

R&S®TS8997

Regulatory Test System for Wireless Devices

ETSI EN 300328 V1.8.1/ETSI EN 301893 V1.7.1
compliance tests in the 2.4/5 GHz band



ROHDE & SCHWARZ

R&S®TS8997 Regulatory Test System for Wireless Devices At a glance

All wideband transmission systems in the 2.4 GHz and 5 GHz bands must be tested to verify compliance with ETSI EN 300328 for the 2.4 GHz band and ETSI EN 301893 for the 5 GHz band. The latest versions of these standards require the use of special automated test procedures and test equipment. The R&S®TS8997 fully meets these requirements.

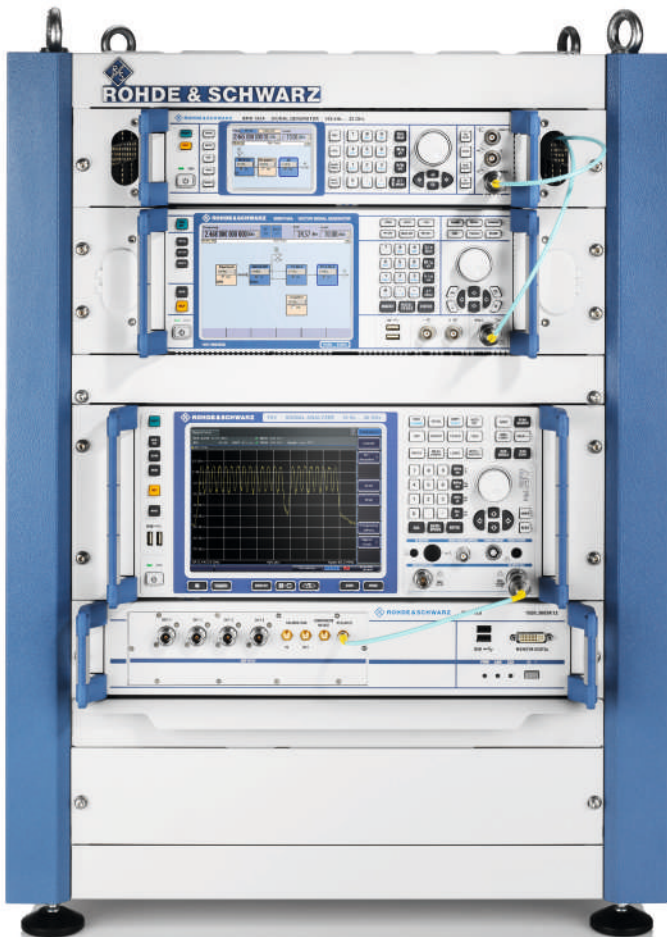
Measurements are performed using the R&S®EMC32 software platform, which is the standard solution in EMC test labs. The key components in the test system are the R&S®EMC32-K97x options and the R&S®TS8997 specific R&S®OSP module, which provides power measurement, filtering and path switching. Users are guided through the multistage measurements by a menu-driven navigation system as required for the technology used and the characteristics of the device under test (DUT). The test system supports all measurements required by the standards, even for complex DUTs such as those featuring MIMO or adaptive hopping.

The R&S®TS8997 measures technologies typically used in wideband wireless devices, i.e. devices with a radio interface, in the 2.4 GHz and 5 GHz bands:

- WLAN IEEE 802.11a/b/g/n/ac
- Bluetooth®
- Wireless video transmission
- Radio remote control

Key facts

- Fast wideband power measurement that exceeds ETSI requirements
- Support for MIMO DUTs with up to four antenna ports
- Menu-driven, automatic measurements based on radio technology selected by the user
- Measurements via RF connection or antenna coupler
- Tried and tested R&S®EMC32 GUI and software structure
- Automatic switching of test paths up to 18 GHz



R&S®TS8997

Regulatory Test System for Wireless Devices

Benefits and key features

Testing DUTs for enhanced performance and coexistence behavior

- Verification of DUT behavior in crowded, unlicensed frequency bands
- Support of frequency hopping and MIMO devices
- Adaptivity test for devices with and without listen before talk (LBT) functionality

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Complete characterization in line with ETSI EN 300328/ETSI EN 301893

- Coverage of all test cases from the ETSI standards
- Special power measurement in line with ETSI standards
- Simultaneous measurements on up to four antenna ports for MIMO devices
- Frequency-selective measurements with high resolution
- DUT stimulation using Rohde & Schwarz communications tester or golden device

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Easy operation

- Tried and tested R&S®EMC32 GUI and software structure
- Technology-dependent test sequence control and querying of device parameters
- User guidance by test sequence, taking into account test case dependencies
- Integrated calibration routines

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Modular and future-ready

- Support of measurements using antenna coupler for devices without antenna connector

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Testing DUTs for enhanced performance and coexistence behavior

Verification of DUT behavior in crowded, unlicensed frequency bands

As the occupancy of the 2.4 GHz band grows, it has become necessary to revise and extend the standard in order to introduce methods that allow different applications to coexist in this frequency range.

