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EMC-Testlab

Date: 2013-03-06
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Report Nr. 2012-122b

Shielding effectiveness of the cabinet: multipac 2U 280D AlZn 20860-126 with EMC gasket kit 20860-132 made by Schroff

Customer: Schroff GmbH
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75334 Straubenhardt

Engineers: Dipl.-Ing. D. Geißler
Dipl.-Ing. C. Freitag

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1 Subject of this report

This report describes the shielding effectiveness measurements of the cabinet multipac 2U 280D AlZn 20860-126 with EMC gasket kit 20860-132 made by Schroff.

2 General

Equipment under test (EUT):	multipac 2U 280D AlZn 20860-126 with EMC gasket kit 20860-132 made by Schroff
EUT received:	2013-01-29
Place of test facility:	EMV-Laboratory Institute of Electrical Energy Systems and High Voltage Engineering (IEH) KIT – Campus Süd Engesserstraße 11 76131 Karlsruhe
Test date:	2013-01-29
Environmental conditions:	temperature: 19,0 °C humidity: 33,6 % barometric pressure: 1002 hPa
Representative customer:	Mr. Benko
Test engineer:	D. Geißler / C. Freitag
Applied standards:	Shielding effectiveness in the frequency range of 30 MHz to 1000 MHz according to VG 95373, Part 15 and in the extended frequency range of 1 GHz to 2 GHz in dependence on the mentioned standard

3 Test setup

3.1 Test equipment

Table 1: Test equipment in a frequency range of 30 MHz - 1 GHz

Name	Type	Manufacturer	Inventory number
Signal generator	SMIQ 06 ATE	R & S	07-100976
Power amplifier (9 kHz - 220 MHz)	BTA 0122-1000	BONN GmbH	950003
Power amplifier (220 - 1000 MHz)	BLWA 2010-200	BONN GmbH	950004
Sending antenna	UHALP9108-G	Schwarzbeck	050084
Receiving antenna	E-field probe, Mod.-Nr. 904, 3,6cm ball	EMCO	n.a.
Test receiver	ESVP	R & S	872991/0011

Table 2: Test equipment in a frequency range of 1 GHz – 2 GHz

Name	Type	Manufacturer	Inventory number
Network analyzer	ZVRE	R & S	272/0074/96
Power amplifier	25S1G4A	Amplifier Research	990043
Sending antenna	STLP 9149	Schwarzbeck	TL2008_28
Receiving antenna	E-field probe, Mod.-Nr. 904, 3,6cm ball	EMCO	n.a.

3.2 Setup

The EUT was fixed on upon a brass tubing in a semi anechoic chamber. The tube was used to shield and guide the measuring cable from the receiving antenna via tunnel under the ground plane to the test receiver. Possible eigenfrequencies of the test setup were suppressed with ferrites around the tubing

Table 3: Position data of the test setup

	30 MHz – 1 GHz	1 GHz – 2 GHz
Height of the receiving antenna	1,16 m	1,16 m
Distance between sending and receiving antenna	3,4 m	1,84 m
Height of sending antenna	1,8 m	1,16 m
Polarization of sending antenna	vertical	vertical
Irradiated sides	left, right, top, bottom	left, right, top, bottom

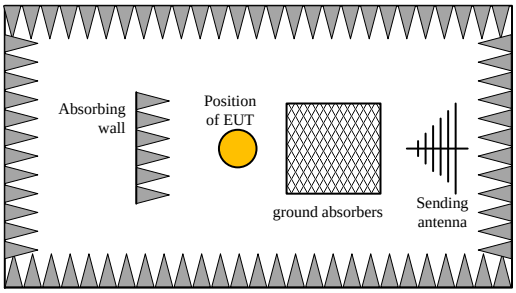

Fig. 1: Setup 30 MHz – 1 GHz

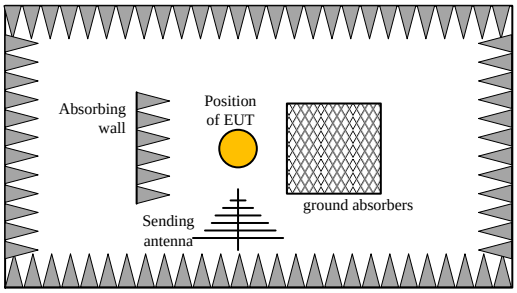

Fig. 2: Setup 1 GHz – 2 GHz

3.3 Measurement procedures

The measurement of the shielding effectiveness was performed according to the “middle point method” which describes an insertion-loss method.

