

# InGaAs APD Preamplifier Module with TEC



CMC Electronics' 264-339814 series use an InGaAs APD with a low k-factor of 0.2, with a built-in preamplifier and a thermoelectric cooler (TEC), enabling optimum signal-to-noise performance.

The APD is coupled to a GaAs FET input transimpedance amplifier (TIA) in a 12-lead TO-8 package with an TEC allowing temperature control of the APD and easing stabilization of gain and optimized sensitivity.

The internal temperature can be monitored via an embedded thermal sensor close to the APD. The module is designed with a 50  $\Omega$  output impedance which can be AC- or DC-coupled.

The amplifier has an overload input protection circuit that sustains high optical power exposure with a very fast recovery time.

Customizations such as bandwidth tuning, NEP screening, responsivity optimization and different temperature sensors are available upon request.

## Features

- 80 – 200  $\mu\text{m}$  InGaAs APD
- 100 – 200 MHz Preamplifier Module
- Spectral Response: 1050 – 1600 nm
- Low k-factor InGaAs APD
- Low Noise Equivalent Power (NEP)
- High Efficiency TEC
- Hermetically Sealed TO-8 Package
- ITAR-Free
- ROHS compliant
- Optional: Fiber Receptacle

## Applications

- LiDAR and Laser Range Finding
- Instrumentation
- Free-Space Communications
- Industrial
- Photometry
- Distributed Fiber Optic Sensing (DFOS)
- Distributed Temperature Sensing (DTS)
- Distributed Acoustic Sensing (DAS)
- Structural Health Monitoring (SHM)

**Table 1. Electro-Optical Characteristics**

Unless otherwise specified:  $T_{\text{case}} = 25\text{ °C}$ ,  $V_{\text{POS}} = 5.0\text{ V}$ ,  $V_{\text{NEG}} = -5.0\text{ V}$ ,  $\lambda = 1570\text{ nm} \pm 10\text{ nm}$ ,  
Cooler OFF (Externally AC coupled through  $4.7\text{ }\mu\text{F}$ )

Parameter	Min.	Typ.	Max.	Units
Operating Voltage, $V_{\text{OP}}$ (Note 1)	40	54	85	V
Temperature coefficient of $V_{\text{OP}}$		0.07		V/°C
Responsivity		1.2		MV/W
Output impedance, $R_{\text{out}}$		50		$\Omega$
Noise equivalent power (Note 2)				
Active diameter 80 $\mu\text{m}$		65	120	fW/ $\sqrt{\text{Hz}}$
Active diameter 200 $\mu\text{m}$		90	135	fW/ $\sqrt{\text{Hz}}$
Bandwidth, $f_{-3\text{dB}}$				
Active diameter 80 $\mu\text{m}$	180	200		MHz
Active diameter 200 $\mu\text{m}$	80	100		MHz
Rise time (10-90 %) & Fall time (90-10 %)				
Active diameter 80 $\mu\text{m}$		1.75		ns
Active diameter 200 $\mu\text{m}$		3.5		ns
Linear output voltage swing (Pulse)	0.75	1.25	2.0	V
Output offset voltage	-0.75	-0.45	0	V
Thermal sensor (Note 3)				
Voltage output		1.5740		V
Accuracy (at +30 °C)	$\pm 1.5$		$\pm 4$	°C
Accuracy (-55 °C to +130 °C)	$\pm 2.5$		$\pm 5$	°C
Non-linearity		$\pm 0.4$		%
Overload recovery for optical power input signal of 1 mW, 20 ns pulse width:				
$V_{\text{out}} \rightarrow 200\text{ ns}$ after pulse start			250	mV
$V_{\text{out}} \rightarrow 1\text{ }\mu\text{s}$ after pulse start			40	mV
Hybrid Supply current				
$V_{\text{POS}}$ (pin 10)	25		40	mA
$V_{\text{NEG}}$ (pin 11)	-20		-10	mA

- Notes:**
1. Each APD receiver will have its individual  $V_{\text{OP}}$  (provided on its production tests report).
  2. Integration of the noise calculation is based on  $f_{-3\text{dB}}$  bandwidth.
  3. Alternate thermal sensors (thermistance or diode) are available upon request.

