HFW59D

High Frequency Analyser
for frequencies from 2.4 GHz to 10 GHz

Instruction Manual

Revision 1.3

This manual is subject to continuous updates, amendments and adjustments. The most current version can always be found for download on your local distributor's homepage or under www.gigahertz-solutions.de

Please carefully review the manual before using the device. It contains important advice for use, safety and maintenance of the device. In addition it provides the background information necessary to make reliable measurements.

Thank you!

We appreciate the confidence you have shown in purchasing this HF Analyser. It will allow a professional analysis of the exposure with high frequency (HF) radiation corresponding to the baubiology recommendations.

Further to this manual you are welcome to have a look at the training videos on our homepage for an optimal use of our measurement technology.

If you should encounter any problems, please contact us immediately. We are here to help.

For your local distributor pls check:

www.gigahertz-solutions.com

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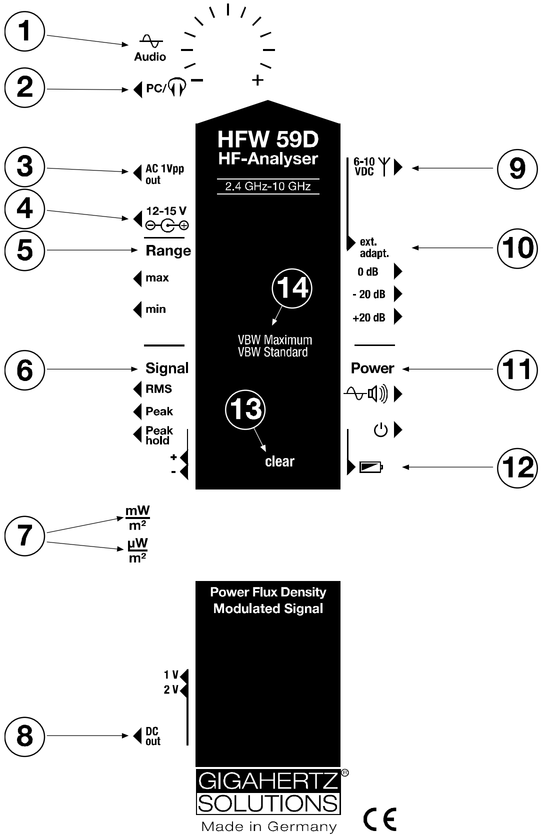
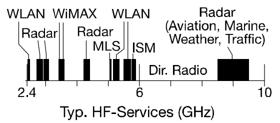
Safety Instructions:

The HF analyser should never come into contact with water or be used outdoors during rain. Clean the case only from the outside, using a slightly moist cloth. Do not use cleaners or sprays.

Due to the high sensitivity level, the electronics of the HF analyser are very sensitive to heat, impact as well as touch. Therefore do not leave the instrument in the hot sun, on a heating element or in any other damaging environment. Do not let it drop or try to manipulate its electronics inside when the case is open.





The HF component of the testing instrument is shielded against interference by an internal metal box at the antenna input (shielding factor ca. 35 – 40 dB)

Functions and Controls

1) Volume control for the audio analysis (on/off switch).

2) Jack, 3.5 mm: AC output for the modulated part of the signal, for audio analysis via PC or headset.

3) Calibrated AC output 1 Volt peak-peak, proportional to the field strength.

4) Jack, 12-15 Volt DC for charging the battery. AC adapter for 230 Volt/50 Hz and 60 Hz is included. For other Voltages/Frequencies please get an equivalent local AC adaptor with the output parameters 12 – 15 Volt DC / >100mA.
Caution: If an alkaline battery is used, under no circumstances should the power adapter be connected at the same time, otherwise the battery may explode.

5) **Measurement ranges**
max = 19.99 $\mathrm{mW/m^2}$ (= 19,990 $\mathrm{\mu W/m^2}$)
min = 1999 $\mathrm{\mu W/m^2}$
Scaling differs when applying the optionally available amplifier or damper!

6) Selector switch for **signal evaluation. Standard setting: "Peak hold".** In the peak hold mode you can choose a time setting for the droop rate (Standard = "+"). The peak hold value can be manually reset by pressing (13) "clear".

