Product Brochure

Anritsu

PIM Master™

High-Performance Passive Intermodulation Analyzer

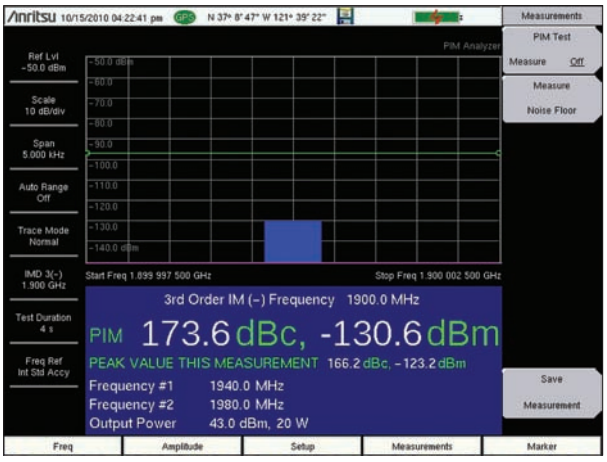
Featuring Distance-to-PIM™ (DTP)
The Fastest Way to Pinpoint the Source of PIM

MW8219A
PCS/AWS Bands
1900/2100 MHz

PIM Master™ Overview

PIM Master top view with easy reference connection diagram

40 W Residual PIM Measurement in trace view with GPS tagging
Listen to relative PIM level with audible tone
Save / Recall Setups for standardized testing



20 W Residual PIM Measurement in bar graph view with limit line
Plot instantaneous value or Max Hold value
Peak Value displayed below the PIM Value

PIM Master™ Introduction

Anritsu Company introduces its first generation high performance PIM testing solution, the MW8219A, for the PCS and AWS cellular frequency bands. Anritsu has developed the PIM Master to verify if receiver interference at a cell site is due to an intermodulation product of two or more transmit frequencies, also known as passive intermodulation (PIM).

The PIM Master generates two high power tones in the transmit band of a base station and Anritsu's family of handheld RF instruments' PIM Analyzer measures the 3rd, 5th, or 7th order intermodulation products in the receive band coming back down the same cable. And the GPS option will record the location of the measurement.

Anritsu's handheld instruments supporting the PIM Master include:

- Site Master™ S332E, S362E
- Spectrum Master™ MS2712E, MS2713E
- Cell Master™ MT8212E, MT8213E
- BTS Master™ MT8221B, MT8222A/B

PIM Testing

The current standard of PIM testing offers a well-known system of two primary carriers and a calculated PIM frequency, which is monitored via a spectrum analyzer. This provides a measurement of the overall linearity of the antenna system and the surrounding environment.

As more power goes up the antenna lines a coaxial connection is more likely to cause a fault on a tower. Traffic through the site plays a big part – a relatively quiet site will not usually see the same performance problems that a busy site will see.

The main reason we use a PIM test is that it is the most comprehensive measure of electrical connection quality that is commercially available.

PIM Testing versus Line Sweeping

A PIM test cannot, however, measure VSWR. This means the test set will not see an open or short condition, unless the fault displays non-linear behavior. A return loss figure that is failing will not be determined with a PIM test measurement.

Components deteriorate as they age due to a number of issues, including poor mechanical design, poor installation, and moisture ingress (which is the most significant).

On-site faults can mostly be categorized into two main types: linearity related and impedance related.

PIM testing measurements reflect the overall linearity of an antenna feed line and Line Sweep measurements reflect the overall impedance matching of all of the components in an antenna feed line. Both tests need to be performed to ensure the overall quality of an antenna feed line. Passing one type of test (PIM or Line Sweep) does not guarantee the other test will pass.

