

Cree® LMR2 Series Design Guide



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THANK YOU

Thank you for choosing to incorporate the LMR2 series of LED modules into your luminaire designs.

If you need assistance, Cree will support you with:

- Engineering assistance for product design and manufacturability.
- Thermal testing assistance for lifetime analysis.
- Thermal design assistance.

The LMR2 is a fully functioning module that delivers:

- Known and predictable lumens
- Known and predictable color temperature
- Life of 35,000 and 50,000 hours, depending on the case temperature (Tc) test results

Again, thank you, and we look forward to working with you.

ABOUT THIS DESIGN GUIDE

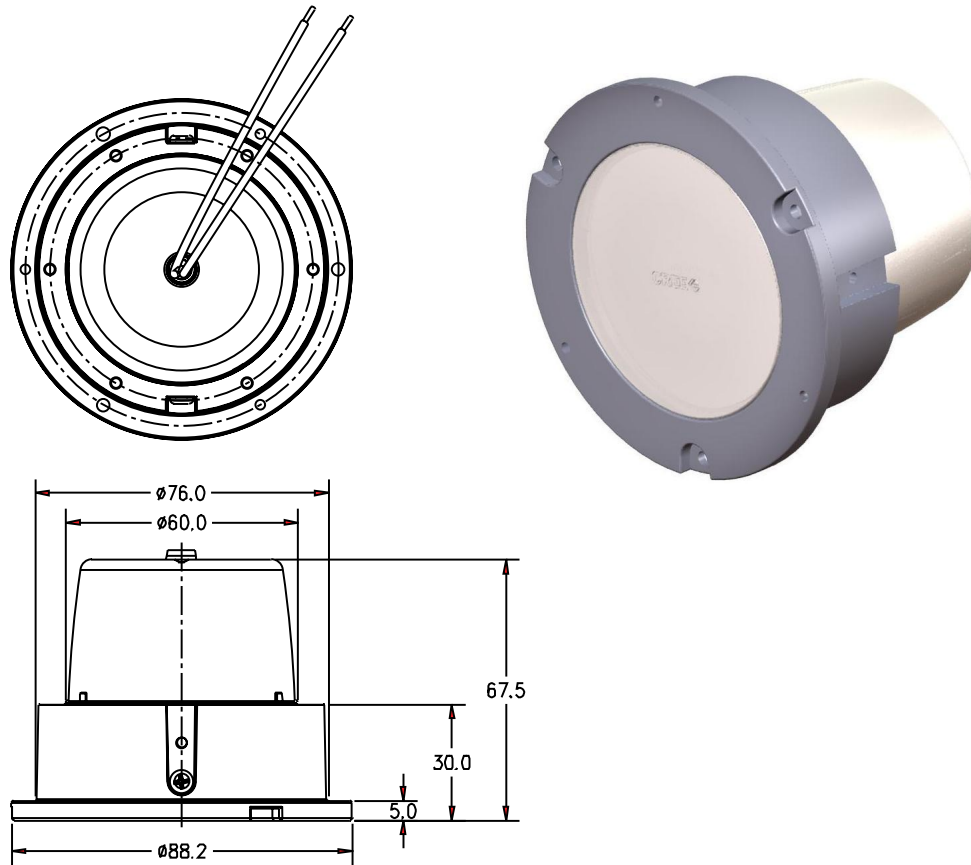
This design guide is intended to provide luminaire manufacturers an introduction to the LMR2 series of modules. The design guide provides critical design guidelines for successfully integrating the LMR2 into your existing and new luminaire designs.

- For additional information please contact your local Cree sales representative.
- For technical information and support visit us on the [web](#) or e-mail us at modules_support@cree.com.
- All dimensions are in millimeters unless otherwise noted.

Please note that failure to follow the design guidelines in this document may void the product warranty.

ABOUT THE LMR2 SERIES

The LMR2 series of LED lighting modules is engineered to allow lighting designers and luminaire manufacturers to quickly incorporate Cree's patented TrueWhite® Technology and EasyWhite® Technology into their lighting designs. The LMR2 module is a complete LED lighting solution with integrated LED power supply and thermal management system combined in a single, compact form factor. The LMR2 modules are designed to be used in general lighting applications where high efficacy and constant and stable color rendering index (CRI) values are important. LMR2 modules are available in 120 VAC/60 Hz or 230 VAC/50 Hz versions.



