



上海交通大学
SHANGHAI JIAO TONG UNIVERSITY



lab2 PVT and Monte-Carlo simulation

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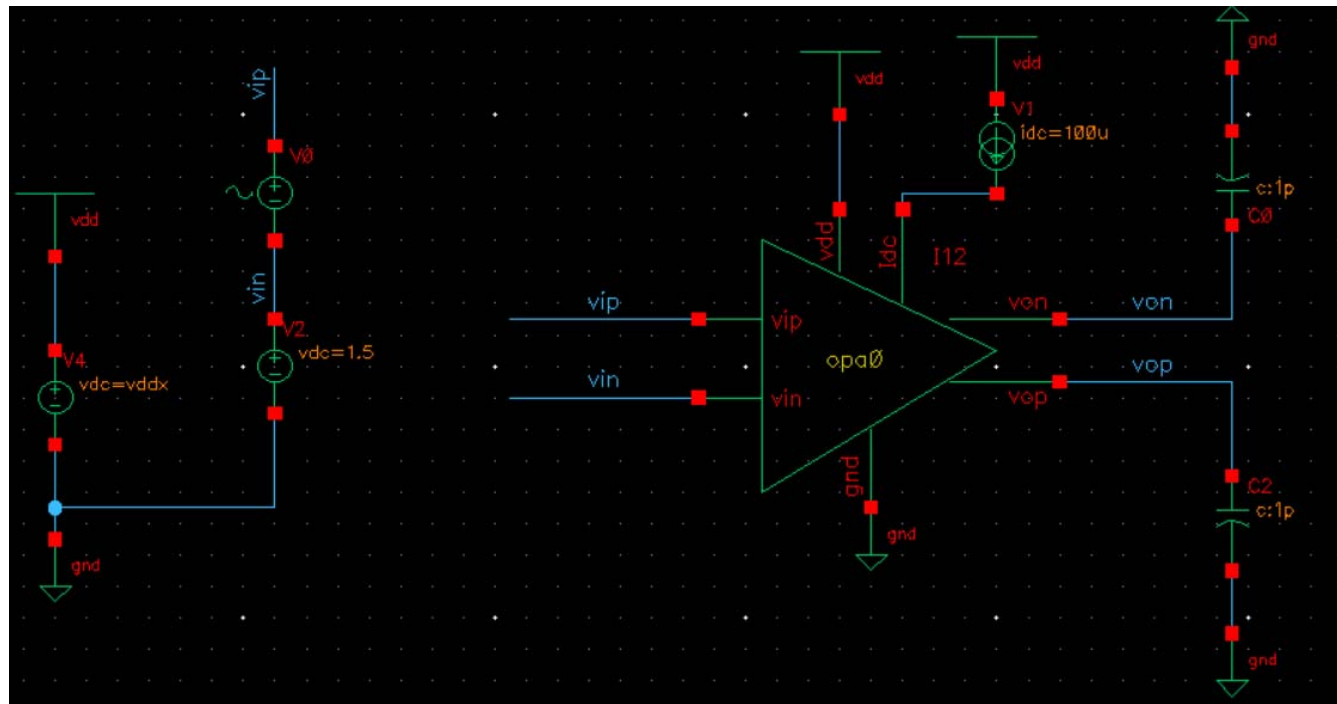
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Outline

- AC simulation of OPA
- PVT simulation
- Monte-Carlo Simulation

AC simulation of OPA

■ Testbench example



■ 设置Vsin源的 AC magnitude =1

AC simulation of OPA

- Set DC and AC analyses

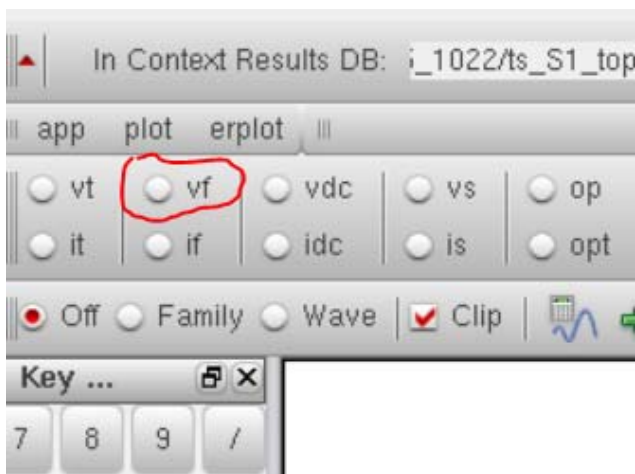
The screenshot shows the Cadence Virtuoso interface for a schematic named '32) - layout_course ts_opa0 schematic'. The 'Analyses' window is open, showing two analysis types: 'dc' and 'ac'. The 'dc' analysis is enabled with arguments 't'. The 'ac' analysis is also enabled with arguments '1 1G Automatic Start-Stop'. The 'Outputs' window is also open, showing a list of output signals. The 'DCgain' and 'Phase' outputs are circled in red. The 'Outputs' window has columns for Name/Signal/Expr, Value, Plot, Save, and Save Options.

Type	Enable	Arguments
1 dc	<input checked="" type="checkbox"/>	t
2 ac	<input checked="" type="checkbox"/>	1 1G Automatic Start-Stop

Name/Signal/Expr	Value	Plot	Save	Save Options
1 DCgain	wave	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
2 Phase	wave	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
3 DCgain_value	20.5	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
4 PM_value	95.23	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
5 GBW	120....	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	

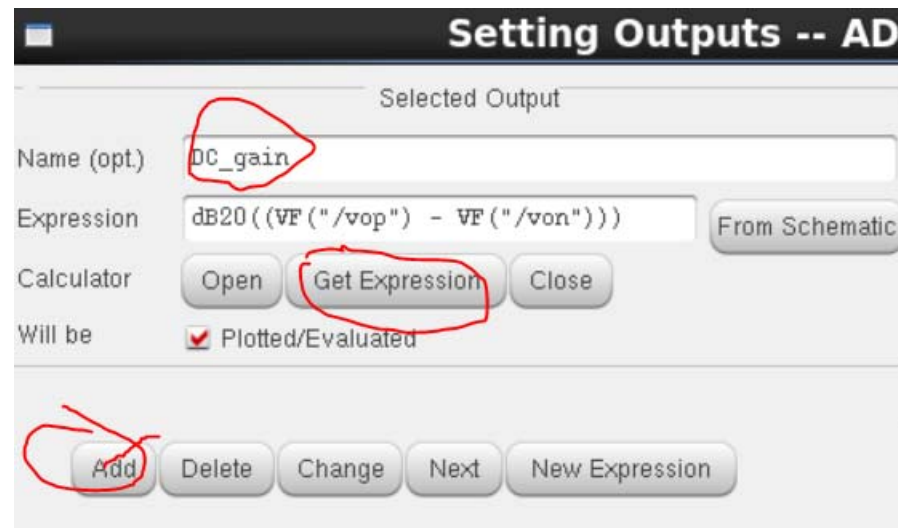
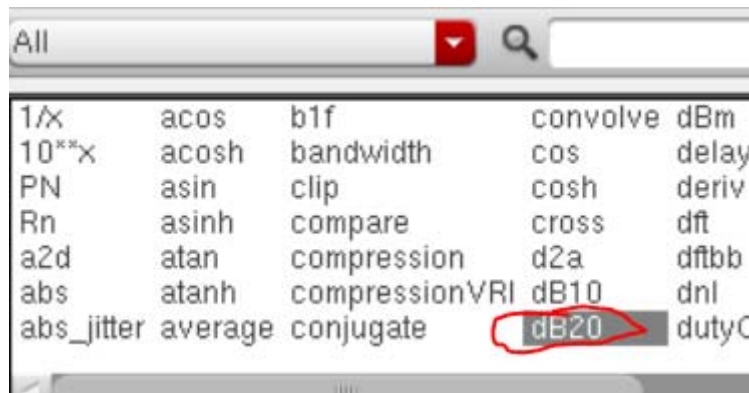
AC simulation of OPA

