

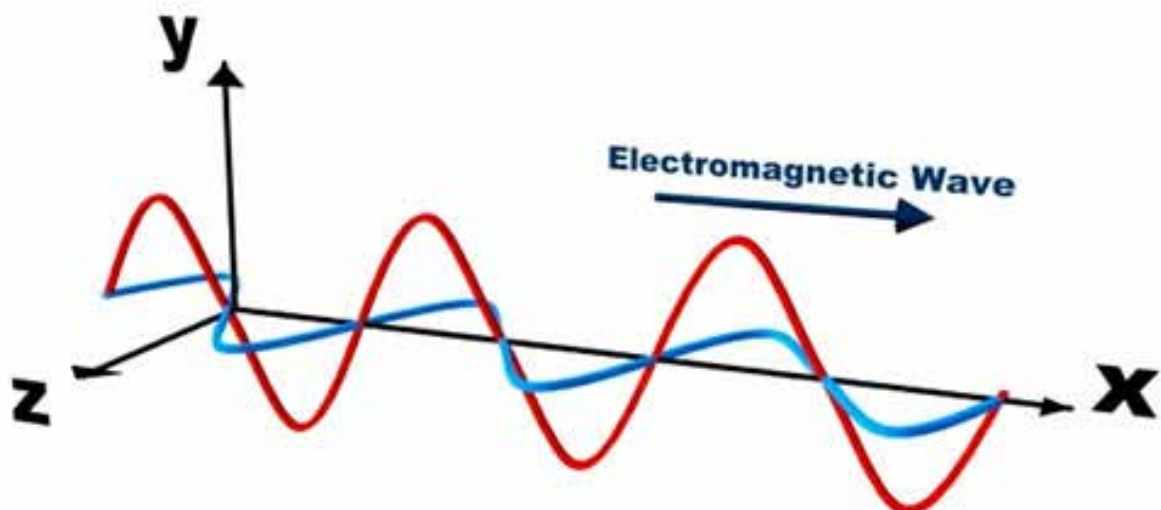


Electromagnetic Radiation

Many paranormal investigators will have heard of an 'EMF' meter. They may have seen them being used on TV ghost hunting programmes. They may already have them in their paranormal investigation kit. Generally however, few seem to be fully aware of the reasons they are used or the way in which they work. The first mistake many make is actually calling these devices EMF meters. In fact an EMF is totally different physical force - any good Physics book will tell you that an EMF refers to Electromotive Force and is in reality the force that causes electrons to flow through an electrical circuit and produces an electrical current. Correctly, these devices should be referred to these as Magnetometers, or in some cases Magnetic Flux Density Meters and Electromagnetic Radiation Meters. However, the term 'EMF meter' has now become almost universally accepted by paranormal investigators and even some equipment manufacturers and so we will use the term EMF meter and Electromagnetic Fields (EMF's).

Electromagnetism

As the name suggests an electromagnetic field is actually made up of two separate component fields; an electric field and a magnetic field. Each can exist separately; for example, in physics, an electric field surrounds electrically charged particles. This electric field exerts a force on other electrically charged objects. It was Michael Faraday who introduced the concept of an electric field. The electric field is a vector field with SI units of volts per metre (V / m). An electric field also surrounds time-varying magnetic fields. A Magnetic field is produced by moving electric charges, by electric fields that vary in time, and by the 'intrinsic' magnetic field of some materials caused by the spin of atomic particles within the material. Electric and magnetic fields are intrinsically linked, changes within one causing changes within the other. The relationship between the magnetic and electric fields, and the currents and charges that create them, is described by the Maxwell equations named after the Scottish physicist and mathematician James Clerk Maxwell and described in his paper "On Physical Lines of Force," published in 1861. In special relativity, electric and magnetic fields are two interrelated aspects of a single object, called the electromagnetic field. In measuring terms the two interlinked fields that comprise an electromagnetic field co-exist at right angles to one another.



