Test report

Applicant:

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Test report no.:

190250-AU02+W02

for:

DESKO GmbH
RFID Reader Module
RFID Reader Module

according to:

15.225

RSS-210

EMV TESTHAUS

DAkkS Deutsche Akkreditierungsstelle D-PL-12155-01-04

DAkkS Deutsche Akkreditierungsstelle D-PL-12155-01-03

Accreditation:

FCC test firm accreditation expiration date: 2021-05-30
MRA US-EU, FCC designation number: DE0010
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BnetzA-CAB-02/21-02/5 Valid until 2023-11-26

Recognized on March 14th, 2019 by the
Department of Innovation, Science and Economic Development (ISED) Canada
as a wireless testing laboratory
CAB identifier: DE0011
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Location of Testing:

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The technical accuracy is guaranteed through the quality management of the EMV **TESTHAUS** GmbH.

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1 General Remark

The EUT is a certified RFID module operating at 13.56 MHz with detachable antennas. The purpose of this test report is that the manufacturer wants to expand the certification about more antennas. Therefore only partly tests were performed.

2 Summary of test results

System type: RFID Reader

47 CFR part and section	*Test*	*Equivalent to IC radio standard(s)*	*Page*	*Result*	*Note(s)*
15.209	Emissions outside the operating frequency band(s) specified 9 kHz to 10th harmonic	RSS-Gen, section 6.13 RSS-Gen, section 8.9			
	9 kHz to 30 MHz		20	Passed	---
	30 MHz to 1 GHz		29	Passed	---
	1 GHz to 10th harmonic		---	Not applicable	2,3

Notes (for information about EUT see clause 4):

1 Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.

2 Not applicable if the 10th harmonic of the intentional transmitter is beyond 1 GHz (please see 47 CFR Part 15, section 15.33(a)(1), and RSS-Gen, section 6.13)

3 According to 47 CFR Part 15, §15.33, the frequency range of investigation for the digital device shall be used if the range of investigation determined by the highest internal frequency of the digital device is higher then the 10th harmonic of the intentional radiator

Straubing, January 23, 2020

Andreas Menacher
Test engineer
EMV **TESTHAUS** GmbH

Konrad Graßl
Head of radio department
EMV **TESTHAUS** GmbH

3 Referenced publications

Publication	*Title*
CFR 47 Part 2 November 2019	Code of Federal Regulations, Title 47 (Telecommunication), Part 2 (Frequency allocation and radio treaty matters; General rules and regulations) of the Federal Communication Commission (FCC)
CFR 47 Part 15 November 2019	Code of Federal Regulations, Title 47 (Telecommunication), Part 15 (Radio Frequency Devices) of the Federal Communication Commission (FCC)
ANSI C63.10 June 2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
RSS-Gen, Issue 5 April 2018	Spectrum Management and Telecommunications - Radio Standards Specification - General Requirements for Compliance of Radio Apparatus
RSS-210 Issue 9, August 2016	Spectrum Management and Telecommunications Radio Standards Specification Licence-exempt Radio Apparatus (All Frequency Bands): Category I Equipment

4 Equipment under test (EUT)

All Information in this clause is declared by customer.

4.1 General information

Product type:	RFID Reader module		
Model name:	RFID Reader Module		
Serial number(s):	Serial prototype		
Applicant:	DESKO GmbH		
Manufacturer:	DESKO GmbH		
Version:	Hardware:	Rev 1.1	
	Software:	0805010A.00000090	
Additional modifications:	None		
FCC ID:	WTM-NFCREADER2		
IC registration number:	7998A-NFCREADER2		
Power supply:	DC supply		
	Nominal voltage:	5.00 V	
	Minimum voltage:	4.75 V	
	Maximum voltage:	5.25 V	
	Nominal frequency:	---	
Temperature range:	-25 °C to +50 °C (customer defined)		
Device type:	☐ Portable	☐ Mobile	☒ Fixed

4.2 Radio specifications

System type:	RFID Reader		
Application frequency band:	13.110 MHz – 14.010 MHz		
Operating frequencies:	13.56 MHz		
Short description:	The EUT is a RFID reader module operating at the frequency 13.56 MHz.		
Number of RF channels	1		
Modulation	ASK		
Antenna:	Type:	PCB antenna	
	Connector:	☒ external	☐ internal
		☐ temporary	☐ none (integral antenna)

4.3 Photo documentation

For photos of the EUT see annex B.
Photos taken during testing including EUT positions can be found in annex A.

5 Test configuration and mode of operation

5.1 Test configuration

Device	*Type designation*	*Serial or inventory no.*	*Manufacturer*
	EUT		
RFID Reader module	RFID Reader Module	---	DESKO GmbH
PCB antenna	2063512:4612	0190048108	DESKO GmbH
PCB antenna	2009168:4834	0190047027	DESKO GmbH
PCB antenna	2063503:4477[1]	0190048109	DESKO GmbH
PCB antenna	2063514:5171	0190048112	DESKO GmbH
PCB antenna	2063513:5170	0190048111	DESKO GmbH
	Support equipment		
RFID-tag	13.56 MHz	---	---
Notebook	1143-B6G	R9-KAG1C 11/12	Lenovo
Power supply of notebook	42T4416	11S42T4416Z1F3A9947NA	Lenovo
Evaluation board[2]	RFID Reader Module Adapter	0190048105	DESKO GmbH
USB-Ethernet extender kit	UA0267	W01406	LogiLink

Table 1: Devices used for testing

Port	*Classification*	*Cable type*	*Note*
USB	DC power/Signal control	Shielded	

Table 2: Ports of EUT

[1] Contains two different antennas (large & small).
[2] Only used for testing purposes, no part of EUT.

5.2 Mode of operation

5.2.1 Test software used for all tests

Manufacturer programmed all EUT´s to “continuous-tag-reading-mode”.

5.2.2 Test modes applied

The module was permanent searching after tags and polled between its two antennas. As soon as a tag was detected the respective antenna was permanent activated and the maximum RF power was used.
For the information If a RFID-tag was used or not look at the respective test.

6 Test procedures

6.1 General specifications

6.1.1 Test setups

Tabletop devices are placed on a non-conductive table with a height of 0.8 m. In case of AC power-line conducted emissions test, the rear of the EUT is located 40 cm to the vertical wall of the RF-shielded (screened) room which is used as vertical conducting plane. For radiated emission measurements above 1 GHz, tabletop devices are placed at a height of 1.5 m above the floor using a support made of styrene placed on top of the non-conductive table.

Floor-standing devices are placed either directly on the reference ground-plane or on insulating material (see clause 6.2.3 of ANSI C63.10-2013 for more details).

All other surfaces of tabletop or floor-standing EUTs are at least 80 cm from any other grounded conducting surface. This includes the case or cases of one or more LISNs when performing an AC power-line conducted emissions test.

Radiated emission measurements of equipment that can be used in multiple orientations (e.g. portable or handheld devices) are performed with the EUT in each of three orthogonal axis positions.

6.2 Radiated emissions below 30 MHz

Radiated emissions below 30 MHz are measured according to clause 6.4 of ANSI C63.10 using an inductive shielded loop antenna. As this antenna measures the magnetic field only, its antenna factors are converted to electric field strength values assuming a free space impedance of 377 Ω as described in clause 4.3.1 of ANSI C63.10. This results in an additional correction of 51.53 dB.

According to clause 6.4.3 of ANSI C63.10, at frequencies below 30 MHz, measurements may be performed at a distance closer than that specified in the requirements. In this case, the results are extrapolated to the specified distance by using a recalculation factor determined according to one of the methods described in clause 6.4.4 of ANSI C63.10, provided that the maximum dimension of the device is equal to or less than 0.625 times the wavelength at the frequency being measured. As the minimum wavelength is 10 meters corresponding to the maximum frequency of 30 MHz, this requirement is fulfilled if the maximum dimension of the device is equal to or less than 6.25 meters.

