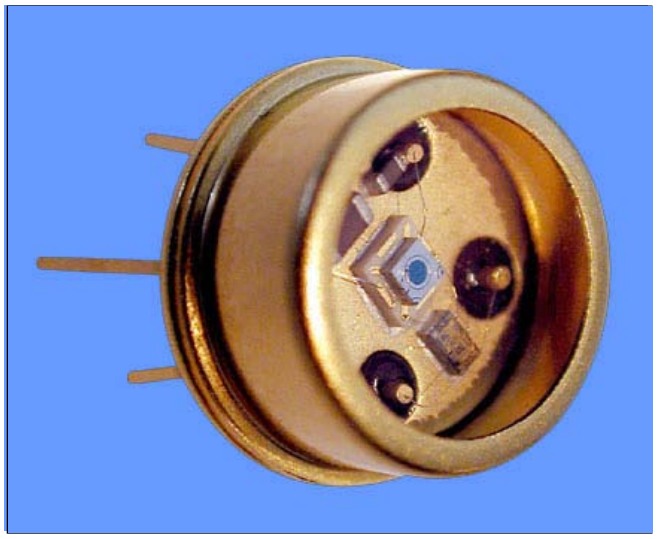
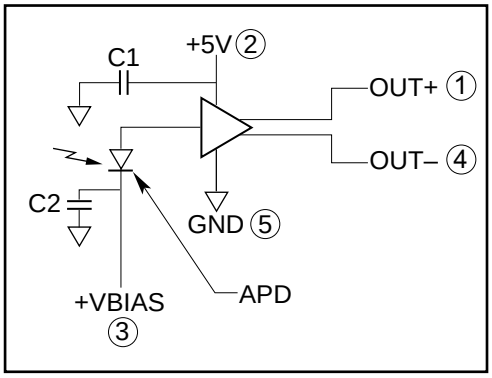
DATA SHEET AD230-9-400M-TO5

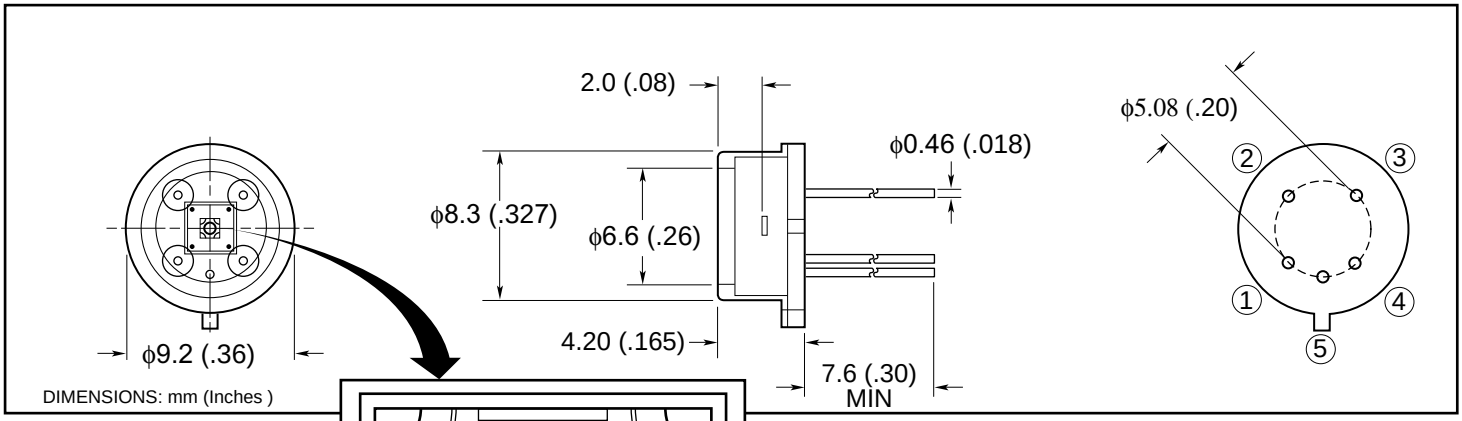
OPTICAL DATA RECEIVER USING AN AVALANCHE PHOTODIODE AND A HIGH SPEED TRANSIMPEDANCE AMPLIFIER

AD230-9-400M-TO5 is a high frequency optical data receiver comprising an Avalanche Silicon Photodiode and a transimpedance amplifier in a hermetically sealed TO-5 package.

