# EM DISTURBANCE SOURCE POSITION EFFECT ON MEASURED FIELD STRENGHT

**Rostislav Vídenka**
Doctoral Degree Programme, FEEC BUT
E-mail: xviden01@stud.feec.vutbr.cz

Supervised by: Jiří Svačina
E-mail: svacina@feec.vutbr.cz

## ABSTRACT

Radiated disturbance source position effect on measured field strength is described in this paper. As a disturbance source was used Emission reference source (ERS).

ERS position was changed in small area (10 and 20 cm) and measured values variation was observed.

## 1. INTRODUCTION

In full EMC tests the radiated disturbance measuring is of the most technically demanding. There are many quantities, which have to be considered for open area test site or alternative test site.

Position of measured device is one of these quantities. EUT have to be placed to the specified distance from receiver antenna (3 m, 10m, etc). But EUT can have various dimensions, so the point of disturbance radiation from EUT can be everywhere in its volume or on the surface. CISPR 16-4-2 specifies wooden table height of 80 cm and it's height deviation of 1.

In EMI pre-compliance testing measurement procedures and equipment can differ from standard (CISPR) requirements. For example situation with fixed receiver antenna height and non-conducting floor can be solved by using special signal sources (CNE, ERS, CSS).

## 2. EMISSION REFERENCE SOURCE

Emission reference source (ERS) is very long-time stable and it is precisely calibrated according to valid EMC standards (height scanned receiver antenna, etc.) in both polarizations (vertical and horizontal) for specific measuring distance (most often 3 m) in professional semi-anechoic chamber.

By ERS signal measurement we acquire different values (field intensity) at our (=non-ideal) test site. Values swing from calibration data is caused by test site imperfections and by other measuring chain segments (including antenna and measuring receiver), so we can "calibrate" our test site.

For my measurement the ERS (manufactured by Laplace instruments) was used as a stable signal source to observe field strength variations during ERS location changes.

## 3. TEST SITE AND MEASUREMENT PROCEDURE

Measurement was done in basement empty room with dimension of 11*7*4.5 m (L*W*H) and with dropped ceilings in the height of 3.3 m. A corridor is behind the door along the wall. On the wall opposite the door is heating (tube radiator). This room is not designed for EMC measurement, so non-conducting PVC floor, no absorbers on walls, no shielding. For test site symbolic scheme displacement and floor projection see figure 1.

Receiver BiLog antenna from Schaffner and HP E7404A EMC analyser were used in the tests. EMC analyser was driven by Agilent VEE program.

Measurement was done in bandwidth form 30 to 86 MHz and from 110 to 800 MHz. Bandwidth from 87 to 109 MHz was missed to avoid strong radio broadcasting. Frequencies above 800 MHz (to 1 GHz) were not scanned bacause our ERS has in this bandwidth insufficient output power (due to malfunction). Values were measured with 2 MHz frequency step (as ERS transmits) and with 120 kHz BW filter (100 kHz video filter). For each frequency step 10 values were averaged to supress noise and random peaks.

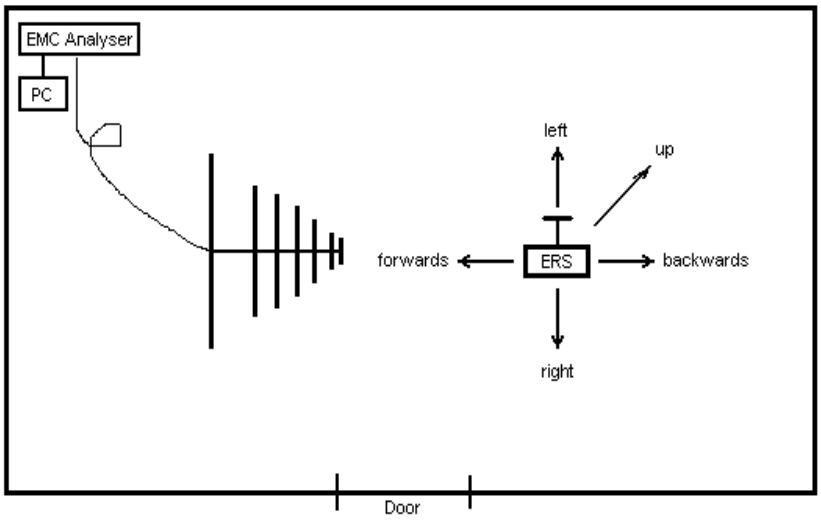


**Figure 1:** Test site symbolic scheme displacement, floor projection

Receiver antenna height was 1.6 m and declination about 10 degrees to the ERS.

For the opening (comparative) measurement was the ERS placed in the 0.8 m height and in the 3m distance from the antenna center.

