ilac-MRA DAkkS Deutsche Akkreditierungsstelle D-PL-21375-01-03

INGENIEURBÜRO LENHARDT

Bundesnetzagentur

BNetzA-CAB-21/21-21

Partial Test Report

Test report no.: 23028484-32554-1
Date of issue: 2023-07-31

Test result: The test item **- passed - and complies** with below listed standards.

Applicant
Symeo GmbH

Manufacturer
Same as applicant

Test Item
BSX300350

RF-Spectrum Testing according to:

FCC 47 CFR Part 15
Radio Frequency Devices, Subpart C -
§ 15.258 Operation in the bands 116-123 GHz, 174.8-182 GHz, 185-190 GHz and 244-246 GHz

Tested by (name, function, signature)	*Sebastian Janoschka* *Head of Department Radio*	signature
Approved by (name, function, signature)	*Karsten Geraldy* *Lab Manager*	signature

Applicant and Test item details	
Applicant	Symeo GmbH Prof.-Messerschmitt-Str. 3 85579, Neubiberg/München, Germany Phone: +49 89 6607796-0 Fax: +49 89 6607796-190
Manufacturer	Same as applicant
Test item description	LPR-1DHP-350 Radar Sensor
Model/Type reference	BSX300350
Standard specific information	
FCC ID	W5IBSX300350
Frequency	120 GHz – 123 GHz
Antenna	integrated chip antenna with dielectric lens
Power supply	100 - 240 V AC via Power Over Ethernet Adapter (48 V DC)
Temperature range	-40 °C to +60 °C

Disclaimer and Notes

The content of this report relates to the mentioned test sample(s) only.
IBL-Lab GmbH does not take samples. The samples used for testing are provided by the applicant.
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Signatures are done electronically, if signer does not match stated signer, it is signed per order.
Information supplied by the applicant can affect the validity of results. The data is marked accordingly.

Within this test report, a ☒ point / ☐ comma is used as a decimal separator.
If otherwise, a detailed note is added adjected to its use.

Decision rule:
Decision rule based on simple acceptance without guard bands, binary statement, based on mutually agreed uncertainty tolerances with expansion factor k=2 according to ILAC-G8:09/2019

1 TABLE OF CONTENTS

2 GENERAL INFORMATION

2.1 Administrative details

Testing laboratory	**IBL-Lab GmbH** Heinrich-Hertz-Allee 7 66386 St. Ingbert / Germany Fon: +49 6894 38938-0 Fax: +49 6894 38938-99 URL: https://ib-lenhardt.com/ E-Mail: info@ib-lenhardt.com
Accreditation / Designation	The testing laboratory is accredited by Deutsche Akkreditierungsstelle GmbH (DAkkS) in compliance with DIN EN ISO/IEC 17025:2018. Scope of testing and registration number: • Attachment to the accreditation certificate D-PL-21375-01-00 ○ Electronics ○ Electromagnetic Compatibility ○ Radio ○ Electromagnetic Compatibility and Telecommunication (FCC requirements) ○ Telecommunication (TC) and Electromagnetic Compatibility (EMC) for Canadian Standards ○ Automotive EMC Website DAkkS: https://www.dakks.de/ The Deutsche Akkreditierungsstelle GmbH (DAkkS) is also a signatory to the ILAC Mutual Recognition Arrangement. • Designations ○ FCC Testing Laboratory Designation Number DE0024 ○ ISED ISED Company Number 27156 Testing Laboratory CAB Identifier DE0020 Kraftfahrt-Bundesamt KBA-P 00120-23
Testing location	**IBL-Lab GmbH** Heinrich-Hertz-Allee 7 66386 St. Ingbert / Germany
Date of receipt of test samples	2023-01-19
Start – End of tests	2023-05-03 – 2023-05-03

2.2 Possible test case verdicts

Test sample meets the requirements	P (PASS)
Test sample does not meet the requirements	F (FAIL)
Test case does not apply to the test sample	N/A (Not applicable)
Test case not performed	N/P (Not performed)

2.3 Observations

No additional observations other than the reported observations within this test report have been made.

2.4 Opinions and interpretations

No appropriate opinions or interpretations according ISO/IEC 17025:2017 clause 7.8.7 are within this test report.

2.5 Revision History

-0 Initial Version

-1 Revision: Hardware status added within chapter 5.3

This test report 23028484-32554-1 replaces the previous test report 23028484-32554-0.
Utilisation, publication and control of previous report editions is under responsibility of the applicant.

2.6 Further documents

List of further applicable documents belonging to the present test report:
– no additional documents –

3 ENVIRONMENTAL & TEST CONDITIONS

3.1 Environmental conditions

Temperature	20°C ± 5°C
Relative humidity	25-75% r.H.
Barometric Pressure	860-1060 mbar
Power supply	230 V AC ± 5%

3.2 Normal and extreme test conditions

	minimum	nominal	maximum
Temperature	-20 °C	20 °C	50 °C
Relative humidity	-/-	45 % r.h.	-/-
Power supply	94 V AC	110 V AC	127 V AC

4 TEST STANDARDS AND REFERENCES

Test standard (accredited)	**Description**
FCC 47 CFR Part 15	Radio Frequency Devices, Subpart C - § 15.258 Operation in the bands 116-123 GHz, 174.8-182 GHz, 185-190 GHz and 244-246 GHz

Reference	**Description**
ANSI C63.4-2014	American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz
ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices

5 EQUIPMENT UNDER TEST (EUT)

5.1 Product description

The LPR®-1DHP-350 radar system performs 1D distance measurements for short and medium ranges with high accuracy. By means of primary radar or secondary radar measurements, the LPR®-1DHP-350 can detect the position and speed - for example of cranes and rail-bound transport systems - in real-time and make the data available via the device interfaces.
The sensors are simple to install and easy to put into operation with the aid of a web interface. A directional antenna is integrated into the housing. The device features the latest mm-wave technology, allowing it to achieve highly precise measurements. Even under the harshest environments and weather conditions such as rain, fog, snow, dust, smoke or vibrations, the maintenance- and wear-and-tear-free wireless technology operates reliably and with a high degree of availability - indoors and outdoors.

5.2 Description of test item

Model name*	BSX300350
Serial number*	EI6FR20037
PCB identifier*	PLB102266, E621, 1.30 PLB102932, 1.13
Hardware status*	V1.13
Software status*	v3.2.0-2-gc0edb5d.cw_mode_291_350

*: as declared by applicant

5.3 Technical data of test item

Operational frequency band*	120 GHz – 123 GHz
Type of radio transmission*	modulated carrier
Modulation type*	FMCW
Number of channels*	3 GHz band (block no. 32): 180
Channel bandwidth*	<3 GHz
Channel spacing*	N/A
Duty cycle*	100%
Antenna*	integrated chip antenna with dielectric lens
Rated RF output power*	<20 dBm
Power supply*	100 - 240 V AC via Power Over Ethernet Adapter (48 V DC)
Temperature range*	-40 °C to +60 °C

*: as declared by applicant

5.4 Additional information

Model differences	N/A
Ancillaries tested with	Levelone, PoE Injector POI-2012AC/DC , LAN cable
Additional equipment used for testing	Lab Notebook with AC/DC-adapter used for EUT setup

6 SUMMARY OF TEST RESULTS

Test specification
FCC 47 CFR Part 15

Clause	Requirement / Test case	Test Conditions	Result / Remark	Verdict
§15.258(c) / §15.209(a)	Spurious emissions	Normal	< limit	P

Note
FCC's Millimeter Wave Test Procedures: I. A radiated method of measurements in order to demonstrate compliance with the various regulatory requirements has been chosen in consideration of test equipment availability and the limitations of many external harmonic mixers. A conducted method of measurement could be employed if EUT and mixer waveguides both are accessible and of the same type (WG number) and if waveguide sections and transitions can be found. Another potential problem is that the peak power output may exceed the +20 dBm input power limit of many commercially available mixers. For these reasons a radiated method is preferred.

Comments and observations
A special test firmware was flashed on EUT to set cw test mode low, mid and high

7 TEST RESULTS

7.1 Field strength of emissions (spurious and harmonics)

Description / Limits

§15.258(c) Spurious emissions shall be limited as follows:

(1) The power density of any emissions outside the band of operation, *e.g.,* 116-123 GHz, 174.8-182 GHz, 185-190 GHz or 244-246 GHz, shall consist solely of spurious emissions.

(2) Radiated emissions below 40 GHz shall not exceed the general limits in §15.209:

Frequency	Field Strength	Measurement distance
0.009 – 0.490 MHz	2400/F[kHz] µV/m	300 m
0.490 – 1.705 MHz	24000/F[kHz] µV/m	30 m
1.705 – 30.0 MHz	30.0 µV/m / 29.5 dBµV/m	30 m
30 – 88 MHz	100 µV/m / 40.0 dBµV/m	3 m
88 – 216 MHz	150 µV/m / 43.5 dBµV/m	3 m
216 – 960 MHz	200 µV/m / 46.0 dBµV/m	3 m
960 – 40 000 MHz	500 µV/m / 54.0 dBµV/m	3 m

(3) Between 40 GHz and the highest frequency specified in §15.33, the level of these emissions shall not exceed 90 pW/cm^2 at a distance of 3 meters. This corresponds to an EIRP of -9.9 dBm.

(4) The levels of the spurious emissions shall not exceed the level of the fundamental emission.

Test procedure

§15.31 (c) Except as otherwise indicated in §15.256, for swept frequency equipment, measurements shall be made with the frequency sweep stopped at those frequencies chosen for the measurements to be reported.

§15.31 (m) Measurements on intentional radiators or receivers, other than TV broadcast receivers, shall be performed and, if required, reported for each band in which the device can be operated with the device operating at the number of frequencies in each band specified in the following table:

Frequency range	Number of frequencies	Location
< 1MHz bandwidth	1	middle
1 – 10 MHz bandwidth	2	1 near bottom and 1 near top
> 10 MHz bandwidth	3	1 near bottom / middle / top

§15.35 (b) Unless otherwise specified, on any frequency or frequencies above 1000 MHz, the radiated emission limits are based on the use of measurement instrumentation employing an average detector function. Unless otherwise specified, measurements above 1000 MHz shall be performed using a minimum resolution bandwidth of 1 MHz. When average radiated emission measurements are specified in this part, including average emission measurements below 1000 MHz, there also is a limit on the peak level of the radio frequency emissions. Unless otherwise specified, e.g.,see §§15.250, 15.252, 15.253(d), 15.255, 15.256, and 15.509 through 15.519, the limit on peak radio frequency emissions is 20 dB above the maximum permitted average emission limit applicable to the equipment under test. This peak limit applies to the total peak emission level radiated by the device, e.g., the total peak power level. Note that the use of a pulse desensitization correction factor may be needed to determine the total peak emission level. The instruction manual or application note for the measurement instrument should be consulted for determining pulse desensitization factors, as necessary.

§15.35 (c) Unless otherwise specified, e.g., §§15.255(b), and 15.256(l)(5), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to Supplier's Declaration of Conformity.

Calculation of the far field distance (Rayleigh distance):
The aperture dimensions of these horn antennas shall be small enough so that the measurement distance in meters is equal to or greater than the Rayleigh distance (i.e. $R_m = 2D^2 / \lambda$), where D is the largest linear dimension (i.e. width or height) of the antenna aperture in m and λ is the free-space wavelength in meters at the frequency of measurement.

