Nonlinear Amplifier

Where To Find This Example

Select Help > Open Examples... from the menus and type either the example name listed above or one of the keywords below.

Or in Version 13 or higher you can open the project directly from this page using this button. Make sure to select the Enable Guided Help before clicking this button.

Open Install Example

Design Notes

Nonlinear Harmonic Balance Power Amplifier Simulation

This example demonstrates a simple configuration for starting a power amplifier design. The setup has the nonlinear device configured to explore the potential performance of the device in a power amplifier. The nonlinear device is configured properly to look at power amplifier characteristics (P1dB, PAE, gain, IP3).

Expand the Graphs folders under the Graphs icon in the Project tree to view the measurements made in this project.

Overview

The nonlinear device being investigated is configured in two test configurations. The schematic "One Tone" is the setup for a single tone measurement. The non-linear device is wired up with a bias-T, a nonlinear source, and a tuner element with a built in bias-T on the output of the device. The "Two Tone" schematic is setup identically except that the input source is a two-tone harmonic balance port.

One Tone Schematic

For the "One Tone" schematic, there are 5 model parameters setup to be tuned, the input power level, the gate bias voltage, the drain bias voltage, the magnitude of the impedance presented to the device, and the phase of the impedance presented to the device. Then many different characteristics of the device are being plotted such as:

- The input and output currents
- The input and output voltages
- The voltage and current at the output of the device
- The input and output power spectrum
- The load line of the device superimposed on the IV curves of the device.

If you bring up the tuner, the left 5 tuning bars will change these parameters. Change any parameter and watch the simulation results change in real-time, even for a complete nonlinear simulation.

Two Tone Schematic

For the "Two Tone" schematic, no model parameters are setup to be tuned. The input power is being sweep from -20 dBm to 10 dBm in 2.5 dBm steps. All of the waveform measurements from this simulation have been setup to display at one of the simulated input powers. The specific value of the input power is set to be used with the tuner. The left most tuner bar will change the level of input power to display the results. Note, in this mode, the tuner is changing which results are displayed, not re-simulating the circuit each time. Also, the fundamental and third order intermodulation products are being plotted.

For the OIP3 measurement, the spacing of the second tone was chosen to be 1GHz in order to clearly illustrate the spectrum graph. Also for Two Tone OIP3 measurement, note that the OIP3 is not changing with frequency and this is due to all capacitances in the device model being set to 0pF.

Schematic - Two_Tone
Notice that the values of the Voltage and Current at the output of the device at a single time point are the identical voltages and currents on the load line graph.
Graph - Two Tone Pin Vs Pout

ICURVE
ID=IV1
VSWEEP_start=0 V
VSWEEP_stop=8 V
VSTEP_start=-1 V
VSTEP_stop=1 V
VSTEP_step=0.5 V

SUBCKT
ID=S1
NET="Device_Model"