# Test report

**Applicant:**

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**Test report no.:**

170586-AU01+W04

**for:**

Xylem Analytics Germany GmbH

Wireless charger for TLC750 system

IF 750 / CS 750

**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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Germany

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)* |
|---|---|---|---|---|
| 15.205 | Restricted bands of operation | 24 | Passed | 1 |
| 15.207 | AC power line conducted emissions 9 kHz to 30 MHz | 29 | Passed | 2 |
| 15.209 | Radiated emissions | | | |
| | 9 kHz to 30 MHz | 35 | Passed | --- |
| | 30 MHz to 1 GHz | 45 | Passed | |
| | 1 GHz to 10$^{th}$ harmonic | --- | Not applicable | 3 |
| 15.215 | Emission bandwidth | 51 | Recorded | 4 |

*Notes (for information about EUT see clause 3):*

1 Restricted band according to §15.205 close to operating frequency range is 90 kHz to 110 kHz.

2 According to §15.207, conducted emission limits are defined for the frequency range 150 kHz to 30 MHz.

3 As the intentional radiator of the WPT system operates below 10 GHz and the tenth harmonic of the highest fundamental frequency is lower than 1 GHz (see 47 CFR Part 15, section 15.33(a)(1)), this measurement needs to be applied only if the digital part of the WPT device generates or uses internal frequencies higher than 108 MHz (see 47 CFR Part 15 section 15.33(b)(1)).

4 Required for intentional radiators operating under the alternative provisions to the general emission limits, only.

Straubing, November 29, 2019

Andreas Menacher
Test engineer
EMV **TESTHAUS** GmbH

Konrad Graßl
Head of Radio Department
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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* |
|---|---|
| 47 CFR Part 2:2017-10 | Code of Federal Regulations Part 2 (Frequency allocation and radio treaty matters; General rules and regulations) of the Federal Communication Commission (FCC) |
| 47 CFR Part 15:2017-10 | 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 |
| FCC KDB 174176 D01<br>June 3, 2015 | AC power-line conducted emissions Frequently Asked Questions |

# 3 Equipment under test (EUT)

All Information in this clause is declared by customer.

## 3.1 General information

| | | | |
|---|---|---|---|
| Product type: | Wireless charger for TLC750 system | | |
| Model name: | Power transmitter: | IF 750<br>CS 750 | |
| | (WPT source device)<br>Power receiver:<br>(WPT client device) | TLC 750 NFC | |
| Serial number(s): | Power transmitter: | DUT_7<br>DUT_5 | |
| | Power receiver: | DUT_1 | |
| FCC ID: | VQ5-IF750 | | |
| Manufacturer: | Xylem Analytics Germany GmbH | | |
| Version: | Power transmitter: | Hardware:<br>Software: | 1.00<br>1.00 |
| | Power receiver: | Hardware:<br>Software: | V1.0<br>V0.59.91 |
| Short description: | EUT is a Wireless power transmission (WPT) system that has a range of operating frequencies from 112 kHz to 177 kHz. | | |
| Additional modifications: | None | | |
| Power supply: | DC supply | | |
| | Nominal voltage:<br>Minimum voltage:<br>Maximum voltage: | 5.00 V<br>4.75 V<br>5.25 V | |
| Supply used for testing: | 120 V / 60 Hz for power supply of notebook | | |
| Temperature range: | 0 °C to +50 °C (Customized) | | |
| Period of tests: | 27.08.2018 – 14.02.2019 | | |

## 3.2 Radio specifications

| | | | |
|---|---|---|---|
| Application(s): | Wireless Power Transfer (WPT) | | |
| Range of operating frequencies: | 112 kHz to 177 kHz | | |
| Frequency stability during charging: | ☐ Fixed frequency<br>☒ Frequency depending on charge of battery | | |
| Modulation: | ASK | | |
| Antenna: | Type: | Power transmitter:<br>Power receiver: | TDK WT303012-12F2-ID<br>Würth Electronic 760308101214 |
| | Size: | Power transmitter:<br>Power receiver: | 30 mm Ø<br>19 mm Ø |
| | Style: | ☒ integral | ☐ dedicated |
| | Connector: | ☐ external<br>☐ temporary | ☒ internal<br>☒ 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

| *EUT* | | | |
|---|---|---|---|
| *Device* | *Type designation* | *Serial or inventory no.* | *Manufacturer* |
| Power transmitter | IF 750 | DUT_7 | Xylem Analytics Germany GmbH |
| Power transmitter | CS 750 | DUT_5 | Xylem Analytics Germany GmbH |
| *Peripheral devices* | | | |
| *Device* | *Type designation* | *Serial or inventory no.* | *Manufacturer* |
| Notebook | LATITUDE E6510 | 5FWTZN1 | DELL |
| AD/DC adaptor of notebook | LA130PM121 | OVJCH5 | DELL |
| Power receiver | TLC 750 NFC | DUT_1 | Xylem Analytics Germany GmbH |
| Power receiver dummy | TLC 750 NFC | MUSTER | Xylem Analytics Germany GmbH |
| *Support devices* | | | |
| *Device* | *Type designation* | *Serial or inventory no.* | *Manufacturer* |
| AC power source | 616062 | E00633 | Chroma |

Table 1: Devices used for testing

*Note:* The power receiver is used for determining the operating frequency range when charging. For testing at a single frequency, the power receiver dummy is selected. This dummy device is equipped with the same power receiver part as the original power receiver device, but the battery is disconnected and a special load mounted outside the cabinet is used instead. This enables testing the EUT operating in charging mode at a single and stable frequency.

| *Port* | *Classification* | *Cable type* |
|---|---|---|
| Ethernet[1] | Signal/control | Shielded |
| USB | DC power / Signal control | Shielded |

Table 2: Ports of EUT and appropriate cables[2]

[1] Only IF 750 includes Ethernet port.
[2] As specified by customer.

## 5.2 Versions of EUT

CS 750: Wireless charger for TLC750 Systems. Powered via USB (no communication via this interface).
IF 750: Wireless charger for TLC750 Systems, with NFC and BLE module integrated. Powered via USB (communication possible). Includes also an Ethernet interface for communication (no PoE).

All tests were performed with the version IF 750 as this transmits the maximum radiated emission at the operating frequency and represents the maximum assembly of the EUT. Additionally, radiated spurious emissions of the CS 750 were performed to ensure that this version also complies with the requirements. Therefore, with radiated spurious emissions the version is reported. If no version is stated, IF 750 was used.

## 5.3 Mode of operation

### 5.3.1 Separation distance

For EUTs that are capable of wireless power transfer over a non-zero separation distance between the source and the client devices, testing at zero separation only is not sufficient.

☒ EUT is not capable of wireless power transfer over a non-zero separation distance: Testing at zero separation is performed.
☐ EUT is capable of wireless power transfer over a non-zero separation distance.

### 5.3.2 Orientation

The EUT is tested in its typical setup configuration, as per the manufacturer's instructions in the user manual. If the device can be operated in various orientations (e.g. tabletop and wall-mount), it is tested in each orientation in which it is intended to be used.

☒ EUT has one position of use which is selected for testing.
☐ EUT is tested in three orthogonal orientations.

For photos of EUT positions see annex A.

### 5.3.3 Operational modes

In table 3 the operational modes of the WPT system are listed.

| *Operational mode* | *Set-up* | *Function of WPT source* | *Function of WPT client* | *Tests performed* |
|---|---|---|---|---|
| Standby mode: WPT source in standby or idle mode | WPT source only | Transmitter | Not applicable | • Restricted bands of operation<br>• AC power line conducted emissions<br>• Radiated emissions |
| Charging mode 1: energy transmission with communication | WPT system alignment with WPT source and standard WPT client | TX and RX | TX and RX | • Restricted bands of operation |
| Charging mode 2: energy transmission with communication on fixed frequency | WPT system alignment with WPT source and power receiver dummy | TX and RX | TX and RX | • Restricted bands of operation<br>• AC power line conducted emissions<br>• Radiated emissions |

Table 3: Operational modes of WPT system

Note: The power transfer and communication operate at the same frequency.
There is no communication without power transfer.

# 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 AC power-line conducted emissions

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 4: 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 4). 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).

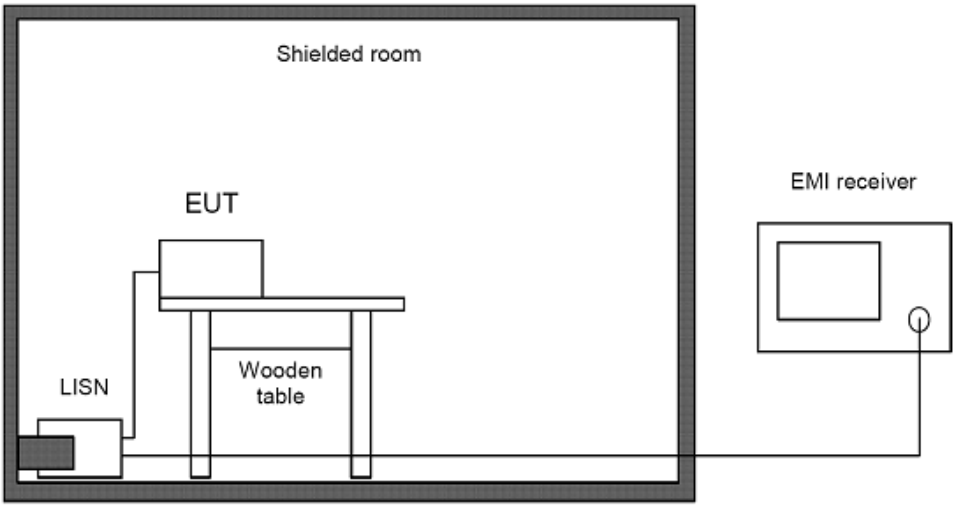


Figure 1: Setup for AC power-line conducted emissions test from 150 kHz to 30 MHz

## 6.3 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.

### 6.3.1 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:

$d_{near\ field}$ = 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<br>490 kHz < f ≤ 1.592 MHz | 300 m<br>30 m | 3 m | $-40 \log(d_{limit} / d_{measure})$ |
| 159 kHz < f ≤ 490 kHz<br>1.592 MHz < f ≤ 15.923 MHz | 300 m<br>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 5: Recalculation factors for extrapolation

## 6.3.2 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 6.

| *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 6: 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 6).
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.

