Edition 4.4
September 2011

MAGNETIC FIELD METER 3000

Operator's Manual

The MFM 3000 is a professional magnetic field instrument

To make the best use of the instrument we recommend that you read this manual carefully.

COMBINOVA AB

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CONTENT

Section 1 - INTRODUCTION

CONTENT

The Magnetic Field Meter 3000 (MFM 3000) is a professional instrument designed to measure magnetic fields in the frequency range from 5 Hz to 400 kHz. The MFM 3000 has been developed for self-contained operation with such features as built in rechargeable batteries, LCD touch panel display, PC communication using a USB 2 interface and a large data logging memory. The instrument has a full bandwidth real time spectrum analysis to provide detailed information about the magnetic field.

MFM 3000 is a flexible general purpose magnetic field instrument and it also has built in applications for testing of household appliances according to EN 50366 and exposure standards based on ICNIRP recommendations. With its flexible digital design the MFM 3000 is well prepared for easy upgrade to future standards concerning magnetic field measurements.

1.1 Magnetic Fields

Increasing use of electrical equipment has meant that there is increased exposure to low frequency magnetic fields. In recent years this has led to concern that a health hazard could arise from these low frequency magnetic fields. Strong magnetic fields can also cause electrical interference problems, for example disturbance of video monitors from external power frequency magnetic fields. The largest magnetic fields are found around power transmission lines and power supply installations.

Magnetic fields from power lines are directly related to the phase current. Seasonal and daily variations are caused by different power consumption demands. Close to the power line the mange-tic flux can reach a maximum of 10 to 30 µT, but decreases to less than 1 µT at distances of 50 to 200 meters.

The earth magnetic field is a DC field of around 50 µT with rather small variations in time. The MFM 3000 instruments has a lower frequency limit of just 5 Hz and movement of the instrument in the earth magnetic field will result in low frequency alternating magnetic field components. To avoid that type of influence on the magnetic field measurements, especially at low levels of the magnetic field, it is important to keep the instrument fixed during measurements.

Based on a lot of research reports regarding possible health effects from exposure of magnetic fields the international organization ICNIRP has issued recommendations regarding public and occupational exposure to magnetic fields. As a result many countries are preparing regulations based on the ICNIRP recommendations.

Magnetic fields in the home and the working environment are caused both by internal and external sources. Typical external sources are power line and power distribution substations close to buildings, while even water pipes, when carrying unbalanced neutral currents create significant magnetic fields. Internal sources are the variety of household appliances that at user distance can have relatively strong magnetic fields. Since February 1, 2006 all household appliances needs to meet the standard EN 50366 to get the CE mark needed for sales in the European Union.

1.2 The Instrument

The MFM 3000 instrument is designed using the latest technology in amplifiers, AD-converters and signal processors to achieve the best measurement performance.

Using the same antenna the instrument covers the complete frequency range from 5 Hz to 400 kHz and with an innovative concept for signal handling it has a wide dynamic range and still a very good resolution at low magnetic field levels. With full band-width spectrum analysis built into the instrument the measurement gives complete information of the different frequency components in the magnetic field.

The user interface is mainly handled by the graphic LCD-display that has a touch panel to select the type of measurement, display settings and to define the parameters controlling measurements and related functions. Two push buttons are used. Power ON/OFF and START measurement.

The instrument has a large memory bank to store test results and to provide possibilities for manual or automatic logging of test results. The internal clock displays date and time in the upper left corner and provides time information for logged data.

External communication to a PC is handled by the USB 2 interface and the PC software handles a variety of applications including remote control for laboratory use and handling of logged data for field applications.

The “smart” battery allows for extended use in the field. The standard external power supply can be used both to charge the battery and to supply the instrument in laboratory applications.

1.3 Combinova AB - The company behind the product

Magnetic Field Meter 3000 has been developed by Combinova. We are also responsible for the manufacturing, marketing and after sales service of the instrument.

Combinova has been making instruments for magnetic and electric field measurements for the last 20 years. Other products in this product family are:

MFM 2000 - Magnetic Field Meter, dual band 5 Hz – 2 kHz and 2 kHz – 400 kHz with spectrum analysis for TCO testing applications.

