DOMINANT™
Opto Technologies
Innovating Illumination

APPLICATION NOTES:

Surface Mounting Guide for Bevel-LED

Introduction:

This diminutive size with bevel angle LED is designed for full array local dimming (FALD) display. Its batwing radiation profile with wide viewing angle of 180° enable thin and brightness uniformity display.

- 180° viewing angle.
- Compact package outline (LxWxH) of 1.2 x 1.6 x 1.2 mm.
- Compatible to IR reflow soldering.
- Environmentally friendly; RoHS compliance.
- Compliance to automotive standard; AEC-Q102.
- Superior corrosion robustness, class A.
- High NTSC solution for wide color gamut backlight display.
- Qualified according to JEDEC moisture sensitivity level 1 (MSL 1).

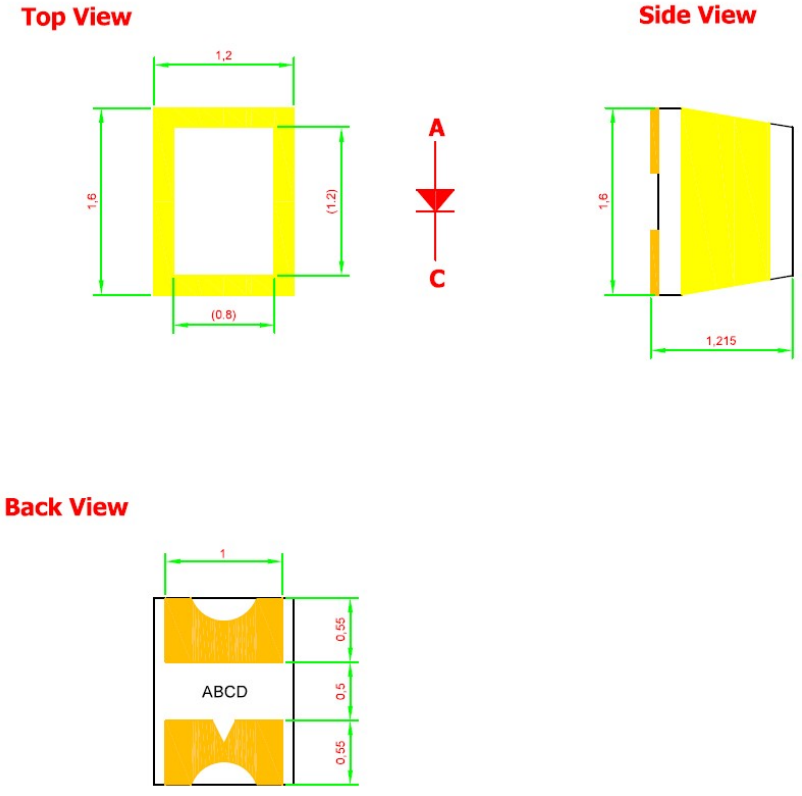


Figure 1: Bevel-LED, Package Dimension

Bevel-LED Soldering Process:

The Bevel-LED package soldering surfaces are plated with gold (Au) and are therefore RoHs compliant. The component is designed to be compatible to the existing industry SMT process and IR-reflow.

However, due to the unique design, all the soldering terminals are located at the bottom surface of the component. This greatly reduces the space required and also enhances the thermal dissipation capability of the component.

