

Introduction

Home electric appliances generate magnetic fields at various frequencies. According to the measurement procedures described in the IEC standard 62233^[1], the Association for Electric Home Appliances in Japan (AEHA, 2013)^[2] published the measurement results of magnetic flux density generated by the appliances at several frequencies, not the actual measured values but the proportional values to the reference levels for the general public recommended by the International Commission on Non-Ionizing Radiation Protection (ICNIRP, 2010)^[3]. As it is difficult for lay people to understand the implication of proportional values, we have been frequently asked to show actual measured values. In order to respond the request, we conducted measurements at more than one frequency generated by the latest devices.

[1] International Electrotechnical Commission (2005). IEC 62233:2005. Measurement methods for electromagnetic fields of household appliances and similar apparatus with regard to human exposure

[2] Association for Electric Home Appliances (2013). Measurement survey of electromagnetic wave (10 Hz - 400 kHz) generated by the home electric appliances, Fiscal Year 2013 (available in Japanese only).

[3] International Commission on Non-Ionizing Radiation Protection (2010). Guidelines for Limiting Exposure to Time-Varying Electric and Magnetic Fields (1 Hz - 100 kHz). Health Phys 99(6):818-836.

Methods

Measuring instrument

We used Narda S.T.S. ELT-400 suitable for measurement of low frequency magnetic fields (10 Hz - 400 kHz) complying with JIS C 1912^[4], a Japanese standard identical to IEC 62233, by conducting time-domain evaluation.

[4] Japanese Standards Association (2014). JIS C1912:2014. Measurement methods for electromagnetic fields of household appliances and similar apparatus with regard to human exposure (available in Japanese only).



- [Sensor]**
- 3-D coil magnetometer
 - NARDA S.T.S., Germany, model ELT-400
 - Frequency range ; 10Hz ~ 400kHz (By use low frequency cut filter)
 - Measurement range ; 320μT
- [Probe]**
- ELT+ B-Field-Probe 100 cm²

Measurement object

We selected generally used 131 models of 42 products (about 3 models per product; each model was most popular according to web research in Japan) such as TV, washing machine, vacuum cleaner, PC, heater, lighting equipment, etc.

42 products

Audio / visual appliances (3)

Component audio, Blu-ray recorder, liquid crystal display TV

Home information appliances (2)

Desktop PC, laptop PC

Household chores / cooking appliances (18)

Home bakery, coffee maker, hot plate, robot vacuum cleaner, washing machine (vertical type), washing machine (drum type), vacuum cleaner (holdings type), iron, microwave oven, electric kettle, food processor, toaster, clothes dryer, dishwasher, refrigerator, IH (induction heating) hob, desktop IH hob, IH rice cooker

Beauty / health care home appliances (4)

Electric toothbrush, electric shaver, hair dryer, massage equipment

Air conditioning / seasonal home appliances (9)

Air cleaner, air conditioner (cooling / heating operation), fan, fan heater, oil filled radiator, far infrared heater, Kotatsu (Japanese style heating table), electric blanket, electric carpet

Other / Lighting etc. (6)

Light bulb type LED (light emitting diode) lamp, LED ceiling light, fluorescent light ceiling light, LED stand, fluorescent lamp stand, hot water washing toilet seat

Measurement position

Measurements were taken around the appliances, and at the point the highest magnetic flux density was found, detailed measurements were conducted on the surface of and up to 50 cm from the appliances with 10 cm interval.

