PIM Testing with the Kaelus iBA 40 Watt Bench PIM Analyzer

Application Note

Brendan Horsfield

Introduction

Commercial PIM analyzers have historically been designed to operate at tone levels of 20 watts (+43 dBm) per carrier. This power level was chosen in accordance with IEC 62037, the international standard for PIM testing on passive RF devices [1], and it has served the industry well.

Indeed, in the nearly 20 years since IEC 62037 was first published, the 20W standard has consistently proven itself effective in characterizing the linearity of RF devices and systems, even as cellular signals have evolved from relatively simple narrowband waveforms like AMPS and GSM, into the complex, wideband modulation schemes used in modern 4G LTE networks [2].

Despite the success of the 20W standard, situations can arise in a factory testing environment in which a 20W carrier level is not enough. This occurs whenever a device with high insertion loss is inserted between the PIM analyzer and the device under test (DUT). In such cases, the PIM analyzer's output power must be increased to compensate for the insertion loss of the device, so that the RF power at the input to the DUT is maintained at 20W, as required under IEC 62037.

With that in mind, Kaelus is pleased to announce the release of the iBA Series 40W Bench PIM Analyzer.

The iBA 40W PIM analyzer offers all of the features and operating modes of previous iBA models, but with the maximum carrier power increased to 40W (+46 dBm). Variants are available to cover all major commercial cellular bands. The iBA 40W base model (C-Series) measures Reverse PIM only, while the D-Series adds a second test port to support both Forward and Reverse PIM measurements.

a) iBA C-series

b) iBA D-series

Figure 1. iBA 40W bench PIM analyzer.

Key Features of the iBA 40W Bench PIM Analyzer

A summary of the key features of the iBA 40W PIM analyzer is as follows:

- 40W (+46 dBm) maximum output power per carrier, able to be reduced to +30 dBm in steps of 0.1 dB
- User-defined "Test Port Cable Loss" parameter in iBA software enables instrument to automatically scale carrier levels and reported PIM levels to compensate for insertion loss of device connecting iBA to DUT
- Same intuitive user interface as 20W iBA
- Same operating modes as 20W iBA
- Same AC power consumption as 20W iBA
- Compatible with Kaelus RTF module
- Optional internal DC/AISG bias tee available
- Compatible with Kaelus ACE Calibration Extender – allows users to self-calibrate their iBAs on-site with minimal downtime

Refer to the iBA 40W Bench PIM Analyzer datasheet for detailed specifications.

Examples of PIM Tests Requiring More Than 20W of Carrier Power

Some examples of factory PIM tests that may require the higher carrier power provided by the iBA 40W PIM analyzer are presented below.

Case 1: Antenna PIM Testing in an Anechoic Chamber

A common test case in which a 20W carrier level may not be sufficient occurs in antenna PIM testing. In this scenario the antenna under test is placed inside an anechoic chamber, with the PIM analyzer located outside as shown in Figure 2 [3]. A coaxial cable assembly connects the PIM analyzer to the antenna via a gland plate in the wall of the chamber.

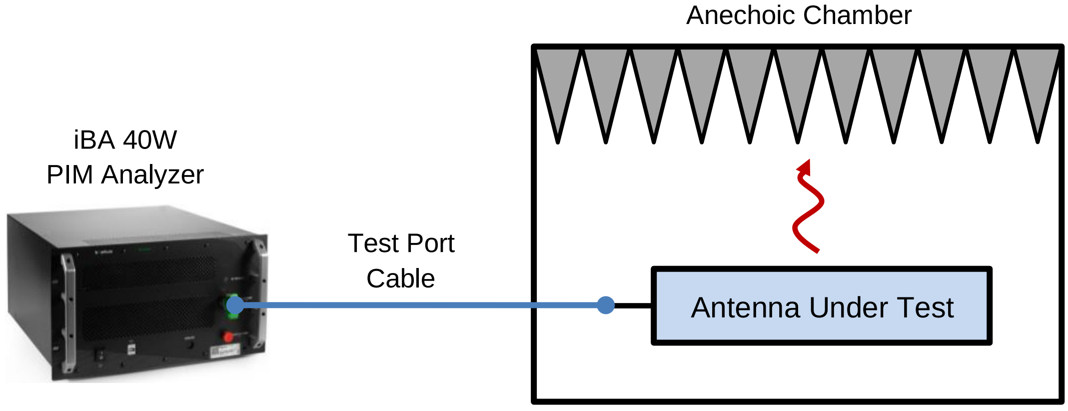

Figure 2. Equipment setup for an antenna reflected PIM test.