7) A little bar on the very left of the LCD indicates the unit of the numerical reading:
bar on top = **m**$\mathrm{W/m^2}$ (Milliwatts/$\mathrm{m^2}$)
bar on bottom = **µ**$\mathrm{W/m^2}$ (Microwatts/$\mathrm{m^2}$)

8) DC output, allows you to connect additional instruments, e.g. data logging devices for longterm recordings. Scalable to 1 V DC full scale (scalable to 2 V DC, only for the use of an external display unit).

9) Connecting socket for antenna cable. The antenna is inserted into the cross slot at the front tip of the instrument.

10) Power Level Adapter Switch for external optional amplifier or attenuator only (not part of the standard scope of supply). For regular use of the instrument the switch should be in pos. "0 dB". (Any other position will shift the decimal point to an incorrect position).

11) **ON/OFF switch**. Using the top switch-position activates the audio analysis mode.

12) **Load indicator**

13) Push button to reset peak hold. (Push and hold for 2 seconds or until the readings no longer drop)

14) Switch for choosing the **Video Bandwidth. Standard setting: "VBW Standard"**

Typical default settings of major functions are highlighted in the above text.

Long and short switches

Long switches: Standard functions.

Short switches: In order to avoid unintentional switching for rarely used functions, some of the switches are recessed in the casing of the instrument.

Contents of the package

Instrument

LogPer antenna with SMA-connector

NiMH rechargeable batteries
(inside the meter)

Instructions manual

Getting Started

Connecting the Antenna

Screw the SMA angle connector of the antenna connection into the uppermost right socket of the HF analyser. It is sufficient to tighten the connection with your fingers. (Do not use a wrench or other tools because over tightening may damage the threads).

Normally, the sources of radiation in the frequency range subject to measurement are vertically polarised. Therefore, the antenna should ideally be aligned as shown in the photo below:

Important: Please do not bend or twist either of the antenna cables.

For a horizontal antenna alignment please do not twist the cable itself, but turn the whole measurement device into the right direction. With the help of the LED at the antenna tip you can control the connection of the antenna cable to the device.

Please do not touch the antenna cable during measurement.

Further notes to the antenna

The SMA connection between the antenna and the meter is the highest quality industrial HF connection of this size. Furthermore, the semi-rigid antenna cable implied has excellent parameters for the frequency range in question. It is designed for several hundred bending cycles without causing losses to the quality of the measurements. The special implementation of a second “dummy” antenna cable is the subject matter of one of our pending patents, and compensates the internal weakness of the “simple-log-per-antenna” which is based on conductor plates. These are also sensitive to frequencies below the specified bandwidth, thus possibly falsifying measurements in the principal direction. The antenna supplied with the meter can suppress these disturbances by approx. 15 to 20 dB (in addition to the 40 dB of the internal high pass filter).

Checking Battery Status

If the “Low Batt” indicator appears in the center of the display, measurement values are no longer reliable. In this case, the battery needs to be charged.

If there is no display at all upon switching the analyser on, check the connections of the rechargeable battery. If that does not help try to insert a regular 9 Volt alkaline, (non-rechargeable) battery.

If a non-rechargeable battery is used, do not connect the analyser to a charger / AC-adaptor!

Note

Each time you make a new selection (e.g. switch to another measurement range), the display will systematically overreact for a moment and show higher values which will, however, droop down within a couple of seconds.

The instrument is now ready for use.

In the next chapter you will find the basics for true, accurate HF-measurement.

Introduction to Properties and Measurements of HF Radiation

This instruction manual focuses on those properties that are particularly relevant for measurements in residential settings.

Across the specified frequency range (and beyond), HF radiation causes the following effects in materials exposed to it:

1. Partial Permeation

2. Partial Reflection

3. Partial Absorption.

The proportions of the various effects depend, in particular, on the exposed material, its thickness and the frequency of the HF radiation. Wood, drywall, roofs and windows, for example, are usually rather transparent spots in a house.

Minimum Distance

In order to measure the quantity of HF radiation in the common unit "power density" (W/m²), a certain distance has to be kept from the HF source.

For measurements in the lower frequency limits of the HFW59D, the minimum distance between the antenna tip and the object of measurement should be half a meter.

