

Cree® LMR4 Series Design Guide



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THANK YOU

Thank you for choosing to incorporate the LMR series and specifically the LMR4 series of LED modules into your state-of-the-art luminaire designs.

The LMR4 module team commits to you:

- Product design support that is lighting-knowledgeable and quick to respond.
- Thermal testing for lifetime analysis.
- Thermal path dissipation design assistance.

In addition, the LMR4 is a fully functioning module that delivers:

- Known and predictable lumens.
- Known and predictable correlated color temperature.
- L70 of 50,000 hours.

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

ABOUT THIS DESIGN GUIDE

Thank you for choosing the Cree LMR4 series of LED lighting modules. This design guide is intended to provide lighting designers an introduction to the LMR4 series of modules and provide critical design guidelines for successfully integrating the LMR4 into new and existing lighting fixtures.

For additional information please contact your local Cree sales representative. For technical information and support visit us on the web at www.cree.com/led-components-and-modules/products/modules/integrated/lmr4 or email us at modules_support@cree.com.

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

ABOUT THE LMR4 SERIES

The LMR4 series of LED lighting modules is designed to allow lighting designers and manufacturers to quickly incorporate Cree's patented TrueWhite Technology into their lighting designs. The LMR4 module is a complete LED lighting solution with integrated LED power supply and thermal management system combined in a single compact form factor. The LMR4 modules are designed to be used in general lighting applications where high efficacy and color rendering index (CRI) are important. LMR4 modules are available in either 120 VAC/60 Hz or 230 VAC/50 Hz versions.



ELECTRICAL DESIGN

The LMR4 modules contain a fully integrated LED power supply designed specifically to run directly from AC mains. Module operation is accomplished by simply connecting the two (2) lead wires (line and neutral) to the fixture wiring 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) 7-in. 18 AWG lead wires. (Strip length = 5 mm)

Power Requirements (Nominal)

Connection	700 lm		1000 lm	
	120 V / 60 Hz	230 V / 50 Hz	120 V / 60 Hz	230 V / 50 Hz
Power Consumption (W)	12		15	
Input Current (mA)	100	52	130	70
Power Factor	>.80	>.90	>.95	>.95

Wiring Strain Relief

The module must not be suspended directly via the AC wiring leads. Though the wiring from the LMR4 module is internally strain relieved within the housing, additional strain relief methods must be employed if the fixture is to be suspended solely by the wiring, as in a pendant fixture.

Electrostatic Discharge

No special electrostatic discharge (ESD) precautions are required for handling LMR4 modules in a production environment.

Protective Earth Ground

The LMR4 module must be properly protective earth grounded for safety and electromagnetic compatibility (EMC) compliance. A secure electrical connection must be made between the mounting plate or mounting plate screws and the fixture's protective earth ground point.

Dimming

The LMR4 module works with standard leading- and trailing-edge dimming technologies. The dimming range with leading-edge dimmers is 5-100%, and 10-100% with trailing-edge dimmers.

Please note that most residential dimmers are designed to control 600 to 1000 watts of standard lighting technologies, i.e., incandescent, halogen. Because the LMR4 module has a much higher efficiency and efficacy (lumens per watt) than standard lighting fixtures, it requires much less power. There may be some cases that require the use of more than one LMR4 module or lighting fixture on a single dimmer to achieve the minimum dimmer load. This will depend heavily upon the particular dimmer used. The tables below provide a partial list of compatible dimmers.

Dimmer Compatibility (120 VAC)

Manufacturer	Model / Series	Part Number(s)	Type	Compatible w/ 1 or more LMR4s	Compatible w/ 2 or more LMR4 modules
Cooper	Aspire	9530WS-K-L	600W STD		✓
	Aspire	9534WS-K-L	600W STD		✓
Lutron	Glyder	GL-600	600W STD	✓	✓
	Skylark	S-1000	1000W STD	✓	✓
	Toggler	TGLV-600PR	600W MLV	✓	✓
	Diva	DVLV-600P	600W MLV		✓
	Diva	DV-10P	1000W MLV		✓
	Glyder	GL-1000	1000W STD		✓
	Lyneo	LX-10PL	1000W STD		✓
Leviton	Decora	RPI06	600W STD		✓

Dimmer Compatibility (230 VAC)

