R&S®TSMW Universal Radio Network Analyzer

Scanner with high dynamic range for WiMAX measurements and I/Q streaming

75 Years of Driving Innovation

ROHDE & SCHWARZ

Universal Radio Network Analyzer R&S®TSMW

At a glance

The R&S®TSMW universal radio network analyzer is a high-end platform for optimizing all conventional mobile radio networks. Two highly sensitive 20 MHz frontends for any input frequency from 30 MHz to 6 GHz, a dual-channel preselection and an FPGA-based software-defined architecture offer unsurpassed performance while providing maximum flexibility and operational readiness. In addition to functioning as a WiMAX scanner, the R&S®TSMW is also an ideal digital I/Q receiver for customer-specific applications.

Owing to its hardware platform, the R&S®TSMW universal radio network analyzer offers maximum flexibility. For example, the R&S®TSMW comes in handy as a WiMAX scanner, and it can be utilized to roll out and optimize IEEE 802.16e networks (R&S®TSMW-K28 WiMAX option). In addition, the R&S®TSMW can be used as an I/Q realtime scanner. The R&S®TSMW-K1 option offers one MATLAB® and one C++ interface via which I/Q measurement data can be transmitted and evaluated.

Key facts

▪ User-definable input frequency range from 30 MHz to 6 GHz
▪ Two independent RF and signal processing paths, each with a bandwidth of 20 MHz
▪ Integrated preselection for high intermodulation suppression while dynamic range is high
▪ Support of WiMAX IEEE 802.16e measurements together with the R&S®ROMES drive test software (R&S®TSMW-K28)
▪ I/Q baseband measurement with Gigabit interface (R&S®TSMW-K1)
▪ Future-ready software-defined architecture
▪ Integrated GPS

Universal Radio Network Analyzer R&S®TSMW
Benefits and key features

WiMAX network roll-out and network optimization
❚ Checking of neighboring cells
❚ Easy detection of coverage gaps
❚ Scan function for detecting unknown WiMAX carrier frequencies
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All-in-one drive test solution with R&S®ROMES
❚ Network optimization together with WiMAX terminal
❚ Improvement of IEEE802.16e network QoS
❚ Verification of successful handover
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Maximum flexibility when evaluating I/Q data with MATLAB® and C++ interface
❚ Measurement of I/Q raw data
❚ Data access via MATLAB® or C++ interface
❚ Air interface analysis, e.g. of non-specified wireless communications standards such as LTE variants or proprietary standards
▷ page 7

Unsurpassed hardware platform performance and flexibility
❚ Broadband with 20 MHz bandwidth and maximum frequency range from 30 MHz to 6 GHz
❚ Top dynamic range and measurement accuracy owing to adaptive preselection
❚ Parallel scanning on multiple center frequencies with outstanding measurement speed
❚ Update of hardware platform via software
❚ Integration of SuperSense GPS
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WiMAX network roll-out and network optimization

When combined with the WiMAX option, the WiMAX test data card and the R&S®ROMES drive test software, the R&S®TSMW provides a simple solution for assuring fast roll-out and profitoriented network optimization.

Checking of neighboring cells

As a universal mobile radio scanner, the R&S®TSMW is a platform that is open for all technologies. When operated together with the R&S®ROMES drive test software, the R&S®TSMW-K28 WiMAX scan option can perform detailed measurements on the air interface. Owing to its high sensitivity and wide dynamic range, the scanner can detect all existing WiMAX signals – even if they are considerably below the noise level. Missing neighborhoods or interferences can therefore be detected, which is not possible when using a WiMAX test data card.

Easy detection of coverage gaps

In addition to the basic WiMAX parameters (bandwidth, FFT size, length of cyclic prefix, segment number used, ID cell and frame rate), preamble-related parameters such as RSSI, CINR and preamble ID can also be measured. These parameters can then be used, for example, to detect unwanted signals and coverage gaps. Particularly during a network roll-out, these measurements play an important role. Since the hardware platform is flexible, parallel measurements of a variety of different WiMAX carriers is no problem.

