Radiofrequency Protection for You and Your Family

This article is separated into 6 sections, each of which can be individually downloaded. It is a 'work in progress' incorporating new information whenever time permits.

Section 4

Measuring exposure, screening and protection

1. Introduction; health effects associated with RF radiation; TV and radio; mobile phone masts or base stations; graphs showing change of symptoms experienced according to RF exposure levels; other sources of RF radiation

2. Sources outside the home; mobile phone masts (base stations); Televisions and TV transmitters; WiFi; interactive whiteboards in classrooms; kindergartens; hospitals; wLANs in offices; railway stations; rubbish tagging; transport; internet cafés; WiMAX; street lighting; bus stops; radar; amateur radio enthusiasts; local radio communication services; local broadband services; military equipment; police surveillance

3. Sources inside the home; mobile phones; digital cordless (DECT) phones; wired telephones; television; lighting; computer monitors; wireless mice; computer broadband connections; laptop computers; computer wireless LAN (local area network) broadband connections; dLANs/Homeplug devices; microwave ovens; baby monitors; alarm buttons; children's games; burglar alarms; 'smart' utility meters; hearing aids; dental work; de-humidifiers

4. Measuring exposure, screening and protection; How does microwave radiation get in from outside? Windows; the glass; windowfilm; curtains; bed canopies; shielding sleeping bag; earthed grounding sheets; walls; paint; skirting boards and curtain battens; ceilings; doors; Why, when I screen out the fields, does my phone still work? insulation; phones; mains filters; dirty electricity; lighting; ELF noise to reduce RF effects

5. Personal Screening; shielding clothing; phone pouches and headsets

6. 58 references

Measuring exposure, screening and protection

You may want to know whether you are exposed to RF sources from outside (or inside, including by neighbours). The only reliable way to know is by measuring the fields using an appropriate piece of equipment.

The instrument we recommend for ease of use, accuracy and helpfulness is the Acoustimeter, available from EMFields. It has been designed by Alasdair Philips of Powerwatch. If you decide to buy an Acoustimeter, EMFields also supplies a carry pouch (free of charge, pictured at the bottom of the linked page) to protect the meter when you use it away from the house.

The Acoustimeter registers peak and average field levels both with a series of LEDs and a digital display. The Acoustimeter detects the higher band WiFi, which is above the level that many other RF meters are sensitive to, as well as all other RF signals.

The Acousticom 2 is also available to buy; it registers peak field levels, which we believe are more biologically active, and thus affect people's health, more than do average field levels. It is a small, easy to use instrument, giving both visual and auditory feedback and is small enough to slip unobtrusively into a pocket or bag. It can be an ideal guide to investigate magnetic field levels when you are thinking of moving home. See also the free article called 'Buying an EMF Safe Property' which will help in your decision-making process.

The RadAware is a personal alarm which will let you know (using lights and/or sound) if you are being exposed to higher levels of RF than the level you have selected as being a level your body reacts to.

Acoustimeter

Acousticom 2

RadAware

How does microwave radiation get in from outside?

Microwave radiation from external sources travels through most common building materials, most easily through ordinary glass with very little reduction, and fairly easily through most building materials, brick, wood, concrete, etc.

When microwave radiation enters a home, a lot of it is absorbed by whatever is there, especially people. The body does not store up the radiation, it is dissipated as heat, at such low levels that we are unaware of any temperature change. But there is evidence that this exposure is sufficient

to sensitise many people, resulting in their suffering ill-health or a more generalised, debilitating, electrical hypersensitivity (ES).

If a mobile phone is placed in a microwave oven, designed to stop high levels of radiation leaking out, and the door is then shut, 2 out of 3 mobiles will still ring. For a microwave signal strong enough for a mobile phone to work to get in, it becomes clear how pervasive and intrusive microwave radiation is.

Microwave frequency is such that the radiation can get through small holes, especially slots, and great care needs to be taken with any form of shielding that no gaps are left for the radiation to get through. Microwaves are like a cross between light, which travels in straight lines, and water which flows around obstacles. If you try to dam water, it will still manage to get through small holes and will then go into the area behind. If microwaves find a hole, they will get through into the area behind the shielding in such a way that the shielding is less effective. "Total RF shielding" is very difficult and expensive and is unnecessary for most people, however for any shielding to be worthwhile, care will need to be taken with its installation.

After measuring the fields, you may find that the field levels are undetectable and there is nothing you need to do. If you find microwave radiation penetrating your home, or place of work, there are several ways you can reduce the levels you are exposed to. We consider the advantages and disadvantages of many of these below.