■ Set DC gain



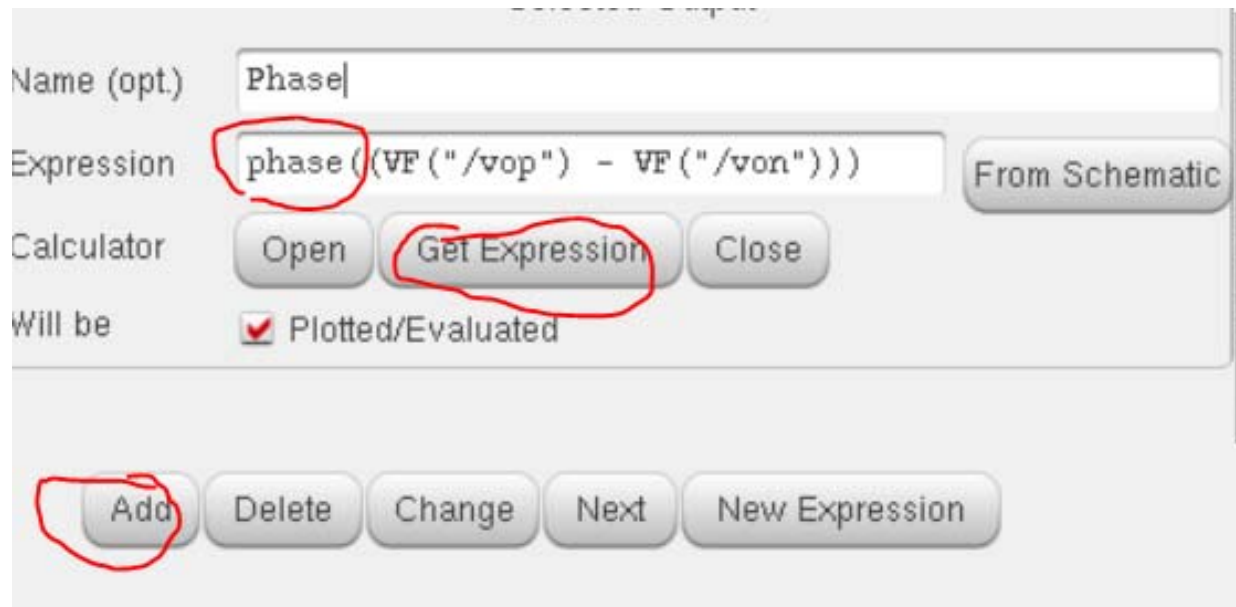
AC simulation of OPA

■ Set DC gain



AC simulation of OPA

■ Set Phase

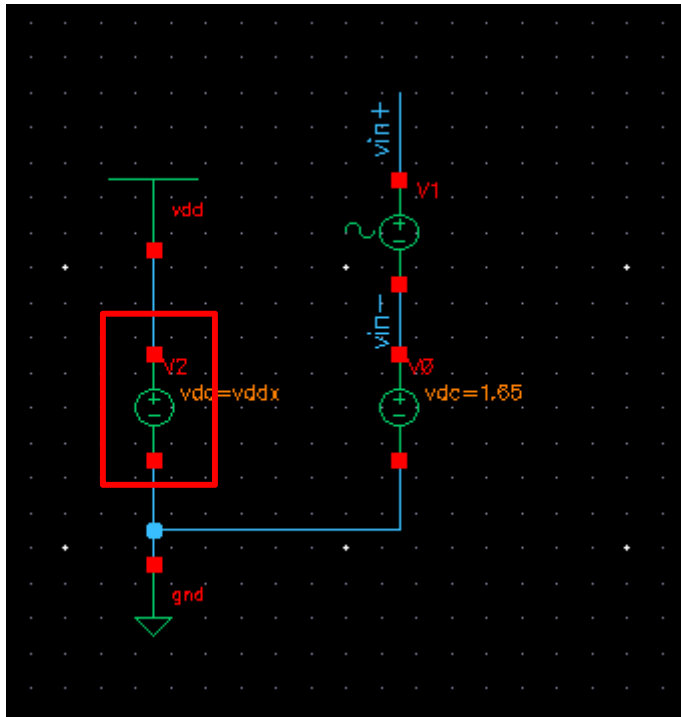


PVT simulation

- PVT means Process, Voltage, Temperature
- In XFAB035 technology, Process corner includes tm, wp, ws
- Voltage may include 3.2, 3.3, 3.4V
- Temperature may include -20, 27, 80°