Support of frequency hopping and MIMO devices

The available frequency spectrum is shared by a wide range of services that offer different functionality and use different transmission technologies. These include, for example, wideband high-speed data transmission such as WLAN with MIMO, low data rate remote control, and Bluetooth® using frequency hopping. The test routines and test equipment used must therefore support the whole range of signal types such as narrowband hoppers with a large number of frequencies and skipped channels, as well as OFDM signals with fast signal power variations due to high crest factors.

Adaptivity test for devices with and without listen before talk (LBT) functionality

The latest ETSI standards define adaptivity mechanisms to help ensure that all users will still have access to available frequency resources as band occupancy increases.

Alternatively, systems can function without adaptivity if they fulfill certain requirements with respect to power and timing behavior. The requirements for power, timing and adaptivity have been defined in the standard for the first time and call for new, and in part complex, test methods. In the previous version of ETSI EN300328 (1.7.1), these requirements existed only at a rudimentary level, and test methods were not yet defined.

Complete characterization in line with ETSI EN 300328/ ETSI EN 301893

Coverage of all test cases from the ETSI standards

The test system covers the test cases listed in the table as stipulated by the standards.

Which test cases are needed and how they should be parameterized depends on the DUT characteristics and the technology used.

Test case	2.4 GHz band (ETSI EN 300328)	5 GHz band (ETSI EN 301893)
Carrier frequency accuracy		•
RF output power	•	•
Transmit power control (TPC)		•
Spectrum power density	•	•
Duty cycle, TX sequence, TX gap	•	
Dwell time, minimum frequency occupation, hopping sequence (only for frequency hopping DUTs)	•	
Hopping frequency separation	•	
Medium utilization (MU) factor	•	
Adaptivity	•	•
Occupied channel bandwidth	•	•
Transmitter unwanted emissions in the out-of-band domain	•	• ¹⁾
Transmitter unwanted emissions in the in-band domain		•
Transmitter unwanted emissions in the spurious domain	•	
Receiver spurious emissions	•	• ¹⁾
Receiver blocking	•	
Dynamic frequency selection (DFS)		•

¹⁾ For spurious emission measurements above 18 GHz, a manual, direct RF connection to the spectrum analyzer is required.

Special power measurement in line with ETSI standards

For all DUTs, a power measurement has to be performed that requires special power sensors.

The R&S®OSP-B157 module supports a power measurement specifically adapted to the ETSI EN 300328 and ETSI EN 301893 standards with the following characteristics:

- High sampling rate greater than 1 Msample/s
- Long measurement time of up to 32 s at 1 Msample/s
- Long integration time per sample
- High measurement accuracy
- Frequency range up to 6 GHz
- Precise measurement of hopping and wideband signals with high crest factor up to a bandwidth of max. 300 MHz

The signal types used in the frequency range up to 6 GHz require a wideband measurement in order to precisely determine the output power. This measurement must cover the entire scope of the signal and allow the reliable determination of parameters such as average power, peak power, duty cycle and other parameters. To obtain reproducible and dependable results, a statistical summary must be generated over typically several seconds, during which all samples taken are saved and evaluated. The R&S®EMC32-K97 software module is used to generate, from the level values stored in the measurement module, the relevant signal parameters such as output power, duty cycle, TX sequence, TX gap and medium utilization (MU) factor.

GUI for configuring automated test sequences.

