous dimming from 100% to 35% of total light output.  Step dimming, if employed, shall provide at least two discrete light output levels $\geq$ 35% of total light output and not including 100% output.
Power factor requirements: directional and non-directional luminaires	Total luminaire input power less than or equal to 5 watts: PF $\geq$ 0.5  Total luminaire input power greater than 5 watts: Residential: PF $\geq$ 0.7 Commercial: PF $\geq$ 0.9
Transient protection requirements: all luminaires	Ballast or driver shall comply with ANSI/IEEE C62.41.1-2002 and ANSI/IEEE C62.41.2-2002, Class A operation. The line transient shall consist of seven strikes of a 100 kHz ring wave, 2.5 kV level, for both common mode and differential mode.
Operating frequency requirements: directional and non-directional luminaires	Frequency $\geq$ 120 Hz  Note: This performance characteristic addresses problems with visible flicker due to low frequency operation and applies to steady-state as well as dimmed operation. Dimming operation shall meet the requirement at all light output levels.
Noise requirements: directional and non-directional luminaires	All ballasts & drivers used within the luminaire shall have a Class A sound rating.  Ballasts and drivers are recommended to be installed in the luminaire in such a way that in operation, the luminaire will not emit sound exceeding a measured level of 24 BA.

**Table 4: ENERGY STAR luminaire requirements**

The DesignLights™ Consortium (DLC) provides requirements for track or mono-point directional lighting fixtures, summarized in Table 5.<sup>4</sup>

Characteristic	Unit	DLC Value
Minimum light output	lm	250
Zonal lumen density		$\geq$ 85%: 0-90°
Minimum luminaire efficacy	lm/W	40
Allowable CCTs (ANSI C78.377-2008)	K	$\leq$ 5000
CRI		80
L70 lumen maintenance	hours	50,000
Minimum luminaire warranty	years	5

**Table 5: DLC track light requirements**

## 2. DEFINE DESIGN GOALS

Examination of existing CMH PAR38 lamp data sheets gives the basic benchmark data shown in Table 6.<sup>5</sup>

4 Technical Requirements Table v1.7, DesignLights Consortium Qualified Products List - Non-Residential Applications, [www.designlights.org/solidstate.manufacturer.requirements.php](http://www.designlights.org/solidstate.manufacturer.requirements.php)

5 Source: Data sheet information on-line.

Lamp	Power (W)	Luminous Flux (lm)	Efficacy (lm/W)	CBCP (cd)	Beam Angle (°)	CCT (K)	CRI	Lifetime (hours)
CMH Lamp A	20	1,200	60	24,000	10	3100	82	12,000
CMH Lamp B	20	1,000	50	13,000	8	3000	81	12,000
CMH Lamp C	25	1,450	58	26,000	10	3000	87	15,000

**Table 6: PAR38 benchmark data**

This retail track light design benefits from the directional XLamp CXA1512 LED. Omnidirectional CMH lamps do not emit all their light toward the target area to be illuminated, resulting in losses within the fixture. The directional CXA1512 LED emits all its light toward the target area, with minimal losses within the fixture. As a result, a lumens-for-lumens comparison between an CXA1512 LED and a CMH lamp is only partially relevant.

Table 7 shows the design goals for this project.

Characteristic	Unit	Minimum Goal	Target Goal
Light output	lm	1,200	> 1,200
Light intensity - CBCP	cd	10,000	> 10,000
Beam angle - FWHM	degrees	13	13
Luminaire efficacy	lm/W	70	> 70
CCT	K	3000	3000
CRI	100-point scale	80	> 80
Power	W	18	< 18

**Table 7: CXA1512 retail track light design goals**

### 3. ESTIMATE EFFICIENCIES OF THE OPTICAL, THERMAL & ELECTRICAL SYSTEMS

We used Cree’s Product Characterization Tool (PCT) tool to determine the drive current for the design.<sup>6</sup> Figure 1 shows basic electrical data and optical output from the PCT. We estimated 90% optical efficiency, 88% driver efficiency and a solder-point temperature ( $T_{sp}$ ) of 70 °C.

