

**$\phi 50 \mu\text{m}$ InGaAs APD COAXIAL MODULE
FOR 622 Mb/s, 156 Mb/s FIBEROPTIC COMMUNICATIONS**

DESCRIPTION

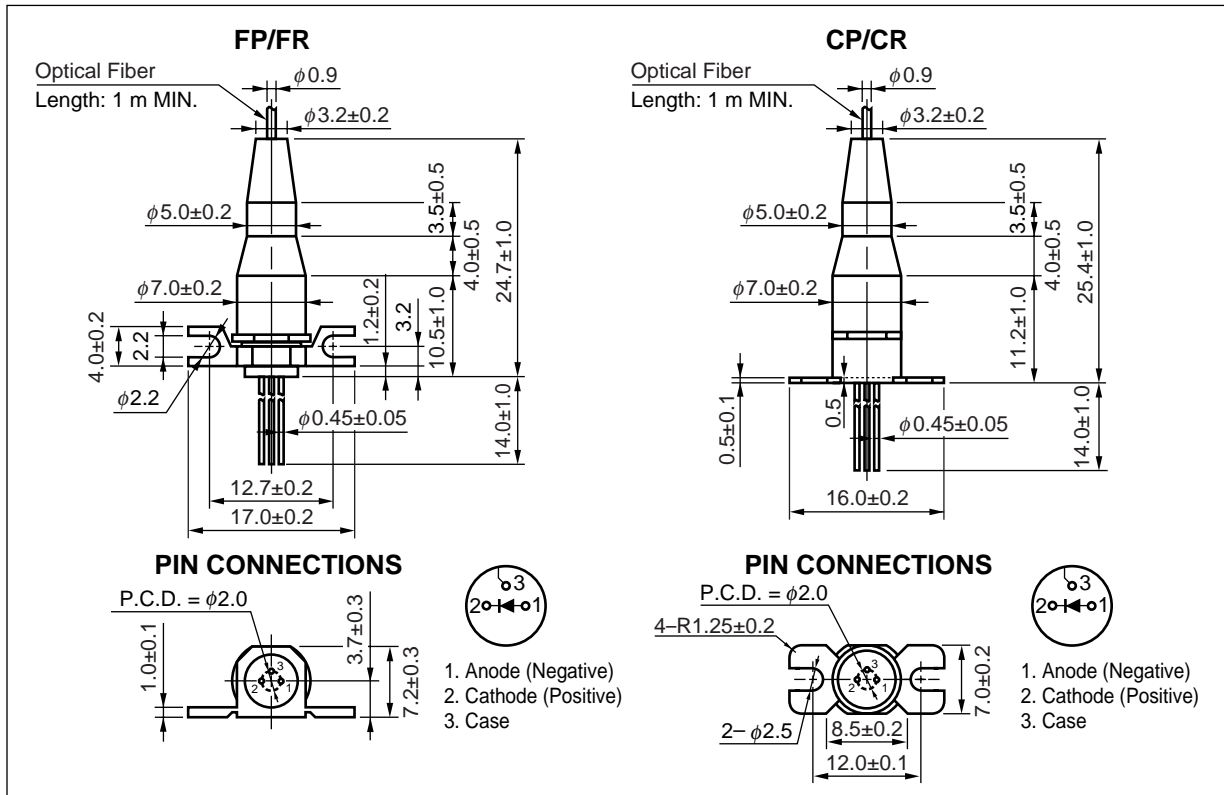
The NR8500 Series is an InGaAs avalanche photo diode (APD) coaxial module with optical fiber pigtail. This module is designed for long wavelength optical communication systems and ideal as a receiver for Synchronous Digital Hierarchy (SDH) system, STM-4 and STM-1, ITU-T recommendations.

FEATURES

- Small dark current $I_D = 7 \text{ nA}$
- High sensitivity $S = 0.94 \text{ A/W @ } \lambda = 1310 \text{ nm, } M = 1$
 $S = 0.96 \text{ A/W @ } \lambda = 1550 \text{ nm, } M = 1$
- High speed response $f_c = 1.5 \text{ GHz @ } M = 10$
- Coaxial module with SMF or GI-50 fiber
- With SC connector : standard, FC connector : option
(Refer to **ORDERING INFORMATION**)

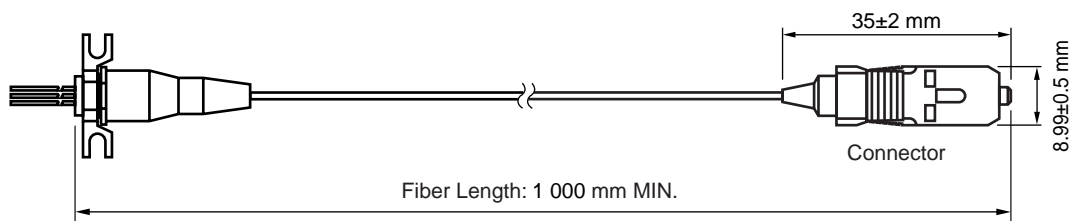
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 Not all devices/types available in every country. Please check with local NEC Compound Semiconductor Devices representative for availability and additional information.

