Spectre Noise Analysis

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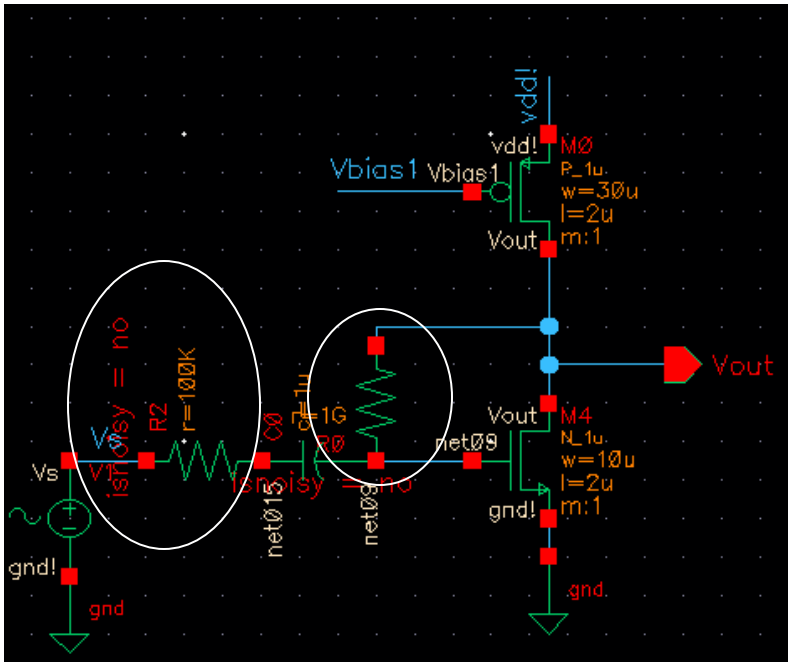
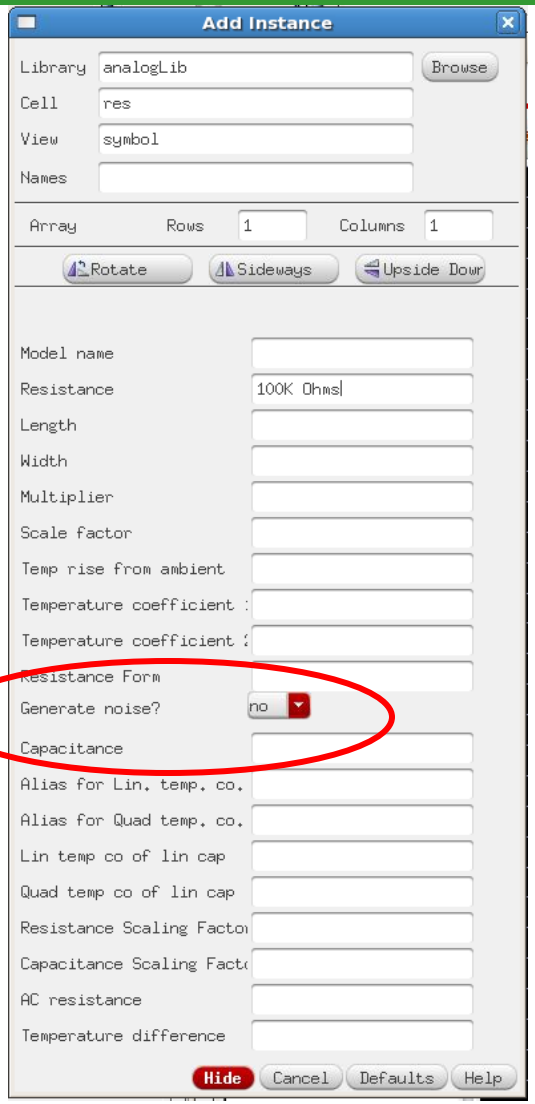
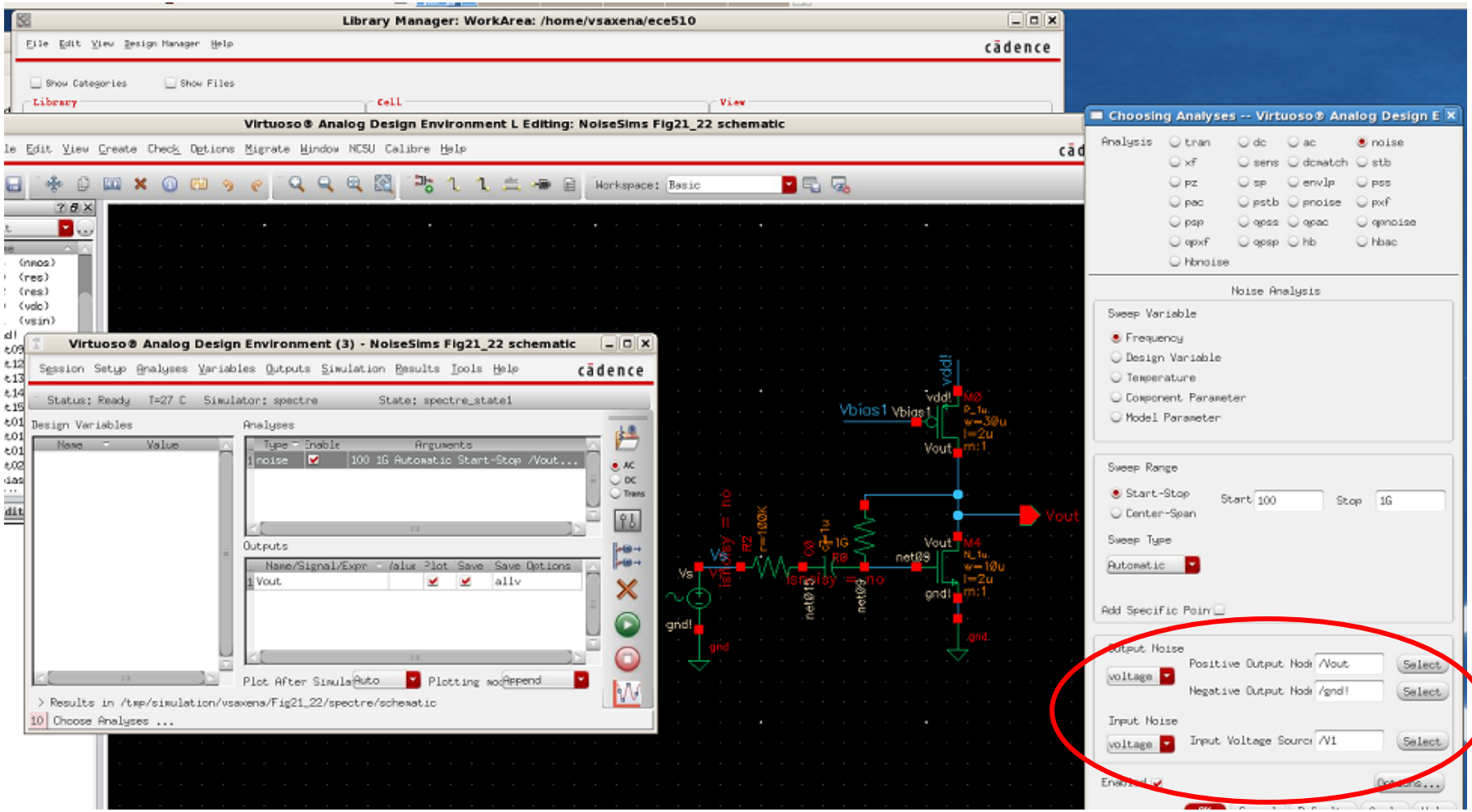
Making Resistors Noiseless

