Product Document

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Application Note

AN001049

TMF882X System-Crosstalk

Optical Stack Design for TMF882X-SHIELD Board

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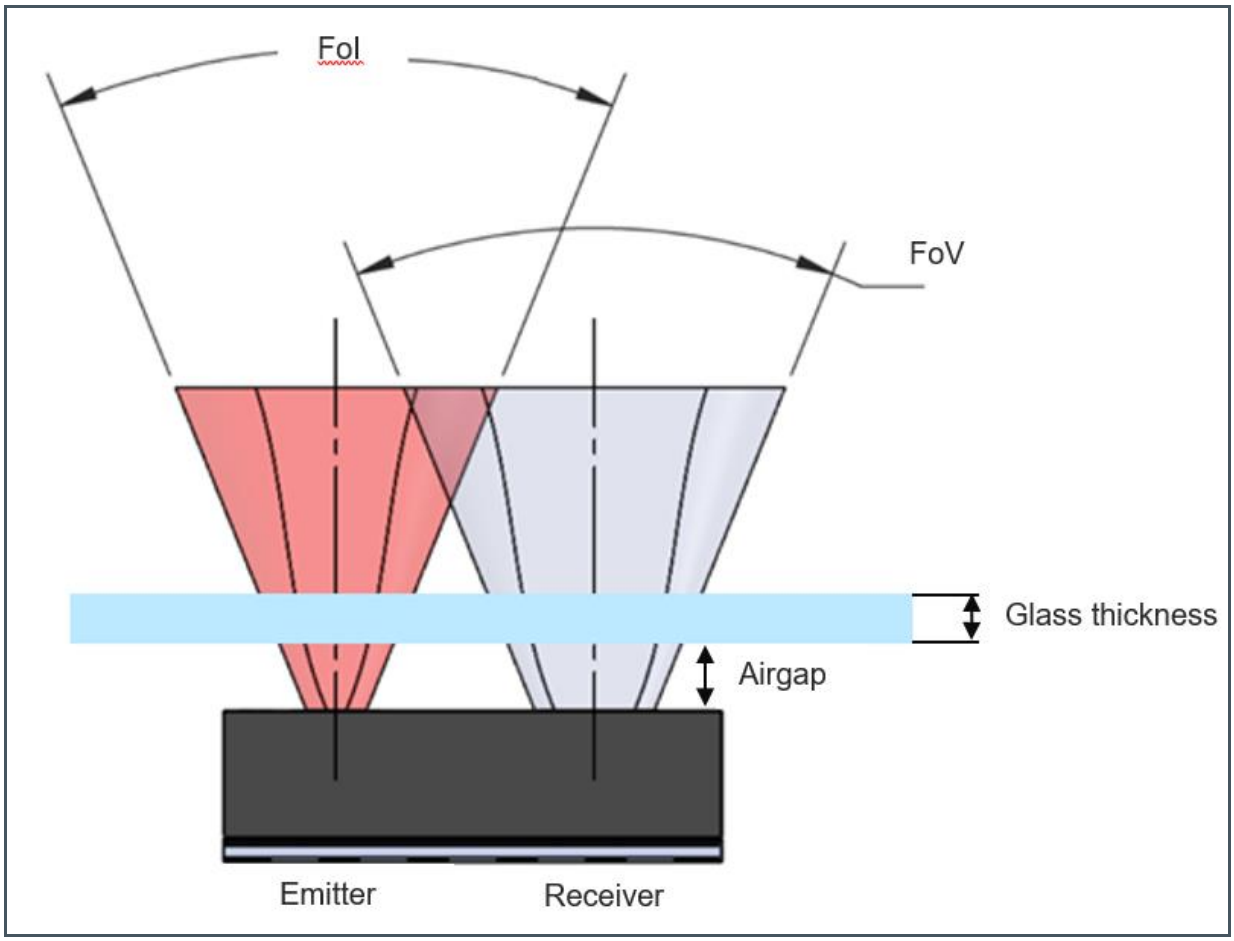
Content Guide

1 Introduction

For optimal sensor performance, a well-adjusted optical design is required. This document covers the required information and guidelines for an optimal optical-stack setup. The main points covered in the document will be the cover glass and the air-gap size between the sensor surface and the cover glass.

Figure 1:
Optical Stack With an Illustration of the Field of View (FoV) and Field of Illumination (FoI)



2 System Crosstalk

2.1 Explanation and Contributive Factors

The system crosstalk is a result of internal package and cover glass crosstalk. The defined system crosstalk range (see TMF882X Optical Design Guide) should be used to give the ideal Time-of-Flight (ToF) system performance.

