LED Lamps

Lamp description

Light emitting diodes, commonly called LED's, are tiny light bulbs that fit easily into an electrical circuit. But, unlike ordinary incandescent bulbs, they don't have a filament that will burn out, and they don't get especially hot. They are illuminated solely by the movement of electrons in a semiconductor material, and they last just as long as a standard transistor.

LED's are used for many different applications and are found in all kinds of devices. They can form the numbers on digital clocks, transmit information from remote controls, light up watches and tell you when your appliances are turned on. Collected together, they can form images on a jumbo television screen or illuminate a traffic light.

What is a Diode?

A diode is the simplest sort of semiconductor device. A semiconductor is a material with a varying ability to conduct electrical current. Most semiconductors are made of a poor conductor that has had impurities (atoms of another material) added to it. The process of adding impurities is called doping.

In the case of LED's, the conductor material is typically aluminum-gallium-arsenide (AlGaAs). In pure aluminum-gallium-arsenide, all of the atoms bond perfectly to their neighbors, leaving no free electrons (negatively-charged particles) to conduct electric current. In doped material, additional atoms change the balance, either adding free electrons or creating holes where electrons can go. Either of these additions make the material more conductive.

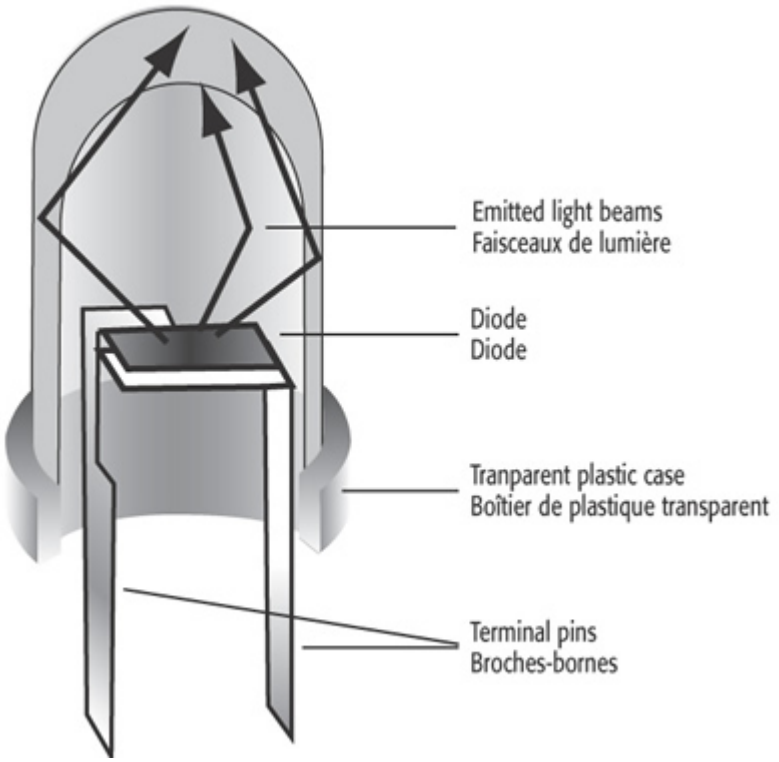
How Can a Diode Produce Light?

Light is a form of energy that can be released by an atom. It is made up of many small particle-like packets that have energy and momentum but no mass. These particles, called photons, are the most basic units of light.

Photons are released as a result of moving electrons. In an atom, electrons move in orbitals around the nucleus. Electrons in different orbitals have different amounts of energy. Generally speaking, electrons with greater energy move in orbitals farther away from the nucleus.

For an electron to jump from a lower orbital to a higher orbital, something has to boost its energy level. Conversely, an electron releases energy when it drops from a higher orbital to a lower one. This energy is released in the form of a photon. A greater energy drop releases a higher-energy photon, which is characterized by a higher frequency.

