IEH Institut of Electric Energy Systems
and High-Voltage Technology
Ordinarius and Director: Prof. Dr.-Ing. T. Leibfried

Engesserstraße 11
Gebäude 30.36
D-76128 Karlsruhe

Tel.: +49-721-608 2912
Fax: +49-721-695 224

http://www.ieh.uni-karlsruhe.de

EMC-Testlab

2006-04-25

submitted by: D. Giselbrecht / M. Nagel
phone: +49 721 608-3063 / 3137

Report Nr. 2006-43/1

Shielding effectiveness of the subrack: "europacPRO 6HE 84TE 235mm with stainless steel-sealing"

Customer: Schroff GmbH
Langenalber Str. 96-100

75334 Straubenhardt

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

This report consists of 9 numbered pages and is only valid with authentic signature. The examination results are only related to the equipment under test.
Without written permission of the examination engineers it is not allowed to extract copies from this report.

1 Subject of this report

This report describes the shielding effectiveness measurements of the cabinet: ”europacPRO 6HE 84TE 235mm, surface colour-passivated, stainless steel-sealing”.

2 General

Equipment under test: europacPRO 6U 84HP 235mm with stainless steel-sealing

parts list:
1. europacPRO 6U 84HP 235mm,
2. surface colour-passivated,
3. stainless steel-sealing

EUT received: 2006-04-13

Place of test facility: EMV-Laboratory
Institute of Electrical Energy Systems and High Voltage Engineering (IEH)
Universität Karlsruhe (TH)
Engesserstrasse 11
76128 Karlsruhe

Test date: 2006.04.13

Environmental conditions:

temperature:	21	°C
humidity:	31	%
barometric pressure:	761	Torr

Representative customer: Mr. Robert Benko; Schroff

Test engineers: Dipl. Wi.-Ing. D. Giselbrecht / Dipl.-Ing. M. Nagel

Applied standards: Shielding effectiveness in the frequency range of 30 MHz to 2000 MHz according to VG 95373, Part 15

3 Test setup

The EUT was placed inside a shielded semi anechoic chamber and irradiated on four sides (front, back, right and left). The transmitting antenna was located in a 3m distance and 1,8m above ground. Vertical polarization was used. The basic setup is illustrated in Fig. 1.

The applied test equipment for the frequency range of 30 MHz to 1 GHz were the signal generator SMH (Inv.Nr.: 910031HO), manufactured by Rohde & Schwarz, the amplifiers BTRA 0122-1000 (9kHz…220MHz; Inv.Nr.: 950003) and BLWA 2010-200 (220MHz…1000MHz; Inv.Nr.: 950004), manufactured by Bonn GmbH. The logarithmic-periodical antenna UHALP 9108-G (Inv.Nr.: 050084), manufactured by Schwarzbeck, was used for emission. The EATON-ALL Tech Probe was used as receiving antenna and connected to the test receiver ESVP (Ser.Nr.: 872991/0011) manufactured by Rhode & Schwarz.

The applied test equipment for the frequency range of 1 GHz to 2 GHz was the vector-network-analyzer ZVRE (Inv.Nr.: 272/0074/96), manufactured by Rohde & Schwarz, the amplifier 25S1G4A, manufactured by Amplifier Research (Inv.-Nr.: 990043). The horn-antenna BBHA 9120A, manufactured by Schwarzbeck (Inv.-Nr.: 990042), was used for emission.The EATON-ALL Tech Probe was used as receiving antenna and connected to the network-analyzer ZVRE.

