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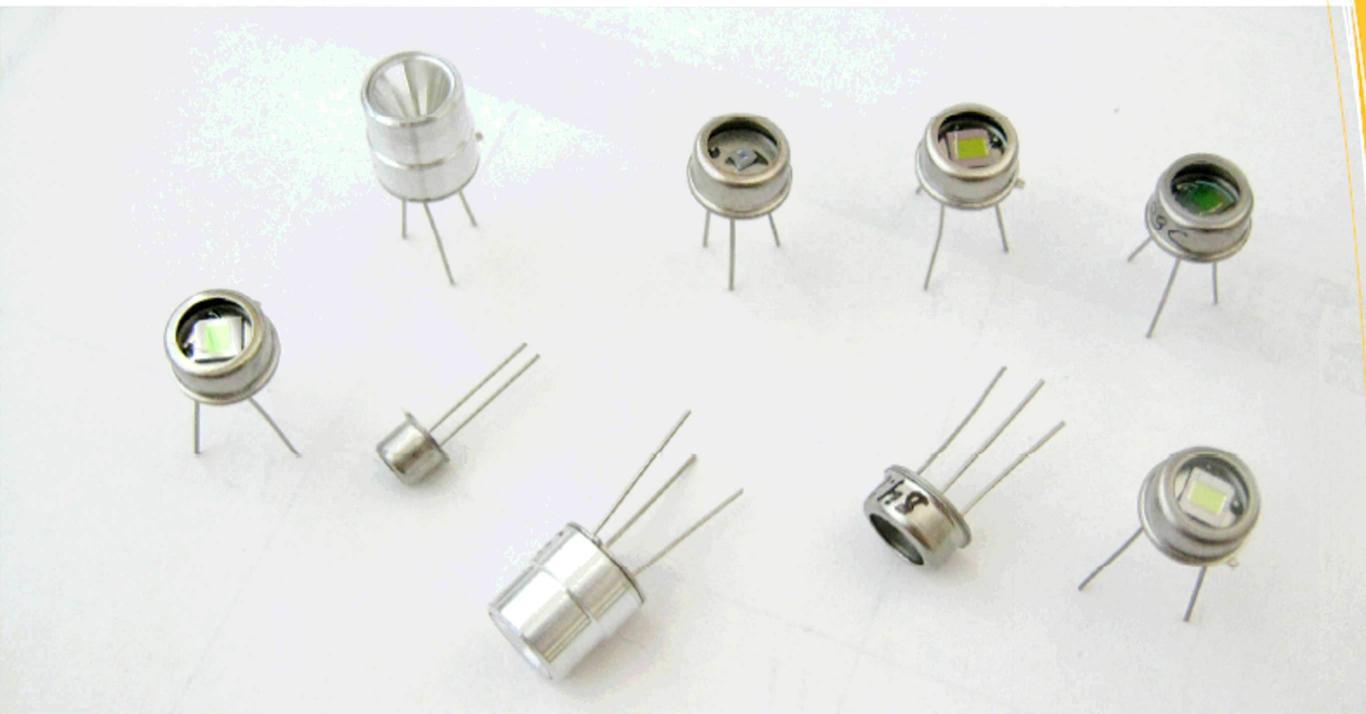
intex



