Test report

according to ISO/IEC 17025:2017

FCC
(Federal Communications Commission)
Test Firm Registration Number: 768032
Designation Number DE0022

ISED
(Inovation, Science and Economic Development)
CAB identifier: DE0012
ISED#: 6155A

Electromagnetic compatibility

e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C
RSS-210 – Licence - Exempt Radio Apparatus

Intentional Radiators

DAkkS Deutsche Akkreditierungsstelle
D-PL-17379-01-01
D-PL-17379-01-02
D-PL-17379-01-03

TESTED IN GERMANY

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Location of test facility:

STC TESTED IN GERMANY

STC Germany GmbH
Ohmstrasse 1
84160 Frontenhausen
Germany

1. Client information

Name:	RFC Technology Norms
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2. Equipment under test (EUT)

2.1 Identification of the EUT

Equipment:	Transmitter for Passive Entry Passive Start (PEPS) RKE TPMS
Model:	FI7
Brand name:	APTIV
Serial no.:	Sample 1: -/-
Manufacturer:	APTIV Services Hungary Kft. Zanati út 29/A 9700 Szombathely
Country of origin:	Hungary
Power rating:	
Highest frequency generated or used in the device or on which the device operates or tunes (MHz):	434 MHz
Date Sample Received:	29.04.2021
Tests were performed:	15.06.2021 – 28.06.2021

2.2 Additional information about the EUT:

The device includes a 434 MHz receiver, which will be authorized under the sDOC procedure.

3. Description of the Equipment under test and test conditions

FCC-ID:	LTQFI7
IC:	3659A-FI7
HVIN:	C2-R1-CND4
Power:	12 V ⎓ (8.0 V – 16.0 V) powered via vehicle battery
Cables:	DC: 195 cm
Approx. Size (l x w x h):	(19.5 x 13.5 x 7.0) cm
Test conditions:	The “Transmitter for Passive Entry Passive Start (PEPS) RKE TPMS” (= equipment under test – EUT) is an immobilizier system for vehicular use and had been tested in following Configurations: (1) 125 kHz transmission for keyless entry function (LF PEPS) Antenna 1 and Antenna 3 (2) 125 kHz transmission for keyless entry function (Shared Immobilizer, LF IMMO) Antenna 1 (3) 125 kHz transmission for passive start function (Shared immobilizier, LF IMMO) Coil Antenna Type 2 (4) RX 433.920 MHz signal, Internal PCB Antenna with maximum RF-output power in order to find the worst case. During the tests the EUT was powered with 12 V DC. Tests where performed with different antennas the table below show the tested combination of antenna types and transmitter function.
Additional information:	-/-
Operating frequencies:	Transmitter: 125 kHz Receiver: 433,92 MHz
Type of modulation:	K1D
Environmental conditions during tests:	Ambient temperature: 20 °C Relative humitity 40 % Atmospheric pressure 965 mbar
Antenna Transmitter:	Model: Antenna Type 1 Antenna Type 3 Coil Antenna Type 2 Type: ☒ External ☐ Internal (integrated, PCB antenna)
Antenna Receiver:	Model: Printed PCB Antenna Type: ☐ External ☒ Internal (integrated, PCB antenna)

Function/involved antennas	Antenna Type 1	Internal Antenna	Antenna Type 3	Coil Antenna Type 2
Mode 1 (PEPS TX)	x	-/-	x	-/-
Mode 2 (Shared immobilizer TX/RX))	x	-/-	-/-	-/-
Mode 3 (Shared Immobilizer TX/RX)	-/-	-/-	-/-	x
Mode 4 (RF Receiver RX)	-/-	x	-/-	-/-

Remarke: There is no simultaneous 125 KHz transmission of antenna 1, 3 or coil antenna in park mode or drive mode possible.

4. Performed measurements and results

The complete list of measurements required in e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C & RSS-210 is given below.

Standard:	**Standard:**	**Test Method:**		**Test requirements:**			
				applicable:		**fulfilled:**	
				Yes	**No**	**Yes**	**No**
§ 15.207	RSS-210 issue 10 RSS-Gen issue 5	ANSI 63.10 Section 6.2	AC Mains Conducted Emissions	☐	☒	☐	☐
§ 15.209	RSS-210 issue 10 RSS-Gen issue 5	ANSI 63.10 Section 6.3 - 6.6	Radiated Emissions	☒	☐	☒	☐
§15.209	RSS-210 issue 10 RSS-Gen issue 5	ANSI 63.10 Section 6.4	Output Power of Fundamental Emissions	☒	☐	☒	☐
-/-	RSS-210 issue 10 RSS-Gen issue 5	ANSI 63.10 Section 6.9.3	99% Power Bandwidth	☒	☐	☒	☐

The test § 15.209 (RSS-210 issue 10 / RSS-Gen issue 5) Radiated Emissions at 125 KHz were performed under the STC-Ref.-Nr. 20/01-0048. All other required / applicable tests were performed under the STC-Ref.-Nr. 21/04-0029.

- e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C with test Method according to ANSI C63.10-2013
- e-CFR data is current as of April 17, 2020

-RSS-210 issue 10 December 2019 Licence-Exempt Radio Apparatus: Category I Equipment
-RSS-Gen issue 5 March 2019 General Requirements for Compliance of Radio Apparatus

Remark: -/-

5. AC Mains conducted emissions

Applied standards
-e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C, § 15.207 Conducted limits
-RSS-Gen issue 05 section 7.2

Test site
Not applicable

Test equipment and test set up
Not applicable

Detector function selection and bandwidth
Not applicable

Frequency range to be scanned
Not applicable

Test conditions and configuration of EUT
Not applicable

Requirements

Frequency Range [MHz]	Quasi-Peak Limits [dBµV]	Average Limits [dBµV]
0.15 - 0.5	66 to 56 Note 1	56 to 46 Note 1
0.5 - 5.0	56	46
5.0 - 30.0	60	50
Note 1: The level decreases linearly with the logarithm of the frequency		

Measurement

The measurement is not applicable. The EUT is powered via vehicle battery.

6. Radiated emission measurements

Test site
Measurement of radiated emissions from EUT was made in the semi-anechoic chamber SAC3 (DC to 40 GHz) located in the test facility.

Test equipment and test set up
Test equipment used for radiated measurements as given in clause Test equipment of this report.
Test setup used for radiated measurements as given in clause Test Setups of this report.

Detector function selection and bandwidth
In radiated emissions measurement, an EMI test receiver with CISPR detectors was used.

Frequency range	Resolution Bandwidth
9KHz – 150kHz (Quasi Peak & Average* Detector)	200Hz
150KHz – 30MHz (Quasi Peak & Average* Detector)	9kHz
30MHz – 1GHz (Quasi Peak Detector)	120kHz
Above 1GHz (Peak & Average Detector)	1MHz

*Average Detector only in specified frequency range.

Antennas
Measurements were made using a calibrated loop antenna in the range 9 kHz – 30 MHz, as well as a calibrated bilog antenna in the range of 30 to 1000 MHz to determine the emission characteristics of the EUT. Measurements were also made for both horizontal and vertical polarization in a SAC .
The horizontal distance between the receiving antenna and the EUT was 3 meters.
In the range of 1 GHz to 7 GHz measurements were made using a calibrated horn antenna to determine the emission characteristics of the EUT. Measurements were also made for both horizontal and vertical polarization in a SAC with floor absorbers. The horizontal distance between the receiving antenna and the EUT was 3 meters.

Frequency range to be scanned
For radiated emissions measurements, the spectrum in the range of 9 kHz MHz to 7 GHz was investigated as the highest used frequency in the EUT is 433,92 MHz.

Test conditions and configuration of EUT

The EUT was configured and operated with conditions as mentioned under “Test conditions” in clause 3.

During test the EUT was operated as specified in the technical intstruction of the EUT. For frequencies below 1000 MHz the EUT was placed on a 80 cm and for frequencies above 1000 MHz the EUT was placed on a 150 cm high non metallic table placed on the turntable. The EUT was rotated and the antenna height was varied between 1 m to 4 m to find the maximum RF energy generated from EUT. The procedure according to ANSI C63.10:2013 is used and all modes are investigated by operating the EUT in a range of typical modes of operation, with typical cable positions, and with a typical system equipment configuration and arrangement. For each mode of operation, cable manipulation are performed within the range of likely configurations. The highest values measured are shown in the table below.

Remarks:
-Correction factor included antenna factor and cable attenuation.

Applied standards
-e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C, § 15.209 Radiated emission limits
-RSS-Gen issue 05 section 8.9

Requirements:

acc. e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C, § 15.209 Radiated emission limits

Frequency MHz	Limits [µV/m] Quasi-peak	Limits [dBµV/m] Quasi-peak	Limits [µV/m] Average	Limits [dBµV/m] Average	Test distance [m]
0.009 – 0.090	-/-	-/-	2400/F (kHz)	48.5 – 28.5	300
0.090 - 0.110	2400/F (kHz)	28.5 – 26.8	-/-	-/-	300
0.110 – 0.490	-/-	-/-	2400/F (kHz)	26.8 – 13.8	300
0.490 - 1.705	24000/F (kHz)	33.8 – 23.0	-/-	-/-	30
1.705 - 30.0	30	29.5	-/-	-/-	30

acc. RSS-Gen issue 05 section 8.9

Frequency MHz	Limits [µA/m] Quasi-peak	Limits [dBµA/m] Quasi-peak	Limits [µA/m] Average	Limits [dBµA/m] Average	Test distance [m]
0.009 – 0.090	-/-	-/-	6.37/F (kHz)	-3.0 – -23.0	300
0.090 - 0.110	6.37/F (kHz)	-23.0 – -24.7	-/-	-/-	300
0.110 – 0.490	-/-	-/-	63.7/F (kHz)	-24.7 – -37.7	300
0.490 - 1.705	63.7/F (kHz)	-17.7 – -28.5	-/-	-/-	30
1.705 - 30.0	0.08	-22	-/-	-/-	30

acc. e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C, § 15.209 Radiated emission limits and RSS-Gen issue 05 section 8.9

Frequency MHz	Limits [µV/m] Quasi-peak	Limits [dBµV/m] Quasi-peak	Limits [µV/m] Average	Limits [dBµV/m] Average	Test distance [m]
30 - 88	100	40	-/-	-/-	3
88 - 216	150	43.5	-/-	-/-	3
216 - 960	200	46	-/-	-/-	3
960 - 1000	500	54	-/-	-/-	3
Above 1000	-/-	-/-	500	54	3

Measurements

The Measurement was performed on: 15.06.2021 - 28.06.2021

6.1 Result 9 kHz – 30 MHz

In the frequency range 9 kHz – 30 MHz the EUT had been scanned in a distance of 3 m and the Limit were corrected to the test distance of 3 m using a factor with 40 dB/decade acc. to § 15.31 (f)(2).

Only the worst case of the X,Y and Z axis measurement is documented in this report.

Summery result for frequency range 9 kHz - 30 MHz to show combliance with RSS-Gen limits:

Function	Freq.	Measured Value @ 3m	Conversion to magnetic field[Note 1]		Limit @ 3m		Margin	Result
	[MHz]	[dBµV/m]	[dBµA/m]	[µA/m]	[dBµA/m]	[µA/m]	[dB]	
Mode 1 (PEPS)								
Antenna Type 1	0.125	65.7	14.2	5.13	54.2	512.86	40.0	pass
Antenna Type 3	0.125	65.6	14.1	5.07	54.2	512.86	40.2	pass
Mode 2 (Shared immobilizer)								
Antenna Type 1	0.125	48.5	-3.0	7.08	54.2	512.86	57.2	pass
Mode 3 (Shared Immobilizer)								
Coil Antenna Type 2	0.125	64.9	13.4	4.68	54.2	512.86	40.8	pass
Mode 4 (RF Receiver)								
Internal PCB Antenna	0.009 – 0.490	< 86.8	< 22.3	-/-	77 - 42.3	-/-	>20	pass
	0.490 – 1.705	< 83.0	< -8.5	-/-	22.3 - 11.5	-/-	>20	pass
	1.705 - 30	< 89.5	< -2.0	-/-	18	-/-	>20	pass

Note 1: Converstion E-field to H-Field:
- x [dBµV/m] – 51.5 = y [dBµA/m]
Converstion [dBµA/m] in [µA/m]
- 10 ^ (y [dBµA/m] / 20) = z [µA/m]

Note 2: Measured Values are from Output Power Fundamental Emission (Clause 7)

Representative one plot of Receiving mode and each polarisation was added in this report.

Receiving mode 433 MHz, Internal Antenna

TESTED IN GERMANY

IT 3/4

Interference radiation (9kHz – 30MHz)

acc.FCC Subpart C § 15.209

STC

Ref.-No.: 21/04-0029

Product: Transmitting/Receiving System

Sample: 01

Date: 08.06.2021

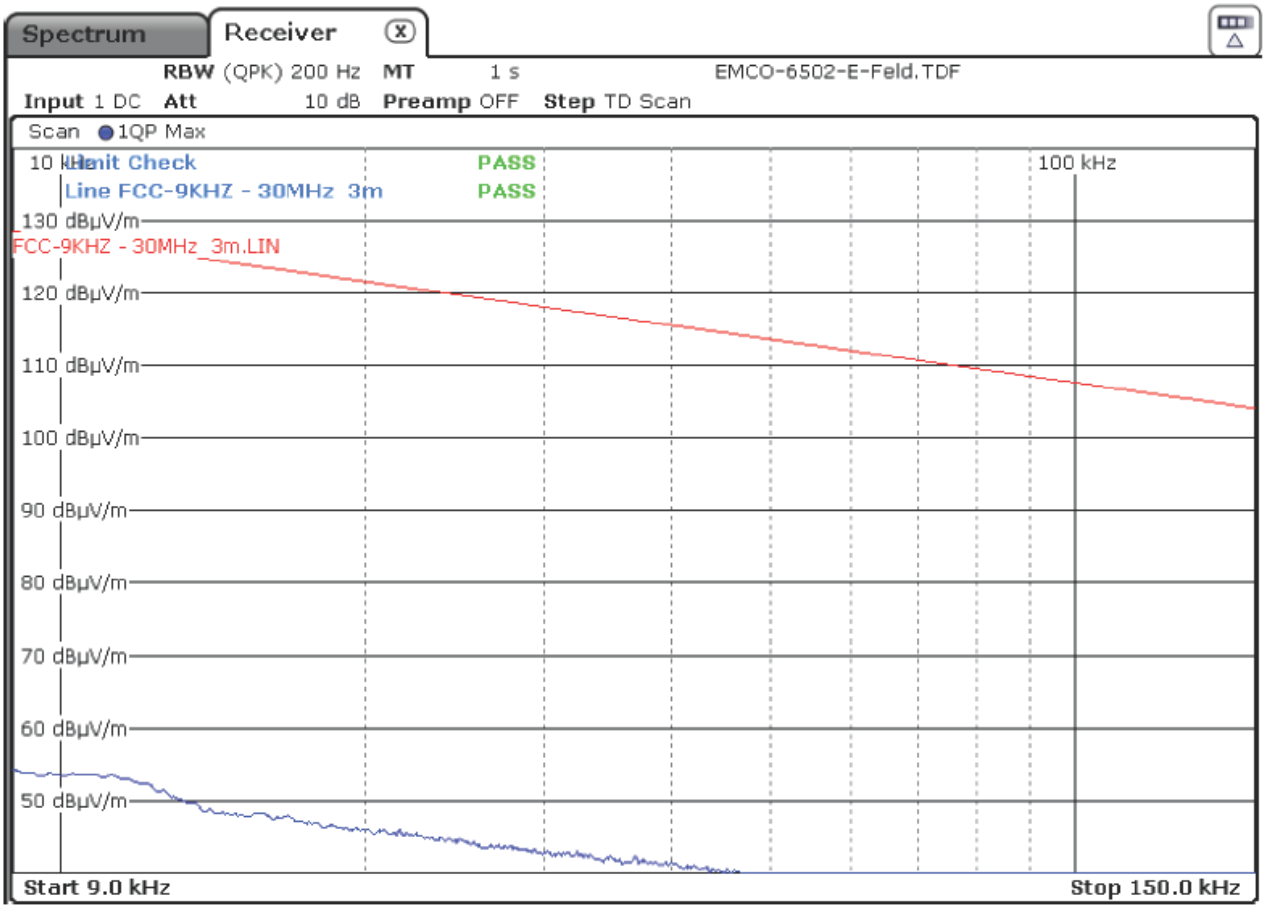
Operator: BI

Remarks:

	pass	fail
Result:	☒	☐

Operation mode: Receiving/Stand by 433,920MHz

Position X (9kHz – 150kHz)



