Freescale_LDMOS_Swept_Variables

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 at the bottom of this page.

You can also open the project directly from this page using this button. Make sure to select the **Help > Enable Guided Help** from the menus before clicking this button.

Open Install Example

Design Notes

Freescale LDMOS Swept Variables Example

This project demonstrates how to use the new swept variable capability to perform multiple parametric sweeps on a 945 MHz Power Amplifier design using a Freescale LDMOS device. In this example, there are 4 parameters being swept:

1. Frequency

2. Input Power

3. Drain Voltage

4. Length of Transmission Line.

The goal of this project was to have one schematic that could be used to produce plots of output power versus input power at a fixed frequency and also plots of output power versus frequency at a fixed input power. The design in this example was taken from a datasheet from Freescale's website.

Total_Circuit Schematic

The setup for this schematic is what will make all of the plots of this circuit possible. The project frequencies are setup to sweep from 900 MHz to 1000 MHz in steps of 5 MHz. The document frequency (the frequency local to the schematic) is set to 945 MHz. The input power is a swept variable sweeping from 20 to 40 dBm in steps of 2 dBm (We could have used a swept power port but did not for a good reason). The drain bias is setup to simulate at 24, 26, and 28 Volts. Finally, the length of transmission line at the immediate output of the device is swept at values of 100,200, and 300 mils. Notice the gamma_probe placed directly after the device. This is used to measure the impedance presented to the device. Please see the end of these notes for a detailed discussion of how to setup swept variables.

Output Power Graph

This graph is showing several plots of output power versus input power at a fixed frequency of 945 MHz. The settings for the measurements are the key to getting these results to display properly. The third box down for this measurement is the frequency list specification. For this measurement, this is set to FDOC (the frequencies local to the schematic). This setting is set to **Freq = 0.945** because frequency is not being used on the x-axis. There is one more additional pull-down box for each swept variable block in that schematic. The next three combo boxes setup the measurement to plot the input power on the x-axis and then plot all the traces for the swept transmission line length. Drain voltage is also a swept parameter but is disabled in the measurement to speed up the simulation time. If you enable this swept variable you can watch the status dialog and see that the drain voltage is also swept.

Note that FPRJ could have been used for the frequency and chosen **Freq = 0.945** from the FPRJ list. This would not have been a good idea since the simulation would have been simulated at all the frequency points in this list, as well as the other swept variables (20x more simulations to get the same data). By choosing FDOC, which only has one frequency point, the software is only simulating exactly what is needed.

PAE Graph

The measurement settings for this graph are identical to the Output Power graph except it is measuring efficiency rather than output power. All the swept parameter settings are the same.

PAE 3D Graph

Same as the PAE graph except on a 3D graph instead of 2D.

Output_impedance Graph

This graph is showing the impedance presented to the output of the device (using the GPROBE (Gamma Probe) measurement device) versus the changing length of line right at the output of the device. For the swept variable settings, FDOC is set for the x-axis of the measurement (must always have an x-axis setting). The transmission line length is set to all traces and the others are disabled. The output impedance won't depend on input power or drain voltage so there is no point in plotting results from those swept parameters.

Pout_VS_Frequency Graph

This plot is different from the others in that it is showing output swept over frequency at a fixed input power. To do this, the frequency is now referencing FPRJ and is set to the x-axis. The measurement is then displaying all traces for the length of transmission line. Again the drain voltage sweep is disabled but can be enabled to see those results as well. The input power swept parameter is set to be disabled. When disabled, the simulation will use the default value set from the variable in the schematic (pin = 35). This is the reason why the input power was setup as a swept variable instead of a swept power port. If it was a swept power port, the simulation would have run at all the swept power levels, which are many more simulations than was necessary for these results. You can try using a swept power port and not using the swept variable block for input power and see how much longer the simulation time will be.

Exercises

Try changing the swept parameter measurement settings to see the results on the data displayed. There are many different ways to display the data. It should be very easy to get the plots you want using the swept variable capability in AWR.

Swept Variable Framework

It is very simple to setup a swept variable. First, define a variable for the parameter to be swept in the schematic. This variable then needs to be assigned to the appropriate model parameter. Then a swept variable block needs to be added to the schematic. These are found under **Elements > Simulation Control**. The **ID** parameter will be used in the measurement dialog box for setting up measurements. The **VarName** parameter is the name of the variable previously defined. The **Values** parameter is a vector of numbers setting the swept parameter values that will be applied to the variable in the **VarName** blo ck. In this project some variable values are passed down to the Output_Section schematic using the << operator.

