Question: "How Can I Improve IMD Results?"
Frank Goh

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How can I improve my inter-modulation distortion (IMD) results?

Answer:

Inter-modulation distortion occurs when multiple input frequencies (usually two) to a non-linear device cause additional unwanted signals.

To improve the test, it is necessary to minimize the effects of the RF source or the RF measurement sub-system. This can be done by ensuring they are working in their linear region.

On the source side,

1. Avoid using the AWG (arbitrary waveform generator) to generate the two tones. Typically, the distortion of the AWG can be significant. If you must use the AWG, try to use less than 90% of the full range of the AWG for generating the signal. Distortion is usually highest at the 90% to 100% range. IQ imbalance can also cause unbalanced tones.

2. Using two RF source with a tone combiner is a good method as it avoids inter-modulation at the sources. An isolator/amplifier should be added between the tone combiner and the RF sources. This prevents unwanted modulation of the RF source's Automatic Level Control (ALC) due to feed-through of the other RF source via the tone combiner.

3. For any amplification, ensure that the maximum instantaneous input signal is well below the amplifier P1dB point.

4. Generating a good RF stimulus for IMD test can sometimes be tricky; Verigy's Port Scale RF solution has a feature that helps users do that quickly.

On the measurement side,

1. Attenuate the signal appropriately to ensure that the maximum instantaneous input signal is within the linear region of the different amplifier and down-converters in the path.

2. The inter-modulation signal of interest may be at a very low power level. It would be a mistake to measure the low level inter-modulation products using a lower range/attenuation in order to measure the products better. By doing so, the mixer or amplifier in the measurement path may not be working in the linear region/compress due to the higher main tones of the overall signal. This will result in a higher IM product being measured, and is to be avoided.

3. To measure such a weak signal accurately and repeatability in the presence of the larger main tones, sufficient dynamic range is needed. We can:

    a. Use averaging.

    b. Use higher sampling rate with decimation.

    c. Increase the sample points and reduce the resolution bandwidth (RBW).

4. These methods can increase the test time drastically and should be applied to the weaker signal only. In addition, Port Scale RF's receiver has a built-in real time signal processing unit (RT-SPU) which can do these on the fly, reducing the test time drastically.

5. Depending on the span and dynamic range, a single capture on all tones can be used to reduce test time. Multiple captures usually have better dynamic range due to point c. above. When using one capture, the coherency requirement should be kept in mind to prevent spectral leakage. Appropriate DSP Windowing (e.g., Hanning), should also be used.