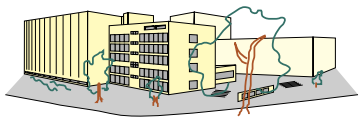
IEH Institute of Electric Energy Systems and High-Voltage Technology

Ordinarius und Director: Prof. Dr.-Ing. A. J. Schwab



Engesserstraße 12 - Building 30.36
D-76128 Karlsruhe
http://www-ieh.etec.uni-karlsruhe.de

Telefon: ++49-721-608-2520
Fax: ++49-721-695224

EMC - Testing

November 2, 2001

submitted by: Kürner / Börninck

phone: ++49 721 608-3137 / 2514

Report No. 2001 – 67/1

Shielding Effectiveness of the cabinets Ratiopac Pro shielded (6HE 84TE 295T) and Ratiopac Pro unshielded (6HE 84TE 295T)

Customer: Schroff GmbH
75334 Straubenhardt

Examination Engineers: Dipl.-Ing. W. Kürner
Dipl.-Ing. S. Börninck

1. Summary

The shielding effectiveness measurements of the cabinets “Ratiopac Pro shielded” (6HE 84TE 295T) and “Ratiopac Pro unshielded” (6HE 84TE 295T) were performed in the frequency range from 30 MHz to 1 GHz according to VG 95 373, Part 15.

2. General

Equipment under test:	1. Cabinet Schroff Ratiopac Pro shielded, (6HE 84TE 295T) 2. Cabinet Schroff Ratiopac Pro unshielded, (6HE 84TE 295T)
Delivery of EUT:	September 20, 2001
Place of Examination:	Anechoic chamber of the Institute of Electric Energy Systems and High-Voltage Technology University of Karlsruhe Kaiserstrasse 12 76128 Karlsruhe
Date of Examination:	September 20, 2001
Representative Customer:	Mr. Peter Reiser
Examination Engineers:	Dipl.-Ing. Wolfgang Kürner Dipl.-Ing. Stefan Börninck
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 x 4.5 x 5 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.

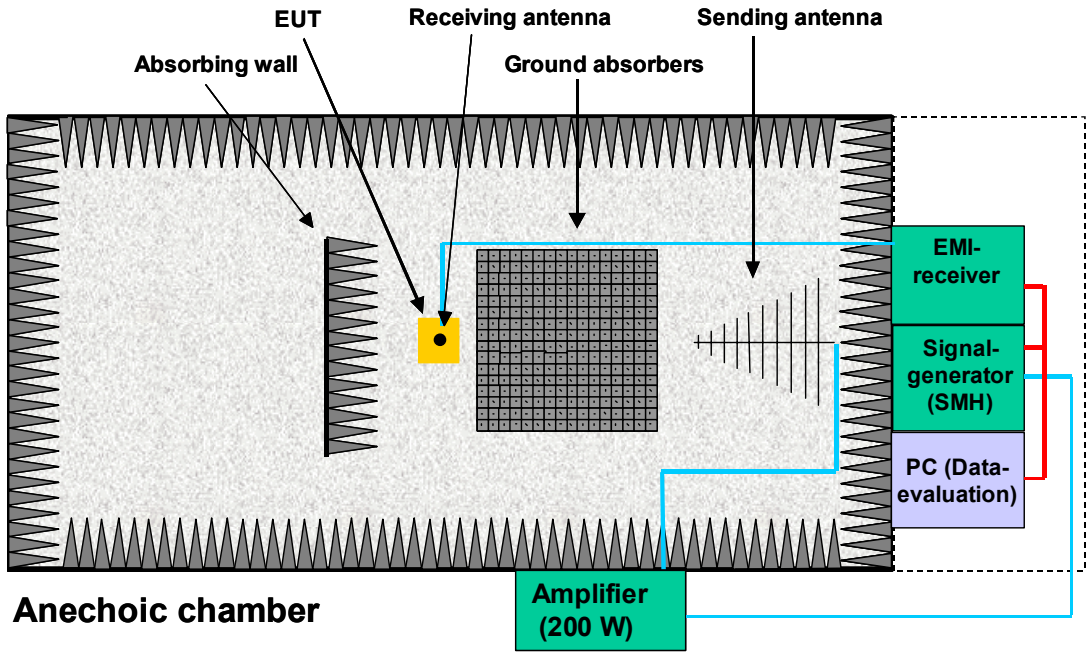


Fig. 1: Test set-up.

