

test report

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Test report no.:

190706-AU03+W03

for:

Continental Automotive GmbH
Regensburg
Immobilizer
A2C95937800

FC

according to:

15.209

EMV **TESTHAUS** GmbH

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Accreditation:



FCC test firm accreditation expiration date: 2021-05-30
MRA US-EU, FCC designation number: DE0010
FCC registration number: 97268
BnetzA-CAB-02/21-02/5 Valid until 2023-11-26

Location of Testing:

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



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1 Summary of test results

| 47 CFR part and section | Test | Page | Result | Note(s) |
|-------------------------|---|-----------------|------------------------------------|--------------------|
| 15.207(a) | AC power line conducted emissions 150 kHz to 30 MHz | --- | Not applicable | 1 |
| 15.215(c) | 20 dB bandwidth | 26 | For information only | |
| 15.205 (a) – (c) | Restricted bands of operation | 17 | Passed | |
| 15.209(a) | Emissions outside the operating frequency band(s) specified 9 kHz to 10 th harmonic 9 kHz to 30 MHz 30 MHz to 1 GHz 1 GHz to 10 th harmonic | 20 23 --- | Passed Passed Not applicable | --- --- 2, 3 |

Notes (for information about EUT see clause 3.1):

- 1 Measurements to demonstrate compliance with the conducted limits are not required for devices which only employ battery power for operation and which do not operate from the AC power lines or contain provisions for operation while connected to the AC power lines. Devices that include, or make provisions for, the use of battery chargers which permit operating while charging, AC adapters or battery eliminators or that connect to the AC power lines indirectly, obtaining their power through another device which is connected to the AC power lines, shall be tested to demonstrate compliance with the conducted limits.
- 2 Not applicable if the 10th harmonic of the intentional transmitter is beyond 1 GHz (please see 47 CFR Part 15, section 15.33(a)(1)).
- 3 According to 47 CFR Part 15, §15.33 (a)(5) the frequency range of investigation for the digital device shall be used if the range of investigation determined by the highest internal frequency of the digital device is higher then the 10th harmonic of the intentional radiator.

Straubing, August 31, 2020



Andreas Menacher
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2 Referenced publications

In this report, any reference to publications without stating the issue date explicitly refers to the versions as listed below.

| Publication | Title |
|------------------------------|---|
| CFR 47 Part 2 November 2019 | Code of Federal Regulations Part 2 (Frequency allocation and radio treaty matters; General rules and regulations) of the Federal Communication Commission (FCC) |
| CFR 47 Part 15 November 2019 | Code of Federal Regulations Part 15 (Radio Frequency Devices) of the Federal Communication Commission (FCC) |
| ANSI C63.10:2013-06 | American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices |

3 Equipment under test (EUT)

All Information in this clause is declared by customer.

3.1 General information

Product type: Immobilizer
Model name: A2C95937800
Serial number(s): ---
FCC ID: KR5A2C95937800
Manufacturer: Continental Automotive GmbH
Version: Hardware: ---
Software: ---
Short description: EUT is a Wireless power transmission (WPT) system that operates at the frequency 125 kHz.
Additional modifications: None
Power supply: Battery supply
Nominal voltage: 12.00 V
Minimum voltage: 7.00 V
Maximum voltage: 24.00 V



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3.2 Radio specifications

Application(s): Wireless Power Transfer (WPT)

Range of operating frequency: 125 kHz

Frequency stability during charging: Fixed frequency Frequency depending on charge of battery

Modulation: ASK

Antenna:

| | |
|------------|--|
| Type: | Loop antenna |
| Connector: | <input type="checkbox"/> external <input checked="" type="checkbox"/> internal |
| | <input type="checkbox"/> temporary <input checked="" type="checkbox"/> none |

4 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.

5 Test configuration and mode of operation

5.1 Test configuration

| Device | Type designation | Serial or inventory no. | Manufacturer |
|--------------------------|------------------|-------------------------|-----------------------------|
| <i>EUT</i> | | | |
| Immobilizer | A2C95937800 | --- | Continental Automotive GmbH |
| <i>Support equipment</i> | | | |
| Trigger tool | Homologation box | --- | Continental Automotive GmbH |
| Vehicle key | Ford | BATT. EMPTY | Continental Automotive GmbH |
| Vehicle key | Ford | BATT. EMPTY | Continental Automotive GmbH |
| Power supply | 3231.1 | E01235 | Statron |

Table 1: Devices used for testing

5.2 Mode of operation

As soon as the EUT was powered via the homologation box, it was sending a permanent carrier at the operating frequency 125 kHz.

