

August 28, 2014

Page 1 of 44

Prüfbericht / Test Report

Nr. / No. 69557-45462 (Edition 1)

Applicant: Brooks Automation (Germany) GmbH
Type of equipment: RFID Reader
Type designation: LF40C-THR
Order No.: Order dated 10 July 2014
Test standards: FCC Code of Federal Regulations,
CFR 47, Part 15,
Sections 15.205, 15.207 and 15.209

Industry Canada Radio Standards Specifications
RSS-GEN Issue 3, Sections 7.2.2, 7.2.4 and 7.2.5 (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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Table of Contents

1	Description of the Equipment Under Test (EUT)	3
2	Administrative Data	4
3	Identification of the Test Laboratory	5
4	Summary	6
5	Operation Mode and Configuration of EUT	7
6	Measurement Procedures	8
6.1	Bandwidth Measurements	8
6.2	Conducted AC Powerline Emission	10
6.3	Radiated Emission Measurement 9 kHz to 30 MHz	12
6.4	Radiated Emission in Fully or Semi Anechoic Room	14
6.5	Radiated Emission at Alternative Test Site	16
7	Photographs Taken During Testing	18
8	Test Results	22
8.1	Occupied Bandwidth	23
8.2	Bandwidth of the Emission	27
8.3	Designation of Emissions	29
8.4	Restricted Bands of Operation	30
8.5	Conducted Powerline Emission Measurement 150 kHz to 30 MHz	31
8.6	Radiated Emission Measurement 9 kHz to 30 MHz	34
8.7	Radiated Emission Measurement 30 MHz to 1 GHz	36
8.8	Exposure of Humans to RF Fields	38
9	Referenced Regulations	40
10	Test Equipment List with Calibration Data	42
11	Revision History	43
Annex A	Charts taken during testing	44

1 Description of the Equipment Under Test (EUT)

General data of EUT	
Type designation ¹ :	LF40C-THR
Parts ² :	
Serial number(s):	1407MIS20017
Manufacturer:	Brooks Automation (Germany) GmbH
Type of equipment:	RFID Reader
Version:	As delivered
FCC ID:	N5GLF40C
Industry Canada ID:	N/A
Additional parts/accessories:	

Technical data of EUT	
Application frequency range:	< 1.705 MHz
Frequency range:	
Operating frequency:	134.2 kHz
Type of modulation:	ASK
Pulse train:	N/A
Pulse width:	N/A
Number of RF-channels:	1
Channel spacing:	Wideband
Designation of emissions ³ :	2K0A1D
Type of antenna:	Integrated (inductive Loop)
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 minimum voltage: 4.75 V maximum voltage: 5.25 V nominal frequency: DC Hz

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.

³ Also known as "Class of Emission".

2 Administrative Data

Application details

Applicant (full address):	Brooks Automation (Germany) GmbH Gartenstrasse 19 D-95490 Mistelgau / Germany
Contact person:	Lothar Düngfelder
Order number:	Order dated 10 July 2014
Receipt of EUT:	11 July 2014
Date(s) of test:	05 - 08 August 2014
Note(s):	

Report details

Report number:	69557-45462
Edition:	1
Issue date:	28 August 2014

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 and 15.209
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 (Category I Equipment)**
of Industry Canada (IC).

Personnel involved in this report

Laboratory Manager:



Mr. Johann Roidt

Responsible for testing:

Mr. Johann Roidt

Responsible for test report:

Mr. Johann Roidt

5 Operation Mode and Configuration of EUT

Operation Mode(s)

Continuously reading a transponder

Configuration(s) of EUT

Reader was connected to the USB port of a Samsung Netbook PC. A Tag was fix mounted at the antenna area of the reader.

List of ports and cables

Port	Description	Classification ⁴	Cable type	Cable length
1	USB interface port	dc power signal/control port	Shielded	2 m

List of devices connected to EUT

Item	Description	Type Designation	Serial no. or ID	Manufacturer
1	Netbook PC			Samsung
2				
3				
4				

List of support devices

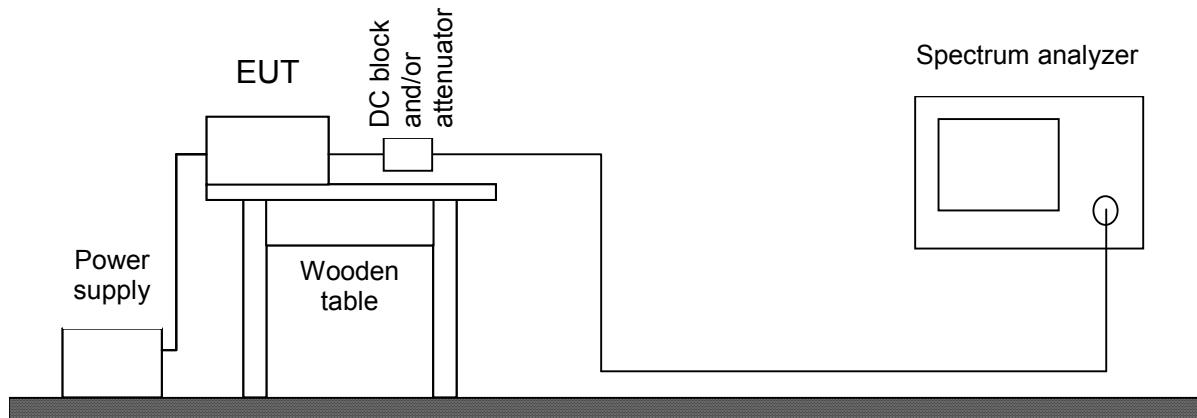
Item	Description	Type Designation	Serial no. or ID	Manufacturer
1	None			
2				
3				
4				

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 Measurement 9 kHz to 30 MHz (6.3)
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).	

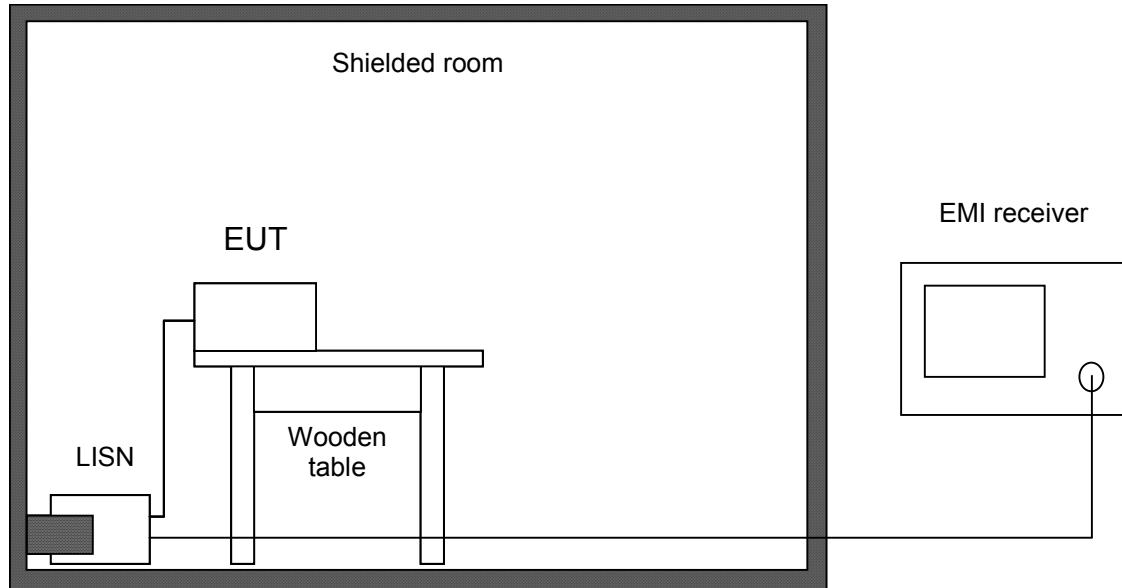


Test instruments used for conducted measurements:

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

6.2 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
<input checked="" type="checkbox"/> Test receiver	ESHS 10	1028	860043/016	Rohde & Schwarz
<input checked="" type="checkbox"/> V-network	ESH 3-Z5	1059	894785/005	Rohde & Schwarz
<input type="checkbox"/> V-network	ESH 3-Z5	1218	830952/025	Rohde & Schwarz
<input type="checkbox"/> Artificial mains network	ESH 2-Z5	1536	842966/004	Rohde & Schwarz
<input type="checkbox"/> Shielded room	No. 1	1451	---	Albatross
<input checked="" type="checkbox"/> Shielded room	No. 4	1454	3FD 100 544	Euroshield

6.3 Radiated Emission Measurement 9 kHz to 30 MHz

Measurement Procedure:

Rules and specifications:	CFR 47 Part 15, sections 15.205 and 15.209 IC RSS-GEN Issue 3, sections 7.2.2 and 7.2.5
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.

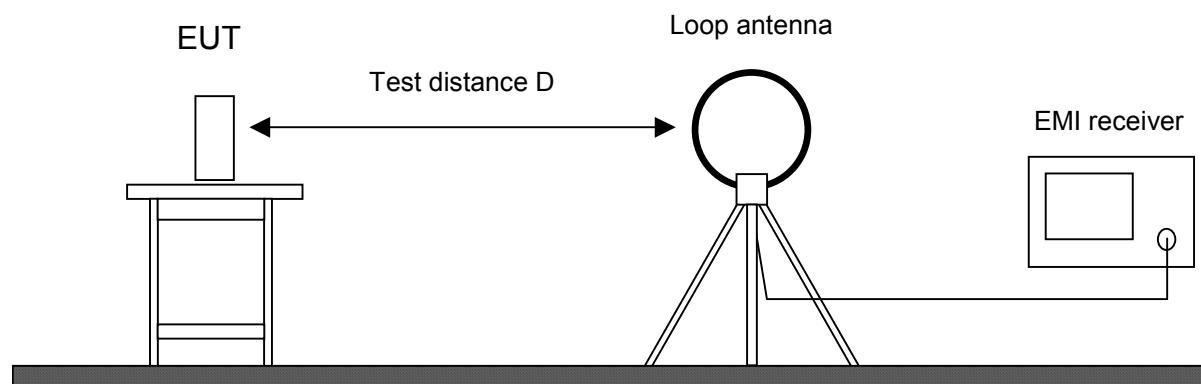
Hand-held or body-worn devices are rotated through three orthogonal axes to determine which attitude and configuration produces the highest emission relative to the limit and therefore shall be used for final testing.

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 type="checkbox"/> Spectrum analyzer	FSP30	1666	100036	Rohde & Schwarz
<input checked="" 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	CPA9231A	1716	3557	Schaffner
<input checked="" type="checkbox"/> Loop antenna	HFH2-Z2	1016	882964/1	Rohde & Schwarz
<input type="checkbox"/> Fully anechoic room	No. 2	1452	---	Albatross
<input type="checkbox"/> Semi anechoic room	No. 3	1453	---	Siemens
<input checked="" type="checkbox"/> Semi anechoic room	No. 8	2057	---	Albatross

6.4 Radiated Emission in Fully or Semi Anechoic Room

Measurement Procedure:

Rules and specifications:	CFR 47 Part 15, section 15.209 IC RSS-GEN Issue 3, section 7.2.5
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.

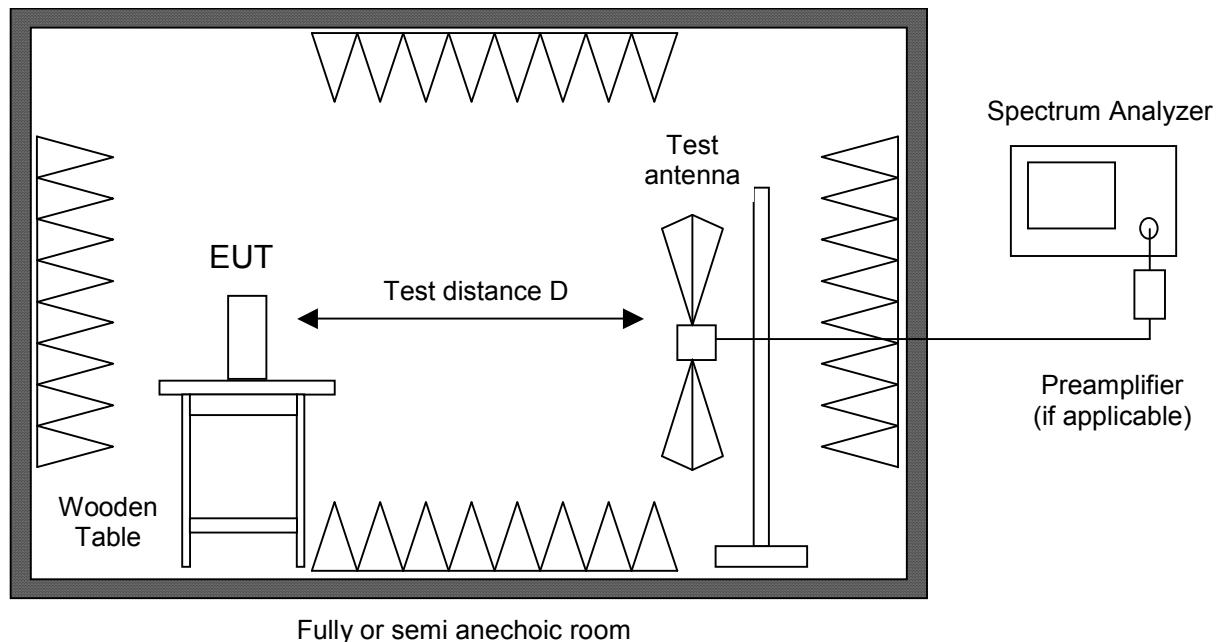
All tests below 8.2 GHz are performed at a test distance D of 3 meters. For higher frequencies the test distance may be reduced (e.g. to 1 meter) due to the sensitivity of the measuring instrument(s) and the test results are calculated according to CFR 47 Part 15 section 15.31(f)(1) using an extrapolation 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 6.5). 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 type="checkbox"/> Spectrum analyzer	FSP30	1666	100036	Rohde & Schwarz
<input type="checkbox"/> EMI test receiver	Cabin no. 3	2010	101018	Rohde & Schwarz
<input checked="" type="checkbox"/> EMI test receiver		2044	100232	Rohde & Schwarz
<input type="checkbox"/> EMI test receiver	ESMI	1569	839379/013	Rohde & Schwarz
			839587/006	
<input type="checkbox"/> Preamplifier	Cabin no. 2	1716	3557	Schaffner
<input type="checkbox"/> Preamplifier		1142	13120026	Advantest
<input type="checkbox"/> Preamplifier (1 - 8 GHz)	AFS3-00100800-32-LN	1684	847743	Miteq
<input type="checkbox"/> Preamplifier (0.5 - 8 GHz)	AMF-4D-005080-25-13P	1685	860149	Miteq
<input type="checkbox"/> Preamplifier (8 - 18 GHz)	ACO/180-3530	1484	32641	CTT
<input type="checkbox"/> External Mixer	WM782A	1576	845881/005	Tektronix
<input type="checkbox"/> Harmonic Mixer Accessories	FS-Z30	1577	624413/003	Rohde & Schwarz
<input type="checkbox"/> Trilog antenna	Cabin no. 2	1802	9163-214	Schwarzbeck
<input type="checkbox"/> Trilog antenna		1722	9163-188	Schwarzbeck
<input checked="" type="checkbox"/> Trilog antenna	Cabin no. 8	2058	9163-408	Schwarzbeck
<input type="checkbox"/> Horn antenna		3115	1516	EMCO
<input type="checkbox"/> Horn antenna	3160-03	1010	9112-1003	EMCO
<input type="checkbox"/> Horn antenna	3160-04	1011	9112-1001	EMCO
<input type="checkbox"/> Horn antenna	3160-05	1012	9112-1001	EMCO
<input type="checkbox"/> Horn antenna	3160-06	1013	9112-1001	EMCO
<input type="checkbox"/> Horn antenna	3160-07	1014	9112-1008	EMCO
<input type="checkbox"/> Horn antenna	3160-08	1015	9112-1002	EMCO
<input type="checkbox"/> Horn antenna	3160-09	1265	9403-1025	EMCO
<input type="checkbox"/> Horn antenna	3160-10	1575	399185	EMCO
<input type="checkbox"/> Fully anechoic room	No. 2	1452	---	Albatross
<input type="checkbox"/> Semi anechoic room	No. 3	1453	---	Siemens
<input checked="" type="checkbox"/> Semi anechoic room	No. 8	2057	---	Albatross

