MICRO WAVE NEWS

A Report on Non-Ionizing Radiation

Wake-Up Call for EV Industry

"Astonishingly High" Magnetic Fields
Compliance Protocol Ignores Peak Pulses

September 11, 2025

Drivers and passengers of electric vehicles are routinely bathed in surprisingly strong electromagnetic pulses, according to the most comprehensive measurement survey ever carried out. These transients, as they are called, are fast bursts of energy which have been implicated in numerous health controversies over the last 40 years, always without resolution.

The new survey, which included close to a million individual measurements in 13 different electric and hybrid car models, showed that peak fields often exceeded the current European reference limits.[1] In special cases, for instance when starting the engine, the fields could be far higher —up to *12 times* those limits (measured in a hybrid).

Gernot Schmid, the study team leader at the Seibersdorf Labs in Austria, described the peak fields as "astonishingly high." Manufacturers could reduce them, he said, if magnetic fields were "taken into account at an early stage of vehicle design."[2]

"One might think," he opined, "that some manufacturers do not consider the issue of magnetic field emissions at all or not sufficiently early on in the vehicle design phase."

Schmid's call to mitigate magnetic fields in EVs was echoed by Dirk Geschwentner, his contract manager at the German Federal Office of Radiation Protection (known as BfS). Low exposure levels are "technically possible," he said in an interview with *Auto Motor und Sport*, a specialty magazine, adding, "With intelligent vehicle design, manufacturers have the power to reduce local peak values and keep average values low."

The BfS sponsored the Seibersdorf EV survey under a two-year contract, valued at €449,000 (~US$525,000). The project, which began in March 2021, issued a 460-page report in April. The report

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is in German, with a two-page abstract in English. BfS' press release is available in German and in English.

A second volume on magnetic fields generated during EV charging is expected within approximately six months, Anja Lutz, a BfS press officer in Berlin, told *Microwave News.* Exposures in the vehicles were, in general, lower while charging than driving, according to Geschwentner.

More Transients When Stepping on the Pedal or the Brakes

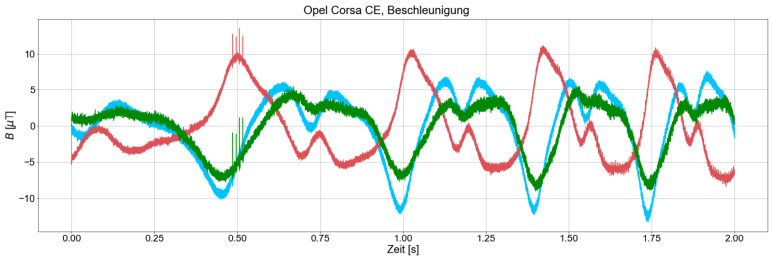
Transients are generated whenever there's a *change* in a vehicle's electrical systems —both in the drive train (e.g., when accelerating or braking) and in its many auxiliary electrical systems (e.g., starting the engine, rolling down windows and, notably, turning on seat warmers).

The most common source of transients is from stepping on the accelerator or on the brakes. Doing this frequently —Schmid calls this "sporty" driving— generates the lion's share of transients. He points out:

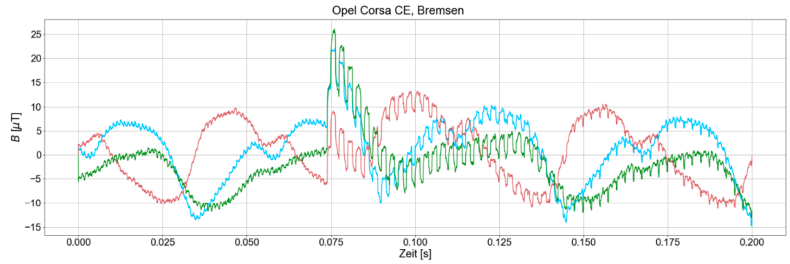
> "It could be clearly shown that in many vehicles the magnetic field emissions can be significantly higher when driving in a "sporty" manner, and that locally the reference values can be significantly exceeded (typically in the foot and lower leg area). The reason for this is usually a transient process in connection with braking and/or acceleration maneuvers."

Sporty driving might conjure up images of James Bond in his Aston Martin in the Swiss Alps, but transients would also be common in urban stop-and-go traffic.

The tracings, below, measured in an Opel Corsa EV, show magnetic field transients from acceleration (top) and from braking (bottom) over the course of two seconds and a fifth of a second, respectively.