Polarization

When HF radiation is emitted, it is sent off with a "polarization". In short, the electromagnetic waves propagate either vertically or horizontally. Therefore, both planes of polarization ought to be checked in order to identify the one applying to the object in question. Please note that the antenna supplied with this instrument measures the vertically polarized plane if the upper surface of the meter is held horizontically.

Fluctuations with Regard to Space and Time

Amplification or cancellation effects can occur in certain spots, especially within houses. This is due to reflection and is dependent on the frequencies involved. Furthermore, the transmitting power can be subject to variation or modification during a given day or over longer periods of time.

All the above-mentioned factors affect the measurement technology and especially the measurement procedure. This is why in most cases several measurement sessions are necessary.

Measuring HF Radiation

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.

It is important to repeat **measurements several times**: First, choose different daytimes and weekdays in order not to miss any of the fluctuations, which sometimes can be quite substantial. Second, once in a while, measurements should also be repeated over longer periods of time, since a situation can literally change "overnight".

Even if you only intend to test indoors, it is recommended first to take measurements **in each direction** outside of the building. This will give you an initial awareness of the "HF tightness" of the building and also potential HF sources inside the building (e.g. WLAN access points, also from neighbours).

Furthermore, you should be aware that taking measurements indoors adds another dimension of testing uncertainties to the specified accuracy of the used HF analyser due to the narrowness of indoor spaces. According to the "theory", quantitatively accurate HF measurements are basically only reproducible under so-called "free field conditions", yet we have to measure HF inside buildings because this is the place where we wish to know exposure levels. In order to keep system-immanent measurement uncertainties as low as possible, it is imperative to carefully follow the measurement instructions.

As mentioned earlier in the introduction, even slight changes in the positioning of the HF analyser can already lead to rather substantial fluctuations in measurement values. (This effect is even more prevalent here than in the ELF range). **It is suggested that exposure assessments are based on the maximum value within a locally defined area** even though this particular value might not exactly coincide with a particular point of interest in, for example, the head area of the bed.

The above suggestion is based on the fact that slightest changes within the environment can cause rather major changes in the power density of a locally defined area. The person who performs the HF testing, for example, affects the exact point of the maximum value. It is quite possible to have two different readings within 24 hours at exactly the same spot. The maximum value across a locally defined area, however, usually only changes if the HF sources are subject to change. This is why the latter value is much more representative for the assessment of HF exposure.

Preliminary Notes Concerning the Antenna

The supplied logarithmic-periodic antenna (or aerial), has exceptional **directionality**. Thus it becomes possible to reliably locate or "target" specific emission sources in order to determine their contribution to the total HF radiation level. To know exactly the direction from where a given HF radiation source originates is a fundamental prerequisite for effective shielding.

The readings from the instrument's display always reflect the integral power density at the measurement location coming from the direction the antenna is pointing at (i.e. based on the spatial integral of the "antenna lobe").

The LogPer antenna supplied is optimised for a frequency range of 2.4 to 10 GHz. It covers the frequencies of both WLAN bands, bluetooth, zigbee, various radar frequencies (especially also the densely used frequency band from 8.5 to 9.5 GHz which includes radar for the control and survey of the air and shipping traffic, as well as further frequency bands used commercially or for military purposes, especially for the directional radio. Critical medicals consider these pulsed or spread spectrum modulated signals as biologically especially harmful.

In order to avoid measurement values to be falsified by the often dominant radiation sources from frequencies below, such as DECT or GSM, the HFW59D is equipped with an internal high pass filter at 2.4 GHz, causing these lower frequencies to be suppressed.

Step-by-Step-Instruction to HF-Measurement

Measurements for a Quick Overview

This is helpful to gain insight into the overall situation. Since the actual number values are of secondary interest in this phase, it is usually best to simply follow the audio signals which are proportional to the field strength.

Procedure for the Quick Overview Measurement:

The HF analyser and antenna are to be checked following the instructions under "Getting Started."

First set the measurement range ("Range") switch to "max". Only if the displayed measurement values are persistently below approx. 0.10 mW/m², change to the measurement range "min" (199.9µW/m²).