6.5 Radiated Emission at Alternative Test Site

Measurement Procedure:

Rules and specifications:	CFR 47 Part 15, section 15.209 IC RSS-GEN Issue 3, section 7.2.5
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.

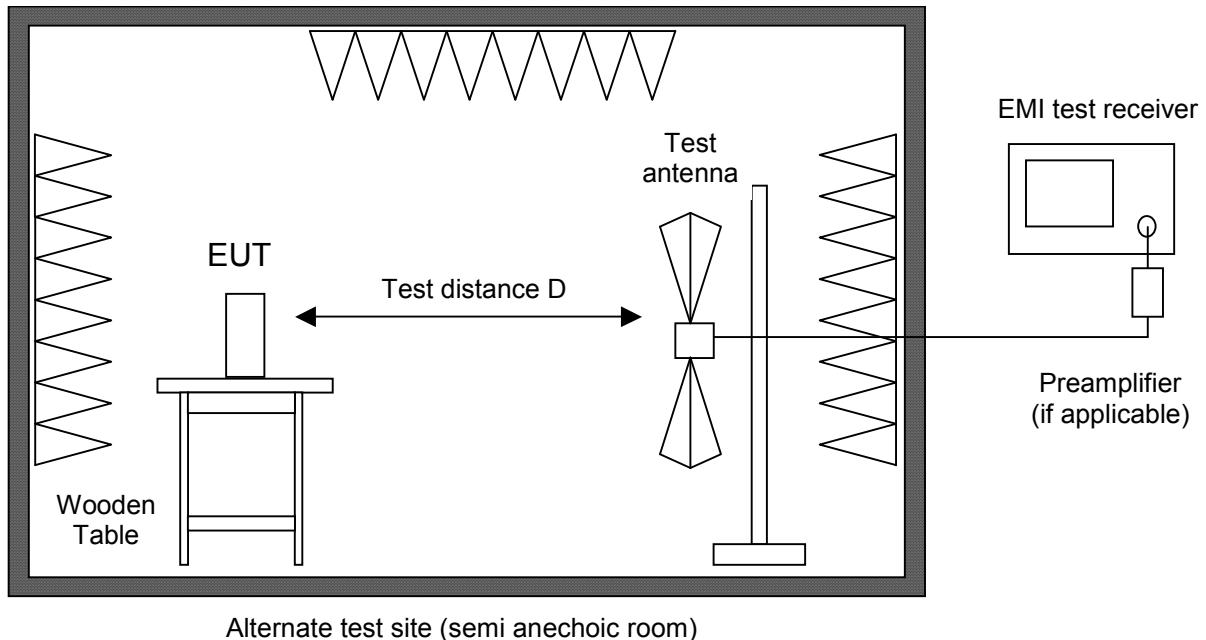
With detector of the test receiver set to quasi-peak final measurements are performed immediately after frequency zoom (for drifting disturbances) and maximum adjustment.

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:

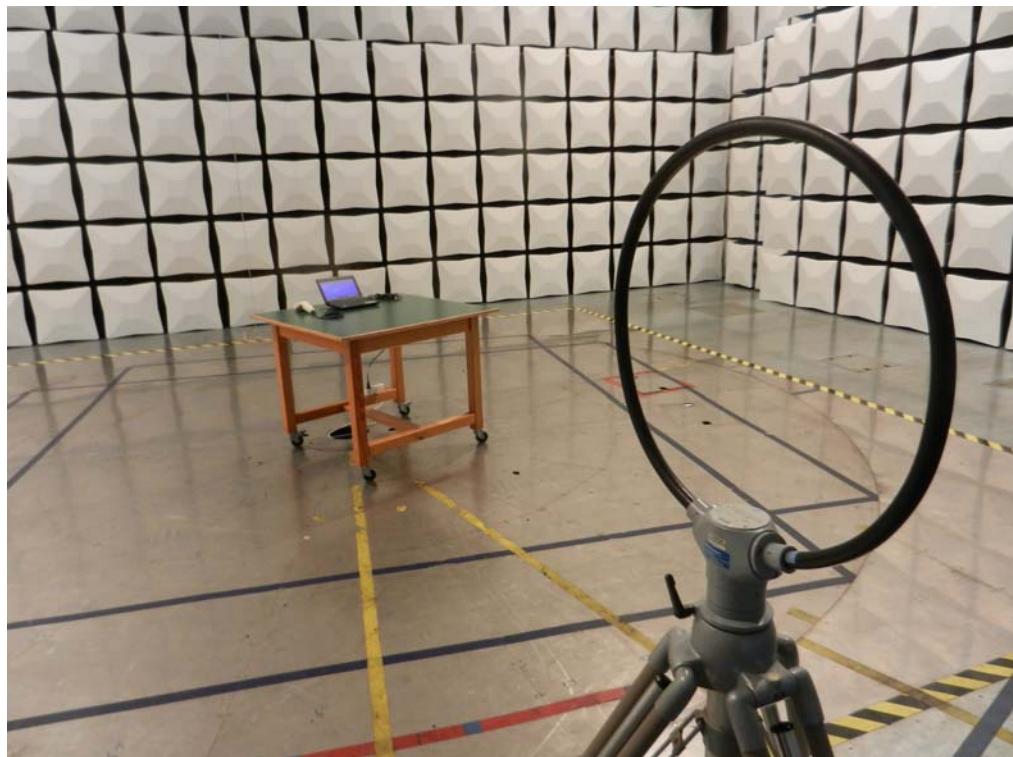
Type	Designation	Inv.-no.	Serial No. or ID	Manufacturer
<input checked="" type="checkbox"/> EMI test receiver	ESU8	2044	100232	Rohde & Schwarz
<input checked="" type="checkbox"/> Trilog antenna	Cabin no. 8	2058	9163-408	Schwarzbeck
<input checked="" type="checkbox"/> Semi anechoic room	No. 8	2057	---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