Silicon MEMS Optical Technology

Infrared Emitters

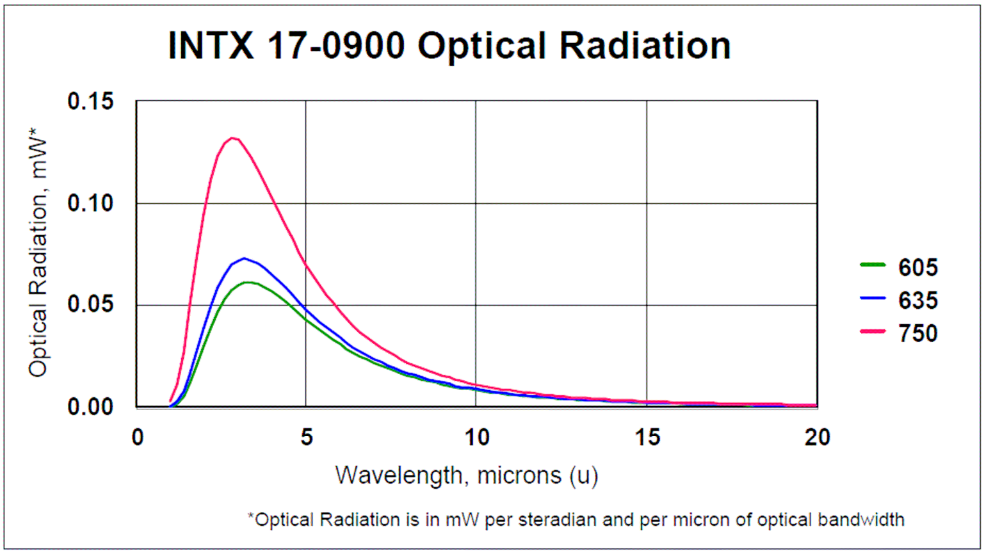
Electronic modulation to 140 Hz

750 C maximum operating temperature

2 ohm hot – cold resistance change

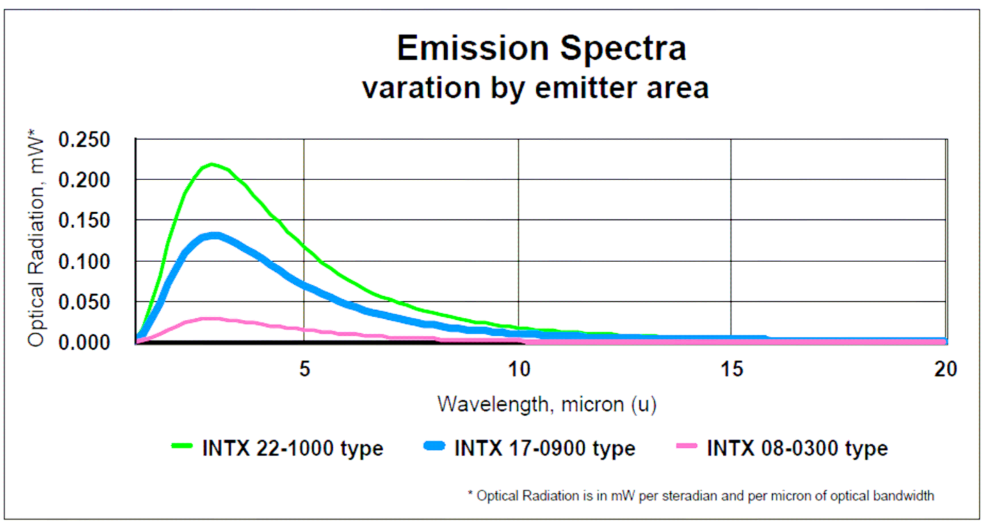
Emission Spectra and Temperature

Intex's pulsed infrared (IR) light sources are thermal sources emitting infrared energy over a wavelength range of 1-20 microns. The energy output at each wavelength is given by Planck's law so the optical energy density at any wavelength is known based on the temperature, size and emissivity of the emitter. All Intex Emitters are designed and specified to operate up to 750° C. Operation at lower temperatures is possible. Many present applications are operating at 605° C. The graph below shows the optical radiation delivered by the INTX 17-0900 series when operated from 605° C to 750° C. Notice that the peak emission shifts slightly to shorter wavelengths as the temperature increases. However, a higher temperature delivers a higher energy output at all wavelengths.



Emission Spectra and Area

Intex's pulsed infrared (IR) light sources have three different emitting area sizes. Increasing membrane area gives increased optical output and a small increase in input power. Plotted below is the energy output from the different size emitters operating at 750° C. The output at every wavelength is affected the same by a change in emission area. Selecting the proper size device is a matter of system optical aperture, S/N ratio desired and energy available to power the emitter.



