# Frequency Master IV

# Table of contents

Thank you for your decision purchasing this equipment.

Enjoy reliable, easy to use, handheld professional measurement up to 10 GHz. At last the professional can go beyond the 3.3GHz measurement range with a portable device!

Detect the new digital TV broadcasting, mobile radio frequencies, cordless and mobile phones, latest Wi-Fi, WiMAX, IEEE, UTMS-WCDMA bands, 5.8 GHz Bluetooth and many RADAR frequencies.

The calibrated FREQUENCY MASTER IV delivers reliable values from 1MHz to 10GHz for professional analysis. This new tool for high frequency measurement is ideal for industry, home, work and environmental analysis of high frequency exposures.

## Compare – Discover the Advanced Features and Value

Turn on your device with a touch pad switch, choose your antenna, then your measurement value in $\mu W/m^2$ or mV/m and you are ready to measure with stand-alone analysis. So easy to use.

Detect high frequency values in many different ways with both quantitative and intuitive analysis. The multi function lighted digital displays in three ways simultaneously:

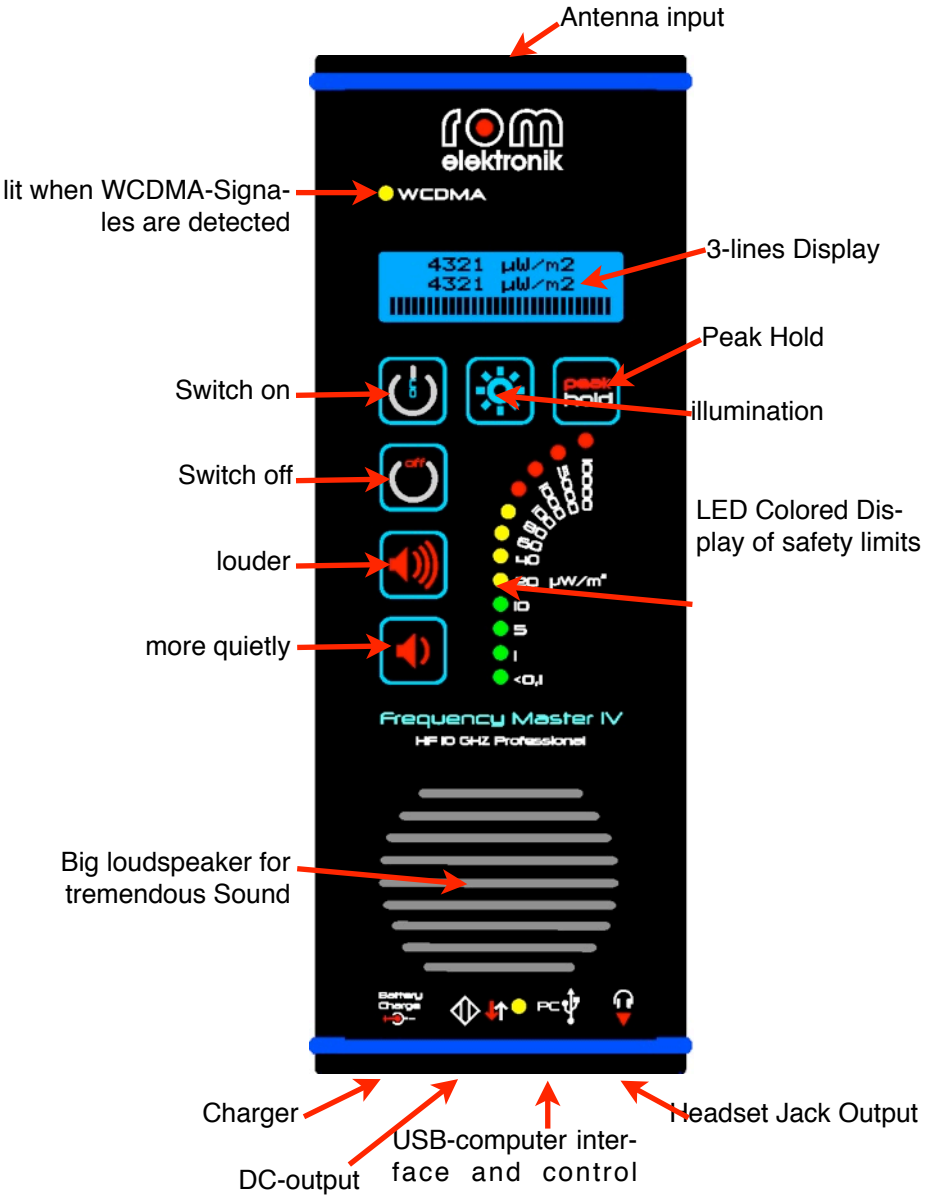
1. the pulsed or non-pulsed numerical value in $\mu W/m^2$ or mV/m,

2. the pulsed or non-pulsed bar graph strength and

3. text message with ROM SMART “Hear and See” technology indicating the predominate detected frequency band. For example, the display will show in text: GSM, WLAN, DECT.

In addition there is easy read intuitive analysis with LED Colored Display of safety limits and an automatic signal light when UTMS-WCDMA is detected. Also there is a built in speaker for audio high frequency analysis.

## Control elements



## Preliminary observations - Safety Tips

You purchased an electronic measuring device. Treat your **Frequency Master IV** carefully! Because of the high sensitivity of the electronics of the measuring device is shock and sensitive to impact. Do not drop it please!

The antenna of the device is very good conductor for electric current. Do NOT attach the antenna too close to electrical outlets, cables or equipment with electrical current! The **Frequency Master IV** could be destroyed when the antenna is in contact with electricity! Even an electric shock to the user here is not totally excluded!

