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February 12, 2014

Prüfbericht / *Test Report* Nr. / *No.* TR73325-23063-4e (Edition 1)

Applicant:	freaquent froschelectronics GmbH
Type of equipment:	RFID Reader
Type designation:	SLRM1000
Order No.:	---
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 3, Sections 7.2.2, 7.2.4 and 7.2.5 and RSS-210 Issue 8, Section A2.6 (Category I Equipment)

Table of Contents

1 Description of the Equipment Under Test (EUT)

General data of EUT	
Type designation[1]:	SLRM1000
Parts[2]:	Reader, External antenna
Serial number(s):	Testsample 13
Manufacturer:	freaquent froschelectronic GmbH
Type of equipment:	RFID Reader
Version:	As received, with modifications according to documentation of applicant.
FCC ID:	2ACK5-SLRM1000-16

[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:	13.110 - 14.010 MHz
Frequency range:	13.56 MHz
Operating frequency:	13.56 MHz
Type of modulation:	ASK
Pulse train:	---
Pulse width:	---
Number of RF-channels:	1
Channel spacing:	---
Designation of emissions[3]:	5K00A1D
Type of antenna:	16 antenna connectors
Size/length of antenna:	Ø 8.5 cm to 41 cm x 32 cm
Connection of antenna:	☒ detachable ☐ not detachable
Type of power supply:	AC supply
Specifications for power supply:	nominal voltage: 110 V minimum voltage: 93.5 V maximum voltage: 126.5 V nominal frequency: 60 Hz

[3] Also known as "Class of Emission".

2 Administrative Data

Application details	
Applicant (full address):	freaquent froschelectronics GmbH Münzgrabengürtel 10 A-8010 Graz
Contact person:	Mr. Helmut Köberl
Order number:	---
Receipt of EUT:	2014-10-08
Date(s) of test:	2013-11-13 and 2014-01-28 to 2014-02-10
Note(s):	Mr. Helmut Köberl, representing the applicant attended tests on 2014-01-28 to 2014-01-30

Report details	
Report number:	TR73325-23063-4e
Edition:	1
Issue date:	2014-02-12

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 3, Sections 7.2.2, 7.2.4 and 7.2.5 and** **RSS-210 Issue 8, Section , A2.6 (Category I Equipment)** of Industry Canada (IC).

Personnel involved in this report	
Laboratory Manager:	 Mr. Johann Roidt
Responsible for testing:	 Mr. Martin Steindl
Responsible for test report:	Mr. Martin Steindl

5 Operation Mode and Configuration of EUT

Operation Mode(s)
Reading tags continuously with smallest and biggest antenna.

Configuration(s) of EUT
The EUT was configured as interface device of a laptop PC. The EUT was configured with the biggest and smallest antenna. The carrier power was 2 W for the smallest antenna and 6 W for the biggest antenna.

List of devices connected to EUT

Item	*Description*	*Type Designation*	*Serial no. or ID*	*Manufacturer*
1	Antenna [4]	1D_C_85 (Ø 8.5 cm)		freaquent
2	Antenna [5]	1D_SL_320x410 (41 cm x 32 cm)		freaquent

List of support devices

Item	*Description*	*Type Designation*	*Serial no. or ID*	*Manufacturer*
1	Switching power supply	IPU31-107	SO1661691333	SINPRO

List of ports and cables

Port	*Description*	*Classification*[6]	*Cable type*	*Cable length*
1	AC supply of AC/DC adapter	dc power	Unshielded	2 m
2	DC supply of EUT	dc power	Unshielded	2 m
3	Service interface	signal/control port	Unshielded	Not connected
4	USB	signal/control port	Shielded	2 m
5	Ethernet	signal/control port	Shielded	2 m
6	RS-232	signal/control port	Shielded	2 m
7	Antenna port 1	signal/control port	Shielded	--- [7]

[4] Smallest antenna, as specified by applicant.
[5] Biggest antenna, as specified by applicant.
[6] Ports shall be classified as ac power, dc power or signal/control port
[7] Not connected, see port 22 for details.

List of ports and cables

Port	*Description*	*Classification*[6]	*Cable type*	*Cable length*
8	Antenna port 2	signal/control port	Shielded	--- [7]
9	Antenna port 3	signal/control port	Shielded	--- [7]
10	Antenna port 4	signal/control port	Shielded	--- [7]
11	Antenna port 5	signal/control port	Shielded	--- [7]
12	Antenna port 6	signal/control port	Shielded	--- [7]
13	Antenna port 7	signal/control port	Shielded	--- [7]
14	Antenna port 8	signal/control port	Shielded	--- [7]
15	Antenna port 9	signal/control port	Shielded	--- [7]
16	Antenna port 10	signal/control port	Shielded	--- [7]
17	Antenna port 11	signal/control port	Shielded	--- [7]
18	Antenna port 12	signal/control port	Shielded	--- [7]
19	Antenna port 13	signal/control port	Shielded	--- [7]
20	Antenna port 14	signal/control port	Shielded	--- [7]
21	Antenna port 15	signal/control port	Shielded	--- [7]
22	Antenna port16	signal/control port	Shielded	1 m

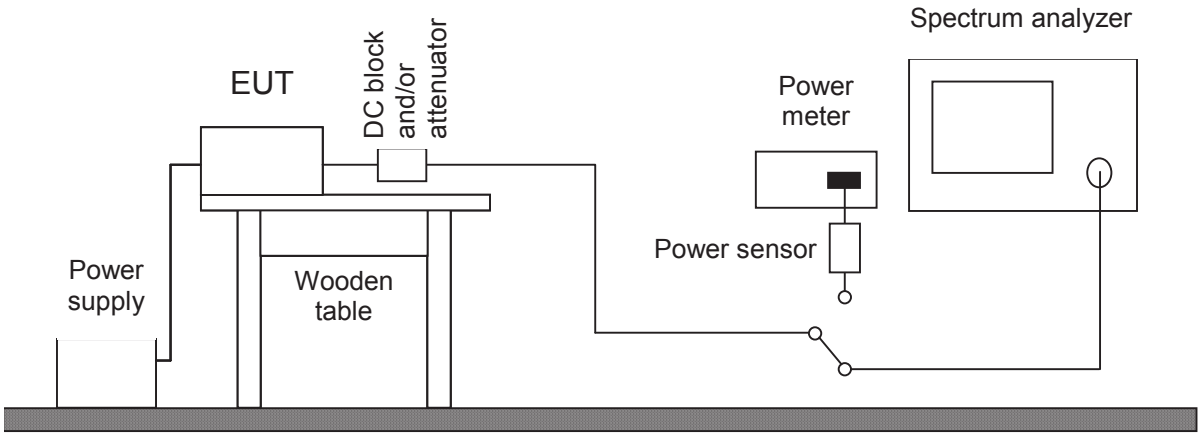
6 Measurement Procedures

6.1 Conducted Output Power

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 2, section 2.1046(a) IC RSS-Gen Issue 3, section 4.8
Guide:	CFR 47 Part 2, section 2.1046 / IC RSS-Gen Issue 3

Conducted output power is measured at the RF output terminals (e.g. antenna connector if antenna is detachable) when the transmitter is adjusted in accordance with the tune-up procedure, if applicable. The RF output terminals are connected to a spectrum analyzer and/or a power meter with appropriate sensor. 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.

If a spectrum analyzer is used and no other settings are specified resolution bandwidth shall be selected according to the carrier frequency f_c and set to 10 kHz (150 kHz $\leq f_c <$ 30 MHz), 100 kHz (30 MHz $\leq f_c <$ 1 GHz) or 1 MHz ($f_c \geq$ 1 GHz). The video bandwidth shall be at least three times greater than the resolution bandwidth. The settings used have to be indicated within the appropriate test record(s).



Test instruments used:

	Type	*Designation*	*Inv.-no.*	*Serial No. or ID*	*Manufacturer*
☐	Spectrum analyzer	FSP30	1666	100063	Rohde & Schwarz
☐	EMI test receiver	ESPI7	1711	836914/0002	Rohde & Schwarz
☐	EMI test receiver	ESMI	1569	839379/013 839587/006	Rohde & Schwarz
☒	Power meter	NRVS	1502	838624/016	Rohde & Schwarz
☒	Peak power sensor	NRV-Z31	1701	8579604.03	Rohde & Schwarz
☐	Power sensor	NRV-Z52	1499	837901/030	Rohde & Schwarz
☐	Power sensor	NRV-Z4	1034	863828/015	Rohde & Schwarz
☐	DC-block	7006	1636	A2798	Weinschel
☒	Attenuator	4776-10	1638	9412	Narda
☒	Attenuator	4776-20	1639	9503	Narda

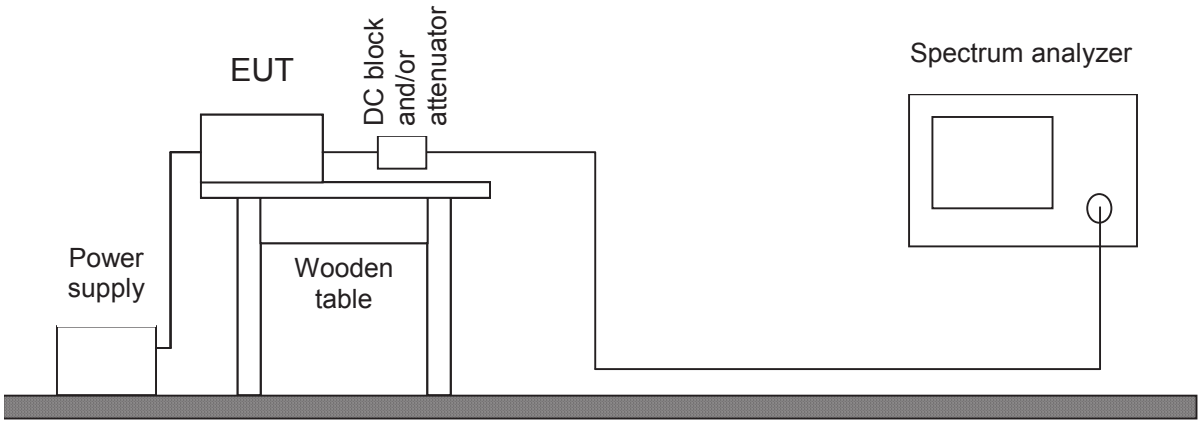
6.2 Bandwidth Measurements

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 3, sections 4.6.1 and 4.6.2 IC RSS-210 Issue 8, section A1.1.3 ANSI C63.4, annex H.6
Guide:	ANSI C63.4 / IC RSS-Gen Issue 3, sections 4.6.1 and 4.6.2
Measurement setup:	☒ Conducted: See below ☐ Radiated: Radiated Emission Measurement 9 kHz to 30 MHz (6.4)

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.

If radiated measurements are performed the same test setups and instruments are used as with radiated emission measurements for the appropriate frequency range.

The analyzer settings are specified by the test description of the appropriate test record(s).