The amount of system crosstalk depends of several parameters:

- Glass thickness
  - Thicker glass will result in higher crosstalk
- Aperture size (exclusion area if cover glass is opaque coated)
  - Apertures are cutting off the FoI/FoV and attenuating the reflection from the cover-glass which causes a reduced crosstalk
- Optical barrier between Tx & Rx apertures
  - An optical barrier cuts off the light transmitting from Tx to Rx which reduces the crosstalk
- Contamination/smudge
  - Smudge on the sensor / cover glass leads to a higher crosstalk
- Ambient light
  - Ambient light increases the crosstalk
- Airgap between sensor and cover glass
  - Increasing the airgap will increase crosstalk , detailed explanation in following chapters
- Ink/tint characteristics

2.2 Optical Design Guide (ODG) Recommendation

For a detailed optical stack design, please refer to the optical design guide:

https://ams.com/documents/20143/6015057/TMF882X_PD001042_2-00.pdf

2.3 System Crosstalk Measurement With TMF882X-EVM GUI

Operate the TMF882X with the full optical stack in the end-application system with 550k iterations.

Additional requirements are, no target in front (at least the crosstalk peak should be distinguishable from the target peak) and a low ambient light environment (best case, no light at all).

The highest peak in the histogram is the valued system crosstalk.

Figure 2:
Recommended Crosstalk Range

Mode	Min. Crosstalk Counts	Max. Crosstalk Counts
3x3	900	15200
4x4	900	16000
8x8	320	6360

2.4 Optical Barrier – Rubber Boot

Where the airgap between the sensor and the cover glass or the cover glass thickness cannot be kept in the recommended range, an option is to utilize a “rubber boot” which is inexpensive to manufacture and easy to install.

This soft rubber fills the gap between the SPADs and VCSEL as well as the gap between the sensor and the glass. The rubber boot then acts as an effective optical barrier and is reducing the system crosstalk.

Please note that a rubber boot is not part of the TMF882X-SHIELD board but is recommended for a stable system crosstalk.

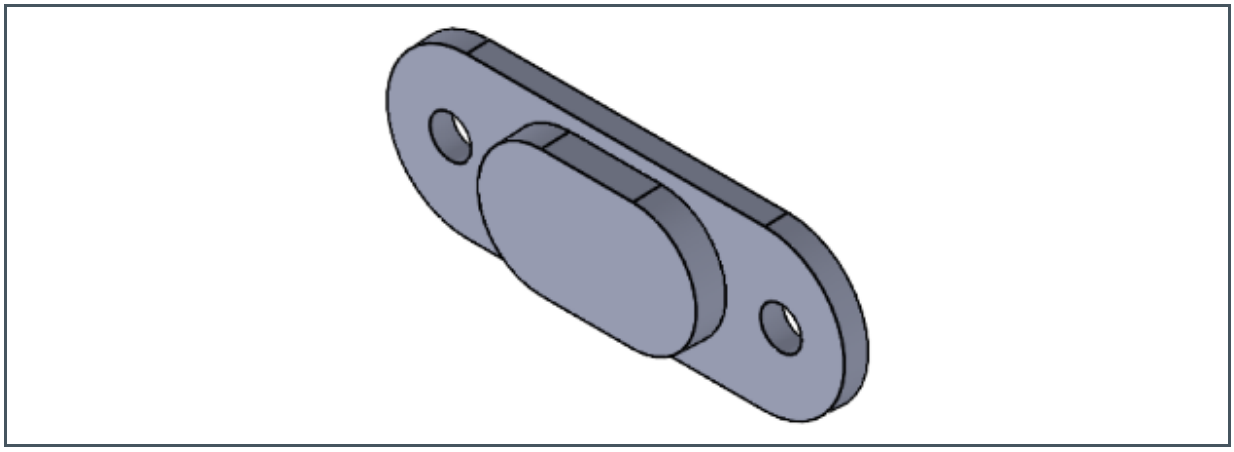
For details regarding rubber boot design used in the TMF882X-EVM kit, please refer to the following document.

