

| | | | | | |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|-----------------------------------------|
| Prüfbericht-Nr.: Test Report No.: | 17120403.13a | Auftrags-Nr.: Order No.: | 89212727 | Seite 1 von 18 Page 1 of 18 | |
| Kunden-Referenz-Nr.: Client Reference No.: | 4692320 | Auftragsdatum: Order date: | 27.11.2017 | | |
| Auftraggeber: Client: | Brusa Elektronik AG | Neudorf 14 Postfach 55 9466 Sennwald Switzerland | | | |
| Prüfgegenstand: Test item: | INDUCTIVE CHARGING SYSTEM | | | | |
| Bezeichnung / Typ-Nr.: Identification / Type No.: | Car Pad Module (CPM) ICSS115-U0-01X-XXX | | | | |
| Auftrags-Inhalt: Order content: | Compliance with regulatory requirements | | | | |
| Prüfgrundlage: Test specification: | 47 CFR PART 15 Subpart C (10-1-17 EDITION) RSS-Gen (Issue 4, November 2014) - | | | | |
| Wareneingangsdatum: Date of receipt: | 21.07.2017 |  | | | |
| Prüfmuster-Nr.: Test sample No.: | - | | | | |
| Prüfzeitraum: Testing period: | 30.11.2017 - 01.12.2017 | | | | |
| Ort der Prüfung: Place of testing: | Leek | | | | |
| Prüflaboratorium: Testing laboratory: | TÜV Rheinland Nederland B.V. Leek Laboratory | | | | |
| Prüfergebnis*: Test result*: | Pass | | | | |
| geprüft von / tested by: |  | | Kontrolliert von / reviewed by: |  | |
| 12.03.2018 | R. van der Meer/Test Eng. | 12.03.2018 | E. van der Wal/Senior Eng. | | |
| Datum <i>Date</i> | Name / Stellung <i>Name / Position</i> | Unterschrift <i>Signature</i> | Datum <i>Date</i> | Name / Stellung <i>Name / Position</i> | Unterschrift <i>Signature</i> |
| Sonstiges / Other: -- | | | | | |
| Zustand des Prüfgegenstandes bei Anlieferung: <i>Condition of the test item at delivery:</i> | | | Prüfmuster vollständig und unbeschädigt <i>Test item complete and undamaged</i> | | |
| * Legende: 1 = sehr gut 2 = gut 3 = befriedigend 4 = ausreichend 5 = mangelhaft P(ass) = entspricht o.g. Prüfgrundlage(n) F(fail) = entspricht nicht o.g. Prüfgrundlage(n) N/A = nicht anwendbar N/T = nicht getestet Legend: 1 = very good 2 = good 3 = satisfactory 4 = sufficient 5 = poor P(ass) = passed a.m. Test specification(s) F(fail) a.m. test specification(s) N/A = not applicable N/T = not tested | | | | | |
| Dieser Prüfbericht bezieht sich nur auf das o.g. Prüfmuster und darf ohne Genehmigung der Prüfstelle nicht auszugsweise vervielfältigt werden. Dieser Bericht berechtigt nicht zur Verwendung eines Prüfzeichens. <i>This test report only relates to the above mentioned testsample. Without permission of the test center this test report is not permitted to be duplicated in extracts. This report does not entitle to carry any test mark</i> | | | | | |

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Liste der verwendeten Prüfmittel
List of used test equipment

Conformance of the used measurement and test equipment with the requirements of ISO/IEC 17025:2005 has been confirmed before testing.
NA= Not Applicable

| Prüfmittel Kind of Equipment | Manufacturer | Model Name | Prüfmittel- Nr. / ID-Nr. Equipment No. / ID-No. | Kalibrierung Calibration (mm/yyyy) | Nächste Kalibrierung Next calibration (mm/yyyy) |
|---------------------------------|--------------|------------|----------------------------------------------------------|------------------------------------------|-------------------------------------------------------------|
|---------------------------------|--------------|------------|----------------------------------------------------------|------------------------------------------|-------------------------------------------------------------|

For Radiated Emissions

| | | | | | |
|-------------------------------|-----------------|--------------------------------------|--------|---------|---------|
| Measurement Receiver | Rohde & Schwarz | ESCI | A00314 | 03/2017 | 03/2018 |
| RF Cable S-AR | Gigalink | APG0500 | A00447 | 01/2017 | 01/2018 |
| Controller | Maturo | SCU/088/ 8090811 | A00450 | N/A | N/A |
| Controller | EMCS | DOC202 | A00257 | N/A | N/A |
| Test facility | Comtest | FCC listed: 786213 IC: 2932G-2 | A00235 | 08/2014 | 08/2018 |
| Spectrum Analyzer | Rohde & Schwarz | FSV | A00337 | 06/2017 | 06/2018 |
| Antenna mast | EMCS | AP-4702C | A00258 | N/A | N/A |
| Temperature- Humiditymeter | Extech | SD500 | A00444 | 04/2017 | 04/2018 |
| Active loop antenna 60 cm | Chase | HLA6120 | A01491 | 04-2017 | 04-2018 |
| Passive loop antenna | Emco | 6509 | A00006 | 04-2017 | 04-2018 |
| Biconilog Testantenna | Teseq | CBL 6111D | A00466 | 06/2017 | 06/2018 |
| Horn antenna 1-18 GHz | EMCO | 3115 | A00008 | 02/2017 | 02/2018 |
| Filterbox | EMCS | RFS06S | A00255 | 02/2017 | 02/2018 |
| AC power supply | EA | EA3050B | A01969 | 04-2017 | 04-2018 |

