

Performing EMF measurements with the
9100 Handheld Spectrum Analyzer Series



boosting wireless efficiency

Introduction to EMF measurements

More and more sources of electromagnetic fields, mostly transmitters for mobile radio, broadcasting and other radio services, are being created and installed. Equipment for home and office communication and other technical devices also contribute to the exposure to electromagnetic fields in the working environment and at home. For health protection regulatory bodies have implemented limit recommendations which were turned into national laws. Network operators, companies installing transmitters for broadcasting and regulatory bodies are faced by the challenge of verifying that limits specified for electromagnetic fields are observed by the sources at hand.

The Willtek 9102 or 9103 Handheld Spectrum Analyzer in conjunction with the 9131 EMF Measurement Option and the appropriate accessories, i.e. antennas, offers a handheld solution and easy-to-use solution for this application area.

The following sections provide you with an introduction to the concepts of EMF verification and show how to perform EMF measurements with the 9102 or 9103 in conjunction with the 9131 EMF Measurement Option.

Electromagnetic fields are usually measured over a defined frequency range to determine the amount of radiation emitted by certain sources, such as broadcast stations or mobile phone base stations. Thus, measurements should be performed on a frequency where radiation is expected, e.g. on a broadcast or cellular radio frequency. For precise measurements a frequency-selective receiver with high sensitivity, a large dynamic range and precise measurements of the field strength is required. These are the prerequisites for accurate and reproducible measurement results.

Basically, there are two different measurement approaches in EMF verification:

- radiation emission and
- radiation immission

The equipment and the methods used vary according to measurement type. With the 9102 or 9103 Handheld Spectrum Analyzer in conjunction with the 9131 EMF Measurement Option and the appropriate accessories, i.e. antennas, Willtek offers a measurement solution covering the different approaches and requirements.

In the following two sections the radiation emission and immission concepts are explained. Furthermore these sections provide you with an overview on the equipment needed in order to perform EMF measurements depending on the measurement approach.

Radiation emission

Using this measurement type operators of cellular networks and broadcast stations verify that the radiation of a particular transmitter installed is within the limits specified by law and regulatory bodies. In many countries worldwide regulatory bodies stipulate a proof of regulation adherence. The radiation emission measurement is a directional measurement determining the electromagnetic field emitted by a transmitter. Within the measurement setup a directional antenna helps to measure the emitted radiation.

Measurement setup for emission measurements

For performing emission measurements according to ICNIRP (International Commission on Non-Ionizing Radiation Protection) standard with the 9102 or 9103 you just need the following two pieces of equipment:

- 9102 or 9103 Handheld Spectrum Analyzer equipped with the 9131 EMF Measurement Option and the 9132 RMS Detector Option
- a directional antenna

Willtek offers two different directional antennas for performing radiation emission measurements. For a detailed description of these two antennas, refer to "Directional antennas" on page 6.

This measurement setup consisting of the 9102 or 9103 and the directional antenna provides a handheld solution for performing radiation emission measurements easily and efficiently.

Radiation immission

For engineering offices and regulatory bodies the specific radiation exposure in a particular place is of special interest. During an immission measurement the electromagnetic field exposure is measured at different locations within a designated area to identify minimum and/or maximum radiation. Typical applications for this kind of measurement are for example:

- Measurements for defining security zones in close proximity of transmitter sites
- Measurements for determining radiation exposure of representative and especially sensitive facilities, e.g. schools, nursery schools and hospitals situated in proximity of transmitter sites
- Long-term measurements for determining immission fluctuations

Measurement setup for immission measurements

As for emission measurements you just need two pieces of equipment for performing immission measurements with the 9102 or 9103:

- 9102 or 9103 Handheld Spectrum Analyzer equipped with the 9131 EMF Measurement Option and the 9132 RMS Detector Option
- 9170 Biconical Antenna (for a detailed description refer to "9170 Biconical Antenna" on page 5)

or

- 9171 Isotropic Antenna (for a detailed description refer to "9171 Isotropic Antenna" on page 6)

The type of antenna you use depends on your measurement requirements. The detailed descriptions of the two different antenna types in "Measurement antennas" on page 4 provide you with useful information for selecting the appropriate measurement antenna for your EMF measurement.

