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## Residual FM and PM Noise

If an unmodulated oscillator is phase demodulated the resulting output voltage is the residual phase modulation resulting from phase noise on the carrier. It is sometimes referred to as incidental phase modulation. The demodulated baseband signal is important only over a limited frequency range. For example, typical baseband frequencies for voice communications are 50 to 3000 Hz, for Doppler radar are 1 Hz to 10 MHz and for navigation systems are subhertz to 10 Hz.

Residual PM may be found by integrating the SSB phase noise over the baseband frequency range of interest. The square of the rms residual PM is

$$\Delta\varphi^2 = 2\int_{f_a}^{f_b} L(f_m)\,df_m$$

Likewise, for rms residual FM

$$\Delta f^2 = 2\int_{f_a}^{f_b} f_m^2 L(f_m)\,df_m$$

Residual PM and FM are related to the ultimate system S/N. If the desired signal rms deviation is $\Delta f_s$, then

$$S/N = 10\log\frac{\Delta f_s^2}{\Delta f^2}$$

Besides relating directly to system performance, residual PM and FM are easier to measure than SSB phase noise, using less expensive instruments. So why is is oscillator and PLL phase noise typically specified as the SSB phase noise? Because the residuals can be found from the SSB phase noise but the inverse is not true without assuming a slope of the SSB phase noise versus offset frequency.

PLL computes rms residual PM and FM by integrating the SSB phase noise over the baseband frequency range specified in the SIM tab. The results are given in the report output section.