Test instruments used for conducted measurements:

	Type	*Designation*	*Inv.-no.*	*Serial No. or ID*	*Manufacturer*
☐	Spectrum analyzer	FSP30	1666	100036	Rohde & Schwarz
☒	EMI test receiver	ESPI7	1711	836914/0002	Rohde & Schwarz
☐	EMI test receiver	ESMI	1569	839379/013 839587/006	Rohde & Schwarz
☐	Power meter	NRVS	1264	836856/015	Rohde & Schwarz
☐	Peak power sensor	NRV-Z31	1701	8579604.03	Rohde & Schwarz
☐	Power sensor	NRV-Z52	1499	837901/030	Rohde & Schwarz
☐	Power sensor	NRV-Z4	1034	863828/015	Rohde & Schwarz
☐	DC-block	7006	1636	A2798	Weinschel
☐	Attenuator	4776-10	1638	9412	Narda
☐	Attenuator	4776-20	1639	9503	Narda
☒	Attenuator	RDL 50	1570	848300/011	Rohde & Schwarz

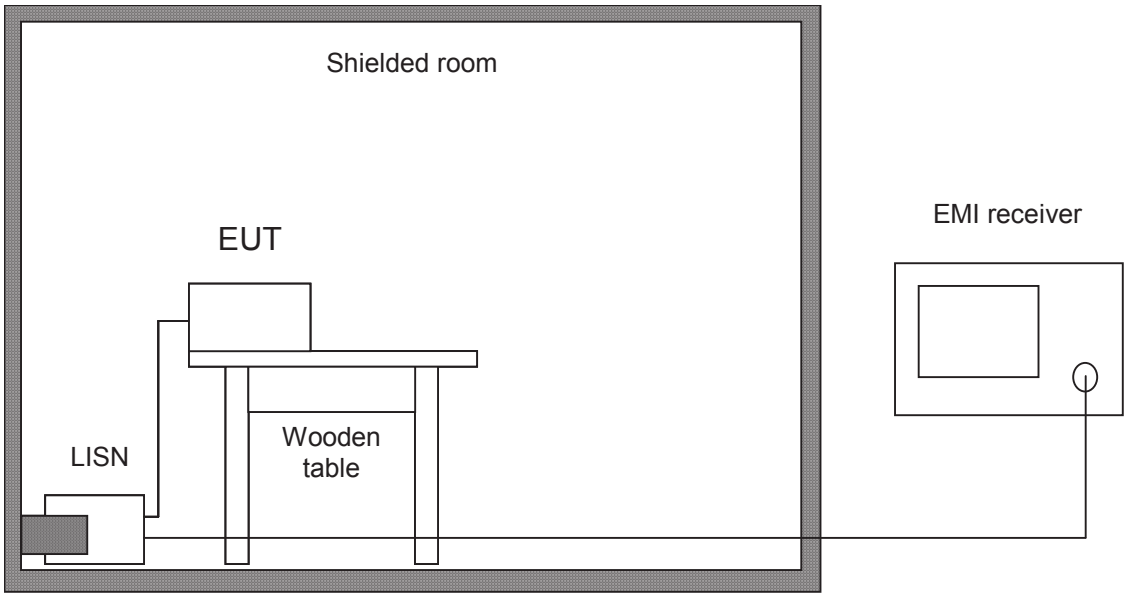
6.3 Conducted AC Powerline Emission

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 15, section 15.207 IC RSS-Gen Issue 3, section 7.2.4
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*
☒	Test receiver	ESHS 10	1028	860043/016	Rohde & Schwarz
☒	V-network	ESH 3-Z5	1059	894785/005	Rohde & Schwarz
☐	V-network	ESH 3-Z5	1218	830952/025	Rohde & Schwarz
☐	Artificial mains network	ESH 2-Z5	1536	842966/004	Rohde & Schwarz
☐	Shielded room	No. 1	1451	---	Albatross
☒	Shielded room	No. 4	1454	3FD 100 544	Euroshield

6.4 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 3, sections 7.2.2 and 7.2.5 and IC RSS-210 Issue 8, section A2.6
Guide:	ANSI C63.4

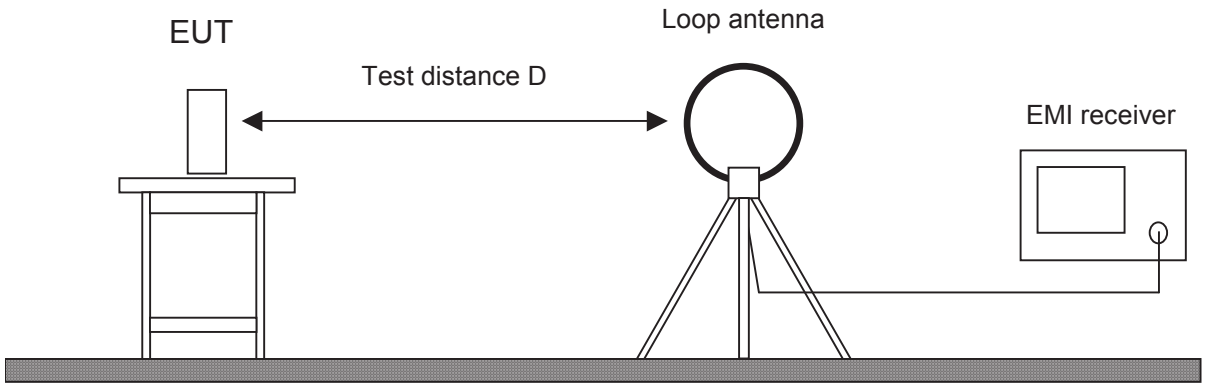
Radiated emission in the frequency range 9 kHz to 30 MHz is measured using an active loop antenna. First the whole spectrum of emission caused by the equipment is recorded at a distance of 3 meters in a fully or semi anechoic room with the detector of the spectrum analyzer or EMI receiver set to peak. This configuration is also used for recording the spectrum of intentional radiators.

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

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

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

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



Test instruments used:

	Type		*Designation*	*Inv.-no.*	*Serial No. or ID*	*Manufacturer*
☐	Spectrum analyzer		FSP30	1666	100036	Rohde & Schwarz
☐	EMI test receiver		ESMI	1569	839379/013 839587/006	Rohde & Schwarz
☐	EMI test receiver		ESU8	2044	100232	Rohde & Schwarz
☒	EMI test receiver		ESU26	R&S	1302-605K26-100504-Wh	Rohde & Schwarz
☐	Test receiver		ESHS 10	1028	860043/016	Rohde & Schwarz
☐	Preamplifier	Cabin no. 2	CPA9231A	1716	3557	Schaffner
☒	Loop antenna		HFH2-Z2	1016	882964/1	Rohde & Schwarz
☐	Fully anechoic room		No. 2	1452	---	Albatross
☐	Semi anechoic room		No. 3	1453	---	Siemens
☒	Semi anechoic room		No. 8	2057	---	Albatross

6.5 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 3, sections 7.2.2(b)(c) and 7.2.5 and IC RSS-210 Issue 8, section A2.6
Guide:	ANSI C63.4

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

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

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

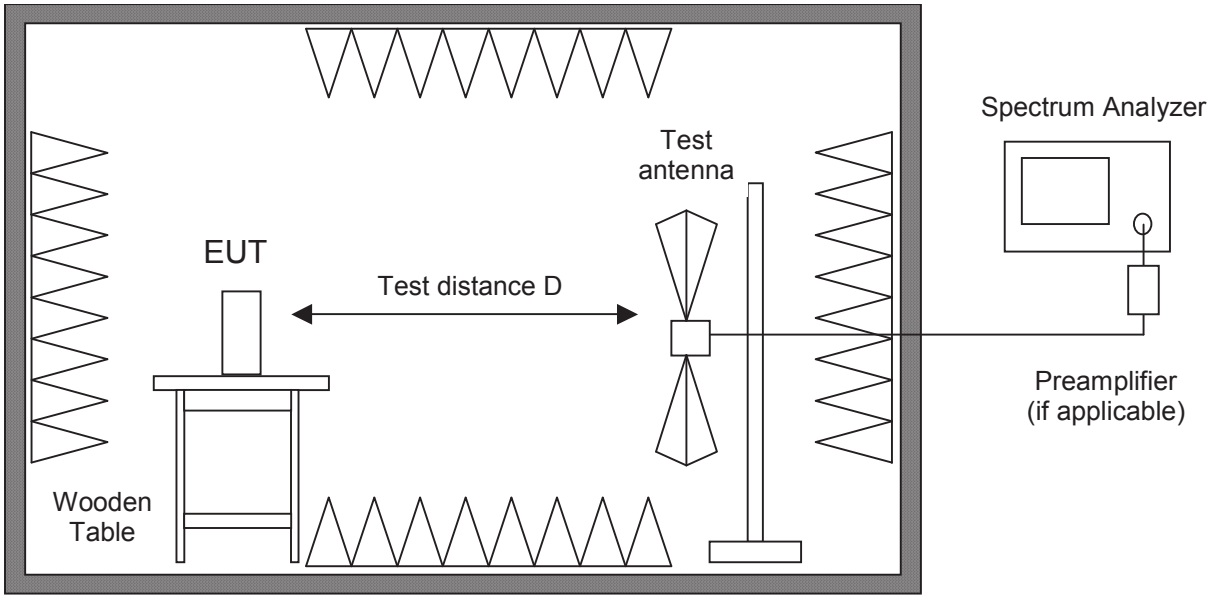
All tests below 8.2 GHz are performed at a test distance D of 3 meters. For higher frequencies the test distance may be reduced (e.g. to 1 meter) due to the sensitivity of the measuring instrument(s) and the test results are calculated according to CFR 47 Part 15 section 15.31(f)(1) using an extrapolation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

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

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

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

For final testing below 1 GHz a semi anechoic room complying with the NSA requirements of ANSI C63.4 for alternative test sites is used (see 6.6). If prescans are recorded in fully anechoic room they are indicated appropriately.



Fully or semi anechoic room

Test instruments used:

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

6.6 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 3, sections 7.2.2(b)(c) and 7.2.5 and IC RSS-210 Issue 8, section A2.6
Guide:	ANSI C63.4

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

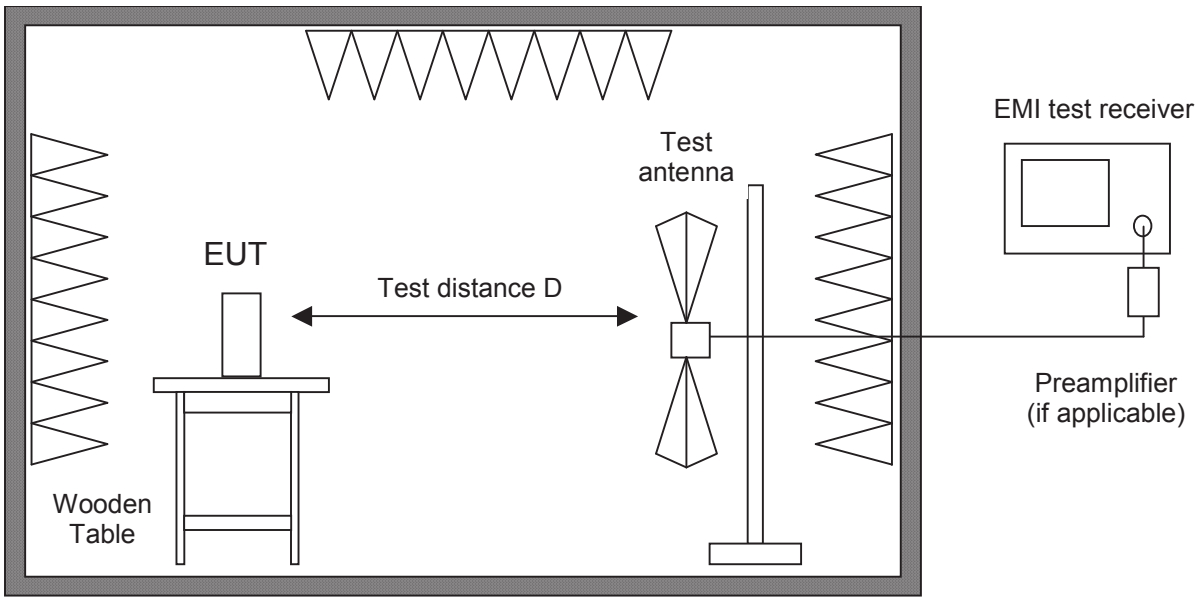
If the radiated emission limits are expressed in terms of the average value of the emission there also is a peak limit corresponding to 20 dB above the maximum permitted average limit. Additionally, if pulsed operation is employed, the average field strength is determined by averaging over one complete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

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

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

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

For measuring emissions of intentional radiators and receivers a test distance D of 3 meters is selected. Testing of unintentional radiators is performed at a distance of 10 meters. If limits specified for 3 meters shall be used for measurements performed at 10 meters distance the limits are calculated according to CFR 47 Part 15 section 15.31(d) and (f)(1) using an inverse linear-distance extrapolation factor of 20 dB/decade.