Measurements were performed in the following modes:

Mode 1: Without vehicle key

Mode 2: With empty battery of vehicle key

Mode 3: With fully charged battery of vehicle key

6 Test procedures

6.1 General specifications

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 6.3.3 of ANSI C63.4-2014 for more details).

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

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

6.2 Radiated emissions below 30 MHz

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

6.2.1 Extrapolation according to ANSI C63.10

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:

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

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

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:

| | |
|-------------------|-----------------------|
| $f_{MHz}(300\ m)$ | $\approx 0.159\ MHz$ |
| $f_{MHz}(30\ m)$ | $\approx 1.592\ MHz$ |
| $f_{MHz}(3\ m)$ | $\approx 15.923\ MHz$ |

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 \leq f \leq 159 kHz 490 kHz $<$ f \leq 1.592 MHz | 300 m 30 m | 3 m | -40 log($d_{limit} / d_{measure}$) |
| 159 kHz $<$ f \leq 490 kHz 1.592 MHz $<$ f \leq 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 2: Recalculation factors for extrapolation

6.2.2 Measuring radiated emissions below 30 MHz

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 3.

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

Table 3: Bandwidth and detector type for radiated emissions test below 30 MHz

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 3).
- 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 $\pm 45^\circ$ around the table position found during prescans while measuring the emission level continuously. For final scan, the worst-case table position is set and the maximum emission level is recorded.
- h) Step g) is repeated for all other frequencies in the list.
- i) Finally, for frequencies with critical emissions the loop antenna is rotated again to find the maximum of emission. At least, frequency and level of the six highest emissions relative to the limit have to be recorded. However, emissions more than 20 dB below the limit do not need to be reported.

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

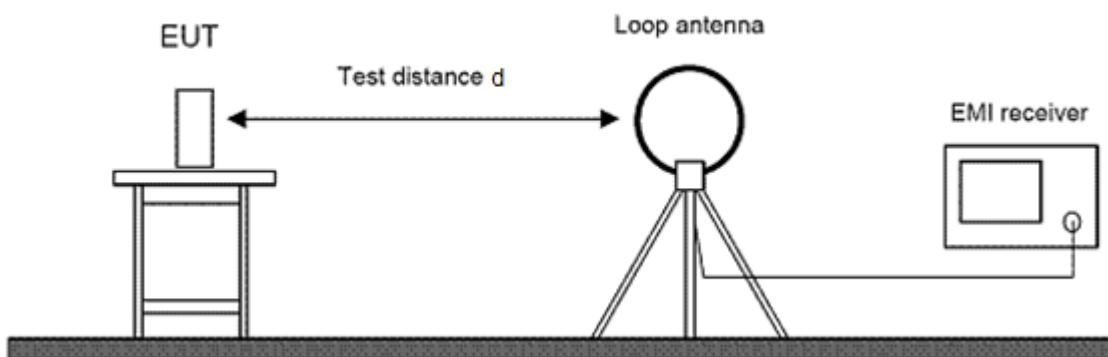


Figure 1: Setup for radiated emissions test below 30 MHz

6.3 Radiated emissions from 30 MHz to 1 GHz

Radiated emissions in the frequency range 30 MHz to 1 GHz are measured according to clause 6.5 of ANSI C63.10 using a semi-anechoic chamber (SAC) with a ground plane on the floor. The measurement distance is 3 meters. The emissions of the EUT are recorded with an EMI test receiver configured as described in table 4.

| 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 4: Bandwidth and detector type for radiated emissions test from 30 MHz to 1 GHz

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 4).
- 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 I) to n) are repeated for all other frequencies in the list. At least, frequency and level of the six highest emissions relative to the limit have to be recorded. However, emissions more than 20 dB below the limit do not need to be reported.

