AMENDED EMC TEST REPORT

Report Number: 103090353LEX-004.1
Project Number: G103090353

Report Issue Date: 6/23/2017

Model(s) Tested: Tork EasyCube Gateway

Standards: 47 CFR Part 15, Subpart C, Section 15.247
RSS GEN Issue 4: 2014
RSS 247 Issue 1: 2015

Tested by:
Intertek Testing Services NA, Inc.
731 Enterprise Drive
Lexington, KY 40510
USA

Client:
SCA Hygiene Products AB
Molndals Bro 2
Goteborg, 405 03

Report prepared by

Brian Daffin,
Engineer

Report reviewed by

Bryan Taylor,
Team Leader

Table of Contents

1 Introduction and Conclusion

The tests indicated in section 2.0 were performed on the product constructed as described in section 4.0. The remaining test sections are the verbatim text from the actual data sheets used during the investigation. These test sections include the test name, the specified test Method, a list of the actual Test Equipment Used, documentation Photos, Results and raw Data. No additions, deviations, or exclusions have been made from the standard(s) unless specifically noted.

Based on the results of our investigation, we have concluded the product tested **complies** with the requirements of the standard(s) indicated. The results obtained in this test report pertain only to the item(s) tested. Intertek does not make any claims of compliance for samples or variants which were not tested.

2 Reason for Amendment

This report was amended from its original condition in order to include the conducted report as an appendix.

3 Test Summary

Section	Test full name		Result
7	Radiated Spurious Emissions FCC 15.209 FCC 15.247	RSS-GEN Table 5 RSS-247	Compliant
8	Revision History		
9	Annex A: Conducted Report		Compliant

Note: See original certification report exhibit for data on conducted port tests.

4 Client Information

This EUT was tested at the request of:

Client: SCA Hygiene Products AB
Molndals Bro 2
Goteborg, 405 03

Contact: Peter Blomstrom
Telephone: +46 317460000

Manufacturer: SCA Hygiene Products AB
Molndals Bro 2
Goteborg, 405 03
Sweden

5 Description of Equipment under Test and Variant Models

Description of Equipment Under Test (provided by client)			
Wireless sensor gateway equipped with SRD radio and 3G wireless module.			
Equipment Under Test			
Description	Manufacturer	Model Number	Serial Number
Tork EasyCube Gateway	SCA Hygiene Products AB	652810, 682920	Test Unit #1

Receive Date:	5/3/2017
Received Condition:	Good
Type:	Production

Equipment Under Test Power Configuration			
Rated Voltage	Rated Current	Rated Frequency	Number of Phases
5 VDC	<1 A	DC	1

Operating modes of the EUT:

No.	Descriptions of EUT Exercising
1	Continuous O-QPSK modulated transmission, restricted to one channel on 2405MHz

Variant Models:

There were no variant models covered by this evaluation.

6 System Setup and Method

Cables used in the test configuration:

Cables					
ID	Description	Length (m)	Shielding	Ferrites	Termination
	AC Power	1.5	No	No	DC Plug

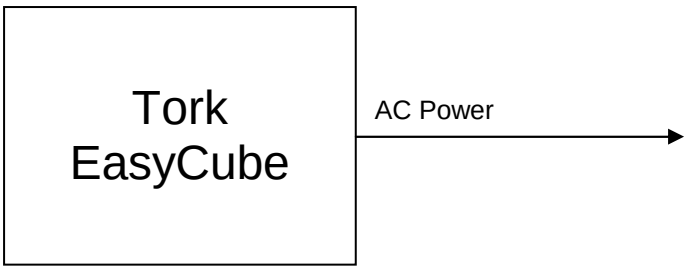
Support equipment used in the test configuration:

No support equipment was used in the test configuration.

6.1 Method:

Configuration as required by ANSIC63.10:2013

6.2 EUT Block Diagram:



6.3 EUT Photo (Front):

6.4 EUT Photo (Back):

7 Radiated Spurious Emissions

7.1 Method

Tests are performed in accordance with ANSIC63.10:2013

TEST SITE: 10m ALSE

Site Designation: 10m Chamber

Measurement Uncertainty

Measurement	Frequency Range	Expanded Uncertainty (k=2)	Ucispr
Radiated Emissions, 10m	30-1000 MHz	3.9dB	6.3 dB
Radiated Emissions, 3m	30-1000 MHz	4.0dB	6.3 dB
Radiated Emissions, 3m	1-6 GHz	4.7dB	5.2 dB
Radiated Emissions, 3m	6-15 GHz	4.7dB	5.5 dB
Radiated Emissions, 3m	15-18 GHz	4.7dB	5.5 dB
Radiated Emissions, 3m	18-40 GHz	4.7dB	5.5 dB

As shown in the table above our radiated emissions U_{lab} is less than the corresponding U_{CISPR} reference value in CISPR 16-4-2 Table 1, hence the compliance of the product is only based on the measured value, and no measurement uncertainty correction is required, based on CISPR 22 and CISPR 11 (for 2006 and later revisions) Clause 11.

