VSS_TI_TRF370417_Quadrature_Modulator

Where To Find This Example

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Design Notes

Modeling the Texas Instruments TRF370417 Quadrature Modulator in VSS

This project models TI's TRF370417 Quadrature Modulator. It has been optimized to fit the characteristics given in the data sheet (version SLWS213A - January 2010-Revised November 2015) for an LO frequency of 1960MHz.

It has been modeled to fit:

- Voltage Gain (at all LO frequencies in datasheet)
- P1dB
- PSD
- EVM (at -5dBm output power)

The system diagram '8PSK Modulator' has been set up to emulate the test conditions in the datasheet i.e.

- V_inBB 98mV single-ended in quadrature
- f_BB 50KHz
- LO power 8dBm

The time domain analysis settings are sample rate of 26 MHz and oversampling of 520. The sample rate is so that the spectrum 13MHz either side of the centre frequency can be plotted to see the PSD and compare to the datasheet spec. The two numbers together (26MHz/520) yield the default system data rate of 50kHz.

Notes on graphs:

Graph **EVM Spec at 5dBm Output Power**: If the OPSK_SRC drive level is set to -3dBm, the modulator output yields -5dBm output power. The simulation then predicts close to the 0.43% given in the datasheet at that output power level

Graph **I & Q Waveforms**: the time domain wave forms at the inputs of the modulator.

Graph **I & Q Voltage Spectrum**: at the inputs of the modulator. There are two pairs of traces, for different measurement RBWs (resolution bandwidths). The 1MHz bandwidth captures the whole signal as one spectral component. the other uses an auto setting (smaller) for the RBW.

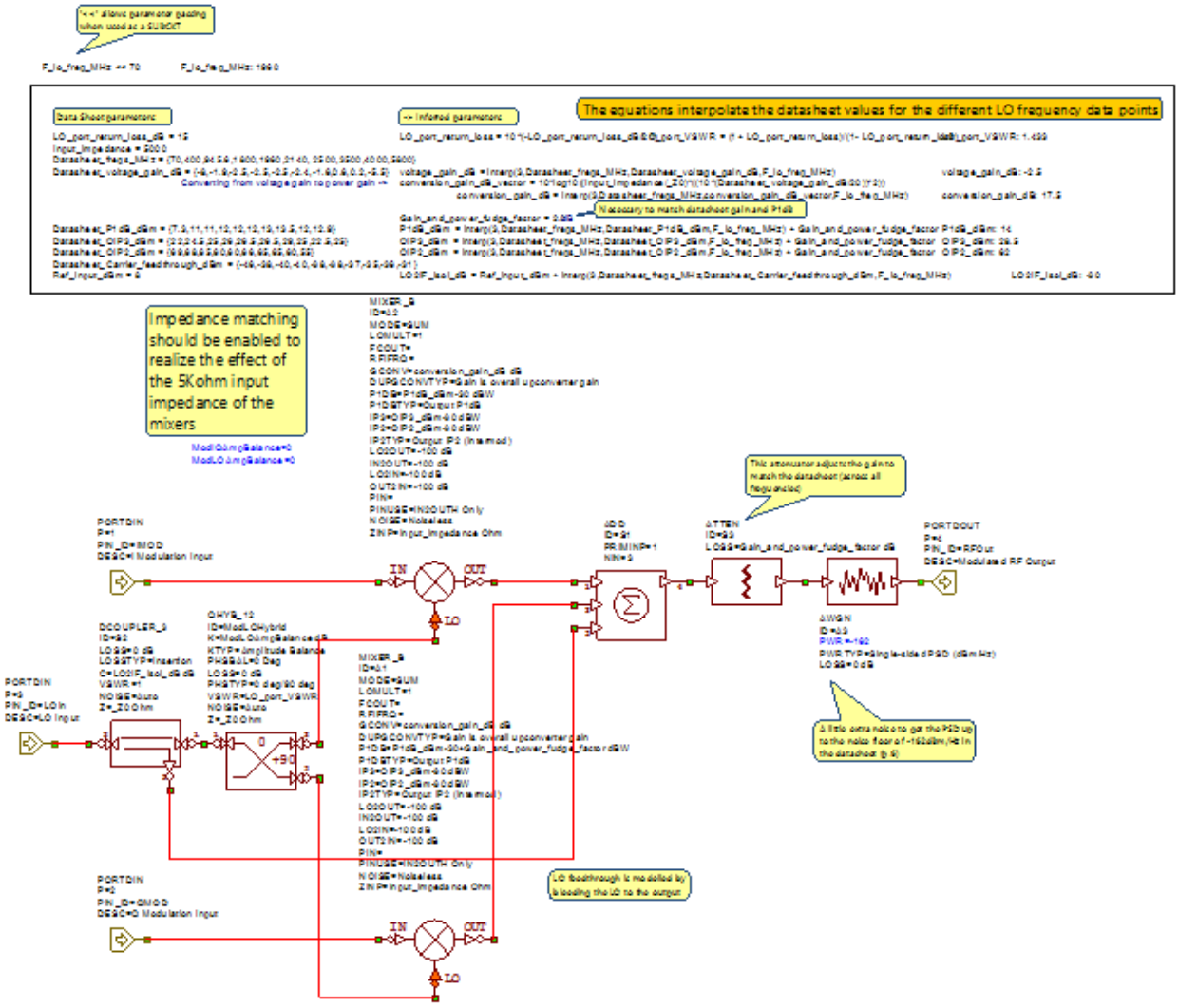
Graph **Output Power Spectrum**: at the output of the modulator. There are two pairs of traces, for different measurement RBWs (resolution bandwidths). The 1MHz bandwidth captures the whole signal as one spectral component. the other uses an auto setting (smaller) for the RBW.

