

Broadband Pulsed Infrared Light Sources




- Broadband IR light from 2-20 μm
- Consistent Pulsed Operation
- Large Temperature Modulation
- Many Package and Window options
- Evaluation Kit for Rapid Prototyping







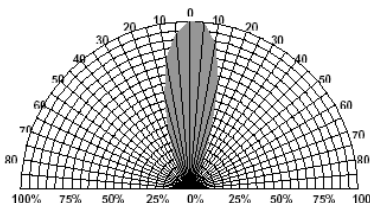
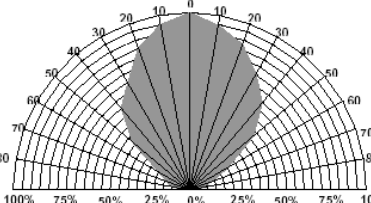
ICx Precision Photonics offers a unique class of electrically pulsed, high intensity infrared radiators for gas analysis, spectroscopy, calibration and tactical infrared friend or foe applications. These radiators feature a low thermal-mass filament tailored for high emissivity. The filament is fabricated using a patented process that supplies more IR power output above $4\mu\text{m}$ than while operating much cooler. This lower temperature operation reduces the chance of igniting combustible gasses, improves power efficiency, and reduces the parasitic heating of the optics and detectors. These IR sources are typically pulsed at rates from $\frac{1}{2}$ to 10 Hz with several hundred degrees of temperature modulation, allowing the design of smaller and simpler systems that do not require the added complexity of a mechanical chopper.

For demonstration and system design, ICx Precision Photonics provides an Evaluation Kit that includes the light source of your choosing. The Evaluation Kit drive card produces a flat-topped current pulse of adjustable amplitude, length, and frequency that runs with pre-programmed settings, or is connected to a PC for user control via Windows™.

PART NUMBERS/WINDOW OPTIONS :

	Parabola	TO-8	TO-5	TO-46
				
Windowless	reflectIR-P1N	NL8LNC	NL5LNC	NL46LNX
Sapphire 2 to 5.25 μm	reflectIR-P1S	NM8ASC	NM5NSC	N/A
Germanium 7 to 12 μm	N/A	N/A	NL5NGC	N/A
Calcium Flouride 2 to 9.5 μm	reflectIR-P1C	NL8ACC	NL5NCC	N/A

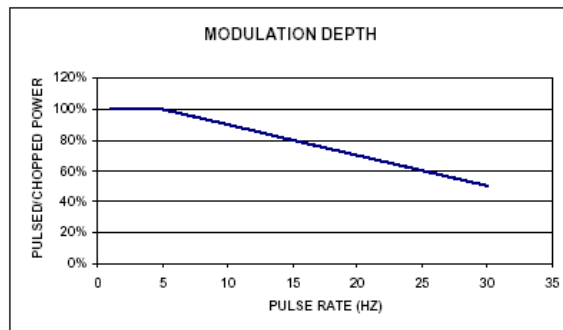
SPECIFICATIONS:

	Parabola	TO-8	TO-5	TO-46
				
Rated Temperature	850 °C	850 °C	850 °C	850 °C
Minimum Resistance	1.4 Ohms	2.8 Ohms	2.5 Ohms	0.4 Ohms
Maximum Resistance	2.0 Ohms	4.5 Ohms	3.7 Ohms	1.0 Ohms
Maximum Input Voltage*	1.75 VDC	2.8 VDC	2.6 VDC	0.9 VDC
Output Radiation Pattern+	<p style="text-align: center;">30 degrees</p> 	<p style="text-align: center;">95 degrees</p> 		

* Maximum Voltage based on typical resistance values.

+ Full angle for 50% of peak power

PULSED OPERATION

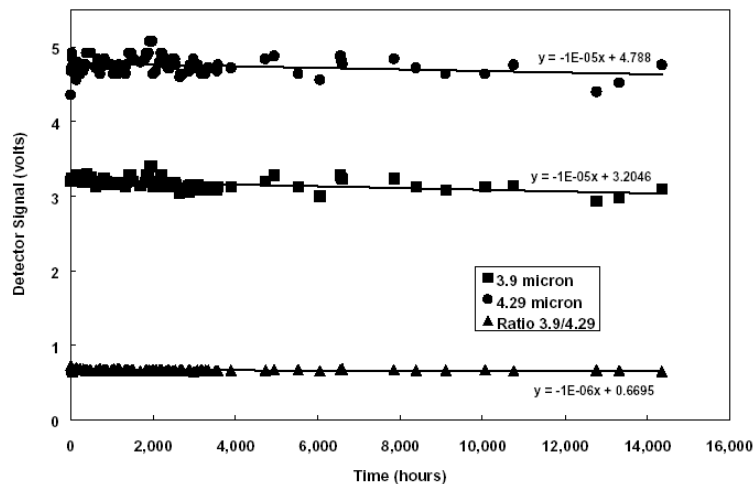


Although capable of running at duty cycles of up to 100 % (DC) most users run the filaments with duty cycles of less than 50%. Square-waveform constant current or constant voltage drive schemes are the simplest and most cost effective means of powering the sources. For constant current drives, the power delivered to the source goes as I²R. As the source heats up, its resistance increases slightly , causing the power delivered to the source to increase during the “ON” portion of a pulse. For constant voltage drives, delivered power goes as V²/R; therefore the power delivered to the source tends to decrease slightly during the length of a pulse. Other drive schemes can also be employed; constant power or DC for example.