The **Frequency Master IV** does not belong in the hands of children! Although the device is very robust, but the antenna could be damaged by misuse.

Never get **Frequency Master IV** in contact with water! Do not use in rain. The sensitive electronics could be damaged by water penetration.

Avoid high temperatures! The device should not exposed to the blazing sun or in the car in summer, nor lie on heating devices!

The **Frequency Master IV** is maintenance free. Recalibration is not necessary! Clean the device from the outside with a damp cloth. Do not use detergent!

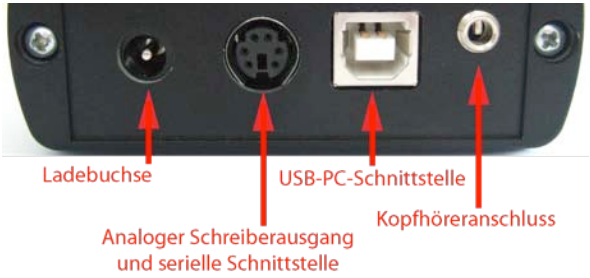
*Frequency Master IV in Case*

## Commissioning

The **Frequency Master IV** is supplied with charged batteries! If the device is switched off unexpectedly, please charge the batteries with the enclosed charger about 15 hours. A control light on the charger lights up when charging occurs.

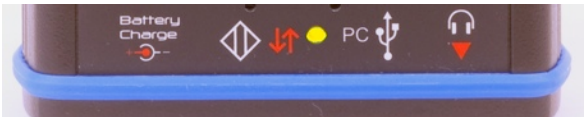

**Charger**

**Connection of the charger to Frequency Master IV**




***Connections and interfaces on Frequency Master IV***

The internal battery is also charged even if the **Frequency Master IV** is connected a USB port (for example, to a PC) via a USB cable. The USB indicator on the **Frequency Master IV** lights up.




***USB-indicator light***

Mount one of the antennas onto **Frequency Master IV**. We recommend to start with the large antenna.

## Selection of the right antenna

**800 MHz to 2,6 GHz (large Antenna)**

**2 GHz to 10 GHz (small Antenna)**

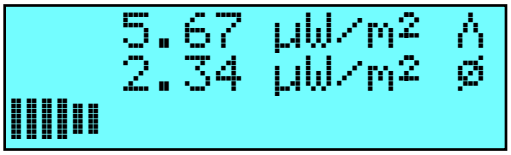
Switch **Frequency Master IV** on by pushing the On-Button . The Display should show some information like below:


it will ask after it after the used antenna:


The control button for lighting chooses the large antenna (<2.5 GHz), the control button "peak hold" chooses the small antenna (> 2 GHz).

Is it intended to measure frequencies mainly up to 2.5 GHz (cellular, WLAN, Bluetooth, etc.), the large antenna is to be selected. For frequencies more than 4 GHz the small antenna is to be selected!

Here, the user should take care in his own interest. The proper selection of the antenna is necessary for using the correct calibration data for each antenna. This procedure is unfortunately necessary to accommodate the different characteristics of the unutilized antennas case. After the selection of the antenna, the measurement readings will appear on the display, for example:




Your Frequency Master IV is ready to go!

## Built-in speaker

The front page of the Frequency Master IV has two buttons for the volume. Here you can adjust the volume of the internal speaker and/or optionally inserted headphones.

louder

more quietly

Press on one of the buttons, the volume is increased or decreased. The volume is devided into 32 steps. A permanent control changes the volume continuously.

The speaker reproduces the modulation signals that are received from the antenna. Do not be alarmed if you hear the signals for the first time. Here you

get an idea of what signals in the "ether" are. You do not notice, because none of your senses is able to capture them.

A simple signal to be recognized is that of a DECT cordless handset. The base station continuously transmits a 100 Hz tone if the phone is in use or not! Once the mains plug of the base station is pulled out, the hum disappears.

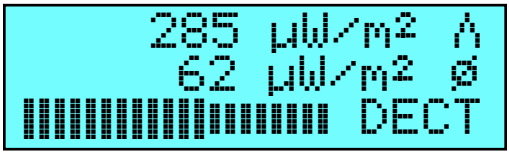
Mobile phones (cell phones), which communicate according to the GSM standard, send a signal of 217 Hz, but this only during the call. The corresponding base stations, however, are identified by a high pitched noise of about 1733 Hz (8x217 = 1733 Hz Hz).

Radar systems send signals from 600 Hz to 1200 Hz

There are countless more, some "exotic" signals, which may not all be enumerated. Over time you will make your own experience.

The Frequency Master IV is able, as we humans, to hear signals "and also to recognize!

When a signal is known, it is immediately identified and shown on the display. Thus gives the ability, just as a beginner, identifying radiation source(s) easier.




Always the strongest signal(s) are detected and displayed on the display. The DECT phone from the neighbors as well as the wireless Internet cafe and of course, mobile phones.

With the menu (see page 12) is also an audio output on measured values (frequency-level strength indicator) possible. Here, a tone is heard, its pitch rises, if the measured value increases and vice versa. This function is ideal for searching increased radiation or for demonstration of shielding actions.

The following radio services are recognized:

| Service | Display |
|---|---|
| DECT cordless-telephone | DECT |
| WLAN Network LAN | WLAN |
| GSM mobile radio | GSM |
| Mixture of WLAN + DECT | W+D |
| Mixture of WLAN + GSM | W+G |
| Mixture of DECT + GSM | D+G |
| Mixture of WLAN + DECT + GSM | WDG |

## WCDMA Detection

The acoustic detection of UMTS-typical signals is not easy. The signal consists primarily of broadband noise. That fact alone makes a detection very difficult. We have implemented a WCDMA detection into **Frequency Master IV**.


