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Examination of Magnetic Fields of Televisions

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Abstract
Human bodies damages induced by electronic equipment is into of physical and biological research since the revolutionary distribution in households of electric and electromagnetic devices e.g. radios, televisions, mobile phones, microwave ovens etc.

This article is related to systematic examinations of magnetic fields generated by such a devices, e.g. televisions in their close vicinity and far away.

Key words: Nonionizing electromagnetic radiation; Biological impact; SA; SAR; Magnetic induction; Induction map; SURFER

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INTRODUCTION
The so called non ionizating radiations emitted by such a devices has an energy less than one need for split off chemical bounds of composites of human body ($E < 6\times10^{-19}$ J, $f < 10^{15}$ Hz). Such a radiation are as UV-A, light (visible, IR), microwaves (MW), radiowaves (RF), mains (houses) etc.

To speak about the biological aspects of radiation we must introduce some dosiometric concepts. The human body as a biological object subjected to radiation absorbs some part of this radiation. The dose of that is Specific Absorption Rate (SAR) which is equivalent to absorbed radiation energy related to unit volume for a specific unit time duration (W/kg or mW/g). The Specific Absorption (SA) is the SAR integrated for a time interval (J/kg or mJ/g) (Köteles, 2002).

The biological aspects of MW and RF radiation is connected to change of biological polarization of molecules. Due to time dependence of electric and magnetic fields the polarization itself will be also time dependent. If the frequencies of electromagnetic fields and molecule polarization are closely rated the absorption reaches his max. value. Also the electrical and magnetic properties of molecules play a very important role s.c. relative permittivity and permeability. The higher permittivity of tissues the higher absorption of radiation therefore the penetration depth is smaller.

The tissues with high concentration of water (muscle, skin, internal parts) have permittivity 10 times large than tissues with low water concentration (bone, fat) therefore their penetration is smaller (1/10). The permittivity of air and tissues are strongly different, otherwise their permeabilities are closely related. The electric fields penetration into tissues is small otherwise the magnetic fields penetrate more deeply.

The absorption depends on wavelength of radiation and tissue size. If they are closely rated the absorption is larger (Sós Katalin, Bálint Ágnes, Nánai László, & Bálint István, 2005).

The thermal impact radiation on tissues depends on thermal conductivity of tissues. F.e. the brain thermal conductivity is large while the eye thermal conductivity is small therefore at same value of SAR the eye reaches higher heating effect (Sós Katalin et al., 2005).

Previously; spending a long time before old CRT monitors the eyes became red, vein channels became wider.

The influence of electromagnetic radiation on central nervous system is also important. Some ions are

transported through membranes differently e.g. after microwave irradiation the Ca^{2+} ions are transporting with highest speed. Ca ions play very important role in physiological function therefore their speed distribution affects on brain function also. Because of widening of capillary channels due to thermal effects the capillary allows to transport such a chemicals which are forbidden in normal circumstances (Sós Katalin et al., 2005).

The experiments with animals showed, that of 4 mW/g the above mentioned irregularities are already present. The standards of Human Health are different by regions because they are used different methods. Also a member of particular interest (personal, group, economic) should be taken into accounts. The real compromise between health, environment and economical interest should be discussed (Thuróczy György, & Bakos József, 2002).

The widely accepted standards based on ICNIRP (International Commission of Non-Ionising Radiation Protection) are listed below in Table 1.

Table 1
Human Recommendation of ICNIRP EU for 50 Hz Electronic and Magnetic Fields (Thuróczy György, & Bakos József, 2002).

			ICNIRP	EU
Induced current density		(mA/m^2)	2	2
Electric field	(kV/m)		5	5
Magnetic induction	(mG)		1000	1000
Touching current	(mA)		-	1,5

The Hungarian Regulation the effect on central nervous system is the key parameter, therefore the value related to animal experiments is the threshold value 4 mW/g for SAR. The population's SAR value is the 1/50 parts e.g. 0,08 mV/g (mean value for 30 minutes). The employment's value is a little higher but for smaller time interval (10 times safety threshold) 0,4 mV/g (for 6 min). Both thresholds are related to full body. They are also some local values related to head, trunk etc.; 2 mW/g for population, 8 mW/g for employment (Thuróczy György, 2002).

