Features

- High-gain NIR InGaAs single-carrier-multiplicatiion APD (SCM-APD)
- 950–1700nm response
- High responsivity
- Low excess noise and high gain combine for superior sensitivity not achieved with conventional APDs
- Provides high-gain with low noise, leading the industry in solid-state NIR detection
- Custom devices available upon request

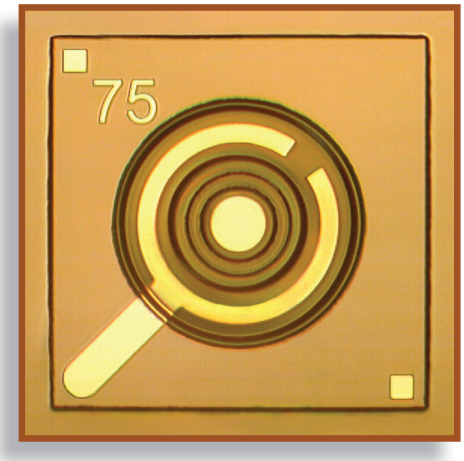
Applications

- Free-space optical communications
- Laser range finding
- Optical time domain reflectometry
- Optical coherence tomography
- Fluorescence measurements, spectroscopy, chromatography and electrophoresis

SILETZ™

Submounted APD Die

High-Gain, Low Excess-Noise NIR Single Carrier Multiplication APDs (SCM-APDs)



VFP-1000 Series

Back-illuminated, high-gain, ultra-low-excess-noise SCM-APDs combine the industry's highest gain and lowest excess noise, providing unsurpassed sensitivity in the near infrared spectral range from 950 to 1700nm.

Voxtel's single-carrier multiplication APDs (SCM-APDs) are photodetectors that exceed the capabilities of conventional APDs in both gain and noise performance. This allows for active optical systems with better sensitivity, longer range, and lower laser power.

APDs achieve high responsivity through internal current gain, but the usefulness of this gain is undermined by the accompanying avalanche noise. Voxtel's SCM-APDs can be operated at high gain with low noise, providing a significant advantage.

The Siletz series of SCM-APDs has a low effective ratio of ionization coefficients (k_{eff} ~.02), and can be operated with low excess noise: F(M)<2 up to M=10, and F(M)<3 up to M~40, with maximum usable linear-mode gain of Siletz SCM-APDs at typically M=50. Standard telecom NIR APDs are not useful above M=15, and carry a much greater noise penalty (k=0.4; F(M)>7 at M=15).

With high gain, low noise and high quantum efficiency, Voxtel's SCM-APDs are ideal for low-light-level detection, or other applications that call for industry-leading sensitivity in the 900–1700 nm spectral band. Coupling the SCM-APD to a low-noise amplifier produces a receiver with high gain, superior noise equivalent power, and better sensitivity.

