Rosenberger

Passive Intermodulation Analyzers

PIM Test Solutions for All Applications

COMMUNICATION

Rosenberger Group

Rosenberger is one of the worldwide leading suppliers of controlled impedance and optical connectivity solutions, system components for mobile communications networks, data centers and test & measurement as well as high voltage contact systems.

Contents

Our Rosenberger online catalog contains the current standard product range with specific details, including data sheets, assembly instructions and panel piercings.

www.rosenberger.com/ok/pim

Competencies & Technology

Rosenberger's mission is to be recognized as an innovation and technology leader within its business segments. The most modern manufacturing technologies, the highest possible levels of efficiency in production and continuous development are our core competencies guaranteeing not only fast delivery and strict adherence to delivery dates, but also the highest levels in product quality.

Quality and the Environment

Ensuring the optimum quality of products and services and taking responsibility for our environment are fundamental elements of Rosenberger's corporate philosophy.

Our approach to ensuring quality covers more than just the optimization of parts and products – it also includes the continuous improvement of all company processes: from product development, planning, procurement, production, sales, and logistics right through to environmental policy.

To summarize, we want to offer maximum benefits for our customers all over the world.

We aim to act in an environmentally conscious manner, use materials economically, protect natural resources, recycle, and ensure energy efficiency.

As we have continuously improved our processes and consistently applied our quality management systems, we have been awarded many certificates.

Certifications

- IATF 16949
- DIN EN 9100
- ISO 9001
- ISO 14001
- DaKKs accreditation according to DIN EN ISO 17025

Rosenberger has won a number of prestigious quality awards and prizes from several renowned customers and organizations for achieving its quality and environmental objectives.

PIM Test Solutions for all Applications

High-speed data transmission in today's global mobile communications networks demands high efficiency of network infrastructure. Passive Intermodulation (PIM) in a network can cause serious interferences and significantly degrade the network quality and impact KPI figures.

The cause of Passive Intermodulation is very complex and uncertain. It can be caused by low-grade transmission line components or even loose connectors, dirty surfaces, magnetic materials or the surrounding environment like a rusty roof. As a global leader of RF connectivity solutions, Rosenberger has a strong expertise in manufacturing low-PIM components as well as PIM T&M solutions for all applications:

- R&D / Test Lab
- Production Environment
- Site Testing

Passive Intermodulation

Passive Intermodulation is a non-linear response of two or more signals of different frequencies mixing together in a passive device, e.g. antenna, cable, connector or splitter. Today, PIM has become a very serious and challenging task for mobile operators, equipment vendors and component manufacturers due to frequency planning in modern communication networks, the usage of high-power transmitters and more sensitive receivers in base stations. If a PIM with sufficient magnitude generated from a transmitter falls within an adjacent receiver channel, it causes serious interferences to the base station receiver and will significantly degrade the network quality of service.

The cause of PIM is very complex and uncertain. Even dirty surfaces, poor soldering, and loose connections will cause serious intermodulation. Hence, in theory, it cannot be calculated nor be simulated by software. To verify the PIM and look for the root cause, specific test instruments are required.

Passive Intermodulation Analyzers

Passive Intermodulation Analyzers are professional measurement instruments which are characterized by very low self intermodulation and high power level signal output. Their high accuracy receiver allows fast and precise measurements of the 3rd, 5th and 7th order intermodulation of passive devices under high-power conditions, e.g. connectors, cable assemblies, antennas, filters and other passive components.

Definition of Intermodulation

Passive Intermodulation

Intermodulation occurs when two or more signals mix on a non-linear device and create undesired output at other frequencies.

In a communications system, this means that signals in one channel may cause interference with adjacent channels.

