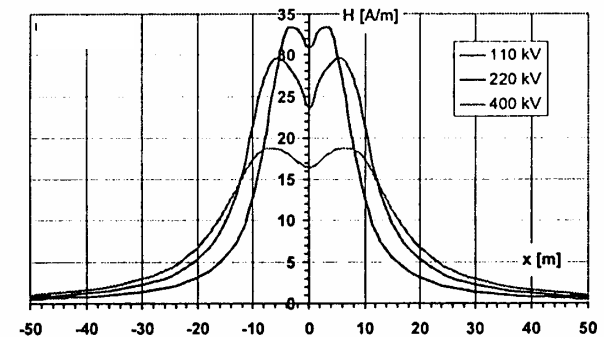
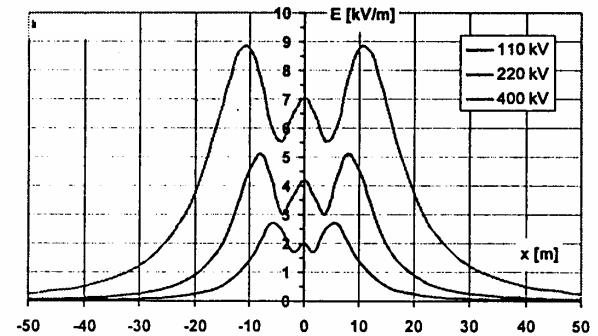


# **Electromagnetic environment in Electrical Hypersensitives homes and workplaces**

Kjell Hansson Mild

National Institute for Working Life,  
Umeå, Sweden

- **External sources: High voltage power lines, distribution lines**
- magnetic flux density depends on the current in the line
- electric field strengths depends on the towers design (various in particular countries)
- electric and magnetic fields fall to background strengths at distances of about 50-100 m
- under 400 kV power lines - maximum magnetic flux density is about 15  $\mu\text{T}$
- maximum electric field can be approx. 1 kV/m<sup>1</sup> under 110



# Examples of ELF sources inside houses



## Overall mean levels in homes in Sweden and Norway

E fields: Swe 54 V/m (SD = 37), Nor 77 V/m (SD = 58)

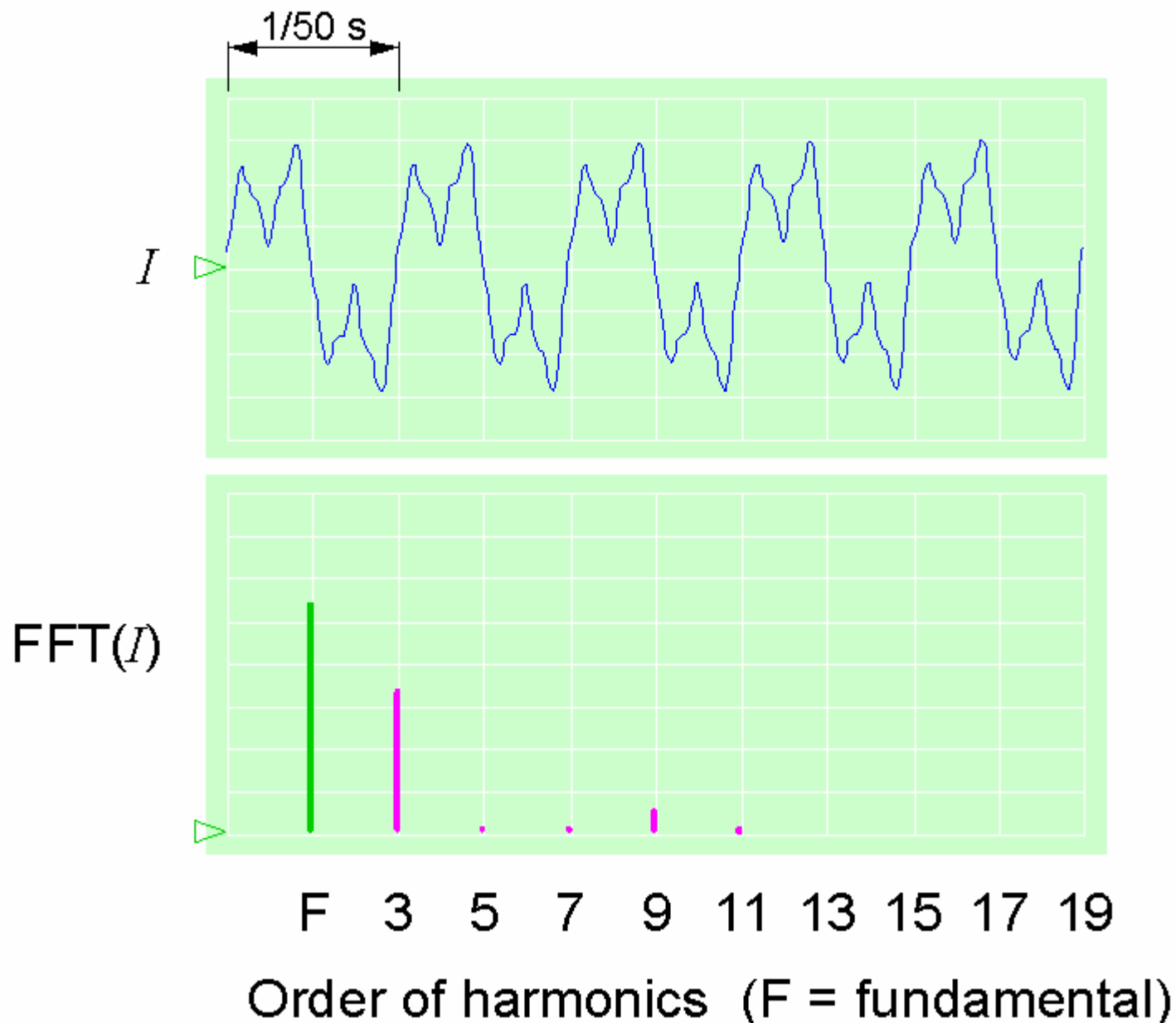
B fields: Swe 40 nT (SD = 37), Nor 13 nT (SD = 17)