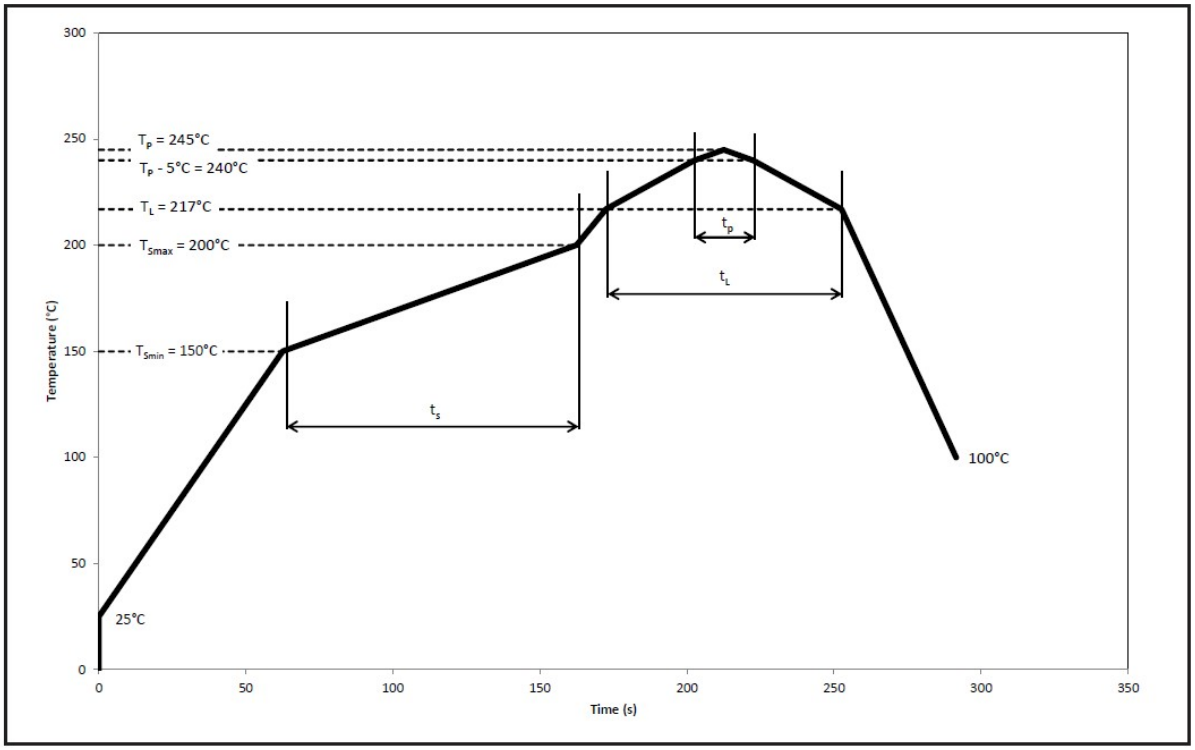
As for the soldering process, the component is qualified for Pb-free soldering profile. The profiles are as per described in the datasheet.

Bevel-LED Mounting PCB Surface Requirement

- Bevel-LED is specially design with the purpose to eliminate top bright spot for application that require good brightness uniformity in thin panel design.
- The primary light emitting path is through the 4 sides of the LED. The side ray intensity for Bevel-LED is much stronger compare to conventional top light emitting LED.
- To ensure all the emitted light is harness to achieve high optical efficiency, it is advise to use PCB coated with white solder mask with high reflectivity or use white reflector around the LED to collimate the light.
- It is critical to select white solder mask and white reflector material that can withstand strong blue light without yellowing.

Recommended IR Reflow Profile:

Product complies to MSL Level 1 acc. to JEDEC J-STD-020E



Profile Feature	Symbol	Pb-Free Assembly			Unit
		Min.	Recommended	Max.	
Ramp-up rate to preheat 25°C to T_{smin}	-	-	2	3	°C/s
Time t_S T_{smin} to T_{smax}	t_S	60	100	120	s
Ramp-up rate to peak T_L to T_P	-	-	2	3	°C/s
Liquidous temperature	T_L	-	217	-	°C
Time above liquidous temperature	t_L	60	80	150	s
Peak temperature	T_p	-	245	260	°C
Time within 5°C of the specified peak temperature T_P - 5°C	t_p	10	20	30	s
Ramp-down rate T_p to 100°C	-	-	3	6	°C/s
Time 25°C to T_P	-	-	-	480	s

Surface Mounting – Factors to Consider:

This application note provides a guideline for the surface mounting of Bevel-LED 1216. The following parameters have to be considered in order to optimize the surface mounting performance.

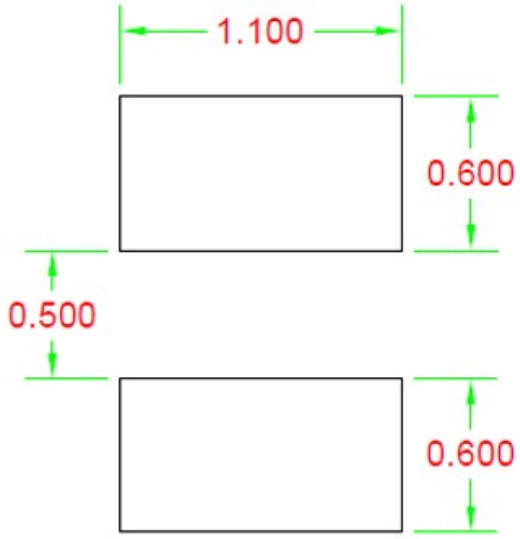
- Solder pad size
- Solder stencil dimension
- Pipette (nozzle)
- Solder paste thickness