- Use AnalogLib→res component
- Set “Generate noise” parameter to No

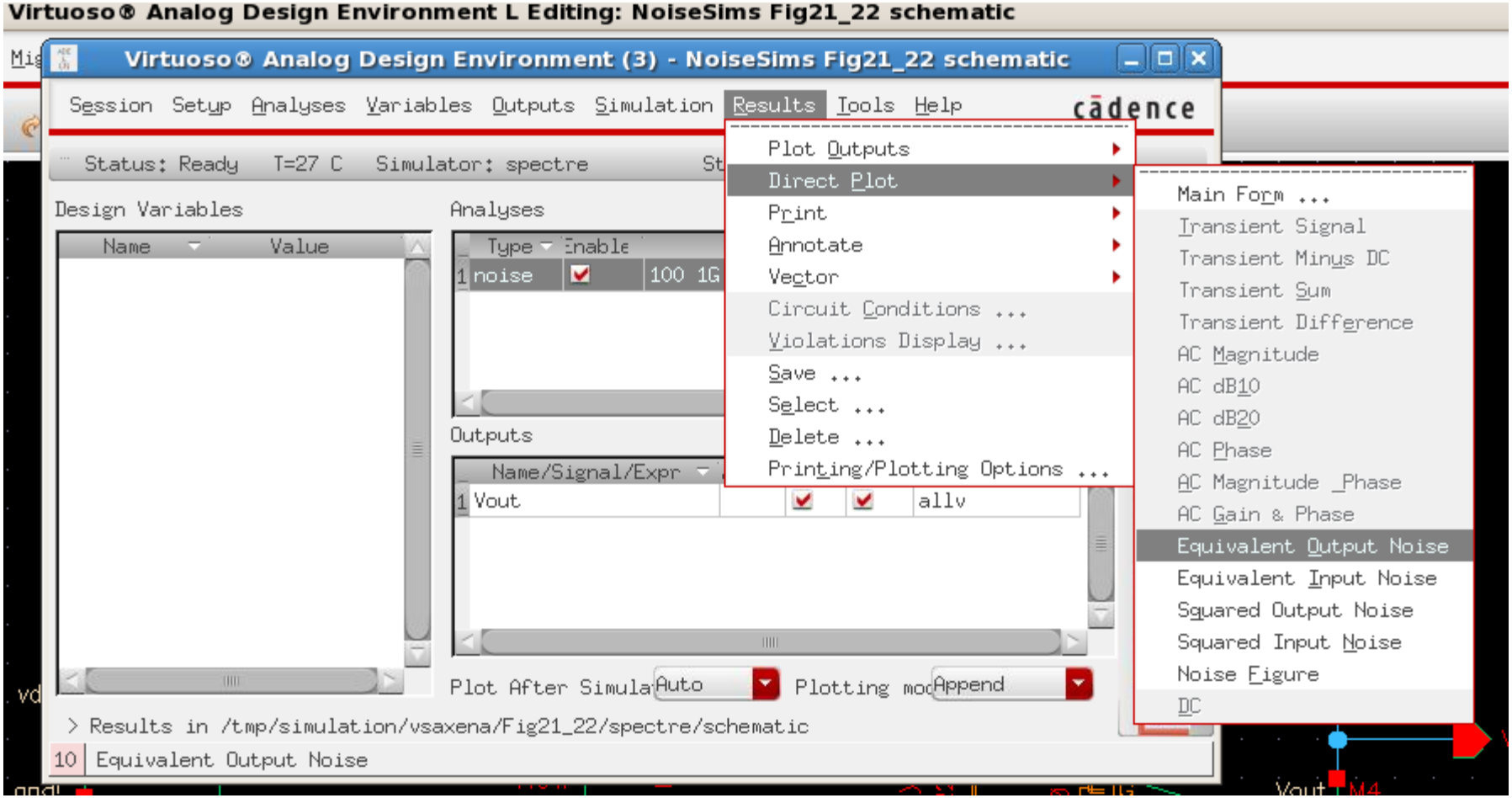




.noise Analysis

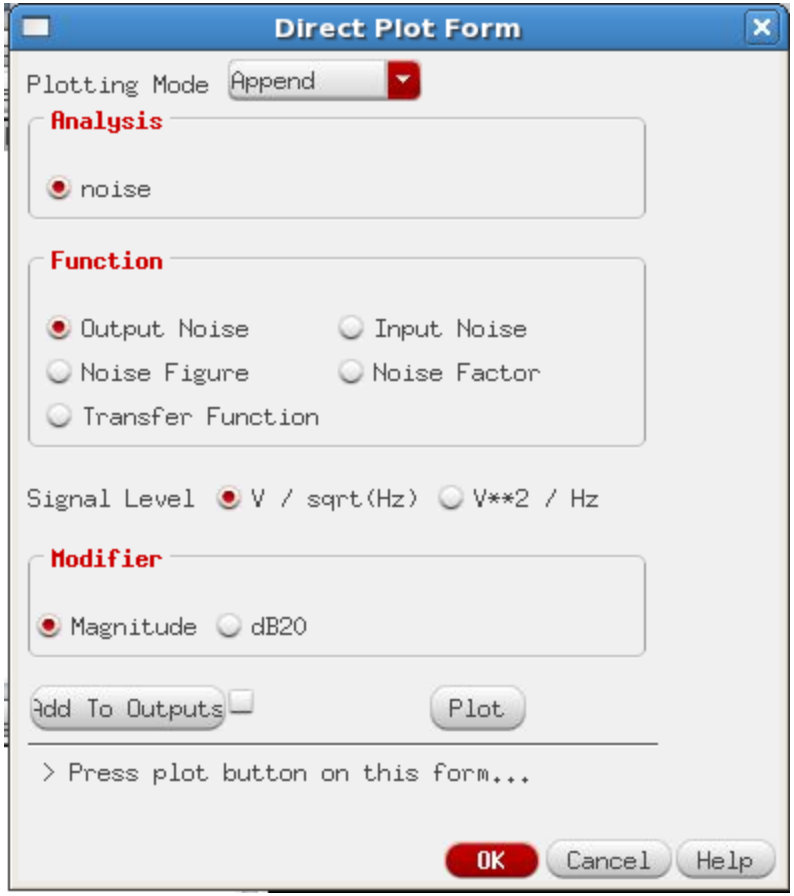


Plotting Results

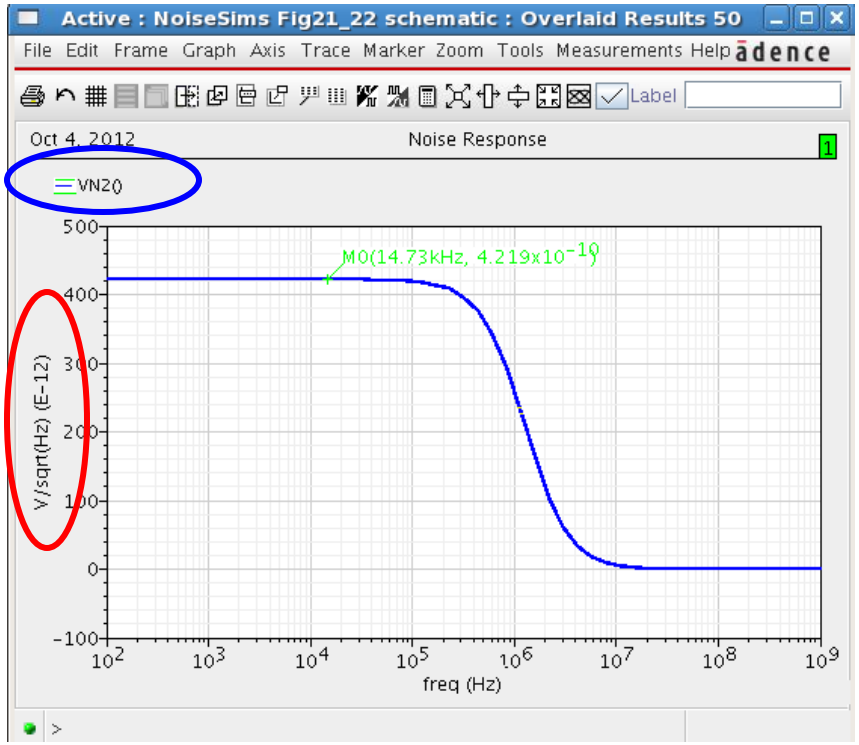