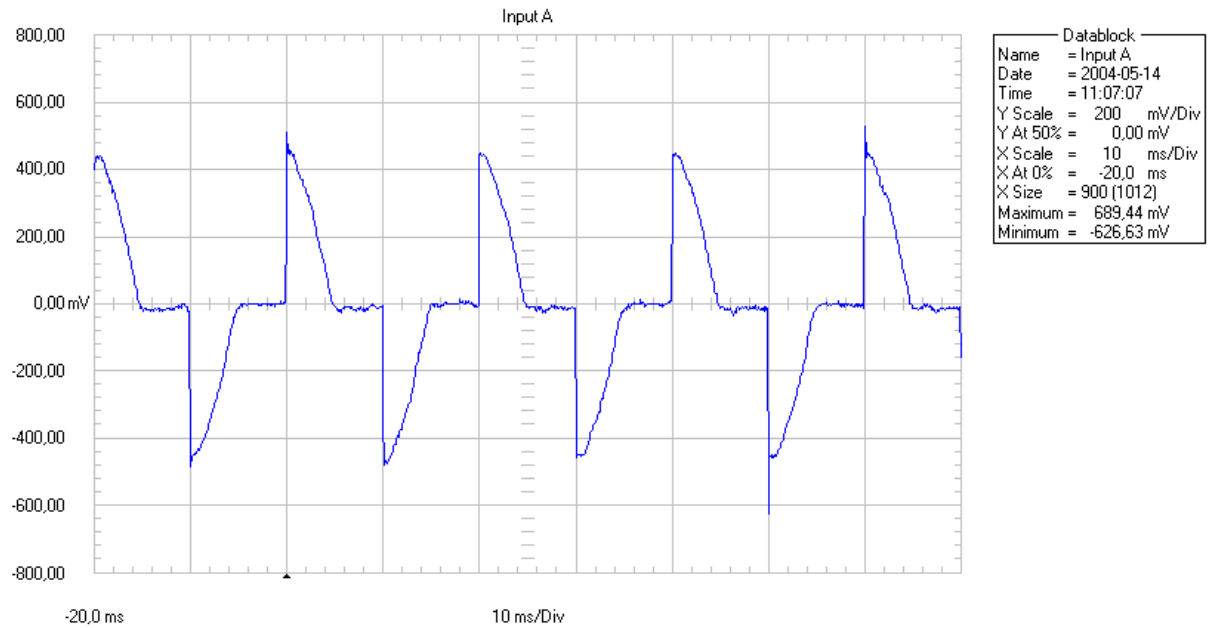
Offices: E fields Swe 40 V/m, Nor 15 V/m

B fields varied from some nT to over 1  $\mu$ T in both countries.

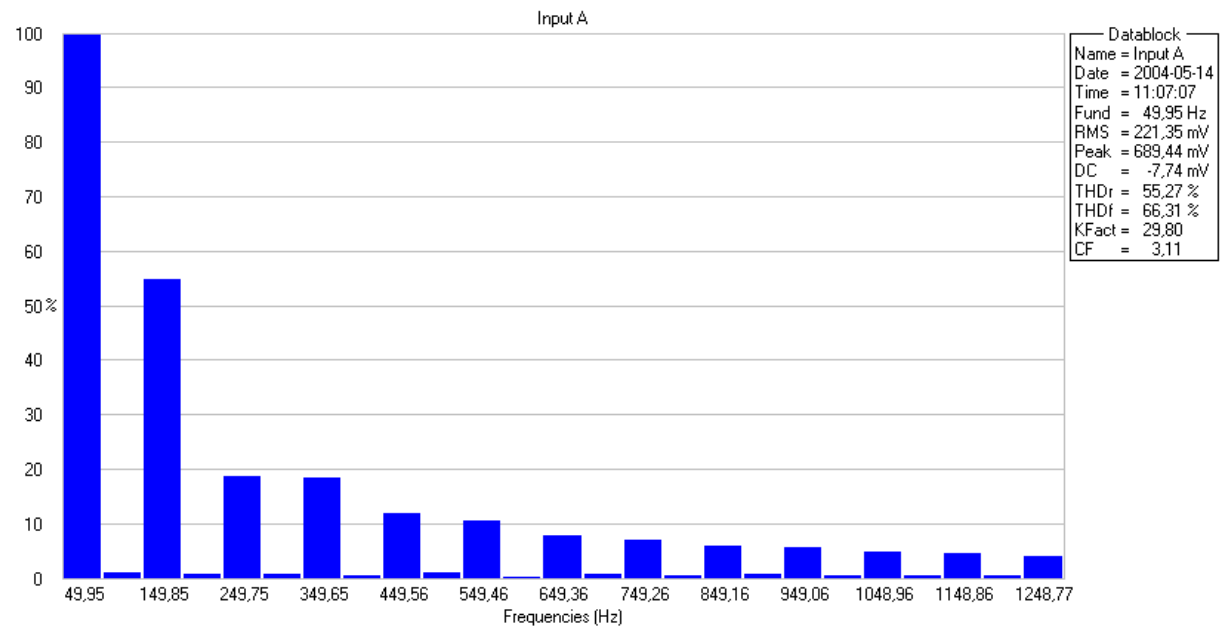
Hansson Mild et al. Measured 50 Hz Electric and Magnetic Fields in Swedish and Norwegian Residential Buildings. IEEE Transactions on Instrumentation and measurement. 1996, 45:3:710-714.

