SGS Germany GmbH

Test Report No.: V0EE0005

Order No.: V0EE **Pages:** 53

Client:	Schroff GmbH
Equipment Under Test:	EuropacPro
Manufacturer:	Schroff GmbH
Task:	Evaluation of Shielding Effectiveness
Test Specification(s): [covered by accreditation]	acc. to IEC 61000-5-7
Result:	see Summary

The results relate only to the items tested as described in this test report.

approved by:	**Date**	**Signature**
Bauer Lab Manager EMC	May 29, 2024	
More Group Leader	May 29, 2024	

This document was signed electronically.

CONTENTS

1 Summary

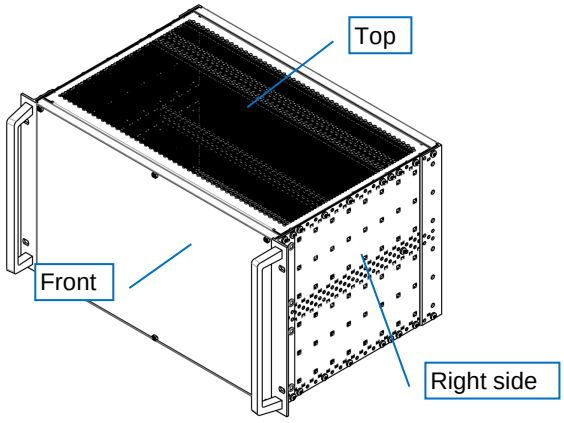
1.1 Common

The shielding effectiveness of the EuropacPro should be measured acc. to IEC 61000-5-7 in the frequency range 10 kHz to 40 GHz.

1.2 Execution of the measurements

The measurements of the shielding effectiveness of the EUT were performed with three sides of EUT facing the antenna:

1. Front
2. Right side
3. Top



The measurements were performed in the following frequency ranges:

- 0.01 – 30 MHz
- 30 – 1000 MHz
- 1 – 18 GHz
- 18 – 40 GHz [1]

1.3 EM shielding code designators of IEC 61000-5-7

In Table 1 of IEC 61000-5-7, the following EM shielding code designators are defined:

Table 1 – EM shielding code designators

Frequency band	Shielding designator
10 kHz – 100 kHz	*A*
100 kHz – 1 MHz	*B*
1 MHz – 30 MHz	*C*
30 MHz – 1 GHz	*D*
1 GHz – 10 GHz	*E*
10 GHz – 40 GHz	*F*

Shielding performance dB	Shielding designator value
Untested	x
<10	0
≥10	1
≥20	2
≥30	3
≥40	4
≥50	5
≥60	6
≥70	7
≥80	8
≥100	9

[1] In this frequency range the shielding effectiveness was evaluated at the following spot frequencies: 20, 24, 28, 32, 36 and 40 GHz.

1.4 Summary of Results

The EM code acc. to IEC 61000-5-7 derived from the results of shielding effectiveness measurements is

EM123110

Table 1-1 shows the mimimum shielding effectiveness in the Frequency Bands acc. to IEC 61000-5-7 and the correlated performance levels.

Frequency Band (MHz)	Shielding designator	Minimum shielding effectiveness (dB) [2]	Performance level
0.01 – 0.1	A	12.6	1
0.1 – 1	B	20.2	2
1 – 30	C	34.7	3
30 – 1,000	D	16.3	1
1,000 – 10,000	E	10.0	1
10,000 – 40,000	F	8.2	0

Table 1-1

2 References

2.1 Specifications

- IEC 61000-5-7: 2001-01
  Electromagnetic compatibility (EMC) –
  Part 5-7:
  Installation and mitigation guidelines –
  Degrees of protection provided by enclosures against electromagnetic disturbances (EM code)

2.2 Glossary of Terms

EMC specific Abbreviations

BW	Bandwidth
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EN	European Standard
EUT	Equipment Under Test
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
SE	Shielding Effectiveness
SW	Software
RX	receive
TX	transmit
VNA	Vectorial Network Analyzer
VSWR	Voltage Standing Wave Ratio

[2] Read from smoothed results.

3 General Information

3.1 Identification of Client

Schroff GmbH
Langenalber Str. 96-100
75334 Straubenhardt

3.2 Test Laboratory

SGS Germany GmbH
Hofmannstraße 50
81379 München

3.3 Time Schedule

Delivery of EUT:	Apr 09, 2024
Start of test:	Apr 16, 2024
End of test:	Apr 19, 2024

3.4 Participants

Name	Function
Andreas Pauli	Accredited testing, Editor
Cedric Njoteng Ngankam	Accredited testing

3.5 Environmental conditions

During the measurement the environmental conditions were within the listed ranges:
Temperature: 20 - 26 °C
Humidity: 30 - 60 %

4 Equipment Under Test

All information regarding the EUT(s) was provided by the customer and has been approved by customer during report-review-process.

Test item description .....:	19-inch Subrack EuropacPro, EMC-Version, front panels with textile gasket (60100-560)
Trade Mark .....:	nVent
Manufacturer / Importer .....:	Schroff GmbH
Model/Type .....:	EuropacPro
Dimensions .....:	Rack Height: 6 U
	Rack Width: 84 HP
	Depth: 295 mm
Serial No. .....:	24567-473 2x 84HP front panel (20848-189; front and back) 42x guide rails (64560-001; 21 slots)
Number of tested samples.:	1

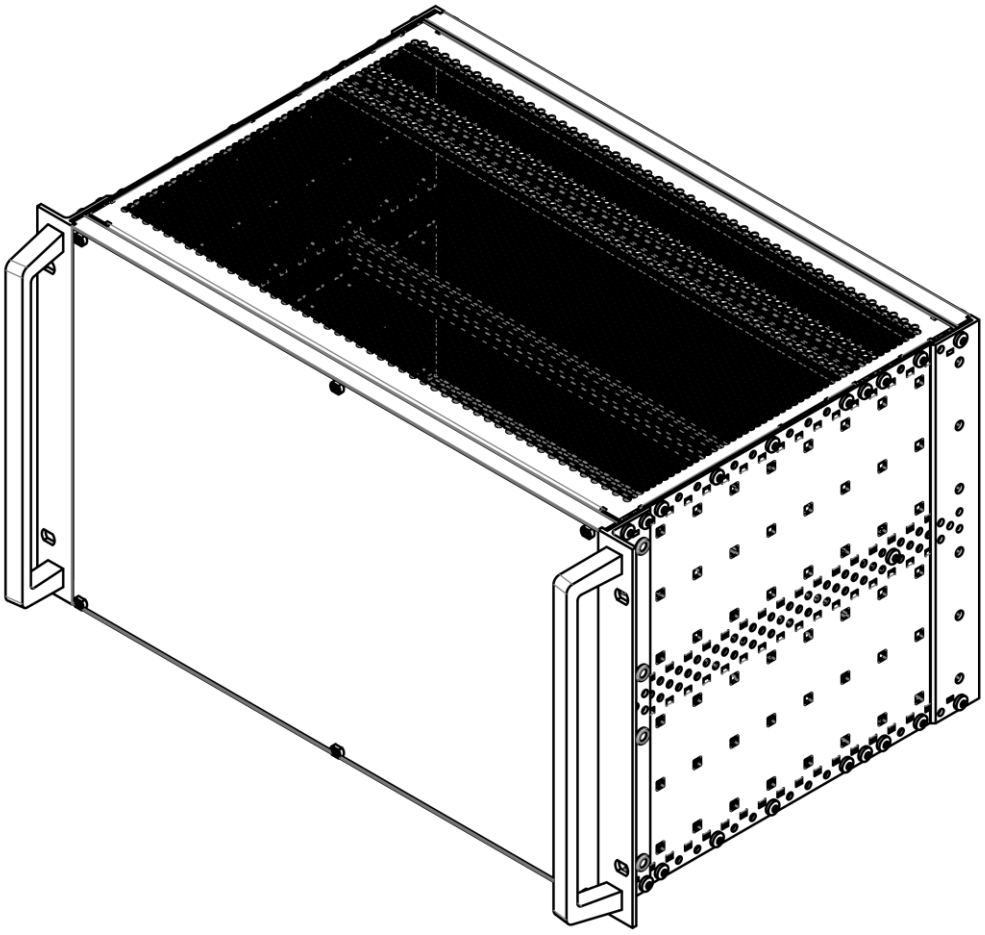


Figure 4-1: EUT

4.1 Photographs of EUT

Figure 4-2: EuropacPro

5 Test Equipment

5.1 Test Facility

The EMC-tests are carried out in the EMC-laboratory of SGS Germany, Consumer and Retail, Benzstraße 26, 82178 Puchheim, Germany.

Chamber	1	2	3	4 / 5	6	7	8
Dimensions (net)	20.2 * 11.3 * 6.8 m	10.8 * 5.4 * 4.9 m	7.4 * 6.6 * 5.2 m	4.1 * 3.5 * 3.5 m	6.4 * 4.3 * 4.3 m	4.6 * 4.3 * 3 m	10.8 * 5.4 * 4.9 m
Max. Door Exit (w x h)	4.2 x 4.2 m	3.4 * 3.5 m	2.0 * 2.7 m	0.9 * 2.2 m (4) 1.5 * 2.5 m (5)	1.8 * 3.0 m	1.2 * 2 m	3.5 * 3.5 m
Absorbers	Pyramidal hybrid absorbers on walls and ceiling	Pyramidal hybrid absorbers on walls and ceiling	Pyramidal hybrid absorbers on walls and ceiling	Without absorbers	Without absorbers	Pyramidal hybrid absorbers on walls and ceiling	Pyramidal hybrid absorbers on walls and ceiling
Floor	Metallic ground plane floor load: 15 t/m² max. 35 t Vehicle	Metallic ground plane floor load: 1 t/m² max. 5 t	Metallic ground plane floor load: 1 t/m²	Metallic ground plane floor load: 1.5 t/m²	Metallic ground plane floor load: 1.5 t/m²	Metallic ground plane floor load: 1.5 t/m²	Metallic ground plane floor load: 3 t/m² max. 5 t
Turntable	∅ 6 m / 10 t	∅ 3 m / 3 t	∅ 2.0 m / 1 t				∅ 3 m / 5 t
Specials	***Emission*:** ***9 kHz* – 30 MHz** (d = 3 m, NSIL) ***30 – 1000 MHz*** ***(d = 10 m)*** NSA/RSM acc. to: CISPR 16-1-4 ANSI C63.4 ***1 – 18 GHz*** ***(d = 3/5/10 m)*** Site VSWR 1 – 18 GHz acc. to CISPR 16-1-4	***Emission*:** ***9 kHz* – 30 MHz** (d = 3 m, NSIL) ***30 – 1000 MHz*** ***(d = 3/5 m)*** NSA/RSM acc. to: CISPR 16-1-4 ANSI C63.4 ***1 – 18 GHz*** ***(d = 3/5 m)*** Site VSWR 1 – 18 GHz acc. to CISPR 16-1-4 CISPR 25	***Emission*:** ***9 kHz* – 30 MHz** (d = 3 m, NSIL) ***30 – 1000 MHz*** ***(d = 3 m)*** NSA/RSM acc. to: CISPR 16-1-4 ANSI C63.4 ***1 – 18 GHz*** ***(d = 3 m)*** Site VSWR 1 – 18 GHz acc. to CISPR 16-1-4 CISPR 25			For automotive components only CISPR 25	***Emission*:** ***9 kHz* – 30 MHz** (d = 3 m, NSIL) ***30 – 1000 MHz*** ***(d = 3/5 m)*** NSA/RSM acc. to: CISPR 16-1-4 ANSI C63.4 ***1 – 18 GHz*** ***(d = 3/5 m)*** Site VSWR 1 – 18 GHz acc. to CISPR 16-1-4 CISPR 25
	Immunity: Field uniformity 27 – 6000 MHz acc. IEC/EN 61000-4-3	***Immunity:*** Field uniformity 80 – 6000 MHz acc. IEC/EN 61000-4-3 ISO 11452-2	***Immunity:*** Field uniformity 80 – 6000 MHz acc. IEC/EN 61000-4-3 ISO 11452-2			Immunity ISO 11452-2	***Immunity:*** Field uniformity 27 – 6000 MHz acc. IEC/EN 61000-4-3 ISO 11452-2

FCC (Federal Communication Commission): Recognition by Bundesnetzagentur (BNetzA-CAB-14/21-09) and Designation as **CAB (Conformity Assessment Body):** Designation Number DE0013; Test firm Registration #: 366296
Designation **KBA** (**Kraftfahrt-Bundesamt**) as Technical Service category A and D. Registration Number: KBA-P 00083-97
CB Testing Laboratory under the responsibility of SGS CEBEC as National Certification Body and to carry out testing within the **IECEE CB Scheme.**
Designation No. for **RRA** (Radio Research Agency) in **Korea; EU0145**
VCCI Member No. 2793

5.2 Measuring Equipment

See the respective sections of Chapter 6, Results.

5.3 Test Setup

To perform the tests, a vectorial network analyzer (VNA) is used which is controlled via a software “Schirmdämpfung” based on Labview.
The software version is v2.30.

Prior to the measurement of a shielding effectiveness a reference measurement is done. For that the TX and RX antennas are positioned in the predefined distance to each other, connected to the VNA with the same cabling and preamplifiers (optional) as used during the subsequent measurements.
At each antenna, an attenuator pad is applied to improve the VSWR.

For measurement of the shielding effectiveness, the RX antenna is located inside the EUT in front of the selected measuring point with distances to metallic surfaces as large as possible. The TX antenna is positioned outside the EUT directly opposite so that the overall distance between the antennas is the same as during the reference measurement.

Now the measurement is started again, and the shielding effectiveness is calculated automatically by the software.

5.3.1 Testing above 20 GHz

In the frequency range above 20 GHz, instead of the VNA a signal generator together with a frequency doubler was used as sender. The receiving antenna was connected to an EMI receiver.

In this frequency range, no automatic measurement is possible. Therefore, the shielding effectiveness in this frequency range is performed manually at selected frequencies.

5.4 Measurement Uncertainty

As far as the underlying standards include requirements concerning the uncertainty of measuring instruments or measuring methods, they are met.

The expanded measurement uncertainty of the measuring chain was calculated for all tests according to the “ISO Guide to the expression of uncertainty in measurement (GUM)”. The results are documented in an “internal controlled document”.

The measuring accuracy for all measuring devices is given in their technical description. The measuring instruments, including any accessories, are calibrated respectively verified to ensure the necessary accuracy. Depending on the kind of measuring equipment it is checked within regular intervals or directly before the measurement is performed. Adjustments are made and correction factors applied to measured data in accordance with the specifications of the specific instrument.

The expanded measurement instrumentation uncertainty of our Test Laboratory meets the requirements of IEC CISPR 16-4-2 “Specification for radio disturbance and immunity measuring apparatus and methods – Part 4-2: Uncertainties, statistics and limit modeling – Uncertainty in EMC measurements” for all listed tests.

5.5 Statement of Conformity & Decision Rule

If not otherwise stated, the Decision Rule is considered in different ways.

Emission based on CISPR 11, CISPR 14-1, CISPR 15, CISPR 32, CISPR 36, IEC 61000-6-3, IEC 61000-6-4:
The decision rule for statement of conformity is based on U_{CISPR} given in CISPR 16-4-2. The

relevant MIU (Measurement Instrumentation Uncertainty) calculations U_{LAB} of the EMC-lab for the single emission tests is below U_{CISPR}. Therefore, it can be considered that the measurement result is valid without any need of adaption and e.g., a result of 0 dB to the limit can be stated as pass.

All other emission tests:
For all other emission tests, the relevant MIU have been calculated by the EMC-lab and U_{LAB} keep typical levels. In this case, the “Binary Statement for Simple Acceptance Rule” acc. 4.2.1 of ILAC G8:2019 is applied. The result can be considered to be passed if the measurement value is at least equal to the limit. Probability is only 50% in this case. If the measured value is below the limit by the amount of the measurement uncertainty, the risk of an incorrect assumption is already reduced to 2.5%.

