Test report

Customer:

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RF test report

190250-AU01+W01

DESKO GmbH

RFID reader module

RFID Reader Module

DAkkS Deutsche Akkreditierungsstelle D-PL-12155-01-00

EMV **TESTHAUS** GmbH

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Accreditation:

Test Firm Type “accredited”: Valid until 2019-06-05
MRA US-EU, FCC designation number: DE0010
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

Test laboratory:

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

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1 Summary of test results

System type: RFID Reader

47 CFR part and section	*Test*	*Equivalent to IC radio standard(s)*	*Page*	*Result*	*Note(s)*
15.207	AC power line conducted emissions 150 kHz to 30 MHz	RSS-210, section 3.1 RSS-Gen, section 8.8	---	Passed	---
15.215(c)	20 dB bandwidth	---	28	For information only	---
2.202(a)	Occupied bandwidth (99 %)	RSS-Gen, section 6.7	59	For information only	---
15.225 (a) – (d)	Operation within the band 13.110 – 14.010 MHz	RSS-210 section B.6	67	Passed	---
15.225(e)	Carrier frequency stability	RSS-210, section B.6 RSS-Gen, section 6.11	75	Passed	---
15.209	Emissions outside the operating frequency band(s) specified 9 kHz to XXX GHz	RSS-Gen, section 6.13 RSS-Gen, section 8.9			
	9 kHz to 30 MHz		89	Passed	---
	30 MHz to 1 GHz		95	Passed	---
	1 GHz to XXX GHz		---	Not applicable	1

Notes (for information about EUT see clause 3):

1 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)

Straubing, June 6, 2019

Andreas Menacher
Test engineer
EMV **TESTHAUS** GmbH

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

2 Referenced publications

Publication	*Title*
CFR 47 Part 2 October 2017	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 October 2017	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
KDB 174176 D01 June 3, 2015	AC power-line conducted emissions Frequently Asked Questions
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

3 Equipment under test (EUT)

All Information in this clause is declared by customer.

3.1 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:	---		
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

3.2 Radio specifications

System type:	RFID Reader		
Application frequency band:	13.553 MHz – 13.567 MHz		
Frequency range used:	13.560679 MHz – 13.560904MHz		
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	
	Gain:	n/a	
	Connector:	☒ external	☐ internal
		☐ temporary	☐ none (integral antenna)

3.3 Photo documentation

For external photos of the EUT see annex B, for internal ones see annex C.
Photos taken during testing including EUT positions can be found in annex A.

4 Test configuration and mode of operation

4.1 Test configuration

Device	*Type designation*	*Serial or inventory no.*	*Manufacturer*
EUT			
RFID reader module	RFID Reader Module	---	DESKO GmbH
PCB antenna	2063510:4498[1]	0190048102	DESKO GmbH
PCB antenna	2063511:4499[1]	0190048103	DESKO GmbH
PCB antenna	2063508:4500[2]	0190048104	DESKO GmbH
PCB antenna	2063509:4502[3]	0190048104	DESKO GmbH
Support equipment			
RFID-tag	13.56 MHz	---	---
Evaluation board[4]	RFID Reader Module Adapter	0190040105	Desko GmbH
Notebook	1143-B6G	R9-KAG1C 11/12	Lenovo
Power supply of notebook	42T4416	11S42T4416Z1F3A994 7NA	Lenovo
DC-Power supply[5]	Statron 3231.1	E01236	Statron Gerätetechnik GmbH
USB box[5]	---	SEB01231	EMV Testhaus GmbH
Multimeter[5]	METRAHit 29S	SEB01231	Gossen-Metrawatt
USB-Ethernet extender kit[6]	UA0267	E01407	LINDY-Elektronik GmbH

Table 1: Devices used for testing

[1] Part of antenna set Penta Scanner
[2] Contains two different antennas (large & small), set Metall Rev. 1.1 & 1.2
[3] Contains two different antennas (large & small), set Standard Rev. 1.1
[4] Only used for testing purposes, no part of product.
[5] Used for frequency stability tests.
[6] Used for communication of RFID reader module and notebook during radiated emission tests.

4.2 Mode of operation

4.2.1 Test software used for all tests

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

4.2.2 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.

5 Test procedures

5.1 General specifications

5.1.1 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.

5.2 AC power line conducted emission

AC power-line conducted emissions are measured according to clause 6.2 of ANSI C63.10 over the frequency range from 150 kHz to 30 MHz to determine the line-to-ground radio-noise voltage that is conducted from all of the EUT current-carrying power input terminals that are directly (or indirectly via separate transformers or power supplies) connected to a public power network. The tests are performed in a shielded room.

If the EUT normally receives power from another device that in turn connects to the public utility ac power lines, measurements are made on that device with the EUT in operation to demonstrate that the device continues to comply with the appropriate limits while providing the EUT with power. If the EUT is operated only from internal or dedicated batteries, with no provisions for connection to the public utility ac power lines (600 VAC or less) to operate the EUT (such as an adapter), then ac power-line conducted measurements are not required.
For direct current (dc) powered devices where the ac power adapter is not supplied with the device, an “off-the-shelf” unmodified ac power adapter is used. If the device is supposed to be installed in a host (e.g., the device is a module or PC card), then it is tested in a typical compliant host.

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

Table 2: Bandwidth and detector type for AC power-line conducted emissions test

The AC power-line conducted emissions test is performed in the following steps:

a) The EUT is arranged as tabletop or floor-standing equipment, as applicable, and connected to a line impedance stabilization network (LISN) with 50 µH / 50 Ω. If required, a second LISN of the same type and terminated by 50 Ω is used for peripheral devices. The EUT is switched on.
b) The measurement equipment is connected to the LISN for the EUT and set-up according to the specifications of the test (see table 2). At the LISN, the neutral line is selected to be tested.
c) The prescan is performed with both detectors activated at the same time. If the test receiver is capable of FFT analysis, it is used for prescan, but not for final scan.
d) When the prescan is completed, maximum levels with less margin than 10 dB or exceeding the limit are determined and collected in a list.
e) With the first frequency of the list selected, a frequency zoom over a range of ten times of the measurement receiver bandwidth around this frequency is performed. If the EUT has no significant drift in frequency, the frequency zoom can be skipped.
f) For final scan, the emission level is measured and the maximum is recorded.
g) Steps e) to f) are repeated for all other frequencies in the list. At least the six highest EUT emissions relative to the limit have to be recorded.
h) Steps c) to g) are repeated for all current-carrying conductors of all of the power cords of EUT, i.e. all phase and (if used) neutral line(s).

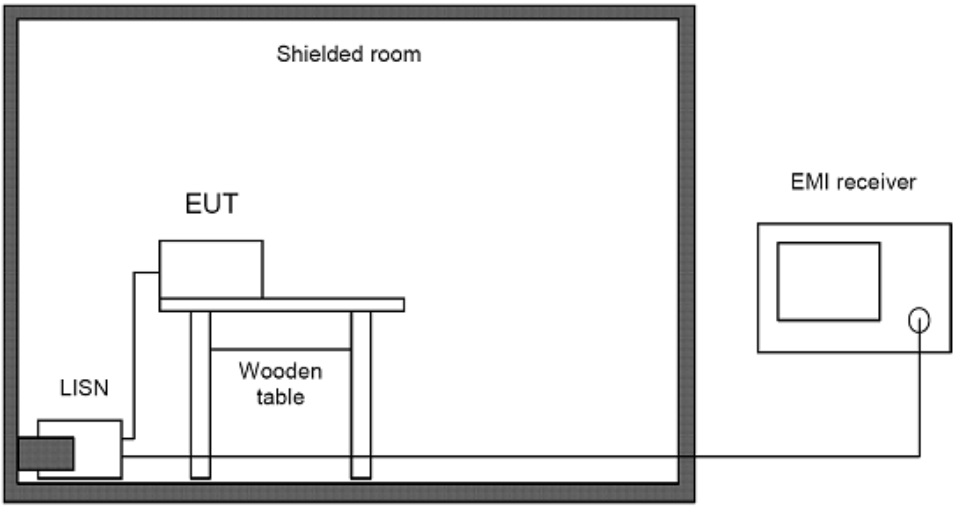


Figure 1: Setup for AC power-line conducted emissions test from 150 kHz to 30 MHz

5.3 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.

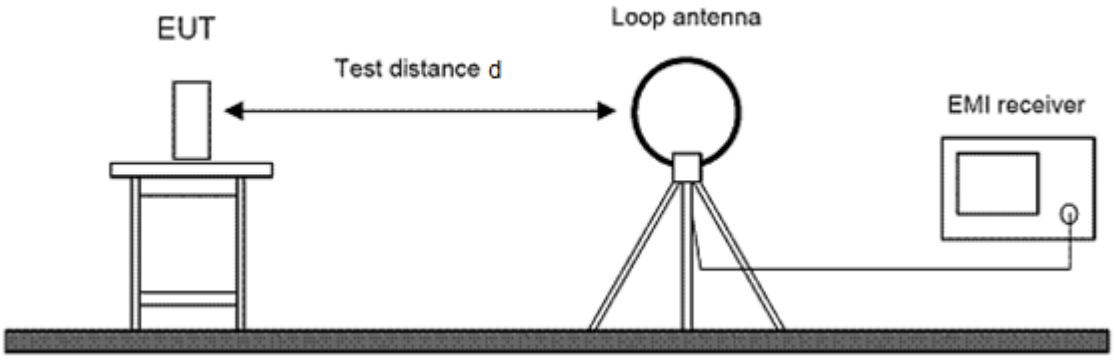


Figure 2: Setup for radiated emissions test below 30 MHz

5.4 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.

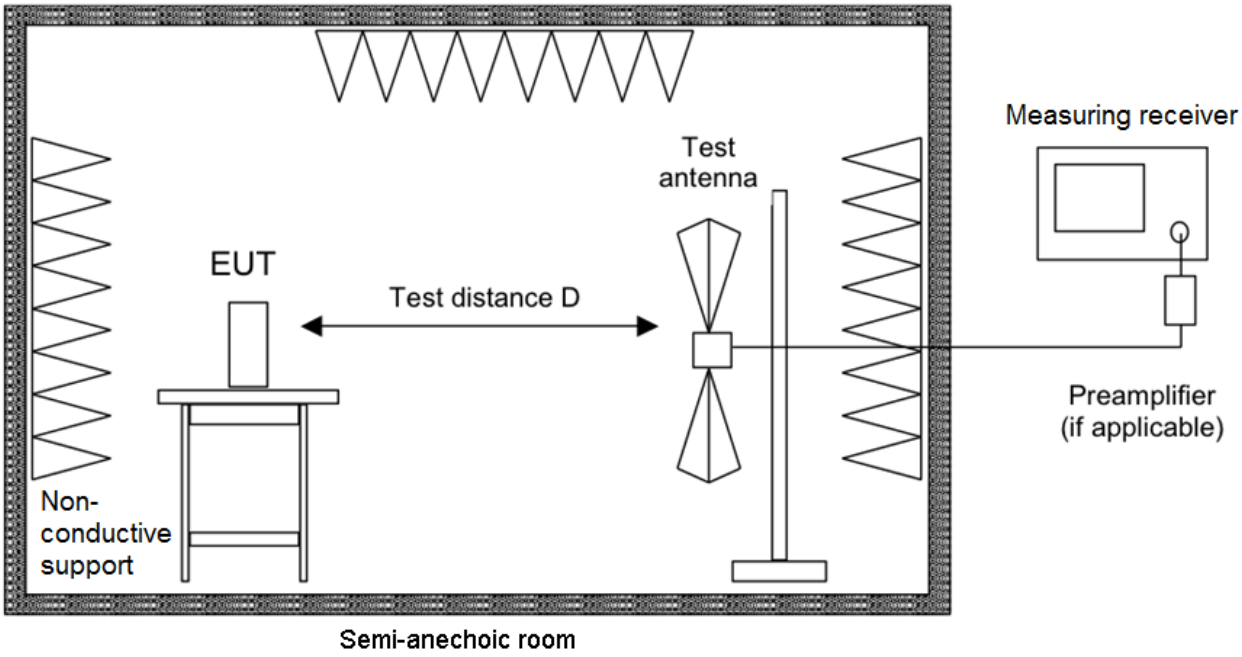


Figure 3: Setup for radiated emissions test from 30 MHz to 1 GHz

5.5 Radiated emissions above 1 GHz

Radiated emissions above 1 GHz are measured according to clause 6.6 of ANSI C63.10 by conducting exploratory and final radiated emission tests. According to clause 6.6.4.1 of ANSI C63.10, measurements may be performed at a distance closer than that specified in the requirements. However, an attempt shall be made to avoid making final measurements in the near field of both the measurement antenna and the EUT.

For measurement of radiated emissions above 1 GHz, horn antennas are used.

Sample calculation:

Frequency (MHz)	Reading value (dBµV)	Antenna correction (dB/m)	Correction pre-amplifier (dB)	Cable attenuation (dB)	Correction factor (Corr.) (dB/m)	Level (dBµV/m)
2400	50.00	27.76	-47.91	5.24	-14.92	35.08

Correction factor = Antenna correction + Correction pre-amplifier + Cable attenuation

Level = Reading value + Correction factor = 50.00 dBµV - 14.92 dB/m = 35.08 dBµV/m

5.5.1 Exploratory radiated emissions measurements

Exploratory radiated emissions above 1 GHz are measured in a semi-anechoic chamber with RF absorbing material on the floor or a fully anechoic room. They are performed by moving the receiving antenna over all sides of the EUT at a closer distance (e.g. 0.5 or 1 m) while observing the display of the test receiver to find the emissions to be re-tested during final radiated emission measurements.

According to clause 5.3.3 of ANSI C63.10, when performing measurements at a distance other than that specified, the results shall be extrapolated to the specified distance using an extrapolation factor of 20 dB/decade of distance (inverse of linear distance for field-strength measurements). To simplify testing and documentation, the limits are increased accordingly instead of decreasing the results.

The emissions of the EUT are displayed and recorded with an EMI test receiver operating in the spectrum analyzer mode using the settings as described in table 6.

Frequency (f)	*Resolution bandwidth*	*Video bandwidth*	Sweep time	*Trace detector(s)*	*Trace mode(s)*	*Test*
f ≥ 1 GHz	1 MHz	3 MHz	AUTO	Max Peak, Average	Clear Write	Searching
					Max Hold	Recording

Table 6: Bandwidth and trace settings for exploratory radiated emissions test above 1 GHz

If during exploratory radiated emissions measurements no levels to be re-tested are found, the final radiated emissions measurement may be omitted. In this case, the chart of the exploratory radiated emissions measurements has to be reported.

5.5.2 Final radiated emissions measurements

Final radiated emissions above 1 GHz are measured in a semi-anechoic chamber (SAC) with RF absorbing material on the floor between measurement antenna and EUT. The measurement distance is 3 meters. The emissions of the EUT are recorded with an EMI test receiver configured as described in table 7.

Frequency (f)	*Measurement receiver bandwidth*	*Step size*	*Detector type*	
			Prescan	*Final scan*
f ≥ 1 GHz	1 MHz	≤ 500 kHz	Peak, Average	Peak, Average

Table 7: Bandwidth and detector type for final radiated emissions test above 1 GHz

Prescans are performed with both 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.

The horn antenna is mounted on a support capable of allowing the antenna to be used in either horizontal or vertical polarization and to be moved in a scan height range between 1 m and the scan height upper range defined in clause 6.6.3.3 of ANSI C63.10. When the EUT is manipulated through three different orientations, the scan height upper range for the measurement antenna is limited to 2.5 m above the ground plane.or 0.5 m above the top of the EUT, whichever is higher. Otherwise, the scan height upper range is 4 m above the ground plane.
To keep the emission signal within the illumination area of the 3 dB beamwidth of the measurement antenna, the automatic tilt function of the antenna support device is used to point the antenna at an angle toward the source of the emission.

The final radiated emissions test above 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 7).
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 the scan height upper range 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 the scan height upper range 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 30°. 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 ±30° 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.

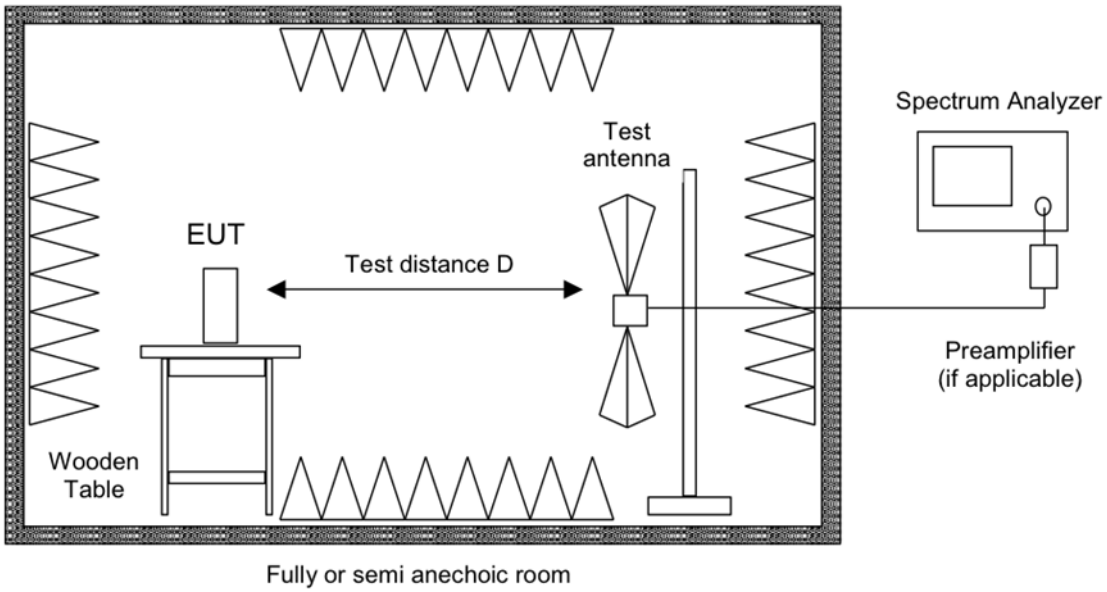


Figure 4: Setup for radiated emissions test above 1 GHz

5.6 Bandwidth measurements

5.6.1 20 dB bandwidth of the emission

The 20 dB bandwidth of the emission is measured according to clause 6.9.2 of ANSI C63.10 as the width of the spectral envelope of the modulated signal, at an amplitude level reduced by a ratio of 20 dB down from the reference value.

The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the EMI receiver or spectrum analyzer is between two times and five times the 20 dB bandwidth. The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1 % to 5 % of the 20 dB bandwidth and the video bandwidth (VBW) shall be approximately three times RBW.

The reference level of the instrument is set 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 (20 dB bandwidth/RBW)] below the reference level.

5.6.2 99 % occupied bandwidth

According to section 6.7 of RSS-Gen, the occupied bandwidth (OBW) is defined as the 99 % emission bandwidth.

The span of the spectrum analyzer is 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 resolution bandwidth is in the range of 1 % to 5 % of the occupied bandwidth and the video bandwidth is not smaller than three times the resolution bandwidth. Video averaging is not permitted.
If possible, the detector of the spectrum analyzer is set to “Sample”. However, if the device is not transmitting continuously, a peak, or peak hold is used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement).

To measure the 99 % emission bandwidth, the OBW function of the test receiver is used with the power bandwidth set to 99 %. This function indicates the lowest frequency (starting from the left side of the span) and the highest frequency (starting from the right side of the span) where 0.5% of the total sum is reached. The difference between the two frequencies is the 99 % occupied bandwidth.

5.7 Operation within the band 13.110 MHz - 14.010 MHz

The EUT was placed in a fully anechoic chamber and the testing was performed in accordance with ANSI C63.10 and 47 CFR Part 15, section 15.225 (a) to (d). The measurement distance was 3 m. To find the closest margin of the spectrum to the limit mask adapted to the test distance the EUT was rotated by 360 degrees with detector of the test receiver set to peak. The loop antenna placed in a fixed height of 1 meter was rotated by 360 degrees to get the maximum of emission. In case of exceeding the limits the detector is switched to quasi peak for final testing in position of maximum emission.

5.8 Carrier frequency stability

1. If possible EUT is operating providing an unmodulated carrier. The peak detector of the spectrum analyzer is selected and resolution as well as video bandwidth are set to values appropriate to the shape of the spectrum of the EUT. The frequency counter mode of the spectrum analyzer is used to maximize the accuracy of the measured frequency tolerance. If an unmodulated carrier is not available a significant and stable point on the spectrum is selected and the span is reduced to a value that delivers an accuracy which shall be better than 1% of the maximum frequency tolerance allowed for the carrier signal. This method may be performed as long as the margin to the frequency tolerance allowed is larger than the uncertainty of the measured frequency tolerance.
2. The carrier frequency is measured depending on the 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 an external supply voltage can be used and set at the battery nominal voltage, and again at the battery operating end point voltage which must be specified by the equipment manufacturer. Alternatively, tests shall be performed using a new battery.
3. The carrier frequency is measured over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage.

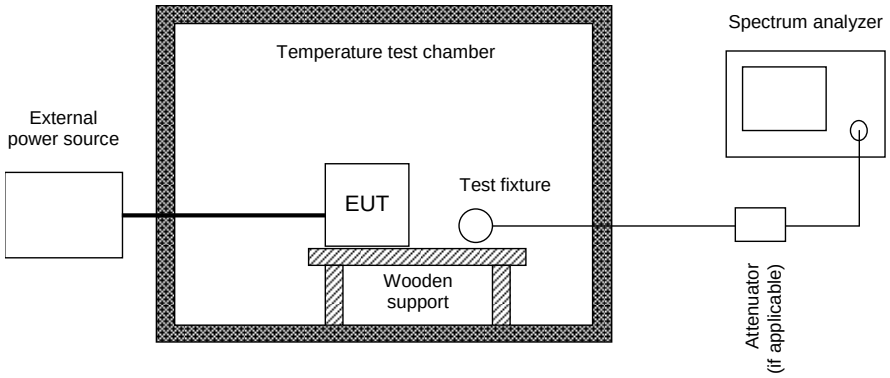


Figure 5: Test setup for carrier frequency stability measurement

6 Test results

This clause gives details about the test results as collected in the summary of test results on page 8.

6.1 AC power line conducted emissions 150 kHz to 30 MHz

Section(s) in 47 CFR Part 15:	Requirement(s):	15.207
	Reference(s):	ANSI C63.10, clause 6.2
Section(s) in RSS:	Requirement(s):	RSS-Gen, section 8.8
	Reference(s):	ANSI C63.10, clause 6.2

Result[7] ☒ Test passed ☐ Test not passed

6.1.1 Test equipment

	Type	*Designation*	*Manufacturer*	*Inventory no.*
☒	Shielded room	P92007	Siemens Matsushita	E00107
☐	EMI test receiver (CDC)	ESCI 3	Rohde & Schwarz	E00552
☒	EMI test receiver (OATS)	ESCI 3	Rohde & Schwarz	E00001
☐	EMI test receiver	ESCS 30	Rohde & Schwarz	E00003
☐	EMI test receiver	ESR 7	Rohde & Schwarz	E00739
☐	EMI test receiver	ESU 26	Rohde & Schwarz	W00002
☐	EMI test receiver	ESW 44	Rohde & Schwarz	E00895
☐	Field probe	RF-R 400-1	Langer EMV-Technik	E00270
☒	Artificial mains network	ESH2-Z5	Rohde & Schwarz	E00004
☐	Artificial mains network	ESH2-Z5	Rohde & Schwarz	E00005
☒	Attenuator (10 dB)	50FHB-010-10	JFW Industries	E00471
☒	Test software	EMC32-EB (V10.35)	Rohde & Schwarz	E00777
☐	Test software	EMC32-MEB (V10.35)	Rohde & Schwarz	E00778
☐	Test software	EMC32-MEB (V10.35)	Rohde & Schwarz	E01073

[7] For information about measurement uncertainties see page 85.

6.1.2 Limits

As specified in section 15.207 of 47 CFR Part 15, the emissions from an intentional radiator shall not exceed the conducted limits as specified in table 8.

Frequency of emission [MHz]	*Conducted limit*	
	Quasi-peak [dBµV]	*Average [dBµV]*
0.15 – 0.5	66 to 56*	56 to 46*
0.5 – 5.0	56	46
5 – 30	60	50

Table 8: AC power-line conducted limits

* Decreases with the logarithm of the frequency.

6.1.3 Test procedure

AC power line conducted emissions are measured using the test procedure as described in clause 5.2.

6.1.4 Test results

Performed by:	Andreas Menacher	Date(s) of test:	April 16, 2018
Climatic conditions:	Ambient temperature 22 °C	Relative humidity 32 %	Barometric pressure 972 hPa

Frequency range	*Step size*	*IF Bandwidth*	*Detector*		*Measurement Time*		*Preamplifier*
			Prescan	*Final scan*	*Prescan*	*Final scan*	
150 kHz – 30 MHz	≤ 4.5 kHz	9 kHz	PK, AV	QP, AV	10 ms	1 s	Off

Remark: According to KDB 174176 D01 Line Conducted FAQ v01r01 the intentional operator which operates below 30 MHz was first measured with the antenna connected to determine compliance with section 15.207 limits outside the transmitter´s fundamental emission band and then the antenna was replaced by a dummy load and the test was repeated to show compliance with section 15.207 limits within the transmitter´s fundamental emission band.

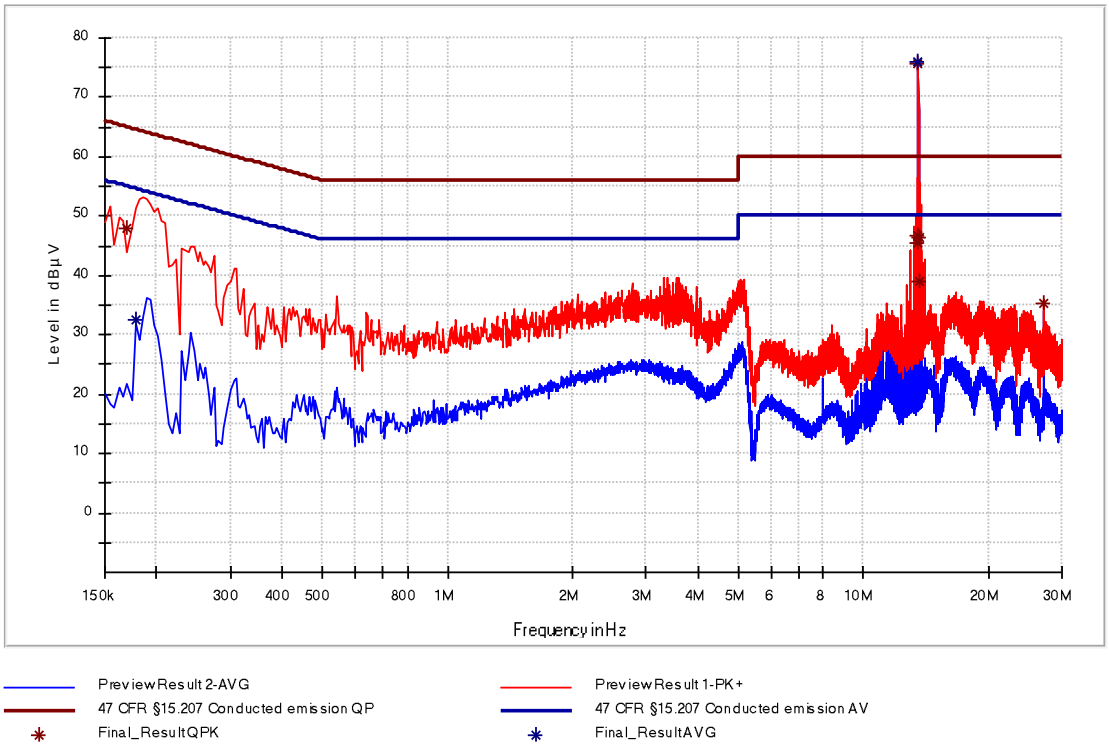


Figure 6: Chart of AC power-line conducted emissions test – with antenna 2063510:4498 - phase L1

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.170000	47.85	---	64.96	17.11	1000.0	9.000	L1	GND	10.1
0.178000	---	32.39	54.58	22.19	1000.0	9.000	L1	GND	10.1
13.441000	45.61	---	60.00	14.39	1000.0	9.000	L1	GND	11.8
13.477000	46.68	---	60.00	13.32	1000.0	9.000	L1	GND	11.8
13.561000	---	75.96	50.00	-25.96	1000.0	9.000	L1	GND	11.8
13.561000	75.63	---	60.00	-15.63	1000.0	9.000	L1	GND	11.8
13.609000	39.15	---	60.00	20.85	1000.0	9.000	L1	GND	11.8
13.661000	46.55	---	60.00	13.45	1000.0	9.000	L1	GND	11.8
27.121000	35.38	---	60.00	24.62	1000.0	9.000	L1	GND	12.5

Table 9: Final results of AC power-line conducted emissions test – with antenna 2063510:4498 - phase L1

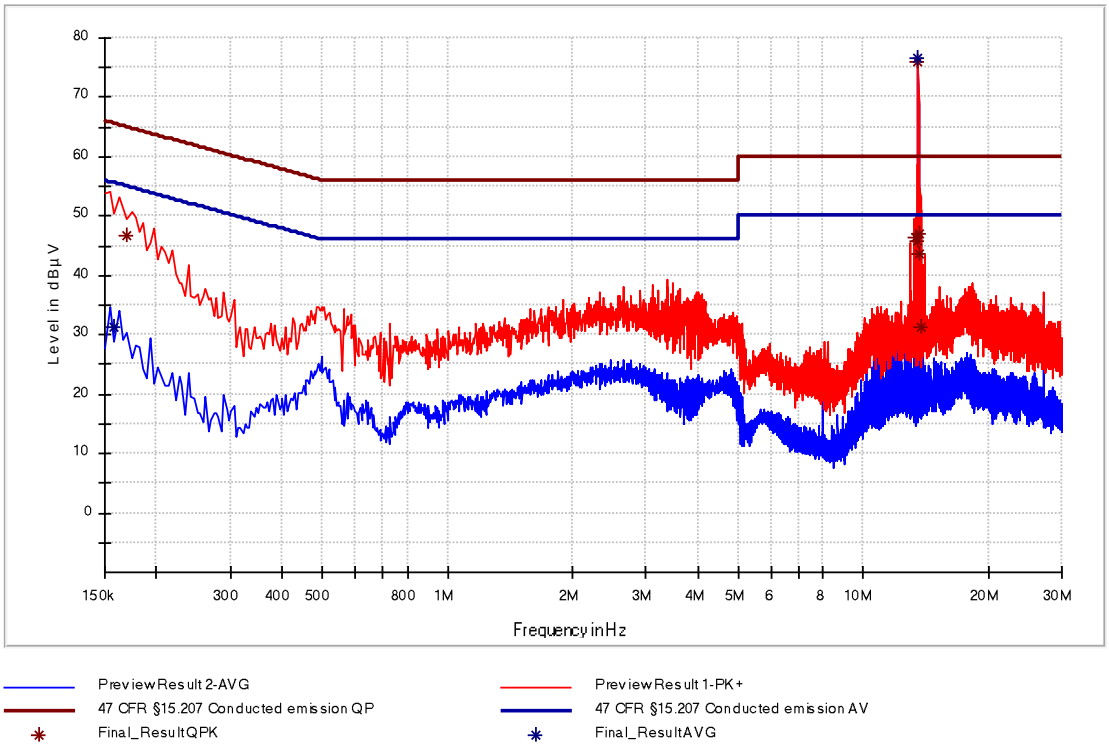


Figure 7: Chart of AC power-line conducted emissions test – with antenna 2063510:4498 - phase N

