

PAR Series High Sensitivity APD Front End Receiver Modules



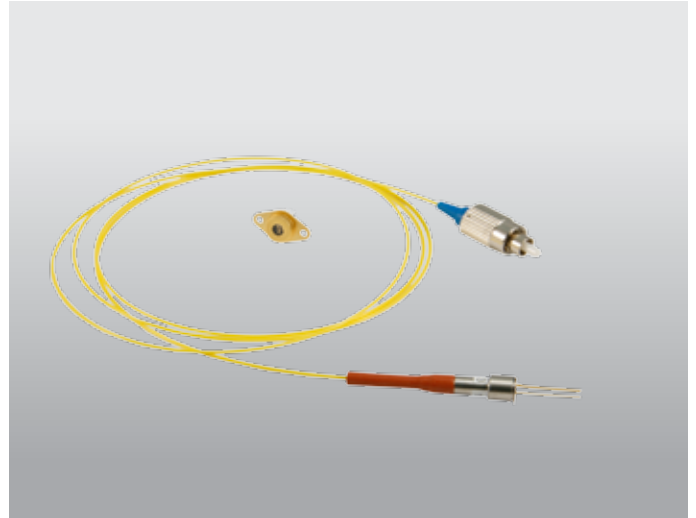
Princeton Lightwave's PAR series product family offers an APD and a reliable monolithic transimpedance amplifier in multiple packaging formats with industry-leading sensitivity. These modules leverage Princeton Lightwave's high-performance, planar InP-InGaAs avalanche photodiodes (APDs) developed specifically for demanding low-light level detection in ranging, LADAR, and scientific applications.

Applications

- Laser Radar (LADAR) and Range finding
- Low-level Optical Pulse Discrimination
- Free-space Optical Communication
- Optical Time Domain Reflectometry
- Confocal Microscopy

Key Features and Benefits

- 80 or 200 μm InGaAs APD ultra-low noise TIA
- 100 and 550 MHz bandwidth
- Overload protection circuitry
- Industry leading sensitivity & overload performance
- Small form-factor



The PAR-1XXM series incorporates the above features in a 6-pin, TO-46 style package. It achieves a 100 MHz bandwidth, enabling 2 nanosecond timing accuracy. The PAR-550M series achieves 550 MHz bandwidth, enabling sub-nanosecond timing accuracy. The ultra-low noise of the monolithic TIA, in combination with the low dark current of the APD, offers excellent low-light-level performance over a wide operating temperature range. The APD module also includes circuitry for overload protection of the receiver and for enhanced recovery from high optical input pulses. The combination of minimal dependence on temperature variation, un-cooled operation, and compact packaging enables significant SWaP (size, weight, and power) advantages.

For more demanding applications where the dependence of the APD operating voltage on temperature must be controlled by temperature stabilization, the PAR-1XXM-1550TOC and PAR-550M-1550TOC versions incorporate, in a flanged packaging format, the receiver performance of the PAR-1XXM-1550TO and PAR-550M-1550TO but with an internal thermoelectric cooler (TEC) and temperature sensor. The PAR series receivers are designed to provide drop-in compatibility with industry standard pin-outs for applications in legacy systems.

All versions are assembled in a hermetic enclosure and incorporate packaging designs and processes that ensure robust, reliable operation in harsh environments.

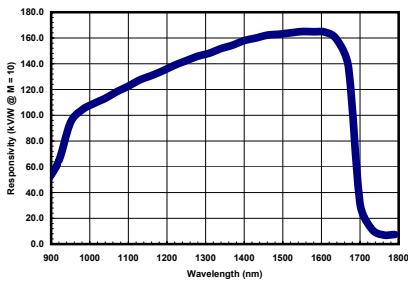
Performance Specifications

Operating conditions: $V_{dd} = +3.3V$ to GND; Case temperature = $25^{\circ}C$; $R_{LOAD} = 100\Omega$ differential

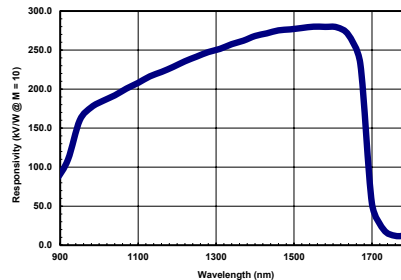
Parameter	Conditions	Specifications PAR-150M-1550TO/TOC			Specifications PAR-100M-1550TO/TOC			Specifications PAR-550M-1550TO/TOC			Units
		Min	Typ.	Max	Min	Typ.	Max	Min	Typ.	Max	
Active Region			80			200			80		
Breakdown Voltage, V_b	$I_d = 10 \mu A$	50		90	50		90	50		90	V
Temp. Dependence $\Delta V_b/\Delta T$			0.15			0.15			0.15		$V/^{\circ}C$
Impulse Response (FWHM)	M=10	2.1	2.4		0.9	3.5		0.8	1		ns
Bandwidth (3dB, optical)	M=10	120	150		90	100		400	550		MHz
Responsivity @ 1550 nm	Differential output, M=10	280	360		280	360		56	120		kV/W
	Single-ended output, M=10	140	180		140	180		28	60		
Dark Noise Equivalent Power ¹	1550 nm, M=10		90			130			250		fW/√Hz
Output Impedance (Nominal)	Differential output		100			100			150		Ω
	Single-ended output		50			50			75		
Output Voltage Swing	Differential output		0.8			0.8			0.46		Vp-p
	Single-ended output		0.4			0.4			0.23		
Dynamic Range	1550 nm, M=10		30			30			20		dB
Overload Recovery ² (equiv. optical signal @ 1 μ s)	Optical input: 10 mW, 30 ns		65			65					nW
	Optical input: 1 mW, 30 ns		10			10					
Power Supply Current	0 nW optical input		30	50		30	50		25	35	mA
TEC Voltage ³ (TOC version)				0.6			0.6			0.6	V
TEC Current ³ (TOC version)				1.5			1.5			0.6	A