Owing to the extremely low thermal mass of pulsIR emitters, shot-to-shot stability is directly related to drive circuit stability. Variations in drive pulses will translate into variations in output.

To determine this we used a liquid nitrogen cooled InSb detector available in our laboratory for detecting energy in the 2-5 μm range. The pulsIR source was driven with a constant-voltage drive circuit that ensures pulse-to-pulse repeatability (standard deviation) of 5.3×10^{-4} . Measurements of the InSb detector reading from 16 seconds of 10 Hz operation was measured to have a comparable standard deviation of 6.8×10^{-4} .

SOURCE LIFETIME



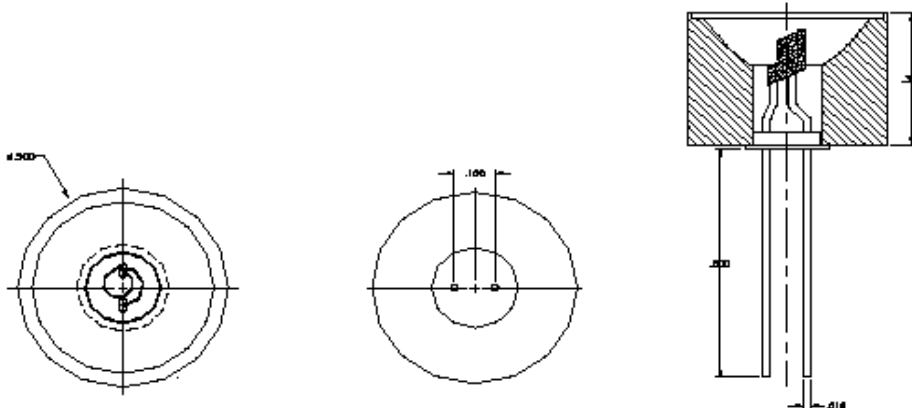
The following graph shows the results (to date) from an ongoing extended life test experiment using an ICx Precision Photonics NM8ASC source. The source is being driven by a constant current drive board at 1 Hz, 30% duty cycle at an approximate temperature of 650°C . Two pyroelectric detectors are monitoring the source output at two distinct wavelengths. In the following chart, the circles show the source output at 4.29 microns (CO_2) while the diamonds show the output at 3.9 microns (reference). The detectors are mounted about four inches from the front face of the source and a dry nitrogen purge is used to prevent water vapor and carbon dioxide in the lab air from affecting the measurement. The temperature in the lab is not very well controlled however, and much of the variation (specifically the bump at ~ 2000 hours) is due to room temperature swings.

The definition of failure, and thus the definition of lifetime, is very subjective as each system has unique sensitivity to drift (largely related to the A/D bandwidth). We have encountered several applications which define failure as $>15\%$ drift from the original power level, so we will adopt this definition for the purposes of this computation. The graph below shows that the median signal level from the 3.9 and 4.29 μm detectors is roughly 4 volts; the linear regression fits to the raw data indicate that both of these signals are decreasing at a rate of 1×10^{-5} volts/hour. With our assumed signal drift tolerance of 15% and 4 volt signal level, we require a 0.6 volt signal change to signal failure of the light source $[0.15 \times 4]$. With our measured rate of change being 1×10^{-5} volts/hour it will take approximately **6.85 years** of continuous operation to obtain a 15% signal change $[(0.6\text{v})/(1 \times 10^{-5}\text{v/hr})/(8760\text{hrs/yr})]$. Since many systems utilize the ratio of the gas measurement to a reference, they are sensitive not to signal changes, but to change in the ratio of the two signals. With a measured slope

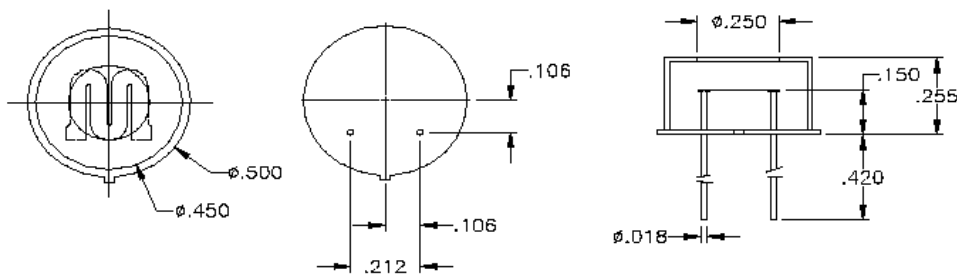
of 1×10^{-6} volts/hour and a 0.75 volt signal the same computation yields a lifetime of **12.84 years**.

