

PIM Site Analyzer α

User Manual



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1 General Information and Safety Instructions



Operation not according to the intended purpose, ignorance of this documentation, the use of insufficiently qualified personnel as well as unauthorized modifications exclude the liability of the manufacturer for damages resulting from this and render any warranty void.



People with cardiac stimulator must not expose the magnetic field of the batteries, the battery unit, the power unit or the charging cable.

Rosenberger makes every effort to keep the safety standards of our products up to date to offer our customers the highest possible degree of safety. Our products and the accessory equipment they require are designed, built and tested in accordance with the safety standards that apply in each case. The compliance with these standards is monitored by our quality assurance system. The product described here has been designed, built and tested in accordance with the attached CE Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards. To maintain this condition and to ensure safe operation, you must observe all instructions and warnings provided in this manual. If you have any questions regarding these safety instructions please contact Rosenberger to answer them.

Furthermore, it is your responsibility to use the product in an appropriate manner. This product is designed for field use and must not be used in any way that may cause personal injury or property damage. You are responsible if the product is used for any intention other than its designated purpose or in disregard of the manufacturer's instructions. The manufacturer shall assume no responsibility for such use of the product.

The product is used for its designated purpose if it is used in accordance with its product documentation and within its performance limits (see data sheet, documentation, the following safety instructions). Using the product requires technical skills and a basic knowledge of the English language. It is therefore essential that only skilled and specialized staff or thoroughly trained personnel with the required skills are allowed to use the product. If personal safety gear is required for using Rosenberger PIM Site Analyzer α , this will be indicated at the appropriate place in the product documentation. Keep the basic safety instructions and the product documentation in a safe place and pass them on to the subsequent users.

Observing the safety instructions will help prevent personal injury or damage of any kind caused by dangerous situations. Therefore, carefully read through and adhere to the following safety instructions before and when using the product. It is also absolutely essential to observe the additional safety instructions on personal safety, for example, that appear in relevant parts of the product documentation.

Operating states and operating positions

The product may be operated only under the operating conditions and in the positions specified by the manufacturer without the product's ventilation being obstructed. If the manufacturer's specifications are not observed, this can result in electric shock, fire and/or serious personal injury or death. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed.

- Never switch output power on (in manual mode or remote mode) without load or terminated OUT connected to the test port.
- Unless otherwise specified, the following requirements apply to this product: IP protection 2X, pollution severity 2, over voltage category 2, max. operating altitude 2000 m above sea level, max.

transport altitude 4500 m above sea level. A tolerance of: $\pm 10\%$ shall apply to the nominal voltage and $\pm 5\%$ to the nominal frequency.

- Do not place the product on surfaces, vehicles, cabinets or tables that for reasons of weight or stability are unsuitable for this purpose. Always follow the manufacturer's installation instructions when installing the product and fastening it to objects or structures (e.g. walls and shelves). An installation that is not carried out as described in the product documentation could result in personal injury or death.
- Do not cover the heat sink or ventilation openings.
- Do not place the product on heat-generating devices such as radiators or fan heaters. The ambient temperature must not exceed the maximum temperature specified in the product documentation or in the data sheet. Product overheating can cause electric shock, fire and/or serious personal injury or death.

Electrical safety

If the information on electrical safety is not observed either at all to the extent necessary, electric shock, fire and/or serious personal injury or death may occur.

- Prior to switching on the product, always ensure that the nominal voltage setting on the product matches the nominal voltage of the AC supply network. If the equipment is used at different voltages, the power fuse of the product may have to be changed accordingly.
- In the case of products of safety class I with movable power cord and connector, operation is permitted only on sockets with an earthing contact and protective earth connection.
- Intentionally breaking the protective earth connection either in the feed line or in the product itself is not permitted. Doing so can result in the danger of an electric shock from the product. If extension cords or connector strips are implemented, they must be checked on a regular basis to ensure that they are safe to use.
- To disconnect the device from the AC supply network, the plug of the connecting cable is regarded as the disconnecting device. In such cases, always ensure that the power plug is easily reachable and accessible at all times (corresponding to the length of connecting cable, approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply network. If products without power switches are integrated into racks or systems, a disconnecting device must be provided at the system level.
- Never use the product if the power cable is damaged. Check the power cable on a regular basis to ensure that it is in proper operating condition. By taking appropriate safety measures and carefully laying the power cable, you can ensure that the cable will not be damaged and that no one can be hurt by, for example, tripping over the cable or suffering an electric shock.
- The product must be operated only in TN/TT mains networks fused with max. 16 A or with dedicated Rosenberger battery packs.
- Do not insert the plug into sockets that are dusty or dirty. Insert the plug firmly and all the way into the socket. Otherwise, sparks that result in fire and/or injuries may occur.
- Do not overload any sockets, extension cords or connector strips; doing so can cause fire or electric shocks.

- For measurements in circuits with voltages $V_{rms} > 30\text{ V}$, suitable measures (e.g. appropriate measuring equipment, fusing, current limiting, electrical separation, insulation) should be taken to avoid any hazards.
- Ensure that the connections with information technology equipment, e.g. PCs or other industrial computers, comply with the IEC60950-1 / EN60950-1 or IEC61010-1 / EN 61010-1 standards that apply in each case.
- Unless expressly permitted, never remove the cover or any part of the housing while the product is in operation. Doing so will expose circuits and components and can lead to injuries, fire or damage to the product.
- If a product is to be permanently installed, the connection between the PE terminal on site and the product's PE conductor must be made first before any other connection is made. The product may be installed and connected only by a licensed electrician.
- For permanently installed equipment without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fused in such a way that anyone who has access to the product, as well as the product itself, is adequately protected from injury or damage.
- Use suitable over voltage protection to ensure that no over voltage (such as that caused by a bolt of lightning) can reach the product. Otherwise, the person operating the product will be exposed to the danger of an electric shock.
- Any object that is not designed to be placed in the openings of the housing must not be used for this purpose. Doing so can cause short circuits inside the product and/or electric shocks, fire or injuries.
- Unless specified otherwise, products are not liquid-proof (see also section "Operating states and operating positions", item 1.) Therefore, the equipment must be protected against penetration by liquids. If the necessary precautions are not taken, the user may suffer electric shock or the product itself may be damaged, which can also lead to personal injury.
- Never use the product under conditions in which condensation has formed or can form in or on the product, e.g. if the product has been moved from a cold to a warm environment. Penetration by water increases the risk of electric shock.

Operation

- Operating the products requires special training and intense concentration. Make sure that persons who use the products are physically, mentally and emotionally fit enough to do so; otherwise, injuries or material damage may occur. It is the responsibility of the employer/operator to select suitable personnel for operating the products.
- Operation of the PIM Site Analyzer **α** can produce electromagnetic radiation. Ensure that the radiation levels do not exceed limits of national regulations. Persons with pacemakers and pregnant women are especially endangered.
- Before you move or transport the product, read and observe the section titled "Transport".
- Before you start processing the product mechanically and/or thermally, or before you take it apart, be sure to read and pay special attention to the section titled "Waste disposal", item 1.

- Should a fire occur, the product may release hazardous substances (gases, fluids, etc.) that can cause health problems. Therefore, suitable measures must be taken, e.g. protective masks and protective clothing must be worn.

Fundamental rules for handling fiber optics

Laser Safety must be a concern. Refer to the module's documentation. Infrared Laser light is invisible and may be harmful for your eyes. Check fiber surfaces only with a video microscope.

- Make sure, SFP (pluggable module) is compatible with fiber type
- Do not mix fiber types in a link
- Do not touch connector ferrule
- Use protection caps whenever a connector or a module is not mated
- Do not bend or kink optical cables ($R \geq 25$ mm)
- Do only use suitable cleaning equipment (Reel Cleaner, Click Cleaner)
- Check fiber surface with a video microscope before mating a connector

Repair and Service

- The product may be opened only by authorized, specially trained personnel. Before any work is performed on the product or before the product is opened, it must be disconnected from the AC supply network. Otherwise, personnel will be exposed to the risk of an electric shock.
- Adjustments, replacement of parts, maintenance and repair may be performed only by electrical experts authorized by Rosenberger. Only original parts can be used for replacing safety parts (e.g. power switches, power transformers, fuses). A safety test must always be performed after safety parts have been replaced (visual inspection, PE conductor test, insulation resistance measurement, leakage current measurement, functional test). This helps ensure the continued safety of the product.

Batteries and rechargeable batteries/cells

If the information regarding batteries and rechargeable batteries/cells is not observed either at all or to the extent necessary, product users may be exposed to the risk of explosions, fire and/or serious personal injury, and, in some cases, death. Batteries and rechargeable batteries with alkaline electrolytes (e. g. lithium cells) must be handled in accordance with the EN 62133 standard.

- Cells must not be taken apart or crushed.
- Cells or batteries must not be exposed to heat or fire. Storage in direct sunlight must be avoided. Keep cells and batteries clean and dry. Clean soiled connectors using a dry, clean cloth.
- Cells or batteries must not be short-circuited. Cells or batteries must not be stored in a box or in a drawer where they can short-circuit each other, or where they can be short-circuited by other conductive materials. Cells and batteries must not be removed from their original packaging until they are ready to be used.
- Keep cells and batteries out of the hands of children. If a cell or a battery has been swallowed, seek medical aid immediately.

- Cells and batteries must not be exposed to any mechanical shocks that are stronger than permitted.
- If a cell develops a leak, the fluid must not be allowed to come into contact with the skin or eyes. If contact occurs, wash the affected area with plenty of water and seek medical aid.
- Improperly replacing or charging cells or batteries that contain alkaline electrolytes (e.g. lithium cells) can cause explosions. Replace cells or batteries only with the matching Rosenberger type (see bill of materials) in order to ensure the safety of the product.
- Cells and batteries must be recycled and kept separate from residual waste. Rechargeable batteries and normal batteries that contain lead, mercury or cadmium are hazardous waste. Observe the national regulations regarding waste disposal and recycling.

Transport

- The product may be very heavy. Therefore, the product must be handled with care. In some cases, the user may require a suitable means of lifting or moving the product (e.g. with a lift-truck) to avoid back or other physical injuries.
- The user is responsible for securely fastening the products to or on the means of transport or lifting. Observe the safety regulations of the manufacturer of the means of transport or lifting. Non-compliance can result in personal injury or material damage.
- If you use the product in a vehicle, it is the sole responsibility of the driver to drive the vehicle safely and properly. The manufacturer assumes no responsibility for accidents or collisions. Never use the product in a moving vehicle if doing so could distract the driver of the vehicle. Adequately secure the product in the vehicle to prevent injuries or other damage in the event of an accident.
- **Transportation of Lithium batteries**
Lithium batteries as well as devices containing such batteries are classified as dangerous goods class 9 by the legislative authorities and therefore are subject to special regulations of load- securing and transportation. Regardless the type of battery, damage and contact with water or air moisture can cause heavy chemical reactions. Additionally, a short- circuit may cause a fire hazard. Employees who pack and ship Lithium batteries and devices equipped with batteries, have to be trained in compliance with the regulations: "The European Agreement Concerning the International Carriage of Dangerous Goods by Road" applies for the European traffic, and the "International Maritime Dangerous Goods Code" applies for the maritime traffic.
- **Disposal of Lithium batteries**
You purchased a battery-operated product. The service life of the battery is quite long, but one day it needs to be disposed. Used batteries are not allowed to be dumped in the household garbage. Consumers are legally obligated to bring batteries to a suitable collection point in stores or the community. Used batteries may contain hazardous substances or heavy metals that may damage the environment and health. Batteries will be recycled; they contain important raw materials like iron, zinc, manganese or nickel. The environment and Rosenberger say Thank You.

