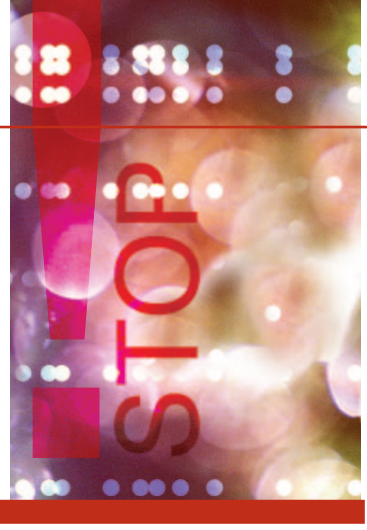

Frequency Selective and Isotropic

A NEW HAND-HELD TESTER MEASURES, EVALUATES AND RECORDS ELECTROMAGNETIC FIELDS FROM VHF TO UMTS ON SITE

Author Details

Franck Placidet, Product Manager at Narda Safety Test Solutions in Pfullingen
Burkhard Braach, Independent Trade Journalist in Reutlingen, Germany
Tel: +49 7121 9732-777
Fax: +49 7121 9732-790
Email: support@narda-sts.de

Ignorance is bliss. That kind of simplistic approach to the unknown is not a good idea when it comes to electromagnetic radiation. True, you can't see it or hear it and you will only rarely feel it, but its ability to generate heat is a well-known physical fact. This property serves as the basis for the limit values published by the ICNIRP (International Commission on Non-Ionizing Radiation Protection), the IEEE and for national regulations like FCC (Federal Communications Commission) in the US, the German BImSchG (Federal Law on Immission Protection) and BGV B11 (Trade Association Regulation for Health and Safety at Work) or the Canadian Safety Code 6. There's a psychological effect too: an uneasy feeling wherever a new antenna appears. As a result of mobile telephony, some buildings have sprouted whole forests of aerials.

Precision measurements provide assurance to operators and authorities alike that limit values are not being exceeded and provide the basis for objective discussions. Rather than the overall exposure level, more and more importance is being given to the proportion contributed by each individual source of radiation, such as FM and TV broadcasts, emergency services radio systems and the in-house services used by railroads and other companies, and mobile telephony from GSM through to UMTS. These various components can only be separated with a frequency selective measurement.
Most of the measurement tasks that mobile service providers, authorities, and test and measurement service providers need to tackle can be divided into the following categories:

Fig. 1: Workplace overview measurement. The probe can be linked to the basic instrument by cable and held in the hand to make sample measurements throughout a room.

• Public sector overview measurements

Apart from public places and buildings, this also includes places of work and private homes; in other words, everywhere that is generally accessible. This is usually an unknown environment as far as electromagnetic fields are concerned. More often than not, the biggest source of radiation is not the highly visible mobile phone network antenna but a hidden radio broadcaster or an inconspicuous DECT phone base station. A selective measurement may sometimes also reveal unauthorised video monitoring or other unknown field sources.

• Measurements at sensitive locations

Particularly low limit values are desirable at sensitive locations such as kindergartens, schools and hospitals. High sensitivity, frequency selective measurements are needed in order to demonstrate that they are being adhered to. Traditional broadband test equipment, which detects the entire frequency range as a whole, often reaches the limit of its sensitivity in such situations.

• Comparison tests at antenna sites

Generally, the field conditions for antennas sited on rooftops are known. There may not be much room to move physically, but things can also become restrictive in respect of the permitted field exposure level if the caretaker has a key to the door on to the roof. Then, the immission protection limit values for publicly accessible areas must be adhered to. If the limits are exceeded, then the anxious questions are: Who contributed what to the overall exposure level? Who must reduce their output power level? And, by how much? Precision, frequency-selective measurement equipment is needed in order to answer these questions. Even if the limits are not exceeded, the measurement results may be decisive in granting approval for new transmitting stations.

• Measurements for determining safety zones

Higher limit values apply for the levels of radiation to which employees may be exposed at their place of work. Even these limits can be exceeded at locations close to radiation sources. Precise selective measurements indicate the field sources and make it easier to define appropriate safety zones.

Practical frequency selective testing

Until recently, frequency selective measurements were cumbersome to perform. Apart from the measuring probe, a spectrum analyser as well as a PC was needed to convert the measured voltages into field strength values and display them. Specialising in test equipment for safety in electromagnetic fields, Narda Safety Test Solutions has taken a new path with the introduction of its Selective Radiation Meter, or SRM for short.