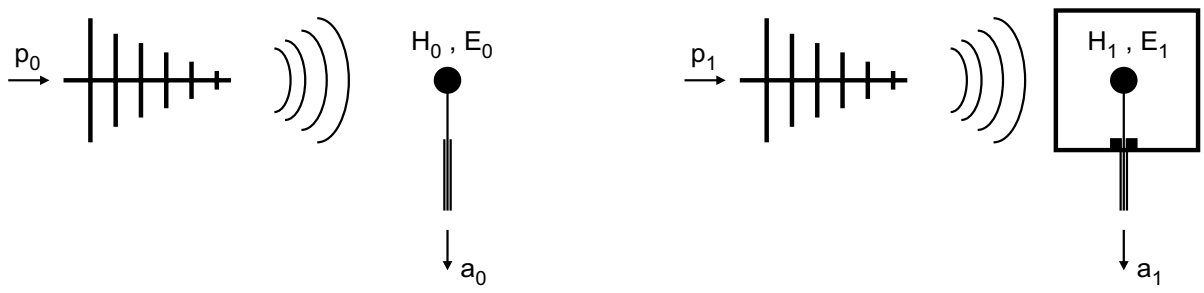
The distance between EUT and antenna was 3 m. The transmitting antenna was vertically polarized in a height of 1,50 m. A receiving antenna was located in the center of the cabinet. The cabinet was fixed in 100 cm above the ground on a brass tubing provided with ferrites to suppress eigenfrequencies.

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 2).



a. b.

Fig 2: Shielding Effectiveness of enclosures.
a) Measurement in the absence of the enclosure.
b) Measurement within the enclosure.

The shielding effeffectiveness is calculated from

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

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. 3 illustrates the dynamic range, which is predominantly more than 100 dB in the frequency range from 30 MHz to 1 GHz.

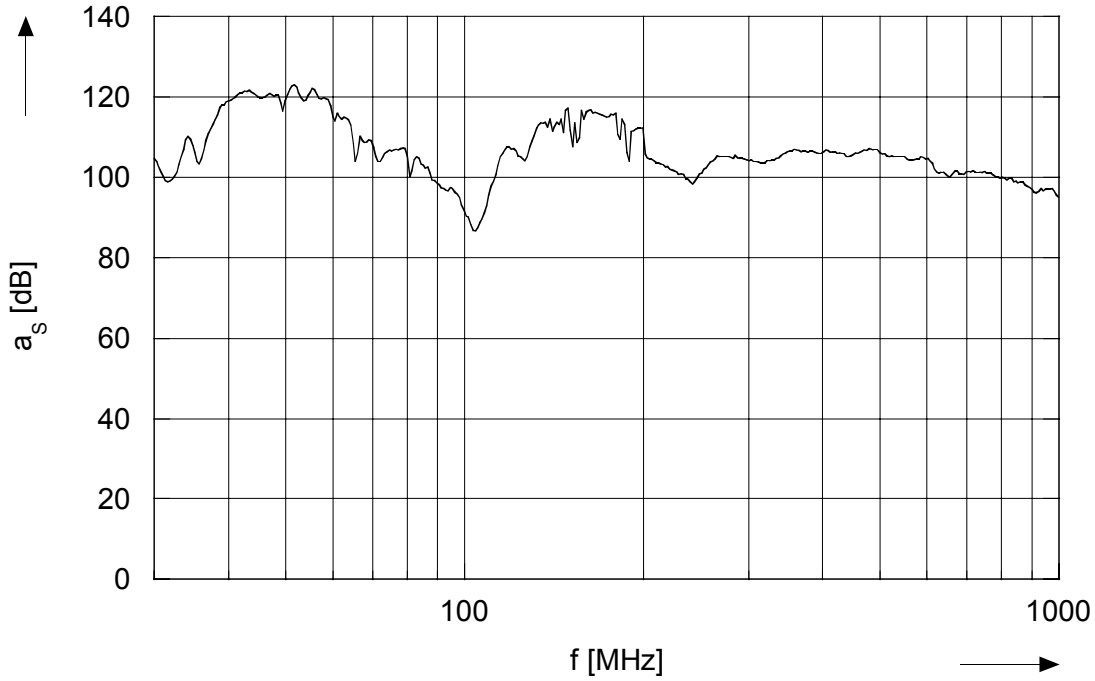


Fig 3: Dynamic Range for the shielding effectiveness measurement in the frequency range from 30 MHz to 1 GHz (vertical polarization).