Inside a light emitting diode



Advantages of LED

LED's have several advantages over conventional incandescent lamps. For one thing, they don't have a filament that will burn out, so they last much longer. Additionally, their small plastic bulb makes them a lot more durable. They also fit more easily into modern electronic circuits.

The main advantage of LED's is efficiency. In conventional incandescent bulbs, the light-production process involves generating a lot of heat (the filament must be warmed). This is completely wasted energy, unless you're using the lamp as a heater, because a huge portion of the available electricity isn't going toward producing visible light. LED's generate very little heat, relatively speaking. A much higher percentage of the electrical power is going directly to generating light, which cuts down considerably on the electricity demands.

Up until recently, LED's were too expensive to use for most lighting applications because they're built around advanced semiconductor material. The price of semiconductor devices has plummeted over the past decade, however, making LED's a more cost-effective lighting option for a wide range of situations. While they may be more expensive than incandescent lights up front, their lower cost in the long run can make them a better buy. In the future, they will play an even larger role in the world of technology.

Filament Designations

Miniature LED Lamps are designed as a replacement for comparable incandescent lamps.

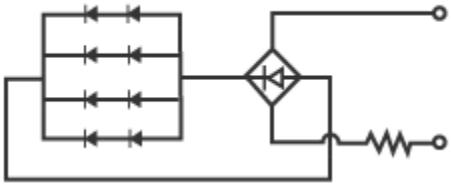
Features

- Super bright - incorporating 8 LED/4 LED chips into one lamp resulting in super bright light.
- AC/DC application - using 4 chip-diodes to form a "Bridge Circuit"*, allows the use of both AC/DC circuit.
- Low power consumption.
- Long life - 50,000 to 100,000 hrs.

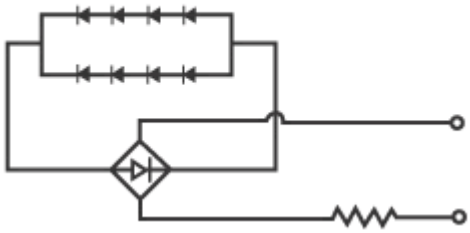
- Comes with a dome shape Fresnel lens cap which when lit, the lamp emits a large luminescent spot.
- Metal rim construction which allows heat to dissipate quickly and gives solid state reliability.
- Available in 3 colors: red, green and yellow.

