Matthew Spencer – Spring 2018

E190AK Lab 5: Cascaded Amplifiers

In this lab you will use a spectrum analyzer to measure the propagation of noise through several amplifiers in series and the distortion introduced by amplifiers.

Noise Performance of the Spectrum Analyzer

Attach the output of the vector signal generator to the input of the spectrum analyzer. Set the center frequency to 2.4GHz and the span to 400MHz on the spectrum analyzer. Set the signal generator to produce a -40dBm signal. Observe the signal and make note of the resolution and video bandwidth of the spectrum analyzer. Repeat for a span of 40MHz and a span of 4MHz. Using these measurements, determine the noise temperature of the spectrum analyzer. (Assume the input signal has no noise.)

Keep the span constant and adjust the resolution and video bandwidth. Find a relationship between these bandwidths and the sweep time. Adjust the ratio of video bandwidth to resolution bandwidth and comment on the effects on the trace.

Adjust the span and the resolution bandwidth such that the resolution bandwidth is 10Hz and the sweep time is reasonable. What is the measured signal power and why?

Noise in Cascaded Elements

Set the resolution bandwidth of the spectrum analyzer to 10kHz. Add 30dB of attenuation in series between the function generator and the spectrum analyzer. Can you observe the attenuation's contribution to the noise floor? What is the noise temperature of the attenuator and how does it compare to the noise temperature of the spectrum analyzer?

Add a 60dB of amplification after the 30 dB of attenuation. Can you observe the attenuator's contribution to the noise floor? Justify with calculations and measurements. Use interstage attenuators (of ~1dB) to keep your amplifiers stable.

Replace the attenuator between your first two amplifiers with a band pass filter and discuss the measured spectrum.

Linearity of Amplifiers

Perform one tone nonlinearity tests on the ZX60-2531M-S+ amplifier at a frequency of 600MHz and use these tests to determine the amplifier's P_{-1dB}. Compare your measured value to the datasheet.

Power splitters can be used backwards as power combiners. Use a power splitter, the vector signal generator and the 1GHz signal generator to perform two tone non-linearity tests on ZX60-2531M-S+ amplifier using two tones of P_{-1dB}-10dB at 600MHz and 601MHz. Vary the input power and plot the power of the intermodulation tones. Use this plot to calculate the IIP2 and IIP3. Compare these values to the datasheet and determine if IIP3 has the expected relationship to P_{-1dB}.

Reduce the power of one tone by 3dB and record the resulting spectrum. Compare it to theory. Also, add a second amplifier in cascade with the first with a 1dB attenuator between them. Measure the cascaded IIP3 and compare to calculations.