Waste disposal

- If products or their components are mechanically and/or thermally processed in a manner that goes beyond their intended use, hazardous substances (heavy-metal dust such as lead, beryllium, nickel) may be released. For this reason, the product may only be disassembled by specially trained personnel. Improper disassembly may be hazardous to your health. National waste disposal regulations must be observed.
- If handling the product releases hazardous substances or fuels that must be disposed of in a special way, e.g. coolants or engine oils that must be replenished regularly, the safety instructions of the manufacturer of the hazardous substances or fuels and the applicable regional waste disposal regulations must be observed. Also observe the relevant safety instructions in the product documentation. The improper disposal of hazardous substances or fuels can cause health problems and lead to environmental damage.

Cleaning

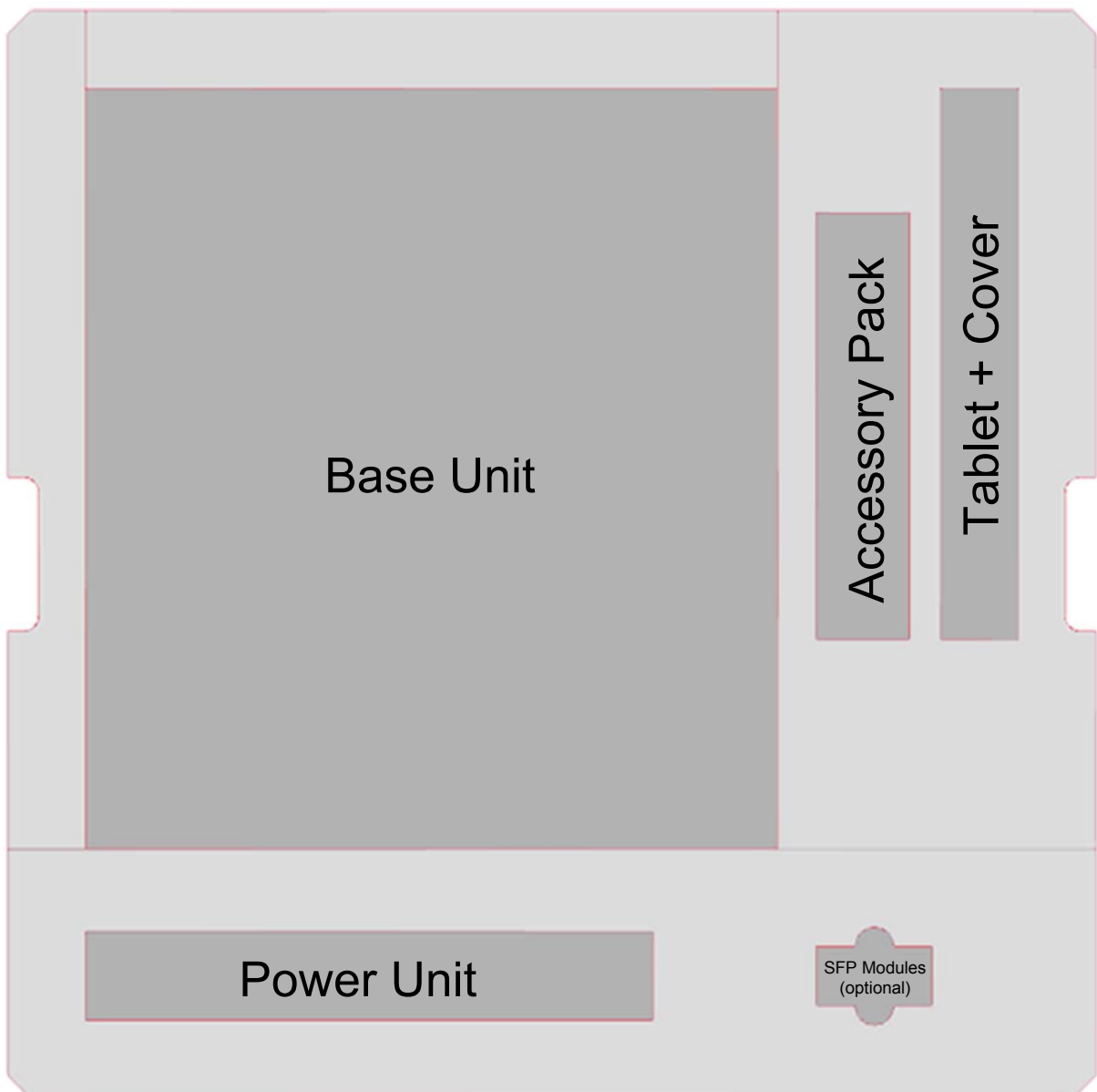
- Prior to cleaning the product, disconnect it completely from the power supply (e.g. AC supply network or battery). Use a soft, non-linting cloth to clean the product. Never use chemical cleaning agents such as alcohol (except Test Port), acetone or diluents for cellulose lacquers.
- For cleaning the Test Port use pressurised air or alcohol soaked cotton swaps.

2 Package Contents and Unpacking



Please keep the original boxes and all packaging materials and use them in the same way as received for sending back the unit, e.g. for calibration. This way the risk of damage during transport can be minimized.

At first, please check if all parts are contained in your shipment; otherwise get in contact with Rosenberger. See graphic below for a description of the contents of the main unit packaging. Filter Unit comes in a separate box.



3 Product Description PIM Site Analyzer α

Dear customer, thank you for purchasing the Rosenberger PIM Site Analyzer α . The PIM Site Analyzer α allows you to perform PIM detection over optical CPRI or RF measurements. The plug-and-play modular and broadband design from 700-2700 MHz with exchangeable band filter units ensures highest flexibility.

3.1 Overview



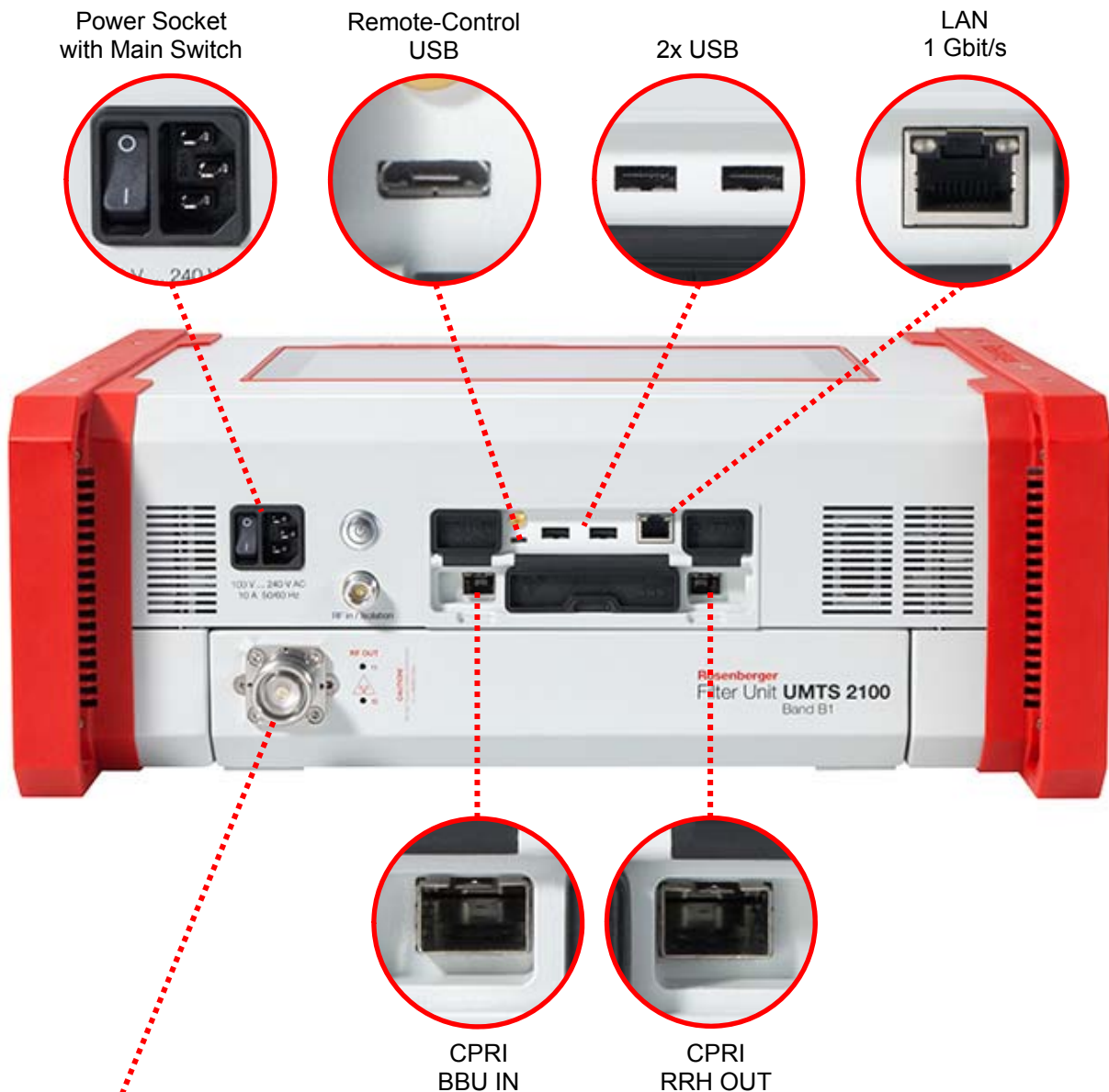
Do not cover cooling fan or ventilation outlets, otherwise the device may overheat.



3.2 Interface Side



When not in use, always keep the interface cover in place, over the socket. Do not touch the unprotected test port since it is energized by high currents.



Test Port

The test port connector is easily exchangeable.

Connection is one of the most important facts causing PIM product. During measurement, stable connection is necessary, so a suitable torque wrench is recommended when connecting test port.

Rosenberger connector interfaces accord with international standard IEC 60169-4, VG 95250, EN 122 190, DIN 47223 completely and the quality accords IEC 6008.

The recommended torque is 25-30 Nm.

3.3 Filter



3.3.1 Changing the filter



Filter removal during measurement is not allowed, but the filter can be changed while the device is running.



