

Electromagnetic (Environmental) Compatibility

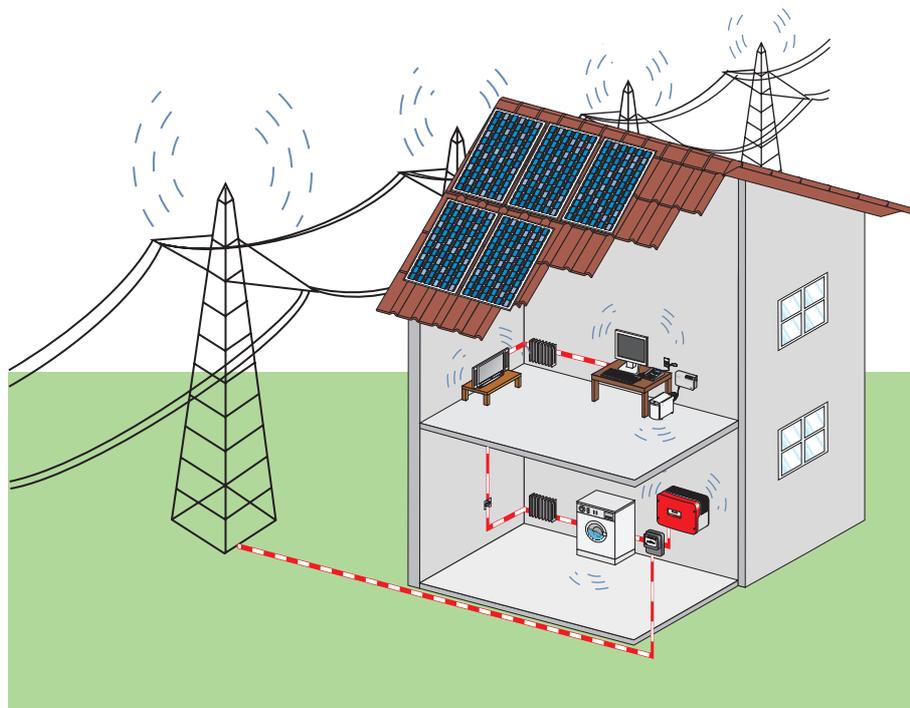


Contents

Each electrical voltage causes electrical fields - each electrical current causes magnetic fields. Since all human functions (muscle contraction, nerve cell signals) are based on slow and weak bio-electrical signals, every human body as well as every electrical device is surrounded by its own magnetic field. In this environment, reciprocal disturbances and the influence on the healing process in people are therefore manifest and also known.

This document discusses the effects of electromagnetic fields and the requirements of the relevant EC regulations on the subject of EMC (Electromagnetic Compatibility in relation to the reciprocal disturbing influences of electrical devices) and EMEC ("Electromagnetic Environment Compatibility of devices in relation to the influence of their magnetic fields on the environment, in particular on people", which is a regulation applied in Germany).

1 Occurrence of electromagnetic fields



Radiation based disturbances



Cable based disturbances

Electromagnetic fields are generated by electrical devices and occur in every household as well as in industrial areas. Furthermore, electromagnetic fields generated by natural phenomena such as the weather or the Earth's magnetic field affect us continually. As already mentioned, additionally every person is surrounded by his or her own electromagnetic field, since our human functions are also based on bio-electrical currents and voltages. A reciprocal positive and negative influence of the various fields is therefore not difficult to imagine. There are special EC guidelines for electrical devices aimed at preventing devices interfering with one another. In this connection it is imperative to fundamentally differentiate between cable-linked and radiated disturbances. For instance the use of an electric drill causes disturbances in the picture quality of the users television or even that of the neighbors. In this case the disturbance transmission takes place via the electrical cable and is therefore a cable-linked disturbance. If on the other hand, a cellular mobile phone is in a car, a disturbance will occur during an incoming call or during the search for a radio signal (crackling on the radio). In this case the disturbance transmission takes place via the outgoing radio radiation from the telephone. For electrical devices which must radiate (mobile telephones), there are different directives in relation to their electromagnetic compatibility than for devices which should not radiate (electric drills).

2 Electromagnetic compatibility (EMC)

Every electrical device is always surrounded by its own electromagnetic field in operation and can thus also affect other electrical devices. These disturbances can also be transmitted via the plug socket through cables.

EMC identifies the capability of a device to work in the electromagnetic environment satisfactorily, without itself causing electromagnetic disturbances which are unacceptable for other devices in the vicinity. In order that several electrical devices can function together, they may not on the one hand emit disturbances too large (emitted interference) and on the other hand must be able to resist a certain level of disturbances (interference stability). The necessary fundamental standards for the devices are regulated in the EMC directive (2004/108/EC & EMC-Law).