ELECTRICAL DESIGN

The LMR2 modules contain a fully integrated LED power supply engineered specifically to run directly from building power. Module operation is accomplished by simply connecting the two (2) building power leads (line and neutral) to the luminaire leads as indicated in the wiring table below.

| Connection | 120 VAC / 60 Hz | 230 VAC / 50 Hz |
|------------|-----------------|-----------------|
| Neutral | White | Blue |
| Line | Black | Brown |

The module has two (2) 175-mm 18 AWG lead wires. (Strip length = 5 mm)

Protective Earth Ground

The LMR2 module must be properly earth grounded for safety and electromagnetic compatibility (EMC) compliance. A secure electrical connection must be made between the cast housing or heat sink mounting screws and the luminaire's protective earth ground point.

Electrostatic Discharge

No special electrostatic discharge (ESD) precautions are required for handling LMR2 modules in a production environment.

Power Requirements

LMR020-0650-xxF9-x0100TW

| Connection | 120 VAC / 60 Hz | 230 VAC / 50 Hz |
|---------------------------------|-----------------|-----------------|
| Power Consumption (W) (Nominal) | 10 | 10.5 |
| Input Voltage (VAC) (Nominal) | 120 | 230 |
| Power Factor | >.80 | >.90 |

LMR020-0750-xxF8-10100EW

| Connection | 120 VAC / 60 Hz |
|---------------------------------|-----------------|
| Power Consumption (W) (Nominal) | 11.5 |
| Input Voltage (VAC) (Nominal) | 120 |
| Power Factor | >.90 |

Wiring Strain Relief

The module must not be suspended directly via the AC supply leads. Though the wiring from the LMR2 is internally strain relieved within the housing, additional strain relief methods must be employed if the luminaire is to be suspended solely by the wiring, as in a pendant luminaire.

Dimming

The LMR2 module works with standard leading- and trailing-edge dimming technologies. Leading-edge dimmers can reduce light levels down to 5%. Trailing-edge dimmers can reduce light levels down to 10%.

Please note that most residential dimmers are designed to control up to 1000 W of standard lighting technologies, i.e., incandescent and halogen, which may be five (5) or more lamps of at least 100 W each. Since the LMR2 requires only 11 watts of power, it has a much higher efficiency and efficacy (lumens per watt) than standard lighting luminaires. There may be some cases that require more than one LMR2 module or lighting luminaire to be used to achieve the minimum dimmer load. This will greatly depend on the particular dimmer used. A partial list of compatible dimmers is provided below.

LMR020-0650-xxF9-10100TW Dimmer Compatibility

| Manufacturer | Model/Series | Part Number(s) | Type | Compatible w/ 1 or more LMR2s | Compatible w/ 2 or more LMR2s |
|--------------|--------------|----------------|------------|-------------------------------|-------------------------------|
| Cooper | Aspire | 9530WS-K-L | 600-W IND | | ✓ |
| | Aspire | 9534WS-K-L | 600-W STD | | ✓ |
| Lutron | Diva | DVLP-10P-WH | 1000-W MLV | | ✓ |
| | Diva | DVLP-600P-WH | 600-W MLV | | ✓ |
| | Glyder | GLV-600-WH | 600-W STD | ✓ | ✓ |
| | Glyder | GL-1000-WH | 1000-W STD | | ✓ |
| | Lyneo | LX-10PL-WH | 1000-W STD | | ✓ |
| | Skylark | S-1000-WH | 1000-W STD | ✓ | ✓ |
| | Toggler | TGLV-600PR-WH | 600-W MLV | ✓ | ✓ |
| Leviton | Decora | RPI06 | 600-W STD | | ✓ |