The Health impact of electromagnetic radiation is widely examined but different to say a final conclusion. It's because of that the high intensity load on human body has only short time history to say something concrete on long time exposure till impossible. The WHO Cancer Agency (IARC) in 2011 based on many years investigations the impact of RF electromagnetic waves on human body declared as concern causing one see glioma, mobile uses, radar and MW expositions as target questions[1].

Artificial Originated Electromagnetic Sources

All of equipment radiating electromagnetic waves by their direct or indirect working conditions. Practically all of equipment based on power of alternative currents radiate e.m. waves see f.e. high voltage translation systems transporting currents 150-2000 A. They represent voltage at 1 m to Earth about 10-20 kV/m and 200-6000 mG (20-600 μT) going away these values are quickly decreasing.

Near the users (households) the relevant values are 10-50 V/m and 20-50 mG (2-5 μT). (Sós Katalin et al., 2005)

The electric field intensity (in a body) below the skin decreases effectively while the magnetic field reaches at original intensity the internal parts of body.

The magnetic field of above mentioned high voltage transport lines decreases rapidly only at distances of some 10 meters. Otherwise at household equipment, televisions, radio-towers the intensity decreases rapidly, only there is RF radiation and low frequency radiation (ELF) at such a distances.

1. MEASUREMENTS

1.1 Instruments Used

Ⅰ EMF tester, type EMF-701. On measures the magnetic component of electromagnetic field in units mG (0,1-199,9) or μT (0,01-19,99). The frequency range is 30 Hz - 300 Hz. Because of electromagnetic interference at low measured values the error is higher e.g. at normal values is ±0,4-0,5 mG at lower values (below 5 mG) ±0,2mG[2].

Ⅱ 3D EMF tester of type PCE-G 28. (Compered with EMF-701)

- Measurements with PCE-G 28 along 3 axis. Measurements with EMF-701 along 1 axis.
- Due to isolated realization of measuring head from house of PCE-G 28, the measurements are running quickly, and the distance measurements are provided more easily.
- The measuring frequency interval is 30-300 Hz, but the measuring value interval is 0–20000 mG

1.2 Description of Measurements

We have used two type TV-s for measurements:

A: Samsung-Plano with electronic tubes
B: Funai-2000A MK 5 electronic tubes
C: Samsung LE26B350F1W LCD
D: Sony KDL-40V4000 LCD

We have determined measuring points as they are showed in Figures. (1-5).

1: A, B, C, D in front
2: A, B at right and left sides
3: A at rear
4: B at rear
5: C, D side

