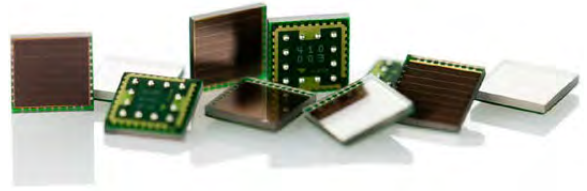


## AFBR-S4K33C0115B

3 × 3 mm<sup>2</sup> SiPM, WB-Type,  
15µm SPAD Pitch



### Overview

The Broadcom<sup>®</sup> AFBR-S4K33C0115B is a single silicon photomultiplier (SiPM) used for ultra-sensitive precision measurement of single photons.

The active area is 3.0 × 3.0 mm<sup>2</sup> with 15 µm single-photon avalanche diode (SPAD) pitch for providing high dynamic range and fastest recovery time to replace PMTs, APDs, and PIN diodes.

### Features

- 3 × 3 mm<sup>2</sup> active area, 15-µm microcells
- High dynamic range
- Fastest recovery time
- Replacement for PMTs, APDs, and PIN diodes
- Low voltage operation (typically about 30V)
- Cost efficient and robust (MSL1 approved)

### Applications

- Cytometry
- Bright scintillator readout
- Biophotonics and analytics
- X-ray photon counting
- Handheld and mobile devices
- High energy physics
- Medical imaging (PET, SPECT)
- Hazard and threat detection
- Optical sorting and XRT

**NOTE:** All values in this data sheet are typical values if not marked with min., max., <, or >.

## Spectral Response

Figure 1: Photo Detection Efficiency at 5V Overvoltage

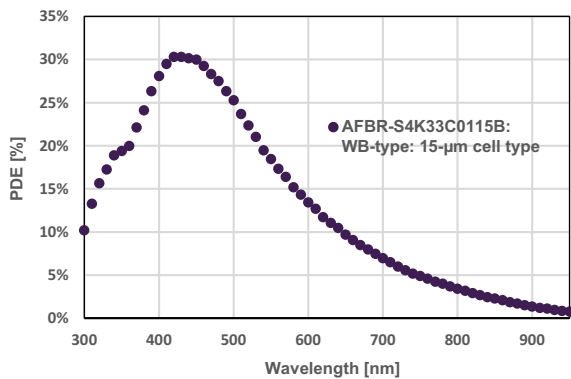
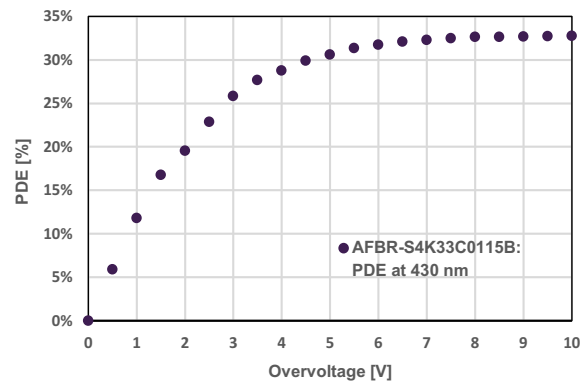


Figure 2: Photo Detection Efficiency vs. Overvoltage at 21°C



## General Parameters and Ordering Information

SiPM Type	Active Area [mm <sup>2</sup> ]	Microcell Size [ $\mu$ m]	No. of Microcells	Dimensions [mm <sup>3</sup> ]
AFBR-S4K33C0115B	3.0 x 3.0	15	38800	3.315 x 3.315 x 0.595

## Main Characteristics

Parameter	Min.	Typ.	Max.	Unit
Breakdown Voltage ( $V_{BD}$ ) at 21°C	26.0	—	28.0	V
Breakdown Voltage Variation per Reel	—	$\pm 0.125$	—	V
Recommended Overvoltage ( $V_{OV}$ )	—	2.0 to 5.0	6.0	V
Temperature Dependency of $V_{BD}$	—	22.0	—	mV/K
Temperature Dependency of Gain	—	0.3% at 5.0 $V_{OV}$	—	1/K
Operating Temperature Range	-40	—	+60	°C
Reliability Classification	—	MSL1	—	
Index of Refraction of Glass Entrance Window	—	1.52 at 430 nm	—	