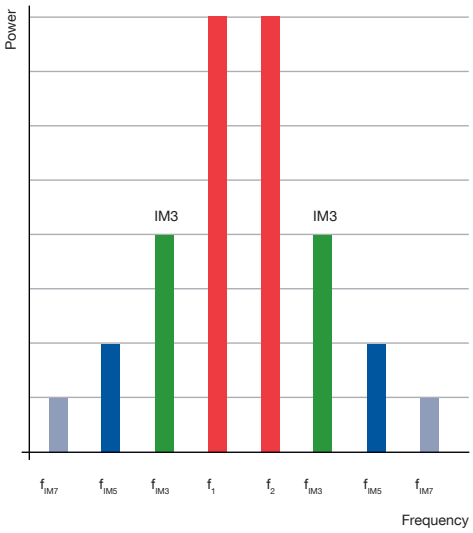
Considering that an input signal contains two frequencies, intermodulation can be indicated as follows:

$f_{IM} = mf_1 \pm nf_2$

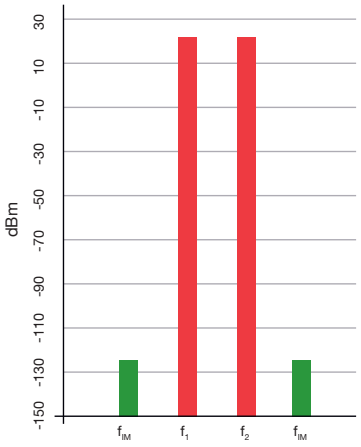
f_1 and f_2 are carrier frequencies

f_{IM} is the intermodulation frequency

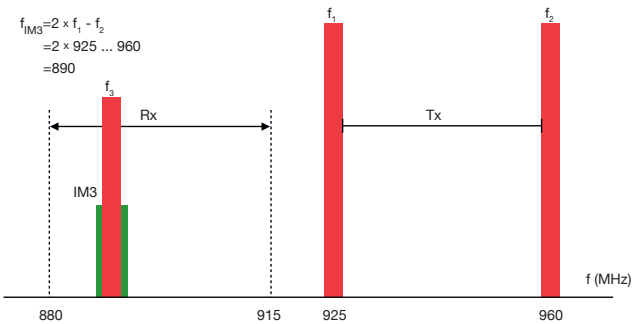
m + n is the order of f_{IM}. For example, when $f_{IM} = 2f_1 - f_2$, f_{IM} is called the 3rd order intermodulation frequency. Commonly, the 3rd, 5th and 7th order intermodulation signals will be considered. The 3rd order intermodulation signal always represents the worst case condition of unwanted signals generated since it is closest to the carriers and has the highest amplitude.



Intermodulation is normally specified in terms of dBm or dBc. For example, +43 dBm (20 Watt) is a typical input power level specified for device under test (DUT). If the allowable intermodulation level for DUT is required to be -117 dBm, thus the specification is -117-43 = -160 dBc.



IEC-62037 is an international standard for RF connectors, cable assemblies and cable intermodulation level measurement. It defines the intermodulation level, test principle and test procedure. In IEC standard chapter 6, it requires that the residual intermodulation of an analyzer should be at least 10 dB below the specified value of DUT. In the above example, the residual intermodulation of the analyzer should be less than -170 dBc. The lower the self-intermodulation, the more accurate the test results obtained.



Continuous Wave (CW) PIM Site Testing

A whole new approach of battery powered PIM testing delivers mobile operators unprecedented distance-to-PIM accuracy.

Rosenberger's CW PIM methodology represents the most precise approach as opposed to conventional PIM testing products based on the pulse method. Unlike pulse testing CW ensures there are no gaps with continuous power which simulates the conditions a Base Transceiver Station (BTS) experiences during actual operation.

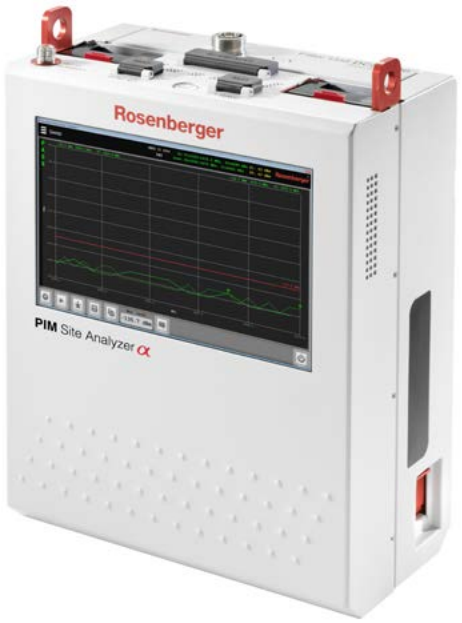
This comprehensive and highly accurate solution for PIM discovery comes at a time when testing for PIM is increasingly critical to mobile operators and equipment manufacturers looking to maximize the performance and reliability of cellular network infrastructures. Rising competition and the imminent arrival of 5G services combined with ageing network infrastructure, cell tower co-location and higher than ever user QoS expectations, risk exposing network PIM vulnerabilities on an unprecedented scale.

