

Electrosensitivity

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Tips for Reducing EMF Exposure

(To Alleviate Symptoms or to Avoid
Becoming Electrosensitive)

A free guide compiled by
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(A charity providing support and information for all
people sensitised by electromagnetic fields and radiation)

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1. Introduction

The aim of this document is to cut-through all the hype, misinformation, flawed reasoning and ‘fake news’ to present the facts and provide common sense, simple, no-cost / low-cost, practical self-help measures that anyone can take to reduce their exposure to, and hence minimise the risk of harm from, a multitude of everyday sources of radiated electromagnetic fields (EMFs), without having to spend a small fortune on often expensive and/or unnecessary (and in some cases, less reliable or unproven) products or services.

As all the symptoms of Electrosensitivity (ES) can also be caused by a multitude of other medical conditions, many of them potentially very serious, you should always first consult a qualified medical professional to rule-out other causes before **relying solely** on reducing your exposure to EMFs. However as there are no negative health effects from reducing your exposure to EMFs there is no reason why you should not do so whilst you are also undergoing investigations for other causes, if you feel it may be of benefit.

Although these tips to reduce EMF exposure are **primarily aimed at people who are**, or think they might be, **electrosensitive**, the measures outlined in Section 2 are well **worth consideration by everyone**, as people without any specific symptoms have reported feeling an **improvement in general wellbeing** and **greater vitality** which is probably due to **reduced external stressors** on the body and **improved sleep quality** from lower EMF exposure. Reducing exposure also reduces the risk of becoming electrosensitive in the future.

Guidance on no / low-cost **basic ‘first line of defence’ self-help measures** is essential for the many, many sufferers who are unable to work due to the severity of their symptoms and simply do not have the money to spend on elaborate solutions or expensive services, which may turn out to be unnecessary. Especially as these people are also often denied any form of benefits because their condition is not officially recognised.

Many people are unsure, or even sceptical, as to whether their symptoms could be caused, or made worse, by EMFs and so are understandably reluctant to spend any significant amount of money on **potential remedies** which may have no beneficial effect because, in their particular case, their symptoms turn out to be unrelated to EMF exposure. Following this guidance also **allows such people to be reasonably certain both** that EMFs are responsible for, or contributing to, their ill-health, **and** to determine if any further action is really necessary, including if expenditure on specialised products and services is likely to be worthwhile.

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The more costly solutions are discussed separately later on, including **when** it might be worthwhile considering them, but **only after** all the no-cost or more affordable options have been tried first.

The general consensus appears to be that addressing any chemical / food sensitivities (including moulds), hydration, and nutritional deficiencies (none of which are discussed any further in this document) is also important for people with severe symptoms as these conditions often co-exist and interact.

Validity of Information

The recommendations and facts contained in this document have been derived from information published by **credible** sources, such as **European Parliament**, the **Institute of Building Biology**, **Austrian Medical Association**, **ES-UK**, etc., respected researchers and reputable institutions, who are completely independent of commercial interests, not from any non-verifiable or biased 'experts' or sources. Wherever possible, links to the original published material that has been referenced have been provided. Additionally some content is based on established electronics and physics principles, and a few comments on the effects of EMFs have come first-hand from sufferers I have met who are far more sensitive than I am.

Although all the basic guidance on how to reduce your level of exposure to EMFs is likely to change very little over time, in order to keep up-to-date with the latest developments in research into the effects of EMFs, the potential impacts of changes in technology, lawsuits, and any resulting changes in policy, regulations and views of the relevant national and international authorities it is advisable to subscribe to email newsletters from independent and reliable sources such as [ES-UK](#) ← click this link to subscribe. The latest Newsletter and back-issues can also be downloaded from the [ES-UK Newsletter](#) page. (This document may be updated periodically to reflect future developments and all ES-UK Newsletter email subscribers will be notified)

Independence

I am now fully retired and have not received, and will not receive, any financial or other incentives from the manufacturers or suppliers of any of the products mentioned within this document. My only affiliation in this area is as a voluntary supporter of ES-UK. Any positive product references are purely to provide examples of items which have been evaluated and found to be reliable, fit-for-purpose, and to represent value for money in order to provide a benchmark for people who have little previous knowledge or experience in this subject.

Validation and Expertise

All the electronics / physics principles and recommendations that have been incorporated within this document are wholly consistent with my experience, knowledge and qualifications from 30+ years working in engineering, design, manufacturing, testing, quality assurance and regulatory compliance in the electronics industry within telecoms, radar, calibration and metrology, electrical safety approvals, and certification and compliance with National / International / MoD Standards and EU Directives, including:

[Electromagnetic Compatibility \[EMC\] Directive 2014/30/EU](#) (see Note 6 in Section 7 below)

Low Voltage Directive 2006/95/EC

Medical Devices Directive 93/42/EEC

I have worked for Post Office Telecommunications (now BT), Halser GB (now Ascom), Racal Marine Radar, Duracell, British Standards Institution (BSI), and National Air Traffic Services (NATS), amongst others, and was formerly an Associate Member of the Chartered Quality Institute and BSI / IRCA Registered Lead Auditor. In the course of my work I have carried out assessments and inspections at hundreds of companies in the electronics industry, both in the UK and overseas, who were involved in the design, manufacture, and/or servicing of a diverse range of products from electronic components to CAT and MRI scanners.

I suffer from ES myself, have helped other ES sufferers, and have implemented all of the precautionary measures recommended in Sections 2 & 3 below, and most of Section 4, in my home and have validated their effectiveness with reputable test equipment (See Section 17 – Table 5, 9 – 11), where applicable, as well as by achieving a very significant improvement in my symptoms. Additionally other ES people who are more sensitive than me have commented how much better they feel in my home environment.

Be wary of differing advice from unqualified, alarmist or 'fake news' bloggers, or web sites which are trying to sell you something, which often make unsubstantiated or grossly exaggerated statements. Also be wary of

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‘cheap and nasty’ testers that do not give reliable, repeatable results which can cause you to either fail to identify sources which are a problem, or to waste your time and money trying to deal with sources which are actually too low to be of concern. (See Section 12 – Test Equipment)

It is also worthy of note that many **US** web sites mention **only** the AC **Magnetic** Field of EMFs (measured in **mGauss** or **nT**) NOT the AC **Electric** Field which travels further and is often more harmful, so their advice does not tell the full story. (The US domestic mains power supply is most commonly half the voltage of the UK and, therefore, items of the same power rating draw twice the current, hence the Magnetic Field is twice as strong, so it is potentially more of a problem there than in the UK. Although the Electric Fields coming from such domestic mains wiring will, therefore, be half the strength that does not mean it is too low to be a problem. Additionally in some places the domestic supply is 230VAC and the commercial and industrial power supply can go up to 600VAC so it is a gross oversight to disregard AC Electric Fields in the US)

Don't panic, it's NOT the end of the world to live without wireless devices!

Many people, especially those too young to have experienced life without modern-day technology, really don't **want** to believe that EMFs could be contributing to their ill-health because they don't want to even start to contemplate what impact that might have on their current lifestyle's reliance on wireless technology and gadgets. They fail to recognise, or accept, that the **ONLY truly important functions** wireless technology has provided is the ability to call for help in an emergency in remote locations and to find your exact location when lost. **Everything else** can still be done perfectly adequately and enjoyably (and generally faster, more reliably and more securely) with **wired** computers, phones, entertainment systems etc., and satnavs **only need** to be **switched ON** and **mobiles taken OFF 'airplane mode', in emergencies.**

Music and movies can still be enjoyed on-the-move on a **mobile** or **tablet** in '**airplane mode**' by downloading them via a **USB-C** cable to a computer with an **Ethernet cable** connection to the router, or via a **USB-C to Ethernet Adapter*** (or 'dongle') wired direct to the router. It's not difficult, and only needs a little planning ahead, which never did anyone any harm. **ALL** internet-based activity can still be enjoyed via a **wired computer, tablet** or **mobile** set-up. (*I use a **UGREEN** Ethernet Adapter – in addition to the compatibility listed the supplier advised me "generally Android v7.0 or higher, and Kernel v4.1 or higher can be used with this adapter, but there are exceptions". It worked fine for my Samsung mobile. Other brands are available)

If either you **don't think** reducing your exposure to high levels of EMFs could, or will, improve your health and wellbeing, or you can't, or don't want to, change your current use of wireless technology, why not give it a try for a week or two so you can then make an **informed decision**, not one based on hearsay, industry hype, fake news or emotions? Although opinions vary, many researchers estimate that up to 80% of the population are affected to some degree by electrosensitivity so if you have **any of the symptoms** which are commonly **caused, or made worse**, by electrosensitivity and **you aren't prepared to try reducing your EMF exposure for a trial period**, then obviously your symptoms really can't be bothering you that much at all...

What to do + the benefits

People who reduce their exposure to EMFs commonly report that they sleep better, feel more refreshed by sleep, have more vitality, fewer headaches, are less stressed and anxious, and have better concentration and skin in addition to significant improvements in the many specific associated conditions.

ES can affect different people in very different ways. Less sensitive people may only suffer mild and relatively trivial symptoms, whereas the most sensitive sufferers can be completely debilitated by severe reactions lasting hours or even days. Similarly sufferers may be affected by only certain, or all, frequencies, mainly by electric or magnetic fields, or equally by both, and the trigger levels and the type and severity of reaction may vary significantly between different frequencies and field types for the same person.

Consequently some exposure reduction measures may be far more effective than others, and some may not be needed at all, depending on each individual's reactions and the types and levels of EMFs in their daily environments. The only way to tell is by experimentation and, therefore, the recommendations that follow are grouped by the easiest, cheapest and most commonly problematic* first, progressively becoming more complex and expensive to implement as these may not be necessary. (*The measures to reduce exposure to microwaves are listed first as microwaves are most often the cause of the worst reactions for a majority of sufferers, and hence the most benefit is often derived from addressing these sources first)

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Although the best advice is to do as much as you can to reduce your exposure throughout the day wherever you are, the most important environment is where you sleep as electromagnetic radiation not only disrupts sleep (even if you don't wake during the night) but also interferes with the many important cleansing, repair, maintenance and rejuvenation processes that (should) take place whilst you are in deep sleep. If you can't, or don't want to, follow all of the recommendations below you will derive the most benefit from doing as many of the recommendations regarding the bedroom / night-time environment (e.g. switching things off at night) as you can, even if you don't implement many of the daytime precautions.

The basic steps to reduce your exposure are quite simple and straightforward, and most cost little or nothing to implement. If you can't eliminate a particular source of EMFs, moving the offending item as far away from you as possible (or you from it) will reduce your exposure significantly as the strength of electromagnetic radiation drops-off quite rapidly with increased distance from the source. (See Section 14 – Technical Stuff – Inverse-square law)

Microwaves are the most harmful, but lower frequencies can be harmful too

Microwave EMFs are the most harmful due to their ability to propagate over great distances and more easily penetrate many materials, which is why they are used for their particular applications. The shorter the wavelength (higher the frequency) the more dangerous they become as more of the energy is absorbed by the cells of the body – hence 5G is causing even greater concern. However research has shown that once people start to become reactive to microwave frequencies they very often also become progressively more and more sensitive to lower frequency EMFs, often right down to mains 50Hz and below.

Although signal levels vary between manufacturers and models, most **DECT Cordless Phones** have a much higher power output than a majority of **Wi-Fi Routers**, and most **Wi-Fi Routers** have a much higher output than **Mobile Phones** – therefore it is essential to follow the advice on **Cordless Phones** and **Wi-Fi devices** as well as **Mobile Phones** in order to reduce the risk of harm from microwave radiation.

Exposure Reduction - 'Distance is your friend' but Duration is Equally Important

'Distance is your friend' is advocated by the Vienna Medical Association in their guidelines for mobile phone use but is equally applicable to all sources of EMFs. However, although the most sensitive sufferers can experience very bad reactions to the shortest of exposures, as for most sufferers the **total exposure** (field strength x duration) is the most important factor affecting both the **severity** and **persistence** of symptoms the length of time spent in close proximity to strong EMF sources has a very significant impact. Therefore it is not only the **further away the better**, but also the **shorter the duration of exposure the better**, in all cases.

There can be quite considerable differences in the levels of EMFs from the same kind of equipment from different manufacturers, and even between different models from the same manufacturer, not only due to the power rating of each device but also due to the degree of screening used within the equipment, the type of screening material used, whether it is earthed or not, and many other design and construction factors.

Therefore the distances recommended in the sections below to keep the various items from the body in order to reduce the harmful effects of EMFs to an acceptable level are **only a rough guide – in all cases the further away, the better**. If you are electrosensitive and don't want to get bogged down with all the details of the various 'safe' distances for different items, a very rough rule of thumb is not to spend any appreciable length of time less than **1m** away from anything that is mains-powered or any battery-powered items that transmit any kind of radio waves* (mobiles, Wi-Fi / Bluetooth devices, cordless phones etc.), and **0.5m** away from mains leads and wiring in the walls, floor and ceiling. The only exceptions being flat screen computer monitors which are okay at **0.5m** because they are made to meet a separate safety standard for emissions, and laptops which should not be used without a separate **wired** keyboard and mouse, even when battery-powered and in 'airplane mode', and **never** on the lap.

If the indications are that EMFs do adversely affect you there is no substitute to checking the actual field strengths from all potential sources around you with reputable test equipment in order to determine which items are actually causing the worst problems, how far away to keep from them, or if further actions might be needed to reduce the EMFs they radiate (as detailed in the following sections) as well as to check how effective any reduction measures have been. (See Section 12 – Test Equipment)

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Alternative Approaches

Although it is widely thought that many complementary therapies and practises such as yoga, tai chi and qigong etc. can be helpful whilst you are being subjected to the stress of high levels of EMFs, I have not encountered any evidence to suggest that any of them can make you **immune**, even temporarily, to their ill-effects. Therefore, as the frequency of treatment or amount of practise required to bring any appreciable degree of relief can be very expensive / time-consuming, **it makes no sense at all to rely on any other type of remedies without first addressing the fundamental underlying cause by reducing your daily exposure – which costs little or nothing to do.**

After all you wouldn't **rely solely** on buckets, umbrellas, pumps and dehumidifiers, or incantations to stop the rain, to address water pouring in through the roof without taking the most obvious and effective step of fixing the holes in the roof first! Similarly, regardless of your beliefs, you wouldn't just rely on prayer, reiki, spiritual healing, herbal remedies, or homeopathy etc. to help you recover from an injury without first carrying out all the basic first aid steps of cleaning, disinfecting and dressing the wound, stopping the bleeding, realigning and supporting any broken bones etc. So why would you **just** rely on crystals, sacred pyramids or any other alternative remedies without first doing all you can to eliminate or reduce the potency of the actual source of the problem, and hence increase the potential effectiveness of any other approach?

Indeed, as you might expect, complementary therapies and practises such as yoga, tai chi and qigong are reported to be far, far **more effective when you also** simultaneously significantly **reduce your daily exposure to EMFs**. Following the recommendations in Sections 2 & 3 below for a week or two will help you to determine if reducing your exposure to EMFs is likely to lead to an improvement in your health wellbeing, and all the actions are all fully reversible if you decide it's just not for you, so what have you got to lose?

2. Simple, NO-COST, Precautions EVERYONE Should Take To Improve Wellbeing

The following simple precautions will significantly reduce your exposure to potentially harmful EMFs and, therefore, help to relieve the many symptoms they can cause or worsen. **These measures also have the potential to improve your general health and wellbeing even if you have no major symptoms yet** and they cost nothing at all to implement, only requiring rearranging some of your furniture and electrical items, and changing some of your habits.

You do not have to stop using electrical / electronic items altogether, just use them more wisely. So there is nothing to lose except the time it takes to reorganise things and there is potentially a good deal to gain. All the actions detailed below are fully reversible if you're not convinced of the benefits or would just rather go back to your old ways and suffer the symptoms instead – either way you can make an **informed** decision.

- 2.1. **Always** use a **corded phone landline**, where available, in preference to a mobile or cordless phone.
- 2.2. Keep all **mobile** or **cordless phone** calls as short as possible and use the phone hands-free at arm's length (or more) or via a headset for a mobile (preferably the hollow-tube type*) – **never** against your ear. Most manufacturers now include **warnings** about keeping mobiles a **minimum distance (usually 15 – 25mm) from your body**, not just the head, buried in their small-print** in order to try to avoid future litigation for any harm caused. In some countries it is illegal to sell mobiles without headsets and more prominent warnings about minimum 'safe' distances. (For further information on this see also the separate document "Health Risks of EMFs from Mobile Phones, Wi-Fi, Cordless Phones and Other Electrical - Electronic Sources" Sections 3 & 7)

* The wires in headsets with speakers in the earpiece will help to conduct some of the undesirable microwaves back towards your head – the 'hollow-tube' or 'air-tube' headsets are the type used for in-flight entertainment and hospital radio and TV.

** This information is often 'hidden' under menu options such as Settings > About Phone > Legal > Safety. It is recommended that you check what your mobile manual says is the 'safe' distance, but note that this is only what is considered 'safe' to keep your **body tissue** from being **damaged by excessive heat after just 6 mins, not** for any longer, and **not** from any **non-thermal ill-effects** which are the most common form of harm caused...

- 2.3. Unless an emergency, only use **mobiles** in good reception areas. In poor reception areas the mobile

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will greatly increase the signal output level in order to reach the tower, which in turn means you are subjected to much higher levels of radiation. Also moving around during the call, particularly over large distances which may cause you to change towers, will result in higher overall signal output during the call and, therefore, increase your exposure as the power output level will be constantly readjusting by going to the maximum and then decreasing again to find the minimum level for acceptable call quality. This is done to maximise battery life, not to protect you from radiation! (See Section 6 Masts – Towers, Transmitters and ‘Safest’ Mobile Phones – Power Levels)

- 2.4. Never have a **mobile** switched-on in contact with your body – switch it **off** or to ‘**airplane mode**’ (not just to ‘standby’) before putting it in your pocket or in a bag held close to your body. If you must carry a switched-on mobile with you for any reason put it in the outer-most pocket of your bag so it is as far away from your body as possible. (See 2.5 below and the separate document “Health Risks of EMFs from Mobile Phones, Wi-Fi, Cordless Phones and Other Electrical - Electronic Sources” Sections 3 & 7)
- 2.5. If you have a **Smartphone** and need it on most of the time just to be contactable, **switching-off** the **Wi-Fi, Bluetooth, NFC, Location and ALL Data Functions** when you don’t need them, so it **only** sends and receives calls and texts, will **greatly reduce** both the **level** and **frequency** of signals being transmitted by your phone whilst these functions are not being used, and hence **greatly reduce your exposure**. Switching these functions **OFF** when not needed will also **speed-up Apps, significantly increase battery life, and reduce the likelihood of overheating problems**, which is why it is also recommended to do this in many mobile manuals (e.g. Samsung Galaxy Note 10 Lite). NB: Excessive heating for extended periods causes semiconductors and batteries to degrade, and eventually fail, quicker– another good reason for turning ALL electronic devices off when not in use)

See 2.13 below and Section 17 Table 5 for the reasons why, and proof that, this significantly reduces your exposure. Switching these functions **on** and **off** is usually very easily done in ‘**Settings**’.
(Alternatively use a ‘dumb’ mobile phone if you just need to be contactable)

If you like to watch videos or listen to music on your phone whilst traveling you can reduce your exposure by downloading videos and music beforehand via a USB connection to your computer (wired to the internet of course!) and then playback with the above settings switched-off if you still want to be contactable or, better still, on ‘**airplane mode**’ if not.