Solder Pad Size

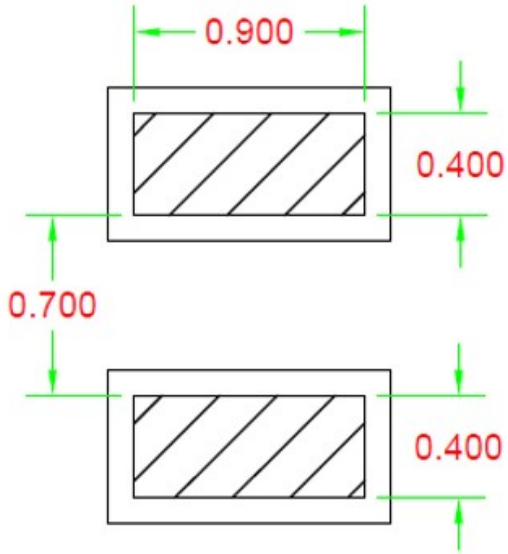
The recommended solder pad design is as illustrated in the data-sheet.

Bevel-LED solder pad and stencil design:

Recommended Solder Pad



Recommended Solder Stencil Design



Solder Stencil Dimension

In order to minimize solder bridging problems, it is common to design stencil aperture size smaller than the recommended solder pad. Excessive amount of solder paste deployed will result to tilted parts and inaccurate placement position. It is recommended that the aperture is reduced to 75% of the recommended solder pad design.

Pipette

Pick and place machine should be able to process Bevel-LED with the required placement accuracy. The material of the pipette should be non-metal e.g. Vespel (plastics) to avoid scratches on the white silicone. Care should be observed that the surface of the pipette which is in contact with the LED is flat and smooth. Because Bevel-LED construction is without plastic housing unlike conventional Plastic Leaded LED package (PLCC), the pick up position of the pipette should be on the white silicone overcoat as depicted in the photo below. Both vacuum suction force and placement force of the pipette should be <2N/mm^2 during SMT to prevent damage to the LED. If excessive force is applied to the white silicone overcoat, it may cause the silicone to be damaged, chip, crack or deformed.

