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Report Nr. 2014-73

Shielding effectiveness of the subracks: europacPRO 6HE 84TE 24563-442 235 mm with textile EMC gasket 60100-560 and europacPRO 6HE 84TE 24563-442 235 mm with textile EMC gasket 60100-572 made by Pentair Schroff GmbH

Customer: Pentair Schroff GmbH
Langenalber Str. 96-100
75334 Straubenhardt

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

This report consists of 9 numbered pages and is valid only with authentic signature. The examination results are related to equipment under test only.

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1 General

Equipment under test (EUT):	europacPRO 6HE 84TE 24563-442 235 mm with textile EMC gasket 60100-560 and europacPRO 6HE 84TE 24563-442 235 mm with textile EMC gasket 60100-572 made by Pentair Schroff GmbH		
EUT received:	2014-06-05		
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:	2014-06-05		
Environmental conditions:	temperature: humidity: barometric pressure:	24,9 31,7 1002	°C % hPa
Representative customer:	Mr. Benko, Pentair Schroff GmbH		
Test engineer:	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		

2 Conclusion

Shielding effectiveness measurements of 2 subracks europacPRO 6HE 84TE 24563-442 depth 235 mm, one with textile EMC gasket 60100-560 (TPE foam), called B1 in this report and one with textile EMC gasket 60100-572 (high temperature sealing 85°C, with silicon core), called B2 in this report were performed in a frequency range of 30 MHz to 2 GHz.

The results of those measurements are displayed in Fig. 7 to Fig. 10. The additionally calculated worst-case scenario is shown in Fig. 11.

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

Karlsruhe, 2014-07-14

Dipl.-Ing. D. Geißler	Dipl.-Ing. C. Freitag	Prof. Dr.-Ing. T. Leibfried
(Head of EMC-testing)	(Deputy Head of EMC-testing)	(Director)

3 Test setup

3.1 Test equipment

Table 1: Test equipment for the 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	Eaton	870035HO
Test receiver	ESVP	R & S	872991/0011

Table 2: Test equipment for the 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	BBHA 9120A	Schwarzbeck	990042
Receiving antenna	E-field probe, Mod.-Nr. 904, 3,6cm ball	Eaton	870035HO

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 1: Position data of the test setup

	30 MHz – 1 GHz	1 GHz – 2 GHz
Height of the receiving antenna	1,31 m	1,31 m
Distance between sending and receiving antenna	3,41 m	1,6 m
Height of sending antenna	1,8 m	1,31 m
Polarization of sending antenna	vertical	vertical
Polarization of receiving antenna	vertical	vertical
Irradiated sides	left, right, top, bottom	left, right, top, bottom

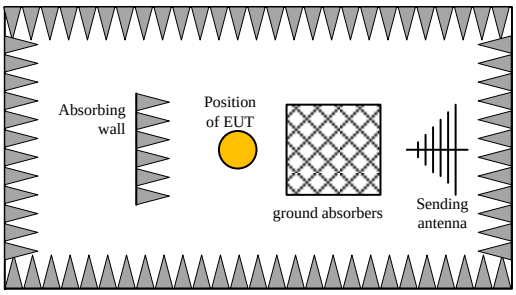

Fig. 1: Setup for 30 MHz – 1 GHz

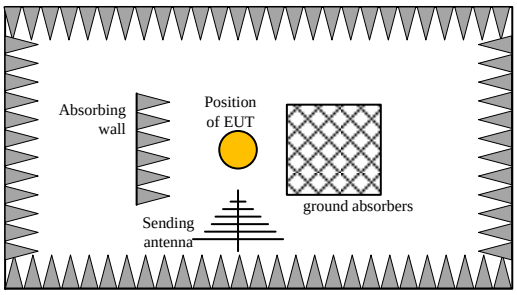

Fig. 2: Setup for 1 GHz – 2 GHz

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.