This type of PIM test often requires a very long test port cable due to the physical separation between the PIM analyzer and antenna. As a result, the overall cable loss can be high, approaching or even exceeding 2 dB, depending on the type of cable used and the frequency at which the PIM test is performed. In such cases, the PIM analyzer's output power must be increased to compensate for the cable loss and ensure that the RF power delivered to the input port of the antenna is maintained at 20W.

Case 2: Multi-Band PIM Testing with a Combiner or Switchbox

Another type of production test in which more than 20W of carrier power may be required is multi-band PIM testing. This type of test entails connecting multiple PIM analyzers to the same DUT port by means of an RF combiner or switchbox, as shown in Figure 3.

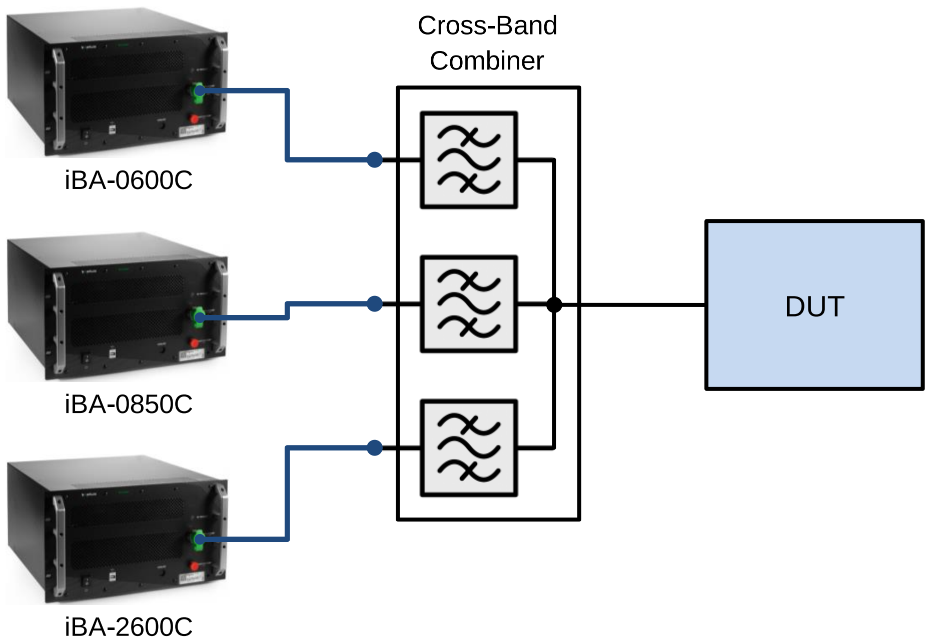

Figure 3. Equipment setup for a multi-band PIM test site, in which 3 PIM analyzers are connected to a common test port via an RF combiner.

The advantage of the above equipment setup is that it allows PIM to be measured in several bands in rapid succession, without requiring any connection changes when switching from one band to the next. It also reduces wear and tear on the DUT's input port.

However, this equipment setup has one significant limitation: Namely, the insertion loss of the combiner or switchbox reduces the amount of RF power that reaches the DUT. Once again, the PIM analyzer's output power must be increased in order to maintain a 20W carrier level at the input to the DUT.

Conclusion

PIM testing at a carrier level of 20W is a highly effective method of characterising the linearity of passive RF devices. However, in situations where the PIM analyzer is connected to the DUT by a device with high insertion loss, the PIM analyzer must generate more than 20W of carrier power in order to compensate for the loss of the device.

The Kaelus iBA 40W bench PIM analyzer caters for these special testing scenarios, while providing the same feature set and intuitive user interface as the iBA 20W system. Carrier levels and PIM results are automatically adjusted by the iBA software to compensate for the insertion loss of the device between the PIM analyzer and the DUT.

The iBA 40W PIM analyzer is available in all major cellular frequency bands. It is compatible with the Kaelus RTF module, and can be factory-fitted with an internal DC/AISG bias tee if desired. It can also be used with the Kaelus ACE Calibration Extender, allowing users to self-calibrate their iBA 40W unit on-site, and limiting downtime to less than one hour in most cases.

References

[1] IEC 62037-1 (Edition 1.0), "Passive RF and microwave devices, intermodulation level measurement - Part 1: General requirements and measuring methods," International Electrotechnical Commission, May 2012.

[2] TTER Working Group PIM Committee, "Passive Intermodulation (PIM) Testing Best Practices," IWPC, November 2014.

[3] IEC 62037-6 (Edition 1.0), "Passive RF and microwave devices, intermodulation level measurement – Part 6: Measurement of passive intermodulation in antennas," International Electrotechnical Commission, Jan 2013.