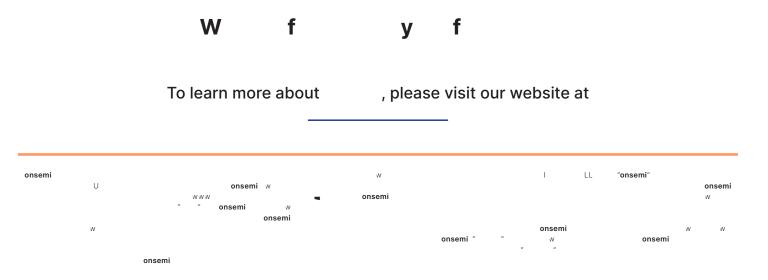
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ON CMI S P (S PM), H PDE a T A R S a TSV Pa a

J-S SPM S

onsemi's J-Series low-light sensors feature a high PDE (photon detection efficiency) that is achieved using a high-volume, P-on-N silicon foundry process. The J-Series sensors incorporate major improvements in the transit time spread which results in a significant improvement in the timing performance of the sensor. J-Series sensors are available in different sizes (3 mm, 4 mm and 6 mm) and use a TSV

Table 3. PERFORMANCE PARAMETERS

	30	035	400	035	60035		Unit
	Overvoltage				1		
Parameter (Note 4)	+2.5 V	+6 V	+2.5 V	+6 V	+2.5 V	+6 V	Unit
PDE (Note 5)	38	50	38	50	38	50	%
Dark Count Rate	50	150	50	150	50	150	kHz/mm ²
Gain (anode-cathode)	$2.9 imes10^{6}$	$6.3 imes10^{6}$	$2.9 imes10^{6}$	$6.3 imes10^{6}$	$2.9 imes10^{6}$	$6.3 imes10^{6}$	
Dark Current typical	0.23	1.9	0.35	3.0	0.9	7.5	μA
Dark Current maximum	0.31	3.00	0.45	4.0	1.25	12.0	
Rise Time (Note 6) anode-cathode output	90	110	90	110	180	250	ps
Microcell Recharge Time Constant (Note 7)	45		48	50	ns		
Capacitance (Note 8) (anode output)	1070		1800		4140		pF
Capacitance (Note 8) (fast output)	40		7	0	10	60	pF
Fast Output Pulse Width (FWHM)	1.5		1	.7	3	.0	ns
Crosstalk	****	3			•		

PERFORMANCE PLOTS

Figure 1. Photon Detection Efficiency (PDE) (MicroFJ 60035 TSV)

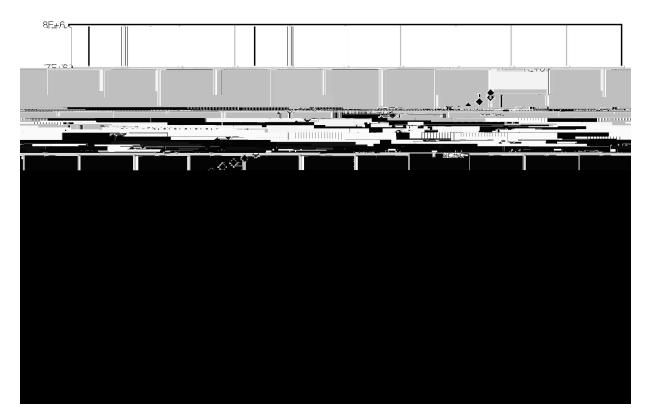


Figure 4. Gain vs. Overvoltage (MicroFJ 30035 TSV)

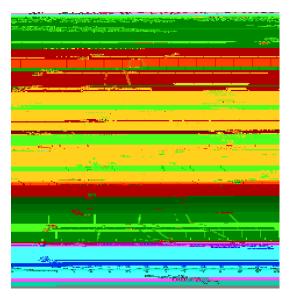


Figure 5. Fast Output Pulse Shape (MicroFJ 30035, MicroFJ 40035, MicroFJ 60035 Vbr + 2.5 V, 10 Ω Sense Resistor)

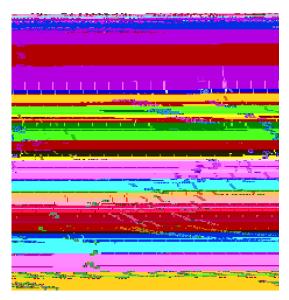


Figure 6. Standard Output Pulse Shape (MicroFJ 30035, MicroFJ 40035, MicroFJ 60035 Vbr + 2.5 V, 10 Ω Sense Resistor)

