# Report on the FCC and IC Testing of the ART S.p.A. Android Auto and Car play system integration device with BT functionality. Model: TSU In accordance with FCC 47 CFR Part 15C, and ISED RSS-247, and ISED RSS-GEN

Product Service

Add value.
Inspire trust.

Prepared for: ART S.p.A.
Voc. Peschiello, 20
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FCC ID: 2AUGZTSU
IC: 25426-TSU

## COMMERCIAL-IN-CONFIDENCE

Date: 2020-08-21
Document Number: TR-69559-79827-01 | Issue: 05

| RESPONSIBLE FOR | NAME | DATE | SIGNATURE |
|---|---|---|---|
| **Project Management** | Martin Steindl | 2020-08-20 | i.V. SIGN-ID 352850 |
| **Authorised Signatory** | Alex Fink | 2020-08-20 | SIGN-ID 391471 |

Signatures in this approval box have checked this document in line with the requirements of TÜV SÜD Product Service document control rules.

**ENGINEERING STATEMENT**
The measurements shown in this report were made in accordance with the procedures described on test pages. All reported testing was carried out on a sample equipment to demonstrate limited compliance with FCC 47 CFR Part 15C. The sample tested was found to comply with the requirements defined in the applied rules.

| RESPONSIBLE FOR | NAME | DATE | SIGNATURE |
|---|---|---|---|
| **Testing** | Martin Steindl | 2020-08-20 | i.V. SIGN-ID 352850 |

Laboratory Accreditation
DAkkS Reg. No. D-PL-11321-11-02
DAkkS Reg. No. D-PL-11321-11-03

Laboratory recognition
Registration No. BNetzA-CAB-16/21-15

Industry Canada test site registration
3050A-2

**EXECUTIVE SUMMARY**
A sample of this product was tested and found to be compliant with FCC 47 CFR Part 15C:2019 and RSS-247, Issue 2, 2017-03, and RSS-GEN, Issue 5, Amendment 1, 2019-03

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Product Service

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# 1 Report Summary

## 1.1 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

| Issue | Description of Change | Date of Issue |
|---|---|---|
| 1 | First Issue | 2020-02-07 |
| 2 | Added references to ISED standards | 2020-03-13 |
| 3 | Added FCC and IC IDs<br>Updated FCC and KdB standard references<br>Moved photo of marking plate in to section 1.2, Renamed Annex A to “Photographs of test setups”.<br>Added note to photo of test setup 1 GHz – 40 GHz<br>Added note on page 2. | 2020-04-17 |
| 4 | Corrected typo in FCC ID | 2020-07-16 |
| 5 | Corrected typo in FCC ID | 2020-08-20 |

**Table 1**

## 1.2 Introduction

| | |
|---|---|
| Applicant | ART S.p.A. |
| Manufacturer | ART S.p.A. |
| Model Number(s) | TSU |
| Serial Number(s) | AFTSU000324 and<br>AFTSU0034C6 (For WLAN 5 GHz, 1 GHz – 13 GHz, only) |
| Note: | Mr. Nicola Scartapacchio, representing Fakt S.p.A. attended tests on 2020-02-06. The EUTs were under his care on this day. |
| Hardware Version(s) | 1.0 |
| Software Version(s) | 99.09.00 |
| Number of Samples Tested | 2 |
| Test Specification/Issue/Date | FCC 47 CFR Part 15C:2019<br>ISED RSS-247, Issue 2, 2017-03<br>ISED RSS-GEN, Issue 5, Amendment 1, 2019-03 |
| Test Plan/Issue/Date | --- |
| Order Number<br>Date | 2020-01-22 |
| Date of Receipt of EUT | 2019-10-31 (AFTSU000324) and<br>2020-02-06 (AFTSU0034C6) |
| Start of Test | 2020-01-23 |
| Finish of Test | 2020-02-06 |
| Name of Engineer(s) | Martin Steindl |
| Related Document(s) | ANSI C63.10 (2013)<br>KDB 558074 D01 V05r02 |

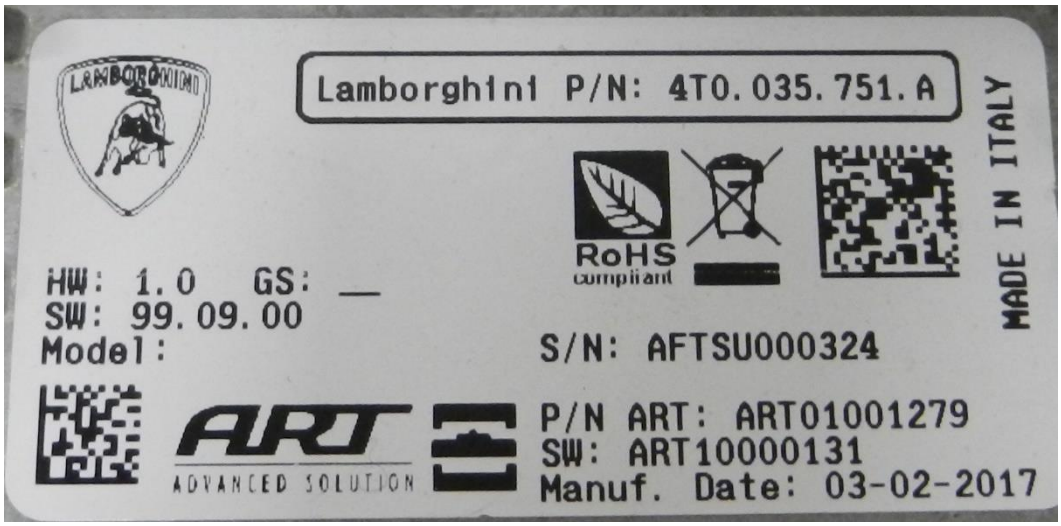



Photo of marking plate

## 1.3 Brief Summary of Results

A brief summary of the tests carried out in accordance with FCC 47 CFR Part 15C and ISED RSS-247 is shown below.

| Section | Specification Clause | Test Description | Result | Comments/Base Standard |
|---|---|---|---|---|
| Configuration and Mode: Stand alone configuration Transmitting continuously, Bluetooth | | | | |
| 2.1 | 15.209, 15.247<br>RSS-247, Section 5.5 | Radiated Emissions (General Requirements) | Pass | |
| Configuration and Mode: Stand alone configuration Transmitting continuously, WLAN 2.4 GHz | | | | |
| 2.1 | 15.209, 15.247<br>RSS-247, Section 5.5 | Radiated Emissions (General Requirements) | Pass | |
| Configuration and Mode: Stand alone configuration Transmitting continuously, WLAN 5 GHz | | | | |
| 2.1 | 15.209, 15.407<br>RSS-247, Section 6.2.3.2 | Radiated Emissions (General Requirements) | Pass | |

**Table 2**

Product Service

## 1.4 EUT Modification Record

The table below details modifications made to the EUT during the test programme.
The modifications incorporated during each test are recorded on the appropriate test pages.

| Modification State | Description of Modification still fitted to EUT | Modification Fitted By | Date Modification Fitted |
|---|---|---|---|
| 0 | As supplied by the customer | Not Applicable | Not Applicable |
| 0 | As supplied by the customer | Not Applicable | Not Applicable |

**Table 3**

## 1.5 Test Location

TÜV SÜD Product Service conducted the following tests at our Straubing Test Laboratory.

| Test Name | Name of Engineer(s) |
|---|---|
| Configuration and Mode: Stand alone configuration Transmitting continuously, Bluetooth | |
| Radiated Emissions (General Requirements) | Martin Steindl |
| Configuration and Mode: Stand alone configuration Transmitting continuously, WLAN 2.4 GHz | |
| Radiated Emissions (General Requirements) | Martin Steindl |
| Configuration and Mode: Stand alone configuration Transmitting continuously, WLAN 5 GHz | |
| Radiated Emissions (General Requirements) | Martin Steindl |

**Table 4**

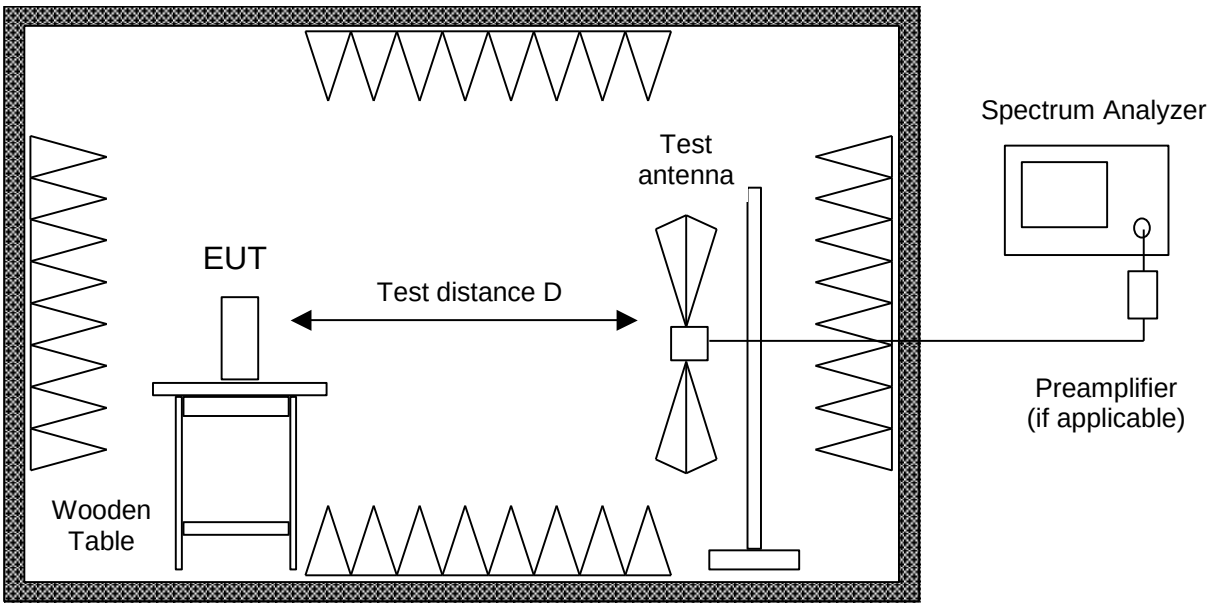
Office Address:

Äußere Frühlingstraße 45

94315 Straubing
Germany

# 2 Test Setups

#### 2.1.1.1 Radiated Emission in Fully or Semi Anechoic Room




Fully or semi anechoic room

Radiated emission in fully or semi anechoic room is measured in the frequency range from 30 MHz to the maximum frequency as specified in CFR 47 Part 15 section 15.33.

Measurements are made in both the horizontal and vertical planes of polarization using a spectrum analyzer with the detector function set to peak and resolution as well as video bandwidth set to 100 kHz (below 1 GHz) or 1 MHz (above 1 GHz).