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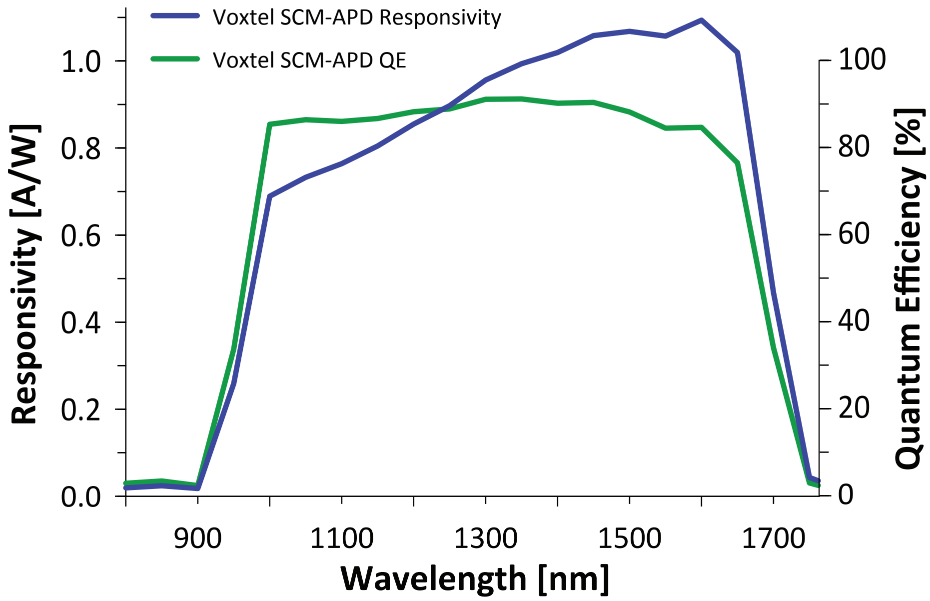
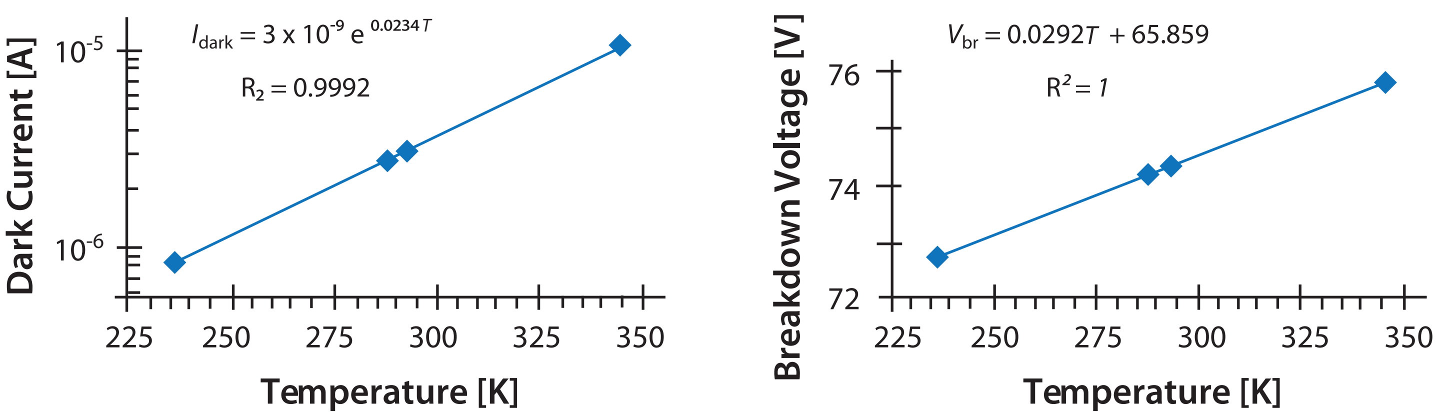
Siletz™ Series APD Photoreceivers



Spectral responsivity
curve and quantum efficiency
@ gain M=1, T=295K, 200µm SCM-APD

Thermal Effects



Effects of temperature on dark current and breakdown voltage of a
200µm SCM-APD @ M=50 ± 2