## Electrical and Optical Characteristics at 21°C

Parameter	Typ. at 2.5 $V_{OV}$	Typ. at 5.0 $V_{OV}$	Unit
Photo Detection Efficiency at 430 nm	22	31	%
Dark Count Rate	50	125	kHz/mm <sup>2</sup>
Dark Current	0.08 (max. 0.16)	0.19 (max. 0.3)	$\mu$ A
Gain	0.35	0.70	$\times 10^6$
Crosstalk Probability <sup>a</sup>	8	18	%
Afterpulsing Probability	1	5	%
Terminal Capacitance	0.8		nF
Recovery Time, $\tau$	13 (at 1 $\Omega$ load), 47 (at 50 $\Omega$ load)		ns
Signal Rise Time	630		ps

a. Including delayed crosstalk with a probability < 0.1%.

# Mechanical Specifications

Figure 3: Dimensions and Recommended Footprint

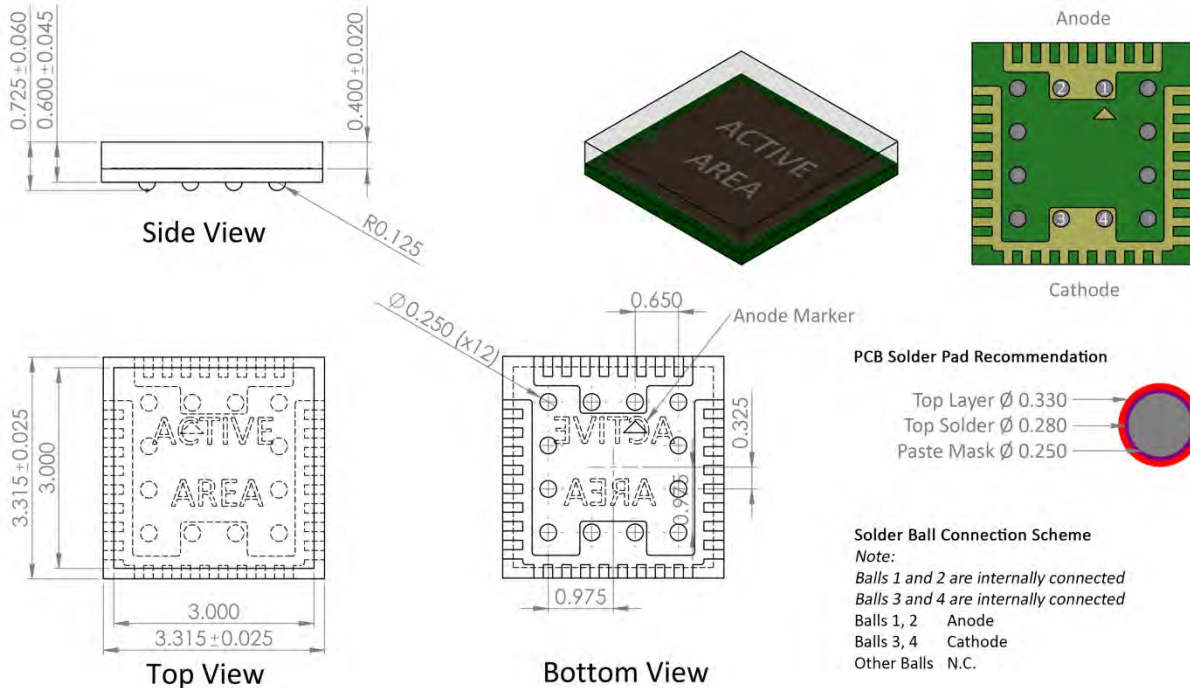
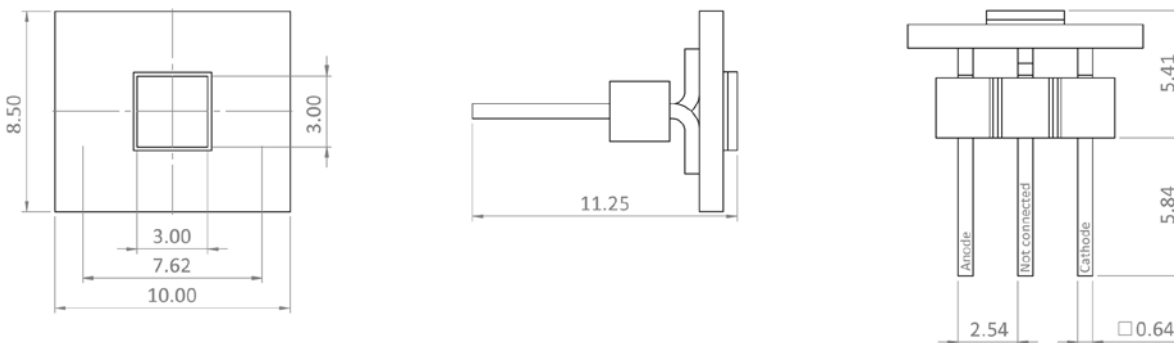