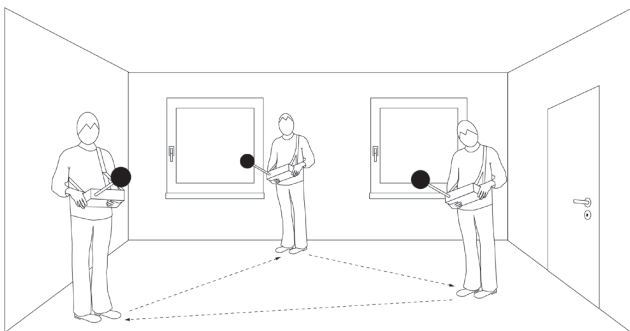
In this measurement setup the 9102 or 9103 captures the electromagnetic waves from all directions and displays the overall field strength in the desired frequency range.

Measurement methods

The location for performing EMF measurements is usually predefined. A main goal of performing EMF measurements is determining the radiation people are exposed to in their everyday life, so the measurements are usually done at locations where people stay for a while, e.g. their work place, home, but also restaurants or sidewalks etc. At the measurement locations a search for the maximum field strength has to be performed in order to determine the radiation exposure caused for example by mobile network base stations. For longterm EMF measurements first the maximum field strength is determined and then the antenna is placed on the location of maximum exposure. Basically there are two methods for determining the maximum field strength within a designated measurement area:

- The stirring method or
- the multipoint method

Using each of the two methods the user will move with the antenna within the area to be measured as shown in the following graphic depicting a user determining the maximum field strength using a measurement setup involving an isotropic antenna.



Stirring method

Using the stirring method the user sets the measurement instrument to maximum hold and moves the antenna within the designated measurement area. Depending on the antenna used the user has to be very thorough in covering the designated measurement area in order to capture the different locations, directions of incidence, and polarisations equally. Using an isotropic antenna directions of incidence and polarisations can be neglected, thus an isotropic antenna provides a more comfortable solution for using the stirring method. For further details on the characteristics of different antennas, refer to "Measurement antennas" on page 4. After completing the coverage of the designated measurement area the measurement instrument provides the maximum field strength value.

Multipoint method

The multipoint approach involves a predefined multipoint matrix providing the user with designated measurement points. For this purpose the dimensions of the measurement area first have to be determined and the measurement points have to be specified. At each measurement point a measurement has to be taken. As three measurements are required at each point (one for each direction, x, y, z), it is recommended to use an isotropic antenna for performing measurements using the multipoint method. For further details on the characteristics of different antennas, refer to "Measurement antennas" on page 4. The user performs the measurement at each of the measurement points and documents the individual measurement results.

Another possibility is to use a simplified approach to the multipoint method. As for the stirring method the user sets the measurement instrument to maximum hold and moves within the designated measurement area covering all predefined measurement points using an isotropic antenna.

Compared to the stirring method the multipoint method, whether in its pure or in its simplified form, has the advantage of offering a guideline to the user performing the measurements and thus constitutes a more structured approach.

Measurement antennas

The antenna is one of the most important factors in EMF measurements. There are different types of antennas which can be used for measuring field strength depending on your measurement requirements. Willtek offers a range of antennas for different measurement requirements:

- The 9170 Biconical Antenna with a frequency range from 60 to 2500 MHz for immission measurements
- The 9171 Isotropic Antenna with a frequency range from 50 to 3000 MHz for immission measurements
- The 9172 and 9173 Directional Antennas, two antennas with a frequency range of 80 to 1000 MHz and 300 to 3000 MHz respectively for emission measurements

For ordering details for Willtek antennas and antenna accessories, refer to the 9102 or 9103 user's guide delivered with your instrument.

During measurements the antenna converts the free progressive wave into a line wave. For antenna calibration a correction table containing k factors is required. These factors are

proportionality factors which correct the antenna's frequency response and help to convert the measured power or voltage to field strength or power density. Using the k factor table the measured level is converted into the relevant quantities, the field strength measured in V/m and the power density measured in W/m².

