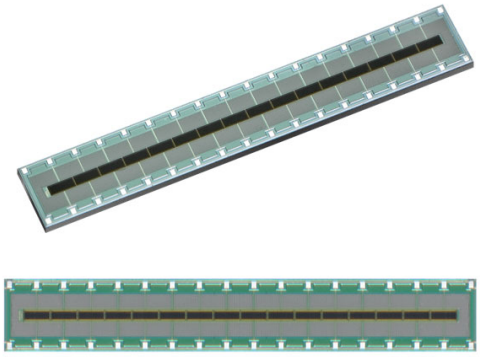
Silicon Photomultiplier (SiPM), 1x16 Monolithic Array, NIR Sensitive

Product Preview
ArrayRDM-0116B10-DBR



The ArrayRDM−0116B10−DBR Device

ORDERING INFORMATION
See detailed ordering and shipping information on page 7 of this data sheet.

The ArrayRDM−0116B10−DBR is a monolithic 1 x 16 array of Silicon Photomultiplier (SiPM) pixels with NIR sensitivity. Each pixel has individual fast and standard (via the cathode) outputs, with a common anode. Product is suitable for automotive applications.

Overview
- Features Unique Fast Output
- Bare Die Delivered as Reconstituted Wafers

Typical Applications
- LiDAR

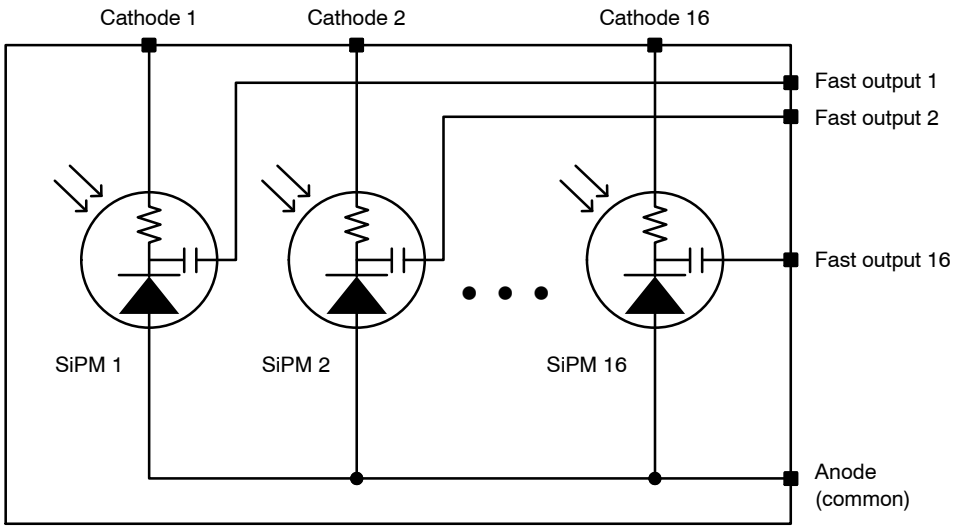


Figure 1. Simplified Block Diagram

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MAXIMUM RATINGS

Rating	Value	Unit	Comment
Maximum Overvoltage	TBD	V	Bias Voltage = Breakdown voltage + overvoltage (Vbias = Vbr + Vov). Vbr is temperature dependent
Maximum Current	TBD	mA	For the whole array at recommended Vov and 21°C
Maximum Storage Temperature	125	°C	
Operating Temperature Range	−40 to +105	°C	Ambient temperature
ESD Capability − Human Body Model	500	V	

Stresses exceeding those listed in the Maximum Ratings table may damage the device. If any of these limits are exceeded, device functionality should not be assumed, damage may occur and reliability may be affected.

ELECTRICAL SPECIFICATION (Parameters are temperature dependent. All values are at room temperature)

Parameter	Test Condition	Symbol	Min	Typ	Max	Unit
Breakdown Voltage		Vbr	21	21.5	22	V

TYPICAL PERFORMANCE CHARACTERISTICS (Sensor performance values are indicative. SiPM parameters are measured on a sample of parts at characterization and are not tested in production. Values are at room temperature and typical Vov.)