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

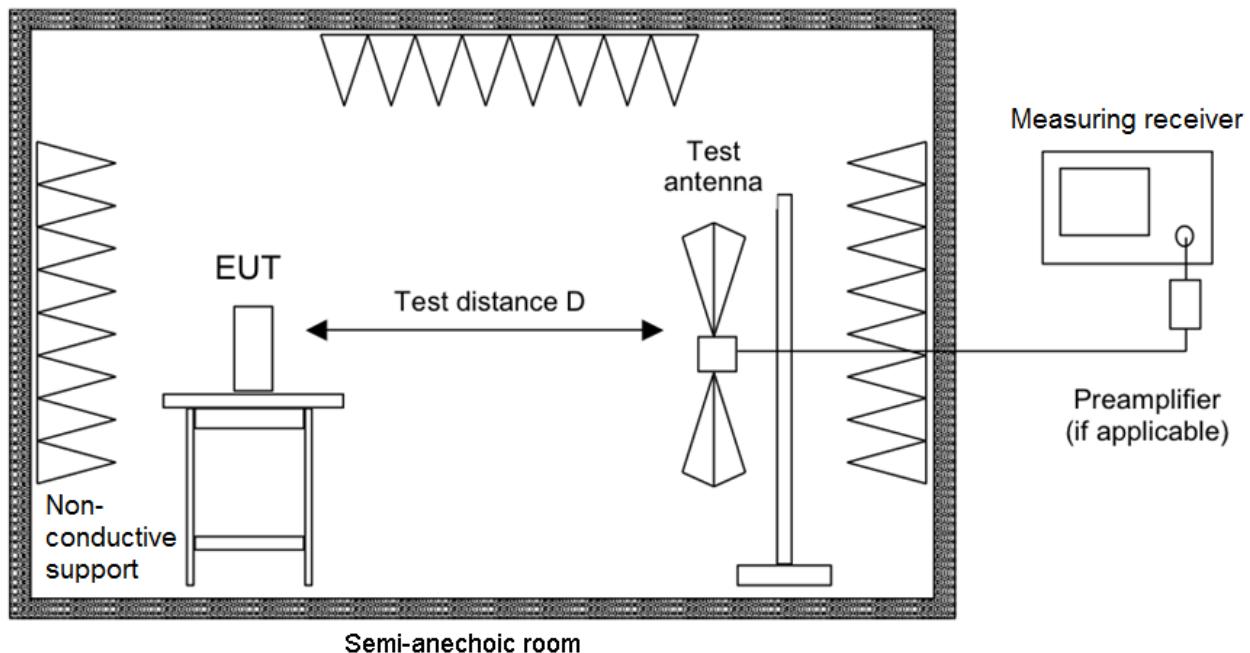


Figure 2: Setup for radiated emissions test from 30 MHz to 1 GHz

6.4 Bandwidth measurements

6.4.1 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 $[10 \log (20 \text{ dB bandwidth}/\text{RBW})]$ below the reference level.

7 Test results

This clause gives details about the test results as collected in the summary of test results starting on page 5.

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

| <i>Ambient temperature</i> | <i>Ambient humidity</i> | <i>Ambient pressure</i> |
|----------------------------|-------------------------|-------------------------|
| 15°C to 35°C | 30 % to 75 % | 86 kPa to 106 kPa |

7.1 Restricted bands of operation

Performed by: Andreas Menacher Date of test: August 27, 2020

Result¹: Test passed Test not passed

7.1.1 Test equipment

| Type | Designation | Manufacturer | Inventory no. |
|----------------------------------|--------------------|---|--------------------------------------|
| Compact Diagnostic Chamber (CDC) | VK041.0174 | Albatross Projects | E00026 |
| EMI test receiver | ESR 7 | Rohde & Schwarz | E00739 |
| Loop antenna | HFH2-Z2 | Rohde & Schwarz | E00060 |
| Cable set CDC | RF cable(s) | Huber + Suhner AME HF-Technik AME HF-Technik Stabo | E00446 E00920 E00921 E01215 |
| Test software | EMC32-MEB (V10.35) | Rohde & Schwarz | E00778 |

¹ For information about measurement uncertainties see page 53.

7.1.2 Limits

The field strength of any emissions including spurious emissions falling into restricted bands as specified in section 15.205(a) of 47 CFR Part 15, shall not exceed the general radiated emission limits as specified in section 15.209 of 47 CFR Part 15. In addition, only spurious emissions are permitted in any of the restricted bands.

| Frequency [MHz] | Field strength [μ V/m] | Field strength [dB μ V/m] | Measurement distance [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 |
| 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 5: Limits for emissions in restricted bands

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 5 using the recalculation factor as described in clause 6.2.1.

