Test Report

Test report no.: 21014965-18642-1
Date of issue: 2021-07-29

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

Applicant
FEIG ELECTRONIC GmbH

Manufacturer
FEIG ELECTRONIC GmbH

Test Item
ID ECCO Smart

RF-Spectrum Testing according to:

FCC 47 CFR Part 15
Radio Frequency Devices, Subpart C -
§15.225 Operation within the band 13.110-14.010 MHz

RSS-210
Licence-Exempt Radio Apparatus: Category I Equipment

RSS-Gen
General Requirements for Compliance of Radio Apparatus

Tested by (name, function, signature)	*Karsten Geraldy* *Head of Laboratory RF*	p.o. signature
Approved by (name, function, signature)	*Dr.-Ing. Harald Ansorge* *Managing Director*	signature

Applicant and Test item details	
Applicant	FEIG ELECTRONIC GmbH Lange Straße 4 D-35781, Weilburg, Deutschland Fon: +49 6471 31 09 0 Fax: +49 6471 31 09 99
Manufacturer	FEIG ELECTRONIC GmbH Lange Straße 4 D-35781, Weilburg, Deutschland
Test item description	RFID Reader (& Barcode Scanner) with Bluetooth LE
Model/Type reference	ID ECCO Smart
FCC ID	PJMECCOSMRT
IC	6633A-ECCOSMRT
PMN	ID ECCO Smart
HVIN	FE1073
FVIN	N/A
HMN	N/A
Frequency	13.56 MHz
Antenna	Integrated loop antenna
Power supply	Lithium Ion Battery: 3.7 VDC (1250 mAh)
Temperature range	-20 °C – +55 °C

Disclaimer and Notes

The content of this rest report relates to the mentioned test sample(s) only.
Without a written permit of IBL-Lab GmbH, this test report shall not be reproduced, except in full.

The last valid version is available at TAMSys®.

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

IBL-Lab GmbH does not take test samples. The sample used for testing is provided by the applicant.

Decision rule: Binary Statement for Simple Acceptance Rule according 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 Sankt Ingbert / Germany Fon: +49 6894 38938-0 Fax: +49 6894 38938-99 URL: www.ib-lenhardt.de E-Mail: info@ib-lenhardt.de
Accreditation	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: • Electromagnetic Compatibility and Telecommunication (FCC requirements) D-PL-21375-01-03 • Telecommunication (TC) and Electromagnetic Compatibility (EMC) for Canadian Standards D-PL-21375-01-04 ISED Company Number 27156 Testing Laboratory CAB Identifier DE0020 Website DAkkS: https://www.dakks.de/ The Deutsche Akkreditierungsstelle GmbH (DAkkS) is also a signatory to ILAC Mutual Recognition Arrangement
Testing location	**IBL-Lab GmbH** Heinrich-Hertz-Allee 7 66386 St. Ingbert / Germany
Rev -0	-
Date of receipt of test samples	2021-05-03
Start – End of tests	2021-05-04 – 2021-05-07
Rev -1	-
Date of receipt of test samples	2021-07-01
Start – End of tests	2021-07-24 – 2021-07-24

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: technical modification 1/3

Applied changes:

- Test item description changes from “ID ECCO Smart” to “ID ECCO Smart (2D) -HF-BLE”
- Added spot checks for worst case scenario according power consumption for model ID ECCO Smart HF-BLE, spurious emissions

Model Differences:

- ID ECCO Smart 2D-HF-BLE: equipped with camera module
- ID ECCO Smart HF-BLE: not equipped with camera module

-2 Revision: administrative modification/correction

Applied changes:

- Test item description changes from “ID ECCO Smart (2D) -HF-BLE” to “ID ECCO Smart”

This test report 21014965-18642-1 **replaces the previous test report 21014965-18642-1. 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 / 50 Hz

3.2 Normal and extreme test conditions

	minimum	nominal	maximum
Temperature	-20 °C	+22 °C	+55 °C
Relative humidity	-/-	45 % r.h.	-/-
Power supply	3.7 V DC	3.7 V DC	3.7 V DC

4 TEST STANDARDS AND REFERENCES

Test standard (accredited)	Description
FCC 47 CFR Part 15	Radio Frequency Devices, Subpart C - §15.225 Operation within the band 13.110-14.010 MHz
RSS-210	Licence-Exempt Radio Apparatus: Category I Equipment
RSS-Gen	General Requirements for Compliance of Radio Apparatus

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

ID ECCO Smart is a mobile Barcode & RFID detection device with performant scan engine and NFC/RFID interface for working with standard RFID transponders and 1D / 2D barcodes. The read data are transmitted directly via Bluetooth LE interface to a host such as a smartphone, tablet PC, laptop or Bluetooth LE capable PC.

(as declared by applicant)

5.2 Description of test item

Model name*	ID ECCO Smart 2D-HF-BLE
Serial number*	Test sample 1: 2021030101
PCB identifier*	FE1073
Hardware status*	FE1073
Software status*	RF-Stack: 01.00
Model name*	ID ECCO Smart HF-BLE
Serial number*	Test sample 2: 7632921
PCB identifier*	FE1073
Hardware status*	FE1073
Software status*	RF-Stack: 01.00

*: as declared by applicant

5.3 Technical data of test item

Operational carrier frequency*	13.56 MHz
Operational frequency band*	13.11 – 14.01 MHz
Type of radio transmission*	modulated carrier
Modulation type*	AM-Modulation acc. to ISO15693/ISO1443
Number of channels*	1
Channel bandwidth*	<1 MHz
Channel spacing*	-/-
Antenna*	Integrated loop antenna
Power supply*	Lithium Ion Battery: 3.7 VDC (1250 mAh)
Temperature range*	-20 °C – +55 °C

*: as declared by applicant

5.4 Additional information

Model differences	None
Ancillaries tested with	None
Additional equipment used for testing	None

Equipment Under Test (EUT) is prepared by the applicant with special test software to produce a continuously operating carrier.

6 SUMMARY OF TEST RESULTS

Test specification
FCC 47 CFR Part 15 RSS-210 / RSS-Gen

Clause	Requirement / Test case	Test Conditions	Result / Remark	Verdict
§15.225 (a) – (c) RSS-210, B.6 a	Field strength of emissions (transmitter spectrum mask)	Normal	70 dBµV/m @3m	- PASS -
§15.225(d) / §15.209(a) // RSS-210, B.6 a RSS-Gen	Field strength of emissions (spurious & harmonics)	Normal	< limit	- PASS -
§15.225(e) RSS-210, B.6 b	Frequency tolerance	Extreme	< 0.002 % < 20 ppm	- PASS -
§15.207 RSS-Gen, 8.8	Conducted limits	Normal	battery powered	- N/A -
§15.215(c) RSS-Gen, 6.7	20 dB bandwidth Occupied bandwidth	Extreme	27.97 kHz 32.986 kHz	- PASS -

Notes
Following pages show requirements and references of FCC Part 15.225 and ANSI C63.10 only. Same tests are also applicable and valid for RSS-210 and RSS-Gen, with clauses given in table above.

Comments and observations
none

7 TEST RESULTS

7.1 Field strength of emissions (transmitter spectrum mask)

Description / Limits

§15.225

(a) The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15848 microvolts/meter at 30 meters (84 dBµV/m).

(b) Within the bands 13.410-13.553 MHz and 13.567-13.710 MHz, the field strength of any emissions shall not exceed 334 microvolts/meter at 30 meters (50.5 dBµV/m).

(c) Within the bands 13.110-13.410 MHz and 13.710-14.010 MHz the field strength of any emissions shall not exceed 106 microvolts/meter at 30 meters (40.5 dBµV/m).

Test procedure

§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
< 1 MHz 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 (a) On any frequency or frequencies below or equal to 1000 MHz, the limits shown are based on measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths, unless otherwise specified. The specifications for the measuring instrumentation using the CISPR quasi-peak detector can be found in ANSI C63.4-2014, clause 4 (incorporated by reference, see §15.38). As an alternative to CISPR quasi-peak measurements, the responsible party, at its option, may demonstrate compliance with the emission limits using measuring equipment employing a peak detector function as long at the same bandwidth as indicated for CISPR quasi-peak measurements are employed.

Test setup: 8.1

Test distance correction factor of 40dB resp. 20dB/decade is already considered in the plots / result table.

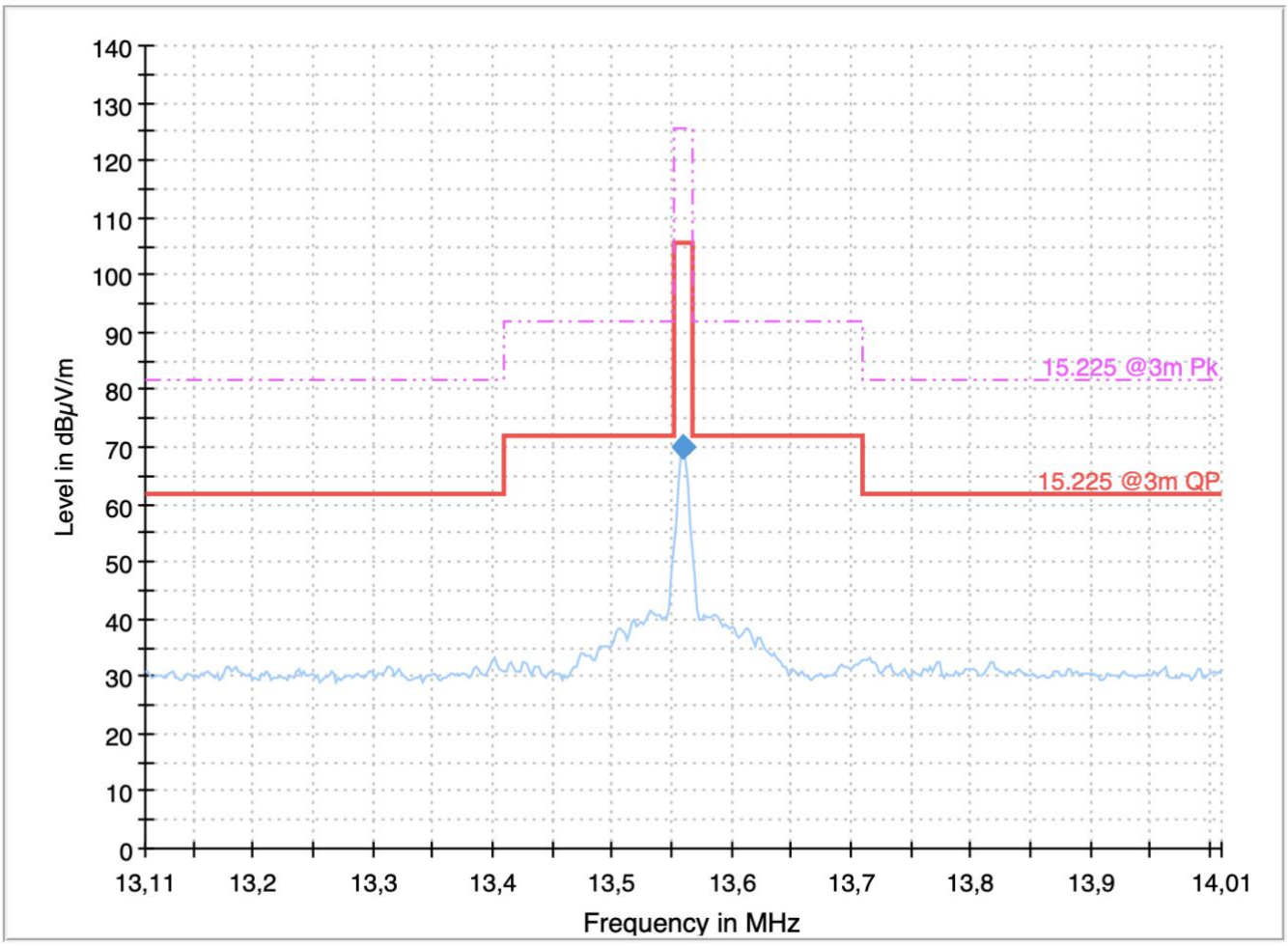
Test results

Channel / Mode	Frequency [MHz]	Detector	Test distance [m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]
Test mode EUT lying	13.56	QP	3	70.0	105.4	35.4
Test mode EUT standing	13.56	QP	3	68.5	105.4	36.9

