
EMC-Testlab

Engesserstraße 11
Building 30.36
D-76128 Karlsruhe
<http://www.ieh.uni-karlsruhe.de>

Phone: +49-721-6082912
Fax: +49-721-695224

submitted by: January, 31 2005
phone: Giselbrecht / Nagel
++49 721 608-3063/3137

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Report No. 2005 – 06

**Shielding Effectiveness of the cabinet
"Varistar EMC 2000Hx600Bx600T,
Reference-No.: 10130-020/10",
Customer: Schroff GmbH
75334 Straubenhardt**

Examination: Dipl.-Wi.-Ing. D. Giselbrecht
Engineers: Dipl.-Ing. A. M. Nagel

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1. Summary

The shielding effectiveness measurements of the cabinet "Varistar EMC 2000Hx600Bx600T, Reference-No.: 10130-020/10" were performed in the frequency range from 30 MHz to 1 GHz according to VG 95 373, Part 15.

2. General

Equipment under test:	Cabinet: "Varistar EMC 2000Hx600Bx600T, Reference-No.: 10130-020/10" EMC-Seal: MTC, Reference-No: 60130-028
Delivery of EUT:	January 27, 2005
Place of Examination:	Anechoic chamber of the Institute of Electric Energy Systems and High- Voltage Technology Universität Karlsruhe (TH) Kaiserstrasse 12 76128 Karlsruhe
Date of Examination:	January 27, 2005
Representative Customer:	Mr. J. Fischer
Examination Engineers:	Dipl.-Wi.-Ing. Dietmar Giselbrecht Dipl.-Ing. A. M. Nagel
Examination:	Shielding effectiveness in the frequency range from 30 MHz to 1000 MHz according to VG 95 373, Part 15.

3. Test Set-Up

The tests were performed in a shielded semi-anechoic chamber lined with absorbers of 1 m length (useful volume approx. $12 \times 4.5 \times 5 \text{ m}^3$, LxWxH). The test equipment consisted of:

- Test receiver ESVP (Rohde & Schwarz).
- Signal generator SMH (Rhode & Schwarz).
- Power amplifiers BTA 01221000 (9 kHz 220 MHz) and BLWA 2010200 (220 MHz ... 1000 MHz) from BONN GmbH.
- Logarithmic-periodical antenna VULP 9118-G (30 MHz - 1100 MHz, 1 kW) from Schwarzbeck as transmitting antenna.
- EATON-ALLTech Probe (Receiving antenna)

Fig. 1 illustrates the test set-up measuring the shielding performance.

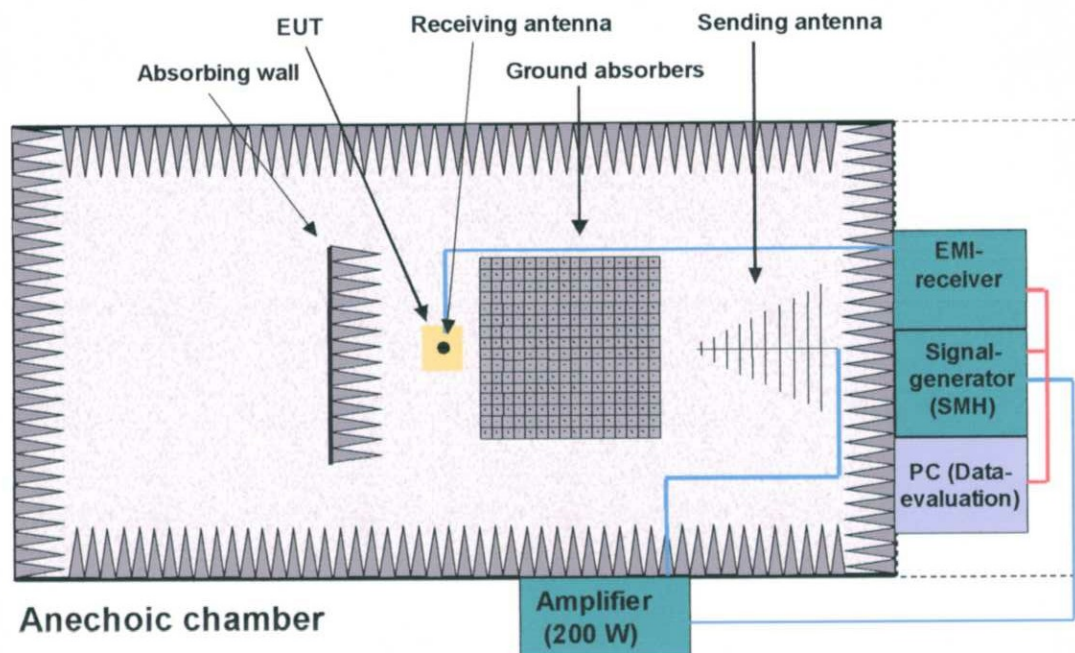


Fig. 1: Test set-up.