Immunity
The calculated MIU U_{LAB} of the test levels are according to the requirements of the corresponding test standards. As the influence of the characteristics of the test disturbance is not known and the DUT shows non-linear system behaviour in most cases, no decision rule can be stated for immunity tests.

6 Results

The test results in the report refer exclusively to the test object described in section 4 and the test period in section 3.3. The results apply to the sample(s) as received.

6.1 Summary of Results

The EM code acc. to IEC 61000-5-7 derived from the results of shielding effectiveness measurements is

EM123110

Table 6-1 shows the mimimum shielding effectiveness in the Frequency Bands acc. to IEC 61000-5-7 and the correlated performance levels.

Frequency Band (MHz)	Shielding designator	Minimum shielding effectiveness (dB) [3]	Performance level
0.01 – 0.1	A	12.6	1
0.1 – 1	B	20.2	2
1 – 30	C	34.7	3
30 – 1,000	D	16.3	1
1,000 – 10,000	E	10.0	1
10,000 – 40,000	F	8.2	0

Table 6-1

[3] Read from smoothed results.

6.2 0.01 – 30 MHz

Tested by : Pauli

Test date : 2024-04-16 Test location : EMC chamber No. 2

6.2.1 Test Setup

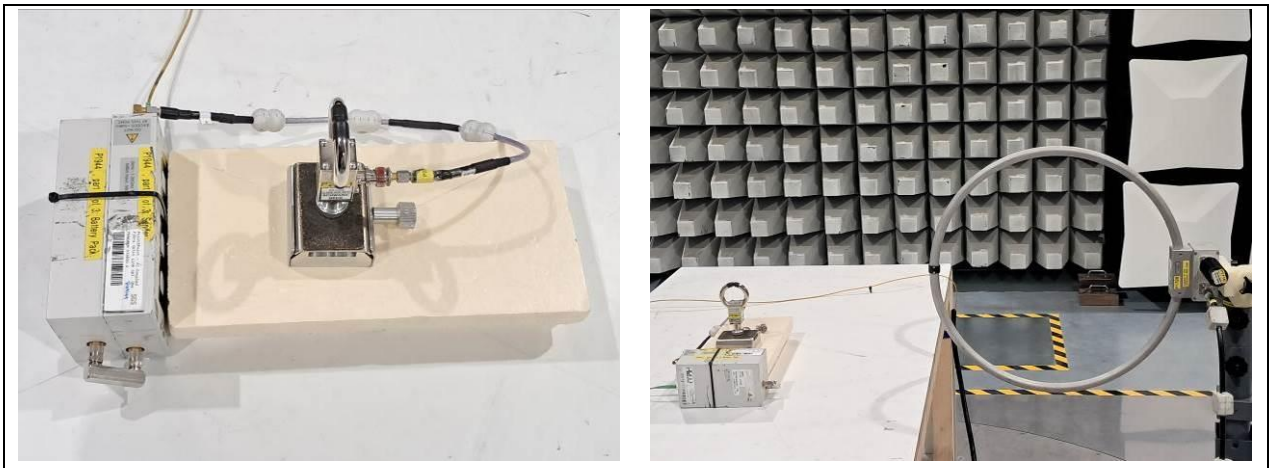
- Antenna distance = 0.40 m (between outer diameter of TX loop and center of RX loop)
- TX Antenna height = 1.00 m (center)
- RX Antenna height = 0.94 m (center)
- no preamp in RX path for Reference measurements
- preamp P1182 in RX path for EUT measurements
- amplifier P1087 (25W) @ TX antenna
- no attenuator at TX antenna
- no attenuator at RX antenna
- measuring bandwidth = 10Hz
- Number of points = 401

6.2.2 Measuring Equipment

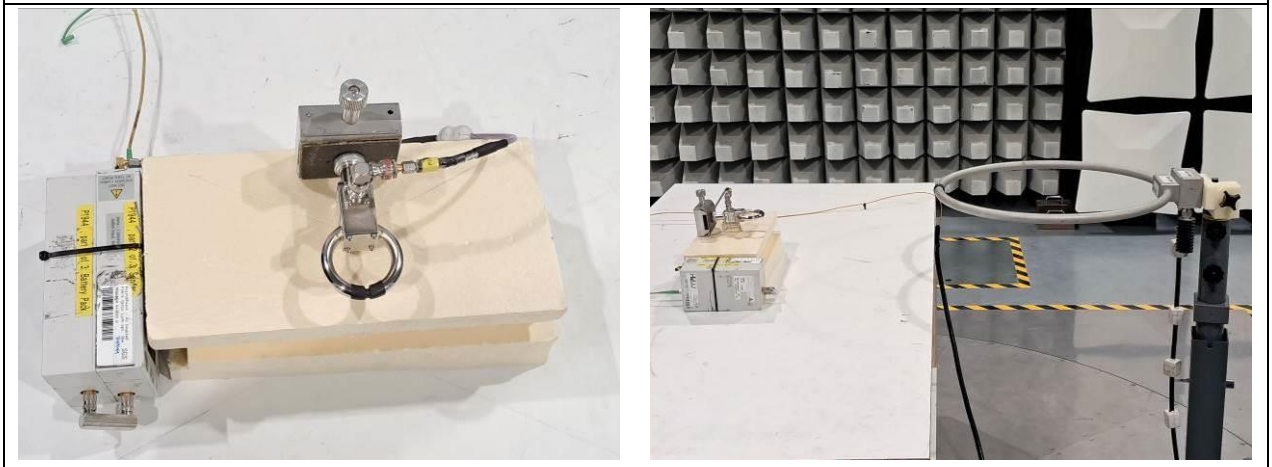
ID	Measuring Instrument	Specification	Status	Due date
P1728	antenna	9 kHz - 30 MHz	cnn	
P2361	Passive RX-Loop Antenna	9 kHz - 400 MHz, 1 turn, loop diameter 50 mm	cal	Jun 30, 2024
P1944	Point2Point - AC Coupled Fibre Optic Link	2 kHz to 1.35 GHz, 0 dBm Input/Output	chk	Jan 31, 2025
P1547	Network Analyzer	9 kHz - 4 GHz	cal	Mar 31, 2025
P1182	preamplifier	9 kHz - 1000 MHz, 32dB gain, +10dBm	cal	Mar 31, 2026
P1087	amplifier	0.01 - 100 MHz, 25 W	cnn	
P2541	Coax cable 4m (with ferrites)	50 Ohm, 3GHz	cnn	
P2578	coax cable 0.45 m, N - SMA	DC - 18 GHz, 0.8 dB @ 18 GHz	cnn	
P2813	EMC chamber 2 (SAC5 light)	12.4 m x 7.3 m x 6.3 m (l x w x h) (net), 1 m hybrid absorbers; Walls: Pyramidal hybrid absorber 12, 18 and 30 inch; Ceiling: Pyramidal hybrid absor	chk	
	coax cable, L = 1,5m, N	Innen, von CP2 zu Amplifier	cnn	
	coax cable, L = 4m	Außen, von ZVLR zu Access panel	cnn	

cal = Calibration, car = Calibration restricted use, chk = Check, chr = Check restricted use, cpu = Check prior to use, calchk = Calibration and check, ind = for indication only, cnn = Calibration not necessary, service = Wartung (Service), man = Maintenance, calservice = Calibration & Service, chkservice = Check & Service, calchkservice = Calibration & Check & Service, calinit = Initial Calibration only

6.2.3 Photographs of test setup for reference measurements

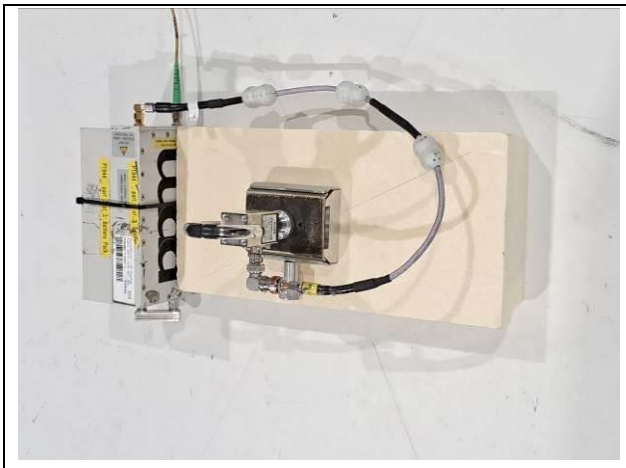
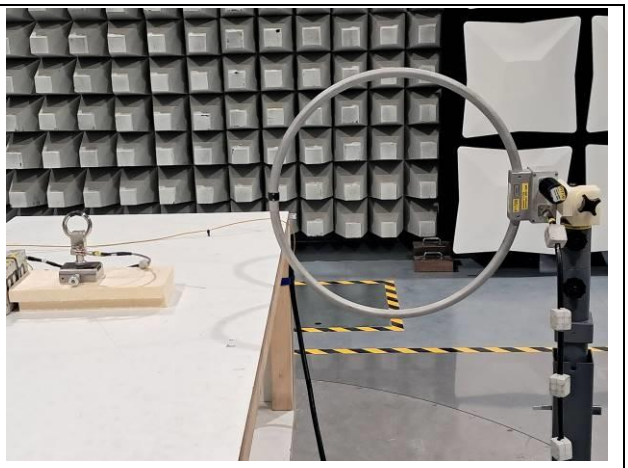


vertical



horizontal

Figure 6-1: test setup reference measurements for position front/top

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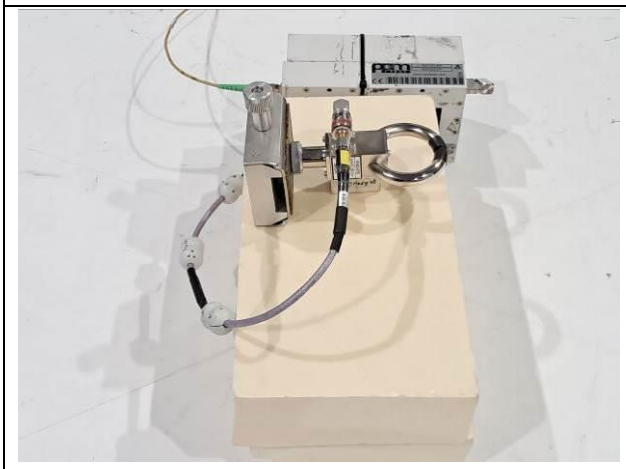
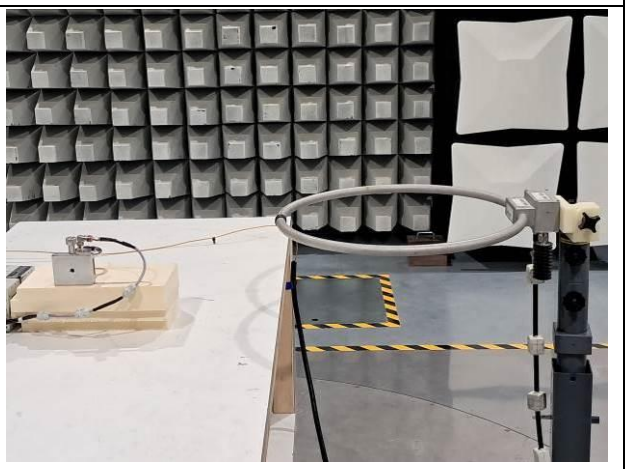
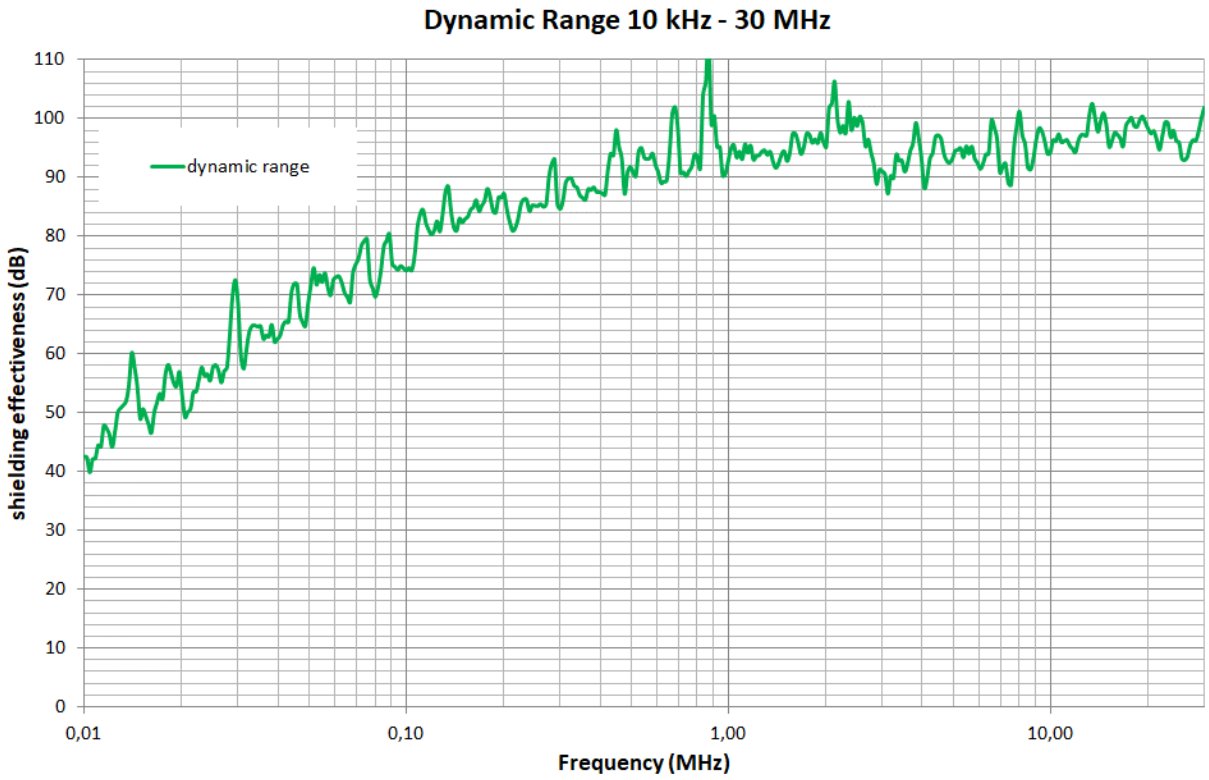



