



Product Service

Choose certainty.
Add value.

February 26, 2015

Page 1 of 54

Prüfbericht / Test Report

Nr. / No. 69583-55945-2 (Edition 1)

Applicant: Baltech AG
Type of equipment: RFID Reader
Type designation: IDE-XG
10089-1X-Y / 10089-2X-Y / 10089-3X-Y
Where "X" and "Y" may be replaced by any alphanumerical numbers
Order No.: N/A
Test standards: FCC Code of Federal Regulations,
CFR 47, Part 15,
Sections 15.205, 15.207, 15.215 and 15.225
Industry Canada Radio Standards Specifications
RSS-GEN Issue 4, Sections 8.8, 8.9 and 8.10 and
RSS-210 Issue 8, Section A2.6 (Category I Equipment)

Note:

The test data of this report is related only to the individual item which has been tested. This report shall not be reproduced except in full extent without the written approval of the testing laboratory.



Table of Contents

| | | |
|-----|--|----|
| 1 | Description of the Equipment Under Test (EUT) | 3 |
| 2 | Administrative Data | 5 |
| 3 | Identification of the Test Laboratory | 6 |
| 4 | Summary | 7 |
| 5 | Operation Mode and Configuration of EUT | 8 |
| 6 | Measurement Procedures | 9 |
| 6.1 | Bandwidth Measurements..... | 9 |
| 6.2 | Conducted AC Powerline Emission | 10 |
| 6.3 | Radiated Emission Measurement 9 kHz to 30 MHz..... | 12 |
| 6.4 | Radiated Emission in Fully or Semi Anechoic Room | 14 |
| 6.5 | Radiated Emission at Alternative Test Site | 16 |
| 6.6 | Carrier Frequency Stability..... | 18 |
| 7 | Photographs Taken During Testing..... | 20 |
| 8 | Test Results | 25 |
| 8.1 | Occupied Bandwidth | 27 |
| 8.2 | Bandwidth of the Emission..... | 33 |
| 8.3 | Designation of Emissions..... | 36 |
| 8.4 | Conducted Powerline Emission Measurement 150 kHz to 30 MHz | 37 |
| 8.5 | Spectrum Mask | 40 |
| 8.6 | Radiated Emission Measurement 9 kHz to 30 MHz..... | 42 |
| 8.7 | Radiated Emission Measurement 30 MHz to 1 GHz..... | 44 |
| 8.8 | Carrier Frequency Stability..... | 46 |
| 8.9 | Exposure of Humans to RF Fields | 49 |
| 9 | Referenced Regulations..... | 51 |
| 10 | Test Equipment List with Calibration Data..... | 53 |
| 11 | Revision History | 54 |

1 Description of the Equipment Under Test (EUT)

| General data of EUT | |
|---------------------------------|---|
| Type designation ¹ : | IDE-XG 10089-1X-Y / 10089-2X-Y / 10089-3X-Y Where "X" and "Y" may be replaced by any alphanumerical numbers |
| HW Revisions: | Functionality 13.56 MHz and 125 kHz: 10089-3X-Y, 10089-300, 10089-301, 10089-302, 10089-330, 10089-340 Functionality 13.56 MHz only: 10089-100, 10089-101, 10089-130, 10089-140, 10089-141, 10089-142 Functionality 125 kHz only: 10089-200, 10089-201 |
| Parts ² : | -- |
| Serial number(s): | 16004511 201501 |
| Manufacturer: | Baltech AG |
| Type of equipment: | RFID Reader |
| Version: | As received |
| Additional parts/accessories: | -- |

¹ Type designation of the system if EUT consists of more than one part.

² Type designations of the parts of the system, if applicable.



| Technical data of EUT | |
|---|--|
| Application frequency range: | 125 kHz and 13.110 - 14.010 MHz |
| Frequency range: | 125 kHz and 13.553 – 13.567 MHz |
| Operating frequency: | 125 kHz, 13.56 MHz |
| Type of modulation: | A1D |
| Pulse train: | N/A |
| Pulse width: | N/A |
| Number of RF-channels: | 1 |
| Channel spacing: | Wideband |
| Designation of emissions ³ : | A1D |
| Type of antenna: | Integrated loop antenna |
| Size/length of antenna: | 3 cm x 4 cm |
| Connection of antenna: | <input type="checkbox"/> detachable <input checked="" type="checkbox"/> not detachable |
| Type of power supply: | DC supply over USB interface |
| Specifications for power supply: | nominal voltage: 5.0 V minimum voltage: 4.75 V maximum voltage: 5.25 V |

³ Also known as "Class of Emission".



2 Administrative Data

Application details

| | |
|---------------------------|--|
| Applicant (full address): | Baltech AG Lilienthalstrasse 27 D-85339 Hallbergmoos |
| Contact person: | Iftekhar Alam |
| Order number: | N/A |
| Receipt of EUT: | 2015-01-22 |
| Date(s) of test: | 2015-01-30 to 2015-02-24 |
| Note(s): | The applicant declares the conformity of the variants covered by this test report. |

Report details

| | |
|----------------|---------------|
| Report number: | 69583-55945-2 |
| Edition: | 1 |
| Issue date: | 2015-02-26 |



3 Identification of the Test Laboratory

Details of the Test Laboratory

| | |
|---|--|
| Company name: | TÜV SÜD Product Service GmbH |
| Address: | Aeussere Fruehlingstrasse 45 D-94315 Straubing Germany |
| Laboratory accreditation: | DAkKS Registration No. D-PL-11321-11-01 |
| FCC test site registration number | 90926 |
| Industry Canada test site registration: | 3050A-2 |
| Contact person: | Mr. Johann Roidt |
| | Phone: +49 9421 5522-0 Fax: +49 9421 5522-99 |



4 Summary

Summary of test results

The tested sample complies with the requirements set forth in the

Code of Federal Regulations CFR 47, Part 15, Sections 15.205, 15.207, 15.215 and 15.225

of the Federal Communication Commission (FCC) and the

Radio Standards Specifications

**RSS-GEN Issue 4, Sections 8.8, 8.9 and 8.10 and
RSS-210 Issue 8, Section , A2.6 (Category I Equipment)**

of Industry Canada (IC).

Personnel involved in this report

Reviewer:

.....
Mr. Markus Biberger

Responsible for testing:

.....
Mr. Martin Steindl

Responsible for test report:

Mr. Martin Steindl



5 Operation Mode and Configuration of EUT

Operation Mode(s)

Continuously reading a transponder card.

Configuration(s) of EUT

The EUT was configured as USB device of a laptop PC.

List of ports and cables

| <i>Port</i> | <i>Description</i> | <i>Classification⁴</i> | <i>Cable type</i> | <i>Cable length</i> |
|-------------|---------------------------------------|-----------------------------------|-------------------|---------------------|
| 1 | AC port of AC/DC adapter of laptop PC | ac power | Unshielded | 1 m |
| 2 | DC supply of laptop PC | dc power | Unshielded | 2 m |
| 3 | USB interface of EUT | signal/control port | Shielded | 2 m |

List of devices connected to EUT

| <i>Item</i> | <i>Description</i> | <i>Type Designation</i> | <i>Serial no. or ID</i> | <i>Manufacturer</i> |
|-------------|--------------------|-------------------------|-------------------------|---------------------|
| 1 | Laptop PC | DELL dimension | | DELL |

List of support devices

| <i>Item</i> | <i>Description</i> | <i>Type Designation</i> | <i>Serial no. or ID</i> | <i>Manufacturer</i> |
|-------------|----------------------------|-------------------------|-------------------------|---------------------|
| 1 | Transponder Card | | | LEGIC |
| 2 | AC/DC adapter of laptop PC | | | DELL |

⁴ Ports shall be classified as ac power, dc power or signal/control port



6 Measurement Procedures

6.1 Bandwidth Measurements

| Measurement Procedure: | |
|--|--|
| Rules and specifications: | CFR 47 Part 2, section 2.202(a) CFR 47 Part 15, section 15.215(c) IC RSS-Gen Issue 4, section 6.6 IC RSS-210 Issue 8, section A1.1.3 ANSI C63.4, annex H.6 |
| Guide: | ANSI C63.4 / IC RSS-Gen Issue 4, section 6.6 |
| Measurement setup: | <input type="checkbox"/> Conducted: See below <input checked="" type="checkbox"/> Radiated: Radiated Emission Measurement 9 kHz to 30 MHz (6.3) |
| <p>If antenna is detachable bandwidth measurements shall be performed at the antenna connector (conducted measurement) when the transmitter is adjusted in accordance with the tune-up procedure, if applicable. The RF output terminals are connected to a spectrum analyzer. If required, a resistive matching network equal to the impedance specified or employed for the antenna is used as well as dc block and appropriate attenuators (50 Ohms). The electrical characteristics of the radio frequency load attached to the output terminals shall be stated, if applicable.</p> <p>If radiated measurements are performed the same test setups and instruments are used as with radiated emission measurements for the appropriate frequency range.</p> <p>The analyzer settings are specified by the test description of the appropriate test record(s).</p> | |

6.2 Conducted AC Powerline Emission

Measurement Procedure:

| | |
|---------------------------|---|
| Rules and specifications: | CFR 47 Part 15, section 15.207 IC RSS-Gen Issue 4, section 8.8 |
| Guide: | ANSI C63.4 / CISPR 22 |

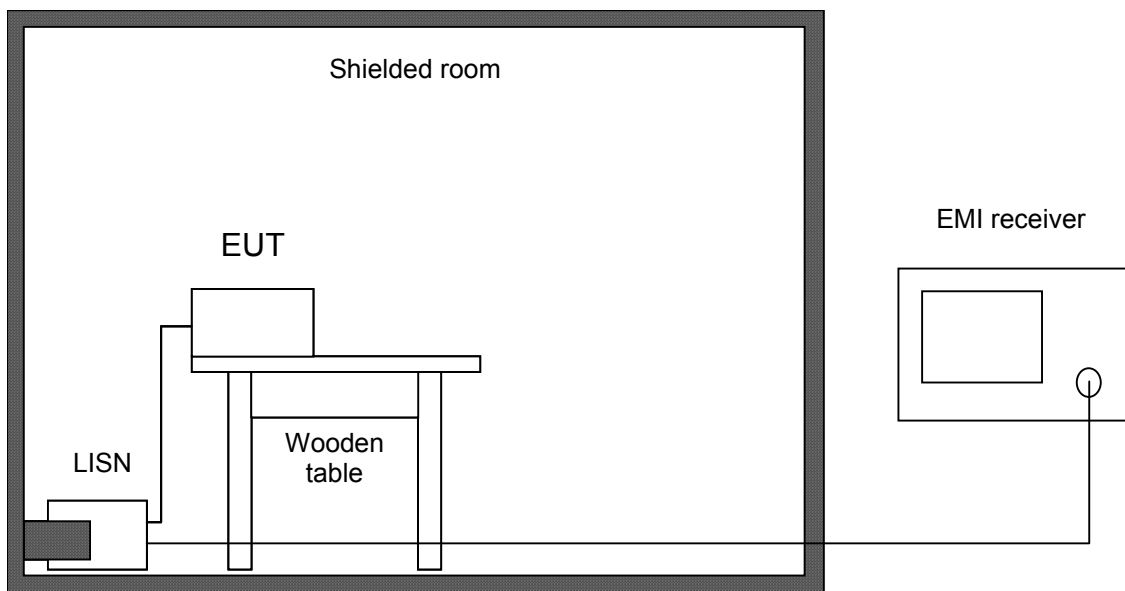
Conducted emission tests in the frequency range 150 kHz to 30 MHz are performed using Line Impedance Stabilization Networks (LISNs). To simplify testing with quasi-peak and average detector the following procedure is used:

First the whole spectrum of emission caused by the equipment under test (EUT) is recorded with detector set to peak using CISPR bandwidth of 10 kHz. After that all emission levels having less margin than 10 dB to or exceeding the average limit are retested with detector set to quasi-peak.

If average limit is kept with quasi-peak levels no additional scan with average detector is necessary. In cases of emission levels between quasi-peak and average limit an additional scan with detector set to average is performed.

According to ANSI C63.4, section 13.1.3.1, testing of intentional radiators with detachable antenna shall be performed using a suitable dummy load connected to the antenna output terminals. Otherwise, the tests shall be made with the antenna connected and, if adjustable, fully extended.

Testing with dummy load may be necessary to distinguish (unintentional) conducted emissions on the supply lines from (intentional) emissions radiated by the antenna and coupling directly to supply lines and/or LISN. Usage of dummy load has to be stated in the appropriate test record(s) and notes should be added to clarify the test setup.