Graph **Output Power vs Input Power**: for a power sweep of the OPSK_SRC. This graph of output power vs input power shows the compression. Note that, for this measurement, the **sweep block must be enabled** in the '8PSK Modulator' system diagram .

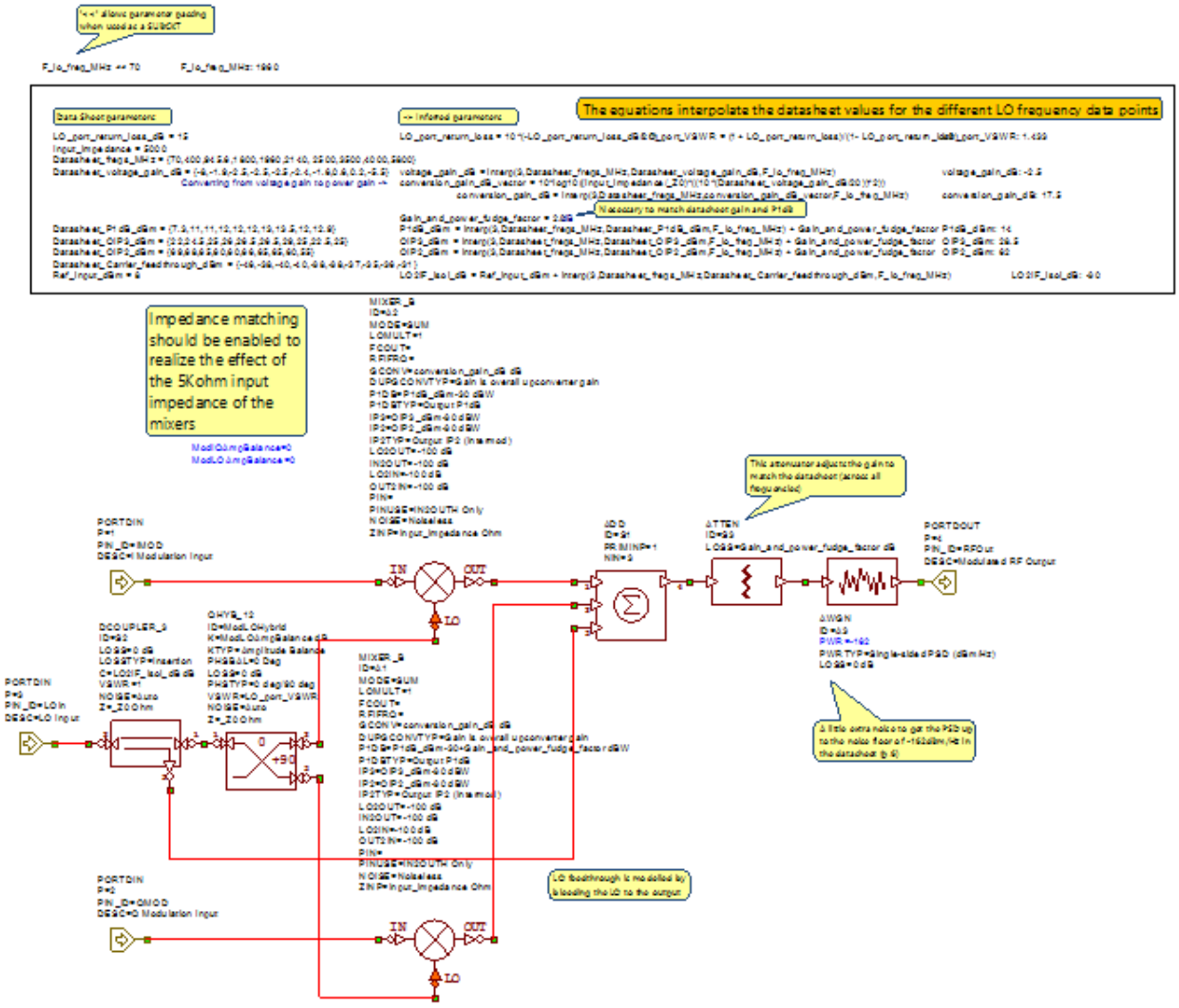
Graph **Output Voltage in 1MHz Bins and PSD dBm per Hz**: The blue trace shows the output voltage spectrum measured in coarse bins (1MHz) to capture the amplitude of the whole signal in one bin. The pink trace shows the output PSD (Power Spectral Density), given in the datasheet at 162dBm/Hz (for f_LO=1960MHz, 13MHz offset, P_out=-5dBm).

