High Sensitivity InGaAs APD Preamplifier Module with TEC

CMC Electronics' 264-339835 series use an InGaAs APD with a low k-factor of 0.2, featuring a built-in preamplifier and a thermoelectric cooler (TEC), tuned for remarkably high sensitivity in the most demanding sensing applications, thereby 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 integrated thermoelectric cooler (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 Ω output impedance and 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 – 350 µm InGaAs APD
- 0.5 – 3 MHz Preamplifier Module
- Spectral Response: 1050 – 1600 nm
- Low k-factor InGaAs APD
- Low Noise Equivalent Power (NEP)
- High Efficiency TEC
- High Sensitivity
- Hermetically Sealed TO-8 Package
- ITAR-Free
- ROHS compliant
- Optional: Fiber Receptacle

Applications

- Differential Absorption LiDAR (DiAL)
- Remote Sensing
- Fluorescence
- Instrumentation

Table 1. Electro-Optical Common Characteristics

Conditions: T_A = 25°C, V_POS = 5.0 V, V_NEG = -5.0 V, R_L = 50 Ω

Parameter	Symbol	Min.	Typ.	Max.	Units
Breakdown Voltage (Note 1)	V_{BR}	45		80	V
Operating point from Breakdown Voltage (V_{BR} - V_{OP})	ΔV	7	8		
Temperature coefficient of V_{OP}	ΔV/ΔT		0.07		V/˚C
Output impedance	R_{out}		50		Ω
Linear output voltage swing (Pulse)		1.5	2.5	4.0	V
Output offset voltage	V_{oo}	-0.75	-0.45	0	V
Thermal sensor (Note 2)					
Voltage output			1.5740		V
Accuracy (at +30 °C)		±1.5		±4	°C
Accuracy (-55 °C to +130 °C)		±2.5		±5	°C
Non-linearity			±0.4		%
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}	25		40	mA
	V_{neg}	-20		-10	mA

Notes: 1. Each APD receiver will have its individual V_{OP} (provided on its production tests report).
2. Alternate thermal sensors (thermistance or diode) are available upon request.

Table 2. Electro-Optical Characteristics

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)

		80 µm (VAR -003)			200 µm (VAR -002)			350 µm (VAR -001)			
Parameter	**Symbol**	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**	**Min.**	**Typ.**	**Max.**	**Units**
Responsivity	R		25			15			15		MV/W
Noise equivalent power											
T_{case} = 25 °C	NEP		15			30			50		fW/√Hz
T_{case} = 85 °C (Note 1)			45			90			125		fW/√Hz
Bandwidth	BW		3		0.7	1			0.5		MHz
Rise time (10-90 %)	t_{rise}		175			350			700		ns
Fall time (90-10 %)	t_{fall}		175			350			700		ns

Note: 1. NEP values for +85°C are by design and are for reference only. No test values are provided on individual test reports.

Table 3. Absolute-Maximum Ratings, Limiting Values

Parameter	Symbol	Min.	Max.	Units
APD breakdown, Maximum voltage (Note 1)	$HV_{positive}$		90	V
Recommended overcurrent limit			100	µA
Input Voltage Positive Supply	V_{pos}	+4.8	+6.0	V
Input Voltage Negative Supply	V_{neg}	-4.8	-6.0	V
Maximum Optical Power, CW			10	µW
Peak value, 20ns pulses <100Hz			100	kW/cm^2
TEC Current	i_{TEC}	-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	T_{oper}	-40	85	°C
Storage Temperature	T_{store}	-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:

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

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 Quantum Efficiency

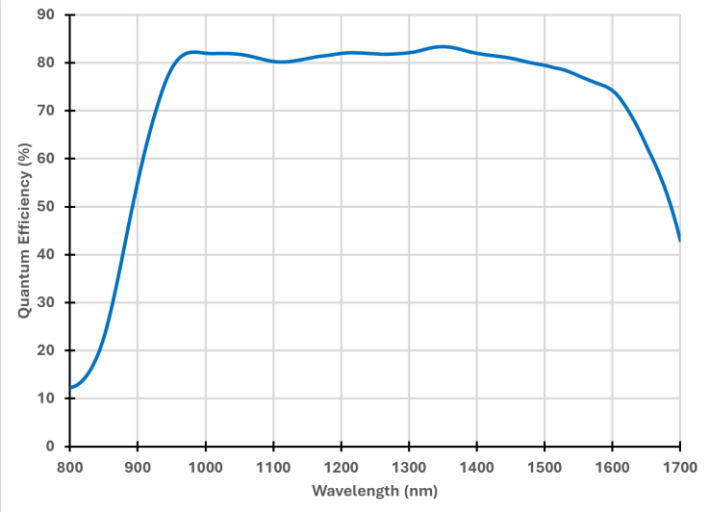


Figure 2. Typical Normalized Responsivity (M=1)