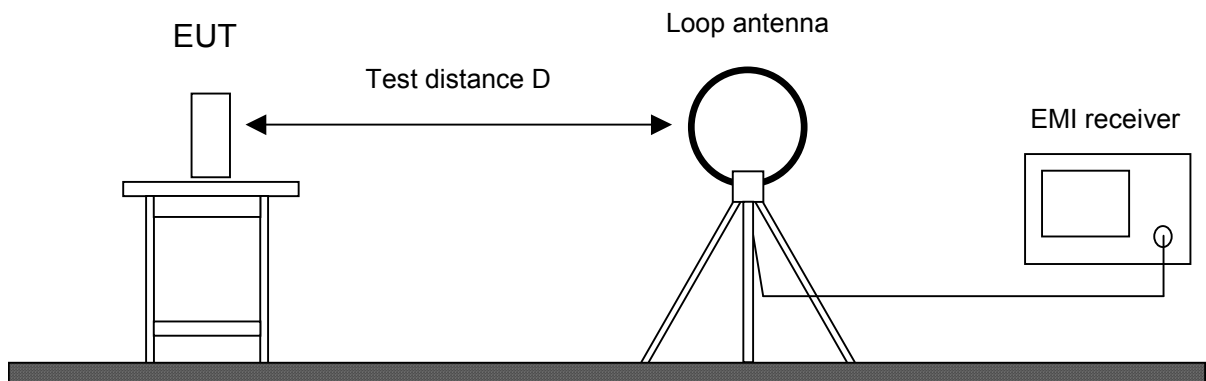


Test instruments used:

| Type | Designation | Inv.-no. | Serial No. or ID | Manufacturer |
|---|-------------|----------|------------------|-----------------|
| <input checked="" type="checkbox"/> Test receiver | ESHS 10 | 1028 | 860043/016 | Rohde & Schwarz |
| <input checked="" type="checkbox"/> V-network | ESH 3-Z5 | 1059 | 894785/005 | Rohde & Schwarz |
| <input type="checkbox"/> V-network | ESH 3-Z5 | 1218 | 830952/025 | Rohde & Schwarz |
| <input type="checkbox"/> Artificial mains network | ESH 2-Z5 | 1536 | 842966/004 | Rohde & Schwarz |
| <input type="checkbox"/> Shielded room | No. 1 | 1451 | --- | Albatross |
| <input checked="" type="checkbox"/> Shielded room | No. 4 | 1454 | 3FD 100 544 | Euroshield |

6.3 Radiated Emission Measurement 9 kHz to 30 MHz

| Measurement Procedure: | |
|---|---|
| Rules and specifications: | CFR 47 Part 15, sections 15.205, 15.215(b) and 15.225(a)-(d) IC RSS-GEN Issue 4, sections 8.9 and 8.10 and IC RSS-210 Issue 8, section A2.6 |
| Guide: | ANSI C63.4 |
| <p>Radiated emission in the frequency range 9 kHz to 30 MHz is measured using an active loop antenna. First the whole spectrum of emission caused by the equipment is recorded at a distance of 3 meters in a fully or semi anechoic room with the detector of the spectrum analyzer or EMI receiver set to peak. This configuration is also used for recording the spectrum of intentional radiators.</p> <p>Hand-held or body-worn devices are rotated through three orthogonal axes to determine which attitude and configuration produces the highest emission relative to the limit and therefore shall be used for final testing. EUT is rotated all around to find the maximum levels of emissions. Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.</p> <p>If worst case emission of the EUT cannot be recorded with EUT in standard position and loop antenna in vertical polarization the EUT (or the radiating part of the EUT) is rotated by 90 degrees instead of changing the loop antenna to horizontal polarization. This procedure is selected to minimize the influence of the environment (e.g. effects caused by the floor especially with longer distances).</p> <p>Final measurement is performed at a test distance D of 30 meters using an open field test site. In case the regulation requires testing at other distances, the result is extrapolated by either making measurements at an additional distance D of 10 meters to determine the proper extrapolation factor or by using the square of an inverse linear distance extrapolation factor (40 dB/decade). In cases of very low emissions measurements are performed at shorter distances and results are extrapolated to the required distance. The provisions of CFR 47 Part 15 sections 15.31(d) and (f)(2) apply. According to CFR 47 Part 15 section 15.209(d) final measurement is performed with detector function set to quasi-peak except for the frequency bands 9 to 90 kHz and 110 to 490 kHz where, for non-pulsed operation, average detector is employed.</p> <p>If the radiated emission limits are expressed in terms of the average value of the emission there also is a peak limit corresponding to 20 dB above the maximum permitted average limit. Additionally, if pulsed operation is employed, the average field strength is determined by averaging over one complete pulse train, including blanking intervals, as specified in CFR 47 Part 15 section 15.35(c). If the pulse train exceeds 0.1 second that 0.1 second interval during which the value of the emission is at its maximum is selected for calculation. The pulse train correction is added to the peak value of the emission to get the average value.</p> | |





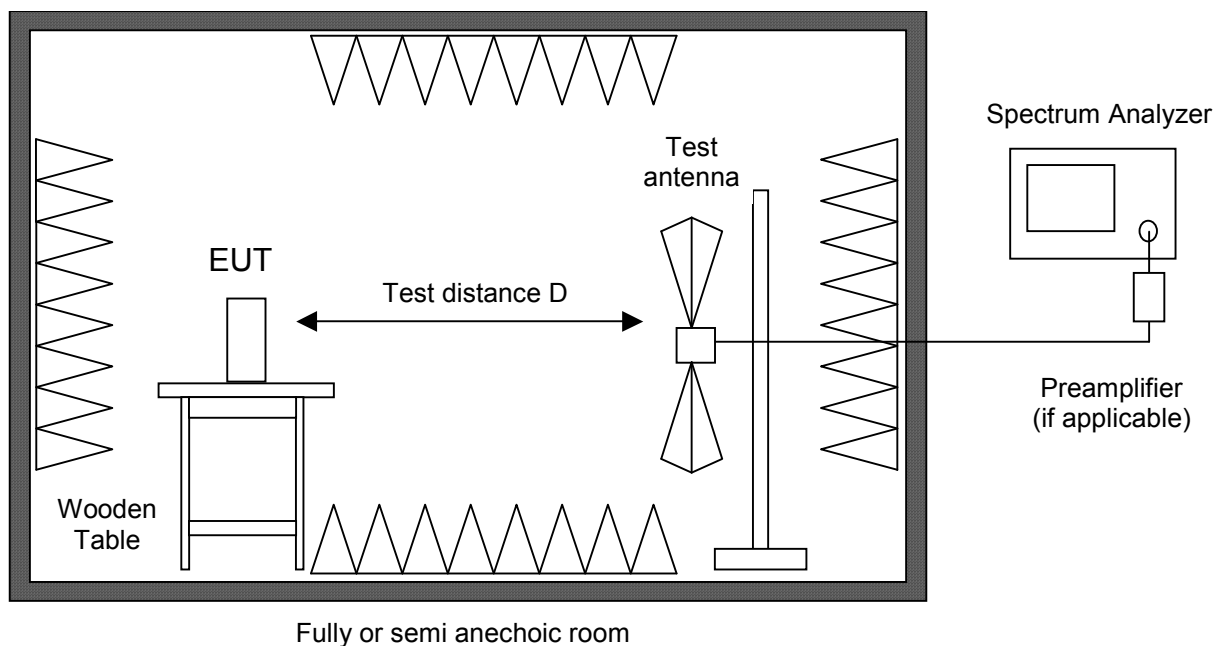
Test instruments used:

| Type | Designation | Inv.-no. | Serial No. or ID | Manufacturer |
|---|-------------------------|----------|--------------------------|-----------------|
| <input checked="" type="checkbox"/> Spectrum analyzer | FSP30 | 1666 | 100036 | Rohde & Schwarz |
| <input type="checkbox"/> EMI test receiver | ESMI | 1569 | 839379/013 839587/006 | Rohde & Schwarz |
| <input checked="" type="checkbox"/> Test receiver | ESHS 10 | 1028 | 860043/016 | Rohde & Schwarz |
| <input type="checkbox"/> Preamplifier | Cabin no. 2 CPA9231A | 1716 | 3557 | Schaffner |
| <input type="checkbox"/> Loop antenna | HFH2-Z2 | 1016 | 882964/1 | Rohde & Schwarz |
| <input checked="" type="checkbox"/> Fully anechoic room | No. 2 | 1452 | --- | Albatross |
| <input type="checkbox"/> Semi anechoic room | No. 3 | 1453 | --- | Siemens |
| <input checked="" type="checkbox"/> Semi anechoic room | No. 8 | 2057 | --- | Albatross |



6.4 Radiated Emission in Fully or Semi Anechoic Room

| Measurement Procedure: | |
|---|---|
| Rules and specifications: | CFR 47 Part 15, sections 15.205(b) and 15.225(d) IC RSS-GEN Issue 4, sections 8.9 and 8.10(b)(c) and IC RSS-210 Issue 8, section A2.6 |
| Guide: | ANSI C63.4 |
| <p>Radiated emission in fully or semi anechoic room is measured in the frequency range from 30 MHz to the maximum frequency as specified in CFR 47 Part 15 section 15.33.</p> <p>Measurements are made in both the horizontal and vertical planes of polarization using a spectrum analyzer with the detector function set to peak and resolution as well as video bandwidth set to 100 kHz (below 1 GHz) or 1 MHz (above 1 GHz).</p> <p>Testing up to 1 GHz is performed with a linear polarized logarithmic periodic antenna combined with a 4:1 broadband dipole ("Trilog broadband antenna"). For testing above 1 GHz horn antennas are used.</p> <p>All tests below 8.2 GHz are performed at a test distance D of 3 meters. For higher frequencies the test distance may be reduced (e.g. to 1 meter) due to the sensitivity of the measuring instrument(s) and the test results are calculated according to CFR 47 Part 15 section 15.31(f)(1) using an extrapolation factor of 20 dB/decade. If required, preamplifiers are used for the whole frequency range. Special care is taken to avoid overload, using appropriate attenuators and filters, if necessary.</p> <p>If the radiated emission limits are expressed in terms of the average value of the emission there also is a peak limit corresponding to 20 dB above the maximum permitted average limit. Additionally, if pulsed operation is employed, the average field strength is determined by averaging over one complete pulse train, including blanking intervals, as specified in CFR 47 Part 15 section 15.35(c). If the pulse train exceeds 0.1 second that 0.1 second interval during which the value of the emission is at its maximum is selected for calculation. The pulse train correction is added to the peak value of the emission to get the average value.</p> <p>Hand-held or body-worn devices are rotated through three orthogonal axes to determine which attitude and configuration produces the highest emission relative to the limit and therefore shall be used for final testing.</p> <p>During testing the EUT is rotated all around to find the maximum levels of emissions. Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.</p> <p>For final testing below 1 GHz a semi anechoic room complying with the NSA requirements of ANSI C63.4 for alternative test sites is used (see 6.5). If prescans are recorded in fully anechoic room they are indicated appropriately.</p> | |

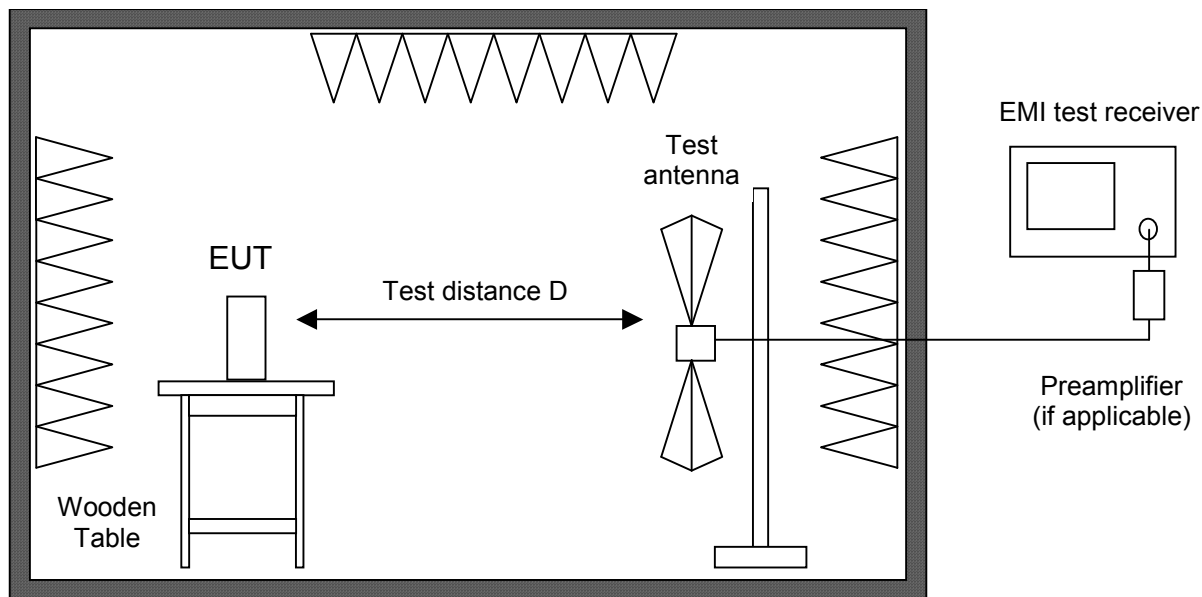


Test instruments used:

