TMF8820/TMF8821 OPTICAL DESIGN GUIDE (ODG)

Rev1 (27Sept): Initial version

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

TMF8820/TMF8821 ODG

Introduction

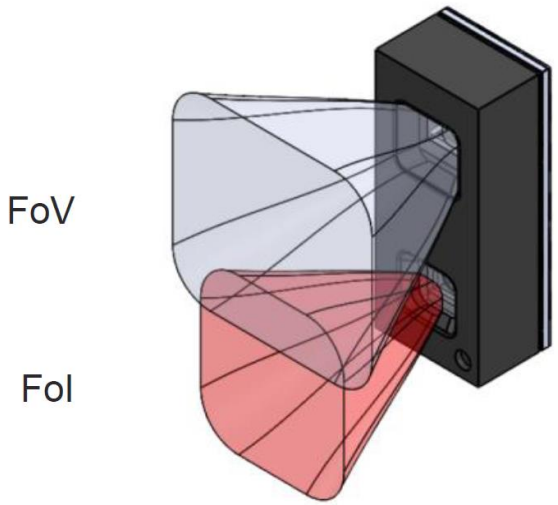
The TMF8820/TMF8821 is a direct time-of-flight (dToF) sensor in a single modular package with associated VCSEL. The dToF device is based on SPAD, TDC and histogram technology and achieves 5000 mm detection range. Due to its lens on the SPAD, it supports 3x3, 4x4, and 3x6 multi-zone output data and a very wide, dynamically adjustable, field of view. A multi-lens-array (MLA) inside the package above the VCSEL widens up the FoI (field of illumination). All processing of the raw data is performed on-chip and the TMF8820/TMF8821 provide distance information together with confidence values on its I2C interface.

TMF8820	3x3 zones operation
TMF8821	3x3, 4x4 and 3x6 zones operation

The ODG provides EVM setup and system xtalk requirement for both 3x3 and 4x4 normal modes. EVM setup and measurement examples are detailed for both 3x3 and 4x4 modes. The EVM optical stack is defined using a rubber boot. The EVM measurement results are provided for the 3x3 normal mode based on 164 test devices. The measured (Peak) xtalk results are correlated with simulated system xtalk results using 3x3 mode and similar optical stack model. This provides the basis for future design-in simulation guidance to meet the system xtalk requirements.