2.1 Classification in accordance with EMC directive

In order to satisfy the various standards, the devices are classified according to their function and operation site in the following classes, amongst others:

- Living areas: high demands are set for devices in living areas. Only a very low level of radiation is permitted. Conversely, the requirements for interference stability are less stringent.

Example: household devices (washing machine, vacuum cleaner, TV, radio) and small PV inverters (photovoltaic inverters, e.g. a Sunny Boy)

- Industrial areas or transmitters: here, conditional on function, high radiation or line-conducted interference emission is permitted and necessary. Therefore greater demands on the interference stability in this area of strong interference are set.

Example: radio, mobile phone or industrial plants and central inverters

2.2 Obligation and Control

In the EU all EMC standards are uniformly defined via the mandatory CE identification. In Germany they are monitored by the Federal Network Agency. PV inverters from SMA Solar Technology AG satisfy the most restrictive EMC standards of the DIN EN 61000 family relevant for the "CE" symbol.



3 Electromagnetic Environment Compatibility (EMEC)

Electromagnetic Environment Compatibility identifies the impacts of electromagnetic fields on the environment, in particular on people. The negative impacts are known colloquially as electro-smog.

Electromagnetic fields from electrical devices and living human bodies can have both positive and negative effects. As an example, during electrical stimulation therapy the electricity stimulates healing, respectively the growth of muscle cells. During EEG (electroencephalography) or ECG (electrocardiogram) the currents in the brain or heart muscle reflexes are measured via electrodes. Furthermore, electromagnetic fields such the Earth's magnetic field or the electrostatically charged atmosphere affect us continually. Since electromagnetic fields strongly lessen when one removes oneself from their cause, sources which are used close to the body (mobiles, seat heating) are of greater risk in relation to health-damaging effects. In the recommendation from the Council of July 12, 1999, the EC directive "for the limitation of exposure to the population of electromagnetic fields (0 Hz - 300 GHz)" stated "it is absolutely necessary to protect the population in the Community from verifiable health-damaging effects, which can occur as a result of electromagnetic fields.". The differentiation between ionizing and non-ionizing radiation is central here in regard to a suspected health risk.

Ionizing radiation	Non-ionizing radiation
These change (mutation) or destroy body cells or cell nuclei. A high risk of cancer exists through this.	Non-ionizing radiation can not, conversely, generate cancer - at most stimulate existing cancer into growth, or even to hinder. The frequency range in focus is up to 300 GHz, which surely belongs to non-ionizing radiation with low quantum energies. Note on frequency specifications: 1 GHz = 1000 MHz = 1E9 Hz = 1 billion Hz
Examples: <ul style="list-style-type: none"> • UV-C-radiation (sun and solariums) • X-ray radiation (also old TV tubes) • radioactive radiation • cosmic radiation (e.g. during long-range flights) 	Examples: <ul style="list-style-type: none"> • Microwave • Mobile phone • Radio • Seat heating

3.1 Non-ionizing radiation characteristics

Impact

1. Causation of body currents up to a few kHz or MHz (e.g. nerve irritation or reflex interference)

The evaluation takes place locally on the body via current density (current / cross-sectional area in Ampere/m²). This specification is more accurate than the measurement of the total current.

