Certify- A Characterization and Validation Tool for Behavioral Models

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Outline

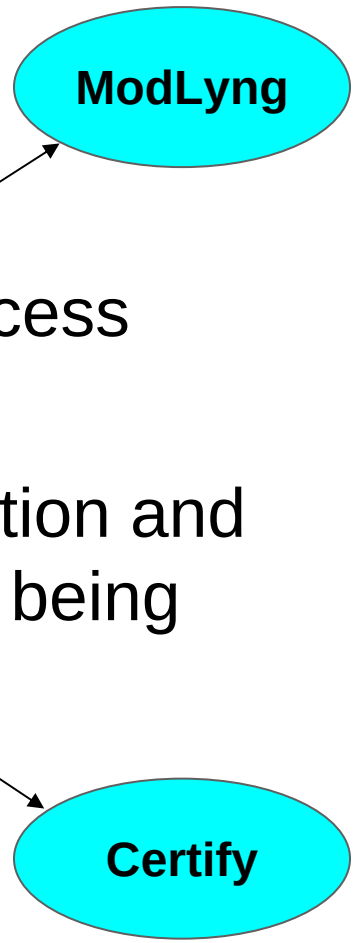
- Introduction
- What is Certify
- Certify Details
- Examples on a Power Diode Model
  - DC transfer Analysis
  - Transient Analysis
- Conclusion

Introduction

- Writing a model which can accurately depict the characteristics of a real device is a challenging task
- Writing a model solves just half of the problem. The other half is testing, characterizing and validating the model.

Why do we need Certify

- Modeling needs
  - Tools to facilitate model creation process
  - Tools to facilitate model characterization and validation process once the model is being developed



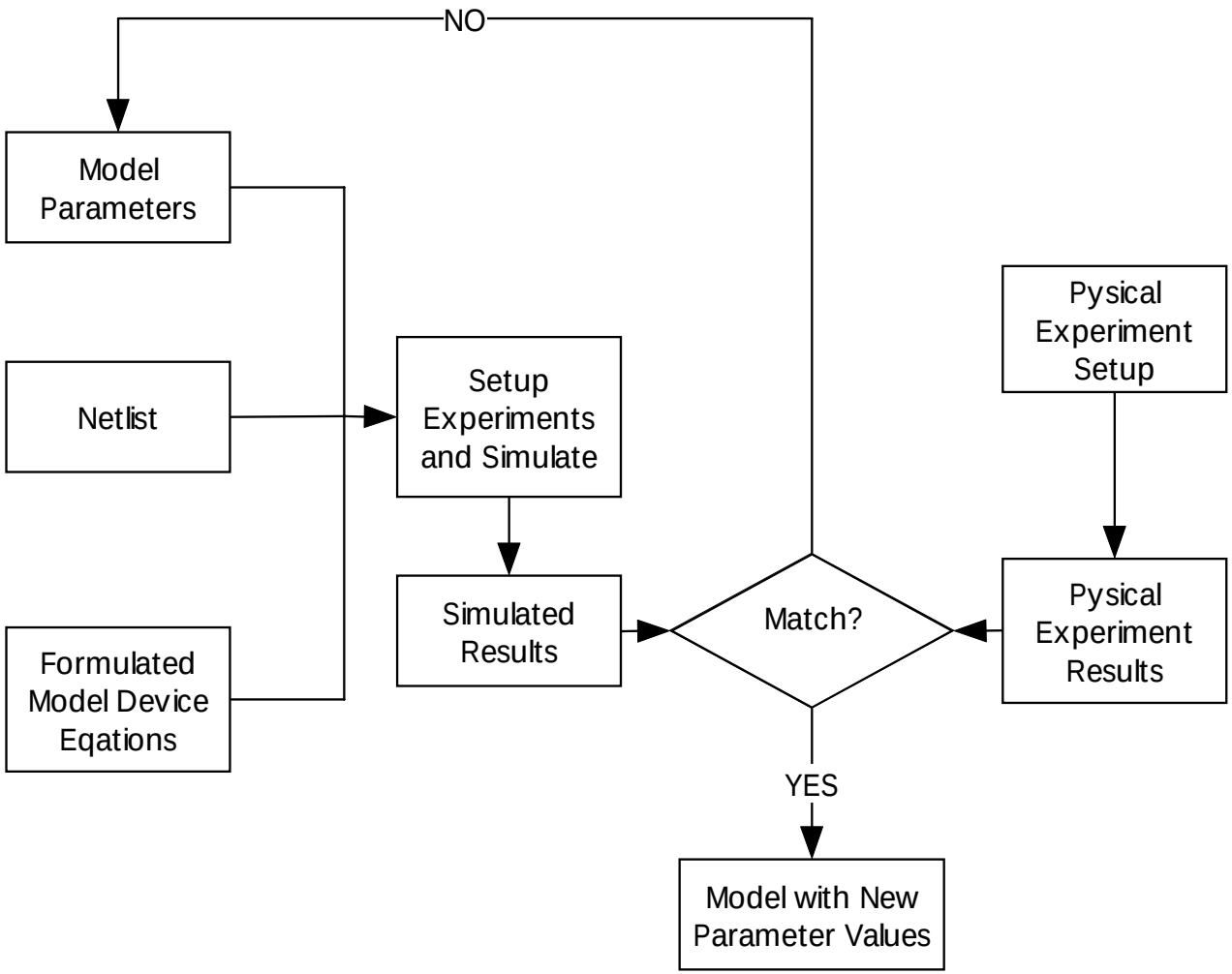
Why do we need Certify

- Model Characterization is a Time-Consuming process
  - Guess a value of the model parameters
  - Simulate the model
  - Compare the results with the target data
  - Change the value of model parameters if there is no match
  - Simulate and compare again
- Validating a model takes additional time
  - Multiple tests must be executed to test a model
  - Each test has to be run individually

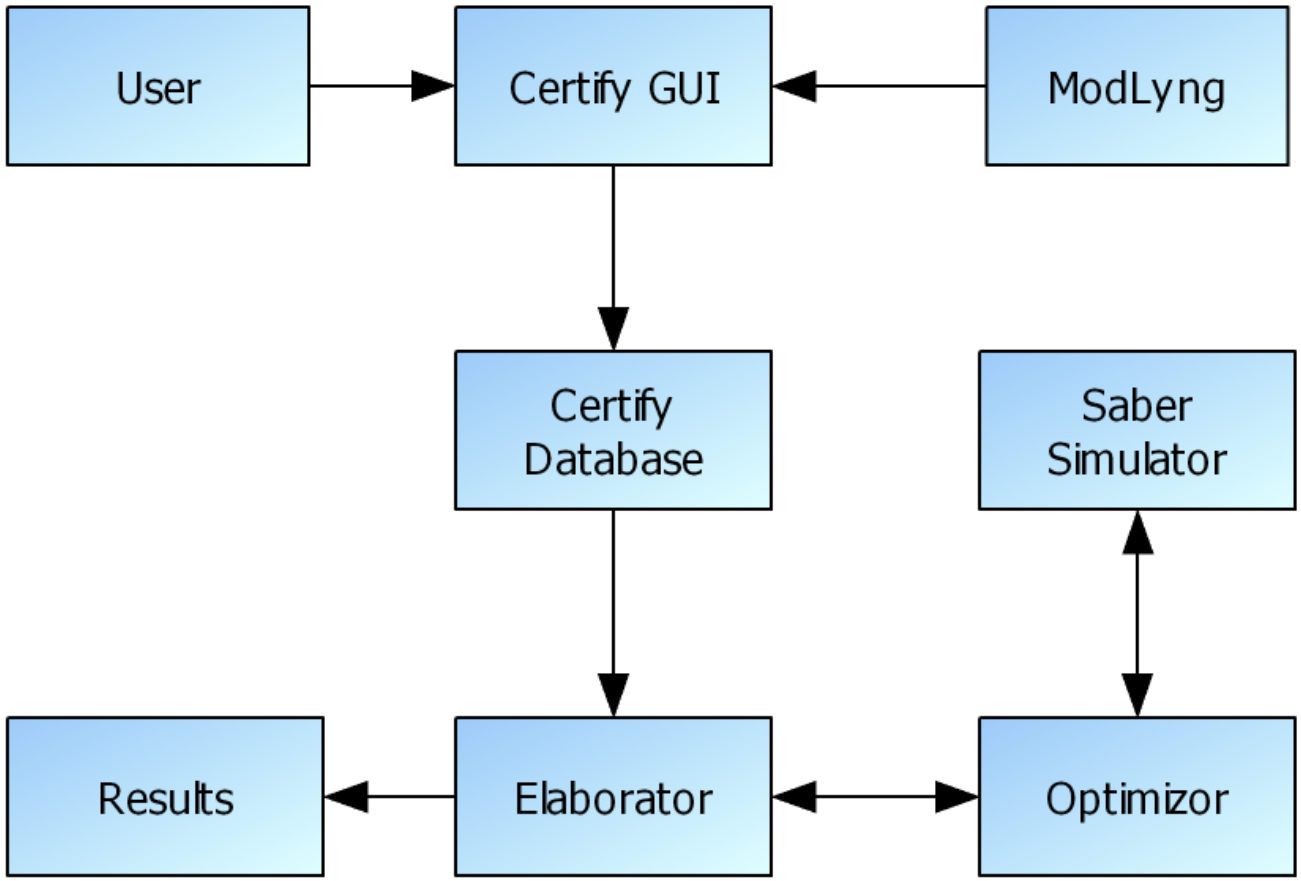
Certify

- Certify is the tool to automate the process
- Uses ModLyng's API to extract model data (parameters, default values, etc)
- Supports models written in MAST, and will expand to Verilog-A, Verilog-AMS and VHDL-AMS
- Is integrated with Saber simulator and partially integrated with VTB simulator