horizontal

Figure 6-2: test setup reference measurements for position side

6.2.4 Dynamic range (with Sonoma, BW = 10 Hz) (eut_0)



6.2.5 Test Results

6.2.5.1 Front

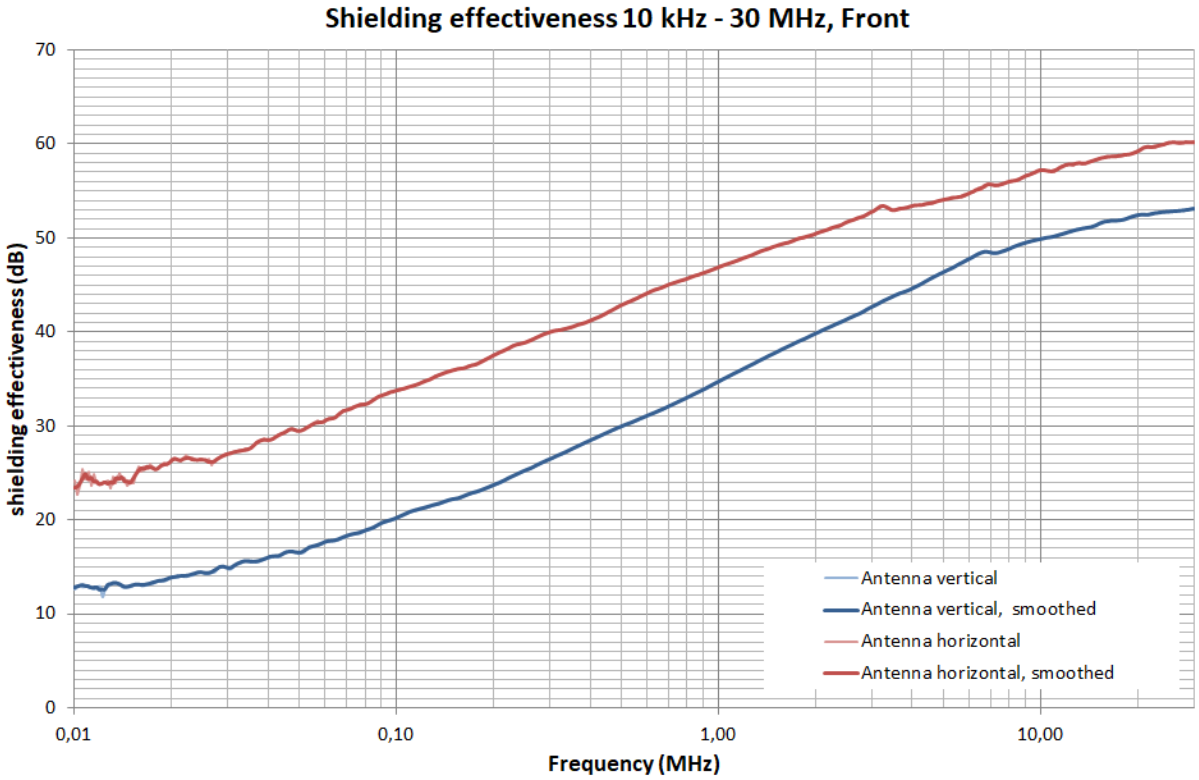
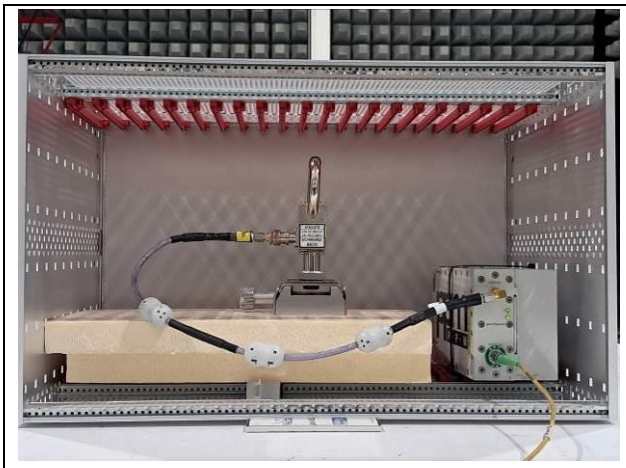
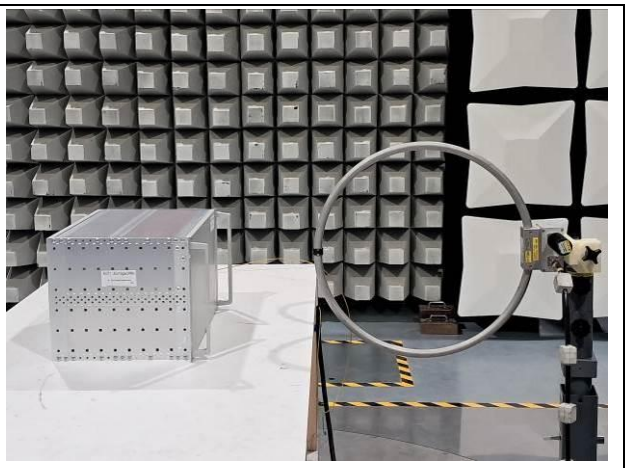


Photo documentation of the test set-up:

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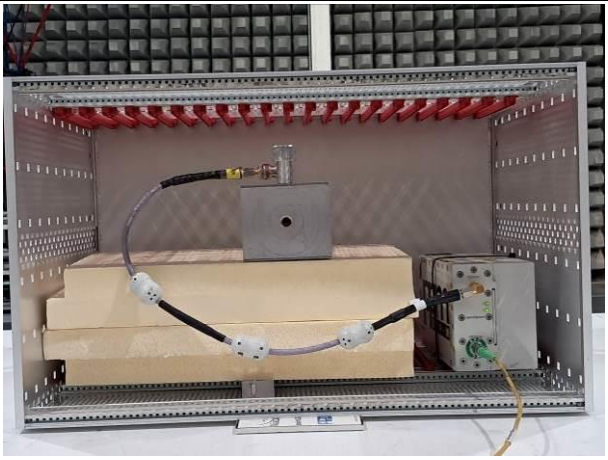
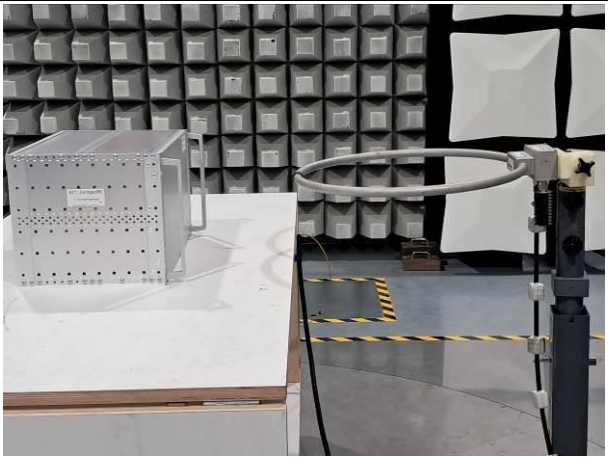



horizontal

Figure 6-3: test setup 0.01 – 30 MHz

6.2.5.2 Side

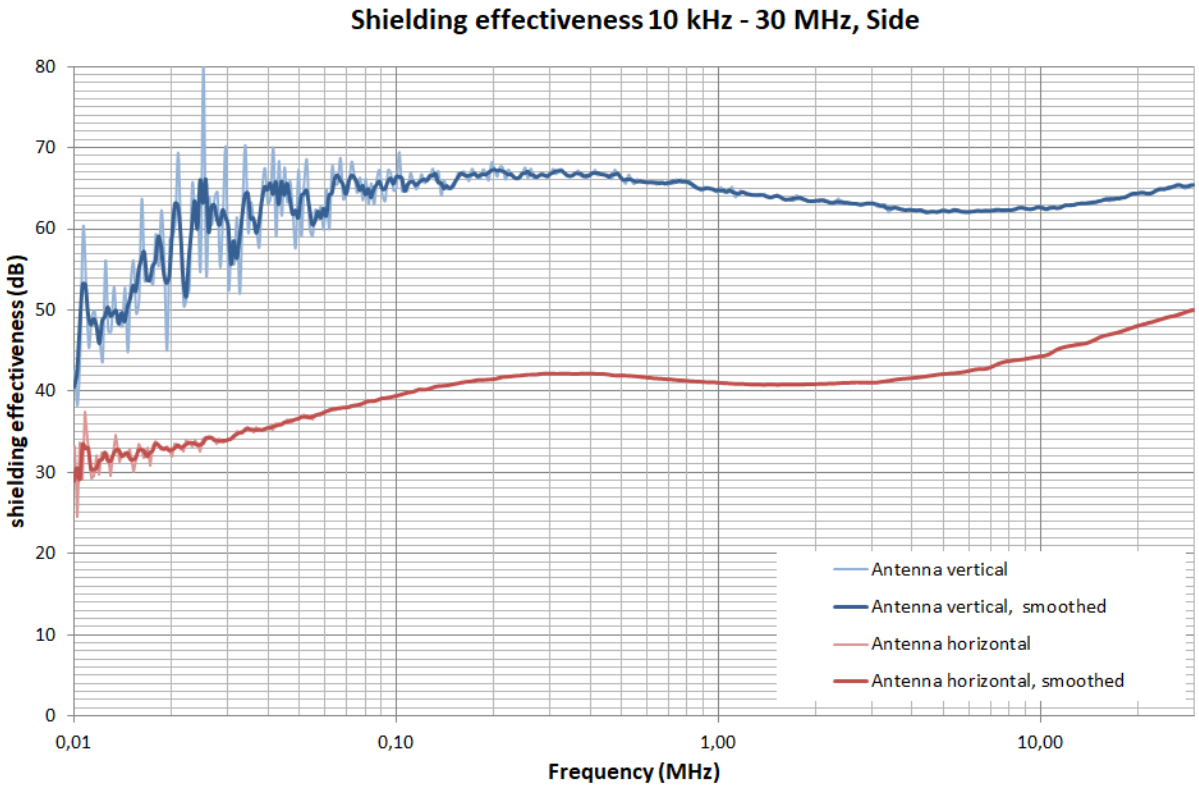
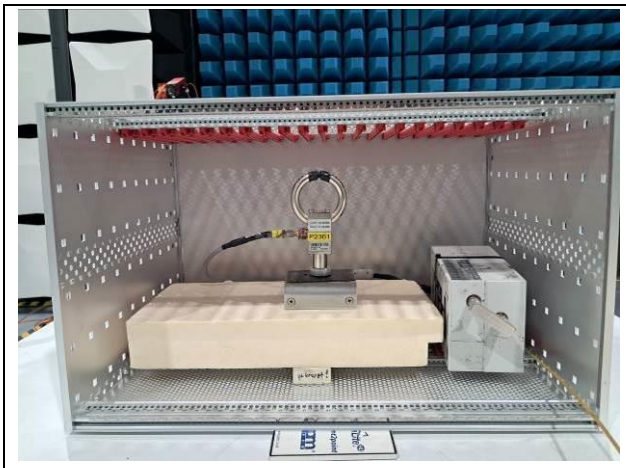


Photo documentation of the test set-up:



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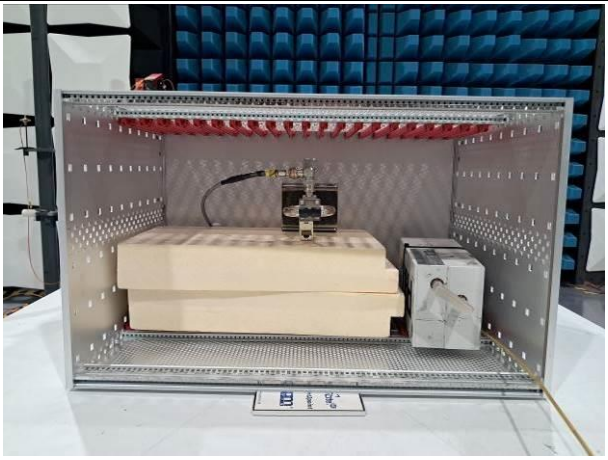


horizontal

Figure 6-4: test setup 0.01 – 30 MHz

6.2.5.3 Top

S

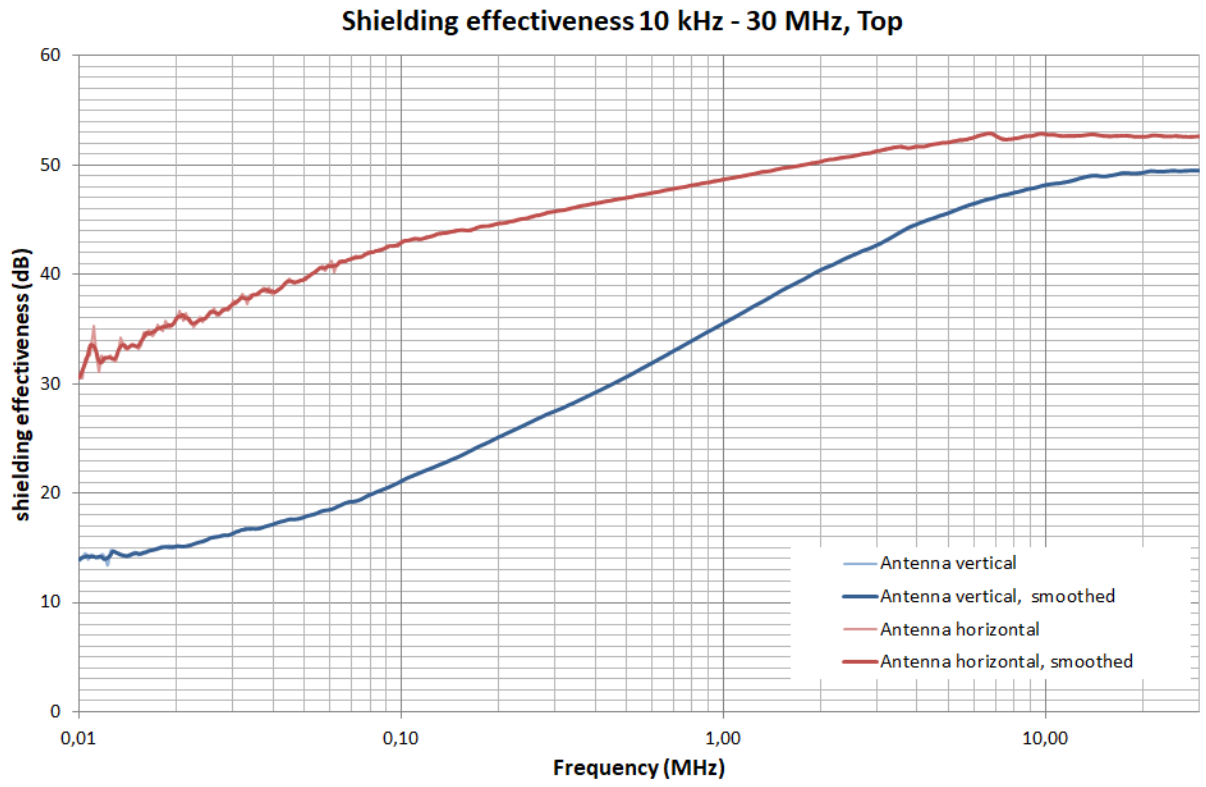
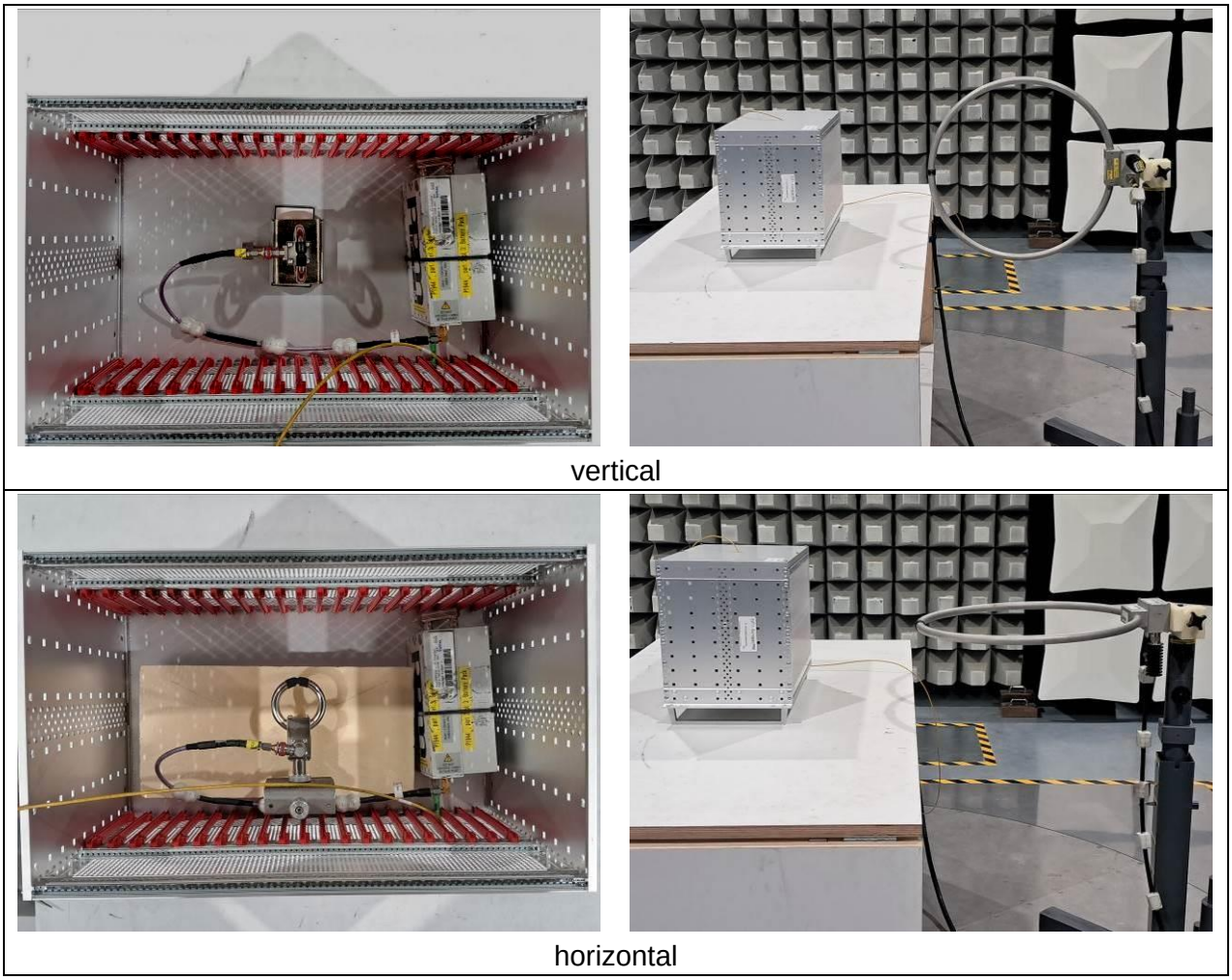


