

**Electromagnetic field measurements with Willtek's
9102 Handheld Spectrum Analyzer**



boosting wireless efficiency

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The 9131 EMF Measurement Option and Willtek's comprehensive portfolio of antennas help you to ensure that the radiation is below legal limits, by measuring the electromagnetic field (EMF) precisely, quick and easily.

The challenge

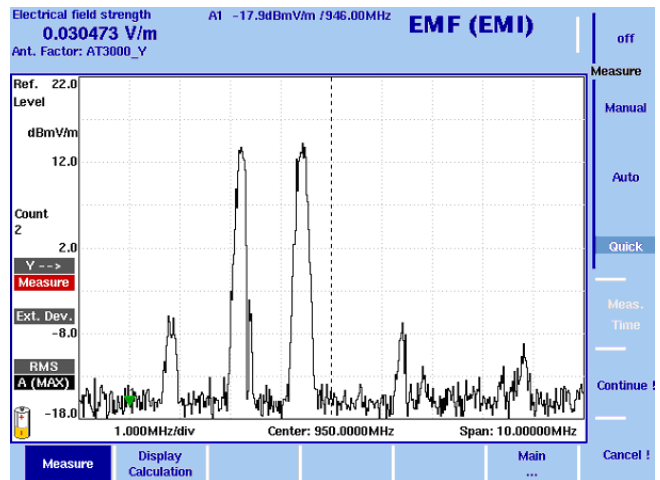
More and more sources of electromagnetic fields are created. In most cases these are transmitters for mobile radio, broadcasting and other radio services. However, also equipment for home and office communications and other technical devices generate electromagnetic fields. We are continually exposed to electromagnetic fields in our normal working environment and at home.

In order to protect health, national and international institutions like ICNIRP prepared recommendations for limits that were turned into national laws. Operators and regulators are faced by the challenge of verifying that these limits for electromagnetic fields are observed by the sources at hand. Adequate measuring equipment is in demand.

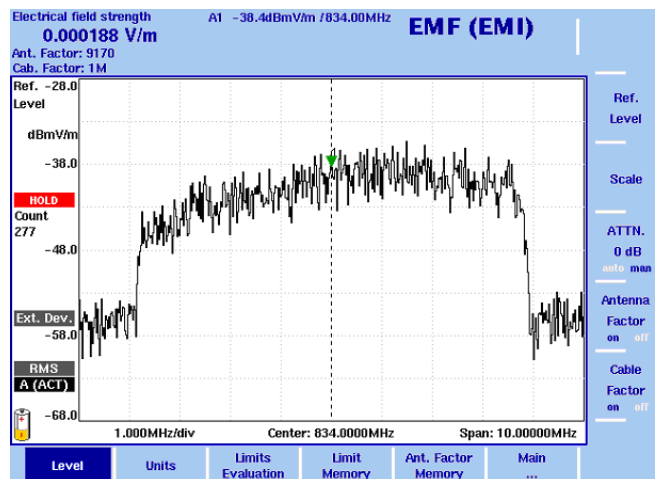
Field measurements in the field

Electromagnetic fields are usually measured over a defined frequency range to determine the amount of radiation emitted by certain sources such as broadcast stations. This requires a frequency-selective receiver with high sensitivity, a large dynamic range and precise measurements of the field strength - prerequisites for accurate and reproducible measurement results.

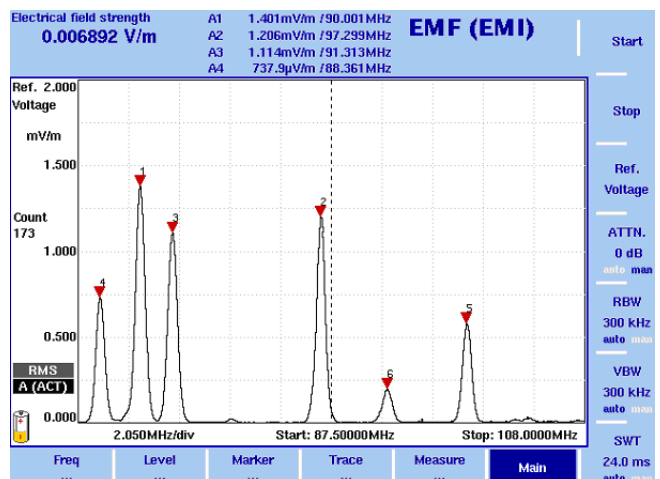
Willtek Communications developed a measurement solution to determine electromagnetic fields, based on the 9102 Handheld Spectrum Analyzer with additional software running on the analyzer. The 9131 EMF Measurement Option is a software-enabled measurement mode for automatic EMF measurements upon the press of a button.



