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January 8, 2014

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Prüfbericht / Test Report

Nr. / No. 1300020030-16397-7 (Edition 2)

Applicant: Texas Instruments Deutschland GmbH
Type of equipment: USB RF Test Board
Type designation: AP434R01
Order No.: 4512457160
Test standards: FCC Code of Federal Regulations,
CFR 47, Part 15,
Sections 15.107, 15.109, 15.205, 15.207, 15.215 and 15.231

Industry Canada Radio Standards Specifications
RSS-GEN Issue 3, Sections 6, 7.2.2, and 7.2.4 and
RSS-210 Issue 8, Sections A1.1 (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.

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1 Description of the Equipment Under Test (EUT)

General data of EUT

Type designation ¹ :	AP434R01
Parts ² :	
Serial number(s):	1
Manufacturer:	Texas Instruments Deutschland GmbH
Type of equipment:	USB RF Test Board
Version:	
FCC ID:	DFOC01M55AP434
Industry Canada ID:	2138A-C01M55AP434
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:	433.05 - 434.79 MHz	
Frequency range:	433.91 MHz	
Operating frequency:	433.91 MHz	
Type of modulation:	2-GFSK	
Pulse train:	---	
Pulse width:	---	
Number of RF-channels:	1	
Channel spacing:	---	
Designation of emissions ³ :	122KF1D	
Type of antenna:	Integrated chip antenna	
Size/length of antenna:	---	
Connection of antenna:	<input type="checkbox"/> detachable <input checked="" type="checkbox"/> not detachable	
Type of power supply:	DC supply	
Specifications for power supply:	nominal voltage:	5.0 V
Primary AC supply	nominal voltage:	110 V
	nominal frequency:	60 Hz

³ Also known as "Class of Emission".

2 Administrative Data

Application details

Applicant (full address):	Texas Instruments Deutschland GmbH Haggertystraße 1 D-85356 Freising
Contact person:	Mr. Claus Kuch
Order number:	4512457160
Receipt of EUT:	2013-02-12
Date(s) of test:	2013-02-12 to 2013-03-08
Note(s):	

Report details

Report number:	1300020030-16397-7
Edition:	1
Issue date:	2014-01-08

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
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 15.107, 15.109, 15.205, 15.207, 15.215 and 15.231(a)-(d)

of the Federal Communication Commission (FCC) and the

Radio Standards Specifications

RSS-Gen Issue 3, Sections 7.2.2, 7.2.3 and

RSS-210 Issue 8, Sections 2.2, A1.1.1 to A1.1.4 (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)

The EUT was operated in continuous transmitting mode and receiving mode on 433.92 MHz.

Configuration(s) of EUT

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

List of ports and cables

Port	Description	Classification ⁴	Cable type	Cable length
1	AC supply of AC/DC adapter of laptop PC	ac power	Unshielded	1 m
2	DC supply of laptop PC	dc power	Unshielded	1.5 m
3	USB interface of EUT	signal/control port	Shielded	1.5 m

List of devices connected to EUT

Item	Description	Type Designation	Serial no. or ID	Manufacturer

List of support devices

Item	Description	Type Designation	Serial no. or ID	Manufacturer
1	Laptop PC	T410	R8-L9B12 11/03	lenovo
2	AC/DC adapter of laptop PC	42T4428	11S42T4428Z1ZGW D079744	Lenovo

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 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:	<input type="checkbox"/> Conducted: See below <input checked="" type="checkbox"/> Radiated: Radiated Emission in Fully or Semi Anechoic Room (6.5)
<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 Pulse Train Measurement

Measurement Procedure:	
Rules and specifications:	CFR 47 Part 15, section 15.35(c) IC RSS-Gen Issue 3, section 4.5
Guide:	ANSI C63.4
Measurement setup:	<input type="checkbox"/> Conducted: See below (direct connection or via test fixture) <input checked="" type="checkbox"/> Radiated: Radiated Emission in Fully or Semi Anechoic Room (6.5)
<p>If antenna is detachable pulse train measurements shall be performed at the antenna connector (conducted measurement). The RF output terminals are connected to a spectrum analyzer or to a diode detector in combination with an oscilloscope. 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 antenna is not detachable a test fixture may be used instead of direct connection to RF output terminals.</p> <p>If radiated measurements are performed similar test setups and instruments are used as with radiated emission measurements for the appropriate frequency range. However, the spectrum analyzer may be replaced by a diode detector connected to an oscilloscope.</p>	

6.3 Conducted AC Powerline Emission

Measurement Procedure:

Rules and specifications: CFR 47 Part 15, sections 15.107 and 15.207
IC RSS-GEN Issue 3, section 7.2.4

Guide: ANSI C63.4 (CISPR 22)

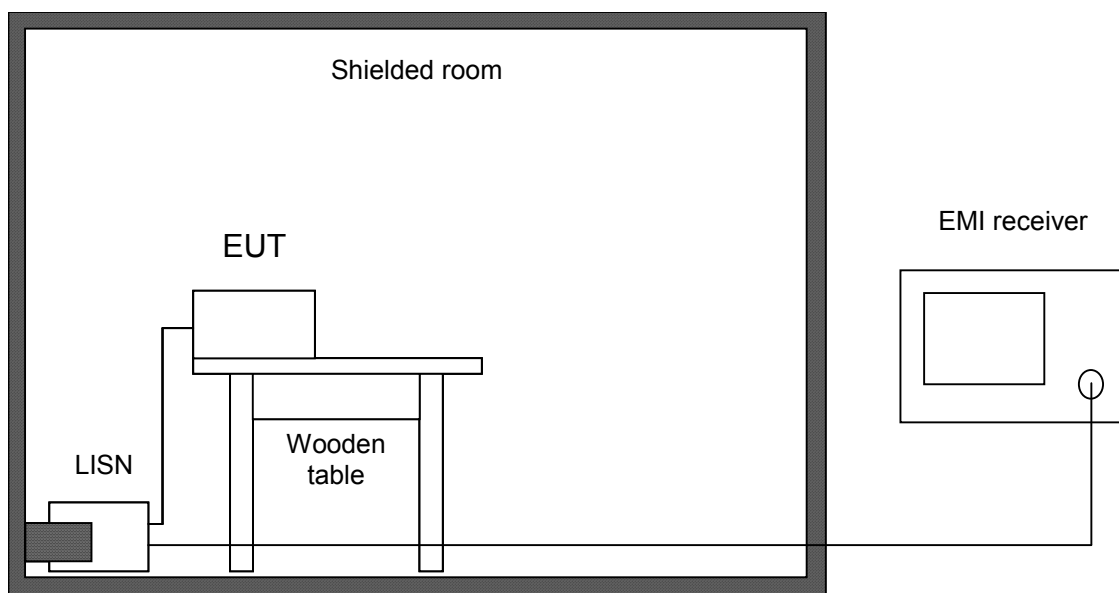
Conducted emission tests in the frequency range 150 kHz to 30 MHz are performed using Line Impedance Stabilization Networks (LISNs). To simplify testing with quasi-peak and average detector the following procedure is used:

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
<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

6.4 Radiated Emission Measurement 9 kHz to 30 MHz

Measurement Procedure:

Rules and specifications: CFR 47 Part 15, sections 15.215(b) and 15.231(b)(3)
IC RSS-210 Issue 8, section A1.1.2(b)

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.