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.158000	---	31.18	55.57	24.39	1000.0	9.000	N	GND	10.1
0.170000	46.59	---	64.96	18.37	1000.0	9.000	N	GND	10.1
13.425000	46.45	---	60.00	13.55	1000.0	9.000	N	GND	12.0
13.429000	45.73	---	60.00	14.27	1000.0	9.000	N	GND	12.0
13.561000	---	76.52	50.00	-26.52	1000.0	9.000	N	GND	12.0
13.561000	76.06	---	60.00	-16.06	1000.0	9.000	N	GND	12.0
13.617000	43.49	---	60.00	16.51	1000.0	9.000	N	GND	12.0
13.661000	47.04	---	60.00	12.96	1000.0	9.000	N	GND	12.0
13.823000	31.26	---	60.00	28.74	1000.0	9.000	N	GND	12.0

Table 10: Final results of AC power-line conducted emissions test – with antenna 2063510:4498 - phase N

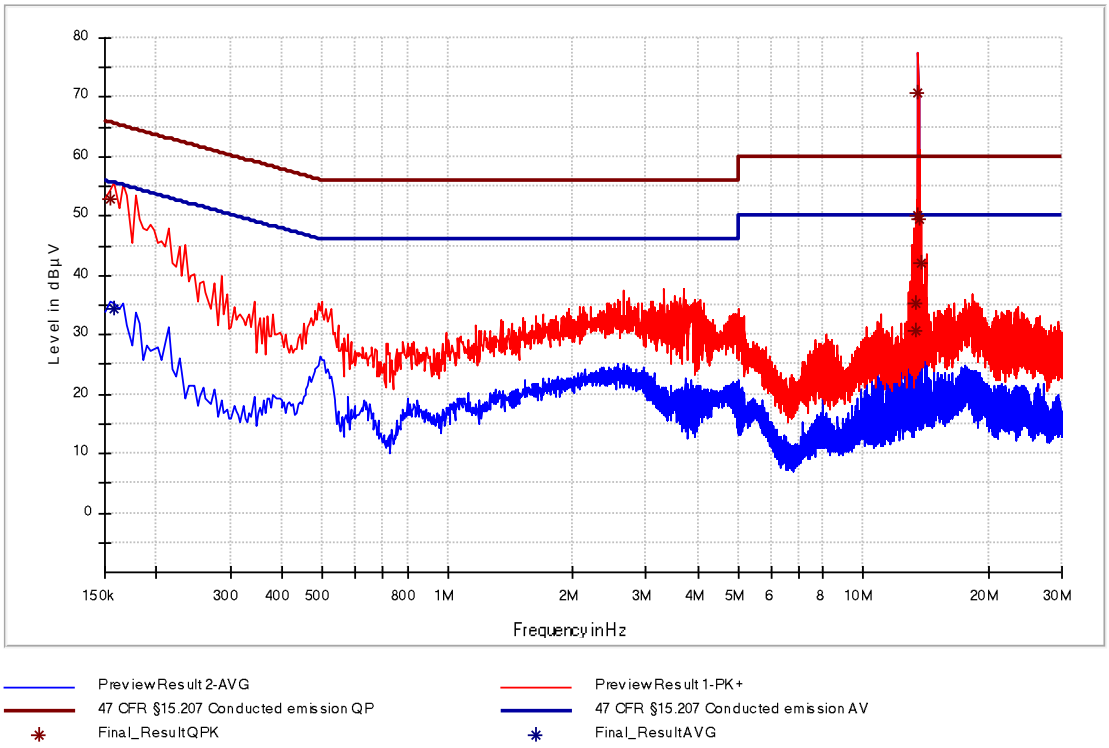


Figure 8: Chart of AC power-line conducted emissions test – with antenna 2063511:4499 - phase L1

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.154000	52.96	---	65.78	12.82	1000.0	9.000	L1	GND	10.1
0.158000	---	34.26	55.57	21.31	1000.0	9.000	L1	GND	10.1
13.309000	35.28	---	60.00	24.72	1000.0	9.000	L1	GND	11.7
13.397000	30.81	---	60.00	29.19	1000.0	9.000	L1	GND	11.8
13.441000	50.11	---	60.00	9.89	1000.0	9.000	L1	GND	11.8
13.555000	70.69	---	60.00	-10.69	1000.0	9.000	L1	GND	11.8
13.561000	---	81.12	50.00	-31.12	1000.0	9.000	L1	GND	11.8
13.561000	80.65	---	60.00	-20.65	1000.0	9.000	L1	GND	11.8
13.629000	49.51	---	60.00	10.49	1000.0	9.000	L1	GND	11.8
13.721000	42.09	---	60.00	17.91	1000.0	9.000	L1	GND	11.8

Table 11: Final results of AC power-line conducted emissions test – with antenna 2063511:4499 - phase L1

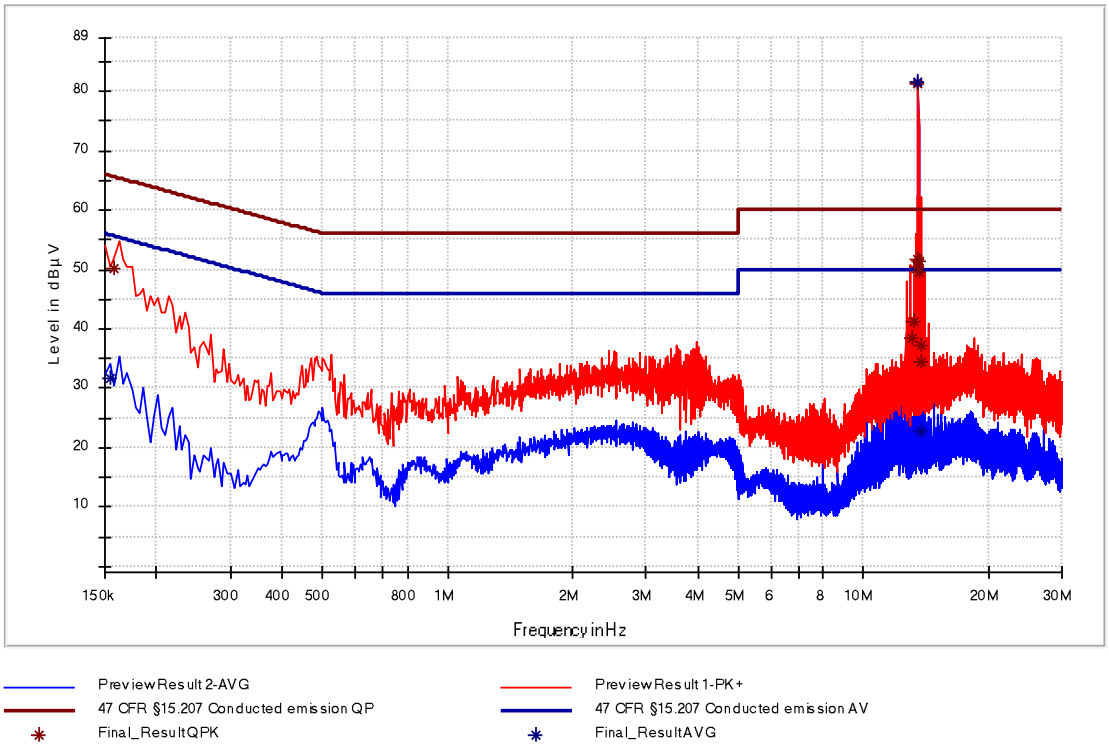


Figure 9. Chart of AC power-line conducted emissions test – with antenna 2063511:4499 - phase N

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.154000	---	31.71	55.78	24.07	1000.0	9.000	N	GND	10.1
0.158000	50.26	---	65.57	15.31	1000.0	9.000	N	GND	10.1
13.057000	38.44	---	60.00	21.56	1000.0	9.000	N	GND	11.9
13.249000	41.31	---	60.00	18.69	1000.0	9.000	N	GND	11.9
13.429000	50.51	---	60.00	9.49	1000.0	9.000	N	GND	12.0
13.437000	51.77	---	60.00	8.23	1000.0	9.000	N	GND	12.0
13.561000	---	81.66	50.00	-31.66	1000.0	9.000	N	GND	12.0
13.561000	81.42	---	60.00	-21.42	1000.0	9.000	N	GND	12.0
13.633000	51.29	---	60.00	8.71	1000.0	9.000	N	GND	12.0
13.693000	49.59	---	60.00	10.41	1000.0	9.000	N	GND	12.0
13.761000	37.13	---	60.00	22.87	1000.0	9.000	N	GND	12.0
13.765000	---	22.82	50.00	27.18	1000.0	9.000	N	GND	12.0
13.817000	34.58	---	60.00	25.42	1000.0	9.000	N	GND	12.0

Table 12: Final results of AC power-line conducted emissions test – with antenna 2063511:4499 - phase N

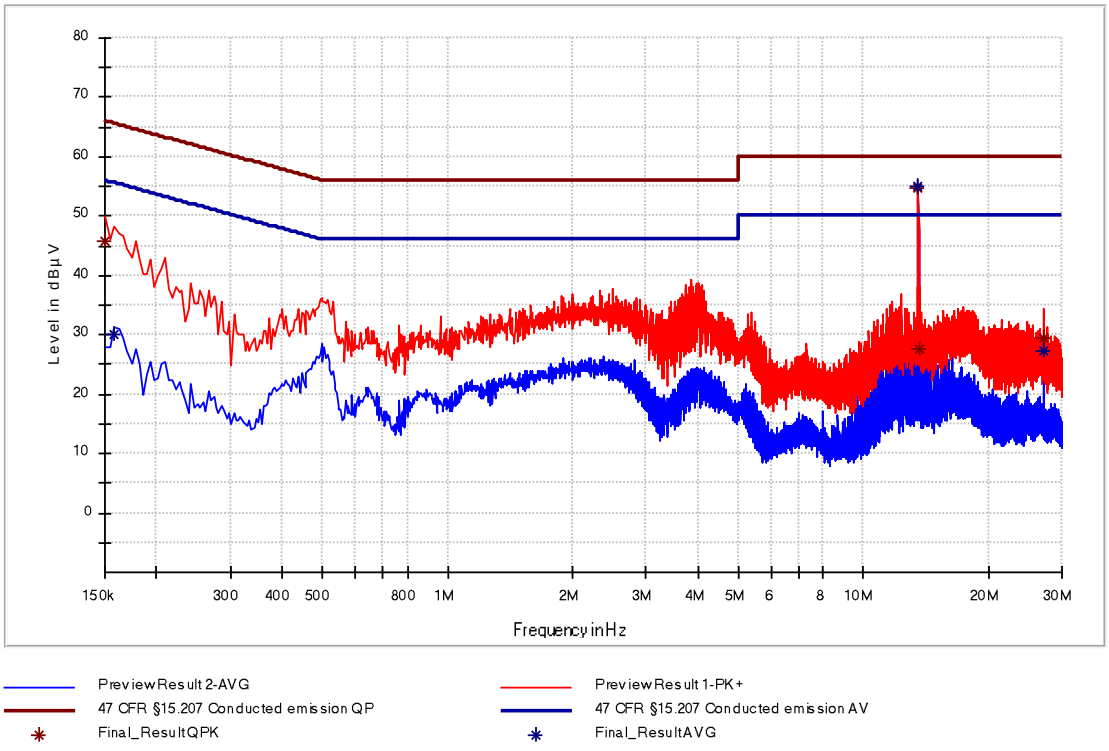


Figure 10: Chart of AC power-line conducted emissions test – with antenna 2063508:4500 large - phase L1

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.150000	45.66	---	66.00	20.34	1000.0	9.000	L1	GND	10.1
0.158000	---	30.22	55.57	25.35	1000.0	9.000	L1	GND	10.1
13.561000	---	55.06	50.00	-5.06	1000.0	9.000	L1	GND	11.8
13.561000	54.82	---	60.00	5.18	1000.0	9.000	L1	GND	11.8
13.649000	27.49	---	60.00	32.51	1000.0	9.000	L1	GND	11.8
27.121000	---	27.41	50.00	22.59	1000.0	9.000	L1	GND	12.5
27.121000	29.54	---	60.00	30.46	1000.0	9.000	L1	GND	12.5

Table 13: Final results of AC power-line conducted emissions test – with antenna 2063508:4500 large - phase L1

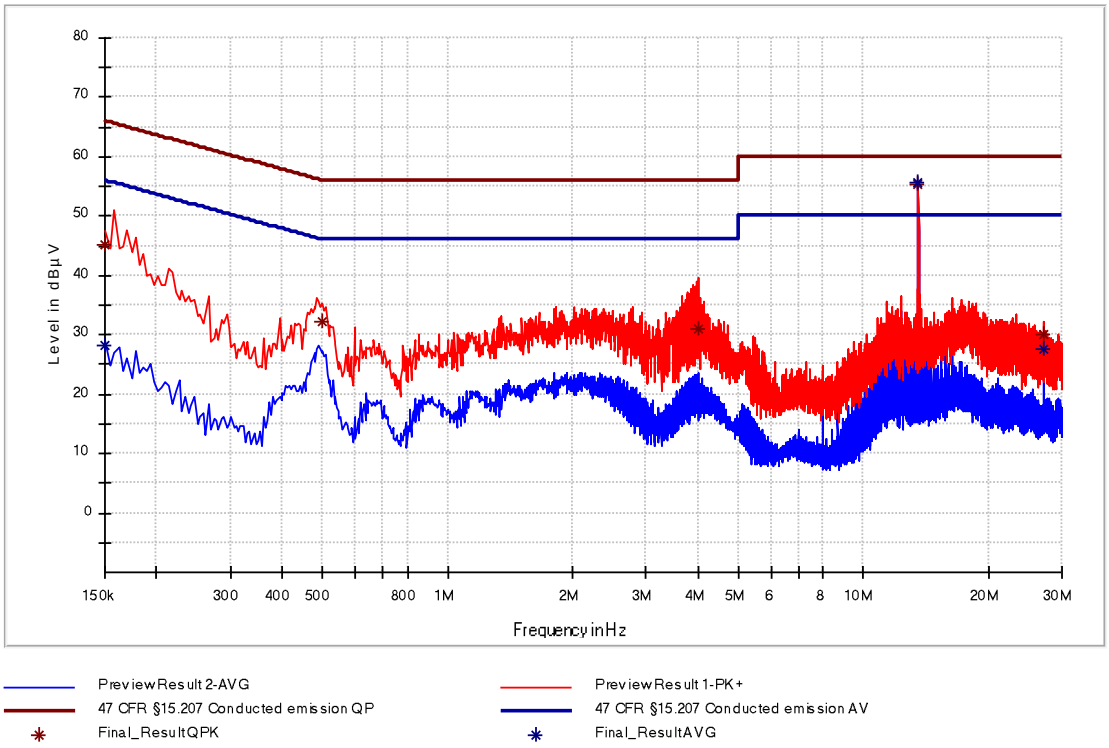


Figure 11: Chart of AC power-line conducted emissions test – with antenna 2063508:4500 large - phase N

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.150000	45.09	---	66.00	20.91	1000.0	9.000	N	GND	10.1
0.150000	---	28.37	56.00	27.63	1000.0	9.000	N	GND	10.1
0.501000	32.31	---	56.00	23.69	1000.0	9.000	N	GND	10.1
3.993000	31.13	---	56.00	24.87	1000.0	9.000	N	GND	10.7
13.561000	55.39	---	60.00	4.61	1000.0	9.000	N	GND	12.0
13.561000	---	55.59	50.00	-5.59	1000.0	9.000	N	GND	12.0
27.121000	29.97	---	60.00	30.03	1000.0	9.000	N	GND	12.5
27.121000	---	27.73	50.00	22.27	1000.0	9.000	N	GND	12.5

Table 14: Final results of AC power-line conducted emissions test – with antenna 2063508:4500 large - phase N

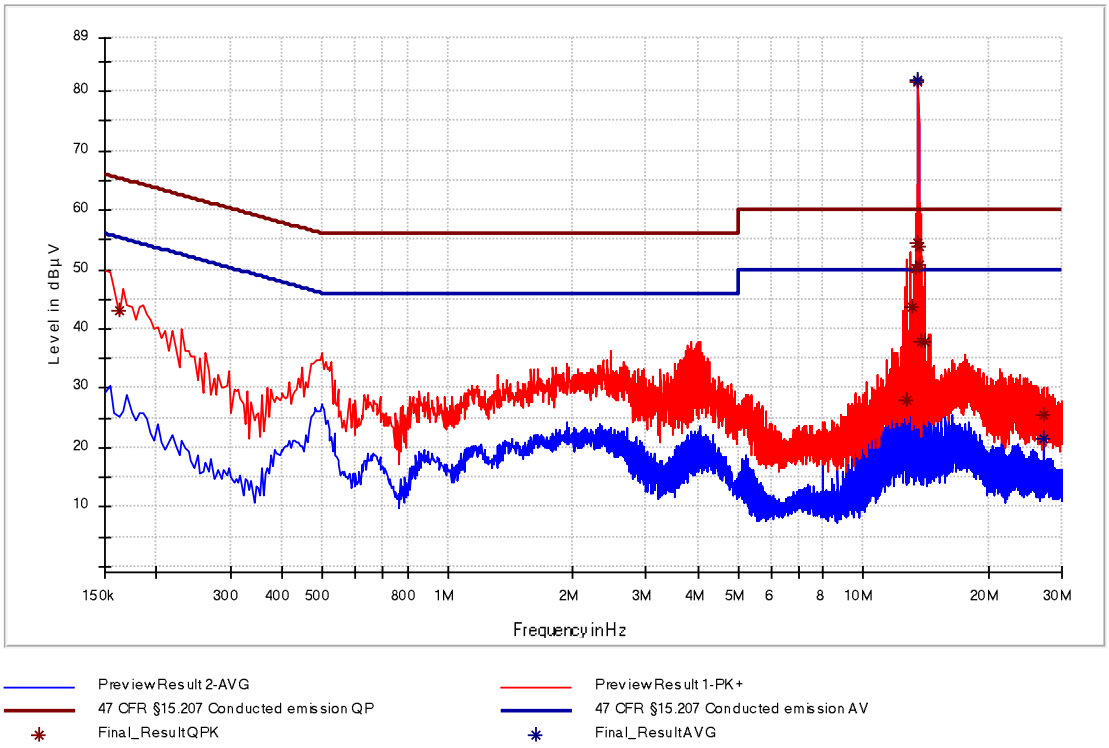


Figure 12: Chart of AC power-line conducted emissions test – with antenna 2063508:4500 small - phase L1

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.162000	42.99	---	65.36	22.37	1000.0	9.000	L1	GND	10.1
12.677000	28.07	---	60.00	31.93	1000.0	9.000	L1	GND	11.7
13.029000	43.64	---	60.00	16.36	1000.0	9.000	L1	GND	11.7
13.417000	50.29	---	60.00	9.71	1000.0	9.000	L1	GND	11.8
13.453000	54.46	---	60.00	5.54	1000.0	9.000	L1	GND	11.8
13.561000	---	81.96	50.00	-31.96	1000.0	9.000	L1	GND	11.8
13.561000	81.74	---	60.00	-21.74	1000.0	9.000	L1	GND	11.8
13.665000	53.88	---	60.00	6.12	1000.0	9.000	L1	GND	11.8
13.693000	50.70	---	60.00	9.30	1000.0	9.000	L1	GND	11.8
13.761000	37.94	---	60.00	22.06	1000.0	9.000	L1	GND	11.8
14.097000	37.88	---	60.00	22.12	1000.0	9.000	L1	GND	11.8
27.121000	---	21.45	50.00	28.55	1000.0	9.000	L1	GND	12.5
27.121000	25.59	---	60.00	34.41	1000.0	9.000	L1	GND	12.5

Table 15: Final results of AC power-line conducted emissions test – with antenna 2063508:4500 small - phase L1

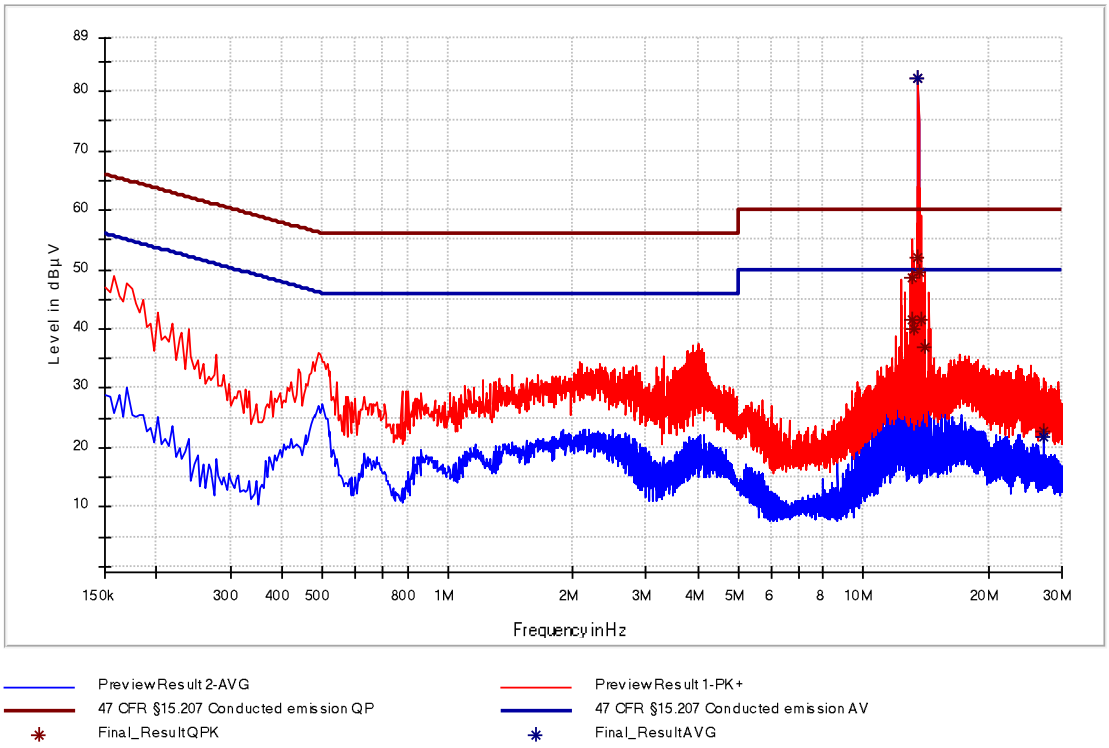


Figure 13: Chart of AC power-line conducted emissions test – with antenna 2063508:4500 small - phase N

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
13.057000	41.54	---	60.00	18.46	1000.0	9.000	N	GND	11.9
13.137000	48.58	---	60.00	11.42	1000.0	9.000	N	GND	11.9
13.261000	40.06	---	60.00	19.94	1000.0	9.000	N	GND	11.9
13.441000	52.12	---	60.00	7.88	1000.0	9.000	N	GND	12.0
13.561000	---	82.30	50.00	-32.30	1000.0	9.000	N	GND	12.0
13.561000	82.08	---	60.00	-22.08	1000.0	9.000	N	GND	12.0
13.621000	49.62	---	60.00	10.38	1000.0	9.000	N	GND	12.0
13.729000	41.49	---	60.00	18.51	1000.0	9.000	N	GND	12.0
14.109000	37.00	---	60.00	23.00	1000.0	9.000	N	GND	12.0
27.121000	---	21.86	50.00	28.14	1000.0	9.000	N	GND	12.5
27.197000	22.64	---	60.00	37.36	1000.0	9.000	N	GND	12.5

Table 16: Final results of AC power-line conducted emissions test – with antenna 2063508:4500 small - phase N

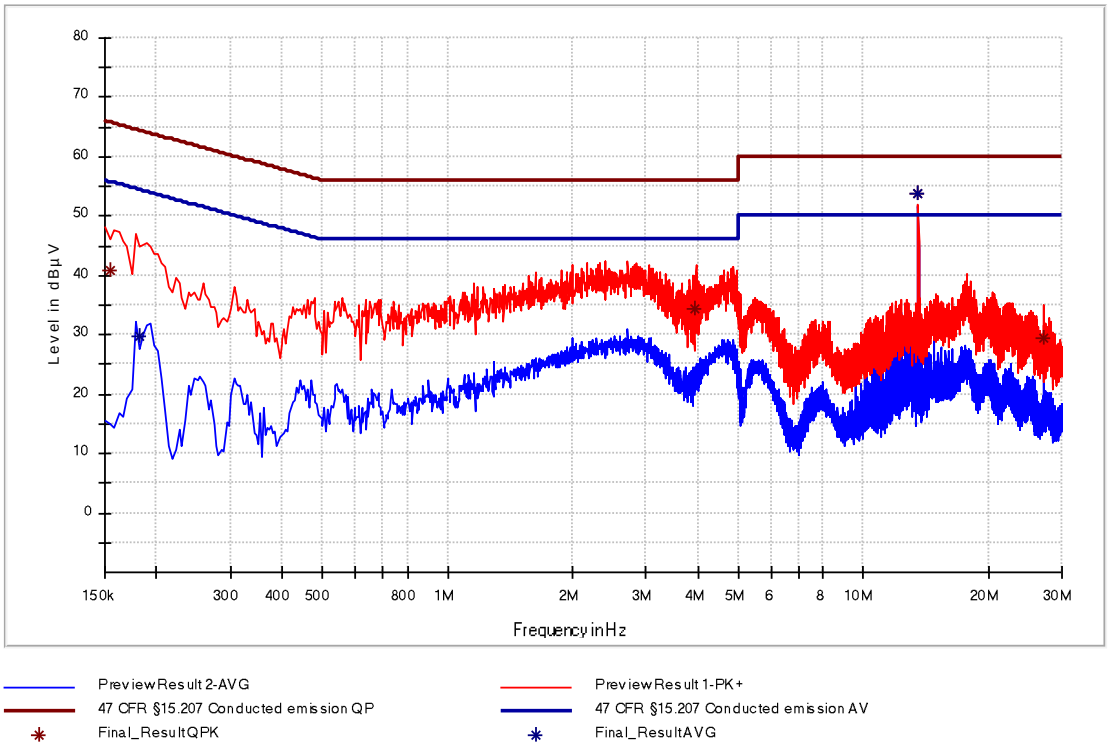


Figure 14: Chart of AC power-line conducted emissions test – with antenna 2063509:4502 large - phase L1

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.154000	40.78	---	65.78	25.00	1000.0	9.000	L1	GND	10.1
0.182000	---	29.67	54.39	24.72	1000.0	9.000	L1	GND	10.1
3.933000	34.45	---	56.00	21.55	1000.0	9.000	L1	GND	10.6
13.561000	---	53.81	50.00	-3.81	1000.0	9.000	L1	GND	11.8
13.561000	53.76	---	60.00	6.24	1000.0	9.000	L1	GND	11.8
27.125000	29.43	---	60.00	30.57	1000.0	9.000	L1	GND	12.5

Table 17: Final results of AC power-line conducted emissions test – with antenna 2063509:4502 large - phase L1

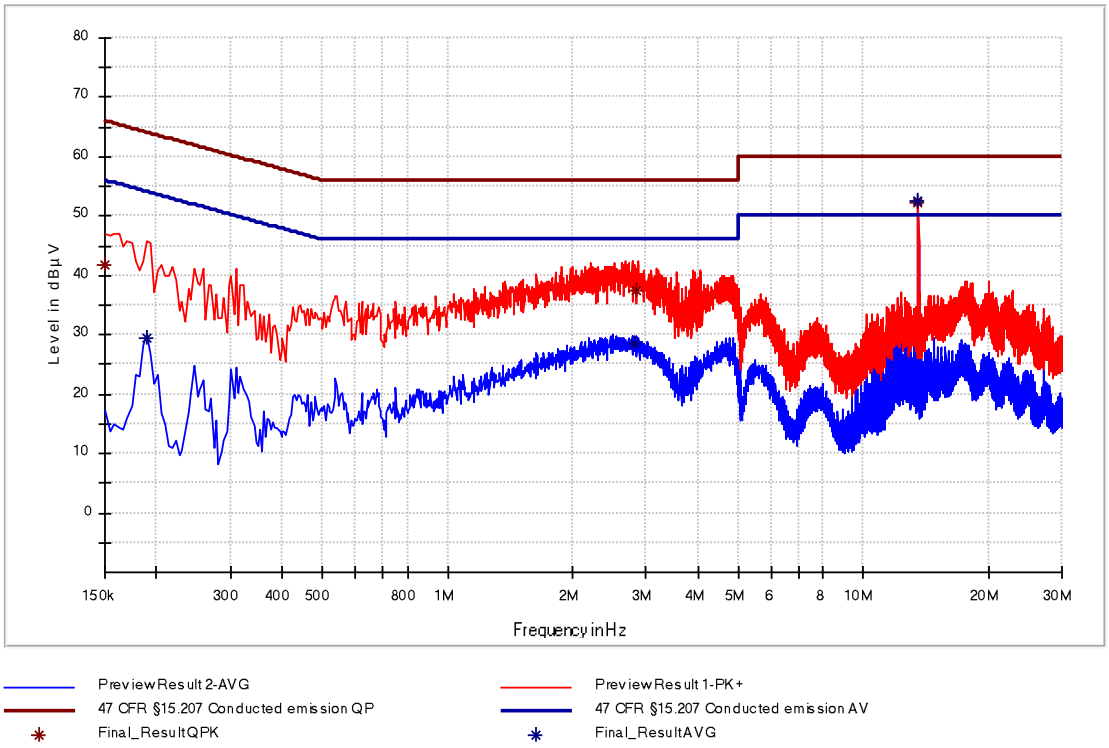


Figure 15: Chart of AC power-line conducted emissions test – with antenna 2063509:4502 large - phase N