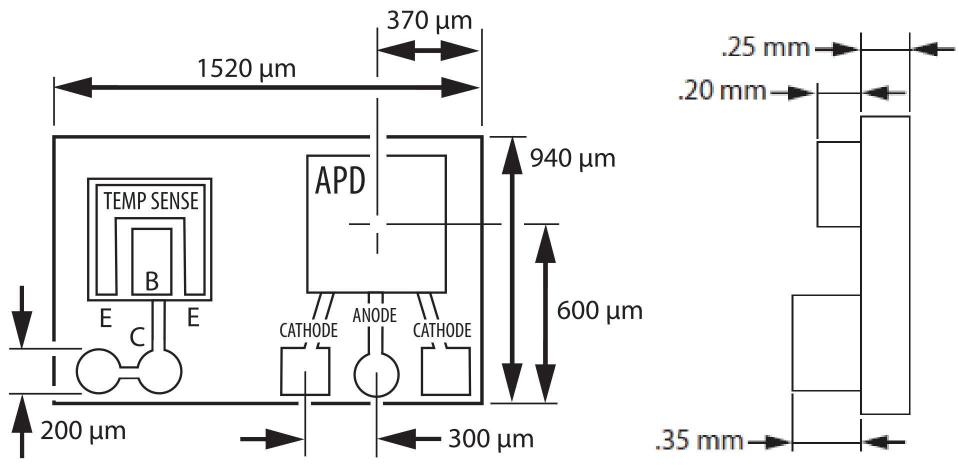
Model VFP1-EBZB

VFP-1000 Series Near-Infrared SCM-APD
30µm, 4.0GHz

Specifications

Parameter	Min	Typical	Max	Units
Spectral Range, λ	950	1000–1600	1750	nm
Active Diameter		30		µm
Bandwidth		4.0		GHz
APD Operating Gain, *M*	1	20	40	
Responsivity at *M*=1	.66 .91	.73 1.01	.78 1.04	A/W λ=1064nm λ=1550nm
Excess Noise Factor, *F(M,k)*		2.0 2.9		M=10 M=40
Noise Spectral Density @ *M*=10		.78		$pA/Hz^{1/2}$
Dark Current @ *M*=1[i]		6.6		nA
Total Capacitance[ii]		35		pF
Breakdown Voltage, V_{BR}[iii]	70	74	80	V
$\Delta V_{BR}/\Delta T$		29		mV/K
Temperature Sensing Diode Voltage and ΔV/K[iv]	0.48	0.50 -2.18 mV/K	0.51	V
Maximum Instantaneous Input Power[V]			125	µW

[i] Unity referenced from *M*=10, T=298K
[ii] M>3
[iii] *T*=298K, I_{dark}>0.1mA
[iv] Sourcing 10µA, T=298K
[v] 10ns, 1064nm signal at a 20Hz PRF with an APD multiplication gain of *M*=10



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Voxtel Literature No. VFP1-xBZB, Version date: 06/2012 ©

VOXTEL OPTO

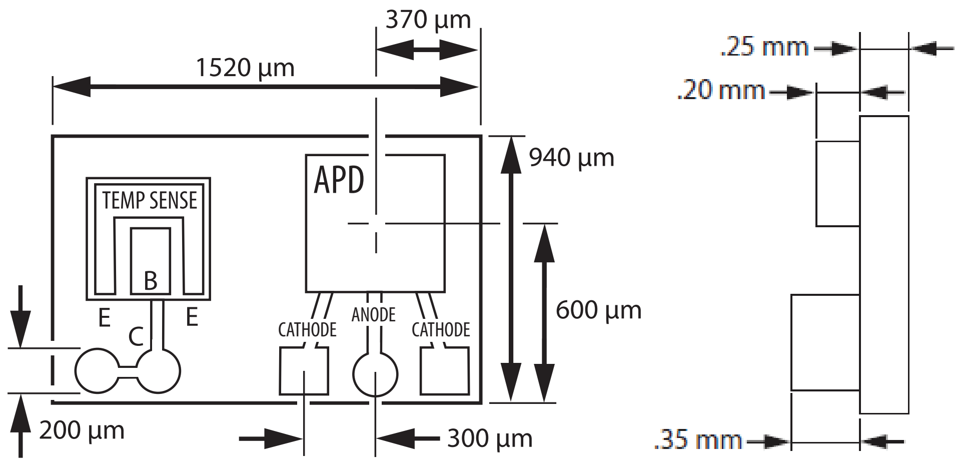
Model VFP1-JBZB

VFP-1000 Series Near-Infrared SCM-APD
75µm, 2.3GHz

Specifications

Parameter	Min	Typical	Max	Units
Spectral Range, λ	950	1000–1600	1750	nm
Active Diameter		75		µm
Bandwidth		2.3	2.7	GHz
APD Operating Gain, *M*	1	20	40	
Responsivity at *M*=1	.66 .91	.73 1.01	.78 1.04	A/W λ=1064nm λ=1550nm
Excess Noise Factor, *F(M,k)*		2.0 2.9		M=10 M=40
Noise Spectral Density @ *M*=10		1.46		$pA/Hz^{1/2}$
Dark Current @ *M*=1[i]	12	23	28	nA
Total Capacitance[ii]		0.23		pF
Breakdown Voltage, V_{BR}[iii]	70	74	80	V
$\Delta V_{BR}/\Delta T$		29		mV/K
Temperature Sensing Diode Voltage and ΔV/K[iv]	0.48	0.50 -2.18 mV/K	0.51	V
Maximum Instantaneous Input Power[V]			1	µW

[i] Unity referenced from *M*=10, T=298K
[ii] M>3
[iii] *T*=298K, I_{dark}>0.1mA
[iv] Sourcing 10µA, T=298K
[v] 10ns, 1064nm signal at a 20Hz PRF with an APD multiplication gain of *M*=10