- 2.6. Don’t have **mobiles** switched-on or on-charge (see 2.19 below) in your bedroom – if you use a mobile as an alarm or to listen to music switch it to ‘**airplane mode**’. If you **must** have it on in the bedroom put it as far away from your body as possible and switch-off the Wi-Fi, Bluetooth and data functions. (See also 2.5 above)
- 2.7. Replace **cordless phones** with corded ones – if you really can’t do without a cordless phone put the base-station and the handsets as far away as possible from anywhere you sleep, sit or stand for any length of time and, preferably, don’t have one at all in the bedroom. (You can buy DIY kits to add extra phone points yourself if not being able to connect the phone where you want was a reason for getting a cordless phone in the first place, and BT will add extra sockets for you too for a fee)

If you must have a cordless phone in the bedroom have a handset rather than the base station as the base station transmits continuously whether or not a call is in progress. Digital cordless phones (DECT) also use microwaves, usually at much higher power output than either mobiles or Wi-Fi, and are often the worst source of harmful electromagnetic radiation in your home. (As cordless phones and Wi-Fi Hubs are not battery-powered they do not have to worry about limiting the power level they output)

You should always have at least one corded phone anyway as cordless phones won’t work during a power cut as the base station requires mains power even though the handsets have batteries, and mobile signals may become unreliable during a storm, or the mobile’s battery might be flat when you need it most and you wouldn’t be able to recharge it. A corded phone is powered by the telephone exchange which has an emergency back-up generator so will always work unless the lines are down. However beware that corded answerphones use mains power for the additional features and only in some models do the basic phone functions continue to work during a power cut, so do check yours works with the power turned off at the wall and if it does not install at least one ordinary, non-mains - powered handset as well.

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The mains power to an answerphone may be enough to adversely affect sensitive people and very sensitive people may need to use even a corded phone at a distance on hands-free, especially for longer calls. See also 3.5 below. (Okay this one does have a cost if you don't have any old corded phones in the loft or garage you can resurrect - see Typical Costs of Wired Alternatives in Section 17)

Note: There are only 2 Siemens models of DECT Cordless phones which **do not** constantly transmit whether or not a call is in progress. Although these are preferable to the other types they still subject you to very high levels of harmful EMFs during a call.

- 2.8. Switch your **mobile** to 'airplane mode' when using it for any function other than making a call or actually sending/receiving texts or data (compose messages in 'airplane mode') If you must have a mobile on whilst at your desk, at work or in your car etc. put it as far away from you as possible, preferably at least **2m**. Putting your mobile on the window sill or wherever it gets the strongest signal, if far enough away, is the best option as the clearer the path to the tower, the lower the power of the transmitted signal will be set, thus further reducing your exposure.
- 2.9. Connect all your devices with **Ethernet cables** instead of **Wi-Fi** and **disable** the **Wi-Fi function** on them as Wi-Fi doesn't get disabled automatically by plugging-in a cable. (See Section 16 – **How to Disable Wi-Fi** for details) Also check Wi-Fi isn't enabled on your Smart TV. (Wired connections are always faster, more reliable and more secure than Wi-Fi).

Computers – changing the network set-up to **Ethernet** on a desktop computer will normally disable the **Wi-Fi** output, but you **may** have to do it **manually**, and you **definitely will** need to **disable Bluetooth** devices separately. To do this on a **Windows PC** either go to **Control Panel** and select **Hardware & Sound** and then **Device Manager** (listed under **Devices and Printers**), or go to **Settings** and type "**Device Manager**" into the **Search Bar**. In either case, when the **Device Manager** window opens click **Bluetooth** and then right-click anything in the list and select the **Disable** option. Then repeat the process by clicking **Network Adaptors** and then right-click **only** anything in the list with '**Wireless**' in its name and select the **Disable** option. (See Section 16 – **How to Disable Wi-Fi** for screenshots of this)

Simply selecting 'airplane mode' on a laptop will disable **both** Wi-Fi and Bluetooth.

Sky-Q Boxes are supplied with **Wi-Fi ON** as the **default setting** although they actually work better with a wired connection. However there is a known bug in that changing the setting to Wi-Fi Off doesn't always disable Wi-Fi and you may need to do it 2 or 3 times for it to work, so you need to check with either a test meter, or by temporarily switching your mobile on and to Wi-Fi mode, to see if the 'SKYxxxx' network disappears when you change the Sky-Q Box settings to Wi-Fi Off.

Devices which enable network connectivity via the ring mains, such as '**Powerline**' are slightly preferable to using Wi-Fi, but are still **highly undesirable** and Ethernet cables should be used instead.

(Okay this one does have a cost too if you don't have enough ports on your Router to connect all your devices, or they are spread around the house – see Typical Costs of Wired Alternatives in Section 17)

- 2.10. If you simply must use **Wi-Fi** for any reason position the router as far away from you as possible, preferably at least 3m, **switch off the Wi-Fi function whenever it is not needed** and **especially at night**. (Additionally if you must use Wi-Fi choose a hub with the shortest range / lowest power possible to work satisfactorily as this will reduce your exposure – you don't need 100m range unless your garden is the size of a football pitch with the house at one end and a shed or summerhouse at the other!)
- 2.11. Don't use any **Wi-Fi** or **Bluetooth devices** such as smart speakers (e.g. Amazon Alexa & Google Home), baby monitors, central heating controls (e.g. Hive), hi-fi speakers, printers, security alarm sensors, smart doorbells, games consoles (e.g. Xbox, Wii, PlayStation) etc. unless they can be connected via an Ethernet or USB cable and the Wi-Fi can be permanently **disabled**.
- 2.12. Don't have a **Smart Meter** installed (you have the legal right to refuse one) and be aware if switching electricity suppliers for cheaper deals that many of the cheapest tariffs are **contingent** on having a Smart Meter fitted within 3 months and if you don't, you revert to the standard tariff. Switching sites don't always make this clear so check the Ts & Cs carefully before signing-up. (Note that the initial wording often **implies** that you must have a Smart Meter but if you read all the text carefully they state further down that you can simply tell them if you don't want one.

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- 2.13. **Mobiles, Bluetooth and Wi-Fi devices** are still emitting harmful radiation even when no call is in progress, or no data is being transmitted or received, as the devices are constantly in contact with the towers / Wi-Fi routers / base-stations effectively saying to each other “does anyone there out want to talk to me” and “yes me, I’m here” at frequent intervals (often every few seconds), depending on the device and settings, as this is how the devices can automatically find a connection and how the networks know where the device is, or that it is online, when they need to forward a call or data. This is why it is important to turn all such devices **off** or to ‘**airplane mode**’ when not needed, **not** just to ‘**standby**’ as this activity still continues whilst in ‘**standby**’ on many devices.
- 2.14. Never have a **mobile** switched-on in the car or train if you can avoid it as the metal body blocks and reflects the signal. The blocking effect causes the mobile to increase the strength of the signal it is transmitting in order to reach the tower and the reflection means you get even more of it hitting you. (If you need a mobile on in the car on a regular basis get a model which has a socket for an antenna and get an external antenna fitted to the car as this will greatly reduce your exposure) See also 2.3.
- 2.15. Never use a **laptop, tablet** or similar device on your lap or in close proximity to your body whilst **Wi-Fi** or **Bluetooth** functions are enabled, put it on a desk / table as far away as is comfortable, and preferably use a separate **wired** keyboard and mouse so you can keep the laptop / device further away from your body. (Apple have stopped referring to their portable computers as ‘laptops’ in a bid to prevent future litigation for harm caused by using them on your lap)
- 2.16. Don’t buy **cars** with built-in **Wi-Fi / Bluetooth** unless it can be permanently switched-off.
- 2.17. Don’t use a **Satnav** which receives traffic condition updates or other location specific information unless that feature can be disabled as it is constantly transmitting your position in order to receive the relevant information (acting just like a mobile phone – see 2.14 above). Use a Satnav which only receives GPS data and download map updates via a wired internet connection, or switch-off the transmit function when you don’t need the additional information services.
- 2.18. Preferably stop using a **microwave oven** altogether (microwave radiation leaks out through the holes in the mesh covering the window and even though this is considered to be a ‘safe’ level that is only with respect to heating effects – i.e. it won’t cook your flesh / internal organs). If you must use a microwave oven stand as far away as possible from it when it is on, at least 3m. (If your kitchen is too small use the microwave in the garage if you have one)

NB: Quite apart from the harmful effects from microwave emissions it is also advisable to avoid using microwave ovens as experiments reported in ‘The Lancet’ (09/12/89) demonstrate that microwave cooking alters food enough to cause, upon ingestion, “structural, functional and immunological changes” in the body. The report further states that microwaves transform the amino acid L-proline into D-proline, a proven toxin to the nervous system, liver, and kidneys.

- 2.19. Don’t sleep, sit or stand for any length of time next to anything with a **motor** or **large transformer** (e.g. fridge, freezer, heater, air conditioner etc.), the fuse box / consumer unit / electricity meter, or any equipment containing a [Switched-Mode Power Supply \(SMPS\)](#) – including just the other side of a wall from any of these. Preferably keep at least **2m** away from appliances with motors or transformers and **1.2m** from SMPSs, or switch them off whenever you need to be closer to them for any length of time.

SMPSs are the small power supplies installed in-line in the power cable or built into the mains plug which are typically used as chargers, or to power, mobiles, laptops, printers, modems, TV boxes etc. as they are smaller, lighter and more efficient than the old transformer types and many are designed to operate on a wide range of mains input voltages so can be used worldwide without having to alter the input voltage settings. Many larger electronic devices also have built-in SMPSs so are equally a problem e.g. desktop computers, Sky boxes, TVs, larger printers etc.

SMPSs are a particular problem as they have high frequency oscillators in them (typically 1 kHz – 1 MHz) which produce higher levels of EMFs, and also the products which contain them are often double-insulated* with plastic casings, instead of earthed metal casings, which means that any in-built shielding is generally less effective and more of the EMFs are emitted externally. (*See Section 16 – Figure 6)

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- 2.20. **Laptop power supplies / chargers** with a **3-wire** mains lead have an earth connection and, therefore, produce much lower levels of EMFs which are generally low enough to be little cause for concern if the power supply unit itself is kept as far from the body as the length of the DC power cord permits.
- 2.21. Move your **computer** and **everything connected to it** (including **all** the leads) as far away from your body as possible and use a **wired keyboard** and **mouse** (see also 4.3 and 4.4). Although even a small increase in distance is still beneficial it is preferable to keep all the mains-powered items at least 2m away, however the monitor should only be as far away as you can still read it comfortably. (You will probably need to buy USB extension leads for the keyboard and mouse to do that – online specialist cable suppliers are generally much cheaper and as good quality as Currys, Argos, and Amazon etc.)
- 2.22. Although **aerial and most audio / data / video cables** are screened to prevent interference with the signals they carry (especially from adjacent mains leads), it is not a problem for them to be close to the body **only if** the cable screens are earthed. However this is very often **not** the case nowadays with the prevalence of double-insulated* products with only a two-wire mains lead (no earth wire) so it is best to keep all cables as far away from you as you can. (See also 4.4 for more info) (*See Section 16 – Fig 6)

Note: **DC power cords** are also low-voltage and produce negligible EMFs themselves, therefore, as long as the **chargers** and **external power supplies**, and their **mains leads**, are kept away from your body and the DC power cord itself (to avoid induction of EMFs into the DC cord) they should not pose a problem.

- 2.23. Preferably **switch-off** at the socket or **unplug*** all mains-powered electrical items when not in use, particularly items which only go into 'Stand By' as they almost certainly have SMPSs and although the main power-consuming circuits will not be active, the power to the remote control circuitry will still be on and, therefore, the SMPSs can still be radiating significant levels of EMFs. (*Turning off the item's power button still leaves the mains lead radiating EMFs)

Turning everything off rather than to standby will also reduce your electricity bills – many low-power devices such as computers**, monitors, TVs and Hi-Fi etc. use nearly as much power in standby as they do when switched-on. (**That is computers in standby use nearly as much power as they do when they are on and the disk drive is not active)

NOTE: In the UK the Neutral side of the mains supply is grounded (which is why you don't get a shock if you touch it when the power is on) so a Single Pole switched socket disconnects the Live wire and stops any EMFs being radiated from the power cord of any item plugged into the socket. However in other countries this is not necessarily the case and, therefore, where the Neutral side is **not** grounded it is necessary to fit Double Pole switched sockets to disconnect both the Live and Neutral otherwise you need to unplug the items when not in use to prevent EMFs being radiated from their power cords)

- 2.24. Use a **battery-operated alarm clock** instead of a mains-powered clock-radio and keep the bedside lamps and any other electrical items, and their mains leads, at least 60cm from your body when in bed – preferably don't have anything mains-powered in your bedroom at night.
- 2.25. Move your **bed** at least **15cm** away from the wall to avoid the effects from wiring in the wall (even if you think there is no wiring directly in the wall next to your bed as some unlikely construction materials can conduct and radiate undesirable levels of EMFs some distance away from the wiring itself) This is especially important if your bed has a metal frame or the mattress contains metal springs.
- 2.26. Preferably avoid sleeping, sitting or standing close to any power sockets, light switches or any wiring or items connected to them. E.g. position sofas, chairs, beds etc. away from switches and sockets and at least **15cm** away from walls, and don't have any mains leads trailing past or under them. Prepare food away from electrical items in the kitchen. Keep all electrical items and mains leads as far away from your legs / feet as possible at your computer or other desks, tables or chairs.
- 2.27. When it comes time to renew, replace **plasma TVs** with an LED TV as they produce much, much lower levels of EMFs. In the meantime keep as far away as you can from the plasma TV. (At least **3m** – some suffers report being adversely affected by plasma TVs up to **50m** away)
- 2.28. Replace any **fluorescent tubes**, **compact fluorescent lamps (CFLs)**, and older **LED lamps** with the latest type of LED lamps. The **latest** LED lamps are generally okay in ceiling or wall lights that are at least **1m** away from you but if used in a desk / table lamp at close proximity are best used in a lamp with a metal

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shade that is earthed and still kept at least **30cm** away. (Cheaper brands often tend to emit a higher level of EMFs and DE due to cost-cutting in the design and manufacture of the power conversion circuitry in the base of the lamp. So if you find the levels are too high for you it is worth experimenting with higher quality, more expensive brands)

Standard fluorescent and LED lamps, unless specially treated to achieve a colour temperature of 3000K or less (usually described as 'Warm' or 'Soft' White), also emit high levels of blue light which disrupts melatonin production and, therefore, sleep. ('Bright White', 'Cool White', 'Daylight' and 'Full Spectrum' lamps should be avoided in areas occupied 1-2 hours before going to bed as they contain high levels of blue-light) See also **Blue Light and Poor Sleep** (Section 11) for more information on this separate topic.

Incandescent bulbs or **mains voltage** halogen lamps are okay both from an EMF radiation and light spectrum and quality point of view but are now both being phased out. If you use **low-voltage** halogen or LED lamps ensure that the transformer / driver is located well away, preferably at least **1.2m**, from anywhere you sleep and sit or stand for any length of time. (This may be difficult to determine without an EMF meter for existing installations as the transformers are often hidden in ceiling / floor voids)

Note: The 'old-fashioned' (wound) transformers for low-voltage lighting produce very high magnetic fields which cannot effectively be shielded, whereas the newer electronic 'transformers' and LED drivers produce a magnetic field on par with most consumer electronic products containing SMPs **but instead** produce a significant level of HF EMFs **unless** they have a **metal case**. (Metal -cased models are available on Amazon) However the HF from a plastic-bodied electronic transformer / LED driver can be shielded by enclosing it in an earthed enclosure formed from a 1 mm sq steel wire mesh. (**Do not** enclose in a solid metal case as ventilation is required for heat dissipation and large ventilation holes or slots can allow too much HF to escape, hence an enclosure made of small mesh is recommended)

The German consumer organization Stiftung Warentest recommends keeping at least **1.5m** from CFLs because of the electro-magnetic pollution, while EMF UK recommends **2m**. CRIREM says that they should **not** be used for reading, desk or bedside lights. The Swiss consumer magazine K-Tipp concluded that "All tested CFLs cause electrosmog" and the Swiss government recommends a safety distance of at least **30cm** because of the high EMFs. For people sensitive to EMFs there should be greater distances; some recommend up to **7m**. Many sensitive people do not use any CFLs in their homes. For more details see [Health effects from the electromagnetic fields of Compact Fluorescent Lights \(CFLs\)](#)

- 2.29. Use a hot water bottle instead of an **electric blanket**. If you must use an electric blanket only use it to preheat the bed and both switch it off / unplug it and remove it from the bed before you get in.
- 2.30. Preferably do not use a **water bed** with electric heaters or wave generators etc. If you must use one switch it off and unplug the mains lead before you get into bed.
- 2.31. When using **public transport**, if you have the option, don't sit right next to anyone using a mobile phone or Wi-Fi device – even one seat away will significantly reduce your exposure. Also if you use the same mode of transport regularly, try to determine the location of the Wi-Fi hub and keep as far away from it as you can. If you don't have a test meter, you can (briefly) use the signal strength indicator on your mobile when you sit in different places to help you to determine the best seats to aim for.
- 2.32. Replace dimmer switches with ordinary switches as the oscillating circuit in dimmer switches produces high levels of EMFs and DE.
- 2.33. Very sensitive people have reported that being near to **radio** remote control model boats, cars, and planes, combined harvesters, mowers and tractors, etc. as well as electric fences and close proximity to solar panels or their power inverters can also bring on severe symptoms, so if you suspect that you are very sensitive these should be avoided. (Passing by a house with solar panels on the roof should not be a problem for most sufferers, but being in a upstairs room directly under the panels could be)

Note: Infra-Red (IR) remote controls* such as those used for TVs, audio systems, roof-light blinds etc. and IR motion detectors on security lights and cameras etc. are NOT a problem. *These are usually easily identifiable by the LED or plastic window in the front edge of the remote control. If you are unsure whether a remote control works by **infra-red** or **radio** put it inside an opaque bag and press the buttons – if it still works it is radio, if it doesn't it is infra-red.

3. Additional NO COST / LOW-COST Precautions EVERYONE Should Consider if Above Actions Helped

If you have noticed any reduction in your symptoms or improvement in general health and wellbeing as a result of taking the steps in Section 2 above you are almost certainly adversely affected by EMFs and you should consider taking these additional steps if you think there is scope for further improvement:

- 3.1. Preferably **switch all power off at the fuse-box / consumer unit at night** if you can do so without compromising safety and security – the effects of EMFs are most detrimental when you are sleeping as they are particularly disruptive to the restorative and regenerative processes that take place then. (Battery-operated motion detector LED lights can be used as an alternative to a torch for safety in essential areas, and your emergency escape route, in the dark).

Modern freezers keep cold for 24 – 48 hrs without power if not opened. Fridges will get a little warmer overnight but are usually okay if you keep a couple of 1.5L plastic bottles of water in the freezer during the day and put them in the fridge at night when the power is off, as long as you don't have any raw meat / fish in the fridge – freeze those instead. If you doubt that the fridge stays cold enough overnight this can be easily checked with a fridge thermometer. Alternatively put the fridge/freezer in the garage and leave just that circuit on at night, or run an extension lead from the garage supply to power the fridge/freezer, but ensure the lead doesn't run close to anywhere you sit, stand or sleep.