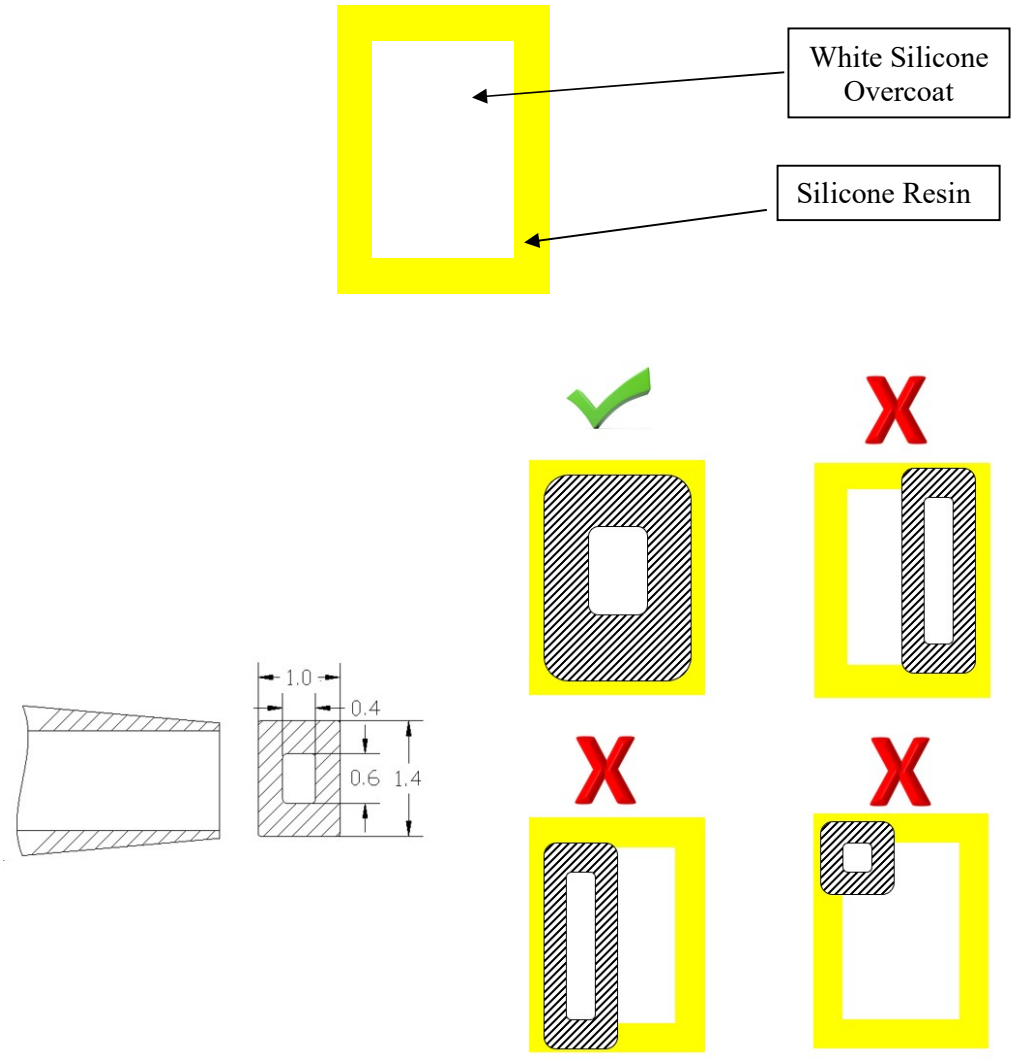


Figure 2: Recommended LED Pick & Place Pipette Size And Pick Up Position for Bevel-LED

If the nozzle is off-centre during pick & place and make contact with the edges of phosphor layer, it may cause chip or crack to the LED package.

Solder Paste Thickness

We recommend using minimum solder paste in order to achieve a good solder formation. A solder paste thickness of 0.100 mm will be optimum to ensure good planarity of the LED after reflow process.

Solder Quality Check After SMT Process

For Bevel-LED, the primary soldering surfaces are at the bottom of the LED component. Thus no solder fillet will be observed on the part after SMT. Current industry practice is to install AOI after solder paste printing to ensure solder paste is perfectly print on pad before component landing. Alternately, inline X-ray can be used for solder void check after SMT process.

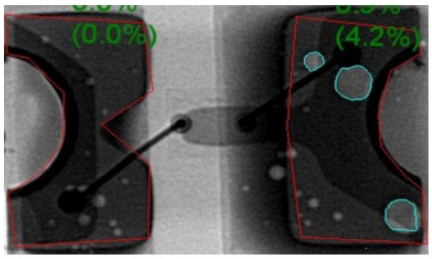
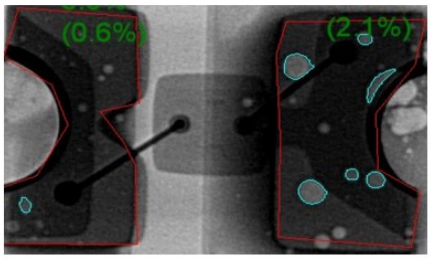
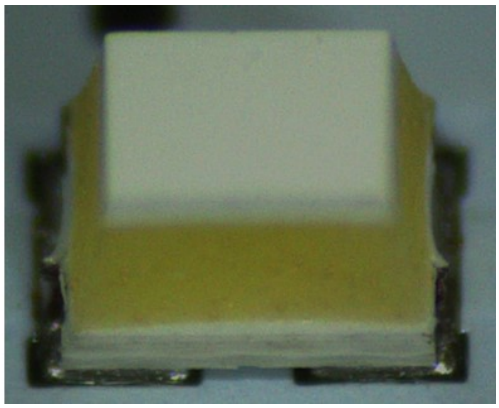
LED	Void Percentage
Bevel-LED Specification Limit <25%	5.1%  3.8% 

Figure 3: Inline X-Ray Solder Void Inspection After SMT

After Reflow



Storage Method After SMT

For PCB assembly that mounted with Bevel-LED, it should not be stack together after IR reflow, else it would have high chance of damaging the LED. To avoid the risk of damage or shear to the assembled LEDs, make sure that they are not exposed to compression forces of any kind. Recommended method is having a dedicated carrier so that each PCB assembly is with at least 5mm away from each other.

