How to measure the EMF in a house

This article provides detailed instructions on how to do simple EMF measurements of a home. This is suitable for evaluating the home you are presently living in, or one you are considering renting or buying.

Keywords: How to measure EMF, how to measure RF, how to measure dirty electricity, house EMF evaluation, healthy house, measure electromagnetic fields

Introduction

A good electrical environment is an important factor for health. Some people may wish to avoid possible long-term health effects, while others are very sensitive to electromagnetic fields (EMF) and must live in a low-EMF environment.

There are many kinds of EMF, such as radio-frequency, low-frequency magnetic, electrical fields, dirty electricity, etc. They are all important. Some people are more sensitive to a particular kind. Several instruments are needed to measure the various types of EMF, though three or four instruments will cover the most important types.

This article provides detailed instructions for do-it-yourself measurements.

Buying the instruments

You will need up to four instruments: a gaussmeter, an RF meter, an AM radio and a meter for dirty electricity.

The gaussmeter measures low-frequency magnetic radiation, which comes from power lines, household wiring, ground currents and various appliances. Many low-cost models are not sensitive enough. Get one that can show at least 0.1 milligauss (10 nanotesla). If you are electrically sensitive you'll need one that can display 0.01 milligauss (1 nanotesla) or lower.

It is best to get a three-axis (isotropic) instrument. A single-axis instrument requires three times as many measurements, and you may miss the important one.

A suitable gaussmeter will typically cost below $200.

A radio-frequency (RF) meter measures radiation from cell towers, wireless computer networks (Wi-Fi/WLAN), cell phones, cordless phones, baby monitors, smart meters, etc. The typical RF meter does not measure the lower RF

frequencies, such as shortwave radios, AM radio broadcasters, coastal radios, etc. Nor do they pick up the various types of radar.

Make sure the RF meter can detect radiation levels below 0.1 microwatt/m^2 ($\mu W/m^2$, 0.0001 $\mu W/cm^2$). Some RF meters can use other units, such as V/m, dBm, and A/m.

The meter should have a 3-axis (isotropic) antenna.

Such an instrument should cost within $200.

An AM radio can be used to detect dirty electricity and lower radio frequencies, such as emitted by energy-efficient lights, computers, televisions and many kinds of electronic equipment.

It is a simple low-cost tool that is easy to use. The best choice is a simple hand-held battery powered model that does *not* have digital tuning. These are available for about $15.

An AM radio is a crude instrument, as it does not give a number to compare with, but it is a very practical tool.

The Stetzer meter is superior to the AM radio for investigating most cases of dirty electricity. It has a digital scale that makes it easy to compare results, but it only measures the types of dirty electricity that can be fixed by the Stetzer filters (sold by the same vendor). This meter does not detect other kinds of dirty electricity, such as from some PLC smart meters and Broadband over Power Lines systems.

The Stetzer meter costs about $100.

Measuring the ambient EMF

Start by measuring the ambient EMF levels around the house. This is the EMF environment the house sits in. It consists of radiation from power lines, ground currents, cell towers, radio towers, neighbors' wireless gadgets, smart meters, etc. This is the baseline for the house. It is difficult, sometimes impossible, to create an indoor environment much below this baseline.

The following steps should provide you with good measurements of the ambient levels. It is essential that all the steps are followed, to ensure good readings.

1. Turn off all electricity to the house on the master breaker panel. There may be a single master breaker, or you'll have to turn off every breaker separately.

2. Use a gaussmeter, set on the most sensitive MAGNETIC range

3. Walk around the outside of the house with the instrument in your hand. Stop every 10 to 20 ft (3 to 6 m) and at least 6 ft (2 m) from the wall. Make a reading while standing still, as any movement can affect the result. Write down the numbers on a simple diagram of the house.

   If your gaussmeter is very sensitive, any slight movement of your hand will affect the reading. You may need to rest the meter on the ground for accurate readings.

   You may pick up the electrical cable to the house and perhaps also stray currents running on metal pipes or in the soil. The lowest readings will be the ambient level, which may vary with the time of the day, and the weather.

   The ambient level is typically 0.1 to 0.5 milligauss (10-50 nanotesla) in suburbia. In rural areas, they are typically in the 0.01 to 0.1 milligauss (1-10 nanotesla) range, but can be much lower.

