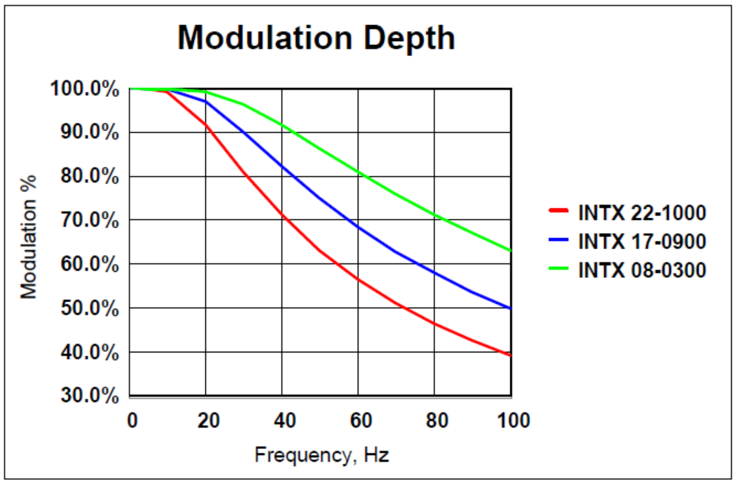
Modulation Depth

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:

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

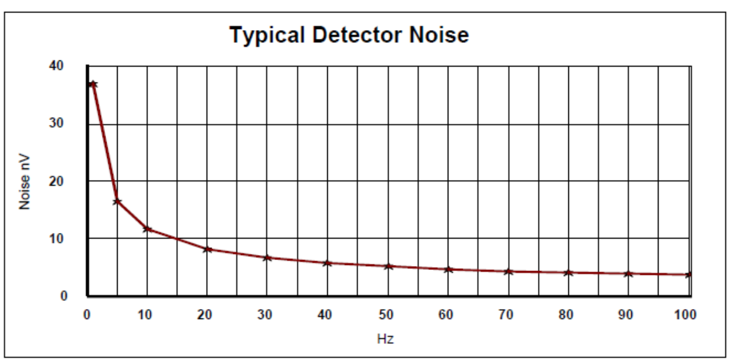
dT = membrane temperature at time T
dT_o = membrane temperature at time Zero
T = time since Zero
Tau = thermal time constant

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.