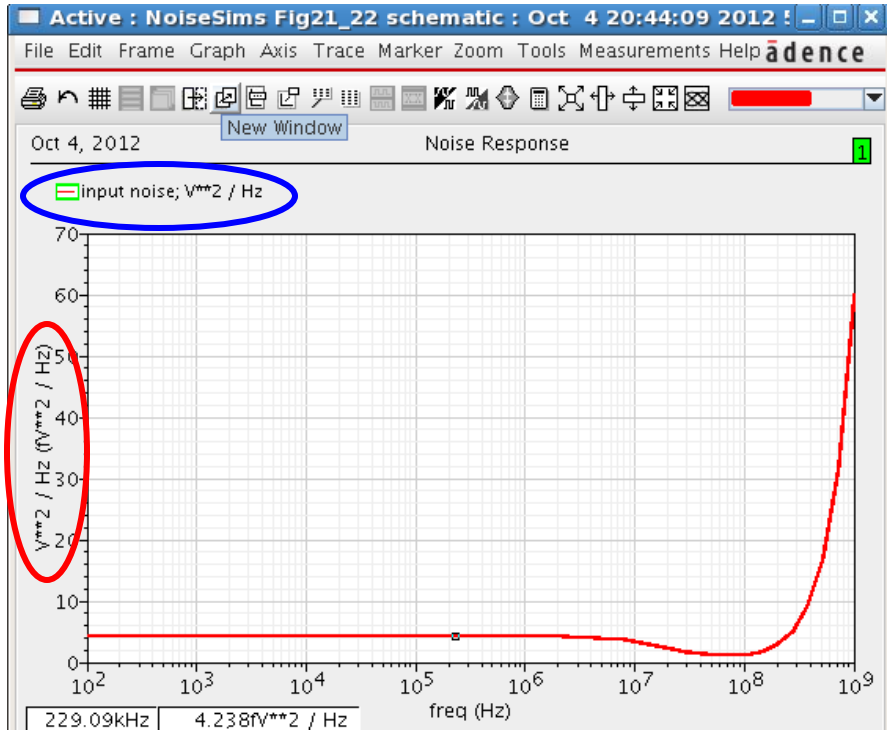
Direct Plot Form

- Can change units to PSD or VSD
- Add plots to outputs



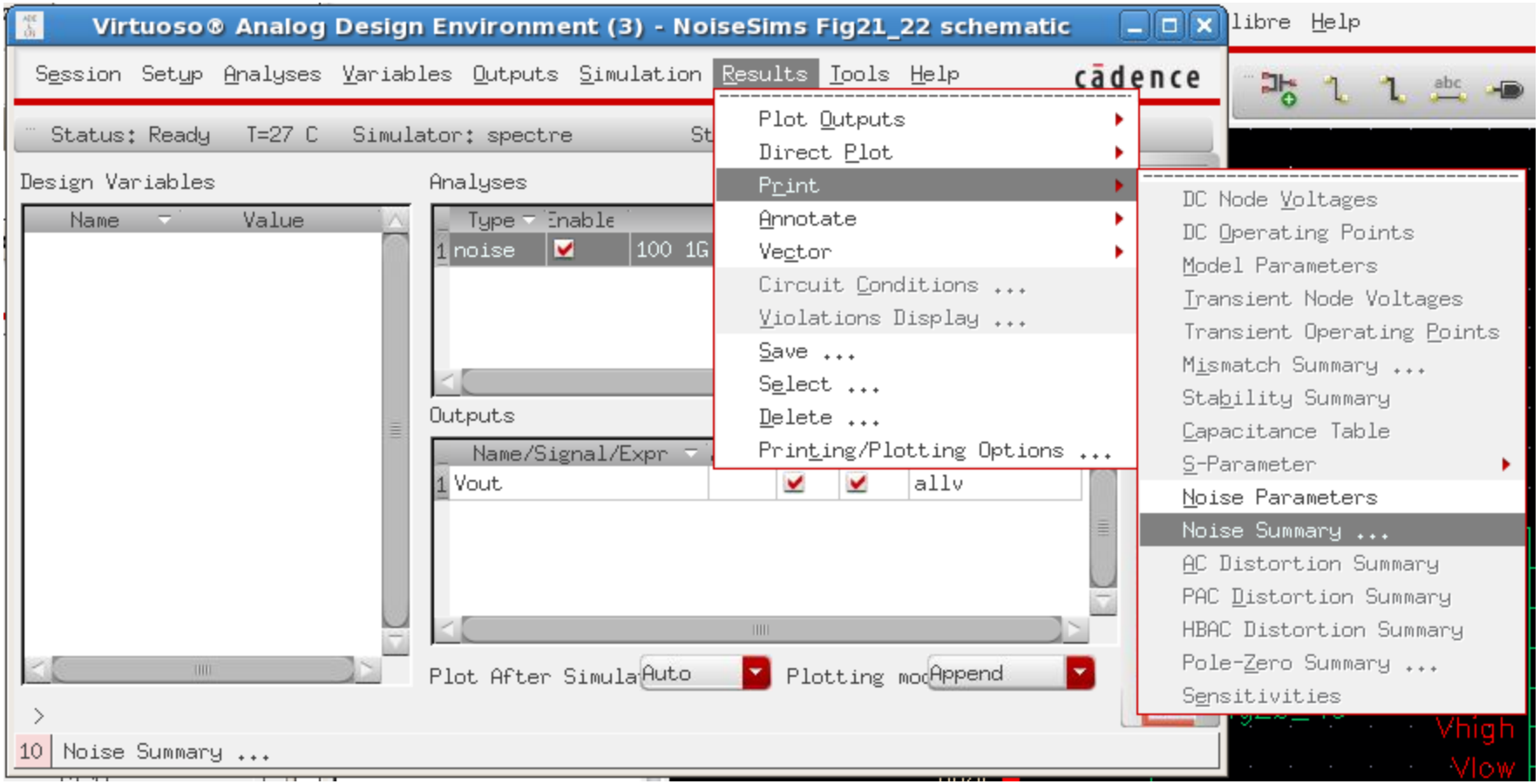
Plotting Results



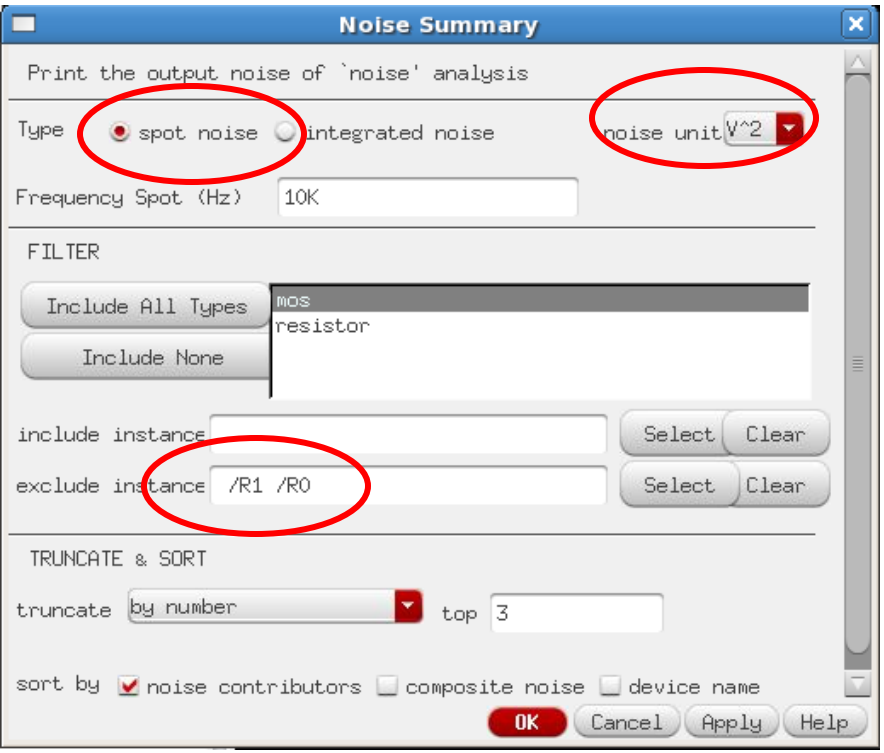


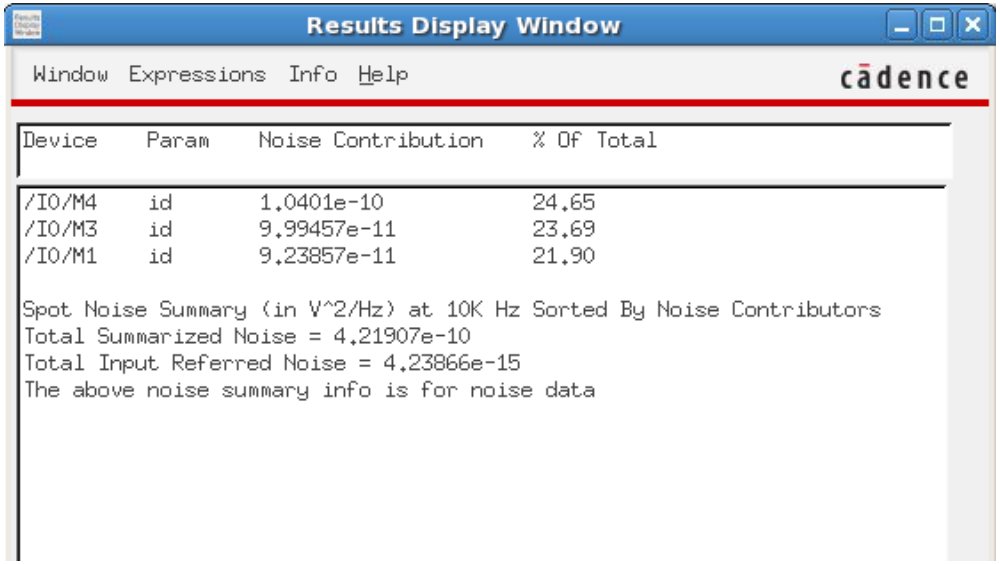
- Note that this model didn't have flicker noise
- VN2() is output noise. Can plot input noise and change the units
- Understand the frequency response effects when plotting input noise and see if the plot makes sense!