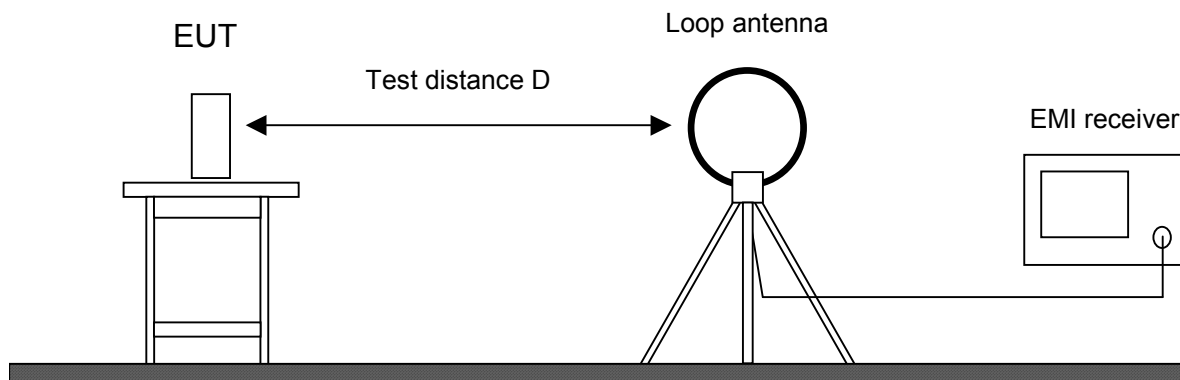
Hand-held or body-worn devices are rotated through three orthogonal axes to determine which attitude and configuration produces the highest emission relative to the limit and therefore shall be used for final testing.

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
<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 type="checkbox"/> Test receiver	ESHS 10	1028	860043/016	Rohde & Schwarz
<input type="checkbox"/> Preamplifier	Cabin no. 2 CPA9231A	1716	3557	Schaffner
<input checked="" 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 type="checkbox"/> 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 15.109, 15.215(b) and 15.231 IC RSS-GEN Issue 3, section 6.1 IC RSS-210 Issue 8, section A1.1.2
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.

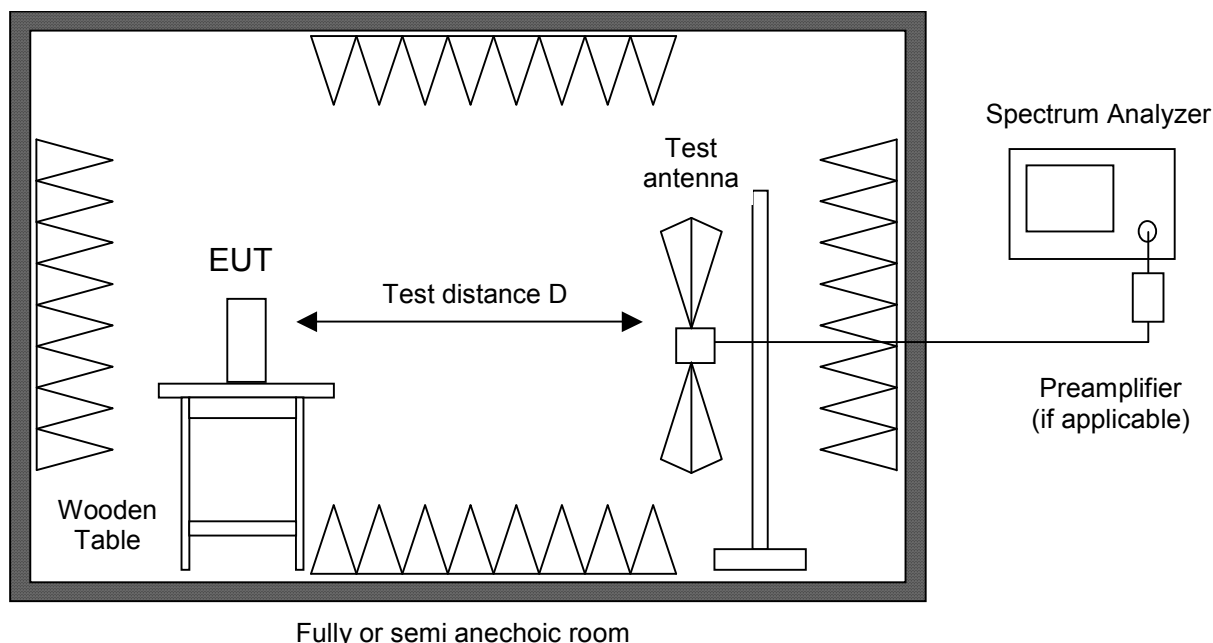
All tests below 8.2 GHz are performed at a test distance D of 3 meters. For higher frequencies the test distance may be reduced (e.g. to 1 meter) due to the sensitivity of the measuring instrument(s) and the test results are calculated according to CFR 47 Part 15 section 15.31(f)(1) using an extrapolation 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.



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	Cabin no. 3 ESPI7	2010	101018	Rohde & Schwarz
<input 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 checked="" 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 type="checkbox"/>	Trilog antenna	Cabin no. 8 VULB 9163	2058	9163-408	Schwarzbeck
<input checked="" 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 checked="" type="checkbox"/>	Fully anechoic room	No. 2	1452	---	Albatross
<input type="checkbox"/>	Semi anechoic room	No. 3	1453	---	Siemens
<input type="checkbox"/>	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 15.109, 15.215(b) and 15.231 IC RSS-GEN Issue 3, sections 6.1 IC RSS-210 Issue 8, section A1.1.2
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.

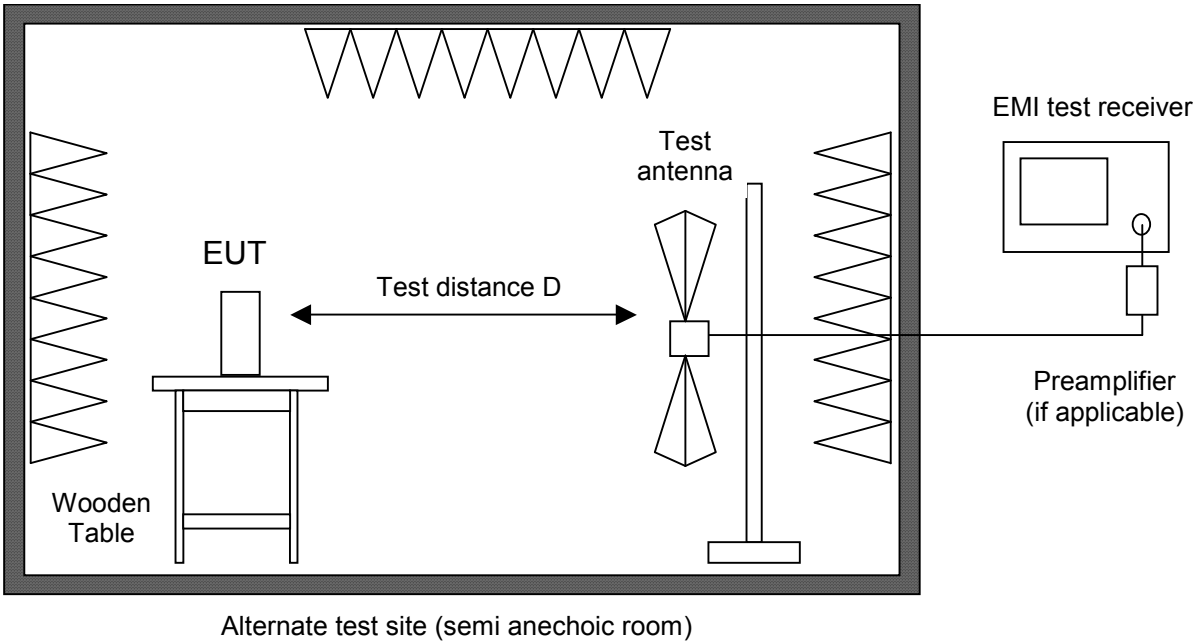
Equipment and cables are placed and moved within the range of position likely to find their maximum emissions.

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 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.

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.