Testing up to 1 GHz is performed with a linear polarized logarithmic periodic antenna combined with a 4:1 broadband dipole ("Trilog broadband antenna"). For testing above 1 GHz horn antennas are used.

All tests below 8.2 GHz are performed at a test distance D of 3 meters. For higher frequencies the test distance may be reduced (e.g. to 1 meter) due to the sensitivity of the measuring instrument(s) and the test results are calculated according to CFR 47 Part 15 section 15.31(f)(1) using an extrapolation factor of 20 dB/decade. If required, preamplifiers are used for the whole frequency range. Special care is taken to avoid overload, using appropriate attenuators and filters, if necessary.

If the radiated emission limits are expressed in terms of the average value of the emission there also is a peak limit corresponding to 20 dB above the maximum permitted average limit. Additionally, if pulsed operation is employed, the average field strength is determined by averaging over one complete pulse train, including blanking intervals, as specified in CFR 47 Part 15 section 15.35(c). If the pulse train exceeds 0.1 second that 0.1 second interval during which the value of the emission is at its maximum is selected for calculation. The pulse train correction is added to the peak value of the emission to get the average value.

Hand-held or body-worn devices are rotated through three orthogonal axes to determine which attitude and configuration produces the highest emission relative to the limit and therefore shall be used for final testing.

During testing the EUT is rotated all around to find the maximum levels of emissions. Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.

For final testing below 1 GHz a semi anechoic room complying with the NSA requirements of ANSI C63.4 for alternative test sites is used (see 2.1.1.2). If prescans are recorded in fully anechoic room they are indicated appropriately.

Radiated emission in the frequency range 9 kHz to 30 MHz is measured using an active loop antenna. First the whole spectrum of emission caused by the equipment is recorded at a distance of 3 meters in a

fully or semi anechoic room with the detector of the spectrum analyzer or EMI receiver set to peak. This configuration is also used for recording the spectrum of intentional radiators.

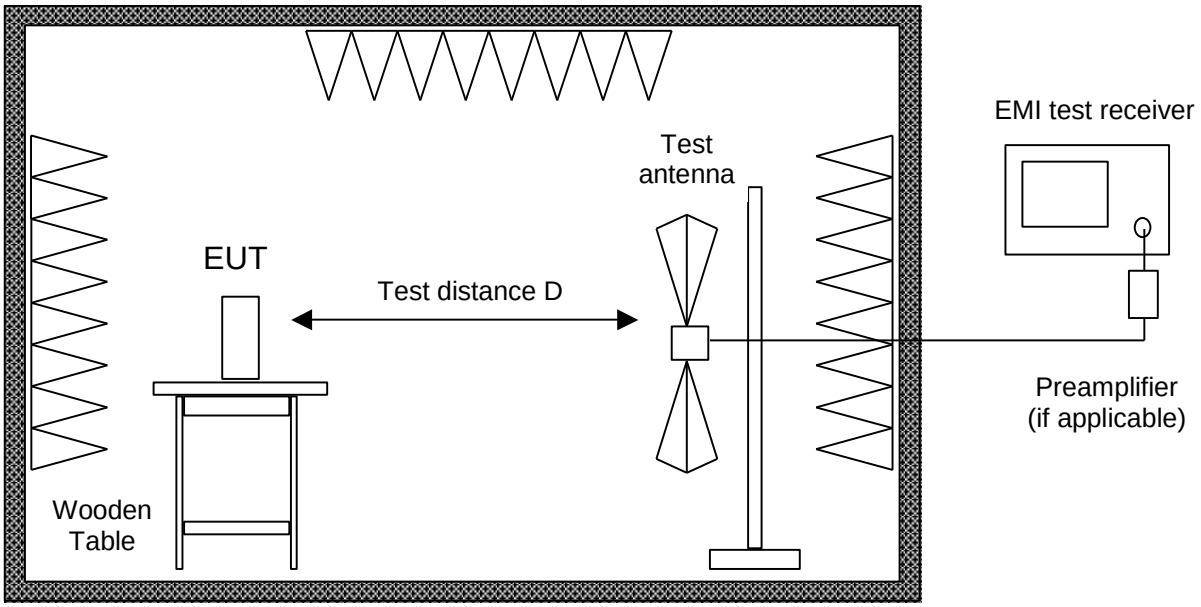
Hand-held or body-worn devices are rotated through three orthogonal axes to determine which attitude and configuration produces the highest emission relative to the limit and therefore shall be used for final testing.

EUT is rotated all around to find the maximum levels of emissions. Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.
If worst case emission of the EUT cannot be recorded with EUT in standard position and loop antenna in vertical polarization the EUT (or the radiating part of the EUT) is rotated by 90 degrees instead of changing the loop antenna to horizontal polarization. This procedure is selected to minimize the influence of the environment (e.g. effects caused by the floor especially with longer distances).

Final measurement is performed at a test distance D of 30 meters using an open field test site. In case the regulation requires testing at other distances, the result is extrapolated by either making measurements at an additional distance D of 10 meters to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). In cases of very low emissions measurements are performed at shorter distances and results are extrapolated to the required distance. The provisions of CFR 47 Part 15 sections 15.31(d) and (f)(2) apply. According to CFR 47 Part 15 section 15.209(d) final measurement is performed with detector function set to quasi-peak except for the frequency bands 9 to 90 kHz and 110 to 490 kHz where, for non-pulsed operation, average detector is employed.

If the radiated emission limits are expressed in terms of the average value of the emission there also is a peak limit corresponding to 20 dB above the maximum permitted average limit. Additionally, if pulsed operation is employed, the average field strength is determined by averaging over one complete pulse train, including blanking intervals, as specified in CFR 47 Part 15 section 15.35(c). If the pulse train exceeds 0.1 second that 0.1 second interval during which the value of the emission is at its maximum is selected for calculation. The pulse train correction is added to the peak value of the emission to get the average value.

#### 2.1.1.2 Radiated Emission at Alternative Test Site




Alternate test site (semi anechoic room)

Radiated emission in the frequency range 30 MHz to 1 GHz is measured within a semi-anechoic room with groundplane complying with the NSA requirements of ANSI C63.4 for alternative test sites. A linear polarized logarithmic periodic antenna combined with a 4:1 broadband dipole ("Trilog broadband antenna") is used. The measurement bandwidth of the test receiver is set to 120 kHz with quasi-peak detector selected.

If the radiated emission limits are expressed in terms of the average value of the emission there also is a peak limit corresponding to 20 dB above the maximum permitted average limit. Additionally, if pulsed operation is employed, the average field strength is determined by averaging over one complete pulse train, including blanking intervals, as specified in CFR 47 Part 15 section 15.35(c). If the pulse train exceeds 0.1 second that 0.1 second interval during which the value of the emission is at its maximum is selected for calculation. The pulse train correction is added to the peak value of the emission to get the average value.

Hand-held or body-worn devices are tested in the position producing the highest emission relative to the limit as verified by prescans in fully anechoic room.

If no prescan in a fully anechoic room is used first a peak scan is performed in four positions to get the whole spectrum of emission caused by EUT with the measuring antenna raised and lowered from 1 to 4 m to find table position, antenna height and antenna polarization for the maximum emission levels. Data reduction is applied to these results to select those levels having less margin than 10 dB to or exceeding the limit using subranges and limited number of maximums. Further maximization is following.
With detector of the test receiver set to quasi-peak final measurements are performed immediately after frequency zoom (for drifting disturbances) and maximum adjustment.
Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.

In cases where prescans in a fully anechoic room are taken (e. g. if EUT is operating for a short time only or battery is dircharged quickly) final measurements with quasi-peak detector are performed manually at frequencies indicated by prescan with EUT rotating all around and receiving antenna raising and lowering within 1 meter to 4 meters to find the maximum levels of emission.
Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.

For measuring emissions of intentional radiators and receivers a test distance D of 3 meters is selected. Testing of unintentional radiators is performed at a distance of 10 meters. If limits specified

for 3 meters shall be used for measurements performed at 10 meters distance the limits are calculated according to CFR 47 Part 15 section 15.31(d) and (f)(1) using an inverse linear-distance extrapolation factor of 20 dB/decade.

# 3 Test Details

## 3.1 Radiated Emissions (General Requirements)

### 3.1.1 Specification Reference

FCC 47 CFR Part 15C, Clause 15.209
ISED RSS-247, Sections 5.5 and 6.2.3.2

### 3.1.2 Equipment Under Test and Modification State

TSU, S/N: AFTSU000324 - Modification State 0
TSU, S/N: AFTSU0034C6 - Modification State 0

### 3.1.3 Date of Test

2020-01-23 to 2020-02-06

### 3.1.4 Test Method

The EUT was set up in a semi-anechoic chamber on a remotely controlled turntable and placed on a non-conductive table 0.8m above a reference ground plane for frequencies up to 1 GHz and 1.5 m above reference ground plane for frequencies above 1 GHz. A pre-scan of the EUT emissions profile was made while varying the antenna-to-EUT azimuth and antenna-to-EUT polarization using a peak detector. Using the pre-scan list of the highest emissions detected, their bearing and associated antenna polarization, the EUT was then formally measured using a Quasi-Peak, Peak, Average detector as appropriate. The readings were maximized by adjusting the antenna height, polarization and turntable azimuth, in accordance with the specification.

| *Frequency range:* | *Test distance:* | *Antenna:* |
|---|---|---|
| 9 kHz – 30 MHz: | 3 m | HFH2-Z2 |
| 30 MHz – 1 GHz: | 3 m | HL562E |
| 1 GHz – 13 GHz: | 3 m | HF907 |
| 13 GHz – 18 GHz: | 1 m | HF907 |
| 18 GHz – 40 GHz: | 3 m | LB-180400H-KF+ TS-LNA1840 |

