Appendix

Appendix A Components

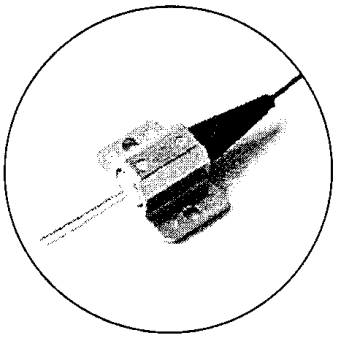
1 FPD5W1KS

FPD5W1KS

InGaAs Avalanche Photodiode

FEATURES

- Multi-mode fiber pigtail
- 30dB Optical Return Loss (ORL)
- 30 Micron Active Area APD
- High reliability planar structure with a guard ring based on advanced InGaAs/Inp material technology
- High cut-off frequency, 2.5GHz
- Low dark current
- Low multiplied dark current
- Low excess noise factor



APPLICATIONS

- 2.4 Gb/s optical transmission systems

DESCRIPTION

The FPD5W1KS is a wide bandwidth, high sensitivity InGaAs avalanche photodiode (APD) optimized for operation at 1550nm. This APD is designed for use in optical transmission systems operating at a giga-bit-rate, above 2.4Gb/s, and for long transmission distances. The APD chip has a photosensitivity area diameter of 30μm. Fujitsu's advanced InGaAs/InP material technology realizes a high reliability planar structure device with wide bandwidth (large gain-bandwidth product) as well as low noise characteristics. A multi-mode fiber is aligned to a hermetically sealed APD through a lens. The optical coupling alignment system is highly stable.

InGaAs Avalanche Photodiode

FPD5W1K^{S}

ABSOLUTE MAXIMUM RATINGS (T_a=25°C)

Parameter	Symbol	Ratings	Unit
Storage Temperature	T_{stg}	-40 to +85	°C
Operating Case Temperature	T_{op}	-40 to +85	°C
Forward Current	I_F	10	mA
Reverse Current	I_R	1.0	mA

OPTICAL & ELECTRICAL CHARACTERISTICS (T_a=25°C)

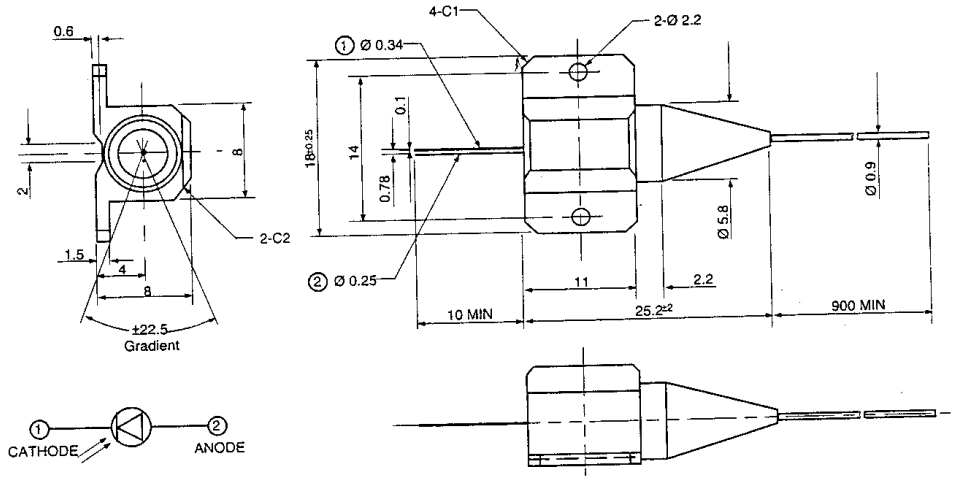
Parameter	Symbol	Limits Min.	Limits Max.	Unit	Conditions	
Responsivity	R	0.88	-	A/W	λ=1550nm	M=1
		0.73	-	A/W	λ=1300nm	
Temperature Dependence of Responsivity	-	-3	+3	%	Ta=-20 to +70°C	λ=1300nm, 1550nm
		-4	+4		Ta=-40 to +85°C	
Breakdown Voltage	VB	45	65	V	ID=10μA	
Temperature Coefficient of Breakdown Voltage	γ	0.09	0.15	V/degC	-	
Dark Current	I_{D1}	-	50	nA	Ta=25°C	V_R=0.9VB
	I_{D2}	-	0.8	μA	Ta=70°C	
	I_{D3}	-	1.7	μA	Ta=85°C	
Multiplied Dark Current	I_{DM1}	-	10	nA	Ta=25°C	M=1
	I_{DM2}	-	160	nA	Ta=70°C	
	I_{DM3}	-	340	nA	Ta=85°C	
Excess Noise Factor	F	-	6.3	-	λ=1300, 1550nm, M=10, f=30 MHz B=1 MHz, Ipo=2μA	
Cutoff Frequency	fc	2.5	-	GHz	M=5	λ=1300, 1550nm R_L=50Ω -3dB from 500KHZ
		2.5	-		M=10	
		1.5	-		M=20	
Capacitance	C_t	-	0.6	pF	f=1MHz, V_R=0.9V_B	
Maximum Multiplication Factor	M_{max}	30	-	-	λ=1300, 1550nm, Ipo=2μA	
Optical Return Loss	ORL	30	-	dB	λ=1300, 1550nm	

Note: Optical characteristics are specified on the condition that single mode fiber is used as the optical source for testing.

