Optical Considerations for LED Selection

Introduction

When choosing an LED for an application, its optical properties must first be considered. Properties such as lumen output, intensity distribution, and source size need to be suited to the optical system of the application. This document will provide guidelines for LED selection given a particular optical system.

Luminous Flux

One of the first questions asked when considering an LED type is “How bright is it?”, which really means, “How many lumens can I expect?” Like all LED products, a range of lumen outputs results from the manufacturing process. OSRAM Opto Semiconductors sorts these outputs by groups or “bins”. The yield (portion of the distribution) in a particular bin can vary over the life of the product.

Helligkeitsgruppe Brightness Group	Lichtstrom[1) Seite 20] Luminous Flux[1) page 20] Φ_V (mlm)
KX	71.000 ... 82.000
KY	82.000 ... 97.000
KZ	97.000 ...112.000
LX	112.000 ...130.000
LY	130.000 ...150.000

Figure 1. Example listing of flux bins.

Another question related to lumen output is “How many more lumens will I get by increasing the drive current?” (temp has to be kept constant or else increase in current -> increase in light output -> increase in Tj -> decrease in light output). The lumen output will increase with higher current, but not at a constant rate. Figure 2. shows the relationship between drive current and lumen output. Instead of a straight line, the curve “droops” at higher currents. The newest product families from OSRAM Opto Semiconductors, namely the OSLON SSL products and OSRAM OSTAR Lighting Plus LEDs, exhibit a more linear relationship between flux and current than other LEDs.

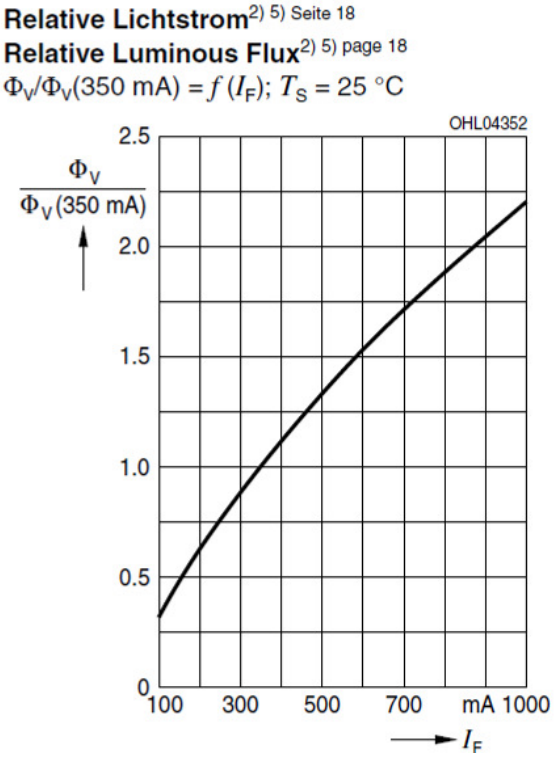

Figure 2. Graph of flux versus drive current.

Another way to increase the number of lumens in an application is to add LEDs. High lumen density can be achieved by concentrating a number of LEDs in a small area (see Figure 3.). A small LED with high lumen output is desirable in such cases. The OSLON family of LEDs is best suited for such applications, combining the smallest footprint of any

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1 W device with a high lumen output.

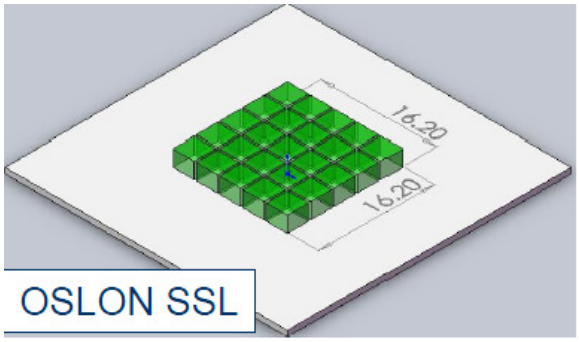


Figure 3. Cluster of OSLON LEDs.