- 3.2. If you can't turn off all the power at night, turn off the circuits that supply your bedroom and adjacent rooms (including above/below) if you can without compromising safety and security. Note that without the right kind of meter to test for electromagnetic fields (see Section 12 – Test Equipment) you could still be affected by the wiring to other rooms you haven't switched-off passing through the floor, ceiling or walls of your bedroom without you knowing.
- 3.3. '**Double-insulated**'* electrical items (identifiable by a two-wire mains leads and often, but not always, a plastic earth pin on the plug) don't have an earth connection and so although they are safe from electric shocks they are often very bad at suppressing the lower frequency EMF radiation, especially if they have a metal chassis and a Switch-Mode Power Supply. Ideally keep such items well away from you (preferably **2m**) or, alternatively, if it can be done safely by a competent person, earth the metal chassis or case. (*See Section 16 – Figure 6)

(My printer was emitting very high levels of radiation so I attached a temporary earth wire with a crocodile clip to the metal chassis and it stopped it completely – when I turned the printer over to look for somewhere suitable to make a permanent connection I found part of the metal chassis was exposed through a gap in the plastic cover and there was an unused screw hole labelled 'FG' [Frame Ground] – I connected a proper earth wire to that and the problem was solved. It looks like the Canon designers identified the possible need for an earth connection but it hadn't been used on this variant)

- 3.4. **Lighting Circuit** wiring in the walls / floors / ceilings can often radiate far higher levels of EMFs than the Ring Main wiring (connecting the power sockets) because for large parts of the circuits the Live wire does not have a Neutral and/or Earth wire running next to it (which reduces the electric fields produced), as is the case in the Ring Mains. So preferably, where and when practical and safe to do so, use table / floor lamps instead and switch the lighting circuits off at the fuse box. (Battery-powered LED lights with motion detectors are cheap and can be used to provide enough illumination for you to switch on/off table or floor lamps)
- 3.5. Using a corded landline phone is vastly preferable to using a mobile, however the EMFs from corded phones can be further reduced by keeping the phone and its lead away from any mains wiring, especially the mains lead and power supply of a corded answerphone. Very sensitive people may find that even corded phones connected to a landline carrying broadband are still a problem for longer calls, despite the line filters that are fitted, and so using the phone 'hands-free' at a distance of at least 30cm can help in this eventuality.
- 3.6. Walking or cycling is not only beneficial from the exercise point of view but is also to be preferred as it keeps you away from Wi-Fi and mobile radiation on public transport and from adjacent vehicles.
- 3.7. Use loudspeakers instead of headphones and keep them **60cm** or as far away from you as possible.

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- 3.8. If you are a performer always try to use a wired microphone instead of a radio mike.
- 3.9. Low-voltage DC-powered electronic equipment generally produce negligible **electric** fields unless they are designed to transmit signals (e.g. mobiles, Bluetooth and Wi-Fi devices) and also usually generate insignificant **magnetic** fields unless they contain powerful motors (e.g. power tools). Also electrical / electronic items with 3-wire mains leads and **earthed metal cases** generally produce far lower levels of EMFs than items with 2-wire mains leads and/or plastic cases. (See Section 16 – Figures 7 & 8)

Consequently when buying such items, from an EMF emissions point of view, you would be well advised to choose either the battery-powered versions or mains-powered versions with a metal case and 3-wire mains lead. Avoid double-insulated* products with a two-wire mains lead (usually flat or figure-of-eight in profile with a plug that often has a plastic earth pin) as although they are safe from an electric-shock point of view they often radiate much higher levels of EMFs as they are not earthed. (*See Section 16 – Figure 6)

Although battery-powered tools do produce a significant **magnetic** field it is usually very much smaller in comparison to the **magnetic** field produced by an equivalent mains-powered tool. (See Section 17 – Table 11) Battery-powered tools, being both low-voltage and DC, produce much lower **electric** fields which are only generated when the motor is running, whereas mains-powered tools generate **very high electric** fields when the motor is running and are still producing significant **electric** fields from the mains leads even when it isn't being used. Therefore battery-powered tools are preferable.

- 3.10. Equipment manufactured for aerospace, aviation, marine, medical, military, railway and similar environments where malfunctions due to interference could have serious consequences are designed to produce minimal or zero radiated EMFs. Many companies which supply these markets also manufacture commercial and domestic products which are 'stripped-down' versions and, therefore, have inherently superior performance in respect of EMFs as the designers often employ a lot of the same fundamental design principles just using lower grade, cheaper components.

So although the products from these manufacturers may be slightly higher in price than similar products from the high-volume consumer-market-only manufacturers they are often much safer from an ES point of view. (Due to their derivation they are also usually more robust and reliable too)

4. Further Steps Anyone Who Still has SIGNIFICANT Symptoms Should Definitely Consider

Some of these measures are more costly and more hassle but are nevertheless worth considering if you are **very sensitive** and have any **significant symptoms** which have been helped by the measures in Sections 2 & 3 above but you are still suffering to a sufficient degree to want to seek further improvement.

Any unshielded cables or wiring running in close proximity to other unshielded cables or wiring for any distance have the propensity to 'pick-up' induced EMFs from each other depending on the voltages and frequencies they are carrying. Hence if you are very sensitive and unable to get the field strengths down to the recommended levels in your environment simply by keeping your distance from the worst sources, an alternative option to shielding all cables is to check if the EMF levels reduce sufficiently if you segregate any problem cables / wiring you can't avoid from other cables / wiring.

- 4.1. If after carrying out all the recommendations in Section 2 & 3 you still have significant levels of EMFs from a corded landline phone check the routing of the fixed internal phone wiring to the phone socket to ensure that it doesn't run close to any mains leads or mains wiring in the wall, behind the skirting boards or under the floor for any distance. If it does run close to any mains wiring first try to prove that is the problem by disconnecting the internal wiring at the BT Master Socket and plugging the phone in there instead. If that reduces the EMFs from the phone to an acceptable level either reroute the mains or phone wiring away from one another, or enclose either one in an **earthed metal** conduit, if you are competent to do so. (Don't put both in the same conduit!)
- 4.2. Unshielded **Ethernet cables**, designated UTP (Unshielded Twisted Pair) can radiate very high levels of EMFs despite being low-voltage due to the high-frequency of the digital signals, and this can be augmented by mains frequency as well if they run adjacent to mains leads or fixed wiring in the walls / under the floor. Most Ethernet cables supplied free with products and sold in high-street stores are

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unshielded UTP ('UTP' is usually printed on the cable). Keeping such cables away from any mains wiring and yourself will help to reduce the level of EMFs you are subjected to, but replacing them with screened cables **if they are properly earthed** (see 4.4) will eliminate the problem completely. Shielded Ethernet cables are designated **F/UTP, S/UTP, S/FTP or S/STP** (in order from most to least flexible) and are designed for use in high EMF environments such as power stations, data centres, factories and hospitals to prevent interference.

- 4.3. Although **USB cables** are shielded as standard, again the shield is not fully effective unless it is earthed and whilst standard USB sockets provide a connection to the outer shield of the plug on the USB cable, this part of the socket is not always earthed within the equipment, although it ought to be, so it is worth checking. Properly earthed USB cable shields significantly reduce the EMFs from the computer keyboard and mouse.
- 4.4. Shielded audio, data and video signal cables do not offer the full protection unless they are plugged into sockets which have an earth connection – if **both** the items that the cable is connected to have only a two-wire mains lead then the cable screen will **definitely not** be earthed unless another shielded cable which is properly earthed at the other end is also connected to one of the items.

Unfortunately this lack of earthing is **very common** with most consumer items such as Smart TVs, Sky Boxes, Wi-Fi Hubs / Modem / Routers, games consoles and compact hi-fi systems etc. as they only have a two-wire mains lead, or are powered by a DC lead from an external power supply which itself has only a two-wire mains lead.

Just because the mains lead has an earth wire does not *necessarily* mean that the earth is connected through to the signal cable socket, but this can easily be checked with a multimeter or continuity tester by putting one probe on the earth pin of the plug on the mains lead and the other probe on the shield contact of the signal cable socket (either the outer metal shell of the socket or a contact strip which will connect with the metal shell of the plug on the cable). (See Section 16 – Figure 3)

For Ethernet connectors earthing is provided by a metal spring strip down the inside of each side of the socket which makes contact with the outer metal side of the plug. (See Section 16 – Figures 1, 2, 4 & 5)

Only reputable brand desktop computers seem to have the connectors properly earthed, although this is not guaranteed. (E.g. my Dell desktop Ethernet connectors were earthed but through either a design oversight or manufacturing error, the USB connectors were not so I had to rectify that myself)

Tip: If you have any audio, video, or computing item with a two-wire mains lead and, therefore, the signal cable screens are not earthed, first check that the earth connections on all of the signal cable sockets are connected together, which should normally be the case. If they are, the simplest way to provide an earth connection (without opening up the item and voiding the warranty) if you are competent to do so safely, is to 'cannibalise' a spare cable which plugs into one of the data or signal sockets you are not using and connect its screen to earth, taking care not to short-out any of the other connections. Then when you plug the modified cable into the item it will earth all the other screened cables plugged into the other sockets. (See Section 16 – Figure 3)

To avoid any doubt, digital optical cables don't require screens as they do not carry electrical signals.

- 4.5. If after all the other measures loudspeakers still produce unacceptable levels of EMFS putting an earthed metal mesh (fine mesh) in front of them will reduce the level further.
- 4.6. Similarly putting an earthed metal mesh (fine mesh) over the open part of an earthed metal lampshade will further reduce the level of EMFs radiated without affecting the light output too much.
- 4.7. As any objects made of metal have the propensity to attract and radiate EMFs, unless all sources of radiated EMFS have been dealt with at source (e.g. fixed mains wiring all run in **earthed metal** conduits, mains leads with **earthed** screens, where applicable etc.) in order to reduce the overall levels of EMFs in your home it is recommended to earth any metal furniture and fittings such as filing cabinets, bed frames*, lamp bodies / shades etc. – get someone qualified to do this if you are not competent working with electricity.

* For more sensitive people it is considered better to have a wooden bed frame, preferably with no, or

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minimal, metal fittings unless the bed is in a very low EMF environment.

NB: Earthing metal furniture is likely to lead to more static electricity shocks if you wear synthetic materials, but if you are sensitive to EMFs then it would probably be wise to avoid wearing synthetic materials anyway due to the electric charge they can build-up.

- 4.8. Similarly if you think you might be very sensitive (i.e. if taking the other measures brings about improvements and your symptoms are reduced but still present) it is recommended not to wear any items made of metal or containing metal parts such as watches, spectacles*, jewellery, belt buckles, buttons, studs, zips, and steel toecaps etc. and not to keep metal pens, coins, keys etc. in the pockets of close-fitting clothes such as jeans and shirts.

Note: None of the metal objects above will cause any problems in environments with really low EMFs.

* Beware that many apparently plastic frame spectacles still have metal side arms and/or metal hinges inside the plastic and this can be enough to cause problem for very sensitive people – all-plastic frames seem to be very difficult to find but I found some cheap reading glasses with plastic frames that have just one metal screw as the pivot in each hinge which seemed to have reduced my headaches prior to me achieving very low levels of EMFs in my house. Sadly that particular item doesn't seem to be available anymore but there may be others that are similar. If you want to find all-plastic prescription glasses try searching for MRI Safety Glasses – I've seen them but unfortunately can't remember where.

Metal mattress springs are also thought to cause problems for sensitive people so it is recommended to use alternatives such as a foam mattress or futon. If you are not sure that changing to a foam mattress is worth it in case it doesn't have the desired effect, you can get many different brands on a 100-night free trial and they will collect for free if you decide you don't want to keep it – that's what I did and it made such a difference I kept it! (I can't say for sure that it was the absence of metal springs that made the difference but who cares what the reason is if you are sleeping better?)

- 4.9. If it can be done safely by a competent person, earth the metal chassis of double-insulated* items such as printers and scanners. (*See Section 16 – Figure 6)
- 4.10. If it can be done safely by a competent person, earth the metal bodies of double-insulated* lamps, cooker hoods etc. (*See Section 16 – Figure 6). Note that earthing the metal housing of a cooker hood will help to reduce the Electric Field produced by the fan motor but will NOT reduce the Magnetic Field at all. Consequently if the Magnetic Field is a problem for you increasing the distance is the only option. This can be achieved by either fitting a fan in an exterior wall instead (connected to the cooker hood via ducting - preferably plastic) if that is far enough away to reduce the Magnetic Field sufficiently, or by routing the duct through another room or roof space and fitting an inline duct fan further away (not close to anywhere you will spend any length of time).

It is also worth noting that although many sufferers think it is best not to use an extractor fan at all because of the EMFs they produce a documentary on air quality (Dr Michael Mosley?) recommended that they should ALWAYS be used with gas cookers and should be turned on before you even ignite the gas due to the noxious fumes produced and which are even more of a problem if you have MCS.

- 4.11. If it can be done safely by a competent person, consider replacing mains leads with a screened mains cable; especially in any places where they can't be kept well away from the body.
- 4.12. As an alternative to switching circuits off manually at night, and when not required, many sources recommend installing Demand Switches which automatically disconnect the mains when the last item on the circuit is switched-off and reconnect the mains as soon as any item is switched-on again. However they are not cheap (approx. £175 ea.), they don't fit into many 'standard' domestic consumer units and you will need one Demand Switch per circuit*so you will most often also need a new, much larger, consumer unit fitted in order to accommodate them, and the larger consumer unit may not fit in the same space as the existing one so some fairly extensive rewiring may be needed to move it to a new location. To comply with Building / IEEE Wiring Regulations all such work needs to be carried out and certified by a qualified electrician which can be very costly. Additionally this method only reduces EMFs from the fixed mains wiring when nothing is switched on, or on 'Standby', so personally I would recommend the solution outlined in 5.1 as this totally eliminates EMFs from the fixed wiring 24/7.

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If you **are** thinking about getting Demand Switches installed why not ask the electrician to quote separately for rewiring the house in metal conduits (with metal-clad switches and sockets) as well, so that you can evaluate whether it is worth paying the difference for total 24/7 protection. And don't forget with the latter option you will also get the opportunity to reposition sockets away from any places you spend any appreciable amount of time, for an even better outcome.

*A [Demand Switch](#) would be required for all the circuits that run in the walls, ceiling and floor of your bedroom – which would often be both the upstairs and downstairs rings mains and lighting circuits and could possibly include the separate cooker and immersion heater circuits too depending on the location of your kitchen and hot water tank in respect to your bedroom, i.e. 4-6 circuits.

- 4.13. If your car's engine is in the front get someone else to drive if you can so you can sit in the back, preferably on the opposite side to the fuel pump (consult a workshop manual or your mechanic to determine the location of the fuel pump). If you do all the driving consider getting a rear-engine car next time you change your car, if you can find a suitable one. (Porsches have rear engines!)
- 4.14. It is often recommended if you are badly affected to choose base-model cars with the fewest electrical accessories and no electronic devices (e.g. manual window winders, door mirrors, and sun roof, no air conditioning etc.) and if you drive an automatic a mechanical automatic transmission is preferable. (You would probably have to find quite an old model to achieve that as all automatic transmissions are electronic nowadays as far as I am aware) However in my car the levels from all the electrical systems and equipment are negligible compared to those coming from the engine's ignition system, the alternator and the charging circuit wiring from the alternator to the battery.
- 4.15. It is also often recommended to have any mercury amalgam fillings removed by a specialist who knows how to do so without risk of inhalation, absorption or ingestion of any toxins.
- 4.16. Although many ES sufferers think that open fires or wood-burning stoves are an attractive alternative for heating and/or cooking the ITV Tonight programme "[Air Pollution](#)" broadcast on 21/10/21 revealed that open fires and any wood-burning stoves / cookers more than 2 years old emitted levels of 'particulate matter' high enough to pose major problems for anyone suffering from any respiratory conditions or multiple chemical sensitivity (MCS), which is common among ES sufferers.

5. Considerations for New Builds, Renovations or House Extensions to Reduce EMF Exposure

The following measures will further reduce exposure and / or avoid the need for some of the previous precautions.

- 5.1. Run all fixed wiring in **metal** conduits together with metal-clad switches and sockets, and a consumer unit with a metal casing. This system is traditionally, and most economically, surface-mounted (as seen in historic buildings and factories) but can be concealed at considerable extra labour and cost, as well as the upheaval of lifting floorboards in every room and, of course, redecorating all the walls that have been tampered with to conceal the conduit within. (Some electricians will decline to quote, or give a ridiculous price to avoid winning the job to retrofit concealed conduits because it is such a pain) However surface-mounted electrical conduits are currently regarded as trendy 'industrial chic'!

As regulations require that all these metal fittings are earthed it totally eliminates radiation from the fixed wiring (including all but the very worst 'dirty electricity' too) and avoids the need to switch circuits off at night / when not in use and to keep sofas, chairs, and beds etc. away from walls, sockets* and switches. (*Precautions still need to be taken with regard to mains leads plugged into the sockets – see section 2.26)

In order to keep costs down, if you are competent to do so, you can install all the new wiring yourself (without disconnecting the old system) but to comply with Building / IEEE Wiring Regulations you would need to get a qualified electrician to inspect, test and certify the new installation as well as to change over the connections from the existing to the new installation. However as labour charges are usually more significant than the cost of materials this still represents a substantial saving. (**Tip:** Find and talk to the electrician you intend to use before starting the work yourself as some are reluctant to certify someone else's work and may want to discuss or vet certain system design elements and will

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almost certainly need to inspect intermediate stages as well. Also check with them whether leaving all the sockets and switches open will reduce the time and, therefore, cost of the certification process)

The [Scientific Panel on Electromagnetic Field Health Risks](#) also recommends that “Governmental codes relating to building design and construction should be revised so **that all new electrical wiring is enclosed in a grounded metal shield;**”

Although ‘**Ring Mains**’ are promoted by the IEEE Wiring Regulations (18th Edition) / BS7671 they are **not mandatory** and a properly designed and installed ‘**Star**’ or ‘**Radial**’ configuration, as widely used in most other countries, is also completely compliant and is preferable from the point of view of reducing the Magnetic Field generated by the mains wiring. See also Powerwatch Electrical Wiring [Overview](#) and [Article](#) for more information and guidance.

- 5.2. Position sockets well away from anywhere you might want to sit or stand for any length of time and especially where you sleep. Although the above measure will eliminate radiation from the fixed wiring there will still be a degree of radiation from the mains leads of the items plugged into the sockets (unless the mains leads are screened and earthed) and from the items themselves so careful positioning of the sockets and the items that will be connected to them will help to maintain a suitable distance from these sources and thereby further reduce exposure levels.
- 5.3. If installing under-floor heating use the piped-water type **not** electrical heating elements.

6. Masts, Towers, Transmitters and ‘Safest’ Mobile Phones

Power Levels

The average mobile phone transmitter / antenna **unit** (commonly referred to as a tower, mast or base-station) has a power output of **10W**, but in order to increase coverage and call capacity a single mast or tower *may* have up to **10 units** giving a potential total output of **100W**. However most mobile phone base stations have between 1 – 6 units and even then they usually only approach full power output on all units for short durations at peak call times.

Mobile phones on the other hand have two power settings of **0.6W** and **3W**. A call is always initiated at full power output from the mobile; the tower then determines the received signal strength and instructs the mobile to reduce its power output to the minimum that is consistent with maintaining an acceptable call quality. This is done to extend the battery life, not to protect you from excessive radiation.

The farther you are from a tower or base-station, or the more obstacles in between, the higher the power output of the phone will be set in order to establish reasonable call quality. Also the more you move around during a call the higher the overall levels will be, as each time the tower senses a significant change in the received power level it instructs the phone to readjust the power output, which means going to maximum power output again before reducing to find the new optimum level.

This is worst of all in densely populated built-up areas where base-stations can be only a few hundred metres apart as every time you connect to a different base-station the phone goes to maximum power output and starts the process over again. Plus of course you are closer to the base-stations so you are also receiving a much stronger level of signals from them too. Therefore using a mobile whilst walking or driving down the street in a densely populated built-up area or travelling by train are possibly the worst case scenarios for getting maximum radiation exposure, so best to keep to very short, essential calls only in those situations. Whereas for minimum exposure, remaining stationary in a location with a strong signal (and Wi-Fi / Bluetooth disabled) is the best scenario for a longer call.