<sup>6</sup> PCT is available at: [pct.cree.com](http://pct.cree.com)

Current (A)	LED 1			
	Model	Cree XLamp CXA1512 LES 9r {EZW} ▼		
	Flux	K4 [1290] ▼	1290.0	
	Price	\$ -	Tsp (°C) ▼	70
	ΔVf	0.000	Multiple	x1 ▼
	SYS lm tot	SYS lm/W	SYS W	SYS # LED
0.360	2308.8	76.4	30.209	2
0.370	2354.9	75.6	31.146	2
0.380	1200.4	74.8	16.044	1
0.390	1222.7	74	16.517	1
<b>0.400</b>	<b>1244.7</b>	<b>73.3</b>	<b>16.991</b>	<b>1</b>
0.410	1266.4	72.5	17.467	1
0.420	1287.7	71.8	17.945	1
0.430	1308.7	71	18.424	1
0.440	1329.5	70.3	18.906	1

Figure 1: PCT output with CXA1512 flux data

The PCT output shows that, at 400 mA, a single XLamp CXA1512 LED produces the desired lumen output and efficacy.

### Thermal Requirements

Proper thermal management is a key component of any successful LED-based lamp or luminaire design. Operating at 17 W of power in this retail track light design, the XLamp CXA1512 LED requires a heat sink to dissipate this thermal load. The heat sink in this design must not only dissipate the heat generated by the LED, but also provide the mechanical frame for the LED and optic. We used a market-ready track light kit, shown in Figure 2, that includes an anodized aluminum alloy heat sink, track adaptor, cover glass and front optic cover ring.<sup>7</sup>



Figure 2: CXA1512 retail track light kit

<sup>7</sup> Model AL6063/24W, Lighting Co., Ltd., www.loswan.cn

We performed thermal simulation to verify that this thermal design is sufficient.<sup>8</sup> Figure 3 shows thermal images of the retail track light. The simulated peak solder point temperature ( $T_{sp}$ ) is 63 °C, or 38 °C above ambient.

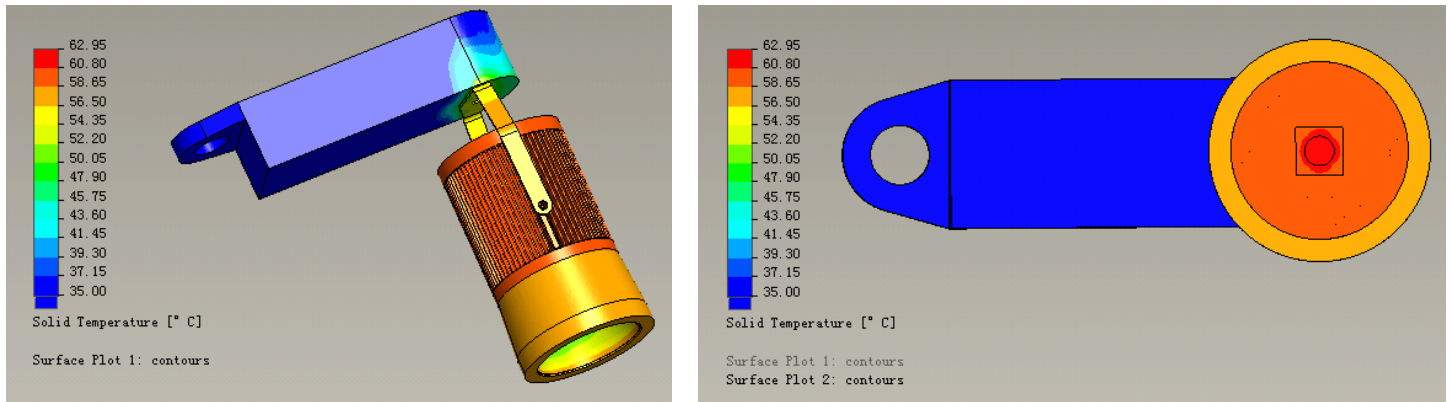


Figure 3: CXA1512 retail track light thermal simulation

### Drive Electronics

Cree selected a constant-current driver to supply power to the retail track light.<sup>9</sup> The driver, shown in Figure 4, is not mounted to the heat sink assembly but instead is housed inside the track adaptor that connects the track light to the track.



