

6.25-mm (1/2.9-inch) diagonal SPAD ToF Depth Sensor with signal-amplifying pixels

Preliminary

IMX459-AAMV-W

For the latest data sheet, please visit www.sunnywale.com

1. Description and Usage

The IMX459-AAMV-W is a 6.25-mm (1/2.9-inch) diagonal Single Photon Avalanche Diode (SPAD) ToF Depth Sensor with signal-amplifying pixels. It features two readout modes, line mode and array mode, and supports a variety of scanning methods. By arraying a large number of SPADs and summing their outputs, it achieves a measurement distance of up to 300 m. Its light emission timing control function is able to compensate for the delay in timing between laser emission and reception. Its ambient light elimination function ensures that it does not saturate even under sunlight and can achieve distance measurements with a high dynamic range. Equipped with echo and peak detection functions, ranging data output modes, digital signal processing, and more, it is optimized to meet the performance and functionality required by LiDAR.

Applications: LiDAR for automotive

2. Features and Functions

- ◆ SPAD signal-amplifying pixels
- ◆ Number of effective SPAD
 - 597 (H) × 168 (V) approx. 100K SPAD
- ◆ CRA: 0 degrees
- ◆ Input frequencies: 16, 20, 24, 30 MHz
- ◆ External communication interfaces
 - I²C communication
 - SPI communication
- ◆ Output interface
 - MIPI CSI-2 serial output (4 lanes/2 lanes)
- ◆ Readout modes
 - Line mode
 - Array mode
- ◆ Output formats
 - Ranging data output mode (RAW12, ToF width: 2024 bins, gray scale width: 12 bits)
 - Echo output mode (RAW12, ToF width: 2024 bins, gray scale width: 12 bits)
 - Histogram output mode (RAW12, ToF width: 2024 bins, gray scale width: 12 bits)
- ◆ Variable pixel size, region of interest (ROI) function
- ◆ Ambient light monitor function
 - Ambient light count width: 22 bits
- ◆ Emission timing control function
- ◆ Histogram generation function
- ◆ Echo and peak detection functions
- ◆ AEC-Q100 Grade 2 qualified
- ◆ Electrostatic rank
 - HBM (Grade 2): **T.B.D.**
 - CDM (Grade 2): **T.B.D.**

Sony reserves the right to change products and specifications without prior notice.

This information does not convey any license by any implication or otherwise under any patents or other right.

Application circuits shown, if any, are typical examples illustrating the operation of the devices. Sony cannot assume responsibility for any problems arising out of the use of these circuits.

3. Device Structure

- ◆ SPAD ToF Depth Sensor
- ◆ Image size: Diagonal 6.25 mm (1/2.9 inch)
- ◆ SPAD unit cell size: 10.08 μm (H) $\times$ 10.08 μm (V)
- ◆ Element size: 3 (H) $\times$ 3 (V) SPAD
- ◆ Number of physical active SPAD*1: 600 (H) $\times$ 189 (V) approx. 110K SPAD
- ◆ Number of effective SPAD: 597 (H) $\times$ 168 (V) approx. 100K SPAD
- ◆ Substrate material: Silicon

*1 Including non-effective pixels and monitor pixels

4. Absolute Maximum Ratings

Table 4 -1 Absolute Maximum Ratings

Item	Symbol	Min.	Max.	Unit	Remarks
SPAD breakdown voltage power supply	VOP*1	-24.5	+0.3	V	—
SPAD excess voltage power supply	Vex*2	-0.3	4.0	V	—
Digital power supply	VDDD*3	-0.3	1.5	V	—
Analog power supply	VDDA*4	-0.3	4.0	V	—
I/O power supply	VDDIO*5	-0.3	2.5	V	—

5. Recommended Drive Conditions

Table 5 -1 Recommended Drive Conditions

Item	Symbol	Min.	Typ.	Max.	Unit	Remarks
SPAD breakdown voltage power supply	VOP*1	-24.5	-20.5	-17	V	—
SPAD excess voltage power supply	Vex*2	3.15	3.3	3.6	V	—
Digital power supply	VDDD*3	1.0	1.1	1.2	V	—
Analog power supply	VDDA*4	3.15	3.3	3.45	V	—
I/O power supply	VDDIO*5	1.7	1.8	1.9	V	—
Operating temperature	Topr	Ta = -40 to +105 Tj = -40 to +125			°C	—
Storage temperature	Tstg	Ta = -40 to +125			°C	—

*1 VOP: VRLD

*2 Vex: VDDHPF

*3 VDDD: VDDLSC, VDDLPL1, VDDLPL2, VDDLIF

*4 VDDA: VDDHAN

*5 VDDIO: VDDMIO, VDDMIF

6. Use Restriction Notice

Application of the Product

- ◆ The product described in this specification (hereinafter referred to as “the Product”) is intended for use in general electronic equipment or in-vehicle camera units, and should not be used for any other purpose.
- ◆ Please do not use the Product for any application where a high level of safety is required and the use of or a defect in the Product is likely to cause risk to human life or person or substantial harm to property or the environment (e.g., control of nuclear facilities including nuclear power plants, aircraft control, communication systems, air traffic control, or life support equipment). Also, please do not use the Product for any military applications.