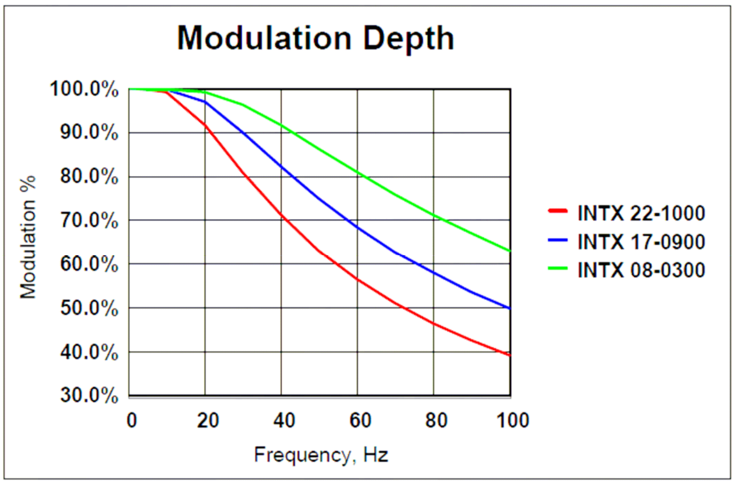
Modulation Depth

The thermal time constant of the Emitter's membrane is the time it takes to heat and cool one complete cycle. This time constant restricts how much the device will modulate when electrically "chopped". It is an exponential function described by the equation:

$$dT = dT_o \exp(-T/Tau)$$

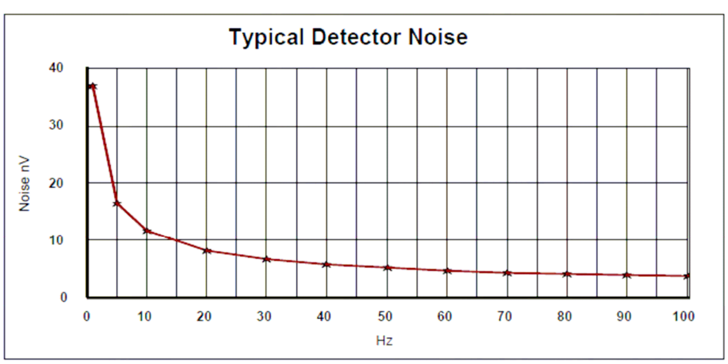
dT = membrane temperature at time T
dT_o = membrane temperature at time Zero
T = time since Zero
Tau = thermal time constant

One feature of the Intex technology, Vs. typical competitors, is a low thermal time constant which results in high modulation depth at high chopping frequencies.



The "slowest" Intex part INTX 22-1000 can be chopped at up to 70 Hz before the modulation depth goes below 50%. The fastest, INTX 08-0300 can be electronically chopped up to 140 Hz. with modulation above 60%.

High chopping frequencies can improve system Signal to Noise ratio (S/N) by overcoming detector 1/f noise. Consider a popular thermopile detector that has a noise specification of 37 nV/ Sqrt Hz. Operating at 40 Hz as opposed to 5 Hz will lower the noise figure from 16.5 nV to 5.8 nV .

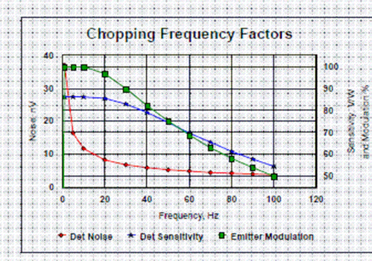


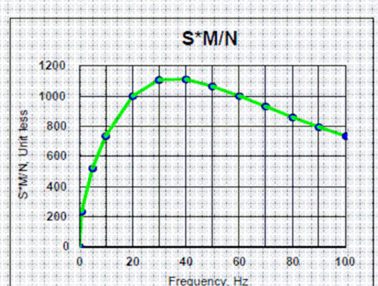
Optimal Chopping Frequency

System designers need to balance electronic chopping frequency with emitter modulation depth, detector sensitivity and detector noise level which all decrease with increasing chopping frequency, but not at the same rate. The optimum electronic chopping frequency is chosen to maximize signal-to-noise ratio.

An approach to optimizing the chopping frequency is to generate a unit-less function, the product of detector sensitivity and emitter modulation depth divided by detector noise floor. That function will peak near the optimal operating frequency.