Photo documentation of the test set-up:



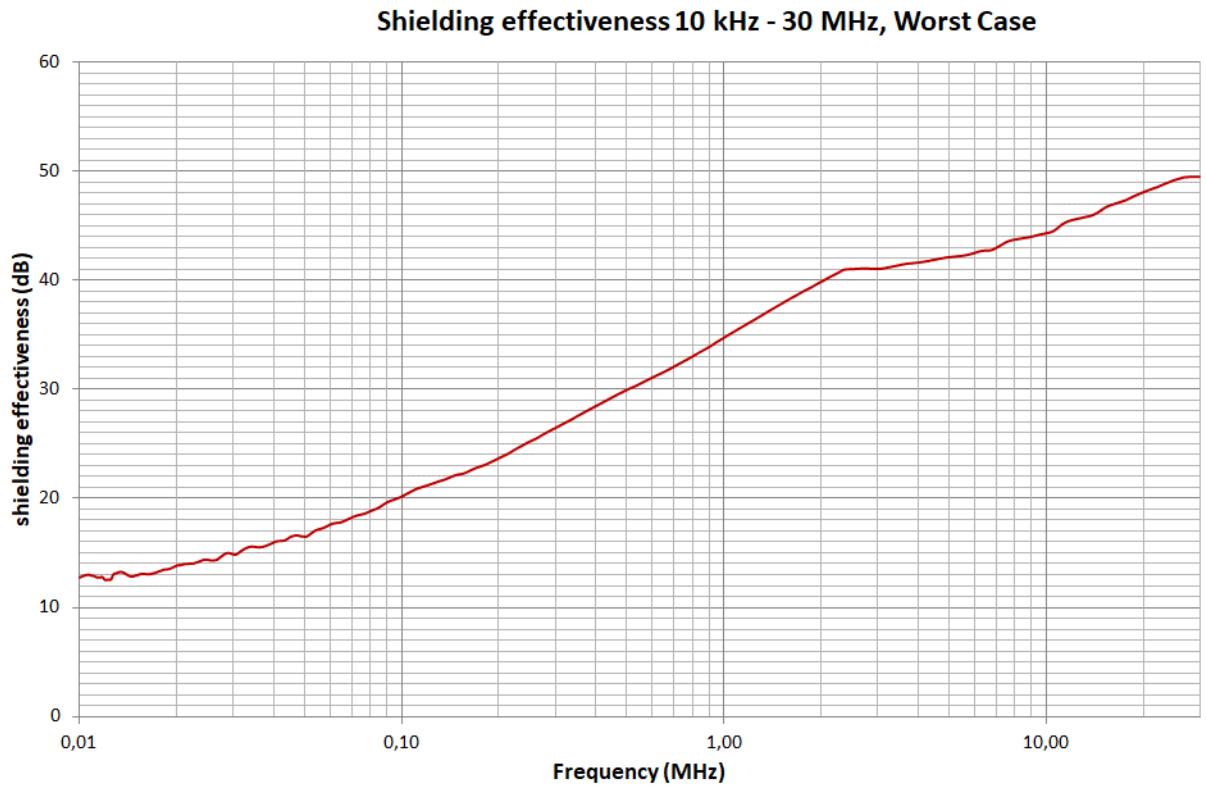
vertical

horizontal

Figure 6-5: test setup 0.01 – 30 MHz

6.2.5.4 Worst case

The figure below shows the worst case of shielding effectiveness, that means the lowest value of all positions and antenna polarisations at each frequency:



6.3 30 – 1000 MHz

Tested by : Pauli

Test date : 2024-04-18 Test location : EMC chamber No. 2

6.3.1 Test Setup

- Antenna distance = 2.00 m (between center of biconical ant. and reference point of Bilog.)
- Antenna height = 0.90 m
- no preamp in RX path for Reference measurements
- preamp P1182 (sonoma) in RX path for EUT measurements
- amplifier P2185 @ TX antenna
- 4dB attenuator at TX antenna
- 6dB attenuator @ RX antenna
- measuring bandwidth = 30Hz
- Number of points = 401
-

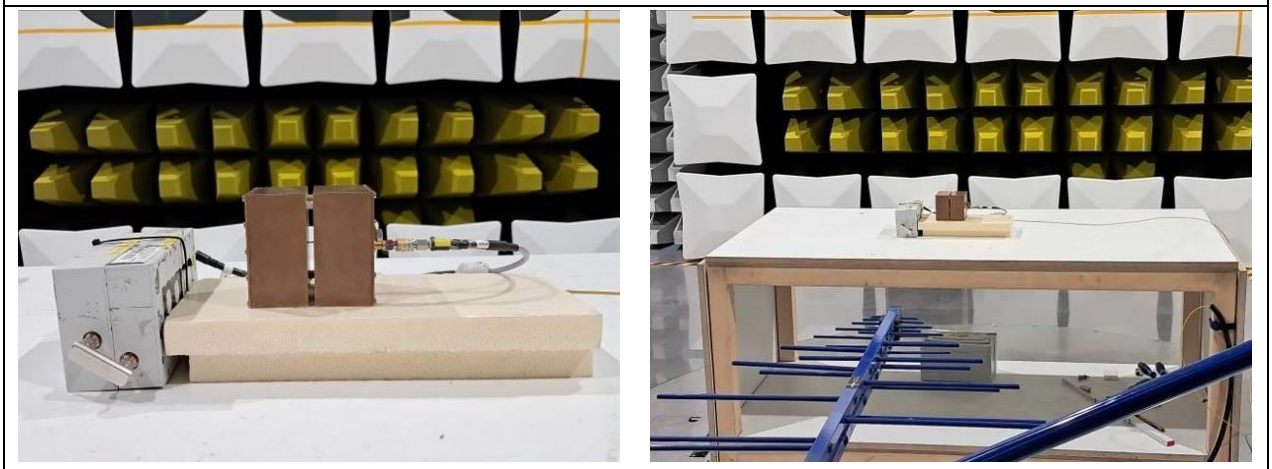
6.3.2 Measuring Equipment

ID	Measuring Instrument	Specification	Status	Due date
P1547	Network Analyzer	9 kHz - 4 GHz	cal	Mar 31, 2025
N0925	antenna cubic, 86 x 86 x 99 mm (122 mm incl. 90°-Adapter SMA)	Cubic Dipole Antenna	cnn	
P2506	coax cable, L = 0.5m	DC - 2 GHz, 0.56dB @ 2GHz, SMA, with ferrites	cnn	
P1944	Point2Point - AC Coupled Fibre Optic Link	2 kHz to 1.35 GHz, 0 dBm Input/Output	chk	Jan 31, 2025
P2578	coax cable 0.45 m, N - SMA	DC - 18 GHz, 0.8 dB @ 18 GHz	cnn	
P1182	preamplifier	9 kHz - 1000 MHz, 32dB gain, +10dBm	cal	Mar 31, 2026
P2517	coax cable, L = 0,5m, N	DC - 6GHz, 0,6dB@6GHz, N	cnn	
P1538	attenuator 6dB	6 dB; 5.5 W, SMA, DC to 18 GHz	chk	Dec 31, 2024
P2743	attenuator 4dB	Type N, 4 dB/ 5 W dc to 18 GHz	cal	Mar 31, 2026
P1950	Surface current blocking filter	DC-10 GHz, 2.6dB @ 10GHz, L = 1.4 m	chk	Sep 30, 2024
P1808	Surface current blocking filter	1 m / 11 ferrites, with polyester mesh, L = 1.4m	chk	Jun 30, 2026
P2158	LISN, Kfz - V-LISN 5µH	(5 µH+ 1 Ohm) || 50 Ohm, 70 (100) A, 0.1 - 150MHz	cal	Mar 31, 2026

cal = Calibration, car = Calibration restricted use, chk = Check, chr = Check restricted use, cpu = Check prior to use, calchk = Calibration and check, ind = for indication only, cnn = Calibration not necessary, service = Wartung (Service), man = Maintenance, calservice = Calibration & Service, chkservice = Check & Service, calchkservice = Calibration & Check & Service, calinit = Initial Calibration only

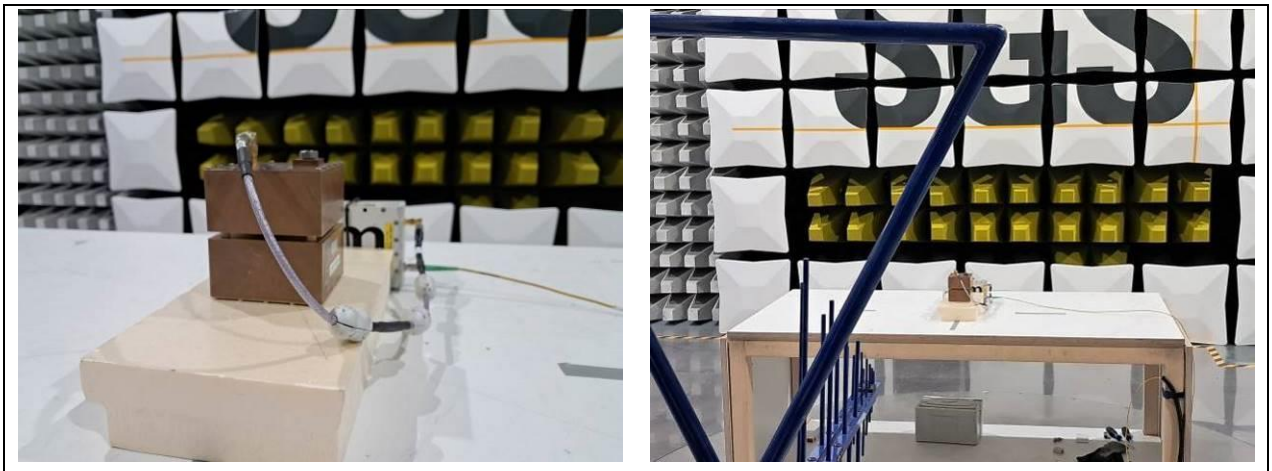
6.3.3 Photographs of test setup for reference measurements