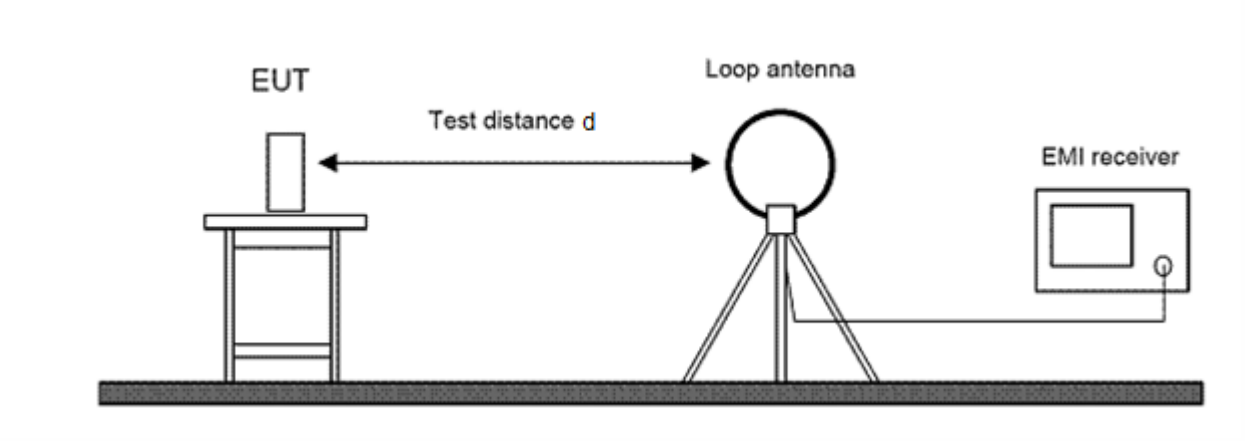


Figure 2: Setup for radiated emissions test below 30 MHz

## 6.4 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 7.

| *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 7: 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 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 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.

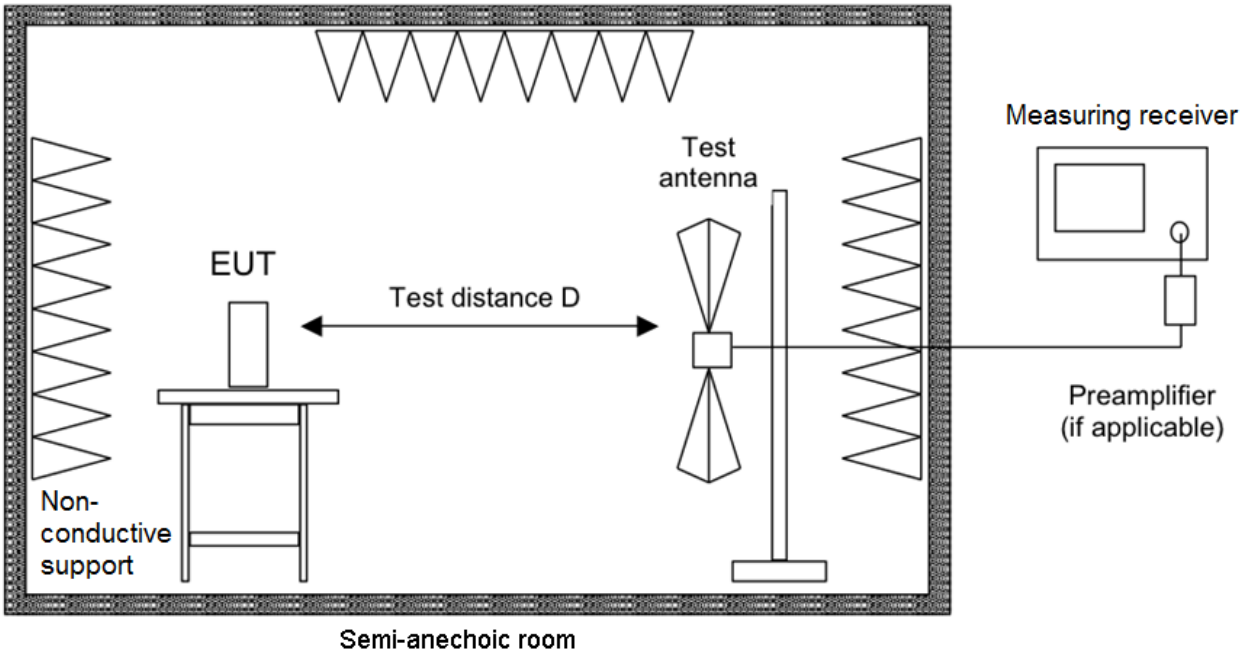


Figure 3: Setup for radiated emissions test from 30 MHz to 1 GHz

## 6.5 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.

### 6.5.1 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 8.

| *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 8: 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.

### 6.5.2 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 9.

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

Table 9: 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 9).
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.

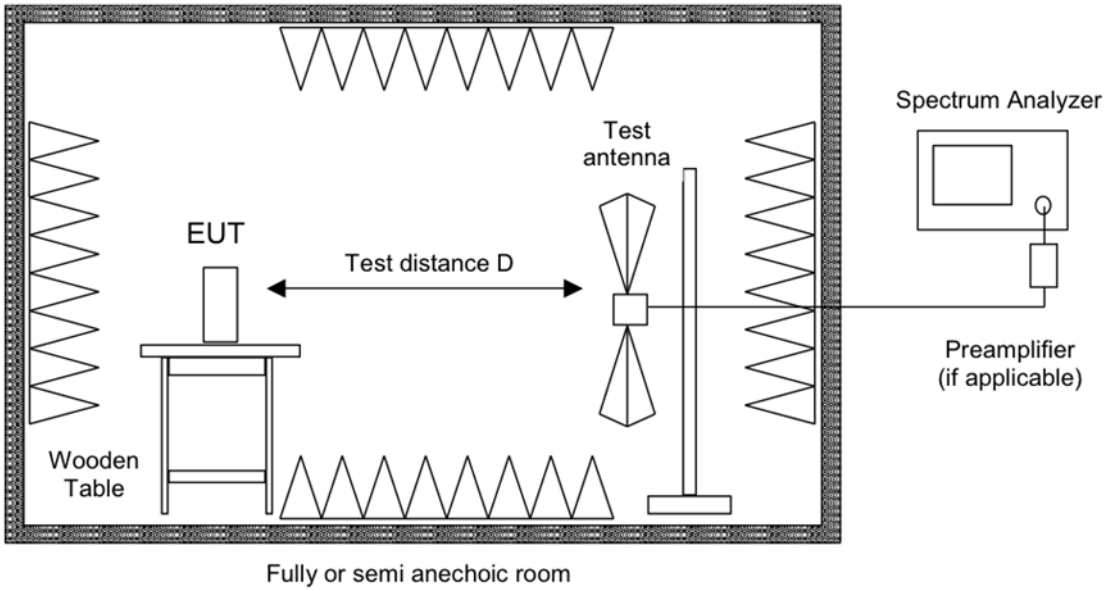


Figure 4: Setup for radiated emissions test above 1 GHz

# 7 Test results

This clause gives details about the test results as collected in the summary of test results starting on page 6.

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

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

## 7.1 Restricted bands of operation

Section(s) in 47 CFR Part 15: Requirement: 15.205
Reference(s): ANSI C63.10, clause 6.4

Result[3]: ☒ 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<br>AME HF-Technik<br>AME HF-Technik<br>Stabo | E00446<br>E00920<br>E00921<br>E01215 |
| ☒ | Test software | EMC32-MEB (V10.35) | Rohde & Schwarz | E00778 |

[3] For information about measurement uncertainties see page 73.

## 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* | *Field strength* | | *Measurement distance* |
|---|---|---|---|
| *[MHz]* | *[µV/m]* | *[dBµV/m]* | *[m]* |
| 0.009 – 0.490 | 2400/F(kHz)<br>(266.67 – 4.90) | 48.52 – 13.80 | 300 |
| 0.490 – 1.705 | 24000/F(kHz)<br>(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 10: 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 10 using the recalculation factor as described in clause 6.3.1.

## 7.1.3 Test procedure

Emissions in the restricted bands of operation are measured using the test procedure as described in clause 6.3.

## 7.1.4 Test results

### 7.1.4.1 Test results for standby mode

| Performed by: | Andreas Menacher | Date of test: | November 16, 2018 |
|---|---|---|---|
| Test distance: | ☒ 3 m | ☐ 10 m | ☐ ….. m |
| Antenna alignment: | ☒ in parallel | ☐ in line | ☐ angle ….. ° |
| EUT position: | ☐ 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 |

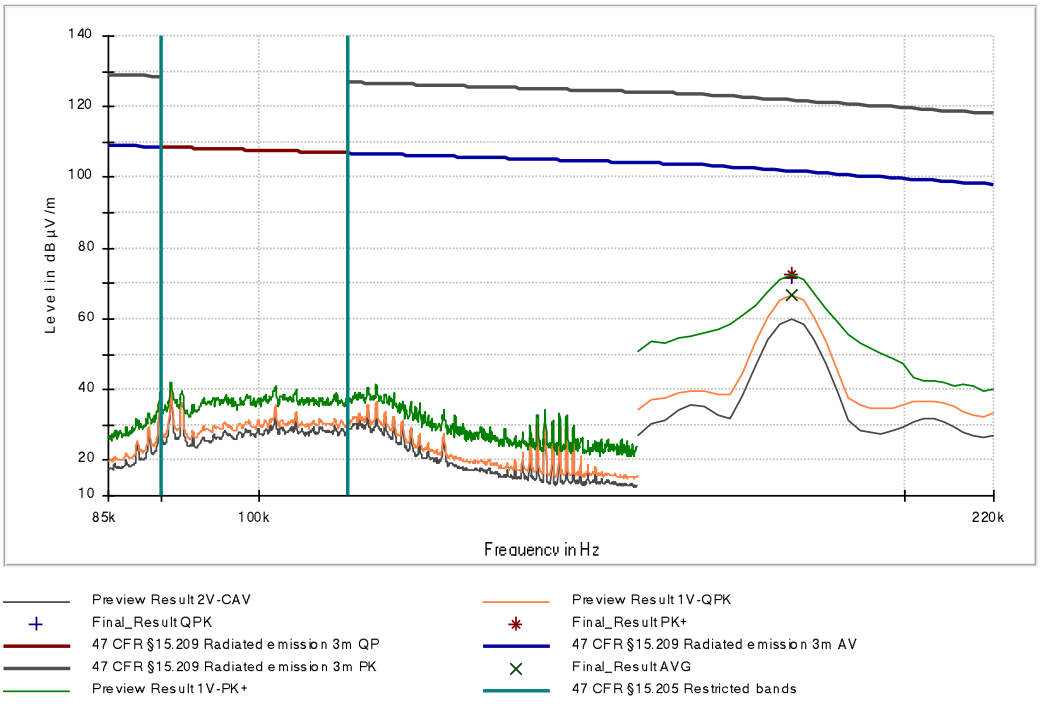


Figure 5: Chart of restricted bands of operation test for standby mode

## 7.1.4.2 Test results for charging mode 1

| Performed by: | Andreas Menacher | Date of test: | February 28, 2019 |
|---|---|---|---|
| Test distance: | ☒ 3 m | ☐ 10 m | ☐ ….. m |
| Antenna alignment: | ☒ in parallel | ☐ in line | ☐ angle ….. ° |
| EUT position: | ☐ Position 1 | ☒ Position 2 | ☐ Position 3 |