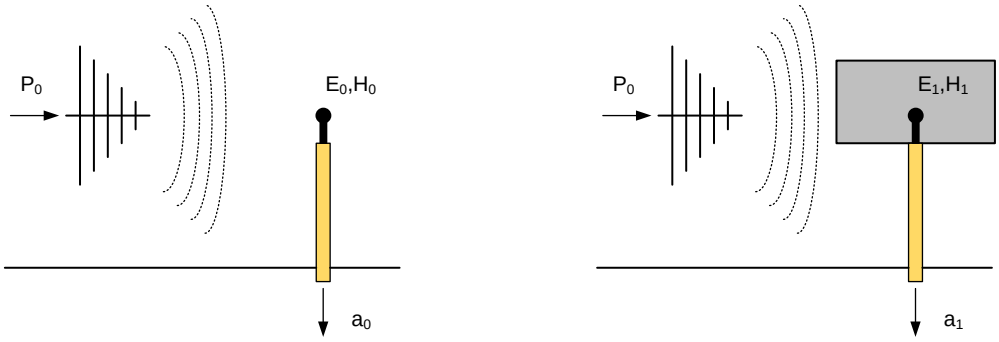

Fig. 3: Illustration of insertion-loss measurement method

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).

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

In order to reduce the influence of resonances inside the cabinet the measurement results for shielding effectiveness are smoothed by a moving average filter with a width of 10 frequency points.

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.