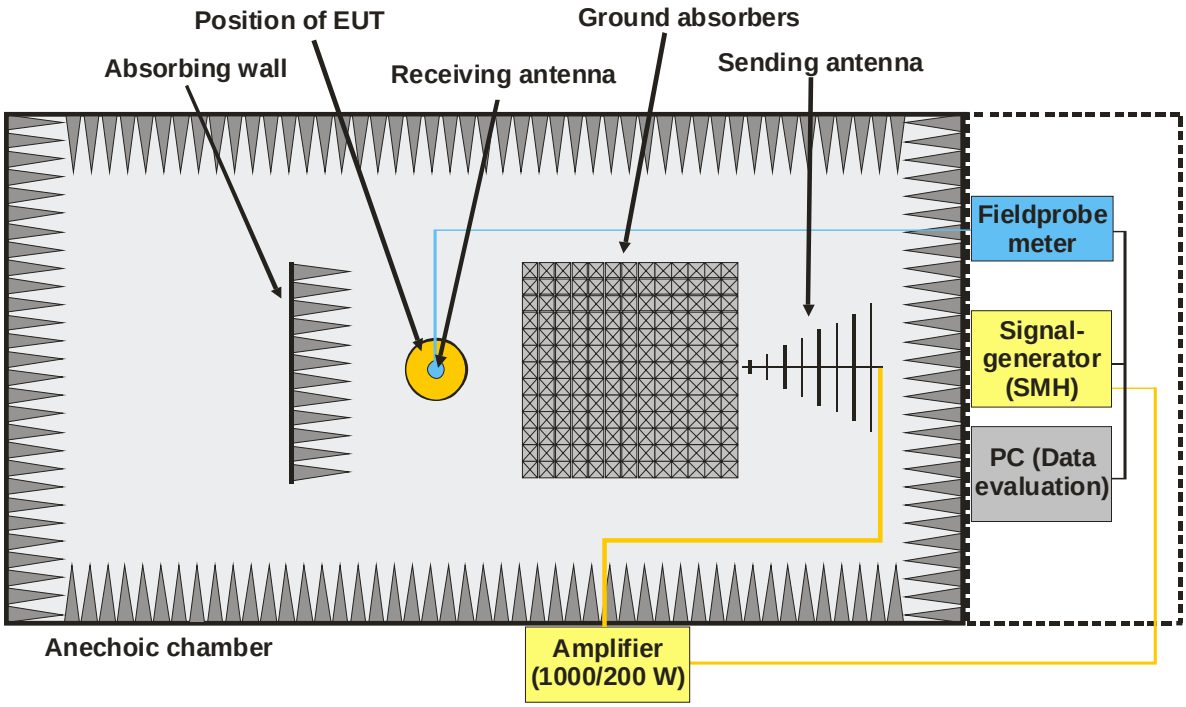

Fig. 1: test setup for shielding effectiveness

The EUT was fixed upon a turntable, 80 cm above ground. The cavities in the turntable were filled with similar absorbers as used at the walls of the semi anechoic chamber (see Fig. 4 for details). The receiving antenna was mounted on a brass tubing and aligned in the center of the EUT. Possible eigenfrequencies of the tubing were suppressed with ferrites.

3.1 Measurement procedures

The measurement of the shielding effectiveness was performed according to the “middle point method” in the frequency range of 30 MHz to 1 GHz which describes an isertion-loss method.

Coupling is first measured with no enclosure present an afterwards with one inserted. During those measurements the distance between sending- and receiving antenna, as well as the orientation are kept constant.

The enclosure shielding effectiveness is the difference between the reference level a_0 without, and the level a_1 with applied shielding (Fig. 2).

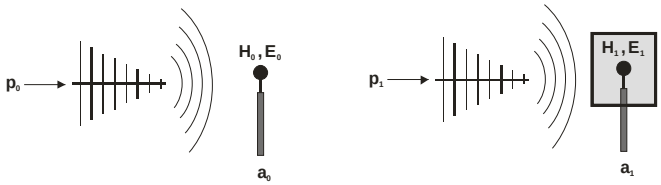

Fig. 2: Illustration of insertion-loss measurement method

The shielding effectiveness is calculated by: $a_s = a_0 - a_1$ in dB.

3.2 Dynamic range

The dynamic range is determined as the difference between reference level a_0 and the level without the receiving antenna. It is a quantification for the maximum shielding effectiveness, achievable with the used test setup and is dependable on the noise level of the epuipment (e.g., the shielding effectiveness of the cables) and the intrinsic noise of the receiver. The measured dynamic range is illustrated in Fig. 3, which is predominantly above 80 dB in the required frequency range.

