EMISSION OF SMART METER ELECTROMAGNETIC FIELD (50–100 KHZ) IN FINLAND

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ABSTRACT

The aim was to present example measurements of magnetic field exposure to smart meters for cable-transmitted signal emissions. We employed 46 smart meters that used Power Line Communication (PLC). The highest magnetic field was 0.48 µT, which is 2% of the ICNIRP guidelines to public exposure.

INTRODUCTION

The use of smart meters has increased around the world, and the discussion on the possible health effects has been active. To evaluate the possible effects of the 50–100 kHz frequencies electromagnetic fields, it is possible to use guidelines of the International Commission on Non-ionizing Radiation Protection (ICNIRP) [1].

ICNIRP has published recommended values for the magnetic fields for those frequencies concerning the general public, and the value is 27 µT for magnetic flux density.

In Finland, these smart meters most often send information or communicate using either a 50–100 kHz electromagnetic field signal through cables or a radio frequency (800–3000 MHz) aerial signal to masts. Communication durations are typically from a few seconds to tens of seconds each time.

Figures 1–2 show examples of smart meters in Finland.

Figure 1. Example of smart meter outside house.

Figure 2. Example of smart meters in basement.

Aim of the study

The aim of this paper was to present example measurements of magnetic field exposure to smart meters for cable-transmitted (50–100 kHz) signal emissions.

METHODS

We used the magnetic field meter MFM 3000 by Combinova, with a separate probe version and video recording with RMS values and a spectrum (Samsung smart phone type Samsung Galaxy S III). Figures 3–5 show examples of measurement places.

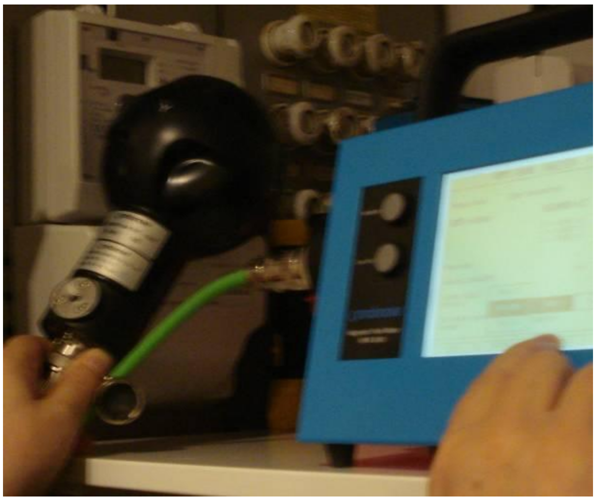

Figure 3. Example of EM measurements

The measurement location was at the surface of the meter because the values were too small possible to obtain values from other distances. The operator of a utility company remotely read the smart meters when we measured magnetic fields.

Figure 4. Example of EM measurements

Figure 5. Example of EM measurements

RESULTS

Altogether, we measured 46 smart meters that utilized Power Line Communication (PLC). The highest magnetic field was 0.48 µT, which is only 2% of the ICNIRP guidelines to public exposure.

Table 1 shows the smart meters and their protocols. In the 14 smart meters the protocol was plan, and in the 31 smart meters, the protocol was lon. In addition, we measured one Iskra meter with a DLC protocol.

Table 1. Measured smart meters and protocols

n	Smart meter	Protocol
1	E450-3P	Plan
2	E450-3P	Plan
3	E450-3P	Plan
4	E450-3P	plan
5	E450-3P	plan
6	E120LiME	lon
7	ET10	lon
8	ET10	lon
9	ET10	lon
10	E120LiME	lon
11	E120LiME	lon
12	E120LiME	lon
13	ET10	lon
14	E450-1P	plan
15	E450-1P	plan
16	E450-1P	plan
17	E450-1P	plan
18	E120LiME	lon
19	E120LiME	lon
20	E120LiME	lon
21	E120LiME	lon
22	E120LiME	lon
23	E120LiME	lon
24	E120LiME	lon
25	E120LiME	lon
26	E120LiME	lon
27	E120LiME	lon
28	E120LiME	lon
29	E120LiME	lon
30	E120LiME	lon
31	E120LiME	lon
32	E450-3P	plan
33	E450-3P	plan
34	E450-3P	plan
35	E450-3P	plan
36	E450-3P	plan
37	Iskra	DLC
38	E120LiME	lon
39	E120LiME	lon
40	E120LiME	lon
41	E120LiME	lon
42	E120LiME	lon
43	E120LiME	lon
44	E120LiME	lon
45	E120LiME	lon
46	E120LiME	lon

Table 2 shows the maximum magnetic fields during the reading of the smart meters. We measured meter 42 so that the operator read the meter many times.