Schematic representation of an electromagnetic field; the red line showing the magnetic field component, the blue line the electric field

Most meters measure the electromagnetic radiation flux density (DC fields) or the change in an electromagnetic field over time (AC fields), essentially the same as a radio wave, but with different frequency characteristics. There are many different types of EMF meters, but the two largest categories are single axis and tri-axis. Single axis meters are cheaper, but take longer to complete a survey because the meter only measures one dimension of the field. Single axis instruments have to be tilted and turned on all three axes to obtain a full measurement. A tri-axis meter measures all three axes simultaneously, but these models tend to be more expensive. An EMF meter can measure AC electromagnetic fields, which are usually emitted from man-made sources such as electrical wiring or radio transmitters while Gauss meters or magnetometers measure DC fields, which occur naturally in Earth's geomagnetic field and are emitted from other sources where inherent magnetism is present.



Tecpel EMF 701 Single Axis EMF Meter

Since the early 1980's paranormal investigators have become increasingly interested in various types of electromagnetism. This followed from the work of a number of researchers, but most notably Professor Michael Persinger at The Laurentian University in Canada. Working with others he conducted many experiments which showed that when certain parts of the brain - particularly the temporal lobes (those regions of the brain located above and behind the ears) were exposed to low frequency (below 100Hz) electromagnetic fields of varying intensity and duration, test subjects reported experiences that were similar to those experiences associated with reported paranormal activity. Using the God Helmet - a helmet modified with electromagnetic emitting coils, Persinger reported that at least 80 percent of his participants experience a presence beside them in the room, which ranges from a simple 'sensed presence' to visions of God, while many more had less evocative, but still significant experiences of "another consciousness" or sentient being. This research led to the suggestion that some people may be more susceptible to these EM emissions. Persinger claimed that similar EMF's might be present within the environment and concluded that the source for these EMF's were both natural in the form of variations within the Earth's geomagnetism or interactions with solar radiation, or manmade from sources that included electrical wiring and appliances or a combination and interaction of both types of source. He suggested that these might be responsible for the production of a range of anomalous experiences from the sighting of apparitions to poltergeist phenomena and even UFO encounters. Other researchers following Persinger's lead disagree with Persinger's conclusions, most notably a team from Uppsala University in Sweden, who used a second God Helmet to try and replicate Persinger's experiments. They concluded that EMF was not a significant factor in creating anomalous sensations. We have evolved to use and trust our 5 normal senses and the human brain can only interpret any

electromagnetic interference to its normal functioning in a sensory manner. The percipient may therefore see, hear, taste, touch or smell something which they believe to be a real experience without any apparent cause and therefore interpret it as anomalous. EMF has also been claimed to affect PSI performance; for example, experimenters have reported that success in PSI testing and spontaneous instances of PSI are adversely affected at times when high rates of fluctuation have been recorded in the local geomagnetic field (GMF) The GMF strength is normally between 20 and 60 microTesla (uT) [200-600 milliGauss (mG)] depending where in the World it is measured. Factors that can affect the GMF include the local geology and the presence of ferrous rocks. The Solar electromagnetic radiation (Solar wind) interacts with and affects the GMF on a local, regional and global scale. Metals used in building construction and long distance cables and pipelines can also affect the local electromagnetic fields, solar radiation (solar wind) too can directly affect the local EMF surrounding such large man-made structures and cause dramatic changes in the observed EMF. In the past this has caused a particular problem when long distance power lines in North America and Canada were overloaded by the very high voltages induced by Solar winds, leading to Nationwide blackouts and power failures.

Electromagnetic fields at 50 or 60Hz are mainly produced by the electricity supply. Such frequencies are very close to those naturally found within the brain. It is therefore not surprising to discover that exposure to these manmade fields can have a measurable effect on human physiology and behaviour. Some research has also suggested that EMF exposure may even be detrimental to health and well-being and is the main reason why there are so many EMF detectors now being readily available in an increasingly health conscious world. To date all this of this research has been confined to lab studies with very few detailed studies ever being conducted in the field. These limited studies do suggest that exposure to environmental EMF's may indeed be linked to some personal anomalous experiences. In an experiment carried out in the Edinburgh vaults by Prof. Richard Wiseman, the test volunteers reported a higher instance of feelings of being watched or feeling uncomfortable in particular areas where the ambient EMF was higher than in areas where fewer anomalous experiences had been reported. Persinger investigated a location in Sudbury, Ontario in which he claimed to have found a link between fluctuating EMF and GMF fields and reports of paranormal experiences. A similar link was found in a Cheshire farmhouse between reported paranormal experiences and a high region of EMF from a damaged electrical supply cable during an investigation carried out by Para.Science.

