# Measured distribution of electric field in GTEM-cell

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# Measured Distribution Of Electric Field In GTEM-Cell


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**Abstract:** *The electric field inside the GTEM-cell* [1] *was measured with the field probe. The variation of the electric field was within 3 dB. The measured results were compared with the numerical model performed with Finite Element Method (FEM). There is a very good agreement between measured results and the computer model. Both results prove that almost 80% of the area below septum could be used for testing purposes.*


## INTRODUCTION

The measurement of the electric field inside the GTEM-cell (Figure 1.), were done in order to test the cell for comparison with the computer model of the GTEM-cell described in [2]. Although the measurements of the SWR and return loss are the first parameters to be measured, it is only the measurements of the electric field distribution in the GTEM or any other cell that can give us the more complete knowledge about the quality of the structure. Although there is no component in the direction of the wave propagation for the TEM mode, it would be desirable to measure all three electric field components, because as it is well known [5] not only TEM mode, but also higher order modes can propagate in such cells. In practice, however, we never have the ideal situation, and there is always a parasite modes and components.

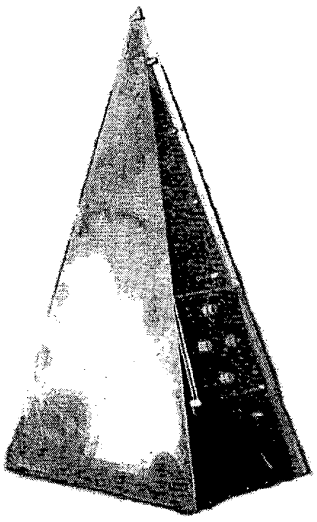

**Figure 1. Photo of GTEM-cell**

## NUMERICAL MODELING

Finite element method (FEM) can be efficiently used in solving complex, nonlinear problems in electromagnetic compatibility [3]. The first step in finite-element analysis is to divide the analyzed configuration into small elements. The model contains information about the device geometry, material constants, excitations and boundary constraints. Applied mesh is shown in Figure 2 and the field values at the nodes have been calculated. In each finite element, a linear variation of the field quantity is assumed. The corners of the elements are called *nodes.* The goal is to find the electric field values at these nodes. Other quantities can be derived from the electric field values.