Figure 4: CXA1512 retail track light driver

### Secondary Optics

The small optical source size of the XLamp CXA1512 LED facilitates the creation of this narrow-beam retail track light. We selected a commercially available reflector that is about 90% optically efficient and produces a 13° beam angle.<sup>10</sup> The reflector, shown in Figure 5, fits within the heat sink assembly.

<sup>8</sup> For additional information on thermal management, refer to the Thermal Management of Cree XLamp LEDs Application Note, AP05, [www.cree.com/xlamp\\_app\\_notes/thermal\\_management](http://www.cree.com/xlamp_app_notes/thermal_management)

<sup>9</sup> Model 18W, FGEST, [www.fgest.com](http://www.fgest.com)

<sup>10</sup> Model 06215, Opto-Source Optoelectronic Technology Development Co., Ltd., [www.opto-source.net](http://www.opto-source.net)




**Figure 5: Two views of CXA1512 retail track light reflector**

#### 4. CALCULATE THE NUMBER OF LEDS NEEDED

The purpose of this reference design is to show that a single LED package can deliver equivalent lighting utility and superior performance compared to existing 25-W CMH lamps on the market and show that it is possible to produce a narrow-beam retail track light based on the XLamp CXA1512 LED. The CXA1512 LED is a multi-chip LED package that can offer the required CBCP with new levels of LED-to-LED color consistency and efficiency. Other LED arrays on the market cannot offer the XLamp CXA1512 LED's lumen output with such a small optical source size.

We selected a Warm White LED for this reference design, shown highlighted in yellow in Table 8. To demonstrate the performance of the CXA1512 LED, we chose an LED from the highest 3000 K flux bin.

Color	CCT Range	Base Order Codes Min. Luminous Flux @ 350 mA			2-Step Order Code		4-Step Order Code	
		Group	Flux (lm) @ 85 °C	Flux (lm) @ 25 °C*	Chromaticity Region		Chromaticity Region	
EasyWhite	5000K	M2	1380	1563	50H	CXA1512-0000-000N00M250H	50F	CXA1512-0000-000N00M250F
		M4	1485	1682		CXA1512-0000-000N00M450H		CXA1512-0000-000N00M450F
	4000K	K4	1290	1461	40H	CXA1512-0000-000N00K440H	40F	CXA1512-0000-000N00K440F
		M2	1380	1563		CXA1512-0000-000N00M240H		CXA1512-0000-000N00M240F
		M4	1485	1682		CXA1512-0000-000N00M440H		CXA1512-0000-000N00M440F
	3500K	K2	1200	1359	35H	CXA1512-0000-000N00K235H	35F	CXA1512-0000-000N00K235F
		K4	1290	1461		CXA1512-0000-000N00K435H		CXA1512-0000-000N00K435F
		M2	1380	1563		CXA1512-0000-000N00M235H		CXA1512-0000-000N00M235F
	3000K	K2	1200	1359	30H	CXA1512-0000-000N00K230H	30F	CXA1512-0000-000N00K230F
		K4	1290	1461		CXA1512-0000-000N00K430H		CXA1512-0000-000N00K430F
	2700K	J4	1120	1269	27H	CXA1512-0000-000N00J427H	27F	CXA1512-0000-000N00J427F
		K2	1200	1359		CXA1512-0000-000N00K227H		CXA1512-0000-000N00K227F
		K4	1290	1461		CXA1512-0000-000N00K427H		CXA1512-0000-000N00K427F

**Table 8: CXA1512 LED order codes**



## 5. CONSIDER ALL DESIGN POSSIBILITIES

There are a vast number of design possibilities for an LED-based track light. We used a commercially available heat sink, driver and reflector to produce the performance necessary for a true 25-W CMH-equivalent retail track light.