Frequency [MHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
9kHz-150kHz	-/-	>10	-/-	pass

TESTED IN GERMANY

IT 3/4

Interference radiation (9kHz – 30MHz)

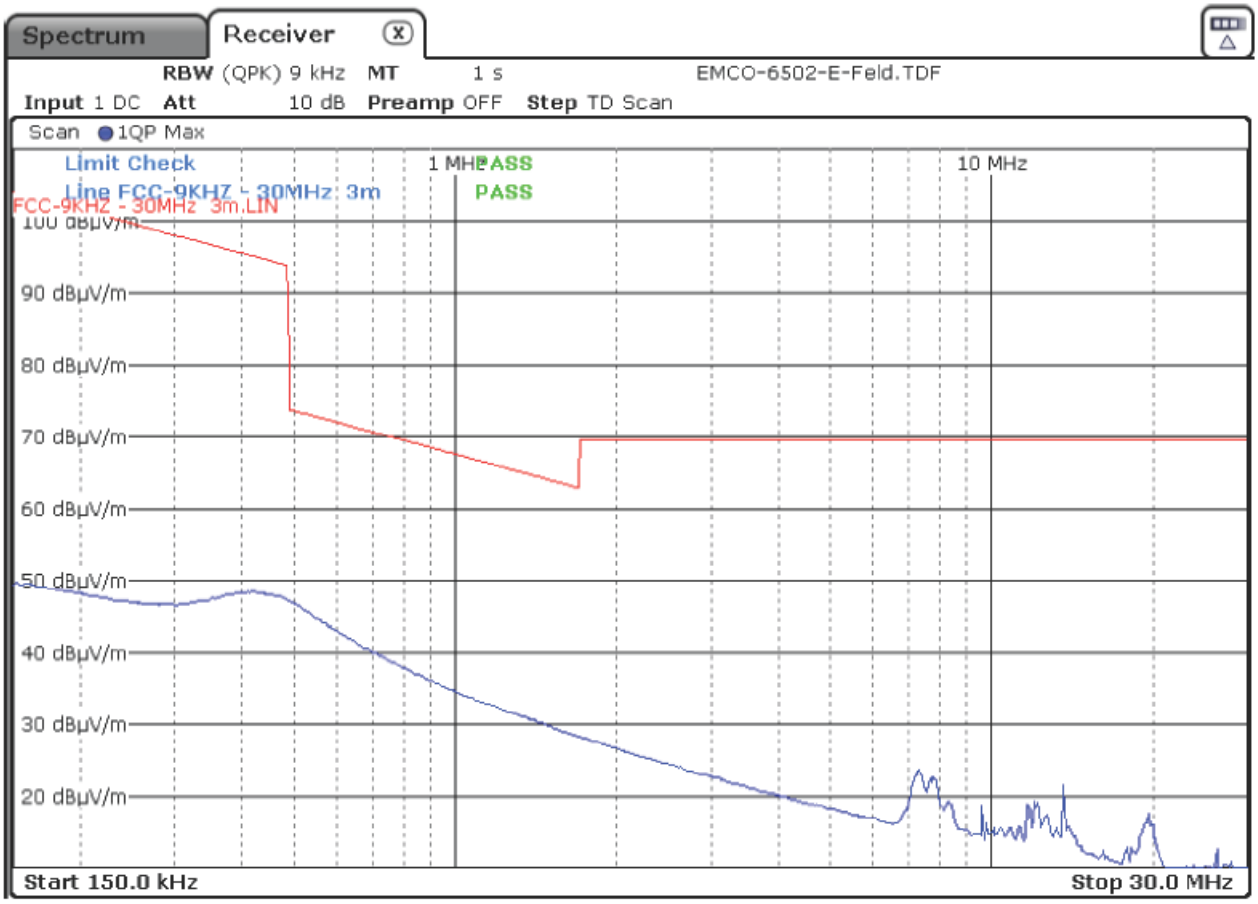
acc.FCC Subpart C § 15.209

STC

Ref.-No.: 21/04-0029

Operation mode: Receiving/Stand by 433,920MHz

Position X (150kHz – 30MHz)



Frequency [MHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
150kHz-30MHz	-/-	>10	-/-	pass

TESTED IN GERMANY

IT 3/4

Interference radiation (9kHz – 30MHz)

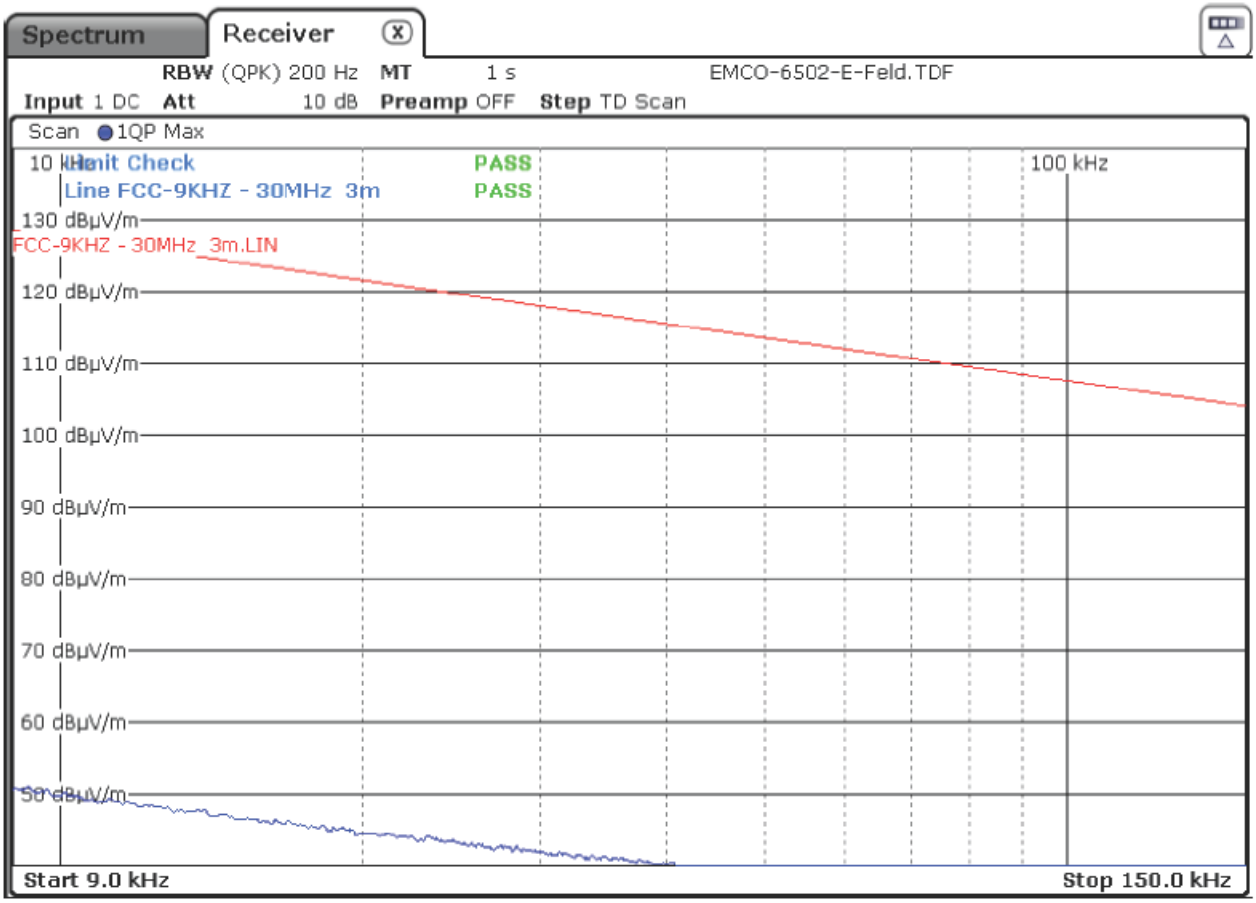
acc.FCC Subpart C § 15.209

STC

Ref.-No.: 21/04-0029

Operation mode: Receiving/Stand by 433,920MHz

Position Y (9kHz – 150kHz)



Frequency [MHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
9kHz-150kHz	-/-	>10	-/-	pass

TESTED IN GERMANY

IT 3/4

Interference radiation (9kHz – 30MHz)

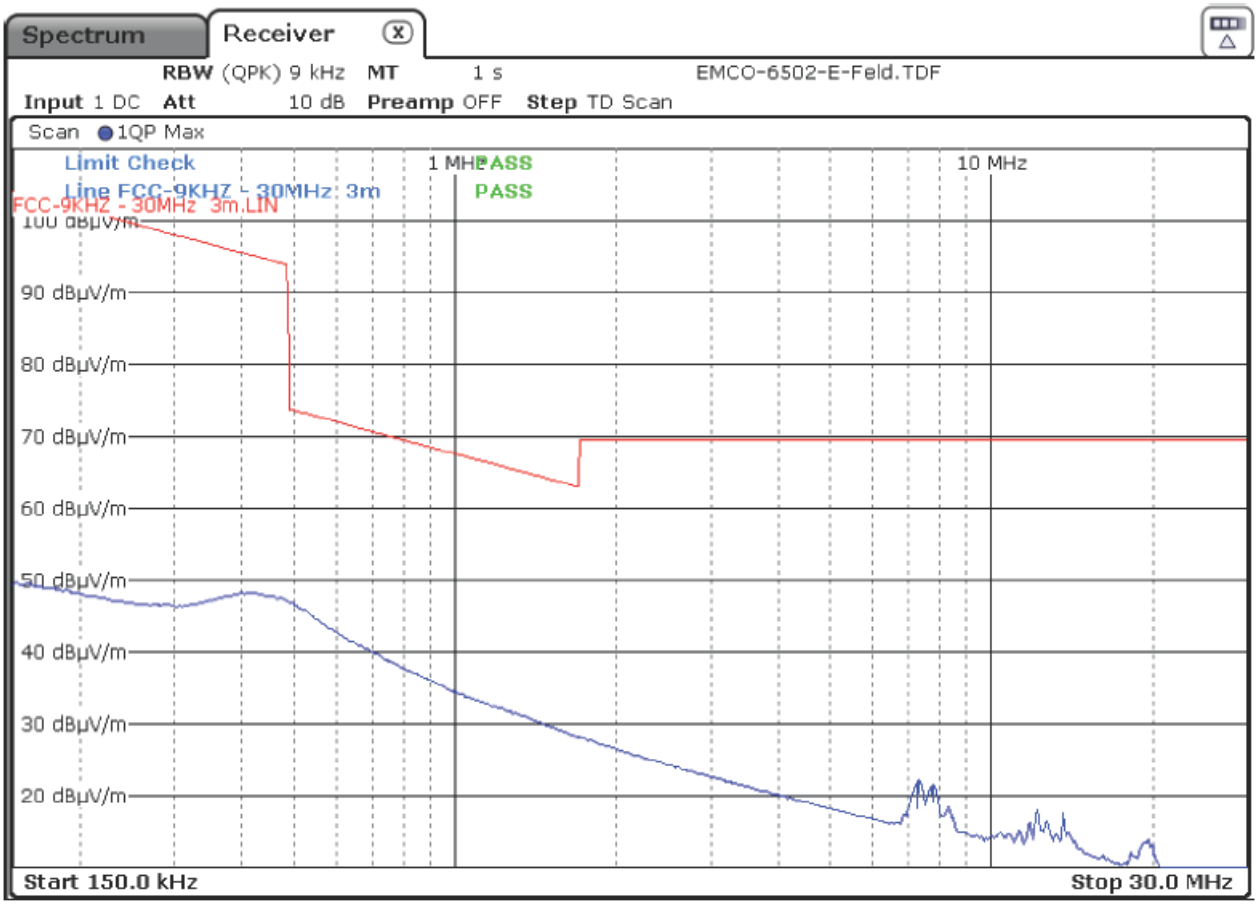
acc.FCC Subpart C § 15.209

STC

Ref.-No.: 21/04-0029

Operation mode: Receiving/Stand by 433,920MHz

Position Y (150kHz – 30MHz)



Frequency [MHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
150kHz-30MHz	-/-	>10	-/-	pass

TESTED IN GERMANY

IT 3/4

Interference radiation (9kHz – 30MHz)

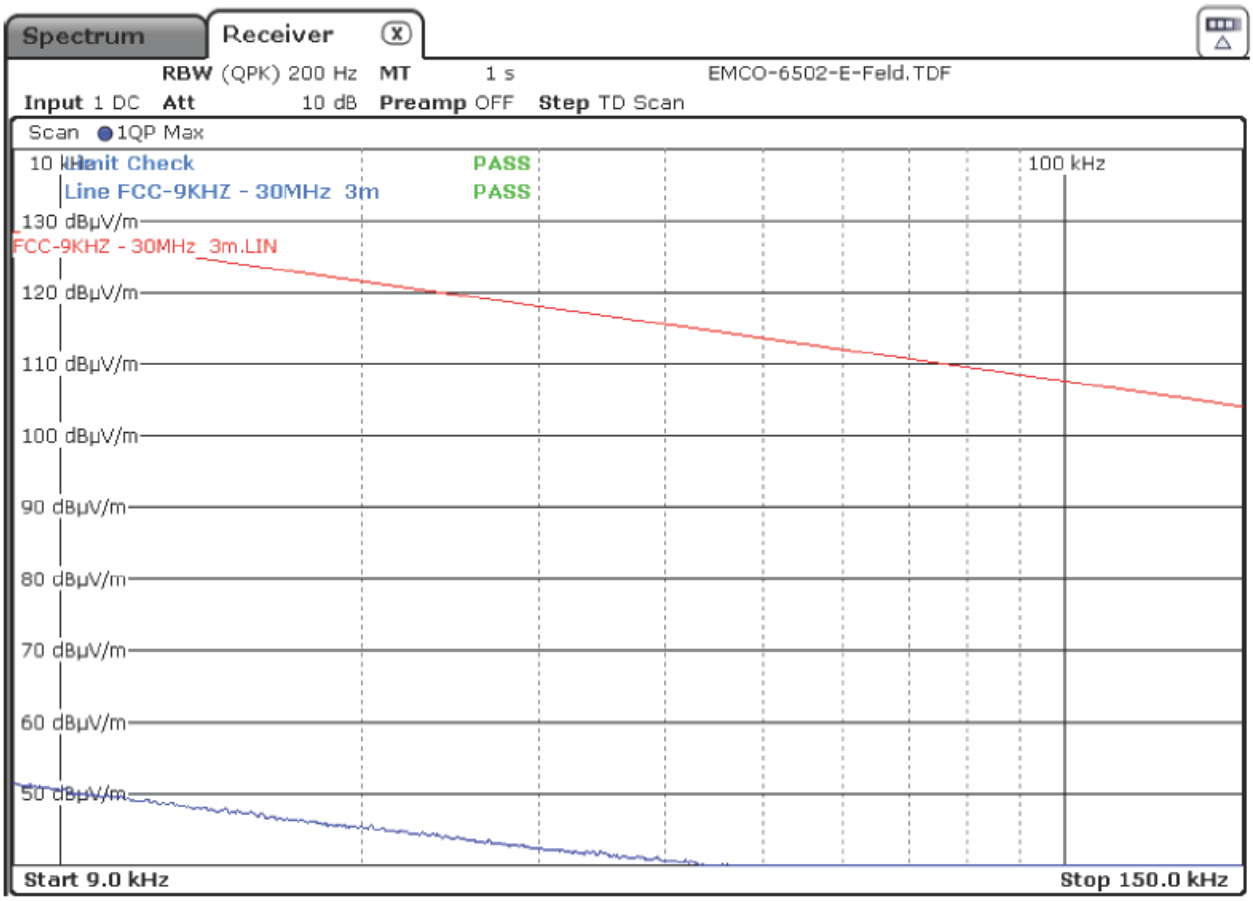
acc.FCC Subpart C § 15.209

STC

Ref.-No.: 21/04-0029

Operation mode: Receiving/Stand by 433,920MHz

Position Z (9kHz – 150kHz)



Frequency [MHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
9kHz-150kHz	-/-	>10	-/-	pass