| Prüfmittel Kind of Equipment | Manufacturer | Model Name | Prüfmittel- Nr. / ID-Nr. Equipment No. / ID-No. | Kalibrierung Calibration (mm/yyyy) | Nächste Kalibrierung Next calibration (mm/yyyy) |
|-------------------------------------------------|-----------------|------------|----------------------------------------------------------|------------------------------------------|-------------------------------------------------------------|
| For AC Powerline Conducted Emissions | | | | | |
| Pulse limiter | R&S | ESH3-Z2 | A00051 | 01/2017 | 01/2018 |
| Variac | RFT | LSS020 | A00171 | NA | NA |
| LISN | EMCO | 3625/2 | A00019 | 06/2016 | 06/2018 |
| Measurement Receiver | Rohde & Schwarz | ESCS30 | A00726 | 10/2017 | 10/2018 |
| Shielded room for Conducted emissions | -- | -- | A00437 | NA | NA |
| Temperature- Humiditymeter | Extech | SD500 | A00441 | 04/2017 | 04/2018 |

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Produktbeschreibung
Product description

| | | |
|---|----------------------------------------------------------------|---------------------------|
| 1 | Produktdetails <i>Product details</i> | Inductive Charging System |
| 2 | Maße / Gewicht <i>Dimensions / Weight</i> | See product documentation |
| 3 | Bedienelemente <i>Operating elements</i> | See product documentation |
| 4 | Ausstattung / Zubehör <i>Equipment / Accessories</i> | -- |
| 5 | Verwendete Materialien <i>Used materials</i> | -- |
| 6 | Sonstiges <i>Other</i> | -- |
| | | |
| | | |
| | | |

| Absatz | | | | |
|---------------|----------------------------------------------------------------------------------------------------|--------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------|--|
| Clause | Anforderungen – Prüfungen / Requirements - Tests | | | |
| 1 | 47 CFR Part 15 Subpart C (10-1-17 Edition) - 15.207(a) RSS-Gen (Issue 4, November 2014) - (8.8) | AC Power Line Conducted Emissions | P <input checked="" type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input type="checkbox"/> | |
| 2 | 47 CFR Part 15 Subpart C (10-1-17 Edition) - 15.209 RSS-Gen (Issue 4, November 2014) - (8.9) | Radiated unwanted emissions | P <input checked="" type="checkbox"/> F <input type="checkbox"/> N/A <input type="checkbox"/> N/T <input type="checkbox"/> | |

Testmethods: ANSI C63.10-2013.

| Revisions <i>Revisions</i> | | | | |
|--------------------------------------|----------------------|------------------------------|----------------------------|--|
| Revision Revision | Datum Date | Anmerkung Remark | Verfasser Author | |
| - | 19.12.2017 | First release | R. van der Meer | |
| 01 | 12.03.2018 | Added reference to subpart C | R. van der Meer | |
| | | | | |

Note: Latest revision report will replace all previous reports

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1 General information.

1.1 Product description.

1.1.1 Introduction.

The brand Brusa, model Car Pad Module (CPM ICSS115-U0-01X-XXX), hereafter referred to as EUT, is part of an inductive charging system for hybrid and electrical vehicles. This report concerns the Positioning and Charging modes of the device, not the WLAN part (which is covered in a separate test report).

The content of this report and measurement results have not been changed other than the way of presenting the data.

The EUT is part of an inductive charging system for hybrid and electrical vehicles including a Positioning System for hybrid and electrical vehicles including a Positioning System for optimized power transfer.

The system consists of GPM ("Ground Pad Module") and CPM ("Car Pad Module"). Communication between CPM and GPM is established by WLAN. The GPM is placed on the ground and generates its H-Field about the primary coil and the standard AC power. The CPM is placed on the vehicle under-chassis and receives the high H-Field and converts this high density field into the vehicles charging current. Due to the high density field and the risk of burning the system includes life and foreign object detection.

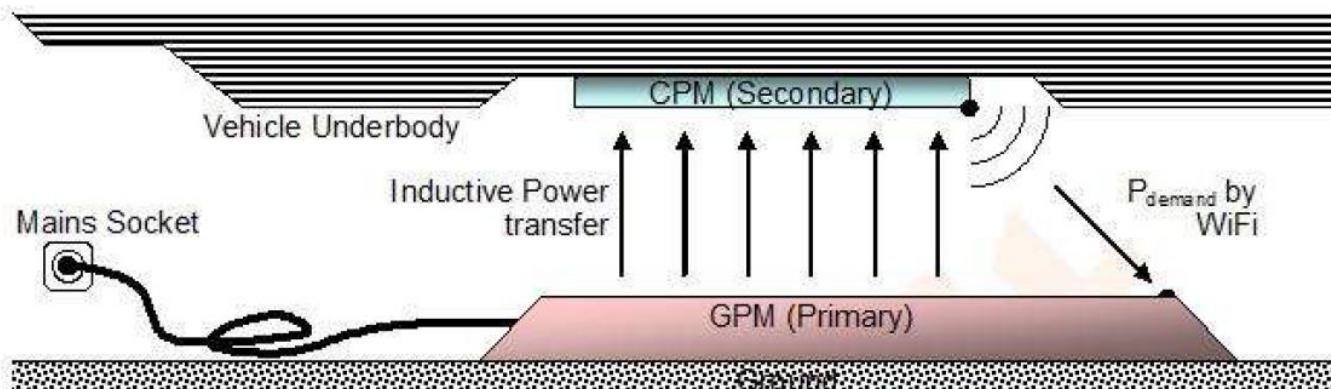


Figure 1: System description

1.2 Tested system details.

Details and an overview of the system and all of its components, as it has been tested, may be found below.