Operators and manufacturers are already well aware of the negative impact of PIM so we are delighted to offer a much more accurate PIM Site Analyzer, allowing them to achieve and maintain ultra-low PIM levels. While pulse-based PIM testing has been the traditional approach it is not reliable enough for comprehensive detection of all potential failures – including the quality of components and workmanship.

Our own research has found that pulse test equipment has the potential of leaving many errors to go unnoticed. The system under test must be consistently loaded with sufficient power of at least 2 x 20 W to replicate the same conditions the BTS experiences when in operation. This is when component behaviour will likely change and can become unstable. The inherent design of pulse-reliant test equipment makes reaching and sustaining these power loads impossible.

Site Testing

Broadband. Precise. Future-proof.



The Rosenberger portable and multifunctional broadband PIM Site Analyzer α provides the best alternative of performing the most precise and efficient PIM tests on site.

Site Testing

The PIM Site Analyzer α consists of a single master unit with band-specific, interchangeable filter units, since the form factor of the filter units is the same.

Take out one filter unit, e.g., 900 MHz, and replace with another filter unit, e.g., 1800 MHz, without any calibration of the filter unit, potential adaptors, test cable, or operational mode(s). Future-proof plug and play concept covering 700 to 2700 MHz.

Benefits

- Broadband base unit 700 to 2700 MHz with field interchangeable, band-specific filter units
- Stressed PIM tests – continuous wave (CW) signal simulates real operating conditions of the base station (in conformity with IEC 62037-1)
- Outstanding PIM performance < -125 dBm (< -130 dBm typical)
- No on-site calibration
- Accuracy of < 0.3 m for PIM distance to fault (DTF) measurement
- Future-proof for upcoming bands
- Hardware ready for later CPRI SW upgrade

Features

- Optional broadband VSWR/RL module incl. DTF measurement (error correction with open/short/match)
- In-built WiFi for remote control via optional Android tablet
- Operation via batteries or external power supply
- VSWR/return loss measurements
- Antenna isolation measurement
- Integrated spectrum analyzer
- 12" touchscreen
- Intuitive software operation
- Exchangeable test port adaptors (7-16 and 4.3-10)

Wide range of tools & accessories

Fast and easy interchangeable band filter units

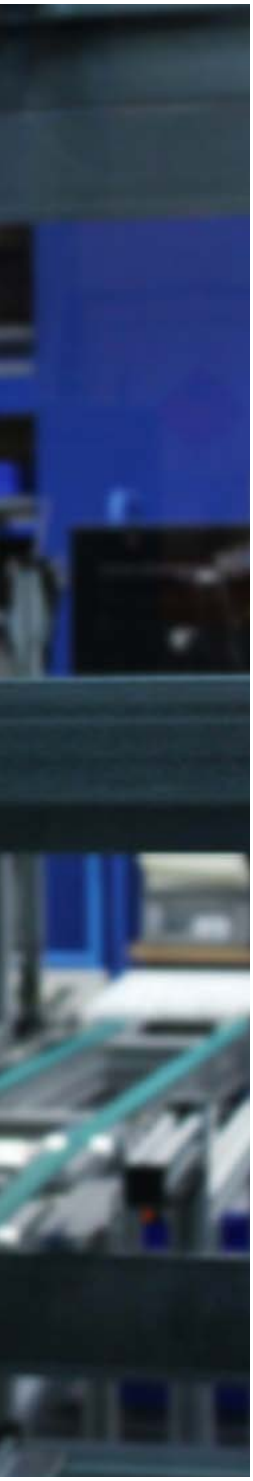
Specification Overview

IM order	3rd, 5th, 7th, 9th, 11th, 13th, 15th, 17th
Output power at test port	23 ... 46 dBm
Residual PIM	< -125 dBm (< -168 dBc @ 2 x +43 dBm) typical < -173 dBc
PIM and RL/VSWR vs. distance accuracy resolution	< 0.3 m depends on number of PIM sources and accuracy of cable velocity factor
DTF range	Down to -120 dBm PIM, 0 to 150 m
Frequency range (seamless)	700 ... 2700 MHz
Filter units*	Interchangeable to frequency band(s) 700, 800, 850, 900, 1400, 1800, 1900, 2100, 2300, 2600 MHz

* Other frequency bands on request

Testing in Production Environment

Exceptionally modular. Precise. Efficient.