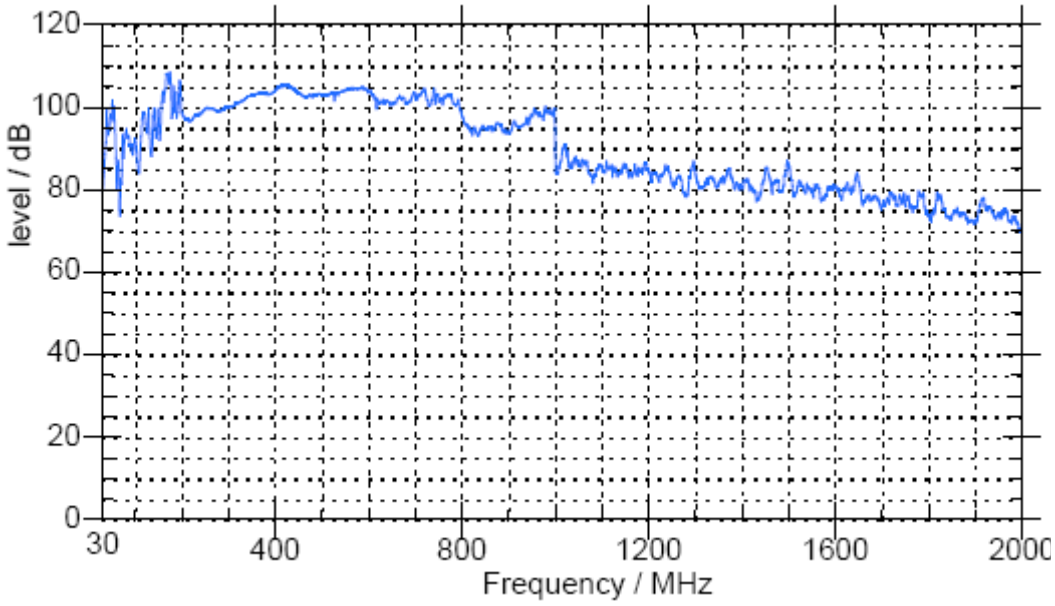

Fig. 3: Measured dynamic range

4 Results

4.1 Measured shielding effectiveness

The EUT was irradiated on four sides (front, back, right and left). The antenna was located in a 3m distance and 1,8 m above ground with a vertical polarization.