4 Setting up the Device

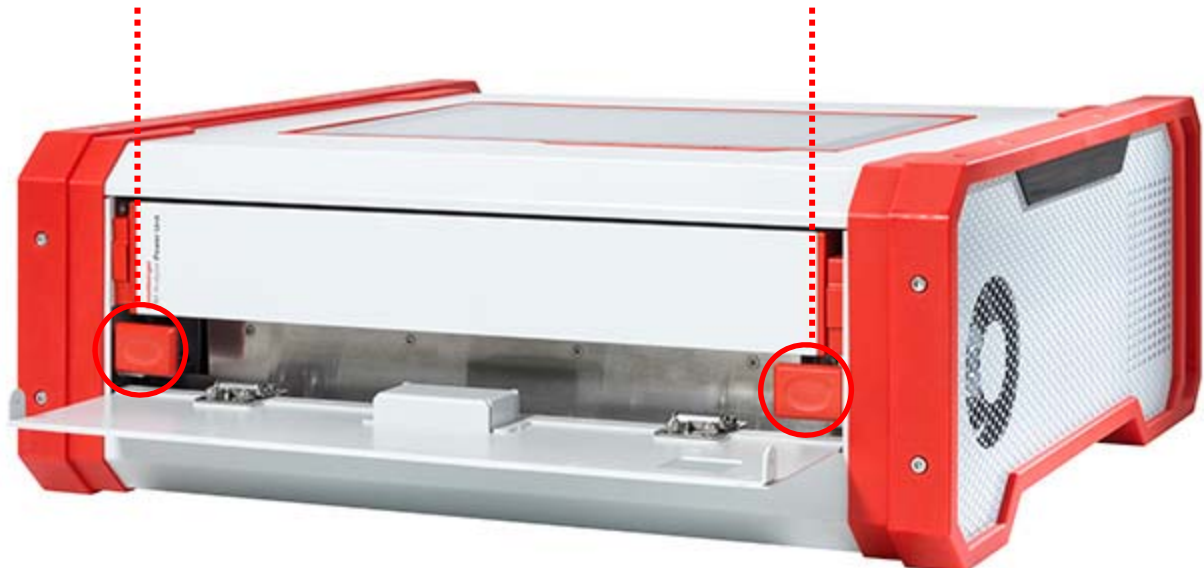


Always ensure the device stands stable and that the environmental conditions – listed under Chapter 1 – Section: *Operating states and operating positions* – are okay before starting to use the PIM Site Analyzer α .

The first step is to insert the filter unit into the device as shown in chapter 3.3.1. After that, install the power unit as shown below. If you have purchased the optional battery unit, the installation works the same way.

4.1 Changing Power Unit / Battery Unit

Push firmly onto the two latches to unlock the unit. After that it can be pulled out easily. To install the unit just push it in the slot, until it snaps in.



4.2 Changing SFPs

Choosing the right SFP modules depends on the site equipment. The SFP modules in the PIM Site Analyzer α have to be compatible with the Base Band Unit or else malfunction may occur. To remove the SFP modules flap out the lever to unlock the module and pull the SFP module out. To equip a SFP module slide it in with the lever pushed down until the SFP snaps in. Mind the latching tab when connecting / disconnecting the FO cable.

4.3 Connecting and powering on/off

Plug the power cord into the Power Socket on the device and connect it to an AC outlet. Set the Main Switch right next to the Power Socket to "I". The cooling fan should now start to spin. To boot the device press the Power Button, which is illuminated as long as the device is running. The boot process is finished as soon as the menu for the measurement operations is shown. You can now start your measurements.

To power off the device, shortly press the Power Button again and the device will shut down. The device has finished shutting down as soon as the illumination of the Power Button is off. For energy saving reasons we recommend to switch off the Main Switch after the shutdown process is finished.

5 Software Operation



The PIM Site Analyzer α runs on Microsoft Windows 7. If you install additional software or change system settings, Rosenberger can't guarantee a flawless operation anymore. Please backup your data (e.g. reports) on a regular basis.

5.1 Main Menu

The main menu can be accessed from every screen with the button in the upper left corner. It allows you to switch between all the different measurement types and settings.

Toggle Main Menu ⋮

Switch to specific measurement ⚙️

Settings for specific measurement ⚙️

5.2 Device Info

The “Device info” screen shows useful information on your PIM Site Analyzer α device, e.g. manufacturing and calibration dates of filters and base unit.

Device Components Rosenberger

SW Version: 1.0.3231.1

	Part No.	Model	Serial No.	Manufactured	Calibrated
PIM α Base Unit	300287	IM-A-BU-0727	010IM-A5516	2016-06-15	2016-06-16
PIM α Filter	300293	IM-A-FI-2600/B7	010IM-A5594	2016-06-10	2016-06-17

License Options State Due Date
CPRI Disabled Unlimited

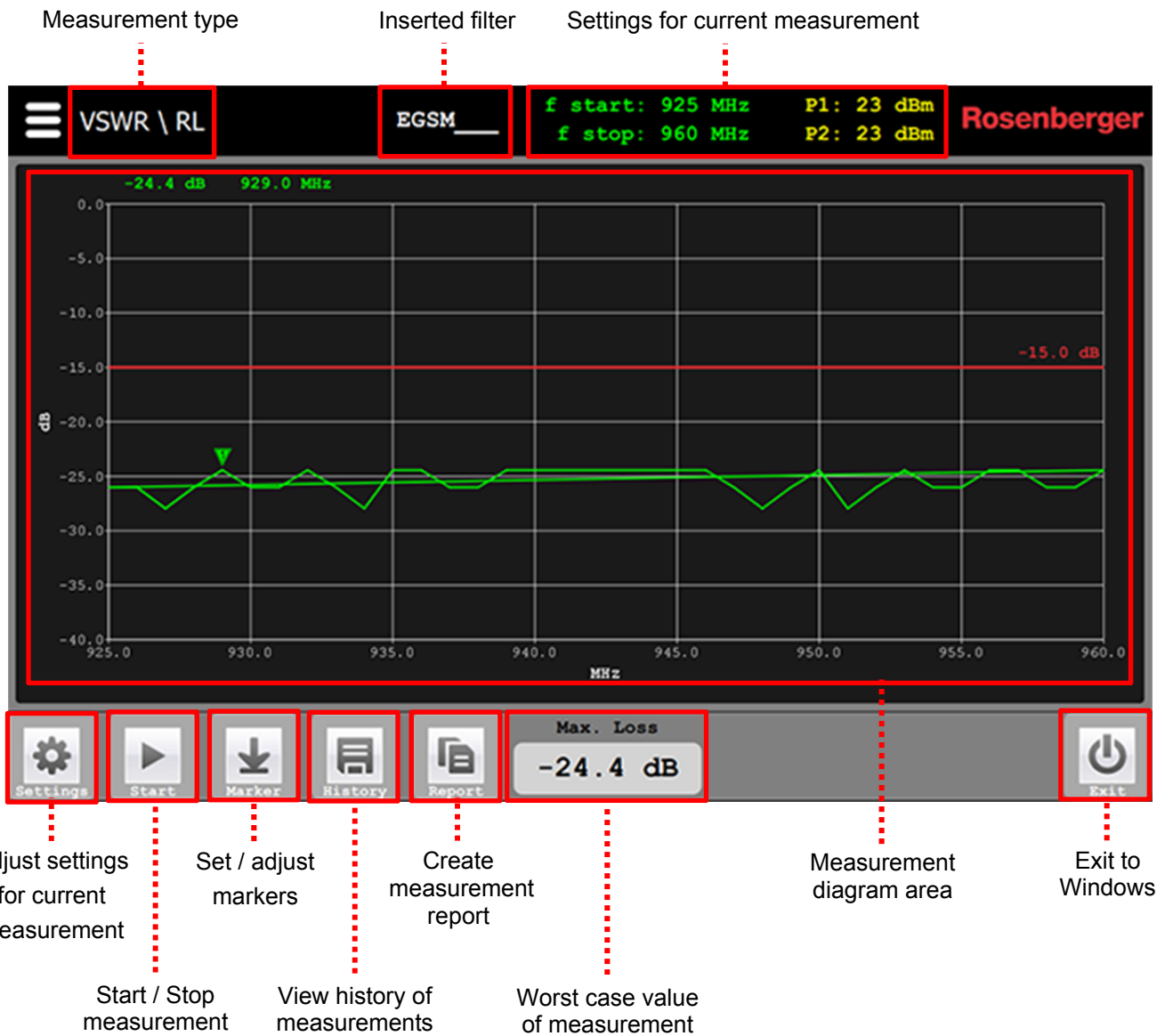
External 10MHz Reference: No signal present

	PA 1	PA 2	Internal
Temperatures	31.2°C	31.2°C	50.0°C

5.3 Measurement Screen



In the following picture the measurement screen for “VSWR \ RL” is shown. The explanations of the screen elements apply to all other measurement types, too.



5.4 Report generation

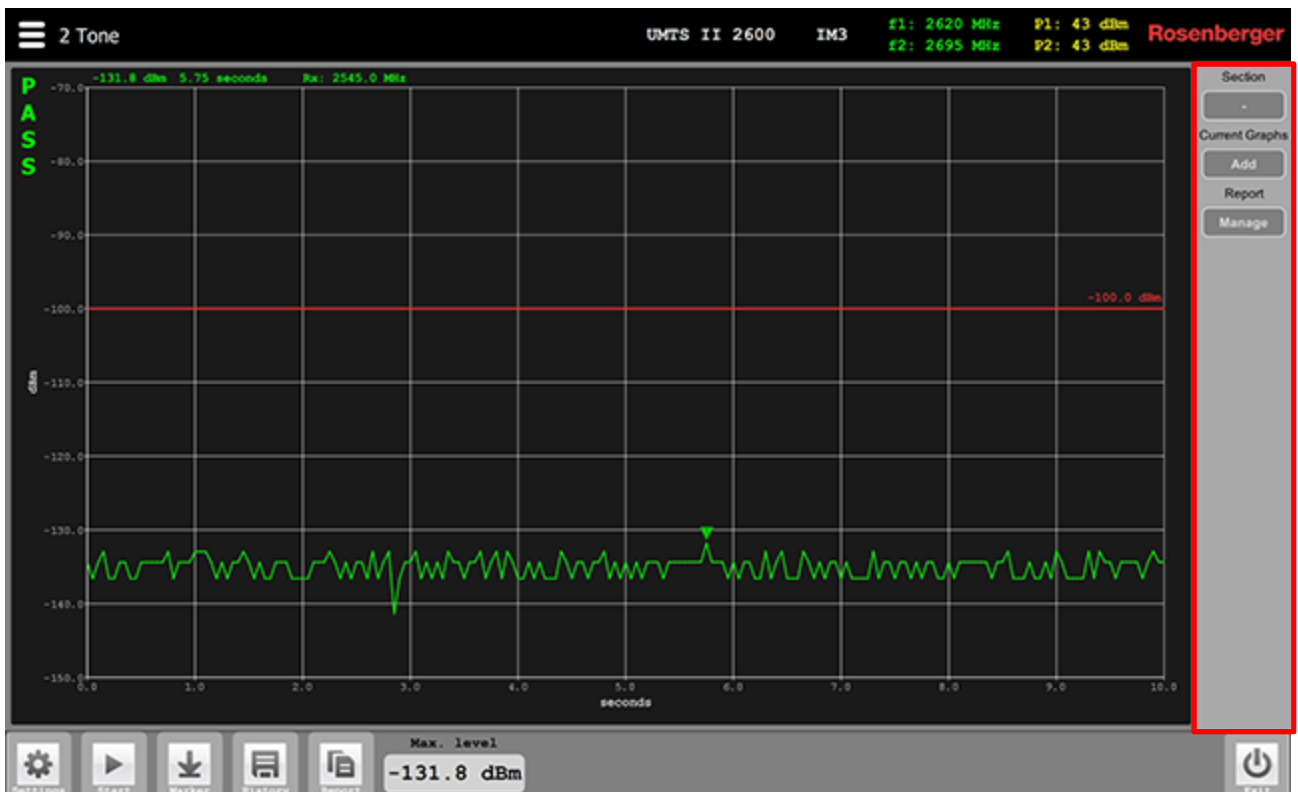
5.4.1 Configuring the report

Choose “Common Settings” in the main menu to configure the settings (e.g. operator’s name and logo) for your reports.