Alternate test site (semi anechoic room)

Test instruments used:

	Type		*Designation*	*Inv.-no.*	*Serial No. or ID*	*Manufacturer*
☐	EMI test receiver		ESU8	2044	100232	Rohde & Schwarz
☒	EMI test receiver		ESU26	R&S	100504	Rohde & Schwarz
☒	Trilog antenna	Cabin no. 8	VULB 9163	2058	9163-408	Schwarzbeck
☒	Semi anechoic room		No. 8	2057	---	Albatross

6.7 Carrier Frequency Stability

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 15, section 15.225(e) IC RSS-Gen Issue 3, section 4.7 and IC RSS-210 Issue 8, section A2.6
Guide:	ANSI C63.4

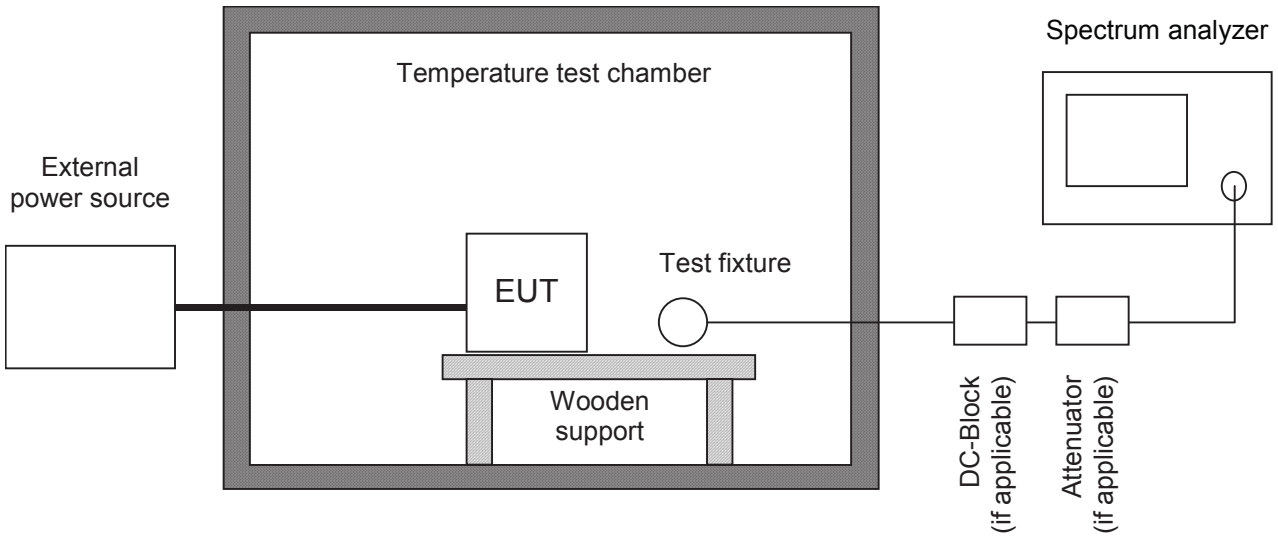
The frequency tolerance of the carrier signal is measured over a temperature variation of -20 °C to +50 °C at normal supply voltage, and for a variation in the primary supply voltage from 85% to 115% of the rated supply voltage at a temperature of 20 °C.

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.



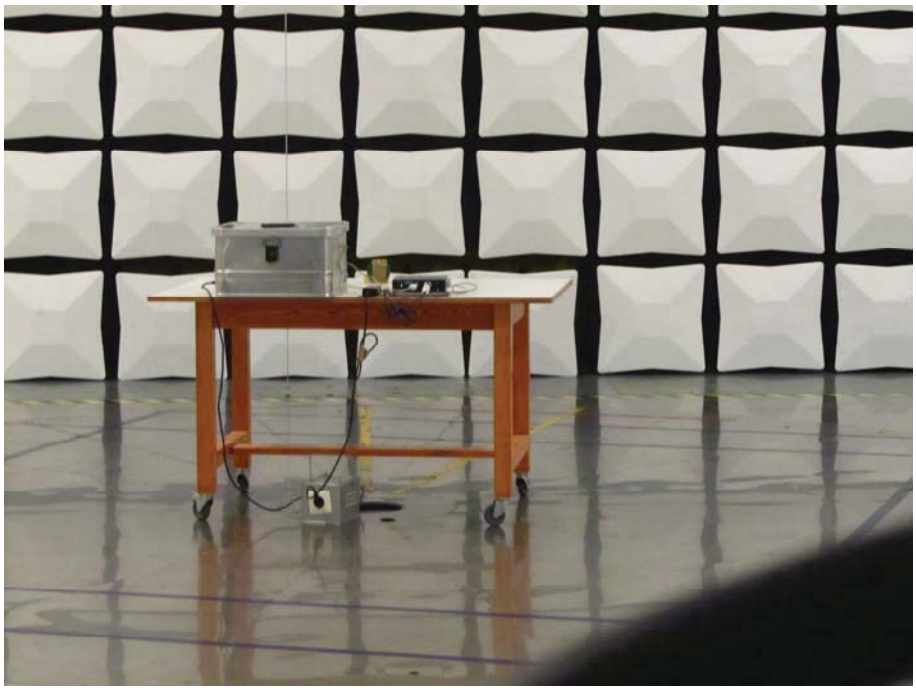
Test instruments used:

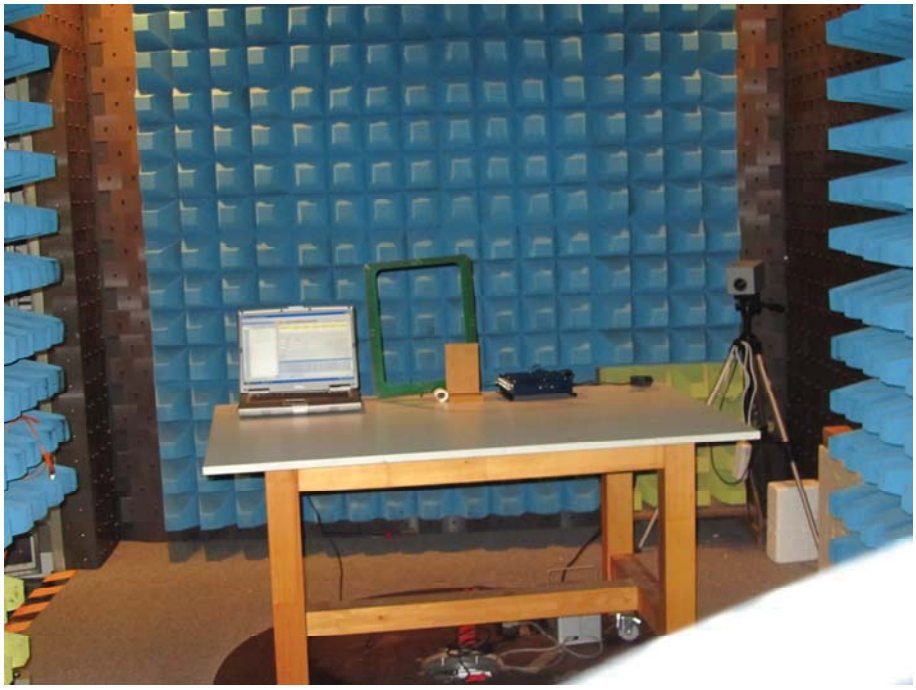
	Type	*Designation*	*Inv.-no.*	*Serial No. or ID*	*Manufacturer*
☐	Spectrum analyzer	FSP30	1666	100036	Rohde & Schwarz
☒	EMI test receiver	ESPI7	1711	836914/0002	Rohde & Schwarz
☐	EMI test receiver	ESMI	1569	839379/013 839587/006	Rohde & Schwarz
☐	DC-block	7006	1636	A2798	Weinschel
☐	Attenuator	4776-10	1638	9412	Narda
☐	Attenuator	4776-20	1639	9503	Narda
☒	Attenuator	RDL 50	1570	848300/011	Rohde & Schwarz
☐	Test probe	TP 01	1628	001	TÜV SÜD PS
☐	Multimeter	21 III	1653	76530546	Fluke
☐	Multimeter	21 III	1654	76381229	Fluke
☐	Multimeter	Fluke 77 III	1975	92370108	Fluke
☐	Multimeter	Fluke 77 IV	1976	93090238	Fluke
☐	Multimeter	Fluke 177	2025	96720024	Fluke
☒	Multimeter	Fluke 177	2026	96720025	Fluke
☐	DC power supply	NGSM 32/10	1267	203	Rohde & Schwarz
☒	Isolating transformer	RT 5A	1127	10387	Grundig
☐	Isolating transformer	RT 5A	1128	10416	Grundig
☒	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





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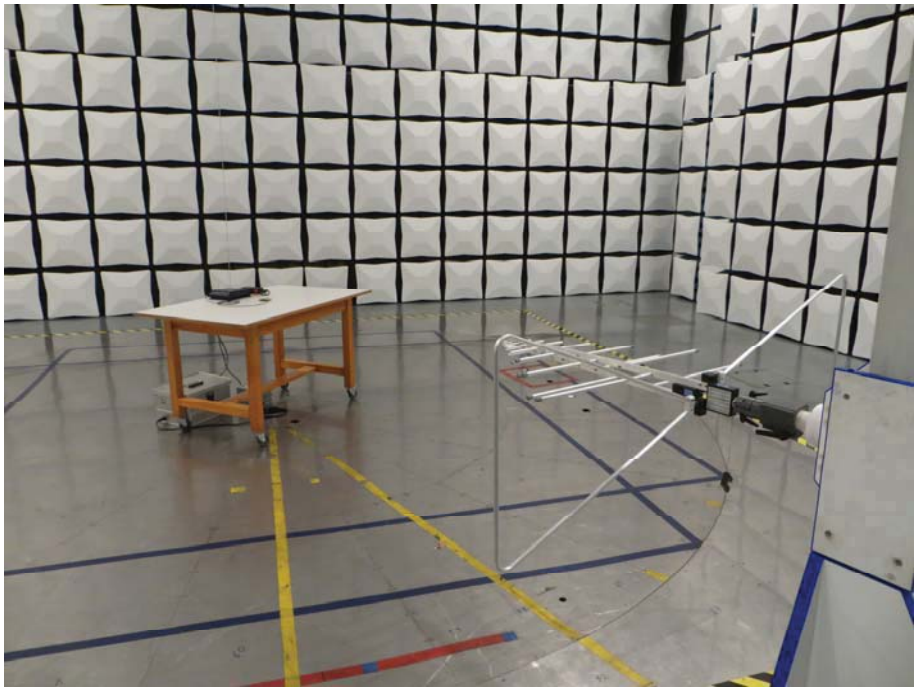
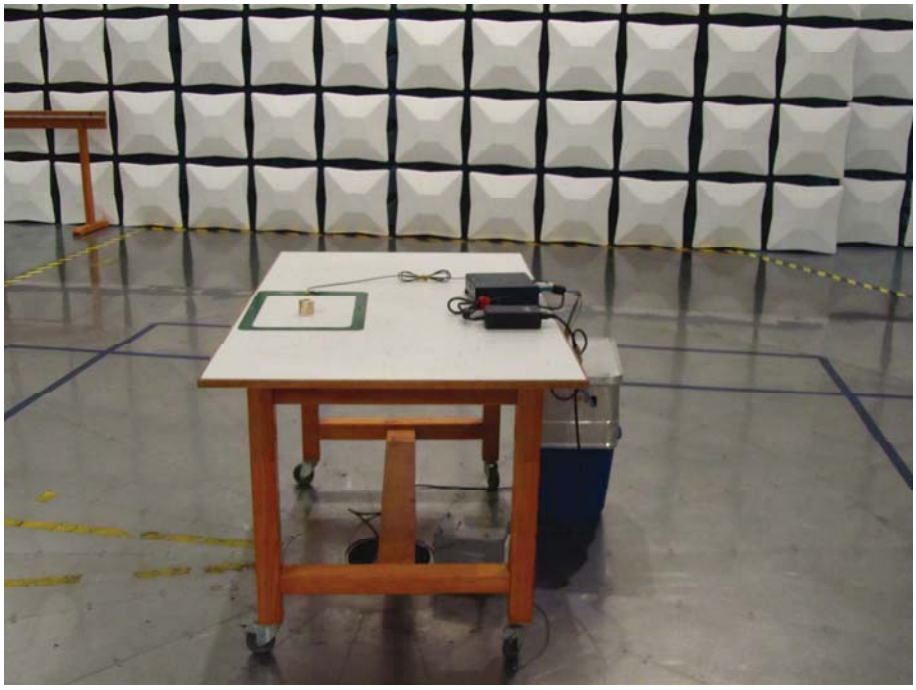
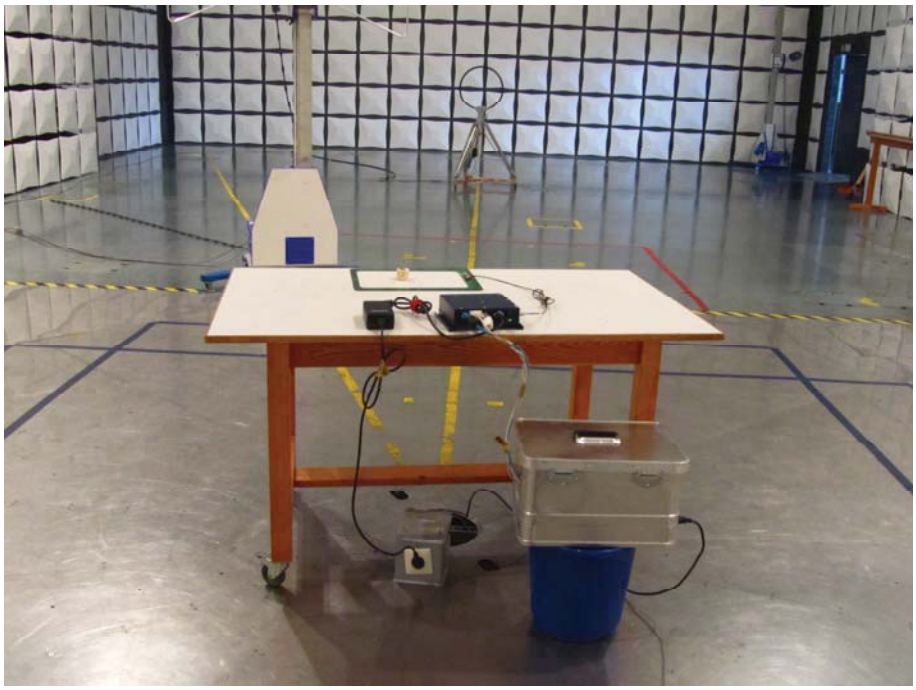
Test setup for radiated emission measurement (alternate test site)