4.3. Measurement Results

4.3.1 Cabinet No. 1, „Ratiopac pro shielded“:

The Cabinet „Ratiopac pro shielded" was examined in four orientations, Figures 4, 5, 6, 7 and 8.

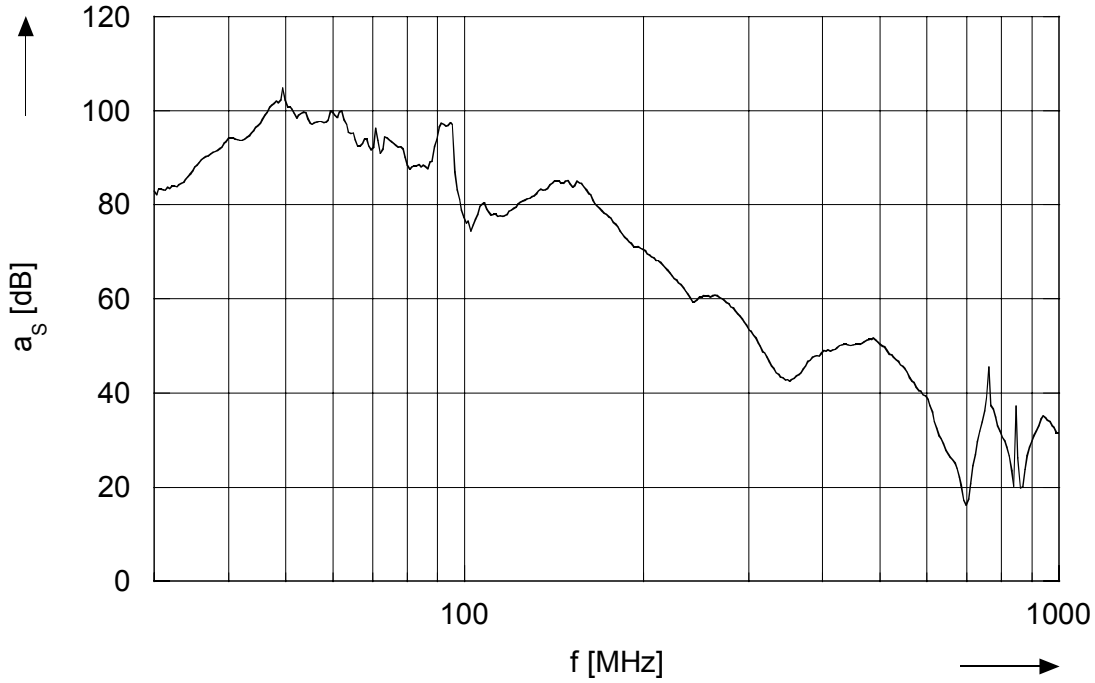


Fig. 4: Shielding effectiveness of „Ratiopac pro shielded", in the frequency range from 30 MHz to 1 GHz, direct radiation on the front side, vertical polarization.