Parameter	Test Conditions, Comments	Symbol	Typical Value	Unit
Overvoltage	Vbias = Vbr + Vov. Vbr is temperature dependent. Note maximum Vov in Maximum Ratings table	Vov	6.5	V
Photon Detection Efficiency	@ 905 nm	PDE	13	%
Total Dark Count Rate per Pixel		DCR	20	kcps
Gain		M	0.4×10^6	
Crosstalk Probability		XT	25	%
Delayed Noise			20	%
Rise Time (Standard Output)	20% − 80%, see Figures 3 & 4		0.25	ns
Recovery Time (Standard Output)	90% − 10%, see Figures 3 & 4		30	ns
Rise Time (Fast Output)	20% − 80%, see Figure 3 & 4		0.3	ns
Pulse Width (Fast Output)	See Figures 3 & 4	FWHM	1	ns
1PE Pulse Height (Fast Output)	For reference only. Amplified measurement, Gain 100x, see Figure 2		30	mV

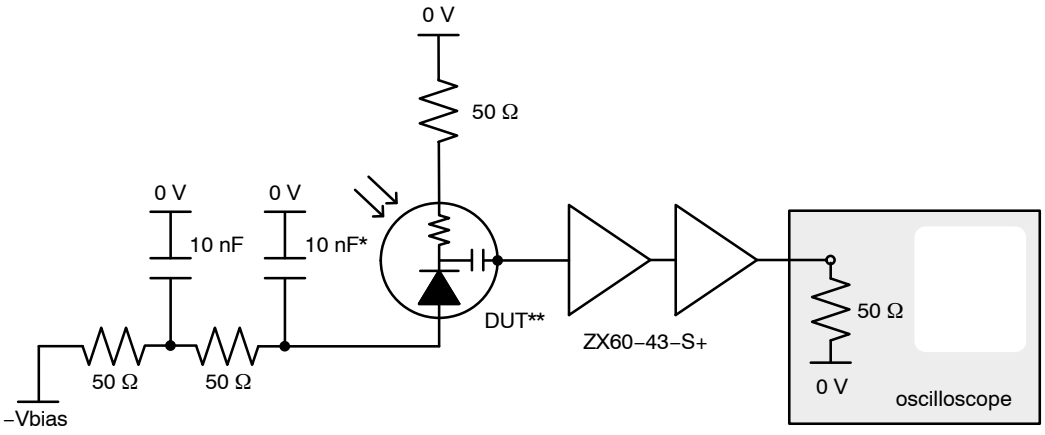

Figure 2. Circuit Used for 1PE Measurement (* Additional Decoupling not Shown). Amplifier Gain is 100x

APPLICATIONS INFORMATION

Biasing Information

The SiPM array is operated with Vbias = Vbr + Vov.

Vbias is applied between cathode and anode (reverse bias for Geiger mode operation).

Each SiPM in the array may be biased individually using the cathode pin. The anode is common to all 16 SiPMs.

Note that Vbr varies with temperature. Do not exceed the maximum bias or current ratings as the array may be damaged.

Fast Output

Unused fast outputs should be directly connected to ground or terminated using a 50 Ω resistor to ground. This is to avoid noise pickup and reflections from floating unterminated tracks.

- Avoid using only a capacitor to couple to fast outputs as this can lead to unwanted DC bias on the fast terminal network. At the input of the readout amplifier stage use resistive coupling to ground (50 Ω to 1 kΩ recommended) to avoid the floating condition of the fast output.
- Use series termination resistors close to the fast output pins (pins 2 to 17) of the Array. This helps to match the source impedance of the SiPM pixels to the PCB and amplifier load and reduces reflections of the high speed signals. 0201 package size resistors fit neatly beside each fast output pin
- Ground cathodes near to each cathode pin (pins 20 to 35) using vias to ground plane when standard readout is not required

90% – 10% Recovery Time Parameter

The recovery time indicates the time taken for the microcells to recover to fully biased state. Recovery time is measured by applying a low power 905 nm 50 ps laser pulse at the SiPM and measuring the resulting pulse shape on the standard output. The 90% to 10 % recovery time is the time interval between the signal crossing the 90% threshold and the 10% threshold, relative to the peak amplitude. Note that recovery time will depend on a number of factors including the circuit. The circuit used for this measurement is pictured in Figure 4. Typical pulse shapes for both the standard and fast output, also using this circuit, are shown in Figure 3.