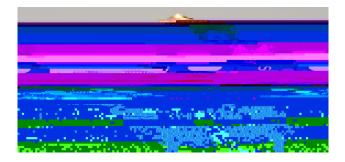
EVALUATION BOARD OPTIONS

SMA BIASING BOARD (MicroFJ SMA XXXXX)

The MicroFJ–SMA is a printed circuit board (PCB) that can facilitate the evaluation of the J-Series sensors. The board has three female SMA connectors for connecting the bias voltage, the standard output from the anode and the fast output signal. The output signals can be connected directly to a 50 Ω -terminated oscilloscope for viewing. The biasing and output signal tracks are laid out in such a way as to preserve the fast timing characteristics of the sensor.

The MicroFJ–SMA is recommended for users who require a plug-and-play set-up to quickly evaluate J-Series TSV sensors with optimum timing performance. The board also allows the standard output from the anode to be sthe fast output. The outputs can be connected directly to the oscilloscope or measurement

device, but external preamplification may be required to boost the signal. The table below lists the SMA board connections. The SMA board electrical schematics are available to download in the <u>AND9808/D</u> document.



MicroFJ SMA XXXXX		
Output	Function	
Vbias	Positive bias input (cathode)	
Fout	Fast output	
Sout	Standard output (anode)	

PIN ADAPTER (MicroFJ SMTPA XXXXX)

The TSV Pin Adapter board (SMTPA) is a small PCB board that houses the TSV sensor and has through-hole pins to allow its use with standard sockets or probe clips. This product is useful for those needing a quick way to evaluate the TSV package without the need for specialist surface-mount soldering. While this is a 'quick fix' suitable for many evaluations, it should be noted that the timing performance from this board will not be optimized and if the best possible timing performance is required, the MicroFJ–SMA–XXXXX is recommended. The SMTPA

circuit schematic is shown in Figure 8. Please consult the <u>Readout and Biasing Application Note</u> for further information on biasing. The SMTPA board electrical schematics are available to download in the <u>AND9808/D</u>.

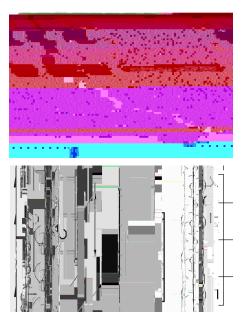


Figure 7. Top View of the SMTPA Board Showing the Pin Numbering

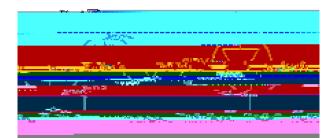


Figure 8. SMTPA Circuit Schematic

MicroFJ SMTPA XXXXX		
Pin No.	Connection	
1	Anode	
2	Fast output	
3	Cathode	

CIRCUIT SCHEMATICS

An SiPM is formed of a large number (hundreds or thousands) of microcells. Each microcell (Figure 9) is an avalanche photodiode with its own quench resistor and a capacitively coupled fast output. These microcells are arranged in a close-packed array with all of the like terminals (e.g. all of the anodes) summed together (Figure 10). The array of microcells can thus be considered as a single photodiode sensor with three terminals: anode, cathode and fast output, as shown in Figure 11.

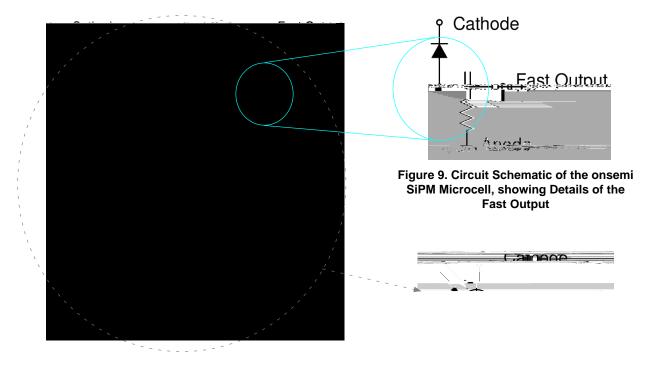


Figure 10. Simplified Circuit Schematic of the onsemi SiPM showing only a 12 Microcell Example. Typically, SiPM Sensors have Hundreds or Thousands of Microcells Figure 11. onsemi SiPM Component Symbol

TILING OF THE TSV PACKAGE

For the J-Series, **onsemi** has developed a market-leading, high-performance package using a TSV process. It is a chip-scale package that is compatible with lead-free, reflow soldering processes. The glass cover is ideal for coupling to scintillators or fibre optic elements.