FUJITSU

LIGHTWAVE COMPO
MODULES

"KS" PACKAGE



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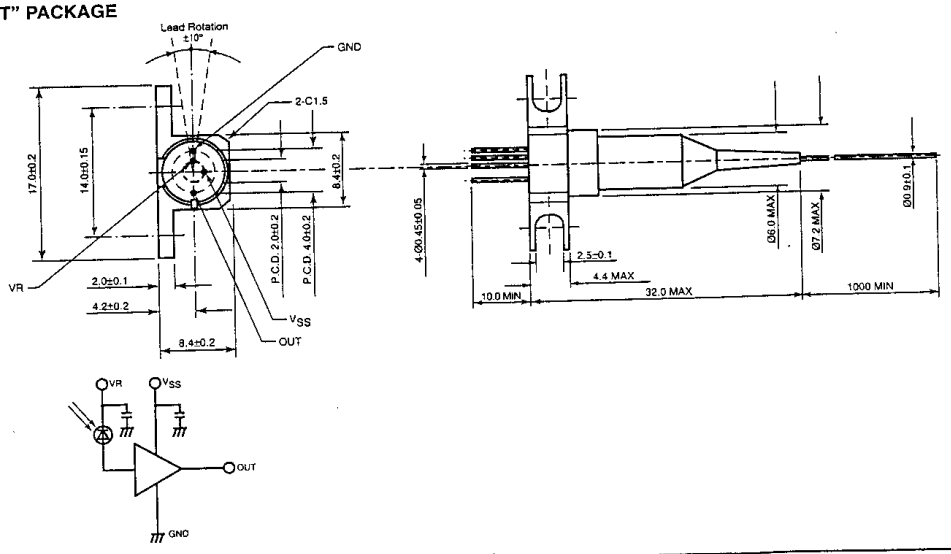


FUJITSU

ENEREPRESENTANT FOR NORGE
ODD TVEDT & CO A/S
Damsgårdsvei 59 - 5037 Bergen
Tlf.: 55 59 98 90 - Fax 55 59 98 99

(2/3)

FPD5W1KS-A

InGaAs Avalanche Photodiode

Preliminary Specification
Oct. 27, 1995
Standard

1. ABSOLUTE MAXIMUM RATINGS (Ta=25degC)

Parameter	Symbol	Ratings	Unit
Storage Temperature	Tstg	-40 to +85	degC
Operating Temperature	Top	-40 to +85	degC
Forward Current	IF	10	mA
Reverse Current	IR	1.0	mA

2. OPTICAL AND ELECTRICAL CHARACTERISTICS
(Ta=-40 to +85degC and Lambda=1.3/1.55um unless otherwise specified)

Parameter	Symbol	Test Conditions	Limits Min.	Typ.	Max.	Unit
Quantum Efficiency	n	M=1, 1550nm	70	75	-	%
		1300nm	70	75	-	%
Responsivity	R	M=1, 1550nm	0.88	0.78	-	A/W
		1300nm	0.73	0.78	-	A/W
Variation of Responsivity		M=1, Ta=-40 to +85degC	-	-	+/-4.0	%
		Ta=-20 to +70degC	-	-	+/-3.0	%
(reference to 25degC)						
Breakdown Voltage	VB	ID=10uA	45	60	75	V
Dark Current	ID	VR=0.9VB, Ta=25degC	-	-	50	nA
		Ta=70degC	-	-	0.8	uA
		Ta=85degC	-	-	1.7	uA
Multiplied Dark Current	IDM	M=1,Ta=25degC	-	1	10	nA
		Ta=70degC	-	-	160	nA
		Ta=85degC	-	-	340	nA
Temp.Coefficient of VB	gamma	note 2	0.09	-	0.15	V/degC
Excess Noise Factor	F(x)	M=10, f=30MHz	-	5	6.3	-
		B=1MHz,Ipo=2uA	-	0.7	0.8	-
Cutoff Frequency	fc	RL=50ohm, M=3	0.6	-	-	GHz
		M=10 -3dB from 500kHz	1.0	-	-	GHz
Capacitance	Ct	f=1MHz,VR=0.9VB	-	-	0.6	pF
Maximum Multiplication Factor	Mmax	Ipo=2uA	30	40	-	-
Optical return loss	ORL		30	-	-	dB

NOTE 1: Optical characteristics are specified on the condition that single mode fiber is used for optical source for testing.