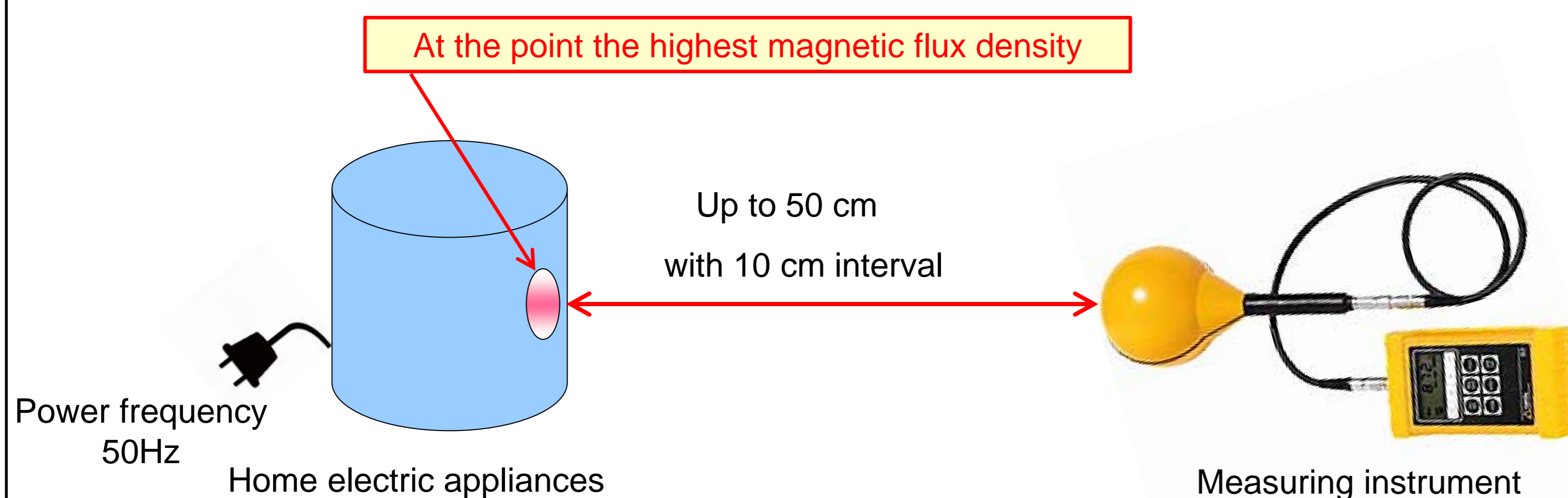
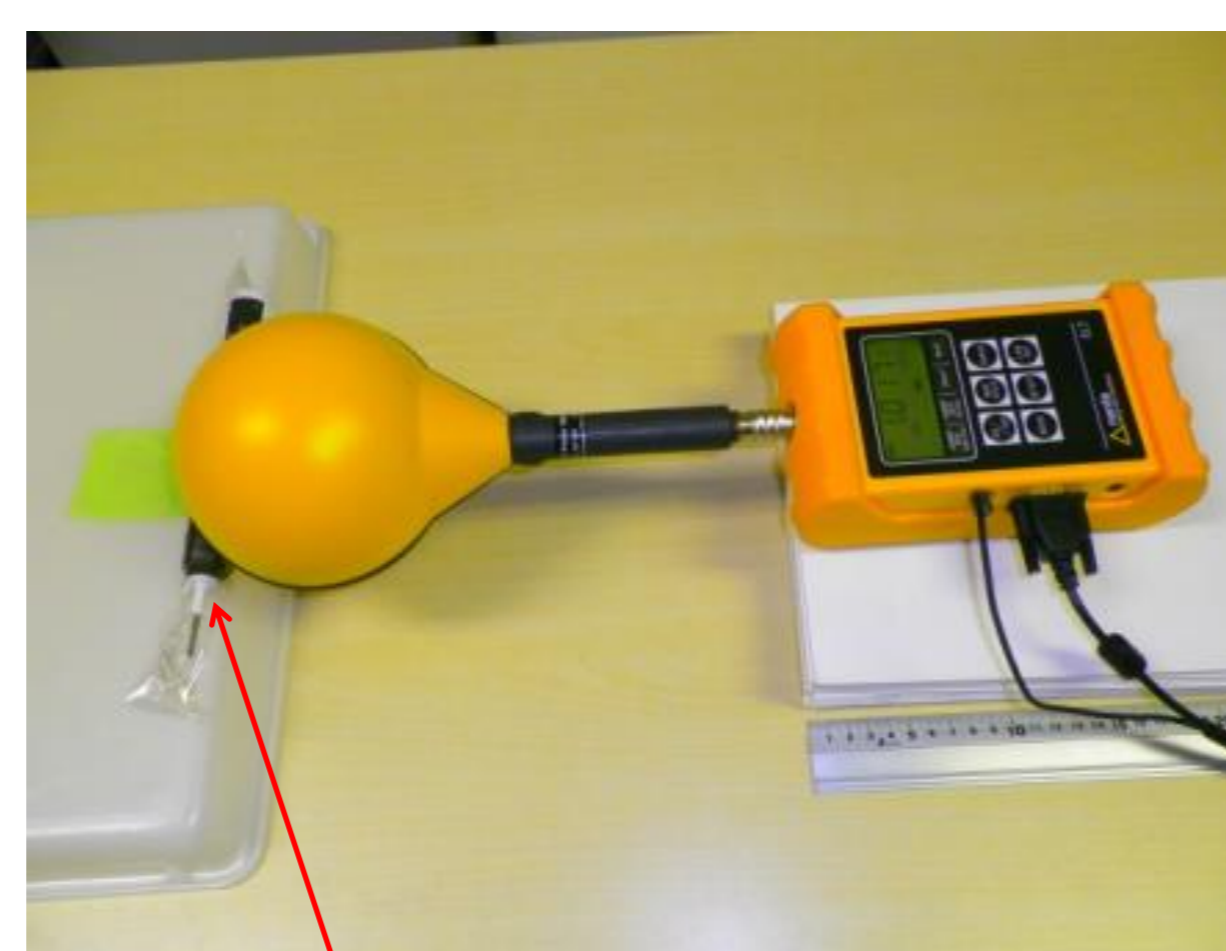