Comment:	---

Verdict	**- PASS -**	*see plots*

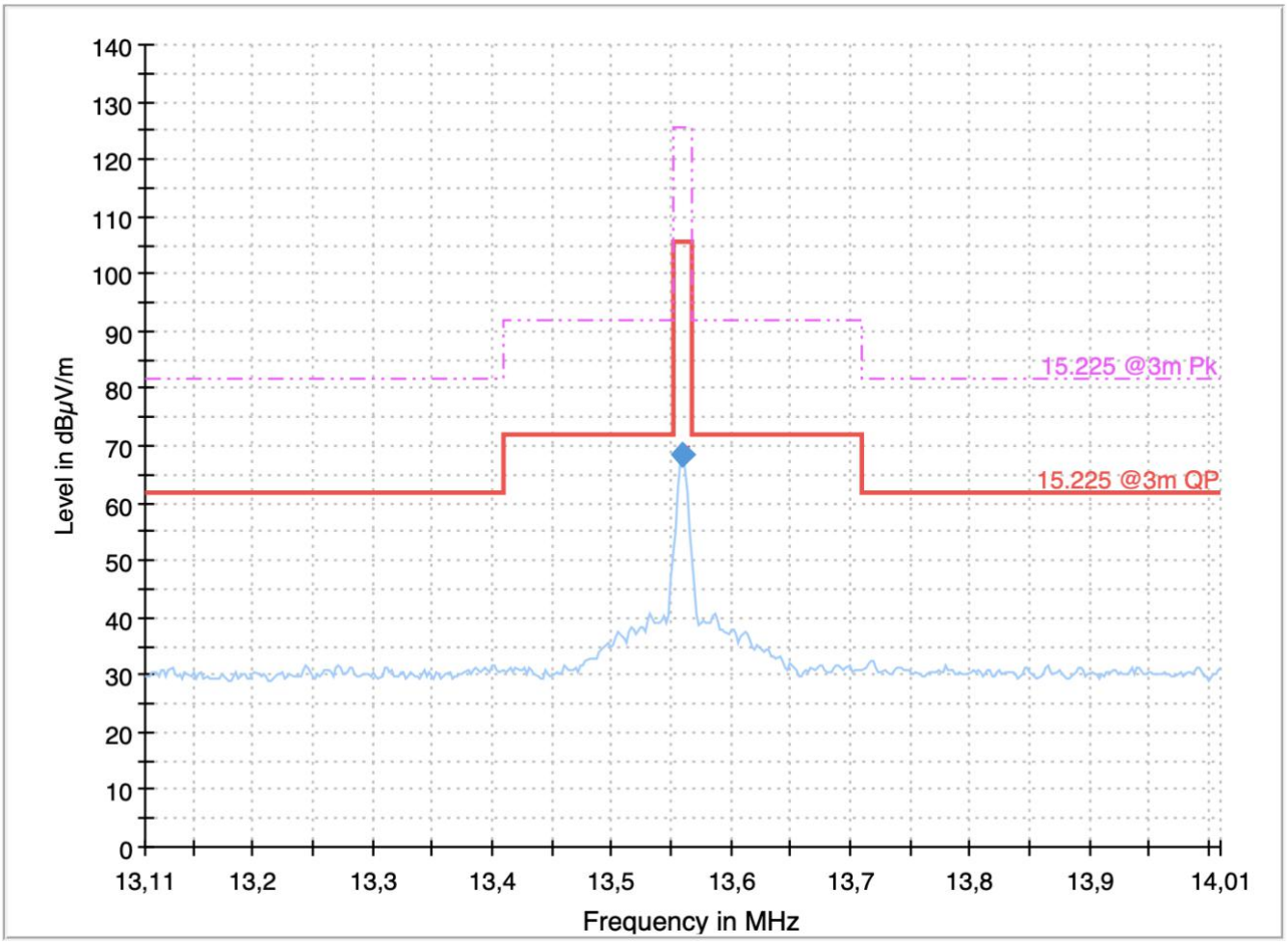
Plot no. 1: Transmitter Spectrum Mask (TSM), loop antenna, EUT lying



Final_Result

Frequency [MHz]	QuasiPeak [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Meas. Time [ms]	Bandwidth [kHz]	Pol	Azimuth [deg]	Corr. [dB/m]
13.560000	69.97	105.40	35.43	100.0	9.000	H	19.0	20.5

Plot no. 2: Transmitter Spectrum Mask (TSM), loop antenna, EUT standing



Final_Result

Frequency [MHz]	QuasiPeak [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Meas. Time [ms]	Bandwidth [kHz]	Pol	Azimuth [deg]	Corr. [dB/m]
13.560000	68.45	105.40	36.95	100.0	9.000	H	200.0	20.5

7.2 Field strength of emissions (spurious and harmonics)

Description / Limits

§15.225 (d) The field strength of any emissions appearing outside of the 13.110-14.010 MHz band shall not exceed the general radiated emission 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 – 100 000 MHz	500 µV/m / 54.0 dBµV/m	3 m

Test procedure

§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 (a) On any frequency or frequencies below or equal to 1000 MHz, the limits shown are based on measuring equipment employing a CISPR quasi-peak detector function and related measurement bandwidths, unless otherwise specified. The specifications for the measuring instrumentation using the CISPR quasi-peak detector can be found in ANSI C63.4-2014, clause 4 (incorporated by reference, see §15.38). As an alternative to CISPR quasi-peak measurements, the responsible party, at its option, may demonstrate compliance with the emission limits using measuring equipment employing a peak detector function as long at the same bandwidth as indicated for CISPR quasi-peak measurements are employed.

Test setup: 8.1

Test distance correction factor of 40dB resp. 20dB/decade is already considered in the plots / result table.

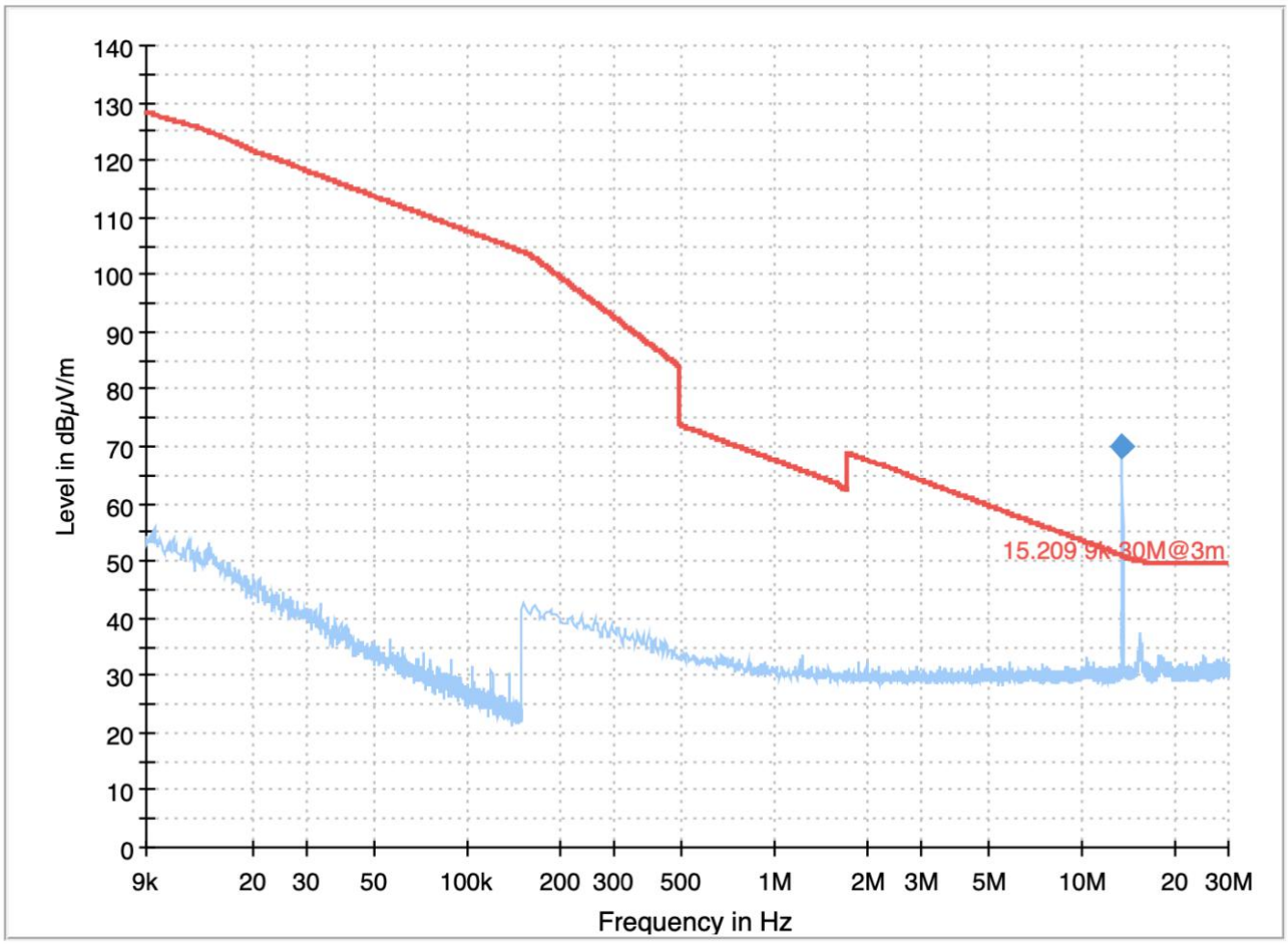
Test results, EUT Testsample 1

Channel / Mode	Frequency [MHz]	Detector	Test distance [m]	Level [dBµV/m]	Limit [dBµV/m]	Margin [dB]
EUT lying	13.560000	QP	3	69.97	105.40	35.43
	30.775000	QP	3	19.79	40.00	20.21
	298.325000	QP	3	30.57	46.00	15.43
	433.925000	QP	3	20.90	46.00	25.10
EUT standing	13.560000	QP	3	68.45	105.40	36.95
	298.325000	QP	3	31.89	46.00	14.11
	474.600000	QP	3	23.74	46.00	22.26
	976.325000	QP	3	21.07	54.00	32.93

Comment:	---

Verdict	**- PASS -**	*see plots*

Plot no. 3: radiated emissions 9 kHz – 30 MHz, loop antenna, EUT lying

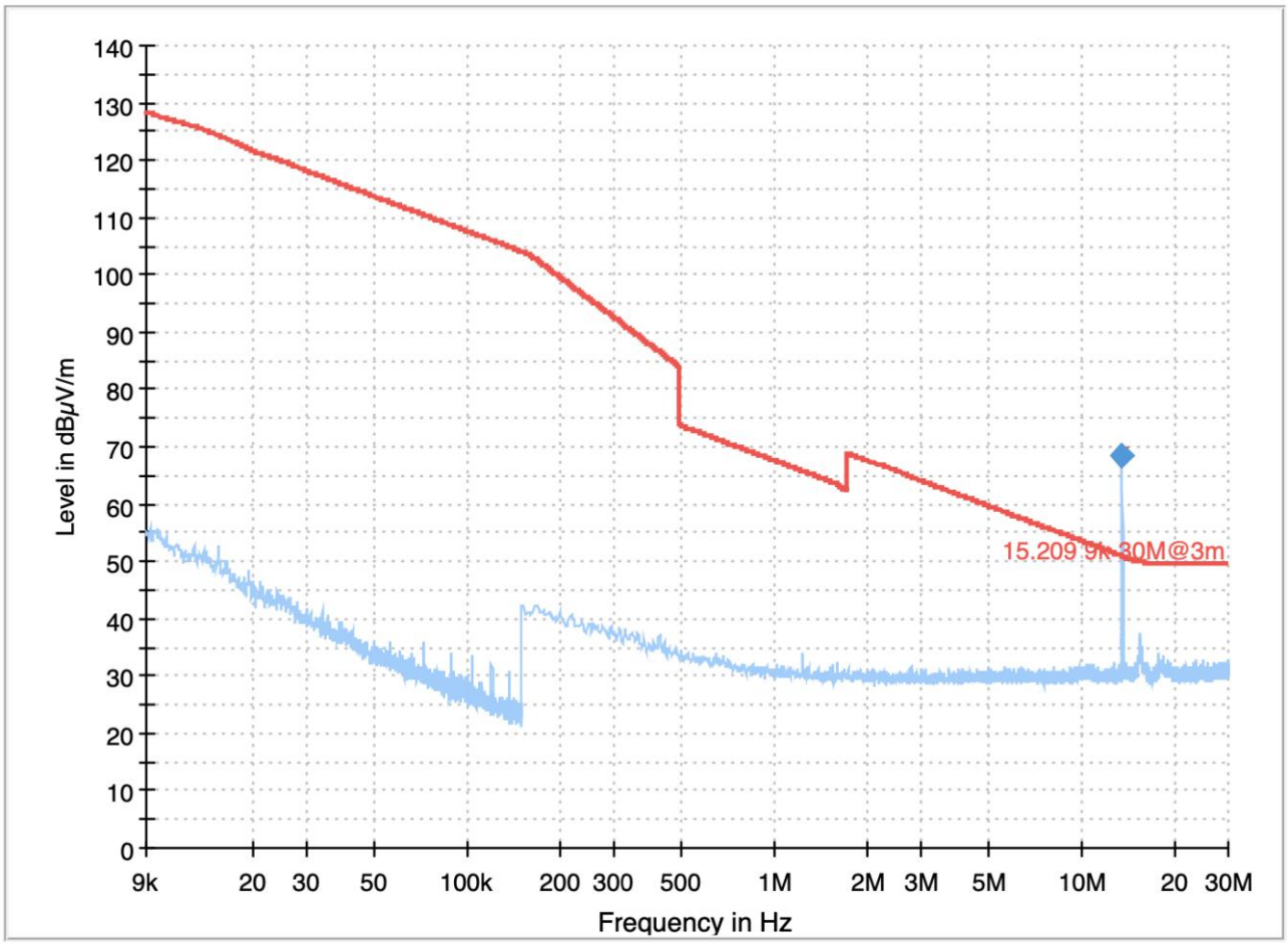


Final_Result

Frequency [MHz]	QuasiPeak [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Meas. Time [ms]	Bandwidth [kHz]	Pol	Azimuth [deg]	Corr. [dB/m]
13.560000	69.98	50.94	-19.04	100.0	9.000	H	17.0	20.5

Note:
Please see plot no. 1 for transmitter spectrum mask (TSM)!