TS8997 settings for ETSI EN 300 328 (2.4GHz)

File	System	Modulation	Report	Frequency Settings
Set to Defaults Frequency Change Power PSD Hop seq Dwell HFS DBW DOB Adapt Tx Rx				
Stop before --> ☒ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐ ☐				
DUT is in Hoppingmode --> ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒ ☒				
DUT Frequencies: Lowest: 2.40500 GHz Mid: Hz Highest: 2.47900 GHz				
Add. Frequencies: User Def 1: Hz User Def 2: Hz Measured Low: Hz Measured High: Hz				
HFS: Center: Hz Measured Center: Hz				
Skip at EIRP <10 dBm: ☐				
Cancel Start				

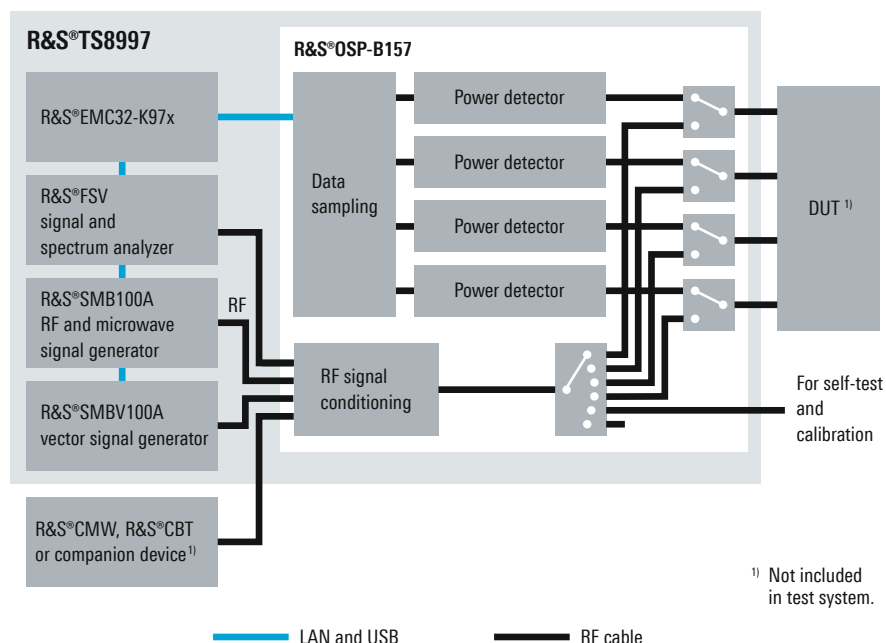
Simultaneous measurements on up to four antenna ports for MIMO devices

MIMO enabled DUTs place special requirements on test equipment since they transmit and receive simultaneously via multiple antennas. MIMO is already widely used in WLANs and will become more and more common.

For all tests except power, measurements can be made sequentially on the antenna ports, so that a coaxial switch in the R&S®OSP-B157 module is sufficient. Power, by contrast, must be measured simultaneously on all antenna ports, and the measurements must be perfectly time-synchronized. The R&S®TS8997 supports simultaneous power measurements on up to four antenna ports.

The A/D converters for the four-channel power measurement – and the recording of measured values – are controlled by a common trigger. This ensures sufficient sampling time and uninterrupted measurement on each channel, along with reliable determination of the total transmit power. Here, even a small timing offset can cause the total transmit power to be overvalued or undervalued since the transmitted signals can exhibit large timing variations due to their frame structure and high data rates.

Block diagram of the R&S®TS8997 test system



Frequency-selective measurements with high resolution

With 32 000 points per sweep, the spectrum analyzers used in the test system exceed the minimum number of 30 000 points required by the ETSI standards.

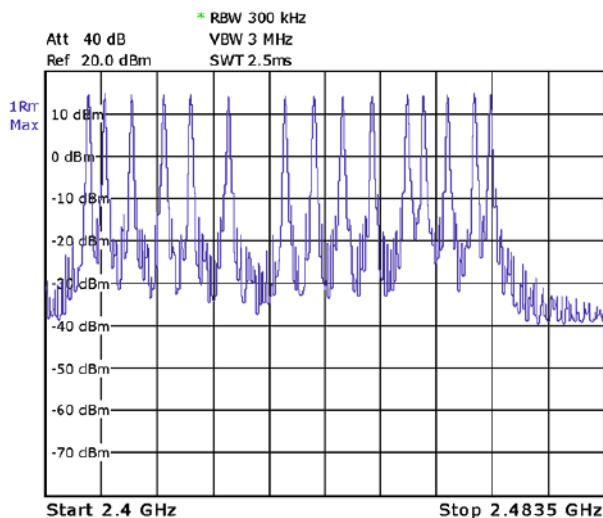
DUT stimulation using Rohde&Schwarz communications tester or golden device