Typical configuration of a WiMAX drive test system consisting of the R&S®TSMW, test data card and R&S®ROMES software

All-in-one drive test solution with R&S®ROMES

When used together with the R&S®TSMW, the R&S®ROMES drive test software also supports WiMAX test data cards. The R&S®TSMW can be used to detect and eliminate errors caused by a WiMAX data card.

Network optimization and verification of successful handover

When used together with the R&S®TSMW, the R&S®ROMES drive test software also supports WiMAX test data cards. These cards are used to detect network errors during an active connection. Two examples of such errors are faulty handover or insufficient data throughput. The R&S®TSMW WiMAX scanner simultaneously delivers additional measurement data of the entire air interface. This data can provide clues about missing neighboring cells or interferences.

R&S®ROMES offers a wealth of display alternatives for this purpose. Scanner-specific evaluations are, for example, the TopN values and the channel impulse response (CIR), which gives the user a general idea about the properties of the WiMAX channel and the multipath propagation.

Measurements

Regardless of the network infrastructure or chipsets of the terminals, the scanner returns the following measurement results across all WiMAX frequencies:

- Rank within the TopN pool
- Preamble index
- Segment
- ID cell
- Mode (average/max)
- RSSI
- CINR
- Center frequency
- Bandwidth
- FFT size
- Cyclic prefix ratio
- Frame rate
- Base station name
- Distance (to BTS)

Typical WiMAX drive test configuration

WiMAX data card   R&S®ROMES software

All important information at a glance

Several predefined measurement displays are available for WiMAX terminals. Theses include the protocol view with MAC protocol information and IP protocol messages, and the overview with physical, qualitative and statistical parameters.

The user can see all important information about the currently active cell at a glance.

Equipment required for WiMAX drive tests:

❙ R&S®TSMW universal radio network analyzer
❙ R&S®TSMW-K28 WiMAX scanner option for R&S®ROMES
❙ R&S®TSMW-Z1 power supply
❙ R&S®ROMES4 drive test software
❙ R&S®ROMES4T1W WiMAX scanner driver for R&S®ROMES
❙ R&S®ROMES4WMX: R&S®ROMES driver for WiMAX data cards
❙ R&S®ROMES4DQA: R&S®ROMES option for data quality analysis
❙ Data card based on Beceem chipset
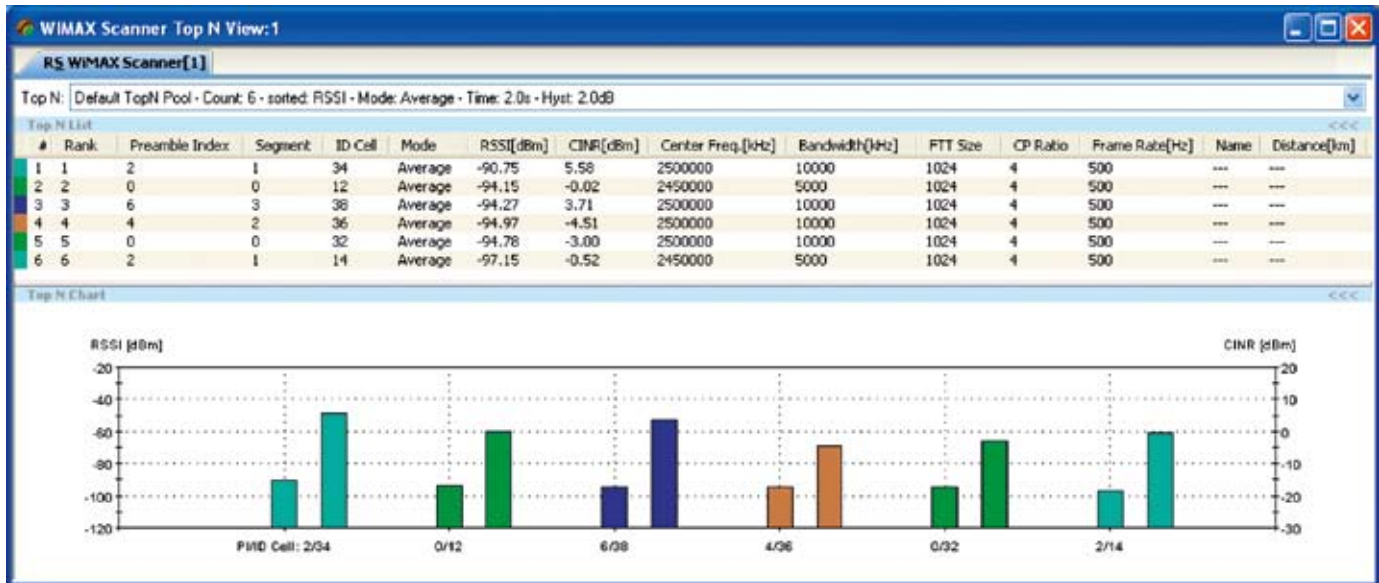
Scanner measurement: display of all WiMAX signals present on the air interface, sorted by signal strength
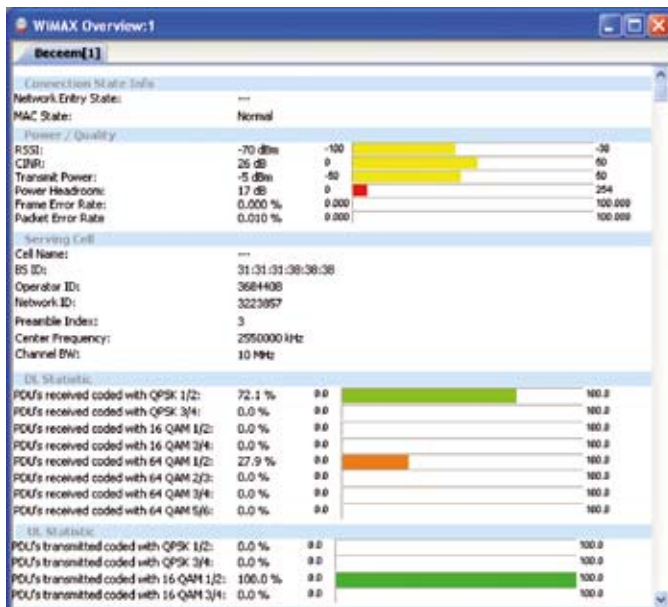
Overview of the cell currently active, measured by a WiMAX test data card based on a Beceem chipset