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

0

7 Photographs Taken During Testing

Test setup for conducted AC powerline emission measurement



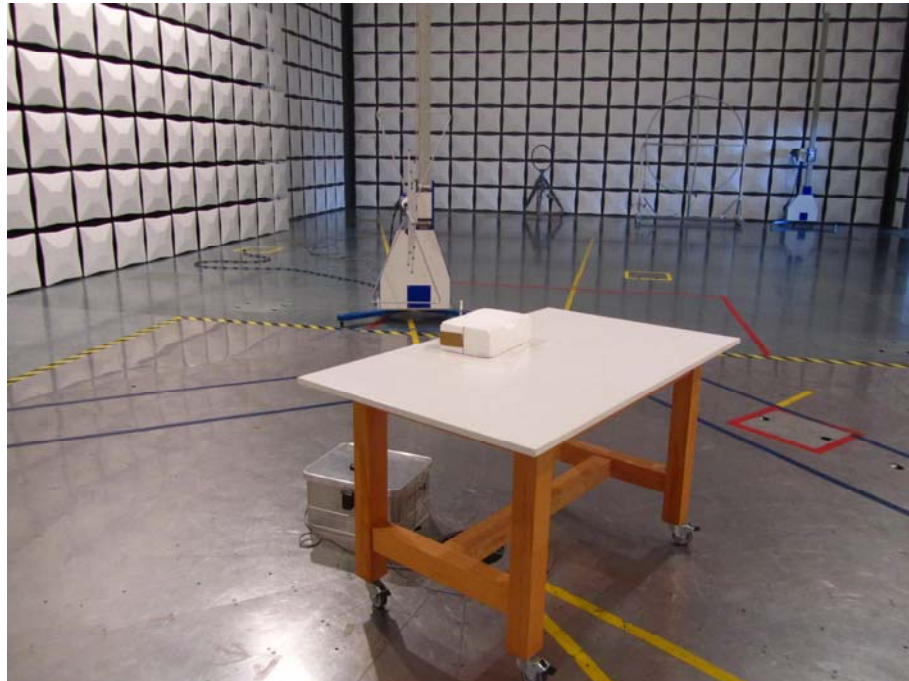
Test setup for radiated emission measurement 9 kHz – 30 MHz



Test setup for radiated emission measurement (fully anechoic room)



Test setup for radiated emission measurement (alternate test site)



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



8 Test Results for Transmitter

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) 15.231(c)	Bandwidth of the emission	31	Test passed
2.201, 2.202	Class of emission	34	Calculated
15.35(c)	Pulse train measurement for pulsed operation	---	Not applicable
15.205(a)	Restricted bands of operation	37	Test passed
15.207	Conducted AC powerline emission 150 kHz to 30 MHz	38	Test passed
15.231(a)	Periodic operation requirements	40	Test passed
15.205(b) 15.231(b)	Radiated emission 9 kHz to 30 MHz	41	Test passed
15.205(b) 15.215(b) 15.231(b)	Radiated emission 30 MHz to 5 GHz	43	Test passed
15.231(d)	Carrier frequency stability	---	Not applicable

IC RSS-Gen Issue 3

Section(s)	Test	Page	Result
4.8	Transmitter output power (conducted)	---	Not applicable
4.6.1	Occupied Bandwidth	27	Recorded
8	Designation of emissions	34	Calculated
4.5	Pulsed operation	---	Not applicable
7.2.4	Conducted AC powerline emission 150 kHz to 30 MHz	38	Test passed
7.2.2(a)	Restricted bands and unwanted emission frequencies	37	Test passed
7.2.2(b)(c), 7.2.5	Unwanted emissions 9 kHz to 30 MHz	41	Test passed
7.2.2(b)(c), 7.2.6	Unwanted emissions 30 MHz to 5 GHz	43	Test passed
5.5	Exposure of Humans to RF Fields	46	Exempted from SAR and RF evaluation

IC RSS-210 Issue 8

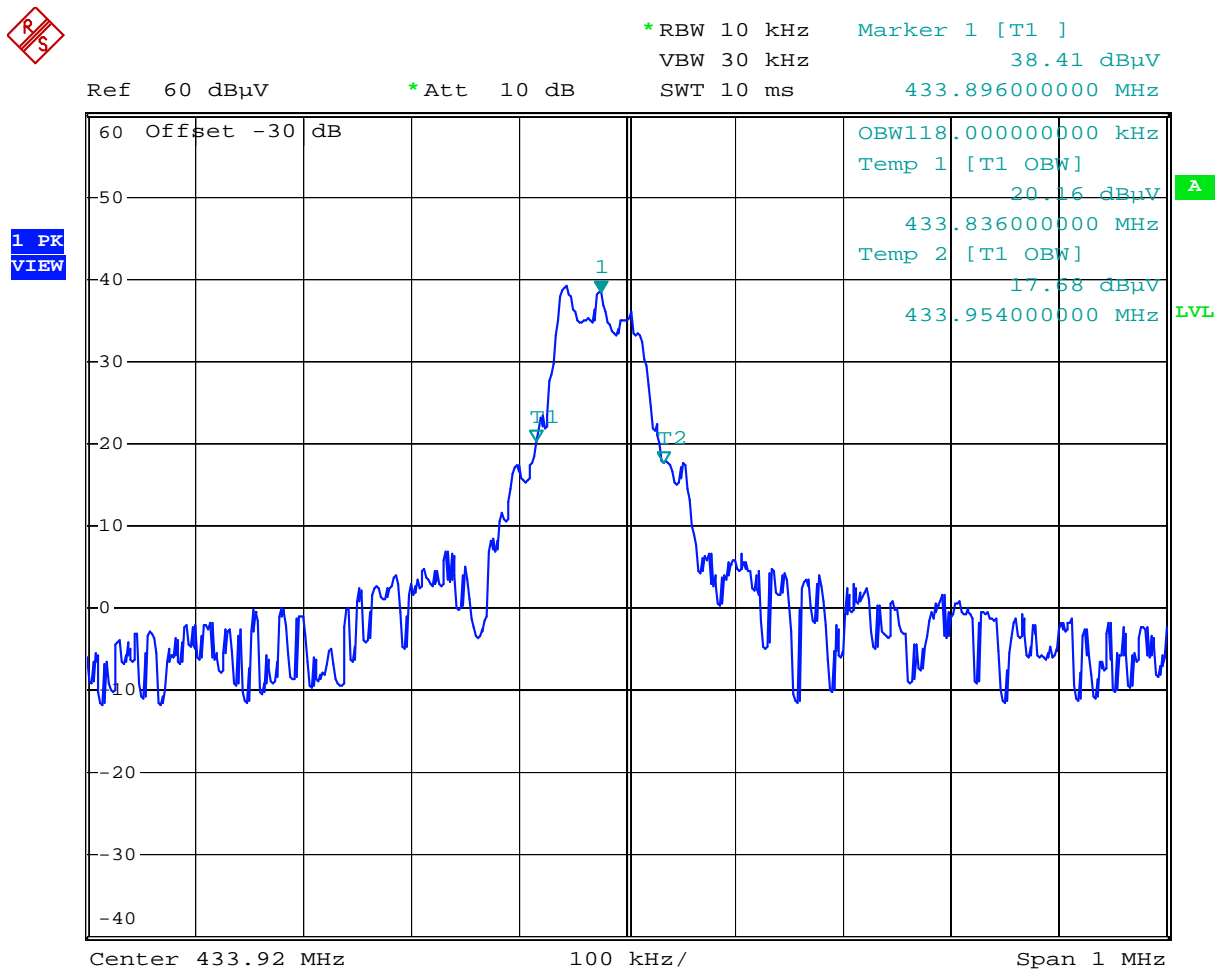
Section(s)	Test	Page	Result
A1.1.1	Requirements for momentarily operated devices	40	Test passed
A1.1.2	Unwanted emissions 9 kHz to 30 MHz	41	Test passed
A1.1.2	Unwanted emissions 30 MHz to 5 GHz	43	Test passed
A1.1.3	Bandwidth of momentary signals	33	Test passed
A1.1.4	Carrier frequency stability	---	Not applicable

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:	2013-03-08
Test site:	Fully anechoic room, cabin no. 2

Occupied Bandwidth (99 %):