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.150000	41.67	---	66.00	24.33	1000.0	9.000	N	GND	10.1
0.190000	---	29.30	54.04	24.74	1000.0	9.000	N	GND	10.1
2.813000	---	28.47	46.00	17.53	1000.0	9.000	N	GND	10.4
2.837000	37.35	---	56.00	18.65	1000.0	9.000	N	GND	10.5
13.561000	---	52.58	50.00	-2.58	1000.0	9.000	N	GND	12.0
13.561000	52.33	---	60.00	7.67	1000.0	9.000	N	GND	12.0

Table 18: Final results of AC power-line conducted emissions test – with antenna 2063509:4502 large - phase N

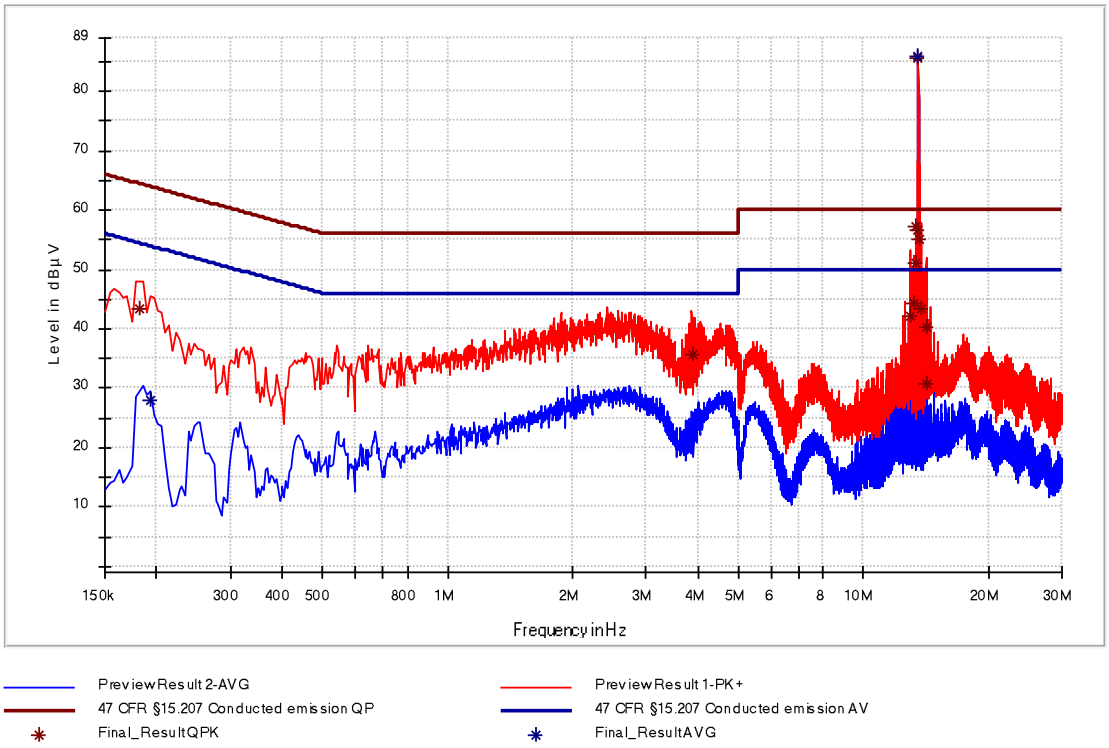


Figure 16: Chart of AC power-line conducted emissions test – with antenna 2063509:4502 small - phase L1

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.182000	43.37	---	64.39	21.02	1000.0	9.000	L1	GND	10.1
0.194000	---	28.12	53.86	25.74	1000.0	9.000	L1	GND	10.1
3.885000	35.59	---	56.00	20.41	1000.0	9.000	L1	GND	10.6
13.009000	42.27	---	60.00	17.73	1000.0	9.000	L1	GND	11.7
13.261000	44.18	---	60.00	15.82	1000.0	9.000	L1	GND	11.7
13.345000	57.31	---	60.00	2.69	1000.0	9.000	L1	GND	11.7
13.405000	51.00	---	60.00	9.00	1000.0	9.000	L1	GND	11.8
13.473000	56.60	---	60.00	3.40	1000.0	9.000	L1	GND	11.8
13.561000	---	85.94	50.00	-35.94	1000.0	9.000	L1	GND	11.8
13.561000	85.71	---	60.00	-25.71	1000.0	9.000	L1	GND	11.8
13.697000	54.96	---	60.00	5.04	1000.0	9.000	L1	GND	11.8
13.745000	43.40	---	60.00	16.60	1000.0	9.000	L1	GND	11.8
14.125000	40.31	---	60.00	19.69	1000.0	9.000	L1	GND	11.8
14.169000	30.84	---	60.00	29.16	1000.0	9.000	L1	GND	11.8

Table 19: Final results of AC power-line conducted emissions test – with antenna 2063509:4502 small - phase L1

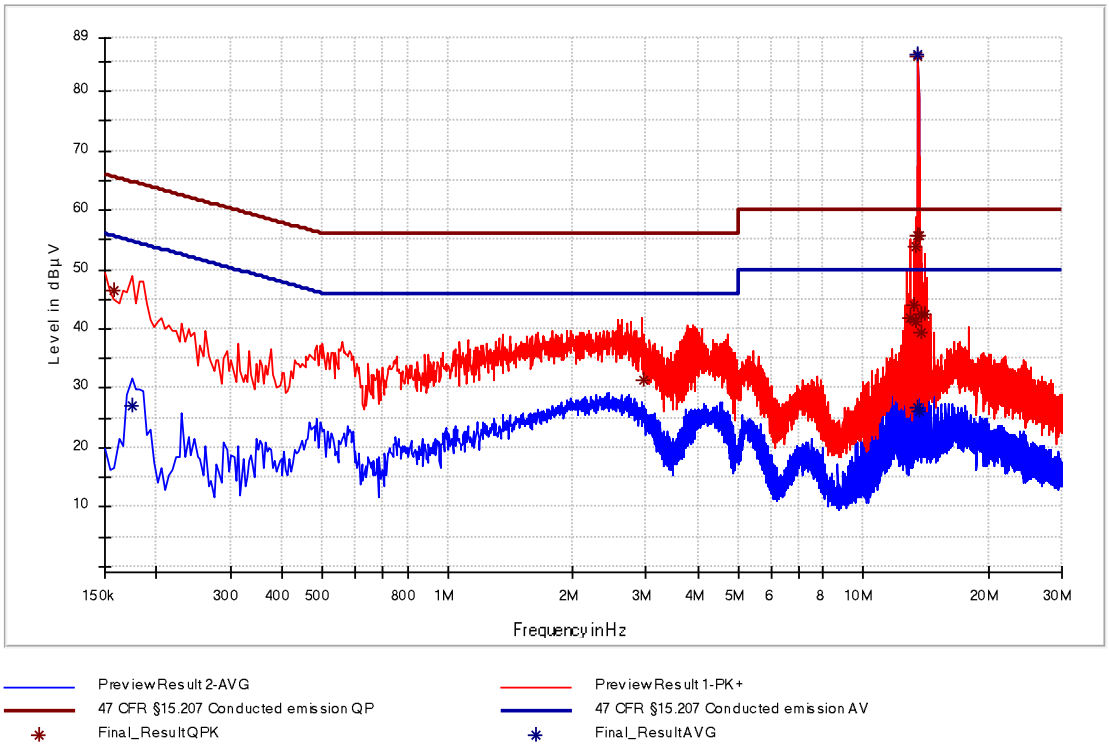


Figure 17: Chart of AC power-line conducted emissions test – with antenna 2063509:4502 small - phase N

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.158000	46.43	---	65.57	19.14	1000.0	9.000	N	GND	10.1
0.174000	---	27.07	54.77	27.70	1000.0	9.000	N	GND	10.1
2.957000	31.46	---	56.00	24.54	1000.0	9.000	N	GND	10.5
12.997000	41.82	---	60.00	18.18	1000.0	9.000	N	GND	11.9
13.289000	43.85	---	60.00	16.15	1000.0	9.000	N	GND	11.9
13.317000	41.17	---	60.00	18.83	1000.0	9.000	N	GND	11.9
13.417000	53.93	---	60.00	6.07	1000.0	9.000	N	GND	12.0
13.433000	55.66	---	60.00	4.34	1000.0	9.000	N	GND	12.0
13.505000	---	26.74	50.00	23.26	1000.0	9.000	N	GND	12.0
13.561000	---	86.28	50.00	-36.28	1000.0	9.000	N	GND	12.0
13.561000	86.06	---	60.00	-26.06	1000.0	9.000	N	GND	12.0
13.685000	55.74	---	60.00	4.26	1000.0	9.000	N	GND	12.0
13.685000	---	26.19	50.00	23.81	1000.0	9.000	N	GND	12.0
13.761000	42.51	---	60.00	17.49	1000.0	9.000	N	GND	12.0
13.813000	39.46	---	60.00	20.54	1000.0	9.000	N	GND	12.0
14.057000	42.34	---	60.00	17.66	1000.0	9.000	N	GND	12.0

Table 20: Final results of AC power-line conducted emissions test – with antenna 2063509:4502 small - phase N

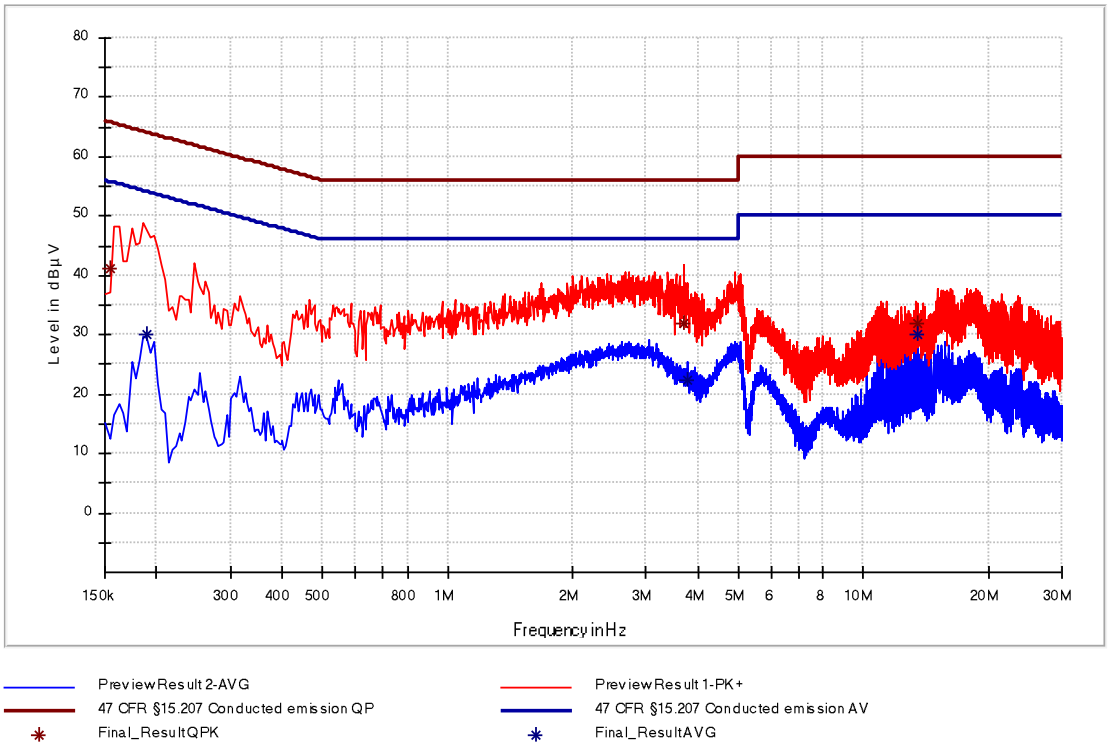


Figure 18: Chart of AC power-line conducted emissions test – with antenna port terminated - phase L1

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.154000	41.08	---	65.78	24.70	1000.0	9.000	L1	GND	10.1
0.190000	---	30.21	54.04	23.83	1000.0	9.000	L1	GND	10.1
3.681000	31.80	---	56.00	24.20	1000.0	9.000	L1	GND	10.6
3.769000	---	22.44	46.00	23.56	1000.0	9.000	L1	GND	10.6
13.545000	---	30.14	50.00	19.86	1000.0	9.000	L1	GND	11.8
13.549000	32.04	---	60.00	27.96	1000.0	9.000	L1	GND	11.8

Table 21: Final results of AC power-line conducted emissions test – with antenna port terminated-phase L1

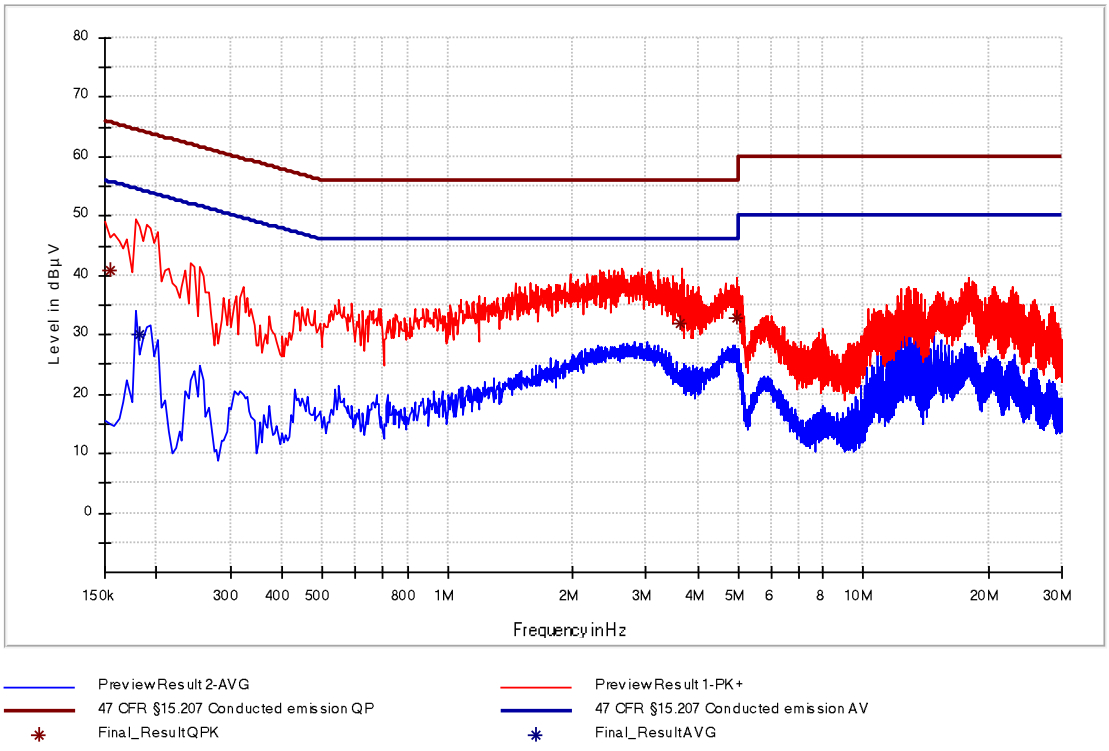


Figure 19: Chart of AC power-line conducted emissions test – with antenna port terminated - phase N

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	PE	Corr. (dB)
0.154000	40.81	---	65.78	24.97	1000.0	9.000	N	GND	10.1
0.182000	---	30.17	54.39	24.22	1000.0	9.000	N	GND	10.1
3.637000	31.89	---	56.00	24.11	1000.0	9.000	N	GND	10.6
4.985000	32.78	---	56.00	23.22	1000.0	9.000	N	GND	10.9

Table 22: Final results of AC power-line conducted emissions test – with antenna port terminated-phase N

6.2 20 dB bandwidth

Section(s) in 47 CFR Part 15: Requirement(s): 15.215(c)
Reference(s): ANSI C63.10 , clause 6.9

Performed by:	Andreas Menacher	Date(s) of test:	April 29, 2019
Climatic conditions:	Ambient temperature 24 °C	Relative humidity 34 %	Barometric pressure 976 hPa
Result[8]:	☒ Test passed	☐ Test not passed	

6.2.1 Test equipment

	Type	*Designation*	*Manufacturer*	*Inventory no.*
☒	EMI test receiver (CDC)	ESCI 3	Rohde & Schwarz	E00552
☐	EMI test receiver (OATS)	ESCI 3	Rohde & Schwarz	E00001
☐	EMI test receiver	ESR 7	Rohde & Schwarz	E00739
☐	EMI test receiver	ESU 26	Rohde & Schwarz	W00002
☐	EMI test receiver	ESW 44	Rohde & Schwarz	E00895
☒	Field probe	RF-R 400-1	Langer EMV-Technik	E00270

[8] For information about measurement uncertainties see page 92.

6.2.2 Limits

According to §15.215(c), intentional radiators operating under the alternative provisions to the general emission limits must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated. The requirement to contain the designated bandwidth of the emission within the specified frequency band includes the effects from frequency sweeping, frequency hopping and other modulation techniques that may be employed as well as the frequency stability of the transmitter over expected variations in temperature and supply voltage. If a frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

6.2.3 Test procedure

The 20 dB bandwidth is measured using the test procedure as described in clause 5.6.1.

6.2.4 Test results

Remark: The 20 dB bandwidth measurements were performed without tag, because this was the worst case.

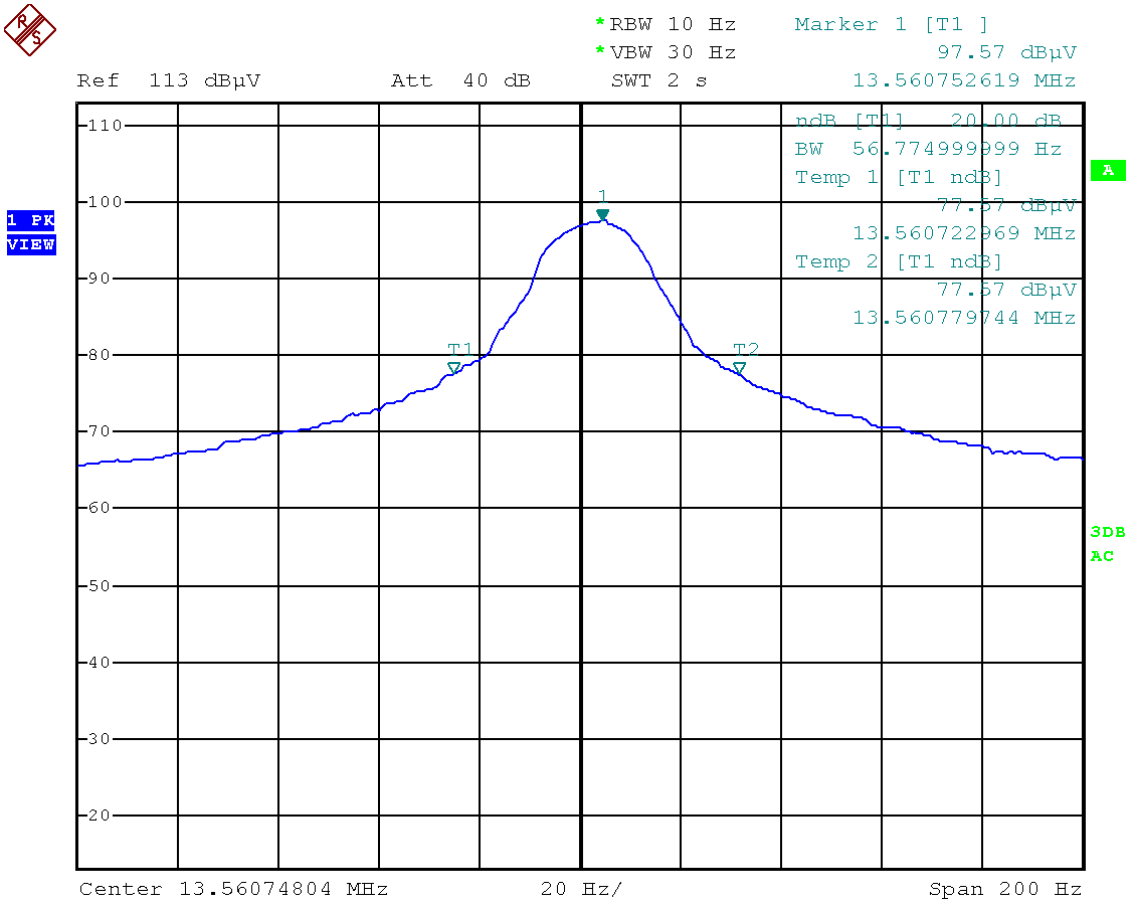


Figure 20: Chart of 20 dB bandwidth with antenna 2063510:4498

20 dB bandwidth	*Band edge left*		*Band edge right*		*Result*
[kHz]	*Frequency [MHz]*	*Limit [MHz]*	*Frequency [MHz]*	*Limit [MHz]*	
0.056	13.560722	13.553000	13.560779	13.567000	Recorded

Table 23: Results of 20 dB bandwidth test 2063510:4498

$f_{assigned}$ (MHz)	Index	f_{-20dB} (MHz)	Δf_T (kHz)	Δf_U (kHz)	$f_{-20dB(T, U)}$ (MHz)	Limit (MHz)	Margin (kHz)	Result
13.560752	low	13.560722	0.044	0.000	13,560678	13.553000	7.678	Passed
	high	13.560779	0.082	0.030	13.560891	13.567000	6.109	Passed
	Bandwidth	0.056 kHz			0.213 kHz			

with:
$f_{-20dB(low)}$ = lower frequency in MHz where emission is at least 20 dB below the carrier
$f_{-20dB(high)}$ = upper frequency in MHz where emission is at least 20 dB below the carrier
$f_{assigned}$ = assigned frequency in kHz
$\Delta f_{T(low)}$ = maximum absolute value of negative frequency offset to frequency at nominal conditions caused by temperature variation in kHz
$\Delta f_{U(low)}$ = maximum absolute value of negative frequency offset to frequency at nominal conditions caused by voltage variation in kHz
$\Delta f_{T(high)}$ = maximum absolute value of positive frequency offset to frequency at nominal conditions caused by temperature variation in kHz
$\Delta f_{U(high)}$ = maximum absolute value of positive frequency offset to frequency at nominal conditions caused by voltage variation in kHz
$\Delta f_{volt(high)}$ = maximum absolute value of positive frequency offset to frequency at nominal conditions caused by voltage variation in kHz
$f_{-20dB(T, U)}$ = frequency in MHz where emission is at least 20 dB below the carrier, including offset caused by variations of temperature and supply voltage as recorded in clause 5.8

Measured -20 dB emission bandwidth:
At nominal conditions: 0.056 kHz
Including variations in temperature and supply voltage: 0.213 kHz

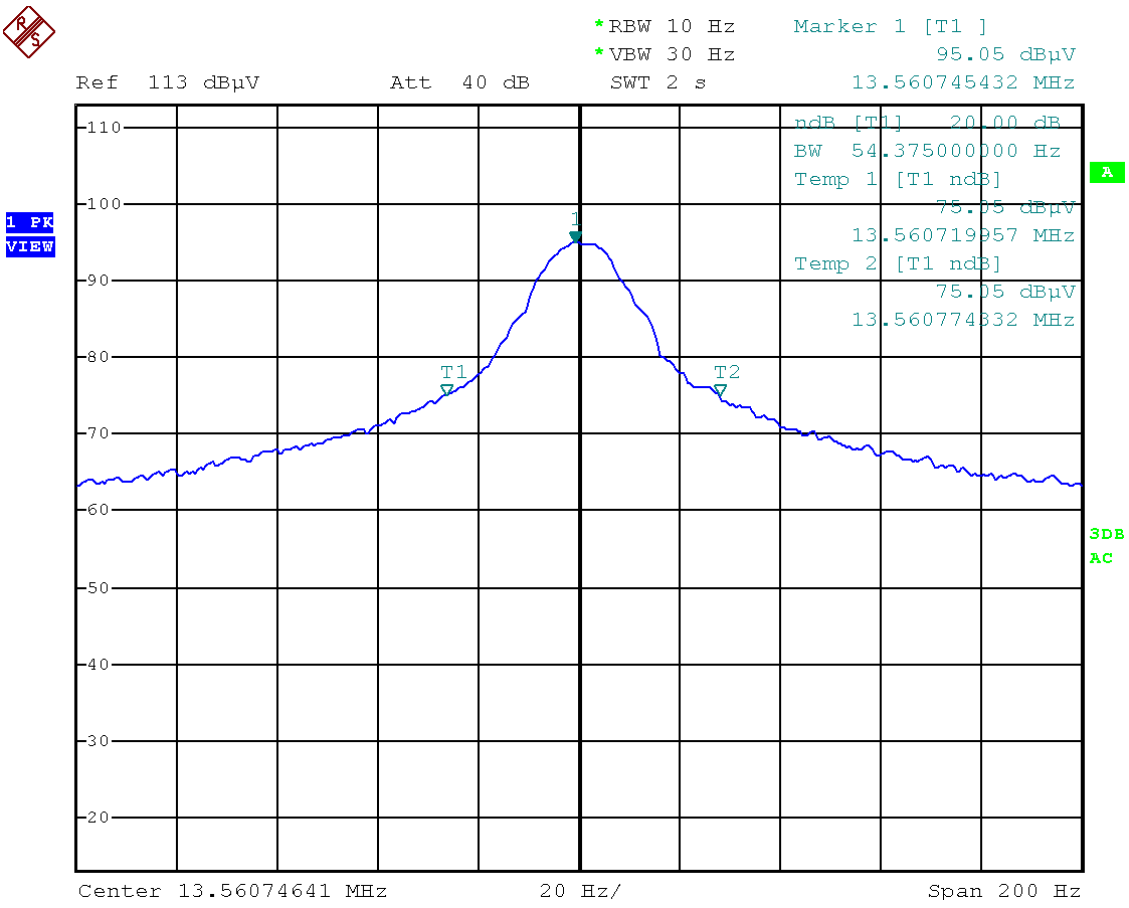


Figure 21: Chart of 20 dB bandwidth with antenna 2063511:4499

20 dB bandwidth	*Band edge left*		*Band edge right*		*Result*
[kHz]	*Frequency [MHz]*	*Limit [MHz]*	*Frequency [MHz]*	*Limit [MHz]*	
0.054	13.560719	13.553000	13.560774	13.567000	Recorded

Table 24: Results of 20 dB bandwidth tests with antenna 2063511:4499

$f_{assigned}$ (MHz)	Index	f_{-20dB} (MHz)	Δf_T (kHz)	Δf_U (kHz)	$f_{-20dB(T, U)}$ (MHz)	Limit (MHz)	Margin (kHz)	Result
13.560745	low	13.560719	0.037	0000	13,560682	13.553000	7.682	Passed
	high	13.560774	0.092	0.034	13.560900	13.567000	6.100	Passed
	Bandwidth	0.054 kHz			0.218 kHz			

with:
$f_{-20dB(low)}$ = lower frequency in MHz where emission is at least 20 dB below the carrier
$f_{-20dB(high)}$ = upper frequency in MHz where emission is at least 20 dB below the carrier
$f_{assigned}$ = assigned frequency in kHz
$\Delta f_{T(low)}$ = maximum absolute value of negative frequency offset to frequency at nominal conditions caused by temperature variation in kHz
$\Delta f_{U(low)}$ = maximum absolute value of negative frequency offset to frequency at nominal conditions caused by voltage variation in kHz
$\Delta f_{T(high)}$ = maximum absolute value of positive frequency offset to frequency at nominal conditions caused by temperature variation in kHz
$\Delta f_{U(high)}$ = maximum absolute value of positive frequency offset to frequency at nominal conditions caused by voltage variation in kHz
$\Delta f_{volt(high)}$ = maximum absolute value of positive frequency offset to frequency at nominal conditions caused by voltage variation in kHz
$f_{-20dB(T, U)}$ = frequency in MHz where emission is at least 20 dB below the carrier, including offset caused by variations of temperature and supply voltage as recorded in clause 5.8

Measured -20 dB emission bandwidth:
At nominal conditions: 0.054 kHz
Including variations in temperature and supply voltage: 0.218 kHz

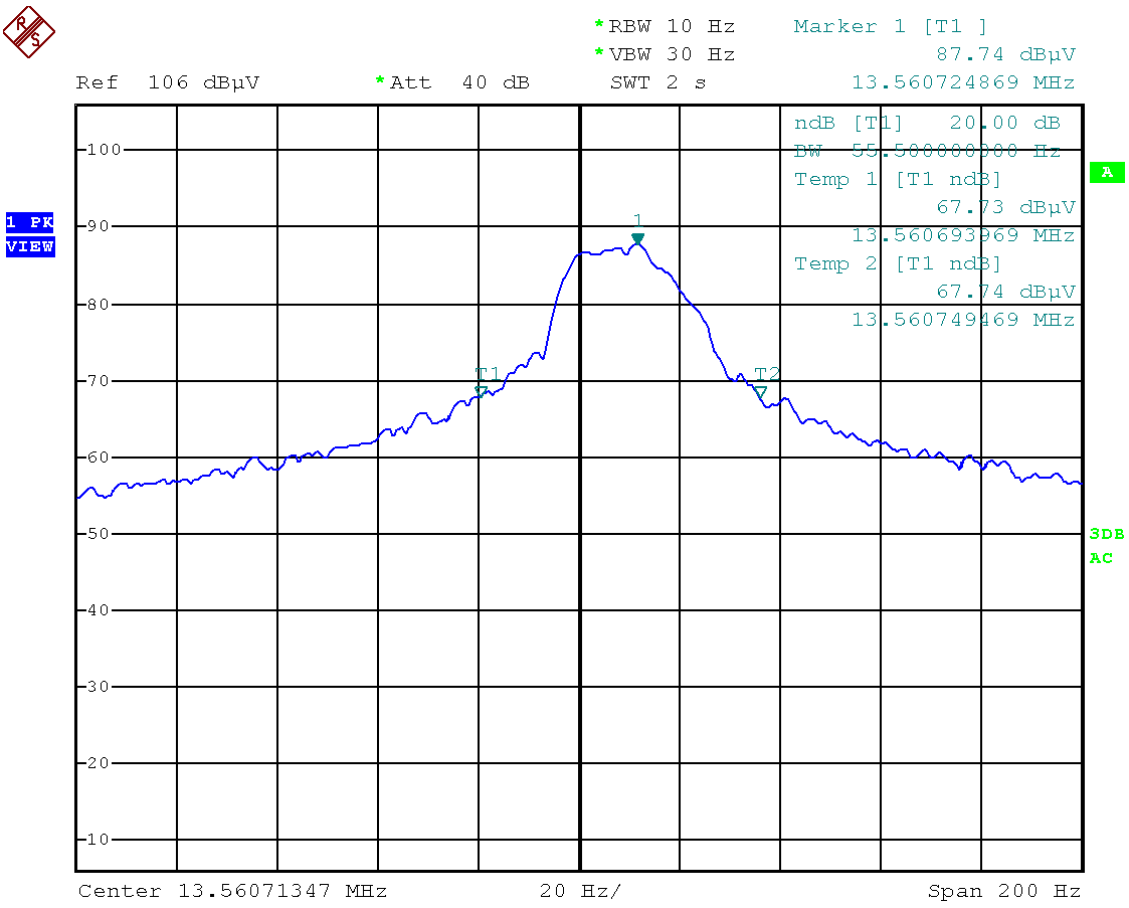


Figure 22: Chart of 20 dB bandwidth with antenna 2063508:4500 large

20 dB bandwidth	*Band edge left*		*Band edge right*		*Result*
	Frequency	*Limit*	*Frequency*	*Limit*	
[kHz]	*[MHz]*	*[MHz]*	*[MHz]*	*[MHz]*	
0.055	13.560693	13.553000	13.560749	13.567000	Recorded