Since all of the known filament degradation mechanisms are temperature dependent, the time to 15% failure is strongly dependent upon operating temperature or electrical power applied. Therefore, caution should be used in extrapolating these results to your application.

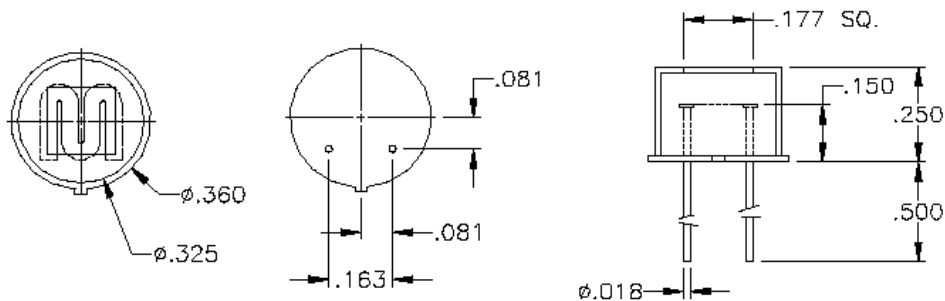
REFLECTIR PACKAGE DIMENSIONS



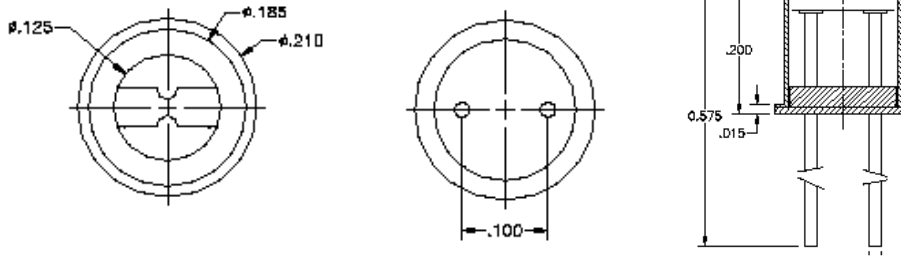
TO-8 PACKAGE DIMENSIONS



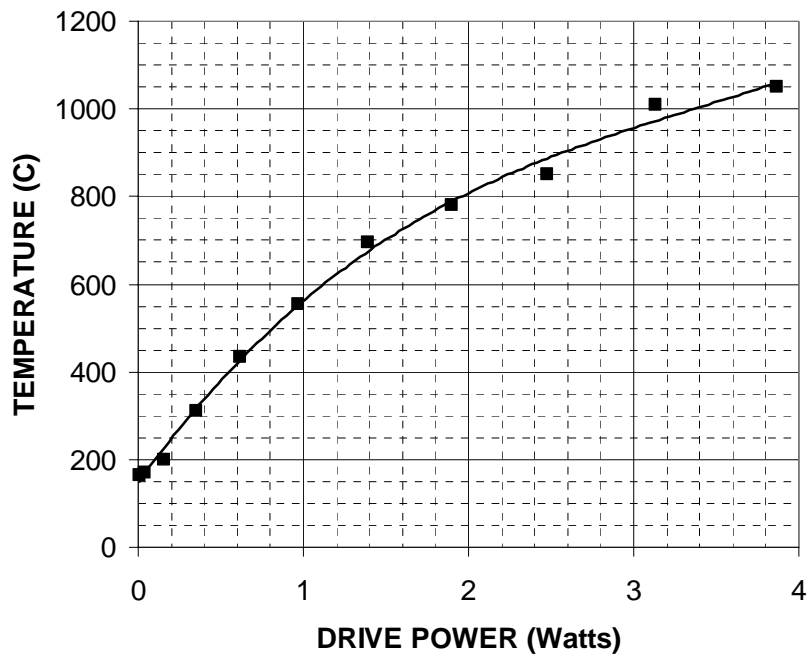
TO-5 PACKAGE DIMENSIONS



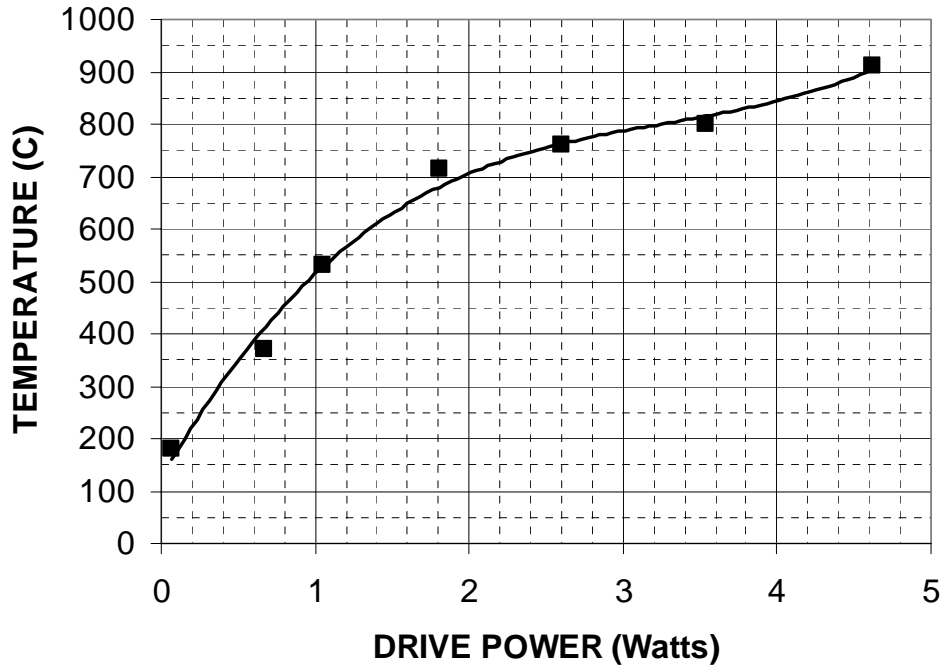
TO-46 PACKAGE DIMENSIONS



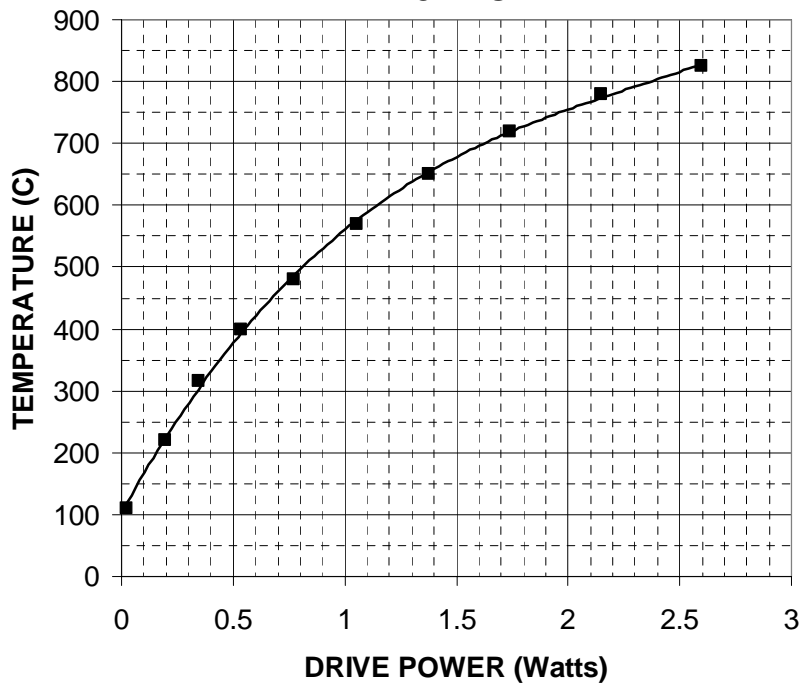
reflectIR - P1N

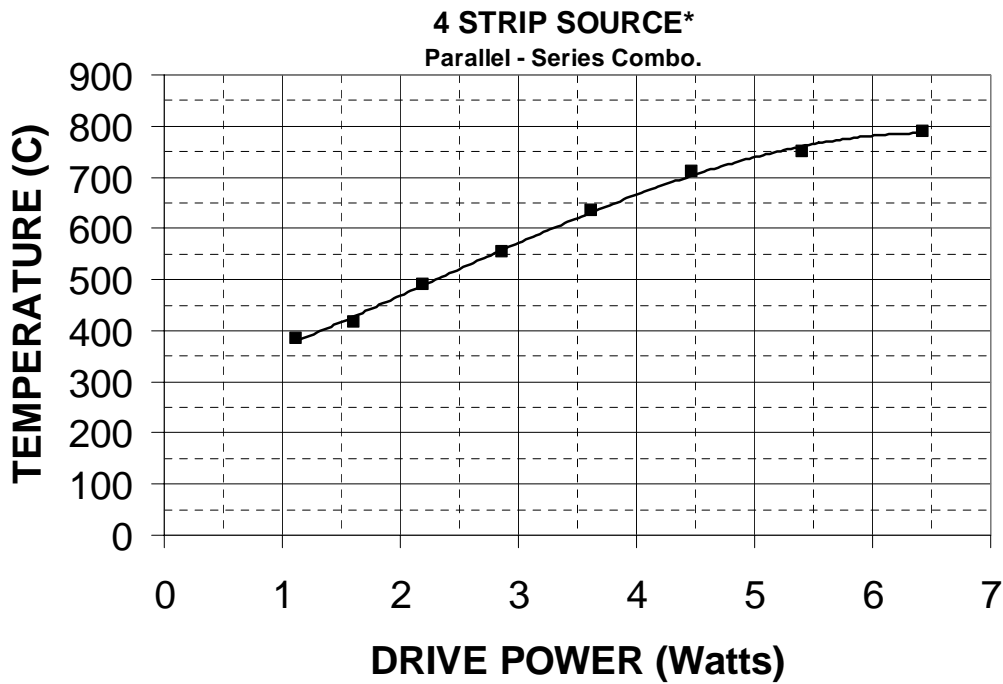
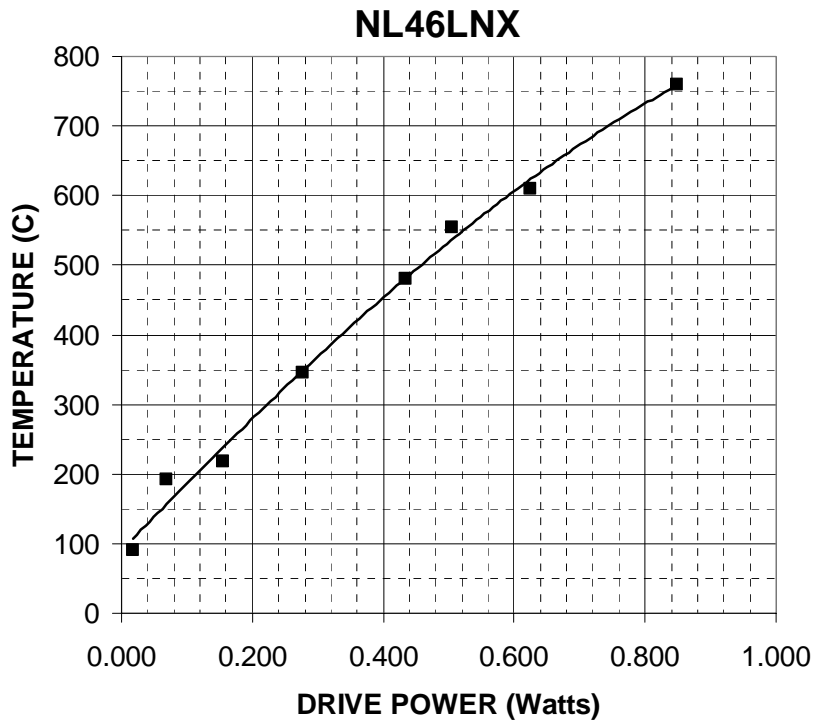


NL8LNC



NL5LNC





Please view datasheet 10249 on our 'New high power, multi-element pulsIR sources' for more information on our 4-strip source.

pulsIR™ High Power, Multi- Element Devices

DESCRIPTION

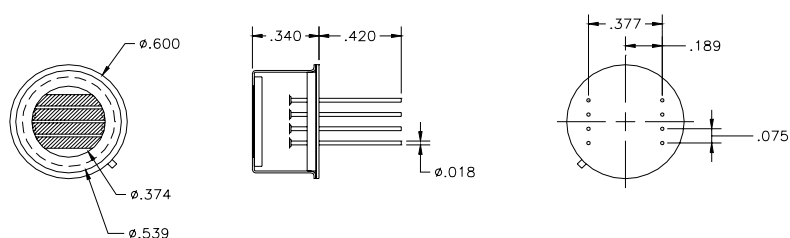
