High Bandwidth InGaAs Avalanche Photodiode Preamplifier Module

CMC Electronics' 264-339834 series use an InGaAs APD with a low k-factor of 0.2, with a built-in preamplifier 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. The internal temperature can be monitored via an embedded thermal sensor close to the APD.

The module is designed with a 50 Ω output impedance which can be AC- or DC-coupled and can sustain high optical power exposure with a very fast recovery time with its integrated overload input protection circuit.

Customizations such as bandwidth tuning, NEP screening, responsivity optimization and different temperature sensors are available to fit your system design needs upon request.

Features

- 80 – 200 µm InGaAs APD
- 300 – 450 MHz Preamplifier Module
- Spectral Response: 1050 - 1600 nm
- Low k of 0.2 (Low noise) InGaAs APD
- Low Noise Equivalent Power (NEP)
- High Sensitivity
- Hermetically Sealed TO-8 Package
- ITAR-Free
- ROHS compliant
- Optional: Fiber Receptacle

Applications

- Free-Space Communications
- Decoding
- LiDAR
- Distributed Temperature Sensing (DTS)
- Laser Microscopy
- Imaging Systems
- Industrial (Safety curtains)

Table 1. Electro-Optical Characteristics for 80 µm Active Area (-001)

Unless otherwise specified: T_A = 25 °C, V_POS = 5.0 V, V_NEG = -5.0 V, R_L = 50 Ω, λ = 1570 nm ± 10 nm, Cooler OFF (Externally AC coupled through 4.7 µF)

Parameter	Min.	Typ.	Max.	Units
Operating Voltage, V_{OP} (Note 1)	40	54	85	V
Temperature coefficient of V_{OP}		0.07		V/˚C
Responsivity		400		kV/W
Noise equivalent power (Note 2)				
1570 nm [T_{case}=25 °C]		65		fW/√Hz
1570 nm [T_{case}=85 °C]		125		fW/√Hz
Output impedance, R_{out}		50		Ω
Bandwidth		450		MHz
Rise time (10-90 %)		0.875		ns
Fall time (90-10 %)		0.875		ns
Linear output voltage swing (Pulse)	0.75	1.25	2	V
Output offset voltage	-0.75	-0.45	0	V
Thermal sensor (1N914 diode)(Note 3)				
I_f of 5 mA at 25°C		645		mV
Sensor sensitivity		-1.9		mV/°C
Overload recovery for optical power input signal of 1 mW, 20 ns pulse width:				
V_{out} → 200 ns after pulse start			125	mV
V_{out} → 1 µs after pulse start			20	mV
Hybrid Supply current V_POS (pin 10)	25		40	mA
V_NEG (pin 11)	-20		-10	mA

Notes:
1. Each APD receiver will have its individual V_{OP} (provided on its production tests report).
2. NEP values for +85°C are by design and are for reference only. No test values are provided on individual test reports. Integration of the noise calculation is based on minimum bandwidth.
3. Alternate thermal sensors (IC sensors or thermistance) are available upon request.

Table 2. Electro-Optical Characteristics for 200 µm Active Area (-002)

Unless otherwise specified: T_A = 25 °C, V_POS = 5.0 V, V_NEG = -5.0 V, R_L = 50 Ω, λ = 1570 nm ± 10 nm, Cooler OFF (Externally AC coupled through 4.7 µF)

Parameter	Min.	Typ.	Max.	Units
Operating Voltage, V_{OP} (Note 1)	40	54	85	V
Temperature coefficient of V_{OP}		0.07		V/˚C
Responsivity		150		kV/W
Noise equivalent power (Note 2)				
1570 nm [T_{case}=25 °C]		200		fW/√Hz
1570 nm [T_{case}=85 °C]		180		fW/√Hz
Output impedance, R_{out}		50		Ω
Bandwidth		300		MHz
Rise time (10-90 %)		1		ns
Fall time (90-10 %)		1		ns
Linear output voltage swing (Pulse)	0.75	1.25	2	V
Output offset voltage	-0.75	-0.45	0	V
Thermal sensor (1N914 diode)(Note 3)				
I_f of 5 mA at 25°C		645		mV
Sensor sensitivity		-1.9		mV/°C
Overload recovery for optical power input signal of 1 mW, 20 ns pulse width:				
V_{out} → 200 ns after pulse start			125	mV
V_{out} → 1 µs after pulse start			20	mV
Hybrid Supply current V_POS (pin 10)	25		40	mA
V_NEG (pin 11)	-20		-10	mA