7.1.3 Test procedure

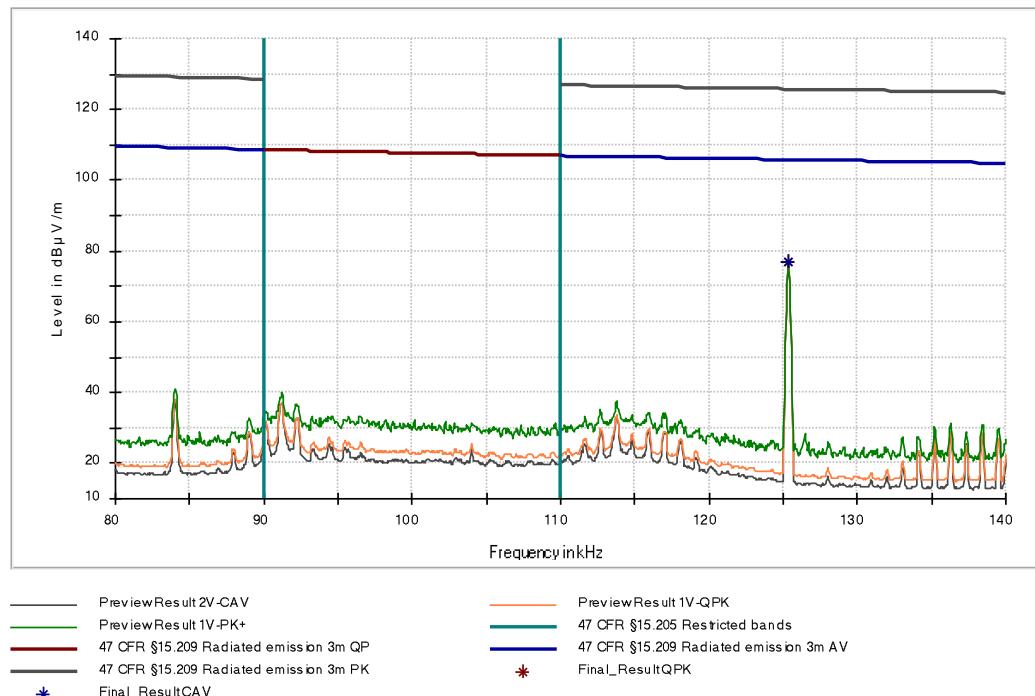
Emissions in the restricted bands of operation are measured using the test procedure as described in clause 6.2.

7.1.4 Test results

| | | | |
|--------------------|---|--|--|
| Test distance: | <input checked="" type="checkbox"/> 3 m | <input type="checkbox"/> 10 m | <input type="checkbox"/> m |
| Antenna alignment: | <input checked="" type="checkbox"/> in parallel | <input checked="" type="checkbox"/> in line | <input type="checkbox"/> angle ° |
| EUT position: | <input checked="" type="checkbox"/> Position X | <input checked="" type="checkbox"/> Position Y | <input checked="" type="checkbox"/> Position Z |

Note(s):

1. Premeasurements were performed to declare the worst-case which is documented below.
2. No assessable emissions could be detected.



7.2 Radiated emissions

7.2.1 Radiated emissions below 30 MHz

| | | | |
|-----------------------|---|--|-----------------|
| Performed by: | Andreas Menacher | Date of test: | August 27, 2020 |
| Result ² : | <input checked="" type="checkbox"/> Test passed | <input type="checkbox"/> Test not passed | |

7.2.1.1 Test equipment

| Type | Designation | Manufacturer | Inventory no. |
|----------------------------------|--------------------|---|--------------------------------------|
| Compact Diagnostic Chamber (CDC) | VK041.0174 | Albatross Projects | E00026 |
| EMI test receiver | ESR 7 | Rohde & Schwarz | E00739 |
| Loop antenna | HFH2-Z2 | Rohde & Schwarz | E00060 |
| Cable set CDC | RF cable(s) | Huber + Suhner AME HF-Technik AME HF-Technik Stabo | E00446 E00920 E00921 E01215 |
| Test software | EMC32-MEB (V10.35) | Rohde & Schwarz | E00778 |

² For information about measurement uncertainties see page 53.