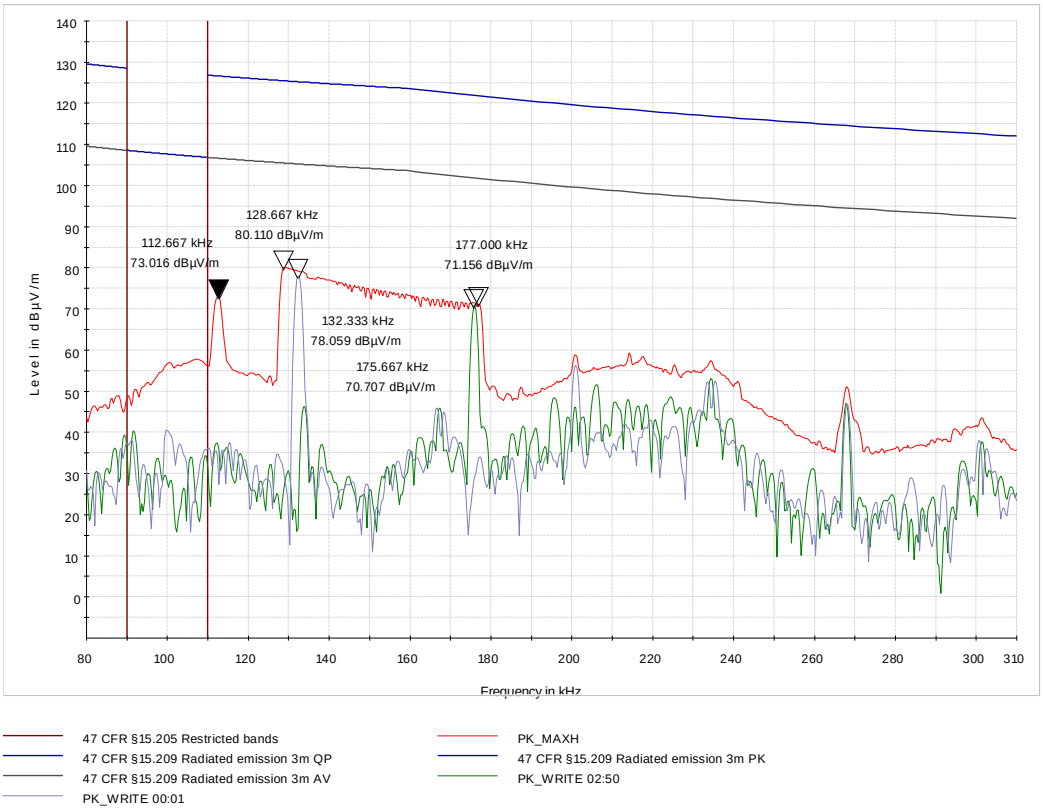


Figure 6: Chart of restricted bands of operation test for charging mode 1

## 7.1.4.3 Test results for charging mode 2

| Performed by: | Andreas Menacher | Date of test: | February 14, 2019 |
|---|---|---|---|
| Test distance: | ☒ 3 m | ☐ 10 m | ☐ ….. m |
| Antenna alignment: | ☒ in parallel | ☐ in line | ☐ angle ….. ° |
| EUT position: | ☐ 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 |

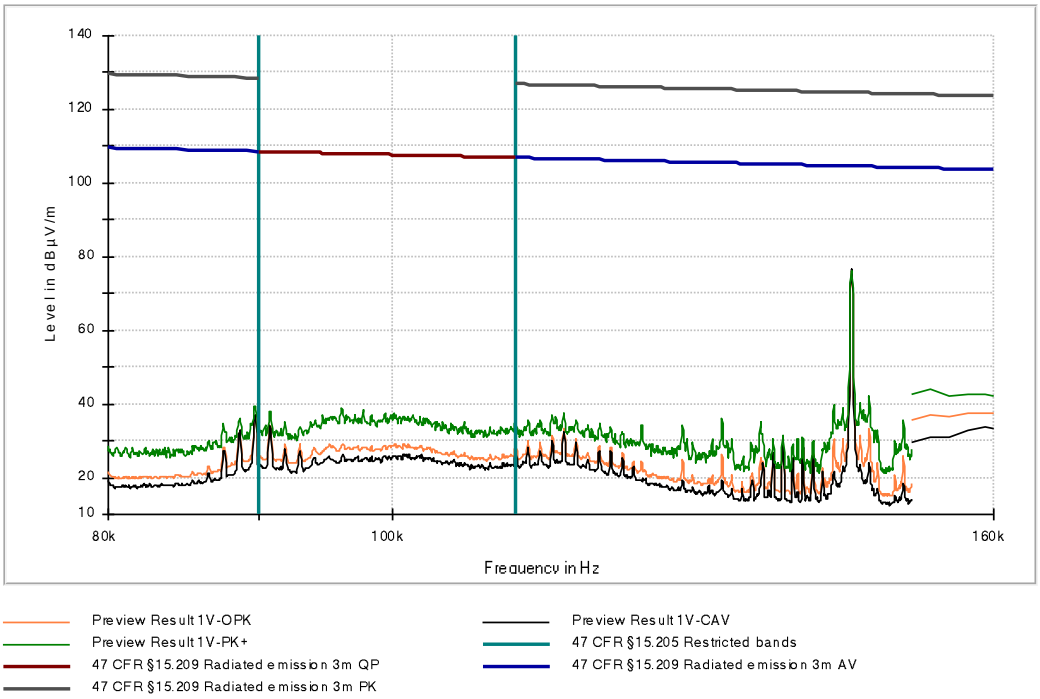


Figure 7: Chart of restricted bands of operation test for charging mode 2

## 7.2 AC power line conducted emissions

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

Result[4]: ☒ Test passed ☐ Test not passed

**Remark: The test was performed with a representative power supply**

### 7.2.1 Test equipment

| | *Type* | *Designation* | *Manufacturer* | *Inventory no.* |
|---|---|---|---|---|
| ☒ | Shielded room | P92007 | Siemens Matsushita | E00107 |
| ☒ | EMI test receiver | ESR 7 | Rohde & Schwarz | E00739 |
| ☒ | Artificial mains network | ESH2-Z5 | Rohde & Schwarz | E00004 |
| ☒ | Attenuator (10 dB) | 50FHB-010-10 | JFW Industries | E00471 |
| ☒ | Cable set (shielded room) no. 1 | RF cable(s) | Huber + Suhner | E00741<br>E00804 |
| ☒ | Test software | EMC32-EB (V10.35) | Rohde & Schwarz | E00777 |

[4] For information about measurement uncertainties see page 73.

## 7.2.2 Limits

As specified in section 15.207 of 47 CFR Part 15, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 kHz to 30 MHz, shall not exceed the limits in table 11.

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

Table 11: Limits for AC power-line conducted emissions according to §15.207

## 7.2.3 Test procedure

AC power line conducted emissions are measured using the test procedure as described in clause 6.2.

## 7.2.4 Test results

### 7.2.4.1 Test results for standby mode

| Performed by: | Andreas Menacher | Date of test: | November 21, 2018 |
|---|---|---|---|

.

| *Frequency range* | *Step size* | *IF Bandwidth* | *Detector* | | *Measurement Time* | | *Preamplifier* |
|---|---|---|---|---|---|---|---|
| | | | *Prescan* | *Final scan* | *Prescan* | *Final scan* | |
| 9 kHz – 150 kHz | 100 Hz | 200 Hz | PK, AV | QP, AV | 100 ms | 1 s | Off |
| 150 kHz – 30 MHz | 4 kHz | 9 kHz | PK, AV | QP, AV | 10 ms | 1 s | Off |

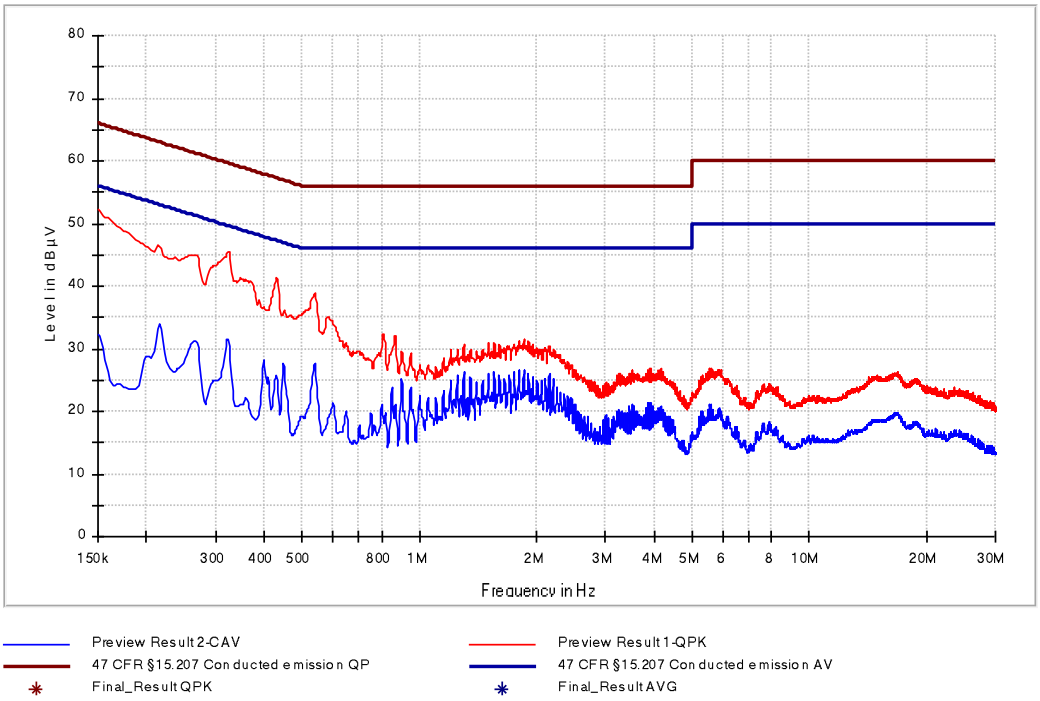


Figure 8: Chart of AC power-line conducted emissions test (15.207) on live wire L1 for standby mode

Note: No assessable emissions detected.