This is a 7-pole noise filter, which is specifically sized for "UMTS-noise signals“. Whenever such a signal is detected, the blue lamp lights up.

Practice has shown that other radio services such as DECT and WLAN have these special noise signals too. Therefore the statement "the lamp lit - then we have UMTS“ is not correct. Rather, we can say, when the lamp is off, then we have NO UMTS.

## LED Colored Display- Quick Glance of Safety Values

Quick glance of LED colored lights indicate GREEN (within limits), YELLOW (above limits), RED (limits with remedial action recommended) according to Building Biology Safety Standards

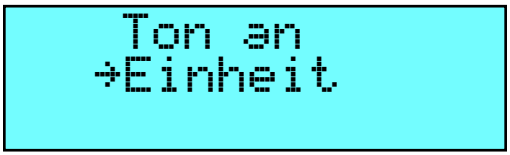

The color separation facilitates the classification of the readings in safer and less safer values. The color scale is chosen according to current recommendations, such as Building Biology SBM 2008

## Selection of unit

The Frequency Master IV is able to show readings of the unity of the electric field strength (mV/m) or the radiation density (µW/m²).

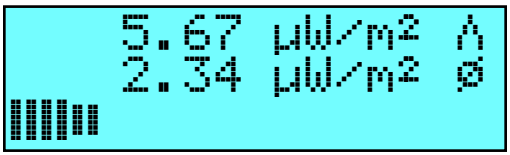
The unit is changed as follows:

Press and hold lighting button , then hold the „peak hold“ button It should then be a menu on the diaplay:

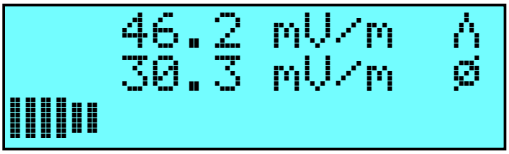



With the lighting button the selection arrow is moved between "tone" and "unity" back and forth. To change the unit, select entry unit and confirm with the control button „peak hold“ . The display changes back to measurement display, but shows the other unit.

Example: display in units of radiance (µW/m²).



After changing the unit:

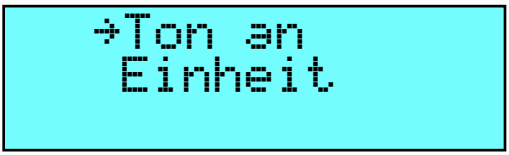



## Sound output on measured values

When the measured value output sound a tone is heard, its pitch rises or falls in proportion with the measured value. This function is ideal for searching increased radiation or for demonstration of shielding actions.

The function is activated as follows:

Press and hold lighting button then the „peak hold“ button. It should then be on display in the display a menu:




With the lighting button the selection arrow is moved between "tone" and "unity" back and forth. To activate the sound output, place the selection arrow on the entry "ton an" and confirm with the „peak hold“ button. The display changes back to measurement display and it is a sound heard, its pitch changes with the measured value.

To disable the function, the menu must be called again. The entry is now called "ton aus". So it is always displayed the future functioning.

## Modulation

High frequency signals are difficult not only because of their very different frequencies shows. A further complication is that there are also many different types of modulation. Recent research findings suggest that the modulation (eg pulse modulation) has a strong influence on the biological relevance of high-frequency signals. Exactly how biological systems respond and the radiation detector is not equal to all types of modulation. The modulation of the RF signals can be detected via the built-in speaker.

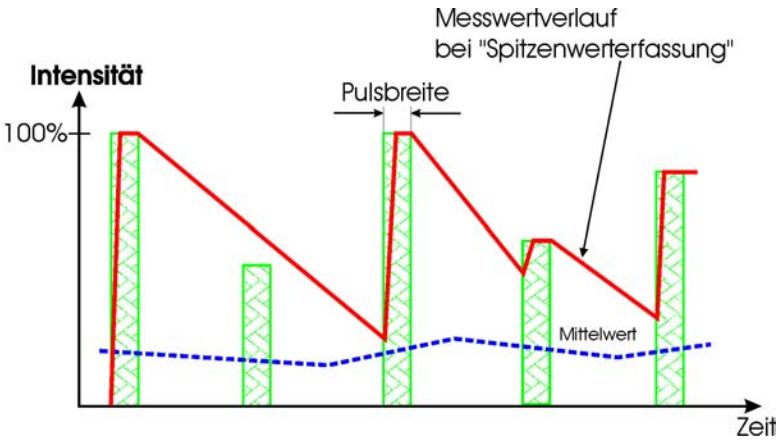
The Frequency Master IV has built a record peak for pulsed signals down and shows the unpulsed and pulsed measurement simultaneously on the display!


The problem of peak detection is the following:
The meter require a certain time for measuring. The meter looks "occasionally“ if a reading is available. If this „looking“, randomly always takes place between the pulses, so the meter shows a very low reading.

From time to time a pulse is catched and displayed. This happens far too rarely.

The peak detection "remembers" the peak of the pulse a certain time. Thus, the chances are greater for the instrument to measure the correct peak.

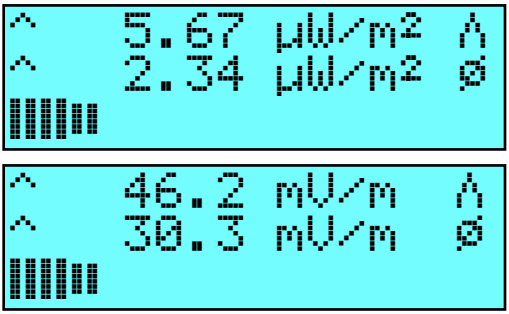
If the pulse width is very narrow (about 100 ns = 100 ns = 100 billionths of a second in DECT), the "Peak Memory" is not quite full, and the reading is a bit too low. If the pulse lasts longer (about 577µs GSM), the chance that the "peak memory" is quite full is greater, resulting in a correct measurement reading.