| Type | | Designation | Inv.-no. | Serial No. or ID | Manufacturer |
|-------------------------------------|----------------------------|--------------------------|----------|--------------------------|-----------------|
| <input type="checkbox"/> | Spectrum analyzer | FSP30 | 1666 | 100036 | Rohde & Schwarz |
| <input type="checkbox"/> | EMI test receiver | Cabin no. 3 ESPI7 | 2010 | 101018 | Rohde & Schwarz |
| <input checked="" type="checkbox"/> | EMI test receiver | ESU8 | 2044 | 100232 | Rohde & Schwarz |
| <input type="checkbox"/> | EMI test receiver | ESMI | 1569 | 839379/013 839587/006 | Rohde & Schwarz |
| <input type="checkbox"/> | Preamplifier | Cabin no. 2 CPA9231A | 1716 | 3557 | Schaffner |
| <input type="checkbox"/> | Preamplifier | R14601 | 1142 | 13120026 | Advantest |
| <input type="checkbox"/> | Preamplifier (1 - 8 GHz) | AFS3-00100800-32-LN | 1684 | 847743 | Miteq |
| <input type="checkbox"/> | Preamplifier (0.5 - 8 GHz) | AMF-4D-005080-25-13P | 1685 | 860149 | Miteq |
| <input type="checkbox"/> | Preamplifier (8 - 18 GHz) | ACO/180-3530 | 1484 | 32641 | CTT |
| <input type="checkbox"/> | External Mixer | WM782A | 1576 | 845881/005 | Tektronix |
| <input type="checkbox"/> | Harmonic Mixer Accessories | FS-Z30 | 1577 | 624413/003 | Rohde & Schwarz |
| <input type="checkbox"/> | Trilog antenna | Cabin no. 2 VULB 9163 | 1802 | 9163-214 | Schwarzbeck |
| <input type="checkbox"/> | Trilog antenna | Cabin no. 3 VULB 9163 | 1722 | 9163-188 | Schwarzbeck |
| <input checked="" type="checkbox"/> | Trilog antenna | Cabin no. 8 VULB 9163 | 2058 | 9163-408 | Schwarzbeck |
| <input type="checkbox"/> | Horn antenna | 3115 | 1516 | 9508-4553 | EMCO |
| <input type="checkbox"/> | Horn antenna | 3160-03 | 1010 | 9112-1003 | EMCO |
| <input type="checkbox"/> | Horn antenna | 3160-04 | 1011 | 9112-1001 | EMCO |
| <input type="checkbox"/> | Horn antenna | 3160-05 | 1012 | 9112-1001 | EMCO |
| <input type="checkbox"/> | Horn antenna | 3160-06 | 1013 | 9112-1001 | EMCO |
| <input type="checkbox"/> | Horn antenna | 3160-07 | 1014 | 9112-1008 | EMCO |
| <input type="checkbox"/> | Horn antenna | 3160-08 | 1015 | 9112-1002 | EMCO |
| <input type="checkbox"/> | Horn antenna | 3160-09 | 1265 | 9403-1025 | EMCO |
| <input type="checkbox"/> | Horn antenna | 3160-10 | 1575 | 399185 | EMCO |
| <input type="checkbox"/> | Fully anechoic room | No. 2 | 1452 | --- | Albatross |
| <input type="checkbox"/> | Semi anechoic room | No. 3 | 1453 | --- | Siemens |
| <input checked="" type="checkbox"/> | Semi anechoic room | No. 8 | 2057 | --- | Albatross |

6.5 Radiated Emission at Alternative Test Site

| Measurement Procedure: | |
|--|---|
| Rules and specifications: | CFR 47 Part 15, sections 15.205(b) and 15.225(d) IC RSS-GEN Issue 4, sections 8.9 and 8.10(b)(c) and IC RSS-210 Issue 8, section A2.6 |
| Guide: | ANSI C63.4 |
| <p>Radiated emission in the frequency range 30 MHz to 1 GHz is measured within a semi-anechoic room with groundplane complying with the NSA requirements of ANSI C63.4 for alternative test sites. A linear polarized logarithmic periodic antenna combined with a 4:1 broadband dipole ("Trilog broadband antenna") is used. The measurement bandwidth of the test receiver is set to 120 kHz with quasi-peak detector selected.</p> <p>If the radiated emission limits are expressed in terms of the average value of the emission there also is a peak limit corresponding to 20 dB above the maximum permitted average limit. Additionally, if pulsed operation is employed, the average field strength is determined by averaging over one complete pulse train, including blanking intervals, as specified in CFR 47 Part 15 section 15.35(c). If the pulse train exceeds 0.1 second that 0.1 second interval during which the value of the emission is at its maximum is selected for calculation. The pulse train correction is added to the peak value of the emission to get the average value.</p> <p>Hand-held or body-worn devices are tested in the position producing the highest emission relative to the limit as verified by prescans in fully anechoic room.</p> <p>If no prescan in a fully anechoic room is used first a peak scan is performed in four positions to get the whole spectrum of emission caused by EUT with the measuring antenna raised and lowered from 1 to 4 m to find table position, antenna height and antenna polarization for the maximum emission levels.</p> <p>Data reduction is applied to these results to select those levels having less margin than 10 dB to or exceeding the limit using subranges and limited number of maximums. Further maximization is following.</p> <p>With detector of the test receiver set to quasi-peak final measurements are performed immediately after frequency zoom (for drifting disturbances) and maximum adjustment.</p> <p>Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.</p> <p>In cases where prescans in a fully anechoic room are taken (e. g. if EUT is operating for a short time only or battery is discharged quickly) final measurements with quasi-peak detector are performed manually at frequencies indicated by prescan with EUT rotating all around and receiving antenna raising and lowering within 1 meter to 4 meters to find the maximum levels of emission.</p> <p>Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.</p> <p>For measuring emissions of intentional radiators and receivers a test distance D of 3 meters is selected. Testing of unintentional radiators is performed at a distance of 10 meters. If limits specified for 3 meters shall be used for measurements performed at 10 meters distance the limits are calculated according to CFR 47 Part 15 section 15.31(d) and (f)(1) using an inverse linear-distance extrapolation factor of 20 dB/decade.</p> | |



Alternate test site (semi anechoic room)

Test instruments used:

| Type | Designation | Inv.-no. | Serial No. or ID | Manufacturer |
|--|--------------------------|----------|------------------|-----------------|
| <input checked="" type="checkbox"/> EMI test receiver | ESU8 | 2044 | 100232 | Rohde & Schwarz |
| <input checked="" type="checkbox"/> Trilog antenna | Cabin no. 8 VULB 9163 | 2058 | 9163-408 | Schwarzbeck |
| <input checked="" type="checkbox"/> Semi anechoic room | No. 8 | 2057 | --- | Albatross |

6.6 Carrier Frequency Stability

Measurement Procedure:

| | |
|---------------------------|--|
| Rules and specifications: | CFR 47 Part 15, section 15.225(e) IC RSS-Gen Issue 4, section 6.11 and IC RSS-210 Issue 8, section A2.6 |
| Guide: | ANSI C63.4 |

The frequency tolerance of the carrier signal is measured over a temperature variation of -20 °C to +50 °C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 °C.

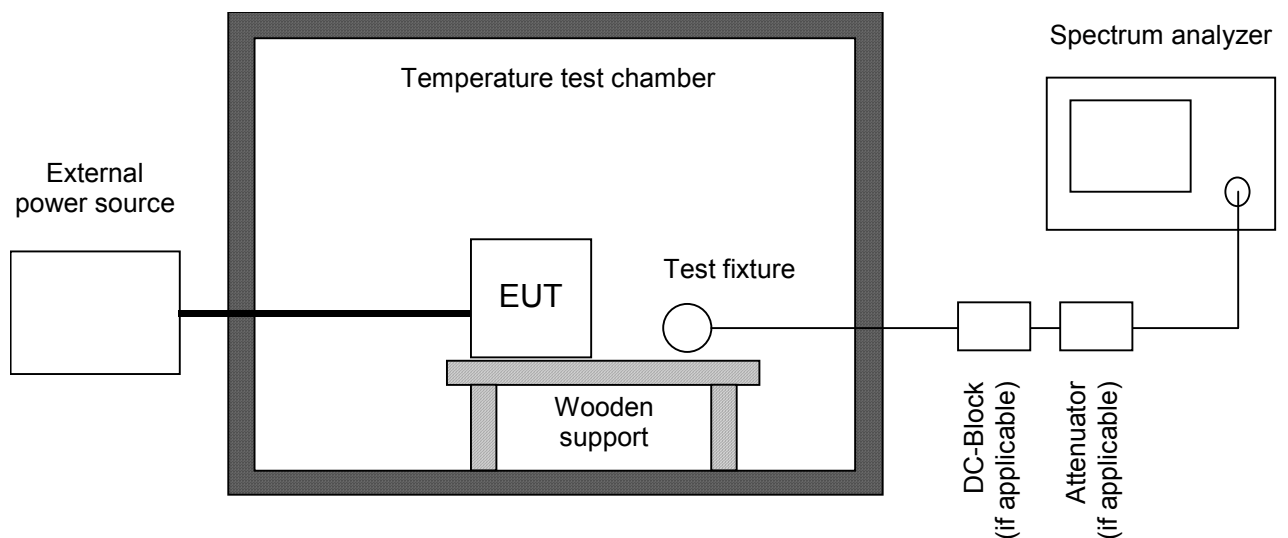
If the EUT provides an antenna connector the spectrum analyzer is connected to this port. If required, a resistive matching network equal to the impedance specified or employed for the antenna is used as well as dc block and appropriate attenuators (50 Ohms). In cases where the EUT does not provide an antenna connector a test fixture is used.

For battery operated equipment, the test is performed using a new battery. Alternatively, an external supply voltage can be used and is at least set to:

- the maximum battery voltage as delivered by a new battery or 115% of the battery nominal voltage
- the battery nominal voltage
- 85% of the battery nominal voltage
- the battery operating end point voltage which shall be specified by the equipment manufacturer

The EUT is operating providing an unmodulated carrier. The peak detector of the spectrum analyzer is selected and resolution as well as video bandwidth are set to values appropriate to the shape of the spectrum of the EUT. The frequency counter mode of the spectrum analyzer is used to maximize the accuracy of the measured frequency tolerance.

If an unmodulated carrier is not available a significant and stable point on the spectrum is selected and the span is reduced to a value that delivers an accuracy which shall be better than 1% of the maximum frequency tolerance allowed for the carrier signal. This method may be performed as long as the margin to the frequency tolerance allowed is larger than the uncertainty of the measured frequency tolerance.





Test instruments used:

| Type | Designation | Inv.-no. | Serial No. or ID | Manufacturer |
|--|--------------|----------|--------------------------|-----------------|
| <input type="checkbox"/> Spectrum analyzer | FSP30 | 1666 | 100036 | Rohde & Schwarz |
| <input checked="" type="checkbox"/> EMI test receiver | ESPI7 | 1711 | 836914/0002 | Rohde & Schwarz |
| <input type="checkbox"/> EMI test receiver | ESMI | 1569 | 839379/013 839587/006 | Rohde & Schwarz |
| <input type="checkbox"/> DC-block | 7006 | 1636 | A2798 | Weinschel |
| <input type="checkbox"/> Attenuator | 4776-10 | 1638 | 9412 | Narda |
| <input type="checkbox"/> Attenuator | 4776-20 | 1639 | 9503 | Narda |
| <input checked="" type="checkbox"/> Test probe | TP 01 | 1628 | 001 | TÜV SÜD PS |
| <input type="checkbox"/> Multimeter | 21 III | 1653 | 76530546 | Fluke |
| <input type="checkbox"/> Multimeter | 21 III | 1654 | 76381229 | Fluke |
| <input checked="" type="checkbox"/> Multimeter | Fluke 77 III | 1975 | 92370108 | Fluke |
| <input type="checkbox"/> Multimeter | Fluke 77 IV | 1976 | 93090238 | Fluke |
| <input type="checkbox"/> Multimeter | Fluke 177 | 2025 | 96720024 | Fluke |
| <input type="checkbox"/> Multimeter | Fluke 177 | 2026 | 96720025 | Fluke |
| <input checked="" type="checkbox"/> DC power supply | NGSM 32/10 | 1267 | 203 | Rohde & Schwarz |
| <input type="checkbox"/> Isolating transformer | RT 5A | 1127 | 10387 | Grundig |
| <input type="checkbox"/> Isolating transformer | RT 5A | 1128 | 10416 | Grundig |
| <input checked="" type="checkbox"/> Temperature test chamber | HT 4010 | 1271 | 07065550 | Heraeus |