# Current in delivery cable



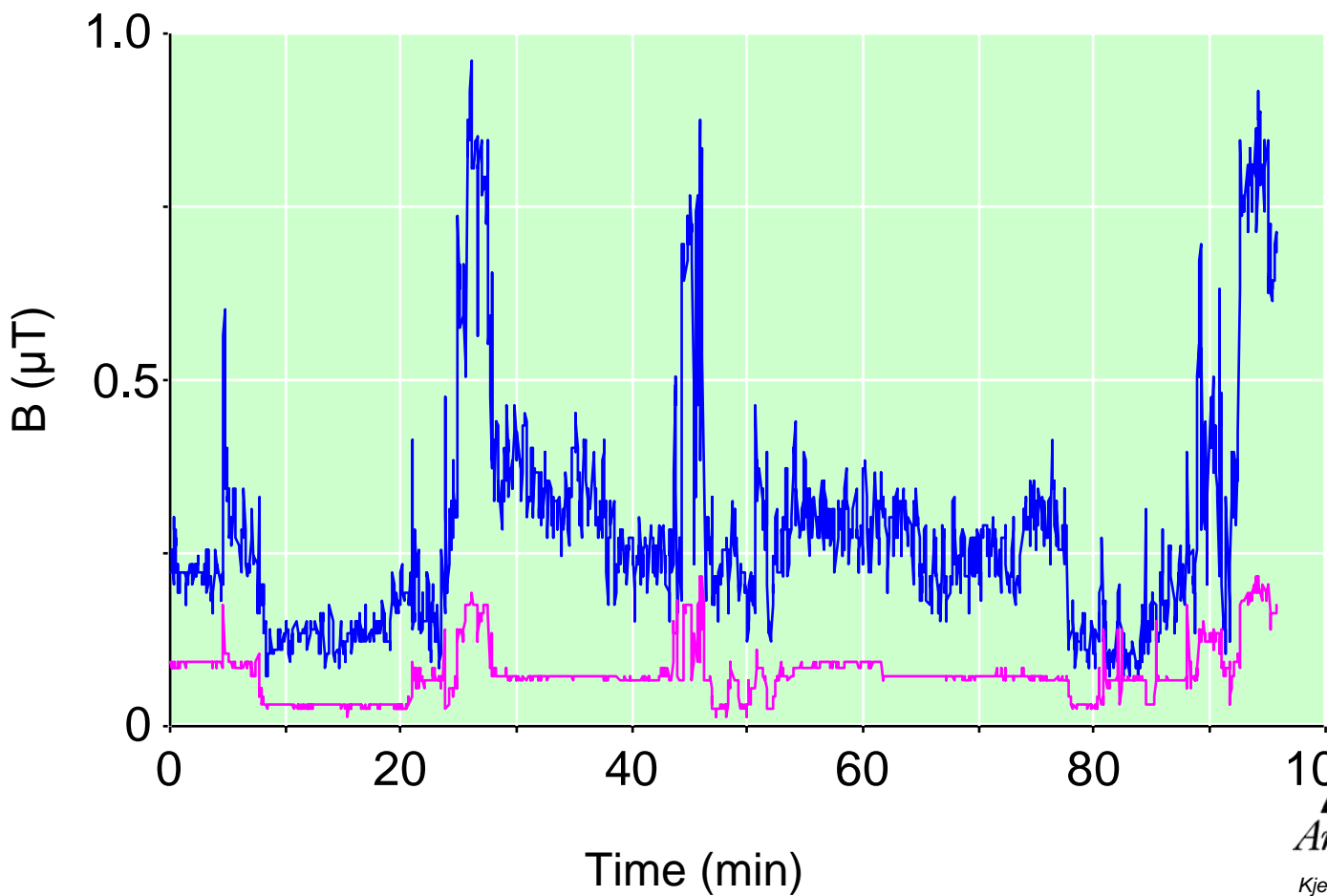


## Wave shape for a dimmer



Magnetic field

— Broad band  
— Harmonics





Electrical  
central