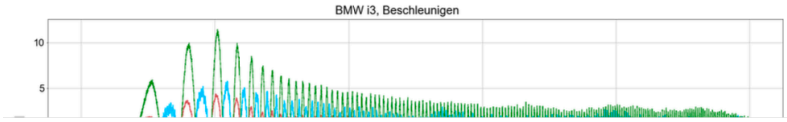


(click to enlarge)



(click to enlarge)
Top: Magnetic fields during the first phase of acceleration (at ~3-4 km/h), measured near the left foot at the driver's seat. The spikes visible in the signal curve at 0.5 sec are approximately 80% of the ICNIRP peak limit. Bottom: Magnetic fields during the start of braking, near the left foot at the driver's seat. [Figures 9.282 and 9.283, BfS Report, p.364] [Zeit = time]

Here's an example of the transients measured at abdomen height of the rear passenger seat of a BMW i3 during acceleration:



(click to enlarge)

Magnetic fields during acceleration, measured in the abdomen area of the rear seat (right seat).
Top: Beginning of acceleration;
Bottom: Final phase of acceleration —distinct "spikes" occur after a transient, on left in the image.
[Figure 9.66, BfS Report, p.165.]

Peak Magnetic Fields Routinely Exceed European Limits

Many EV transients were higher than the reference limits adopted by the European Council in 1999.[1] These guidelines are based on the ones recommended by ICNIRP in 1998. While ICNIRP updated them in 2010,[3] the Council has not followed suit, and the 1999 EC limits still apply.

Schmid is not the first to report that peak EV magnetic fields exceed the EC limits. In the report, he states that the peak magnetic fields he measured exceeding 100 µT [1G] are consistent with those in the published literature. Here's what he wrote:

> "That peak magnetic fields of just over 100 µT can occur in EVs and PHEVs [plug-in hybrid EVs] and that exceeding the ICNIRP 1998 reference values for the general population can occur in the double-digit percentage range is confirmed by the results presented [here] for most vehicles under "gentle" driving conditions. However, it was also shown that in many vehicles under "sporty" driving conditions, the magnetic fields are significantly greater, and that the reference values can be significantly exceeded locally in some vehicles."

Alasdair Philips, a founder of Powerwatch who is now based in Scotland, prepared the diagram below to illustrate how Schmid's

peak magnetic fields exceeded the EC1999/ICNIRP1998 limit of 10 µT (100 mG) approximately 10% of the time.



Click to enlarge

The magnetic fields were highest near the floor of the EVs, with the lower parts of the driver's and passengers' bodies most exposed, which as Schmid explains is "plausible" because significant parts of the wiring are located in the vehicle floor and/or near the foot areas.

In the chart below, the fields in a Porsche Taycan at the feet are represented by red and yellow dots. Exposures to the head, usually the lowest, are shown in orange and to the abdomen in aqua green.

(click to enlarge)

The abdomen is repeatedly exposed to ~3-4 µT (30-40 mG). This is less than the ICNIRP limit, but ICNIRP has never recognized any chronic, long-term effect, including cancer. The limit is based only on immediate effects. For comparison, childhood leukemia has been linked to long-term exposure to an average power-frequency magnetic fields on the order of 0.3-0.4 µT (3-4 mG) —a level that's ten times lower.

Compliance Protocol Exempts Dominant EV Transients

Whether one should look to the EC or to ICNIRP for an exposure limit is a moot point. The governing measurement protocol *exempts*

the most important transients in EVs. That is, they are not measured in measurement surveys.

The protocol was developed by a technical committee (#106) of the International Electrotechnical Commission (IEC), based in Geneva. The procedures are set out in Standard IEC 62764-1, last revised in 2022. (A copy costs CHF250, ~$310.)

The IEC exemption applies to magnetic field transients shorter than 200 msec (0.2 sec). This, the standard states, is because of "the difficulty of performing reliable and repeatable measurements."

Schmid —who, of course, succeeded in making such measurements— has sharp words for the IEC exemption. He writes:

> The fact that the largest exposure indices were caused by transient processes casts particularly critical light on the EN IEC 62764-1 standard currently used for magnetic field measurements in vehicles, as this standard does not consider the recording of transient processes that are shorter than 200 msec. In this respect, this standard cannot be considered sufficient for a comprehensive radiation protection assessment of the magnetic fields occurring in vehicles.

I asked Mike Wood, a senior manager at Telstra in Melbourne, who was the chair of TC106 when the protocol was adopted in 2022, about the exemption. He referred the question to the current chair, Teruo Onishi at the National Institute of Information and Communications Technology in Tokyo. Onishi replied by quoting the standard's rationale, without elaboration.

The exemption cannot stand, according to BfS' Geschwentner: "The BfS sees a need for further development of the existing standards for measuring magnetic fields in vehicles," he told *Auto Motor und Sport* magazine.

Fast Transients Are a Major Factor

How much of the magnetic fields are left unmeasured under the IEC protocol? I asked Schmid. It's not an easy question, he replied, because the waveforms are often very complex.