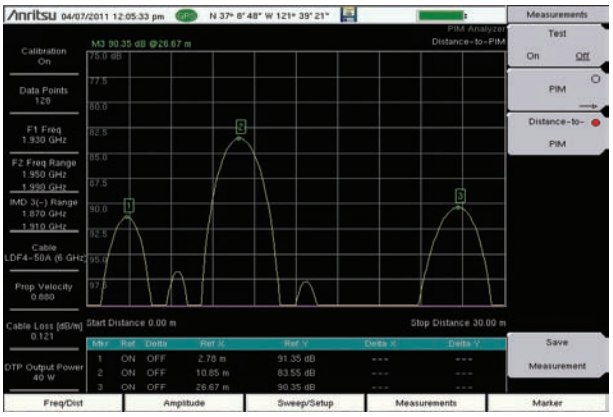
Symptoms of PIM problems

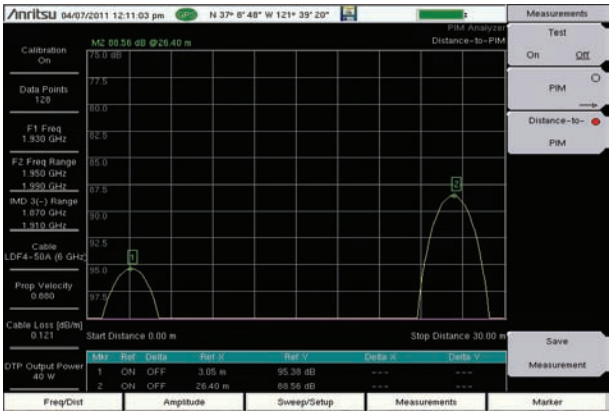
Many symptoms could be indicators of PIM problems.
These include:

- Receiver desensitization (raised noise floor)
- Rx Diversity alarms
- Spectral re-growth in the transmitter mask
- Excessive dropped/blocked calls
- Cell site coverage shrinking
- Complaints of interference from neighboring cell site owners

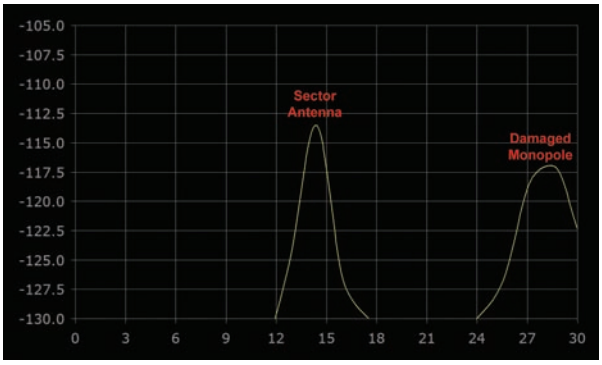
PIM Master™ Overview

Distance-to-PIM™ (DTP) Plots
PIM Level (dBm) vs. Distance (meters)





Locating multiple PIM occurrences in antenna cables with DTP



Locating external PIM occurrences beyond the antenna

Where is the PIM?

Anritsu labs has invented and succeeded in developing a patent pending technology that pinpoints PIM faults called Distance-to-PIM™ (DTP). No more wasting time rappelling down towers trying to locate PIM, no more wondering if the PIM is coming from the antenna system or the surrounding environment.

The Distance-to-PIM test is simple, immediate, and accurate. DTP informs the technician of the distance and magnitude of all the PIM sources simultaneously, both inside the antenna system and beyond the antenna.

DTP is similar to Distance-to-Fault (DTF), which Anritsu introduced in the Site Master™ in 1997, displaying distance versus impedance changes. DTP utilizes algorithms much like DTF to show distance versus the magnitude of non-linear faults.

DTP is an option available on the PIM Master.

Distance-to-PIM lab results

DTP has been tested extensively in our development lab with very positive results as shown on the left. DTP shows the location for PIM problems within the antenna system, as well as distance to external PIM sources outside the antenna system. This is an incredible step forward in improving the quality of information received from the on-site PIM test.

The Distance-to-PIM test offers far more insight than traditional PIM testing. This information can speed up repairs, control repair costs, and help plan budgets accurately. Comparison of PIM values over time can show if a device is deteriorating with age. This permits fault correction before a failure causes dropped or blocked calls.