Set the "Signal" switch to "Peak"

HF radiation exposure can differ at each point and from all directions. Even though the HF field strength of a given space changes far more rapidly than in the lower frequencies, it is neither feasible nor necessary to measure all directions at any given point.

Since there is no need to look at the display during an overview measurement, you only need to listen to the **audio signal**. It is very easy to walk slowly through in-door or outdoor spaces in question. In doing so, constantly move the antenna or the HF analyser with attached antenna in each direction. This will provide you with a quick overview of the situation. In in-door spaces, antenna movements towards the ceiling or the floor will reveal astonishing results.

As already mentioned above, the aim of the quick overview measurement is to identify the zones of local peaks, not to supply exact data.

Quantitative Measurement: Settings

Once the relevant measurement points have been identified following the instructions in the previous section, the quantitative and precise measurements can be started.

Setting: **"Range"**

Select the appropriate switch settings as described under "Quick Overview Measurements": First switch the Range switch to "max". Only switch to "min" if you're constantly shown very low values. Basic rule for measurement range selection:

As coarse as necessary, as fine as possible.

Power densities beyond the designed range of the instrument (display shows "1" on its left side with the range set to "max") can still be measured by inserting the attenuator DG20_G10, available as an optional accessory. By setting the "ext. adapt." switch to 20 dB on your instrument, you will ensure a correct display of the measurement value (i.e. indication of unit and correct decimal point).

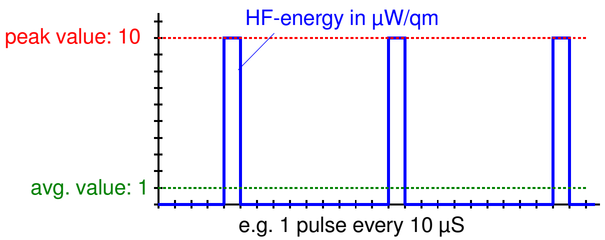
The optional HF preamplifier HV20_2400G10, to be used as plug-in into the antenna input socket, increases the sensitivity by a factor of 100. With the help of this, the meter reaches a theoretical minimum resolution of 0.01 µW/m². The realistic minimum resolution is slightly lower due to the noise margin.

A list of all possible ranges can be found at the end of this brochure.

Setting: **"Signal"**

Peak / RMS

A pulsed signal consists of sections of its time period with high output and another sections with zero output. Their maximum output is the wave peak. The following illustration shows the difference in the evaluation of a pulsed signal if displayed as an average value reading or a peak value reading ("RMS" and "Peak"):



Note: The **peak HF radiation value**, not the average value, is regarded as the measurement of critical "biological effects". The peak value is displayed in the switch setting: "Peak". The average value is displayed in the switch setting: "RMS".

Peak Hold

Many measuring technicians work with the function “Signal” “Peak hold“. In “Peak hold” mode the highest value of the signal within a defined time span can be obtained / “collected”.

In order to obtain accurate readings you must use the small black button on the meter face labeled "clear”. Failure to clear the LCD display screen by pressing this button, for two seconds, will result in inaccurate readings. While this button is pushed and held, the readings are regular "Peak" readings. If any switch settings are changed while measuring, and also in order to start any new "Peak hold" measurement, you must always first hold this "clear" button for some seconds, then release it. This will ensure accurate readings.

In everyday measurement practice this function has great value. The peak value is related to the actual signal situation. This is important because the immission situation can change rapidly with time, direction of the radiation, polarization, and the points of measurements. The “Peak hold” mode guarantees that you do not miss single peaks.

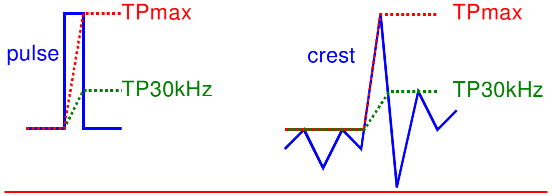
The tone signal works independently of data collection in the peak hold mode. Its sound is proportional to the actual value measured. It helps to identify the location, direction, and polarization of the maximum field strength.