There are various ways of setting the DUT to a defined transmit state as required for the tests:

- The DUT has a control interface or software that can be used to set the DUT to a defined transmit state, e.g. to configure the radio channel or select the transmit mode, without a partner device
- A second device (e.g. a golden device) is used to set up and configure a radio link
- A Rohde&Schwarz communications tester is used to set up and configure a radio link. Rohde&Schwarz testers are already widely used in labs for other tests (EMC, OTA, conformance). For example, the R&S®CMW500 wideband radio communication tester and the R&S®CBT Bluetooth® tester support the WLAN and the Bluetooth® standard, respectively

Users can select the most appropriate method to stimulate their DUT and set up a radio link.

Spectrum of a frequency hopping DUT in the 2.4 GHz band



Easy operation

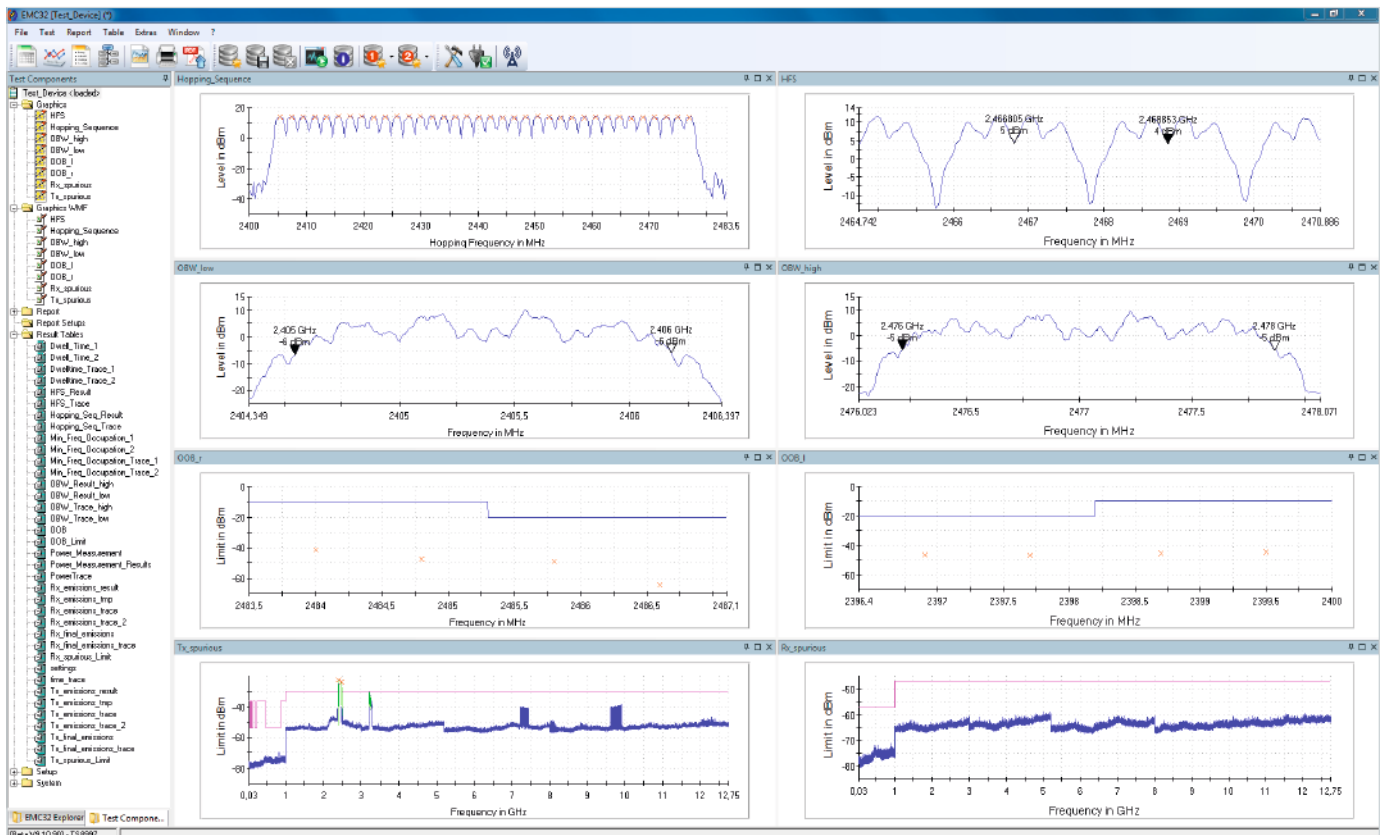
Tried and tested R&S®EMC32 GUI and software structure

The test system uses the R&S®EMC32 measurement software platform with the R&S®EMC32-K97x options.