EFM 200 – Electric Field Meter for electrostatic and alternating electric fields in two bands 5 Hz – 2 kHz and 2 kHz – 400 kHz.

EFM 100 - Electric Field Meter for alternating electric fields in two bands 5 Hz – 2 kHz and 2 kHz – 400 kHz.

FD 1 – Field Detector for magnetic and electric fields in the frequency range 20 Hz – 2 kHz.

FD 2 - Field Detector for magnetic and electric fields in the frequency range 2 kHz – 400 kHz..

FD 3 – Field Dosimeter for logging of magnetic fields in the frequency range 20 Hz – 2 kHz.

More details about these products are available at www.combinova.se

SECTION 2 - UNPACKING AND INSPECTION

The MFM 3000 is delivered in a specially designed transportation case, which also contains the standard accessories that are used with the instrument.

Open the case and check that the following items have been supplied (see Fig. 2.1).

Standard Instrument

» MFM 3000 instrument
» Universal Battery Charger
» USB Communication Cable
» CD with PC Software
» Operator's manual / PC Software manual

Inspect the transportation case, the instrument and the accessories for any damage caused during transit. If damage has occurred, please contact the shipping company who delivered your instrument.

IMPORTANT! Complete the warranty form and return a copy to:

Combinova AB
Domkraftsvägen 1
S 197 40 Bro
Sweden

NOTE! Before switching on the instrument, read this manual carefully.

Section 3 - OPERATING INSTRUCTIONS

Content

3.1 General Operation

The instrument is operated by the ON-OFF button and the MEASURE button on the front panel. All other settings are handled by menus on the touch panel.

ON-OFF

To turn on the instrument is turned on by pressing the ON-OFF button on the front panel until the display is lit up. After power on a start up display is shown with program versions and some initial tests. The initial tests shown on the display are:

DSP Boot
DSP RAM-Test
DSP Vector Init

When tests are completed it shows the text “Init Ready” and automatically moves to the measurement display selected last time the instrument was used.

To turn off the instrument depress the ON-OFF button for a few seconds and wait for the display to turn off.

MEASURE

The measure button is used to start a single measurement. If the button is depressed until the single measurement is completed a continuous measurement is started and keeps on running until the measure button is depressed again. After stopping a continuous measurement the last result is shown on the display.

The instrument can also be set up to make logging measurements at predefined time intervals. Selection of logging and time intervals is made in the parameter menu. When logging measurements are selected or in progress the measure button or the touch panel is used to start and stop the logging operation. For more details about logging measurements see 3.4 Parameters.

Touch panel

The display is also a touch panel where all selections and settings in the instrument can be made. The three menus are:

”MEASUREMENT” menu contains selections of different measurement modes. They are described separately in chapters 3.5-3.7.

”DISPLAY” menu includes settings for the display of measurement results. Details are described in chapter 3.3.

”PARAMETERS” menu contains all other instrument settings. Details are described in chapter 3.4.

”SAVE X” is a function key that saves the last measurement. X is the number of the results that will be saved when activated. If no measurement has been done or the data is already saved the response when attempting to save is “NO DATA”. You cannot save data from continuous measurements. The memory can handle up to around 7,000 sets of data including results and spectra. When automatic logging is selected the same key is changed to “START X” and “STOP X” and is used to start and to stop logging operation. The measure button also can be used to start and stop logging.

To enter a menu use the touch panel pointer to enter the menu. The available selections are shown when a menu is selected and the text for the current selection is shown inverted (white text on a black background). As soon as a menu is selected a new line of keys will appear at the bottom part of the display. These keys and their functions are:

”UP +” key is used to move up among available selections in the menu or to increase the setting of a variable.

”DOWN –“ key is used to move down among available selections in the menu or to decrease the setting of a variable.

Pointing directly at a selection in a menu is also possible.

”ENTER” key is used to confirm a selection and if there are available sub-menus they will appear after confirming the first selection until all related selections are made.

”CANCEL**”** key is used to leave a menu without changing of any selections or settings.

3.2 Battery Charging

The MFM 3000 can be operated either from the mains using the battery charger or from the internal rechargeable battery. When having the battery charger connected during measurements make sure the charger is located as far away from the instrument as possible to make sure that the magnetic field from the charger has a minimum influence on the measurement results.