Test setup for radiated emission measurement (alternate test site) - continued -

Test setup for radiated emission measurement (alternate test site) - continued -





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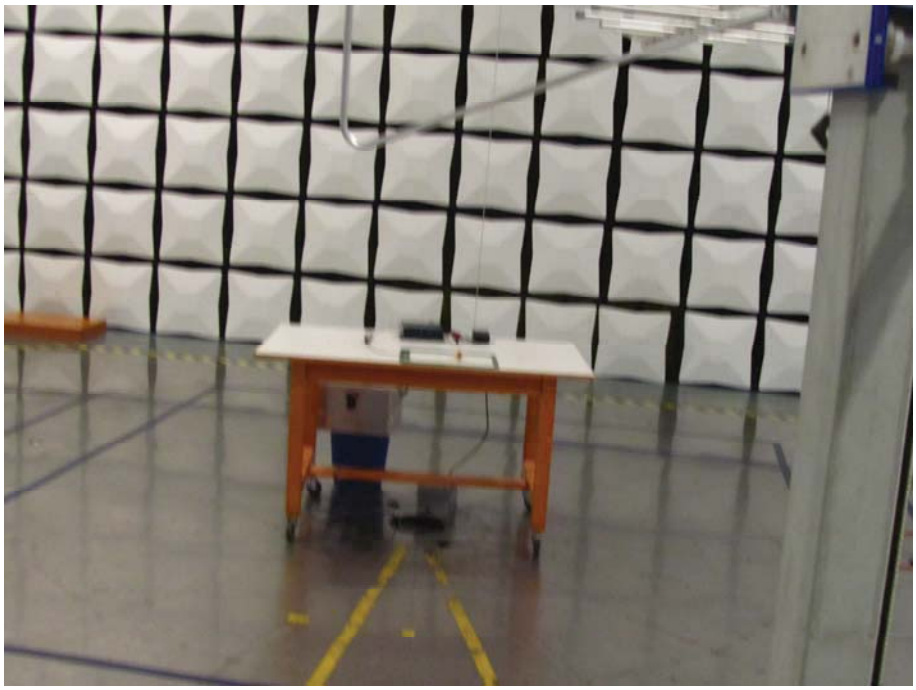
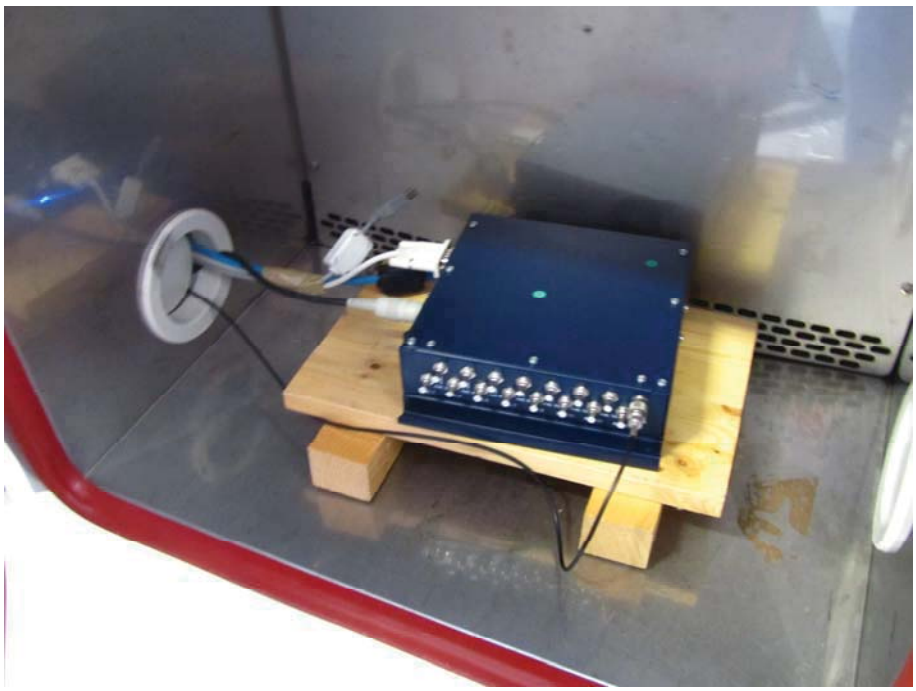
Test setup for radiated emission measurement (alternate test site) - continued -



Test setup for carrier frequency stability measurement



8 Test Results

FCC CFR 47 Parts 2 and 15			
Section(s)	*Test*	*Page*	*Result*
2.1046(a)	Conducted output power	34	Recorded
2.202(a)	Occupied bandwidth	36	Recorded
15.215(c)	Bandwidth of the emission	40	Test passed
2.201, 2.202	Class of emission	42	Calculated
15.35(c)	Pulse train measurement for pulsed operation	---	Not applicable
15.205(a) 15.205(d)(7)	Restricted bands of operation	---[8]	Test passed
15.207	Conducted AC powerline emission 150 kHz to 30 MHz	43	Test passed
15.225(a)-(d)	Spectrum Mask	48	Test passed
15.205(b) 15.215(b) 15.225(a)(d)	Radiated emission 9 kHz to 30 MHz	50	Test passed
15.205(b) 15.225(d)	Radiated emission 30 MHz to 1 GHz	53	Test passed
15.225(e)	Carrier frequency stability	57	Test passed

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

IC RSS-GEN Issue 3			
Section(s)	*Test*	*Page*	*Result*
4.8	Transmitter output power (conducted)	34	Recorded
4.6.1	Occupied Bandwidth	36	Recorded
8	Designation of emissions	42	Calculated
4.5	Pulsed operation	---	Not applicable
2.2(a)	Restricted bands and unwanted emission frequencies	---[9]	Test passed
7.2.2(b)(c) 7.2.5	Unwanted emissions 9 kHz to 30 MHz	50	Test passed
2.2(b)(c) 7.2.5	Unwanted emissions 30 MHz to 1 GHz	53	Test passed
7.2.2	Transmitter AC power lines conducted emissions 150 kHz to 30 MHz	43	Test passed
5.5	Exposure of Humans to RF Fields	60	Exempted from SAR and RF evaluation

IC RSS-210 Issue 8			
Section(s)	*Test*	*Page*	*Result*
A2.6	Spectrum Mask	48	Test passed
A2.6	Unwanted emissions 9 kHz to 30 MHz	50	Test passed
A2.6	Unwanted emissions 30 MHz to 1 GHz	53	Test passed
A2.6	Carrier frequency stability	57	Test passed

[9] See "Spectrum Mask" and "Unwanted emissions".

8.1 Conducted Output Power

Rules and specifications:	CFR 47 Part 2, section 2.1046(a) IC RSS-Gen Issue 3, section 4.8
Guide:	CFR 47 Part 2, section 2.1046 / IC RSS-Gen Issue 3
Description:	Conducted output power shall be measured at the RF output terminals (e.g. antenna connector if antenna is detachable) when the transmitter is adjusted in accordance with the tune-up procedure, if applicable. The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.
Measurement procedure:	Conducted Output Power (6.1)

Comment:	Transmitting continuously with nominal 6 W.
Date of test:	2014-01-30
Test site:	Unshielded room

Test Result:	Test passed

Antenna gain: dBi

Mode	Frequency (MHz)	Power Type	Reading (dBm)	Correction (dB)	Output Power (dBm)	Limit (dBm)	Margin (dB)
1	13,56	PEP	7,5	30,0	37,5		
2	13,56	PEP	7,5	30,0	37,5		
3	13,56	PEP	7,5	30,0	37,5		
4	13,56	PEP	7,5	30,0	37,5		
5	13,56	PEP	7,6	30,0	37,6		
6	13,56	PEP	7,6	30,0	37,6		
7	13,56	PEP	7,6	30,0	37,6		
8	13,56	PEP	7,6	30,0	37,6		
9	13,56	PEP	7,9	30,0	37,9		
10	13,56	PEP	7,6	30,0	37,6		
11	13,56	PEP	7,6	30,0	37,6		
12	13,56	PEP	7,6	30,0	37,6		
13	13,56	PEP	7,6	30,0	37,6		
14	13,56	PEP	7,6	30,0	37,6		
15	13,56	PEP	7,6	30,0	37,6		
16	13,56	PEP	7,6	30,0	37,6		

Note 1: If applicable, PEP (peak envelope power) and RMS values are measured using a power meter with appropriate sensor.
Note 2: If applicable, peak or average values are measured using a spectrum analyzer with resolution and video bandwidth set to: RBW = ..., VBW = ...

Note 3: If transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power limit is reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

8.2 Occupied Bandwidth

Rules and specifications:	CFR 47 Part 2, section 2.202(a) ANSI C63.4, annex H.6
Guide:	ANSI C63.4
Description:	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. 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. 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:

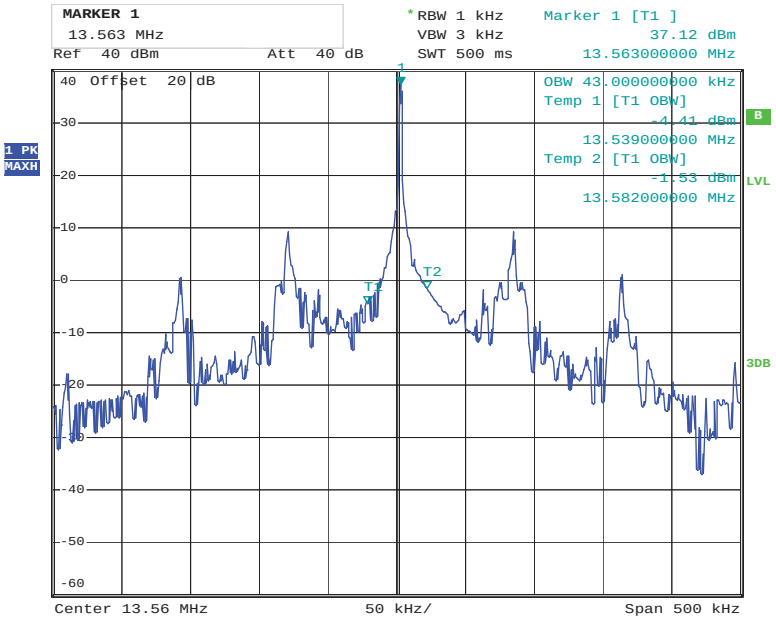
Fundamental frequency	Minimum resolution bandwidth
9 kHz to 30 MHz	1 kHz
30 MHz to 1000 MHz	10 kHz
1000 MHz to 40 GHz	100 kHz

The video bandwidth shall be at least three times greater than the resolution bandwidth.