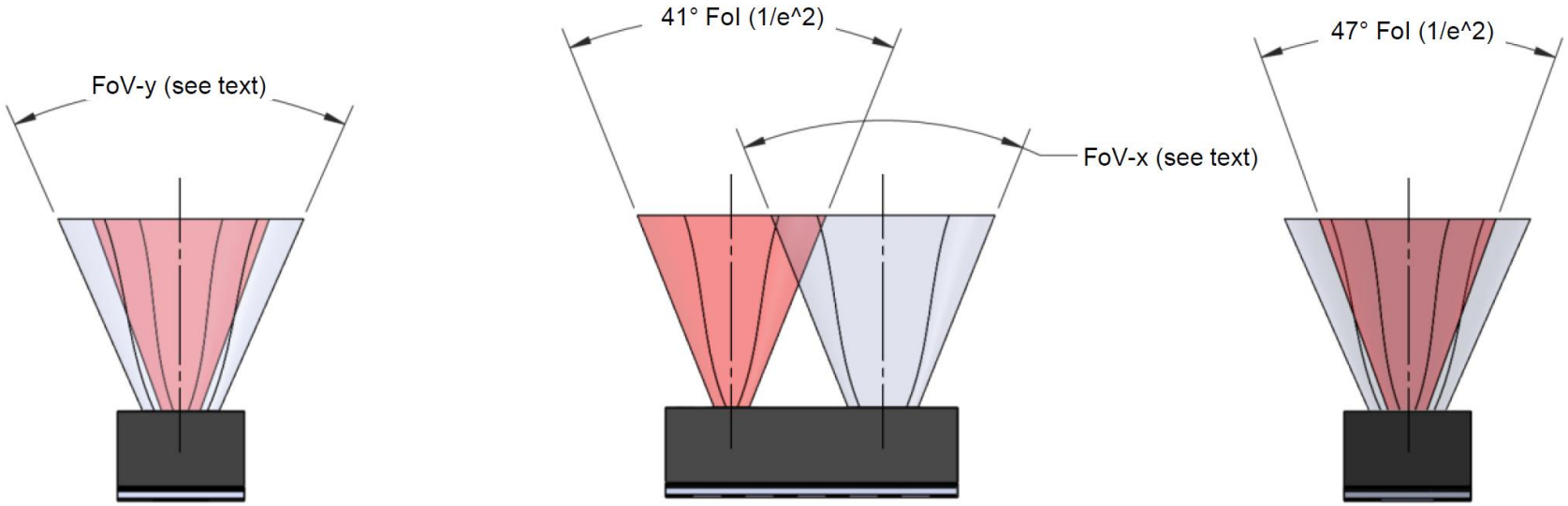
TMF8820/TMF8821 ODG

Drawing, FoV and FoI



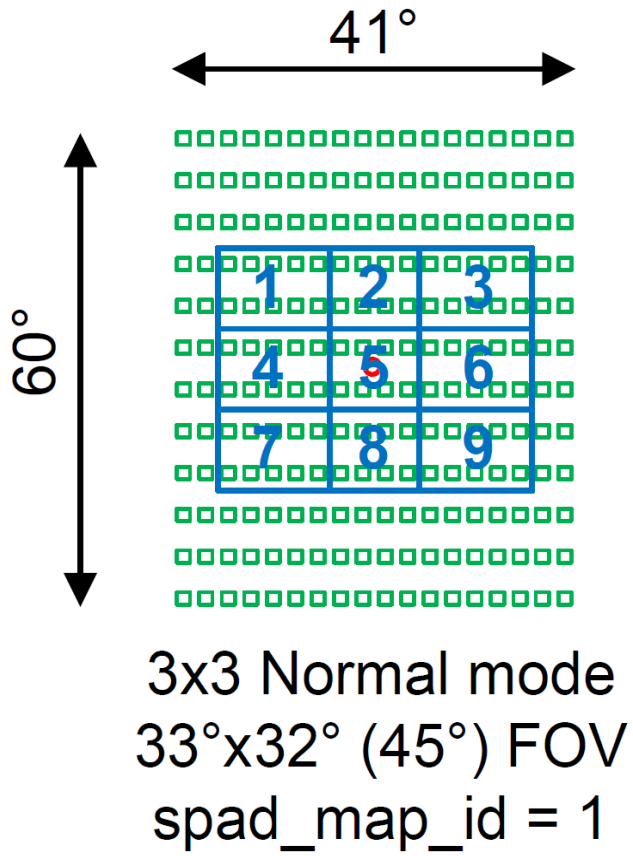
dToF Sensor Field of View (FoV – [x] x [y])

- 41x52º (63° diagonal calc.) spad_map_id=6 or 7
- 33x32º (45° diagonal calc.) spad_map_id=1



Crosstalk Levels for TMF8820

3x3 Normal mode setup and crosstalk requirements



Setup

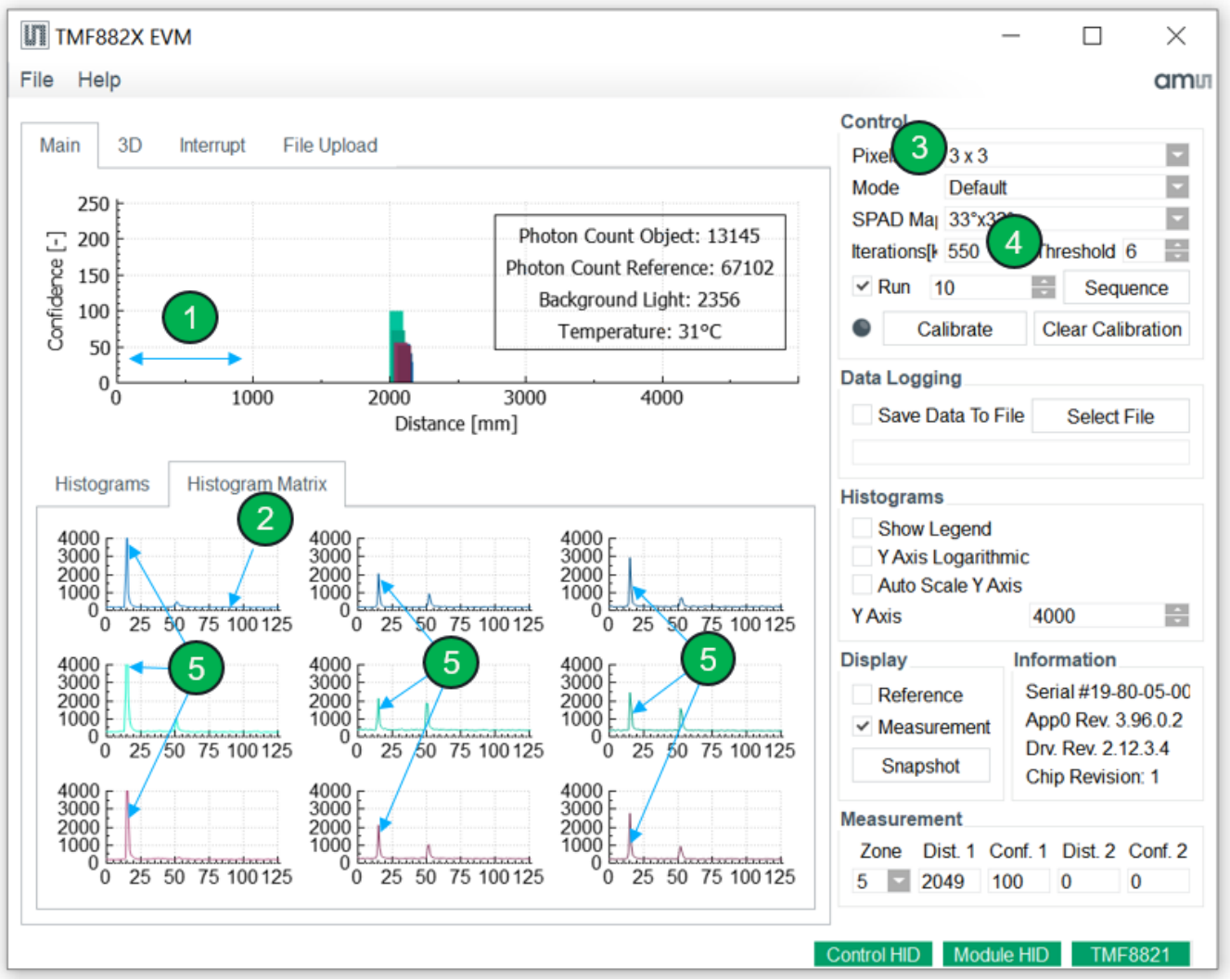
- No target within >40cm
- No IR light
- 550k iterations (= 30 Hz output data rate)
- Use 3x3 mode with 33° x 32° FOV (spad_map_id = 1, see datasheet)
- Optical calibration shall be done with 4M iterations.