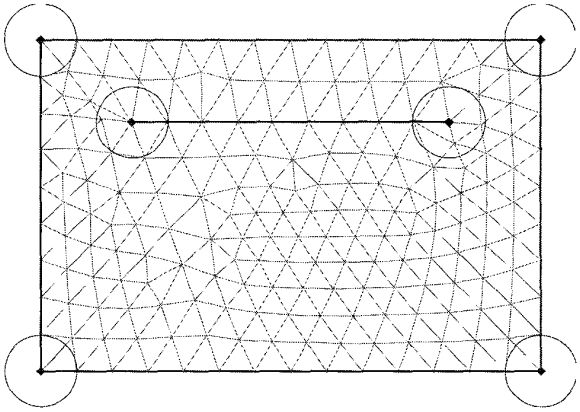

**Figure 2. FEM model**

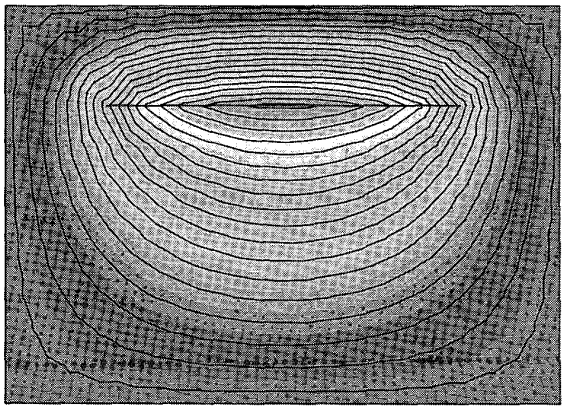

**Figure 3. Potential lines**


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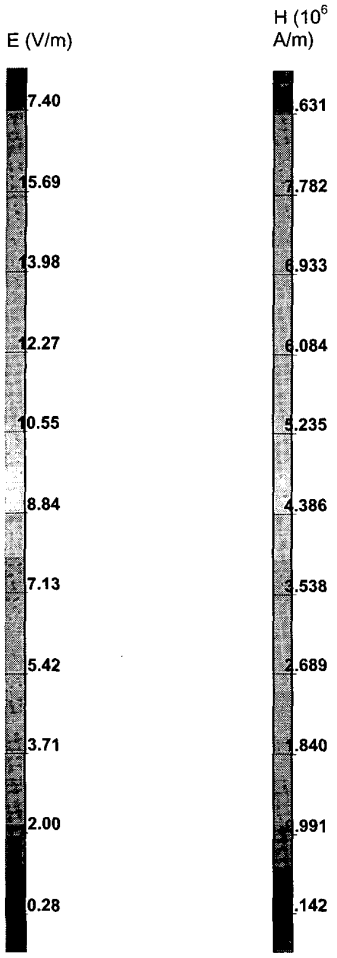


**Figure 4. Legend**

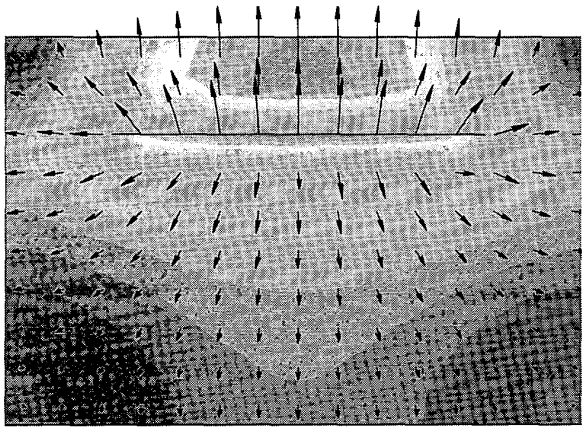

**Figure 5. Strength and vectors of E**

Figures. 3. through 6. are showing the potential lines, legend, the transverse electric field vectors and the magnetic field vectors in the GTEM-cell, respectively. The results were generated using the program QuickField. The obtained electric and magnetic field distributions inside the GTEM-cell show that the usable area for the measurements inside the cell can be about 80% of the area between the septum and the lower wall of the cell. The same incident power of 1W was chosen in the case of modeling (the results are shown in Figures 5. and 6.) and for the measurements. Legend of field values in Fig. 4., is the reference for Figures 5. and 6.

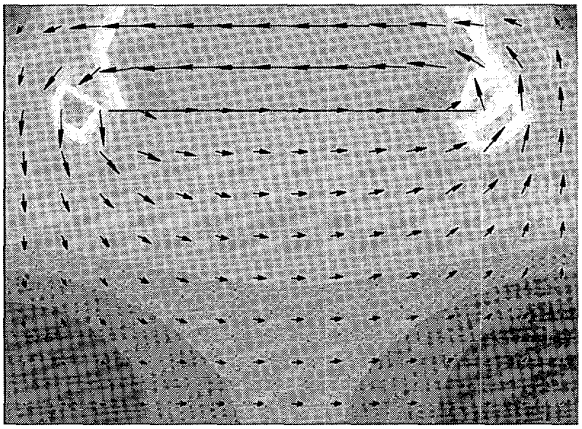

**Figure 6. Strength and vectors of H**

## MEASUREMENT OF THE FIELD INSIDE THE GTEM-CELL

The measurement of the electric field was carried out with radio frequency generator HP 8657A (0.1 - 1040 MHz), amplifier Mini Circuits (max. amplification of 28 dB) in the frequency range of 100-900 MHz, using the electric field probe Holaday HI-4455 connected to HI-4460 readout. Electric field probe HI-4455 has wide frequency range from 200 kHz to 40 GHz. Measurement range of the probe is from 1.5 to 300 V/m. The result is displayed on the HI-4460 readout, which is connected to the probe via optical cable.

The readout can only show the total electric field values, and not the separate values for each component. Still, it gives useful information about the situation inside the cell. In the center area of the cell, the electric field is nearly constant (Fig. 7.), at value of about 5.2 V/m. The black dots are showing the measured values at the center of the cell and at both sides. The green (gray) dots and line represents the computed values with the FEM method. It can be seen that there is a good agreement between those values. The electric field was measured at the frequency of 100 MHz where the influence of the higher order modes can be neglected [2]. At this frequency only TEM mode is present and the field in the cell can be considered as static one.