Figure 4: AFBR-S4K33C0115B Preassembled on PCB with Pins (Available for Evaluation Purposes)<sup>1</sup>



1. Mates, for example, with Preci-Dip 801-87-003-10-001101.

# Typical Performance Characteristics

Figure 5: Temperature Coefficient of the Breakdown Voltage

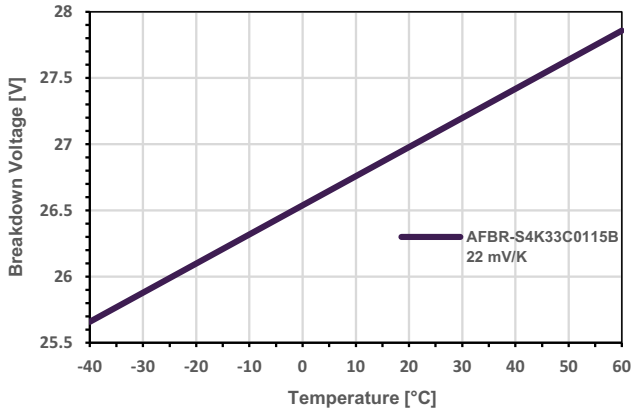


Figure 6: Temperature Coefficient of the Gain

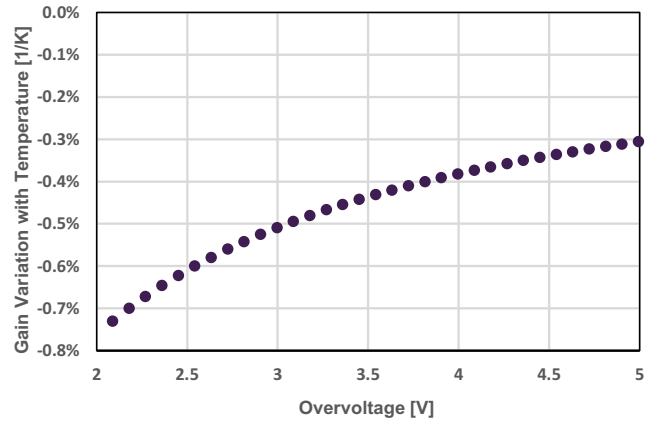


Figure 7: Linearity at 430 nm

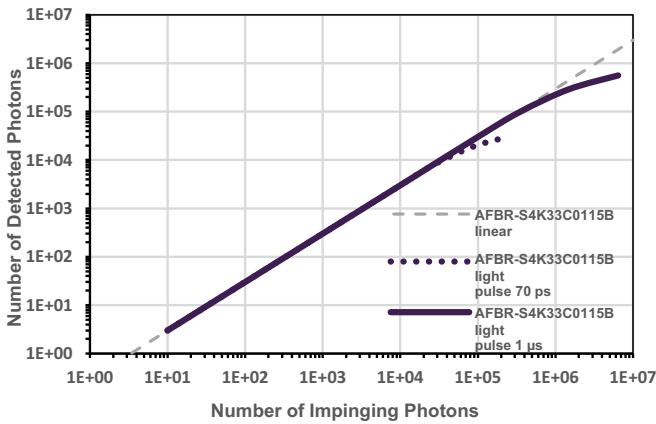