Date: 8.MAR.2013 10:47:41

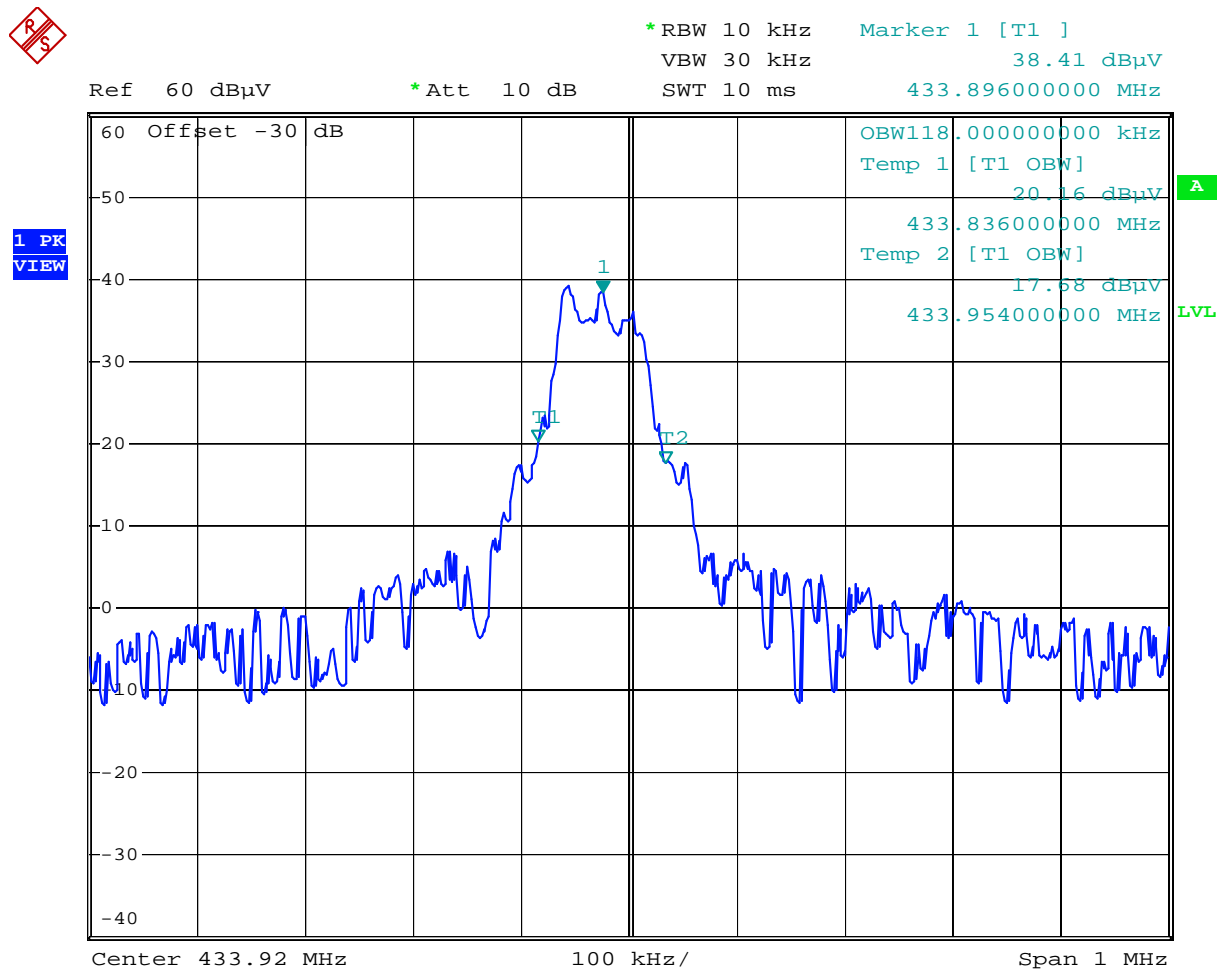
Occupied Bandwidth (99 %): **118 kHz**

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:	<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:	2013-03-08
Test site:	Fully anechoic room, cabin no. 2

Occupied Bandwidth (99 %):



Date: 8.MAR.2013 10:47:41

Occupied Bandwidth (99 %): **118 kHz**

8.2 Bandwidth of the Emission

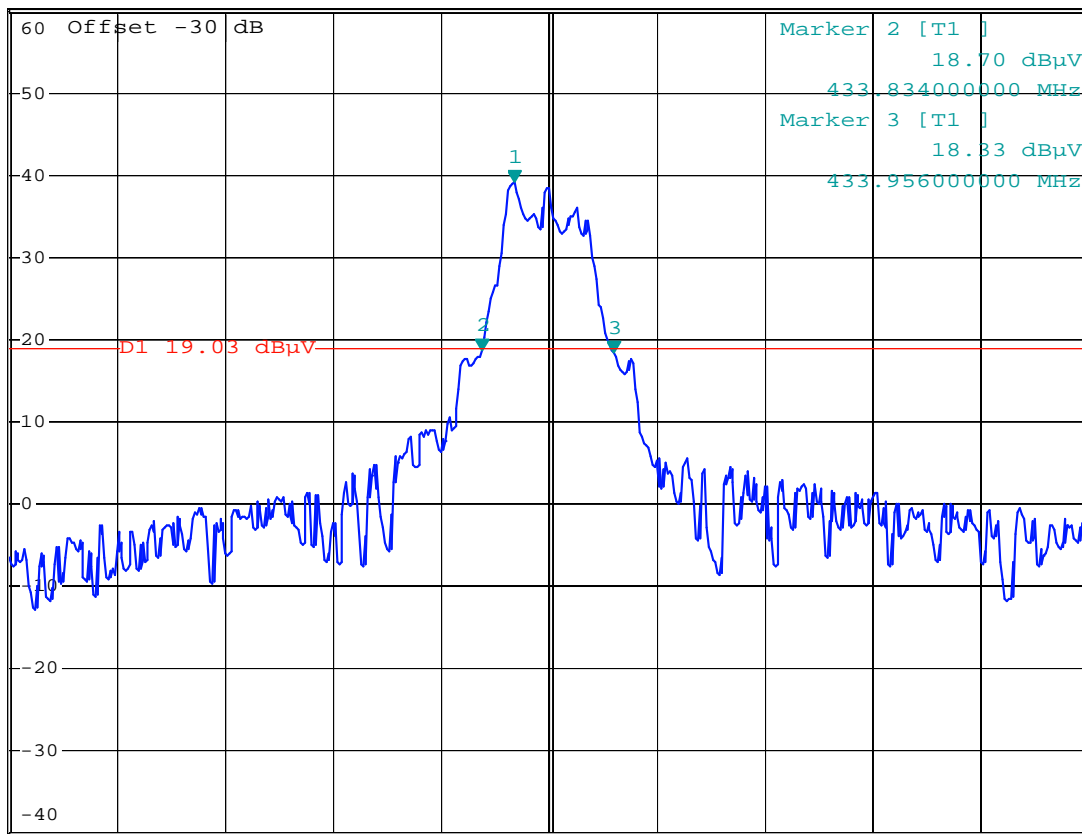
Rules and specifications:	CFR 47 Part 15, section 15.215(c)	
Guide:	ANSI C63.4	
Description:	<p>The 20 dB bandwidth of the emission is measured as the frequency range defined by the points that are 20 dB down relative to the maximum level of the modulated carrier.</p> <p>For intentional radiators operating 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:	2013-03-08	
Test site:	Fully anechoic room, cabin no. 2	



MARKER 1
433.864 MHz
Ref 60 dBµV *Att 10 dB

*RBW 10 kHz Marker 1 [T1]
VBW 30 kHz 39.03 dBµV
SWT 10 ms 433.864000000 MHz

1 PK
VIEW



Center 433.896 MHz 100 kHz/ Span 1 MHz

Date: 8.MAR.2013 10:49:46

Permitted frequency band:	433.05 - 434.79 MHz	
20 dB bandwidth:	122 kHz	
Carrier frequency stability:	<input type="checkbox"/> specified	<input checked="" type="checkbox"/> not specified
Maximum frequency tolerances:	---	
Bandwidth of the emission:	122 kHz	within permitted frequency band ⁵ : <input checked="" type="checkbox"/> yes <input type="checkbox"/> no

Test Result: Test passed

⁵ 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 Bandwidth of Momentary Signals

Rules and specifications:	IC RSS-210 Issue 8, section A1.1.3
Guide:	IC RSS-Gen Issue 3, section 4.6.1
Limit:	For the purpose of Section A1.1, the 99% bandwidth shall be no wider than 0.25% of the centre frequency for devices operating between 70 and 900 MHz. For devices operating above 900 MHz, the emission shall be no wider than 0.5% of the centre frequency.