Willtek delivers its measurement antennas in conjunction with the appropriate correction factor tables. Using the 9100 Data Exchange Software you can transfer the k factor tables delivered to your instrument. With the 9171 Isotropic antenna this step is not necessary as the factors are stored in a memory inside the antenna interface. You can also use the 9100 Data Exchange Software to collect the correction data for antennas from other vendors and transfer them to your 9102 or 9103. For further details on using the 9100 Data Exchange Software, refer to the 9102 or 9103 user's guide included on the documentation CD delivered with your instrument. After transferring the correction tables to the instrument they will be available for selection for EMF measurements.

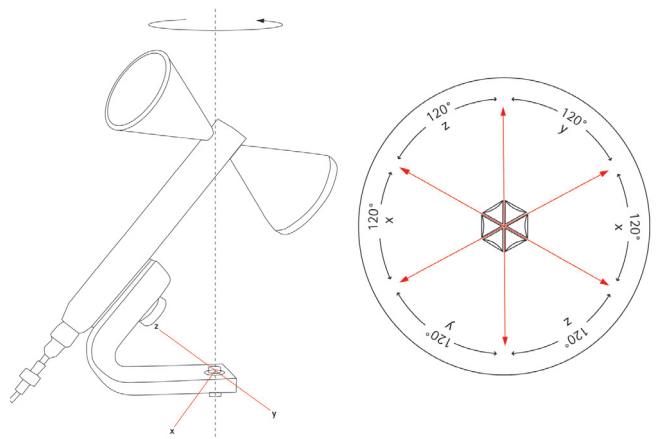
Willtek also offers antenna accessories like a tripod as well as calibrated cables. Thus you will be able to master any situation in the field using the 9102 or 9103 and its accessories. If you use a tripod and cable setup for your measurements, cable attenuation is taken into account by activating the appropriate cable factor on the instrument.

Following is a general technical description of the different measurement antenna types providing information on the relevant measurement purpose as well as technical details. For a detailed description of all individual steps to be taken during EMF measurements using the different measurement antenna types, refer to "Performing an automatic EMF measurement" on page 7 and "Performing a manual EMF measurement" on page 10.



9170 Biconical Antenna

Biconical antennas are characterised by their dipole-like structure. The two reception lobes are highly symmetrical and provide the biconical antenna with two main reception directions with an opening angle of 120° each. When manually turning the biconical antenna during measurements into three main planes (x, y, z) the same antenna element is used for the measurements in each of the different directions. This leads to an unmatched isotropy and thus makes biconical antennas most suitable for high-precision measurements. Mounting the antenna on a turning device you can easily turn the antenna in the directions indicated on the device and perform the measurements for each plane. Thereby a globe-like coverage for the measurement, comparable to the one using an isotropic antenna, is achieved as shown in the following graphic.



The 9102 and 9103 support consecutive measurements in three axes and automatically calculates the resulting field strength.

Willtek offers the 9170 Biconical Antenna for EMF immersion measurements with the 9102 or 9103 and the 9131 EMF Measurement Option.

For ordering information and technical specifications of the 9170 Biconical Antenna, refer to your 9102 or 9103 user's guide.



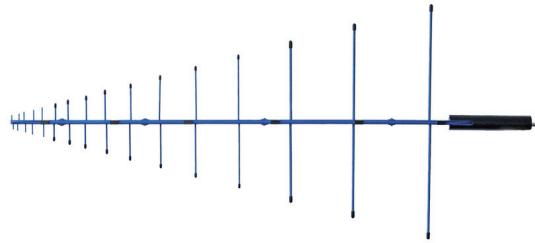
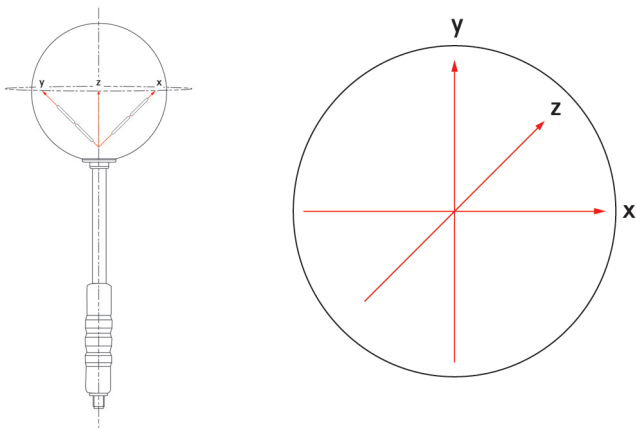
9171 Isotropic Antenna