The software platform is used in many test houses for EMC and spurious emission measurements, so that many users are already familiar with relevant aspects such as operation, software structure and reporting.

The R&S®TS8997 can be expanded to perform additional measurements.

Results of test sequences with R&S®EMC32-K97x.



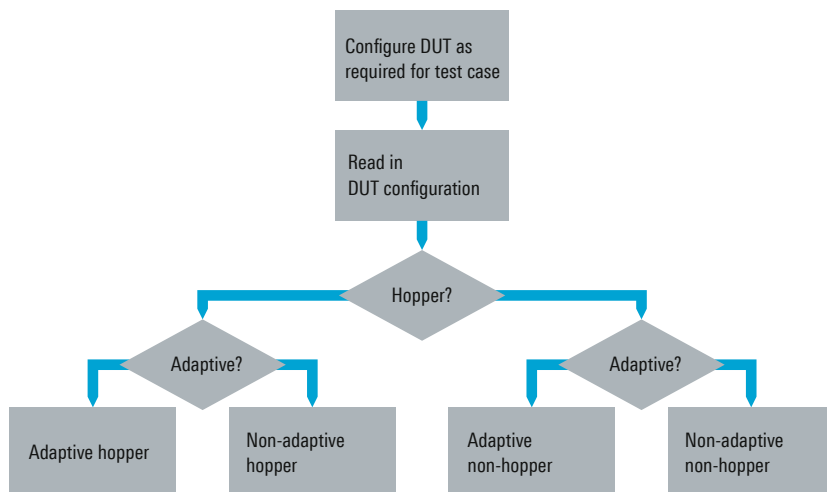
Technology-dependent test sequence control and querying of device parameters

Different test cases have to be performed depending on the radio standard, radio technology and the capabilities implemented in the DUT. For example, different tests are required for a hopper such as Bluetooth® and a device providing a wideband service such as WLAN.

The R&S®TS8997 test system comes with preconfigured test sequences for specific radio services. These test sequences also include querying of the relevant radio standard parameters.

For radio services that are not preconfigured, users can create templates of their own with presettings for the most important parameters.

