Introduction
Rosenberger Hochfrequenztechnik GmbH&Co. was founded in Germany in 1958 and ranks among the leading manufacturers of high-speed interconnect solutions worldwide. To serve the continuous growth and demand of the global market, Rosenberger Asia Pacific Electronic Co., Ltd. was established in China in 1997. With its long tradition of excellence and providing creative solutions, Rosenberger Asia Pacific has excelled and earned an outstanding reputation in the Asia Pacific region.

Rosenberger Asia Pacific provides products and solutions for Telecommunication, Automotive Electronics, Information Technology, Test & Measurement, Aviation, and Medical & Industries. Their product portfolio includes:

- RF In-Cabinet Connection Solutions
- Total Site Solutions for Base Station Applications
- In-Building Wireless Solutions and Enhancement
- Microwave Transmission Systems
- Passive Intermodulation Analyzers
- FTTX
- Data Center Cabling Systems

A sales network covering the entire Asia Pacific region generates an annual turnover close to 200 million USD. Reliability and competitiveness are the cornerstones of this sustainable growth, resulting in long term partnerships with most of the leading companies in their respective industries.

Rosenberger Asia Pacific maintains 6 modern manufacturing and R&D base locations in Beijing, Shanghai, and Dongguan in China; and New Delhi in India, the largest of its kind in the Asia Pacific Region. Rosenberger Asia Pacific is an ISO 9001 quality system, ISO 14001 environmental system, and ISO/TS16949 automotive industry system certified company. Equipped with advanced machining, electronic plating, assembly and testing centers and staffed by a large group of more than 200 R&D engineers, Rosenberger Asia Pacific has developed first class production assembly lines and exercises stringent product and quality control.

Presently, Rosenberger Asia Pacific maintains a far reaching network of R&D, Production, Sales and Service which extends to the whole Asia Pacific and Middle East area. For over 50 years Rosenberger has established its brand all over the world. In the future, Rosenberger Asia Pacific will continue to provide excellent product solutions and services for its customers in the entire region.
Intermodulation Definition
Intermodulation occurs when two or more signals mix due to non-linearities within a system and create undesired mixing products in other frequencies. In a communication system, signals deployed in a given channel may cause interference with adjacent channels.

Consider an input signal containing 2 frequencies. The intermodulation is as follows:

\[ f_{IM} = mf_1 \pm nf_2 \]

\( f_1 \) and \( f_2 \) are carrier frequency

\( f_{IM} \) is intermodulation frequency

\( m+n \) is the order of \( f_{IM} \). For example, when \( f_{IM} = 2f_1 - f_2 \), \( f \) is called 3rd order intermodulation frequency. Generally, the 3rd, 5th, 7th, 9th order intermodulation terms are considered. Specifically the 3rd order intermodulation signal is the highest and represents the worst-case of unwanted signals as they are closest to the carrier and can fall within the receive band. A passive Intermodulation (PIM) is defined as a non-linearity that is typically produced in passive elements, such as Cables, Connectors, Combiners, and Filters.

Intermodulation levels are normally specified in terms of dBm or dBc. For example, +43 dBm (20 Watts) is a typical input power level specified for device under test (DUT) for PIM. If the system limit for PIM is defined as -115 dBm, then the PIM test specification is -158 dBc ( -115 – 43)

IEC-62037 is an international standard for RF connectors, cable assemblies and cable intermodulation level measurements. It defines the intermodulation level, test conditions, and procedure. In IEC standard chapter 6, it requires the residual intermodulation of the PIM tester to be 10dB below the specified value of DUT. In the example above, the residual intermodulation of the PIM tester should be better than -168dBc, otherwise, the analyzer does not have adequate sensitivity to accurately measure PIM.
Mobile telecommunication systems have advanced significantly in recent years. Due to frequency planning, power levels, multi-carrier transmitters, and improved receiver sensitivity, Passive Intermodulation (PIM) has become a challenging problem for mobile operators. PIMs can generate interference which reduces the performance of the base station, affects capacity/coverage, and quality of service.