Graph **Output voltage spectrum Narrowband View**: This shows the output spectrum but only over Fc+-/0.5MHz wth an RBW of 1kHz

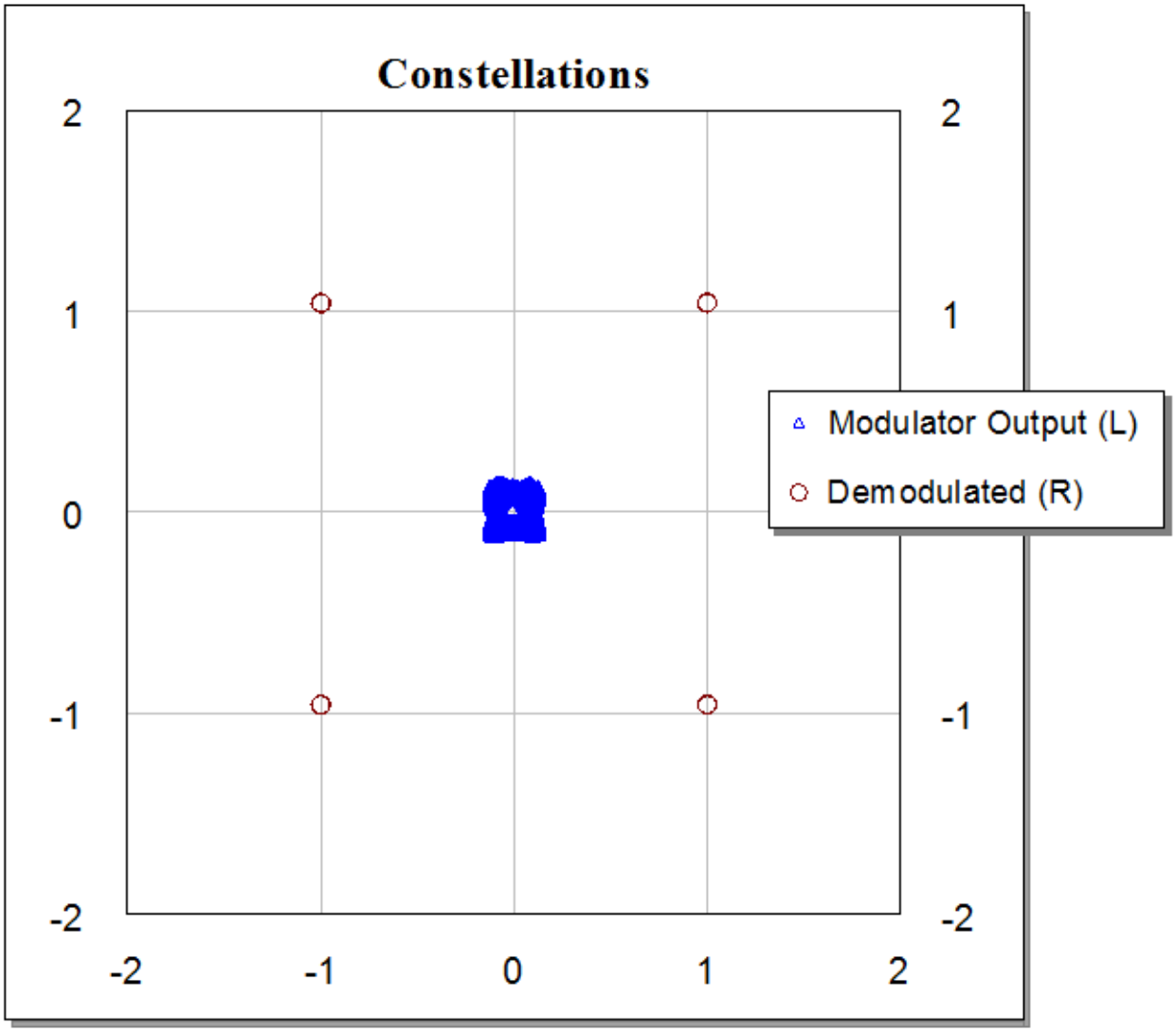
System Diagram - Quad Modulator TRF370417



