

# PGA-series Single Photon Counting Avalanche Photodiode



The Princeton Lightwave SPAD is an InGaAs/InP avalanche photodetector designed specifically for single photon counting applications. The device is intended for use at voltage biases above the breakdown voltage (in the so-called "Geiger mode") so that a single photon incident on the detector will give rise to a macroscopic current pulse. Combined with appropriate pulse detection circuitry, this device allows for the detection of single photons in the wavelength range from 0.9 to 1.6  $\mu\text{m}$ .

The PLI SPAD's described in this datasheet come in a variety of packages with and without fiber and TEC.

## Applications

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

## Key Features and Benefits

- Industry leading InGaAs/InP avalanche photodetector
- Designed specifically for single photon counting applications
- Integrated 3-stage TE cooler allows operation at  $-50^{\circ}\text{C}$  without external cooling
- Optimized for 0.95 $\mu\text{m}$  to 1.6 $\mu\text{m}$  wavelengths.



## ABSOLUTE MAXIMUM RATINGS

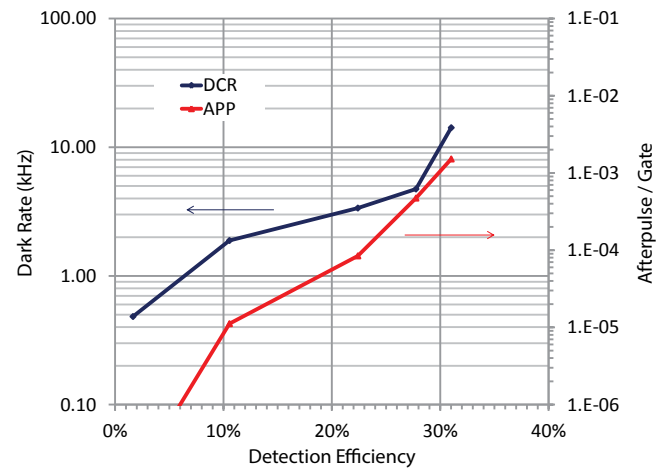
Parameter	Conditions	Max	Units
Forward Current	Continuous bias	+1	mA
Forward Voltage	Continuous bias	+1	V
Optical Power	Continuous wave (CW)	1	mW
Reverse Current	Continuous bias	-1	mA
Reverse Voltage	Continuous bias	-(V <sub>b</sub> +5)	V
Reverse Voltage	Pulsed (gated operation)	-(V <sub>b</sub> +10)	V

## Performance Specifications

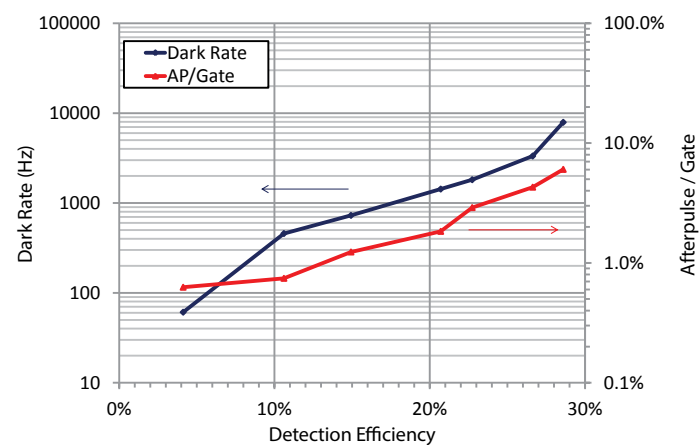
Parameter	Conditions	PGA-025u series <sup>3</sup>						PGA-016u series <sup>4</sup>						PGA-080u series <sup>3</sup>			Units			
		-1550TF / -1550TO			-1550TOT			-1550TFT			-1550TFX			-1550TFZ <sup>2</sup>				-1064TO/-1064TOT/-1064TF		
		Min	Typ.	Max	Min	Typ.	Max	Min	Typ.	Max	Min	Typ.	Max	Min	Typ.	Max		Min	Typ.	Max
<b>Linear Mode Parameters</b> (295K, all voltages and currents are reverse biased)																				
Breakdown voltage, $V_b$	295K, $I_d = 10 \mu A$	50	70	90	50	70	90	50	70	90	50	70	90	50	70	90	80	90	100	V
Temperature dependence of $V_b$	Between 300K and 150K, linear approximation		0.15			0.15		0.15		0.15		0.15		0.15				0.15		V/K
Capacitance, C	M=10, 1 MHz		0.25			0.25		0.25		0.25		0.25		0.25				1.5		pF
<b>Geiger Mode Parameters</b> (all voltages and currents are reverse biased)																				
Dark Count Rate, DCR	at 20% detection efficiency			100			75			75			10			2			100	kHz
Detection Efficiency, DE	at max DCR	20			20			20			20			20			20			%
Afterpulsing <sup>1</sup>	20% DE		$2.5 \times 10^{-4}$			$2.5 \times 10^{-4}$		$5 \times 10^{-5}$		$5 \times 10^{-5}$		$5 \times 10^{-5}$		$2 \times 10^{-2}$		$5 \times 10^{-5}$				

1. Afterpulsing is generated primarily due to a photon-induced avalanche occurring at the prior gating pulse.
2. The PGA-016u-1550TFZ is measured at a repetition rate of 100MHz.
3. Operating temperature 233K.
4. Operating temperature 223K.

