IMD Measurement Techniques using Quad Hybrid and EVM

1. This document suggests some possibilities for IMD measurement techniques.
2. The base line IMD has to be at least 6 to 10 dB better than what you are trying to measure. If your base line measurement is 70 dBc, for example and the isolator happens to measure an IMD of 70dBc, the combined measurement will be 3 dB worse, at 67dB, for example. Someone may erroneously say the isolator is out of spec. at 67 dB, when, in fact, it is 70 dBc.
3. The best method for measuring the linearity of a telecom
4. Amplifier is to use a modulation analysis test set, and measure the EVM (Error Vector Magnitude) Agilent and Rohde and Schwartz (and others) have equipment for measuring this. Test equipment is quite expensive. This is a much better measurement for the linearity of the amplifier and complete system linearity, as it is based on the actual modulated signal. For this, a Vector modulated signal generator is needed, with a modified test set, usually a Spectrum analyzer with additional digital demodulator etc. There is a very good correlation between "true" IMD generation and EVM. To measure this you need the amplifier and isolator together, not just isolator! as the linearity is measured at the high power generated by the amplifier you are using-it measures the whole system, which is what you want anyway.
5. The traditional methods are more tedious. If a feed forward, high power amp is used at a different frequency!). With the feed forward, it was manually tuned with the 2 or more tones going in so as to minimize all the IMD products to an acceptable level. For example, the operating power for a WiMax 64QAM modulated waveform with 1024 subcarriers is around 2.6% or less at the full operating power. Correction data can e stored in a look up table versus temperature and level etc.
   Conventional ways of measuring using quadrature hybrids have a limited IMD range, and a 3dB loss per hybrid!! With 4 amplifiers, you will have 3 quad hybrids and 6 dB loss, so you need to start with at least 120W P1dB amplifiers. Each is fed with a sequence of CW frequencies with the 3MHz separation from stable signal generators. On a high dynamic range Spectrum analyzer, you will be able to see all the IMD products, third order and beyond! Having first tested the base line measurement (with no test isolator) to makes sure there are no third order products worse than the expected IMD plus at least 3dB margin. This may be difficult to achieve for very low IMD levels!!
   The isolator under test is inserted at the Nth tone summing junction, and a high power attenuator is placed after the isolator to terminate and protect the front end of the spectrum analyzer. I have attached a drawing of the set up. Purists will (correctly) say the attenuators and quad hybrids will generate IMDs themselves. In addition, 3 series isolators need to be placed in series with the output of the test set power amplifiers to prevent signals from re-entering the amplifiers at levels that could generate IMDs in the amplifiers themselves, and thus degrading the base level IMD for the systems, this can be verified by measuring the system IMD, i.e. with no test isolator in the circuit!

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