Fig. 4: EUT at the measurement position inside the anechoic chamber

4.1.1 TOP-side of EUT towards antenna

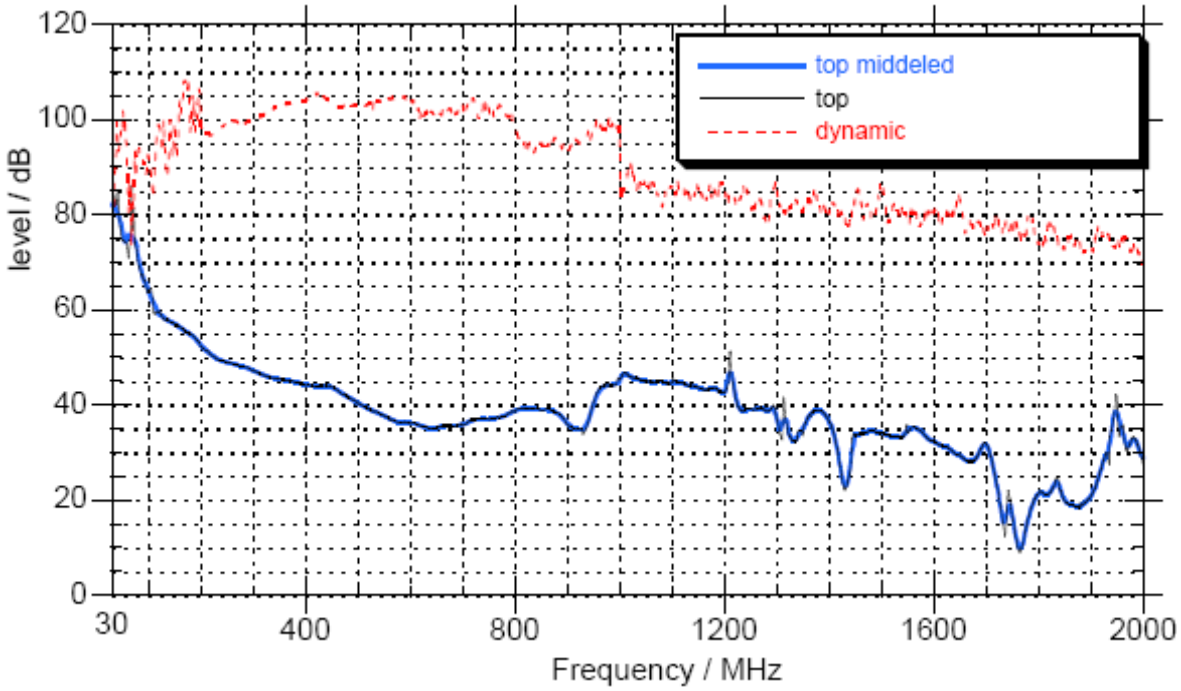

Fig. 5: Measurement results for direct radiation on TOP-side of the EUT

4.1.2 LEFT-side of EUT towards antenna

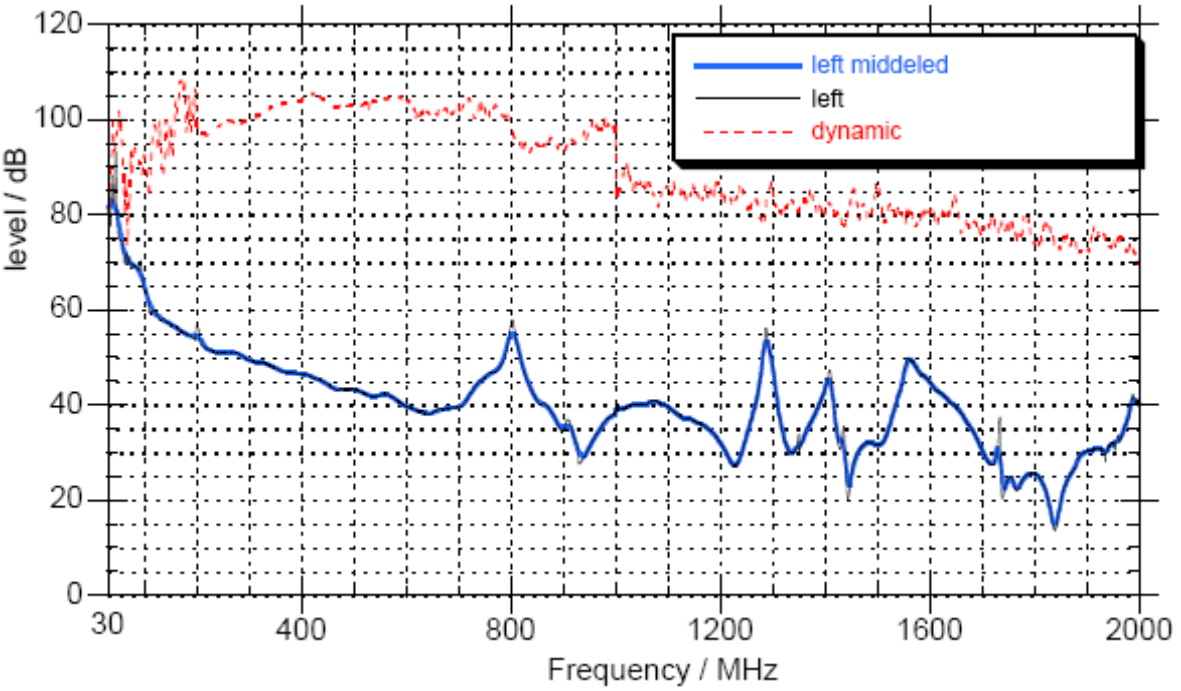

Fig. 6: Measurement results for direct radiation on LEFT-side of the EUT

4.1.3 BOTTOM-side of EUT towards antenna

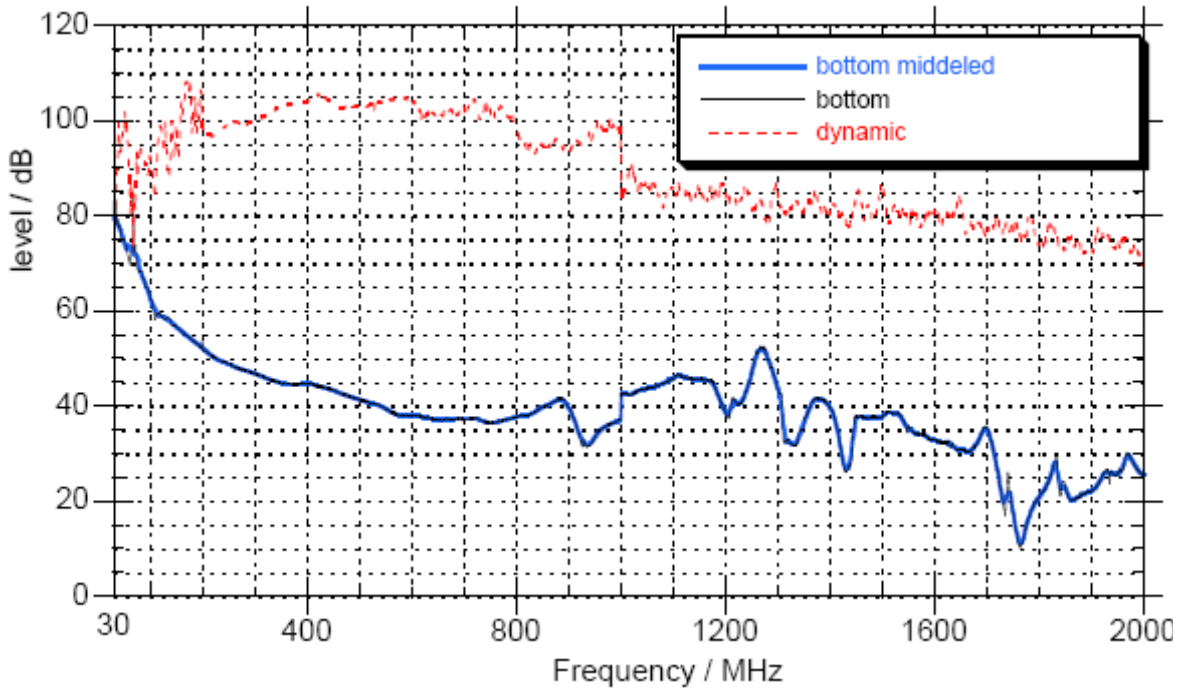

Fig. 7: Measurement results for direct radiation on BOTTOM-side of the EUT

4.1.4 RIGHT-side of EUT towards antenna

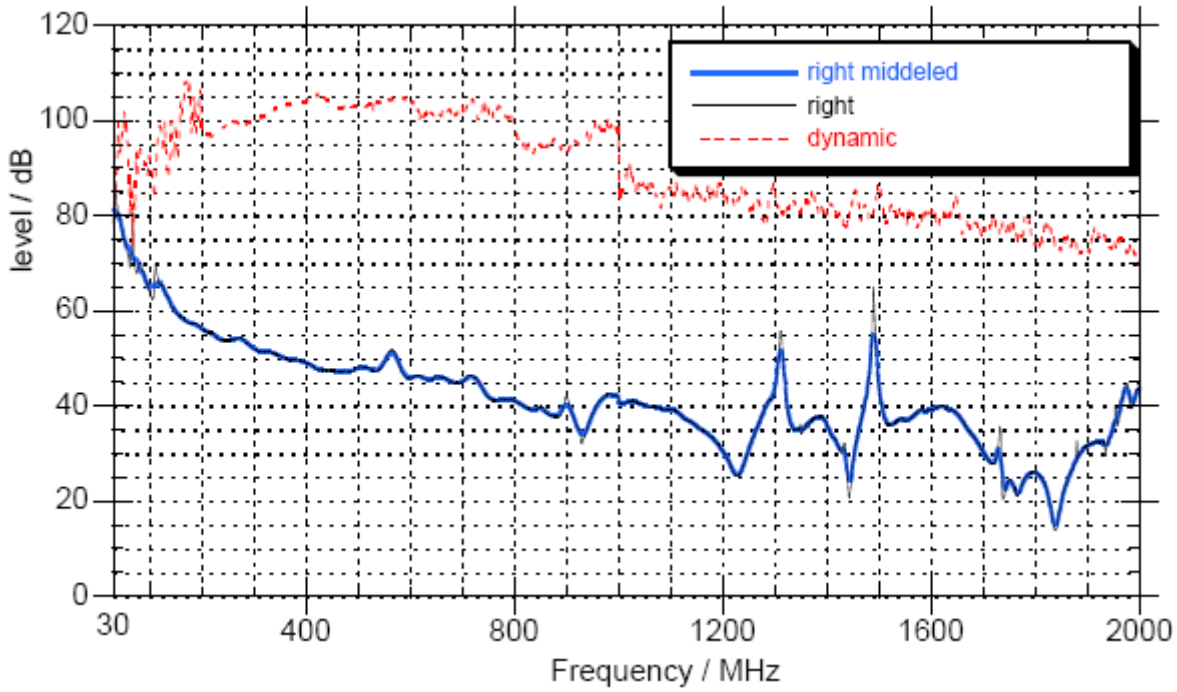