### 3.1.5 Environmental Conditions

| | |
|---|---|
| Ambient Temperature | 22.0 °C |
| Relative Humidity | 30.0 % |

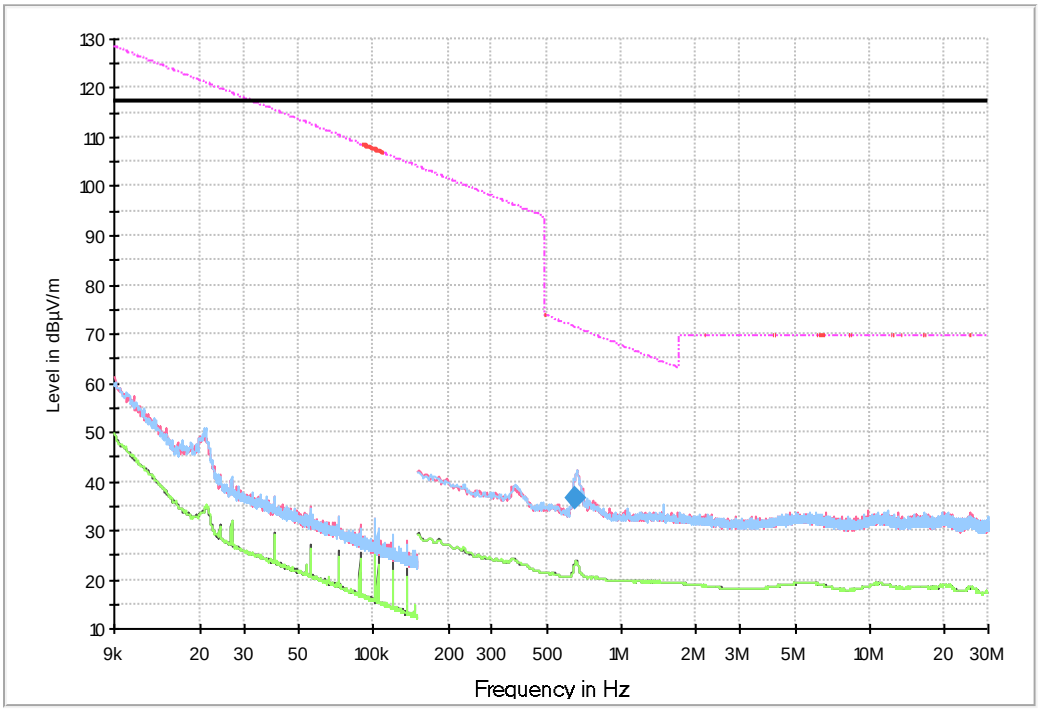
### 3.1.6 Test Results

Stand alone configuration Transmitting continuously and Bluetooth

Limit line outside restricted bands of operations is -20 dBc (peak value relative to carrier emission). For test distances other than 3 m the limit is extrapolated with 40 dB/decade for frequencies less than 30 MHz and 20 dB/decade for frequencies of 30 MHz and above.

Sample calculation of final values:

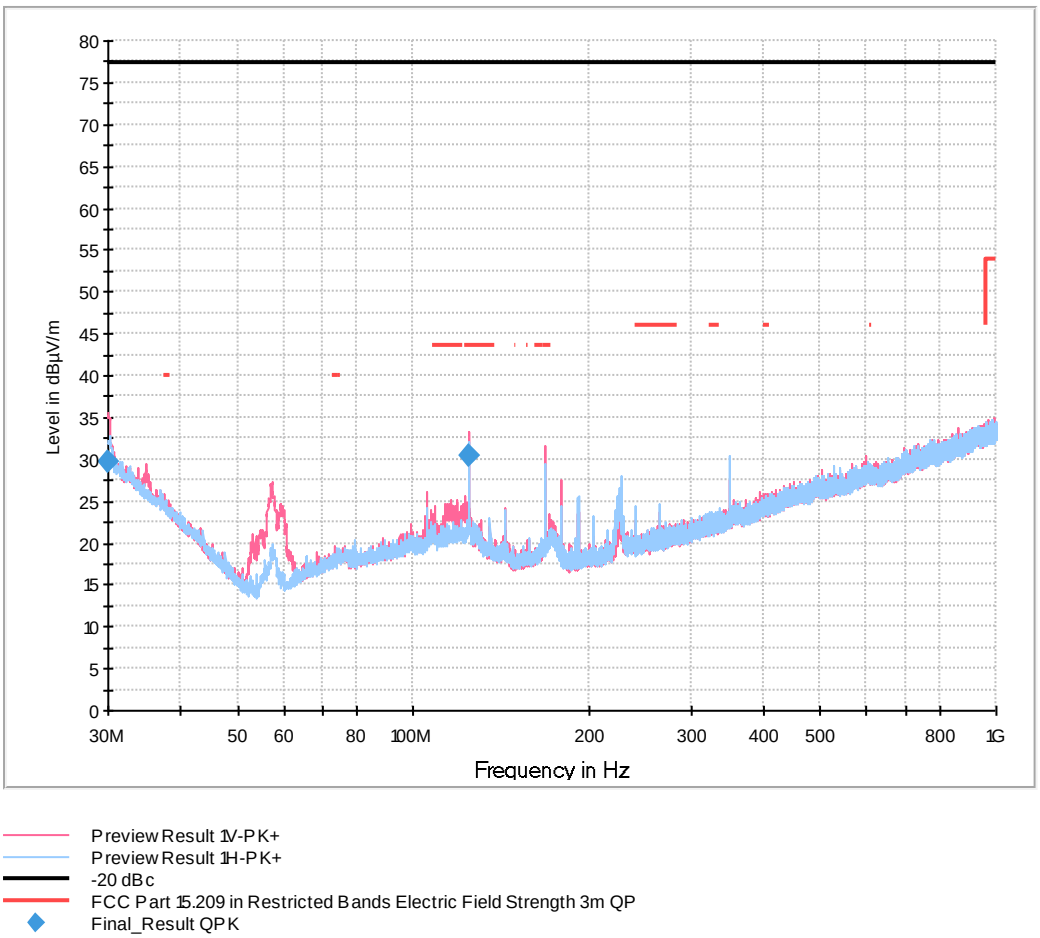
Final Value (dBµV/m) = Reading Value (dBµV
+ ( Cable correction Factor (dB)
+ Antenna Correction Factor (dB/m) )



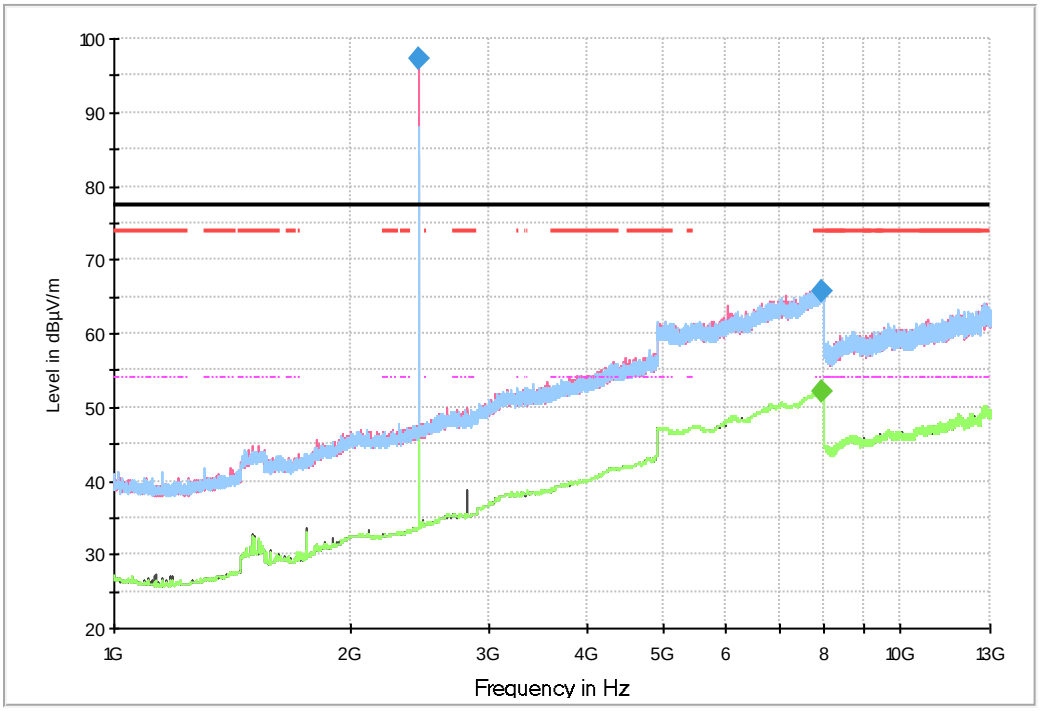

Preview Result 2V-AVG
Preview Result 1V-PK+
Preview Result 2H-AVG
Preview Result 1H-PK+
FCC Part 15C Electric Field Strength 3m QP+AV (9k-30M)
-20 dBc (30m to 3m corr.)
Final_Result QPK
Final_Result CAV
FCC Part 15.209 in Restricted Bands Electric Field Strength 3m QP+AV (9k-30M)

| *Frequency* *MHz* | *QuasiPeak* *dBµV/m* | *CAverage* *dBµV/m* | *Limit* *dBµV/m* | *Margin* *dB* | *Meas. Time* *ms* | *Bandwidth* *kHz* | *Height* *cm* | *Pol* | *Azimuth* *deg* | *Corr.* *dB* |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.654000 | 36.49 | | 117.31 | 80.82 | 1000.0 | 9.000 | 100.0 | V | -70.0 | 19.8 |

Note: -20dBc limit for frequency range 9 kHz – 490 kHz is 157.31 dBµV/m and is not shown in diagram since not relevant.



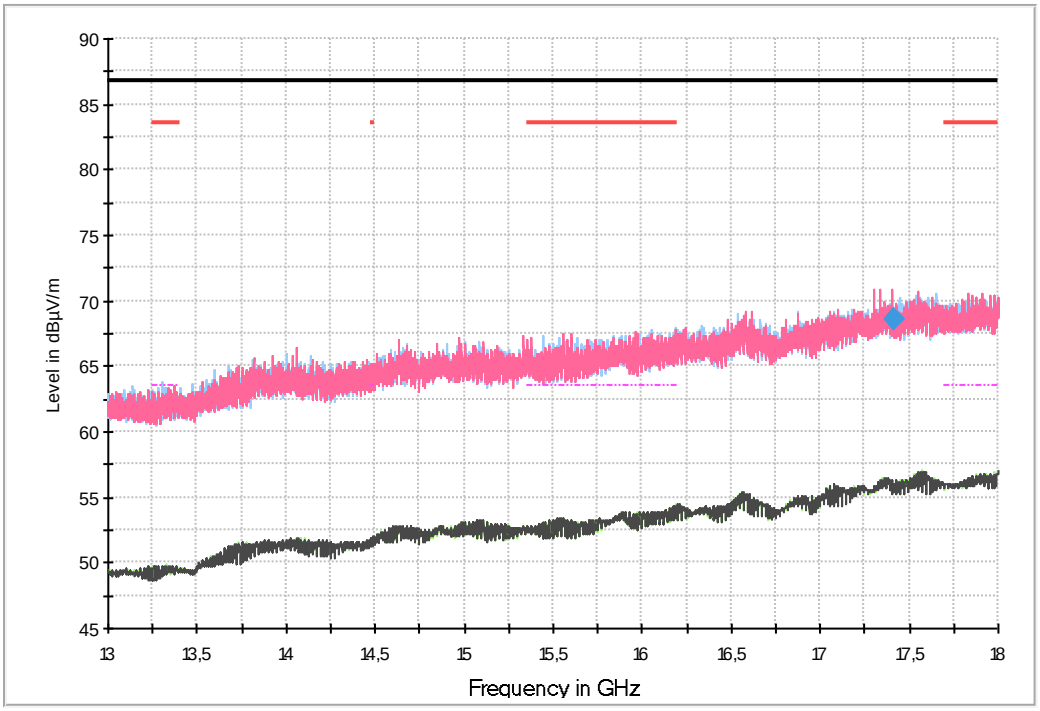

| Frequency MHz | QuasiPeak dBµV/m | Limit dBµV/m | Margin dB | Meas. Time ms | Bandwidth kHz | Height cm | Pol | Azimuth deg | Corr. dB/m |
|---|---|---|---|---|---|---|---|---|---|
| 30.000000 | 29.65 | 77.31 | 47.66 | 1000.0 | 120.000 | 100.0 | V | 183.0 | 25.8 |
| 125.010000 | 30.48 | 43.52 | 13.04 | 1000.0 | 120.000 | 396.0 | V | -17.0 | 17.9 |




