SRM-3006 – Reliably measuring actual HF immissions

Application Note „SRM-3006- Reliably measuring actual HF immissions“

Immission measurement studies on the exposure of the general public to high frequency electromagnetic fields (HF EMF) have in the past been limited to examining individual wireless services and the wireless Internet. However, in everyday life we are surrounded by a much more complex mixture of a large number of different RF sources. As a result, questions about the actual total level of personal exposure are being raised more and more in public discussions on the subject. How high is the actual exposure at a given time and place? The SRM-3006 from Narda STS has proven to be particularly suitable for such demanding measurement tasks.

Many things must be considered in order to correctly measure the prevailing total exposure of persons to high frequency electromagnetic fields in typical everyday situations. The various contributions of and interactions between the different emitters present play a decisive role in all of this. The bandwidth can range from devices close to the body such as cellular phones or cordless phones, through to local RF sources like DECT or WLAN, and on to more distant radio and TV transmitters or base stations.

Frequency selective measuring devices

Frequency selective measuring devices such as spectrum analyzers are the only instruments capable of determining the actual total exposure to HF EMF including the particular distribution within the field. Dr. Christian Bornkessel from the Ilmenau Technical University used the SRM-3006 (Selective Radiation Meter) from Narda Safety Test Solutions for such “measurements of average immission in typical everyday situations” as part of a study.

According to Dr. Bornkessel, an internationally recognized expert in RF measurement, this instrument is in many respects ideally suited for precisely these measurement tasks, being both robust and easily handled. It allows efficient recording of several wireless services with different spectrums in a single measurement run. This powerful hand held instrument also boasts good sensitivity and its precise results – even in an inhomogeneous field – are easy to interpret.

Figure 2: The SRM-3006 (Selective Radiation Meter) from Narda Safety Test Solutions used by Dr. Christian Bornkessel for the measurements.

SRM-3006 development goals

Before developing the frequency selective field measuring instrument, Narda’s measurement engineers held many discussions, particularly with those who would use such a device in practical situations. This resulted in a comprehensive and concrete picture of the target group requirements and a clear concept. This, combined with Narda’s many years of experience, has resulted in an application-oriented portable spectrum analyzer for professional users. This device together with its PC software makes it as easy as possible for users to obtain and manage correct values, thanks to its many clever features. In this way, it helps to save time and avoid measurement errors.

2015: IZMF study of total RF immissions

The main aim of the 2015 study “Systematic measurement of total RF immission in typical everyday situations”, supported by Informationszentrum Mobilfunk e.V. (IZMF), was to firstly provide authoritative data for assessing the total immissions in the high frequency range taking mobile terminal equipment into account, and then to give information about which RF sources contribute to the total immission and in what quantity

Method and device settings

The IZMF study covers the current services in Germany, differentiated for transmitting and receiving equipment. The scientists used “Safety Evaluation” mode for the actual measurements. The SRM-3006 can capture several wireless services separated by frequency practically simultaneously during a single measurement run.

The individual wireless service parameters of start and end frequency and resolution bandwidth (RBW) were entered into a so-called service table along with the service names. In practice, a useful input editor supported by the Narda SRM-3006 TS software is used for this. The more detailed the initial information about the service to be measured and the more thoroughly the service table is completed, the easier, quicker and more reliable the measurements are to make. This is the part before the measurement that requires more exact expert knowledge of the subject. Once it has been set up professionally, the SRM-3006 can be used by a “trained layman” to make correct measurements.

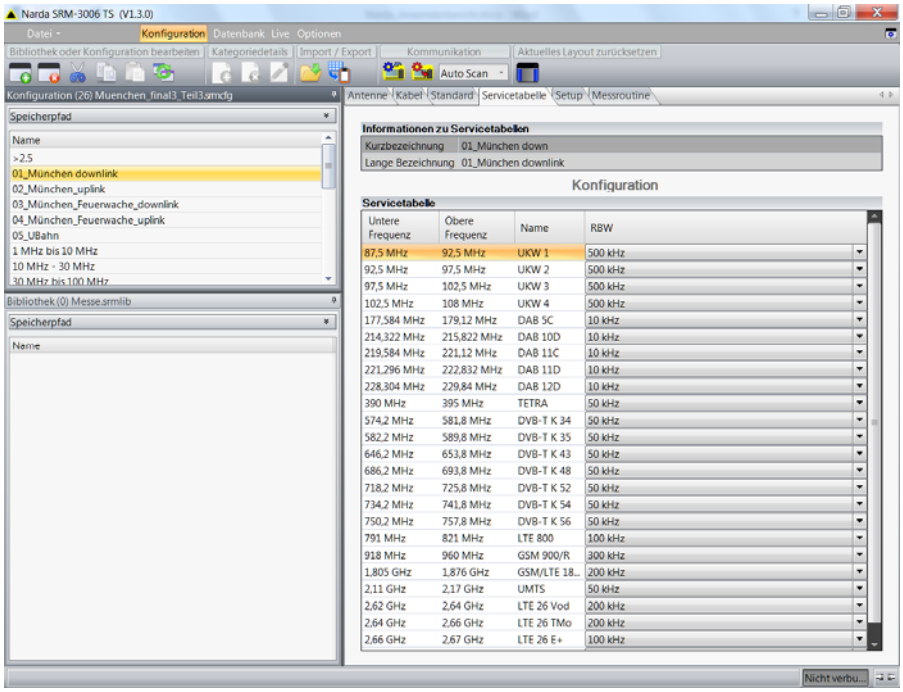

Figure 3: Beispielhaft – Servicetabelle für Sendeanlagen nach der derzeitigen Frequenzbelegung in Deutschland – für die Region München konkretisiert

Expert recommendations

Dr. Bornkessel recommends that the immissions due to transmitting and receiving equipment are measured separately. This is because neighboring terminal equipment can generate comparatively high levels that require adjustment of the measurement range by inserting an attenuator. Time is also a factor. Simultaneous recording of both sources in a common service table would otherwise lead to a disadvantageous reduction in the overall sensitivity, which might result in all the measurement values for the transmitting equipment being below the indication threshold of the measuring device.