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 (alternate test site)



8 Test Results

FCC CFR 47 Parts 2 and 15			
Section(s)	Test	Page	Result
2.1046(a)	Conducted output power	---	Not applicable
2.202(a)	Occupied bandwidth	23	Recorded
2.201, 2.202	Class of emission	29	Calculated
15.35(c)	Pulse train measurement for pulsed operation	---	Not applicable
15.205(a)	Restricted bands of operation	30	Test passed
15.207	Conducted AC powerline emission 150 kHz to 30 MHz	31	Test passed
15.205(b) 15.209	Radiated emission 9 kHz to 30 MHz	34	Test passed
15.205(b) 15.209	Radiated emission 30 MHz to 1 GHz	36	Test passed

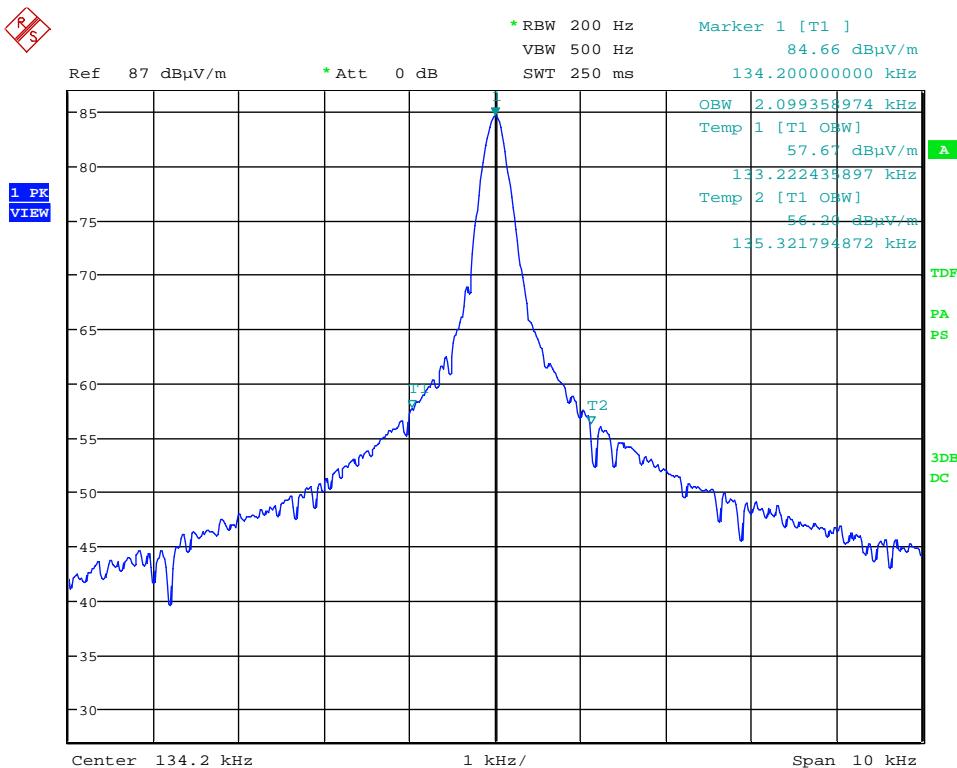
IC RSS-GEN Issue 3			
Section(s)	Test	Page	Result
4.8	Transmitter output power (conducted)	---	Not applicable
4.6.1	Occupied Bandwidth	23	Recorded
8	Designation of emissions	29	Calculated
4.5	Pulsed operation	---	Not applicable
7.2.4	Transmitter AC power lines conducted emissions 150 kHz to 30 MHz	31	Test passed
7.2.2	Restricted bands and unwanted emission frequencies	30	Test passed
7.2.2(b)(c) 7.2.5	Unwanted emissions 9 kHz to 30 MHz	34	Test passed
7.2.2(b)(c) 7.2.5	Unwanted emissions 30 MHz to 1 GHz	36	Test passed
5.6	Exposure of Humans to RF Fields	38	Exempted from SAR and RF evaluation

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> <table border="1"><thead><tr><th>Fundamental frequency</th><th>Minimum resolution bandwidth</th></tr></thead><tbody><tr><td>9 kHz to 30 MHz</td><td>1 kHz</td></tr><tr><td>30 MHz to 1000 MHz</td><td>10 kHz</td></tr><tr><td>1000 MHz to 40 GHz</td><td>100 kHz</td></tr></tbody></table> <p>The video bandwidth shall be at least three times greater than the resolution bandwidth.</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
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								
Measurement procedure:	Bandwidth Measurements (6.1)								

Comment:	
Date of test:	08 August 2014
Test site:	Fully anechoic room, cabin no. 2

Occupied Bandwidth (99 %):



Date: 8.AUG.2014 12:30:59

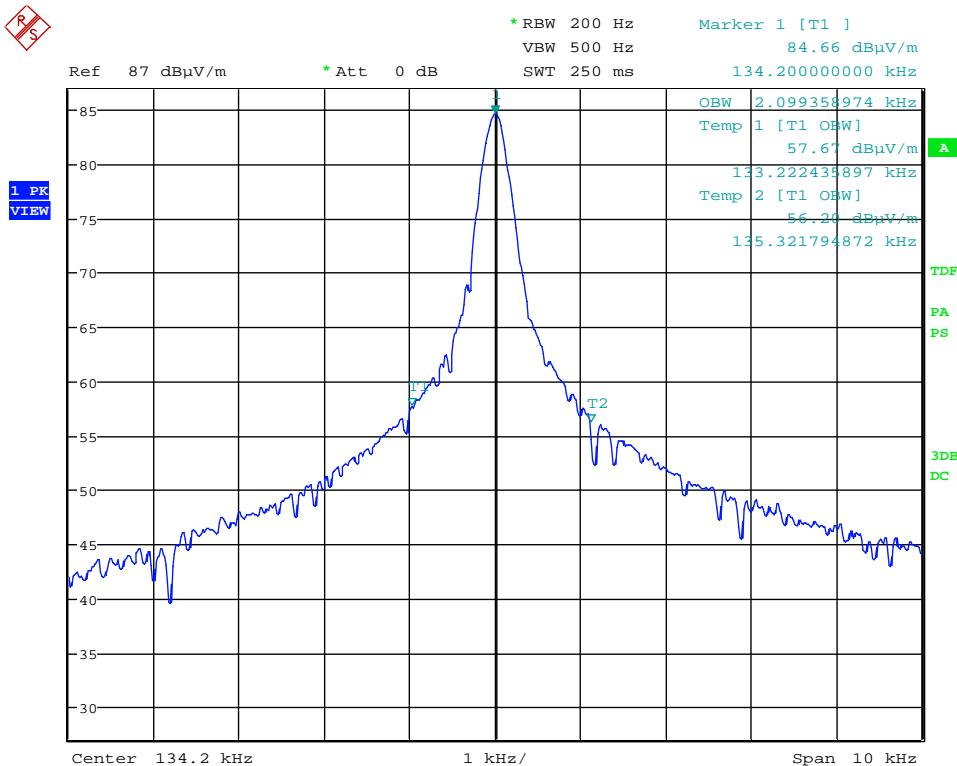
Occupied Bandwidth (99 %): **2.09 kHz**

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:	08 August 2014
Test site:	Fully anechoic room, cabin no. 2

