

TMF8806 - OPTICAL DESIGN GUIDE (ODG)

Version 25. July 2024

*Optical simulation results are meant for relative comparison of competing design configurations.
Design prototypes are required for optical performance verification.*

TMF8806 Optical design guide

The design goal is to control system xtalk to stay with min and maximum levels. The main factors for controlling system xtalk are airgap, glass thickness, glass apertures, optical barrier, and ink/tint characteristics.

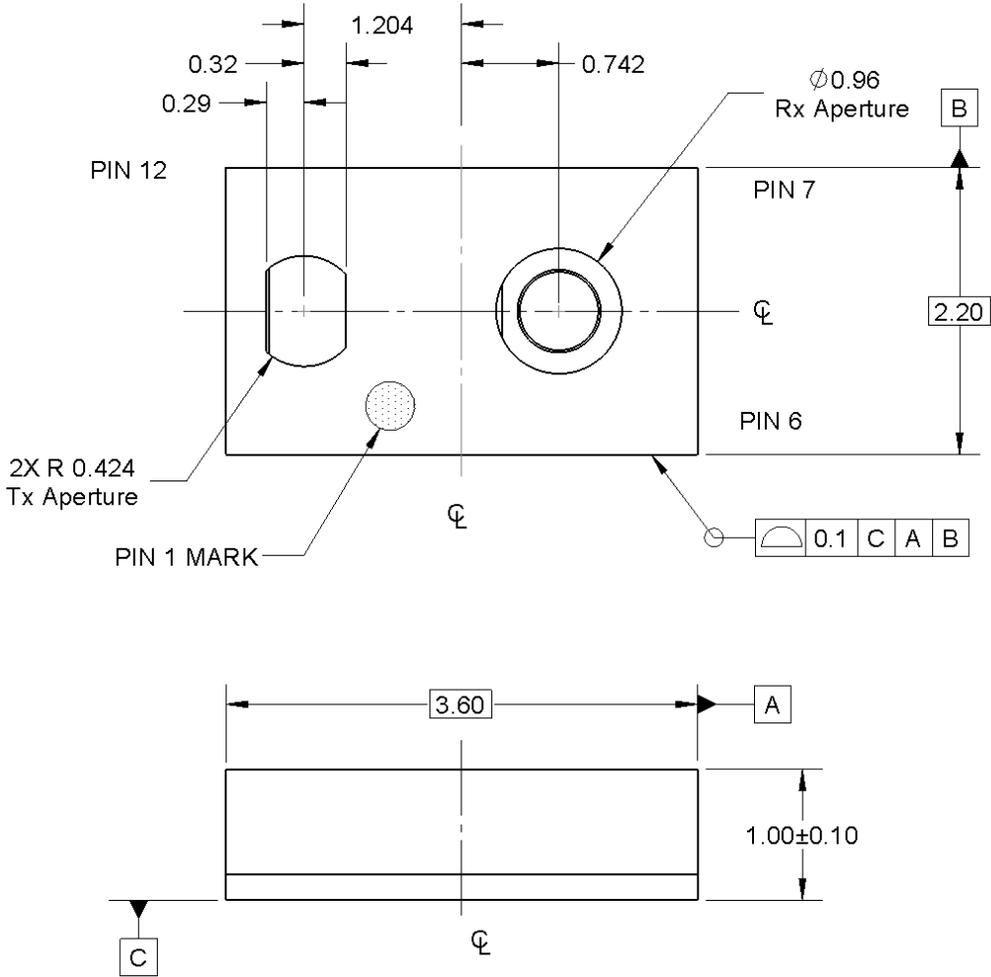
General system recommendations are for default mode with 2.5m maximum distance:

- Glass/TMF8006 airgap 0.4 - 0.8 mm range; IR ink required for calibration and operation
- Optical barrier design (e.g. rubber boot)
- Glass thickness 0.55mm
- Glass ink with 85% or better IR transmissivity
- Assembly XY tolerance between Glass apertures and TMF8806 is ± 0.20 mm maximum

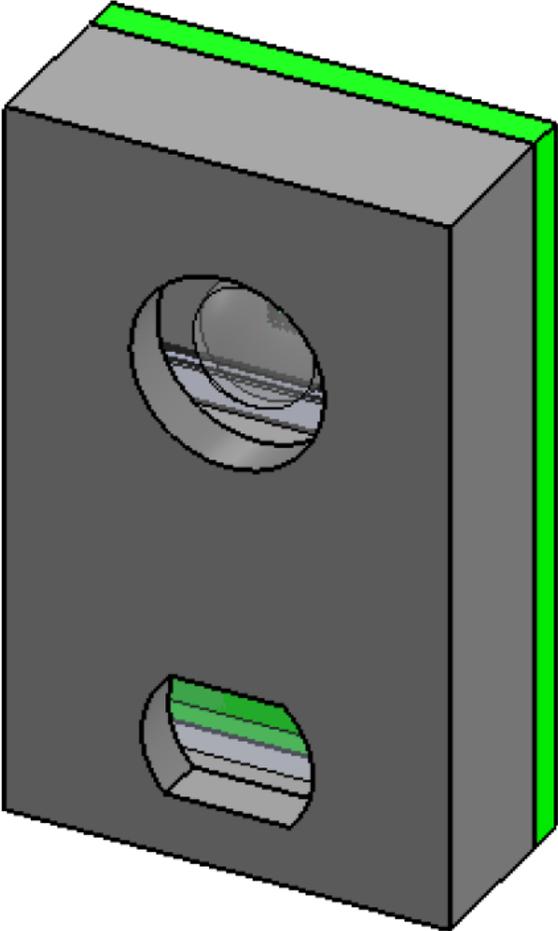
The TMF8806 additionally has a large airgap and thick cover glass mode – see the section later describing the setup.

TMF8806 - ODG

DRAWING



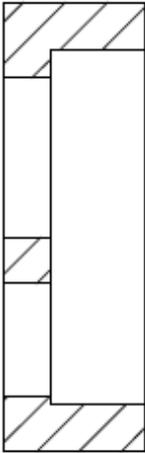
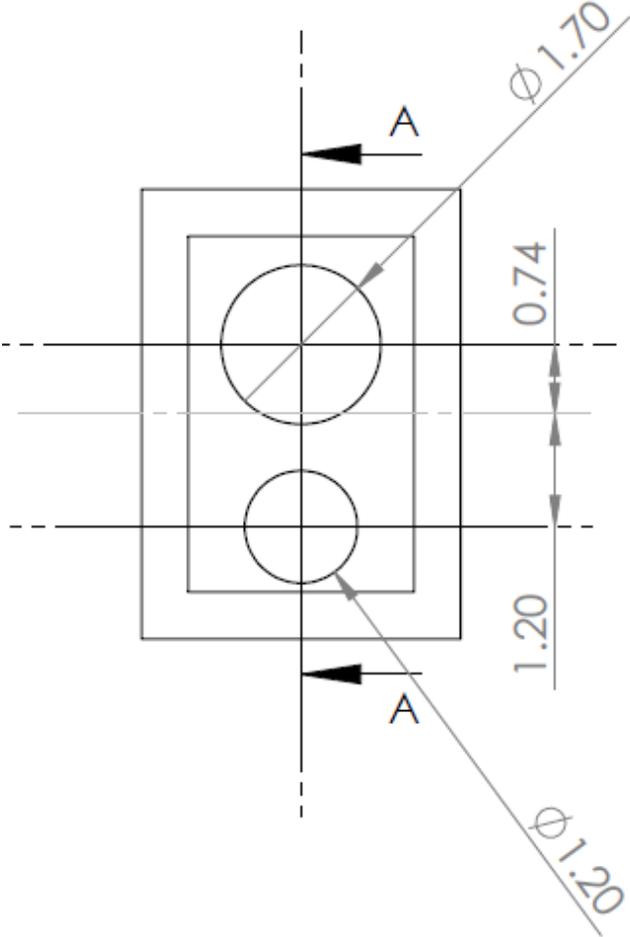
TMF8806_FOI_FOV.7z