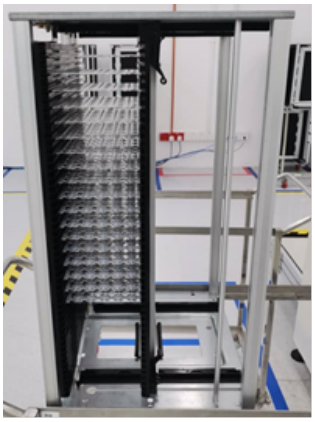
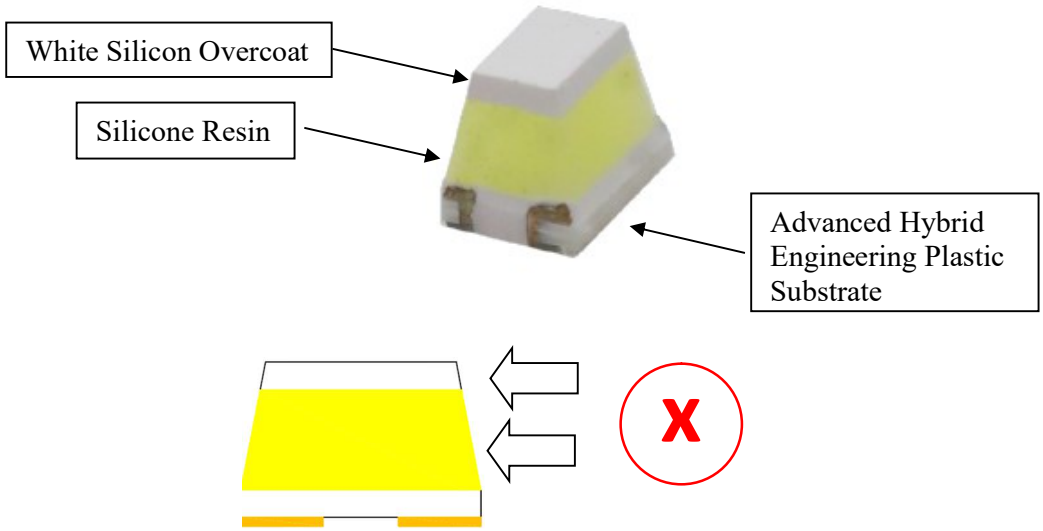


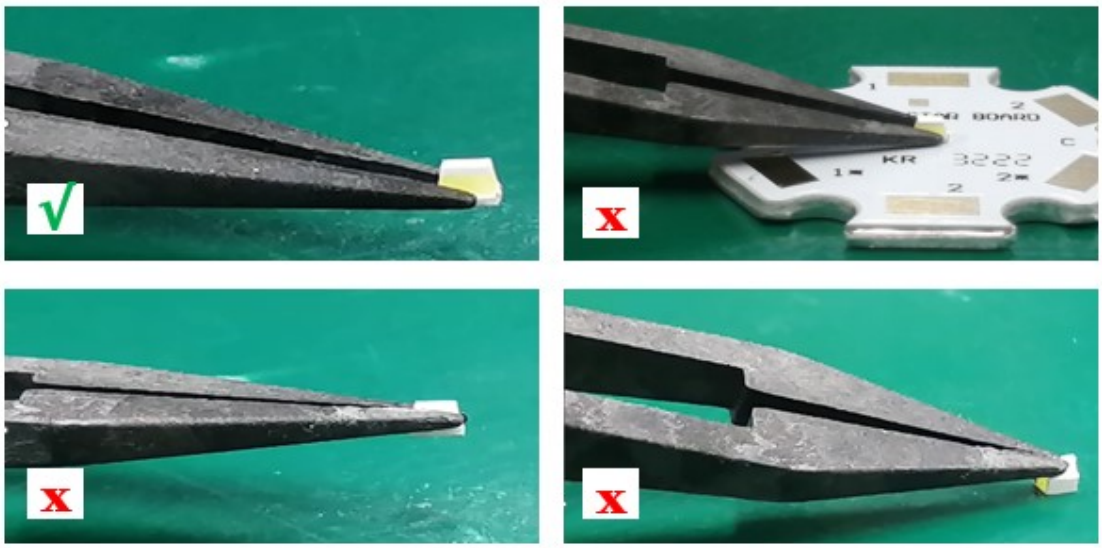
Figure 4: Example of carrier to store the PCBA

Handling Precautions

- Mechanical forces exerted onto the Bevel-LED should be minimized.
- Uncontrolled lateral force applied to the LED could possibly damage the LED package



- For manual handling, anti-static/conductive plastic tweezers should be use, always pick up from the sides of the substrate and never pick up from the LED body which is made of silicone. Handling with metal tweezers can possibly inducing package crack at silicone layer.