Initial quick measurements present an overview of the received signals and by turning the antenna, help to find the optimum direction.



Antenna factors and cable attenuation can be defined with the comfort of the 9100 Data Exchange Software before activating them in the 9102 and taking measurements, e.g. from digital broadband signals (DVB-T).



The measured signals can be displayed both graphically and numerically, in log or linear terms like the field strength in this example.

This up-to-date solution comes along with the comprehensive flexibility and precision of a real spectrum analyzer. Filter bandwidth and channel numbering systems can be selected according to the signal to be measured, producing results of utmost measurement accuracy.

All you need to effectively record electromagnetic fields is the 9102 with the 9131 option and a suitable antenna. The 9102 provides all the necessary functions like detecting the peak value over a given time period or integrating the broadband signal power over a given frequency range, without requiring an external PC. The recorded measurement values can be compared with the relevant threshold values as a percentage. The results can be displayed in logarithmic or linear format, the displayed range quickly and easily being adapted to the measured signal.

The high update rate of the 9102 facilitates searching for the maximum field strength by swivelling the antenna. Once the optimum point is found, measurements can be taken with a choice of automatic functions such as measurements over a user-definable time period and integration of the receive level over a selected frequency range. The measurement result is presented as a graph and a numerical value.

The 9102 is equipped with features exceeding simple EMF monitors by far. The high-contrast colour display set a new standard in this class of test equipment. Exchangeable high-capacity batteries and the design of the housing show that Willtek did not compromise on usability in the field. The housing highly attenuates internal mixing products and other unwanted emissions so that they do not interfere in highly sensitive EMF measurements; strong fields are captured over antenna only and cannot radiate directly into the instrument.

The whole range of applications in RF spectrum measurements is available with the 9102 Handheld Spectrum Analyzer, including tests of the cable and antenna installation (VSWR/DTF) and general-purpose test tasks.



With biconical antennas, the same antenna pair is used to take measurements in different directions.



The 9102 with the 9171 Isotropic Antenna is a comfortable test solution for immission measurements.

Antenna for testing

The antenna is another important factor in the field strength measurement. It converts the electromagnetic field, the field strength and power flux density into voltage and current so that it can be captured by the spectrum analyzer. A correction table (k factors) should be available to calibrate the antenna. With the help of this table, the measured level is converted into the relevant quantities, field strength (measured in V/m) and power flux density (W/m²).

Willtek delivers measurement antennas with the appropriate correction factors tables. The 9100 Data Exchange Software, a standard tool delivered with the 9102, can also be used to collect the data for antennas from other vendors and to transfer them to the 9102. Activating these user-defined correction factors in the instrument is only a keypress away.

The 9102 with the 9131 EMF Measurement Option can master any situation in the field, for example by taking the cable attenuation into account in the measurement results. Calibrated cables of six metres (19 feet) length are available as an accessory.

9170 Biconical Antenna

Biconical antennas have a dipole-like structure and hence are very symmetric. Their isotropic characteristic is achieved by the user turning about the antenna in three planes. This means that for each of the different directions one and the same antenna element is used, leading to an unmatched isotropy. The Biconical Antenna is best suited for high-precision measurements.

9171 Isotropic Antenna

Willtek's Isotropic Antenna is controlled by the 9102 Handheld Spectrum Analyzer, rendering manual rotation of the antenna unnecessary. Remote control is achieved with the help of a circuit integrated into the antenna; this circuit is connected to the Multi Port connector of the 9102 by way of a shielded cable with a high-precision connector. This connection is also used by the 9102 to read the calibration data for the antenna from the EPROM within the circuit. The calibration data are automatically loaded and activated when the antenna is connected to the Multi Port. Simple operation and fast measurements with remote control make the 9171 Isotropic Antenna an ideal choice for measuring the radiation off mobile networks at varying locations.

9170 Biconical Antenna

General data

Antenna type	Biconical (linear passive device)
Frequency range	60 MHz to 2.5 GHz
Sensitivity	> 0.5 mV/m
Max. applicable field strength	> 300 V/m
Dipole balun symmetry	
60 to 80 MHz	±0.6 dB
80 MHz to 3 GHz	±0.2 dB
Isotropy error	
up to 1.5 GHz	< 0.5 dB
1.5 to 2.2 GHz	< 0.9 dB
2.2 to 3 GHz	< 1.2 dB
Dimensions	
Radome diameter	200 mm
Length	520 mm
Weight	2.4 kg
RF connector	N-type
Operational temperature range	-30°C to +55°C
Environmental protection class	IP 44

Delivery includes

- Antenna
- Clip with ¼ inch thread for tripod, with stops in 120° steps
- 10 m calibrated, ferrite beaded coaxial cable
- Calibration certificate and k factor table