Sample Calculation

The field strength is calculated by adding the Antenna Factor and Cable Factor, and subtracting the Amplifier Gain (if any) from the measured reading. The basic equation with a sample calculation is as follows:

FS = RA + AF + CF - AG
Where FS = Field Strength in dBμV/m
RA = Receiver Amplitude (including preamplifier) in dBμV
CF = Cable Attenuation Factor in dB
AF = Antenna Factor in dB
AG = Amplifier Gain in dB

In the following table(s), the reading shown on the data table reflects the preamplifier gain. An example for the calculations in the following table is as follows.

Assume a receiver reading of 52.0 dBμV is obtained. The antenna factor of 7.4 dB and cable factor of 1.6 dB is added. The amplifier gain of 29 dB is subtracted, giving a field strength of 32 dBμV/m. This value in dBμV/m was converted to its corresponding level in μV/m.

RA = 52.0 dBμV
AF = 7.4 dB/m
CF = 1.6 dB
AG = 29.0 dB
FS = 32 dBμV/m

To convert from dBμV to μV or mV the following was used:

$UF = 10^{(NF / 20)}$ where UF = Net Reading in μV
NF = Net Reading in dBμV

Example:

FS = RA + AF + CF – AG = 52.0 + 7.4 + 1.6 – 29.0 = 32.0
$UF = 10^{(32\ dB\mu V / 20)}$ = 39.8 μV/m

7.2 Test Equipment Used:

Description	Serial Number	Manufacturer	Model	Cal. Date	Cal. Due
EMI Test Receiver	10887490.26	Rohde & Schwarz	ESI26	9/20/2016	9/20/2017
Preamplifier	122005	Rohde&Schwarz	TS-PR18	11/17/2016	11/17/2017
Biconnilog Antenna	00051864	ETS	3142C	4/6/2017	4/6/2018
Horn Antenna	154521	ETS	3117	11/14/2016	11/14/2017
System Controller	121701-1	Sunol Sciences	SC99V	Verify at Time of Use	Verify at Time of Use
3m Cable Antenna→Preamp	3074			11/17/2016	11/17/2017
3m Cable Preamp→Chamber	2588			11/17/2016	11/17/2017
3m Cable Chamber→Control Room	2593			11/17/2016	11/17/2017
3m Cable Control Room→Receiver	2592			11/17/2016	11/17/2017
10m Cable Antenna→Preamp	3339			11/17/2016	11/17/2017
10m Cable Preamp→Chamber	3172			11/17/2016	11/17/2017
10m Cable Chamber→Control Room	2590			11/17/2016	11/17/2017
10m Cable Control Room→Receiver	2589			11/17/2016	11/17/2017