IND = Incandescent dimmer

STD = Standard dimmer

MLV = Magnetic low-voltage dimmer

LMR020-0650-xxF9-20100TW Dimmer Compatibility

| Manufacturer | Model/Series | Part Number(s) | Type | Compatible w/ 1 or more LMR2s | Compatible w/ 2 or more LMR2s |
|--------------|--------------|----------------|-----------|-------------------------------|-------------------------------|
| Bush | | 2247 U | 600-W STD | | ✓ |
| | | 2250 U | 500-W STD | ✓ | ✓ |
| Clipsal | | E32V500 | 500-W STD | ✓ | ✓ |
| | | KB31RD400 | 400-W STD | ✓ | ✓ |
| Gira | | 030600/100 | 500-W STD | ✓ | ✓ |
| | | 030700/101 | 525W STD | ✓ | ✓ |
| Key-Top | | BP-81 | 600-W STD | ✓ | ✓ |
| Lutron | Lyneo | LLSM-502-FAW | 600-W STD | | ✓ |
| Leviton | Trimatron | 6602-220 | 600-W STD | ✓ | ✓ |
| Merten | | 572529 | 500-W STD | ✓ | ✓ |
| PDL 600 | | 634M | 450-W STD | ✓ | ✓ |
| Siemens | | 5TC8 240 | 400-W STD | ✓ | ✓ |
| | | 5TC8 256 | 400-W STD | ✓ | ✓ |
| Tradim | | 1431 | 250-W STD | ✓ | ✓ |

STD = Standard dimmer

LMR020-0750-xxF8-10100EW Dimmer Compatibility

| Manufacturer | Model/Series | Part Number(s) | Type | Compatible w/ 1 or more LMR2s | Compatible w/ 2 or more LMR2s |
|--------------|--------------|----------------|-------------------|-------------------------------|-------------------------------|
| Cooper | | RAI10 | 1000-W IND/HAL | | ✓ |
| | | RI101 | 1000-W IND | ✓ | |
| | | TI061-W | 1000-W IND/HAL | ✓ | |
| | Aspire | 9530 | 600-W IND | | ✓ |
| | Aspire | 9530WS-KL | 600-W IND | ✓ | |
| | Aspire | 9534WS-KL | 600-W IND/MLV | ✓ | |
| | Devine | DI06P-V | 600-W IND/MLV | ✓ | |
| | Devine | DI10P | 1000-W IND/HAL | ✓ | |
| | Skye | SI06P | 600-W IND/HAL/MLV | ✓ | |
| | Skye | SI061-V | 600-W IND/MLV | ✓ | |
| | Skye | SI10P | 1000-W IND/MLV | ✓ | |
| | Skye | SLC03P | 300-W IND/HAL | ✓ | |
| Leviton | | HCM06-1DW | 600-W IND | ✓ | |
| | Acenti | ATCE06 | 600-W ELV | ✓ | |
| | Acenti | AT106-1LW | 180-W IND | ✓ | |
| | Decora | 6631-LW | 600-W IND | ✓ | |
| | Illumatech | IPI06 | 600-W IND | ✓ | |

| Manufacturer | Model/Series | Part Number(s) | Type | Compatible w/ 1 or more LMR2s | Compatible w/ 2 or more LMR2s |
|------------------|--------------|----------------|---------------|-------------------------------|-------------------------------|
| Lutron | Ceana | CN-600P | 600-W IND/HAL | ✓ | |
| | Ceana | CNLV-V-600P | 600-W MLV | ✓ | |
| | Centurion | C-600 | 600-W IND/HAL | ✓ | |
| | Dial Dimmer | D-600 | 600-W IND | ✓ | |
| | Diva | DV-10P | 600-W IND | ✓ | |
| | Diva | DV-600P | 600-W IND | ✓ | |
| | Diva | DVELV-300P | 300-W ELV | ✓ | |
| | Diva | DVF-103P | 1000-W MLV | ✓ | |
| | Diva | DVLP-600P | 600-W MLV | ✓ | |
| | Diva | DVWCL-153DH | 150-W CFL/LED | ✓ | |
| | Faetra | FAELV-500 | 300-W ELV | ✓ | |
| | Glyder | GL-600H | 600-W IND | ✓ | |
| | Lumea | LG-603PG | 600-W IND/HAL | ✓ | |
| | Lyneo | LX-600PL | 600-W IND/HAL | ✓ | |
| | Maestro | MA-1000 | 1000-W IND | | ✓ |
| | Maestro | MAELV-600 | 600-W ELV | ✓ | |
| | Maestro | MALV-1000 | 1000-W MLV | | ✓ |
| | Maestro | MAW-600 | 600-W IND | ✓ | |
| | Nova | NLV-1503P | 1200-W MLV | | ✓ |
| | Nova | N-600 | 600-W IND | ✓ | |
| | Nova T | NT-603P | 600-W IND/HAL | ✓ | |
| | Nova T | NTB-600 | 600-W IND/HAL | ✓ | |
| | Nova T | NTELV-600 | 600-W ELV | ✓ | |
| | Radio | RA2 RRD-6NA | 600-W MLV/ELV | ✓ | |
| | Radio | RA2 RRD-10ND | 1000-W MLV | ✓ | |
| | Skylark | S-10P | 1000-W IND | ✓ | |
| | Skylark | S-600P | 600-W IND | ✓ | |
| | Skylark | SELV-300P | 300-W ELV | ✓ | |
| | Skylark | SL-2 | 1000-W UNI | ✓ | |
| | Skylark | SLV-600P | 600-W MLV | ✓ | |
| Sureslide | 6673-P | 600-W IND | ✓ | | |
| Toggler | TG-600PR-WH | 600-W IND/HAL | ✓ | | |
| Pass and Seymore | | LS600 | 600-W IND | ✓ | |
| | WideSlide | 90680-W | 600-W IND | ✓ | |
| Wattstopper | | | 600-W UNI | | ✓ |