Fig.1. Outline of measurement



Air conditioner



Electric toothbrush

Fig.2. Measurement setup

Results

Examples of the measurement results of magnetic fields generated by home electric appliances are shown in figure 3 to 5.

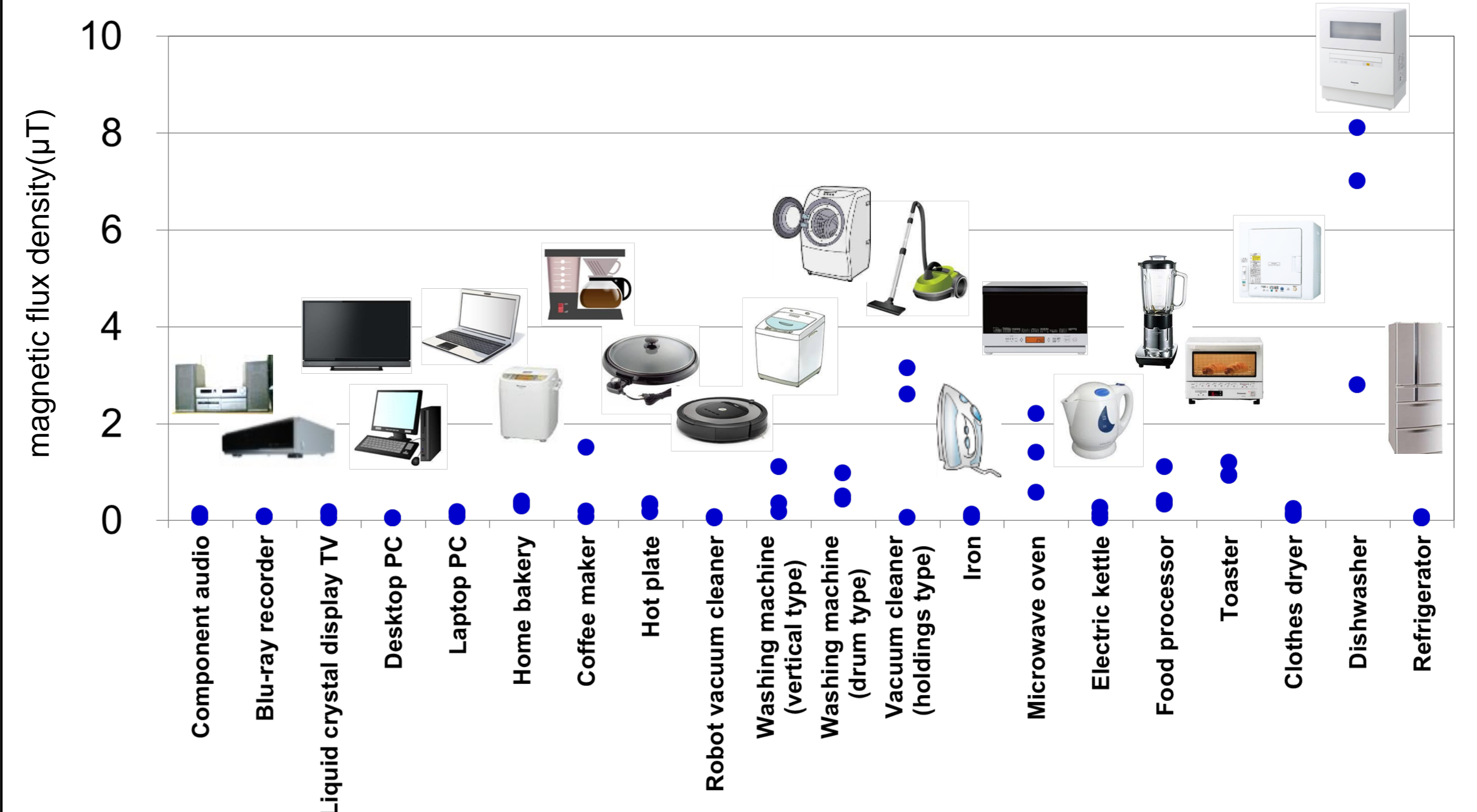


Fig.3. Magnetic flux density by the types of products (Part 1)

(Measurement distance was 0 cm for laptop PC, 30 cm for others.)