You can chose the (inevitable) droop rate, at which the held peak value decreases over time. Set the switch below the signal evaluation switch (recessed in the casing) to “+” or “-”. In the slow mode it takes about 20 minutes to run out of tolerance, but in order to get an accurate reading the display should be checked frequently. If very short signal peaks occur then the holding capacity of the function needs some recurrences to load fully.

Setting:
VBW Maximum / VBW Standard

VBW stands for “video bandwidth” and is an important classification of the technical capabilities and limits of a high frequency measurement device. It defines the minimum duration of short pulses that still can be measured by the meter without being distorted.

For most signals, select the setting “VBW Standard” (30 kHz). In order to be able to display signals such as radar (“pulse” in the following drawing), or broadband modulated signals such as LTE (4G), or WLAN during data transmission without falsifications, you will need the maximum video bandwidth (2 MHz). The following drawing will explain why:



However, the advantages of the high video bandwith also involve a higher noise level.

Quantitative Measurement: Determination of Total High Frequency Pollution

Hold the HF analyser from its rear side with a **slightly outstretched arm**.

In the area of a **local maximum,** the positioning of the HF analyser should be changed until the highest power density (the most important measurement value) can be located. This can be achieved as follows:

- When **scanning** “all directions“ with the LogPer to locate the direction from which the major HF emission(s) originate, move your wrist right and left. For emission sources behind your back, you have to turn around and place your body behind the HF analyser.
- Through **rotating** the HF analyser around its longitudinal axis, thus taking into account the polarization plane of the HF radiation.
- **Change** the measurement position and avoid measuring exclusively in one spot, because that spot may have local or antenna-specific cancellation effects.

Some manufacturers of field meters propagate the idea that the effective power density should be obtained by taking measurements of all three axes and calculating the result. Most manufacturers of professional testing equipment, however, do not share this view.

In general, it is well accepted that exposure limit comparisons should be based on the maximum value emitted from the direction of the strongest radiation source.

To be on the safe side with exposure limit comparisons, it might be useful to multiply the displayed value by a factor of 4, and take the result as a basis for your comparison. This method is often applied by building biologists in order to avoid to be assuming a far lower exposure than realistically existent should the meter be measuring in the lower tolerance field, taking into account, however, that this may lead to far too high values if the meter was to be measuring in the higher tolerance area.

This factor may appear very high, but is realistic in view of the fact that a factor of 2 is applied when mesuring with professional spectrum analysers.

Quantitative Measurement: Broadband modulated signals such as WLAN during transmission

In many aspects, these signals have similar characteristics as the "white noise" and therefore deserve special consideration. If the acoustic analysis allows detection of such a signal, the setting should be "VBW Maximum". When measuring, the device is to be held in the direction of the radiancy for approx. 1 to 2 minutes. This is important for realistic measurement results, as due to the signal characteristics, you might experience fluctuations by a factor of +/- 3 to 6 within a very short period of time.

Quantitative Measurement: Radar

For air and sea navigation a radar antenna slowly rotates around its own axis, thereby emitting a tightly bundled "radar ray". Even with sufficient signal strength, this ray can only be detected every couple of seconds, for a few milliseconds. This requires special measurement technology.

Please use the following procedure to ensure correct readings:

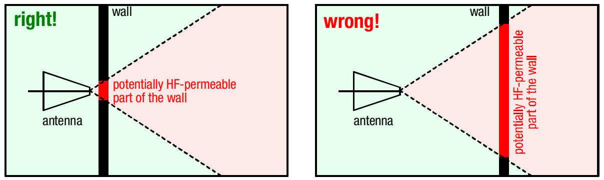
Setting: "VBW Maximum".

Set signal switch to "Peak" to identify the main direction of the source of the signal. Each of the radar pulses is so short that you will only shortly be shown a rather stochastical value.

Set signal switch to "Peak hold" and direct the LogPer antenna towards the signal emitting source. Wait for several circles of the radar ray, move the instrument a little left and right in order to get the relevant quantitative measurement value.

Quantitative Measurement: Identify where the radiation enters a structure

As a first step eliminate sources from within the same room (e.g. WLAN). 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!), ceiling and floor, which are penetrated by the radiation. To do this one should <u>not</u> 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[1]. That is because the antenna lobe widens with increasing frequency. In addition reflections and cancellations inside rooms make it difficult and often impossible to locate the "leaks" accurately. See the illustrating sketch below!