Manufacturer	Part Number(s)	Type	Compatible w/ 1 or more LMR4 modules	Compatible w/ 2 or more LMR4 modules
Bush Jaeger	2250 U	500W STD	✓	✓
	2247 U	600W STD		✓
Clipsal	KB31RD400	400W STD	✓	✓
	E32V500	500W STD	✓	✓
Gira	030600/100	500W STD	✓	✓
	030700/101	525W STD	✓	✓
Key-Top	BP-81	600W STD	✓	✓
Lutron	LLSM-502-FAW	600W STD		✓
Leviton	6602-220	600W STD	✓	✓
Merten	572529	500W STD	✓	✓
PDL	634M	450W STD	✓	✓
Siemens	5TC8 256	400W STD	✓	✓
	5TC8 240	400W STD	✓	✓
Tradim	1431	250W STD	✓	✓

STD = Standard Dimmer

MLV = Magnetic Low Voltage Dimmer

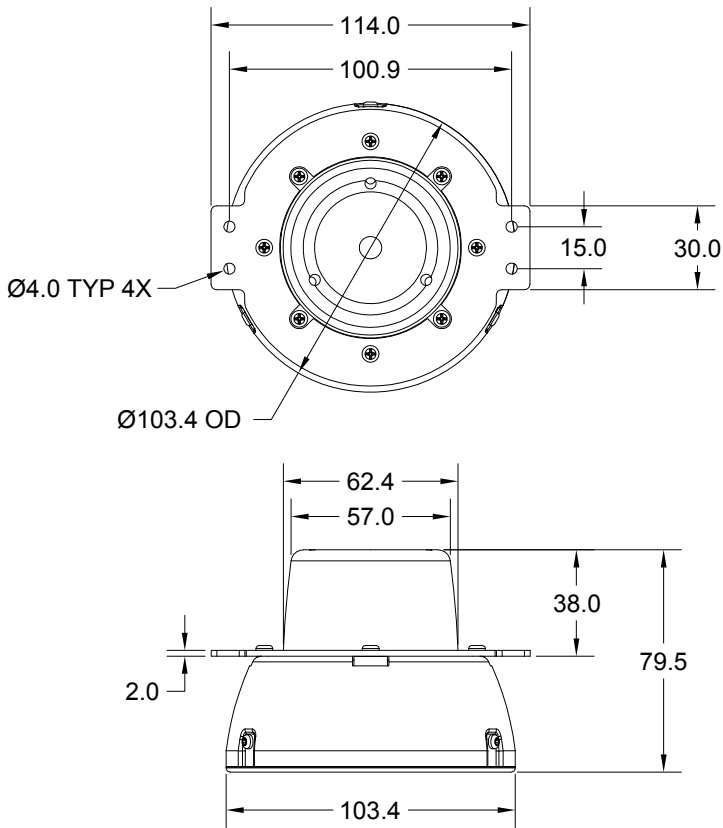
The presence of a dimmer in the compatibility tables is not a guarantee or warranty of the compatibility of the LMR4 product family in any particular installation. The absence of a dimmer from these tables does not necessarily imply incompatibility. Please reference the dimmer manufacturer's instructions for installation and further product information.

MECHANICAL DESIGN

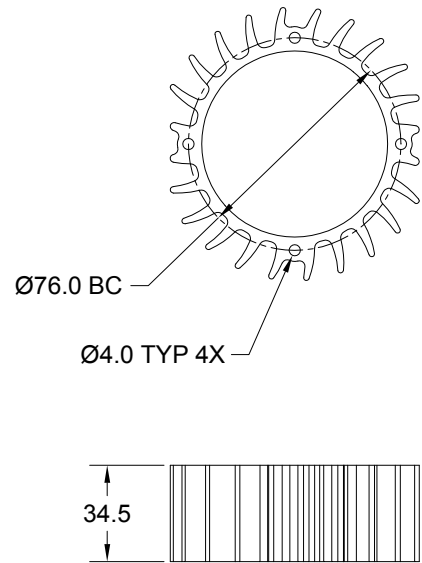
The LMR4 module is housed in a compact aluminum housing with a durable, white, powder-coat finish. The small form factor allows the LMR4 module to be easily incorporated into new and existing lighting designs.