1. NEP computed with measured output noise, with no optical illumination, divided by the responsivity.
2. Equivalent optical signal computed by dividing measured optical voltage by responsivity.
3. For the TEC version only, enables the above performance across operating case temperature range of $-40^{\circ}C$ to $+85^{\circ}C$

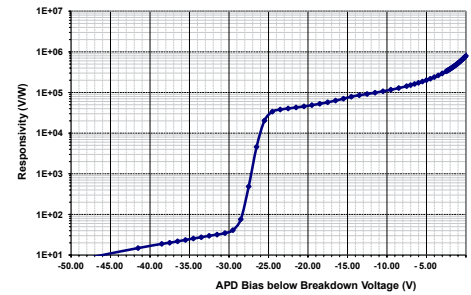
PAR-550M Series APD Receiver Module
Typical Spectral Response



PAR-100M Series APD Receiver
Module with Differential Output
Typical Spectral Response



PAR-100M Series
Typical Response v. Bias with Differential Output

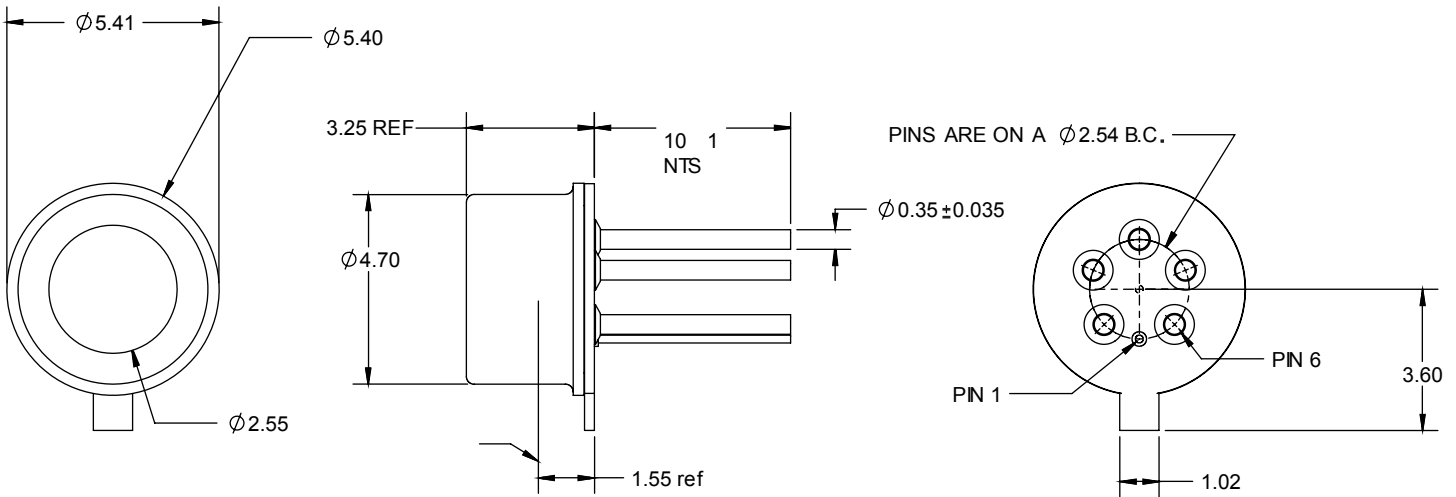


LIMITER

LIMITER is a control voltage that manages overload protection and recovery of the APD and TIA. Effective overload recovery is achieved by applying a fixed voltage so that the limiter diode is zero-biased (typical 0.9V). Alternatively, the pin may be left unconnected, allowing the internal capacitor to hold the zero-bias voltage.

MECHANICAL SPECIFICATIONS PAR-1X0M-1550TO & PAR-550M-1550TO

PAR-1X0M & PAR-500M-1550TO Series is a 6-pin TO-46 module.