A typical case using the INTX 17-0900 emitter and a thermopile detector with a noise figure of 37 nV/ sqrt Hz and a detector response time constant of 10 mS yields an optimal chopping rate near 40 Hz, graphed below.





	INTX 17-0900	INTX 22-1000	INTX 08-0300 Preliminary
Description	**Basic Product**	**Larger Area and Power**	**Small Area with Lower Power 2.5 Volt Drive**
Thermal Time Constant	14.4 mS typ.	20.0 mS typ.	10.0 mS typ.
Operating Temperature	605° C Typical / 750° C Max.		
Heated Membrane Area	2.89 mm^2 1.7x1.7 mm	4.80 mm^2 2.2 X 2.2 mm	0.64mm^2 0.8 X 0.8 mm
Drive Power, mW	690 Typical /900 Max.	767 Typical / 1,000 Max.	230 Typical / 300 Max.
Emissivity	.80		.90
Spectral Range	1 – 20 microns typical		
Modulation Frequency	1-100 Hz. Typical		1-200 Hz. Typical
Frequency at 50% Modulation	100 Hz.	70 Hz.	140 Hz.
Resistance at Operating Temperature (750 C) ohms	**Min.** 40 / **Typical** 50 / **Max.** 60	**Min.** 35 / **Typical** 45 / **Max.** 55	**Min.** 16 / **Typical** 21 / **Max.** 26
Resistance at Room Temperature (25 C) ohms	48 Typical	43 Typical	14 Typical
Drive Voltage at Operating Temperature (750 C) volts	5.9 Typical / 6.7 Max.	5.9 Typical / 6.7 Max.	2.2 Typical / 2.5 Max.
Drive Current at Operating Temperature (750 C) mA	117 Typical / 134 Max.	130 Typical / 149 Max.	105 Typical / 120 Max.
Average Lifetime, at 10 Hz, 50% duty cycle	100,000 hrs at 605° C 5,000 hrs at 750° C		TBD
Package	**Type Code - P**: 1 2	**ANSI #**: TO-5 TO-39	**Type Code - P**: 3 **ANSI #**: TO-18

A Range of Emitters

The INTX 17-0900 was our first emitter, introduced in 2005. With an emission area of 1.7 mm X 1.7mm and a 900 mW maximum drive power it is still very popular.

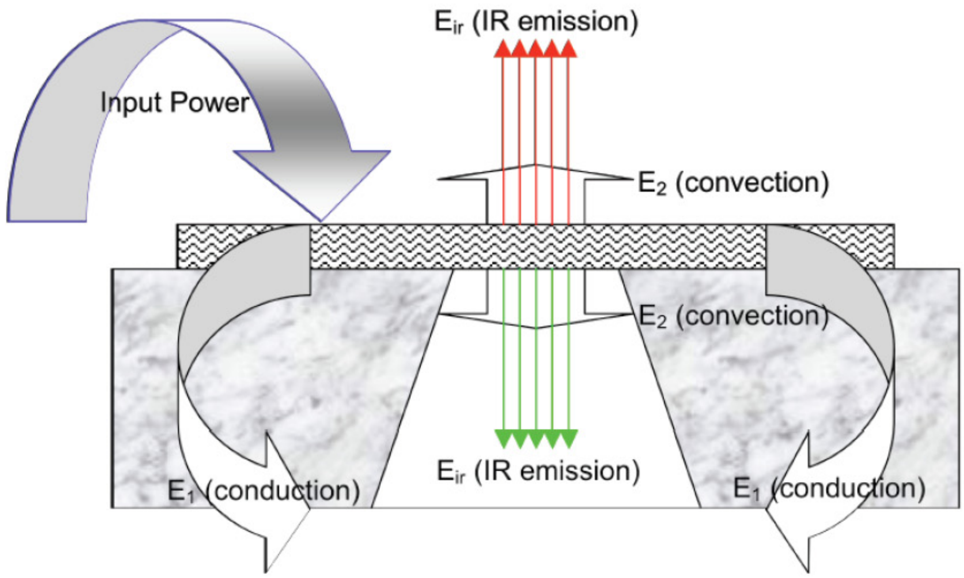
In response to requests for more power, for instance to illuminate larger detector arrays, the INTX 22-1000 was developed. It's emission area is 2.2 mm X 2.2 mm and it has a maximum drive power of 1000 mW.

