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Version  
02.00March  
2005

# Portable EMF Measurement System R&S®TS-EMF

Accurate measurements of electromagnetic fields caused by transmitter systems

## Versatile

- ◆ Wide frequency range from 30 MHz to 3 GHz
- ◆ Short-term and long-term measurements
- ◆ For all common measurement methods
- ◆ Editable measurement packets

## Accurate

- ◆ High sensitivity and wide dynamic range
- ◆ Correct measurement and evaluation in compliance with radio services
- ◆ High measurement accuracy
- ◆ CPICH decoding for UMTS

## User-friendly

- ◆ Isotropic sensor
- ◆ Compact design
- ◆ Easy operation, preconfigured
- ◆ Measurement of single and summed emission
- ◆ Direct limit-specific evaluation

# R&S®TS-EMF – the solution for EMF measurements

## General

The Portable EMF Measurement System R&S®TS-EMF measures electromagnetic fields in the environment (EMF). The measurements are a necessary basis for discussions about the effects of electromagnetic radiation.

Due to its wide frequency range from 30 MHz to 3 GHz, the R&S®TS-EMF complies with all common radio services:

- ◆ Mobile radio (GSM, CDMA)
- ◆ UMTS (frequency-selective)
- ◆ CPICH decoding for UMTS (option)
- ◆ DECT
- ◆ Bluetooth®
- ◆ WLAN (802.11b, g)
- ◆ Sound broadcasting
- ◆ TV broadcasting (analog, DVB)

The frequency-selective measurements not only determine total emission but also permit assignment to specific radio services. All common measurement methods and regulations are supported. Graphic and numeric result display with reference to a limit value simplifies evaluation.

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## Applications of the R&S®TS-EMF

## System design

Due to its compact design, the R&S®TS-EMF can be used for both mobile and stationary measurements. It consists of the following components:

- ◆ An isotropic sensor for accurate field-strength measurements independent of the signal's direction of incidence and polarization
- ◆ A spectrum analyzer – a wide range of spectrum analyzers and test receivers as well as radio network analyzers from Rohde & Schwarz being supported
- ◆ R&S®RFEX, easy-to-use EMF measurement software that is flexible in configuration and evaluation

All system components – including the Spectrum Analyzer R&S®FSH and the Radio Network Analyzer R&S®TSMU – fit into the transit case that comes with the system.

The R&S®RFEX software can also be optionally installed directly on the Spectrum Analyzer R&S®FSH or the Test Receiver R&S®ESPI, allowing a compact solution comprising a spectrum analyzer and antenna.

## One system for all measurements

All common EMF measurement methods are supported:

- ◆ Quick overview measurement
- ◆ Stirring method
- ◆ Multipoint method
- ◆ Average and peak value versus time
- ◆ Spatial average and peak value
- ◆ Long-term measurement

The R&S®TS-EMF is the ideal measurement equipment especially for measurements using the multipoint method in line with the (still temporary) European standard prEN 50400.

An optical and acoustic indication of the maximum value optimally supports the stirring method. The use of alternative antennas is possible.

A quick start using the settings last selected makes it easier to perform a large sequence of measurements.

Together with other measurement modes, for example the quick overview measurement or measurements of long-term behavior, the R&S®TS-EMF covers all types of EMF measurements.

The R&S®TS-EMF has also proven to be the ideal solution as a measurement system for stationary monitoring.



*The R&S®TS-EMF system with R&S®FSH3 applications of the R&S®TS-EMF*



*The R&S®TS-EMF: UMTS decoding with the R&S®TSMU*

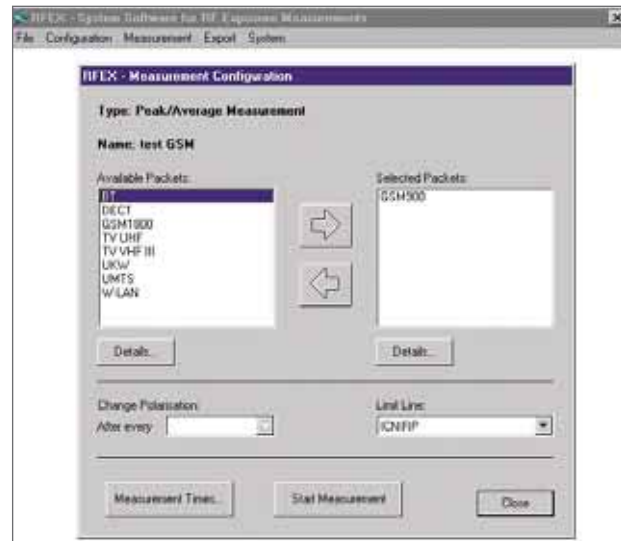
# Efficiency through ...