PVT simulation

- Step1: set variable of supply voltage



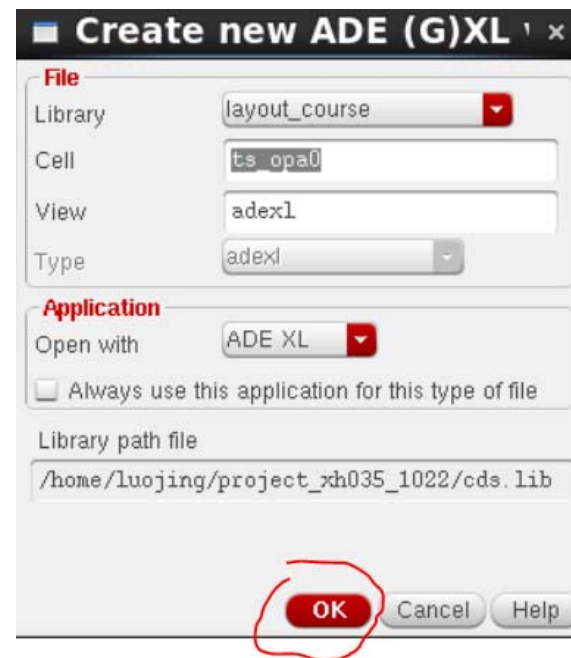
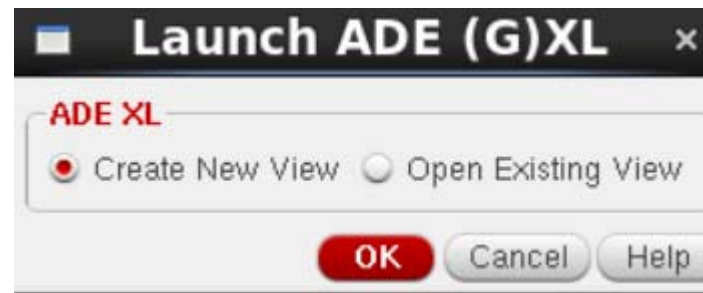
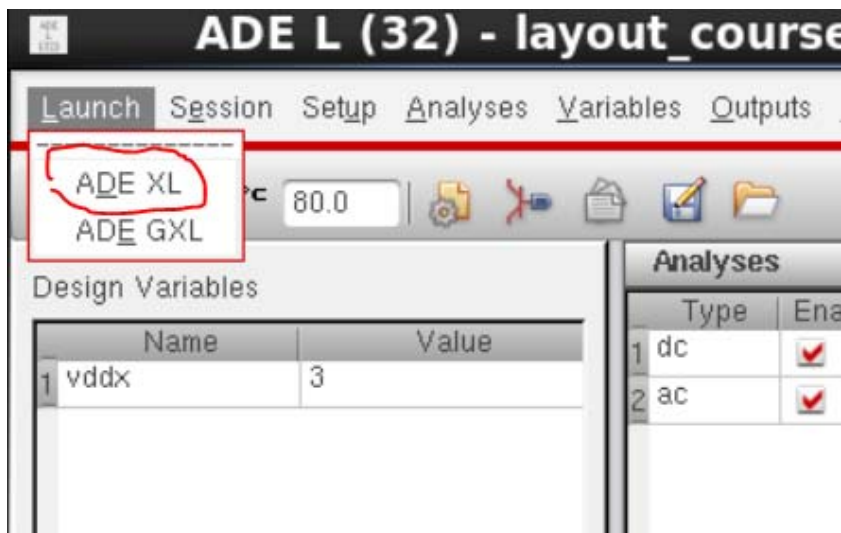
CDF Parameter	Value
Noise file name	
Number of noise/freq pairs	0
DC voltage	vddx V
AC magnitude	
AC phase	
XF magnitude	
PAC magnitude	

The screenshot shows the ADE L (26) - layout_course ts_opa1 software interface. The Variables tab is active, showing a table of design variables. The variable vddx is highlighted, and a context menu is open over it, with the 'Copy From Cellview' option selected.

Name	Value
vddx	3.3

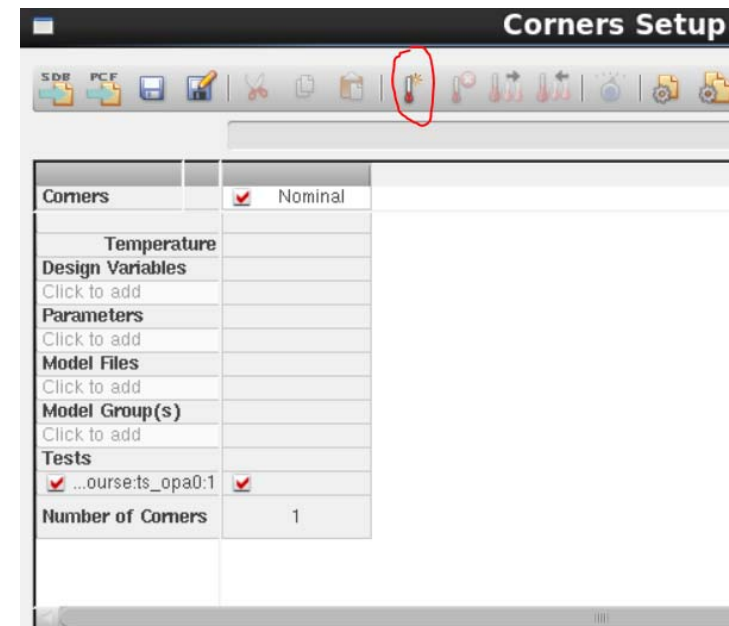
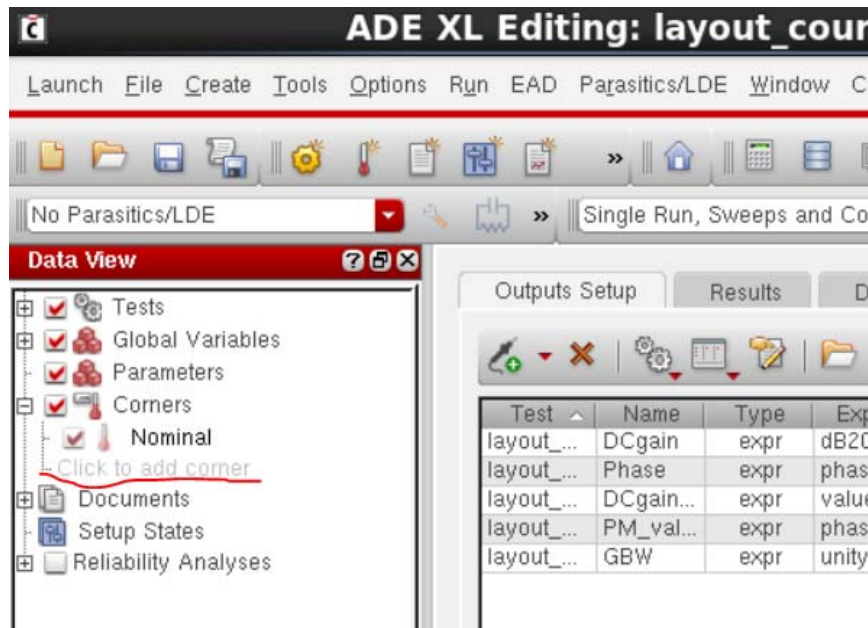
PVT simulation