Physical Characteristics of the LMR4 Series Modules

Physical Characteristic	w/o Heat Sink	w/ Heat Sink
Weight (g)	250	400
Maximum Height (mm)		79.45
Maximum Width (mm)		114.00
Lens Diameter (mm)		103.40



LMR4 module



Optional heat sink

* units = mm

Mounting Options

The LMR4 module may be mounted in any orientation provided the thermal design guidelines are followed and the case temperature (T_c) remains below the specified maximum. (See the Thermal Design section for further details). There are three (3) options for properly securing the LMR4 module to the fixture. CAD models are available for download at www.cree.com/led-components-and-modules/products/modules/integrated/lmr4. 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.

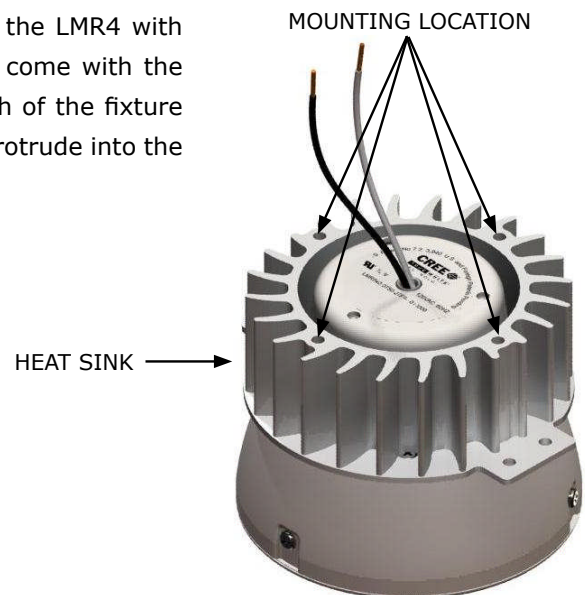
Option 1

There are four (4) mounting holes (4 mm), two (2) located on each side of the module mounting plate. The mounting plate comes pre-attached to the module with four (4) M3 x 6-mm screws and provides a simple and convenient method to attach the LMR4 module to the fixture. Alternatively, the mounting plate may be removed from the module for attachment directly to the fixture. Please note that if longer screws are used, they must not protrude more than 6 mm into the LMR4 module.



