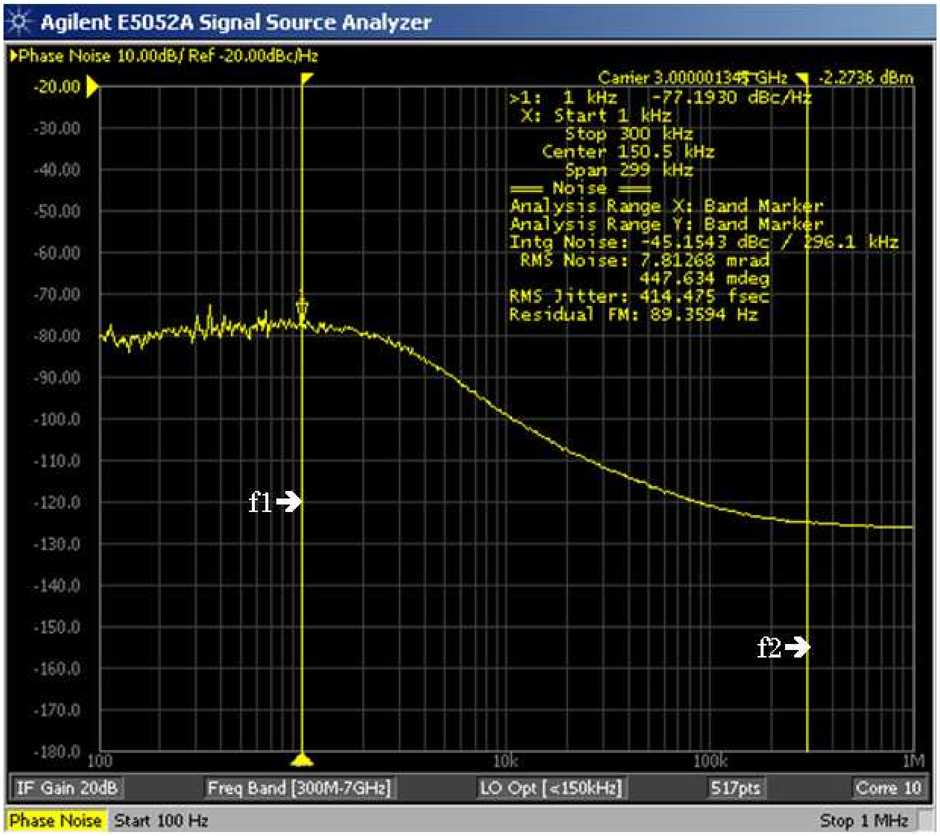
E5052A Integrated Phase Noise Measurements



Example E5052A integrated phase noise measurement. The band markers (f1 and f2) set the offset frequencies used for lower and upper bounds of integration.

Common phase noise related terms:

$S_{\phi}(f)$ = Spectral density of phase fluctuations (S-phi)

$S_{\nu}(f)$ = Spectral density of frequency fluctuations (S-nu)

$\mathcal{L}$(f) = Single-sideband phase noise relative to total signal power (script-L)

Relationships between the above terms:

$$\mathcal{L}(f) = \frac{S_{\phi}(f)}{2}$$ usually this result is given in dBc, in this case:

$$\mathcal{L}_{dBc}(f) = 10\log\frac{S_{\phi}(f)}{2}$$

$$S_{\nu}(f) = f^2 S_{\phi}(f)$$

Note: The formulas below assume that $\mathcal{L}(f)$, if expressed in dBc, has been converted to a linear power ratio by using $10^{(\mathcal{L}_{dBc}(f)/10)}$

RMS Phase Jitter [radians] = $\sqrt{\int_{f_1}^{f_2} S_{\phi}(f)df}$

RMS Phase Jitter [degrees] = $\frac{180}{\pi} \cdot \sqrt{\int_{f_1}^{f_2} S_{\phi}(f)df}$

Residual FM [Hz] = $\sqrt{\int_{f_1}^{f_2} S_{\nu}(f)df}$

Since the E5052A displays $\mathcal{L}(f)$ (SSB phase noise) directly, the relations shown below are useful in understanding how the integrated noise function works. The E5052A results (in dBc) must be converted to linear before being used in these formulas:

RMS Phase Jitter [radians] = $\sqrt{2\int_{f_1}^{f_2} \mathcal{L}(f)df}$

RMS Phase Jitter [degrees] = $\frac{180}{\pi} \cdot \sqrt{2\int_{f_1}^{f_2} \mathcal{L}(f)df}$

Residual FM [Hz] = $\sqrt{\int_{f_1}^{f_2} 2 f^2 \mathcal{L}(f)df}$

Integrated Noise [dBc/(f2-f1) Hz] = $10\log\int_{f_1}^{f_2} \mathcal{L}(f)df$

RMS Jitter [seconds] = $\frac{Jitter\ (radians)}{2\pi} \cdot \frac{1}{f_{carrier}}$