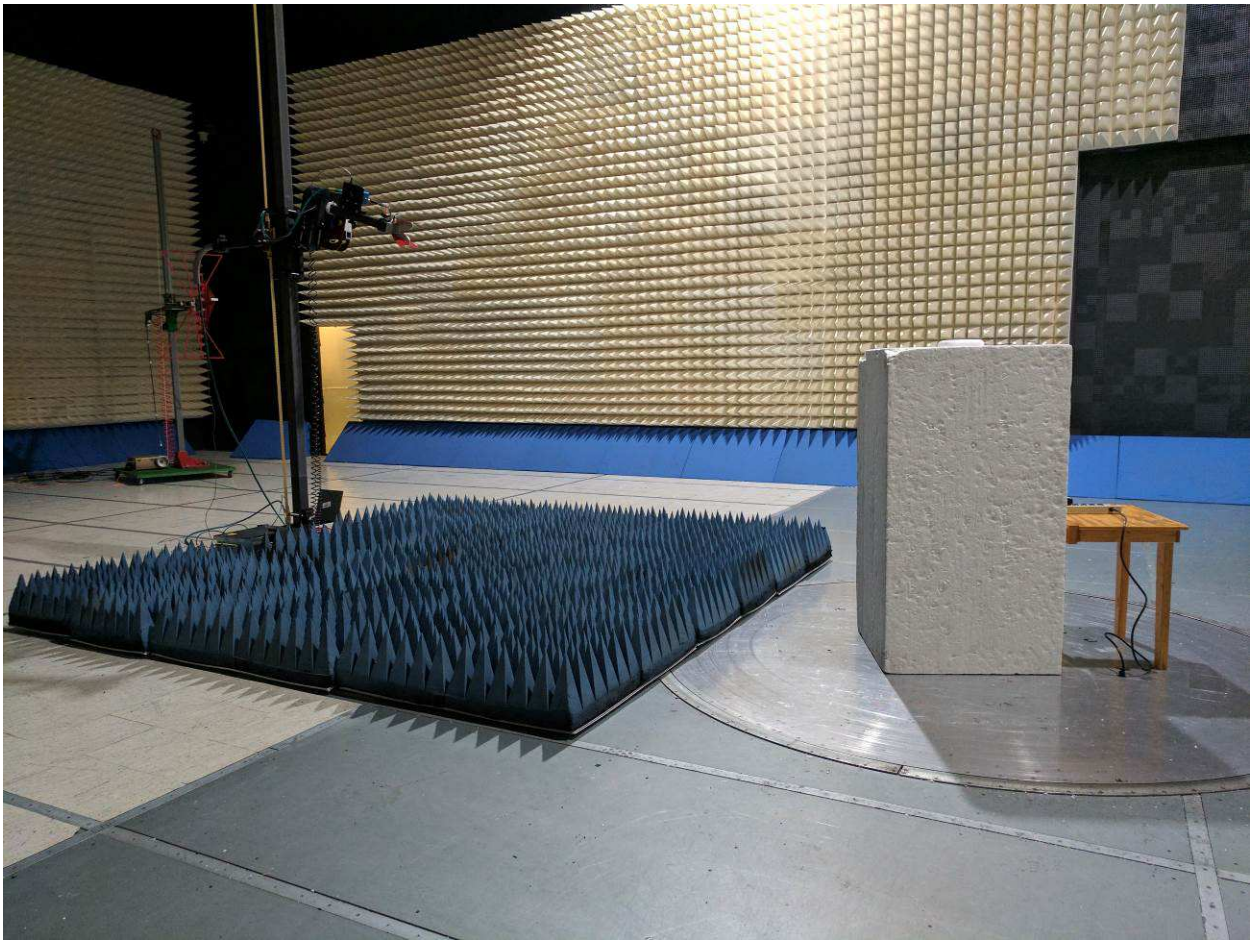
Software Utilized:

Name	Manufacturer	Version
EMC32	Rohde&Schwarz	Version 9.15.02

7.3 Results:

The sample tested was found to Comply.

7.4 Setup Photographs:



7.5 Test Data:

Final_Result_PK+

Frequency (MHz)	MaxPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4809.000000	45.19	74.00	28.81	1000.000	100.0	H	198.0	7.5
7213.800000	45.74	74.00	28.26	1000.000	377.0	V	234.0	10.4
9609.800000	46.26	74.00	27.74	1000.000	210.0	H	141.0	13.6
12005.800000	50.74	74.00	23.26	1000.000	246.0	V	148.0	17.5

Final_Result_AVG

Frequency (MHz)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)	Corr. (dB)
4809.000000	34.76	54.00	19.24	1000.000	100.0	H	198.0	7.5
7213.800000	35.02	54.00	18.98	1000.000	377.0	V	234.0	10.4
9609.800000	33.58	54.00	20.42	1000.000	210.0	H	141.0	13.6
12005.800000	37.62	54.00	16.38	1000.000	246.0	V	148.0	17.5

Test Personnel:	Brian Daffin	Test Date:	5/3/2017
Supervising/Reviewing Engineer: (Where Applicable)	N/A		
Product Standard:	FCC 15.209	Limit Applied:	FCC 15.209 and 15.247
Input Voltage:	5 VDC		
Pretest Verification w/ Ambient Signals or BB Source:	**Yes**	Ambient Temperature:	23.7 C
		Relative Humidity:	34.3 %
		Atmospheric Pressure:	977.9 mbar

Deviations, Additions, or Exclusions: None

Note: Measurements were performed in three orthogonal positions and the worst case measurements were reported.

8 Revision History

Revision Level	Date	Report Number	Prepared By	Reviewed By	Notes
0	6/2/2017	103090353LEX-004	BD	BCT	Original Issue
1	6/23/2017	103090353LEX-004.1	BD	BCT	Added appendix with conducted report.