Unless otherwise stated, the recalculation factor is determined according to clause 6.4.4.2 “Extrapolation from the measurement of a single point” of ANSI C63.10:

$d_{near\ field}$ = 47.77 / f_{MHz}, or

f_{MHz} = 47.77 / $d_{near\ field}$

The frequency f_{MHz} at which the near field distance is equal to the limit and/or test distance is important for selection of the right formula to determine the recalculation factor:

f_{MHz}(300 m) ≈ 0.159 MHz
f_{MHz}(30 m) ≈ 1.592 MHz
f_{MHz}(3 m) ≈ 15.923 MHz

Based on the test distances for the general radiated emission limits as specified in §15.209 of 47 CFR Part 15, the following formulas are used to determine the recalculation factor:

Frequency (f)	d_{limit}	$d_{measure}$	*Formula for recalculation factor*
9 kHz ≤ f ≤ 159 kHz 490 kHz < f ≤ 1.592 MHz	300 m 30 m	3 m	-40 log(d_{limit} / $d_{measure}$)
159 kHz < f ≤ 490 kHz 1.592 MHz < f ≤ 15.923 MHz	300 m 30 m	3 m	-40 log($d_{near\ field}$ / $d_{measure}$) - 20 log(d_{limit} / $d_{near\ field}$)
f > 15.923 MHz	30 m	3 m	-20 log(d_{limit} / $d_{measure}$)

Table 3: Recalculation factors for extrapolation

Prescans for radiated measurements below 30 MHz are performed in a fully anechoic room (called "CDC"). The measurement distance is 3 meters. The emissions of the EUT are recorded with an EMI test receiver configured as described in table 4.

Frequency (f)	*Measurement receiver bandwidth*	*Step size*	*Detector type*		
			Prescan	*Prescan with FFT*	*Final scan*
9 kHz ≤ f < 150 kHz	200 Hz	≤ 100 Hz	Peak, Average	Peak Quasi-peak, Average	Peak Quasi-peak, Average
150 kHz ≤ f < 30 MHz	9 kHz	≤ 4.5 kHz	Peak, Average	Peak Quasi-peak, Average	Peak Quasi-peak, Average

Table 4: Bandwidth and detector type for radiated emissions test below 30 MHz

Sample calculation:

Frequency (MHz)	Reading value (dBµV)	Antenna correction (dB/m)	Cable attenuation (dB)	Correction factor (Corr.) (dB/m)	Level (dBµV/m)
10	20.00	19.59	0.33	19.92	39.92

Correction factor = Antenna correction + Cable attenuation

Level = Reading value + Correction factor = 20 dBµV + 19.92 dB/m = 39.92 dBµV/m

Prescans are performed with all detectors activated at the same time. If the test receiver is capable of FFT analysis, it is used for prescans, but not for final scans. If no limit is specified for certain detectors, final scan measurement with these detectors may be omitted.

The radiated emissions test below 30 MHz is performed in the following steps:

a) The loop antenna is positioned with its plane perpendicular to the ground with the lowest height of the antenna 1 m above the ground.
b) The EUT is placed in its standard position on a turntable capable of rotation through 360° in the horizontal plane and arranged as tabletop or floor-standing equipment, as applicable. The EUT is switched on.
c) The measurement equipment is connected to the loop antenna and set-up according to the specifications of the test (see table 4).
d) The EUT is turned to a position likely to get the maximum and the test antenna is rotated to detect the maximum of the fundamental in this EUT position.
e) Then the EUT is rotated in a horizontal plane through 360° in steps of 45°. Starting at 0°, at each table position the spectrum for the full frequency range is recorded. If the emission at a certain frequency is higher than the levels already recorded, the current table position is noted as the maximum position.
f) After the last prescan, the significant maximum emissions and their table positions are determined and collected in a list.
g) With the test receiver set to the first frequency of the list, the EUT is rotated by ±45° around the table position found during prescans while measuring the emission level continuously. For final scan, the worst-case table position is set and the maximum emission level is recorded.
h) Step g) is repeated for all other frequencies in the list.
i) Finally, for frequencies with critical emissions the loop antenna is rotated again to find the maximum of emission. At least, frequency and level of the six highest emissions relative to the limit have to be recorded. However, emissions more than 20 dB below the limit do not need to be reported.

If the EUT may be used in various positions, steps a) to i) are repeated in two other orthogonal positions. If the EUT may be used in one position only, steps a) to i) are repeated in one orthogonal position.

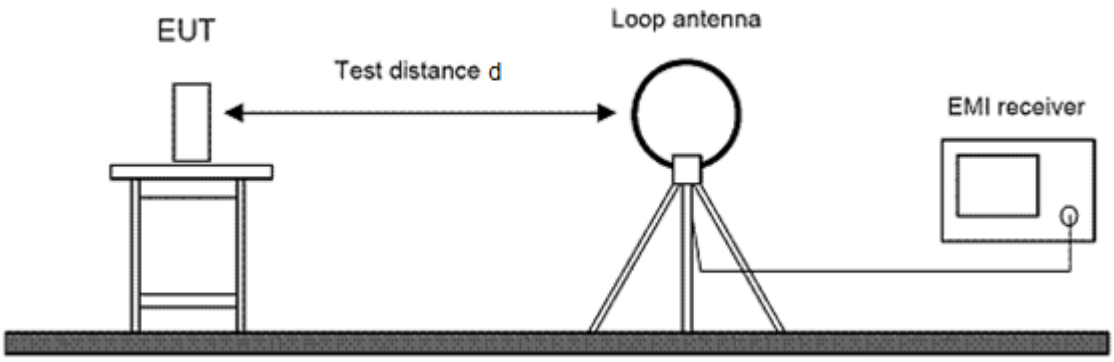

Figure 1: Setup for radiated emissions test below 30 MHz

6.3 Radiated emissions from 30 MHz to 1 GHz

Radiated emissions in the frequency range 30 MHz to 1 GHz are measured according to clause 6.5 of ANSI C63.10 using a semi-anechoic chamber (SAC) with a ground plane on the floor. The measurement distance is 3 meters. The emissions of the EUT are recorded with an EMI test receiver configured as described in table 5.

Frequency (f)	*Measurement receiver bandwidth*	*Step size*	*Detector type*		
			Prescan	*Prescan with FFT*	*Final scan*
30 MHz ≤ f ≤ 1 GHz	120 kHz	≤ 60 kHz	Peak	Quasi-peak	Quasi-peak

Table 5: Bandwidth and detector type for radiated emissions test from 30 MHz to 1 GHz

Sample calculation:

Frequency (MHz)	Reading value (dBµV)	Antenna correction (dB/m)	Cable attenuation (dB)	Correction factor (Corr.) (dB/m)	Level (dBµV/m)
100	30.00	11.71	1.06	12.77	42.77

Correction factor = Antenna correction + Cable attenuation

Level = Reading value + Correction factor = 30 dBµV + 12.77 dB/m = 42.77 dBµV/m

The measurement antenna is a combination of a biconical antenna and a logarithmic-periodic dipole array antenna. It is mounted on a support capable of allowing the antenna to be used in either horizontal or vertical polarization and in a height between 1 m and 4 m above the ground plane.

If the test receiver is capable of FFT analysis, it is used for prescans, but not for final scans.

The radiated emissions test from 30 MHz to 1 GHz is performed in the following steps:

a) The measurement antenna is oriented initially for vertical polarization.
b) The EUT is placed in its standard position on a turntable capable of rotation through 360° in the horizontal plane and arranged as tabletop or floor-standing equipment, as applicable. The EUT is switched on.
c) The measurement equipment is connected to the measurement antenna and set-up according to the specifications of the test (see table 5).
d) The table position is set to 0°.
e) The antenna height is set to 1 m.
f) The spectrum for the full frequency range is recorded. If the emission at a certain frequency is higher than the levels already recorded, the polarization and height of the measurement antenna as well as the current table position are noted as the maximum position.
g) The antenna height is increased to 4 m in steps of 50 cm. At each height, step f) is repeated.
h) The polarization of the measurement antenna is changed to horizontal.
i) The antenna height is decreased from 4 m to 1 m in steps of 50 cm. At each height, step f) is repeated.
j) The EUT is rotated in a horizontal plane through 360° in steps of 60°. At each table position, steps e) to i) are repeated.
k) After the last prescan, the significant maximum emissions with their polarizations and heights of the measurement antenna as well as their table positions are determined and collected in a list.
l) With the test receiver set to the first frequency of the list, the measurement antenna is set to the polarization and height and the table is moved to the position as determined during prescans.
m) The antenna is moved by ±50 cm around this height and the EUT is rotated by ±60° around this table position while measuring the emission level continuously.
n) For final scan, the worst-case positions of antenna and table are set and the maximum emission level is recorded.
o) Steps l) to n) are repeated for all other frequencies in the list. At least, frequency and level of the six highest emissions relative to the limit have to be recorded. However, emissions more than 20 dB below the limit do not need to be reported.