★ PACKAGE DIMENSIONS (UNIT: mm)



OPTICAL FIBER CHARACTERISTICS

Parameter	Specification		Unit
	SMF	GI-50 Fiber	
Mode Field Diameter	9.5±1	—	μm
Core Diameter	—	50±3	μm
Cladding Diameter	125±2	125±2	μm
Maximum Cladding Noncircularity	2	2	%
Maximum Core/Cladding Concentricity	1.6	4.0	%
Outer Diameter	0.9±0.1	0.9±0.1	mm
Cut-off Wavelength	1 100 to 1 270	—	nm
Minimum Fiber Bending Radius	30	30	mm
Fiber Length	1 000 MIN.	1 000 MIN.	mm
Flammability	UL1581 VW-1		



ORDERING INFORMATION

Part Number	Flange Type	Fiber Type	Available Connector ^{*1}
★ NR8500FP-BC	Flat Mount Flange	SMF	With FC-UPC Connector
★ NR8500FP-CC			With SC-UPC Connector
★ NR8500FR-BB		GI-50 Fiber	With FC-SPC Connector
★ NR8500FR-CB			With SC-SPC Connector
NR8500CP-BC	Vertical Mount Flange	SMF	With FC-UPC Connector
NR8500CP-CC			With SC-UPC Connector
NR8500CR-BB		GI-50 Fiber	With FC-SPC Connector
NR8500CR-CB			With SC-SPC Connector

*1 SC Connector : standard
 FC Connector : option

ABSOLUTE MAXIMUM RATINGS

Parameter	Symbol	Ratings	Unit
Forward Current	I _F	10	mA
Reverse Current	I _R	1.0	mA
Operating Case Temperature	T _C	-40 to +85	°C
Storage Temperature	T _{stg}	-40 to +85	°C
Lead Soldering Temperature	T _{sl}	260 (10 sec.)	°C
Relative Humidity (noncondensing)	RH	85	%

ELECTRO-OPTICAL CHARACTERISTICS (T_c = 25°C, unless otherwise specified)

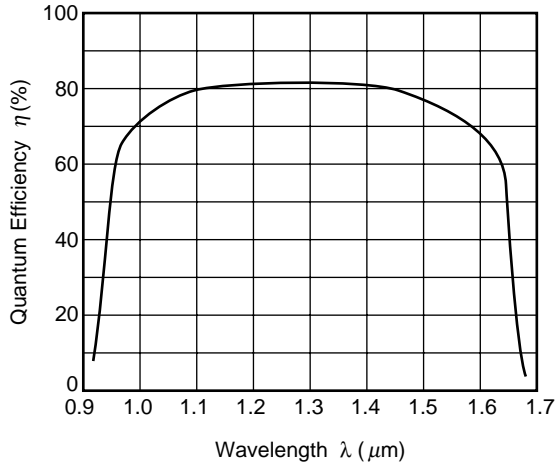
Parameter	Symbol	Conditions	MIN.	TYP.	MAX.	Unit
Reverse Breakdown Voltage	V _{BR}	I _D = 100 μA	50	70	90	V
Temperature Coefficient of Reverse Breakdown Voltage	δ ⁻¹			0.2		%/°C
Dark Current	I _D	V _R = V _{BR} × 0.9		7	30	nA
Multiplied Dark Current	I _{DM}	M = 2 to 10		1	5	nA
Terminal Capacitance	C _t	V _R = V _{BR} × 0.9, f = 1 MHz		0.5	0.75	pF
Cut-off Frequency	f _c	M = 10	1.0	1.5		GHz
		M = 20		1.2		
Sensitivity	S	λ = 1 310 nm, M = 1	0.8	0.94		A/W
		λ = 1 550 nm, M = 1	0.81	0.96		
Multiplication Factor	M	λ = 1 310 nm, I _{po} = 1.0 μA, V _R = V (@ I _D = 1 μA)	30	40		
Excess Noise Factor ^{*2}	x	λ = 1 310 nm, 1 550 nm, I _{po} = 1.0 μA,		0.7		
	F	M = 10, f = 35 MHz, B = 1 MHz		5		
Optical Return Loss	ORL	SMF	30			dB
		GI-50 Fiber	28			