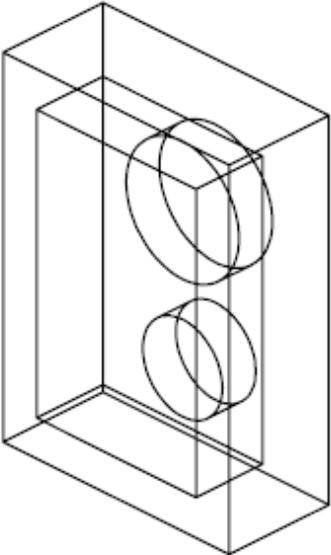
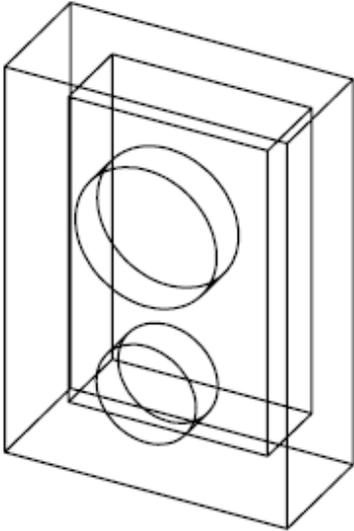
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TMF8806 OPTICAL BARRIER DESIGN

 TMF8806_EVM_4.7z

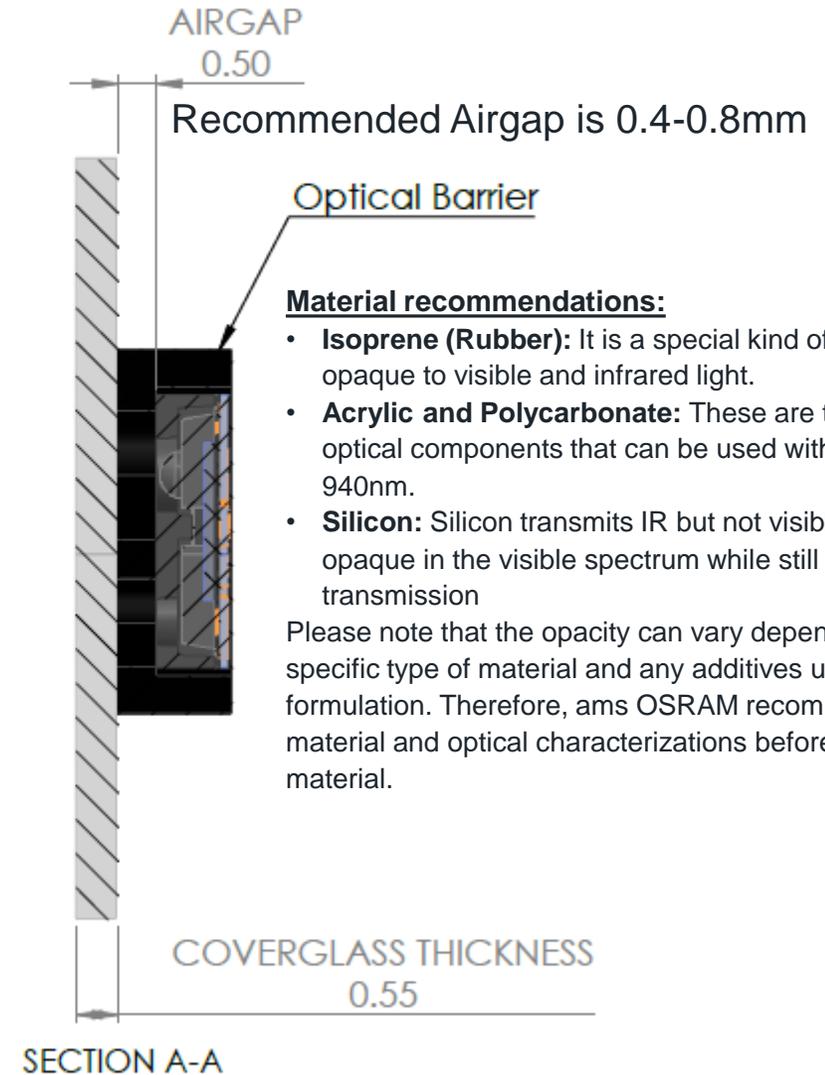
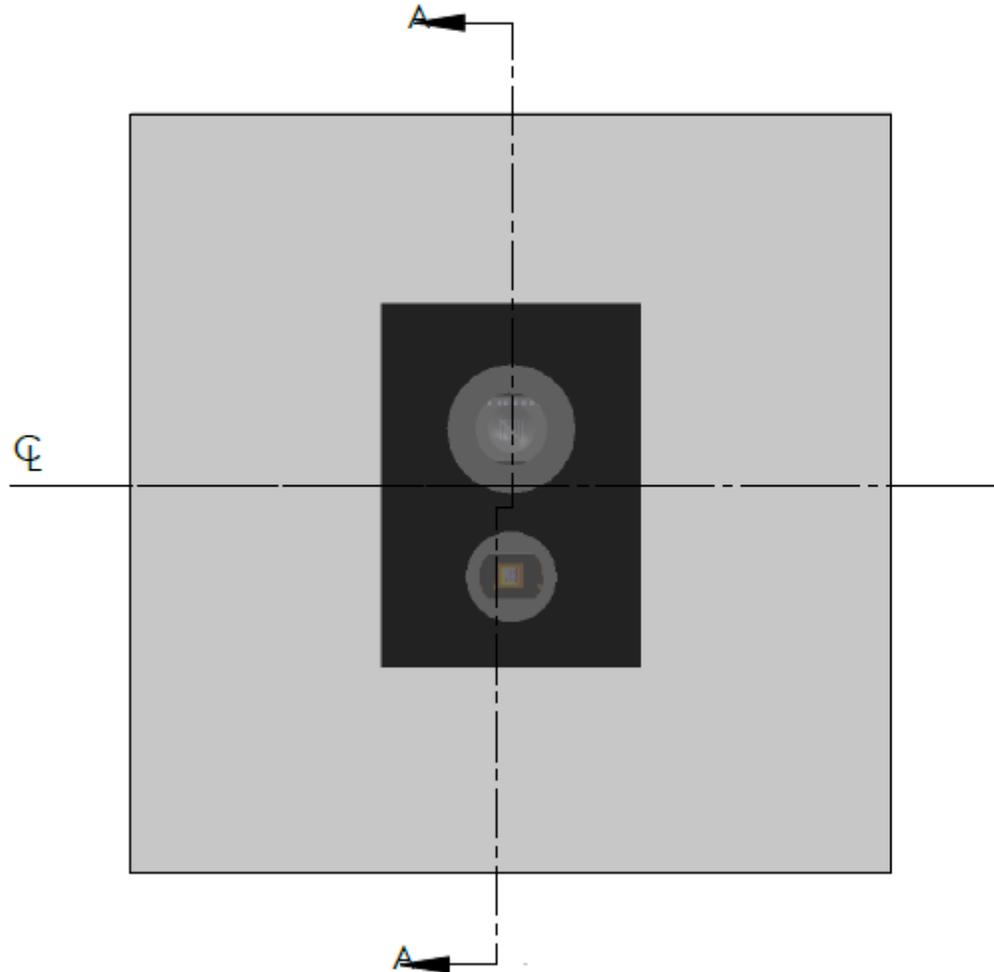