**Difference between mean value und peak value**

## PeakHold

The Frequency Master IV can also freeze the peak value in the display! For this, the button „peak hold“ is activated until the symbol of the peak memory „^„ will appear in the display:




When PeakHold is activated, the display is updated whenever the new reading is over the saved, old reading. The bar graph remains untouched, is saying that the bar graph follows the actual measured value.

A repressing of „peak hold“ disables the feature.

## RF Basics

In case of high frequencies, electrical fields (E-fields) and magnetic fields (H-fields) no longer exist independently of each other. They are both in a fixed relationship and carry energy together. The radiant flux density S results from the energy that flows through a certain section area ($m^2$) per unitof time (sec).

S, E and H can be converted at any time[1]:

$$S = E \bullet H = \frac{E^2}{377\Omega} = H^2 \bullet 377\Omega$$

S: Radiant flux density [$W/m^2$]

E: Electrical field strength [V/m]

H: Magnetic field strength [A/m]

It is therefore sufficient to measure one variable in order to be able to determine all others as well. Very frequently it is the radiant flux density S that is measured. Our HFR-4 measures the component of the electrical field strength!

For the measurement, a suitable antenna is required, which absorbs a certain radiant flux density quantity with its effective surface $A_w$ and converts it into a line-conducted wave. The power of this wave results from the radiant flux density and the effective surface of the antenna:

$$P_E = S \bullet A_w$$

$P_E$: Received power

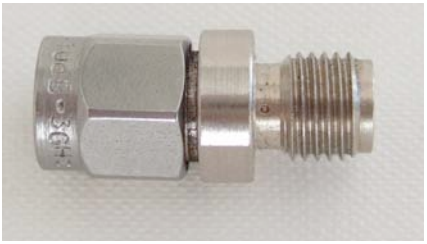
$A_w$: Effective surface of the antenna

S: Radiation flux density

The measuring range of the Frequency-Master IV extends from approx. 6 mV/m to 4400 mV/m or from 0,1 µW/m² to 50000 µW/m². If higher levels should be measured, the measuring range can be adapted upwards through external attenuators. There are attenuators available with 6 dB, 10 dB and 20 dB. The attenuators are easily connected between antenna and Frequency-Master IV.

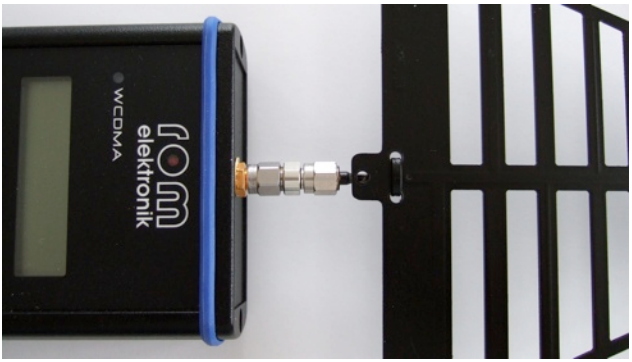
| | Attenuation factor for fieldstrength (mV/m) | Attenuation factor for power (µW/m²) |
|---|---|---|
| 6 dB | 2 | 4 |
| 10 dB | 3 | 10 |
| 20 dB | 10 | 100 |

The most frequently required attenuators are those with 10 dB and 20 dB. If e.g. you wish to extend the measuring range from the present 10 mW/m² to 1000 mW/m² (approx. 20V/m), you require the 20 dB attenuator (Factor 100).



***Attenuator***

If you wish 50000 mW/m² (ca. 137 V/m), then you must additionally use the 10 dB attenuator (Factor 100 + Factor 10 = Factor 1000 = 30 dB).




***Mounted attenuator***

In the practice, a measurement of so high field-strengths with attenuators is impossible. Such high field-strengths influences is the entire measuring instrument itself. I. e., the measuring instrument will show (also without antenna) any values, but no secured measurements. For measurements of field-strength of about 10 V/m and over, there are particular sensors and measuring instruments necessary.

## Antennas

Along with Frequency-Master IV two antennas (Logper antenna) for the frequency range 900 MHz to 2.6 GHz and 2 GHz to 11 GHz are included. With these antennas, the direction and polarization of the RF radiation are determined accurately.

A logper antenna consists of several dipoles of different lengths. Every rod pair receives a different frequency. The long rods are responsible for the low frequencies (larger wavelength) and the short rods for the high frequencies (smaller wavelength).

Wavelength and frequency have the following relationship to each other:

$$c_0 = \lambda \bullet f$$

λ: Wavelength

$c_0$ Velocity of light (=300000 km/s)

f: Frequency

With the Frequency-Master IV the electrical field strength E can be measured in mV/m and the radiant flux density S in µW/m2 and converted back and forth with the formula (3). Prerequisite, however, is that the effective surface area of the antenna is known.

The effective surface area is not constant, however, but dependent on frequency:

$$A_W = G \bullet \frac{\lambda^2}{4 \cdot \pi} = G \bullet \frac{c_0^2}{4 \cdot \pi \cdot f}$$

G: Antenna gain (= amplification; frequency-dependent)

λ: Wavelength

$c_0$ Velocity of light (=300000 km/s)

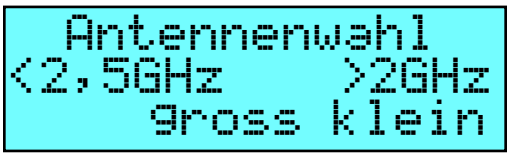
f: Frequency

In order to be able to determine the radiant flux density exactly, you must measure not only the received power, but you must also determine the frequency. For this, spectrum analyzers are generally used, which are very expensive because of their complicated structure.