Table 2. Maximum magnetic fields during the reading of meters. µT (measurement range 40 kHz–100 kHz.)

n	Smart meter	Maximum magnetic fields µT
1	E450-3P	0.23
2	E450-3P	0.24
3	E450-3P	0.30
4	E450-3P	0.28
5	E450-3P	0.38
6	E120LiME	0.01
7	ET10	0.10
8	ET10	0.18
9	ET10	0.00
10	E120LiME	0.00
11	E120LiME	0.00
12	E120LiME	0.00
13	ET10	0.00
14	E450-1P	0.12
15	E450-1P	0.19
16	E450-1P	0.20
17	E450-1P	0.26
18	E120LiME	0.13
19	E120LiME	0.17
20	E120LiME	0.00
21	E120LiME	0.13
22	E120LiME	0.15
23	E120LiME	0.00
24	E120LiME	0.00
25	E120LiME	0.11
26	E120LiME	0.10
27	E120LiME	0.14
28	E120LiME	0.11
29	E120LiME	0.00
30	E120LiME	0.13
31	E120LiME	0.00
32	E450-3P	0.42
33	E450-3P	0.42
34	E450-3P	0.48
35	E450-3P	0.48
36	E450-3P	0.39
37	Iskra	0.11
38	E120LiME	0.02
39	E120LiME	0.01
40	E120LiME	0.12*
41	E120LiME	0.07
42	E120LiME	0.06
43	E120LiME	0.29
44	E120LiME	0.10
45	E120LiME	0.07
46	E120LiME	0.02

*many readings

When we analyze our results, it is important to take into account that we measured fields during the reading of a smart meter. Readings were very short, about 20 s. Thus, the possible exposure time period is also only about 20 s.

Figures 6 and 7 show example photos of the videos illustrating where the magnetic field spectrum is during the smart meter readings. It is possible to see an MF peak near the 100 kHz mark (the blue arrow).

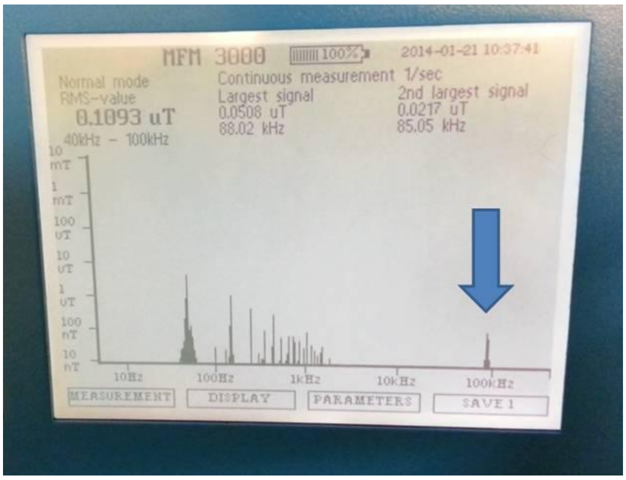

Figure 6. Example photo of video, where magnetic field spectrum is during smart meter reading. (The blue arrow indicates an MF peak near the 100 kHz mark).