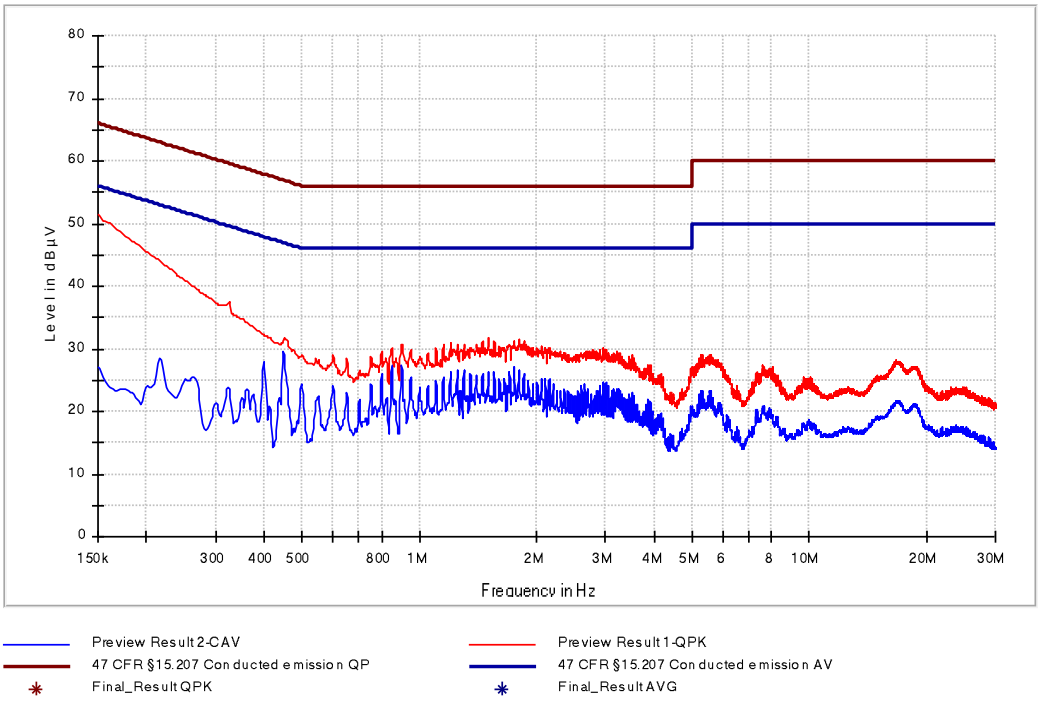


Figure 9: Chart of AC power-line conducted emissions test (15.207) on live wire N for standby mode

Note: No assessable emissions detected.

## 7.2.4.2 Test results for charging mode 2

| Performed by: | Andreas Menacher | Date of test: | November 21, 2018 |
|---|---|---|---|

| *Frequency range* | *Step size* | *IF Bandwidth* | *Detector* | | *Measurement Time* | | *Preamplifier* |
|---|---|---|---|---|---|---|---|
| | | | *Prescan* | *Final scan* | *Prescan* | *Final scan* | |
| 9 kHz – 150 kHz | 100 Hz | 200 Hz | PK, AV | QP, AV | 100 ms | 1 s | Off |
| 150 kHz – 30 MHz | 4 kHz | 9 kHz | PK, AV | QP, AV | 10 ms | 1 s | Off |

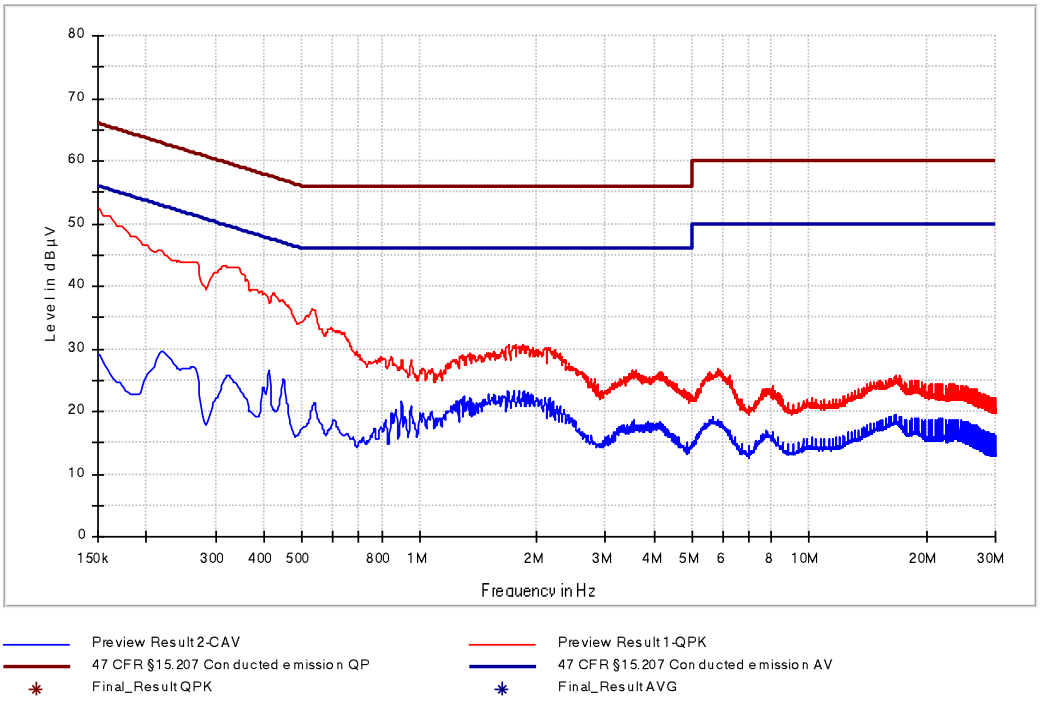


Figure 10: Chart of AC power-line conducted emissions test (15.207) on live wire L1 for charging mode 2

Note: No assessable emissions detected.

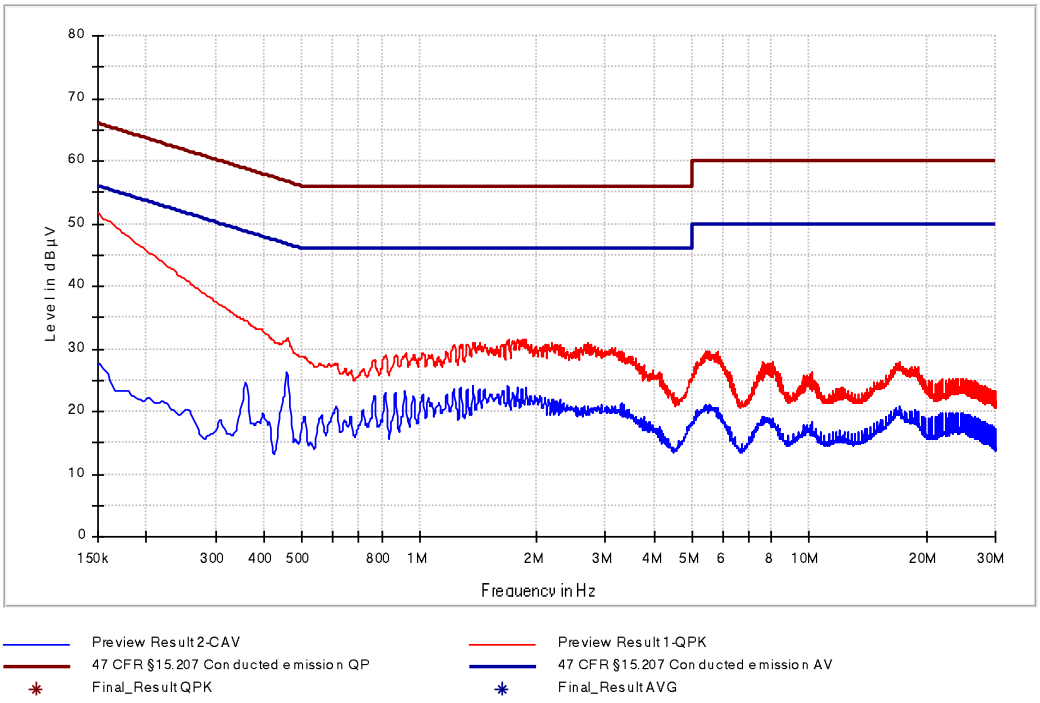


Figure 11: Chart of AC power-line conducted emissions test (15.207) on live wire N for charging mode 2

Note: No assessable emissions detected.

## 7.3 Radiated emissions

### 7.3.1 Radiated emissions below 30 MHz

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

Result[5]: ☒ Test passed ☐ Test not passed

#### 7.3.1.1 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<br>AME HF-Technik<br>AME HF-Technik<br>Stabo | E00446<br>E00920<br>E00921<br>E01215 |
| ☒ | Test software | EMC32-MEB (V10.35) | Rohde & Schwarz | E00778 |

[5] For information about measurement uncertainties see page 73.

### 7.3.1.2 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 12:

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

Table 12: 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 12 using the recalculation factor as described in clause 6.3.1.

### 7.3.1.3 Test procedure

Radiated emissions below 30 MHz are measured using the test procedure as described in clause 6.3.