Preview Result 2V-AVG
Preview Result 1V-PK+
Preview Result 2H-AVG
Preview Result 1H-PK+
-20 dBc
FCC Part 15.209 in Restricted Bands Electric Field Strength 3m PK
FCC Part 15.209 in Restricted Bands Electric Field Strength 3m AV
Final_Result PK+
Final_Result CAV

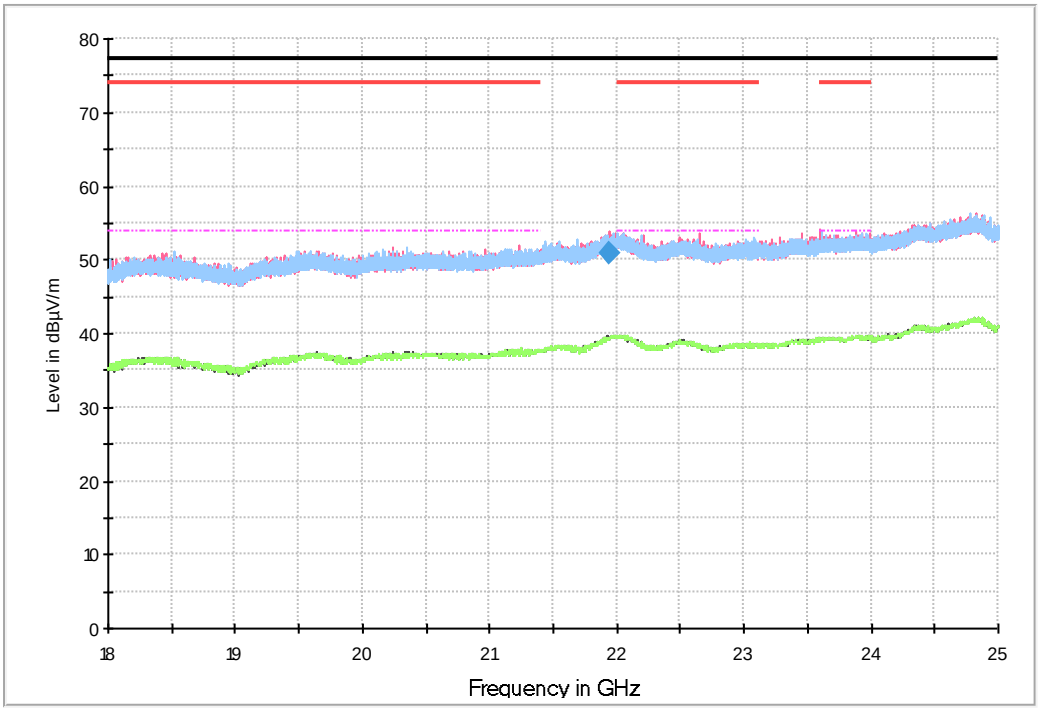
| *Frequency* *MHz* | *MaxPeak* *dBµV/m* | *CAverage* *dBµV/m* | *Limit* *dBµV/m* | *Margin* *dB* | *Meas. Time* *ms* | *Bandwidth* *kHz* | *Height* *cm* | *Pol* | *Azimuth* *deg* | *Corr.* *dB* |
|---|---|---|---|---|---|---|---|---|---|---|
| 2440.750000 | 97.31 | | * | --- | 1000.0 | 1000.000 | 203.0 | V | -48.0 | 32.6 |
| 7954.250000 | 65.67 | | 77.31 | 11.64 | 1000.0 | 1000.000 | 350.0 | H | -91.0 | 43.4 |
| 7954.250000 | | 52.12 | ** | --- | 1000.0 | 1000.000 | 350.0 | H | -91.0 | 43.4 |

*: No radiated limit within band of wanted emission
**: No average limit outside of restricted bands of emission




Preview Result 2H-AVG
Preview Result 1H-PK+
Preview Result 2V-AVG
Preview Result 1V-PK+
FCC Part 15.209 in Restricted Bands Electric Field Strength 1m PK
FCC Part 15.209 in Restricted Bands Electric Field Strength 1m AV
-20 dBc (1m corr.)
Final_Result PK+
Final_Result CAV

| *Frequency* *MHz* | *MaxPeak* *dBµV/m* | *CAverage* *dBµV/m* | *Limit* *dBµV/m* | *Margin* *dB* | *Meas. Time* *ms* | *Bandwidth* *kHz* | *Height* *cm* | *Pol* | *Azimuth* *deg* | *Corr.* *dB* |
|---|---|---|---|---|---|---|---|---|---|---|
| 17410.500000 | 68.57 | | 86.81 | 18.24 | 1000.0 | 1000.000 | 325.0 | V | 148.0 | 54.1 |




Preview Result 2V-AVG
Preview Result 1V-PK+
Preview Result 2H-AVG
Preview Result 1H-PK+
FCC Part 15.209 in Restricted Bands Electric Field Strength 3m PK
FCC Part 15.209 in Restricted Bands Electric Field Strength 3m AV
-20 dBc
Final_Result PK+
Final_Result CAV

| *Frequency* *MHz* | *MaxPeak* *dBµV/m* | *CAverage* *dBµV/m* | *Limit* *dBµV/m* | *Margin* *dB* | *Meas. Time* *ms* | *Bandwidth* *kHz* | *Height* *cm* | *Pol* | *Azimuth* *deg* | *Corr.* *dB/m* |
|---|---|---|---|---|---|---|---|---|---|---|
| 21941.250000 | 50.90 | | 77.31 | 26.41 | 1000.0 | 1000.000 | 270.0 | V | 64.0 | 19.2 |

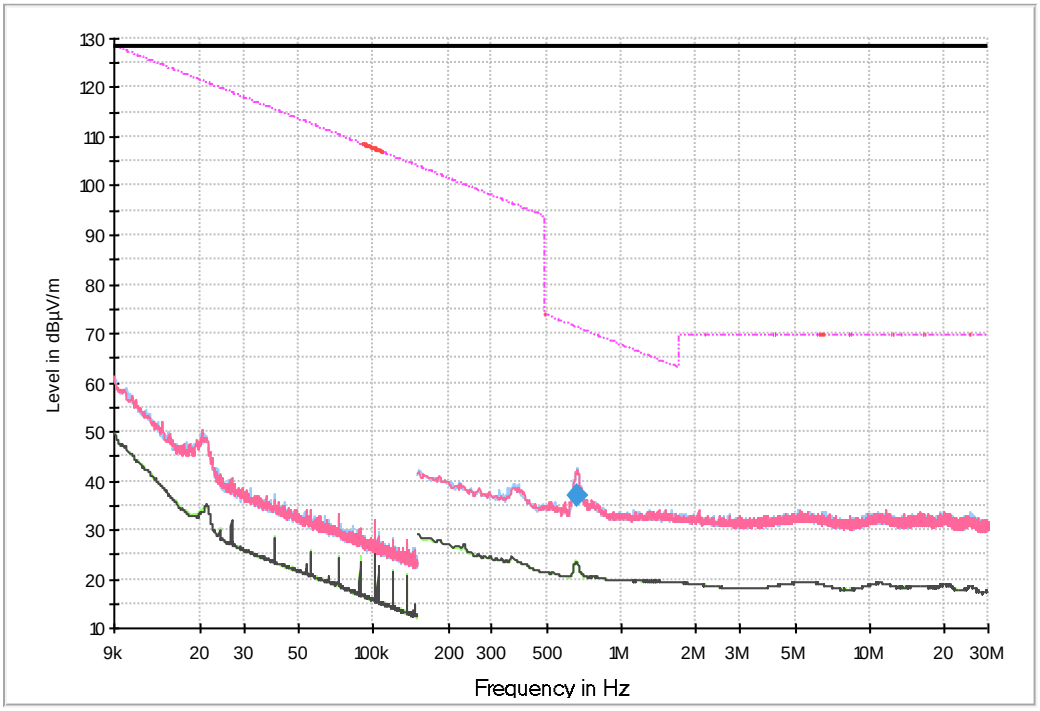
Product Service

Stand alone configuration Transmitting continuously and WLAN 2.4 GHz

Limit line outside restricted bands of operations is -20 dBc (peak value relative to carrier emission). For test distances other than 3 m the limit is extrapolated with 40 dB/decade for frequencies less than 30 MHz and 20 dB/decade for frequencies of 30 MHz and above.

Sample calculation of final values:

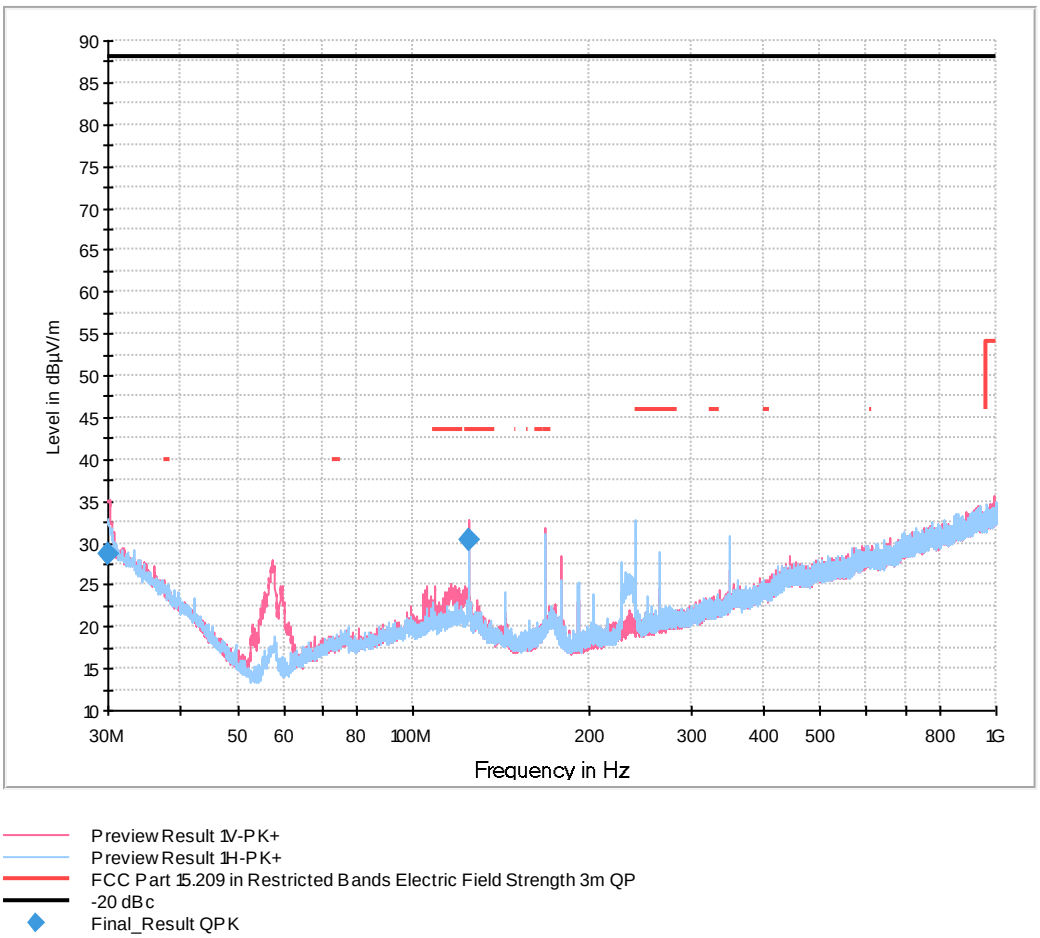
Final Value (dBµV/m) = Reading Value (dBµV
+ ( Cable correction Factor (dB)
+ Antenna Correction Factor (dB/m) )