Table 25: Results of 20 dB bandwidth test with antenna 2063508:4500 large

$f_{assigned}$ (MHz)	Index	f_{-20dB} (MHz)	Δf_T (kHz)	Δf_U (kHz)	$f_{-20dB(T, U)}$ (MHz)	Limit (MHz)	Margin (kHz)	Result
13.560724	low	13.560693	0.021	0.008	13,560664	13.553000	7.664	Passed
	high	13.560749	0.109	0000	13.560858	13.567000	6.142	Passed
	Bandwidth	0.055 kHz			0.194 kHz			

with:
$f_{-20dB(low)}$ = lower frequency in MHz where emission is at least 20 dB below the carrier
$f_{-20dB(high)}$ = upper frequency in MHz where emission is at least 20 dB below the carrier
$f_{assigned}$ = assigned frequency in kHz
$\Delta f_{T(low)}$ = maximum absolute value of negative frequency offset to frequency at nominal conditions caused by temperature variation in kHz
$\Delta f_{U(low)}$ = maximum absolute value of negative frequency offset to frequency at nominal conditions caused by voltage variation in kHz
$\Delta f_{T(high)}$ = maximum absolute value of positive frequency offset to frequency at nominal conditions caused by temperature variation in kHz
$\Delta f_{U(high)}$ = maximum absolute value of positive frequency offset to frequency at nominal conditions caused by voltage variation in kHz
$\Delta f_{volt(high)}$ = maximum absolute value of positive frequency offset to frequency at nominal conditions caused by voltage variation in kHz
$f_{-20dB(T, U)}$ = frequency in MHz where emission is at least 20 dB below the carrier, including offset caused by variations of temperature and supply voltage as recorded in clause 5.8

Measured -20 dB emission bandwidth:
At nominal conditions: 0.055 kHz
Including variations in temperature and supply voltage: 0.194 kHz

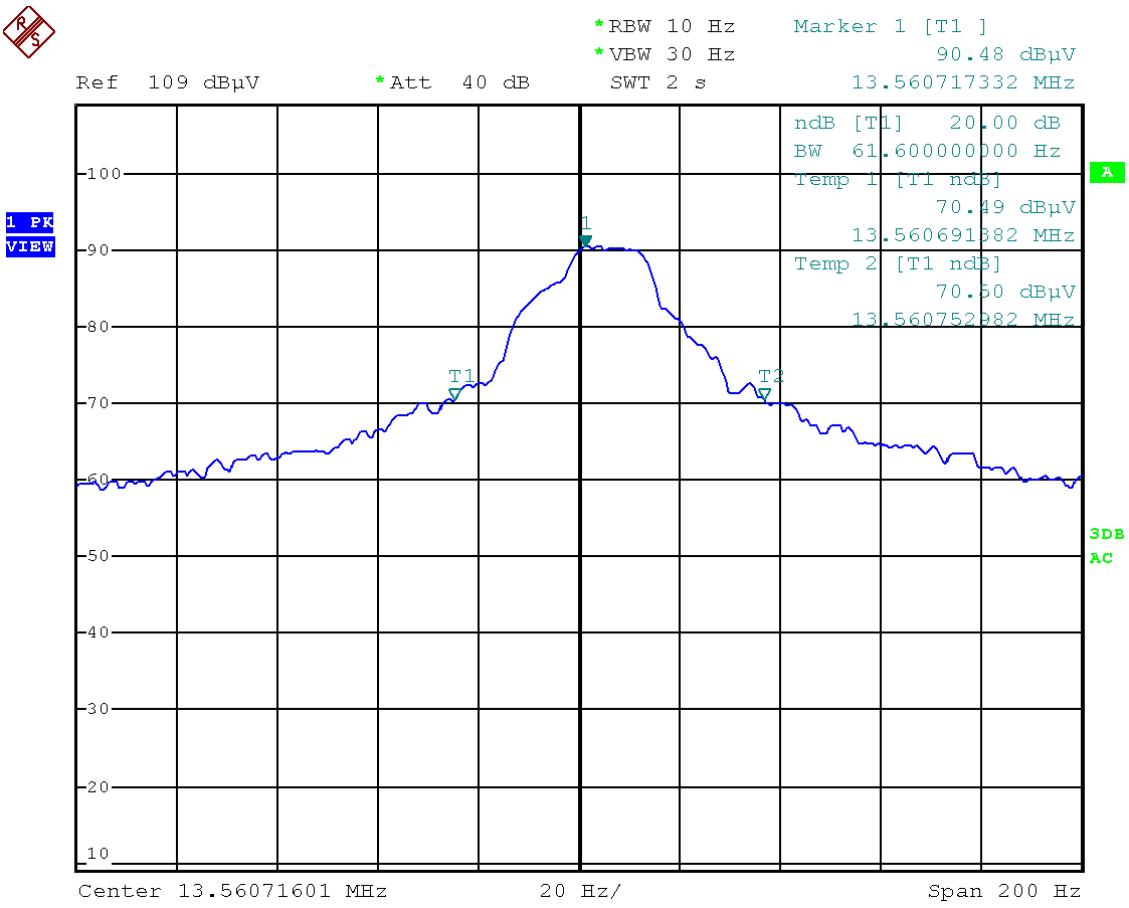


Figure 23: Chart of 20 dB bandwidth with antenna 2063508:4500 small

20 dB bandwidth	*Band edge left*		*Band edge right*		*Result*
	Frequency	*Limit*	*Frequency*	*Limit*	
[kHz]	*[MHz]*	*[MHz]*	*[MHz]*	*[MHz]*	
0.061	13.560691	13.553000	13.560752	13.567000	Recorded

Table 26: Results of 20 dB bandwidth tests with antenna 2063508:4500 small

$f_{assigned}$ (MHz)	Index	f_{-20dB} (MHz)	Δf_T (kHz)	Δf_U (kHz)	$f_{-20dB(T, U)}$ (MHz)	Limit (MHz)	Margin (kHz)	Result
13.560717	low	13.560691	0.010	0000	13,560681	13.553000	7.681	Passed
	high	13.560752	0.120	0.024	13.560896	13.567000	6.104	Passed
	Bandwidth	0.061			0.215 kHz			

with:
$f_{-20dB(low)}$ = lower frequency in MHz where emission is at least 20 dB below the carrier
$f_{-20dB(high)}$ = upper frequency in MHz where emission is at least 20 dB below the carrier
$f_{assigned}$ = assigned frequency in kHz
$\Delta f_{T(low)}$ = maximum absolute value of negative frequency offset to frequency at nominal conditions caused by temperature variation in kHz
$\Delta f_{U(low)}$ = maximum absolute value of negative frequency offset to frequency at nominal conditions caused by voltage variation in kHz
$\Delta f_{T(high)}$ = maximum absolute value of positive frequency offset to frequency at nominal conditions caused by temperature variation in kHz
$\Delta f_{U(high)}$ = maximum absolute value of positive frequency offset to frequency at nominal conditions caused by voltage variation in kHz
$\Delta f_{volt(high)}$ = maximum absolute value of positive frequency offset to frequency at nominal conditions caused by voltage variation in kHz
$f_{-20dB(T, U)}$ = frequency in MHz where emission is at least 20 dB below the carrier, including offset caused by variations of temperature and supply voltage as recorded in clause 5.8

Measured -20 dB emission bandwidth:
At nominal conditions: 0.061 kHz
Including variations in temperature and supply voltage: 0.0215 kHz

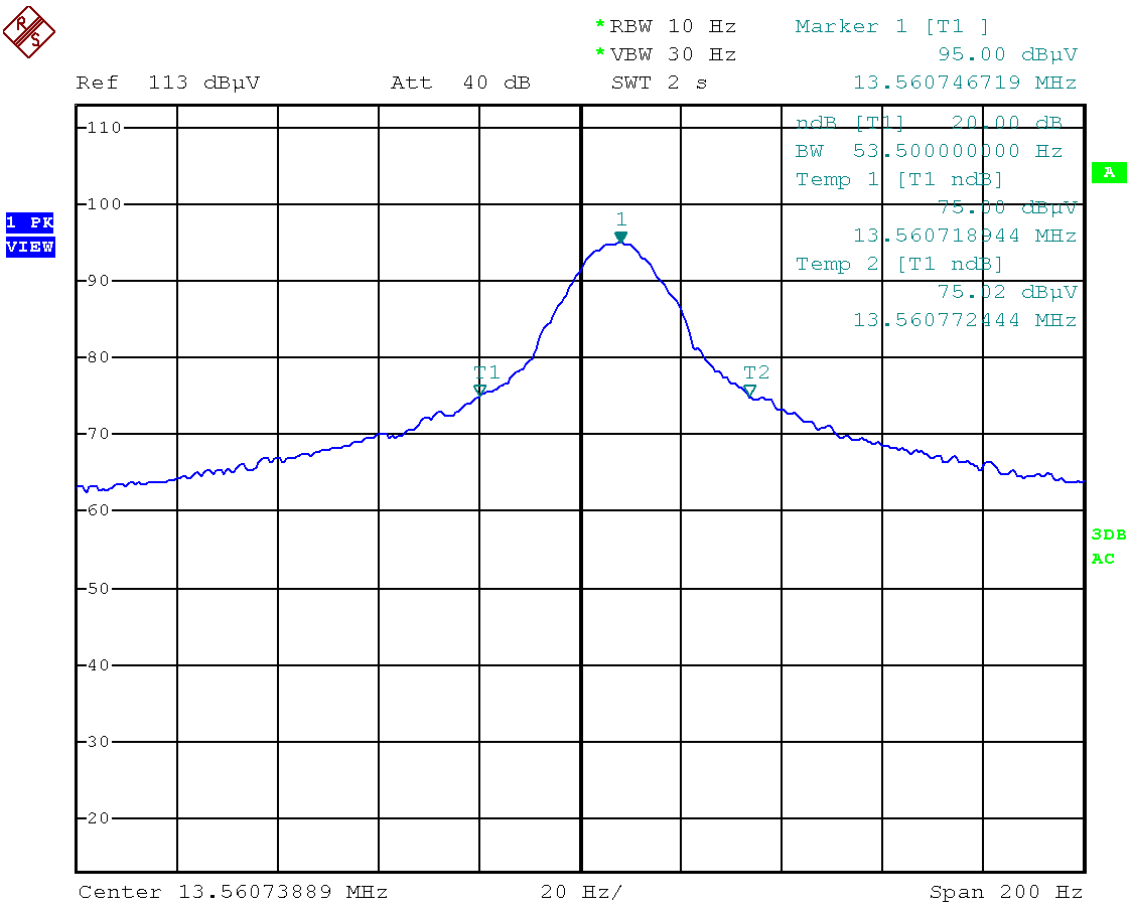


Figure 24: Chart of 20 dB bandwidth with antenna 2063509:4502 large

20 dB bandwidth	*Band edge left*		*Band edge right*		*Result*
	Frequency	*Limit*	*Frequency*	*Limit*	
[kHz]	*[MHz]*	*[MHz]*	*[MHz]*	*[MHz]*	
0.053	13.560718	13.553000	13.560772	13.567	Recorded

Table 27: Results of 20 dB bandwidth tests with antenna 2063509:4502 large

$f_{assigned}$ (MHz)	Index	f_{-20dB} (MHz)	Δf_T (kHz)	Δf_U (kHz)	$f_{-20dB(T, U)}$ (MHz)	Limit (MHz)	Margin (kHz)	Result
13.560746	low	13.560718	0.039	0000	13.560679	13.553000	7.679	Passed
	high	13.560772	0.091	0.041	13.560904	13.567000	6.096	Passed
	Bandwidth	0.053			0.225 kHz			

with:
$f_{-20dB(low)}$ = lower frequency in MHz where emission is at least 20 dB below the carrier
$f_{-20dB(high)}$ = upper frequency in MHz where emission is at least 20 dB below the carrier
$f_{assigned}$ = assigned frequency in kHz
$\Delta f_{T(low)}$ = maximum absolute value of negative frequency offset to frequency at nominal conditions caused by temperature variation in kHz
$\Delta f_{U(low)}$ = maximum absolute value of negative frequency offset to frequency at nominal conditions caused by voltage variation in kHz
$\Delta f_{T(high)}$ = maximum absolute value of positive frequency offset to frequency at nominal conditions caused by temperature variation in kHz
$\Delta f_{U(high)}$ = maximum absolute value of positive frequency offset to frequency at nominal conditions caused by voltage variation in kHz
$\Delta f_{volt(high)}$ = maximum absolute value of positive frequency offset to frequency at nominal conditions caused by voltage variation in kHz
$f_{-20dB(T, U)}$ = frequency in MHz where emission is at least 20 dB below the carrier, including offset caused by variations of temperature and supply voltage as recorded in clause 5.8

Measured -20 dB emission bandwidth:
At nominal conditions: 0.053 kHz
Including variations in temperature and supply voltage: 0.225 kHz

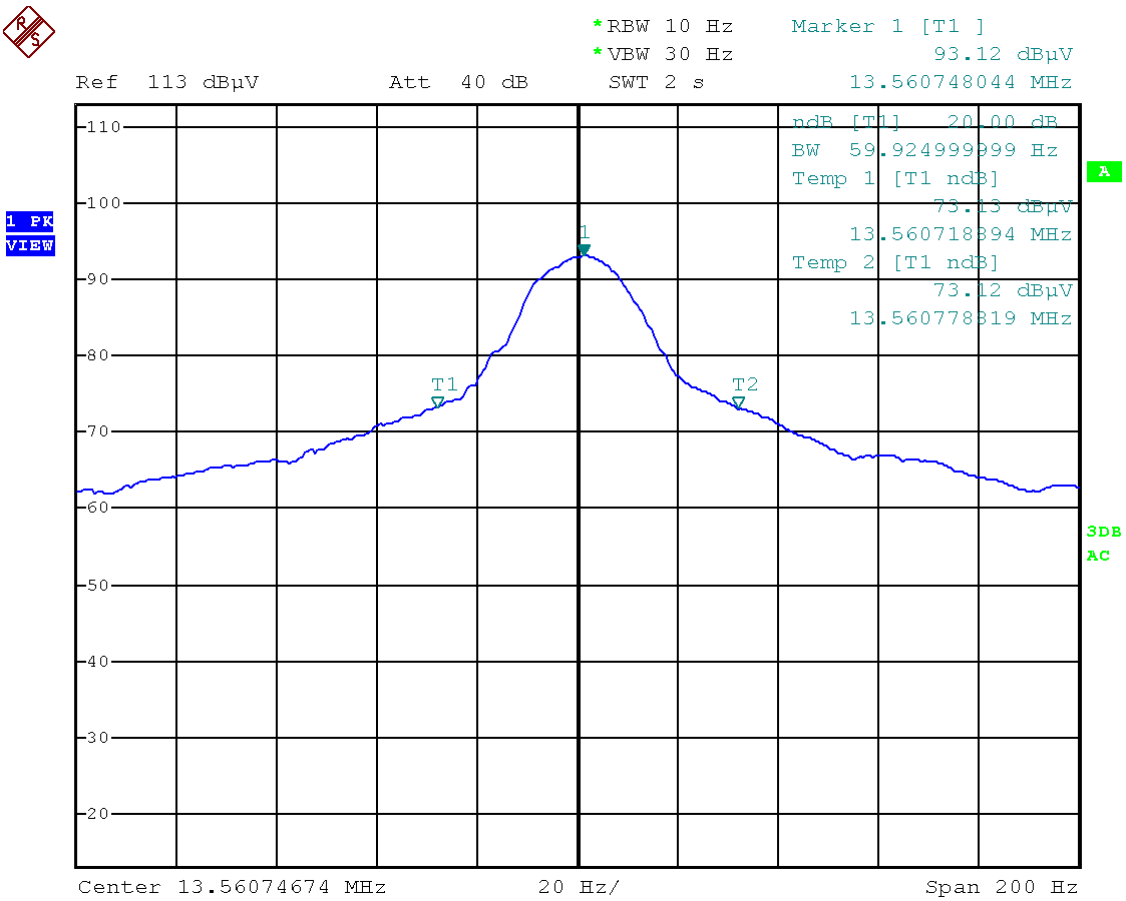


Figure 25: Chart of 20 dB bandwidth with antenna 2063509:4502 small

20 dB bandwidth	*Band edge left*		*Band edge right*		*Result*
	Frequency	*Limit*	*Frequency*	*Limit*	
[kHz]	*[MHz]*	*[MHz]*	*[MHz]*	*[MHz]*	
0.059	13.560718	13.553000	13.560778	13.567	Recorded

Table 28: Results of 20 dB bandwidth test with antenna 2063509:4502 small

$f_{assigned}$ (MHz)	Index	f_{-20dB} (MHz)	Δf_T (kHz)	Δf_U (kHz)	$f_{-20dB(T, U)}$ (MHz)	Limit (MHz)	Margin (kHz)	Result
13.560748	low	13.560718	0.045	0000	13.560673	13.553000	7.673	Passed
	high	13.560778	0.085	0.031	13.560894	13.567000	6106	Passed
	Bandwidth	0.059 kHz			0.221 kHz			

with:
$f_{-20dB(low)}$ = lower frequency in MHz where emission is at least 20 dB below the carrier
$f_{-20dB(high)}$ = upper frequency in MHz where emission is at least 20 dB below the carrier
$f_{assigned}$ = assigned frequency in kHz
$\Delta f_{T(low)}$ = maximum absolute value of negative frequency offset to frequency at nominal conditions caused by temperature variation in kHz
$\Delta f_{U(low)}$ = maximum absolute value of negative frequency offset to frequency at nominal conditions caused by voltage variation in kHz
$\Delta f_{T(high)}$ = maximum absolute value of positive frequency offset to frequency at nominal conditions caused by temperature variation in kHz
$\Delta f_{U(high)}$ = maximum absolute value of positive frequency offset to frequency at nominal conditions caused by voltage variation in kHz
$\Delta f_{volt(high)}$ = maximum absolute value of positive frequency offset to frequency at nominal conditions caused by voltage variation in kHz
$f_{-20dB(T, U)}$ = frequency in MHz where emission is at least 20 dB below the carrier, including offset caused by variations of temperature and supply voltage as recorded in clause 5.8

Measured -20 dB emission bandwidth:
At nominal conditions: 0.059 kHz
Including variations in temperature and supply voltage: 0.221 kHz

6.3 Occupied bandwidth

Section(s) in 47 CFR Part 15:	Requirement(s): Reference(s):	2.202(a) ANSI C63.10, clause 6.9
Section(s) in RSS:	Requirement(s): Reference(s):	RSS-Gen, section 6.7 ANSI C63.10, clause 6.9

Performed by:	Andreas Menacher	Date(s) of test:	April 29, 2019
Climatic conditions:	Ambient temperature 24 °C	Relative humidity 35 %	Barometric pressure 976 hPa
Result[9]:	☒ Test passed	☐ Test not passed	

6.3.1 Test equipment

	Type	*Designation*	*Manufacturer*	*Inventory no.*
☒	EMI test receiver (CDC)	ESCI 3	Rohde & Schwarz	E00552
☐	EMI test receiver (OATS)	ESCI 3	Rohde & Schwarz	E00001
☐	EMI test receiver	ESR 7	Rohde & Schwarz	E00739
☐	EMI test receiver	ESU 26	Rohde & Schwarz	W00002
☐	EMI test receiver	ESW 44	Rohde & Schwarz	E00895
☒	Field probe	RF-R 400-1	Langer EMV-Technik	E00270

[9] For information about measurement uncertainties see page 76.

6.3.2 Limits

Although there is no limit specified, the occupied bandwidth has to be recorded and reported.

6.3.3 Test procedure

The occupied bandwidth is measured using the test procedure as described in clause 5.6.2.

6.3.4 Test results

Remark: The occupied bandwidth measurement was performed without tag, because this was the worst case.

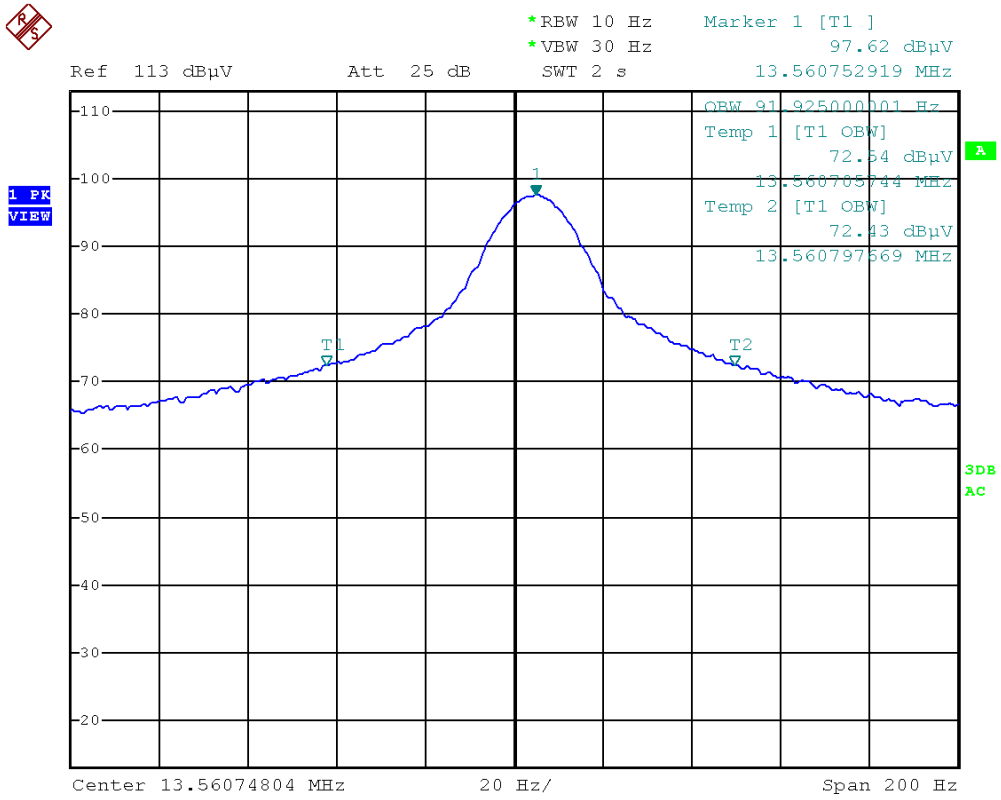


Figure 26: Chart of occupied bandwidth test with antenna 2063510:4498

99% bandwidth	*Band edge left*		*Band edge right*		*Result*
[kHz]	*Frequency [MHz]*	*Limit [MHz]*	*Frequency [MHz]*	*Limit [MHz]*	
0.091	13.560705	13.553000	13.560797	13.567000	Recorded

Table 29: Results of occupied bandwidth test with antenna 2063510:4498

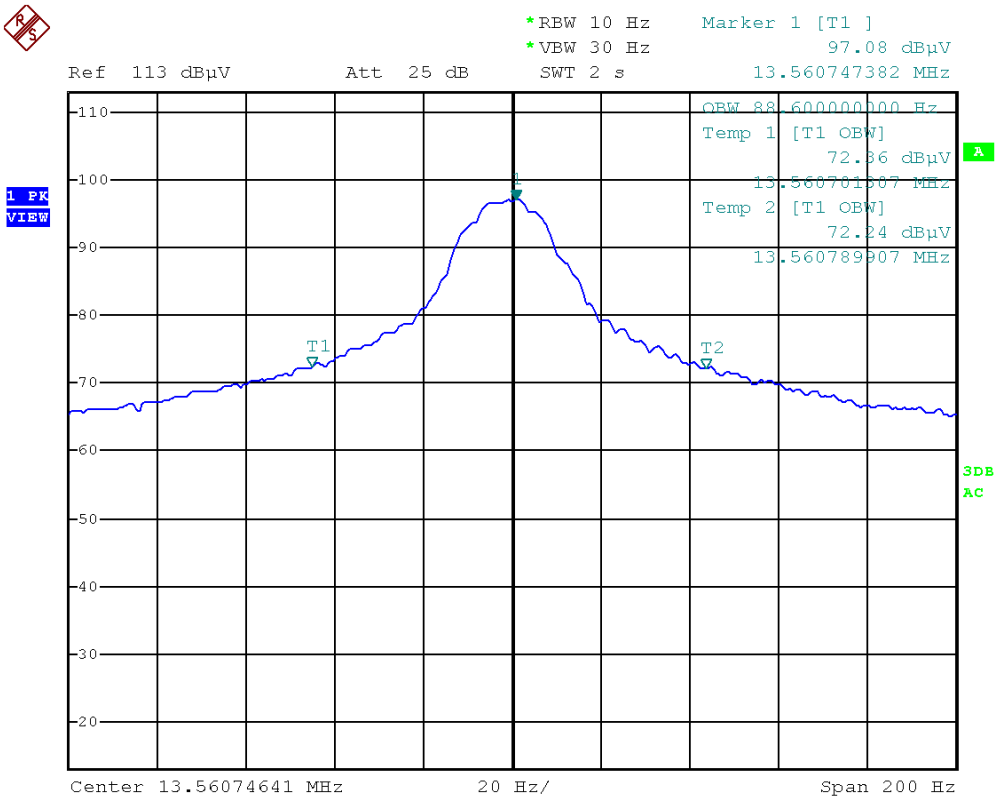


Figure 27: Chart of occupied bandwidth test with antenna 2063511:4499

99% bandwidth	*Band edge left*		*Band edge right*		*Result*
[kHz]	*Frequency [MHz]*	*Limit [MHz]*	*Frequency [MHz]*	*Limit [MHz]*	
0.088	13.560701	13.553000	13.560789	13.567000	Recorded

Table 30: Results of occupied bandwidth test with antenna 2063511:4499

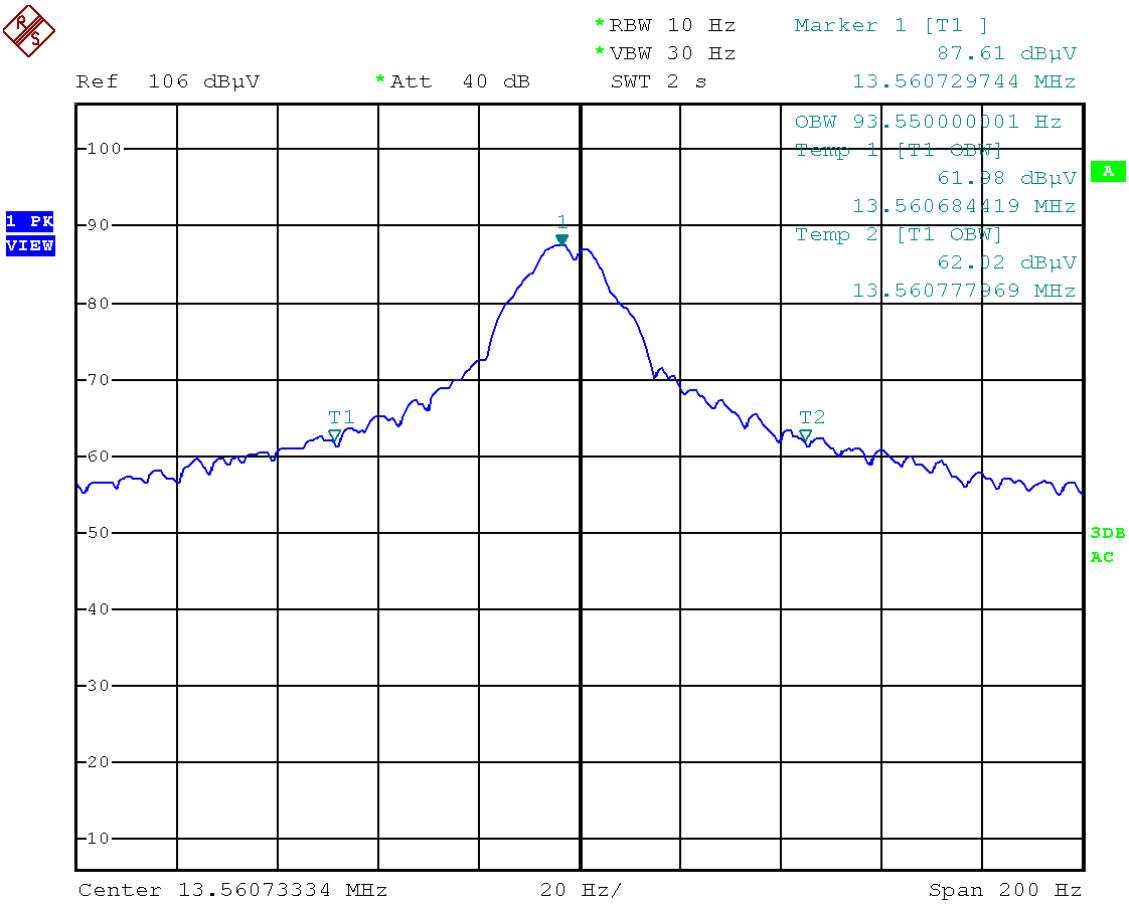


Figure 28: Chart of occupied bandwidth test with antenna 2063508:4500 large

99% bandwidth	*Band edge left*		*Band edge right*		*Result*
[kHz]	*Frequency [MHz]*	*Limit [MHz]*	*Frequency [MHz]*	*Limit [MHz]*	
0.093	13.560684	13.553000	13.560777	13.567000	Recorded