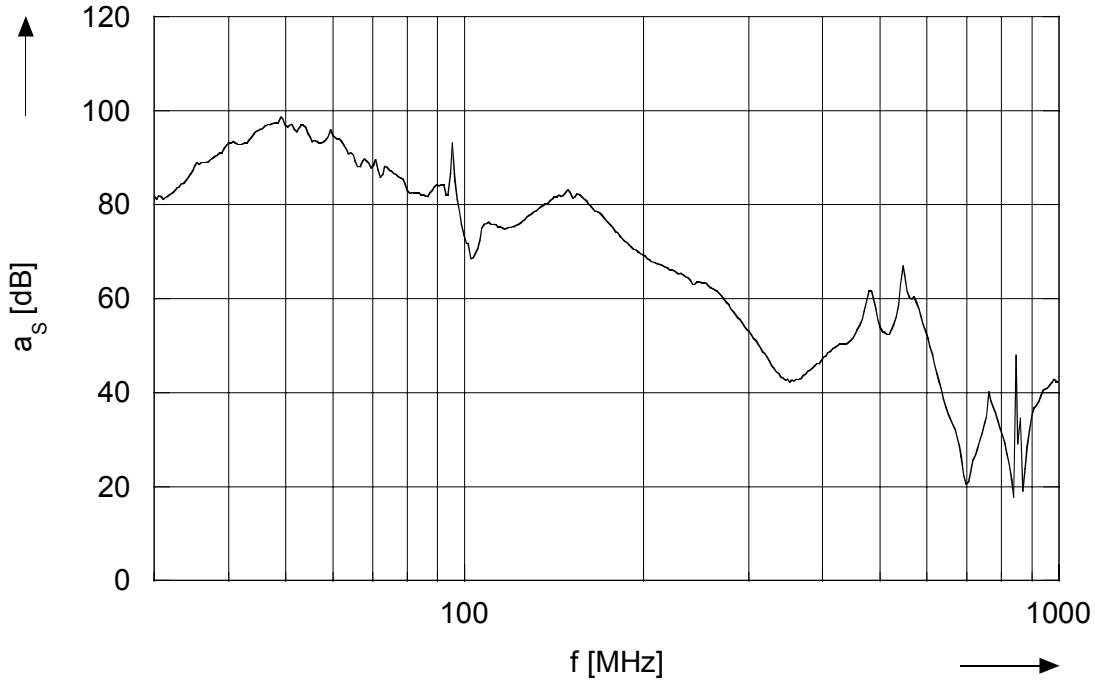


Fig. 5: Shielding effectiveness of „Ratiopac pro shielded", in the frequency range from 30 MHz to 1 GHz, direct radiation on the right side, vertical polarization.

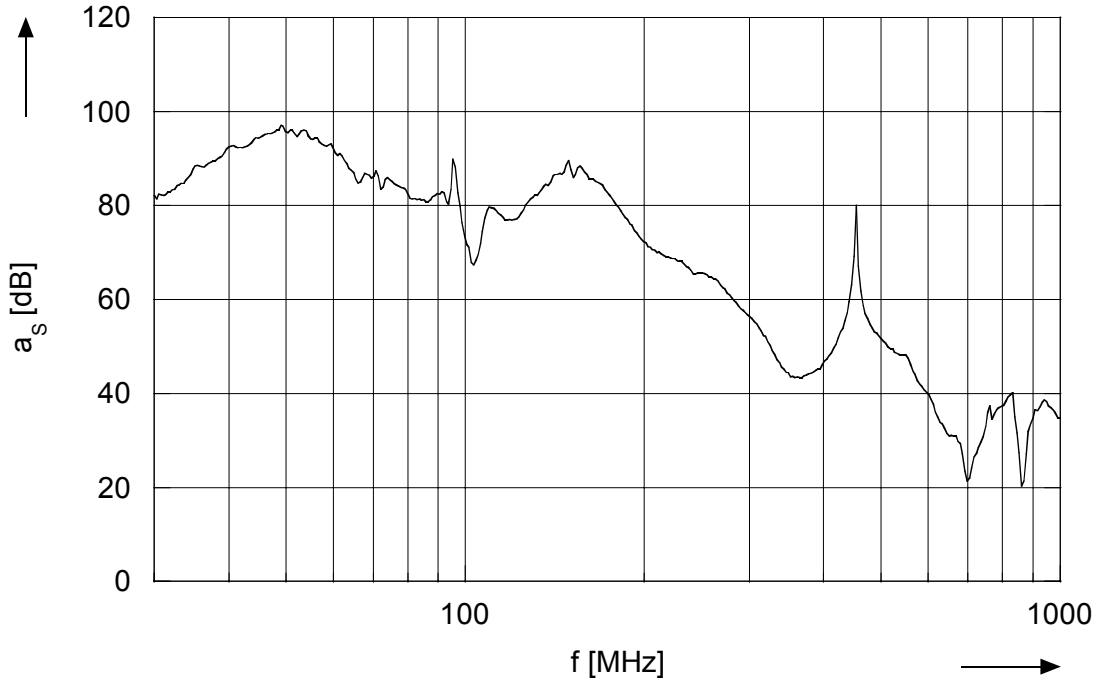


Fig. 6: Shielding effectiveness of „Ratiopac pro shielded", in the frequency range from 30 MHz to 1 GHz, direct radiation on the back side, vertical polarization