The uncertainty of localization with HF-antennas

The shielding itself should be defined and surveyed by a specialist and in any case the area covered by it should be much larger than the leak.

[1] Please note: In this position the readings on the LCD only indicate relative highs and lows that cannot be interpreted in absolute terms.

Limiting values, reference values, and precautionary values

Precautionary recommendation
for pulsed radiation in sleeping areas

Below 0.1 µW/m²
(SBM 2008: "no concern")

below 1 µW/m² ("for indoors")
(Landessanitätsdirektion Salzburg, Austria)

The official regulations in many countries specify limits far beyond the recommendations of environmentally oriented doctors, "building biologists" and many scientific institutions and also those of other countries. They are vehemently criticised, but they are nonetheless "official". The limits depend on frequencies and in the HF range of interest here they are between 4 and 10 W/m², far beyond 10 million times the recommendations (1 W/m² = 1,000,000 µW/m²). Official limits are determined by the potential heat generation in the human body and consequently measurements of averages rather than peaks. This ignores the state of environmental medicine. The "official" limits are far beyond the range of this instrument, which is optimized for accurate measurement of power densities targeted by the building biologists.

The standard SBM 2008 cited above classifies power densities of below 1 µW/m² as "no anomaly" for non pulsed radiation in sleeping areas, and for pulsed radiation one tenth of that.

Building biology guideline acc.to SBM-2008
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	no concern	**slight** concern	**strong** concern	**extreme** concern
Readings in µW/m²	< 0.1	0.1 - 10	10-1000	> 1000

The "Bund fuer Umwelt und Naturschutz Deutschland e. V." (BUND) proposes 100 µW/m² outside buildings. In view of the shielding properties of normal building materials, far lower values exist inside buildings.

In February 2002 the Medical Authority of the Federal State of Salzburg, Austria, recommends to reduce its "Salzburger Precautionary Recommendation" from 1,000 µW/m² to 1 µW/m² inside buildings and 10 µW/m² outside. These limits are based on empirical evidence over the past few years.

The ECOLOG-Institute in Hanover, Germany made a recommendation only for outside areas, namely 10,000 µW/m². This is well above the recommendation by building biologists and aims at getting consent also from the industry. This would possibly enable a compromise for a more realistic limit than the government regulations cited above. The authors qualify their recommendation in

- The limit should be applicable to the maximum possible emission of the transmitting stations. As the emission measured depends on the constantly varying actual load, this restricts the normal exposure much further.
- A single station should not contribute more than one third to this total.
- The extensive experience and findings of medical and building biology specialists could not be considered for the proposed limits, as their results are not sufficiently documented. The authors state, that "scientific scrutiny of their recommendations is needed urgently".
- Not all effects on and in cells found in their research could be considered for the proposed limits, as their damaging potential could not be established with sufficient certainty.

In summary it confirms the justification of precautionary limits well below the present legal limits.

Audio Frequency Analysis

The audio analysis of the modulated portion of the HF signal helps to **identify the source of a given HF radiation signal**.

First get the HF analyser ready for testing by following the instructions in the relevant section.

How to proceed:

For audio analysis, simply turn the volume knob of the speaker at the top of the case all the way to the left ("-"). If you are switching to audio analysis while high field strength levels prevail, high volumes can be generated quite suddenly. This is especially true for measurements which are to be taken without audio analysis. The knob is not fastened with glue to prevent over winding. However, if by accident you should turn the knob too far, simply turn it back again. No damage will be caused.

Sounds and signals are very difficult to describe in writing. The best way to learn the signals is to approach known HF sources very closely and listen to their specific signal patterns.

The volume can be controlled with the "audio" knob. Note: The power consumption of the speaker is directly proportional to the volume.

There is a selection of audio data samples on our homepage (www.gigahertz-solutions.de) – follow "Mulitmedia" – for you to have a listen to.

Use of Signal Outputs

AC output:

The AC output "PC/head-set", 3.5 mm jack socket, is meant for in-depth analysis of the AM/pulsed content of the signal by headset or a PC-audiocard with the corresponding software.