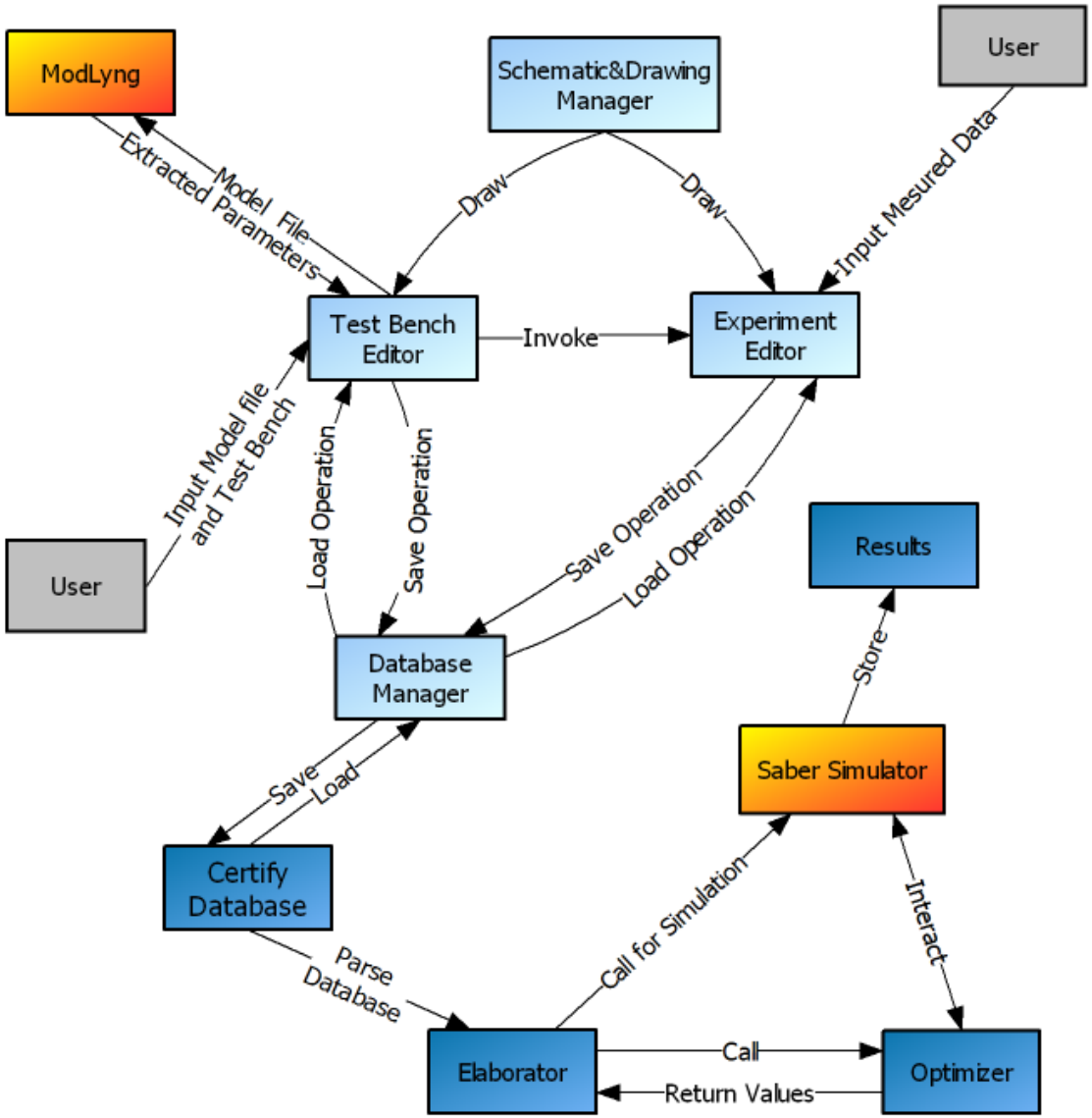
Model Characterization Methodology



Interaction with ModLyng and Saber



Architecture of Certify



Certify Details

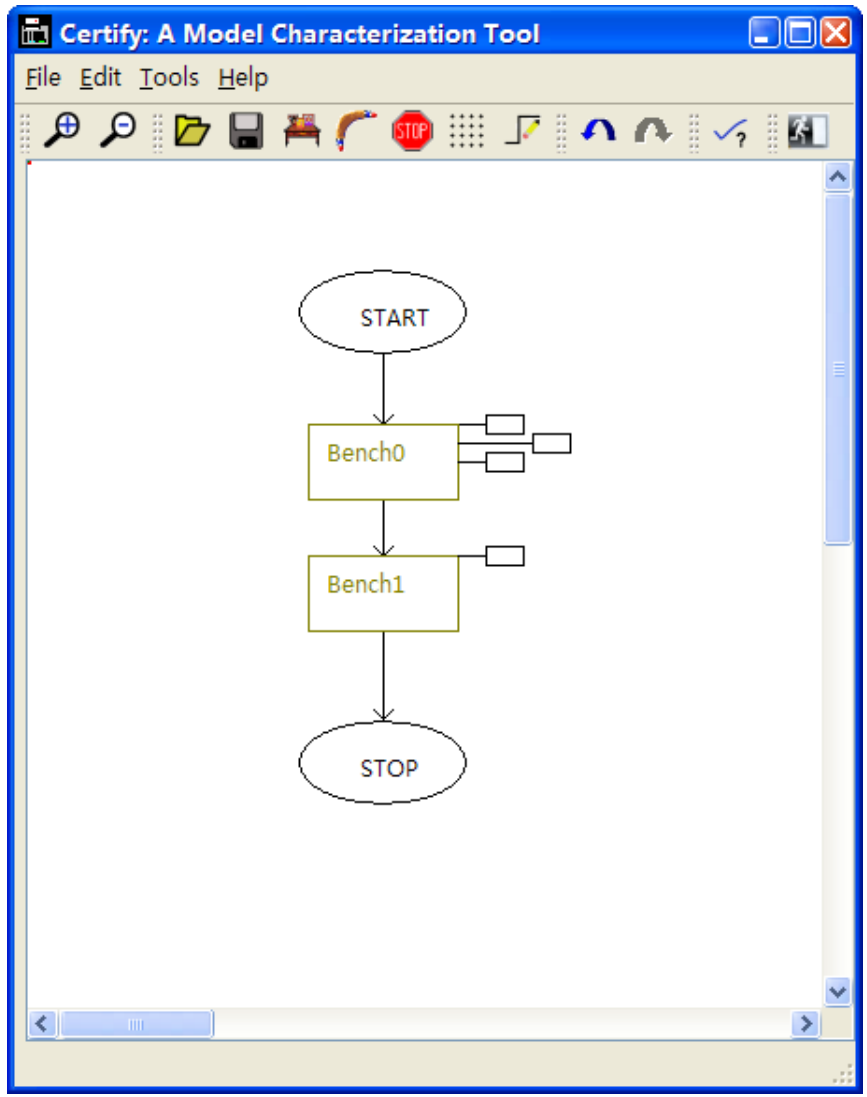
- Certify is written in Python Language
- Certify GUI is developed using PyQt toolkit
- Certify Database uses XML format to represent all the information

Optimizer

- Get simulation commands from Elaborator
- Get model parameters and default values from ModLyng
- Interacts with Saber simulator through AIM language.

Certify GUI

- Test Bench Editor
- Experiment Editor
- Analysis Information
- Parameter Spreadsheet
- Optimizer



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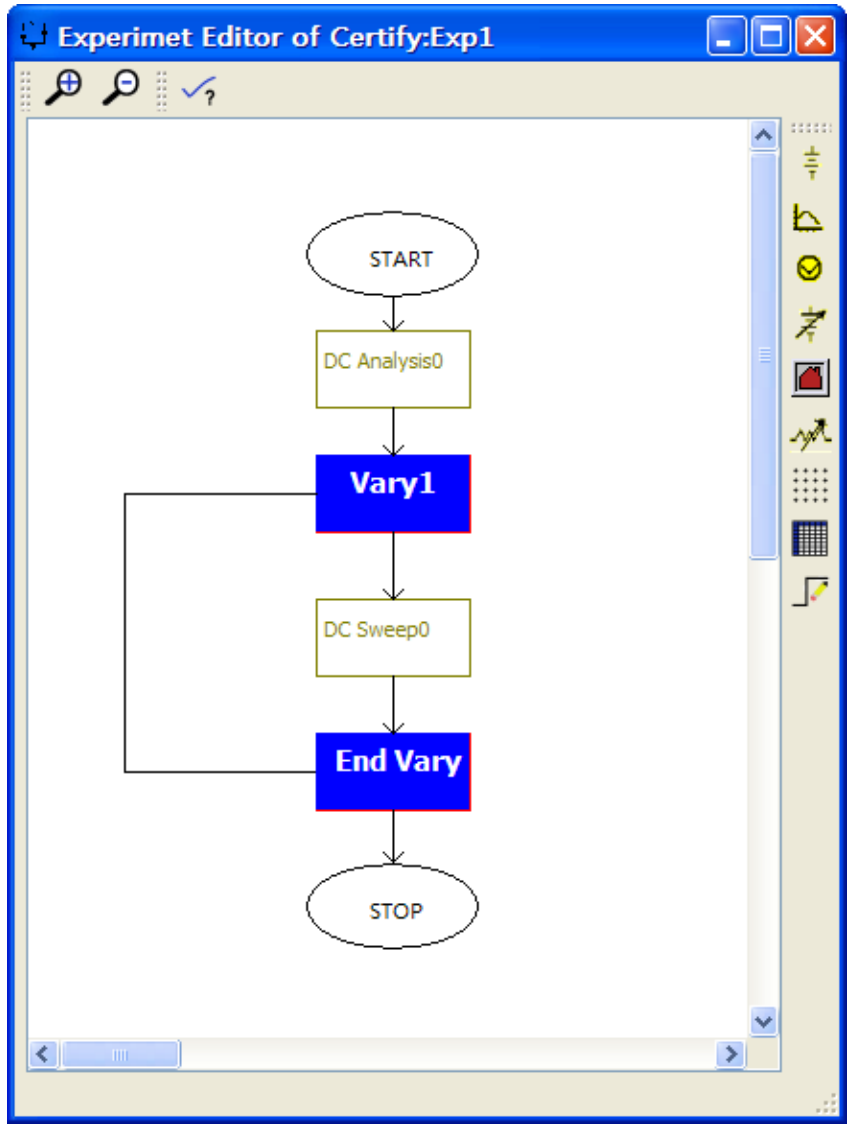