**Table 2. Absolute-Maximum Ratings, Limiting Values**

Parameter	Min.	Max.	Units
APD breakdown, Maximum voltage [ HV_POSITIVE (pin7) ] (Note 1)		90	V
Recommended overcurrent limit		100	μA
Input Voltage Positive Supply [ V_POS (+5V) (pin10) ]	+4.8	+6.0	V
Input Voltage Negative Supply [ V_NEG (-5V) (pin11) ]	-4.8	-6.0	V
Maximum Optical Power, CW		10	μW
Peak value, 20ns pulses <100Hz		100	kW/cm <sup>2</sup>
TEC Current	-0.9	0.9	A
Temperature sensor (LM20)			
Sensor bias voltage (pin 4)	2.5	5.0	V
Sensor drive current	1	10	mA
Sensor output (pin 5)	0.2	2.5	V
Operating Temperature	-40	85	°C
Storage Temperature	-55	125	°C
Soldering Temperature (5 s, leads only)		250	°C

**Note:** 1. Absolute maximum over the product Temperature Operating Range (-40°C to +85°C).

To obtain the expected voltage from a specific temperature:

$$V_o = (-3.88 \times 10^{-6} \times T^2) + (-1.15 \times 10^{-2} \times T) + 1.8639$$

And to convert in Celsius the voltage measured at the sensor output:

$$T = -1481.96 + \sqrt{2.1962 \times 10^6 + \frac{1.8639 - V_o}{3.88 \times 10^{-6}}}$$

In the above formulas:

$V_o$  is the voltage level of the temperature sensor (receiver PIN 5 -  $T_{\text{sensor}}$   $V_{\text{out}}$ )

T is the temperature expressed in Celsius.

Figure 1. Typical Normalized Responsivity (M=1)