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Siletz™

VFP-1000 Series

Submounted APD Die

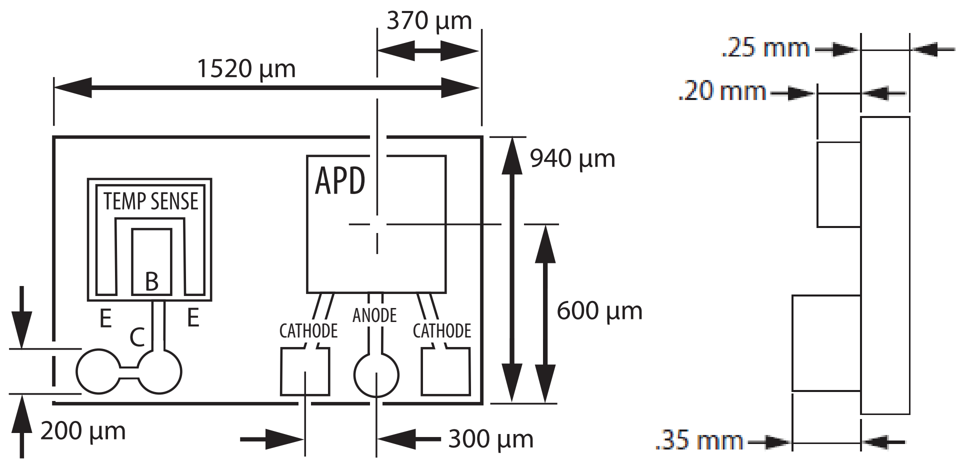
Model VFP1-NBZB

VFP-1000 Series Near-Infrared SCM-APD
200µm, 350MHz

Specifications

Parameter	Min	Typical	Max	Units
Spectral Range, λ	950	1000–1600	1750	nm
Active Diameter		200		µm
Bandwidth	300	350	400	MHz
APD Operating Gain, *M*	1	20	40	
Responsivity at *M*=1	.66 .91	.73 1.01	.78 1.04	A/W λ=1064nm λ=1550nm
Excess Noise Factor, *F(M,k)*		2.0 2.9		M=10 M=40
Noise Spectral Density @ *M*=10		3.92		$pA/Hz^{1/2}$
Dark Current @ *M*=1[i]	90	165	200	nA
Total Capacitance[ii]		1.47		pF
Breakdown Voltage, V_{BR}[iii]	70	74	80	V
$\Delta V_{BR}/\Delta T$		29		mV/K
Temperature Sensing Diode Voltage and ΔV/K[iv]	0.48	0.50 -2.18 mV/K	0.51	V
Maximum Instantaneous Input Power[V]			5	µW

[i] Unity referenced from *M*=10, T=298K
[ii] M>3
[iii] *T*=298K, I_{dark}>0.1mA
[iv] Sourcing 10µA, T=298K
[v] 10ns, 1064nm signal at a 20Hz PRF with an APD multiplication gain of *M*=10



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Ordering Information For VFP-1000 Series APD Products

V	F	P	1	-	B	Z	B
Device	**Device Type**	**Detector**		**Diameter**	**Package**	**Window**	**Revision**
V=APD	F=Linear mode	P=Siletz SCM APD	1=Single Element	E=30µm J=75µm N=200µm	B=Ceramic Submount	Z=None	

Not all combinations of product features are available. Please contact Voxtel for specific ordering information and parts availability.

Caution During APD Operation

If an APD is operated above its breakdown voltage without some form of current protection, it can draw enough current to destroy itself. To guard against this, the user can add either a protective resistor to the bias circuit or a current-limiting circuit in the supporting electronics.

The breakdown voltage of an APD is dependent upon its temperature: the breakdown voltage decreases when the APD is cooled. Consequently, a reverse bias operating point that is safe at room temperature may put the APD into breakdown at low temperature. The approximate temperature dependence of the breakdown voltage is published in the spec sheet for the part, but caution should be exercised when an APD is cooled.

Low-noise readout circuits usually have high impedance, and an unusually strong current pulse from the APD could generate a momentary excessive voltage that is higher than the readout's supply voltage, possibly damaging the input to the amplifier. To prevent this, a protective circuit should be connected to divert excessive voltage at the inputs to a power supply voltage line.

As noted in the specification, another consideration is that the APD gain changes depending on temperature. When an APD is used over a wide temperature range, it is necessary to use some kind of temperature compensation to obtain operation at a stable gain. This can be implemented as either regulation of the applied reverse bias according to temperature, feedback temperature control using a thermoelectric cooler (TEC) or other refrigerator, or both.

Upon request, Voxtel will gladly assist customers in implementing the proper controls to ensure safe and reliable operation of APDs in their system.