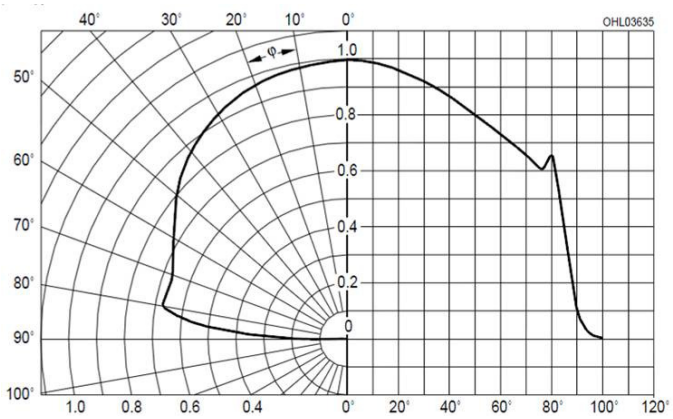
Intensity Distribution

The light distribution of the LED is also an important consideration, as it can mean the difference between adding a secondary optic or not. Figure 4. shows intensity distributions for various OSRAM Opto Semiconductors LEDs. For example, the wide angle distribution of the Golden DRAGON Plus is suitable for applications such as high bay lighting without the need for secondary optics. The OSLON 80° LED is well suited for applications such as downlights.

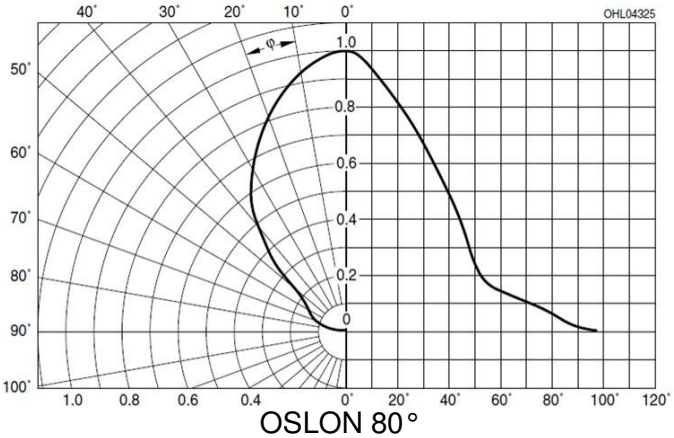
Apparent Source Size

For certain applications and optical systems, the source size and magnification are important. Examples include collimating lenses with extremely tight beam angles and reflector systems with sharp cut-offs at the edge of the beam. An LED with a lower magnification lens (such as a Golden DRAGON Plus) would have an advantage over an LED with a higher magnification lens (such as OSLON SSL).

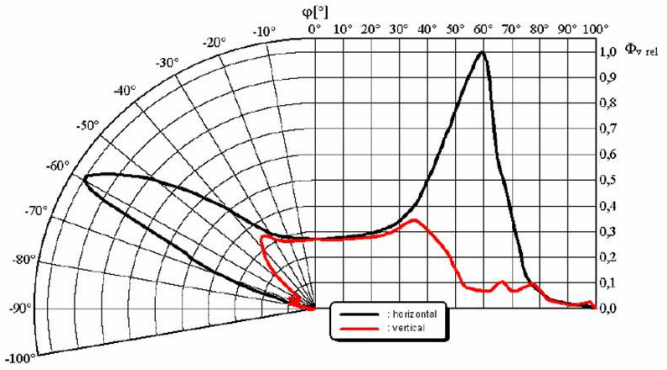
It should be noted that these issues arise in very demanding applications. Beam collimation of 16° full width at half maximum (FWHM) is achievable with a small lens, even with an OSLON SSL.



Golden DRAGON Plus



OSLON 80°



Golden DRAGON Oval Plus

Figure 4. LED intensity distributions.

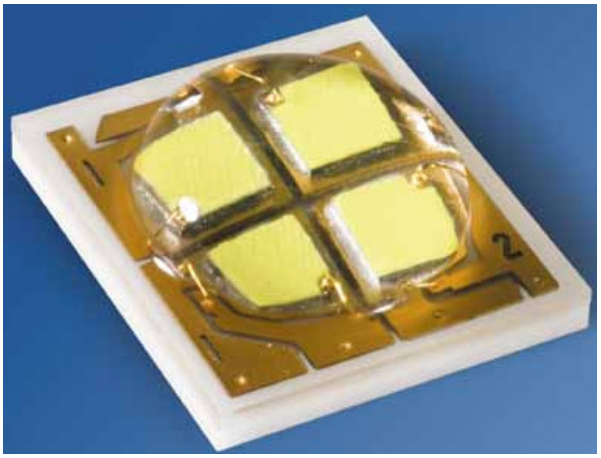


Figure 5. Magnification of the source by the lens of the OSRAM OSTAR Lighting Plus.