Maximum flexibility when evaluating I/Q data

The demo application makes it possible to define the center frequency, the sampling rate and the measurement filter. In this context, the measurement filter is used primarily to define the bandwidth to be measured. Individual measurements or continuous measurements may be carried out. The user can also define which of the two R&S®TSMW receivers is to be used.

For professional applications, it is furthermore possible to set the attenuation values, the activation of the preamplifier, and the data format of the digital I/Q data.

To reduce the amount of data accumulated, the application offers bit resolutions of 8 bit, 12 bit, 16 bit and 20 bit. Users can therefore reduce the transmission rate on the LAN interface.

Measurement and recording of I/Q raw data in real-time with data access via MATLAB® or C++ interface

A special asset of the R&S®TSMW is its R&S®TSMW-K1 digital I/Q data interface. Both a flexible MATLAB® interface and an equivalent C++ interface are available. They make it possible to perform measurements directly on the R&S®TSMW and to process the results on the PC. Users can thus, for example, not only design and analyze receiver algorithms in MATLAB®, but also port them to C++ as a realtime version. Or they can even perform technology-independent channel measurements, which can be used to simulate realistic fading scenarios in the lab.

The R&S®TSMW-K1 digital I/Q interface

The demo application included in the R&S®TSMW-K1 option is based on MATLAB® code and may be used for initial reference measurements in the frequency and time domains. Likewise, the demo application may be utilized as a skeletal structure for customized applications in order to quickly obtain the measurement results needed.

Materials included with the R&S®TSMW-K1 option

In addition to the demo application, the materials supplied together with the R&S®TSMW-K1 option include an operating and a programming manual. The programming manual supplies all information regarding the required MATLAB® functions and data structures. To enable users to immediately start operating the R&S®TSMW together with the demo application, a MATLAB® runtime license is included.

