How to Measure EMF

by Andrew Eriksen, MS

Instruments for measuring electromagnetic fields (EMFs)
Left to Right: upgraded Trifield gaussmeter, AM radio, HF Detektor

Electromagnetic fields (EMF) are invisible, but exist everywhere on Earth. To find them, we use instruments.

There are many types of EMF and no single instrument can measure them all. This article explains what frequencies are and presents three low-cost instruments, each of which measures some forms of EMF. It is necessary to use all three types of instruments to get a more complete picture of the EMF in a particular place. After that, the question of how much EMF is acceptable is looked into, together with where to check for EMF.

Frequency ranges

EMF radiation is mainly characterized by its frequency and its strength. [1]

The frequency is measured in the unit hertz, which means “cycles per second”. Most people are familiar with hertz from radios--if an FM station advertises that

people can find them at "97.9 on the dial," that means they broadcast on the frequency of 97.9 mega hertz (or 97,900,000 hertz). The EMF transmitted by this station is received by radios and turned into music and speech. However, an FM radio is not good at telling us how strong the signal is, or what goes on across the dial at the same time.

An electrical wire in a house also broadcasts a signal, though much weaker than a radio station. Here it sends out the frequency 60 hertz (50 hertz in some countries), which an FM radio cannot pick up, but a gauss meter can. The gauss meter, in turn, is completely blind to a radio signal, or to most of the radiation coming from a computer, for instance.

All sorts of electronic devices broadcast at different frequencies; most do it on many frequencies at the same time.

For a person who is sensitive to EMF, it is important to know the full picture if trying to minimize exposures to EMF.

The figure on page three gives an overview of the frequency bands, and roughly which of them are measurable by which instrument. In practice, there is some overlap.

The gauss meter

The gauss meter measures the strength of the low-frequency EMF radiation, like that coming from electrical wires (50 or 60 hertz). The better models can also show some higher frequencies (thousands of hertz, kilo hertz), which come from some electronic appliances, such as power supplies.

In North America, a gauss meter measures the strength of the radiation in the unit milligauss. In other countries, microtesla is used. (1 microtesla = 10 milligauss).

Cheaper gauss meters are usually only able to show EMF levels down to about one milligauss (0.1 microtesla). That is barely acceptable for healthy people, and inadequate for people sensitive to EMF. People who are sensitive to EMF are often affected by levels below 0.1 milligauss, sometimes even below 0.01 milligauss (0.001 microtesla, 1 nanotesla).