2 x 40 Watt PIM Testing

PIM problems can be intermittent and power sensitive. This is often the case when PIM problems are just beginning to show up. This can be due to light corrosion, high traffic loading, or changing weather conditions activating environmental diodes. Using higher power levels can often force otherwise intermittent failures to become visible. Higher power levels may be required to find faults in a multicarrier antenna system and to discover microscopic arcing in connectors.

In many cases PIM faults cannot be discovered with just 2 x 20 Watts of power. With the ability to test at 40 Watts, one can spot serious problems that cannot be seen on a 20 Watt PIM tester.

Storing and Recalling Setups and Measurements

When saving files many choices are available. One can save and recall:

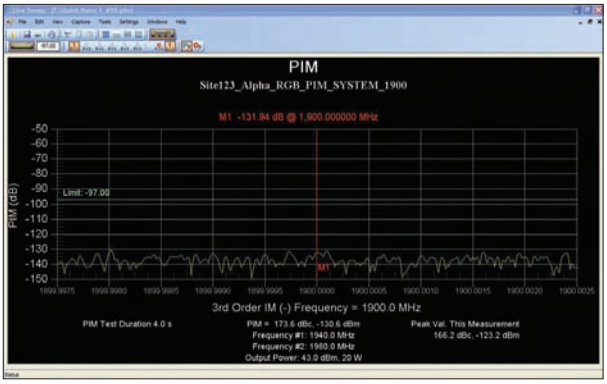
- Set-up file
- Measurement file
- Jpeg screen shot (save only)

Saving and recalling setups makes it quicker to run the same tests over and over again at different sites. Saving and recalling a measurement becomes a reference measurement at a site when you return to see if there has been any deterioration since the last time the site was tested.

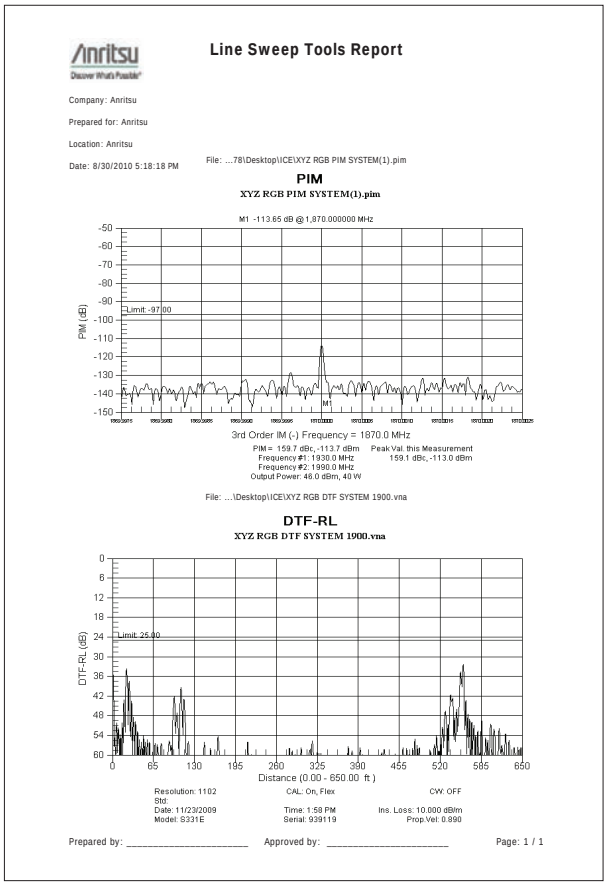
Run Line Sweep Tests on the same instruments

Since both PIM measurements and Line Sweep measurements can be made on the same instruments (Site, Cell, or BTS Masters) one can efficiently make Line Sweep measurements at the same time. Now all PIM measurements and Line Sweep measurements are stored together on the same instrument. An installation contractor or technician only has to learn how to use one instrument to make all related antenna measurements for linearity and impedance testing.

PIM Report Generation and Certified Training



PC Line Sweep Tool utilized for report generation on a PIM trace



Line Sweep Tools Report with Limit Lines

Line Sweep Tools for Cable, Antenna, and PIM Analysis

Anritsu's Line Sweep Tools is a new generation post processing tool to manage, archive and report on all cable, antenna, and PIM analyzer sweeps. In one tool all measurements can be incorporated into one unified report per antenna system.