INTERNAL CIRCUIT	BRIDGE CIRCUIT

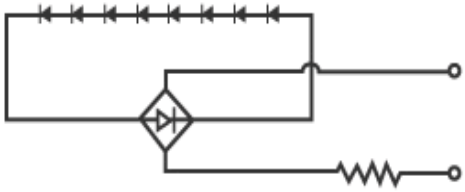
AC/DC 6V



AC/DC 12V

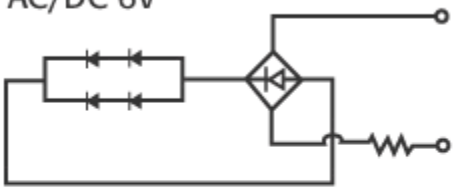


AC/DC 24V & 28V

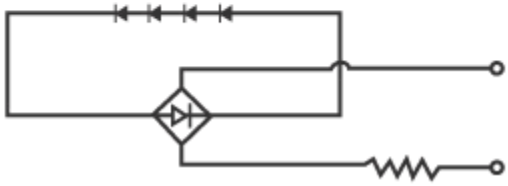


4 LED CHIPS / 4 DEL

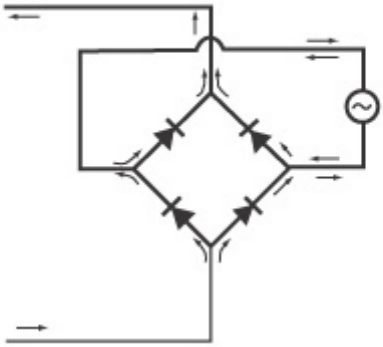
AC/DC 6V



AC/DC 12V, 24V & 48V



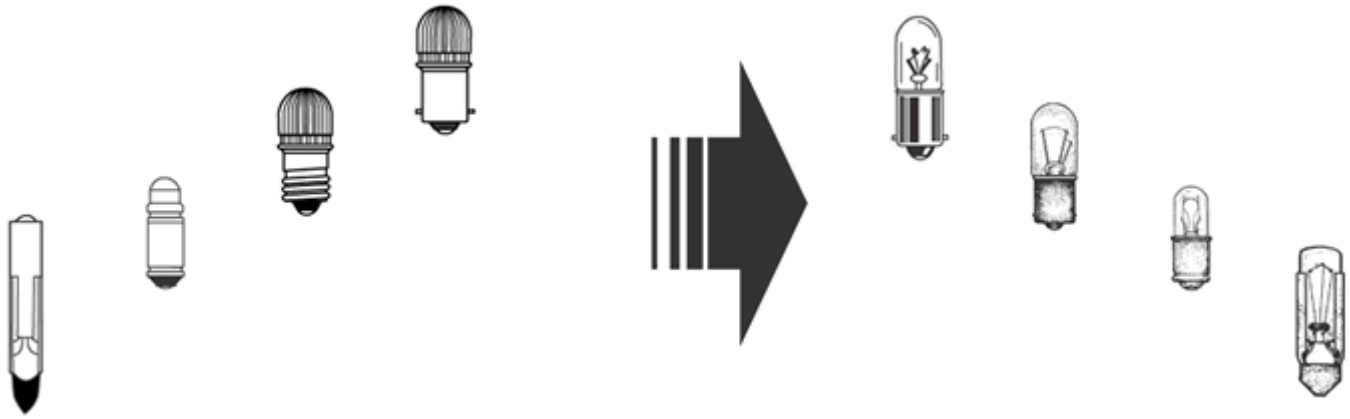
*** BRIDGE CIRCUIT / MONTAGE EN PONT**



Symbol of "Bridge Circuit"
Symbole du "montage en pont"

Convert Incandescent Miniature Lamps to Super Long Life and Reliable LED Technology.

Retrofit These Incandescent To LED's



- Long life
- Reduction in maintenance cost
- Wide range of voltages
- Wide range of bases
- 50,000 - 100,000 hours
- No lamp replacement
- 6V, 12V, 24V, 28V, 120V
- BA9s, E-10, S4s, F6
- Telephone slide

Compare and Save

Miniature lamp costs		**LED costs**	
Cost of 10 miniature lamps*	$10.00	Cost of 1 LED	$8.00
Cost of installation labor over 50,000 hours**	$100.00	Cost of installation labor over 50,000 hours	$0.00
Total	**$110.00**		**$8.00**

Save $102 per Socket over 50,000 hours

* Assume miniature lamps are rated for 5,000 hours and costs $1.00.
** Assume maintenance costs of $10.00 per replacement of 5,000 hour miniature lamp.

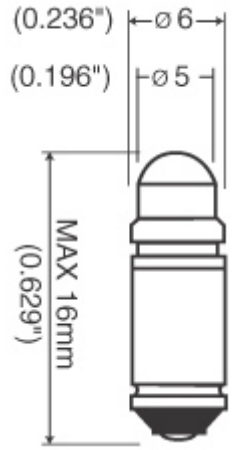
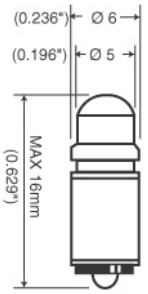
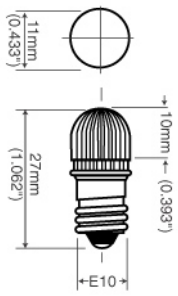
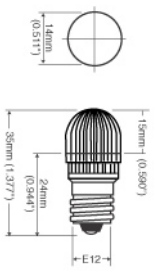
Long life and reduced maintenance costs