The most comfortable and fastest solution for performing EMF immission measurements comprises using an isotropic antenna. In an isotropic antenna three antennas or dipole elements, one for each direction (x, y and z), are arranged orthogonally and combined by interconnection as shown in the following graphic.

Willtek offers the 9171 Isotropic Antenna for EMF immission measurements with the 9102 or 9103 equipped with the 9131 EMF Measurement Option. The 9171 Isotropic Antenna is controlled by the 9102 or 9103 Handheld Spectrum Analyzer, rendering manual rotation of the antenna during measurements unnecessary. This antenna enables you to perform fast automatic measurements. Remote control is achieved by way of a circuit integrated into the antenna. The circuit is connected to the 9102 or 9103's Multi Port connector via an additional shielded cable with a high-precision connector. Via this connection the 9102 or 9103 also reads the calibration data, i.e. the k factor correction information, automatically from the EPROM within the circuit. As soon as you connect the cable to the 9102 or 9103's Multiport the instrument automatically detects the antenna and loads a set of individual calibration values from the antenna.

On starting the measurement the instrument automatically controls the antenna's receiving direction, performs the measurements in each direction and calculates the isotropic total value from the three individual measurement values.

For ordering information and technical specifications of the 9171 Isotropic Antenna, refer to your 9102 or 9103 user's guide.



Directional antennas

Directional antennas are log-periodic broadband antennas covering a wide spectrum of applications. They are typically used for measuring the emission from a specific antenna site.

Willtek offers two different directional antennas of 1 m length each accommodating different frequency ranges:

- 9172 Directional Antenna – 80 to 100 MHz
- 9173 Directional Antenna – 300 to 3000 MHz

Thanks to their small angle of beam and their excellent frequency response, these two directional antennas can also be used for EMF prequalification and for finding interferers. With these two antenna types and their overlapping frequency ranges, the whole range of commercial radio services is covered.

For ordering information and technical specifications of the 9172 and 9173 Directional Antennas, refer to your 9102 or 9103 user's guide.

EMF measurements with the 9102 and 9103

The 9102 or 9103 in conjunction with the 9131 EMF Measurement Option offers the EMF (EMI) measurement mode allowing you to perform radiation measurements easily and efficiently. All you need to effectively record electromagnetic fields is the 9102 or 9103 with the 9131 EMF Measurement Option installed and the appropriate antenna for your measurement method.

The EMF (EMI) measurement mode enables you to perform automatic EMF measurements upon the press of a button. In this mode, the 9102 or 9103 measures the electromagnetic field over a user-definable frequency range and displays the field strength in V/m or the power density in W/m². All necessary functions, e.g. detecting the peak value over a given time period or integrating the broadband signal power over a given frequency range, are available. You can compare the recorded measurement values with the relevant threshold values.

Results can be displayed in logarithmic or linear format, the displayed range quickly and easily being adapted to the measured signal. The measured signals can be displayed both graphically and numerically in logarithmic or linear terms.

In EMF (EMI) mode the 9102 or 9103 measures the electrical field strength (E) as well as the power density (S) to enable you to compare the measured EMF with the binding limits specified by the responsible regulatory bodies. You can specify which result should be displayed.

The display unit for the electrical field strength is V/m.

The electrical field strength is calculated as the square root taken from $S \times R_0$, with R_0 being the air wave resistance of 377 Ω .

The 9102 or 9103 displays the total electrical field strength by adding all measurement values measured for the three directions x, y, z.

Result is calculated as the square root taken from $E_{xresult}^2 + E_{yresult}^2 + E_{zresult}^2$.

The display unit for the power density is W/m².