Coupling is first measured with no enclosure present and afterwards with one inserted. During those measurements the distance between sending- and receiving antenna as well as the orientation and sending power P_0 are kept constant.

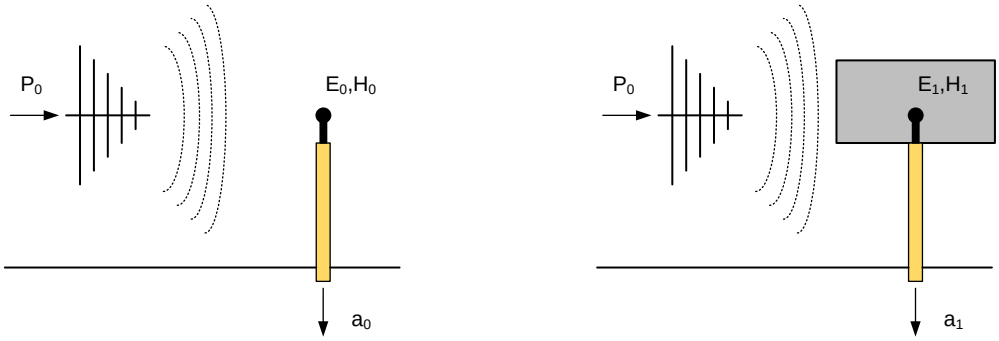

Fig. 3: Illustration of insertion-loss measurement method

The enclosure shielding effectiveness a_s is the difference between the reference level a_0 without and the level a_1 with applied shielding (Fig. 3).

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

3.4 Dynamic range

The dynamic range a_D is determined as the difference between reference level a_0 and the level a_2 without receiving antenna and a reflection free enclosed cable (Fig. 4).

$$a_D = a_0 - a_2 \text{ in dB}$$

Dynamic range is a quantification for the maximum shielding effectiveness, achievable with the used test setup. It depends on the noise level of the equipment (e.g., the shielding effectiveness of the cables) and the intrinsic noise of the receiver.