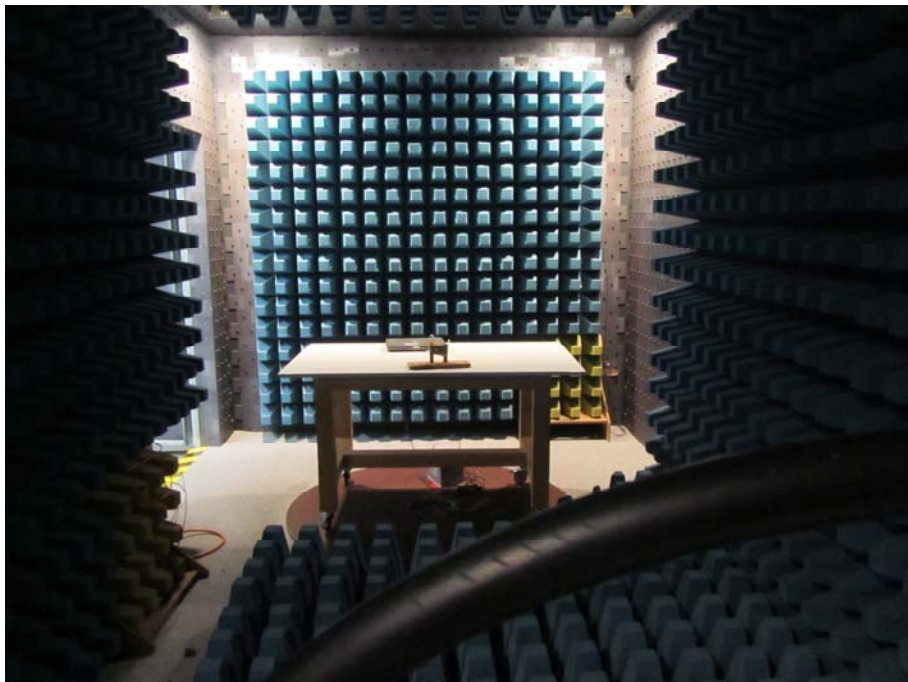


7 Photographs Taken During Testing

Test setup for conducted AC powerline emission measurement



Test setup for radiated emission measurement 9 kHz – 30 MHz



**Test setup for radiated emission measurement 9 kHz – 30 MHz
- continued -**



Test setup for radiated emission measurement (alternate test site)



8 Test Results

| FCC CFR 47 Parts 2 and 15 | | | |
|--|--|------------------|----------------|
| Section(s) | Test | Page | Result |
| 2.1046(a) | Conducted output power | --- | Not applicable |
| 2.202(a) | Occupied bandwidth | 27 | Recorded |
| 15.215(c) | Bandwidth of the emission | 33 | Test passed |
| 2.201, 2.202 | Class of emission | 36 | Calculated |
| 15.35(c) | Pulse train measurement for pulsed operation | --- | Not applicable |
| 15.205(a) 15.205(d)(7) | Restricted bands of operation | --- ⁵ | Test passed |
| 15.207 | Conducted AC powerline emission 150 kHz to 30 MHz | 37 | Test passed |
| 15.225(a)-(d) | Spectrum Mask | 40 | Test passed |
| 15.205(b) 15.215(b) 15.225(a)(d) | Radiated emission 9 kHz to 30 MHz | 42 | Test passed |
| 15.205(b) 15.225(d) | Radiated emission 30 MHz to 1 GHz | 44 | Test passed |
| 15.225(e) | Carrier frequency stability | 46 | Test passed |

⁵ See "Spectrum Mask" for the 13.36 to 13.41 MHz band. For all other restricted bands see "Radiated Emission".

| IC RSS-GEN Issue 4 | | | |
|---------------------------|---|------------------|---|
| <i>Section(s)</i> | <i>Test</i> | <i>Page</i> | <i>Result</i> |
| 6.12 | Transmitter output power (conducted) | --- | Not applicable |
| 6.6 | Occupied Bandwidth | 27 | Recorded |
| 9 | Designation of emissions | 36 | Calculated |
| 6.10 | Pulsed operation | --- | Not applicable |
| 8.10 | Restricted bands and unwanted emission frequencies | --- ⁶ | Test passed |
| 6.4, 6.13, 8.9 | Unwanted emissions 9 kHz to 30 MHz | 42 | Test passed |
| 6.4, 6.13, 8.9 | Unwanted emissions 30 MHz to 1 GHz | 44 | Test passed |
| 8.8 | Transmitter AC power lines conducted emissions 150 kHz to 30 MHz | 37 | Test passed |
| 3.2 | Exposure of Humans to RF Fields | 49 | Exempted from SAR and RF evaluation |

| IC RSS-210 Issue 8 | | | |
|---------------------------|---------------------------------------|-------------|---------------|
| <i>Section(s)</i> | <i>Test</i> | <i>Page</i> | <i>Result</i> |
| A2.6 | Spectrum Mask | 40 | Test passed |
| A2.6 | Unwanted emissions 9 kHz to 30 MHz | 42 | Test passed |
| A2.6 | Unwanted emissions 30 MHz to 1 GHz | 44 | Test passed |
| A2.6 | Carrier frequency stability | 46 | Test passed |

⁶ See "Spectrum Mask" and "Unwanted emissions".

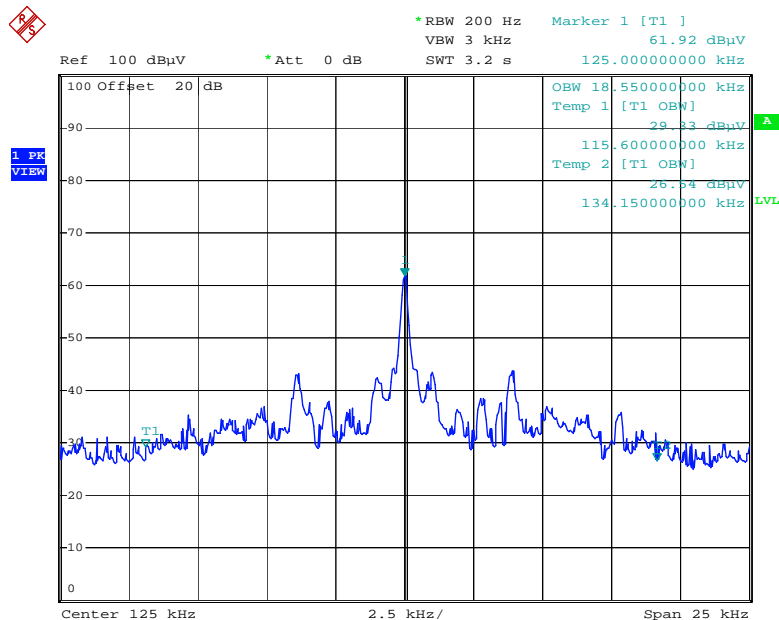


8.1 Occupied Bandwidth

| | | |
|---------------------------|--|------------------------------|
| Rules and specifications: | CFR 47 Part 2, section 2.202(a) ANSI C63.4, annex H.6 | |
| Guide: | ANSI C63.4 | |
| Description: | <p>The occupied bandwidth according to CFR 47 Part 2, section 2.202(a), is measured as the 99% emission bandwidth, i.e. below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5% of the total mean power radiated by a given emission.</p> <p>The occupied bandwidth according to ANSI C63.4, annex H.6; is measured as the frequency range defined by the points that are 26 dB down relative to the maximum level of the modulated carrier.</p> <p>The resolution bandwidth of the spectrum analyzer shall be set to a value greater than 5.0% of the allowed bandwidth. If no bandwidth specifications are given, the following guidelines are used:</p> | |
| | Fundamental frequency | Minimum resolution bandwidth |
| | 9 kHz to 30 MHz | 1 kHz |
| | 30 MHz to 1000 MHz | 10 kHz |
| | 1000 MHz to 40 GHz | 100 kHz |
| | The video bandwidth shall be at least three times greater than the resolution bandwidth. | |
| Measurement procedure: | Bandwidth Measurements (6.1) | |

| | |
|---------------|----------------------------------|
| Comment: | |
| Date of test: | 2015-02-20 |
| Test site: | Fully anechoic room, cabin no. 2 |

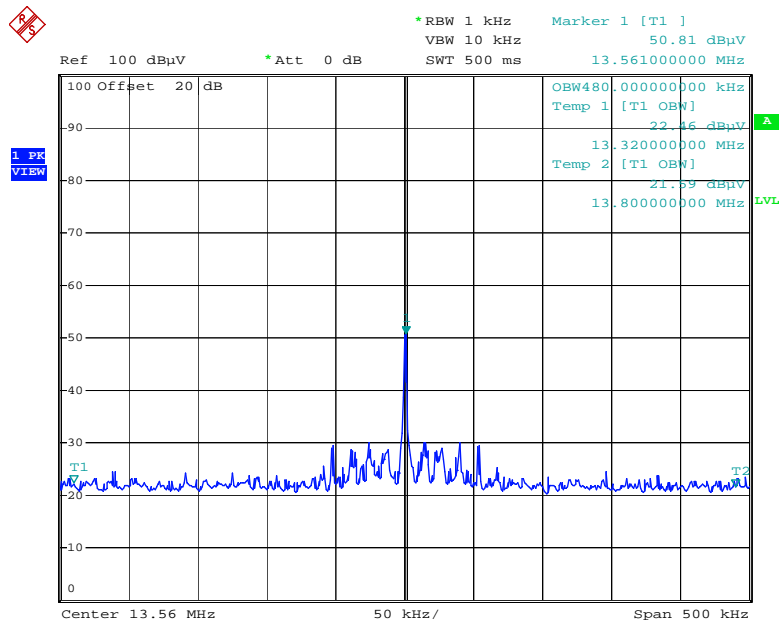
125 kHz: Occupied Bandwidth (99 %):



Date: 20.FEB.2015 11:11:37

Occupied Bandwidth (99 %): **18.55 kHz**

13.56 MHz: Occupied Bandwidth (99 %):



Date: 20.FEB.2015 10:57:44

| | |
|----------------------------|----------------|
| Occupied Bandwidth (99 %): | 480 kHz |
|----------------------------|----------------|

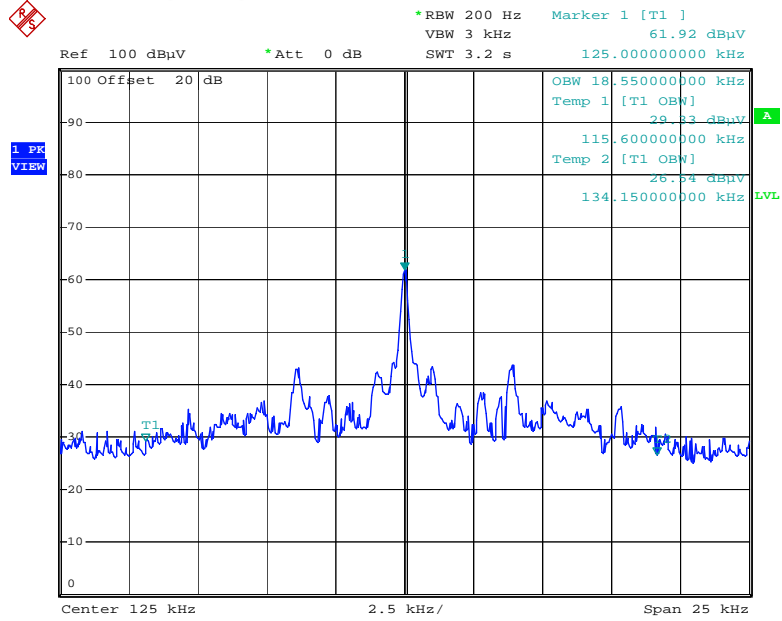


Occupied Bandwidth (continued)

| | |
|---------------------------|---|
| Rules and specifications: | IC RSS-Gen Issue 4, section 6.6 |
| Guide: | IC RSS-Gen Issue 4, section 6.6 |
| Description: | <p>If not specified in the applicable RSS the occupied bandwidth is measured as the 99% emission bandwidth.</p> <p>The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts. The resolution bandwidth shall be set to as close to 1% of the selected span as is possible without being below 1%. The video bandwidth shall be set to 3 times the resolution bandwidth.</p> <p>The trace data points are recovered and are directly summed in linear terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached and that frequency recorded. The process is repeated for the highest frequency data points. This frequency is also recorded. The span between the two recorded frequencies is the occupied bandwidth.</p> |
| Measurement procedure: | Bandwidth Measurements (6.1) |

| | |
|---------------|----------------------------------|
| Comment: | |
| Date of test: | 2015-02-20 |
| Test site: | Fully anechoic room, cabin no. 2 |