NOTE 2: Gamma=(VB(T)-VB(25degC))/DeltaT

2 FLD3F6CX

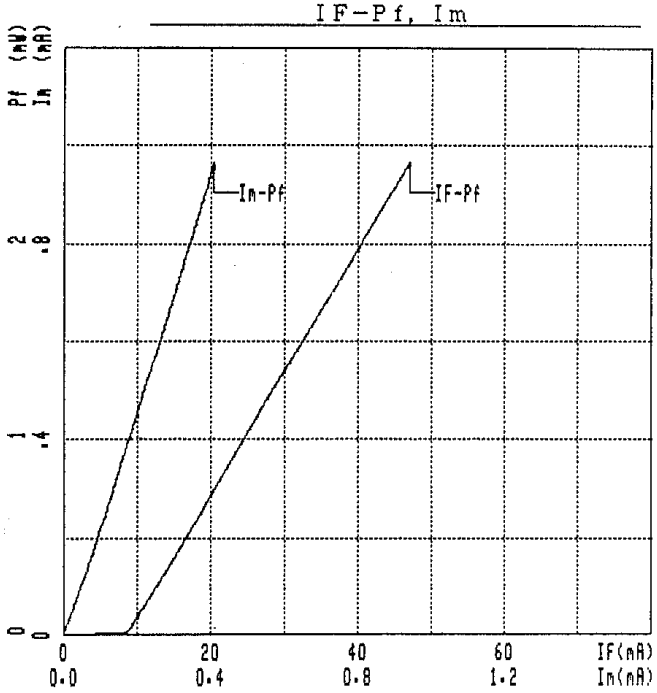
ENEREPRESENTANT FOR NORGE
ODD TVEDT & CO A/S
Damsgårdsvei 59 • 5037 Bergen
Tlf.: 55 59 98 90 • Fax 55 59 98 9

Sample No . ES-1028 FLD3F6CX Date ; 97/06/18

Tested by ;

Approved by ;

IF-Pf, Im

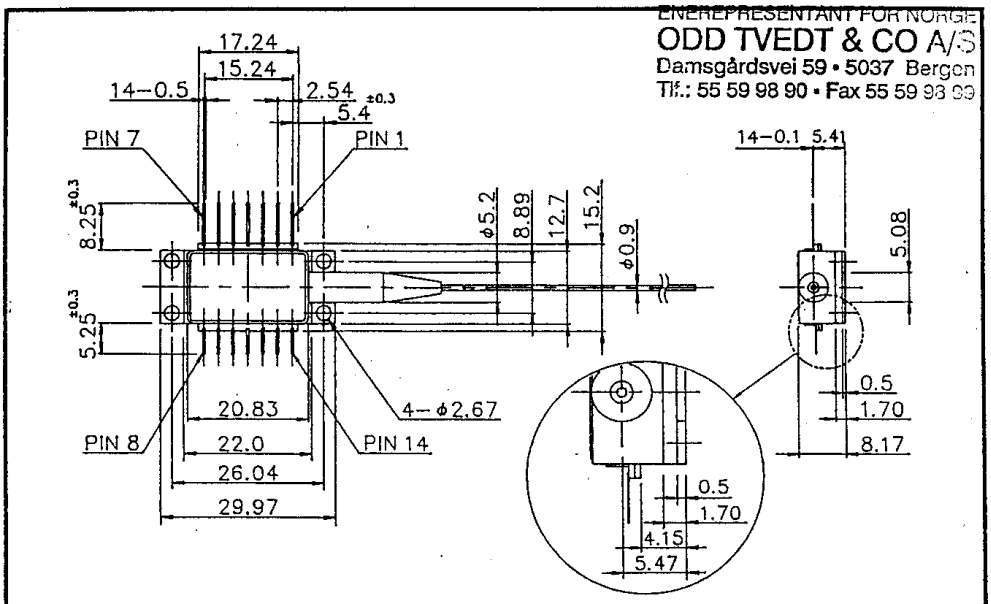


ITEM		CONDITIONS(25deg.C)	LIMIT	VALUE	UNIT
Threshold Current	Ith	CW	4~ 20	8.7	mA
Slope Efficiency	S	CW,Pf=2mW	0.05~0.083	0.063	W/A
Monitor Current	Im	CW,Pf=2mW	0.1~ 1.0	0.342	mA
Peak Wavelength	λp	Note.1	1290~ 1330	1309.3	nm
Thermistor Resistance	Rth	TLD=25 degC	9.5~ 10.5	10.3	KΩ

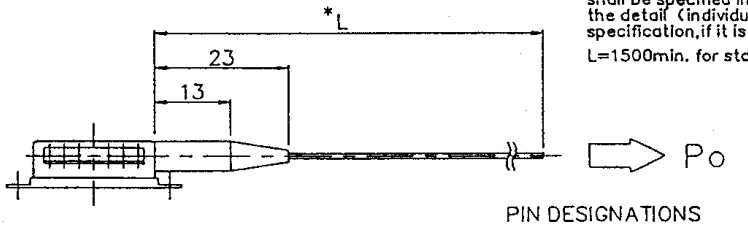
Note.1 Ipp=30mA,2.5Gb/s,NRZ,PRBS,Ib=0.8Ith

CAUTION ! Use of control or adjustment or performance of procedures other than those specified herein may result in hazardous radiation exposure.

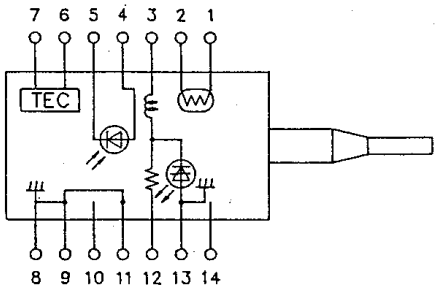
FUJITSU LIMITED



*Note) Pigtail length (L) shall be specified in the detail (individual) specification, if it is special.
L=1500min. for standard.



