R&S®TS6650
Interference Test System for ATC Radar Systems
Countering interference from LTE and WiMAX™ signals

ROHDE&SCHWARZ

Test & Measurement

Product Brochure | 01.00

R&S®TS6650 Interference Test System for ATC Radar Systems

At a glance

The R&S®TS6650 detects potential interference to air traffic control (ATC) radar systems caused by LTE and WiMAX™ emissions in the adjacent frequency band. The effectiveness of counteraction is verified on the radar.

Air traffic control (ATC) S-band radar systems installed at airports cover the frequency range from 2.7 GHz to 3.1 GHz. These systems can be affected by interference from LTE and WiMAX™ signals in the adjacent frequency band from 2.496 GHz to 2.69 GHz. In many countries, the relevant frequency bands have been approved for use or will be activated in the near future. Various studies have proven that this type of interference makes aircraft disappear from the radar screen, for example. The radar's immunity to interference must first be determined, taking into account the radar and the conditions in the vicinity of the airport. For this purpose, the R&S®TS6650 generates signals of up to 20 different LTE and WiMAX™ base stations and mobile stations and irradiates the radar with defined peak power levels of altogether 600 W using a directional antenna that is 100 m to 300 m away. At the same time, the system is protected against the radar's transmit power, allowing tests during normal operation. The radar can be tested and corrective action taken before problems with installed base stations occur. The R&S®TS6650 makes it possible to detect interference in time and to ascertain the effectiveness of corrective action.

It is particularly important to differentiate between direct interference caused by LTE and WiMAX™ broadband signals outside the radar band and the signals' out-of-band emissions in the radar band. This is why all intermodulation products of the R&S®TS6650 in the radar band have been reduced to below the radar receiver's limit sensitivity (< –130 dBm/MHz).

Key facts

- Verification of immunity using realistic scenarios involving multiple LTE and WiMAX™ emitters
- High total field strength of ≥ 1 V/m peak envelope power (PEP) at radar antenna 200 m away
- High suppression of intermodulation products and spurious emissions in radar band to < –130 dBm/MHz through decoupled, low-intermodulation filters
- Flexible setup at 100 m to 300 m from radar for taking local conditions into account
- Tests in normal radar operating mode
- Flexible, modular system based on standardized instruments; expandable for other interference tests

R&S®TS6650 Interference Test System for ATC Radar Systems

Benefits and key features

Realistic, adaptable scenarios

- Transmit frequency range from 2.496 GHz to 2.69 GHz
- Emission of a complete scenario including multiple base stations and mobile stations
- Up to 120 MHz total signal bandwidth
- Flexible setup of scenarios on the R&S®SMBV100A and transfer to system software
- High output power (600 W PEP) equivalent to power of several base stations
- Integrated automatic level control and calibration routine

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Complete radar test in normal operating mode

- Protection of RF path against radar pulses up to 1000 MW equivalent isotropically radiated power (EIRP)
- Testing of radar receiver for immunity to out-of-band emissions using the interfering signal's very high spectral purity of > 110 dBc in the frequency range from 2.72 GHz to 3.1 GHz
- Testing of radar receiver for immunity to inband emissions using a direct generator signal

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Modular, future-ready system concept

- Based on standardized instruments
- Adaptable to other interference test scenarios
- Adaptable to existing customer masts

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Realistic, adaptable scenarios

The test system's frequency range from 2.496 GHz to 2.69 GHz covers the frequency bands of the following radio services:

Frequency ranges		
LTE FDD (EUTRA), downlink	band 7	2620 MHz to 2690 MHz
LTE FDD (EUTRA), uplink	band 7	2500 MHz to 2570 MHz
LTE TDD (EUTRA)	band 38	2570 MHz to 2620 MHz
WiMAX™	band 3	2496 MHz to 2690 MHz

In many countries, approval for using these frequency bands has already been granted or is scheduled. This usually includes nationwide use, also in the vicinity of airports. Since these frequency bands are directly adjacent to the ATC radar frequency range from 2.7 GHz to 3.1 GHz, it is likely that radar reception will be impaired by these radio services, depending on the following local conditions:

- Spatial configuration with reflections
- Number, locations, transmit power, antenna type and direction of radio services
- Frequency occupancy, bandwidths and utilization of radio services
- Type of radar

The radiated interference depends on how many radio services share a location or closely adjacent locations, and at which minimum distance these locations have to be from the radar. In addition, the radar is influenced by the bandwidths and modulation methods used, since these determine, for example, the crest factor and the peak-to-average power ratio (PAPR). The test system comes with a variety of standard scenarios made up of signals of different bandwidths from one or more base stations. These scenarios approximate real-world LTE or WiMAX™ signals; at the same time, they are optimized in terms of crest factor in order to attain the highest possible power at the antenna. Radiated power and frequency are user-selectable.

User-specific test scenarios can be easily added to the standard scenarios that come with the R&S®TS6650:

- Defining an LTE or WiMAX™ signal on the generator, with detailed selection of signal parameters
- Combining individual signals to form an overall signal with up to 120 MHz bandwidth
- Loading and saving the signal in the software
- Calling the signal from the software with definable level and frequency

Numerous predefined standard test models can be used to customize the individual parameters. For LTE, for example, the user can select FDD or TDD mode, bandwidth and physical channel settings (P-SYNC/S-SYNC, PDSCH, PBCH, PCFICH, PHICH, PDCCH, PUSCH, PUCCH) with detailed data traffic allocation in the frames.

As a result, realistic signals that are representative of country and location are available. The power at the radar antenna, equivalent to that of multiple base stations, is generated using a 600 W PEP amplifier, a very low-loss system design and a directional antenna. The radiated power is more than 35 kW EIRP PEP. With a crest factor of 14 dB (standard scenario with 14 LTE base stations), this corresponds to 1.45 kW EIRP. If the test system is 200 m away from the radar system, this is equivalent to the typical radiated power of 14 base stations with 10 W at a distance of 1 km.

Complete radar test in normal operating mode

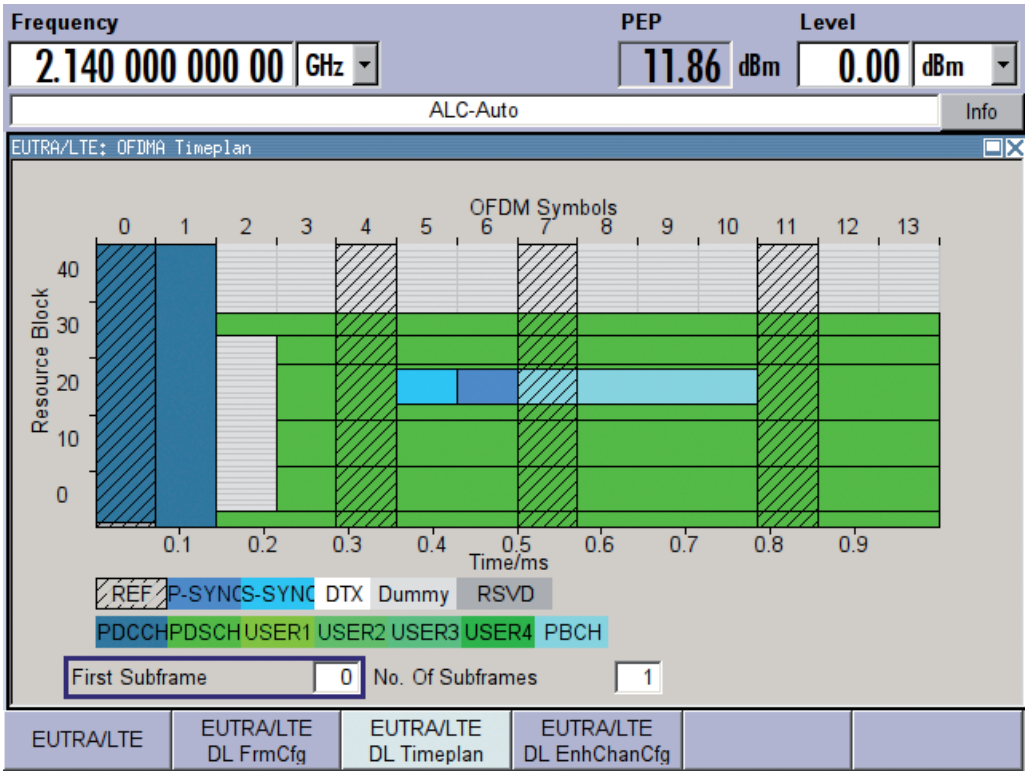
To determine the effects of the test and to assess, for example, whether aircraft in the irradiated sector are no longer detected at a certain distance, the radar must be tested during normal operation. Since the test system's antenna receives the full radar signal, the system is protected against radar signals up to 1000 MW EIRP radar power at 1 % duty cycle.