To meet customer demands for more IR power, ICx Precision Photonics has added multi-element devices to our pulsIR line of broad-band infrared light sources. These new devices feature 2 or 4 filaments which may be powered together or independently to provide very high intensity infrared output. As a member of the pulsIR family, this device features a low thermal-mass filament that has been ion-beam treated for high infrared emissivity. These electrically-pulsed, high intensity infrared radiators provide intense IR output while operating at relatively low temperature. This improves power efficiency, extends lifetime, and reduces the parasitic heating of system optics and detectors. They may be operated constant or pulsed at rates up to 10 Hz enabling the design of smaller and simpler systems that do not require the added complexity of a mechanical chopper. Samples in any configuration are available for \$80 each.

SPECIFICATIONS

Attribute	Nominal Value	Range
Device Resistance (per strip)	1.5 Ω	± 0.2
Resistance Matching (strip-to-strip within a device)	± 0.1 Ω	
Rated Drive Power (per strip)	1.6 Watts	± 0.1
Temperature Rating	850 C	
Modulation Rate (for full turn off/on)	Constant - 5 Hz	70 % Mod @ 10 Hz
Ouput Pattern	Lambertian	

PART NUMBERS

Window	Wavelength	2-Strip	4-Strip
None	2-20 μm	NL82LNC	NL84LNC
Sapphire	2-5 μm	NM82ASC	NM84ASC
CaF ₂	2-10 μm	NL82ACC	NL84ACC



TM
tunIR

restricted band infrared source 3-5 μ m or 8-12 μ m

DESCRIPTION

The tunIR Tuned Band Emitter uses a two-dimensional photonic crystal structure to tune and confine the IR emission to the spectral region of interest. They are available in either the 3 – 5 μ m or 8 – 12 μ m ranges.

These miniature devices provide high energy infrared signals with minimal power consumption. Each device contains 2 elements which may be coupled together or independently driven in pulsed or constant modes. Both elements are vacuum sealed to create an intrinsically safe package.