IT 3/4

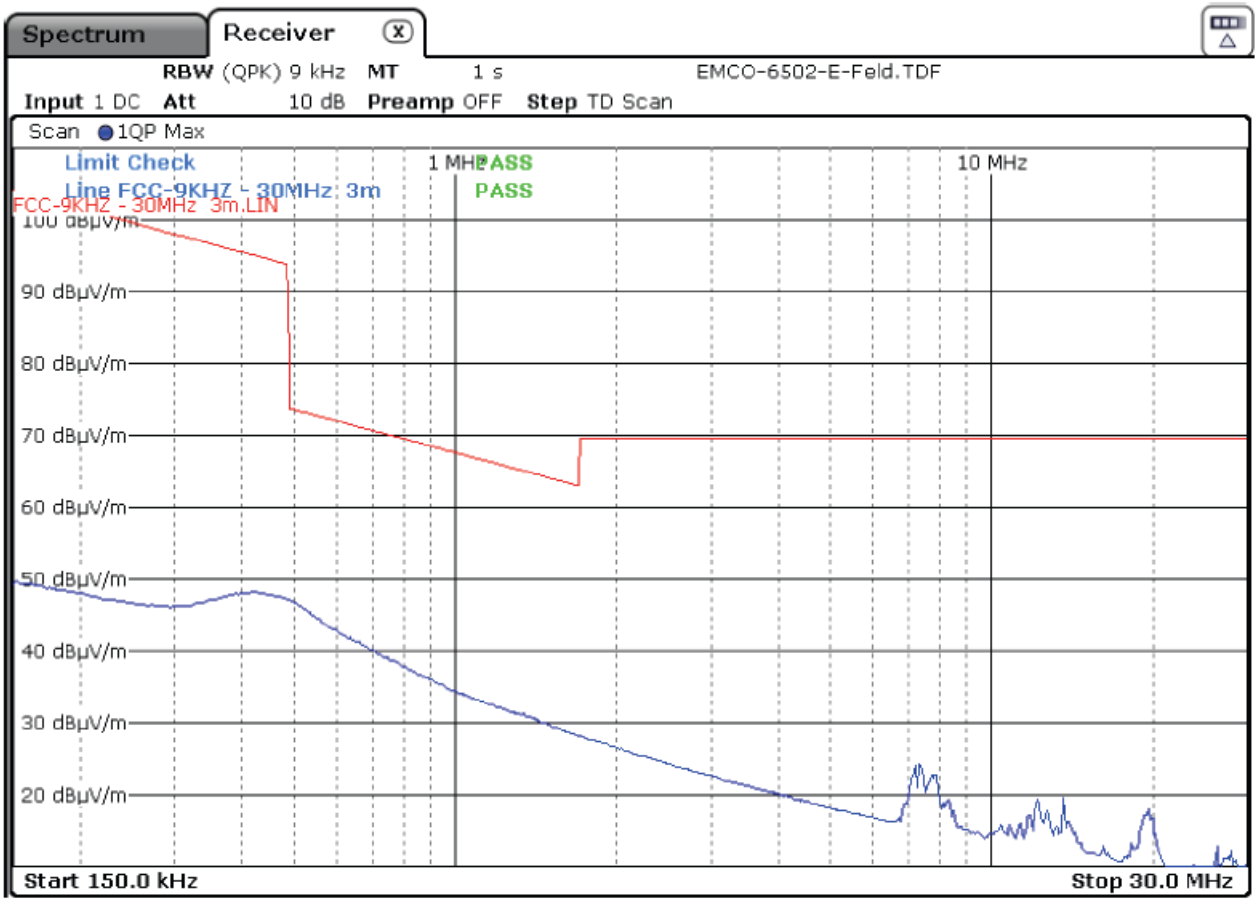
Interference radiation (9kHz – 30MHz)

acc.FCC Subpart C § 15.209

Ref.-No.: 21/04-0029

Operation mode: Receiving/Stand by 433,920MHz)

Position Z (150kHz – 30MHz)



Frequency [MHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
150kHz-30MHz	-/-	>10	-/-	pass

6.2 Result 30 MHz – 1000 MHz

The highest emissions for each polarization (H/V) in the frequency range

Frequency [MHz] (1)	Detector (2)	Antenna polarization (3)	Radiated emission [dBµV/m] (4)	Radiated emission [µV/m] (5)	Limit [dBµV/m] (3 m) (6)	Limit [µV/m] (3 m) (7)	Result (8)
< 960.00	**QP**	**V**	**< 36.00**	**63.10**	**46.00**	**200**	**Pass**
< 960.00	**QP**	**H**	**< 36.00**	**63.10**	**46.00**	**200**	**Pass**

(1) = test frequency
(2) = used detector - quasi peak (QP), peak (PK), average (AV)
(3) = polarization of the test antenna (Horizontal/Vertical)
(4) = Reading of test receiver + coversaion factor
(5) = 10 ^ ((Radiated emission [dBµV/m] (4))/20)
(6) = relevant limit in dBµV/m
(7) = relevant limit in µV/m
(8) = comparison between Limit [dBµV/m] (6) and Radiated emission [dBµV/m] (4)

Representative one plot of Receiving mode and each polarisation was added in this report.

Internal Antenna, Receiving mode 433,92 MHz

TESTED IN GERMANY

IT 5/6

Interference radiation

according to FCC Subpart C §15.209

STC

Ref.-No.: 21/04-0029

Product: Transmitting/Receiving System

Sample: 01

Date: 08.06.2021

Operator: BI

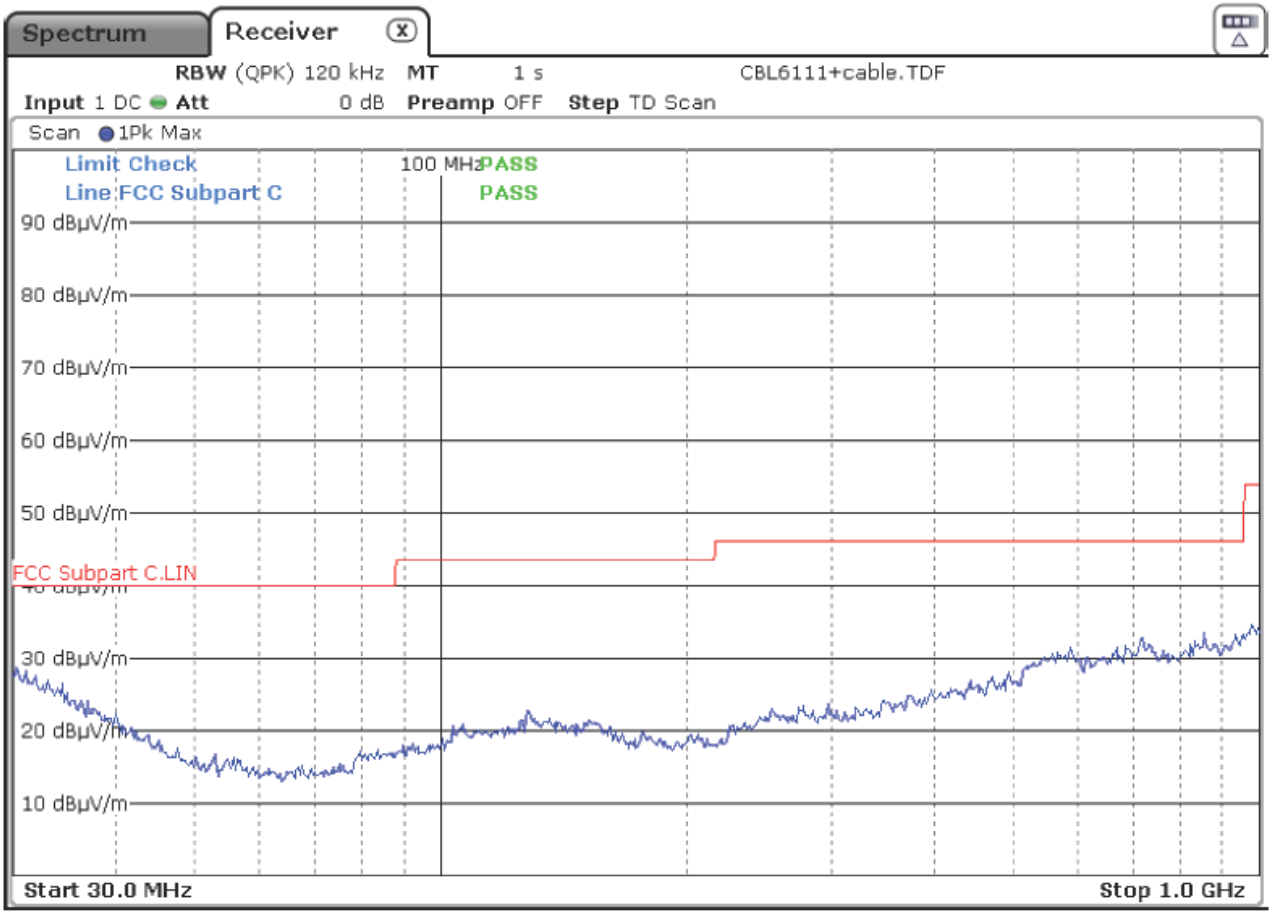
Remarks:

pass ☒ fail ☐

Result:

Final Measurement

Operation mode: Receiving/Stand by 433,920MHz



Polarisation: V

Scan Detector Peak					Final Detector Quasi Peak				
Frequ. [MHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. [MHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
30-1000	--/--	>10		pass					
*Retest with Quasi Peak					Retest with Quasi Peak Detector not required				

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IT 5/6

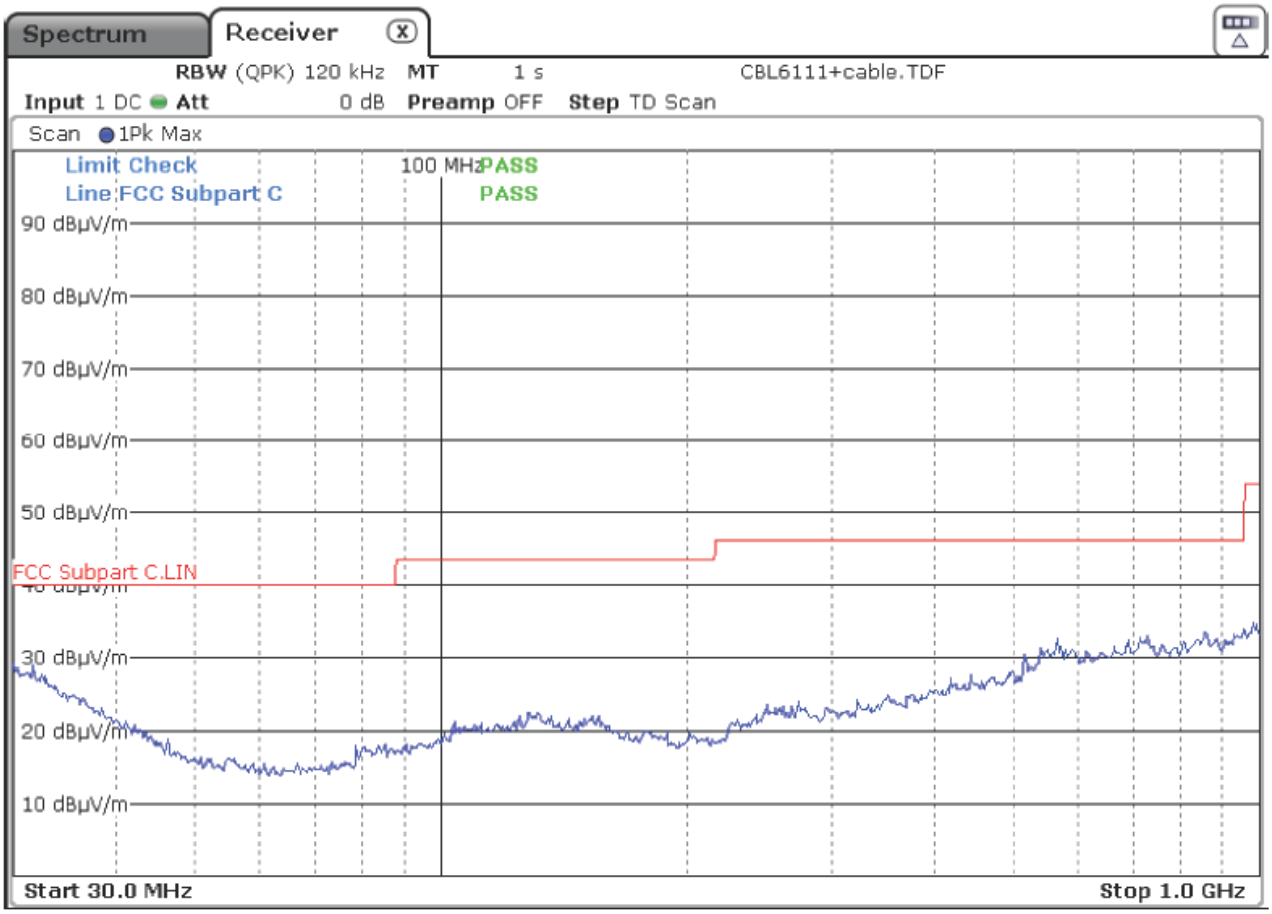
Interference radiation

according to FCC Subpart C §15.209

STC

Ref.-No.: 21/04-0029

Operation mode: Receiving/Stand by 433,920MHz



Polarisation: H									
Scan Detector Peak					Final Detector Quasi Peak				
Frequ. [MHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. [MHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
30-1000	--/--	>10		pass					
*Retest with Quasi Peak					Retest with Quasi Peak Detector not required				

Testdistance Antenna/EUT: 3m

6.3 Result 1 GHz – 7 GHz

All emissions in the frequency range 1 GHz - 7 GHz are at least 10 dB below the relevant limit.

Representative one plot of Receiving mode and each polarisation was added in this report.

Receiving mode 433,92 MHz, Internal Antenna

TESTED IN GERMANY

IT 5/6
Interference radiation
acc. to FCC § 15.209

STC

Ref.-No.: 21/04-0029

Product: Transmitting/Receiving System

Sample: 01

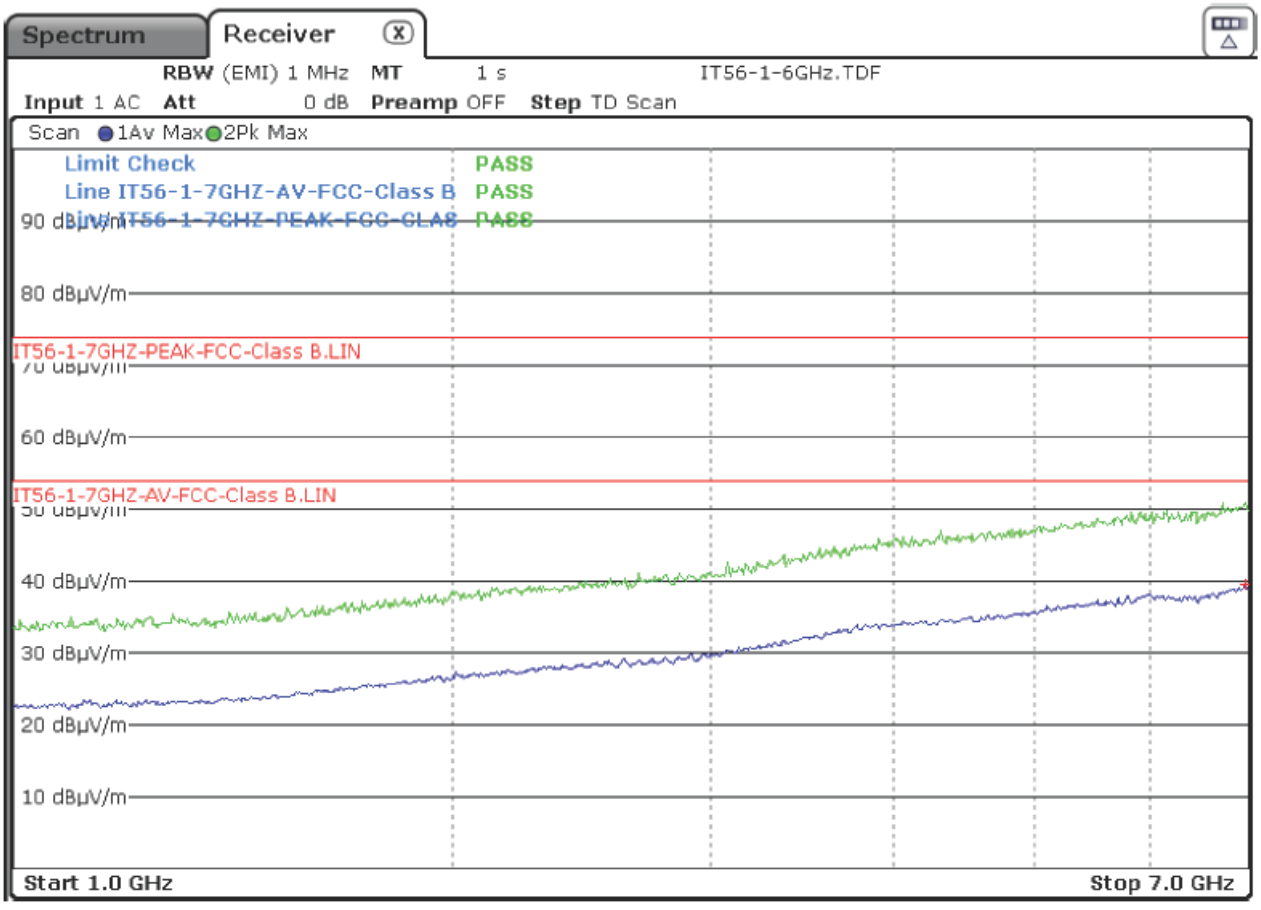
Date: 08.07.2021

Operator: BI

Remarks:

	pass	fail
Result:	☒	☐

Operation mode: Receiving/Stand by 433,920MHz



Polarisation: V									
Detector Average					Detector Peak				
Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
1 - 7	-/-	>20	54	pass	1 - 7	-/-	>20	74	pass
				pass					pass
				pass					pass
				pass					pass
				pass					pass
				pass					pass