Antenna type	Frequency range [GHz]	D [m]	Highest frequency in use [GHz]	Far field distance R_m [m]
20240-20	18.0 – 26.5	0.0520	26.5	0.47
22240-20	26.5 – 40.0	0.0342	40	0.31
23240-20	33.0 – 50.0	0.0280	50	0.26
24240-20	40.0 – 60.0	0.0230	60	0.21
25240-20	50.0 – 75.0	0.0185	75	0.17
26240-20	60.0 – 90.0	0.0150	90	0.13
27240-20	75.0 – 110	0.0124	110	0.11
28240-20	90.0 – 140	0.0100	140	0.09
29240-20	110 – 170	0.0085	170	0.08
30240-20	140 – 220	0.0068	220	0.06
32240-20	220 – 325	0.00446	325	0.04
570240-20	325 – 500	0.00294	375	0.02

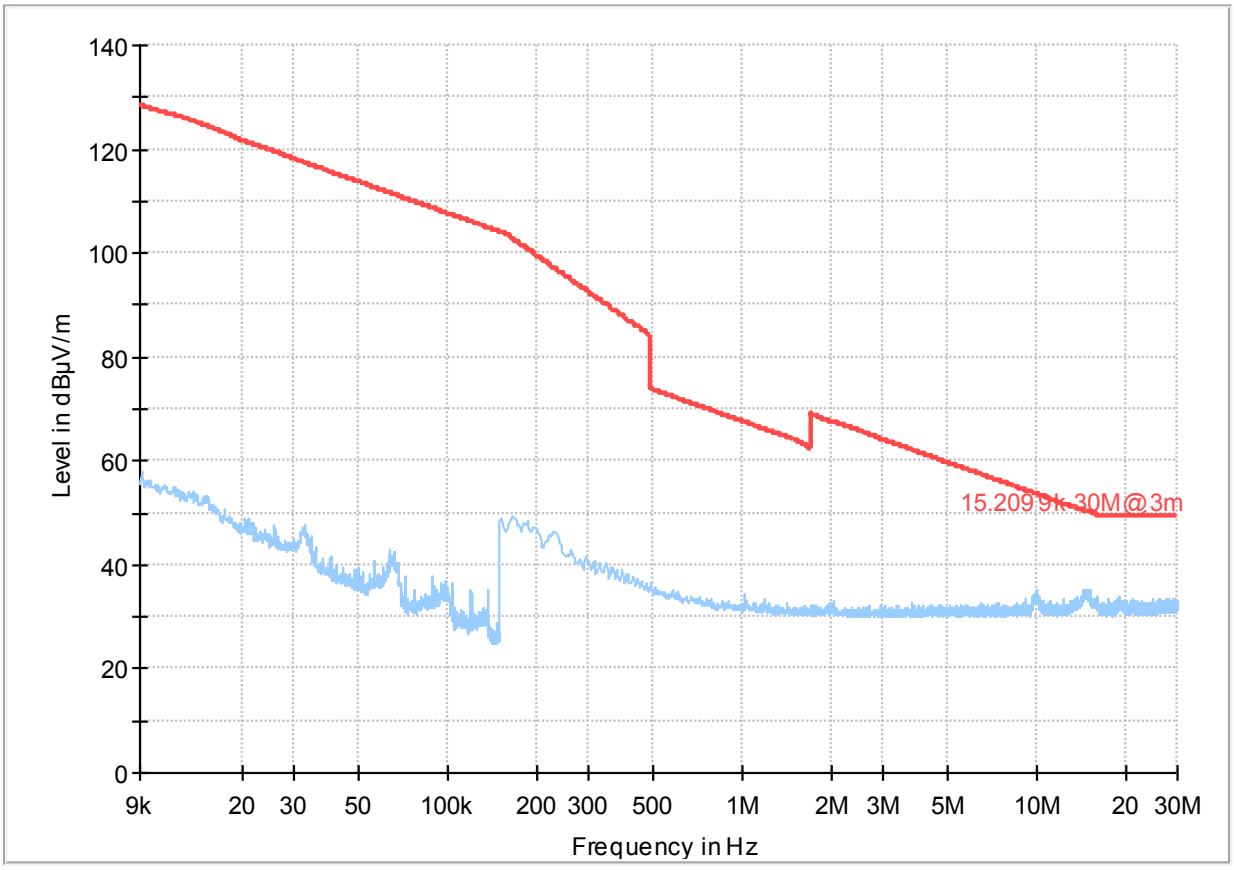
Used test distances:
Up to 18 GHz: 3.00 m

Test setup: 8.1 – 8.4
Test distance correction factor of 20dB/decade is already considered in the plots / result table (if applicable).

Test results:

Channel / Mode	Frequency [GHz]	Detector	Test distance [m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]
No critical emissions found, please refer to plots.						

Plot no. 1: radiated emissions 9 kHz – 30 MHz, loop antenna, bottom frequency



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
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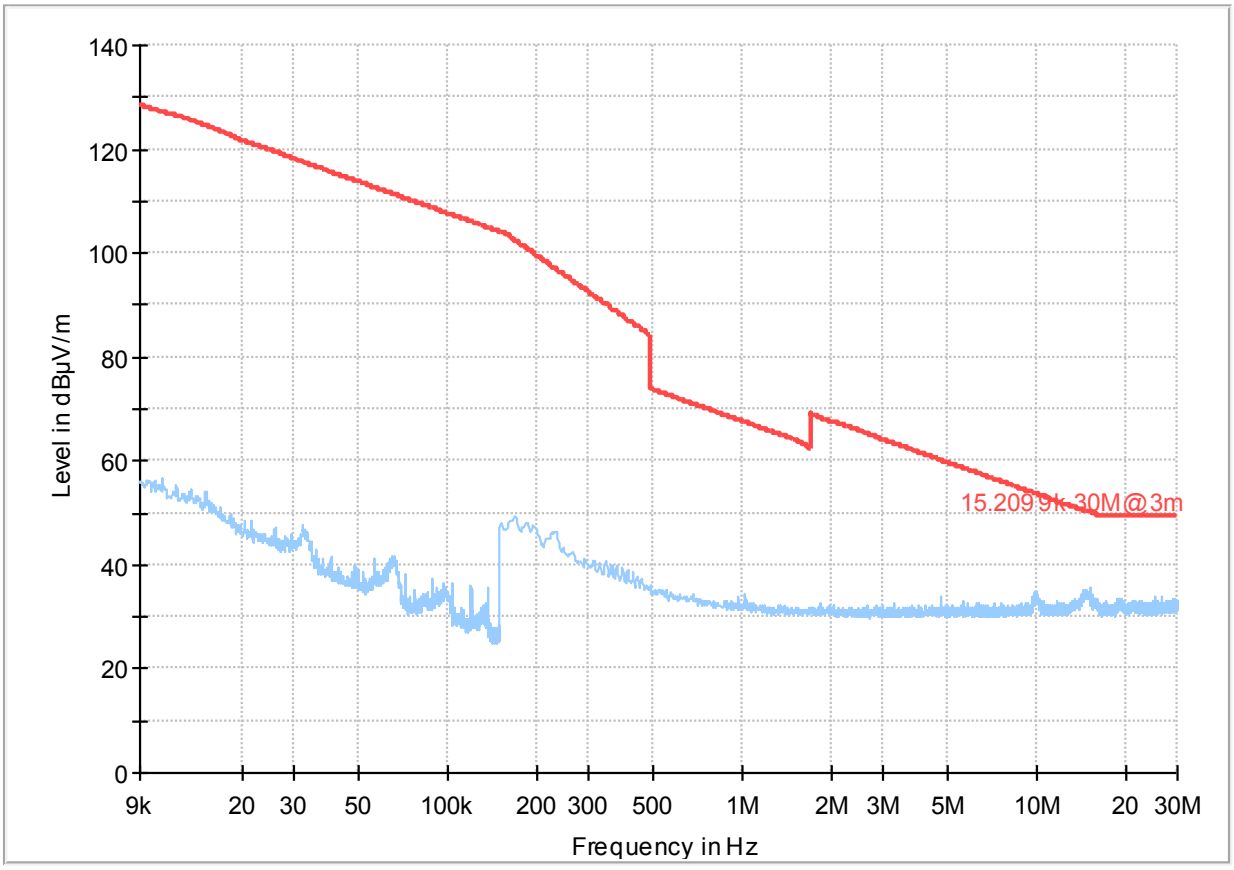
(continuation of the "Final_Result" table from column 15 ...)

Frequency (MHz)	Comment
---	-

Plot no. 2: radiated emissions 9 kHz – 30 MHz, loop antenna, mid frequency



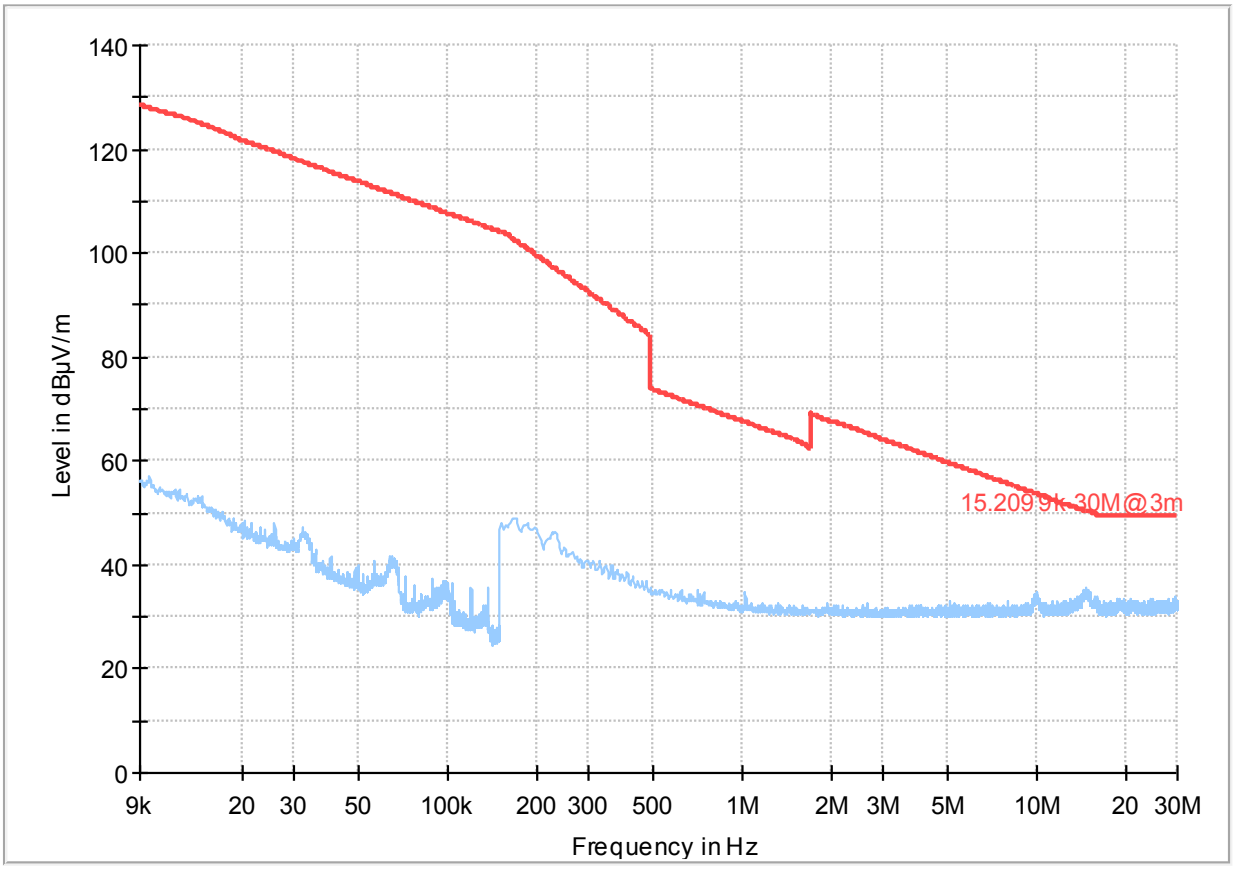
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
---	---	---	---	---	---		---	---

(continuation of the "Final_Result" table from column 15 ...)