Measurement procedure:	Bandwidth Measurements (6.2)

Comment:	
Date of test:	2014-01-30
Test site:	Unshielded Room

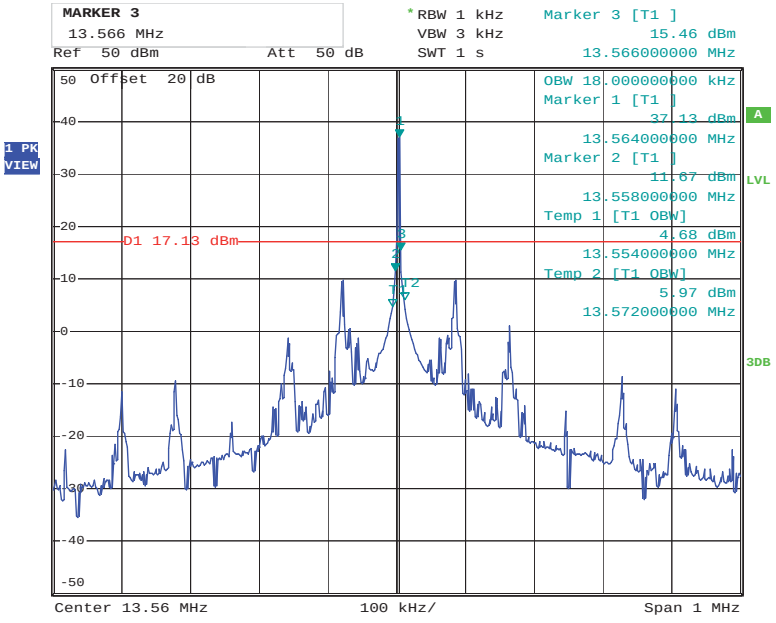
Occupied Bandwidth (99 %):



Date: 30.JAN.2014 11:40:48

Occupied Bandwidth (99 %):	**43.0 kHz**

Prescan bandwidth measurements:



Date: 30.JAN.2014 11:36:12

Occupied Bandwidth (continued)

Rules and specifications:	IC RSS-Gen Issue 3, section 4.6.1
Guide:	IC RSS-Gen Issue 3, section 4.6.1
Description:	If not specified in the applicable RSS the occupied bandwidth is measuredas the 99% emission bandwidth. 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. 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.
Measurement procedure:	Bandwidth Measurements (6.2)

Comment:	
Date of test:	2014-01-30
Test site:	Unshielded Room

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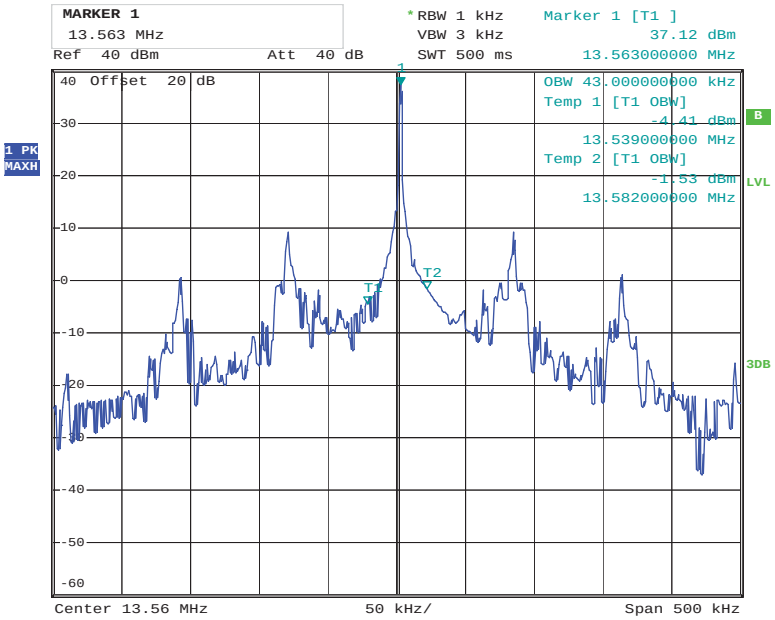
Occupied Bandwidth (99 %):



Occupied Bandwidth (99 %):	**43.0 kHz**

8.3 Bandwidth of the Emission

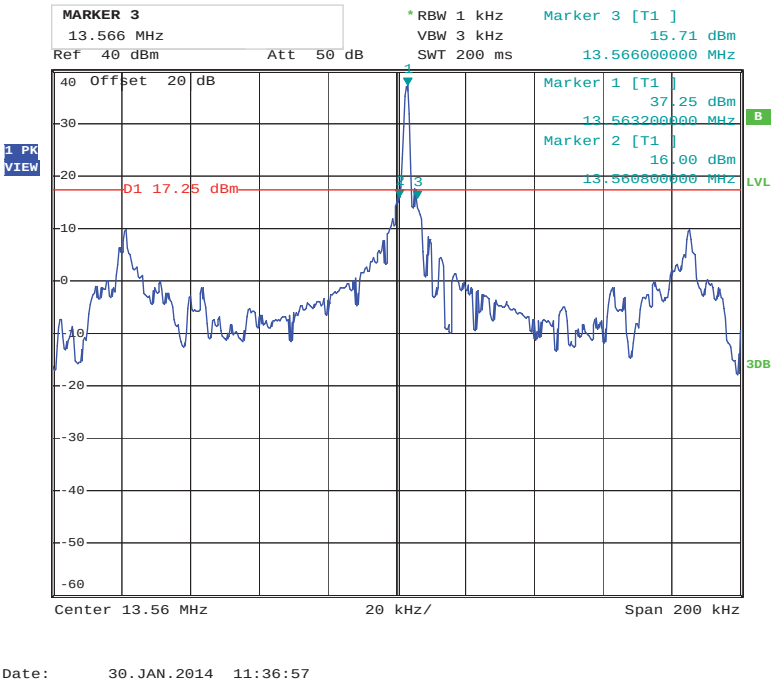
Rules and specifications:	CFR 47 Part 15, section 15.215(c)
Guide:	ANSI C63.4
Description:	The 20 dB bandwidth of the emission is measured as the frequency range defined by the points that are 20 dB down relative to the maximum level of the modulated carrier. For intentional radiators operating under 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. 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:

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 (6.2)

Comment:	
Date of test:	2014-01-30
Test site:	Fully anechoic room, cabin no. 2



Permitted frequency band:	**13.110 - 14.010 MHz**	
20 dB bandwidth:	**5.2 kHz**	
Carrier frequency stability: Maximum frequency tolerances:	☒ **specified** **+0.209 kHz** **-0.103 kHz**	☐ **not specified**
Bandwidth of the emission:	**5.51 kHz**	**within permitted frequency band[10]:** ☒ **yes** ☐ **no**

Test Result:	Test passed

[10] 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.

8.4 Designation of Emissions

Rules and specifications:	CFR 47 Part 2, sections 2.201 and 2.202 IC RSS-Gen Issue 3, sections 8
Guide:	ANSI C63.4 / TRC-43

Type of modulation:	Amplitude Modulation

B_n = Necessary Bandwidth	B_n = 2BK
B = Modulation rate	B = 2.5 kHz
K = Overall numerical factor	K = 1
Calculation:	$B_n = 2 \cdot (2.5\ kHz) \cdot 1 = 5\ kHz$

Designation of Emissions:	**5K00A1D**

8.5 Conducted Powerline Emission Measurement 150 kHz to 30 MHz

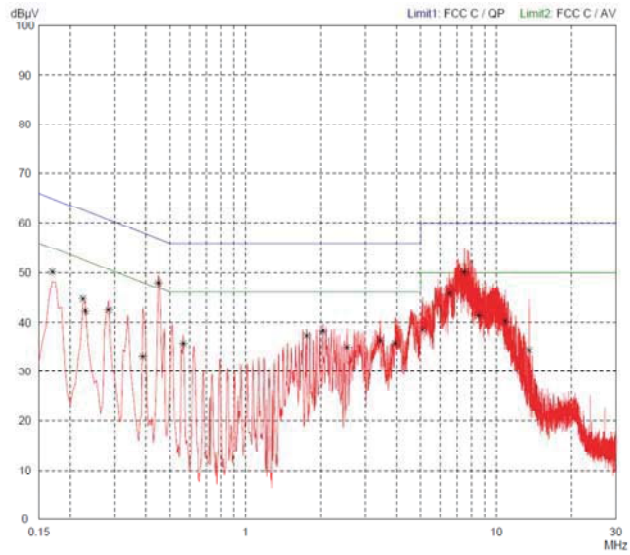
Rules and specifications:	CFR 47 Part 15, section 15.207 IC RSS-GEN Issue 3, section 7.2.4		
Guide:	ANSI C63.4 / CISPR 22		
Limit:	Frequency of Emission (MHz)	Conducted Limit (dBµV)	
		Quasi-peak	Average
	0.15 - 0.5	66 to 56	56 to 46
	0.5 - 5	56	46
	5 - 30	60	50
Measurement procedure:	Conducted AC Powerline Emission (6.3)		

Comment:	With dummy load connected to the antenna output terminal
Date of test:	2014-01-30
Test site:	Shielded room, cabin no. 1

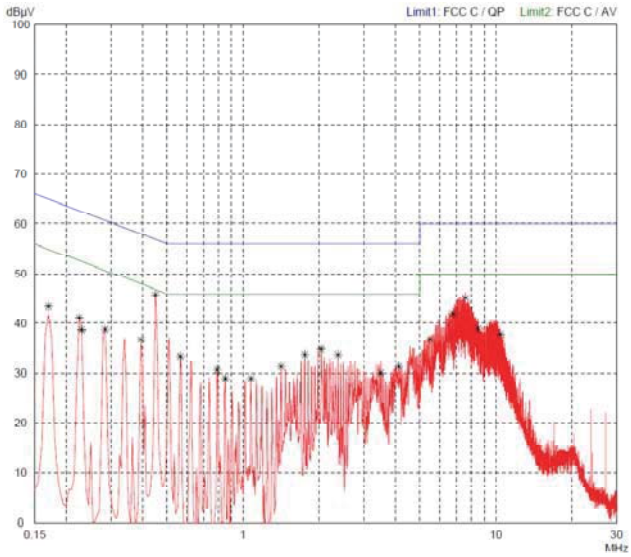
Test Result:	Test passed

Tested on:	L1

Frequency (MHz)	Detector	Reading Value (dBµV)	Correction Factor (dB)	Final Value (dBµV)	Limit (dBµV)	Margin (dB)
0.170	Quasi-Peak	50.2	0.0	50.2	65.0	14.8
0.170	Average	43.4	0.0	43.4	55.0	11.6
0.225	Quasi-Peak	44.7	0.0	44.7	62.6	17.9
0.225	Average	41.2	0.0	41.2	52.6	11.4
0.230	Quasi-Peak	42.2	0.0	42.2	62.4	20.2
0.230	Average	38.7	0.0	38.7	52.4	13.7
0.285	Quasi-Peak	42.5	0.0	42.5	60.7	18.2
0.285	Average	38.8	0.0	38.8	50.7	11.9
0.390	Quasi-Peak	33.0	0.0	33.0	58.1	25.1
0.395	Average	36.7	0.0	36.7	48.0	11.3
0.450	Quasi-Peak	48.0	0.0	48.0	56.9	8.9
0.450	Average	45.8	0.0	45.8	46.9	**1.1**
0.565	Quasi-Peak	35.6	0.0	35.6	56.0	20.4
0.565	Average	33.4	0.0	33.4	46.0	12.6
0.790	Average	30.6	0.0	30.6	46.0	15.4
0.850	Average	28.9	0.0	28.9	46.0	17.1
1.075	Average	28.9	0.0	28.9	46.0	17.1
1.415	Average	31.2	0.0	31.2	46.0	14.8
1.755	Quasi-Peak	37.2	0.0	37.2	56.0	18.8
1.755	Average	33.8	0.0	33.8	46.0	12.2
2.035	Quasi-Peak	38.0	0.0	38.0	56.0	18.0
2.035	Average	34.8	0.0	34.8	46.0	11.2
2.375	Average	33.8	0.0	33.8	46.0	12.2
2.545	Quasi-Peak	34.9	0.0	34.9	56.0	21.1
3.450	Quasi-Peak	36.2	0.0	36.2	56.0	19.8
3.505	Average	30.0	0.0	30.0	46.0	16.0
3.960	Quasi-Peak	35.7	0.0	35.7	56.0	20.3
4.130	Average	31.2	0.0	31.2	46.0	14.8
5.085	Quasi-Peak	38.5	0.0	38.5	60.0	21.5
5.485	Average	36.8	0.0	36.8	50.0	13.2
6.500	Quasi-Peak	45.7	0.0	45.7	60.0	14.3
6.785	Average	42.0	0.0	42.0	50.0	8.0
7.465	Quasi-Peak	50.1	0.0	50.1	60.0	9.9
7.580	Average	45.1	0.0	45.1	50.0	4.9
8.490	Average	38.9	0.0	38.9	50.0	11.1
8.555	Quasi-Peak	41.4	0.0	41.4	60.0	18.6
10.410	Average	37.9	0.0	37.9	50.0	12.1
10.860	Quasi-Peak	40.2	0.0	40.2	60.0	19.8
13.545	Quasi-Peak	34.3	0.0	34.3	60.0	25.7