If the EUT may be used in various positions, steps a) to o) are repeated in two other orthogonal positions.

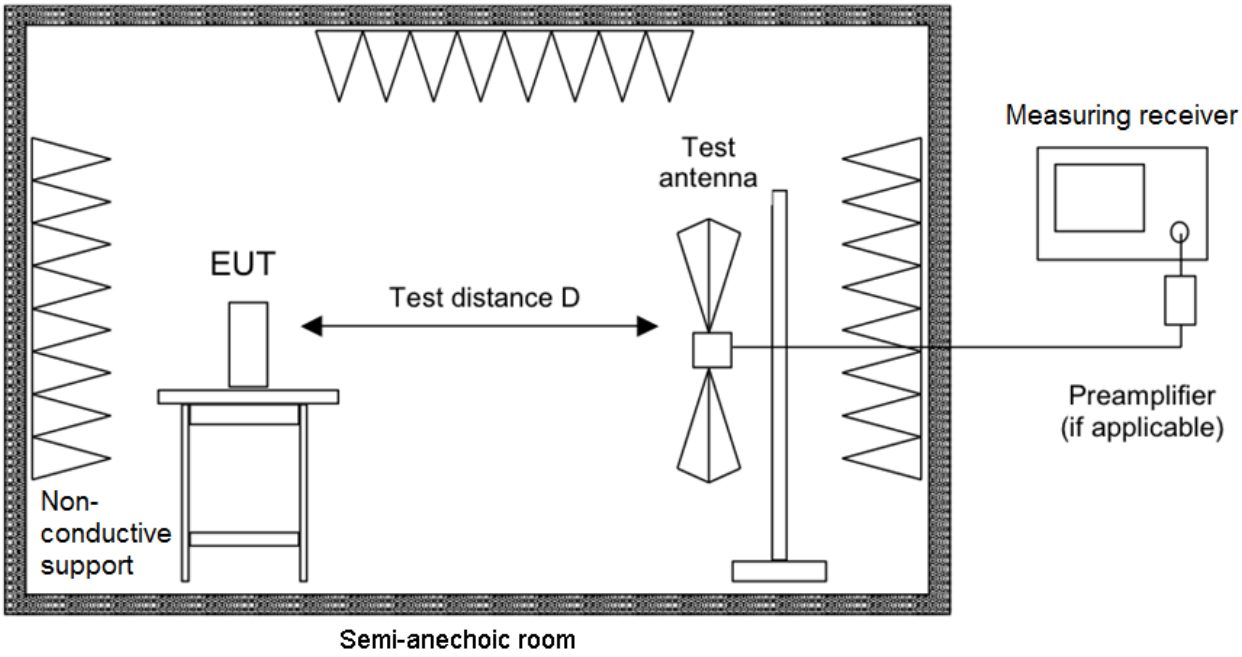

Figure 2: Setup for radiated emissions test from 30 MHz to 1 GHz

7 Test results

8 This clause gives details about the test results as collected in the general remark

the eut is a certified rfid module operating at 13.56 mhz with detachable antennas. the purpose of this test report is that the manufacturer wants to expand the certification about more antennas. therefore only partly tests were performed.
summary of test results on page 6.

The climatic conditions are recorded during the tests. It is ensured that the climatic conditions are within the following ranges:

Ambient temperature	*Ambient humidity*	*Ambient pressure*
15°C to 35°C	30 % to 75 %	86 kPa to 106 kPa

8.1 Emissions outside the operating frequency band(s) specified

8.1.1 Emissions below 30 MHz

Section(s) in 47 CFR Part 15:	Requirement(s):	15.209
	Reference(s):	ANSI C63.10, clause 6.4
Section(s) in RSS:	Requirement(s):	RSS-Gen, section 6.13
	Reference(s):	ANSI C63.10, clause 6.4

Performed by:	Andreas Menacher	Date of test:	January 14, 2020
Result[3]:	☒ Test passed	☐ Test not passed	

8.1.1.1 Test equipment

Type	*Designation*	*Manufacturer*	*Inventory no.*
Compact Diagnostic Chamber (CDC)	VK041.0174	Albatross Projects	E00026
EMI test receiver	ESR 7	Rohde & Schwarz	E00739
Loop antenna	HFH2-Z2	Rohde & Schwarz	E00060
Cable set CDC	RF cable(s)	Huber + Suhner AME HF-Technik AME HF-Technik Stabo	E00446 E00920 E00921 E01215
Test software	EMC32-MEB (V10.35)	Rohde & Schwarz	E01073

[3] For information about measurement uncertainties see page 53.

8.1.1.2 Limits

Frequency	*Field strength*		*Measurement distance*
[MHz]	*[µV/m]*	*[dBµV/m]*	*[m]*
0.009 – 0.490	2400/F(kHz) (266.67 – 4.90)	48.52 – 13.80	300
0.490 – 1.705	24000/F(kHz) (48.98 – 14.08)	33.80 – 22.97	30
1.705 – 30	30	29.54	30

Table 6: General radiated emission limits up to 30 MHz according to §15.209

In case of measurements are performed at other distances than that specified in the requirements, the limits in the charts and tables reported with the test results are derived from the general radiated emission limits as listed in table 6 using the recalculation factor as described in clause 6.2.

8.1.1.3 Test procedure

The emissions below 30 MHz are measured using the

☒ test procedure for radiated measurements as described in clause 6.2.

8.1.1.4 Test results

Test distance:	☒ 3 m	☐ 10 m	☐ ….. m
EUT position[4]:	☒ Position 1	☒ Position 2	☒ Position 3

Frequency range	*Step size*	*IF Bandwidth*	*Detector*		*Measurement Time*		*Preamplifier*
			Prescan	*Final scan*	*Prescan*	*Final scan*	
9 kHz – 150 kHz	50 Hz	200 Hz	QP, PK, CAV	QP, PK, AV	1 s	1 s	Off
150 kHz – 30 MHz	2.25 kHz	9 kHz	QP, PK, CAV	QP, PK, AV	1 s	1 s	Off

[4] Exploratory measurements are performed in all positions as indicated. However, the figures and result tables within this test report show the worst case position, only.

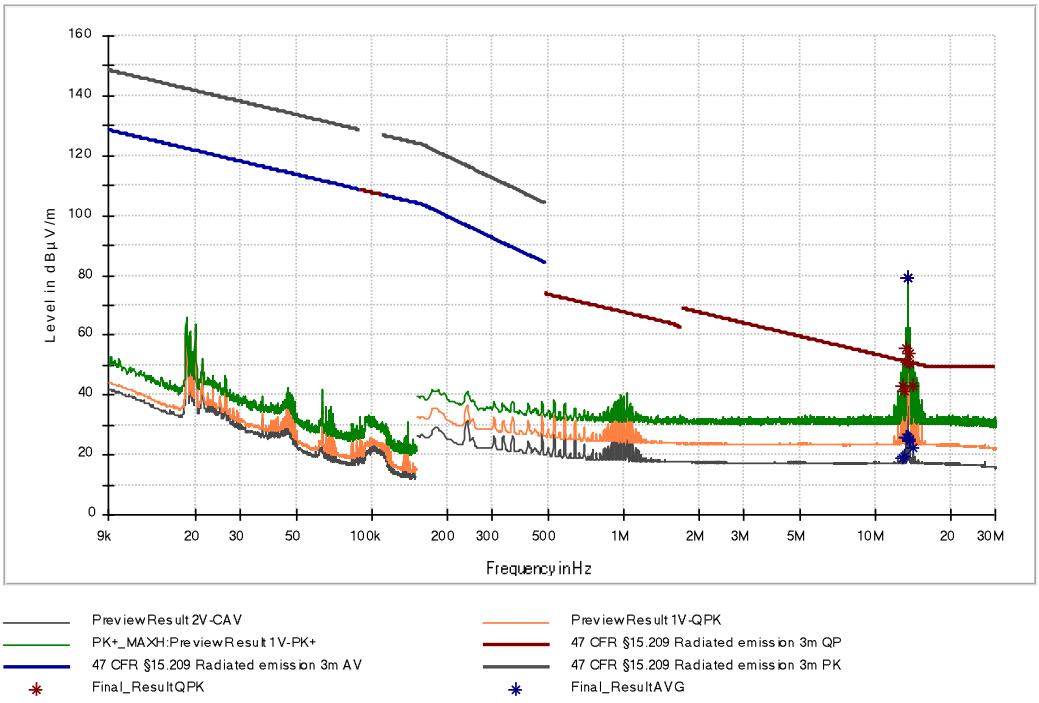

Figure 3: Chart of emissions test below 30 MHz with tag in position 2, antenna in line at 3 m – antenna 2063512:4612