Plot no. 4: radiated emissions 9 kHz – 30 MHz, loop antenna, EUT standing

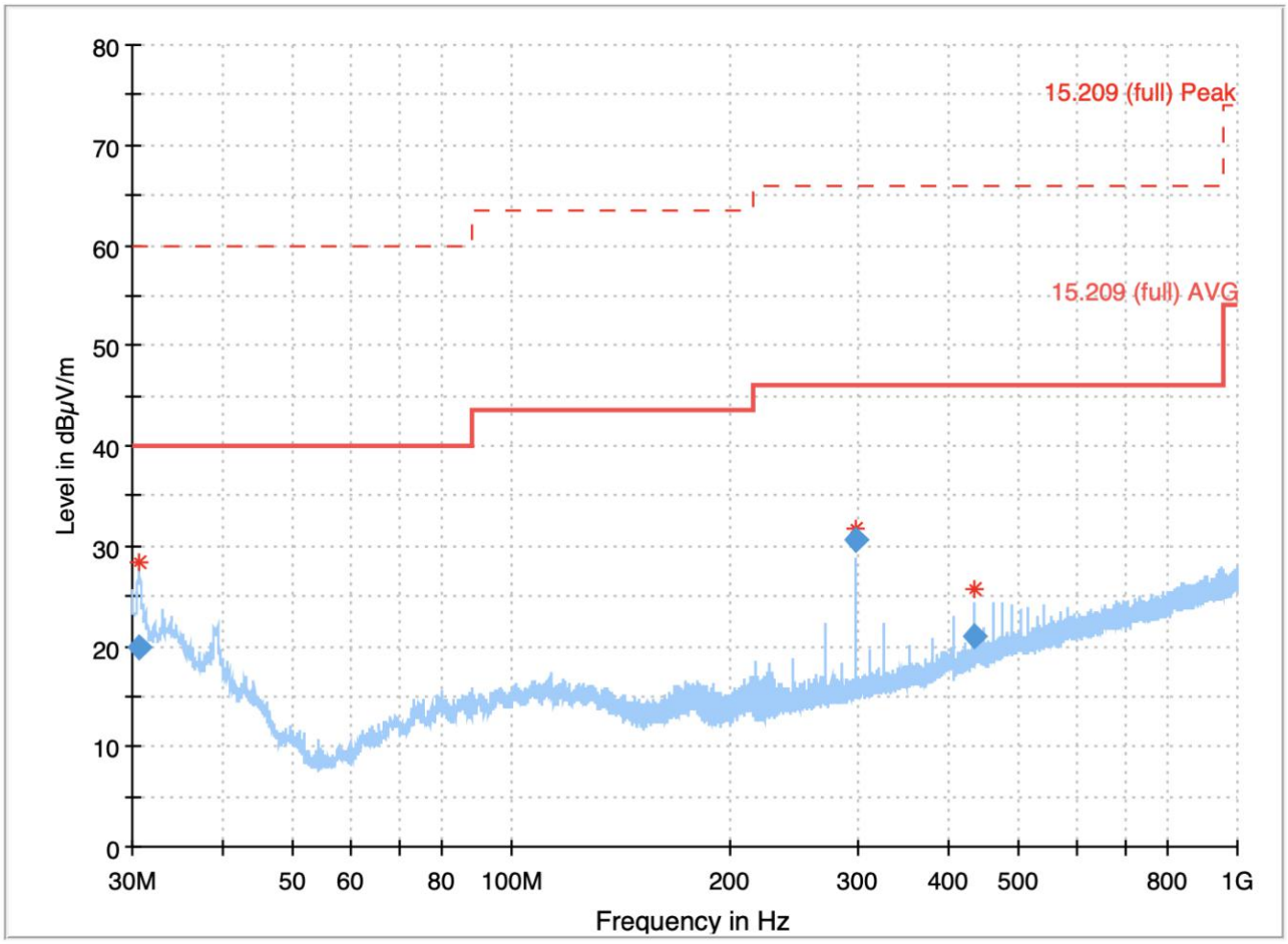


Final_Result

Frequency [MHz]	QuasiPeak [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Meas. Time [ms]	Bandwidth [kHz]	Pol	Azimuth [deg]	Corr. [dB/m]
13.560000	68.49	50.94	-17.55	100.0	9.000	H	207.0	20.5

Note:
Please see plot 2 for transmitter spectrum mask (TSM)!

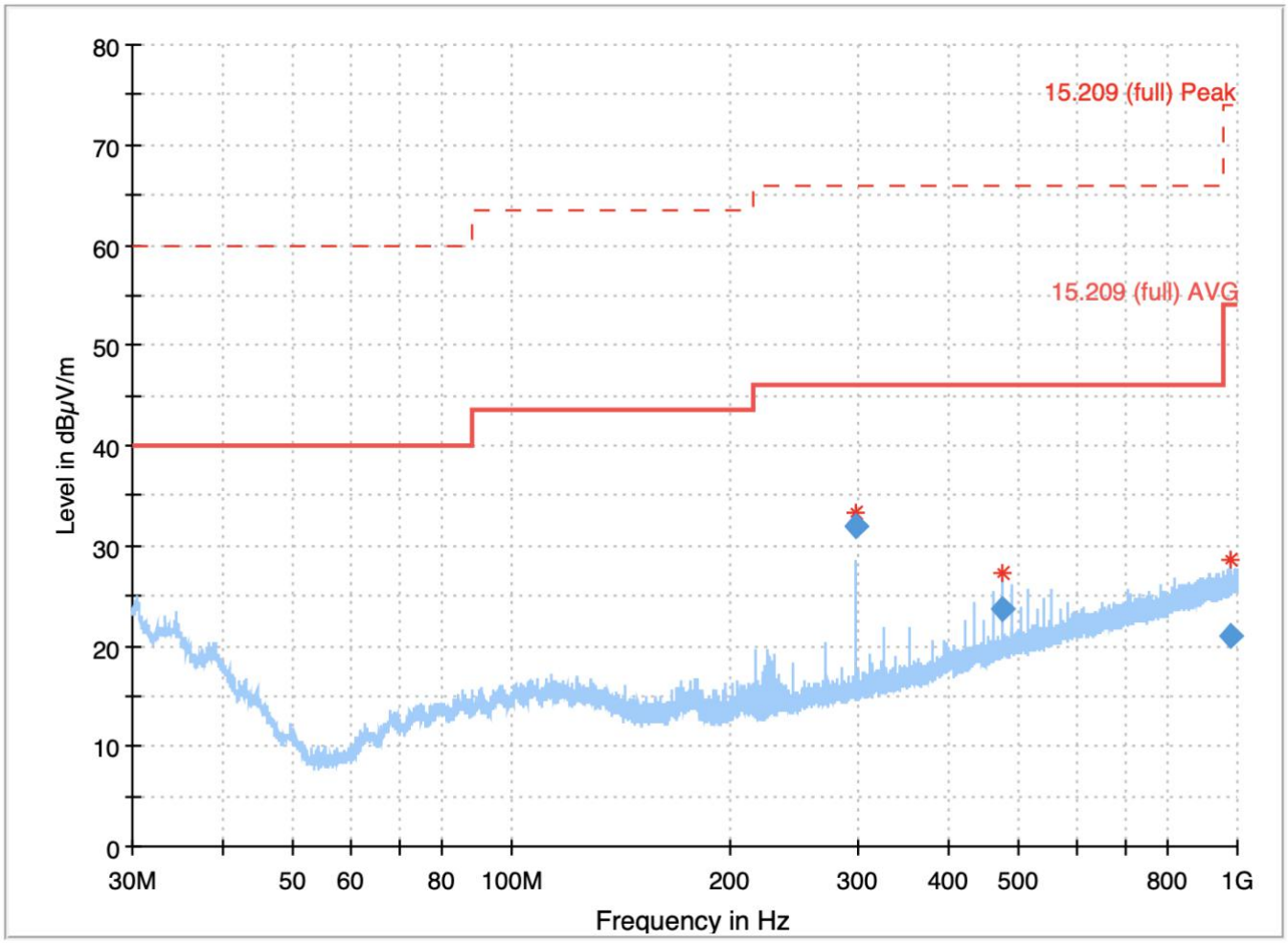
Plot no. 5: radiated emissions 30 MHz – 1 GHz, hor./vert. polarization, EUT lying



Final_Result

Frequency [MHz]	QuasiPeak [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Meas. Time [ms]	Bandwidth [kHz]	Height [cm]	Pol	Azimuth [deg]	Corr. [dB/m]
30.775000	19.79	40.00	20.21	100.0	120.000	100.0	V	208.0	20.0
298.325000	30.57	46.00	15.43	100.0	120.000	150.0	H	270.0	13.3
433.925000	20.90	46.00	25.10	100.0	120.000	104.0	V	42.0	16.7

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



Final_Result

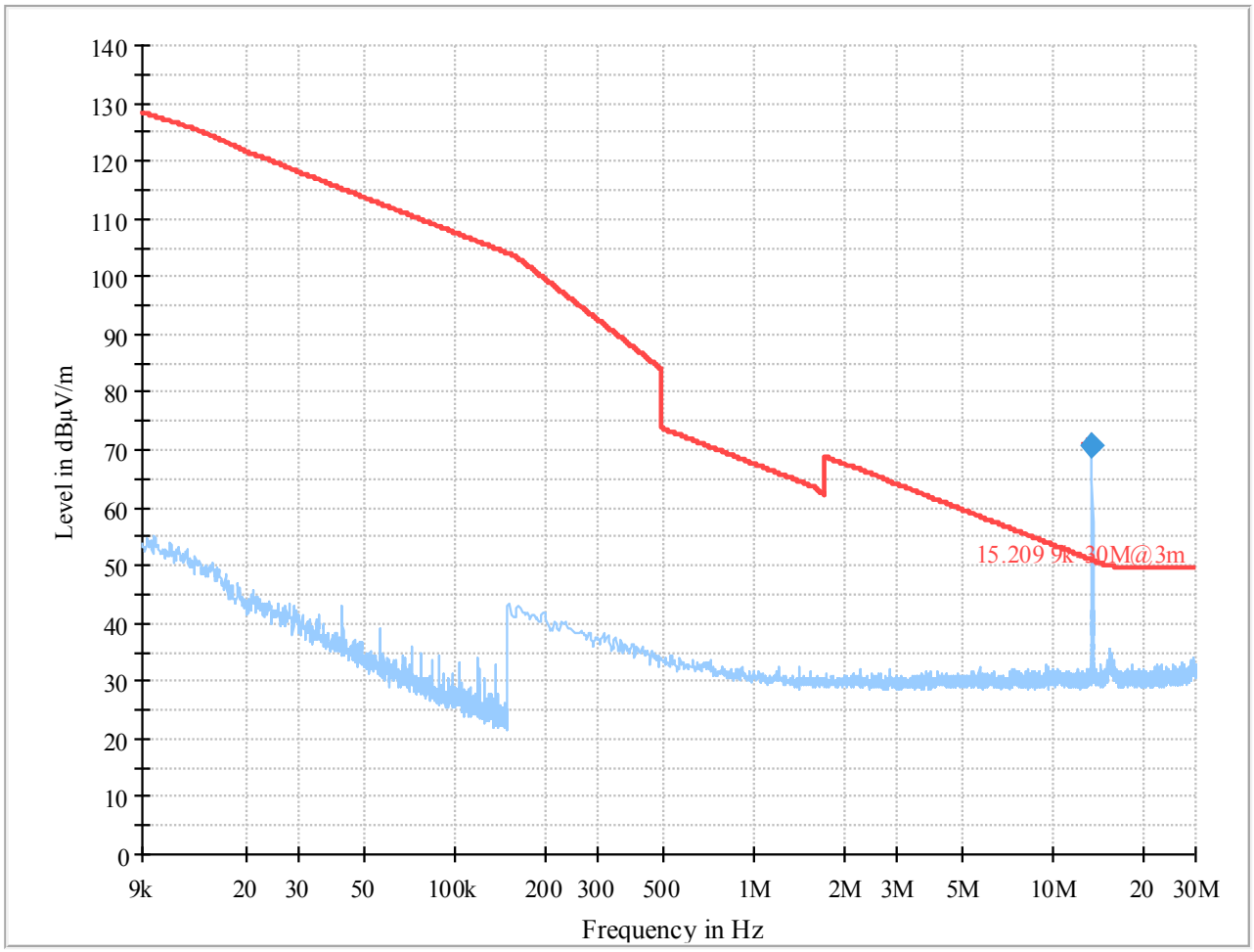
Frequency [MHz]	QuasiPeak [dBµV/m]	Limit [dBµV/m]	Margin [dB]	Meas. Time [ms]	Bandwidth [kHz]	Height [cm]	Pol	Azimuth [deg]	Corr. [dB/m]
298.325000	31.89	46.00	14.11	100.0	120.000	167.0	V	174.0	13.3
474.600000	23.74	46.00	22.26	100.0	120.000	108.0	V	156.0	17.6
976.325000	21.07	54.00	32.93	100.0	120.000	170.0	V	143.0	23.8