Rosenberger’s Multi-function Site Passive Intermodulation Analyzer integrates PIM testing, Precise PIM Location, VSWR testing, spectrum analysis and isolation testing. The portable all-in-one design is an effective tool for fast network fault diagnosis and interference location during field testing.

Especially designed for PIM testing at cell sites, Multi-function Site PIA is installed in a rugged, water-proof case (551×358×226mm). It is easily transportable to the base-station site to do field test.

Main Features

- PIM measurement
- Precision PIM locator
- VSWR & return loss measurement under high RF power
- VSWR locator
- Spectrum analyzer
- Isolation measurement
- 2nd order PIM test
- Touch screen interface, simple to operation
- 18~20 kg light-weight
- Water-proof carrying case
Application Scenarios

As for mobile telecommunication system, interference has become a challenging problem for both network operators and equipment vendors. There are many deployments of both indoor and outdoor systems resulting in interference and degradation of the overall network. In order to solve these problems, network optimization engineers have to take multiple test equipments for site surveys, field tests and analysis.

Now, Rosenberger provides a strong on-site testing instrument -- Multi-function Site Passive Intermodulation Analyzer. It combines functions of PIM testing, Precision PIM Locator, Spectrum analyzer, VSWR measurement and isolation testing. And it is specifically designed for portability to be transported to the cell sites for interference positioning and fault diagnosis. With high level integration, light-weight carry-on size, simple operation, high accuracy and high reliability, it is an ideal test instrument for network optimization.

General Specification

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Display</td>
<td>12” touch screen</td>
</tr>
<tr>
<td>Dimensions</td>
<td>551×358×226mm with carry handle</td>
</tr>
<tr>
<td>Weight</td>
<td>18~20Kg</td>
</tr>
<tr>
<td>RF Ports</td>
<td>1×N(F), 1×DIN(F)</td>
</tr>
<tr>
<td>User Interface Ports</td>
<td>3×USB</td>
</tr>
<tr>
<td>Power Supply</td>
<td>AC110-220V±10%, 50Hz, 350W</td>
</tr>
<tr>
<td>Operating Temperature Range</td>
<td>0°C ~ +50°C</td>
</tr>
<tr>
<td>Storage Temperature Range</td>
<td>-10°C ~ +50°C</td>
</tr>
<tr>
<td>Carrier Power Adjustable Level</td>
<td>+20 ~ +46dBm</td>
</tr>
<tr>
<td>Water-proof Enclosure</td>
<td>IP67</td>
</tr>
<tr>
<td>Mechanical Shock</td>
<td>40G</td>
</tr>
</tbody>
</table>
Precision PIM Locator

By using advanced STDR technology, Precision PIM Locator (PPL) can compare the measured PIM signal with a internal reference PIM signal and precisely work out the distance to the fault.

One of network optimization steps is to find the internal interference of network. It may take the network optimization engineers a lot of time to troubleshoot and identify the fault location. The in-building systems contain plenty of combiners, splitters, couplers, filters, antennas and other passive components, and combine with different systems of 2G, 3G, 4G or WLAN. The traditional troubleshooting method is segmentation measurement, which measures different passive components one by one from base-station output port to antenna at the end, so fault diagnosis and its elimination are very difficult and time-consuming.

Multi-function PIA is an effective, powerful and high-performance tool for network optimization. First, with connection to the network, the PPL function can easily and quickly calculate the distance between the test port and the poor PIM source in network. Then cross-referencing this information with the construction drawings, the PIM locations can be identified quickly and easily, thereby reducing work, cost, time.

PIM Measurement

Multi-function Site PIM analyzer provides a function of testing 3rd, 5th, 7th, 9th order passive intermodulation distortions under 2-tone measurement and sweep measurement mode. Complying with IEC 62037 (IEC SC 46 D. WG6) testing standard, it can accurately measure the signal level of PIM and help to analyze the cause and improve network performance.