Basic line

Multifunctional line

Rosenberger Rack Analyzers are designed to make PIM tests in production or test lab environments exceptionally modular, precise, and efficient.

Testing in Production Environment

The budget-friendly broadband base unit concept offers maximum flexibility thanks to the option of connecting up to 11 filter units to one base unit. Integrated DTF measurement enables faster fault-finding by accurately pointing out the source of PIM.

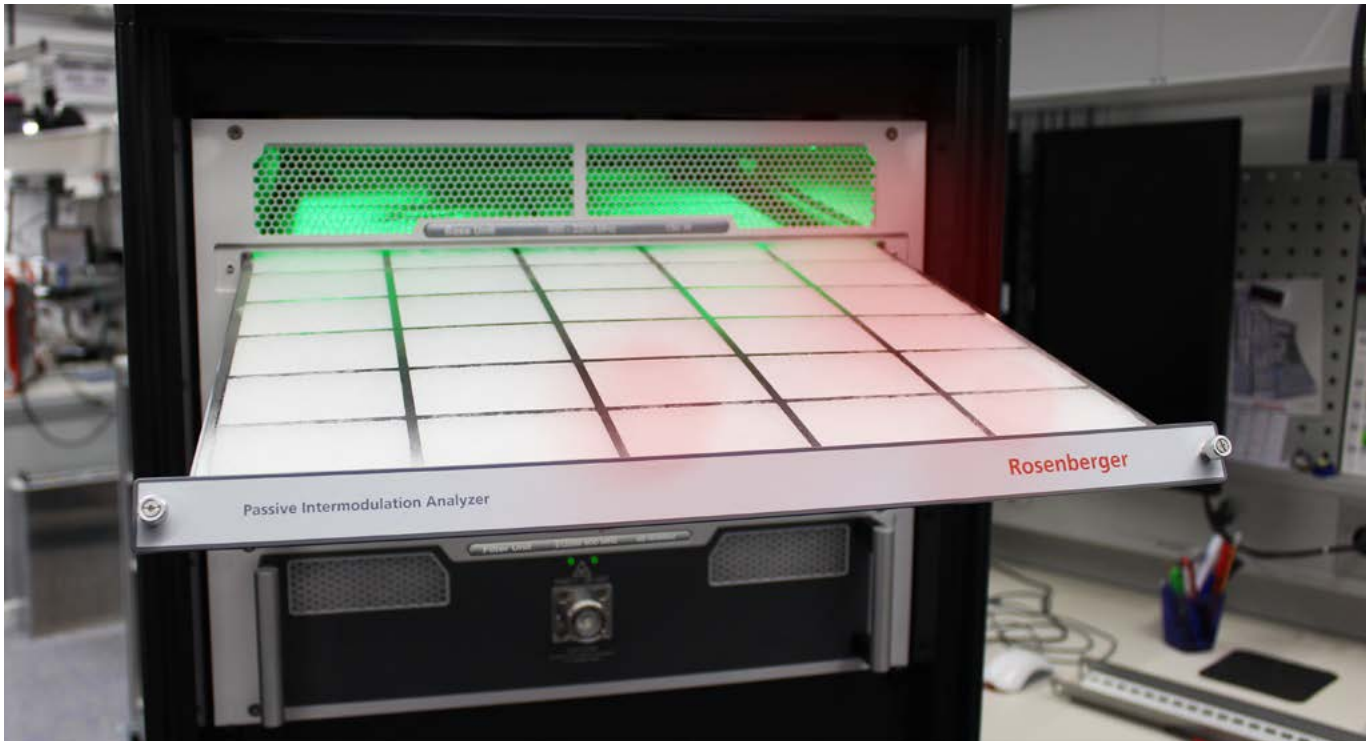
With the plug-and-play filter concept, intuitive software operation, and easy-to-replace dust filters, it is possible to create a significant reduction in production downtime caused by changes in test frequencies or maintenance and servicing work.