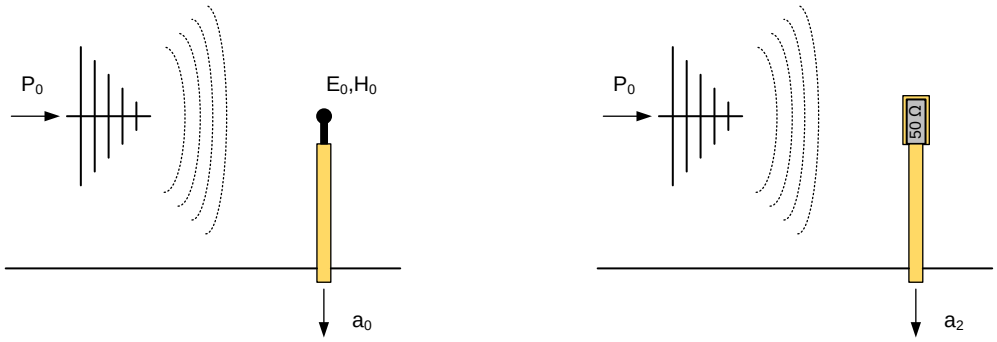

Fig. 4: Determination of the dynamic range

3.5 Pictures of the EUT as part of the test setup

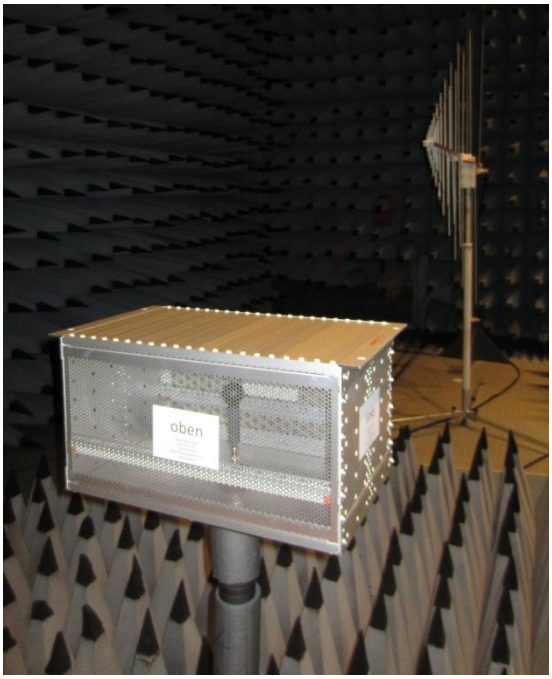

Fig. 5: Setup for the frequency range of 30 MHz - 1 GHz

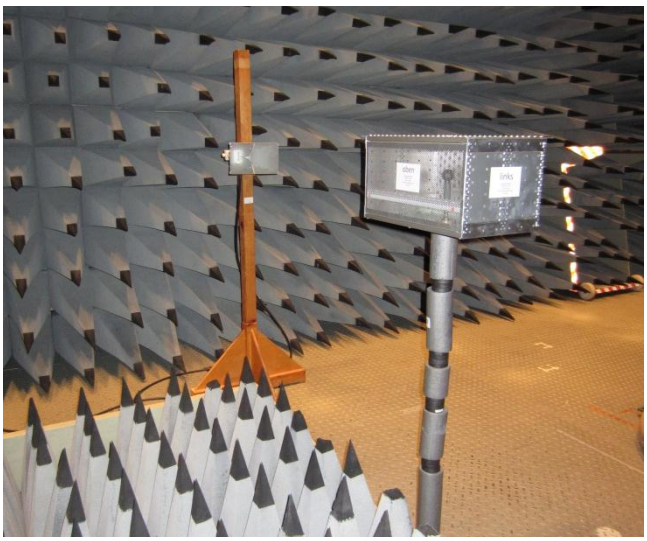

Fig. 6: Setup for the frequency range of 1 - 2 GHz

4 Results

4.1 Measured shielding effectiveness from 30 MHz - 2 GHz

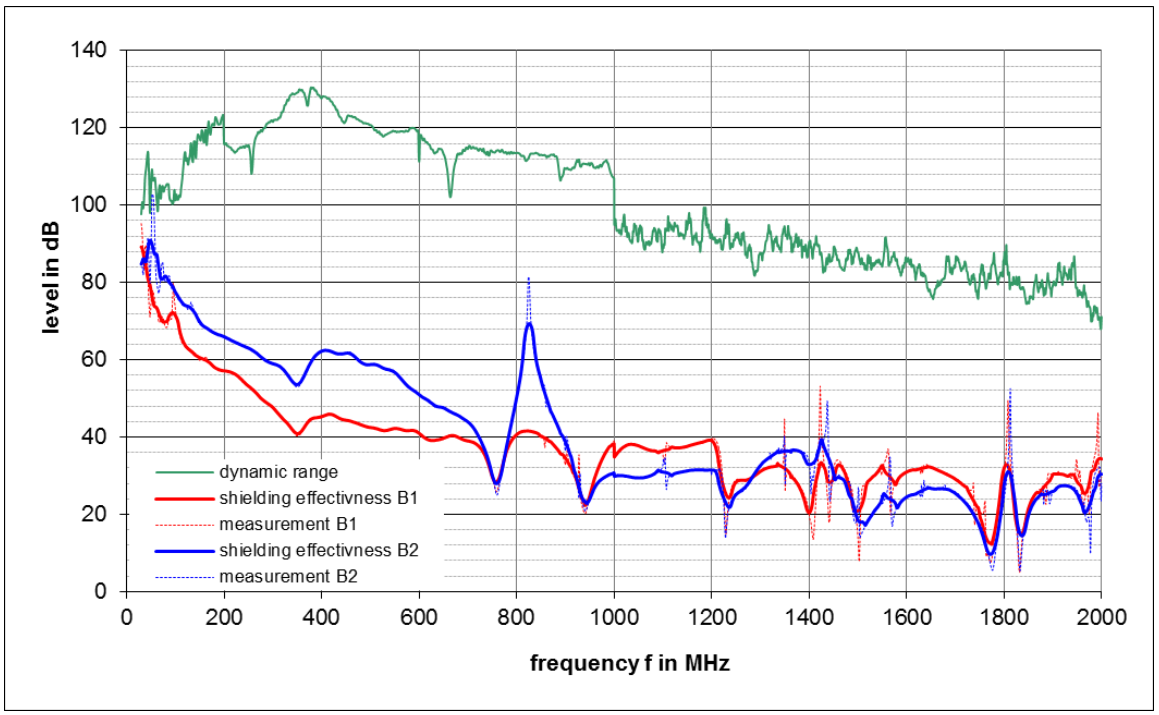

Fig. 7: Measurement results of B1 and B2 for direct radiation on LEFT-side of the EUT