https://ams.com/documents/20143/6015057/TMF882x-RB_PD001049_1-00.STEP

3 Cover Glass for TMF882X-SHIELD Board

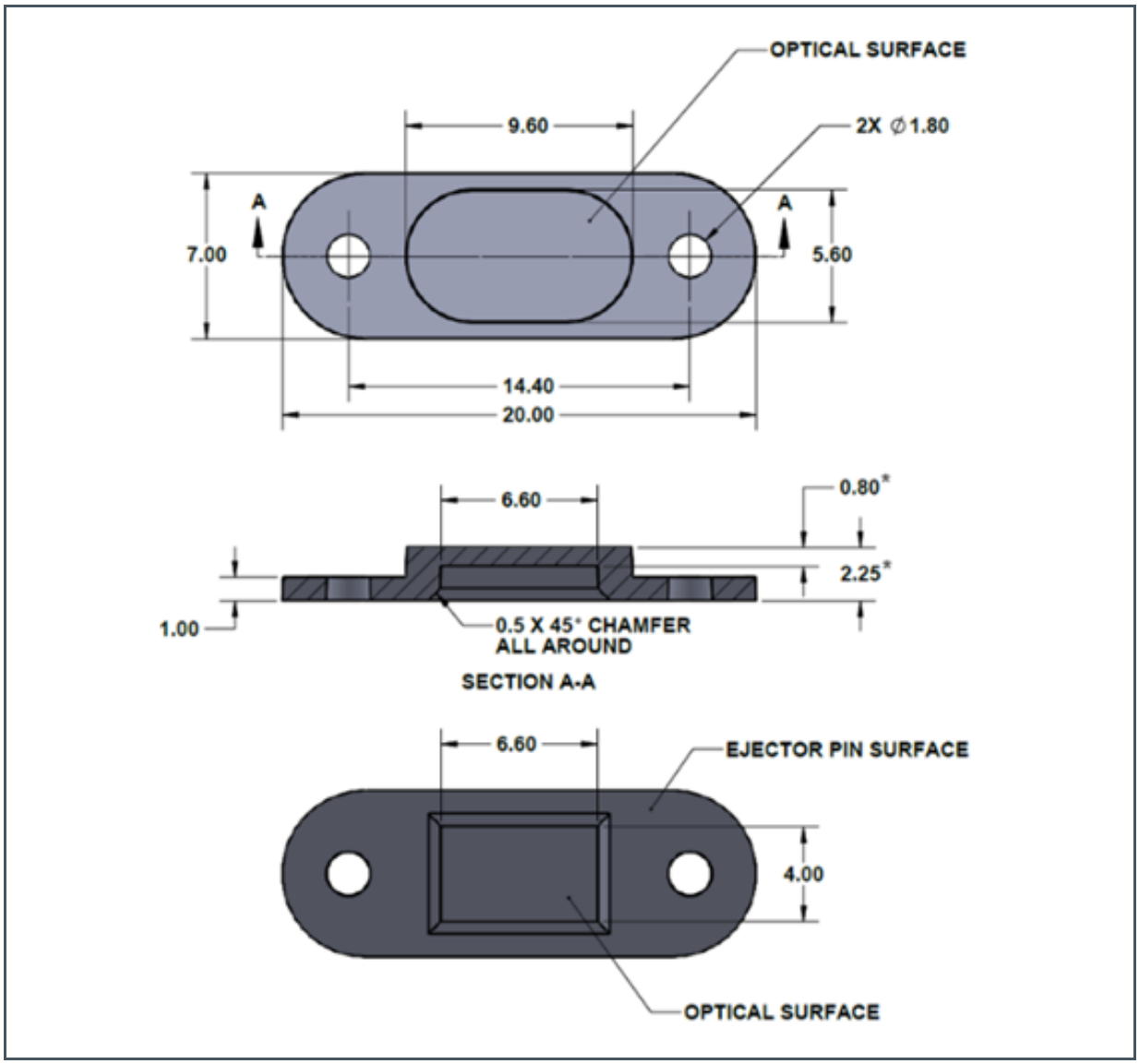
The TMF882X-SHIELD board contains four different glass thickness variants (0.5 mm / 0.6 mm / 0.7 mm and 0.8 mm).

