PD1XX2 SERIES

FOR OPTICAL COMMUNICATION AND RADAR SYSTEMS

TYPE NAME

PD1002, PD1032

DESCRIPTION

PD1XX2 is a silicon avalanche photodiode (Si-APD) having a light receiving area of 200 μm in diameter. Mitsubishi Si-APD realizes the P-side incidence method having a deep junction of planar mesa structure, increasing the gain band width area and decreasing the noise generated by the multiplication mechanism.

FEATURES

- High speed response (pulse rise time 150ps)
- Flat frequency characteristics (cutoff frequency 2GHz)
- High gain-bandwidth product (800GHz)
- Low noise index in multiplication process ($< M^{0.3}$)
- Active diameter 200 μm

APPLICATION

Light receiving element for optical fiber communication systems and optical telemetry systems

ABSOLUTE MAXIMUM RATINGS

Symbol	Parameter	Conditions	Ratings	Unit
I_R	Reverse current	$T_{opr} \leq 80$℃	200	μA
I_F	Forward current		10	mA
T_C	Case temperature	–	−40～+110	℃
T_{stg}	Storage temperature	–	−55～+150	℃

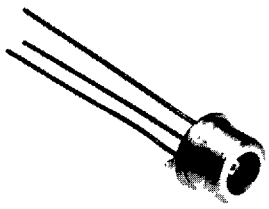
ELECTRICAL/OPTICAL CHARACTERISTICS (T_C = 25℃)

Symbol	Parameter	Test conditions	Limits			Unit
			Min.	Typ.	Max.	
$V_{(BR)R}$	Breakdown voltage	I_D = 100 μA	100	150	200	V
β	Temp.coeff.of $V_{(BR)R}$		–	0.12	–	%/℃
C_t	Total capacitance	$V_R = 0.9V_{(BR)R}$	–	1.5	2	pF
I_D	Dark current	V_R = 50V	–	0.3	1	nA
R	Responsivity	V_R = 50V, λ = 800nm	0.4	0.45*	–	A/W
Mmax	Maximum multiplication rate	I_{PO} = 10nA, R_L = 1kΩ	–	1000	–	–
f_C	Cutoff frequency	M = 100, R_L = 50Ω, −3dB	–	2	–	GHz
NEP	Noise equivalent power	λ = 800nm	–	1×10^{-14}	–	W/Hz
F	Excess noise factor	M = 100	–	$M^{0.25}$	–	–

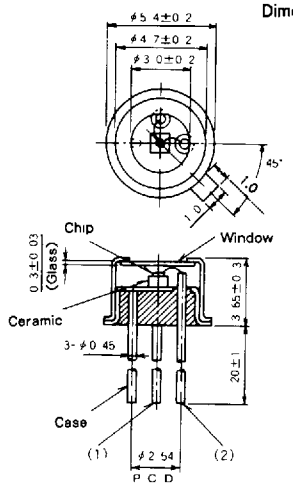
With PD1032, the minimum coupling response is 0.3A/W and the typical coupling response is 0.4A/W against GI50/125 outgoing light.

OUTLINE DRAWINGS

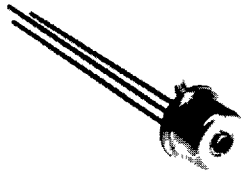
PD1002



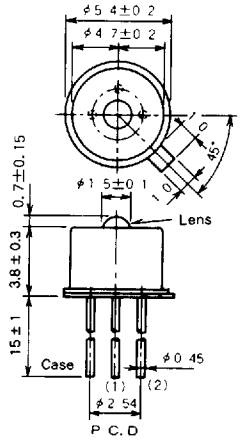
Dimensions in mm



PD1032



Dimensions in mm

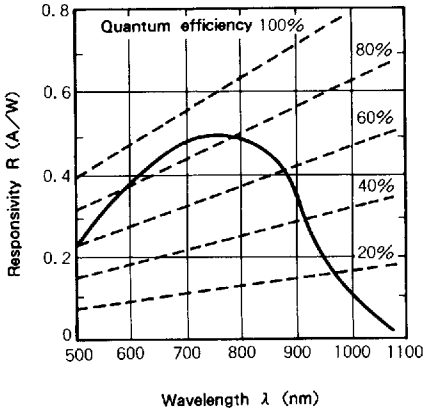


SAMPLE CHARACTERISTICS

1 Responsivity under no multiplication condition

Figure 1 shows PD1XX2's typical response characteristic against wavelength at a 50Vbias. PD1XX2 is a PIN structure APD suitable for receiving the lights having a wavelength band of 600 to 900nm like He – Ne laser (633nm) and AlGaAs laser (750 to 900nm). At a wavelength of 750nm, the response becomes about 0.5A/W at peak. The dashed lines indicate quantum efficiency levels.