4. Turn on the RF meter, set it on the microwatt/m2 (μW/m2) scale, if possible.

5. Walk around the outside of the house, at least 10 ft (3 meters) from any wall or structure. Measure on all sides of the house. Do the measurement for a minute each place and record the average number.

6. Turn the breakers back on again (as you originally found them), or proceed to do indoor measurements.

The RF meter should give you the averaged ambient radiation levels from communication systems. In a dense neighborhood, these readings can fluctuate dramatically, both from minute to minute and hour to hour. If you get dramatically different readings around the house, it may simply be because the overall level fluctuates, not that one side of the house is more “hot” than another. Try to walk around the house a second time to see.

The readings can depend on whether it is a weekday or weekend, and which part of the day it is.

Indoor baseline measurements

The following measurements will show the baseline radiation levels inside the house. That is how low the house levels are, without any electrical equipment turned on. It is essential that the breakers are turned off for this test.

1. Turn off the master breaker, or all the individual breakers for the entire building.

2. Use a gaussmeter, set on the most sensitive MAGNETIC range.

3. Walk around the house with the meter and do readings in every room. Make detailed readings in places where you will spend a lot of time, such as:

   - bed
   - kitchen
   - home office

4. Place the instrument on various metal pipes, such as:

   - by the water heater
   - incoming water line
   - incoming district heating line
   - incoming gas line

   There should be no elevated fields here.

5. Put the meter up against the electrical wires around the breaker panel. There should be no elevated fields here, except for the electrical meter and any specialty breakers or filters installed.

If the house has no major wiring errors or stray currents, the measured levels should be about the same throughout the house, and similar to the ambient outside levels.

Elevated levels inside the house can often be fixed, but you'll probably need the help of a specialist to locate and fix the problems.

A typical American house does not provide any shielding against radio-frequency radiation from the outside. It passes unhindered through thin walls of wood, drywall, glass and plastic. If you use your RF meter, the inside levels should be similar to the outside for such a house.

A house with metal siding or thick walls of stone, brick, concrete, adobe or logs, can provide some shielding. So can a basement located below ground level. Windows with a metallic film (tinted or low-E glass) also help.

Indoor "live" measurements

1. Turn on the breakers again, so the house is electrically "alive".

   If you are evaluating the house to buy or rent, it is better just to turn on the breakers for the fixed appliances, i.e. the water heater, stove, refrigerator, etc. Leave all other circuits off, as the gadgets powered by them are not relevant if they are not yours.

2. Turn on the lights and whatever else is relevant.

3. Measure the house again with the gaussmeter, as in the previous section ("Indoor baseline measurements"). Be aware that some appliances cycle on and off, so their readings change over time.

4. Measure the house with the RF meter. If the house has various wireless gadgets, the readings can be higher. Some gadgets only transmit intermittently.

5. Turn on the portable AM radio.

   - make sure it is set to AM, not FM
   - turn the dial to the lowest setting (near 530 kHz), where only light static is heard (i.e. no talk or music)
   - hold the radio with the speaker facing you

6. Hold the AM radio up against any kind of electronic device in the house, such as:

   - low-energy light bulbs
   - television
   - computer
   - printer
   - network equipment
   - plug-in power supplies
   - clocks
   - electronic control panel on stove
   - digital camera

- wrist watch

Most of these devices will make the AM radio buzz, as it receives the radiation. People who are hypersensitive to these frequencies are affected at a greater distance than the AM radio can detect the radiation.

Dirty electricity from the outside

Dirty electricity consists of unwanted frequencies, which travel on the electrical system, i.e. the power lines along the street, the household wiring and the ground currents. Most dirty electricity is frequencies in the kilohertz range, but dirty electricity can contain any frequency, from single digit hertz and up into the megahertz range. The following methods only work for the kilohertz and low megahertz range, which is the most common range.

1. Turn off all breakers for the house.

2. Turn on your AM radio. Make sure:

   - it is set for AM, not FM
   - the dial is on the low end of the scale
   - there is only static, not music or talk

3. Turn the radio so the speaker faces you. Then hold the AM radio up against the electrical line going into the house, if possible. Listen for increased static or buzzing sounds.

4. Hold the AM radio up against the breakers. Be aware that digital electrical meters, AFCI breakers and other nearby electronics may cause the sounds, instead of dirty electricity.

5. Move the dial to the other end of the scale (around 1700 kHz), to a place where only light static can be heard.

6. With the speaker facing you, hold the AM radio up against the electrical line to the house, and the breakers. Again listen for increased static or buzzing noise.