5.4.2 Creating the report

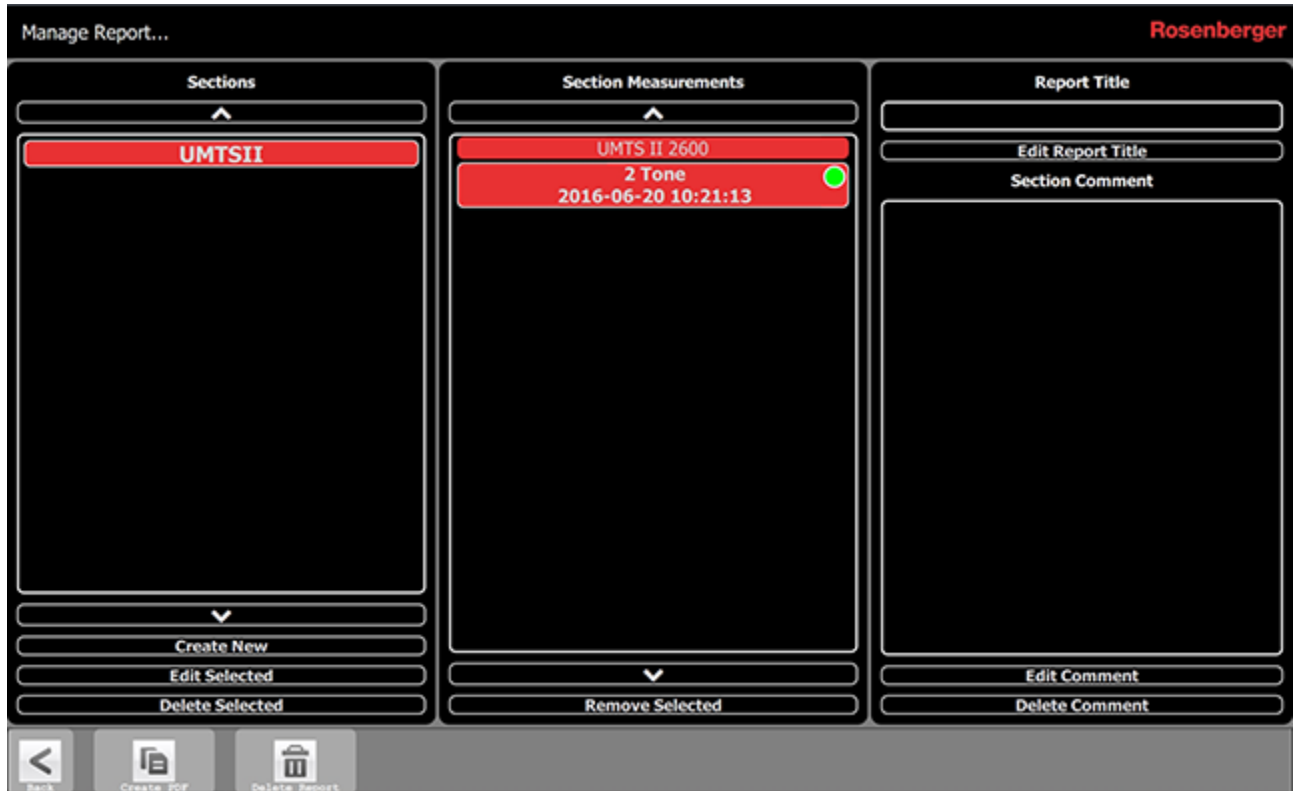
The “Report” button can be found on every measurement screen. After a measurement was performed you can tap on it and a sidebar menu is shown.



Section: A report is divided into sections which hold the individual measurements. To add a measurement to your report you will have to create a section first. If a section already exists you can choose it here.

Current Graphs - Add: Add this measurement to the chosen section of your report.

Report - Manage: Show all the saved measurement graphs and create a final report with them. This function can also be accessed in the main menu via the button “Reports”.



In the “Manage Report” screen all your saved measurements can be seen and arranged for the report. Additionally you can set common attributes of your report.

After tapping the button “Create PDF” choose the desired location of your report and it will be saved as a PDF file.

6 Measurement Settings

6.1 Manual Mode



Manual controlling of test carrier's power and frequency while observing receiver frequency and signal strength in real time. Used to characterize DUT behavior, find and tryout appropriate settings for regular RF Measurements.

The screenshot displays the 'Manual Mode' interface. At the top, it shows 'Manual Mode', 'EGSM', and carrier parameters: f1: 925-939 MHz, f2: 946-960 MHz, Rx: 880-915 MHz, Power: 23-47 dBm. The interface is divided into four main control panels. The top-left panel controls 'Output Power f1' (43.0 dBm) and 'Output Frequency f1' (925.0 MHz), with an 'OFF' indicator. The top-right panel controls 'Output Power f2' (43.0 dBm) and 'Output Frequency f2' (960.0 MHz), also with an 'OFF' indicator. Below these are receiver settings: 'Rx 1' is set to 'PIM' and 'FWD' paths, with 'IM3' selected; its frequency is 890.0 MHz and power is - dBm, with 'Use IM Frequency' checked. 'Rx 2' is set to 'ISOL' and 'REF' paths, with a frequency of 890.0 MHz and power of -124.5 dBm. The bottom of the screen shows a date/time stamp '22.02.2016 17:13:21' and three buttons: 'Defaults', 'Restart', and 'Exit'.

Group	Parameter	Description
Carrier 1	Frequency f_1	Frequency setting for CW carrier 1
	Power f_1	Power setting for CW carrier 1
	On Off f_2	Enable or Disable carrier 2
Carrier 2	Frequency f_2	Frequency setting for CW carrier 2
	Power f_2	Power setting for CW carrier 2
	On Off f_2	Enable or Disable carrier 2
Receiver 1	Path RX_1	Select between PIM or FWD monitor path
	Frequency RX_1	Set frequency where RX_1 is listening
	IM Order + use IM Frequency	Select between IM_2 IM_3 IM_5 IM_7 ... depending on Filter and Set RX_1 to a frequency derived from f_1 , f_2 and IM-Order settings
Receiver 2	Path RX_2	Select between ISOLation or REFL monitor path
	Frequency RX_2	Set frequency where RX_2 is listening

6.2 2 Tone



Measuring PIM under dynamic stress (e.g. tap with a tool, to simulate tower movements during wind). Two fixed frequency CW carriers are stimulating PIM at the DUT while the PIM level is recorded over time and displayed.

2 Tone
f1: 925-939 MHz Rx: 880-915 MHz
f2: 946-960 MHz Power: 23-47 dBm
Rosenberger

EGSM _____
IM order: 3

Output Frequency

f1 fixed MHz

f2 fixed MHz

Output Power

P1 dBm

P2 dBm

Equal Power

Receiver IM Frequency

890.0 MHz

Error Limit

Level dBm

Measurement Duration

Time sec

Endless Mode

Display Unit

dBm

✕
Cancel

✓
Apply

🗑️
Defaults

Group	Parameter	Description
Stimulus	Frequency f_1	Frequency setting for CW carrier 1
	Frequency f_2	Frequency setting for CW carrier 2
	Power f_1	Power setting for CW carrier 1
	Power f_2	Power setting for CW carrier 2 – can be coupled to Power f_1
Measurement Setup	IM Order	Select between IM ₂ IM ₃ IM ₅ IM ₇ ... measurements
	Time	Set time duration of 2-Tone measurement
	Endless Mode	Run 2-Ton measurement until stop is pressed
	Display Unit	Select scale between dBm (absolute) and dBc (relative to carriers)
Alarm Setup	Error Limit	Set error limit level

6.3 Sweep



Measuring PIM with swept carrier frequencies. Allows detection of multiple PIM sources in the signal path. An unsteady graph would indicate that more than one PIM source is present because all reflected PIM waves would interfere positively and negatively over frequency.

Sweep EGSM f1: 925-939 MHz Rx: 880-915 MHz Power: 23-47 dBm Rosenberger

IM order:

Upsweep	Downsweep	Output Power
f1 start <input type="text" value="925.0"/> MHz	f2 start <input type="text" value="960.0"/> MHz	P1 <input type="text" value="43.0"/> dBm
f1 stop <input type="text" value="937.5"/> MHz	f2 stop <input type="text" value="948.0"/> MHz	P2 <input type="text" value="43.0"/> dBm
f2 fixed <input type="text" value="960.0"/> MHz	f1 fixed <input type="text" value="925.0"/> MHz	<input checked="" type="checkbox"/> Equal Power
f1 step <input type="text" value="0.1"/> MHz	f2 step <input type="text" value="0.1"/> MHz	Display Unit
IM Range Up	IM Range Down	<input type="text" value="dBm"/>
890.0 -> 915.0 MHz	890.0 -> 902.0 MHz	Error Limit
	Number of Cycles	Level <input type="text" value="-100.0"/> dBm
	Cycles <input type="text" value="1"/>	

Group	Parameter	Description
Upsweep	Frequency f ₁	Frequency from-to setting of swept carrier 1
	Frequency f ₂	Frequency setting for fixed carrier 2
	Step size	Frequency step size for swept carrier
	Power f ₁	Power setting for carrier 1
Downsweep	Frequency f ₂	Frequency from-to setting of swept carrier 2
	Frequency f ₁	Frequency setting for fixed carrier 1
	Step size	Frequency step size for swept carrier
	Power f ₂	Power setting for carrier 2 (must be equal if unit dBc is used)
Measurement Setup	IM Order	Select between IM ₂ IM ₃ IM ₅ IM ₇ ... measurements
	No. of Cycles	Set number of sweep cycles per measurement
	Endless Mode	Run Sweep measurement until stop is pressed
	Display Unit	Switches scale between dBm (absolute) and dBc (relative to carriers)
Alarm Setup	Error Limit	Set error limit level