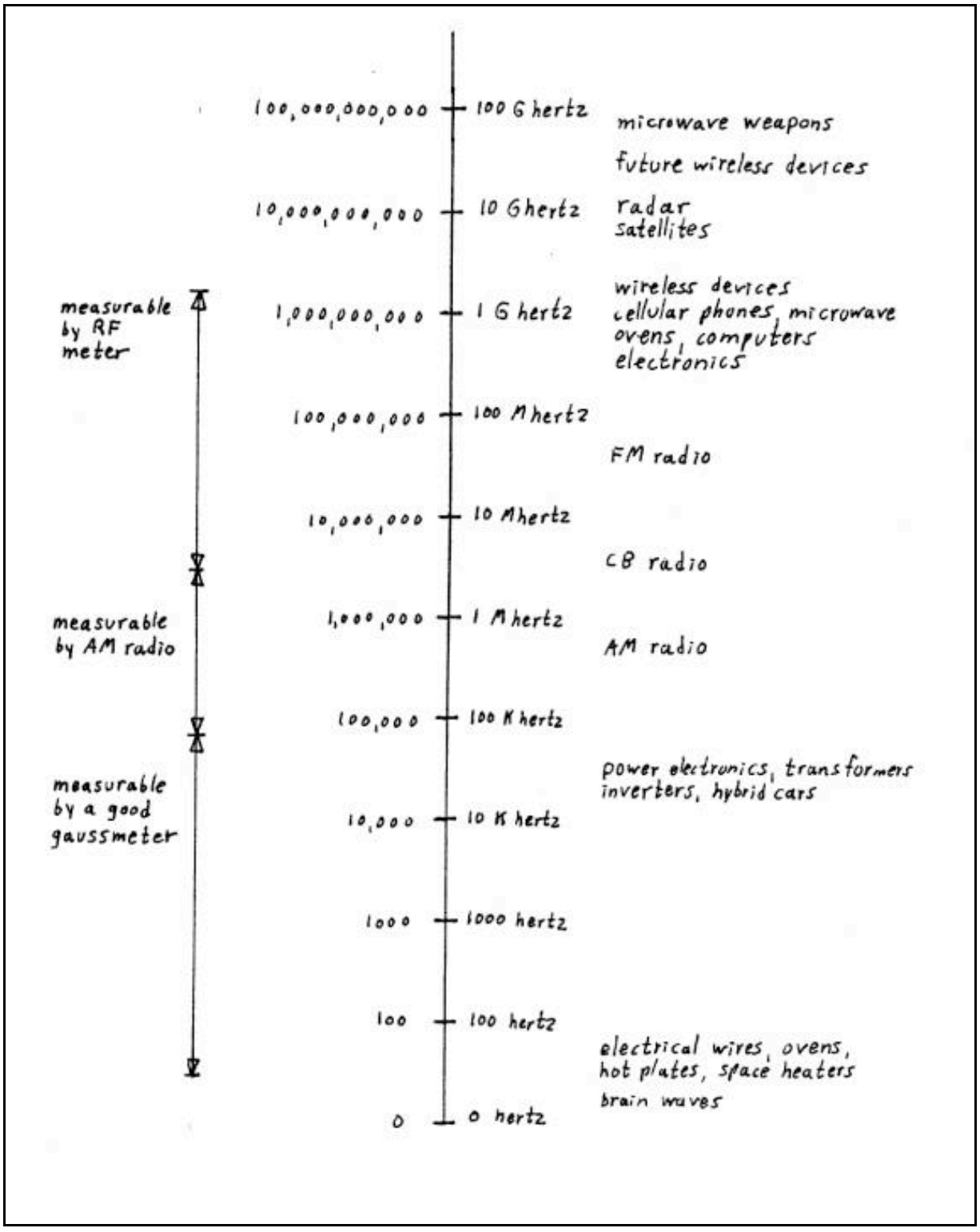

Figure 1: Frequency bands and frequency ranges measured by three different instruments.

A good cost-effective gaussmeter is the TriField meter from Alpha Labs, which is available from several mail-order sources, such as NEEDS and Less EMF (see vendor list).

The TriField meter can measure down to 0.2 milligauss and does not contain any digital electronics, so it is tolerable to use, even by the most sensitive people. It has three built-in sensors, so it automatically measures in all three dimensions. Most cheaper models have only one sensor and must be turned around to find the highest reading. This instrument can also measure electrical fields and radio waves, but it is not sensitive enough on those settings to be of any value.

For a general survey of an area, simply walk around with the meter in hand and notice what the levels are.

Areas where much time is spent, such as the bed, the favorite chair and the dining and computer areas should be checked more thoroughly. In these places of longer exposure times, it is important to check for EMF where all the body parts will be, both the feet, the head, and in between. The field can be much stronger on the floor than higher up--either because of wires under the floor, or perhaps from electronic equipment placed on the floor.

The human body appears to pick up EMF in all body parts, but some areas, such as the head, may be more sensitive.

Other places to check with a gauss meter are near the circuit breakers and the electrical meter, space heaters, electric stoves and water heater, and various electronic equipment--including those little plug-in transformers. And remember to check on the other side of the wall from an electrical device. Finally, check the car with the engine running, especially the dash board and the foot well.

TriField meter with upgrade

By request from the community of electrically sensitive people, Alpha Labs designed an upgrade to their TriField meter, that makes it 100 times as sensitive. This allows it to measure down to 0.002 milligauss (2 microgauss, 0.2 nanotesla).

This upgrade is only available directly from Alpha Labs, which also sells enhanced meters directly. The upgrade costs about $70 and requires the meter to be mailed to Alpha Labs. Call first (see below). There are no other meters available in this price range with this level of sensitivity.

The upgraded TriField meter is shown in the picture. The wand is an external probe, which does the measuring when plugged in. When not plugged in, the meter works with the standard sensitivity.

With the probe plugged in, the scale on the meter must be divided by 100 when read. For instance, if the instrument knob is turned to "MAGNETIC 0-3 range)" and the dial shows "1" on the middle scale, it is actually 0.01 milligauss. If it shows "0.6", that means 0.006 milligauss (which is also 6 micro gauss).

If the knob is set at "MAGNETIC (0-100 range)" and the dial points to "4" on the top scale, that means the EMF level is 0.04 milligauss (or 40 micro gauss).

The external probe is a wand 11 inches long. To save money and space, it measures only in one direction. To get an accurate measurement, it is necessary to perform three measurements at each location.