It is calculated as $S = E_r^2 \div R_0$. R_0 again being the air wave resistance of 377 Ω .

The following sections explain how to perform EMF measurements with the 9102 or the 9103. As the most typical application examples in this area are immission measurement we will concentrate on two different immission measurement examples: an automatic measurement in conjunction with the 9171 Isotropic Antenna and a manual measurement in conjunction with the 9170 Biconic Antenna.

The preparative steps which have to be performed before starting the actual measurement, e.g. selecting the EMF (EMI) measurement mode, setting the required frequency range, selecting the measurement unit and specifying the measurement result to be displayed (power density or field strength) are identical for both measurements with the exception of connecting the antennas to the 9102 or 9103. The steps involved in this procedure depend on the antenna used.

Due to the physical nature of EMF measurements the following has to be taken into account:

When performing measurements on broadband signals the electrical field strength or the power density displayed may show deviations. In this case the measurement has to be performed via a channel power measurement. Furthermore a very big or very small relation between span and RBW may lead to false measurements or invalid measurement results.

Performing an automatic EMF measurement

With the 9171 Isotropic Antenna you can perform measurements in automatic mode. A prerequisite for performing automatic measurements is that the 9171 Isotropic Antenna's controller cable is connected to the 9102 or 9103's multiport. Via this connection the 9102 or 9103 reads the relevant correction data from the antenna and controls the measurement. However, if you use a tripod measurement setup in conjunction with an extension cable, the cable attenuation also has to be taken into account by using cable correction data. For further information this measurement setup, cable attenuation and on activating cable correction data, refer to your 9102 or 9103 user's guide.

There are two different options selectable from the Measure menu for performing automatic measurements: Auto and Quick. In the following application example we will concentrate on the Auto mode. For a description of the Quick mode, a special form of the Auto mode, refer to your 9102 or 9103 user's guide.

Auto measurements provide you with the comfort of the 9102 or 9103 controlling the measurement process for all three measurement panes. Once you start your Auto measurement the 9102 or 9103 will run automatically through all measurements and calculate and display the overall measurement result from the individual results for x, y and z. However, you can specify the measurement time.

Connecting the isotropic antenna

The first preparative step is to establish a connection between the 9102 or 9103 and the 9171 Isotropic antenna. To do so, simply connect the antenna directly to the 9102 or 9103's RF in connector and connect the controller cable to the 9102 or 9103's Multi Port connector. As soon as you have connected the antenna to both connectors the spectrum analyzer automatically detects the antenna and loads the correction data.

If you connect the antenna controller to the instrument with the EMF (EMI) mode already running, it takes about 10 seconds for the 9102 or 9103 to detect the antenna. In order to avoid any disturbance of the process do not press any buttons on the instrument during this time.

Selecting the EMF (EMI) measurement mode

To select the EMF (EMI) mode, proceed as follows:

1. Push the **MODE** function key.
The Mode menu appears.
2. Select **EMF (EMI)**.
The EMF (EMI) main menu appears.

The EMF (EMI) mode is available on the 9102 and 9103 in conjunction with the 9130 EMF Measurement Option and is model specific.

Setting the unit

After selecting the EMF (EMI) measurement mode the next step is to select the unit.

1. In the main menu, select **Level > Units**.
2. You can use logarithmic or linear units. In order to toggle the display between logarithmic and linear units press the **Unit** softkey in the lower right corner of the display and select log or lin.
3. You can now choose between the following units via the Unit softkey in the upper right corner of the display.
Logarithmic units: dBm/m², dBμV/m and dBV/m
Linear units: V/m, mW/m²

Setting the frequency range

The next step is to set the frequency range for the EMF measurement. In the EMF (EMI) main menu press the Freq softkey to select the desired frequency band. Now the EMF (EMI) Frequency menu is displayed.

There are different methods to set the frequency range to be measured; the range can be expressed by either the start and stop frequencies (i.e. first and last frequencies on the display), or by center frequency and span (i.e. the center and the frequency range), or by other combinations of center frequency, span, start and stop frequencies. All four parameters are accessible in the 9102 and 9103's Frequency menu. For further details the different methods of setting the frequency range refer to your 9102 or 9103 user's guide.