6.4 VSWR \ RL



Measures if components in the signal path are impedance matched or not. High RL or VSWR values means that signals are reflected back instead of passing the mismatched component

Rosenberger
f1: 925-939 MHz Rx: 880-915 MHz
f2: 946-960 MHz Power: 23-47 dBm
EGSM _____

	Start	Output Power	Display Unit
f start	<input type="text" value="925.0"/> MHz	P1 <input type="text" value="23.0"/> dBm	<input type="text" value="dB"/>
	Stop	P2 <input type="text" value="23.0"/> dBm	Error Limit
f stop	<input type="text" value="960.0"/> MHz	<input checked="" type="checkbox"/> Equal Power	Level <input type="text" value="-15.0"/> dB
	Step Size		Number of Cycles
f step	<input type="text" value="0.1"/> MHz		Cycles <input type="text" value="1"/>

Group	Parameter	Description
Stimulus	Frequency	Frequency from-to setting of swept carrier
	Step size	Frequency step size for swept carrier
	Power	Power setting for carrier
Measurement Setup	Display Unit	Select scale between dB (Return Loss) and VSWR Factor (1:1.0 – 1:∞)
	Error Limit	Set error limit line
	No. of Cycles	Set number of sweep cycles per measurement

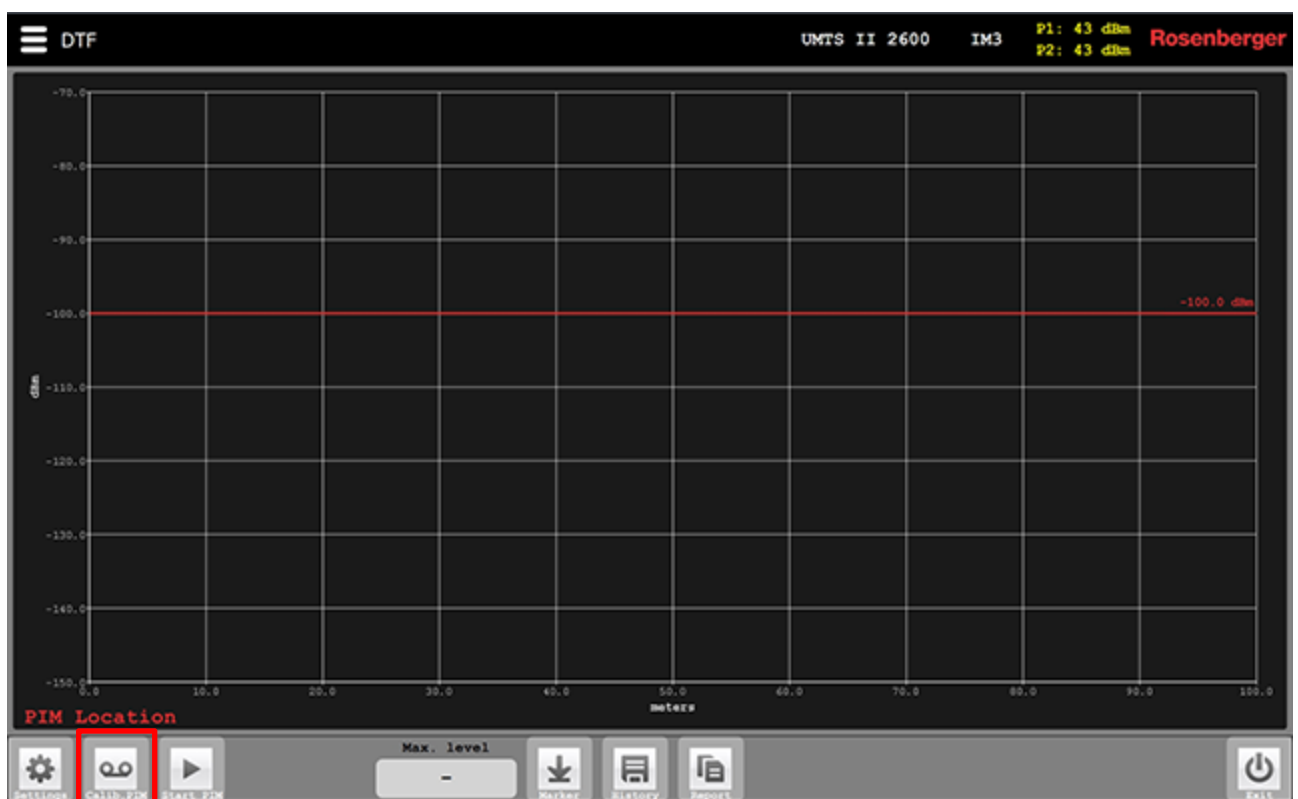
6.5 DTF



Measuring of the distance to the PIM fault and Return Loss fault position. The graph plots the PIM and RL value over distance, so even multiple sources can be detected and level measured. The velocity factor has to be known for accurate display scaling.



In order to perform DTF measurements the filter needs to be calibrated first. The calibration must be done only once after a new filter was inserted.



Calibrate PIM

DTF EGSM f1: 925-939 MHz Rx: 880-915 MHz Rosenberger
f2: 946-960 MHz Power: 23-47 dBm

IM order:

Measurement Mode <input type="radio"/> PIM Location <input type="radio"/> Return Loss Location <input checked="" type="radio"/> Both Display Unit PIM <input type="text" value="dBm"/> Display Unit RL <input type="text" value="dB"/>	Output Power PIM P1 <input type="text" value="43.0"/> dBm P2 <input type="text" value="43.0"/> dBm <input checked="" type="checkbox"/> Equal Power PIM Error Limit Level <input type="text" value="-100.0"/> dBm Velocity Factor <input r-88.0%"="" type="text" value="1/2\"/>	Output Power RL P= <input type="text" value="23.0"/> dBm Return Loss Error Limit Level <input type="text" value="-15.0"/> dB Return Loss Used Tx Port <input checked="" type="radio"/> Tx 1 <input type="radio"/> Tx 2
--	--	---

Group	Parameter	Description
Measurement Setup	Measurement Mode	Selects between Distance to PIM only Distance to RL only Both
	Velocity Factor	Sets the cable type or user defined velocity factor for proper scaling of the distance measurement (x-axis)
Distance to PIM	Power f ₁	Power setting for carrier 1
	Power f ₂	Power setting for carrier 2 (must be equal if unit dBc is used)
	Equal Power	Couples Power f ₂ to Power f ₁ that only one has to be adjusted
	Error Limit	Sets error limit line
	Display Unit	Switches scale between dBm (absolute) and dBc (relative to carriers)
Distance to RL	Power	Select between IM ₂ IM ₃ IM ₅ IM ₇ ... measurements
	Error Limit	Set error limit line
	Freq. / Channel	Select channel where previous measurement showed worst point
	Display Unit	Select scale between dB (Return Loss) and VSWR Factor (1:1.0 – 1:∞)

6.6 Isolation



Measuring the isolation between separate RF-paths (e.g. decoupling of two antennas or separate polarizations). Therefore a signal is transmitted from the PIM measuring Port (7/16 or 4.3/10) and the leakage received at the N-connector.

Isolation
f1: 925-939 MHz
Rx: 880-915 MHz
Rosenberger
Power: 23-47 dBm
EGSM

	Start	Output Power	Error Limit
f start	925.0 MHz	P1 23.0 dBm	Level -60.0 dB
	Stop	P2 23.0 dBm	Number of Cycles
f stop	960.0 MHz	<input checked="" type="checkbox"/> Equal Power	Cycles 1
	Step Size		
f step	0.1 MHz		

Cancel
 Apply
 Defaults

Group	Parameter	Description
Stimulus	Frequency	Frequency from-to setting of swept carrier
	Step size	Frequency step size for swept carrier
	Power	Power setting for carrier
Measurement Setup	Error Limit	Set error limit line
	No. of Cycles	Set number of sweep cycles per measurement

6.7 Power Sweep



Measuring PIM as a function of power to the DUT. Because PIM is an extremely nonlinear effect of many causes, it is hard to predict at which power PIM starts to rise. PIM sources or measurement headroom can be identified in this manner.

Power Sweep
f1: 925-939 MHz Rx: 880-915 MHz
f2: 946-960 MHz Power: 23-47 dBm
Rosenberger

IM order:

Output Frequency	Output Power	Display Unit
f1 fixed <input type="text" value="925.0"/> MHz	P start <input type="text" value="23.0"/> dBm	<input type="text" value="dBm"/>
f2 fixed <input type="text" value="960.0"/> MHz	P stop <input type="text" value="47.0"/> dBm	Error Limit
Receiver IM Frequency	P step <input type="text" value="1.0"/> dBm	Level <input type="text" value="-140.0"/> dBc
890.0 MHz		Number of Cycles
		Cycles <input type="text" value="1"/>

Group	Parameter	Description
Sweep Setup	Frequency f_1	Frequency setting for CW carrier 1
	Frequency f_2	Frequency setting for CW carrier 2
	Frequency f_{IM}	Shows resulting IM Frequency from f_1 f_2 setting
	Power	Power sweep from-to setting of both carriers
	Step size	Power increase per step for power sweep
Measurement Setup	IM Order	Select between IM_2 IM_3 IM_5 IM_7 ... measurements
	No. of Cycles	Set number of sweep cycles per measurement
	Display Unit	Switches scale between dBm (absolute) and dBc (relative to carriers)
Alarm Setup	Error Limit	Set error limit level

6.8 Spectrum Analyzer



Measuring the uplink spectrum prior PIM measurements is useful to detect if interferences (e.g. mobile devices transmitting unintentionally) disturb the PIM measurement. The RF power density on the graph shows if there are static signals which must be ignored on PIM measurements.

