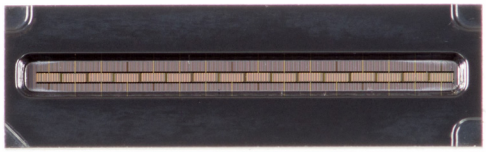
ArrayRA-0116A20

Advance Information

Silicon Photomultipliers (SiPM), Red-Enhanced 1 x 16 Monolithic Array for Long-Range LiDAR

ON Semiconductor®

www.onsemi.com



The RA−Series 16−pixel linear array from ON Semiconductor has been designed for automotive LiDAR applications. The array is a single monolithic sensor featuring 16 of ON Semiconductor's industry−leading silicon photomultiplier (SiPM) pixels. The SiPM is a single−photon sensitive, high internal gain sensor that has a responsivity of >30 kA/W at 905 nm and operates at a low bias of <50 V. The ArrayRA−0116A20 features a summed anode and summed cathode, for supplying a single bias, and 16 individual 'fast outputs' (one per pixel). The ON Semiconductor SiPMs have been proven to provide ranging at long distance with low reflectivity targets.

It is strongly recommended that those new to SiPM sensors consult the Introduction to Silicon Photomultipliers Application Note.

ORDERING INFORMATION

See detailed ordering and shipping information in the ordering information section on page 7 of this data sheet.

ABSOLUTE MAXIMUM RATINGS

Parameter	Value
Maximum bias	Vbr + 20 V
Maximum current	TBD
Recommended operating temperature range	−40°C − +85°C
Maximum storage temperature	125°C

PHYSICAL SPECIFICATIONS

Parameter	Value	Comments
Silicon process	RA−Series	N−on−P structure
Number of pixels	16	
Array configuration	1 x 16	Monolithic silicon array
Pixel size	0.491 mm x 0.171 mm	
Pixel−to−pixel spacing	59 μm	
Microcell size	20 μm	
Number of microcells per pixel	133	

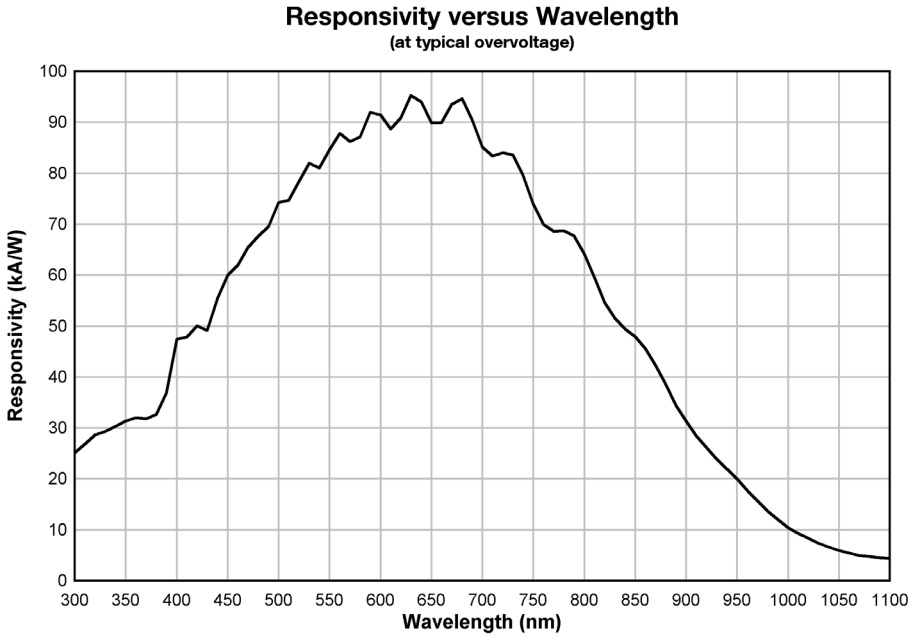
This document contains information on a new product. Specifications and information herein are subject to change without notice.

PERFORMANCE SPECIFICATIONS

Parameter[1]	Value	Comments
Breakdown voltage (Vbr) − typical	30 V	
Breakdown voltage (Vbr) range	28 V − 32 V	
Overvoltage (Vov) − typical	12 V	Operating (bias) voltage = Vbr + Vov
Overvoltage (Vov) − maximum	20 V	Operating (bias) voltage = Vbr + Vov
Responsivity @ 905 nm − typical	31 kA/W	At typical overvoltage
Responsivity @ 905 nm − maximum	430 kA/W	At maximum overvoltage
PDE @ 905 nm − typical	3.3 %	At typical overvoltage
PDE @ 905 nm − maximum	5.1 %	At maximum overvoltage
Dark count rate	103 kHz	Per pixel
Dark current − summed	3.9 μA	All pixels summed
Optical crosstalk	7 %	
Afterpulsing	5 %	
Fast output rise time	450 ps	Using the test circuit in Figure 4 on page 4
Fast output pulse width	2.3 ns	FWHM, using the test circuit in Figure 4 on page 4
Gain	1×10^6	
Single photoelectron pulse amplitude	2.7 mV	Typical, using the test circuit in Figure 4 on page 4
Fast output capacitance	TBD	
Temperature coefficient of operating voltage	0.2 V/°C	