Requirements

- Scale crosstalk to 550k iterations
  - Example for 4M iterations: Crosstalk divided by 4M/550k = 7.27
- The peak of the crosstalk for all channels except reference channel in 3x3 default mode (33° x 32° degree FOV) shall be within **min 900** counts **max 15200** counts

Crosstalk Levels checked with the EVM TMF8820

EVM setup and measurement



Setup

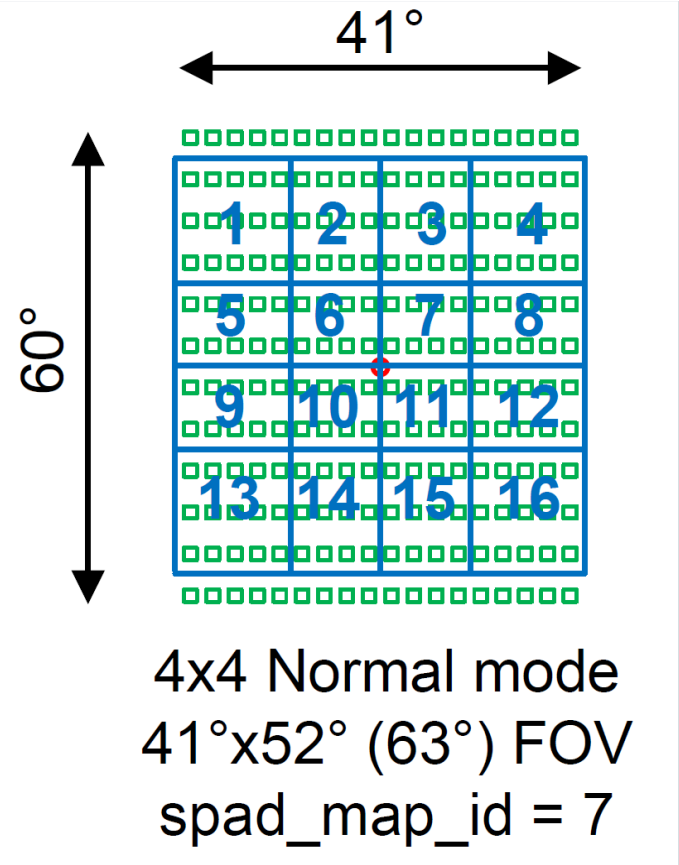
- (1) No target within >40cm
- (2) No IR light
- (3) 3x3 mode, 33° x 32° FOV
- (4) Set iterations to default (550k)

Measurement

- (5) The crosstalk peaks of all channels shall be within **min 900** counts **max 15200** counts