Now in one integrated report an operator can have all of the information on the integrity of an antenna system with the measurements of:

- PIM
- Return Loss
- Insertion Loss
- Distance-to-Fault

Contractors, technicians, and engineers can be more productive with one cohesive tool to learn and use in managing antenna line quality measurements.

PIM Master™ Certified PIM Measurement Training Course

Specialized PIM Master™ passive intermodulation measurement training is an intense one-day instructor led training course that focuses on making PIM measurements (theory and lab). This is modeled on our successful Site Master™ Certified Line Sweep course.

- Brief Course Outline
  - Definition and Description
  - How PIM differs from Return Loss
  - Why is PIM a problem
  - What causes PIM
  - How to test for PIM
  - PIM test equipment
  - PIM testing process
  - Hints for successful testing
  - Assessing Results
- Labs
  - Hooking up the equipment and confirming proper operation
  - Measuring known good and bad devices
  - Device measurement practice
- Exams
  - Theory and safety
  - Hands-on practical
- Certification (after passing exams)
  - Certificate of Completion
  - Wallet-sized photo ID

Students will learn technical aspects of PIM measurements, how to set up a PIM measurement, useful examples of what works and what doesn't, interpreting results, and locating the PIM.

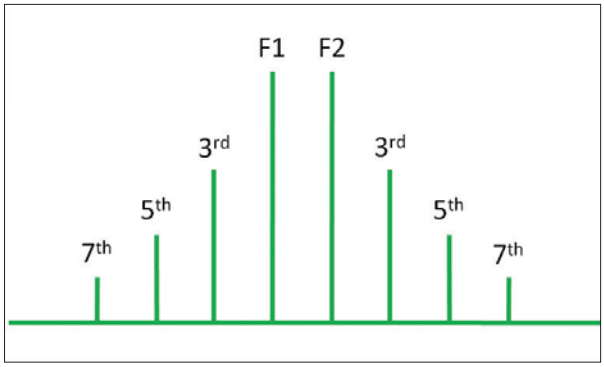
Customer Support

Like all Anritsu products, the PIM Master has a range of support products, services and training allowing you to maximize your return-on-investment.

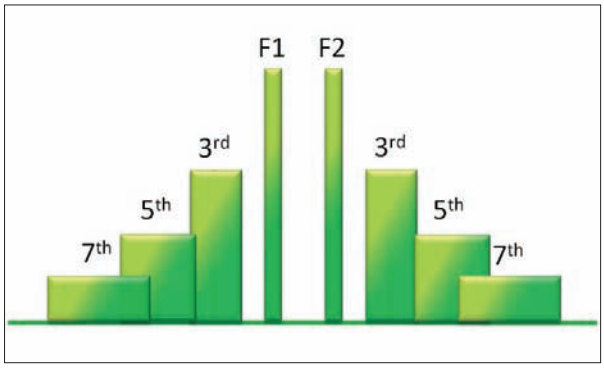
- Anritsu Line Sweep Tool for report generation
- A full line of PIM testing accessories
- Extended warranty
- PIM Certified Technician Training Course
- Made in the USA

With Anritsu's design know-how and demanding production testing and performance verification you can count on the PIM Master to give you years of reliable dependable service.

PIM Overview



Carriers F1 and F2 with 3rd through 7th order products



PIM Bandwidth increases with the order of the product

Corrosion (rust) in view of the antenna can cause PIM

Rusty rooftops and fences can be prime sources of PIM

What is PIM?

PIM is a form of intermodulation distortion that occurs in passive components normally thought of as linear, such as filters, combiners, surge protectors, cables, connectors, and antennas. However, when subject to the high RF powers found in cellular systems, these devices can generate spurious signals.

PIM shows up as a set of unwanted signals created by the mixing of two or more strong RF signals in a non-linear device, such as in a loose or corroded connector, or in nearby rust. Other names for PIM include the “diode effect” and the “rusty bolt effect.”