Frequency (MHz)	Measured value QuasiPeak (dBµV/m) at 3 m	Recalculation factor (dB)	Field strength (dBµV/m) at 30 m	Limit (dBµV/m) at 30 m	Margin (dB)	Azimuth (deg)	Result
12.925500	43.09	-21.81	21.28	29.54	8.26	96.0	Pass
13.560000	78.87	-38.90	39.97	---	---	90.0	Carrier
14.196750	42.99	-20.99	21.99	29.54	7.55	80.0	Pass

Table 7: Final results of emission below 30 MHz, with tag in position 2, antenna in line at 3 m - antenna 2063512:4612

Recalculation factor is determined according to ANSI C63.10, section 6.4.4.2 “Extrapolation from the measurement of a single point”.

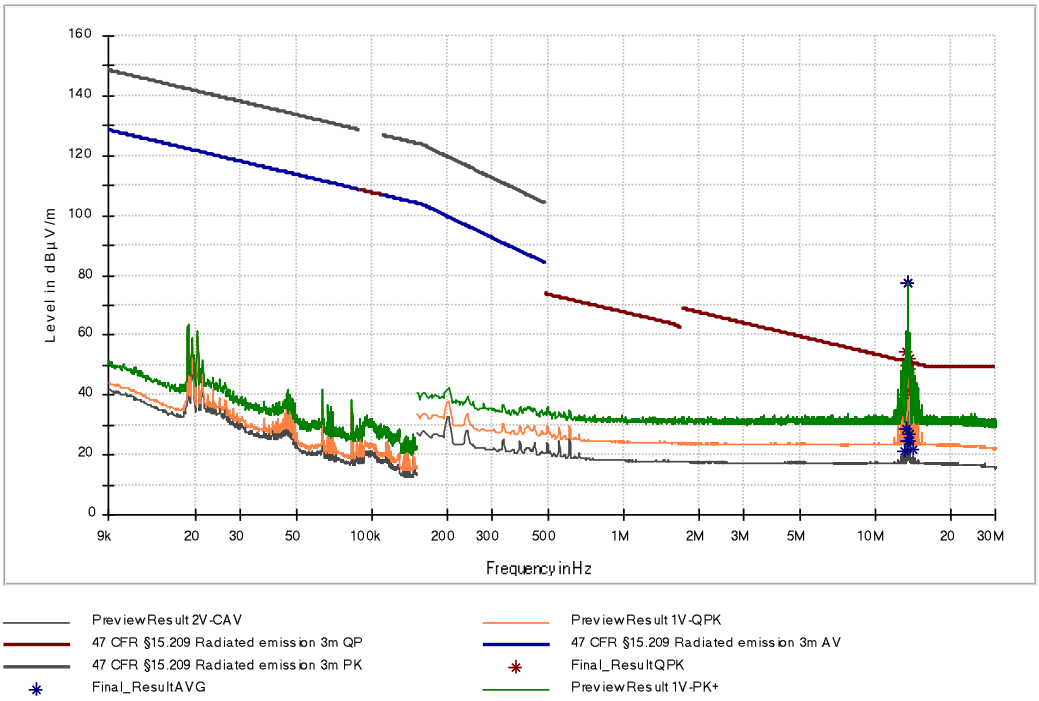

Figure 4: Chart of emissions test below 30 MHz with tag in position 2, antenna in line at 3 m – antenna 2009168:4834

Frequency (MHz)	Measured value QuasiPeak (dBµV/m) at 3 m	Recalculation factor (dB)	Field strength (dBµV/m) at 30 m	Limit (dBµV/m) at 30 m	Margin (dB)	Azimuth (deg)	Result
13.560000	77.33	-38.90	38.43	---	---	85.0	Carrier
14.196750	41.97	-20.99	20.97	29.54	8.57	83.0	Pass

Table 8: Final results of emission below 30 MHz, with tag in position 2, antenna in line at 3 m - antenna 2009168:4834

Recalculation factor is determined according to ANSI C63.10, section 6.4.4.2 “Extrapolation from the measurement of a single point”.

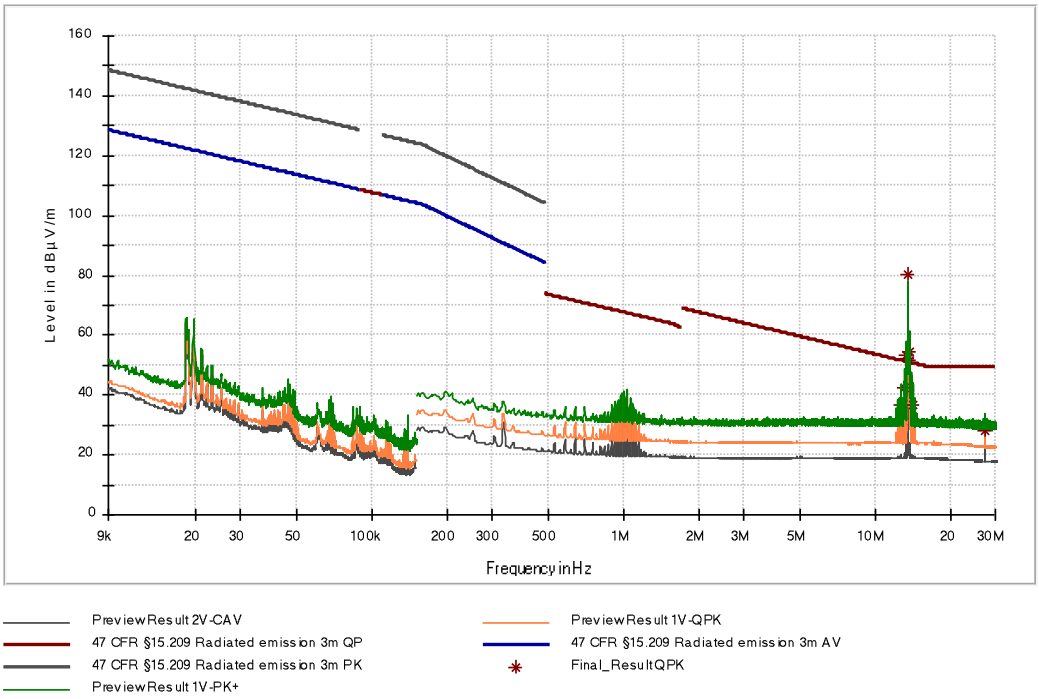

Figure 5: Chart of emissions test below 30 MHz with tag in position 1, antenna in line at 3 m – antenna 2063503:4477 small

Frequency (MHz)	Measured value QuasiPeak (dBµV/m) at 3 m	Recalculation factor (dB)	Field strength (dBµV/m) at 30 m	Limit (dBµV/m) at 30 m	Margin (dB)	Azimuth (deg)	Result
12.714000	36.83	-21.96	14.87	29.54	14.67	292.0	Pass
13.560000	80.01	-38.90	41.11	---	---	90.0	Carrier
14.196750	36.70	-20.99	15.70	29.54	13.83	90.0	Pass
27.120750	28.18	-20.00	8.18	29.54	21.36	90.0	Pass

Table 9: Final results of emission below 30 MHz, with tag in position 1, antenna in line at 3 m – antenna 2063503:4477 small

Recalculation factor is determined according to ANSI C63.10, section 6.4.4.2 “Extrapolation from the measurement of a single point”.