System Diagram - Quad Modulator TRF370417



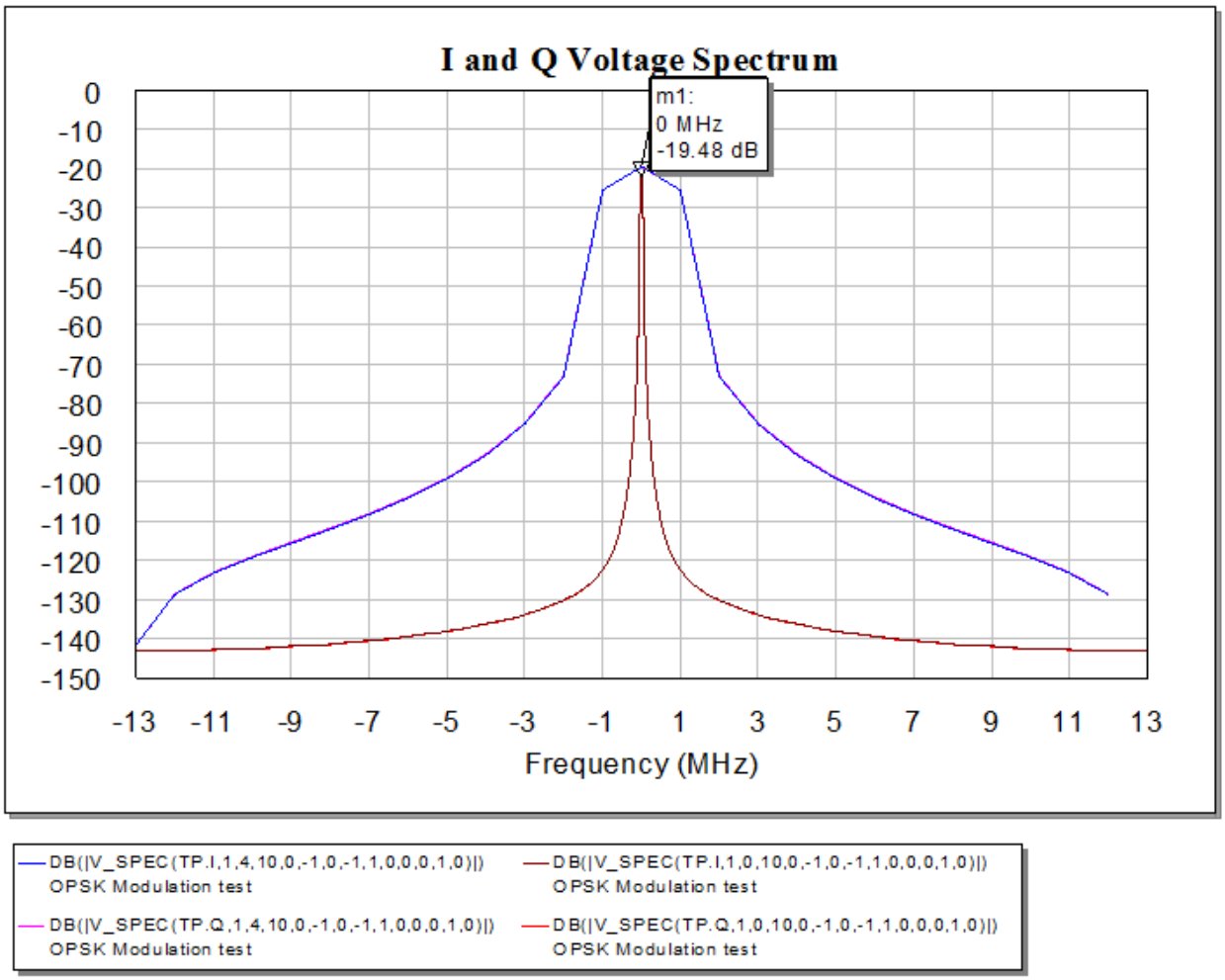
Graph - Constellations



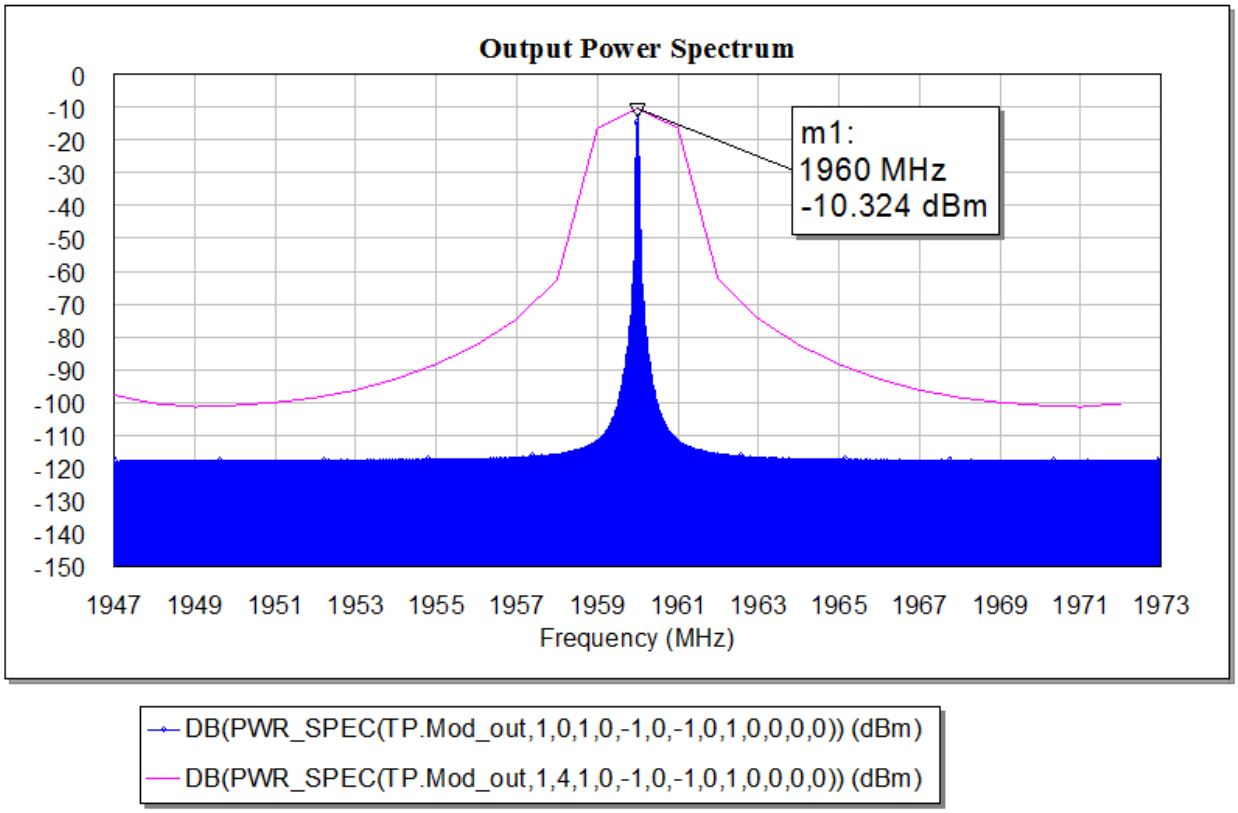