Occupied Bandwidth (99 %):



Date: 8.AUG.2014 12:30:59

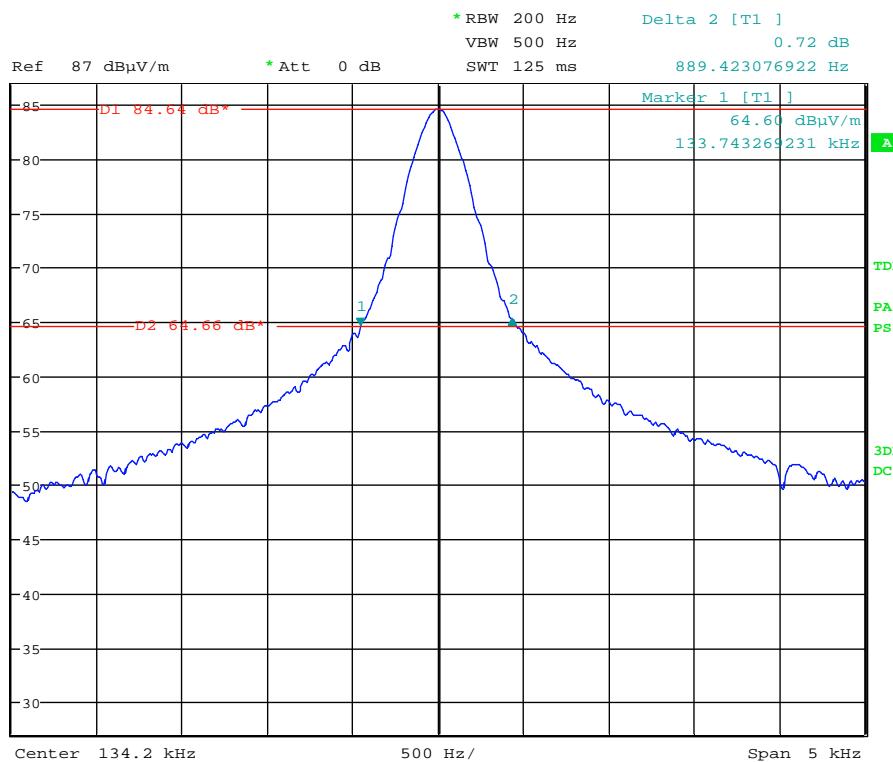
Occupied Bandwidth (99 %): **2.09 kHz**

8.2 Bandwidth of the Emission

Rules and specifications:	CFR 47 Part 15, section 15.209 IC RSS-GEN Issue 3, section 7.2.5								
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> <table border="1"><thead><tr><th>Fundamental frequency</th><th>Minimum resolution bandwidth</th></tr></thead><tbody><tr><td>9 kHz to 30 MHz</td><td>1 kHz</td></tr><tr><td>30 MHz to 1000 MHz</td><td>10 kHz</td></tr><tr><td>1000 MHz to 40 GHz</td><td>100 kHz</td></tr></tbody></table> <p>The video bandwidth shall be at least three times greater than the resolution bandwidth.</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
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								
Measurement procedure:	Bandwidth Measurements (6.1)								

Comment:	
Date of test:	08 August 2014
Test site:	Fully anechoic room, cabin no. 2

85



Date: 8.AUG.2014 12:37:18

Bandwidth of the emission: **0.890 kHz**

8.3 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
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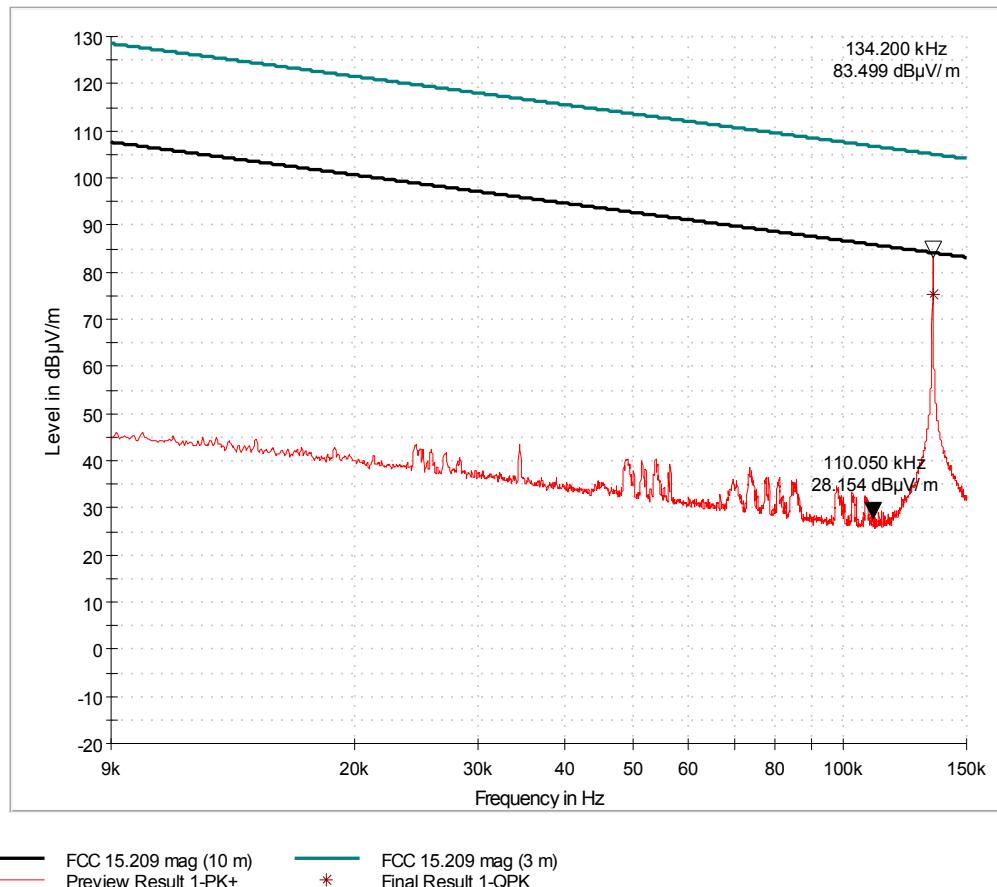
$B_n = \text{Necessary Bandwidth}$	$B_n = 2BK$
$B = \text{Modulation rate}$	$B = 2 \text{ kHz}$
$K = \text{Overall numerical factor}$	$K = 1$
Calculation:	$B_n = 2 \cdot (2 \text{ kHz}) \cdot 1 = 2 \text{ kHz}$

Designation of Emissions:	2K0A1D
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8.4 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 Measurement 9 kHz to 30 MHz (6.3)