### 7.3.1.4 Test results for IF 750

#### 7.3.1.4.1 Test results for standby mode

| Performed by: | Andreas Menacher | Date of test: | November 16, 2018 |
|---|---|---|---|
| Test distance: | ☒ 3 m | ☐ 10 m | ☐ ….. m |
| Antenna alignment: | ☒ in parallel | ☐ in line | ☐ angle ….. ° |
| EUT position: | ☐ 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 |

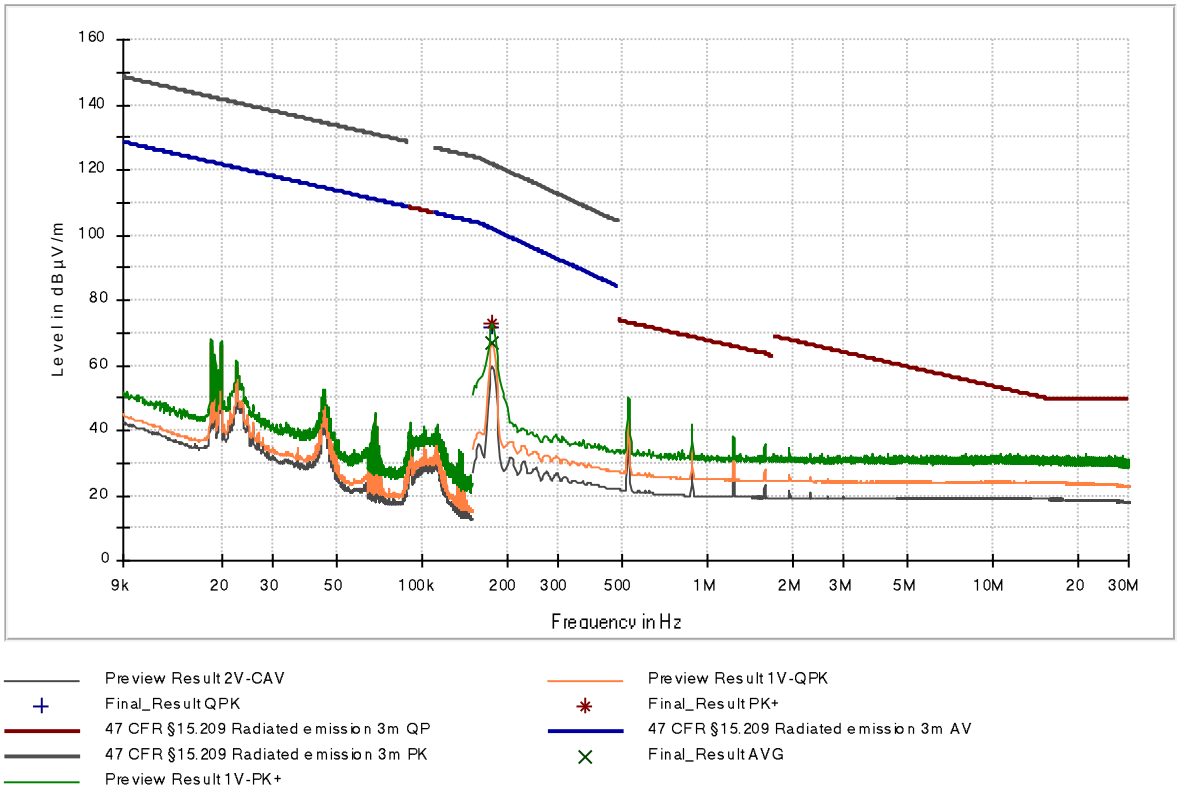


Figure 12: Chart of radiated emissions test below 30 MHz according to §15.209 for standby mode

| *Frequency* (MHz) | *De-tector* | *Measured field strength* (dBµV/m) | *Distance referred to limit* (m) | *Recalculation factor* (dB) | *Calculated field strength* (dBµV/m) | *Limit* (dBµV/m) | *Margin* (dB) | *Azi-muth* (deg) |
|---|---|---|---|---|---|---|---|---|
| 0.17700 | AV | 66.78 | 300 | 79.08 | -12.30 | 22.64 | 34.94 | 183.0 |
| 0.17700 | PK | 72.81 | 300 | 79.08 | -6.27 | 42.64 | 48.91 | 183.0 |

Table 13: Results of radiated emissions test below 30 MHz according to §15.209 for standby mode

Note: The emission within the restricted band from 90 kHz to 110 kHz is a spurious emission for which the quasi-peak limit applies. In standby mode, no power receiver is present, i.e. there is no communication.

## 7.3.1.4.2 Test results for charging mode 2

| | | | |
|---|---|---|---|
| Performed by: | Andreas Menacher | Date of test: | February 14, 2019 |
| Test distance: | ☒ 3 m | ☐ 10 m | ☐ ….. m |
| Antenna alignment: | ☒ in parallel | ☐ in line | ☐ angle ….. ° |
| EUT position: | ☐ 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 |

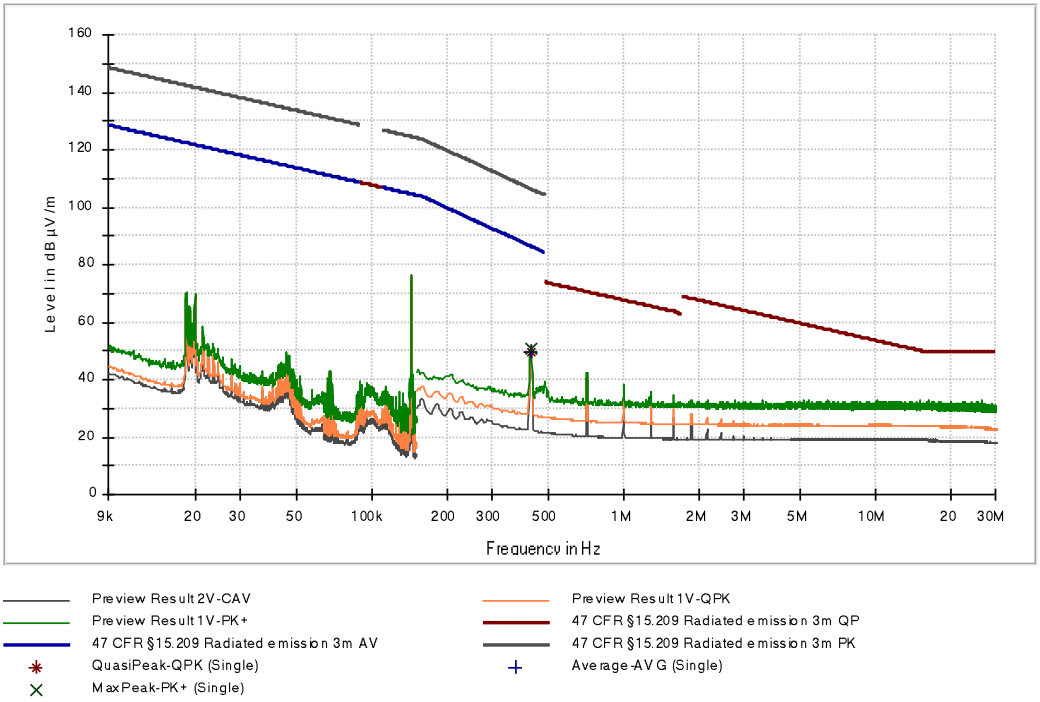


Figure 13: Chart of radiated emissions test below 30 MHz according to §15.209 for charging mode 2

| *Frequency (MHz)* | *Detector* | *Measured field strength (dBµV/m)* | *Distance referred to limit (m)* | *Recalculation factor (dB)* | *Calculated field strength (dBµV/m)* | *Limit (dBµV/m)* | *Margin (dB)* | *Azimuth (deg)* |
|---|---|---|---|---|---|---|---|---|
| 0.142750 | AV | 75.29 | 300 | 80.00 | -4.71 | 24.51 | 29.22 | 180.0 |
| 0.142750 | PK | 75.62 | 300 | 80.00 | -4.38 | 44.51 | 48.89 | 180.0 |
| 0.429000 | AV | 49.51 | 300 | 80.95 | -31.44 | 14.96 | 46.40 | 180.0 |
| 0.429000 | PK | 50.67 | 300 | 80.95 | -30.28 | 34.96 | 65.24 | 180.0 |

Table 14: Results of radiated emissions test below 30 MHz according to §15.209 for charging mode 2

## 7.3.1.5 Test results for CS 750

### 7.3.1.5.1 Test results for standby mode

| Performed by: | Andreas Menacher | Date of test: | November 16, 2018 |
|---|---|---|---|
| Test distance: | ☒ 3 m | ☐ 10 m | ☐ ….. m |
| Antenna alignment: | ☒ in parallel | ☐ in line | ☐ angle ….. ° |
| EUT position: | ☐ 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 |

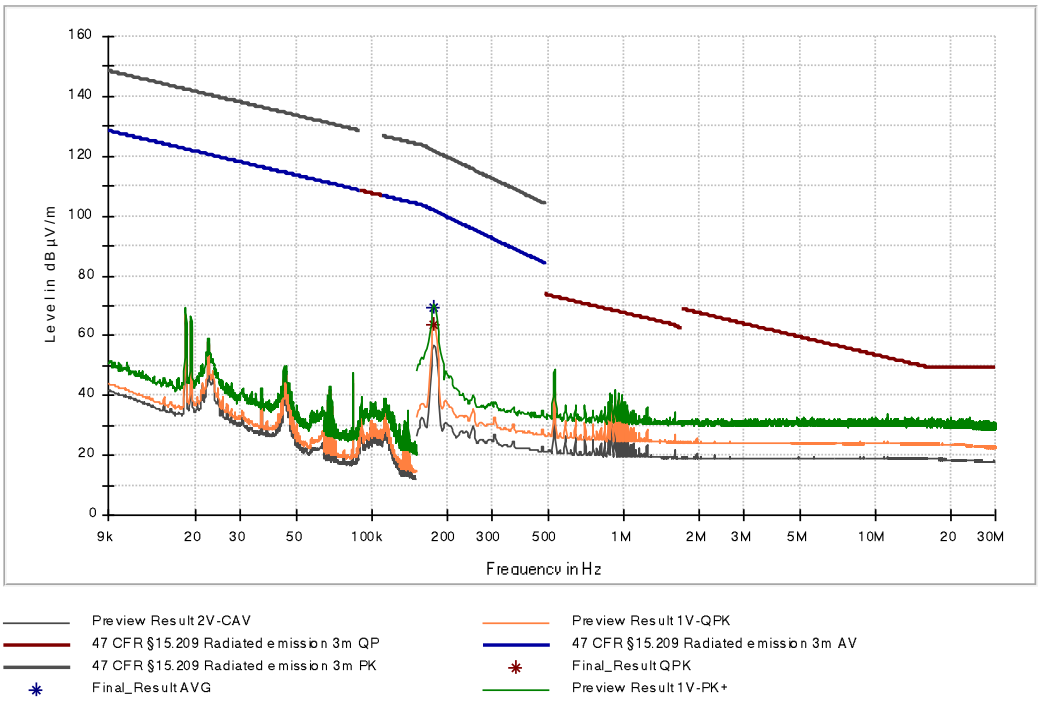


Figure 14: Chart of radiated emissions test below 30 MHz according to §15.209 for standby mode

| *Frequency* *(MHz)* | *De-tector* | *Measured field strength (dBµV/m)* | *Distance referred to limit (m)* | *Recalculation factor (dB)* | *Calculated field strength (dBµV/m)* | *Limit (dBµV/m)* | *Margin (dB)* | *Azi-muth (deg)* |
|---|---|---|---|---|---|---|---|---|
| 0.17700 | AV | 69.58 | 300 | 79.08 | -9.50 | 22.64 | 34.14 | 4.0 |
| 0.17700 | PK | 70.80 | 300 | 79.08 | -8.28 | 42.64 | 50.92 | 4.0 |

Table 15: Results of radiated emissions test below 30 MHz according to §15.209 for standby mode

Note: The emission within the restricted band from 90 kHz to 110 kHz is a spurious emission for which the quasi-peak limit applies. In standby mode, no power receiver is present, i.e. there is no communication.