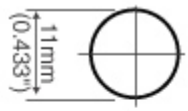
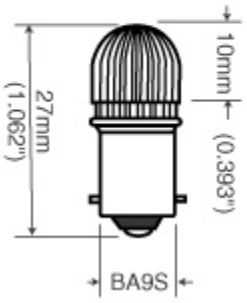
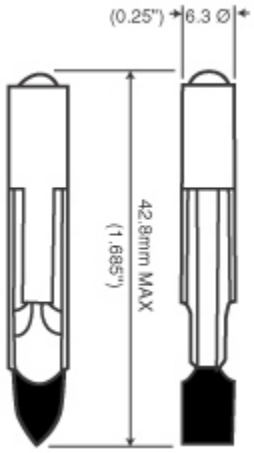
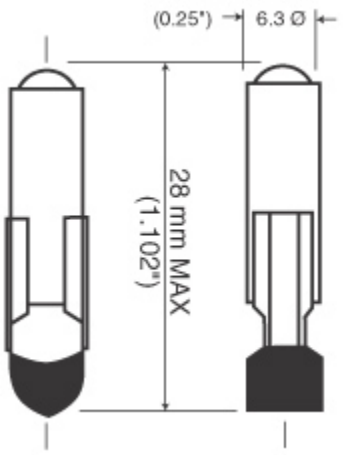
Now you can reduce maintenance costs and down time by substituting incandescent miniature lamps for long life, reliable LED's.

LED's are 4 and 8 chip light emitting diodes for use on both AC and DC circuits. LED's have a built in resistor, low power consumption and long life (50,000 to 100,000 hours). Metal rim construction allows heat to dissipate and provides solid state reliability. Available in red, green, and yellow, 6V, 12V, 24V, 28V and 120V.

Standard's high quality LED's offer voltage, base types and lamp sizes compatible with many incandescent miniature lamps.

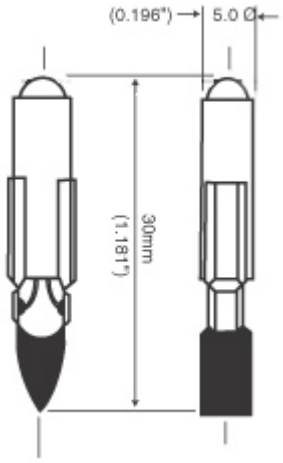
Guide for substituting miniature lamps with LED lamps

Miniature Lamp	LED Substitute	
Midget groove S4s base		
341, 3152, 6950, 7345, 7347, 7748, 7350	LMG0005 (red, green, yellow), 5 volt midget groove S4s	
337, 379, 398, 3751, 3752, 8705, 8706, 8708	LMG0006 (red, green, yellow), 6 volt midget groove S4s	
336, 386, 393, 7353, 7354	LMG0012 (red, green, yellow), 12 volt midget groove S4s	
457, 8177	LMG0024 (red, green, yellow), 24 volt midget groove S4s	
Midget flange F6 base		
339, 3150, 7332, 7333, 7334, 7335	LMF005 (red, green, yellow), 5 volt midget flange F6	
328, 332, 345, 349, 350, 377, 380, 381, 7336, 7337	LMF0006 (red, green, yellow), 6 volt midget flange F6	
330, 382, 384, 394, 7338, 8918	LMF0012 (red, green, yellow), 12 volt midget flange F6	
459, 8176	LMF0024 (red, green, yellow), 24 volt midget flange F6	
327, 376, 385, 387, 7341	LMF0028 (red, green, yellow), 28 volt midget flange F6	
E-10 miniature screw base		
40, 46, 63M, 133, 435, 437, 1483, 7121D	LMS8006 (red, green, yellow), 6 volt E-10 miniature screw base	
52, 57, 67M, 1487, 1814	LMS8012 (red, green, yellow), 12 volt E-10 miniature screw base	
599, 1448, 1487, 1814	LMS8024 (red, green, yellow), 24 volt E-10 miniature screw base	
SP126, 1821, 8108D	LMS8028 (red, green, yellow), 28 volt E-10 miniature screw base	
SP116	LMS8048 (red, green, yellow, mixed), 48 volt E-10 miniature screw base	
E-12 candelabra screw base		
63K, 81K	LCA8006 (red, green, yellow), 6 volt E-12 candelabra screw base	
67K, 89K, SP42	LCA8012 (red, green, yellow), 12 volt E-12 candelabra screw base	
SP46, 509K	LCA8024 (red, green, yellow), 24 volt E-12 candelabra screw base	
BA9s base		
6MB, 39, 44, 47, 51, 55, 130, 137, 219, 238, 239, 240, 242, 316, 755, 1302, 1406, 1810, 1847, 1855 1866, 1886, 1888, 3895	LMB8006 (red, green, yellow), 6 volt BA9s single contact	
12MB, 53, 57, 181, 182, 216, 230, 250, 293,	LMB8012 (red, green, yellow), 12	