Cables

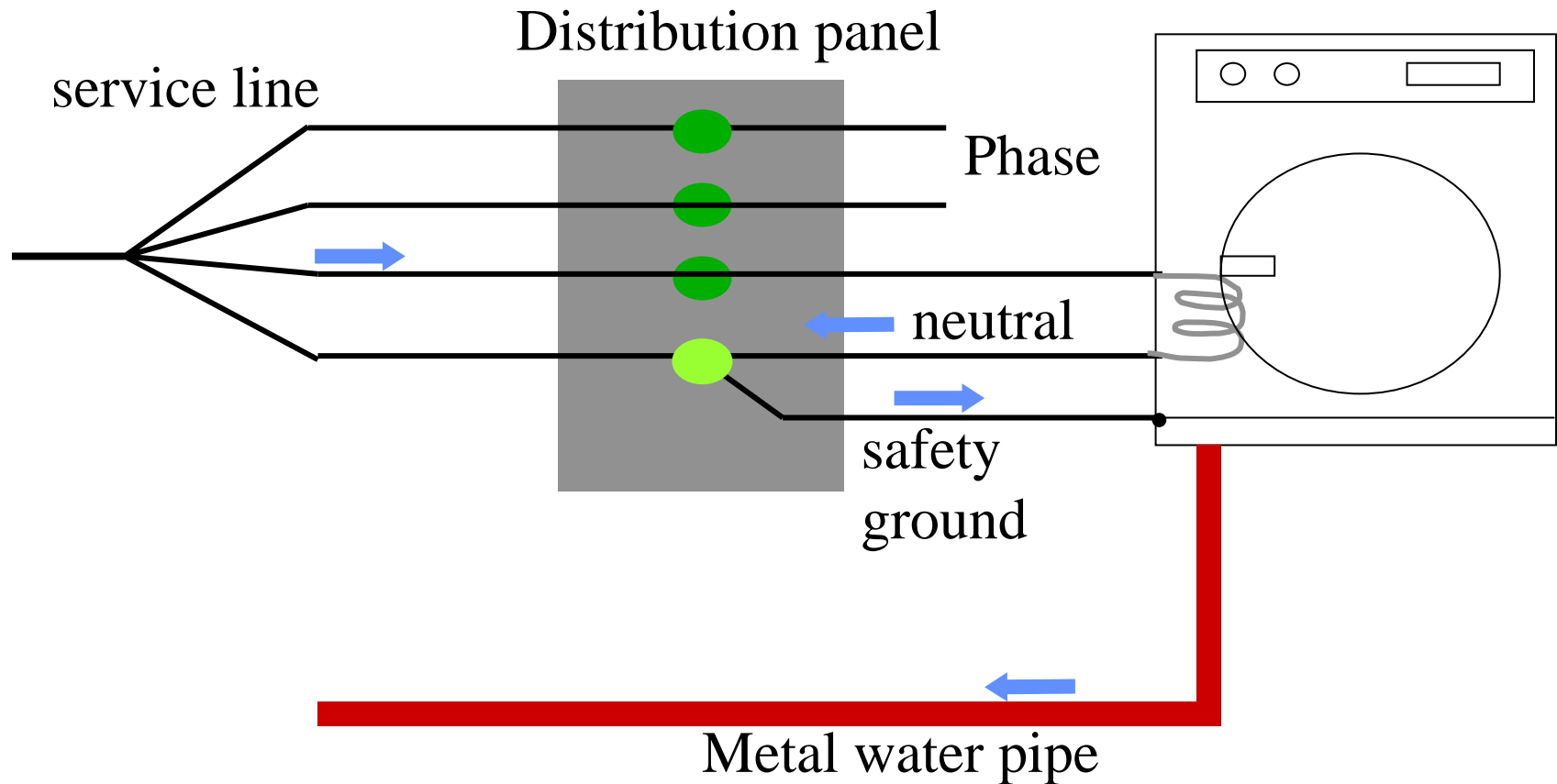


Stray current

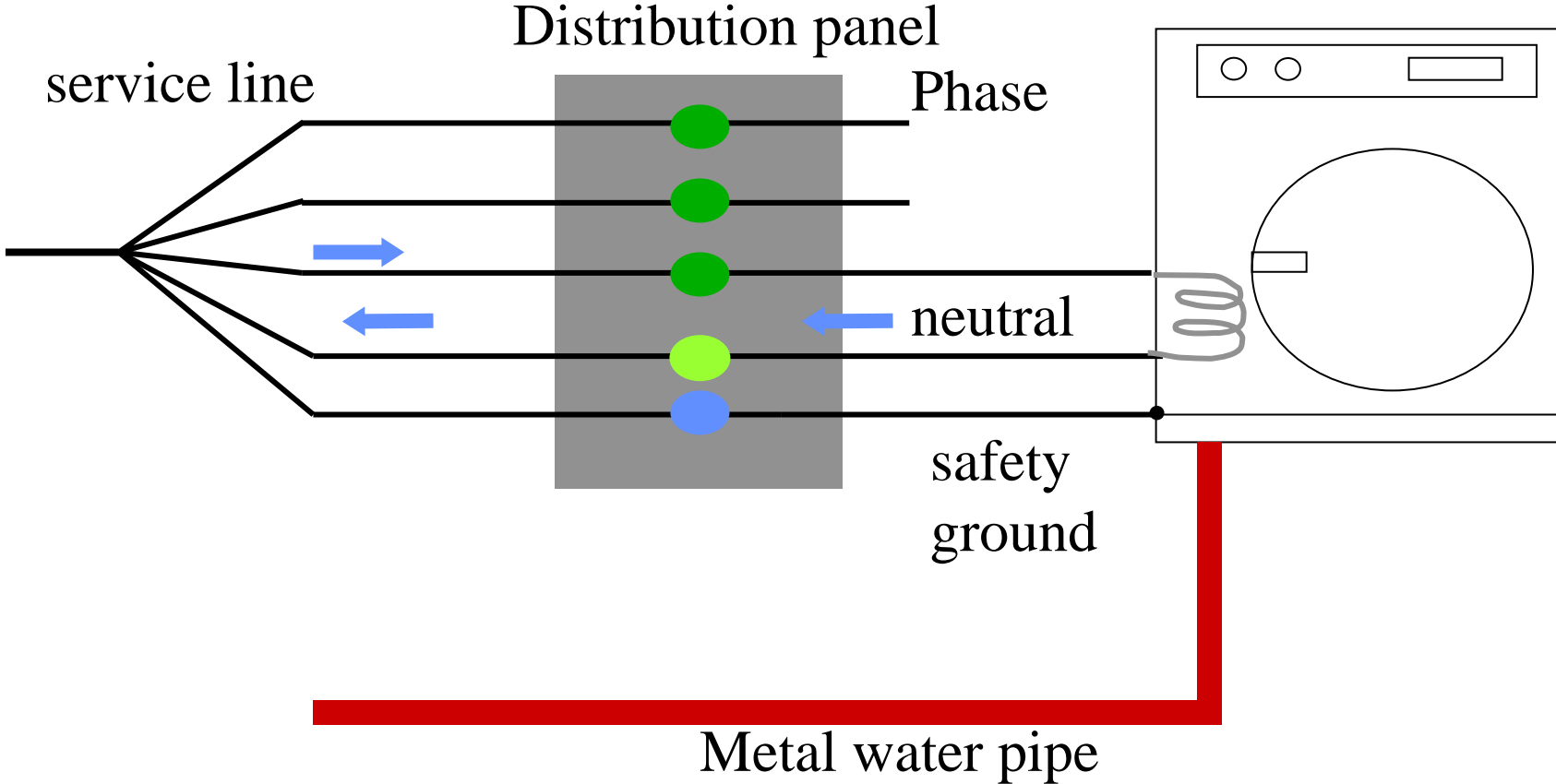




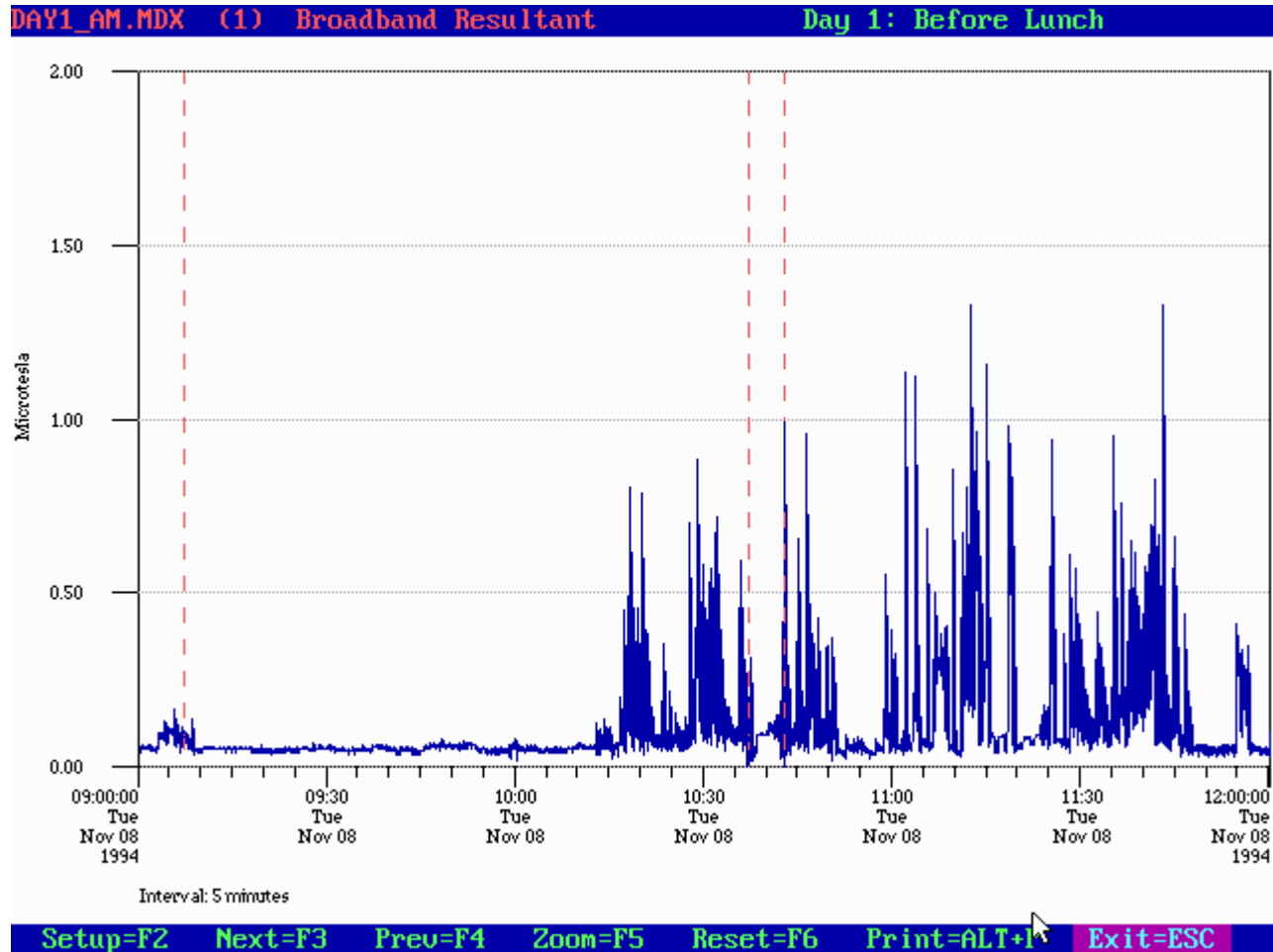
# 4-wire distribution system