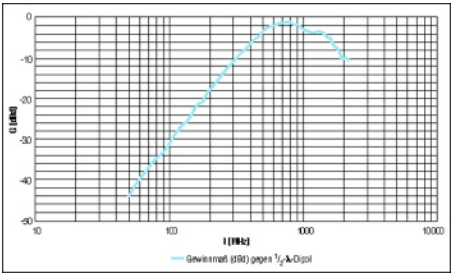
If it is a question of the effect of electromagnetic waves on persons, however, the radiant flux density generally does not have to be determined exactly. Here it is of primary importance to know the order of magnitude of the radiant flux density, in order to make a judgment of the potential danger. For this purpose the Frequency-Master IV was developed.

It consists of a very sensitive RF power measuring device (detector). Since the detector cannot determine the frequency of the radio frequency radiation, no high-precision measurements are possible with it for the above explained reasons.

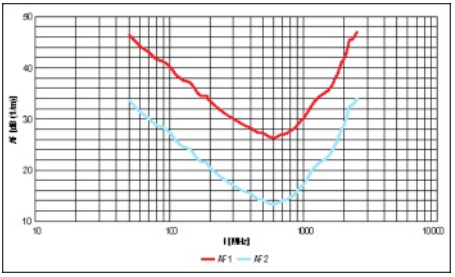
For unidirectional measurement or measurement of lower frequencies than 900 MHz, a biconical antenna is optionally available.



**If the biconical antenna is used, then please select the large antenna (<2.5 GHz) in the antenna selection, so that the correct calibration factor is used.**




**Gewinnmaß Bikonische Antenne dBd gegen ½-λ-Dipol**




**Antennenfaktoren der Feldstärke (AF1) und Leistung (AF2) für die Bikonische Antenne**


***Frequency Master IV with bikonical antenna for frequencyrange from approx. 50 MHz to 3 GHz***

## Notes on antenna

The included LogPer antennas are part of a measurement system! Please handle with care! They receive electromagnetic radiation in the range from 900 MHz to 2600 MHz and 2000 MHz to 11000 MHz. They can be bend near the plug easily. If this happens, they can be gently unwound. However, this

should not happen too often for a sustained damage is excluded. If an antenna no longer be solved with the fingers, then the enclosed tool is to be used.


*Loosen the antenna with tool*

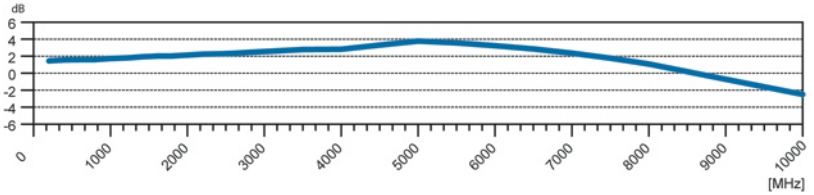
**Please use the tool to loosen the antenna ONLY!**
**Not to tighten!**

## Uncertainties

From the above-mentioned facts, it can be identifiable that, with the measurement of the radio frequency, uncertainties of measurement (measuring errors) must be expected. Which order of magnitude of the measuring errors must be dealt with? If we look at the best RF measuring devices which can be bought, they mostly have an uncertainty of measurement of ±3 dB. In the measuring of output, 3 dB means a factor of 2! For the measured value, this means that the true value can be twice as large or only half of the indicated value. Expressed in percent, we therefore have an uncertainty of measurement of ±50% with a very good measuring device!

In case of more economical devices, these measuring errors are often far greater. However, what is the situation with the Frequency-Master IV? We must consider the inadequacies of the antenna and the measuring device. This is because the combination of the two of them should supply the "correct" measured value.

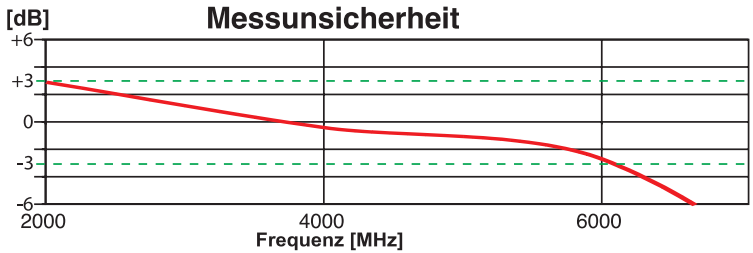
A high level of linearity is necessary for the measuring device (in order to keep the measuring error low). High-frequency amplifiers generally have a more or less linear frequency response. Without special measures, this unsuitable characteristic can affect the overall linearity. Only by means of large-scale development efforts and with close cooperation and support through the University of the German Armed Forces, Munich, a suitable radio frequency circuit was finally developed, which does not indicate the disadvantages mentioned. The results of these efforts are represented in the following graphics.