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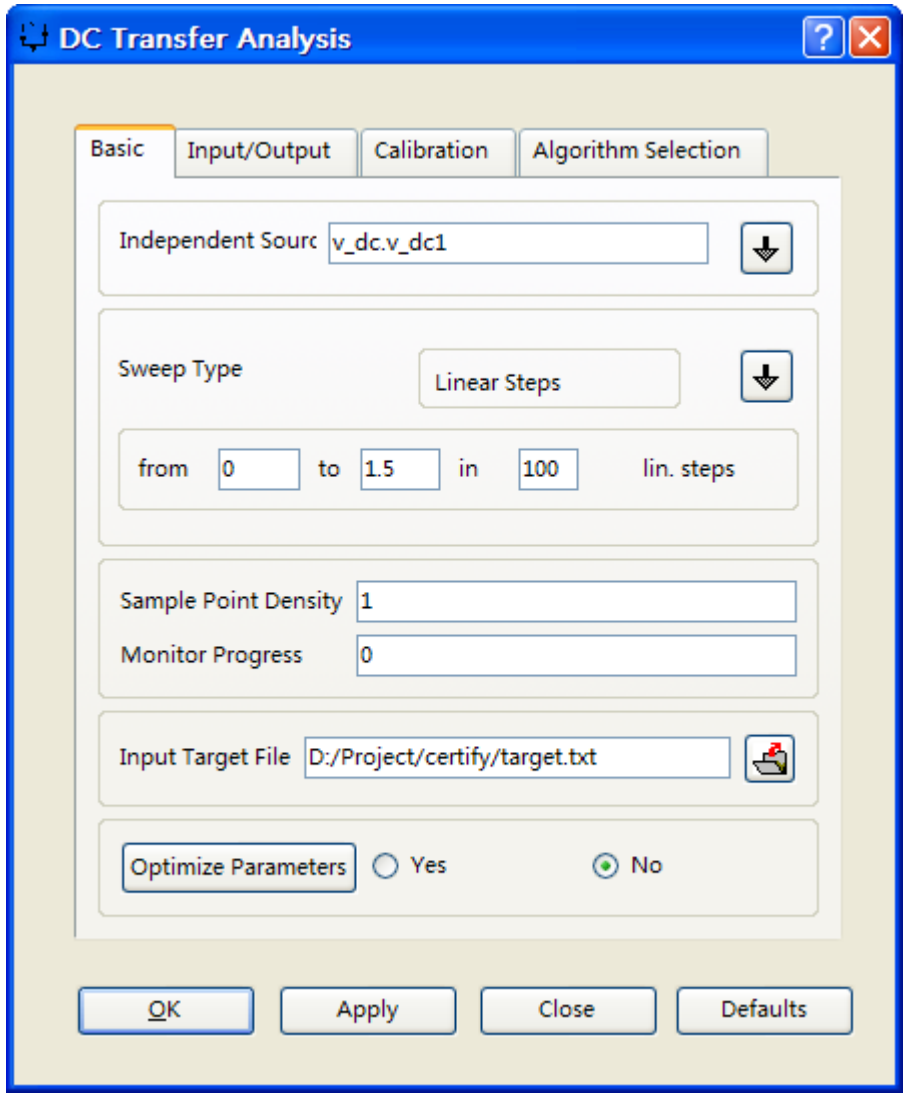

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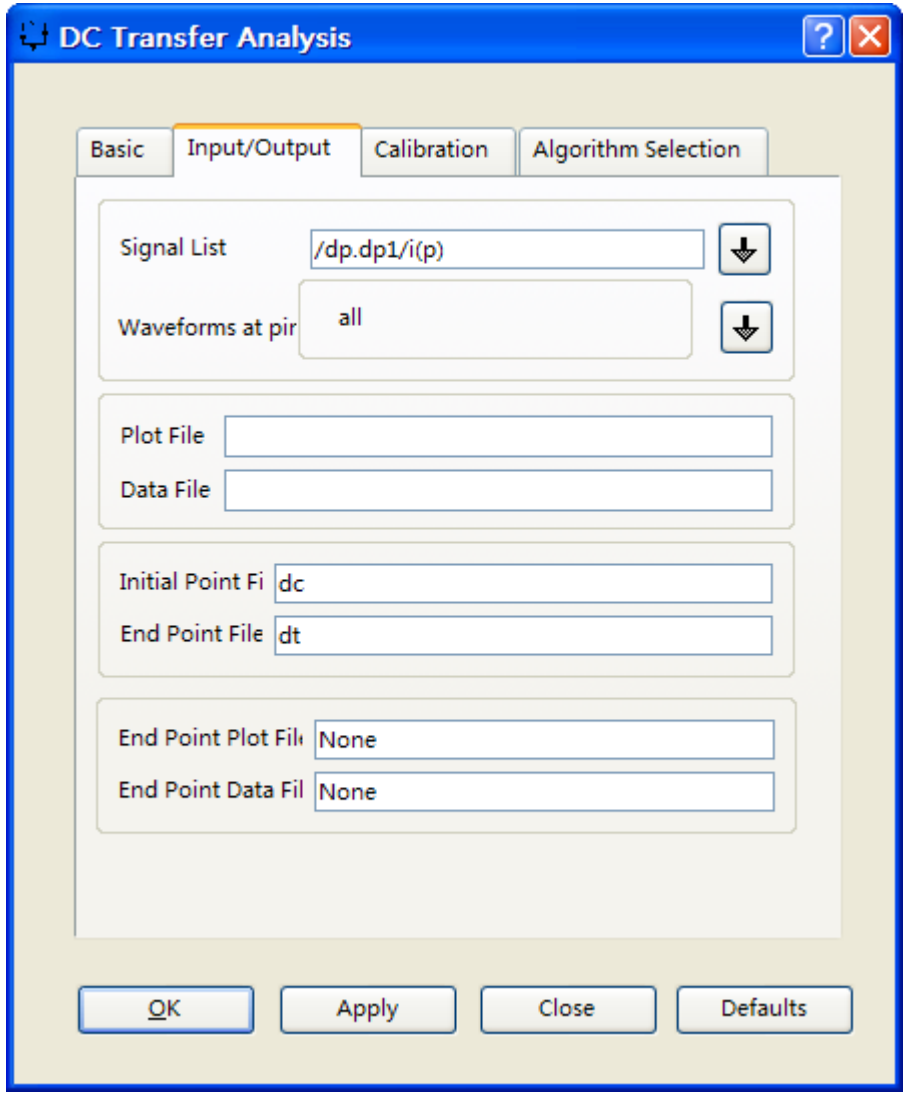

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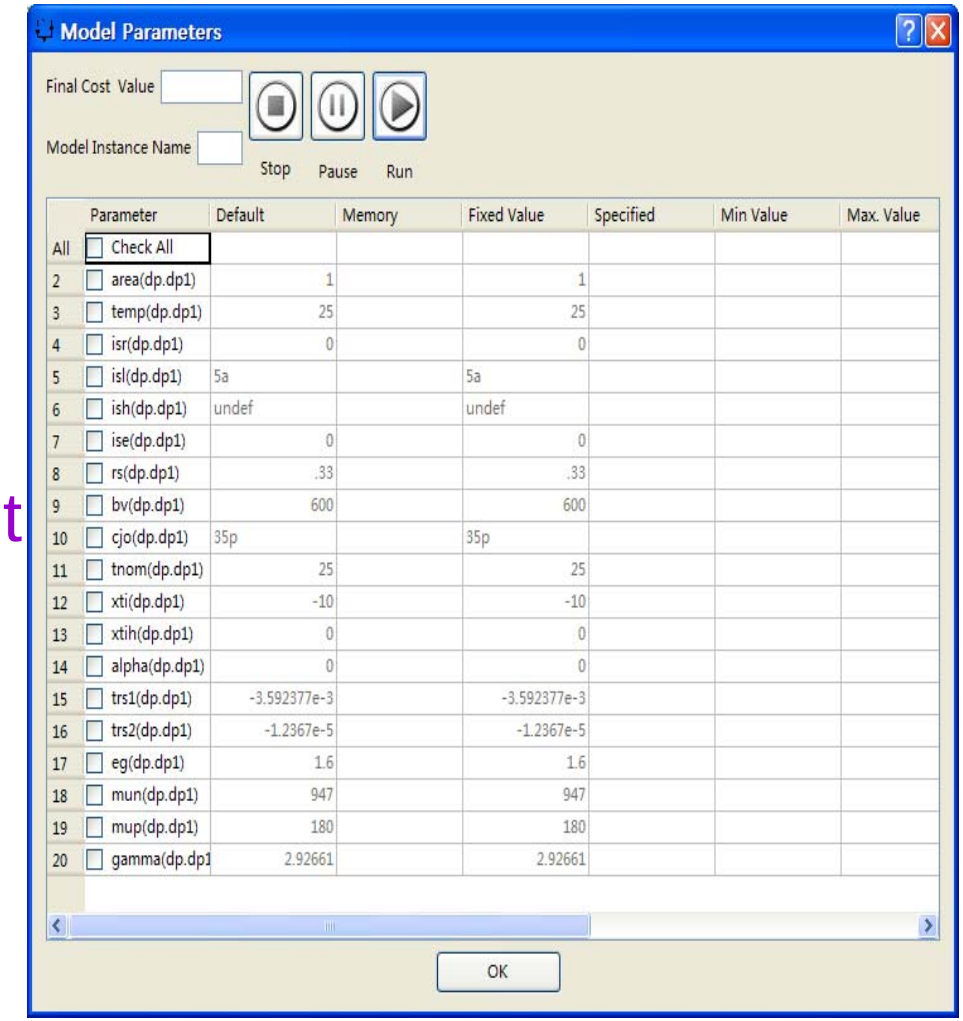
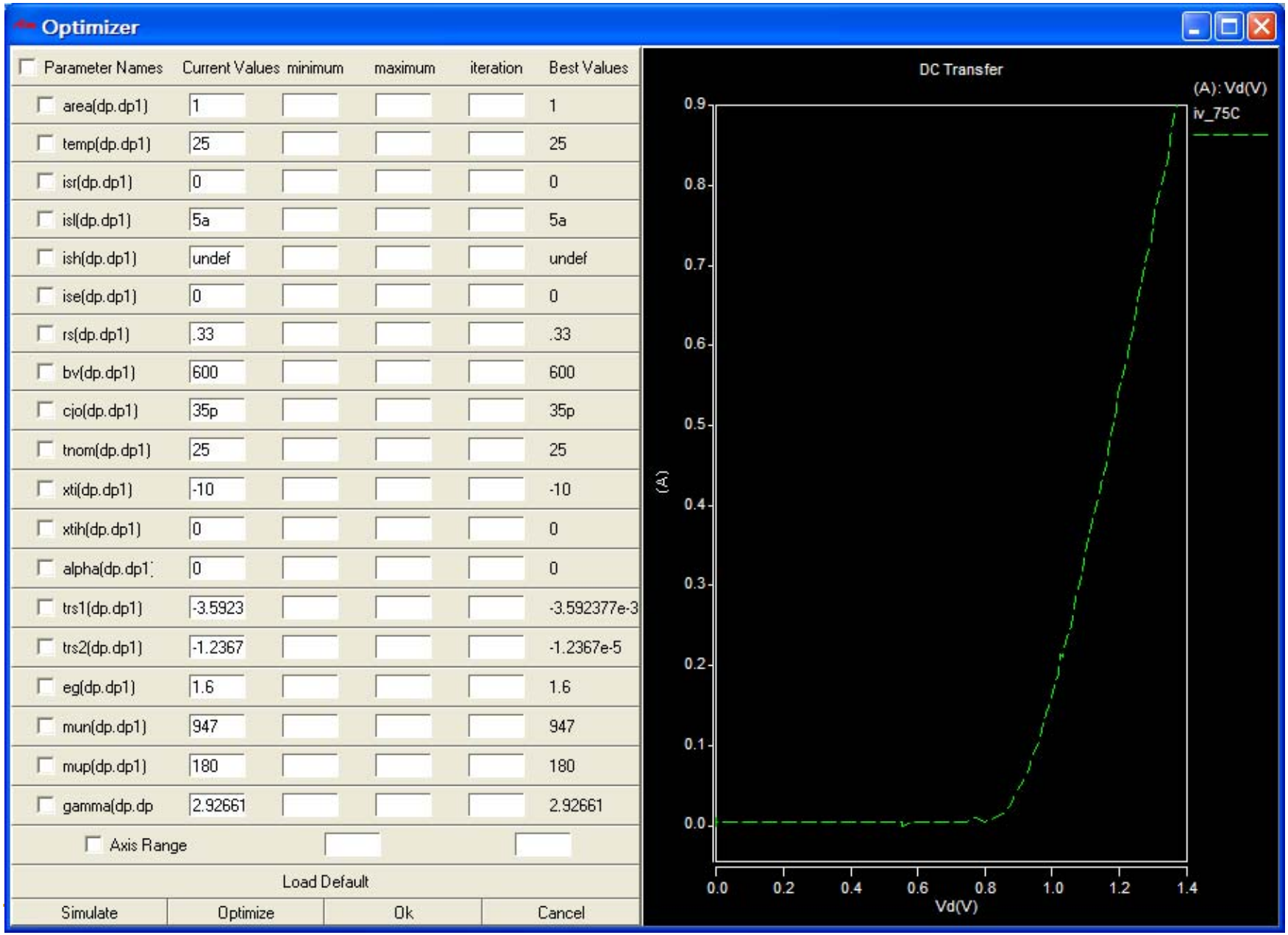
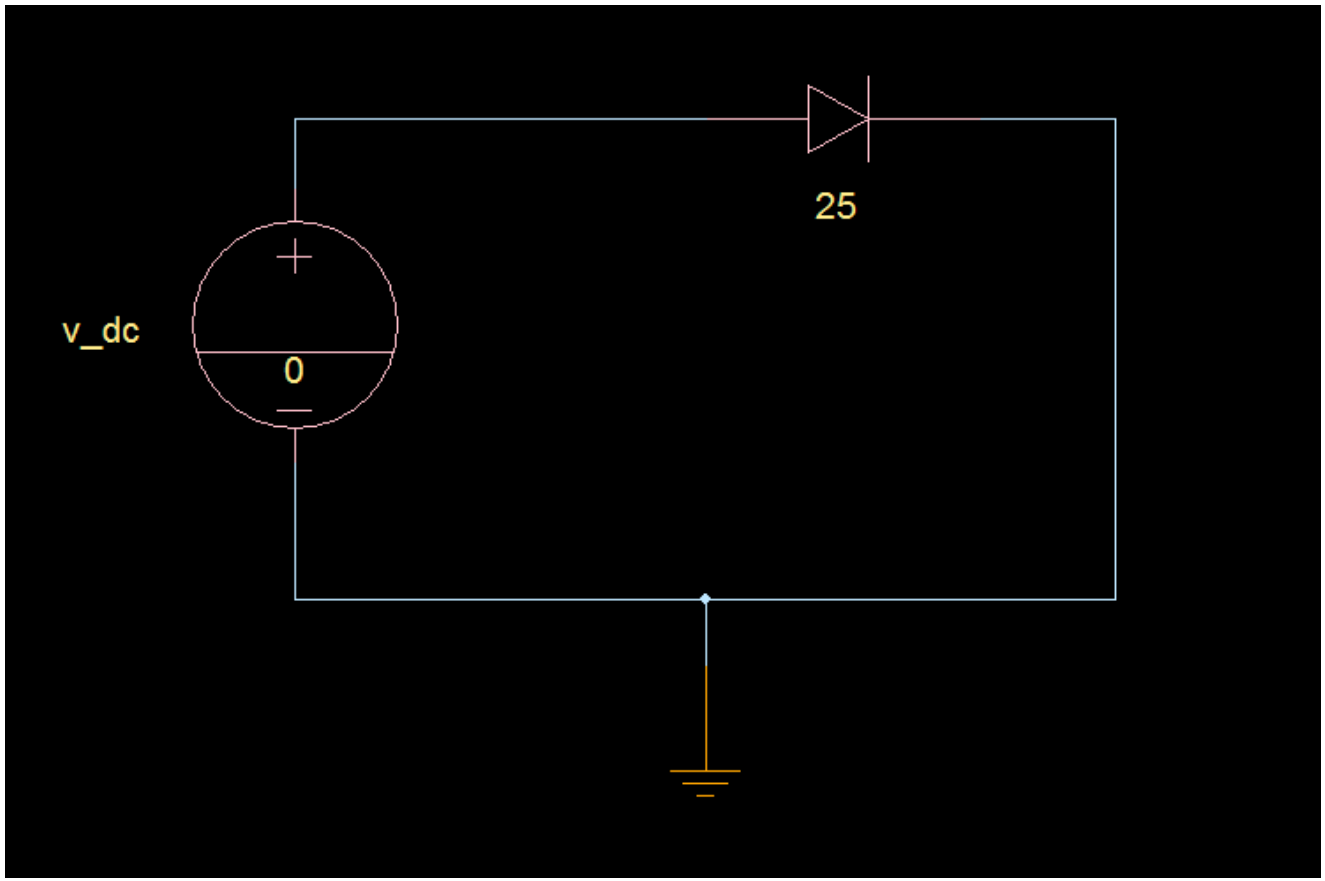