PGA-025u-1550TF Tested at 1MHz

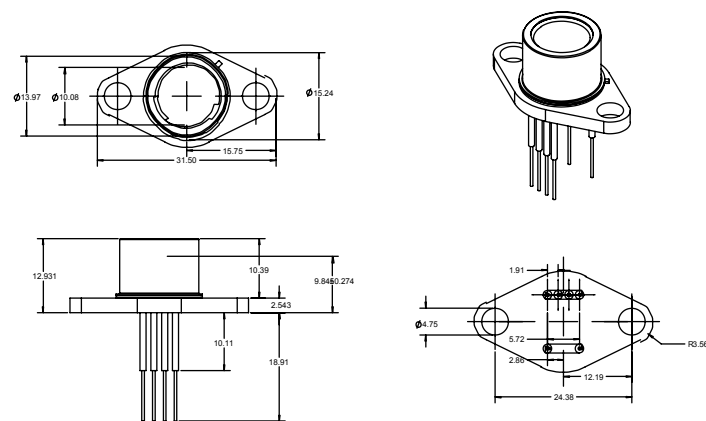


PGA-016u-1550TFZ Tested at 100MHz



## MECHANICAL SPECIFICATIONS PGA-025u-1550TOT

The pin out designation and TEC specifications are the same as for the TO-8 fiber coupled.



### TEC Specifications for PGA-025u-1550TOT

TEC Current	1.5A max
TEC Voltage	1.9V max
Thermistor	2.2 kΩ at 25°C
Thermistor Constant	A = 1.6529E-03, B = 2.2102E-04, C = 4.1874E-09

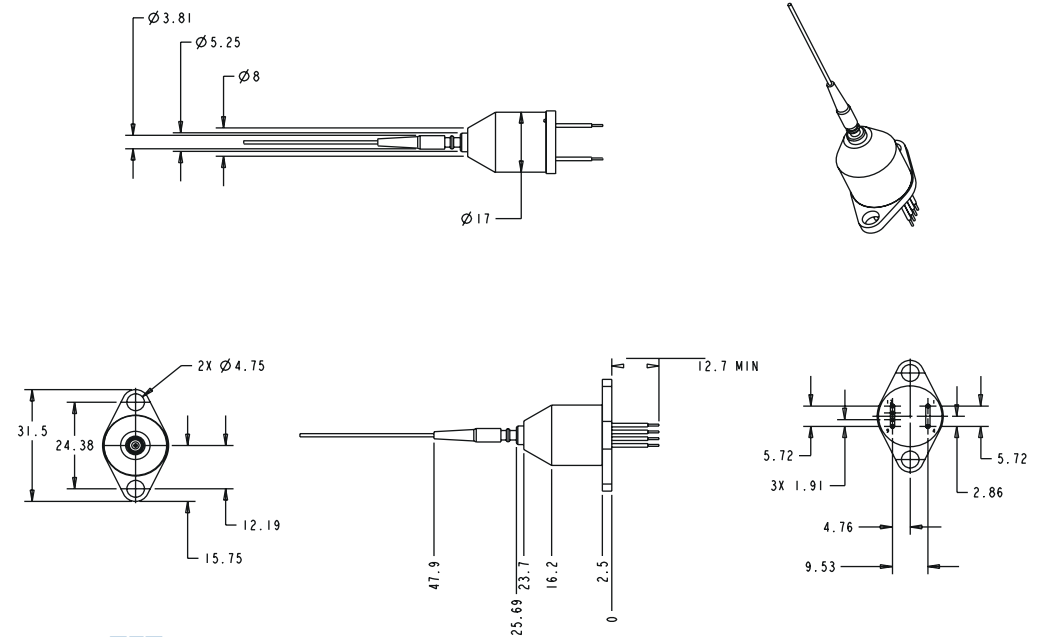
$$1/T = A + B \times \ln(R_T) + C \times (\ln(R_T))^3$$