Test results, EUT Testsample 2						
Channel / Mode	**Frequency [MHz]**	**Detector**	**Test distance [m]**	**Level [dBµV/m]**	**Limit [dBµV/m]**	**Margin [dB]**
EUT lying	13.560000	QP	3	70.74	105.40	34.66
	30.250000	QP	3	17.91	40	22.09
	298.300000	QP	3	22.98	46	23.02
	-	-	-	-	-	-
EUT standing	13.560000	QP	3	70.02	105.40	35.38
	30.275000	QP	3	21.00	40.00	19.00
	298.325000	QP	3	27.87	46	18.13
	-	-	-	-	-	-

Comment:	---

Verdict	**- PASS -**	*see plots*

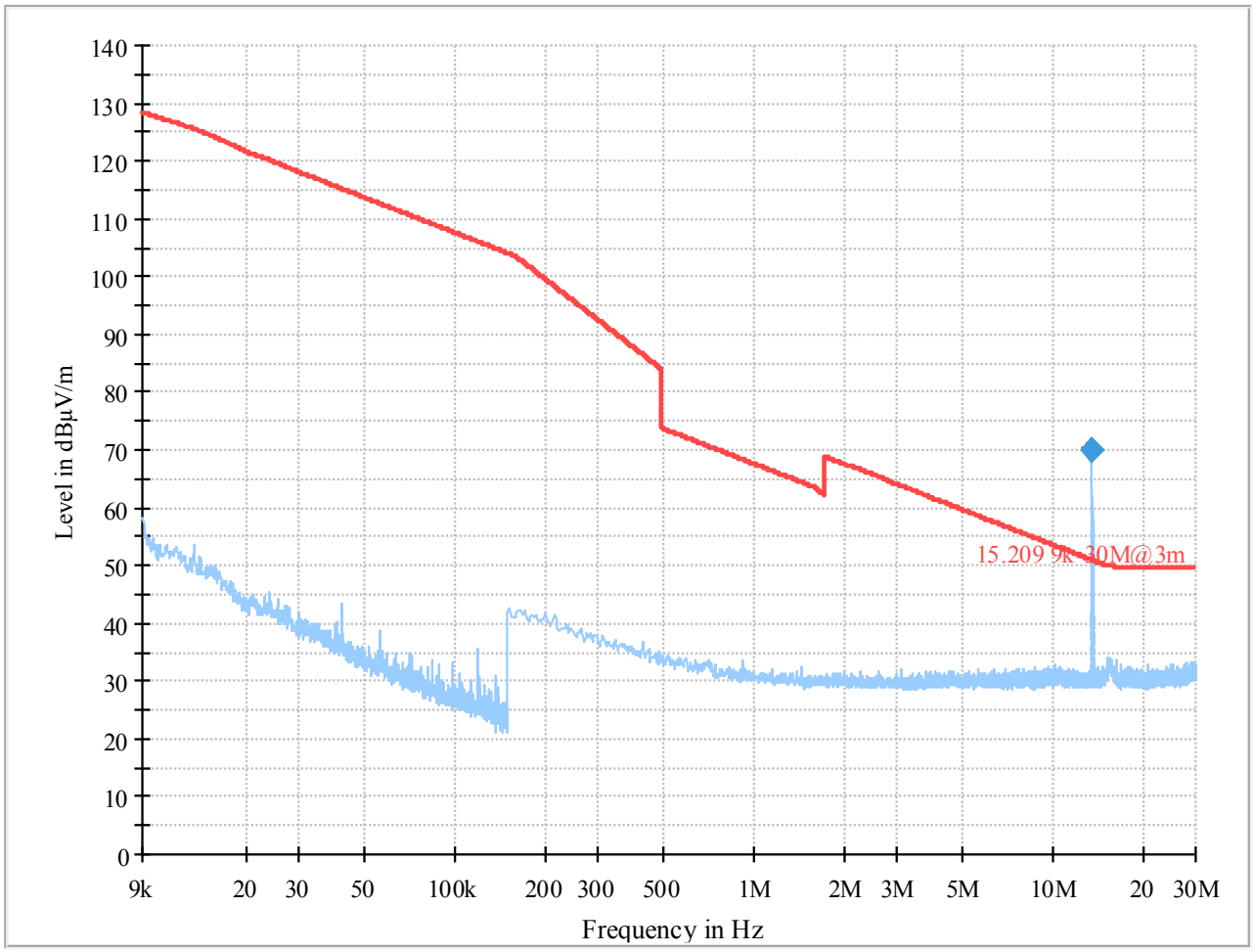
Plot no. 7: radiated emissions 9 kHz – 30 MHz, loop antenna, EUT lying



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
13.560000	70.74	50.94	-19.80	100.0	9.000	H	5.0	20.5

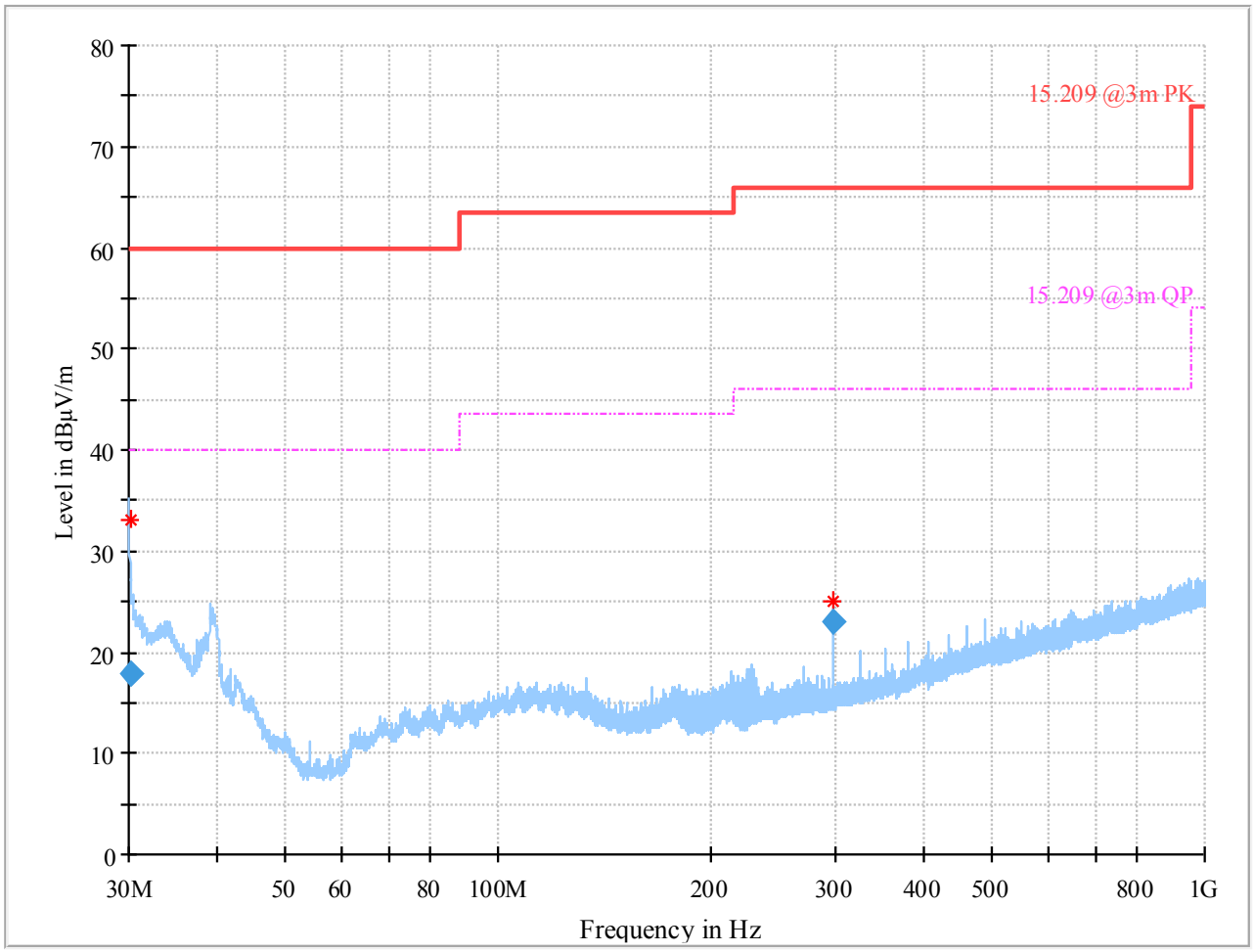
Plot no. 8: radiated emissions 9 kHz – 30 MHz, loop antenna, EUT standing



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Pol	Azimuth (deg)	Corr. (dB/m)
13.560000	70.02	50.94	-19.08	100.0	9.000	H	169.0	20.5

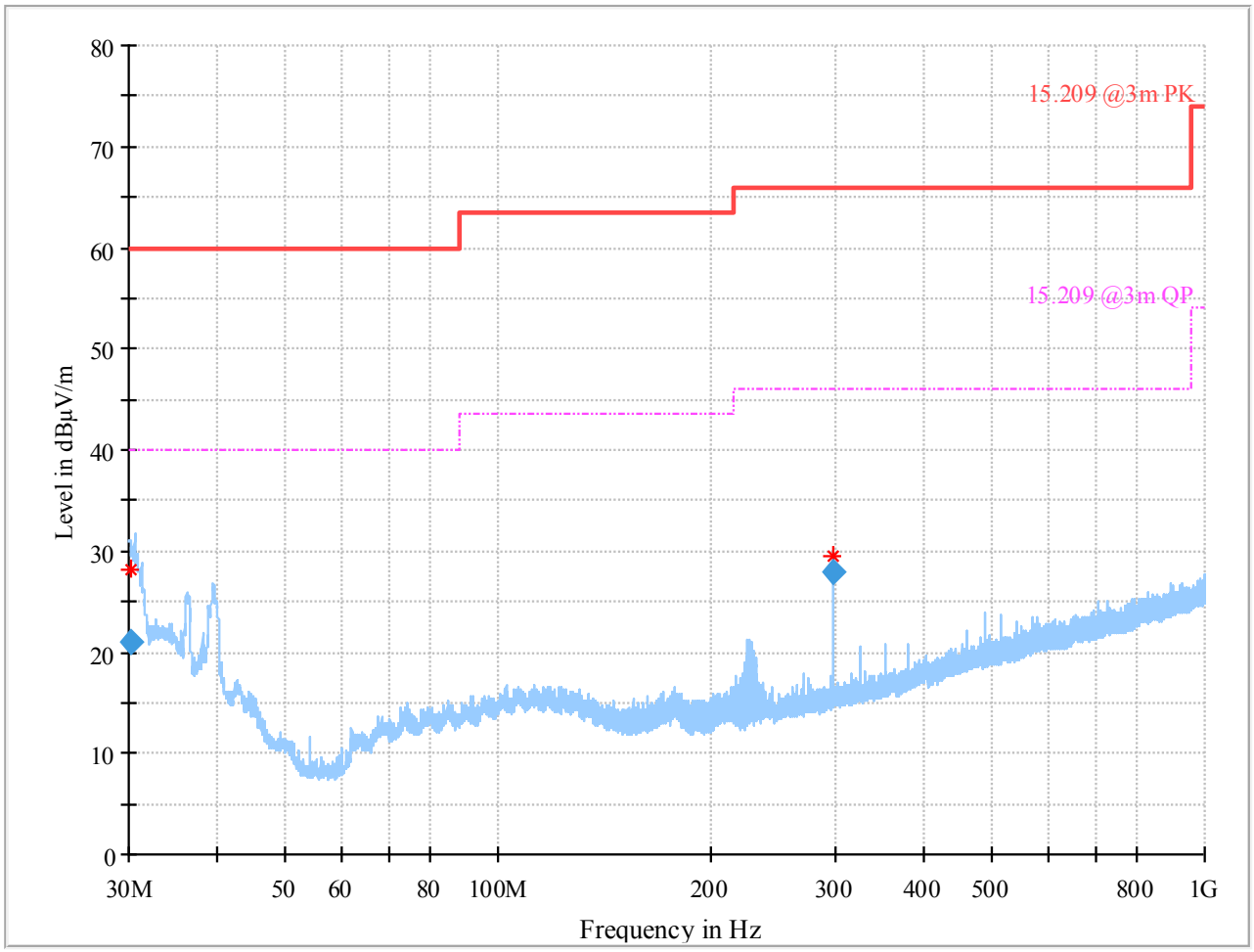
Plot no. 9: radiated emissions 30 MHz – 1 GHz, hor./vert. polarization, EUT lying



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
30.250000	17.91	60.00	42.09	100.0	120.000	183.0	V	15.0
298.300000	22.98	66.00	43.02	100.0	120.000	150.0	H	82.0

Plot no. 10: radiated emissions 30 MHz – 1 GHz, hor./vert. polarization, EUT standing



Final_Result

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
30.275000	21.00	60.00	39.00	100.0	120.000	117.0	V	15.0
298.325000	27.87	66.00	38.13	100.0	120.000	152.0	V	142.0

7.3 Frequency tolerance

Description / Limits

§15.225 (e) The frequency tolerance of the carrier signal shall be maintained within ±0.01% of the operating frequency over a temperature variation of −20 degrees to + 50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C. For battery operated equipment, the equipment tests shall be performed using a new battery.

