Using OPT3006 FoV simulator tool for evaluating industrial/mechanical designs

Author: *Alex Bhandari-Young*

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Introduction

This document is intended to expedite evaluation of mechanical industrial designs using the TI OPT300x family of ambient light sensors.

The OPT3001 application guide provides the theory and more background (specifically section 3: Field-of-View and Window Size) http://www.ti.com/lit/an/sbea002a/sbea002a.pdf

The OPT3006 FoV simulator implements some of the equations from the app note and is available here: http://www.ti.com/product/OPT3006/toolssoftware

Software (2)

Name	Part#	Type
OPT3006 Field of View (FoV) Simulator (ZIP 5461 KB) 27 Oct 2017		

Disclaimer: the tools and methods described in this document use simplified methods to provide quick approximations for evaluating window designs. This is much simpler and quicker than running a full optical simulation. The user should understand these simplifications and when a full optical simulation is needed for accurate results. Additionally, testing on the assembled system should always be done to validate the results. Limitations of the tool are outlined in the limitations section.

Using the FoV Simulator Tool

From the OPT3001 application guide the use of a hole or window can restrict the device field of view as shown.

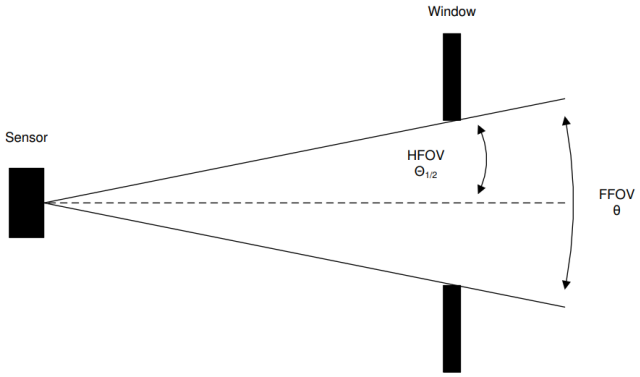
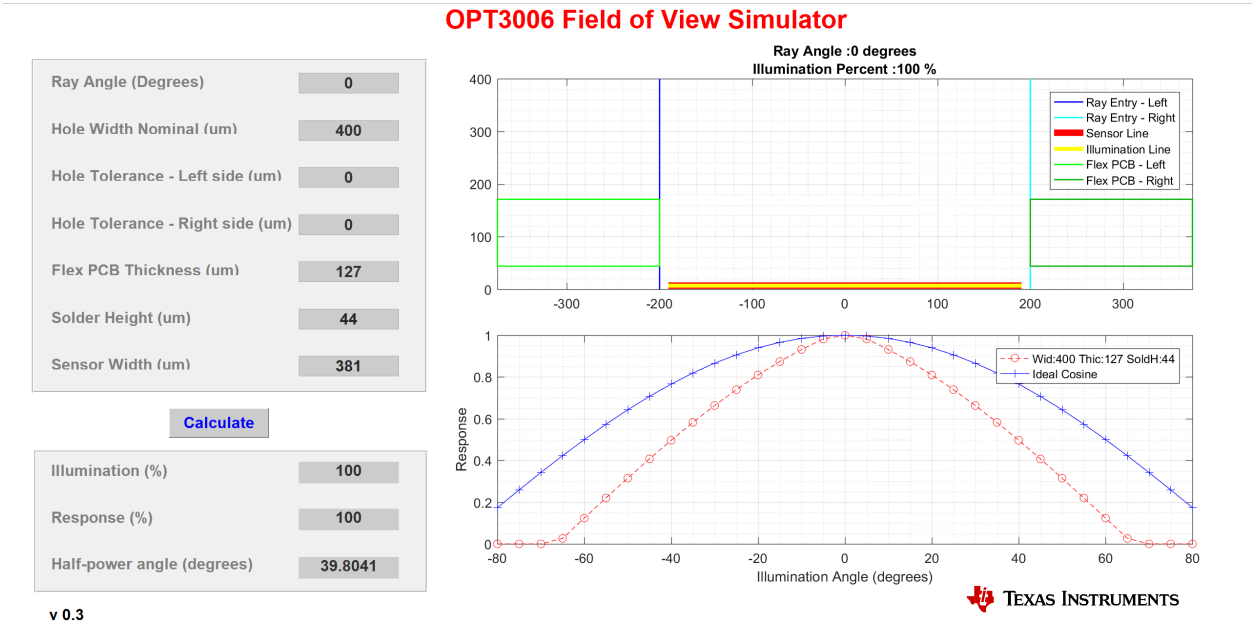


Figure 5. Field of View

The tool pictured below is used to simulate this effect. Instructions for using the tool are available with the software download. In this document we focus on the differences needed when using this for a hole in a cover over the light sensor rather than a hole in a flex PCB.