Noise Summary Reports

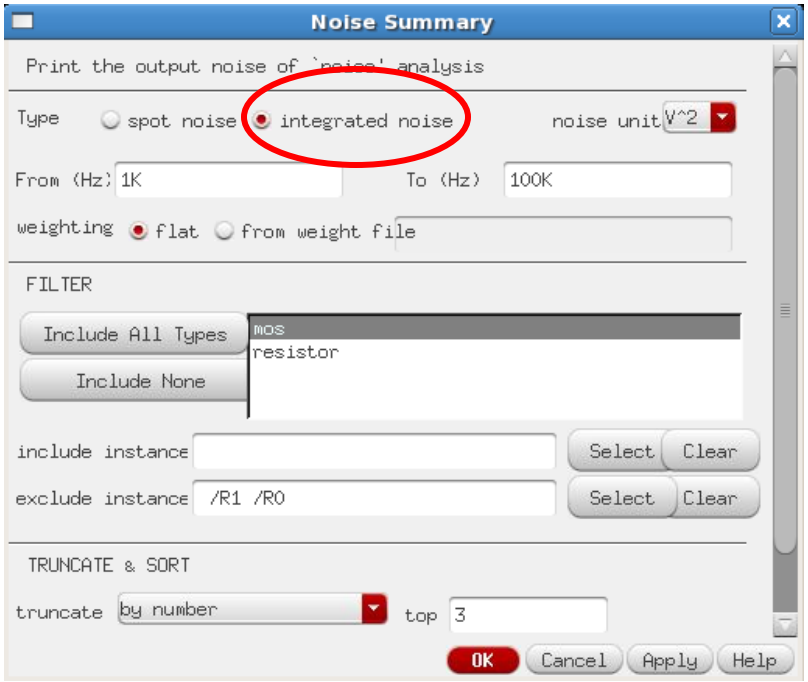


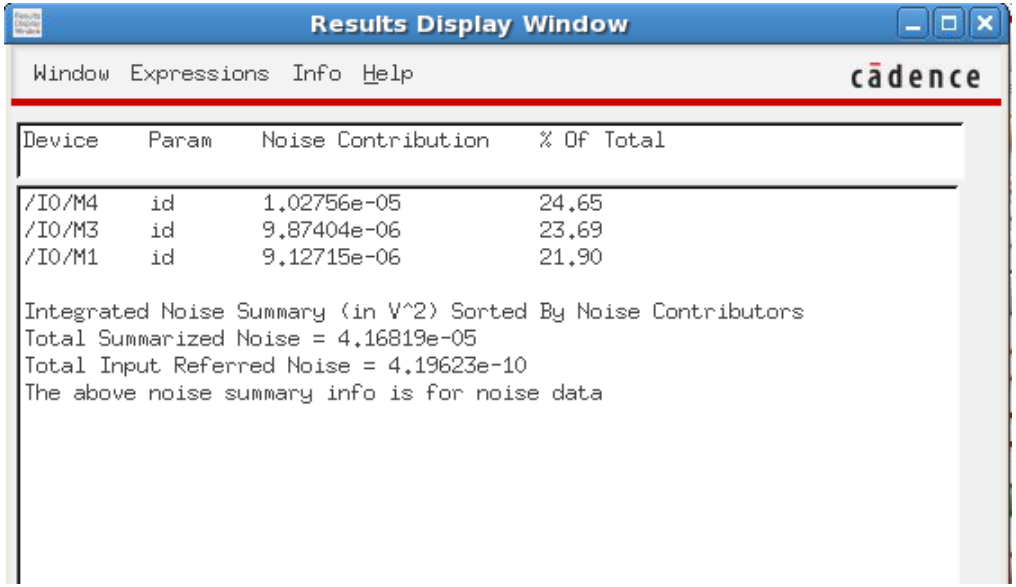
Noise Summary Reports





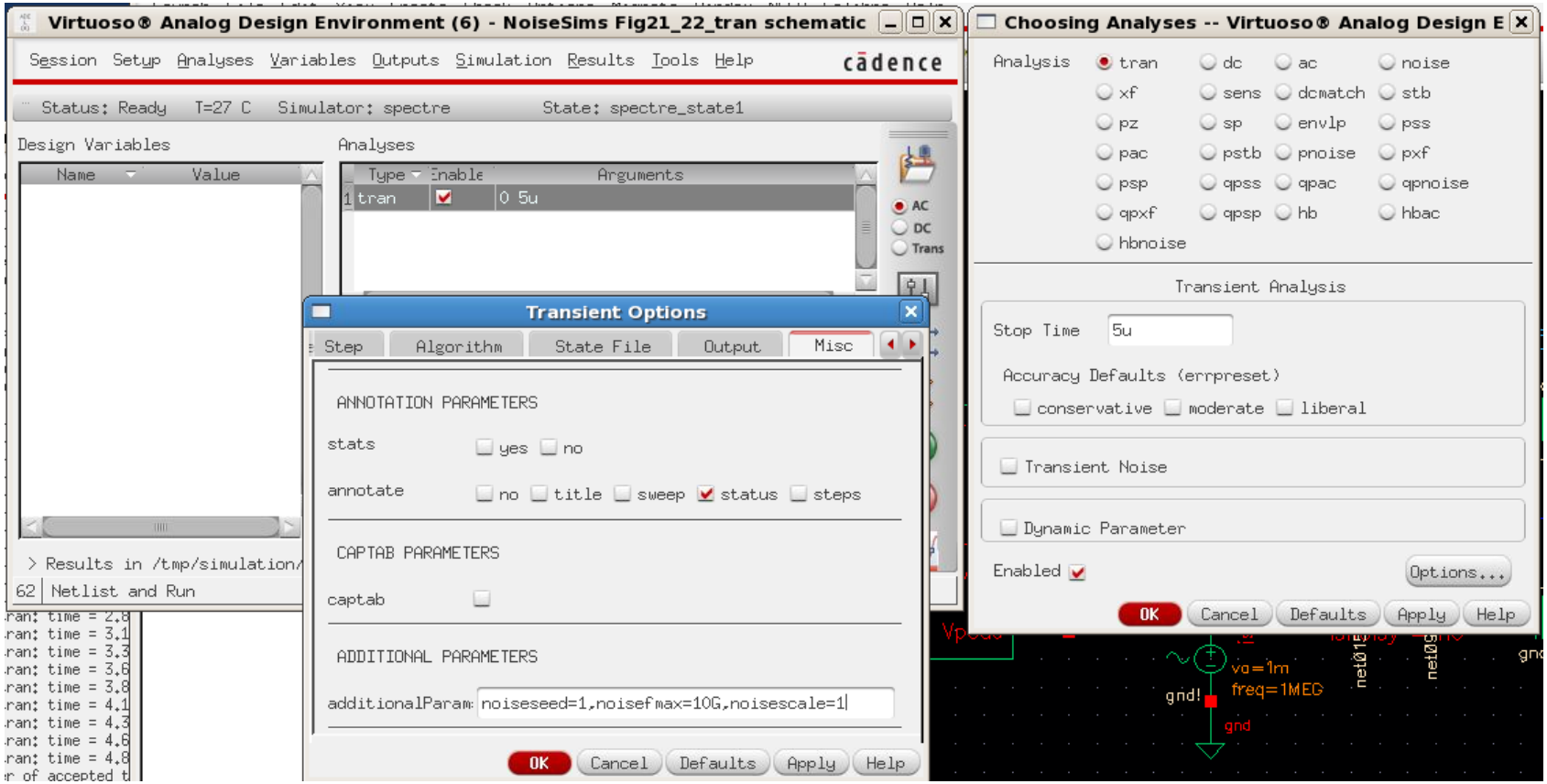
Integrated Noise Summary





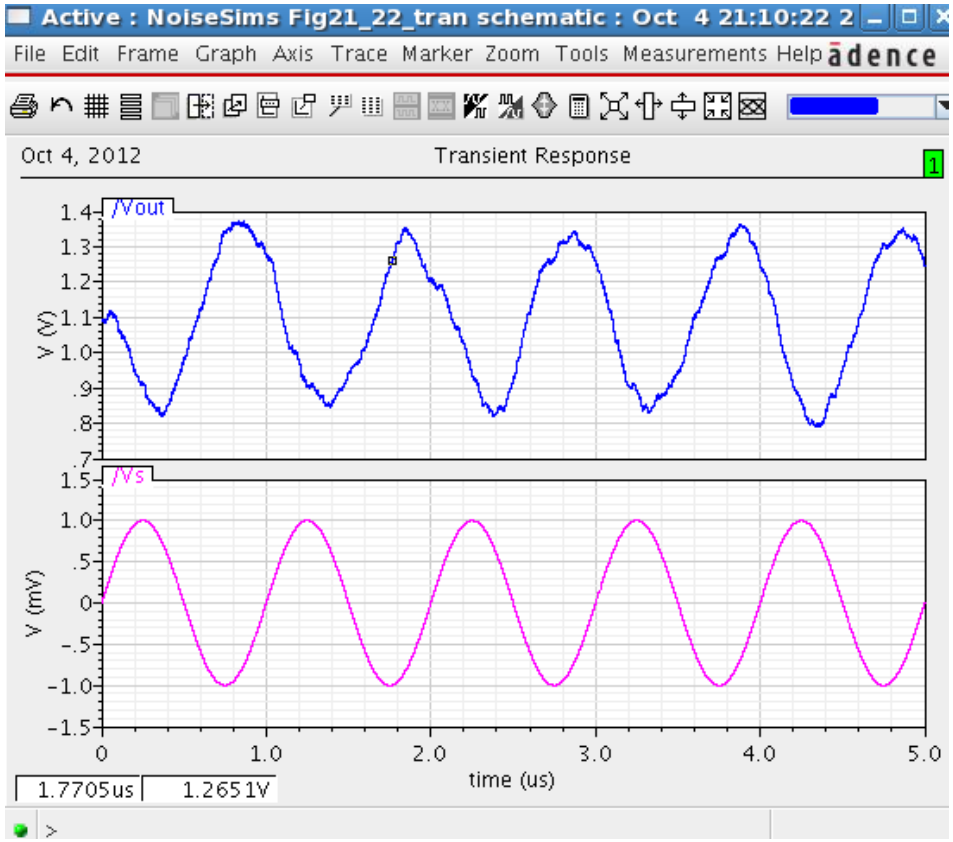
- Use the filters appropriately for the noise reports