SECTION A-A



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TMF8806 OPTICAL ASSEMBLY RECOMMEDATION



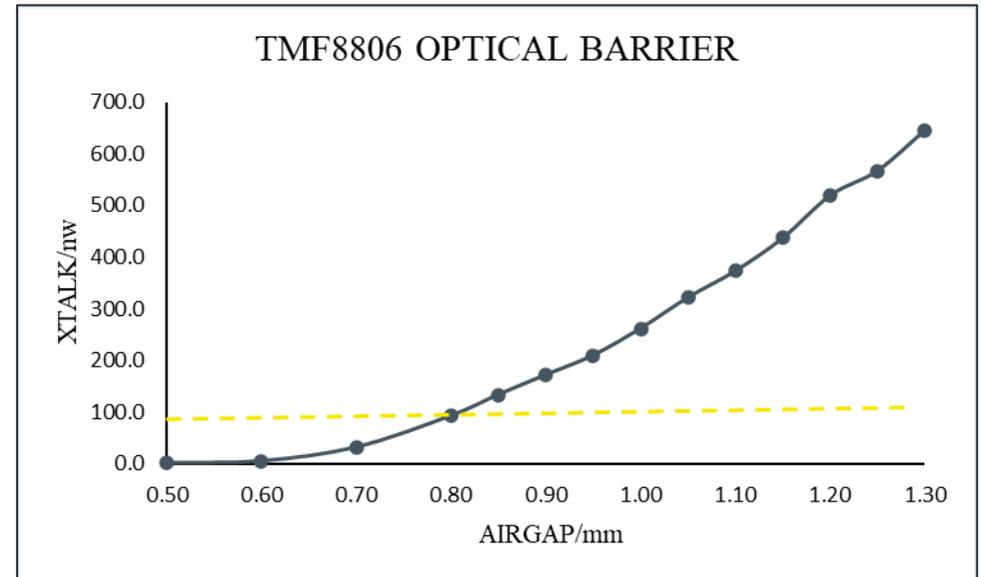
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CORRELATION BETWEEN MEASUREMENT (COUNTS) & SIMULATION (WATTS), 2.5m default mode

TMF8806 with Optical Barrier		
AIRGAP	XTALK (nW)	Counts
0.50	0.5	1295
0.60	4.1	3659
0.70	31.2	4982
0.80	92.4	6245
0.85	133.4	7807
0.90	171.6	9161
0.95	209.6	10328
1.00	261.6	10906
1.05	321.7	11597
1.10	373.0	12373
1.15	437.1	12368
1.20	519.3	12305
1.25	567.3	13065
1.30	645.9	13596

Allowed crosstalk range
400 to 7000 counts

Crosstalk too high!
>7000 counts



TMF8806 - ODG

TARGET XTALK VALUES

Operate the EVM with the full optical stack
No target in front below 40 cm, low ambient light

Procedure

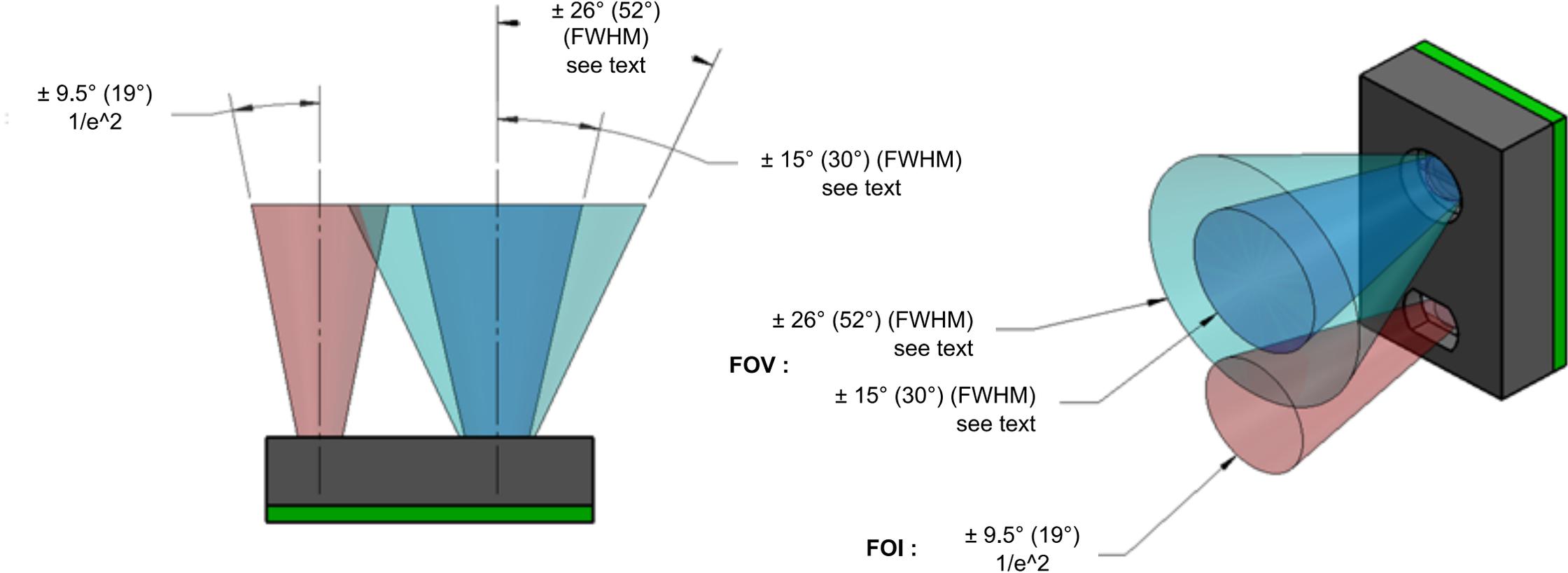
1. Select short range histogram only
2. Pick the **same operating mode** as in the final application (5m mode, large airgap, thick cover glass)
3. Minimal ambient light
4. The highest peak shall be within **400-7000 counts**



