IPx6 Rated Surface Mount LED

Application Note 5487

1. Introduction

The LED has been used in variable-message signs and full-color display applications for years. Its popularity in such applications stems from the vibrant and wide color gamut that it produces, its long operating lifetime, and its exceptional brightness which makes it suitable for outdoor viewing. The common LED package used in outdoor sign and display applications has typically been the through-hole package, due to its robust package design, high optical efficiency and shapeable radiation pattern.

Thanks to the advancement of surface mount LED package design and materials in recent years, coupled with the progress in LED die efficiency, surface mount LED packaging can now deliver the required brightness for outdoor sign and display applications. In order to fully enable their potential for use in harsh outdoor environments, Avago has developed a series of surface mount tricolor packages with high reliability and durability that fully satisfy the requirements for outdoor applications. With our patented package design and proprietary material, these packages comply with IPX6 coding per IEC 60529 standard for protection against water.

The objective of this Application Note is to provide users a general understanding of the IPX6 coding, its advantages as well as precautions needed when using these LEDs.

2. Reference Documents

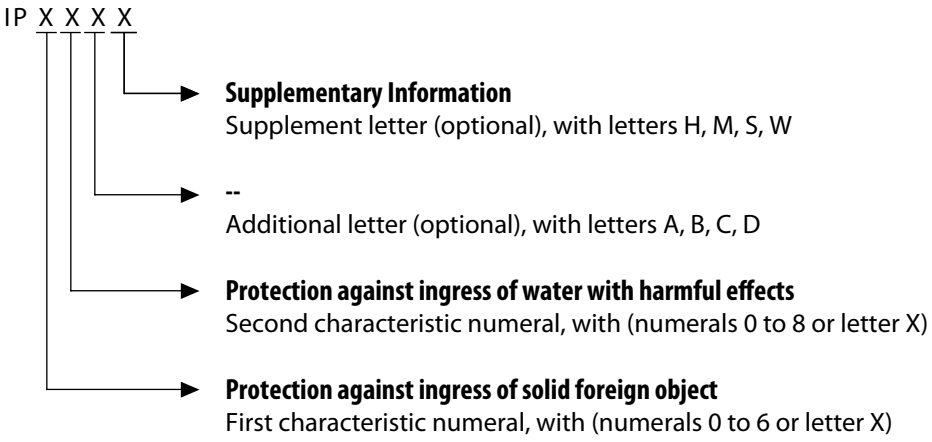
IEC 60529: Degree of protection provided by enclosure (IP Code)

This standard provides a summarized definition of ingress protection (IP) code designations and the test requirements with which a package must comply to qualify for a specific IP coding.

3. What is IP code?

IP code is used to determine the degree of ingress protection provided by an enclosure against solid foreign objects (first characteristic numeral), ingress of water (second characteristic numeral) and hazardous parts (additional letter). Since surface mount LED packages are a complete solid without air gap, the ingress of solid objects (such as dust or dirt) is of less concern. As such, this application note focuses mainly on the ingress of water within the surface mount package.

3.1 IP Code Delineation



3.2 Description of IP code against ingress of water (second characteristic numeral)

IP code	Description for degree of protection
IPX 0	Non-protected
IPX 1	Protected against vertically falling water drops
IPX 2	Protected against vertically falling water drops when enclosure tilted up to 15°
IPX 3	Protected against spraying water
IPX 4	Protected against splashing water
IPX 5	Protected against water jets
IPX 6	Protected against powerful water jets
IPX 7	Protected against the effects of temporary immersion in water
IPX 8	Protected against the effects of continuous immersion in water

4. Benefits of IPX6-rated LED packages

Common surface mount LED packages, especially those with silicone encapsulation, require additional protection commonly in the form of a transparent cover on top of the LED or LED panel to shield off direct water exposure. The cover also acts as a protection against dust accumulation on the silicone surface. Prolonged exposure to water without protection on such LED packages might lead to premature LED failures.

In contrast, Avago's IPX6-rated surface mount LED packages are capable of withstanding direct exposed to the outdoor environment where rainfall, condensation, mist or water splashes can come in direct contact with the LED surface. Moreover, sign and display makers can now design their products without a transparent plastic cover when using Avago's LED with IPX6 rating. This directly reduces the material and assembly costs of the end product as well as eliminating the unwanted reflection from the plastic cover.

5. Cleaning

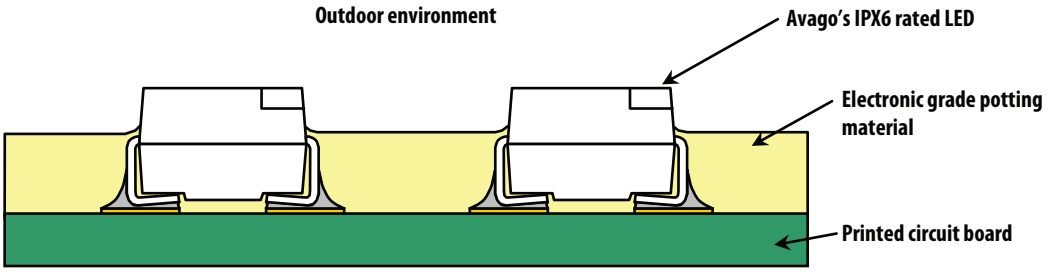
Surface mount LED packages with silicone encapsulation generally attract dust and dirt due to their surface tackiness. To clean the LED surface when this happens, water can be sprayed directly on the LED panel, as these LED packages are IPX6 rated. It is recommended that the water pressure be kept below 30kPa to avoid exerting too much pressure on the LED surface.

6. Precautions

Avago surface mount LED packages have metal leads protruding from the polymer body. These leads act as electrical terminals to the package and are meant to be soldered onto a printed circuit board. Although packages that are IPX6 rated are protected against powerful water jets, it is necessary to protect the leads and the solder joints from being exposed to the environment. If left unprotected, such exposure may lead to corrosion, shorts, leakage or breakdowns.

After having been in contact with water, small globules of water might remain on the LED surface. These small globules, acting just like lenses, might slightly affect the optical performance of the LED package. However, the effect is not permanent and will disappear as the water dries off.

Although these IPX6-rated LED packages are protected against exposure to water, the soft silicone encapsulation is still susceptible to external mechanical stress which may lead to unwanted catastrophic failure. It is therefore necessary to observe appropriate precautions as listed in Avago application note AN 5288 when handling these devices.



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