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P2D Simulation

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About P2D Simulation

The P2D simulator can be used to generate a .p2d file, which contains S-parameters that can be used to develop component models. A P2D simulation generates power-dependent S-parameters, which can then be used in a behavioral model for faster, system-level simulations. The resulting .p2d file can be accessed by components such as AmplifierP2D (System-Data Models palette) by selecting P2D Filename as the Parameter Entry Mode for the P2DFile= parameter.

Refer to the following topics for details on P2D simulation:

- Performing a P2D Simulation describes the minimum setup requirements for generating a . p2d file from a simulation.
- Example of P2D Simulation is a detailed setup for generating a . p2d file from a simulation.
- Using the P2D file describes how to use the file with a component that accepts file-based parameters.
- Using Terms in a P2D Simulation describes how to terminate the circuit with Term components instead of sources and loads.
- The topic "P2D Format" in the chapter "Working with Data Files" in the Using Circuit Simulators documentation describes how to write a . p2d file using a text editor. This is as an alternate method of creating a . p2d .

> **Note**
> You must have the LSSP license to run the simulator. You can build the examples in this chapter without the license, but you will not be able to simulate them.

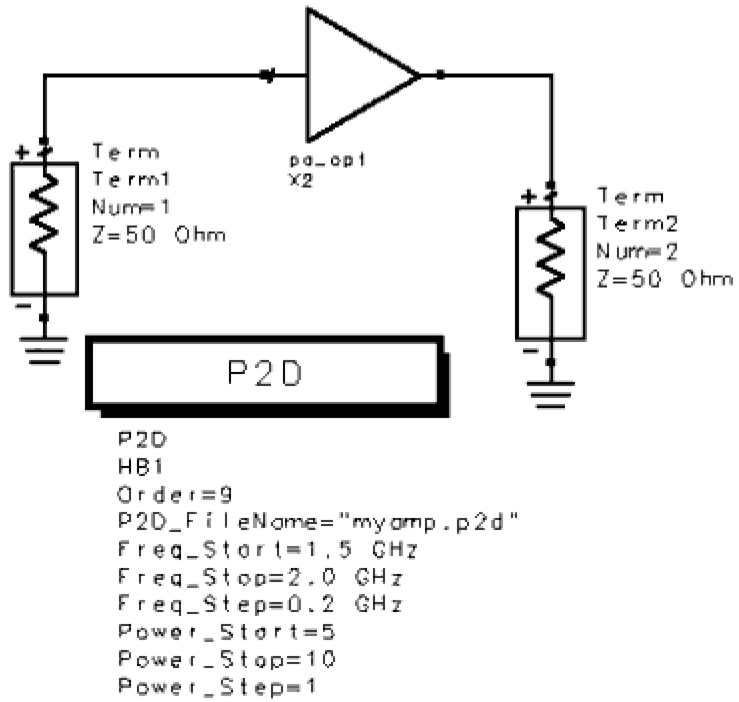
Performing a P2D Simulation

Start by creating your design, then add current probes and identify the nodes from which you want to collect data. For a successful analysis:

- Add the P2D control component to the schematic and double-click to edit it. Fill in these fields under the Freq tab:
  - Specify the name of the .p2d file. This is where the S-parameters that are generated by the simulation will be saved. The .p2d file will be saved in the project in the same location where dataset (. ds) files are saved (/data directory), unless you specify a path.
  - Select a sweep type. For a single point, enter the frequency. For a linear or logarithmic sweep, elect to define the frequency sweep with start/stop or center/span values.
- For a power sweep, fill in these fields under the Power tab:
  - Select a sweep type. For a single point, enter the power level for that point. For a linear or logarithmic sweep, define the power levels of the sweep with start/stop or center/span values. Power is in dBm.
- The P2D control component can extract noise characteristics to the . p2d file. You can control this noise characterization and other simulation parameters by placing an Options component on the schematic. For more information, refer to the topic "Using the Options Component" in the chapter "Simulation Basics" in the Using Circuit Simulators documentation.
- You can perform budget calculations as part of the simulation. For more information on budget analyses, refer to the chapter "Using Circuit Simulators for RF System Analysis" in the Using Circuit Simulators documentation.
- You can apply the Krylov subspace solution option for faster calculations of circuits with large numbers of nonlinear devices or large numbers of harmonics. Do not select this option for one-tone or power-sweep problems. See the topic "Selecting a Solver" in the chapter "Harmonic Balance Basics" in the Harmonic Balance Simulation documentation for instructions on how to use this option.
- You can use previous simulation solutions to speed up the simulation process. For more information, see the topic "Reusing Simulation Solutions" in the chapter "Harmonic Balance Basics" in the Harmonic Balance Simulation documentation.
  For details about each field, click Help from the dialog box.

