Measurements of electromagnetic compatibility using GTEM chambers

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Abstract – The paper will give basic knowledge about EMC from measurements point of view. Principals of tests done in GTEM chamber will be presented.

I. INTRODUCTION

Electromagnetic compatibility is relatively new concept. The producers of devices sold in the European Union common market are obligated to check EMC from year 1996. EMC is nothing else then ability of the device, installation or system to proper work in electromagnetic environment without adding additional distortions to this environment or other working devices. Because there are more then one possible scenario of interferences between two devices, the main problem if how to analysis those distortions. For this goal the GTEM chamber was design and build.

II. THEORY

From the entire EMC test, the measurements of radiation emission are the hardest, most time consuming and most expensive, because they need special, big enough field with low external radiation emission coming from other sources. Most of todays directives concerning EMC test, recommend performing the measurements in open area test site (OATS). Main elements of this environment are:

- low ambient and noise floor,
- oversized ground plane,
- host equipment area,
- Weather protection.

Building such location is very hard due to weather conditions and electromagnetic wave propagation. Taking into account many inconveniences of this method, other one is needed, which will allow carrying out test in more friendly conditions. One of the most common techniques is the anechoic and shielded chamber, which are independent form external weather and electromagnetic conditions.

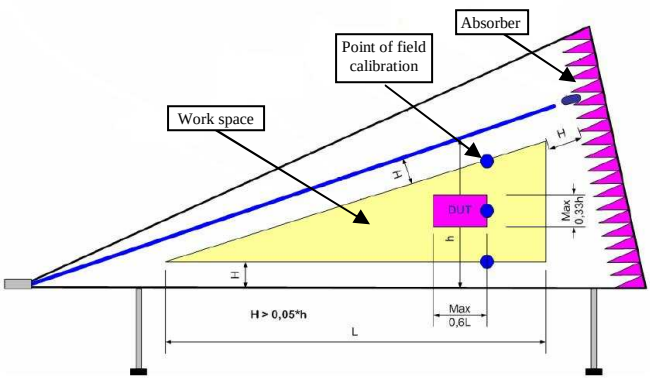

Figure 1. Schema of GTEM chamber

III. CONSTRUCTON OF GTEM CHAMBER

The GTEM cell (Gigahertz Transverse Electromagnetic cell) is usually a construction in shape of the rectangular prism, equipped with screens limiting influence of external electromagnetic fields and special internal shields preventing leakage of electromagnetic wave generated in the chamber. With proper shielding level and wave absorption (absorbing function is carried out be special absorbers build in the chamber) it is possible to obtain restricted measurement area, which is usually few times smaller then dimensions of the chamber. In this area propagation of electromagnetic wave is know and can be controlled.

The GTEM chamber are developed version of TEM chamber, they are able to measure frequencies up to several GHz.

IV. MEASUREMENTS

The GTEM chamber is used to measure intensity of field distortions produced by examined devices. Basic equipment is the chamber and measurement device.

Emission of investigated device is obtained by measuring voltage at the output of the chamber for 3 planes of examined object. The emission distortion level is calculated basing on the dependence between obtained values and field intensity values

Figure 2. GTEM chamber in Laboratorium Urządzeń Elektronicznych Poznań

measured on OATS.

To fulfill standard EN 55022 the analyzer must be set to check the object in the range of frequencies from 30 MHz to 1 GHz with step of 120 Hz. The detector must be able to measure quasi peak value for which maximum emission levels are defined – table 1. Other values like peak, average, RMS are optional.

The main problem with performing the measurements is the time. It is easy to calculate that 8084 measures need to be taken. The quasi peak detector needs at least 1 second to register the value. For 1 plane it is more then 2 hours. This time needs to by multiply be 3, because the tests are performed in 3 planes.

To circumvent this barrier special procedure was created:

- pre-testes for whole frequencies range with peak value detector,
- choice of frequencies were the intensity exceeds or is close to threshold,
- precise tests for chosen frequencies with quasi-peak detector.

All three points are performed for each plane.

Table 1
Permissible values of quasi-peak value for IT devices according to EN 55022

Frequencies range [MHz]	Permissible level [dBuV/m]	
	Class A devices Quasi-peak value	Class B devices Quasi-peak value
30 – 230	40	30
230 – 1000	47	37

V. SUMMARY

Recently electronic and electric devices were checked only in a meaning of fundamental requirements. The EMC tests were not so important to producer. Now all producers must fulfill conditions given by EN 55022, because of that they are obligated to create the technical documentation of the product. The documentation will give overview if the object is safe in meaning of EMC. What is more the manufacturer need to guarantee the production procedure according to created documents.

It is estimated that 10% of nowadays devices are connected with usage of components that will not cause problem in point of electromagnetic compatibility.

Good strategy is to test main elements of designed device separately – it will give lower probability that they will cause problem working together.

REFERENCES

[1] Ph. D. Maik Honscha Lecture material for Introduction to EMC – BTU Cottbus 2008.

[2] Jarosław Łuszcz, Artur Knitter “Badanie emisyjności promieniowanej urządzeń energoelektronicznych w komorach GTEM”, XV Seminarium zastosowanie komputerów w nauce i technice 2005.

[3] Clemens Icheln „The construction and application of a GTEM cell”, HUT Hmaburg 1995

[4] Jan Bogucki, Andrzej Chudziński, Justyn Połujan “Emisja elektromagnetyczna urządzeń w praktyce” Telekomunikacja i techniki informacyjne 1-2/2007.

[5] Krzysztof Sieczkarek „Badania Kompatybilności elektromagnetycznej” Instytut Logistyki i Magazynowania Poznań