Application Note

PicoStar™ Package Assembly Guidelines for Ambient Light Sensors

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ABSTRACT

This application note includes assembly guidelines for PicoStar™ packages available in TI's OPT3006, OPT3007, and OPT4001 devices. The PicoStar™ package's unique ultra-small, ultra-thin form factor enables light sensing in very space-constrained designs. A key advantage of the device is the bottom facing sensitive area (on the same side of the device as the pads). A cutout in the flex PCB to allow light to reach the sensor allows the device to be placed on one side of the flex PCB and look out the other, enabling the flex PCB to sit flush against the product enclosure. This further reduces the area occupied by the light sensor circuitry and creates a light seal around the sensor, reducing or eliminating the need for other light blocking materials (shrouds). This unique package and integration comes with specific assembly guidelines and considerations to make sure of the best performance, which is covered in this document.

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1 Introduction

The TI PicoStar™ package enables ultra-small, ultra-thin device form factor. TI light sensing devices such as OPT4001YMN-Q1 offer 5x reduction in device area (1mm x 0.8mm) and 3x reduction in device thickness (0.226mm) over conventional optical packages such as the SOT-5x3 package.

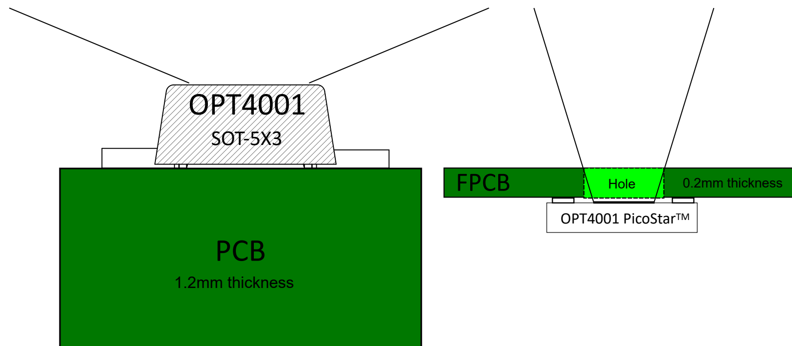

Figure 1-1. Placement Side View of Packages

Additionally, the light sensor PicoStar™ package enables bottom-facing assembly for integration in space-constrained applications and minimization of stray light leakage. See *Advantages of Implementing a Light Sensor in TI's Ultra-Thin PicoStar Package*, application brief for more details on this package. With these advantages come some unique assembly requirements outlined in this document.

2 Assembly

With the bottom facing assembly, the PicoStar™ package requires a cutout in the flex PCB (FPCB) to allow light to reach the sensing area. Increasing the cutout size can maximize the field of view of the sensor resulting in the best optical performance. The maximum cutout size can be limited by the manufacturing capability of the FPCB fabrication and assembly shop. Figure 2-1 illustrates two options for PCB cut out shape (plus shape and circular shape). The clearance required between the PCB pads and the cutout can typically be very small and can require consultation with the FPCB vendor.

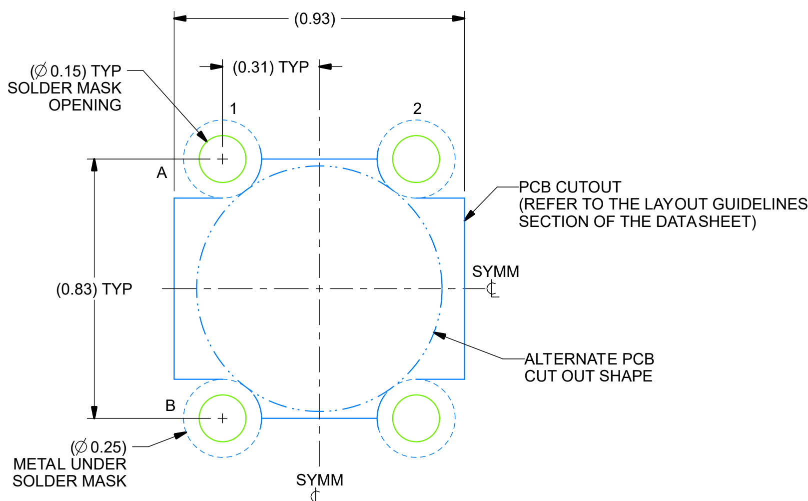

Figure 2-1. Flex PCB Cutout Recommendations

With the 4-pin design on OPT4001YMN, the diagonal distance between the pads is >800µm, which enables a cutout with very large field of view (>50°) with a simple circular cutout. Using a plus-shaped cutout maximizes the field of view even further in the directions where the pads do not restrict enabling best optical performance. A rectangular cutout can enable the largest field-of-view in one direction similar to the plus cutout, but can restrict the field-of-view somewhat in the opposing direction. Examples of PCB layout and cutout shapes for the plus and rectangular cases are shown in the following images.