[1] http://www.osski.hu/info/rfbesorolas/OSSKI_rfbesorolas.pdf

[2] http://www.extechinstruments.com/instruments/product.asp?catid=57&prodid=353

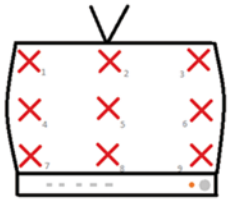


Figure 1

Figure 2

Figure 3

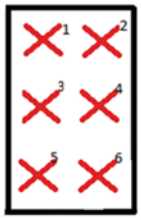


Figure 4

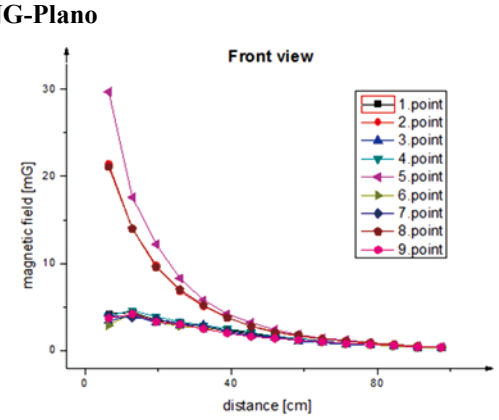
Figure 5

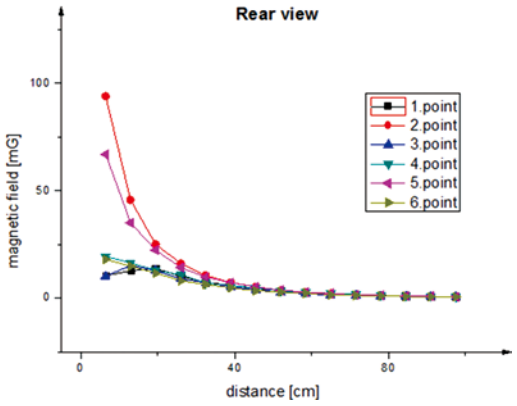
1.3 Results of Measurements

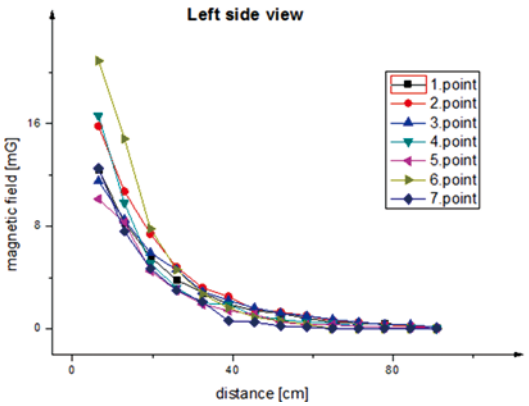
FUNAI-TV-2000A

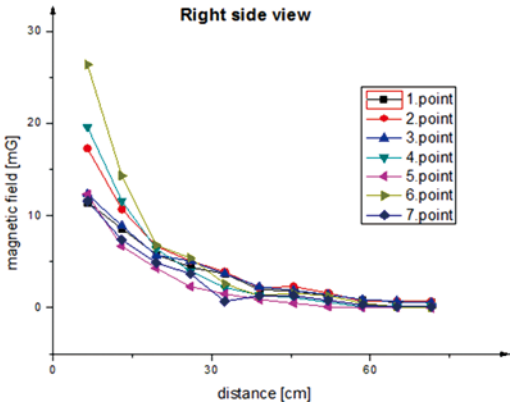
IN FRONT magnetic field (mG)									
Distance (x, cm)	**1. point**	**2. point**	**3. point**	**4. point**	**5. point**	**6. point**	**7. point**	**8. point**	**9. point**
6,5	11,5	19,4	9,8	9,6	22	8,9	8,4	19,8	10,4
13	7,4	12,3	6,7	7,1	13,0	6,9	6,6	11,7	7,0
19,5	5,8	8,1	5,3	5,1	8,3	4,9	5,4	7,9	5,2
26	4,0	5,5	4,2	4,3	5,7	3,8	4,0	5,4	4,1
32,5	3,3	3,9	2,9	3,0	4,1	2,9	3,2	3,9	3,1
39	2,5	2,9	2,3	2,4	2,9	2,3	2,4	2,8	2,3
45,5	1,9	2,1	1,7	1,9	2,2	1,8	1,9	2,2	1,8
52	1,4	1,6	1,3	1,4	1,6	1,3	1,6	1,6	1,4
58,5	1,2	1,2	1,0	1,2	1,2	1,0	1,2	1,2	1,0
65	1,0	0,9	0,8	0,9	0,9	0,8	0,9	0,9	0,8
71,5	0,7	0,7	0,6	0,7	0,7	0,6	0,7	0,7	0,6
78	0,6	0,6	0,5	0,5	0,5	0,5	0,6	0,6	0,5
84,5	0,4	0,4	0,4	0,4	0,5	0,4	0,4	0,5	0,4
91	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,3
97,5	0,2	0,2	0,2	0,2	0,3	0,2	0,2	0,3	0,2

