

## **HF38B**

(700MHz - 2,7GHz ; 3,3GHz -3dB)



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**English**

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**RF-Analyser**

High Frequency Analyser for Frequencies  
from 700 MHz to 2.7 (3.3) GHz

**Manual**

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## Control Elements and Quick Start Guide



**Connecting socket for antenna cable.** The antenna is inserted into the “cross like” opening at the front tip of the instrument. **Important:** Do not bend the cable too sharply or overtighten the connector screw!

„Power“      **On/Off switch** (☰▶ = ”Off“ )

„Signal“      For building biological assessment use „peak“ or „Peak hold“.

„Range“      Set the sensitivity according to the level of radiation.



**Volume control for audio analysis** of digital HF services

All meters include an **Auto-Power-Off**-feature and a Low-Batt indication.

## Introduction to Properties of HF Radiation and Consequences for their Measurement

### Permeation of many materials

In particular for measurements inside of buildings it is important to know that construction materials are permeable for HF radiation to a varying degree. Some part of the radiation will also be reflected or absorbed. Wood, drywall, and wooden window frames, for example, are usually rather transparent spots in a house.

### Polarisation

Most **High Frequency** radiation (“waves”) is vertically or horizontally polarised. With the antenna attached the meter measures the vertically polarised component, if the display is positioned horizontally. By rotating the meter around its longitudinal axis you will be able to pick up any polarisation plane.

### Fluctuations with regard to space and time

Reflexions can cause highly localised amplifications (“hot spots”), in particular inside buildings.

In addition, most transmitters and cellular phones emit with considerably varying power during a given day and in the long term, depending on local reception and load. **Therefore repeat measurements at different times of the day on working days and at weekends. In addition it may be advisable to repeat them occasionally over the year, as the situation can change overnight.** As an example, a transmitter only needs to be tilted down by a few degrees in order to cause major changes in exposure levels (e.g. during installation or repair of cellular phone base stations). Most of all it is the enormous speed with which the cellular

phone network expands every day that causes changes in the exposure levels.

### Minimum distance 2 meters

Due to the physics of wave generation it is not possible to reliably measure the customary "power density" ( $W/m^2$ ) in the close vicinity of the source of radiation. For the instruments described here, the distance should be in excess of 2 meters.

The nature of HF radiation requires a specific approach for each

- the determination of the total exposure to it and
- the identification of the sources or leaks for the pollution.

## Step-by-Step Procedure to Measure the Total Exposure

When testing for HF exposure levels in an apartment, home or property, it is always recommended to **record** individual measurements on a **data sheet**. Later this will allow you to get a better idea of the complete situation.

### Preliminary Notes Concerning the Antenna

As the LogPer Antenna provided with this instrument is shielded against ground influences, one should "aim" about 10 degrees below the emitting source subject to measurement so as to avoid distortions in the area of sensitivity transition (aim horizontally for moderately elevated targets such as transponder masts).

The analyser suppresses frequencies below 700 MHz to avoid the readings being disturbed by lower frequency sources. In order to measure frequencies below 700 MHz down to 27 MHz the instruments HFE35C and HFE59B are available from Gigahertz Solutions. They come with an active horizontally isotropic ultra-broad band antenna from 27 MHz up to beyond 3 GHz, the UBB27.



### Settings of the Analyser

At first, set "Range" to "19.99  $mW/m^2$ ". Only if there are constantly very small readings, switch to the next finer range<sup>5</sup>.

**The basic rule is: as coarse as necessary, as fine as possible.**

<sup>5</sup> Range": When switching from 'Coarse' to 'Medium' for very small readings, it could happen, that the instrument tolerance of +/- 6 dB full range is absorbed. In this worst case there may be a factor 4 between the displayed numbers in 'Coarse' and 'Medium'. Example: In 'Medium' you read 150.0  $\mu W/m^2$ . If worst comes to worst 'Coarse' might show between 0.6 and 0.03  $mW/m^2$  (instead of 0.15  $mW/m^2$  which would be the correct value). However, normally the differences shown will be much smaller. For comparing measurements (e.g. 'before' and 'after') take the same range setting.

Higher power densities beyond the designed range are indicated by a "1" on the left end of the display. In this case, the attenuator DG20 (available as accessory) can be applied and will allow measurements of 100 times higher fields.

Setting **Signal Evaluation ("Signal")**: The **peak HF radiation value**, not the average value, is regarded as the measurement of critical "biological effects" affecting the organism and to be compared to recommended safety limits. This is the standard setting!

The **average value ("RMS")** of pulsed signals is often only a very small fraction of the peak value. Nonetheless it forms the basis of most of the "official" safety limits regulations. Building biologists consider this a trivialization.