Notes:
1. Each APD receiver will have its individual V_{OP} (provided on its production tests report).
2. NEP values for +85°C are by design and are for reference only. No test values are provided on individual test reports. Integration of the noise calculation is based on minimum bandwidth.
3. Alternate thermal sensors (IC sensors or thermistance) are available upon request.

Table 3. Absolute-Maximum Ratings, Limiting Values

Parameter	Min.	Max.	Units
APD breakdown, Maximum voltage [HV_POS (pin 4)] (Note 1)		90	V
Recommended overcurrent limit		100	µA
Input Voltage Positive Supply [V_POS (+5V) (pin 12)]	+4.8	+6.0	V
Input Voltage Negative Supply [V_NEG (-5V) (pin 3)]	-4.8	-6.0	V
Maximum Optical Power, CW		10	µW
Peak value, 20 ns pulses < 100 Hz		100	kW/cm^2
Temperature sensor fixed input current between Sensor V_{in} → TSensor ANODE (pin 8) Sensor output → TSensor CATHODE (pin 9)	1	10	mA
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:

$$V_o = (-3.88x10^{-6}xT^2) + (-1.15x10^{-2}xT) + 1.8639$$

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_{sensor} V_{out})

T is the temperature expressed in Celsius.

Figure 1. Typical Responsivity at 25°C

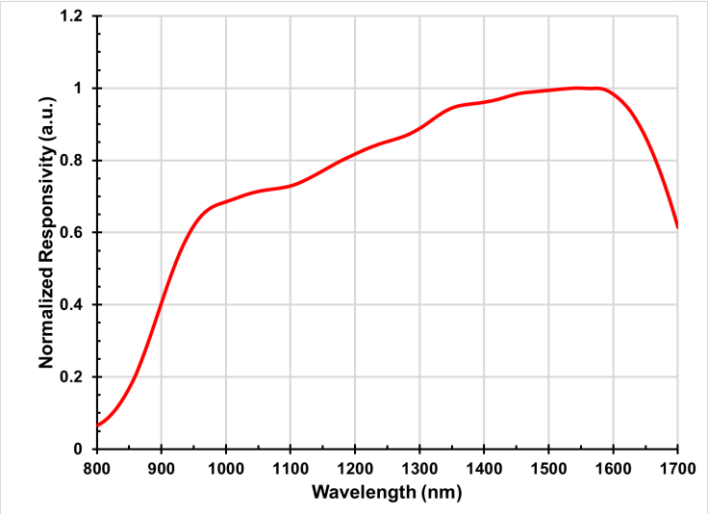


Figure 2. Typical Frequency Response (-001)