5G

Although there are huge amounts of marketing hype about how great 5G will be it is very difficult to find much about the technical details of the phones and infrastructure. However the information available from credible sources all say at the much higher frequencies that it will operate (necessary to get the sought after bandwidth) the signals don’t travel very far, have more difficulty penetrating common building materials than the frequencies used for the current 2, 3 & 4G systems, and will be adversely affected by some types of window glass and even heavy rain! Consequently it is reported that antennas will be needed at least every

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500m and this is confirmed by footage of US cities where antennas are being fitted to almost every other lamppost or telegraph pole.

If the above limitations are true it would appear to be entirely possible that unless you are situated close to an antenna with a clear line of sight, through the right kind of window glass, you will need an external antenna wired to an internal repeater (possibly in every room) in order to get a reliable signal indoors!

The bad news for ES sufferers is that it is thought that the higher frequencies are likely to be more problematic. But the good news is that given the reported range and penetration problems it will be much easier to get away from 5G if you are prepared to relocate to a rural environment with few near neighbours, as the most sparsely populated areas will almost certainly be the very last to get 5G, if ever... It seems unlikely to ever be economically viable for service providers to install the infrastructure required to erect an antenna to serve just one or two households unless they receive major subsidies for such work, and given that adequate funding is not available for essential services such as healthcare, education, social housing, policing, pensions etc. surely no government would be prepared to fund 5G rollout where there is already any adequate existing mobile and broadband coverage.

See [5G – a building biology perspective](#) for more information and recommendations.

Distance is Key

The [inverse-square law](#) means that unless you live close to a mast / transmitter* the EMF radiation you receive from devices in your immediate environment (including possibly neighbouring** properties) is likely to be **much stronger** than that from local masts / transmitters. This is reflected in '[How dangerous are mobile phones, transmission masts, and electricity pylons?](#)' published by Swinburne University of Technology, Melbourne, Australia which states "**In terms of absorbed RF energy, the delivery from a handset is typically around a thousand times more than that from a base station...**" due to the fact that most people hold their mobiles directly against their head so the signal strength is at its maximum. This also illustrates why it is most important to deal with all the EMF-radiating devices in your surroundings before starting to worry about more distant sources.

*Opinions vary considerably as it depends on the antenna design, power output, height, and location of the mast / transmitter but as a general guideline Wi-Fi Hotspot <100m, Mobile mast <600m, Radio & TV masts < 1km is considered too close for sensitive individuals but, as always, the further away the better.

** Cordless phones and Wi-Fi are the worst culprits and many Home Wi-Fi Hubs now have a range of 100m.

Mast / Tower Locations

The web site [Cell Mapper](#) can be useful for identifying the location of mobile towers but note that it does NOT show ALL of the towers in ANY ONE VIEW – you have to select each **Provider** in turn (i.e. Vodafone, O2, EE, 3 etc.*) and for **each Provider** you have to step through **each of the Networks** they operate (2G, 3G, 4G & 5G), one at a time, to see ALL the towers in the area. (Leave the **Band** setting as 'All Bands') Also note that it can take some time for the towers to appear each time you change the Provider / Network selection and the larger the area of the map on the screen the longer it will take to populate with all the known towers.

* Although Vodafone, O2, EE and 3 are the main providers across the whole of the UK you need to work through all 21 of the providers listed (and every network for each of them) if you want to be absolutely sure there are no more towers in the area as a number of the other providers supply regional services.

Checking the location of towers can be a useful first step in choosing a general area to relocate to but is no substitute for measuring the actual levels on-the-ground at any likely-looking location, and always try to do that at busy call times to see the worst case levels. Remember that unless you will be very near to a tower that EMF sources in your home, and from close neighbours, are likely to be much stronger.

TETRA (Terrestrial Trunked Radio) is a network operating at frequencies slightly lower than microwaves that also causes problems for many sufferers. The system is used by emergency and government agencies, and although there does not appear to be any way to look-up the location of TETRA masts they are normally located on ambulance, fire and police stations, or local council and government buildings, but sometimes also as free-standing towers in rural areas with large regions to cover away from any of these types of buildings.

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Real-Life Examples

Bearing in mind that there are many factors which affect the actual power levels received from masts such as the rated power output, number and type of antennas, cell size and configuration, surrounding geography and obstructions, weather conditions, the number of calls in progress, the distance of the connected users at the time of measurement, the output from the connected mobiles varies from model to model, the settings, and the distance from the mast, and there are problems with measuring constantly changing signals with less sophisticated equipment, the above theory is generally supported by my own observations.

At approximately **840m** from a local mobile **mast** (in clear line of sight) the power level was around the same as **50cm** away from my **mobile** during a **call** (Wi-Fi + Bluetooth disabled), and around **10 times less** than being **2m** away from my **mobile** with **Wi-Fi enabled**.

Similarly the power level at approx. **110m** from the **mast** is **5 times less** than **5mm*** from my **mobile** during a **call** and around the same as being **50cm** away from the **mobile with Wi-Fi enabled**, or **2m** away from the **Wi-Fi Router** (*There are inherent problems in making accurate measurements in the 'near field' with any test equipment)

It is also interesting to note that at **6m** away from the **Wi-Fi Router** the signal level is around the same as **850m** from the mobile **mast**, and my router isn't even one that has a **100m** range.

'Safest' Mobile Phones

If you are not so badly affected that you cannot use a mobile phone at all and you want one for occasional use, following all the 'best practice' guidelines, it makes sense to have one which has the lowest levels of radiation. Although it doesn't tell you everything that is important about the level of risk of harm from a mobile phone the best measure we have to go on at present is the Specific Absorption Rate or SAR value. (SAR is a measure of the heating effect, which is proportional to the power output of the mobile. A lower SAR value means a lower power output, which in turn is **very likely** to have **reduced, but still significant, non-thermal effects**) Note that the SAR test mobile manufacturers use only has a phone call in progress, they do not have Wi-Fi and Bluetooth transmitting simultaneously with the call which will significantly increase the radiation levels, and in many cases far exceeds the phone network signal by many times – see Table 5 in Section 17.

The German organisation BfS stopped updating its SAR Search Tool in Dec 2020 and it is no longer listed on their web site but can still be accessed [here](#) – it is useful to look-up SAR values of older mobiles but most of the mobiles with the lowest ratings listed as 'Current model' are no longer available through regular outlets, although you might be able to find second-hand or reconditioned units. The only model with one of the lower SAR values I could find available as brand new was the Samsung Galaxy Note 10 Lite (Head SAR 0.16 W/kg) which was a model made for the Indian market and bought from a supplier in the USA.

Many, but not all, manufacturers publish the SAR values for their various models but you often have to dig around very hard to find them on their web sites as they are rarely included in their general specifications. From the searches I have done recently Samsung seem to have the lowest SAR values for currently available mobiles and this is said to be due to a specially designed antenna which only radiates away from the head instead of being omnidirectional which is the standard in most mobile designs. However this antenna is not fitted in all their phones and the levels can vary dramatically even between models of the same series, including 'XY' and 'XY Lite'. Often it can be easier to find SARs for other brands on review sites rather than from the manufacturer's web site – here are a few useful sites:

[Samsung SAR Information](#) – Note that you have to enter the Model **Number** here NOT the **Name** they are known by, (e.g. Galaxy Note 10 Lite is an **SM-N770F**) and the part number is not given on their own web site descriptions but are most easily found in ads on Amazon or eBay! (This SAR Info page is not linked on their web site either; I got given it by their Tech Support when I asked them for the SAR values) Also note that different Model Number suffices such as **/DS** etc. can have different SAR values as they are intended for different markets which have different limits that must be met.

[Device Specifications](#) – also useful for additional spec info, especially the frequency bands supported

[GSM Arena](#) – also useful for additional spec info not given by manufacturers on their own web sites

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A new **minimalist** mobile, the [Mudita Pure](#), has been designed to have ultralow SAR values of around Head 0.08 W/kg and Body 0.62 W/kg. However you can't use it for internet, social media, Apps, games etc. **only** phone calls, texts, music, calendar, alarms and notes as it is deliberately designed to minimise intrusions into daily life as well as radiation exposure. However you can tether your laptop to it via USB-C cable to access the internet over GSM if needed. It looks very well designed for an 'offline life' and the only real negative is that it doesn't have GPS to enable you to give your precise location in emergencies (especially in the wild) – I have raised this with them and they will be putting considering it for the first round of design modifications.

7. Important Notes re Surveys, Field Strengths and Distance, and 'Protective' Devices etc.

Note 1: Expert Surveys

Surveys by 'experts' can be very costly and although they have their place if all else fails I would strongly recommend implementing all of the measures in Sections 2 & 3 above, and as many as possible of Section 4, before spending the money on such a survey as you may well find that these actions alone are enough to reduce your exposure and symptoms to an acceptable level.

If the above actions don't bring about the degree of improvement desired it is also worth considering buying the Acoustimeter + GS ME3830B test meters mentioned in Section 12 below to help you identify the sources of problems as they come with good instructions and are pretty straightforward to use (if you can master a Smartphone or Satnav you should have no trouble using these) and together they cost considerably less than a survey, plus you will have them for future use to check out any new equipment or premises.

Note 2: Keep Your Distance

The strength of radiated electromagnetic waves, in this case EMFs, reduces significantly with increased distance from the source (the inverse-square law). Keeping away from the things mentioned in the sections above applies to being the other side of a wall, ceiling or floor too as most construction materials have little effect on the penetration of EMFs and some actually attract, concentrate and, therefore, in effect amplify it. Therefore being completely detached from your neighbours is a definite advantage as you cannot control what is emitted from their property.

Note 3: Electric vs Magnetic Fields

The harmful **AC electric fields** are produced by **voltage not current**, so they are **still present even when all appliances and lights are switched off** as the voltage is still fluctuating in all the Live wiring in the walls, ceilings, floors and the mains leads of appliances up to the contacts of the switch on the item, **even when there is no current flowing**. Therefore it is preferable to **switch things off at the wall or unplug them** when not in use (unless their mains leads have earthed screens) to prevent EMFs being radiated from the trailing mains leads which are often positioned close to your body.

Many items nowadays have no power switch as they are designed to be permanently on 'standby'. This means that as the remote control part of the internal circuitry is always functioning the power supply is permanently on, albeit in a low-power mode, and so the SMPS will also be producing the higher frequency, more penetrative and more harmful EMFs in addition to the mains frequency EMFs from the power lead. Therefore it is even more important to switch these items off at the wall or unplug them when not in use.

(Although all CE-Marked items have to comply with the EMC Directive, which limits the amount of EMF they can radiate, the limits are aimed at preventing interference with other electrical equipment and so actually permit levels high enough to cause harm to sensitive individuals. However the levels radiated depend on the shielding and suppression techniques used and, consequently, some items are well below the limits and hence far less harmful)

It is **magnetic fields** that are produced by the **current flow** when an item is **switched on**.

Although a small **magnetic field** is produced by a current flowing in any circuit, **much stronger magnetic fields** will be produced by anything with a **coil** or **winding** in it such as alternators, dynamos, generators, motors, relays, solenoids and transformers. So that includes anything with moving parts that is powered by, or generating, electricity. And the **higher the power** rating of the item (for items operating at the same

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voltage), the **higher the current** that will be flowing and, hence, the **stronger the magnetic field** will be.
Power (W) = Voltage (V) x Current (A).

Note 4: ‘Blocking’ / ‘Protection’ Devices

There are all manner of chips, crystals, diodes, pouches, stickers etc. and devices to plug into the wall socket or stand next to your mobile or Wi-Fi router on the market, that are no-doubt aimed specifically at people who don't want to change their dependence on wireless devices and who just want a 'quick and easy, fit and forget it, fix', which are claimed to '**block**', '**neutralise**' or '**harmonise**' the harmful EMFs they produce. Mobiles and wireless devices work by transmitting microwaves which are the 'harmful EMFs' and any device (whether due to technological or 'alternative' methodology) which actually succeeds in blocking, neutralising or 'transforming' the EMFs (microwaves) effectively would also stop the mobile or wireless device from working, so you might just as well save your money and **turn the device off** or onto '**airplane mode**', a **scientifically proven solution**.

It is cheaper, and unquestionably far more effective and reliable, to reduce your exposure by eliminating, or distancing yourself from, all sources of EMFs (see Sections 2 & 3 above) than to rely on any form of 'protection or blocking device' – why would you trust something, often relatively expensive for what it is, that **cannot be proven to work**, over taking **free / low-cost measures which can be verified** by mainstream test equipment? ('Shielding' is covered separately in Section 7)

Note 5: Devices and Products to Reduce the Effects of EMFs

Then there are devices and products which you either wear, or put near you, which claim to help your body to withstand the harmful effects of EMFs, rather than to 'block' or 'neutralise' the EMFs which cause them. Again these seem to me to be aimed specifically at people who don't want to change their dependence on wireless devices and who just want a 'quick and easy, fit and forget it, fix'.

I have tried pretty much all of the most common complementary therapies and, indeed, I have been a practitioner in a couple of them myself, I practise Tai Chi and Qigong, and have discussed with other ES sufferers the alternative approaches they have used. Whereas **most** complementary therapies and exercise regimes seem to provide *some temporary* beneficial effects, none have been found to be **fully effective** in enabling the body to cope with the level of daily exposure to EMFs in modern everyday life, even with frequent treatments or daily exercises. (As mentioned earlier it is commonly reported that natural therapies are more effective and 'hold' for longer on people who also minimise their exposure to EMF radiation)

However, in my opinion, in majority of cases, there is a world of difference between **a physical or spiritual therapy, or practise**, which produces **perceivable** (and often **measurable**) changes in the body, and **wearing an item or placing an item** somewhere either **close to you** or **within the same building**, which generates **no perceivable or measurable change within the body or environment**. So despite being open to 'alternative' methodologies in general, the electronics engineer and scientist in me is still very sceptical about the proof of efficacy of most of these 'alternative' devices and products, and the principles by which they are supposed to work. So again, why would you choose to pay for and trust devices that **may**, but **cannot be proven**, to work **before** taking **free / low-cost** measures which **have been scientifically verified**?

The only product I have personally evaluated and found to be of any help (but not a complete solution) is an electronic pendant which utilises ultra-low-level Pulsed Electromagnetic Fields (PET) designed to resonate with the body's natural acupuncture meridian system and provide support for the body's natural self-regulating and adaption mechanisms, effectively periodically helping to resynchronise and readjust these internal systems when they have been disrupted by external factors such as EMFs. However the only evidence of its efficacy I have is empirical, so it is impossible to rule-out the possibility that something else was responsible for, or contributed to, the improvement I noticed.

Note 6: Electromagnetic Compatibility [EMC] Directive (latest version [2014/30/EU](#))

The EMC Directive was essentially introduced to limit the electromagnetic radiation produced by all electrical and electronic items to a level which would eliminate interference principally with computers, other digital electronics and radio-frequency equipment and 'clean-up the airwaves' to pave the way for the roll-

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out of mobile phones (and ultimately other wireless technology) which would not have performed acceptably in the then existing electromagnetic environment.

However it is important to note that the levels of EMFs which will not cause significant interference with electronic devices is still way above the levels which have the potential to cause harm in humans and other living organisms. Also the Directive only applies to electrical / electronic items sold in the EU since its introduction in 1992 – 1995 (i.e. bearing the 'CE' mark), so older items and those not imported legally into the EU are unlikely to comply and, therefore, are likely to emit much higher levels of EMFs.

8. Shielding Considerations

It's Generally Difficult and Expensive

Without going into a great deal of detail about the technicalities of achieving effective shielding and the pros and cons of different materials and techniques, when working on compliance with the [Electromagnetic Compatibility \(EMC\) Directive](#) it was found that even very small gaps or holes of only a few millimetres can let through significant levels of high frequency EMFs dependent on their location, proximity to, and strength of the source. Additionally given the way that high frequency waves propagate, reflect, refract and diffract and the multitude of sources encountered in the typical built-up area, I seriously doubt whether it is practical and economically viable to make any significant area of the average home into a Faraday Cage impervious enough to reduce EMFs to a level acceptable for highly sensitive people.

If you could achieve the required level of shielding in a particular space to sufficiently reduce harmful EMFs you would still be subjected to problematic levels in the rest of the home, garden and surrounding area.

Faraday Cages Not Recommended

If you do manage to create an effective Faraday Cage it would also block-out natural radiation such as the Schumann Resonance which is considered by many to be beneficial and, therefore, highly undesirable to block. Some sources recommend leaving a small gap in the shielding to allow the Schumann Resonance to penetrate but this relies on **ALL** the unwanted EMFs coming from much the **same direction** so you can leave a gap on the opposite side **and** there being **no reflective surfaces** on the other side within range of the gap.

(I have found that even a very small gap allows EMFs in – see Example under 'Bed Canopies' below)

Shielding Is The Last Resort

For these reasons shielding should only be considered as the **very last resort** (a view supported by Dimitris J. Panagopoulos, Radiation and Environmental Biophysics Research Centre, Greece). Eliminating the sources of EMFs and keeping the maximum distance from any sources which can't be eliminated (as described above) should always be the preferred approach **before** considering relying upon **any** kind of shielding.

Bed Canopies Could Be A Worth A Try?

That said an **earthed** 'bed canopy' **plus** an earthed mat or metal sheet under the bed, with all the joins overlapping properly can reduce the level of exposure but is unlikely to completely eliminate unwanted EMFs unless they are already at a relatively low level. The canopies are made of a mesh material interwoven with strands of silver (a conductor) and this will **attenuate** the signals but is **not claimed to block them** completely. Not all materials are equal, so if you have implemented all the precautions above and still have problems that might warrant giving a bed canopy a try, look at the material specifications for the ones with the highest attenuation rating (e.g. 60dB attenuation is better than 40dB). It is also worth considering the permeability as this can also vary considerably between different materials and some don't allow enough fresh air through to stop your sleep quality from being significantly impaired by low oxygen levels instead! There are a number of suppliers who offer a 'free' trial period of 1 month (i.e. you get a full refund if not satisfied with the results).

Earthing the canopy and the mat or metal sheet under the bed will **greatly** improve the shielding effect; however the level of reduction will be dependent on both the attenuation rating of the material and the strength of the EMFs, so eliminating the sources or increasing your distance from them is recommended.

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Real Life Example – I bought a bed canopy made from ‘Bloc Silver’ conductive shielding fabric which is supposed to be one of the best materials for both attenuation (60dB at 3 GHz) and breathability. The canopy was earthed and used with an earthed steel sheet under the bed to form a Faraday Cage. When I switched my Wi-Fi router back on, solely for testing purposes, the signal was reduced to 25% of the strength from outside to inside the canopy, but was still at a significant level even though the router was **8m** and 2 rooms away.

Simple tests with my mobile showed a signal reduction of only 1 bar inside the canopy and it was still possible to make and receive calls inside. I also tried leaving a gap, as recommended to avoid problems with blocking the Schumann Resonance and low oxygen levels, but found that a **1cm** gap on either of 2 (opposite) sides was enough to restore the mobile signal to full strength and a **2cm** and **4cm** gap on the other two sides respectively did the same. Additionally the same gaps in the side of the canopy facing my router, or in either of the two adjacent sides, also let through almost the full strength Wi-Fi signal.

Similarly, with no Wi-Fi operating in my house, the mobile found 7 Wi-Fi networks available outside the canopy but 1 network was still available when inside the canopy, even though my nearest neighbour is **12m** away. Finally with my mobile on standby on the bedside table the signal level inside the canopy was still undesirable even though it was significantly reduced.

All of which demonstrates the importance of dealing with the sources as effectively as possible rather than just relying on shielding instead. After all you wouldn't pay to have wet room floor installed in your bathroom to deal with water overflowing from the bath or sink coming through the ceiling below, you would address the **cause** of the problem by turning-off the taps and ensuring the overflow and waste pipes were not blocked – a far more effective and cheaper solution.