If you live in the beams from a nearby mast, shielding only the windows will usually reduce the microwave levels in a room by quite a lot, but you will probably also need to shield your walls and maybe even the ceilings and floors. If the radiation is from a neighbour's DECT phone, WiFi, burglar alarm or baby monitor, you will certainly need to think about shielding the walls.

All bed canopies, shielding sleeping bags, grounding sheets and headnets are available zero-rated for VAT for those who sign the form saying they are electrically sensitive. No doctor's signature is necessary.

Windows

We start with the windows as these provide least protection from microwaves entering your home from an external source.

The glass

Normal single, double, or even triple-glazing glass offers little resistance to the passage of microwaves into your rooms – almost all pass straight through. Aluminium window frames will prevent microwaves coming through the frames. Other window frames without any metal content will need to be painted with special screening paint, or covered with screening material, window film or aluminium foil tape, otherwise the 'long slots' around the glass panes will allow microwaves to enter the room.

Window film

EMFields offers three different sorts of film (listed from best to least in order of effectiveness)-

- **Hilite** – This is the most effective film for shielding, blocking over 99.99% of the power, and between 96% and 99% (depending on frequency) of the signal strength. It is extremely transparent, letting over 90% of visible light through.

- **Sterling 20** - Perfect for use in bedrooms. It offers a similar power reduction, but slightly less effective shielding on the signal strength as the Hilite. It is a dark film, letting 20% of visible light through.
- **Sterling 50** - It screens out over 99% of the power and over 90% of the signal strength, varying by frequency. It lets in more light than the Sterling 20.

For further information about the effectiveness of the Window films.

Like book-covering film, all window films need ***extremely*** careful fixing. EMFields has a DVD with full instructions for do-it-yourself.

Opening a window for ventilation (essential for good health) will also allow entry to microwaves, even when the windows are covered with film.

Curtains

Curtains made of special screening material offer protection even when the windows are open. These can be obtained from various companies you can find on the Internet. EMFields is unable to advise on which are best as we have not measured all the materials available. Most companies have screening reduction information online.

If your windows are wider than the material and you need more than one length to cover the window, there should be at least a 3cm overlap, where the curtains meet so that microwaves cannot get between the two curtains. You may want to ensure the microwaves cannot get around the material by fixing the sides to the wall side of the window frame and the bottom of the material to the underside of the windowsill.

Hot sunlight in combination with high ultra violet levels (which are increasing because of the hole in the ozone layer), degrades most fabric materials with time.

Bed canopies

All bed canopies are available zero-rated for VAT for those who sign the form saying they are electrically sensitive. No doctor's signature is necessary. The canopies do not reduce your exposure to the earth's geomagnetic field, which is beneficial.
These can be made to order in different sizes, depending on bed measurements.

Pyramid

Box

Orders can take up to 2 weeks for delivery.

Please see the chart for details of shapes, sizes and materials.

The material should touch the floor all around, without gaps. You may need to consider painting the floor under and around the bed to prevent microwaves from below entering the canopy (see below for paint details).

Shielding sleeping bag

Many people asked us about bed screening when they go away to visit friends and relations, on holiday or business trips. Or you may be in rented accommodation, and do not wish to screw a hook into the ceiling.

The sleeping bags come in one size - 2.2m x 0.9m, and come with a separate washable liner made from 100% cotton. The Shielding Sleeping bag can be washed if necessary, but if the cotton inner is kept clean, there's rarely a need to wash the bag itself.

Earthed grounding sheets

These sheets are designed to be placed underneath a sheet on a bed, and when earthed, can lower powerfrequency electric fields and drain any charge from your body to ground. It is vitally important to remove any source of mains electricity close to your bed or your electric field exposure will rise. We advise that you should measure the electric fields your body is exposed to when you are lying on the bed - both with and without the sheet being earthed. That will enable you to ensure your electric field exposure is lowered. The PF5 meter can measure these. If used in addition to a canopy, this product is suitable for the screening underneath the canopy as the material is also effective at screening RF fields. The canopy and the grounding sheet should be connected together. Body grounding sheets normally cover about a third of the bed as shown in the picture. Most people just want to be earthed, if however you feel you are being zapped from rising pulsed RF fields from below then you might want a large one to cover the whole bed.

You can also use the smaller size earthed material on a chair to minimise electric field exposure whilst working on an earthed computer.