Using the customer's own mast or one provided by Rohde&Schwarz, the R&S®TS6650 antenna is positioned at the same height as the radar antenna. The rack, which can be easily transported by two persons, is placed at the base of the mast in a vehicle or a shelter.

During the test, it must be ensured that the radar is not impaired by out-of-band interference or by intermodulation products generated by the test system in the radar band.

The highly sensitive radar is affected even by very low intermodulation in the generator and amplifier, as well as by radiation on connectors or in system components. The broadband signals used are particularly critical.

In the test distance range (100 m to 300 m), the system design and the filters used reduce the intermodulation products' loss in the frequency range from 2.72 GHz to 3.1 GHz to less than –110 dBc, which is below a radar receiver's typical sensitivity of –130 dBm/MHz. This ensures that the interference is caused by low radio receiver selectivity. This makes it possible to test corrective action such as the installation of filters.



Graphical display of an LTE subframe in the R&S®SMBV100A.

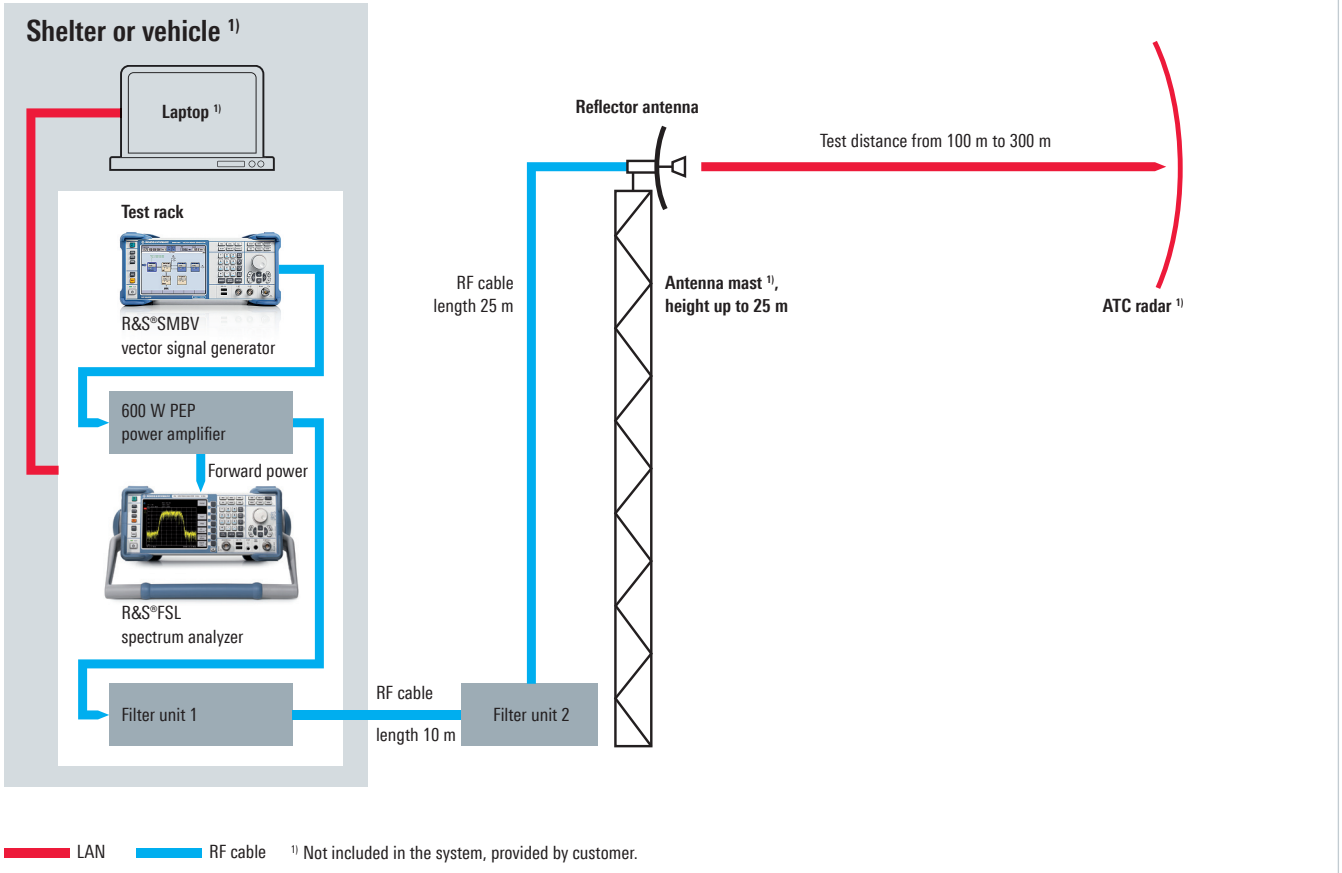
Modular, future-ready system concept

The test system is based on standardized instruments such as the R&S®SMBV vector signal generator and the R&S®FSL spectrum analyzer. This concept ensures support and service, and also allows flexible use of the instruments, for example to manually analyze the transmitted signal, the radar signal or interference scenarios.

Interference caused by the ever more densely meshed network of radio services continues to increase. The R&S®SMBV vector signal generator offers options for a wide range of radio services and waveforms, making it possible for the system to cover additional interference scenarios.