9 Annex A: Conducted Report

The following appendix includes the original report with the conducted data that still applies. The radiated emission testing was repeated in Lexington KY due to an antenna change. The original radiated emission data is still included in the following report so as not to modify it from its original condition.

RADIO TEST REPORT

No. 1303478-1 Ed. 2

RF performance

EQUIPMENT UNDER TEST

Equipment :	Control unit for wireless sensor system
Type / model :	DCU
Manufacturer :	SCA hygiene products AB
Tested by request of :	SCA hygiene products AB

SUMMARY

Referring to the emission limits and the operating mode during the tests specified in this report the equipment complies with the requirements according to

47 CFR Part 15, Subpart C, Intentional radiators, section 15.247
RSS GEN Issue 4 (2014), RSS 247 ISSUE 1 (2015) (ICES-003 Issue 5 (2012)
Test methods according to ANSI C63.10-2013 and ANSI C63.4 (2014)

Date of issue: 2015-08-28

Tested by: Matti Virkki Approved by: Stefan Andersson

Intertek Semko AB
Torshamnsgatan 43, Box 1103, SE-164 22 Kista, Sweden
Telephone +46 8 750 00 00, Fax +46 8 750 60 30
www.intertek.se
Registered in Sweden: No: SE556024059901, Registered office: As address

Revision History

Edition	Date	Description
1	2013-05-15	First release
2	2015-08-25	Update to RSS-GEN issue 4, RSS-247 Issue 1 and ANSI C63.10 (2013) Re-measurement of radiated emission above 1 GHz, output power and 6 dB bandwidth

CONTENTS

1 CLIENT INFORMATION

The EUT has been tested by request of

Company:	SCA Hygiene products AB Bäckstensgatan 5 405 03 Gothenburg Sweden
Name of contact:	Allan Elfström

2 EQUIPMENT UNDER TEST (EUT)

2.1 Identification of the EUT according to the manufacturer/client declaration

Equipment:	Control unit for wireless sensor system
Type/Model:	DCU
Brand name:	SCA
Serial number:	-
Manufacturer:	SCA Hygiene products AB Bäckstensgatan 5 405 03 Gothenburg Sweden
Transmitter frequency range:	2405 MHz
Receiver frequency range:	2405 MHz

Frequency agile or hopping:	☐ Yes	☒ No
Antenna:	☒ Internal antenna	☐ External antenna
Antenna connector:	☒ None, internal antenna	☐ Yes, type
Antenna gain:	2 dBi	
Rating RF output power:	3 dBm	
Type of modulation:	O-QPSK	
Temperature range:	☐ Category I (General): -20°C to +55°C ☐ Category II (Portable equipment): -10°C to +55°C ☒ Category III (Equipment for normal indoor use): +5°C to +35°C ☐ Other:	
Power rating:	2 mW	
Transmitter standby mode supported:	☒ Yes	☐ No

2.2 Additional hardware information about the EUT

The EUT consists of the following units:

Unit	Part number	Revision	Serial number
DCU	-	--	-

2.3 Additional software information about the EUT

During the tests the EUT supported the following software:

-TX continuous modulated signal
-RX mode

2.4 Peripheral equipment

Peripheral equipment is defined as equipment needed for correct operation of the EUT during the tests, but not included as a part of the testing and evaluation of the EUT.

Equipment	Manufacturer / Type	Serial number
Switch mode power supply	EMSA05012	-

2.5 Test signals

All transmitter tests were made with continuous modulated signal.
Normal

2.6 Modification during the tests

EUT was equipped with power switch and jumper was used between test point 3 and R 55 to enable continuous transmission.
One unit was equipped with SMA connector to enable conducted tests.
No other modifications were made during the tests.

3 TEST SPECIFICATIONS

3.1 Standards

47 CFR Part 15, Subpart C, Intentional radiators, section 15.247
RSS-GEN Issue 4 (2014), RSS-247 Issue 1 (2015)
ICES-003 Issue 5 (2012)

Test methods in:

ANSI C63.10-2013: American National Standard for Testing Unlicensed Wireless Devices

ANSI C63.4 2014: : 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

3.2 Test site

Measurements were performed at:

Intertek Semko AB.
Torshamnsgatan 43,
P.O. Box 1103
SE-164 22 Kista

Intertek Semko AB is a FCC listed test site with site registration number 90913
Intertek Semko AB is a Industry Canada listed test facility with IC assigned code 2042G

Measurement chambers

Measurement Chamber	Type of chamber	IC Site filing #
STORA HALLEN a.k.a. BIG CHAMBER	Semi-anechoic 10m and 3m	2042G-2
Björkhallen	Semi anechoic 3m	2042G-1
RADIOHALLEN	Fully-anechoic 3m	--

3.3 Test set-up

If not stated otherwise EUT was connected to spectrum analyser with coaxial cable.

