

Specially Designed ultra-low PIM Duplexers Making PIM Test More Accurate and Affordable

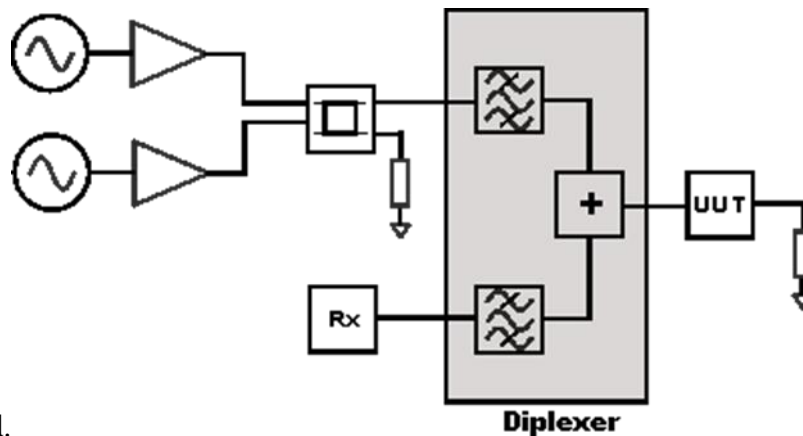
Passive Intermodulation (PIM) is a form of signal distortion that occurs whenever signals at two or more frequencies conduct simultaneously in a passive device (i.e. connectors, cables, cable assemblies, waveguide components) which contains some non-linear response. This interference phenomenon is attributable to many sources such as dissimilar metals, dirty interconnects. While today's mobile handset users expect consistent high throughput from their devices, consequently, PIM performance in the network is increasingly important and hence PIM test become imperative.

RF One recognizes the importance to achieve low PIM levels and offers specially designed ultra-low PIM duplexers (170dBc min) to make such testing more accurate and affordable.

This article in a form of Q&A is intended to present some basics of PIM testing and the key considerations to take into when you plan for a PIM testing system.

Q: What is the procedure for PIM test and the construction of a PIM Tester?

A: The below block diagram shows how a PIM tester is basically



constructed.

Basic block diagram of a PIM tester

→The basic steps for PIM test is firstly to generate two signals (20W) similar to the ones used in the system and apply them to the cable, antenna, or other objects to be tested.

→The two signals then are amplified to ensure that they are of a sufficiently high level for the test.

→The signals are combined-an RF isolator may be used to prevent reverse RF power from the combiner entering the signal generator and causing spurious intermodulation products in the signal generator output that would alter the readings.

→The two signals from the signal generators simulating the transmitted signals are then applied to a duplexer within the PIM tester. This only allows signals through from the transmitter in the transmit band to the unit or component under test, e.g. a feeder, the item under test is terminated in a 50 Ω matched load.

→If non-linearity occurs, PIM is generated. Any PIM spurious signals generated within the receive band will be able to return through the duplexer and be routed through to the receiver / detector where they can be detected and their levels and frequencies can be displayed via a spectrum analyzer.

Q: What are the main conditions to realize an accurate PIM measurement?

A:

1. The PIM level of the passive module (duplexer, filter) within the tester must be at least 10dB less than the UUT itself.
2. The PIM level of the termination/load used in the PIM tester must be less/better than the passive module of duplexer. For example, if the duplexer reads -168dBc, the load should feature at least -170dBc.
3. All connectors should be tightened to the proper value and proper **torque wrench** is also required to help minimize the PIM. The safe practice is to tighten the connectors per the manufacture's specified values with a torque wrench.
4. It is recommended to use a circulator after the PAs to isolate interference from the two amplified signals.
5. When necessary, using an extra isolator before the low PIM duplexers, to filter the spurious intermodulation.
6. Calibrating the power every time when UUT or signal generator is replaced or PA is re-started.
7. Choose the spectrum analyzer with sufficient floor noise.

Q: How to understand Self-assembling a PIM test system vs Buying a PIM test analyzer

A: It is interesting to understand them in the way of Building (DIY) a PC vs Buying a PC.

1. Self-assembling a PIM test system would save cost at least 30% over buying a branded PIM test analyzer.
2. Self-assembling a PIM test system provides more flexibility in parts selection and is more customer-tailored based on your own needs.
3. Using a PIM test analyzer saves much time in choosing various parts/components and in setting up the test platform.
4. Using a branded PIM test analyzer features more functions and better compatibility.

5. As said above, make sure the specs of your cable assemblies, duplexers, terminations, spectrum analyzer and all connections are satisfactory to your testing requirements, and do not ignore the job of adding necessary isolator, filter and power calibration, in this way, building a PIM test system is always feasible, reliable and not so hard.
6. Nevertheless, each customer's need varies, urgency varies, budget varies; quantity varies. Based on all these factors, you can decide whether to go for a branded PIM tester, or a self-assembled one.

Q: What is the typical application of a low PIM duplexer?

A: This test-grade low PIM duplexer is mostly common to be seen in the PIM test analyzer or in a self-assembling PIM test system where duplexer is an essential and critical component. The above described PIM test procedure is a good resource to refer for how a Low PIM duplexer works.

Q: What are the key specifications for low PIM duplexers?

1. **Frequency bands:** Today most customers choose a band from 700-2600MHz. We provide duplexers covering LTE 700MHz, CDMA 800MHz, GSM 900MHz, DCS1800MHz, WCDMA 2100MHz and LTE 2600MHz.
2. **PIM level:** As a test-grade low PIM duplexer, the typical level should be at least 125dBm (2*20W). Our low PIM duplexers are guaranteed with 127dBm min.
3. **S Parameter** of VSWR, Insertion loss and isolation. Our duplexers features 90dB min isolation (between TX&RX), 1.0db max insertion loss and 20dB min return loss.

Q: What are the major techniques making an ultra-low PIM duplexer?

1. At design phase, try to reduce the number of components used inside the cavity, which are likely become the potential generator of PIM.
2. On the cover plate, adopt a Pin+Busing self-locking techniques to ensure a perfect connection and contact with finer threads.
3. At production phase, make sure to complete the soldering and assembling work at one shot. Our duplexer is designed to have only three soldering points inside the cavity to reduce potential PIM.
4. After S-parameter testing, it is recommended to clean the cavity again to remove any dirty chippings or foreign materials.
5. Implement rigid knock test on all sides of the duplexer and its connectors to verify the PIM performance reliability.

Q: What are the advantages of RF One's duplexer?

1. **Quick lead time:** Our low PIM duplexer line cover bands from 700MHz-2600MHz. Normally lead time 4 weeks.
2. **Highly competitive pricing:** Our offer is much lower than the competitors' equivalent.
3. **Over 10-year dedication:** Our dedicated engineers for low PIM duplexer have been delving in this field over 10 years. Low PIM result largely owns to the engineers' experience and their special knowledge/skills as well as consistency and accuracy of operators' work.
4. **Extremely low PIM guarantee:** Each of our shipped duplexers meets 170dBc PIM (2*20W), mostly with typical result is minimum 173dBc.
5. **12-Month warranty:** We provide a 12-month warranty. Free replacement or free repair is available within warranty period. If out of warranty, repair charge is very reasonable.

To learn more about our low PIM duplexer for your accurate PIM test measurement, please contact our sales at sales@rfone.cn.

****Parts of the notes are from the courtesy of K&L Microwave's website.**