Yizh, the simulation results you have exposed tend to confirm that the approach you have followed is admissible in this particular situation. In fact this is true for practically all oscillator problems with relatively high Q, which is probably the case here.

The reason is that in a free running oscillator there is a conjunction of two types of noise, a frequency modulation noise and a frequency conversion noise. The frequency modulation noise is the direct oscillation frequency perturbation due to noise (noise stimulus behave like a control voltage of a VCO) while the frequency conversion noise results from the mixing of the small noise stimulus with the large signal generated by the oscillator (oscillator circuit behave like a mixer for noise stimulus). The dynamics of the oscillator is such that the frequency conversion noise (equal parts of phase and amplitude perturbations) tends to be suppressed in the short term (Barkhausen criterion: unity feedback gain constraint for stable oscillator maintains constant amplitude) while the frequency modulation results in a phase drift (integral of frequency) that cumulate indefinitely. The net effect is that in the long term, the noise observed at the oscillator output is dominated by the oscillation frequency modulation term.

Now suppose $\delta\omega_0(t)$ is the frequency modulation term and $\delta V_k(t)$ the frequency conversion noise around harmonic $k\ (k=1,2,..)$ due to noise stimulus.

We may write the oscillator output signal as $v(t)=\mathrm{Re}[\sum_k (V_k+\delta V_k(t))\exp(jk\omega_0 t+k\delta\phi_0(t))]$ with

$$\delta\phi_0(t)=\int_0^t \delta\omega_0(\tau)d\tau$$

Now provided that the frequency/phase modulation term $\delta\phi_0(t)$ supersedes the frequency conversion terms $\delta V_k(t)$ for the reasons given previously, the above equation shows that the net phase noise resulting at the various harmonics of oscillation follow a simple linear law: $k.\delta\phi_0(t)$, that is jitter measured at the first harmonic or any filtered non zero harmonic k will be the same.

Here is the reason why Pnoise/noisetyp=FM jitter option in Spectre tends to be sufficient for characterizing free running oscillator jitter.

Another important point is that the frequency modulation term is essentially coming out of the noise stimulus located around DC (low frequency) since only slow variations have enough inertia to move the oscillation frequency. Though noise frequency lines located close to oscillation harmonics will fold to DC by frequency conversion mechanisms and also modulate the oscillation frequency, but this is comparatively a second order response.

Here is the reason why Yizh is obtaining reasonable result by setting maxsideband to the minimum maxsideband=1, because It includes the main contributors of frequency modulation noise.

It is however not correct to sweep the sideband frequency above F0/2, this is theoretically wrong since jitter is a low sampled process, which means that its power spectral density is periodic with period F0. So integrating above F0/2 would mean doubling and tripling power, if the calculation in the simulator were correctly done.

I need to warn that the sufficiency of the two approximations above will of course depend on the circuit picture. The Q of the oscillator – the number of significant harmonics in the output signal – the noise in the output buffer will have various impacts on the approximations. Indeed noise added outside the oscillator feedback loop will only be of type frequency conversion and will not follow the mechanisms described above.

Note also that jitter obtained from why *Pnoise/noisetyp=FM jitter* correspond only to the minimum observable timing jitter, which is normally obtained for a sine wave (filtered single harmonic) at zero crossing.

A question Yizh – since you have the possibility of computing an effective threshold crossing jitter figure using Pnoise/noisetyp=PM jitter what is the primary reason why you prefer the FM one despite of the possible limitations ? I didn't clearly get it.