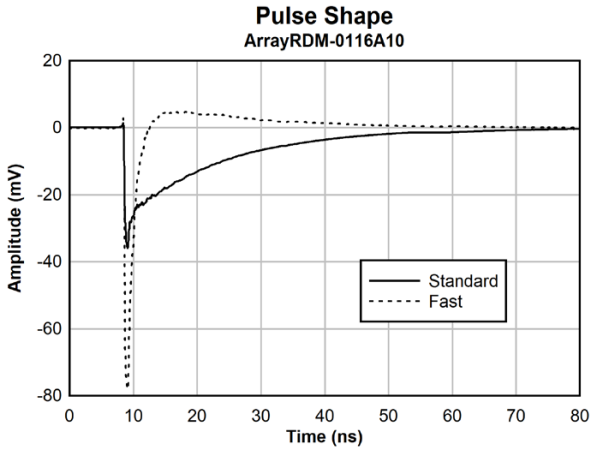

Figure 3. Typical Fast and Standard Pulse Shapes Using Circuit in Figure 5

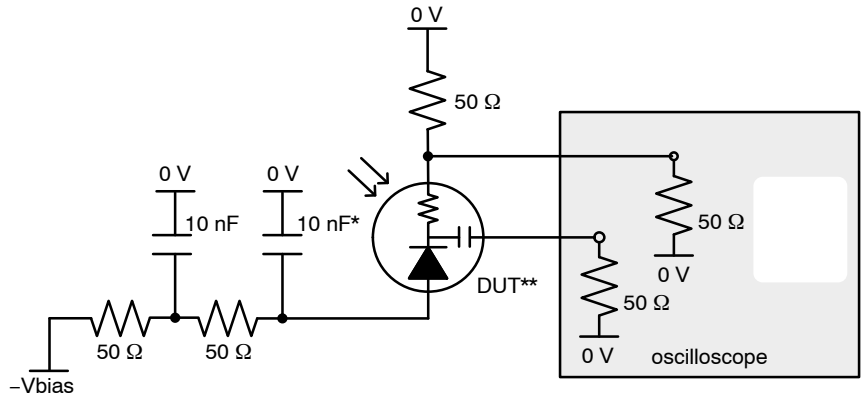

Figure 4. Circuit Used for Pulse Shape Measurements (* Additional Decoupling not Shown)

Recon Wafer Shipping Information

Reconstructed wafers are shipped on carrier tape (N6801) on a frame in a wafer cassette and sealed in a dry pack.

Recon Wafer Shipping Information

onsemi die products are packaged in a clean room environment for shipping. Upon receipt, the customer should transfer the die to a similar environment for storage. **onsemi** recommends the die to be maintained in a filtered nitrogen atmosphere until removed for assembly. The moisture content of the storage facility should be maintained at 30% relative humidity ±10%. ESD damage precautions are necessary during handling. The die must be in an ESD−protected environment at all times for inspection and assembly.