Figure 3:
Cover Glass



3.1 Cover Glass Dimensions

Figure 4:
Cover Glass Dimensions



(1) * varies with glass thickness

3.2 Optical Transmission

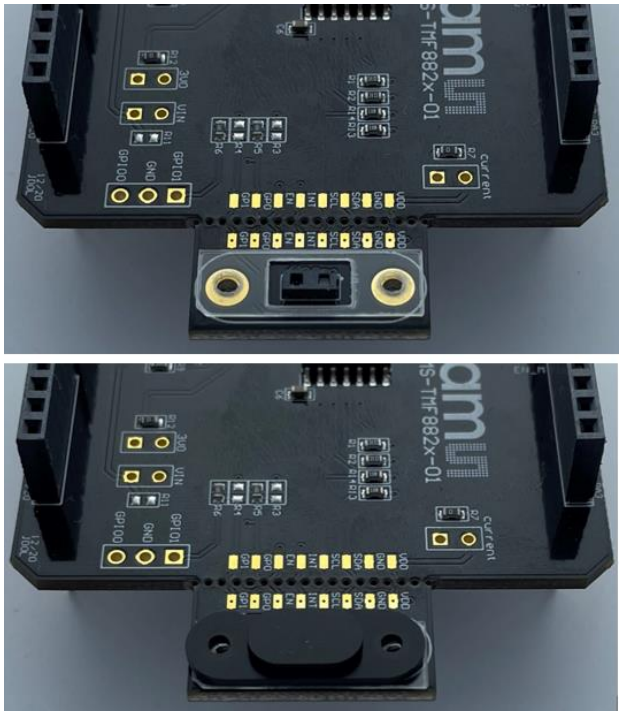
The TMF882X uses a VCSEL at 940 nm wavelength.

The attached cover glass transmission in the 940 nm wavelength range is ~95% for all four-thickness variants.

3.3 Airgap Setting

The airgap between sensor and cover glass is adjustable with the included airgap-spacers (0.17 mm / 0.25 mm / 0.38 mm / 0.5 mm). Place the air-gap spacer of your choice underneath the cover glass and tighten the screws.

Figure 5:
Optical Stack for TMF882X-SHIELD Board



3.4 Crosstalk Measurements

In this measurement (4x4 mode), you can see how the airgap and the glass-thickness affect the system-crosstalk.

The maximum and minimum crosstalk count of all zones per measurement is shown in the chart.

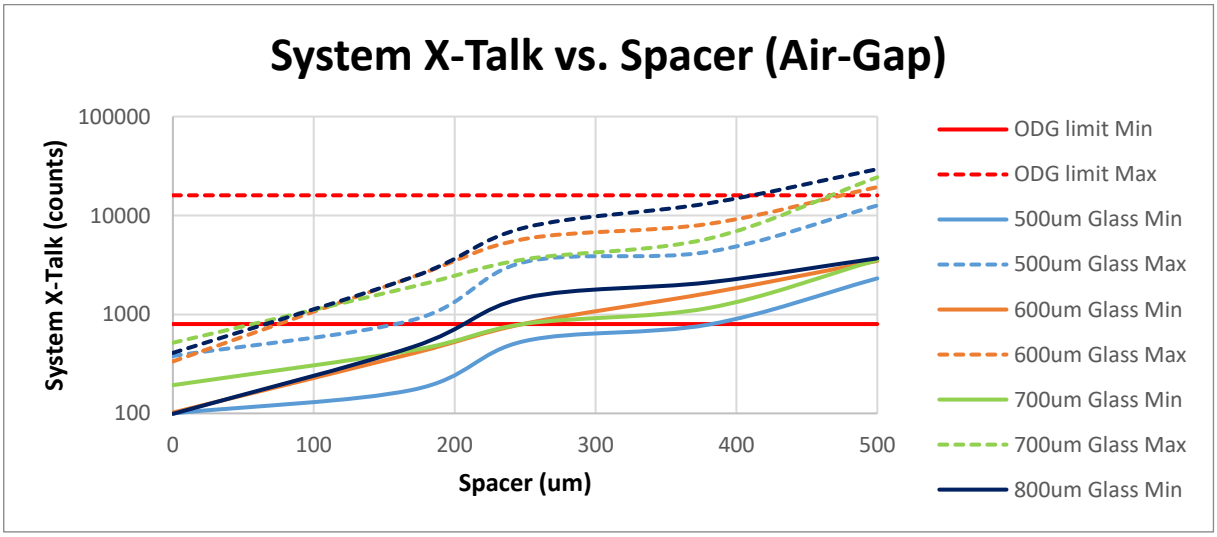
The two red lines show the ODG limits for the system-crosstalk.

If the crosstalk exceed the max limit then the tolerance to smudge is reduced - as a general rule if the crosstalk + smudge is about 60k count, it will be detected as a false target.

If the crosstalk is below the minimal ODG limit then this following effects may happen:

- Calibration can fail.
- Optical zero compensation over temperature might be degraded.