1. All measurements made at 21°C and typical overvoltage unless otherwise stated.

Performance Plots



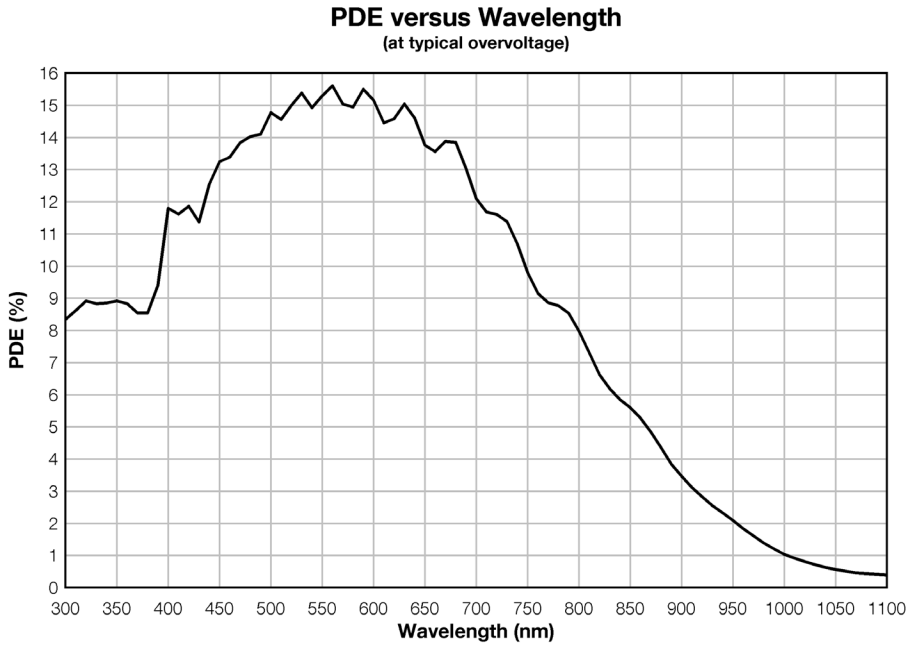
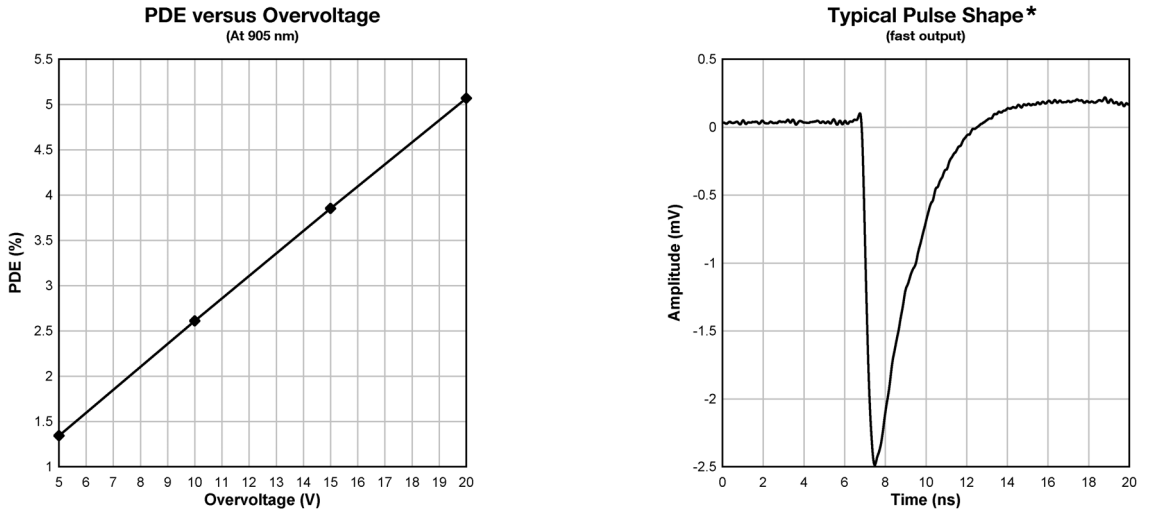


Figure 1.