Benefits

- Broadband base units 700 to 2200 MHz and 2100 to 2700 MHz
- Connect up to 6/11 filters to one base unit via optional easy-to-install switch matrix
- Time-efficient, automatic band switching when measurement band is changed (thanks to the optional switch matrix)
- Designed for 24/7 production use

Features

- Intuitive, user friendly software operation
- Easy-to-replace dust filters to reduce downtime caused by maintenance work
- No production downtime when setup is rearranged (plug-and-play filter inserts)
- 9" touchscreen, Win7 OS
- Temperature controlled fan for quiet operation
- Optional safety port to remote disable amplifiers from test chamber contact
- Exchangeable test port adaptors (7-16 and 4.3-10)



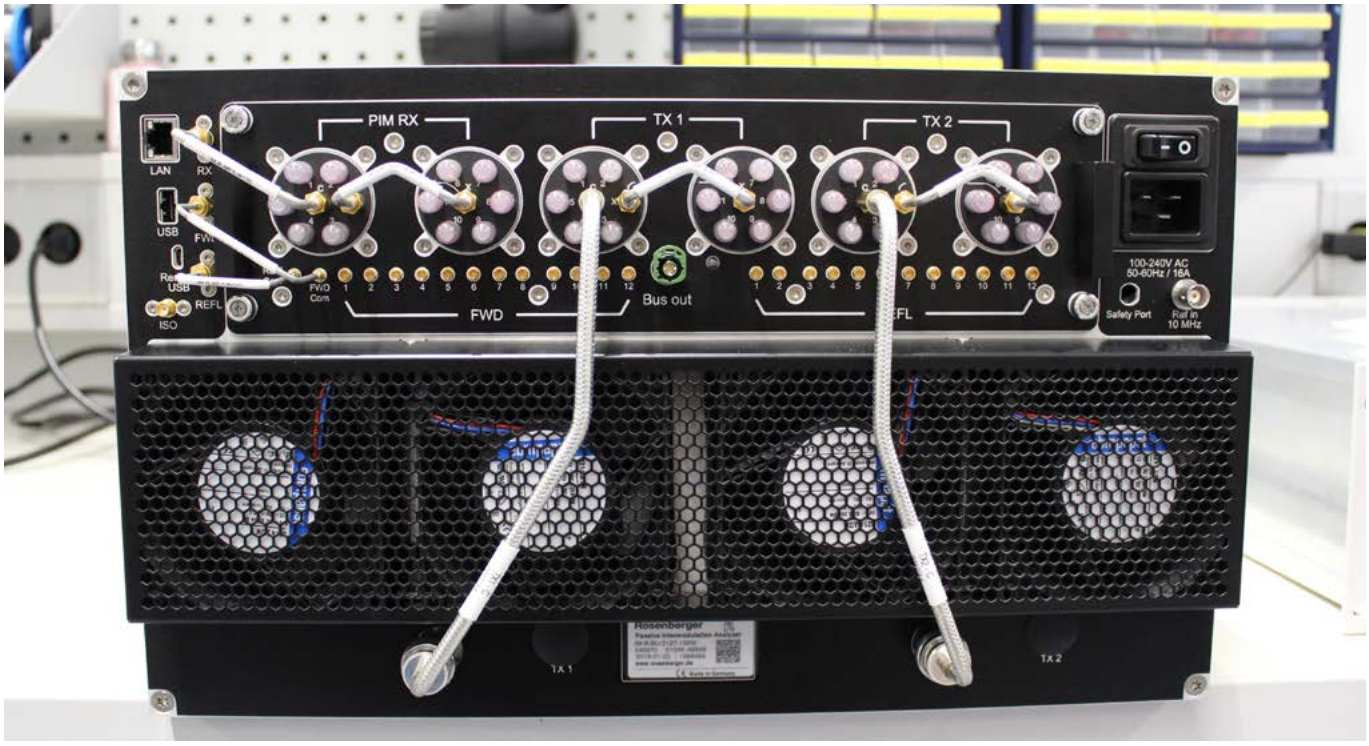
Easy-to-replace dust filters

Rosenberger provides 2 lines of rack models

	Basic Line	Multifunction Line
Application range	Robust and field proven design for standard applications	Exceptionally modular multifunction equipment, easy handling and maintenance
Frequency range	300 ... 500, 600 ... 2200, 2100 ... 2700, 3400 ... 3600 MHz	700 ... 2200, 2100 ... 2700 MHz (600 ... 3500 MHz on request)
DTF	–	Integrated in base unit (no separate module needed)
Dust/cleaning	Part of recommended annual calibration service	Easy-to-replace dust filters in base unit and filter units
Features	2-tone, sweep	2-tone, sweep, DTF, spectrum analyzer, VSWR/ return loss, power sweep, isolation measurement, CPRI option