Fig. 1 Spectral response



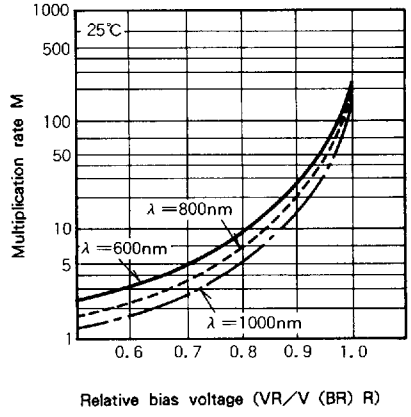
2 Multiplication characteristics

Typical voltage dependence of the multiplication rate at various wavelengths is shown in Fig. 2. Multiplicaiton rate as high as 1000 is obtainable when the output voltage (product of multiplied photocurrent and load resistance) is smaller than 100mV.

Practically available responsivity is a product of the value in Fig.1 and the multiplication rate M.A value as high as 300A/W can be easily obtained.

Because of the PIN structure, the PD1XX2 have much amaller scattering of the multiplication rate from device sto device, more uniform multiplication rate throughout the detecting area as compared with reach through devices.

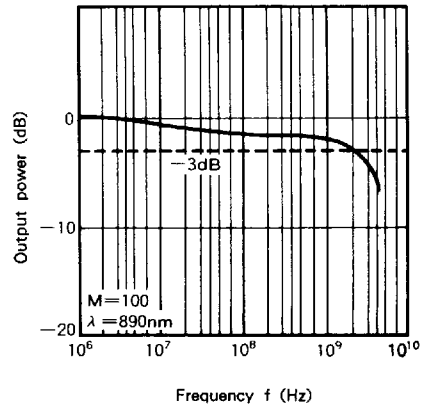
Fig. 2 Multiplication characteristics



3 Frequency response

Figure 3 shows PD1XX2's typical frequency response characteristic. The cutoff frequency (the frequency at output being –3dB) at a 50-ohm load is 2GHz or higher.

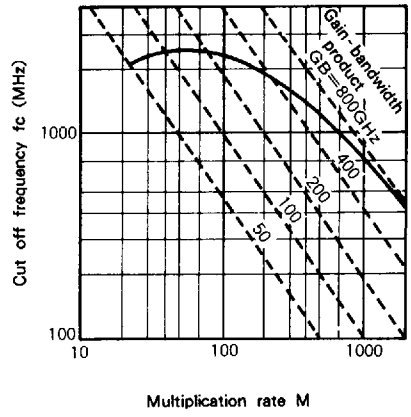
Fig. 3 Frequency response



4 Gain-bandwidth product

The gain-bandwidth product of an APD is a product of the multiplication rate and the cutoff frequency, GB. It increases with M and approaches an asymptote which is determined by the GB of multiplication process. Fig. 4. shows the GB of the PD1XX2. The multiplication limited GB of the devices is approximately 800GHz. Such a large GB is required particularly in detection of very weak and very wideband signals.

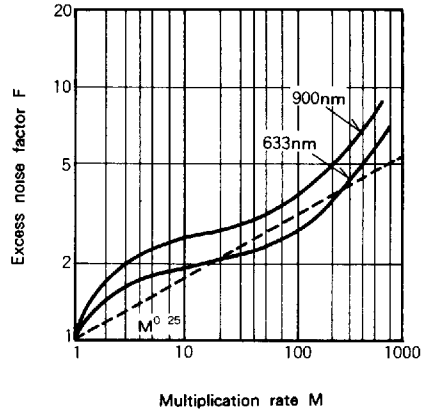
Fig. 4 Multiplication rate dependence of cutoff frequency



5 Noise characteristics

Excess noise factor of the multiplication process depends on the multiplication rate M. It is generally approximated by an expression M^x. Fig. 5 shows the noise characteristics of the PD1XX2. They depend slightly on wavelength of incident light signals. The constant, x, of the PD1XX2 is approximately 0.25. The PD1XX2 can be low noise detectors even in the high multiplication region since their noise increment is so small.

Fig. 5 Excess noise factor of multiplication process



6 Bias circuit

Fig. 6 shows an example of APD receiver circuit. Because the multiplication rate obtained when a constant reverse bias is added changes with temperature, a stable operation for long time requires the compensation of the temperature dependence of the multiplication rate. Figure 7 shows an example of the bias circuit for temperature compensation which uses an avalanche diode (AD1000) for temperature compensation.

Fig. 6 Receiver circuit with APD

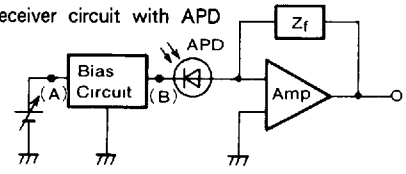
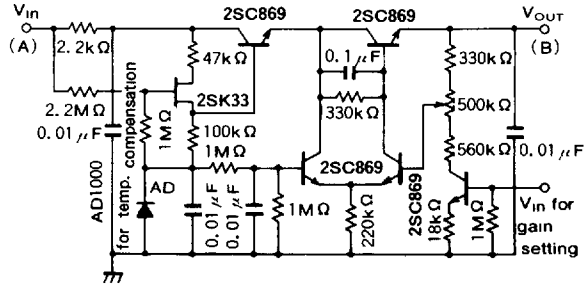


Fig. 7 APD bias circuit with temperature compensation



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