Comment:	
Date of test:	08 August 2014
Test site:	Fully anechoic room, cabin no. 2
Test distance:	3 meters



Test Result:	Test passed
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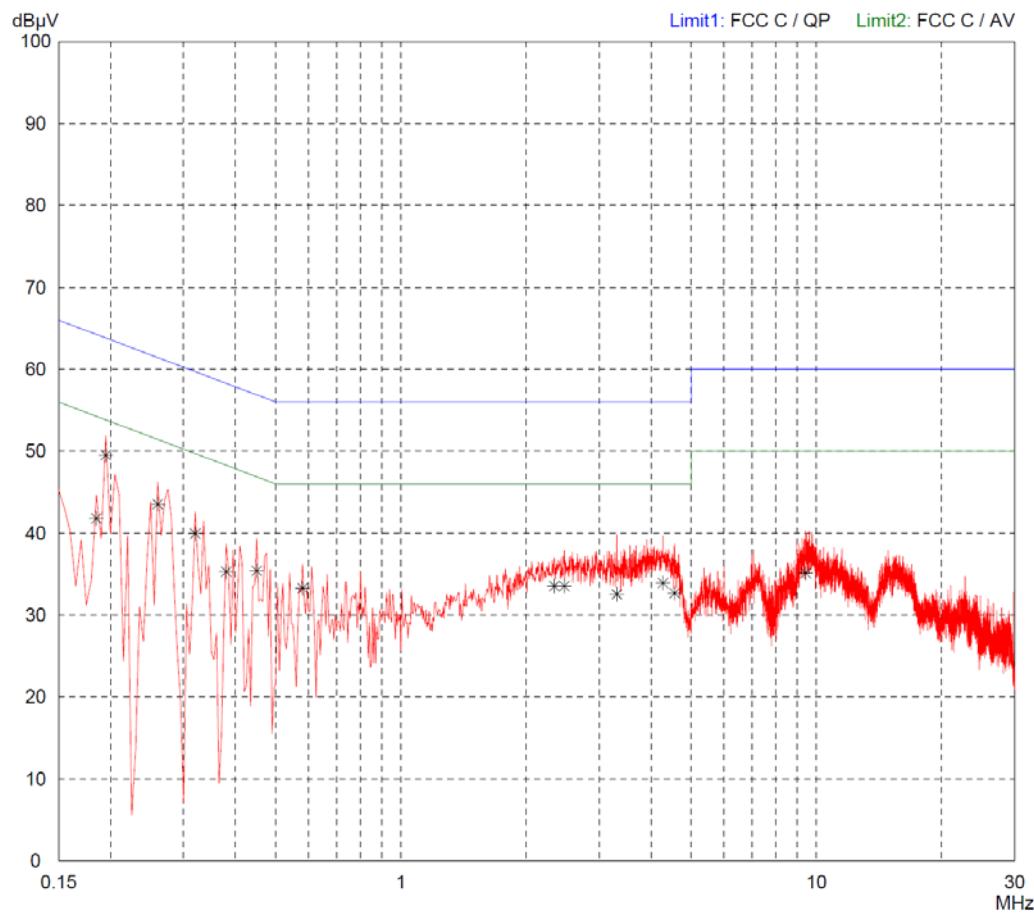
8.5 Conducted Powerline Emission Measurement 150 kHz to 30 MHz

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 (dB μ V)	
		Quasi-peak	Average
	0.15 - 0.5	66 to 56	56 to 46
	0.5 - 5	56	46
	5 - 30	60	50
Measurement procedure:	Conducted AC Powerline Emission (6.2)		

Comment:	
Date of test:	05 August 2014
Test site:	Shielded room, cabin no. 1

Test Result:	Test passed
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Tested on: Live Wire

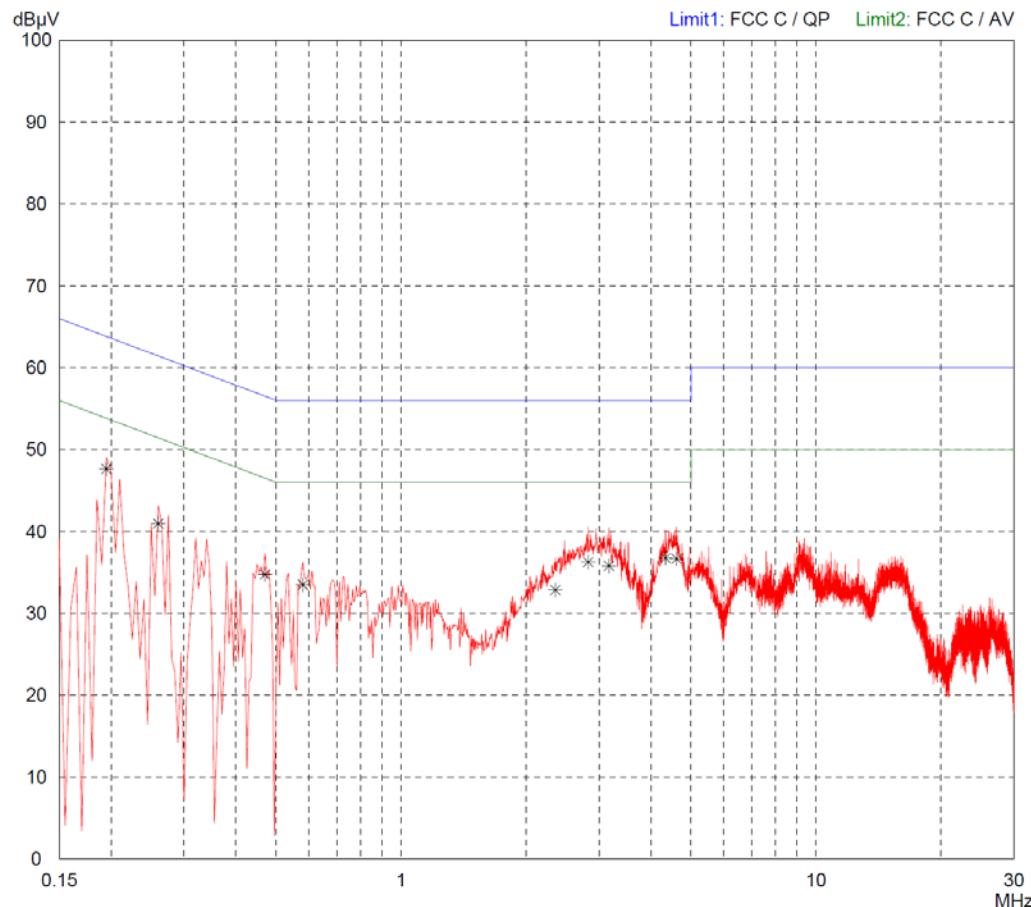


Detector: Peak / Final Results: QP	Final results: 20 dB Margin	25 Subranges
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Frequency MHz	Reading dB μ V	Correction factor dB	Value dB μ V	Limit dB μ V	Margin dB
0.185	41.8		41.8	64.3	22.5
0.195	49.5		49.5	63.8	14.3
0.260	43.5		43.5	61.4	17.9
0.320	39.9		39.9	59.7	19.8
0.380	35.3		35.3	58.3	23.0
0.450	35.4		35.4	56.9	21.5
0.580	33.3		33.3	56.0	22.7
2.340	33.5		33.5	56.0	22.5
2.475	33.5		33.5	56.0	22.5
3.310	32.5		32.5	56.0	23.5
4.275	33.9		33.9	56.0	22.1
4.560	32.7		32.7	56.0	23.3
9.430	35.1		35.1	60.0	24.9