TESTED IN GERMANY

IT 5/6

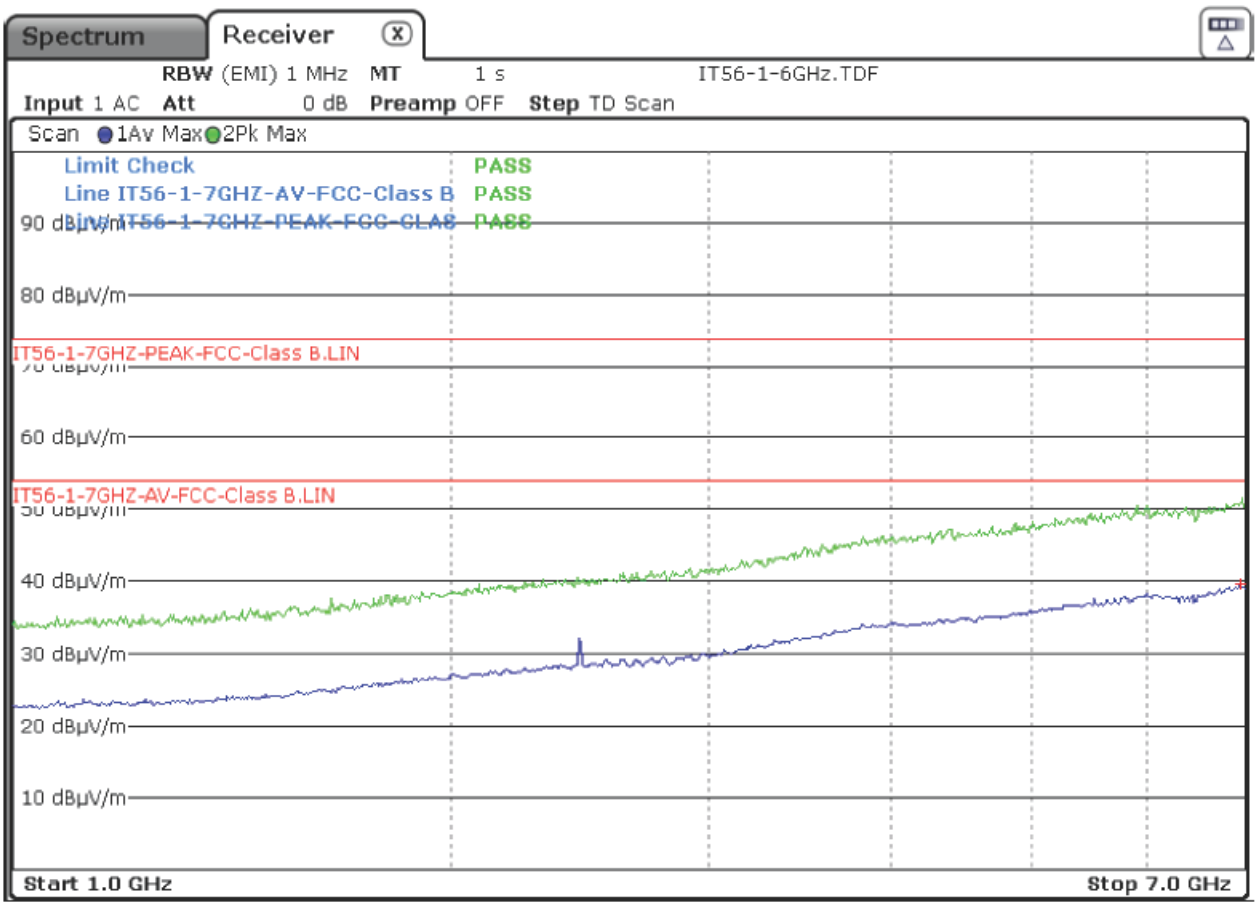
Interference radiation

acc. to FCC § 15.209

STC

Ref.-No.: 21/04-0029

Operation mode: : Receiving/Stand by 433,920MHz



Polarisation: H									
Detector Average					Detector Peak				
Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result	Frequ. [GHz]	Level [dBµV/m]	Margin to Limit [dB]	Limit [dBµV/m]	Result
1 - 7	-/-	>20	54	pass	1 - 7	-/-	>20	74	pass
				pass					
				pass					
				pass					
				pass					
				pass					

Results

From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements for the **Radiated Emissions**.

7. Output Power of Fundamental Emission

Applied standards

e-CFR Title 47 Chapter I Subchapter A Part 15 Subpart C, § 15.209 Radiated emission limits
RSS-210 Issue 10 Annex D
RSS-Gen issue 05 section 7.3

Test equipment and test set up
Test equipment used for radiated measurements as given in clause Test equipment of this report.
Test setup used for radiated measurements as given in clause Test setups of this report.

Measurement:

The Measurement was performed on: 21.06.2021

Measurement distance 3 m

Function	Frequency of fundamental Emission	Antenna Type 1 [dBµV/m]	Antenna Type 3 [dBµV/m]	Coil Antenna [dBµV/m]	Limit [dBµV/m]	Result
Mode 1 (LF PEPS)	125 kHz	65.7	65.6	-/-	105,7	pass
Mode 2 (LF IMMO)	125 kHz	48.5	-/-	-/-	105,7	pass
Mode 3 (LF IMMO)	125 kHz	-/-	-/-	64.9	105,7	pass

Converted value at distance 300 m[Note 1]

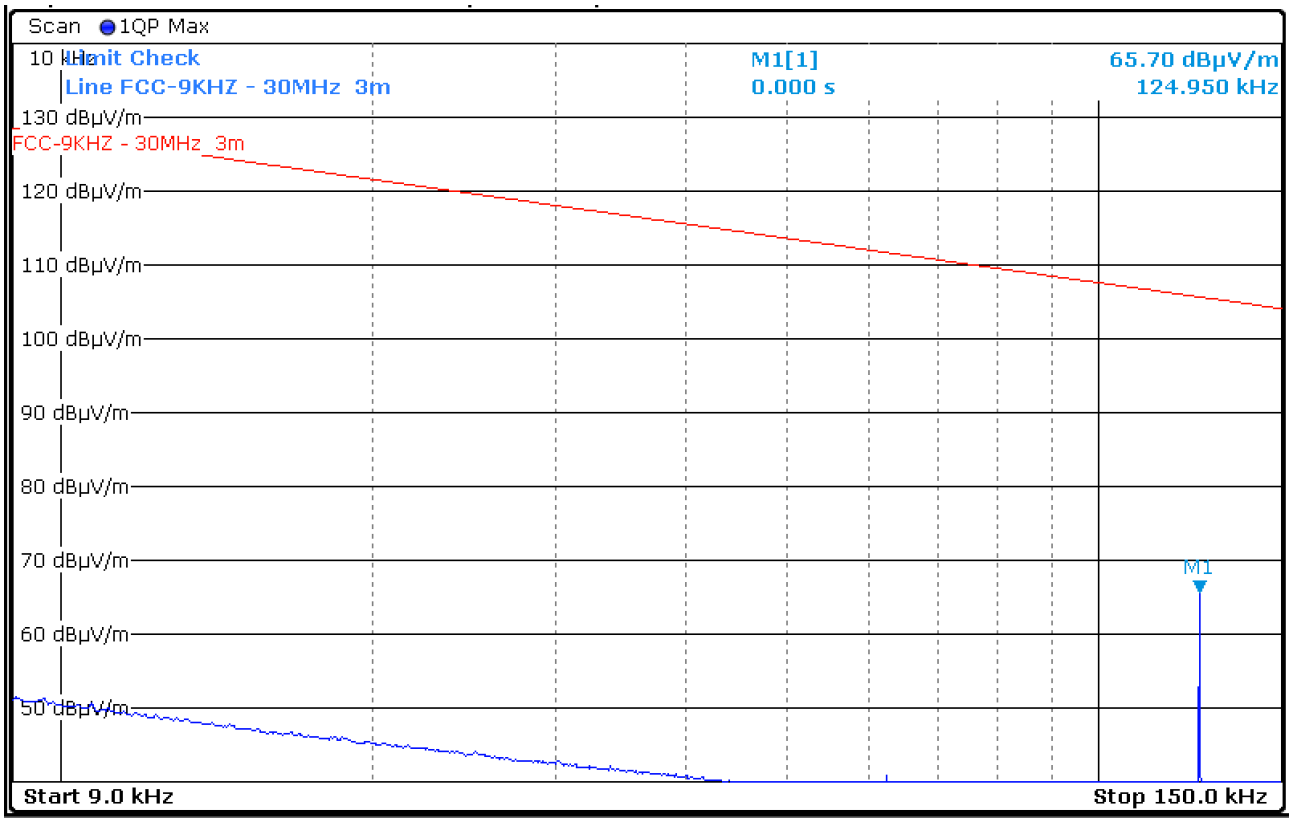
Function	Frequency of fundamental Emission	Antenna Type 1 [dBµV/m]	Antenna Type 3 [dBµV/m]	Coil Antenna [dBµV/m]	Limit [dBµV/m]	Result
Mode 1 (LF PEPS)	125 kHz	-14.3	-14.4	-/-	25,7	pass
Mode 2 (LF IMMO)	125 kHz	-31.5	-/-	-/-	25,7	pass
Mode 3 (LF IMMO)	125 kHz	-/-	-/-	-15.1	25,7	pass

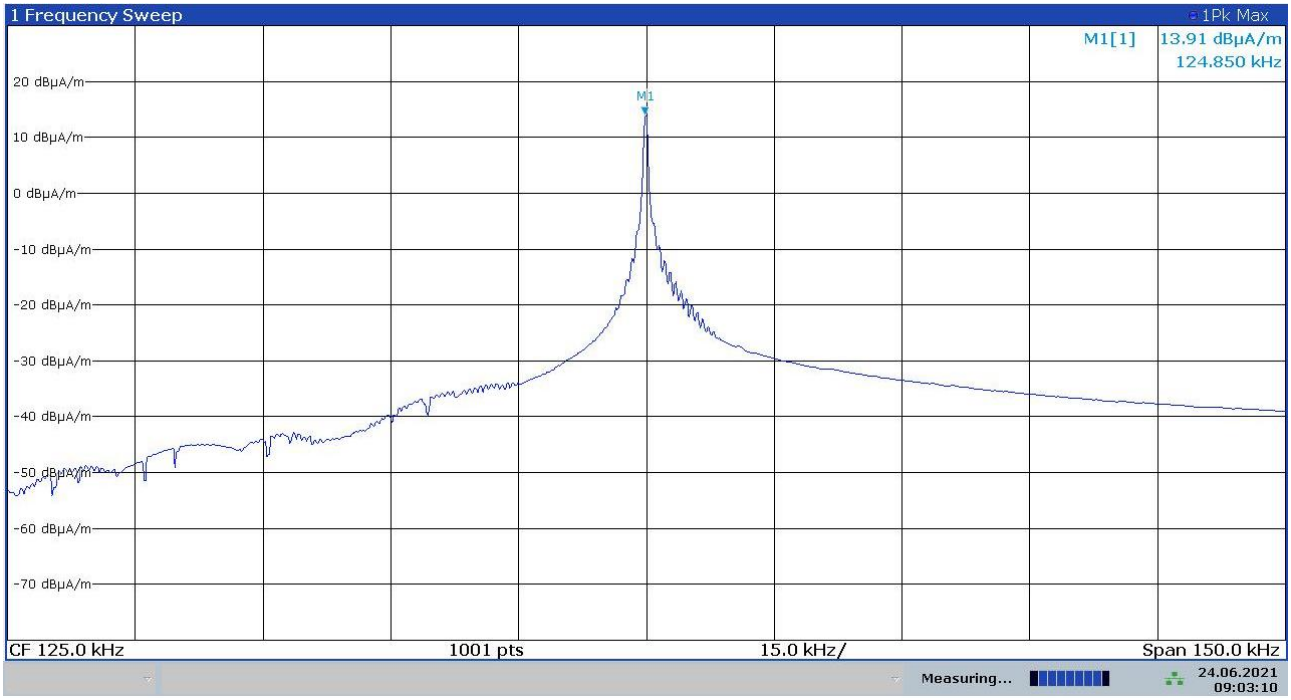
Note 1: using a conversion factor of 40 dB/decade acc. to § 15.31 (f)(2)

Results

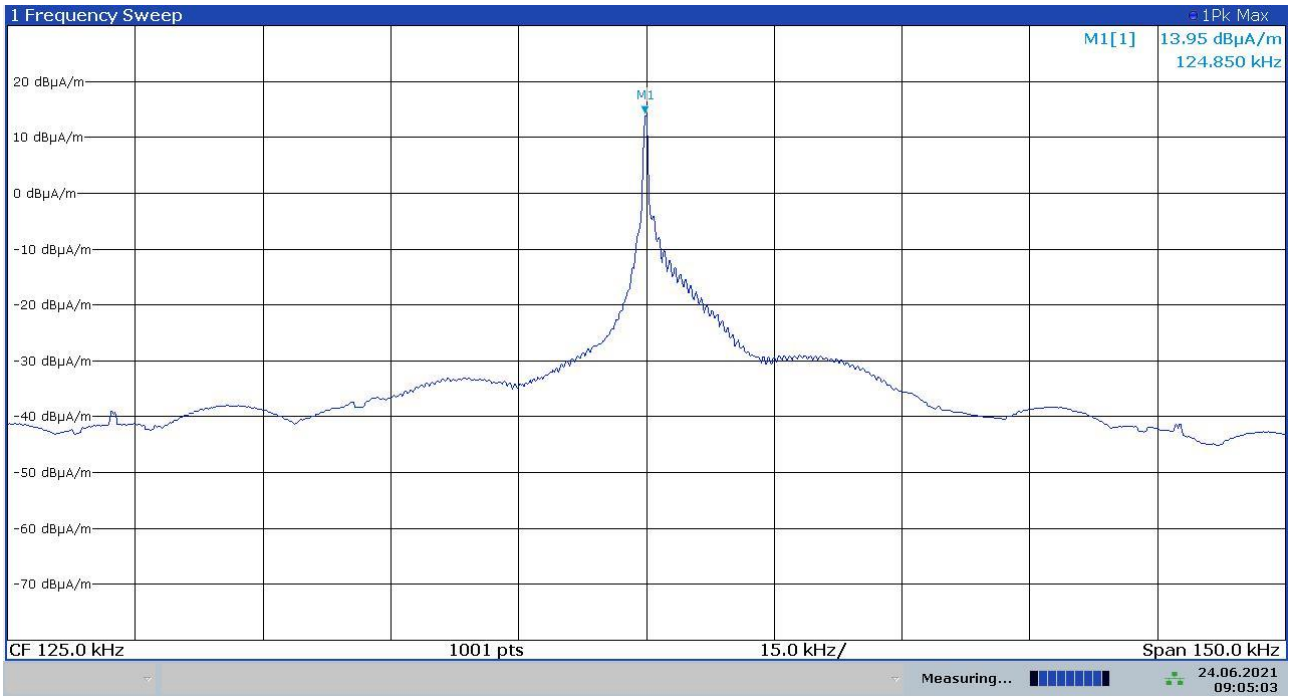
From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements of **Output Power of Fundamental Emissions**.