TMF8806 - ODG

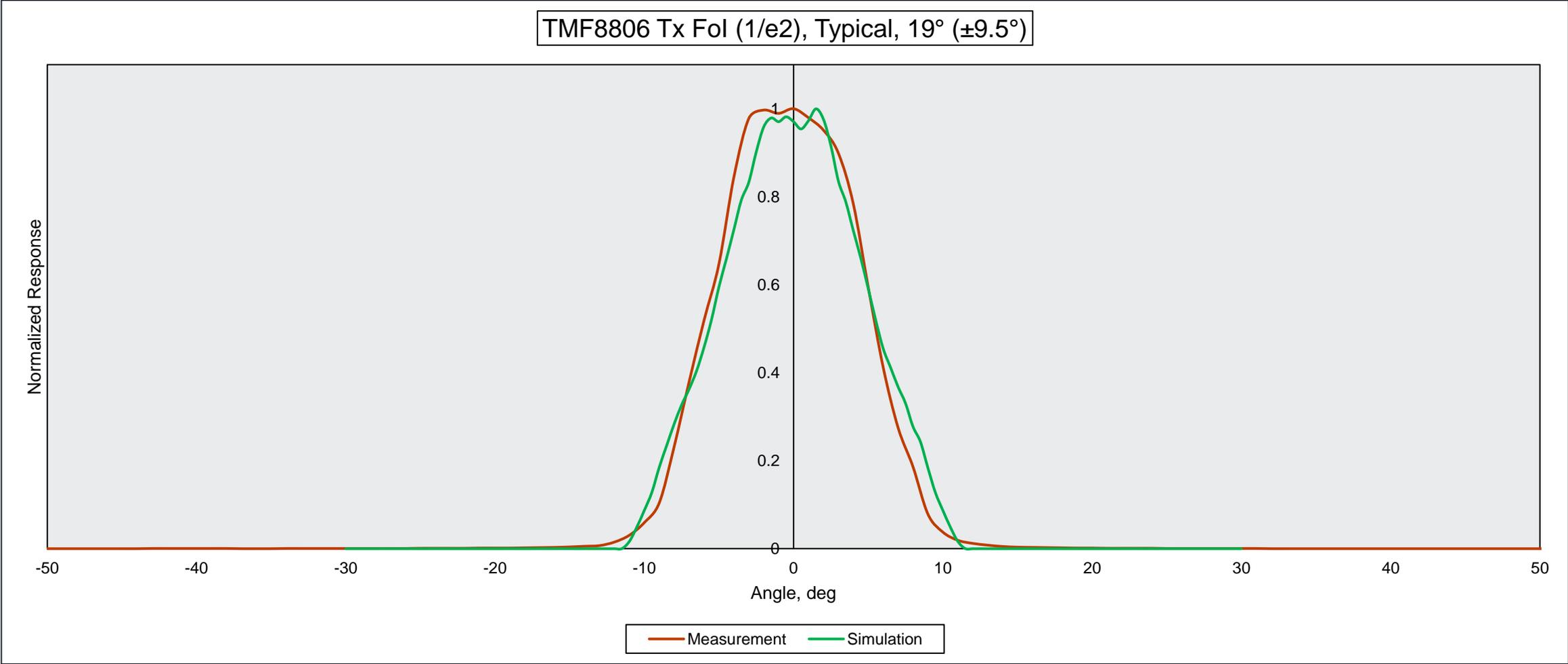
FoI / FoV Cones

FOV: +/- 26° only used for short range, default mode
+/- 15° used for all other modes



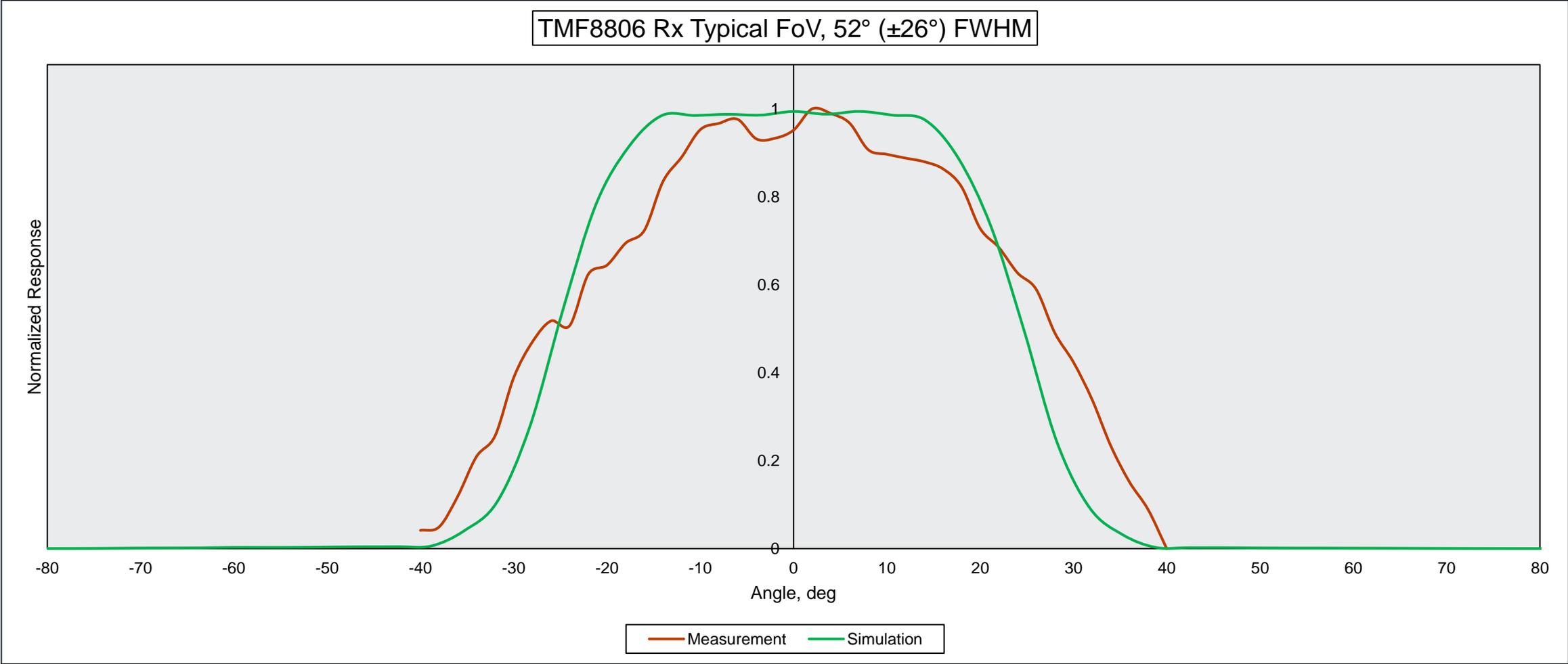
TMF8806 - ODG

FoI, EMISSION, $\pm 9.5^\circ$ (19°) $1/e^2$



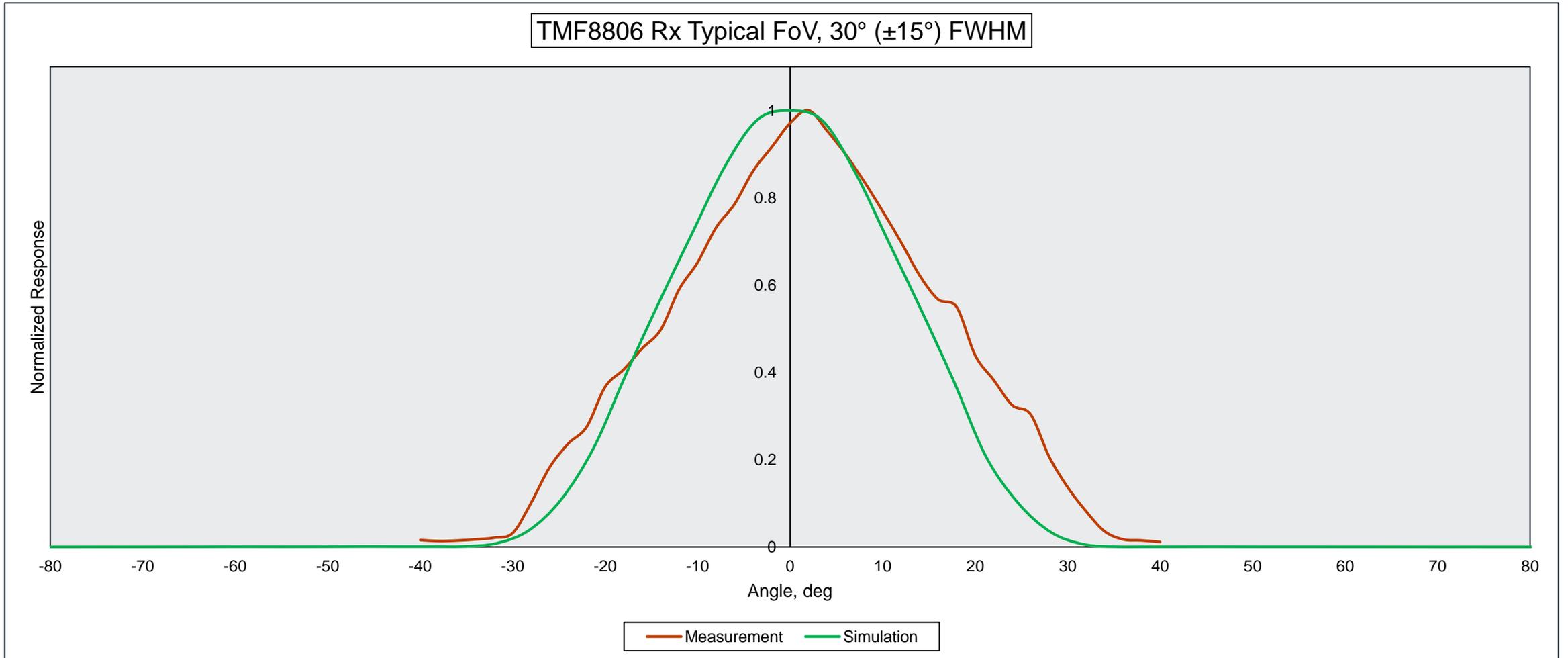
TMF8806 - ODG

SPAD FoV: 52° ±26° FWHM **Short range default mode is based on the entire SPAD array.**