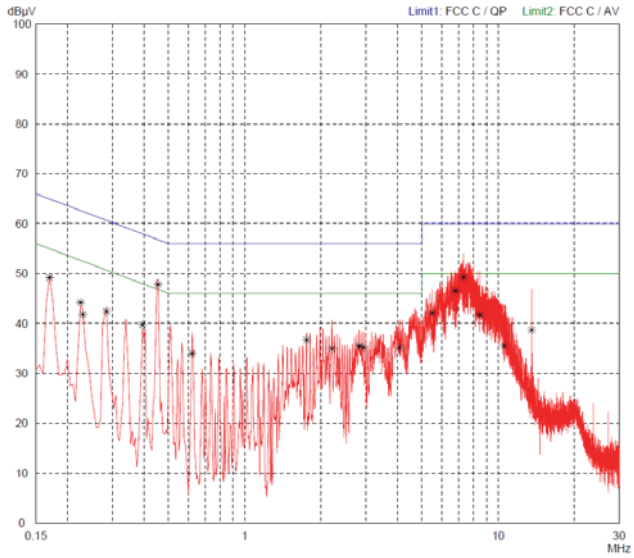
Peak / Quasi-peak



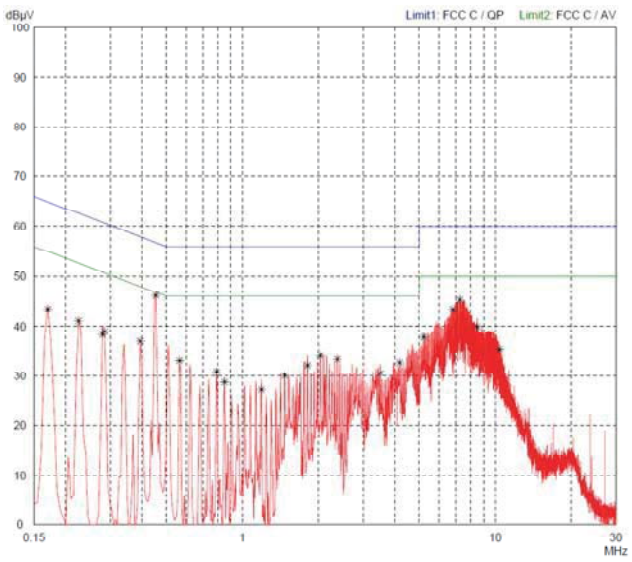
Average

Tested on:	N

Frequency (MHz)	Detector	Reading Value (dBµV)	Correction Factor (dB)	Final Value (dBµV)	Limit (dBµV)	Margin (dB)
0.170	Quasi-Peak	49.2	0.0	49.2	65.0	15.8
0.170	Average	43.3	0.0	43.3	55.0	11.7
0.225	Quasi-Peak	44.2	0.0	44.2	62.6	18.4
0.225	Average	41.1	0.0	41.1	52.6	11.5
0.230	Quasi-Peak	41.8	0.0	41.8	62.4	20.6
0.280	Average	38.2	0.0	38.2	50.8	12.6
0.285	Quasi-Peak	42.4	0.0	42.4	60.7	18.3
0.285	Average	38.9	0.0	38.9	50.7	11.8
0.395	Quasi-Peak	39.7	0.0	39.7	58.0	18.3
0.395	Average	36.9	0.0	36.9	48.0	11.1
0.455	Quasi-Peak	47.8	0.0	47.8	56.8	9.0
0.455	Average	46.1	0.0	46.1	46.8	**0.7**
0.565	Average	33.1	0.0	33.1	46.0	12.9
0.620	Quasi-Peak	34.0	0.0	34.0	56.0	22.0
0.790	Average	30.8	0.0	30.8	46.0	15.2
0.850	Average	28.8	0.0	28.8	46.0	17.2
1.190	Average	27.3	0.0	27.3	46.0	18.7
1.470	Average	30.0	0.0	30.0	46.0	16.0
1.755	Quasi-Peak	36.7	0.0	36.7	56.0	19.3
1.810	Average	32.1	0.0	32.1	46.0	13.9
2.035	Average	34.1	0.0	34.1	46.0	11.9
2.210	Quasi-Peak	35.0	0.0	35.0	56.0	21.0
2.375	Average	33.4	0.0	33.4	46.0	12.6
2.830	Quasi-Peak	35.5	0.0	35.5	56.0	20.5
2.940	Quasi-Peak	35.2	0.0	35.2	56.0	20.8
3.505	Average	30.5	0.0	30.5	46.0	15.5
4.080	Quasi-Peak	35.1	0.0	35.1	56.0	20.9
4.185	Average	32.7	0.0	32.7	46.0	13.3
5.205	Average	37.7	0.0	37.7	50.0	12.3
5.490	Quasi-Peak	42.1	0.0	42.1	60.0	17.9
6.785	Quasi-Peak	46.5	0.0	46.5	60.0	13.5
6.790	Average	43.4	0.0	43.4	50.0	6.6
7.240	Average	45.2	0.0	45.2	50.0	4.8
7.300	Quasi-Peak	49.2	0.0	49.2	60.0	10.8
8.470	Quasi-Peak	41.7	0.0	41.7	60.0	18.3
8.485	Average	39.9	0.0	39.9	50.0	10.1
10.410	Average	35.4	0.0	35.4	50.0	14.6
10.540	Quasi-Peak	35.5	0.0	35.5	60.0	24.5
13.555	Quasi-Peak	38.7	0.0	38.7	60.0	21.3



Peak / Quasi-peak



Average

Sample calculation of final values:

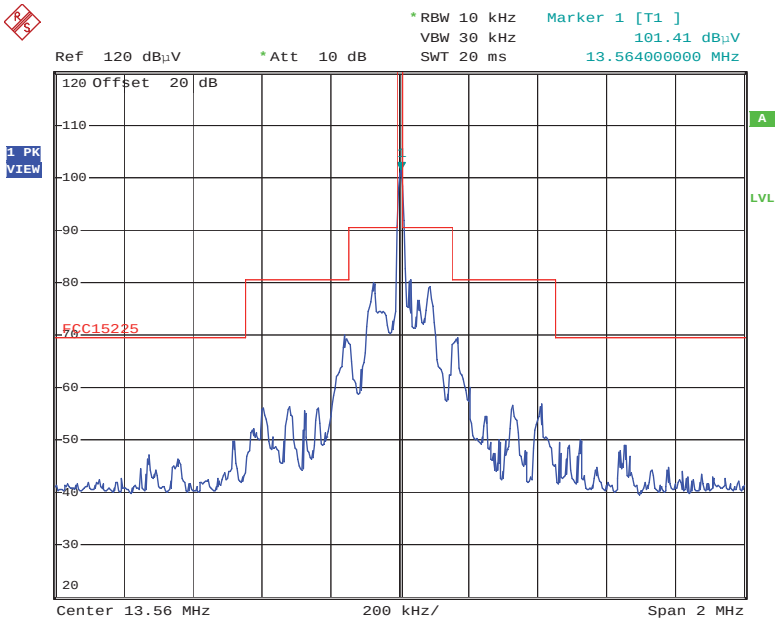
Final Value (dBµV) = Reading Value (dBµV) + Correction Factor (dB)

8.6 Spectrum Mask

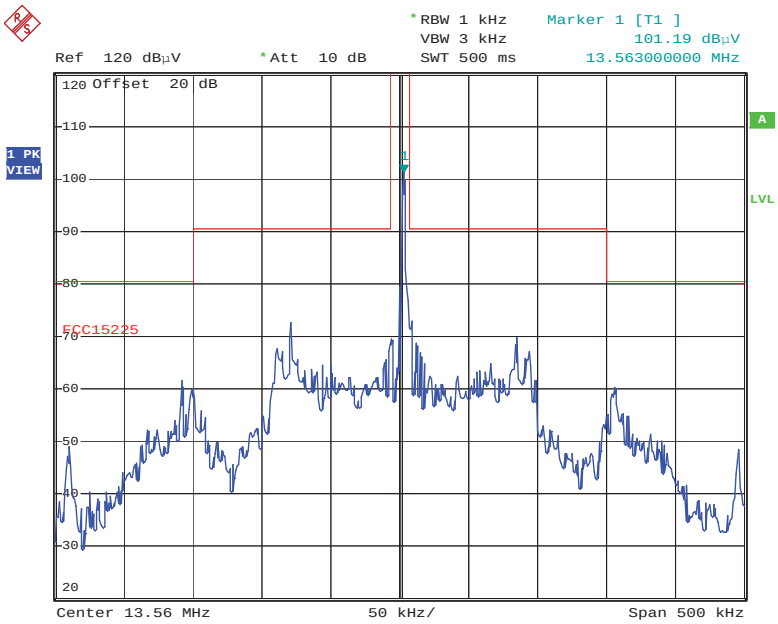
Rules and specifications:	CFR 47 Part 15, section 15.225(a)-(d) IC RSS-210 Issue 8, section A2.6			
Guide:	ANSI C63.4			
Description:	Compliance with the spectrum mask is tested using a spectrum analyzer with resolution bandwidth set to a 1 kHz for the band 13.553 to 13.567 MHz and to 10 kHz outside this band. The video bandwidth shall be at least three times greater than the resolution bandwidth.			
Limit:	Frequency of Emission (MHz)	Field Strength (µV/m)	Field Strength (dBµV/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 (6.4)			

Comment:	
Date of test:	2014-02-10
Test site:	Fully anechoic room, cabin no. 2
Test distance:	3 meters
Extrapolation Factor:	40 dB/decade

Test Result:	Test passed



Date: 10.FEB.2014 16:18:59



Date: 10.FEB.2014 16:21:03

8.7 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 3, sections 7.2.2(b)(c) and 7.2.5 and IC RSS-210 Issue 8, section A2.6			
Guide:	ANSI C63.4			
Limit:	Frequency of Emission (MHz)	Field Strength (µV/m)	Field Strength (dBµV/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 (6.4)			

