Portable System for EMF Measurements R&S®TS-EMF

How ambient conditions influence electromagnetic field measurements

The R&S®TS-EMF [*] from Rohde & Schwarz is a versatile system for measuring high-frequency electromagnetic compatibility in the environment. Even if receive conditions are difficult (e.g. multipath propagation due to reflections), EMF measurements must be able to reliably and reproducibly determine peak and average field-strength values. In this case, ambient conditions have a large impact. This article presents the latest findings on the influence of ambient conditions, based on measurements with the R&S®TS-EMF.

Versatile configurability and specific measurement modes (long-term measurements, determination of peak and average values) make the R&S®TS-EMF system (FIG 1) ideally suited for measurements at a fixed location and fundamental measurements. The new measurement routines for measuring across several points in a room are a special advantage.

In cooperation with Prof Dr Wuschek from the University of Applied Siences Deggendorf, Rohde & Schwarz performed EMF measurements and analyzed spatial field distribution and signal timing.

Spatial level fluctuations

Shadowing and interference with reflected signals result in significant field-strength fluctuations at the reception site, especially in buildings. FIG 2 shows an example of field-strength distribution in a room alongside a straight line. If, in this case, measurements were carried out at only one point, measurement errors in the order of 20 dB could occur.

Magnitude and period of the fluctuation depend on the strength and distance of the reflection. In particular if there are

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FIG 1
The R&S®TS-EMF measures electromagnetic fields in the environment. These measurements provide a basis for discussions about the effects of electromagnetic radiation.

many different overlapping reflections, behaviour becomes erratic and cannot be anticipated. It is therefore necessary to use specific measurement methods in order to reproducibly measure the maximum or average value even under these circumstances.

To do so, mainly the stirring method and the multipoint method have become established. With the stirring method, the antenna is shifted in all directions across a spatial volume and the maximum value of the field strength is recorded. With the multipoint method, measurements – from which the peak or average value is derived – are performed in defined spatial intervals. The multipoint to be used is still being discussed by experts; one possibility is specified in the European standard prEN 54000 which is currently being created.

Outside of buildings, reflection conditions are simpler since it is usually the ground that causes the main reflection. Thus, a few measurement points of the multipoint method yield excellent results. FIG 3 shows a comparison between the multipoint method (three measurement points at different heights) and the stirring method, indicating a good match.

Level fluctuations as a function of time

Level fluctuations as a function of time may be caused by changes in the transmit power (e.g. changing traffic volume in mobile radio) and/or influences by the current measurement environment (e.g. weather).

FIG 4 shows the result of measuring the timing of transmitters with constant power (e.g. organization channel BCCH with GSM). The same location was selected as for measuring the spatial level fluctuations (FIG 2). It turns out that the level is time-constant if the transmit power and the weather conditions remain constant, despite significant spatial fluctuations. The reflection conditions are therefore of minor importance for long-term measurements which refer above all to changes in field-strength. Thus, fluctuations due to transmit power or weather conditions can be reliably determined by means of long-term measurements. FIG 5 shows an increase in the GSM network utilization, in which case voice channels that are only occasionally active are added to the signalling channels with constant power that are always present.

With short-term measurements, no information is available about the current system utilization. For this purpose, measurement methods are applied that extrapolate to the worst case, i.e. maximum utilization of a base station. This ensures that the measured value is independent of system utilization.

Summary

If there are significant spatial level fluctuations, especially in buildings, suitable measurement methods (stirring method, multipoint method) ensure high measurement accuracy and reproducibility. Spatial fluctuations have no direct impact on the timing of signals. Long-term measurements with fixed, isotropic antennas are therefore ideally suited for the characterization of changes in the field strength due to different system utilization or weather influences.

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More information and data sheet at www.rohde-schwarz.com (search term: TS-EMF)

REFERENCES

[*] Portable System for EMF Measurements R&S®TS-EMF – Accurate measurements of electromagnetic fields caused by transmitter systems. News from Rohde & Schwarz (2003) No. 177, pp 29–31

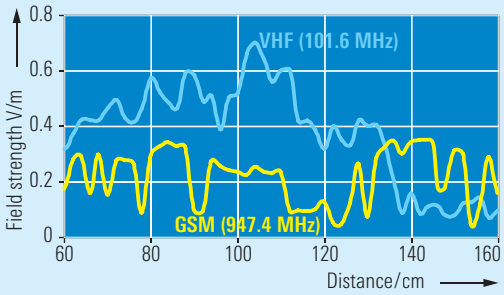

FIG 2 Field-strength distribution within a room.

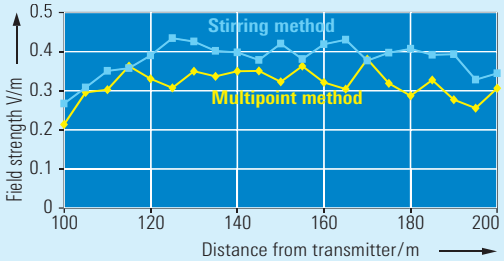

FIG 3 Comparison between the stirring method and the multipoint method (three points) outdoors.

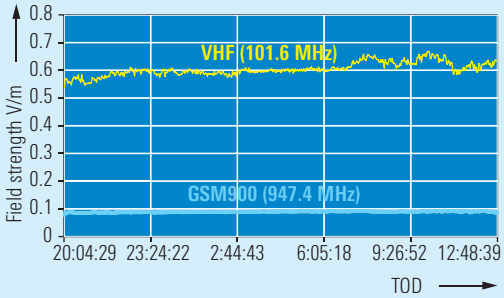

FIG 4 Timing of field strength indoors if transmit power is constant.

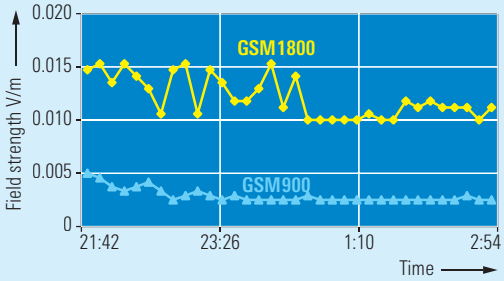

FIG 5 Changed timing of the sum field strength with GSM due to shifting traffic volume.