7.2.1.2 Limits

As specified in section 15.209 of 47 CFR Part 15, the emissions from an intentional radiator shall not exceed the field strength levels specified in table 6:

| Frequency [MHz] | Field strength [μ V/m] | Field strength [dB μ V/m] | Measurement distance [m] |
|--------------------|---------------------------------|----------------------------------|-----------------------------|
| 0.009 – 0.490 | 2400/F(kHz) (266.67 – 4.90) | 48.52 – 13.80 | 300 |
| 0.490 – 1.705 | 24000/F(kHz) (48.98 – 14.08) | 33.80 – 22.97 | 30 |
| 1.705 – 30 | 30 | 29.54 | 30 |

Table 6: General radiated emission limits according to §15.209

In case of measurements are performed at other distances than that specified in the requirements, the limits in the charts and tables reported with the test results are derived from the general radiated emission limits as listed in table 6 using the recalculation factor as described in clause 6.2.1.

7.2.1.3 Test procedure

Radiated emissions below 30 MHz are measured using the test procedure as described in clause 6.2.

7.2.1.4 Test results

| | | | |
|--------------------|--|--|--|
| Test distance: | <input checked="" type="checkbox"/> 3 m | <input type="checkbox"/> 10 m | <input type="checkbox"/> m |
| Antenna alignment: | <input type="checkbox"/> in parallel | <input checked="" type="checkbox"/> in line | <input type="checkbox"/> angle ° |
| EUT position: | <input checked="" type="checkbox"/> Position X | <input checked="" type="checkbox"/> Position Y | <input checked="" type="checkbox"/> Position Z |

Note(s):

- Premeasurements were performed to declare the worst-case which is documented below.

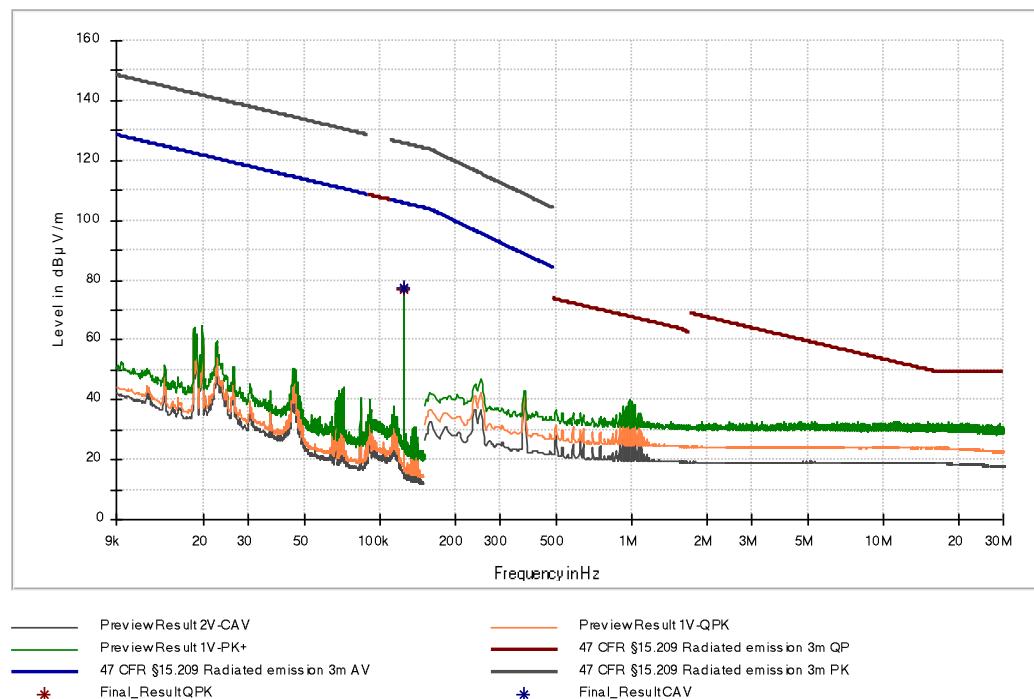


Figure 4: Chart of radiated emissions test below 30 MHz according to §15.209, EUT position X, mode 2, antenna parallel

| Frequency (MHz) | Measured value (dBμV/m) at 3 m | Recalculation factor (dB) | Field strength (dBμV/m) at 300 m | Limit (dBμV/m) at 300 m | Margin (dB) | Detector | Azimuth (deg) | Result |
|-----------------|--------------------------------|---------------------------|----------------------------------|-------------------------|-------------|----------|---------------|--------|
| 0.125350 | 77.17 | -80.00 | -2.83 | 45.64 | 48.47 | PK | 179.0 | Pass |
| 0.125350 | 76.85 | -80.00 | -3.15 | 25.64 | 28.79 | AV | 179.0 | Pass |

