

# Focus on IFA's work

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## Strong magnetic fields during high-power inductive charging in the kW range

### Problem

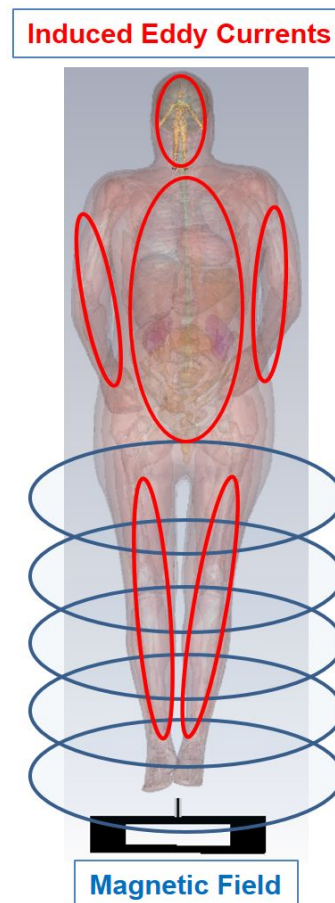
The inductive charging of electrically powered vehicles offers a number of advantages, particularly with regard to the expansion of e-mobility. The charging process is not only wireless, but it is also possible to charge the vehicle while driving. However, depending on the charging power (11 kW, 22 kW, 100 kW), strong magnetic fields with pulsating waveforms in the high kHz range (up to approx. 85 kHz) are generated.

High charging power, however, causes massive interference to sensitive electronics such as electronic controls, active implants and sensors for temperature, speed, Hall sensors, etc. Some of these sensors operate with low signal voltages in the mV range. Medical wearables such as active implants (heart pacemakers, defibrillators, and insulin and pain pumps) work with even lower signal voltages in the  $\mu\text{V}$  range. These very low signal voltages can be influenced to a greater or lesser extent by the interference occurring during inductive charging.

The biological effects on the human body are described in detail in the documents in the section "Additional Information".

### Activities

IFA has already gained extensive knowledge of the interference of pulsating magnetic fields from switched-mode power supplies and variable-frequency drives in the industrial sector on



Effect of magnetic fields on humans. Image: IFA

sensitive electronics (controls, sensors, digital bus systems). Further findings have been obtained through research, expert discussions and practical measurements and field strength simulations.

## Result and Application

In sensitive electronic circuits, strong magnetic fields in the kW range generate interference signals by inductive coupling, which superimpose the useful signals. Measurement signals, for example, can be strongly distorted, and digital controls crash and often go into an undefined state. More sensitive systems can even be destroyed.

A magnetic field simulation with and without shielding measures, for example, shows that, without shielding measures, the field strength inside the coil and up to approx. 30 cm above the coil is about 1000 A/m (1257  $\mu$ T).

Even at a distance of 1.4 m above the coil or 70 cm to the side of the coil, the field strength is still about 37  $\mu$ T. Even this can have a major effect on implants. According to DGUV Regulation 15, however, only a maximum of 21.22  $\mu$ T is permitted in exposure range 2 at 85 kHz and, in accordance with 26th BImSch ordinance and ICNIRP, a maximum of 27  $\mu$ T. And these values do not apply to pregnant women, children or infants!

A significant magnetic field reduction can be achieved by using two 3 mm aluminium plates: The aluminium plates were placed 20 cm above and below the coil for the measurement and reduced the magnetic field strength to well below the demanded limit values.

Without shielding measures, dangerous magnetic field strengths can therefore occur in the vicinity of charging coils. Such fields must be subjected to field strength measurement and hazard analysis. Warnings for implant carriers are mandatory.

Manufacturers of inductive charging systems, technical inspectors of the social accident insurance institutions, industrial inspectorates

## Additional Information

- Grommes, W.: [Wireless Power im kW-Bereich: Achtung! Starke Magnetfelder](#). elektroniknet.de (9.2018)
- [DGUV Regulation 15](#): Electromagnetic fields accident prevention regulation (6.2001)
- [EMF Directive 2013/35/EU](#)
- [Leitfaden „Nichtionisierende Strahlung“ – Elektromagnetischer Felder](#) (Fachverband für Strahlenschutz e.V.)
- [Forschungsbericht „Elektromagnetische Felder am Arbeitsplatz“](#). BMAS (2015)
- 26th Ordinance of the Federal Immission Control Act  
[https://www.gesetze-im-internet.de/bimschv\\_26/](https://www.gesetze-im-internet.de/bimschv_26/)
- Publications of the International Commission on Non-Ionizing Radiation Protection ([ICNIRP](#))

## Expert Assistance

IFA Division 5: Accident prevention – product safety

## Literature Requests

IFA Central Division