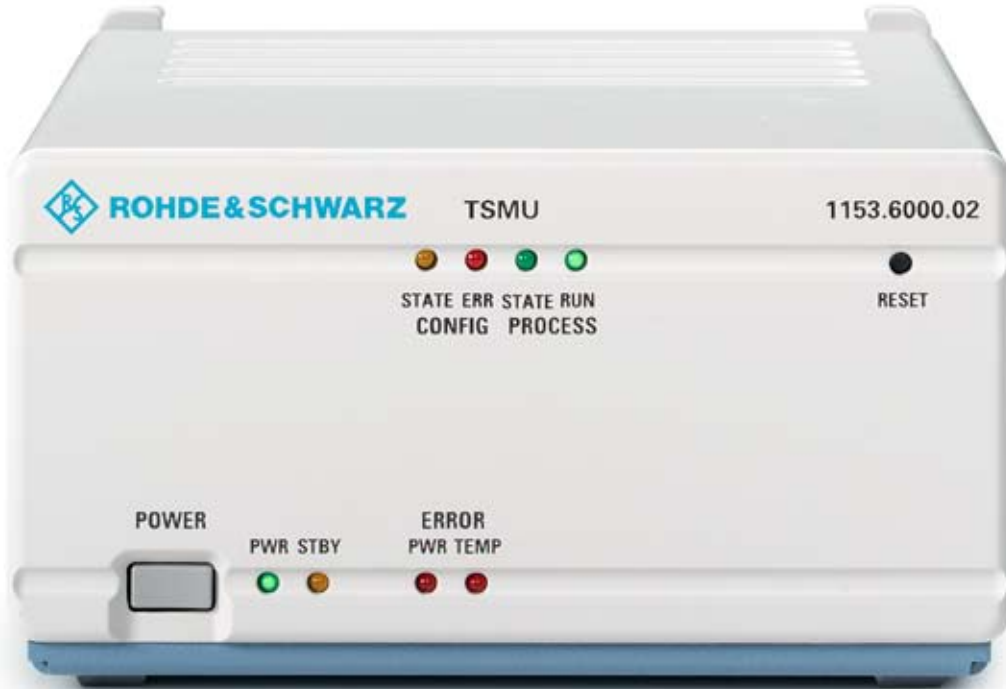# R&S®TSMU/TSMU-H Radio Network Analyzer

Universal platform for drive testing and coverage measurements

- ◆ WCDMA PN scanning (bands I to IX) with BCH (SIB) decoder (R&S®TSMU)
- ◆ GSM network scanning (all GSM bands) with system type info decoder (R&S®TSMU)
- ◆ CDMA2000® 1x PN scanning (SR1 band classes 0 to 16)
- ◆ Power measurement from 80 MHz to 3 GHz (R&S®TSMU)
- ◆ EMF applications (R&S®TSMU-H)

ROHDE&SCHWARZ

Versatile – future-proof – user-friendly

Front view of the R&S® TSMU

At a glance

Never before has so much performance been available in such a small package. The R&S®TSMU radio network analyzer is a uniquely compact solution for coverage testing of WCDMA, GSM, and other networks. All expertise in receiver and signal-processing technology has been combined in a unit that offers amazing capabilities.

Benefits

◆ Wideband receiver → applications possible with the same hardware for different technologies (GSM, WCDMA, CDMA2000® 1x, RF power, etc) → **universal usage, reduces investment costs**

◆ Modular concept → different applications covered by same basic hardware (indoor, outdoor, interference, QoS, etc) → **future-proof, easy upgrade to new technologies**

◆ Operation of several R&S®TSMU analyzers in parallel → for example, parallel WCDMA and GSM measurements for handover analysis → **reduces measurement time and costs**

◆ Light and compact design → ideal for drive test applications → **easy integration in vehicles and convenient use in a backpack**

◆ Software control via R&S®ROMES measurement software → flexible and powerful user interface → **reduces startup time and also offers powerful applications for post-processing**

◆ Easy system extensions with other sensors, e.g. test mobile phones, GPS, receivers, etc → **cost-effective upgrade to new applications**