Equipment required for performing I/Q measurements

- R&S®TSMW universal radio network analyzer
- R&S®TSMW-K1 digital I/Q interface
- R&S®TSMW-Z1 power supply
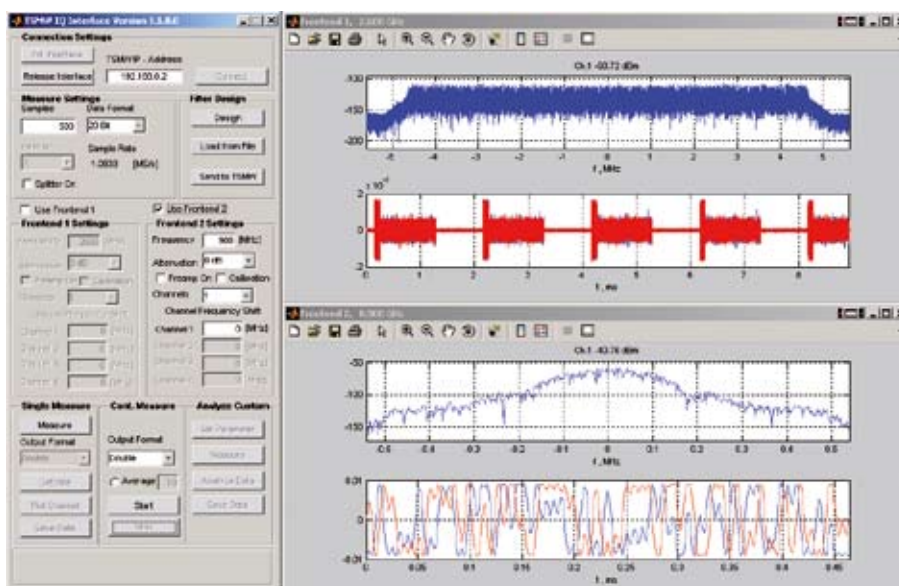
The left-hand side of this screenshot shows the demo application for configuring the settings. The right-hand side shows the measurement result in the frequency domain (blue) and time domain (red/blue) for each receiver

Unsurpassed hardware platform performance and flexibility

Broadband with 20 MHz bandwidth and maximum frequency range from 30 MHz to 6 GHz

The R&S®TSMW universal radio network analyzer from Rohde & Schwarz offers a hardware platform with maximum flexibility. The two integrated broadband receivers (30 MHz to 6 GHz) with a bandwidth of 20 MHz each and a separate preselection open the door to a variety of applications.

Parallel scanning on multiple center frequencies with outstanding measurement speed

The two receivers can be operated independently or in combination with one another. Depending on the application, the measurement speed can be increased in this manner, and the measurement bandwidth can be expanded.

Featuring a high measurement bandwidth of 20 MHz, the R&S®TSMW is optimally suited particularly for new wireless communications standards such as WiMAX. Even measurements during development can be performed on standards that have not yet been specified (LTE, for example) together with the solution based on MATLAB®. By virtue of the promising and widely used Gigabit Ethernet LAN interface, operation even at high measurement rates is no problem.