This pair of formulas can predict PIM frequencies for two carriers:

$$IM_{n+m} = nF1 - mF2$$

$$IM_{n+m} = nF2 - mF1$$

F1 and F2 are the Tx carrier frequencies and the constants n and m are positive integers. When referring to PIM products, the sum of n + m is called the product order, so if m is 2 and n is 1, the result (2+1=3) is referred to as a third order product or IM3.

Typically, the third order product is the strongest causing the most harm when they fall into the Rx band. Because PIM amplitude becomes lower as the order increases, higher order products typically are not strong enough to cause direct frequency problems, but they usually assist in raising the adjacent noise floor.

Once this raised noise floor crosses into the Rx band, it then has an open door (and sometimes gain via an LNA) into the BTS.

It is important to recognize that intermodulation created from modulated signals occupies more bandwidth than the fundamentals. PIM products can be very wide band, covering wide swaths of frequencies.

Why has PIM become an issue recently?

The introduction of high-speed data within mobile communications devices has increased the network traffic within a cellular system to the degree that it is greatly affecting network performance.

As extra cellular transmitters and modulation formats are commissioned into service in new or existing sites, the statistical performance can appear to change dramatically. Ultimately, this can result in poor site/sector performance and reduced coverage, and this is why testing for PIM is now required in the field.

PIM has come to the forefront of network problems recently due to a variety of reasons which can be any combination of the following:

- Higher RF power
  - Multiband systems on the same antenna lines
  - Fully loaded multicarrier systems
  - High density/traffic sites – heavily loaded
- Wideband receive filters
- Duplex antenna lines
- Wider bandwidth signals up to 5, 10, and 20 MHz
- Aging infrastructure – primarily connectors corroding and loosening
- Environmental diodes created by corrosion in the surrounding area
- Intermittent environmental diodes due to wet and dry conditions
- Neighboring cell sites generating PIM

An on site PIM test is a comprehensive measure of linearity and construction quality. For more information about PIM testing refer to our whitepaper “Troubleshooting Passive Intermodulation Problems in the Field” document number 11410-00586.

PIM Master™ Specifications

General Specifications

All specifications and characteristics apply under the following conditions, unless otherwise stated: 1) After 5 minutes of warm-up time, where the instrument is left in the ON state; 2) All specifications apply when using internal reference; 3) All specifications subject to change without notice; 4) Typical performance is the measured performance of an average unit; 5) Recommended calibration cycle is 12 months.