The charging status in percent of full charge of the battery is indicated in battery symbol on the display. Charging the battery should be done when the charging level drops below 20 %.

Whenever the battery needs charging just connect the battery charger to the instrument. If the instrument is off the charging will start automatically. During charging the battery symbol alternates between percent value and “<<<<” symbol.

Battery charging cycle is controlled by the firmware in the instrument so there is no risk involved if the battery charger is left connected to the instrument even after the battery has been fully charged. Charging time for an empty battery is around 4 hours.

If the battery is replaced, the charger must be connected to start the instrument and initialize the new battery.

NOTE! The battery is a smart battery with its own electronics and no other type of battery can be used with the instrument.

3.3 Display

The MFM 3000 uses a touch panel for all operator settings and selections.

To calibrate the coordinates on the touch screen keep the “MEASURE” button depressed at power on until you to get into the calibration function. A screen with a square in the upper left and another square in the lower left corner will appear. Mark the upper left corner with the pointer and keep it there until the instructions on screen asks you to mark the lower right corner. Keep the pointer on the square until the screen reports calibration ready. Wait for the saving of calibration data. The instrument will automatically return to the measurements after the calibration is completed. This calibration procedure can be repeated at any time if the positions of different screen selections are changing.

In the “Display” menu you can select to show the results either with the “Normal” numerical display or “Spectrum” graphical display where a spectrum is shown together with the numerical results. “Normal” numerical display also show X, Y, Z values for single and continues measurements. In logging mode the X, Y, Z values are not displayed but still saved in log memory. The Max-hold value is updated in continues measurement, it will be cleared by the next measurement.

To enable you to look at different parts of the full spectrum there is a sub-menu under “Spectrum” with a choice of 5 different ways to zoom in the spectrum.

The choices are:

- no zoom (5 Hz – 400 kHz) with logarithmic frequency scale
- 5 Hz - 400 Hz with linear frequency scale
- 100 Hz - 4000 Hz with logarithmic frequency scale
- 1 kHz - 40 kHz with logarithmic frequency scale

- 10 kHz - 400 kHz with logarithmic frequency scale

The largest and second largest signal shown is first of all related to the selected bandwidth and secondly to the actual zoom window shown on the display.

3.4 Parameters

The parameter menu is used to define settings in the instrument. How to use the menu keys is described in chapter 3.1 General operation. Below is a detailed description of the different settings and their function.

Logging

The logging menu defines possibilities to perform automatic measurements at predefined time intervals from start of logging.

The selections in the logging menu are:
”No logging” means that the automatic logging function is disabled. Time intervals that can be chosen are: 2s, 5s, 10s, 20s, 30s, 1min, 2min, 5min, 10min, 20min, 30min and 60min.

When a time interval from this list is selected the bottom right key changes from “Save X” to “Start X” indicating that this key now is used to start a logging session. During logging the “X” value indicates the number of measurements stored in the instrument. Once a logging is started the bottom right key is changed to ”Stop X” and is now used to stop the logging session. The measure button also can be used to start and stop logging.

The logging function is possible for all measurements modes defined in the measurement menu. Logging results consist of a measurement values and a spectrum with the zoom setting

selected. More details about the stored results can be found in the MFM 3000 software manual.

The logging function can be disabled by selecting “no logging” in the menu. After a power off the instrument always starts with the logging function disabled.

NOTE! Use charger when logging for more than 12 hours.

Date and Time

The parameter Date is used to set the date in the internal clock. Use “UP +” and “DOWN –“ keys to set the correct Year and confirm the setting with the “ENTER” key. Use the same procedure for Month and Date settings.

The parameter Time is used to set the time in exactly the same way by setting the correct Hour (24 hour clock), Minute and Second.