9171 Isotropic Antenna

General data

Antenna type	Isotropic transducer with 3 orthogonal dipole antennas
Frequency range	30 MHz to 3 GHz
Sensitivity	< 5 mV/m
Max. applicable field strength	> 300 V/m
Dipole balun symmetry	
50 to 80 MHz	±1.5 dB
80 MHz to 3 GHz	±0.5 dB
Isotropy error vertical polarization	
up to 1.7 GHz	±0.5 dB
1.7 to 2.1 GHz	±1.0 dB
2.1 to 3 GHz	±0.5 dB
Isotropy error horizontal polarization	
up to 1.2 GHz	±0.5 dB
1.2 to 1.7 GHz	±1.0 dB
1.7 to 2.1 GHz	±1.5 dB
2.1 to 3 GHz	±1.0 dB
Dimensions	
Radome diameter	200 mm
Length	520 mm
Weight	0.5 kg
RF connector	N-type
Operational temperature range	-20°C to +60°C
Environmental protection class	IP 54

Delivery includes

- Antenna
- Clip with ¼ inch thread for tripod
- 6 m combined remote control cable and calibrated, ferrite-beaded coax cable
- N to N adapter, supports direct antenna mounting on the instrument
- Antenna interface (control and calibration data)
- Calibration certificate and k factor table

9172 Directional Antenna 80 – 1000 MHz 9173 Directional Antenna 300 – 3000 MHz

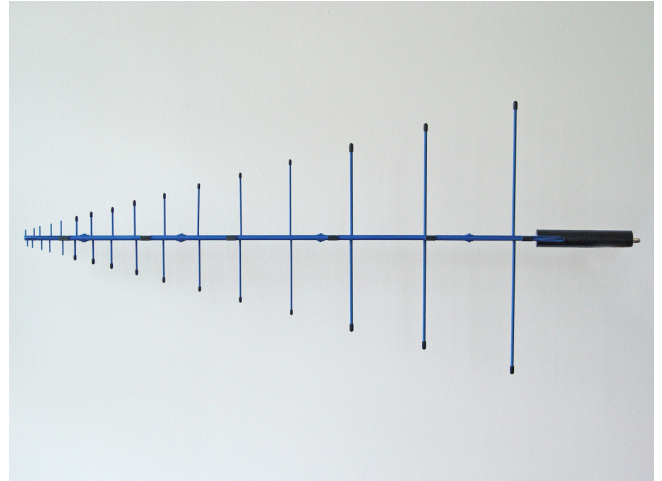
These log-periodic broadband antennas cover a wide spectrum of applications. Directional antennas are typically used to measure the emission from a specific antenna site. Thanks to their small angle of beam and their excellent frequency response, Willtek's directional antennas can also be used for EMF prequalification and for finding interferers. With these two antenna types and their overlapping frequency ranges, Willtek supplies excellent equipment covering the whole range of commercial radio services.

Directional Antennas

	9172 Directional Antenna 80 to 1000 MHz	9173 Directional Antenna 300 to 3000 MHz
Frequency range	80 to 1000 MHz	300 to 3000 MHz
Max. transmission power (CW)	500 W	200 W
Nominal impedance	50 Ω	
VSWR (typ.)	< 2.0	
RF connection	N (female)	
Polarisation	Linear (vertical/horizontal)	
Pole clamp	5/8" UNC thread 37 mm round flange	
Size (L x W)	2.1 m x 1.5 m	1 m x 0.55 m
Weight	3.6 kg	2.4 kg

Delivery includes

- Antenna
- Clip with 5/8 inch thread for tripod



Emission measurements over a wide frequency range are best performed with Willtek's directional antennas.

9131 EMF Measurement Option

Measurement range	1 mV/m to 200 V/m
Measurement units	dBV/m, V/m, dBm/m ² , W/m ²

Ordering details

9102 Handheld Spectrum Analyzer	M 100 412
9102 Handheld Spectrum Analyzer Field Edition	M 248 806
9102 Handheld Spectrum Analyzer Tracking Edition	M 248 801
9102 Handheld Spectrum Analyzer VSWR/DTF Edition	M 248 802
9131 EMF Measurement Option	M 897 274
9132 RMS Detector Option	M 897 275
9170 Biconical Antenna	M 860 368
9171 Isotropic Antenna	M 248 809
9172 Directional Antenna 80 to 1000 MHz	M 860 158
9173 Directional Antenna 300 to 3000 MHz	M 860 159
Composite Cable 10 m for 9171	M 860 396
Antenna Tripod	M 860 256
Bag for Antenna Tripod	M 860 395

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