Graph - EVM Spec at 5dBm Output Power

%EVM (ns) OPSK Modulation test Time	%EVM OPSK Modulation test
1.3601e+08	1.04772

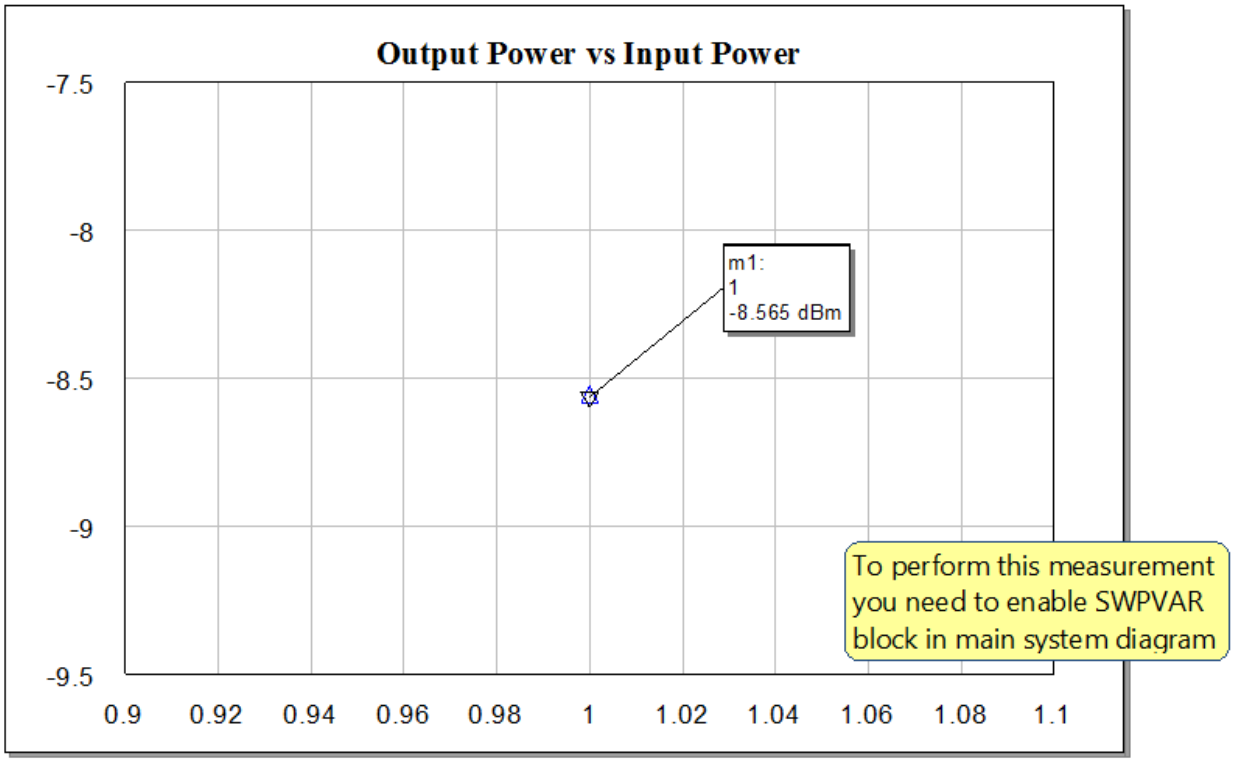
Graph - I and Q Voltage Spectrum