- Step2: open ADE XL



PVT simulation

- Step3: set PVT parameters



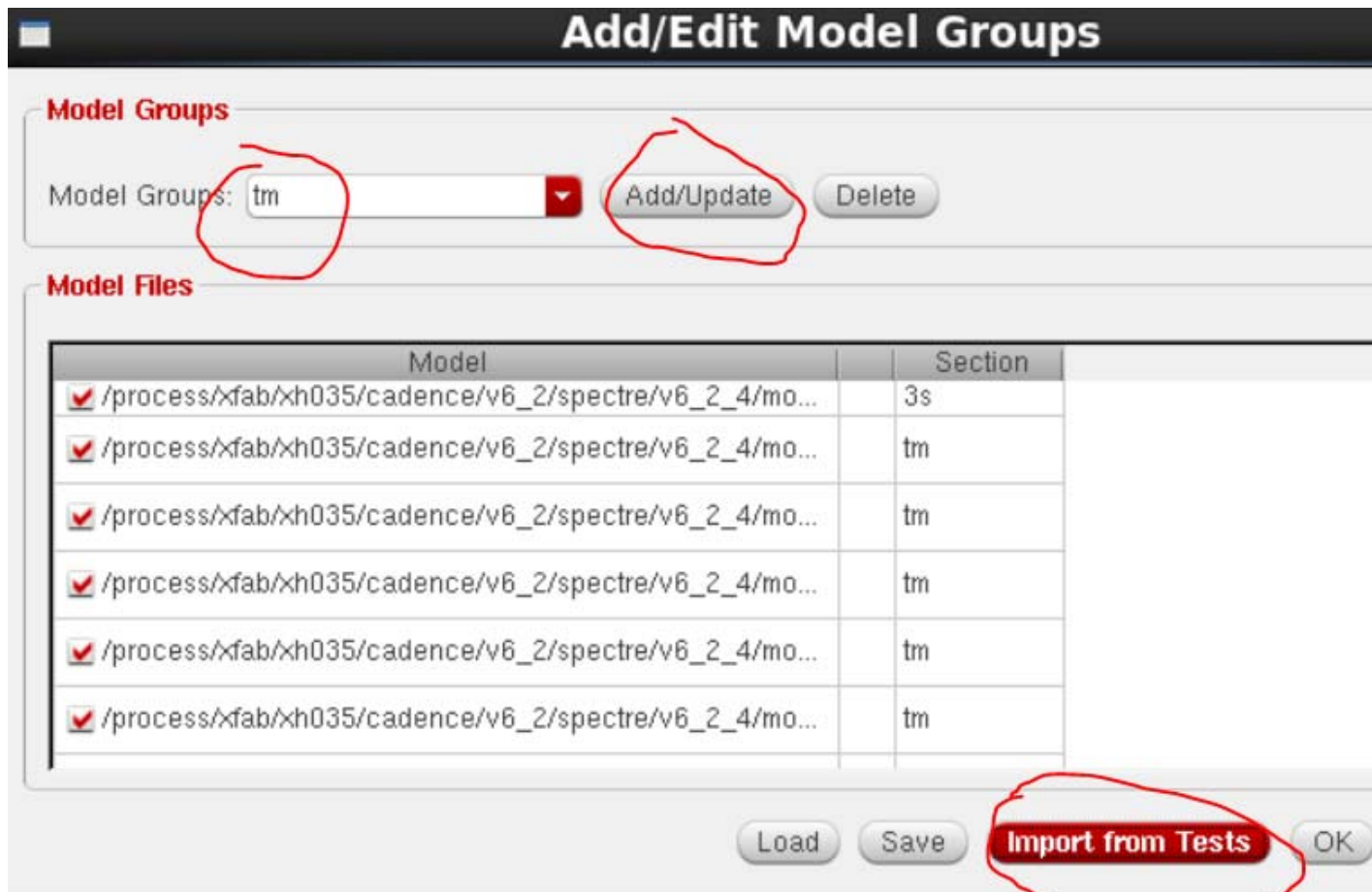
PVT simulation

- Step3: set PVT parameters

Corners	<input checked="" type="checkbox"/> Nominal	<input checked="" type="checkbox"/> C0
Temperature		0 27 80
Design Variables		2.9 3 3.1
Click to add		
Parameters		
Click to add		
Model Files		
Click to add		
Model Group(s)		<modelgroup>
Click to add		
Tests		
<input checked="" type="checkbox"/> ...ourse:ts_opa0:1	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Number of Corners	1	9

PVT simulation

- Step3: set PVT parameters



PVT simulation

- Step3: set PVT parameters

Model Groups

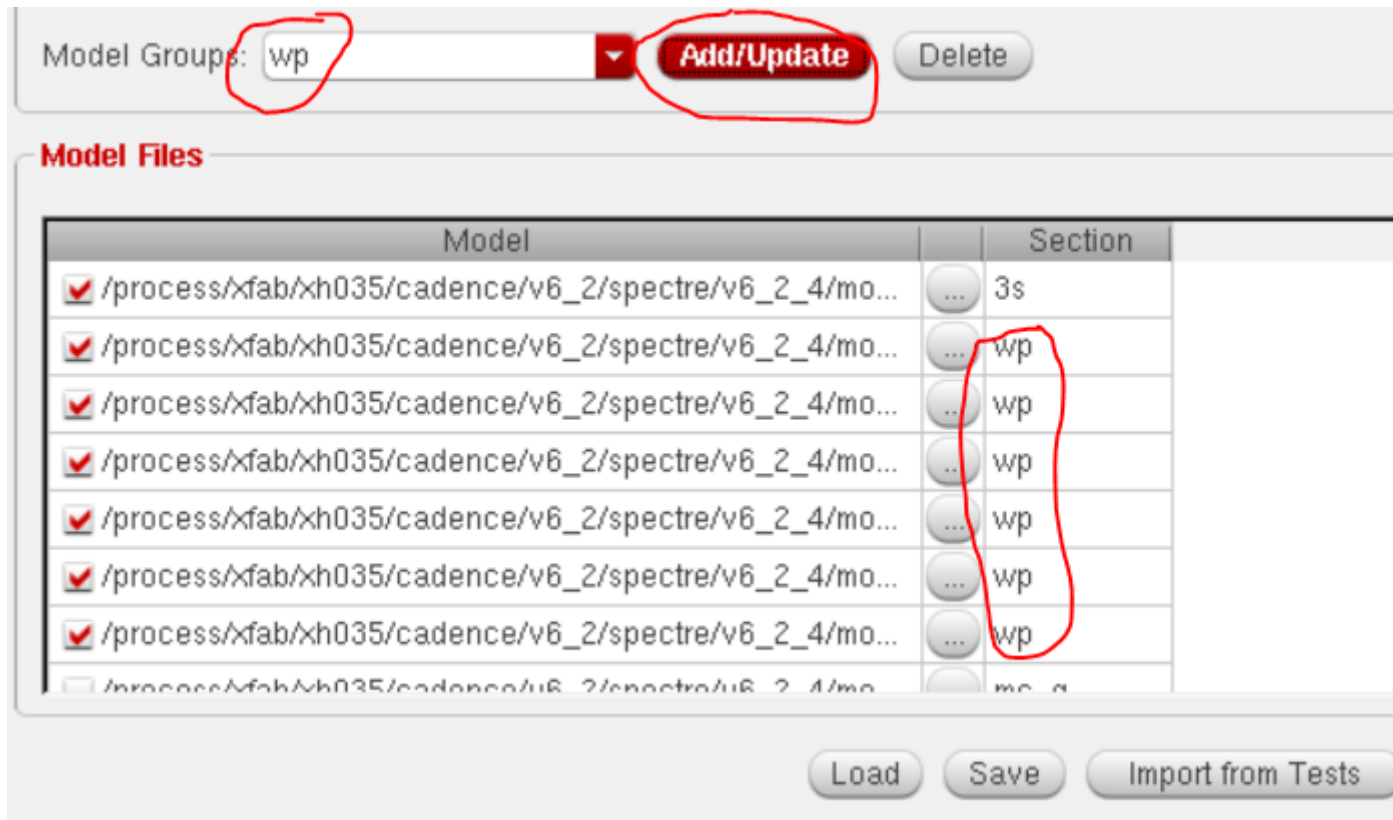
Model Groups:

Model Files

Model	Section
<input checked="" type="checkbox"/> /process/xfab/xh035/cadence/v6_2/spectre/v6_2_4/mo...	3s
<input checked="" type="checkbox"/> /process/xfab/xh035/cadence/v6_2/spectre/v6_2_4/mo...	ws
<input checked="" type="checkbox"/> /process/xfab/xh035/cadence/v6_2/spectre/v6_2_4/mo...	ws
<input checked="" type="checkbox"/> /process/xfab/xh035/cadence/v6_2/spectre/v6_2_4/mo...	ws
<input checked="" type="checkbox"/> /process/xfab/xh035/cadence/v6_2/spectre/v6_2_4/mo...	ws
<input checked="" type="checkbox"/> /process/xfab/xh035/cadence/v6_2/spectre/v6_2_4/mo...	ws
<input checked="" type="checkbox"/> /process/xfab/xh035/cadence/v6_2/spectre/v6_2_4/mo...	ws
<input type="checkbox"/> /process/xfab/xh035/cadence/v6_2/spectre/v6_2_4/mo...	mc...

PVT simulation

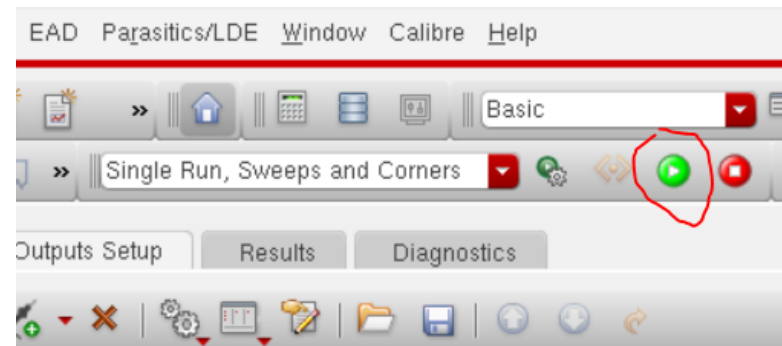
- Step3: set PVT parameters



PVT simulation

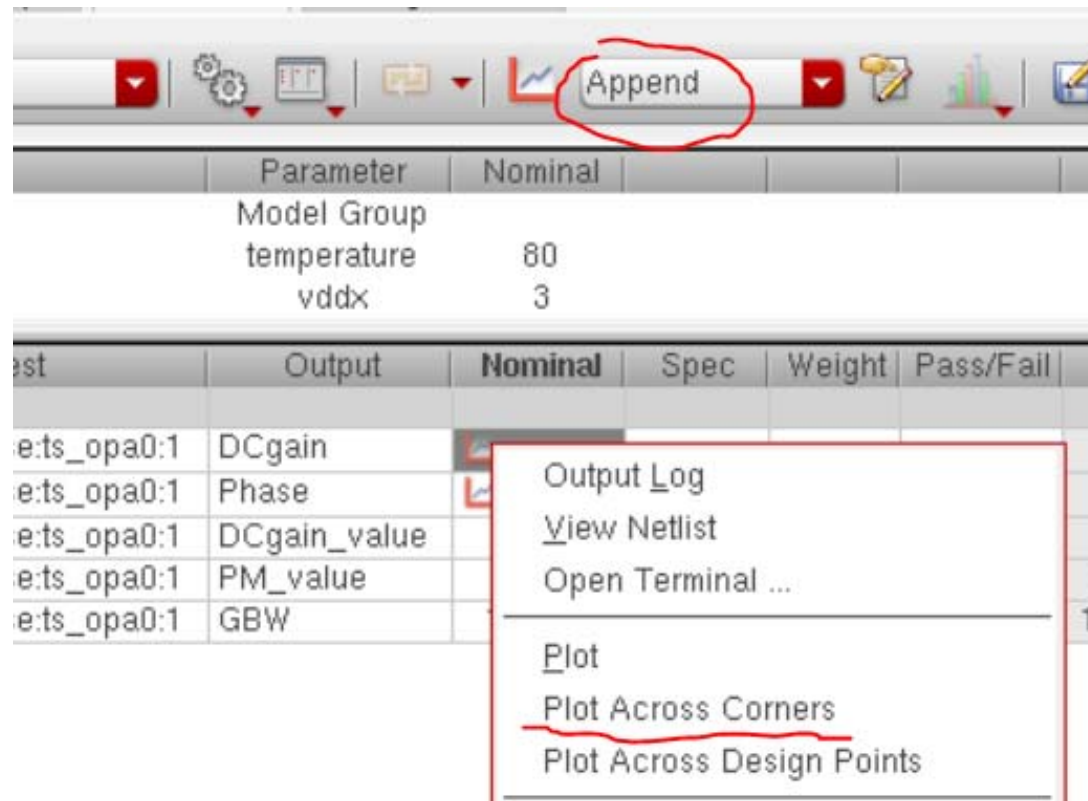
- Step3: set PVT parameters

Corners	<input checked="" type="checkbox"/>	Nominal	<input checked="" type="checkbox"/>	C0
Temperature				0 27 80
Design Variables				
vddx				2.9 3 3.1
Click to add				
Parameters				
Click to add				
Model Files				
Click to add				
Model Group(s)				tm ws wp
Click to add				
Tests				
<input checked="" type="checkbox"/> ...ourse:ts_opa0:1	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	
Number of Corners		1		27



PVT simulation

- Step3: set PVT parameters



The screenshot shows a software interface for PVT simulation. At the top, a toolbar contains several icons, with the 'Append' button highlighted by a red circle. Below the toolbar is a table with columns 'Parameter' and 'Nominal'. The table contains the following data:

Parameter	Nominal
Model Group	
temperature	80
vddx	3

Below this table is another table with columns 'Output', 'Nominal', 'Spec', 'Weight', and 'Pass/Fail'. The table contains the following data:

Output	Nominal	Spec	Weight	Pass/Fail
e:ts_opa0:1 DCgain				
e:ts_opa0:1 Phase				
e:ts_opa0:1 DCgain_value				
e:ts_opa0:1 PM_value				
e:ts_opa0:1 GBW				

A context menu is open over the table, listing the following options:

- Output_Log
- View Netlist
- Open Terminal ...
- Plot
- Plot Across Corners
- Plot Across Design Points

Monte-Carlo simulation

- Process variation and mismatch simulation
- Step 1: set output results as values(double click outputs)

	Name/Signal/Expr	Value	Plot	Save	Save Options
1	DCgain	wave	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
2	Phase	wave	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

Selected Output

Name (opt.)