To measure with the wand, first place the wand horizontally and read off the number, once the needle has stabilized. It may be best to remove your hands from the wand, as any slight movement affects the reading. Then turn the wand ninety degrees in either direction and do another reading.

Finally, stand the wand vertically and do a third reading. The highest reading is the correct measurement for this location.[2]

One of the things this very sensitive wand can pick up is ground currents, which is electricity which runs in the soil. Some people refer to ground currents as "stray voltage" or "stray currents". Ground currents typically come from grounding rods on electrical power poles, transformers and in buildings. They can be found hundreds of yards away from any human structure.

Large power lines can sometimes be picked up more than a mile away, in very rural areas.

When measuring ground currents, the reading will be the same whether the probe is lying on the ground, or is several feet above it. The EMF-level does not rapidly diminish with distance, as it does with a point source.

The AM radio

To get an idea of what EMF lurks in the middle range of frequencies, a simple AM radio can be used. It does not provide a reading on a dial, but instead it allows one to hear EMF emissions from electronic equipment, electrical motors, arcing wires, GFCI relays and much more, most of which a gauss meter cannot pick up.

A cheap AM radio is best, as more sophisticated models have circuitry to suppress static--and static is what we want to pick up. Radios with digital controls are unlikely to be useful here. A simple, cheap battery-powered hand held radio is a good choice. (I use a Radio Shack model 12-467, which costs about $20.)

Simply turn on the radio and set the dial in an area where the least amount of noise is heard, and where there is nothing received from any station. In my area, the top and bottom of the dial range works very well. Then walk around and put the radio close to electrical outlets in the wall, exposed wires, fluorescent lights, telephone cords, any electronic equipment, GFCI-protected outlets in the bathroom and kitchen, and so forth.

The radio will only pick up static when it is close to the source in most cases. Humans may be more sensitive than the radio and need to keep a greater distance.

Try to move the station dial to another place and check around again. Some equipment may sound differently or louder on a different setting.

If the speaker is put against a wall or some equipment, the sound coming from it may be reflected back and sound louder than it is, so you may think there is an EMF problem where there isn't. It is thus best to hold the radio so the speaker is pointed towards you and away from the item being checked.

Metallic surfaces act like antennas. When the AM radio is held near a metallic surface, it may pick up a far-away radio station. When touching metal, crackles may be heard. This is normal and does not mean there is a problem. The metal doesn't somehow gather and enhance the EMF that was already there; it merely reflects and channels it.

Radio frequency meter

In the high-frequency bands we encounter a soup of EMF from near and far. High frequency EMF reaches further than low-frequency EMF. In our own homes, there may be cordless phones, microwave oven, computers and wireless networks. Some of these emissions can also come in from neighboring buildings. From afar, transmission towers of many kinds contribute to the overall level of electro-smog.

Today, there are virtually no areas free from radio frequency radiation. The question is only how much there is.

A great number of instruments are available to warn us about radio frequency EMF, from simple pocket-devices that beep when the level rises, to instruments

one can point towards a source and it will display what frequencies are being transmitted on.

A compromise on cost and sensitivity that I myself use is the HF-Detektor from the German company Aaronia. It costs about $150 and is very sensitive for the price. One has to go to a very remote area for it not to pick up anything.

It is a little more complicated to use than the TriField gauss meter, so it is not for people who are uncomfortable with any sort of electronics. It contains a microprocessor and is uncomfortable to handle for some electro sensitives, but with experience, a measurement can be done in 5 seconds.
The instrument comes in a stylish design, but it needs to be redesigned, because the antenna breaks off easily and the output is hard to read in sunlight.

Reading the manual is essential for being able to use this instrument. It gives readings in decibel, which can be converted into watt-per-square-meter, using a table. The unit milligauss is meaningless for these frequencies.

Things to try

With these tools in hand, it is like being outfitted with a new set of ears. Here is a list of things to try to measure. When measuring, notice how the reading is higher close up, and how it diminishes rapidly with a little distance, and notice how the different instruments react.

- Computer, screen and keyboard
- Wrist watch
- Electronic thermostat and thermometer
- Fluorescent light, low-energy light
- Microwave oven
- Refrigerator, freezer,
- Electric water heater
- Cordless phone, mobile phone
- Outlets with GFI/GFCI protection
- Electric fence
- Car, car electronics
- Electric power lines
- Night stand clock
- Wireless network equipment

Tips on measuring EMF

The levels of EMF may change over time, when measuring power lines or the ambient level. Try to measure on different times of the day, and on both weekdays and weekends.