The distance between EUT and antenna was 3 m. The transmitting antenna was vertically polarized in a height of 1,80 m. A receiving antenna was located in the center of the cabinet. The cabinet was fixed on a turntable in 80 cm above the ground (see figure 2) on a brass tubing provided with ferrites to suppress eigenfrequencies.

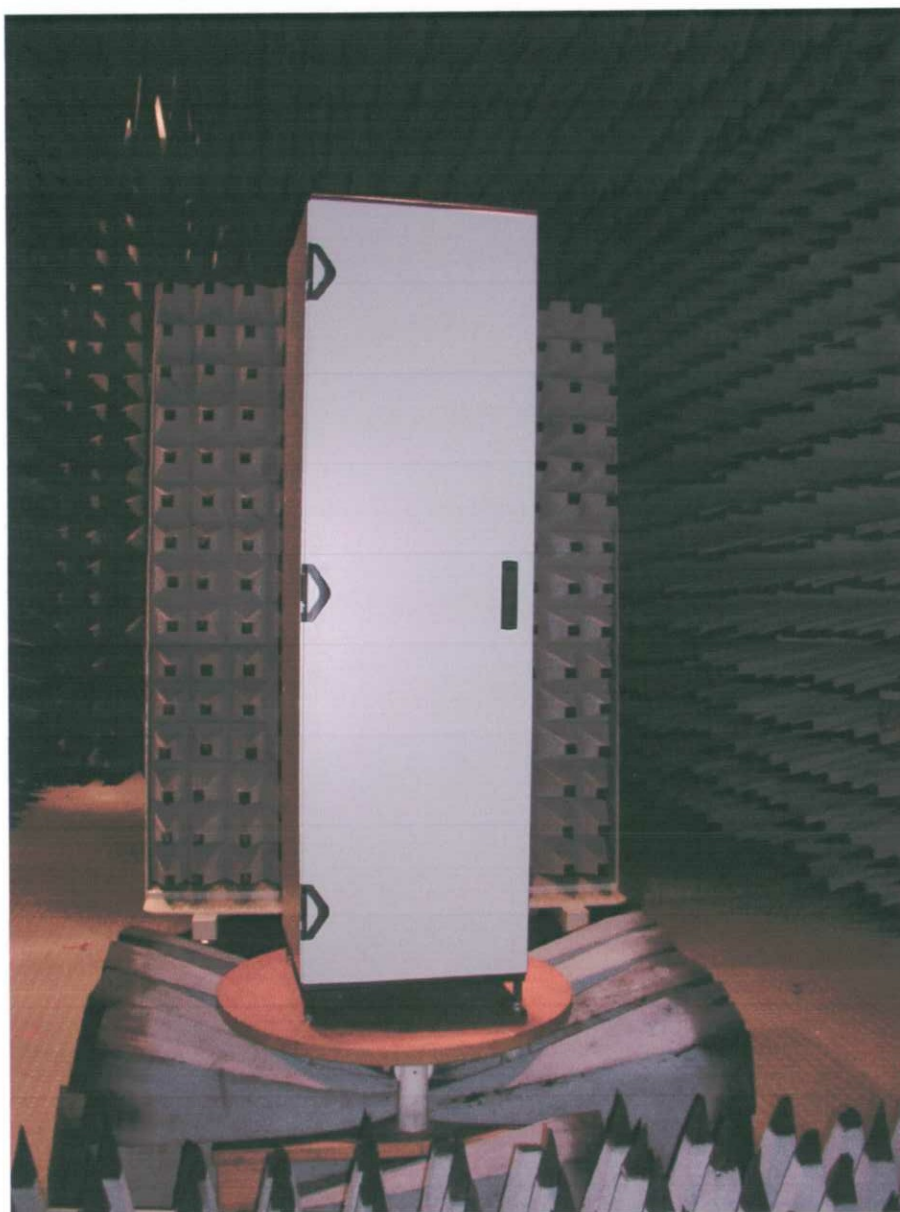


Fig. 2: Cabinet "Varistar EMC 2000Hx600Bx600T, Reference-No.: 10130-020/10"
(front-side to antenna)

4. Measurement Procedures

4.1 Shielding Effectiveness

The measurement was performed according to the middle point method in the frequency range from 30 MHz to 1 GHz. This method is an insertion loss method. Coupling is first measured with no enclosure present and then with the enclosure inserted. During the measurement the antenna separation and orientation are kept constant.