TMF8806 - ODG

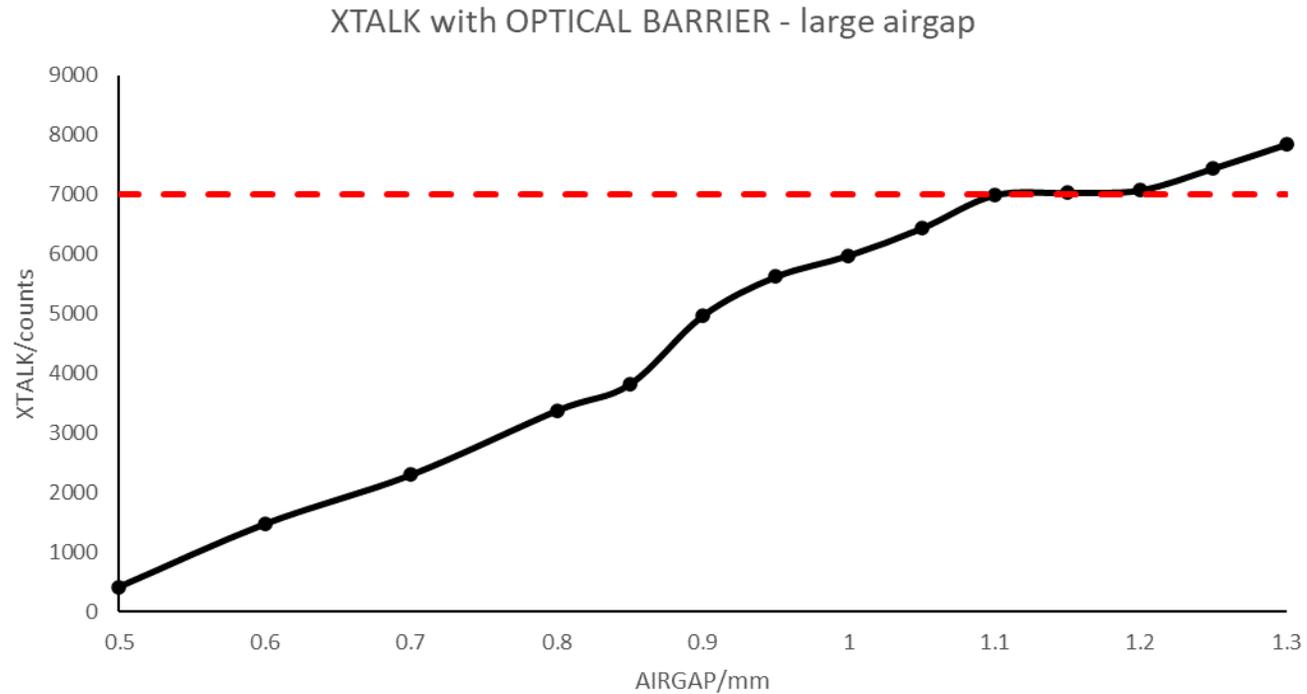
SPAD FoV: 30° ($\pm 15^\circ$) FWHM All other modes expect short range, default mode is based on a part of the SPAD array.



TMF8806 - ODG

Coverglass 0.55mm thick, large airgap mode

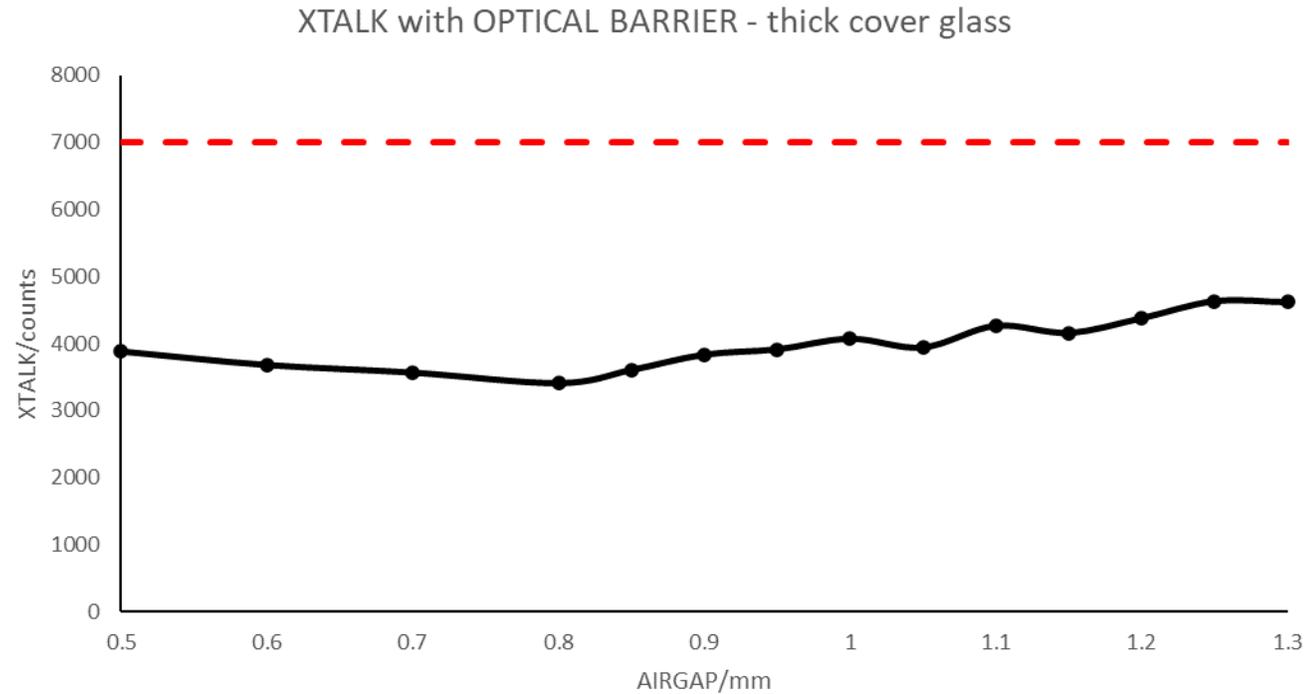
TMF8806 with Optical Barrier - large airgap	
AIRGAP	Counts
0.5	420
0.6	1476
0.7	2299
0.8	3376
0.85	3818
0.9	4969
0.95	5624
1	5981
1.05	6438
1.1	6997
1.15	7037
1.2	7081
1.25	7446
1.3	7847



TMF8806 - ODG

Coverglass 3.2mm thick, thick cover-glass mode

TMF8806 with Optical Barrier - thick CG	
AIRGAP	Counts
0.5	3883
0.6	3680
0.7	3566
0.8	3408
0.85	3605
0.9	3835
0.95	3914
1	4073
1.05	3943
1.1	4267
1.15	4161
1.2	4380
1.25	4635
1.3	4619