Operating frequency:	433.91 MHz
Bandwidth limit:	1.0848 MHz
Occupied bandwidth:	118 kHz
Emission bandwidth within bandwidth limit:	<input checked="" type="checkbox"/> yes <input type="checkbox"/> no

Test Result:	Test passed
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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:	Frequency Shift Keying (FSK)
---------------------	------------------------------

B_n = Necessary Bandwidth	$B_n = 2DK + B$
D = Peak deviation	D = 22.65 kHz
K = Overall numerical factor	K = 1
B = Modulation rate	B = 76.7 kHz
Calculation:	$B_n = 2 \cdot (22.65 \text{ kHz}) \cdot 1 + 2 \cdot (76.7 \text{ kHz}) = \dots \text{ kHz}$

Designation of Emissions:	122KF1D
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8.5 Pulse Train Measurement

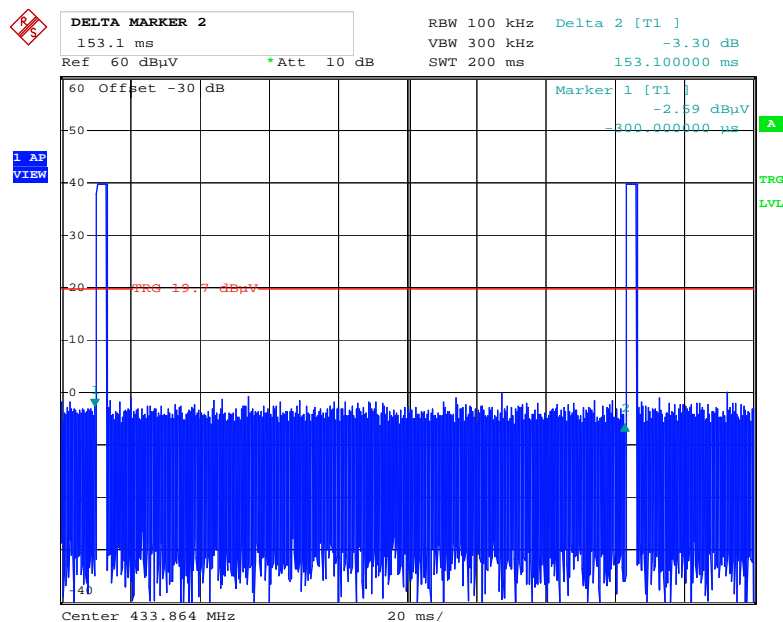
Rules and specifications:	CFR 47 Part 15, section 15.35(c) IC RSS-Gen Issue 3, section 4.5
Guide:	ANSI C63.4
Measurement procedure:	Pulse Train Measurement (6.2)

Comment:	
Date of test:	2013-03-08
Test site:	Fully anechoic room, cabin no. 2

Calculation of pulse train correction:

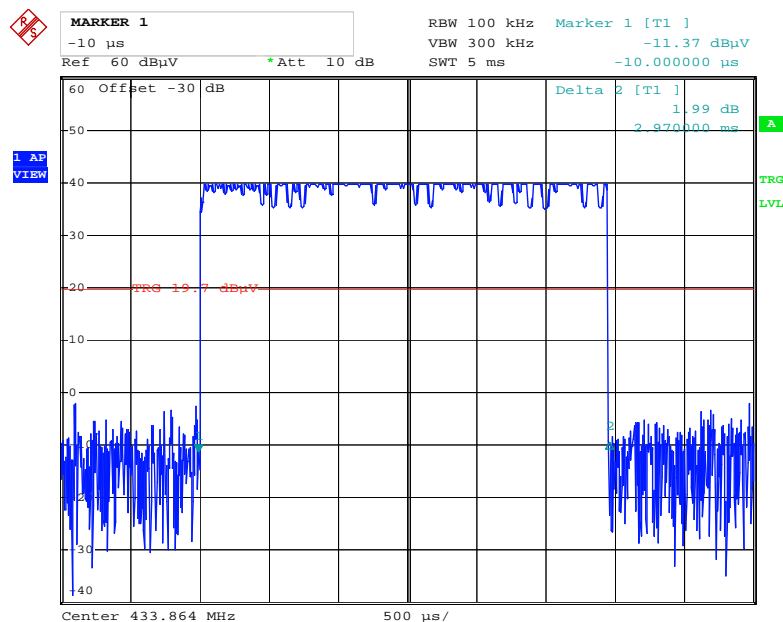
TX-On-Time (worst case):	T_{on}	=	2.97 ms
Pulse Train Time:	T_{pt}	=	153.1 ms
Period Time:	T_{period}	=	100 ms
Pulse Train Correction:	$C_{pt, real}$	=	$20 \cdot \log(T_{on} / T_{period})$ dB
		=	-30.54 dB
Pulse Train Correction used:	C_{pt}	=	-20 dB

Total Pulse Train:



Date: 8.MAR.2013 10:53:50

Worst case 0.1 second interval:

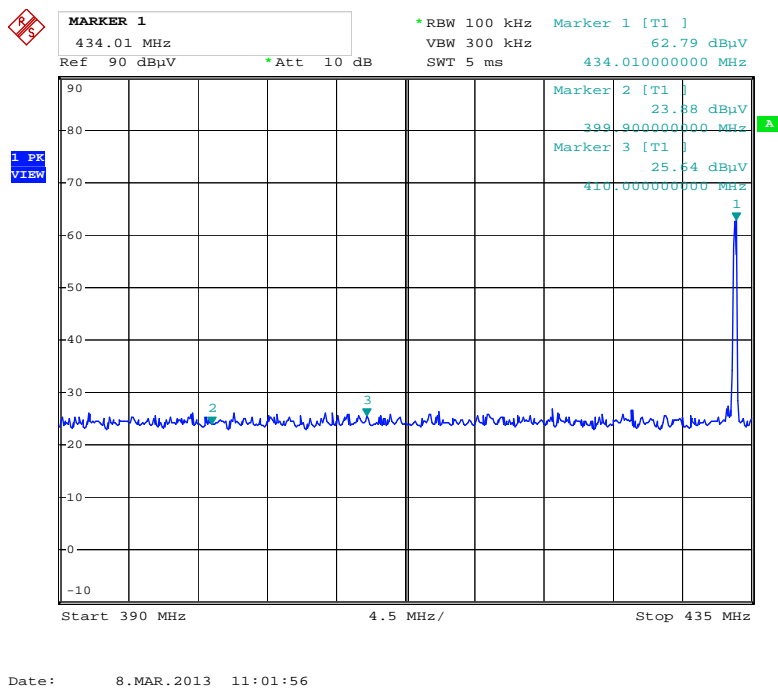


Date: 8.MAR.2013 10:54:40

8.6 Restricted Bands of Operation

Rules and specifications:	CFR 47 Part 15, section 15.205(a) IC RSS-210 Issue 8, section 7.2.2(a)
Guide:	ANSI C63.4
Limit:	Only spurious emissions are permitted in any of the frequency bands listed in CFR 47 Part 15, section 15.205(a) or IC RSS-210 Issue 7, section 2.2(a).
Measurement procedure:	Radiated Emission in Fully or Semi Anechoic Room (6.5)

Comment:	
Date of test:	2013-03-08
Test site:	Fully anechoic room, cabin no. 2
Test distance:	3 meters



Test Result: Test passed

8.7 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:	
Date of test:	2013-03-04
Test site:	Shielded room, cabin no. 4