In 2011, a 5.0 Volt version of the INTX 22-1000 is planned to accommodate single supply systems.

In response to requests for low-cost, low-power devices, we are also developing the model INTX 08 -0300. With a smaller 0.8 mm X 0.8 mm emission area, it has a maximum power consumption of only 300 mW. Drive voltage will be typically 2.2-2.5 volts. This device is targeted at high-volume potentially battery-powered, sensor devices.

Various optical windows as well as reflector options are available.

Power Dissipation of the Infrared Emitter



The power E_0, input electrically, is dissipated by the Emitter in three ways,

$$\mathbf{Eo = Eir + E_1 + E_2}$$

Eir =infrared radiation, the desired optical output of the emitter
E_1 = conduction through the silicon substrate, wasted energy
E_2 = convection through air, wasted energy

The magnitude of the infrared radiation is a function of the surface area, emissivity and temperature.

$$\mathbf{Eir = € \cdot £ \cdot T^4 \cdot A}$$

€ = emissivity of the surface, typically 0.8 in Intex Emitters
£ = $5.67 \cdot 10^{-8}$ [$W \cdot m^{-2} \cdot K^{-4}$]
T = Kelvin Temperature, typically 1023° K , (750° C max) in Intex Emitters
A = Area of the emitting surface, meter^2 , $2.89 \cdot 10^{-6}$ in INTX 17-0900

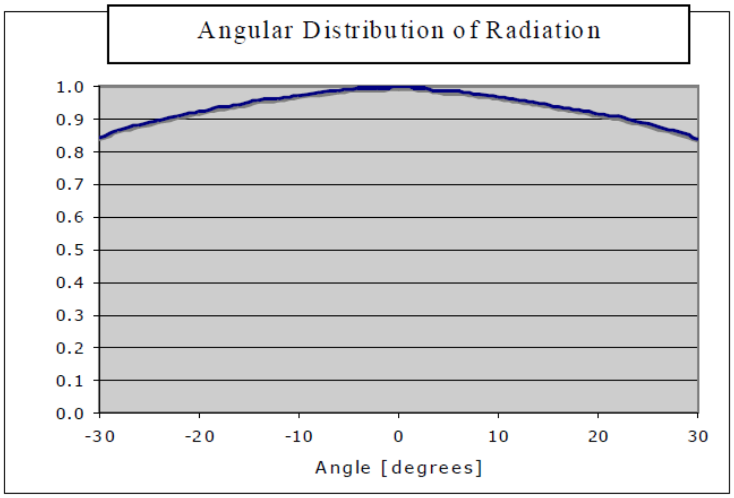
Eir = 144 mW, per side of the emitter

Typically the backside radiation is not projected toward the detector array and it contributes to wasted heat. For calculation purposes we lump this wasted energy into the conduction losses. Typical power dissipation is shown below. Notice 16% is converted into useful, forward projected, optical infrared radiation.

Typical Power Dissipation of an INTX 17-0900 type emitter at 750° C		
Input Power	900 mW	100%
Eir – Radiation power (forward)	144 mW	16%
E_1 – Conduction and rear surface radiation loss	215 mW	24%
E_2 – Convection loss	541 mW	60%