Top dynamic range and measurement accuracy owing to adaptive preselection

To achieve top measurement accuracy and dynamic range, the R&S®TSMW has an integrated preselection. Thus, multiple adjustable filters reduce intermodulations in advance. The analyzer can therefore detect signals with a sensitivity that is considerably below the noise level (noise figure 7 dB at 3.5 GHz).
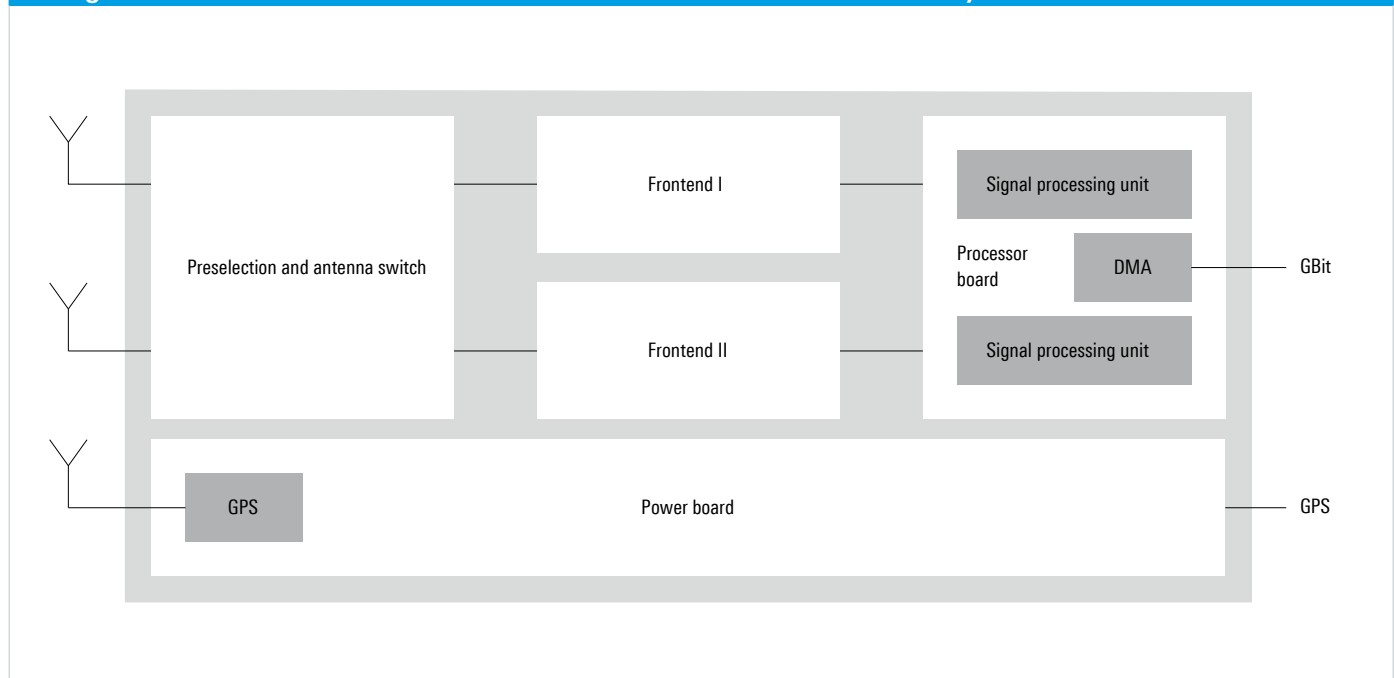
Update of hardware platform via software

The hardware platform can be updated and its functionality enhanced by means of software. This allows the R&S®TSMW to be expanded in the field to handle additional technologies without having to be sent in for an upgrade. Only the specific options required are added, for example when the user wants to convert an I/Q scanner to a WiMAX scanner.

Integration of SuperSense GPS

An integrated SuperSense GPS receiver with 16 channels and a refresh rate of 4 Hz also allows the analyzer to be used in areas with weak GPS signals.