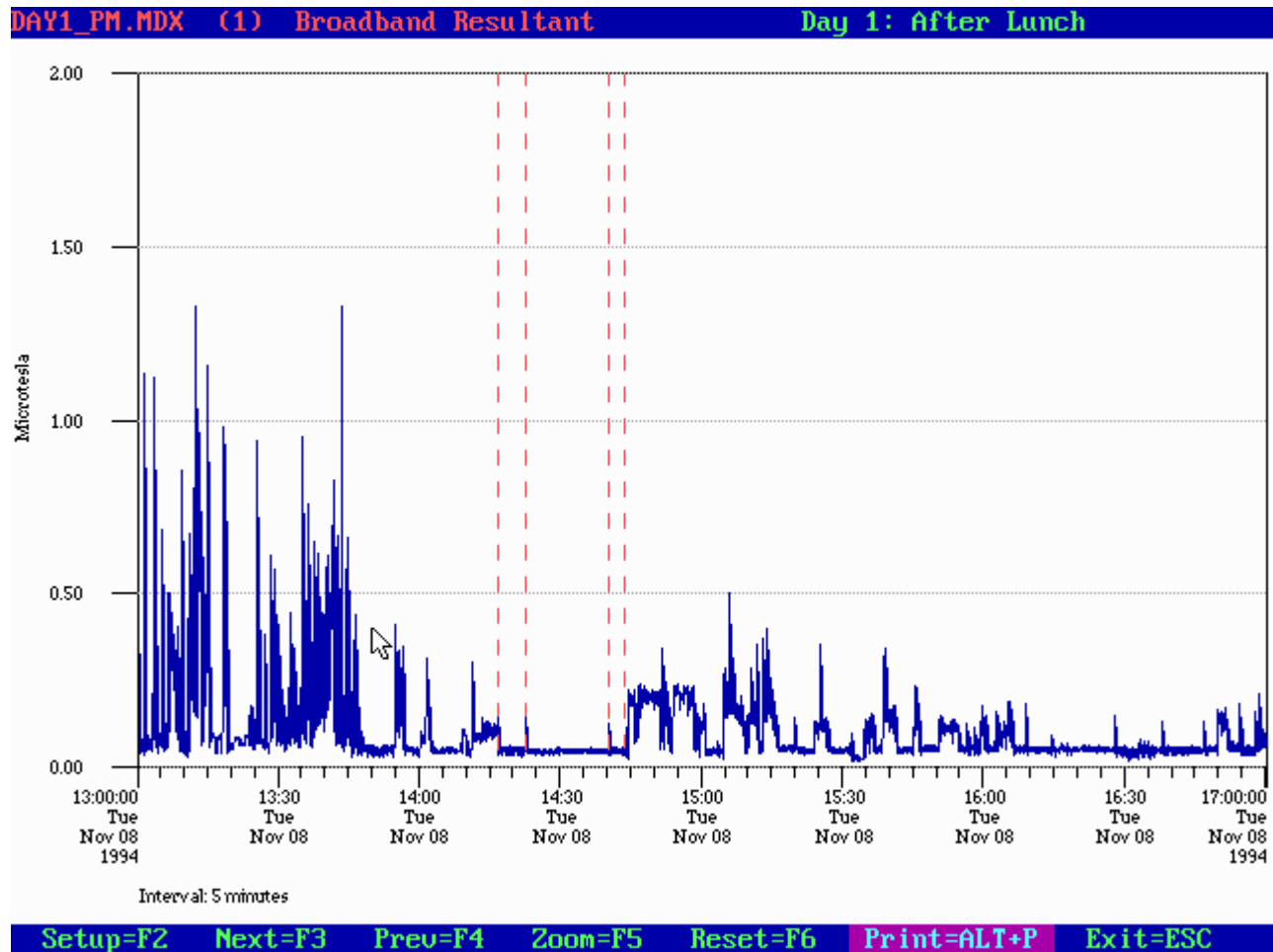
# 5-wire distribution system



# Examples of EMDEX recordings from EHS study Sandström et al, 2003.



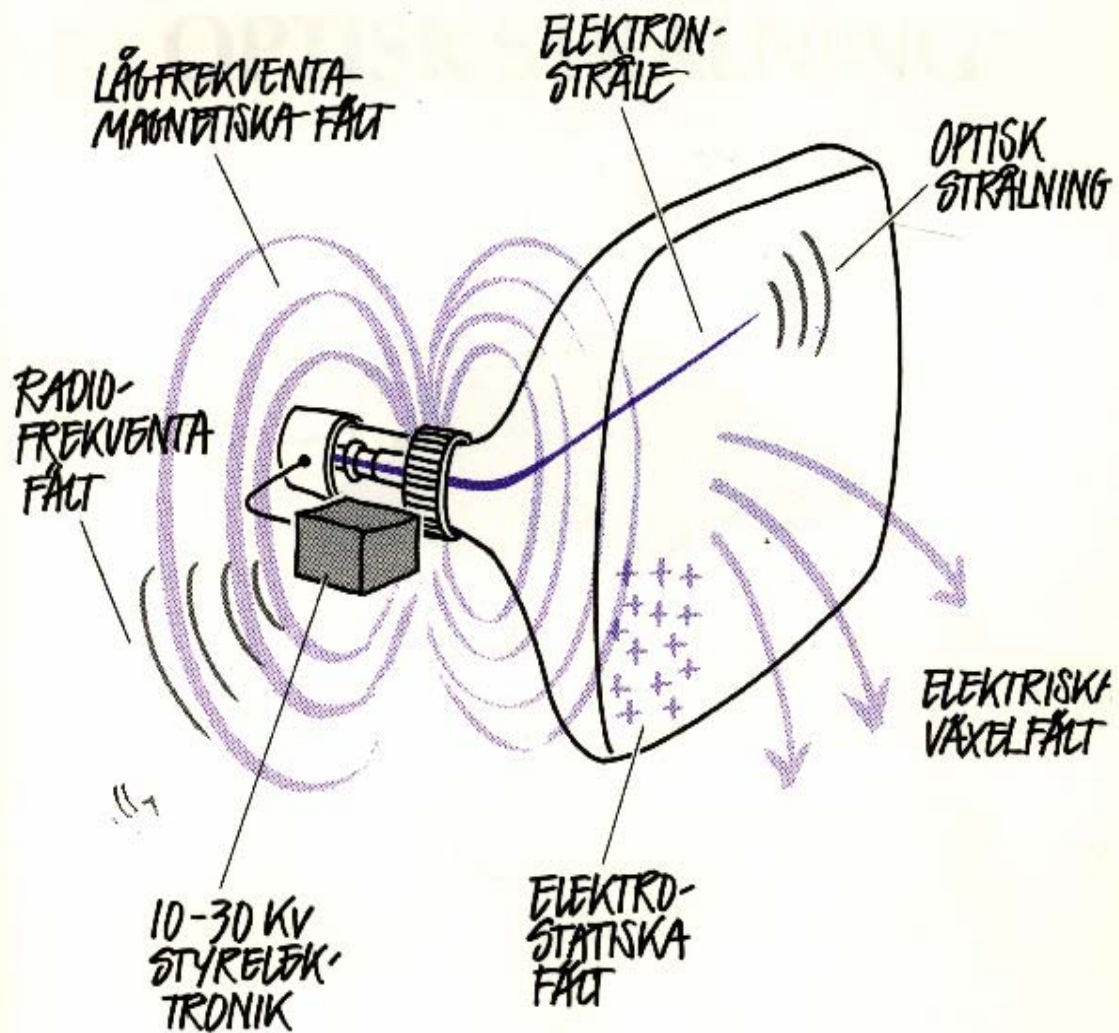
# Examples of EMDEX recordings from EHS study Sandström et al, 2003.



Emdex values from 24 h recordings for  
EHS patients and controls. Values in  $\mu\text{T}$ .