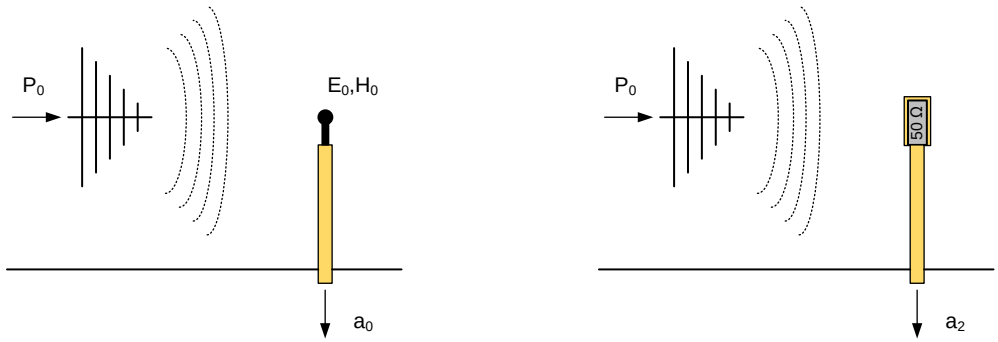

Fig. 4: Determination of the dynamic range

3.5 Pictures of the EUT as part of the test setup

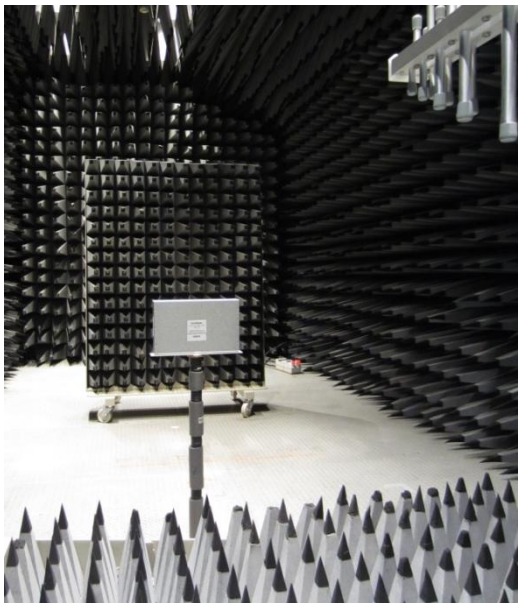

Fig. 5: Setup in a frequency range of 30 MHz - 1 GHz

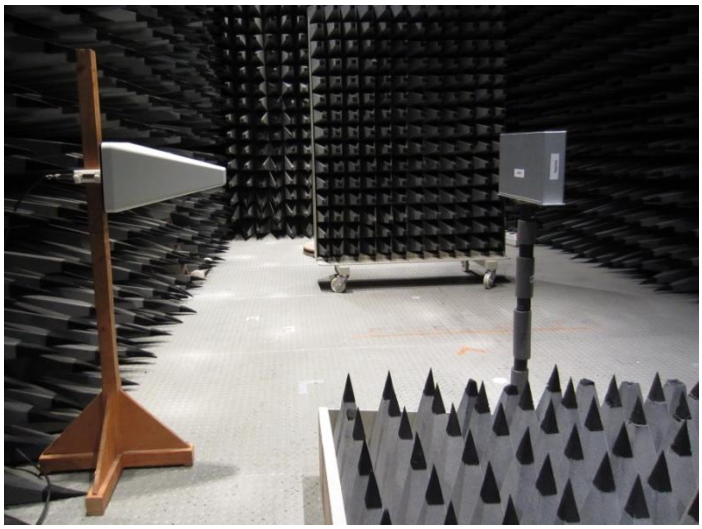

Fig. 6: Setup in a frequency range of 1 - 2 GHz

4 Results

4.1 Measured shielding effectiveness from 30 MHz - 1 GHz