<table>
<thead>
<tr>
<th>IM Order</th>
<th>3rd, 5th, 7th, 9th, 11th</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residual IM-level</td>
<td>&lt; -168dBc</td>
</tr>
<tr>
<td>Carrier Power Range</td>
<td>+20 ~ +46dBm</td>
</tr>
<tr>
<td>Carrier Power Accuracy</td>
<td>±0.35dB</td>
</tr>
<tr>
<td>Frequency Accuracy</td>
<td>± 4ppm</td>
</tr>
<tr>
<td>Receive Frequency Range</td>
<td>100KHz ~3.6GHz</td>
</tr>
<tr>
<td>Average Noise Floor</td>
<td>-135dBm</td>
</tr>
<tr>
<td>Carrier Power Adjustable Level</td>
<td>+20 ~ +46dBm</td>
</tr>
</tbody>
</table>

**PIM Locator Display**

- Numeric: maximum PIM magnitude and distance
- Graphical: multiple PIM vs distance

**Accuracy** ± 0.5m

**Zero Meter Offset** support
2\textsuperscript{nd} Order PIM Test

When two or more signals of different frequencies are mixed together in a passive component, e.g. antenna, cable, connector or splitter, it not only produces 3\textsuperscript{rd}, 5\textsuperscript{th}, 7\textsuperscript{th}, 9\textsuperscript{th} order PIM distortion, but also creates 2\textsuperscript{nd}, 4\textsuperscript{th}, 6\textsuperscript{th}, 8\textsuperscript{th} Order PIM distortion. Although these even order PIM terms do not fall within its own RX band, they may interfere in other frequency bands.

For example, when \( f_{IM} = f_1 + f_2 \), \( f_{IM} \) is called 2\textsuperscript{nd} order intermodulation frequency. Multi-function PIA can verify the amplitude and order PIM.

### Desired Signal

- Intermodulation
- Intermodulation & Harmonic

<table>
<thead>
<tr>
<th>IM Order</th>
<th>2\textsuperscript{nd}, 4\textsuperscript{th}, 6\textsuperscript{th}, 8\textsuperscript{th}</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residual IM-level (2x43dBm, S/N = 10dB)</td>
<td>&lt; -155dBc</td>
</tr>
<tr>
<td>TX band</td>
<td>AMPS, EGSM</td>
</tr>
<tr>
<td>RX band</td>
<td>1710 – 2170MHz</td>
</tr>
<tr>
<td>Carrier Power Range</td>
<td>+20 ~ +46dBm</td>
</tr>
</tbody>
</table>
Isolation Measurement
PIA can measure the isolation among the different ports of antennas or passive components to ensure adequate isolation between the ports at specific frequencies.

- Frequency: downlink frequency band
- Power: +20dBm
- Isolation: 0 – 100dB
- Resolution: 0.1dB

VSWR, Return Loss Measurement
The PIA can accurately and quickly measure VSWR/Return Loss of antenna and feeder system using higher power. It can quickly locate VSWR/Return Loss faults within the network.

- VSWR range: 1.05–20.00
- Return Loss: 1.00–33.00dB
- Resolution: 0.01 / 0.01dB
- VSWR Locator Display: Numeric: maximum VSWR magnitude and distance; Graphical: multiple VSWR vs distance
- Accuracy: ± 0.5m

Spectrum Analyzer
Spectrum Analyzer can analyze the wide-band spectrum so that it can measure the transmit carrier, the noise level and spurious emissions. It can also measure the spectrum of uplink frequency band with narrow RBW and low average noise level, so that it can accurately monitor the in-band interference generated by outside signals.