The LED and Your Application

For many applications, the light distribution from the bare LED will not meet the application requirements and a secondary optical system is needed. In order to optimize a system, the type of optic must be matched with the correct LED. For example, reflector optics are best matched with wide angle LEDs. While optics based upon total internal reflection (TIR) can be designed for most OSRAM LEDs, sources with small apparent source size (i.e. minimum magnification from the LED lens) are best for extremely tight collimation.

Table 1. provides a summary of OSRAM Opto Semiconductors' LEDs for solid state lighting (SSL) applications, listing their advantages and preferred applications. The following sections will relate more details for each LED.

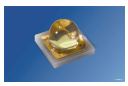
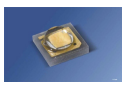
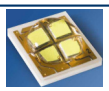
	LED	Lumen Output	Apparent Source Size	Intensity Distribution	Preferred Applications & Advantages
	Advanced Power TOPLED Plus	Low	Small	Wide	Wide beam applications. Combine with reflector or TIR optics.
	Golden DRAGON Plus	Medium	Small	Wide	Combine with reflector or TIR optics.
	Golden DRAGON Oval Plus	Medium	Largest	Wide Oval	Specialized applications (pathway lighting, tunnels). Combine with reflectors.
	OSLON SSL 80°	High	Medium	Narrow	Narrow beam applications. Combine with TIR optics. Can be packaged in tight clusters.
	OSLON SSL 150°	High	Medium	Wide	Wide beam applications. Combine with reflector or TIR optics. Can be packaged in tight clusters.
	OSRAM OSTAR Lighting Plus	Very High	Large	Wide	Applications where high source luminance is required. Combine with reflector or TIR optics.

Table 1. Summary of optical parameters for selecting OSRAM Opto Semiconductors LEDs.

Advanced Power TOPLED Plus LEDs

The APT+ incorporates a small extraction lens for higher lumen output than other 0.5 W devices. It has a wide beam angle, providing light coverage to large areas. It is suitable for use with reflectors or TIR optics.

Golden DRAGON Plus LEDs

The Golden DRAGON Plus LEDs also incorporate an extraction lens for extra lumen output and wider beam angle. The wide beam angle is well suited to applications such as high bay luminaires and troffers where secondary optics are not desired. It is also a good match with both reflectors and TIR optics because of its wide beam angle and minimal source magnification.

Golden DRAGON Oval Plus LEDs

The GD Oval Plus LED adds a special optic directly onto the Golden DRAGON package. The special optic creates an oval beam pattern, with the peak intensity angle designed specifically for tunnel lighting and path lighting. It is also possible to incorporate a reflector(s) with several Golden DRAGON Oval Plus LEDs for other SSL applications.

OSLON SSL 80 Degree LEDs

As its name implies, the OSLON SSL 80 was designed with SSL applications in mind. Its small footprint, ceramic package, and narrow beam angle allow a number of OSLONs to be arranged in a cluster, without the need for significant secondary optics. Downlights are a typical application which benefits from the features of OSLON. This device can also be used with TIR optics.

OSLON SSL 150 Degree LEDs

This LED is the same as the OSLON SSL 80 except for its beam shaping lens. The OSLON 150 has a 150° beam angle, compared with 80° for the OSLON 80. The wide beam angle makes it well suited for use with reflector optics. TIR optics can also be matched with this LED.

OSRAM OSTAR Lighting Plus LEDs

The OSRAM OSTAR Lighting Plus has been designed for applications requiring high luminance/high lumen density in a very small area. Its wide beam angle and low source magnification make it well suited for both reflector and TIR optics.

Conclusion

There are several optical considerations that need to be evaluated when selecting an LED for an SSL application. OSRAM Opto Semiconductors offers products suited for a wide range of applications and optical systems. Please contact your OSRAM Opto Semiconductors representative for assistance with your application.

About OSRAM Opto Semiconductors

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