Light

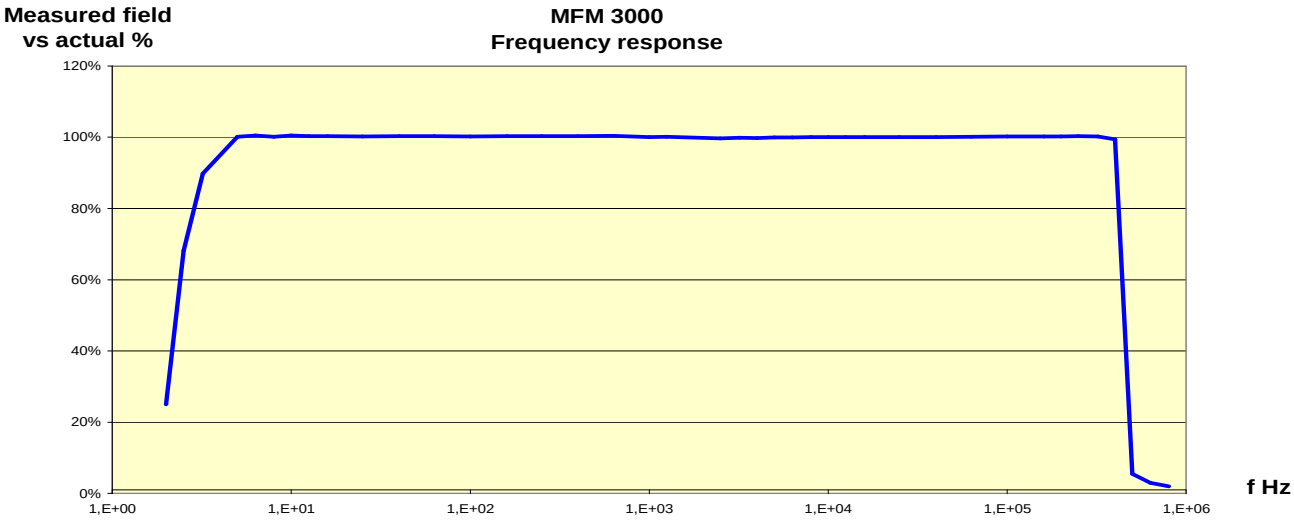
The Light parameter is used to set the background light of the display in steps from 0 (no background light) to 255 (maximum background light). Use “UP +” and “DOWN –“ keys to set the light wanted and confirm the setting with the “ENTER” key. Background light is turned off after 60 sec of inactivity in order to save battery. A short touch anywhere on the screen or a new measurement activates the background light for another 60 sec.

Contrast

The Contrast parameter is used to set the contrast of the display in steps from 0 to 75. Use “UP +” and “DOWN –“ keys to set the best contrast for the used viewing angle and confirm the setting with the “ENTER” key.

3.5 Measurement general purpose (normal mode)

For general purpose measurements of magnetic fields select ”Normal” from the “Measurement” menu. Normal mode has a flat response across the full frequency range with very steep filters at the upper and lower frequency limit as shown in the figure below.



RMS-value presented in measurement display is a wideband value taking onto account all magnetic field components in the frequency range.

In a sub-menu to “Normal” it is possible to reduce the “Bandwidth” if only a limited part of the frequency range is of interest. The fixed choices for frequency limits are:

Lower frequency limit:
5 Hz, 10 Hz, 20 Hz, 40 Hz, 100 Hz, 200 Hz, 400 Hz, 1 kHz, 2 kHz, 4 kHz, 10 kHz, 20 kHz, 40 kHz, 100 kHz and 200 kHz

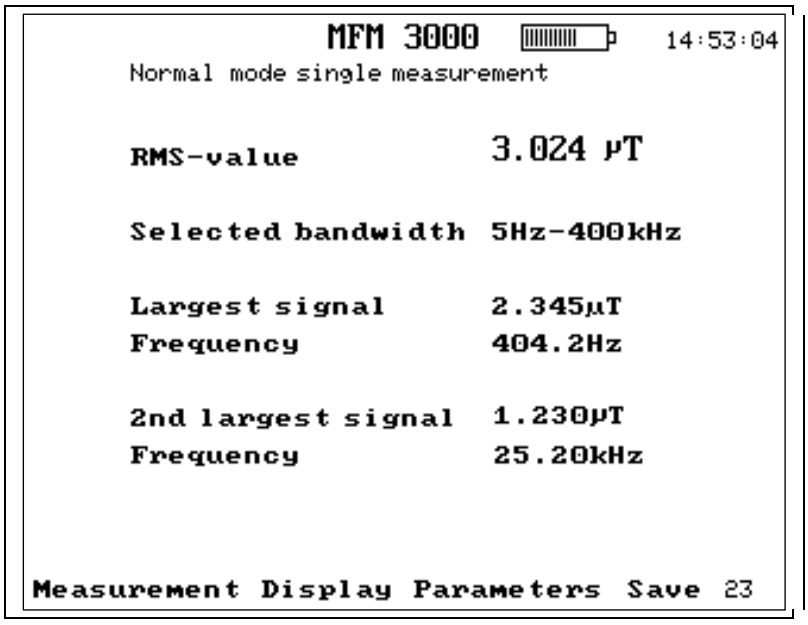
Upper frequency limit
10 Hz, 20 Hz, 40 Hz, 100 Hz, 200 Hz, 400 Hz, 1 kHz, 2 kHz, 4 kHz, 10 kHz, 20 kHz, 40 kHz, 100 kHz, 200 kHz and 400 kHz.