*1
$$\delta = \frac{V_{BR}(25^\circ\text{C} + \Delta T^\circ\text{C}) - V_{BR}(25^\circ\text{C})}{\Delta T^\circ\text{C} \cdot V_{BR}(25^\circ\text{C})}$$

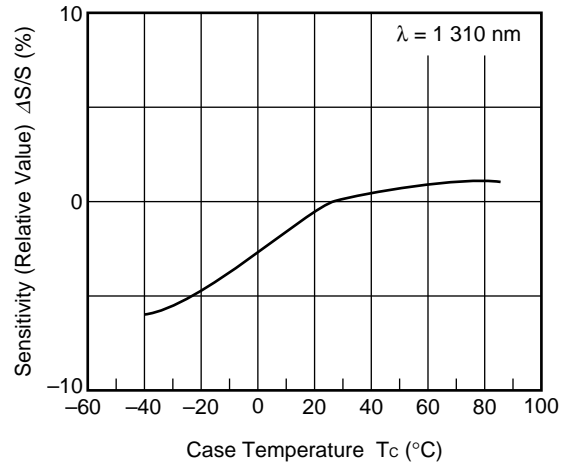
*2 $F = M^x$

TYPICAL CHARACTERISTICS ($T_c = 25^\circ\text{C}$, unless otherwise specified)

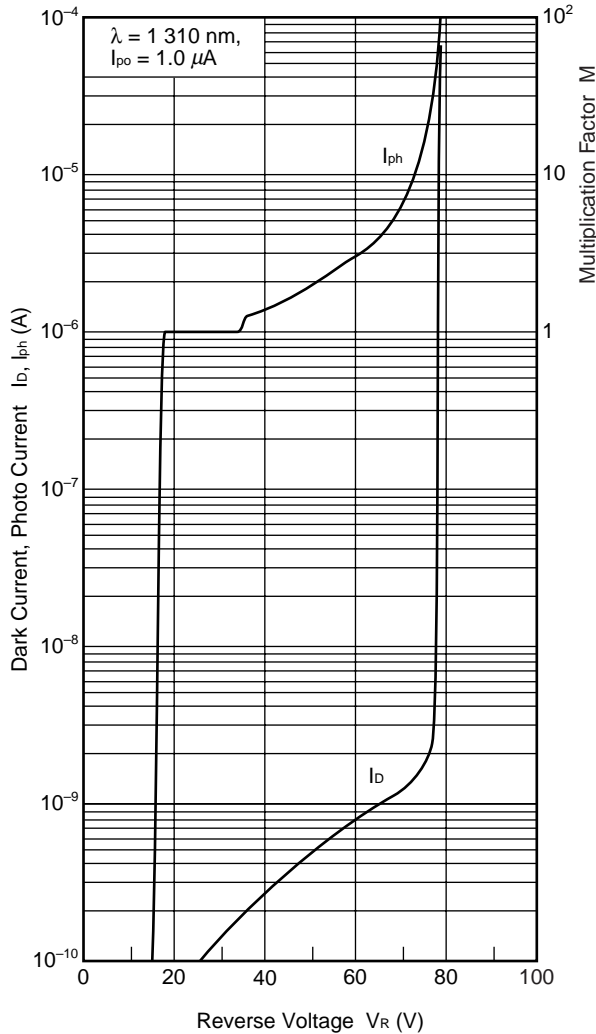
WAVELENGTH DEPENDENCE OF QUANTUM EFFICIENCY