Customer feedback - *"They're so unobtrusive, you hardly know that they're there.. and yet they're quietly working in the background keeping you grounded as you go about your daily business (this review is for the chair grounding sheet). As for the double bed grounding sheet - again, I cannot recommend this highly enough. I think it's so important that a sleeping area is kept as calm as possible and, in my opinion, being grounded is certainly helping me sleep better at night. "*

Walls

There may be significant amounts of RF radiation coming in through the walls of your home, and possibly even the ceiling, through the loft space, or upstairs neighbour, or through the floor, from downstairs, or a neighbour living below.

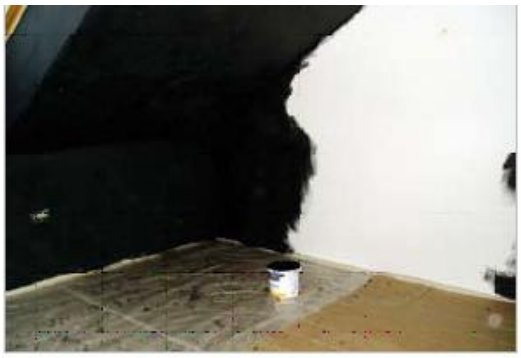
Paint

YShield paint has been tested by the Microwave Laboratory of the University of the German Federal Armed Forces in Munich. One layer has a shielding effectiveness of up to 99.99%, an attenuation of 40dB. Multiple layers can even improve on this.

It contains carbon, is water-based, free of toxic solvents, plasticisers, film-forming agents, and it allows the walls to breathe.

Customer feedback *"So far have used this paint only on one wall to reduce wi-fi signal from neighbours behind my childrens bedroom. Amazing! One coat = full reduction of signal! Beautifully smooth surface, very easy to overcoat with emulsion. Was great to work with. No splatting from roller. Well worth the expense. "*

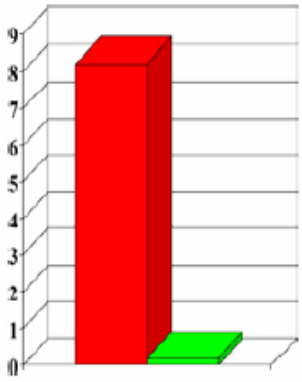
Below, you can see pictures taken after application of the shielding paint, and subsequent top-coat finish.



The paint needs to be stirred VERY thoroughly in order for the conductive carbon filaments to be distributed evenly throughout the paint. If this is not done sufficiently well, the coverage and screening will be patchy.

You need to apply the paint with a good quality brush or paint roller with long fibres for best results. It is important to make the layer even, and not to cover too thinly as this will reduce the paint's screening potential. You can then over-paint it with a colour of your choice, using a good vinyl paint, without reducing the microwave protection. The screening paint needs to be left for ***at least*** 24 hours, depending on weather conditions before overpainting. This is not only to allow the paint to dry, but to ensure that no chemical bonding will take place with a subsequent layer of paint, reducing the shielding effectiveness. If you wish to hang pictures on the painted wall, it will not affect the screening properties of the painted surface. Metal nails will provide a conductive link, and small holes will not allow the microwave radiation to enter the room, unlike slots.

The coverage is about 7 - 7½ square metres per litre for the paint used internally and between 3 to 8 square meters per litre for the paint used externally, depending on how rough the surface of the house is. Rough plaster will give a coverage of about 3 square metres.



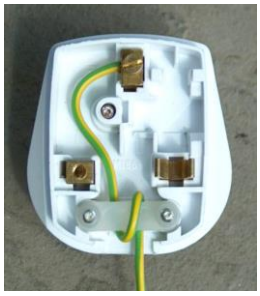
A graphical representation of RF exposure before and after screening with the carbon paint.

A neighbour's DECT phone may result in significant levels of RF radiation in your home, and you may need to paint the party wall to reduce incoming emissions. It may be necessary to cover the whole of the wall to prevent the microwaves coming round the ends of the painted surface.

If the source of microwaves is above or beneath you, such as a DECT telephone or WiFi system in a neighbouring flat, the best thing to do is paint the ceiling or the floor underneath your carpet or other floor covering. Most modern houses are wired in ways that give rise to high electric fields and you may want to earth the paint you use. If you have painted the floor and the wall(s), we recommend earthing them both. If you have only done one or two walls, you may choose not to earth them.

Grounding leads are available from EMFields, complete with fixing instructions. The grounding lead needs to be carefully fixed in place so that it will not be pulled from the wall. It can then be painted or papered over.