Interestingly however, my bed canopy (with metal sheet underneath) completely blocks low-frequency EMFs such as mains, even though the specification for the material says the attenuation at low frequency is poor.

Shield or Move?

If your symptoms are not reduced to an acceptable level by following all the advice in the sections above personally I would recommend **seriously** considering moving house to a more favourable location rather than trying to install effective shielding. However, in either case, before incurring the expense and hassle of moving house or installing shielding I would strongly recommend trying to verify whether either measure is likely to achieve the desired results by staying for at least a week (preferably two) in an extremely low EMF environment e.g. camping in the middle of a field well away from overhead power cables or possible underground cables, at least **100m** away from any buildings and at least **1km** from any masts. (If you use a caravan or campervan don't use the electrics and disconnect the battery)

In order not to confuse the issue it is recommended to keep your diet, alcohol consumption, smoking, exercise, sleep patterns and **all other aspects of daily life** as near normal as you can to try to eliminate the possibility that a change to one or more of these other factors could be responsible for any improvement in your symptoms rather than the reduction in EMF exposure. **If** your symptoms don't start to improve any further in this kind of environment then it would seem that shielding **or** moving house is **not** very likely to bring any benefit. **If** your symptoms **do improve** in this environment, **and it's not due to any other factors you have changed during your stay** (e.g. not working, more rest and relaxation etc.), then moving house without **also improving your environment at work*** may only bring limited relief. However as the **duration of exposure** is equally important as the **strength of the EMFs**, drastically **reducing your exposure** outside of working hours **may possibly increase your resilience** enough to be **less affected** by exposure during your time at work, **especially** if you can do everything that is within your direct control to reduce exposure in the immediate surroundings of your workspace (e.g. positioning and use of mobiles, computers, phones, Wi-Fi / Bluetooth devices, electrical and electronic equipment and their leads etc.), **but equally it may not**.

*Under the **Health & Safety at Work 1974 Act** and the **Equality Act 2010** employers are required to provide safe and healthy conditions for all workers and visitors to their premises, and excluding some people is not an option. However unless you have an extremely understanding and sympathetic employer, and/or the changes required are minimal and easily implemented, due to the potential significant hassle and cost of suitably adapting your workspace, it is likely that most employers would want **written confirmation of the diagnosis** from a **licensed medical professional** before undertaking any such changes and, unfortunately,

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this can be a very difficult to obtain due to the lack of knowledge and recognition of the condition within the NHS. (See Section 15 - References / Useful Links - **Letters Intended for Medical Professionals** which may be of help in this regard)

If you are unable to stay in an extremely low EMF environment for a long enough period of time as described above, an alternative approach which *might* help you to determine if moving or shielding would help is to keep a detailed diary of your daily activities and symptoms for a few weeks to see if there is any correlation between the worsening of your symptoms and your use of electrical / electronic equipment, vehicles, public transport, public buildings / spaces etc. and working, living, sleeping environment – however it is important to bear in mind that there may be a time delay (sometimes hours) between exposure and symptoms becoming apparent, and reduction in exposure and symptoms disappearing, and it may take longer for symptoms to disappear than to become apparent in the first place. Also short exposures / weaker fields may have little effect whereas prolonged exposures or stronger fields could.

Unless you can replicate absolutely ALL the aspects of normal daily life in an environment with extremely low EMFs there are NO GUARANTEES that either moving house OR installing shielding will be worth it. (In my case I also have other reasons for wanting to move, such as greater peace and quiet, so it makes sense to include the ES considerations of increased distance from sources outside my control in the selection criteria for my new house)

It is worth noting that although asking the family to move house, especially if other members of the household would also need to change jobs and schools etc. in the process, can cause a lot of stress on relationships, living with a person who is severely affected by ES, and is very likely to become worse as time goes on if they do not move away from the causes, can be equally stressful and destructive. **Consequently discussing all the possible options and solutions with everyone involved is highly recommended.**

If you should decide to move, the consensus seems to be that choosing a location where there is a poor but perfectly usable signal (at least on one network / band), preferably far enough away from masts to be below the recommended level of $0.1 \mu\text{W}/\text{m}^2$ (Peak) in the bedroom, **and** that has a reasonable landline-based broadband speed, is likely to be a much safer bet than an area with NO signal at all, or unreliable coverage, and/or poor landline-based broadband speeds, as the latter cases are far more likely to get new masts installed in the future given the government's policy to eradicate all mobile blackspots (eventually) and to give everyone access to high-speed broadband. (5G is already being used in some rural areas to provide high-speed broadband where it is cheaper to install than landline-based broadband) See Section 15 - References / Useful Links – Cellmapper and Signalchecker to make preliminary checks on an area of interest, but these are **no substitute** for taking measurements on the ground in the actual location.

Undoubtedly a detached house with no close neighbours, well away from masts, pylons and other infrastructure would be the ideal choice from an EMF point of view. However if the electricity supply is overhead with a step-down transformer mounted on the side of the house (rather than on a pole 10m or so away) you should plan not to spend any time at all in the area the other side of the wall if you cannot get the transformer moved away from the house. (Here a meter to check the field strengths inside the house would be highly recommended to determine how far away you need to keep from the location of the transformer)

If you **are** considering installing shielding it is very worthwhile reading this document first:

[Reduction of high-frequency EMFs during house reconstruction](#) – Hugo Schooneveld PhD – A good guide to the practicalities and pitfalls, however please note that rather than leaving the wall and floor earth connections disconnected because the mains supply earth was, in their words, “contaminated with dirty power transients” it would have been better to connect them to an independent earth provided by an entirely separate earth rod /spike.

Given the amount of work and expense of installing **truly effective** shielding, and bearing in mind that it will often **only reduce, NOT eliminate, strong external EMFs, IF** the **main** sources causing you problems are **just Wi-Fi** and **DECT** from your **immediate neighbours** it would be much cheaper, and far more effective, to offer to pay for them to get **corded phones** (+ additional sockets, if required) plus **data switches** and **Ethernet cables** to create a **wired LAN**, than to pursue shielding. That is if you know them well enough to be confident that no-one in their household is addicted to wireless gadgets and they would always use those alternatives instead. It can cost circa £1,000 for a double-bed canopy and > £10,000 to shield 2 rooms properly, whereas

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paying for corded phones and a wired LAN for neighbours **both** sides could cost as little as a £100 – £300 (See **Typical Costs of Wired Alternatives** in Section 16) and would reduce the levels in the **whole of your house and garden** **IF** there are no other local external sources strong enough to cause problems.

9. Earthing the Body

Walking bare foot on wet grass or ground is the best natural way of earthing the body but getting cold feet in the process is highly undesirable health-wise so it is best confined to warm days.

Wearing socks and footwear made of only natural materials (other than rubber), although less effective than bare feet, can also help with earthing outdoors, but only works indoors if the floor is deliberately earthed and a conductive material – most modern construction methods include a damp-proof course which also electrically insulates the floor from the ground. (Flooring materials which don't absorb water and, therefore, don't need a damp-proof course are generally non-conductive too)

A variety of earthing products are available from wristbands, mats and pads to bed sheets, however using such products is **completely counterproductive in the presence of high levels of EMFs** as earthing the body in such environments causes the body to act like an antenna and actually **attracts** the RF and conducts it to ground **increasing the body voltage** in the process, rather than reducing it. So as with other 'protection' methods it is extremely important to eliminate or reduce all sources of EMFs **before** relying on earthing.

(Wearing only natural materials will help to avoid high body voltages due to the build-up of static charges caused by synthetics and will also reduce the need for earthing.)

10. 'Dirty Electricity'

So-called 'dirty-electricity' (DE) and its effects is a contentious subject. The term DE refers to the presence of transient voltage spikes and high frequency (HF) signals 'superimposed' on the mains power supply.

Transient voltage spikes can be produced by arcing from un-suppressed or inadequately suppressed heavy industrial equipment, faulty equipment or connections, and potentially by anything that switches on and off rapidly, unless adequate circuit design measures have been taken to prevent or suppress it. This includes anything which 'arcs and sparks' as part of its normal operation, such as the brushes on electric motors, and the contacts of switches and relays. As the majority of transient voltage spikes usually dissipate over relatively short distances in the electricity supply lines, unless you live very close to an industrial area, or someone using industrial equipment in their garage, it is **not very likely** that a **majority** of transient voltages would be **strong enough**, or **frequent enough** to be a **significant** factor in causing health problems for a vast majority of households. (Voltage spikes can cause harm to electronic items such as computers which is why 'surge suppressors' are commonly recommended to protect them.)

The HF elements of DE are produced most commonly by the 'Switched Mode' circuitry used in the power supplies and voltage regulators of many everyday electronic products, such as computers, entertainment systems, printers, TVs, chargers, power inverters and dimmer switches etc. but also including fluorescent lights, induction hobs and anything else with rapidly oscillating currents / voltages, especially if preventing external EMFs was not a prime design consideration, which sadly is all too often the case with the cheaper mass-produced consumer products. **Conducted** HF EMFs usually don't travel far and are mostly likely to be caused by items in your own home, or your immediate neighbour's.

Whilst DE undoubtedly exists there is controversy over its potential to cause harm to sensitive individuals, its degree of prevalence in the average home, the accuracy* and reliability of the test meters, and the safety of some of the filters marketed for use by ES sufferers. (*These test meters cannot be 'calibrated' in the conventional sense as there are no National or International Standards for this type of measurement, so each manufacturer will have their own method which could give rise to very different results from one brand of meter to another) Furthermore I have not seen any **justification** as to why ES sufferers should require any **special** meters to measure DE. For **if** any DE present is **strong enough to generate EMFs which radiate out from the mains wiring** they would be expected to be detected by **standard EMF meters** (see Section 12). And **if** the DE present is **too weak to generate any fields which radiate out from the wiring**, but is just

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conducted along it, I have not seen any evidence that purely **conducted** EMFs (as opposed to **radiated** EMFs) of any kind have any potential to cause ES, although they can harm susceptible electronic equipment.

Additionally I have not seen any convincing evidence to suggest that the level of DE on a normal household mains supply would be **likely** to produce EMFs that can **radiate** from the wiring to any **significantly greater extent** than the normal **low-frequency EMFs** generated by a 'clean' mains supply and hence would usually be expected to be dealt with effectively by the same measures recommended for **mains-frequency EMFs**. Consequently I would strongly recommend **implementing ALL the other preventive measures** described in Sections 2 - 5 above (esp. 3.1 – 3.4, 4.1 – 4.11) **BEFORE** spending any time or money on test equipment, filters, or any other measures to attempt to identify and deal with DE.

Commercial and domestic electrical items should comply with the EMC Directive* and hence should not produce significant external EMFs unless they are faulty, if they were bought after 1st Jan 1996 when the transition period to introduce the new regulations had ended. (*First became law in the UK on 28th Oct 1992) Therefore if you suspect you have an issue with DE a **wise first step** would be to disconnect any of the items described above that were bought or installed before 1996 to see if that cures the problem. However, as **Solar Panel Mains Inverters** are notorious for producing high levels of DE, unless specifically designed not to, it would no doubt be wise to check for this when choosing a system.

If you have **already tried everything else** and think that DE might be a problem for you, see [EMFields Solutions - How to deal with Dirty Electricity \(DE\)](#) or [Powerwatch - Dirty Electricity](#) for more information and a somewhat different point of view. (See also 5.1 above)

11. Blue Light and Poor Sleep (This can also Affect Many Health Conditions)

Although nothing to do with ES another thing to be aware of regarding poor quality sleep is the blue light output from LED computer monitors & TVs, mobiles, tablets, Kindles etc. As mentioned in the notes too much blue light at night inhibits the production of melatonin which is responsible for sleep.

This was mentioned in both the TV programmes 'Doctor In The House' and 'The Truth About Sleep' but they only suggested not using such devices 1-2 hours before bedtime or using special (amber) tinted glasses to filter out the blue light – neither mentioned that the best solution which is to download and install an app called f.lux: <https://justgetflux.com/>. **f.lux** is a cross-platform computer program that adjusts a display's colour temperature according to location and time of day. The program was designed to reduce eye strain during night-time use and reduce disruption of sleep patterns <https://en.wikipedia.org/wiki/F.lux> and is also available for smartphones. I have used this for many years and it is reliable and malware free. If your computer runs **Windows 10** the '**Night Light**' option under **Display Settings** does the same function.

Additionally for TVs set the colour (white) balance to '**Warm**' or '**Movie**' settings to reduce the blue light output. (Neither of the aforementioned TV programmes mentioned that LED and Fluorescent /CFL lamps were a problem regarding blue light too)

12. Test Equipment

I would strongly recommend implementing all the measures in Sections 2 & 3 above and waiting a couple of weeks to see if your symptoms start to improve **before** buying **any** test equipment of any kind, as you may well find that those measures are enough to bring about the level of relief from your symptoms you are seeking and there is no need to 'dig any deeper' or get more technical about solutions.

Caution: All the values for 'typical' or 'average' field strengths emitted by any given item in this document, 'official' web sites, and anywhere else you might see them are just **examples for general guidance** and in reality **will vary wildly, up and down**, depending on the make, model, ratings, settings and current mode of operation of every individual item, the particular test equipment used and its distance from the item, and their respective orientation. Consequently if you are more than moderately affected there is **no substitute** for having your own test equipment, or being able to borrow some, to check out the exact circumstances for **your items**, in **your environment**, in the **position** and **way you use them**.

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Although I have not had the opportunity to test too many different examples of these particular instruments myself I have been responsible for evaluating, selecting and using a wide range of sophisticated test equipment in the electronics industry (and confirming the suitability of equipment chosen by others) the main criteria being **accuracy, resolution, repeatability, reliability** and **fitness for purpose**, which also includes the ability of the likely operators to use it correctly. I assessed the specifications and reviews of all the popular meters offered to meet the particular needs of EHS sufferers before deciding upon the recommendations below. I own and use the **Acoustimeter AM-10 & Gigahertz Solutions ME3830B** which have performed perfectly adequately to help me dramatically improve my everyday environment and, consequently, my general health and wellbeing.

Spectrum Analysers are the only truly accurate device to measure all aspects of EMFS but they are very expensive and require a fair degree of expertise to use correctly and to analyse and interpret the results that are obtained properly. However Spectrum Analysers are **not** strictly necessary to identify the **presence, relative strength** and **approximate direction** of all the most common sources sufficiently reliably to enable them to be dealt with effectively, where that is possible.

In most situations it is not necessary to know to the n^{th} degree the exact nature, strength and precise direction of every EMF and the equipment recommended below is perfectly adequate to help to find it, eliminate /reduce it, and check that the reduction measures taken have worked.

NOTE 1: When choosing any test equipment the **poorer*** the **accuracy** and/or **sensitivity / resolution** of the meter, then **the closer** that the measured value gets **to the threshold** (boundary) between any 2 particular classifications (e.g. in Tables 3 & 4 in Section 17 'No Abnormality' / 'Slight Abnormality' / 'Severe Abnormality' etc.), the **more uncertain** it becomes as to which category the real level actually falls into and hence the **more likely** you will make a **false** 'Okay' / 'NOT Okay' judgement. (***Poorer = larger number** in both cases)

NOTE 2: The **sensitivity** of a test instrument is the **smallest incremental change** in signal level that the instrument can **detect** and is **not to be confused** with the **lowest value** that a particular measurement range **goes down to**. Whereas **resolution** is **smallest increment** or **division** which can be indicated on the instrument's **display** or **dial**. E.g. a meter with a frequency measurement range of **100 kHz to 500 MHz** could perhaps have a **sensitivity** of **100 Hz** but may only be able to **display** readings to the nearest **1 KHz** due to insufficient digits on a digital display. (Note that in this instance although the resolution is poorer than the sensitivity the last digit of the reading is more reliable than if the resolution and the sensitivity are the same as the higher sensitivity allows rounding-up and down to derive the last digit of the value displayed)

NOTE 3: As the **accuracy, sensitivity** and **resolution** of **each measurement range** are absolutely fundamental to determining the suitability of any measurement instrument to perform the task required and to assess its ability to give reliable and repeatable results when used for the intended purpose (as well as to be able to compare the performance of similar instruments) and, therefore, this data is always provided as standard by every reputable test equipment manufacturer I would NOT TRUST any test meter that does not clearly state this information in their product listings and User Manual.

Recommended Testers

[EMFields Acoustimeter Model AM-11 \(200 MHz – 8 GHz\)](#) perfectly adequate and seems to give reliable and repeatable results but only measures down to $1 \mu\text{W}/\text{m}^2$ not the $0.1 \mu\text{W}/\text{m}^2$ limit recommended by the IBB for sleeping areas and IGNIR for Sensitive Individuals. This model has **both** $0.02 - 6.00 \text{ V/m}$ **Peak Voltage** and $1 - 100,000 \mu\text{W}/\text{m}^2$ **Average Power** (Density) scales. **Note:** There is debate as to whether **Peak Voltage** (V/m) or **Average Power** (Density) ($\mu\text{W}/\text{m}^2$) levels are the most harmful aspect of HF fields. (See Section 14 - [Measuring the Power of Analogue and Digital Radiofrequency \(RF\) Signals](#) and Section 17 for further info)

There are a variety of reasonable-looking **multi-axis directional meters** to test for microwave frequencies such as [Gigahertz Solutions HF32D](#) or [HF35C](#) plus the [HFW35C](#) but for all the reputable manufactures I have seen you need to buy 2 separate meters to cover the full frequency range, unless you go to the high-end professional equipment which costs much more than the 2 separates. However I would suggest that in most cases **multi-axis directional meters** are unnecessary as the direction the signal is coming from is not really that useful as, given my comments on shielding in Section 7 above, partial shielding is rarely achieved

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sufficient improvement and **if** you should decide to try to create a Faraday Cage (not generally recommended) the direction of the source is totally irrelevant. If you are trying to identify and eliminate sources the Acoustimeter is perfectly adequate in most situations as the signal strength will increase or decrease as you move towards or away from the source.

If you go to the [Acoustimeter web page](#) and click on the “**Further Information**” tab you can play recordings of the type of audio you will hear on the Acoustimeter to help you to identify the different signal types i.e. GSM, DECT, 3G, Wi-Fi and Tetra which may help you to identify the source and direction of the signal.

[Gigahertz Solutions ME3830B M/E Analyser \(16 Hz – 100 kHz\)](#) best for Low Frequency Electric (V/m) and Magnetic (nT) Fields (A reputable company making professional instruments for the electronics industry, not just for ES sufferers) **Note:** The ME3030B model only goes up to 2 kHz.

NOT Recommended

ESI24 EMF Meter – A recently introduced relatively cheap 3-in-1 meter which does not give any figures for accuracy and sensitivity (resolution) on any of its ranges, which immediately makes me suspicious as these are fundamental to evaluating the capabilities of ANY measuring instrument, and especially for comparison purposes. Promoters claim it to be ‘very precise for the money’, so if it is so good why isn’t this important information provided anywhere, not even in its manual? (I asked one of the sellers for this information but did not receive any response to my email) (See also Note 3 on page 27)

Adverts claim it measures magnetic fields, electric fields, and radiowaves **simultaneously**, but the manual states “**Move slowly** around to detect ambient electro-smog (**the device performs a new detection every two seconds**)” which seems to indicate that it will take 6 seconds in one position to measure all 3 EMF types.

Additionally, the **lowest** indication on the **electric field strength** scale is only **<6 V/m**, which is at the bottom end of the IBB ‘**Severe Abnormality**’ category. (**< 1 V/m** is their limit for **sleeping areas**, which couldn’t be measured on this meter). Also you have to switch to the ‘enhanced sensitivity’ mode which uses all 3 scales just for RF to measure levels as low as, and anywhere near comparable in range and increments, to the Acoustimeter AM-11 which somewhat defeats the object of having a 3-in1 meter as you still need to take multiple measurement scans in the different modes.