***Linearity characteristic of the input amplifier circuit of the* Frequency Master IV**

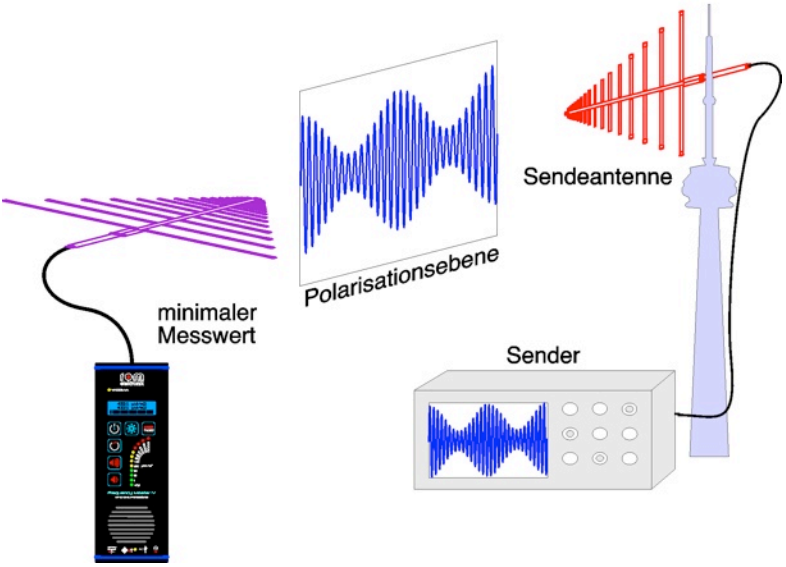
In order to achieve a corresponding sensitivity, antennas are required which supply a sufficient outlet voltage in a large frequency range. Logarithmic-periodic antennas are very well suited for this. Therefore 2 of these antennas are also included in the scope of delivery of the Frequency-Master IV.

However, these have the disadvantage that their output voltage decreases with the square of the frequency. When measuring with a spectrum analyzer, the fault arising from that can be calculated from the result of measurement, since the frequencies of the measured signals are known. In case of a broadband measuring device, such as the Frequency-Master IV, on the other hand, the fault must be taken into consideration. The following graphics indicate the error curve.




***Uncertanty of „System* Frequency Master IV“**

It is easily seen that in the frequency range from 2000 MHz to 6000 MHz, the measurement uncertainty is within ± 3 dB.



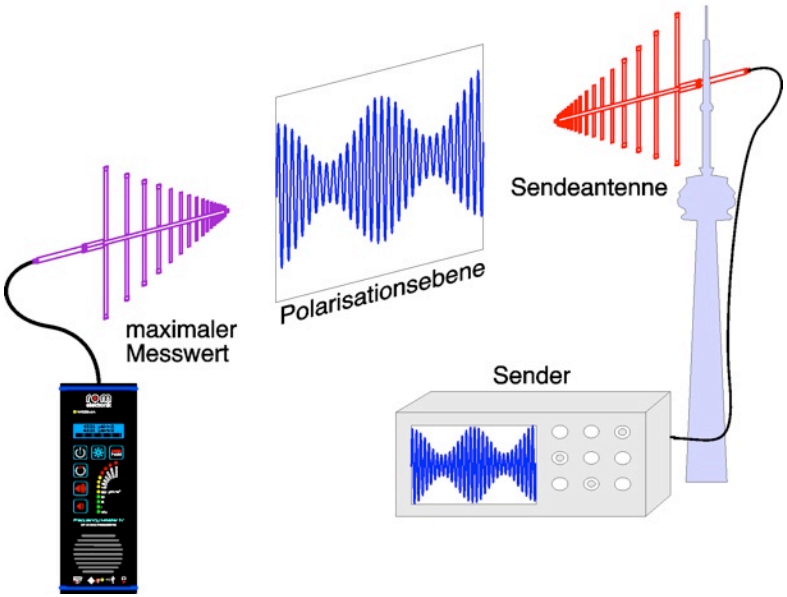

***Minimum measured value if transmitting and receiving antenna point in same direction but have different planes of polarization.***

## Polarization

If we consider the electrical field component of an electromagnetic wave, it is determined that this is in one plane. This plane is also designated as a plane of polarization. The maximum measured value is provided in the case where the receiving antenna points in the same direction and plane as the transmitting antenna.

Determination of the polarization is simple:

Point Frequency Master-IV in the desired direction of measurement. Loosen the antenna at the antenna port a little and turn left or right. Watch the measured value in the display and continue turning. Stop turning if the highest reading is shown in the display.




***Maximum measured value if transmitting and receiving antenna point in same direction and polarization level.***

***determination of polarisation***

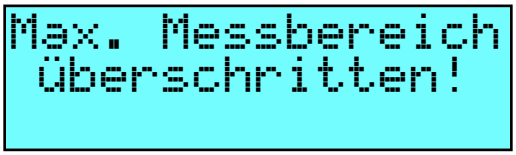
## Evaluation of the results

Basically, an evaluation of the measured values is to be recommended in accordance with the provision principle. With frequent employment of the device, you will also get a feeling for which measured value is normal and which measured value can be regarded as increased, or maybe even dubious. The following Table 5 gives provisional values for provision and limit values. The following table gives an indication values for prevention and limits.

| Limit value in W/m² | Limit value in W/cm² | Limit value in mV/m | Recommended in case of |
|---|---|---|---|
| 0,1-5 µW/m² | 0,001-0,5 nW/cm² | 5-50 mV/m | Weak anomaly according to SBM 2003 for pulsed radiation |
| >10 µW/m² | >1 nW/cm² | >50 mV/m | Weak anomaly according to SBM 2003 for unpulsed radiation |
| 1 mW/m² | 0,1 µW/cm² | 614 mV/m | EEG changes (pused, v. Klitzing) |
| >100 mW/m² | >10 µW/cm² | 6140 mV/m | ECOLOG |
| 2-10 W/m² | 0,2-1 mW/cm² | 27500-61000 mV/m | BImSchV (according to frequency) |
| 2-10 W/m² | 0,2-1 mW/cm² | 27500-61000 mV/m | Population (according to frequency) |

Dr. Lebrecht von Klitzing (Luebeck), who carried out investigations concerning the influence of brain currents through pulsed radio frequency radiation, indicates the value 0.1 mW/cm²= 1 mW/m² for short-term exposures as a lowest influence threshold. For constant loads, such as e.g. in case of DECT base stations, which continuously emit pulsed radio frequency, 5 µW/m² = 0.5 nW/cm²≈40 mV/m should not be exceeded!