Specification Overview

	Basic Line	Multifunction Line
IM order	3rd, 5th, 7th, 9th, 11th, 13th, 15th, 17th	3rd, 5th, 7th, 9th, 11th, 13th, 15th, 17th
Output power at test port (filter unit)	2 x 36 ... 46 dBm	2 x 23 ... 46 dBm
Residual PIM	< -128 dBm (< -171 dBc @ 2 x +43 dBm) < -131 dBm (< -174 dBc @ 2 x +43 dBm) typical	< -128 dBm (< -171 dBc @ 2 x +43 dBm) < -131 dBm (< -174 dBc @ 2 x +43 dBm) typical
PIM and RL/VSWR vs. distance accuracy resolution	–	< 0.3 m, all bands – depends on number of PIM sources
Range	–	Down to -120 dBm PIM, 0 to 150 m



Easy-to-install switch matrix

Multiport Analyzer

Time saving during measurement – less screwing of the cables.

The Multiport Analyzer can help to significantly reduce PIM test time in production lines. Due to the multiport capabilities, up to 4 (optionally: 8) ports in same frequency can be tested sequentially.

Multiport Analyzer

The Rosenberger multiport PIA (Passive Intermodulation Analyzer) provides an easy way to precisely determine the intermodulation characteristics of

- Antenna
- Transmission line
- Connector
- Jumper
- Filter and combiner
- Splitter
- Other passive components

in all LTE 600, LTE 700, LTE 2600, AMPS, Dig.Div., EGSM, DCS, PCS, WiMAX and UMTS frequency range.

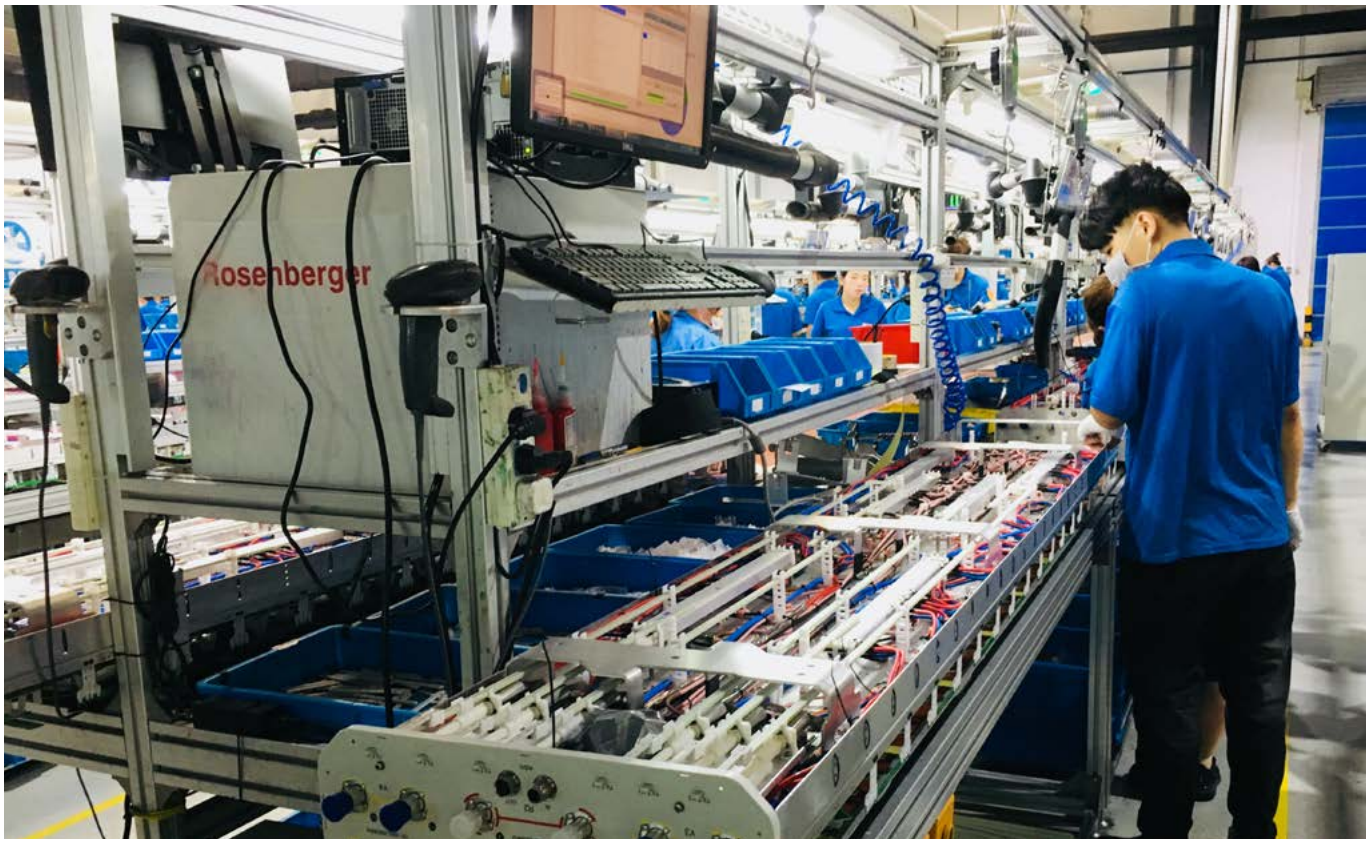
This Analyzer is designed for the use in production lines to measure the reversed 3^{rd}, 5^{th}, 7^{th}, 9^{th}, 11^{th}, 15^{th} and 17^{th} order intermodulation products. The control unit of the Analyzer is equipped with a system controller, high-power amplifiers and a receiver. The Analyzer is controlled by the supported remote software.