Specifying the display calculation

After setting the frequency range we now specify which measurement result the 9102 or 9103 is to display: field strength (E) in V/m or power density (S) in W/m². You can switch the display between these two results values.

This step is preparative and has to be taken before you start your actual measurement in automatic as well as manual mode.

To switch the display between electrical field strength and power density, proceed as follows

1. In the EMF (EMI) main menu select **Measure > Display Calculation**.
2. Toggle the **Display** softkey until the required option, E for electrical field strength and S for power density, is highlighted. In the upper left corner of the display the appropriate value will be displayed during your measurement in the relevant unit: electrical field strength in V/m and power density in W/m².

Setting the reference level

The next step is setting the reference level for the measurement display. The reference level basically determines the level at the top of the display. The vertical axis is divided into eight horizontal lines; you can adjust the scale (which defaults to 10 dB per line) to your preferences.

In order to set the reference level proceed as follows:

1. In the main menu, push the Ref. Level softkey. You can also select **Level** followed by Ref. Level Alternatively, push the **REF** function key.
The reference level input field opens.

Depending on the unit you use and the specified display calculation the Ref. Level softkey changes to Ref. Power or Ref. Voltage. Furthermore the input field name and the display on the left-hand side of the screen changes accordingly.

2. Enter the new reference power or voltage either using the numeric keys, closing the input field with the appropriate enter key, or with the **UP/DOWN** arrow keys.

The new reference level appears at the top of the vertical axis. The reference is based on the actually set output power.

For further details on specifying level settings refer to your 9102 or 9103 user's guide.

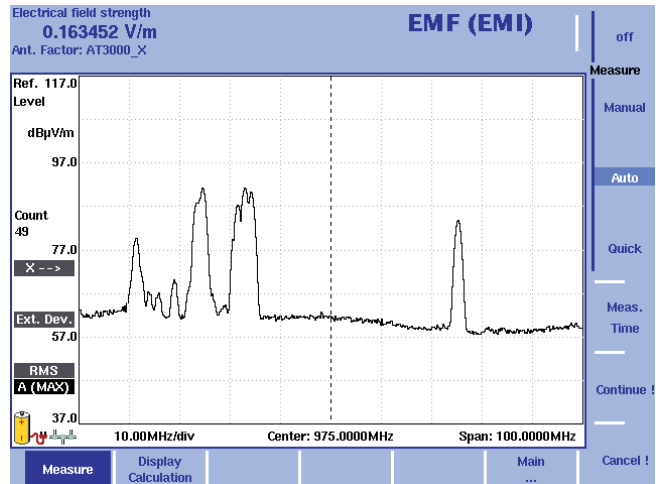
Activating the antenna factor settings

After the antenna is detected and the correction data are loaded the 9102 or 9103 switches to the Level menu and the Antenna Factor softkey is highlighted. To activate the antenna factor, press the Antenna Factor softkey until on is highlighted.

Starting the Auto measurement

You can now start your actual EMF measurement in Auto mode. In order to do so proceed as follows:

1. In the EMF (EMI) main menu select **Measure**. The EMF (EMI) Measure menu is displayed.



2. In the Measure menu select **Meas. Time**. An input field for the measurement time will be displayed.
3. Enter the time interval to be used for measuring on each of the measurement panes. The default is 360 seconds, the maximum value is 600 seconds. Press **ENTER** to set the measurement time.
4. Now select the **Auto** softkey and press **Continue !** to start the Auto measurement.
5. On the right-hand side of the display the red Measure indicator shows that a measurement is in progress. Above this indicator the direction measured is shown (x as the first one).
You can abort the measurement by pressing the **Cancel !** softkey.
6. On completing the measurement for the x measurement pane the Measure indicator disappears and the 9102 or 9103 automatically switches to y followed by z.
7. On completion of the measurement the measurement result is displayed with the graph automatically put on hold and the overall calculated electrical field strength or power density, depending on the selection you have made via **Measure > Display Calculation** (see "Specifying the display calculation" on page 8) is displayed. You can now save your results trace on the instrument.