3.4 Test conditions

If not additionally specified, the tests were performed under the following environmental conditions:

Parameter	Normal	Extreme
Supplying voltage, V	120	85-138
Air temperature, ^{o}C	20	20

4 TEST SUMMARY

The results in this report apply only to the tested sample:

Test	Result	Section in report	Note
Standard test methods			
AC power-line conducted tests	Pass	5	Class B
Radiated test below 30 MHz	N/A		
Radiated emissions measurements from 30 to 1000 MHz	Pass	6	
Determination of radiated and antenna conducted emissions above 1 GHz	Pass	7	
Frequency Stability Test	Pass	9	
Occupied bandwidth and band-edge tests	Pass	10 11 13	
Output Power average symbol envelope power	NA		
Power Spectral Density < 40 GHz	Pass	14	
Power Spectral Density > 40 GHz	NA		
In-situ measurements	NA		
Polar plot, main lobe and variation on radiated emissions test	NA		
Device-specific tests			
Measurement of cable locating equipment	NA		
Determining of cordless telephone handset security code	NA		
Determination of total input power	NA		
Procedure determining compliance for periodic operation [15.231, 15.240(b)]	NA		
Determining the average value of pulsed emissions per 15.35(c)	NA		
Comparison of limits per 15.231(b)(3)	NA		
Procedure to determine compliance of frequency pairing for 47 CFR 15.233(b)(2)	NA		
Determination of frequency hopping compliance per 47 CFR 15.247	NA		
Determination of digital modulation compliance per 47 CFR 15.247	PASS	10	
Determination of peak conducted output unlicensed wireless device power [15.247(b), 15.255]	PASS	12	
Determination of maximum conducted output power (15.247, 15-E)	PASS	12	
Determination of MIMO compliance (2nd edition)	NA		
Determination of Smart antenna compliance (2nd edition)	NA		
Determination of antenna gains, including those emitting in multiple directions (15.247)	PASS	2	
Determination of compliance with RF exposure limits	PASS	12	
Millimeter wave test procedures for systems operating at 54GHz and greater	NA		
Determination of EIRP (15-F)	NA		
Determination Transmitter Etiquette FCC Part 15.255	NA		
Determination of Dynamic Frequency Selection (DFS) including Channel Move Time and In Service Monitoring	NA		
Determination of channel availability	NA		
Determination of Dynamic Frequency Selection including Channel Move Time	NA		
Determination of transmitter power control (TPC) (15-E)	NA		
Peak excursion measurement for UNII devices	NA		
Determination of UWB bandwidth	NA		
Determination of the center frequency, *f*C, and highest radiated emissions, *f*M (15-F)	NA		

NT = Not Tested, by request of the Client
NA = Not Applicable

5 AC LINE CONDUCTED EMISSION, 150 KHZ TO 30 MHZ

Date of test:	2013-4-16	Test location:	EMC Center
EUT Serial:	-	Ambient temp.	23°C
Tested by:	Matti Virkki	Relative humidity	33%
Test result:	Pass	Margin:	9.4 dB

5.1 Requirement

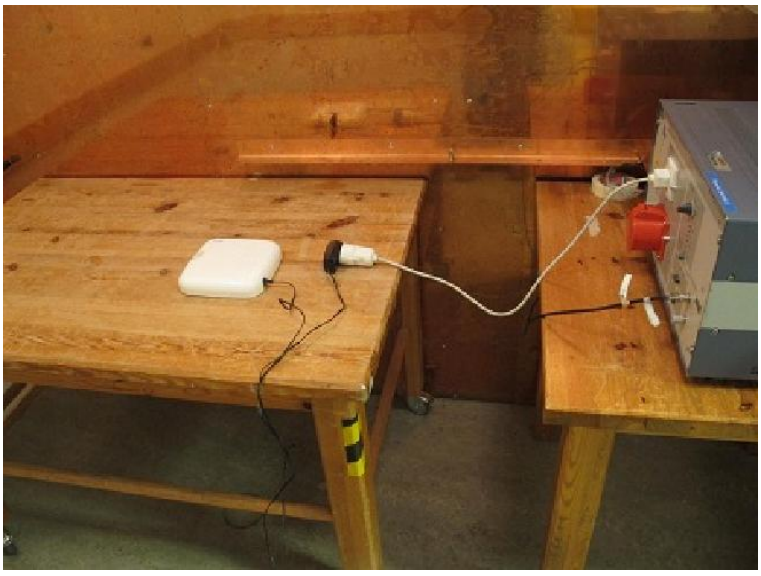
Reference: FCC §15.107, Class B limit
FCC §15.207
RSS-GEN 8.8 table 3
ICES-003 Issue 5 (2012)

