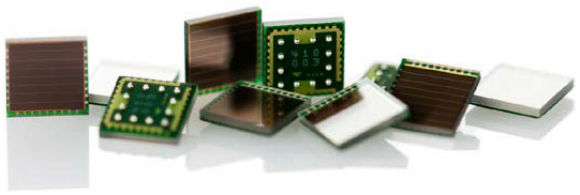
BROADCOM®

Data Sheet

AFBR-S4K33C01XXL Series

3 × 3 mm^2 Single SiPM, WL-Type, 15-µm, 35-µm, or 47-µm SPAD Pitch



Overview

The Broadcom® AFBR-S4K33C01XXL product family comprises single silicon photomultipliers (SiPM) used for ultrahigh photo detection.

The active area of these SiPMs is 3.0 × 3.0 mm^2 with single-photon avalanche diode (SPAD) pitches of 15 µm, 35 µm, or 47 µm. The WL-type series stands for high efficiency and low noise performance. Its excellent timing enables easy replacement of PMTs, APDs, and PIN diodes.

Features

- 3 × 3 mm^2 active area
- 15-µm, 35-µm, or 47-µm microcells
- High photo detection efficiency and low noise
- Excellent timing properties
- Replacement for PMTs, APDs, and PIN diodes
- Cost efficient and robust (MSL1 approved)

Applications

- Single photon counting
- Photon timestamping
- Biophotonics
- Scintillator readout
- Handheld and mobile devices
- High energy physics and research
- Medical imaging (PET, SPECT)
- Hazard and threat detection
- Analytical instrumentation

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

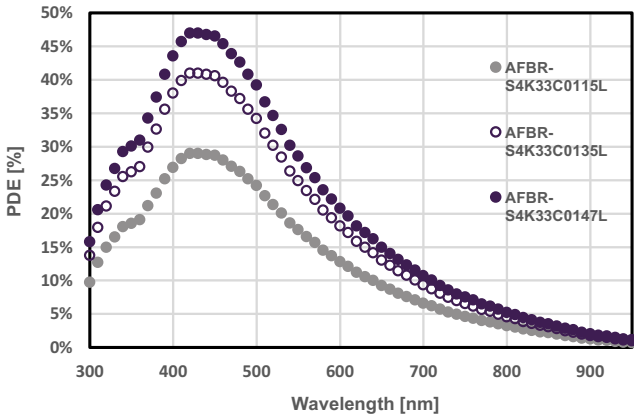
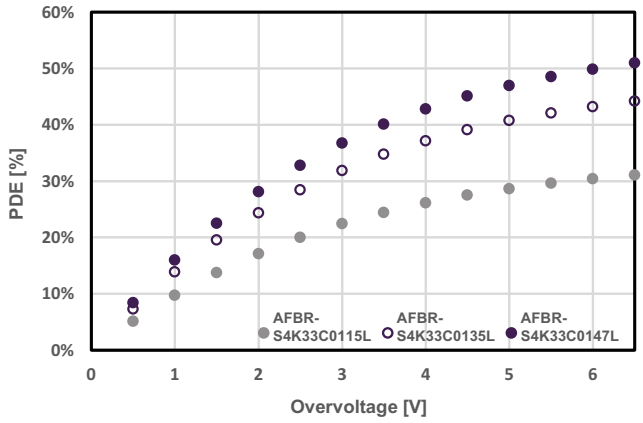


Figure 2: Photo Detection Efficiency vs. Overvoltage at 21°C



Noise Improvement of WL-Type Compared to WB-Type

Figure 3: Previous AFBR-S4K33C0125B at 5.0V Overvoltage

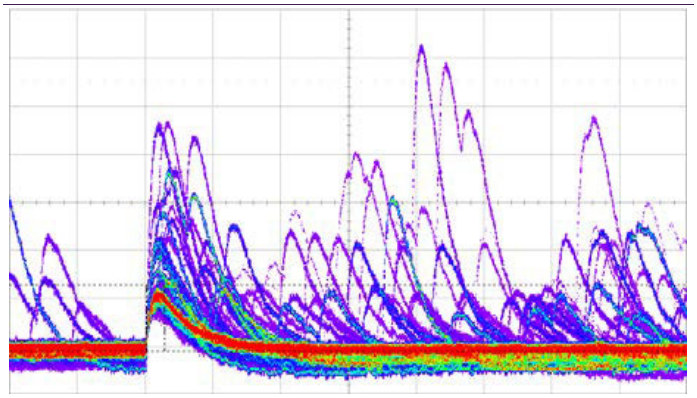
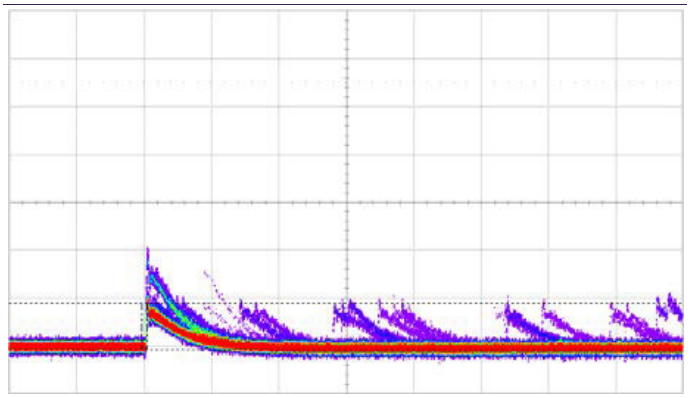