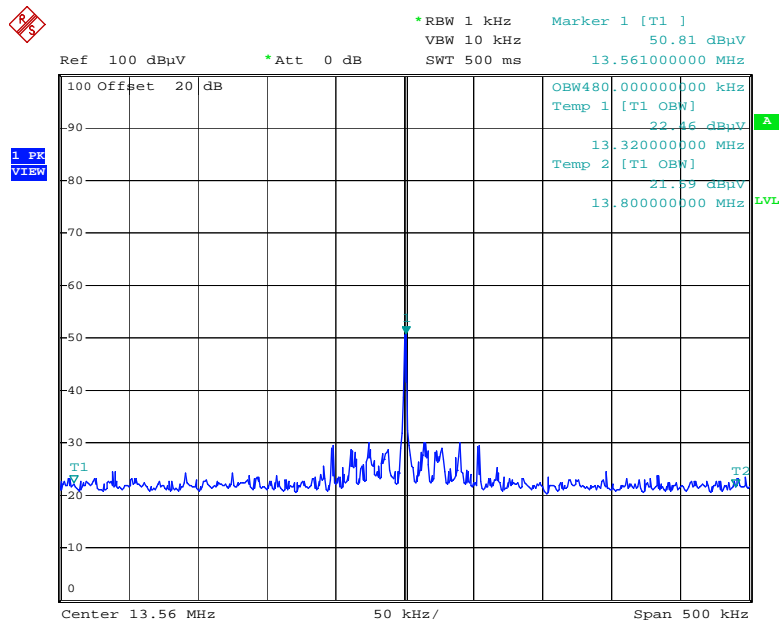
125 kHz: Occupied Bandwidth (99 %):



Date: 20.FEB.2015 11:11:37

| | |
|----------------------------|------------------|
| Occupied Bandwidth (99 %): | 18.55 kHz |
|----------------------------|------------------|

13.56 MHz: Occupied Bandwidth (99 %):



Date: 20.FEB.2015 10:57:44

Occupied Bandwidth (99 %): **480 kHz**

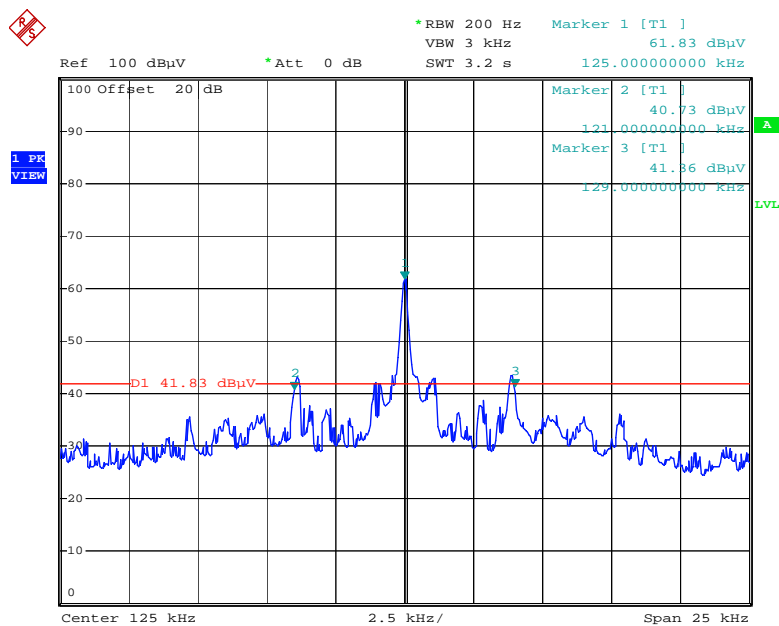


8.2 Bandwidth of the Emission

| | | |
|---------------------------|---|------------------------------|
| Rules and specifications: | CFR 47 Part 15, section 15.215(c) | |
| Guide: | ANSI C63.4 | |
| Description: | <p>The 20 dB bandwidth of the emission is measured as the frequency range defined by the points that are 20 dB down relative to the maximum level of the modulated carrier.</p> <p>For intentional radiators operating under the alternative provisions to the general emission limits the requirement to contain the 20 dB 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.</p> <p>The resolution bandwidth of the spectrum analyzer shall be set to a value greater than 5.0% of the allowed bandwidth. If no bandwidth specifications are given, the following guidelines are used:</p> | |
| | Fundamental frequency | Minimum resolution bandwidth |
| | 9 kHz to 30 MHz | 1 kHz |
| | 30 MHz to 1000 MHz | 10 kHz |
| | 1000 MHz to 40 GHz | 100 kHz |
| | The video bandwidth shall be at least three times greater than the resolution bandwidth. | |
| Measurement procedure: | Bandwidth Measurements (6.1) | |

| | |
|---------------|----------------------------------|
| Comment: | |
| Date of test: | 2015-02-20 |
| Test site: | Fully anechoic room, cabin no. 2 |

125 kHz

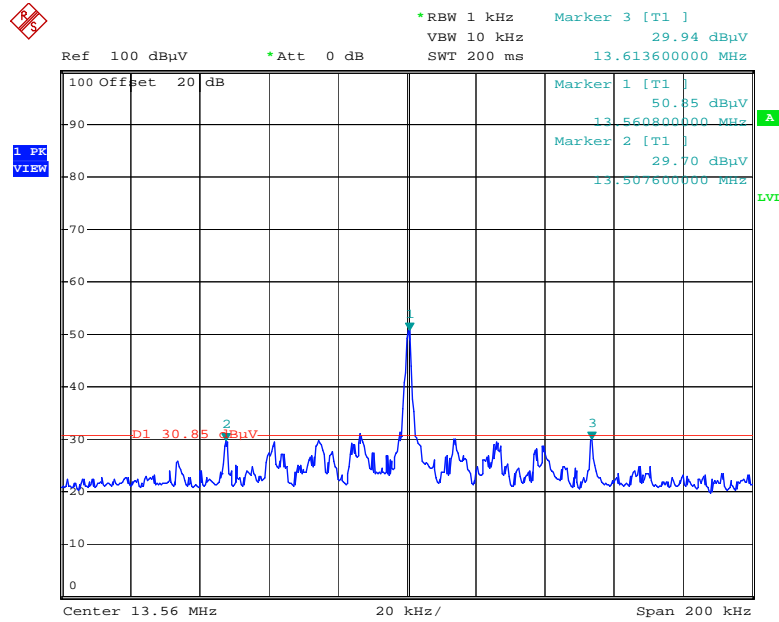


Date: 20.FEB.2015 11:07:45

Bandwidth of the emission:

8 kHz

13.56 MHz:



Date: 20.FEB.2015 11:00:53

| | | |
|-------------------------------|--|--|
| Permitted frequency band: | 13.110 – 14.010 MHz | |
| 20 dB bandwidth: | 106 kHz | |
| Carrier frequency stability: | <input checked="" type="checkbox"/> specified | <input type="checkbox"/> not specified |
| Maximum frequency tolerances: | +0.044 kHz -0.024 kHz | |
| Bandwidth of the emission: | 106.1 kHz | within permitted frequency band⁷: <input checked="" type="checkbox"/> yes <input type="checkbox"/> no |

| | |
|--------------|-------------|
| Test Result: | Test passed |
|--------------|-------------|

⁷ If a frequency stability is not specified, it is recommended that the fundamental emission is kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.



8.3 Designation of Emissions

| | |
|---------------------------|--|
| Rules and specifications: | CFR 47 Part 2, sections 2.201 and 2.202 IC RSS-Gen Issue 4, section 9 |
| Guide: | ANSI C63.4 / TRC-43 |

125 kHz :

| | |
|---------------------|----------------------|
| Type of modulation: | Amplitude Modulation |
|---------------------|----------------------|

| | |
|------------------------------|---|
| B_n = Necessary Bandwidth | $B_n = 2BK$ |
| B = Modulation rate | B = 4 kHz |
| K = Overall numerical factor | K = 1 |
| Calculation: | $B_n = 2 \cdot (4 \text{ kHz}) \cdot 1 = 8 \text{ kHz}$ |

| | |
|---------------------------|----------------|
| Designation of Emissions: | 8K00A1D |
|---------------------------|----------------|

13.56 MHz :

| | |
|---------------------|----------------------|
| Type of modulation: | Amplitude Modulation |
|---------------------|----------------------|

| | |
|------------------------------|--|
| B_n = Necessary Bandwidth | $B_n = 2BK$ |
| B = Modulation rate | B = 53 kHz |
| K = Overall numerical factor | K = 1 |
| Calculation: | $B_n = 2 \cdot (53 \text{ kHz}) \cdot 1 = 106 \text{ kHz}$ |

| | |
|---------------------------|----------------|
| Designation of Emissions: | 106KA1D |
|---------------------------|----------------|



8.4 Conducted Powerline Emission Measurement 150 kHz to 30 MHz

| | | | |
|---------------------------|---|------------------------|----------|
| Rules and specifications: | CFR 47 Part 15, section 15.207 IC RSS-GEN Issue 4, section 8.8 | | |
| Guide: | ANSI C63.4 / CISPR 22 | | |
| Limit: | Frequency of Emission (MHz) | Conducted Limit (dBµV) | |
| | | Quasi-peak | Average |
| | 0.15 - 0.5 | 66 to 56 | 56 to 46 |
| | 0.5 - 5 | 56 | 46 |
| | 5 - 30 | 60 | 50 |
| Measurement procedure: | Conducted AC Powerline Emission (6.2) | | |

| | |
|---------------|----------------------------|
| Comment: | |
| Date of test: | 2015-02-20 |
| Test site: | Shielded room, cabin no. 4 |

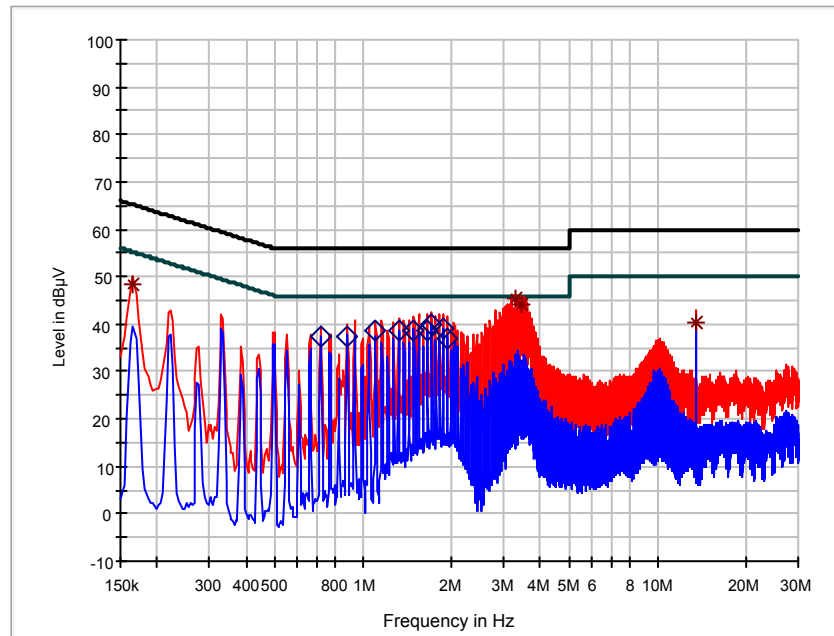
| | |
|--------------|-------------|
| Test Result: | Test passed |
|--------------|-------------|

Sample calculation of final values:

$$\text{Final Value (dB}\mu\text{V)} = \text{Reading Value (dB}\mu\text{V)} + \text{Correction Factor (dB)}$$

Tested on:

L1



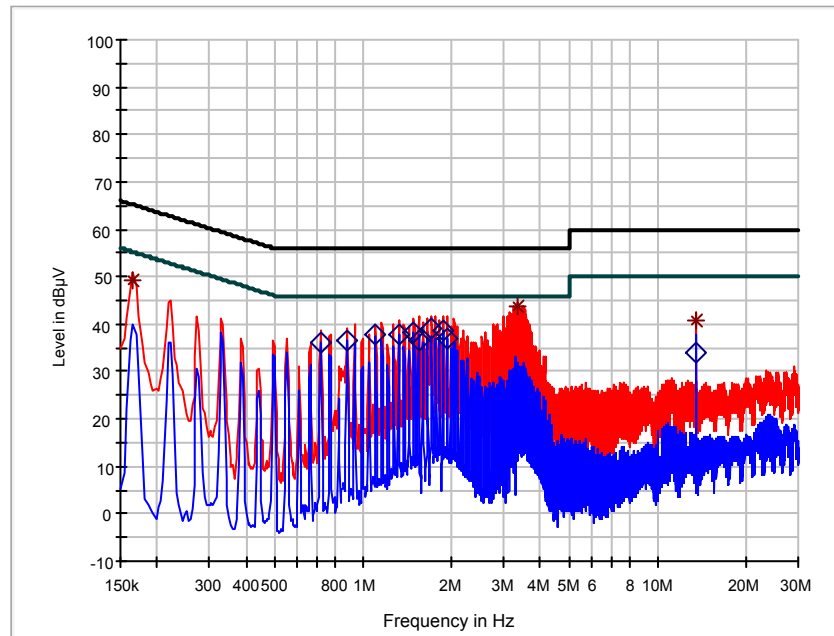
— FCC § 15.207 QP
 — FCC 15.207 AV
 — Preview Result 1-PK+
— Preview Result 2-AVG
 * Final Result 1-QPK
 ◇ Final Result 2-AVG

| Frequency MHz | QuasiPeak dBµV | Meas. Time ms | Bandwidth kHz | PE | Line | Corr. dB | Margin dB | Limit dBµV |
|---------------|----------------|---------------|---------------|----|------|----------|-----------|------------|
| 0.166000 | 48.4 | 1000.0 | 10.000 | 0 | 0 | 0.3 | 16.7 | 65.2 |
| 3.310000 | 45.4 | 1000.0 | 10.000 | 0 | 0 | 0.3 | 10.6 | 56.0 |
| 3.422000 | 44.1 | 1000.0 | 10.000 | 0 | 0 | 0.3 | 11.9 | 56.0 |
| 13.558000 | 40.5 | 1000.0 | 10.000 | 0 | 0 | 0.4 | 19.5 | 60.0 |

| Frequency MHz | Average dBµV | Meas. Time ms | Bandwidth kHz | PE | Line | Corr. dB | Margin dB | Limit dBµV |
|---------------|--------------|---------------|---------------|----|------|----------|-----------|------------|
| 0.718000 | 37.3 | 1000.0 | 10.000 | 0 | 0 | 0.3 | 8.7 | 46.0 |
| 0.882000 | 37.6 | 1000.0 | 10.000 | 0 | 0 | 0.3 | 8.4 | 46.0 |
| 1.102000 | 38.6 | 1000.0 | 10.000 | 0 | 0 | 0.3 | 7.4 | 46.0 |
| 1.322000 | 38.8 | 1000.0 | 10.000 | 0 | 0 | 0.3 | 7.2 | 46.0 |
| 1.490000 | 38.7 | 1000.0 | 10.000 | 0 | 0 | 0.3 | 7.3 | 46.0 |
| 1.654000 | 38.7 | 1000.0 | 10.000 | 0 | 0 | 0.3 | 7.3 | 46.0 |
| 1.710000 | 39.8 | 1000.0 | 10.000 | 0 | 0 | 0.3 | 6.2 | 46.0 |
| 1.874000 | 39.2 | 1000.0 | 10.000 | 0 | 0 | 0.3 | 6.8 | 46.0 |
| 1.930000 | 37.0 | 1000.0 | 10.000 | 0 | 0 | 0.3 | 9.0 | 46.0 |

Tested on:

N



— FCC § 15.207 QP
 — FCC § 15.207 AV
 — Preview Result 1-PK+
 * Final Result 1-QPK
 ◇ Final Result 2-AVG

| Frequency MHz | QuasiPeak dBµV | Meas. Time ms | Bandwidth kHz | PE | Line | Corr. dB | Margin dB | Limit dBµV |
|---------------|----------------|---------------|---------------|----|------|----------|-----------|------------|
| 0.166000 | 49.1 | 1000.0 | 10.000 | 0 | 0 | 0.3 | 16.0 | 65.2 |
| 3.366000 | 43.8 | 1000.0 | 10.000 | 0 | 0 | 0.3 | 12.2 | 56.0 |
| 13.562000 | 40.9 | 1000.0 | 10.000 | 0 | 0 | 0.4 | 19.1 | 60.0 |

| Frequency MHz | Average dBµV | Meas. Time ms | Bandwidth kHz | PE | Line | Corr. dB | Margin dB | Limit dBµV |
|---------------|--------------|---------------|---------------|----|------|----------|-----------|------------|
| 0.718000 | 36.1 | 1000.0 | 10.000 | 0 | 0 | 0.3 | 9.9 | 46.0 |
| 0.882000 | 36.5 | 1000.0 | 10.000 | 0 | 0 | 0.3 | 9.5 | 46.0 |
| 1.102000 | 37.6 | 1000.0 | 10.000 | 0 | 0 | 0.3 | 8.4 | 46.0 |
| 1.322000 | 37.7 | 1000.0 | 10.000 | 0 | 0 | 0.3 | 8.3 | 46.0 |
| 1.490000 | 38.2 | 1000.0 | 10.000 | 0 | 0 | 0.3 | 7.8 | 46.0 |
| 1.546000 | 36.7 | 1000.0 | 10.000 | 0 | 0 | 0.3 | 9.3 | 46.0 |
| 1.710000 | 39.0 | 1000.0 | 10.000 | 0 | 0 | 0.3 | 7.0 | 46.0 |
| 1.874000 | 38.8 | 1000.0 | 10.000 | 0 | 0 | 0.3 | 7.2 | 46.0 |
| 1.930000 | 36.8 | 1000.0 | 10.000 | 0 | 0 | 0.3 | 9.2 | 46.0 |
| 13.562000 | 34.0 | 1000.0 | 10.000 | 0 | 0 | 0.4 | 16.0 | 50.0 |

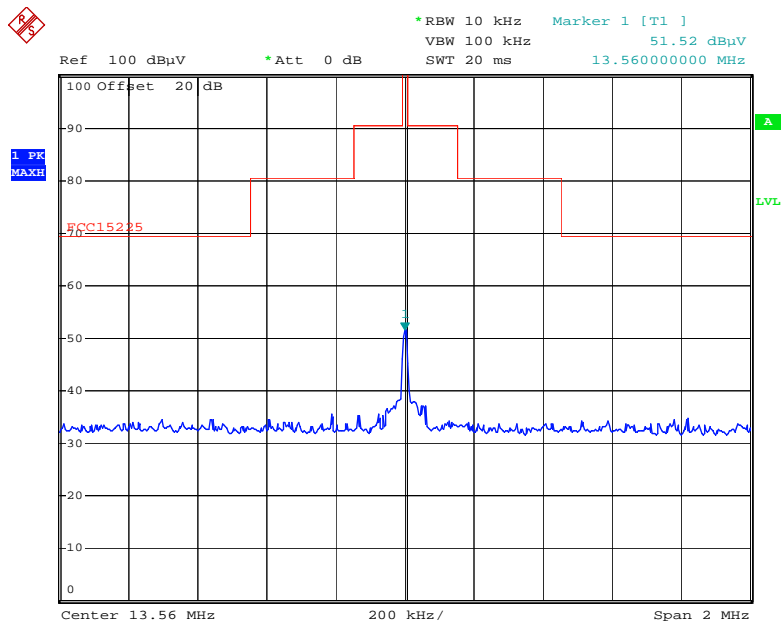


8.5 Spectrum Mask

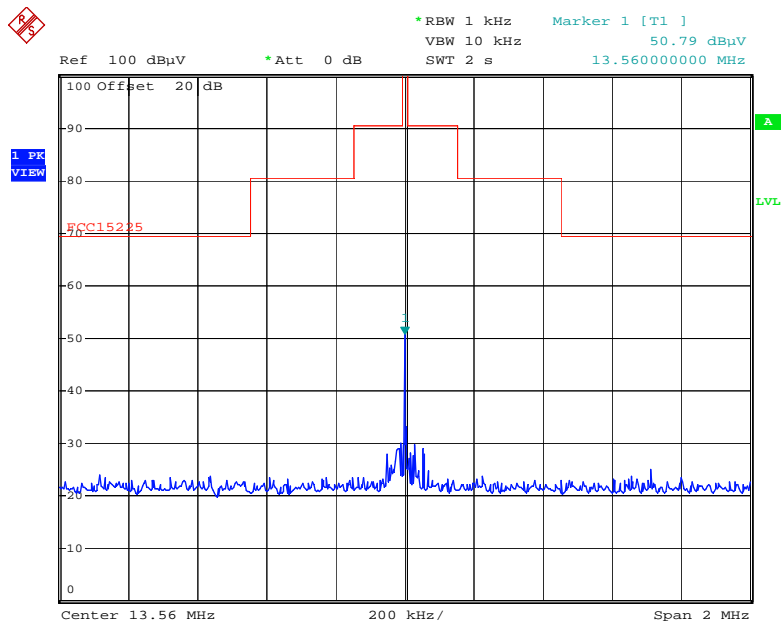
| | | | | |
|---------------------------|--|---|---|---------------------------------|
| Rules and specifications: | CFR 47 Part 15, section 15.225(a)-(d) IC RSS-210 Issue 8, section A2.6 | | | |
| Guide: | ANSI C63.4 | | | |
| Description: | Compliance with the spectrum mask is tested using a spectrum analyzer with resolution bandwidth set to a 1 kHz for the band 13.553 to 13.567 MHz and to 10 kHz outside this band. The video bandwidth shall be at least three times greater than the resolution bandwidth. | | | |
| Limit: | Frequency of Emission (MHz) | Field Strength ($\mu\text{V}/\text{m}$) | Field Strength (dB $\mu\text{V}/\text{m}$) | Measurement Distance d (meters) |
| | 1.705 - 13.110 | 30 | 29.5 | 30 |
| | 13.110 - 13.410 | 106 | 40.5 | 30 |
| | 13.410 - 13.553 | 334 | 50.5 | 30 |
| | 13.553 - 13.567 | 15848 | 84.0 | 30 |
| | 13.567 - 13.710 | 334 | 50.5 | 30 |
| | 13.710 - 14.010 | 106 | 40.5 | 30 |
| | 14.010 - 30.000 | 30 | 29.5 | 30 |
| Measurement procedure: | Radiated Emission Measurement 9 kHz to 30 MHz (6.3) | | | |

| | |
|-----------------------|----------------------------------|
| Comment: | |
| Date of test: | 2015-02-20 |
| Test site: | Fully anechoic room, cabin no. 2 |
| Test distance: | 3 meters |
| Extrapolation Factor: | 40 dB/decade |

| | |
|--------------|-------------|
| Test Result: | Test passed |
|--------------|-------------|



Date: 20.FEB.2015 10:54:16



Date: 20.FEB.2015 10:51:54



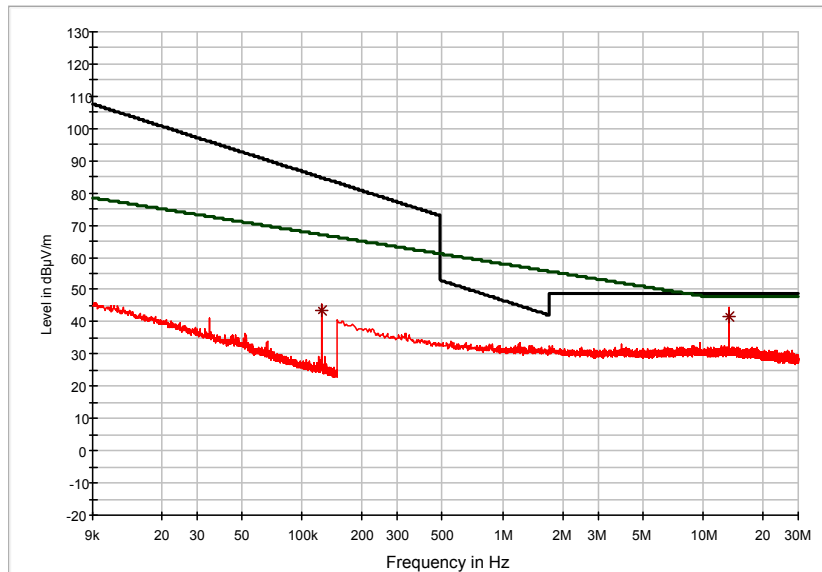
8.6 Radiated Emission Measurement 9 kHz to 30 MHz

| | | | | |
|---|--|---|--|---------------------------------|
| Rules and specifications: | CFR 47 Part 15, sections 15.205 and 15.225(a)-(d) IC RSS-GEN Issue 4, sections 8.9 and 8.10(b)(c) and IC RSS-210 Issue 8, section A2.6 | | | |
| Guide: | ANSI C63.4 | | | |
| Limit: | Frequency of Emission (MHz) | Field Strength ($\mu\text{V}/\text{m}$) | Field Strength ($\text{dB}\mu\text{V}/\text{m}$) | Measurement Distance d (meters) |
| | 0.009 - 0.490 | 2400/F(kHz) | 67.6 - 20 · log(F(kHz)) | 300 |
| | 0.490 - 1.705 | 24000/F(kHz) | 87.6 - 20 · log(F(kHz)) | 30 |
| | 1.705 - 13.110 | 30 | 29.5 | 30 |
| | 13.110 - 13.410 | 106 | 40.5 | 30 |
| | 13.410 - 13.553 | 334 | 50.5 | 30 |
| | 13.553 - 13.567 | 15848 | 84.0 | 30 |
| | 13.567 - 13.710 | 334 | 50.5 | 30 |
| | 13.710 - 14.010 | 106 | 40.5 | 30 |
| | 14.010 - 30.000 | 30 | 29.5 | 30 |
| Additionally, the level of any unwanted emissions shall not exceed the level of the fundamental emission. | | | | |
| Measurement procedure: | Radiated Emission Measurement 9 kHz to 30 MHz (6.3) | | | |

| | |
|---------------|----------------------|
| Comment: | |
| Date of test: | 2015-02-20 |
| Test site: | Open field test site |

| | |
|--------------|-------------|
| Test Result: | Test passed |
|--------------|-------------|