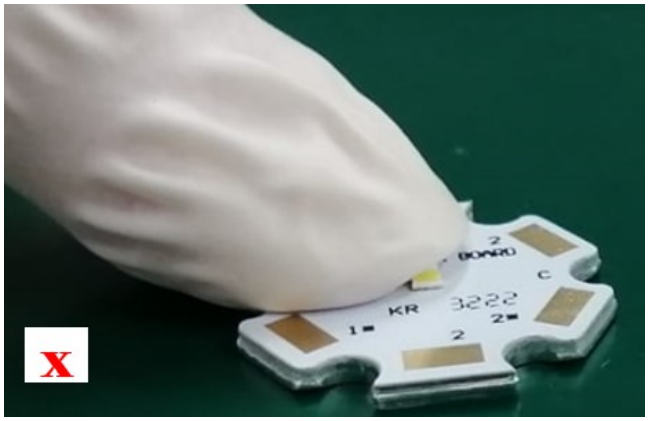


- A better alternative for manual handling of Bevel-LED is using vacuum pen. The suction tip should be made of a soft material such as rubber to minimize the mechanical force exerted onto the top surface of the white silicone layer. Care should be taken to avoid the soft material from contaminating the surface of the LED light emitting area.

- In order to avoid any mechanical damage to the LED, do not apply more than 2N of shear force (200g-f) on the LED package.

- Generally, all LED assemblies should return to room temperature after soldering, before subsequent handling, or next process step.

- Do not touch the top surface of LED with fingers or apply any pressure to it when handling finished boards containing Bevel-LED. Also packaging material like bubble wrap must not touch the LEDs



Cleaning Of LED

- If cleaning is required after soldering, we suggest customer to use IPA as cleaning agent. Maximum recommended rinsing time is 10 seconds. Ultrasonic cleaning might damage the LED and thus we do not recommend customer to use this method to perform cleaning.

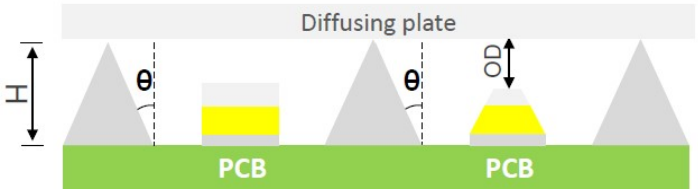
Water Interaction With LED

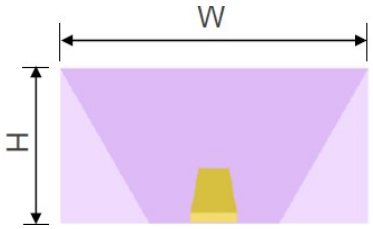
- Similar to majority of the electronic ICs, LED should not be in direct interaction with water. Water will cause lead frame corrosion and device short circuit.

Recommended Reflector Dimension to Couple with Bevel-LED

Term and Definition

- Θ Bevel angle of reflector is defined as the angle between reflector surface and the normal of PCB surface.
- H is defined as the height of the reflector.
- OD is defined as the distance between the top surface of the LED and the bottom surface of diffuser plate. In this design, OD can be regarded as H minus the height of the LED (1.215mm).
- W is defined as the width of the opening of reflector. In this design, W can be regarded as the pitch of LED on PCB.
- P/OD is defined as pitch divided by OD.