Transient Noise Simulation



- Create a new transient simulation, open the transient options form, then add the transient noise parameters to the Additional Options field.
  - noiseseed=1,noisefmax=10G,noisescale=1

Transient Noise Simulation

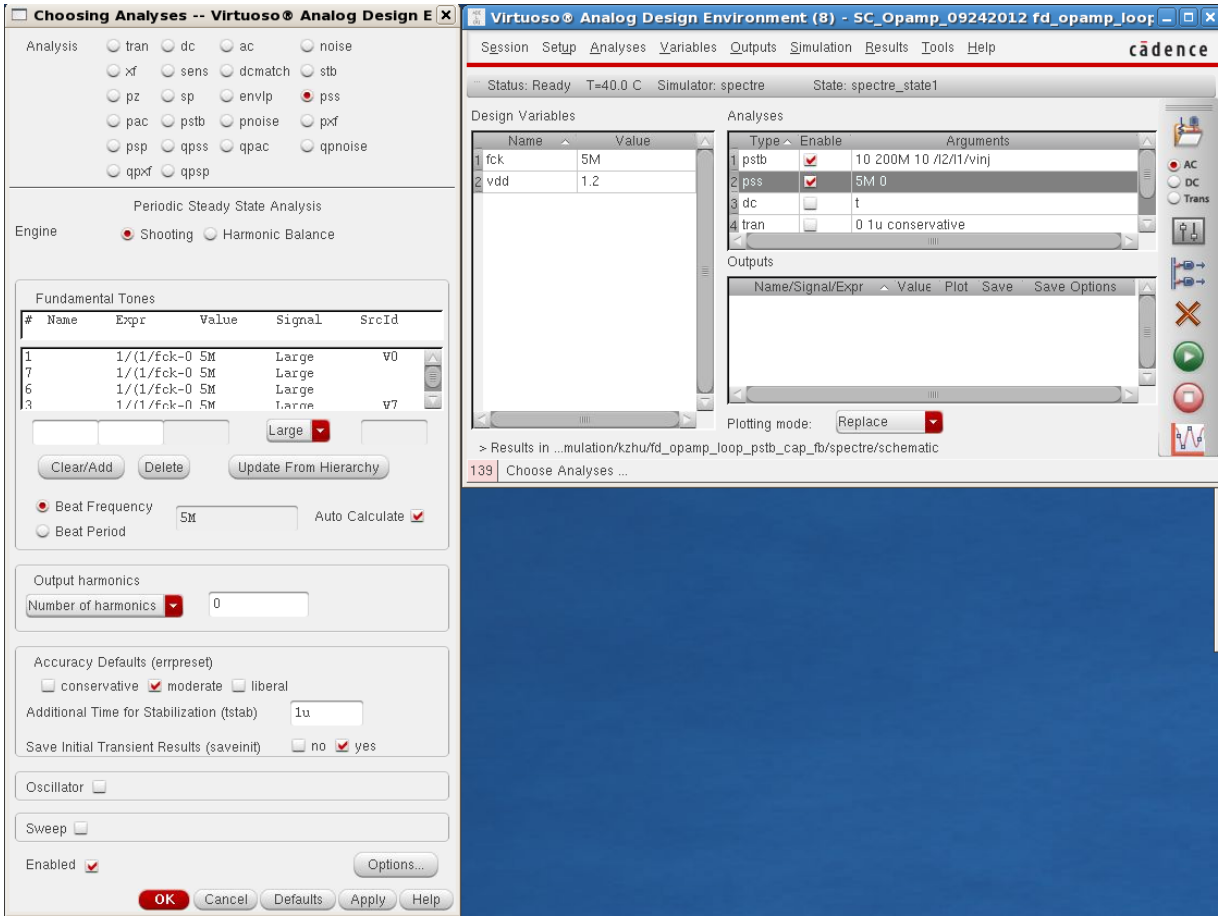


- Use FFT to interpret noise spectrum

Sampled Circuit Noise Analysis

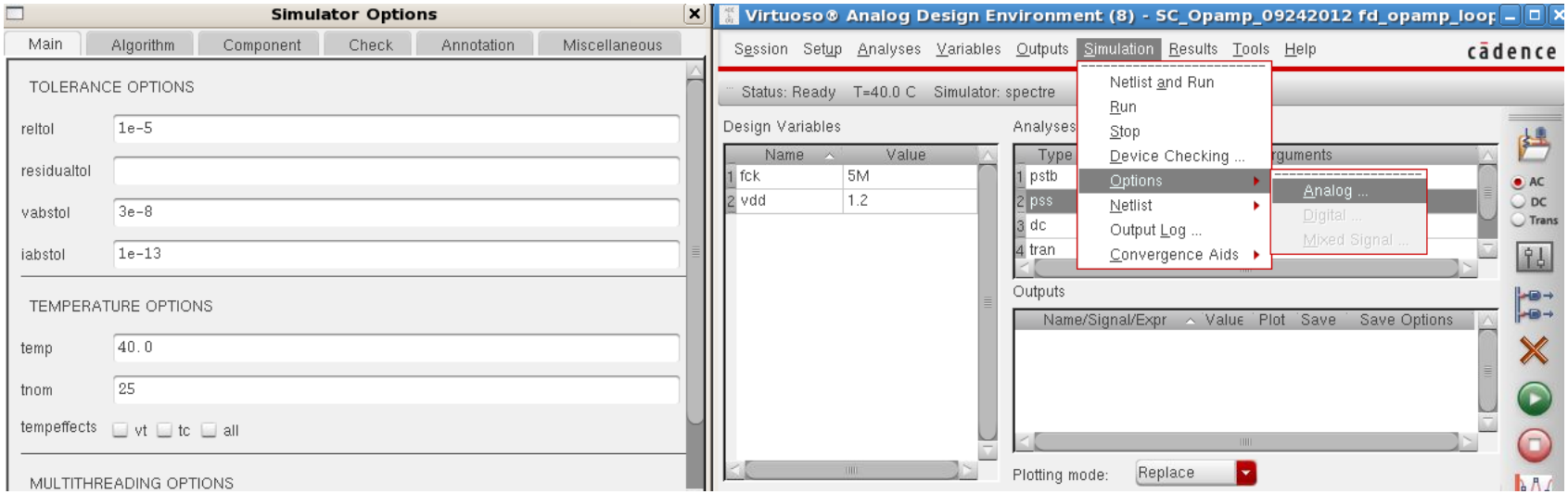
- Use .pnoise along with .pss analysis
  - Look at the Spectre PSS setup slides
- PNOISE analysis works similar to the .noise analysis for CT circuits
  - Same plotting and noise report forms as shown for .noise analysis