The other end of the grounding lead can be connected to a metal water pipe (a hot water radiator system is ideal). Any paint or varnish needs to be removed so that the grounding wire makes good contact with the metal. Use a proper pipe earthing-bond-clamp (similar to a 'jubilee clip') available from any good electrical supplier. Radiators will be earth bonded, where only copper piping is used for the heating system. However, many plumbers are now using plastic pipes to get round some of the more difficult corners in a plumbing system. These will mean that the radiators will not be bonded to the house earth. It is not always easy to spot lengths of plastic pipe as they may have been painted to resemble their metal counterparts.



If your system is not earth bonded, or you are unsure, you may want to earth the paint through the house wiring system, by connecting the 'Grounding lead' attached to the painted surface directly to the Earth pin of a 13Amp plug (see diagram). The plug should be inserted in to a socket, where it will make a continuous contact with the house earth. The wall socket does not need to be switched on for it to do so. Sometimes grounding the paint can make people who are very sensitive feel worse. In which case it is easy to remove the earth wire.

Skirting boards and curtain battens

Ideally, for maximum reduction, skirting boards should be taken off and the paint should extend to floor level before the skirting board is replaced. If this is not possible then you can paint the skirting board. Oil-based paint would need to be well prepared or removed first.

Microwaves can easily go through slots in shielding that are longer than about 10 cm (4 inches). To ensure they cannot penetrate the wall and then the curtain batten, you need to either remove the batten and paint behind it or you can paint it or cover it with the self-adhesive aluminium tape available from EMFields.

Ceilings

Microwave radiation from an external source, or upstairs flat, may be coming through the roof or ceiling. If you are still getting high microwave fields after having shielded the walls and windows, you may need to paint the ceiling. Painting is by far the easiest way of applying a screening layer. We have found houses where the signals are picked up on the ceiling / loft wiring and then rebroadcast from the lights hanging from the ceiling. Typical 7.5, 15 and 30 cm drops of cable from the ceiling to the light make quite efficient transmitting antennas at mobile phone frequencies. EMFields can supply clip-on ferrites to help reduce this problem.

Doors

Doors can let microwave radiation through and may need to be painted. If the door is a critical entry point for the microwave radiation you want to shield against, you will also need to ensure you deal with the door frame in such a way that there is a snug fit when the door is closed.

Why, when I screen out the fields, does my phone still work?

A mobile phone is not a suitable means of detecting the strength of microwave radiation entering a room. A phone handset can work at tiny signal levels (0.00001 V/m), and can still display a number of signal strength bars even after a significant amount of remedial reduction work has been done. If there is a 1 volt per metre RF level in the room you are concerned to shield, then you would need to screen by 99.99% before the phone starts to lose bars, and 99.9995% to reduce the incoming signal strength sufficiently to stop the phone from ringing. In Salzburg (where they currently have the lowest public microwave exposure guidelines in the world) the maximum recommended level is 0.02 V/m inside buildings. At this level a mobile phone will show 'full signal strength'. We believe that 0.05 V/m is low enough not to cause adverse health effects in most people. If it does so, most of us will have problems in the medium or long-term, as most of us are subject to this sort of level of microwave exposure outside our houses, and indeed levels considerably higher than this are common in towns and cities. A few extremely sensitive people who suffer from Electrical Hypersensitivity (ES) can react to levels of 0.02 V/m and below.

If a mobile phone is placed in a microwave oven and the door is then shut, 2 out of 3 mobiles will still ring. A microwave oven is designed to stop high levels of radiation leaking out when it is working. For a microwave signal strong enough for a mobile phone to work to get in, it becomes clear how pervasive and intrusive microwave radiation is. It may give some indication of how difficult it is to screen them out altogether.

Professional EMC enclosure cabinets use multiple interleaving spring fingers at the internal door edges combined with woven metal screening tapes on the two flat overlap edges than close against each other. Then inside you have carbon foam absorbers on the walls to absorb any leaks and any reflections inside the cabinet. Even then you only have to slightly crack open the door (by say 1 mm) in order to be about to pick up radio TV and cell network signals inside.

Insulation

Foil-backed plasterboard and foil-backed insulation board can reduce incoming microwave radiation significantly. It is important to ensure that the foil at the back of the board is not damaged at the edges, as slots are ideal entry points for microwave radiation. It would be best to use aluminium foil tape to join two sections. This will provide a continuous screen that can then be earthed, to avoid the problem of re-radiating electric fields mentioned above.

Some insulation materials that look like metallised plastic do screen against microwaves, some do not! The only way to find out for certain is to test with an instrument such as the Acoustimeter or Acousticom 2, before screening large areas. Those that do may be ideal for use in a loft to prevent microwave entry through the roof.