The setting “Average Type: Average Time” should also be selected with the “Result Type” softkey and a value of 6 minutes set. This results in automatic averaging over a period of 6 minutes with the result value displayed on the instrument. This 6-minute interval corresponds exactly to the recommendations of the ICNIRP (International Commission on Non-Ionizing Radiation Protection). Immission values measured in this way can then be compared with the limit values specified in the recommendations.

The three-axis Narda antenna

A three-axis antenna must be used for this measurement, because the correct measurement of the average immission can only be determined using an antenna with isotropic directional characteristics. There are three sensors inside this antenna, which are selected by the measuring instrument one after the other, so the antenna is quasi-isotropic. The SRM-3006 thus only needs one RF module to measure the three channels.

Figure 4: Three-axis antenna from Narda with isotropic directional characteristic for mobile services.

LTE option saves time

The SRM-3006 has also been equipped with an LTE option in addition to the UMTS option since mid-2012. This enables the instrument to measure the electromagnetic fields emanating from LTE base stations as a total as well as broken down according to radio cells and their respective antennas. The special feature here is that the field measuring instrument can extrapolate at any time to determine the exposure level that would theoretically occur at full transmission capacity or maximum traffic load. This saves users a lot of time and helps to avoid errors that could occur as a result of complicated manual calculations.

Measurement evaluation

After a 6-minute measurement, the results are saved in the instrument. The results can be evaluated back in the office once they have been transferred to a PC using the “Narda SRM-3006 TS” PC software. The record of results should include the percentage of the limit value reached (%LV) for field strength “E” and magnetic flux density “S” as well as their absolute values.

Immission from transmitting equipment					Immission from receiving equipment				
Source	E [V/m]	E [% GW]	S [mW/m²]	S [% LV]	Source	E [V/m]	E [% GW]	S [mW/m²]	S [% LV]
Cellular base station	0.17	0.29	0.078	0.0009	Cellular terminal (phone)	0.23	0.40	0.140	0.0016
Broadcast radio	0.04	0.12	0.003	0.0002	DECT	0.02	0.03	0.001	0.0000
					WLAN	0.07	0.11	0.013	0.0001
					ISM 434/868	0.05	0.12	0.006	0.0001
Total	0.18	0.32	0.081	0.0010	Total	0.25	0.43	0.159	0.0019

Table 1: Example evaluation of a measurement with the SRM-3006 made using the method described, separated into transmitting and receiving equipment

Note: The values in this particular case (Table 1) come from the IZMF measurement set made in Hall 8 of the Hannover Trade Fair in 2015. This clearly shows that the immissions due to the receiving equipment are greater than those due to the transmitting equipment. This may possibly be due to the reduced network quality in enclosed spaces, which requires a higher radiated power from the terminal equipment. This only transmits at a power level sufficient to enable correct communication. At the same time, many handset users are present within a relatively small space inside the exhibition hall..

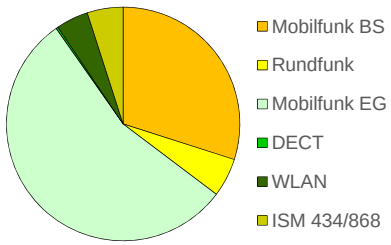

Figure 5: Graphical representation of an example evaluation as part of the IZMF study (yellows ≙ transmitters and greens ≙ receivers)

Long term measurements

Long term measurements can be a sensible addition to 6-minute average immission measurements. These are also possible with the SRM-3006. The defined service tables and the setups resulting from them can generally be used for such measurements too. It should however be mentioned that the

measurement concept and interpretation of the results require a certain amount of experience on the part of the user. This is because of the physical effects and phenomena that may occur under these conditions: Due to an inhomogeneous field distribution, say indoors, with the field strength maximum values for different services at different locations, the absolute field strength values can be completely different depending on the place of measurement.

Few studies so far

There are currently very few studies that take these RF field dependent interactions into account. Some of these studies use compact dosimeters that can be worn directly on the person, which is exactly where the measurement needs to be made, of course. The disadvantage here is their inadequate sensitivity. The fields that are present are usually below the detection limit. The conditions of use also result in considerable measurement uncertainty resulting from shadowing effects due to the close proximity of the sensor to the body. The measured values can also be distorted by inadequate discrimination between different wireless services in adjacent frequency bands.

Summary

The SRM-3006 is a frequency selective field measuring instrument for professional users. As well as standard-compliant immission measurement of GSM, UMTS and LTE base stations at maximum load or of broadcasting transmitters, it is superbly suited for time averaged or mean immission measurements on various sources. “Safety Evaluation” mode plays a significant role in this regard. It allows considerably more efficient measurement of the immissions contributed by wireless services of different frequencies than a large, manually operated conventional laboratory spectrum analyzer.

It is true that the measurement concept and definition of device settings and service tables for the SRM-3006 require users to have detailed knowledge of how the device works and of the structure of the signals being measured. However, once the measurement parameters have been set correctly, the comprehensive software control features allow for a very high degree of automation in the measurement sequence. This means that users who are not RF specialists can also use the SRM-3006 (with some limitations).

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