

Lamp Replacement Modules (LRM) 101

Theory of operation

LED stands for Light Emitting Diode. An LED is a semiconductor chip that converts electrical energy into light. The conversion of energy into light happens on the quantum level within the molecular makeup of the semiconductor chip. The process begins with the chip acting as a diode with two terminals, a P (Positive hole carrier) and N (Negative electron) region in its basic structure, which allow the chip to conduct in one direction for operation. In addition, there are added chemical layers called epitaxy layers that enhance the ability of the device to emit light (Photons).

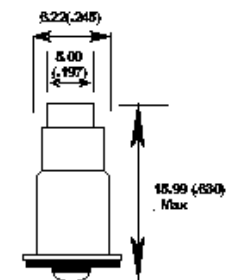
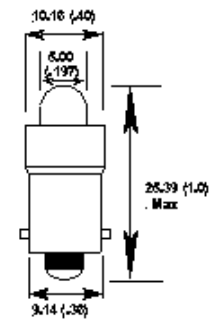
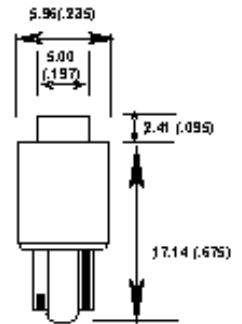
As electrical energy passes through the P and N regions of the LED, electrons move to higher energy levels called band gap potentials. To meet the conservation of energy law, the electron's excess energy, gained while moving energy levels, will then produce a photon that our eye will perceive as light. At this point, the band gap potentials equal the energy of the photon created when the electron that was moving energy levels comes back to the ground state. The color of the light emitted directly relates to the size of the band gap potentials or the amount of energy the photons produce. Since different colors occur at different band gap potentials, or energy levels, this explains why different color LEDs exhibit different forward voltages to operate.

The simplest packaged LED is the indicator lamp. Typically, LEDs have a mean time between failures (MTBF) of more than 100,000 hr.

Today's ultra bright LEDs exceed the light output of incandescent and halogen lamps. They don't have the maintenance requirements associated with filament lamps. LEDs can be dimmed using a pulse-width modulation (PWM) circuit, which delivers energy in pulses of varying duty cycle.

LEDs, by nature are durable and colorful; they are a perfect light source for decoration, for hard-to-reach area lighting, for high vibration applications, and so forth.

Lamp Replacement Modules are the alternatives to the incandescent lamp. The Lamp Replacement Module (LRM) is produced using either a single chip LED or a multi LED cluster. They have an internal resistor and are produced as a drop in replacement for their incandescent counterpart.



These innovative LED products replace standard based incandescent lamps in miniature switches, indicators, enunciators and other applications where complete compatibility, durability and efficiency are needed. The LED single chip and cluster lamps last 10 - 20 times longer than the incandescent lamps they replace, and their low-current, high-efficiency operation delivers power savings of 80% - 90% or more.

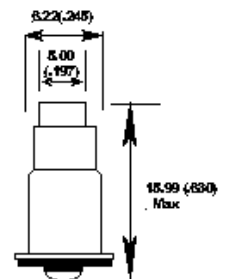
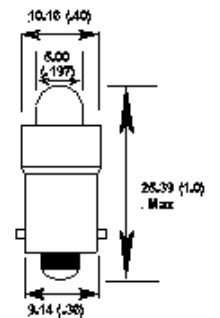
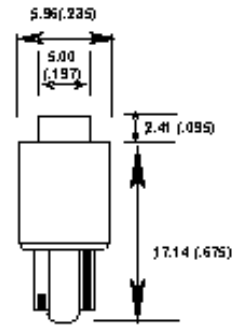
Solid-state design renders Based LEDs impervious to electrical and mechanical shock, vibration, frequent switching and environmental extremes. A typical LED cluster lamp contains one to six solid-state emitters arranged to provide an intense beam of colored light. The emitter arrangement provides a very wide viewing angle. Colored lenses or filters are not needed since LED lamps emit colored light. The intensity and wavelength remain stable over the lamp's lifetime of 100,000-plus hours. (That's 10-20 times longer than incandescent bulbs!) Additionally, Based LEDs are environmentally friendly because they use 80% to 90% less operating power than standard incandescent bulbs.