## MECHANICAL SPECIFICATIONS PGA-016u-1550TFT/TFX & TFZ

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

### TO-8

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



### TEC Specifications for PGA-016u-1550TFT

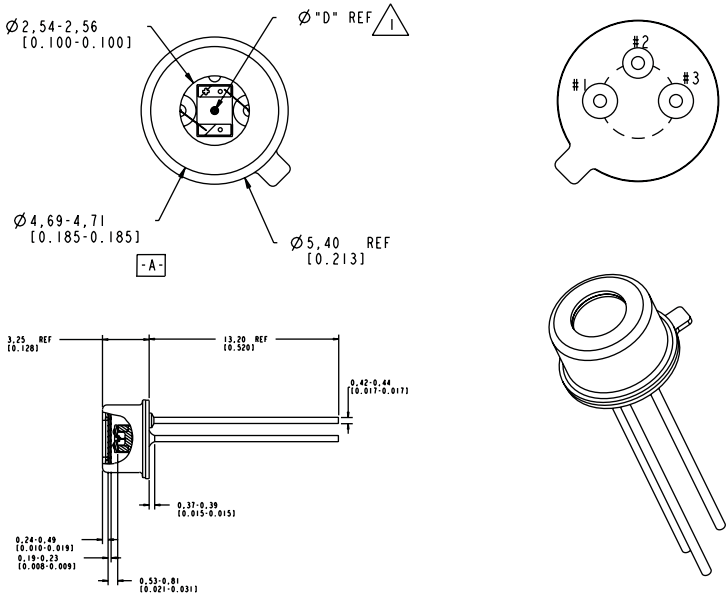
TEC Current	0.7A max
TEC Voltage	3.5V max
Thermistor	2.2 kΩ at 25°C
Thermistor Constant	A = 7.755E-04, B = 3.425E-04, C = 1.611E-13

$$1/T = A + B \times \ln(R_T) + C \times (\ln(R_T))^3$$

## PRODUCT HANDLING

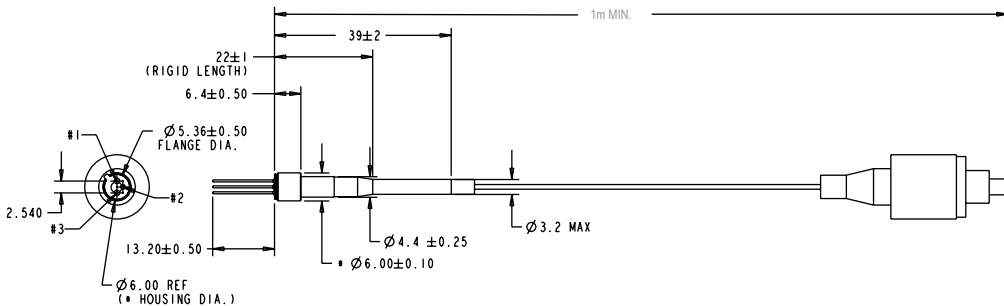
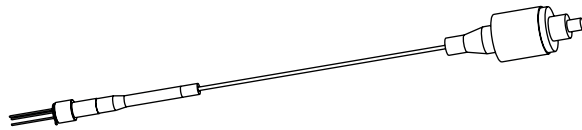
These avalanche photodiodes are sensitive to electrostatic discharge (ESD) and should be handled with appropriate caution, including the use of ESD protective equipment such as grounding straps and anti-static mats.

## MECHANICAL SPECIFICATIONS PGA-025u-1550TO & PGA-080u-1064TO



## MECHANICAL SPECIFICATIONS PGA-025u-1550TF & PGA-080u-1550TF

TO-46 fiber coupled



### TO-46

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

Specifications subject to change without notice

Document #: PGA-0##u-1550T## -- PGcj

## Ordering Information

### PGA-025u-1550TF

Coax fiber pigtailed single photon counting APD (formerly PGA-300)

### PGA-025u-1550TO

1550nm Coax single photon counting APD (formerly PGA-246-25)

### PGA-080u-1064TO

1064nm Coax single photon counting APD (formerly PGA-284)

### PGA-080u-1064TOF

1064nm Coax fiber pigtailed single photon counting APD (formerly PGA-384)

### PGA-080u-1064TOT

1064nm/80µm Geiger mode APD in TO-8 package with three stage cooler (formerly PGA-200-1064)

### PGA-025u-1550TOT

1550nm/25µm Geiger mode AOD in TO-8 package with three stage cooler (formerly PGA-200)

### PGA-016u-1550TFT

1550nm Geiger mode APD in fibered TO-8 package with three stage cooler (formerly PGA-308)

### PGA-016u-1550TFX

1550nm Geiger mode APD in fibered TO-8 package with three stage cooler – low DCR (formerly PGA-308-U)

### PGA-016u-1550TFZ

1550nm Geiger mode APD in fibered TO-8 package with three stage cooler – ultra low DCR (formerly PGA-308-U100)

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