vertical

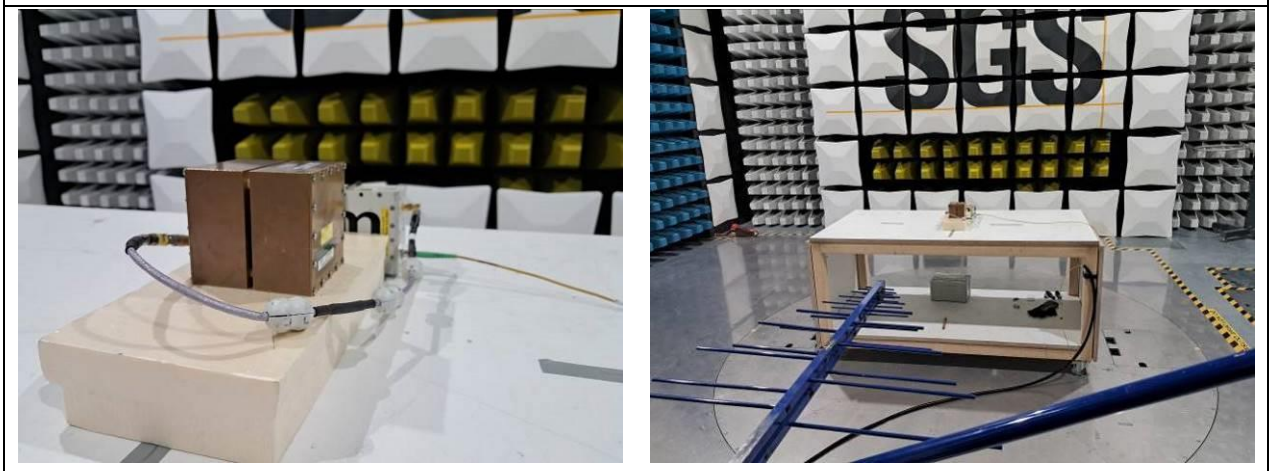


horizontal

Figure 6-6: test setup reference measurements for position front/top



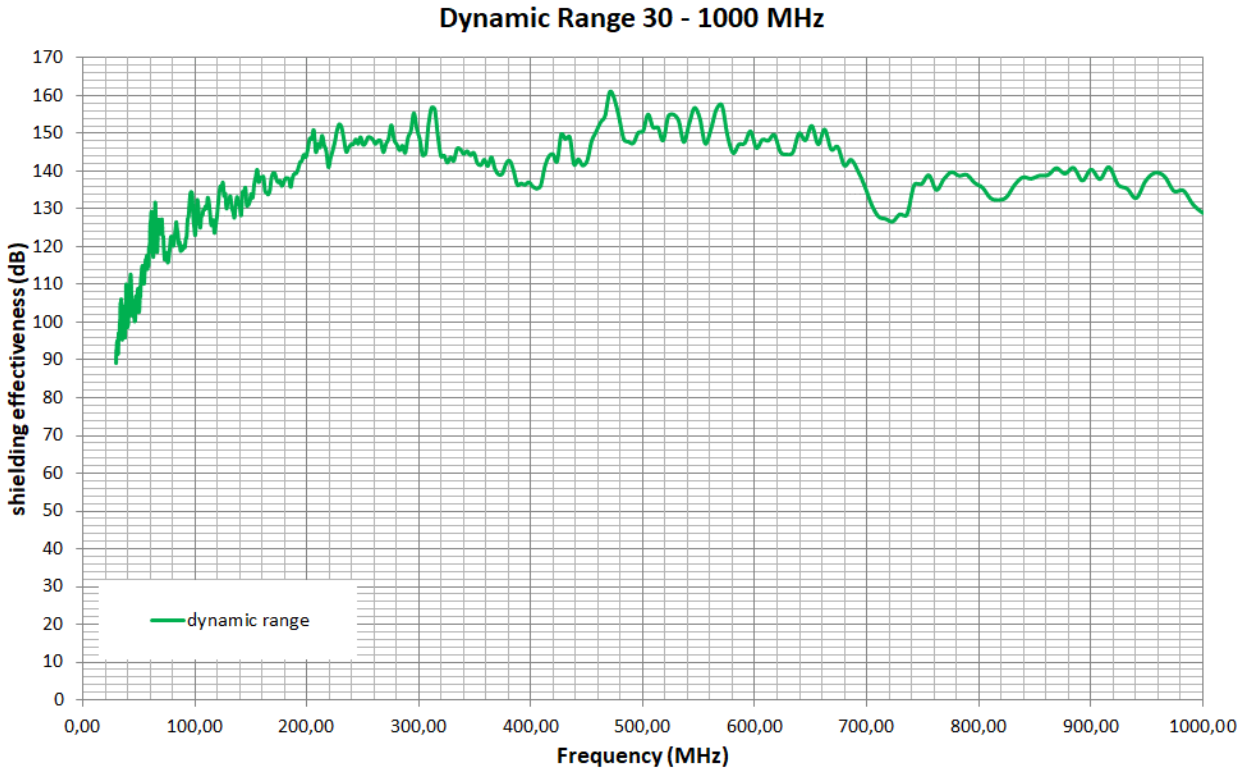
vertical



horizontal

Figure 6-7: test setup reference measurements for position side

6.3.4 Dynamic range with Sonoma, BW = 10 Hz) (eut_0)



6.3.5 Test Results

6.3.5.1 Front

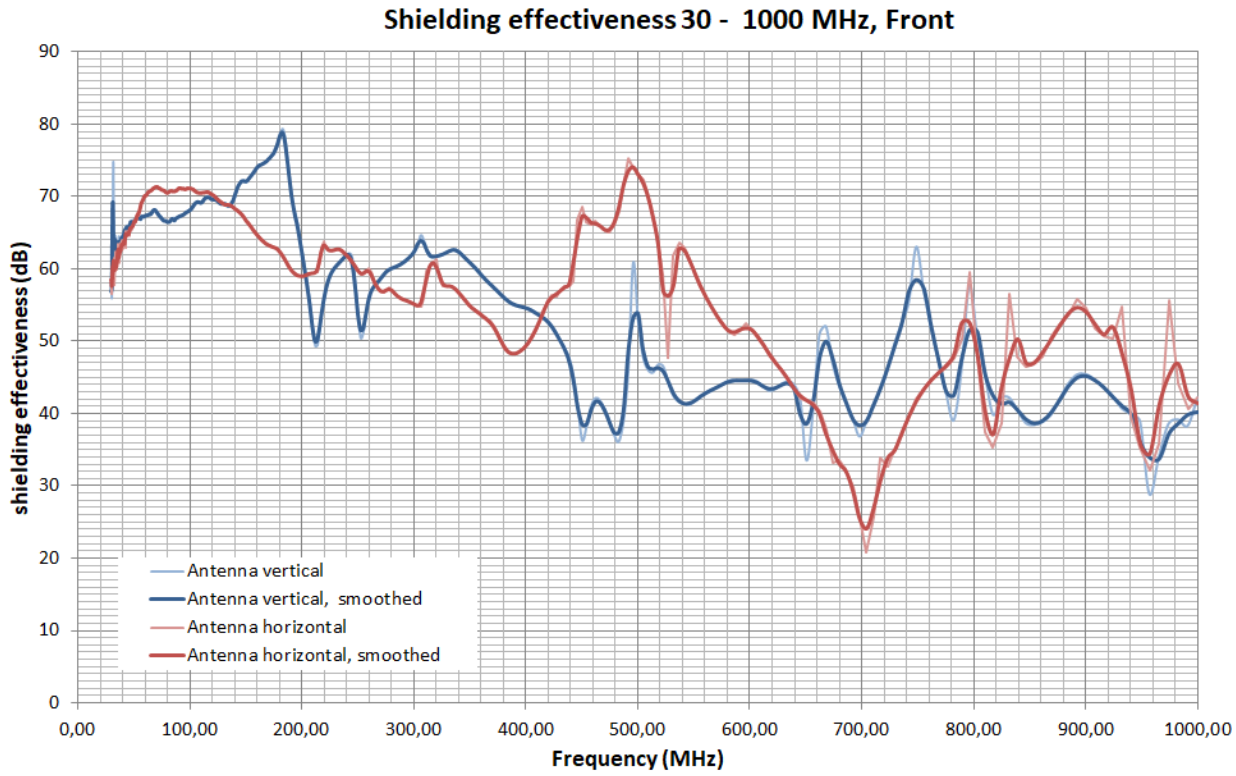
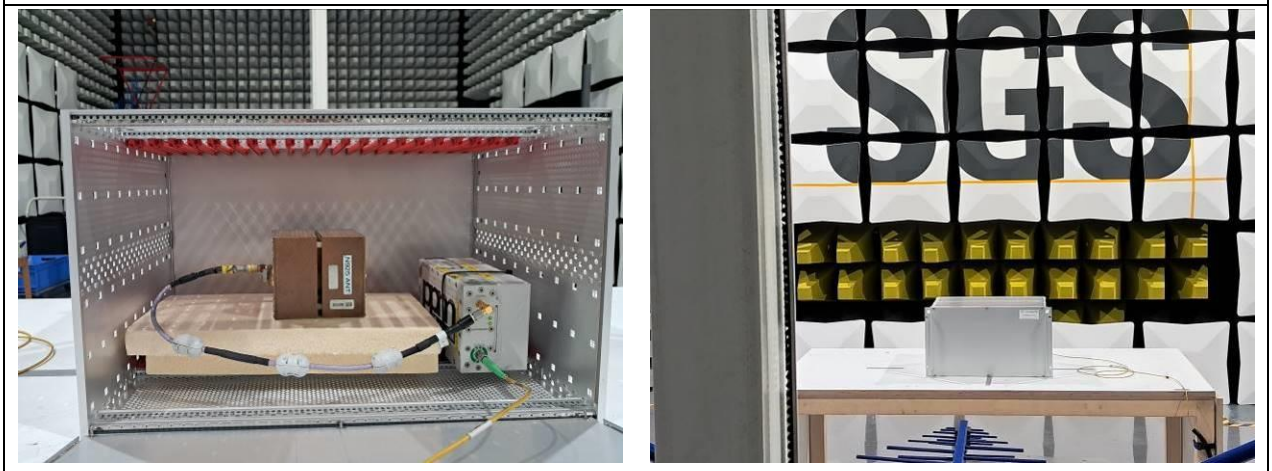


Photo documentation of the test set-up:

vertical



horizontal

Figure 6-8: test setup 30 – 1000 MHz

6.3.5.2 Side

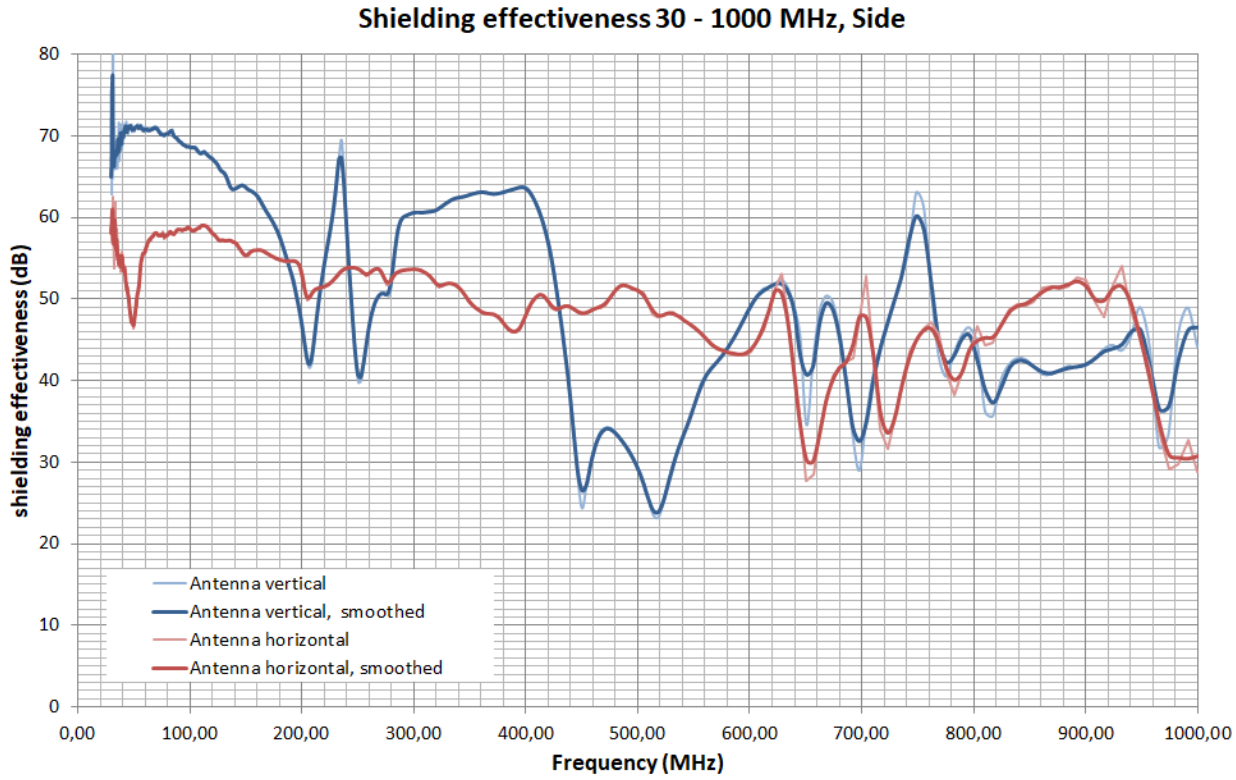
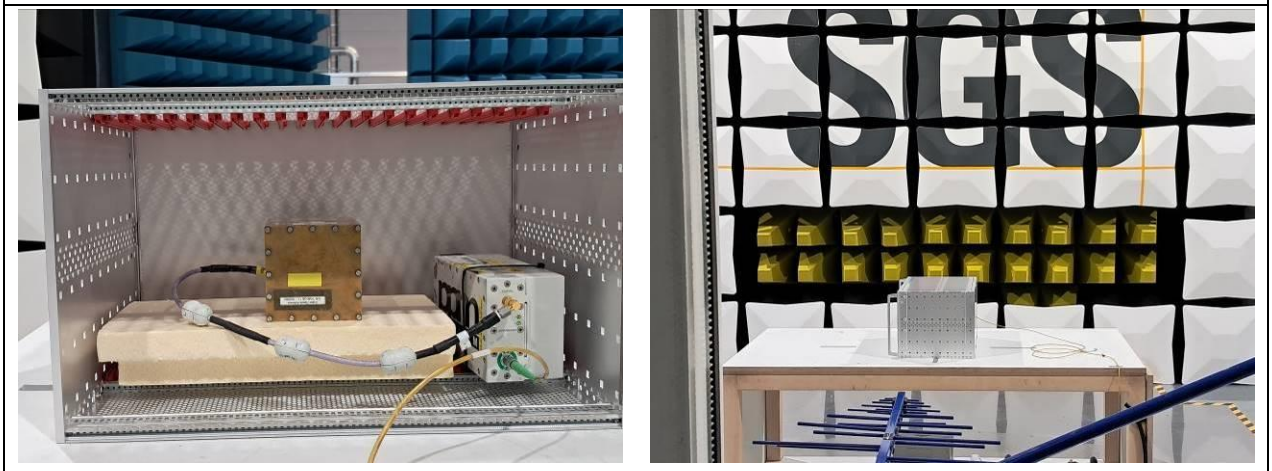


Photo documentation of the test set-up:

vertical



horizontal

Figure 6-9: test setup 30 – 1000 MHz

6.3.5.3 Top

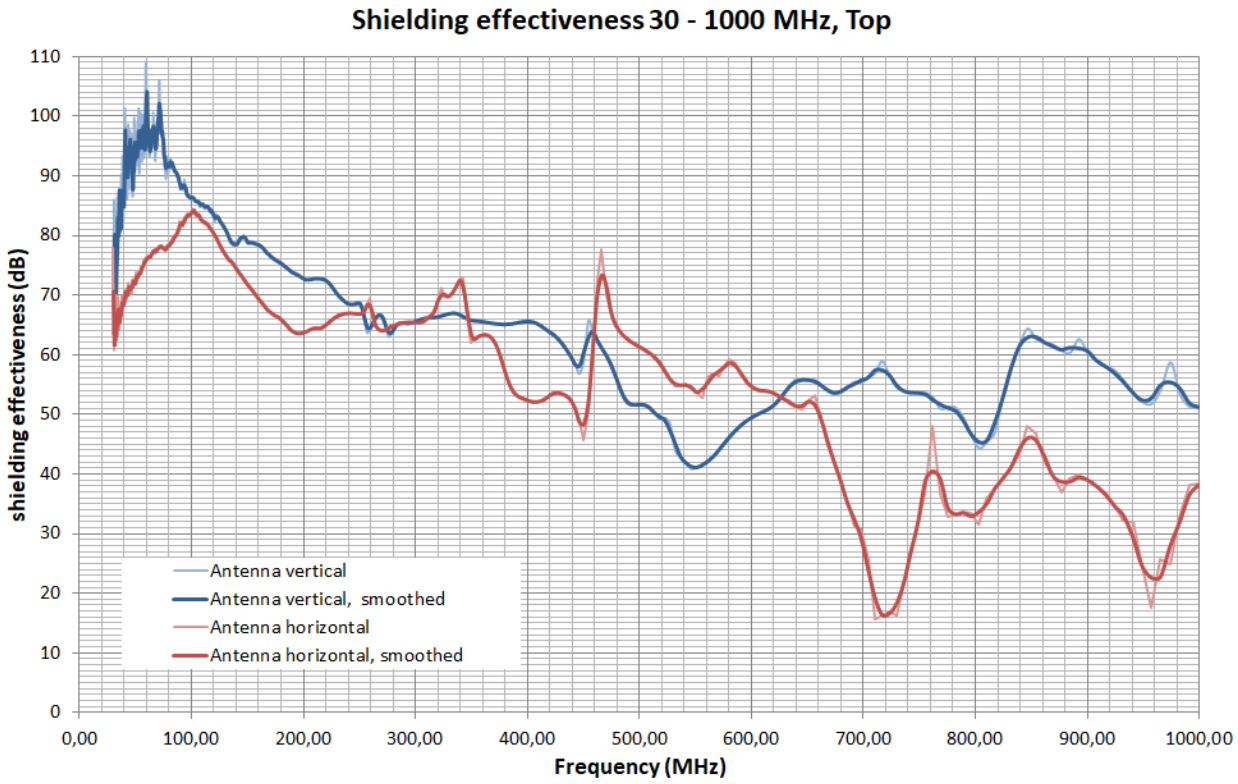
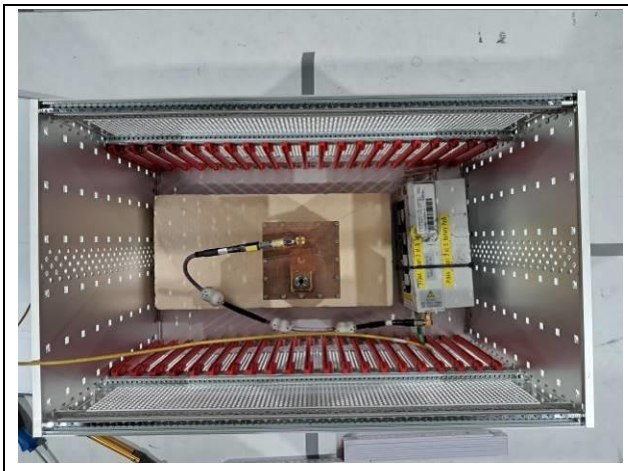
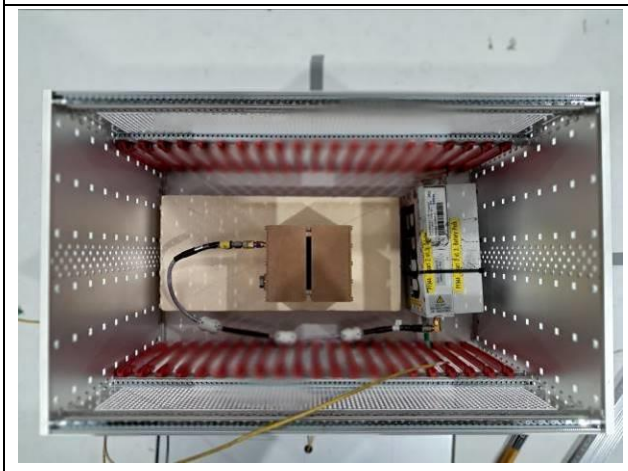