Table 31: Results of occupied bandwidth test with antenna 2063508:4500 large

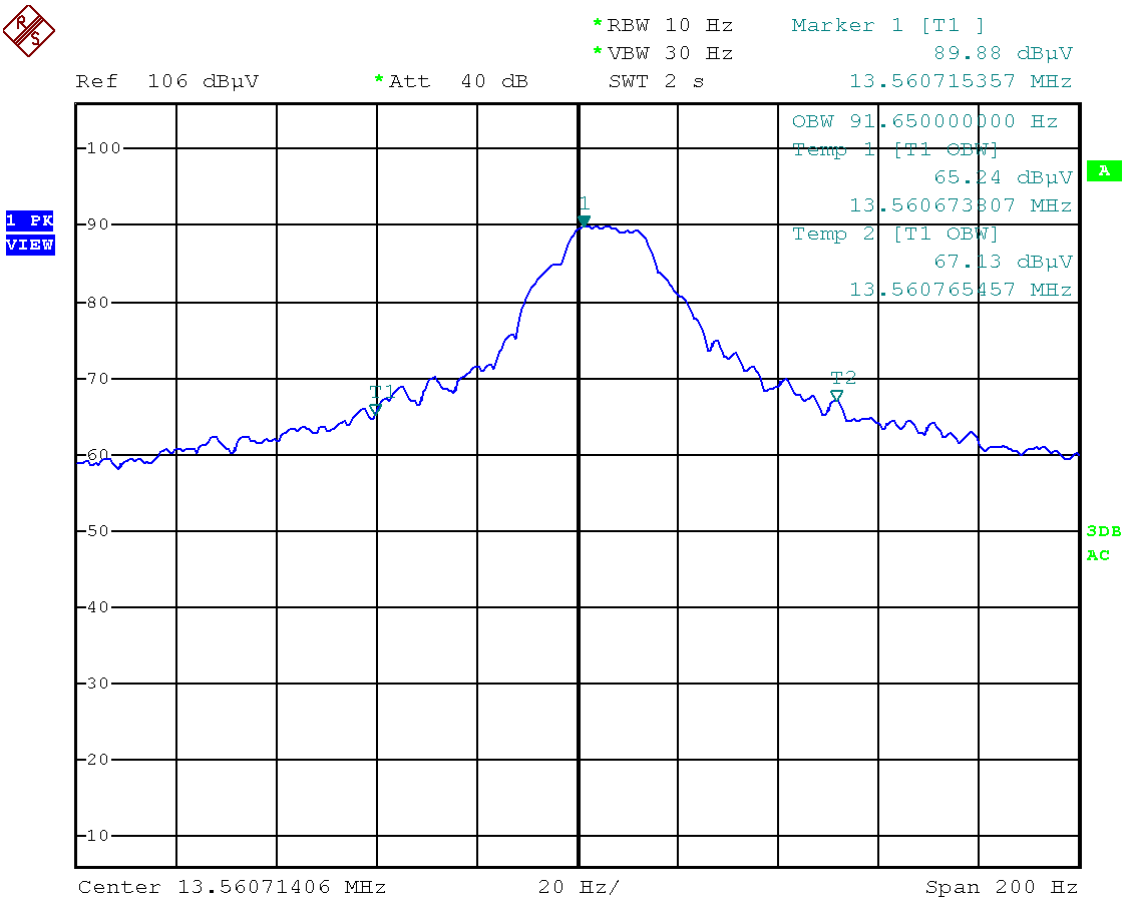


Figure 29: Chart of occupied bandwidth test with antenna 2063508:4500 small

99% bandwidth	*Band edge left*		*Band edge right*		*Result*
[kHz]	*Frequency [MHz]*	*Limit [MHz]*	*Frequency [MHz]*	*Limit [MHz]*	
0.091	13.560673	13.553000	13.560765	13.567000	Recorded

Table 32: Results of occupied bandwidth test with antenna 2063508:4500 small

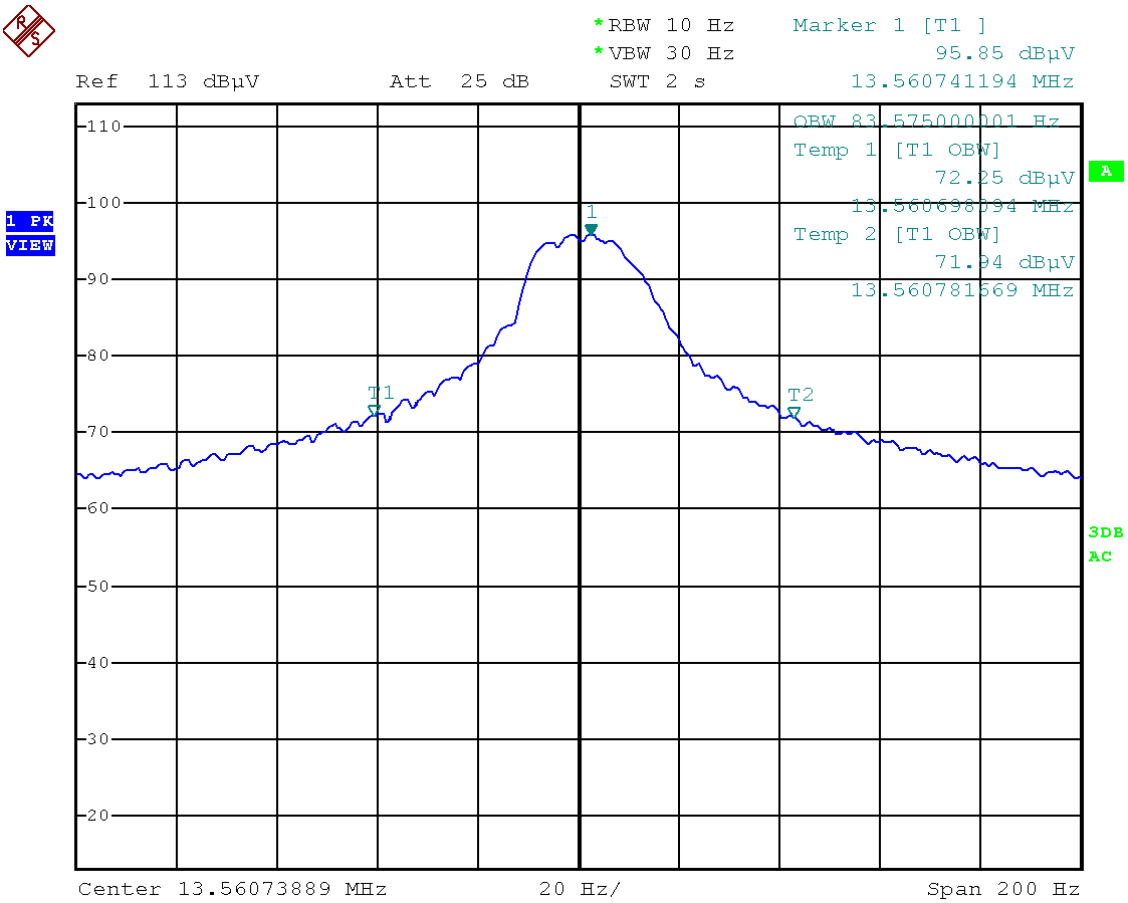


Figure 30: Chart of occupied bandwidth test with antenna 2063509:4502 large

99% bandwidth	*Band edge left*		*Band edge right*		*Result*
[kHz]	*Frequency [MHz]*	*Limit [MHz]*	*Frequency [MHz]*	*Limit [MHz]*	
0.083	13.560698	13.553000	13.560781	13.567000	Recorded

Table 33: Results of occupied bandwidth test with antenna 2063509:4502 large

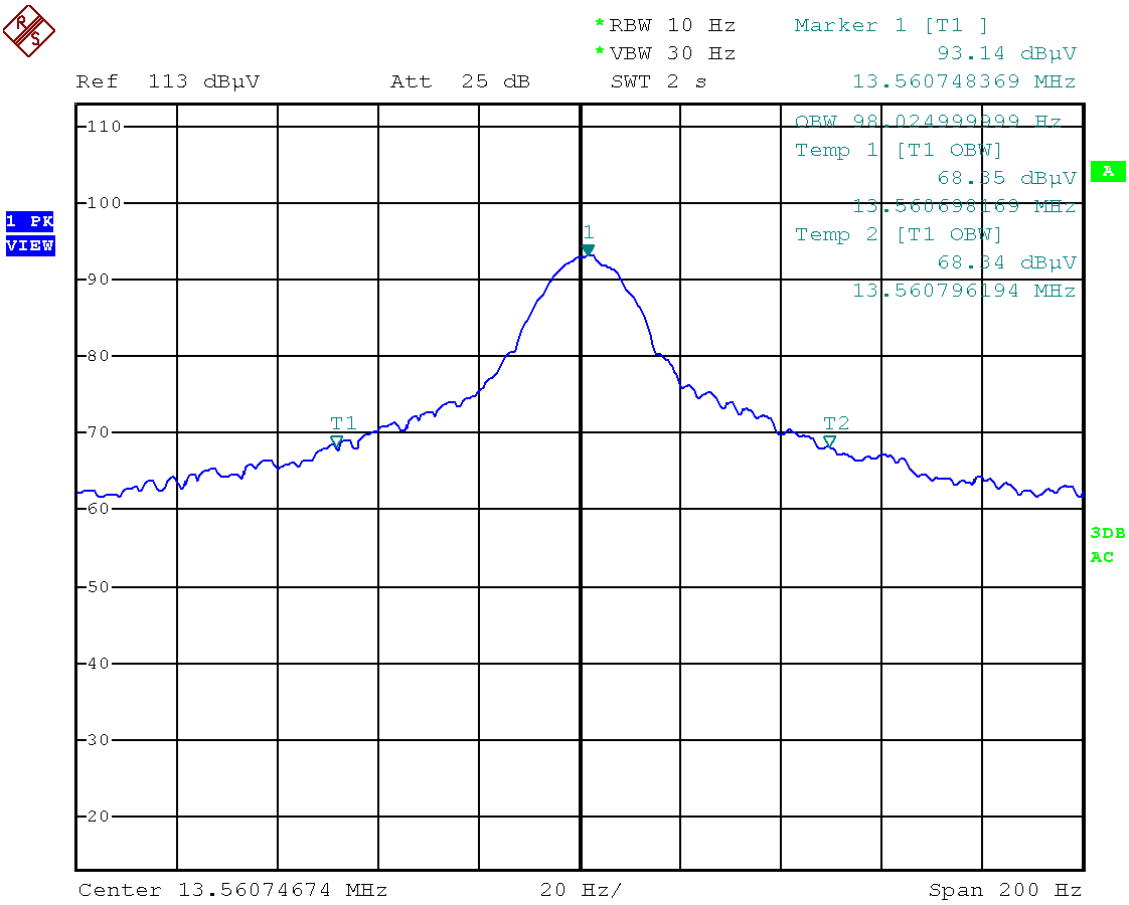


Figure 31: Chart of occupied bandwidth test with antenna 2063509:4502 small

99% bandwidth	*Band edge left*		*Band edge right*		*Result*
[kHz]	*Frequency [MHz]*	*Limit [MHz]*	*Frequency [MHz]*	*Limit [MHz]*	
0.098	13.560698	13.553000	13.560796	13.567000	Recorded

Table 34: Results of occupied bandwidth test with antenna 2063509:4502 small

6.4 Operation within the band 13.110 MHz – 14.010 MHz

Section(s) in 47 CFR Part 15:	Requirement(s):	15.225 (a)-(e)
	Reference(s):	ANSI C63.10, section 6.4
Section(s) in RSS:	Requirement(s):	RSS-210, section B.6
	Reference(s):	ANSI C63.10, section 6.4

Performed by:	Andreas Menacher	Date(s) of test:	April 8, 2019
Climatic conditions:	Ambient temperature 23 °C	Relative humidity 34 %	Barometric pressure 976 hPa
Result[10]:	☒ Test passed	☐ Test not passed	

6.4.1 Test equipment

	Type	*Designation*	*Manufacturer*	*Inventory no.*
☒	Compact Diagnostic Chamber (CDC)	VK041.0174	Albatross Projects	E00026
☐	EMI test receiver (CDC)	ESCI 3	Rohde & Schwarz	E00552
☐	EMI test receiver (OATS)	ESCI 3	Rohde & Schwarz	E00001
☒	EMI test receiver	ESR 7	Rohde & Schwarz	E00739
☐	EMI test receiver	ESU 26	Rohde & Schwarz	W00002
☐	EMI test receiver	ESW 44	Rohde & Schwarz	E00895
☐	Field probe	RF-R 400-1	Langer EMV-Technik	E00270
☒	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-EB (V10.35)	Rohde & Schwarz	E00777
☒	Test software	EMC32-MEB (V10.35)	Rohde & Schwarz	E00778
☐	Test software	EMC32-MEB (V10.35)	Rohde & Schwarz	E01073

[10] For information about measurement uncertainties see page 76.

6.4.2 Limits

As specified in section 15.225(a)-(d) of 47 CFR Part 15:

The field strength of any emissions within the band 13.553-13.567 MHz shall not exceed 15,848 microvolts/meter at 30 meters.

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.

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.

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.

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 above using the recalculation factor as described in clause 5.3.

6.4.3 Test procedure

The emission within the band 13.110 MHz – 14.010 MHz is measured using the test procedure as described in clause 5.7.

6.4.4 Test results

Remark: If possible the measurements were performed with peak detector. Where emissions exceeded the limits of § 15.225 the quasi peak detector as specified in ANSI C 63.10 was used, to show compliance with the limits.

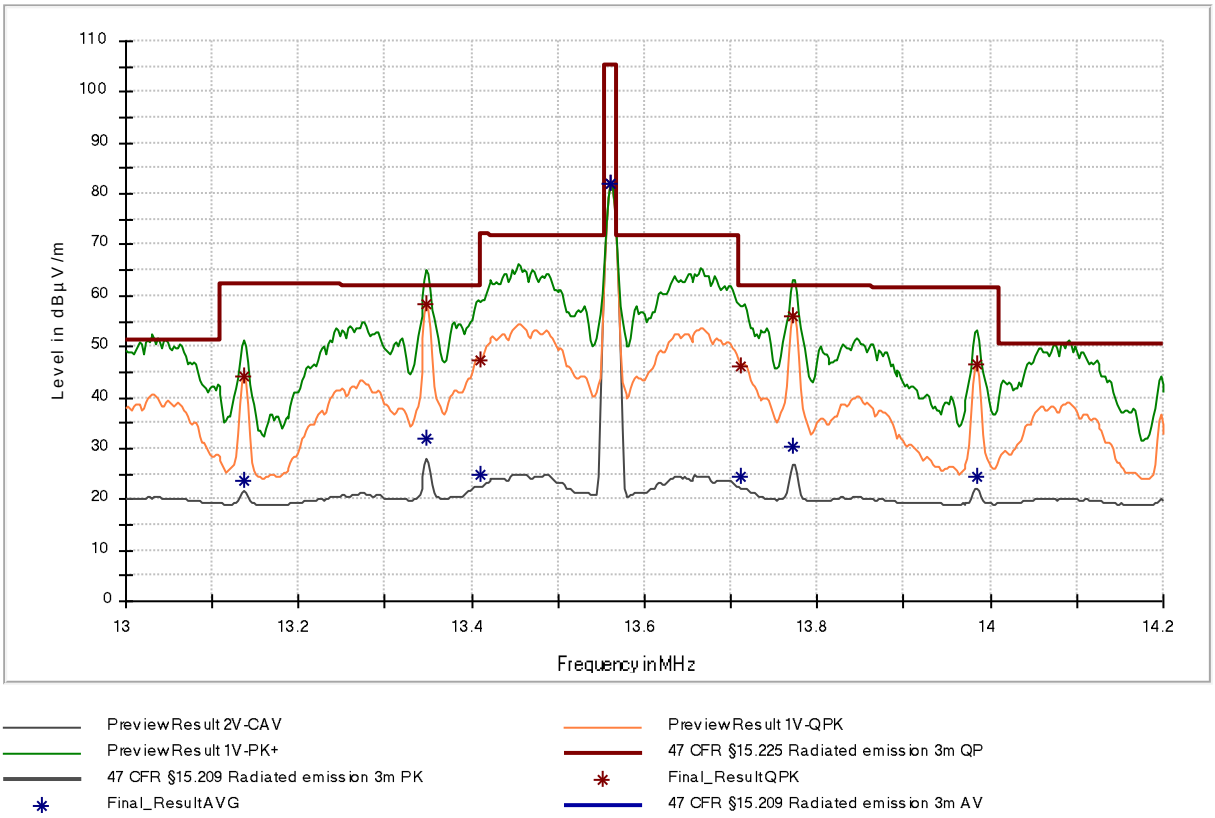


Figure 32: Spectrum mask of 13.56 MHz @ 3m distance with antenna 2063510:4498

Frequency [MHz]	Measured value [dBµV/m] @ 3m	Detector	Limit [dBµV/m] @ 3 m	Margin [dB]	BW [kHz]
13.137000	44.26	QP	62.17	17.91	10
13.348500	58.18	QP	62.03	3.85	10
13.409250	47.31	QP	61.99	14.68	10
13.560000	81.97	QP	105.39	23.42	10
13.710750	46.24	QP	61.80	15.56	10
13.771500	56.15	QP	61.76	5.61	10
13.985250	46.34	QP	61.63	15.29	10

Table 35: Results of emission within the band 13.110 MHz to 14.010 MHz @ 3 m distance with antenna 2063510:4498

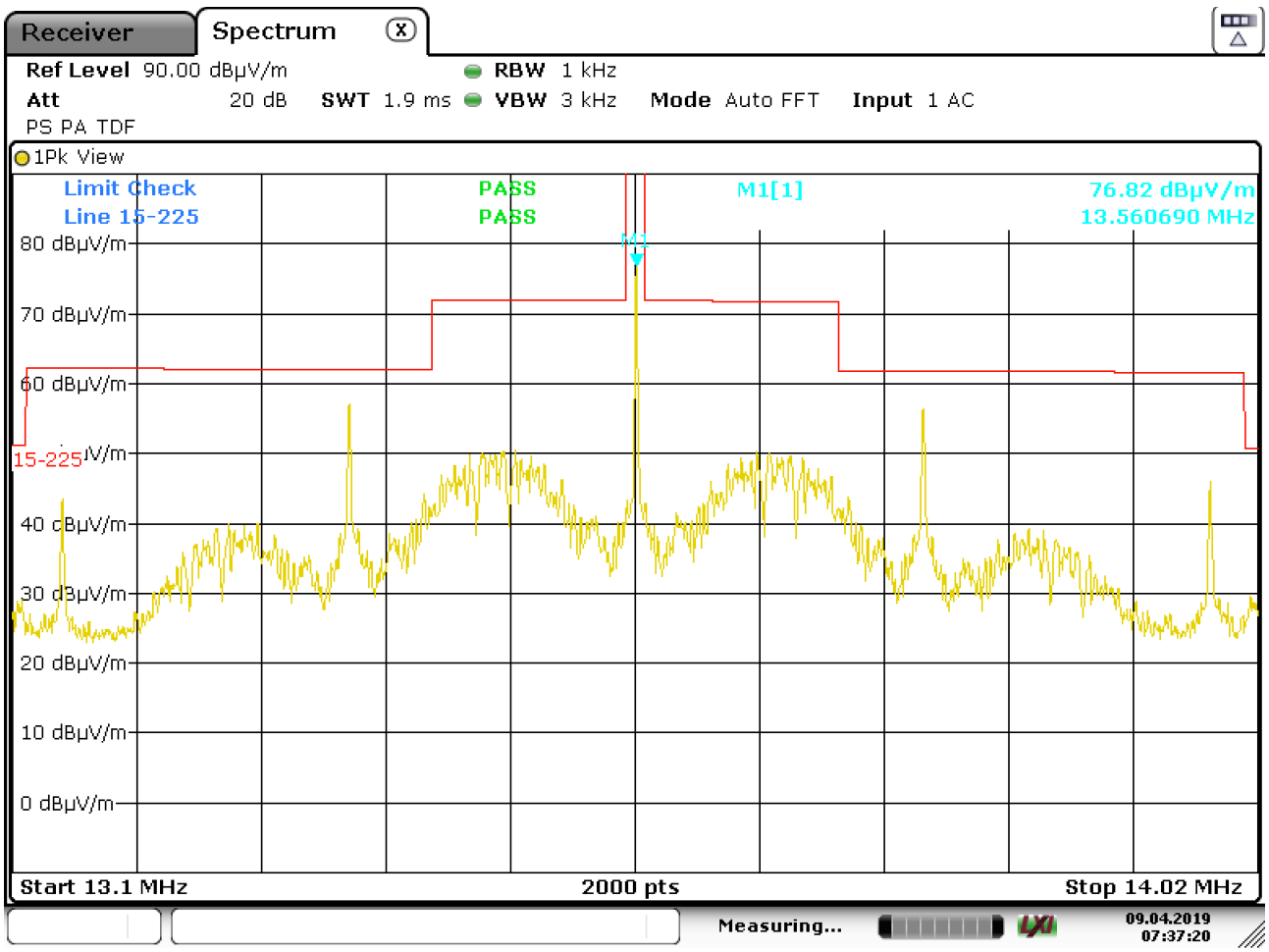


Figure 33: Spektrum mask of 13.56 MHz @ 3m distance with antenna 2063511:4499

Frequency [MHz]	Measured value [dBµV/m] @ 3m	Detector	Limit [dBµV/m] @ 3 m	Margin [dB]	BW [kHz]
13.560000	76.82	PK	105.39	28.57	1
13.560000	76.89	PK	105.39	28.5	10

Table 36: Results of emission within the band 13.110 MHz to 14.010 MHz @ 3 m distance with antenna 2063511:4499

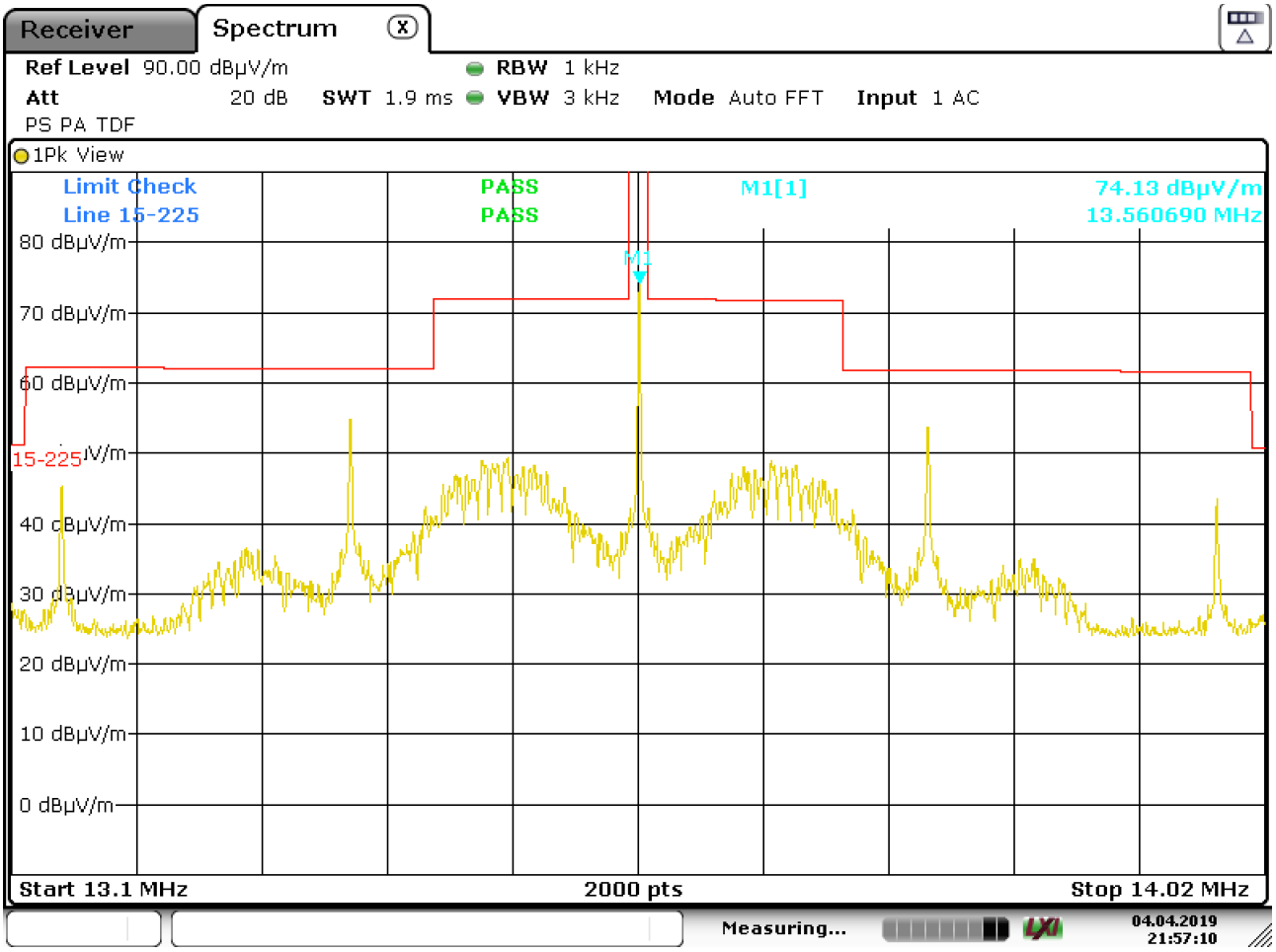


Figure 34: Spektrum mask of 13.56 MHz @ 3m distance with antenna 2063508:4500 large

Frequency [MHz]	Measured value [dBµV/m] @ 3m	Detector	Limit [dBµV/m] @ 3 m	Margin [dB]	BW [kHz]
13.560690	74.13	PK	105.39	31.26	1
13.561300	74.65	PK	105.39	30.74	10

Table 37: Results of emission within the band 13.110 MHz to 14.010 MHz @ 3 m distance with antenna 2063508:4500 large

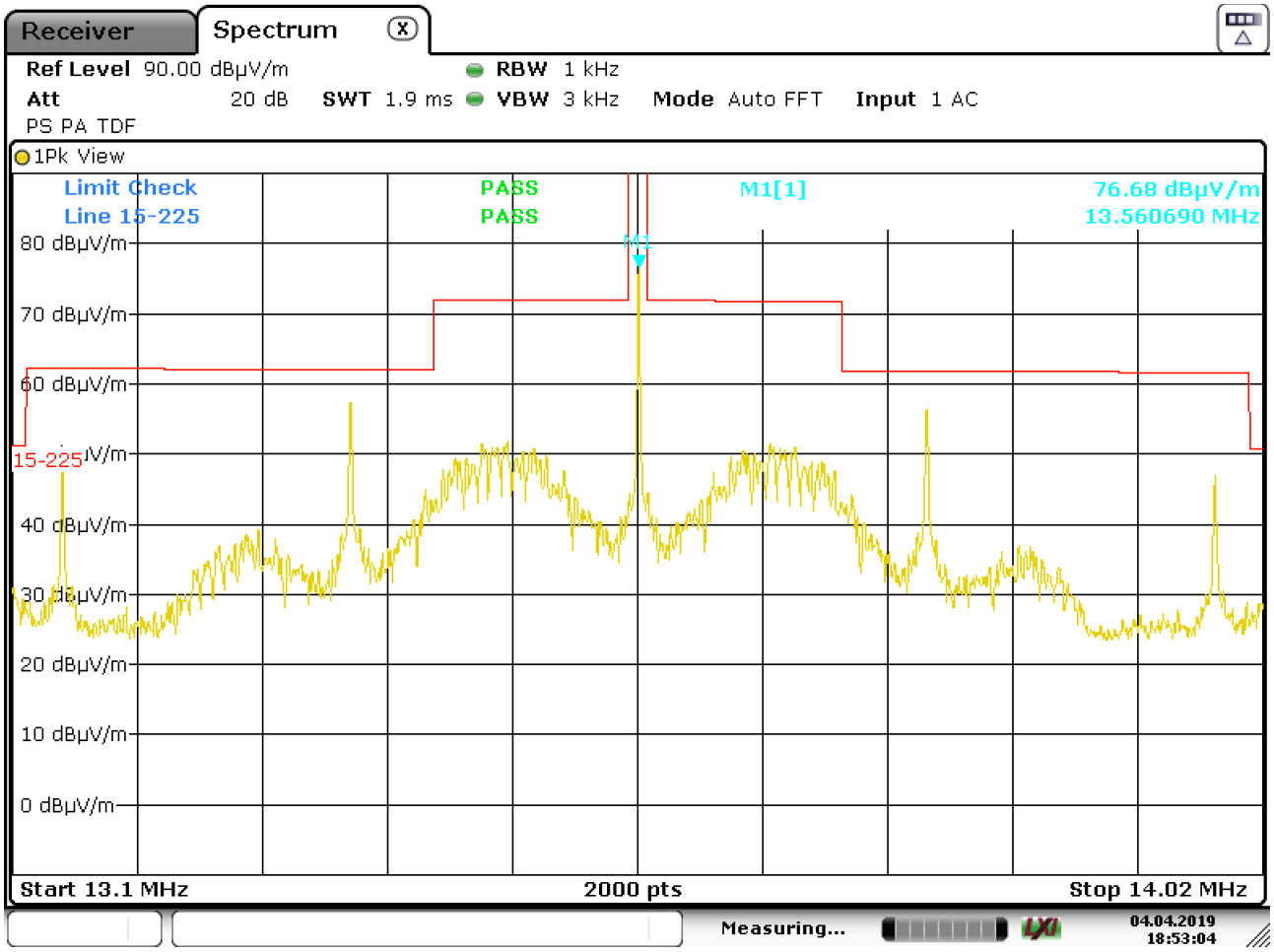


Figure 35: Spektrum mask of 13.56 MHz @ 3m distance with antenna 2063508:4500 small

Frequency [MHz]	Measured value [dBµV/m] @ 3m	Detector	Limit [dBµV/m] @ 3 m	Margin [dB]	BW [kHz]
13.560690	76.68	PK	105.39	28.71	1
13.561300	76.72	PK	105.39	28.67	10

Table 38: Results of emission within the band 13.110 MHz to 14.010 MHz @ 3 m distance with antenna 2063508:4500 small