Optimizer
Parameter Names
Current Values
minimum
maximum
iteration
Best Values
area(dp.dp1) 1 1
temp(dp.dp1) 25 25
isr(dp.dp1) 0 0
isl(dp.dp1) 5a 5a
ish(dp.dp1) undef undef
ise(dp.dp1) 0 0
rs(dp.dp1) .33 .33
bv(dp.dp1) 600 600
cjo(dp.dp1) 35p 35p
tnom(dp.dp1) 25 25
xti(dp.dp1) -10 -10
xtih(dp.dp1) 0 0
alpha(dp.dp1 0 0
trs1(dp.dp1) -3.5923 -3.592377e-3
trs2(dp.dp1) -1.2367 -1.2367e-5
eg(dp.dp1) 1.6 1.6
mun(dp.dp1) 947 947
mup(dp.dp1) 180 180
gamma(dp.dp 2.92661 2.92661
Axis Range
Load Default
Simulate
Optimize
Ok
Cancel
DC Transfer
(A):Vd(V)
iv_75C
(A)
Vd(V)
0.0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4

Examples: Power Diode Characterization

- Example 1: DC Transfer



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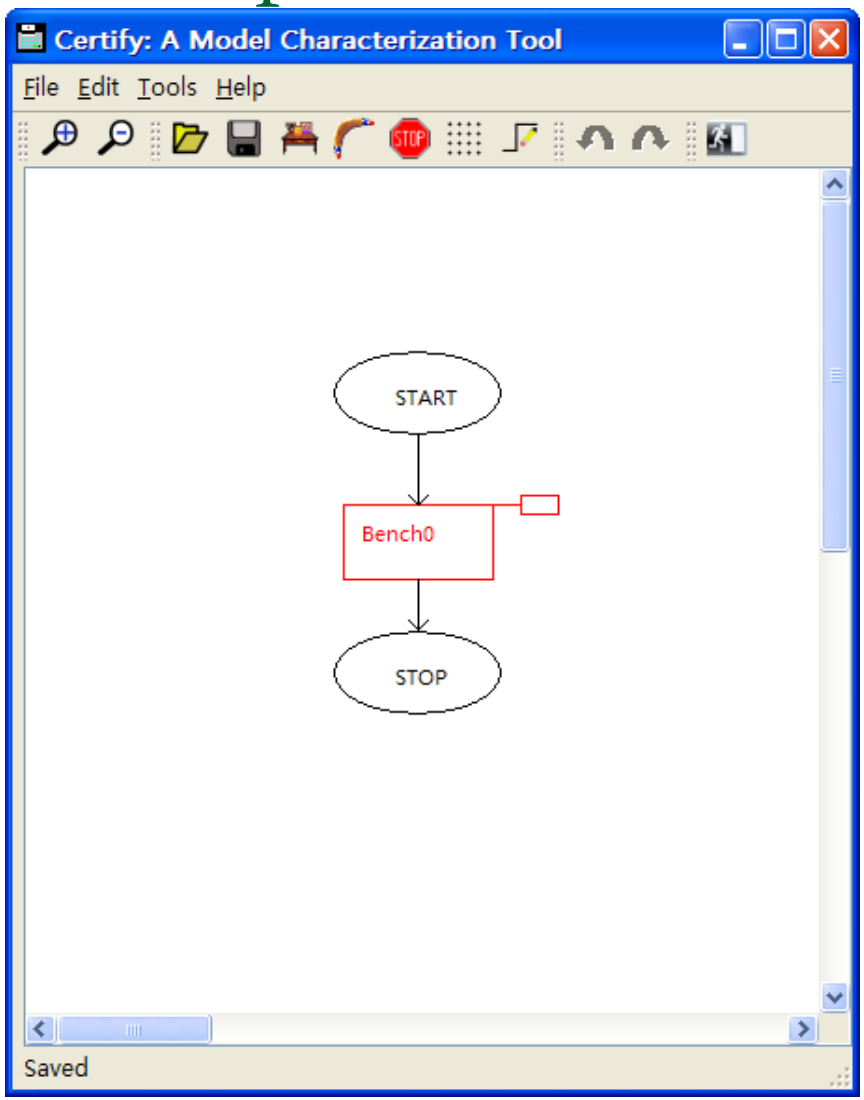