Test Result:	Test passed
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Tested on:	L1
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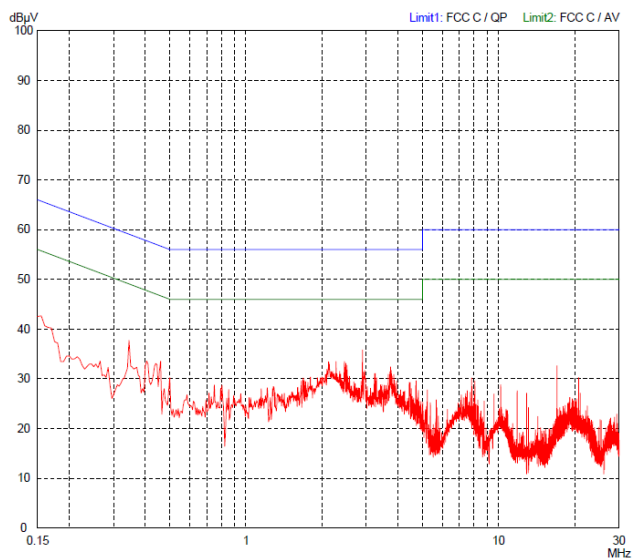
All emissions show more than 20 dB margin to the limit

Tested on:	N
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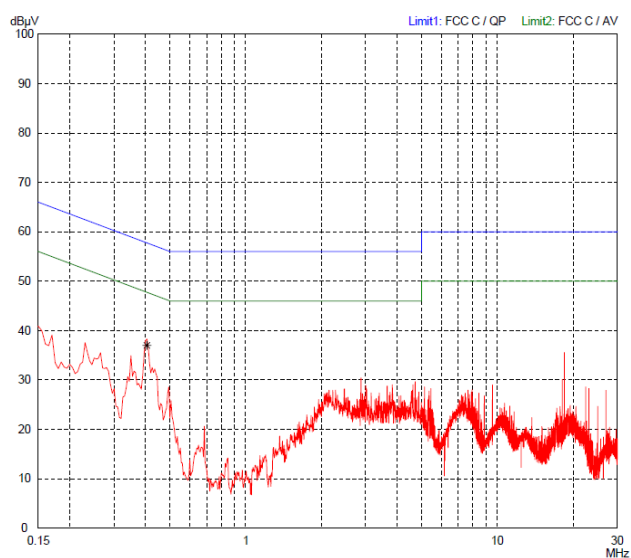
Frequency (MHz)	Detector	Reading Value (dBµV)	Correction Factor (dB)	Final Value (dBµV)	Limit (dBµV)	Margin (dB)
0.405	Quasi-Peak	37,0	0,0	37,0	57.8	41506,0

Sample calculation of final values:

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



L1



N

8.8 Periodic Operation Requirements

Rules and specifications:	CFR 47 Part 15, section 15.231(a) IC RSS-210 Issue 8, section A1.1.1
Guide:	---

Periodic operation requirements	Applicable	Declared by applicant	Test performed	Passed
The transmitter is used for				
<input type="checkbox"/> security or safety applications <input type="checkbox"/> other applications		<input checked="" type="checkbox"/>		
The transmitter is operated				
<input type="checkbox"/> manually <input type="checkbox"/> automatically		<input checked="" type="checkbox"/>		
Periodic operation according to				
<input type="checkbox"/> CFR 47 Part 15, section 15.231(a) / IC RSS-210 Issue 7, section A1.1.1				
Only control signals are sent and there is no continuous transmission	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A manually operated transmitter employs a switch that will automatically deactivate the transmitter within not more than 5 seconds of being released	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
A transmitter activated automatically ceases transmission within 5 seconds after activation	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Periodic transmissions at regular predetermined intervals are <input type="checkbox"/> not performed <input type="checkbox"/> performed with total transmission time of two seconds per hour or less (for polling or supervision transmissions to determine system integrity of transmitters used in security or safety applications)	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/> CFR 47 Part 15, section 15.231(e) / IC RSS-210 Issue 7, section A1.1.5				
The device is provided with a means for automatically limiting operation so that the duration of each transmission is not greater than one second and the silent period between transmissions is at least 30 times the duration of the transmission but in no case less than 10 seconds.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>

Note: Result may be based on the appropriate declaration of the applicant (i.e. no test is performed). However, in this case there is no verification by the test laboratory.

8.9 Radiated Emission Measurement 9 kHz to 30 MHz

Rules and specifications:	CFR 47 Part 15, sections 15.215(b) and 15.231(b)(3) IC RSS-210 Issue 8, section A1.1.2(b)			
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 - 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)			

Comment:	
Date of test:	2013-02-22
Test site:	Open field test site

Test Result:	Test passed
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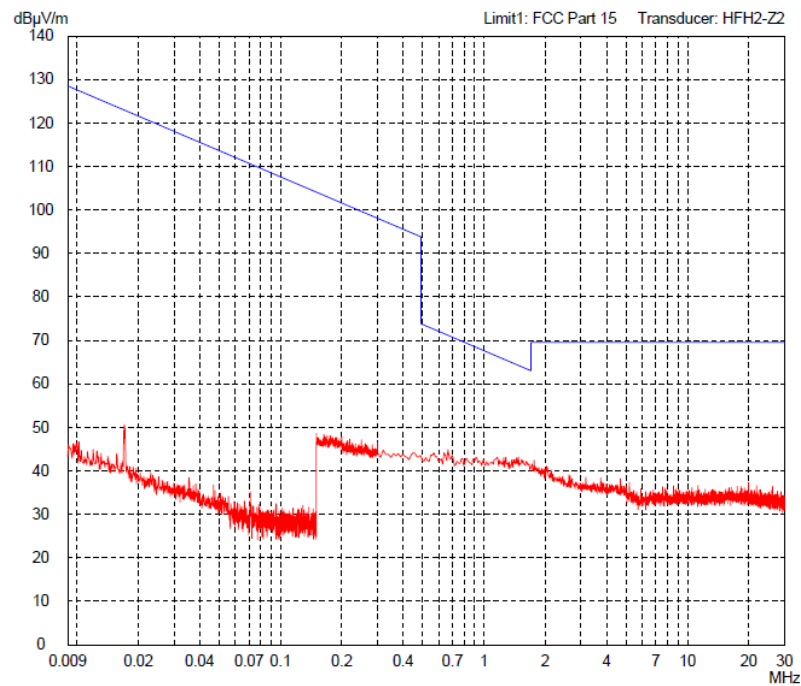
No emissions above noise level detected

Sample calculation of final values:

Extrapolation Factor (dB) = (Log(d) - Log(d₁)) · Extrapolation Factor (dB/decade)

Final Value (dBµV/m) = Reading Value d₁ (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.



8.10 Radiated Emission Measurement 30 MHz to 5 GHz

Rules and specifications:	CFR 47 Part 15, sections 15.205, 15.215(b) and 15.231(b) IC RSS-210 Issue 8, section A1.1.2				
Guide:	ANSI C63.4				
Limit:	In addition to the provisions of section 15.205, the field strength shall not exceed the levels as listed in the table below or the general limits shown in section 15.209, whichever limit permits a higher field strength. In no case shall the level of the unwanted emissions exceed the field strength of the fundamental emission.				
	Frequency of Emission (MHz)	Field Strength of Fundamental ($\mu\text{V/m}$) (dB $\mu\text{V/m}$)		Field Strength of Spurious Emissions ($\mu\text{V/m}$) (dB $\mu\text{V/m}$)	
	40.66 - 40.70	2,250	67.0	225 **	47.0
	70 - 130	1,250	61.9	125	41.9
	130 - 174	1,250 to 3,750 *	61.9 to 71.5	125 to 375 *	41.9 to 51.5
	174 - 260	3,750	71.5	375	51.5
	260 - 470	3,750 to 12,500 *	71.5 to 81.9	375 to 1,250 *	51.5 to 61.9
	Above 470	12,500	81.9	1,250	61.9
	* linear interpolations ** for harmonics only				
Measurement procedures:	Radiated Emission in Fully or Semi Anechoic Room (6.5) Radiated Emission at Alternative Test Site (6.6)				