LEDs have enjoyed continued success because they use considerably less power and last much longer than tungsten filament incandescent bulbs. LED lamps use only 10% to 20% of the energy consumed by equivalent incandescent lamps. An average LED life span can exceed 100,000 hr — more than 11 yr.

LEDs are solid-state devices, which make them virtually immune to electrical and mechanical shock — unlike incandescent lamps, which have filaments that are very susceptible to electrical and mechanical shock. Electrical shock comes from constant on-off transitions, transients, and surges; mechanical shock comes from bumping, jarring, and other forms of vibration. Also, LEDs produce very little heat, making them an attractive alternative to incandescent lamps in applications where heat is an issue, such as biotechnology, chemical, and food processing.

The LED lamp replacements are available in various industrial standard voltages, bases, and 6 colors, including Red, Amber, Green, Blue, White, and newly developed Warm White colors. Unlike incandescent light which has only a white color, LED can produce color lights directly.

In order to preserve the light efficiency, you should choose the color of the LED that is closest to your needs; for example, if you need LED light bulbs for your red marker light, you should choose red LED; otherwise you won't have the maximum potential of light coming out of your light fixture.



The cost-effectiveness of LEDs depends on the application. For established LED applications, such as control panel indicators and annunciator lamps, LEDs are very cost effective. Although the unit price is higher, the lower power consumption and longer lamp life help offset the initial purchase price.







Benefits of using LRM (Lamp Replacement Module):

- LRMs withstand most shocks and vibrations.
- LRMs last an average of 100,000 hours (about 10 years).
Reducing maintenance costs.
- LRMs generate almost no heat.
- LRMs are 10 to 50 times more efficient than incandescent lamps reducing energy costs.
- The LRM emits true controllable color based on the LED die and encapsulation of the part. Thus removing the need for a colored lens cap.
- LRMs have a very fast response time measured in nanoseconds.
- Are available in custom sizes for exact replacement
- LRM's offer the option of special voltage limiting resistors for specific applications.
- LRMs are available in all of the popular base configurations.
- LRMs offer the option of true non-polarized design allows both center positive and center negative operation.

Pertinent Questions:

1. What is the part number of the original incandescent lamp being replaced?
2. What is the base type?
3. What is the operating voltage and the polarity of the center contact?
4. What is the viewing angle if known?
5. Is the lamp going into a lamp holder? If so what manufacture and part number?
6. Does it have to fit behind a lens cap? What color cap? How thick the lens?
7. What is the gap between the top of the incandescent lamp and the lens?
8. What is the ambient lighting?

Available Bases:

	T2 #5 Telephone Slide Base	Replaces the following Incandescent: 6PSB, 12PSB, 24PSB, 28PSB,48PSB
	T5 Wedge Base	Replaces the following Incandescent: 56,74,79,84,86,18,73,37,70,85,17,915912,917,921,906,904,916,928
	T3 1/4 8mm Single Wedge Base	Replaces the following Incandescent: 447, 159,555,259,192,658,193, 161,168,194, 158, 585,656,152,657,400,655,464
	T10 Wedge Base	Replaces the following Incandescent: 17,18,37,56,73,74,79,84,85,86
	T10 BA9S Bayonet Base	Replaces the following Incandescent: 6MB, 12MB, 24MB, 48MB,60MB, 120MB, 44, 47,49,51, 130, 137, 182, 216, 219, 239, 240, 256, 257,293, 313, 755, 756, 757, 1302, 1445, 1819, 1820,1822, 1828, 1835, 1847, 1850, 1855, 1864, 1866, 1873, 1888, 1889, 1891, 1892.
	T10 T3 1/4 Edison Screw Base	Replaces the following Incandescent: 42,40,46,1487,1821,1832,1823, 60MS, 120MS