### 7.3.1.5.2 Test results for charging mode 2

| | | | |
|---|---|---|---|
| Performed by: | Andreas Menacher | Date of test: | February 14, 2019 |
| Test distance: | ☒ 3 m | ☐ 10 m | ☐ ….. m |
| Antenna alignment: | ☒ in parallel | ☐ in line | ☐ angle ….. ° |
| EUT position: | ☐ 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 |

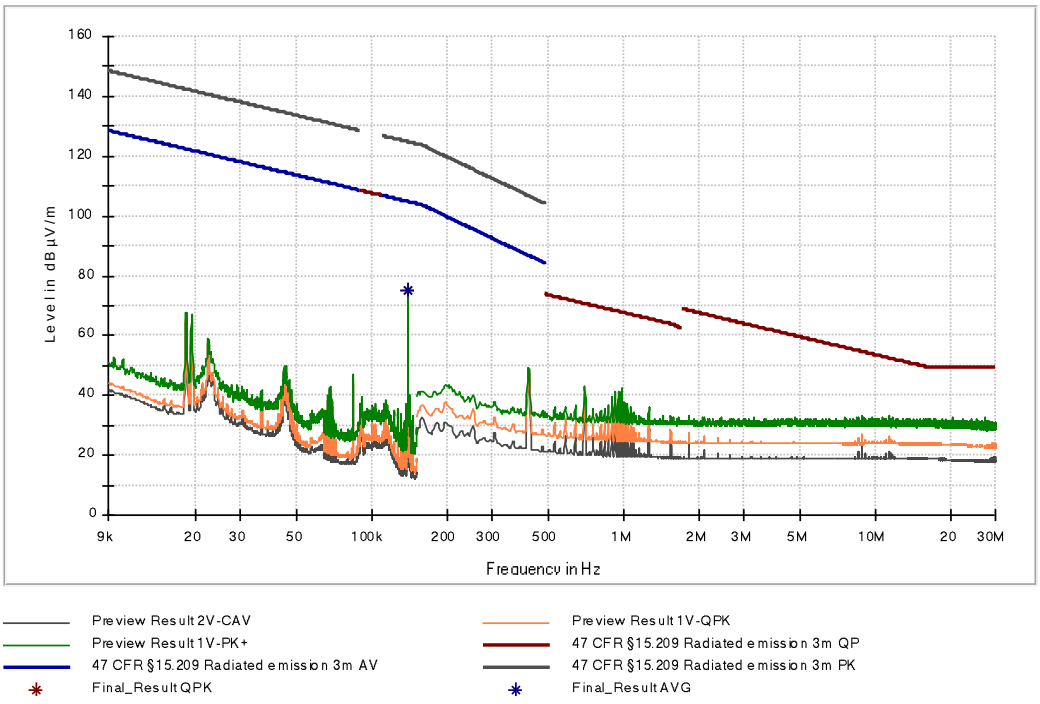


Figure 15: Chart of radiated emissions test below 30 MHz according to §15.209 for charging mode 2

| *Frequency (MHz)* | *De-tector* | *Measured field strength (dBµV/m)* | *Distance referred to limit (m)* | *Recalculation factor (dB)* | *Calculated field strength (dBµV/m)* | *Limit (dBµV/m)* | *Margin (dB)* | *Azi-muth (deg)* |
|---|---|---|---|---|---|---|---|---|
| 0.140150 | AV | 74.96 | 300 | 80.00 | -5.04 | 24.67 | 29.71 | 11.0 |
| 0.140150 | PK | 75.40 | 300 | 80.00 | -4.60 | 24.67 | 29.27 | 11.0 |

Table 16: Results of radiated emissions test below 30 MHz according to §15.209 for charging mode 2

## 7.3.2 Radiated emissions from 30 MHz to 1 GHz

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

Result[6]: ☒ Test passed ☐ Test not passed

### 7.3.2.1 Test equipment

| | *Type* | *Designation* | *Manufacturer* | *Inventory no.* |
|---|---|---|---|---|
| ☒ | Semi-anechoic chamber (SAC) | SAC3 | Albatross Projects | E00716 |
| ☒ | EMI test receiver | ESW 44 | Rohde & Schwarz | E00895 |
| ☒ | TRILOG broadband antenna (SAC) | VULB 9162 | Schwarzbeck | E00643 |
| ☒ | Cable set SAC | RF cable(s) | Huber + Suhner | E00755<br>E01033<br>E01034 |
| ☒ | Test software | EMC32-MEB (V10.35) | Rohde & Schwarz | E00778 |

[6] For information about measurement uncertainties see page 73.

### 7.3.2.2 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 17:

| *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 17: General radiated emission limits according to §15.209

### 7.3.2.3 Test procedure

Radiated emissions from 30 MHz to 1 GHz are measured using the test procedure as described in clause 6.4.

## 7.3.2.4 Test results for IF 750

### 7.3.2.4.1 Test results for standby mode

| Performed by: | Andreas Menacher | Date of test: | February 5, 2019 |
|---|---|---|---|
| Test distance: | ☒ 3 m | ☐ 10 m | ☐ ….. m |
| EUT position: | ☒ 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 |

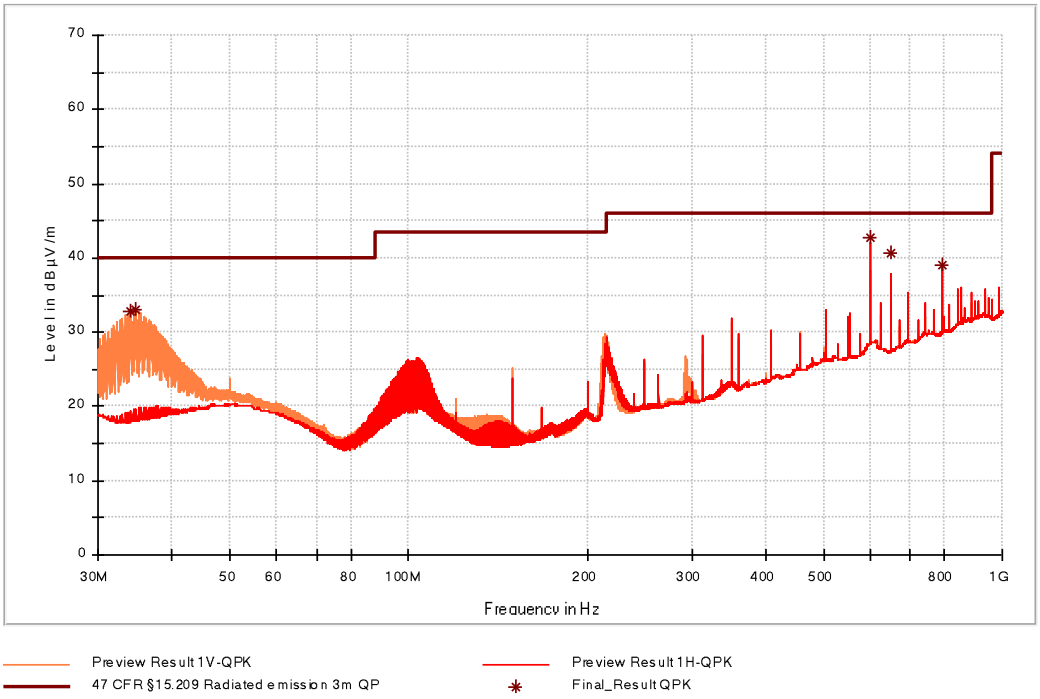


Figure 16: Chart of radiated emissions test 30 MHz to 1 GHz according to §15.209 for standby mode

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB) |
|---|---|---|---|---|---|---|---|---|---|
| 34.080000 | 32.88 | 40.00 | 7.12 | 1000.0 | 120.000 | 100.0 | V | 240.0 | 11.1 |
| 34.770000 | 32.95 | 40.00 | 7.05 | 1000.0 | 120.000 | 100.0 | V | 260.0 | 11.4 |
| 600.000000 | 42.75 | 46.00 | 3.25 | 1000.0 | 120.000 | 140.0 | H | 68.0 | 21.6 |
| 648.000000 | 40.63 | 46.00 | 5.37 | 1000.0 | 120.000 | 123.0 | H | 132.0 | 21.6 |
| 792.000000 | 39.04 | 46.00 | 6.96 | 1000.0 | 120.000 | 101.0 | H | 59.0 | 24.0 |

Table 18: Results of radiated emissions test 30 MHz to 1 GHz according to §15.209 for standby mode

## 7.3.2.4.2 Test results for charging mode 2

| | | | |
|---|---|---|---|
| Performed by: | Andreas Menacher | Date of test: | April 25, 2018 |
| Test distance: | ☒ 3 m | ☐ 10 m | ☐ ….. m |
| EUT position: | ☒ 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 |

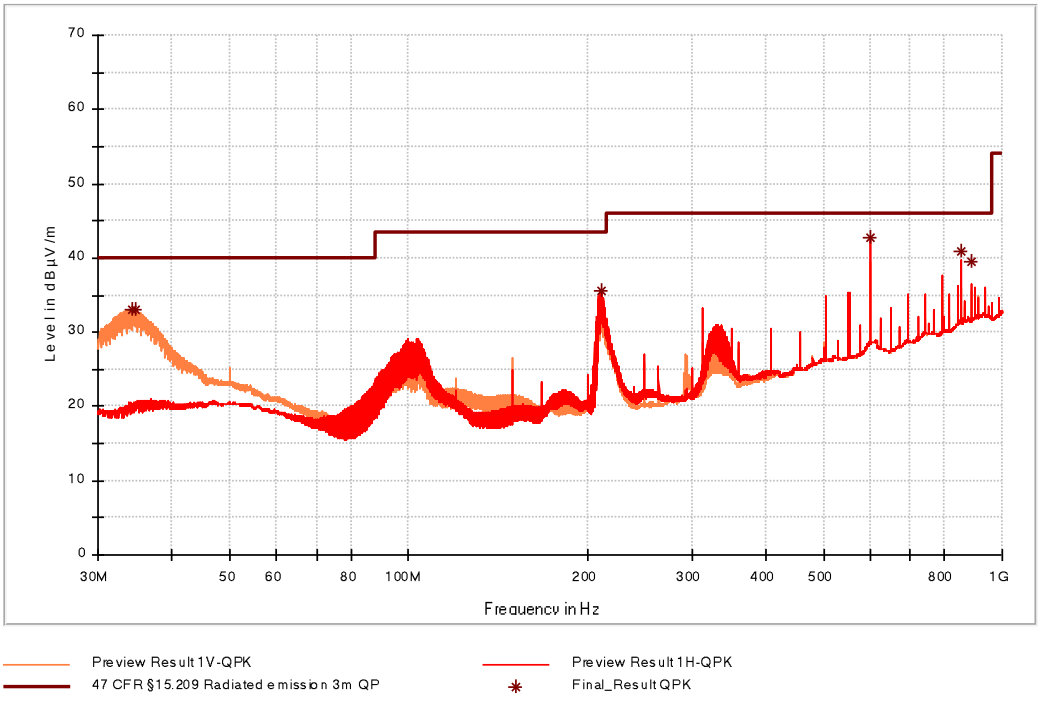


Figure 17: Chart of radiated emissions test 30 MHz to 1 GHz according to §15.209 for charging mode 2