- Frequency Range: 100KHz ~ 3.6GHz (In-Band: uplink frequency band)
- Frequency Resolution: 1Hz
- Resolution Bandwidth: 100Hz ~ 1MHz RBW
- Noise Floor: -135 dBm DANL
- Frequency Uncertainty: ± 1 ppm
- Amplitude Accuracy: ± 1.0dB typ, ± 1.5dB max
- RF Input: +20dBm (100mW) max
- Sweep Time: 2s, full span; 1ms, zero span
- Attenuator: 0, 10, 20, or 30dB; internal

- Frequency Range: 100KHz ~ 3.6GHz
- In-Band: uplink frequency band
- Frequency Resolution: 1Hz
- Resolution Bandwidth: 100Hz ~ 1MHz RBW
- Noise Floor: -135 dBm DANL
- Frequency Uncertainty: ± 1 ppm
- Amplitude Accuracy: ± 1.0dB typ, ± 1.5dB max
- RF Input: +20dBm (100mW) max
- Sweep Time: 2s, full span; 1ms, zero span
- Attenuator: 0, 10, 20, or 30dB; internal

- VSWR range: 1.05–20.00
- Return Loss: 1.00–33.00dB
- Resolution: 0.01 / 0.01dB
- VSWR Locator Display: Numeric: maximum VSWR magnitude and distance; Graphical: multiple VSWR vs distance
- Accuracy: ± 0.5m

- Spectrum Analyzer can analyze the wide-band spectrum so that it can measure the transmit carrier, the noise level and spurious emissions. It can also measure the spectrum of uplink frequency band with narrow RBW and low average noise level, so that it can accurately monitor the in-band interference generated by outside signals.

- Frequency Range: 100KHz ~ 3.6GHz (In-Band: uplink frequency band)
- Frequency Resolution: 1Hz
- Resolution Bandwidth: 100Hz ~ 1MHz RBW
- Noise Floor: -135 dBm DANL
- Frequency Uncertainty: ± 1 ppm
- Amplitude Accuracy: ± 1.0dB typ, ± 1.5dB max
- RF Input: +20dBm (100mW) max
- Sweep Time: 2s, full span; 1ms, zero span
- Attenuator: 0, 10, 20, or 30dB; internal

- VSWR range: 1.05–20.00
- Return Loss: 1.00–33.00dB
- Resolution: 0.01 / 0.01dB
- VSWR Locator Display: Numeric: maximum VSWR magnitude and distance; Graphical: multiple VSWR vs distance
- Accuracy: ± 0.5m

- Spectrum Analyzer can analyze the wide-band spectrum so that it can measure the transmit carrier, the noise level and spurious emissions. It can also measure the spectrum of uplink frequency band with narrow RBW and low average noise level, so that it can accurately monitor the in-band interference generated by outside signals.

- Frequency Range: 100KHz ~ 3.6GHz (In-Band: uplink frequency band)
- Frequency Resolution: 1Hz
- Resolution Bandwidth: 100Hz ~ 1MHz RBW
- Noise Floor: -135 dBm DANL
- Frequency Uncertainty: ± 1 ppm
- Amplitude Accuracy: ± 1.0dB typ, ± 1.5dB max
- RF Input: +20dBm (100mW) max
- Sweep Time: 2s, full span; 1ms, zero span
- Attenuator: 0, 10, 20, or 30dB; internal

- VSWR range: 1.05–20.00
- Return Loss: 1.00–33.00dB
- Resolution: 0.01 / 0.01dB
- VSWR Locator Display: Numeric: maximum VSWR magnitude and distance; Graphical: multiple VSWR vs distance
- Accuracy: ± 0.5m

- Spectrum Analyzer can analyze the wide-band spectrum so that it can measure the transmit carrier, the noise level and spurious emissions. It can also measure the spectrum of uplink frequency band with narrow RBW and low average noise level, so that it can accurately monitor the in-band interference generated by outside signals.