Tenmars TM-196 3-Axis RF Field Strength Meter - I bought one as the specification stated it would cover the range of both the above Gigahertz Solutions models in one instrument but it didn’t have anywhere near the stated* sensitivity and required to detect the necessary levels. (*Possibly due to confusion / loss in translation of the difference between the smallest **value** that could be **displayed** and the smallest **change in signal level** the instrument could **detect**?) It also had a serious bug which randomly gave completely inaccurate readings that an inexperienced user would be unlikely to identify, so I returned it for a full refund. (I later found that this bug had been reported on the web by a number of other pro users)

Trifield TF100XE EMF Meter - Although astonishingly this meter seems to have many fans there are also a number of very bad reviews regarding the accuracy, sensitivity and repeatability of readings obtained from it and this extremely poor performance is now confirmed on the [manufacturer’s own web site](#) . Scroll down their web page to see the specification comparison with their newer model, the TF2 – on the RF/Microwave range the TF100XE has **accuracy** as poor as **-50% / +200%** and **sensitivity** of only **100mW/m²**.

A sensitivity of **100mW/m²** means the meter can only detect any difference in signal level in 100 mW/m² steps and nothing in-between so an actual level of say **50 mW/m²** (even with a very high accuracy) could be displayed as **either 0 mW/m² or 100 mW/m²**. Whereas the accuracy of **-50% / +200%** means for an actual level of **50 mW/m²** that the meter’s display could read **anywhere between 25 – 150 mW/m²**.

So with the two factors taken together, an actual level of **50mW/m²** (IBB ‘**Slight Abnormality**’) could be displayed as **anywhere between 0 – 150 mW/m²** and hence it would be **completely arbitrary** as to whether the reading the TF100XE gives would fall into the category of ‘**No Abnormality**’, ‘**Slight Abnormality**’ or ‘**Severe Abnormality**’ and be completely misleading as to whether action is required or not. Note that in comparison, on Trifield’s new model **TF2** the same RF/Microwave measurement range is quoted as having an **accuracy** of **+/- 20%** (10 times better) and a **sensitivity** of **0.001mW/m²** (100,000 times better!) which would seem to be an acknowledgment of the total inadequacy of the TF100XE’s capability on this range.

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13. Electromagnetic Frequency Spectrum Typical Usage

Table 1 - Electromagnetic Frequency Spectrum Typical Usage		
Frequency Range	Unit	Usage
0.1 - 30	Hz	'Brainwaves'
7.83	Hz	'Schumann Resonance'
16.7	Hz	(Rail & Tram) Electric Traction Systems (Europe)
50	Hz	Building mains supply - UK and Europe + (former) Territories and Dependencies
60	Hz	Building mains supply – USA + (former) Territories and Dependencies
1 - 1000	kHz	Switched Mode Power Supplies (SMPS), inverters
20 - 50	kHz	Compact Fluorescent Lights (CFLs)
150 - 1600	kHz	AM radio broadcasts
3 – 300,000	MHz	Radar (see Table 2 below)
27	MHz	CB radio
31 - 77	MHz	Analogue Cordless Phones
35 & 40	MHz	RC models
88 – 108	MHz	FM Radio broadcasts
370 – 400	MHz	TETRAPOL (used in Europe instead of TETRA but non-pulsed signals*)
380 – 460	MHz	TETRA (Terrestrial Trunked Radio – used by emergency + gov agencies)
466	MHz	PMR446 personal 2-way radio
470 – 855	MHz	Digital TV broadcasts
694 – 790	MHz	Mobile Phones (5G)
800 & 900	MHz	Mobile phones (2G – 4G)
964 – 1,860	MHz	Satellite TV Channels
1.8, 2.1 & 2.6	GHz	Mobile phones (2G – 4G)
1.2276 & 1.57542	GHz	SatNav
1.9	GHz	DECT (Digital) Cordless Phones
2.1	GHz	Mobiles phones (5G)
2.4 – 2.5	GHz	Wi-Fi (Wireless-b, -g and -n), Bluetooth, RC models, mice, doorbells etc.
2.45	GHz	Microwave Ovens
3.4 – 3.8	GHz	Mobiles phones (5G)
5.15 – 5.85	GHz	Wi-Fi (Wireless-a and -n), wireless data links and CCTV cameras
24.25 – 27.5	GHz	Mobiles phones (5G)
32 – 33	GHz	Mobiles phones (5G)

***non-pulsed signals** have very little effect on EHS sufferers compared to pulsed signals at the same frequency and power

For full details of the entire radio frequency spectrum see the [Ofcom UK Frequency Allocation Table](#)

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The shorter the wavelength / higher the frequency, the more potentially dangerous the signals are as more of the energy is absorbed by cells. Although radar frequencies may not in themselves be of any particular interest to you the descriptions of 'typical usage' in the table below give a good indication of the distance the different frequencies can propagate and their ability to penetrate foliage, the ground, and rain / water vapour and hence how much of a problem they are likely to pose. However it should be noted that long-range signals will be very weak at a distance but will be much stronger than short-range signals at the same distance from the installation as they need to have the power to travel further.

Table 2 - Radar Frequency Bands			
IEEE Band Designation	Frequency Range	Wavelength Range	Typical Usage
HF	3 – 30 MHz	100 – 10 m	Over the horizon surveillance (ionospheric propagation); long range low resolution
VHF	50 – 330 MHz	10 – 1 m	Long-range (line of sight) surveillance, foliage penetration (FOPEN), counter-stealth, ground penetrating; low / medium resolution
UHF	300 – 1,000 MHz	1 m – 30 cm	Long-range surveillance, FOPEN; low / medium resolution
L	1 – 2 GHz	30 – 15 cm	Long-range surveillance, long-range air traffic control; medium resolution and small weather effects
S	2 – 4 GHz	15 – 7.5 cm	Moderate-range surveillance, terminal air traffic control long-range weather observation, airborne early warning (AEW); moderate weather effects in heavy precipitation
C	4 – 8 GHz	7.5 – 3.8 cm	Long-range tracking, weather observation, weapon location; increased weather effects in light / medium rain
X	8 – 12 GHz	3.8 – 2.5 cm	Short-range tracking, missile guidance, mapping marine radar, airborne intercept, battlefield surveillance, weapon location; reduced to short range operation in rain
K _u	12 – 18 GHz	2.5 – 1.7 cm	High resolution mapping, satellite altimetry, man-portable / unmanned air vehicle (UAV) radar; short range due to water vapour absorption
K	18 – 27 GHz	1.7 – 1.1 cm	Police radar; very limited use due to high water vapour absorption
K _a	27 – 40 GHz	1.1 – 0.75 cm	Short-range very high resolution mapping, airport surveillance; short range due to water vapour absorption
V	40 – 75 GHz	7.5 – 4.0 mm	Scientific remote sensing; high water vapour absorption
W	75 – 110 GHz	4.0 – 2.7 mm	Automobile cruise control (77 GHz), missile seekers, very high resolution imaging (94 GHz), high water vapour absorption elsewhere in band
mm	110 – 300 GHz	2.7 – 1.0 mm	Experimental; limited to short-range due to high water vapour absorption

14. The Technical Stuff (If You're Interested) + Why EMFs Have the Potential to Cause Harm

This section is non-essential reading, intended only for anyone who is interested in the science behind why it can cause harm or is yet to be convinced that it is not all in the imagination or complete hokum...

Electromagnetic waves are composed of a **magnetic field** depending on the electric current (ampere), and an **electric field**, depending on the electrical voltage (volts). Near the source (near-field) the magnetic component is dominant. At a greater distance, the electrical part and the magnetic part are present in a fixed ratio (far field). **Radiofrequency Radiation (RFR)** is a specific sub-section of the **Electromagnetic Spectrum** and, therefore, is included in the general term **Electromagnetic Fields (EMFs)**.

The Inverse-square Law

The strength of radiated electromagnetic fields is governed by the [inverse-square law](#), which means that the power reduces in proportion to the square of the distance from the source, i.e. at double the distance the power is reduced to a quarter, at treble the distance the power is reduced to a ninth etc. Therefore it can be seen that increasing the distance from sources of EMFs by even a small amount is still beneficial. This law also illustrates why, in the case of devices *designed* to transmit signals, in order to be able to cover large distances, the levels are so high (and potentially so harmful) in close proximity to the transmitting device. See also Section 6 - Masts, Towers and Transmitters.

[What are electromagnetic fields and where do they come from?](#) – World Health Organisation (WHO)

[Near and Far Fields](#) – Wikipedia

[Classical Electromagnetism](#) – Wikipedia

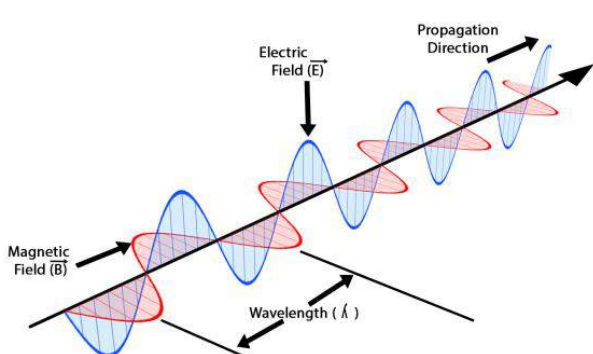
[Maxwell's Equations](#) – Wikipedia

[Electromagnetism](#) – Wikipedia

[Phase \(Waves\)](#) – Wikipedia – re waves in antiphase cancelling each other out

[Electrical Measurements on the Human Body](#) - JA de Groot

Electromagnetic Wave



Frequency is **inversely proportional** to **Wavelength**

therefore

the **higher** the **frequency**, the **shorter** the **wavelength**

and conversely

the **lower** the **frequency**, the **longer** the **wavelength**

How can EMFs be harmful?

The only form of harm to humans currently acknowledged by safety and regulatory authorities is the heating effect caused by microwaves which is exactly the same process by which the microwave oven works, but that is not the full story...

In the human body (and all living things) many of the internal processes are electrical in nature, such as nerve impulses and signalling which is why ECGs and EEGs are able to pick-up the electrical activity in the heart and brain, and also why electrical muscle stimulation works and artificial limbs can be controlled by implanted sensors. Additionally diffusion through cell membranes, both intake of nutrients and expulsion of toxic waste products, is influenced by a number of factors including the electrical charge of ions on either side of the barrier which can potentially be adversely affected by certain types of external EMFs.

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It is a basic law of physics that fluctuating EMFs induce currents / voltages in any conducting material or circuit that they intersect – which is why radio, TV and Hi-Fi interference, and computer memory corruption / crashes (e.g. ZX80) were frequently caused by nearby hairdryers, power tools, vacuum cleaners, taxi radios etc. prior to implementation of the EMC Directive.

EMFs can, and do, induce currents / voltages in the human body too and this is a fact that is acknowledged in documents published by the International Commission on Non-Ionising Radiation Protection (ICNIRP – who set the safety limits) and World Health Organisation (WHO) although they claim that there is (as yet) insufficient evidence that the levels are high enough to cause harm. Essentially they seem to want cast-iron proof before upsetting a multi-trillion dollar industry regardless of the fact that this is contrary to the [UNESCO Precautionary Principle](#) (which they have signed-up to) which states “**Interventions are required before possible harm occurs, or before certainty about such harm can be achieved (that is, a wait-and-see strategy is excluded)**”

Once an **induced current / voltage** becomes high enough in proportion to the **wanted signal** it can prevent that signal from being ‘understood’ by the receiving circuit in digital electronics, or causing the intended action or sound in analogue electronics.

For example, if you are old enough to remember the days before digital telecommunications you will probably recall that on long distance calls you could often hear another conversation in the background due to a type of interference call ‘crosstalk’ after this effect. If the other conversation was little more than a whisper it did not affect the ability of your message to be correctly understood at the other end, but once it becomes loud enough your message either becomes misunderstood or doesn’t get through at all.

(Two pairs of wires running side-by-side will induce ‘interference’ currents in each other but the induced currents are normally too low to be a problem. However as the induced currents become greater the longer the pairs of wires run in parallel the level of interference becomes great enough to cause a problem on long distance calls.)

The same principle applies in all areas of electronics – low levels of interference do not cause malfunctions or undesirable performance but there is a threshold at which they do, and this is what the EMC Directive was established to prevent.

As the signal levels in the human body are extremely low (micro-voltage and micro-wattage) compared to those in electronic equipment they are susceptible to disruption from interference signals at much, much lower levels than those which adversely affect electronic devices. Therefore it is undeniable that EMFs in the surrounding environment have the **potential** to disrupt the body’s functions. The **ONLY** question is at **what EMF strength and duration of exposure** does the disruption **reach a level which starts to cause harm**? This essentially is the basis of all the disagreements between researchers and medical experts, and regulatory and governmental bodies.

All the tests that have been used to support the case that exposure to currently permitted levels of EMFs does not cause harm have either relied on test subjects being able to consciously ‘detect’ that an unseen EMF source has been switched ON or OFF, which is invalid as very few electrosensitive people have instantaneous reactions of such intensity that can be felt, or the duration of exposure has been far too short for the disruption of biological processes in the body to be sustained long enough for symptoms to manifest to an observable degree.

It seems that the test philosophies applied to disprove the case (deliberately?) ignore that in many systems, biological or man-made, any given process does not necessarily need to function continually at optimum performance in order to achieve the desired outcome and so periods of stopping and starting, or running at reduced capacity can be tolerated. Also in all systems there is a threshold at which too many interruptions or too long running at too low a capacity will eventually cause the output to fall to a level which results in undesirable effects. Hence they do not take account of the potential cumulative, long-term effect of extended exposure to what they regard as low-levels of EMFs in disrupting human biological processes to a sufficient degree to cause ill-effects.

To draw an analogy, if you impair the operation of the heater, pump and filtration system in a tropical fish tank although their ‘life support processes’ are no longer functioning properly the fish won’t notice any change at all at first. It may be an hour or two before they notice any change and much, much longer before

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they start to feel unwell and become sick. Similarly once the impairment is removed and the heater, pump and filtration system are restored to normal operation it may take hours, and even days, for the normal environment to be re-established (achieve 'homeostasis') and for the fish to fully recover.

Measuring the Power of Analogue and Digital Radiofrequency (RF) Signals

RF signals may be a simple continuous wave (CW) signal, a pulse, an analogue modulated signal, or a complex digitally modulated transmission and each of these require the correct test equipment and methodology to measure their power accurately. Only the most complex (and expensive) professional power meters or a spectrum analyser, used correctly, are capable of giving truly accurate results for the power output of **all** these different signal types, as most power meters are optimised for a particular type of waveform and, consequently, are often (far) less accurate on the other types. The subject is further confused by the fact that different people mean different things when they use many of the terms (inappropriately) concerning waveform types and measuring their various characteristics, especially power.

The various waveform characteristics and behaviours and the effects on their measurement is quite a complex subject but here we will just focus on the main aspects which affect whether **peak voltage** (V/m) or **average power** (density) ($\mu\text{W}/\text{m}^2$) measurement is the most useful in the context of ES.

Radio frequency signals consist of a high frequency **continuous carrier wave** which has the 'information content' **encoded** onto it by either **analogue modulation** techniques (e.g. AM, FM, FDM etc.) or **digital modulation** techniques (e.g. ASK, FSK, PSK, FDMA, TDMA, CDMA etc.) as used in mobiles, Wi-Fi, Bluetooth, DECT etc.

With **analogue modulation** the resulting waveform **doesn't usually vary drastically in amplitude** over time which means that the **peak power** and **average power** levels are **not so very different** from each other.

Whereas in **some** formats of **digital modulation** the resulting waveforms are **far less consistent in overall amplitude**, especially as the **data** may **not be transmitted continuously** but in **bursts**, or '**pulses**', interposed with **unmodulated carrier signal**. The cumulative effect of all the breaks in between the bursts of data is to significantly reduce the average signal level compared to continuous data transmission. For **TDMA modulation** the **peak power** is **8.3 times higher** than the **average power**, a far greater difference between **peak** and **average** than typical **analogue** RF signals, and such variability in the difference between the two values causes problems for measuring instruments when trying to determine the **true average**.

Additionally it is thought by some that the **peak voltage** element of the signal is more **biologically disruptive**, and hence the greater cause of harmful effects, than the **average power** of a signal.

The combination of the problem of measuring the **average power** accurately across **all waveform types** in order to align with any recommendations, and the theory that **peak voltage** may actually be **more harmful**, has led to debate as to whether **average power** (density) or **peak voltage** is the most useful measure for use in Guidelines. See Section 17 for information on which **Guidelines** use **peak voltage** or **average power**.

Regardless of the chosen method of measuring signal levels, peak or average, and which aspect is most harmful, it is further proposed by some that the **stop / start bursts of data** is more '**shocking**' to the body, and hence more disruptive, than the comparatively '**smoother**' and more '**consistent**' wave pattern delivered by **analogue signals** which is easier for the body to cope with. However as the '**gaps**' between bursts of data in many formats are only fractions of a second this view is also subject to controversy.

Nevertheless perhaps this 'more shocking' theory could explain why it is reported that the European **analogue** TETRAPOL system is **well-tolerated** by ES sufferers, whereas the UK equivalent **digital** TETRA system (which operates on very similar frequencies) is **extremely problematic** for many sufferers.

This report from the [US National Toxicology Program](#) presents a lot of useful information on [Radio Frequency Radiation \(RFR\) Measurement and Applications](#) with regard to mobile phone systems and safety.

15. References / Useful Links

Note: In the early drafts of this document there were quite a number of links both in this Section and throughout the texts which have had to be removed because when they were rechecked prior to finalisation they no longer worked as the content had been removed from the relevant web site – not just reworked or

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reorganised, completely REMOVED and the subject matter no longer mentioned. Evidence of the growing controversy and that these organisations are no longer prepared to stand up and be counted for presenting factual information about the true science and developing research on the subject? Many more links had to be updated because the content had been renamed or reorganised but the (revised) content was still there.

[BioInitiative Report 2012](#) - A Rationale for Biologically-based Public Exposure Standards for Electromagnetic Fields (ELF and RF) which contains scientific evidence of the many harmful effects on the human body

[BroadBand International Legal Action Network](#) (BBILAN) – A network of lawyers and experts dedicated to finding balanced solutions for the global challenges of over-exposure to electromagnetic field radiation

[Cellmapper](#) - This web site can help to identify the location of mobile phone masts but note that you need to step through **each** of the (UK) Providers (Vodafone, O2, EE, 3) **AND, for each Provider, every Network** they operate (2G – 5G) as the masts are unfortunately shown on the map separately for each Network per Provider. Tip: **Turn-off** everything other than ‘**Display Towers**’ under ‘**Settings**’ in the left-hand menu.

[Comparison of international policies on electromagnetic fields 2018](#) - National Institute for Public Health and the Environment (Netherlands) – shows limits set by different countries, often well below ICNIRP limits

[Electromagnetic Compatibility \[EMC\] Directive 2014/30/EU](#) – European Commission

[ES-UK](#) – Homepage of Electrosensitivity UK a charity providing support and information for all people sensitised by electromagnetic fields and radiation

[ES-UK Resources](#) – Directory of useful documents on all aspects of electrosensitivity

[EUROPAEM EMF Guideline 2016 for the prevention, diagnosis and treatment of EMF-related health problems and illnesses](#)

[Guideline of the Austrian Medical Association for the diagnosis and treatment of EMF related health problems and illnesses \(EMF syndrome\)](#) – Austrian Medical Association

[Health effects from the electromagnetic fields of Compact Fluorescent Lights \(CFLs\)](#) – M Bevington, ES-UK

[How dangerous are mobile phones, transmission masts, and electricity pylons?](#) – AW Wood, Swinburne University of Technology, Melbourne, Australia – Contains some useful reference information but, as with many other sources, concludes there is insufficient evidence of ‘non-thermal’ effects

[Institute of Building Biology](#) The documents available in the ‘Downloads’ panel on the right-hand side of the home page are well worth reading, especially ‘Building Biology Evaluation Guidelines (PDF)’.