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) | Corr. (dB/m) |
|---|---|---|---|---|---|---|---|---|---|
| 34.200000 | 33.10 | 40.00 | 6.90 | 1000.0 | 120.000 | 100.0 | V | 266.0 | 11.2 |
| 34.770000 | 32.94 | 40.00 | 7.06 | 1000.0 | 120.000 | 100.0 | V | 240.0 | 11.4 |
| 210.720000 | 35.61 | 43.50 | 7.89 | 1000.0 | 120.000 | 139.0 | H | 245.0 | 12.5 |
| 600.000000 | 42.85 | 46.00 | 3.15 | 1000.0 | 120.000 | 128.0 | H | 64.0 | 21.6 |
| 849.990000 | 40.87 | 46.00 | 5.13 | 1000.0 | 120.000 | 100.0 | H | 131.0 | 24.9 |
| 888.030000 | 39.61 | 46.00 | 6.39 | 1000.0 | 120.000 | 150.0 | H | 140.0 | 25.4 |

Table 19: Results of radiated emissions test 30 MHz to 1 GHz according to §15.209 for charging mode 2

## 7.4.1.1 Test results for CS 750

### 7.4.1.1.1 Test results for standby mode

| Performed by: | Andreas Menacher | Date of test: | February 5, 2019 |
|---|---|---|---|
| Test distance: | ☒ 3 m | ☐ 10 m | ☐ ….. m |
| EUT position: | ☒ 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 |

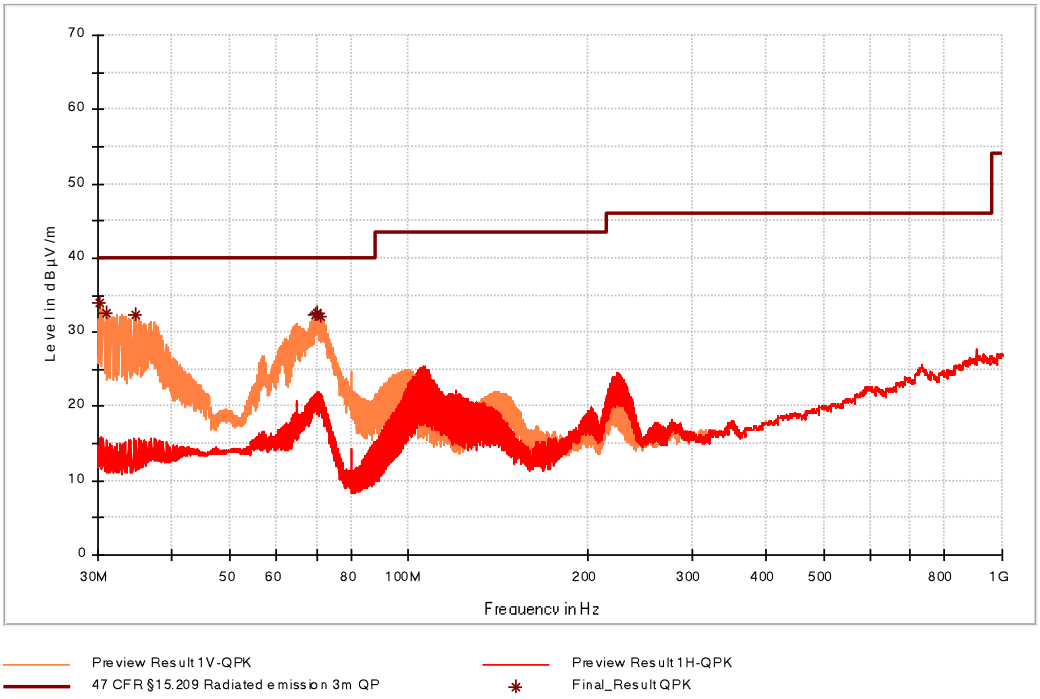


Figure 18: Chart of radiated emissions test 30 MHz to 1 GHz according to §15.209 for standby mode

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) |
|---|---|---|---|---|---|---|---|---|
| 30.270000 | 34.00 | 40.00 | 6.00 | 1000.0 | 120.000 | 100.0 | V | 170.0 |
| 30.960000 | 32.67 | 40.00 | 7.33 | 1000.0 | 120.000 | 101.0 | V | 129.0 |
| 34.770000 | 32.36 | 40.00 | 7.64 | 1000.0 | 120.000 | 102.0 | V | 50.0 |
| 69.570000 | 32.37 | 40.00 | 7.63 | 1000.0 | 120.000 | 102.0 | V | 222.0 |
| 70.290000 | 32.65 | 40.00 | 7.35 | 1000.0 | 120.000 | 114.0 | V | 206.0 |
| 71.160000 | 32.02 | 40.00 | 7.98 | 1000.0 | 120.000 | 100.0 | V | 239.0 |

Table 20: Results of radiated emissions test 30 MHz to 1 GHz according to §15.209 for standby mode

## 7.4.1.1.2 Test results for charging mode 2

| | | | |
|---|---|---|---|
| Performed by: | Andreas Menacher | Date of test: | April 25, 2018 |
| Test distance: | ☒ 3 m | ☐ 10 m | ☐ ….. m |
| EUT position: | ☒ 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 |

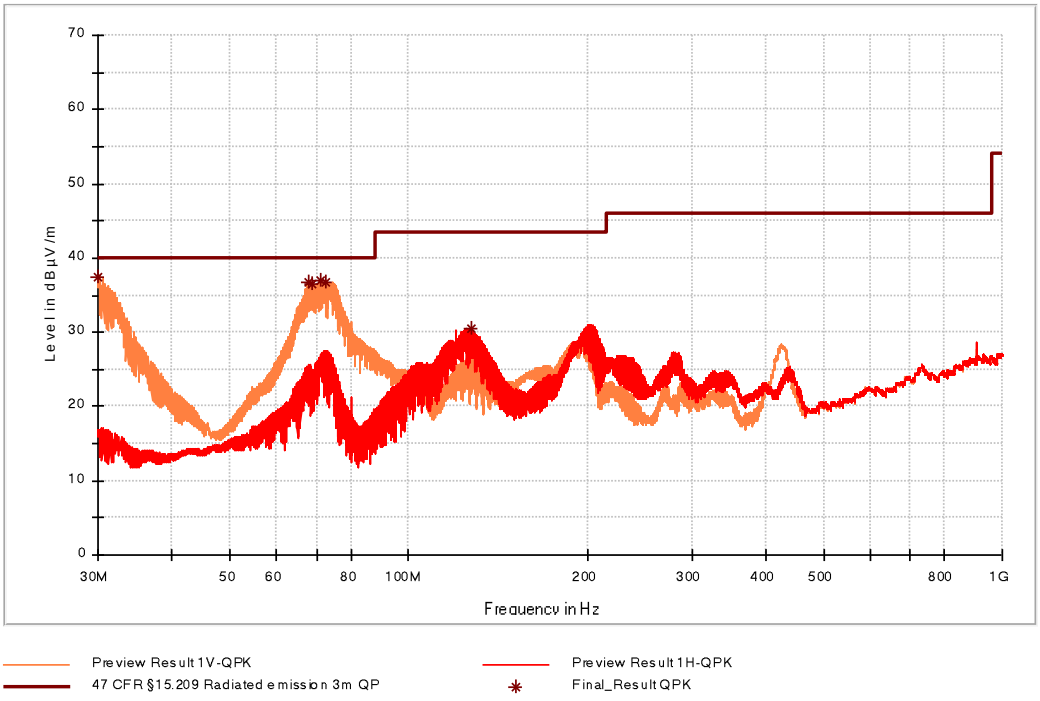


Figure 19: Chart of radiated emissions test 30 MHz to 1 GHz according to §15.209 for charging mode 2

| Frequency (MHz) | QuasiPeak (dBµV/m) | Limit (dBµV/m) | Margin (dB) | Meas. Time (ms) | Bandwidth (kHz) | Height (cm) | Pol | Azimuth (deg) |
|---|---|---|---|---|---|---|---|---|
| 30.000000 | 37.33 | 40.00 | 2.67 | 1000.0 | 120.000 | 100.0 | V | 180.0 |
| 67.980000 | 36.82 | 40.00 | 3.18 | 1000.0 | 120.000 | 100.0 | V | 0.0 |
| 68.700000 | 36.57 | 40.00 | 3.43 | 1000.0 | 120.000 | 100.0 | V | 9.0 |
| 71.250000 | 36.89 | 40.00 | 3.11 | 1000.0 | 120.000 | 100.0 | V | 176.0 |
| 72.570000 | 36.72 | 40.00 | 3.28 | 1000.0 | 120.000 | 100.0 | V | 231.0 |
| 127.350000 | 30.45 | 43.50 | 13.05 | 1000.0 | 120.000 | 278.0 | H | 274.0 |

Table 21: Results of radiated emissions test 30 MHz to 1 GHz according to §15.209 for charging mode 2

## 7.5 Bandwidth tests

Section(s) in 47 CFR Part 15: Requirement: 15.215(c)
Reference(s): ANSI C63.10, clause 6.9.2

Result[7]: ☒ Test passed ☐ Test not passed

### 7.5.1 Test equipment

| | *Type* | *Designation* | *Manufacturer* | *Inventory no.* |
|---|---|---|---|---|
| ☒ | EMI test receiver | ESR 7 | Rohde & Schwarz | E00739 |
| ☒ | Field probe | RF-R 400-1 | Langer EMV-Technik | E00270 |

[7] For information about measurement uncertainties see page 73.

## 7.5.2 Limits

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in §§15.217 through 15.257 and in subpart E of 47 CFR Part 15, 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. However, as WPT systems are certified with reference to the general radiated emission limits as specified in §15.209, no limit for the 20 dB bandwidth applies.

The occupied bandwidth is recorded according to section 6.6 of RSS-Gen with no limit applied, as there is no occupied bandwidth limit stated in RSS-216.

## 7.5.3 Test procedure

Emissions in the restricted bands of operation are measured using the test procedure as described in clause 6.3.

### 7.5.3.1 Test procedure for 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 reference value is

☐ the level of the unmodulated carrier, or

☒ the highest level of the spectral envelope of the modulated signal.

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.