FEATURES & BENEFITS:

Power output: Power in either band: 1.5-2 mW

Power efficient: <67.5 mW per filament

Continuous/Pulsed operation: 0-1 Hertz

Wavelength Specific: tunIR 425 or tunIR 812 Band Emitters

Lightweight & Small: Different packaging options available

Vacuum Sealed: Impermeable to liquids & vapors

Intrinsically Safe: Non-incendiary

APPLICATIONS:

The power efficient tightly controlled emission spectrum of the tunIR devices makes them suitable for multiple applications where power consumption and intrinsic safety are critical.

- NDIR gas sensors
- Medical applications
- Automotive emissions
- Refrigerant detection
- Indoor air quality

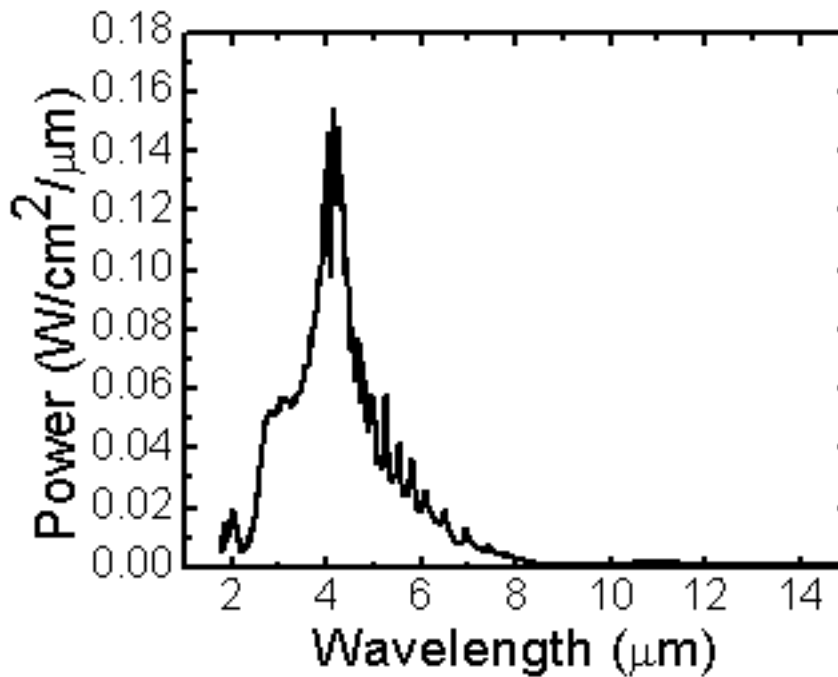
The tunIR units can be operated individually or in combination to produce single or multiwavelength emitters in the mid- or long infrared portions of the spectrum.

ELECTRICAL SPECIFICATIONS

Device Resistance	two 116 ohm filaments (configurable in series or parallel)
Device Resistance when powered	240 ohm
Input voltage	4 V per filament
Power Consumption	<67.5 mW per filament
Current Draw	<17 mA per filament
Operational package temperature	< 40 ° C

OPTICAL CHARACTERISTICS

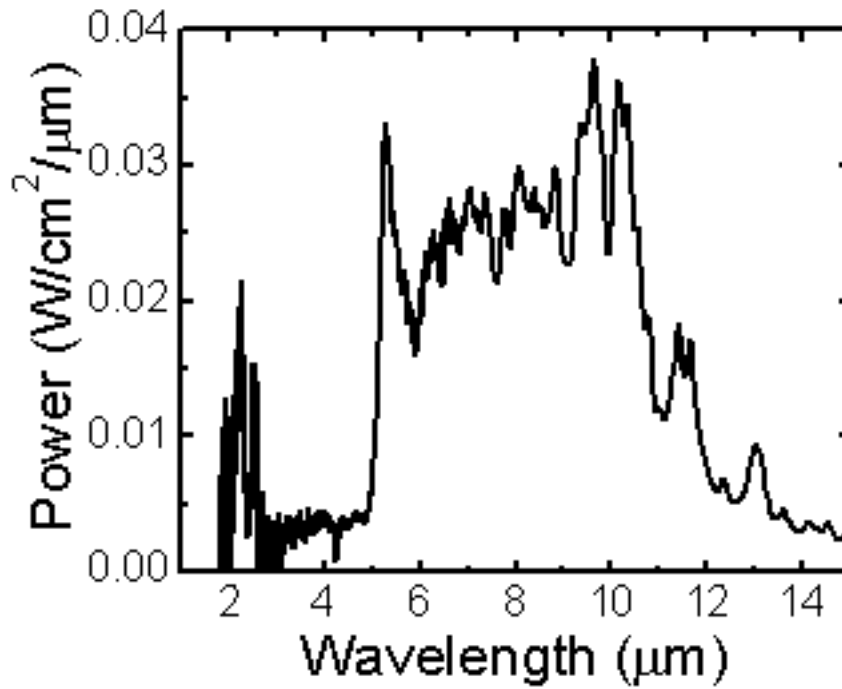
tunIR 3-5 μm



Inband power (integrated 3-5 μm)	>15 mW
Out of band power	<0.2 mW
Modulation depth @ 1Hz	100 %
Modulation depth @ 5Hz	70 %
Emitter Area	two 1.5 x 3 mm ² filaments