SAMSUNG-Plano

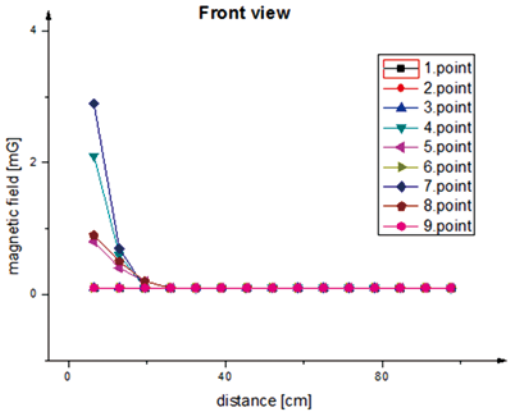


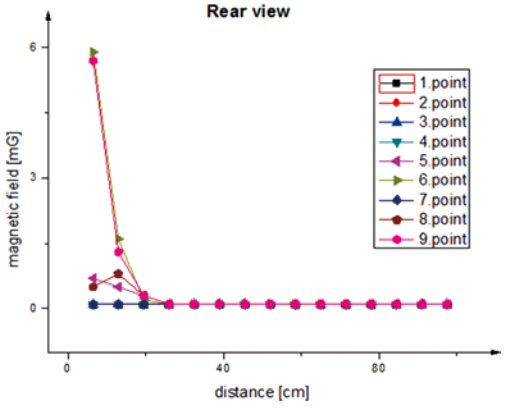


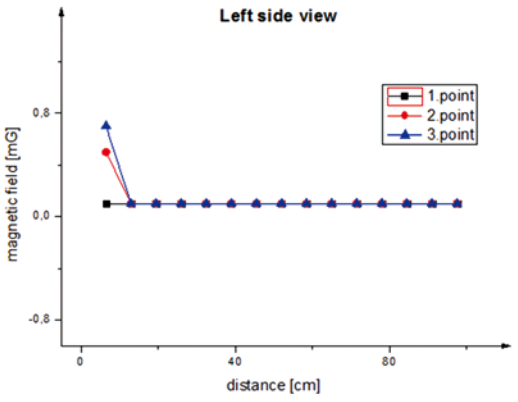


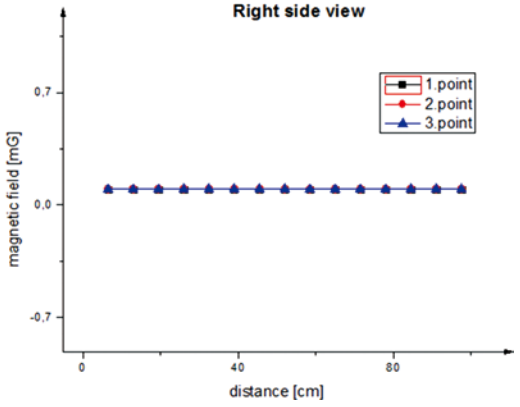


LCD Samsung TV (LE26B350F1W)