Logically therefore, it might be argued that if investigators use their own EMF meters and locate unusual or unexpected electromagnetic fields at a site being investigated they may be a little closer to determining a probable cause for some of the activity being reported. Unfortunately, many investigators did not fully read the published research or chose to simply ignore the parts they did not agree with. In time, the sound logic of looking for and measuring EMF became diluted and lost. EMF meters became Ghost Detectors.

Other investigators came forward with their own versions of why an EMF meter was a useful tool for paranormal investigation - *"Ghosts emit EMF's or distort the Earth's natural electromagnetism"*. *"Ghosts use the electricity supply or the electromagnetic energy to obtain energy that allows them to manifest"*. There are many variations on these themes and many books have earnestly declared that using an EMF meter will allow the investigator to detect the energy or presence of a ghost or spirit.

To date there is simply no evidence that ghosts or other forms of apparent paranormal activity can emit or give off an EMF. They also do not have any proven ability to use EMF from any man made or natural sources.

Many paranormal investigators use an AC EMF meter of a type that is designed to measure frequencies around 50Hz or 60 Hz, which are the domestic electricity supply frequencies for the UK and the USA. Typically they will also measure EMF at frequencies above and below this calibration point although often with a greatly a reduced accuracy and sensitivity as the frequency moves further from the 50/60Hz optimum. Unless one is using one of the more expensive meters that measure both components of the Electromagnetic Field most EMF meters costing less than £100 (\$150) measure only

the magnetic component of the field. The measurement is normally given in units of magnetic field strength - milli Gauss or micro Tesla, although often known as 'EMF meters' they are in fact only Magnetic Field Meters. Some meters are available that can also measure the electric field component, the measurement being expressed in Volts/metre. These meters usually allow the user to switch between measurement of the Magnetic Field and measurement of the Electric Field or to take a reading of both fields combined together.

Electromagnetic Fields are directional, surrounding the source such as a cable or appliance. The primary field strength is dependent upon the direction of current flow. The field strength also diminishes as the distance from the source is increased, for ease of visualisation they may be likened to the ripples produced when a single pebble is dropped into a pond, the ripples diminishing in size as they move away from point where the pebble is dropped. Electromagnetic Fields from several sources can also interact with one other similar to the effect seen when two or more pebbles are dropped into the pond. This leads to areas where the strength may be much higher or significantly lower than would be expected from a single source.

To obtain the maximum accuracy for ones measurements it is important that the actual sensor within the EMF meter corresponds to the direction of maximum field strength at any given location. If it does not then the user risks making measurements that may be much lower than the true field strength. One solution to this problem would be to use a meter that has 3 sensors each at right angles to the others - this arrangement is known as the X-axis, Y-axis and Z-axis.

By combining the information from all three sensors mathematically inside the meter the display then shows a much more representative measurement for the field strength. Single axis meters are available and are often preferred by investigators as they are generally much cheaper than 3-axis models and more readily available. A single axis meter needs to be used with care. By carefully moving the meter around when making the measurement it is possible to discover the orientation of the field at a given location and then correctly align the meter's sensor with it to obtain the most accurate measurements.

Limitations for Use

There are a number of considerations that must be made when making any measurements in order that the subsequent data is as accurate and reliable as possible. Obviously the 1st of these is to become fully conversant with the instruction supplied by the manufacturer. These instructions should also tell you the technical specifications of the device - the measuring range, frequency and accuracy are important pieces of information. Be aware of any limitations placed on the use or positioning of the device - if it is to be used near other items of equipment this may affect the subsequent data. Normally the meter is measuring only the magnetic field that is generated when electricity is flowing through the wiring and the electronic circuits of the appliance. If you have a meter that can measure electric fields you will find that they are present even if an appliance is turned off and that their value doesn't change as the appliance is turned on and off.