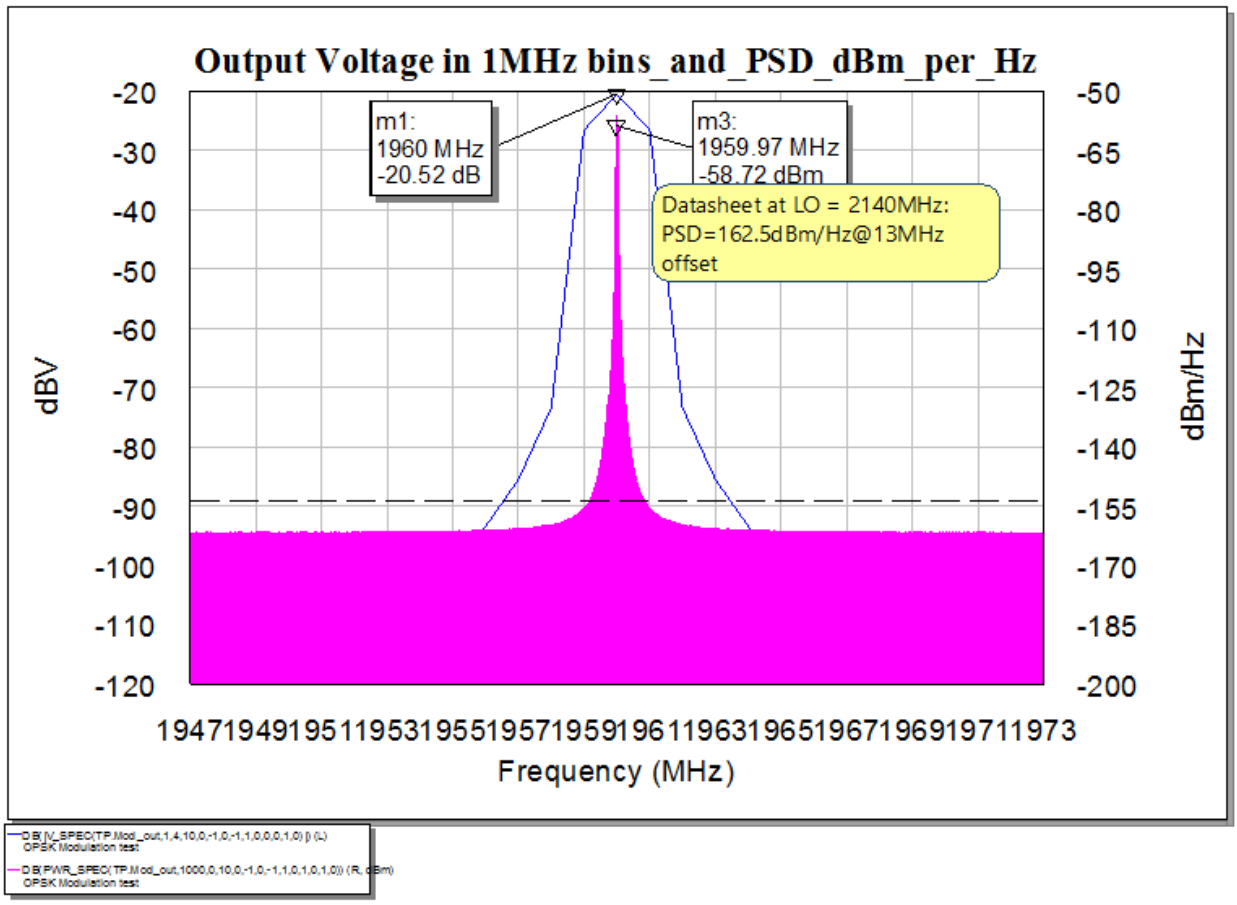
Graph - Output Power Spectrum



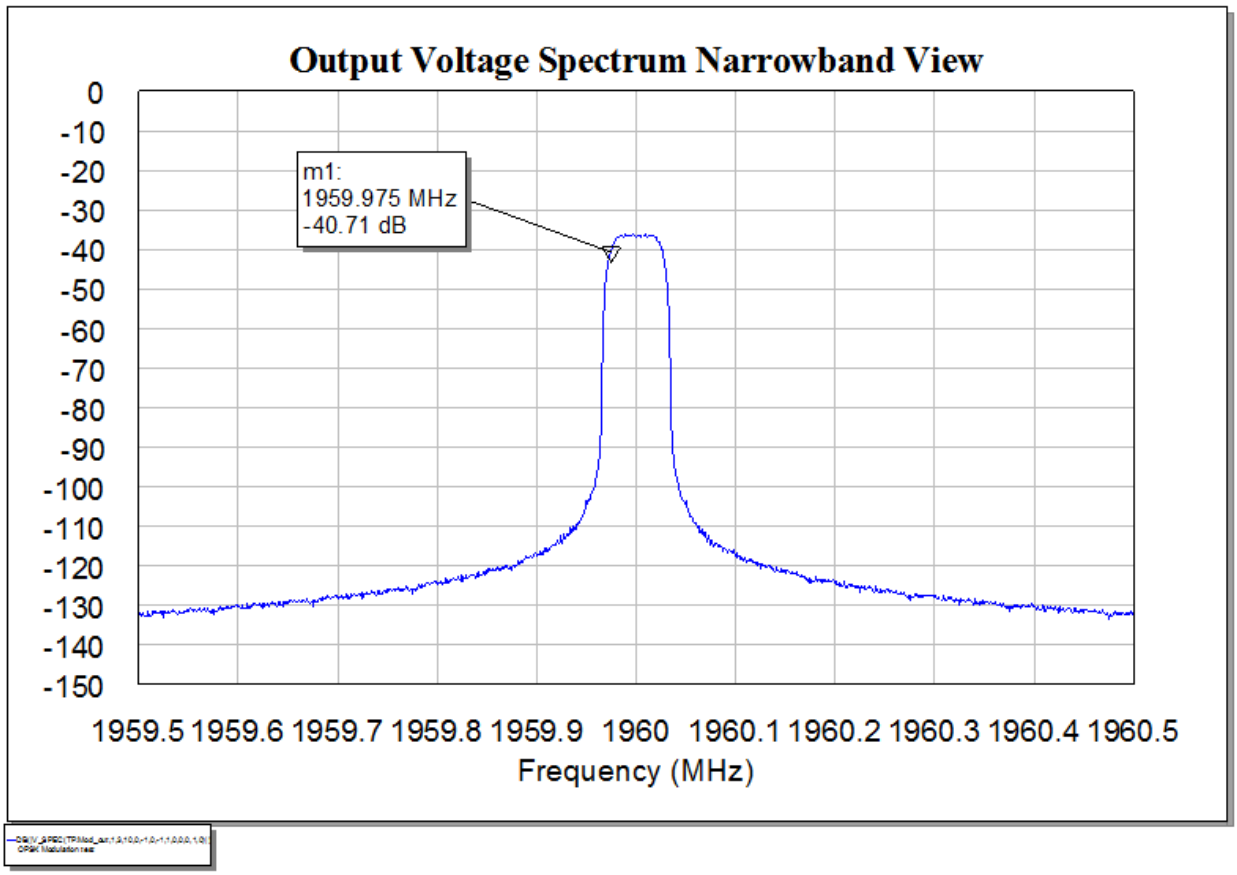
Graph - Output Power vs Input Power



Graph - Output Voltage in 1MHz Bins and PSD dBm per Hz



Graph - Output Voltage Spectrum Narrowband View


Output Voltage Spectrum Narrowband View
0
-10
-20
-30
-40
-50
-60
-70
-80
-90
-100
-110
-120
-130
-140
-150
m1:
1959.975 MHz
-40.71 dB
1959.5 1959.6 1959.7 1959.8 1959.9 1960 1960.1 1960.2 1960.3 1960.4 1960.5
Frequency (MHz)