Table 7: Results of radiated emissions test below 30 MHz according to §15.209 for mode 2

7.2.2 Radiated emissions from 30 MHz to 1 GHz

Performed by: Andreas Menacher Date of test: August 27, 2020

Result³: Test passed Test not passed

7.2.2.1 Test equipment

| Type | Designation | Manufacturer | Inventory no. |
|--------------------------------|--------------------|--------------------|----------------------------|
| Semi-anechoic chamber (SAC) | SAC3 | Albatross Projects | E00716 |
| EMI test receiver | ESW 8 | Rohde & Schwarz | N/A |
| TRILOG broadband antenna (SAC) | VULB 9162 | Schwarzbeck | E00643 |
| Cable set SAC | RF cable(s) | Huber + Suhner | E00755 E01033 E01034 |
| Test software | EMC32-MEB (V10.35) | Rohde & Schwarz | E01073 |

³ For information about measurement uncertainties see page 53.

7.2.2.2 Limits

As specified in section 15.209 of 47 CFR Part 15, the emissions from an intentional radiator shall not exceed the field strength levels specified in table 8:

| Frequency [MHz] | Field strength [μ V/m] | Field strength [dB μ V/m] | Measurement distance [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 8: General radiated emission limits according to §15.209

7.2.2.3 Test procedure

Radiated emissions from 30 MHz to 1 GHz are measured using the test procedure as described in clause 6.3.

7.2.2.4 Test results

| | | | |
|--------------------|--|--|--|
| Test distance: | <input checked="" type="checkbox"/> 3 m | <input type="checkbox"/> 10 m | <input type="checkbox"/> m |
| Antenna alignment: | <input checked="" type="checkbox"/> vertical | <input checked="" type="checkbox"/> horizontal | <input type="checkbox"/> angle ° |
| EUT position: | <input checked="" type="checkbox"/> Position X | <input checked="" type="checkbox"/> Position Y | <input checked="" type="checkbox"/> Position Z |

Note(s):

1. Premeasurements were performed to declare the worst-case which is documented below.

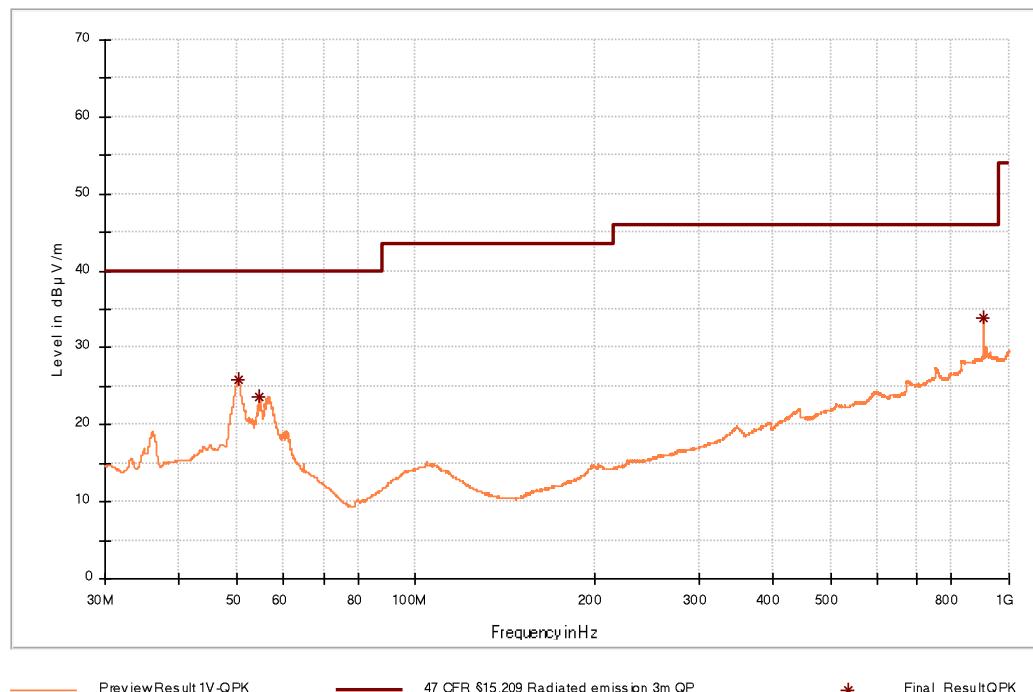


Figure 5: Chart of radiated emissions test 30 MHz to 1 GHz according to §15.209, EUT position X, mode 1, antenna vertical