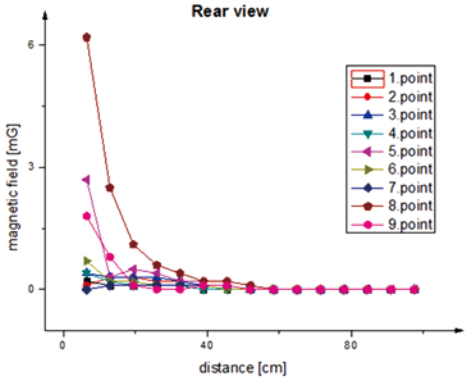


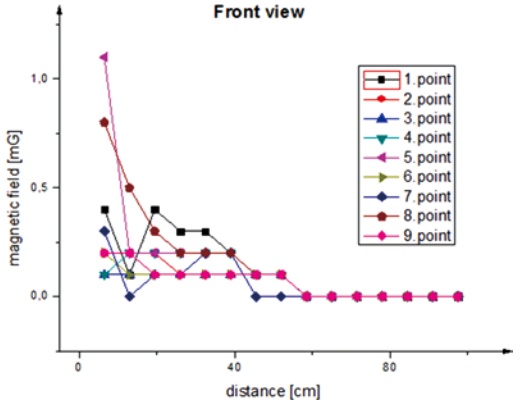


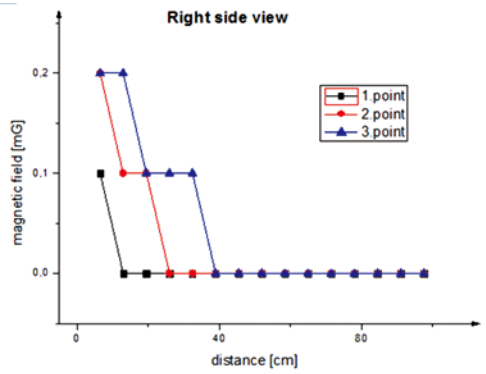


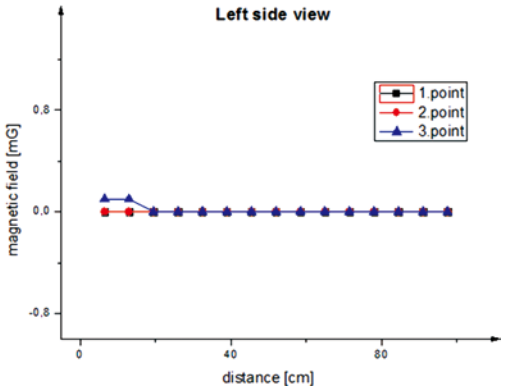


LCD Sony TV (KDL-40V4000)



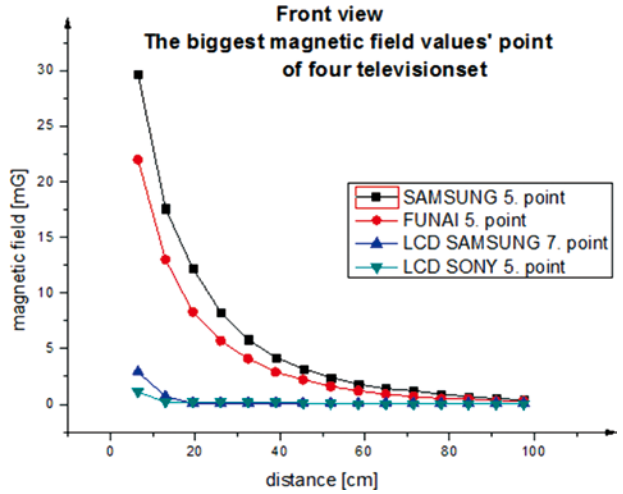




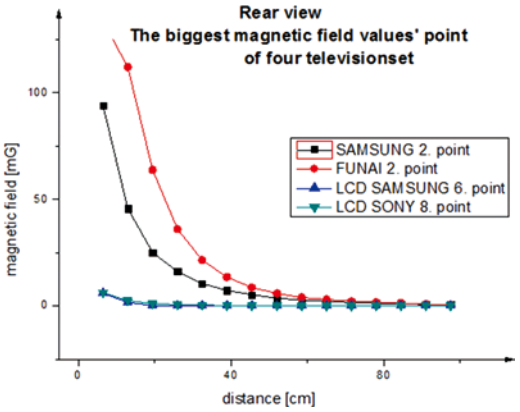


2. CONCLUSIONS OF MEASUREMENTS

Our measurement allowed to conclude that the magnetic induction of LCD TV-s are strongly lower that one for CRT TV-s. In front of TV-s, see point 5 is the induction higher – this point is located closer to diverting coil and most of the electrons hit this area. For LCD-s the situation differs because of different construction. For the SAMSUNG-s this point is located aside. For LCD-s in both causes the magnetic field geometry is non symmetric: the TV "soul" (the polarized light emitting equipment) is located at left side. The magnetic field induction for CRT-s is about 15-16 times larger compered to LCD ones, but away about 1-1,5 m the value of induction for both types decreases below 0,1 mG.