Test setup: 8.2

Test results

EUT mode	Test conditions	Declared frequency [MHz]	Measured frequency [MHz]	Deviation [%]	Deviation [ppm]
Tx	-20 °C	13.56	13.560035	+0.000258	+2.58
Tx	+20 °C	13.56	13.559955	-0.000332	-3.32
Tx	+55 °C	13.56	13.559990	-0.000074	-0.74

Comment:	---

Verdict	**- PASS -**	*see plots*

Plot no. 11: frequency tolerance @ -20 °C

Plot no. 12: frequency tolerance @ +20 °C:

Plot no. 13: frequency tolerance @ +55 °C:

7.4 20 dB bandwidth / occupied bandwidth

Description

The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

In some cases, the “x dB bandwidth” is required, which is defined as the frequency range between two points, one at the lowest frequency below and one at the highest frequency above the carrier frequency, at which the maximum power level of the transmitted emission is attenuated x dB below the maximum in-band power level of the modulated signal, where the two points are on the outskirts of the in-band emission.

The following conditions shall be observed for measuring the occupied bandwidth and x dB bandwidth:

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
- The detector of the spectrum analyzer shall be set to “Sample”. However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or “Max Hold”) may be necessary to determine the occupied / x dB bandwidth if the device is not transmitting continuously.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / x dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in compliance with the above requirement.

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).

Test procedure

ANSI C63.10, 6.9.3

The occupied bandwidth is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers are each equal to 0.5% of the total mean power of the given emission.

The following procedure shall be used for measuring 99% power bandwidth:

a) The instrument center frequency is set to the nominal EUT channel center frequency. The frequency span for the spectrum analyzer shall be between 1.5 times and 5.0 times the OBW.

b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW, and VBW shall be approximately three times the RBW, unless otherwise specified by the applicable requirement.

c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level. Specific guidance is given in 4.1.5.2.

d) Step a) through step c) might require iteration to adjust within the specified range.

e) Video averaging is not permitted. Where practical, a sample detection and single sweep mode shall be used. Otherwise, peak detection and max hold mode (until the trace stabilizes) shall be used.

f) Use the 99% power bandwidth function of the instrument (if available) and report the measured bandwidth.

g) If the instrument does not have a 99% power bandwidth function, then the trace data points are recovered and directly summed in linear power terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached; that frequency is recorded as the lower frequency. The process is repeated until 99.5% of the total is reached; that frequency is recorded as the upper frequency. The 99% power bandwidth is the difference between these two frequencies.

h) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).
Note Measurements with the peak detector are also suitable to demonstrate compliance of an EUT, as long as the required resolution bandwidth is used, because peak detection will yield amplitudes equal to or greater than amplitudes measured with RMS detector. The measurement data from a spectrum analyser peak detector will represent the worst-case results (see ANSI C63.10).
Test setup: 8.2

Test Parameters:

Detector	Pos-Peak (worst-case)		
Trace-mode	Max Hold		
Resolution bandwidth RBW	10 kHz		
Video bandwidth	≥ RBW		
Span	see plots		
Sweep time	see plots		
Measurement uncertainty	±1 x 10^{-7}		
Test environment	Normal and extreme		
Test set-up	☐ Conducted	☐ Radiated	☒ Test Fixture

Test Results:

Channel	Temperature [°C]	Min. Frequency F_L [MHz]	Max. frequency F_H [MHz]	20 dB bandwidth (99%) [kHz]
1	-20	13.54601	13.57399	27.97
1	+20	13.54601	13.57349	27.47
1	+55	13.54651	13.57349	26.97

Channel	Temperature [°C]	Min. Frequency F_L [MHz]	Max. frequency F_H [MHz]	Occupied bandwidth (99%) [kHz]
1	-20	13.543734	13.576720	32.986
1	+20	13.543698	13.576365	32.668
1	+55	13.543701	13.576362	32.660

Where: F_L = is the lower edge of the OBW
F_H = is the upper edge of the OBW

Comment	

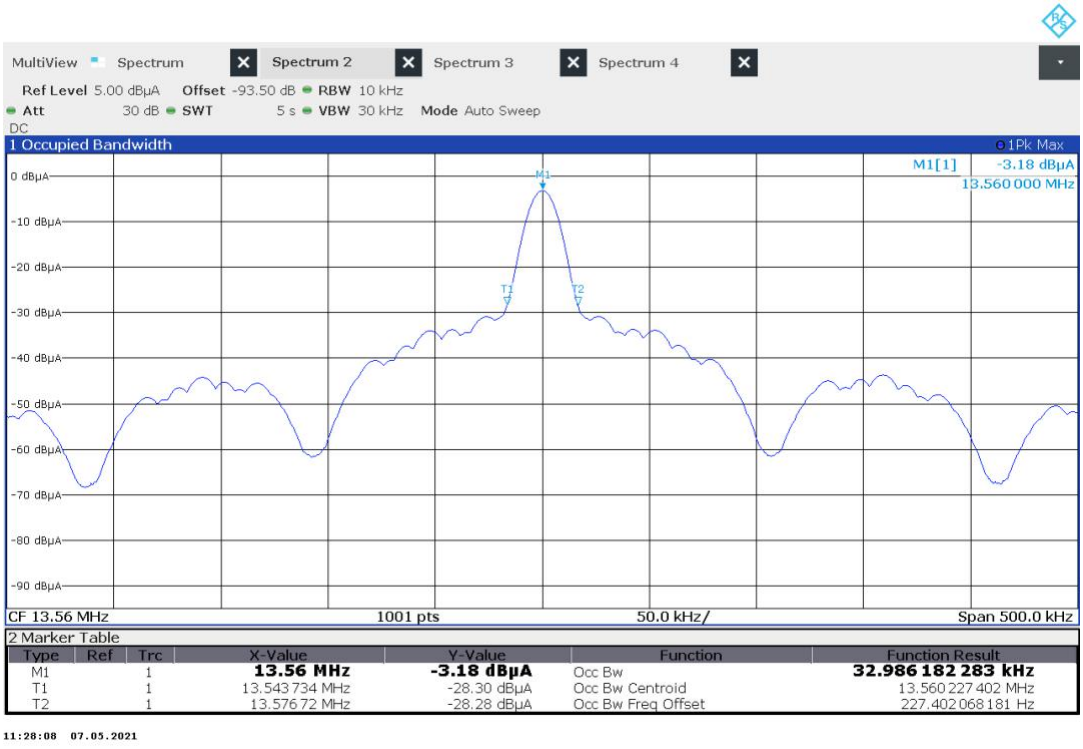
Verdict	- PASS -	*Measurement plot(s) see next page(s).*

Plot No. 14: 20 dB bandwidth @ -20 °C:

Plot No. 15: 20 dB bandwidth @ +20 °C:

Plot No. 16: 20 dB bandwidth @ +55 °C:

Plot No. 17: occupied bandwidth @ -20 °C:



Plot No. 18: occupied bandwidth @ +20 °C:

Plot No. 19: occupied bandwidth @ +55 °C:

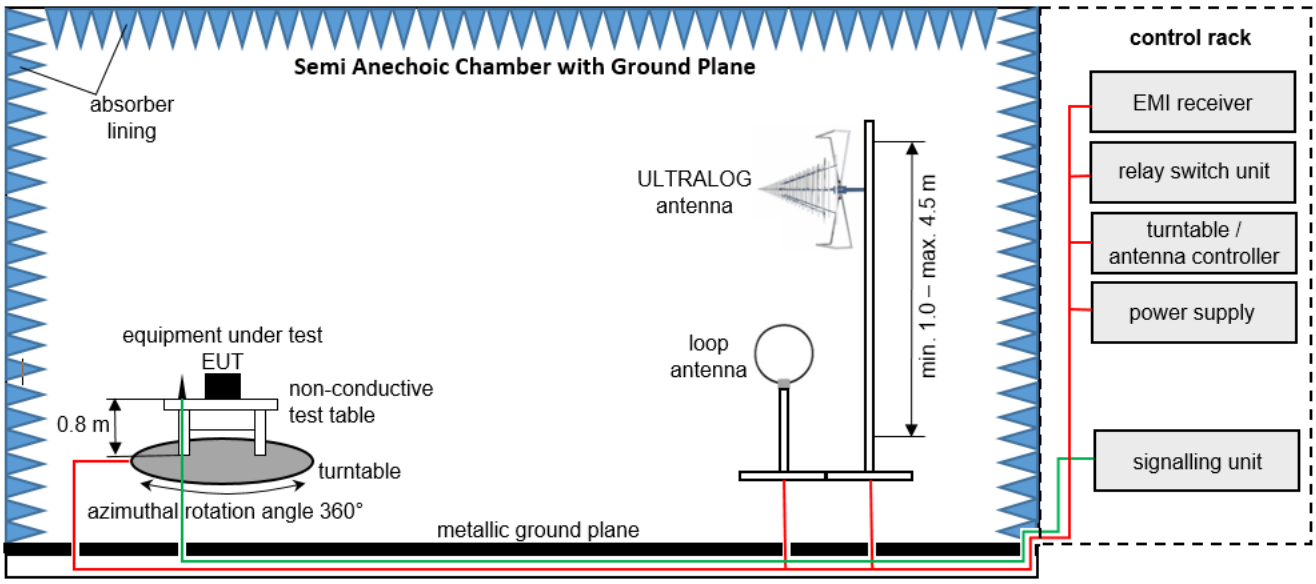
8 Test Setup Description

Calibrations of test equipment used are 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. Weekly chamber inspections and range calibrations are performed. Where possible, RF generating and signalling equipment as well as measuring receivers and analysers are connected to an external high-precision 10 MHz reference (GPS-based or rubidium frequency standard).