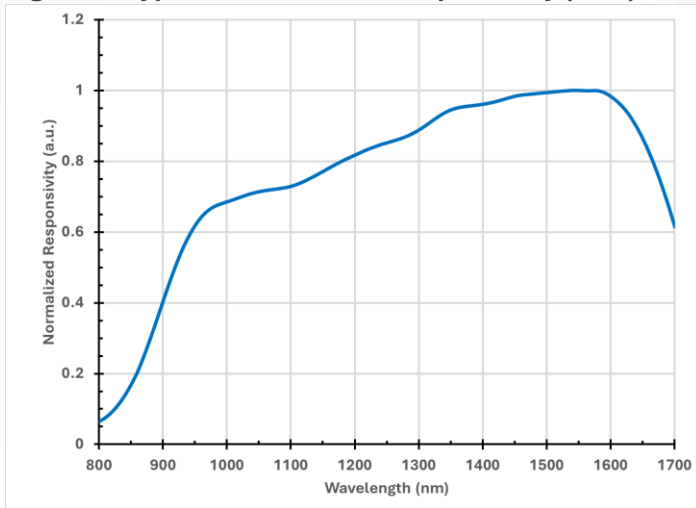


Figure 2. Typical Normalized Frequency Response

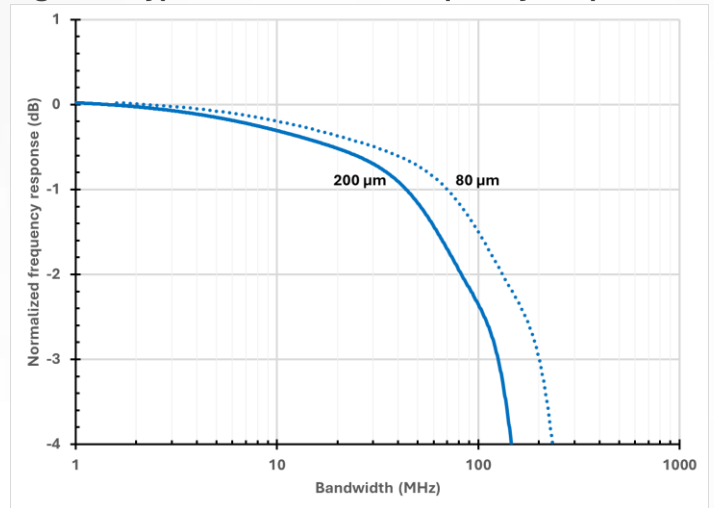


Figure 3. Typ. Responsivity, Diameter = 80 μm

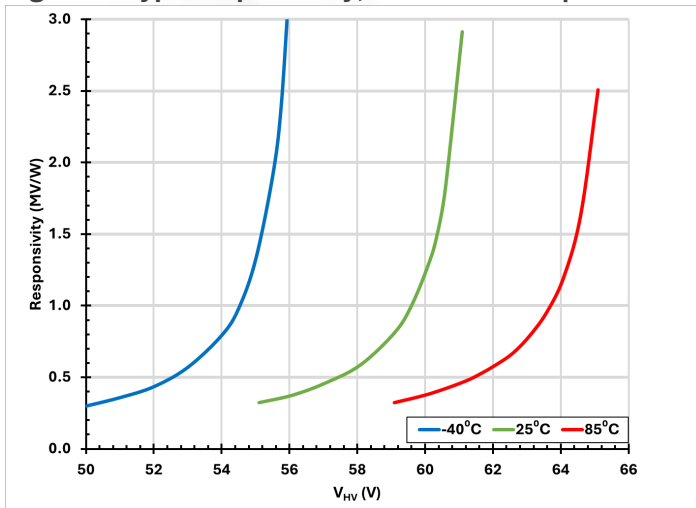


Figure 4. Typ. NEP, Diameter = 80 μm

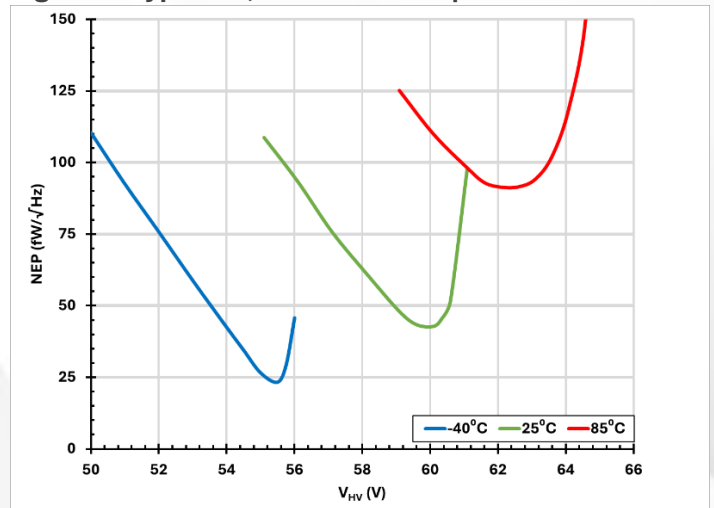


Figure 5. Typ. Responsivity, Diameter = 200 μm

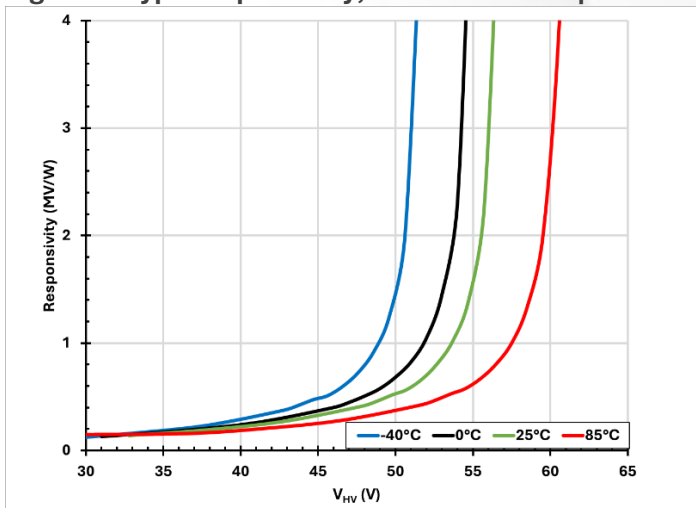


Figure 6. Typ. NEP, Diameter = 200 μm

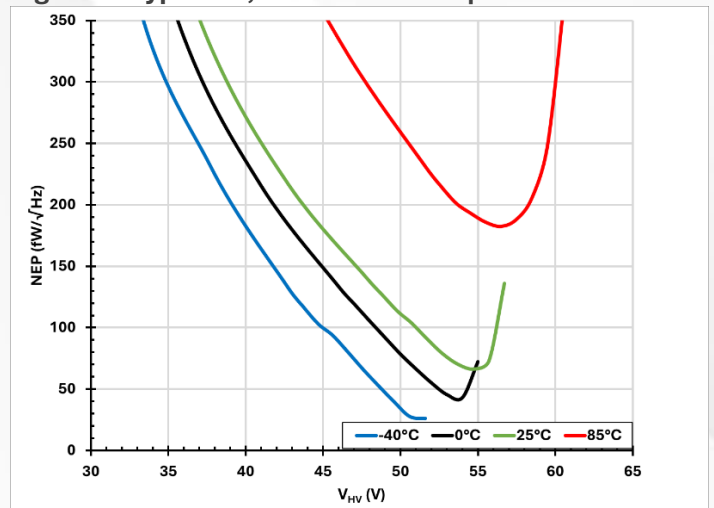
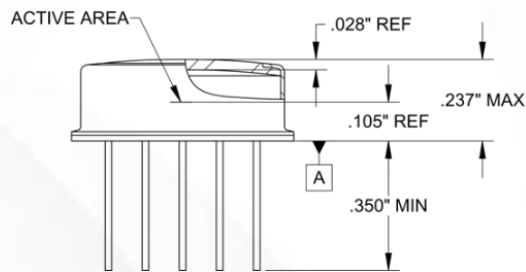
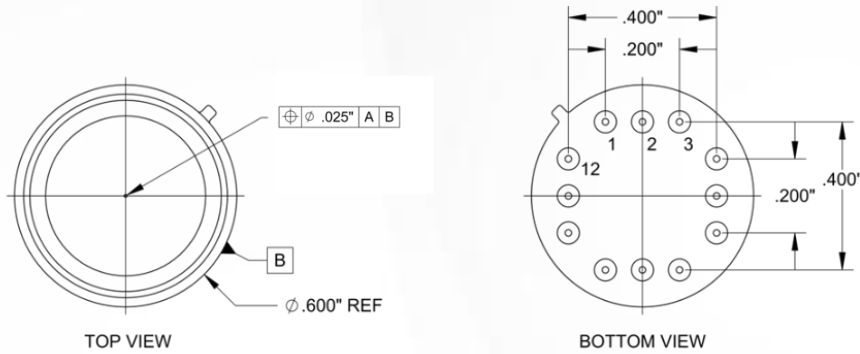


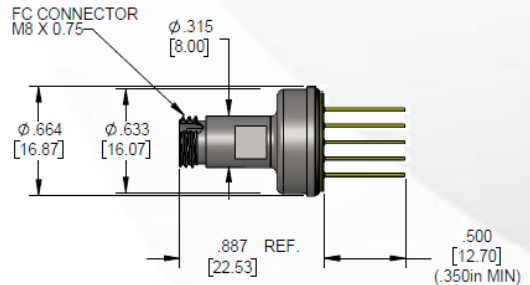
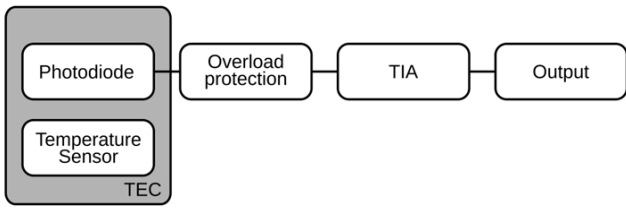
Figure 7. Package Dimension and Pinout



1	NC	7	HV POSITIVE
2	TEC -	8	GND
3	TEC +	9	OUTPUT
4	T sensor VS+	10	V_POS (+5V)
5	T sensor Vout	11	V_NEG (-5V)
6	GND	12	GND

Figure 8. CMC 264-339814 Series block diagram

Figure 9. FC connector (617-339814)



Unless otherwise specified, dimensions are in inches [mm] and are for reference only.

Table 3. Ordering Guide

VAR	Typical Bandwidth	Active Diameter	Comments
264-339814-002	200 MHz	80 $\mu$ m	
617-339814-002			with FC connector
264-339814-003	100 MHz	200 $\mu$ m	
617-339814-003			with FC connector



For more information, visit [www.cmcelectronics.ca/optoelectronics](http://www.cmcelectronics.ca/optoelectronics) or email us at [opto@cmcelectronics.ca](mailto:opto@cmcelectronics.ca)

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