J16A Ge Avalanche Photodiodes (APDs) (0.8 to 1.5 µm)

Judson technologies

Description

The J16A series Germanium Avalanche Photodiodes are designed for high-speed applications at 800 and 1300 nm. Judson APDs offer low dark currents and bandwidths up to 1.5 GHz with active sizes of 100 µm and 300 µm diameter.

The J16A Series APDs have undergone extensive reliability testing. Reliability has been demonstrated to be better than 10 FITs corresponding to less than 1% failure rate over 20 years service. Reliability data available upon request.

Applications

- Local Area Networks
- OTDRs
- Transmission Systems

Multiplication Characteristics

An internal gain mechanism makes the J16A the solid state counterpart of the photomultiplier tube. This internal gain is known as the Multiplication Factor (M) and is a function of the reverse bias voltage V_R applied to the diode (Fig. 10-1).

Breakdown Voltage and Dark Current

The avalanche breakdown voltage V_B is the reverse bias voltage at which the diode's dark current becomes infinite. In practice, the dark current used to define breakdown voltage is 100 µA (Fig. 10-3).

Cutoff Frequency

The cutoff frequency f_c is the frequency at which the output signal power is down by 3dB. In the high multiplication region, the product of M and bandwidth becomes a constant, called the gain-bandwidth product, and cutoff frequency decreases with increasing M (Fig. 10-4).

Figure 10-2
J16A-18A Package

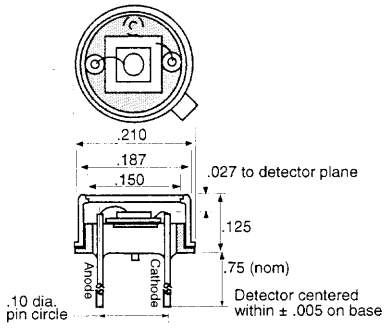


Figure 10-1
Multiplication Characteristics

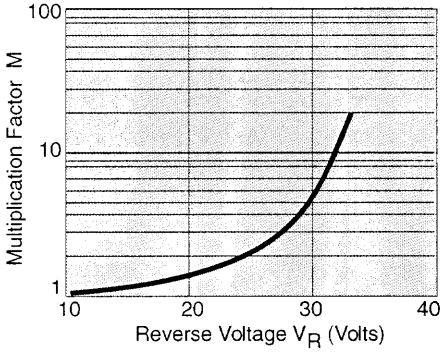


Figure 10-3
Dark Current and Reverse Voltage

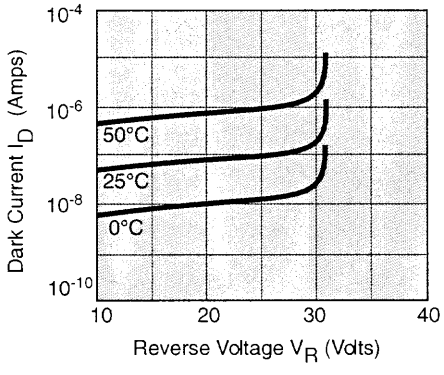
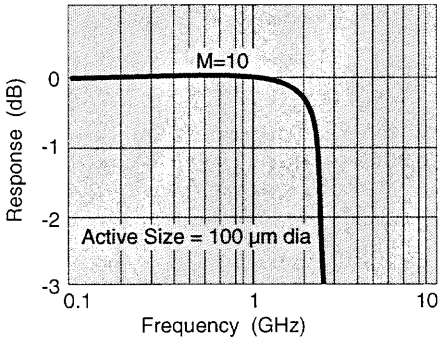


Figure 10-4
Frequency Response



Parameter		Test Conditions	J16A-18A-R100U Active Size 100µm dia.			J16A-18A-R300U Active Size 300µm dia.			Units
			Min.	Typ.	Max.	Min.	Typ.	Max.	
Quantum Efficiency	η	λ = 1300nm	60	70	--	60	70	--	%
Responsivity	R	M = 1	0.63	0.73	--	0.63	0.73	--	A/W
Breakdown Voltage	V_B	I_D = 100µA	20	25	40	20	25	40	V
Temp Coefficient of V_B	γ		0.1	--	--	0.1	--		%/°C
Dark Current	I_D	V_R = 0.9 V_B	--	0.3	0.5	--	1.4	3	µA
Multiplied Dark Current	I_{DM}	M = 1	--	100	150	--	300	400	nA
Cutoff Frequency (-3dB)	f_c	λ = 1300nm, M = 10, RL = 50Ω	1000	1500	--	300	500	--	MHz
Excess Noise Factor	F	λ = 300nm, f = 30MHz	--	9	--	--	9	--	--
Excess Noise Figure	x	BW = 1MHz, M = 10, I_{ph} = 2µA	--	0.95	--	--	0.95	--	--
Capacitance	C	f = 1MHz, M = 10	--	1.5	2	--	8	10	pF
Forward Current	I_f	Maximum Rating			100			100	mA
Reverse Current	I_R	Maximum Rating			1			3	mA

