IIP3 Measurement

The following is a modification of the procedure found in Accurate and Rapid Measurement of IP2 and IP3 by Ken Kundert. Whereas the referenced paper uses a single point measurement of the IP3, the following procedure plots the 3rd order modulation over input power so the extrapolated values can be check for accuracy.

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Continuous Systems (LNA, Filter, ect.)

1. Specify the input port parameters in the schematic.
   - Under Source type set the following values:
     - Source type = sine
     - Frequency 1 = f1
     - Amplitude 1 (dBm) = input_power
   - Enable the "Display small signal params" check box and set:
     - PAC Magnitude (dBm) = input_power
2. Save the schematic.
3. Specify design variables.
   1. In the Analog Environment window select:
      - Variables -> Copy From Cellview
        The design variables input_power and f1 will appear in the Design Variables field.
   2. Assign values to the design variables
      - input_power is arbitrary because it will be swept later so set it to 0. This value is in dBm.
      - f1 should be set to the frequency of one of the input test signals. In this example it is the lower frequency input signal. Make sure that it is within the bandwidth of the system.
      - Add one more design variable, f2. This will be the second test signal which is the higher frequency input in this example.
        - To add a design variable, select Variables -> Edit. Press "Clear" to enter a new variable.
        - Set Name = f2
        - Set "Value (Expr)" to the frequency of the second input tone. It is often convenient to specify the second input tone as f1 plus the frequency difference between the tones. This is because the frequency difference is often much smaller than the input frequency and Cadence truncates the display of numbers so they don't always look correct (eg. 1.000001GHz will get truncated to 1GHz when displayed). Another reason is that it is easy to misplace a zero when typing the exact f2 frequency (eg. 1.000001GHz looks a lot like 1.0000001GHz). As an example you could set "Value (Expr)" = f1 + 10K, where f2 is 10KHz higher than f1. If you do it this way, you can avoid the aforementioned problems. *NOTE:* It is important that both the input tones and intermodulation tones fall within the bandwidth of the system. This may require a small frequency difference between the input tones.
        - Click on Add and OK
4. Enable the PSS analysis

- Assure that the fundamental frequency is set to f1. If there are other tones in the list, delete them.
- Check the Auto Calculate box.
- In the Output harmonics field, set Number of harmonics = 2.
- In the Accuracy Defaults (errpreset), select the moderate check box.

5. Enable the PAC analysis
   - Under "Input Frequency Sweep Range (Hz)" select the pull-down box choose Single-Point.
   - Set Freq = f2.
   - Under Sidebands, set Maximum sideband = 2.
6. Setup a Parametric Analysis.
   - In the Analog Environment window select, Tools -> Parametric Analysis...
   - Set "Variable Name" = input_power.
   - Select a sweep range for the input power. The lower bound of this range should be at least 20-40 dB below the input referred 1dB compression point.
   - A total number of steps from 10 to 50 works well for small circuits.
7. Run the Parametric Analysis by choosing Analysis -> Start.
8. View the results.
   - Open the direct plot form by going to Results -> Direct Plot -> Main Form...
   - Under Analysis select **pac**.
   - Under Function select **IPN Curves**. Set the following:
     - Select = **Port (fixed R(port))**.
     - Under Circuit Input Power select **Variable Sweep ("input_power")**.
     - Input Power Extrapolation Point should be set to a point above the noise floor of the simulator and well below the 1db compression point. This may need to be changed later after viewing the intermodulation curves.
     - **Input Referred IP3**
     - Order = **3rd**
     - In the "3rd Order Harmonic" field select the frequency with label **-2**. This is 2f1-f2.
     - In the "1st Order Harmonic" field select the frequency with label **0**. This is f2.
   - Select the output port in the schematic to initiate the display of the intercept point.

Periodic Systems (Mixer)

under construction