[International Guidelines on Non-Ionising Radiation \(IGNIR\)](#) (2021) based on EUROPAEM EMF Guidelines 2016

[Inverse-Square Law](#) – Wikipedia

[Powerwatch](#) – small non-profit independent organisation – interesting and useful information on EMFs

[Scientific Panel on Electromagnetic Field Health Risks](#) – Dr Adamantia Fragopoulou, Prof. Yuri A Grigoriev, Prof. Olle Johansson, Prof. Lukas H Margaritis, Lloyd Morgan, Prof. Elihu Richter and Cindy Sage

[Selected Studies on ES & EHS](#) – Over 2,000 studies and references - compiled by Michael Bevington, ES-UK

[Signalchecker.co.uk](#) – Mobile Coverage Checker by postcode for all UK networks with one search

[Switched-Mode Power Supply](#) – Wikipedia

Letters Intended for Medical Professionals

[Electrosensitivity – an Environmental illness, an Authentic Diagnosis, not a Delusional Disorder](#) – By Dr Andrew Tresidder MBBS MRCGP (1989) Cert Med Ed, Section 12 Approved Doctor

[ES GP Patient Letter](#) – By Dr Andrew Tresidder MBBS MRCGP (1989) Cert Med Ed, Sect 12 Approved Doctor

[Talking To Your Doctor](#) – WEEP Canadian Initiative to stop **Wireless, Electric, and Electromagnetic Pollution**

For queries related solely to implementing the recommendations to reduce EMF exposure in this document please contact [Tips for Reducing EMF Exposure@es-uk.info](mailto:Tips_for_Reducing_EMF_Exposure@es-uk.info) (Please note that this is not the address for queries on other ES topics and we are unable to give any advice on specific electrical safety issues)

16. Illustrations and Supplementary Information



Figure 1 – Ethernet Socket Cable Shield Contacts

Without the contacts shown in **Figure 1** on the socket at (at least) one end of the Ethernet cable there is no possibility that the cable shield /screen (see **Figure 5**) will be earthed. Even if these contacts are present they will not be earthed if the product has only a two-wire mains lead (see **Figure 8**) or is powered by an external DC power supply fitted with a two-wire mains lead.

In the case of the data switch above, as the shield contacts on all the sockets are connected together, if only one of the shielded Ethernet cables (see **Figure 5**) plugged into any one of the ports is earthed at the other end it will then earth the shields of all the cables connected to the other ports on this data switch.

Alternatively, as these contacts are connected to the metal case on this particular product, connecting an earth wire to the case will do the same job if you are competent to do so.

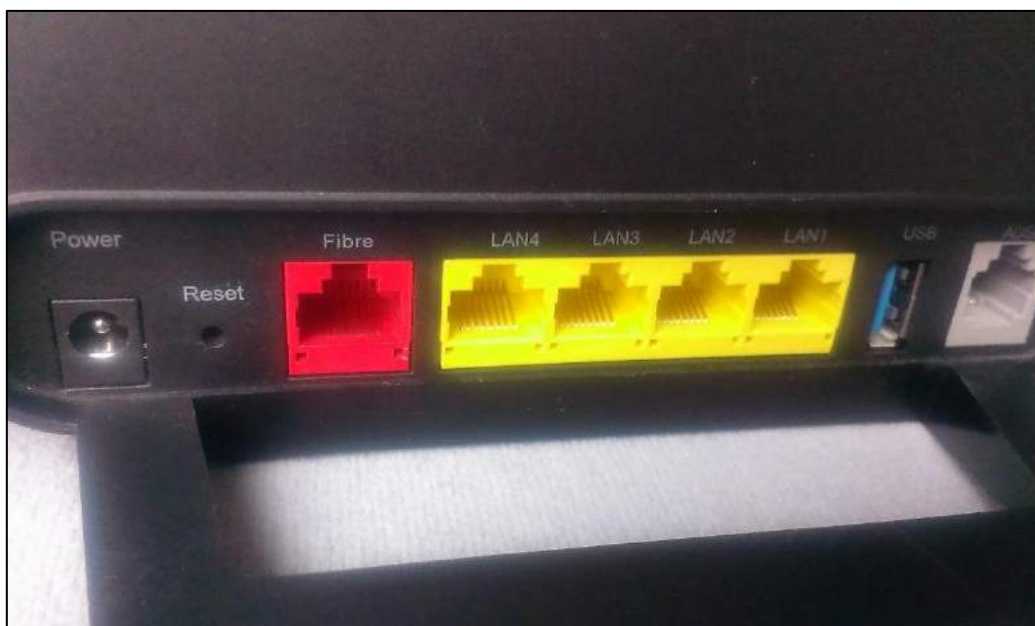


Figure 2 - Ethernet Sockets WITHOUT Cable Shield Contacts – No metal strips

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Figure 3 – Cable Shield Contacts for HDMI, Ethernet, Audio and Aerial Sockets (rear of a Smart TV)

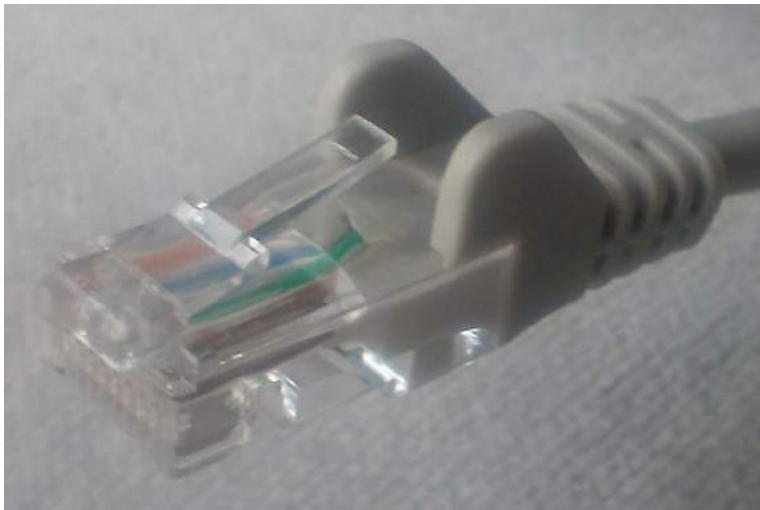


Figure 4
Unshielded Ethernet Cable – No metal cover on the connector



Figure 5
Shielded Ethernet Cable
Note the metal shield around the connector which also provides the contact for earthing the cable shield

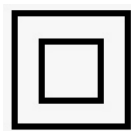


Figure 6
Double Insulated – The symbol used on product Rating Labels to indicate the item is double-insulated, and NOT earthed

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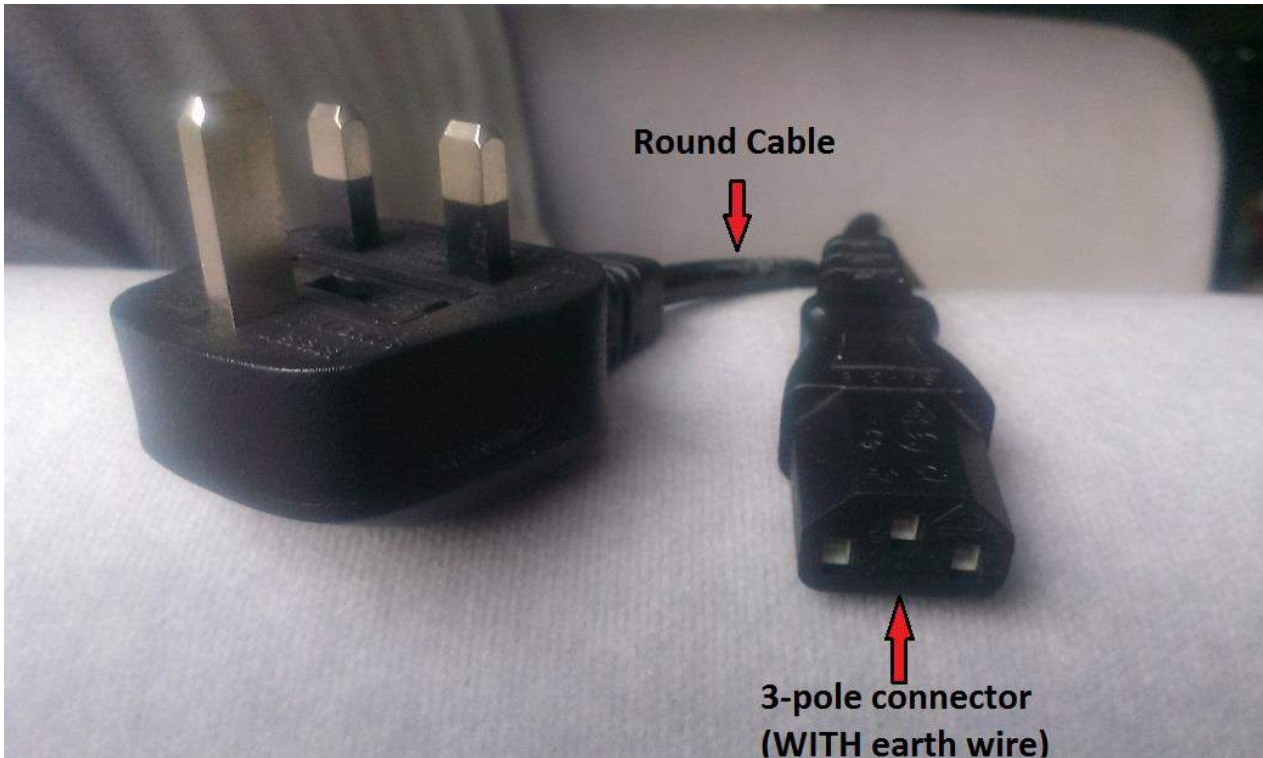


Figure 7 – 3-wire Mains Cable - EARTHED

Even if a product has a 3-wire mains cable with an earth wire it doesn't necessarily follow that the data or signal cable shield contacts shown in **Figure 3** are connected to earth without checking with a multimeter or continuity tester – **ALWAYS UNPLUG** any electrical item **BEFORE** testing earth continuity.



Figure 8 – 2-Wire Mains Cable – NO EARTH

Although 2-wire mains leads often have a plug with a plastic earth pin many also have a metal earth pin, which can mislead you into thinking that the product is earthed. Products which are **not** earthed usually emit **much higher** levels of EMFs.

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Earth or Ground?

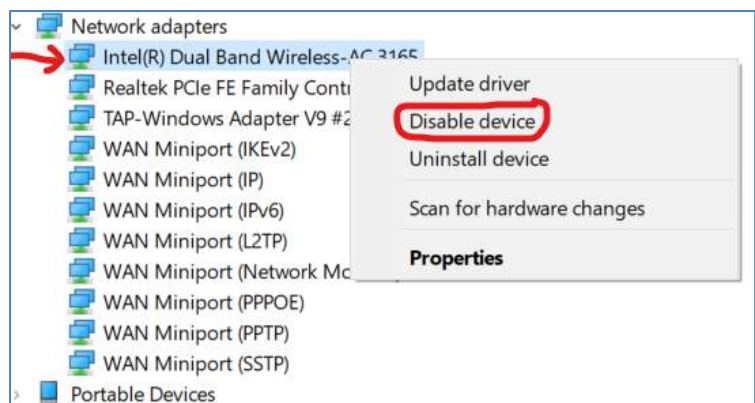
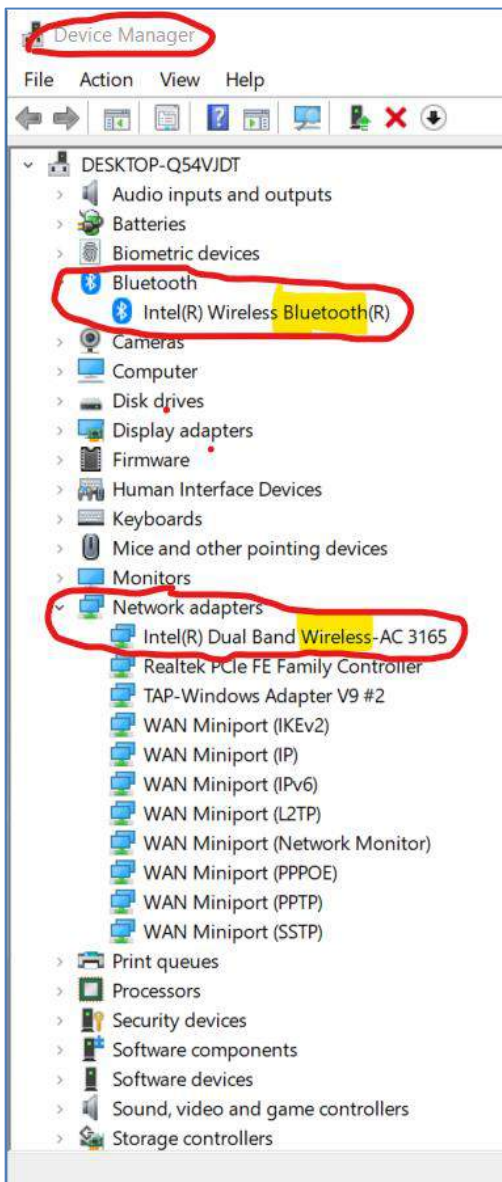
When reading guidance on dealing with EMFs you may see the words ‘earth’ or ‘ground’ used in different texts. In electrical and electronic engineering the terms ‘earth’ and ‘ground’ are used interchangeably and mean exactly the same thing, an electrical connection to the 0 Volts potential of the earth. (The term ‘ground’ is more commonly used in the USA)

How to Disable Wi-Fi

Some routers have a button that turns off the Wi-Fi, in which case just press it to immediately shut down the wireless signal. If there is no button, connect a computer directly to the router with an Ethernet cable. To access the router's settings, open an Internet Browser and enter the router's IP address* in the address bar to Login* to it and find the setting to turn off Wi-Fi. (*Check the ID + Rating Label on the router, or look in the manual, to find the **default** IP address and password).

Alternatively Google “how to disable Wi-Fi on [Manufacturer] [Model Number]”, which can also be used to find the instructions for any other device if disabling Wi-Fi is not found under the ‘Settings’ menu option.

Below are screenshots to illustrate how to disable **Bluetooth** and **Wi-Fi** on a **Windows PC** as described in 2.9 above.



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Typical Costs of Wired Alternatives

At the time of writing (Feb 2022) the approximate costs of typical wired alternatives are as follows:

Corded Phone + Extensions

Simple Value Corded Desk Phone	£7
BT Décor 2200 Corded Phone (with additional features)	£32
BT Décor 2600 Corded Answerphone	£30
DIY Phone Extension Socket Kit 10m (B&Q / Screwfix)	£6

Wired Local Area Network (LAN)

TP-Link 5 Port Gigabit Desktop (Data) Switch (as per Figure 1)	£13
TP-Link 8 Port Gigabit Desktop (Data) Switch	£25
Standard UTP Cat5e RJ45 Ethernet Cables 1m – 20m	£1 – £7
Shielded FTP Cat5e RJ45 Ethernet Cables 1m – 20m	£3.50 – £17
External Cat6 UTP LDPE RJ45 Ethernet Cables 10m – 75m	£13 – £50

Note that a **Data Switch** is only required if there are not enough ports on the **Router** to connect all your devices directly to it **or**, if you want to have multiple devices connected both upstairs and downstairs, or in different rooms, and only want one Ethernet cable going between the two floors or rooms.

All except one (as noted) of the above examples are from Argos and Cable Monkey as being representative of easy to obtain, cost-effective products of suitable quality and performance. Other suitable models and brands may be available elsewhere.

(Remainder of page intentionally left blank)

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17. Typical Levels of EMFs from Everyday Sources + Levels Before and After Reduction Measures

Table 3 – Comparison of Field Strength <u>GUIDELINES</u> from Different Advisory Bodies (See Note 1 & 2 below)									
Institute of Building Biology Categories - sleeping areas		No abnormality	Slight abnormality	Severe abnormality	Extreme abnormality				
Austrian Medical Assoc. Categories - occupied > 4 hrs / day		Within normal limits	Slightly above normal	Far above normal	Very far above normal				
IGNIR Categories		Sensitive #	Night	Day > 4hrs					
High Frequency <small>(See frequency ranges below)</small>	$\mu\text{W}/\text{m}^2$ <small>(Peak)</small>	IBB	< 0.1	0.1 – 100	100 – 1000	> 1000			
		AMA	< 1	1 – 10	10 – 1000	> 1000			
		IGNIR – Av*	0.1	1	10				
		IGNIR - Max	1	10	100				
	V/m	IGNIR – Av*	0.006	\$	0.06	<< \$ = 0.02 for Night			
		IGNIR - Max	0.02	0.06	0.2				
Low Frequency <small>ELF / VLF</small>	Magnetic Fields		nT	IBB	< 20	20 – 100	100 -500	> 500	
				AMA	< 20	20 – 100	100 – 400	> 400	
				IGNIR – Av*	30	100	300		
				IGNIR – Max	100		300	1000	
	Electric Fields		V/m	With grounding cable	IBB	< 1	1 - 5	5 – 50	> 50
				Potential-free	IBB	< 0.3	0.3 – 1.5	1.5 – 10	> 10
				Potential-free	AMA	< 0.3	0.3 – 1.5	1.5 – 10	> 10
				Potential-free	IGNIR – Av*	1		3	10
Specified High Frequency Ranges:			IBB = 100 kHz – 6+ GHz	AMA = 900 MHz – 5 GHz	IGNIR = 30 MHz – 300 GHz				
Specified Low Frequency Ranges:			IBB = 10 Hz – 400+ kHz	AMA = 5 Hz – 2 kHz,	IGNIR = 1 Hz – 3 kHz				
IGNIR: # Sensitive groups include children, foetuses, the elderly, pregnant women, the ill and people with ES							* An average of 6 readings in 1 minute		

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Note 1: The ‘scales’ in **Table 3** are **not linear** and are a very rough approximation in order to illustrate the **relative magnitude** of each of the **category threshold levels** between each of the different **guidelines**.

Note 2: IBB use the term ‘Anomaly’ in the English version of their standards but the original German word used “Auffälligkeit” also translates as ‘abnormality’ which appears to be more appropriate in this context of degrees of **abnormality** compared to an EMF environment which is not considered harmful.

Table 3 above shows that the **Institute of Building Biology (IBB)** recommended field strengths for **sleeping areas** are the same as, or very similar to, the **Austrian Medical Association (AMA)** recommended levels for **areas occupied for more than 4 hrs per day**. (The IBB do not specify any levels for **non-sleep** areas but simply say that they should be ‘as low as possible’) Whereas the **International Guidelines on Non-Ionising Radiation (IGNIR)** levels, which are based on the **EUROPAEM EMF Guidelines 2016**, give three different values for **Day, Night** and **Sensitive** people for each field type and the **IGNIR Night average** levels are all **higher** than the **IBB** levels for **Sleep Areas**, the **IGNIR Day average** levels are all **higher** than the **AMA** levels for **areas occupied for more than 4 hrs**, and the **IGNIR ‘Sensitive’ average** levels are fairly close to the **IBB** levels for **Sleep Areas**.