J16A Germanium APDs (30µm and 50µm)

Judson technologies

Description

The J16A-FC1-R30U and J16-FC1-R50U are Germanium Avalanche Photodiodes (APDs) with singlemode fiber pigtails designed for use in optical transmission systems operating at high-bit-rates and over long distances. The J16A-CO3-R30U and J16A-CO3-R50U packages are small alumina chip cariers designed for low parasitic capacitance and ease of installation onto a hybrid circuit. The 30µm and 50µm photosensitive diameters are optimized to achieve both higher coupling efficiency with singlemode fiber and higher electrical performances (low dark current, low capacitance and wide bandwidth) at the same time. The APD chip uses planar, fully implanted structure yielding low dark current and high reliability. A laser welding assembly process assures long term stability of fiber coupling and a -40°C to +85°C operating temperature range.

Features

- Meets extended environmental conditions
- JT package with 125µm cladding / 9µm core singlemode fiber coupled to 30µm and 50µm diameter Ge APD
- Storage and operating temperature: -40°C to +85°C
- High quantum efficiency: 80% @ 1300nm
- Cutoff frequency: 4.0 GHz
- Low dark currents: 100nA
- Low multiplied dark current: 5nA

Applications

- High-bit-rate optical transmission systems
- Optical Time Diode Reflectometer (OTDR)

Absolute Maximum Ratings (Tc = 25C)

Parameter	Symbol	Ratings		Ratings		Unit
		J16A-CO3-R30U	J16A-FC1-R30U	J16A-CO3-R50U	J16A-FC1-R50U	
Storage Temperature	Tstg	-40°C to +85°C		-40°C to +85°C		C
Operating Case Temperature	Top	-40°C to +85°C		-40°C to +85°C		C
Forward Current	If	20		50		mA
Reverse Current	Ir	500		500		µA

J16A Germanium APDs (30µm and 50µm)

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30 Micron Optical and Electrical Characteristics (Tc = 25C)

Parameter	Symbol	Test Conditions	J16A-C03-R30U			J16A-FC1-R30U			Units
			Min.	Typ.	Max.	Min.	Typ.	Max.	
Quantum Efficiency/(Responsivity)	η / (ℜ)	M = 1 1060nm	70/(0.60)	80/(0.68)	---	70/(0.60)	75/(0.68)	---	%/(A/W)
		M = 1 1300nm	70/(0.73)	85/(0.88)	---	70/(0.73)	80/(0.83)	---	
		M = 1 1550nm	50/(0.62)	60/(0.74)	---	50/(0.62)	60/(0.74)	---	
Breakdown Voltage	Vb	Id = 100µm	25	30	40	25	30	40	V
Temperature Coefficient	γ		---	0.1	---	---	0.1	---	%/C
Dark Current	Id	Vr = 0.9Vb	---	100	200	---	1000	200	nA
		Vr = 10V	---	30	100	---	30	100	nA
Unmultiplied Dark Current	Ipo	M = 1	---	5	10	---	5	10	nA
Cutoff Frequency	fc	M=10 1300nm Ipo=0.1µA	3000	4000	---	3000	4000	---	MHz
Excess Noise Factor	F	f = 1KHz	---	7	---	---	7	---	---
	x	M=10 1300nm Ipo=0.1µA	---	0.85	---	---	0.85	---	---
Capacitance	C	Vr = 20V f = 1MHz	---	0.6	---	---	1.0	---	pF

50 Micron Optical and Electrical Characteristics (Tc = 25C)

Parameter	Symbol	Test Conditions	J16A-C03-R50U			J16A-FC1-R50U			Units
			Min.	Typ.	Max.	Min.	Typ.	Max.	
Quantum Efficiency/(Responsivity)	η / (ℜ)	M = 1 1060nm	70/(0.60)	80/(0.68)	---	70/(0.60)	75/(0.68)	---	%/(A/W)
		M = 1 1300nm	70/(0.73)	85/(0.88)	---	70/(0.73)	80/(0.83)	---	
		M = 1 1550nm	50/(0.62)	60/(0.74)	---	50/(0.62)	60/(0.74)	---	
Breakdown Voltage	Vb	Id = 100µm	25	30	40	25	30	40	V
Temperature Coefficient	γ		---	0.1	---	---	0.1	---	%/C
Dark Current	Id	Vr = 0.9Vb	---	150	300	---	150	300	nA
		Vr = 10V	---	40	100	---	40	100	nA
Unmultiplied Dark Current	Ipo	M = 1	---	10	20	---	10	20	nA
Cutoff Frequency	fc	M=10 1300nm Ipo=0.1µA	2000	3000	---	2000	3000	---	MHz
Excess Noise Factor	F	f = 1KHz	---	7	---	---	7	---	---
	x	M=10 1300nm Ipo=0.1µA	---	0.85	---	---	0.85	---	---
Capacitance	C	Vr = 20V f = 1MHz	---	1.0	---	---	1.2	---	pF