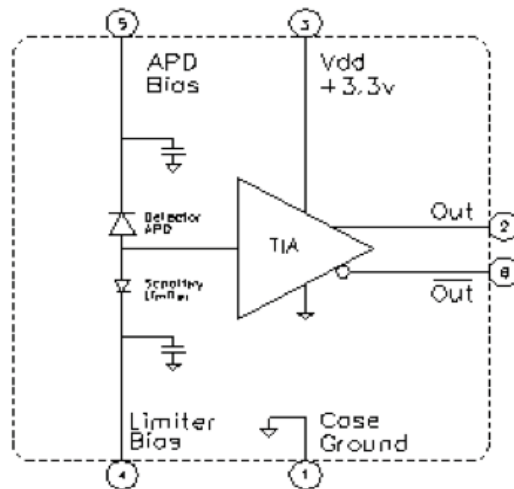


TO-46 Pin-out

Pin	Function
1	CASEGND
2	OUT+
3	Vdd (+3.3v)
4	LIMITER
5	+HV
6	OUT-

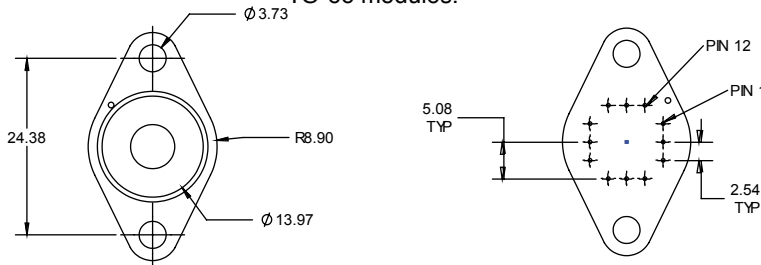
Dimensions in mm

ELECTRICAL BLOCK DIAGRAM: PAR-1X0M-1550TO and PAR-550M-1550TO



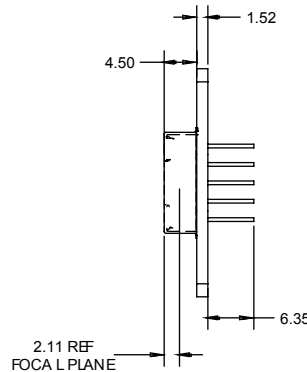
MECHANICAL SPECIFICATIONS: PAR-1X0M-1550TOC and PAR-550M-1550TOC

The PAR-1X0M-1550TOC and PAR-550M-1550TOC are 12-pin TO-66 modules.



TO-66 Pin-out

Pin	Function
1	+5V (alternative)
2	TEC-
3	TEC+
4	TSENS1
5	TSENS2
6	CASE GND
7	+HV (APD Cathode)
8	OUT+
9	OUT-
10	V _{dd} (+3.3V)
11	N.C.
12	LIMITER



Ordering Information

PAR-100M-1550TO

APD receiver, 100 MHz bandwidth, InGaAs for 1550 nm use, TO-46 package. (formerly known as PLA-641)

PAR-150M-1550TO

APD receiver, 150 MHz bandwidth, InGaAs for 1550 nm use, TO-46 (formerly known as PLA-641-80)

PAR-100M-1550TOC

PAR-100M-1550TO in TO-66 package with thermoelectric cooler (formerly known as PLA-661)

PAR-150M-1550TOC

PAR-150M-1550TO in TO-66 package with thermoelectric cooler (formerly known as PLA-661-80)

PAR-550M-1550TO

APD receiver, 550 MHz bandwidth, InGaAs for 1550 nm use in TO-46 package (formerly known as PLA-841)

PAR-550M-1550TOC

PAR-550M-1550TO in TO-66 package with thermoelectric cooler (formerly known as PLA-861)

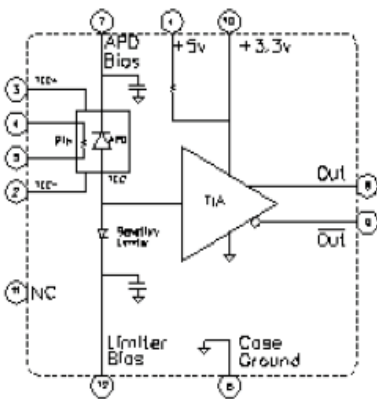
ABSOLUTE MAXIMUM RATINGS

CW operation unless specified

Parameter	Min	Max	Units
Supply Voltage ¹ (+3.3V)	-0.5	4	V
Supply Voltage ² (+5V)	-0.5	6	V
APD Reverse Bias ³	0	V _{br}	V
Limiter Voltage	0	2.5	V
TIA Output Voltage	-0.5	V _{dd}	V
Tsens Current		1	A
TEC Voltage		1	V
TEC Current		2	mA

- Should be applied after APD reverse bias.
- For PAR-1XXM with TEC, applied as alternative to +3.3V, should be applied after APD reverse bias.
- APD reverse bias should be applied before TIA supply voltage.

ELECTRICAL BLOCK DIAGRAM: PAR-1X0M-1550TOC and PAR-550M-1550TOC



The temperature sensor is an NTC thermistor with a resistance of 5 kΩ ± 5% at 25°C.

The thermistor coefficients are:
Alpha @ 25°C = -4.39%
Beta = 3892 ± 1.0%

The Steinhart-Hart Constants are:
A = 1.28745 × 10⁻³
B = 2.357394 × 10⁻⁴
C = 9.5052 × 10⁻⁸

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.

Specifications subject to change without notice

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