Boonton

Data Sheet

Pim 31
Passive Intermodulation Analyzer 2 x 20W

Taking performance to a new peak

PIM 31 - Passive Intermodulation Analyzer 2 x 20W

Boonton's PIM 31 series test systems are precision analyzers for passive intermodulation generated in RF paths, components and assemblies. PIM 31 analyzers allow the detailed examination of components used in radio base stations, in-building-DAS installations and other systems transmitting radio frequencies. Components such as coaxial feeder assemblies, jumper cables, splitters, hybrids, filters, DC blocks, lighting arrestors and antennas, are all potential sources of PIM problems.

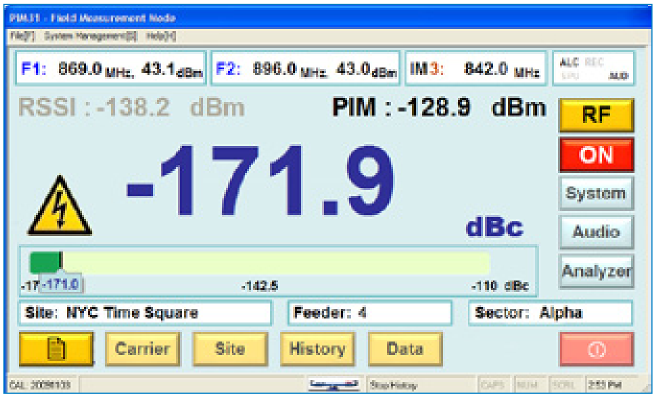
Passive intermodulation is an unwanted mixing effect caused by non-linearity of passive components in the RF path. Intermodulation diverts signal energy partially to other frequencies (spurious), which may fall into receive bands and cause serious degradation of system performance.

Boonton's PIM 31 passive intermodulation analyzer emulates a base station radio by providing two signals, up to 20W each, thus following the IEC62037 standard for PIM testing. The frequencies of these carriers are variable within the band of the analyzer, allowing PIM 31 operators to select the optimal frequencies for their wireless systems. PIM 31 analyzers combine portability with accuracy and a very high sensitivity of -175 dBc @ 2x43dBm. They are well suited for both, field use and the production floor. Applications range from performance evaluation of RF infrastructure, to RF component quality testing.

To provide optimal functionality, Boonton's PIM 31 analyzers offer two user interfaces (except UL models). Depending on the application it can be switched between a functional field diagnostic mode and detailed analysis mode with accessibility to all settings and readings. PIM 31 analyzers can be controlled by external mouse and keyboard or through the built-in touch screen display. Whether analyzing wireless infrastructure, or tracking device quality on the production floor, recording of the measurement results is mandatory for quality management. It offers a recording capability as a standard feature (except UL models). Data files or images can be stored, allowing the user to review and analyze measurements at a later point in time.

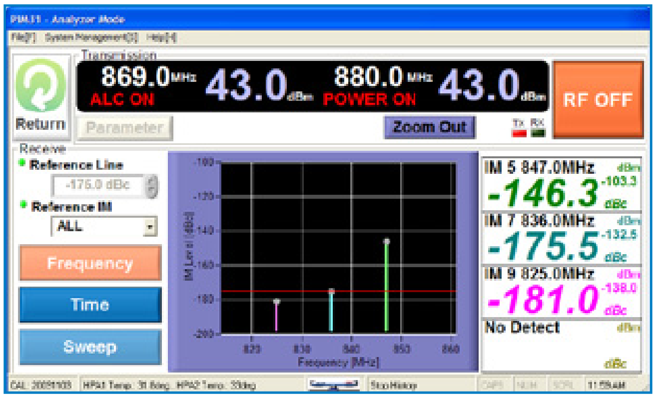
Features

- 20W PIM analyzer
- Two variable signals +20 to +44 dBm each
- User selectable TX frequencies within the analyzer's band
- Very high PIM sensitivity of -175 dBc @ 2 X 43 dBm carriers
- Measures Intermodulation products IM3, IM5, IM7 and IM9
- User settable frequency sweeps
- Measurement recording numeric or image traces
- Touch screen display
- Self calibrating
- PIM vs. Time Graph
- Maxhold (Not available on UL models)



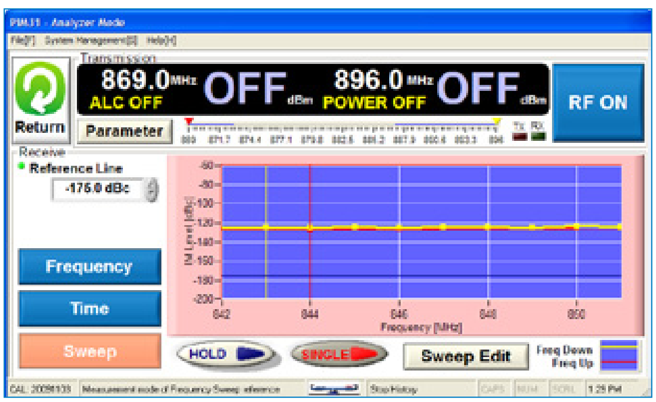
Field Diagnostic Interface*

For field applications PIM 31's field diagnostic mode presents the relevant information in a clear way. In this mode frequency and power levels of the carrier signals are set. The screen shows the PIM measurement in large digits, for easy readability even from a greater distance. The dBm value is presented simultaneously to the dBc value. A future software update will provide a bar graph for immediate visual display of the measured value and its tendencies.