The enclosure shielding effectiveness is the difference between the reference level a_0 (in the absence of the enclosure) and the level a_1 within the enclosure (Figure 3).

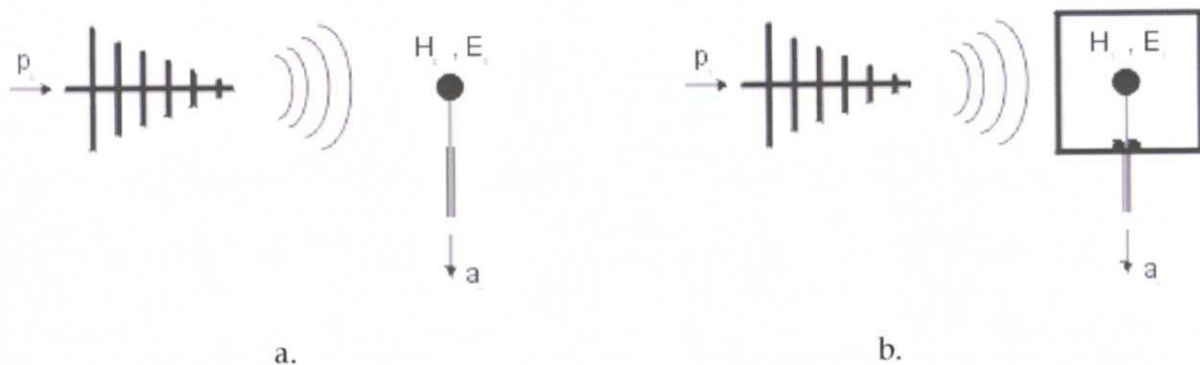


Fig. 3: Shielding Effectiveness of enclosures.
a) Measurement in the absence of the enclosure.
b) Measurement within the enclosure.

The shielding effectiveness is calculated from

$$a_s = a_0 - a_1 \text{ in dB.}$$

4.2 Dynamic Range

The *dynamic range* is determined as the difference between reference level a_0 and level measured without receiving antenna. It depends on the noise level of the equipment (e.g., the shielding effectiveness of the cables and the intrinsic noise of the receiver). The dynamic range takes into account the maximum shielding effectiveness which can be measured with the actual test set-up. Fig. 4 illustrates the dynamic range, which is predominantly more than 80 dB in the frequency range from 30 MHz to 1 GHz.

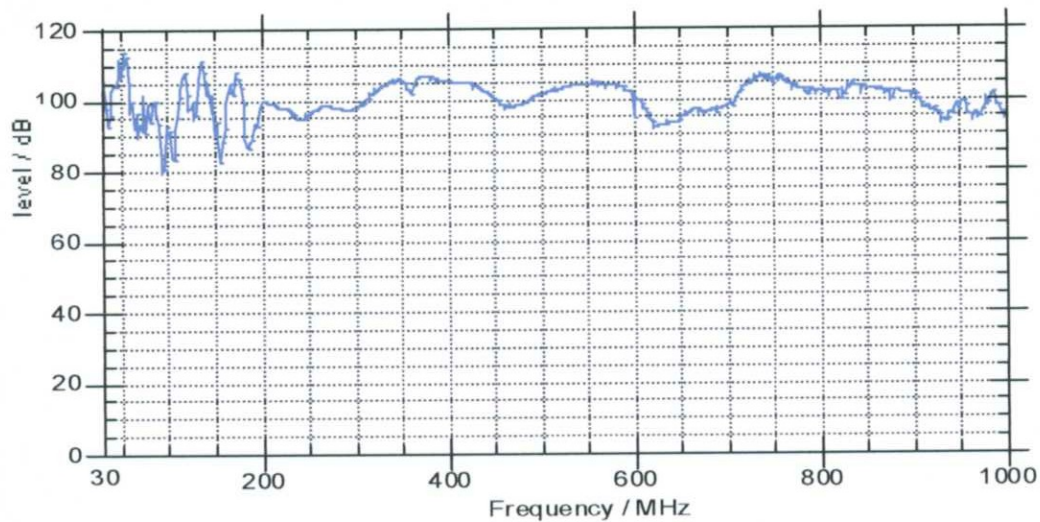


Fig. 4: Dynamic Range for the shielding effectiveness measurement in the frequency range from 30 MHz to 1 GHz (vertical polarization).