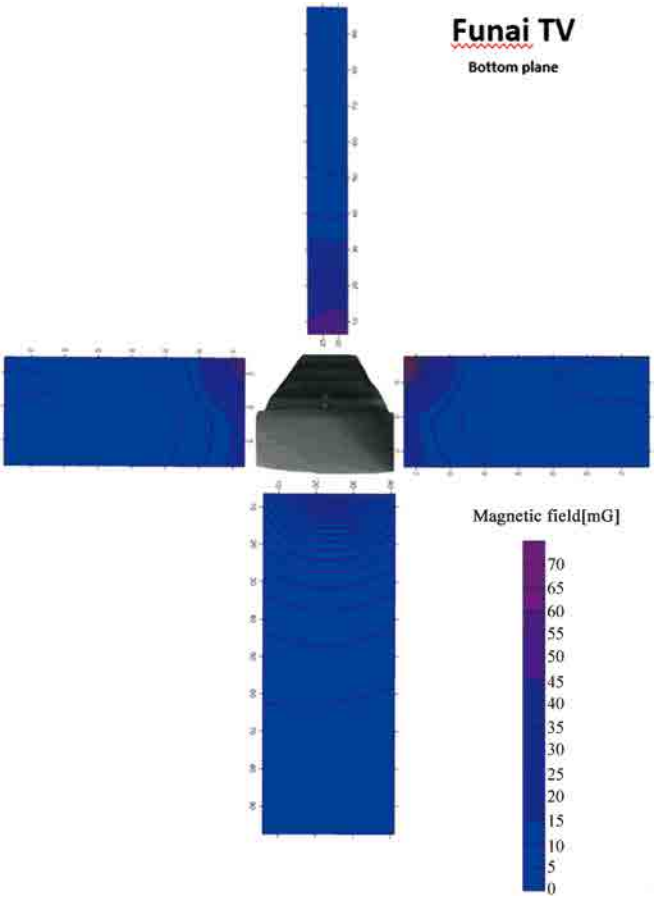
For back side – we can say – that these values for LCD-s are lowers compared to CRT-s. The Funai (from CRT-s) has higher value because his construction materials are older with lower isolation parameters, the thickness of the cover sheet is more thin and located more closer to diverting coils compared to SAMSUNG ones. For back side of CRT the highest introduction point is in the center (point 2 at top center). For LCD-s the higher value points is located aside – point 6. For SONY this is the point 8 probably because this is the area close to power current entrance.