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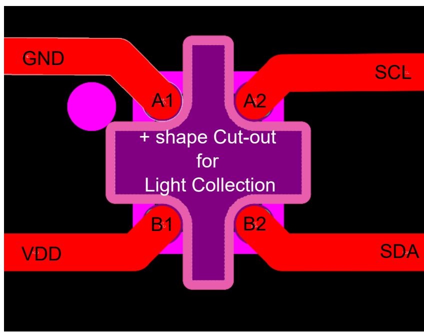

Figure 2-2. Layout Example With a Plus Shaped Cut Out

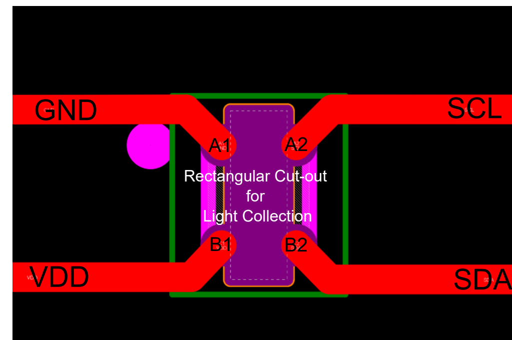

Figure 2-3. Layout Example With a Rectangular Shaped Cut Out

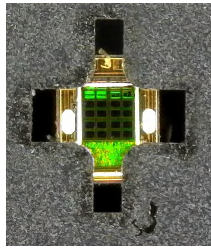

Figure 2-4. Image of FPCB With OPT4001YMN-Q1 Mounted, Receiving Light Through the Cutout with a Plus Shape

Figure 2-5. Image of FPCB With OPT4001YMN-Q1 Mounted, Receiving Light Through the Cutout with a Rectangular Shape

3 Handling

The PicoStar™ package is a piece of active silicon, without the mechanical protection of an epoxy-like package or other re-enforcement. This design allows the device to be as thin as possible. Take extra care to handle the device gently to not crack or break the device. Use a properly sized vacuum manipulation tool to handle the device.

The flex PCB needs to be handled with care once the device is soldered down to make sure the PCB does not flex in the area where the device is placed, which can put stress on the solder joints.

4 Reliability Recommendations

To maximize device reliability, TI recommends placing a drop of epoxy over the top-side of the device. The drop needs to be large enough to cover the device and make contact with the FPCB on all sides of the device. The amount of epoxy applied needs to be controlled to make sure that the epoxy does not flow near the device sensing area on the bottom of the device. A pneumatic epoxy dispenser enables control over the amount of epoxy deposited and makes sure of uniformity across units. This drop is meant to both protect the device from direct contact from outside objects and increase the board level reliability by providing additional stability between the device and the flex PCB.

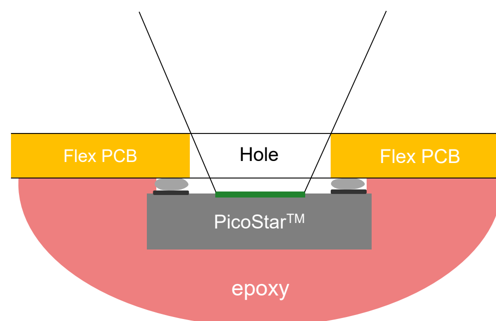

Figure 4-1. Epoxy Application Example Side View

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Epoxy needs to be rated above the maximum temperature range expected by the application. The viscosity of the epoxy needs to be chosen to allow the epoxy to flow to contact with the solder joints between the device and flex-PCB. However, the epoxy needs to not flow to obstruct or intrude into the field of view of the sensing area. Figure 4-2 illustrates an example of proper epoxy application as seen through the flex-PCB cutout.

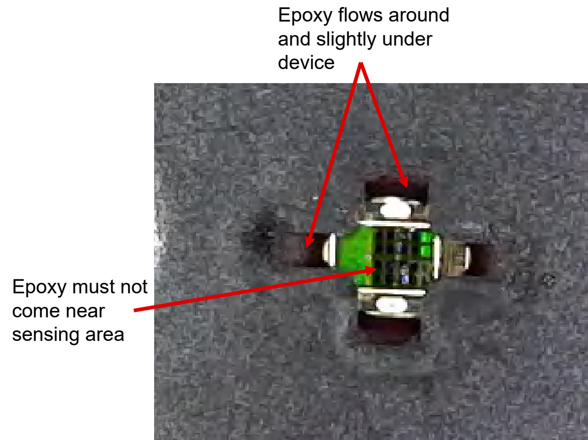

Figure 4-2. Epoxy Application Example Bottom View

Epoxy application guidelines are similar for different cutout shapes (plus sign, circular, rectangular, and so on.). Care needs to be taken that the epoxy does not flow through the cutout to the other side of the FPCB or sensing area. For example, in the plus cutout image gaps can be seen between the device and flex that enables very large field of view. Make sure the epoxy does not flow through this gap into the field of view of the sensor.

5 Summary

The PicoStar™ package's unique ultra-small, ultra-thin device form factor enables light sensing in very space contrained designs. With the small form factor and package design comes some unique assembly considerations, which were outlined in this document. This document has covered important considerations for working with the PicoStar™ package including assembly guidelines and handling best practices to make sure of best device performance and reliability. The PicoStar™ package is available in TI's OPT3006, OPT3007, and OPT4001 devices.

6 References

- Texas Instruments, *Advantages of Implementing a Light Sensor in TI's Ultra-Thin PicoStar Package*, application brief.
- Texas Instruments, *OPT3006 Ultra-Thin Ambient Light Sensor*, data sheet.
- Texas Instruments, *OPT3007 Ultra-Thin Ambient Light Sensor*, data sheet.
- Texas Instruments, *OPT4001 High Speed, High Precision, Digital Ambient Light Sensor*, data sheet.
- Texas Instruments, *TI Precision Labs Series: Ambient Light Sensors*, video

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