| | |
|-----------------------|-----------------------------------------------------------------------------------------------|
| EUT | : INDUCTIVE CHARGING SYSTEM |
| Manufacturer | : Zollner Elektronika AG |
| Brand | : Brusa |
| Model | : CPM (ICS115-U0-01X-XXX) |
| Serial number | : - |
| Voltage input rating | : 12 Vdc (Car battery operated only) |
| Voltage output rating | : -- |
| Current input rating | : -- |
| Antenna | : Integral |
| Operating frequency | : 125 kHz (Positioning mode) and 85-90 kHz (Charging mode), WLAN (Not covered in this report) |
| Remarks | : n.a. |
| AUX1 | : Auxiliary power supply |
| Manufacturer | : Sorensen |
| Brand | : Sorensen |
| Model | : SGA 600/42 |
| Serial number | : - |
| Voltage input rating | : 230 Vac |
| Voltage output rating | : 220 – 290 Vac |
| Current input rating | : 6.4 A |
| Remarks | : Property Zollner Inv Nr 052257 |
| AUX2 | : Optical CAN Transceiver |
| Manufacturer | : SonTec electronic K. Kohler |
| Brand | : SonTec |
| Model | : "High Speed"- transceiver Ver.2.0 |
| Serial number | : - |
| Remarks | : Property Zollner |
| AUX3 | : Auxiliary power supply |
| Manufacturer | : EA |
| Brand | : EA |
| Model | : EA3050B |
| Serial number | : 2791510591 |
| Voltage input rating | : 230 Vac |
| Voltage output rating | : 220 – 290 Vac |
| Current input rating | : - |
| Remarks | : Inv Nr 01969 |



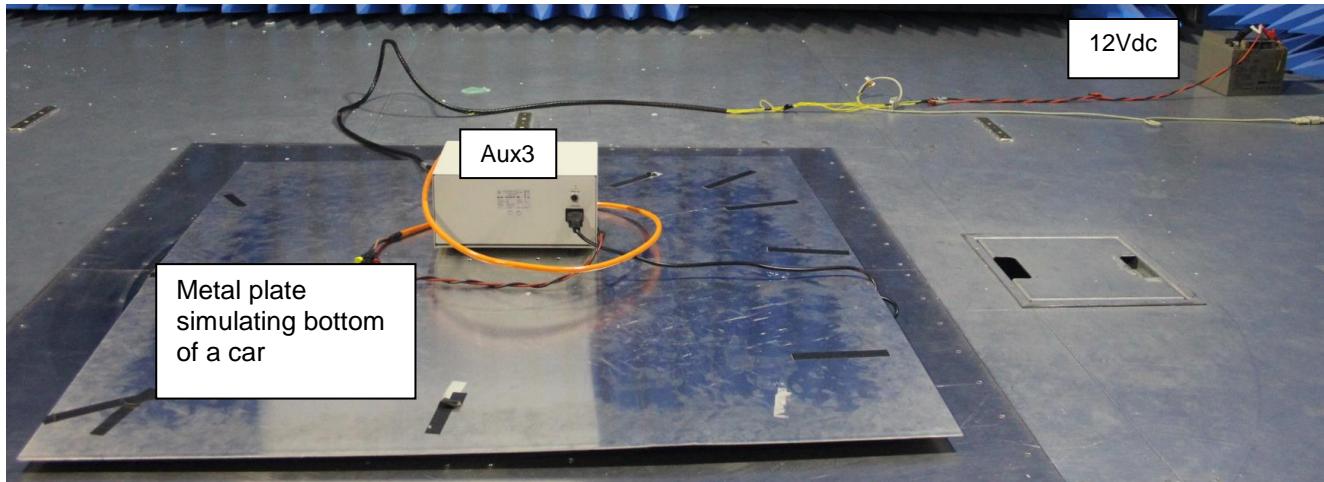
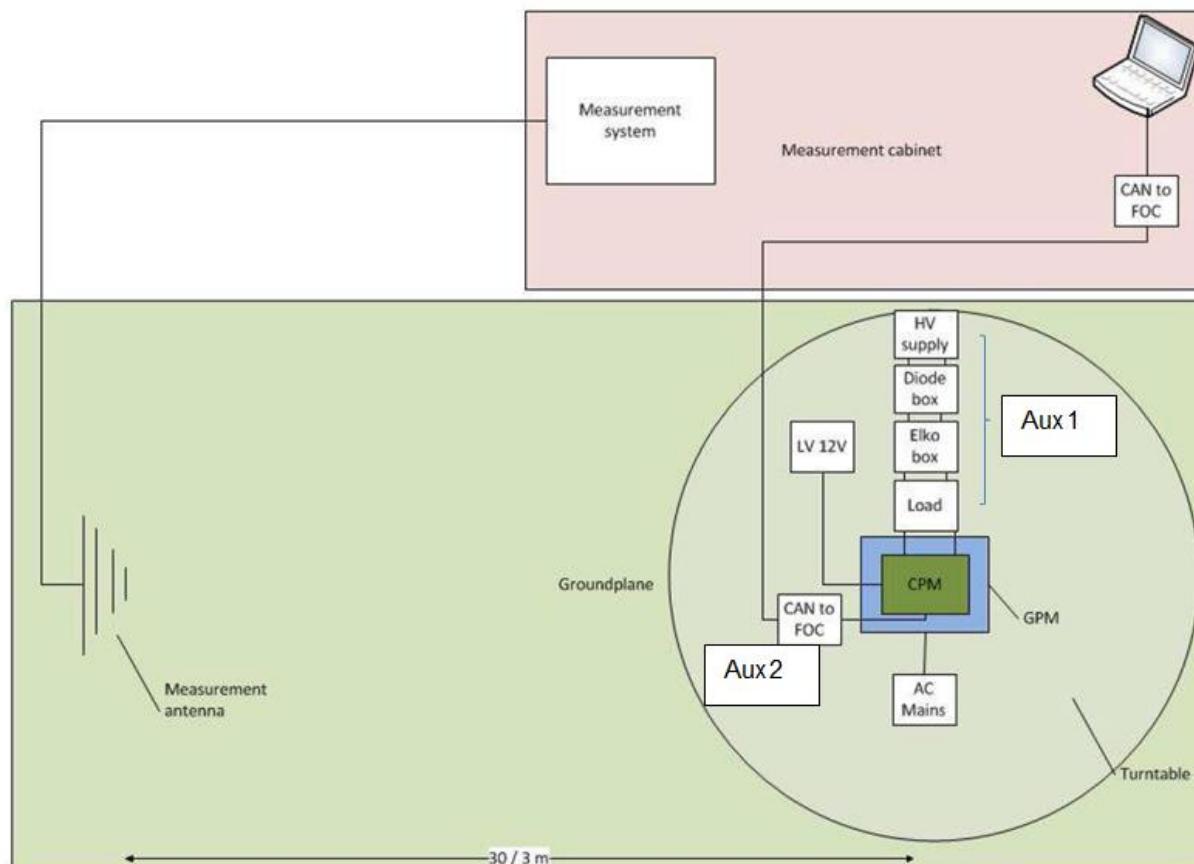