The dead-space between the sensor active area and the edge of the package has been minimized, resulting in a package that can be tiled on 4 sides with high fill-factor.

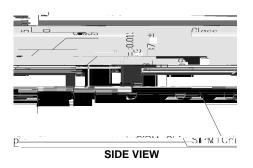
This allows multiple sensors to be configured into unique layouts for a wide range of custom applications. The distance between sensor packages can be as little as 200 µm when tiled, but actual alignment and placement tolerances will depend on the accuracy of the user's assembly process. An <u>Application Note</u> is available that gives advice on creating arrays of the TSV sensors.

PACKAGE DIMENSIONS

(All Dimensions in mm)

MicroFJ 300XX TSV



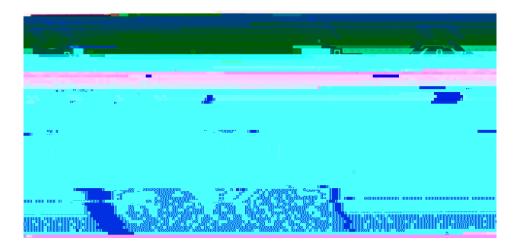


BOTTOM VIEW

Pin Assignments		
Pin Number	MicroFJ 300XX TSV	
B1	Anode	
B3	Fast output	
A1, C3	Cathode	
All others	No Connect*	

*The 'No Connect' pins are electrically isolated and should be soldered to a ground (or bias) plane to help with heat dissipation.

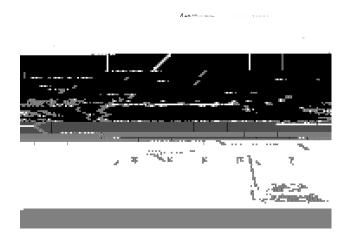
The MicroFJ-300XX-TSV-A2 CAD, and solder footprint, is available to download here.

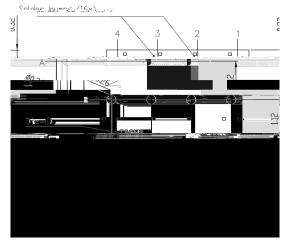


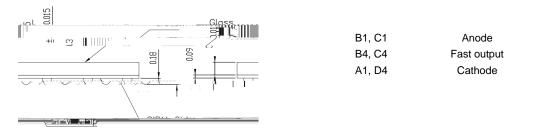
PACKAGE DIMENSIONS

(All Dimensions in mm)

MicroFJ 40035 TSV







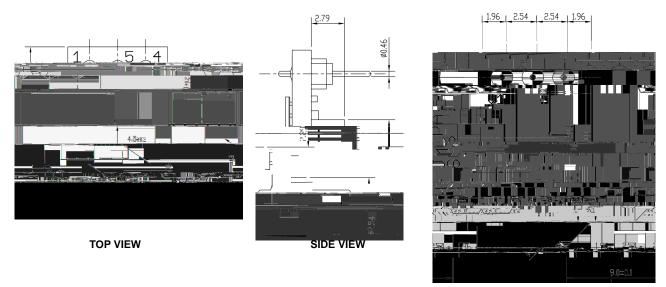
*The 'No Connect' pins are electrically isolated and should be soldered to a ground (or bias) plane to help with heat dissipation.

MicroFJ SMA 60035 Board



BOTTOM VIEW

The complete CAD for the SMA boards can be downloaded from the website: <u>3 mm</u>, <u>4 mm</u> and <u>6 mm</u> versions.



MicroFJ SMTPA 60035 Board

BOTTOM VIEW

The complete CAD for the SMTPA boards can be downloaded from the website: <u>3 mm</u> and <u>6 mm</u> versions.

ORDERING INFORMATION

Table 5. ORDERING INFORMATION

		Sensor
	Microcell Size	Active
Product Code	(No. of Microcells)	Area

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