



**NEC's  $\phi 50 \mu\text{m}$   
InGaAs APD IN COAXIAL PACKAGE  
FOR 155 Mb/s AND 622 Mb/s APPLICATIONS**

**NR8500 Series**

**FEATURES**

- **SMALL DARK CURRENT:**  
 $I_D = 7 \text{ nA}$
- **HIGH SENSITIVITY:**  
 $S = 0.94 \text{ A/W}$  at  $\lambda = 1310 \text{ nm}$ ,  $M = 1$   
 $S = 0.96 \text{ A/W}$  at  $\lambda = 1550 \text{ nm}$ ,  $M = 1$
- **HIGH SPEED RESPONSE:**  
 $f_c = 1.5 \text{ GHz}$  at  $M = 10$
- **COAXIAL MODULE WITH SMF or GI-50 FIBER**
- **WITH SC CONNECTOR: Standard**  
**FC CONNECTOR: Option**

**DESCRIPTION**

NEC's 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 is ideal as a receiver for Synchronous Digital Hierarchy (SDH) system, STM-4 and STM-1, ITU-T recommendations.

**ELECTRO-OPTICAL CHARACTERISTICS** ( $T_C = 25^\circ\text{C}$ , Unless otherwise specified)

PART NUMBER			NR8500 Series		
SYMBOLS	PARAMETERS AND CONDITIONS	UNITS	MIN	TYP	MAX
$V_{BR}$	Reverse Breakdown Voltage, $I_D = 100 \mu\text{A}$	V	50	70	90
$\delta^1$	Temperature Coefficient of Reverse Breakdown Voltage	$\%/^\circ\text{C}$		0.2	
$I_D$	Dark Current, $V_R = V_{BR} \times 0.9$	nA		7	30
$I_{DM}$	Multiplied Dark Current, $M = 2$ to $10$	nA		1	5
$C_t$	Terminal Capacitance, $V_R = V_{(BR)} \times 0.9$ , $f = 1 \text{ MHz}$	pF		0.5	0.75
$f_c$	Cut-off Frequency, $M = 10$ $M = 20$	GHz	1.0	1.5 1.2	
S	Sensitivity, $\lambda = 1310 \text{ nm}$ $\lambda = 1550 \text{ nm}$	A/W	0.8 0.81	0.94 0.96	
M	Multiplication Factor, $\lambda = 1310 \text{ nm}$ , $I_{PO} = 1.0 \mu\text{A}$ $V_R = V$ (@ $I_D = 1 \mu\text{A}$ )		30	40	
x	Excess Noise Factor <sup>2</sup> , $\lambda = 1310 \text{ nm}$ , $1550 \text{ nm}$ , $I_{PO} = 1.0 \mu\text{A}$ , $M = 10$ , $f = 35 \text{ MHz}$ , $B = 1 \text{ MHz}$			0.7	
F	Excess Noise Factor <sup>2</sup> , $\lambda = 1310 \text{ nm}$ , $1550 \text{ nm}$ , $I_{PO} = 1.0 \mu\text{A}$ , $M = 10$ , $f = 35 \text{ MHz}$ , $B = 1 \text{ MHz}$			5	
ORL	Optical Return Loss SMF GI-50 Fiber	dB	30 28		

Note:

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

$$2. F = M^x$$

**ABSOLUTE MAXIMUM RATINGS<sup>1</sup>**

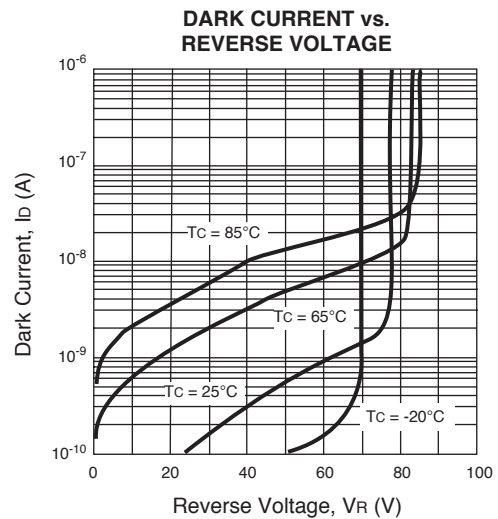
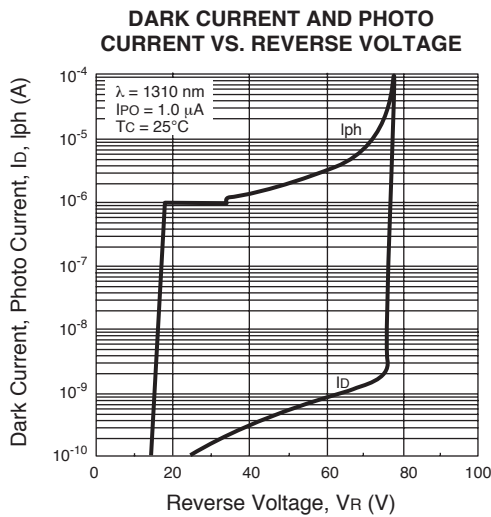
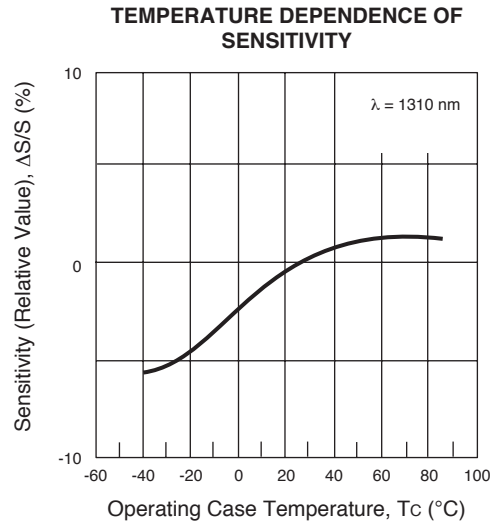
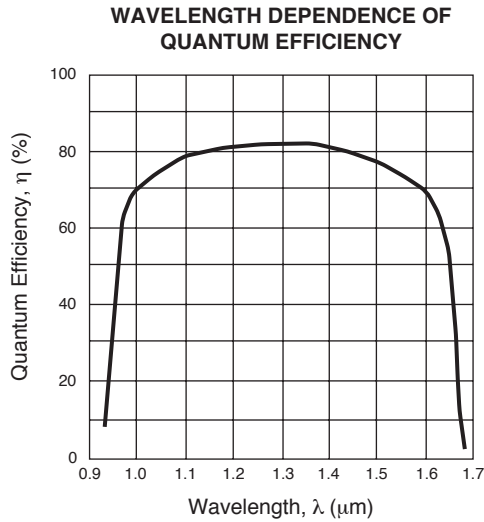
(T<sub>C</sub> = 25°C, unless otherwise specified)

SYMBOLS	PARAMETERS	UNITS	RATINGS
I <sub>F</sub>	Forward Current	mA	10
I <sub>R</sub>	Reverse Current	mA	1.0
T <sub>C</sub>	Operating Case Temp.	°C	-40 to +85
T <sub>STG</sub>	Storage Temperature	°C	-40 to +85
T <sub>SLD</sub>	Lead Soldering Temperature	°C	260 (10 sec.)
RH	Relative Humidity (noncondensing)	%	85

Note:

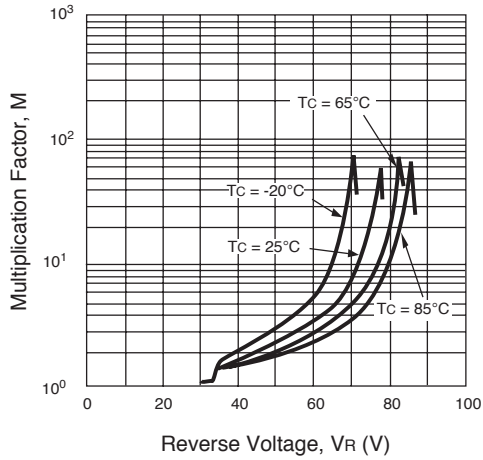
1. Operation in excess of any one of these parameters may result in permanent damage.