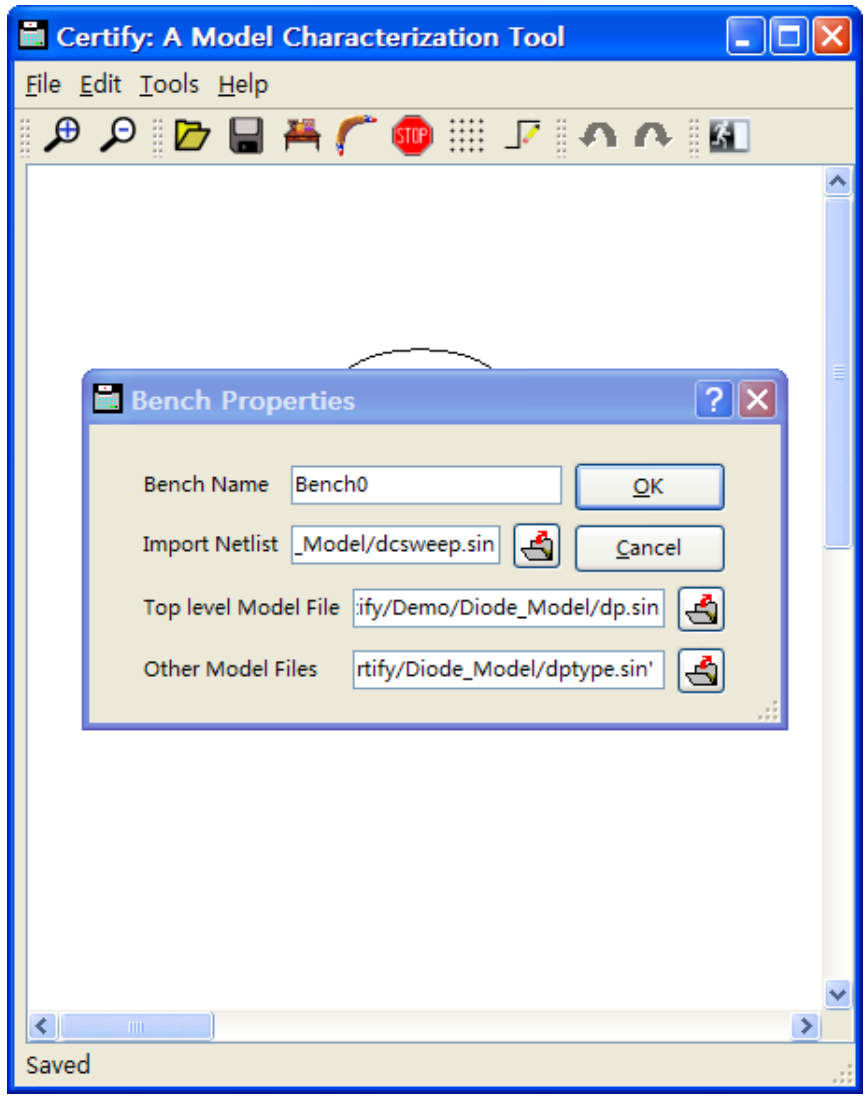

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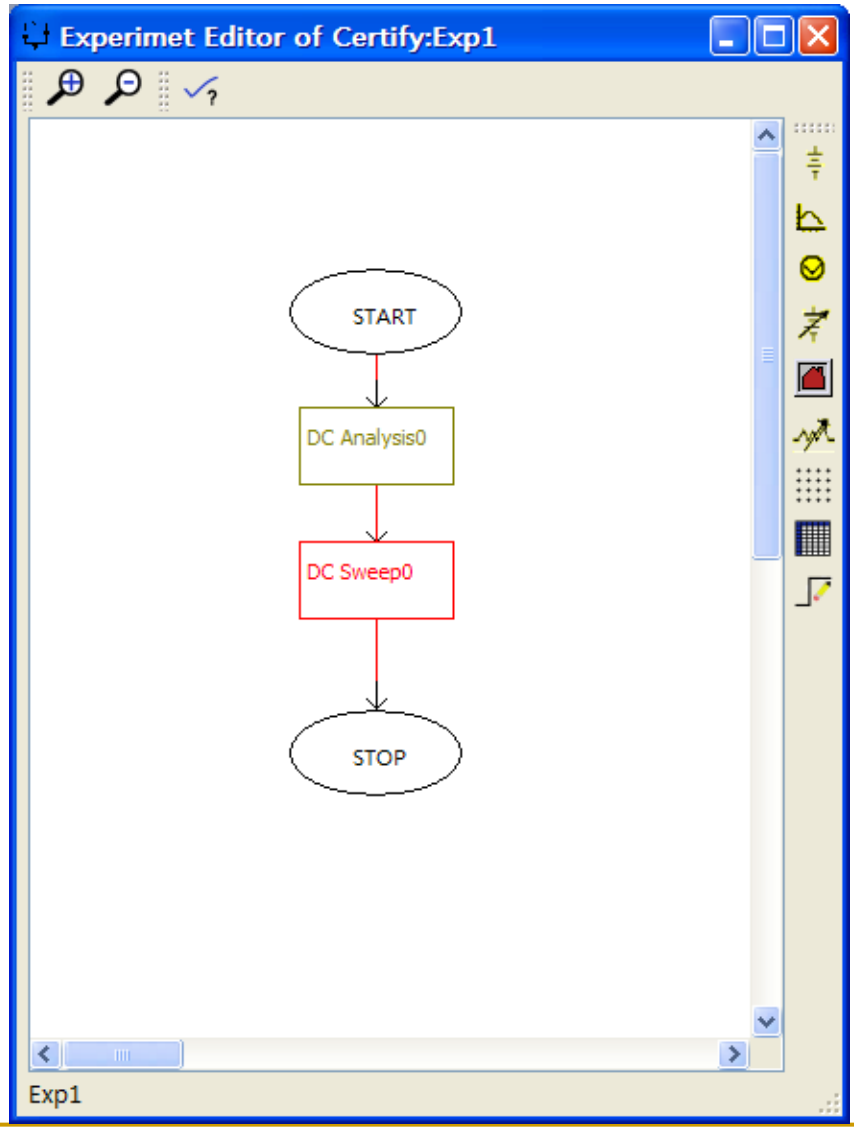
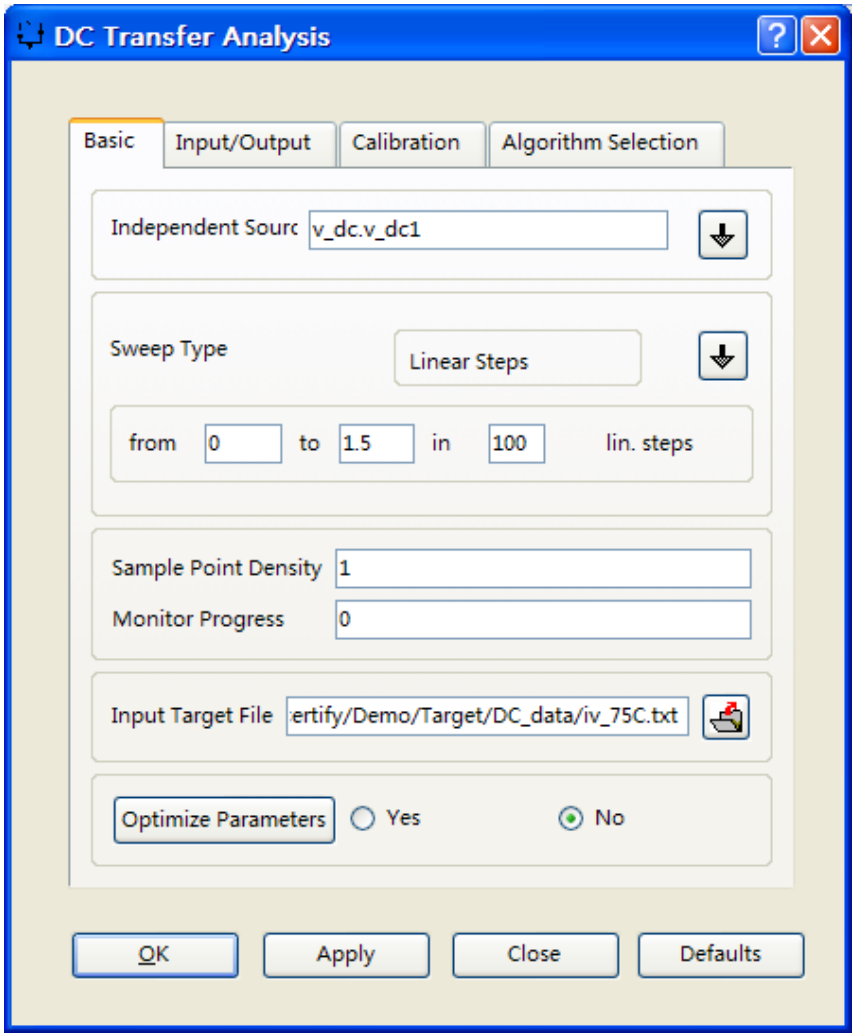
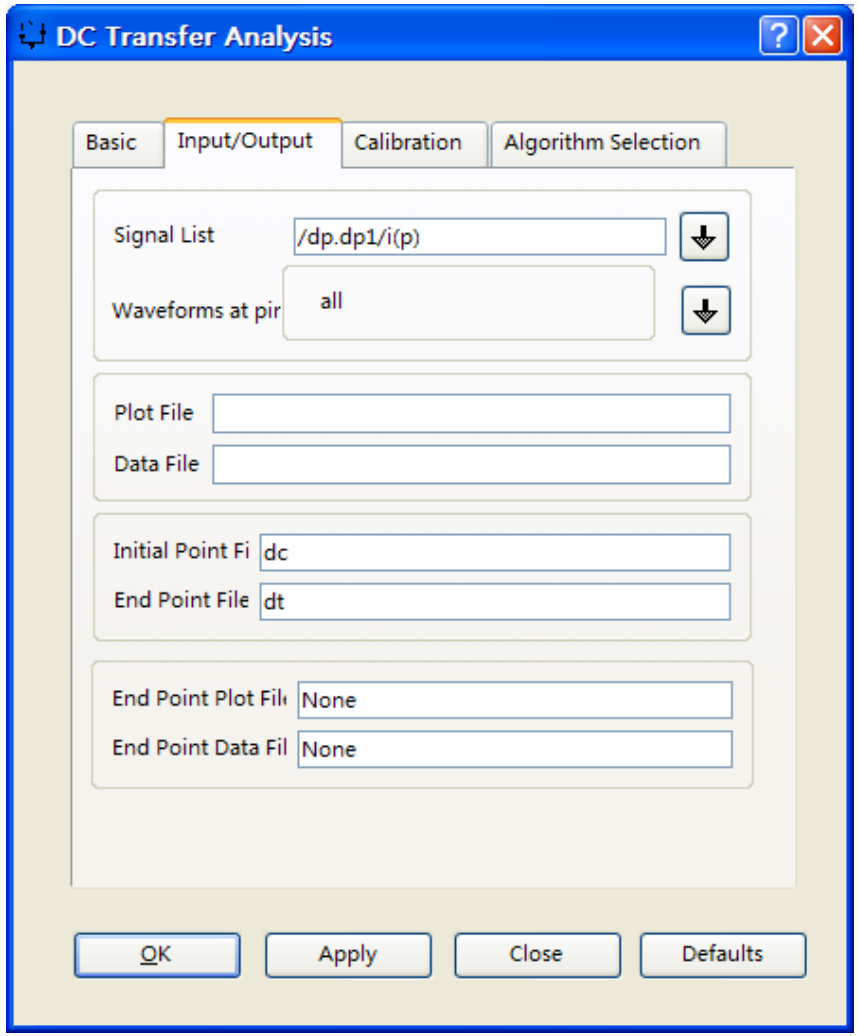