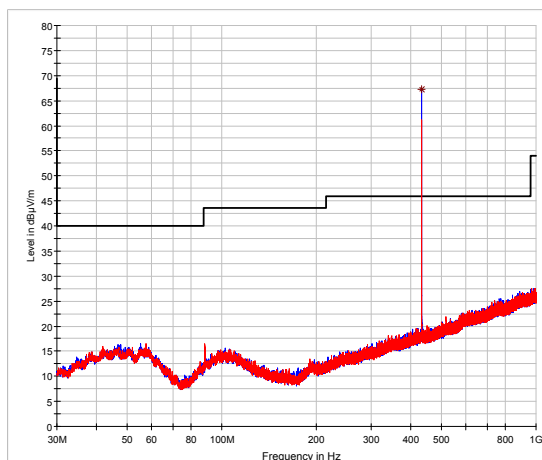
Comment:	
Date of test:	2013-08-23
Test site:	Frequencies \leq 1 GHz: Semi-anechoic room, cabin no. 8 Frequencies $>$ 1 GHz: Fully anechoic room, cabin no. 2
Test distance:	3 meters

Test Result:	Test passed
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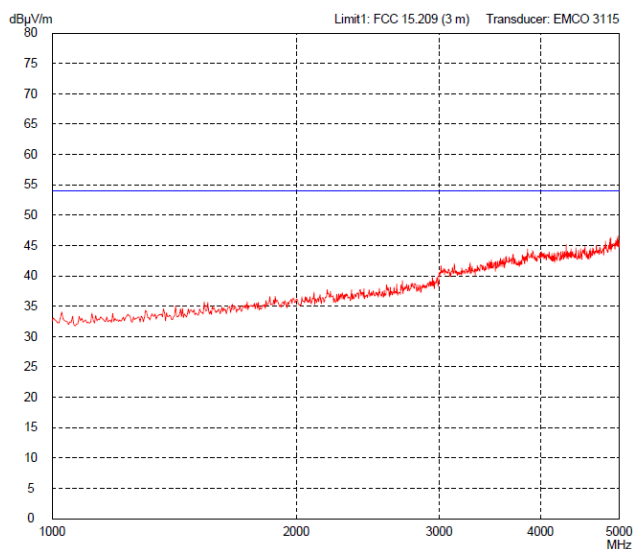
Frequency (MHz)	Antenna Polarization	Detector	Receiver Reading (dB μV)	Correction Factor (dB/m)	Pulse Train Correction (dB)	Final Value (dB $\mu\text{V/m}$)	Limit (dB $\mu\text{V/m}$)	Margin (dB)
433,910	horizontal	Peak	54,7	17,8	-20,0	52,5	72,9	20,4
2200,000	vertical	Peak	5,6	32,8	-20,0	18,4	54,0	35,6

Sample calculation of final values:

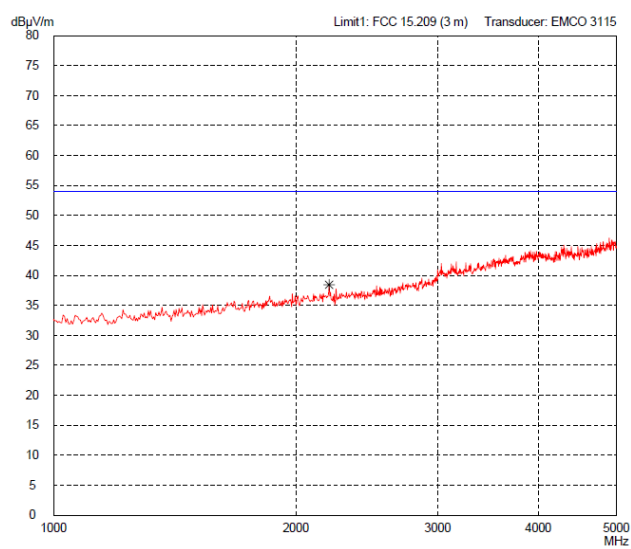
$$\text{Final Value (dB}\mu\text{V/m)} = \text{Reading Value (dB}\mu\text{V)} + \text{Correction Factor (dB/m)} \\ + \text{Pulse Train Correction (dB)}$$



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



Horizontal polarisation



Vertical polarisation

8.11 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				
<input type="checkbox"/> detachable				
<p>The conducted output power (CP in watts) is measured at the antenna connector:</p> <p style="text-align: center;">$CP = \dots\dots\dots \text{W}$</p> <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> <p style="text-align: center;">$EIRP = G \cdot CP \Rightarrow EIRP = \dots\dots\dots \text{W}$</p> <p><input type="checkbox"/> the field strength⁶ in V/m: $FS = \dots\dots\dots \text{V/m}$</p> <p style="text-align: center;">$EIRP = \frac{(FS \cdot D)^2}{30} \Rightarrow EIRP = \dots\dots\dots \text{W}$</p> <p>with:</p> <p>Distance between the antennas in m: $D = \dots\dots\dots \text{m}$</p>			<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 by⁶:</p> <p style="text-align: center;">$EIRP = \frac{(FS \cdot D)^2}{30} \Rightarrow EIRP = 53.3 \text{ nW}$</p> <p>with:</p> <p>Field strength in V/m: $FS = 421.7 \text{ µV/m}$</p> <p>Distance between the two antennas in m: $D = 3 \text{ m}$</p>			<input checked="" 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> <p style="text-align: center;">$TP = 53.3 \text{ nW}$</p>				

⁶ 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.

9 Test Results for Receiver

FCC CFR 47 Part 15

Section(s)	Test	Page	Result
15.107	Conducted AC powerline emission 150 kHz to 30 MHz	49	Test passed
15.109	Radiated emission 30 MHz to 2.5 GHz	51	Test passed
15.111(a)	Antenna power conduction emission of receivers 9 kHz to 2.5 GHz	---	Not applicable

IC RSS-Gen Issue 3

Section(s)	Test	Page	Result
7.2.4	Conducted AC powerline emission 150 kHz to 30 MHz	49	Test passed
6.1	Receiver spurious emissions (radiated) 30 MHz to 2.5 GHz	51	Test passed
6.2	Receiver spurious emissions (antenna conducted) 9 kHz to 2.5 GHz	---	Not applicable

9.1 Conducted Powerline Emission Measurement 150 kHz to 30 MHz

Rules and specifications:	CFR 47 Part 15, section 15.107 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:	
Date of test:	2013-03-04
Test site:	Shielded room, cabin no. 1

Test Result:	Test passed
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Tested on:	L1
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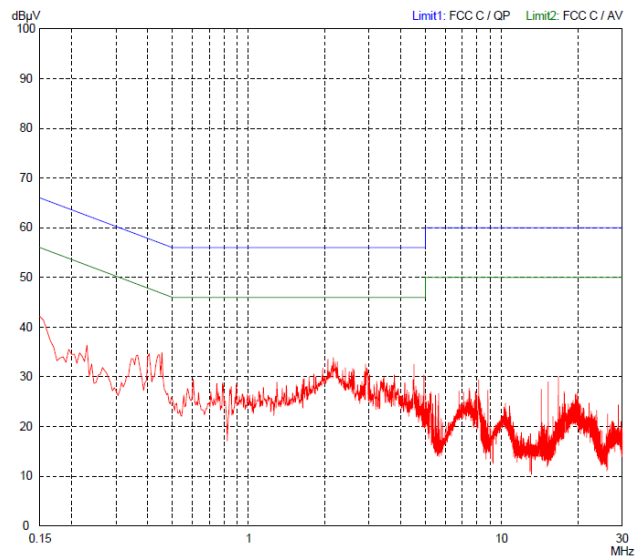
All emissions show more than 20 dB margin to the limit