4.3. Measurement Results

4.3.1 Cabinet "Varistar EMC 2000Hx600Bx600T, Reference-No.: 10130-020/10"

The cabinet "Varistar EMC 2000Hx600Bx600T (Reference-No.: 10130-020/10)" was examined in four orientations, Figures 5, 6, 7, 8.

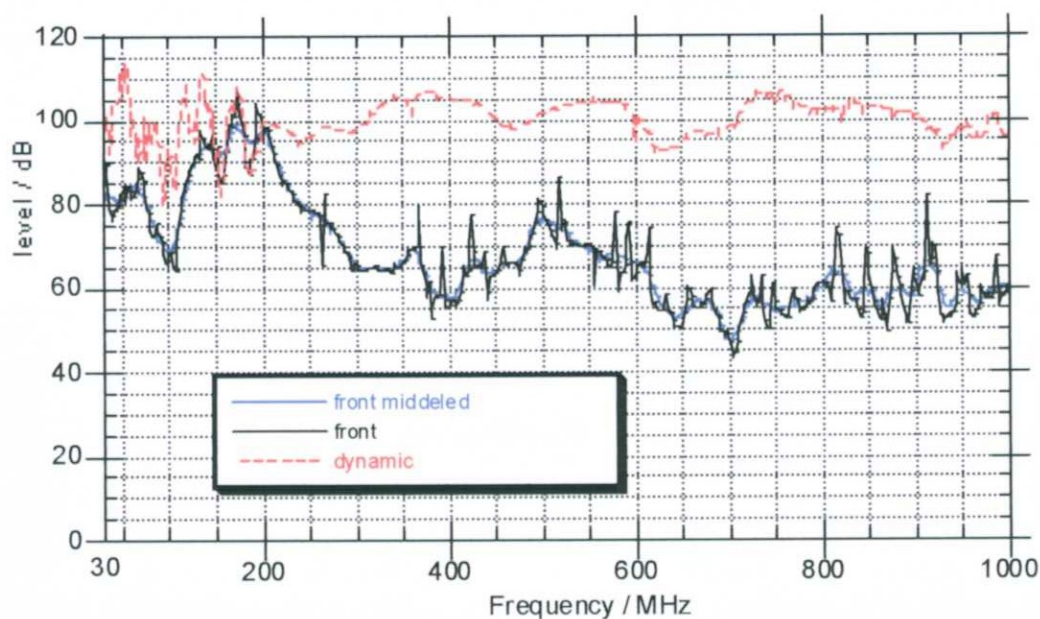


Fig. 5: Shielding effectiveness of the EUT, in the frequency range from 30 MHz to 1 GHz, direct radiation on the front side, vertical polarization.

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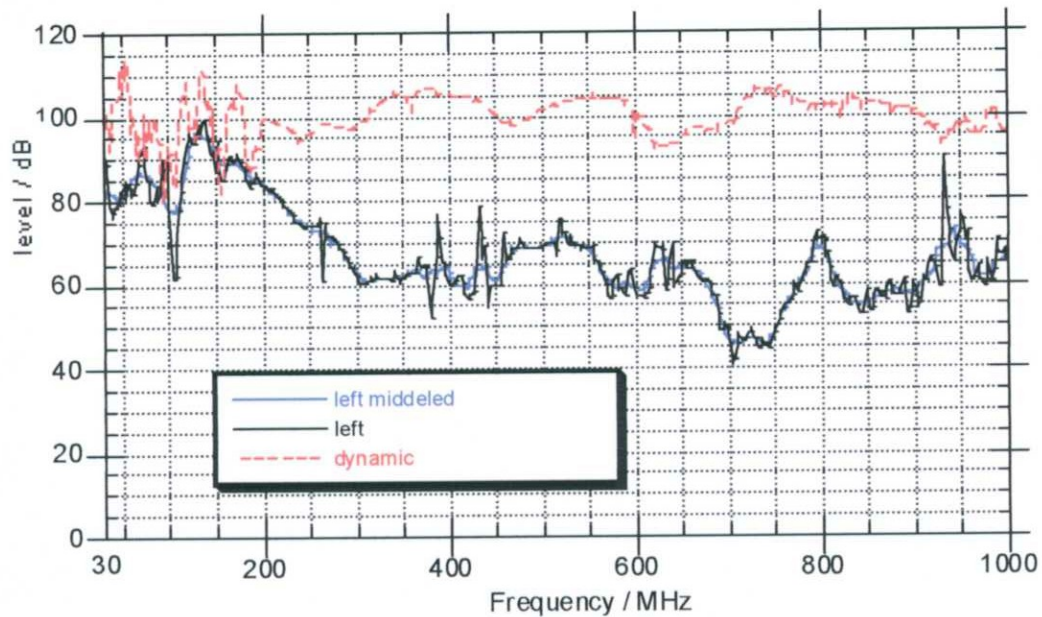