It depends, Schmid explained, on how you define the starting point of the transient (easy in most cases) and its endpoint (difficult in almost all cases). For illustration, he offered the tracing below, also from a Porsche Taycan, and posed the question, "Would you consider this a single transient, or would you subdivide it in a sequence of several separate transients?"

(click to enlarge)

I rephrased the question: If you exclude transients shorter than 200 msec, what proportion of the incident magnetic fields would be missed? Schmid answered: “In 70-80% of the examined cars the highest found exposure index would drop significantly.”

What Do We Know About the Health Effects of Transients?

The short answer is not much.

Over 40 years ago, a team from the University of Umeå in northern Sweden raised concerns when they found health and reproductive problems among workers in high-voltage electrical substations, an environment rich in transients from the electrical switching equipment. Substations are also known as switchyards. The Swedes urged more studies —few were ever done.

A significant opportunity was lost when a Canadian electric utility stopped research on transients at McGill University in the mid-1990s. Gilles Thériault, then the chair of the department of occupational health at the medical school, had been contracted by Hydro-Québec to study cancer rates in the workforce. Paul Héroux, a young associate, designed a portable meter —the Positron— that could log worker exposures to not only electric and magnetic fields but also transients. Analysis of the transient data showed some of the highest and most consistent EMF–cancer risks ever reported. Hydro-Québec shut down the project and confiscated the data. No one followed up, and the trail went cold. [More here and here.]

Some 20 years later, Sam Milham, another leading EMF epidemiologist, tried to revive interest in transients with his book, *Dirty Electricity*. (The transients make it “dirty”.) Milham’s plea for more research was dismissed —most aggressively by Frank de Vocht. “Further discussion on whether [Dirty Electricity] has any effects on human health…is meaningless,” he wrote in 2016.

Now come EV transients. Why have they escaped attention up to now? Here is what Schmid says:

> “The reason why this has not been found in previous literature is probably because the rigorous measurement methodology applied in this research project must be considered unprecedented.”

Postscript

The EV report has received little media attention in Germany —and practically none elsewhere. Part of the reason is likely that BfS downplayed the Seibersdorf findings in its April press release. The title was:

Radiation Protection Study: Analyzed Electric Cars Comply with Recommended Maximum Values for Health Protection

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FOOTNOTES

1. ICNIRP exposure guidelines present two different sets of exposure limits: “basic restrictions” and “reference levels.” The basic restrictions specify induced current densities, induced electric fields and SARs, all unmeasurable quantities in human tissue. The reference levels specify electric and magnetic field strengths and power densities, which can be measured. In this article, I refer to the reference levels to allow a comparison with the levels measured by the Seibersdorf team.

Determining whether measured values comply with the basic restrictions requires complex computer calculations, with detailed anatomical simulations of the human body.

In an email exchange, Seibersdorf’s Gernot Schmid stressed that the “basic restrictions were not exceeded as we showed by the numerical computations in our report, even when the peak field levels were way beyond the reference levels.” He went on to explain, “The reason for this is that the exposure in the cars is very localized, while the reference levels have been derived for the (worst) case of uniform body exposure —that is, reference levels are overly conservative for the specific kind of exposure conditions inside the cars.”

The computations allow Schmid to conclude, as he states in the FSM report: “The results of the extensive and systematic measurements showed that the basic restrictions defined in EU Council Recommendation 1999/519/EC and in the ICNIRP recommendations from 2010 were not exceeded in any case.” [See next footnote.]

2. Schmid made extensive comments about his findings, including those quoted in this article, in a special feature, in the 2024 annual report of the Research Foundation for Electricity and Mobile Communication (FSM), based in Zurich. It’s in German and English.

3. Why Did ICNIRP Relax Its Magnetic Field Limits in 2010? ICNIRP’s rationale for loosening its magnetic field limits in 2010 is not transparent —at least to me. Here’s the explanation for the relaxation of the ICNIRP 1998 guidelines offered by Google’s new AI-enhanced search engine:

The relaxation may give the impression that a lot was known about the biological effects of the kHz band, known as intermediate frequencies (IF). This is not the case. IF fields are among the least well studied in the electromagnetic spectrum. A Japanese literature review published in 2007, not long before the ICNIRP revision, concluded: “Available research data is inadequate for health risk assessment of IF electromagnetic fields.” Nor has much changed since then. A 2019 systematic review sponsored by the BfS came to a similar conclusion.

Electric Vehicle, BfS, transients, Gernot Schmid, Seibersdorf Labs, Germany, Austria, Dirk Geschwenter, FSM, ICNIRP, Alasdair Philips, IEC, Mike Wood, Teruo Onishi, Gilles Thériault, Paul Héroux, Hydro-Québec, Sam Milham, Dirty Electricity,

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