TOP VIEW



PIN DESIGNATIONS

1. TEMPERATURE MONITOR
2. TEMPERATURE MONITOR
3. LASER DC BIAS (−)
4. MONITOR (ANODE)
5. MONITOR (CATHODE)
6. TEHP (+)
7. TEHP (−)
8. GROUND
9. GROUND
10. N.C.
11. LASER GROUND
12. LASER MODULATION (−)
13. GROUND
14. N.C.

(Preliminary)

all dimensions in mm

Non−limited dimensions tolerance shall be as follows.				
Length Diameter	0.2 ~ 0.5	~ 30	~ 120	~ 300
	±0.1	±0.2	±0.3	±0.5
Chamfer Radius	0.2 ~ 0.4	~ 1.0	~ 5.0	~ 10.0
	±0.1	±0.2	±0.3	±0.5

EDIT.	DATE	DESIG	CHECK	DESCRIPTION
DESIG.	'93-09-27	K. Aoki	CHECK	K. Komiya
APPR.	T. Kanada			

TITLE: CX PKG WO/CON.
DRAW.NO.: FLD−DR027
CUST.:
FUJITSU LIMITED
SHEET 1/1

High Speed Receptacle Photodiodes

Technical Data

PDT0313-FC-A

Features

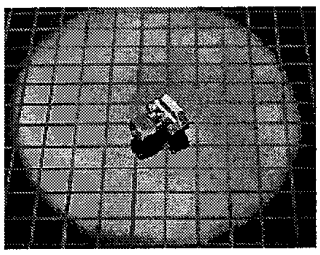
- **Industry Standard FC Connector**
- **Low Dark Current**
- **High Reliability Planar InGaAs PIN Photodiode**
- **High Responsivity**

Applications

- **Instrumentation**
- **O-E Convertors**
- **Single and Multimode Fiber Communications Systems**
- **Data Communications Receivers**

Description

The PDT0313-FC-A uses Hewlett-Packard's highly reliable top entry photodiode mounted in a high speed packaging environment to exploit the wide bandwidth performance of the PIN. The optical interface is by means of an FC connector housing. The electrical interface is through an SMA compatible connector. The receptacle includes a standard two hole panel mounting flange.



PDT0313-FC-A Specifications

Absolute Maximum Ratings

Absolute maximum limits mean that no catastrophic damage will occur if the product is subjected to these ratings for short periods, provided each limiting parameter is in isolation and all other parameters have values within the performance specification. It should not be assumed that limiting values of more than one parameter can be applied to the product at the same time.

Parameter	Minimum	Maximum	Units
Reverse Voltage	-	15	V
Forward Voltage	-	0.5	V
Forward Current	-	5	mA
Optical Power	-	5	mW
Operating Temperature	-20	65	°C

The following are measured with a bias of +5 volt to the center conductor of the electrical connector with 9/125 μm single mode fiber, and at 25°C, unless otherwise specified.

Optical Specification

Parameter	Minimum	Maximum	Units
Responsivity @ 1300 nm	0.75	-	A/W
Responsivity @ 1550 nm	0.8	-	A/W
Operating Wavelength	1100	1650	nm
Optical Return Loss	22	-	dB

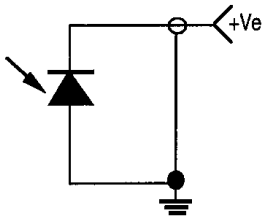
Electrical Specification

Parameter	Minimum	Maximum	Units
Bandwidth (-3 dB, 50 Ω) referred to 130 MHz	6	10	GHz
Ripple	-	±1.5	dB
Dark Current	-	2	nA

Patch Cord

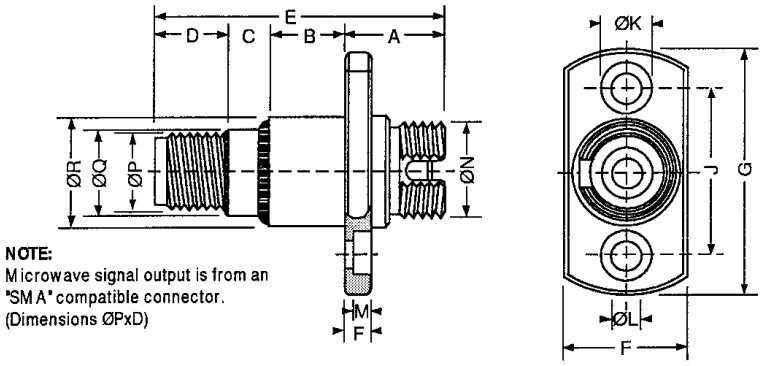
The product is supplied with a single mode patch cord, with one end coated to give >22 dB optical return loss.