Almost without exception EMF meters used by paranormal investigators are designed for measuring EMF's caused by the domestic electricity supply. This is either 50Hz in the UK or 60Hz in the USA. That means that the meter is designed to be most accurate when measuring EMF's within that range of frequencies. Just about every building has an electricity supply or is located close to the electricity supply network of over ground and underground cables. Most buildings have a number of electrical appliances, all of which generate an EMF that will be registered by an EMF meter. Depending upon a number of factors such as the distance from the appliance or the wiring, the power being consumed by the appliance and the type of appliance you may expect to see EMF readings from 0.1 milli Gauss (mG) to more than 100mG. For example a TV set on standby may give a reading of less than 1mG at 30cm but over 50mG when it is turned on. A bedside clock radio can give you a surprisingly high reading of around 100mG at 20-30cm! Many types of meter are described as 'Frequency Weighted' or Frequency Calibrated. These do not give a simple measure of the field strength but instead their measurements

are proportional to the frequency of the field. Instead of the actual strength of the EMF being shown the meter actually indicates the amount of energy the field is carrying - as the frequency of the EM emission increases so does the energy it carries. The Alpha Labs TriField is just such a meter. An actual EMF of 3mG at a frequency of 60Hz will be shown as 3mG which is the true value. However if the EMF frequency is then increased to 120Hz the same strength field will now be shown as 6mG on the scale.

You may ask "What is the point of making any measurements at all if the meter isn't even giving me the correct information?"

The reality facing the ghost hunter wishing to measure EMF is made even worse by another failing of most EMF meters; they fail to provide any information about the frequency of the EMF being measured. Meters such as the CellSensor and Dr Gauss; even the expensive 3-axis EMF-1394 provide information only about the level of EMF's present and no information about the frequency, which may be 50Hz from the electrical supply or it might just as easily be a 2000Hz field from a radio transmitter. In fact, it has been shown by using specialist EMF meters that do provide frequency information that the electrical supply is rarely the cause of the measured ambient EMF's that are detected by the hand-held devices used by ghost hunters. The fields that are measured by the frequency indicating meters are at far higher frequencies, typically at radio frequencies and therefore cannot be linked to the lab research in any way. It would therefore seem logical to assume that the use of cheap EMF meters by ghost hunters is a wasted effort.

If you still intend to use an EMF meter it is important to understand that the meter will register changes in the EMF levels as you move around a location. Even if you keep the meter static in one position any changes in the flow of electricity (current) nearby will cause changes to register on your EMF meter. This is quite normal and should be expected. You may come across areas where the EMF seems unusually high. Often wires can be hidden inside walls and other structures. Domestic water pipes are also used as part of the buildings Earth (Ground) protection and electrical currents will flow through them causing EMF's to be formed around the pipe or wire. Hidden metal structures can also hold or even generate an electric charge - this affect may vary depending upon the weather or the humidity. If this static electric charge then leaks to Earth you may well see a fluctuation in the EMF take place. The wiring and the pipe work can also act as an antenna picking up and re-broadcasting the radio frequency EMF's from even quite distant transmitters. This will lead to regions within a location where the measured ambient EMF will be higher than expected. Natural changes in the Earth's electromagnetic field such as during thunderstorms, increased solar activity or even seismic activity can also induce electricity to flow in conductive manmade and natural structures including wiring and appliances. This flow of electricity will produce a corresponding electromagnetic field that may be detected and measured by your EMF meter. Other investigation equipment you may be using such as radios or computers will also generate EMF's around them and these too can affect the reliability of your EMF measurements. The problems measuring EMF's are therefore legion and to hope that one can disentangle these normal fluctuations and assign them to a particular source using a cheap single axis EMF meter is a forlorn hope. The claims that some investigators are making that they can use such simple meters to detect the presence of an anomalous and potentially paranormal EMF in such circumstances also start to look increasingly ridiculous.

A Very Special EMF Meter?

In recent years a number of investigators have virtually ceased to make conventional EMF measurements and have instead switched to using their EMF meters as spirit communication devices. They base their assumption on the idea that spirits and other discarnate entities can affect the meter display in some fashion and by this means answer questions put to them by the investigators. This dramatic change of use was inspired by American Sensitive and investigator Chris Fleming who in 2007 used a cheap KII EMF meter to apparently communicate with spirits during an episode of the US TV series Ghost Hunters. This apparent success was quickly followed up by Fleming's endorsement and the KII being offered for sale on a number of ghost hunting equipment websites. As paranormal groups got

their own KII's they also began to report apparently amazing examples of spirit communication using this meter. Following the success of the KII it was quickly 'discovered' that many other types of simple EMF meter were also effective spirit communication devices and more and more models were offered for sale and demonstrated by groups on their websites and on YouTube.

