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Application Note #1900-2

High IM Level Passive IM Measurements

Introduction

The Passive IM Analyzers provided by Summitek Instruments are optimized for receiving IM signals between approximately –75 and –140 dBm. Signals which compress the instrument in excess of approximately 0.5 dB will result in an "IM OVERLOAD" error being displayed. However, if the IM signal is more than 20 dB higher than the instruments maximum measurable power, the internal receiver actually begins to shut down. The result is that a very, very strong IM signal (-50 dBm or higher) can erroneously be reported by the instrument as a valid IM power level anywhere between –70 and –140 dBm (depending upon the shutdown mode of the receiver).

This application note demonstrates how to configure the test setup to ensure a strong IM signal can be accurately measured by the analyzer without the risk of over-driving the analyzer's internal receiver.

Configure the Test Setup

Figure 1 illustrates the connection used to measure the forward IM of a device which is expected to produce IM levels in excess of –80 dBm. Such a device might be a ferrite isolator. In this configuration, the two carrier tones are injected directly into the device under test (DUT). IM generated within the DUT propagates back towards Port 1 of the test set and also into the directional coupler (connected to the DUT output port).

The directional coupler is oriented so that a sample of both the carrier tones and the IM signal are routed to the coupled port. The through arm of the coupler is terminated into a low IM termination such as the Summitek Instruments Model SI-20A.

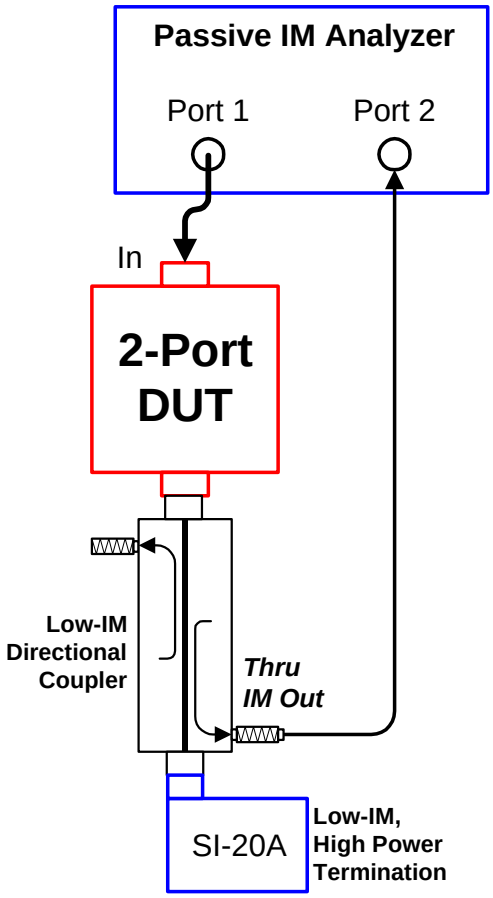

Figure 1. Measuring High Forward IM Levels with the Passive IM Analyzer

Figure 2 shows how the same approach may be used to measure the reverse IM from a DUT. Notice the coupler direction is reversed in this application compared to Figure 1. This allows the IM signal travelling *towards* Port 1 of the analyzer to be sampled and eventually measured at Port 2.

In both figures, a fixed attenuator is attached to the coupled arm of the directional coupler. The value of this attenuator is determined by the

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expected IM level. If unsure, start with two 30 dB attenuators placed back-to-back. The purpose of the attenuators is to further reduce the IM power below the level achieved with the directional coupler alone.

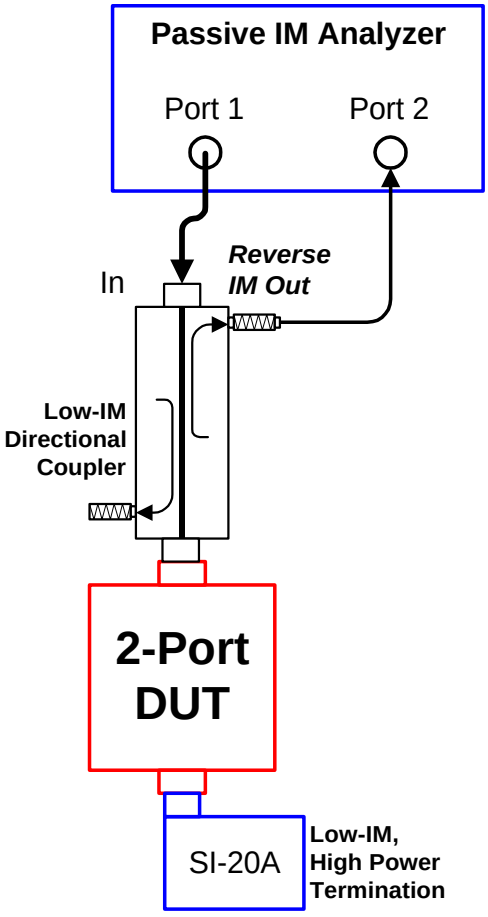

Figure 2. Measuring the IM of a Power Combiner Using Individual CW Tones.

The output of the fixed attenuator is then connected to Port 2 of the analyzer. Using the mouse (or by pressing the "F10" key), change the analyzer's measurement mode to "Forward/ Thru." The green indicator above Port 2 should be illuminated for this test. This means that the IM power incident on Port 2 of the analyzer will be displayed on the screen.

In both forward and reverse test setups, ensure the IM generated by the test setup does not generate significant IM levels (relative to the DUT) for the power levels used in the testing. This may be done by simply removing the DUT and checking the residual IM prior to making the measurements.

Making the Measurement

Turn on the carrier power and begin with the carriers set to a very low level. Be sure and disable ALC (power leveling) if you are working below a carrier power level of 1 Watt (30 dBm). Increase the power in small increments (3 dB per step) until an IM signal is detected. If an IM signal is not detected at the maximum desired carrier power, remove some attenuation from the coupled port of the directional coupler and repeat this test.

It is desirable to find a combination of coupling coefficients and attenuator values which will result in an IM signal which ranges between -130 and –75 dBm over the range of carrier powers of interest. For example, if the indicated IM level on the analyzer's display is –80 dBm for the lowest carrier power level of interest, increase the value of the attenuator by at least 40 dB.

Once the IM power level has been placed within the dynamic range of the analyzer, you must manually add back the combined loss inserted by the directional coupler and the attenuator(s). For example, if the display indicates a forward IM level of –90 dBm, and you are using a 30 dB directional coupler and 40 dB of attenuation, the true IM level is –20 dBm (-90 dBm + 70 dB).

Helpful Hints

These quick tips can help reduce measurement uncertainty:

- Choose the IM Units to be displayed in "dBm" for the best measurement accuracy. This removes the uncertainty associated with the carrier power level measurement from the receive IM power level results.
- Minimize the length of cable between Port 1 of the analyzer and the DUT.
- Make sure the IM signal decreases when the carrier power decreases. If not, the receiver may be in hard compression and not properly reporting an "IM OVERLOAD."
- Use the "Log to ASCII" capability of the analyzer to generate an ASCII data file. A spreadsheet program may then be used to

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add the required offsets to the measured data.