VCO Simulation with Cadence Spectre

Kehan Zhu, Vishal Saxena

AMS Lab, Boise State University

http://www.lumerink.com/

Contents

- VCO voltage tuning range
- □ Frequency pushing
- Phase noise



Note: the simulation results shown are not optimized, and provided only for simulation guidance purpose.

Kvco simulation

PSS (Periodic Steady State) Analysis

- Any Verilog-A models are not allowed in the simulation bench, PSS does not support Verilog-A.
- Do .tran analysis first to estimate the VCO frequency at the fixed Vctrl as the Beat frequency.
- Make sure the VCO works by setting the "Initial Condition", "tstab" should be longer than the time the VCO needs to stable.
- If the VCO frequency is off the beat frequency by too much over sweeping Vctrl, PSS may fail. So confine the Vctrl to a reasonable range.
- After finishing simulation, go to ADE Results->Direct Plot >Main Form...open the Direct Plot Form, see later

PSS setup

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	🔾 xf	🔾 sens	🔾 dcmatch	🔾 stb	
	🔾 pz	🔾 sp	🔾 envlp	🖲 pss	
	🔘 pac	🔘 pstb	🔘 pnoise	🔾 pxf	
	🔾 psp	🔾 qpss	🔾 qpac	🔾 qpnoise	
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	Period	lic Steady	State Analysi	s	
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Converge	nce				
Additional Time for Transient-Aided HB (tstab)					
Save Initial Transient Results (saveinit) 🛛 🗌 no 🛄 yes					
Harmonic Balance Homotopy Method default					

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	Osc initial condition 🛛 🗹 default 🛄 linear			
	Osc Newton method 🔲 onetier 🛄 twotier			
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Variable	Variable Name vctrl			
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● Start-Stop ○ Center-Span	Start 0.3 Stop 0.8			
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🖲 Linear	Step Size			
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	OK Cancel Defaults Apply Help			

PSS Plotting

264.9M - 811M

> Press plot button on this form...

3 397.3M - 1.21 4 529.7M - 1.62

Add To Outputs 🗹

2

Direct	Plot Form				
Plotting Mode Append					
🖲 pss					
~ Function					
🔘 Voltage	Current				
Power	🔘 Voltage Gain				
🔘 Current Gain	🔘 Power Gain				
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Compression Point	IPN Curves				
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Harmonic Frequency	Over Added Eff.				
🔘 Power Gain Vs Pout	🔾 Comp. Vs Pout				
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1 132.4M - 405.5					

Plot

0K

Cancel

Help

×

			Selected Output
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Name	(opt.)	KACO (MH/V)
Expres	ssion	deriv(<pre>(harmonic(xval(getData("/vout" ?result "pss_fd")) '1) / #000000))</pre>

Choose the fundamental frequency to plot Also, you can use calculator setting the outputs as above to get the KVCO plot, see next.

PSS simulation plots



VCO frequency and KVCO versus Vctrl are plotted.

Frequency Pushing

Engine	Shooting	🥑 Harmonic I	Balance
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Sweep Ran	ge		
Start-Sto Center-Sto	ip Star Span	t 1	Stop 1.3

To test the VCO frequency changing with power supply voltage variations, in the same manner as before, just change the sweeping variable to "vdd".

Notice here beat frequency is defined as a variable for easy change at the ADE.

🚪 Virtuoso 🕯	Analog I	Design Er	nvironm	ent (13)	- ece51	8_hw1	cs_vco	_sim schem	atic 💶 🗆 🗙
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> 223 Delete	AND		Plot After	Simulation:	Auto	PI	otting mod	le: New Win	

PSS simulation plots



Phase noise

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hbnoise	
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OK Cancel Defaults Apply H	elp OK Cancel Defaults Annly He
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Setup PSS first, then Pnoise

Pnoise Simulation Result