PDT0313



Schematics

Product Code	Product Marking	Part Number
PDT0313	PDT0313	105082.002



NOTE:
Microwave signal output is from an "SMA" compatible connector. (Dimensions ØPxD)

Dim	Min	Max	Dim	Min	Max
A	7.72	8.28	J	13.25	13.65
B	6.20	6.50	ØK	3.74	4.26
C	2.85	6.20	ØL	1.98	2.42
D	5.80	6.20	M	1.28	1.72
E	23.50 NOM		ØN	M8 x 0.75	
F	1.78	2.22	ØP	1/4-36 UNS-2A	
G	18.65	19.35	ØQ	6.85	7.10
H	8.92	9.48	ØR	8.80	9.10

All dimensions in mm

4 AFS4-00101800-43-10P-4

MITEQ
100 Davids Drive, Hauppauge, N.Y. 11788-2034
TEL: (516) 436-7400
TELEX: 6716148
FAX: 516-436-7430

PROJECT No:	P34129
MODEL No:	AFS4-00101800-43-10P-4
SERIAL No:	203897
CUSTOMER:	EUROCOM
P.O. No:	0-9009/91

IMPORTANT - MUST USE HEAT SINK IF CASE TEMPERATURE EXCEEDS 70°C

SPECIFICATIONS AT 23° C:

FREQUENCY:	.1 to 18.0 GHz	OUTPUT POWER @ 1dB GAIN COMPRESSION:	+10 dBm
MIN. GAIN:	18 dB	VOLTAGE:	+15 VOLTS
MAX.GAIN FLATNESS:	+/- 2 dB	MEASURED CURRENT:	111 mA
MAX. VSWR INPUT:	:1	MAX. NOISE FIGURE:	4.3 dB
MAX. VSWR OUTPUT:	2.5 :1	HOUSING No:	115327

NOTE: TEST DATA TAKEN WITH CASE TEMP. OF 23°C

FREQUENCY (GHz)	GAIN (dB)	VSWR IN	VSWR OUT	NOISE FIGURE (dB)	OUTPUT POWER (dBm) (@ 1dB GAIN COMPRESSION)
.1	22.55	1.81	1.44	4.69	+10.5
.5	23.35	1.75	1.44	3.85	+11
1.0	23.23	1.79	1.43	3.94	+11
2.0	23.40	1.89	1.41	3.88	+11.5
3.0	24.73	1.83	1.40	3.69	+11.5
4.0	25.45	1.81	1.40	3.70	+12
5.0	26.01	1.94	1.40	3.71	+13
6.0	25.80	2.10	1.41	3.72	+13
7.0	24.90	2.17	1.45	3.77	+14
8.0	23.80	2.11	1.51	3.77	+15
9.0	22.95	2.01	1.58	3.75	+14.5
10.0	22.99	2.00	1.66	3.80	+15
11.0	23.69	2.05	1.76	3.62	+15.5
12.0	24.12	2.03	1.91	3.79	+15
13.0	24.47	1.77	2.03	3.68	+15
14.0	24.65	1.51	2.03	3.55	+14.5
15.0	23.97	1.33	1.88	3.69	+14.5
16.0	23.15	1.32	1.71	3.77	+13.5

TESTED BY: Ronald Oman (RONALD OMAN) DATE: 02/22/91

COPY

ANALOG DEVICES

1 GHz, 5,500 V/µs Low Distortion Amplifier

AD8009

FEATURES

Ultrahigh Speed
- 5,500 V/µs Slew Rate, 4 V Step, G = +2
- 545 ps Rise Time, 2 V Step, G = +2
- Large Signal Bandwidth
  - 440 MHz, G = +2
  - 320 MHz, G = +10
- Small Signal Bandwidth (–3 dB)
  - 1 GHz, G = +1
  - 700 MHz, G = +2
- Settling Time 10 ns to 0.1%, 2 V Step, G = +2

Low Distortion Over Wide Bandwidth
- SFDR
  - –44 dBc @ 150 MHz, G = +2, V_O = 2 V p-p
  - –41 dBc @ 150 MHz, G = +10, V_O = 2 V p-p
- 3rd Order Intercept (3IP)
  - 26 dBm @ 70 MHz, G = +10
  - 18 dBm @ 150 MHz, G = +10

Good Video Specifications
- Gain Flatness 0.1 dB to 75 MHz
- 0.01% Differential Gain Error, R_L = 150 Ω
- 0.01° Differential Phase Error, R_L = 150 Ω

High Output Drive
- 175 mA Output Load Drive
- 10 dBm with –38 dBc SFDR @ 70 MHz, G = +10

Supply Operation
- ±5 V Voltage Supply
- 14 mA (typ) Supply Current

APPLICATIONS

Pulse Amplifier
IF/RF Gain Stage/Amplifiers
High Resolution Video Graphics
High Speed Instrumentations
CCD Imaging Amplifier

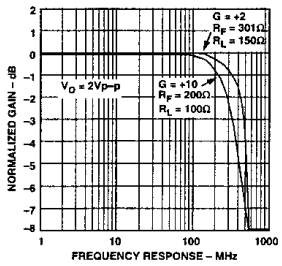
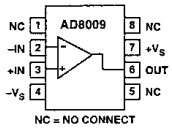


Figure 1. Large Signal Frequency Response; G = +2 & +10

FUNCTIONAL BLOCK DIAGRAM

8-Pin Plastic SOIC (SO-8)



PRODUCT DESCRIPTION

The AD8009 is an ultrahigh speed current feedback amplifier with a phenomenal 5,500 V/µs slew rate that results in a rise time of 545 ps, making it ideal as a pulse amplifier.