Photo 1: test setup Positioning mode



Block diagram of the test setup for Radiated emissions

1.3 Test methodology.

The test methodology used is based on the requirements of 47 CFR Part 15 (10-1-17 Edition), sections 15.31, 15.35, 15.205, 15.209 and RSS-GEN (ISSUE 4, NOVEMBER 2014). The EUT was tested in horizontal position only and is regarded as floor standing equipment.

The test methods, which have been used, are based on ANSI C63.10-2013.

Radiated emission tests above 30 MHz were performed at a measurement distance of 3 meters.

Radiated emission tests below 30 MHz were performed at a measurement distance of 3 meters.

To calculate the field strength level from these results to the appropriate distance at which the limit is specified, the appropriate extrapolation factor is used.

The receivers are switching automatically to the right bandwidth in accordance with CISPR 16. This is implemented in the receiver. The antenna factors are programmed in the test receiver. The receiver automatically calculates the appropriate correction factor for the utilized antenna and also the appropriate antenna factor for the cable loss. The total correction is automatically added to the measured value.

1.4 Test facility.

The Federal Communications Commission and Industry Canada has reviewed the technical characteristics of the test facilities at TÜV Rheinland Nederland B.V., located at Eiberkamp 10, 9351 VT Leek, The Netherlands, and has found these test facilities to be in compliance with the requirements of 47 CFR Part 15, section 2.948.

The description of the test facilities has been filed at the Office of the Federal Communications Commission under registration number 786213. The facility has been added to the list of laboratories performing these test services for the public on a fee basis.

The description of the test facilities has been filed to Industry Canada under registration number 2932G-2. The facility has been added to the list of laboratories performing these test services for the public on a fee basis.

1.5 Test conditions.

Normal test conditions:

Temperature (*) : +15°C to +35°C
Relative humidity(*) : 20 % to 75 %
Supply voltage : 12 Vdc (EUT is Car Battery operated only)

**When it was impracticable to carry out the tests under these conditions, a note to this effect stating the ambient temperature and relative humidity during the tests are stated separately.*

2 System test configuration.

2.1 Justification.

The system was configured for testing in a typical situation as a customer would normally use it. The test sample was configured by the applicant to enable continuous transmit..

The justification and manipulation of cables and equipment in order to simulate a worst-case behavior of the test setup has been carried out as prescribed in ANSI C63.10-2013.

2.2 EUT mode of operation.

The EUT was tested in Positioning mode. The EUT has been tested in continues transmit mode. The intentional radiator tests have been performed with a complete functioning EUT.

2.3 Special accessories.

No special accessories are used and/or needed to achieve compliance.

2.4 Equipment modifications.

No modifications have been made to the equipment.

3 Radiated emission data.

RESULT: PASS

Date of testing: 2017-10-24 & 25

Frequency range: 9kHz - 12.5 GHz

Requirements:

FCC 15.205, FCC 15.209, FCC 15.231(e) and IC RSS-Gen(8.9, 8.10)

Radiated emissions which fall in the restricted bands, as defined in FCC 15.205(a), must comply with the radiated emission limits specified in FCC 15.209(a).