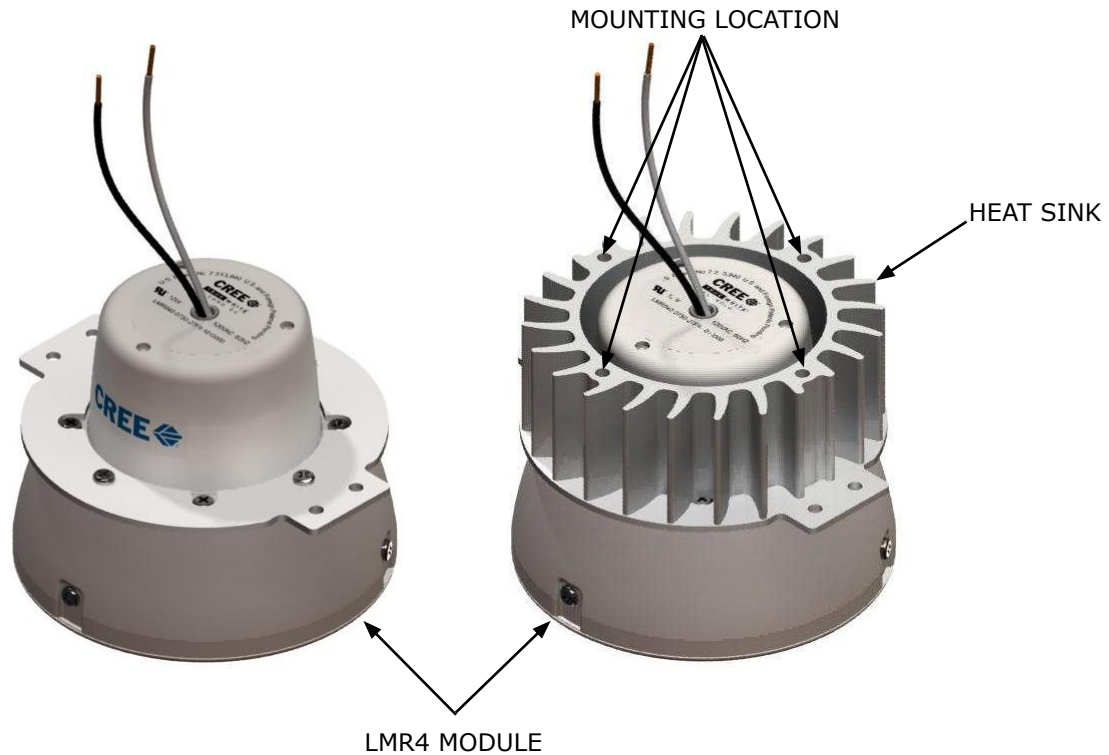
Option 2

This option requires the use of the optional heat sink. Mount the LMR4 with heat sink by replacing the four (4) M3 x 40-mm screws that come with the heatsink with longer screws to accommodate the added length of the fixture bracket. Please note that the maximum length the screw can protrude into the LMR4 module is 6 mm.



Optional Heat Sink

A specifically designed heat sink (P/N LMR040-HS00-0000-0000001 (pack of 10)) is available as an optional accessory to improve thermal performance. Though the optional heat sink is not required for proper operation of the LMR4 module, it does provide a simple and cost-effective method for improving the thermal performance in enclosed downlight applications. The optional heat sink attaches to the mounting plate by replacing the four (4) M3 x 6-mm screws that hold the mounting plate to the module housing with four (4) M3 x 40-mm screws, which are included with the heat sink.



DESIGN EXAMPLES

The following section contains design examples of fixtures (luminaires) with the LMR4 module inside. Please note the various attachment methods employed.



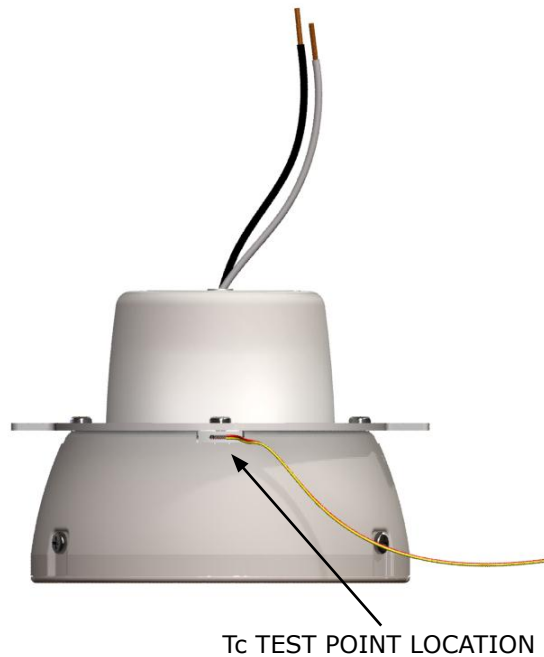


THERMAL DESIGN

LMR4 modules are designed to perform in a variety of environments and their expected lifetimes are highly dependent upon their operating temperature. The LMR4 module is designed to efficiently transfer heat away from the LEDs to the case of the module. When designing a fixture that incorporates the LMR4 module, careful consideration must be taken to ensure a sufficient thermal path to ambient is provided. To simplify the design and verification process, a thermocouple location is specified for testing purposes. The LMR4 module must not exceed 70 °C in thermal equilibrium at the test point to ensure proper performance and expected lifetime and to maintain warranty terms.