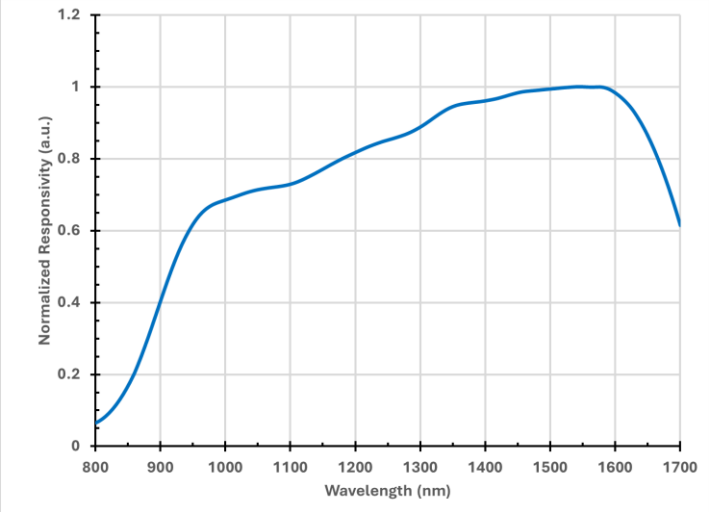


Figure 3. Typ. Responsivity, R_L = 50 Ω Area = 80 µm

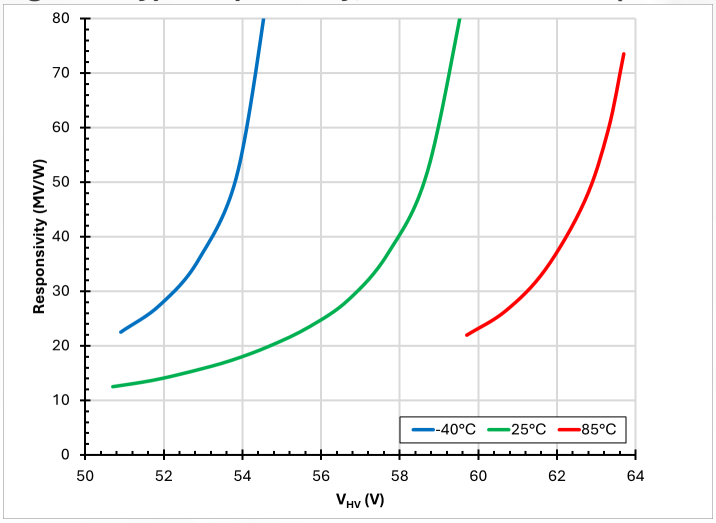


Figure 4. Typ. NEP, R_L = 50 Ω Area = 80 µm

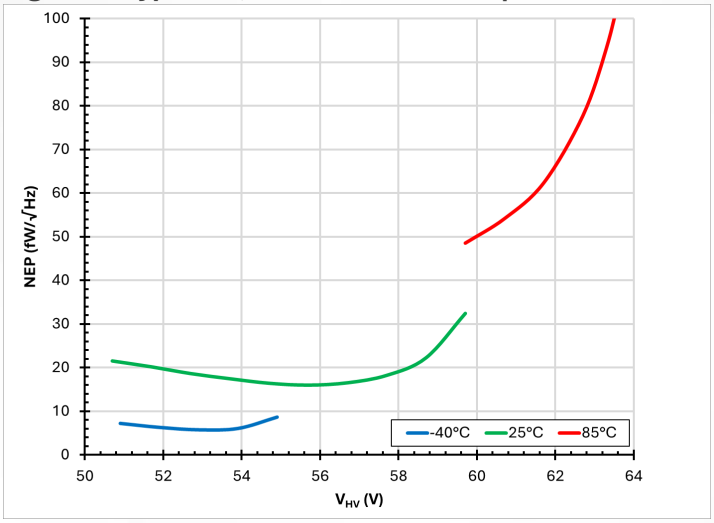


Figure 5. Typ. Responsivity, R_L = 50 Ω Area = 200 µm

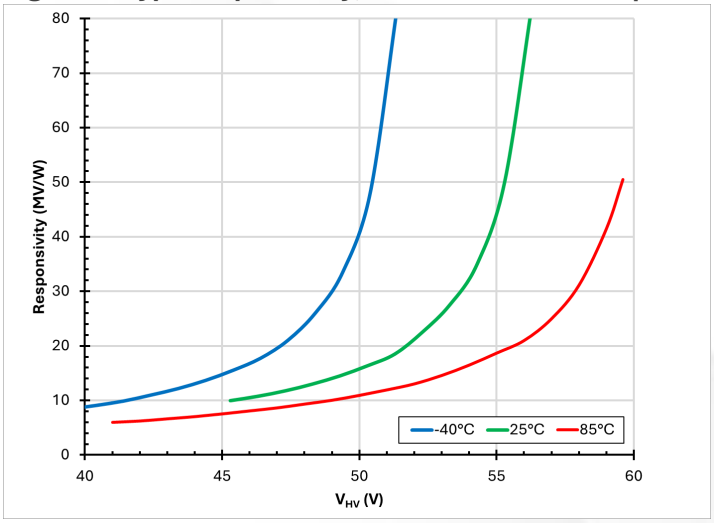


Figure 6. Typ. NEP, R_L = 50 Ω Area = 200 µm

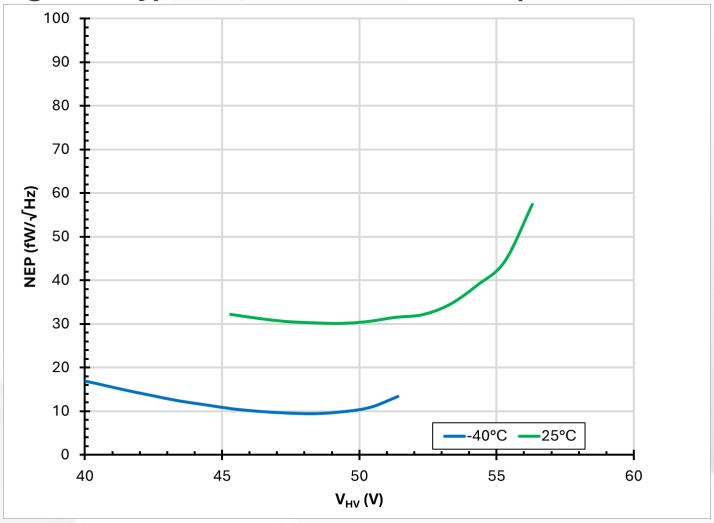