Expression From Schematic

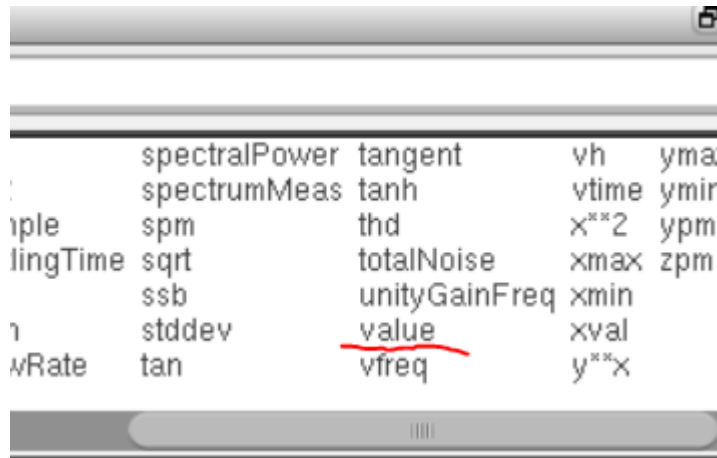
Calculator Open Get Expression Close

Will be Plotted/Evaluated

Add Delete Change Next New Expression

Monte-Carlo simulation

- Step 1: set output results as values



	spectralPower	tangent	vh	yma
	spectrumMeas	tanh	vtime	ymin
ple	spm	thd	x**2	ypm
lingTime	sqrt	totalNoise	xmax	zpm
	ssb	unityGainFreq	xmin	
1	stddev	<u>value</u>	xval	
wRate	tan	<u>vfreq</u>	y**x	



Value

Signal: dB20((VF("/vop") - VF("/von")))

Interpolate At: 10

Number of occurrences: single



Name (opt): DCgain_value

Expression: value (dB20 ((VF ("/vop") - VF ("/von"))))

Calculator: Open **Get Expression** Close

Will be: Plotted/Evaluated

Add Delete Change Next New Expression

Monte-Carlo simulation

- Step 1: set output results as values

Selected Output

Name (opt.) PM_value

Expression phaseMargin((VF("/vop") - VF("/von")) From Schematic

Calculator Open Get Expression Close

Will be Plotted/Evaluated

Add Delete Change Next New Expression

Selected Output

Name (opt.) GBW

Expression unityGainFreq((VF("/vop") - VF("/von")) From Schematic

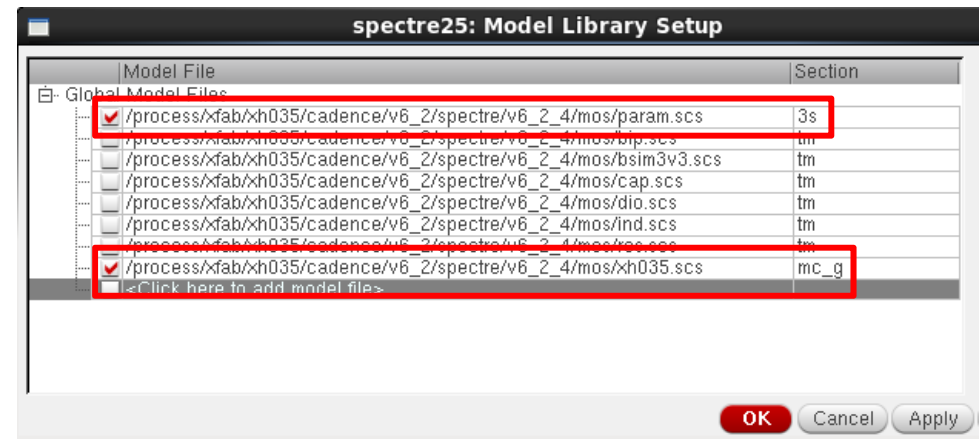
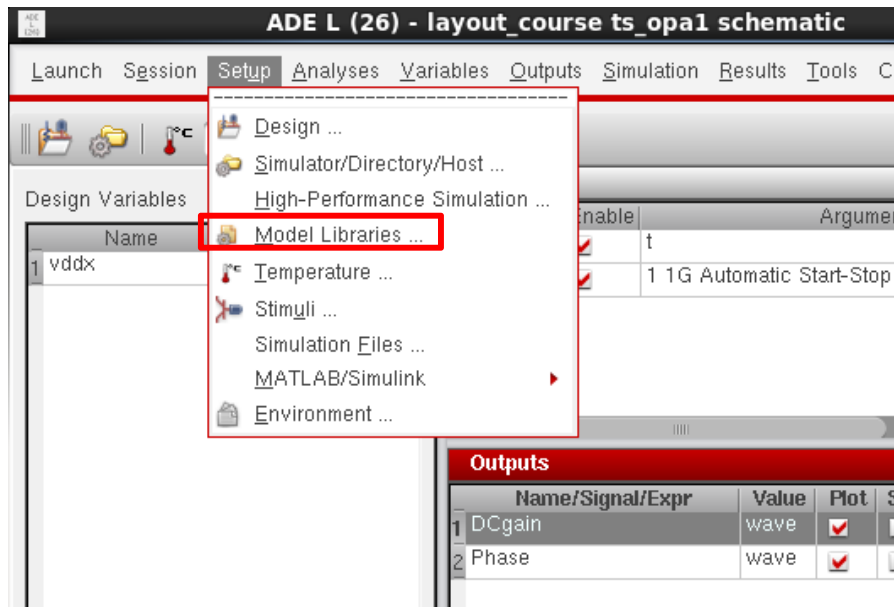
Calculator Open Get Expression Close