Crosstalk Levels for TMF8821

4x4 Normal mode setup and crosstalk requirements



Setup

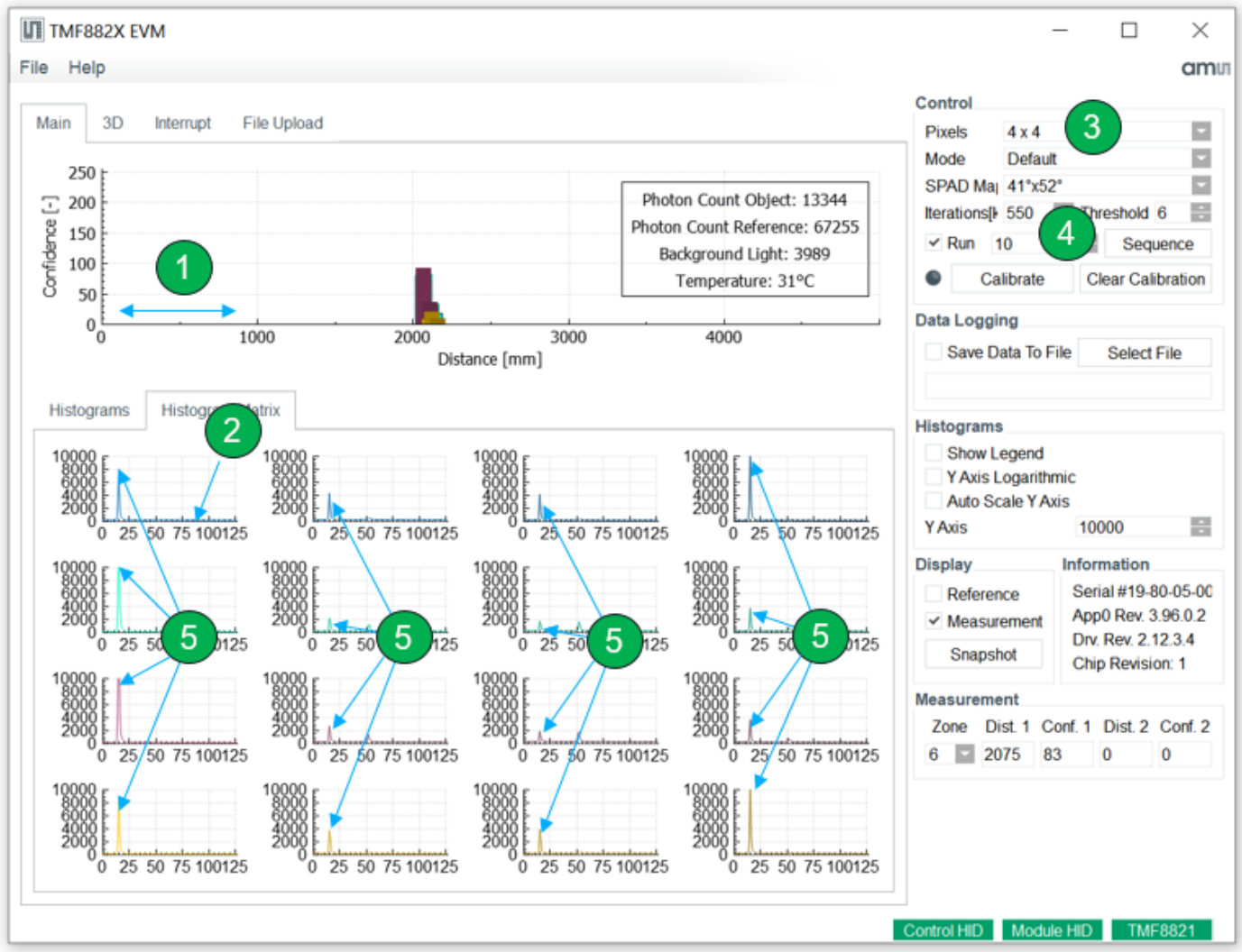
- No target within >40cm
- No IR light
- 550k iterations (= 15 Hz output data rate)
- Use 4x4 mode with 41° x 52° FOV (spad_map_id = 7, see datasheet)
- Optical calibration shall be done with 4M iterations.

Requirements

- Scale crosstalk to 550k iterations
  - Example for 4M iterations: Crosstalk divided by 4M/550k = 7.27
- The peak of the crosstalk for all channels except reference channel in 3x3 default mode (33° x 32° degree FOV) shall be within **min 800** counts **max 16000** counts

Crosstalk Levels checked with the EVM TMF8821

EVM setup and measurement



Setup

- (1) No target within >40cm
- (2) No IR light
- (3) 4x4 mode, 41° x 52° FOV
- (4) Set iterations to default (550k)