WCDMA PN scanner application (bands I to IX)

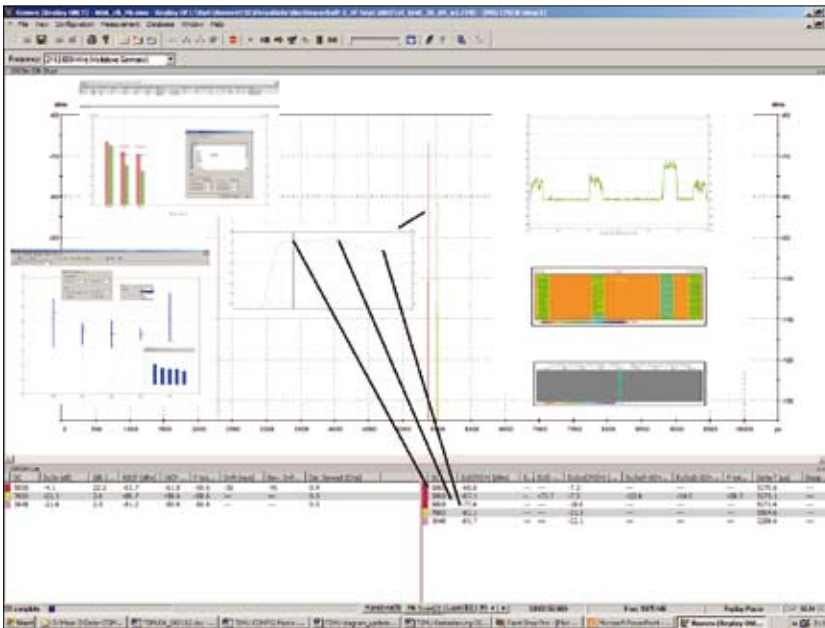## with the R&S®TSMU plus R&S®ROMES3NG and the R&S®TSMU-K11/-K14, R&S®ROMES3T11 options

The PN scanner system measures basic RF parameters of the WCDMA network. The actual carriers of the WCDMA signal, the pseudo-random noise (PN) codes, are detected and determined along with their power, scrambling code, and quality parameters, or with their S/N ratios and timing. All data can be immediately analyzed or stored for subsequent processing. A wide variety of display modes ensures that WCDMA parameters and network coverage quality are easy to examine.

Three basic test modes for the WCDMA PN scanner are available

◆ High-speed (HS) mode: standard test mode
 – Measurement on 12 channels (carriers) in parallel
 – 20 measurements per second
 – 2500 dynamic rake receivers
 – Timing parameter analysis: drift, deviation, delay spread, delta time, Doppler frequency shift
◆ High-dynamic (HD) mode: highly sensitive mode for small signal analysis
◆ Ultra-high-speed (UHS) mode: scientific mode for fading effect analysis and EMF tests on one scrambling code, tracer view for one scrambling code

What you can see on the display

◆ CPICH view with analysis of scrambling codes, timing parameter, and zoom on multipath signal
◆ Tracer view for one scrambling code
◆ Spectrum view for uplink and downlink bands in parallel
◆ Waterfall diagram for analysis of out-of-band interferers, for example
◆ TopN view with SIB decoder and hard and soft pilot pollution
◆ Pilot view with measured scrambling codes


WCDMA PN scanning, incl. TopN, CIR, and spectrum

CDMA2000® 1x and IS-95 PN scanner application (all bands)

with the R&S®TSMU plus R&S®ROMES3NG and the R&S®TSMU-K12, R&S®ROMES3T12 options

The CDMA2000® 1x PN scanner system measures basic RF parameters of a CDMA2000® 1x or IS-95 network. The carriers of the CDMA2000® signal, the pseudo-random noise (PN) codes are detected and determined along with their power, scrambling code, and quality parameters, or with their S/N ratios and timing. All data can be immediately analyzed or stored for subsequent processing. A wide variety of display modes ensures that CDMA2000® parameters and network coverage quality are easy to examine.