The high slew rate reduces the effect of slew rate limiting and results in the large signal bandwidth of 440 MHz required for high resolution video graphic systems. Signal quality is maintained over a wide bandwidth with worst case distortion of –40 dBc @ 250 MHz (G = +10, 1 V p-p). For applications with multitone signals such as IF signal chains, the third order Intercept (3IP) of 12 dBm is achieved at the same frequency. This distortion performance coupled with the current feedback architecture make the AD8009 a flexible component for a gain stage amplifier in IF/RF signal chains.

The AD8009 is capable of delivering over 175 mA of load current and will drive four back terminated video loads while maintaining low differential gain and phase error of 0.02% & 0.04° respectively. The high drive capability is also reflected in the ability to deliver 10 dBm of output power @ 70 MHz with –38 dBc SFDR.

The AD8009 is available in a small SOIC package and will operate over the industrial temperature range –40°C to +85°C.

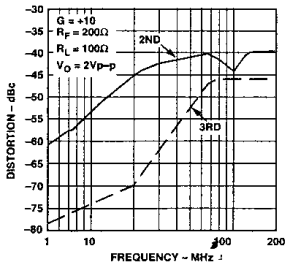


Figure 2. Distortion vs. Frequency; G = +10

REV. 0

One Technology Way, P.O. Box 9106, Norwood, MA 02062-9106, U.S.A.
Tel: 617/329-4700 World Wide Web Site: http://www.analog.com
Fax: 617/326-8703

AD8009–SPECIFICATIONS

(@ T_A = +25°C, V_S = ±5 V, R_L = 100 Ω, R_F = 301 Ω for G = +1 and G = +2 or R_F = 200 Ω for G = +10 unless otherwise noted.)

Model	Conditions	AD8009AR Min	Typ	Max	Units
DYNAMIC PERFORMANCE					
–3 dB Small Signal Bandwidth	G = +1		1000		MHz
V_O = 0.2 V p-p	G = +2	480	700		MHz
	G = +10	300	350		MHz
Large Signal Bandwidth V_O = 2 V p-p	G = +2	390	440		MHz
	G = +10	235	320		MHz
Gain Flatness 0.1 dB V_O = 0.2 V p-p	G = +2, R_L = 150 Ω	45	75		MHz
Slew Rate	G = +2, R_L = 150 Ω, 4 V Step	4500	5500		V/µs
Settling Time to 0.1%	G = +2, R_L = 150 Ω, 2 V Step		10		ns
	G = +10, 2 V Step		25		ns
Rise & Fall Time	G = +2, R_L = 150 Ω, 4 V Step		0.725		ns
HARMONIC/NOISE PERFORMANCE					
SFDR G = +2, V_O = 2 V p-p	5 MHz		–74		dBc
	70 MHz		–53		dBc
	150 MHz		–44		dBc
G = +10, V_O = 2 V p-p	5 MHz		–58		dBc
	70 MHz		–41		dBc
	150 MHz		–41		dBc
Third Order Intercept (3IP)	70 MHz		26		dBm
W.R.T. Output, G = +10	150 MHz		18		dBm
	250 MHz		12		dBm
Input Voltage Noise	f = 10 MHz		1.9		nV/√Hz
Input Current Noise	f = 10 MHz, +In		46		pA/√Hz
	–In		41		pA/√Hz
Differential Gain Error	NTSC, G = +2, R_L = 150 Ω		0.01	0.03	%
	R_L = 37.5 Ω		0.02	0.05	%
Differential Phase Error	NTSC, G = +2, R_L = 150 Ω		0.01	0.03	Degrees
	R_L = 37.5 Ω		0.04	0.08	Degrees
DC PERFORMANCE					
Input Offset Voltage			2	5	mV
	T_{MIN}–T_{MAX}			7	mV
Offset Voltage Drift			4		µV/°C
–Input Bias Current			50	150	±µA
	T_{MIN}–T_{MAX}		75		±µA
+Input Bias Voltage			50	150	±µA
	T_{MIN}–T_{MAX}		75		±µA
Open Loop Transresistance		90	250		kΩ
	T_{MIN}–T_{MAX}		170		kΩ
INPUT CHARACTERISTICS					
Input Resistance	+Input		110		kΩ
	–Input		8		Ω
Input Capacitance	+Input		2.6		pF
Input Common-Mode Voltage Range			3.8		±V
Common-Mode Rejection Ratio	V_{CM} = ±2.5	50	52		dB
OUTPUT CHARACTERISTICS					
Output Voltage Swing		±3.7	±3.8		V
Output Current	R_L = 10 Ω, P_D Package = 0.7 W	150	175		mA
Short Circuit Current			330		mA
POWER SUPPLY					
Operating Range		±4 V		±6	V
Quiescent Current			14	16	mA
	T_{MIN}–T_{MAX}			18	mA
Power Supply Rejection Ratio	V_S = ±4 V to ±6 V	64	70		dB

Specifications subject to change without notice.

ABSOLUTE MAXIMUM RATINGS[1]

Supply Voltage ..... 12.6 V
Internal Power Dissipation[2]
Small Outline Package (R) ..... 0.75 Watts
Input Voltage (Common Mode) ..... $\pm V_S$
Differential Input Voltage ..... ±3.5 V
Output Short Circuit Duration
..... Observe Power Derating Curves
Storage Temperature Range R Package .... –65°C to +125°C
Operating Temperature Range (A Grade) ... –40°C to +85°C
Lead Temperature Range (Soldering 10 sec) ..... +300°C

NOTES
[1]Stresses above those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. This is a stress rating only, and functional operation of the device at these or any other conditions above those indicated in the operational section of this specification is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.
[2]Specification is for device in free air:
8-Pin SOIC Package: θ_{JA} = 160°C/Watt.