Fig. 6: Shielding effectiveness of the EUT, in the frequency range from 30 MHz to 1 GHz, direct radiation on the left side, vertical polarization.

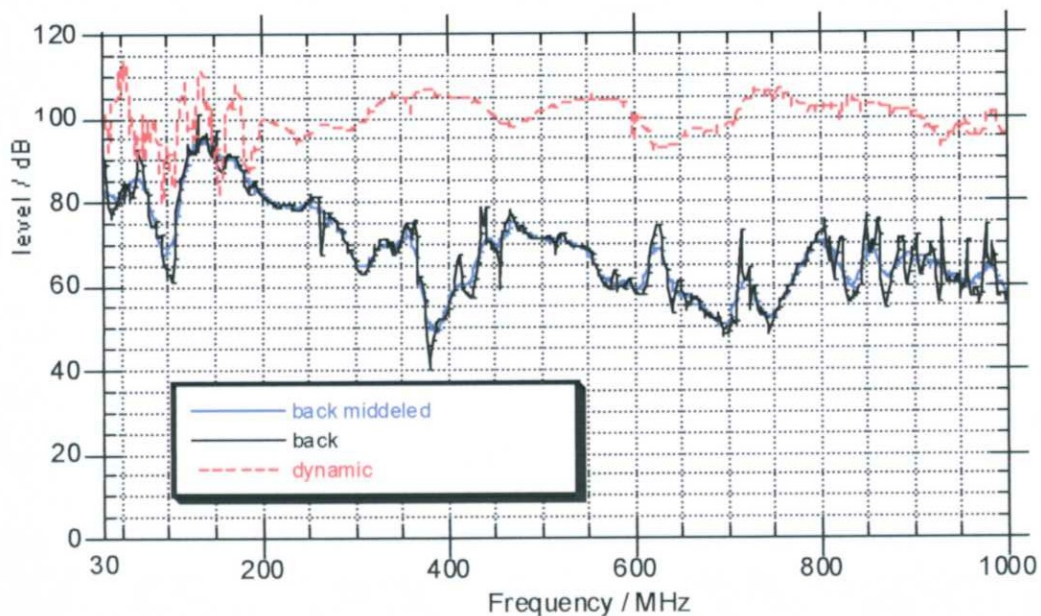


Fig. 7: Shielding effectiveness of the EUT, in the frequency range from 30 MHz to 1 GHz, direct radiation on the back side, vertical polarization