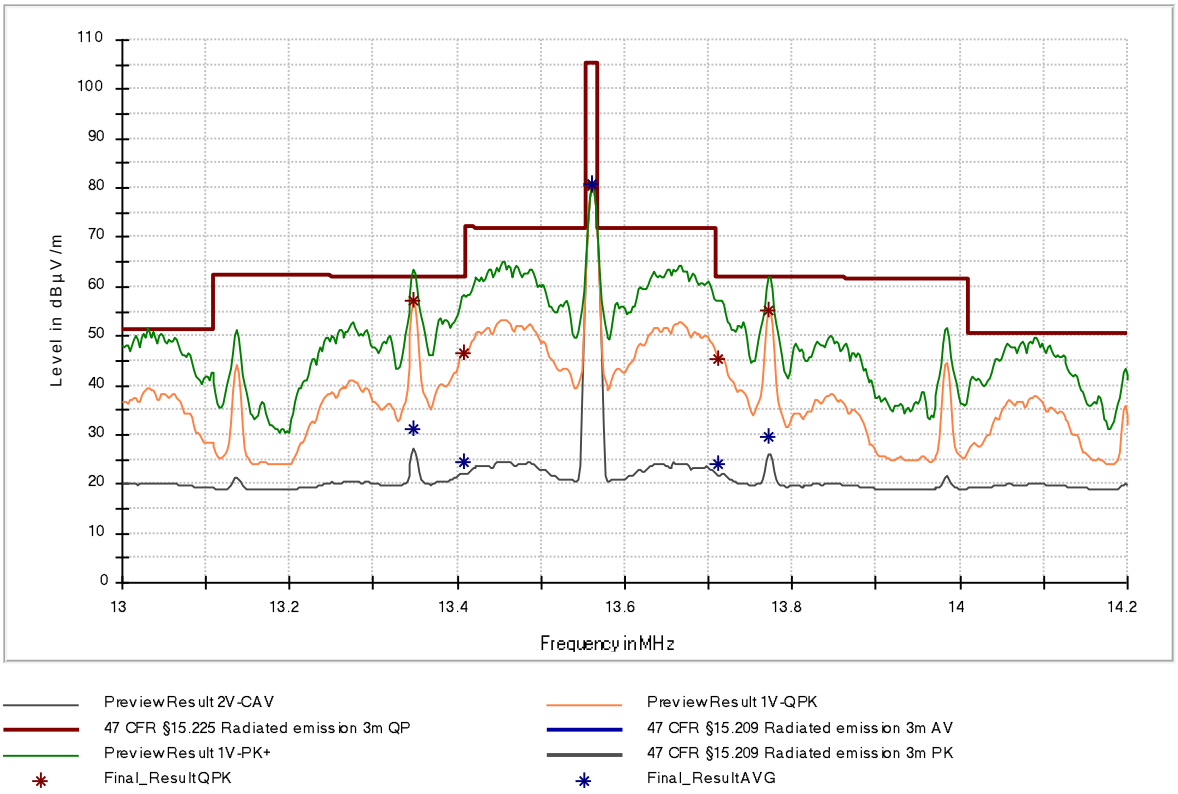


Figure 36: Spectrum mask of 13.56 MHz @ 3m distance with antenna 2063509:4502 large

Frequency [MHz]	Measured value [dBµV/m] @ 3m	Detector	Limit [dBµV/m] @ 3 m	Margin [dB]	BW [kHz]
13.348500	57.10	QP	62.03	4.93	10
13.407000	46.68	QP	61.99	15.31	10
13.560000	80.58	QP	105.39	24.81	10
13.710750	45.33	QP	61.80	16.74	10
13.771500	55.04	QP	61.76	6.72	10

Table 39: Results of emission within the band 13.110 MHz to 14.010 MHz @ 3 m distance with antenna 2063509:4502 large

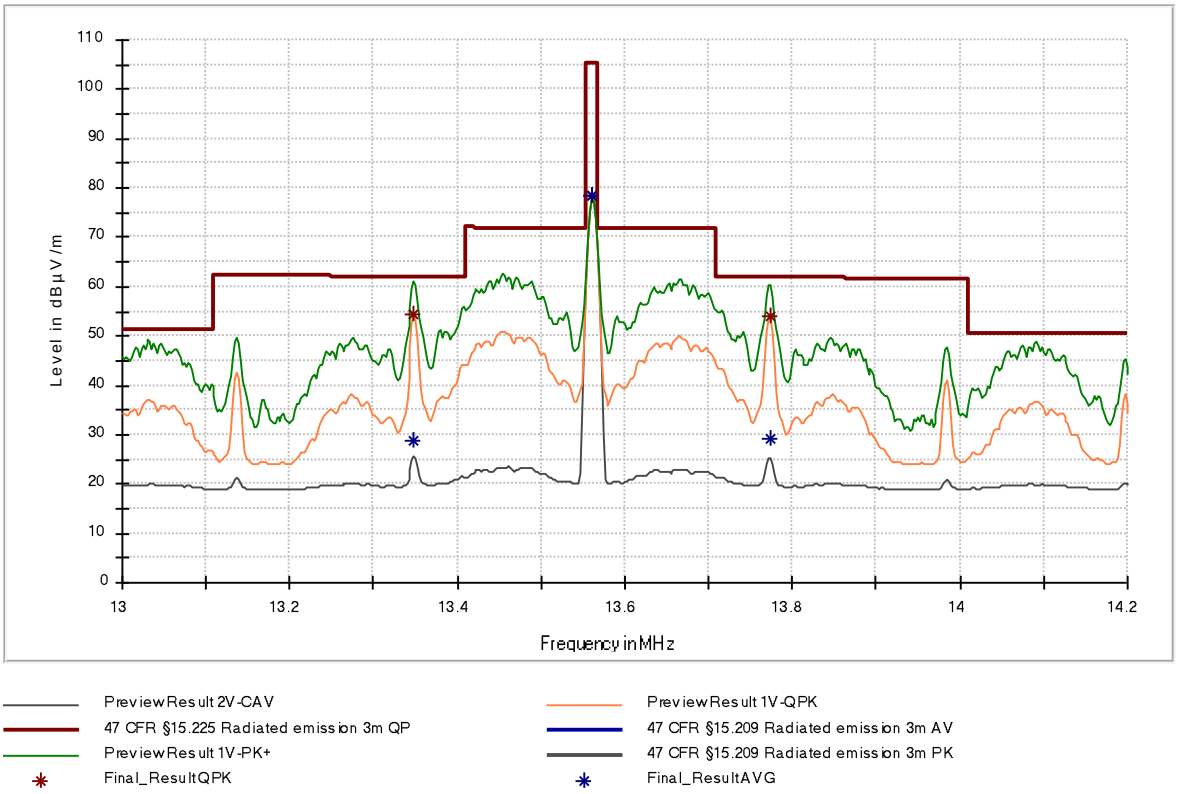


Figure 37: Spectrum mask of 13.56 MHz @ 3m distance with antenna 2063509:4502 small

Frequency [MHz]	Measured value [dBµV/m] @ 3m	Detector	Limit [dBµV/m] @ 3 m	Margin [dB]	BW [kHz]
13.348500	54.34	QP	62.03	7.69	10
13.560000	78.57	QP	105.39	26.82	10
13.773750	54.19	QP	61.76	7.57	10

Table 40: Results of emission within the band 13.110 MHz to 14.010 MHz @ 3 m distance with antenna 2063509:4502 small

6.5 Carrier frequency stability

Section(s) in 47 CFR Part 15:	Requirement(s):	15.225(e)
	Reference(s):	15.225(e)
Section(s) in RSS:	Requirement(s):	RSS-210, annex B6, RSS-Gen, section 6.11
	Reference(s):	RSS-Gen, section 6.11

Performed by:	Andreas Menacher	Date(s) of test:	April 9 – 10, 2019
Climatic conditions:	Ambient temperature 22 °C	Relative humidity 34%	Barometric pressure 977 hPa
Result[11]:	☒ Test passed	☐ Test not passed	

6.5.1 Test equipment

	Type	*Designation*	*Manufacturer*	*Inventory no.*
☐	Climatic chamber 990 l	VC4100	Vötsch Industrietechnik	C00014
☒	Climatic chamber 340 l	VC³ 4034	Vötsch Industrietechnik	C00015
☒	EMI test receiver (CDC)	ESCI 3	Rohde & Schwarz	E00552
☐	EMI test receiver (OATS)	ESCI 3	Rohde & Schwarz	E00001
☐	EMI test receiver	ESR 7	Rohde & Schwarz	E00739
☐	EMI test receiver	ESU 26	Rohde & Schwarz	W00002
☐	EMI test receiver	ESW 44	Rohde & Schwarz	E00895
☒	Field probe	RF-R 400-1	Langer EMV-Technik	E00270

[11] For information about measurement uncertainties see page 92.

6.5.2 Limits

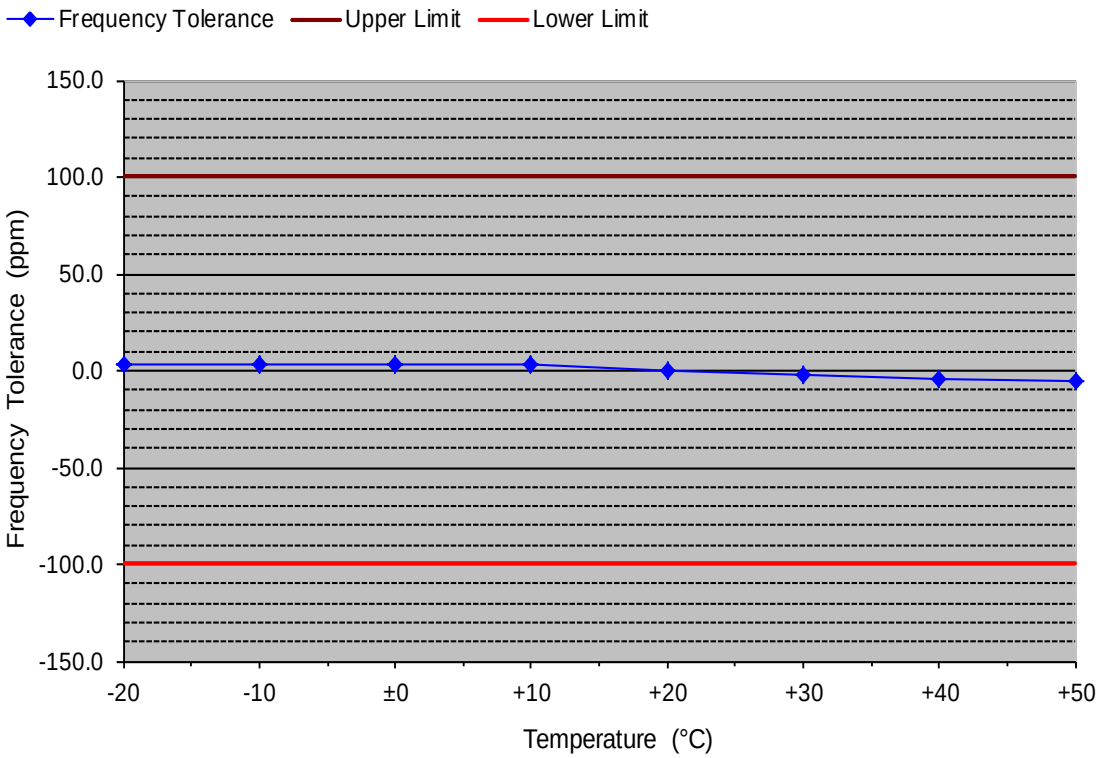
The frequency tolerance of the carrier signal shall be maintained within ±0.01% (100 ppm) of the operating frequency over a temperature variation of -20 degrees to +50 degrees C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 degrees C.
For battery operated equipment, the equipment tests shall be performed using a new battery. Alternatively, an external supply voltage can be used and set at the battery nominal voltage, and again at the battery operating end point voltage which must be specified by the equipment manufacturer.

6.5.3 Test procedure

The carrier frequency stability is measured using the test procedure as described in clause 5.8.

6.5.4 Test results

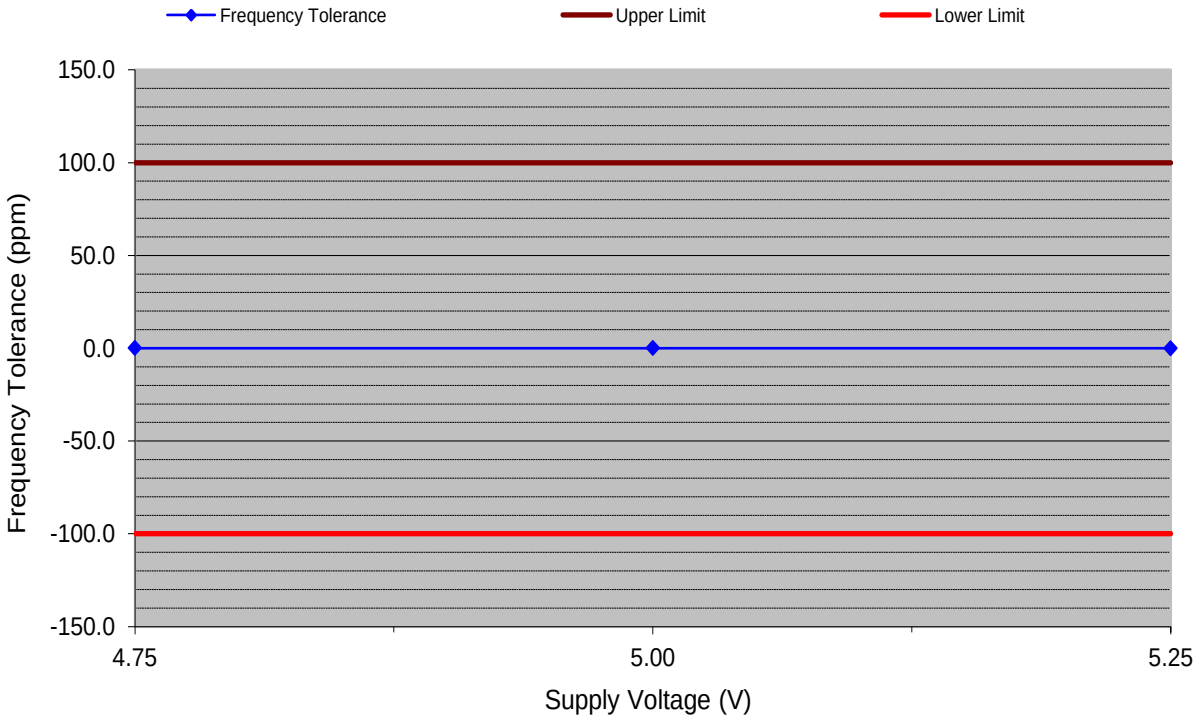
Carrier frequency stability vs. temperature with antenna 2063510:4498



Supply voltage:	5 V	Frequency under nominal conditions:	13.560783 MHz

Temperature (°C)	Frequency (MHz)	Frequency Tolerance (Hz)	Frequency Tolerance (ppm)	Upper Limit (ppm)	Lower Limit (ppm)	Margin (ppm)
-20	13.560830	46	3.4	+100.0	-100.0	96.6
-10	13.560834	50	3.7	+100.0	-100.0	96.3
±0	13.560829	46	3.4	+100.0	-100.0	96.6
+10	13.560825	42	3.1	+100.0	-100.0	96.9
+20	13.560783	0	0.0	+100.0	-100.0	100.0
+30	13.560758	-25	-1.8	+100.0	-100.0	98.2
+40	13.560729	-54	-4.0	+100.0	-100.0	96.0
+50	13.560708	-75	-5.5	+100.0	-100.0	**94.5**

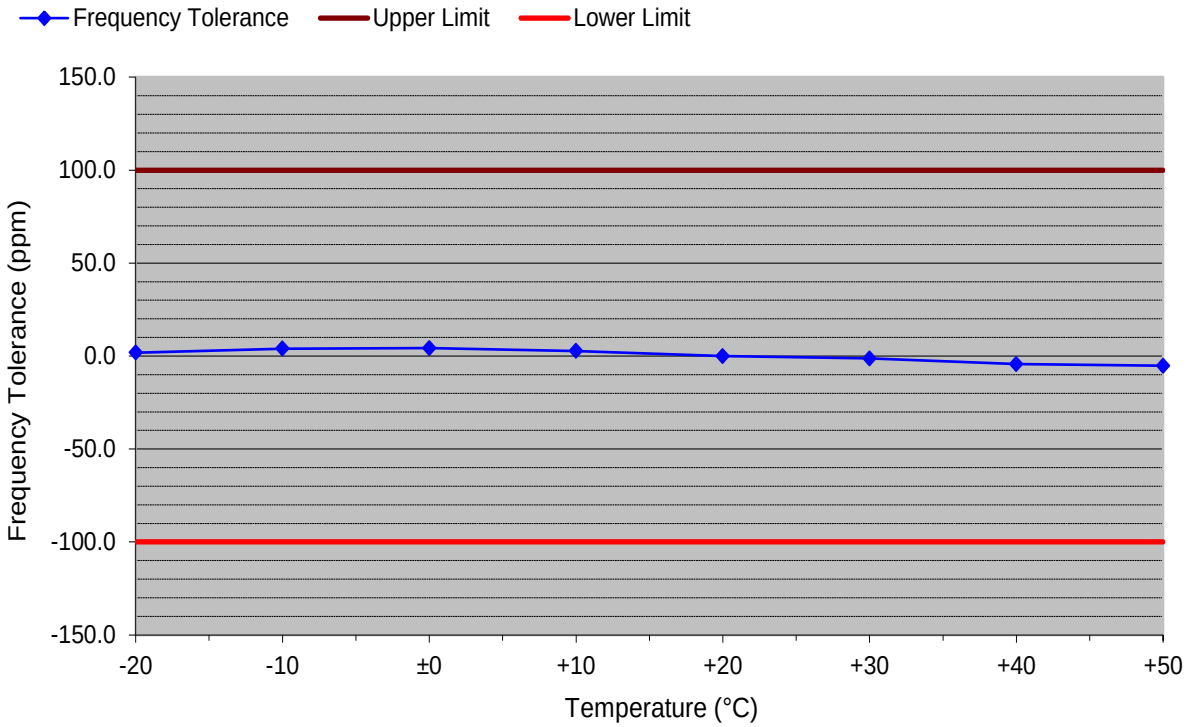
Carrier frequency stability vs. supply voltage with antenna 2063510:4498



Temperature:	+20 °C	Battery End Point:	not applicable
Frequency under nominal conditions:	13.560783 MHz		

Supply Voltage (V)	Frequency (MHz)	Frequency Tolerance (Hz)	Frequency Tolerance (ppm)	Upper Limit (ppm)	Lower Limit (ppm)	Margin (ppm)
4.75	13.560783	0	0.0	+100.0	-100.0	100.0
5.00	13.560783	0	0.0	+100.0	-100.0	100.0
5.25	13.560783	0	0.0	+100.0	-100.0	100.0

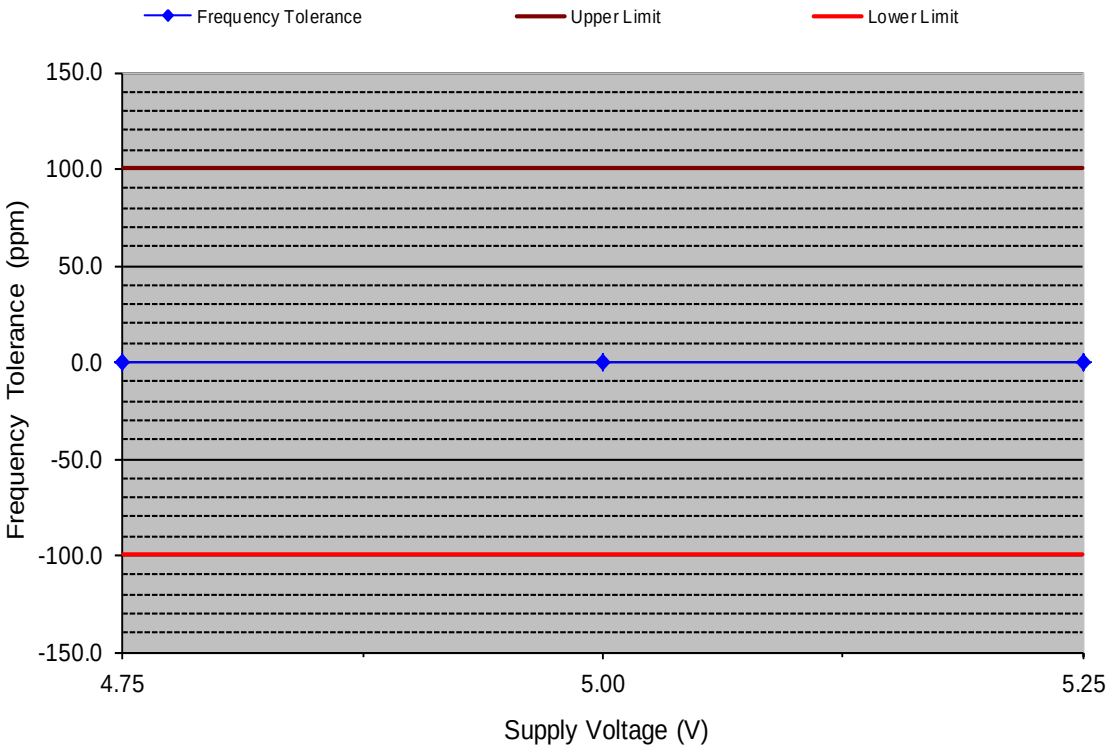
Carrier frequency stability vs. temperature with antenna 2063511:4499



Supply voltage:	5 V	Frequency under nominal conditions:	13.560779 MHz

Temperature (°C)	Frequency (MHz)	Frequency Tolerance (Hz)	Frequency Tolerance (ppm)	Upper Limit (ppm)	Lower Limit (ppm)	Margin (ppm)
-20	13.560804	25	1.8	+100.0	-100.0	98.2
-10	13.560833	54	4.0	+100.0	-100.0	96.0
±0	13.560837	58	4.3	+100.0	-100.0	95.7
+10	13.560816	37	2.7	+100.0	-100.0	97.3
+20	13.560779	0	0.0	+100.0	-100.0	100.0
+30	13.560762	-17	-1.3	+100.0	-100.0	98.7
+40	13.560720	-59	-4.4	+100.0	-100.0	95.6
+50	13.560708	-71	-5.2	+100.0	-100.0	**94.8**

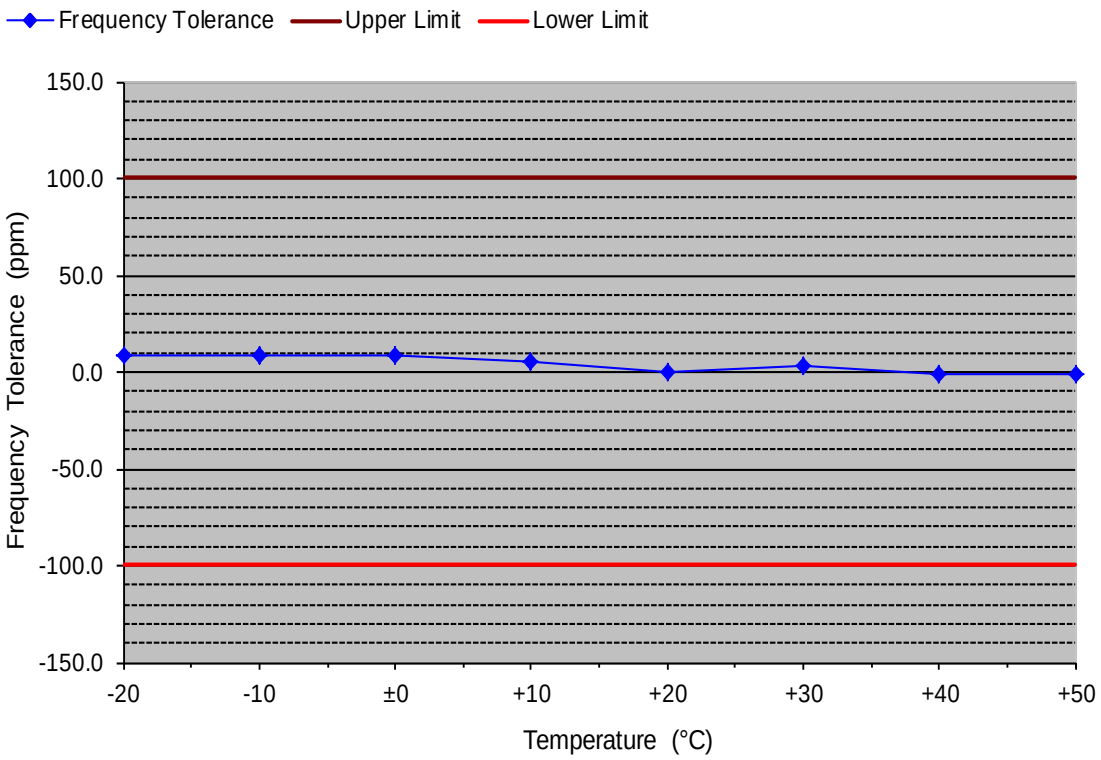
Carrier frequency stability vs. supply voltage with antenna 2063511:4499



Temperature:	+20 °C	Battery End Point:	not applicable
Frequency under nominal conditions:	13.560779 MHz		

Supply Voltage (V)	Frequency (MHz)	Frequency Tolerance (Hz)	Frequency Tolerance (ppm)	Upper Limit (ppm)	Lower Limit (ppm)	Margin (ppm)
4.75	13.560775	-4	-0.3	+100.0	-100.0	99.7
5.00	13.560779	0	0.0	+100.0	-100.0	100.0
5.25	13.560775	-4	-0.3	+100.0	-100.0	99.7

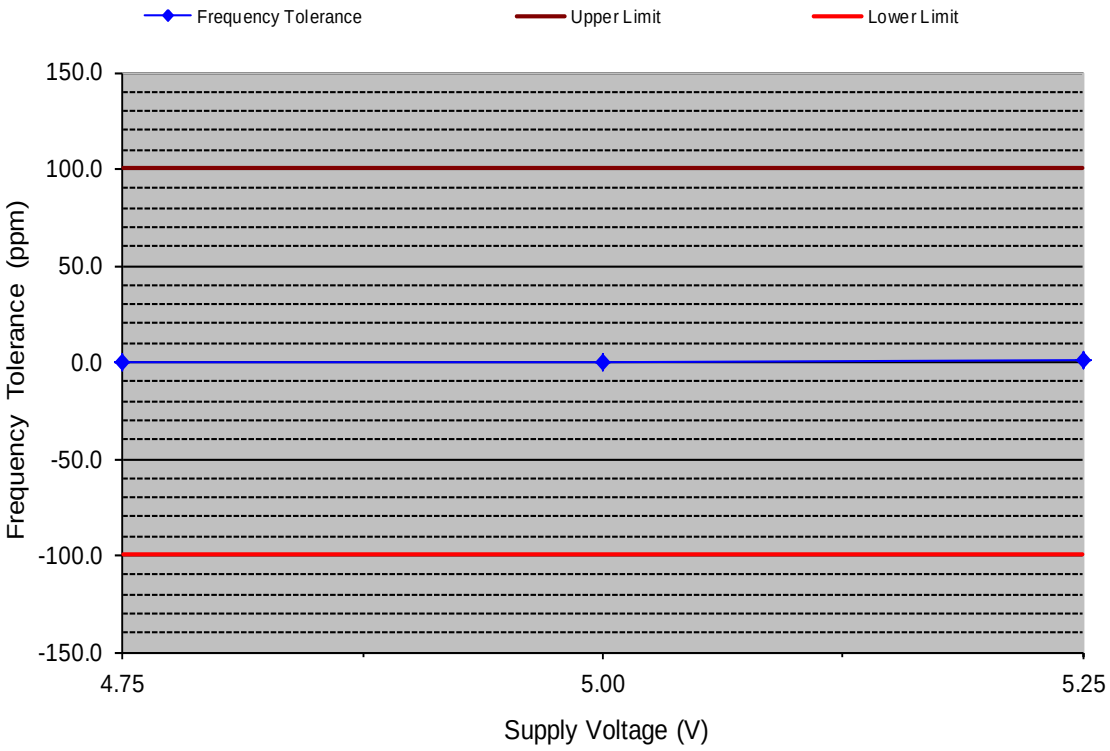
Carrier frequency stability vs. temperature with antenna 2063508:4500 large



Supply voltage:	5 V	Frequency under nominal conditions:	13.560716 MHz

Temperature (°C)	Frequency (MHz)	Frequency Tolerance (Hz)	Frequency Tolerance (ppm)	Upper Limit (ppm)	Lower Limit (ppm)	Margin (ppm)
-20	13.560833	117	8.6	+100.0	-100.0	**91.4**
-10	13.560829	113	8.3	+100.0	-100.0	91.7
±0	13.560833	117	8.6	+100.0	-100.0	**91.4**
+10	13.560787	71	5.2	+100.0	-100.0	94.8
+20	13.560716	0	0.0	+100.0	-100.0	100.0
+30	13.560766	50	3.7	+100.0	-100.0	96.3
+40	13.560703	-13	-1.0	+100.0	-100.0	99.0
+50	13.560703	-13	-1.0	+100.0	-100.0	99.0

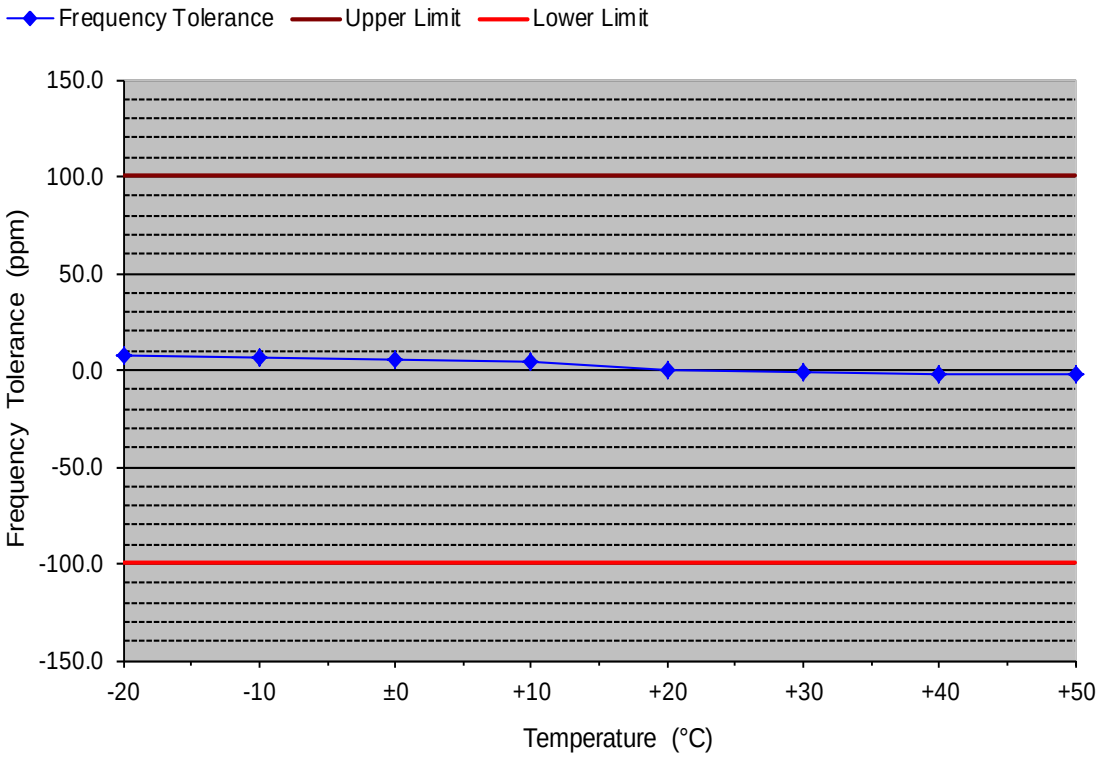
Carrier frequency stability vs. supply voltage with antenna 2063508:4500 large