## ... easy operation

To perform a measurement, simply select the desired mode (single or long-term measurement) and the packets to be measured (e.g. radio services). Measurement packets for all common radio services are already included. The measurement itself runs automatically via the isotropic antenna independently of the signal's direction of incidence and polarization.

With the automatically generated test report, interpretation is direct, fast and simple. It takes just a single mouse click to start subsequent measurements with the same settings.

The R&S®TS-EMF requires minimum effort and only little time for carrying out measurements on site and generating the test report.



R&S®RFX software for measurements using measurement packets

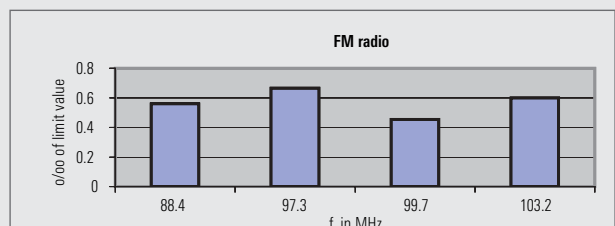
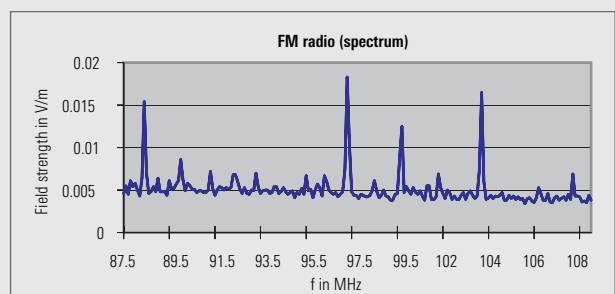
## ... highly informative results

The numeric and graphic display of the results in MS Excel<sup>1)</sup> immediately following the measurement makes on-site interpretation of the results quick and easy:

- ◆ List of summed values and list for individual frequencies (e.g. single emission, emission of antenna facility, total emission)
- ◆ Graphics for the summed values and the individual emitters as well as spectrum display
- ◆ Display of measured levels as absolute values and as a function of the limit value
- ◆ Display for different limit values
- ◆ Simple extrapolation to maximum system utilization
- ◆ Configurable output format
- ◆ Straightforward display on PC with all possibilities for displaying and processing with MS Office

<sup>1)</sup> If MS Excel is not installed on the laptop, the result output is in a purely numeric format.

Packet: FM radio			
Frequency MHz	Field strength V/m	o/oo of limit value	Power flux density $\mu\text{W}/\text{cm}^2$
88.4	0.0154	0.56	6.29E-05
97.3	0.0183	0.6655	8.88E-05
99.7	0.0125	0.4545	4.14E-05
103.2	0.0165	0.6	7.22E-05
Total (RMS)		1.1502	
Total (square)		1.3231	
Max. single value		0.6655	





## ... accurate measurements

Measurement packets are used to detect each radio service with optimized measurement parameters.

The packets contain all the important information such as bandwidth, measurement times, detector to be used and measurement frequencies. This makes it possible to activate different measurement modes for a radio service – e.g. in the case of GSM fast measurements

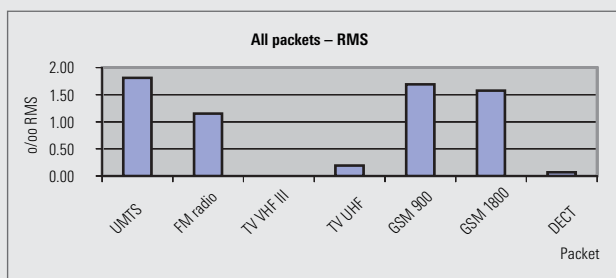
for the stirring method and slower measurements in which the utilization of the TDMA channels is exactly taken into account. Extrapolations to maximum system utilization can also be easily performed.