Selection of appropriate test case depending on DUT characteristics

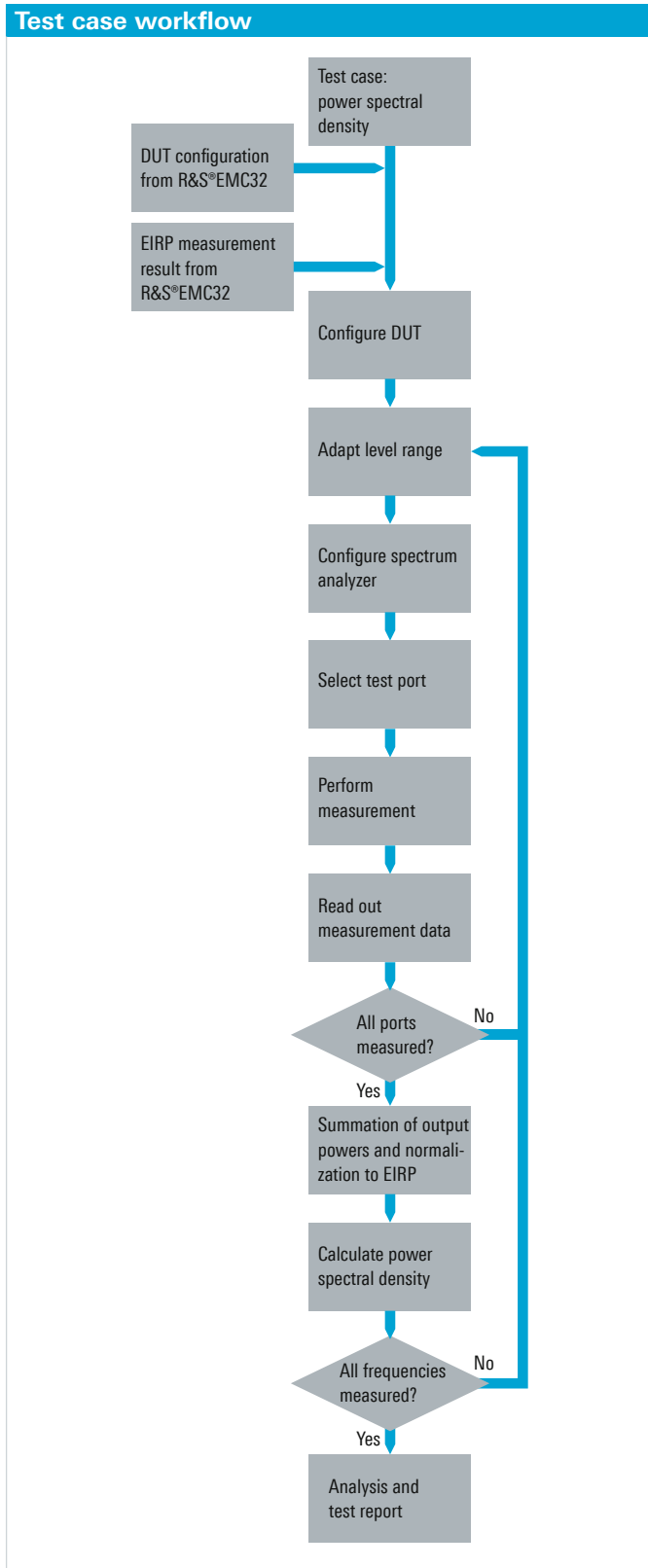


User guidance by test sequence, taking into account test case dependencies

During measurements in line with the ETSI standards, many parameters are determined from a single measurement, and in some cases the results of a measurement also provide parameters needed for the next measurement. Predefined test sequences, therefore, ensure that measurements are carried out and parameters determined in the right order. This allows even less experienced users to perform these measurements in a precise and reproducible manner.

Integrated calibration routines

Calibration of the power measurement paths and all other RF paths is performed using the test instruments included in the system and the test routines provided in the R&S®EMC32 software platform. No other components are necessary for system calibration, which can be performed at any time.



Modular and future-ready

Support of measurements using antenna coupler for devices without antenna connector

The preferred test method as defined by the ETSI standards involves connection of the DUT via RF cables. The test system fully supports this approach, and if the DUT's antenna gain is known, the radiated parameters are determined from this value. Alternatively, users can enter the maximum EIRP value obtained from a radiated measurement.

Some DUTs have integrated antennas without antenna connectors. For these DUTs, radiated measurements have to be performed. These can be carried out in an R&S®CMW-Z10 RF shielding box with integrated antenna coupler, for example. Based on the known RF output power or the EIRP value, the coupling factor is determined and used to correct measurement results.

A third, highly effective way to perform precise radiated measurements during development is by using the R&S®DST200 RF diagnostic chamber. Here, all radiated measurements up to 6 GHz can be performed. The maximum EIRP is determined using a shorter measurement distance than that specified in the standard.

When the test system is used together with the R&S®CMW-Z10, the R&S®DST200 or an anechoic chamber, additional components may be required in order to compensate for the attenuation introduced by the shielding box or chamber. For DUTs with integrated antenna(s), spurious emission measurements need to be performed in an anechoic chamber.

R&S®TS8997 test system used with R&S®DST200 RF diagnostic chamber.



System configuration

The R&S®TS8997 test system (model .03) consists of the following components:

- R&S®FSV30 signal and spectrum analyzer for all frequency-selective measurements, e.g. occupied channel bandwidth, dwell time, minimum frequency occupation, hopping sequence, spurious emission
- R&S®OSP120 with R&S®OSP-B157 plug-in module for
 - Power measurements e.g. RF output power, transmit power control (TPC), duty cycle, medium utilization (MU) factor
 - Antenna and test path switching, combining of RF signals

The R&S®OSP120 with the R&S®OSP-B157 is controlled via LAN and additionally via USB for power measurements

- R&S®SMBV100A vector signal generator as a wideband and radar interferer for adaptivity and receiver blocking measurements
- R&S®SMB100A RF and microwave signal generator as a simultaneous narrowband interferer and for test path calibration
- R&S®EMC32-K97 option for power measurement test cases in line with ETSI EN300328 and ETSI EN301893
- R&S®EMC32-K971 option for frequency-selective test cases in line with ETSI EN300328 and ETSI EN301893
- R&S®EMC32-K972 option for adaptivity test cases in the 2.4 GHz band in line with ETSI EN300328
- R&S®EMC32-K973 option for adaptivity test cases in the 5 GHz band in line with ETSI EN301893
- R&S®EMC32-K974 option for remote control of test system
- R&S®EMC32-K975 option for spurious emission test cases

In the 18 GHz version of the R&S®TS8997, the R&S®FSL spectrum analyzer is used instead of the R&S®FSV.