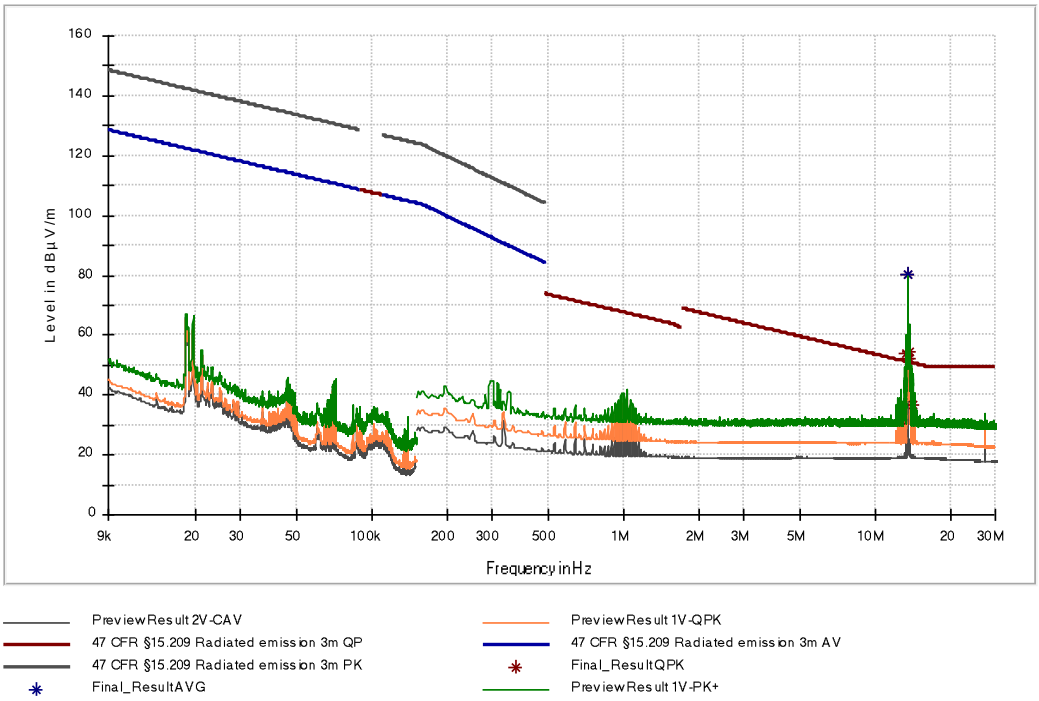

Figure 6: Chart of emissions test below 30 MHz with tag in position 1, antenna in line at 3 m – antenna 2063503:4477 large

Frequency (MHz)	Measured value QuasiPeak (dBµV/m) at 3 m	Recalculation factor (dB)	Field strength (dBµV/m) at 30 m	Limit (dBµV/m) at 30 m	Margin (dB)	Azimuth (deg)	Result
12.711750	31.50	-21.96	9.54	29.54	20.00	93.0	Pass
13.560000	80.01	-38.90	41.11	---	---	93.0	Carrier
14.196750	36.50	-20.99	14.54	29.54	15.00	93.0	Pass

Table 10: Final results of emission below 30 MHz, with tag in position 1, antenna in line at 3 m – antenna 2063503:4477 large

Recalculation factor is determined according to ANSI C63.10, section 6.4.4.2 “Extrapolation from the measurement of a single point”.

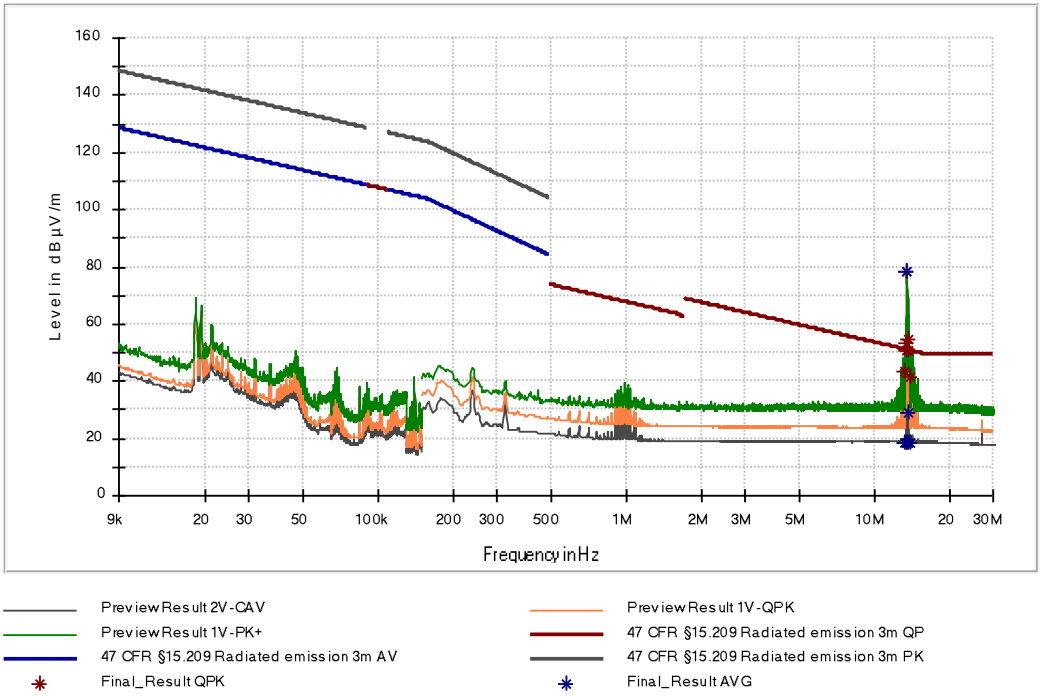

Figure 7: Chart of emissions test below 30 MHz with tag in position 2, antenna in line at 3 m – antenna 2063513:5170

Frequency (MHz)	Measured value QuasiPeak (dBµV/m) at 3 m	Recalculation factor (dB)	Field strength (dBµV/m) at 30 m	Limit (dBµV/m)	Margin (dB)	Azimuth (deg)	Result
13.560000	78.58	-38.90	39.68	---	---	264.0	Carrier

Table 11: Final results of emissions test below 30 MHz with tag in position 2, antenna in line at 3 m – antenna 2063513:5170

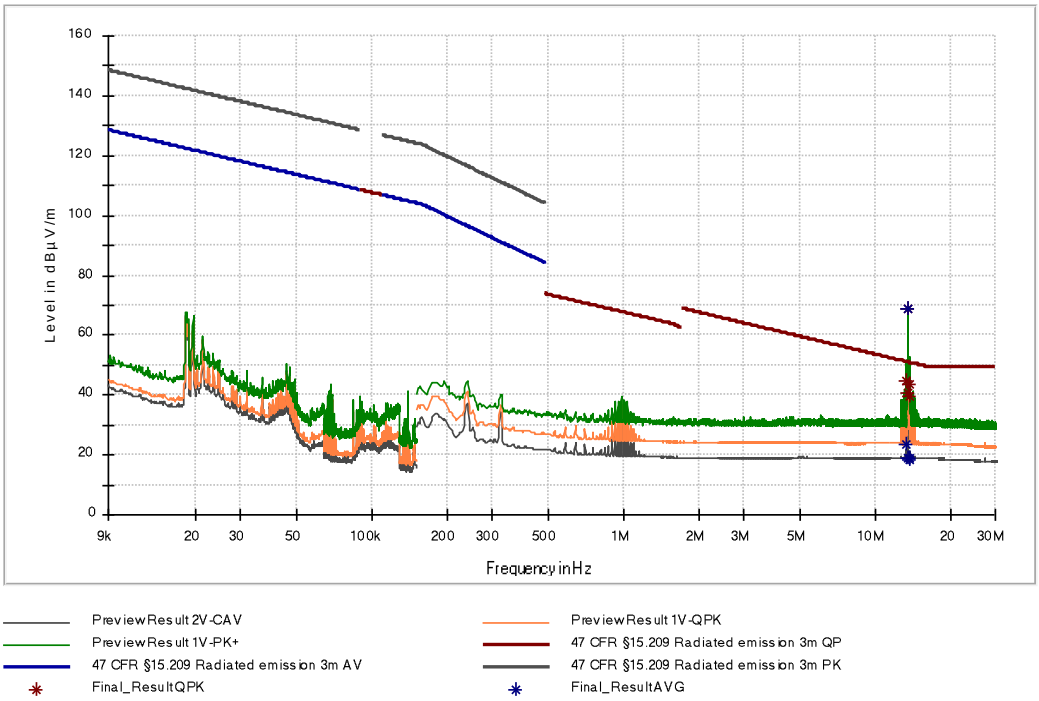

Figure 8: Chart of emissions test below 30 MHz with tag in position 2, antenna in line at 3 m – antenna 2063514:5171