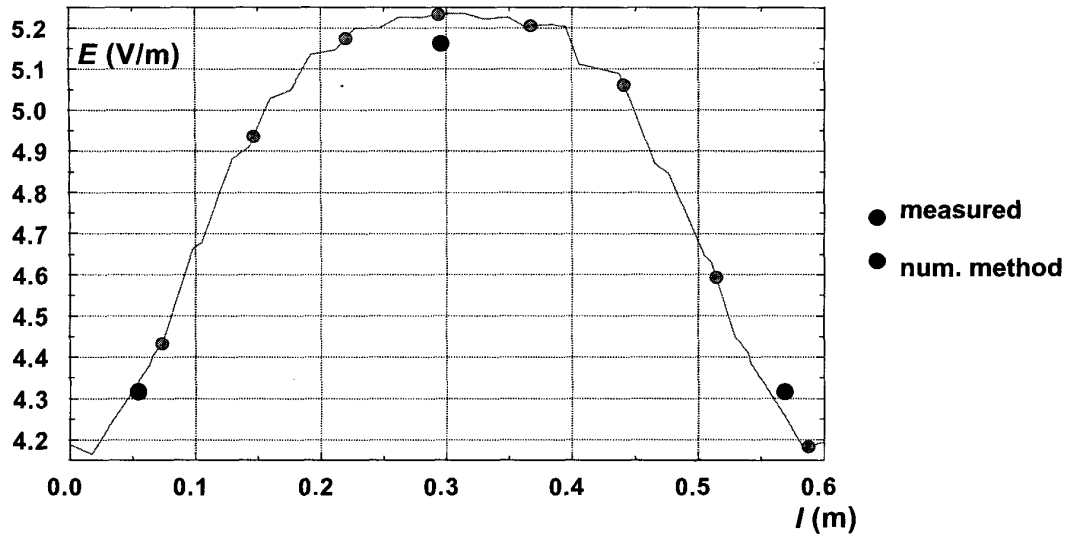


**Figure. 7. Distribution of the electric field in the GTEM-cell at 1/2 septum height (100 MHz)**

Figure 7. shows the distribution of the electric field inside the GTEM-cell at 1/2 height of the septum at 100 MHz. Figures 8. and 9. are showing frequency responses of the GTEM-cell at the middle of the area used for testing the equipment at the power of 17 dBm and 40 dBm. It can be seen that the variations of the electric fields are 3 dB inside the cell.

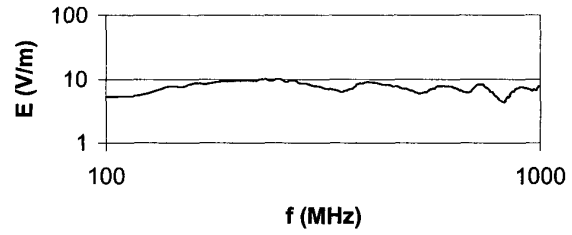


**Figure. 8. Measured el. field in GTEM-cell at the power of 17 dBm**

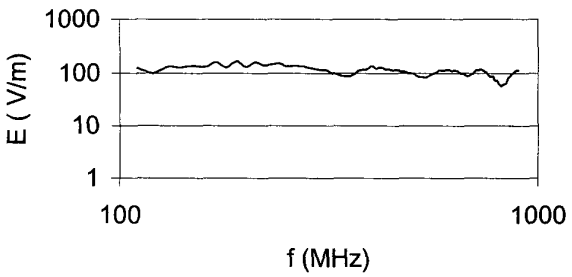


**Figure. 9. Measured el. field in GTEM-cell at the power of 40 dBm**

## CONCLUSION

The electric field was measured inside the GTEM-cell. The GTEM-cell was modeled using FEM. It was shown that for the tested cell, the electric field variations were well within 3 dB. The comparison of the measurements of the electric field and the computed results show that the method used for modeling was well chosen and that the cell has been very good designed. The largest difference between measured values and those obtained by the computer model was about 1%.

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