The upper frequency limit must be at least one step higher then the lower frequency limit. When selecting a reduced bandwidth it is useful to first study the broadband spectrum (5 Hz to 400 kHz)
to determine where to set the limits. Reduced bandwidth limits should not be chosen at frequencies where significant magnetic fields are present in the broadband spectrum.

There are of course many applications where it is of interest to get an RMS-value representing a reduced bandwidth. It can also be of interest to limit the bandwidth at the lowest frequencies to avoid influence from movements in the earth magnetic field. Another use of as limited bandwidth is to study only the fundamental or just the harmonic components of a magnetic field source.

Compared to a broadband RMS-value the limited bandwidth RMS-value has less noise content and will give an even more accurate reading of specific components of interest.

A typical result display in normal mode is shown in the figure below.

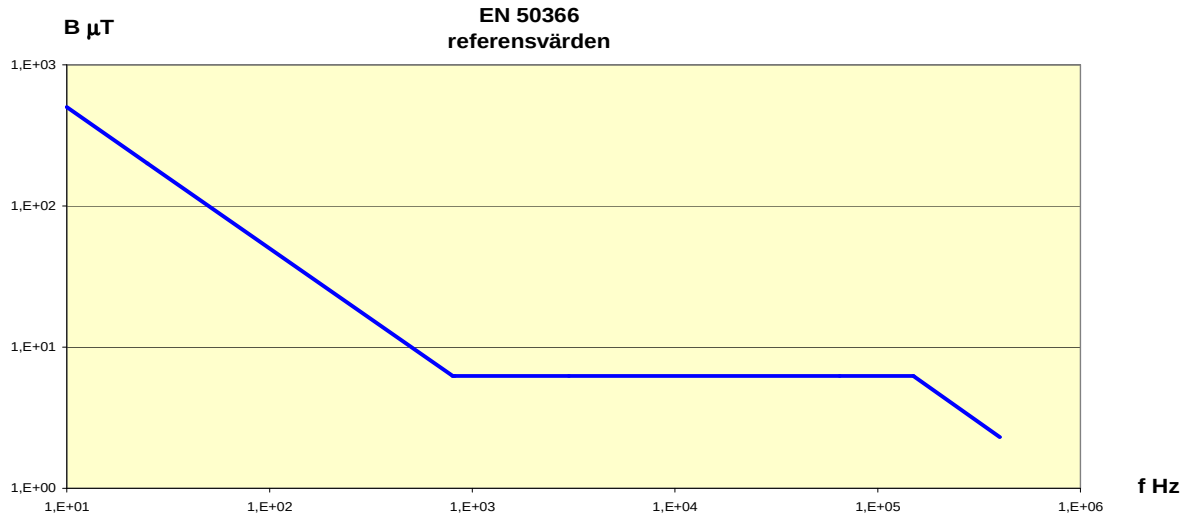


3.6 Measurement EN 50366 and IEC 62233

Measurements according to EN 50366 and IEC 62233 are evaluating the magnetic field as a percentage value related to the reference level at different frequencies within the frequency range 10 Hz to 400 kHz.