Temperature:	+20 °C	Battery End Point:	not applicable
Frequency under nominal conditions:	13.560716 MHz		

Supply Voltage (V)	Frequency (MHz)	Frequency Tolerance (Hz)	Frequency Tolerance (ppm)	Upper Limit (ppm)	Lower Limit (ppm)	Margin (ppm)
4.75	13.560716	0	0.0	+100.0	-100.0	100.0
5.00	13.560716	0	0.0	+100.0	-100.0	100.0
5.25	13.560724	8	0.6	+100.0	-100.0	99.4

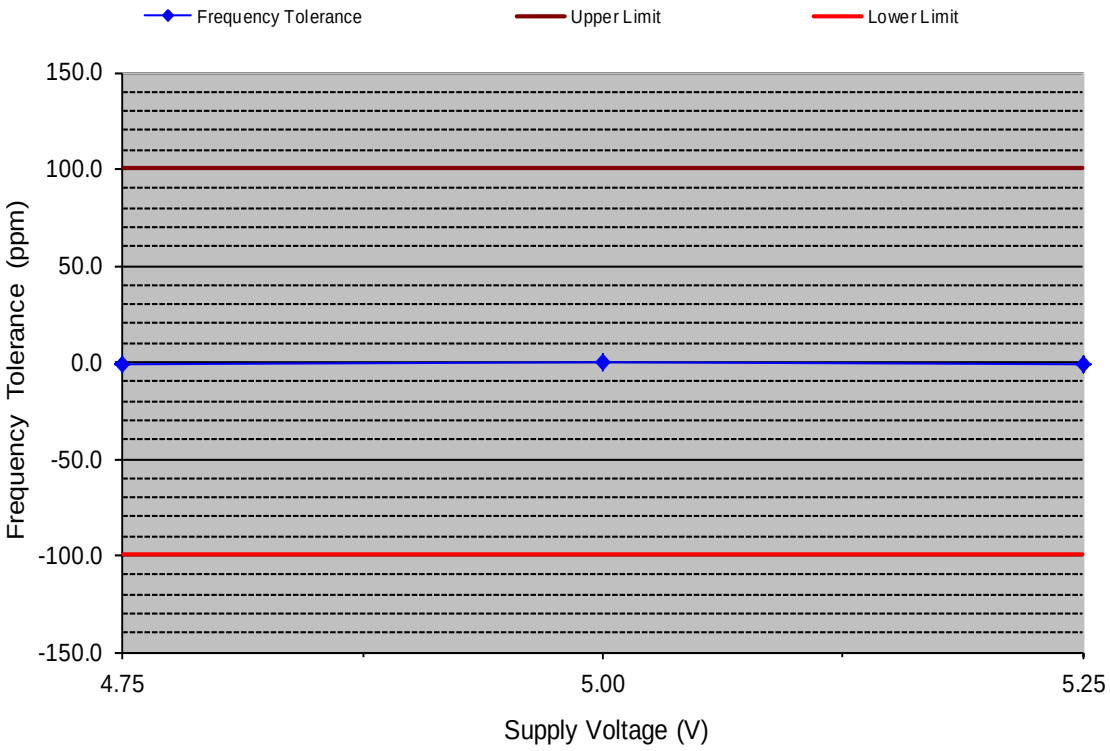
Carrier frequency stability vs. temperature with antenna 2063508:4500 small



Supply voltage:	5 V	Frequency under nominal conditions:	13.560741 MHz

Temperature (°C)	Frequency (MHz)	Frequency Tolerance (Hz)	(ppm)	Upper Limit (ppm)	Lower Limit (ppm)	Margin (ppm)
-20	13.560837	96	7.1	+100.0	-100.0	**92.9**
-10	13.560833	92	6.8	+100.0	-100.0	93.2
±0	13.560821	80	5.9	+100.0	-100.0	94.1
+10	13.560800	59	4.4	+100.0	-100.0	95.6
+20	13.560741	0	0.0	+100.0	-100.0	100.0
+30	13.560728	-13	-1.0	+100.0	-100.0	99.0
+40	13.560707	-34	-2.5	+100.0	-100.0	97.5
+50	13.560707	-34	-2.5	+100.0	-100.0	97.5

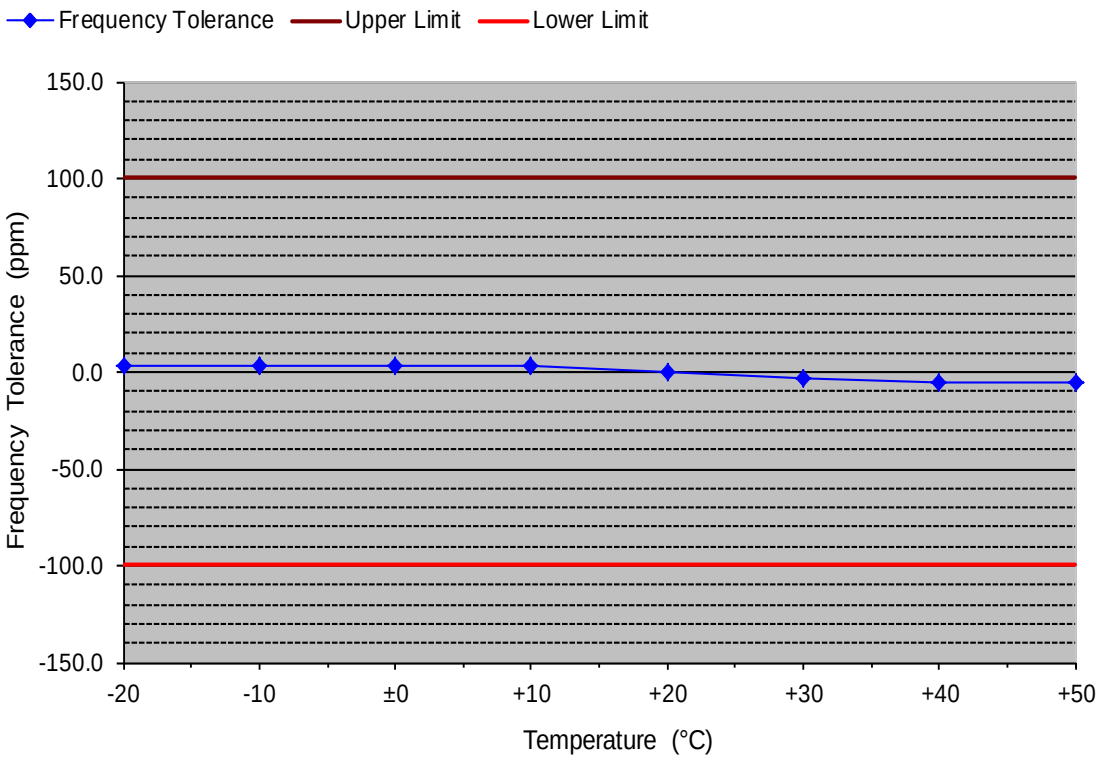
Carrier frequency stability vs. supply voltage with antenna 2063508:4500 small



Temperature:	+20 °C	Battery End Point:	not applicable
Frequency under nominal conditions:	13.560741 MHz		

Supply Voltage (V)	Frequency (MHz)	Frequency Tolerance (Hz)	Frequency Tolerance (ppm)	Upper Limit (ppm)	Lower Limit (ppm)	Margin (ppm)
4.75	13.560733	-8	-0.6	+100.0	-100.0	99.4
5.00	13.560741	0	0.0	+100.0	-100.0	100.0
5.25	13.560728	-13	-1.0	+100.0	-100.0	99.0

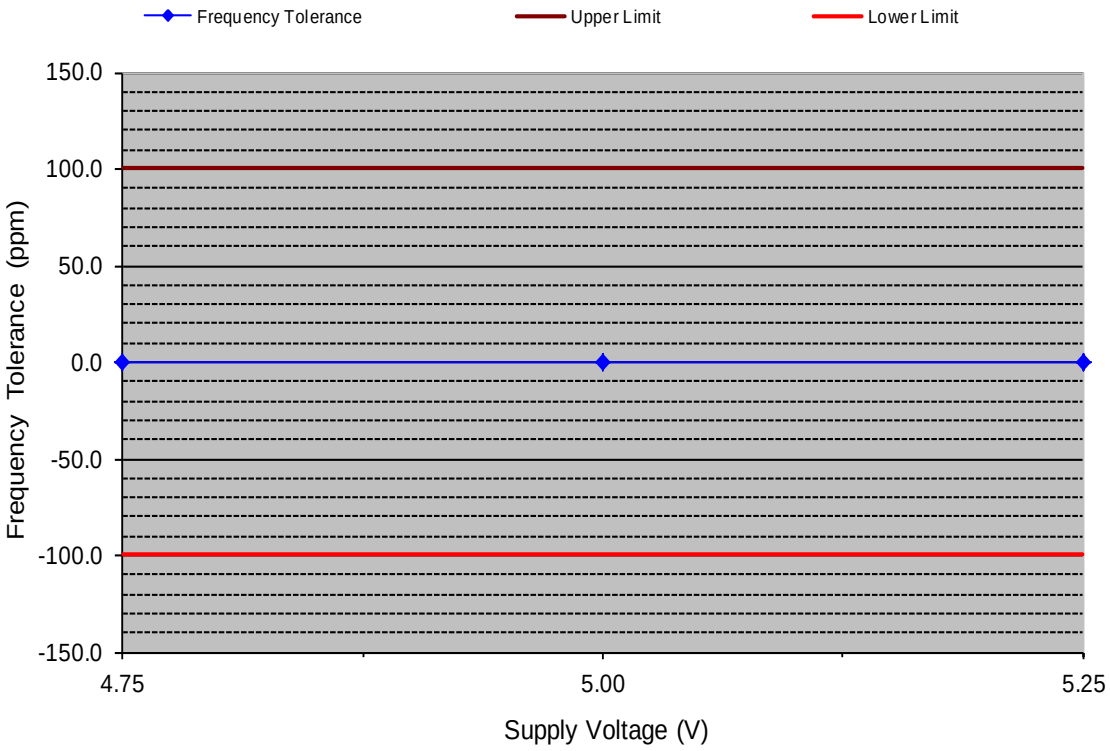
Carrier frequency stability vs. temperature with antenna 2063509:4502 large



Supply voltage:	5 V	Frequency under nominal conditions:	13.560787 MHz

Temperature (°C)	Frequency (MHz)	Frequency Tolerance (Hz)	(ppm)	Upper Limit (ppm)	Lower Limit (ppm)	Margin (ppm)
-20	13.560825	38	2.8	+100.0	-100.0	97.2
-10	13.560837	50	3.7	+100.0	-100.0	96.3
±0	13.560829	42	3.1	+100.0	-100.0	96.9
+10	13.560825	38	2.8	+100.0	-100.0	97.2
+20	13.560787	0	0.0	+100.0	-100.0	100.0
+30	13.560749	-38	-2.8	+100.0	-100.0	97.2
+40	13.560720	-67	-4.9	+100.0	-100.0	95.1
+50	13.560707	-80	-5.9	+100.0	-100.0	**94.1**

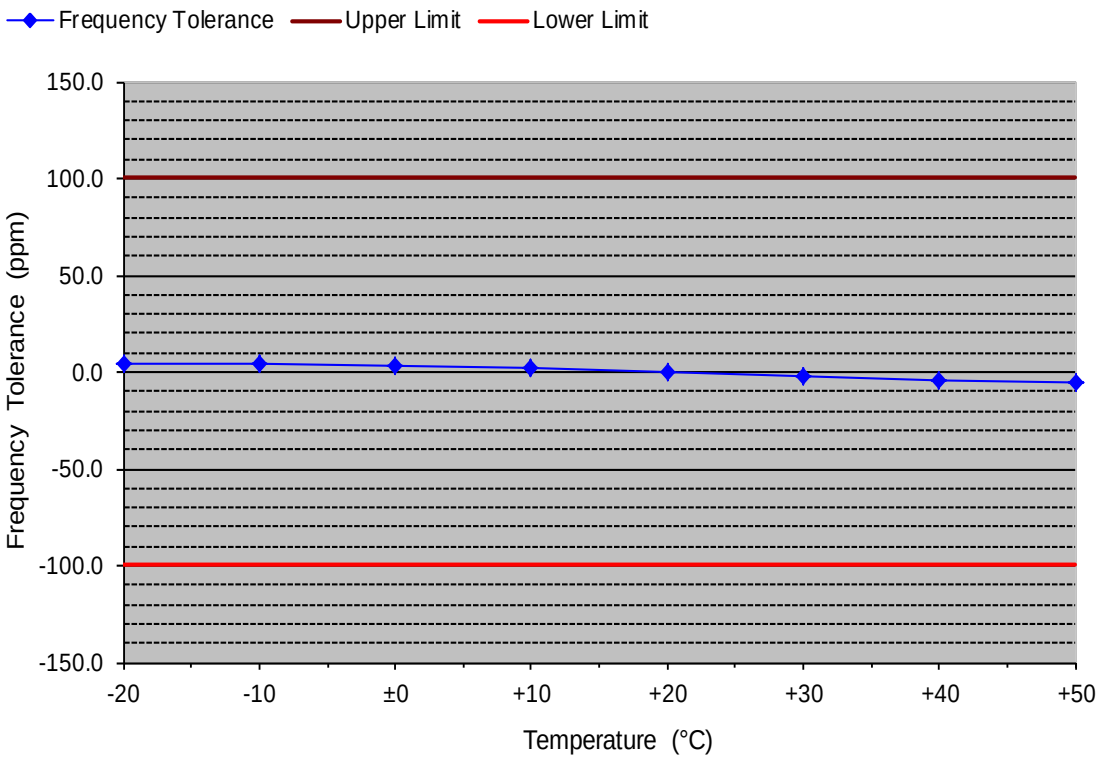
Carrier frequency stability vs. supply voltage with antenna 2063509:4502 large



Temperature:	+20 °C	Battery End Point:	not applicable
Frequency under nominal conditions:	13.560787 MHz		

Supply Voltage (V)	Frequency (MHz)	Frequency Tolerance (Hz)	Frequency Tolerance (ppm)	Upper Limit (ppm)	Lower Limit (ppm)	Margin (ppm)
4.75	13.560783	-4	-0.3	+100.0	-100.0	99.7
5.00	13.560787	0	0.0	+100.0	-100.0	100.0
5.25	13.560783	-4	-0.3	+100.0	-100.0	99.7

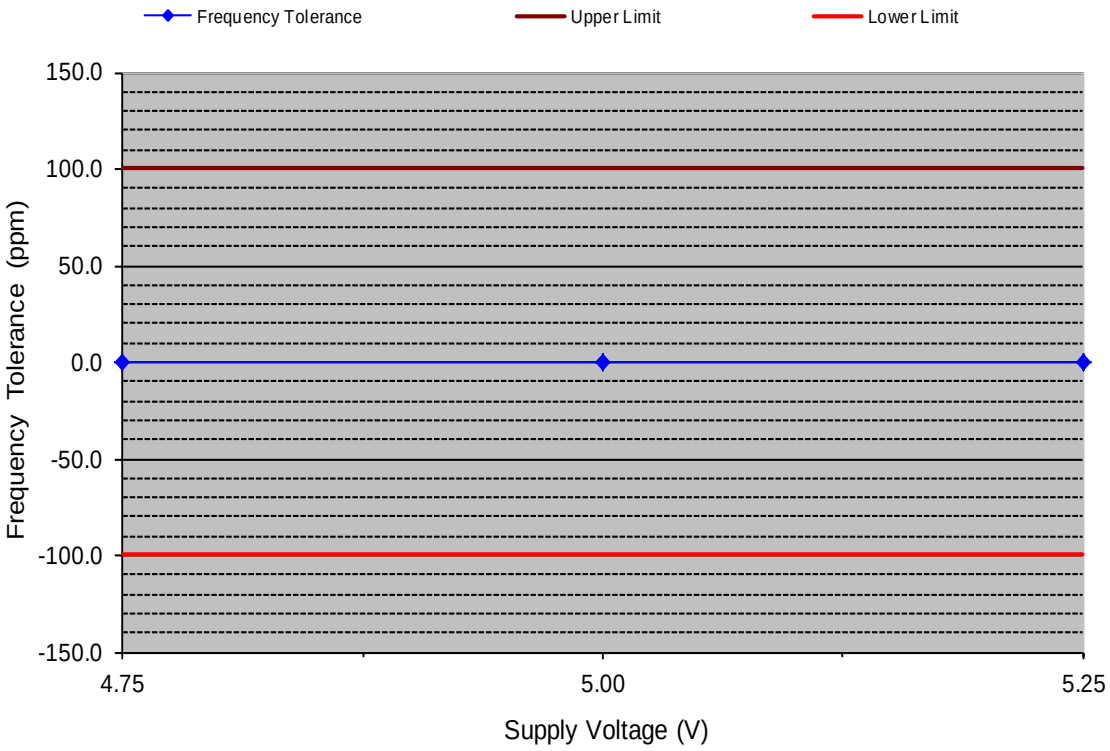
Carrier frequency stability vs. temperature with antenna 2063509:4502 small



Supply voltage:	5 V	Frequency under nominal conditions:	13.560779 MHz

Temperature (°C)	Frequency (MHz)	Frequency Tolerance (Hz)	(ppm)	Upper Limit (ppm)	Lower Limit (ppm)	Margin (ppm)
-20	13.560833	54	4.0	+100.0	-100.0	96.0
-10	13.560833	54	4.0	+100.0	-100.0	96.0
±0	13.560825	46	3.4	+100.0	-100.0	96.6
+10	13.560812	33	2.4	+100.0	-100.0	97.6
+20	13.560779	0	0.0	+100.0	-100.0	100.0
+30	13.560749	-30	-2.2	+100.0	-100.0	97.8
+40	13.560720	-59	-4.4	+100.0	-100.0	95.6
+50	13.560703	-76	-5.6	+100.0	-100.0	**94.4**

Carrier frequency stability vs. supply voltage with antenna 2063509:4502 small



Temperature:	+20 °C	Battery End Point:	not applcable
Frequency under nominal conditions:	13.560779 MHz		

Supply Voltage (V)	Frequency (MHz)	Frequency Tolerance (Hz)	Frequency Tolerance (ppm)	Upper Limit (ppm)	Lower Limit (ppm)	Margin (ppm)
4.75	13.560779	0	0.0	+100.0	-100.0	100.0
5.00	13.560779	0	0.0	+100.0	-100.0	100.0
5.25	13.560779	0	0.0	+100.0	-100.0	100.0

6.6 Emissions outside the operating frequency band(s) specified

6.6.1 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

Result[12]: ☒ Test passed ☐ Test not passed

6.6.1.1 Test equipment

	Type	*Designation*	*Manufacturer*	*Inventory no.*
☒	Compact Diagnostic Chamber (CDC)	VK041.0174	Albatross Projects	E00026
☐	Open area test site (OATS)	---	EMV TESTHAUS	E00354
☐	Semi-anechoic chamber (SAC)	SAC3	Albatross Projects	E00716
☐	EMI test receiver (CDC)	ESCI 3	Rohde & Schwarz	E00552
☐	EMI test receiver (OATS)	ESCI 3	Rohde & Schwarz	E00001
☒	EMI test receiver	ESR 7	Rohde & Schwarz	E00739
☐	EMI test receiver	ESU 26	Rohde & Schwarz	W00002
☐	EMI test receiver	ESW 44	Rohde & Schwarz	E00895
☐	Field probe	RF-R 400-1	Langer EMV-Technik	E00270
☒	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-EB (V10.35)	Rohde & Schwarz	E00777
☒	Test software	EMC32-MEB (V10.35)	Rohde & Schwarz	E00778
☐	Test software	EMC32-MEB (V10.35)	Rohde & Schwarz	E01073

[12] For information about measurement uncertainties see page 92.

6.6.1.2 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 41: 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 41 using the recalculation factor as described in clause 5.3.

6.6.1.3 Test procedure

The emissions below 30 MHz are measured using the

☒ test procedure for radiated measurements as described in clause 5.3.

6.6.1.4 Test results

Performed by:	Andreas Menacher	Date(s) of test:	April 8, 2019
Climatic conditions:	Ambient temperature 23 °C	Relative humidity 34 %	Barometric pressure 978 hPa
Test distance:	☒ 3 m	☐ 10 m	☐ ….. m
Antenna alignment:	☐ in parallel	☒ in line	☐ angle ….. °
EUT position[13]:	☒ 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	2 s	1 s	Off
150 kHz – 30 MHz	2.25 kHz	9 kHz	QP, PK, CAV	QP, PK, AV	2 s	1 s	Off

Remark: Emissions from 13.110 MHz to 14.010 MHz fall under the limit of § 15.225.

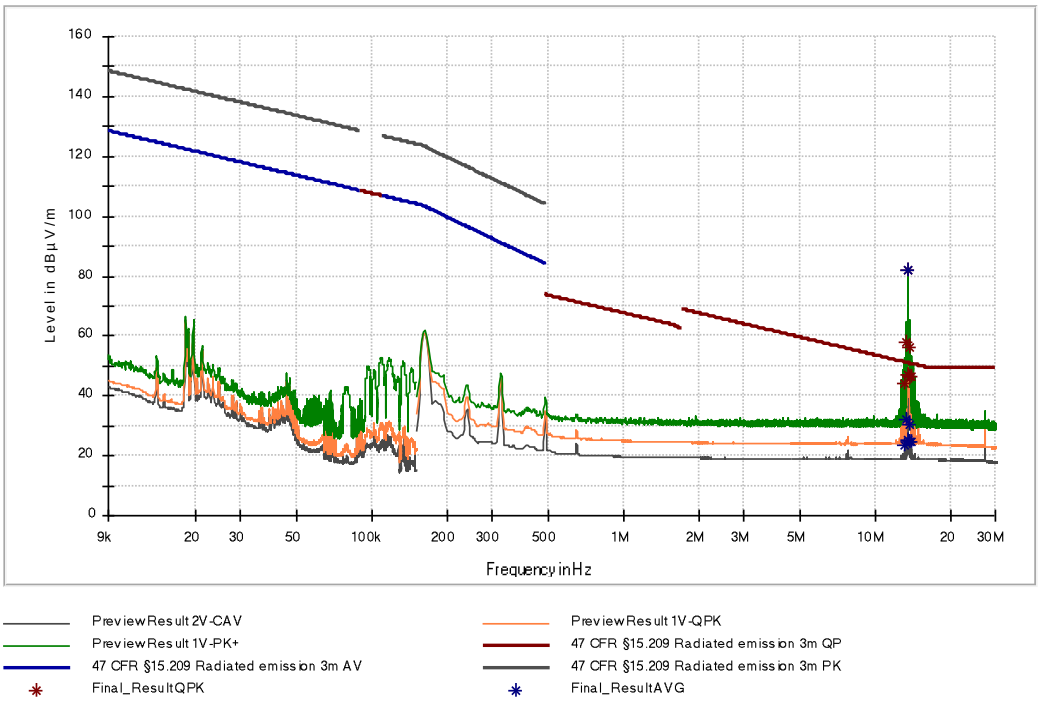


Figure 38: Chart of emissions test below 30 MHz with tag on antenna 2063510:4498 in position 2, measurement antenna in line @ 3 m

[13] 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.

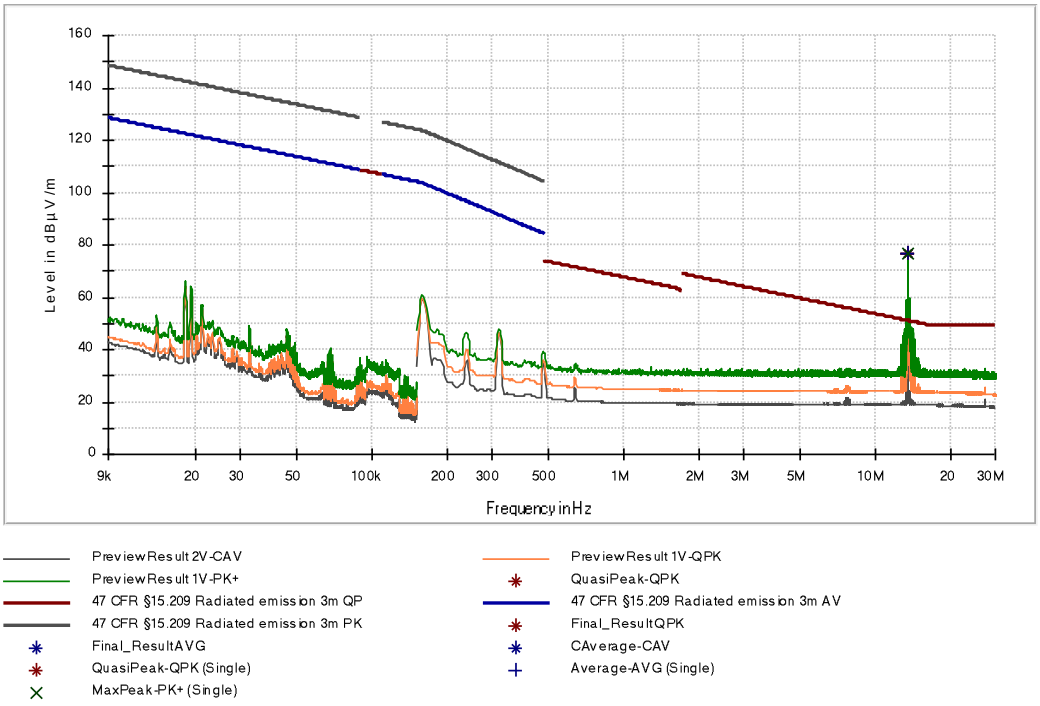


Figure 39: Chart of emissions test below 30 MHz with tag on antenna 2063511:4499 in position 2, measurement antenna in line @ 3 m

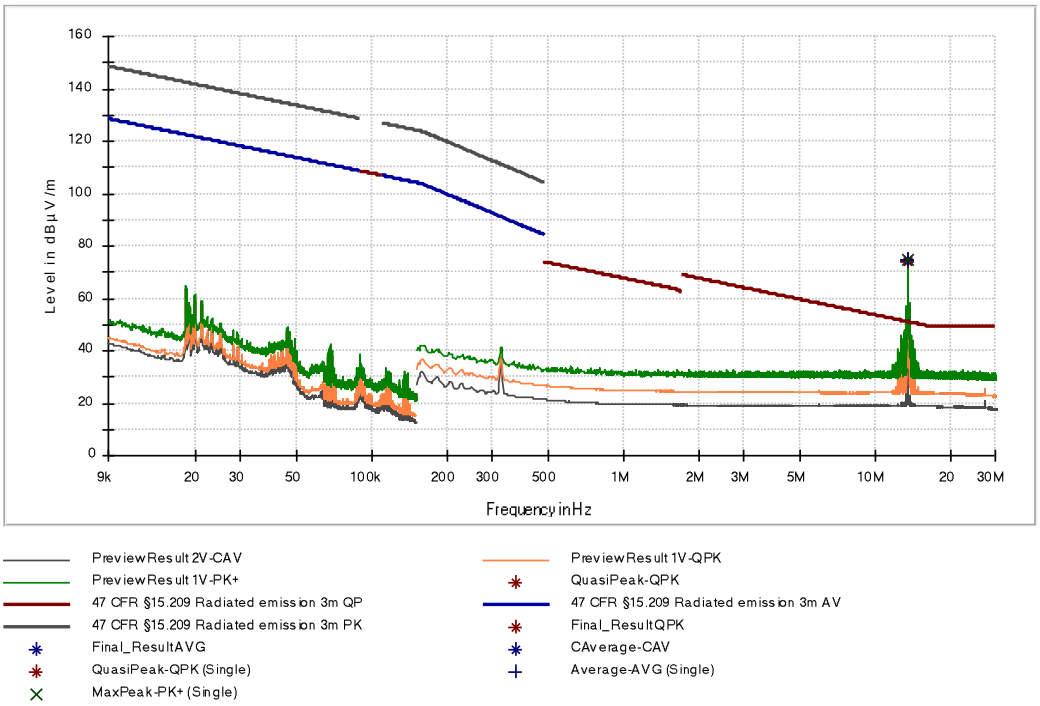


Figure 40: Chart of emissions test below 30 MHz with tag on antenna 2063508:4500 large in position 2, measurement antenna in line @ 3 m

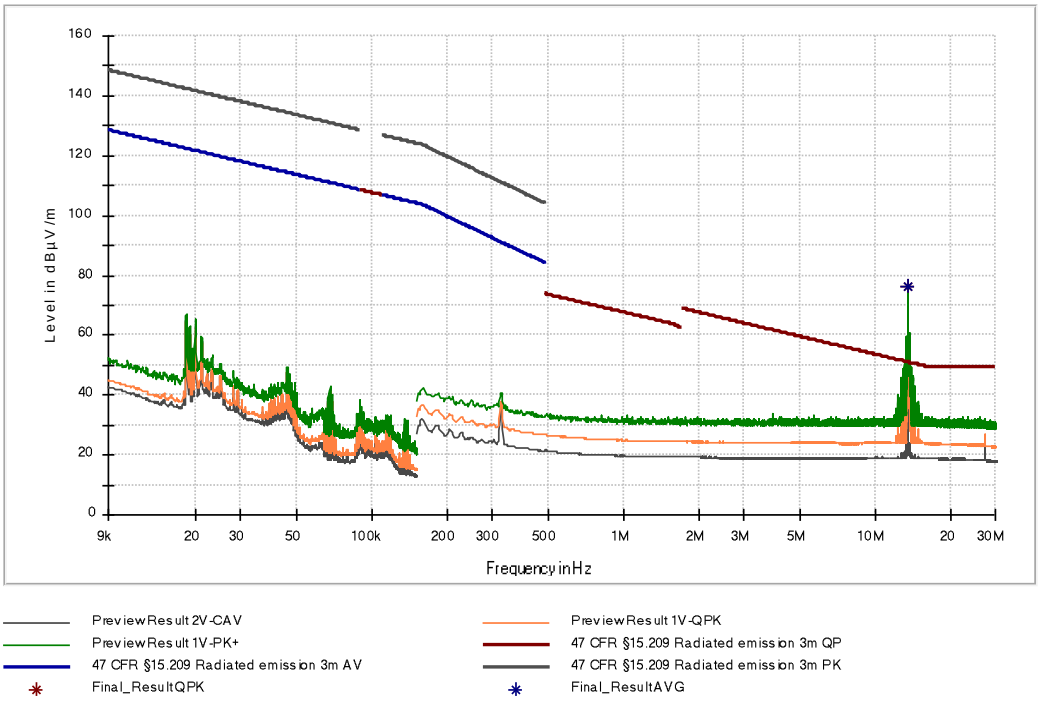


Figure 41: Chart of emissions test below 30 MHz with tag on antenna 2063508:4500 small in position 2, measurement antenna in line @ 3 m