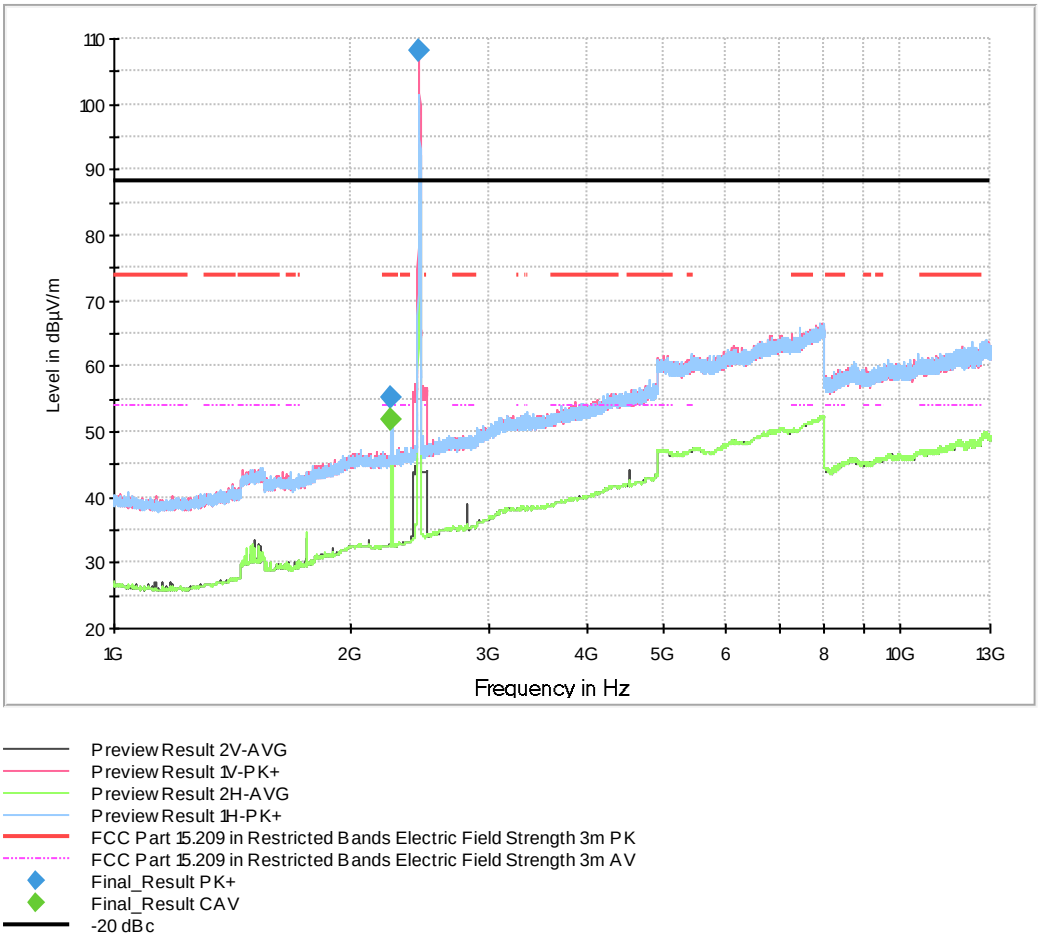

Preview Result 2H-AVG
Preview Result 1H-PK+
Preview Result 2V-AVG
Preview Result 1V-PK+
FCC Part 15C Electric Field Strength 3m QP+AV (9k-30M)
-20 dBc (30m to 3m corr.)
Final_Result QPK
Final_Result CAV
FCC Part 15.209 in Restricted Bands Electric Field Strength 3m QP+AV (9k-30M)

| *Frequency* *MHz* | *QuasiPeak* *dBµV/m* | *CAverage* *dBµV/m* | *Limit* *dBµV/m* | *Margin* *dB* | *Meas. Time* *ms* | *Bandwidth* *kHz* | *Height* *cm* | *Pol* | *Azimuth* *deg* | *Corr.* *dB* |
|---|---|---|---|---|---|---|---|---|---|---|
| 0.656250 | 36.74 | | 128.17 | 91.43 | 1000.0 | 9.000 | 100.0 | H | -87.0 | 19.8 |

Note: -20dBc limit for frequency range 9 kHz – 490 kHz is 168.17 dBµV/m and is not shown in diagram since not relevant.

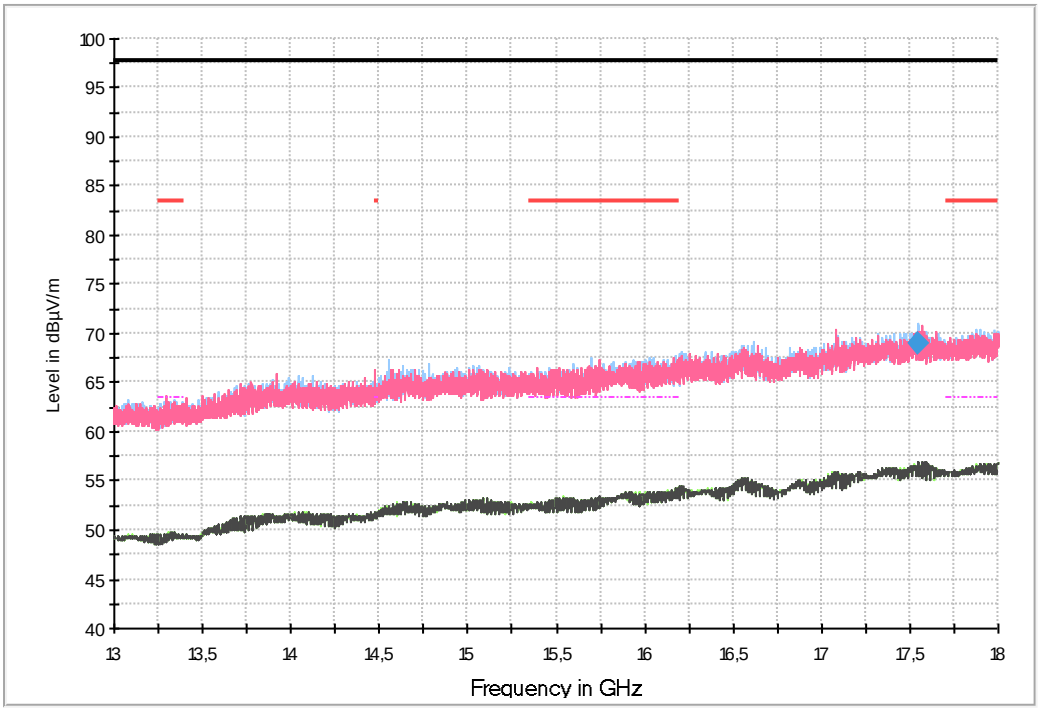



| Frequency MHz | QuasiPeak dBµV/m | Limit dBµV/m | Margin dB | Meas. Time ms | Bandwidth kHz | Height cm | Pol | Azimuth deg | Corr. dB/m | Comment |
|---|---|---|---|---|---|---|---|---|---|---|
| 30.030000 | 28.62 | 88.17 | 59.55 | 1000.0 | 120.000 | 100.0 | V | 214.0 | 25.8 | |
| 125.010000 | 30.35 | 43.52 | 13.17 | 1000.0 | 120.000 | 400.0 | V | 149.0 | 17.9 | |



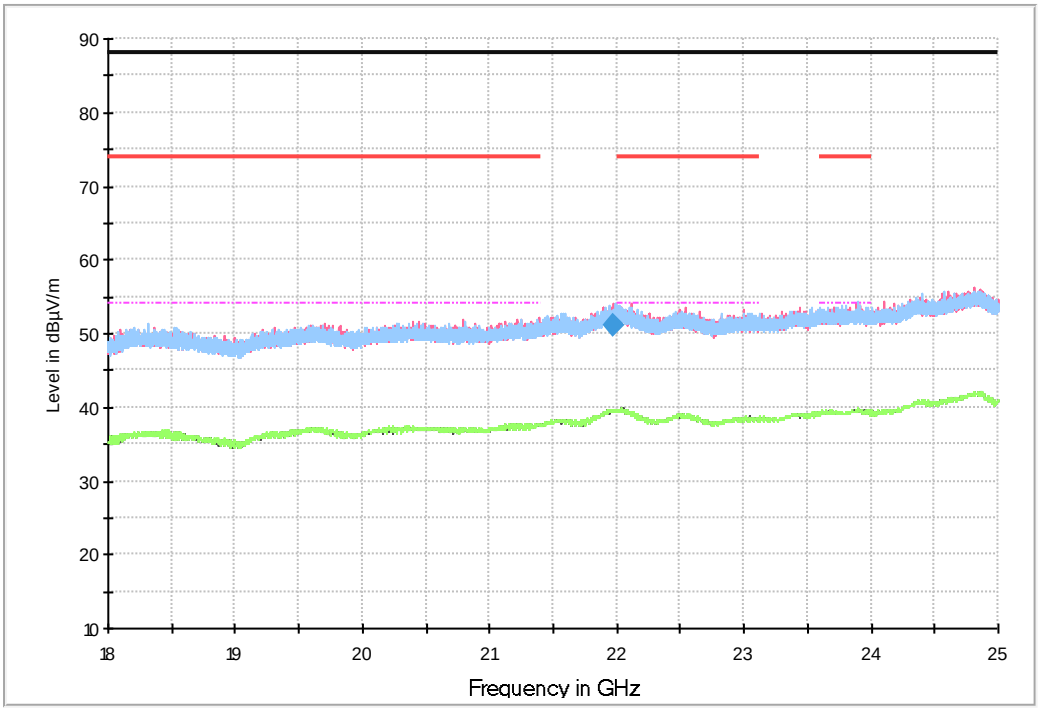

| *Frequency* *MHz* | *MaxPeak* *dBµV/m* | *CAverage* *dBµV/m* | *Limit* *dBµV/m* | *Margin* *dB* | *Meas. Time* *ms* | *Bandwidth* *kHz* | *Height* *cm* | *Pol* | *Azimuth* *deg* | *Corr.* *dB* |
|---|---|---|---|---|---|---|---|---|---|---|
| 2254.250000 | 55.12 | | 73.98 | 18.86 | 1000.0 | 1000.000 | 111.0 | H | 195.0 | 31.9 |
| 2254.250000 | | 51.81 | 53.98 | 2.17 | 1000.0 | 1000.000 | 111.0 | H | 195.0 | 31.9 |
| 2442.000000 | 108.17 | * | | | 1000.0 | 1000.000 | 200.0 | V | -115.0 | 32.6 |