K8 CISPR 16-2-3 Magnetic Field Strength 9kHz - 30 MHz



— FCC 15.209 mag (10 m) — EN 300 330 tx mag — Preview Result 1-PK+ * Final Result 1-QPK

| Extrapolation factor: -40 dB/decade | | | | | | | | | | |
|-------------------------------------|------------|-----------|----------|----------------------------|--------------------------------|---------------------------------|-----------------------------------|----------------------------|-------------------|----------------|
| Frequency (MHz) | Detector | Distance | | Reading Value (dBµV) | Correction Factor (dB/m) | Extrapolation Factor (dB) | Pulse Train Correction (dB) | Final Value (dBµV/m) | Limit (dBµV/m) | Margin (dB) |
| | | d1 (m) | d (m) | | | | | | | |
| 0.12500 | Quasi-Peak | 10 | 300 | 20.7 | 20.0 | -59.1 | | -18.4 | 25.7 | 44.1 |
| 13.56000 | Quasi-Peak | 10 | 30 | 27.4 | 20.0 | -19.1 | | 28.3 | 84.0 | 55.7 |

Sample calculation of final values:

$$\text{Extrapolation Factor (dB)} = (\text{Log}(d) - \text{Log}(d_1)) \cdot \text{Extrapolation Factor (dB/decade)}$$

$$\text{Final Value (dBµV/m)} = \text{Reading Value } d_1 \text{ (dBµV)} + \text{Correction Factor (dB/m)} + \text{Extrapolation Factor (dB)} + \text{Pulse Train Correction (dB)}$$

Note: Extrapolation factor (dB) and final value (dBµV/m) are relating to distance d.



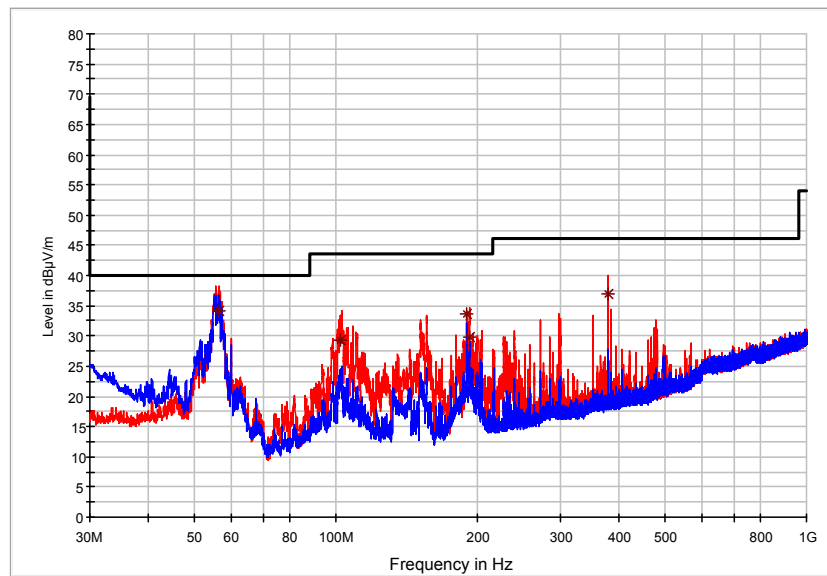
8.7 Radiated Emission Measurement 30 MHz to 1 GHz

| | | | |
|---------------------------|---|------------------------------------|---|
| Rules and specifications: | CFR 47 Part 15, sections 15.205(b) and 15.225(d) IC RSS-GEN Issue 4, sections 8.9 and 8.10(b)(c) and IC RSS-210 Issue 8, section A2.6 | | |
| Guide: | ANSI C63.4 | | |
| Limit: | Frequency of Emission (MHz) | Field Strength ($\mu\text{V/m}$) | Field Strength ($\text{dB}\mu\text{V/m}$) |
| | 30 - 88 | 100 | 40.0 |
| | 88 - 216 | 150 | 43.5 |
| | 216 - 960 | 200 | 46.0 |
| | Above 960 | 500 | 54.0 |
| | Additionally, the level of any unwanted emissions shall not exceed the level of the fundamental emission. | | |
| Measurement procedures: | Radiated Emission in Fully or Semi Anechoic Room (6.4) Radiated Emission at Alternative Test Site (6.5) | | |

| | |
|----------------|--|
| Comment: | |
| Date of test: | 30 January 2015 |
| Test site: | Frequencies \leq 1 GHz: Semi-anechoic room, cabin no. 8 Frequencies $>$ 1 GHz: Fully anechoic room, cabin no. 2 |
| Test distance: | 3 meters |

| | |
|--------------|-------------|
| Test Result: | Test passed |
|--------------|-------------|

K8 CISPR 16-2-3 Electric Field Strength 30MHz-1GHz (3m)



— FCC 15.209 — Preview Result 1H-PK+ — Preview Result 1V-PK+ * Final Result 1-QPK

| Frequency (MHz) | Antenna Polarization | Detector | Receiver Reading (dBµV) | Correction Factor (dB/m) | Pulse Train Correction (dB) | Final Value (dBµV/m) | Limit (dBµV/m) | Margin (dB) |
|-----------------|----------------------|------------|-------------------------|--------------------------|-----------------------------|----------------------|----------------|-------------|
| 56.280 | horizontal | Quasi-Peak | 18.1 | 16.0 | | 34.1 | 40.0 | 5.9 |
| 102.270 | horizontal | Quasi-Peak | 15.4 | 13.8 | | 29.2 | 43.5 | 14.3 |
| 189.810 | horizontal | Quasi-Peak | 21.4 | 12.2 | | 33.6 | 43.5 | 9.9 |
| 191.980 | horizontal | Quasi-Peak | 17.6 | 12.3 | | 29.9 | 43.5 | 13.6 |
| 379.680 | horizontal | Quasi-Peak | 20.3 | 16.7 | | 37.0 | 46.0 | 9.0 |

Sample calculation of final values:

$$\text{Final Value (dB}\mu\text{V/m)} = \text{Reading Value (dB}\mu\text{V)} + \text{Correction Factor (dB/m)} + \text{Pulse Train Correction (dB)}$$

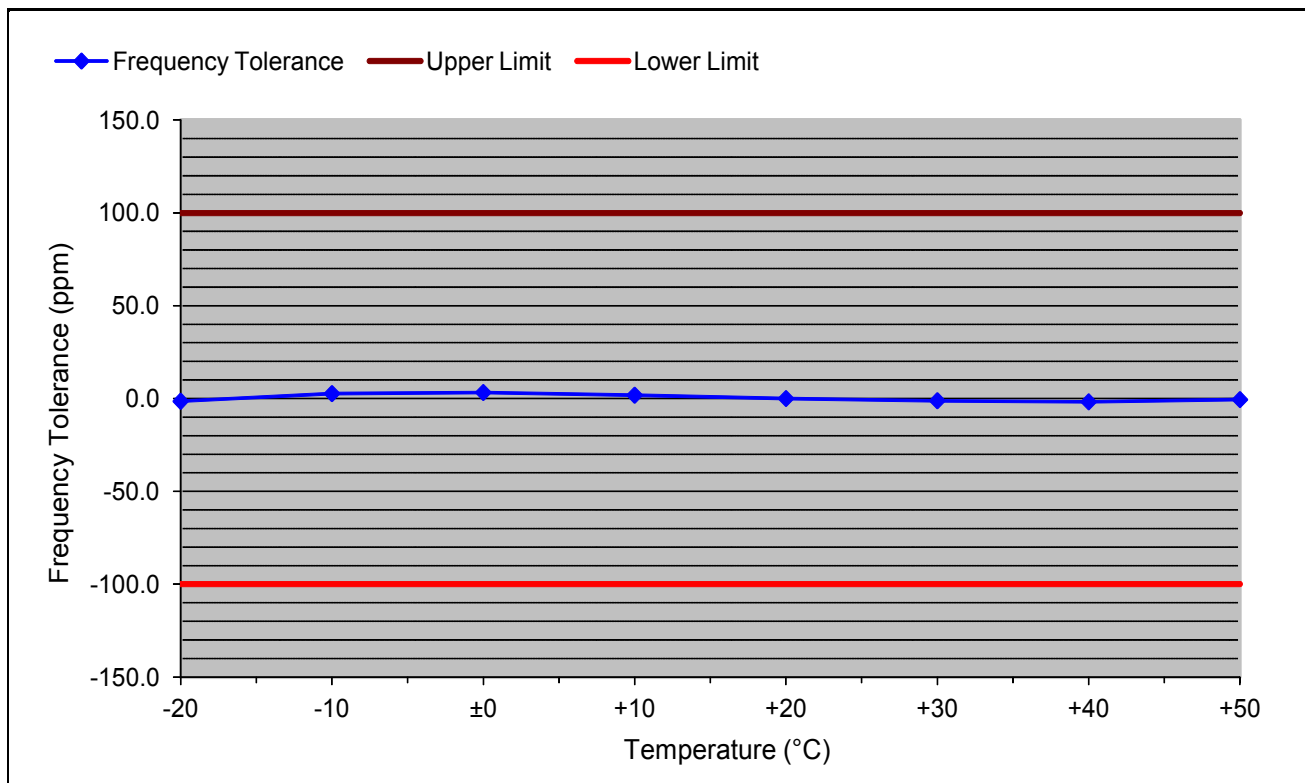
8.8 Carrier Frequency Stability

| | |
|---------------------------|---|
| Rules and specifications: | CFR 47 Part 15, section 15.225(e) IC RSS-Gen Issue 4, section 8.11 and IC RSS-210 Issue 8, section A2.6 |
| Guide: | ANSI C63.4 |
| Limit: | The frequency tolerance of the carrier signal shall be maintained within ± 0.01 % (± 100 ppm) of the carrier frequency under nominal conditions. |
| Temperature range: | -20°C to +50°C (at normal supply voltage) |
| Voltage range: | 85% to 115% of the rated supply voltage (at a temperature of +20°C) |
| Measurement procedure: | Carrier Frequency Stability (6.6) |

| | |
|---------------|------------|
| Comment: | |
| Date of test: | 2015-02-23 |