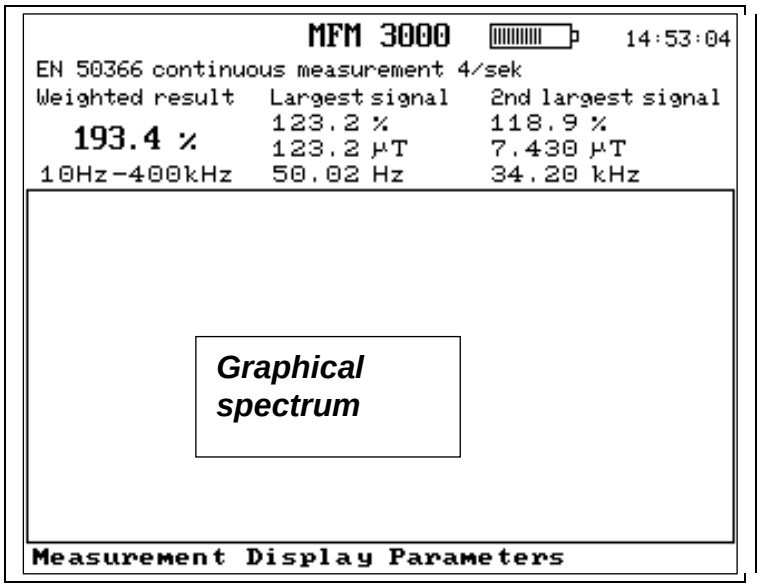
The same measurement as for EN 50366 is also applicable for IEC 62233 even if measurement distances may differ between the two standards. Select either EN 50366 or IEC 62233 in the measurement menu.

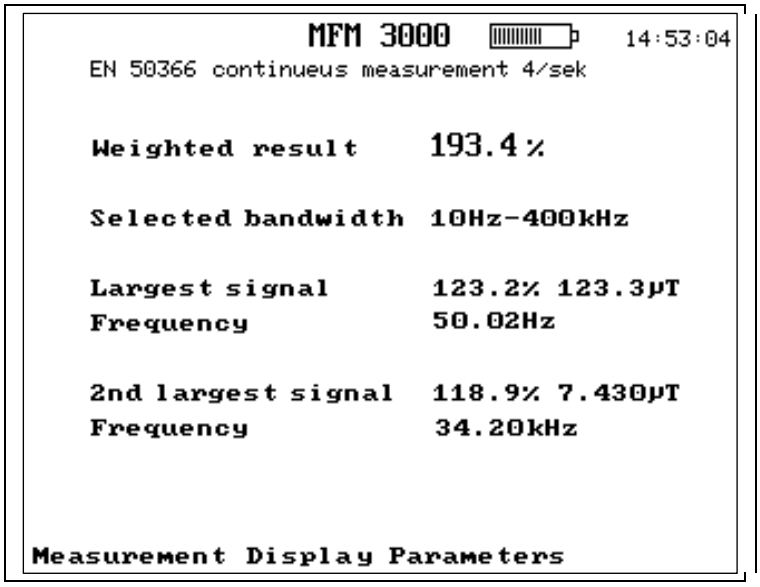
The frequency dependence of the reference level is shown in the figure below.



The standards specify that the largest magnetic field at the specified distance should be found**.** A good way to find the position for the largest magnetic field is to use continuous measurements and move the instrument across the specified surfaces until the highest reading is found. When the position is found it is recommended to make a single measurement with the instrument in the found fixed position to avoid any influence form movements in the earth magnetic field. As can be seen in the result displays below the “Weighted result” is a combination

of all magnetic field components in the fixed frequency range of the standard. The two largest components contributing to the result are also shown.