Frequency (MHz)	Measured value QuasiPeak (dBµV/m) at 3 m	Recalculation factor (dB)	Field strength (dBµV/m) at 30 m	Limit (dBµV/m)	Margin (dB)	Azimuth (deg)	Result
13.560000	68.54	-38.90	29.64	---	---	264.0	Carrier

Table 12: Final results of emissions test below 30 MHz with tag in position 2, antenna in line at 3 m – antenna 2063514:5171

8.1.2 Emissions from 30 MHz to 1 GHz

Section(s) in 47 CFR Part 15:	Requirement(s):	15.209
	Reference(s):	ANSI C63.10, clause 6.5
Section(s) in RSS:	Requirement(s):	RSS-Gen, section 6.13
	Reference(s):	ANSI C63.10, clause 6.5

Performed by:	Andreas Menacher	Date of test:	January 14, 2020
Result[5]:	☒ Test passed	☐ Test not passed	

8.1.2.1 Test equipment

Type	*Designation*	*Manufacturer*	*Inventory no.*
Semi-anechoic chamber with floor absorbers	FS-SAC	Albatross Projects	E00100
EMI test receiver	ESW 44	Rohde & Schwarz	E00895
TRILOG broadband antenna (SAC)	VULB 9162	Schwarzbeck	E00643
Cable set SAC	RF cable(s)	Huber + Suhner	E00755 E01033 E01034
Test software	EMC32-MEB (V10.35)	Rohde & Schwarz	E00778

[5] For information about measurement uncertainties see page 53.

8.1.2.2 Limits

Frequency	*Field strength*		*Measurement distance*
[MHz]	*[µV/m]*	*[dBµV/m]*	*[m]*
30 – 88	100	40.00	3
88 – 216	150	43.52	3
216 - 960	200	46.02	3
Above 960	500	53.98	3

Table 13: General radiated emission limits ≥ 30 MHz according to §15.209

8.1.2.3 Test procedure

The emissions from 30 MHz to 1 GHz are measured using the

☒ test procedure for radiated measurements as described in clause 6.3.

8.1.2.4 Test results

Test distance:	☒ 3 m	☐ 10 m	☐ ….. m
EUT position[6]:	☒ Position 1	☒ Position 2	☒ Position 3

Frequency range	*Step size*	*IF Bandwidth*	*Detector*		*Measurement Time*		*Preamplifier*
			Prescan	*Final scan*	*Prescan*	*Final scan*	
30 MHz – 1 GHz	30 kHz	120 kHz	QP	QP	1 s	1 s	20 dB

[6] Exploratory measurements are performed in all positions as indicated. However, the figures and result tables within this test report show the worst case position, only.

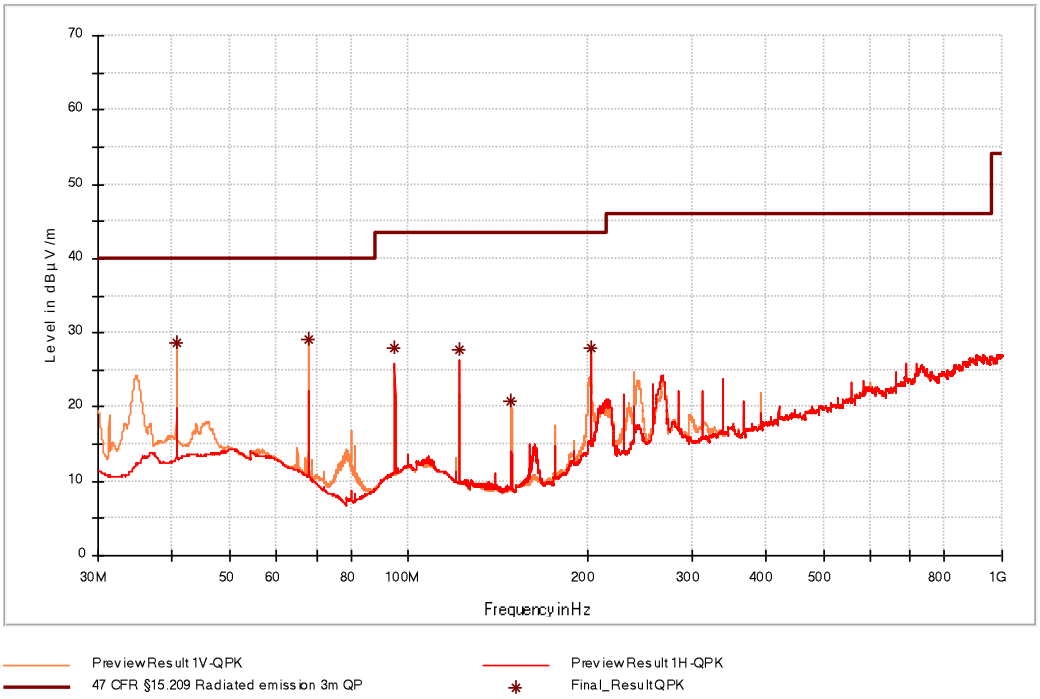

Figure 9: Chart of emissions test from 30 MHz to 1 GHz with tag in position 3 at 3 m – antenna 2063512:4612

Frequency (MHz)	Measured value QuasiPeak (dBµV/m) at 3m	Limit (dBµV/m) at 3m	Margin (dB)	Height (cm)	Polarization	Azimuth (deg)	Result
40.680000	28.62	40.00	11.38	100.0	V	211.0	Pass
67.800000	29.11	40.00	10.89	129.0	V	1.0	Pass
94.920000	27.92	43.50	15.58	323.0	H	74.0	Pass
122.040000	27.65	43.50	15.85	292.0	H	99.0	Pass
149.160000	20.72	43.50	22.78	100.0	V	211.0	Pass
203.400000	28.01	43.50	15.49	146.0	H	108.0	Pass

Table 14: Final results of emissions test from 30 MHz to 1 GHz with tag in position 3 at 3 m – antenna 2063512:4612

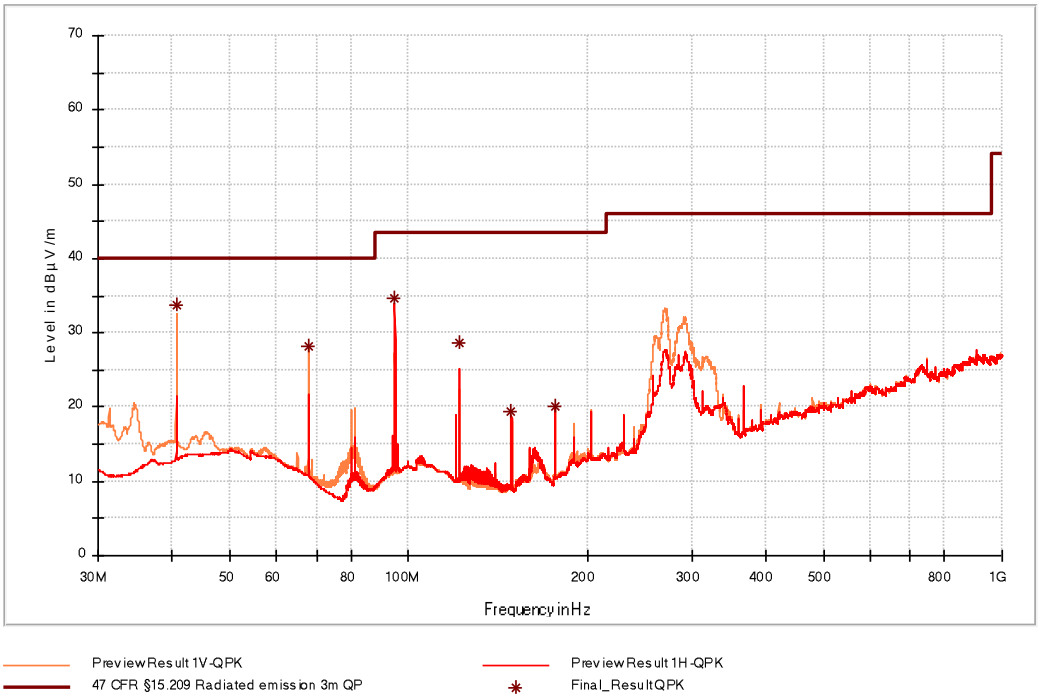

Figure 10: Chart of emissions test from 30 MHz to 1 GHz with tag in position 3 at 3 m – antenna 2009168:4834