Tested on:	N
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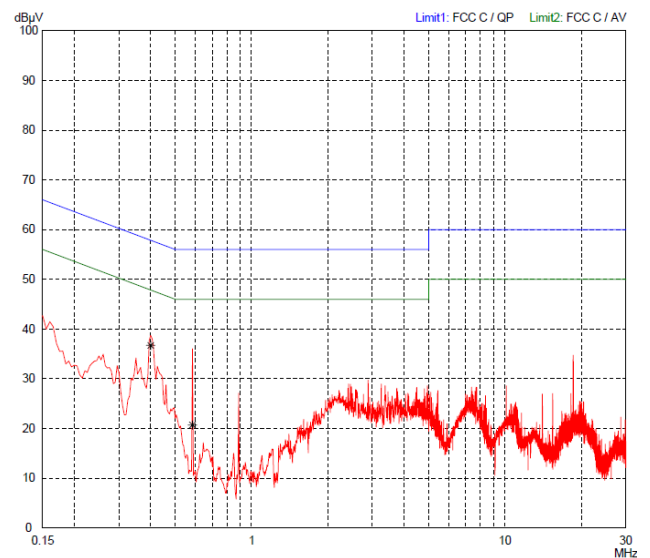
Frequency (MHz)	Detector	Reading Value (dBµV)	Correction Factor (dB)	Final Value (dBµV)	Limit (dBµV)	Margin (dB)
0,400	Quasi-Peak	36,7	0,0	36,7	57,9	21,2
0,585	Quasi-Peak	20,7	0,0	20,7	56,0	35,3

Sample calculation of final values:

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



L1



N

9.2 Radiated Emission Measurement 30 MHz to 2.5 GHz

Rules and specifications:	CFR 47 Part 15, section 15.109 (Class B) IC RSS-Gen Issue 3, sections 6.1		
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
Measurement procedures:	Radiated Emission in Fully or Semi Anechoic Room (6.5) Radiated Emission at Alternative Test Site (6.6)		

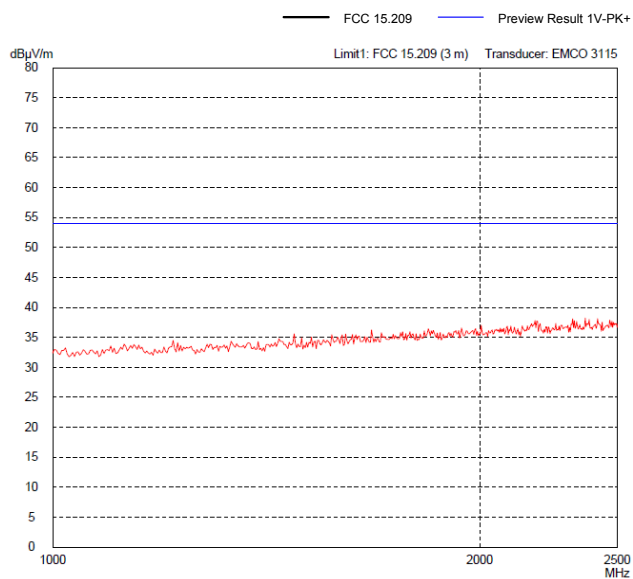
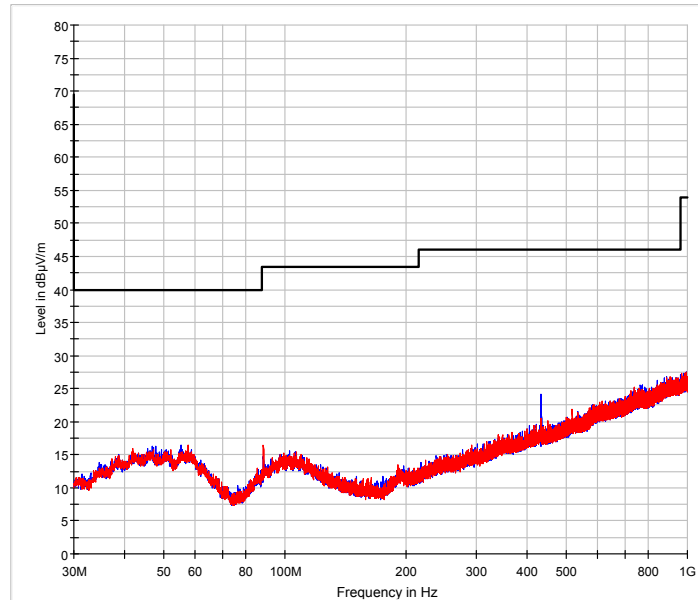
Comment:	
Date of test:	2013-08-23
Test site:	Frequencies ≤ 1 GHz: Semi-anechoic room, cabin no. 8 Frequencies > 1 GHz: Fully anechoic room, cabin no. 2
Test distance:	3 meters

Test Result:	Test passed
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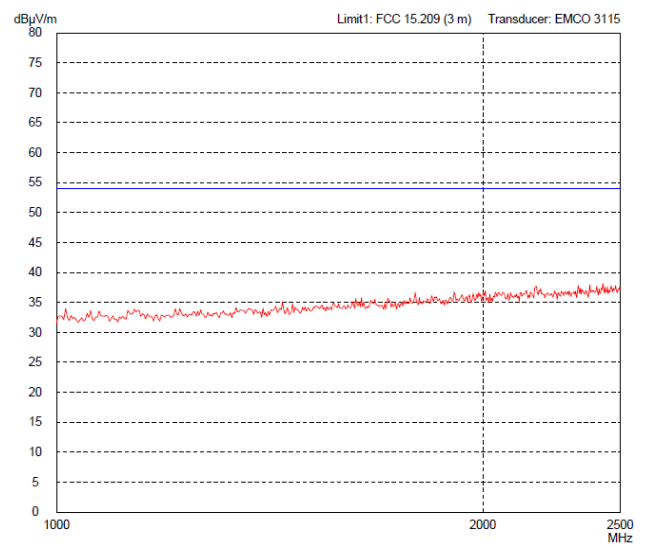
No emissions above noise level detected

Sample calculation of field final values:

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



Horizontal polarisation



Vertical polarisation

10 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, 2013
<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, 2013
<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 3 containing General Requirements and Information for the Certification of Radiocommunication Equipment, published by Industry Canada	December 2010
<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 4 for Digital Apparatus, published by Industry Canada	February 7, 2004
<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- CEI/IEC CISPR 22	Limits and Methods of Measurement of Radio Disturbance Characteristics of Information Technology Equipment	2002
		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)	
<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	Notes Regarding Designation of Emissions (Including Necessary Bandwidth and Classification), Class of Station and Nature of Service, published by Industry Canada	October, 2008

11 Test Equipment List with Calibration Data

Type	Inv.-No.	Type Designation	Serial Number	Manufacturer	Calibration Organization	Last Calibration	Next Calibration
EMI test receiver	2044	ESU8	100232	Rohde & Schwarz	Rohde & Schwarz	07/2012	01/2014
EMI test receiver	1028	ESHS10	860043/016	Rohde & Schwarz	Rohde & Schwarz	04/2012	10/2013
Spectrum analyser	1666	FSP30	100063	Rohde & Schwarz	Rohde & Schwarz	11/2012	05/2014
Preamplifier	1684	AFS3-00100800-32-LN	847743	MITEQ	TÜV SÜD PS-EMC-STR	10/2011	10/2013
Double ridged waveguide horn antenna	1516	3115	9508-4553	EMCO Elektronik	Seibersdorf Laboratories	11/2012	11/2014
Loop antenna	1016	HFH2-Z2	882964/0001	Rohde & Schwarz	Rohde & Schwarz	11/2012	05/2014
V-network	1059	ESH3-25	894785/005	Rohde & Schwarz	Rohde & Schwarz	08/2011	08/2013
TRILOG Broadband Antenna	2058	VULB 9163	9163-408	Schwarzbeck	Rohde & Schwarz	11/2012	05/2014

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.

12 Revision History

Revision History			
<i>Edition</i>	<i>Date</i>	<i>Issued by</i>	<i>Modifications</i>
1	2013-08-29	Martin Steindl (gz)	First Edition
2	2014-01-08	M. Steindl	Update of normative references and correction of calibration datas