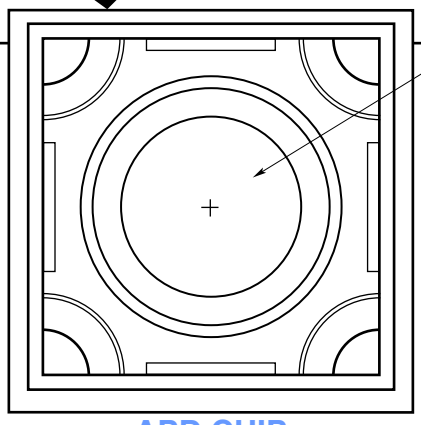




SCHEMATIC DIAGRAM



OUTLINE DIMENSIONS



APD CHIP

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AVALANCHE PHOTODIODE DATA

TYPICAL VALUES AT 22°C											
	ACTIVE AREA		V_{BR}		C_T	I_d	RESP		T_R	CUT OFF FREQUENCY	NEP
MODEL	Dia.	mm^2	V	TC of $V_{BR(\%/°C)}$	pF	nA	@ 905 nm A/W	GAIN	ps	MHz (–3 db)	$(W/Hz^{1/2})$
AD230-9	230 µm	0.042	260	0.4	0.8	0.6	0.60	200	550	400	1×10^{-14}

Symbols:
- V_{BR} - Breakdown Voltage
- C_T - Capacitance
- I_d - Dark Current
- Resp. - Responsivity (no avalanche effect)
- T_R - Rise Time
- NEP - Noise Equivalent Power

TRANSIMPEDANCE AMPLIFIER DATA

(V_{CC} = +3.0V to + 5.5V, T_A = 0°C to 70°C, 100Ω load between OUT+ and OUT–. Typical values are at T_A = +25°C, V_{CC} = 3.3V).

PARAMETER	CONDITIONS	MIN	TYP	MAX	UNITS
SUPPLY VOLTAGE		3	5	6	V
SUPPLY CURRENT			34	63	mA
TRANSIMPEDANCE	DIFFERENTIAL, MEASURED W. 40µA P-P SIGNAL	2100	2750	3400	Ω
OUTPUT IMPEDANCE	SINGLE ENDED PER SIDE	48	50	52	Ω
MAXIMUM DIFFERENTIAL OUTPUT VOLTAGE	INPUT = 2mA p-p w/100 Ohm differential termination	220	380	575	mV p-p
AC INPUT OVERLOAD		2			mA p-p
DC INPUT OVERLOAD		1			mA
INPUT REFERRED RMS NOISE	TO-5 PACKAGE		490	668	nA
INPUT REFERRED NOISE DENSITY	NOTE 2		11		$pA/(Hz)^{1/2}$
SMALL SIGNAL BANDWIDTH	SOURCE CAPACITANCE = 0.85 pF NOTE 1	1525	2000		MHz
LOW FREQUENCY CUTOFF	–3 dB, INPUT < 20 µADC		30		kHz
TRANSIMPEDANCE LINEAR RANGE	PEAK TO PEAK 0.95 < LINEARITY < 1.05	40			µA p-p
POWER SUPPLY REJECTION RATIO (PSRR)	OUTPUT REFERRED, f < 2 MHz PSSR = –20 LOG ($\Delta V_{OUT}/\Delta V_{CC}$)		50		dB

Note 1: Source capacitance for AD500-400M-TO5 is the capacitance of APD.
Note 2: Input Referred Noise is calculated as RMS Output Noise/ (Gain at f = 10 Mhz)
Noise Density is (Input Referred Noise)/√bandwidth

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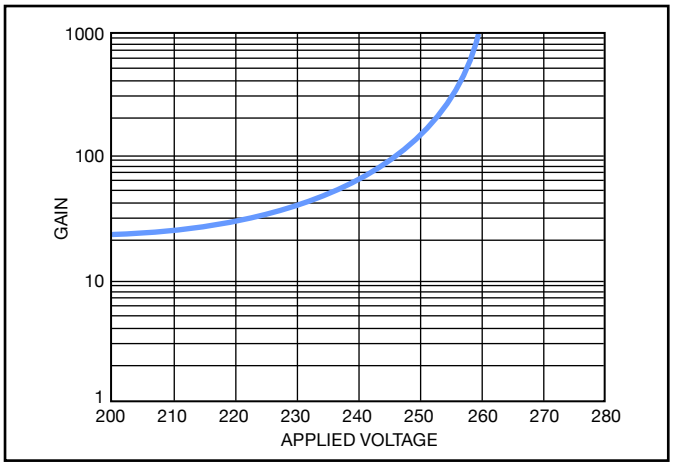