CFL = Compact fluorescent dimmer
 ELV = Electronic low-voltage dimmer
 IND = Incandescent dimmer

LED = Light emitting diode dimmer
 MLV = Magnetic low-voltage dimmer
 UNI = Universal dimmer

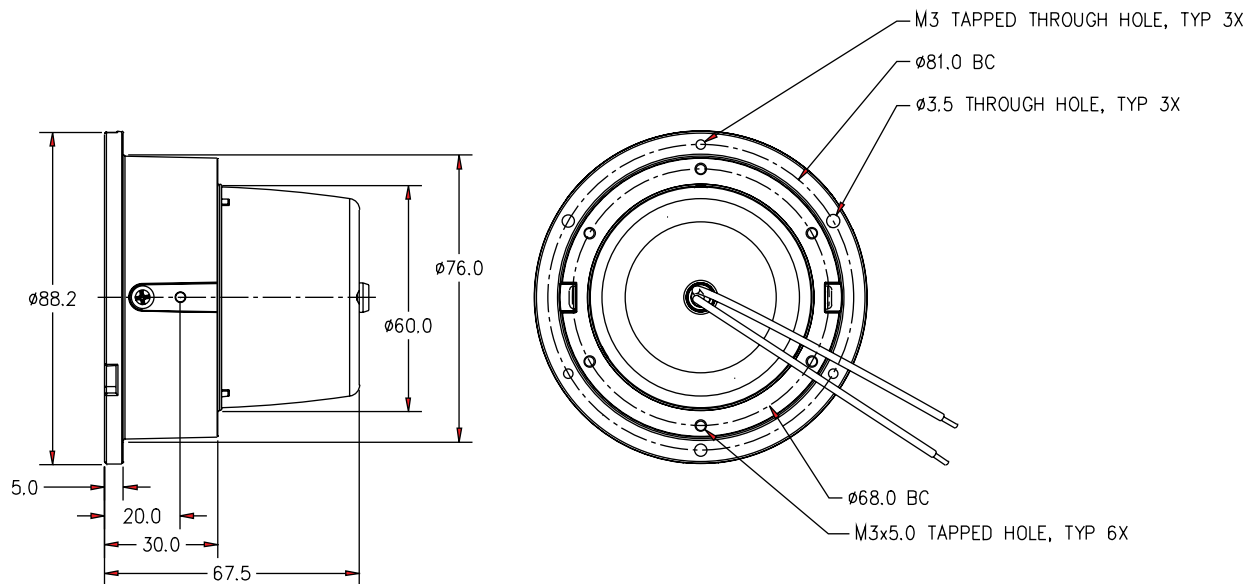
The presence of a dimmer in the above tables is not a guarantee or warranty of the compatibility of the LMR2 product family in any particular installation. The absence of a dimmer from these tables does not necessarily imply incompatibility. Please refer to the dimmer manufacturer's instructions for installation and further product information.

MECHANICAL DESIGN

The small form factor of the LMR2 allows the module to be easily incorporated into new and existing lighting designs with minimal impact and tooling modification.