Test Result:	Test passed

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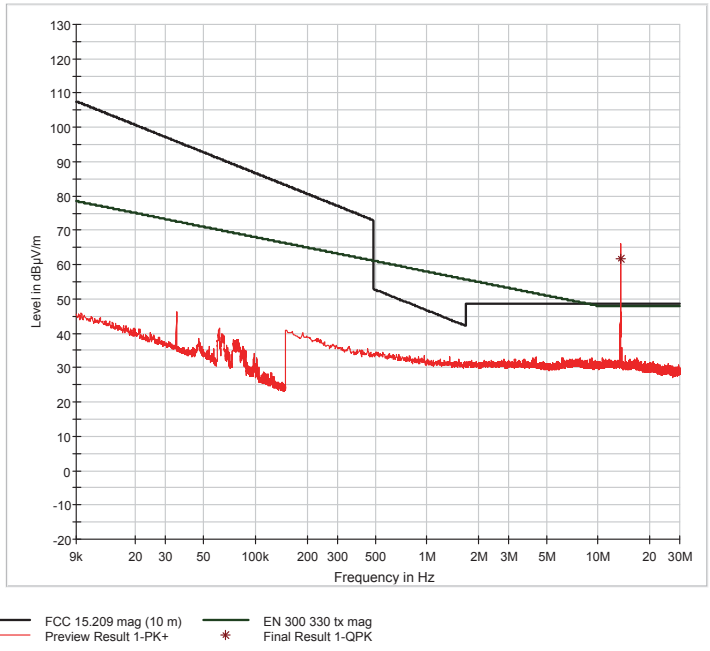
Comment:	Transmitting with smallest antenna
Date of test:	2014-01-28
Test site:	Open field test site

Test Result:	Test passed

Extrapolation factor: -40 dB/decade

Frequency (MHz)	Detector	Distance d1 (m)	Distance d (m)	Reading Value (dBµV)	Correction Factor (dB/m)	Extrapolation Factor (dB)	Pulse Train Correction (dB)	Final Value (dBµV/m)	Limit (dBµV/m)	Margin (dB)
13.56000	Quasi-Peak	10	30	41.8	20.0	-19.1		42.7	84.0	**41.3**



Sample calculation of final values:

Extrapolation Factor (dB) = (Log(d) - Log(d_1)) · Extrapolation Factor (dB/decade)

Final Value (dBµV/m) = Reading Value d_1 (dBµV) + Correction Factor (dB/m) + Extrapolation Factor (dB) + Pulse Train Correction (dB)

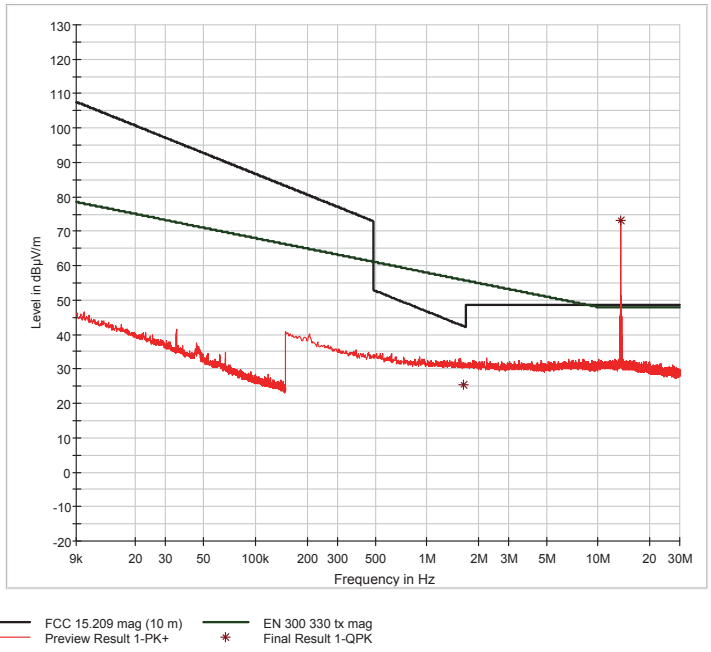
Note: Extrapolation factor (dB) and final value (dBµV/m) are relating to distance d.

Comment:	Transmitting with biggest antenna
Date of test:	2013-09-13
Test site:	Open field test site

Test Result:	Test passed

Extrapolation factor: -40 dB/decade

Frequency (MHz)	Detector	Distance d1 (m)	Distance d (m)	Reading Value (dBµV)	Correction Factor (dB/m)	Extrapolation Factor (dB)	Pulse Train Correction (dB)	Final Value (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1.63950	Quasi-Peak	10	30	5.3	20.0	-19.1		6.2	23.3	**17.1**
13.56000	Quasi-Peak	10	30	53.1	20.0	-19.1		54.0	84.0	30.0



Sample calculation of final values:

Extrapolation Factor (dB) = (Log(d) - Log(d_1)) · Extrapolation Factor (dB/decade)

Final Value (dBµV/m) = Reading Value d_1 (dBµV) + Correction Factor (dB/m) + Extrapolation Factor (dB) + Pulse Train Correction (dB)

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

8.8 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 3, sections 7.2.2(b)(c) and 7.2.5 and IC RSS-210 Issue 8, section A2.6		
Guide:	ANSI C63.4		
Limit:	Frequency of Emission (MHz)	Field Strength (µV/m)	Field Strength (dBµV/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 (6.5) Radiated Emission at Alternative Test Site (6.6)		

Test Result:	Test passed

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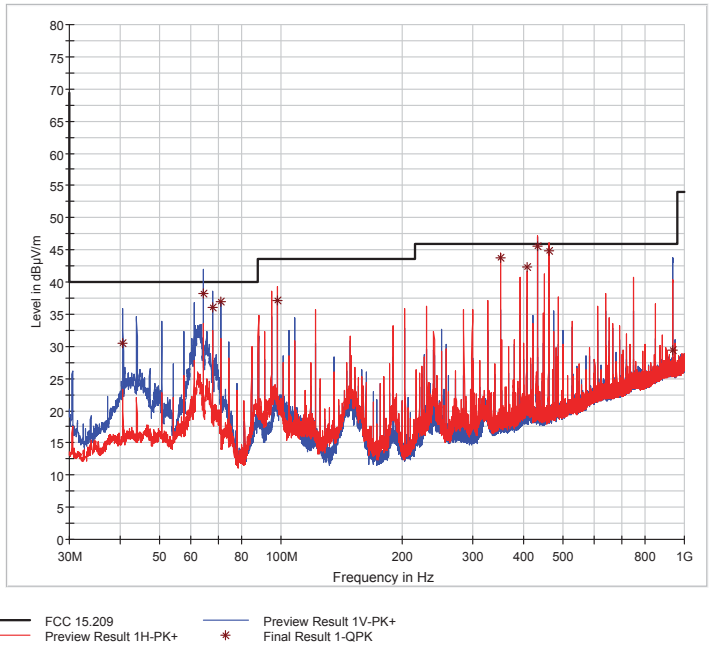
Comment:	Transmitting with smallest antenna
Date of test:	2014-01-29
Test site:	Frequencies ≤ 1 GHz: Semi-anechoic room, cabin no. 8
Test distance:	3 meters

Test Result:	Test passed

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)
40.740	vertical	Quasi-Peak	15.0	15.6		30.6	40.0	9.4
64.430	vertical	Quasi-Peak	25.6	12.6		38.1	40.0	1.9
67.820	vertical	Quasi-Peak	25.3	10.8		36.1	40.0	3.9
71.200	vertical	Quasi-Peak	27.5	9.5		37.0	40.0	3.0
98.320	horizontal	Quasi-Peak	23.6	13.6		37.2	43.5	6.3
349.990	horizontal	Quasi-Peak	27.3	16.6		43.8	46.0	2.2
406.910	horizontal	Quasi-Peak	24.9	17.5		42.3	46.0	3.7
433.990	horizontal	Quasi-Peak	27.6	18.0		45.6	46.0	**0.4**
461.150	horizontal	Quasi-Peak	26.7	18.1		44.8	46.0	1.2
933.540	vertical	Quasi-Peak	4.2	25.2		29.4	46.0	16.6



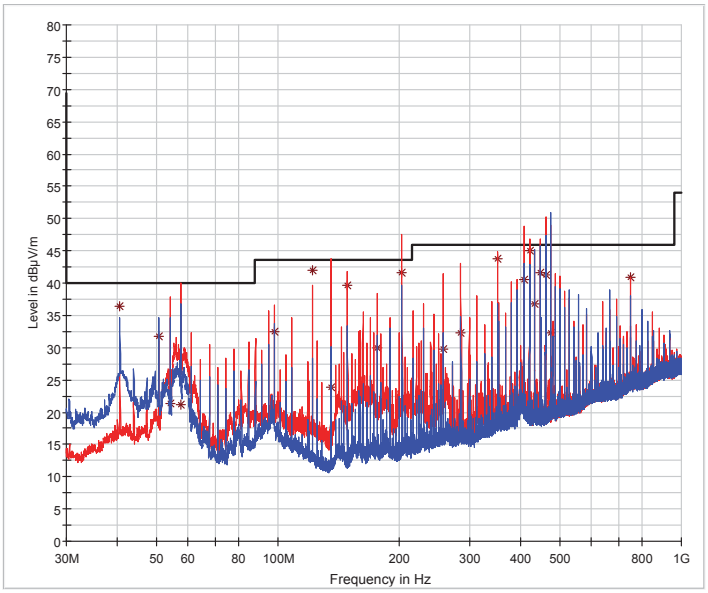
Sample calculation of final values:

Final Value (dBµV/m) = Reading Value (dBµV) + Correction Factor (dB/m) + Pulse Train Correction (dB)

Comment:	Transmitting with biggest antenna
Date of test:	2014-01-29
Test site:	Frequencies ≤ 1 GHz: Semi-anechoic room, cabin no. 8
Test distance:	3 meters

Test Result:	Test passed

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)
40.700	vertical	Quasi-Peak	0.0	15.5		36.4	40.0	3.6
50.870	vertical	Quasi-Peak	0.0	15.6		31.7	40.0	8.3
54.250	horizontal	Quasi-Peak	0.0	15.3		21.3	40.0	18.7
57.650	horizontal	Quasi-Peak	0.0	15.7		21.2	40.0	18.8
98.320	horizontal	Quasi-Peak	0.0	13.6		32.4	43.5	11.1
122.050	horizontal	Quasi-Peak	0.0	11.5		41.9	43.5	1.6
135.690	horizontal	Quasi-Peak	0.0	10.4		23.8	43.5	19.7
149.170	horizontal	Quasi-Peak	0.0	9.8		39.6	43.5	3.9
176.330	horizontal	Quasi-Peak	0.0	10.5		29.9	43.5	13.6
203.440	horizontal	Quasi-Peak	0.0	12.2		41.6	43.5	1.9
257.640	horizontal	Quasi-Peak	0.0	14.0		29.8	46.0	16.2
284.840	horizontal	Quasi-Peak	0.0	14.8		32.3	46.0	13.7
349.990	horizontal	Quasi-Peak	0.0	16.6		43.8	46.0	2.2
406.830	horizontal	Quasi-Peak	0.0	17.5		40.6	46.0	5.4
420.470	horizontal	Quasi-Peak	0.0	17.7		45.0	46.0	**1.0**
433.950	vertical	Quasi-Peak	0.0	18.0		36.7	46.0	9.3
447.590	horizontal	Quasi-Peak	0.0	17.9		41.6	46.0	4.4
461.070	horizontal	Quasi-Peak	0.0	18.1		41.3	46.0	4.7
474.820	vertical	Quasi-Peak	0.0	18.5		32.2	46.0	13.8
750.020	horizontal	Quasi-Peak	0.0	23.2		40.8	46.0	5.2



Sample calculation of final values:

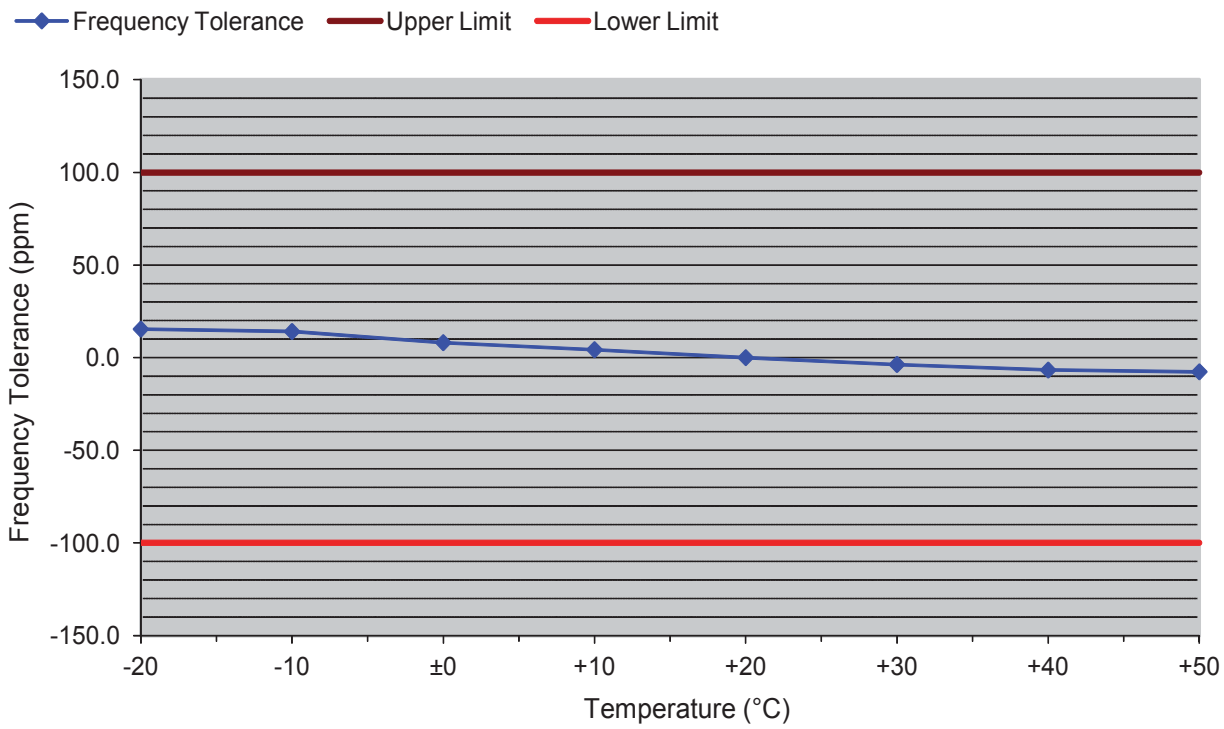
Final Value (dBµV/m) = Reading Value (dBµV) + Correction Factor (dB/m) + Pulse Train Correction (dB)

8.9 Carrier Frequency Stability

Rules and specifications:	CFR 47 Part 15, section 15.225(e) IC RSS-Gen Issue 3, section 4.7 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: Voltage range:	-20°C to +50°C (at normal supply voltage) 85% to 115% of the rated supply voltage (at a temperature of +20°C)
Measurement procedure:	Carrier Frequency Stability (6.7)

Comment:	
Date of test:	2014-01-30

8.9.1 Carrier Frequency Stability vs. Temperature

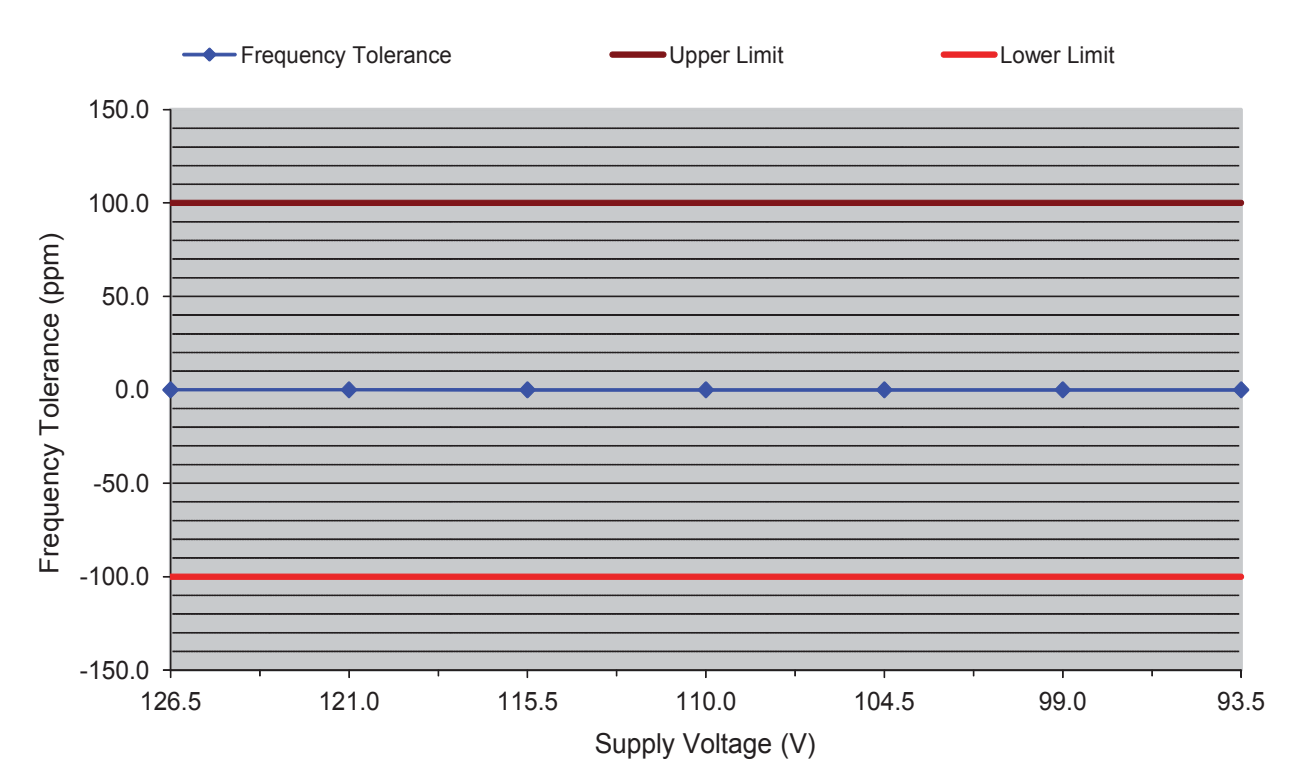


Supply voltage: 110 V Nominal frequency: 13.562994 MHz

Temperature (°C)	Frequency (MHz)	Frequency Tolerance (Hz)	Frequency Tolerance (ppm)	Upper Limit (ppm)	Lower Limit (ppm)	Margin (ppm)
-20	13.563203	209	15.4	+100.0	-100.0	**84.6**
-10	13.563185	191	14.1	+100.0	-100.0	85.9
±0	13.563104	110	8.1	+100.0	-100.0	91.9
+10	13.563052	58	4.3	+100.0	-100.0	95.7
+20	13.562994	0	0.0	+100.0	-100.0	100.0
+30	13.562944	-50	-3.7	+100.0	-100.0	96.3
+40	13.562903	-91	-6.7	+100.0	-100.0	93.3
+50	13.562891	-103	-7.6	+100.0	-100.0	92.4

Test Result:	Test passed

8.9.2 Carrier Frequency Stability vs. Supply Voltage



Temperature: +20 °C
Nominal frequency: 13.562994 MHz
Battery End Point: Not applicable

Supply Voltage (V)	Frequency (MHz)	Frequency Tolerance (Hz)	Frequency Tolerance (ppm)	Upper Limit (ppm)	Lower Limit (ppm)	Margin (ppm)
126.5	13.562994	0	0.0	+100.0	-100.0	100.0
121.0	13.562994	0	0.0	+100.0	-100.0	100.0
115.5	13.562994	0	0.0	+100.0	-100.0	100.0
110.0	13.562994	0	0.0	+100.0	-100.0	100.0
104.5	13.562994	0	0.0	+100.0	-100.0	100.0
99.0	13.562994	0	0.0	+100.0	-100.0	100.0
93.5	13.562994	0	0.0	+100.0	-100.0	**100.0**

Test Result:	Test passed

8.10 Exposure of Humans to RF Fields

Rules and specifications:	IC RSS-Gen Issue 3, section 5.6
Guide:	IC RSS-102 Issue 4, section 2.5

Exposure of Humans to RF Fields	Applicable	Declared by applicant	Measured	Exemption
The antenna is				
☒ detachable				
The conducted output power (CP in watts) is measured at the antenna connector: CP = **5.8 W**			☒	
The effective isotropic radiated power (EIRP in watts) is calculated using				
☐ the numerical antenna gain: G = **0.4** $EIRP = G \cdot CP \Rightarrow EIRP$ = **2.32 W**		☒		
☒ the field strength[11] in V/m: FS = **117.63 mV/m** $EIRP = \frac{(FS \cdot D)^2}{30} \Rightarrow EIRP$ = **4.15 mW** with: Distance between the antennas in m: D = **3 m**			☒ ☒	
☐ not detachable				
A field strength measurement is used to determine the effective isotropic radiated power (EIRP in watts) given by[11]: $EIRP = \frac{(FS \cdot D)^2}{30} \Rightarrow EIRP$ = **..... W** with: Field strength in V/m: FS = **..... V/m** Distance between the two antennas in m: D = **..... m**			 ☐ ☐	
Selection of output power				
The output power TP is the higher of the conducted or effective isotropic radiated power (e.i.r.p.): TP = **2.32 W**				

[11] 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.

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Product Service

Exposure of Humans to RF Fields (continued)	Applicable	Declared by applicant	Measured	Exemption
Separation distance between the user and the transmitting device is				
☐ less than or equal to 20 cm ☒ greater than 20 cm		☒		
Transmitting device is				
☐ in the vicinity of the human head ☐ body-worn		☒		
SAR evaluation				
SAR evaluation is required if the separation distance between the user and the device is less than or equal to 20 cm.				
☐ 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.				☐
☐;				
☐ 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.				☐
☐ 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.				☐
☐ 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.				☐
☐ SAR evaluation is documented in test report no.				
RF exposure evaluation				
RF exposure evaluation is required if the separation distance between the user and the device is greater than 20 cm.				
☒ 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.				☒
☐ 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.				☐
☐ RF exposure evaluation is documented in test report no.				

9 Referenced Regulations

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

☒	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, 2013
☒	CFR 47 Part 15	Code of Federal Regulations Part 15 (Radio Frequency Devices) of the Federal Communication Commission (FCC)	October 1, 2013
☒	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)
☐	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)
☒	RSS-Gen	Radio Standards Specification RSS-Gen Issue 3 containing General Requirements and Information for the Certification of Radiocommunication Equimpment, published by Industry Canada	December 2010
☒	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
☐	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
☒	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
☐	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
☒	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

☐	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
☒	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	03/2013	09/2014
EMI test receiver	1711	ESPI7	836914/0002	Rohde & Schwarz	Rohde & Schwarz	11/2012	05/2014
EMI test receiver	R&S	ESU26	100504	Rohde & Schwarz	Rohde & Schwarz	06/2013	---
Preamplifier	1651	CPA9231A	3393	Schaffner Electrotest	TÜV SÜD PS-EMC-STR	09/2012	09/2014
V-network	1059	ESH3-Z5	894785/005	Rohde & Schwarz	Rohde & Schwarz	08/2013	08/2015
V-network	1060	ESH3-Z5	862770/021	Rohde & Schwarz	Rohde & Schwarz	05/2012	05/2014
Impedance stabization network (ISN)	2080	ISN T800	28597	Teseq	Teseq	08/2012	11/2014
Loop antenna	1016	HFH2-Z2	882964/0001	Rohde & Schwarz	Rohde & Schwarz	11/2012	05/2014
TRILOG broadband antenna	1722	VULB 9163	9163-188	Schwarzbeck	Rohde & Schwarz	10/2013	04/2015
TRILOG Broadband Antenna	2058	VULB 9163	9163-408	Schwarzbeck	Rohde & Schwarz	11/2012	05/2014
Digital multimeter	2026	Fluke 177	96720025	Fluke	ZMK	07/2013	07/2015
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	
Peak power sensor	1701	NRV-Z31	8579604.03	Rohde & Schwarz	Rohde & Schwarz	04/2013	04/2016
Power meter	1502	NRVS	838624/016	Rohde & Schwarz	Rohde & Schwarz	04/2013	07/2015
Attenuator	1638	4776-10	9412	Narda	TÜV SÜD PS-EMC-STR	08/2013	11/2015
Attenuator	1639	4776-20	9503	Narda	TÜV SÜD PS-EMC-STR	08/2013	11/2015

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.

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11 Revision History

Revision History			
Edition	*Date*	*Issued by*	*Modifications*
1	2014-02-11	M. Steindl (gz)	First Edition