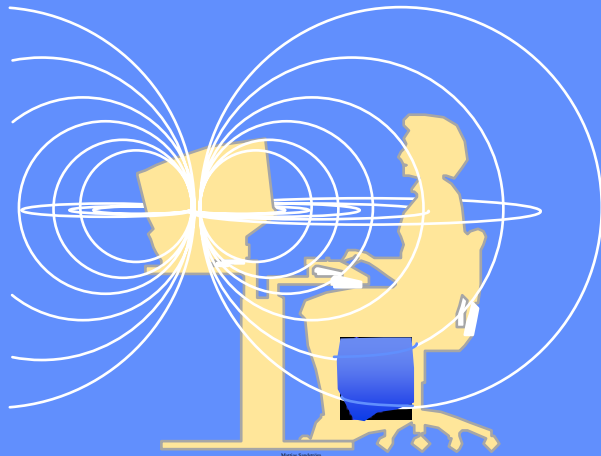
	Mean	Median	Max
Case	0.10	0.05	5.57
Cont.	0.11	0.06	3.87

From Sandström et al.: Long-term Holter ECG recordings  
in patients with perceived electrical hypersensitivity.  
*Internat J Psychophysiol.* 49; 227-235, 2003.

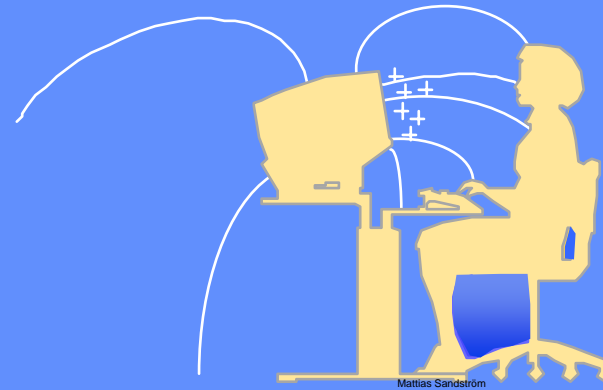


Figur 5

# VDT related fields



REFRESH RATE MAGNETIC FIELD  
LINE FREQUENCY MAGNETIC FIELD



AC ELECTRIC FIELD  
DC ELECTRIC FIELD

# EM-fields in offices

	Md	Max
<b>In rooms</b>		
<b>E-field (V/m)</b>	<b>20</b>	<b>100</b>
<b>B-field (<math>\mu\text{T}</math>)</b>	<b>0.07</b>	<b>1.0</b>
<b>VDT related fields</b>		
<b><math>E_{\text{ELF}}</math>-field (rms) (V/m)</b>	<b>20</b>	<b>330</b>
<b><math>B_{\text{ELF}}</math>-field (rms) (<math>\mu\text{T}</math>)</b>	<b>0.21</b>	<b>1.2</b>
<b><math>E_{\text{VLF}}</math>-field (rms) (V/m)</b>	<b>1.5</b>	<b>15</b>
<b><math>B_{\text{VLF}}</math>-field (rms) (nT)</b>	<b>26</b>	<b>142</b>

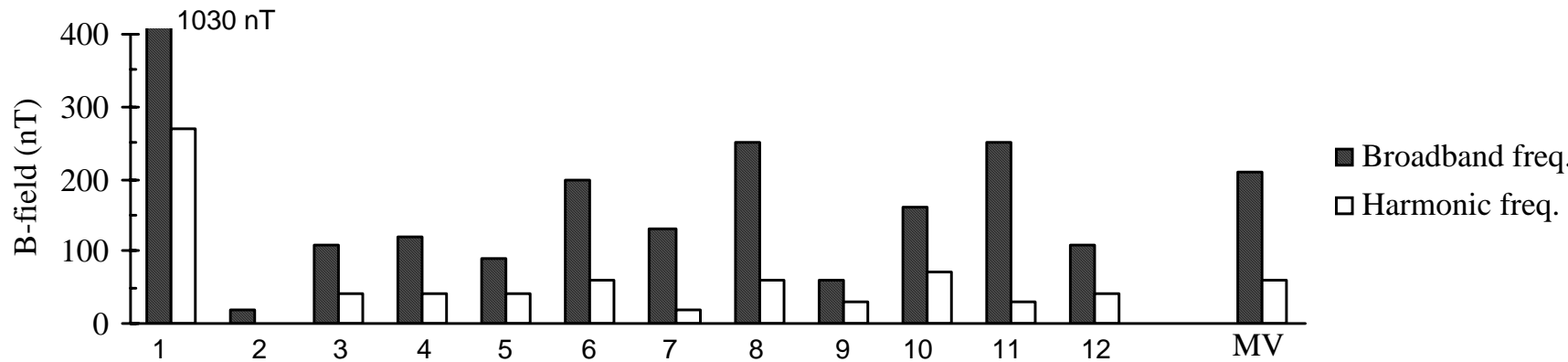


## Electric fields

- 65 % of the screens had an equivalent surface potential less than 0.5 kV
- Dominating sources in the ELF range were not the VDTs but other ungrounded electric appliances in the room
- Filter screens were used by 53 % of the office workers

## Magnetic fields

- Many VDTs had a reduced B-field in the VLF range,  $Md=0.03 \mu\text{T}$
- VDTs contributed to the B-field level in the ELF range,  $Md=0.21 \mu\text{T}$   
Background field,  $Md= 0.07 \mu\text{T}$
- 5% of the offices had a background field higher than  $0.5 \mu\text{T}$ , high enough to induce jitter on the VDT screen



*The magnetic field measurements at 12 different offices. The filled bars represent the broadband measurements (both the fundamental and the harmonic frequency magnetic fields). The unfilled bars represent the harmonic content of the magnetic field in each workplace.*

# Electrical disturbances

Short circuits

Corona discharges

Relay, triac

Fluorescent tubes

Frequency converters

PC, printers...