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option
AD8009AR	–40 to +85°C	8-Pin SOIC	SO-8
AD8009AR-REEL	REEL-SOIC		
AD8009-EB		Evaluation Board	

MAXIMUM POWER DISSIPATION

The maximum power that can be safely dissipated by the AD8009 is limited by the associated rise in junction temperature. The maximum safe junction temperature for plastic encapsulated devices is determined by the glass transition temperature of the plastic, approximately +150°C. Exceeding this limit temporarily may cause a shift in parametric performance due to a change in the stresses exerted on the die by the package. Exceeding a junction temperature of +175°C for an extended period can result in device failure.

While the AD8009 is internally short circuit protected, this may not be sufficient to guarantee that the maximum junction temperature (+150°C) is not exceeded under all conditions. To ensure proper operation, it is necessary to observe the maximum power derating curves.

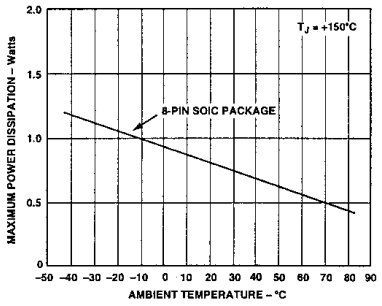


Figure 3. Plot of Maximum Power Dissipation vs. Temperature

CAUTION

ESD (electrostatic discharge) sensitive device. Electrostatic charges as high as 4000 V readily accumulate on the human body and test equipment and can discharge without detection. Although the AD8009 features proprietary ESD protection circuitry, permanent damage may occur on devices subjected to high energy electrostatic discharges. Therefore, proper ESD precautions are recommended to avoid performance degradation or loss of functionality.

6 MSA 0485

7 HP 5082-0840

Appendix B Preliminary experiment

1 Bias

VE=1,0
V
Gate=1s
Samplesize=10

Bias	Count1	σ	Count2	σ
22,5	562	24	567	46
22,7	592	31	605	39
22,9	551	44	543	34
23,1	566	29	587	28
23,3	590	25	579	22
23,5	571	43	587	21
23,7	605	28	611	28
23,9	591	27	600	38
24	574	31	602	16
24,1	758	25	761	37
24,2	844	34	872	48
24,3	841	44	812	25
24,4	1715	50	1733	50
24,5	21617	321	22717	209
24,6	81188	191	81018	205

VE=1,5
V
Gate=1s
Samplesize=10

Bias	Count1	σ	Count2	σ
22,5	9233	370	9051	467
22,7	8448	244	8306	417
22,9	7032	271	6856	178
23,1	6127	231	6206	215
23,3	5448	186	5612	191
23,5	6082	356	6265	259
23,7	5793	278	5724	132
23,9	6586	258	6436	215
24	6175	268	6146	301
24,1	9227	331	9256	394
24,2	5961	168	5978	215
24,3	5746	274	5672	178
24,4	7605	229	7492	192
24,5	37688	426	38568	304
24,6	97330	86	97167	102

VE=2,0

V
Gate=1s
Samplesize=10

Bias	Count1	σ	Count2	σ	
22,5	53872	1630	53523	1570	
22,7	51026	1410	57127	1070	
22,9	47448	1050	47618	1670	
23,1	44589	1460	46056	1080	
23,3	41206	1760	41734	890	
23,5	36058	800	36869	869	
23,7	33849	1120	33844	781	
23,9	30357	988	31179	1130	
24	29845	699	29876	1270	
24,1	29413	1010	29559	762	
24,2	29551	1200	29168	853	
24,3	28948	745	28413	903	
24,4	53750	683	53977	1310	
24,5	109756	259	110294	139	
24,6					

2 Rep.rate

VE=1,5
V
VR=23,7
tg=10n
Gate=0.
1s
Samplesize=500

kHz	Count1	σ	Count2	σ
100	183	28	185	26
200	613	83	625	86
300	19096	807	19395	140
				0
500	40195	738	40798	740

VE=1,5
V
VR=23,7
tg=20n
Gate=0.
1s
Samplesize=500

kHz	Count1	σ	Count2	σ
100	1123	126	1125	125
200	17677	349	17602	340
300	30633	96	30558	95
500	53320	61	53313	109

3 Gate width

VE=1,0
V
VR=23,7
frep=100kHz
Gate=0.
1s
Samplesize=500

ns	Count1	σ	Count2	σ
5	48	7	47	7
10	100	13	99	12
15	181	21	176	20
20	247	27	246	28
25	432	76	471	46
30	734	82	738	70
35	1187	167	1223	106
50	4723	252	4676	241

VE=1,0
V
VR=23,7
frep=200kHz
Gate=0.
1s
Samplesize=500

ns	Count1	σ	Count2	σ
5	111	13	110	14
10	394	40	355	37
15	708	60	686	60
20	2071	170	1982	165
25	5360	347	5290	306
30	9966	370	10322	466
35	14460	276	14353	289
50	18997	45	18977	45