„**Peak hold**“simplifies measurements of the total exposure by retaining the highest readings for some time (it slowly drops). Note of caution: Switch on "softly" to avoid switching peaks, which then will be retained for some time simulating unrealistic power densities. If peaks are very short and very high the holding capacity needs an instant until it is fully charged.

## How to execute the measurements

Hold the HF analyzer with a **slightly outstretched arm**, your hand at the rear of the instrument.

For a rough **first overview** it is sufficient to probe for areas of higher levels of radiation simply by following the audio signals walking through the rooms of interest, directing the analyser everywhere and rotating it.

Having identified the area of interest for a closer evaluation, change the positioning of the instrument in order to analyse the actual power flux density. This is done

- by **pointing** in all directions including upwards and downwards in flats to establish the main direction of the incoming radiation,
- by **rotating** the instrument around its longitudinal axis by up to 90° to also find the plane of polarisation, and
- by **shifting** the instrument in order to find the point of maximum exposure and to avoid being trapped by local cancellation effects.

**It is generally accepted to use the highest reading in the room for comparison with limit or recommended values.**

## Evaluating the different radio services

The displays of the meters of this series show the sum of the total power density within the frequency range of the most common digital radio services. This means for the often dominating sources of DECT and GSM as well as analogue sources: Simply take the readings and compare them to the building biology standard values!

To be able to evaluate the different radio standards and transmission and modulation patterns with one single measurement tech-

nology, the following approach to compensate for these differences is recommended:

**UMTS/3G, LTE/4G, WiMAX, DVB, WLAN** during full data transmission:

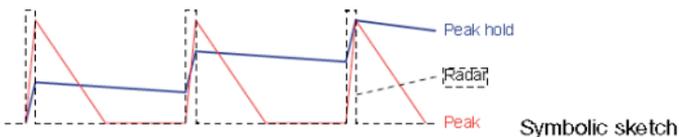
The modulation of these high-speed services includes high, needle-like peaks compared to the average power transmitted. Such signals are referred to as “high crest factor” signals. Measure for 1 or 2 minutes by slightly panning the meter pointing to the direction of the main source, and multiply the highest value by ten for a comparison with the building biology recommendations<sup>6</sup>. Often you will find different telecommunication services being present at the same time. With the help of the audio analysis<sup>7</sup>, you will be able to estimate how much of the total value shown is caused by such high crest factor signals. Depending on the proportion to the total signal, please apply the following “rules of thumb”:

- Low portion of “high crest factor signals” audible: multiply display reading by 2.
- ~“Fifty-fifty”-ratio: multiply display reading by 5
- Dominating “high crest factor signals”: multiply display reading by 10.

Taking into account the multiple external factors of measurement uncertainty, this approach is perfectly adequate for an assessment of the total pollution. The use of a frequency filter and service specific correction factors will allow an increased accuracy.

**Radar** beams are emitted by slowly rotating antennas. Therefore they are only measurable and audible for only milliseconds every few seconds. Due to the extremely fast rise-time of the signal only a rough estimation of the real signal level is possible:

- Set “Signal“ to “Peak hold“ and allow for several beam passes to establish the equilibrium of charging and droop rate of the holding capacitor. The reading may take a few minutes to stabilize. Multiply the highest reading by 10.



**Smart meters** transmit data to the respective providers very irregularly and in pulses, by using the locally available cell phone services. Additionally there may be pulsed in-house wireless connections. Therefore, it makes sense to keep measuring until you pick up some pulses, and if necessary, apply correction factors.

<sup>6</sup> Even though their standards specify far higher crest factors, the industry strives for crest limitation for economic reasons, so that the resulting correction doesn't exceed a factor of 10. For TETRA a factor of 2, for WLAN (“standby-rattling”) a factor 4 is enough.

Mind the internal noise level, where a correction does not make sense.

<sup>7</sup> Sound samples on our homepage (section RF measurement).

## Limiting values, recommendations and precautions

The "Standard der baubiologischen Messtechnik" (Standard for Building Biology Measurements), SBM 2015, classifies measurements (per radio communication service), with a note of caution "pulsed signals to be taken more seriously than continuous ones", as follows:

Building Biology Recommendations as per SBM-2015				
Peak measurements $\mu\text{W}/\text{m}^2$	un-conspicuous	moderately conspicuous	very conspicuous	extremely conspicuous
	< 0.1	0.1 - 10	10 - 1000	> 1000

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In fall 2008 the "Bund für Umwelt und Naturschutz Deutschland e.V." (**BUND**) (environmental NGO) recommended a limiting value of **1  $\mu\text{W}/\text{m}^2$  even for outdoor** situations.