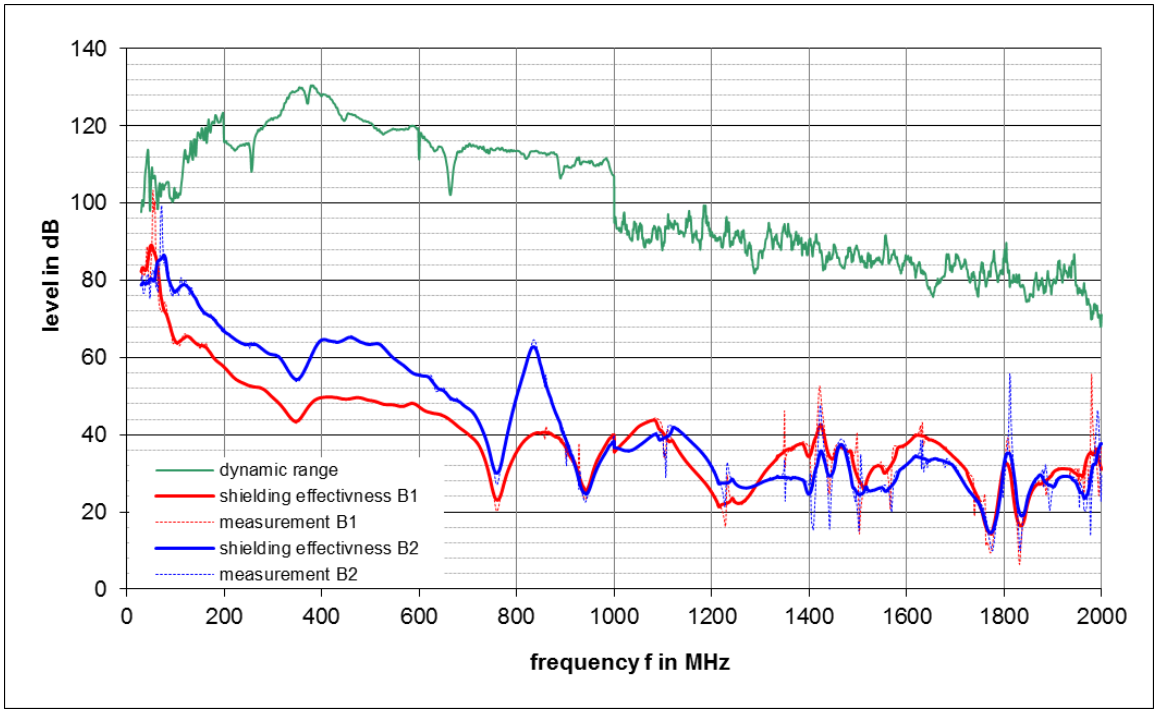

Fig. 8: Measurement results of B1 and B2 for direct radiation on RIGHT-side of the EUT