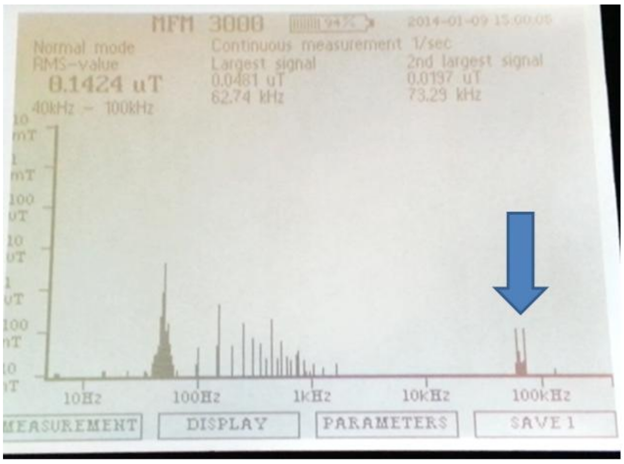

Figure 7. Example photo of the video, where magnetic field spectrum reveals an MF peak near the 100 kHz mark (blue arrow) during smart meter reading.

Figures 8 and 9 show example photos of the videos, giving maximum magnetic fields during smart meter readings.

We took both video spectrums and maximum values during the measurements.

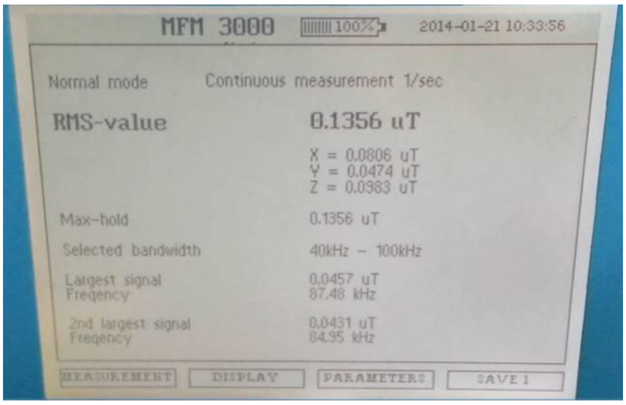

Figure 8. Example photo of video, where maximum magnetic field is during smart meter reading. The measurement range was 40 kHz–100 kHz.

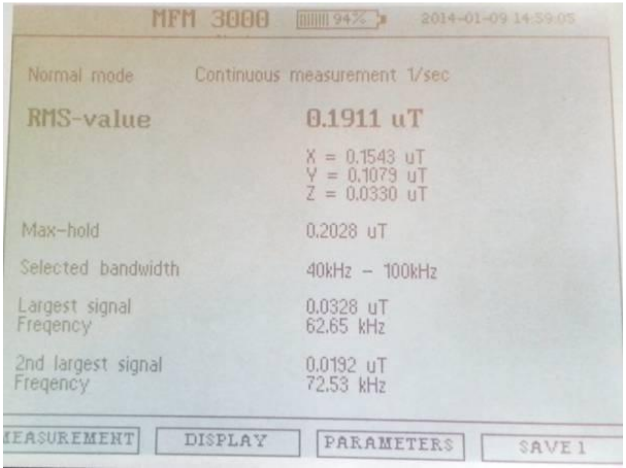

Figure 9. Example photo of the video, where maximum magnetic field is obtained during smart meter reading. The measurement range was 40 kHz–100 kHz.

The 50 Hz magnetic field does not influence the result because the measurement range was 40 kHz–100 kHz.

DISCUSSION

This work is a preliminary study. Therefore, we have not measured at further distances from the smart meters. It was not easy to acquire reliable values even at the surfaces of the meters because the values were so low compared to the detection threshold of the used meter.

However, this indicates that the magnetic field values of those smart meters are very low in the reading phase; moreover, the duration of this field emission is about 20 s in one day, so that the fields cannot be deemed significant when health effects are considered compared, for example, to ICNIRP guidelines [1]. Furthermore, the World Health Organization (WHO) published in 2007 an environmental health criteria monograph titled “Extremely Low Frequency Fields.” The monograph described that health effects caused by ELF magnetic fields and the MFs that can affect human beings are higher than the fields that we measured in this study.

In an earlier study [3], the radiofrequency field emissions from smart meters were also studied, and exposure levels were not high.

These kinds of analyses are needed because there are many suspicions on these magnetic fields. On the other side, when radio frequency field communication smart meters are evaluated, these values are sometimes mixed with these types of meters. Then, it is also important to evaluate smart meters using frequencies of 50–100 kHz.

CONCLUSION

In conclusion, it can be stated that there is no specific need to improve the sheltering of the meters from the public or to measure magnetic field emissions from all smart meters in the future.

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