Frequency MHz	Quasi-peak Limit dBµV	Average Limit dBµV
0.15 – 0.5	66 – 56	56 – 46
0.5 – 1.6	56	46
1.6 – 30	60	50

5.2 Test setup details

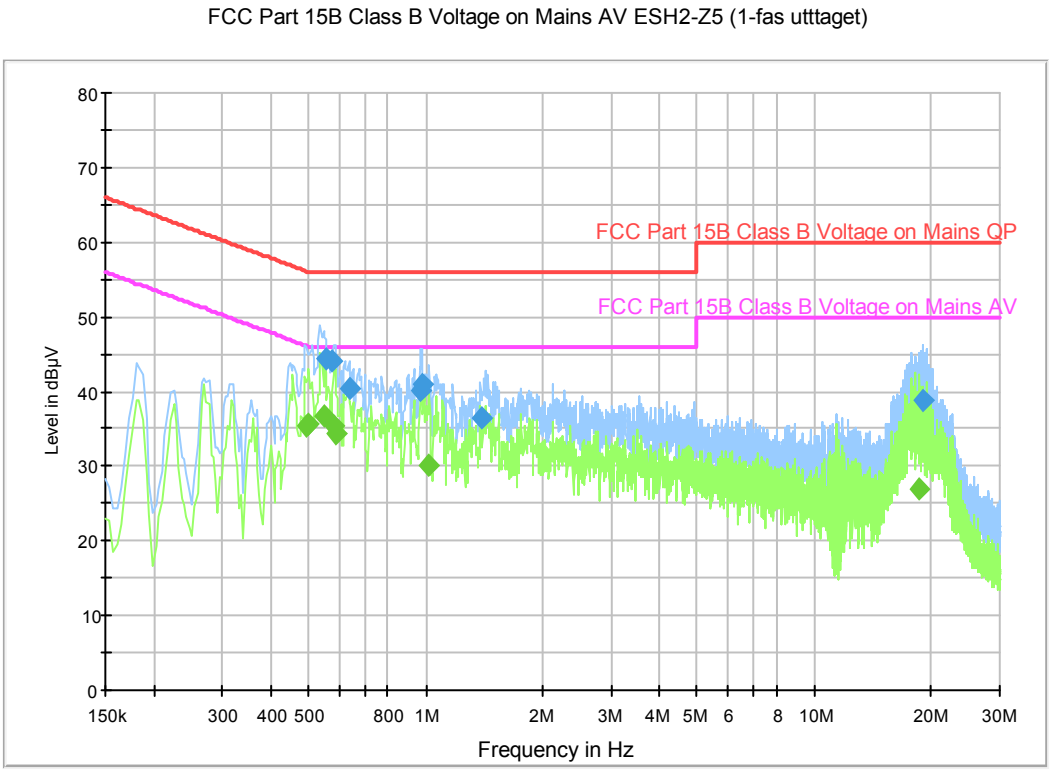
The mains terminal disturbance voltage was measured with the EUT located 0,8 m above the ground plane and 0,4 m from the vertical ground plane. The EUT was connected to an artificial mains network (AMN). The AMN was bonded to the ground plane. Amplitude measurements were performed with a quasi-peak detector. The EUT was supplied by 120 VAC (60 Hz) during the test.

Test set-up photo:



5.3 Test data

Overview sweeps performed with peak and average detectors



Quasi-Peak				Average			
Frequency MHz	Disturbance level dBµV	Limit dBµV	Margin dB	Frequency MHz	Disturbance level dBµV	Limit dBµV	Margin dB
0.55	**44.2**	**56.0**	**11.8**	**0.49**	**35.5**	**46.1**	**10.6**
0.57	**44.1**	**56.0**	**11.9**	**0.50**	**35.6**	**46.0**	**10.4**
0.63	**40.5**	**56.0**	**15.5**	**0.55**	**36.6**	**46.0**	**9.4**
0.97	**40.2**	**56.0**	**15.8**	**0.58**	**35.5**	**46.0**	**10.5**
0.98	**40.9**	**56.0**	**15.1**	**0.58**	**34.4**	**46.0**	**11.6**
1.39	**36.5**	**56.0**	**19.5**	**1.01**	**30.1**	**46.0**	**15.9**
18.96	**38.9**	**60.0**	**21.1**	**18.50**	**27.0**	**50.0**	**23.0**