Features

◆ All bands or SR1 band classes 1 to 16 (e.g. 450, 850, 1900, 2 GHz, JTACS, TACS, Korean)
◆ Multicarrier with 12 channels
◆ Fast measurement rate of 10 Hz
◆ Fast synchronization time of 100 ms
◆ 2500 virtual rake receivers
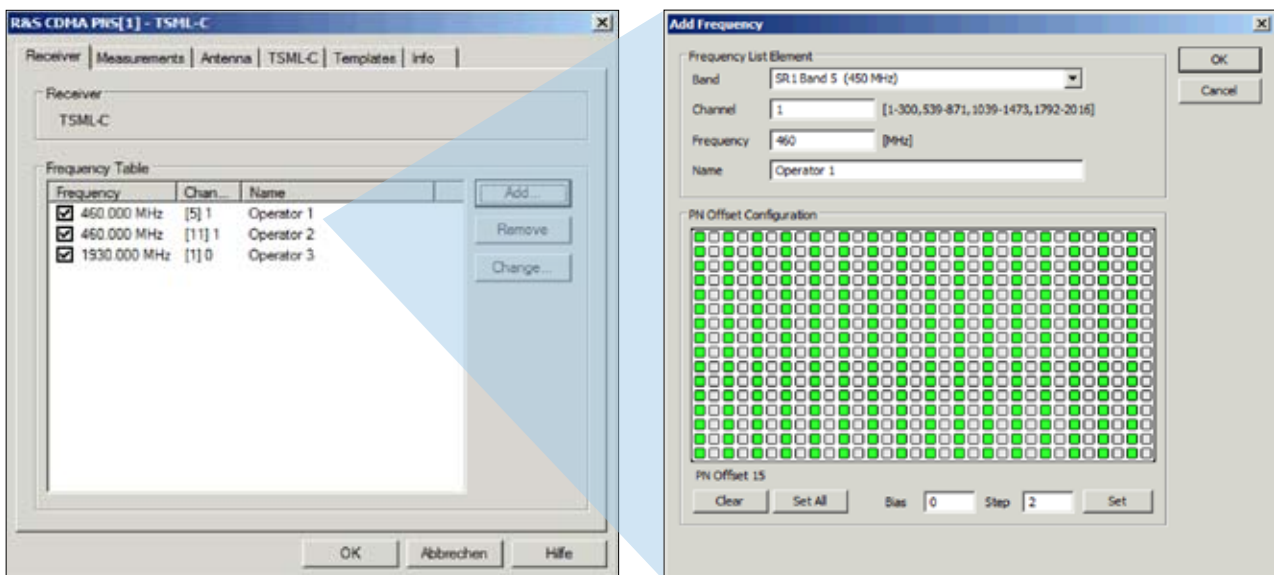
Receiver setup (max. 12 frequencies)

CDMA2000® is a registered trademark of the Telecommunications Industry Association (TIA – USA).

Functions of the R&S®TSMU for CDMA2000® 1x PN scanning

◆ TopN view
◆ Forward pilot channel overview
◆ Forward sync channel overview

The function of the CDMA2000® 1x PN scan is similar to the WCDMA PN scan. The TopN view and channel impulse response chart are structured like WCDMA views.

TopN view of all scanned scrambling codes
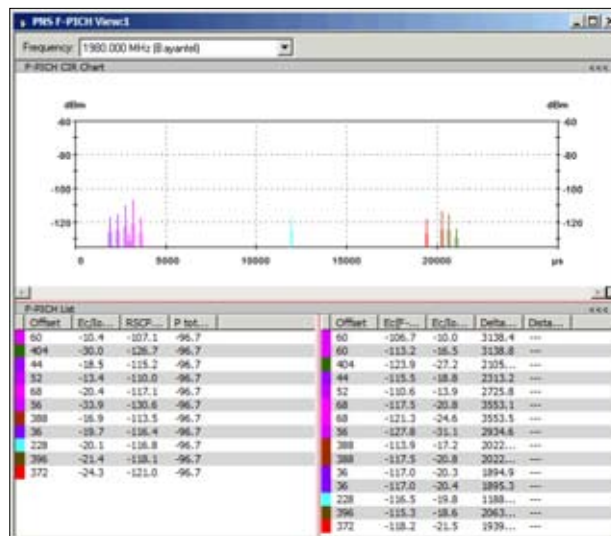
PN scanner F-PICH view with multipath signals