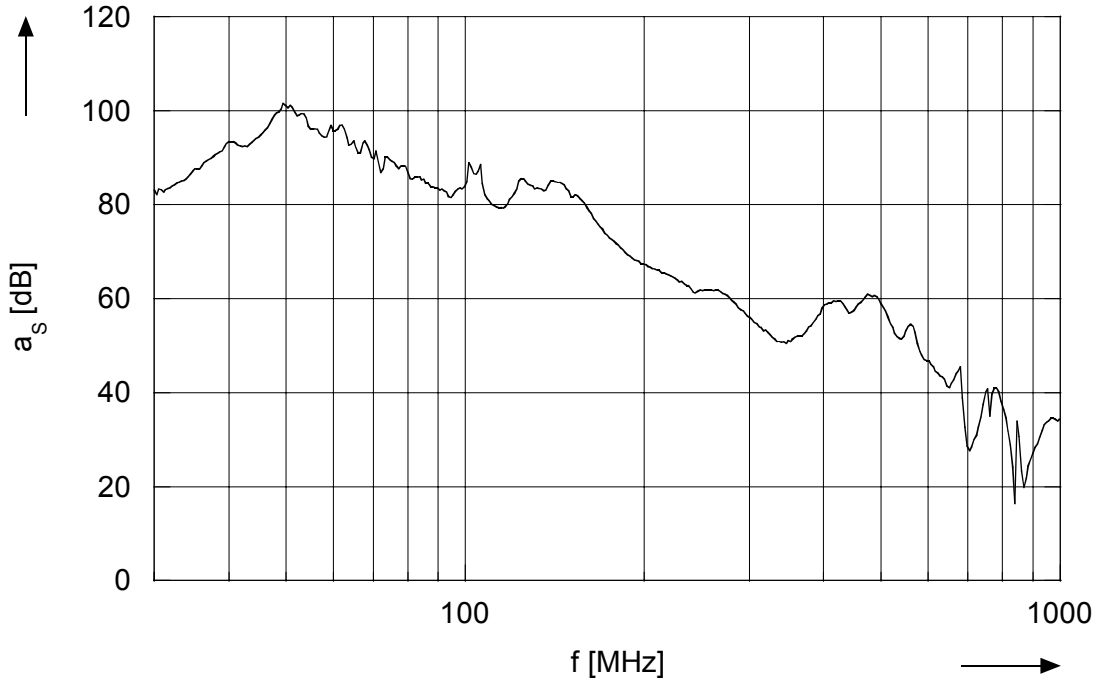


Fig. 7: Shielding effectiveness of „Ratiopac pro shielded", in the frequency range from 30 MHz to 1 GHz, direct radiation on the left side, vertical polarization.