Spectrum Analyzer
f1: 925-939 MHz Rx: 880-915 MHz
f2: 946-960 MHz Power: 23-47 dBm
Rosenberger

Rx Frequency

f start MHz

f stop MHz

Bandwidths

Resolution KHz

Video KHz

Error Limit

Level dBm

Capture once or endless

Endless Mode

✕
Cancel

✓
Apply

☰
Defaults

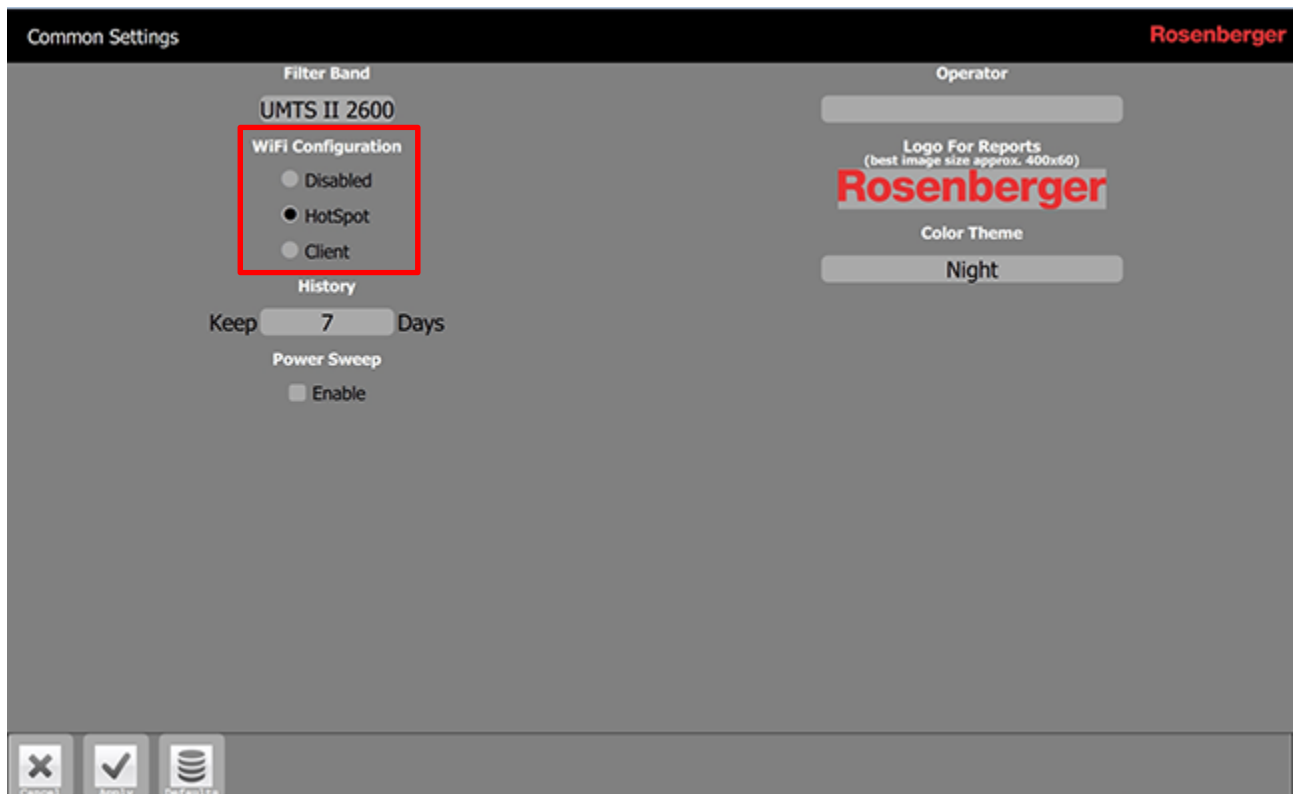
Group	Parameter	Description
Measurement Setup	Frequency	Frequency from-to setting of monitoring range (in RX range)
	Reference Level	Level of reference line (Line 9)
	Scale	Power scale between lines
	Resolution BW	Resolution Bandwidth (Frequency resolution and noise floor)
	Video BW	Video Bandwidth (Smoothens dynamic signals)
Display Setup	Detector	Select between Peak Average Min
	Persistence	Switch between persistence mode # of Cycles Off
Alarm Setup	Error Limit	Set error limit level

7 Remote Control

7.1 Tablet

The PIM Site Analyzer **α** comes with a Google Android based tablet computer. The preinstalled PIM Site Analyzer alpha remote control app enables you to start and control measurements remotely, e.g. on top of a tower.

To be able to work remotely you need to activate the WiFi hotspot functionality of your PIM Site Analyzer **α**. Open the “Common Settings” screen from the main menu and check “Hotspot” under “WiFi Settings. A pop-up window with the device’s SSID and WiFi password will appear.



Open the WiFi connections screen on your tablet and connect with the network entitled with the SSID shown on the PIM Site Analyzer **α**. You will be prompted to input the password also shown on your device’s screen.

After connecting the tablet you can launch the PIM Site Analyzer **α** remote control app on the launcher screen. After launching the app will search for devices nearby. As soon as the device you wish to connect to appears on the results list tap on it and the tablet will be connected to the chosen device.

Graphical interface and operation via remote app is identical to the device itself.

8 Maintenance of the device

8.1 Handling

Only use the PIM Site Analyzer α according to the intended purpose and comply with this documentation to prevent damages.

To prevent damages to the device we recommend using the carrying bag (see chapter “Accessories”) if you are using the PIM Site Analyzer α in the field.

To lift the device up the tower apply the rope on the handles. Do not open the device, always ensure it stands stable, don't expose it to hard shocks and always make sure that the environmental conditions for usage and storage are met. Avoid storing uncharged batteries since it can have a negative effect on the batteries lifetime. Keep all interfaces clean and use protection caps whenever possible.

8.2 Cleaning

Prior to cleaning the product, disconnect it completely from the power supply (e.g. AC supply network or battery). Use a soft, non-linting cloth to clean the product. Never use chemical cleaning agents such as alcohol (except Test Port), acetone or diluents for cellulose lacquers. For cleaning the Test Port use pressurised air or alcohol soaked cotton swaps. Ventilation outlets can be cleaned with pressurized air.

8.3 Calibration & Repair



Note that any repairs or calibration of the device not performed by Rosenberger can have a negative impact on the flawless operation of the device and will render any warranty void.



Due to transportation directive, used batteries must be removed and must not be sent with the device since potentially damaged batteries can cause fire or may explode. If a shipment contains used batteries, Rosenberger will remove and scrap them and will replace them with new batteries at customer's expense.

To ensure highest precision of measurements, we recommend a calibration interval of 12 months. If you wish to send back a unit for calibration or repair, for smooth transaction please contact us prior to shipment. Refer to the last chapter of this manual for global support addresses.

Calibration FAQs

- Calibration: 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: We are happy to inform about additional service options

8.4 Fundamental rules for handling fiber optics

Laser Safety must be a concern. Refer to the module's documentation. Infrared Laser light is invisible and may be harmful for your eyes. Check fiber surfaces only with a video microscope.

- Make sure, SFP (pluggable module) is compatible with fiber type
- Do not mix fiber types in a link
- Do not touch connector ferrule
- Use protection caps whenever a connector or a module is not mated
- Do not bend or kink optical cables ($R \geq 25$ mm)
- Only use suitable cleaning equipment (Reel Cleaner, Click Cleaner)
- Check fiber surface with a video microscope before mating a connector

9 Measurement Examples



The following instructions are only recommendations. The actual requirements of PIM testing and verification can vary depending on the site operators specifications.

9.1 RF Measurements



Common Checklist for fixing PIM:

1. Tighten RF-Connectors using appropriate torque
2. Cleaning connector interfaces with alcohol, Q-Tip and compressed air
3. Replace components (e.g. feeder connector)

9.1.1 PIM acceptance test

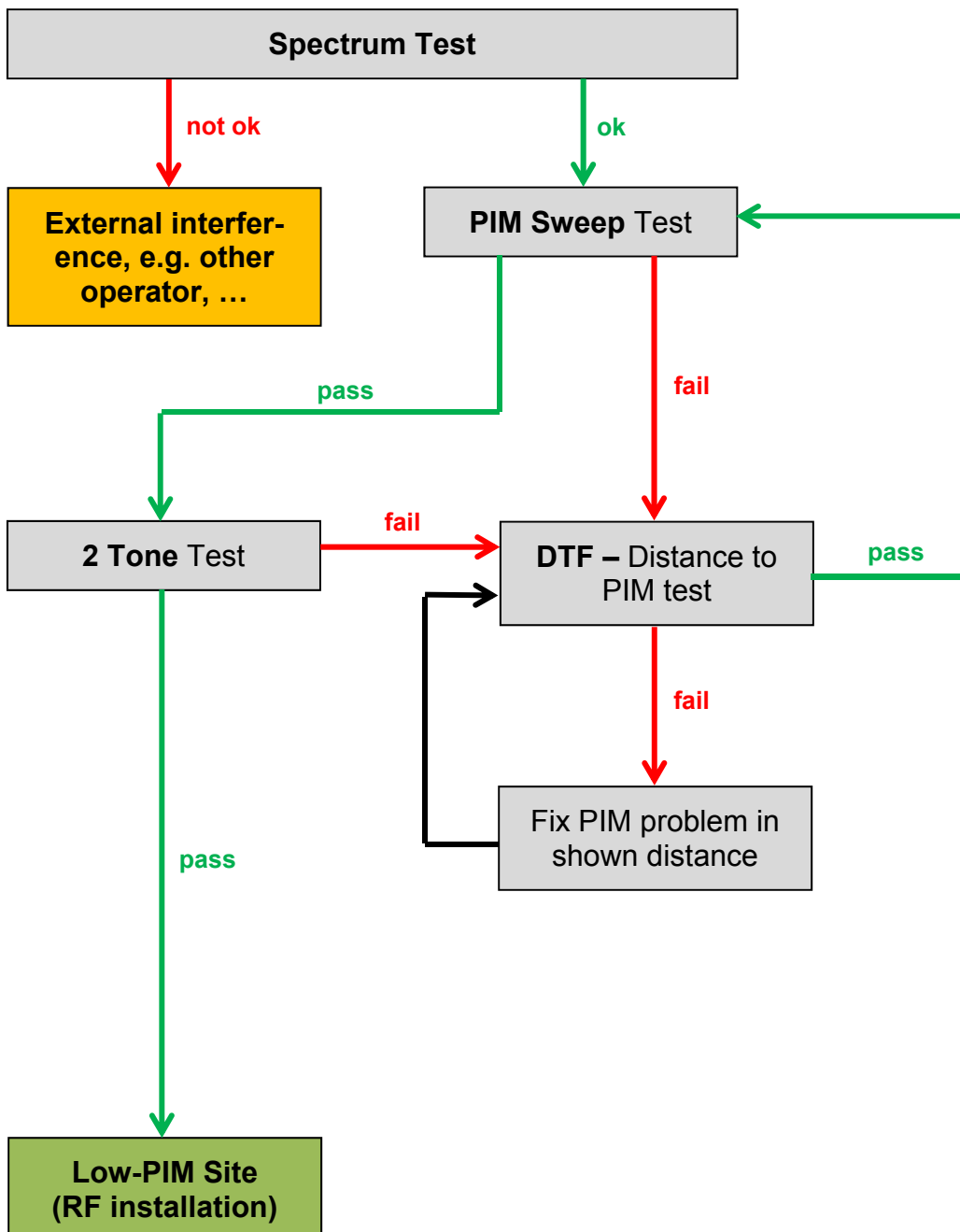
1. Disconnect cable from base station and connect it to the test port of the device
2. Disconnect the antenna and terminate the connection with a Low PIM Load (60Z150-020)
3. Do a 2 Tone measurement, during which you tap on every cable junction to simulate mechanical stress (e.g. wind)
4. Do a Sweep measurement over the widest possible frequency range
5. If PIM is not within specified limit refer to 9.1.2
6. IF PIM is within specified limit, create test report and save it

9.1.2 Troubleshooting a PIM problem

1. Disconnect cable from base station and connect it to the test port of the device
2. Disconnect the antenna and terminate the connection with a Low PIM Load (60Z150-020)
3. Use the Spectrum Analyzer to evaluate interference signals from external sources (e.g. mobile phones or other operator creating strong PIM signals) and eliminate them if present
4. Do a Sweep measurement to evaluate if the PIM depends on frequency
 1. If no PIM is present do a 2 Tone measurement with a tap test

2. If PIM is present do a DTF measurement to measure the distance to the static PIM in meters. If the value is not within cabling length, an environmental influence is causing the problem. (e.g. rusty roof, surge arrester, ...)
5. Fix the located PIM problem
6. Do an acceptance test, described in 9.1.1.