PN scanner F-Synch table view

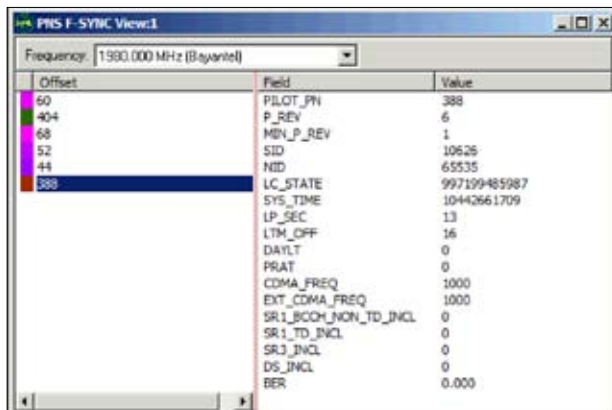# GSM network scanner application / C/I analysis (all GSM bands)

with the R&S®TSMU plus R&S®ROMES3NG and the R&S®TSMU-K13, R&S®ROMES3T13 options

The R&S®TSMU is the high-performance hardware platform for a GSM network scanner. The R&S®ROMES3NG coverage measurement software in combination with the R&S®TSMU-K13 GSM network scan driver and an optional GPS system are needed for a basic GSM network scan configuration. The application software runs on a standard PC or notebook with Windows® operating system.

GSM interference analysis is available as an extension to the basic system. A base station list and a GSM test mobile phone are needed in this case. The R&S®ROMES3NG software combines all the information coming from the R&S®TSMU network scanner, the test mobile phone, the GPS system, and the base station list for a complex analysis process. Special windows enable easy interpretation of the results.

Features

◆ Highly effective, time-saving GSM/GPRS/EDGE network optimization, independent from infrastructure

◆ All-band (GSM 450/480/850/900/1 800/1900), multichannel capability within one measurement setup

◆ Higher speed, higher accuracy compared to test mobile phones; no authentication necessary

◆ Combined operation with GSM/GPRS/EDGE test mobile phones for triggering and signaling

◆ Detection of roaming problems and interference by operators in neighboring countries

◆ Automatic measurement and demodulation of all GSM channels off-the-air – decodes system information types 1 to 4, including ARFCN, RF level, NCC, BCC, CI, LAC, MNC, MCC, base station name and position (if included in database)

◆ Delivers area coverage data, i.e. one measurement value for one time stamp and one position

◆ Integral part of the R&S®ROMES3NG network optimization system software platform

◆ Measurement rate: 80 channels/s
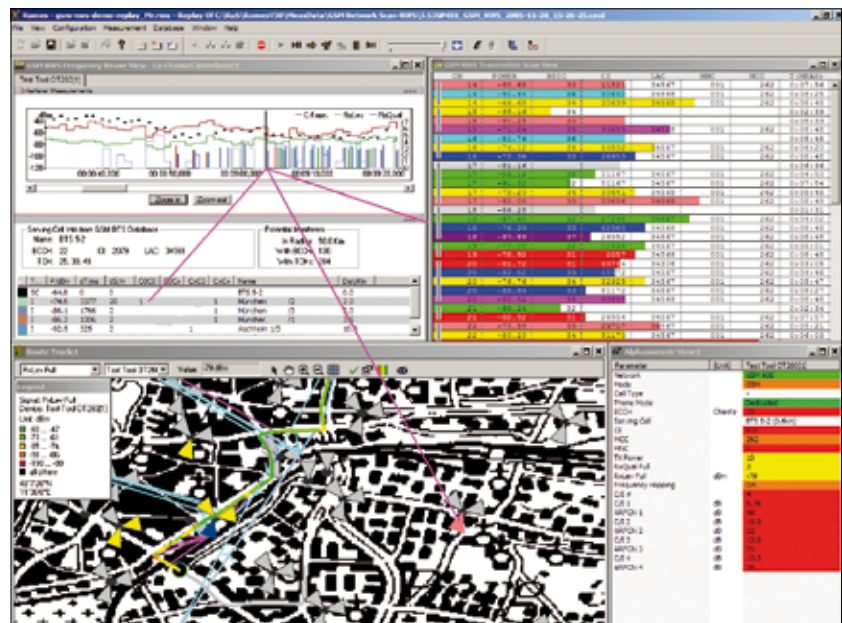
GSM network scanning, incl. interference analysis