To start with, the instrument is just as portable as a noise level meter or a conventional broadband field strength meter. The probe can be fitted to it to form a single unit. A great advantage, since a complicated setup with the probe on a tripod connected to several other instruments is not likely to survive the hustle and bustle of, say, a school playground, and is simply impossible to set up halfway up a n antenna mast.

Additionally, the probe is isotropic, i.e. it has the same sensitivity in all directions. This means that you don’t need to worry about the main axis of the radiation when measuring. You also do not need to make cumbersome measurements in three orthogonal directions, which would require a tripod with a swivel head. For precision measurements, however, the probe can be fitted on a tripod and connected to the instrument by a cable if required.

Ruggedness is a prerequisite for on site use. The casing of the SRM is made from the same kind of plastic that is used for percussion drilling machines. The instrument takes the weather as

Fig. 2: Rooftop comparison measurement. The probe can also be fitted to a tripod for making precision measurements.

Fig. 3: The basic instrument and probe form a single unit that you can take anywhere.

it comes. It is unaffected by temperature from -10 °C up to +50 °C, humidity levels of up to 95%, and a few drops of rain or a little condensation. The instrument is also rugged with regard to its immunity to electromagnetic irradiation. Even though the SRM is capable of measuring field strengths of just a few millvolts per meter, it still works even when situated close to transmitting equipment that can generate several hundred volts per meter.

Safety Evaluation: Immediate results

Most important for practical use is the fact that in Safety Evaluation mode the SRM not only indicates the result immediately, but also does so in a way that meets the needs of telecom and mobile network providers, measurement service providers and public authorities:

- as a field strength or as a percentage of the permitted limit value
- for a single source or a single radio channel,
- as a list of sources and channels,
- as the value contributed by a given mobile phone service, or
- as the total value for all services with the percentage each contributes to the total exposure level.

The relevant limit value curves (ICNIRP, IEEE, BGV B11, ÖNORM S1120, Safety Code 6) are stored in the SRM for this, along with numerous frequency and service tables (VHF, GSM-900, GSM-1800, UMTS etc.). Further tables can be easily created on a PC and downloaded to the SRM; for example, the correlation between GSM channel frequencies and individual service providers at a multiple antenna site. In the same way, all the results can be exported from the SRM to common PC software applications.

Measurement accuracy – not just a question of technology

High measurement accuracy is only one prerequisite for reliable results. As a special instrument designed to check safety requirements in electromagnetic field also takes the human aspect of the problem into consideration. Anyone can operate the instrument; no specialist background knowledge is needed. It is unlikely that someone who only occasionally needs to measure electromagnetic fields, but who may also have to measure things like noise or gas levels, will want to be bothered with frequency ranges or resolution bandwidths.

In Safety Evaluation mode, the instrument automatically selects the frequencies and the appropriate resolution bandwidths. The frequency ranges are set according to the services that are selected. Only those services that can be detected with the probe that is fitted are available for selection. Totals are calculated according to the selected standard. This reduces an often-underestimated uncertainty factor: incorrect operation and errors in evaluation.

Fig. 4: Measurement of field exposure level for workers on a transmitting tower directly adjacent to digital radio broadcasting antennas (DAB).