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 analyser 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

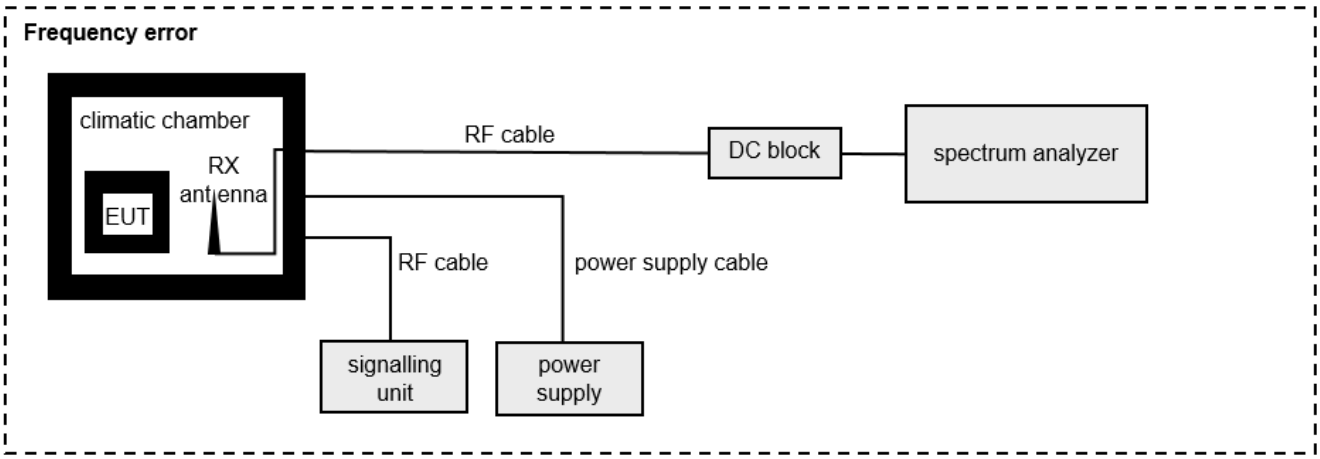
FS = UR + CL + AF
(FS-field strength; UR-voltage at the receiver; CL-loss of the cable; AF-antenna factor)

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	2020-06-03 → 12M → 2021-06-03
6	Semi-Anechoic Chamber (SAC)	Albatross Projects GmbH	SAC 5 (Babylon 5)	20168.PRB	LAB000235	ZW	2020-08-24 → 12M → 2021-08-24
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	ZW	2020-07-07 → 12M → 2021-07-07
14	Antenna	Rohde & Schwarz	HF907	102898	LAB000124	K	2020-04-23 → 36M → 2023-04-23
15	Antenna	Rohde & Schwarz	HL562E	102001	LAB000123	K	2020-07-05 → 36M → 2023-07-05
16	Antenna	Rohde & Schwarz	HFH2-Z2E - Active Loop Antenna	100954	LAB000108	K	2020-03-25 → 36M → 2023-03-25
17	Pre-Amplifier	Schwarzbeck Mess-Elektronik OHG	BBV 9718 C	84	LAB000169	NE	–

8.2 Frequency error, OBW, 20 dB BW



List of test equipment used:

No.	Equipment	Manufacturer	Type	Serial No.	IBL No.	Kind of Calibration	Last / Next Calibration
1	Coaxial Cable	Huber & Suhner	ST18/48"	2276454-01	LAB000157	ZW	2020-07-03 → 12M → 2021-07-03
2	Spectrum Analyser	Rohde & Schwarz	FSW50	101450	LAB000111	K	2020-05-05 → 12M → 2021-05-05
3	Loop antenna	IBL	–	–	–	NE	–

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

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 A **EUT Photographs, external**

Photo No. 1:

Photo No. 2:

Photo No. 3:

Photo No. 4:

Photo No. 5:

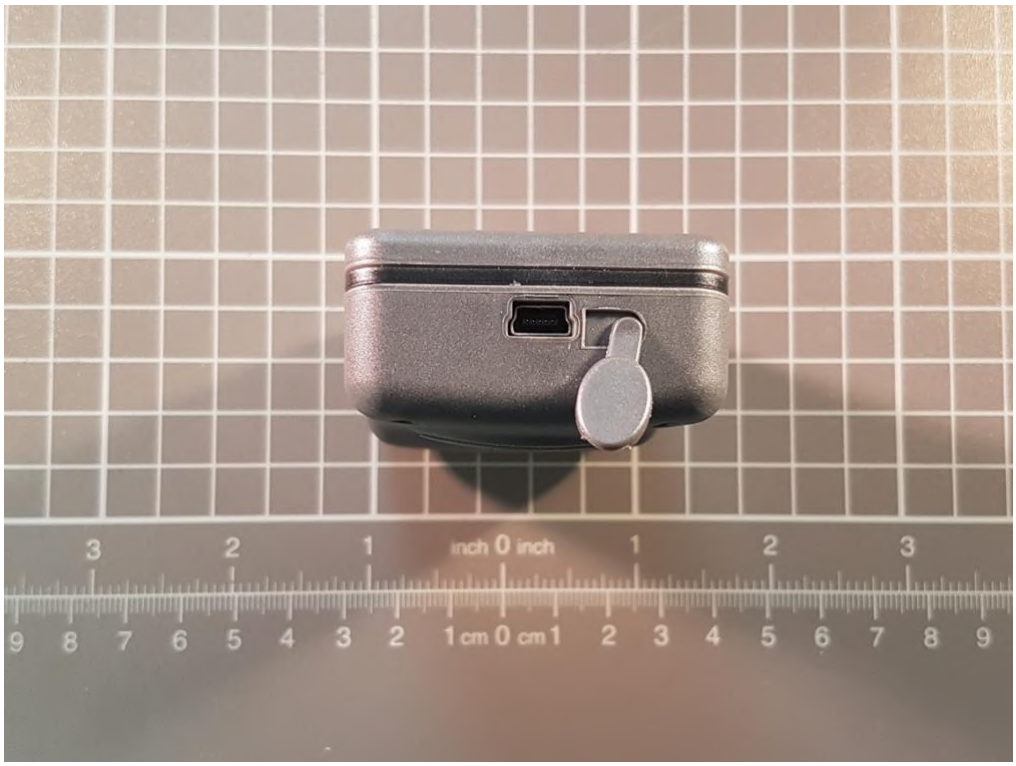


Photo No. 6:

Photo No. 7: Testsample 2

Photo No. 8: Testsample 2

Photo No. 9: Testsample 2


FEIG

Annex B **EUT Photographs, internal**

Photo No. 10:

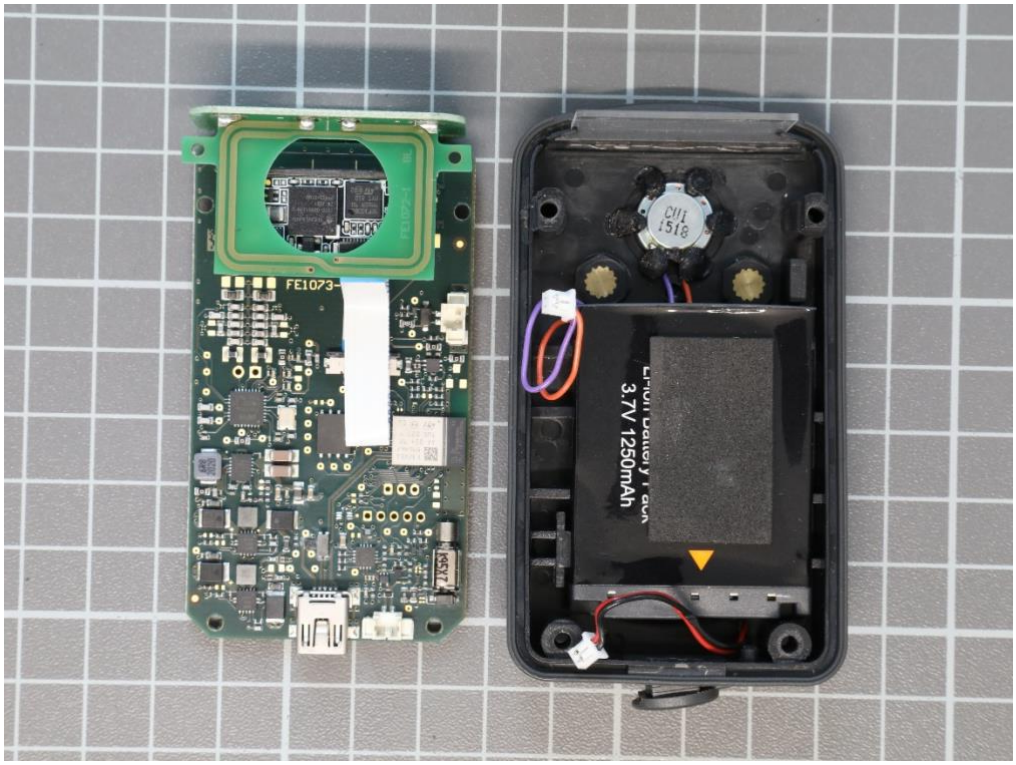


Photo No. 11:

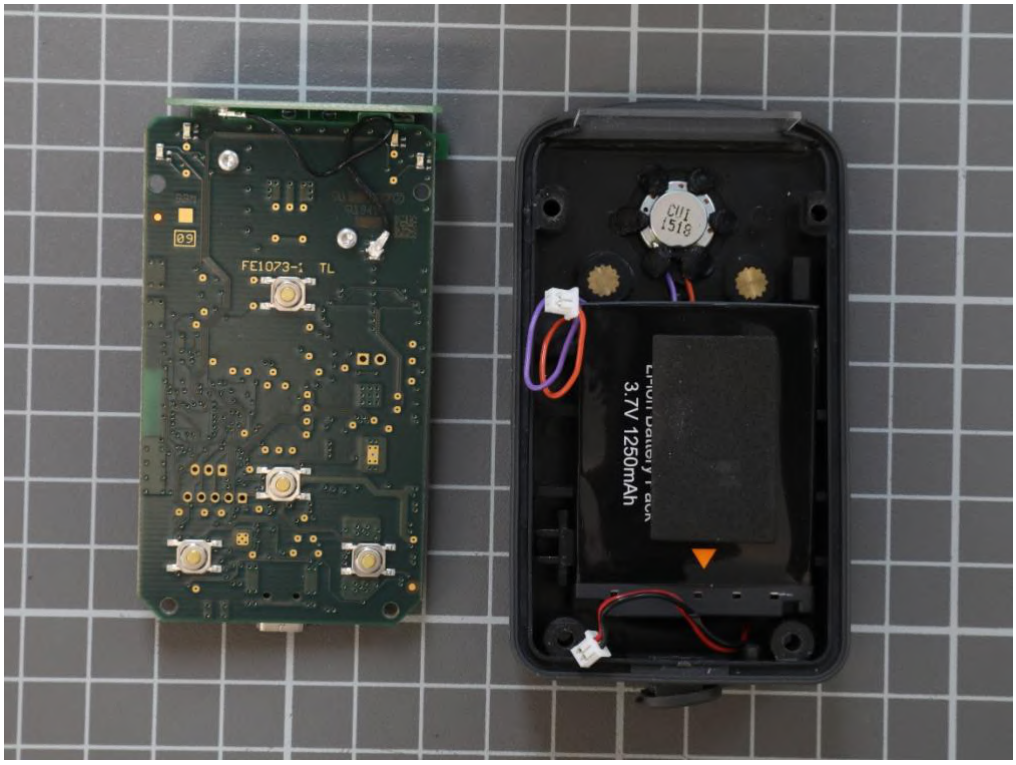


Photo No. 12:

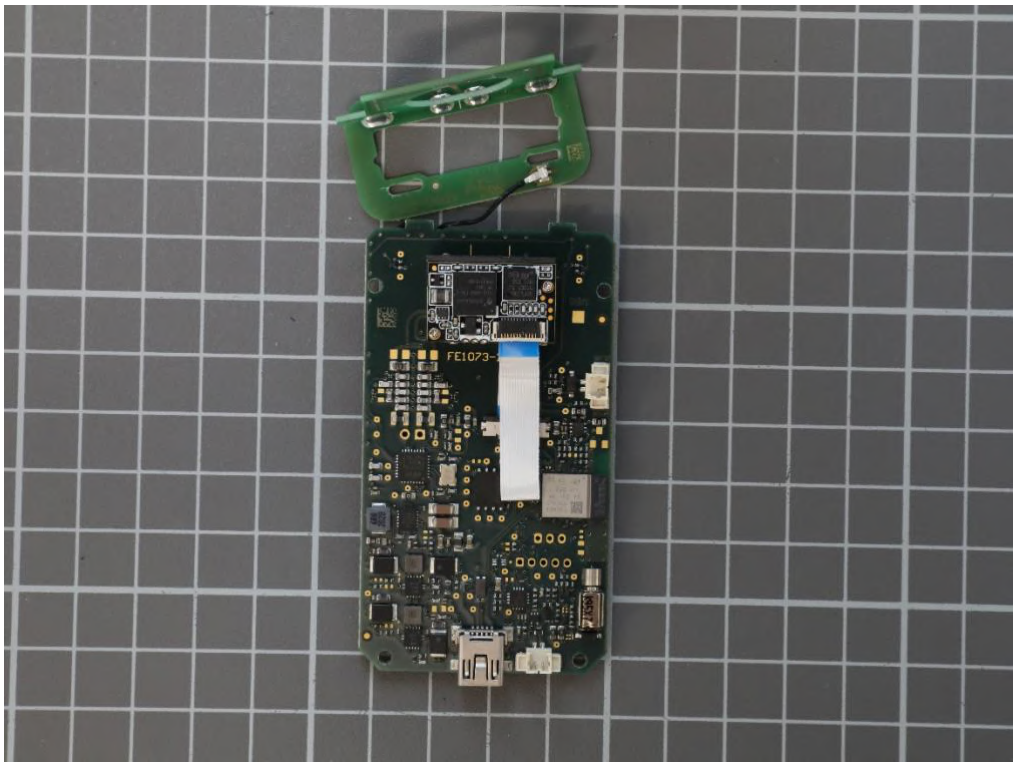
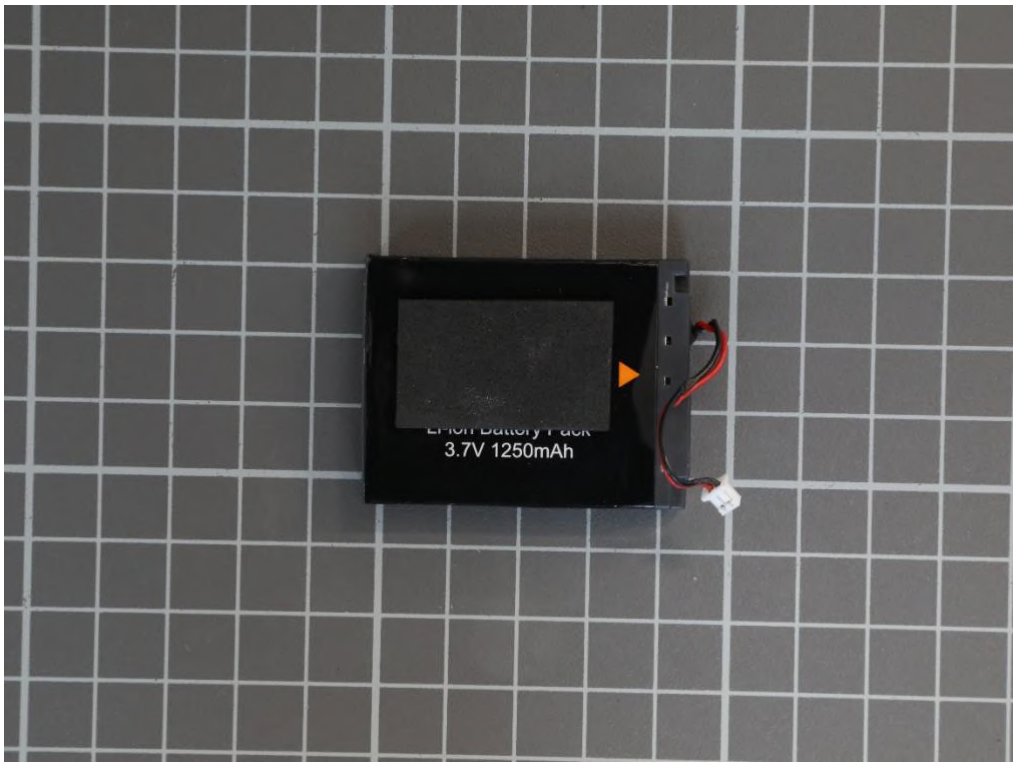