Frequency (MHz)	Comment
---	-

Plot no. 3: radiated emissions 9 kHz – 30 MHz, loop antenna, top frequency



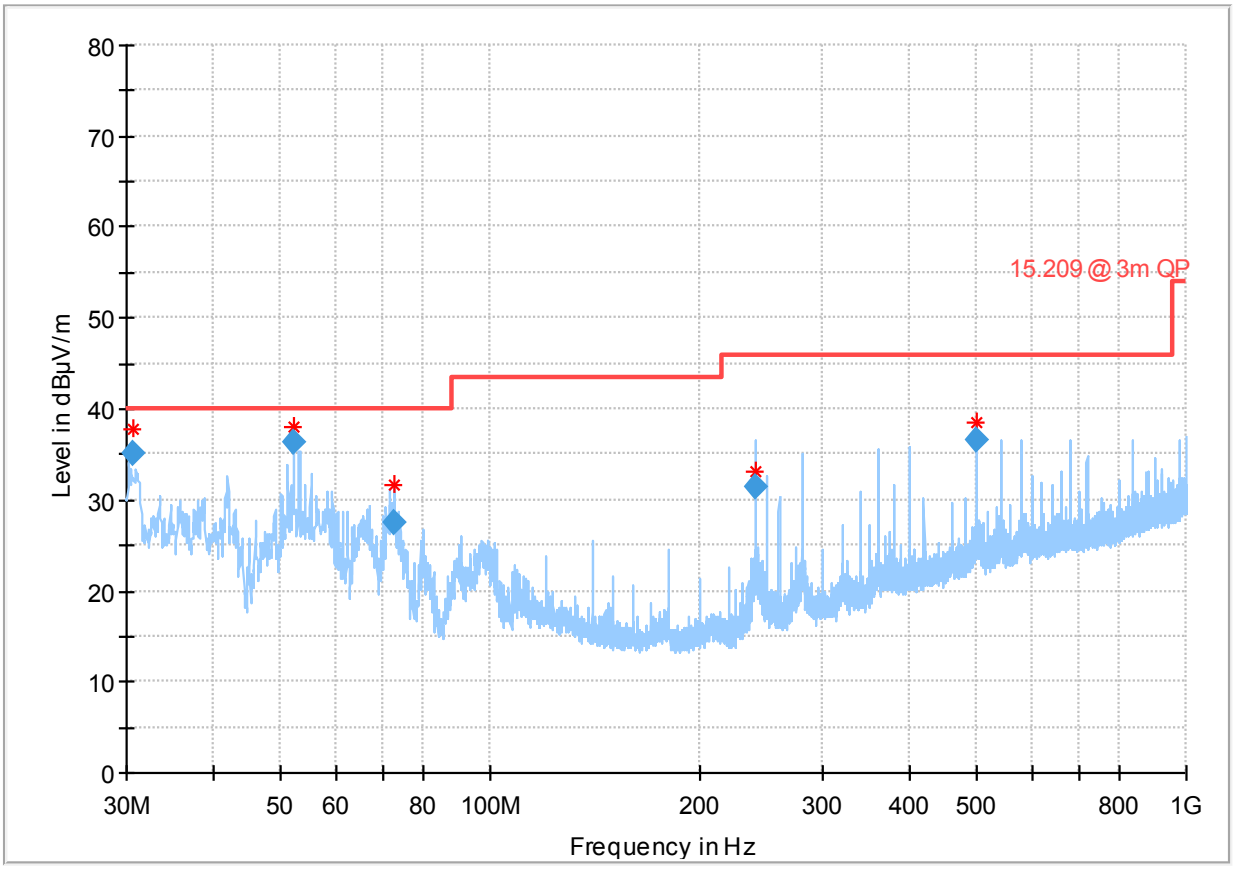
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
---	---	---	---	---	---		---	---

(continuation of the "Final_Result" table from column 15 ...)

Frequency (MHz)	Comment
---	-

Plot no. 4: radiated emissions 30 MHz – 1 GHz, hor./vert. polarization, bottom frequency



Preview Result 1-PK+ | Critical_Freqs PK+ | 15.209 @ 3m QP
Final_Result QPK | MaxPeak-PK+ (Single) | QuasiPeak-QPK (Single)

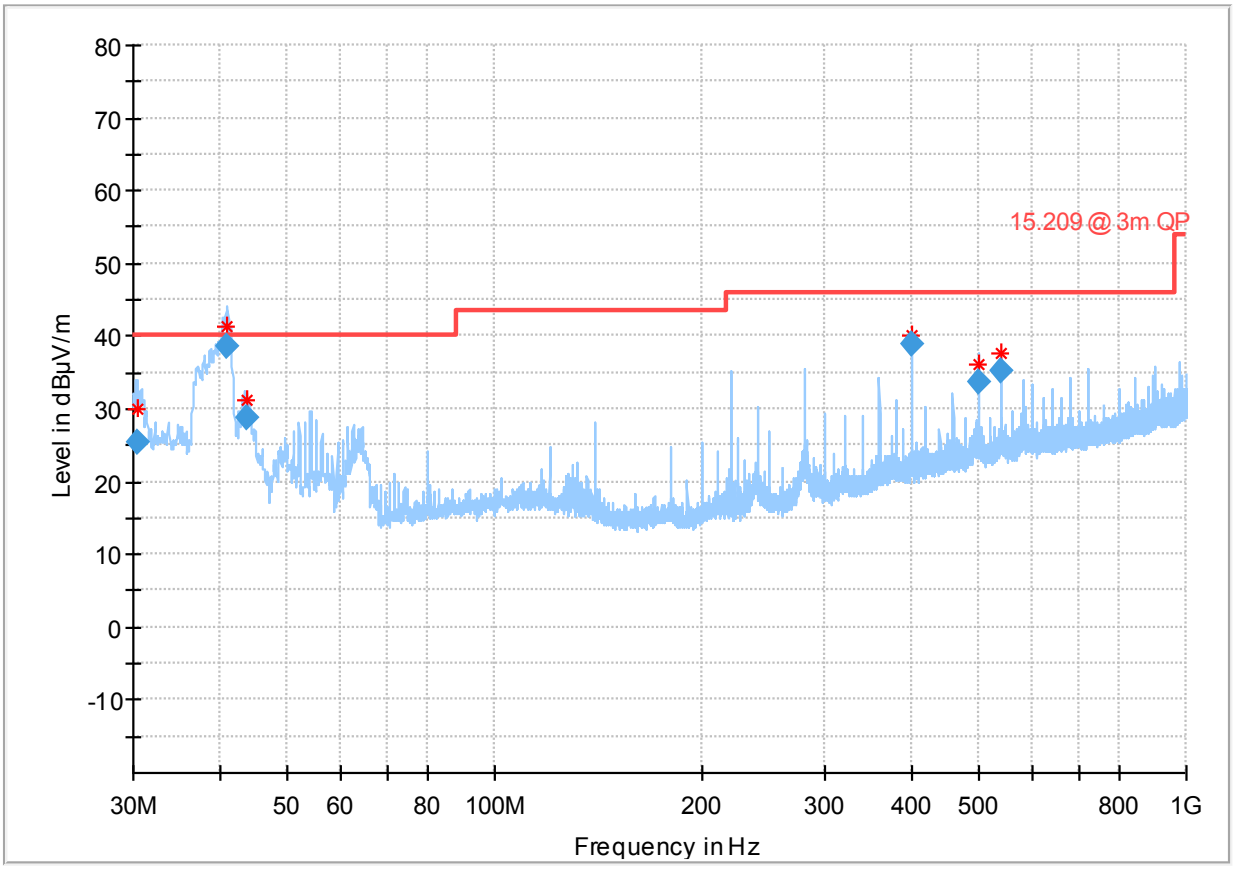
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
30.621500	35.16	40.00	4.84	100.0	120.000	100.0	V	339.0
52.164500	36.27	40.00	3.73	100.0	120.000	100.0	V	86.0
72.608000	27.59	40.00	12.41	100.0	120.000	146.0	V	205.0
240.005000	31.46	46.00	14.54	100.0	120.000	100.0	H	218.0
499.988500	36.56	46.00	9.44	100.0	120.000	100.0	V	69.0

(continuation of the "Final_Result" table from column 15 ...)

Frequency (MHz)	Corr. (dB/m)	Comment
30.621500	20.1	-
52.164500	7.0	-
72.608000	10.1	-
240.005000	11.9	-
499.988500	18.2	-

Plot no. 5: radiated emissions 30 MHz – 1 GHz, hor./vert. polarization, mid frequency



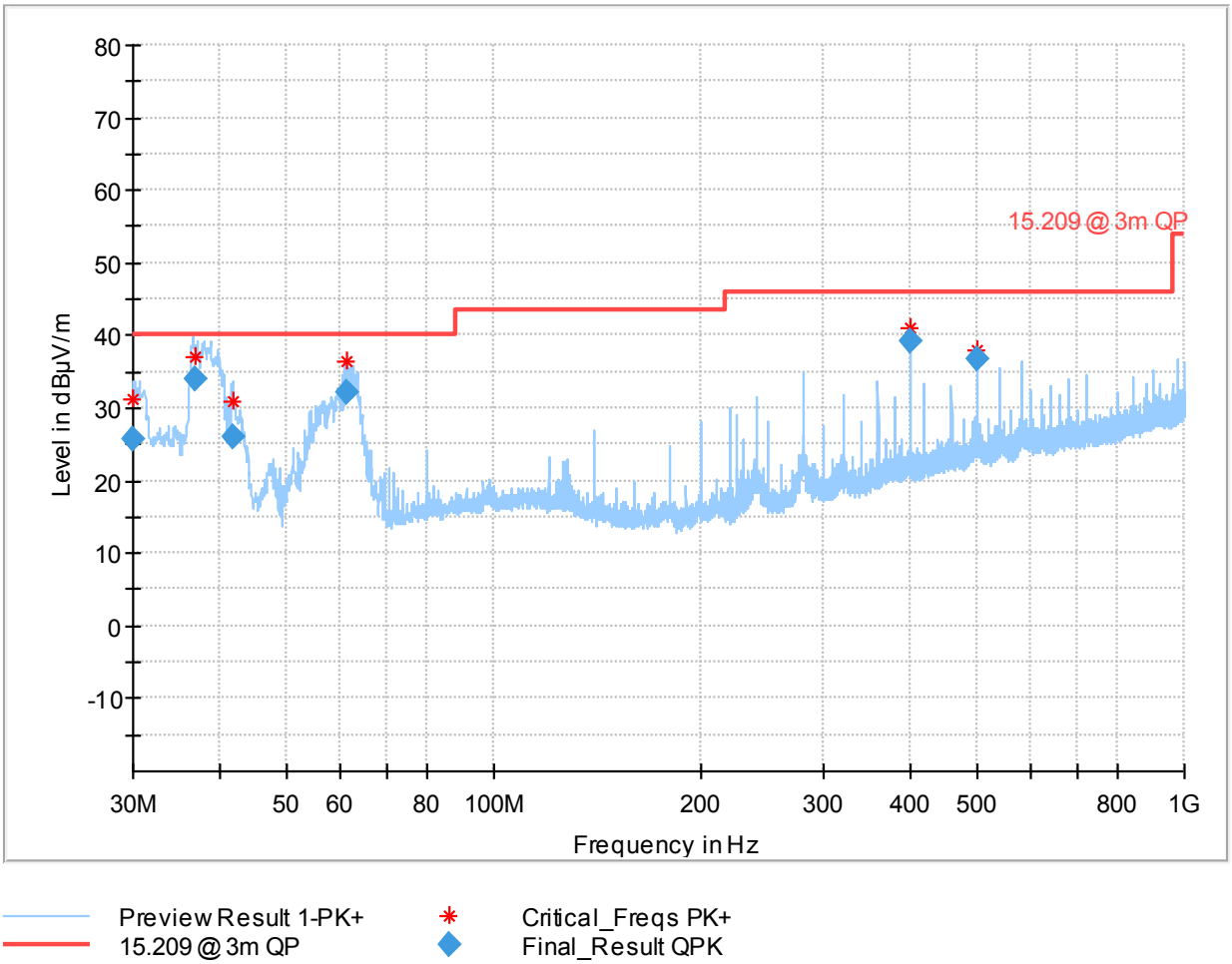
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
30.375000	25.35	40.00	14.65	100.0	120.000	100.0	V	262.0
40.908000	38.69	40.00	1.31	100.0	120.000	100.0	V	37.0
43.736000	28.64	40.00	11.36	100.0	120.000	100.0	V	337.0
400.006500	38.85	46.00	7.15	100.0	120.000	116.0	V	2.0
499.988500	33.71	46.00	12.29	100.0	120.000	119.0	V	103.0
540.001000	35.29	46.00	10.71	100.0	120.000	100.0	V	343.0

(continuation of the "Final_Result" table from column 15 ...)