Radiated emissions which fall outside the operation frequency band and outside restricted bands shall either meet the limit specified in FCC 15.209(a)/ RSS-Gen (8.9) or be attenuated at least 20dB below the power level in the 100kHz bandwidth within the band that contains the highest level of the desired power (the less severe limit applies).

| Frequency (MHz) | Field strength (μ V/meter) | Field strength (dB μ V/m) | Measurement distance (meters) |
|-----------------|---------------------------------|-------------------------------|-------------------------------|
| 30-88 | 100 | 40.0 | 3 |
| 88-216 | 150 | 43.5 | 3 |
| 216-960 | 200 | 46.0 | 3 |
| Above 960 | 500 | 54.0 | 3 |

Table of applicable limits

Test procedure:

ANSI C63.10-2013.

The EUT, regarded as floor standing equipment, was placed on an isolating plane of max 12mm. Before final measurements of radiated emissions were performed, the EUT was scanned to determine its emission spectrum profile. The physical arrangement of the test system, the associated cabling and the EUT orientation (X, Y, Z) were varied in order to ensure that maximum emission amplitudes were attained.

The spectrum was examined from 9 kHz to 12.5 GHz. Final radiated emission measurements were made at 3m distance.

At each frequency where a spurious emission was found, the EUT was rotated 360° and the antenna was raised and lowered from 1 to 4m in order to determine the emission's maximum level. Measurements were taken using both horizontal and vertical antenna polarizations.

The highest emission amplitudes relative to the appropriate limit were recorded in this report. Field strength values of radiated emissions at frequencies not listed in the tables are more than 20 dB below the applicable limit.

3.1 Radiated field strength measurements (30 MHz – 12.5 GHz, E-field)

| Frequency [MHz] | Antenna Orientation | Detector / Bandwidth | Level QP [dB μ V/m] | Limit QP [dB μ V/m] | Result Pass/Fail |
|-----------------|---------------------|----------------------|-------------------------|-------------------------|------------------|
| 53.34 | Vertical | Qp / 120 kHz | 10.0 | 40.0 | Pass |
| 102.2 | Vertical | Qp / 120 kHz | 27.4 | 43.5 | Pass |
| 155.9 | Vertical | Qp / 120 kHz | 19.0 | 43.5 | Pass |
| 252.9 | Vertical | Qp / 120 kHz | 20.3 | 46.0 | Pass |
| 805.6 | Vertical | Qp / 120 kHz | 29.4 | 46.0 | Pass |
| 925.4 | Vertical | Qp / 120 kHz | 33.5 | 46.0 | Pass |
| 1772.42 | Vertical | Pk / 1MHz | 42.5 Pk (-52.7 dBm) | 54 Av/ 74 Pk | Pass |
| 4227.16 | Vertical | Pk / 1MHz | 34.8 Pk (-60.4 dBm) | 54 Av/ 74 Pk | Pass |
| 9818.86 | Vertical | Pk / 1MHz | 42. Pk (-52.6 dBm) | 54 Av/ 74 Pk | Pass |

Table 2 Radiated emissions of the EUT in Positioning mode

The results of the radiated emission tests, carried out in accordance with 47 CFR Part 15 section 15.205, 15.209 and RSS-Gen, section 8.9 and 8.10 are depicted in Table 2.

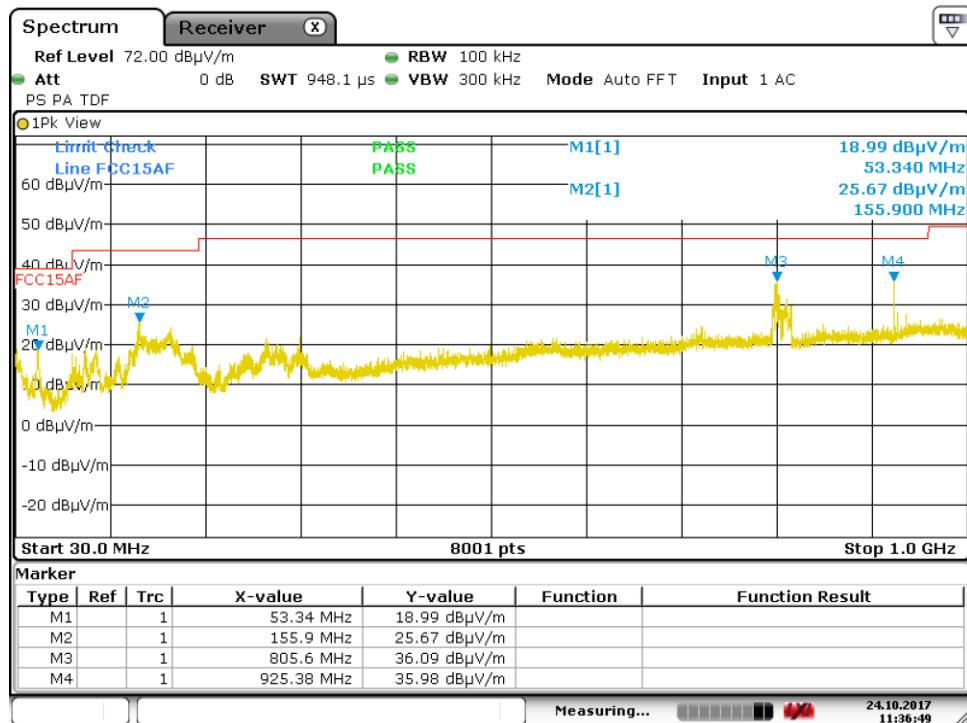
Notes:

1. Field strength values of radiated emissions at frequencies not listed in the table above are more than 20 dB below the applicable limit.
2. Measurement uncertainty is 5.22 dB.
3. For conversion of dBm to dB μ V/m a conversion factor of 95.2 dB was used
4. See plots on the next pages.