Frequency (MHz)	Measured value QuasiPeak (dBµV/m) at 3m	Limit (dBµV/m) at 3m	Margin (dB)	Height (cm)	Polarization	Azimuth (deg)	Result
40.680000	33.62	40.00	6.38	100.0	V	50.0	Pass
67.800000	28.19	40.00	11.81	123.0	V	61.0	Pass
94.920000	34.74	43.50	8.76	301.0	H	69.0	Pass
122.040000	28.71	43.50	14.79	292.0	H	232.0	Pass
149.160000	19.31	43.50	24.19	217.0	H	352.0	Pass
176.280000	20.11	43.50	23.39	181.0	H	301.0	Pass

Table 15: Final results of emissions test from 30 MHz to 1 GHz with tag in position 3 at 3 m – antenna 2009168:4834

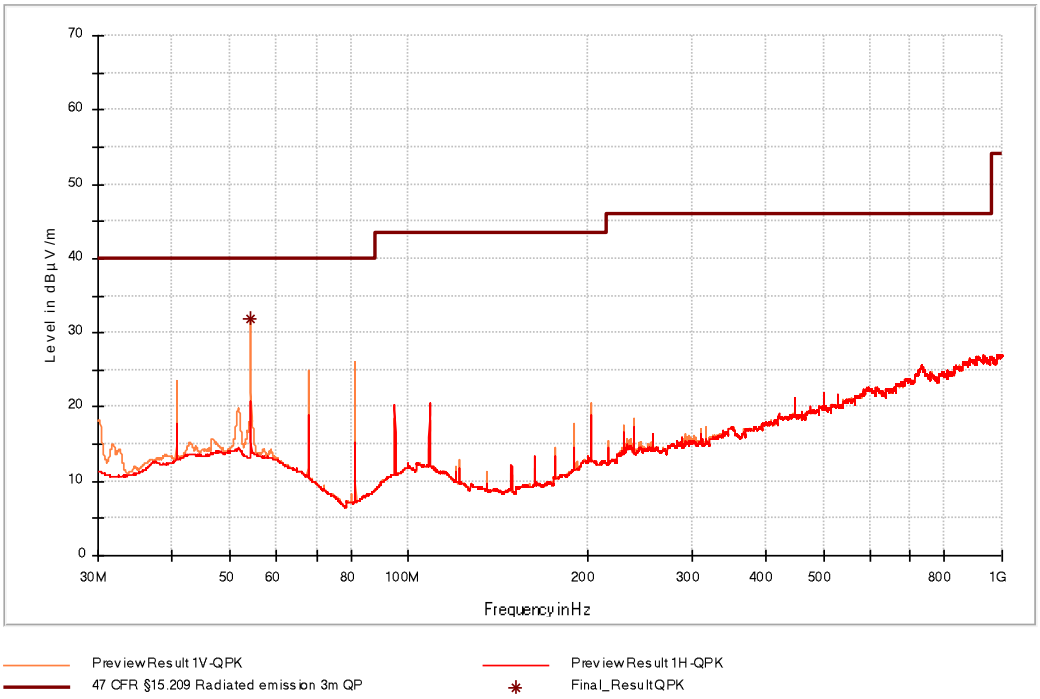

Figure 11: Chart of emissions test from 30 MHz to 1 GHz with tag in position 3 at 3 m – antenna 2063503:4477 small

Frequency (MHz)	Measured value QuasiPeak (dBµV/m) at 3m	Limit (dBµV/m) at 3m	Margin (dB)	Height (cm)	Polarization	Azimuth (deg)	Result
54.240000	**31.86**	**40.00**	**8.14**	**100.0**	**V**	**44.0**	**Pass**

Table 16: Final results of emissions test from 30 MHz to 1 GHz with tag in position 3 at 3 m – antenna 2063503:4477 small

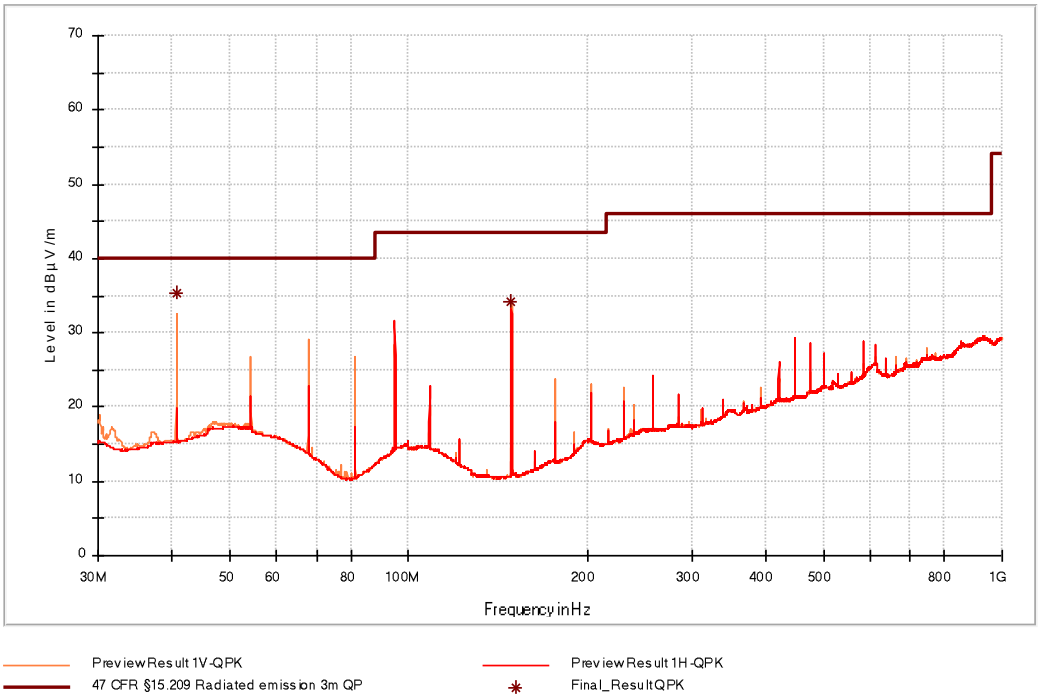

Figure 12: Chart of emissions test from 30 MHz to 1 GHz with tag in position 3 at 3 m – antenna 2063503:4477 large

Frequency (MHz)	Measured value QuasiPeak (dBµV/m) at 3m	Limit (dBµV/m) at 3m	Margin (dB)	Height (cm)	Polarization	Azimuth (deg)	Result
40.680000	35.28	40.00	4.72	100.0	V	320.0	Pass
149.160000	34.21	43.50	9.29	100.0	V	1.0	Pass

Table 17: Final results of emissions test from 30 MHz to 1 GHz with tag in position 3 at 3 m – antenna 2063503:4477 large