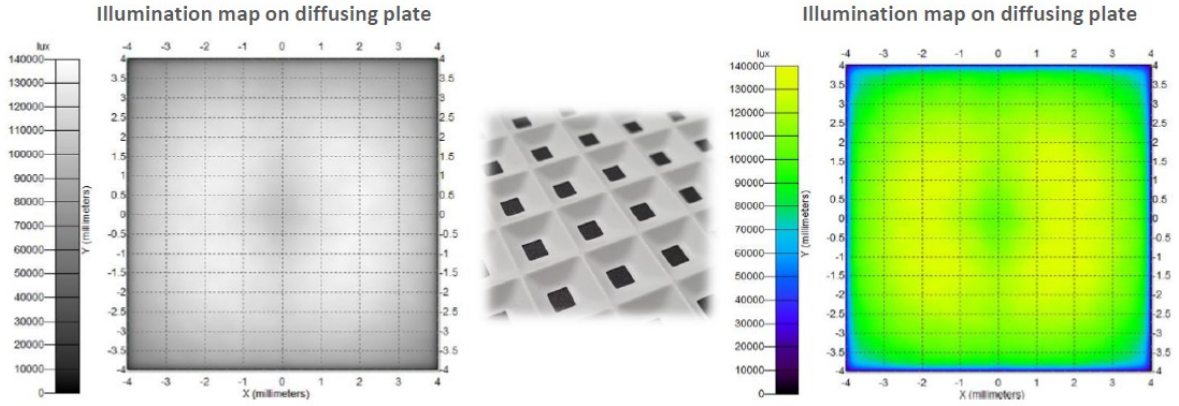




- Light extraction rate for reflector system = $\frac{\text{All visual flux from the reflector system}}{\text{All visual flux from the LED with cap}}$

Reflector Reference Design I

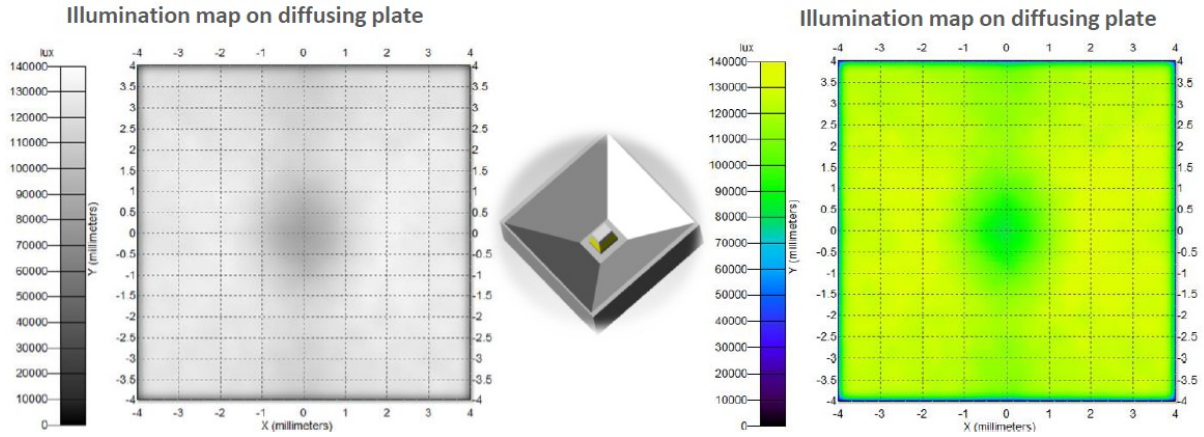
- LED flux output is set to 8.5 lm.
- W is set to 8*8 mm
- H=4mm, POD = 8/2.8 = 2.9.
- Reflector surface is defined as flat white paint (90% reflection).



Θ (°)	OD (mm)	E_ave (lx)	E_max (lx)	L.E.R.
15	2.8	108000	135000	81%

Reflector Reference Design II

- LED flux output is set to 8.5 lm.
- W is set to 8*8 mm
- H = 4mm, POD = 8/2.8 = 2.9.
- Reflector surface is defined as mirror (Aluminum coated) (95% reflection).



Θ (°)	OD (mm)	E_ave (lx)	E_max (lx)	L.E.R.
7	2.8	120000	134000	90%

Summary

- A single and simple facet reflector is designed for local dimming for easy reference in general local dimming application.
- Aluminum coating reflector, whose θ also needs to be optimized for better backlighting uniformity, could help to improve the system lighting efficiency dramatically comparing with white painted surface reflector.
- Lower P/OD will help to improve the BL uniformity.
- Reflector could be optimized further by using multiple flat facets or curved facet.
- By using diffusing plate/film and optical film, the uniformity of brightness for the LCD module could be improved further.