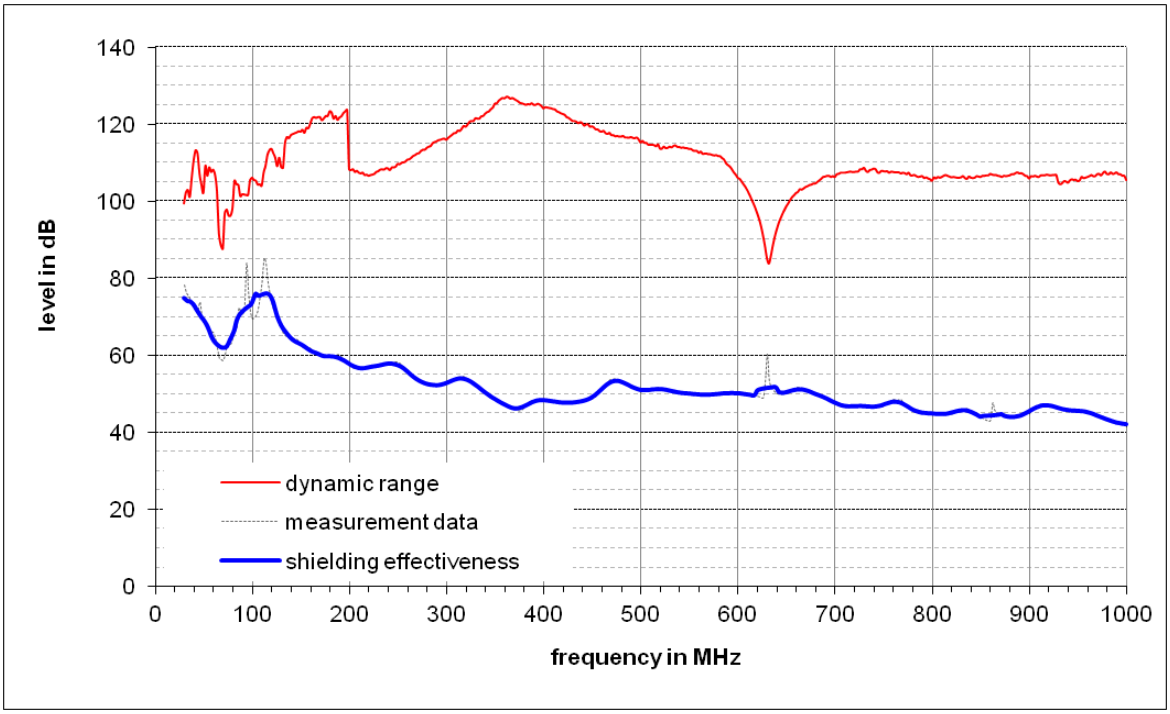

Fig. 7: Measurement results for direct radiation on LEFT-side of the EUT

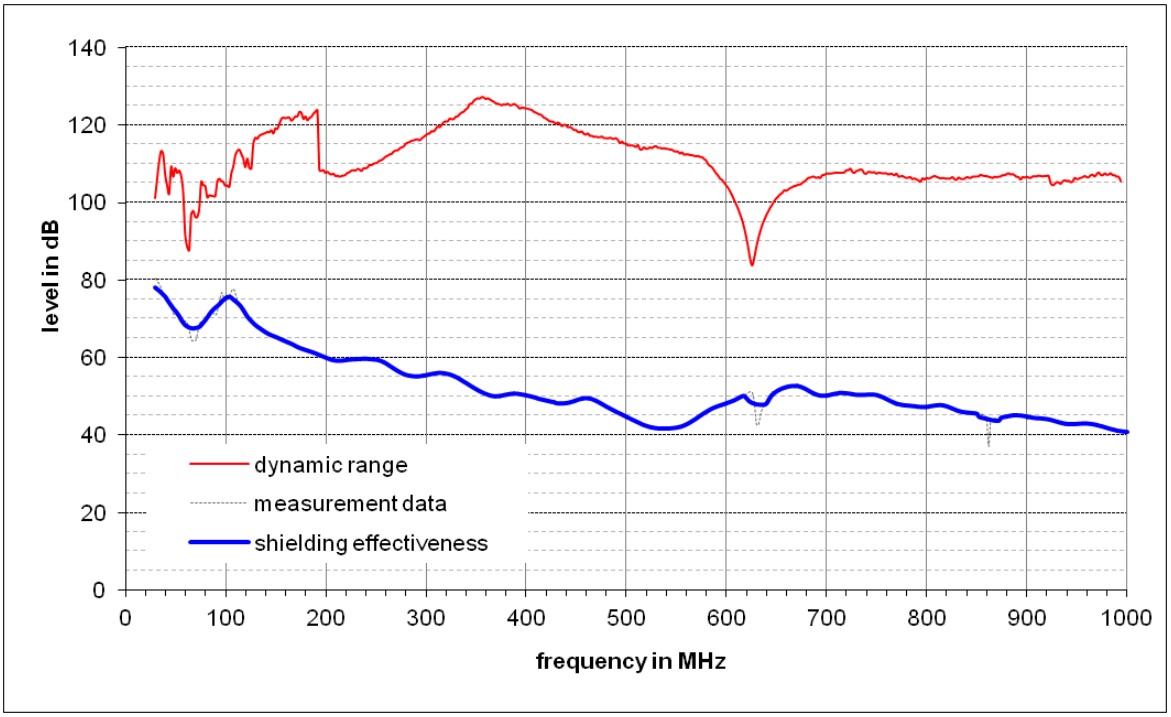

Fig. 8: Measurement results for direct radiation on RIGHT-side of the EUT

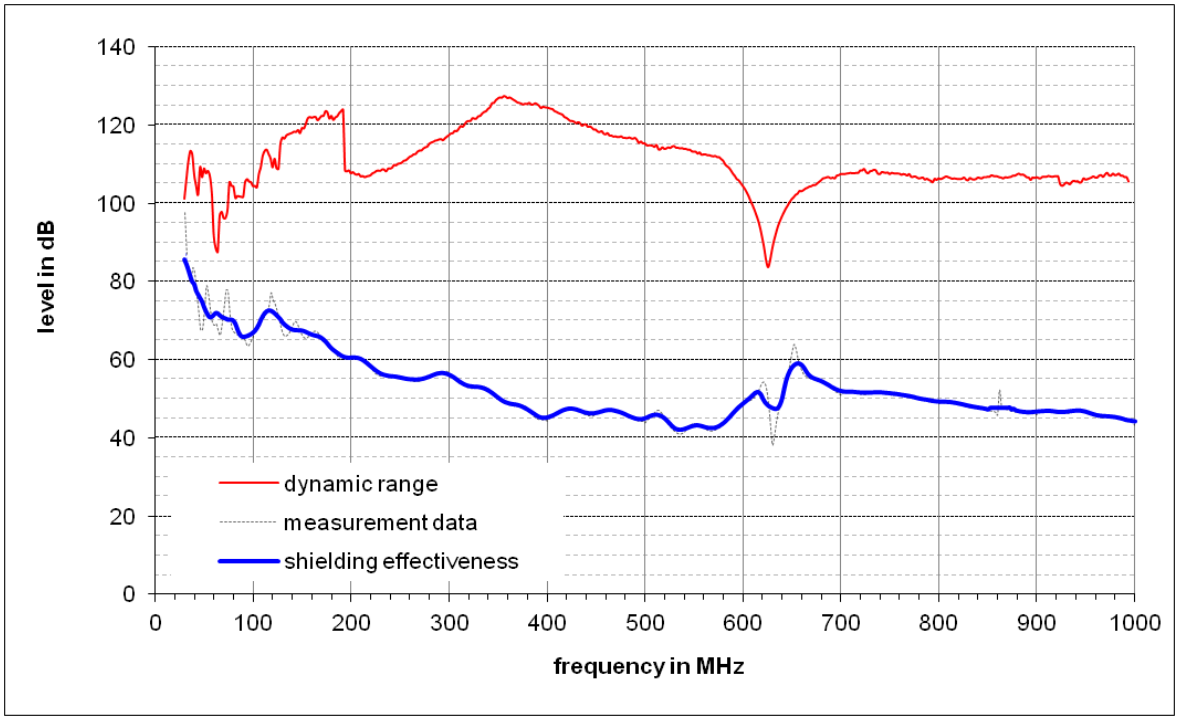

Fig. 9: Measurement results for direct radiation on TOP-side of the EUT