The XLamp CXA1512 LED package provides this design with a number of desirable performance-related benefits. Because the CXA1512 LED uses EasyWhite® technology, LED-to-LED color consistency can be held to within two or four MacAdam ellipses for any given CCT, depending on the order code. The CXA1512 LED is binned at 85 °C, so the CCT will be as faithful as possible to the system operating environment. These component features allow for new levels of specification accuracy.

However, the primary purpose of this reference design is to show how simple and straightforward it is to design with Cree's XLamp CXA1512 LED. This application note shows only one of the many ways to do this, and demonstrates the ease of implementation with this set of engineering constraints. Certainly numerous other successful solutions are possible.

It is common for a track light manufacturer to design a reflector for a particular beam angle and install the light source and reflector in multiple housings. This reference design supports such a practice and in addition, the performance range of the XLamp CXA1512 LED enables a wide variety of luminaires that all use a single CXA1512 LED. For demanding retail applications, the CXA1512 LED is offered in a 90-minimum CRI option, providing even better color rendering than this reference design. CCTs from 2700 K to 5000 K and lumen output up to 2100 lm<sup>11</sup> are possible, providing manufacturers the flexibility to offer a variety of luminaires that use a single LED light source and reflector.

## 6. COMPLETE THE FINAL STEPS

This section describes the techniques used to create a working retail track light using the XLamp CXA1512 LED and shows the results of the design.

### Prototyping Details

The essence of the design is to attach a Cree XLamp CXA1512 LED to a heat sink and assemble the necessary optics and driver around this to create a true 25-W CMH-equivalent LED-based luminaire. The assembly steps are detailed below.

1. We verified the component dimensions to ensure a correct fit.
2. We attached the CXA1512 LED to the heat sink with a small amount of thermally conductive compound.<sup>12</sup> Thermally conductive epoxy can also be used.<sup>13</sup>
3. We fed the driver output wires through the track adaptor and the heat sink and, following the recommendations in Cree's Soldering and Handling Application Note for the CXA family of LEDs<sup>14</sup>, soldered them onto the CXA1512 LED.
4. We tested the connection by applying power to the LED and verified that the LED lit up.

<sup>11</sup> At 19.4 W, 85 °C

<sup>12</sup> Dow Corning Thermally Conductive Compound, TC-5026, [www.dowcorning.com/content/publishedlit/11-1689a-01.pdf](http://www.dowcorning.com/content/publishedlit/11-1689a-01.pdf)

<sup>13</sup> Refer to Cree's Chemical Compatibility application note for compounds that are safe to use with Cree LEDs.

Cree XLamp LED Chemical Compatibility Application Note, AP63, [www.cree.com/products/pdf/XLamp\\_Chemical\\_Comp.pdf](http://www.cree.com/products/pdf/XLamp_Chemical_Comp.pdf)

<sup>14</sup> Cree XLamp CXA Family LEDs Soldering and Handling, Application Note AP74, [www.cree.com/xlamp\\_app\\_notes/CXA\\_SH](http://www.cree.com/xlamp_app_notes/CXA_SH)

5. We placed a plastic LED connector<sup>15</sup> over the LED and positioned the connector so the LED was centered on the heat sink.
6. We secured the LED connector to the heat sink with screws.
7. We placed the reflector on the heat sink so the opening aligned with the LED.
8. We placed the cover glass on the reflector and screwed the front optic cover ring to the heat sink to secure the cover glass and the reflector to the heat sink.
9. We performed final testing.