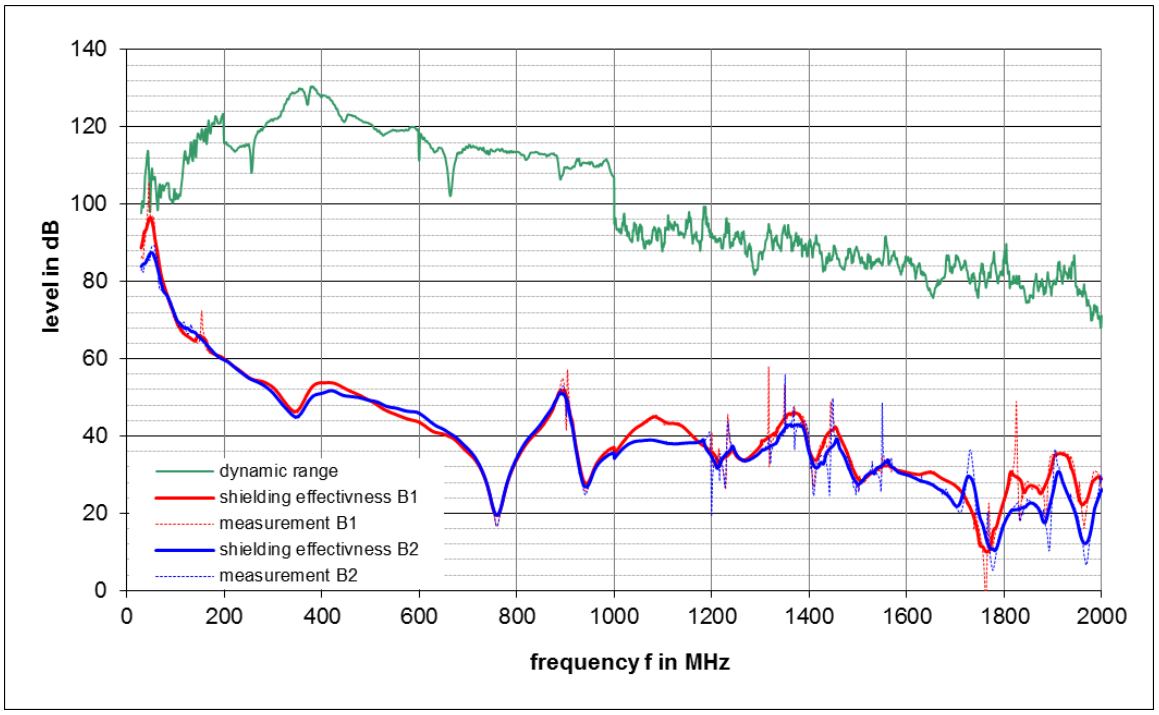

Fig. 9: Measurement results of B1 and B2 for direct radiation on TOP-side of the EUT