ESD



High frequency noise on  
the electrical net

- Intensity



- rate of change



- Frequency



- transients on-off



- Pulsed



**DOSE ?**



## **Far field exposure from base stations (COST281)**

**SAR = 3 mW/kg per incoming W/m<sup>2</sup>**

**Locally SAR-values can be 10 times higher**

**Max measured from base: 13,4 mW/m<sup>2</sup>**

**Median value: 0,01 mW/m<sup>2</sup>**

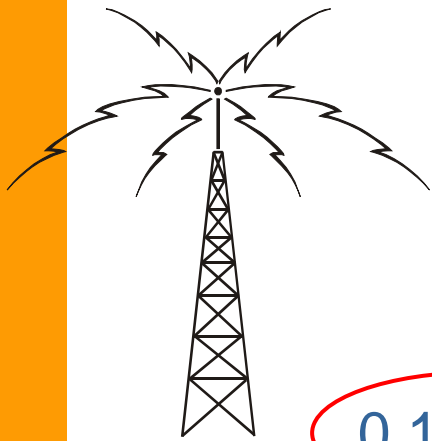
**SAR<sub>wb</sub>max = (3x13,4)= 40 μW/kg**

**Local max 400 μW/kg = 0,4 mW/kg**

**EU limit: SAR<sub>wb</sub> = 0,08 W/kg, SAR<sub>lok</sub> = 2 W/kg**

**Max whole body 2 000 times lower, Locally 5 000 times**

**Median value 2 000 000 times lower, Locally 5 000 000 times**



TV-transmitter

0,1 W/m<sup>2</sup>

0,001 W/m<sup>2</sup>

0,00001 W/m<sup>2</sup>  
= 0,01 mW/m<sup>2</sup>

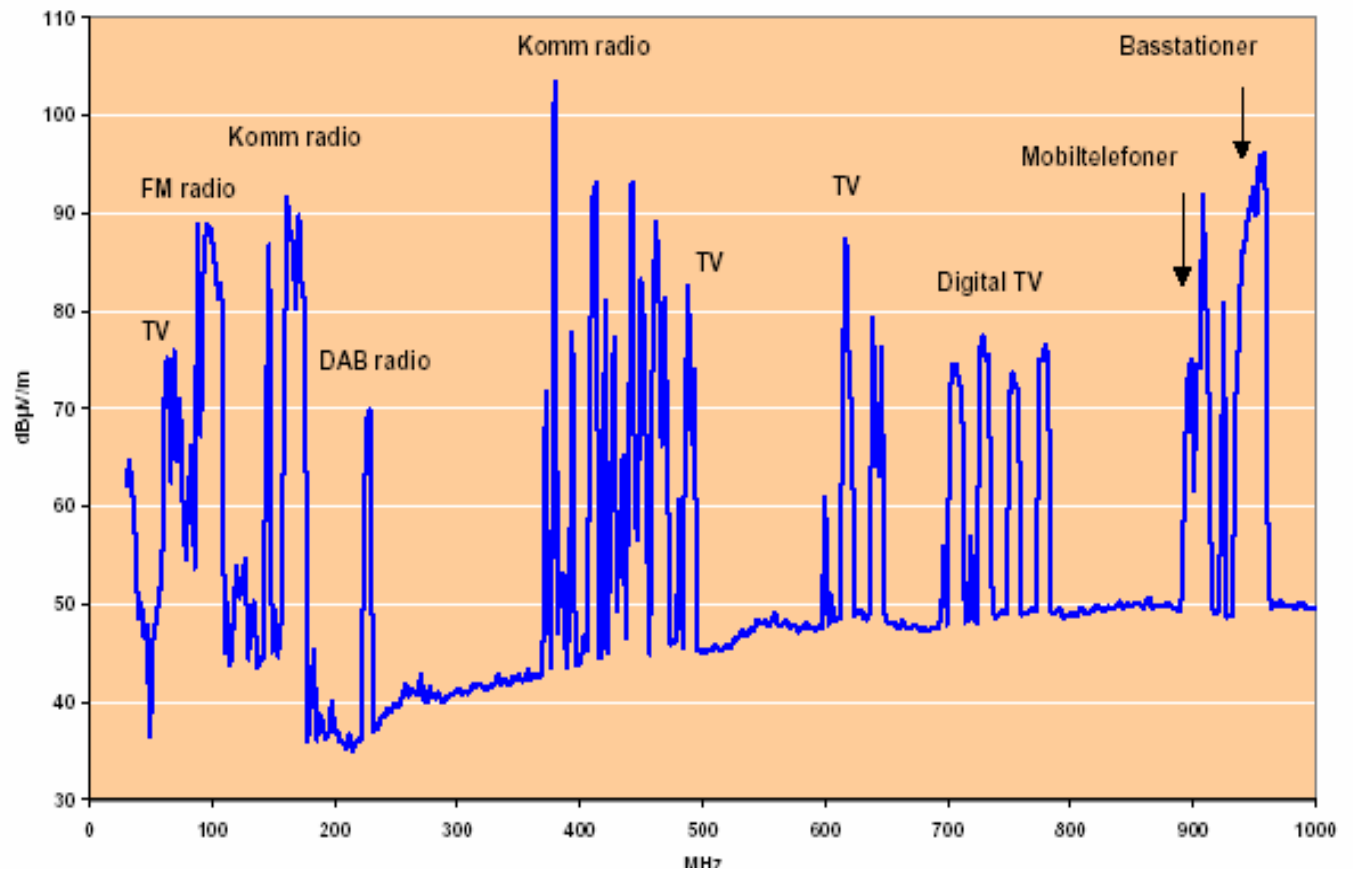


Microwave oven



Base station





- Typiskt spektrum 30-1000 MHz registrerat i Stockholm utan fri sikt till radio/TV sändaren i Nacka. Diagrammet visar maximalt värde av den elektriska fältstyrkan under en tvåminuters period i logaritmisk amplitudskala (dB/μV/m). (Källa: SSI)

# Summary

E and B fields in homes and offices are no longer pure 50 Hz sinusoidal, but have harmonics and transients.

There is an increase in our everyday environment of low level RF signals from different communication devices.

EHS cases do not have an EMF environment different from others.