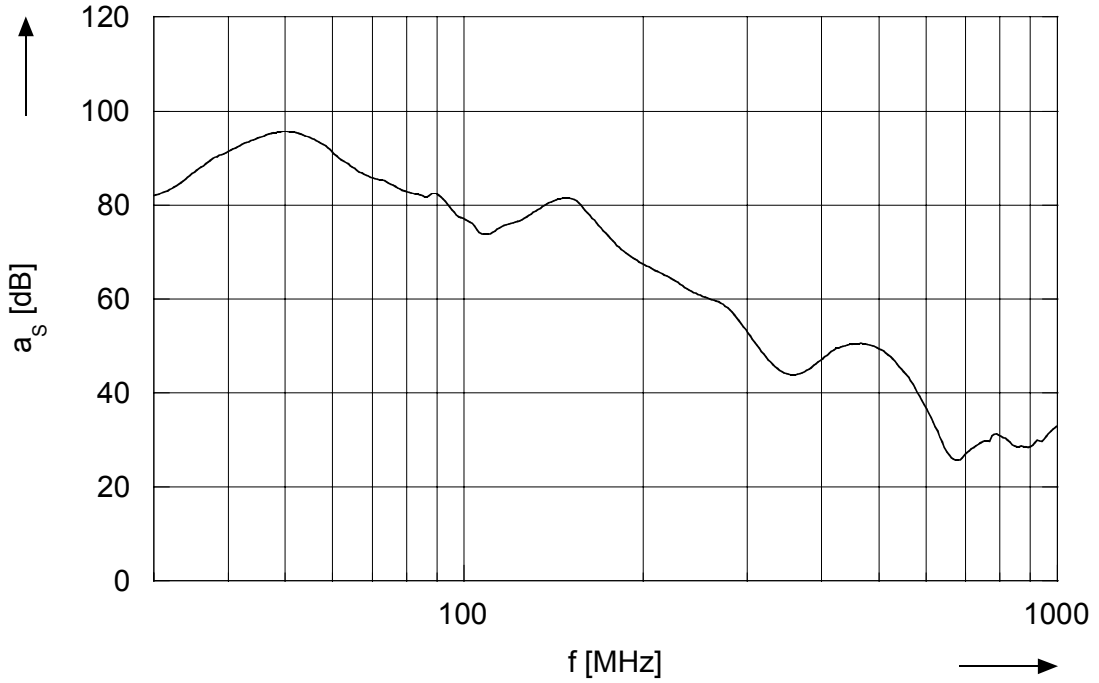


Fig. 8: Typical Shielding effectiveness of „Ratiopac pro shielded", in the frequency range from 30 MHz to 1 GHz. Calculated with the worst-case of each examined side and smoothing of the resonance frequencies.

4.3.2 Cabinet No. 2, „Ratiopac pro unshielded“:

The Cabinet „Ratiopac pro shielded" was examined in four orientations, Figures 9, 10, 11,12 and 13.

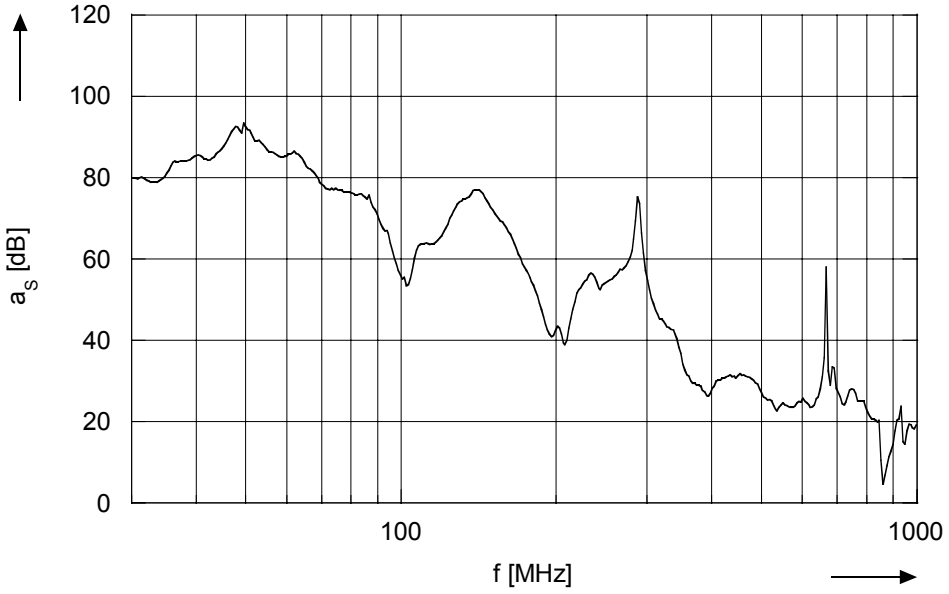


Fig. 9: Shielding effectiveness of „Ratiopac pro unshielded", in the frequency range from 30 MHz to 1 GHz, direct radiation on the front side, vertical polarization.