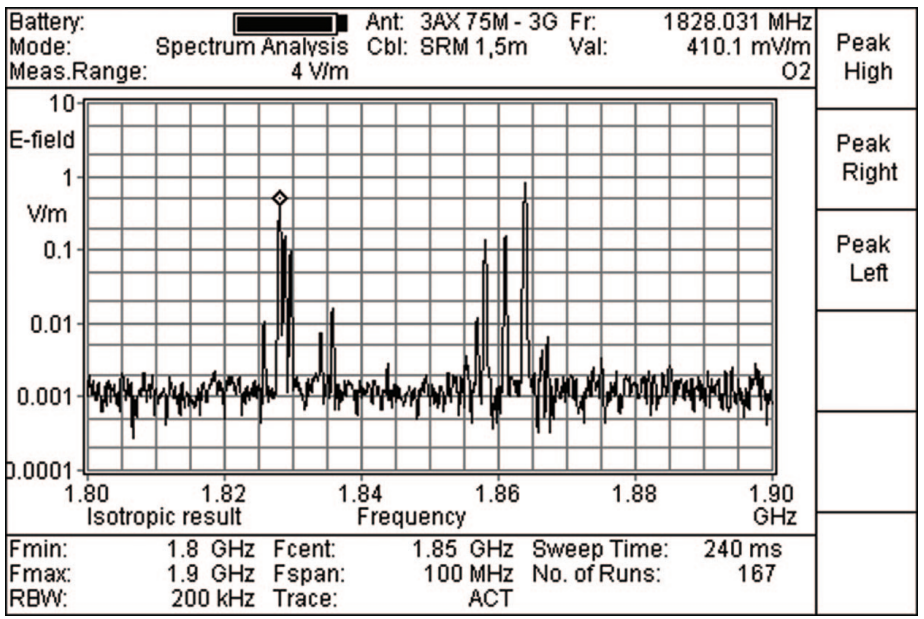

Fig. 5: Result of an automatic Safety Evaluation test. The instrument indicates the proportions due to individual services as well as the overall exposure level as a percentage of the permitted limit value, based in this case on BGV B11, Exposure Range 1.

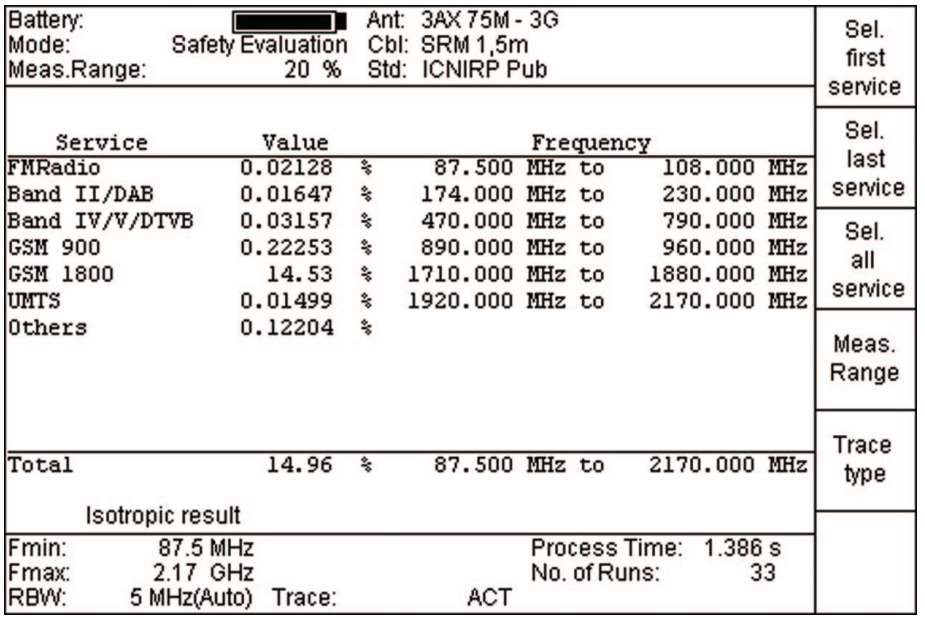

Fig. 6: If you are familiar with spectrum analysis, you can use the instrument as a "normal" spectrum analyser and still benefit from the automatic functions. Here, for example, the spectral line in the GSM 1800 band is identified with the provider O2.

If you are familiar with spectrum analysis, you can still make full use of all the separate technical features of the instrument in Spectrum Analysis mode. The specifications also ensure that it can be used for general field measurements as well.

Fig. 7: The Selective Radiation Meter and E-field probe from Narda Safety Test Solutions.

Technical data	
Basic instrument	Frequency range 100 kHz to 3 GHz
Test probe	E-field probe, isotropic, 75 MHz to 3 GHz (probes from other manufacturers can also be used)
Resolution bandwidths (RBW)	1 kHz to 5 MHz, dependent on frequency span setting, Spectrum Analysis mode
Sensitivity	2 mV/m at 900 MHz with 100 kHz resolution bandwidth (suitable for GSM measurements) 15 mV/m at 2.1 GHz with 5 MHz resolution bandwidth (suitable for UMTS measurements)
Spectrum measurement time (Sweep Time)	<600 ms for a frequency span of 100 kHz to 3 GHz with 5 MHz resolution bandwidth (RBW)
Memory capacity	More than 500 spectra
Operating time	About 4 hours from fully charged battery
Weight	About 1.9 kg including battery