Some EMF is seasonal. A big power line may give a much higher reading on hot summer afternoons, when everybody runs their air conditioners. Or, the neighbors next door may only generate EMF when they are home and doing certain things.

Some equipment will broadcast on many frequencies. One example is a hairdryer: the heating element will emit EMF on 50 or 60 hertz, while the blower motor will broadcast across many frequencies.

A computer consists of many parts inside the box and the screen. All parts may generate a multitude of frequencies. There will be a number of transformers inside, which generate the different voltages needed by various parts in the computer. Each transformer emits EMF in the low kilo hertz range. The processor chip itself will emit EMF around a few gigahertz (the advertised speed is the frequency of the processor). There are many other components inside the computer case, such as disk controller, network card, etc., which will run (and thus emit EMF) in the megahertz range.

The screen and the cable going to it will have their own set of emitted frequencies.

It is actually possible to tune in to a computer, using special equipment. It is then possible to read what is on the screen, right through walls of a building. Intelligence agencies and spies have used this method for decades.

How much EMF is too much?

What levels of EMF are acceptable? That is a good question, with no firm answers. Nobody knows for sure, and it also depends on whether it is continuous exposure--perhaps round the clock--or just for shorter periods of time, like in a car. Some people also think that exposures during sleep should be lower than what is acceptable during the day. And then it also depends on whether the person is healthy or electrically hypersensitive.

The official standards for how much EMF radiation is allowed are in the United States based solely on the heating effect on body tissues--the “microwave oven effect”. Any other effects were completely unknown when the standard was set decades ago. Most other countries then simply copied the US standard. All these standards are nearly worthless.

Among health practitioners and some researchers, there is an unofficial consensus that low-frequency EMF should be kept under the 1-4 milligauss range. This is for ongoing exposures for a healthy person.

For people who are hypersensitive to EMF, the 1-to-4 milligauss range is not low enough. It is up to the individual to find out what is. Some people do fine with 0.1 milligauss, some need less than 0.01 milligauss.

For the middle frequencies--those picked up by an AM radio--the best advice is to avoid places where any static is picked up--especially for the sleeping area.

For radio frequencies, the standards are all over the place, and are again based on the heating effect of body tissues. These standards are published in the unit watt-per-square-meter (W/m2) or microwatt-per-square-centimeter (uW/cm2, 100 uW/cm2 = 1 W/m2). A list of the standards for several countries are published in the June 2002 issue of the "No Place to Hide" journal (no longer published).

Most countries, including Australia, Canada, Japan, the United States and most of Europe have standards limiting the radiation to 2 to 10 W/m2 (200 to 1000 uW/cm2). Great Britain allows up to 100 W/m2. A number of countries, like Russia, China and several European countries limit the exposure to 0.1 W/m2. A few local rules are much stricter. The most strict is New South Wales, Australia, which only allows 0.000,01 W/m2 (10 uW/m2). New South Wales is the most populous state in Australia and includes the Sydney metropolis. The New South Wales standard is not as outlandish as it may seem; it is the other standards that are outlandishly high.

Ambient levels of high-frequency EMF will rarely get near even the New South Wales (NSW) standard, even in a big city. But being within a few feet of a wireless network hub, or a roof-mounted cell-phone transmitter, probably would. In the country, where the cell-towers cover a larger area and thus have a higher signal strength, this standard may be exceed when close to the tower.

There is no consensus on at what level people who are hypersensitive to tower-emissions are safe. Some sensitive people suggest 1/10 of the NSW standard (0.000,001 W/m2, 1 uW/m2), others prefer even lower.

Vendors

Alpha Labs
1280 South 300 West Street
Salt Lake City, UT 84101

USA
Phone: 1-801-487-9492

Aaronia AG
D-54597 Euscheid
Germany
www.electrosmog.de

Less EMF Inc.
809 Madison Avenue
Albany, NY 12208
USA
Phone: 1-888-LESS-EMF / 1-518-432-1550
www.lessemf.com

NEEDS
P.O. Box 580
E. Syracuse, NY 13057
USA
Phone: 1-800-634-1380
www.needs.com

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[1] Other characteristics include the shape of the signal (sinus wave, square wave, irregular, etc.), whether it is continuous or pulsed, and many other factors.

[2] The more precise number is the geometric sum of the three readings, but such accuracy is not needed, and the instrument is not that accurate anyway. If the three readings were 2,3, and 10, the more correct number is the square root of (2 x 2) + (3 x 3) + (10 x 10) = 10.6.