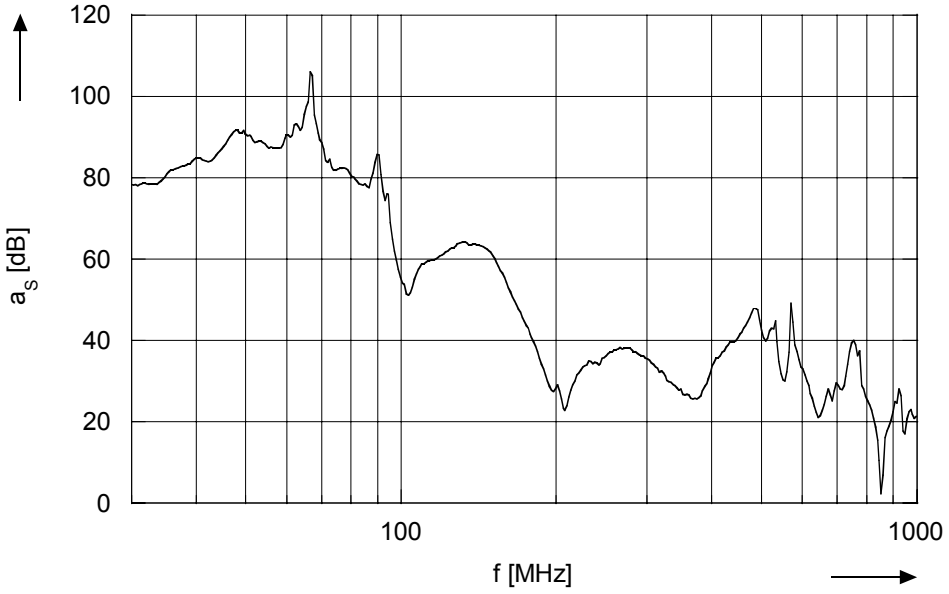


Fig. 10: Shielding effectiveness of „Ratiopac pro unshielded", in the frequency range from 30 MHz to 1 GHz, direct radiation on the right side, vertical polarization.

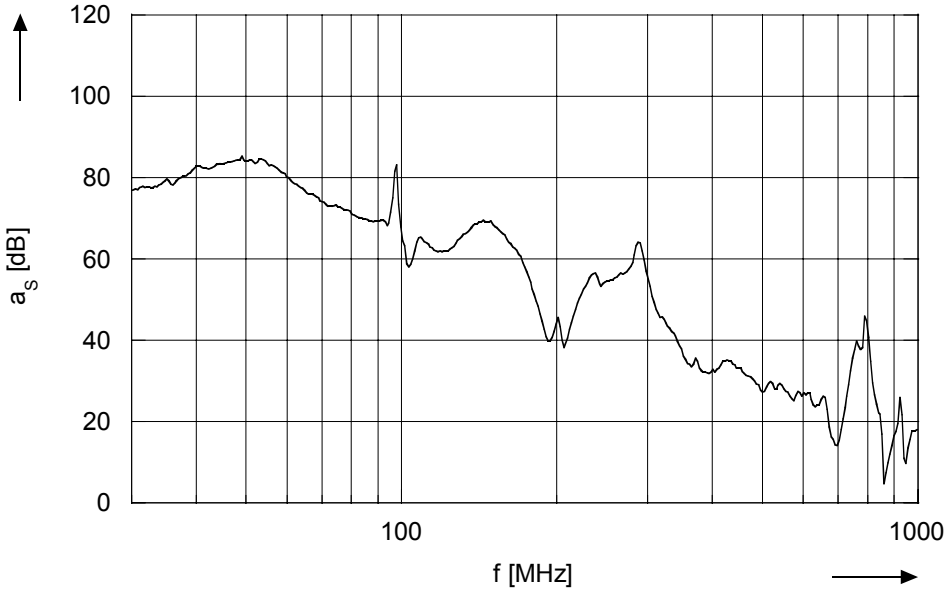


Fig. 11: Shielding effectiveness of „Ratiopac pro unshielded", in the frequency range from 30 MHz to 1 GHz, direct radiation on the back side, vertical polarization.