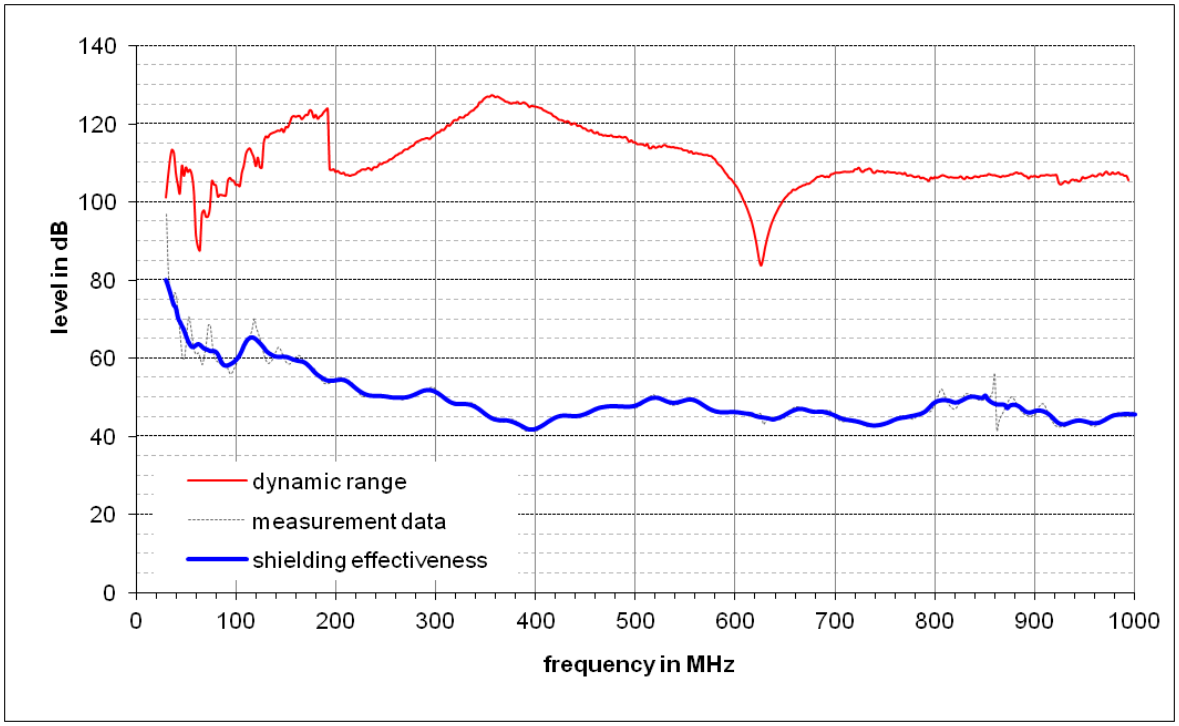

Fig. 10: Measurement results for direct radiation on BOTTOM-side of the EUT

4.2 Measured shielding effectiveness from 1 - 2 GHz

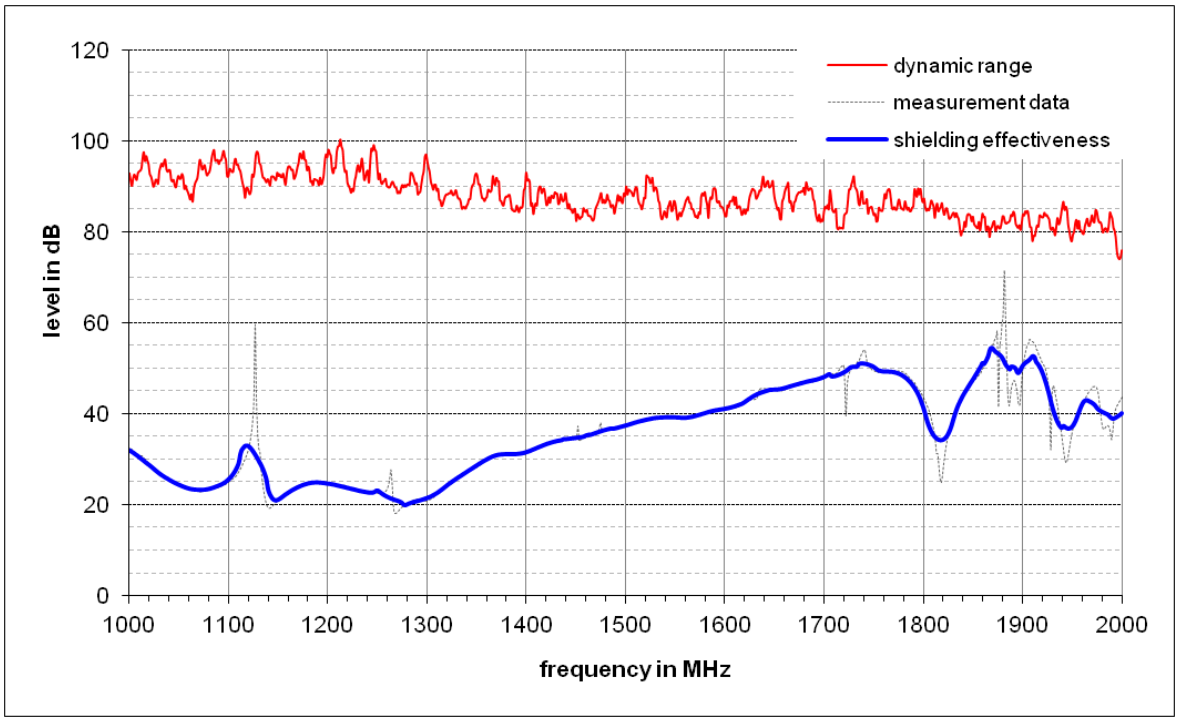

Fig. 11: Measurement results for direct radiation on LEFT-side of the EUT

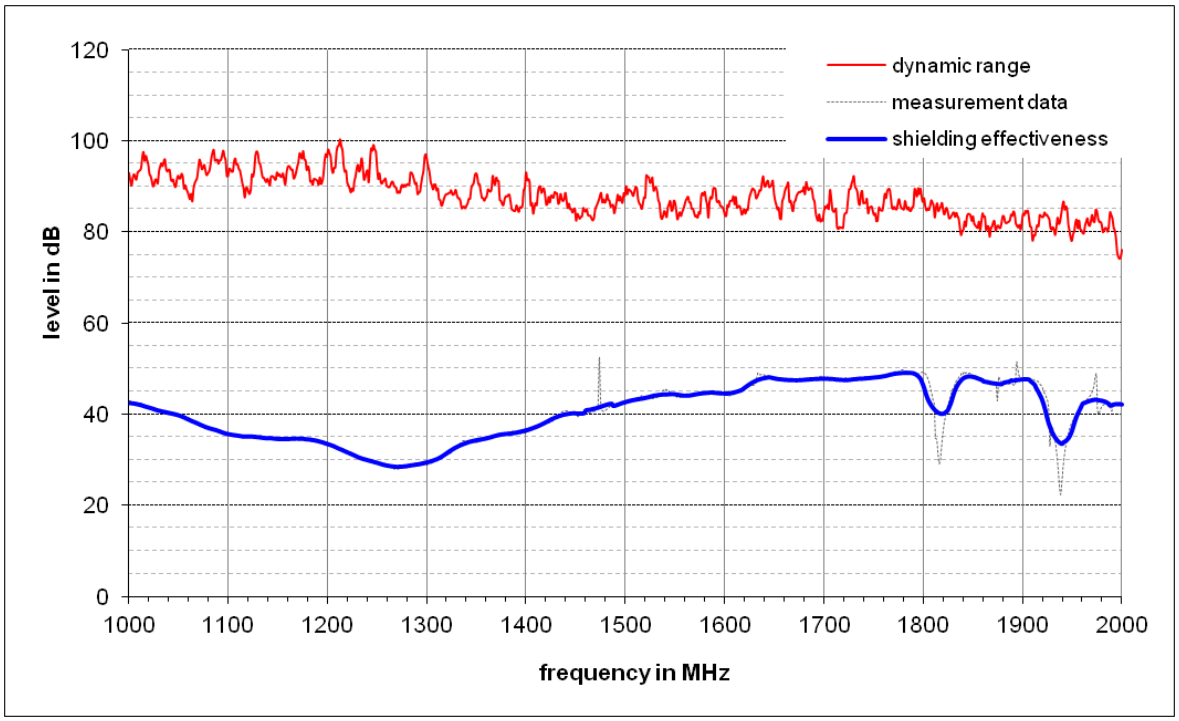

Fig. 12: Measurement results for direct radiation on RIGHT-side of the EUT