Figure 6:
System Crosstalk for Different CG and Spacer Combinations

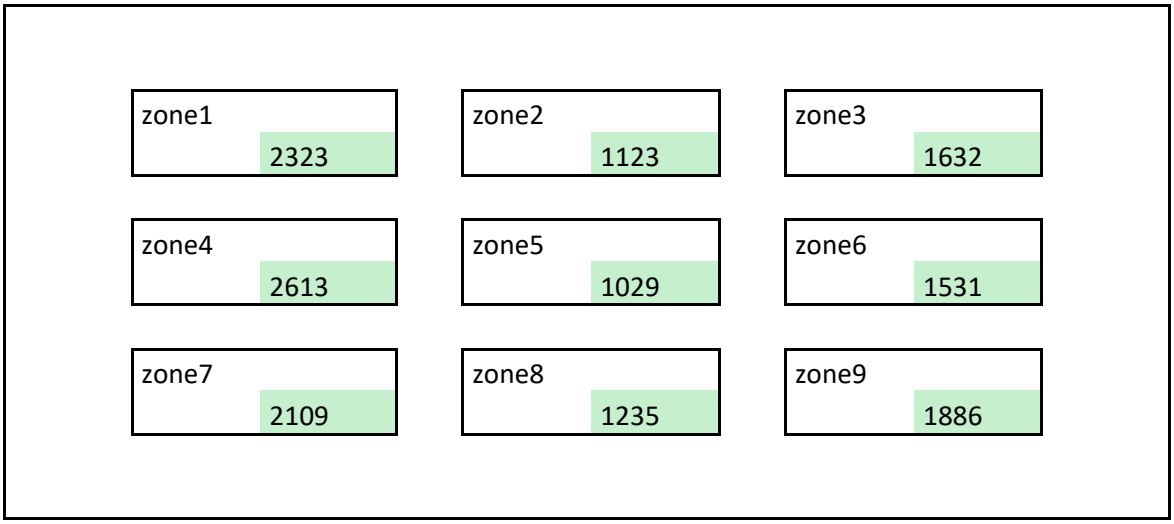


The trend is showing that a higher airgap and glass-thickness is increasing the system crosstalk.

3.5 System-Crosstalk Over Zones

The crosstalk distribution over the zones is not constant. In the following chart, you can see a typical arrangement over the zones:

Figure 7:
System-Crosstalk in 3x3 Mode



System crosstalk over the zones in 3x3 mode with 0.6 mm thick cover glass and 0.38 mm airgap-spacer.

The zones in the edge and corner position have potentially a higher crosstalk then the ones in the center position; this also applies for the 4x4 and 8x8 mode.

The distribution amount is not consistent, part-to-part variation is expected.

3.6 Cover Glass and Spacer (air-gap) Recommendation for Each Mode

Here you can find a cover glass and air-gap recommendation for the shield board which fulfill the ODG crosstalk limits.

Figure 8:
Recommendation for Cover Glass and Airgap in 3x3 Mode

cover-glass thickness \ airgap	None	0.17mm	0.25mm	0.38mm	0.5mm
0.5mm	✘	✘	✘	✓	✓
0.6mm	✘	✘	✘	✓	✓
0.7mm	✘	✘	✓	✓	✘
0.8mm	✘	✘	✓	✓	✓

Figure 9:
Recommendation for Cover Glass and Airgap in 4x4 Mode

cover-glass thickness \ airgap	None	0.17mm	0.25mm	0.38mm	0.5mm
0.5mm	✘	✘	✘	✘	✓
0.6mm	✘	✘	✓	✓	✘
0.7mm	✘	✘	✓	✓	✘
0.8mm	✘	✘	✓	✓	✘

Figure 10:
Recommendation for Cover Glass and Airgap in 8x8 Mode

cover-glass thickness \ airgap	None	0.17mm	0.25mm	0.38mm	0.5mm
0.5mm	✘	✘	✓	✓	✘
0.6mm	✘	✓	✓	✓	✘
0.7mm	✓	✓	✓	✘	✘
0.8mm	✘	✓	✓	✘	✘

3.7 Cover Glass Ordering Codes

Please find here the ordering codes for the cover glasses (http://www.hornix.com.tw/en/home/).

0.5mm thickness:

IR-T114-PM3D-A610

0.6mm thickness:

IR-T115-PM3D-A610

0.7mm thickness:

IR-T116-PM3D-A610

0.8mm thickness:

IR-T117-PM3D-A610

4 Revision Information

Changes from previous version to current revision v1-00	Page
Initial version	

- Page and figure numbers for the previous version may differ from page and figure numbers in the current revision.
- Correction of typographical errors is not explicitly mentioned.

5 Legal Information

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