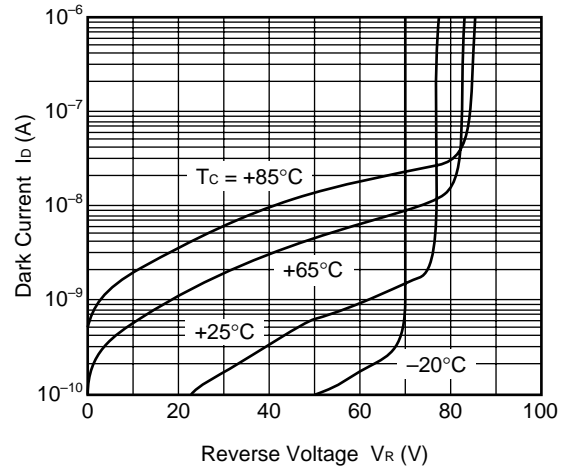
TEMPERATURE DEPENDENCE OF SENSITIVITY



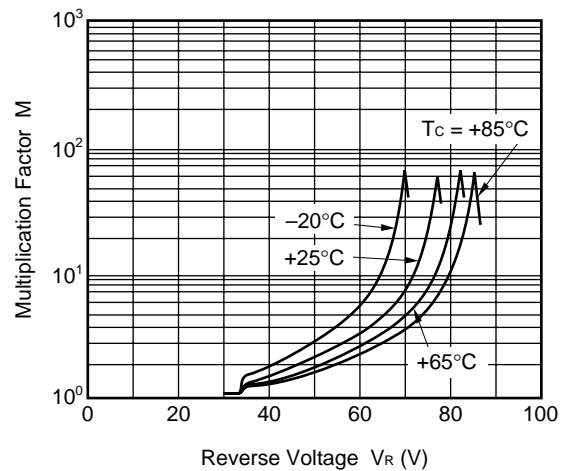
DARK CURRENT AND PHOTO CURRENT vs. REVERSE VOLTAGE



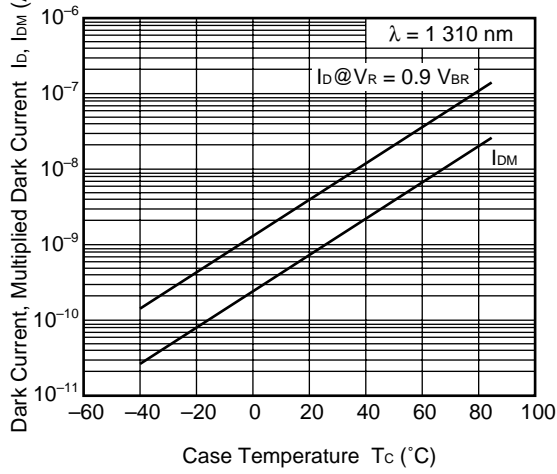
DARK CURRENT vs. REVERSE VOLTAGE



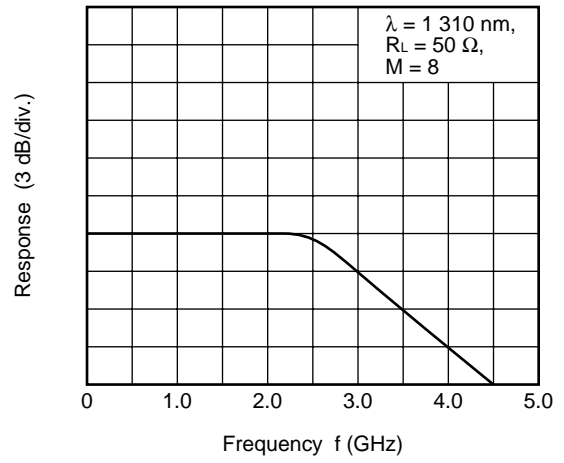
MULTIPLICATION FACTOR vs. REVERSE VOLTAGE