Physical Characteristics of the LMR2

| Physical Characteristic | w/o Heat Sink | w/ Heat Sink |
|-------------------------|---------------|--------------|
| Weight (g) | 274 | 392 |
| Maximum Height (mm) | 70 | 70 |
| Maximum Diameter (mm) | 88.2 | 88.2 |
| Lens Diameter (mm) | 57.5 | 57.5 |

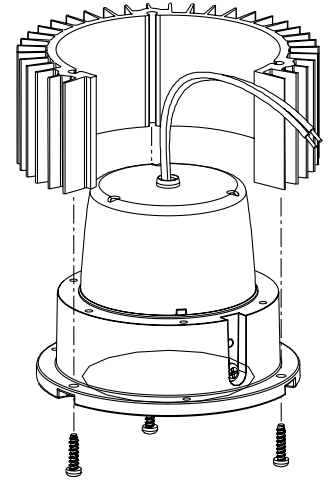


Mounting Options

The LMR2 module has been engineered for universal mounting, provided the thermal design guidelines are followed and the temperature at the Tc point remains below the specified maximum. (See the Thermal Design section for details). There are four (4) options for properly securing the LMR2 module to the luminaire. 3D CAD models of the options are available for download on the [LMR2 product page](#). For technical assistance in determining which option is best for a particular design, please contact the Cree Modules team directly at modules_support@cree.com.

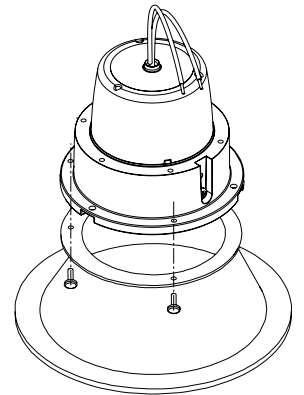
Option 1

Three (3) through-holes in the casting face are recessed in 3.5-mm by 9.5-mm slots. The holes provide clearance for M3 screws. The slots are 120° apart. The holes are on an 81-mm bolt circle and the slots are suitable for locking a keyed reflector or mounting your casting in place.



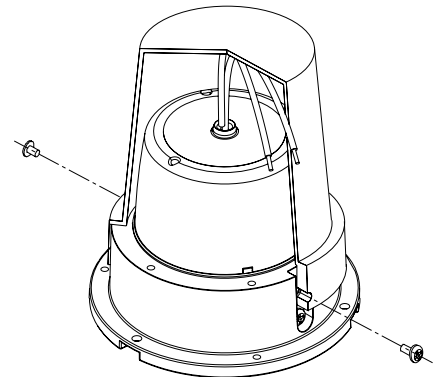
Option 2

Three (3) tapped M3 holes are in the casting face. The holes are 120° apart, on an 81-mm bolt circle and are suitable for mounting a cone flange.



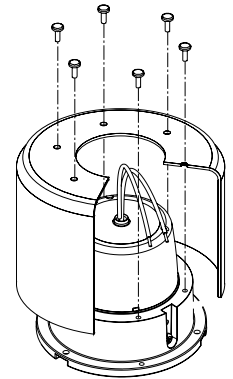
Option 3

Two (2) vertical slots in the casting side are 180° apart, with a minimum width of 8 mm. Each slot is recessed 3.9 mm into the casting and has two (2) tapped M3 mounting holes in each side. Each hole is 20.0 mm up from mounting face.



Option 4

Six (6) tapped M3x .5 holes are in the upper casting face. The holes are 60° apart, on a 68-mm bolt circle and are suitable for mounting a cone to the module or the module to a plate or a custom heat sink.



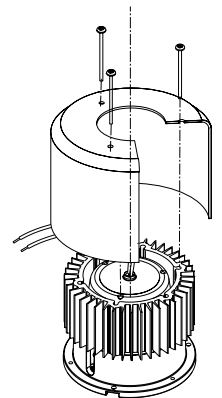
Optional Heat Sink

A specifically designed heat sink (P/N LMR020-HS00-0000-0000001) is available as an optional accessory to improve thermal performance. This specific heat sink is not required for proper operation of the LMR2 module. A heat dissipation path is required; the LMR2 family of modules should not be operated for extended times without a properly tested heat dissipation path. The heat sink available from Cree does provide a simple and cost-effective method for improving the thermal performance in various applications. The optional heat sink attaches to the upper casting flange with three (3) M3x40 screws, which are included with the heat sink. There are two (2) methods to attach the LMR2 module with the Cree heat sink to the luminaire.

Proper operation of the heat sink requires it to be mounted to the module with three (3) screws 120° apart. Failure to follow this hole pattern may result in uneven cooling of the module and overheating of the internal electronics, and this will void the warranty.