Will be Plotted/Evaluated

Add Delete Change Next New Expression

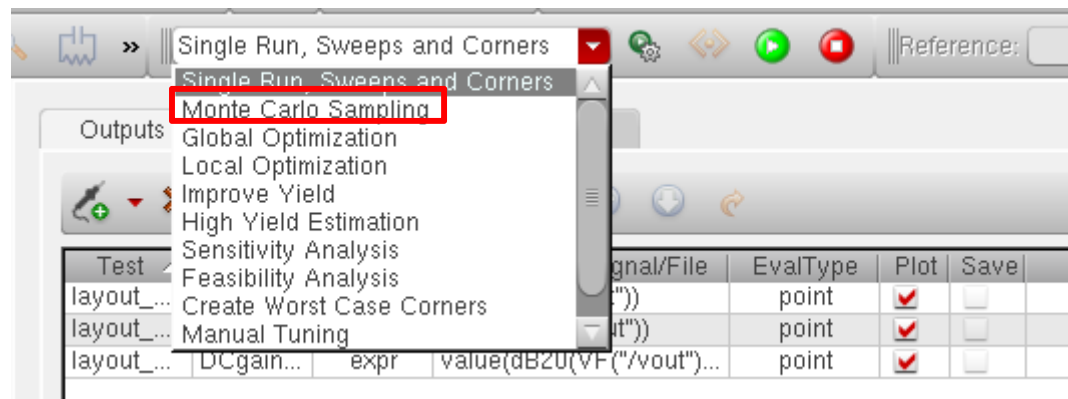
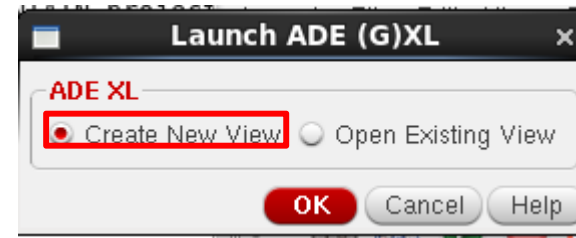
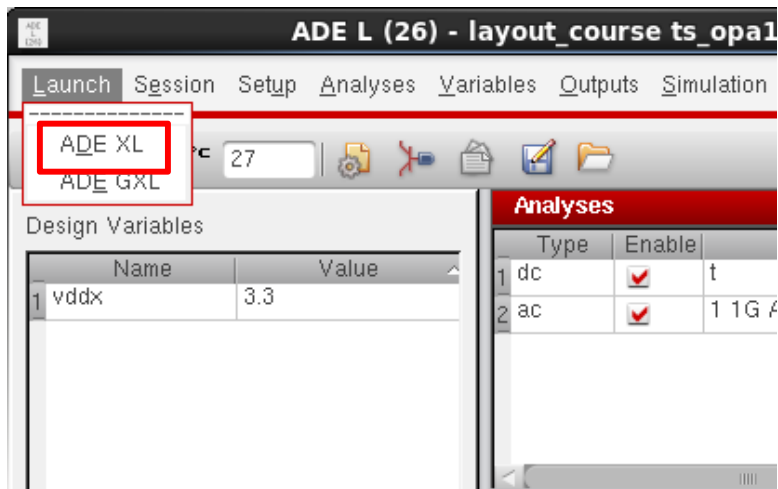
Monte Carlo simulation

- Step 2: change model library



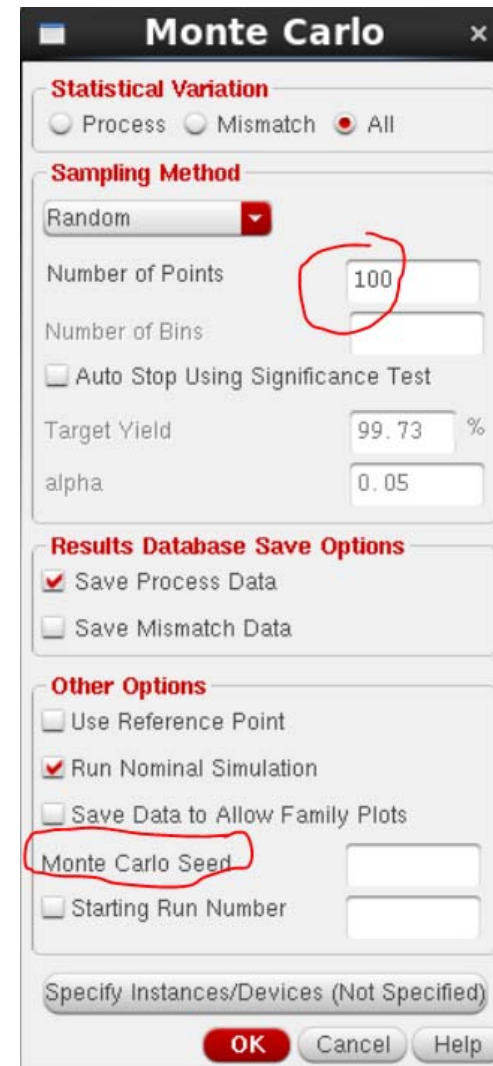
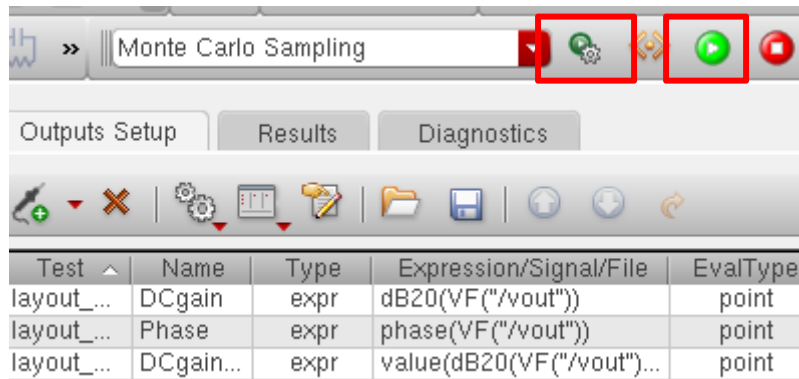
Monte Carlo simulation