Examples: Power Diode Characterization





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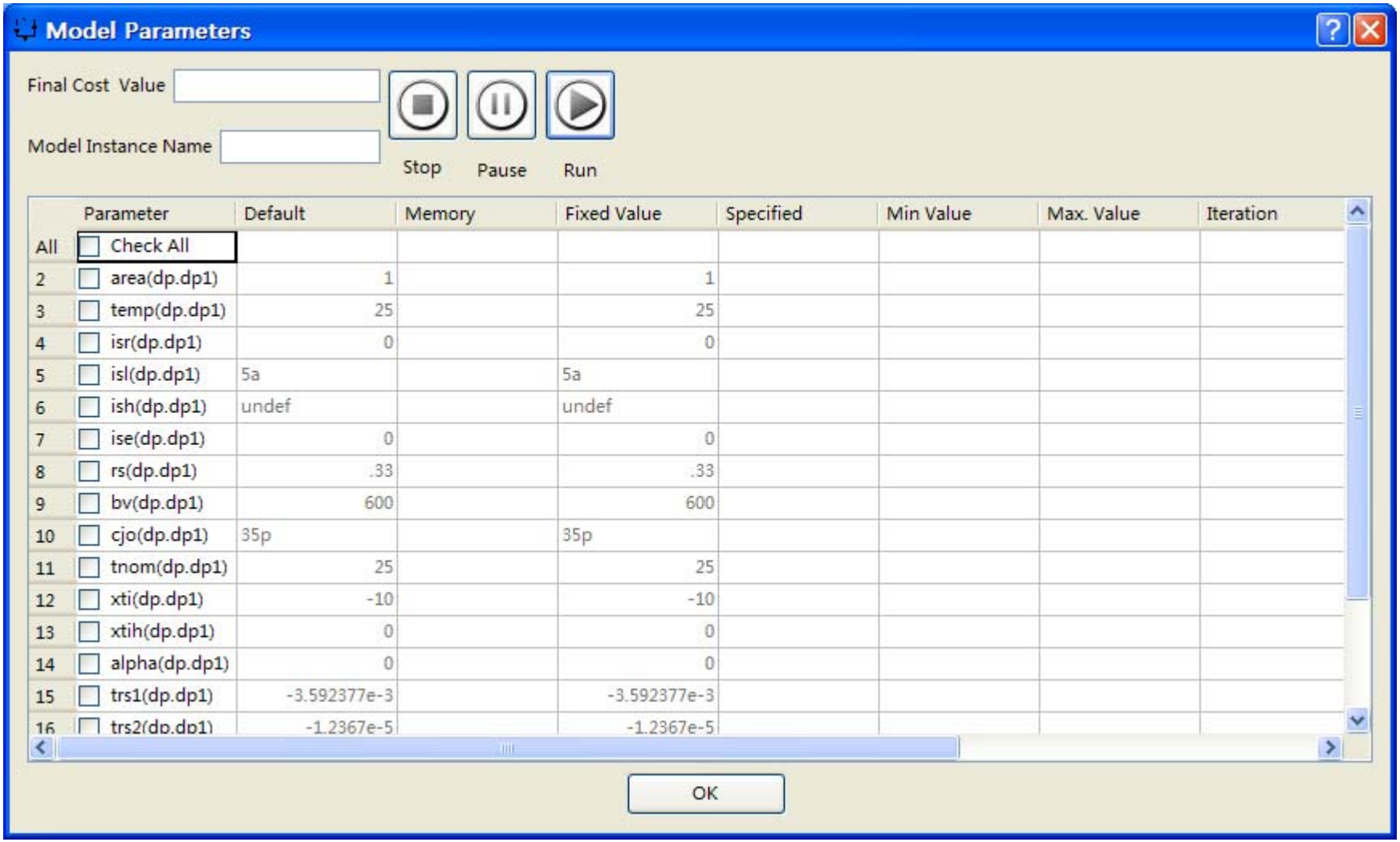
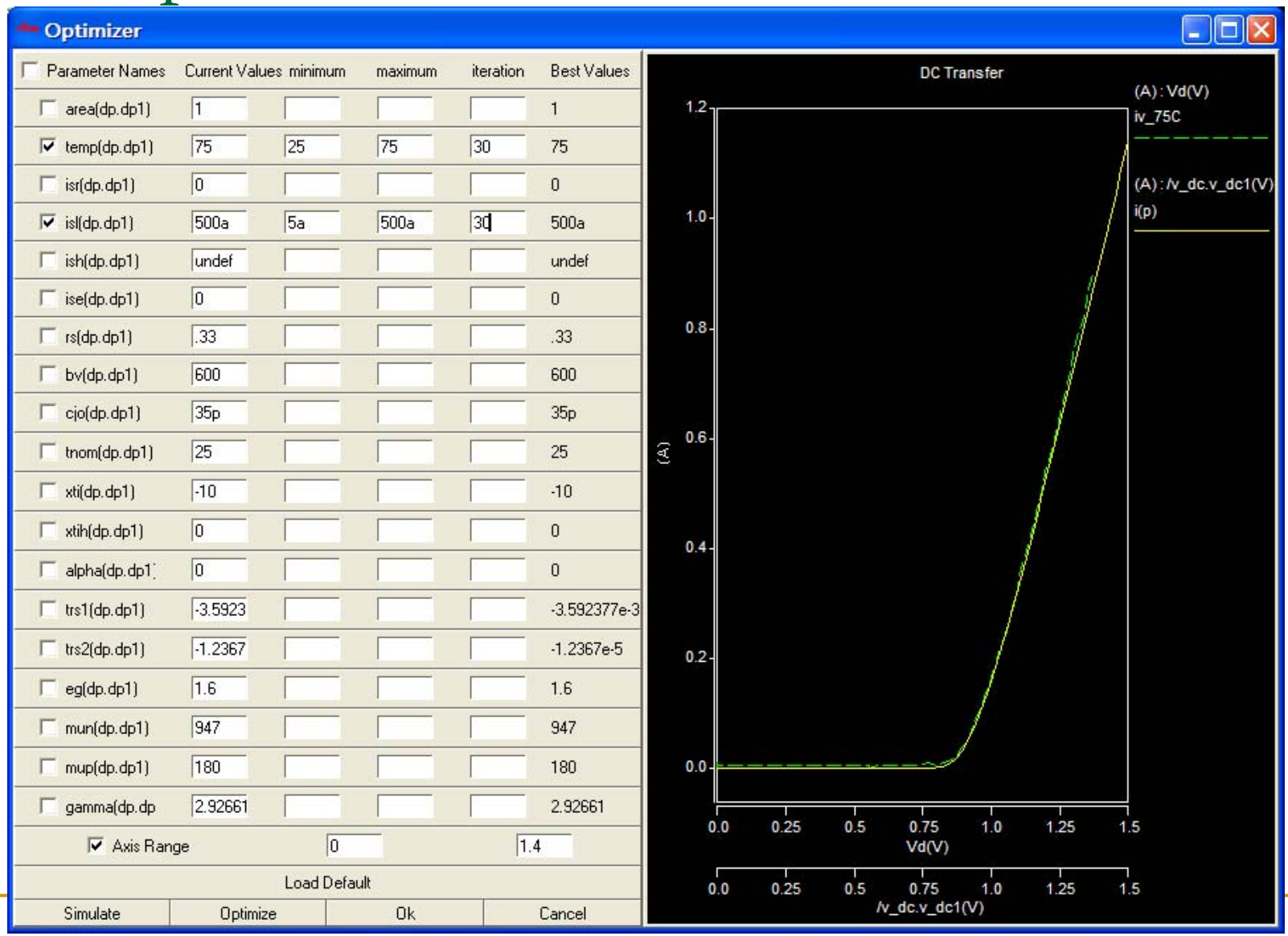


	Parameter	Default	Memory	Fixed Value	Specified	Min Value	Max. Value	Iteration
All	Check All							
2	area(dp.dp1)	1		1				
3	temp(dp.dp1)	25		25				
4	isr(dp.dp1)	0		0				
5	isl(dp.dp1)	5a		5a				
6	ish(dp.dp1)	undef		undef				
7	ise(dp.dp1)	0		0				
8	rs(dp.dp1)	.33		.33				
9	bv(dp.dp1)	600		600				
10	cjo(dp.dp1)	35p		35p				
11	tnom(dp.dp1)	25		25				
12	xti(dp.dp1)	-10		-10				
13	xtih(dp.dp1)	0		0				
14	alpha(dp.dp1)	0		0				
15	trs1(dp.dp1)	-3.592377e-3		-3.592377e-3				
16	trs2(dp.dp1)	-1.2367e-5		-1.2367e-5				