Configuration of the dual-channel R&S®TSMW universal radio network analyzer

Specifications

Base unit data		
RF characteristics		
Frequency range		30 MHz to 6 GHz
Reference frequency	internal	1×10^{-6} aging per year
Level measurement uncertainty	S/N > 16 dB	<1 dB at 30 MHz to 2500 MHz <1.5 dB at 2500 MHz to 6000 MHz
Maximum permissible input level		5 dBm/0 V DC
Noise figure	preamplification on preamplification off	typ. 7 dB at 3500 MHz typ. 19 dB at 3500 MHz
Intermodulation-free dynamic range	preamplification on: level 2 × –45 dBm preamplification off: level 2 × –35 dBm	typ. –65 dBc (–12.5 dBm TOI) at 3500 MHz typ. 70 dBc (0 dBm TOI) at 3500 MHz
RF receive paths	independent	2
VSWR	30 MHz ≤ f ≤ 2.5 GHz 2.5 GHz ≤ f ≤ 6 GHz	typ. 1,5 typ. 1,7
Preselection channels	per RF path (used as tracking filters)	5 (3)
WiMAX characteristics		
Frequency bands supported		no restrictions
Measurement speed		5 measurements/s
Preamble decoding accuracy	frame duration: 2 ms; FFT size 1024; bandwidth 10 MHz	
Sensitivity for initial preamble decoding		<–97 dBm (RSSI)
Sensitivity for succeeded preamble decoding		<–112 dBm (RSSI)
I/Q characteristics		
Digital filter bandwidth, burst	burst	1.25 MHz to 20 MHz
Digital filter bandwidth, streaming	hardware requirements: Gbit LAN link, jumbo frames 8k, transfer rate hard disk: 40 Mbyte/s	max. 10 MHz
Resampling rate		2 MHz to 21.94 MHz
Demodulation bandwidth		20 MHz
Data format	14-bit ADC resolution	8 bit, 12 bit, 16 bit or 20 bit
I/Q buffer size		200 Mbyte
Physical characteristics		
RF inputs	SNAP N connector	50 Ω
Data interface	RJ-45	10/100/1000BaseT
External reference input	BNC female	50 Ω
External trigger input/output	BNC female	5 V, TTL
GPS antenna connector	SMA female/active GPS antenna	50 Ω/3 V max. 100 mA
GPS USB interface (standalone)		type B USB connector
Operating temperature range		+5 °C to +40 °C
Permissible temperature range		0 °C to +50 °C
Storage temperature range	EN 60068-2-1 and EN 60068-2-2	–25 °C to +85 °C
Humidity	EN 60068-2-30	+50 °C at 95 % rel. humidity
EMC		in line with EN 61326 1997 + A1: 1998 + A2: 2001 + A3: 2003; class B (emission), EN 55011: 1998 + A1: 1999 + A2: 2002 (industrial immunity)
Safety		in line with IEC 61010–1: 2001 (Ed. 2), EN 61010–1: 2001 (second edition), UL 61010-1 (second edition), CAN/CSA-C22.2 NO. 61010-1

Base unit data		
Physical characteristics (continued)		
Mechanical resistance		
Vibration, sinusoidal		EN 60068-2-6
Vibration, random		EN 60068-2-64
Shock		40 g shock spectrum, in line with MIL-STD-810F, method 516.4, procedure 1
Dimensions (W × H × L)		180 mm × 130 mm × 270 mm (7.09 in × 5.12 in × 10.63 in)
Weight		5.1 kg (11.24 lb)
Power consumption		typ. 65 W, max. 10 A DC at 9 V
Input voltage		9 V to 18 V DC
Input current		max. 10 A DC
GPS receiver		
Sensitivity		
Acquisition		–148 dBm
Tracking		–158 dBm
Channels		16
Fixed time		
Cold/warm/hot start	at –125 dBm	41 s/33 s/<3.5 s
System requirements	R&S®ROMES drive test software [1]; controller (Pentium IV, 2 Gbyte RAM, Gigabit Ethernet, USB 1.0, USB required only if GPS standalone is used)	

[1] If the R&S®TSMW-K1 Gigabit digital I/Q interface is used, the R&S®ROMES drive test software is not required. Instead, MATLAB® or custom-specific software must be installed.

Ordering information

Designation	Type	Order No.
Base unit		
Universal Radio Network Analyzer	R&S®TSMW	1503.3001.02
Hardware options		
WiMAX Scanner Option (for R&S®ROMES)	R&S®TSMW-K28	1503.4543.02
Digital I/Q Interface	R&S®TSMW-K1	1503.3960.02
Software options		
WiMAX Scanner Driver for R&S®ROMES Drive Test Software	R&S®ROMES4T1W	1117.6885.02
Additional software options		
Drive Test Software	R&S®ROMES4	1117.6885.04
R&S®ROMES Driver for WiMAX Data Cards	R&S®ROMES4WMX	1117.6885.52
R&S®ROMES Option for Data Quality Analysis	R&S®ROMES4DQA	1117.6885.16
System components		
Power Supply	R&S®TSMW-Z1	1503.4608.02

Rear view of the R&S®TSMW

About Rohde & Schwarz

Rohde & Schwarz is an independent group of companies specializing in electronics. It is a leading supplier of solutions in the fields of test and measurement, broadcasting, radiomonitoring and radiolocation, as well as secure communications. Established 75 years ago, Rohde & Schwarz has a global presence and a dedicated service network in over 70 countries. Company headquarters are in Munich, Germany.

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More information at
www.rohde-schwarz.com

*0.14 €/min within German wireline network; rates may vary in other networks (wireline and mobile) and countries.