The test setup complies with the test methods suggested by proposal paper IEC 62037-1.

Specification Overview

IM order	3^{rd}, 5^{th}, 7^{th}, 9^{th}, 11^{th}, 13^{th}, 15^{th}, 17^{th}
Output power at test port (filter unit)	2 x 36 ... 46 dBm
Residual PIM	< 128 dBm (< -171 dBc @ 2 x +43 dBm) < 131 dBm (< -174 dBc @ 2 x +43 dBm) typical
Control	by remote software via external PC (USB)
Exchangeable test port adaptors	7-16 and 4.3-10

Setup for 8-port measurement



Test Lab and Product Design Environment

Portable. Flexible. Budget friendly.

Basic line

Multifunction line

Rosenberger desktop analyzers are portable and flexible for R&D and test labs.

Test Lab and Product Design Environment

The budget friendly broadband base unit concept offers maximum flexibility to include another extension filter to a base unit (basic line) or add any other filter unit in the range of 700 to 2700 MHz to the base unit (multifunction line).

It allows continuous flexibility in an ever changing environment.

Benefits

- Reduction of T&M investment cost (for multiband-testing)
- High flexibility/portability in test environment

Features

- Basic line: 1 additional filter unit can be added*
- Single band units for band specific testing
- Outstanding dynamic residual IM-Level < -171 dBc (2 x +43 dBm), typical -174 dBc
- Fast & efficient PIM testing

*698 to 1000MHz: one base model 700, 800, 850, 900 MHz can have one additional filter from any other of these frequency bands
1800 to 2100 MHz: one base model 1800, 1900, 2100MHz can have one additional filter from any other of these frequency bands

Rosenberger provides 2 lines of desktop models

	Basic Line	**Multifunction Line**
Application range	Portability and flexibility in production line, R&D and test labs	Multifunction desktop base unit with plug and play exchangeable filter units supports various types of measurements in production environment, R&D and test labs
Frequency range	300 ... 400, 600 ... 1000, 1400 ... 1500, 1800 ... 2200, 2500 ... 2700, 3400 ... 3600 MHz	700 ... 2700 MHz (600 ... 3500 MHz on request)
DTF	–	Integrated in base unit (no separate module needed)
Features	2-tone, sweep	2-tone, sweep, DTF, spectrum analyzer, VSWR/ return loss, power sweep, isolation measurement, CPRI option, in-built WiFi for remote control via optional Android tablet, 12" touchscreen, intuitive software operation, exchangeable test port adaptors (7-16 and 4.3-10)