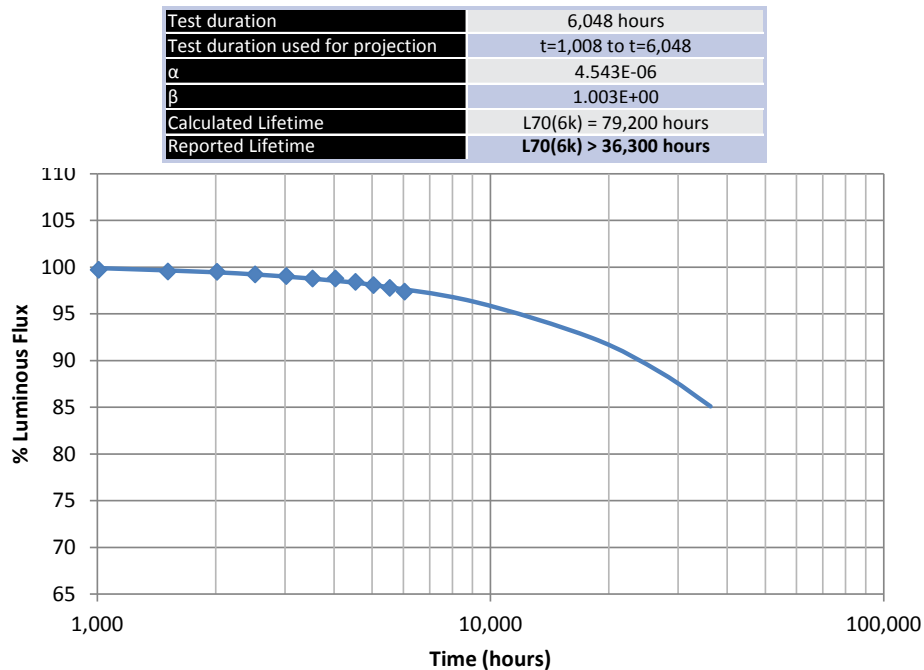
**Results**

**Thermal Results**

We measured the thermal performance of the retail track light by attaching a thermocouple to the XLamp CXA1512 LED mounted on the heat sink. The case temperature ( $T_c$ ) of the CXA1512 retail track light was 57.8 °C. This thermal performance is within the operating limit curve for the CXA1512 LED.

**Estimated LED Lifetime**

We used Cree’s TM-21 Calculator Tool to project the lifetime of the CXA1512 LED used in this track light. Figure 6 shows the calculated and reported lifetimes, determined using the TM-21 projection algorithm, for the CXA1512 LED at a 519 mA input current and a  $T_c$  of 85 °C. We expect the CXA1512 retail track light to easily meet the L70 goal of 50,000 hours.



**Figure 6: TM-21 data**

<sup>15</sup> Model PC, Mekoda Optical Co., Ltd., www.mekoda.cn

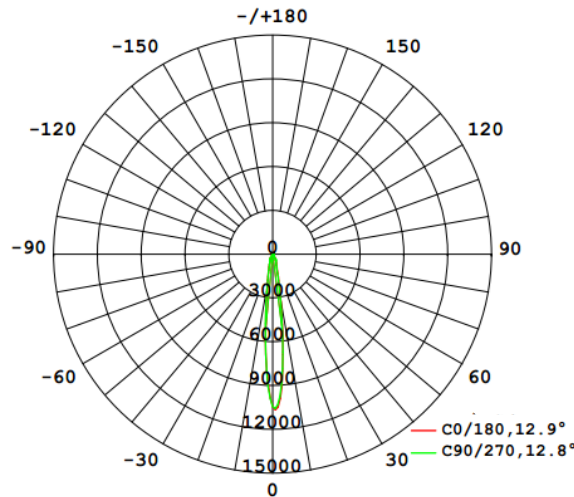
**Optical and Electrical Results**

We obtained the results in Table 9 by testing the retail track light in a 1.5-meter sphere and a Type A goniometer after a 60-minute stabilization time.<sup>16</sup> The performance exceeds the project goals and accomplishes this using a single XLamp CXA1512 LED to produce a symmetric 13° beam with CBCP exceeding 10,000 cd. In addition to the maintenance cost savings offered by the CXA1512 LED’s longer lifetime, this retail track light also provides energy cost savings, operating on one third less power than 25-W CMH track lights.