Photo No. 13:

Photo No. 14:



Annex C **Test Setup Photographs**

Photo No. 15:

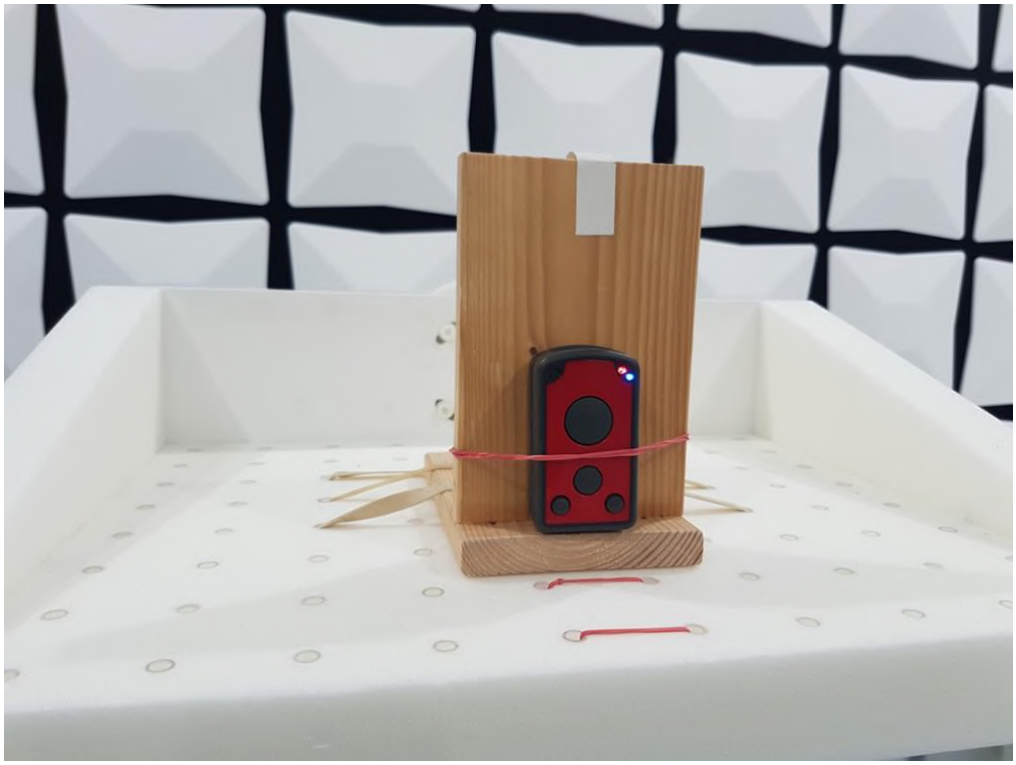


Photo No. 16:

Photo No. 17:

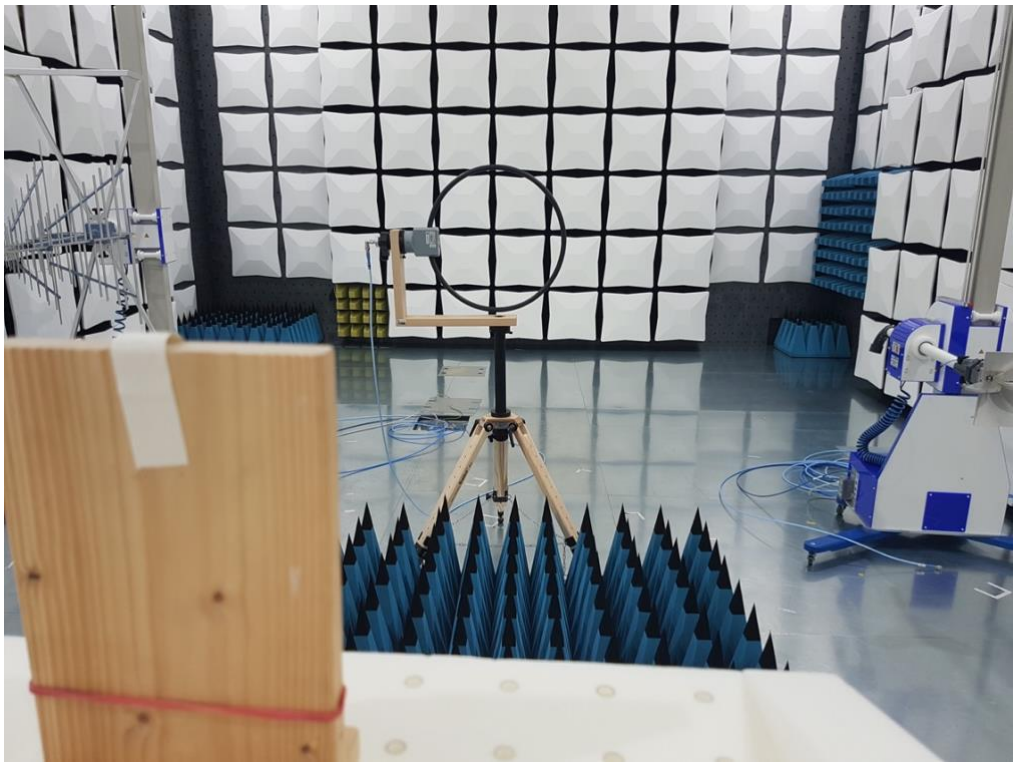


Photo No. 18:

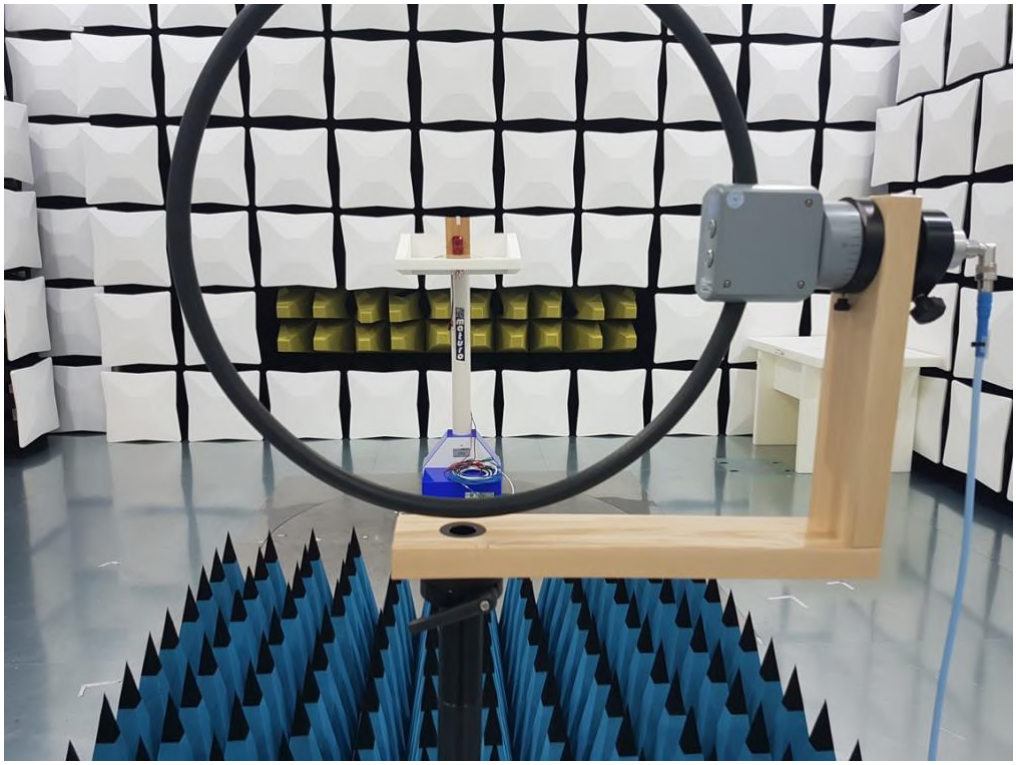


Photo No. 19:

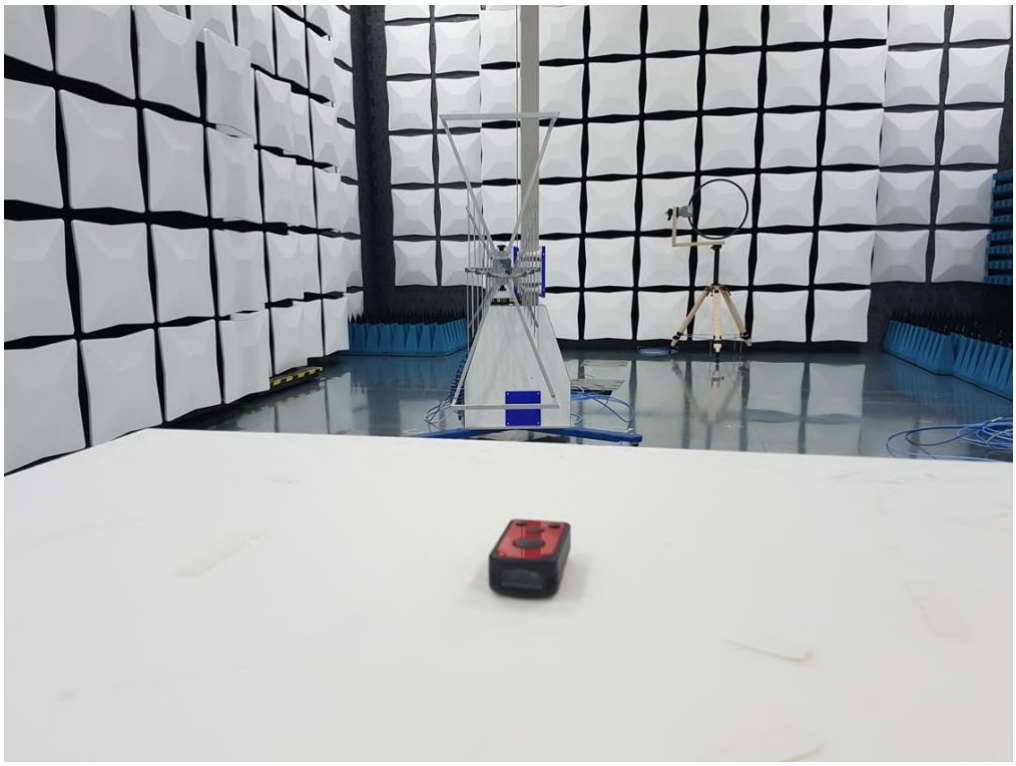


Photo No. 20:

Photo No. 21:

Photo No. 22:

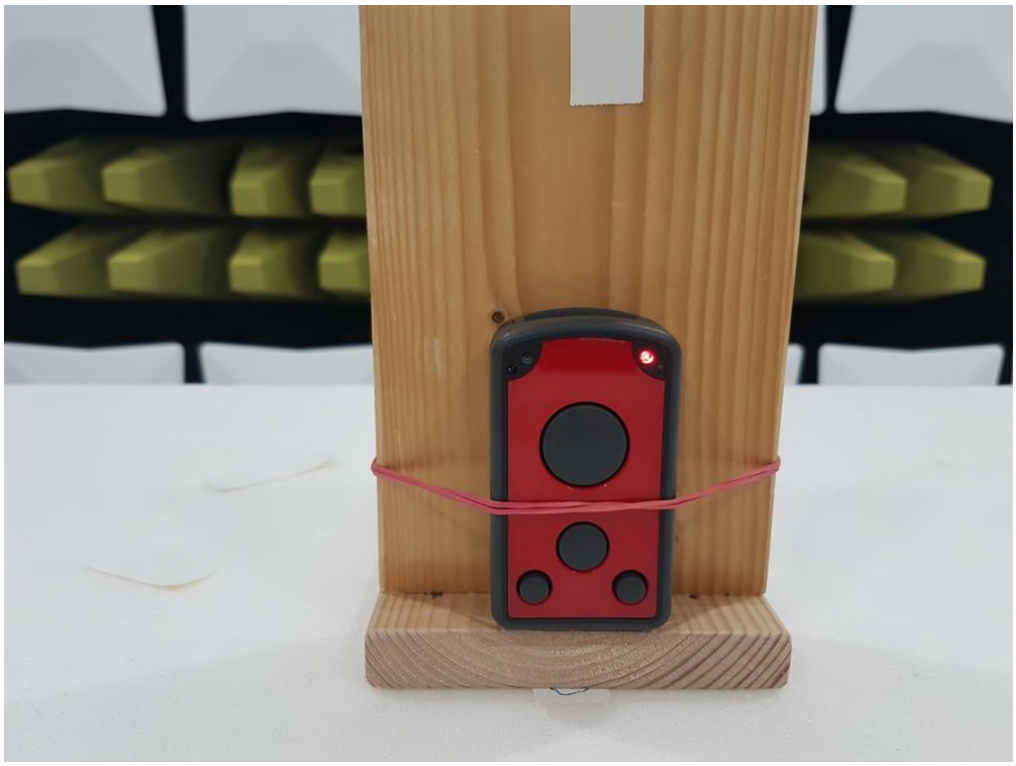


Photo No. 23:

Photo No. 24:

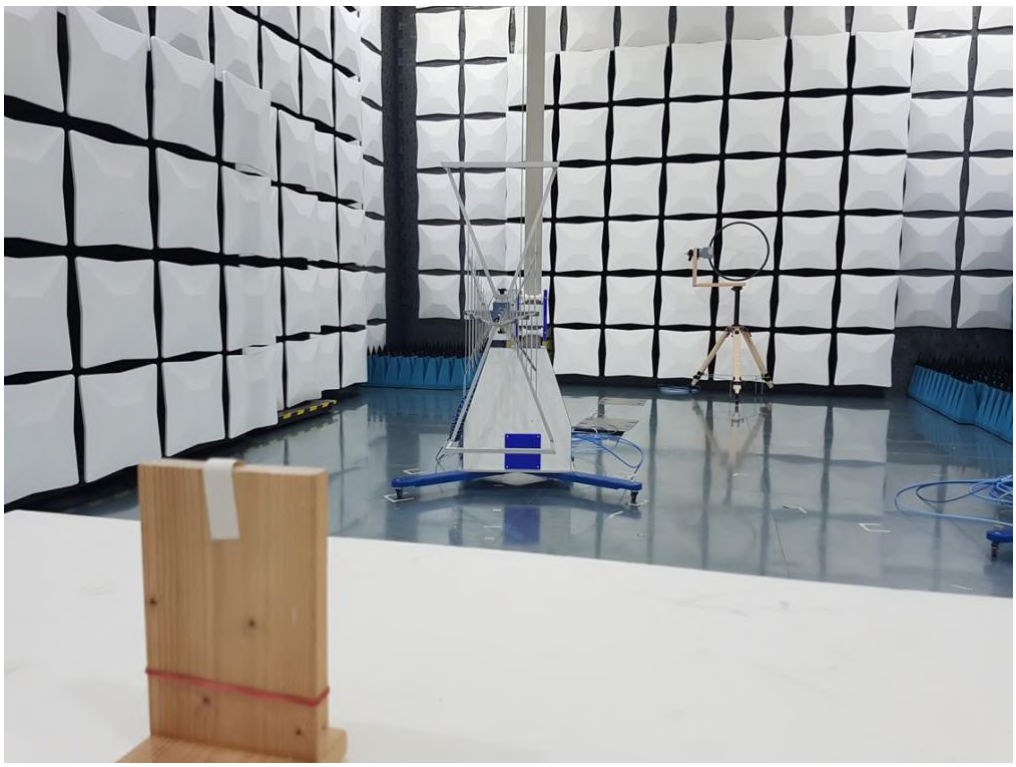


Photo No. 25: Testsample 2

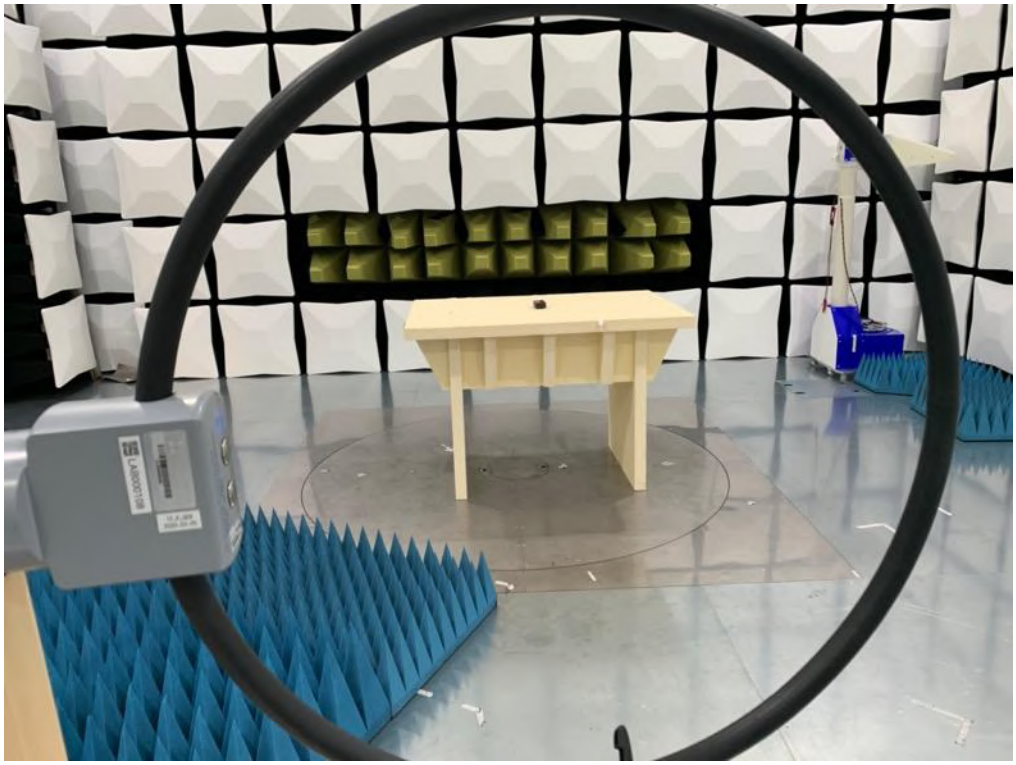


Photo No. 26: Testsample 2

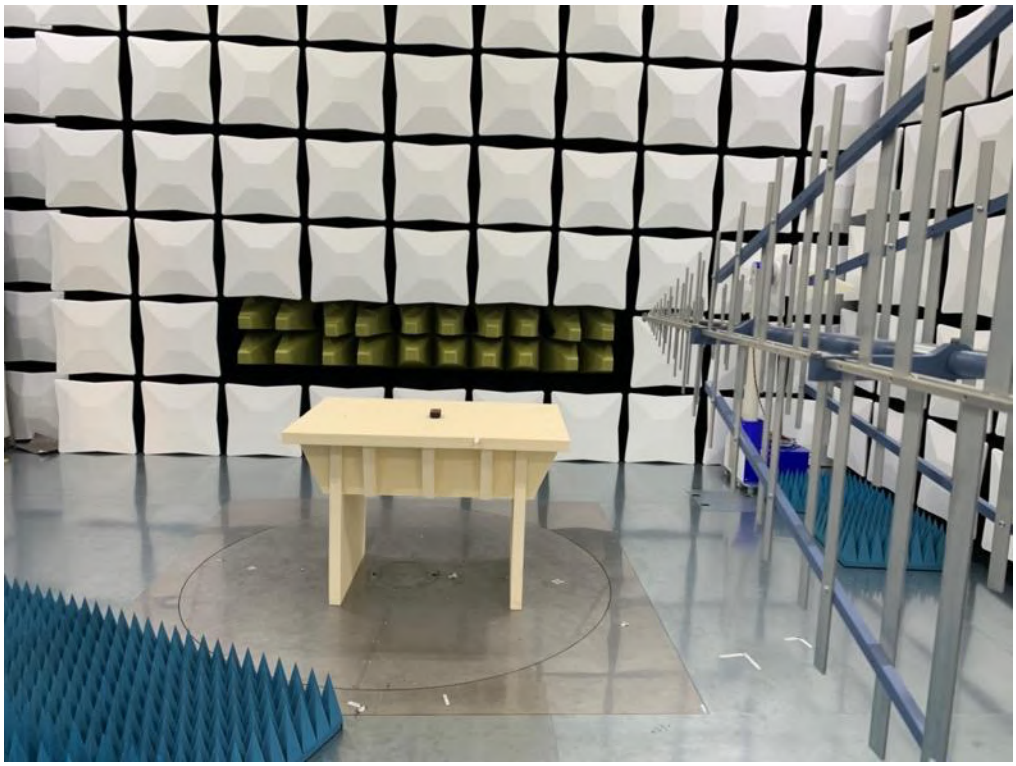
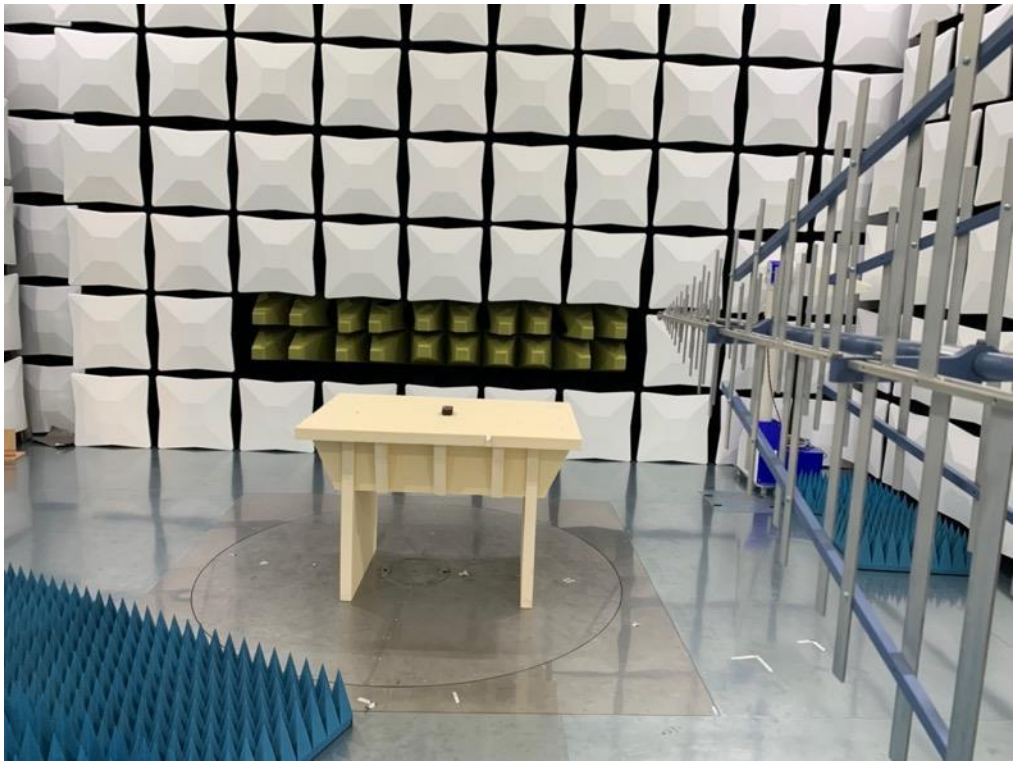


Photo No. 27: Testsample 2



End of Test Report