RF power measurement (80 MHz to 3 GHz, variable bandwidth)

with the R&S®TSMU plus R&S®ROMES3NG and the R&S®TSMU-K15, R&S®ROMES3T15 options

Combining R&S®ROMES3NG with the R&S®TSMU RF power measurement driver is an extremely flexible approach for drive tests. Multiple technologies such as GSM (all-band), WCDMA, or TETRA can be measured with a single R&S®TSMU RF receiver.

The RF power measurement can be performed either on one specific frequency, on a frequency band (or parts of it), and on a random list of frequencies, all between 80 MHz and 3 GHz.

The trigger for the measurement is delivered either internally or externally (distance pulse input). The driver automatically calculates the distance pulses to the trigger rate for the required distance (e.g. Lee criterion).

The R&S®TSMU is the high-performance hardware platform for RF power measurement (CW application). R&S®ROMES3NG coverage measurement software in combination with the R&S®TSMU-K15 RF power measurement driver and an optional GPS system are needed for a basic RF measurement configuration. The application software runs on a standard PC or notebook with Windows® operating system.

The main advantage of the R&S®TSMU RF measurement compared to dedicated solutions (restricted to one band, e.g. GSM 900 or GSM 1800) is the broad RF frequency range from 80 MHz to 3 GHz. This makes universal application possible.

The R&S®TSMU RF measurement can be applied to

◆ Broadcast bands
◆ TV bands
◆ TETRA
◆ All GSM bands
◆ WCDMA bands I to VI, VIII, IX
◆ All other frequencies in the range 80 MHz to 3 GHz
◆ Variable bandwidth selection

Features

◆ Multitechnology and multiband
◆ User-configurable frequency range 80 MHz to 3 GHz
◆ Optimized for fast and accurate power measurement (e.g. 20 GSM channels with 1.6 ms cycle time)
◆ Single-frequency, frequency-list, frequency-band measurements
◆ Time- and distance-triggered measurements (distance under development)
◆ Generation of data in accordance with Lee criterion (with external distance trigger, under development)
◆ Automatic and manual tracking (test mobile phone reports, RF to be set)
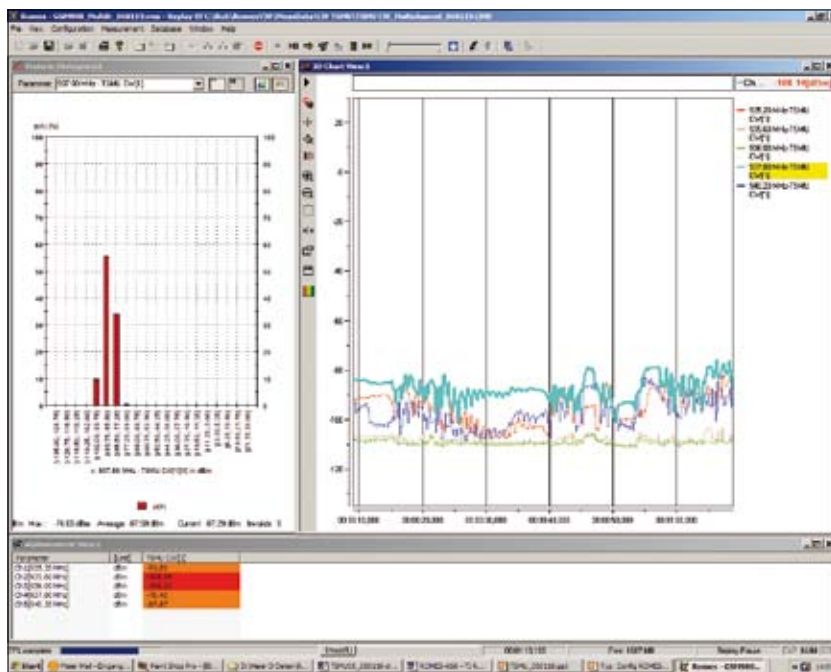
Power measurements with alphanumeric, statistical, and 2D displays