Frequency (MHz)	Corr. (dB/m)	Comment
30.375000	20.2	-
40.908000	14.3	-
43.736000	12.4	-
400.006500	16.0	-
499.988500	18.2	-
540.001000	18.4	-

Plot no. 6: radiated emissions 30 MHz – 1 GHz, hor./vert. polarization, top frequency



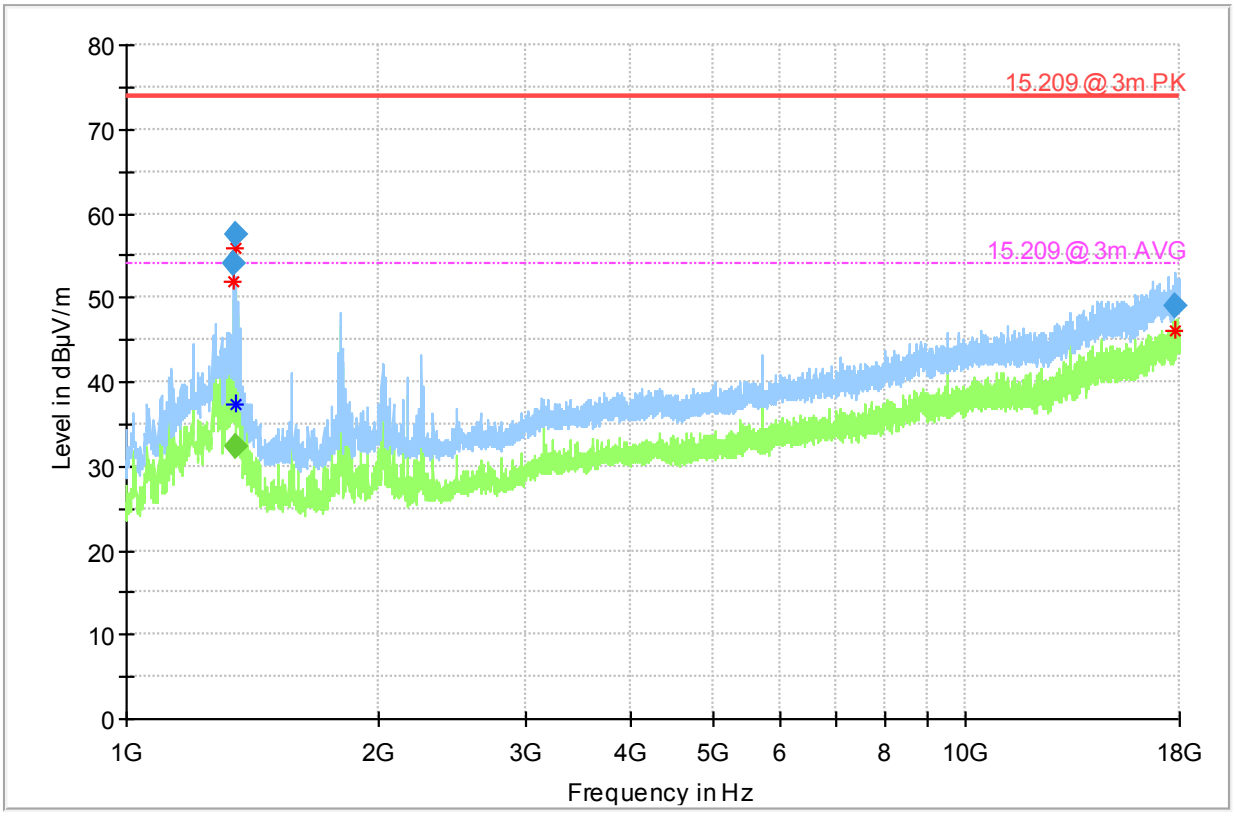
Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
30.075000	25.82	40.00	14.18	100.0	120.000	103.0	V	276.0
36.969500	34.05	40.00	5.95	100.0	120.000	103.0	V	124.0
41.932500	25.92	40.00	14.08	100.0	120.000	201.0	V	14.0
61.356000	32.08	40.00	7.92	100.0	120.000	179.0	V	132.0
400.006500	39.18	46.00	6.82	100.0	120.000	116.0	V	349.0
499.988500	36.62	46.00	9.38	100.0	120.000	100.0	V	165.0

(continuation of the "Final_Result" table from column 15 ...)

Frequency (MHz)	Corr. (dB/m)	Comment
30.075000	20.4	-
36.969500	16.6	-
41.932500	13.6	-
61.356000	7.4	-
400.006500	16.0	-
499.988500	18.2	-

Plot no. 7: radiated emissions 1 GHz – 18 GHz, hor./vert. polarization, bottom frequency



Preview Result 2-AVG
Critical_Freqs PK+
Final_Result PK+
Average-AVG (Single)
Preview Result 1-PK+
15.209 @ 3m PK
Final_Result AVG
Critical_Freqs AVG
15.209 @ 3m AVG
MaxPeak-PK+ (Single)

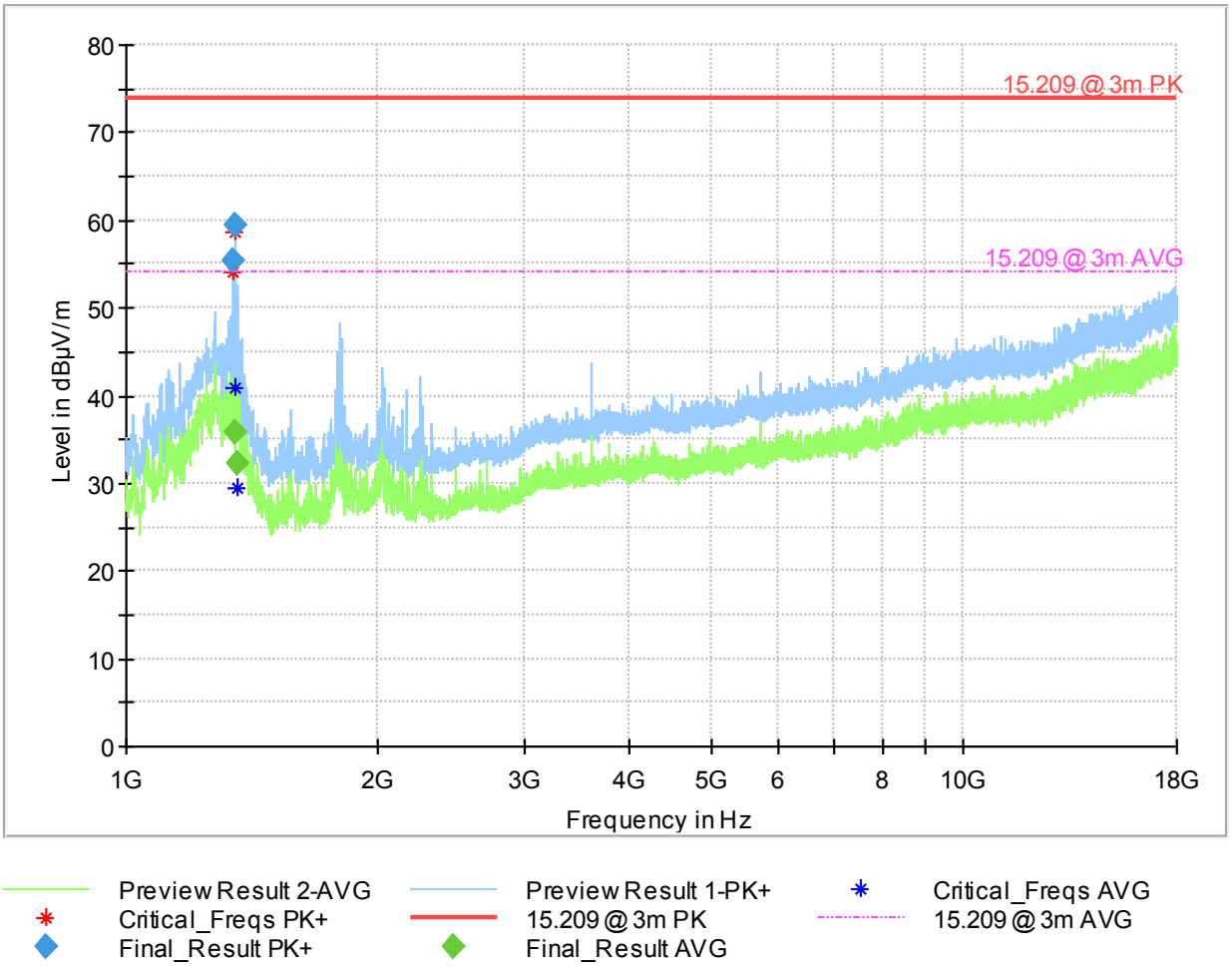
Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
1342.563889	54.01	---	74.00	19.99	100.0	1000.000	150.0	V
1349.969444	57.52	---	74.00	16.48	100.0	1000.000	150.0	V
1349.969444	---	32.39	54.00	21.61	100.0	1000.000	150.0	V
17750.111111	49.12	---	74.00	24.88	100.0	1000.000	150.0	V

(continuation of the "Final_Result" table from column 14 ...)

Frequency (MHz)	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)	Comment
1342.563889	91.0	3.0	-7.1	-
1349.969444	59.0	-17.0	-7.1	-
1349.969444	50.0	10.0	-7.1	-
17750.111111	345.0	-4.0	21.4	-

Plot no. 8: radiated emissions 1 GHz – 18 GHz, hor./vert. polarization, mid frequency



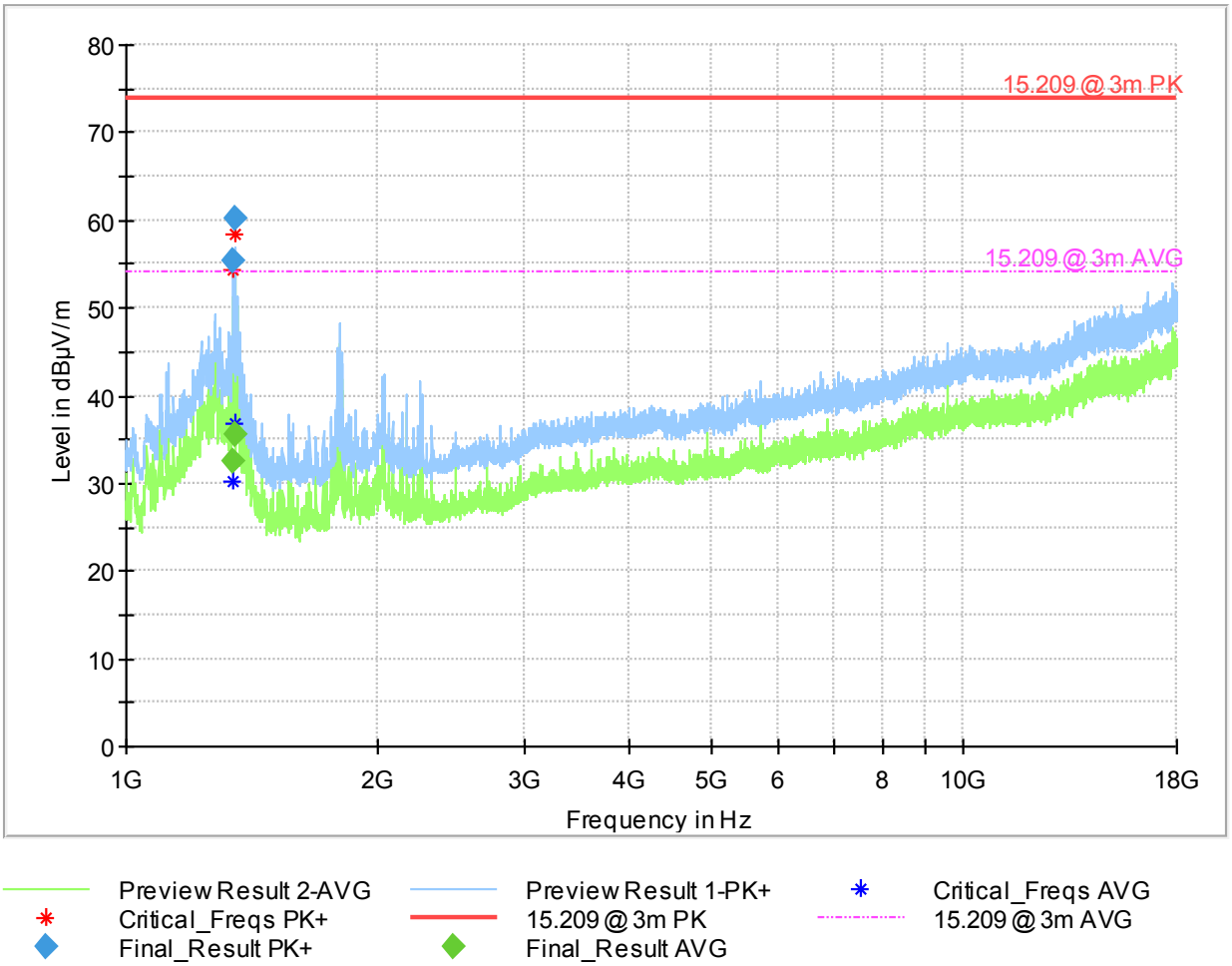
Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
1342.563889	55.44	---	74.00	18.56	100.0	1000.000	150.0	H
1349.969444	---	35.81	54.00	18.19	100.0	1000.000	150.0	H
1349.969444	59.36	---	74.00	14.64	100.0	1000.000	150.0	H
1357.375000	---	32.19	54.00	21.81	100.0	1000.000	150.0	V

(continuation of the "Final_Result" table from column 14 ...)