Figure 4: AFBR-S4K33C0135L at 5.0V Overvoltage



NOTE: Measurement performed using SiPM Evaluation Kit AFBR-S4KPEPCBXX.
Oscilloscope set to 100 ns/div, 2.00 mV/div, 0.5 photon electron trigger, 0.5s persistence, 200-MHz bandwidth limit.

General Parameters and Ordering Information

SiPM Type	Active Area [mm^2]	Microcell Size [µm]	No. of Microcells	Dimensions [mm^3]
AFBR-S4K33C0115L	3.0 × 3.0	15	38400	3.315 × 3.315 × 0.595
AFBR-S4K33C0135L	3.0 × 3.0	35	7396	3.315 × 3.315 × 0.595
AFBR-S4K33C0147L	3.0 × 3.0	47	4096	3.315 × 3.315 × 0.595

Main Characteristics

Parameter	Min.	Typ.	Max.	Unit
Breakdown Voltage (V_{BD}) at 21°C	28.75	—	30.25	V
Breakdown Voltage Variation per Reel	—	±0.125	—	V
Recommended Overvoltage (V_{OV})	—	1.0 to 6.5	7.5	V
Temperature Dependency of V_{BD}	—	22.0	—	mV/K
Temperature Dependency of Gain	—	0.4% 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

	AFBR-S4K33C0115L			AFBR-S4K33C0135L			AFBR-S4K33C0147L			
	Overvoltage									
Parameter	+2.5V	+5.0V	+6.5V	+2.5V	+5.0V	+6.5V	+2.5V	+5.0V	+6.5V	Unit
Photo Detection Efficiency at 430 nm	20	29	31	29	41	44	33	47	51	%
Dark Count Rate	25	45	60	30	60	80	40	85	110	kHz/mm^2
Dark Current	0.0141	0.059	0.114	0.085	0.349	0.636	0.207	0.913	1.80	µA
Dark Current – max.	0.0252	0.112	0.322	0.154	0.517	1.21	0.60	2.00	4.25	µA
Gain	0.35	0.70	0.91	2.0	4.0	5.2	3.5	7.0	9.1	× 10^6
Crosstalk Probability[a]	5	14	21	4	10	14	7	18	26	%
Afterpulsing Probability	1	3	5	1	3	5	1	3	5	%
Terminal Capacitance	1			1			1			nF
Recovery Time, τ (at 1Ω load)	7			35			95			ns