Analyzer Mode

The analysis mode of the user interface provides access to all settings. Power and frequency of each transmitted signal can be set individually. The user interface allows the display of up to four IM products. Reference lines for automatic Pass/Fail decisions can be set. The mode of the test (PIM vs. Frequency, PIM vs. Time, and PIM vs. PIM vs. Frequency also known as Sweep) can be selected as well.



Sweep Mode

Sweep mode allows the user to automatically vary the frequencies of the measurement band. Any up and down sweep frequency range can be set within the unit bandwidth. Sweeps are performed in 1 MHz increments. To allow for the fastest sweep cycles, automatic level control is disabled in this mode.

Benefits to operators of RF transmission systems

- Higher customer satisfaction through higher QoS
- Reduction of maintenance costs achieved through quick detection of components that cause PIM distortion
- Reduction of operational cost through increased network efficiency
- Reduced capital investment through practical network optimization
- Maximization of revenue, due to optimal use of available bandwidth and air time.

Benefits to manufacturers of Passive RF Components

- Reduced capital investment through outstanding price / performance ratio
- Reduction of service calls, since components can be tested and verified on site with the same PIM analyzer used in production

*Not available for UL models.

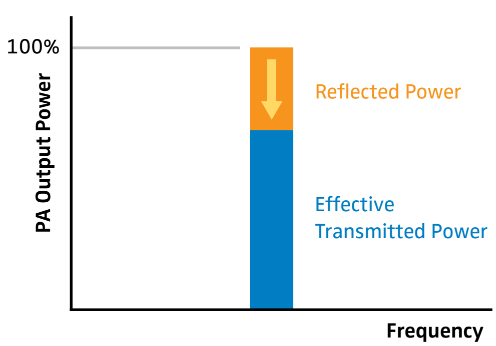
About PIM

Intermodulation can occur whenever more than one signal is present in an RF system. This is clearly the case in modern wireless communication technologies, such as EvDo, WCDMA / UMTS, TD-SCDMA, WiMax or LTE. All of them use spread spectrum signals utilizing a multitude of frequencies simultaneously. With a non-linear component in the RF path these signals will mix and create spurious products.

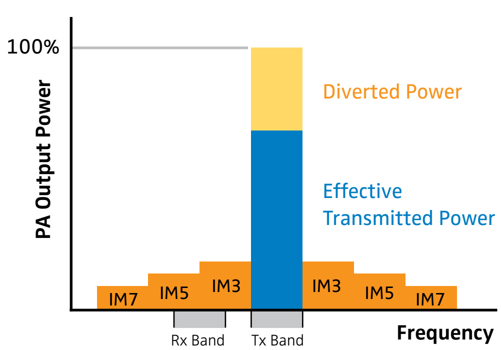
PIM vs. VSWR

Impedance match between components and systems is an important factor for transmitting RF energy. VSWR measurements are used to determine the impedance matching conditions. Ideally impedance of connected components is equal and independent of power and frequency. In reality system impedances vary depending on actual frequency and power levels. Impedance mismatch causes intended transmission energy to be reflected back to the transmitter.

Impedance Mismatch



Spread Spectrum Intermodulation Effects



PIM (Passive Intermodulation distortion)

Ideally all passive components in an RF path offer linear frequency response. As with VSWR, real world conditions are not ideal. All passive components show some degree of non-linearity. The goal is to keep it as low as possible.

The strongest intermodulation product is usually the third order product IM3, closest to the source signals. It is calculated as follows:

1) IM3 = 2x f1 – f2
2) IM3 = 2x f2 – f1

Where f1 is the first signal frequency and f2 is the second signal frequency. IM3 in equations 1) and 2) are of equal power. Using just two frequencies is a simplification since virtually all current communication technologies utilize multitudes of frequencies to carry the information, and therefore provide an ideal precondition for intermodulation effects that generate harmonics. Intermodulation products are often found within the RX band, degrading receiver performance, or disabling receiving channels completely. Unwanted signals present in the active channel will desensitize the cell phone and may drop the call.

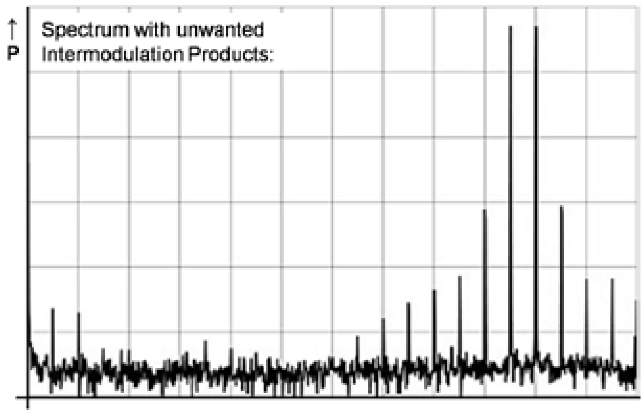
What causes PIM effects?

