

PGQ Series Negative Feedback Avalanche Diodes (NFADs)



Princeton Lightwave's PGQ series NFAD is a photon-counting device consisting of InGaAs/InP avalanche diodes with monolithically integrated negative feedback. Princeton Lightwave's patented approach to the integration of negative feedback resistors provides stable high-performance single photon response in Geiger-mode operation. Leveraging the best-in-class performance of Princeton Lightwave's single photon avalanche diode (SPAD) technology, our NFAD has excellent photon-counting capability in the shortwave infrared (SWIR) band, with high internal gain and very consistent pulse response distributions. These detectors also have fast response coupled with excellent time resolution. Devices with single discrete active regions provide low dark count rate, and devices based on multiple connected active regions provide large detection area and photon number resolution.

Applications

- Quantum optics
- Quantum communications
- Spectroscopy and fluorescence measurements
- Very-low-light sensing

Key Features and Benefits

- Designed specifically for single photon counting
- Free running operation in Geiger-mode
- Passive quenching integrated on the APD chip so external quenching circuitry is not needed
- Available integrated 3-stage TE cooler
- Optimized for 0.95 μm to 1.6 μm wavelength



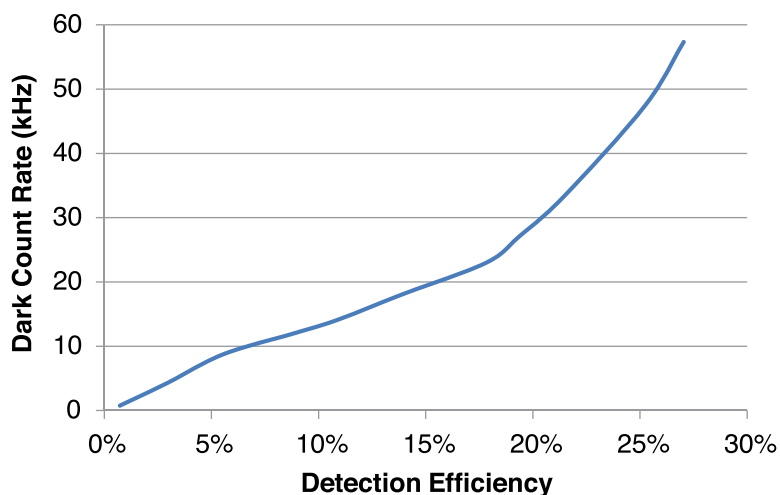
ABSOLUTE MAXIMUM RATINGS

Parameter	Conditions	Max	Units
Forward Current	Continuous bias	+1	mA
Forward Voltage	Continuous bias	+1	V
Optical Power	Continuous wave (CW)	1	mW
Reverse Current	Continuous bias	-1	mA
Reverse Voltage	Continuous bias	$-(V_b+5)$	V
Reverse Voltage	Pulsed (gated operation)	$-(V_b+10)$	V

Performance Specifications

Parameter	Conditions	PGQ-001 series			PGQ-004 series			PGQ-016 series			PGQ-064 series			Units
		Min	Typ.	Max	Min	Typ.	Max	Min	Typ.	Max	Min	Typ.	Max	
Active Region Format			Discrete			2x2			4x4			8x8		
Detection Area Dimensions			Ø22			88x88			180x180			380x380		µm
Fill Factor			100			24			19			17		%
Temperature Dependence of V_b	Between 300K and 150K, linear approximation		0.1			0.1			0.1			0.1		V/K
Spectral Response Range	T = 240K	1020		1650	1020		1650	1020		1650	1020		1650	nm
Operating Voltage	10% DE	70		80	70		80	70		80	70		80	V
Detection Efficiency, DE1	T = 240K	10			2.5			2			2			%
Dark Count Rate, DCR	at 10% detection efficiency; T=240 K		40	75		250			1500			3000		kHz
Terminal Capacitance	At Vop		0.4			0.7			1.9			6.7		pF
Timing Jitter	Single photon level, FWHM		300	400		300	400		300	400		300	400	ps
Output Pulse Amplitude	50Ω termination, depends on PDE	0.50 - 1.5			0.50 - 6			0.50 - 4			0.50 - 96			mV

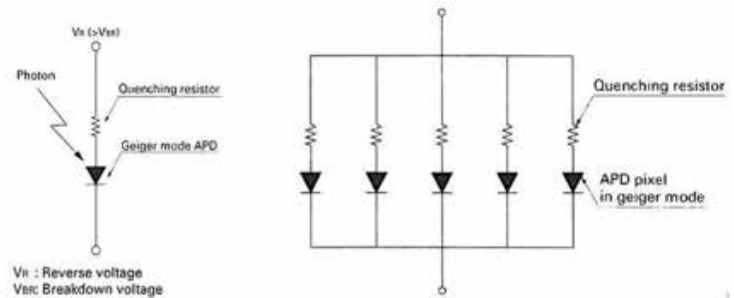
Dark Count (kHz) v. Detection Efficiency
PGQ-001-1550TO; PGQ-022u-1550TF



PRINCIPLE OF OPERATION

Princeton Lightwave NFAD devices are available in four different active region formats:

- PGQ-001 series: discrete device
- PGQ-004 series: 2x2 active region format
- PGQ-016 series: 4x4 active region format
- PGQ-064 series: 8x8 active region format