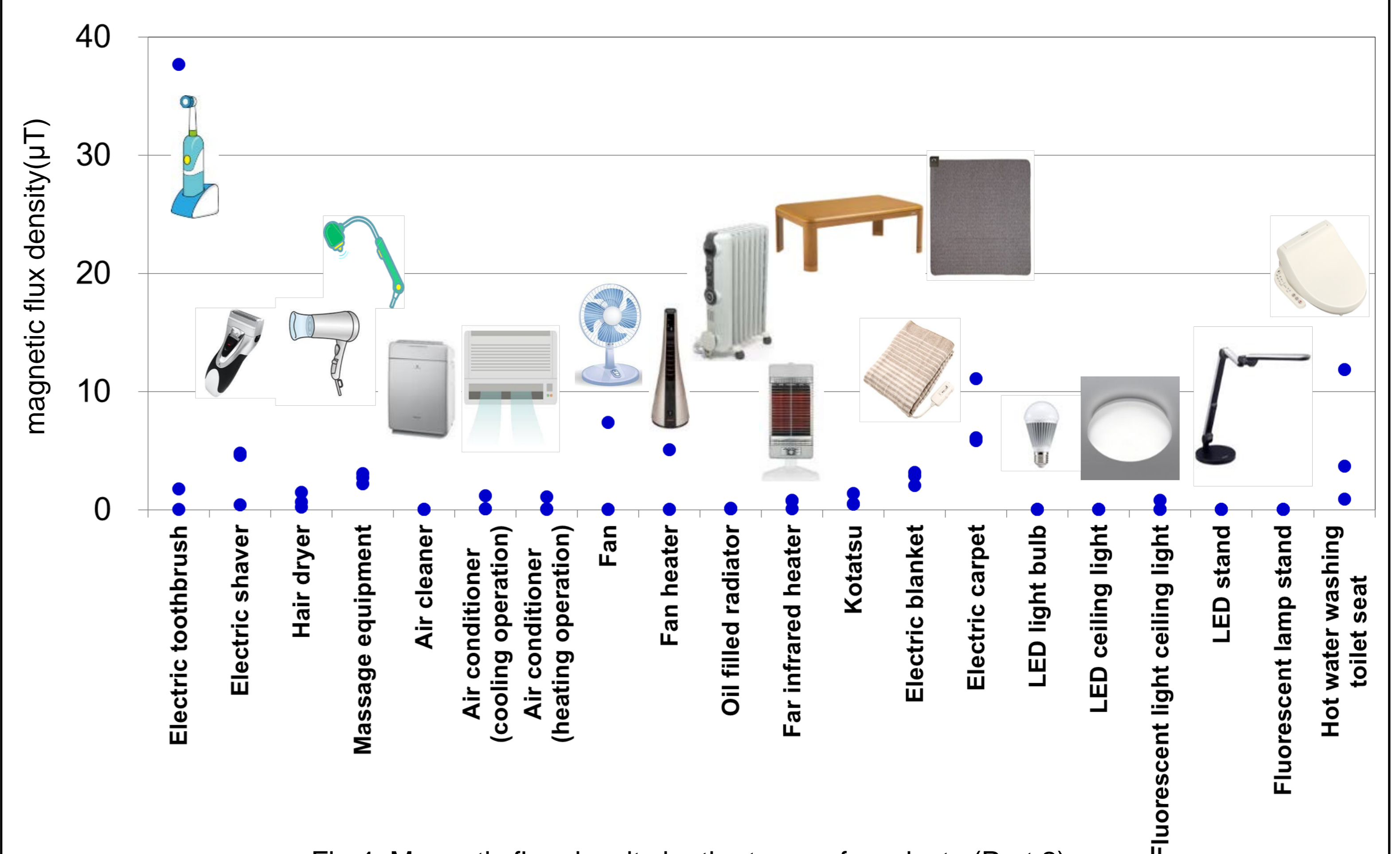


Fig.4. Magnetic flux density by the types of products (Part 2)

(Measurement distance was 0 cm for electric toothbrush, electric shaver, massage equipment, electric carpet, electric blanket, hot water washing toilet seat; 10 cm for hair dryer; 30 cm for others.)