For PC sound card or headphones or PC software please ask or write us.

DC output (2.5 mm jack socket)**:**

For a (longterm) recording of the display value or for the connection of an external display unit (in our scope of supply; please see contact data at the end of this manual).

When "Full Scale" is displayed, it has 1 VDC output.

The normal auto power off function is automatically deactivated as soon as external devices are connected, and is only automatically reactivated if a total discharge is imminent.

Further Analysis / Optional Accessories:

Available from Gigahertz Solutions:

- **Attenuators:** These can be attached to the HF device and allow an upward extension of the measurement range for strong signal sources.
- **Meters for the low frequencies:** Also for this frequency range, Gigahertz Solutions offers a broad range of professional measurement technology. The new NFA series, for instance, which allows a three-dimensional measurement of alternating electrical and magnetic fields.
- **Data loggers:** All NFA-meters, starting from the NFA30M, can equally be applied as data loggers for long-term recordings with our HF analysers (only those with DC output).

Battery Management

The instrument comes with a rechargeable, high quality internal NiMH-Battery. The quality of these high-capacity NiMH batteries (far better than NiCd batteries, for instance) can be best maintained if they are almost totally discharged (i.e. used) before being fully recharged (until the green charging LED turns off).

Changing the rechargeable Battery

The battery compartment is at the back of the analyser. To remove the lid, press on the grooved arrow and pull the cap off. **Insert only rechargeable batteries. If you use regular alkaline (non – rechargeable) batteries do <u>not</u> use a charger or AC-adapter!**

Auto-Power-Off

This function conserves energy and extends the total operating time.

1. In case you have forgotten to turn OFF the HF analyser or it has been turned ON accidentally during transport, it will shut off automatically after 40 minutes.
2. If "low batt" appears vertically between the digits in the center of the display, the HF analyser will turn OFF after 3 min in order to avoid unreliable measurements. In that case charge the rechargeable battery.
3. The built-in function, Auto-Power-Off, will automatically be de-activated by plugging in a 2.5 mm DC. The function will also automatically be re-activated to

prevent a total discharge of the battery by further operation.

Mains operation

The HF analyser can also be supplied with power by using the mains adapter (for instance for long-term measurements). When doing so, please take care to turn the volume button right down to zero ("-"), otherwise you will be hearing the 50 Hertz noise of the mains voltage.

Remediation and Shielding

Please call us or send us an e-mail.

We will assist you in any shielding project you might have.

Any professionally implemented shielding solution will be of proven effect. There is a large selection of shielding possibilities, and an individually fitted solution is definitely recommendable.

The shielding effect of the various materials is normally stated in "- dB", e.g. "- 20 dB".

Conversion of shielding effect into reduction of power density

„-10dB" is measured value divided by 10
"-15dB" is measured value divided by ~30
"-20dB" is measured value divided by 100
"-25dV" is measured value divided by ~300
"-30dB" is measured value divided by 1000
etc.

Please be aware of the manufacturer's notes about the normally achievable shielding effects, as 100% shielding is almost always impossible. Partial shielding reduces the attenuation considerably. That is why shielding of seemingly radiation tight adjacent areas is highly recommended.

Warranty

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

Antenna

The antenna is made of a highly durable FR4 based material that can easily withstand a fall from table height. The luminous diodes at the antenna tip serve as additional proof of functionality, as they signalise a continous contact of all antenna elements while the meter is switched on. Any mechanical damage will cause either one or even both diodes to go out. The warranty will cover any damages caused by falls, should this ever occur.

HF Analyser

The analyser itself is not impact proof, due to the comparatively heavy battery and the large number of wired components.

Any damage as a result of misuse is excluded from this warranty.