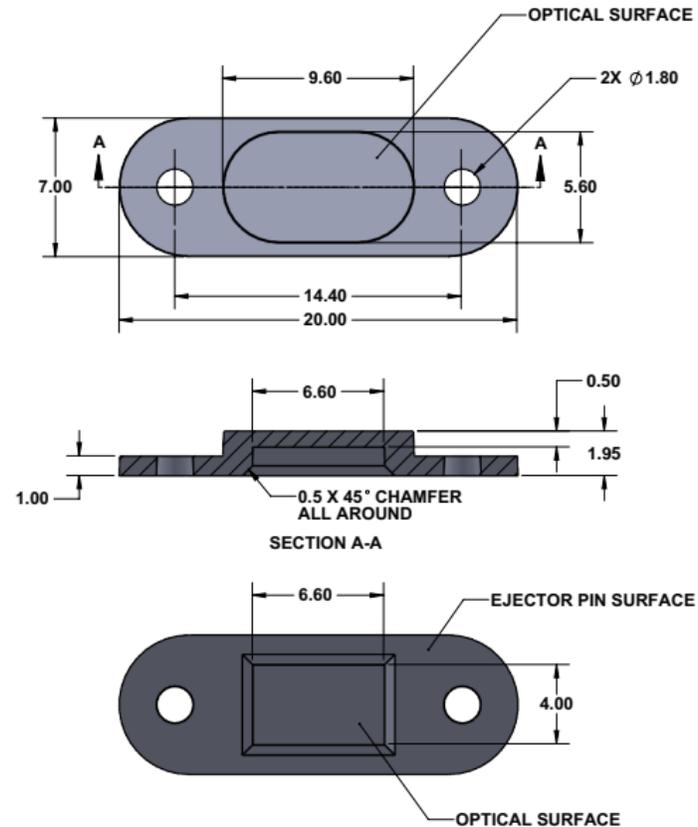


TMF8806_EVM_EB_SHIELD cover glass drawings

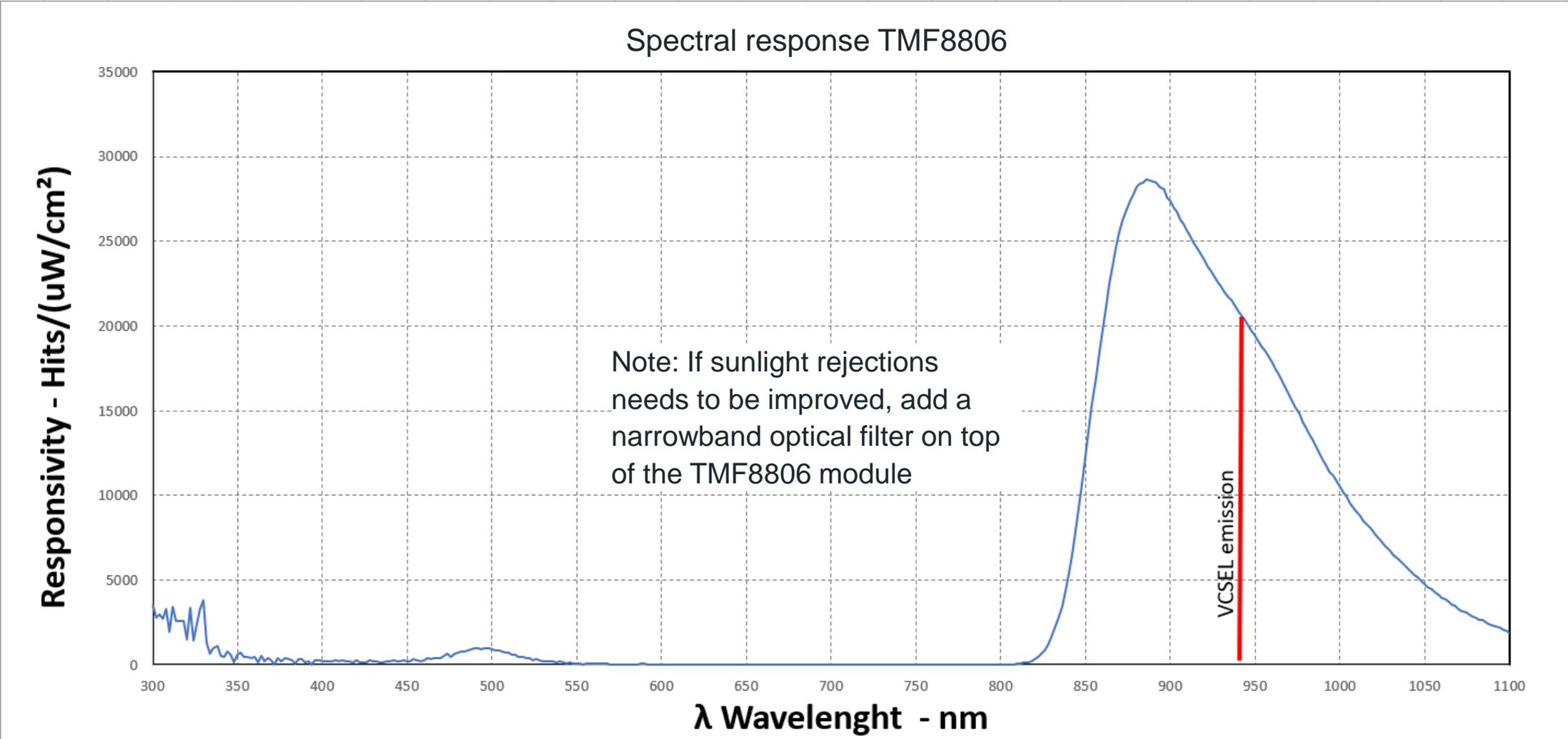
Cover glass drawing for shield board

NOTES:

1. REFER TO CAD FILE TMF8806_CG.STEP FOR ANY MISSING DIMENSIONS.
2. 2° DRAFT SHOWN. DRAFT MAY BE ADJUSTED FOR MANUFACTURING PURPOSES WITH APPROVAL FROM amsAG.
3. SURFACES INDICATED AS OPTICAL SURFACES SHALL MEET THE FOLLOWING REQUIREMENTS:
 1. TOOL SURFACE FINISH 0.1 μ m Ra MAXIMUM ON SURFACES INDICATED. OTHER SURFACES SPI-B1 OR BETTER.
 2. NO BUBBLES OR VOIDS VISIBLE THROUGH OPTICAL SURFACE UNDER 30X MAGNIFICATION MINIMUM.