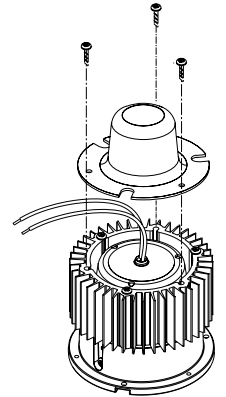
Option 1

The three (3) M3x40 screws may be used to mount additional brackets or a housing to the heat sink. Note that increasing the length of the material stack may require screws longer than 40 mm.



Option 2

The three (3) remaining screw slots in the heat sink extrusion have been sized to accept an M4 or #6 thread-forming screw. Additional brackets, housings, etc. may be secured to the module at these locations.



THERMAL DESIGN

Caution – The LMR2 bench rise temperature is 73 °C. Module components may be damaged if the module is left running without proper thermal dissipation. Do not operate for extended times without proper heat sinking.

LMR2 modules are designed to perform in a variety of environments and their expected lifetimes are highly dependent on their operating temperature. The LMR2 is designed to efficiently transfer heat away from the LEDs to the case of the module. When designing a luminaire that incorporates the LMR2 module, careful consideration must be taken to ensure a sufficient thermal path to ambient is provided. Verification of a proper thermal path is done through the placement of a thermocouple at the specified location. The LMR2 module must not exceed the maximum recommended operating temperature in thermal equilibrium at the Tc point to ensure proper performance, expected lifetime and maintain warranty terms.

| LMR2 Module | Recommended Operating Temperature @ Tc (°C) | | |
|--------------------------|---|---------|---------|
| | Minimum | Typical | Maximum |
| LMR020-0650-xxF9-x0100TW | 0 | 50 | 70 |
| LMR020-0750-xxF8-10100EW | 0 | | 75 |

The optional heat sink can increase thermal performance in luminaire designs and help meet minimum expected lifetimes. Luminaire designs with direct thermal paths to ambient are desired and will provide the best results.

Ambient Temperature Measurement

The ambient temperature of the test environment must be monitored and recorded with the required data during a temperature test. The preferred ambient temperature measurement apparatus is described in UL1598-2008 Rev January 11, 2010; 19.5. The intent of this requirement is to assure that the temperature monitored does not fluctuate during testing. The ambient temperature of the space must be 25 °C ± 5 °C. Note that bare thermocouple wires in open air is not an acceptable method of recording the ambient temperature.

Thermocouple Attachment Method

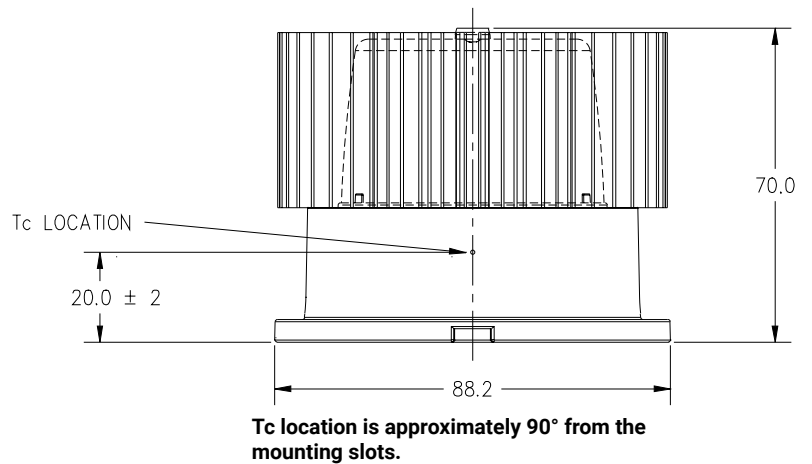
Attach a thermocouple to the indicated Tc location. The attachment method described in UL1598-2008 Rev January 11, 2010; 19.7.4 is preferred; using silver-filled thermal epoxy is an acceptable alternative. Ensuring that the tip of the thermocouple properly contacts

the module at the Tc location and that the attachment method does not add thermal resistance to the test are critical to correct and acceptable testing.

NOTE: Quick-drying adhesives and other cyanoacrylate products or their derivatives are known to be destructive, over time, to the components and adhesives used in Cree LED products. The use of cyanoacrylate products is at the discretion of the testing organization. Cyanoacrylate adhesives should not be used for life, duration or reliability testing.