Requests Relating to Safe Design

- ◆ Please adequately consider redundant designs, design countermeasures to prevent the spread of fire, designs to prevent malfunctions, and other safety designs for customer devices that use the Product such that even if the Product malfunctions, no accident causing injury or death, fire, or other social damage will occur.

Product Information, etc.

- ◆ The product specifications, circuit examples, and other technical information and details in these specifications and other information relating to the product (collectively referred to as “Product Information, etc.”) provided to the customer are provided as reference information for use, and no license or right of use of intellectual property rights or other rights that belong to the Company or third parties is granted in relation to use of Product Information, etc. by the customer.

Warranties and Responsibility Regarding the Product and Product Information, etc.

- ◆ The Product and Product Information, etc. are to be used under the customer’s responsibility, and the Company makes no warranties for customers relating to the Product and the Product Information, etc. The Company shall not bear any liability whatsoever regarding disputes in conjunction with infringement of intellectual property rights or other rights caused by the Products or the Product Information, etc. or damage incurred by the customer or third parties caused by the Products or the Product Information, etc. Any disputes arising from infringement of intellectual property rights or other rights arising out of the use of the Product or Product Information, etc. by the customer shall be handled by the customer.
- ◆ The Company shall not bear any liability whatsoever for special damage, indirect damage, ancillary damage, or derivative damage (including damage resulting from loss of profit that would have been earned, loss of opportunity, loss or destruction of information, and so on) incurred by the customer or third parties as a result of use of the Product or the Product Information, etc.

Compliance with Laws and Regulations

- ◆ Please acquire approvals and take other action pursuant to all applicable laws, regulations, and ordinances (including without limitation Japan’s Foreign Exchange and Foreign Trade Act relating to goods subject to export restrictions and export of technical information and United States export control laws and regulations) when using the Product under your own responsibility.

Other

When purchasing and using the Product, be sure to refer to the warnings set forth in these Specifications and delivery specifications provided by the Company.

For automotive-0.0.1

Rev.0.005

7. Contents

1.	Description and Usage	1
2.	Features and Functions	1
3.	Device Structure	2
4.	Absolute Maximum Ratings	2
5.	Recommended Drive Conditions	2
6.	Use Restriction Notice	3
7.	Contents	4
8.	Optical Center	5
9.	SPAD Configuration	6
10.	Block Diagram	7
11.	Pin Configuration	8
12.	Pin Description	9
13.	Electrical Characteristics	12
13.1	DC Characteristics	12
13.2	AC Characteristics	13
13.2.1.	Master Clock (INCK)	13
13.2.2.	Reference Clock (REFCK)	13
13.2.3.	System Reset (XCLR)	14
13.2.4.	Get Ambient Light Timing Signal (PST_TRG)	14
13.2.5.	Effective Pixel Area Select Signal / Emission Trigger Input Signal (SEL/TRG_I)	15
13.2.6.	Emission Trigger Feedback Signal (TRG_FB0/1)	16
13.2.7.	Emission Trigger Output Signal (TRG_O0/1)	16
13.2.8.	Frame Synchronization Signal / Slot Synchronization Signal (F_SYNC/ S_SYNC)	17
13.2.9.	IC Available Signal/Communication Period Notification (READY/COMREADY)	18
13.2.10.	External Reset Request Signal (XERROR)	18
13.2.11.	SPAD Test Monitor Output (STOUT0/STOUT1)	18
13.2.12.	Serial Communication	19
13.3	Current Consumption	21
14.	Input/Output Equivalent Circuits	24
15.	Characteristics	25
16.	Example of Spectral Sensitivity Characteristics	27
17.	Setting Registers Using Serial Communication	28
17.1.	Selecting the Communication System	28
17.2.	Description of Register Communication (I ² C Communication)	28
17.2.1.	Slave Address	29
17.3.	Description of Register Setting (SPI Communication)	29
18.	Output Interface	30
18.1.	Description	30
18.2.	MIPI Transmitter	31
18.3.	Frame Format	32
18.4.	Frame Structure	32
18.5.	CSI-2 Output Format	33
19.	Operating Modes	34
19.1.	Description	34
19.2.	Data output Format	35
19.2.1.	Ranging Mode	35
19.2.3.	Echo Mode	37
19.2.4.	Histogram Mode	38
20.	Example of Peripheral Circuits	40
21.	Power-On/Off	42
21.1.	Power-on/off Sequence	42
21.2.	Slew Rate during Power-On	42
22.	Special Note on DCR Defect Standards (T.B.D.)	43
22.1.	Description	43
22.2.	DCR Defect Standard (T.B.D.)	43
23.	Marking (T.B.D.)	44
23.1.	Alignment mark	44
23.2.	Mark on the back of the chip	44
24.	Notes on Handling	45
25.	Package Outline	47
26.	Open Source Software License	48
27.	Revision History	49