Specification Overview

	Basic Line	**Multifunction Line**
IM order	3^{rd}, 5^{th}, 7^{th}, 9^{th}, 11^{th}, 13^{th}, 15^{th}, 17^{th}	3^{rd}, 5^{th}, 7^{th}, 9^{th}, 11^{th}, 13^{th}, 15^{th}, 17^{th}
Output power at test port	36 ... 46 dBm	23 ... 46 dBm
Residual PIM	< -128 dBm (< -171 dBc @ 2 x +43 dBm) < -131 dBm (< -174 dBc @ 2 x +43 dBm) typical	< -128 dBm (< -171 dBc @ 2 x +43 dBm) < -131 dBm (< -174 dBc @ 2 x +43 dBm) typical
PIM and RL/VSWR vs. distance accuracy resolution	–	< 0.3 m, all bands – depends on number of PIM sources
Range	–	Down to -120 dBm PIM, 0 ... 150 m

Frequency Bands

Band	Band No.	f_1 (MHz)*, DL	f_2 (MHz)*, DL	RX (MHz), UL
Tetra 390		390 … 400	390 … 400	380 … 385
Tetra 392		392 … 400	392 … 400	380 … 388
Tetra 422		422 … 430	422 … 430	410 … 418
Tetra 462		462 … 470	462 … 470	450 … 458
LTE 600	B71	617 … 652	617 … 652	663 … 698
LTE 700	for max. RX PIM	745 … 793	745 … 793	698 … 730
LTE 700LU	B12, B13, B14 and B17	728 … 764	728 … 764	698 … 716/ 776 … 798
APT700	B28	758 … 803	758 … 803	703 … 748
Dig.Div	B20	791 … 821	791 … 821	832 … 862
AMPS	B5	869 … 894	869 … 894	824 … 849
EGSM	B8	925 … 960	925 … 960	880 … 915
EGSM-R		921 … 960	921 … 960	876 … 915
LTE 1400	B11 and B21	1475,9 … 1510,9	1475,9 … 1510,9	1427,9 … 1462,9
DCS	B3	1805 … 1880	1805 … 1880	1710 … 1785
PCS	B2	1930 … 1990	1930 … 1990	1850 … 1910
PCS and AWS	B2 and B4	1930 … 2155	1930 … 2155	1710 … 1910
TD-SCDMA-A	B34	2010	2017,5	2025
UMTS	B1	2110 … 2170	2110 … 2170	1920 … 2060
TD-SCDMA-F	B39	1900 … 1920	1900 … 1920	1880 … 1890
WCS	B30	2345 … 2360	2345 … 2360	2305 … 2315
TD-SCDMA-E	B40	2442 … 2484	2442 … 2484	2300 … 2340
LTE 2600 / IMTE	B7	2620 … 2690	2620 … 2690	2500 … 2570
LTE 3500	B42	3510 … 3594	3510 … 3594	3410 … 3484

* Frequency range can differ between models for details see specific datasheet
Other frequencies on request

Accessories

- Adaptors in-series
- Adaptors inter-series
- PIM reference adaptors -110 dBm
- Exchangeable test port adaptors (7-16 and 4.3-10)

- Low-PIM terminations

- Test cables 7-16 / 7-16 and 4.3-10

For more information visit:
www.rosenberger.com/pia

Service

Repair & Factory Calibrations

To ensure highest precision of measurements, we recommend a factory calibration interval of 12 months.
In-house calibration & repair service is optionally available. If you wish to send back a unit for factory calibration or repair, for smooth transaction please contact us prior to shipment.

Factory Calibration FAQs

- Calibration: Setting and calibration of the unit to the values based on factory-provided, initial calibration. Check for latest Firmware update
- Calibration frequency: To ensure highest precision of measurements we recommend a calibration interval of 12 months
- Cycle time: Standard cycle time is 10 working days after receipt of unit
- Service options: Service options such as on-site calibration service or a service contract are also available

Download Software & Tools

www.rosenberger.com/pia/downloads

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