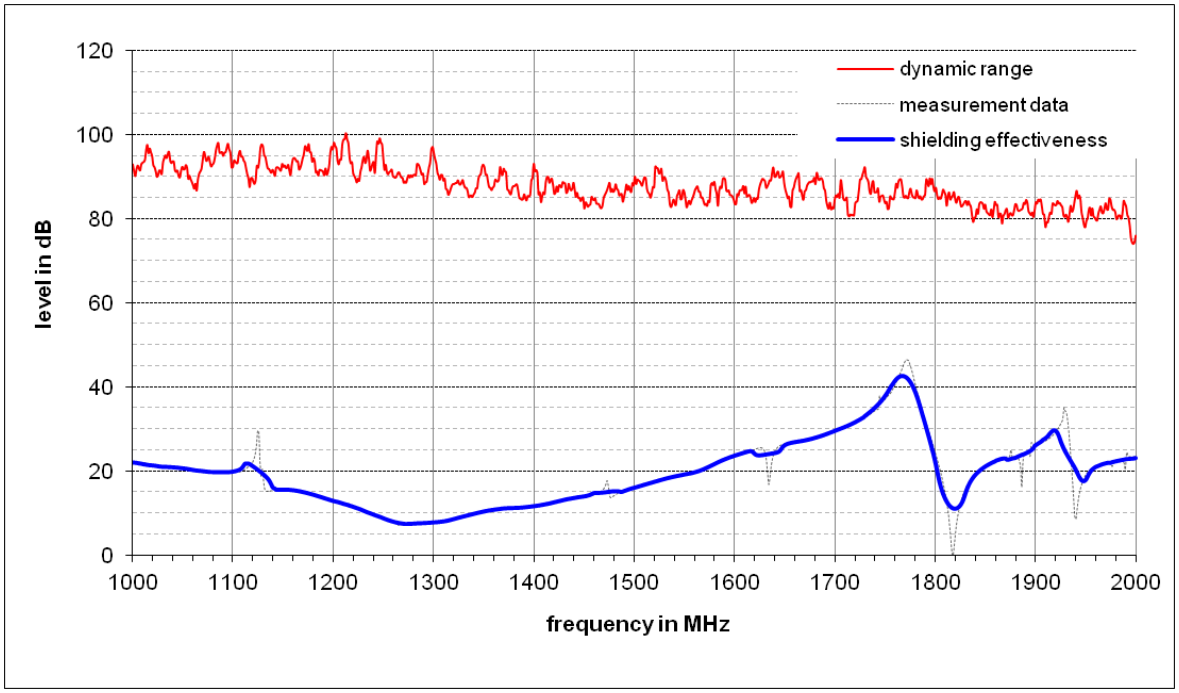

Fig. 13: Measurement results for direct radiation on TOP-side of the EUT

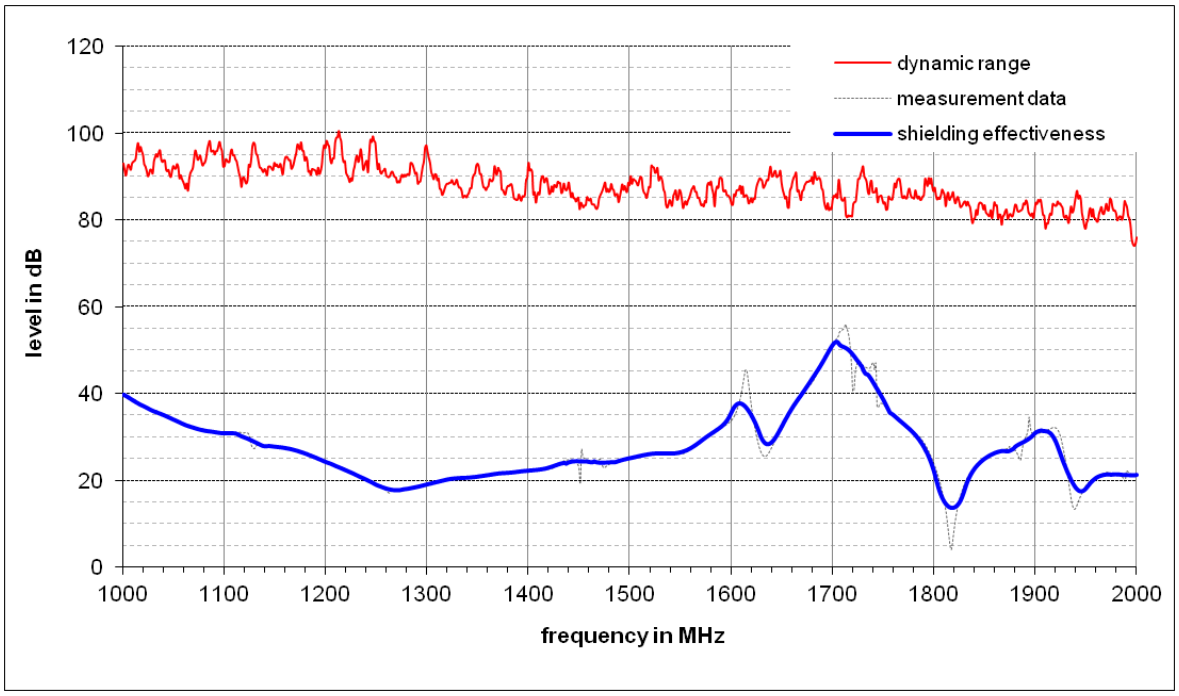

Fig. 14: Measurement results for direct radiation on BOTTOM-side of the EUT

4.3 Typical shielding effectiveness and worst-case scenario