| Frequency (MHz) | Measured value QuasiPeak (dBµV/m) at 3m | Limit (dBµV/m) at 3m | Margin (dB) | Height (cm) | Polarization | Azimuth (deg) | Result |
|-----------------|---|----------------------|-------------|-------------|--------------|---------------|--------|
| 50.310000 | 25.78 | 40.00 | 14.22 | 100.0 | V | 115.0 | Pass |
| 54.690000 | 23.70 | 40.00 | 16.30 | 101.0 | V | 195.0 | Pass |
| 904.200000 | 33.87 | 46.00 | 12.13 | 290.0 | V | 274.0 | Pass |

Table 9: Results of radiated emissions test 30 MHz to 1 GHz according to §15.209, EUT position X, mode 1, antenna vertical

7.3 20 dB bandwidth

Performed by: Andreas Menacher Date of test: August 28, 2020

Result⁴: Test passed Test not passed

7.3.1 Test equipment

| Type | Designation | Manufacturer | Inventory no. |
|-------------------|-------------|--------------------|---------------|
| EMI test receiver | ESU 26 | Rohde & Schwarz | W00002 |
| Field probe | RF-R 400-1 | Langer EMV-Technik | E00270 |

⁴ For information about measurement uncertainties see page 53.

7.3.2 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.

7.3.3 Test procedure

The 20 dB bandwidth is measured using the test procedure as described in clause 6.4.

7.3.4 Test results

Note(s):

- Premeasurements were performed to declare the worst-case which is documented below.