PIN CONNECTIONS

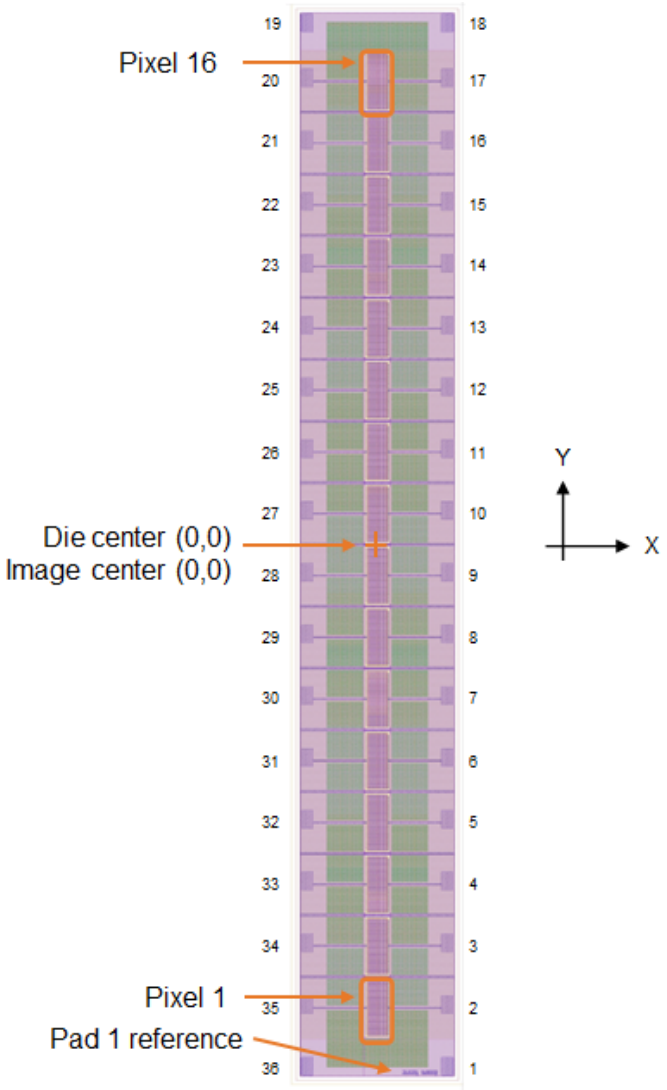

Figure 5. Topside of Die with Pad and Pixel Numbering

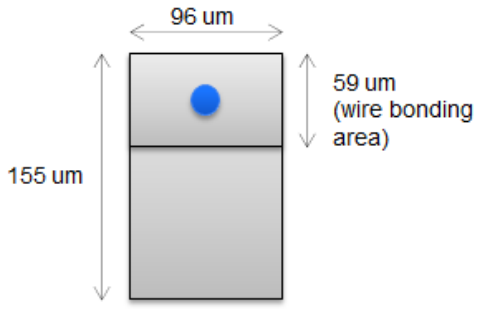

Figure 6. Bond Pad and Wire Bonding Area

PAD ASSIGNMENT & POSITION (Positions are referenced to center of die (0, 0).)

Pad No.	Position X	Position Y (bond pad center)	Position Y (bonding area center)	Unit	Assignment
1	619.5	−4645	−4597	μm	Common Anode
2	619.5	−4094.9	−4046.9	μm	Pixel1 Fast
3	619.5	−3544.9	−3496.9	μm	Pixel2 Fast
4	619.5	−2994.9	−2946.9	μm	Pixel3 Fast
5	619.5	−2444.9	−2396.9	μm	Pixel4 Fast
6	619.5	−1894.9	−1846.9	μm	Pixel5 Fast
7	619.5	−1344.9	−1296.9	μm	Pixel6 Fast
8	619.5	−794.9	−746.9	μm	Pixel7 Fast
9	619.5	−244.9	−196.9	μm	Pixel8 Fast
10	619.5	305.1	353.1	μm	Pixel9 Fast
11	619.5	855.1	903.1	μm	Pixel10 Fast
12	619.5	1405.1	1453.1	μm	Pixel11 Fast
13	619.5	1955.1	2003.1	μm	Pixel12 Fast
14	619.5	2505.1	2553.1	μm	Pixel13 Fast
15	619.5	3055.1	3103.1	μm	Pixel14 Fast
16	619.5	3605.1	3653.1	μm	Pixel15 Fast
17	619.5	4155.1	4203.1	μm	Pixel16 Fast
18	619.5	4645	4597	μm	Common Anode
19	−619.5	4645	4597	μm	Common Anode
20	−619.5	4155.1	4203.1	μm	Pixel16 Cathode
21	−619.5	3605.1	3653.1	μm	Pixel15 Cathode
22	−619.5	3055.1	3103.1	μm	Pixel14 Cathode
23	−619.5	2505.1	2553.1	μm	Pixel13 Cathode
24	−619.5	1955.1	2003.1	μm	Pixel12 Cathode
25	−619.5	1405.1	1453.1	μm	Pixel11 Cathode
26	−619.5	855.1	903.1	μm	Pixel10 Cathode
27	−619.5	305.1	353.1	μm	Pixel9 Cathode
28	−619.5	−244.9	−196.9	μm	Pixel8 Cathode
29	−619.5	−794.9	−746.9	μm	Pixel7 Cathode
30	−619.5	−1344.9	−1296.9	μm	Pixel6 Cathode
31	−619.5	−1894.9	−1846.9	μm	Pixel5 Cathode
32	−619.5	−2444.9	−2396.9	μm	Pixel4 Cathode
33	−619.5	−2994.9	−2946.9	μm	Pixel3 Cathode
34	−619.5	−3544.9	−3496.9	μm	Pixel2 Cathode
35	−619.5	−4094.9	−4046.9	μm	Pixel1 Cathode
36	−619.5	−4645	−4597	μm	Common Anode