*: No radiated limit within band of wanted emission




Preview Result 2H-AVG
Preview Result 1H-PK+
Preview Result 2V-AVG
Preview Result 1V-PK+
FCC Part 15.209 in Restricted Bands Electric Field Strength 1m PK
FCC Part 15.209 in Restricted Bands Electric Field Strength 1m AV
-20 dBc (3m to 1m corr.)
Final_Result PK+
Final_Result CAV

| *Frequency* *MHz* | *MaxPeak* *dBµV/m* | *CAverage* *dBµV/m* | *Limit* *dBµV/m* | *Margin* *dB* | *Meas. Time* *ms* | *Bandwidth* *kHz* | *Height* *cm* | *Pol* | *Azimuth* *deg* | *Corr.* *dB* |
|---|---|---|---|---|---|---|---|---|---|---|
| 17552.000000 | 68.88 | | 97.67 | 28.79 | 1000.0 | 1000.000 | 125.0 | H | 166.0 | 54.4 |




Preview Result 2V-AVG
Preview Result 1V-PK+
Preview Result 2H-AVG
Preview Result 1H-PK+
FCC Part 15.209 in Restricted Bands Electric Field Strength 3m PK
FCC Part 15.209 in Restricted Bands Electric Field Strength 3m AV
-20 dBc
Final_Result PK+
Final_Result CAV

| *Frequency* *MHz* | *MaxPeak* *dBµV/m* | *CAverage* *dBµV/m* | *Limit* *dBµV/m* | *Margin* *dB* | *Meas. Time* *ms* | *Bandwidth* *kHz* | *Height* *cm* | *Pol* | *Azimuth* *deg* | *Corr.* *dB/m* |
|---|---|---|---|---|---|---|---|---|---|---|
| 21971.750000 | 51.22 | | 88.17 | 36.95 | 1000.0 | 1000.000 | 325.0 | V | 198.0 | 19.1 |

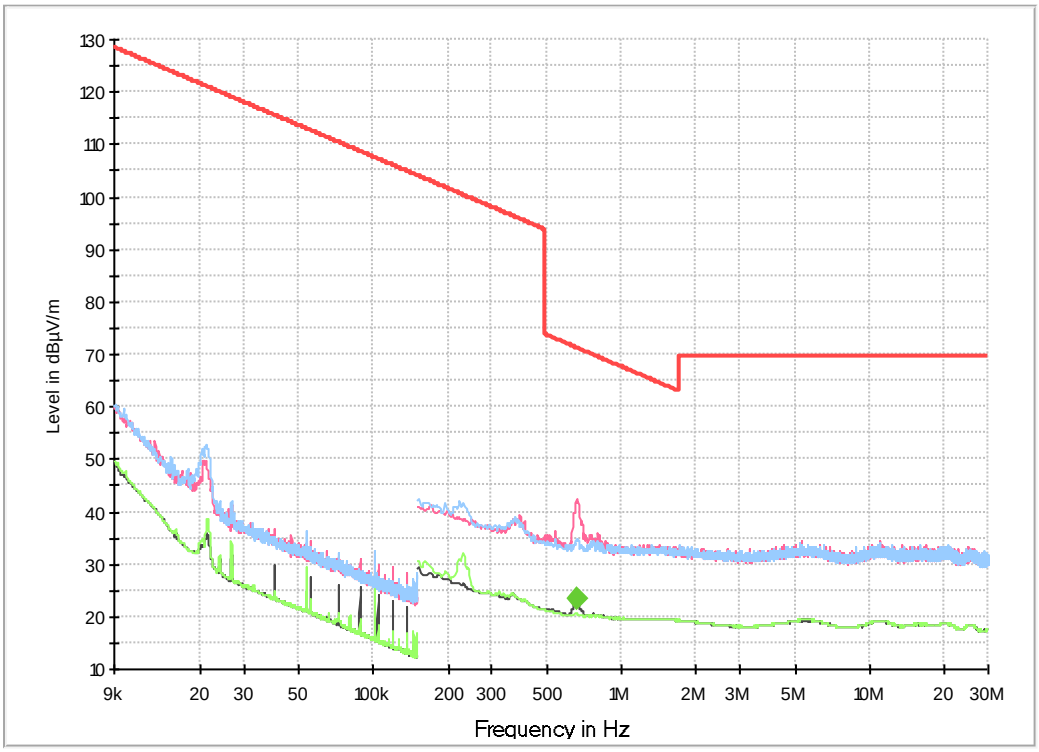
Product Service

Stand alone configuration Transmitting continuously and WLAN 5 GHz

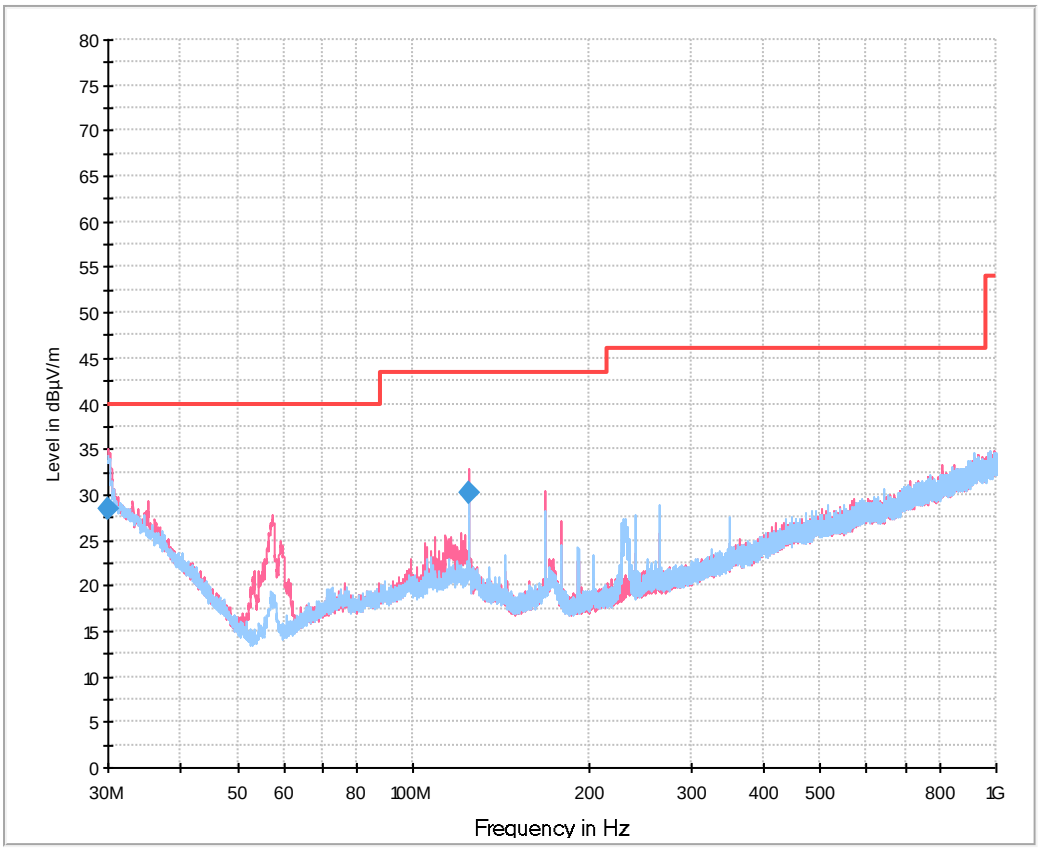
Up to 1 GHz standard radiated emission limits apply.
-20 dBm e.i.r.p. is equivalent to a electric field strength of 68.23 dBµV/m at 3 m distance and 77.77 dBµV/m at 1 m distance.

Sample calculation of final values:

Final Value (dBµV/m) = Reading Value (dBµV
+ ( Cable correction Factor (dB)
+ Antenna Correction Factor (dB/m) )

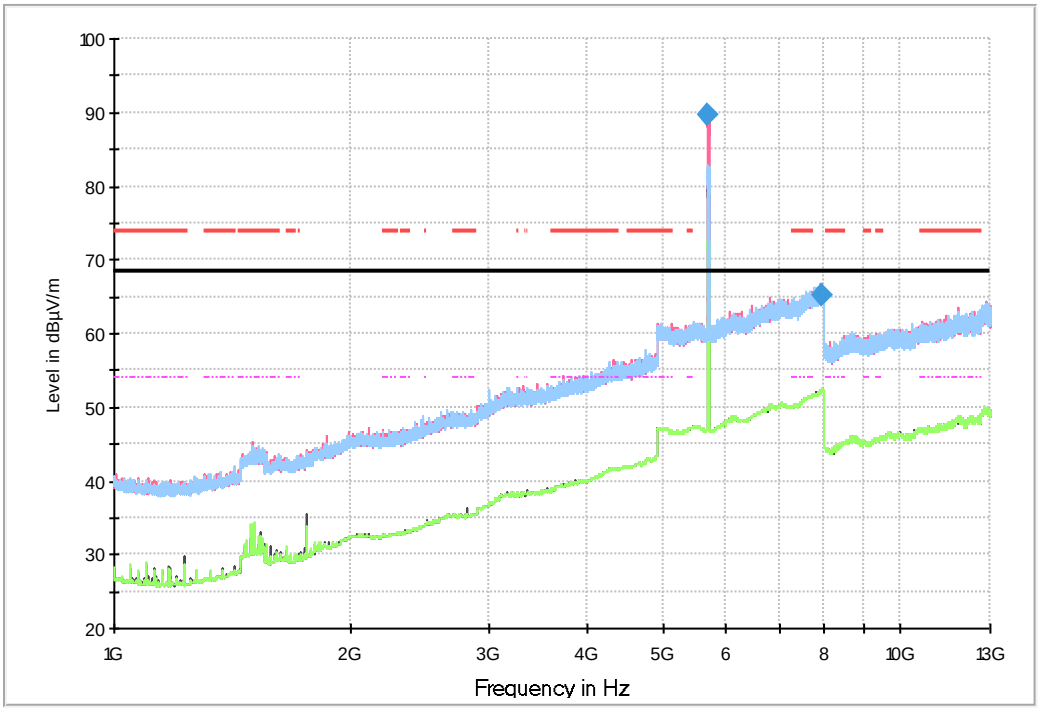



Preview Result 2V-AVG
Preview Result 1V-PK+
Preview Result 2H-AVG
Preview Result 1H-PK+
FCC Part 15C Electric Field Strength 3m QP+AV (9k-30M)
Final_Result QPK
Final_Result CAV