Frequency (MHz)	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)	Comment
1342.563889	173.0	58.0	-7.1	-
1349.969444	216.0	95.0	-7.1	-
1349.969444	214.0	74.0	-7.1	-
1357.375000	223.0	67.0	-7.0	-

Plot no. 9: radiated emissions 1 GHz – 18 GHz, hor./vert. polarization, top frequency



Final_Result

Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol
1342.563889	---	32.41	54.00	21.59	100.0	1000.000	150.0	H
1342.563889	55.47	---	74.00	18.53	100.0	1000.000	150.0	H
1349.969444	---	35.49	54.00	18.51	100.0	1000.000	150.0	H
1349.969444	60.12	---	74.00	13.88	100.0	1000.000	150.0	H

(continuation of the "Final_Result" table from column 14 ...)

Frequency (MHz)	Azimuth (deg)	Elevation (deg)	Corr. (dB/m)	Comment
1342.563889	214.0	65.0	-7.1	-
1342.563889	211.0	60.0	-7.1	-
1349.969444	226.0	108.0	-7.1	-
1349.969444	224.0	100.0	-7.1	-

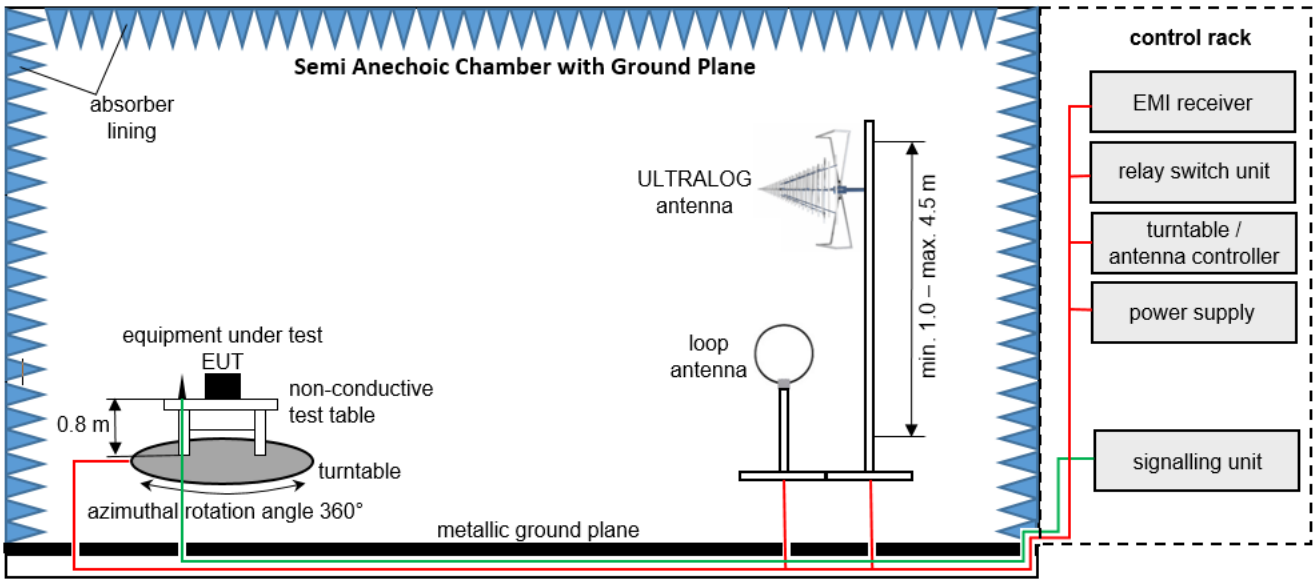
8 Test Setup Description

Typically, the calibrations of the test apparatus are commissioned to and performed by an accredited calibration laboratory. The calibration intervals are determined in accordance with the DIN EN ISO/IEC 17025. In addition to the external calibrations, the laboratory executes comparison measurements with other calibrated test systems or effective verifications. Cyclically chamber inspections and range calibrations are performed. Where possible resp. necessary, RF generating and signaling equipment as well as measuring receivers and analyzers are connected to an external high-precision 10 MHz reference (GPS-based frequency standard).

In order to simplify the identification of the equipment used at some special tests, some items of test equipment and ancillaries can be provided with an identifier or number in the equipment list below (Lab/Item).

8.1 Semi Anechoic Chamber with Ground Plane

Radiated measurements are performed in vertical and horizontal plane in the frequency range 30 MHz to 1 GHz in a Semi Anechoic Chamber with a metallic ground plane. The EUT is positioned on a non-conductive test table with a height of 0.80 m above the metallic ground plane that covers the whole chamber. The receiving antennas conform to specification ANSI C63.10-2013, American National Standard for Testing Unlicensed Wireless Devices. These antennas can be moved over the height range between 1.0 m and 4.5 m in order to search for maximum field strength emitted from the EUT. The measurement distances between EUT and receiving antennas are indicated in the test setups for the various frequency ranges. For each measurement, the EUT is rotated in all three axes until the maximum field strength is received. The wanted and unwanted emissions are received by a spectrum analyzer where the detector modes and resolution bandwidths over various frequency ranges are set according to requirement ANSI C63.



Measurement distance: ULTRALOG antenna 3 m; loop antenna 3 m
EMC32 software version: 11.10.00

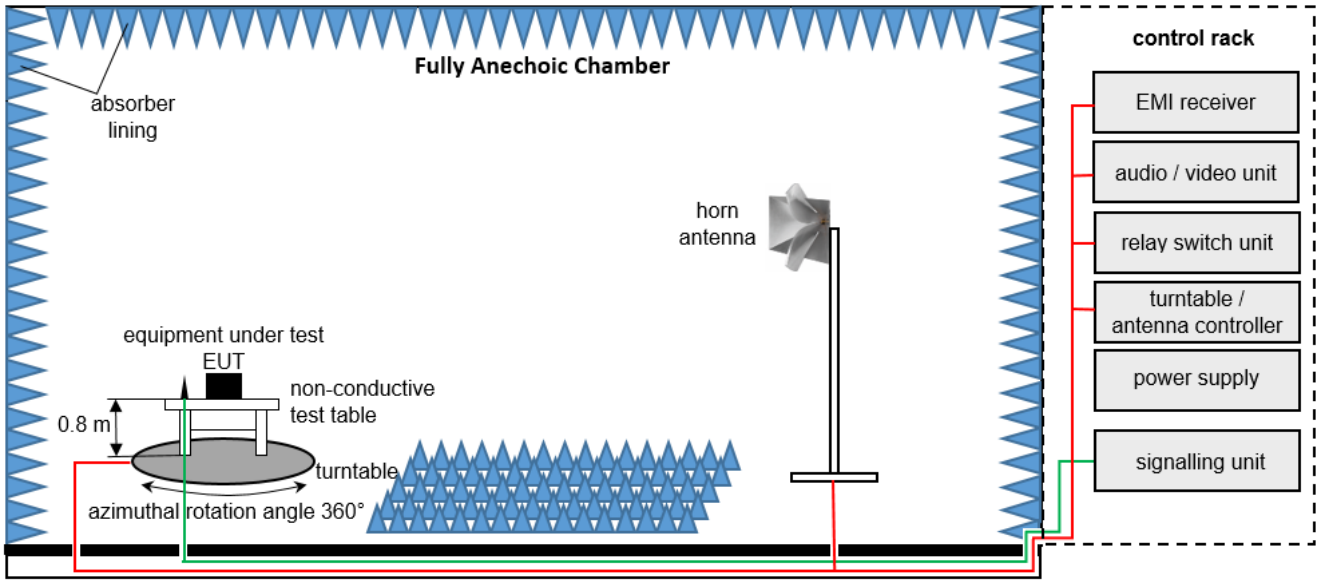
FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

Example calculation:
FS [dBµV/m] = 12.35 [dBµV/m] + 1.90 [dB] + 16.80 [dB/m] = 31.05 [dBµV/m] (35.69 µV/m)

List of test equipment used:

No.	Equipment	Manufacturer	Type	Serial No.	IBL No.	Kind of Calibration	Last / Next Calibration
1	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PSI 9080-40 T	2000230001	LAB000313	NE	–
2	Test table	innco systems GmbH	PT1208-080-RH	-	LAB000306	NE	–
3	Positioner	maturo GmbH	TD 1.5-10KG		LAB000258	NE	–
4	Compressed Air	Implotex	1-850-30	-	LAB000256	NE	–
5	EMI Test Receiver	Rohde & Schwarz	ESW26	101481	LAB000236	K	2022-07-07 → 12M → 2023-07-07
6	Semi-Anechoic Chamber (SAC)	Albatross Projects GmbH	SAC 5 (Babylon 5)	20168.PRB	LAB000235	ZW	2022-01-31 → 36M → 2025-01-31
7	Measurement Software	Rohde & Schwarz	EMC32 V11.00.10		LAB000226	NE	–
8	Turntable	maturo GmbH	TT2.0-2t	TT2.0-2t/921	LAB000225	NE	–
9	Antenna Mast	maturo GmbH	CAM4.0-P	CAM4.0-P/316	LAB000224	NE	–
10	Antenna Mast	maturo GmbH	BAM4.5-P	BAM4.5-P/272	LAB000223	NE	–
11	Controller	maturo GmbH	FCU 3.0	10082	LAB000222	NE	–
12	Power Supply	Elektro-Automatik GmbH & Co. KG	PS 2042-10 B	2878350292	LAB000191	NE	–
13	Open Switch and Control Platform	Rohde & Schwarz	OSP200 Base Unit 2HU	101748	LAB000149	NE	–
14	Antenna	Rohde & Schwarz	HF907	103121	LAB000820	K	2022-12-06 → 36M → 2025-12-06
15	Antenna	Rohde & Schwarz	HL562E	102001	LAB000123	K	2023-04-05 → 36M → 2026-04-05
16	Antenna	Rohde & Schwarz	HFH2-Z2E - Active Loop Antenna	100954	LAB000108	K	2023-05-05 → 36M → 2026-05-05
17	Pre-Amplifier	Schwarzbeck Mess-Elektronik OHG	BBV 9718 C	84	LAB000169	NE	–

8.2 Fully Anechoic Chamber



Measurement distance: horn antenna 3 m
EMC32 software version: 11.10.00

FS = UR + CA + AF
(FS-field strength; UR-voltage at the receiver; CA-loss of the signal path; AF-antenna factor)

Example calculation:
FS [dBµV/m] = 40.0 [dBµV/m] + (-35.8) [dB] + 32.9 [dB/m] = 37.1 [dBµV/m] (71.61 µV/m)

List of test equipment used:

No.	Equipment	Manufacturer	Type	Serial No.	IBL No.	Kind of Calibration	Last / Next Calibration
1	Power Supply	Elektro-Automatik GmbH & Co. KG	EA-PSI 9080-40 T	2000230001	LAB000313	NA	–
2	Test table	innco systems GmbH	PT1208-080-RH	-	LAB000306	NA	–
3	Positioner	maturo GmbH	TD 1.5-10KG		LAB000258	NA	–
4	Compressed Air	Implotex	1-850-30	-	LAB000256	NA	–
5	EMI Test Receiver	Rohde & Schwarz	ESW26	101481	LAB000236	K	2022-07-07 → 12M → 2023-07-07
6	Semi-Anechoic Chamber (SAC)	Albatross Projects GmbH	SAC 5 (Babylon 5)	20168.PRB	LAB000235	ZW	2022-01-31 → 36M → 2025-01-31
7	Measurement Software	Rohde & Schwarz	EMC32 V11.00.10		LAB000226	NA	–
8	Turntable	maturo GmbH	TT2.0-2t	TT2.0-2t/921	LAB000225	NA	–
9	Antenna Mast	maturo GmbH	CAM4.0-P	CAM4.0-P/316	LAB000224	NA	–
10	Antenna Mast	maturo GmbH	BAM4.5-P	BAM4.5-P/272	LAB000223	NA	–
11	Controller	maturo GmbH	FCU 3.0	10082	LAB000222	NA	–
12	Power Supply	Elektro-Automatik GmbH & Co. KG	PS 2042-10 B	2878350292	LAB000191	NA	–
13	Open Switch and Control Platform	Rohde & Schwarz	OSP200 Base Unit 2HU	101748	LAB000149	NA	–
14	Antenna	Rohde & Schwarz	HF907	103121	LAB000820	K	2022-12-06 → 36M → 2025-12-06
15	Antenna	Rohde & Schwarz	HL562E	102001	LAB000123	K	2023-04-05 → 36M → 2026-04-05
16	Antenna	Rohde & Schwarz	HFH2-Z2E - Active Loop Antenna	100954	LAB000108	K	2023-05-05 → 36M → 2026-05-05
17	Pre-Amplifier	Schwarzbeck Mess-Elektronik OHG	BBV 9718 C	84	LAB000169	NA	–

9 Measurement procedures

9.1 Radiated spurious emissions from 9 kHz to 30 MHz

Test setup

- The EUT is set up according to its intended use, as described in the user manual or as defined by the manufacturer.
- In case of floor standing equipment, it is placed in the middle of the turn table.
  In case of tabletop equipment it is placed on a non-conductive table with a height of 80 cm.
- Additional equipment, cables, … necessary for testing, are positioned like under normal operation.
- Interface cables, e.g. power supply, network, … are connected to the connection box in the turn table.
- EUT is powered on and set into operation.