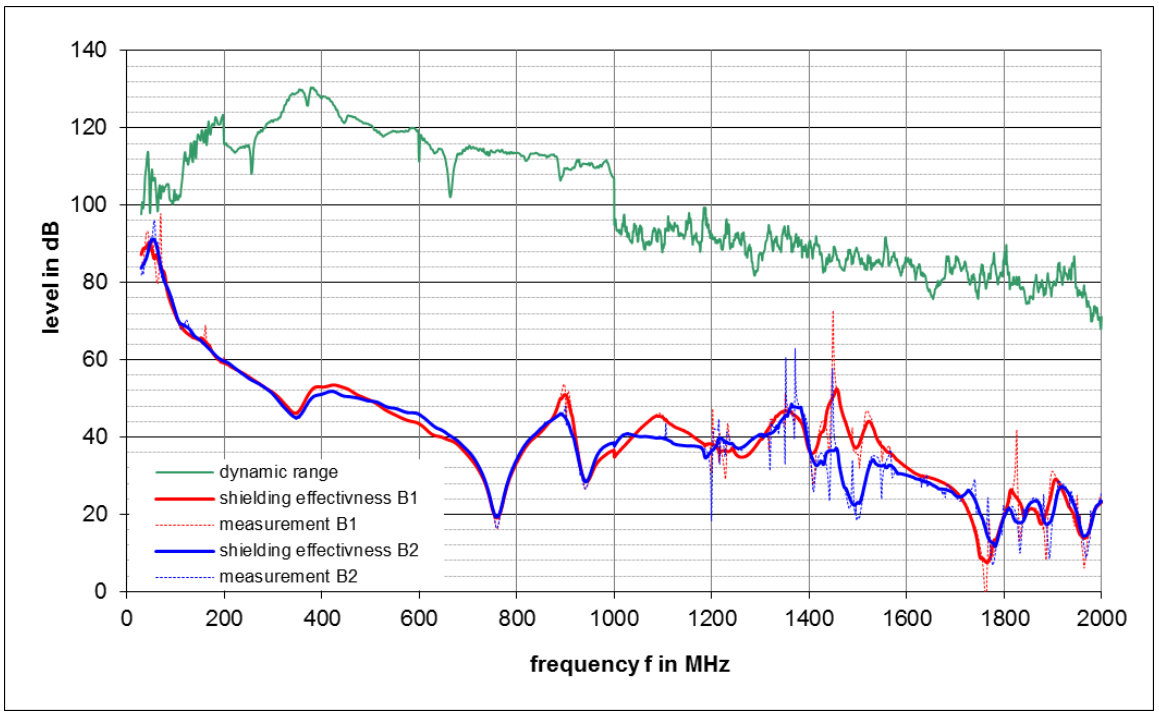

Fig. 10: Measurement results of B1 and B2 for direct radiation on BOTTOM-side of the EUT

4.2 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. 11 shows a worst-case shielding effectiveness of the EUT after an inserted smoothing of resonance frequencies.

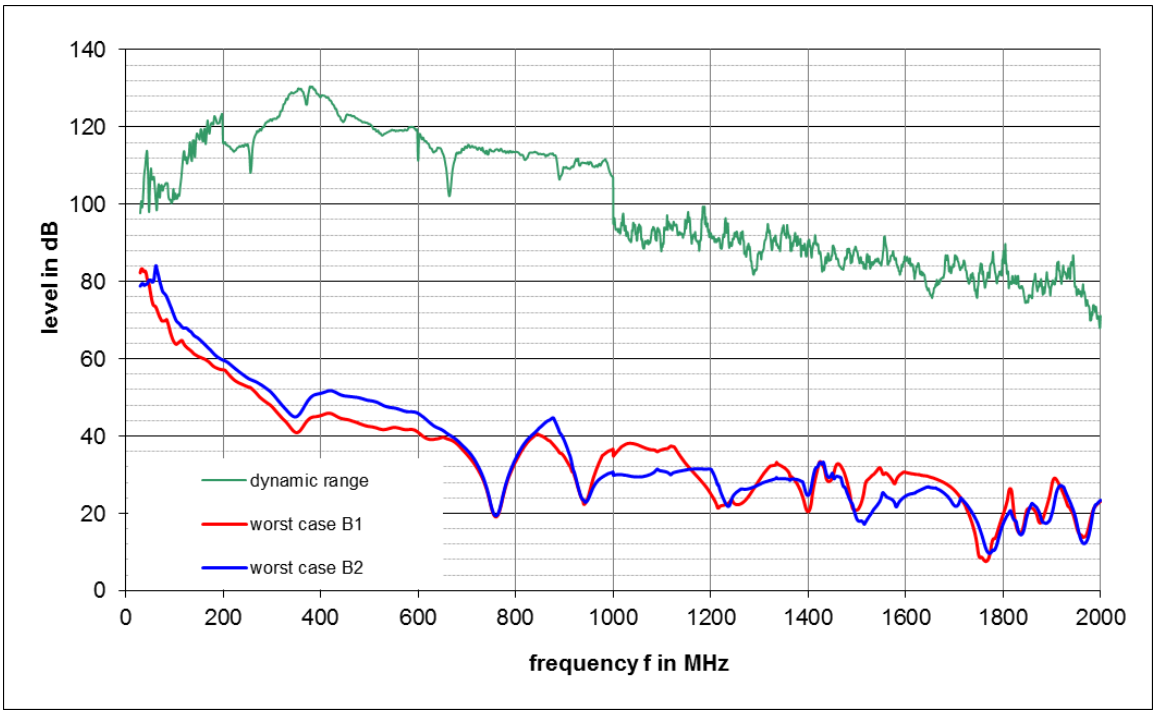

Fig. 11: Worst case scenario of the subracks B1 and B2