8.8.1 Carrier Frequency Stability vs. Temperature

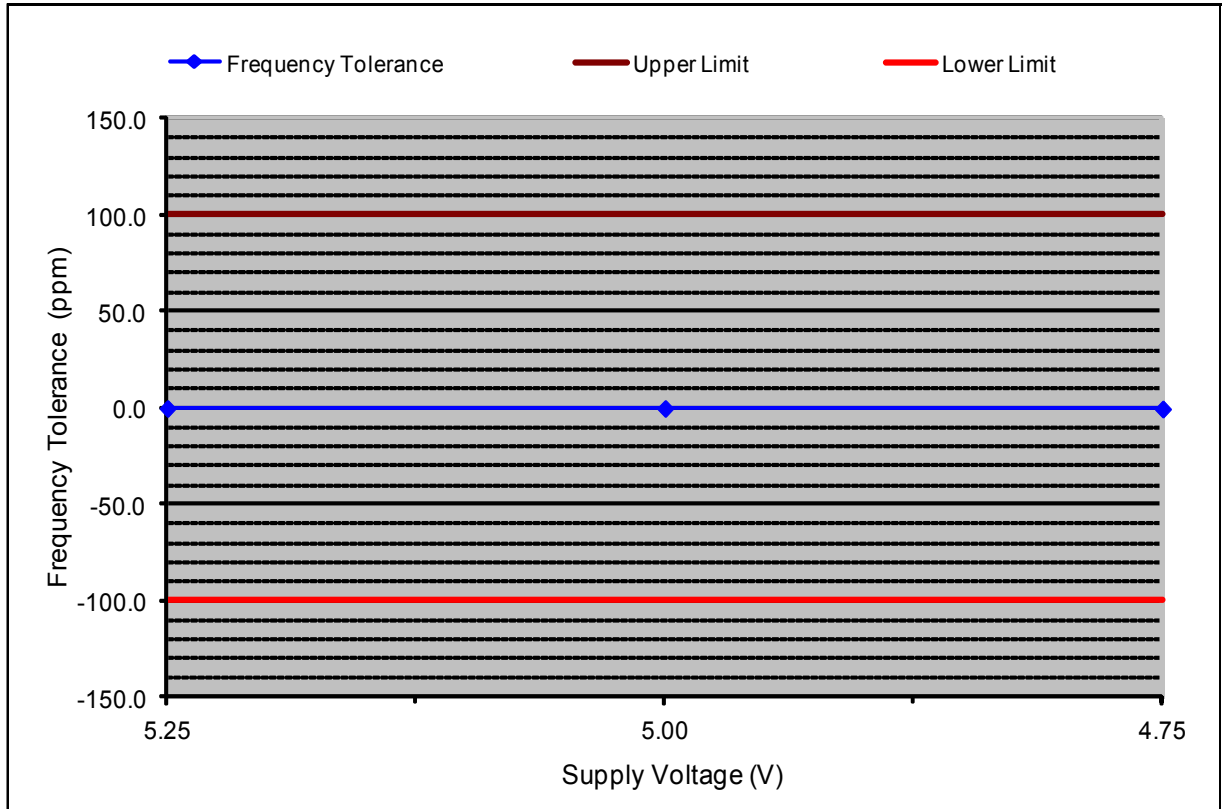


Supply voltage: 12 V Nominal frequency: 13.560572 MHz

| Temperature (°C) | Frequency (MHz) | Frequency Tolerance (Hz) | Frequency Tolerance (ppm) | Upper Limit (ppm) | Lower Limit (ppm) | Margin (ppm) |
|------------------|-----------------|--------------------------|---------------------------|-------------------|-------------------|--------------|
| -20 | 13.560552 | -20 | -1.5 | +100.0 | -100.0 | 98.5 |
| -10 | 13.560608 | 36 | 2.7 | +100.0 | -100.0 | 97.3 |
| ±0 | 13.560616 | 44 | 3.2 | +100.0 | -100.0 | 96.8 |
| +10 | 13.560596 | 24 | 1.8 | +100.0 | -100.0 | 98.2 |
| +20 | 13.560572 | 0 | 0.0 | +100.0 | -100.0 | 100.0 |
| +30 | 13.560556 | -16 | -1.2 | +100.0 | -100.0 | 98.8 |
| +40 | 13.560548 | -24 | -1.8 | +100.0 | -100.0 | 98.2 |
| +50 | 13.560564 | -8 | -0.6 | +100.0 | -100.0 | 99.4 |

Test Result: Test passed

8.8.2 Carrier Frequency Stability vs. Supply Voltage



Temperature: +20 °C Battery End Point: Not applicable
 Nominal frequency: 13.560560 MHz

| Supply (V) | Frequency (MHz) | Frequency Tolerance (Hz) | Frequency Tolerance (ppm) | Upper Limit (ppm) | Lower Limit (ppm) | Margin (ppm) |
|------------|-----------------|--------------------------|---------------------------|-------------------|-------------------|--------------|
| 5.25 | 13.560560 | 0 | 0.0 | +100.0 | -100.0 | 100.0 |
| 5.00 | 13.560560 | 0 | 0.0 | +100.0 | -100.0 | 100.0 |
| 4.75 | 13.560556 | -4 | -0.3 | +100.0 | -100.0 | 99.7 |

Test Result: Test passed

8.9 Exposure of Humans to RF Fields

| | |
|---------------------------|---------------------------------|
| Rules and specifications: | IC RSS-Gen Issue 4, section 3.2 |
| Guide: | IC RSS-102 Issue 4, section 2.5 |

| Exposure of Humans to RF Fields | Applicable | Declared by applicant | Measured | Exemption |
|---|------------|-----------------------|--------------------------|--------------------------|
| The antenna is | | | | |
| <input type="checkbox"/> detachable | | | | |
| <p>The conducted output power (CP in watts) is measured at the antenna connector:</p> $CP = \dots\dots\dots \mathbf{W}$ <p>The effective isotropic radiated power (EIRP in watts) is calculated using</p> <p><input type="checkbox"/> the numerical antenna gain: $G = \dots\dots\dots$</p> $EIRP = G \cdot CP \Rightarrow EIRP = \dots\dots\dots \mathbf{W}$ <p><input type="checkbox"/> the field strength⁸ in V/m: $FS = \dots\dots\dots \mathbf{V/m}$</p> $EIRP = \frac{(FS \cdot D)^2}{30} \Rightarrow EIRP = \dots\dots\dots \mathbf{W}$ <p>with:</p> <p>Distance between the antennas in m: $D = \dots\dots\dots \mathbf{m}$</p> | | | <input type="checkbox"/> | <input type="checkbox"/> |
| <input checked="" type="checkbox"/> not detachable | | | | |
| <p>A field strength measurement is used to determine the effective isotropic radiated power (EIRP in watts) given by⁸:</p> $EIRP = \frac{(FS \cdot D)^2}{30} \Rightarrow EIRP = \dots\dots\dots \mathbf{W}$ <p>with:</p> <p>Field strength in V/m: $FS = \dots\dots\dots \mathbf{V/m}$</p> <p>Distance between the two antennas in m: $D = \dots\dots\dots \mathbf{m}$</p> | | | <input type="checkbox"/> | <input type="checkbox"/> |
| Selection of output power | | | | |
| <p>The output power TP is the higher of the conducted or effective isotropic radiated power (e.i.r.p.):</p> $TP = \dots\dots\dots \mathbf{W}$ | | | | |

⁸ The conversion formula is valid only for properly matched antennas. In other cases the transmitter output power may have to be measured by a terminated measurement when applying the exemption clauses. If an open area test site is used for field strength measurement, the effect due to the metal ground reflecting plane should be subtracted from the maximum field strength value in order to reference it to free space, before calculating TP.



| Exposure of Humans to RF Fields (continued) | Applicable | Declared by applicant | Measured | Exemption | | | | | | | |
|--|------------|-------------------------------------|----------|-----------|--|--|--|-------------------------------------|--------------------------|--------------------------|--------------------------|
| Separation distance between the user and the transmitting device is | | | | | | | | | | | |
| <input type="checkbox"/> less than or equal to 20 cm | | <input checked="" type="checkbox"/> | | | | | | | | | |
| <input checked="" type="checkbox"/> greater than 20 cm | | | | | | | | | | | |
| Transmitting device is | | | | | | | | | | | |
| <input type="checkbox"/> in the vicinity of the human head | | <input checked="" type="checkbox"/> | | | | | | | | | |
| <input type="checkbox"/> body-worn | | | | | | | | | | | |
| SAR evaluation | | | | | | | | | | | |
| <p>SAR evaluation is required if the separation distance between the user and the device is less than or equal to 20 cm.</p> <p><input type="checkbox"/> The device operates from 3 kHz up to 1 GHz inclusively and with output power (i.e. the higher of the conducted or equivalent isotropically radiated power (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 200 mW for general public use and 1000 mW for controlled use.</p> <p><input type="checkbox"/>;</p> <p><input type="checkbox"/> The device operates above 1 GHz and up to 2.2 GHz inclusively and with output power (i.e. the higher of the conducted or radiated (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 100 W for general public use and 500 W for controlled use.</p> <p><input type="checkbox"/> The device operates above 2.2 GHz and up to 3 GHz inclusively and with output power (i.e. the higher of the conducted or radiated (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 20 mW for general public use and 100 mW for controlled use.</p> <p><input type="checkbox"/> The device operates above 3 GHz and up to 6 GHz inclusively and with output power (i.e. the higher of the conducted or radiated (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 10 mW for general public use and 50 mW for controlled use.</p> <p><input type="checkbox"/> SAR evaluation is documented in test report no.</p> | | | | | | | | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> | <input type="checkbox"/> |
| RF exposure evaluation | | | | | | | | | | | |
| <p>RF exposure evaluation is required if the separation distance between the user and the device is greater than 20 cm.</p> <p><input checked="" type="checkbox"/> The device operates below 1.5 GHz and the maximum e.i.r.p. of the device is equal to or less than 2.5 W.</p> <p><input type="checkbox"/> The device operates at or above 1.5 GHz and the maximum e.i.r.p. of the device is equal to or less than 5 W.</p> <p><input type="checkbox"/> RF exposure evaluation is documented in test report no.</p> | | | | | | | | <input checked="" type="checkbox"/> | <input type="checkbox"/> | | |

9 Referenced Regulations

All tests were performed with reference to the following regulations and standards:

| | | | |
|-------------------------------------|----------------|---|--|
| <input checked="" type="checkbox"/> | CFR 47 Part 2 | Code of Federal Regulations Part 2 (Frequency allocation and radio treaty matters; General rules and regulations) of the Federal Communication Commission (FCC) | October 1, 2014 |
| <input checked="" type="checkbox"/> | CFR 47 Part 15 | Code of Federal Regulations Part 15 (Radio Frequency Devices) of the Federal Communication Commission (FCC) | October 1, 2014 |
| <input checked="" type="checkbox"/> | ANSI C63.4 | American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz | December 11, 2003 (published on January 30, 2004) |
| <input type="checkbox"/> | ANSI C63.4 | American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz | June 7, 2009 (published on September 15, 2009) |
| <input checked="" type="checkbox"/> | RSS-Gen | Radio Standards Specification RSS-Gen Issue 4 containing General Requirements for Compliance of Radio Apparatus, published by Industry Canada | November 2014 |
| <input checked="" type="checkbox"/> | RSS-210 | Radio Standards Specification RSS-210 Issue 8 for Low Power Licence-Exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment, published by Industry Canada | December 2010 |
| <input type="checkbox"/> | RSS-310 | Radio Standards Specification RSS-310 Issue 3 for Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category II Equipment, published by Industry Canada | December 2010 |
| <input checked="" type="checkbox"/> | RSS-102 | Radio Standards Specification RSS-102 Issue 4: Radio Frequency (RF) Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands), published by Industry Canada | March 2010, footnote 13 updated December 2010 |
| <input type="checkbox"/> | ICES-003 | Interference-Causing Equipment Standard ICES-003 Issue 5 (Information Technology Equipment (ITE) - Limits and methods of measurement), published by Industry Canada | August 2012 |
| <input checked="" type="checkbox"/> | CISPR 22 | Third Edition of the International Special Committee on Radio Interference (CISPR), Pub. 22, "Information Technology Equipment – Radio Disturbance Characteristics – Limits and Methods of Measurement" | 1997 |



| | | | |
|-------------------------------------|------------------------|---|---------------|
| <input type="checkbox"/> | CAN/CSA CISPR 22-10 | Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement (Adopted IEC CISPR 22:2008, sixth edition, 2008-09) | 2010 |
| <input checked="" type="checkbox"/> | TRC-43 | Designation of Emissions, Class of Station and Nature of Service, published by Industry Canada | November 2012 |



10 Test Equipment List with Calibration Data

| Type | Inv.-No. | Type Designation | Serial Number | Manufacturer | Calibration Organization | Last Calibration | Next Calibration |
|--------------------------|----------|------------------|---------------|-----------------|--------------------------|------------------|------------------|
| EMI test receiver | 1028 | ESHS10 | 860043/016 | Rohde & Schwarz | Rohde & Schwarz | 09/2014 | 09/2015 |
| EMI test receiver | 1711 | ESPI7 | 836914/0002 | Rohde & Schwarz | Rohde & Schwarz | 05/2014 | 05/2015 |
| EMI test receiver | 2044 | ESU8 | 100232 | Rohde & Schwarz | Rohde & Schwarz | 10/2014 | 10/2015 |
| Spectrum analyser | 1666 | FSP30 | 100063 | Rohde & Schwarz | Rohde & Schwarz | 05/2014 | 05/2015 |
| V-network | 1059 | ESH3-Z5 | 894785/005 | Rohde & Schwarz | Rohde & Schwarz | 08/2013 | 08/2015 |
| Loop antenna | 1016 | HFH2-Z2 | 882964/0001 | Rohde & Schwarz | Rohde & Schwarz | 05/2014 | 05/2015 |
| TRILOG Broadband Antenna | 2256 | VULB 9162 | 9162-048 | Schwarzbeck | Schwarzbeck | 09/2013 | 03/2015 |
| Multimeter | 1975 | Fluke 77 III | 92370108 | Fluke | ZMK | 08/2013 | 08/2015 |
| Temperature test chamber | 1271 | HT 4010 | 07065550 | Heraeus | TÜV SÜD PS-EMC-STR | 06/2013 | 06/2015 |
| DC power supply | 1267 | NGSM 32/10 | 203 | Rohde & Schwarz | | see note 4 | |

Note 1: No calibration required.

Note 2: Not calibrated separately but with the whole test system when recording calibration data.

Note 3: No calibration required. Devices are checked before use.

Note 4: No calibration required. Devices are checked by calibrated equipment during test.

11 Revision History

| Revision History | | | |
|------------------|-------------|------------------|----------------------|
| <i>Edition</i> | <i>Date</i> | <i>Issued by</i> | <i>Modifications</i> |
| 1 | 2015-02-26 | M. Steindl(as) | First Edition |