Tc Measurement Method

Once the thermocouple is properly attached at the Tc location, assemble the module into the luminaire. The luminaire must then be tested in its intended environment or that environment which will result in the highest recorded temperature. Take care during assembly to ensure that the thermocouple(s) remain properly attached. Energize the luminaire and allow the assembly to reach thermal equilibrium. Thermal stabilization may require up to 7.5 hours, depending upon the mechanical design. Once thermal equilibrium is achieved, record the room ambient and Tc. Acceptable test results require the ambient temperature to be between 20° C and 30° C (25 °C ± 5 °C). Recorded variations above or below 25 °C must be added to or subtracted from the recorded temperatures. The table below can be used to determine the expected luminaire operating life.



Expected Lifetime versus Temperature at Tc Point

| LMR2 Module | Expected Operation Life (hours) | Tc (°C) @ 25°C room ambient |
|--------------------------|---------------------------------|-----------------------------|
| LMR020-0650-xxF9-x0100TW | 35,000 | 70 |
| | 50,000 | 60 |
| LMR020-0750-xxF8-10100EW | 35,000 | 75 |

ENVIRONMENTAL DESIGN

The LMR2 module is suitable for damp locations but does not have an IP classification. If the LMR2 module is to be designed into an outdoor luminaire classified other than “suitable for damp location; Covered Ceilings,” the luminaire manufacturer must ensure proper intrusion protection and appropriate regulatory-compliance testing.

OPTICAL DESIGN

The LMR2 module comes with a diffuser and lens to provide a uniform light source. The lens, diffuser and reflector cone must not be altered or removed from the LMR2 module. Secondary optics are not required. If secondary optics are used, understand that the following trade-offs occur.

- Reduced light output (luminous flux)
- Reduced efficacy (lumens/watt)
- Possible changes in color characteristics (CCT, CRI)

Photometry

IES (LM-63-2002) files and the optical source model for the LMR2 LED module are available on the Cree website.¹

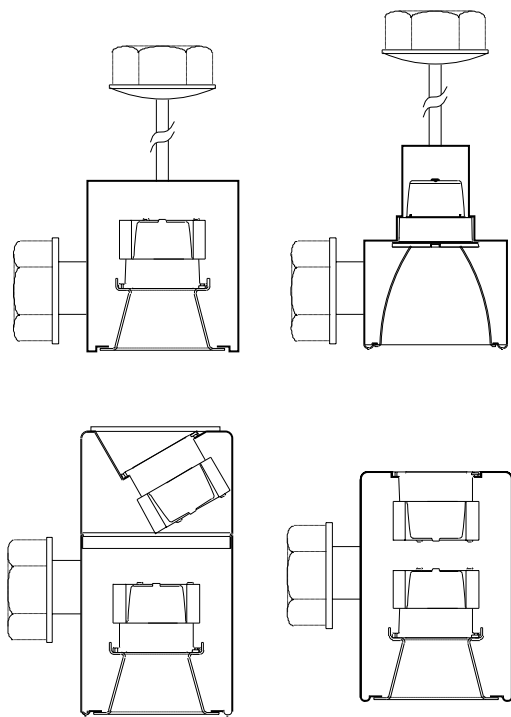
¹ Select the Documentation tab on the [LMR2 product page](#).

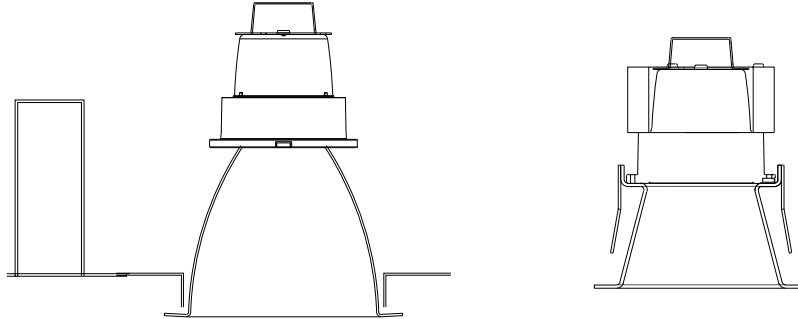
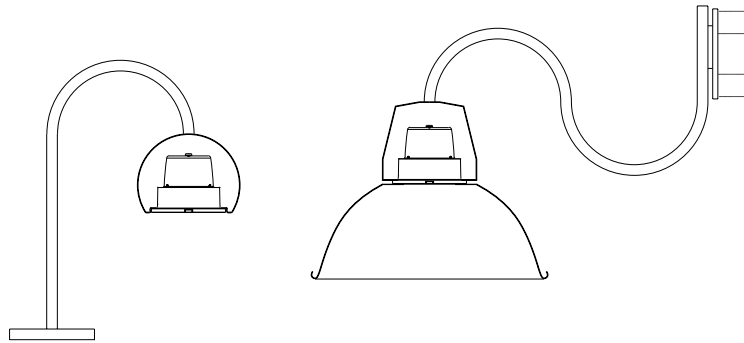
DESIGN EXAMPLES

The following section contains design proposals of luminaires that incorporate the LMR2 module. Please note the various attachment methods employed.