Preview Result 1V-PK+
FCC Part 15C Electric Field Strength 3m QP
Preview Result 1H-PK+
Final_Result QPK

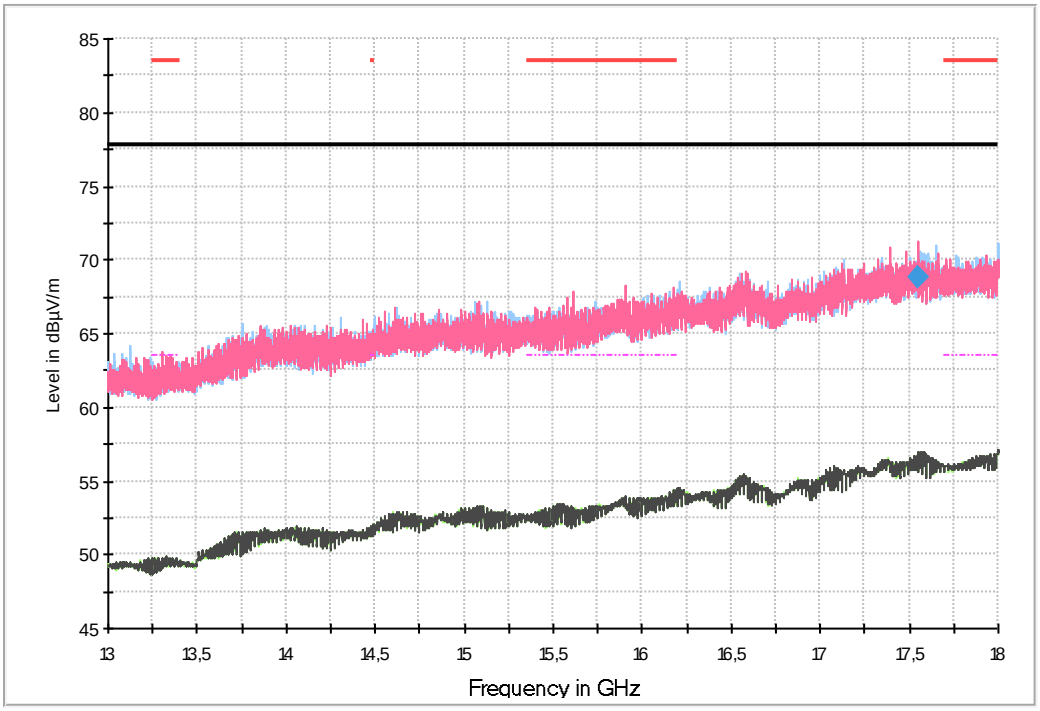
| *Frequency* *MHz* | *QuasiPeak* *dBµV/m* | *Limit* *dBµV/m* | *Margin* *dB* | *Meas. Time* *ms* | *Bandwidth* *kHz* | *Height* *cm* | *Pol* | *Azimuth* *deg* | *Corr.* *dB/m* |
|---|---|---|---|---|---|---|---|---|---|
| 30.060000 | 28.52 | 40.00 | 11.48 | 1000.0 | 120.000 | 100.0 | V | 117.0 | 25.8 |
| 125.010000 | 30.20 | 43.50 | 13.30 | 1000.0 | 120.000 | 396.0 | V | 183.0 | 17.9 |




Preview Result 2V-AVG
Preview Result 1V-PK+
Preview Result 2H-AVG
Preview Result 1H-PK+
FCC Part 15.209 in Restricted Bands Electric Field Strength 3m PK
FCC Part 15.209 in Restricted Bands Electric Field Strength 3m AV
-27 dBm/MHz @ 3m
Final_Result PK+
Final_Result CAV

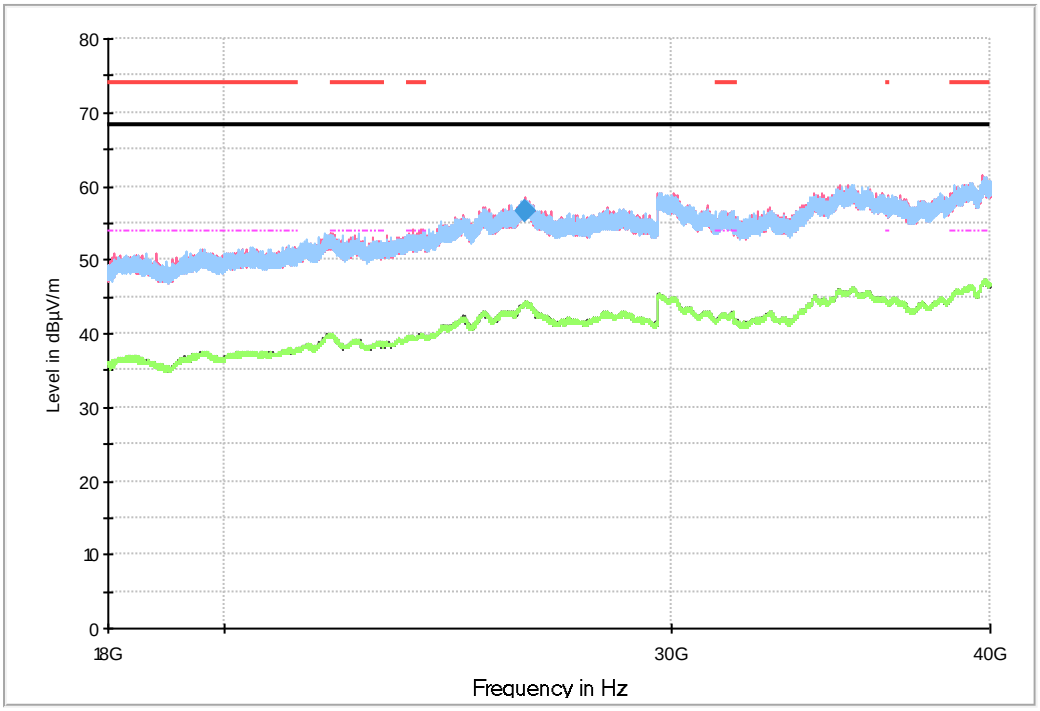
| *Frequency* *MHz* | *MaxPeak* *dBµV/m* | *CAverage* *dBµV/m* | *Limit* *dBµV/m* | *Margin* *dB* | *Meas. Time* *ms* | *Bandwidth* *kHz* | *Height* *cm* | *Pol* | *Azimuth* *deg* | *Corr.* *dB* |
|---|---|---|---|---|---|---|---|---|---|---|
| 5697.250000 | 89.73 | | * | | 1000.0 | 1000.000 | 300.0 | V | 227.0 | 40.3 |
| 7956.250000 | 65.18 | | 68.23 | 3.05 | 1000.0 | 1000.000 | 325.0 | V | -50.0 | 43.4 |

*: No radiated limit within band of wanted emission




Preview Result 2H-AVG
Preview Result 1H-PK+
Preview Result 2V-AVG
Preview Result 1V-PK+
FCC Part 15.209 in Restricted Bands Electric Field Strength 1m PK
FCC Part 15.209 in Restricted Bands Electric Field Strength 1m AV
-27 dBm/MHz @ 1m
Final_Result PK+
Final_Result CAV

| *Frequency* *MHz* | *MaxPeak* *dBµV/m* | *CAverage* *dBµV/m* | *Limit* *dBµV/m* | *Margin* *dB* | *Meas. Time* *ms* | *Bandwidth* *kHz* | *Height* *cm* | *Pol* | *Azimuth* *deg* | *Corr.* *dB* |
|---|---|---|---|---|---|---|---|---|---|---|
| 17553.000000 | 68.86 | | 77.77 | 8.91 | 1000.0 | 1000.000 | 107.0 | V | -132.0 | 54.4 |




Preview Result 2V-AVG
Preview Result 1V-PK+
Preview Result 2H-AVG
Preview Result 1H-PK+
FCC Part 15.209 in Restricted Bands Electric Field Strength 3m PK
FCC Part 15.209 in Restricted Bands Electric Field Strength 3m AV
-27 dBm/MHz @ 3m
Final_Result PK+
Final_Result CAV

| *Frequency* *MHz* | *MaxPeak* *dBµV/m* | *CAverage* *dBµV/m* | *Limit* *dBµV/m* | *Margin* *dB* | *Meas. Time* *ms* | *Bandwidth* *kHz* | *Height* *cm* | *Pol* | *Azimuth* *deg* | *Corr.* *dB/m* |
|---|---|---|---|---|---|---|---|---|---|---|
| 26252.750000 | 56.54 | | 68.23 | 11.69 | 1000.0 | 1000.000 | 121.0 | V | -17.0 | 22.6 |

FCC 47 CFR Part 15, Limit Clause 15.209

| Frequency (MHz) | Field Strength (µV/m) | Measurement Distance (m) |
|---|---|---|
| 0.009 to 0.490 | 2400/F(kHz) | 300 |
| 0.490 to 1.705 | 24000/F(kHz) | 30 |
| 1.705 to 30 | 30 | 30 |
| 30 to 88 | 100 | 3 |
| 88 to 216 | 150 | 3 |
| 216 to 960 | 200 | 3 |
| Above 960 | 500 | 3 |

**Table 5 - FCC Limit Table**

FCC 47 CFR Part 15, Limit Clause 15.247 (d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuator required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in § 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in § 15.205(a), must also comply with the radiated emission limits specified in § 15.209(a).