Pre-scan

- Turntable performs an azimuthal rotation from 0° to 315° in 45° steps.
- For each turntable step the EMI-receiver/spectrum analyser performs a positive-peak/max-hold sweep (=worst-case). Data is transferred to EMI-software and recorded. EMI-software will show the maximum level of all single sweeps as the final result for the pre-scan.

Final measurement

- Significant emissions found during the pre-scan will be maximized by the EMI-software by rotating the turntable from 0° to 360°.
- Loop antenna is rotated with special 3D adapter set to find maximum level of emissions.
- Plot of the pre-scan with frequencies of identified emissions including levels, correction factors, turn table position and settings of measuring equipment is recorded.

Distance correction (extrapolation)

- When performing measurements on test distances other than defined in the rules, the results shall be extrapolated to the specified distance by conservatively presuming that the field strength decays at 40 dB/decade of distance in the region closer than λ in m divided by 2π (i.e., λ/2π), and at 20 dB/decade of distance beyond that, using the measurement of a single point at the radial angle that produces the maximum emission.
  This correction is already included in the limit line of corresponding measurement plots.

Detailed requirements can be found in e.g. ANSI C63.4 / C63.10

9.2 Radiated spurious emissions from 30 MHz to 1 GHz

Test setup

- The EUT is set up according to its intended use, as described in the user manual or as defined by the manufacturer.
- In case of floor standing equipment, it is placed in the middle of the turn table.
  In case of tabletop equipment it is placed on a non-conductive table with a height of 80 cm.
- Additional equipment, cables, … necessary for testing, are positioned like under normal operation.
- Interface cables, e.g. power supply, network, … are connected to the connection box in the turn table.
- EUT is powered on and set into operation.

Pre-scan

- Turntable performs an azimuthal rotation from 0° to 315° in 45° steps.
- Antenna polarisation is changed (H-V / V-H) and antenna height is changed from 1 meter to 4 meters.
- For each turntable step / antenna polarisation / antenna height the EMI-receiver/spectrum analyser performs a positive-peak/max-hold sweep (=worst-case). Data is transferred to EMI-software and recorded. EMI-software will show the maximum level of all single sweeps as the final result for the pre-scan.

Final measurement

- Significant emissions found during the pre-scan will be maximized by the EMI-software based on evaluated data during the pre-scan by rotating the turntable and changing antenna height and polarisation.
- Final measurement will be performed with measuring equipment settings as defined in the applicable test standards (e.g. ANSI C6.4).
- Plot of the pre-scan with frequencies of identified emissions including levels, correction factors, turn table position, antenna polarisation and settings of measuring equipment is recorded.

Distance correction (extrapolation)

- When performing measurements on test distances other than defined in the rules, the results shall be extrapolated to the specified distance by conservatively presuming that the field strength decays at 20 dB/decade of distance beyond the region λ in m divided by 2π (i.e., λ/2π), using the measurement of a single point at the radial angle that produces the maximum emission.
  This correction is already included in the corresponding measurement plots.

Detailed requirements can be found in e.g. ANSI C63.4 / C63.10

9.3 Radiated spurious emissions from 1 GHz to 18 GHz

Test setup

- The EUT is set up according to its intended use, as described in the user manual or as defined by the manufacturer.
- In case of floor standing equipment, it is placed in the middle of the turn table.
  In case of tabletop equipment it is placed on a non-conductive table with a height of 80 cm.
- Additional equipment, cables, … necessary for testing, are positioned like under normal operation.
- Interface cables, e.g. power supply, network, … are connected to the connection box in the turn table.
- EUT is powered on and set into operation.

Pre-scan

- Turntable performs an azimuthal rotation from 0° to 315° in 45° steps.
- Antenna polarisation is changed (H-V / V-H) and antenna height is changed from 1 meter to 4 meters.
- For each turntable step / antenna polarisation / antenna height the EMI-receiver/spectrum analyser performs a positive-peak/max-hold sweep (=worst-case). Data is transferred to EMI-software and recorded. EMI-software will show the maximum level of all single sweeps as the final result for the pre-scan.

Final measurement

- Significant emissions found during the pre-scan will be maximized by the EMI-software based on evaluated data during the pre-scan by rotating the turntable and changing antenna height and polarisation.
- Final measurement will be performed with measuring equipment settings as defined in the applicable test standards (e.g. ANSI C6.4).
- Plot of the pre-scan with frequencies of identified emissions including levels, correction factors, turn table position, antenna polarisation and settings of measuring equipment is recorded.

Distance correction (extrapolation)

- When performing measurements on test distances other than defined in the rules, the results shall be extrapolated to the specified distance by conservatively presuming that the field strength decays at 20 dB/decade of distance beyond the region λ in m divided by 2π (i.e., λ/2π), using the measurement of a single point at the radial angle that produces the maximum emission.
  This correction is already included in the corresponding measurement plots.

Detailed requirements can be found in e.g. ANSI C63.4 / C63.10

10 MEASUREMENT UNCERTAINTIES

Radio frequency	≤ ± 10 ppm
Radiated emission	≤ ± 6 dB
Temperature	≤ ± 1 °C
Humidity	≤ ± 5 %
DC and low frequency voltages	≤ ± 3 %

The indicated expanded measurement uncertainty corresponds to the standard measurement uncertainty for the measurement results multiplied by the coverage factor k = 2. It was determined in accordance with EA-4/02 M:2013. The true value is located in the corresponding interval with a probability of 95 %.

Annex 1 EUT Photographs, external

Photo No. 1:

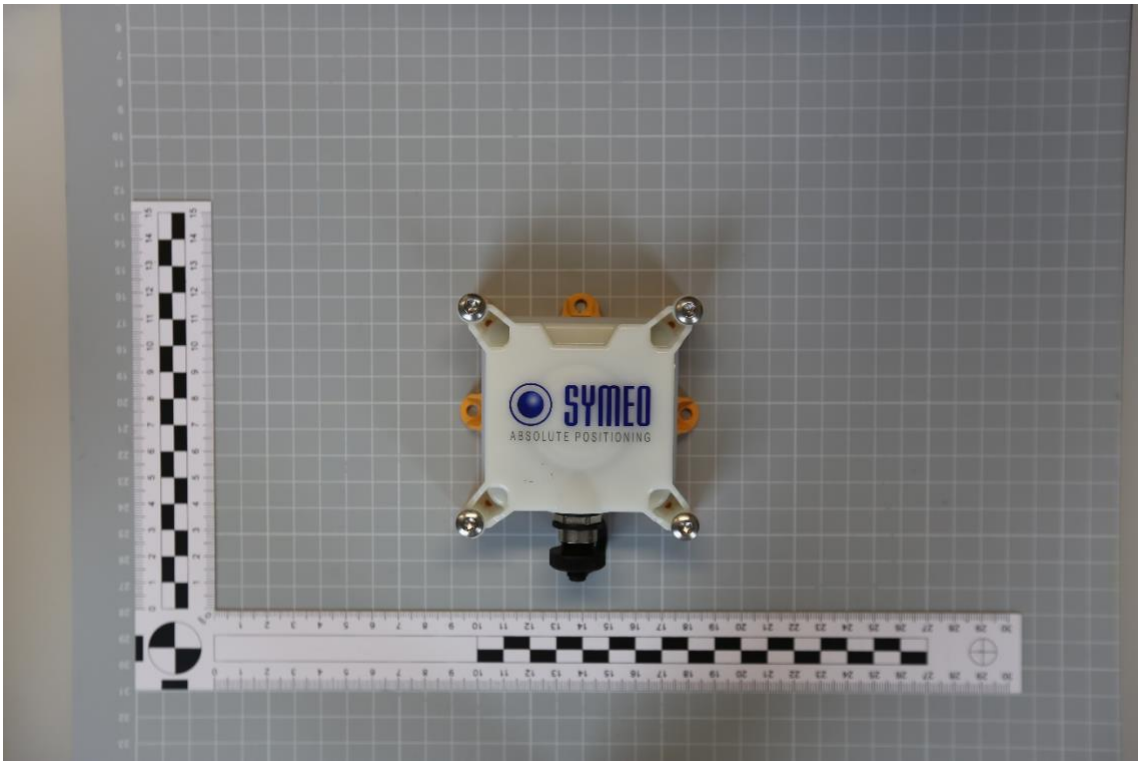


Photo No. 2:

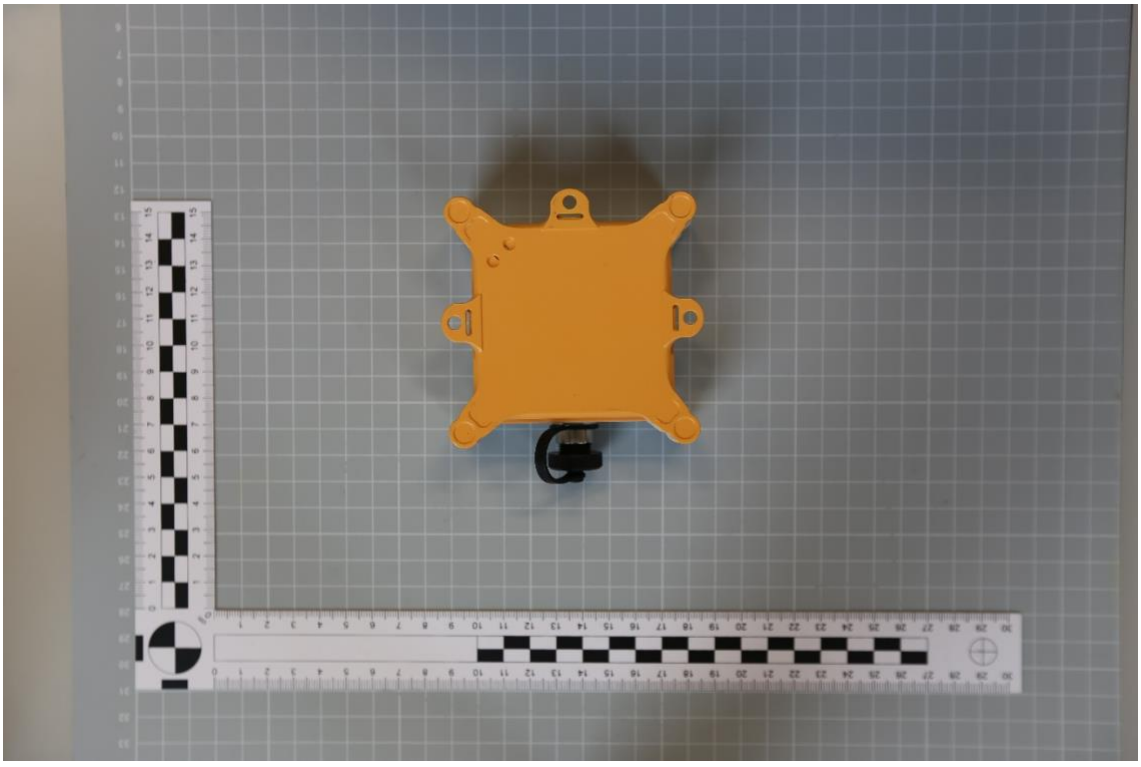


Photo No. 3:

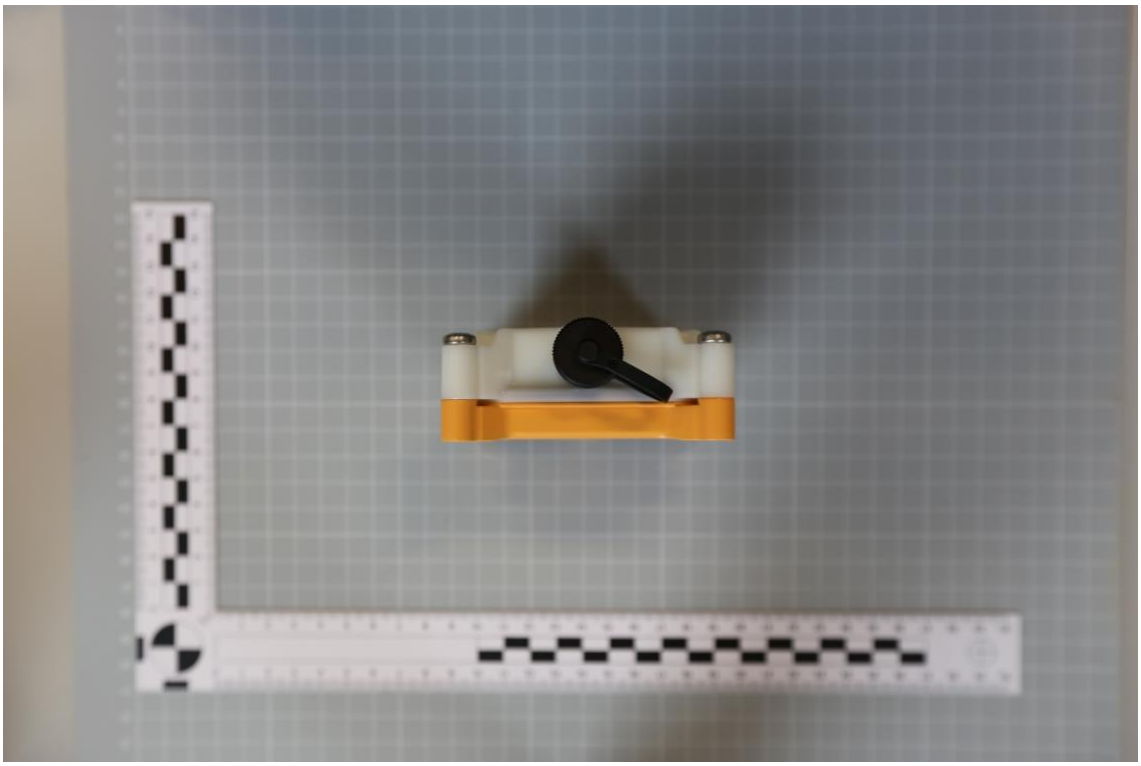


Photo No. 4:

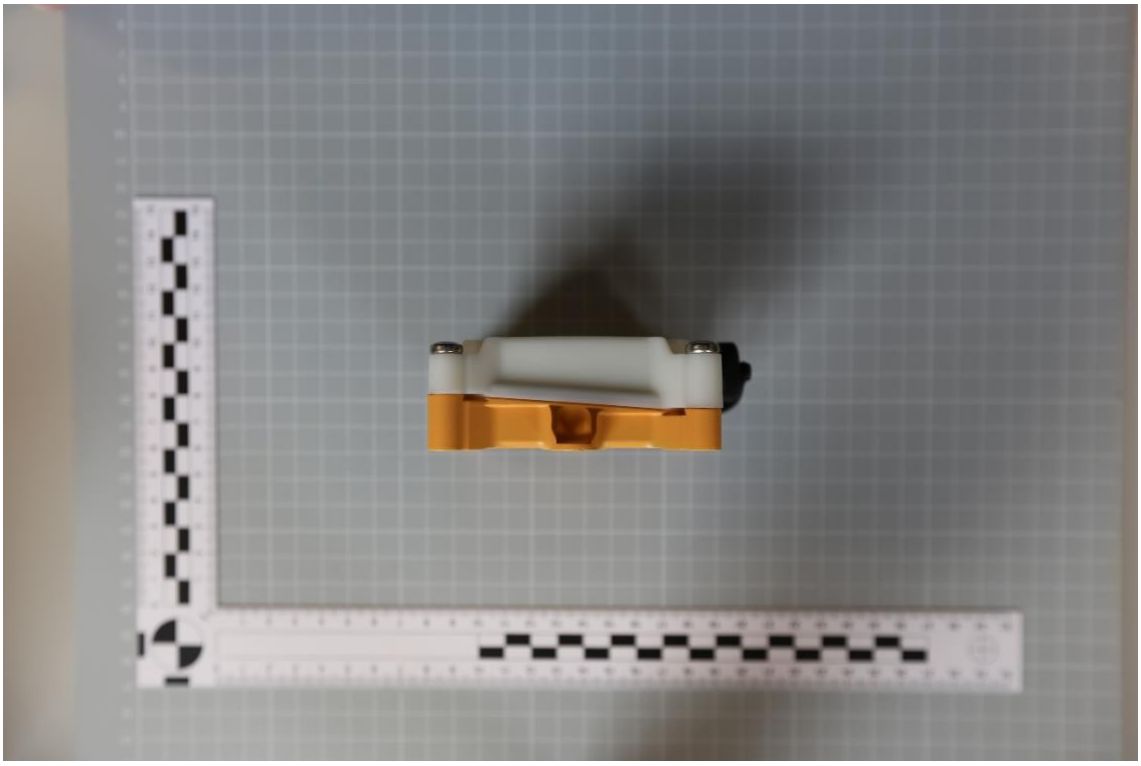


Photo No. 5:

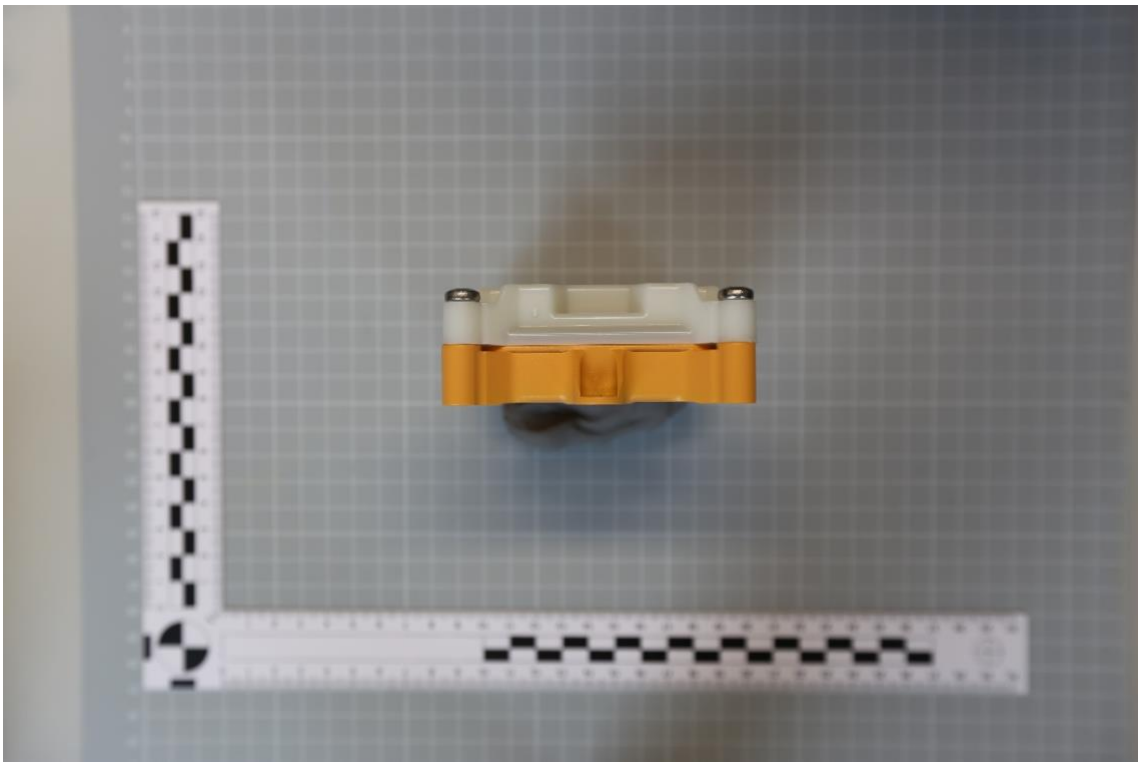
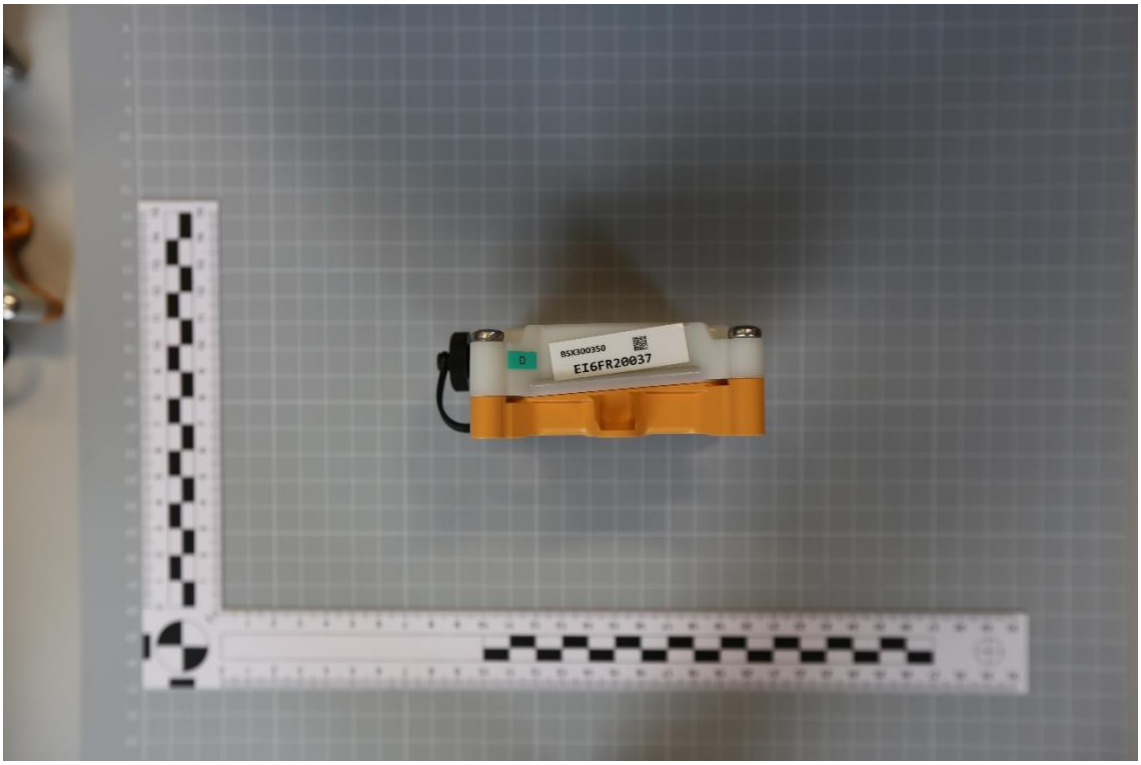


Photo No. 6:



Annex 2 EUT Photographs, internal

Photo No. 7:

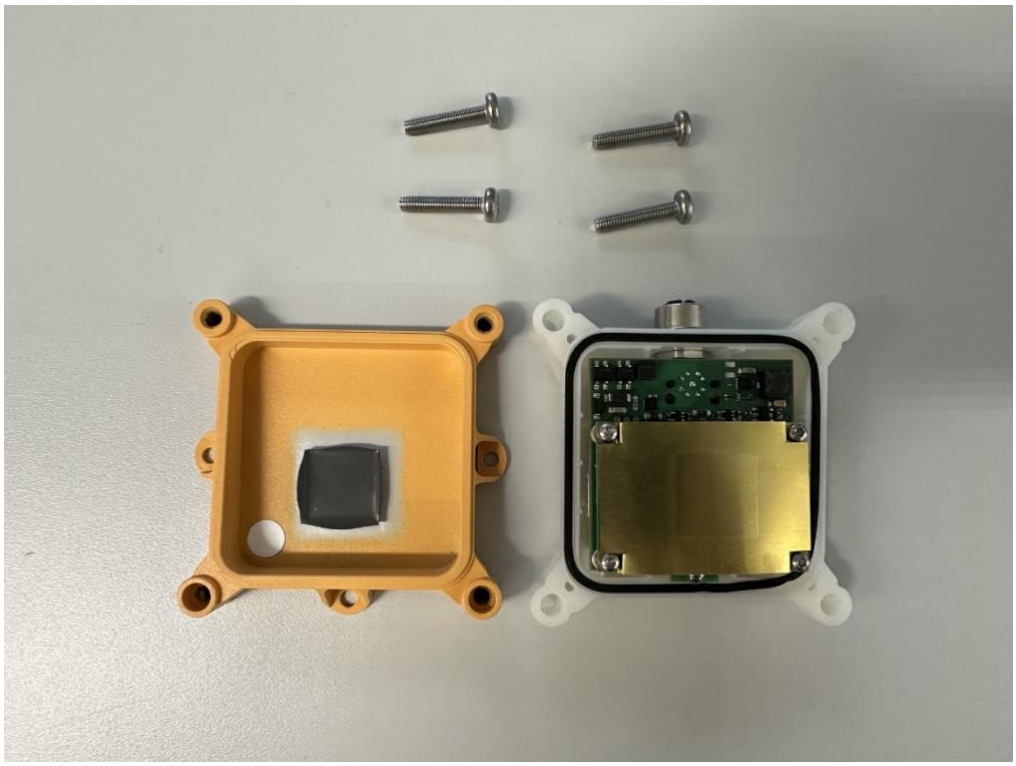


Photo No. 8:

Photo No. 9:

Photo No. 10:

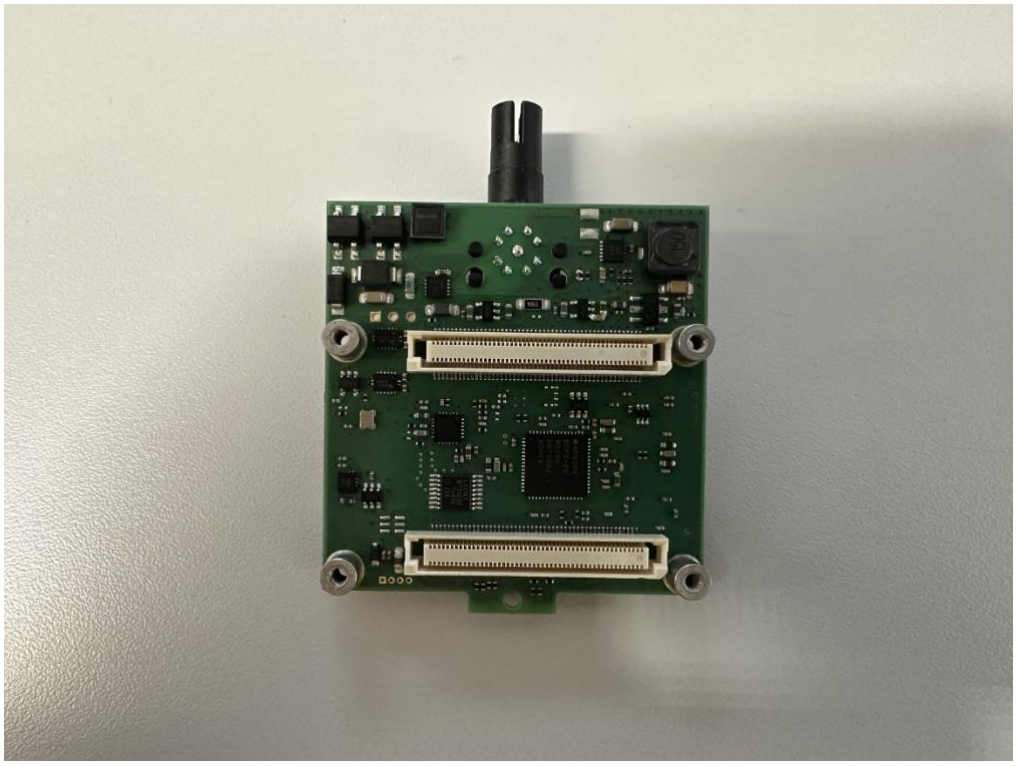
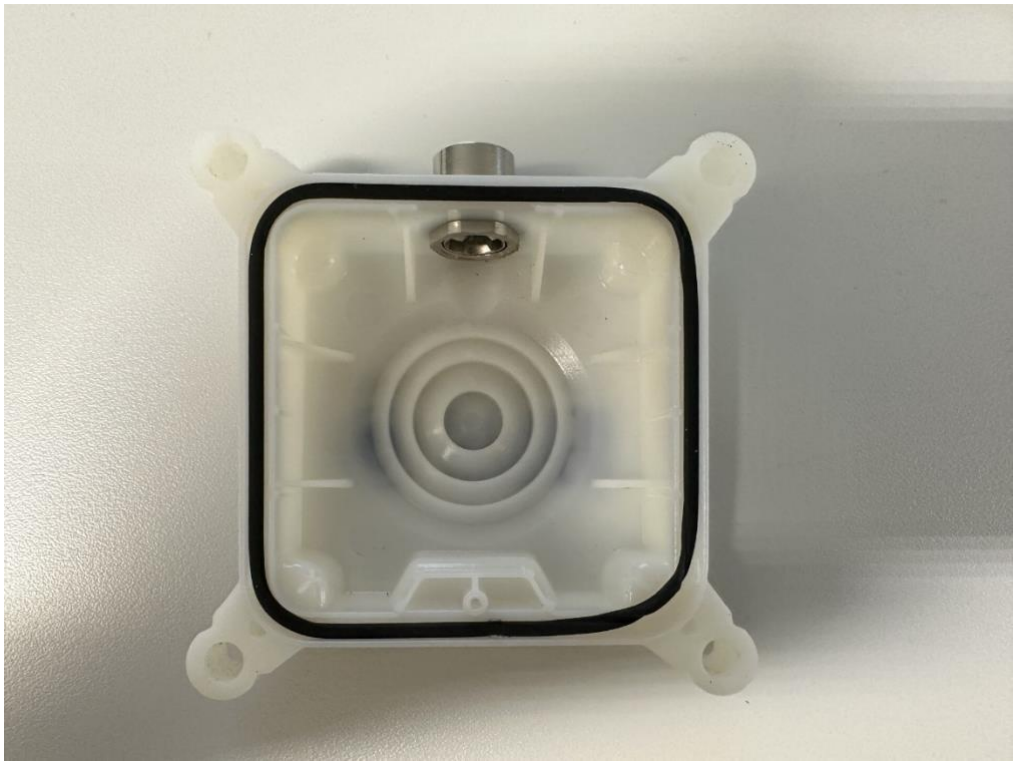


Photo No. 11:

Photo No. 12:



Annex 3 Test Setup Photographs

Photo No. 13:

Photo No. 14:

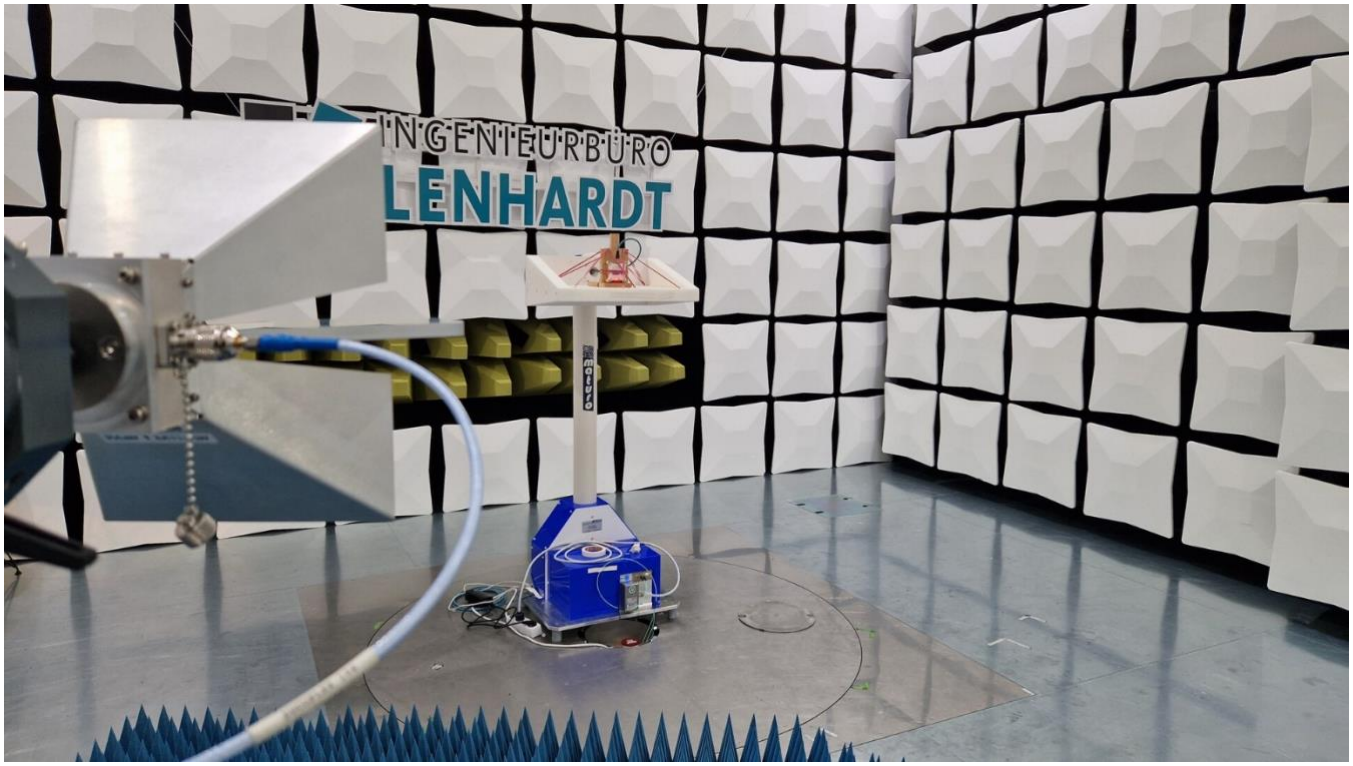
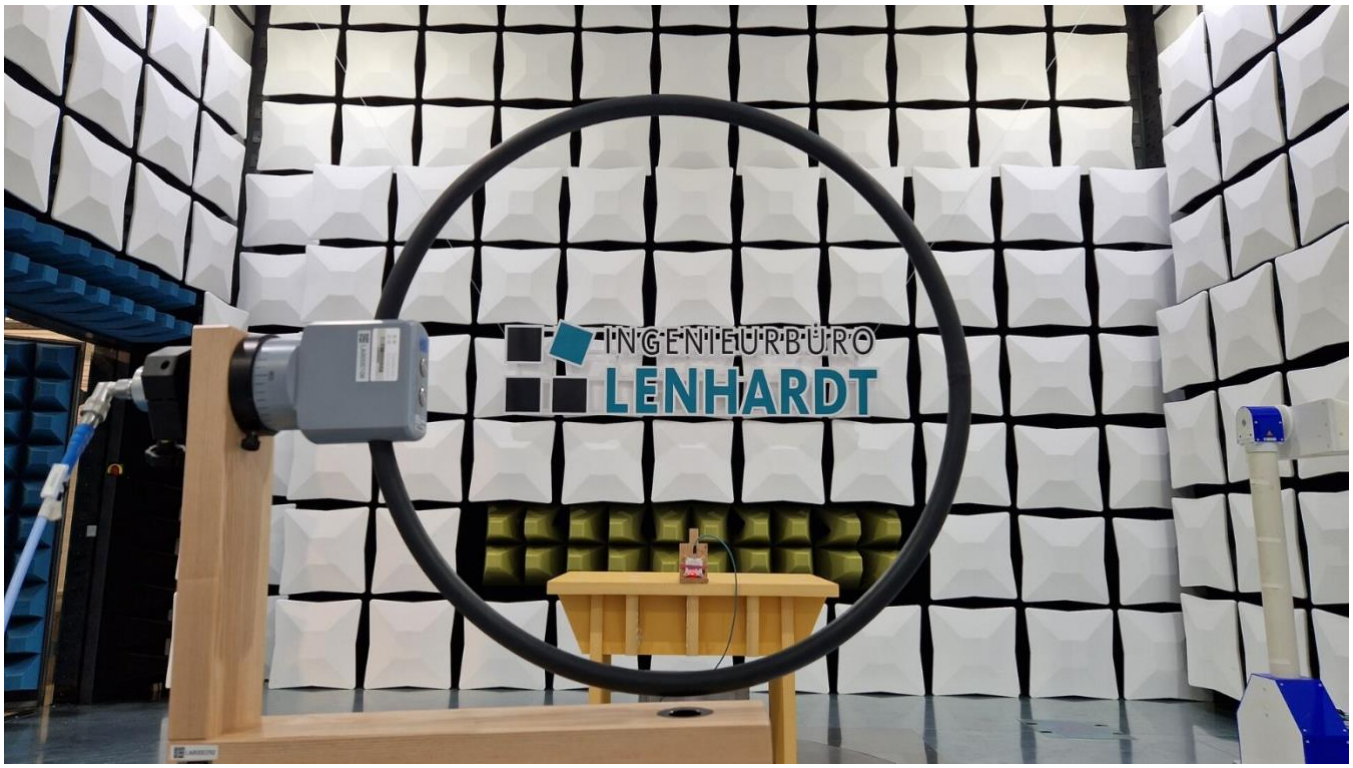


Photo No. 15:

Photo No. 16:



End of Test Report