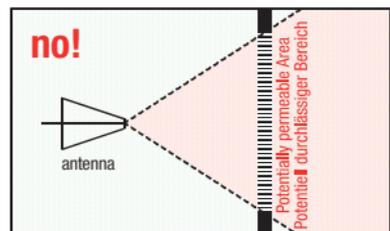
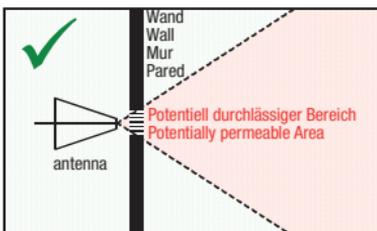
The **Landessanitätsdirektion Salzburg** (Austrian health authority) proposed already in 2002 to lower the present "**Salzburger Vorsorgewert**" (precautionary value) to **1  $\mu\text{W}/\text{m}^2$  for indoor situations**.

Limiting values imposed by governments are mostly considerably higher. There are indications of rethinking, though. The internet provides large collections of recommendations and data.

**Note for users of cellular phones and WLAN: Even below the measurement range of the meters, even the highly sensitive HF38B, a reliable communication is absolutely possible.**

## Identification of the sources of pollution

After determination of the total exposure the next step is to find out where the radiation enters the examined room. As a first step eliminate sources from within the same room (e.g. cordless phones, wireless routers, etc.) Once this is completed, the remaining radiation will originate from outside. For remedial shielding it is important to identify those areas of all walls (including doors, windows and window frames!), of ceiling and floor, which are penetrated by the radiation. To do this one should not stand in the centre of the room, measuring in all directions from there, but monitor the permeable areas with the antenna (LogPer) directed and positioned close to the wall/ceiling/floor. The reason for this is that the antenna lobe widens with increasing frequency. In addition reflections and cancellations inside rooms make it impossible to locate the "leaks" accurately. See the illustrating sketch below!



## Audio Frequency Analysis

Many different frequencies within the frequency band between 700 MHz and 2.7 GHz, are being used by many different services. The audio analysis<sup>8</sup> of the modulated portion of the HF signal helps to **identify the source of a given HF radiation signal**.

Sounds and signals are very difficult to describe in writing. The easiest way to identify them is to listen to the sound samples of the different signal sources, which can be found as MP3 files on our homepage. Alternatively, you can approach known HF sources very closely and listen to and memorise their specific signal patterns.

”Marking“ of unpulsed signals:

Un-pulsed signals or signal portions by their very nature are not audible in the audio analysis and therefore easily missed. For that reason, in our meters they are marked by a uniform “rattling” tone, with its volume proportional to its contents of the total signal. This “marking” has a frequency of 16 Hz (please see sound samples on our website).

## For more in-depth analyses

Gigahertz Solutions offers:

- **Attenuators** for expanding the designed range of the analysers upwards for strong sources of pollution.
- **Instruments for lower HF:** For measurement of signal frequencies above 27 MHz (including: CB radioing, analogue and digital TV and radio TETRA etc.) we offer the instruments HFE35C and HFE59B.
- **Instruments for HF up to 6 GHz / 10 GHz:** For analyses for yet higher frequencies (up to abt. 6 GHz, including WLAN, WIMAX and some directional radio sources and aviation radar), we offer the HFW35C (2.4-6 GHz). For higher frequencies up to 10 GHz (Radar) the HFW59B is available.
- **Instruments for low frequencies:** Electrosmog is not limited to the **Radio Frequency** range! Also for the low frequency range such as power (distribution and domestic installations) and railways including their higher harmonics we offer a broad range of affordably priced instruments with high professional standards.

Please refer to our homepage for further information.

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<sup>8</sup> Turn the volume control for the audio analysis fully to the left („-“) before switching the meter on, as the sound might be very loud at high field strength levels.

## Power Supply / Auto-Power-Off

The battery compartment is at the back of the analyzer. For protection of the battery the instrument turns itself off automatically after initially 40 minutes, in the “LOW BATT” mode already after two minutes. In the “LOW BATT” mode a reliable measurements cannot be guaranteed.

## Shielding done by an expert is a reliable remedy

The effectiveness of shielding done by an experienced craftsman can be verified by measurement. He has quite a number of options at his disposal. There is no “best method”, however, befitting for all problems – shielding always has to be adapted to the specific situation.

Shielding, too, is covered comprehensively on our homepage which also contains further links on this issue.

## Warranty

We provide a two year warranty on factory defects of the HF Analyzer, the antenna and accessories.

Even though the antenna appears to be rather delicate, it is made of a highly durable FR4 base material that can easily withstand a fall from table height. The warranty also covers damages caused by such falls, should these ever occur.

The analyzer itself is **not impact proof**, due to the comparatively heavy battery and the large number of delicate components. Any damage as a result of misuse or shock is therefore excluded from this warranty.