- Step 3: open ADE XL



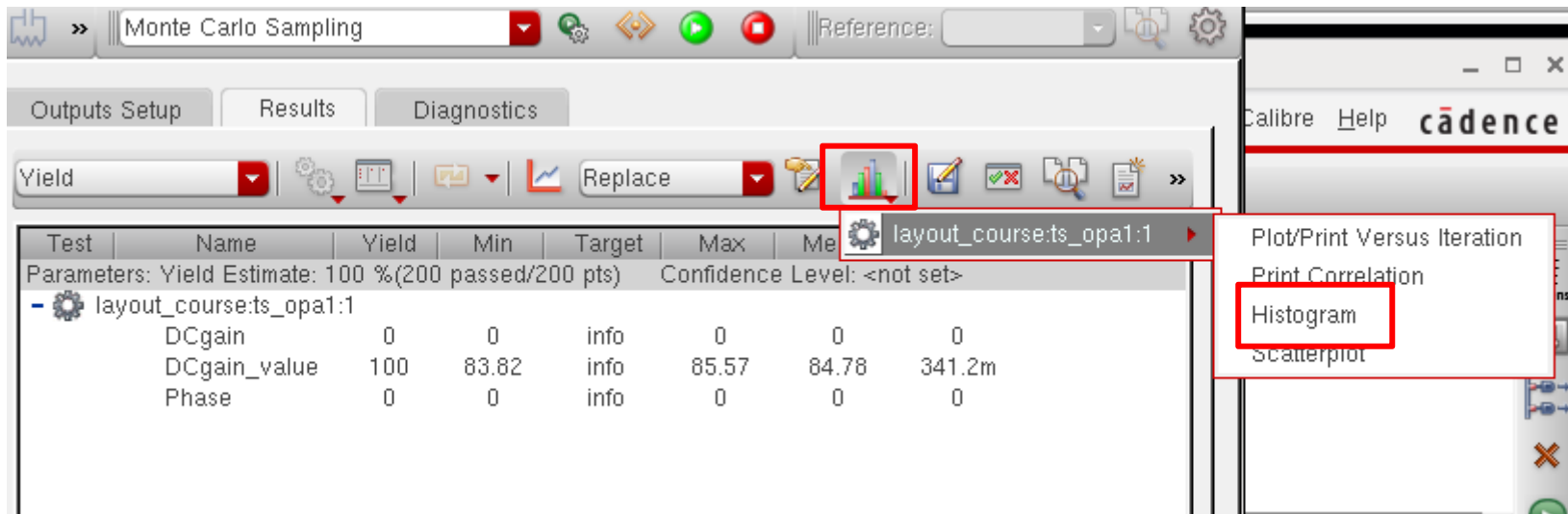
Monte Carlo simulation

■ Step 4: setup for ADE XL



Monte Carlo simulation

■ Step 5: check histogram



The screenshot shows the Monte Carlo Sampling interface in Cadence Calibre. The 'Diagnostics' tab is active, displaying a table of test results for 'layout_course:ts_opa1:1'. The table includes columns for Test, Name, Yield, Min, Target, Max, and Mean. The 'Yield' column shows a 100% yield estimate based on 200 passed points. A context menu is open over the test name, with the 'Histogram' option highlighted.

Test	Name	Yield	Min	Target	Max	Me
Parameters: Yield Estimate: 100 %(200 passed/200 pts) Confidence Level: <not set>						
-	layout_course:ts_opa1:1					
	DCgain	0	0	info	0	0
	DCgain_value	100	83.82	info	85.57	84.78
	Phase	0	0	info	0	0

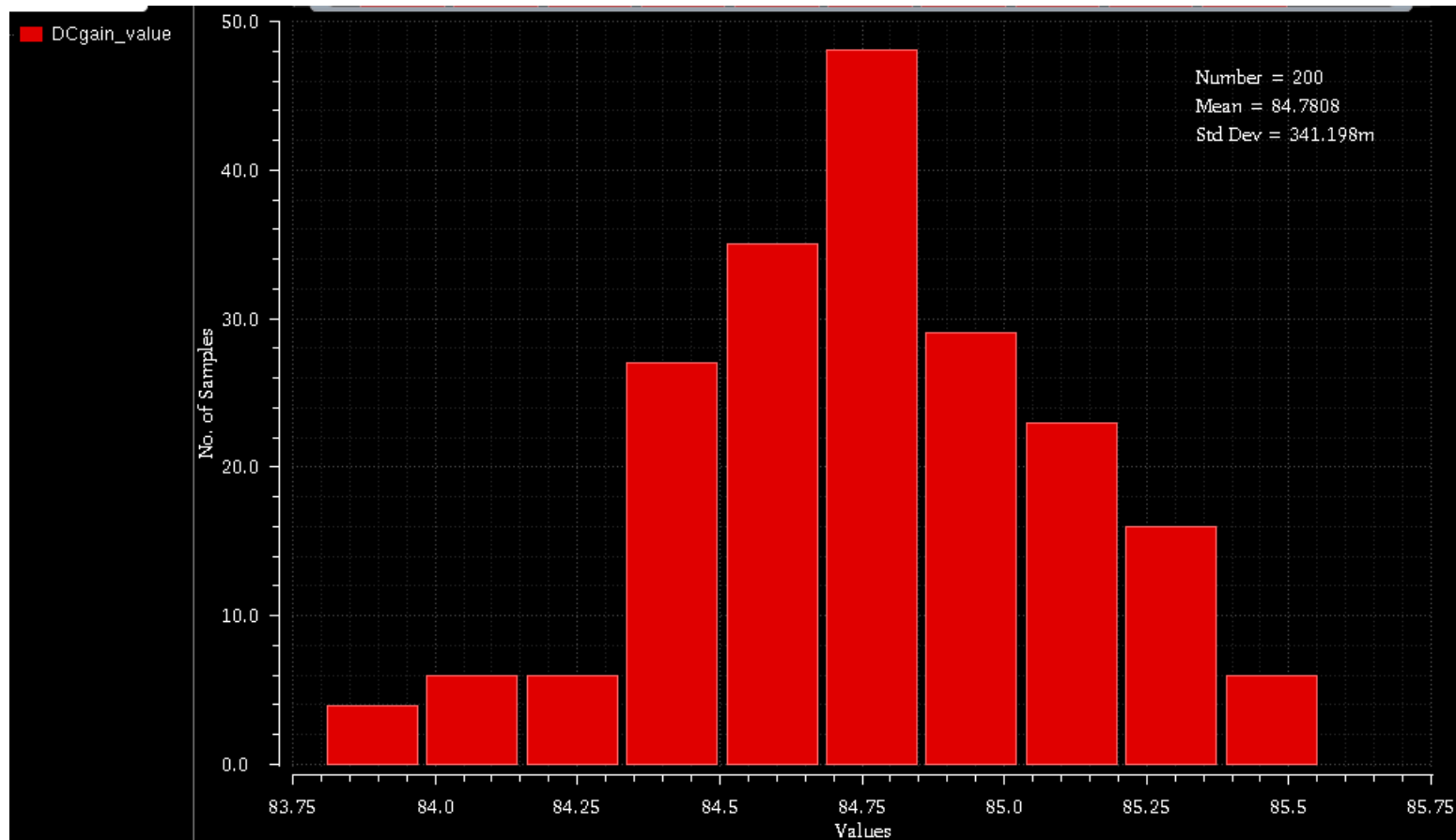
Monte Carlo simulation

- Step 5: check histogram



Monte Carlo simulation

- Step 5: check histogram





Thanks !