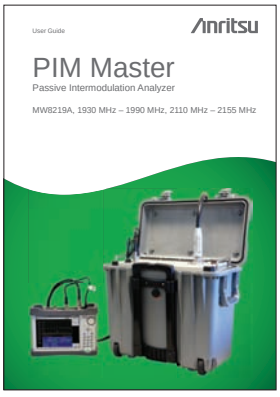
Measurements	
PIM	3rd, 5th, and 7th order intermodulation product in receive band (user selectable)
Noise Floor	Rx noise floor of base station
Distance-to-PIM	Distance and magnitude of multiple PIM sources (Option 0420)
Instrument Setup Parameters	
Instruments Supported	Site Master™ S332E, S362E, Spectrum Master™ MS2712E, MS2713E, Cell Master™ MT8212E, MT8213E, BTS Master™ MT8221B, MT8222A, MT8222B
Frequency	Carrier F1, Carrier F2, Intermod Order (3rd, 5th, 7th), Span
Amplitude	Ref Value, Scale, Ref Level Offset, Auto Range (On/Off), Amplitude Tone (On/Off)
Setup	Output Power, Test Duration (1 to 60 s), Normal → A, Max Hold → A, Display Type (Trace, Bar)
Parameter Setup	F1, F2, Power
Limit Lines	Limit (Upper/Lower), On/Off, Limit Move, Limit Alarm (On/Off)
GPS	On/Off, 3.3/5.0 V
DTP	Cable Velocity, Distance, Calibrate
Measurements	PIM Test (Measure/Off) Measure Noise Floor, Save Measurement
PIM Measurement Ranges	
RF Test Power	Two CW tones of 20, 30, or 40 Watts (≈ 43, 45, 46 dBm) (user selectable)
Transmit Frequency Range	1930 to 1990 MHz, 2110 to 2155 MHz
3rd, 5th, and 7th Order Frequency Ranges	1710 to 1755 MHz, 1850 to 1910 MHz
Residual PIM Performance	< −112 dBm/−155 dBc typical
Measurable PIM order	3rd, 5th, and 7th order intermodulation product (if in band)
Distance-to-PIM	Distance and magnitude of multiple PIM sources (Option 0420)
PIM Master Connectors	
Test Port	7/16 DIN, female, 50 Ω
RF Out	Type N, female, 50 Ω (connect to RF In on instrument)
10 MHz Out	BNC, female, 50 Ω, 10 MHz (connect to Ext. Ref. In on instrument)
USB Interface	Type B (connect to USB Type A port on instrument)
AC Power	IEC60320 C14
Power	
Emergency Stop	Red push button
AC Power	90-240 VAC, 50/60 Hz
Electromagnetic Compatibility	
European Union	CE Mark, EMC Directive 2004/108/EC
Australia and New Zealand	C-tick N274
Interference	EN 61326-1:2006
Emissions	EN 55011:2007
Immunity	EN 61000-4-2/-3/-4-4/-4-5/-4-6/-4-11
Safety	
Safety Class	2006/95/EC, EN 61010-1 Class 1
Product Safety	IEC 60950-1 when used with Company supplied Power cable
Environmental	
Operating Temperature	−10 °C to 55 °C
Maximum Humidity	95%
Shock	MIL-PRF-28800F Class 2
Storage	−51 °C to 71 °C
Altitude	4600 meters, operating and non-operating
Size and Weight	
Size	300 mm x 425 mm x 500 mm (12 in x 17 in x 20 in)
Weight	28.6 kg (63 lbs)

PIM Master™ Ordering Information

Ordering Information

Model Number	Description
MW8219A	PIM Master™ Passive Intermodulation Analyzer, PCS/AWS bands (1900/2100 MHz) (requires S332E, S362E, MS2712E, MS2713E, MT8212E, MT8213E, MT8221B, MT8222A or MT8222B for operation)
Options	
MW8219A-0420	Distance-to-PIM™
MW8219A-0425	Large Wheel Option (as shown in photo)
MW8219A-0098	Standard Calibration to Z540
MW8219A-0099	Premium Calibration to Z540 plus test data

Standard Accessories (included with PIM Master)



Part Number	Description
10580-00280	PIM Master™ User Guide
11410-00546	PIM Master Product Brochure
2000-1635-R	Interface Cable (USB, RF, REF)
(country dependent)	AC Power Cable

Optional Accessories

Part Number	Description
10580-00315	Certified PIM Master™ PIM Measurement Training Course
2000-1637-R	PIM Master Accessory Kit with Torque Wrench
2000-1638-R	PIM Master Accessory Kit without Torque Wrench
PIM accessory kit	Can be ordered separately
MA82103A	Low PIM Load, 700 MHz to 2200 MHz
1091-390-R	PIM Standard, -80 dBm @ 2 x 20 watts
1091-386-R	Adapter, 7/16 DIN(f) to N(f), 50 Ω
1091-389-R	Adapter, 7/16 DIN(f) to N(m), 50 Ω
1091-387-R	Adapter, 7/16 DIN(f) to 7/16 DIN(m), 50 Ω
1091-388-R	Adapter, 7/16 DIN(f) to 7/16 DIN(f), 50 Ω
1091-385-R	Adapter, 7/16 DIN(m) to 7/16 DIN(m), 50 Ω
2000-1626-R	PIM Test Cable, 3.0 m, DC to 4 GHz, 7/16 DIN(m), 50 Ω
67135	Anritsu Backpack (For Handheld Products)
01-510	Crescent Wrench
Torque wrench and parts	Included in PIM accessory package 2000-1637-R only
01-507	Torque Wrench
01-508	1" Open End for Torque Wrench
01-509	1¼'' Open End for Torque Wrench

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MASTER USERS GROUP

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