If you hear increased static or buzzing, there is probably dirty electricity on the wiring. Since the house is turned off, the dirty electricity is coming from either the electrical meter or your neighbors.

Some electrical meters communicate by sending out dirty electricity, instead of wireless signals. These are called PLC meters.

If you have a Stetzer meter, continue with these steps:

5. Find an electrical outlet which is on a circuit that serves no other equipment. Make sure there are no GFCI/GFI outlets on this circuit (common in bathrooms and kitchens), and no AFCI breaker (bedroom circuits in houses built after 2007).

6. Turn on the breaker for this outlet, and leave all other breakers off.

7. Plug the Stetzer meter into this outlet. It should show the level of kilohertz dirty electricity coming from the outside or from the electrical meter.

Dirty electricity inside the house

If there is a lot of dirty electricity coming into the house, it will be difficult to locate inside sources. If you are measuring a house someone else lives in, it may not make sense to measure the inside dirty electricity, as it will mostly come from equipment they will take with them when they move.

To locate sources inside the house:

1. Turn off all breakers to the house.

2. Plug a Stetzer meter into any wall outlet.

3. Turn on one breaker at a time, until the Stetzer meter goes on. Leave all other breakers off.

4. The Stetzer meter will display the dirty electricity generated on that circuit (plus what comes in from the outside).

5. Continue with all other circuits in the house, still having just one breaker on at a time.

This should identify what sources generate the dirty electricity in the house. Then proceed to mitigate or eliminate those sources. The most effective method is to turn off the offending device — use a power strip if necessary to truly turn it off. Filtering should only be the second choice, as it has a spotty record for effectiveness and can make things worse.

What is an acceptable radiation level?

The official radiation limits set by FCC, ICNIRP and IEEE are all totally outdated and nearly worthless. These are all organizations that have strong industry connections, and their focus is not the public health.

The 2007 BioInitiative report was the first attempt at setting limits based on current knowledge. They set the limits to:

1 milligauss (0.1 nanotesla)
1000 $\mu W/m^2$ (0.1 $\mu W/cm^2$)

They stated that these levels may be too high for people with EHS.

The 2012 BioInitiative report cited much new science, which found that the limits should be around

1 milligauss (0.1 nanotesla)
30 $\mu W/m^2$ (0.003 $\mu W/cm^2$)

This may still be too high for people with EHS.

Many people with severe EHS live happily at these levels:

0.01 milligauss (1 nanotesla)
5 $\mu W/m^2$ (0.0005 $\mu W/cm^2$)

Very few people need lower levels. In rural areas of the American west, miles from any tower and electrical service, one can find levels below

0.001 milligauss (0.1 nanotesla)
0.5 $\mu W/m^2$ (0.00005 $\mu W/cm^2$)

Deep forests may presumably also provide such low levels, though it has not been verified by this author.

It may be there simply is no fully safe level for EMF, just as there isn't for radioactivity and various heavy metals. An "acceptable" level will then have to be chosen.

The Stetzer meter comes with the suggestion that a reading of less than 25 Graham-Stetzer (GS) units is "good," and above 50 is "undesirable." Very little science is available to support these specific numbers, however. The science on

the health impacts of dirty electricity, and what levels are "safe," is still in the embryonic stage.

Beware of the limitations

These methods described here are simplified and use simple low-cost instruments. They do not adequately measure:

- electrical fields
- pulsed signals
- short wave, AM, radar and certain other transmitters
- low frequency and very high frequency dirty electricity
- other types of signals

Even professionals, with better equipment, may not be able to detect all the kinds of EMF present. The various health standards do not address these issues well, either.

A house can show up fine on all the measurements, but a sensitive person may still not be able to live there. The instruments are only a help to locate problems, and as an initial survey. The best instrument will always be the sensitive person who is living there, if her health is stable enough to tell the difference. Some people are in such poor condition that they will feel poorly, even in the safest home.

It is best to spend a night, or a week, in a house you are considering buying, if you are electrically sensitive. People with EHS are often the most sensitive at night.

For more information

We recommend the article *How to Measure EMF* (www.eiwellspring.org/HowToMeasureEMF.htm) for more information on how to use the instruments and what the different types of EMF are.

Our website, www.eiwellspring.org, has several other articles on low-EMF housing, EMF mitigation, etc.