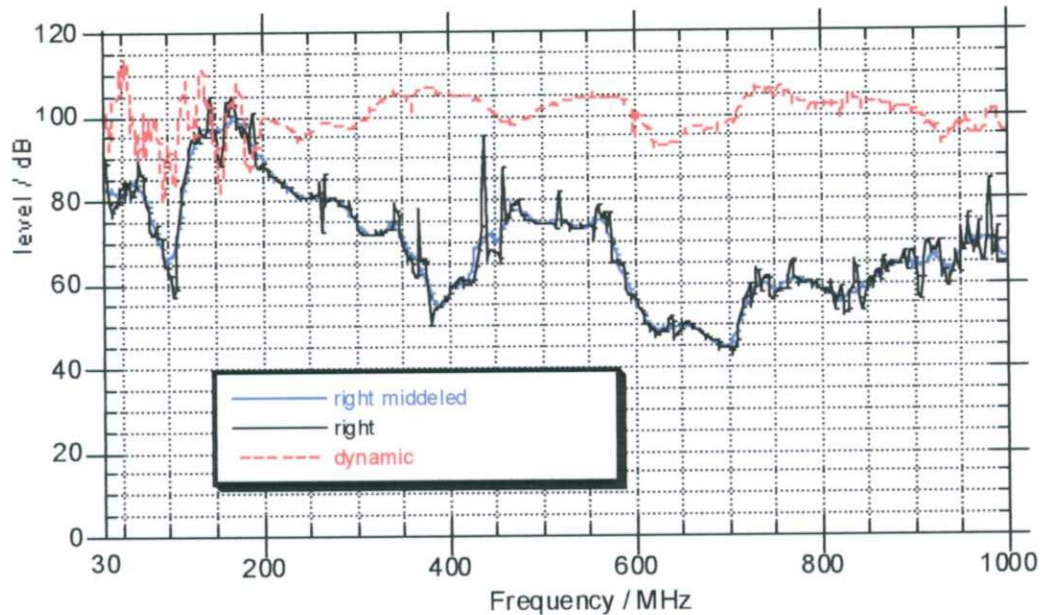


Fig. 8: Shielding effectiveness of the EUT, in the frequency range from 30 MHz to 1 GHz, direct radiation on the right side, vertical polarization.

Additionally an overall worst-case scenario was calculated for Fig.9 using the minimum shielding effectiveness of all examined sides.

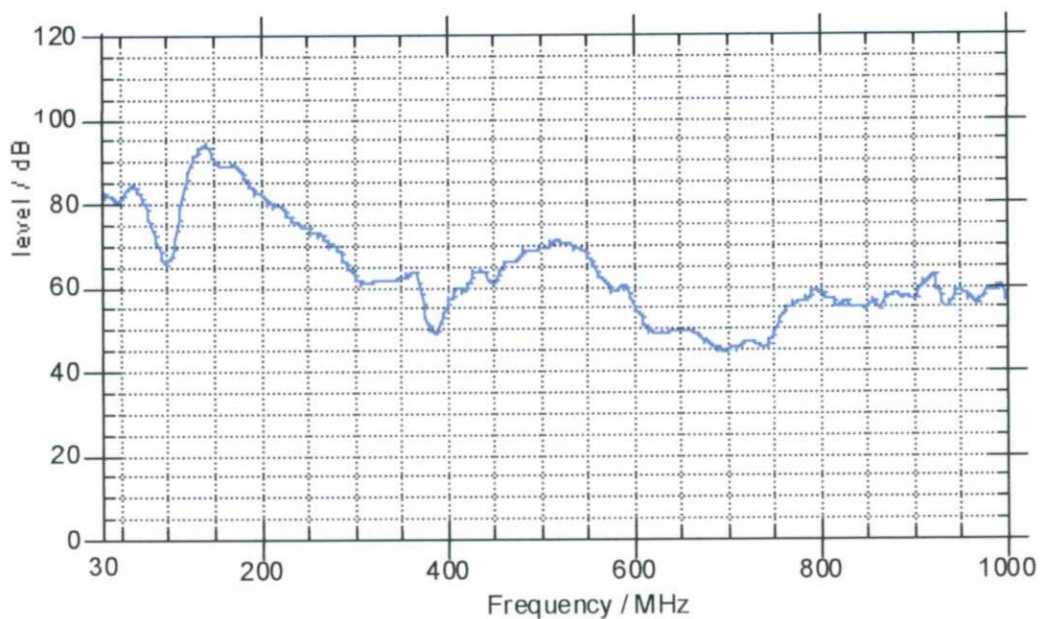


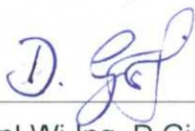
Fig. 9: Typical Shielding effectiveness of the EUT, in the frequency range from 30 MHz to 1 GHz. Calculated with the worst-case of each examined side and smoothing of the resonance frequencies.

5. Conclusions

Shielding effectiveness measurements of the cabinet "Varistar EMC 2000Hx600Bx600T, Reference-No.: 10130-020/10" manufactured by Schroff have been performed in the frequency range from 30 MHz to 1 GHz according to VG 95 373, Part 15.

Responsible for the proper execution of the measurements in accordance with acknowledged rules of technology:

Karlsruhe, 2005-01-31



Dipl.-Ing. D. Giselbrecht



Dipl.-Ing. M. Nagel



Prof. Dr.-Ing. Thomas Leibfried