The measurement setup determines how to display the data when swept parameter blocks are used in a schematic. If you specify a schematic in the **Data Source Name** block with swept parameters, one new combo box will be visible for each swept variable block in that schematic.

For each swept parameter you have the following choices:

1. Use for x-axis: Put this swept block values on the x-axis of the graph.

2. Plot all traces: Puts one trace on the graph for each swept value.

3. Select with tuner: Puts one trace on the graph and then allows the user to use the tuner to change which swept value result gets displayed.

4. Disable sweep: Allows the user to turn off that swept parameter from being simulated.

5. [Swept parameter values]: Allows the user to display results using one specific swept parameter value.

Simulation frequency is treated as its own swept variable with the exception that you cannot disable this sweep. Additionally, you can choose between multiple sweep plans using the up and down arrows next to this combo box. You can choose between the following settings for frequency:

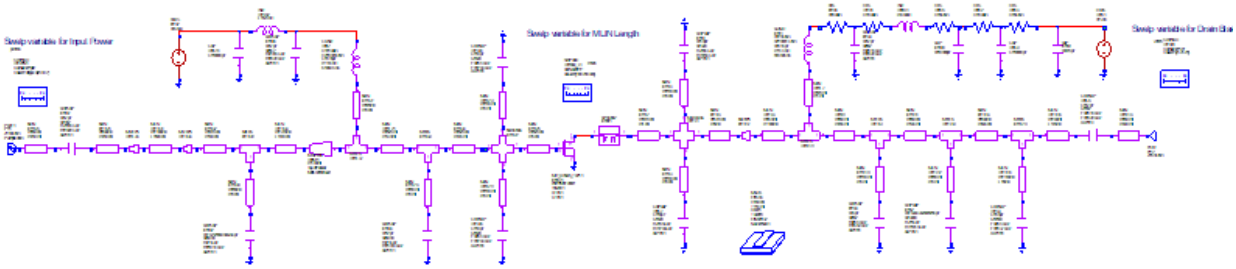
1. Project frequencies, set in the **Project Options.** Called **FPRJ.**

2. Schematic frequencies, set in the local properties for each schematic. Called **FDOC.**

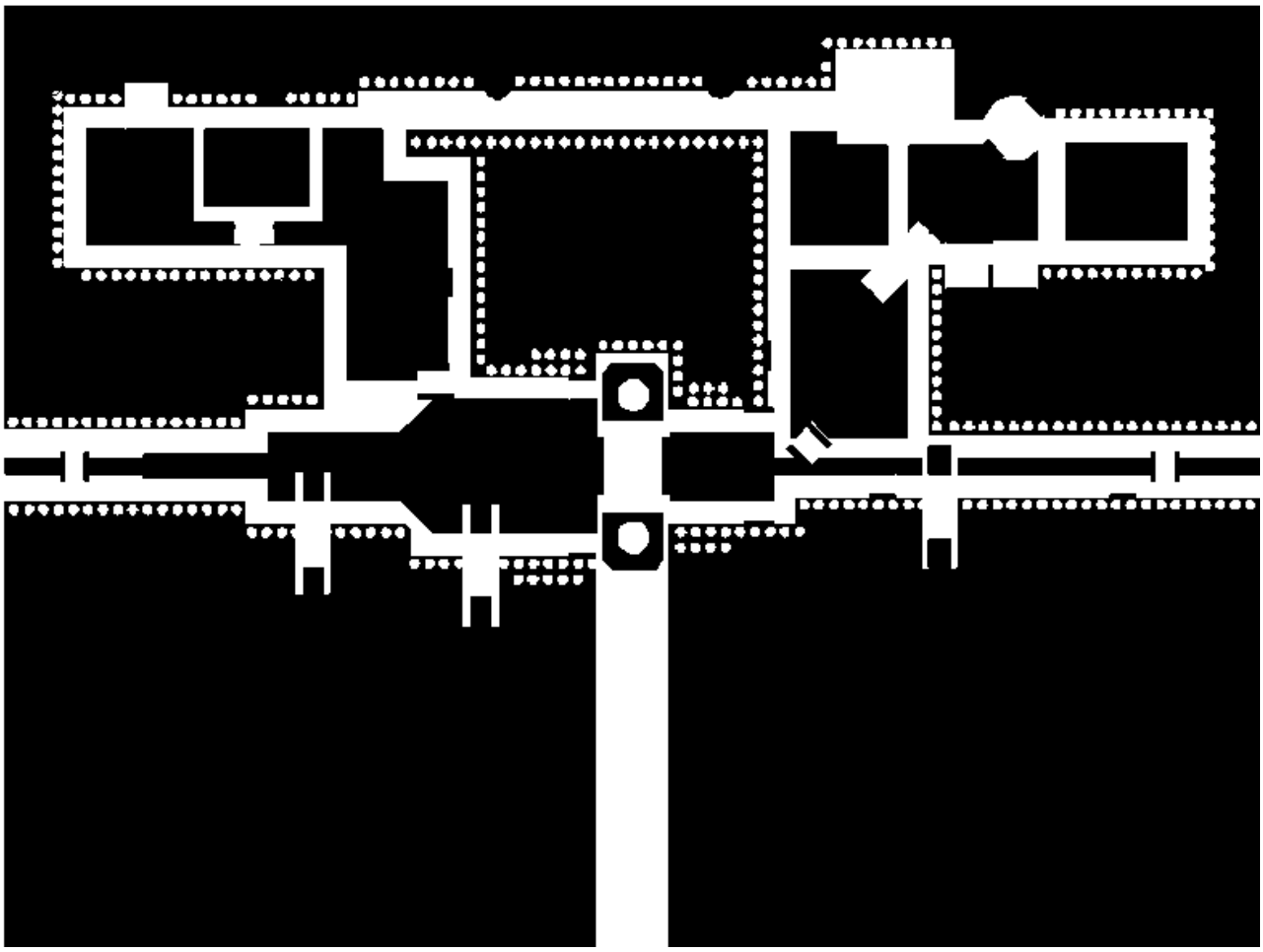
3. Swept frequency control block. You can add a swept frequency control block to any schematic to have a third way of defining unique frequency sweeps. This setting will display the ID of the block when choosing the swept frequency parameter.