## 7.5.4 Test results

### 7.5.4.1 Test results for standby mode

| | | | |
|---|---|---|---|
| Performed by: | Andreas Menacher | Date of test: | August 27, 2019 |
| Test distance: | ☒ 3 m | ☐ 10 m | ☐ ….. m |
| Antenna alignment: | ☒ in parallel | ☐ in line | ☐ angle ….. ° |
| EUT position: | ☐ Position 1 | ☒ Position 2 | ☐ Position 3 |

| *Bandwidth test* | *Value*<br>*kHz* | *Center frequency*<br>*kHz* | *Lowest frequency*<br>*kHz* | *Highest frequency*<br>*kHz* | *Application band*<br>*kHz* | *Result* |
|---|---|---|---|---|---|---|
| 20 dB bandwidth | 5.225 | 177.206 | 174.384 | 179.609 | --- | Recorded |

Table 22: Results of bandwidth tests for standby mode

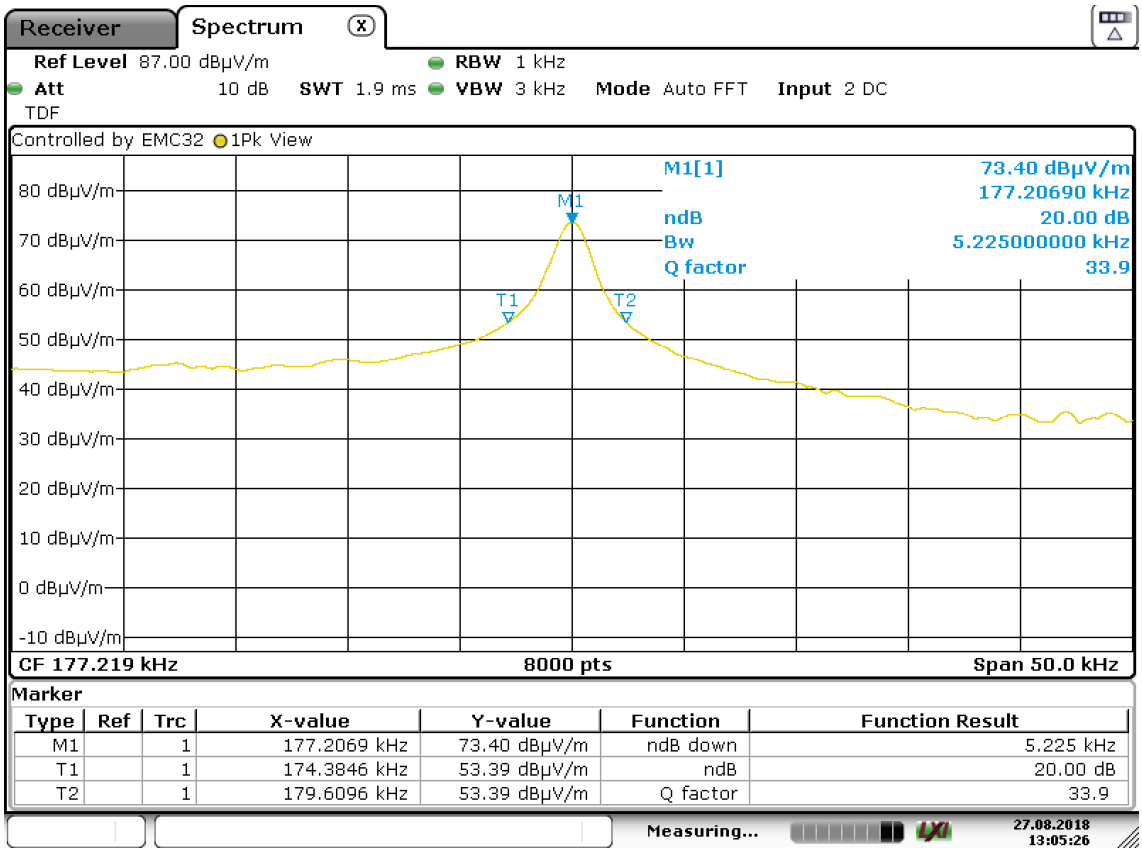


Figure 20: Chart of 20 dB bandwidth of the emission test for standby mode

## 7.5.4.2 Test results for charging mode 2

| | | | |
|---|---|---|---|
| Performed by: | Andreas Menacher | Date of test: | February 14, 2019 |
| Test distance: | ☐ 3 m | ☐ 10 m | ☒ 0.1 m |
| Antenna alignment: | ☒ in parallel | ☐ in line | ☐ angle ….. ° |
| EUT position: | ☒ Position 1 | ☐ Position 2 | ☐ Position 3 |

| *Bandwidth test* | *Value*<br>*kHz* | *Center frequency kHz* | *Lowest frequency kHz* | *Highest frequency kHz* | *Application band*<br>*kHz* | *Result* |
|---|---|---|---|---|---|---|
| 20 dB bandwidth | 0.068 | 146.418 | 146.383 | 146.452 | --- | Recorded |

Table 23: Results of bandwidth tests for charging mode 2

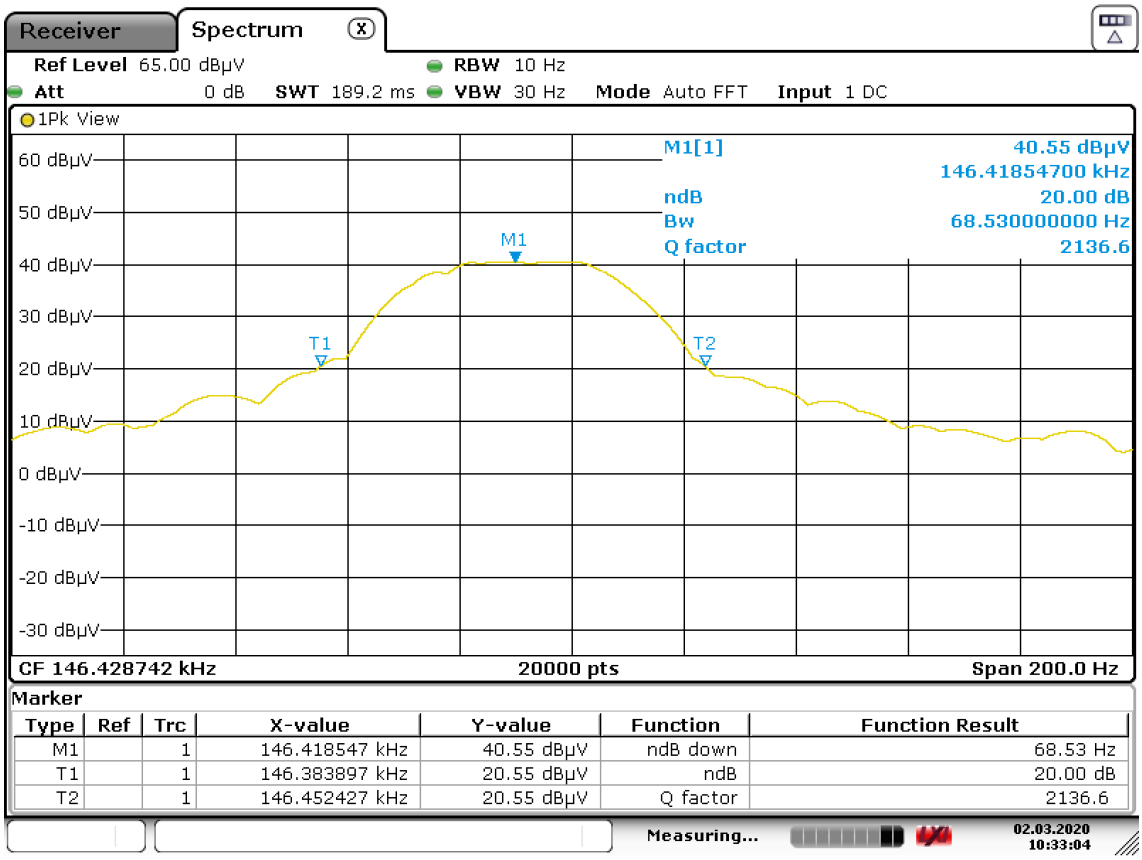


Figure 21: Chart of 20 dB bandwidth of the emission test for charging mode 2

# 8 Equipment calibration status

| *Description* | *Modell number* | *Serial number* | *Inventory number(s)* | *Last calibration* | *Next calibration* |
|---|---|---|---|---|---|
| EMI test receiver | ESR7 | 101059 | E00739 | 2018-05 | 2020-05 |
| EMI test receiver | ESW44 | 101538 | E00895 | 2019-07 | 2020-07 |
| EMI test receiver | ESCI3 | 100013 | E00001 | 2018-05 | 2020-05 |
| EMI test receiver | ESCI3 | 1000328 | E00552 | 2018-10 | 2020-10 |
| Attenuator (10 dB) | 50FHB-010-10 | --- | E00471 | 2017-02 | 2019-02 |
| Artficial mains network (AMN) | ESH2-Z5 | 881362/037 | E00004 | see Note 1 | |
| Artficial mains network (AMN) | ESH2-Z5 | 893406/009 | E00005 | 2018-10 | 2020-10 |
| Loop antenna | HFH2-Z2 | 871398/0050 | E00060 | 2016-09 | 2018-09 |
| Field probe | RF-R 400-1 | 02-2030 | E00270 | see Note 2 | |
| TRILOG broadband antenna (SAC) | VULB 9162 | 9162-041 | E00643 | 2015-11 | 2018-11 |
| 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 | See notes 1 and 2 | |
| Cable set shielded room | RG 223/U | --- | E00741 | 2017-02 | 2019-02 |
| | RG 223/U | --- | E00804 | 2017-02 | 2019-02 |
| Cable set CDC | RG214/U | --- | E00446 | 2018-01 | 2020-01 |
| | LMR400 | 1718020006 | E00920 | 2018-01 | 2020-01 |
| | RG214 Hiflex | 171802007 | E00921 | 2018-01 | 2020-01 |
| | LCF12-50J | --- | E01215 | 2018-01 | 2020-01 |
| Cable set SAC | SF104EA/11PC35/11PC35/10000MM | 501347/4EA | E00755 | 2017-12 | 2019-12 |
| | SF104E/11PC35/11PC35/2000MM | 507410/4E | E01033 | 2017-12 | 2019-12 |
| | SF104E/11PC35/11PC35/2000MM | 507411/4E | E01034 | 2017-09 | 2019-09 |

Note 1: Only used for decoupling of support equipment.
Note 2: Only used for relative measurements (clause 7.4).

# 9 Measurement uncertainties

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

| *Revision* | *Date* | *Issued by* | *Description of modifications* |
|---|---|---|---|
| 0 | 2019-11-29 | Andreas Menacher | First edition |