Simulation Setup---PSS



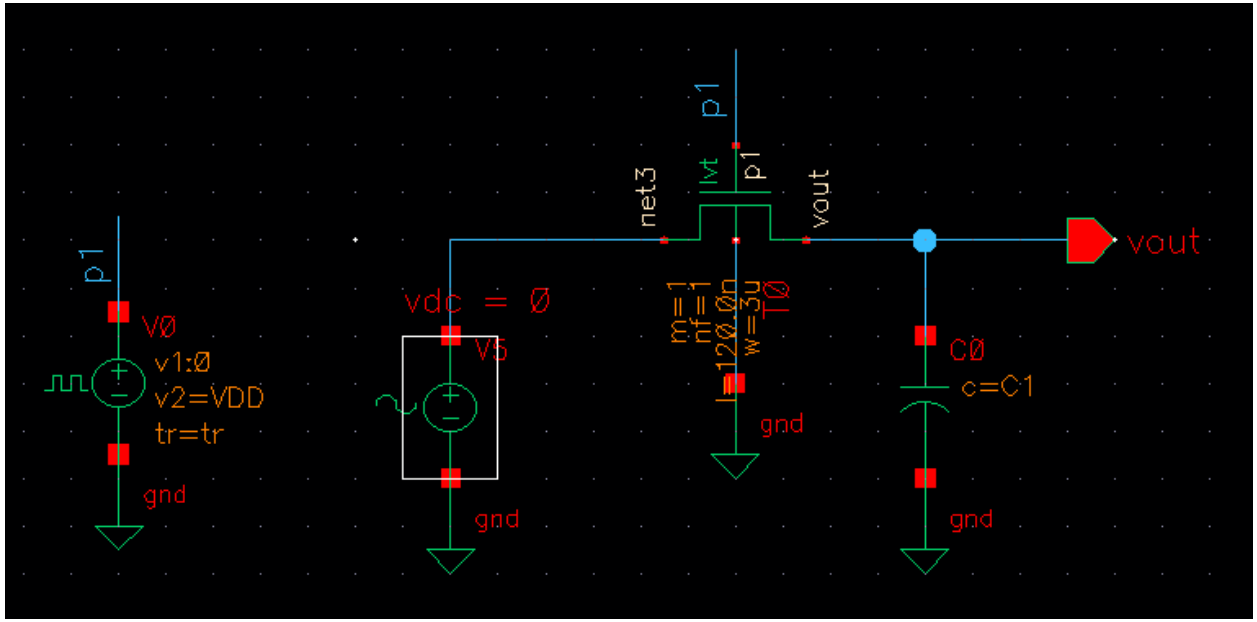
- We can only set the number of harmonics to 0 by choosing Shooting method
- tstab parameter can be obtained by tran analysis first

PSS Accuracy Suggestions



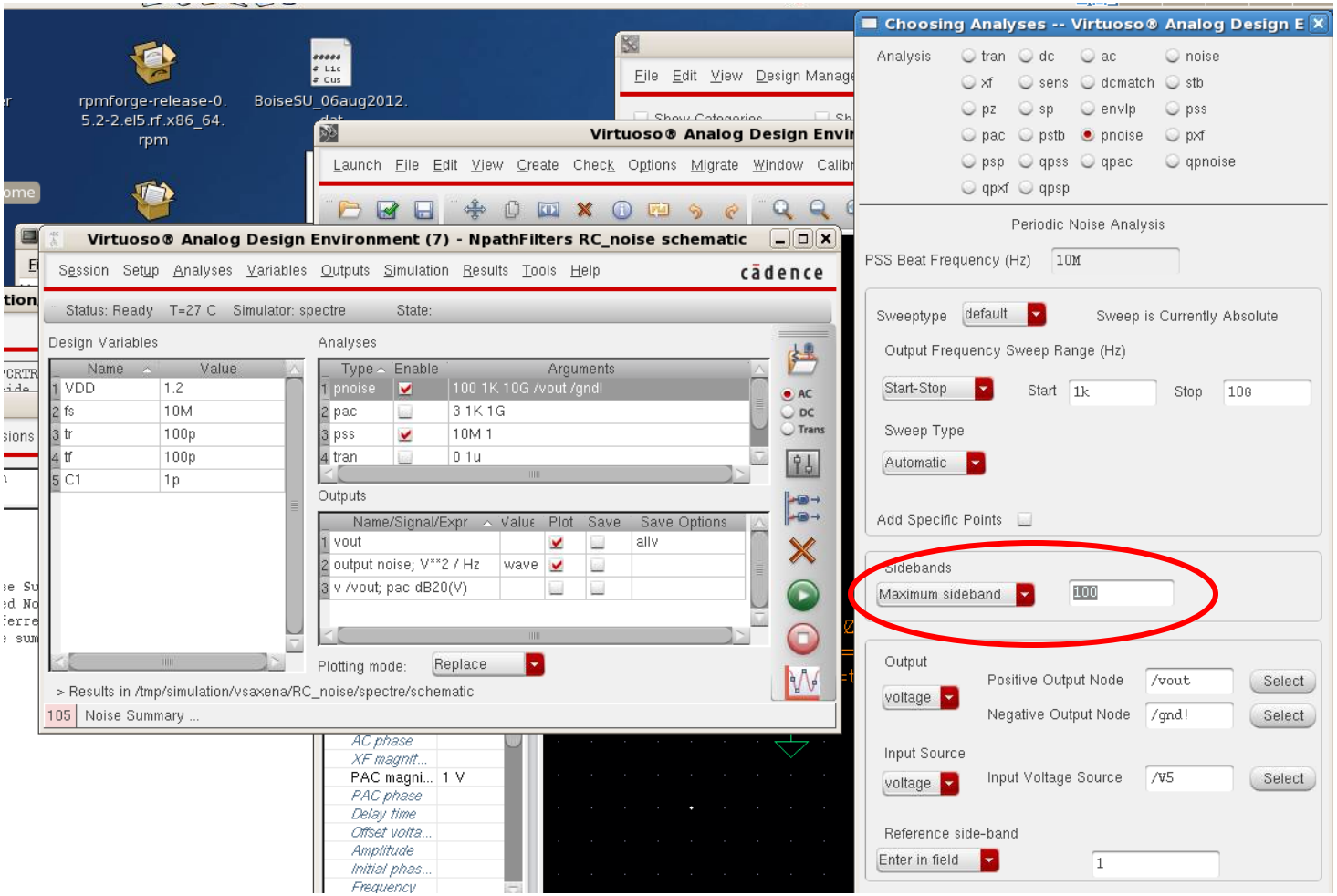
- Go to Simulation →Options→ Analog →Main in the ADE window to setup tolerance options accordingly. If the frequency of periodic small signal analyses followed by PSS is high (e.g. 1G), the *maxacfreq* parameter (options→accuracy) of the PSS can be used to specify the highest frequency, otherwise, the frequency analysis in PAC maybe truncated.