Performing a manual EMF measurement

The manual measurement mode provides you with a comfortable way of performing EMF measurements using the 9170 Biconical Antenna. For this type of EMF measurement the 9170 Biconical Antenna is turned manually in each of the measurement directions (x, y and z), usually mounted on a turning device. For each direction the 9102 or 9103 performs the measurement of electrical field strength or power density depending on the selection you have made via Measure > Display Calculation (see "Specifying the display calculation" on page 8). You start the individual measurements manually after turning the antenna in the relevant direction. As for automatic measurements you can also specify the measurement time for each direction. On completing all three measurements the 9102 or 9103 calculates the total result value.

As the k factor correction data are not automatically loaded and activated when using a biconical antenna you have to activate the appropriate correction table manually on your instrument. Also, as the biconical antenna will often be mounted on a tripod and connected to the 9102 or 9103 via an extension cable, the cable factor has to be activated manually. For further information on this measurement setup, cable attenuation and on activating cable correction data refer to your 9102 or 9103 user's guide.

Connecting the biconic antenna

The first step is to establish a connection between the 9102 or 9103 and the 9170 Biconical Antenna. In order to do so simply connect the antenna via an RF cable to the 9102 or 9103's RF in connector.

Steps identical to automatic mode

The following measurement steps are identical to the ones described for the automatic measurement:

- Selecting the EMF (EMI) measurement mode
- Setting the unit
- Setting the frequency range
- Specifying the display calculation
- Setting the reference level

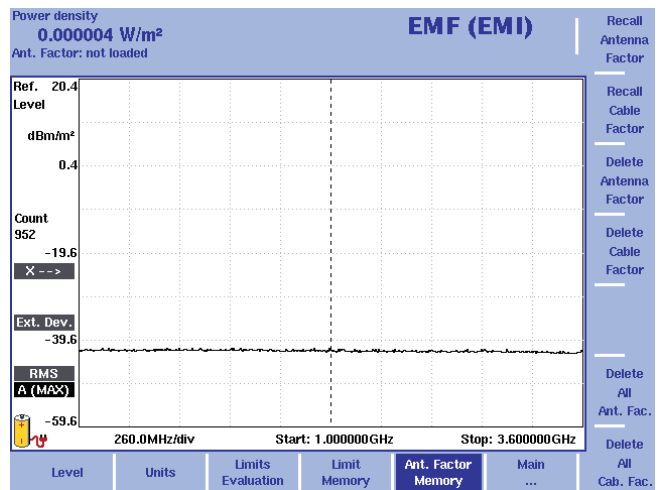
For detailed descriptions of these measurement steps refer to "Performing an automatic EMF measurement" on page 7.

Specifying antenna factor settings

The scope of delivery of the 9170 Biconical Antenna includes the appropriate k factor correction table. The data are available within the 9100 Data Exchange Software. For details on downloading the data the 9102 or 9103 and managing antenna factors within the 9100 Data Exchange Software refer to your 9102 or 9103 user's guide.

To activate the appropriate antenna factor for your EMF measurement, proceed as follows:

1. In the EMF (EMI) main menu select Level > Ant. Factor Memory. The Antenna Factor Memory menu is displayed.



2. Press the Recall Antenna Factor softkey. A dropdown list showing all antenna factors stored on the system is displayed.
3. Select the appropriate antenna factor and press Enter. Now the Level menu is displayed again.

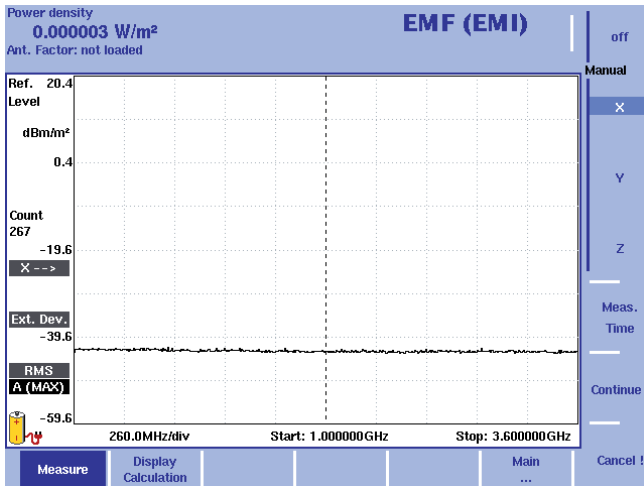
To activate the antenna factor selected, toggle the Antenna Factor softkey until on is highlighted.