This method also works if a cover with hole is used with OPT3006 or 3007. In this case two simulations should be run: one for the flex PCB hole and another for the cover hole, and the worst case should be selected as the limiting case.

Below is the tool when used for OPT3006/7 on flex PCB.

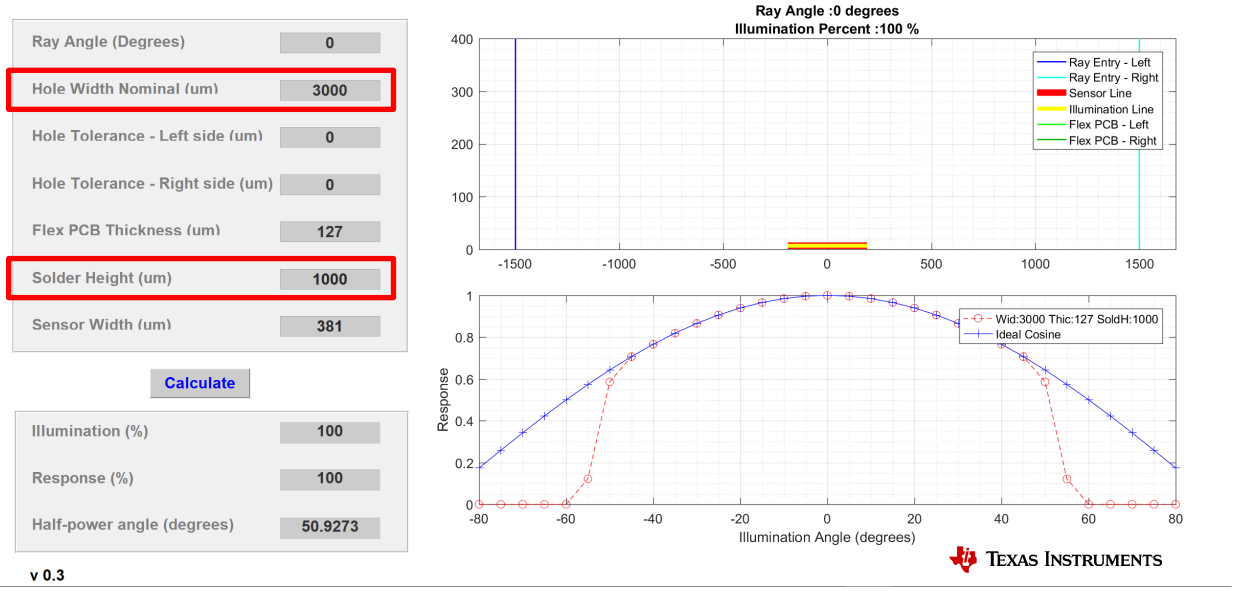


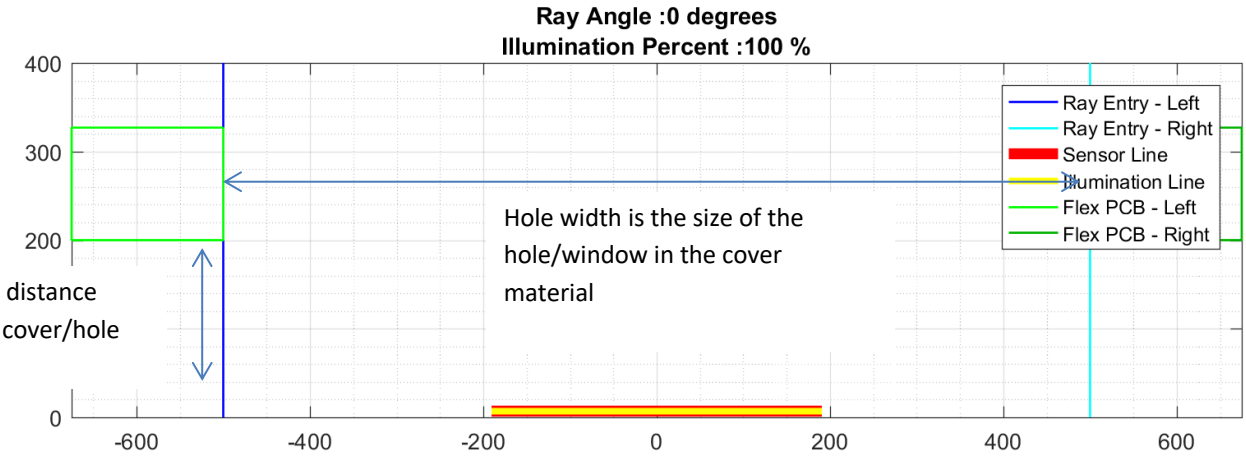
Setup parameters

To use for a cover material the **window/hole width is entered for the hole size**. The **solder height represents the distance between sensor and hole** in the simulator so this distance should be entered here.