**TYPICAL PERFORMANCE CURVES** (T<sub>C</sub> = 25°C, unless otherwise specified)

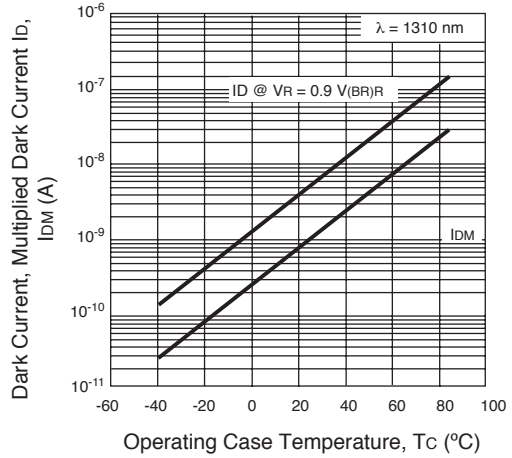


**TYPICAL PERFORMANCE CURVES** ( $T_c = 25^\circ\text{C}$ , unless otherwise specified)

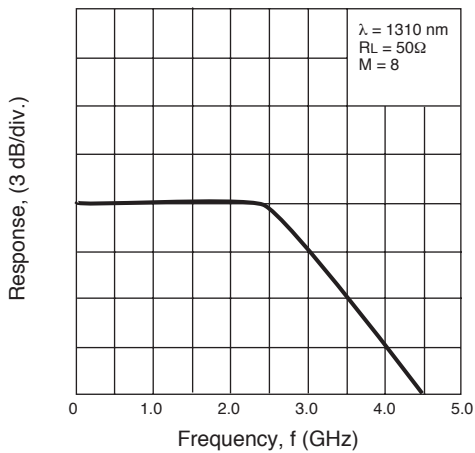
**MULTIPLICATION FACTOR vs. REVERSE VOLTAGE**



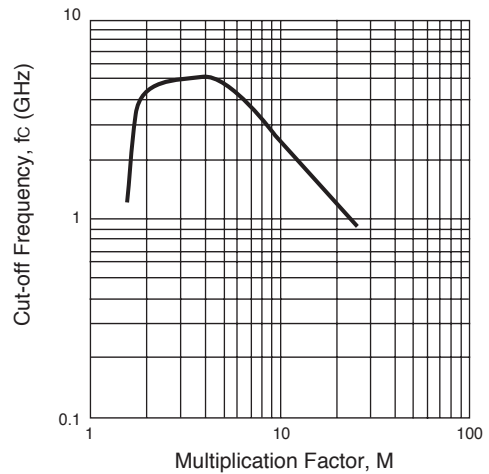
**TEMPERATURE DEPENDENCE OF DARK CURRENT and MULTIPLIED DARK CURRENT**



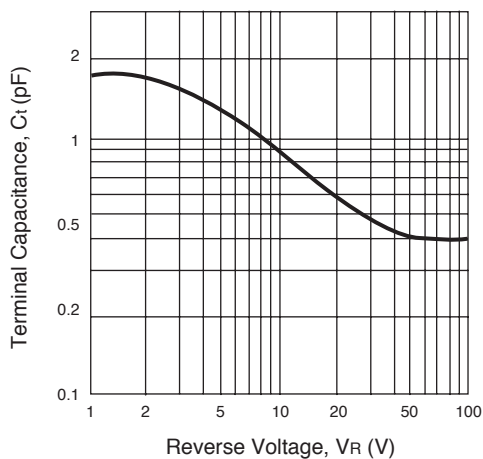
**FREQUENCY RESPONSE**



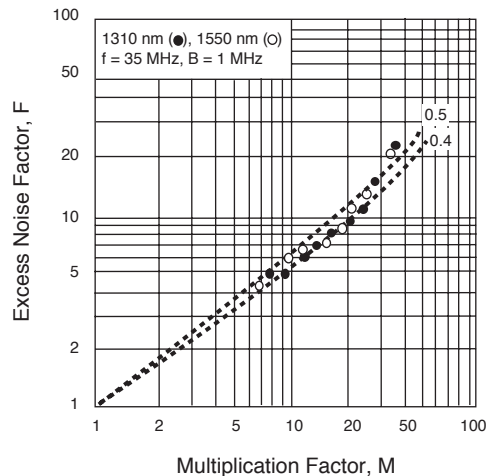
**CUT-OFF FREQUENCY vs. MULTIPLICATION FACTOR**



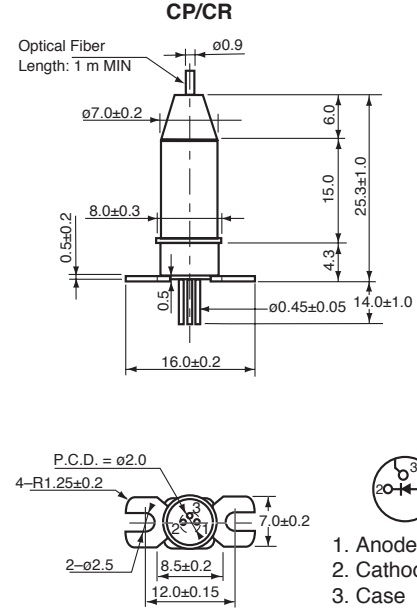
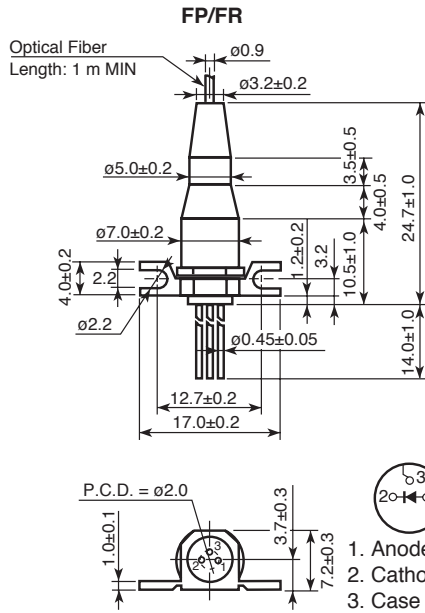
**TERMINAL CAPACITANCE vs. REVERSE VOLTAGE**