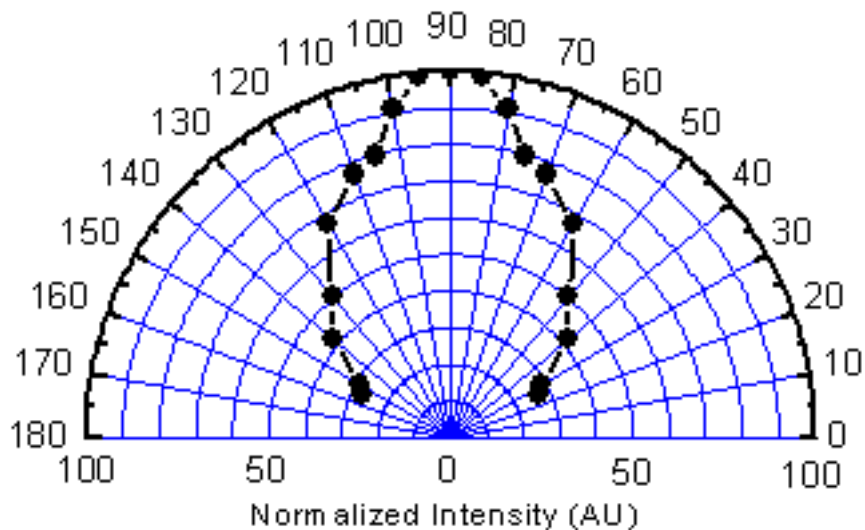
OPTICAL CHARACTERISTICS

tunIR 8-12 μm

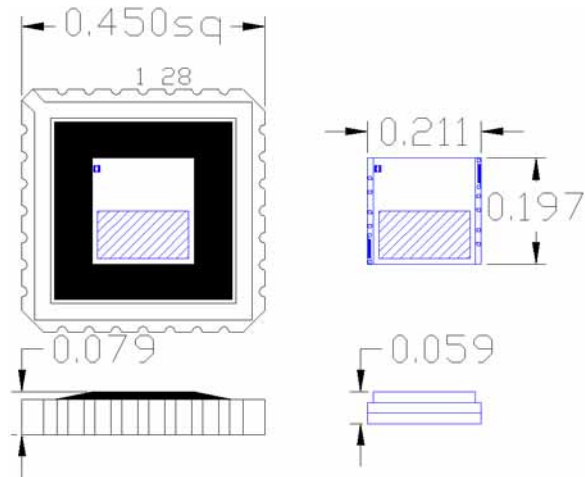


Inband power (integrated 8-12 μm)	6 mW
Out of band power	<0.5 mW
Modulation depth @ 1Hz	100 %
Modulation depth @ 5Hz	not measured
Emitter Area	two 1.5 x 3 mm ² filaments

Normalized angular power spectrum for tunIR 3-5 μm



PACKAGE GEOMETRY



<p>28 pin ceramic LCC surface mount package</p>	<p>Un- packaged device for direct wirebonding to circuit board</p>
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a single component NDIR sensor

DESCRIPTION

The SensorChip CO₂ sensor is a highly integrated single component IR device containing all elements of an NDIR optical bench on a single MEMS chip. This miniature device generates narrowband infrared radiation tuned to CO₂, eliminating the need for optical filters. The emitter provides tuned output with 85% of the blackbody power at the CO₂ wavelength and suppresses emission at other bands for high CO₂ selectivity and power efficiency. This is achieved through ICx Precision Photonics' patented PCE (photonic crystal enhanced) emitter technology.

When designed into a retro-reflecting optical cell, the hot filament source also acts as a narrowband infrared bolometer detector enabling sensitive and repeatable gas measurements. Within the chip is a reference element for self-compensating electronic operation and an on-chip thermistor to facilitate thermal correction. The miniature vacuum encapsulation and very high power conversion efficiency combine to provide a low case temperature and intrinsically safe operation. The SensorChip CO₂ sensors can also be powered intermittently to conserve energy in battery operated systems.