If measured values are over 4400 mV/m or 50 mW/m² (Display: "Max range exceeded!" In Frequency-Master IV), then schielding is certainly



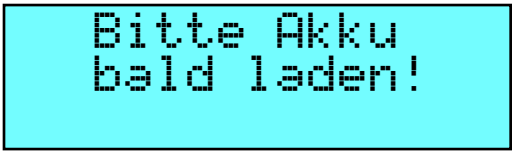

recommended.Maybe in this case an accurate measurement is recommended by a specialist, for clarity about the actual exposure (intensity, frequency, modulation, etc. to get).

We went different shielding materials. If necessary, ask us!

## Maintenance of the device and battery

Please use for the cleaning of the equipment only a slightly damp cloth. The housing and the display never treat with aggressive cleaning agents!

A battery charge is required when display shows:




A charge is also required if the device can no longer switched on.

Then switch the unit off and plug the charger into an AC outlet and the charger cable into the appropriate socket on the Frequency-Master IV charger lights on a red charging light. After a charging time of about 15h, the device is operational.

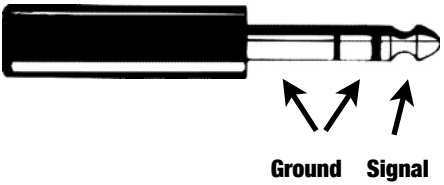
The battery is also loaded when the Frequency Master IV live wire to a USB port (for example, to a PC) via a USB cable is connected. It lights up the USB light on the Frequency Master IV, if the frequency is switched Master IV exists during an active connection to the USB port, then it may happen that the blue light is WCDMA. This is NOT an indication for a UMTS signal, but via the USB port to high-frequency signals in the master frequency to be inserted IV and bring the highly sensitive detection for WCDMA response.


Charger

Connection of the charger to Frequency Master IV

## Technical Annex

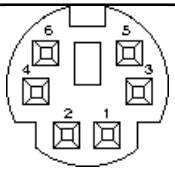
On the headphone jack, a headphone (mono or stereo) can be connected. This improves the acoustic identification of the modulation. This output can also be connected to an NF-spectrum analyzer. There are now some Spectrum analyzer in the market, either as a pure software solution (Connection via sound card and PC), or external accessories.




*Connection of the plug for headphones or signal analysis with spectrum analyzer*

## Options

The Frequency Master-IV is capable of upgrading with a pen writer output (0-2.5 V) and/or serial RS232 computer interface (supplied instead of USB).

| *Interface connector* | |
|---|---|
| 1 = Ground |  |
| 2 = not connected | |
| 3 = TxD (transmit data) | |
| 4 = RxD (receive data) | |
| 5 = DC-output 0 - 2,5 Volt | |
| 6 = Analog-Output from Detector | |



## DC-Output (Analog writer outlet)

The measured value is provided as electric voltage in the range from 0 volt to 2.5 volt ($R_{min}$ =>10 kOhm) at the cinch socket.

## Detector-Output

Here the direct detector output voltage is available (ca. 0,4 Volt to 1,7 Volt, $R_{min}$ =>10 kOhm)

**Use measuring instrument Frequency-Master IV only as in this instruction described. Offenses can destroy the measuring instrument and in consequence a guarantee-loss.**

## Tecnical Data

| | |
|---|---|
| **Frequency range:** | **approx. 1 MHz to 6000 MHz partially compensated (approx. 1 MHz to 10000 MHz with decreased precisiont)** |
| **Measuring range:** | **6 mV/m to 4400 mV/m btw. 0,1 to 50000 µW/m² (= 10 pW/cm² to 5 µW/cm²)** |
| **Max. sensitivity:** | **better than 0,1 µW/m² (= 10 pW/cm²)** |
| **Uncertanty:** | **Basic accuracy better than ±3 dB** |
| **Display:** | **LC-Display, 3 lines analog and digital, LED colored display** |
| **Ambient temperature:** | **-5°C to 40°C** |
| **Dimensions:** | **approx. 90mm x 220mm x 35mm** |
| **Functions:** | **Simultaneous measurement of pulsed and unpulsed signals, Peak-Hold selectable Units, adjustable volume** |
| **Interfaces** | **headphone output, USB- or serial interface, analog voltage-output 0-2,5 V (Option)** |
| **Weight:** | **approx. 500 g** |
| **Power supply:** | **built-in NiMH-Akku** |
| **Actual working time:** | **approx. 24 hours with fully charged batteries** |
| **Scope of delivery:** | **Frequency Master IV, Logper-Antenna 900 MHz - 2600 MHz, Logper-Antenna 2000 MHz - 11000 MHz, tool, charger, case** |
| ***Technical changes without notice*** | |

## Tips and hints on frequently asked questions

**Avoid using a mobile telephone (cell phone) close to Frequency-Master IV! Never touch antennas of Frequency-Master IV and cell phone.**

# DESTRUCTION-DANGER!

It can take a certain time until the measurement is adjusted; especially when readings go downward. The reason for this is that values are stored internally and this storage need a certain time (approx. 30 sec.) until this storage is empty. This is also the reason that readings are not stable when measuring pulsed signals.