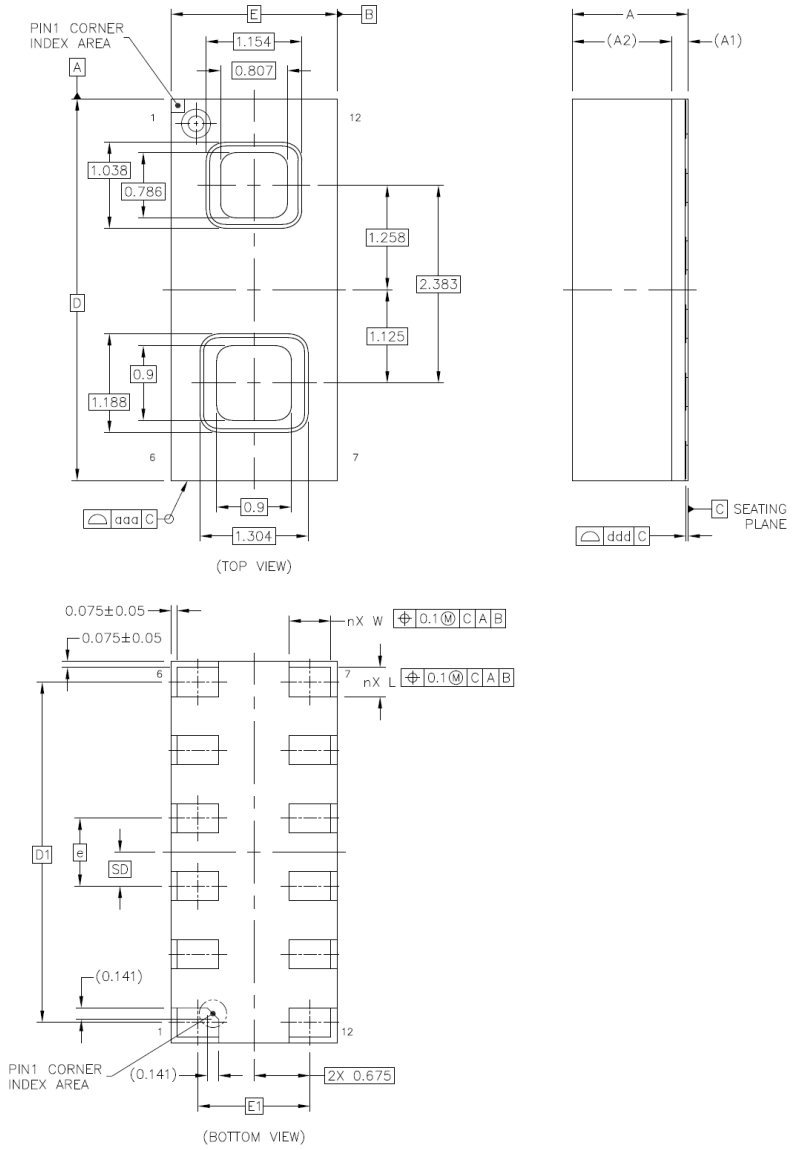
Measurement

- (5) The crosstalk peaks of all channels shall be within **min 800** counts **max 16000** counts