However the recommended **Electric and Magnetic Field** levels for **all areas other than sleep** from other sources, including instrument manufacturer **Gigahertz Solutions**, are **typically 10 times** the **IBB** limits for **sleep areas**. Also worthy of note is that **IBB** and **AMA** only specify **High Frequency** levels for **average power** (density) ($\mu\text{W}/\text{m}^2$), but **IGNIR** specify levels for both **average power** ($\mu\text{W}/\text{m}^2$) and **peak voltage** (V/m). (See Section 14 - **Measuring the Power of Analogue and Digital Radiofrequency (RF) Signals** for the arguments as to whether **average power** or **peak voltage** is the most appropriate measure)

Confused? It is important to note that **all** the above bodies state these are merely ‘**Guidelines**’ intended to aid the assessment of any particular environment to give a rough indication of what might, and might not, be problematic for sensitised and non-sensitised people and, where applicable, what remedial action might be required. As each individual can react quite differently to the exact same source, **definitive values** for what is considered acceptable, or not acceptable, are **not critically important**, it is the **levels that are problematic for you** which actually matter and the **Guidelines** give a good **starting point** to help to determine that.

As the various guidelines in **Table 3** above do not align very closely in some areas, in an attempt to find some **middle ground**, the following levels and colour-coding have been used in the remainder of this document in order to **illustrate** the **comparative strengths** and, therefore, **comparative likelihood** of experiencing ill-effects at the various different distances away from the different sources that have been tested.

Table 4 – ‘Middle Ground’ Field Strength Categories used for the Example Test Results in Table 5 – 11

Approximate levels at which ordinarily sensitive individuals might, or might not, expect to experience adverse reactions		Unlikely to cause harm – recommended for SLEEP areas for EVERYONE + daytime areas if SENSITIVE #	Adverse reactions unlikely unless SENSITIVE # - recommended for areas used for > 4hrs / DAY	Risk of moderate reactions * - avoid or minimise duration of exposure	Risk of severe reactions	Risk of extremely severe reactions
High Frequency	$\mu\text{W}/\text{m}^2$	< 0.1	0.1 – 5	5 – 100	100 – 1000	> 1000
LF Magnetic Fields	nT	< 20	20 – 200	200 – 300	300 – 500	> 500
LF Electric Fields \$	V/m	< 1	1 – 10	10 – 20	20 – 50	> 50

Sensitive groups include children, foetuses, the elderly, pregnant women, the ill and people with ES

* May be tolerable for less sensitive individuals for very short periods without any **too significant** reactions

\$ Measured with a grounding cable (**not** ‘potential-free’)

Note: 20 nT = 0.2 mG (milliGauss)

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Testing HIGH Frequency Electromagnetic Fields

Power meters measure the average power so as the output signal of the devices is **constantly varying** due to the constantly changing nature of the audio or data being transmitted the measured **power levels** similarly **fluctuate all the time**, hence the range of values given below.

The values given below are typical values obtained for the items described in the particular test set-up. However it should be noted that due to the effects of obstacles and reflections on the signal strength as well as the varying nature of the audio or data being transmitted together with the differences between manufacturers and models the levels of radiation you are being exposed to by your devices could vary considerably. Nevertheless the figures below clearly illustrate the **comparative reduction in radiation power levels with increased distance from the device**, and regardless of all the variables stated above this will always be the case. The results also show the **relative difference in strength of the signal output between the different categories of devices and modes of use** which can be expected to be of a **similar order of magnitude** with other models.

When doing your own testing don't get too hung-up on the **exact figures** when taking measurements, '**near enough is good enough**', if the values are high see what can be done to reduce them and then recheck afterwards. You may react at very different thresholds to those given in the various 'Guidelines'...

In respect of **Table 5** below it is important to note that, regardless of the cost and sophistication of the test equipment, due to the laws of physics there are inherent problems in making any **precise** measurements of **high frequency** field strengths in the '**near field**'. For **both** near and far field the **measured values** can also **vary considerably** due to the **exact distance, orientation and position** of the measuring equipment with respect to the item being tested and so the test meter must be moved around, within the stated range from the item under test, to try to establish the minimum and maximum values. For both these reasons it is common practice to give a range of values even when the signal being transmitted is constant in nature, which is never the case in any communications device in real-life usage. (The position of the tester's body with relation to both the meter and the unit under test, the way the tester is holding the meter, and the nature and position of any reflective surfaces in the surroundings can also significantly affect the readings obtained when measuring high frequency fields)

It should also be noted that the levels of any type of radiation from any electrical or electronic device depends not only on the circuit function and design but also the selection, physical location and mounting of all the components used (especially case materials and construction, and any shielding measures taken) and, therefore, even very similar devices of the same type, with the very similar features and ratings can produce **wildly different** levels of radiated fields. Even slightly different models from the same series from one manufacturer can vary considerably in the level of radiated fields produced.

Consequently if you are very sensitive it can be important to establish the levels of radiation emitted from the exact make and model you are considering acquiring, either from reliable published data (if available) or by testing yourself with a meter, or empirically. (Obviously a shop is not a suitable environment to do this by either means as there will be far too many other sources of radiation to be able to establish what is coming from where)

Borrowing the exact model you want to test in a 'clean' environment before you buy one is obviously the best option. Alternatively some stores, and many online suppliers, allow returns for a full refund if 'unused', in perfect condition, and repacked in the original packaging correctly. So if you open the item very carefully, noting exactly how they were packed, and only switch them ON to measure the EMFs, rather than actually use them and get them scratched, dirty, or finger-marked you can often return them without a problem for any plausible reason which doesn't suggest you have done anything more than switch it on, such as too noisy, too heavy, uncomfortable to hold / use etc.

Ranking of High Frequency EMF Sources – Most Harmful to Least Harmful

From Tables 4 and 5 below it can be seen that although it is dependent on distance and exact make and model in all cases, in general, in the average home or office close proximity to the following sources are the most to least harmful as follows:

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MOST HARMFUL

1. **Wi-Fi Router / Hub** or other **Wi-Fi device**
2. **Smartphone** with **Wi-Fi / Bluetooth** switched **ON** (regardless of if the connection is being used)
3. **Cordless Phone Base Station** (regardless of whether a call is in progress)
4. **Cordless Phone Extension Handset** (only a problem when a call is in progress)

LEAST HARMFUL

Although the levels will vary according to the particular masts, devices, operating modes, locations and distances, in this instance it can be seen that:

- the **Wi-Fi Router** is more harmful at **1m** away than the **Mobile Phone Mast** is at **110m**
- the **Wi-Fi Router** is more harmful at **2m** away than the **Mobile Phone Mast** is at **840m**
- the **Cordless Phone** is more harmful at **2m** than the **Mast** is at **650m**
- the **Smartphones** with **Wi-Fi** and **Bluetooth enabled** are as harmful at **2m** as the **Mast** is at **650m**

Whereas the exact levels and distances will be different in other scenarios it is extremely likely that in most cases the general pattern will be the same – the above devices pose more of a health risk when they are at ‘everyday’ distances from you than a mobile mast that is a fair distance away.

Perhaps surprisingly, a Smartphone with **Wi-Fi / Bluetooth / NFC** switched **OFF** + **call in progress HANDS-FREE** at just **15cm*** (6 ins) is **safer than the Wi-Fi Router or Cordless Phone** at **2m** and the least harmful is a Smartphone with **Wi-Fi / Bluetooth** switched **OFF** with **NO** call in progress. (* from the **body**, not just the **head**)

Real World Testing Examples in Table 5, 6 & 10

As the **Acoustimeter AM-11** meter I used for testing **High Frequency EMFs** is unfortunately only sensitive down to **1 $\mu\text{W}/\text{m}^2$** , where the test results are shown in the tables as **< 1 $\mu\text{W}/\text{m}^2$** (i.e. none of the LEDs illuminated) it is entirely possible that the actual level may have been **< 0.1 $\mu\text{W}/\text{m}^2$** but the meter was not able to discriminate.

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Table 5 – Typical HIGH Frequency (Microwave) Electromagnetic Field Strengths from Household Items							
Device Tested – see below for model details	Power $\mu\text{W}/\text{m}^2$ (Average) at the Distances Indicated						
	5 mm	5 cm	15 cm	30 cm	50 cm	1 m	2 m
	0.2 ins	2 ins	6 ins	12 ins	20 ins	40 ins	79 ins
Cordless Phone Base Station – continuously	1,000-5,000	250 – 5,000	100 – 1,000	100 – 1,000	100 – 500	25 – 50	10 – 50
Cordless Phone Handset – only whilst a call is in progress	100 – 1,000	100 – 250	100 – 250	100 – 250	50 – 100	25 – 100	25 – 100
Wi-Fi Router – transmits continuously	5,000	2,500	2,500	2,500	2,500	1,000	100 – 250
HTC Mobile – Wi-Fi, Bluetooth etc. ON (but not in use)	2,500–5,000	1,000–2,500	250 – 500	250 – 500	100 – 500	10 – 25	5 – 10
Samsung Mobile – Wi-Fi, Bluetooth, NFC etc. ON (not in use)	10 – 1,000	10 – 500	10 – 50	10 – 50	10 – 25	5 – 10	1 – 10
HTC Mobile – Wi-Fi, Bluetooth etc. OFF – NO Call	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Samsung Mobile – Wi-Fi, Bluetooth, NFC etc. OFF – NO Call	< 1	< 1	< 1	< 1	< 1	< 1	< 1
HTC Mobile – Wi-Fi, Bluetooth etc. OFF – Call in progress	500 – 2,500	5 - 10	1 -5	1	< 1	< 1	< 1
Samsung Mobile – Wi-Fi, Bluetooth, NFC OFF – Call in progress	100	5	1	< 1	< 1	< 1	< 1
See Table 4 above for colour-coding categorisation							
‘Call in progress’ figures were recorded once levels have dropped after initial call set-up when levels go to maximum. (Signal Strength 2 bars in test location)							
Microwave Background level outside in the garden: $< 1 \mu\text{W}/\text{m}^2$ $A_v < 0.02 \text{ V/m Peak}$							

Models used for testing (only one sample of each type of device was tested so although representative other models may vary considerably):

DECT Cordless Phone - BT Sonus – the **base station** transmits continuously regardless of whether a call is in progress (as all do except for 2 Siemens models)

Wi-Fi Router – Huawei HG533 – **transmits continuously** regardless of whether anyone is actually using Wi-Fi (same as all Wi-Fi Routers / Hubs)

HTC Mobile – HTC One SV (4G LTE) – (2013 model)

Samsung Mobile – Samsung Galaxy Note 10 Lite (SM-N770F/DSM variant made for the Indian market with an exceptionally low Head SAR of 0.16 W/kg) – There are **no measurable emissions** at all when in ‘airplane mode’ but I have not yet been able to determine the source of the low level output when Wi-Fi, Bluetooth and NFC are all DISBALED and no call is in progress. (See also ‘Safest Mobile Phones’ on page 20)

Note: I haven’t had the opportunity to measure the output of any Smart Meters yet.

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Table 6 – HIGH Frequency (Microwave) Electromagnetic Field Strengths from a Typical Mobile Phone Mast

Distance from local Mobile Phone Mast >>		70 m	110 m	500 m <small>(Note 1)</small>	650 m	840 m
Signal Level – Average	μW/m ²	250 – 500	100 – 500	< 1	10	< 1
Signal Level – Peak	V/m	1.0 – 2.0	0.5 – 1.0	0.05	0.2 – 0.3	0.03 – 0.05

See **Table 4** above for colour-coding categorisation

Note 1: Obstructions between the mast and the measurement location in this instance can be seen to reduce the signal strength, as expected.

Note 2: The distances from the mast may seem arbitrary but were dictated by where it was accessible and safe to take measurements.

Note 3: This is only a rough illustration as it was not possible to determine the rated power output of the tower nor if all antennas pointing in the direction of the meter were transmitting (or at full power) at the time of measurement even though the test was conducted at an assumed busy time - hence the actual power at a particular distance cannot be regarded as a reliable indicator of what can be expected from other towers, however the same order of reduction in power with increased distance can be expected with any other masts.

LOW Frequency Electromagnetic Fields

The tables below show **comparative** levels of radiated fields for various types of electricity supply infrastructure, electrical and electronic items, and domestic settings. However it is important to note that due to the nature of the sources, all the factors that affect the way fields propagate and reflect, the often wide range of fluctuations in the electrical currents within the devices during normal operation, and the huge variability in readings that can be obtained even under static operating conditions due to the exact distance, orientation and position of the measuring equipment with respect to the item being tested these levels can vary considerably for any given test set-up, hence the **ranges** of values quoted in many instances.

Electricity Distribution Network Pylons

Table 7 – National Grid Electricity Distribution Network Pylons – High-Level Metal ‘Christmas Tree’ Pylons – 400 kV

Distance From Pylon (m) >>		0	25	50	75	100	125	150	175	200	225
Electric Field Strength	V/m	Off Scale	Off Scale	380	70	45	25	20	15	8	1
Magnetic Field Strength	nT	Off Scale	1500	400	150	75	40	25	15	10	8

See **Table 4** above for colour-coding categorisation ‘Off Scale’ indicates a reading of greater than 1999

The pylons in Table 7 above are the large metal lattice-work pylons often referred to as ‘Christmas tree’ pylons due to their shape. This type of pylon is used to carry electricity at either 400 kV or 275 kV in the UK but I haven’t been able to determine definitively which voltage the pylons measured were carrying as the signage does not give this information, although it is very likely that they were 400 kV. However if they were only 275 kV the field strengths can be expected to significantly higher and extend further around 400 kV pylons.

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Table 8 – Local Rural Distribution Network Pylons – Low-Level Single Wooden Poles with 3 Wires – 11 kV											
Distance From Pylon (m) >>		0	5	10	15	20	25	30	35	50	Background
Electric Field Strength	V/m	300	185	1	1	1	1	1	1	1	0
Magnetic Field Strength	nT	215	155	90	55	40	30	22	18	12	4

See **Table 4** above for colour-coding categorisation

A guide '[Electric and Magnetic Fields – The Facts](#)' (Jan 2012) produced by **The Energy Networks Association** from the **National Grid** web site has some useful explanations about fields and facts about typical ground-level fields from UK overhead powerlines which are in accordance with the levels I measured above, but note that they give the magnetic field values in microTesla (µT) not nanoTesla (nT) so you need to multiply their figures by 1000 to compare with the readings above. However note that they do not give any typical **Electric** Field values for common appliances (only **Magnetic** Field) or state the distance at which they measured the 'close' values, and most particularly that the ICNIRP 'reference levels' for the public they quote are way, way in excess of the levels considered safe by more recent research (see Table 3 above). Also their views on any connections between EMFs and health issues do not reflect recent research either.

Household Levels – Before and After Action Taken

Table 9 – AC Electric Fields Measurements BEFORE and AFTER Action Taken In My Home			
Position / Activity	Before Action Taken (V/m)	After Basic* Actions Taken (V/m)	After Further* Actions Taken (V/m)
Watching 40" LED Smart TV / Listening to Hi-fi @ 1.8m away	105 – 127	22 – 23	4 – 5
Using Desktop Computer @ 80cm from Monitor, 1m from Tower	295 – 340	6 – 22	3 – 5
In Bed - (Lower Sleeping Area limits apply)	180 – 260	1 – 3	0

See **Table 4** above for colour-coding categorisation

Magnetic Field strength was not recorded in any of these positions as it was **well below** the **IBB** level for **sleeping areas** and **IGNIR** level for **sensitive people before** any action was taken

Background level outside in the garden: **Electric Field:** 0 – 1 V/m **Magnetic Field:** 2 – 3 nT

* '**Basic**' Actions as per **Section 2** above - '**Further**' Actions as per **Sections 3 & 4** above

A wired keyboard and mouse were used in the above tests.

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Laptop

Table 10 – Laptop Electric and Magnetic Field Measurements in Different Modes of Use				
Mode of Operation	LAPTOP Keyboard and Touchpad		SEPARATE WIRED Keyboard (@ 10cm) + Mouse	
	Electric Field (V/m)	Magnetic Field (nT) #	Electric Field (V/m)	Magnetic Field (nT)
Battery-Powered – no other leads connected	2	15 – 650	1	5
Battery-Powered + Ethernet lead connected	9 – 21	20 – 925	5 – 7	6
Mains Charger Connected – no other leads connected	42 – 60	15 – 650	15 – 20	8
Mains Charger Connected + Ethernet lead connected	45 – 52	22 – 995	24 – 31	8
	HIGH Frequency (Microwave) Electromagnetic Field Strengths ($\mu\text{W}/\text{m}^2$)			
All above scenarios, only affected by keyboard / mouse used	1 -100 *		< 1	
See Table 4 above for colour-coding categorisation	* from motherboard circuitry			

Model used for testing: Dell Inspiron 15 5000 Series – 5570 (Placed on a table with a separate wired keyboard and mouse 10cm from the front edge of the laptop and using an SSTP Ethernet cable with the screen earthed)

As can be seen in **Table 10** above, using a **separate wired** keyboard and mouse is unquestionably the safest way to use a laptop. Additionally the test results show that the **Electric Field** is significantly lower when the mains charger is disconnected and the laptop is just powered by the battery.

The huge variability in the **Magnetic Field** measurements observed on the laptop keyboard is due to the positions of the different components located underneath it and, in particular, on the level of **hard drive** activity – the harder the drive is working the higher the current flow in its motor and, therefore, the higher the magnetic field it produces. **Solid State Drives** (SSDs), which are becoming more popular due to their higher access speeds (allowing faster loading of software) and their lower power consumption (which extends battery life), do not have this problem as there are no motors or moving parts. However it is **reported** that some manufacturers use **SSDs** which are **NOT hard-wired** into the data circuits but instead use **wireless** connections**which have levels of radiation high enough to affect some ES sufferers. (** I cannot understand why anyone would choose to do this unless they are just too lazy to work out the necessary component and track / wiring harness layout to position and wire the SSDs in properly!)

I have not been able to get definitive answers from any of the laptop manufacturers I have contacted as to whether they use wireless SSDs in any of their models – some of the ‘technical’ people I was able to contact didn’t even seem to understand the question and in all cases I got contradictory answers from different parts of the same company... Also as I do not know anyone with a laptop fitted with SSDs I haven’t been able to test if they are wireless and, if so, what the radiated levels are.

Without the ability to get definitive information from manufacturers, or to test the items for myself, it would seem entirely possible that they are using wireless SSDs which are designed to be used as **external drives** and would therefore emit levels as high as other standalone devices which would be problematic for sufferers. (In theory **internal** wireless SSDs could operate at much lower emission levels due to the greatly reduced distance to be covered but I have not been able to verify if such

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variants exist or are used in these applications) Therefore all I can do is to advise against buying laptops (or PCs for that matter) with SSDs unless you are able to test the emission levels for yourself prior to purchase.

Power Tools –Battery vs Mains

Table 11 – Battery vs Mains Powered Drill Electric and Magnetic Field Measurements at Different Distances				
Distance from the Motor of the Drill	Cordless Combi Drill / Driver		Mains Powered Drill	
	Electric Field (V/m)	Magnetic Field (nT)	Electric Field (V/m)	Magnetic Field (nT)
0 cm – Position of hand gripping the drill during use	2 – 6	>1999 (off the scale)	1050	>1999 (off the scale)
10 cm	3	420	400	>1999 (off the scale)
20 cm	2	90	260	>1999 (off the scale)
30 cm – At typical head position whilst drilling	1*	40	200	1400
50 cm	1*	15	160	350
* Background level in the test environment				

Models used for testing: DeWalt DCD776 Type 20 (18VDC) Cordless Combi Drill / Driver
Black & Decker BD133V (500W) Electric Drill (Mains Powered)

The field level measurements obtained vary with the relative position and orientations of the drill and the test meter as well as the speed settings and load on the drill, therefore the values given below are the approximate worst case in each scenario but nevertheless clearly demonstrate that much lower levels of exposure are experienced when using the cordless drill / driver which is to be expected as it is both DC and far lower voltage.

It should also be noted that there is a constant **Electric** Field produced by the mains drill and its power lead (approx. 130 V/m @ 30cm) all the time that the drill is plugged into the mains supply, whether or not it is actually being used, whereas the cordless version produces none at all when not being used and a negligible level when in use.