Tested on:

Neutral Wire



Detector: Peak / Final Results: QP	Final results: 20 dB Margin	25 Subranges
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Frequency MHz	Reading dB μ V	Correction factor dB	Value dB μ V	Limit dB μ V	Margin dB
0.195	47.6		47.6	63.8	16.2
0.260	41.0		41.0	61.4	20.4
0.470	34.8		34.8	56.5	21.7
0.580	33.5		33.5	56.0	22.5
2.355	32.9		32.9	56.0	23.1
2.825	36.3		36.3	56.0	19.7
3.170	35.8		35.8	56.0	20.2
4.340	36.8		36.8	56.0	19.2
4.615	36.7		36.7	56.0	19.3

Sample calculation of final values:

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

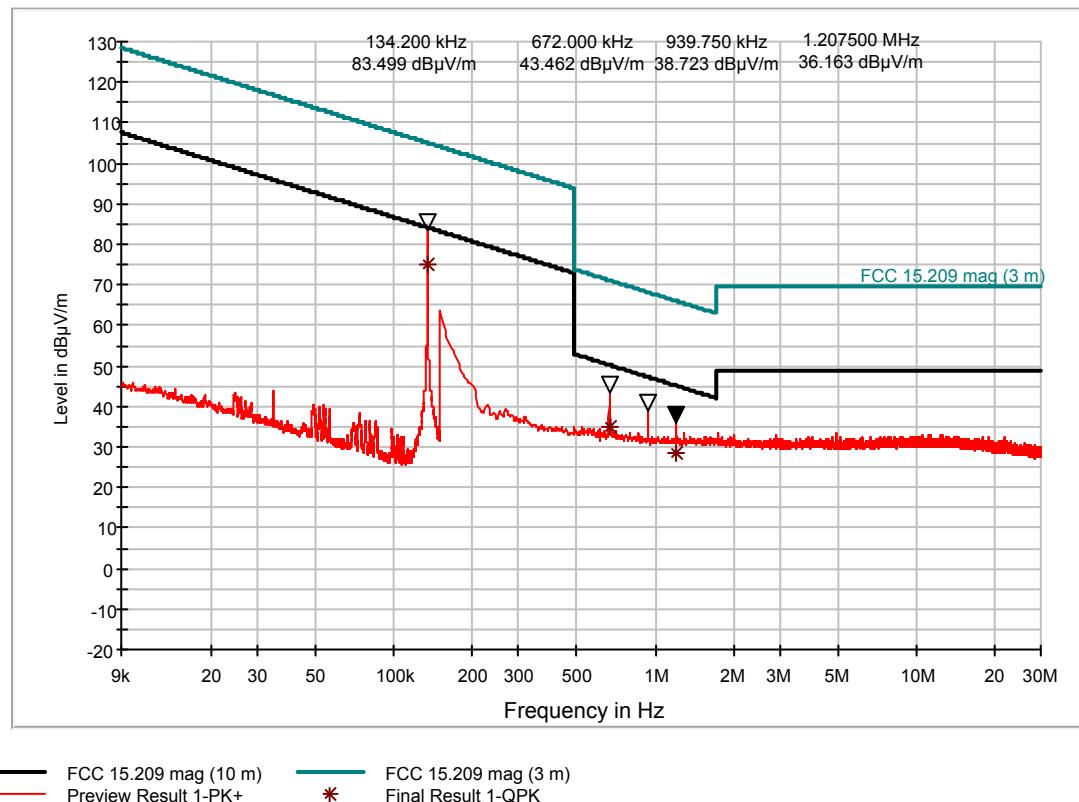
8.6 Radiated Emission Measurement 9 kHz to 30 MHz

Rules and specifications:	CFR 47 Part 15, sections 15.205 and 15.209 IC RSS-GEN Issue 3, sections 7.2.2 and 7.2.5			
Guide:	ANSI C63.4			
Limit:	Frequency of Emission (MHz)	Field Strength (μ V/m)	Field Strength ($\text{dB}\mu$ V/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 (6.3)			

Comment:	
Date of test:	05 August 2014
Test site:	Open field test site

Test Result:	Test passed
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K8 CISPR 16-2-3 Magnetic Field Strength 9kHz - 30 MHz



Final Result 1

Frequency (MHz)	QuasiPeak (dBµV/m)	Bandwidth (kHz)	Polarization	Azimuth (deg)	Extrapolation Factor (dB)	Extrapolated result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
0.134200	75.3	0.200	V	-138.0	80.0	-4.7 (300 m)	25.05	29.75
0.672000	34.7	9.000	V	15.0	40.0	-5.3 (30 m)	31.05	36.35
1.207500	28.7	9.000	V	-157.0	40.0	-11.3 (30 m)	25.97	41.27

Sample calculation of final values:

$$\text{Extrapolation Factor (dB/decade)} = \begin{cases} -40 \text{ (dB/decade)} & \text{if } d_1 = d_2 \\ \frac{\text{Reading Value } d_2 \text{ (dBµV)} - \text{Reading Value } d_1 \text{ (dBµV)}}{\log(d_2) - \log(d_1)} & \text{if } d_1 \neq d_2 \end{cases}$$

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

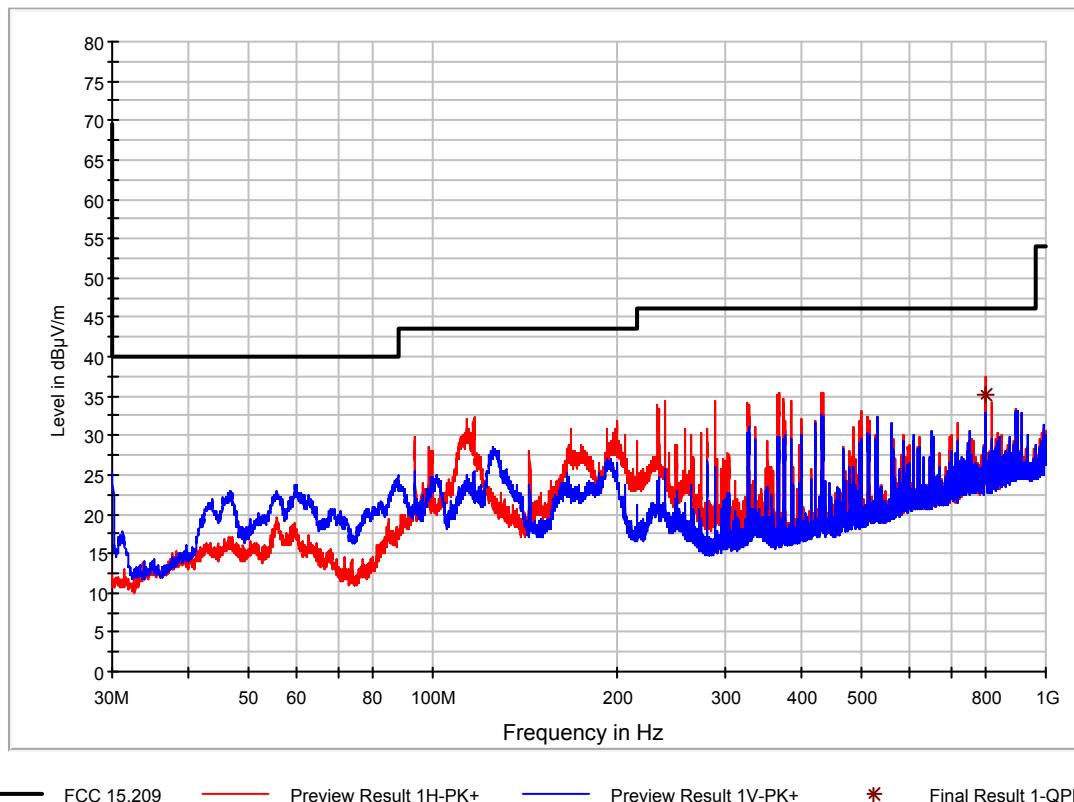
8.7 Radiated Emission Measurement 30 MHz to 1 GHz

