Single Photon Benchtop Receiver
PGA-600

1. PRODUCT DESCRIPTION

The Princeton Lightwave Single Photon Benchtop Receiver is a complete solution for single photon counting applications such as quantum optics. The receiver integrates an InGaAs/InP Single Photon Avalanche diode (SPAD) with all the necessary bias and control electronics. The InGaAs/InP SPAD has been designed specifically for single photon counting to provide high detection efficiency and low dark count rate. The unit's electronics utilize a patented technique to improve system performance. The front panel of the unit displays the number of photons detected in a selected interval as well as diagnostic information. All operating parameters and values can also be accessed through the RS-232 interface. The receiver is packaged in a 3U 19" rack mount chassis.

2. PERFORMANCE SPECIFICATIONS

Parameter Description	Test Conditions	Specifications			Unit
		Min	Typ	Max	
Gate Duration			1		ns
Detection Efficiency, DE	Ambient operating temperature, 1550 nm, at DCR max	20			%
Dark Count Rate, DCR -	Ambient operating temperature, at DE min				
High Sensitivity Receiver				5×10^{-5}	ns^{-1}
Ultra High Sensitivity Receiver				5×10^{-6}	ns^{-1}
Afterpulsing probability	Ambient operating temperature, 500 kHz repetition rate, 0.1 photon/pulse, 20% DE			5×10^{-4}	ns^{-1}

3. GENERAL SPECIFICATIONS

Parameter Description	Specifications			Unit
	Min	Typ	Max	
Ambient Operating Temperature	10		35	℃
Dimensions		19×17×7		$inch^3$
Optical connector		FC/PC		
RF Connectors		SMA (f)		
Power Supply option - 1	90	110	125	V
Power Supply option - 2	195	220	240	V
Wavelength range	1000		1600	nm
CW Optical Input Power			1	mW
Trigger Input Level		1		V
Maximum Trigger Frequency			20	MHz
Adjustable Blanking Interval	0		255	gates

4. INTERFACE

All the unit parameters are set through the front panel LCD display or through the RS-232 interface. For the receiver, settings include APD temperature, blanking value, trigger delay, and discriminator level. The measurement results displayed include the pulse count, gate pulse count and ratio measurement. The sampling time interval is also set through the interface. The unit has an internal pulse generator that provides an internal or external trigger at a repetition rate of 1 Hz to 20 MHz. The output pulse can be TTL, NIM or positive NIM format.

5. THEORY OF OPERATION

The receiver provides a complete solution for detecting single photons integrates an InGaAs SPAD with all the required electronics. The receiver has four major functional elements, as shown in the block diagram below. These are the SPAD, analog signal processing circuitry, a discriminator circuitry, and triggering, biasing and blanking circuitry.

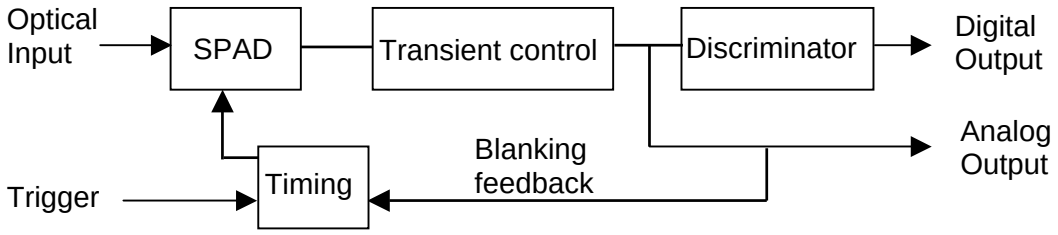
The SPAD is designed for single photon applications. It is operated at ~ 218 K to reduce the probability of dark counts. When the detector is triggered, the APD bias voltage is raised above its reverse breakdown voltage (V_{br}) to operate in “Geiger mode”. A short time later the bias is reduced below V_{br} again to prevent false events.

The analog signal processing circuitry eliminates the transient noise created when a short bias pulse is applied to the SPAD, and isolates the charge pulse that results when a photon trigger an avalanche event. This circuitry is based on single photon detection technology patented by IBM and licensed to Princeton Lightwave.

The discriminator circuitry generates a digital logic pulse when the pulse-height of an analog charge signal exceeds a threshold level set to reject electronic noise.

The triggering circuitry initiates bias pulse generation when a trigger pulse reaches a set threshold level. The delay between triggering and bias pulse generation can be adjusted over a range of ~ 1 – 9 ns. This delay must be adjusted so that the bias pulses accurately coincide with the expected arrival times of the photons. By using short bias pulses, the probability of dark counts can be significantly reduced, improving the detector's signal-to-noise performance.

Finally, this part of the circuitry provides the capability to suppress bias pulse generation for a set number of trigger pulses after the discriminator indicates an avalanche event has occurred. This blanking feature is useful to suppress afterpulsing of the SPAD, a phenomenon where the probability of a dark avalanche event occurring increases sharply just after the SPAD fires.



6. ORDERING INFORMATION

	Sensitivity Option	Power Supply
PGA-600	**-X**	**-XX**
	[blank] High Sensitivity	01: 95-125VAC operation
	U – Ultra High Sensitivity	02: 195-240VAC operation