Example of P2D Simulation

This example simulates an amplifier, sweeping input power over various levels. Setup for P2D simulation illustrates the setup for simulating a simple amplifier.

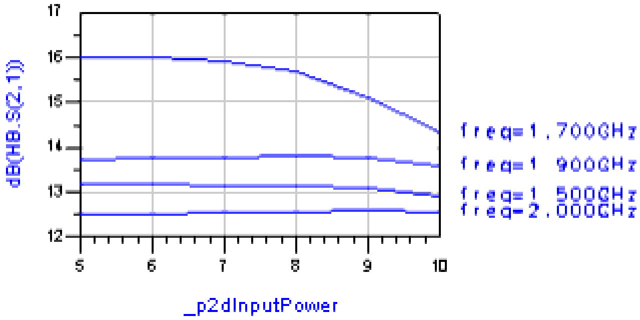


Setup for P2D simulation

1. From the Simulation-LSSP palette, select an P2D simulation component, place it on the schematic, and double-click to edit it.
2. Select the Frequency tab. In the P2D file to output field, enter a name for the .p2d file. This is the file that will be generated by the simulation. The filename must be in quotes. The default filename is "default.p2d" .
3. In the Order field, accept the default value of 3 or edit this value.
4. Select a sweep type and values for Start , Stop , and Step-size as desired. Optionally, you can select a sweep plan.
5. Select the Power tab and select a sweep type, as well as values for Start , Stop , and Step-size as desired. Optionally, you can select a sweep plan. Power is in dBm.

> Note The Krylov option should not be selected for one-tone problems such as this, especially when they involve sweeping.

6. Simulate . The result is a .p2d file that can be used in subsequent simulations.
   Note that with these power sweep settings, gain compression will occur in the amplifier. You can see this if you set up and run this simulation, then plot the results HB.S(2,1) on a rectangular plot. You can view the .p2d file with any ASCII text editor. A portion of the file from the example is shown here.