TMF8820/TMF8821 ODG

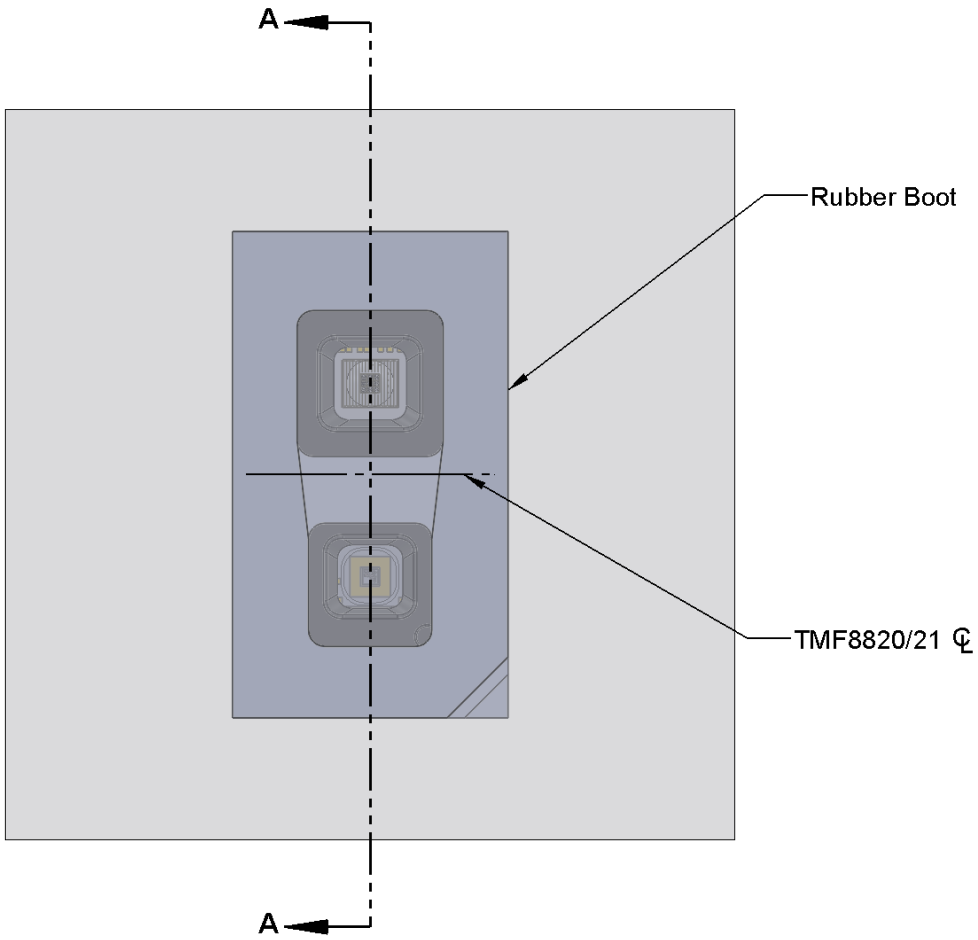
Package Outline Drawing

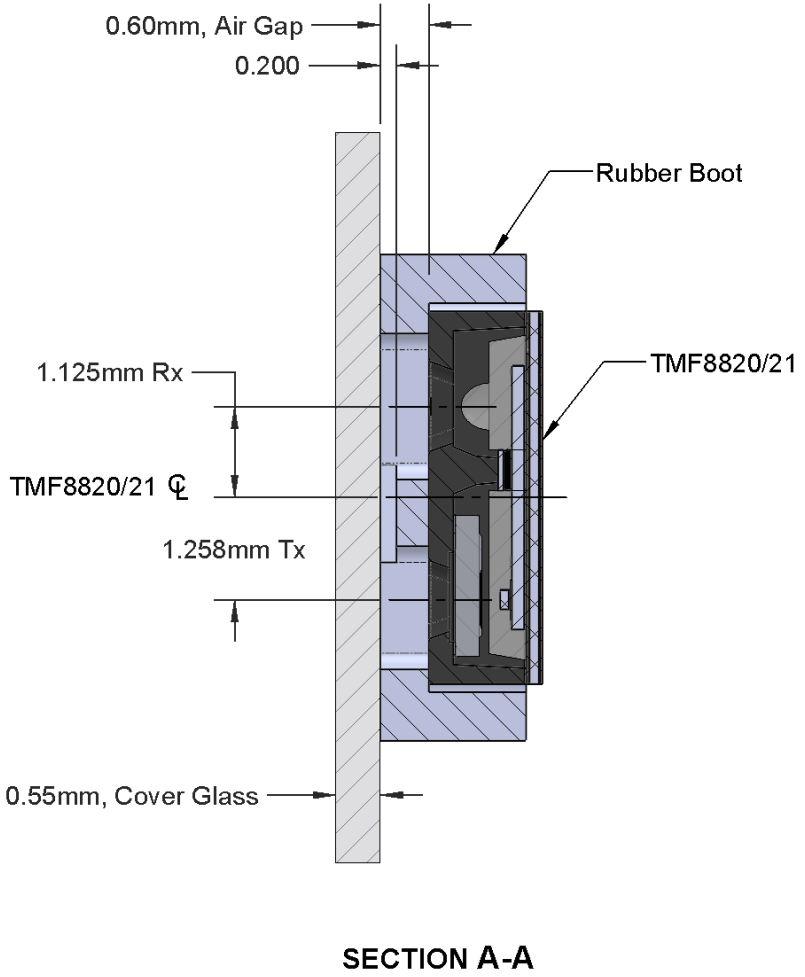
	SYMBOL	COMMON DIMENSIONS		
		MIN.	NOR.	MAX.
TOTAL THICKNESS	A	1.3	1.4	1.5
SUBSTRATE THICKNESS	A1		0.2	REF
LID THICKNESS	A2		1.2	REF
BODY SIZE	D		4.6	BSC
	E		2	BSC
LEAD WIDTH	W	0.45	0.5	0.55
LEAD LENGTH	L	0.3	0.35	0.4
LEAD PITCH	e		0.82	BSC
LEAD COUNT	n		12	
EDGE BALL CENTER TO CENTER	D1		4.1	BSC
	E1		1.35	BSC
BODY CENTER TO CONTACT BALL	SD		0.41	BSC
	SE		---	BSC
BALL WIDTH	b	---	---	---
PRE-SOLDER		---	---	---
PACKAGE EDGE TOLERANCE	aaa		0.1	
MOLD FLATNESS	bbb		---	
COPLANARITY	ddd		0.08	
BALL OFFSET (PACKAGE)	eee		---	
BALL OFFSET (BALL)	fff		---	