Photo documentation of the test set-up:




vertical

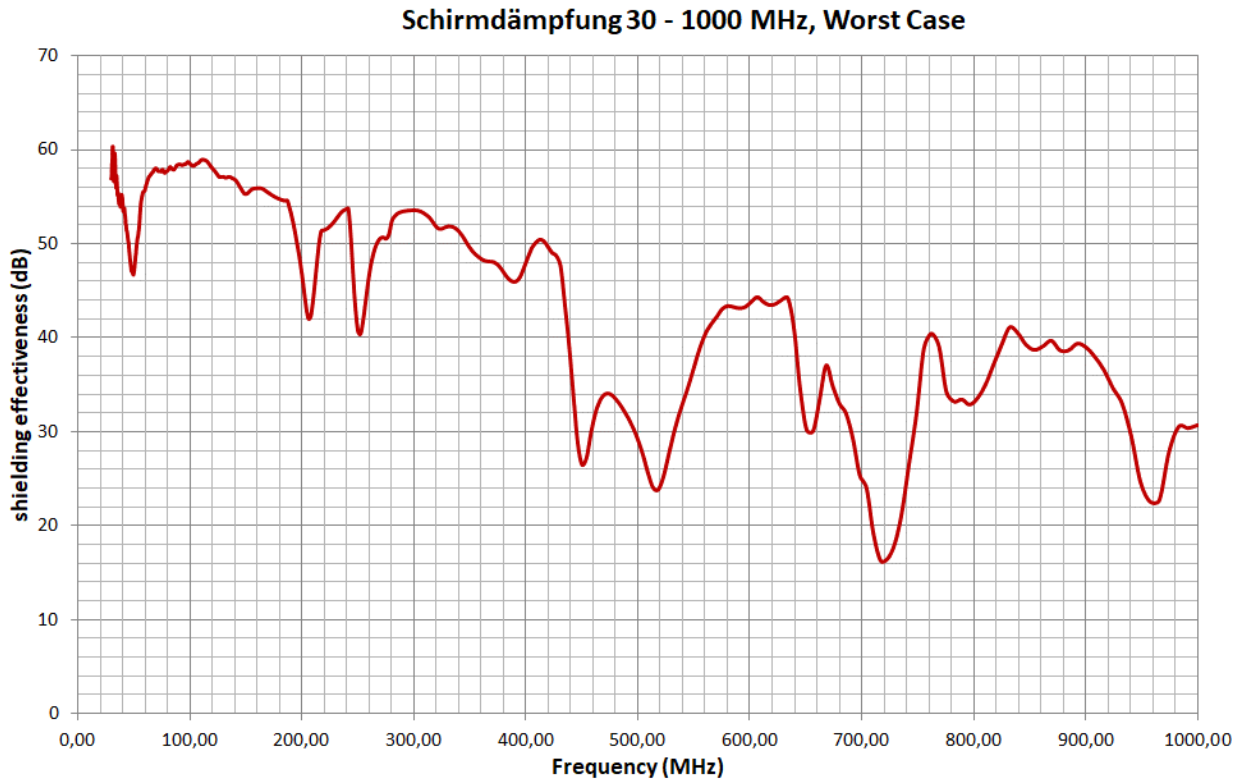



horizontal

Figure 6-10: test setup 30 – 1000 MHz

6.3.5.4 Worst case

The figure below shows the worst case of shielding effectiveness, that means the lowest value of all positions and antenna polarisations at each frequency:



6.4 1 – 18 GHz

Tested by : Pauli

Test date : 2024-04-29 Test location : EMC chamber No. 7

6.4.1 Test Setup

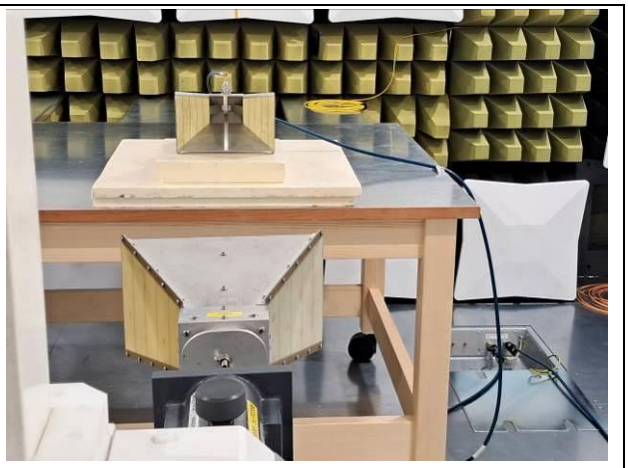
- Antenna distance = 1.20 m (front to front)
- Antenna height = 1.07 m
- no preamp in RX path
- no preamp @ TX antenna
- no attenuator @ TX antenna
- no attenuator @ RX antenna
- measuring bandwidth = 30Hz
- Number of points = 801

6.4.2 Measuring Equipment

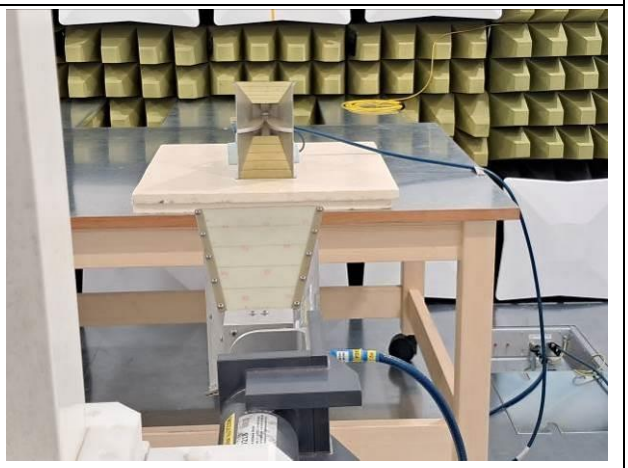
ID	Measuring Instrument	Specification	Status	Due date
P2781	Network analyzer	100 kHz - 20 GHz, Vector network analyzer, 2 ports, 20 GHz, 3.5 mm	cal	Sep 30, 2024
P0030	antenna (MZ3)	1 - 18 GHz	cal	Apr 30, 2026
P0961	antenna (MZ7)	1 - 18 GHz	cal	Apr 30, 2025
P2266	Tektronix SMA cable 0.5m		chk	Apr 30, 2025
P2652	coax cable 3m, ruggedized	DC-18GHz, 3.30dB@18GHz	chk	Aug 31, 2024
P1953	coax cable 2m, ruggedized	DC-18GHz, 2.5dB@18GHz	chk	Jun 30, 2026
P1949	coax cable 3m	DC-18GHz, 3.3dB@18GHz	chk	Jun 30, 2026
P2653	coax cable 5m, ruggedized	DC-18GHz, 5.45dB@18GHz	chk	Aug 31, 2024
P1650	preamplifier (MZ3)	0.1 - 20GHz, gain ca. 28dB	cal	Mar 31, 2025
P2429	EMC chamber 7	dimensions (gross): (L x B x H): 6,1 x 5,5 x 3,6 m; frequency range 10 kHz - 20 GHz	chk	

cal = Calibration, car = Calibration restricted use, chk = Check, chr = Check restricted use, cpu = Check prior to use, calchk = Calibration and check, ind = for indication only, cnn = Calibration not necessary, service = Wartung (Service), man = Maintenance, calservice = Calibration & Service, chkservice = Check & Service, calchkservice = Calibration & Check & Service, calinit = Initial Calibration only

6.4.3 Photographs of test setup for reference measurements



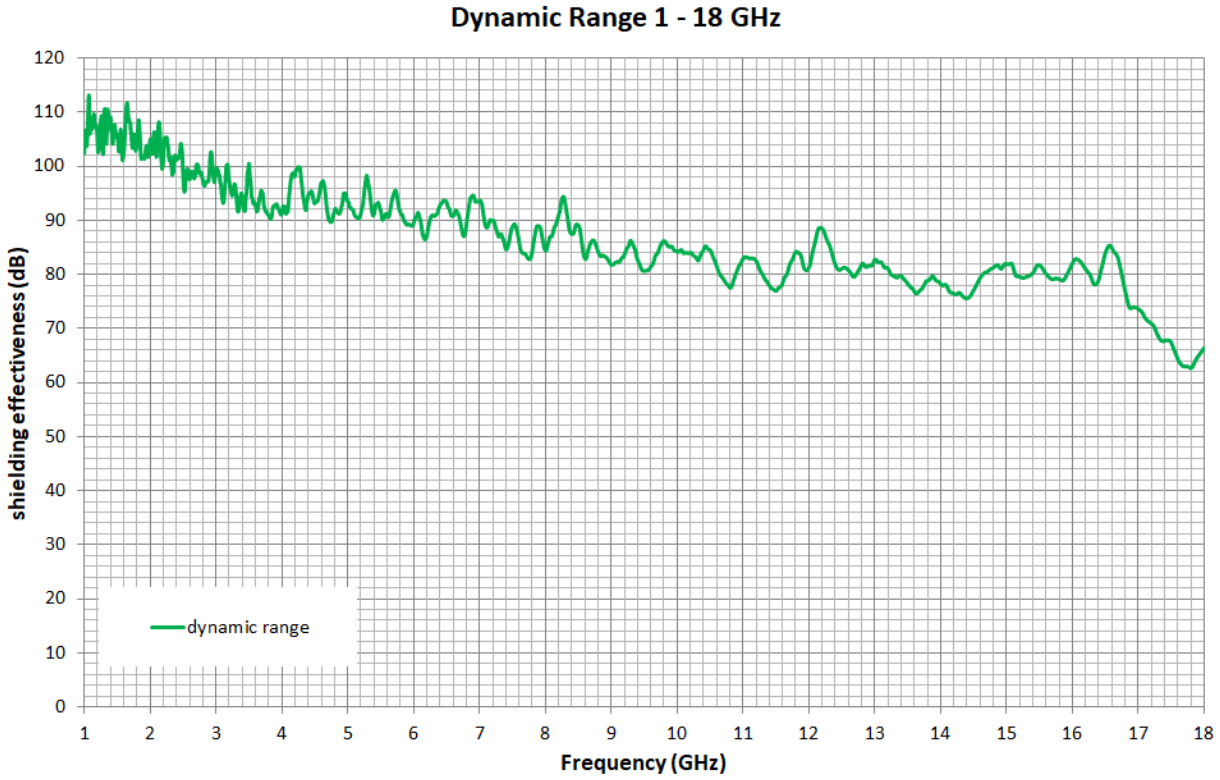
vertical



horizontal

Figure 6-11: test setup reference measurements

6.4.4 Dynamic range



6.4.5 Test Results

6.4.5.1 Front

Due to the dimensions of EUT it was not possible to place the RX antenna inside the EUT in horizontal polarisation. Therefore, only a measurement in vertical polarisation could be done.

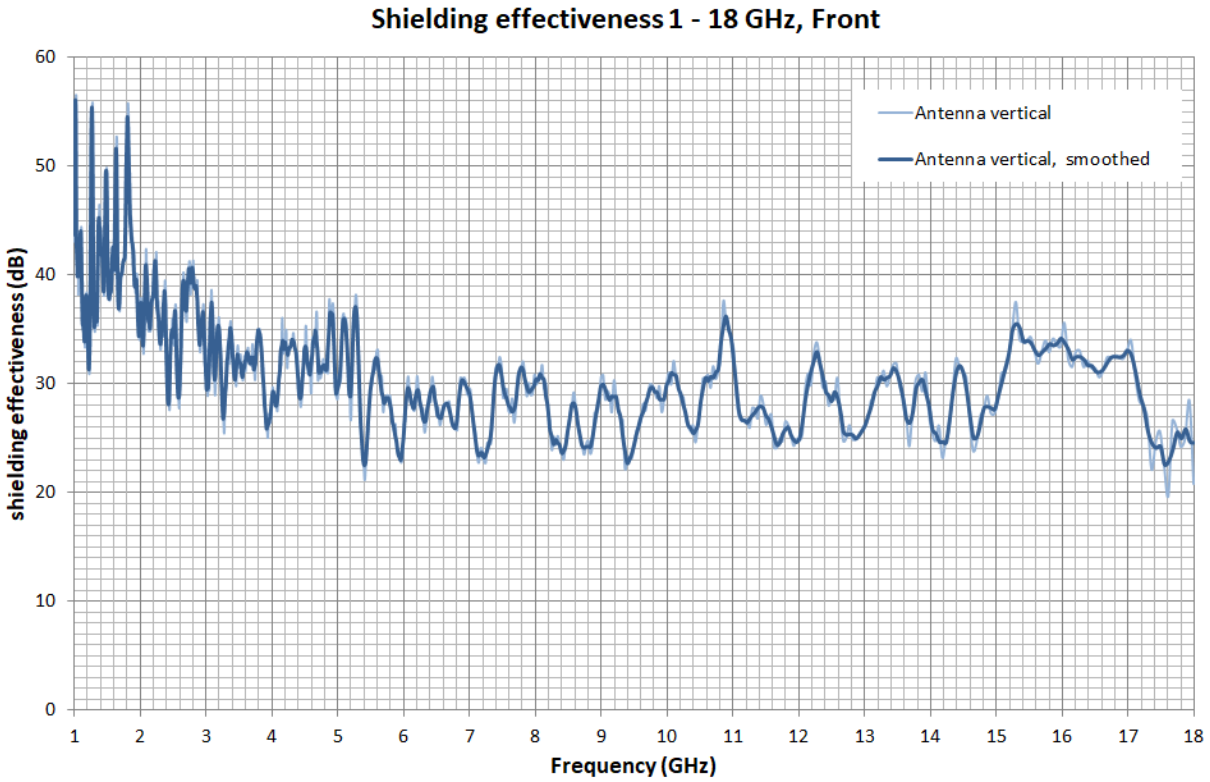


Photo documentation of the test set-up:

vertical

Figure 6-12: test setup 1 – 18 GHz

6.4.5.2 Side

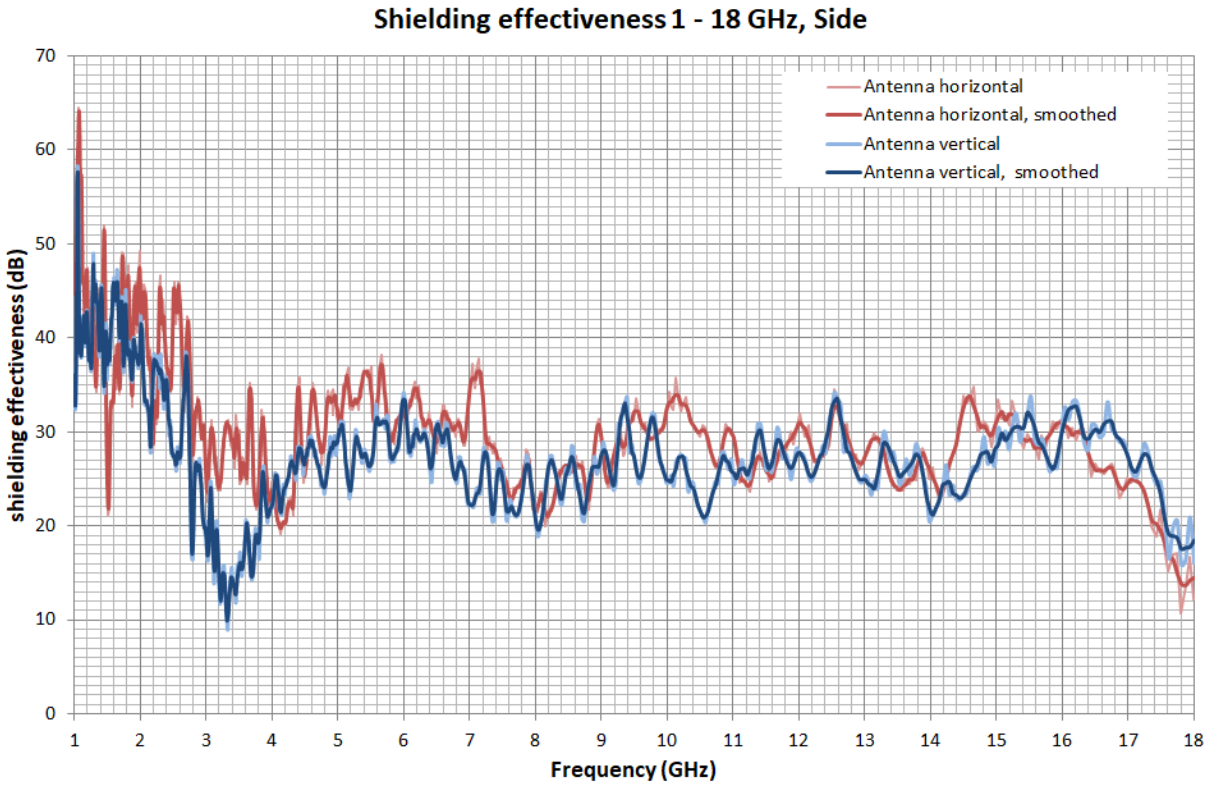
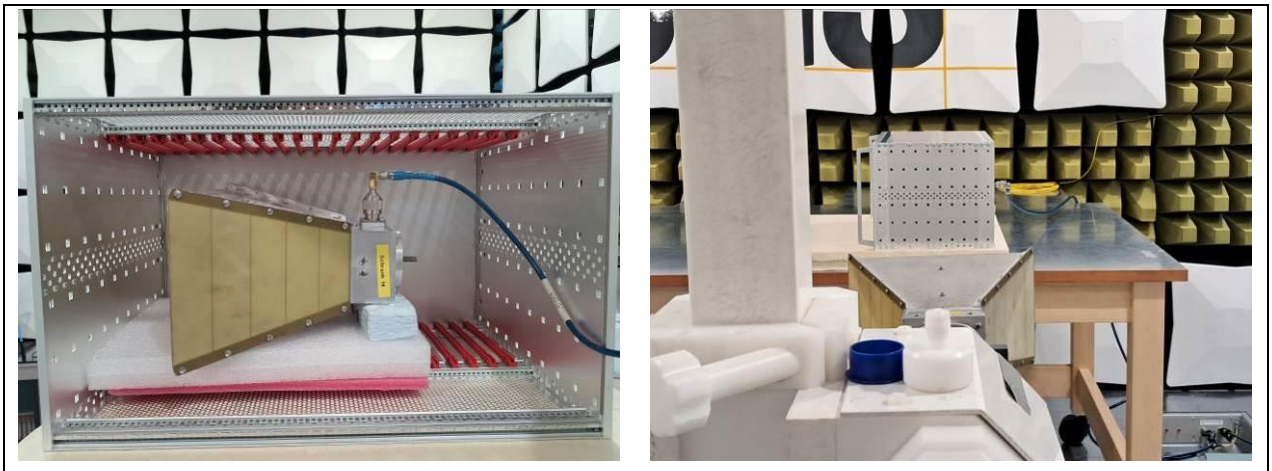
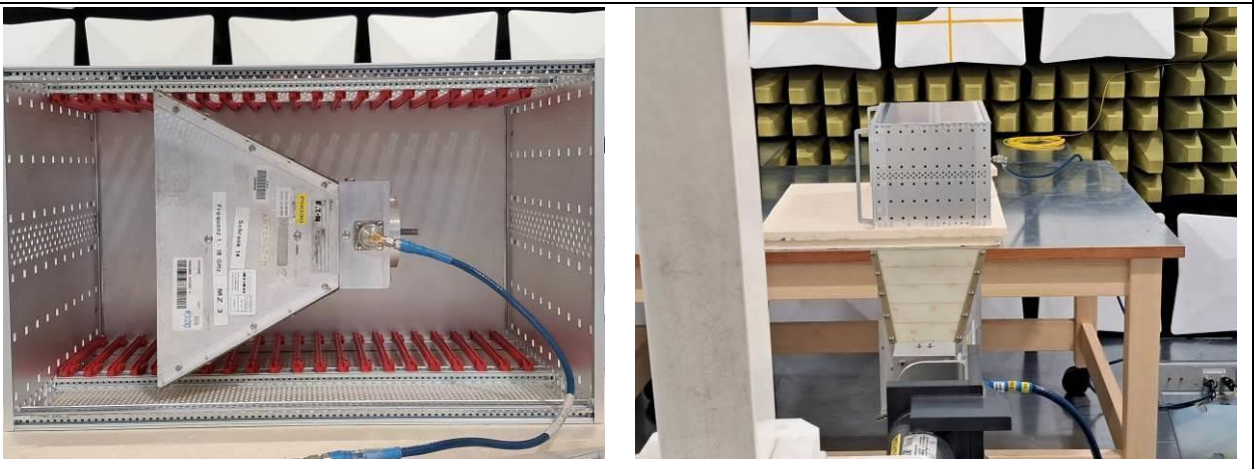


Photo documentation of the test set-up:



vertical



horizontal

Figure 6-13: test setup 1 – 18 GHz

6.4.5.3 Top

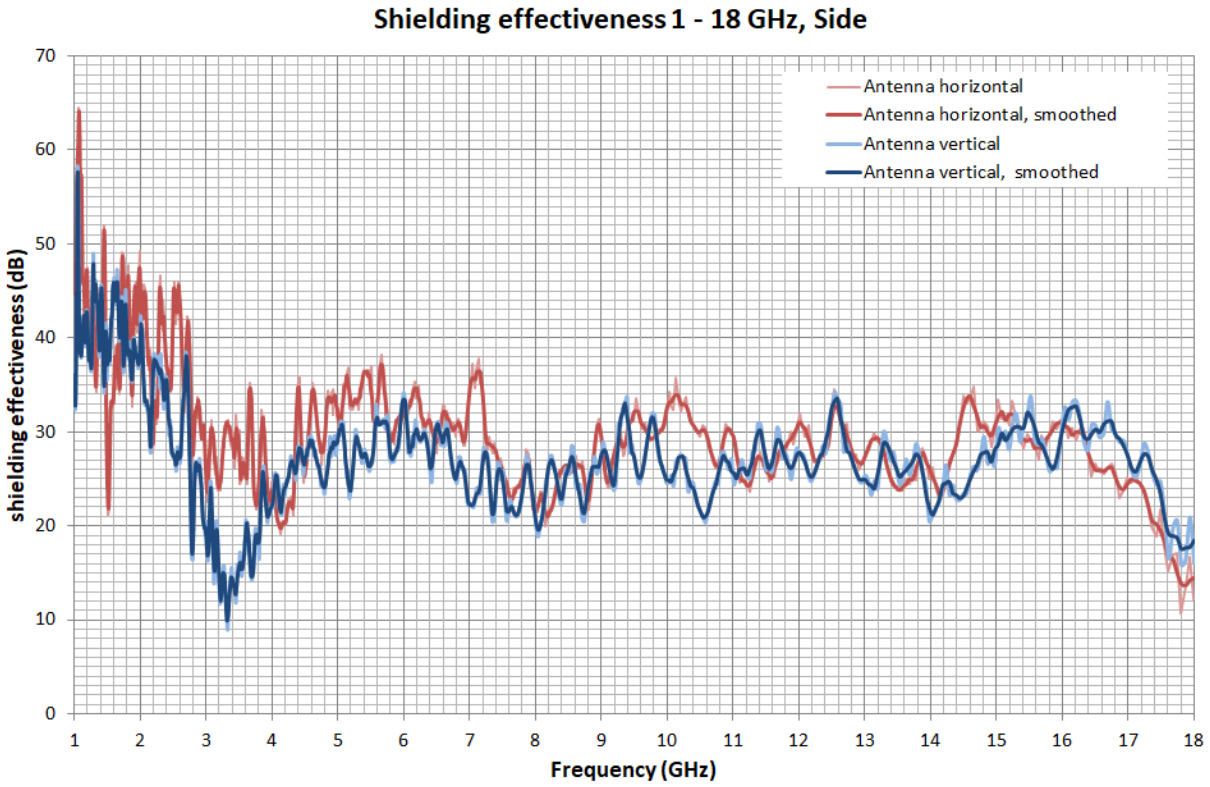
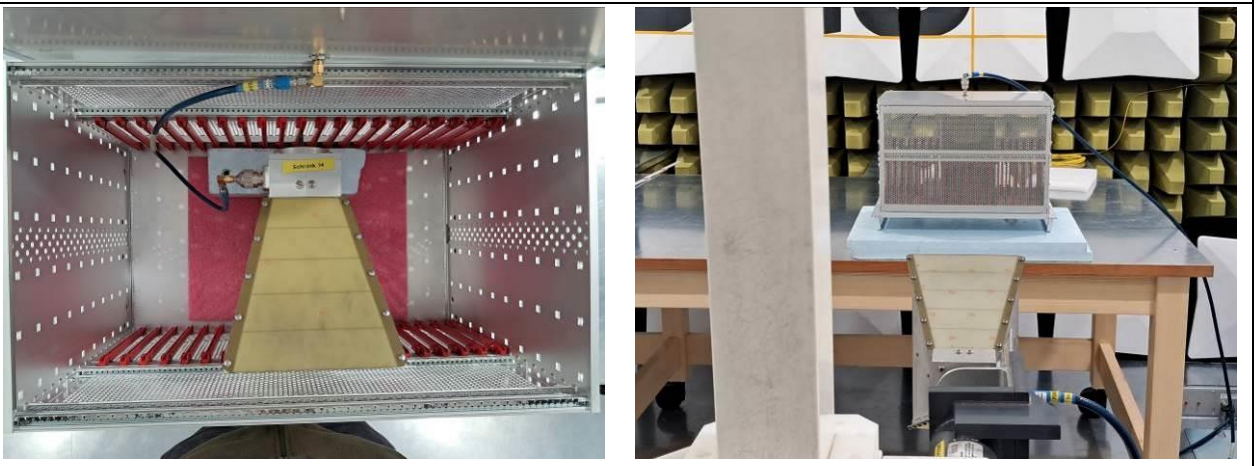


Photo documentation of the test set-up:

vertical

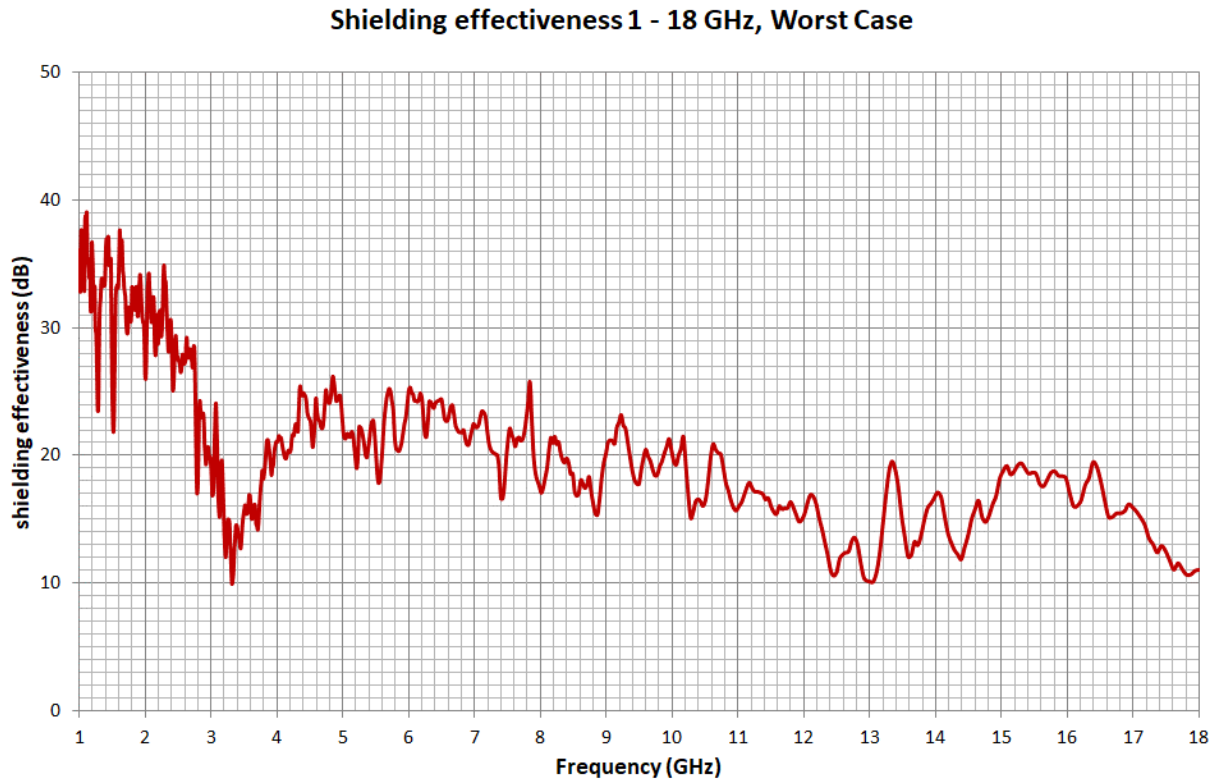


horizontal

Figure 6-14: test setup 1 – 18 GHz

6.4.5.4 Worst case

The figure below shows the worst case of shielding effectiveness, that means the lowest value of all positions and antenna polarisations at each frequency:



6.5 18 – 40 GHz (single frequencies only)

Tested by : Andreas Pauli

Test date : 2024-04-30 Test location : EMC chamber No. 7

6.5.1 Setup

6.5.2 Test Setup

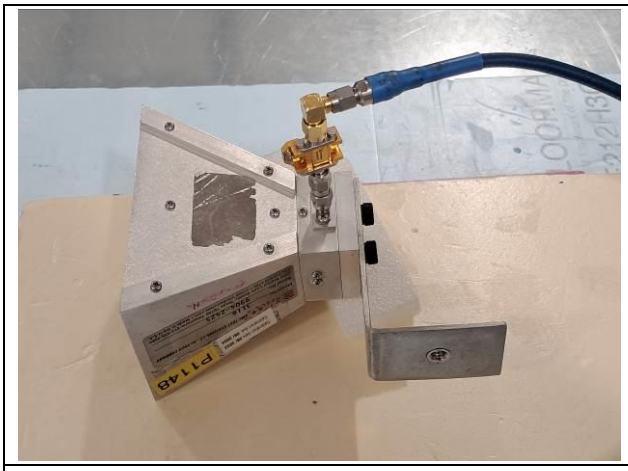
- Antenna distance = 0,80 m (front to front)
- Antenna height = 1.07 m
- no preamp in RX path
- no amplifier @ TX antenna
- no attenuator at TX antenna
- no attenuator @ RX antenna
- measuring bandwidth = 120 kHz
- measuring time = 100 ms
- Detector = Average
- Internal Preamplifier = ON