Examples: Power Diode Characterization

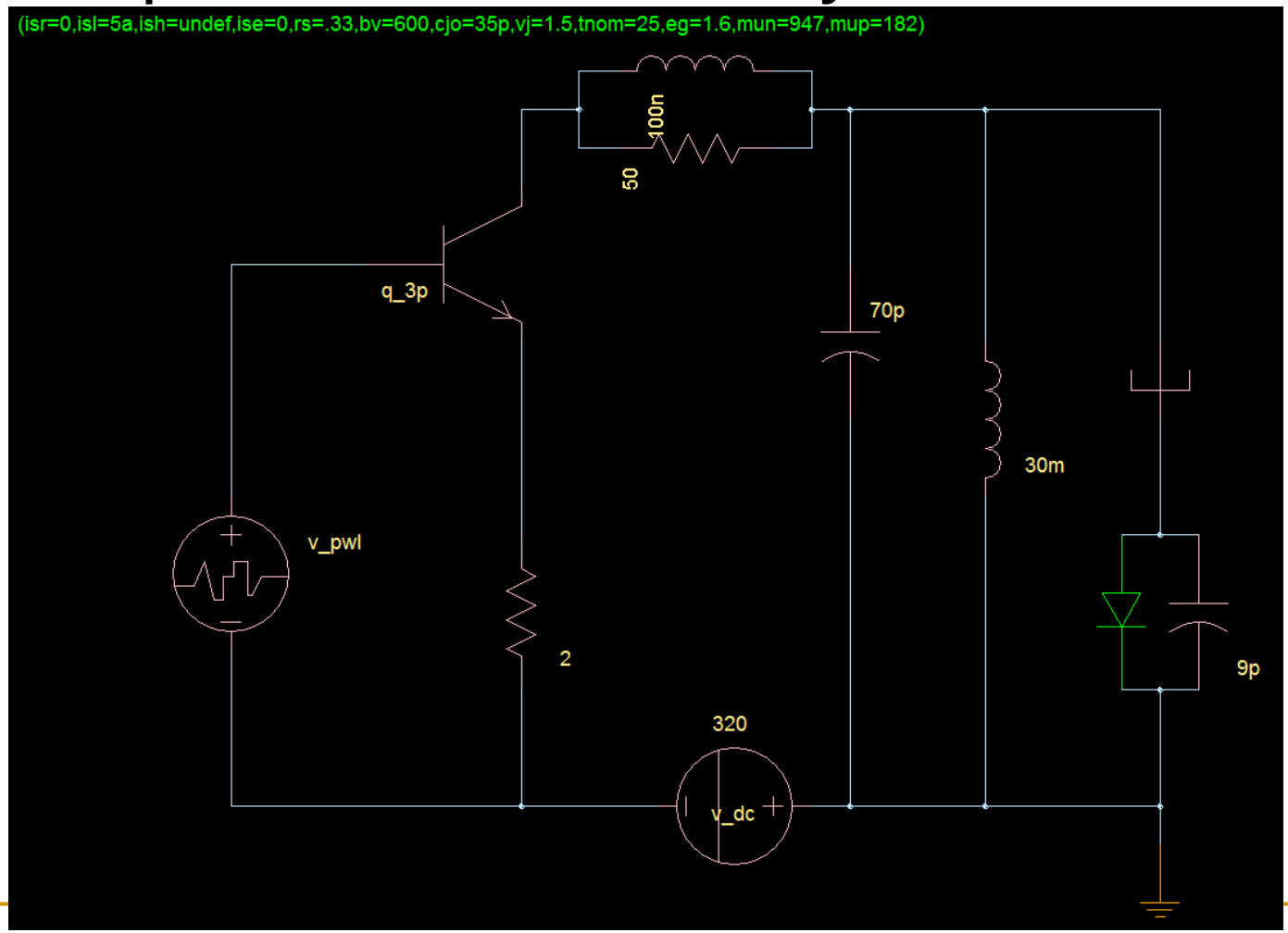


Examples: Power Diode Characterization

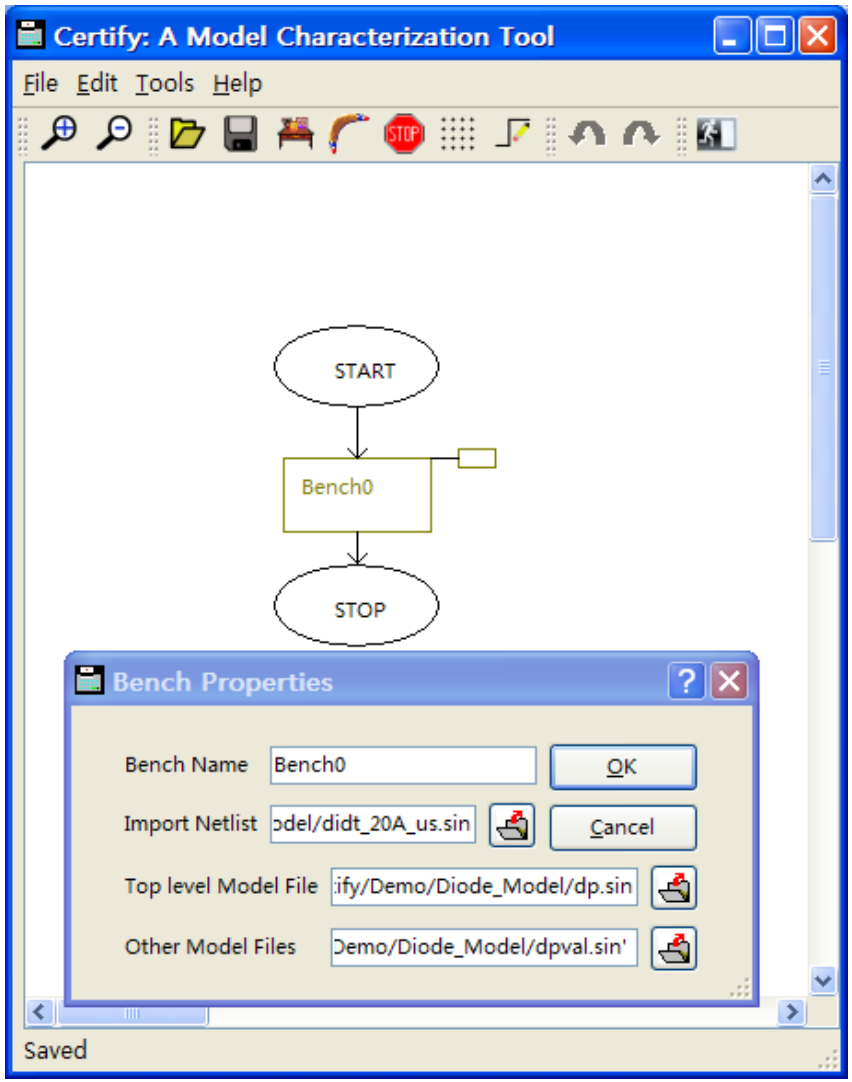
- Extracted Parameters:
  - temp=75
  - isl=500a
  - area=1
  - isr=0
  - ish=undef
  - rs=0.33
  - bv=600
  - cjo=35p
  - tnom=25
  - xti=-10
  - xtih=0
  - alpha=0
  - trs1=-3.592377e-3
  - tsr2=-1.2367e-5
  - eg=1.6
  - mun=947
  - mup=180
  - gamma=2.92661

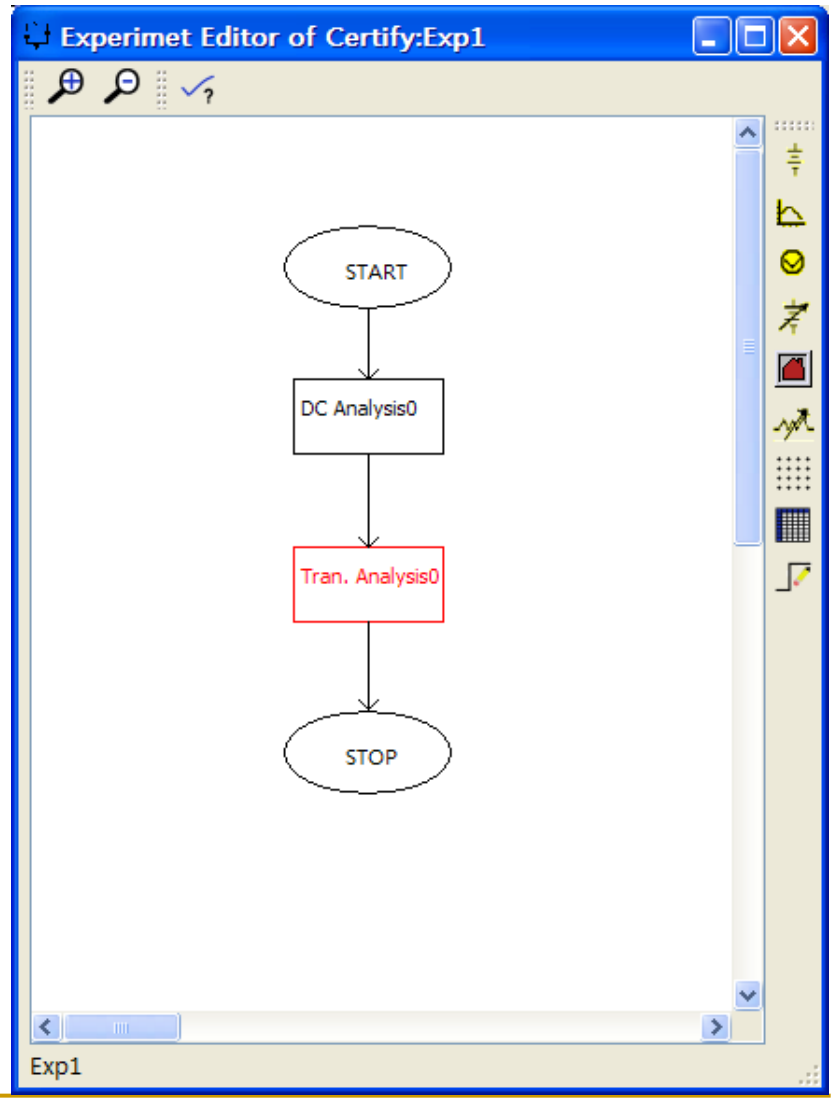
Examples: Power Diode Characterization

- Example 2: Transient Analysis



Examples: Power Diode Characterization





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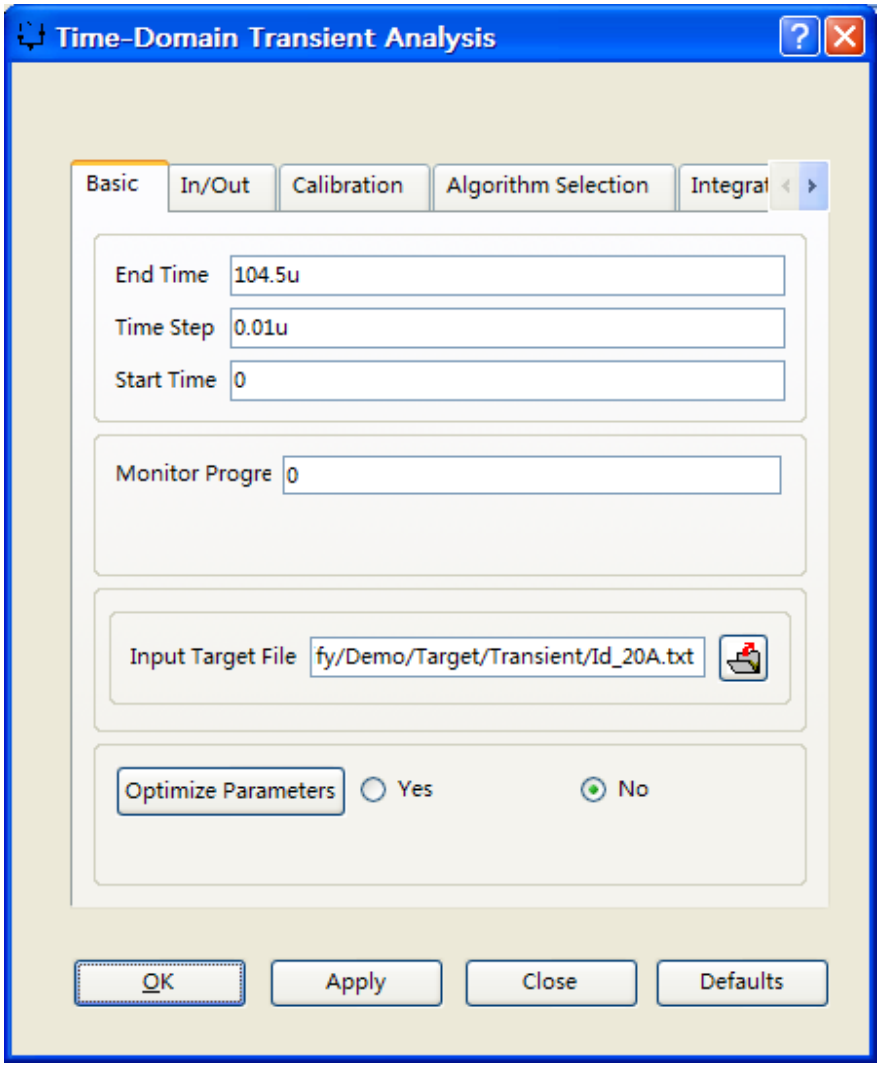