* Single photon pulse acquired using the test circuit in Figure 4.

Figure 2.

Application Advice

The ArrayRA−0116A20 is formed of a linear array of 16 SiPM pixels. Each pixel has 3 outputs: anode, cathode and a fast output as shown in Figure 3. The fast output is a capacitively coupled output that carries an ultra−fast signal which is the derivative of the internal fast switching of the microcell in response to the detection of a single photon.

The DFN package allows access to each individual pixel fast output (16 in total) and a single common (summed) anode and common cathode. This allows the provision of a single bias supply for all 16 pixels. The recommended test circuit is given in Figure 4.

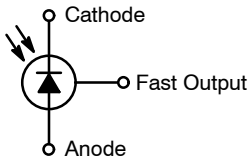


Figure 3.

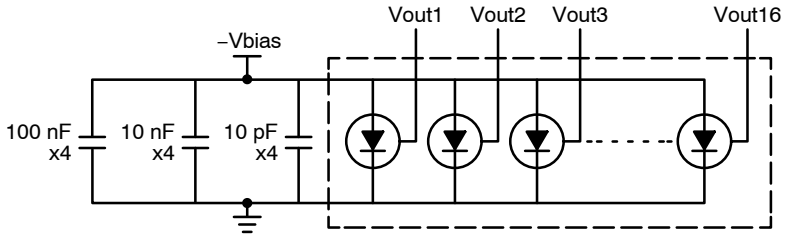


Figure 4.

TEST CIRCUIT

The test circuit in Figure 4 was used in the measurements of the performance parameters on page 2. The signals "Vout*n*" are the fast output signals from each pixel, where '*n*' is the pixel number. −Vbias is the negative bias applied to the common anode, and the common cathode is connected to ground. Note that there are 12 decoupling capacitors in total, 4 of each type.

Please note that the fast output signals should be impedance matched to 50 Ω for best performance.

SOLDERING ADVICE

The ArrayRA is compatible with standard reflow soldering processes. The recommended solder footprint can be found in the CAD file, which can be downloaded from page 6 of this datasheet. The solder reflow temperature profile is shown in Figure 5.

The exposed pad (EPAD) may be soldered to the PCB or left unsoldered. If soldering the EPAD it may be electrically floating or connected to the Anode. If the EPAD is left unsoldered ensure that the PCB area under the EPAD does not contain exposed electrical contacts, such as vias, to avoid shorting between EPAD and other traces.

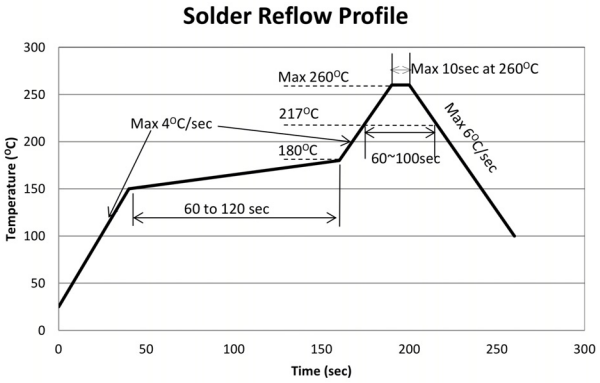
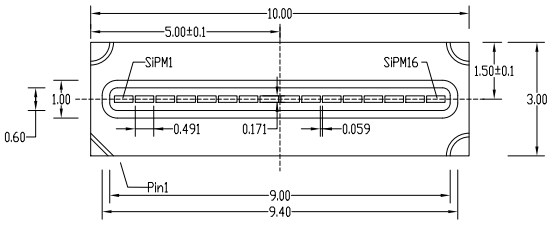


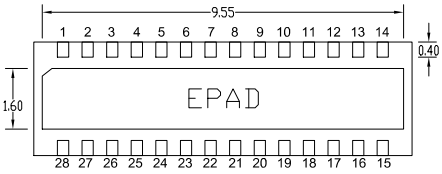
Figure 5.

Product Drawings (all dimensions in mm)