Mode 1: LF PEPS, Antenna Type 1, Transmitting mode 125 kHz

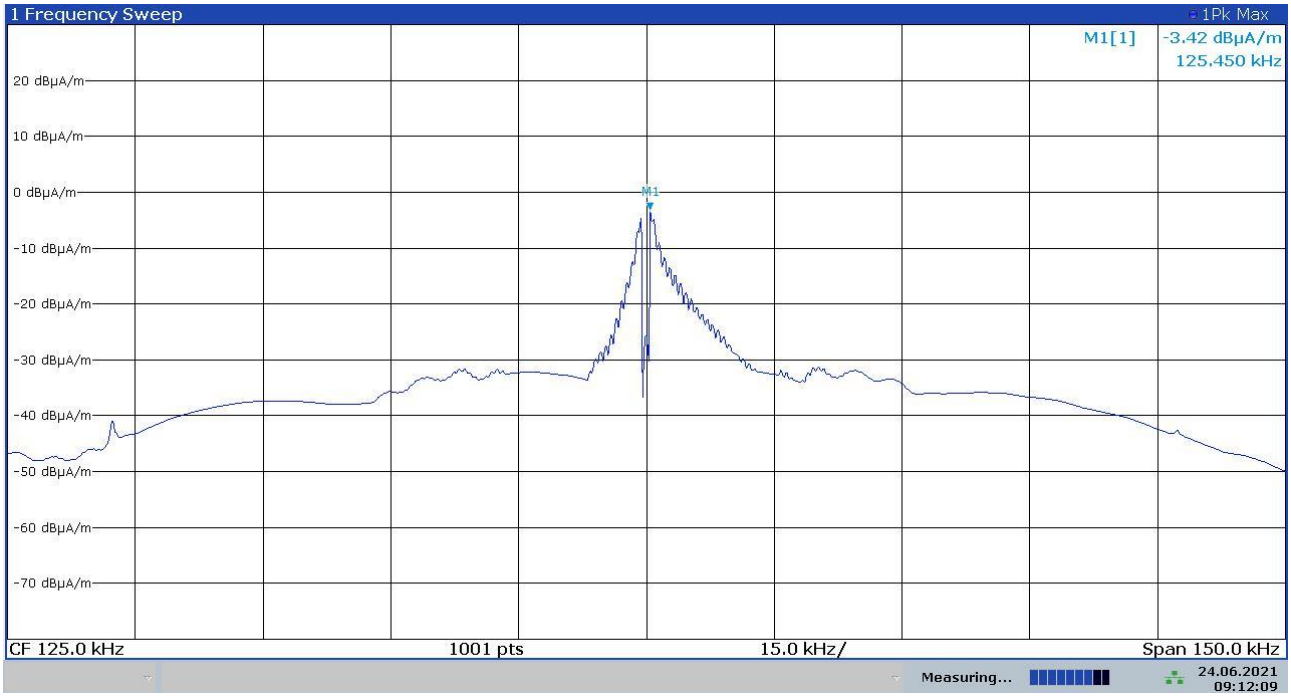




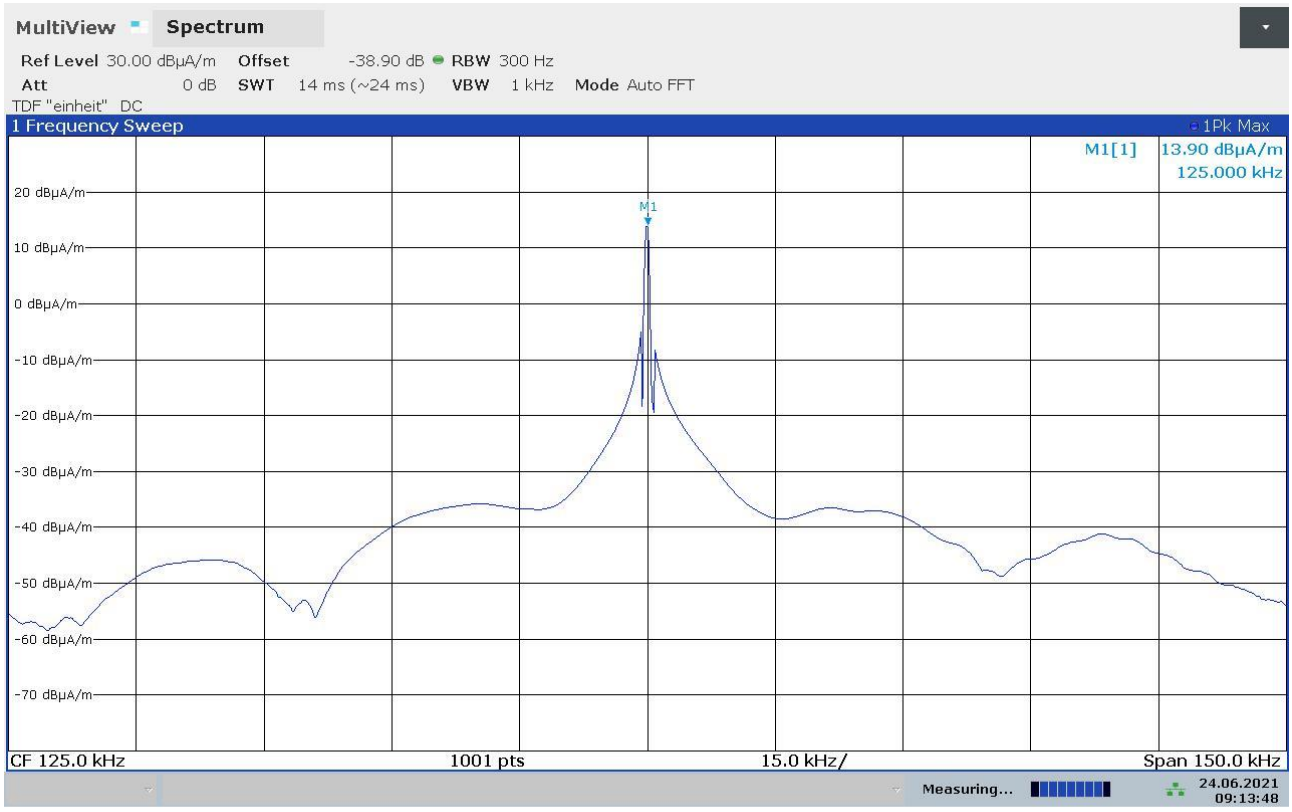
Mode 1: LF PEPS, Antenna Type 3, Transmitting mode 125 kHz



Mode 2: LF IMMO Antenna Type 1, Transmitting mode 125 kHz



Mode 3: LF IMMO, Coil Antenna Type 2, Transmitting mode 125 kHz



09:13:48 24.06.2021

8. 99% Power Bandwidth

Aplied standards
-RSS-210 issue 10 Annex D
-RSS-Gen issue 5 Section 6.7

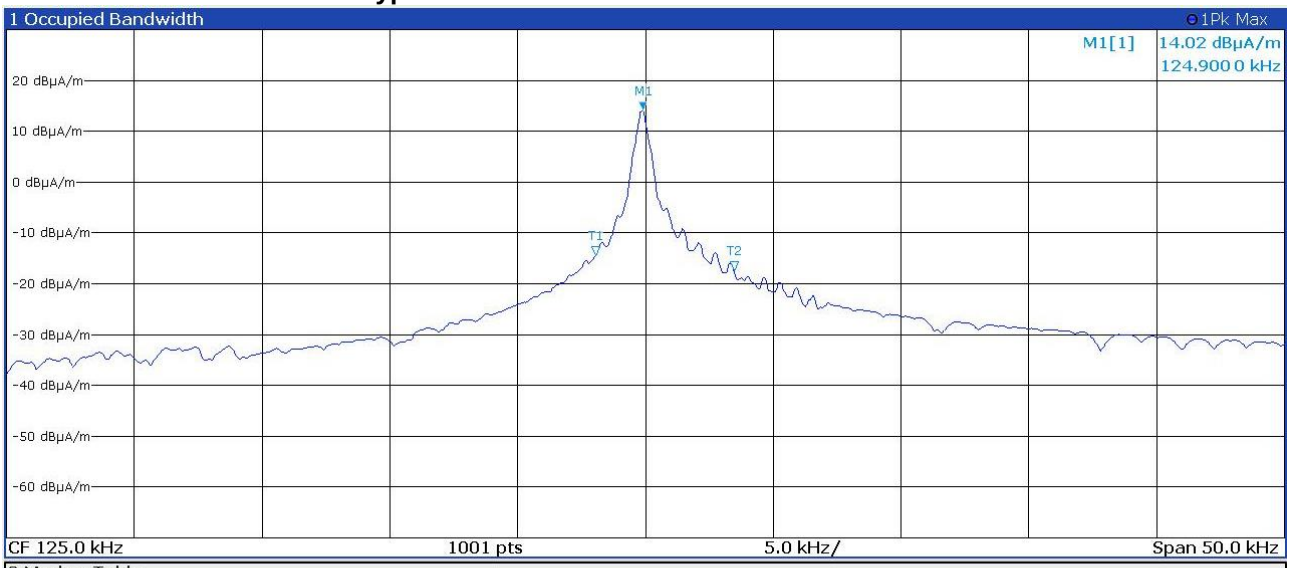
Test equipment and test set up
Test equipment used for conducted measurements as given in clause Test equipment of this report.
Test setup used for conducted measurements as given in clause Test setups of this report.

Description
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 99% power bandwidth function of the instrument was used for the measurement.

Measurement:

The Measurement was performed on: 21.06.2021

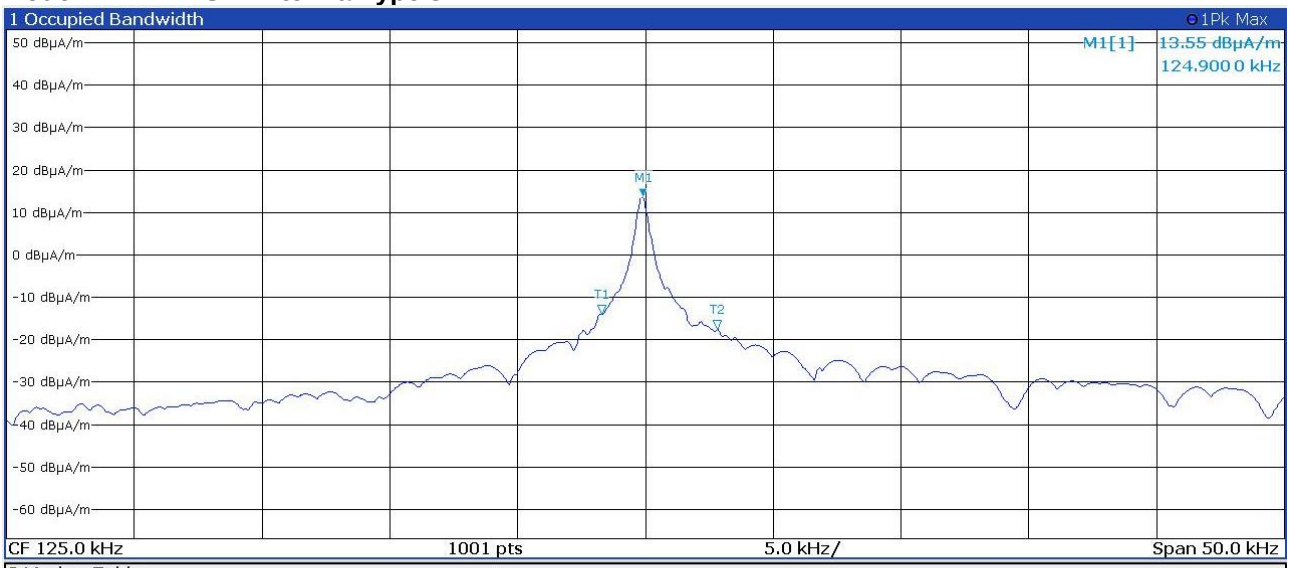
Mode 1: LF PEPS - Antenna Type 1



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**124.9 kHz**	**14.02 dBµA/m**	Occ Bw	**5.401 926 833 kHz**
T1		1	123.062 1 kHz	-14.38 dBµA/m	Occ Bw Centroid	125.763 045 366 kHz
T2		1	128.464 kHz	-17.50 dBµA/m	Occ Bw Freq Offset	763.045 366 228 Hz

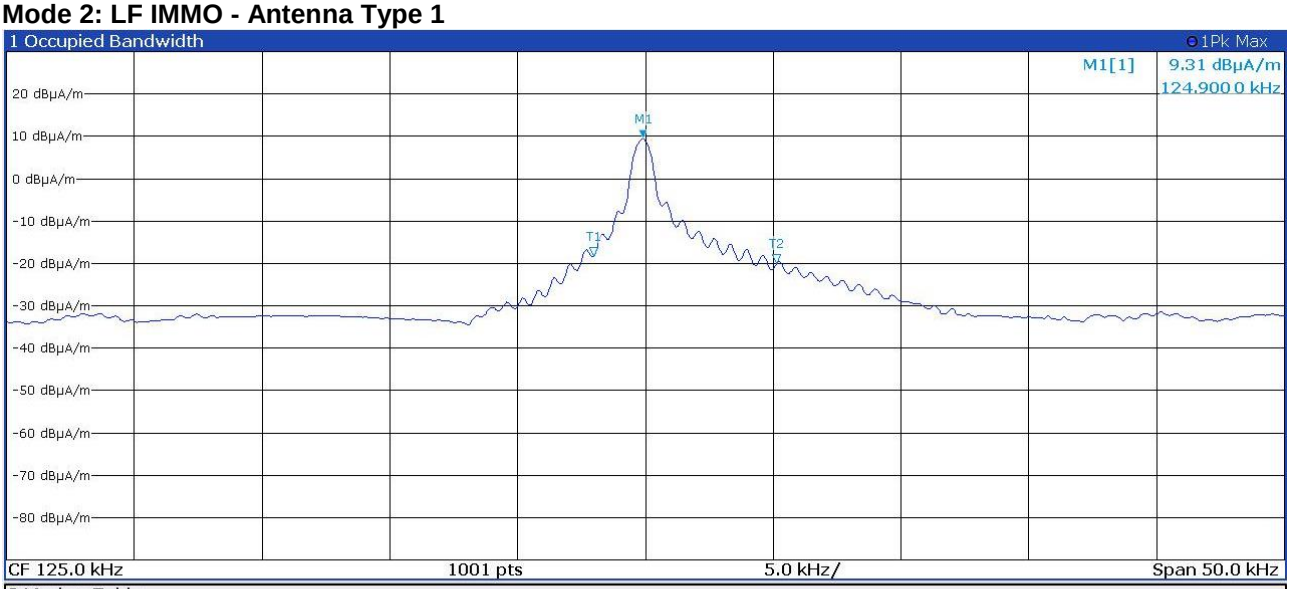
Mode 1: LF PEPS - Antenna Type 3



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**124.9 kHz**	**13.55 dBµA/m**	Occ Bw	**4.535 438 409 kHz**
T1		1	123.28 kHz	-13.94 dBµA/m	Occ Bw Centroid	125.547 715 275 kHz
T2		1	127.815 4 kHz	-17.49 dBµA/m	Occ Bw Freq Offset	547.715 274 894 Hz

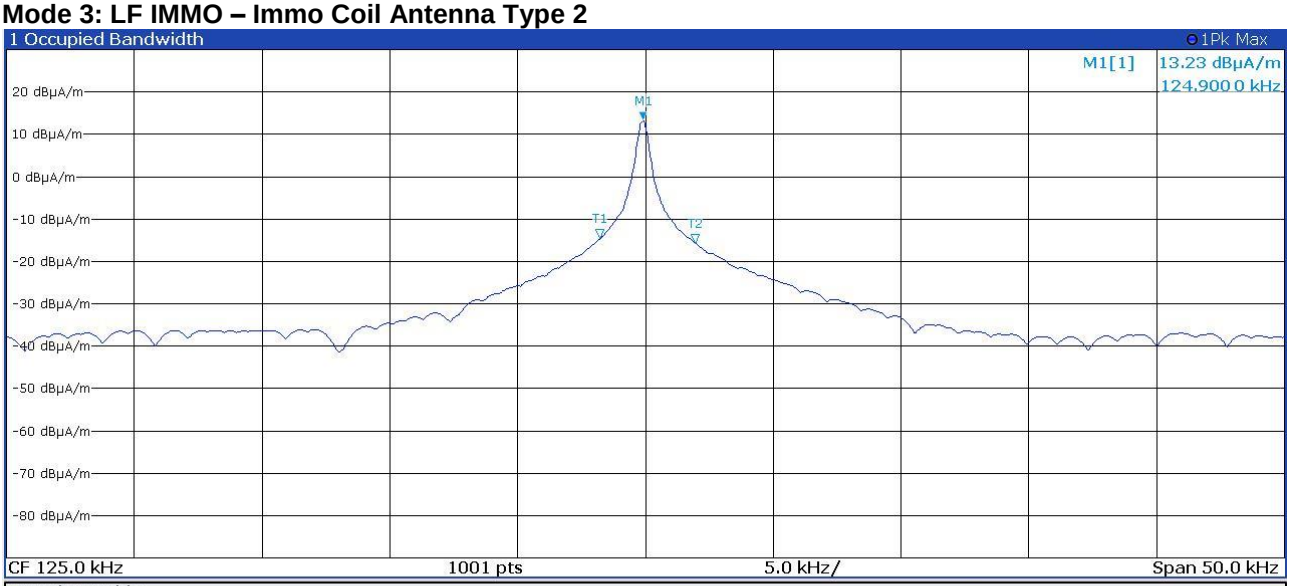
Mode 2: LF IMMO - Antenna Type 1



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**124.9 kHz**	**9.31 dBµA/m**	Occ Bw	**7.161 330 558 kHz**
T1		1	122.971 9 kHz	-18.33 dBµA/m	Occ Bw Centroid	126.552 523 963 kHz
T2		1	130.133 2 kHz	-19.94 dBµA/m	Occ Bw Freq Offset	1.552 523 963 kHz

Mode 3: LF IMMO – Immo Coil Antenna Type 2



2 Marker Table

Type	Ref	Trc	X-Value	Y-Value	Function	Function Result
M1		1	**124.9 kHz**	**13.23 dBµA/m**	Occ Bw	**3.733 121 54 kHz**
T1		1	123.204 7 kHz	-14.69 dBµA/m	Occ Bw Centroid	125.071 252 896 kHz
T2		1	126.937 8 kHz	-15.71 dBµA/m	Occ Bw Freq Offset	71.252 896 406 Hz

Summery List of Bandwidth

EUT Frequency (kHz)	99% OBW lower (f_L) frequency [kHz]	99% OBW upper (f_H) frequency [kHz]	Centre frequency [kHz]	99% Bandwidth [kHz]	Result	Comment
125	123.062	128.464	125.763	5.40	pass	LF PEPS - Antenna 1
125	123.280	127.815	125.548	4.54	pass	LF PEPS - Antenna 3
125	122.972	130.133	126.553	7.16	pass	LF IMMO - Antenna 1
125	123.205	126.938	125.071	3.73	pass	LF IMMO Coil Antenna

Results

From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements for the **99% Power Bandwidth**.