3.1.1 Test equipment used (for reference see test equipment listing).

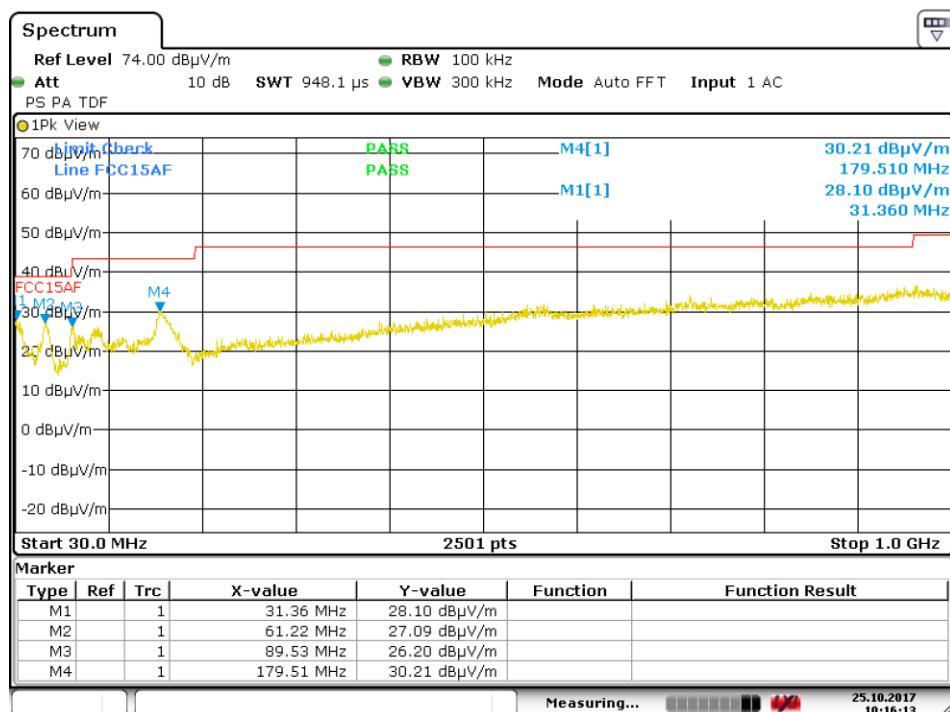
| | | | | | | |
|--------|--------|--------|--------|--------|--------|--------|
| A00257 | A00258 | A00314 | A00447 | A00235 | A00466 | A00008 |
| A00255 | | | | | | |

3.1.2 Plot of the emissions



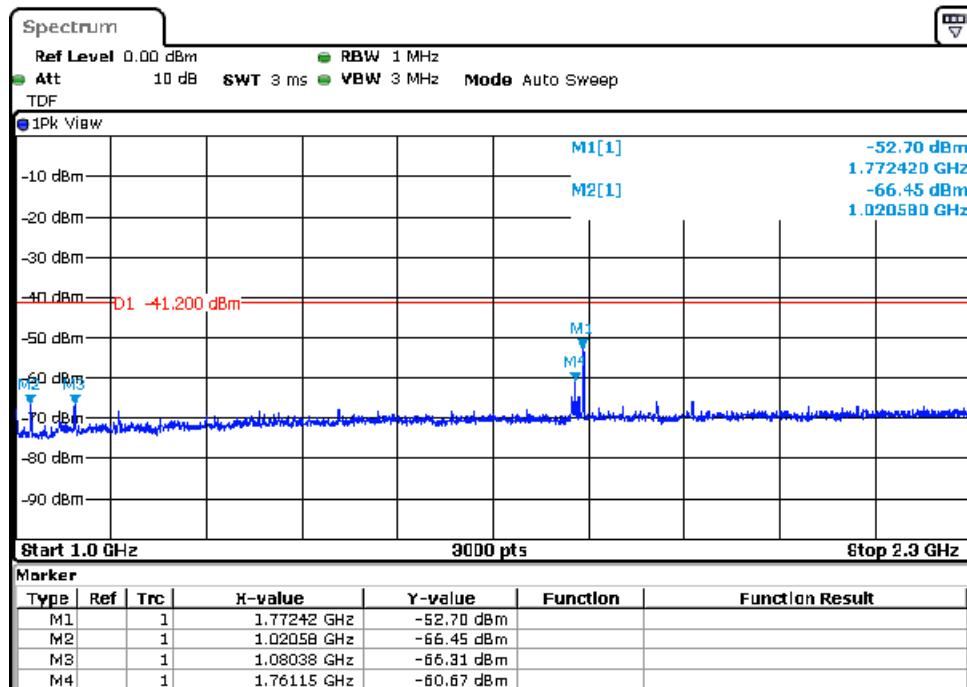
Date: 24.OCT.2017 11:36:49

Plot 1: radiated emissions of the EUT in Positioning mode, in the range 30 – 1000 MHz (peak values shown), EUT Horizontal-Ant Vertical.