Figure 7. Typ. Responsivity, R_L = 50 Ω & Area = 350 µm

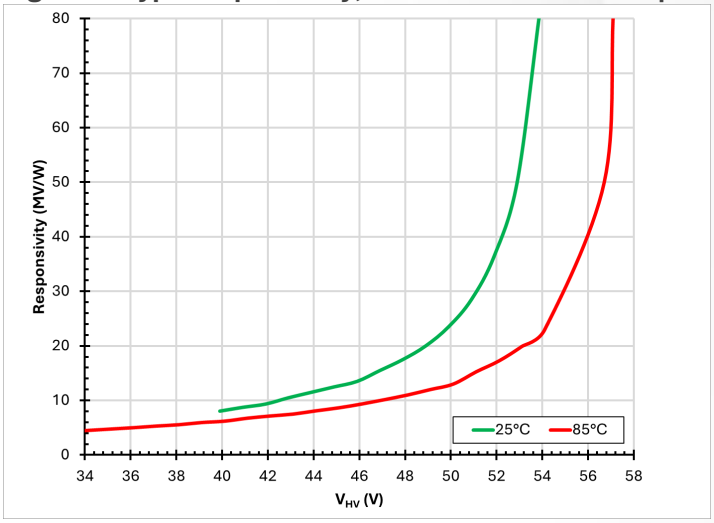


Figure 8. Typ. NEP, R_L = 50 Ω Area = 350 µm

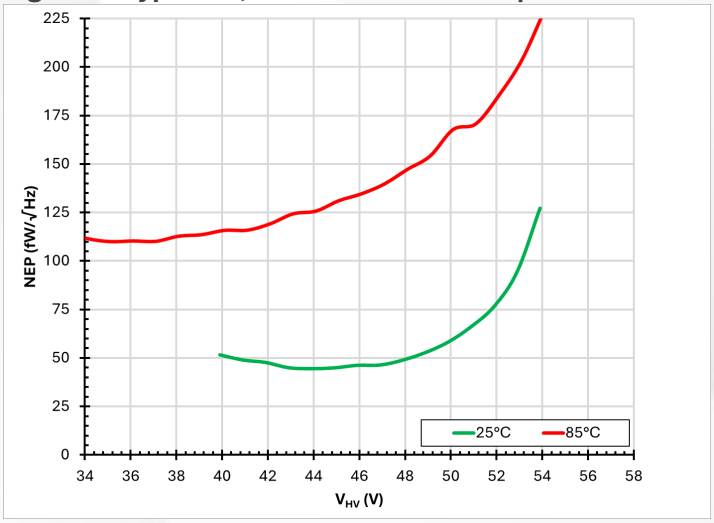


Figure 9. CMC 264-339835 Series block diagram

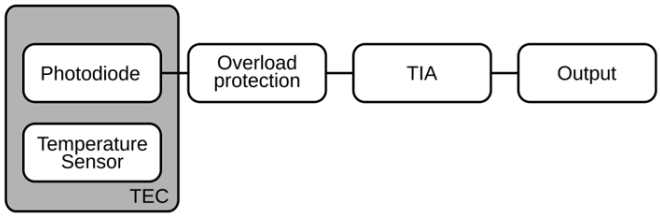
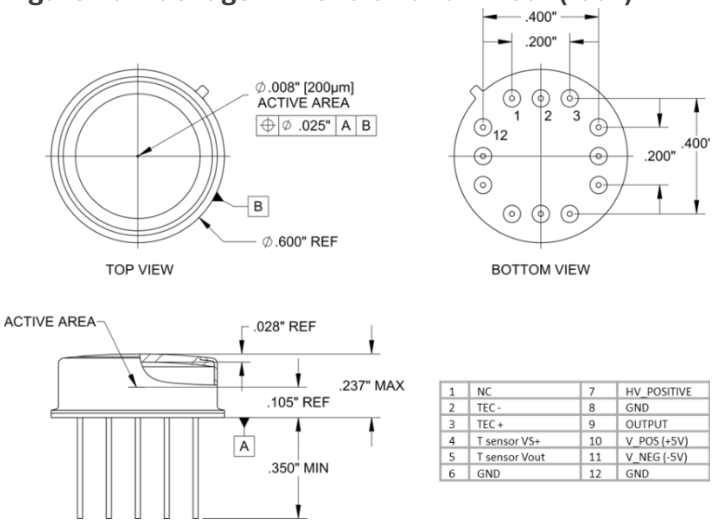
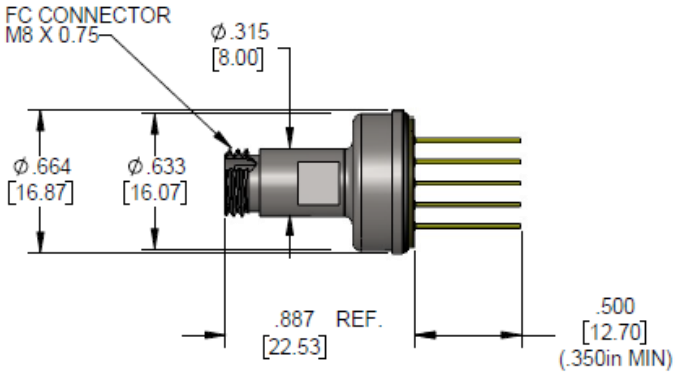


Figure 10. Package Dimension and Pinout (-002)



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 11. FC connector (617-339835)



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

VAR Options

VAR	264-339835-VAR
-001	InGaAs APD 350 µm
-002	InGaAs APD 200 µm
-003	InGaAs APD 80 µm

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

For information purposes only. To accommodate product improvements, specifications are subject to change without notice.

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