Measured level [dBµV] = Analyser reading [dBµV] + cable loss [dB] + LISN insertion loss [dB]

5.4 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Measurement software	Rohde & Schwarz	EMC32	--	--
Receiver	Rohde & Schwarz	ESCI	S32455	13/7
AMN / LISN	Rohde & Schwarz	ESH2-Z5	3017	

6 TRANSMITTER RADIATED EMISSIONS MEASUREMENTS FROM 30 TO 1000MHZ

Date of test:	2013-04-09	Test location:	Big Chamber / wireless center
EUT Serial:	-	Ambient temp.	25 °C
Tested by:	Matti Virkki	Relative humidity	31 %
Test result:	Pass	Margin:	12.6 dB

6.1 Requirement

Reference: FCC §15.209, IC RSS-GEN Table 5.

Frequency (MHz)	Field strength (dBμV/m)	Measurement distance (m)
30 – 88	40.0	3
88 – 216	43.5	3
216 – 960	46.0	3
960 –	54.0	3

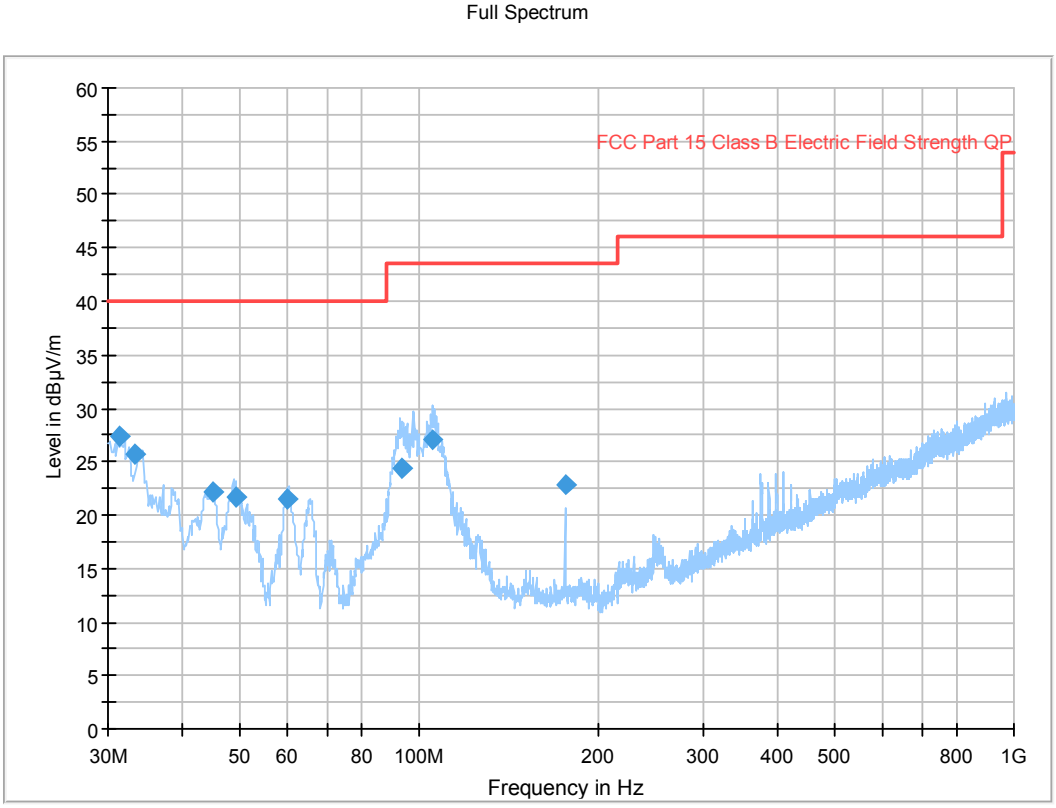
6.2 Test setup details

Operation mode: continuous transmission, modulating.
Test set- up was according to ANSI C63.10 (2013) sections 6.3 and 6.5.