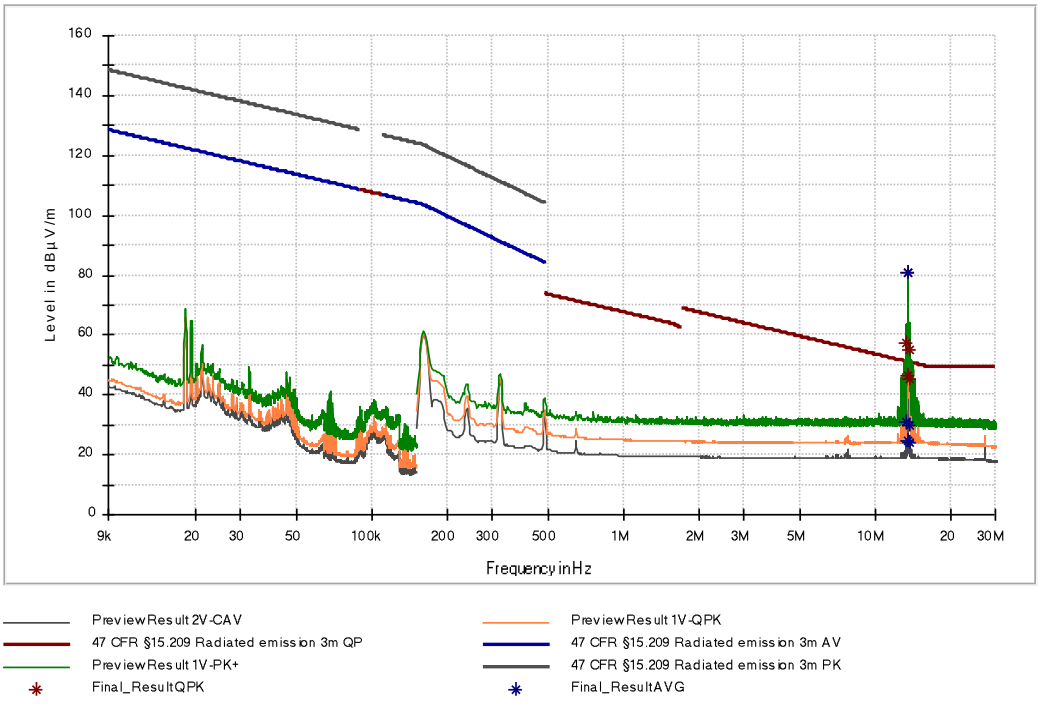


Figure 42: Chart of emissions test below 30 MHz with tag on antenna 2063509:4502 large in position 2, measurement antenna in line @ 3 m

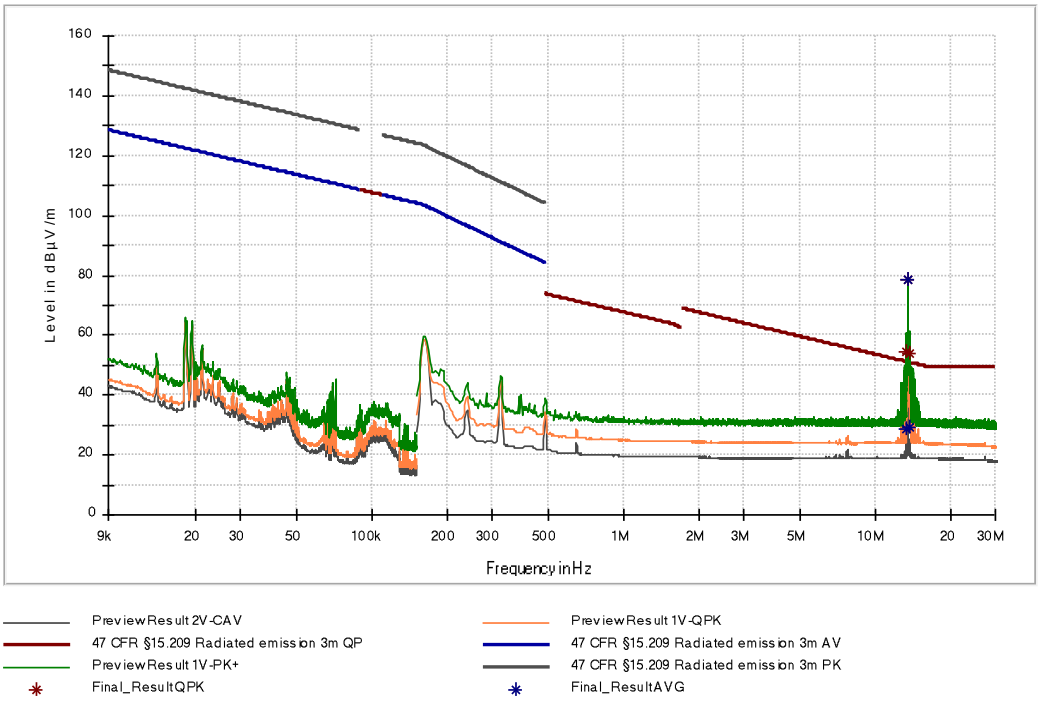


Figure 43: Chart of emissions test below 30 MHz with tag on antenna 2063509:4502 small in position 2, measurement antenna in line @ 3 m

6.6.1.5 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

Result[14]: ☒ Test passed ☐ Test not passed

6.6.1.6 Test equipment

	Type	*Designation*	*Manufacturer*	*Inventory no.*
☒	Semi-anechoic chamber (SAC)	SAC3	Albatross Projects	E00716
☐	Free space semi-anechoic chamber (FS-SAC)	FS-SAC	EMV **TESTHAUS**	E00100
☐	EMI test receiver (CDC)	ESCI 3	Rohde & Schwarz	E00552
☐	EMI test receiver (OATS)	ESCI 3	Rohde & Schwarz	E00001
☐	EMI test receiver	ESR 7	Rohde & Schwarz	E00739
☐	EMI test receiver	ESU 26	Rohde & Schwarz	W00002
☒	EMI test receiver	ESW 44	Rohde & Schwarz	E00895
☐	Preamplifier (1 GHz - 18 GHz)	ALS05749	Aldetec	W01007
☐	TRILOG broadband antenna (CDC)	VULB 9160	Schwarzbeck	E00011
☐	TRILOG broadband antenna (OATS)	VULB 9163	Schwarzbeck	E00013
☒	TRILOG broadband antenna (SAC)	VULB 9162	Schwarzbeck	E00643
☐	Horn antenna	BBHA 9120D	Schwarzbeck	W00052
☐	Horn antenna	BBHA 9170	Schwarzbeck	W00054
☒	Cable set SAC	RF cable(s)	Huber + Suhner	E00755 E01033 E01034
☐	Cable set FS-SAC	RF cable(s)	Teledyne Reynolds Huber + Suhner Teledyne Reynolds	E00435 E00307 E00433
☐	Test software	EMC32-EB (V10.35)	Rohde & Schwarz	E00777
☐	Test software	EMC32-MEB (V10.35)	Rohde & Schwarz	E00778
☒	Test software	EMC32-MEB (V10.35)	Rohde & Schwarz	E01073

[14] For information about measurement uncertainties see page 92.

6.6.1.7 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 42: General radiated emission limits ≥ 30 MHz according to §15.209

6.6.1.8 Test procedure

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

☒ test procedure for radiated measurements as described in clause 5.4.

6.6.1.9 Test results

Performed by:	Andreas Menacher	Date(s) of test:	April 4, 2019
Climatic conditions:	Ambient temperature 22 °C	Relative humidity 33%	Barometric pressure 978 hPa
Test distance:	☒ 3 m	☐ 10 m	☐ ….. m
EUT position[15]:	☒ 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

[15] 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.

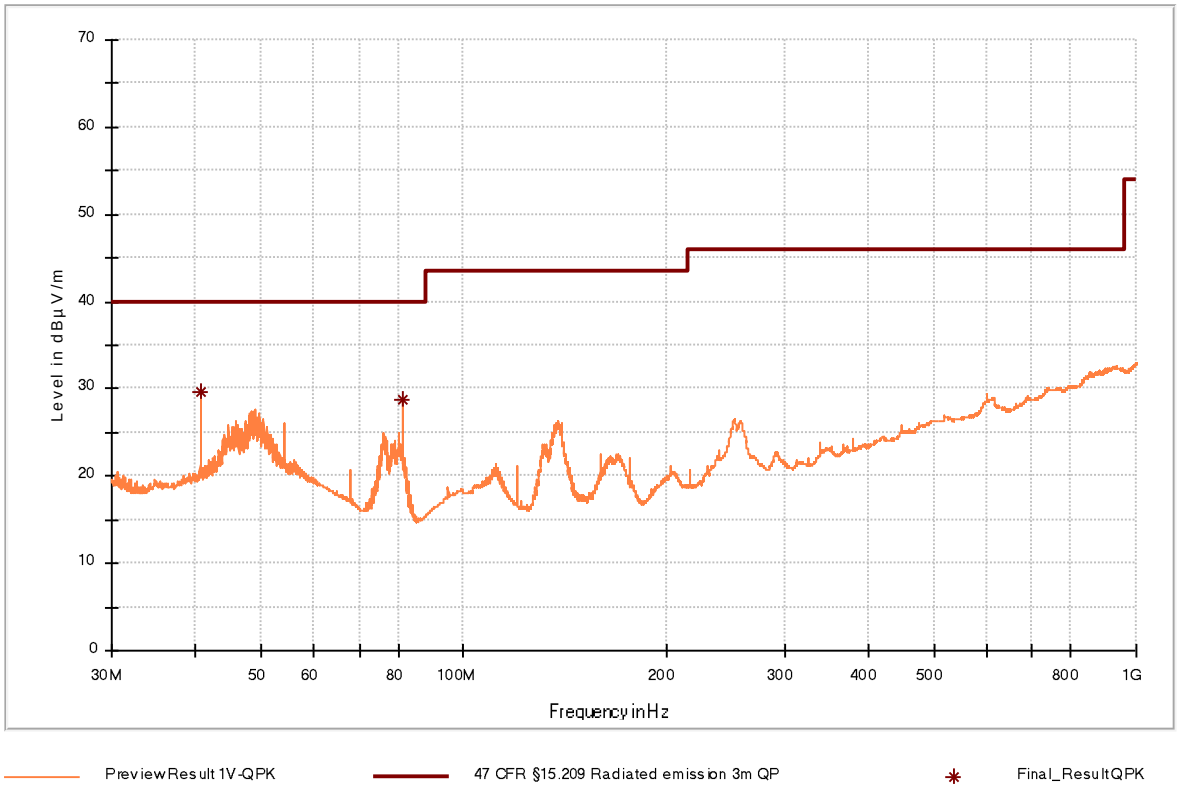


Figure 44: Chart of radiated emissions test from 30 MHz to 1 GHz with tag on antenna 2063510:4498 in position 2, measurement antenna vertical

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
40.680000	29.72	40.00	10.28	1000.0	120.000	100.0	V	60.0	13.5
81.360000	28.80	40.00	11.20	1000.0	120.000	150.0	V	204.0	7.9

Table 43: Final results of radiated emissions test from 30 MHz to 1 GHz with tag on antenna 2063510:4498 in position 2, measurement antenna vertical

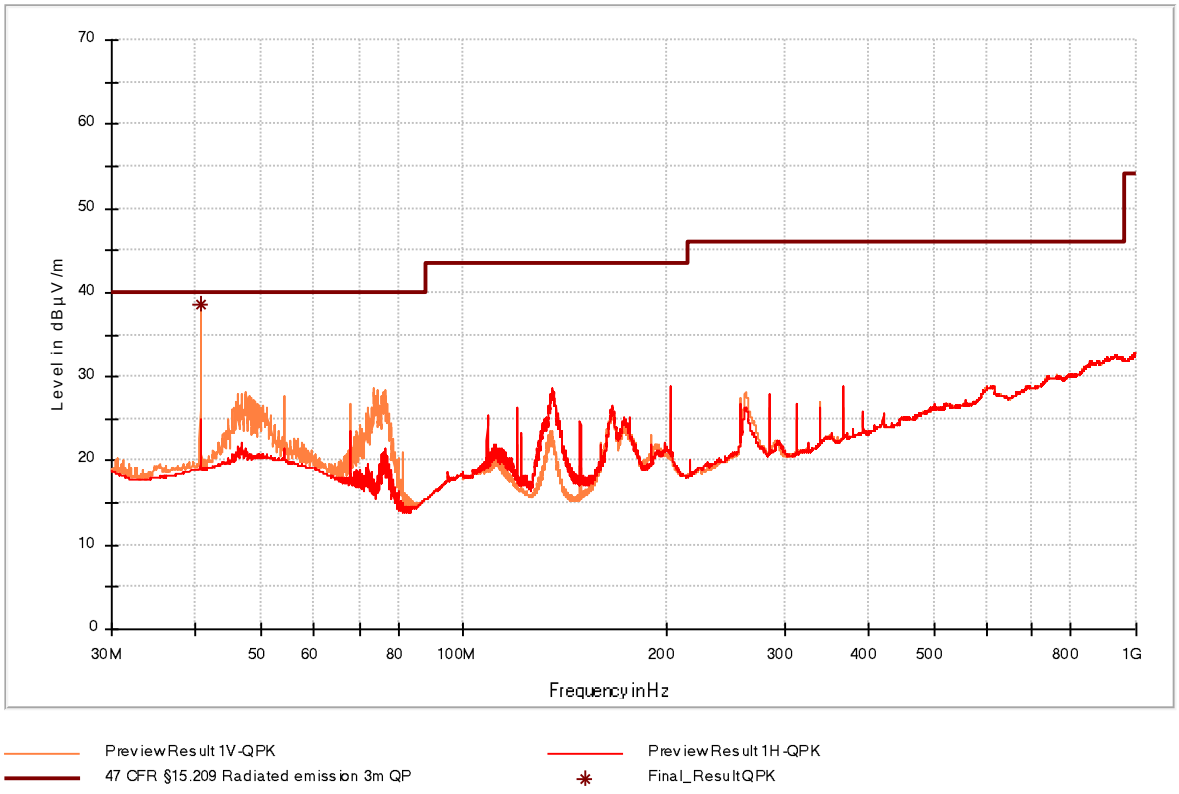


Figure 45: Chart of radiated emissions test from 30 MHz to 1 GHz with tag on antenna 2063511:4499 in position 3, measurement antenna vertical + horizontal

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
40.680000	38.68	40.00	1.32	1000.0	120.000	100.0	V	17.0	13.5

Table 44: Final results of radiated emissions test from 30 MHz to 1 GHz with tag on antenna 2063511:4499 in position 3, measurement antenna vertical + horizontal

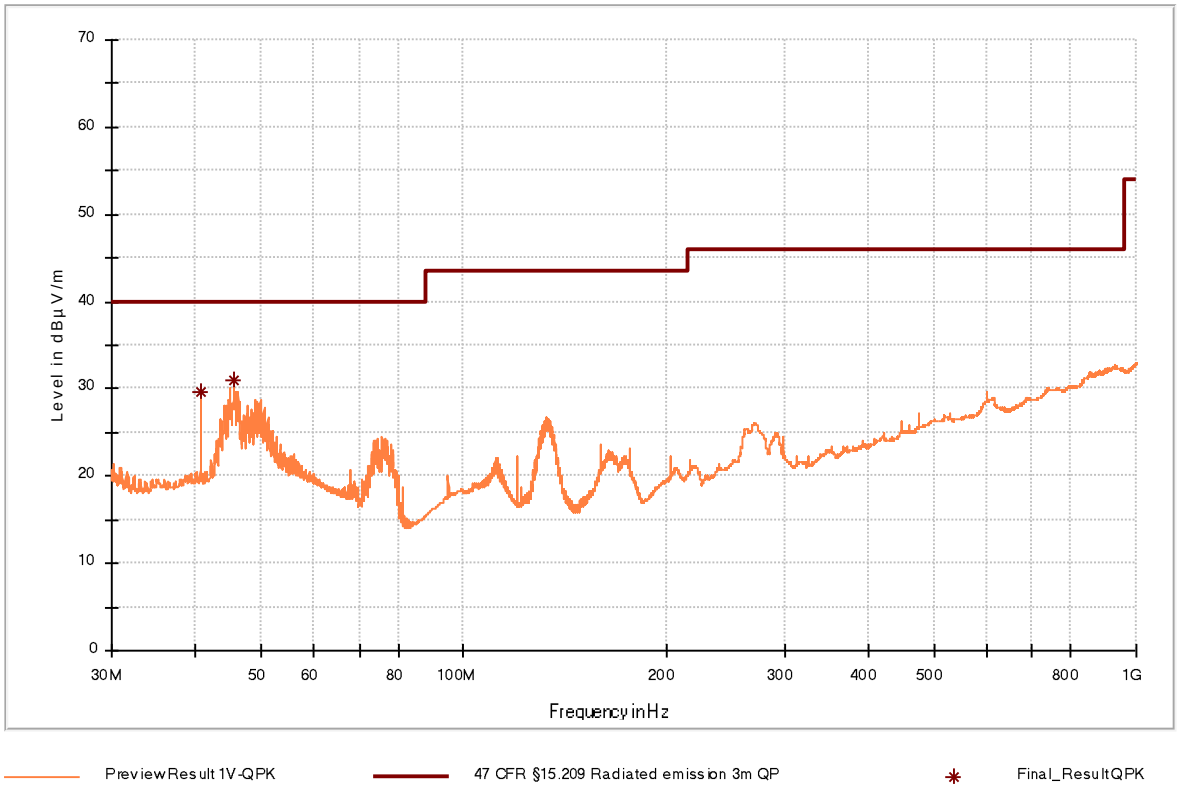


Figure 46: Chart of radiated emissions test from 30 MHz to 1 GHz with tag on antenna 2063508:4500 large in position 2, measurement antenna vertical

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
40.680000	29.74	40.00	10.26	1000.0	120.000	128.0	V	274.0	13.5
45.660000	30.96	40.00	9.04	1000.0	120.000	100.0	V	38.0	14.5

Table 45: Final results of radiated emissions test from 30 MHz to 1 GHz with tag on antenna 2063508:4500 large in position 2, measurement antenna vertical

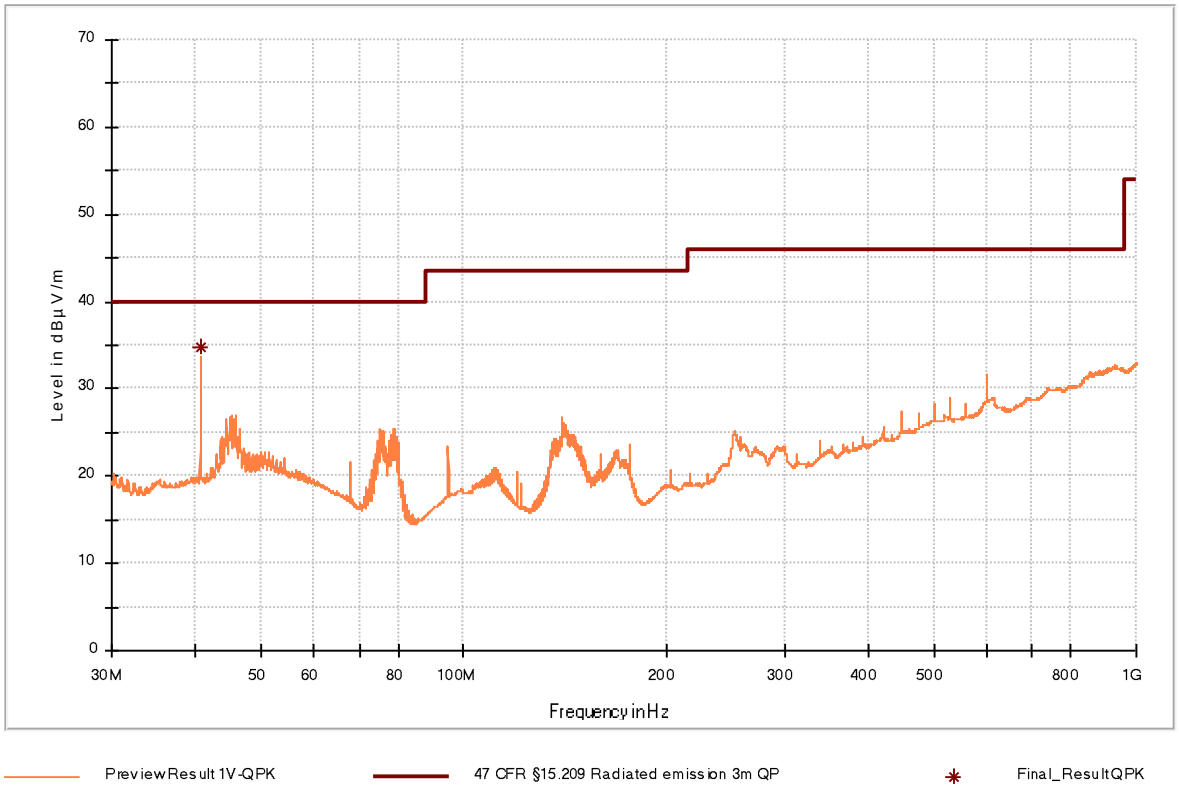


Figure 47: Chart of radiated emissions test from 30 MHz to 1 GHz with tag on antenna 2063508:4500 small in position 2, measurement antenna vertical

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
40.680000	34.80	40.00	5.20	1000.0	120.000	100.0	V	303.0	13.5

Table 46: Final results of radiated emissions test from 30 MHz to 1 GHz with tag on antenna 2063508:4500 small in position 2, measurement antenna vertical

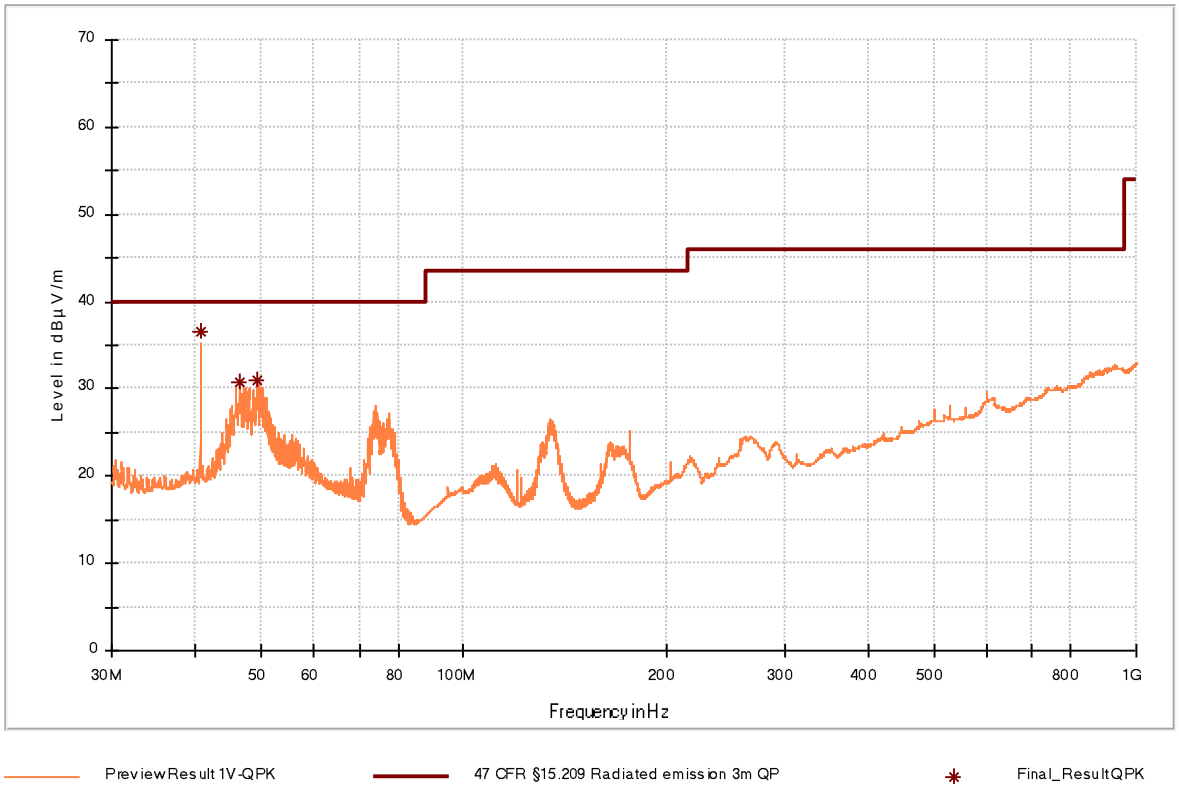


Figure 48: Chart of radiated emissions test from 30 MHz to 1 GHz with tag on antenna 2063509:4502 large in position 2, measurement antenna vertical

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
40.680000	36.48	40.00	3.52	1000.0	120.000	100.0	V	274.0	13.5
46.620000	30.84	40.00	9.16	1000.0	120.000	101.0	V	0.0	14.6
49.410000	30.95	40.00	9.05	1000.0	120.000	101.0	V	138.0	14.7

Table 47: Final results of radiated emissions test from 30 MHz to 1 GHz with tag on antenna 2063509:4502 large in position 2, measurement antenna vertical

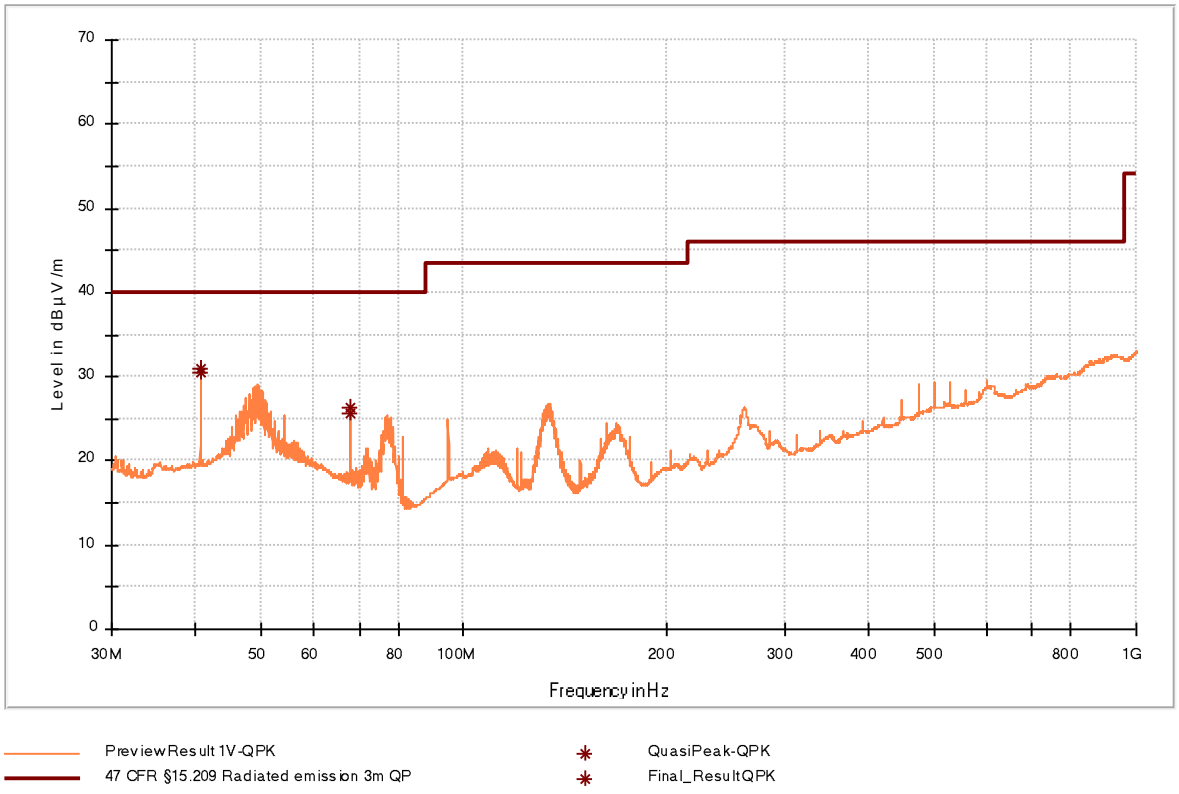


Figure 49: Chart of radiated emissions test from 30 MHz to 1 GHz with tag on antenna 2063509:4502 small in position 2, measurement antenna vertical

Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB/m)
40.680000	30.52	40.00	9.48	1000.0	120.000	100.0	V	285.0	13.5
67.800000	26.28	40.00	13.72	1000.0	120.000	100.0	V	89.0	11.4

Table 48: Final results of radiated emissions test from 30 MHz to 1 GHz with tag on antenna 2063509:4502 small in position 2, measurement antenna vertical

7 Equipment calibration status

Description	*Modell number*	*Serial number*	*Inventory number(s)*	*Last calibration*	*Next calibration*
EMI test receiver	ESW44	101538	E00895	2018-04	2019-04
EMI test receiver	ESCI3	100013	E00001	2018-05	2020-05
EMI test receiver	ESCI3	100328	E00552	2018-10	2020-10
EMI test receiver	ESR7	101059	E00739	2018-08	2019-08
Loop antenna	HFH2-Z2	871398/0050	E00060	2016-09	2018-09
TRILOG broadband antenna (SAC3)	VULB 9162	9162-041	E00643	2018-03	2021-03
LISN	ESH2-Z5	893406/009	E00005	2018-10	2020-10
Magnetic field probe	RF-R 400-1	02.2030	E00270	N/A (see note 1)	
Shielded room	P92007	B 83117 C 1109 T 211	E00107	N/A	
Climatic chamber	VC³ 4034	58566123250010	C00015	2018-08	2020-08
Compact diagnostic chamber (CDC)	VK041.0174	D62128-A502-A69-2-0006	E00026	N/A	
Semi-anechoic chamber (SAC) with floor absorbers	FS-SAC	---	E00100	2018-03	2021-03
Semi-anechoic chamber (SAC)	SAC3	C62128-A520-A643-x-0006	E00716	2018-03	2021-03
Cable set CDC	RG214/U	---	E00446	2018-04	2019-04
	LCF12-50J	---	E01215	2018-04	2019-04
	LMR400	1718020006	E00920	2018-01	2019-01
	RG214 Hiflex	171802007	E00921	2018-01	2019-01
Cable set of semi-anechoic chamber SAC3	SF104EA/11PC35/11PC35/10000MM	501347/4EA	E00755	2017-12	2018-12
	SF104E/11PC35/11PC35/2000MM	507410/4E	E01033	2017-12	2018-12
	SF104E/11PC35/11PC35/2000MM	507411/4E	E01034	2017-09	2018-09

Note 1: Used for relative measurements only (see test instruments for clause 6.2, 6.3 and 6.5).

8 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.

9 Revision history

Revision	*Date*	*Issued by*	*Description of modifications*
0	2019-06-06	Andreas Menacher	First edition