Angular Distribution of Radiation

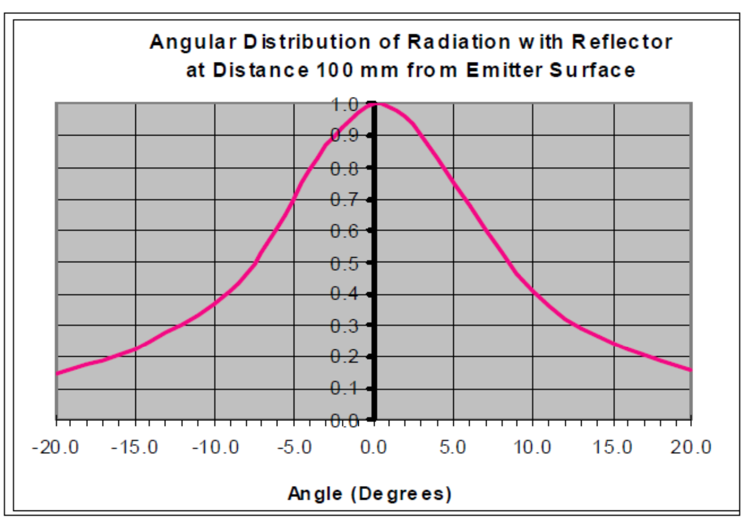
The Intex Emitter has a flat surface and from that surface the angular distribution of the radiation follows a cosine function, peaking at normal incidence.



Some system designs cannot locate the detector plane very close to the emitter and a significant amount of energy falls outside of the detector collection "field of view".

To improve the energy collimation, Intex offers a parabolic reflector option that can be fitted to the emitters.

With the reflector the Emitter's energy is kept within a much tighter solid angle. The distribution of an INTEX source with a parabolic reflector is shown below.



Options

Intex Emitters are rugged and are typically operated exposed to ambient atmosphere. Intex can provide Emitters with windows which can help define a sample compartment in certain applications. Window materials available are:

Calcium Fluoride
Sapphire
Barium Fluoride
Antireflective Coated Silicon

Some system integrators want even more flexibility in packaging. Available configurations are:

TO-5
TO-39
TO-18

Surface mounted Emitters can be supplied under special order.

The ultimate in low overhead packaging is DIE. We can supply cut or wafer level.

To assist customers in getting project concepts proven, and our components "designed in", we offer limited in house feasibility modeling and proof of principal prototyping. It is our goal to be of assistance throughout the entire product life cycle.

Please contact us to discuss your project.

State of the Art Technology

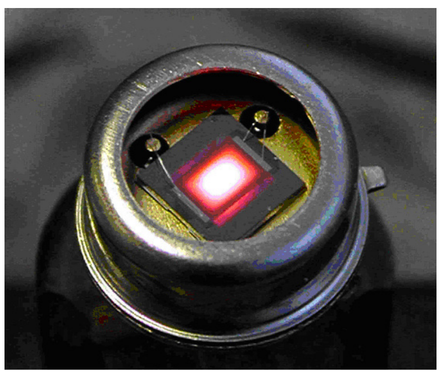
Intex's unique quasi-black body pulsed infrared (IR) light sources can operate at higher frequencies and temperatures than the competition, delivering higher Signal to Noise Ratio in your application.

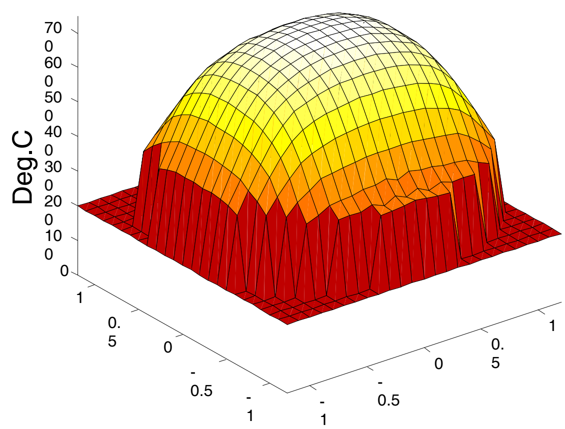
The Sources are made of patented, thin-membrane thermo resistive elements using MEMS technology at lower costs.

Modulation of the light output is achieved by modulating the input electrical power, eliminating the need for optical choppers and allowing precise control over the output spectral range in critical applications.

The temperature distribution of a membrane is shown in the figures below where the temperature in the center is 750°C, the maximum operating temperature.

The nanostructure carbon membrane defines the emission area and overlaps a silicon frame. The radiant area of the membrane is responsible for the spectral emission described by Planck's Equation.





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