## Conversion table radiation-density - electric field-strength

| µW/m² | mV/m | | mV/m | µW/m² | | mV/m | µW/m² | | mV/m | µW/m² |
|---|---|---|---|---|---|---|---|---|---|---|
| 0,1 | 6,1 | | 5 | 0,07 | | 110 | 32 | | 650 | 1121 |
| 0,2 | 8,7 | | 10 | 0,27 | | 120 | 38 | | 700 | 1300 |
| 0,5 | 13,7 | | 15 | 0,60 | | 150 | 60 | | 750 | 1492 |
| 1 | 19,4 | | 20 | 1,1 | | 200 | 106 | | 800 | 1698 |
| 2 | 27,5 | | 25 | 1,7 | | 210 | 117 | | 850 | 1916 |
| 5 | 43 | | 30 | 2,4 | | 220 | 128 | | 900 | 2149 |
| 10 | 61 | | 35 | 3,2 | | 250 | 166 | | 950 | 2394 |
| 20 | 87 | | 40 | 4,2 | | 300 | 239 | | 1000 | 2653 |
| 50 | 137 | | 45 | 5,4 | | 310 | 255 | | 1200 | 3820 |
| 100 | 194 | | 50 | 6,6 | | 320 | 272 | | 1500 | 5968 |
| 200 | 275 | | 55 | 8,0 | | 350 | 325 | | 2000 | 10610 |
| 500 | 434 | | 60 | 9,5 | | 400 | 424 | | 2200 | 12838 |
| 1000 | 614 | | 65 | 11,2 | | 410 | 446 | | 2500 | 16578 |
| 2000 | 868 | | 70 | 13,0 | | 420 | 468 | | 3000 | 23873 |
| 5000 | 1373 | | 75 | 14,9 | | 450 | 537 | | 3200 | 27162 |
| 10000 | 1942 | | 80 | 17,0 | | 500 | 663 | | 3500 | 32493 |
| 20000 | 2746 | | 85 | 19,2 | | 510 | 690 | | 4000 | 42440 |
| 50000 | 4342 | | 90 | 21,5 | | 520 | 717 | | 4200 | 46790 |
| | | | 95 | 23,9 | | 550 | 802 | | 4500 | 53714 |
| | | | 100 | 26,5 | | 600 | 955 | | 5000 | 66313 |

| Number | in Words | Value | EDV | Präfix | Abrev. |
|---|---|---|---|---|---|
| 1000 000 000 000 000 | quadrillion(billiard) | $10^{15}$ | 1.0E015 | Peta | P |
| 1000 000 000 000 | trillion (billion) | $10^{12}$ | 1.0E012 | Tera | T |
| 1000 000 000 | billion (milliard) | $10^{9}$ | 1.0E009 | Giga | G |
| 1000 000 | million | $10^{6}$ | 1.0E006 | Mega | M |
| 1000 | thausand | $10^{3}$ | 1.0E003 | kilo | k |
| 100 | hundred | $10^{2}$ | 1.0E002 | hecto | h |
| 10 | ten | $10^{1}$ | 1.0E001 | deca | da |
| 1 | one | $10^{0}$ | 1.0E000 | | |
| 0,1 | tenth | $10^{-1}$ | 1.0E-01 | dezi | d |
| 0,01 | hundredth | $10^{-2}$ | 1.0E-02 | centi | c |
| 0,001 | thausandth | $10^{-3}$ | 1.0E-03 | milli | m |
| 0,000 001 | millionth | $10^{-6}$ | 1.0E-06 | mikro | $\mu$ |
| 0,000 000 001 | billionth (milliardth) | $10^{-9}$ | 1.0E-09 | nano | n |
| 0,000 000 000 001 | trillionth (billionth) | $10^{-12}$ | 1.0E-12 | piko | p |
| 0,000 000 000 000 001 | quadrillionth (billiardth) | $10^{-15}$ | 1.0E-15 | femto | f |
| 0,000 000 000 000 000 001 | quintillionth (trillionth) | $10^{-18}$ | 1.0E-18 | atto | a |

CE

# EG-KONFORMITÄTSERKLÄRUNG
# DECLARATION OF CONFORMITY
# DECLARATION DE CONFORMITÉ

| | |
|---|---|
| Wir (Name des Anbieters)<br>We (Suppliers Name)<br>Nous (Nom du Fournisseur) | ROM-Elektronik GmbH |
| Anschrift<br>Address<br>Adress | Am Grund 13<br>D-86489 Deisenhausen |

erklären in alleiniger Verantwortung, daß das Produkt: HF-Analyser
declare under sole responsibility, that the product:
déclarons sous notre seule responsibilité, que le produit:

| | |
|---|---|
| Bezeichnung<br>Name<br>Nom | FrequencyMaster IV |
| Typ, Modell, Artikel-Nr.<br>Type, Model, Article No.<br>Typ, Modèle, No. d´Article. | |
| mit den Anforderungen der Normen<br>fullfills the requirements of the standard<br>satisfait aux exigences des normes | EN50081-1:1993<br>EN50082-1:1993<br>EN55011:1991 Class A<br>EN61000-3-2:1995, EN61000-3-3:1995 |

übereinstimmt und damit den Bestimmungen der EG-Richtlinie 89/336/EWG entspricht.
and therefore corresponds to the regulations of the EU-Directive 89/336/EEC.
et, ainsi, correspond aux reglement de la Directive du Conseil 89/336/CCE.

| | |
|---|---|
| Deisenhausen, 01.10.2009 | Robert Mayr |
| Ort und Datum der Ausstellung<br>Place and Date of Issue<br>Lieu et date d´etablissement | Name und Anschrift des Befugten<br>Name and Signature of authorized person<br>Nom et signature de la personne autorsée |

Diese Erklärung entspricht EN 45 014
This Declaration corresponds to EN 45 014
Cette Declaration correspond á EN 45 014