9.1.3 PIM testing flowchart



10 Troubleshooting

Problem	Probable causes	Possible remedy
Device won't turn on (with power unit)	<ul style="list-style-type: none"> - Power Unit is not equipped correctly - Device is not connected to power grid - Main switch is turned off - Malfunction within the power grid 	Check all cabling connections for power supply. Check if the main switch is turned to 'on' and ensure your power grid is working properly.
Device won't turn on (with battery unit)	<ul style="list-style-type: none"> - Battery Unit is not equipped correctly - Batteries are not equipped correctly - Battery charge is low 	Check if the batteries are equipped correctly and charge them if needed.
Software does not respond to any user actions anymore.	<ul style="list-style-type: none"> - Operating system Microsoft Windows doesn't work properly anymore 	Press on the power button and hold it until the device powers off. You can now turn it on, by pressing the button again.
CPRI Measurement button is not active.	<ul style="list-style-type: none"> - Software option is not activated 	Purchase the CPRI Software option
Unstable PIM	<ul style="list-style-type: none"> - Test Port loose, worn out or dirty 	Change Test Port Connector.
CPRI link not possible	<ul style="list-style-type: none"> - Incompatible SFPs for BBU equipped 	Change SFPs to match with BBU

11 Technical Specifications

11.1 Base Unit

11.1.1 General

Display	12.1" Touch screen, readable in direct sunlight
Dimensions	490 × 445 × 185 (L×W×H)
Weight	22 kg
RF Ports	
- Filter	7/16 DIN (F) Test port (4.3/10 DIN on request)
- Base Unit	P-SMP interconnect to Filter, N-Type (F) Isolation
User Interface Ports	2×USB, LAN
Power Supply	Battery Powered or AC Mains supply
Battery Life	120 min (typical use, non-pulsed CW measurement) 200 min (typical use, battery save mode) 30 min (continuous operation non-pulsed CW at +43dBm)
Frequency Stability	± 2.5 ppm

11.1.2 PIM Analyzer RF (Base Unit)

IM Order	3 rd , 5 th , 7 th , 9 th , 11 th , 13 th , 15 th , 17 th
Output Power	26 – 49 dBm equals 23 – 46 dBm at Testport
Residual PIM	< -125 dBm (> 168 dBc @ 2x +43 dBm)
PIM vs. Distance	
- Accuracy / Resolution	0.2 m (typ) Depends on number of PIM sources and accuracy of cable velocity factor
- Range	Down to -120 dBm PIM, 0 - 150 m
Frequency Range (seamless)	698 ... 2700 MHz
Filter Units	Changeable to frequency bands

11.1.3 PIM Analyzer CPRI (SW Option)

Fiber Interface	CPRI up to Rate 7
IM Order	3 rd , 5 th , 7 th
Carrier types	LTE5, LTE10, LTE20, (LTE15 on request)
PIM Range	-130 dBm noise floor (depends on RRH NF & Bandwidth)

11.1.4 Isolation Measurement RF

Frequency	Downlink frequency band of filter unit
RF Output	+23 – 46 dBm
RF Input	+27 dBm max. operating +30 dBm max. no damage +50 VDC max. no damage
Isolation	0 – 60 dB
- Accuracy	1.5 dB
- Resolution	0.1 dB

11.1.5 VSWR / Return Loss RF

Frequency	Downlink frequency band of filter unit
VSWR	1.10 – 20.00
Return Loss	1.00 – 25.00 dB
Distance to VSWR fault	
- Accuracy / Resolution	0.2 m (typ) Depends on number of mismatch sources and accuracy of cable velocity factor
- Range	0 – 150 m

11.1.6 Spectrum Analyzer RF

Frequency	Uplink frequency band of filter unit
Resolution Bandwidth	120 Hz to 20 MHz RBW
Noise Floor	-135 dBm DANL at 1 kHz
Amplitude Accuracy	± 1.0 dB typ, ± 1.5 dB max
RF Input	-40 dBm max. operating +10 dBm max. no damage
Sweep Time	2.5s over full band at 1 MHz RBW

11.1.7 Environmental

Operating Temperature Range	-10° C to +40° C
Storage Temperature Range	-20° C to +80° C
Relative Humidity	5% to 95% RH non-condensing
Mechanical Shock	40G

11.1.8 User Interfaces

Keyboard/USB-Memory	2 × USB A connector
Remote Control	1 × LAN, WiFi (802.11abgn), 1 × Micro-USB B connector
Reference	1 × SMP 10 MHz
CPRI	2 × SFP
Isolation	1 × N-Type
Supply	1 × DC magnetic connector / 1x AC IEC C13

11.2 Filter Units

11.2.1 General

Dimensions	365 × 333 × 71 / 96 (L×W×H) depends on frequency band
Weight	5 – 7 kg (depends on frequency band)
Internal Ports	5 × P-SMP, SLC landing socket
RF Port	Field replaceable Testport 7/16 DIN, 4.3/10 DIN (opt)

11.2.2 Environmental

Operating Temperature Range	-10° C to +40° C
Storage Temperature Range	-20° C to +80° C
Relative Humidity	5% to 95% RH non-condensing
Mechanical Shock	40G

11.2.3 IM-A-FI-700/B12-14 (LTE700 LU)

ETSI Band	B12, B13, B14
Transmit Path	
- Range TX1	728 – 740 MHz
- Range TX2	750 – 764 MHz
Receive Path	
- Range B12 (700L)	698 – 716 MHz
- Range B13+14 (700U)	776 – 798 MHz
Residual PIM	< -125 dBm (> 168 dBc), referred to 2 × +43 dBm
Size	365 × 333 × 96 (L×W×H)
Weight	7 kg

11.2.4 IM-A-FI-800/B20 (DigiDiv800)

ETSI Band	B20
Transmit Path	
- Range TX1	791 – 803 MHz
- Range TX2	812 – 821 MHz
Receive Path	
- Range	832 - 862 MHz
Residual PIM	< -125 dBm (> 168 dBc), referred to 2 × +43 dBm
Size	365 × 333 × 96 (L×W×H)
Weight	6.8 kg

11.2.5 IM-A-FI-850/B5 (AMPS850)

ETSI Band	B5
Transmit Path	
- Range TX1	869 – 880 MHz
- Range TX2	885 – 894 MHz
Receive Path	
- Range	824 - 851 MHz
Residual PIM	< -125 dBm (> 168 dBc), referred to 2 × +43 dBm
Size	365 × 333 × 96 (L×W×H)
Weight	6.6 kg

11.2.6 IM-A-FI-900/B8 (EGSM900)

ETSI Band	B8
Transmit Path	
- Range TX1	925 – 939 MHz
- Range TX2	946 – 960 MHz
Receive Path	
- Range	880 - 915 MHz
Residual PIM	< -125 dBm (> 168 dBc), referred to 2 × +43 dBm
Size	365 × 333 × 96 (L×W×H)
Weight	6.4 kg

11.2.7 IM-A-FI-1800/B3 (DCS1800)

ETSI Band	B3
Transmit Path	
- Range TX1	1805 – 1840 MHz
- Range TX2	1850 – 1880 MHz
Receive Path	
- Range	1710 - 1785 MHz
Residual PIM	< -125 dBm (> 168 dBc), referred to 2 × +43 dBm
Size	365 × 333 × 96 (L×W×H)
Weight	7 kg

11.2.8 IM-A-FI-1900/B2+4 (PCS/AWS1900)

ETSI Band	B2, B4
Transmit Path	
- Range TX1	1930 – 1950 MHz
- Range TX2 (B2 PCS)	1970 – 1995 MHz
- Range TX2 (B4 AWS)	1970 – 2155 MHz
Receive Path	
- Range (B2 PCS)	1850 - 1910 MHz
- Range (B4 AWS)	1710 – 1755 MHz
Residual PIM	< -125 dBm (> 168 dBc), referred to 2 × +43 dBm
Size	365 × 333 × 71 (L×W×H)
Weight	7 kg

11.2.9 IM-A-FI-2100/B1 (UMTS2100)

ETSI Band	B1
Transmit Path	
- Range TX1	2110 – 2130 MHz
- Range TX2	2150 – 2170 MHz
Receive Path	
- Range	1920 - 2060 MHz
Residual PIM	< -125 dBm (> 168 dBc), referred to 2 × +43 dBm
Size	365 × 333 × 71 (L×W×H)
Weight	7 kg

11.2.10 IM-A-FI-2600/B7 (LTE II 2600)

ETSI Band	B7
Transmit Path - Range TX1 - Range TX2	2620 – 2637 MHz 2660 – 2695 MHz
Receive Path - Range	2445 -2590 MHz
Residual PIM	< -125 dBm (> 168 dBc), referred to 2 × +43 dBm
Size	365 × 333 × 71 (L×W×H)
Weight	5 kg

12 CE - Declaration of Conformity

Place and Date:	Fridolfing, August 21st, 2007, update June 15th, 2016
Manufacturer:	Rosenberger Hochfrequenztechnik GmbH & Co. KG
Address:	Hauptstraße 1, 83413 Fridolfing, Germany

declare under our sole responsibility that the product

Intermodulation Test Set

IM-07S, IM-08S, IM-09S, IM-18S, IM-19S, IM-21S, IM-26S, IM-35S
IM-07P, IM-08P, IM-85P, IM-09P, IM-18P, IM-19P, IM-21P, IM-26P, IM-35P
IM-07P-BB, IM-08P-BB, IM-85P-BB, IM-09P-BB, IM-18P-BB, IM-19P-BB, IM-21P-BB,
IM-0710-BB, IM-1822-BB, IM-2526-BB, IM-3435-BB, IM-0722-BB
IM-A-BU-0727

to which this declaration relates is in conformity with the following EC-directives:

73/23/EWG Low-voltage-directive
89/336/EWG Electromagnetic-compatibility-directive

and complies with the following standards or normative documents:

Safety

- EN 61010-1-1

EMC

- EN 55022
- EN 50082-2
- EN55011: Group 1 Class A
- EN 61000-4-2
- EN 61000-4-3
- EN 61000-4-4
- EN 61000-4-6



Christian Entsfellner
Productmanager
R&D PIA Manager

13 Accessories

13.1 Battery Unit



People with cardiac stimulator must not expose the magnetic field of the batteries, the battery unit, the power unit or the charging cable.