756, 1445, 1813, 1815, 1816, 1889, 1891, 1892, 1893, 1895, 1898, 1909, 3796	volt BA9s single contact	
24MB, 1450, 1484, 3797	LMB8024 (red, green, yellow), 24 volt BA9s single contact	
28MB, SP125, 265, 313, 456, 757, 1819, 1820,1828, 1829, 1873	LMB8028 (red, green, yellow), 28 volt BA9s single contact	
967, SP105, SP114	SHTA120 (red, green, yellow, mixed), 120 volt BA9s single contact	
Telephone slide #1 base		
GA1, 6B1, 6C1	LAI0006 (red, green, yellow), 6 volt slide base #1	
12A1, 12B1, 12C1, 2F	LAI0012 (red, green, yellow), 12 volt slide base #1	
24A1, 24B1, 24C1, 24D1, 24E1, 2J, 2G, 2U	LAI0024 (red, green, yellow), 24 volt slide base #1	
48A1, 48B1, 48C1, 48D1, 2Y	LAI0048 (red, green, yellow), 48 volt slide base #1	
Telephone slide #5 base		
6ESB, 6PSB	LPS0006 (red, green, yellow), 6 volt slide base #5	
12ESB, 12PSB	LPS0012 (red, green, yellow), 12 volt slide base #5	
24CSB, 24ESB, 24PSB	LPS0024 (red, green, yellow), 24 volt slide base #5	
28ESB, 28PSB	LPS0028 (red, green, yellow), 28 volt slide base #5	
48 ESB, 48PSB	LPS0048 (red, green, yellow), 48 volt slide base #5	
Telephone slide 4.5X4.5 base		
ATS062, ATS064, ATS5068	LLT0006 (red, green, yellow), 6 volt slide base 4.5X4.5	
ATS5122, ATS5125	LLT0012 (red, green, yellow), 12 volt slide base 4.5X4.5	

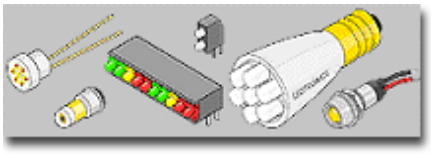
ATS5242,ATS5245

LLT0024 (red, green, yellow), 24 volt slide base 4.5X4.5



LED drivers/converters

Leveraging in-house know-how and experience with DC technology from the development of transformers for open conducted systems, our manufacturer is now in a formidable position to play a leading role in the development of drivers for LEDs for general lighting purposes. This is particularly relevant with the introduction of high powered and brighter LEDs. The first generation of our line, a 25VA/24V DC version, will be demonstrated in May at both Intel and Lightfair 2005. We expect to release additional configurations as well as a second generation driver within the next twelve months.



Not only can they extend the useful life of your LEDs, drivers also aid in dimming and color changing

Light emitting diodes (LEDs) are low-voltage light sources that require a constant DC voltage or current to operate optimally.

Because they operate on a low-voltage DC power supply, they easily adapt to different power supplies, have longer standby power, and are safer. Individual LEDs that are used for illumination require 2V to 4V of direct current (DC) power and several hundred milliamps of current. As LEDs are connected in series in an array, higher voltage is required.