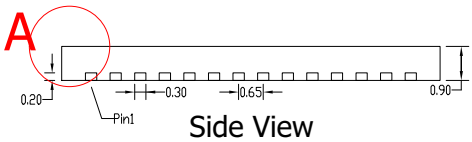
ArrayRA−0116A20−DFN



Top View



Bottom View



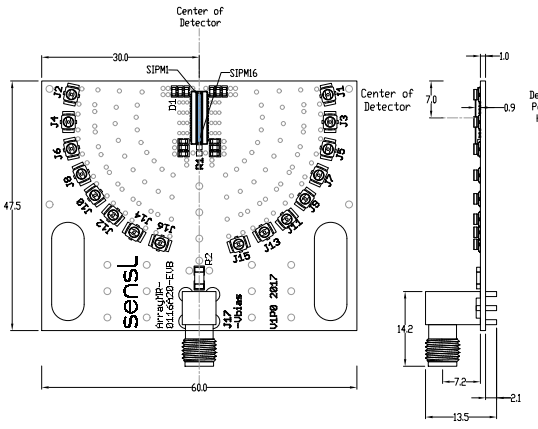
Side View

Pin number	Assignment	Pin number	Assignment
1	Anode	15	Anode
2	F2	16	F15
3	Cathode	17	Cathode
4	F4	18	F13
5	F6	19	F11
6	Cathode	20	Cathode
7	F8	21	F9
8	F10	22	F7
9	Cathode	23	Cathode
10	F12	24	F5
11	F14	25	F3
12	Cathode	26	Cathode
13	F16	27	F1
14	Anode	28	Anode

The complete ArrayRA−0116A20−DFN CAD, including solder footprint, is available to download here.

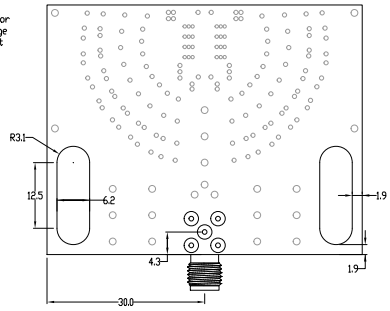
ArrayRA−0116A20−GEVB

Top View



Side View

Back View



Connector	Style
J1 − J16	U.FL Receptacle (Hirose U.FL−R−SMT)
J17	SMA Jack (F)

Pin number	Assignment
1	Fast 1
2	Fast 2
3	Fast 3
4	Fast 4
5	Fast 5
6	Fast 6
7	Fast 7
8	Fast 8
9	Fast 9
10	Fast 10
11	Fast 11
12	Fast 12
13	Fast 13
14	Fast 14
15	Fast 15
16	Fast 16
17	−ve Bias

The complete ArrayRA−0116A20−GEVB CAD, including solder footprint, is available to download here.

Ordering Information

Part Number	Product Description	Package
ArrayRA−0116A20−DFN*	1 x 16 monolithic array of red−enhanced RA−Series SiPM pixels. Each pixel is 0.491 mm x 0.171 mm with 20 μm microcells	DFN
ArrayRA−0116A20−GEVB*	Evaluation board consisting of an ArrayRA−0116A20−DFN sensor array mounted onto PCB, with 16 UMC connectors (Hirose U.FL) for the fast output signals, and an SMA connector for the bias.	

*This part is a pre−production engineering sample. For high volume availability please contact ON Semiconductor sales.

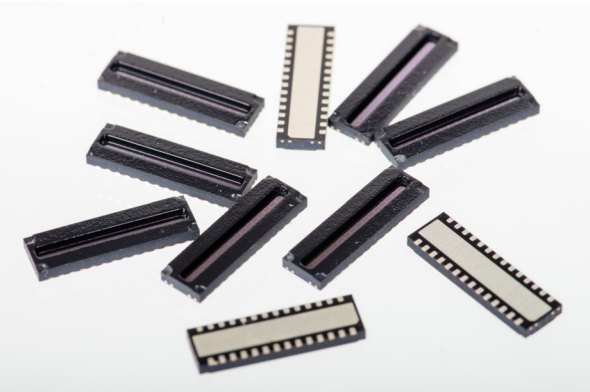


Figure 6. The ArrayRA−0116A20−DFN sensors

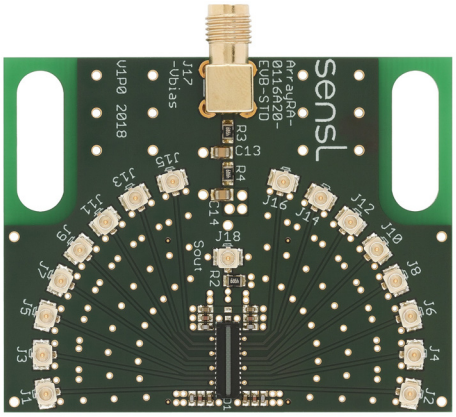


Figure 7. The ArrayRA−0116A20−GEVB evaluation board

This document discusses the use of this product in long−range, scanning LiDAR demonstration system.

PUBLICATION ORDERING INFORMATION

LITERATURE FULFILLMENT:
Literature Distribution Center for ON Semiconductor
19521 E. 32nd Pkwy, Aurora, Colorado 80011 USA
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Fax: 303−675−2176 or 800−344−3867 Toll Free USA/Canada
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