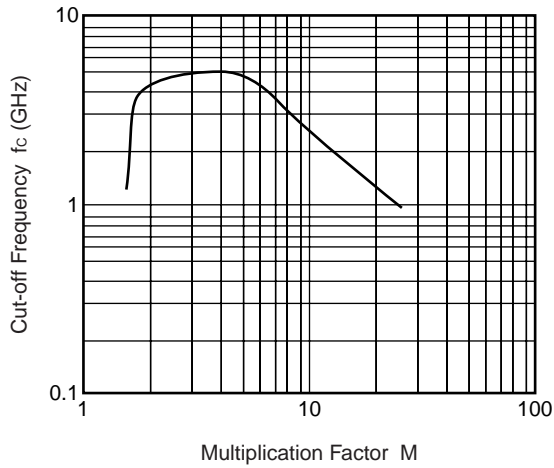
TEMPERATURE DEPENDENCE OF DARK CURRENT AND MULTIPLIED DARK CURRENT



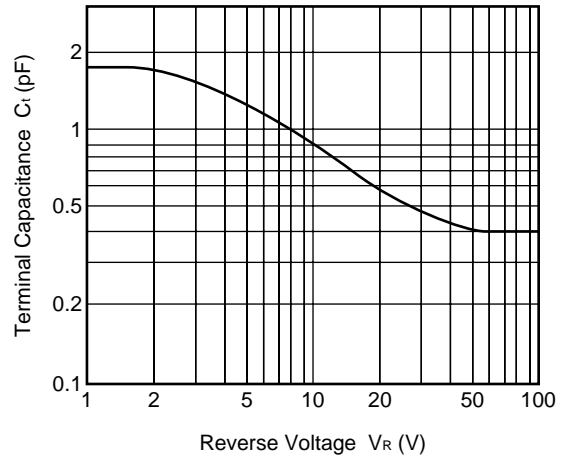
FREQUENCY RESPONSE



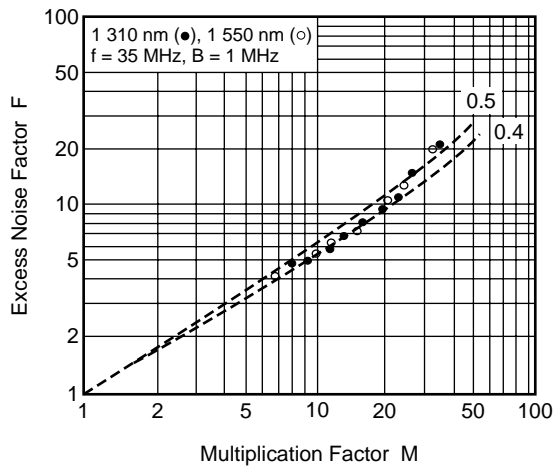
CUT-OFF FREQUENCY vs. MULTIPLICATION FACTOR



TERMINAL CAPACITANCE vs. REVERSE VOLTAGE



EXCESS NOISE FACTOR vs. MULTIPLICATION FACTOR



Remark The graphs indicate nominal characteristics.

InGaAs APD/PD FAMILY

Part Number	Absolute Maximum Ratings		Electro-Optical Characteristics (T _c = 25°C)						Applications	Package
	T _c (°C)	T _{stg} (°C)	Detect- ing Area Size (μm)	I _b (nA)	f _c (GHz)	S (A/W)		V _R (V)		
				TYP.	MIN.	TYP.	@λ (nm)			
★ NR4500BP-CC NR4500CP-CC	0 to +85	-40 to +85	φ50	-	2.5 ^{*1}	0.94	1 310	0.9V _{BR}	2.5 Gb/s: STM-16	Coaxial APD with an Internal pre-amp
						0.96	1 550			
NR7500 Series	-40 to +85	-40 to +85	φ50	0.1	2.5	0.89	1 310	5	2.5 Gb/s: STM-16	Coaxial PD
						0.94	1 550			
NR7800 Series	-40 to +85	-40 to +85	φ80	0.1	2.5	0.89	1 310	5	≤ 622 Mb/s: STM-4, STM-1	Coaxial PD
						0.94	1 550			
NR8500 Series	-40 to +85	-40 to +85	φ50	7	1	0.94	1 310	0.9V _{BR}	≤ 622 Mb/s: STM-4, STM-1	Coaxial APD
						0.96	1 550			
NR8501 Series	-40 to +85	-40 to +85	φ50	7	2.5	0.94	1 310	0.9V _{BR}	2.5 Gb/s: STM-16	Coaxial APD
						0.96	1 550			

*1 \bar{P}_{Low} and \bar{P}_{High} are specified at 2.5 Gb/s

REFERENCE

Document Name	Document No.
Optical semiconductor devices for fiberoptic communications Selection Guide	P12480E
Opto-Electronics Devices Pamphlet	P13623E
Opto-Electronics Devices (CD-ROM)	P12944X
NEC semiconductor device reliability/quality control system ^{*1}	C11159E
Quality grades on NEC semiconductor devices ^{*1}	C11531E
SEMICONDUCTOR SELECTION GUIDE –Products and Packages– ^{*1}	X13769E

*1 Published by NEC Corporation

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M8E 00.4-0110

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<p>Caution GaAs Products</p>	<p>The product contains gallium arsenide, GaAs. GaAs vapor and powder are hazardous to human health if inhaled or ingested.</p> <ul style="list-style-type: none"> • Do not destroy or burn the product. • Do not cut or cleave off any part of the product. • Do not crush or chemically dissolve the product. • Do not put the product in the mouth. <p>Follow related laws and ordinances for disposal. The product should be excluded from general industrial waste or household garbage.</p>
<p>Caution Optical Fiber</p>	<p>A glass-fiber is attached on the product. Handle with care.</p> <ul style="list-style-type: none"> • When the fiber is broken or damaged, handle carefully to avoid injury from the damaged part or fragments.

► **Business issue**

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► **Technical issue**

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