Dissimilar metals with different electrical potential constitute a potential voltaic element. Humidity between them will transform it to a galvanic element acting like a diode.

Ferromagnetic metals, like iron, nickel and steel, show hysteresis effects when energy is applied. The resulting signal level is altered depending on input level and the actual slope of the waves -the resulting signal response is no longer linear.

Irregular contact areas, even on a microscopic scale, cause an inconsistent flow of charge carriers and generate inhomogeneous electromagnetic fields. Dissimilar expansion coefficients of tower and feed lines can expose system connectors to significant mechanical forces. Dissimilar expansion coefficients of tower and feed lines can expose system connectors to significant mechanical forces, which often results in shifted contacts or worse, damaged contact areas.

Spark discharges caused by accidental "hot" connection / disconnection of components result in a combination of negative effects: Craters in the surface, and chemical transformation of contact plating and alloys.



Spectrum with harmonics caused through passive intermodulation effects.

Components that can cause PIM

- Connectors
- Jumper cables
- Splitters
- Hybrids
- Filters
- Antennas
- DC blocks
- Lightning Arrestors

Causes of PIM

- Dissimilar metals
- Ferromagnetic metals (nickel, steel, iron)
- Corrosion of passive components in the RF path
- Irregular contact areas
- Mechanical damage
- Resistive Components
- Poorly designed components

Specifications

Transmitter Specification

Carrier Power Adjustable Level	+20 to + 44 dBm
Carrier Power Resolution / Accuracy	0.25 dB / ±0.35 dB
Frequency Range	see version table
Frequency Increment	200 kHz
Frequency Accuracy (typical)	2 ppm
Frequency Tuning Lock Time (typical)	1 ms
Reverse Power Protection (Include ON/OFF Function)	43 dBm / 5 sec

Receiver Specifications

Reverse IM	-132 dBm / -175 dBc
Average Noise Floor	-138 dBm (1.2 k filter)
Dynamic Range (typical)	96 dB (reference -90 dBm)
Measurement Interval	100 to 350 ms
Effective IF Bandwidth (operator selectable)	300 Hz, 600 Hz, 1.2k, 2.4k, 5k, 10k, 12k, 15k, 25k, 50kHz
Operational Input Power	-45 dBm RMS
Input Power without damage	-10 dBm max
Warm-Up Time for specified accuracy	5 minutes accuracy
PIM Measurement Accuracy	±2 dB for 2 x 43 dBm

System Specifications

RF Connector	DIN 7/16″
User Interface Display	7″ TFT with touch screen display
IM Measurement Alarms	Audio / visual
Operating Voltage	90 to 264 V (50-60 Hz)
Power requirements	750 VA max

Environmental

Operating Temperature	0° to 45°C / 32° to 113°F
Humidity (non-condensing)	85% RH
Max Altitude	2000 Meters / 6560 Feet

Dimensions (W/D/H)	Weight
All types except F02 & F07UL	
396 x 521 x 236 (mm) 15.6 x 20.5 x 9.3 (inches)	23.8 kg / 52.3 lb
PIM31-F02	
396 x 602 x 236 (mm) 15.6 x 23.7 x 9.3 (inches)	25.3 kg / 55.7 lb
PIM31-F07UL	
390 x 586 x 276 (mm) 15.3 x 23.8 x 10.9 (inches)	31 kg / 68.3 lb

Ordering information

Model Number	TX Band	RX Band	Technology
PIM31-F01	869-896 MHz	824-851 MHz	CDMA(850)
PIM31-F02	925-960 MHz	880-915 MHz	E-GSM(900)
PIM31-F03	1805-1880 MHz	1710-1785 MHz	DCS(1800)
PIM31-F04	1930-1990 MHz	1850-1910 MHz	PCS(1900)
PIM31-F05	2110-2170 MHz	1920-2060 MHz	UMTS/WCDMA(2100)
PIM31-F06	935-960 MHz	890-915 MHz	GSM(900)
PIM31-F07U	730-759 MHz	776-788 MHz	LTE-US(700-U)
PIM31-F07L	730-759 MHz	698-716 MHz	LTE-US(700-L)
PIM31-F07UL	730-759 MHz	776-788 MHz	LTE-US(700-UL)
	730-759 MHz	698-716 MHz	
PIM31-F08	2010-2025 MHz	1900-1920 MHz	TD-SCDMA(2000)
PIM31-F09	2110-2155 MHz	1710-1755 MHz	AWS
PIM31-F10	2620-2690 MHz	2500-2570 MHz	IMT-E(2600)

Other frequencies on request

Adapters & Accessories Supplied

- DIN 7/16 Male to Female Connector Saver
- Low PIM Cable, DIN 7/16, Male to Male, 3 meters / 10 feet
- 50W Load (PIM -160 dBc typical)*
- Optical Mouse
- Roll-up Keyboard
- Operating manual

* Loads with lower PIM available. Please contact factory or Boonton / WTG representative.

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Note: Specifications, terms and conditions are subject to change without prior notice.