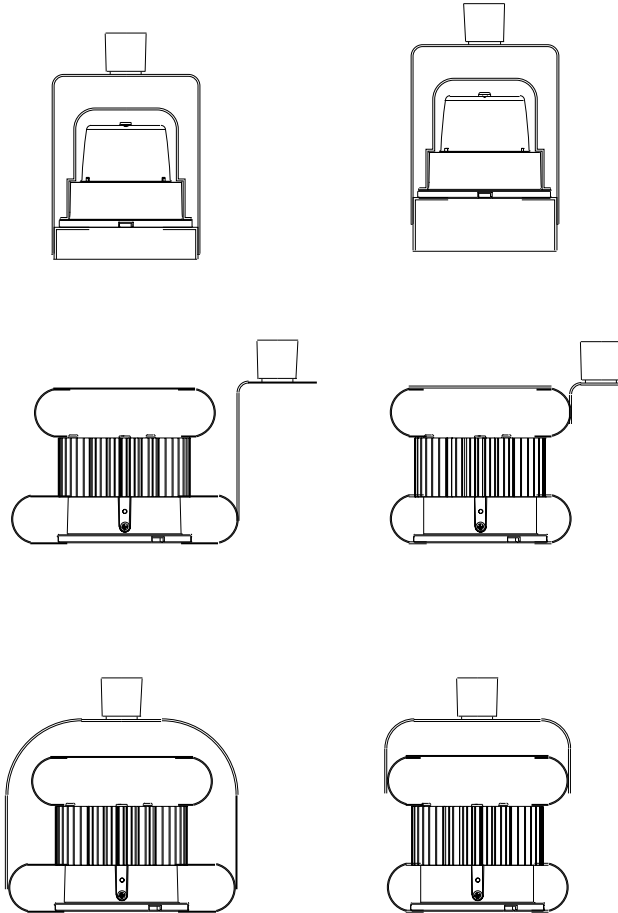
Note – The examples depicted below are conceptual only. The inclusion of a concept in this group does not imply agency approval. The exclusion of any concept from this group should not be seen as a limitation. These examples are not proprietary or protected and may be reproduced wholly or in part as required by a given luminaire manufacturer. Final agency approval(s) and confirmation of acceptable operating parameters is the sole responsibility of the luminaire manufacturer.

Cylinder/Pendant



Retrofit/New Construction**Decorative/Desk or Table**

Track



SAFETY AND REGULATORY NOTE

Do not look directly into an energized LMR2 module!

| Standard | 120 VAC / 60 Hz | 230 VAC / 50 Hz |
|-------------------------------|------------------------|--|
| Electromagnetic Compatibility | FCC 47 Part 15 Class B | EN 55015 IEC 61000-3-2 / 61000-3-0 IEC 61547 |
| Safety | UL 8750 | IEC 62031 IEC 60598-1 |
| Photobiological Safety | - | EN/IEC 62471 |
| Environmental | - | RoHS-Compliant |
| Regional - Energy Efficiency | California Title 24 | - |

Safety Certification

The LMR2 modules are UL® “Recognized” components and are “suitable for damp locations; covered ceilings.” The final luminaire design should go through safety certification, which is the responsibility of the luminaire manufacturer.

ENERGY STAR®

ENERGY STAR is a U.S. government-backed program that defines energy-efficiency standards for products. Qualification for ENERGY STAR certification is the responsibility of the luminaire manufacturer. The final luminaire must be submitted for testing to an independent, certified test facility. Cree can and will assist in the process by providing LM-80 component data for submission to ENERGY STAR.

Module Disposal

LMR2 modules should be disposed of properly at the end of their useful lifetime in accordance with local regulations. The LMR2 module is classified as “Electronic Equipment.”