A description of specific parameters as well as the generation and adaptation of measurement packets to custom tasks are also included. All measurement

packets supplied with the system are verified by Rohde & Schwarz.

The hardware used also provides high measurement accuracy: Each isotropic antenna comes with customized calibration data. In addition, DKD (German Calibration Service) calibration is available for all components.

All packets		
Packet	o/oo – RMS	o/oo – square
UMTS	1.8110	3.2798
FM radio	1.1502	1.3231
TV VHF III	0.0000	0.0000
TV UHF	0.1937	0.0375
GSM 900	1.6935	2.8678
GSM 1800	1.5780	2.4901
DECT	0.0685	0.0047
Total	3.1627	10.0030



*Result display, example of single packet (left) and all measurement packets (top)*

# UMTS decoding with the R&S®TS-EMF

## General

UMTS (universal mobile telecommunications system) is – unlike GSM – a single frequency network in which all the antennas of an operator transmit at the same carrier frequency. Each base station encrypts its signal with a code enabling a terminal to distinguish between the different stations. This requires special measurement methods for the EMF measurement.

## UMTS decoding with the R&S®TS-EMF

With code-selective measurement, the measurement methods used with GSM can be transferred to UMTS. The system measures the power of each existing CPICH which each base station transmits at a constant level.

For this purpose, the R&S®TS-EMF provides an option that is specially tailored to EMF requirements:

- ◆ High measurement accuracy
- ◆ High measurement rate of up to ten decodings per second – prerequisite for using the stirring method
- ◆ High sensitivity (<1 mV/m) and dynamic range, specifically designed for radiated emission measurements
- ◆ Simultaneous measurement of all CPICH codes as well as their reflections – up to 2500 parallel rake receivers available for this purpose

The R&S®TSMU as well as the R&S®FSP, R&S®FSU, R&S®ESPI and R&S®ESCI are suitable measurement instruments for decoding.

In connection with the R&S®TSMU, an additional measurement mode is available for single codes selected from a prescan measurement, which further increases the measurement accuracy.

The test report indicates frequency and field strength as well as the associated scrambling code (see figure). A version without an isotropic antenna is available for users who use exclusively the stirring method.

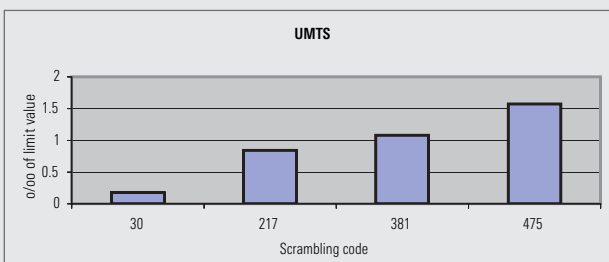
## Frequency-selective measurement on UMTS

A simple alternative is based on the purely spectral measurement of the transmitted signal that can be performed by the R&S®TS-EMF independent of UMTS decoding. The appropriate measurement

packet ensures that the settings that are absolutely essential for a correct measurement (sufficient bandwidth, true RMS detector for measuring the RMS value) are used. Special measurement functions of the spectrum analyzers, such as the channel power function with the R&S®FSH, are supported.

However, there are restrictions involved with the frequency-selective measurement for UMTS. The measurement result shows the emissions of the stations to be measured as well as of all other surrounding stations of an operator – which means that emissions cannot be assigned to a particular station. Since the current system utilization is not known, an extrapolation to the maximum system utilization – as is usually needed – is either not possible or subject to high uncertainty.