dB(HB.S(2,1))
17
16
15
14
13
12
5
6
7
8
9
10
_p2dInputPower
freq=1.700GHz
freq=1.900GHz
freq=1.500GHz
freq=2.000GHz

```
BEGIN ACDATA
# AC( MHZ  S  RI  R 50  FC 1 0 )
! small signal s-parameter
% F n11x n11y n21x n21y n12x n12y n22x n22y
1500  -0.14973   -0.74466    1.05898e-003  -4.57539  -5.87788e-002 -3.51371e-002 0.841147  -0.275706
1700  -3.54194e-002  5.47026e-002  -5.5386  -2.94283  -9.49884e-002 4.81790e-002  0.287816  -0.647277
1900   0.506917  -8.94668e-002  -4.61943  1.34196  -3.60905e-002 8.40664e-002  4.42222e-002  -0.382819
2000   0.566256  -0.241273  -3.64262  2.06492  -1.75349e-002 8.20927e-002  4.42686e-002  -0.321673
! power dependent s-parameter
% F
1500
% P1 P2 n11x n11y n21x n21y n12x n12y n22x n22y
5    18.1744  -0.14594    -0.75056    3.43087e-002  -4.55728  -5.81017e-002 -3.66150e-002 0.799862  -0.247955
6    19.1668  -0.145027  -0.751947  4.20916e-002  -4.55323  -5.73255e-002 -3.76813e-002 0.766918  -0.225389
7    20.158    -0.143936  -0.753596  5.12981e-002  -4.54852  -5.58564e-002 -3.92082e-002 0.715344  -0.190726
8    21.1449  -0.142695  -0.75555    6.20423e-002  -4.54154  -5.39404e-002 -4.09731e-002 0.651845  -0.149458
9    22.0968  -0.141491  -0.758293  7.63355e-002  -4.51623  -5.18580e-002 -4.27849e-002 0.583724  -0.106445
10  22.9241  -0.140564  -0.763445  0.101229  -4.4268  -4.99511e-002 -4.43975e-002 0.521083  -6.77973e-002
% F
1700
% P1 P2 n11x n11y n21x n21y n12x n12y n22x n22y
5    21.0224  -6.04337e-002   4.76748e-002  -5.51531  -3.09798  -0.102685  4.12691e-002  0.237226  -0.561646
6    22.0197  -6.64604e-002   4.68597e-002  -5.49727  -3.12597  -0.106569  3.65968e-002  0.207403  -0.509516
7    22.9328  -7.77040e-002   4.93914e-002  -5.41591  -3.1412  -0.1106  3.15724e-002  0.175171  -0.455106
8    23.7037  -9.74298e-002   5.46652e-002  -5.23131  -3.13353  -0.114291  2.68724e-002  0.145083  -0.405278
9    24.0993  -8.99288e-002   1.09087e-002  -4.85087  -2.97041  -0.116225  2.43362e-002  0.128901  -0.378963
10  24.3455  -5.62783e-002  -4.99003e-002 -4.46457  -2.69559  -0.117431  2.27256e-002  0.118628  -0.362467
% F
1900
% P1 P2 n11x n11y n21x n21y n12x n12y n22x n22y
5  18.7339  0.501498  -8.06491e-002 -4.67845  1.31828  -3.72235e-002 8.40764e-002  3.84839e-002  -0.374854
6  19.7564  0.500116  -7.85094e-002 -4.69323  1.31235  -3.74907e-002 8.41649e-002  3.65473e-002  -0.372692
7  20.783  0.49845  -7.59467e-002 -4.71075  1.30514  -3.79189e-002 8.43492e-002  3.29121e-002  -0.368753
8  21.8042  0.496769  -7.26969e-002 -4.72576  1.29569  -3.90612e-002 8.46008e-002  2.40136e-002  -0.357892
9  22.7653  0.496553  -6.66354e-002 -4.70825  1.27675  -4.14758e-002 8.47738e-002  7.27654e-003  -0.335699
10  23.5895  0.499408  -5.39443e-002 -4.61837  1.23452  -4.44986e-002 8.48838e-002  -1.32114e-002 -0.308663
```

```
% F
2000
% P1 P2 n11x n11y n21x n21y n12x n12y n22x n22y
5  17.5059  0.564973  -0.235164  -3.68053  2.06416  -1.82402e-002 8.21746e-002  4.01378e-002  -0.315699
6  18.5231  0.564627  -0.233628  -3.6902  2.06395  -1.84052e-002 8.22194e-002  3.89939e-002  -0.314172
7  19.5444  0.564185  -0.231743  -3.70223  2.0637  -1.86000e-002 8.22987e-002  3.74514e-002  -0.31222
8  20.57  0.563633  -0.22947  -3.71678  2.06336  -1.88476e-002 8.24501e-002  3.50802e-002  -0.309386
9  21.5946  0.563129  -0.226756  -3.73142  2.06182  -1.93544e-002 8.27421e-002  3.00353e-002  -0.303221
10  22.5766  0.563986  -0.222907  -3.72765  2.05035  -2.07086e-002 8.32049e-002  1.85446e-002  -0.287915
END  ACDATA
BEGIN NDATA
# AC( MHZ  S  MA  R 50 )
! noise parameters
% F NFMIN N11X N11Y RN
1500   0.805004   0.729762   76.3737  0.375956
1700   0.773222   0.472086   85.1077  0.150943
1900   0.778457   0.32785    63.6208   0.142144
2000   0.791368   0.357158   52.3085  0.165415
END  NDATA
```

Using the P2D File

Once the . p2d file is generated, you can use it to describe the behavior of a component, such as the AmplifierP2D, using file-based parameters.

1. From the System-Data Models palette, select the AmplifierP2D component and place it on the schematic. Double-click to edit it.
2. Select P2DFile= from the Select Parameter list box. In the File Name field, enter the name of the .p2d file. Alternatively, user the Browser to select a data file from within the project or click Data files list to select a file from all files found based on the paths set for the DATA_FILES variable. If using a file outside the project, include the complete path.

Using Terms in a P2D Simulation

When setting up a circuit for a P2D simulation, you should substitute Term components for both the source and load. By setting the Power parameters on the P2D simulation component, you can sweep input power to the circuit (see example).