**EXCESS NOISE FACTOR vs. MULTIPLICATION FACTOR**



**OUTLINE DIMENSIONS** (Units in mm)



**ORDERING INFORMATION**

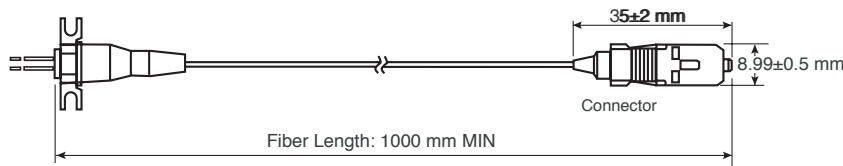
PART NUMBER	FLANGE TYPE	FIBER TYPE	AVAILABLE CONNECTOR
NR8500FP-BC-AZ*	Flat mount Flange	SMF	With FC-UPC Connector
NR8500FP-CC-AZ*			With SC-UPC Connector
NR8500FR-BB-AZ*		GI-50 Fiber	With FC-SPC Connector
NR8500FR-CB-AZ*			With SC-SPC Connector
NR8500CP-BC-AZ*	Vertical Mount Flange	SMF	With FC-UPC Connector
NR8500CP-CC-AZ*			With SC-UPC Connector
NR8500CR-BB-AZ*		GI-50 Fiber	With FC-SPC Connector
NR8500CR-CB-AZ*			With SC-SPC Connector

**\*NOTE:**

Please refer to the last page of this data sheet, "Compliance with EU Directives" for Pb-Free RoHS Compliance Information.

**OPTICAL FIBER CHARACTERISTICS**

PARAMETER	UNITS	SPECIFICATION	
		SMF	GI-50
Mode Field Diameter	$\mu\text{m}$	$9.5 \pm 1$	-
Core Diameter	$\mu\text{m}$	-	$50 \pm 3$
Cladding Diameter	$\mu\text{m}$	$125 \pm 2$	$125 \pm 2$
Maximum Cladding Noncircularity	%	2	2
Maximum Core/Cladding Concentricity	%	1.6	4.0
Outer Diameter	mm	$0.9 \pm 0.1$	$0.9 \pm 0.1$
Cut-off Wavelength	nm	1100 to 1270	-
Minimum Fiber Bending Radius	mm	30	30
Fiber Length	mm	1000 MIN	1000 MIN
Flammability		UL1581 VW-1	



**Life Support Applications**

These NEC products are not intended for use in life support devices, appliances, or systems where the malfunction of these products can reasonably be expected to result in personal injury. The customers of CEL using or selling these products for use in such applications do so at their own risk and agree to fully indemnify CEL for all damages resulting from such improper use or sale.

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DATA SUBJECT TO CHANGE WITHOUT NOTICE

02/27/2003

Subject: Compliance with EU Directives

CEL certifies, to its knowledge, that semiconductor and laser products detailed below are compliant with the requirements of European Union (EU) Directive 2002/95/EC Restriction on Use of Hazardous Substances in electrical and electronic equipment (RoHS) and the requirements of EU Directive 2003/11/EC Restriction on Penta and Octa BDE.

CEL Pb-free products have the same base part number with a suffix added. The suffix –A indicates that the device is Pb-free. The –AZ suffix is used to designate devices containing Pb which are exempted from the requirement of RoHS directive (\*). In all cases the devices have Pb-free terminals. All devices with these suffixes meet the requirements of the RoHS directive.

This status is based on CEL’s understanding of the EU Directives and knowledge of the materials that go into its products as of the date of disclosure of this information.

Restricted Substance per RoHS	Concentration Limit per RoHS (values are not yet fixed)	Concentration contained in CEL devices	
		-A	-AZ
Lead (Pb)	< 1000 PPM	Not Detected	(*)
Mercury	< 1000 PPM	Not Detected	
Cadmium	< 100 PPM	Not Detected	
Hexavalent Chromium	< 1000 PPM	Not Detected	
PBB	< 1000 PPM	Not Detected	
PBDE	< 1000 PPM	Not Detected	

If you should have any additional questions regarding our devices and compliance to environmental standards, please do not hesitate to contact your local representative.

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