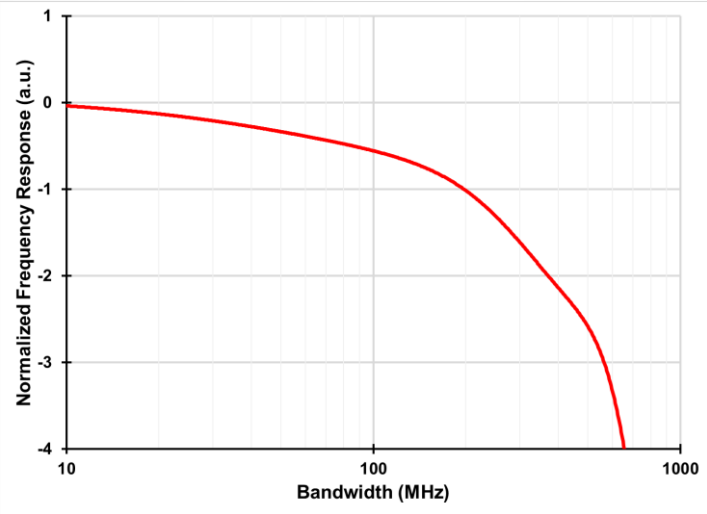


Figure 3. Typical Responsivity and NEP (-001) λ = 1570 nm ± 10 nm

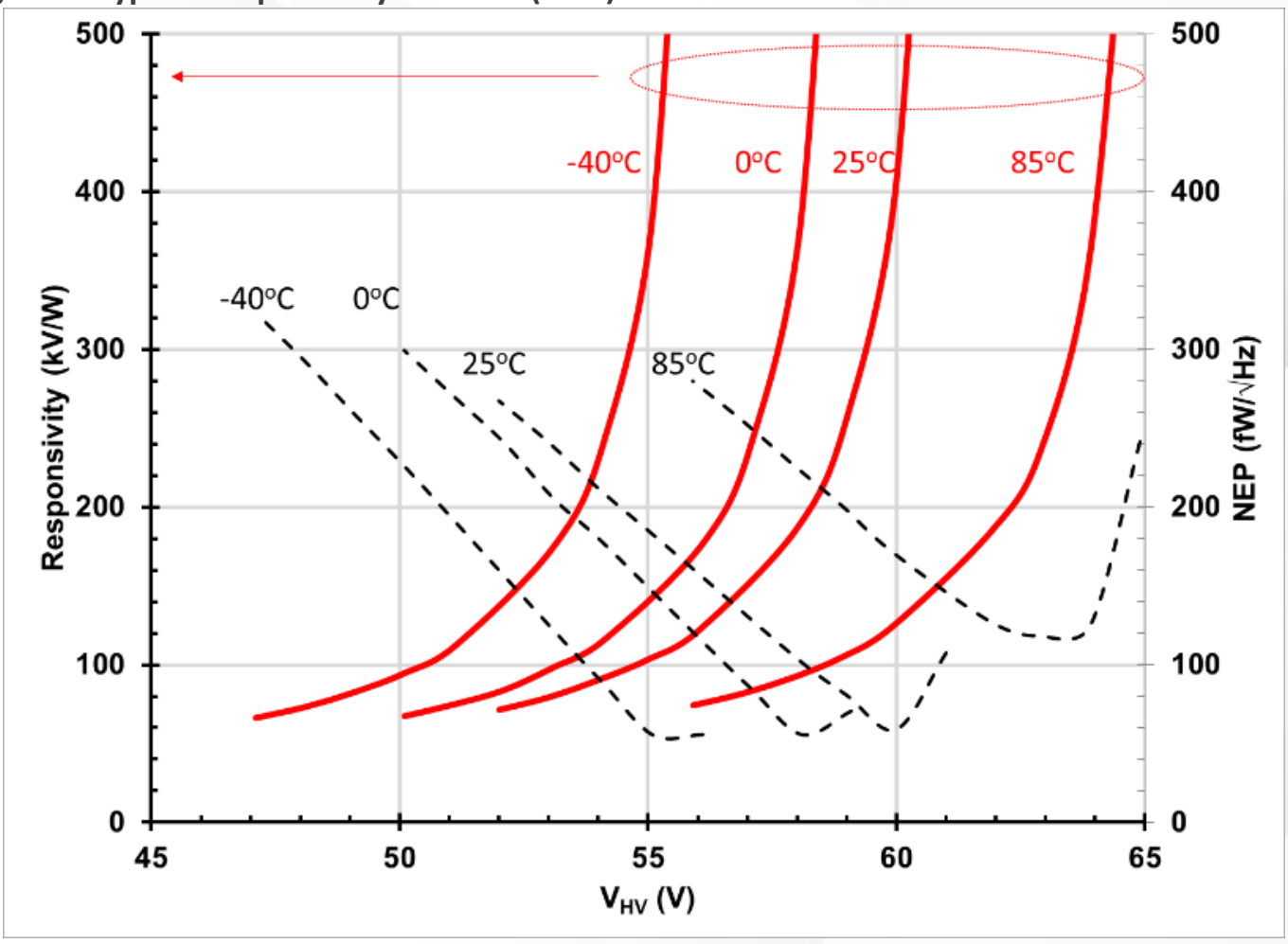


Figure 5. CMC 264-339834 Series block diagram

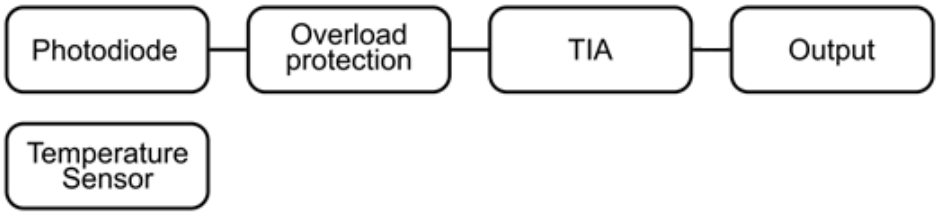
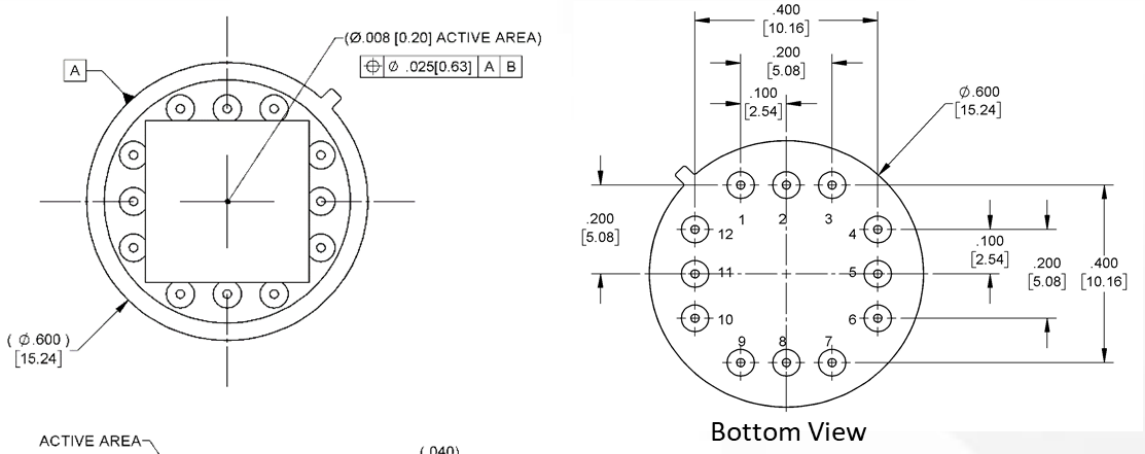
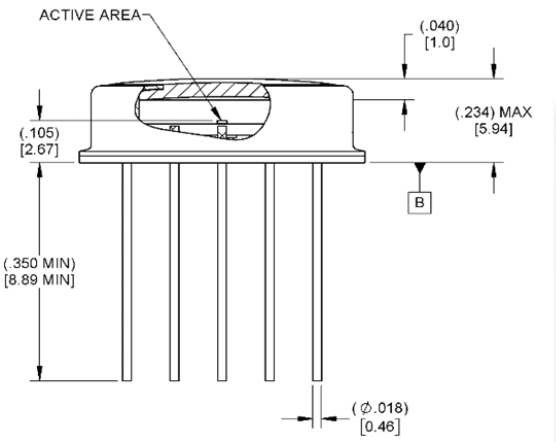


Figure 6. Package Dimension and Pinout

Unless otherwise specified, dimensions are in inches (mm) and are for reference only.





1	OUTPUT	7	GND
2	NC	8	TSensor ANODE
3	V_NEG (-5V)	9	Tsensor CATHODE
4	HV_POSITIVE	10	GND
5	NC	11	NC
6	GND	12	V_POS (+5V)

VAR Options

-001	InGaAs APD 80 µm, 450 MHz
-002	InGaAs APD 200 µm, 300 MHz

For more information, visit www.cmcelectronics.ca/optoelectronics
Or email us at opto@cmcelectronics.ca

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