BENEFITS

- Low power consumption, 70 mW
- Intrinsically safe
- CO₂ selective response
- No sensor hysteresis
- Sensitive & Repeatable, 100 ppm
- Fast response, 1 Sec
- Low system cost

APPLICATIONS:

The highly integrated SensorChip CO₂ sensor system is ideal for many carbon dioxide sensing applications where low-power consumption, gas specificity, and intrinsic safety are critical, these include:

- HVAC / IAQ
- Medical Capnometry
- Industrial Safety
- Automotive Monitoring
- Food & beverage processing and storage

DEVICE PROPERTIES

Attribute	Nominal Value	Range
Resistance (Ω / pixel)	116	± 10
Pixel-Pixel Δ -Resistance (Ω)	< 1.0	-
Bias Voltage- Room T (V/ Pixel)	2.5	1.8 - 4.2
Power Consumption: per pixel @ 2.5 V (mW)	35	± 3
Cold Warm-up Time: 90% accuracy (min)	< 2	-
Response Time: T90/10 Warmed (mSec)	850	± 50
Weight (bare/package:grams)	5/21	-
Operational Ambient Temp ($^{\circ}\text{C}$)	-20-50	-
Storage Temp ($^{\circ}\text{C}$)	-50-75	-
Operational Package T ($^{\circ}\text{C}$)	Ambient + < 15	-
Operational RH (non condensing)	-	0-95%
Physical Shock* (g)	2m drop test	-
Ambient Pressure* (atm)	1	up to 3
MTBF- Continuous Operation (yrs)	5	-
Warranty (yrs)	1	-

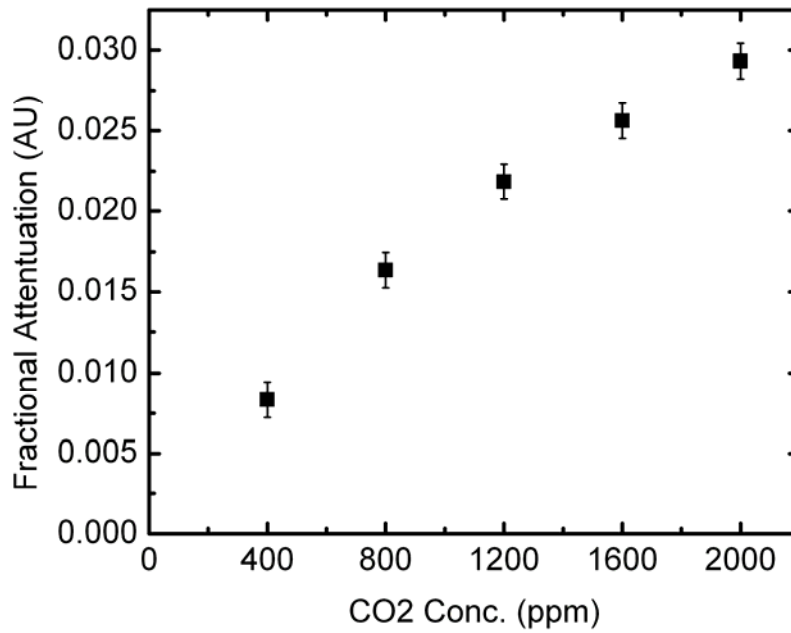
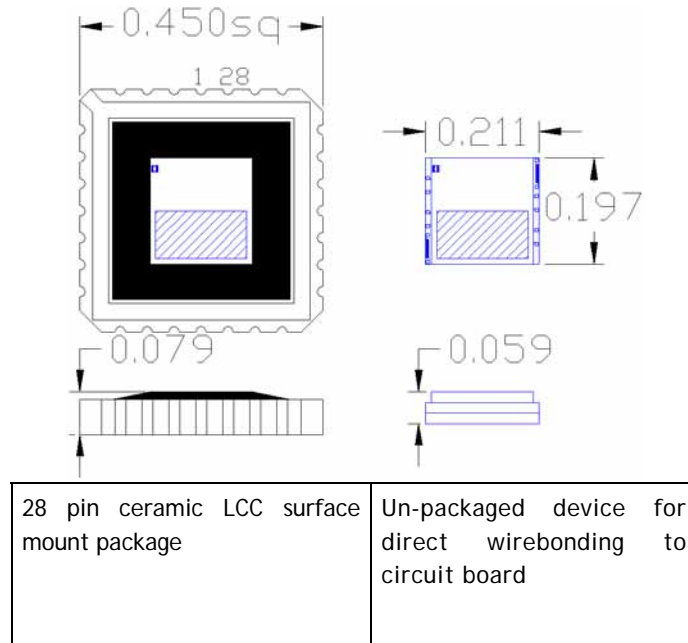
* Consistent sensor performance observed before and after exposure to test conditions, performance while subjected is unknown

SENSING PERFORMANCE (Using ICx Precision Photonics reference circuit and 5.6 cm optical path)

CO ₂ Sensing Range*	0-100 %	-
Accuracy (ppm)	± 50	-
CO ₂ Resolution (ppm)	$\pm 50 + 3\%$ level	-
H ₂ O Sensitivity: CO ₂ equiv. @ 85% RH, 40 $^{\circ}\text{C}$	<100	-
Temp Sensitivity:** CO ₂ equiv. (ppm/ $^{\circ}\text{C}$)	<1	-
Baseline Stability**(ppm)	1% F.S.	-
Span Stability (ppm/mo)	<1	-

* Path length adjustments required

** Compensated output using ICx Precision Photonics recommended circuits and algorithms.



Fractional attenuation at 5.6cm path length