Rules and specifications:	CFR 47 Part 15, section 15.209 IC RSS-GEN Issue 3, section 7.2.5		
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 (6.4) Radiated Emission at Alternative Test Site (6.5)		

Comment:	
Date of test:	05 August 2014
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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K8 CISPR 16-2-3 Electric Field Strength 30MHz-1GHz (3m)



Final Result 1

Frequency (MHz)	QuasiPeak (dB μ V/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimut h (deg)	Corr. (dB)	Margin (dB)	Limit (dB μ V/m)
799.500000	35.1	1000.0	120.000	100.0	H	-38.0	23.3	10.9	46.0

Sample calculation of final values:

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

8.8 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					
The conducted output power (CP in watts) is measured at the antenna connector:	$CP = \dots \text{ W}$			<input type="checkbox"/>	
The effective isotropic radiated power (EIRP in watts) is calculated using			<input type="checkbox"/>		
<input type="checkbox"/> the numerical antenna gain: $G = \dots$	$EIRP = G \cdot CP \Rightarrow EIRP = \dots \text{ W}$		<input type="checkbox"/>		
<input type="checkbox"/> the field strength ⁵ in V/m: $FS = \dots \text{ V/m}$			<input type="checkbox"/>		
	$EIRP = \frac{(FS \cdot D)^2}{30} \Rightarrow EIRP = \dots \text{ W}$				
with:					
Distance between the antennas in m: $D = \dots \text{ m}$			<input type="checkbox"/>		
<input checked="" type="checkbox"/> not detachable					
A field strength measurement is used to determine the effective isotropic radiated power (EIRP in watts) given by ⁵ :	$EIRP = \frac{(FS \cdot D)^2}{30} \Rightarrow EIRP = 10.8 \times 10^{-6} \text{ W}$				
with:					
Field strength in V/m: $FS = 0.006 \text{ V/m}$			<input type="checkbox"/>		
Distance between the two antennas in m: $D = 3 \text{ m}$			<input type="checkbox"/>		
Selection of output power					
The output power TP is the higher of the conducted or effective isotropic radiated power (e.i.r.p.):	$TP = 10.8 \times 10^{-6} \text{ W}$				

⁵ The conversion formula is valid only for properly matched antennas. In other cases the transmitter output power may have to be measured by a terminated measurement when applying the exemption clauses. If an open area test site is used for field strength measurement, the effect due to the metal ground reflecting plane should be subtracted from the maximum field strength value in order to reference it to free space, before calculating TP.

Exposure of Humans to RF Fields (continued)		Applicable	Declared by applicant	Measured	Exemption
Separation distance between the user and the transmitting device is					
<input checked="" type="checkbox"/> less than or equal to 20 cm <input type="checkbox"/> greater than 20 cm			<input checked="" type="checkbox"/>		
Transmitting device is					
<input type="checkbox"/> in the vicinity of the human head <input type="checkbox"/> body-worn			<input checked="" type="checkbox"/>		
SAR evaluation					
<p>SAR evaluation is required if the separation distance between the user and the device is less than or equal to 20 cm.</p> <ul style="list-style-type: none"> <input checked="" type="checkbox"/> The device operates from 3 kHz up to 1 GHz inclusively and with output power (i.e. the higher of the conducted or equivalent isotropically radiated power (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 200 mW for general public use and 1000 mW for controlled use. <input type="checkbox"/> ; <input type="checkbox"/> The device operates above 1 GHz and up to 2.2 GHz inclusively and with output power (i.e. the higher of the conducted or radiated (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 100 W for general public use and 500 W for controlled use. <input type="checkbox"/> The device operates above 2.2 GHz and up to 3 GHz inclusively and with output power (i.e. the higher of the conducted or radiated (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 20 mW for general public use and 100 mW for controlled use. <input type="checkbox"/> The device operates above 3 GHz and up to 6 GHz inclusively and with output power (i.e. the higher of the conducted or radiated (e.i.r.p.) source-based, time-averaged output power) that is less than or equal to 10 mW for general public use and 50 mW for controlled use. <input type="checkbox"/> SAR evaluation is documented in test report no. 					<input checked="" type="checkbox"/>
RF exposure evaluation					
<p>RF exposure evaluation is required if the separation distance between the user and the device is greater than 20 cm.</p> <ul style="list-style-type: none"> <input type="checkbox"/> The device operates below 1.5 GHz and the maximum e.i.r.p. of the device is equal to or less than 2.5 W. <input type="checkbox"/> The device operates at or above 1.5 GHz and the maximum e.i.r.p. of the device is equal to or less than 5 W. <input type="checkbox"/> RF exposure evaluation is documented in test report no. 					<input checked="" type="checkbox"/>

9 Referenced Regulations

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

<input checked="" type="checkbox"/>	CFR 47 Part 2	Code of Federal Regulations Part 2 (Frequency allocation and radio treaty matters; General rules and regulations) of the Federal Communication Commission (FCC)	October 1, 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 5 (Information Technology Equipment (ITE) - Limits and methods of measurement), published by Industry Canada	August 2012
<input checked="" type="checkbox"/>	CISPR 22	Third Edition of the International Special Committee on Radio Interference (CISPR), Pub. 22, "Information Technology Equipment – Radio Disturbance Characteristics – Limits and Methods of Measurement"	1997

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

10 Test Equipment List with Calibration Data

Type	Inv.-No.	Type Designation	Serial Number	Manufacturer	Calibration Organization	Last Calibration	Next Calibration
EMI test receiver	1028	ESHS10	860043/016	Rohde & Schwarz	Rohde & Schwarz	03/2013	09/2014
EMI test receiver	2044	ESU8	100232	Rohde & Schwarz	Rohde & Schwarz	01/2014	07/2015
V-network	1059	ESH3-Z5	894785/005	Rohde & Schwarz	Rohde & Schwarz	08/2013	08/2015
Loop antenna	1016	HFH2-Z2	882964/0001	Rohde & Schwarz	Rohde & Schwarz	05/2014	11/2015
TRILOG Broadband Antenna	2058	VULB 9163	9163-408	Schwarzbeck	Rohde & Schwarz	05/2014	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.

11 Revision History

Revision History			
<i>Edition</i>	<i>Date</i>	<i>Issued by</i>	<i>Modifications</i>
1	28 Aug 2014	J. Roidt	First Edition

Annex A Charts taken during testing