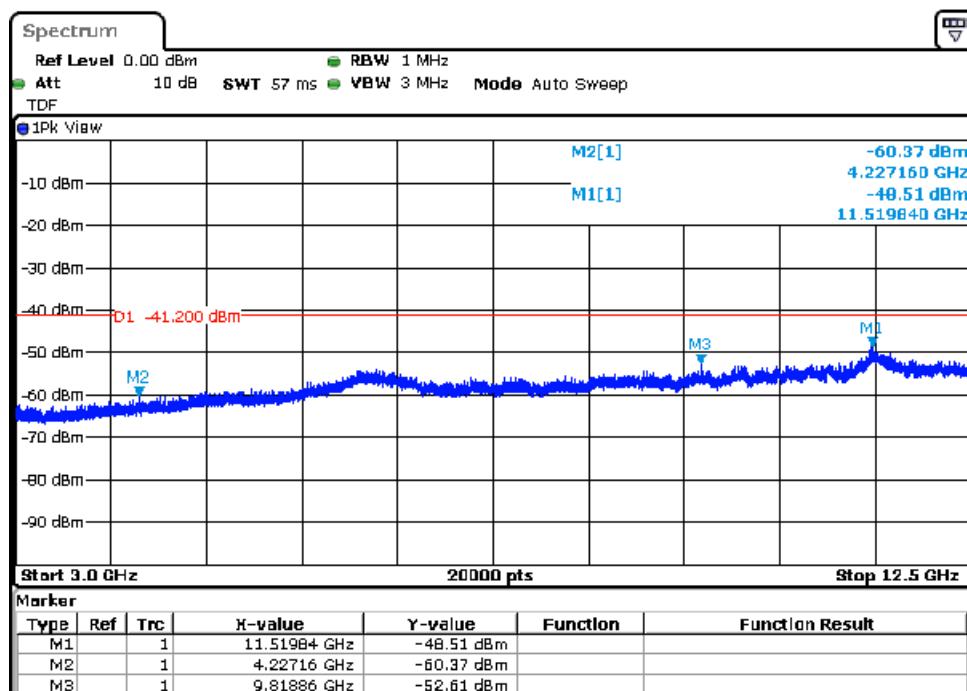


Date: 25.OCT.2017 10:16:13

Plot 2: radiated emissions of the EUT in Charging mode, in the range 30 – 1000 MHz (peak values shown)



Plot 3: radiated emissions of the EUT, in the range 1 – 2.3 GHz (peak values shown), Antenna vertical



Plot 4: radiated emissions of the EUT, in the range 3 – 12.5 GHz (peak values shown), Antenna vertical

3.2 Radiated field strength measurements (frequency range of 0.009-30 MHz, H-field).

| Frequency (MHz) | Measurement results dB μ V @3m | Detector | Antenna factor | Cable loss | Extrapolation factor | Measurement results (calculated) | Limits dB μ V/m @300m | Pass/Fail |
|--------------------------|------------------------------------------|----------|-------------------|---------------|-------------------------|----------------------------------------|---------------------------------|-----------|
| | | | | | | dB μ V/m @300m | | |
| 0.12526 (fundamental) | 65.5 | Pk | 20.0 | 1 | 80 | 6.5 | 45.7 Pk / 25.7 Av | Pass |
| 0.25052 | 24.5 | Pk | 20.0 | 1 | 80 | -9.7 | 39.6 Pk / 19.6 Av | Pass |
| 0.37578 | 46.0 | Pk | 20.0 | 1 | 80 | -29.4 | 36.1 Pk / 16.1 Av | Pass |
| 0.62629 | 32.7 | Qp | 20.0 | 1 | 40 | 13.7 @30m | 38.3 @30m | Pass |
| 1.7999 | 26.1 | Qp | 19.7 | 1 | 40 | 6.8 @30m | 29.5 @30m | Pass |

Table 3 Radiated emissions of the EUT, EUT in Positioning mode (near field),
in the frequency range 0.009 – 30 MHz, Peak values

The results of the radiated emission tests in the frequency range 0.009 – 30 MHz, carried out in accordance with 47 CFR Part 15 section 15.209 and RSS-Gen are depicted in Table 3.

Notes:

- Calculated measurement results are obtained by using a extrapolation factor i.e at 125 kHz: $65.5 \text{ dB}\mu\text{V} + 20.0 \text{ dB} + 1 \text{ dB} - 80 \text{ dB} = 6.5 \text{ dB}\mu\text{V/m}$.
- Peak (Pk) values were already within Av limits.
- A resolution bandwidth of 9 kHz was used during testing.
- Field strength values of radiated emissions at frequencies not listed in Table 3 are more than 20 dB below the applicable limit.
- The loop antenna was varied in horizontal and vertical orientations and also around it's axis. The reported value is the worst case found at the reported frequency.
- Measurement uncertainty is 5.22 dB.