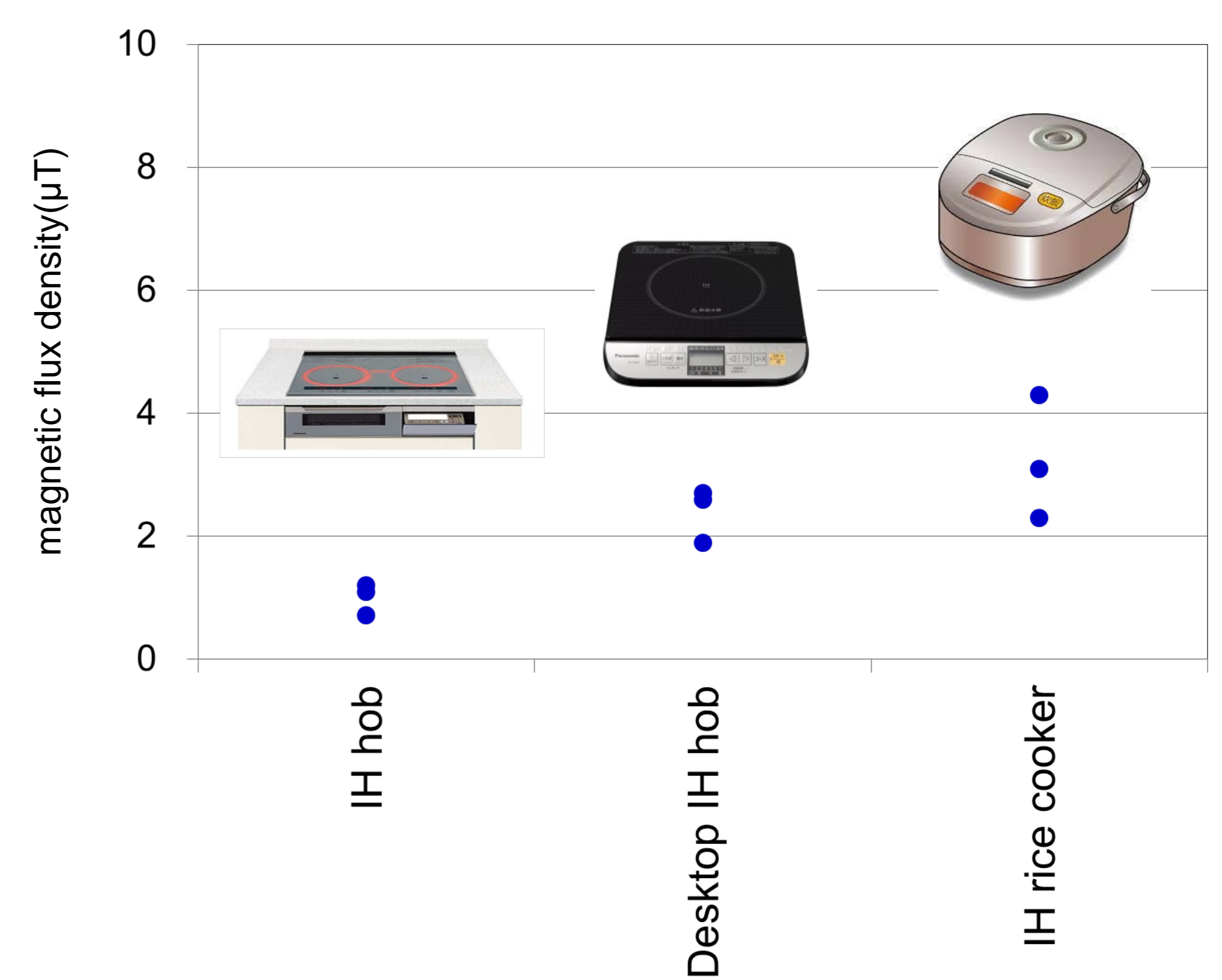


Fig.5. Magnetic flux density by IH(induction heating) cookware

(Measurement distance was 30 cm.)

Conclusion

We measured magnetic fields generated by total of 131 models of 42 products of the latest home electric appliances around us within the frequency range of 10 Hz - 400 kHz. All the measurement results were well below the reference levels for the general public recommended by ICNIRP (200 μT at 50 Hz; 27 μT at 30 kHz).