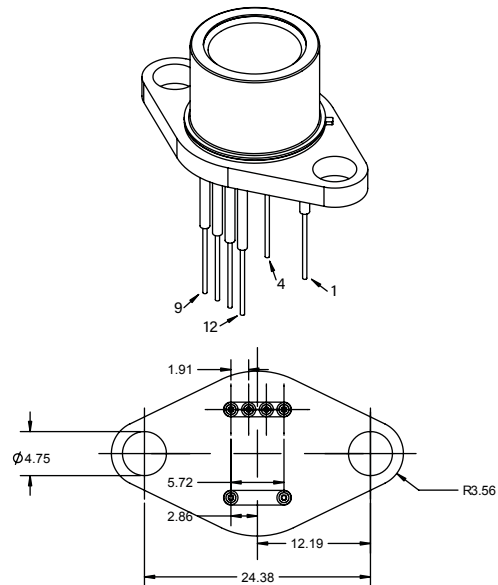
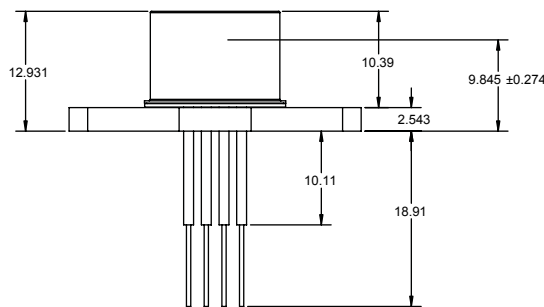
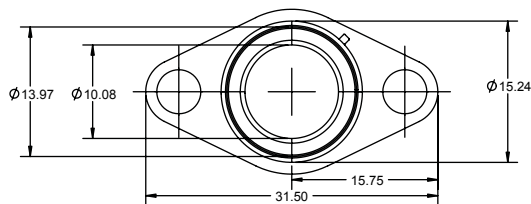


When multiple active regions are present, they are connected in parallel and provide output signals in a pair of anode/cathode connections.

The Princeton Lightwave NFAD's described in the datasheet come in a variety of packages, with and without fiber and TEC.

MECHANICAL SPECIFICATIONS PGQ-###D-1550TOT

This is a standard 6-pin TO-8 header with a three-stage thermoelectric cooler capable of cooling the APD from a package temperature of 27°C to -50°C (223° K). Also available with standard single mode fiber (9/125 μm) pigtail with an FC/PC connector coupled to the APD.



Dimensions in mm

TO-8

Pin	Function
1	TE Cooler (-)
4	TE Cooler (+)
9	APD Anode (P)
10	Thermistor
11	Thermistor
12	APD Cathode (N)

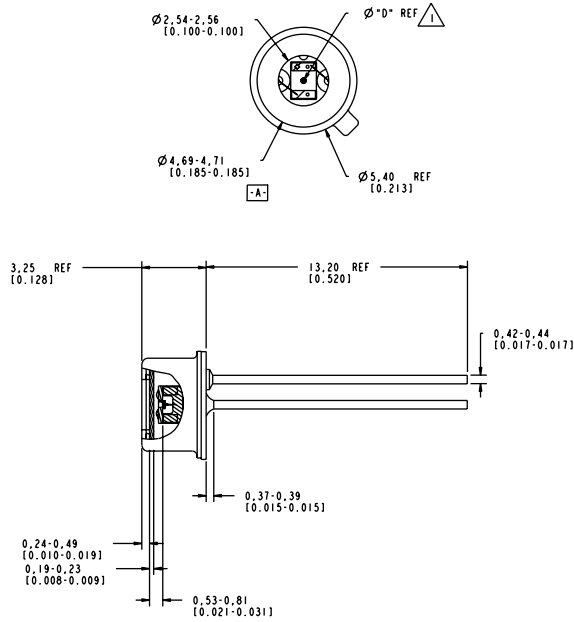
TEC Specifications

TEC Current	1.5 A max
TEC Voltage	1.9 V max
Thermistor	2.20 kΩ at 25°C
Thermistor Constant	A = 1.6529E-03, B = 2.2102E-04, C = 4.1874E-09

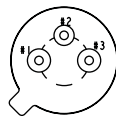
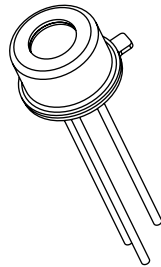
PRODUCT HANDLING

These APDs are sensitive to electrostatic discharge (ESD) and should be handled with appropriate caution, including the use of ESD protective equipment such as grounding straps and anti-static mats.

MECHANICAL SPECIFICATIONS PGQ-###D-1550TO



Dimensions in mm



Ordering Information

PGQ-###D-1550TO

Self-quenching Geiger-mode APD, ### elements, InGaAs for 1550 nm use, negative feedback resistor, in TO-46 package (formerly known as PNA-200-###)

PGQ-###D-1550TOT

Self-quenching Geiger-mode APD, ### elements, InGaAs for 1550 nm use, negative feedback resistor, in TO-8 package with 3-stage cooler (formerly known as PNA-208-###)

PGQ-022u-1550TF

Self-quenching Geiger-mode APD, InGaAs for 1550 nm use, negative feedback resistor, in fiber pigtailed TO-46 package (formerly known as PNA-300-1)

PGQ-022u-1550TFT

Self-quenching Geiger-mode APD, InGaAs for 1550 nm use, negative feedback resistor, in fiber pigtailed TO-8 package with 3-stage cooler (formerly known as PNA-308-1)

Note: ### indicate the number of active element and can be 1, 4, 16 or 64

TO-46

Pin	Function
1	P-contact (Anode)
2	Case Ground
3	N-contact (Cathode)

Specifications subject to change without notice

Document #: PGQ-###-1550T##-PLdb

2555 US Route 130 S. Suite 1
Cranbury, NJ 08512
Tel: 609-495-2600
www.princetonlightwave.com
© 2017, Princeton Lightwave, Inc.