Phones

Some people who are sensitive to EMFs find they react to ordinary wired telephones. One of the reasons this may be, is that there can be broadband radiofrequency "noise" (up to about 10 MHz) coming through the wire from the telephone socket. This noise is almost universal in the UK now, even if you personally do not have a broadband internet connection. The ferrite on the EMFields ADSL filter and ferrite set stops VHF and microwave (DECT and mobile phone) signals travelling along the wires. The ADSL double filter reduces the electromagnetic noise dramatically.

All UK wired phones have magnetic earpieces, so there is a measurable static (DC) magnetic field, typically in the order of a few microtesla. However, none of the ones measured had AC fields from the dialling tone or from speech that exceeded 20 nanotesla at the ear.

Mobile phone protection is also available from EMFields, see section 5.

Mains filters

The mains filter unit available from EMFields contains a powerful mains conditioning filter which will reduce or eliminate interference on your house mains electricity supply coming from computers, TVs, videos, modern switched-mode mains adapters and chargers, etc. It stops RF signals being sent into your house wiring, greatly reduces interference from external sources, often improves picture and sound quality with AV equipment, and has 6 sockets for UK plugs.

Dirty electricity

Dirty electricity (DE), also known as dirty mains, dirty power, or electrical pollution, is a term that describes the problem of electromagnetic noise being on the mains wiring of a house, when it isn't supposed to be. DE occupies a part of the spectrum in between the power frequency fields created by powerlines and substations, and the microwaves produced by mobile phone masts and other modern wireless devices.

Many claims have been made associating Dirty electricity with a wide variety of negative health effects, including cancer, asthma, chronic fatigue syndrome, diabetes, ADD, autism and a number of neurological disorders.

We recommend no more than 2, possibly 3 filters, for a whole house, or up to 5 if the property is very large. You may want to use a mains filter unit instead.

DE consists of high frequency "electrical noise" that has become superimposed on your wires. It includes transient spikes from inductive loads like motors being switched on and off.

Dirty electricity can travel into your house on the local electricity supply and it is often generated by devices in your home. Large blocks of flats and similar multi-occupancy living spaces can have a lot of shared DE sources. If you have high readings when everything in the house is switched off, then you need the DE filters to be placed as close as possible to the incoming mains supply - usually close to your fuse box / consumer unit.

Common large contributors to DE include dimmer switches, televisions, fluorescent light bulbs (including the relatively new CFLs, or energy efficient bulbs) and computers. Any device that has a "switched mode power supply" will naturally create a lot of noise, but it's hard to tell exactly which devices do have them and which ones don't. It's fairly new technology, so most modern, energy efficient, electronic devices now have them. Older, non-electronic devices such as lamps, ovens, or devices that run on motors, don't normally create much DE.

Lighting

Many people do not like the relatively new compact fluorescent (CFL) bulbs that have replaced the older incandescent ones. Many of them give off significant levels of RF as well as containing toxic mercury. LED bulbs are an alternative which do not emit UV light either. They have greatly improved since their first introduction, though many also give off high levels of RF.

ELF noise to reduce RF effects

Rats exposed to microwave radiation were significantly less able to remember a maze than unexposed rats. The effect was reversed with simultaneous exposure to ELF noise (Lai 2004).

In a study by Wu (2008), electromagnetic noise blocked intracellular reactive oxygen species (ROS) production and DNA damage of human lens epithelial cells induced by 1800 MHz mobile phone radiation.

When I hold my Acousticom 2 to my head, the readings go up. Why?

Q. As suspected, RF exposure intermittently increases to the orange level when held near one side of my head. The spikes are similar to what appears upon holding the device near an iPhone.

A. The most likely reason is that it is a frequency between about 400 and 500 MHz that is resonating in your head but is actually coming from outside somewhere. You can demonstrate this effect using most car-key-fobs and their lock / unlock buttons. I have just demonstrated this to my colleagues in the office here. One green light holding the keyfob about a head-width away from the AC2, but when I hold the keyfob to the rear of my head and the AC2 to my forehead, it goes up into the first red LED!

The head is naturally resonant around the 400 to 450 MHz – and keyfobs are typically 436 MHz. So the signal gets stronger close to your head as it sort of "rings like a bell" when the frequency is present.

What else is around those frequencies? Police, fire and rescue services often use frequencies in this waveband. Also civilian TETRA PMR radio (private mobile radio). Some military uses.

To test this, go to a low RF area (preferably out of town) with the AC2 measuring almost nothing and then try your test there. I would be very surprised if it reads in the orange there. Make sure you remove all electronics, including wrist watches, from your body before carrying out the tests and put any mobile phone off or into airplane mode.