MEASURING PASSIVE INTERMODULATION (PIM) IN RF & MICROWAVE HIGH POWER TERMINATIONS

APP NOTE: 39-003

Passive intermodulation (PIM) is an important metric in today's wireless network performance. PIM generated in active devices is familiar and understood, however, the causes of PIM in passive devices are vague and are more difficult to pin point. Studies have shown that passive device PIM can be generated from ferromagnetic materials, poor mechanical contact, surface imperfections (e.g. corrosion, oxidation, poor plating), junctions between dissimilar materials, mechanical micro fractures, temperature variation, and even vibration. PIM is generated when two high power RF sources pass through the device causing non-linear mixing generating higher order harmonic frequency components. If these signals are large enough, it can have detrimental effects on system performance. PIM products can appear in adjacent channels and cause wanted effects such as disabling a receive channel, or cause reduced channel sensitivity resulting in dropped calls in cellular service. The 3rd order intermodulation product (IM3) is the largest being the closest to the source signals. IM3 is determined as follows:

$$IM3 = 2 \cdot f_1 - f_2 \qquad IM3' = 2 \cdot f_2 - f_1$$

If IM3 is reduced, it follows that its harmonics will also be reduced. Due to increased data rates and higher power of modern networks, care must be taken to reduce PIM. It is prudent to select components with low PIM performance though testing of individual components.

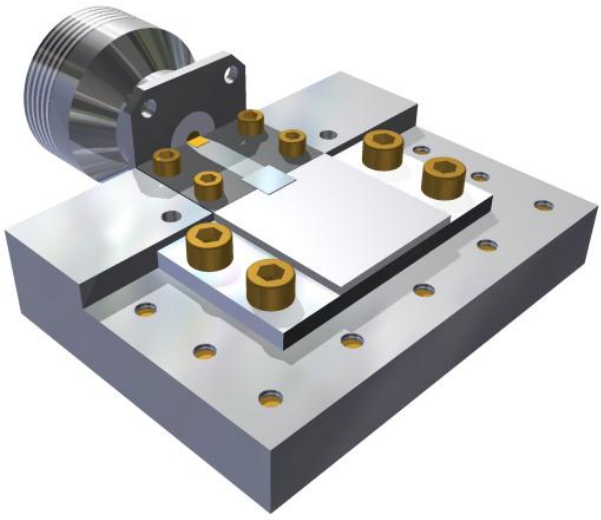

Fig 1: FRFL-0746 1-port DC-4GHz fixture for measuring DUT PIM performance

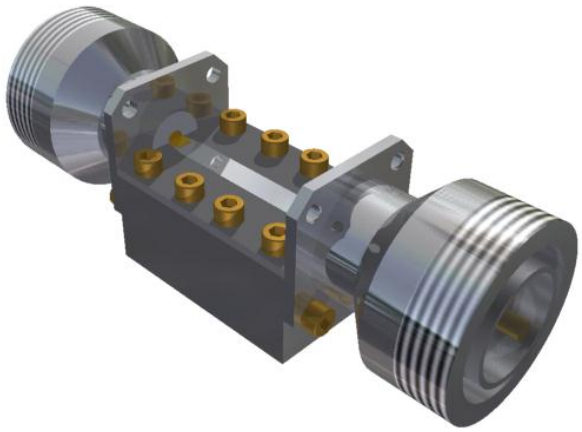

Fig 2: FRFL-0746-T1 2-port DC-4GHz thru line for measuring PIM performance

Electro-Photonics has engineered/designed the FRFL-0746 fixture (Fig. 1) for testing PIM in high RF & microwave high power terminations. The fixture must be designed and constructed in such a way as to provide better PIM performance than that of the DUT by several magnitudes. This is done by careful RF design to provide best matched transition for maximum transmitted and minimal reflected power. In addition, proper material selection, machining, and plating mitigates PIM effects. To determine the fixture PIM performance, a thru line was constructed (Fig. 2) and a 50Ω load was attached. Using an AWS/PCS band PIM tester, a frequency sweep from 1710 MHz to 1910 MHz using two 43 dBm tones reveals a max PIM of -99.2 dBM (-142.2 dBc) @ 1935 MHz (F1) and 1998 MHz (F2).

About:

Electro-Photonics LLC is a global supplier of RF & Microwave components and design services. Our products include wire bondable passive components, SMT hybrid couplers, coaxial products, packages, test fixtures and very useful test boards for evaluating components. We custom design passive components and offer packaging services.

The Electro-Photonics team can support your small R&D design requirements with RF & Microwave test fixtures and save you valuable design and characterization time. Available are chip and wire assembly services in a 10K clean room and RF & Microwave measurements to 110GHz.

Telephone: +1-772-485-0927
Sales: **sales@electro-photonics.com**
Engineering: **eng@electro-photonics.com**