3.2.1 Test equipment used (for reference see test equipment listing).

| | | | | | | |
|--------|--------|--------|--------|--------|--------|--------|
| A01491 | A00726 | A00444 | A00450 | A00447 | A00006 | A01969 |
|--------|--------|--------|--------|--------|--------|--------|

4 AC Power line Conducted emission data.

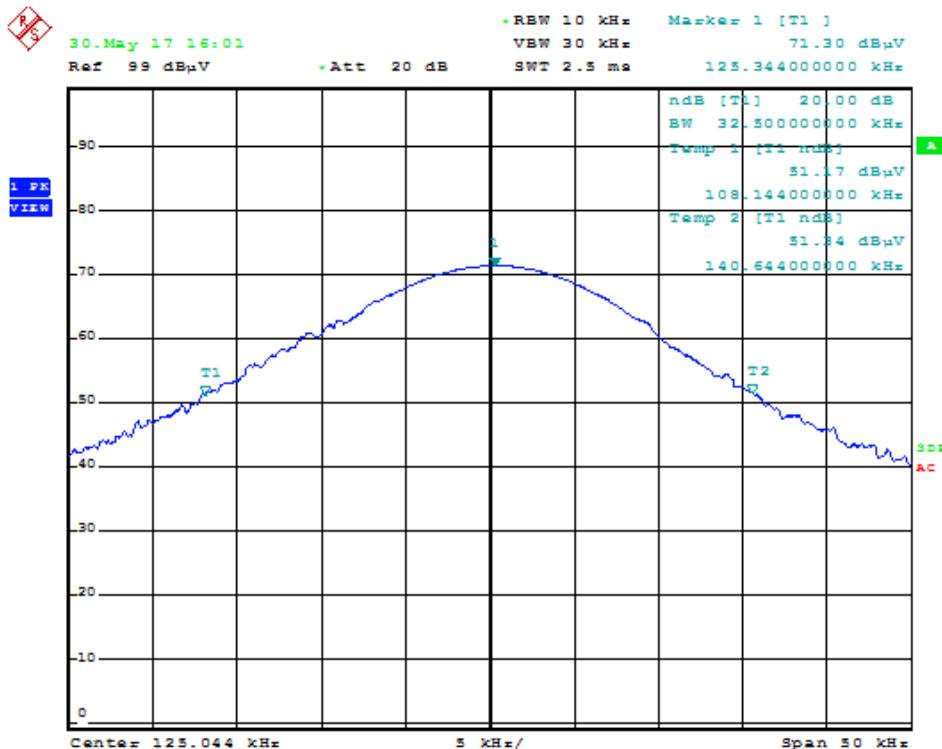
4.1 AC Power Line Conducted Emission data of the EUT

RESULT: Not Applicable, EUT is battery operated only.

Date of testing: --

5 Plots of measurement data

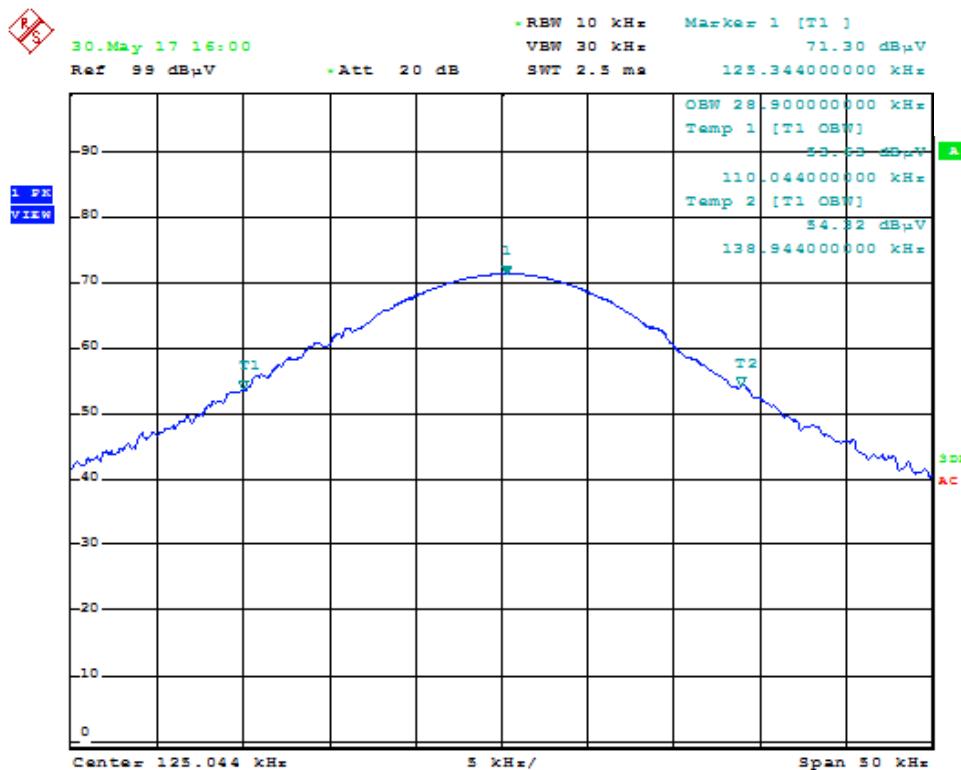
5.1 Bandwidth of the emission



ORI

Date: 30.MAY.2017 16:01:20

Plot1 Emission Bandwidth (-20 dB down points) of the emission
at 125 kHz (Fundamental of the Positioning mode)



ORI
 Date: 30.MAY.2017 16:00:35

Plot2 Occupied Bandwidth (99% points) of the emission at 125 kHz (Fundamental of the Positioning mode), by using the spectrum analyzer function for 99% Occ BW.

<< End of report >>