9. RF Exposure

Refer to “0029-ised-rep-RF-Exposure.pdf” file

10. Test equipment

Test equipment used for radiated Measurements:

Kind of equipment	Manufacturer	Type	Ident no.	Serial no.	Calibrated on (y-m-d)	Calibration interval
Signal Spectrum Analyzer 2 Hz - 26.5 GHz	Rohde & Schwarz	FSW26 Instrument FW 2.60	11571	102047	2019-Jan.	3 years
ESR 7 EMI Testreceiver 7 GHz	Rohde & Schwarz	ESR 7 Instrument FW 3.36	11676	101694	2021-April	3 years
Antenna 1 GHz – 18 GHz	Electro Metric	RGA 50/60	10273	2753	2021-Jan.	3 years
Antenna (FCC) 30 MHz – 1 GHz	Chase	CBL6111	10022	1064	2019-Dec.	3 years
Antenna 9 kHZ – 30 MHz	Schwarzbeck	EMCO 6502	10546	2018	2021-Jan.	3 years
Shielded room/ Chamber	Frankonia	SAC3 "SEMI-ANECHOIC-CHAMBER"	11609	004/16	2019-May	3 years
Broadband-Preamplifier 1 GHz - 18 GHz	Schwarzbeck	BBV9718	11231	9718-002	2021-Jan.	3 years
Cable 8 m	el-spec GmbH	FlexCore-SMA11-SMA11-8000-ARM	11625	-/-	2020-Oct.	3 years
Cable 1.5 m	Suhner	Sucoflex 100	11648	-/-	2020-Oct.	3 years

Test equipment used for conducted Measurements:

Kind of equipment	Manufacturer	Type	Ident no.	Serial no.	Calibrated on (y-m)	Calibration interval
EMC32 Test software	Rohde & Schwarz	EMC32 Test software	-/-	-/-	-/-	
Signal Spectrum Analyzer 2 Hz - 26.5 GHz	Rohde & Schwarz	FSW26 Instrument FW 2.60	11571	102047	2019-Jan.	3 years
Testsystem-Automatisierung und HF-Umschaltung Automatisation unit and RF switch	Rohde & Schwarz	OSP120	11573	100947	2020-Oct.	3 years
Cable 1.5 m	Suhner	Sucoflex 100	11648	-/-	2020-Oct.	3 years

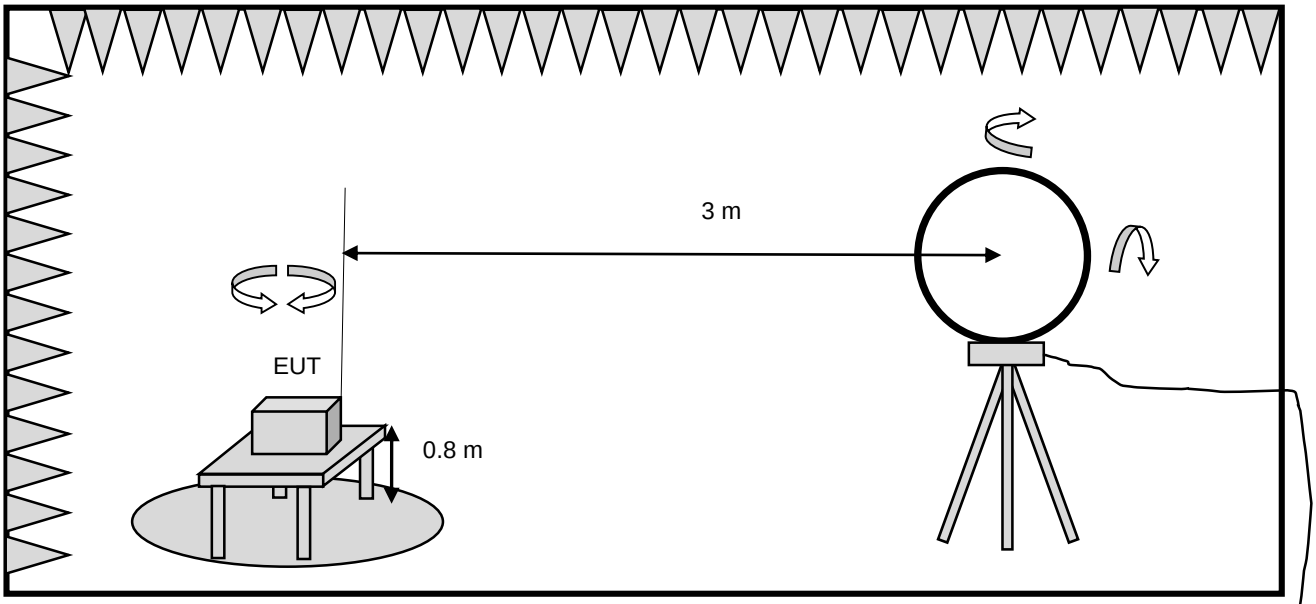
All measurements were made with measuring instruments, including any accessories that may affect test results, calibrated according to the requests of ISO/IEC 17025 according to which the test site is accredited from DAkkS. Measurement of conducted emissions was made with instruments conforming to American National Standard Specification, ANSI C63.4-2014.

Test equipment to support EUT functions:

Kind of equipment	Manufacturer	Type	Ident no.	Serial no.	Calibrated on (y-m-d)	Calibration interval
Power supply	Elektro-Automatik	EA-3013	10093	-/-	-/-	-/-
Multimeter	Fluke	79III	10938	71150461	2020-April	3 years
-/-	-/-	-/-	-/-	-/-	-/-	-/-

11. Test Setups

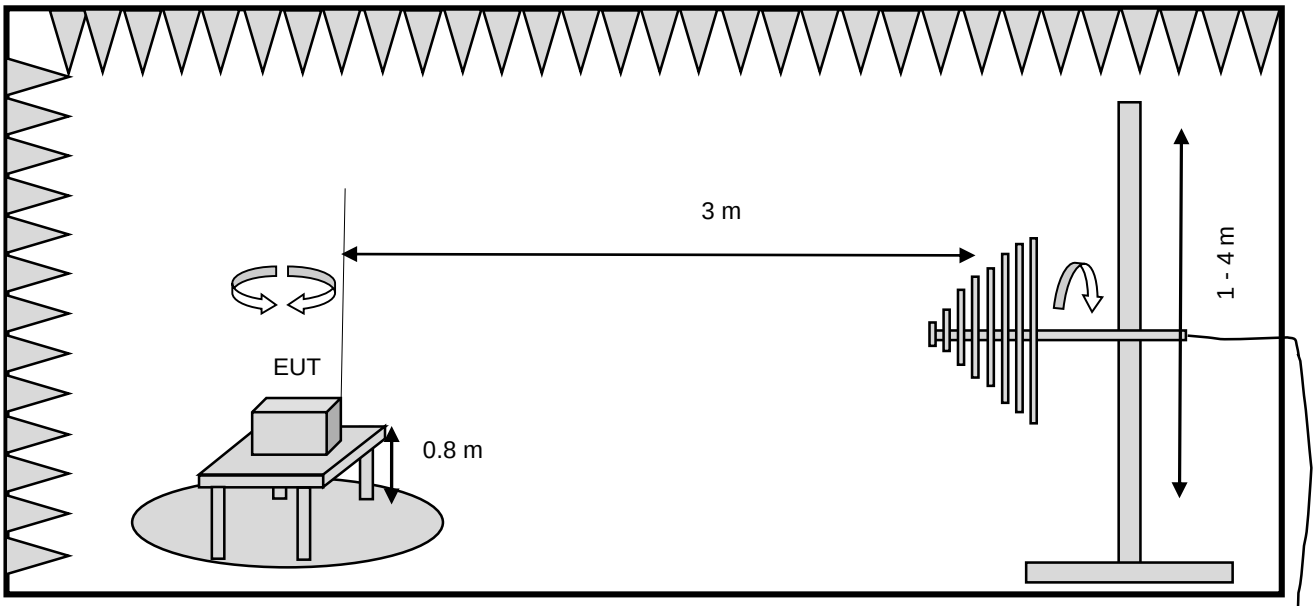
Block diagram Radiated emissions



Semi anechoic chamber with absorber and ferrite tiles

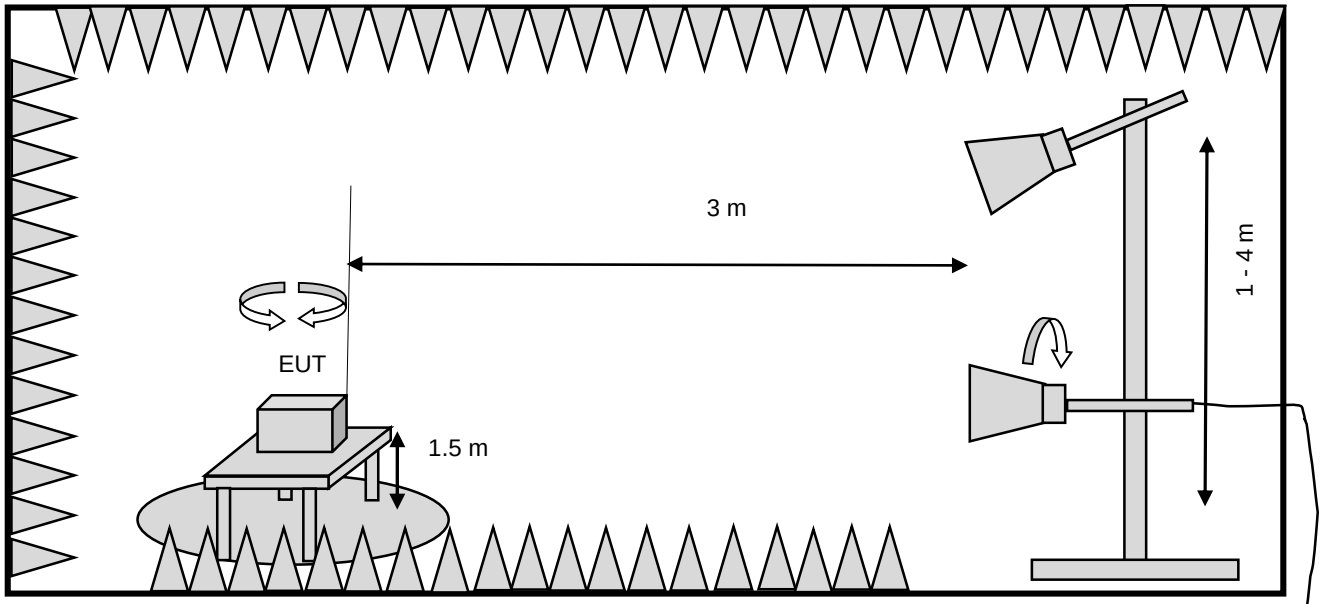
tested frequency range 9 kHz - 30 MHz

Block diagram Radiated emissions

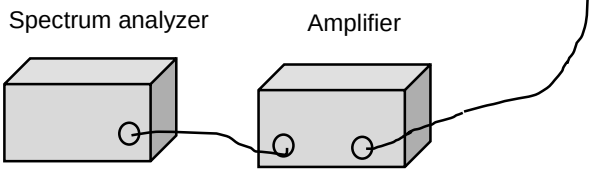


Semi anechoic chamber with absorber and ferrite tiles

tested frequency range 30 MHz - 1000 MHz

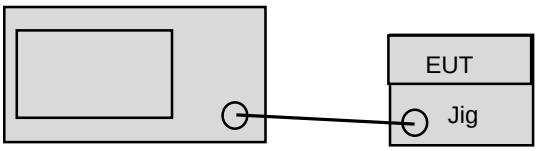


Semi anechoic chamber with absorber and ferrite tiles



tested frequency range > 1000 MHz

Block diagram for conducted measurements



Test Receiver/Analyzer **EUT**

12. Measurement uncertainty

according to *CISPR 16-4-2 Edition 2.0 2011-06*

Measurement	**calculated uncertainty U_{lab}**	**Specified CISPR uncertainty according CISPR 16-4-2 Edition 2.0 2011-06, table 1 U_{CISPR}**
Conducted disturbance at mains port using AMN 9 kHz – 150 kHz	3.6 dB	3.8 dB
Conducted disturbance at mains port using AMN 150 kHz – 30 MHz	3.2 dB	3.4 dB
Magn. fieldstrength 9kHz - 30MHz	3.4 dB	-/-
Radiated disturbance (electric field strength in the SAC) 30 MHz to 1 000 MHz	4.7 dB	6.3 dB
Radiated disturbance (electric field strength in the SAC) 1 GHz to 26.5 GHz	4.1 dB	-/-

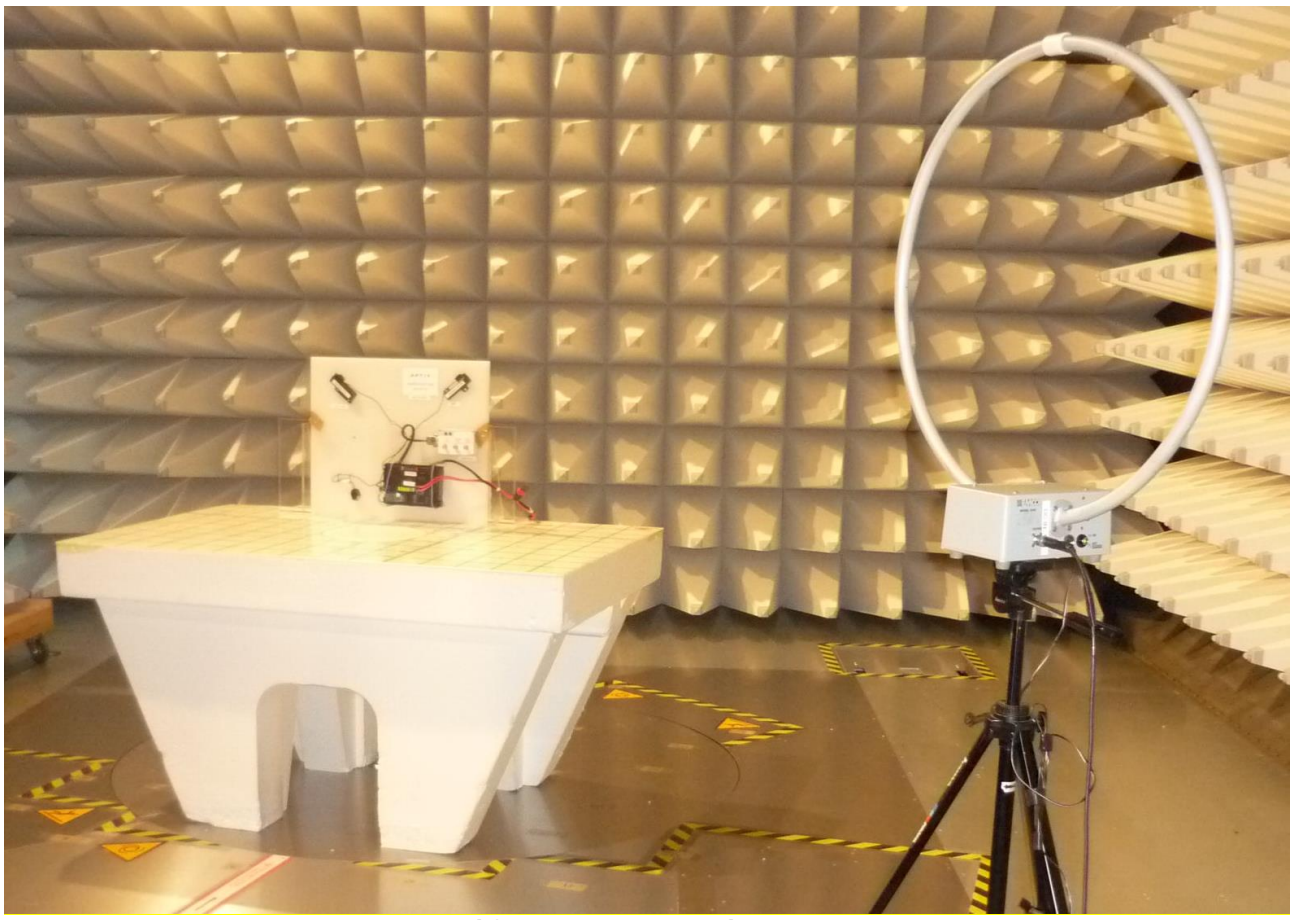
Measurement	**calculated uncertainty U_{lab}**	**Maximum measurement uncertainty**
Channel Bandwidth	±1.17 %	±5 %
RF output power, conducted	±1.36 dB	±1.5 dB
Power Spectral Density, conducted	±1.99 dB	±3 dB
Unwanted Emissions, conducted	±1.71 dB	±3 dB
All emissions, radiated	±4.8 dB	±6 dB
Temperature	±0.72 °C	±3 °C
Supply voltages	±0.76 % (DC up to 40V) ±1.74 % (AC 50Hz up to 400V)	±3 %
Time	±0.012 %	±5 %

The measurement uncertainty describes the overall uncertainty of the given measured value during the operation of the EUT in the above mentioned way.