2. Causation of body warming via absorption of high frequency field energy

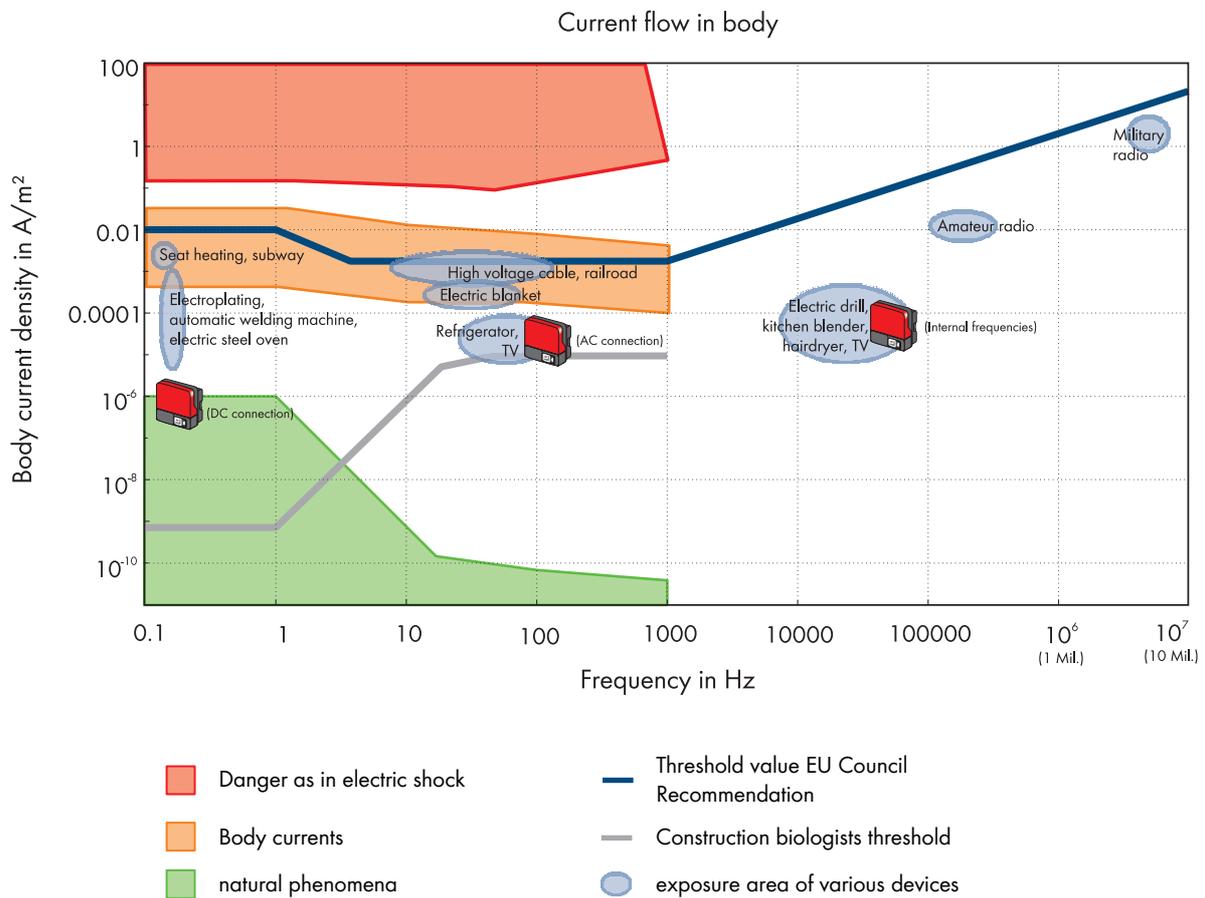
This has an effect for example on cell growth and can also lead to protein deficiencies. The evaluation takes place here locally on the body via power flux density (power / cross-sectional area in Watt/m²). In the cold or during sport the body absorbs and regulates (shivering, sweating) short-term a temperature difference of up to 5 °C. According to current legislation body warming may not exceed 0.1 °C continually (> 6 min).