TMF8820/TMF8821 ODG

Drawing, EVM Setup Optical Stack

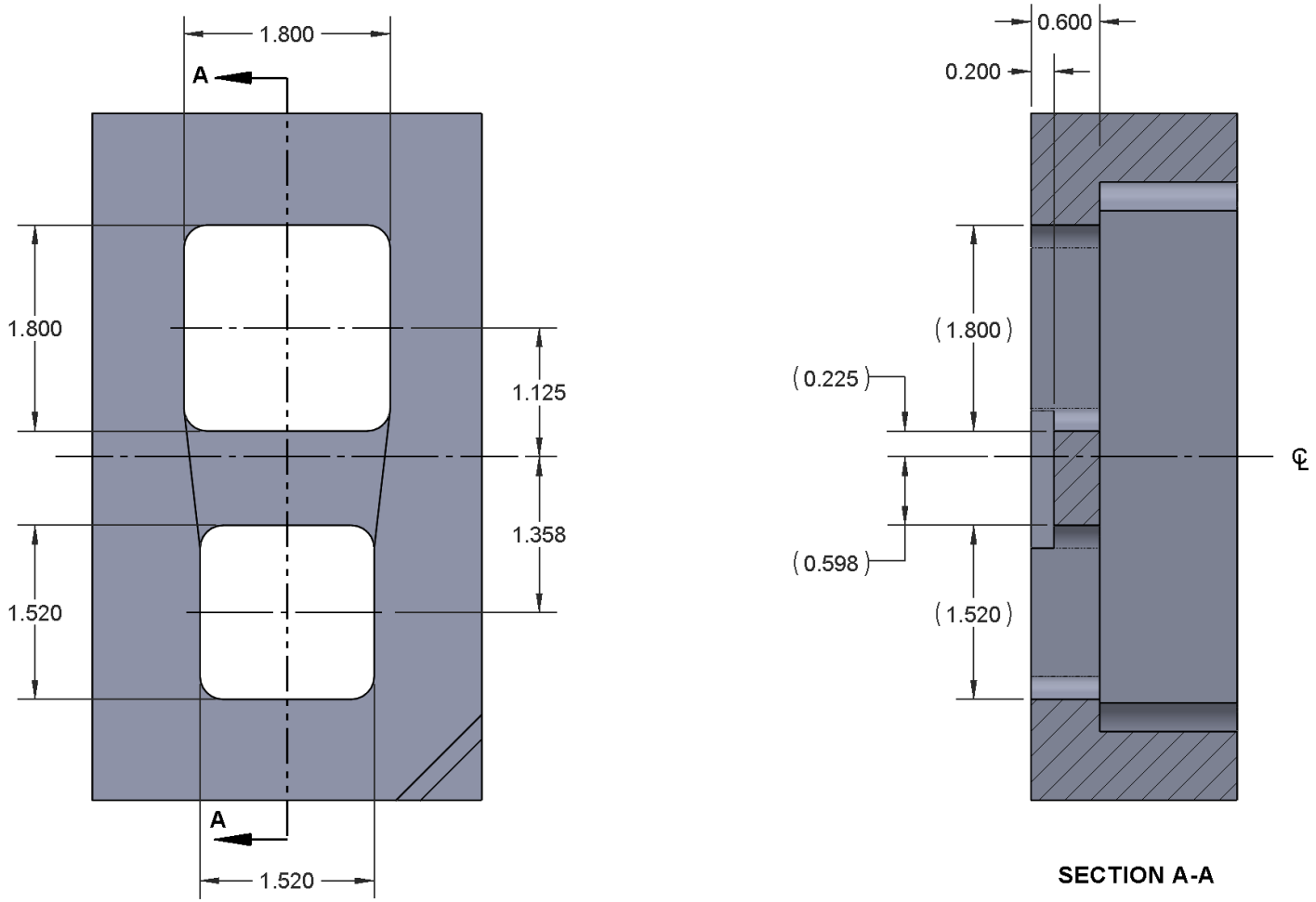




SECTION A-A

TMF8820/TMF8821 ODG

Drawing, EVM Rubber Boot (RB-V2-06-02)