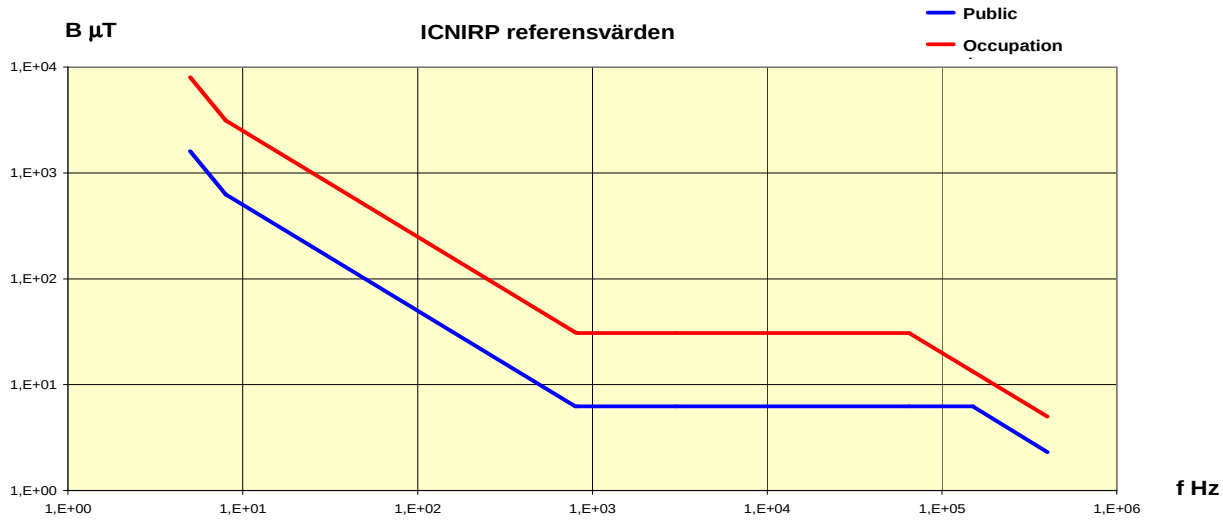




3.8 Measurement ICNIRP

Measurements according to ICNIRP are either related to public exposure or to occupational exposure to magnetic fields. The weighted results are shown in percent of the reference level and represent an evaluation across the full frequency range.

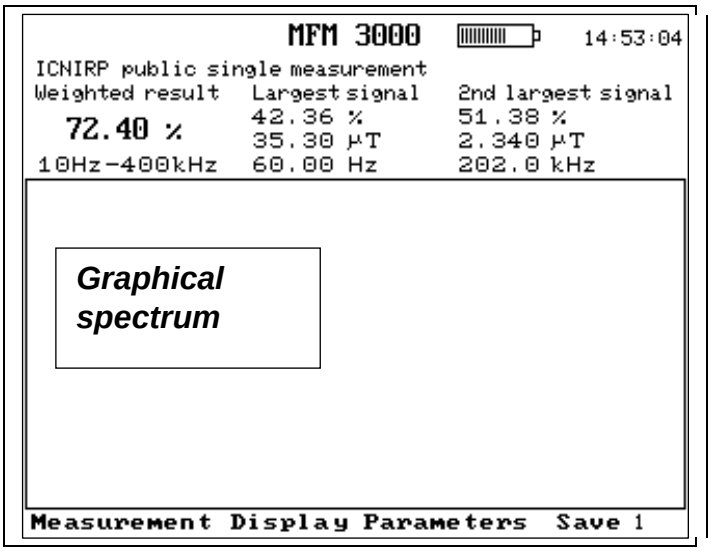
The frequency dependence of the reference level for both public and occupational exposure is shown in the figure below.



As can be seen from the figure the reference levels for public exposure are at most frequency five times lower than the corresponding levels for occupational exposure, except for frequencies between 65 kHz and 150 kHz where an even higher factor is used.