Packet: UMTS				
Scrambling code	Frequency MHz	Field strength V/m	o/oo of limit value	Power flux density $\mu\text{W}/\text{cm}^2$
475	2112.8	0.096	1.5738	2.44E-03
381	2132.6	0.0661	1.0836	1.16E-03
217	2167.2	0.0516	0.8459	7.06E-04
30	2157.2	0.0109	0.1787	3.15E-05
Total (RMS)			2.0973	
Total (square)			4.3985	
Max. single value			1.5738	



UMTS decoding test report

# R&S®TS-EMF – configurable for all applications

The R&S®TS-EMF uses spectrum analyzers from Rohde & Schwarz as measuring equipment. Not only does this allow the system to be flexibly adapted to different measurement tasks but the spectrum analyzer can also be used for other measurements in the laboratory or on site. For example, it is also possible to use the EMI Test Receivers R&S®ESPI and R&S®ESCI, which are often selected for EMC as well as EMF measurements.

The compact and robust Spectrum Analyzer R&S®FSH, which is designed for mobile field applications and is available in versions up to 6 GHz, deserves special mention here. If UMTS decoding is needed, the extremely compact Radio Network Analyzer R&S®TSMU, built for mobile use, can also be deployed.

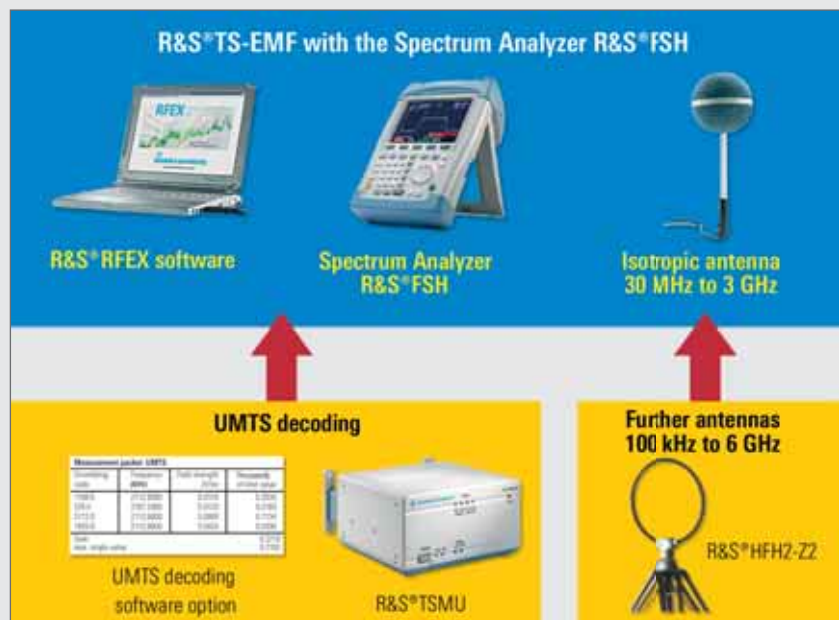
Furthermore, the Spectrum Analyzers R&S®FSP and R&S®FSU as well as the EMI Test Receivers R&S®ESPI and R&S®ESCI can be combined with the R&S®TS-EMF. These instruments likewise permit UMTS decoding with the matching R&S®RFEX software option.

The isotropic antenna is driven directly via the spectrum analyzers and test receivers. Through the use of additional antennas, the R&S®TS-EMF provides a frequency range of 9 kHz to 40 GHz, depending on the measurement instrument used. This covers both the medium- and short-wave range as well as the microwave range.

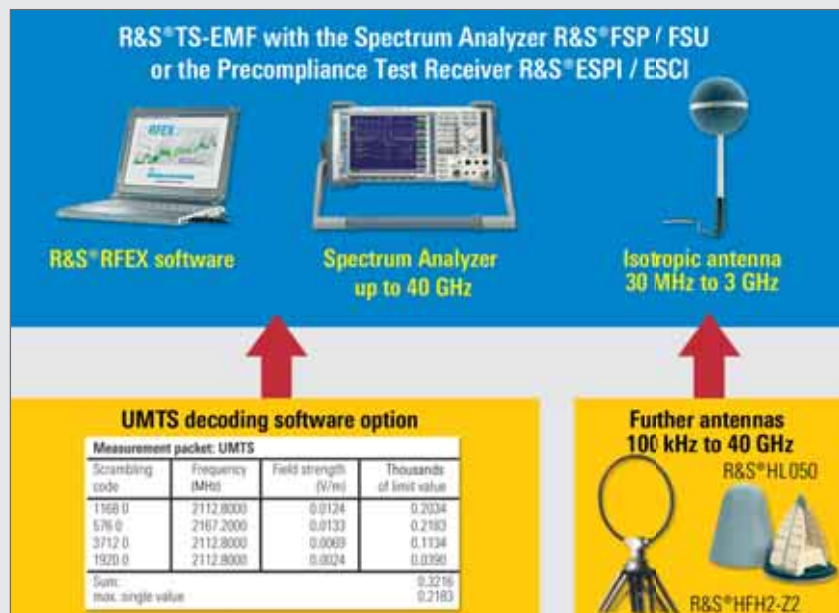
New radio services such as WLAN 802.11a require not only expanded frequency ranges but also special test