EMF measurements

with the R&S®TSMU-H plus R&S®RFEX software

For electromagnetic field (EMF) measurements, the R&S®TSMU-H is used in combination with the R&S®TS-EMF EMF measurement system, implementing the R&S®RFEX software. R&S®RFEX is a special software application designed for EMF tests. Whereas field-strength measurements with a spectrum analyzer are sufficient for most other services, CPICH decoding is necessary for WCDMA in order to extrapolate to maximum traffic and to allocate an emission to a base station.

Important features of R&S®TS-EMF with the R&S®TSMU/TSMU-H

◆ High measurement accuracy
◆ High measurement speed allowing the stirring method (maximum search by moving the antenna during the measurement)
◆ Bargraph display of actual and maximum values, acoustic signal for new maximum
◆ Easy configuration and use
◆ Easy extrapolation by report in Excel

R&S®TS-EMF with R&S®FSH3 spectrum analyzer

R&S®RFEX software
with R&S®TSEMF-U2 option

R&S®TSMU

Isotropic antenna
30 MHz to 3 GHz

Extension for general EMF measurements

Spectrum analyzer

Other antennas 100 kHz to 3 GHz
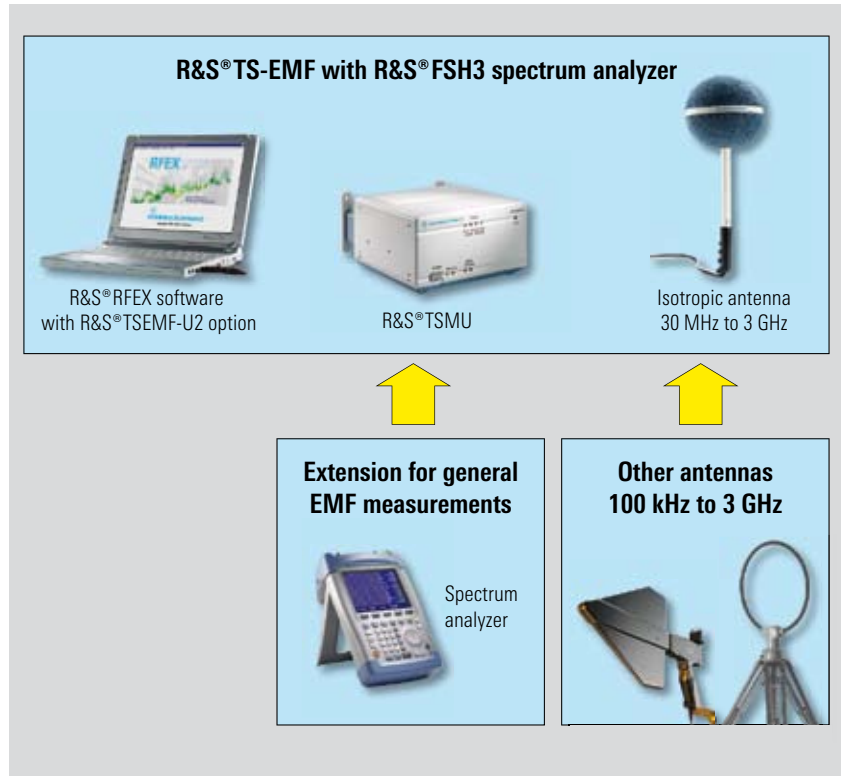
Specifications