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

Mechanical Specifications

Figure 5: Dimensions and Recommended Footprint

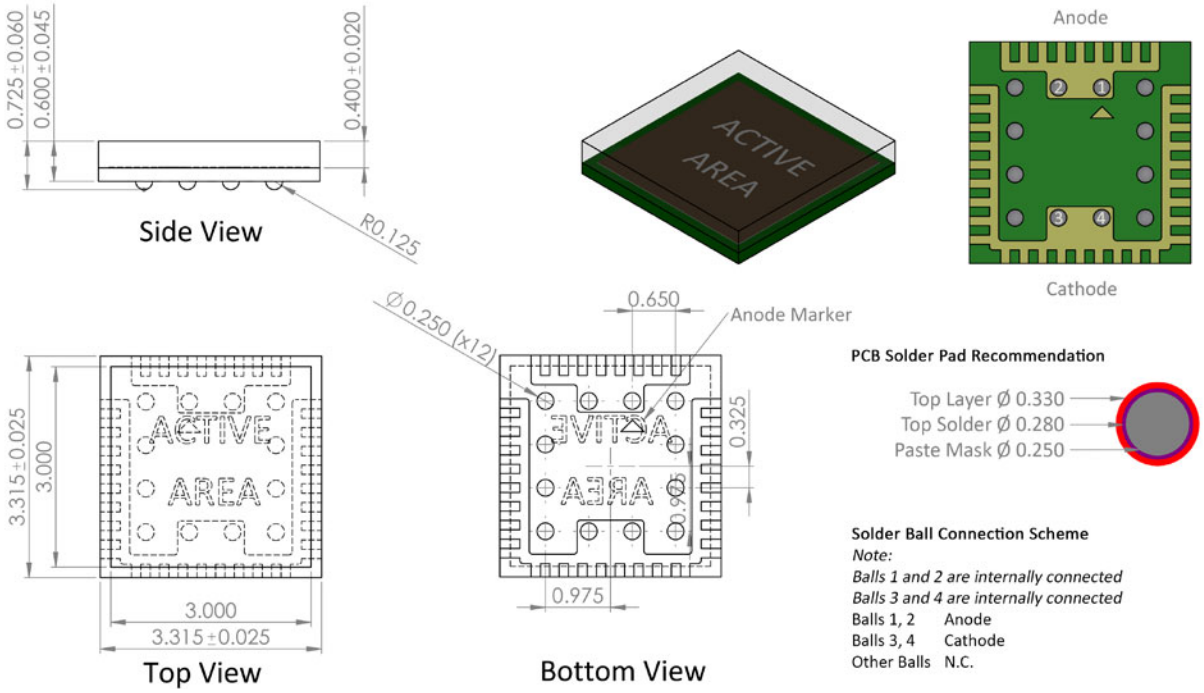
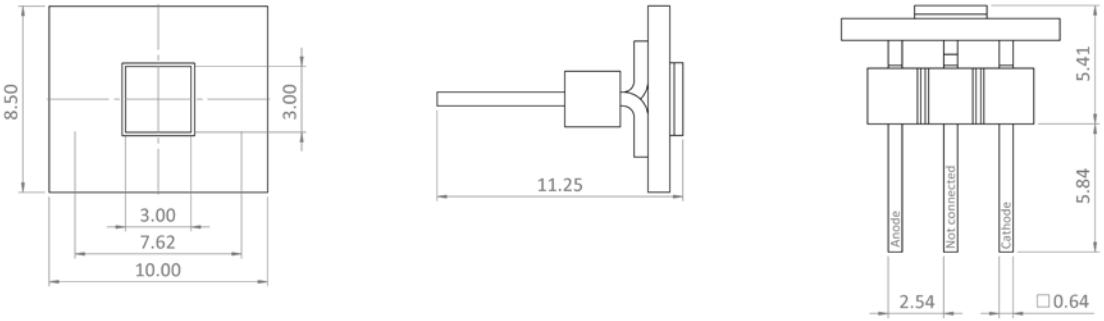


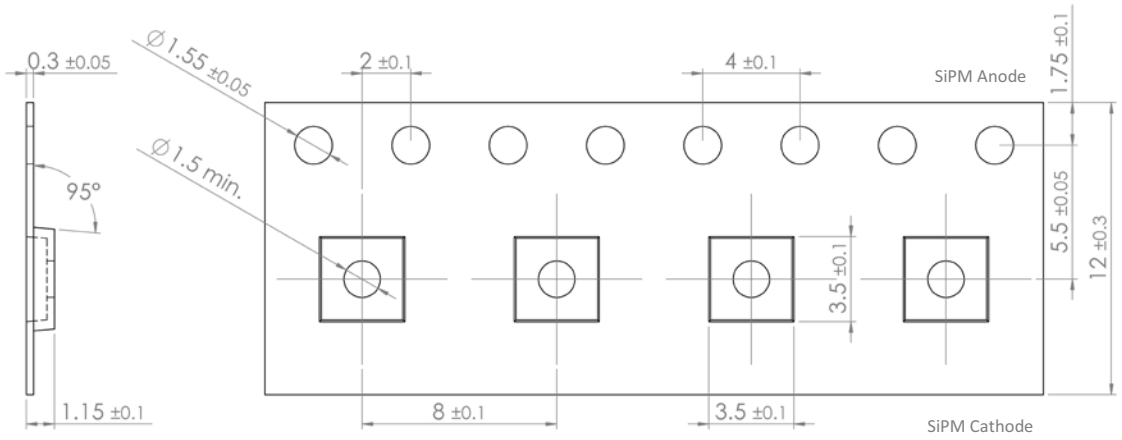
Figure 6: AFBR-S4K33C01XXL Preassembled on PCB with Pins (Available for Evaluation Purposes)[1]



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

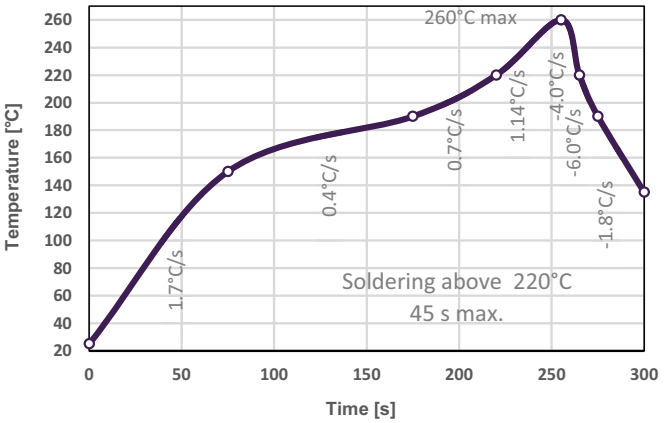
Assembly Specifications

Figure 7: Tape and Reel



NOTE: 1000 pcs per reel, quantities < 1000 pcs delivered as cut tape.

Figure 8: 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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