FIG. 1: APD GAIN VS BIAS VOLTAGE

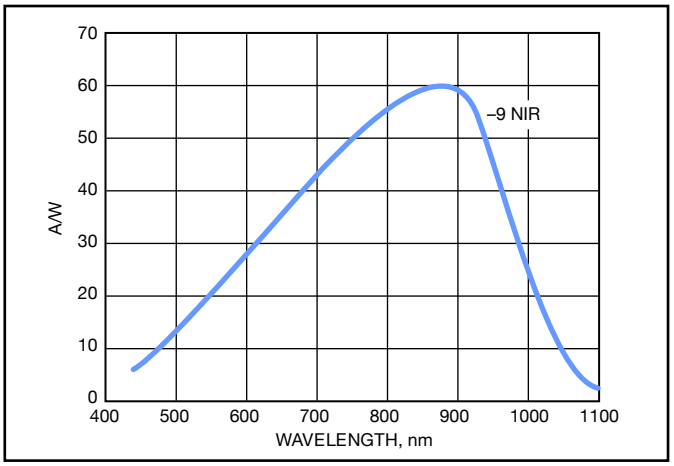

FIG. 2: APD SPECTRAL RESPONSE (NO AVALANCHE EFFECT)

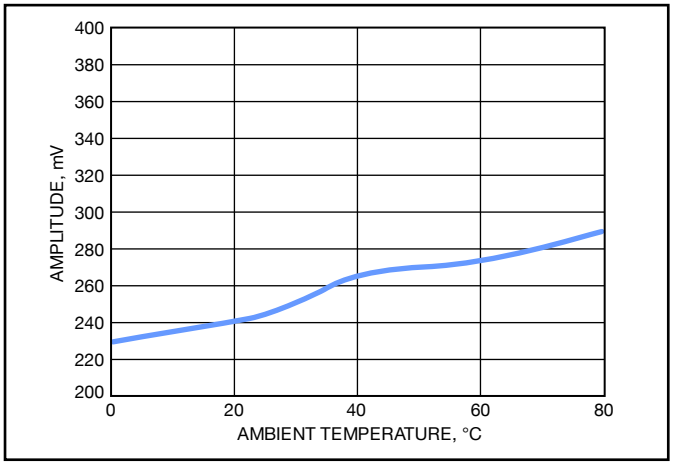

FIG. 3: AMPLIFIER OUTPUT VS TEMPERATURE

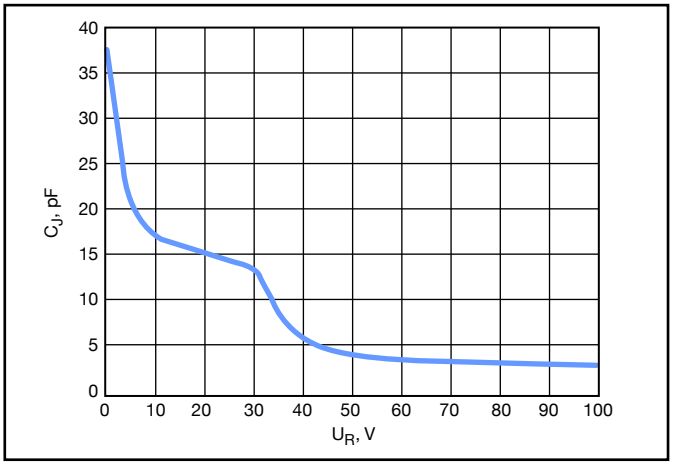

FIG. 4: APD CAPACITANCE VS VOLTAGE

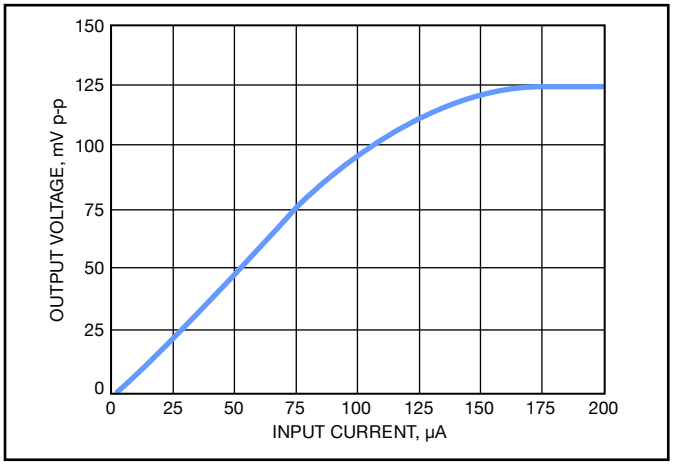

FIG. 5: AMPLIFIER TRANSFER FUNCTION

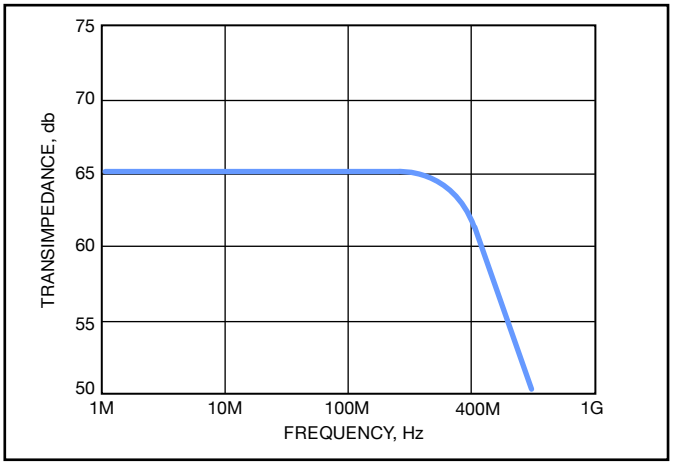

FIG. 6: TOTAL FREQUENCY RESPONSE

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HIGH SPEED OPTICAL DATA RECEIVER

TRANSFER CHARACTERISTICS

The circuit used is an avalanche photodiode directly coupled to a high speed data handling transimpedance amplifier. The output of the APD (light generated current) is applied to the input of the amplifier. The amplifier output is in the form of a differential voltage pulsed signal.

The APD responsivity curve is provided in Fig. 2. The term Amps/Watt involves the area of the APD and can be expressed as Amps/mm^2/Watts/mm^2, where the numerator applies to the current generated divided by the area of the detector, the denominator refers to the power of the radiant energy present per unit area. As an example assume a radiant input of 1 microwatt at 850 nm. The APD's corresponding responsivity is 0.4 A/W.

If energy in = 1 μW, then the current from the APD = (0.4 A/W) x (1 x 10^{-6} W) = 0.4 μA.
We can then factor in the typical gain of the APD of 100, making the input current to the amplifier 40 μA.
From Fig. 5 we can see the amplifier output will be approximately 40 mV p-p.

APPLICATIONS NOTE

The AD500-9-400M-TO5 is a high speed optical data receiver. It incorporates an internal transimpedance amplifier with an avalanche photodiode.

This detector requires +3.5V to +5.0V voltage supply for the amplifier and a high voltage supply (100-180V) for the APD. The internal APD follows the gain curve published for the AD500-TO52i avalanche photodiode. The transimpedance amplifier provides differential output signals in the range of 200 millivolts differential.

In order to achieve highest gain, the avalanche photodiode needs a positive bias voltage (Fig. 1). However, a current limiting resistor must be placed in series with the photodiode bias voltage to limit the current into the transimpedance amplifier. **Failure to limit this current may result in permanent failure of the device.** The suggested initial value for this limiting resistor is 390 k OHM.

When using this receiver, good high frequency placement and routing techniques should be followed in order to achieve maximum frequency response. This includes the use of bypass capacitors, short leads and careful attention to impedance matching. The large gain bandwidth values of this device also demand that good shielding practices be used to avoid parasitic oscillations and reduce output noise.

Caution: These parts are extremely static sensitive. Standard ESD precautions must be followed.

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