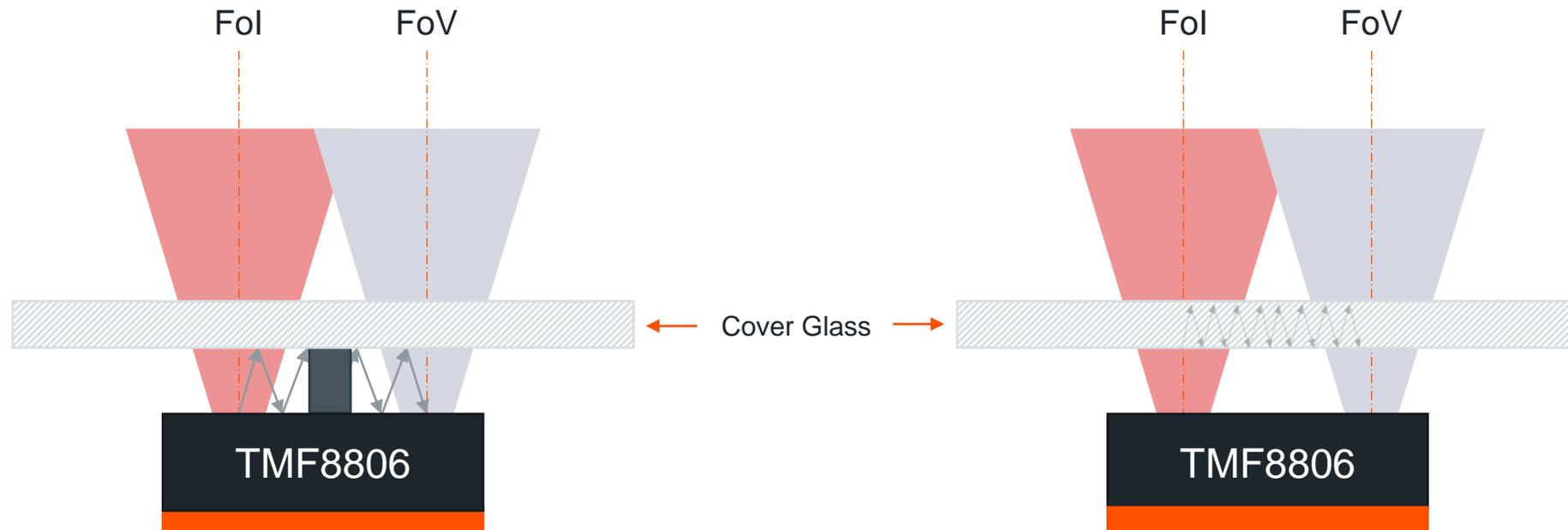


TMF8806 Optical Filter + SPAD response



Evaluation using TMF8806_EVM_EB_SHIELD

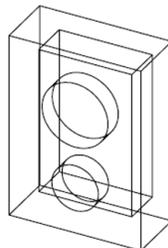
Controlling crosstalk



Crosstalk between device and cover glass
A larger airgap will increase crosstalk



Optical barrier to limit airgap crosstalk



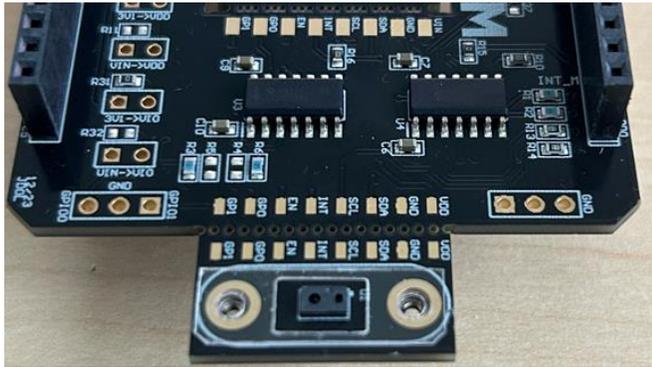
Crosstalk within cover glass
A thicker cover glass will increase crosstalk