Figure 8: Gain of AFBR-S4K33C0115B

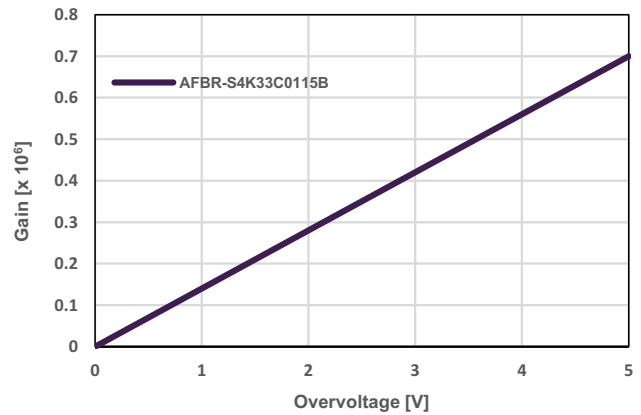


Figure 9: Dark Count Rate at 21°C

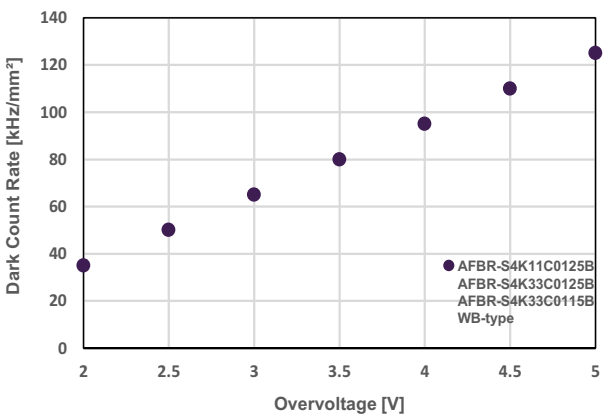


Figure 10: Dark Count Rate vs. Temperature

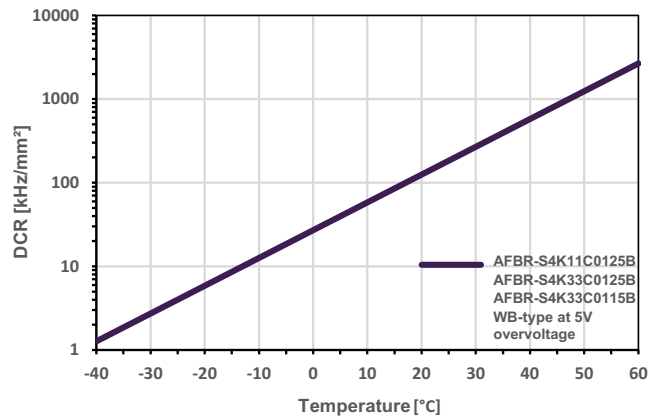


Figure 11: Direct Optical Crosstalk

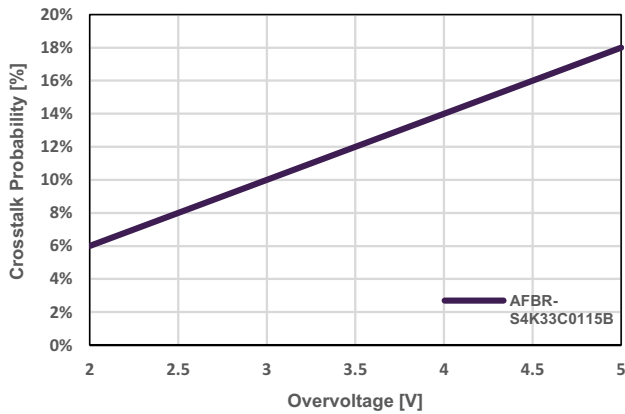


Figure 12: Delayed Optical Crosstalk

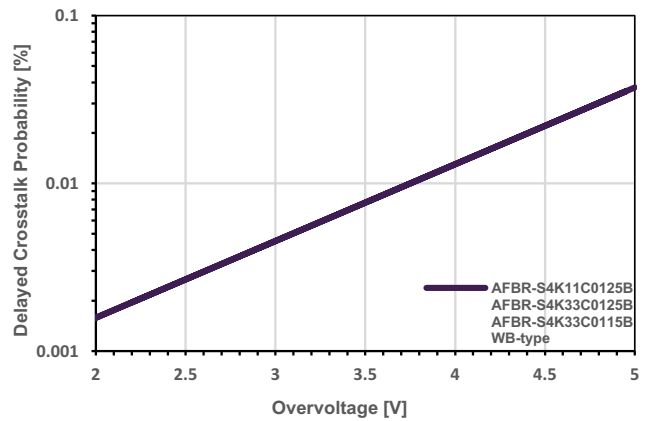


Figure 13: Afterpulsing Probability

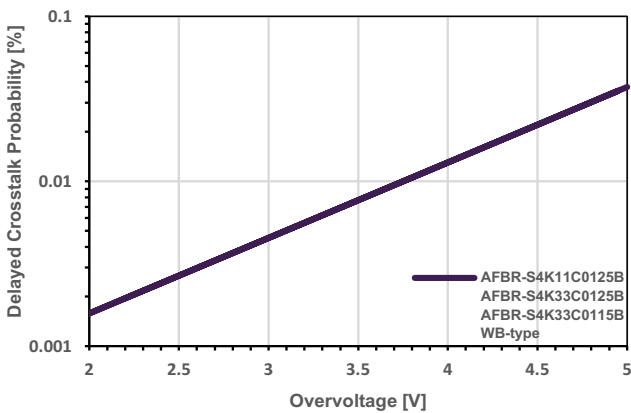
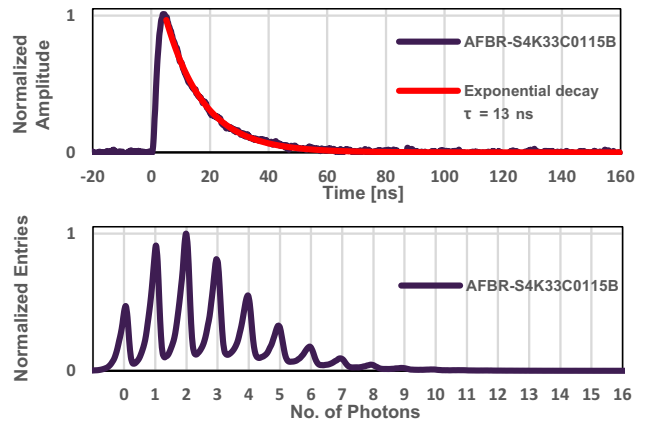