Additionally to the measurements above, 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. Fig. 15 shows a typical shielding effectiveness of the EUT after an inserted smoothing of resonance frequencies.

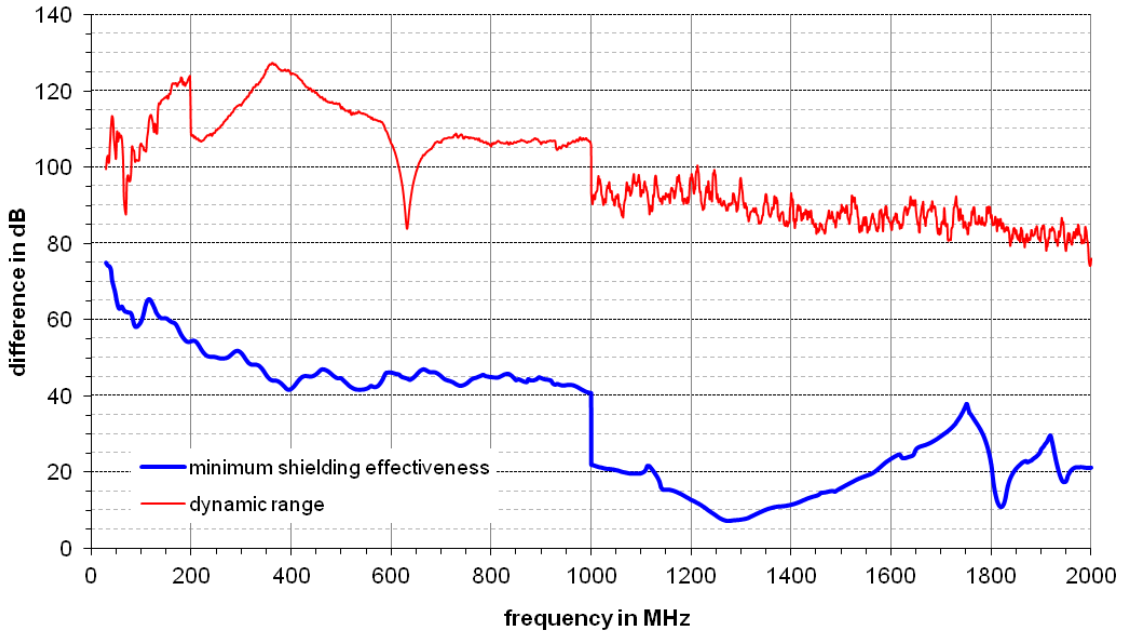

Fig. 15: Typical shielding effectiveness and worst case scenarion of the EUT

5 Conclusion

Shielding effectiveness measurements of the cabinet multipac 2U 280D AlZn 20860-126 with EMC gasket kit 20860-132 made by Schroff were performed in the frequency range of 30 MHz to 2 GHz.

The results of those measurements are displayed in Fig. 7 to Fig. 14. The additionally calculated worst-case scenario is shown in Fig. 15.

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

Karlsruhe, 2013-03-06

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