General RF data		
RF range		80 MHz to 3 GHz
Noise figure	f ≤ 2.2 GHz, preamplifier ON	typ. 10 dB
Reference frequency accuracy	GPS pulse per second (PPS) synchronization	±0.01 ppm
Reference frequency aging		1 ppm/year
Reference frequency temperature drift	0 °C to +30 °C	2 ppm
	+30 °C to +40 °C	additionally 2 ppm/10 °C
IP3	preamplifier ON	typ. −9 dBm
	preamplifier OFF	typ. +3 dBm
1 dB compression point		−15 dBm
WCDMA		
Bands	200 kHz resolution	WCDMA bands I to IX and user-defined bands
Pilot scan		up to 512 pilot channels
Multifrequency scan		max. 12 carriers
IF bandwidth		4.12 MHz
Measurement rate	HS/HD/UHS mode	variable, 1 Hz to 20 Hz/8 Hz/333 Hz
Power measurement dynamic range		−114 dBm to −20 dBm
Power measurement accuracy E_c/I_o	$E_c/I_o > -12$ dB	typ. <1.5 dB
	RSCP	typ. <1 dB
Sync acquisition time	5 pilots, HS/HD mode	typ. 10 ms/24 ms
Sync level E_c/I_o	HS/HD mode	<−14.5 dB/<−25 dB
Dynamic range E_c/I_o	HS/HD mode	20 dB/29 dB
BCH demodulation E_c/I_o	HS/HD mode	≥−14 dB
Adjacent channel rejection		typ. >70 dB
Number of rake receivers	5000 multipath measurement	max. 2500
Ghost code rate		$<10^{-9}$
Timebase for synchronization	internal	GPS PPS/GSM, WCDMA network
GSM		
Bands		GSM 420/450/750/850/900/1700/1800/1900, GSM-E, GSM-R
Measurement modes		SCH code power measurement TCH total in-band power measurement demodulation of BCCH system information type 3
Measurement rate		up to 80 channels/s with SCH demodulation typ. 1.2 s; max. 1.9 s for GSM 900 band typ. 3.8 s; max. 5.3 s for GSM 1800 band
Power measurement dynamic range		−112 dBm to −20 dBm
Power measurement accuracy		typ. ±1 dB
Probability of first BSIC detection	versus co-channel C/I	98 % for C/I > +2 dB
BSIC detection after first decoding	versus co-channel C/I	C/I > −11 dB
Minimum C/I for SCH code power measurement	after first BSIC decoding	C/I > −11 dB
Minimum C/I for first BCCH demodulation	CI, MNC, MCC, LAC	C/I > 2.5 dB
Timebase for synchronization	internal	GPS pulse per second (PPS) signal GSM (sync channel)

Specifications

CDMA2000® 1x		
Bands		SR1 band classes (1 to 16), including US Cellular, PCS 1900, European 450
Pilot scan		up to 512 pilot channels
Input bandwidth		1.22 MHz
Scan length		12288 chips (10 ms)
Measurement rate	(512 pilot channels, F-PICH – single channel)	10 Hz
Power measurement dynamic range	P total F-PICH	−12 dBm to −131 dBm
Measurement accuracy	without fading	$E_c/I_o > −10$ dB, typ. ±0.4 dB
	with fading	$E_c/I_o > −10$ dB, typ. ±0.7 dB
Sync level E_c/I_o	CDMA2000® interference, fast mode	typ. <−16.5 dB (F-PICH) typ. <−25.5 dB (F-SYNC)
	white Gaussian noise, fast mode	typ. <−20.2 dB (F-PICH) typ. <−29.2 dB (F-SYNC)
Synchronization speed	single mode, $E_c/I_o > −15$ dB	100 ms
	single mode, $E_c/I_o \leq −15$ dB	200 ms
Demodulation	synchronous channel demodulation	<0.5 s
	fast synchronous channel demodulation	<0.1 s
Dynamic range E_c/I_o		typ. 30 dB
Ghost code rate		$<10^{-9}$
Number of rake receivers	5000 multipath measurement	max. 2500
Time base for synchronization	internal	GPS PPS/GSM, CDMA network
RF power		
Measurement modes		single frequency, multichannel
Frequency entry		single frequency, frequency list, frequency band
Level uncertainty	$f \leq 3$ GHz	typ. ±1.0 dB
Bandwidth (3 dB)	single frequency mode	12.5 kHz to 4000 kHz
	multichannel mode	200 kHz to 4000 kHz
Channel power measurement dynamic range	GSM	−110 dBm to −20 dBm
	WCDMA	−95 dBm to −20 dBm
Sample acquisition time	multichannel mode	100 µs to 650 µs
Measurement time		0.1 ms to 1000 ms
Minimum cycle time		1.6 ms
Frequency setting time		9.3 ms to 25 ms
Typical measurement rate	multichannel mode	1.6 ms for 19 GSM-R channels 76 ms for 124 GSM 900 channels 208 ms for 373 GSM 1800 channels
Adjacent channel rejection	GSM	30 dB
	WCDMA	60 dB
Detectors		peak, average, RMS
Trigger modes	internal timebase	time-triggered
	external trigger event	distance-triggered
IF attenuation		0 dB, 10 dB, 15 dB
Preamplifier		10 dB, automatic/manual
Timebase for synchronization		GPS pulse per second (PPS) signal