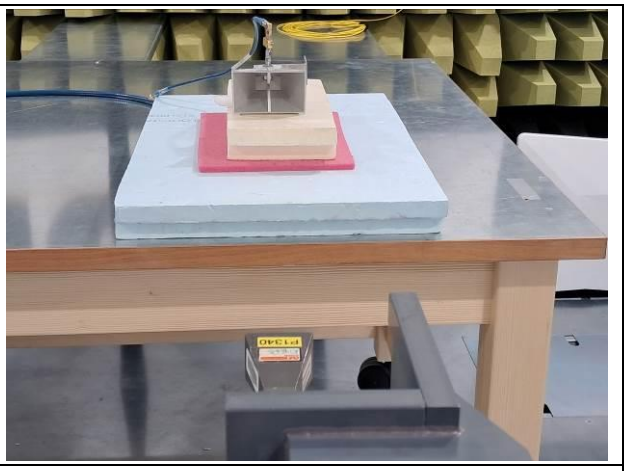
6.5.3 Measuring Equipment

ID	Measuring Instrument	Specification	Status	Due date
P0567	signal generator	10 MHz - 20 GHz	cal	Mar 31, 2027
P2797	EMI receiver (MZ8)	Frequency range: 1 Hz to 44 GHz	cal	Nov 30, 2024
P1340	antenna (18 - 40 GHz)	18- 40 GHz	cal	May 31, 2026
P1148	antenna (horn 18 - 40GHz)	18 - 40 GHz	cal	May 31, 2024
P2738	coax cable 5m	DC- 40GHz, = 90 dB (up to 18 GHz)	cal	Mar 31, 2026
P1227	frequency doubler 13-20GHz	13 - 20GHz (in), 26 - 40GHz (out)	cnn	
P1949	coax cable 3m	DC-18GHz, 3.3dB@18GHz	chk	Jun 30, 2026
P2266	Tektronix SMA cable 0.5m		chk	Apr 30, 2025

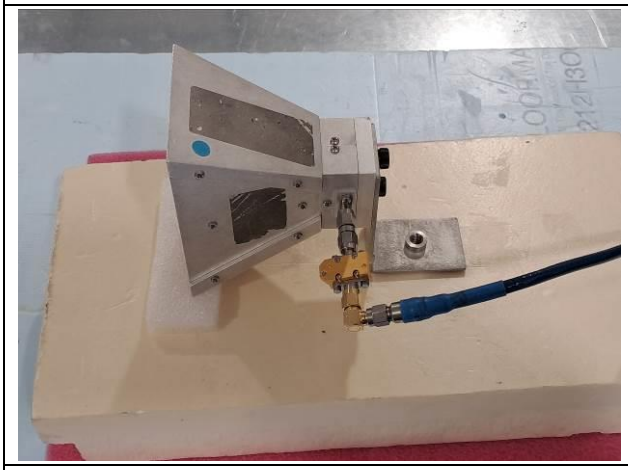
cal = Calibration, car = Calibration restricted use, chk = Check, chr = Check restricted use, cpu = Check prior to use, calchk = Calibration and check, ind = for indication only, cnn = Calibration not necessary, service = Wartung (Service), man = Maintenance, calservice = Calibration & Service, chkservice = Check & Service, calchkservice = Calibration & Check & Service, calinit = Initial Calibration only

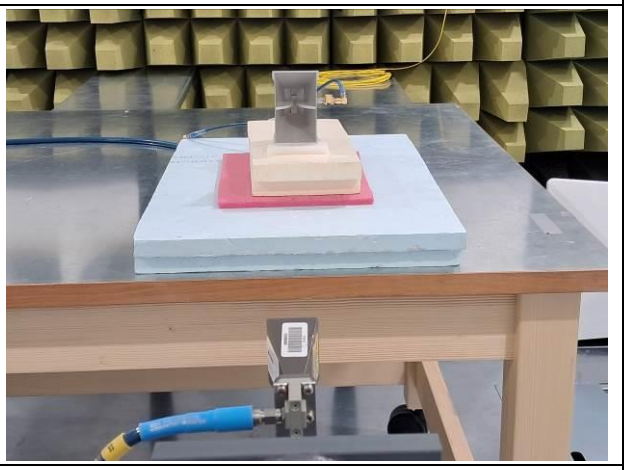
6.5.4 Photographs of test setup





vertical





horizontal

Figure 6-15: test setup, 18 – 40 GHz

6.5.5 Test Results

6.5.5.1 Front

6.5.5.1.1 Horizontal

Frequency in GHz	measured Levels in dBµV		Noise Level	Dynamic Range	Shielding effectiveness
	Reference	EUT			
20,0	67,5	16,8	-8,3	75,8	50,7
24,0	68,1	31,5	-8,0	76,1	36,6
28,0	67,2	27,5	-7,5	74,7	39,7
32,0	63,6	29,5	-7,2	70,8	34,1
36,0	62,5	24,4	-6,3	68,8	38,1
40,0	51,1	12,5	-6,1	57,2	38,6

Photo documentation of the test set-up:

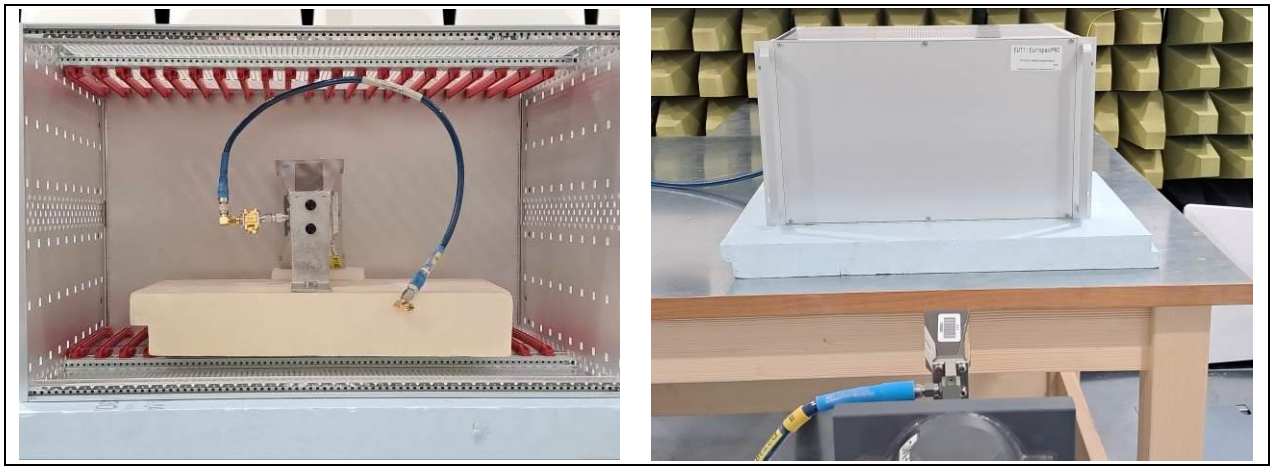


Figure 6-16: test setup horizontal, 18 – 40 GHz

6.5.5.1.2 Vertical

Frequency in GHz	measured Levels in dBµV		Noise Level	Dynamic Range	Shielding effectiveness
	Reference	EUT			
20,0	67,5	34,1	-8,3	75,8	33,4
24,0	68,1	48,9	-8,0	76,1	19,2
28,0	66,9	50,2	-7,5	74,4	16,7
32,0	64,4	39,3	-7,2	71,6	25,1
36,0	62,4	32,6	-6,3	68,7	29,8
40,0	48,5	4,7	-6,1	54,6	43,8

Photo documentation of the test set-up:

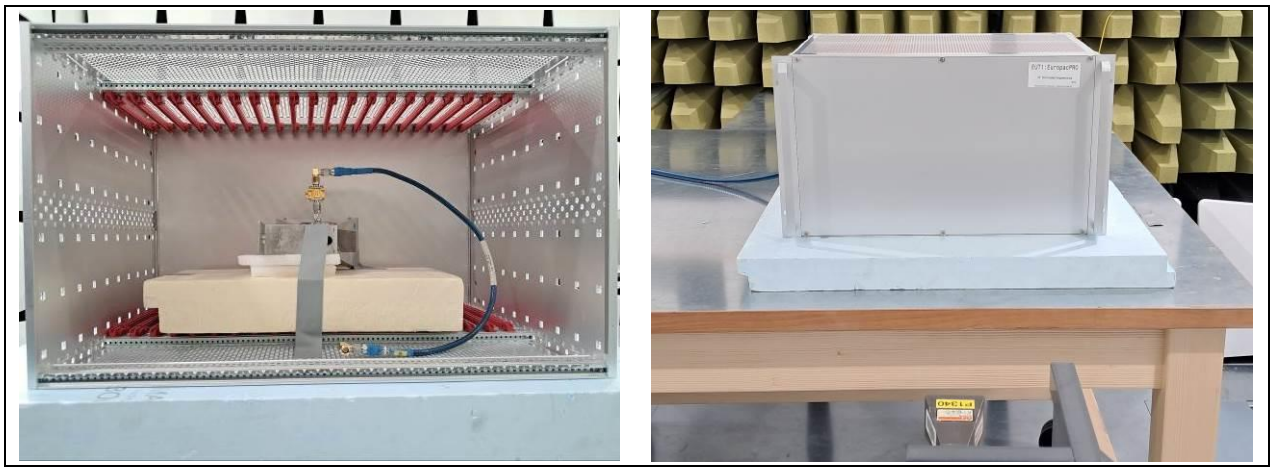


Figure 6-17: test setup vertical, 18 – 40 GHz

6.5.5.2 Side

6.5.5.2.1 Horizontal

Frequency in GHz	measured Levels in dBµV		Noise Level	Dynamic Range	Shielding effectiveness
	Reference	EUT			
20,0	67,5	46,7	-8,3	75,8	20,8
24,0	68,1	57,8	-8,0	76,1	10,3
28,0	67,2	55,7	-7,5	74,7	11,5
32,0	63,6	46,2	-7,2	70,8	17,4
36,0	62,5	41,9	-6,3	68,8	20,6
40,0	51,1	34,1	-6,1	57,2	17,0

Photo documentation of the test set-up:

Figure 6-18: test setup horizontal, 18 – 40 GHz

6.5.5.2.2 Vertical

Frequency in GHz	measured Levels in dBµV		Noise Level	Dynamic Range	Shielding effectiveness
	Reference	EUT			
20,0	67,5	45,2	-8,3	75,8	22,3
24,0	68,1	54,7	-8,0	76,1	13,4
28,0	66,9	54,3	-7,5	74,4	12,6
32,0	64,4	46,1	-7,2	71,6	18,3
36,0	62,4	41,7	-6,3	68,7	20,7
40,0	48,5	26,6	-6,1	54,6	21,9

Photo documentation of the test set-up:

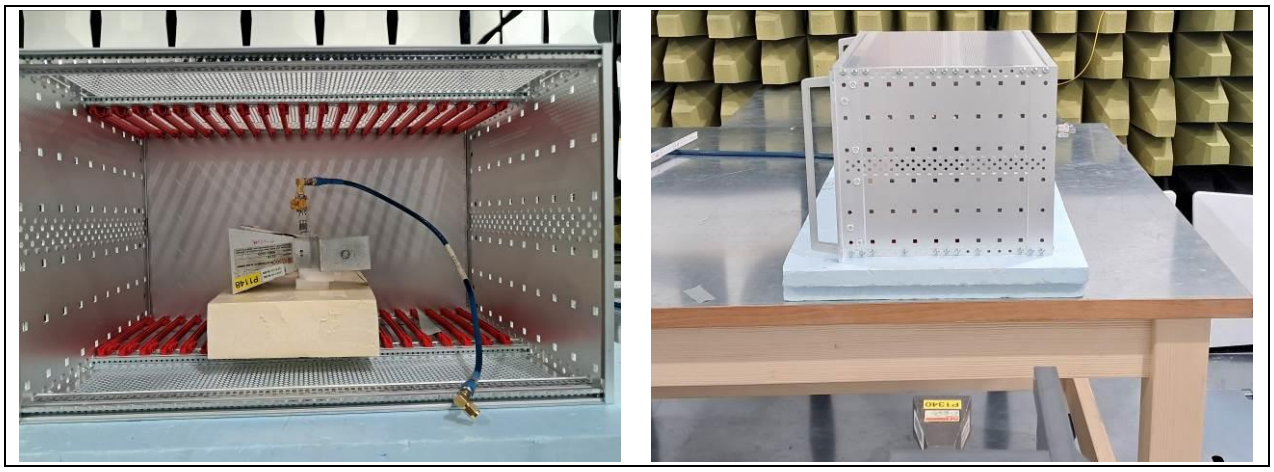


Figure 6-19: test setup vertical, 18 – 40 GHz

6.5.5.3 Top

6.5.5.3.1 Horizontal

Frequency in GHz	measured Levels in dBµV		Noise Level	Dynamic Range	Shielding effectiveness
	Reference	EUT			
20,0	67,5	49,4	-8,3	75,8	18,1
24,0	68,1	48,3	-8,0	76,1	19,8
28,0	67,2	30,2	-7,5	74,7	37,0
32,0	63,6	43,2	-7,2	70,8	20,4
36,0	62,5	33,7	-6,3	68,8	28,8
40,0	51,1	30,5	-6,1	57,2	20,6

Photo documentation of the test set-up:

Figure 6-20: test setup horizontal, 18 – 40 GHz

6.5.5.3.2 Vertical

Frequency in GHz	measured Levels in dBµV		Noise Level	Dynamic Range	Shielding effectiveness
	Reference	EUT			
20,0	67,5	50,2	-8,3	75,8	17,3
24,0	68,1	54,4	-8,0	76,1	13,7
28,0	66,9	58,7	-7,5	74,4	8,2
32,0	64,4	46,7	-7,2	71,6	17,7
36,0	62,4	52,2	-6,3	68,7	10,2
40,0	48,5	37,7	-6,1	54,6	10,8

Photo documentation of the test set-up:

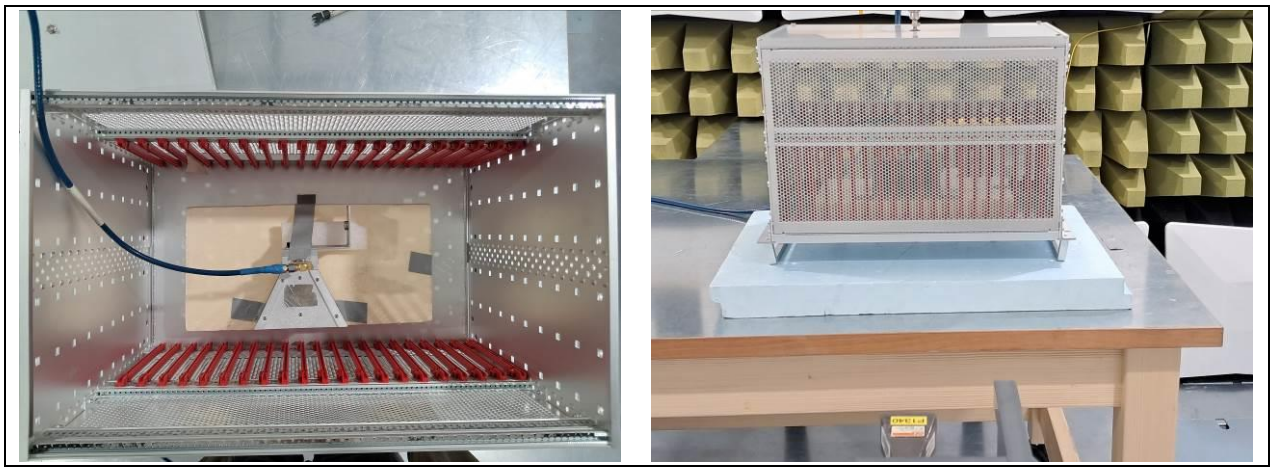


Figure 6-21: test setup vertical, 18 – 40 GHz

6.5.5.4 Worst case

The table below shows the worst case of shielding effectiveness, that means the lowest value of all positions and antenna polarisations at each frequency:

Frequency in GHz	Shielding effectiveness in dB
20,0	17,3
24,0	10,3
28,0	8,2
32,0	17,4
36,0	10,2
40,0	10,8

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End of Test Report