Then ERS was shifted of 10 and 20 cm in six directions (from the receiver antenna point of view: left, right, forward to the antenna, backward, up and down) and after every shift the new field strength in both polarization was measured.

## 4. MEASUREMENT RESULTS

Because there is not enough space in this paper only worse case from each measurement is shown.

### 4.1. SHIFTING LEFT AND RIGHT

Differences with horizontal polarization are mainly below 2 dB with several peaks reaching 4 dB.

Vertical polarization is shown on figure 2.

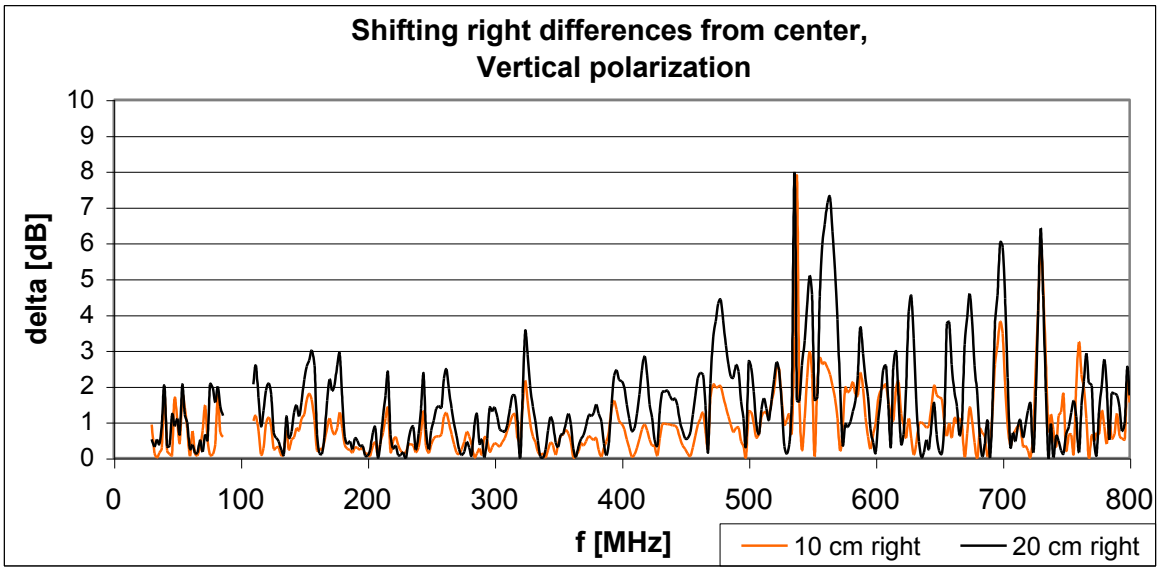


**Figure 2:** Shifting right with vertical polarization

In our room the field strength for shifting left and right was the less sensitive on the ERS position.

### 4.2. SHIFTING FORWARDS AND BACKWARDS

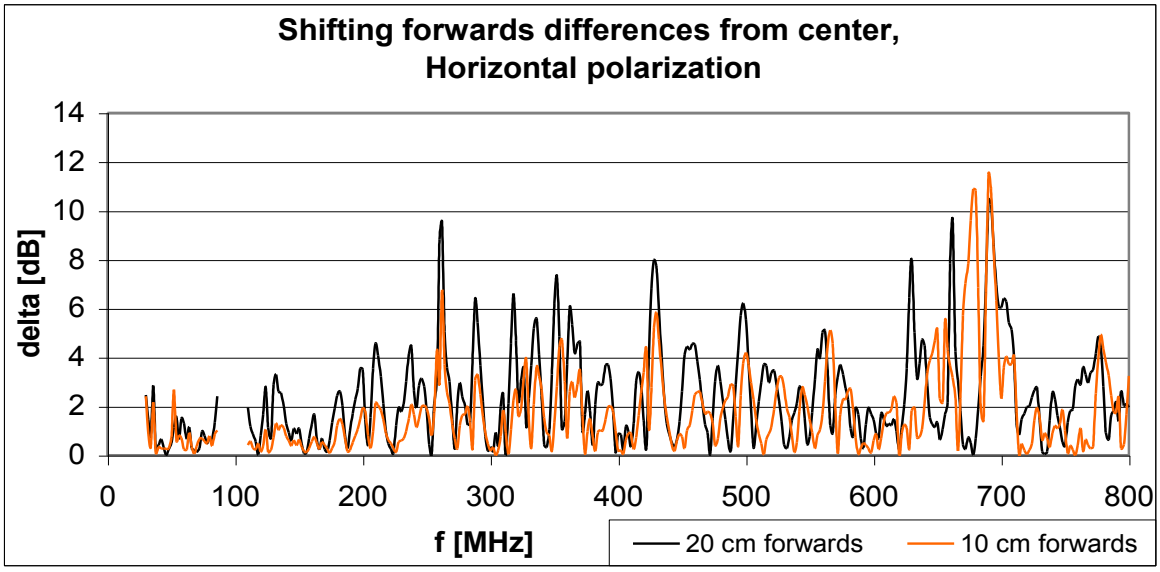


**Figure 3:** Shifting forwards with horizontal polarization

In this case differences for shifting forwards with vertical polarization are little bit smaller than with horizontal polarization.