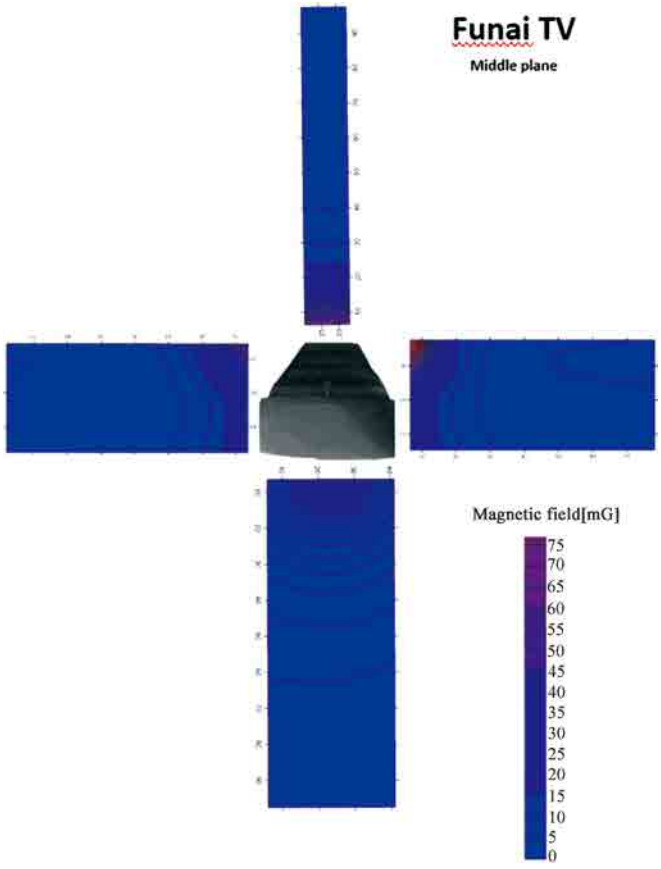


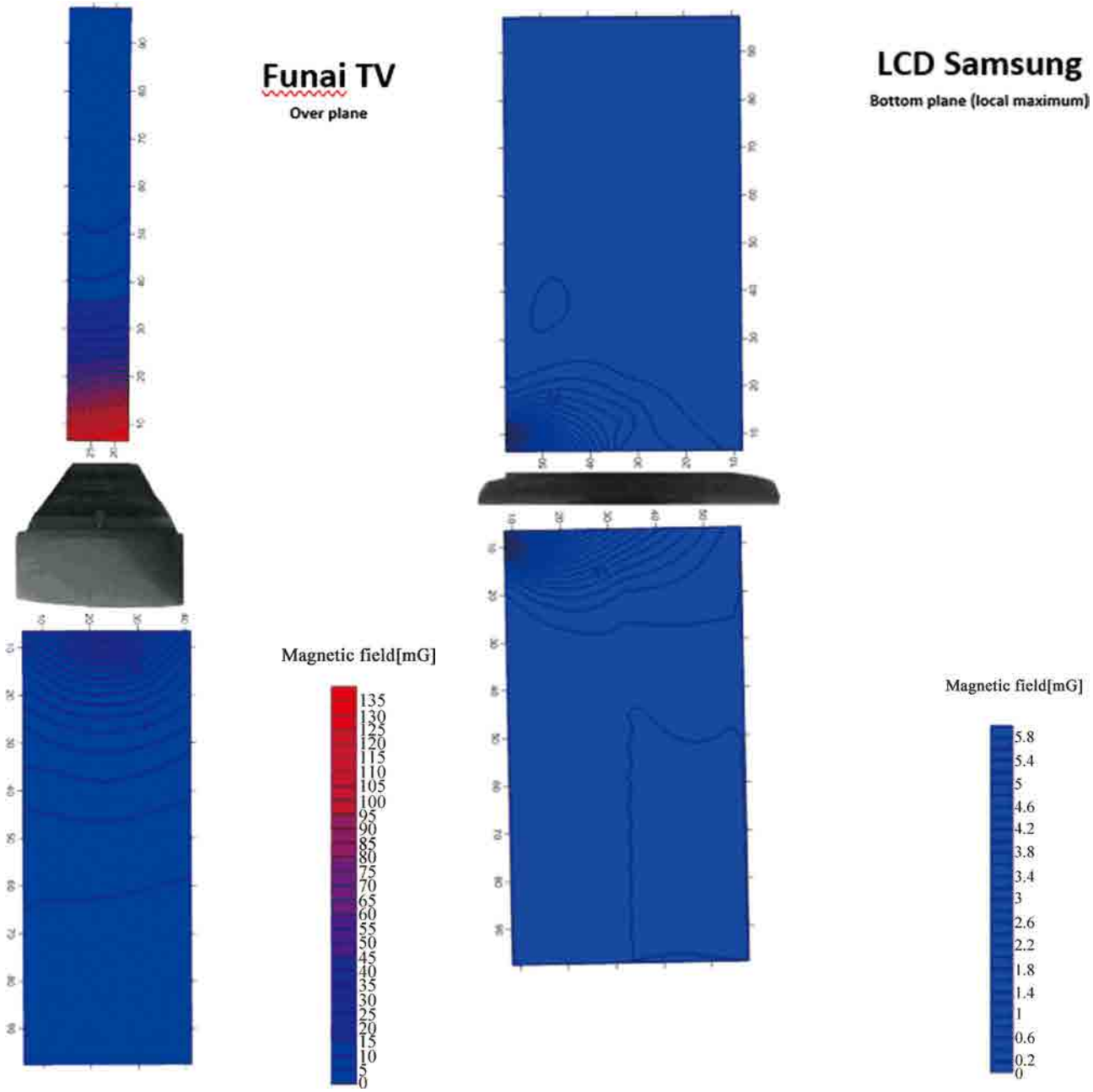
CONCLUSIONS

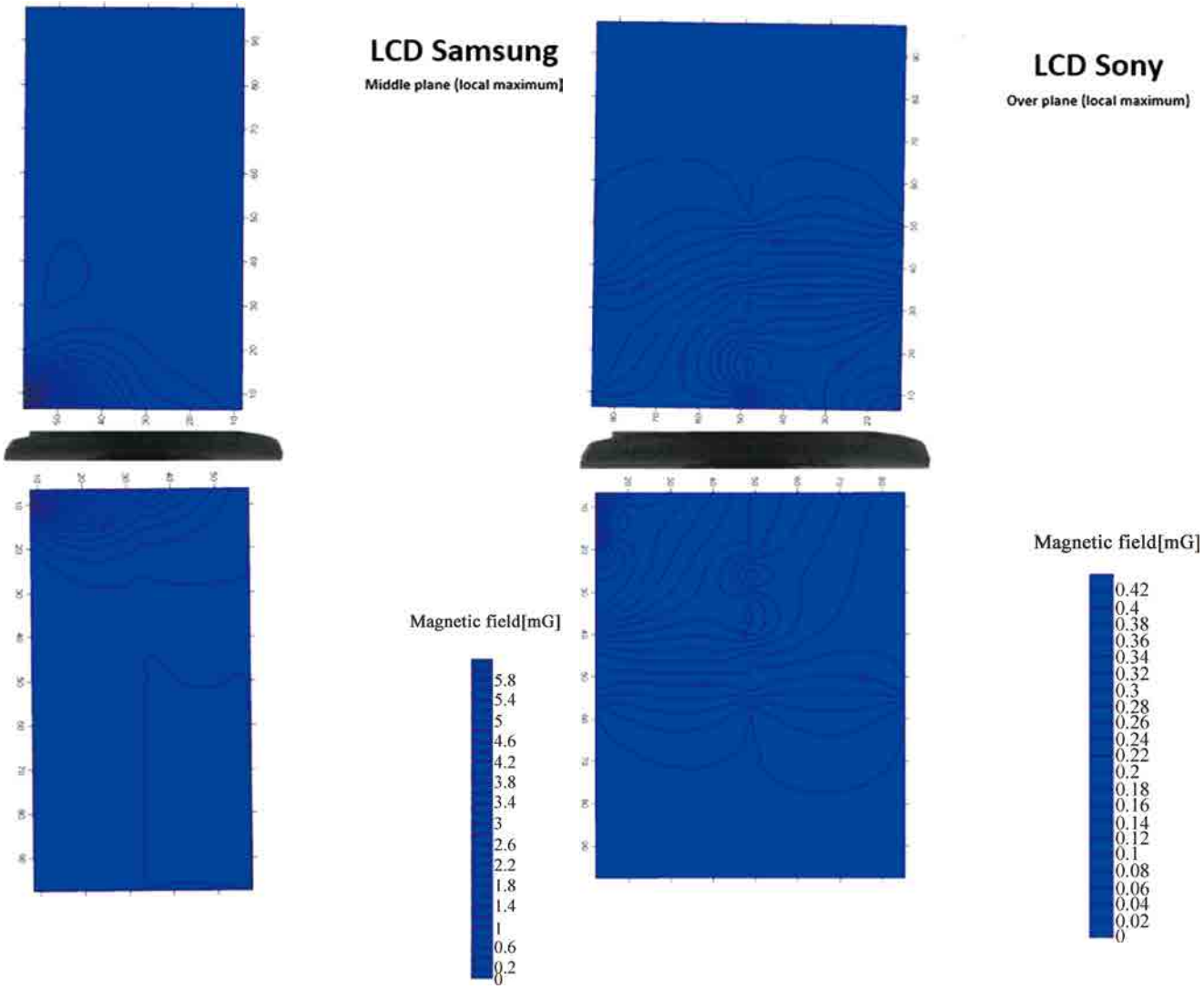
Our measurement had showed that the TV-s magnetic inductions values are more lower compared the recommended 1 G expending places just very close to the coils − close or more than 1 G. The plastic cover sheet serves as a good safety shadowing screen against the magnetic inductions (safety distances from sources and isolating properties). The modern TV-s has a much more lower magnetic induction values compared to old ones. Otherwise the rising member of electromagnetic equipment in households are present, therefore the problem is "living" problem. F.e. in cities about every 5 m is a mean distance between e.m. sources, current holders, transformers, mobile phones, TV-s, wireless equipment, MW ovens, inductive ovens, electric heating equipment etc. The permanent control them is necessary.

The attached SURFER programs has been used the demonstrate the flat pictures of equipment. The different flat relations help to demonstrate the electromagnetic "geometry" nearly to equipment (the colour scale adopted to max.)









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