- Frequency Range: 100KHz ~ 3.6GHz (In-Band: uplink frequency band)
- Frequency Resolution: 1Hz
- Resolution Bandwidth: 100Hz ~ 1MHz RBW
- Noise Floor: -135 dBm DANL
- Frequency Uncertainty: ± 1 ppm
- Amplitude Accuracy: ± 1.0dB typ, ± 1.5dB max
- RF Input: +20dBm (100mW) max
- Sweep Time: 2s, full span; 1ms, zero span
- Attenuator: 0, 10, 20, or 30dB; internal

- VSWR range: 1.05–20.00
- Return Loss: 1.00–33.00dB
- Resolution: 0.01 / 0.01dB
- VSWR Locator Display: Numeric: maximum VSWR magnitude and distance; Graphical: multiple VSWR vs distance
- Accuracy: ± 0.5m
Rack Types

PIA rack types from Rosenberger precisely determine the intermodulation characteristics of connectors, cable assemblies, antennas and other passive components. They are specially designed for manufacturing/production lines to measure the 3rd, 5th and 7th order intermodulation. These can also be applied in R&D, laboratory and calibration center.

Rack types have capability to measure “reverse” and/or “forward” PIM, which operate in LTE700, AMPS, EGSM, DCS, PCS, TD-SCDMA, UMTS II / LTE / BRS-EBS and WiMAX frequency bands.

Due to its RF “know-how” and extensive expertise, Rosenberger can provide excellent customer service and individual technical support. Rosenberger Passive Intermodulation Analyzers are customized according to specific requirements by modular sub-assemblies to reduce cost. Furthermore, Rosenberger provides technical support, product training, calibration as well as maintenance on site.
The portable PIA from Rosenberger has been designed to quickly and accurately measure the intermodulation characteristics of connectors, cable assemblies, antennas, filters, tower-mounted devices and other passive components – fast, effective, and accurate. The PIA can also be used for precise analysis of the RF infrastructure quality and performance of radio base station. The PIA operates in LTE 700, AMPS, EGSM, DCS, PCS, TD-SCDMA, UMTS II / LTE / BRS-EBS and WiMAX frequency bands. Delivered in a highly shock-proof, stable transport case, the portable Rosenberger PIA is pretty suitable for outdoor and field measurements, e.g. radio base stations, as well as for laboratory and manufacturing applications.

Bench-top Types

Bench-top types from Rosenberger are designed for use in production lines, longer test durations and high-strength measurements. One instrument supports one frequency band. This is time-saving and guarantees high test efficiency by not having to switch around different setups.

Bench-top types are available as “reverse” types or “reverse & forward” types, which operate in LTE700, AMPS, EGSM, DCS, PCS, TD-SCDMA, UMTS II / LTE / BRS-EBS and WiMAX frequency bands.

Portable Types

The portable PIA from Rosenberger has been designed to quickly and accurately measure the intermodulation characteristics of connectors, cable assemblies, antennas, filters, tower-mounted devices and other passive components – fast, effective, and accurate. The PIA can also be used for precise analysis of the RF infrastructure quality and performance of radio base station. The PIA operates in LTE 700, AMPS, EGSM, DCS, PCS, UMTS, UMTS II / LTE / BRS-EBS and WiMAX frequency bands. Delivered in a highly shock-proof, stable transport case, the portable Rosenberger PIA is pretty suitable for outdoor and field measurements, e.g. radio base stations, as well as for laboratory and manufacturing applications.

Applications

<table>
<thead>
<tr>
<th>Multi-Function Type</th>
<th>Portable Types</th>
<th>Bench-top Types</th>
<th>Rack Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>site installation</td>
<td>production-line</td>
<td>production-line</td>
<td>manufacturer</td>
</tr>
<tr>
<td>mobile operators</td>
<td>site installation</td>
<td></td>
<td>R &amp; D</td>
</tr>
<tr>
<td></td>
<td>mobile operators</td>
<td></td>
<td>laboratories</td>
</tr>
<tr>
<td></td>
<td>system integrators</td>
<td></td>
<td>calibration centers</td>
</tr>
</tbody>
</table>
## Mainframes