Appendix C Experiment

1 Dark and photo counts

VB= 24,1
temp= -198
VE= 1

VR= 23,6
Average number of photons per pulse

Rep.rate	0	σ	0,05	σ	0,1	σ
50	46	10	378	20	785	25
100	92	7	775	29	1526	49
200	199	11	1808	45	3726	47
300	307	17	3329	107	6541	108
500	605	28	6000	104	12000	107
800	1311	51	12978	196	27189	326

VB= 24,1
temp= -198
VE= 2

VR= 23,6
Average number of photons per pulse

0	σ	0,05	σ	0,1	σ
138	7	880	26	1757	36
303	14	2032	55	3987	85
744	24	5450	84	10892	157
1516	57	11030	308	20938	193
6064	344	40465	640	67834	627
14793	3150	240456	1420	27948	1120
2				9	

VR= 23,8
Average number of photons per pulse

Rep.rate	0	σ	0,05	σ	0,1	σ
50	41	7	428	16	938	23
100	85	9	911	17	1967	33
200	188	17	2072	51	4364	77
300	296	19	3352	81	6916	112
500	549	27	5454	132	11909	163
800	1244	59	14569	191	29449	406

VR= 23,8
Average number of photons per pulse

0	σ	0,05	σ	0,1	σ
151	11	887	25	1728	27
323	6	2016	62	4041	36
881	35	5432	62	10789	142
1864	78	12341	244	22556	325
10318	467	53069	563	85562	1300
25271	2690	311930	1690	34021	801
9				5	

VR= 24
Average number of photons per pulse

Rep.rate	0	σ	0,05	σ	0,1	σ
50	52	4	478	15	999	38
100	103	11	1101	38	2152	72
200	239	19	2330	76	4894	60
300	392	41	3566	53	7445	121
500	786	47	7691	230	16474	203
800	2062	126	18837	302	36106	382

VR= 24
Average number of photons per pulse

0	σ	0,05	σ	0,1	σ
228	16	1047	24	2059	56
529	22	2647	65	5161	77
1863	158	9527	198	17848	270
6459	226	30040	527	49991	396
13619	268	188418	138	20933	992
1				1	
55334	906	545302	508	55591	783
7				6	

VB= 24,7
temp= -188
VE= 1

VR= 24

Average number of photons per pulse

Rep.rate	0	σ	0,05	σ	0,1	σ
50	71	4	483	13	969	37
100	146	8	1062	35	2188	50
200	335	19	2468	61	5004	89
300	544	34	4044	52	8062	146
500	1109	49	8609	154	17197	174
800	2939	178	22356	345	43502	542

VB= 24,7
temp= -188
VE= 2

VR= 24

Average number of photons per pulse

0	σ	0,05	σ	0,1	σ
169	13	894	30	1694	33
382	30	2046	47	3961	68
1010	48	5645	75	11076	221
2242	86	12737	162	23685	275
11962	381	59941	515	92912	1070
29791	931	361847	1770	39123	1440
5				7	

VE= 24,2

Average number of photons per pulse

Rep.rate	0	σ	0,05	σ	0,1	σ
50	61	8	431	25	872	31
100	114	16	909	31	1892	61
200	266	19	2064	53	4199	47
300	428	27	3303	60	6899	69
500	848	32	6994	135	14574	224
800	2088	64	15672	227	29686	336

VR= 24,2

Average number of photons per pulse

0	σ	0,05	σ	0,1	σ
194	14	878	27	1662	25
438	22	2090	58	4073	68
1241	64	6549	161	11826	172
2636	121	13223	197	25368	357
20343	890	76680	908	10883	1460
				0	
34830	1830	393780	1540	41543	896
8				0	

VR= 24,6

Average number of photons per pulse

Rep.rate	0	σ	0,05	σ	0,1	σ
50	78	6	499	26	970	32
100	153	10	1044	25	2156	41
200	336	27	2455	58	5123	75
300	529	25	4416	71	9280	160
500	1249	66	9443	166	19266	139
800	3949	189	26679	427	49260	933

VR= 24,6

Average number of photons per pulse

0	σ	0,05	σ	0,1	σ
276	16	1032	37	1995	52
686	39	2888	81	4987	96
2434	75	11025	203	18909	252
8604	299	29747	879	49648	635
14145	2730	173619	2180	21410	1790
1				4	
54750	639	556429	1000	56534	860
5				3	

2 Histograms

The number of the plot is refered at the handwritten text in the corner of every histogram.

plot1	VE=2	frep=50k	VR=23,6
plot2	VE=2	frep=300k	VR=23,6
plot3	VE=2	frep=800k	VR=23,6
plot4	VE=1	frep=200k	VR=23,6
plot5	VE=2	frep=800k	VR=23,8
plot6	VE=2	frep=50k	VR=24,0
plot7	VE=1	frep=100k	VR=24,0
plot8	VE=1	frep=800k	VR=24,2
plot9	VE=2	frep=100k	VR=24,4
plot10	VE=2	frep=500k	VR=24,4
plot11	VE=1	frep=800k	VR=24,4
plot12	VE=2	frep=500k	VR=24,6
plot13	VE=1	frep=200k	VR=24,6
plot14	VE=1	frep=500k	VR=24,6
plot15	VE=1	frep=800k	VR=24,6