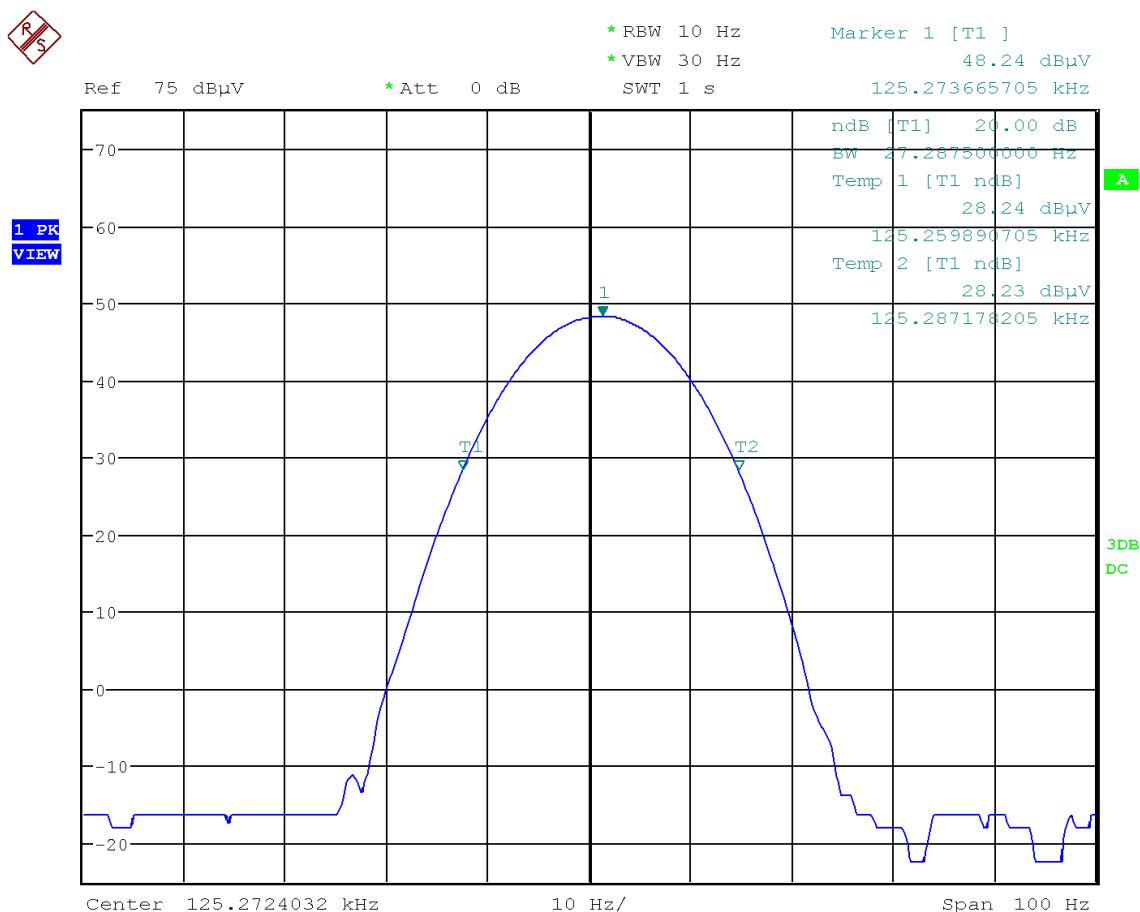


Figure 6: Chart of 20 dB bandwidth of the emission test, mode 1

| 20 dB bandwidth [kHz] | Lower frequency Frequency [MHz] | Higher frequency Frequency [MHz] | Result |
|--------------------------|---------------------------------------|--|----------|
| 0.027 | 0.125259 | 0.125287 | Recorded |

Table 10: Results of bandwidth tests, mode 1

8 Equipment calibration status

| Description | Modell number | Serial number | Inventory number(s) | Last calibration | Next calibration |
|----------------------------------|-------------------------------|-------------------------|---------------------|------------------|------------------|
| EMI test receiver | ESR7 | 101059 | E00739 | 2019-08 | 2021-08 |
| EMI test receiver | ESW8 | 101538 | N/A | 2020-08 | 2022-08 |
| Loop antenna | HFH2-Z2 | 871398/0050 | E00060 | 2018-10 | 2020-10 |
| Field probe | RF-R 400-1 | 02-2030 | E00270 | see Note 1 | |
| TRILOG broadband antenna (SAC) | VULB 9162 | 9162-041 | E00643 | 2018-03 | 2021-03 |
| Shielded room | P92007 | B 83117 C 1109 T 211 | E00107 | N/A | |
| Compact diagnostic chamber (CDC) | VK041.0174 | D62128-A502-A69-2-0006 | E00026 | N/A | |
| Semi-anechoic chamber (SAC) | SAC3 | C62128-A520-A643-x-0006 | E00716 | 2018-03 | 2021-03 |
| Cable set CDC | RG214/U | --- | E00446 | 2020-04 | 2021-04 |
| | LMR400 | 1718020006 | E00920 | 2020-04 | 2021-04 |
| | RG214 Hiflex | 171802007 | E00921 | 2020-01 | 2021-01 |
| | LCF12-50J | --- | E01215 | 2020-01 | 2021-01 |
| Cable set SAC | SF104EA/11PC35/11PC35/10000MM | 501347/4EA | E00755 | 2019-12 | 2020-12 |
| | SF104E/11PC35/11PC35/2000MM | 507410/4E | E01033 | 2019-12 | 2020-12 |
| | SF104E/11PC35/11PC35/2000MM | 507411/4E | E01034 | 2019-09 | 2020-09 |

Note 1: Only used for relative measurements (clause 7.3).

9 Measurement uncertainties

| Description | Uncertainty | k= |
|---|----------------------------------|----|
| AC power line conducted emissions (with AMN) 9 kHz to 150 kHz 150 kHz to 30 MHz | ±3.8 dB ±3.4 dB | 2 |
| Radiated emissions in semi-anechoic chamber or open area test site 9 kHz to 30 MHz 30 MHz to 300 MHz 300MHz to 1 GHz | ± 4.8 dB ± 5.4 dB ± 4.7 dB | 2 |
| Radiated emissions in semi-anechoic chamber with RF absorbing material on the floor or fully anechoic room 1 GHz to 18 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.

All used test instrument as well as the test accessories are calibrated at regular intervals.

10 Revision history

| <i>Revision</i> | <i>Date</i> | <i>Issued by</i> | <i>Description of modifications</i> |
|-----------------|-------------|------------------|-------------------------------------|
| 0 | 2020-08-31 | Andreas Menacher | First edition |