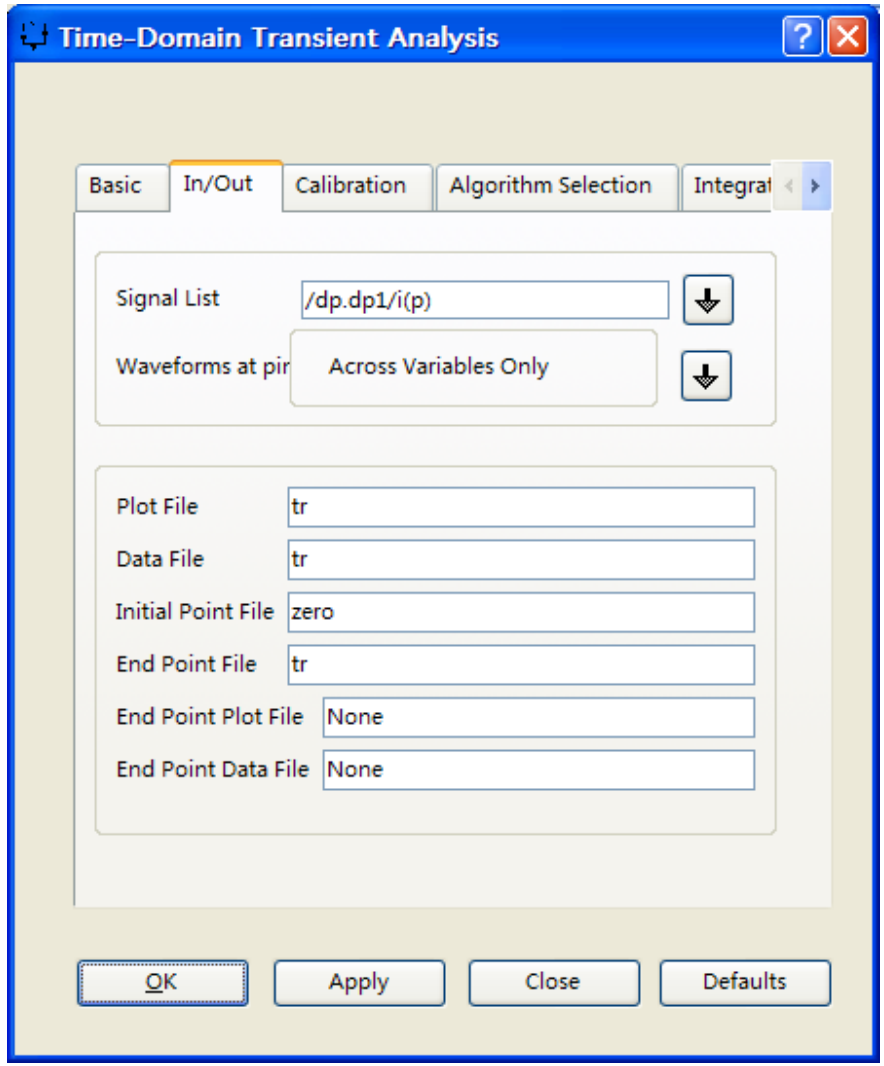

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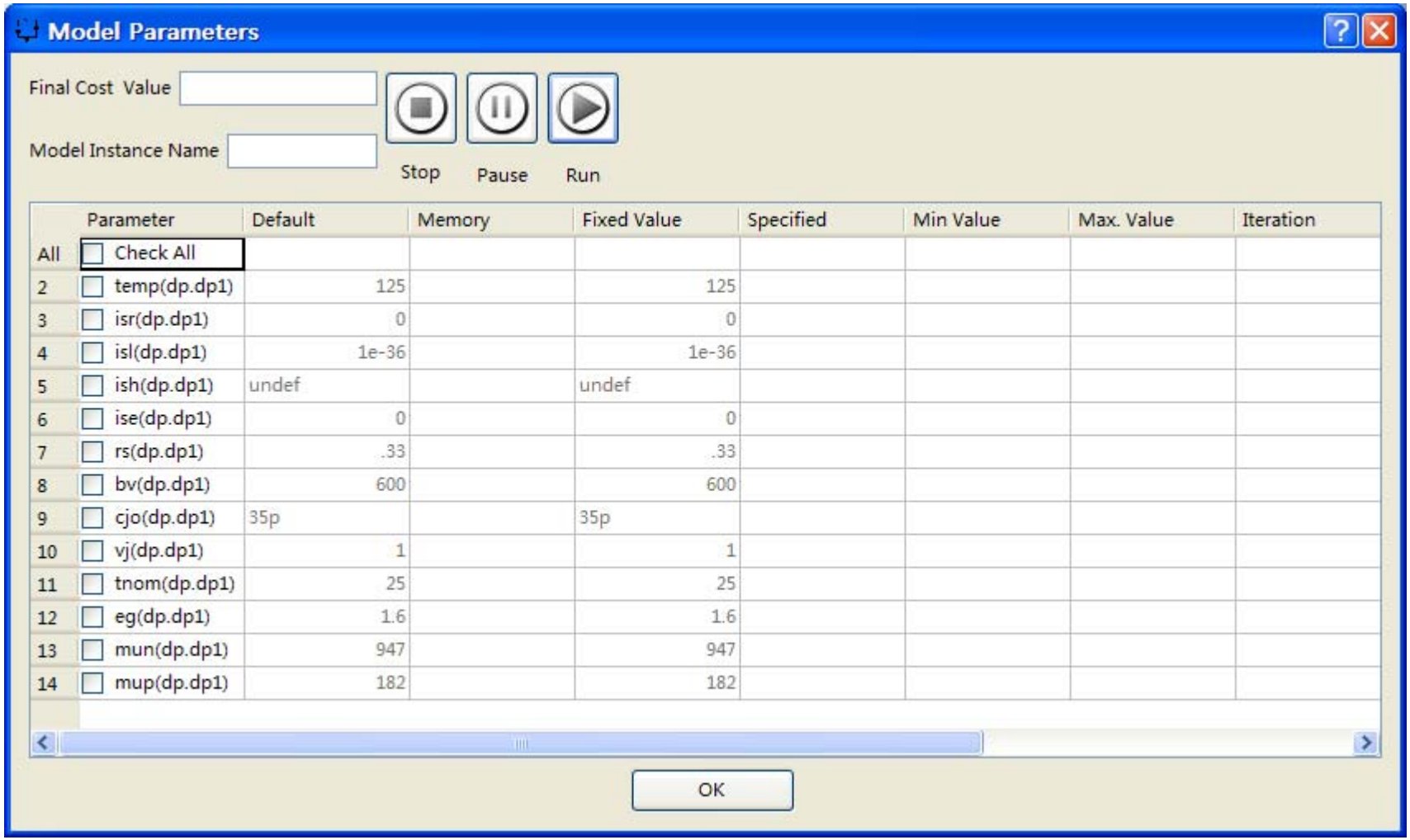

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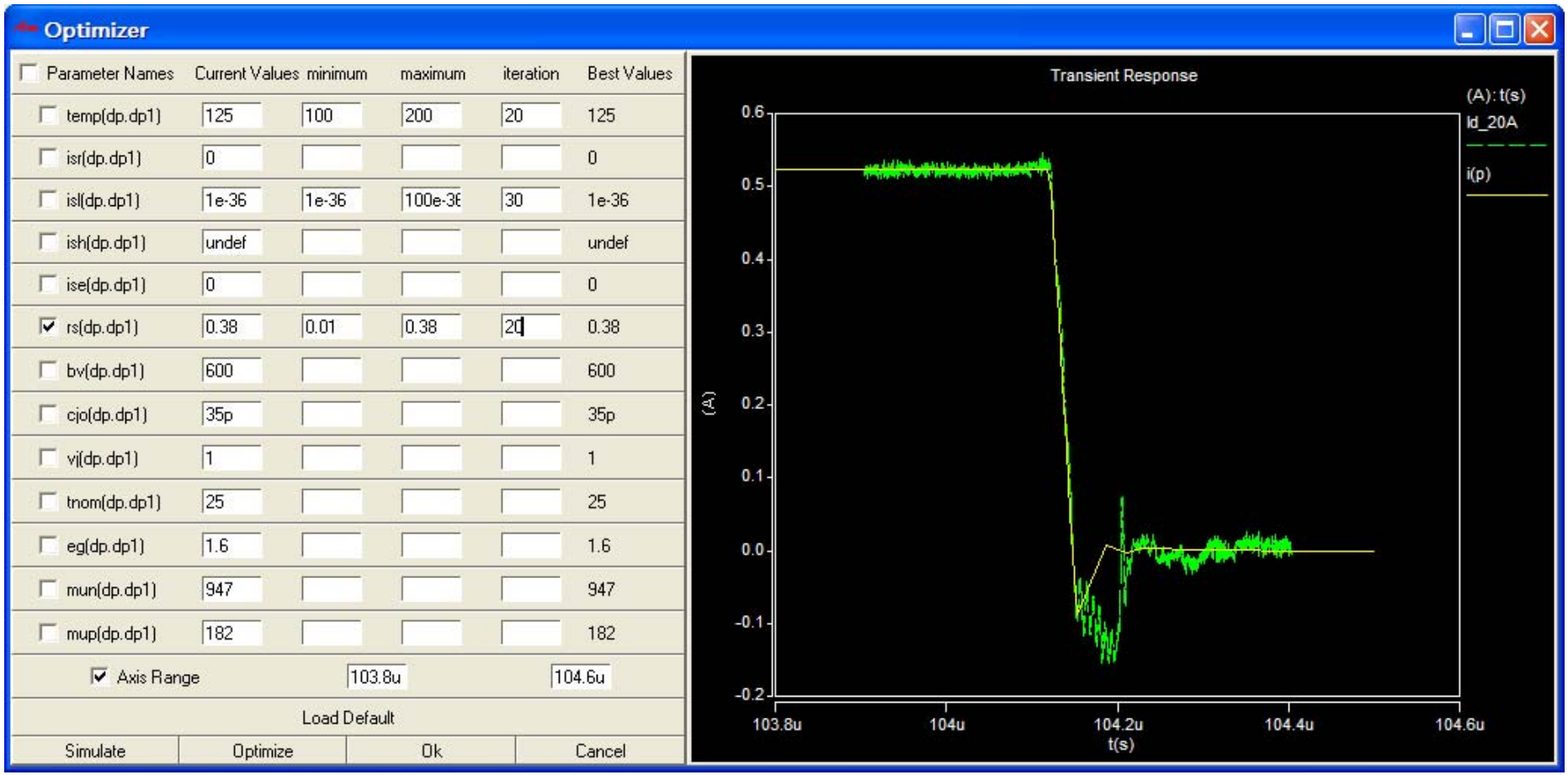

Examples: Power Diode Characterization

- Extracted Parameters:
  - temp=125
  - isl=1e-36
  - isr=0
  - ish=undef
  - ise=0
  - rs=0.38
  - bv=600
  - cjo=35p
  - tnom=25
  - eg=1.6
  - mun=947
  - mup=182

Conclusion and Future Work

- Certify can create and store standard validation and characterization recipes which is reusable
- The characterization process is automated and a lot of time can be saved
- Certify uses ModLyng to extract model parameters and default values, and uses Saber simulator to simulate the model.
- Possible interaction with Matlab to implement optimization algorithm
- Possible integration with other simulators such as Cadence Spectre

Questions