Evaluation using TMF8806_EVM_EB_SHIELD

Optical Design Guide (ODG) crosstalk limits – default mode

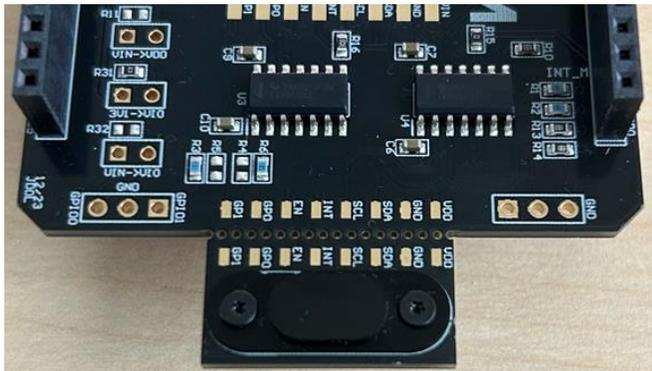
Airgap Spacers

- 0.17mm
- 0.25mm
- 0.35mm
- 0.5mm



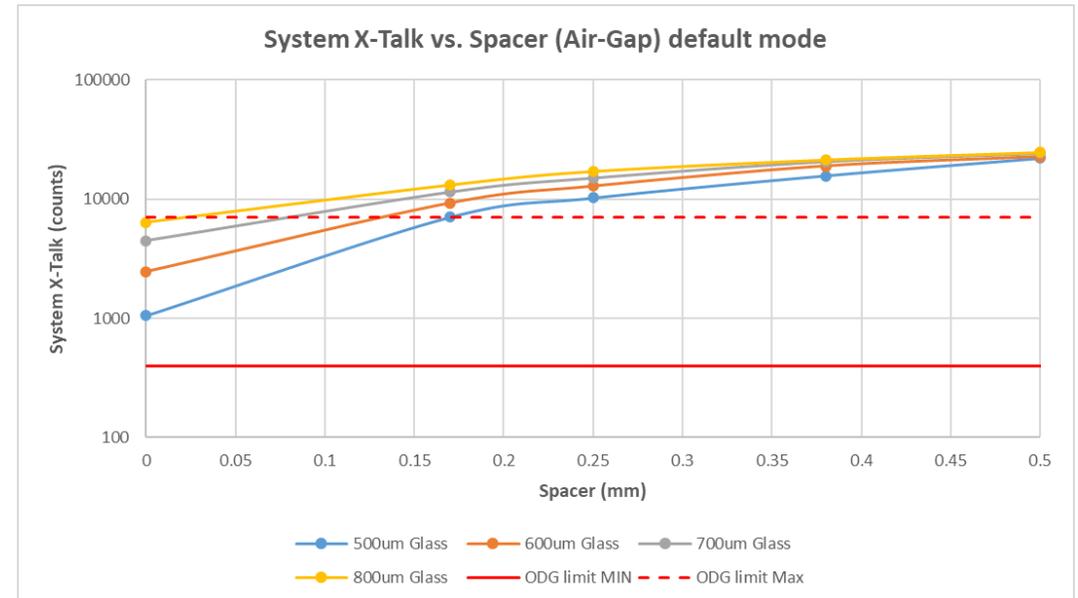
Cover Glass

- 0.5mm
- 0.6mm
- 0.7mm
- 0.8mm



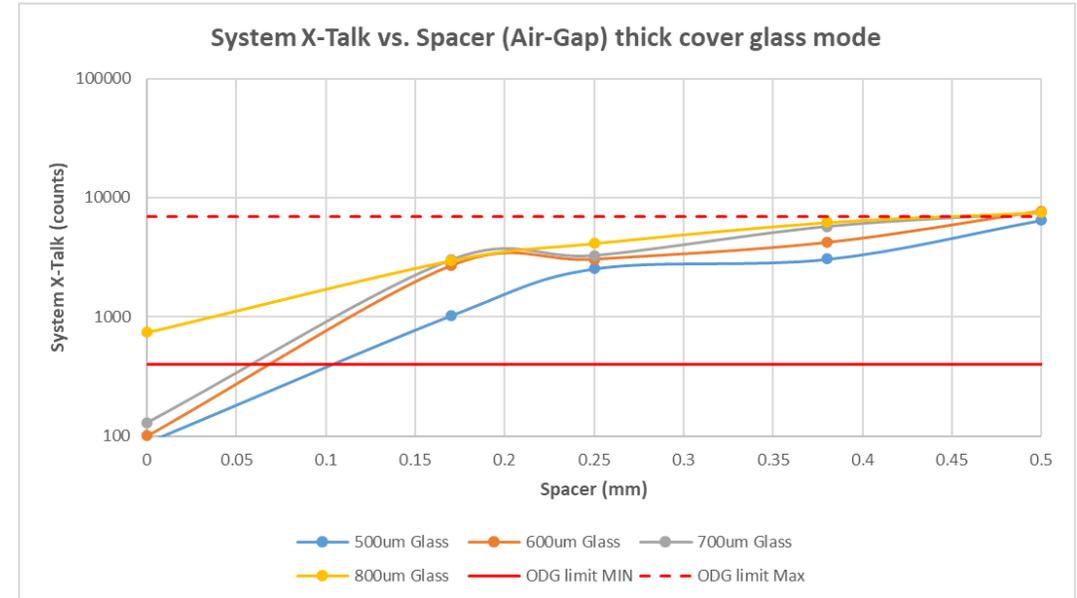
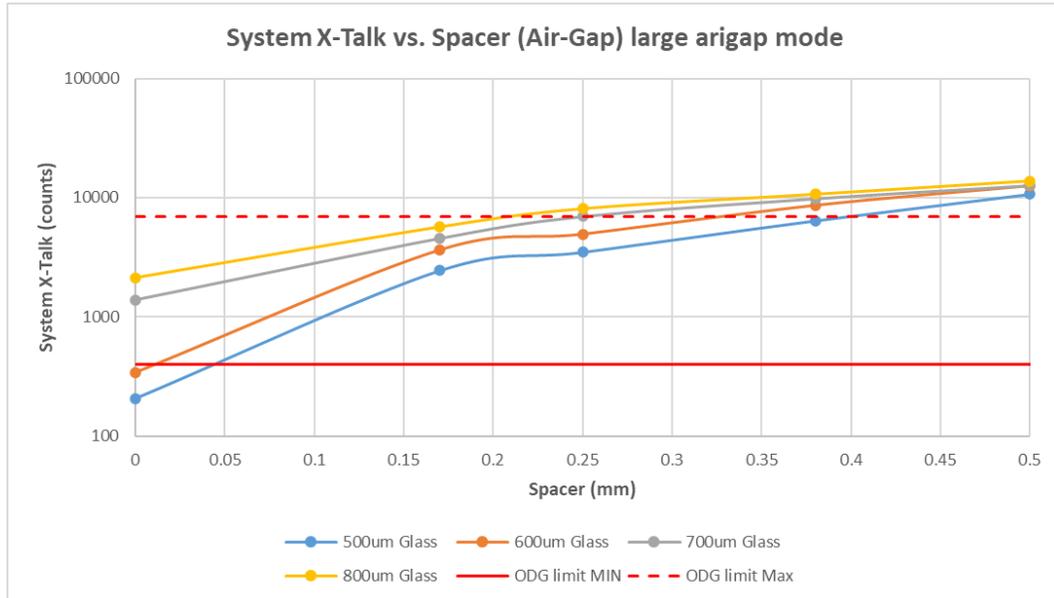
Optical Design Guide crosstalk limits

Mode	Min. crosstalk counts	Max. crosstalk counts
Default mode	400	7000
Larger airgap mode	400	7000
Thick cover glass mode	400	7000



Evaluation using TMF8806_EVM_EB_SHIELD

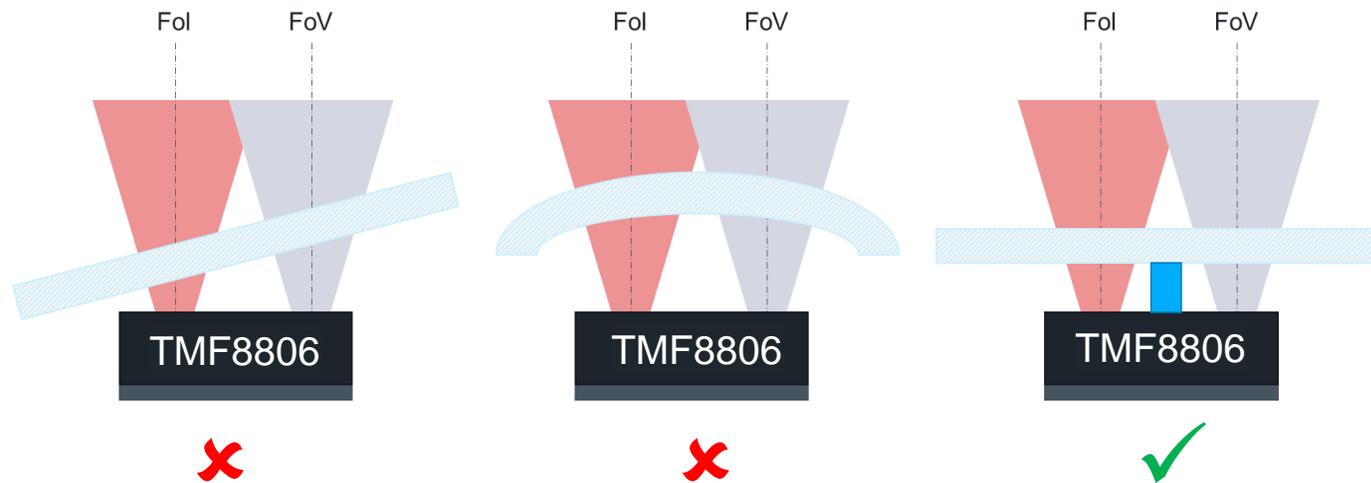
Optical Design Guide (ODG) crosstalk limits – large airgap and thick cover glass mode



Evaluation using TMF8806_EVM_EB_SHIELD

Optical design recommendations

- Keep airgap with limits defined by this document
- Use optical isolation barrier (rubber boot) to reduce crosstalk
- Use cover glass with > 90% 940nm transmissivity
- Ensure crosstalk is within Optical Design Guide min & max range
- Keep cover glass perpendicular to FoI / FoV & no curved, textured or patterned glass



TMF8806 Crosstalk & factory calibration Python script

Setup and run tool

Setup

- Use EVM or shield board
- Download logging tools from https://github.com/ams-OSRAM-Group/tmf8806_zmq_data_logger/releases
- Setup of tools see https://github.com/ams-OSRAM-Group/tmf8806_zmq_data_logger

Execute: Open shell tool and execute following commands:

```
PS C:\...\tmf8806_zmq_data_logger...> pip install zmq_client-1.1.9.tar.gz
...removed output...
PS C:\...\tmf8806_zmq_data_logger...> python.exe .\example_zmq_client_calibration.py
#CONF;2.5m mode;all SPADs
#XTALK;1740
#CONF;2.5m mode;40best SPADs
#XTALK;731
#CONF;2.5m mode;20best SPADs
#XTALK;411
#CONF;4m mode;all SPADs
#XTALK;1067
#CONF;4m mode;40best SPADs
#XTALK;1476
#CONF;4m mode;20best SPADs
#XTALK;894
```

The script outputs crosstalk in all modes and stores all results in `example_log_calibration.csv` – only these `#XTALK` readings are relevant, which are actually used in an application

All SPADs	= default mode
40 best SPADs	= large airgap mode
20 best SPADs	= thick cover glass mode

TMF8806 Crosstalk & factory calibration Python script

How-to interpret the results

Check Optical Design Guide to ensure crosstalk is within specified limits, adjust cover glass / air gap if outside limits

min = 400 counts, max = 7000 counts

- If crosstalk is too high, decrease airgap, reduce cover glass thickness or use optical barrier
- If crosstalk is too low, increase airgap or increase cover glass thickness

See individual driver documentation how-to integrate calibration data.

Note for using the tool for the TMF8806 Shield board:

- Run ZMQ server on PC: `tmf8806_zmq_server_ftdi_arduino_<latest version>.exe` from <https://ams-osram.com/tmf8806>
- Edit `example_zmq_client_calibration.py` script to change server to 127.0.0.1:

```
39 if __name__ == "__main__":
40
41     CMD_SERVER_ADDR = "tcp://127.0.0.1:5555"
42     RESULT_SERVER_ADDR = "tcp://127.0.0.1:5556"
43     LOG_FILE = Path(__file__).parent / "example_log_calibration.csv"
```

am 

OSRAM