All EMF meters work using a simple principle of electromagnetic inductance, not dissimilar that used in any electrical transformer. The sensor normally consists of a simple wire coil wound around a conductive core or former. As the wire coil is moved through a static magnetic field or is exposed to a moving magnetic field a voltage is generated within the coil which can be measured and directly related to the levels of magnetism (or coil movement) that is present. Many investigators are aware of the caution issued by EMF meter makers to avoid excessive movement of the meter for this reason as it can result in false readings being observed. The voltage produced within the coil by the external magnetic field is tiny and it needs to be amplified many times in order to be used in driving the measurement display circuit of the meter. Amplification leads to (electrical) noise being generated within the circuits which may also result in false readings being observed and manufacturers normally take great care to design the amplification circuits to minimise this problem. Other sources of noise include the stray or erroneous electrical spikes from domestic, radio and natural EMF sources such as weather related phenomena, all of which can cause false readings to be indicated by the meter, again manufacturers usually design the amplification and circuits to minimise this problem. However, It is interesting to note that many of the best EMF meters for spirit communications tend to be the cheapest models such as the KII and the CellSensor which have correspondingly poorer noise suppression designed in. Moreover, an examination of some recent KII meters offered for sale as spirit communication devices has shown that the amplification circuits have been adjusted in such a way as to make the amplifier circuit highly unstable in operation and highly prone to electrical noise and interference. The modified meters are in effect over sensitive and will therefore respond to small amounts of interference from any nearby EMF source such as a radio transmitter, cell phone or electrical device. They are also highly reactive to weather related events such as storms - even when they are some distance away. These erroneous responses may then be interpreted as having a spiritual cause by the user. In other cases, it has been observed that the EMF is simply reacting to stimulation by the investigators radios and other equipment either wittingly or unwittingly; the fraudulent misuse of EMF devices has certainly been observed.

A development of the EMF meter - spirit communication notion has led to the use of devices such as the Ovilus in which an electromagnetic signal is used to drive a speech synthesis circuit, supposedly to permit spirit communication with the investigator. From a vocabulary of a little over 1,000 words the communicating spirit supposedly manipulates the local EMF surrounding the device in order to select single words from the pre-set list.



The Ovilus 1

From the Ovilus there are now several other spirit communication devices based on the principle that spirits are able to manipulate the local EMF, temperature and other physical parameters in order to produce apparently evidential information including The Paranormal Puck and Frank's Box.

Most bizarrely of all is the legion of iPhone and other smart phone Apps that are now being used for ghost hunting and paranormal investigation. Various claims are made, often more concerned with advertising hype than any actual capability and all use one or more of the modern smart phone built-in sensors in some way. Sensors such as Magnetometers, Accelerometers, GPS, Thermometers, Light sensors and of course microphones and cameras are all features of modern smart phones and in certain controlled circumstances they may be useful in some investigation circumstances. But Apps such as The Ghost Radar, iOvilus and Ghosthunter M2 must be regarded as novelties with no demonstrable place in ghost hunting or paranormal investigation.



A Legion of Apps exist for Smart phones that claim to be real ghost hunting tools. From left: iOvilus device; Ghost radar app; and Ghost Hunter M2 app

In Conclusion

EMF meters in their various forms and guises have become almost an essential tool for the modern paranormal investigator. Like all equipment designed to collect information they must be used appropriately and with due care. The information they provide needs to be used in context as part of the overall investigation. They are not Ghost Detectors. Some promising research into the reasons why some people may have paranormal experiences may lie in this area of study and it is area worthy of future exploration. Given the lack of frequency specific information provided by almost every EMF currently in use by ghost hunters, the contested research upon which EMF meters are used and the generally poor standards and methodologies employed in their use, the reality seems to be that there is little benefit to be gained from the general measuring of electromagnetic fields by ghost hunters. In fact, it is probably more accurate to say that their use has actually hampered the overall investigation process by misleading investigators with poor quality data and bizarre theories.