Measurement ranges of the HFW59D

Range	Bar on LCD	**Instrument as delivered,** i.e. without preamplifier or attenuator ("ext. adapt." to "0 dB") **Displayed** value & unit
max		0.01 - 19.99 **m**W/m²
min		1 - 1999 **µ**W/m²
Simply read out, no correction factor		

Range	Bar on LCD	**With ext. Attenuator DG20,** ("ext. adapt." to "-20 dB") **Displayed** value & unit
max		1 - 1999 **m**W/m²
min		0.1 - 19.99 **m**W/m²
Simply read out, no correction factor		

Range	Bar on LCD	**With ext. Preamplifier HV20,** ("ext. adapt." to "+20 dB") **Displayed** value & unit
max		0.1 - 199.9 **µ**W/m²
min		0.01 - 19.99 **µ**W/m²
Simply read out, no correction factor		

DRU0197

Conversion Table W/m² and V/m

nW/m²	**µW/m²**	**mW/m²**	**W/m²**	**mV/m**	**V/m**
0,01	0,00001	0,00000001	0,00000000001	0,0614	0,0000614
0,1	0,0001	0,0000001	0,0000000001	0,194	0,000194
1	0,001	0,000001	0,000000001	0,614	0,000614
10	0,01	0,00001	0,00000001	1,94	0,00194
100	0,1	0,0001	0,0000001	6,14	0,00614
1.000	1	0,001	0,000001	19,4	0,0194
10.000	10	0,01	0,00001	61,4	0,0614
100.000	100	0,1	0,0001	194	0,194
1.000.000	1.000	1	0,001	614	0,614
10.000.000	10.000	10	0,01	1.940	1,94
100.000.000	100.000	100	0,1	6.140	6,14
1000.000.000	1.000.000	1.000	1	19.400	19,4
10.000.000.000	10.000.000	10.000	10	61.400	61,4

mV/m and V/m – figures are rounded!

Why no column „dBm"?

Most recommended limiting values for HF radiation are given in W/m² (sometimes also in V/m), which is why this instrument is displaying in power density, µW/m² resp. mW/m². A display in dBm as e.g. on a spectrum analyser requires transformation by a complicated formula, which depends on frequency and specifics of the antenna used. A "reconversion" therefore does not make sense.

Conversion Table

(µW/m² to V/m)

µW/m²	mV/m	µW/m²	mV/m	µW/m²	mV/m
0.01	**1.94**	**1.0**	**19.4**	**100**	**194**
-	**-**	**1.2**	**21.3**	**120**	**213**
-	**-**	**1.4**	**23.0**	**140**	**230**
-	**-**	**1.6**	**24.6**	**160**	**246**
-	**-**	**1.8**	**26.0**	**180**	**261**
0.02	**2.75**	**2.0**	**27.5**	**200**	**275**
-	**-**	**2.5**	**30.7**	**250**	**307**
0.03	**3.36**	**3.0**	**33.6**	**300**	**336**
-	**-**	**3.5**	**36.3**	**350**	**363**
0.04	**3.88**	**4.0**	**38.8**	**400**	**388**
0.05	**4.34**	**5.0**	**43.4**	**500**	**434**
0.06	**4.76**	**6.0**	**47.6**	**600**	**476**
0.07	**5.14**	**7.0**	**51.4**	**700**	**514**
0.08	**5.49**	**8.0**	**54.9**	**800**	**549**
0.09	**5.82**	**9.0**	**58.2**	**900**	**582**
0.10	**6.14**	**10.0**	**61.4**	**1000**	**614**
0.12	**6.73**	**12.0**	**67.3**	**1200**	**673**
0.14	**7.26**	**14.0**	**72.6**	**1400**	**726**
0.16	**7.77**	**16.0**	**77.7**	**1600**	**777**
0.18	**8.24**	**18.0**	**82.4**	**1800**	**824**
0.20	**8.68**	**20.0**	**86.8**	**2000**	**868**
0.25	**9.71**	**25.0**	**97.1**	**2500**	**971**
0.30	**10.6**	**30.0**	**106**	**3000**	**1063**
0.35	**11.5**	**35.0**	**115**	**3500**	**1149**
0.40	**12.3**	**40.0**	**123**	**4000**	**1228**
0.50	**13.7**	**50.0**	**137**	**5000**	**1373**
0.60	**15.0**	**60.0**	**150**	**6000**	**1504**
0.70	**16.2**	**70.0**	**162**	**7000**	**1624**
0.80	**17.4**	**80.0**	**174**	**8000**	**1737**
0.90	**18.4**	**90.0**	**184**	**9000**	**1842**