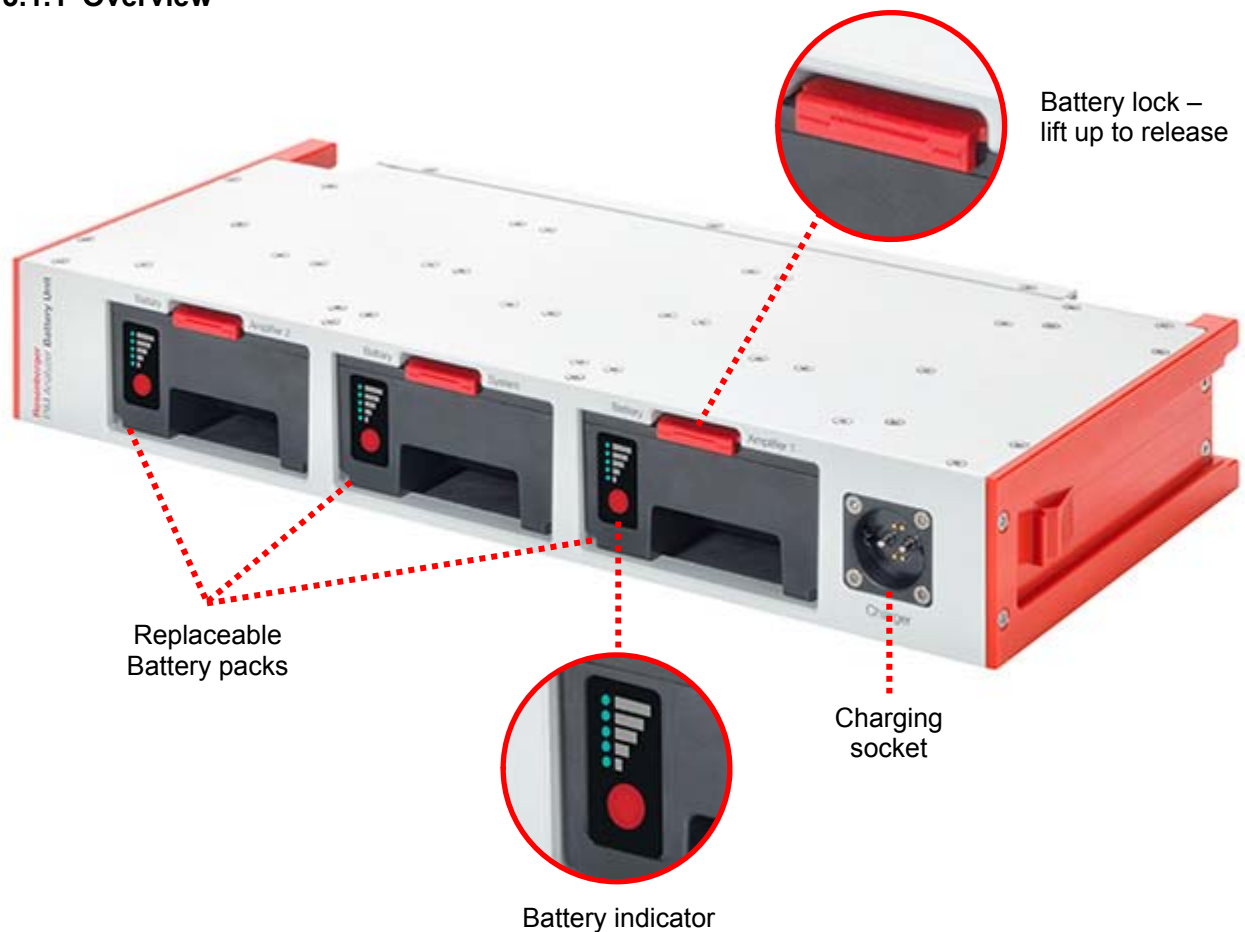
For mobile operation the optional battery unit is available (Rosenberger No. IM-A-BU-BU). It holds three replaceable battery packs (included). Additional battery packs can also be purchased separately (Rosenberger No.: IM-A-BU-BAT).

The battery unit has three slots for battery packs. Each one is labeled and has a dedicated function. If you want to perform RF measurements, all three slots have to be equipped with a battery pack.



If one of the “Amplifier” slots is equipped with a loaded battery pack, the “System” battery can be replaced while the device is running

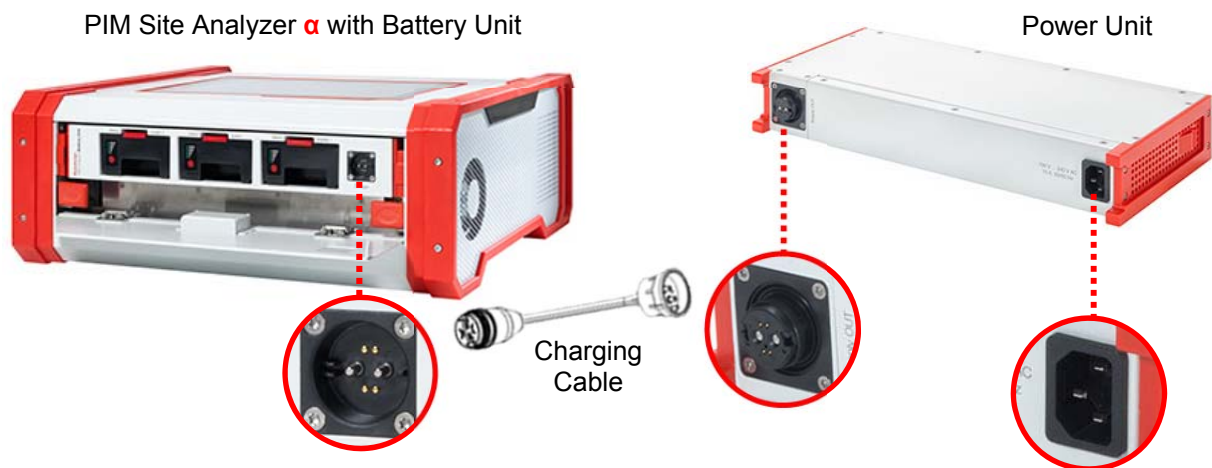
13.1.1 Overview



13.1.2 Installing

To install the battery unit, follow the installation instructions for the power unit, described in chapter 3.

13.1.3 Charging the batteries



13.2 Filter Units

Rosenberger No.	Frequency Band	E-UTRA band	Freq. Range RX	Freq. Range TX
IM-A-FI-700/B12-13	LTE 700 LU	12, 13, 14, 17	698 – 716 MHz 776 – 798 MHz	728 – 760 MHz
IM-A-FI-800/B20	DigDiv	20	832 – 862 MHz	792 – 822 MHz
IM-A-FI-850/B5	AMPS 800	5	824 – 849 MHz	869 – 894 MHz
IM-A-FI-900/B8	EGSM 900	8	880 – 915 MHz	925 – 960 MHz
IM-A-FI-1800/B3	DCS 1800	3	1710 – 1785 MHz	1805 – 1880 MHz
IM-A-FI-1900/B2+4	PCS 1900 / AWS	2, 4	1710 – 1910 MHz	1930 – 2155 MHz
IM-A-FI-2100/B1	UMTS 2100	1	1920 – 2060 MHz	2110 – 2170 MHz
IM-A-FI-2600/B7	UMTS II / LTE 2600	7	2545 – 2580 MHz	2620 – 2695 MHz

13.3 Software option (CPRI)

To perform CPRI measurements with the PIM Site Analyzer α a special software option has to be purchased and activated. After purchasing the option you will receive a license file which you need to import on your PIM Site Analyzer α .

13.4 Bag



13.5 Other Accessories

	Part Number	Description
Useful α Accessories	IM-A-ACSRy-Bag-BU	Carrying bag for Base Unit
	IM-A-ACSRy-Bag-ACSRy	Carrying bag for two Filters, Batteries, Jumper test cables and Tools
	IM-A-ACSRy-Bag-Trolley	Transportation Trolley for both accessory bags
	IM-A-ACSRy-Case-BU	Transportation case for Base Unit
α Spare Parts	60K408-800N1	7/16 Testport Saver for use on α Filter
	64K401-800B1	4.3/10 Testport Saver for use on α Filter
	IM-A-ACSRy-Bat	Battery Pack
Low PIM Adaptors	60S101-KIMN1	7/16 Male to 7/16 Female adapter
	60S101-SIMN1	7/16 Male to 7/16 Male adapter
	60K101-KIMN1	7/16 Female to 7/16 Female adapter
	60S153-KIMN1	7/16 Male to N Female adapter
	53S160-KIMN1	7/16 Female to N Male adapter
	60S164-K00N1	7/16 Male to 4.3/10 Female adapter
	60S164-S00N1	7/16 Male to 4.3/10 Male adapter
	60K164-S00N1	7/16 Female to 4.3/10 Male adapter
PIM Standards	60S110-KxxN1	-110dBm standard adapter (band specific) included with every filter unit
	xx: 07 LTE700; 08 DigDiv AMPS; 09 EGSM; 18 DCS; 19 PCS/AWS;	
	21 UMTS; 26 LTE2600; other frequencies on request	
Low PIM Terminations	60Z150-020	Low PIM termination (portable, with male & female ports)
	60Z150-012	Low PIM termination (Benchtop type)
Tools	60W000-002	32mm torque wrench
	53W010-000	18mm torque wrench
	99W057-000	Adjustable flat wrench
Test Cables	LC02-186-4000	Test Cable 7/16 male / 7/16 male 4.0m
	LC02-186-1500	Test Cable 7/16 male / 7/16 male 1.5m
	LC02-188-4000	Test Cable 7/16 male / N male 4.0m
	LC02-188-1500	Test Cable 7/16 male / N male 1.5m
	SLJ12SP-60M64M-2.0m-00	Test Cable 7/16 male / 4.3/10 male 2.0m
	SLJ12SP-64M64M-2.0m-00	Test Cable 4.3/10 male / 4.3/10 male 2.0m

14 Support and Sales Locations

14.1 Europe, Middle East, Africa

Rosenberger Hochfrequenztechnik GmbH & Co. KG
Hauptstraße 1
83413 Fridolfing, Germany
Phone +49 8684 18-0
Fax +49 8684 18-1499
info@rosenberger.de
www.rosenberger.com

Rosenberger Site Solutions GmbH
Mayerhofen 45A
83410 Laufen, Germany
Phone +49 8684 18-5000
Fax +49 8684 18-1499
siso@rosenberger.de
www.rosenberger.com/siso

14.2 Americas

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Certified by ISO/TS 16949 · DIN EN 9100 · ISO 9001 · ISO 14001

Order No.

pA 325248 · EIM-A-ACSRy-OM-en

6/2016

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