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
<th>TX</th>
<th>RX</th>
</tr>
</thead>
<tbody>
<tr>
<td>IM-207S</td>
<td>LTE700LU multi-function site PIA</td>
<td>728–768MHz</td>
<td>L: 698–716MHz</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>U: 776–786MHz</td>
</tr>
<tr>
<td>IM-208S</td>
<td>AMPS multi-function site PIA</td>
<td>869–894MHz</td>
<td>824–849MHz</td>
</tr>
<tr>
<td>IM-209S</td>
<td>EGSM multi-function site PIA</td>
<td>925–960MHz</td>
<td>880–915MHz</td>
</tr>
<tr>
<td>IM-218S</td>
<td>DCS multi-function site PIA</td>
<td>1805–1880MHz</td>
<td>1710–1785MHz</td>
</tr>
<tr>
<td>IM-219S</td>
<td>PCS multi-function site PIA</td>
<td>1930–1990MHz</td>
<td>1850–1910MHz</td>
</tr>
<tr>
<td>IM-221S</td>
<td>UMTS multi-function site PIA</td>
<td>2110–2170MHz</td>
<td>1920–2060MHz</td>
</tr>
<tr>
<td>IM-226S</td>
<td>LTE2600 multi-function site PIA</td>
<td>2620–2695MHz</td>
<td>2500–2580MHz</td>
</tr>
</tbody>
</table>
## Accessories

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>60Z150-020</td>
<td>Portable low PIM termination, 7/16 DIN male and 7/16 DIN female</td>
</tr>
<tr>
<td>60Z150-021</td>
<td>Portable low PIM termination, 7/16 DIN female</td>
</tr>
<tr>
<td>60Z150-022</td>
<td>Portable low PIM termination, 7/16 DIN male</td>
</tr>
<tr>
<td>60Z150-001</td>
<td>Rack type low PIM termination, 7/16 DIN female</td>
</tr>
<tr>
<td>60Z150-010</td>
<td>Low PIM termination, 7/16 DIN female</td>
</tr>
<tr>
<td>60S101-K50N1</td>
<td>Adapter 7/16 DIN male - 7/16 DIN female</td>
</tr>
<tr>
<td>60S101-S50N1</td>
<td>Adapter 7/16 DIN male-7/16 DIN male</td>
</tr>
<tr>
<td>60K101-K50N1</td>
<td>Adapter 7/16 DIN female-7/16 DIN female</td>
</tr>
<tr>
<td>60S153-K50N1</td>
<td>Adapter 7/16 DIN male - N female</td>
</tr>
<tr>
<td>53S160-K50N1</td>
<td>Adapter 7/16 DIN female - N male</td>
</tr>
<tr>
<td>53S160-S50N1</td>
<td>Adapter 7/16 DIN male - N male</td>
</tr>
<tr>
<td>53K101-K00N5</td>
<td>Adapter N female – N female</td>
</tr>
<tr>
<td>60S110-KxxN1</td>
<td>-110dBm standard adapter (xx: different frequency band number)</td>
</tr>
<tr>
<td>60S080-KxxN1</td>
<td>-80dBm Standard Adapter</td>
</tr>
<tr>
<td>L73-C014-1500</td>
<td>Low PIM test cable, 7/16 DIN male -7/16 DIN male, 1.5m</td>
</tr>
<tr>
<td>L73-C007-1500</td>
<td>Low PIM test cable, 7/16 DIN male – N male, 1.5m</td>
</tr>
<tr>
<td>L73-C011-1500</td>
<td>Low PIM test cable, N male - N male, 1.5m</td>
</tr>
<tr>
<td>Twrench-32</td>
<td>32# torque wrench (for 7/16 DIN)</td>
</tr>
<tr>
<td>Twrench-18</td>
<td>18# torque wrench (for N)</td>
</tr>
</tbody>
</table>
MULTI-FUNCTION SITE PASSIVE
INTERMODULATION ANALYZER