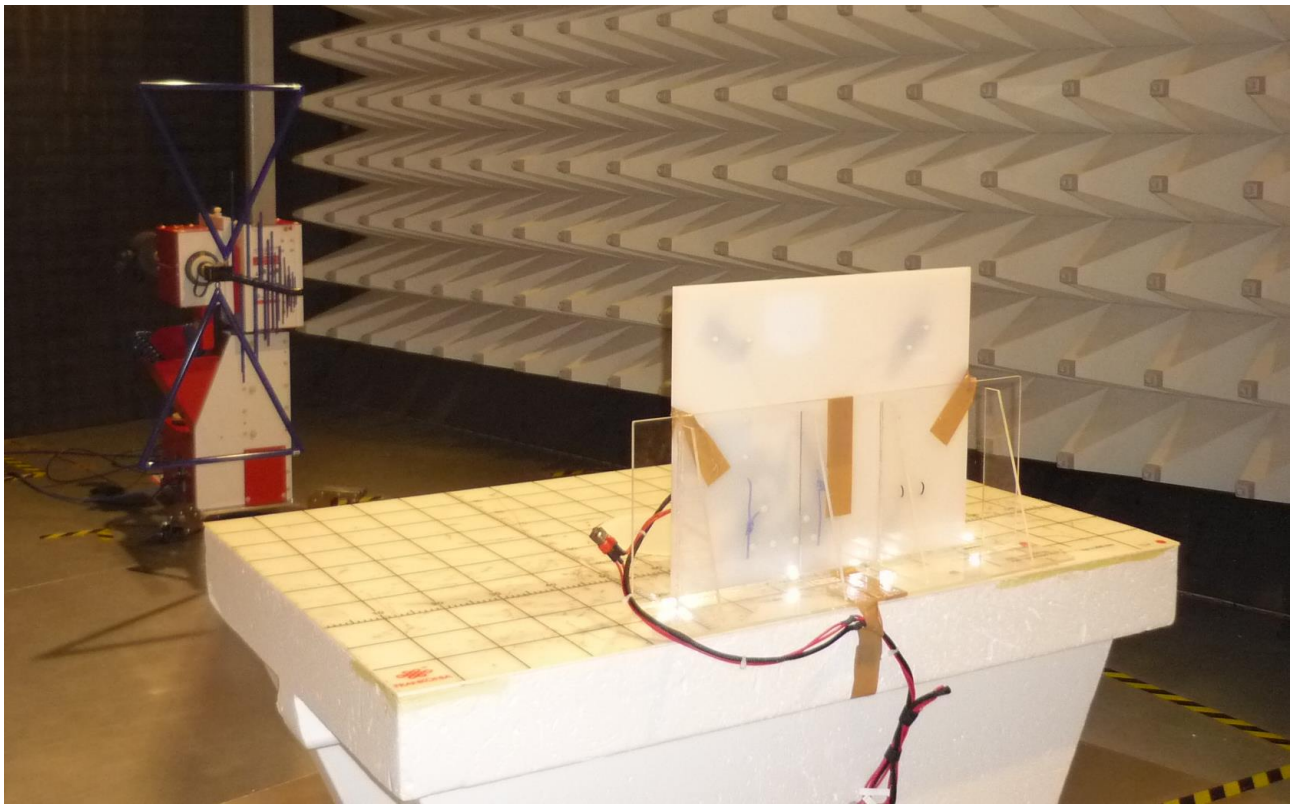
The measurements uncertainty was calculated in accordance with CISPR 16-4-2 Edition 2.0 2011-06.

The measurement uncertainty was given with a confidence of 95 % (k = 2).

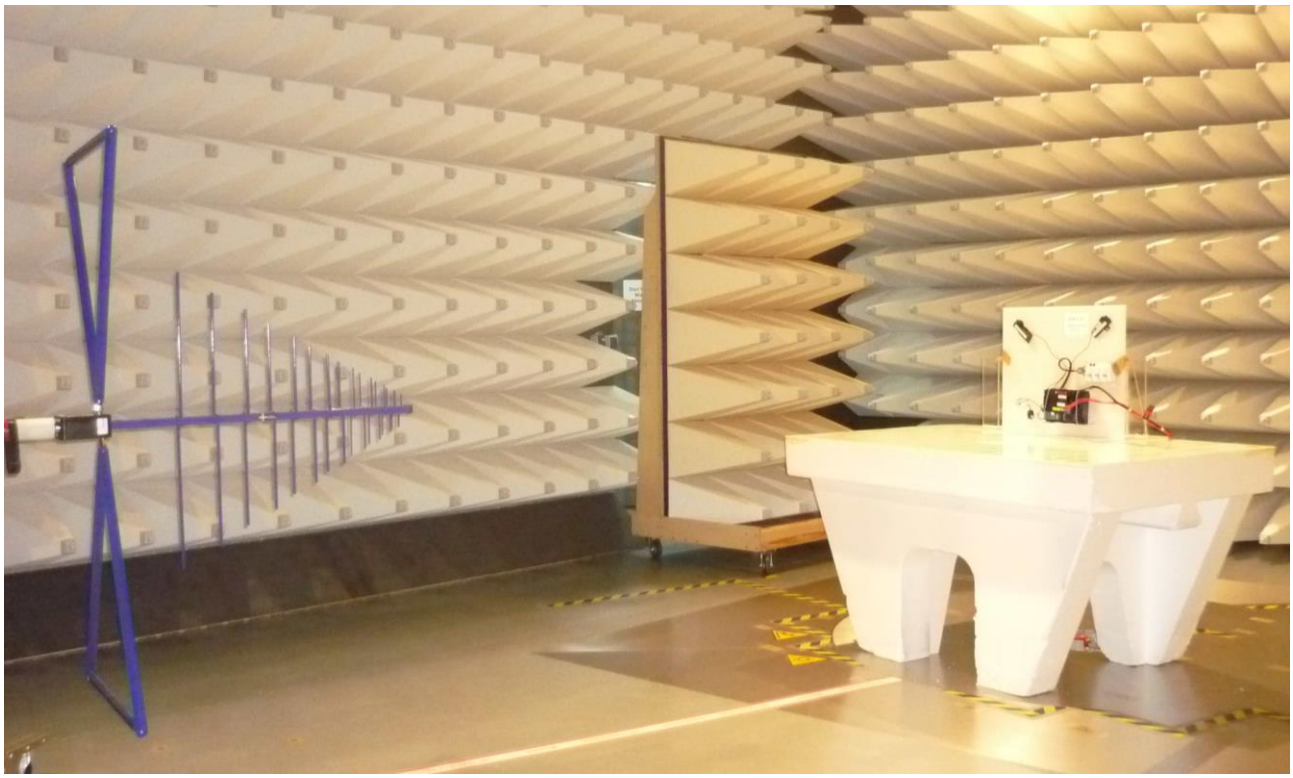
13. Photos setup



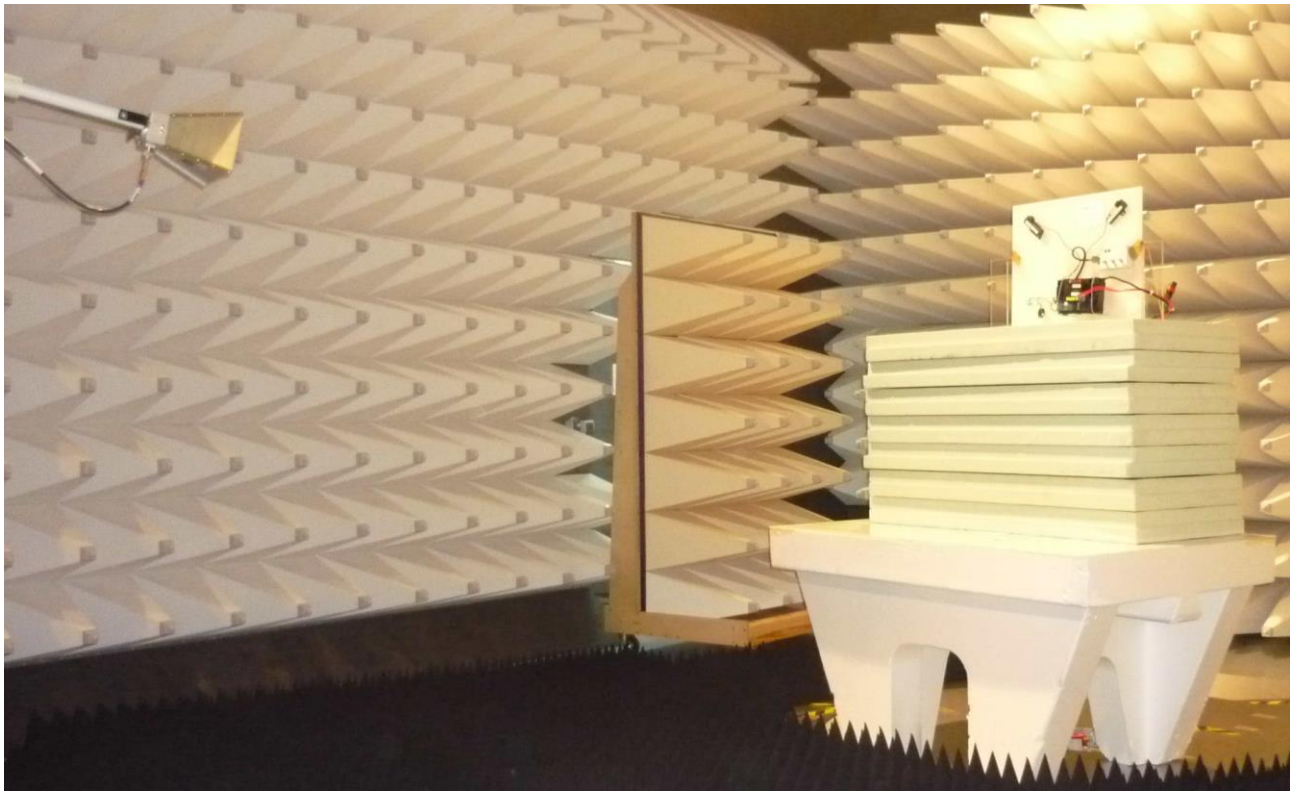
Tested frequency range 9 kHz – 30 MHz



Tested frequency range 30 MHz -1.000 MHz



Tested frequency range 30 MHz -1.000 MHz



Tested frequency range > 1 GHz

14. Conclusions

From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements for the relevant §15.209 Radiated emission limits; general requirements.

From the measurement data obtained, the tested sample was considered to have **COMPLIED** with the requirements for the relevant RSS-210 issue 10 Digital Licence-Exempt Radio Apparatus: Category I Equipment.

Following specific modifications and/or special attributes are necessary to pass the above mentioned requirements:

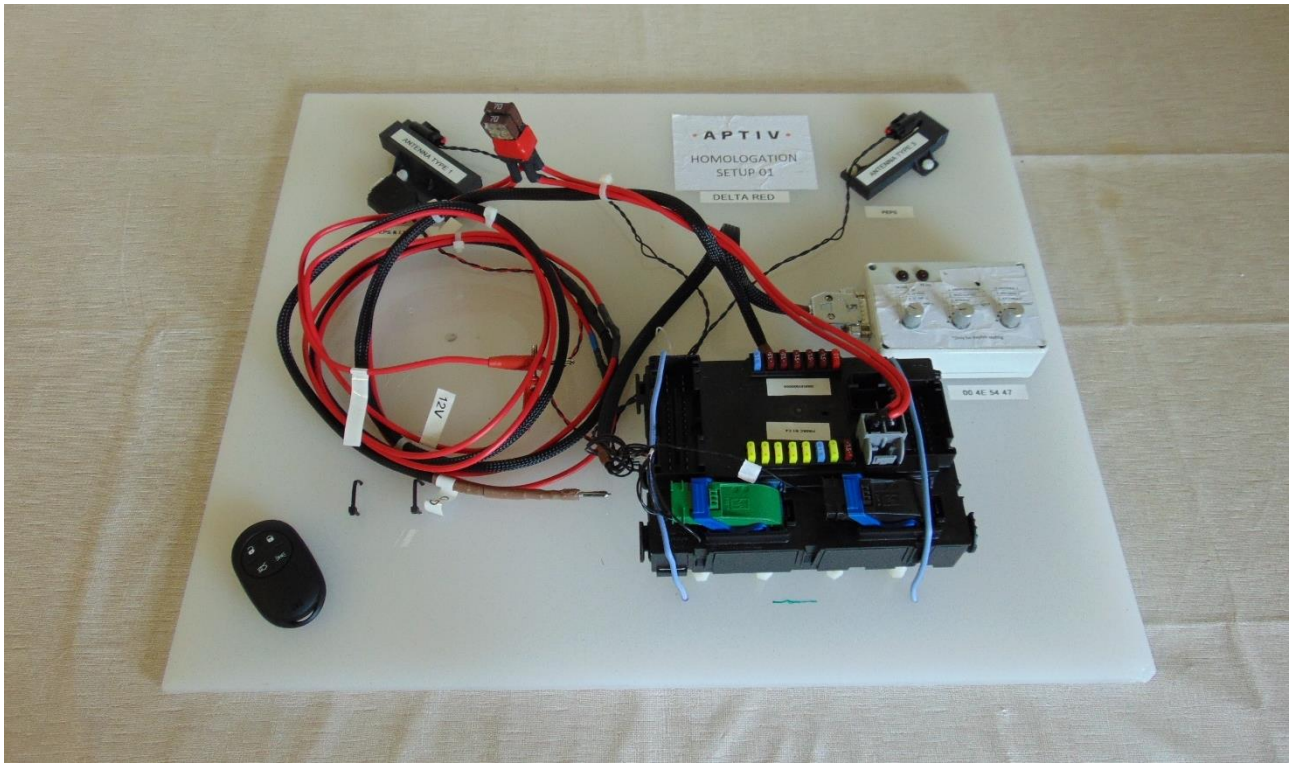
none

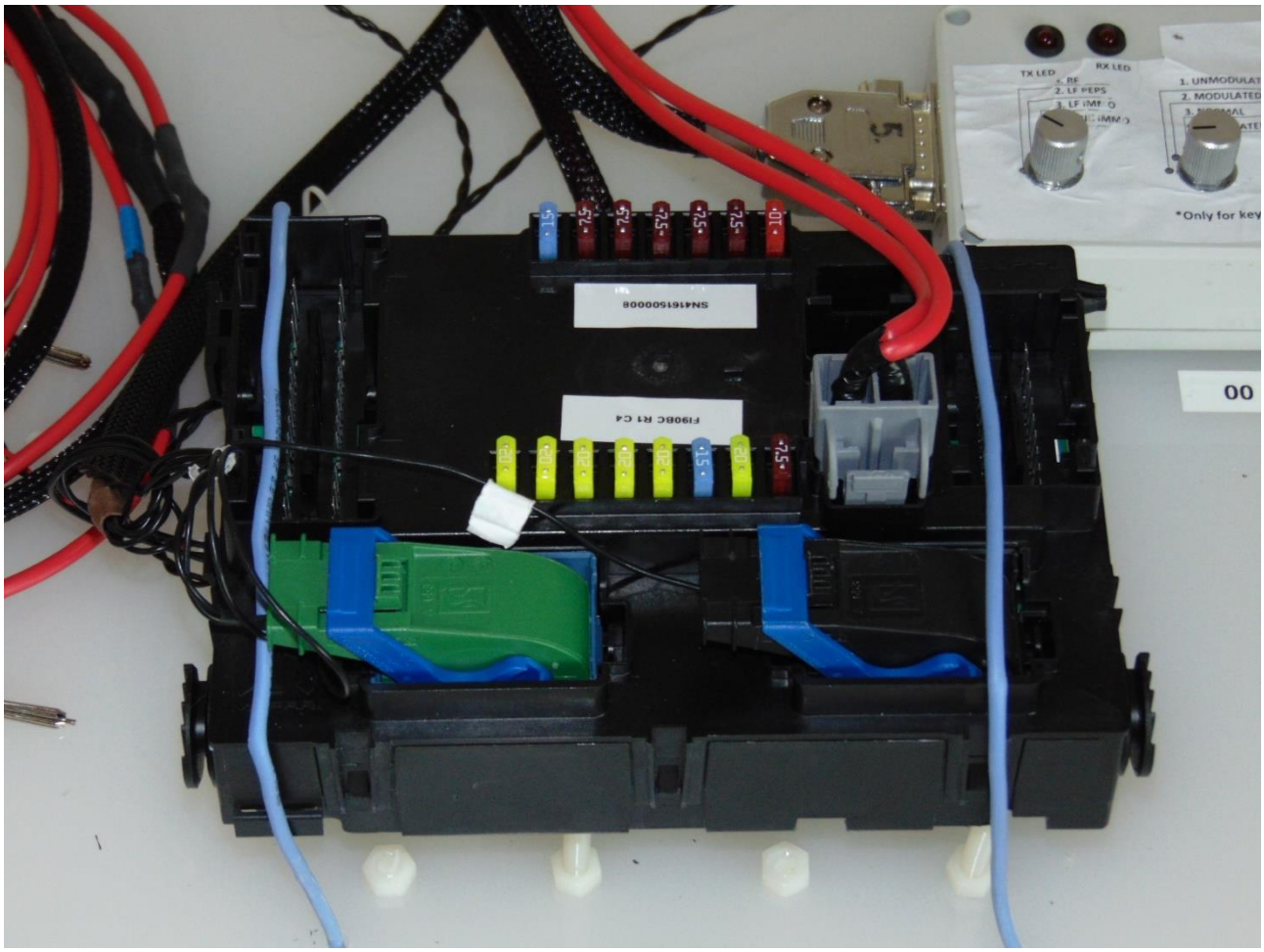
This test report replaces the test report no. 21/04-0029 *dated* 28.06.2021.

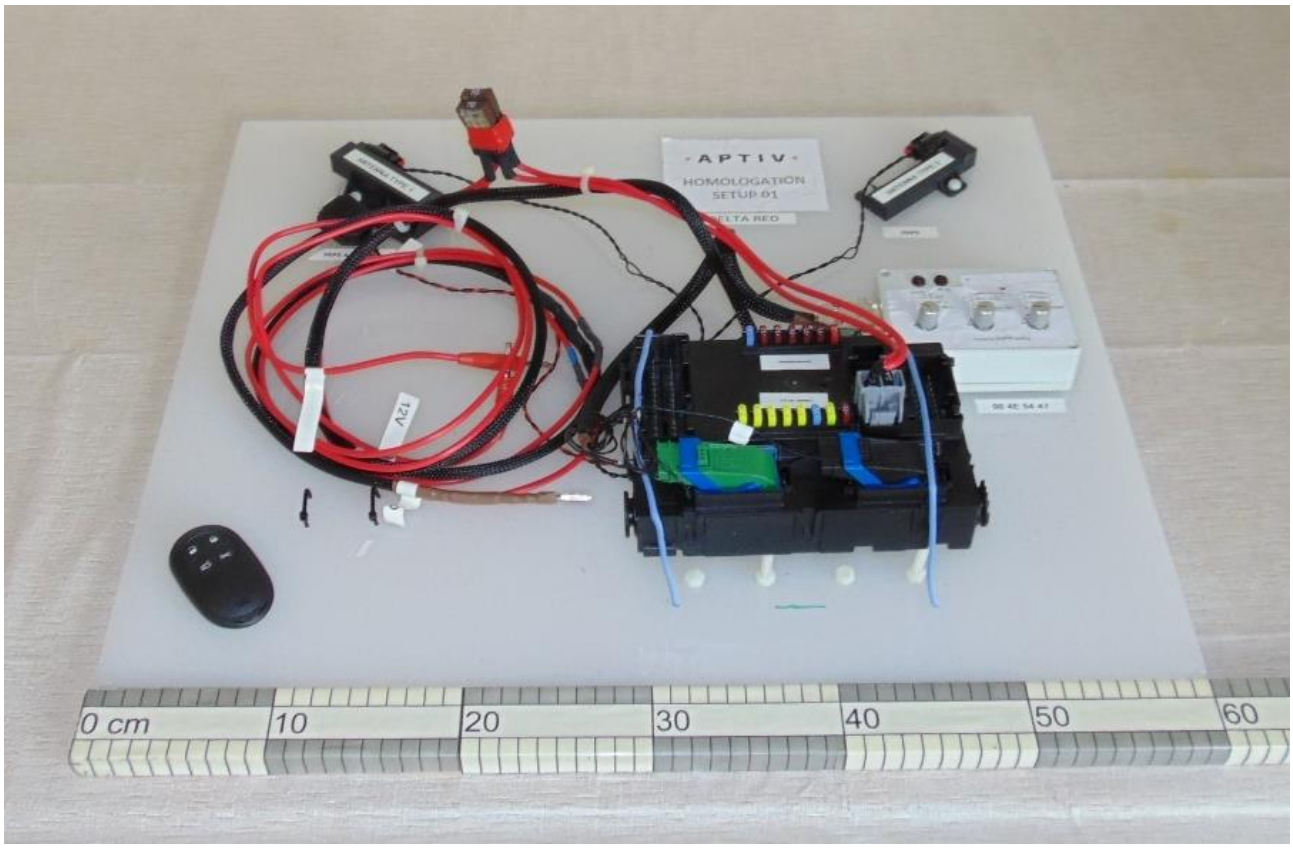
17.01.2022	M. Wundrak, Laboratory Engineer	
Erstellt am/*prepared on*	**(Name***/name* / **Stellung***/position***)**	**(Unterschrift/***signature***)**

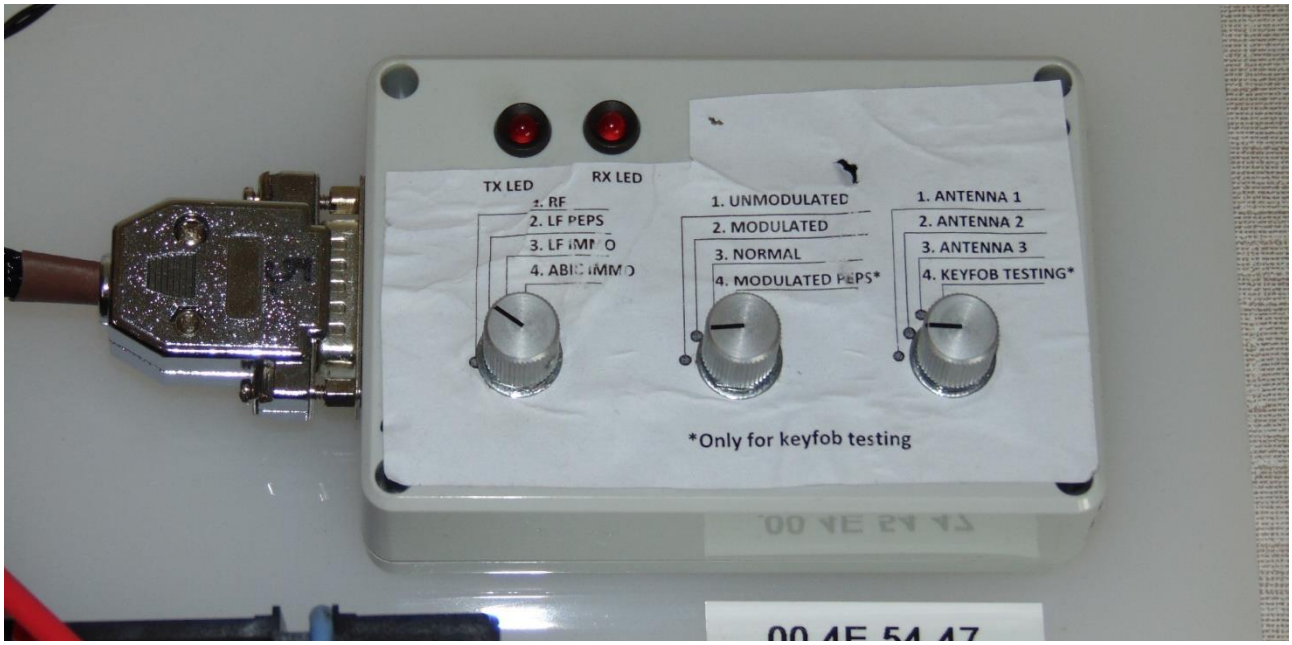
17.01.2022	K. Simon, Head of Laboratory	
Freigabe am/released *on*	**(Name***/name* / **Stellung***/position***)**	**(Unterschrift/***signature***)**

15. Photos of tested sample



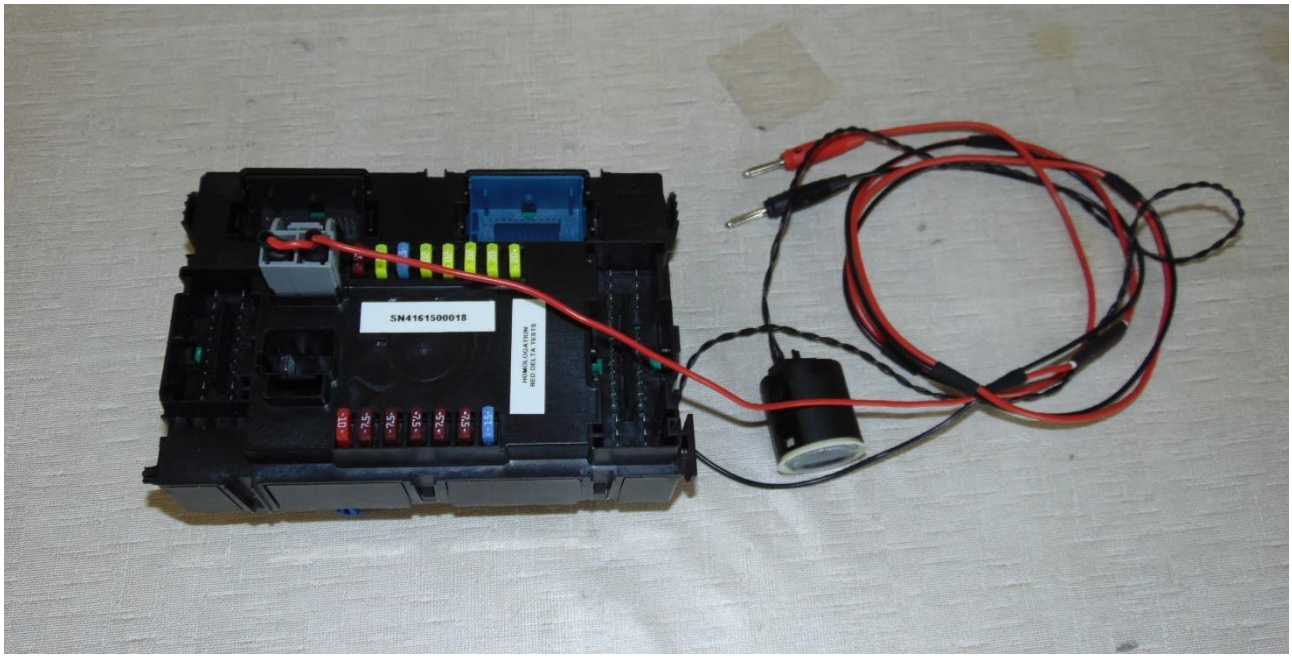


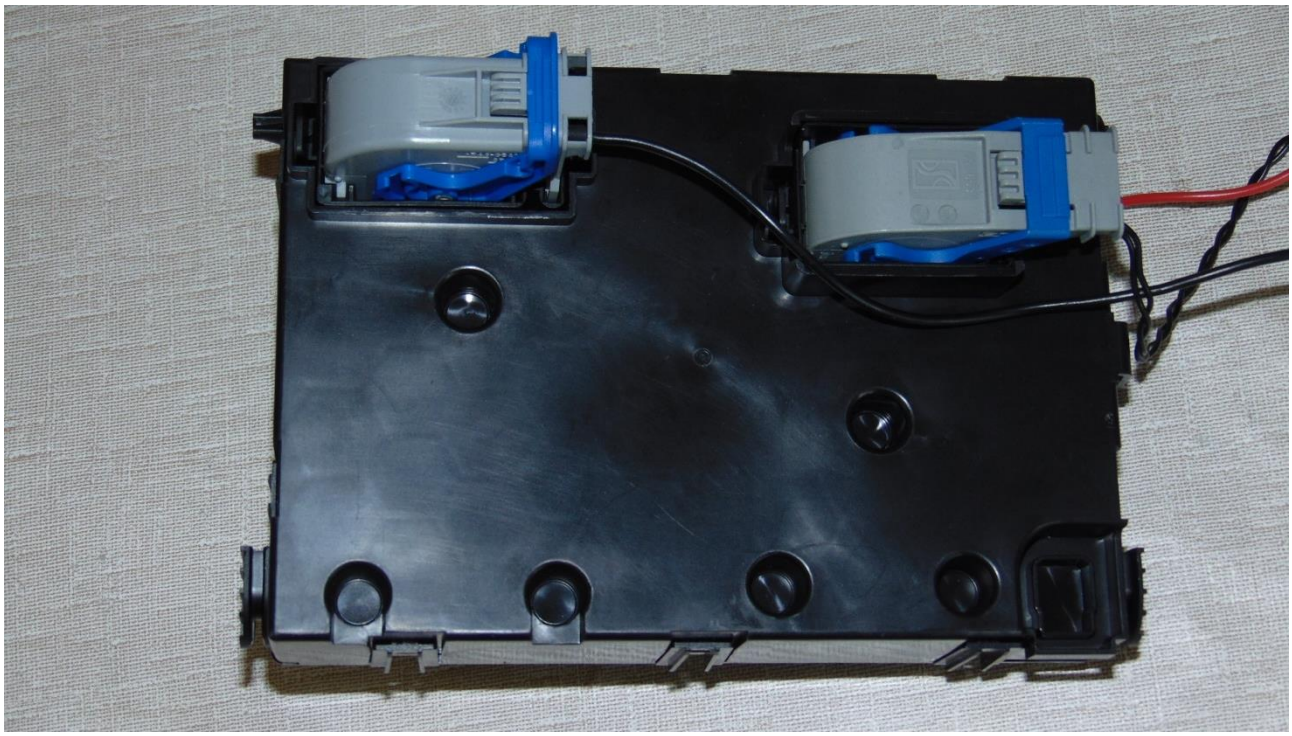

APTIV
HOMOLOGATION SETUP 01
0 cm
10
20
30
40
50
60


TX LED
RX LED
1. UNMODULATED
2. MODULATED
3. NORMAL
4. MODULATED PEPS*
1. ANTENNA 1
2. ANTENNA 2
3. ANTENNA 3
4. KEYFOB TESTING*
*Only for keyfob testing


ANTENNA TYPE 3


ANTENNA TYPE 1


SN4161500018



End of test report