Starting the manual measurement

You can now start your actual EMF measurement in Auto mode. In order to do so proceed as follows:

1. In the Measure menu select Meas. Time. An input field for the measurement time will be displayed.
2. Enter the time interval to be used for measuring on each of the measurement panes. The default is 360 seconds, the maximum value is 600 seconds. Press Enter to set the measurement time.

- Now select the **Manual** softkey. The softkeys for the three different measurement directions (x, y and z) are available on the right-hand side with x highlighted as the first measurement direction and the x direction indicator displayed on the left-hand side as shown in the following picture.

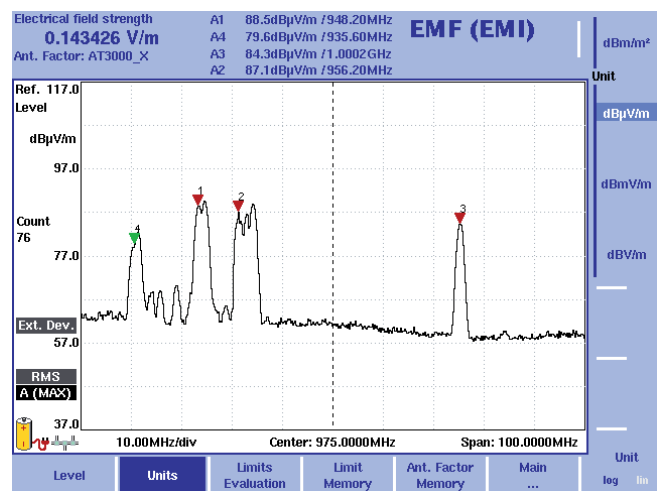


- Press **Continue !** to start the first measurement. On the right-hand side of the display the red Measure indicator shows that a measurement is in progress. You can abort the measurement by pressing the **Cancel !** softkey. After completion of the measurement the Measure indicator disappears.
- Now press the **Y** softkey followed by **Continue !** to start the measurement for the y direction. The procedure is identical to the one described for the x direction above.
- After completion of the y measurement press the **Z** softkey followed by **Continue !**. The procedure is identical to the one described for the x direction above.
- On completion of the measurement the measurement result is displayed with the graph automatically put on hold and the overall calculated electrical field strength or power density, depending on the selection you have made via **Measure > Display Calculation** (see "Specifying the display calculation" on page 8) is displayed. You can now save your results trace on the instrument.

The measurement result

As for the other 9102 or 9103 measurement modes you can use the spectrum analyzer's trace, marker and limit line functionality to further analyze and document measurement results after entering all DTF measurement parameters. For a detailed description of these functionalities refer to the 9102 or 9103 user's guide.

Following is a measurement results display of an EMF measurement showing the electrical field strength in V/m in linear terms with the specified unit dBµV/m. markers have been used to indicate the measured values at different frequencies.



Analyzing and documenting EMF measurement results

You can transfer the results of the measurements performed with your 9102 or 9103 Handheld Spectrum Analyzer via a LAN or RS-232 interface and using the 9100 Data Exchange Software, which is included in the delivery of your 9102 or 9103, to your PC. The results are displayed on the PC as they are displayed on the instrument.

The 9100 Data Exchange Software also offers special methods for documenting your measurement results. In addition to the six markers that can be set on the 9102 and 9103 you can include up to four additional markers in the measurement result display on your PC and have comment fields assigned to them. Thus up to ten markers can be used on each trace. Using the additional four markers with their comment fields you can mark and comment on values that are within tolerance limits although critical. The measurement values at the marker positions are of course included in the display. Using the limit line functionality result values can be assessed at a glance. You can also include measurement parameters in the display to document the measurement conditions.

For a detailed description of the 9100 Data Exchange Software refer to your 9102 or 9103 user's guide.



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