Optical Simulation and Measurement

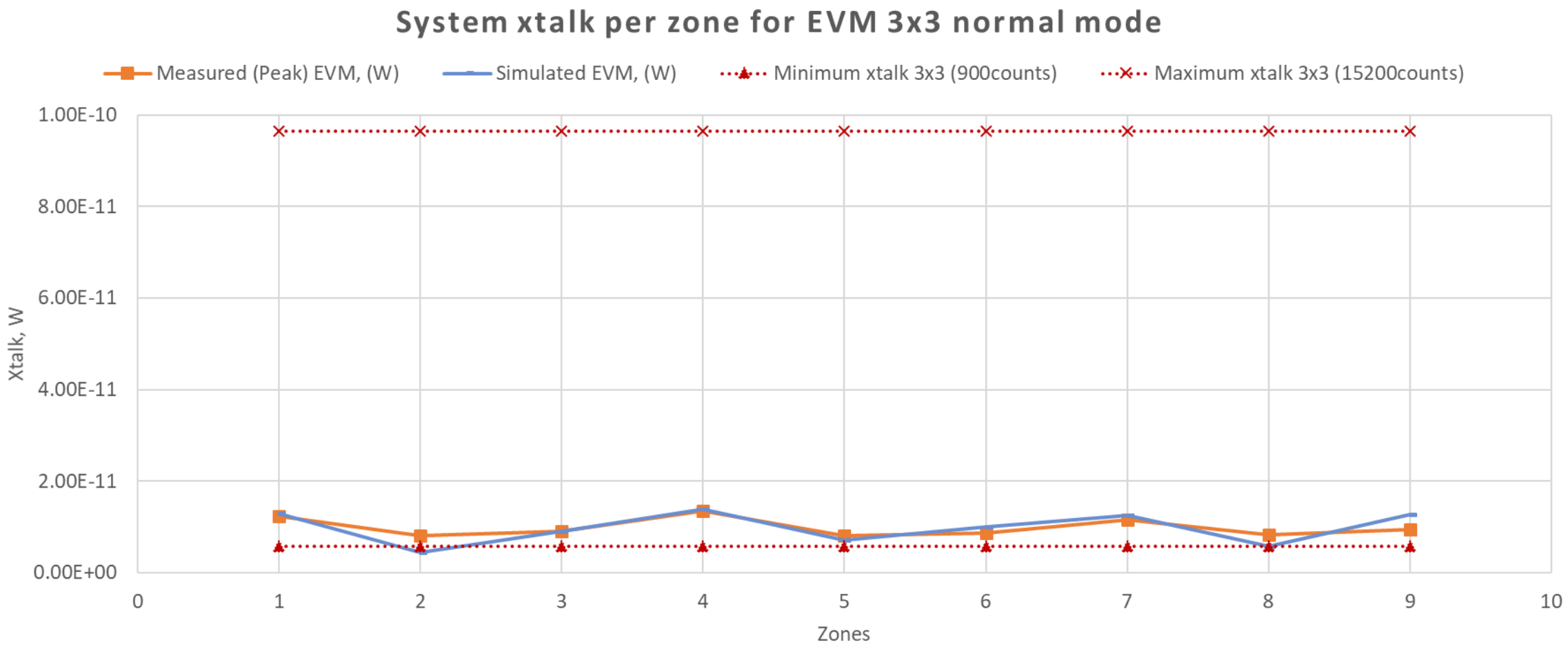
Results, EVM 3x3 normal mode

Xtalk / ZONE	1	2	3	4	5	6	7	8	9	Min	Max	Average
Measured (Peak) EVM, (counts)	2066	1082	1517	2266	1086	1446	1958	1113	1600	1082	2266	1570
Measured (Peak) EVM, (W)	1.22E-11	8.01E-12	8.99E-12	1.34E-11	8.04E-12	8.57E-12	1.16E-11	8.24E-12	9.48E-12	8.01E-12	1.34E-11	9.84E-12
Minimum xtalk 3x3 (900counts)	5.71E-12	5.71E-12	5.71E-12	5.71E-12	5.71E-12	5.71E-12	5.71E-12	5.71E-12	5.71E-12	5.71E-12	5.71E-12	5.71E-12
Maximum xtalk 3x3 (15200counts)	9.65E-11	9.65E-11	9.65E-11	9.65E-11	9.65E-11	9.65E-11	9.65E-11	9.65E-11	9.65E-11	9.65E-11	9.65E-11	9.65E-11
Simulated EVM, (W)	1.30E-11	4.46E-12	9.04E-12	1.38E-11	7.08E-12	9.98E-12	1.25E-11	5.81E-12	1.28E-11	4.46E-12	1.38E-11	9.83E-12

Measured (Peak) xtalk results are based the average of 164 test devices using the EVM optical stack.

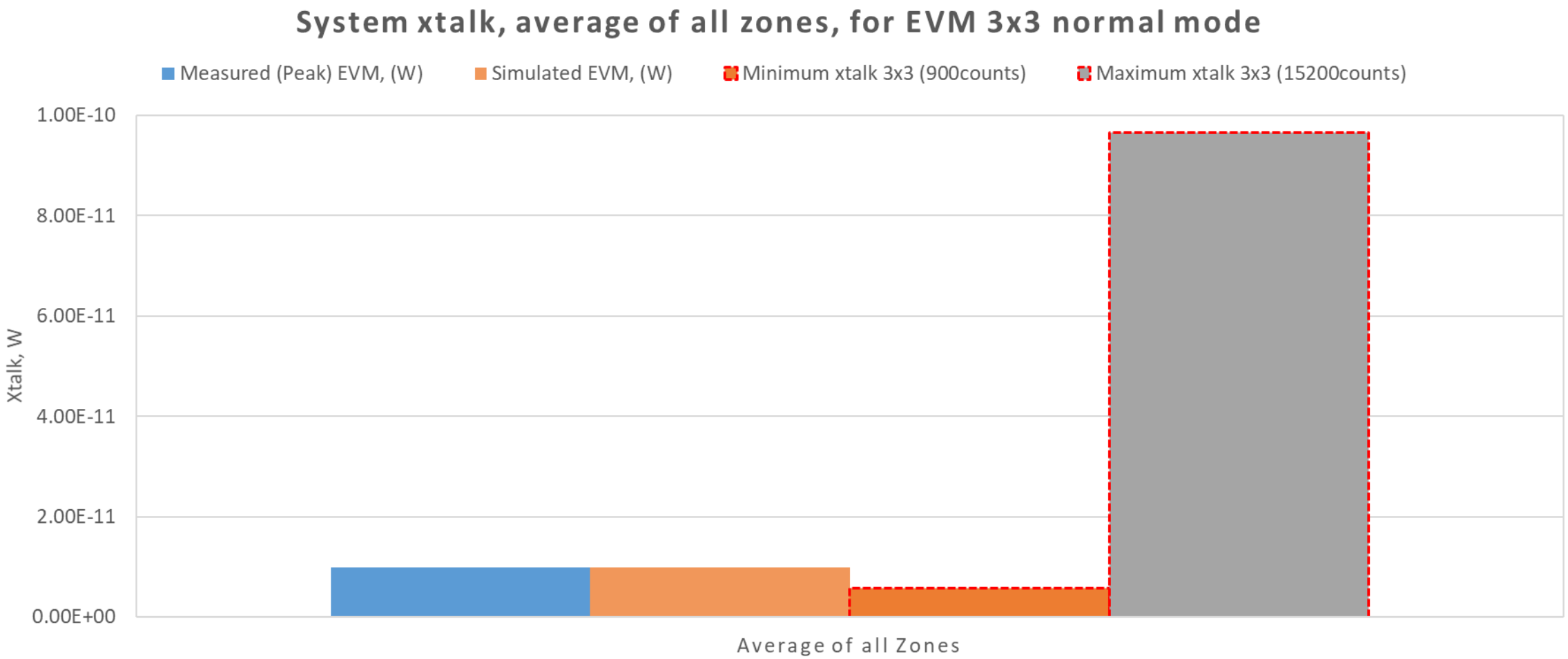
Optical Simulation and Measurement

Results, EVM 3x3 normal mode



Optical Simulation and Measurement

Results, Average of all zones, EVM 3x3 normal mode



Sensing is life