Figure 14: Pulse Shape at 1 $\Omega$  Load, Single Photon Spectrum



# Assembly Specifications

Figure 15: Tape and Reel

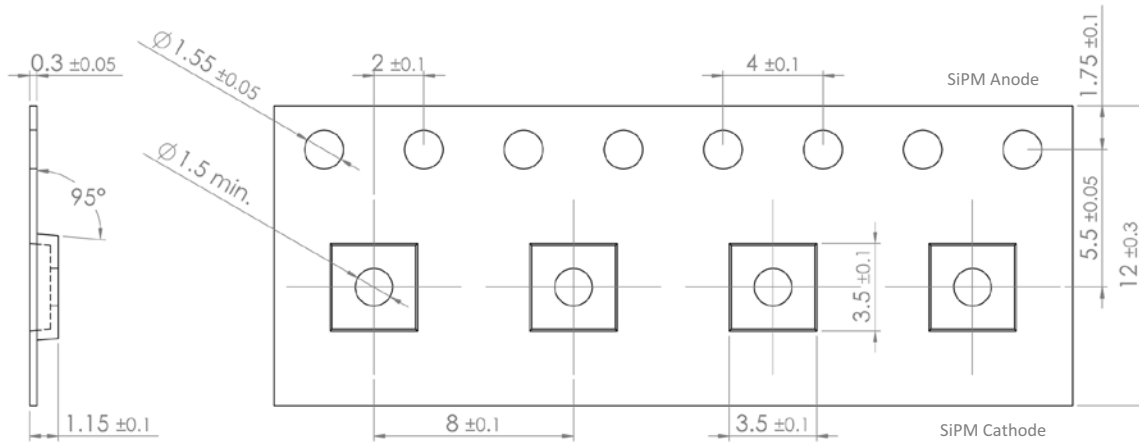
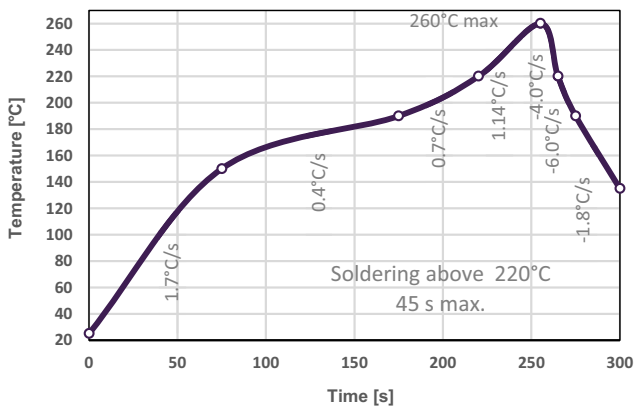


Figure 16: Recommended Reflow Solder Profile



**NOTE:** Lead-free no-clean solder paste type 4 is recommended; for example, SAC305 ROL0 Nihon Handa PF305-118. SMD stencil thickness of 80 µm is recommended.

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