In addition, the light source must be protected from line-voltage fluctuations during operation. Changes in voltage can produce a disproportionate change in current, which in turn can cause light output to vary, as LED light output is proportionate to current and is rated for a current range. If current exceeds the manufacturer recommendations, the LEDs can become brighter, but the increased heat can degrade their light output at a faster rate and shorten useful life. One definition of useful life for LEDs is the point at which light output declines by 30%.

Therefore, LEDs require a device that can convert incoming AC power to the proper DC voltage and regulate the current that flows through the LED during operation. An LED driver converts 120V (or other voltage) 60 Hz AC power to the low-voltage DC power required by the LEDs and protects them from line-voltage fluctuations. It's analogous to a ballast in a fluorescent or HID lighting system.

LED drivers may be constant voltage types (usually 10V, 12V, and 24V) or constant current types (350mA, 700mA, and 1A). Some operate specific LED devices or arrays, while others can operate most commonly available LEDs. They're usually compact enough to fit inside a junction box, include isolated Class 2 output for safe handling of the load, operate at high system efficiency, and offer remote operation of the power supply.

After an electrical fire destroyed the face of a Carl's Jr. fast-food franchise sign, the neon signage was replaced with new LED signage powered by LED drivers. Input watts dropped from 200W to 38W with the LED system, producing a payback in less than two years. (Photo courtesy of Advance Transformer Co.)

Dimming and color changing. Drivers can enable dimming and color-changing or sequencing of LEDs initiated by preset commands, occupant presence, or manual commands. Most LED drivers are compatible with commercially available 0V to 10V control devices and systems like occupancy sensors, photocells, wall box dimmers, remote controls, architectural and theatrical controls, and building and lighting automation systems. They can also work with devices governed by the DMX and digital addressable lighting interface (DALI) protocols and, in the future, may include wireless as a control option.

"With the use of fully electronic drivers, the possibilities are endless," says Al Marble, manager of sales and market development for Rosemont, Ill.-based Philips-Advance Transformer. "This area is only now being developed, but tighter integration of all electronic components is expected to reduce the use of discrete components in the field and simplify application."

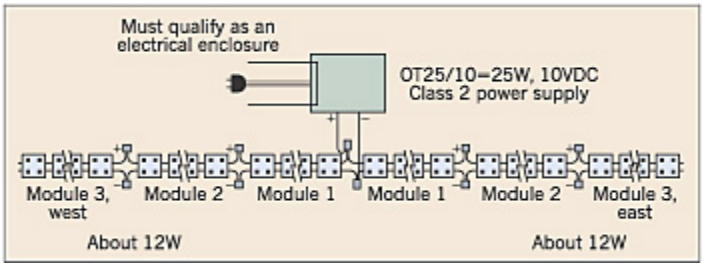
Drivers with dimming capability can dim the LED light output over the full range from 100% to 0%. They do so by reducing the forward current or by using pulse width modulation (PWM) via digital control. More sophisticated methods exist, but most dimming drivers use PWM. With this method, the frequency could range from 100 modulations per second to hundreds of thousands of modulations per second. With that many modulations, the LED appears to be continuously lighted without flicker. A benefit of the PWM method is that it enables dimming with minimal color shift in the LED output. According to the Lighting Research Center, dimming causes LEDs to experience a shift in spectral power distribution similar to what happens in an incandescent lamp. However, if colored LEDs in an array are used to produce white light, the amount of shift, particularly with red and yellow LEDs, may produce an undesirable effect on the white light that is produced by the system.

Dimming doesn't result in a loss of efficiency. During dimming, LEDs still operate at the same voltage and current as during full light output. In addition, lamp life isn't affected by dimming, as is sometimes the case with frequently dimmed fluorescent lighting. Rather, dimming LEDs may lengthen their useful life because it can reduce operating temperatures inside the light source.