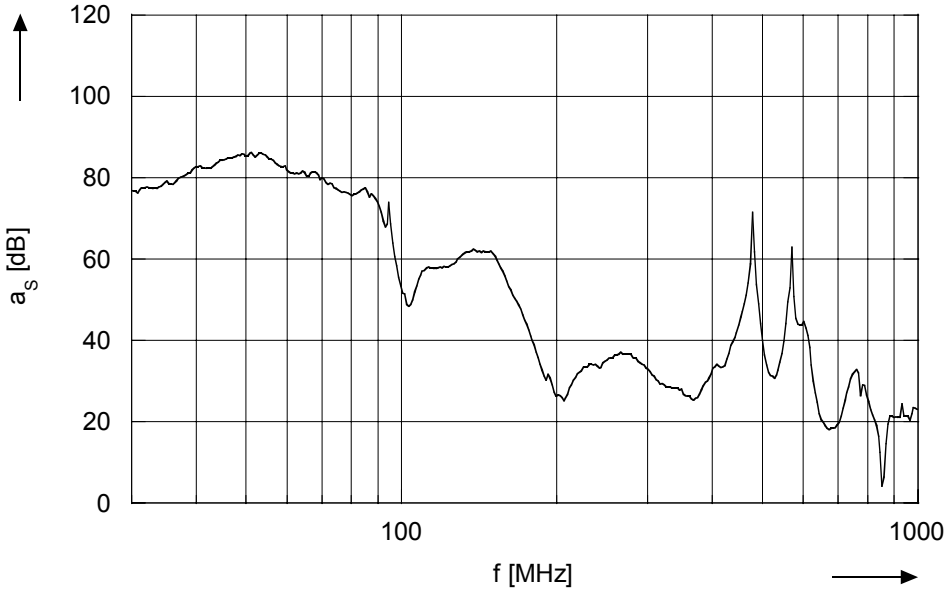


Fig. 12: Shielding effectiveness of „Ratiopac pro unshielded", in the frequency range from 30 MHz to 1 GHz, direct radiation on the left side, vertical polarization.

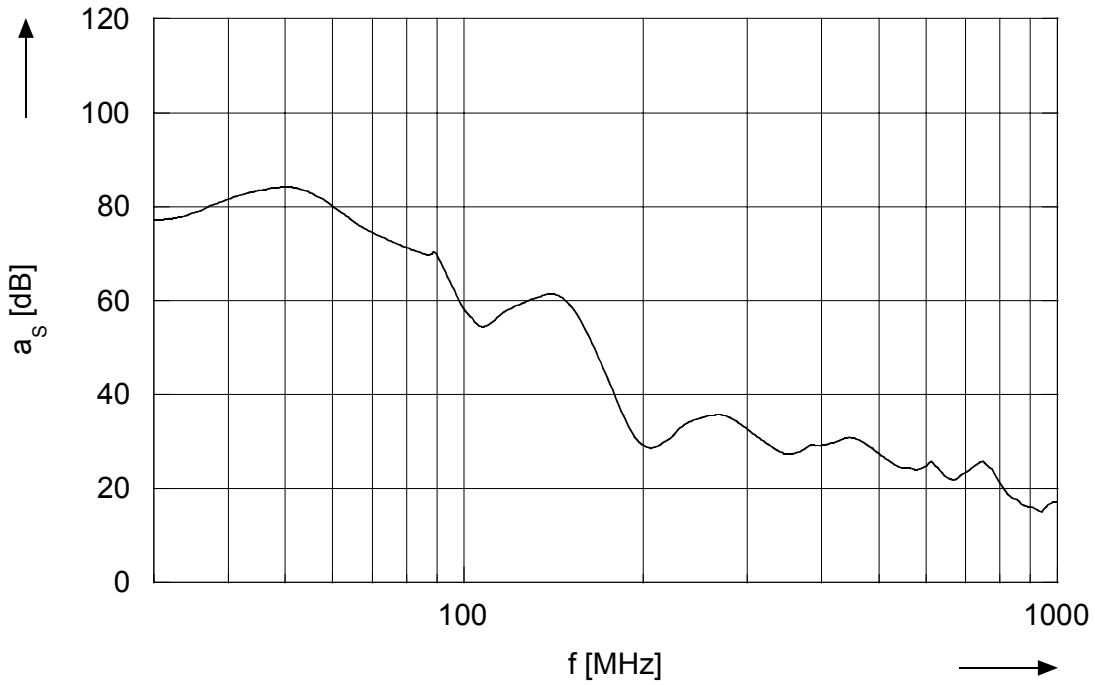


Fig. 13: Shielding effectiveness of „Ratiopac pro unshielded", in the frequency range from 30 MHz to 1 GHz. Calculated with the worst-case of each examined side and smoothing of the resonance frequencies.

5. Conclusions

Shielding effectiveness measurements of the cabinets “Ratiopac Pro shielded” (6HE 84TE 295T) and “Ratiopac Pro unshielded” (6HE 84TE 295T) manufactured by Schroff have been performed in the frequency range from 30 MHz to 1 GHz according to VG 95 373, Part 15.

For the proper execution of the measurements in accordance with acknowledged rule of technology

November 2, 2001, Karlsruhe

Dipl.-Ing. W. Kürner	Dipl.-Ing. Stefan Börninck
(Deputy chief of the EMC-Testing Laboratory)	(Examination Engineer)