Fig. 8: Measurement results for direct radiation on RIGHT-side of the EUT

4.2 Typical shielding effectiveness and worst-case scenario

Additionally to the above measurements with direct radiation on one side of the EUT an overall worst-case scenario was calculated, using the total minimum shielding effectiveness of the previously recorded values. Combined with an inserted smoothing of the resonance frequencies results a typical shielding effectiveness of the EUT as shown in Fig. 9.

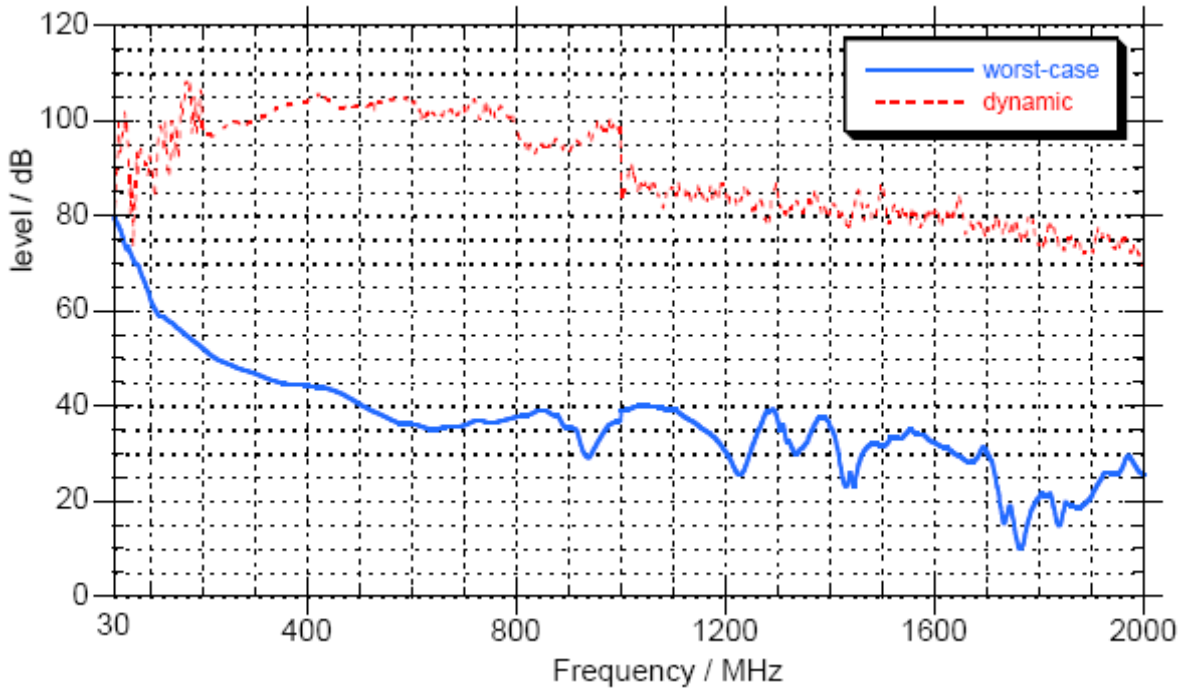

Fig. 9: Typical shielding effectiveness and worst case scenario of the EUT

5 Conclusion

Shielding effectiveness measurements of the cabinet: ”europacPRO 6U 84HP 235mm, surface colour-passivated, stainless steel-sealing” were performed in the frequency range of 30MHz to 1GHz according to VG 95 373, Part 15.

The results of those measurements are displayed in Fig. 5, Fig. 6, Fig. 7 and Fig. 8. The additionally calculated worst-case scenario resulted in Fig. 9.

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

Karlsruhe, 2006-04-25

Dipl. Wi.-Ing. D. Giselbrecht
(Head of EMC-testing)

Dipl.-Ing. M. Nagel
(Deputy head of EMC-testing)

Prof. Dr.-Ing. T. Leibfried
(Director)