Drivers can also be used for color changing or sequencing by dimming a mix of colored LEDs in an array. The driver can also work with a color sequencer, which receives the 10V or 24V LED driver output and converts it into three-channel output — usually red, blue, and green — that can be mixed to create a wide range of colors. A sequencer can carry out a preset series of color changes at a speed determined by the specifier. It's also possible to control and program each LED individually by interfacing with a DMX digital controller, which makes it possible to dynamically dim up or down thousands of LEDs to create a seemingly infinite spectrum of colors.

Specification tips. Sameer Sodhi, product marketing manager for LED power supplies and controls at Osram Sylvania, points out that a common problem with LED system operation involves overloading the driver. LED drivers are rated for a maximum load that must be followed.

"One of the most common mistakes is to connect too many LED strings in series," he says. "Doing so may result in too low a voltage being available to the last string(s) in the chain" (Figure above).



For these six back-light modules, the leads to the power supply should connect at the center of the chain so that three modules travel in one direction and three travel in the other direction.

Another common problem, he warns, is using the wrong voltage driver. "When a wrong voltage driver is used, the LEDs will either not light up or may operate at higher currents than intended," he says. "A prudent practice is to check the voltage rating of the LED load being used against the rated output voltage of the driver. For example, using a 12V driver on a 10V LED load could result in significantly shorter life of the module."

Sodhi also believes that one of the most important LED driver features to examine is the quality of the DC output voltage of the driver.

“To maximize the light output from the LEDs without overstressing them requires a constant DC current to be maintained through them,” he says.

In addition, he cautions that remote mounting of the driver results in voltage drops and power losses on the DC wiring that must be properly accounted for.

Finally, Sodhi advises specifiers to be aware of ambient temperatures at the application. While LEDs have the ability to start at temperatures as low as 240°C, operating them at cold ambient temperatures can cause operating problems. “LEDs draw higher power at cold ambient temperatures, the opposite of what happens with fluorescent lamps, and this can lead to system malfunction,” he warns. “For outdoor applications where the power supply is mounted remotely, the maximum LED load on the driver should be de-rated by 10% to 20% to avoid system conflicts during cold temperatures.”

Marble points out that special attention should be paid to the environmental rating of the driver. Most drivers are “dry location only” in type and must be installed in a weatherproof electrical enclosure if used outdoors. Damp location type drivers should be used in signs or raceways where some moisture is expected, and wet location type drivers are typically supplied in a pre-assembled, sealed enclosure for mounting outdoors.

Marble also believes UL Class 2 ratings — required for LEDs in signage — can benefit general lighting applications.

“UL Class 2 mandates that the driver has voltage, current, and power below certain levels on the secondary,” he says. UL Class 2 rated LED drivers provide electrical isolation from the AC line voltage, which allows for safe handling of the LEDs operating at low-level DC voltages.

“Off-the-shelf DC power supplies are typically designed for room temperature applications, such as IT or telecom,” he adds. “Such power supplies may operate erratically or not at all under the rigors of a lighting application.”

Finally, Marble advises that LEDs can suffer from heat-associated problems even during normal operation. “LEDs are occasionally and incorrectly believed to generate little or no heat,” he says, pointing out that there can be substantial heat generated in higher-wattage LED fixtures. “Hopefully, the integrator/fixture manufacturer designed appropriate heat sinks for the system. Still, allowing ample heat dissipation in the installation by mounting to metal or allowing some ventilation if possible is good practice.”

LEDs continue to break into new markets, proving there are few places they can't go. Whether they stay there will depend on how diligent installers are in applying the devices necessary to keep them working properly.

Sidebar: The Future Looks Bright for LEDs

Colored LEDs currently dominate the exit sign market. They're incorporated into an estimated 85% to 95% of all exit signs sold in the United States, and they're making inroads into the traffic signal market, with current penetration estimated at 30%. They show significant promise for automobile lighting, and are being sold in a variety of consumer products like flashlights and light wands. They're also penetrating mainstream commercial applications like task lights, accent lights, wall washing, signage, advertising, decorative and display lighting, cove lighting, wall sconces, outdoor/landscape/façade lighting, downlighting, and custom lighting.