Rear-panel interfaces	FireWire I + II	IEEE 1394 female, 6-pin
	RF input (RF IN)	N female, input impedance 50 Ω, VSWR typ. 2.0
	power supply input (DC IN)	snap and lock jack, 3-pin, 9 V to 18 V DC
	PPS IN	BNC female, 3 V to −5 V, TTL input for GPS pulse per second (PPS, falling edge with high precision)
	PULSE IN	BNC female, multifunctional (e.g. distance-triggered input), valid input range: 3 V to 15 V
General data		
Operating temperature range		0 °C to +45 °C
Storage temperature range		−20 °C to +70 °C
Humidity	relative humidity at +40 °C	95 %
Sinusoidal vibration	5 Hz to 150 Hz	max. 2 g at 55 Hz
Random vibration		10 Hz to 500 Hz
Shock		40 g shock spectrum
EMC		EN 61326-1: 1997 + A1: 1998 + A2: 2001 E1 95/54/EC E1 ECE-R10
Electrical safety		EN 61010-1: 1993 + A2: 1005
Quality standard		developed and manufactured in line with ISO 9000
Power supply		9 V to 18 V DC
Power consumption		650 mA at 12 V DC
Dimensions (W × H × D)		150 mm × 80 mm × 170 mm (5.9 in × 3.15 in × 6.69 in)
Weight		1.5 kg (3.31 lb)

Ordering information

Designation	Type	Order No.
Drive Test Receiver/Firmware		
Radio Network Analyzer	R&S®TSMU	1153.6000.02
WCDMA PN Scanner Option for R&S®TSMU	R&S®TSMU-K11	1153.4550.02
CDMA2000® 1x PN Scanner Option for R&S®TSMU	R&S®TSMU-K12	1153.4608.02
GSM Network Scanner Option for R&S®TSMU	R&S®TSMU-K13	1153.4572.02
WCDMA BCH Demodulator Option for R&S®TSMU	R&S®TSMU-K14	1153.4614.02
RF Power Measurement Option for R&S®TSMU	R&S®TSMU-K15	1153.4595.02
Software		
Drive Test System Software	R&S®ROMES3NG	1143.7991.40
R&S®ROMES3NG Option: WCDMA PNS for R&S®TSMx	R&S®ROMES3T11	1156.2858.42
R&S®ROMES3NG Option: CDMA2000® PNS for R&S®TSMx	R&S®ROMES3T12	1156.2858.44
R&S®ROMES3NG Option: GSM NWS for R&S®TSMx	R&S®ROMES3T13	1156.2858.46
R&S®ROMES3NG Option: RF Power Measurement for R&S®TSMx	R&S®ROMES3T15	1156.2858.48
Accessories		
Power Supply 230 V AC, 12 V DC/6 A	R&S®TSMU-Z1	1166.3786.02
Rack Adapter 19"	R&S®TSMU-Z2	1153.6700.02
Indoor Backpack System	R&S®TSMU-Z3	1153.6900.02

Certified Quality System
ISO 9001
DQS REG. NO 1954 QM

Certified Environmental System
ISO 14001
DQS REG. NO 1954 UM

More information at
www.tsmu.rohde-schwarz.com

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