### 4.3. SHIFTING UP

Here is only shifting up because nobody will lower the table. Table height of 80 cm is a demand.

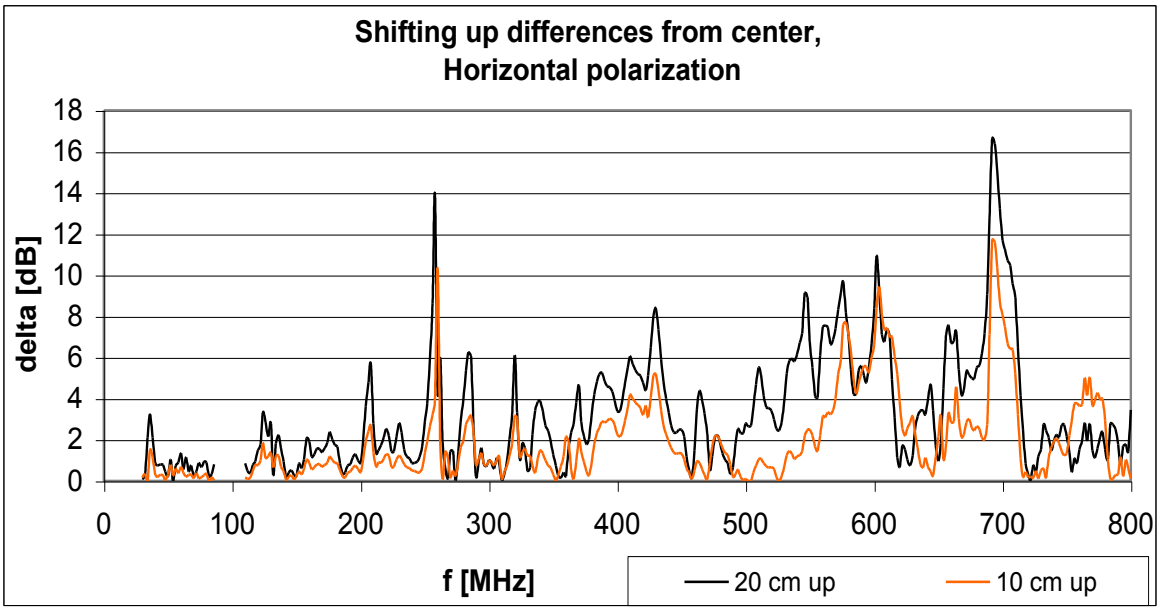


**Figure 4:** Shifting forwards with horizontal polarization

Differences for shifting up with vertical polarization are mainly below 4 dB with two peaks of 8 dB at 550 and 650 MHz.

## 5. CONCLUSION

Shifting left and right with is the least depending on the ERS position. Differences are below 8 dB and at most frequencies even below 4 dB.

Shifting forwards and backwards with both polarizations has differences up to 12 dB.

Greatest differences were for shifting up with horizontal polarization and they were up to 17 dB. This is caused by ground reflection, because ground is nearest surface.

From measurement yields that after ERS pre-compliance test site calibration the EUT center or even better EUT disturbance source point has to be placed to the exact place where ERS was. The EUT disturbance source point could be by near-field probes discovered.

But all these results are valid only for our test site (our basement room) and can not be taken as a model. More measurements will be done to get more general results in different rooms.

Result depends on:

- radiation patterns of the ERS and the receiver antenna
- the test site properties
- the disturbing background

So every who is using ERS or similar reference source for pre-compliance test site calibration should make his own “room prospecting” to get his test site behavior.

Purpose of this measurement was no to observe the exact field strength differences, but to find out the spectrum behavior.

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## REFERENCES

[1] CISPR CISPR 16-4-2: Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics and limit modeling – Uncertainty in EMC measurement, Nov. 2003

[2] The Comparison Noise Emitter and other reference radiators and their uses in EMC Measurements, http://www.yorkemc.co.uk/info/technical/papers/acm-cne.html

[3] SVAČINA, J.: Open-Area Area Test Site Measurements: Dealing with Ambients, http://www.ce-mag.com/archive/05/01/006.html, 2005