If spurious or adaptivity measurements are not required, the system configuration can be modified accordingly. Whether existing generators, spectrum analyzers or test receivers can be used in the test system can be clarified with the customer on a case-by-case basis.

The following components are not included in the test system but are available upon request:

- Control computer with Windows operating system
- Instruments for DUT stimulation, e.g.
 - R&S®CMW500 wideband radio communication tester for WLAN IEEE 802.11a/b/g/n/ac
 - R&S®CBT Bluetooth® tester for Bluetooth®
- RF cables to DUT
- Coupler with antenna for feeding an additional radiated communications signal into the RF path to the DUT; this is necessary if a link to a partner device with an antenna is required during power measurements

Specifications in brief

Specifications in brief		
RF specifications		
Frequency range	overall system	30 MHz to 30 GHz
Frequency range of R&S®OSP-B157	RF paths	30 MHz to 18 GHz
	RF paths with combiner/coupler	0.5 GHz to 18 GHz
	power measurement	0.5 GHz to 8 GHz, calibrated for 2.4 GHz and 5 GHz bands
Number of DUT antenna ports		1 to 4
Maximum input power of R&S®OSP-B157	without attenuation	12 dBm
	with attenuation 10 dB (included)	22 dBm
	with attenuation 20 dB (optional)	32 dBm
Measurement accuracy for power meter / R&S®OSP-B157	power measurement	< 0.5 dB
	VSWR	< 1.3
	frequency response accuracy at 23°	< 0.3 dB
	measurement error due to modulation	< 0.3 dB
	measurement error due to linearity	0.1 dB + 0.005 dB/dB
	resolution	0.01 dB
	measurement error due to temperature	< 0.5 dB
Measurement accuracy for spectrum analyzer	spectrum measurement	±2 dB, typ. 1 dB
	zero span timing measurement (depends on analyzer settings)	$\text{uncertainty} = \frac{\text{sweeptime}}{\text{sweepoints} - 1}$
	sampling rate per channel	1 Msample/s max. 1.25 Msample/s
	blocking measurement	±2 dB, typ. 1 dB
	max. measurement duration	max. 32 s at 1 Msample/s
	signal bandwidth	min. 300 MHz
General data		
Operating temperature range	overall system and R&S®OSP-B157	+5°C to +40°C
Power consumption		max. 580 W
Dimensions	W × H × D	610 mm × 770 mm × 650 mm (24.02 in × 30.31 in × 25.59 in)
Weight		35 kg (77.16 lb)

Ordering information

Designation	Type	Order number
Regulatory Test System for Wireless Devices (frequency range from 30 MHz to 18 GHz, for devices in 2.4 GHz and 5 GHz bands)	R&S®TS8997	1520.9004.02
Regulatory Test System for Wireless Devices (frequency range from 30 MHz to 30 GHz, for devices in 2.4 GHz and 5 GHz bands)	R&S®TS8997	1520.9004.03
Accessories for R&S®TS8997		
Coupler and Antenna for connection to companion device during power measurement	R&S®TS97-KO	1520.9833.02
External Combiner for multiport DFS testing; requires R&S®EMC32-K973	R&S®TS97-CO	1520.9933.02
Software options		
Frequency-Selective Test Cases	R&S®EMC32-K971	1520.9804.02
Adaptivity Test Cases, for devices in the 2.4 GHz band	R&S®EMC32-K972	1520.9810.02
Adaptivity and Dynamic Frequency Selection (DFS) Test Cases, for devices in the 5 GHz band	R&S®EMC32-K973	1520.9827.02
Remote Control of Test System	R&S®EMC32-K974	1520.9879.02
Spurious Emission Test Cases	R&S®EMC32-K975	1520.9885.02

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- ▮ Long-term dependability

Rohde & Schwarz

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Sustainable product design

- ▮ Environmental compatibility and eco-footprint
- ▮ Energy efficiency and low emissions
- ▮ Longevity and optimized total cost of ownership

Certified Quality Management

ISO 9001

Certified Environmental Management

ISO 14001

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