In most cases, customers already have mobile masts that can raise the test antenna to the height of the radar antenna. The test antenna can be easily adapted to an antenna mast. Azimuth and elevation can be manually set in a range of ±15°. Alternatively, a suitable mast for the system can be provided.

Test setup for testing ATC radar receivers



Specifications

R&S®TS6650 specifications		
Frequency range		2500 MHz to 2690 MHz
ATC radar frequency range		2720 MHz to 3100 MHz
Test distance		100 m to 300 m
Max. output power		600 W PEP, 100 W CW
Attainable field strength at radar antenna	test distance 200 m	≥ 1 V/m PEP
Spurious emissions	2720 MHz to 3100 MHz	< –110 dBc (< –130 dBm/MHz at radar receiver)
Max. ATC radar power (EIRP)	duty cycle: max. 1 %; pulse width max. 10 µs	90 dBW
Test antenna		
Type		reflector antenna, 0.9 m diameter
Weight	test antenna and RF cable	< 25 kg (55.1 lb)
Max. height of antenna mast [1]		25 m (82 ft)
Test rack		
Dimensions		19", 20 HU depth: 800 mm
Weight		approx. 50 kg (110.2 lb)
Power supply		200 V to 240 V AC, 2500 W

[1] Antenna mast not included in base system.

Ordering information

Designation	Type	Order No.
Basic system (including accessories like power cable, manual)		
Interference Test System for ATC Radar Systems	R&S®TS6650	1519.6705.02

Service you can rely on

- Worldwide
- Local and personalized
- Customized and flexible
- Uncompromising quality
- Long-term dependability

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 more than 75 years ago, Rohde&Schwarz has a global presence and a dedicated service network in over 70 countries. Company headquarters are in Munich, Germany.

Environmental commitment

- Energy-efficient products
- Continuous improvement in environmental sustainability
- ISO 14001-certified environmental management system

Certified Quality System
ISO 9001

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