Characteristic	Unit	Result
Light output	lm	1,260
Light intensity - CBCP	cd	10,943
Beam angle - FWHM	degrees	13
Luminaire efficacy	lm/W	73.7
CCT	K	3065
CRI	100-point scale	82
Power	W	17.1
Power factor		0.92

**Table 9: CXA1512 retail track light results**

We also tested the intensity distribution of the CXA1512 retail track light. As shown in Figure 7, the retail track light has an even intensity distribution for the narrow beam angle.



**Figure 7: Goniometric intensity polar plot of CXA1512 retail track light**

Table 10 shows the center beam illuminance of the CXA1512 retail track light at various distances from the light source.

<sup>16</sup> Testing was performed at Cree’s Shenzhen Technology Center. An IES file for the retail track light is available on the Cree website: [www.cree.com/xlamp\\_app\\_notes/CXA1512\\_track\\_ies](http://www.cree.com/xlamp_app_notes/CXA1512_track_ies)

Height		Center Beam Illuminance		Beam Width			
				Vertical Spread		Horizontal Spread	
0.3 m	1.0 ft	8,726 fc	93,924 lx	0.1 m	0.3 ft	0.1 m	0.3 ft
0.7 m	2.3 ft	2,182 fc	23,481 lx	0.2 m	0.7 ft	0.2 m	0.7 ft
1.0 m	3.3 ft	970 fc	10,436 lx	0.2 m	0.7 ft	0.2 m	0.7 ft
1.3 m	4.3 ft	545 fc	5,870 lx	0.3 m	1.0 ft	0.3 m	1.0 ft
1.7 m	5.6 ft	349 fc	3,757 lx	0.4 m	1.3 ft	0.4 m	1.3 ft
2.0 m	6.6 ft	242 fc	2,609 lx	0.5 m	1.6 ft	0.5 m	1.6 ft

**Table 10: CXA1512 retail track light center beam illuminance – 13° beam angle**

## CONCLUSIONS

This reference design demonstrates the ease of integrating the Cree XLamp CXA1512 LED into a narrow-beam retail track light with excellent results. Such a luminaire is used in both retail and residential spot light applications to enhance the appearance of merchandise or artwork. The performance of this retail track light makes it an attractive alternative to CMH-based luminaires and could form the basis for a broad product line of CXA1512 LED based track lights. This document shows the level of performance that is achievable with a single XLamp CXA1512 LED component, and suggests that the CXA1512 LED can be the basis of numerous successful track light designs.

## BILL OF MATERIALS

Component	Order Code/Model Number	Company	Web Link
Connector	PC	Mekoda Optical Co., Ltd.	<a href="http://www.mekoda.cn">www.mekoda.cn</a>
Driver	18W	FGEST	<a href="http://www.fgest.com">www.fgest.com</a>
Track light kit	AL6063/24W	Lighting Co., Ltd.	<a href="http://www.loswan.cn">www.loswan.cn</a>
LED	CXA1512-0000-000N00K430H	Cree, Inc.	<a href="http://www.cree.com/XLamp/CXA1512">www.cree.com/XLamp/CXA1512</a>
Reflector	06215	Opto-Source Optoelectronic Technology Development Co., Ltd.	<a href="http://www.opto-source.net">www.opto-source.net</a>
Thermally conductive compound	TC-5026	Dow Corning Corporation	<a href="http://www.dowcorning.com/content/publishedlit/11-1689a-01.pdf">www.dowcorning.com/content/publishedlit/11-1689a-01.pdf</a>

**Table 11: Bill of materials for CXA1512 retail track light**

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