Below shows an example for simulating a 3mm hole and 1mm distance between hole and sensor.

The other parameters can also be used to check tolerances in device placement and hole position if needed. The rectangle will likely move off the screen as these are large values than typically used for OPT3006 and flex PCB holes.





Evaluating results

The plot shows across angle how the hole is going to change the area of the sensor illuminated. A quick check is to compare the half angle of the hole with the half-power angle spec of the OPT device. As the shadow typically creates a sharp drop off keeping this cutoff above the half angle spec of the OPT300x device used will give good performance in most cases. Similarly the half–power angle spec in the simulator can be compared with the OPT device half power angle spec as well.

The OPT3004 has a large half power angle of 57 degrees as shown in the datasheet.

Half-power angle	50% of full-power reading	57	degrees

OPT3001 has a half power angle of 47 degrees.

Half-power angle	50% of full-power reading	47	degrees

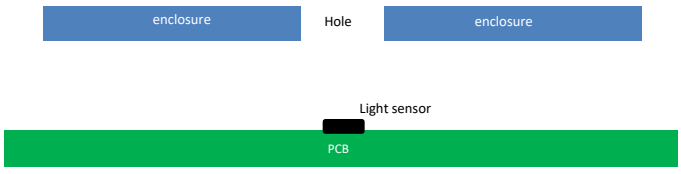
Using these numbers with OPT3001 the hole size could be slightly increased for slightly increased field of view, but the effect would be quite small and most of the device field of view is utilized. If OPT3004 was used with these hole dimensions then the device is being limited closer to the field of view of OPT3001. This is still quite a large field of view and in most applications this reduction could be acceptable. The user should determine the required field of view for their use case when selecting these industrial design window parameters.

OPT3006 and OPT3007 have a smaller FoV due to the hole used for testing. This FoV is a good target for best performance using OPT3006 or OPT3007.

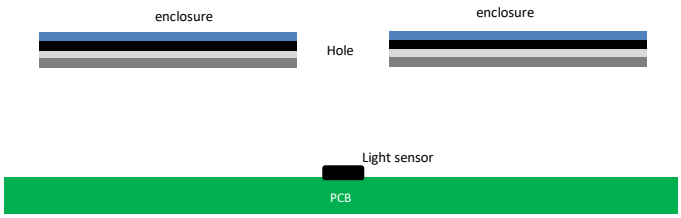
Half-power angle	50% of full-power reading	44	degrees

Evaluating Optical Stack-ups with Multiple Layers or Holes

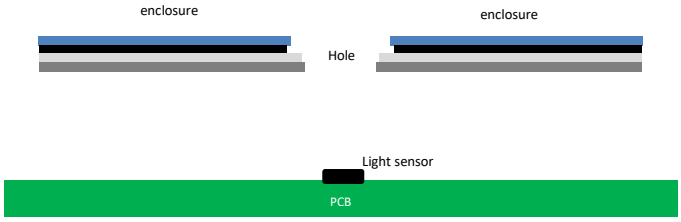
Some products consist of one or more layers between the light sensor and the outer enclosure of the device. So far we have described evaluating the field of view where there is a single material in from of the light sensor as shown



Below is a more complex stack up consisting of 4 layers. This example reduces to a single layer because all layers have the same cutout size – so can be treated as a single layer and inputted to the tool as such.



The below example now shows each layer having a differing cutout size. In this case each layer should be simulated separately and the layer that is most restrictive taken as the field of view of the system.



Limitations

The FoV simulator tool takes a 2D slice of the 3D system and runs a simulation where the light source angle is swept in one dimension. The window opening is modeled as a cutout in a rectangle. Since this uses a 2D slice any cutout shape is treated as a rectangle. This will introduce different inaccuracies depending on the hole shape used and this should be understood. Tapering is not taken into account. The sensor width also assumes the 2D cutout is taken with a certain orientation with respect to the device.

It is assumed light travels in a straight path through the opening and the index of diffraction of the window matches the air (that is there is no window material – window is simply a cutout).

This is a simple shadow simulator and only calculates how much of the device is obscured for each angle of entry. No other effects are taken into account.

See documentation included with the software download for more details.