Product Service

FCC 47 CFR Part 15, Limit Clause 15.407(b)

Expect as shown in paragraph (b)(7) of this section, the maximum emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:

(1) For transmitters operating in the 5.15 GHz – 5.25 GHz band: All emissions outside of the 5.15 GHz – 5.25 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.
(2) For transmitters operating in the 5.25 GHz – 5.35 GHz band: All emissions outside of the 5.25 GHz – 5.35 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.
(3) For transmitters operating in the 5.47 GHz – 5.725 GHz band: All emissions outside of the 5.47 GHz – 5.725 GHz band shall not exceed an e.i.r.p. of -27 dBm/MHz.
(4) For transmitters operating in the 5.725 GHz – 5.85 GHz band:
    (i) All emissions shall be limited to a level of −27 dBm/MHz at 75 MHz or more above or below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above or below the band edge, and from 25 MHz above or below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above or below the band edge, and from 5 MHz above or below the band edge increasing linearly to a level of -27 dBm/MHz at the band edge.
    (ii) Devices certified before March 2, 2017 with antenna gain greater than 10 dBi may demonstrate compliance with the emission limits in §15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease by March 2, 2018. Devices certified before March 2, 2018 with antenna gain of 10 dBi or less may demonstrate compliance with the emission limits in §15.247(d), but manufacturing, marketing and importing of devices certified under this alternative must cease before March 2, 2020.
(5) The emission measured shall be performed using a minimum resolution bandwidth of 1 MHz.A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.
(6) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in § 15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in § 15.207.
(7) The provisions of § 15.205 apply to intentional radiators operating under this section.
(8) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the upper and lower frequency band edges as the design of the equipment permits.

RSS-GEN, Section 8.9 Transmitter emission limits

| Frequency (MHz) | Field Strength (µV/m) |
|---|---|
| 30 to 88 | 100 |
| 88 to 216 | 150 |
| 216 to 960 | 200 |
| Above 960 | 500 |

**Table 6 – General field strength limits at frequencies above 30 MHz**

| Frequency | Magnetic Field Strength (µA/m) | Measurement Distance (m) |
|---|---|---|
| 9 kHz – 490 kHz | 6.37/F(kHz) | 300 |
| 490 kHz – 1705 kHz | 63.7/F(kHz) | 30 |
| 1.705 MHz – 30 MHz | 0.08 | 30 |
| Note 1: The emission limits for the ranges 9 kHz – 90 kHz and 110 kHz – 490 kHz are based on measurements employing a linear average detector. | | |
| Note 2: Electric field strength (*E*) and magnetic field strength (*H*) can be converted by $E = H Z_0$ *with* $Z_0 = 377\ \Omega$ | | |

**Table 7 – General field strength limits at frequencies below 30 MHz**

RSS-247, Section 5.5 Unwanted emissions

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiate measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuator shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-GEN is not required.

RSS-247, Section 6.2.3.2 Unwanted emission limits

Devices operating in the 5470 MHz – 5850 MHz shall not exceed -27 dBm/MHz e.i.r.p. However, devices with bandwidth overlapping the band edge of 5725 MHz can meet the emission limit of -27 dBm/MHz at 5850 MHz instead of 5725 MHz.

### 3.1.7 Test Location and Test Equipment Used

This test was carried out in Semi anechoic room - cabin no. 11

| T-ID | Designation | Type | Serial number | Last Cal. | Valid until | Manufacturer |
|---|---|---|---|---|---|---|
| 18876 | Loop antenna | HFH2-Z2 | 882964/0001 | 13.12.2019 | 31.12.2022 | Rohde & Schwarz GmbH & Co. KG |
| 39897 | EMI test receiver | ESW44 | 101814 | 22.02.2019 | 29.02.2020 | Rohde & Schwarz GmbH & Co. KG |
| 39969 | ULTRALOG Antenna | HL562E | 101062 | 07.11.2019 | 30.11.2022 | Rohde & Schwarz GmbH & Co. KG |
| 40089 | Double ridged horn antenna | HF907 | 102777 | 08.02.2019 | 28.02.2021 | Rohde & Schwarz GmbH & Co. KG |
| 42961 | Semi anechoic room | Cabin no. 11 | | 29.08.2019 | 31.08.2022 | Frankonia |
| 42986 | EMC measurement software | EMC32 Emission K11 - V10.50.10 | | | | Rohde & Schwarz GmbH & Co. KG |
| 42987 | Tilting antenna mast | BAM 4.0P | 224/2621.01 | | | maturo GmbH |
| 43661 | Horn Antenna with preamplifier | A-INFOMW LB-180400H-KF+ TS-LNA1840 | J211060442+101010 | 07.10.2019 | 31.10.2020 | Rohde & Schwarz GmbH & Co. KG |

# 4 Measurement Uncertainty

For a 95% confidence level, the measurement uncertainties for defined systems are:

| Radio Testing | | | |
|---|---|---|---|
| Test Name | kp | Expanded Uncertainty | Note |
| Occupied Bandwidth | 2.0 | ±1.14 % | 2 |
| RF-Frequency error | 1.96 | ±1 · 10-7 | 7 |
| RF-Power, conducted carrier | 2 | ±0.079 dB | 2 |
| RF-Power uncertainty for given BER | 1.96 | +0.94 dB / -1.05 | 7 |
| RF power, conducted, spurious emissions | 1.96 | +1.4 dB / -1.6 dB | 7 |
| RF power, radiated | | | |
| 25 MHz – 4 GHz | 1.96 | +3.6 dB / -5.2 dB | 8 |
| 1 GHz – 18 GHz | 1.96 | +3.8 dB / -5.6 dB | 8 |
| 18 GHz – 26.5 GHz | 1.96 | +3.4 dB / -4.5 dB | 8 |
| 40 GHz – 170 GHz | 1.96 | +4.2 dB / -7.1 dB | 8 |
| Spectral Power Density, conducted | 2.0 | ±0.53 dB | 2 |
| Maximum frequency deviation | | | |
| 300 Hz – 6 kHz | 2 | ±2,89 % | 2 |
| 6 kHz – 25 kHz | 2 | ±0.2 dB | 2 |
| Maximum frequency deviation for FM | 2 | ±2,89 % | 2 |
| Adjacent channel power 25 MHz – 1 GHz | 2 | ±2.31 % | 2 |
| Temperature | 2 | ±0.39 K | 4 |
| (Relative) Humidity | 2 | ±2.28 % | 2 |
| DC- and low frequency AC voltage | | | |
| DC voltage | 2 | ±0.01 % | 2 |
| AC voltage up to 1 kHz | 2 | ±1.2 % | 2 |
| Time | 2 | ±0.6 % | 2 |

**Table 8**

| Radio Interference Emission Testing | | | |
|---|---|---|---|
| Test Name | kp | Expanded Uncertainty | Note |
| Conducted Voltage Emission | | | |
| 9 kHz to 150 kHz (50Ω/50µH AMN) | 2 | ± 3.8 dB | 1 |
| 150 kHz to 30 MHz (50Ω/50µH AMN) | 2 | ± 3.4 dB | 1 |
| 100 kHz to 200 MHz (50Ω/5µH AMN) | 2 | ± 3.6 dB | 1 |
| Discontinuous Conducted Emission | | | |
| 9 kHz to 150 kHz (50Ω/50µH AMN) | 2 | ± 3.8 dB | 1 |
| 150 kHz to 30 MHz (50Ω/50µH AMN) | 2 | ± 3.4 dB | 1 |
| Conducted Current Emission | | | |
| 9 kHz to 200 MHz | 2 | ± 3.5 dB | 1 |
| Magnetic Fieldstrength | | | |
| 9 kHz to 30 MHz (with loop antenna) | 2 | ± 3.9 dB | 1 |
| 9 kHz to 30 MHz (large-loop antenna 2 m) | 2 | ± 3.5 dB | 1 |
| Radiated Emission | | | |
| Test distance 1 m (ALSE) | | | |
| 9 kHz to 150 kHz | 2 | ± 4.6 dB | 1 |
| 150 kHz to 30 MHz | 2 | ± 4.1 dB | 1 |
| 30 MHz to 200 MHz | 2 | ± 5.2 dB | 1 |
| 200 MHz to 2 GHz | 2 | ± 4.4 dB | 1 |
| 2 GHz to 3 GHz | 2 | ± 4.6 dB | 1 |
| Test distance 3 m | | | |
| 30 MHz to 300 MHz | 2 | ± 4.9 dB | 1 |
| 300 MHz to 1 GHz | 2 | ± 5.0 dB | 1 |
| 1 GHz to 6 GHz | 2 | ± 4.6 dB | 1 |
| Test distance 10 m | | | |
| 30 MHz to 300 MHz | 2 | ± 4.9 dB | 1 |
| 300 MHz to 1 GHz | 2 | ± 4.9 dB | 1 |
| Radio Interference Power | | | |
| 30 MHz to 300 MHz | 2 | ± 3.5 dB | 1 |
| Harmonic Current Emissions | | | 4 |
| Voltage Changes, Voltage Fluctuations and Flicker | | | 4 |

**Table 9**

| Immunity Testing | | | |
|---|---|---|---|
| Test Name | kp | Expanded Uncertainty | Note |
| Electrostatic Discharges | | | 4 |
| Radiated RF-Field | | | |
| Pre-calibrated field level | 2 | +32.2 / -24.3 % | 5 |
| Dynamic feedback field level | 2.05 | +21.2 / -17.5 % | 3 |
| Electrical Fast Transients (EFT) / Bursts | | | 4 |
| Surges | | | 4 |
| Conducted Disturbances, induced by RF-Fields | | | |
| via CDN | 2 | +15.1 / -13.1 % | 6 |
| via EM clamp | 2 | +42.6 / -29.9 % | 6 |
| via current clamp | 2 | +43.9 / -30.5 % | 6 |
| Power Frequency Magnetic Field | 2 | +20.7 / -17.1 % | 2 |
| Pulse Magnetic Field | | | 4 |
| Voltage Dips, Short Interruptions and Voltage Variations | | | 4 |
| Oscillatory Waves | | | 4 |
| Conducted Low Frequency Disturbances | | | |
| Voltage setting | 2 | ± 0.9 % | 2 |
| Frequency setting | 2 | ± 0.1 % | 2 |
| Electrical Transient Transmission in Road Vehicles | | | 4 |

**Table 10**

Note 1:
The expanded uncertainty reported according to CISPR 16-4-2:2003-11 is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%
Note 2:
The expanded uncertainty reported according to UKAS Lab 34 (Edition 1, 2002-08) is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%
Note 3:
The expanded uncertainty reported according to UKAS Lab 34 (Edition 1, 2002-08) is based on a standard uncertainty multiplied by a coverage factor of kp = 2.05, providing a level of confidence of p = 95.45%
Note 4:
It has been demonstrated that the used test equipment meets the specified requirements in the standard with at least a 95%confidence.
Note 5:
The expanded uncertainty reported according to IEC 61000-4-3 is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%
Note 6:
The expanded uncertainty reported according to IEC 61000-4-6 is based on a standard uncertainty multiplied by a coverage factor of kp = 2, providing a level of confidence of p = 95.45%
Note 7:
The expanded uncertainty reported according ETSI TR 100 028 V1.4.1 (all parts) to is based on a standard uncertainty multiplied by a coverage factor of kp = 1.96, providing a level of confidence of p = 95.45%
Note 8:
The expanded uncertainty reported according to ETSI TR 102 273 V1.2.1 (all parts) is based on a standard uncertainty multiplied by a coverage factor of kp = 1.96, providing a level of confidence of p = 95.45%