PNOISE Analysis



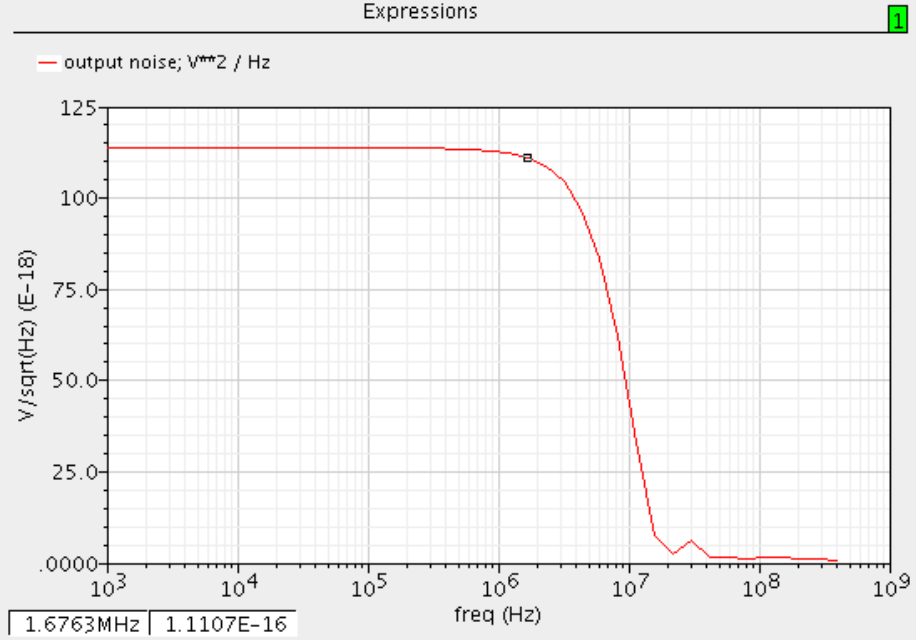
- Simulation of noise in sampled circuits
- Example: Switch-C circuit
  - Here an NMOS switch with C=1pF, f_{clk}=10MHz
- Set up PSS analysis for the f_{clk}=10MHz clock

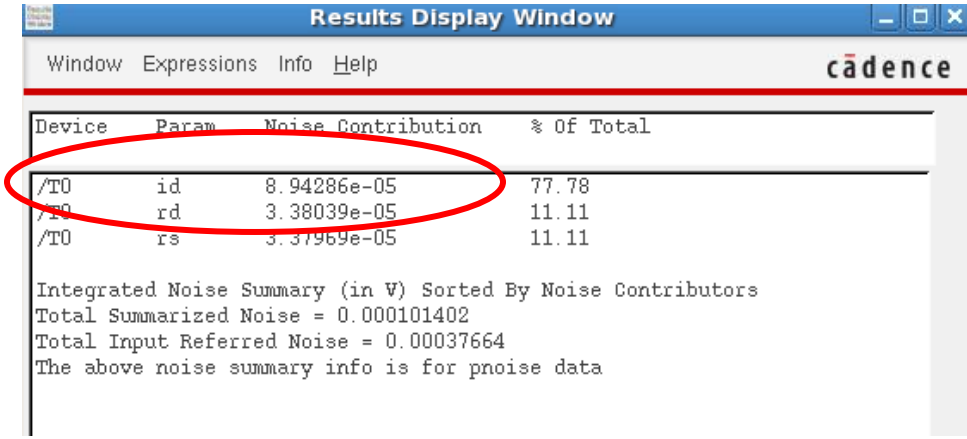
PNOISE Analysis



- Include sufficient number of *maxsideband* for accuracy

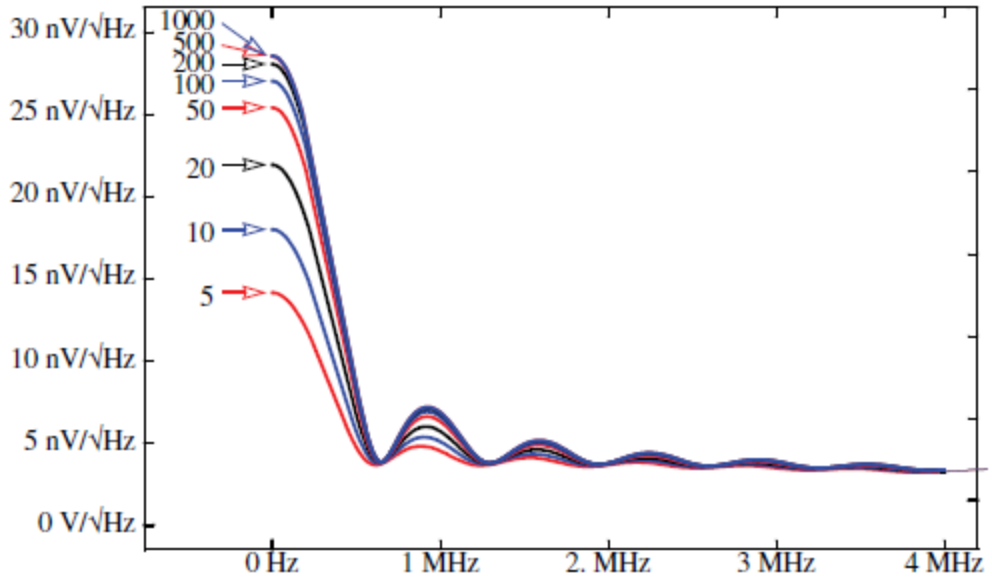
PNOISE Analysis





- Simulation shows 89μV of output RMS noise
  - Ideal √(kT/C) value =64μV,
  - Simulation results close to the approximation of √(kT/C)

PNOISE Analysis



- Accuracy is tightened by using large number of *maxsideband* parameter
  - Determines how many sideband alias into the given band
  - Trades-off simulation time with accuracy
- For analytical details, refer to:

http://www.designers-guide.org/analysis/sc-filters.pdf

References

1. Spectre User Simulation Guide
2. K. Kundert, “Simulating Switched-Capacitor Filters with SpectreRF,” The Designer’s Guide Community, www. http://www.designers-guide.org/, 2005. http://www.designers-guide.org/analysis/sc-filters.pdf
3. K. Kundert, “An Introduction to Cyclostationary Noise,” The Designer’s Guide Community, www. http://www.designers-guide.org/, 2005.
4. K. Kundert, “Device Noise Simulation of Delta-Sigma Modulators,” The Designer’s Guide Community, www. http://www.designers-guide.org/, 2005.
5. C.A. Gobet, “Spectral Distribution of a Sampled 1st-Order Lowpass Filtered White Noise,” Electronics Letters, vol. 17, pp. 720-721, Sep. 1981.
6. C.A. Gobet, A. Knob, “Noise Analysis of Switched Capacitor Networks,” IEEE Trans. Circuits and Systems, vol. cas-30, pp. 37-43, Jan. 1983.
7. J.H. Fischer, “Noise Sources and Calculation Techniques for Switched Capacitor Filters,” IEEE J. Solid-State Circuits, vol. sc-17, pp. 742-752, Aug. 1982.