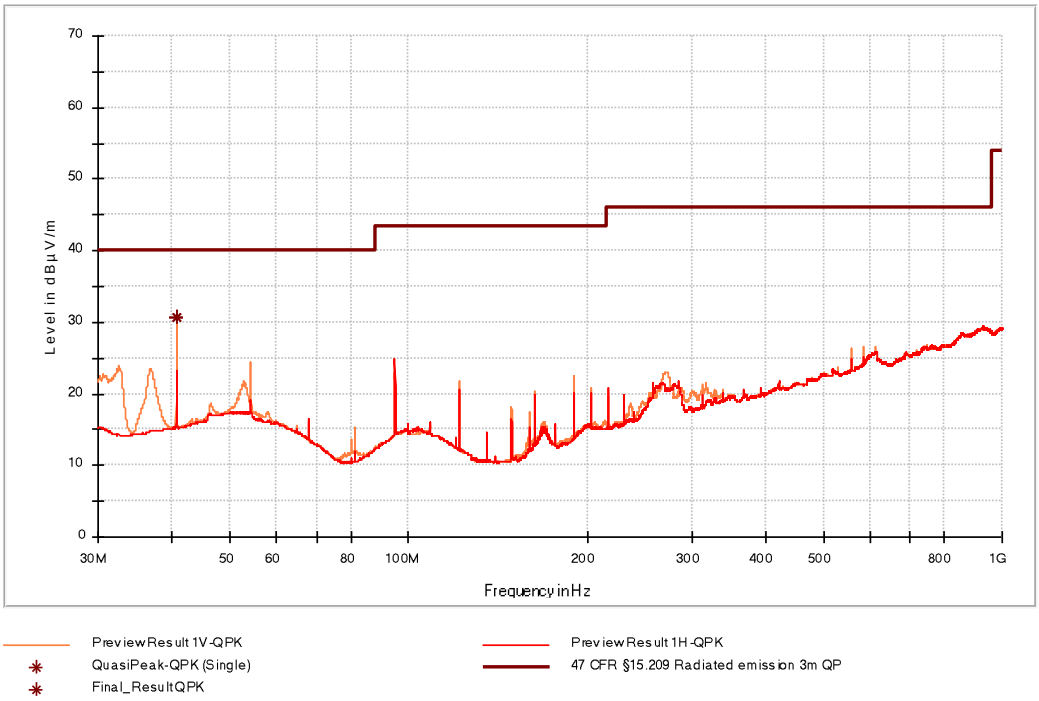

Figure 13: Chart of emissions test from 30 MHz to 1 GHz with tag in position 2 at 3 m – antenna 2063513:5170

Frequency (MHz)	Measured vaule QuasiPeak (dBµV/m) at 3 m	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Result
40.680000	**30.58**	**40.00**	**9.42**	**100.0**	**V**	**269.0**	**Pass**

Table 18: Final results of emissions test from 30 MHz to 1 GHz with tag in position 2 at 3 m – 2063513:5170

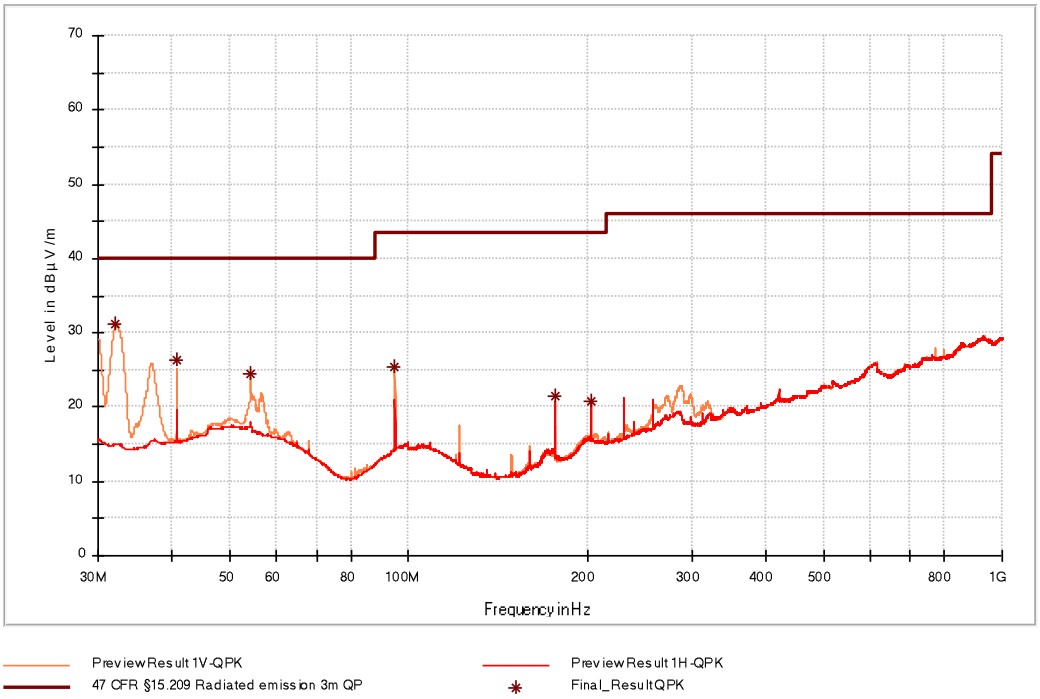

Figure 14: Chart of emissions test from 30 MHz to 1 GHz with tag in position 2 at 3 m – antenna 2063514:5171

Frequency (MHz)	Measured vaule QuasiPeak (dBuV/m) at 3 m	Limit (dBµV/m)	Margin (dB)	Height (cm)	Pol	Azimuth (deg)	Result
32.100000	31.09	40.00	8.91	101.0	V	56.0	Pass
40.680000	26.32	40.00	13.68	101.0	V	86.0	Pass
54.240000	24.51	40.00	15.49	165.0	V	103.0	Pass
94.920000	25.51	43.50	17.99	100.0	V	18.0	Pass
176.280000	21.53	43.50	21.97	169.0	H	240.0	Pass
203.400000	20.87	43.50	22.63	100.0	V	86.0	Pass

Table 19: Final results of emissions test from 30 MHz to 1 GHz with tag in position 2 at 3 m – 2063514:5171

9 Equipment calibration status

Description	*Modell number*	*Serial number*	*Inventory number(s)*	*Last calibration*	*Next calibration*
EMI test receiver	ESW44	101538	E00895	2019-07	2020-07
EMI test receiver	ESR7	101059	E00739	2018-08	2020-08
Loop antenna	HFH2-Z2	871398/0050	E00060	2018-10	2020-10
TRILOG broadband antenna (SAC3)	VULB 9162	9162-041	E00643	2018-07	2021-07
Compact diagnostic chamber (CDC)	VK041.0174	D62128-A502-A69-2-0006	E00026	N/A	
Semi-anechoic chamber (SAC)	SAC3	C62128-A520-A643-x-0006	E00716	2018-03	2021-03
Cable set CDC	RG214/U	---	E00446	2018-04	2020-04
	LCF12-50J	---	E01215	2018-04	2020-04
	LMR400	1718020006	E00920	2018-01	2020-01
	RG214 Hiflex	171802007	E00921	2018-01	2020-01
	SF104EA/2x11PC35-42/5m	11144/4EA	E00307	2017-12	2018-12
	262-0942-1500	003	E00433	2017-10	2018-10
Cable set of semi-anechoic chamber SAC3	SF104EA/11PC35/11PC35/10000MM	501347/4EA	E00755	2019-08	2020-08
	SF104E/11PC35/11PC35/2000MM	507410/4E	E01035	2019-08	2020-08
	SF104E/11PC35/11PC35/2000MM	507411/4E	E01034	2019-08	2020-08

10 Measurement uncertainties

Description	*Uncertainty*	*k=*
AC power line conducted emission	± 4.1 dB	2
Carrier frequency separation Number of hopping frequencies Time of occupancy (dwell time)	± 5.0 %	2
Bandwidth tests	± 2.0 %	
Maximum conducted output power (conducted)	± 1.5 dB	
Power spectral density (conducted)	± 2.9 dB	
Conducted spurious emissions	± 2.9 dB	
Radiated emissions in semi-anechoic chamber		
9 kHz to 30 MHz	± 4.8 dB	2
30 MHz to 300 MHz	± 5.4 dB	2
300MHz to 1 GHz	± 4.7 dB	2
Radiated emissions in semi-anechoic chamber with RF absorbing material on the floor or fully anechoic room		
1 GHz to 25 GHz	± 4.5 dB	2

Comment: The uncertainty stated is the expanded uncertainty obtained by multiplying the standard uncertainty by the coverage factor k. For a confidence level of 95 % the coverage factor k is 2.

Test related measurement uncertainties have to be taken into consideration when evaluating the test results. All used test instrument as well as the test accessories are calibrated at regular intervals.

11 Revision history

Revision	*Date*	*Issued by*	*Description of modifications*
0	2020-01-23	Andreas Menacher	First edition