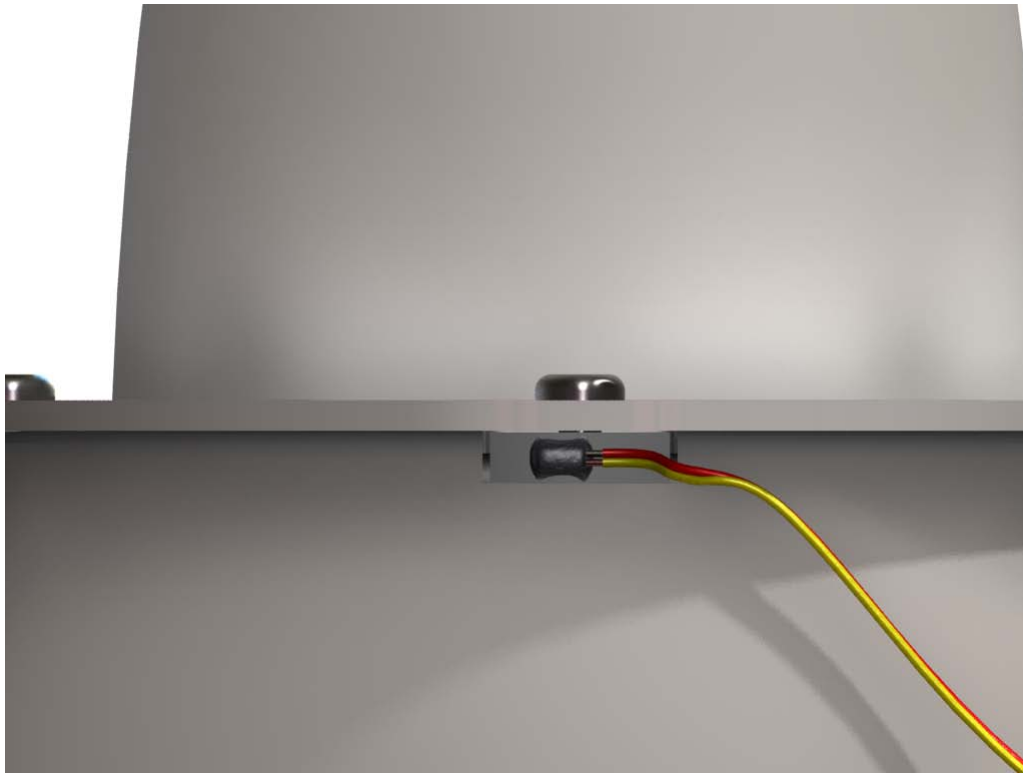
The optional heat sink can increase thermal performance in enclosed fixture designs to help meet minimum expected lifetimes. Fixture designs with direct thermal paths from the universal mounting bracket to ambient are desired and will provide the best results.

	Minimum	Typical	Maximum
Recommended Operating Temperature @ Tc (°C)	0	50	70



Thermocouple Attachment Method

Attach a thermocouple to the indicated Tc location using silver-filled thermal epoxy. It is very important to ensure that the tip of the thermocouple properly contacts the module at the Tc location. The following figure shows a properly attached thermocouple at the Tc location.



Attached thermocouple at Tc location

Tc Measurement Method

Once the thermocouple is properly attached at the Tc location, assemble the module into the fixture. The fixture must then be tested in its intended environment. Ensure that the thermocouple is still properly attached. Turn on the module and allow the fixture to come to thermal equilibrium. It can take up to 6 hours for the fixture to reach equilibrium depending upon the design. Once the module reaches thermal equilibrium, check the temperature at the Tc location. Then use the table below to determine the expected fixture lifetime.

Expected Lifetime

Expected Lifetime (hours)	Tc (°C)
35,000	70
50,000	60

ENVIRONMENTAL DESIGN

The LMR4 module is suitable for “damp locations” but does not have an IP classification. If the LMR4 module is to be designed into an outdoor fixture classified other than “suitable for damp location,” the designer must ensure proper intrusion protection and appropriate regulatory-compliance testing.

OPTICAL DESIGN

The LMR4 module comes with a diffuser and lens to provide a uniform light source. The lens, diffuser and reflector cone should not be altered or removed from the LMR4 module. Secondary optics are not required for use. If secondary optics are used, understand that the following tradeoffs occur.

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

Photometry

IES and photometric data files for the LMR4 modules are available from www.cree.com/led-components-and-modules/products/modules/integrated/lmr4.asp.

SAFETY AND REGULATORY NOTE



Safety Note



Do not look directly into an LMR4 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 LMR4 modules are UL-listed "Recognized" components and are "suitable for damp locations". The final fixture should go through a final safety certification, which is the responsibility of the fixture designer. Contact Cree directly for assistance.

ENERGY STAR®

ENERGY STAR Star is a U.S. government-backed program that defines energy-efficiency standards for products. To qualify for ENERGY STAR certification, the final fixture must be submitted for testing to an independent, certified test facility. Cree can assist in the process by providing LM-80 component data for submission to ENERGY STAR.

Module Disposal

LMR4 modules should be disposed of properly at the end of their useful lifetime in accordance with local regulations. The LMR4 module is classified as "Electronic Equipment".