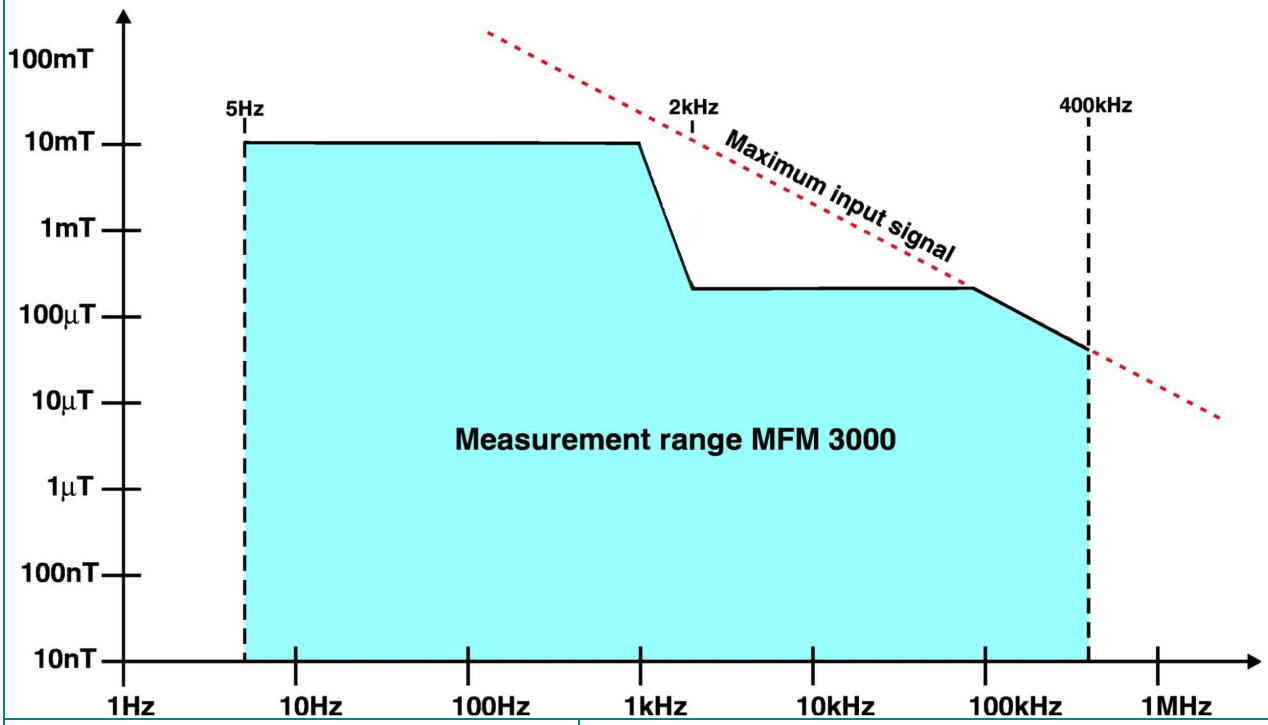
There are two selections available in the measurement menu to choose between public and occupational exposure and these two modes uses the respective curves in the evaluation.

As can be seen in the result display below the “Weighted result” is a combination of all magnetic field components in the fixed frequency range of the standard. The two largest components contributing to the result are also shown.



SECTION 4 - PRODUCT SPECIFICATION
MAGNETIC FIELD METER MFM 3000

Specifications are given at the temperature Tamb = 23 ± 5 ℃.
Specifications subject to change without notice.

ALTERNATING MAGNETIC FIELDS	
Antenna system	**3-axis, concentric, orthogonal. Coil area 100 cm²**
Frequency range	**5Hz - 400 kHz.**
Frequency response: Selectable:	**Flat according to EN 50366 and IEC 62233 according to ICNIRP**
Measurement range	
	
Uncertainty, wideband measurements	**±(1% of reading +2 nT)**
Measurement rates	**1s single or continuous**

MISCELLANEOUS	
Display	**Graphical 5,7" LCD display, with touch panel**
Parameter storage	**Instrument parameters and corrections are stored in a non-volatile memory**
Result memory	**64 Mbit**
Power	**Smart Lithium ion battery, 10.8 V and 4.8 Ah. Universal battery charger 90-250 V, 45 – 65 Hz**
Communication	**USB 2 interface for PC communication**
Operating temperature	**10℃ to +50℃.**
Operating humidity	**10 - 85%.**
Dimensions	**400 x 110 x 190 mm (LxWxH)**
Weight	**Instrument weight 3.5 kg.**
Environment protection	**IP 53**

WARRANTY FORM for MFM 3000

Customer :

Customer address :

Delivery date:
Warranty period:
Serial number:
Program version:

The warranty includes material and labour cost for service and repair, but not transportation costs in any direction. If new program versions become available during the warranty period a free update is also included. A condition for the warranty is that a correctly filled in copy of the warranty form is sent to Combinova.

NOTE! Always return the instrument in its own transportation case.

WARRANTY FORM for MFM 3000 (customer copy)

Customer:

Customer address:

Delivery date:
Warranty period:
Serial number:
Program version:

The warranty includes material and labour cost for service and repair, but not transportation costs in any direction. If new program versions become available during the warranty period a free update is also included. A condition for the warranty is that a correctly filled in copy of the warranty form is sent to Combinova.

NOTE! Always return the instrument in its own transportation case.

If service is required the instrument should be sent to:

Combinova AB
Domkraftsvägen 1
S-197 40 BRO
SWEDEN