settings. The modular design of the R&S®TS-EMF ensures that both present and future requirements can be covered:

- ◆ Regular updates of the R&S®RFEX software
- ◆ Additional measurement packets for new radio services
- ◆ A wide selection of supported measurement instruments and antennas



Configurations of the R&S®TS-EMF with the R&S®FSH and R&S®TSMU



Configurations of the R&S®TS-EMF with the R&S®FSP



## Specifications

<b>Isotropic antenna</b>	
Frequency range	30 MHz to 3 GHz
Measurement principle	isotropic reception due to orthogonally arranged antenna elements that are electronically switched
Mechanical design	radome protection against mechanical damage and environmental hazards
Antenna factor	instrument-specific calibration data, stored on USB dongle
Axis switching	RF solid-state switch
Field-strength measurement range	approx. 1 mV/m to 100 V/m
Connecting cable	integrated 2 m cable, ferritized (8 m extension cable, see options)
RF connector	N male
Switch connector	9-contact D-Sub, incl. adapter cable for spectrum analyzer
Tripod adapter	1/4-inch thread, quick connector for antenna
Ambient conditions	-10 °C to +50 °C, safety class IP54
Power supply	via spectrum analyzer or laptop
Dimensions	length 475 mm, Ø 170 mm
Weight (incl. cable)	1.3 kg
<b>Requirements for laptop (not included with equipment supplied)</b>	
Operating system	MS Windows 2000, XP, XP Tablet PC Edition
Hard disk space	min. 10 Mbyte
Display resolution	min. 800 × 600
Interfaces	USB and depending on measurement instrument R&S®FSH: RS-232-C (or USB with R&S®FSH-Z37) R&S®FSP/FSU, R&S®ESPI/ESCI: LAN or GPIB R&S®TSMU: FireWire

Recommended application	MS Excel 2000, XP
<b>Equipment supplied</b>	isotropic sensor with connecting cable EMF Software R&S®RFEX operating manual (on CD) tripod adapter adapter cable for spectrum analyzers transit case

## Ordering information

Designation	Type	Order No.
Portable EMF Measurement System (without R&S®FSH, laptop and carrying bag)	R&S®TS-EMF	1158.9295.03
<b>Options</b>		
Cable Set for R&S®TS-EMF (8 m)	R&S®TS-EMF-Z2	1166.5708.02
Tripod for R&S®TS-EMF	R&S®TS-EMF-03	1101.8477.03
Desktop Tripod for R&S®TS-EMF	R&S®TS-EMF-05	1166.5850.02
DKD Calibration of Isotropic Antenna	R&S®TS-EMF-DKD	
UMTS Option 1: CPICH UMTS Decoding (can be used with R&S®FSP/FSU, R&S®ESPI or R&S®TSMU)	R&S®TS-EMF-U1	
PCMCIA GPIB Card	R&S®NI-PCMC	1119.4715.02
Strain Relief for PCMCIA Card	R&S®NI-PCMCIA	0322.2267.02
UMTS Option 2: CPICH UMTS Decoding with R&S®TSMU-H	R&S®TS-EMF-U2	
PCMCIA FireWire Card	R&S®TSNB-FIRE	1501.1130.02

More information at  
[www.rohde-schwarz.com](http://www.rohde-schwarz.com)  
 (search term: TS-EMF)



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