DIE AND RECON WAFER DIMENSIONS

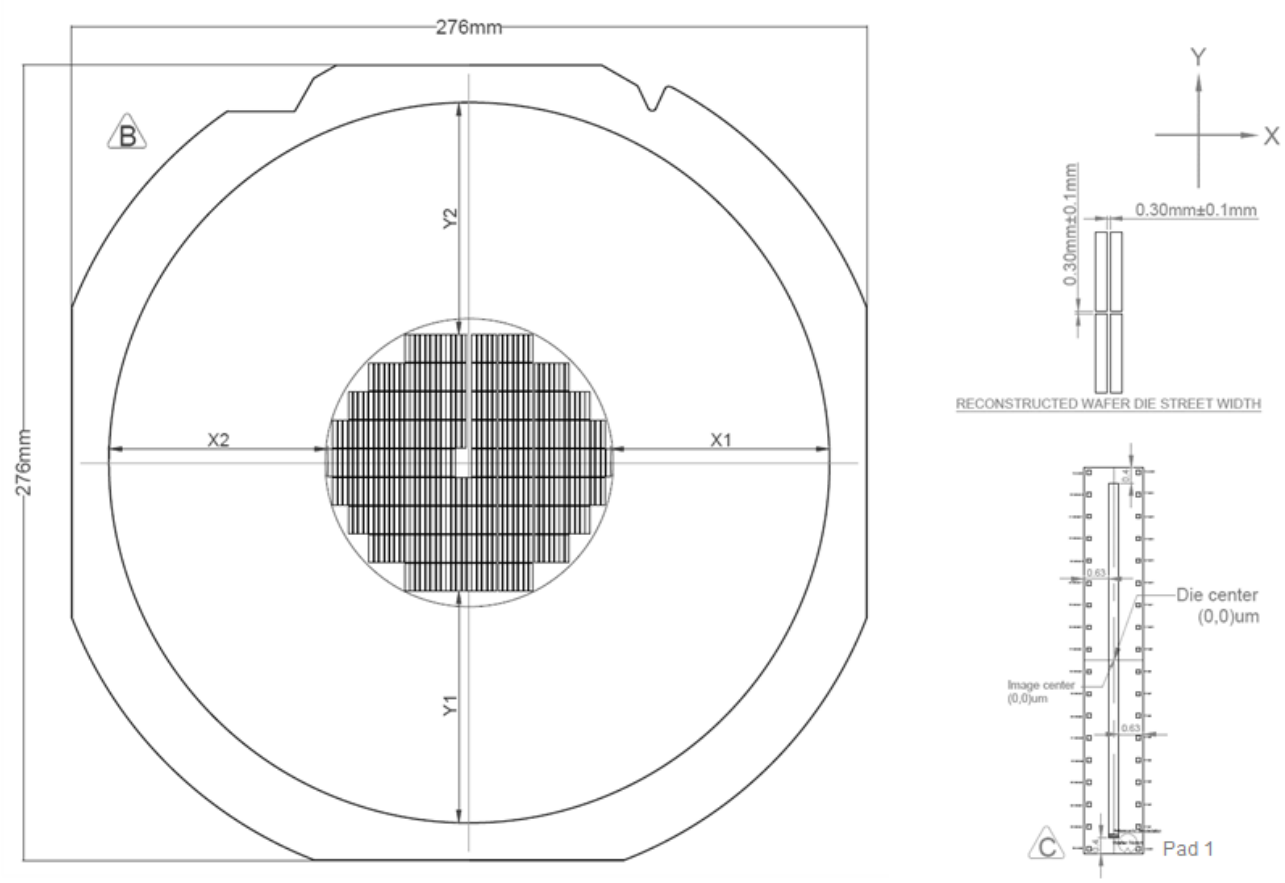

Figure 7. Recon Wafer Format and Dimensions

DIE PHYSICAL DESCRIPTION

Parameter	Value	Unit
Die Size	X = 1490 ±25 Y = 9590 ±25	µm
Die Thickness	229 ±10	µm
Pixel Size	X = 175 Y = 492	µm
Pixel Pitch (Active to Active)	Y = 550	µm
Bond Pad Opening	X = 96 Y = 155	µm
Wire Bonding Area	96 x 59	µm
Minimum Bond Pad Pitch	490	µm
Bond Pad Material	Al Si (1%) Cu (0.1%)	

RECON WAFER CHARACTERISTICS

Parameter	Value	Unit
Recon Wafer Size	100	mm
Recon Wafer Street Width	300 ±100	µm
Placement Accuracy (X, Y, Theta)	X, Y, (±100 µm), Theta < 1°	
Max. Total Die Count	376	
Recon Wafer Layout	X = 55, Y = 9	
Film Frame	COMPACT DISCO STAINLESS SUS420	
Shipping Tape	UV TAPE (FSL−N6801)	

ORDERING INFORMATION

Device	Description	Package	Shipping Format
ArrayRDM−0116B10−DBR−E	Unqualified alpha sample, monolithic 1x16 pixel SiPM array, NIR sensitive	Bare die	Recon wafer on film: 100 mm wafer size on an 8” frame. Frames shipped in cassette
ArrayRDM−0116B10−DBR	Monolithic 1x16 pixel SiPM array, NIR sensitive	Bare die	Recon wafer on film: 100 mm wafer size on an 8” frame. Frames shipped in cassette

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