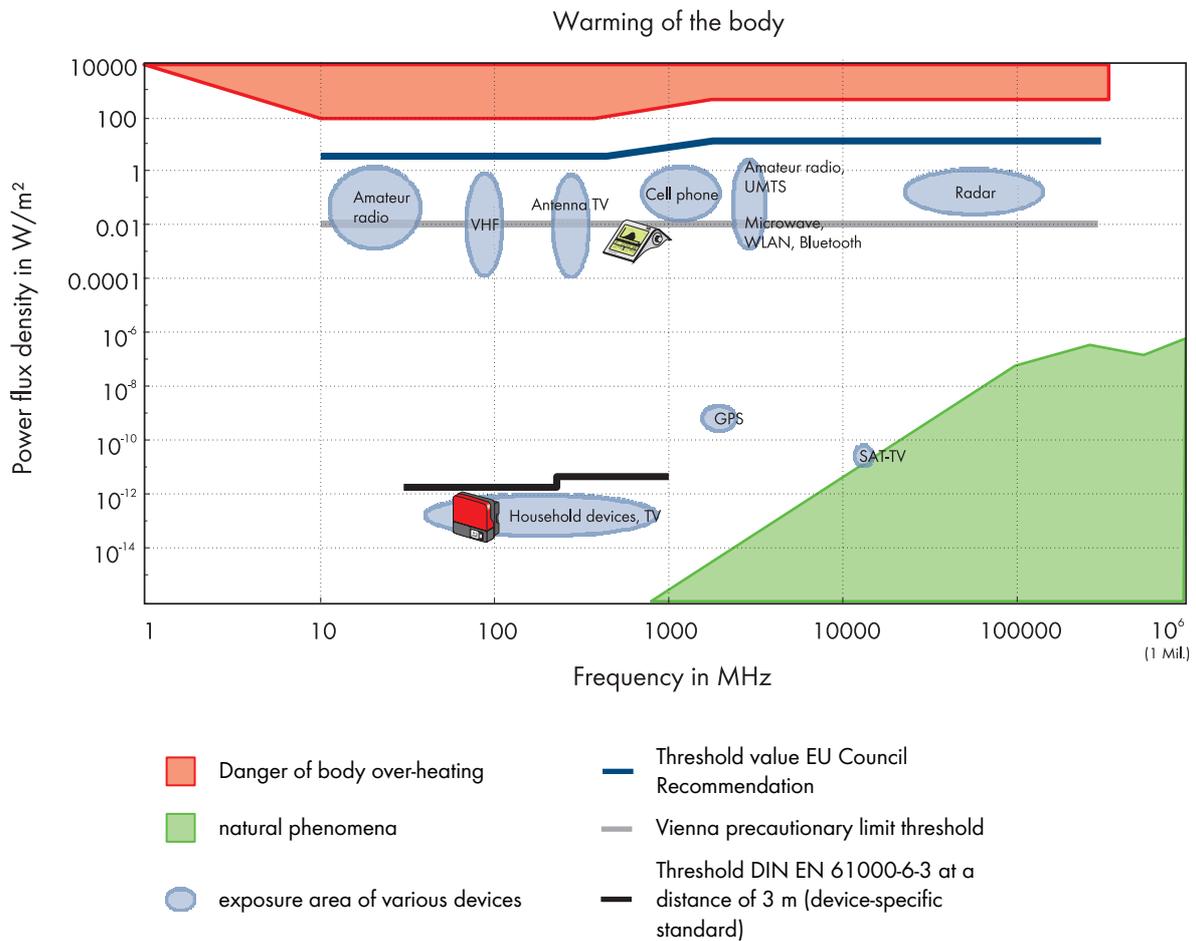
3. Electromagnetic hypersensitivity

This is a very controversial point, since the causalities could be neither clearly disproved nor documented. Electro-sensitive people are however afraid of disturbances to the hormonal balance and the vegetative functions (e.g. blood pressure) with effects such as sleep disturbance or weakening of the immune system.

Thresholds

Globally, to some extent greatly varying "recommendations" or thresholds are valid in relation to the radiation from electrical devices. Both the body current density and the specific absorption rate are almost impossible to measure or only on artificial body models. All the same, here the central base threshold is valid; for directly measurable fields (without the presence of people) so called derivative thresholds exist. A conversion of these between one another strongly depends on the frequency, the body properties (tissue, fat, muscle,..) and from the actual field non-uniformity present and hinders exact conclusions. Particular specifications exist for the "general public", the "workplace" etc. The base threshold "body current density" up to 10 MHz as well as the derived "radiation power density" up to 300 GHz, both valid for the "general public" according to the EU Council Recommendation 1999/519/EC, are illustrated below - each together with the equivalent recommendations of the construction biologists (Vienna precautionary value from 2000) as well as natural and typical example values of everyday life.





This compilation is not absolutely accurate or exhaustive, rather is based on illustrative measured and empirical values, e.g. from literature (LfAS "Electromagnetic fields in the work place", G. Bopp (ISE) "Do PV systems cause electro-smog?"). In exceptions, the values can also fall above or below the marked area.

3.2 Radiation behavior of SMA inverters

PV inverters from SMA Solar Technology (e.g. "Sunny Boy" or "Sunny Mini Central") are only in operation during the day and are not "used" close to the body. The optionally available wireless communication also only sends data infrequently, and then only with a very low power. In the case of transformerless PV inverters the potential of the PV generator is overlaid by the grid voltage, is therefore however equivalent to a normal power line. Overall, all types of PV inverters do not behave any differently than other typical electrical and household devices. PV inverters from SMA Solar Technology additionally reduce all possible interference emissions via the circuit technical avoidance of high frequency currents, the deployment of filters and the use of grounded metal housings. Furthermore the measurement of high frequency emitted interferences of the PV inverter including all connection cables is a fixed element of the product qualification. Sunny Boy and Sunny Mini Centrals satisfy the toughest normative demands. The low emitted interference of PV inverters from SMA Solar Technology has hence also been verified in numerous tests in independent laboratories.

A comparison in percent of a number of electrical devices in relation to their radiation exposure is shown below. The magnitude of the exposure results from the evaluation of the previously presented diagrams. A low exposure is thereby significantly lower risk than for example a medium exposure. However, for example two medium exposures cannot really be set equally, if the cause (the electrical device) is different. The effects also differ from each other in this case.