Note, when you add a swept variable block to a schematic, all of the possible combinations of all of the swept variables will be simulated. The measurement selections choose how to display the data, not which data is simulated. You can watch the status of the swept variables in the simulation status dialog box if the simulation is slow enough to watch these values update. You will be able to watch these in this example.

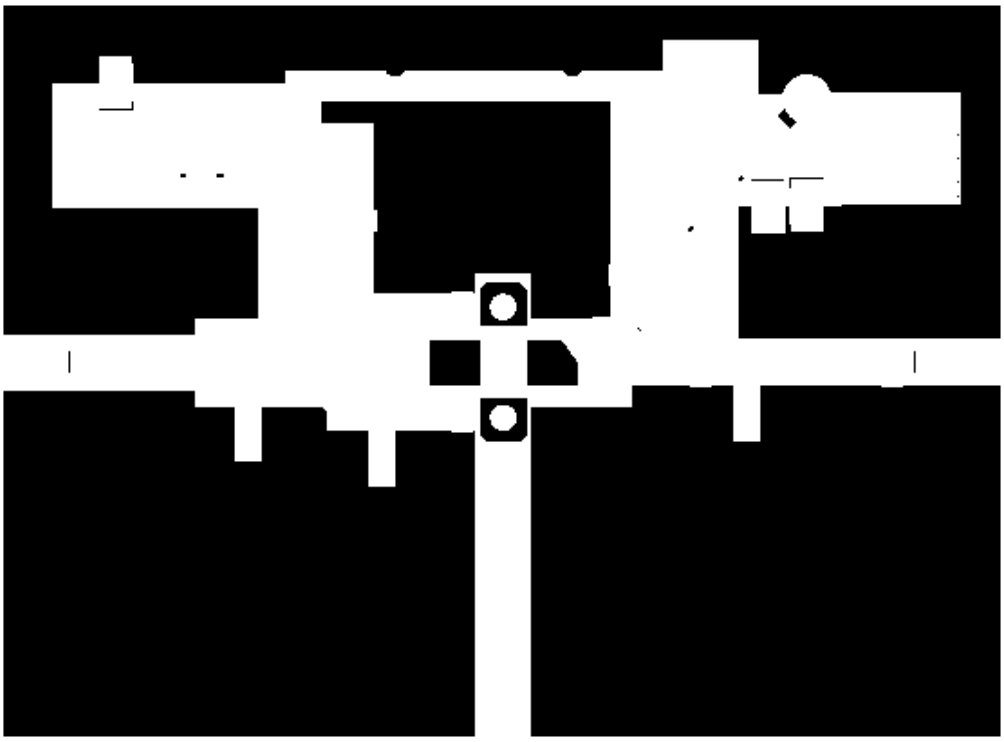
Schematic - Total_Circuit



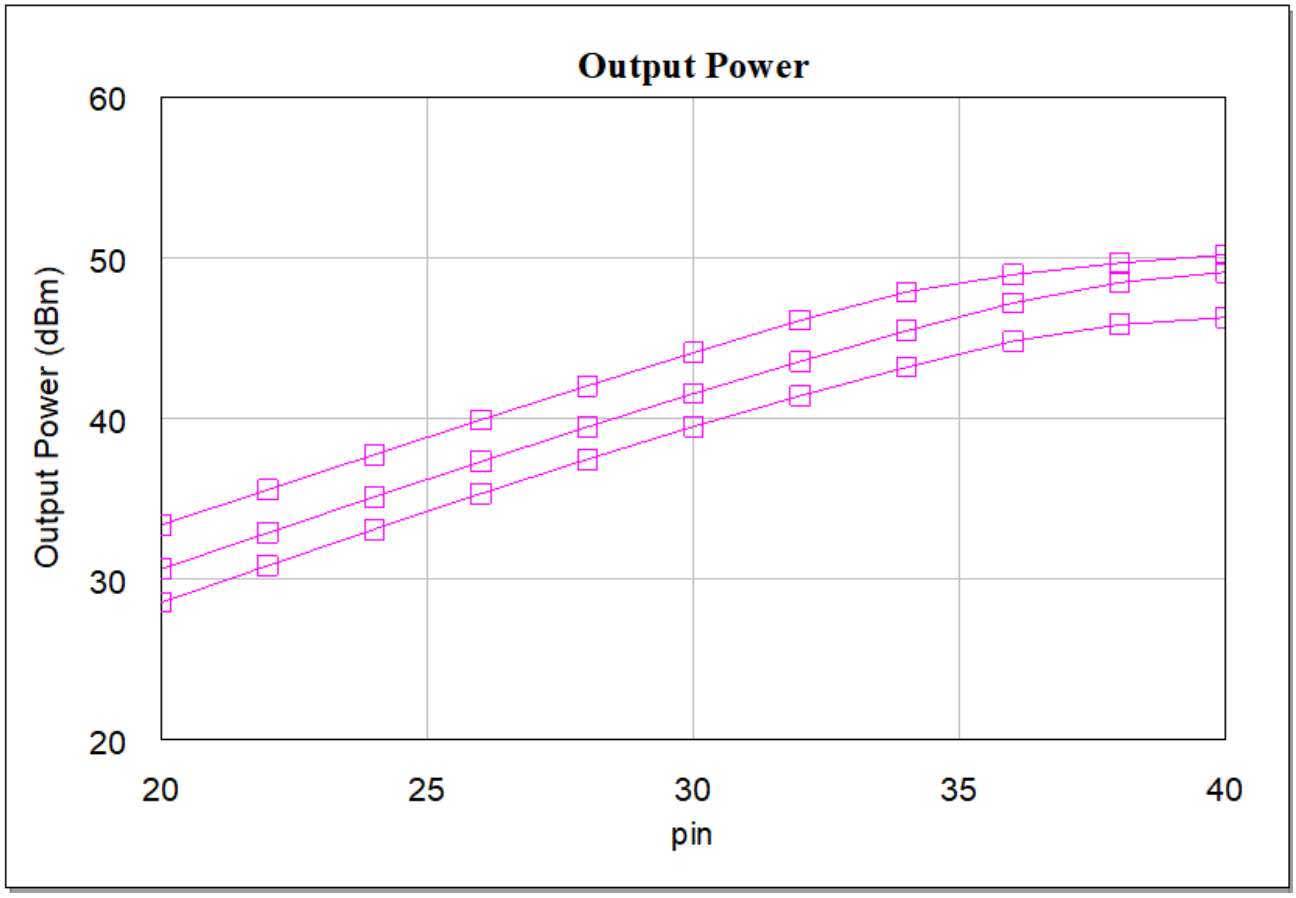
Schematic Layout - Total_Circuit



Schematic 3D Layout - Total_Circuit



Graph - Output Power



Graph - PAE 3D