Test set-up photo:

6.3 Test data

Overview sweeps performed with peak detectors,



Frequency MHz	Disturbance Level dBµV/m	RBW kHz	Detector QP	Limit dBµV/m	Pol.	Azimuth deg	Antenna height cm	Margin dB
31.28	**27.35**	**120**	**QP**	**40.00**	**V**	**68.0**	**103.0**	**12.65**
33.20	**25.77**	**120**	**QP**	**40.00**	**V**	**175.0**	**100.0**	**14.23**
44.96	**22.23**	**120**	**QP**	**40.00**	**V**	**133.0**	**100.0**	**17.77**
49.05	**21.69**	**120**	**QP**	**40.00**	**V**	**103.0**	**103.0**	**18.31**
60.24	**21.51**	**120**	**QP**	**40.00**	**V**	**336.0**	**205.0**	**18.49**
93.18	**24.29**	**120**	**QP**	**43.50**	**V**	**45.0**	**143.0**	**19.23**
105.13	**27.00**	**120**	**QP**	**43.50**	**H**	**83.0**	**225.0**	**16.52**
176.01	**22.84**	**120**	**QP**	**43.50**	**H**	**276.0**	**134.0**	**20.68**

Measured level [dBµV/m] = Analyser reading [dBµV] + cable loss [dB] – preamplifier gain [dB] + antenna factor [dB/m]

6.4 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Measurement software	Rohde & Schwarz	EMC 32	--	--
Receiver	Rohde & Schwarz	ESIB26	32291	7/13
Log periodic antenna	Rohde & Schwarz	HBL562	30711	14/12

7 TRANSMITTER RADIATED EMISSIONS MEASUREMENTS ABOVE 1 GHZ

Date of test:	2015-08-22	Test location:	Big Chamber
EUT Serial:	-	Ambient temp.	22°C
Tested by:	Matti Virkki	Relative humidity	42%
Test result:	Pass	Margin:	9.9 dB

7.1 Requirement

Reference: FCC §15.209, IC RSS-GEN Table 5
Method: AnsiC63.10 (2013) sections 6.3 and 6.6.

Within the restricted bands

Frequency (MHz)	Field strength (dBμV/m)	Measurement distance (m)
30 – 88	40.0	3
88 – 216	43.5	3
216 – 960	46.0	3
960 –	54.0	3

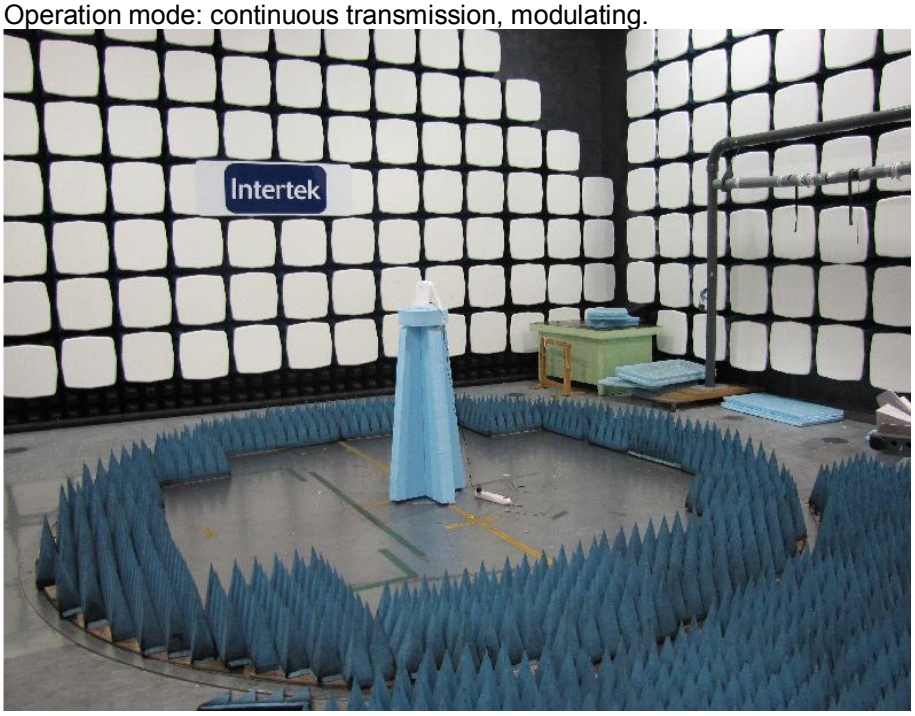
Frequency MHz	Average limit dBμV/m	Peak limit dBμV/m
> 960 MHz	54	74

Outside restricted bands: 15.247 (d) RSS-247 5.5

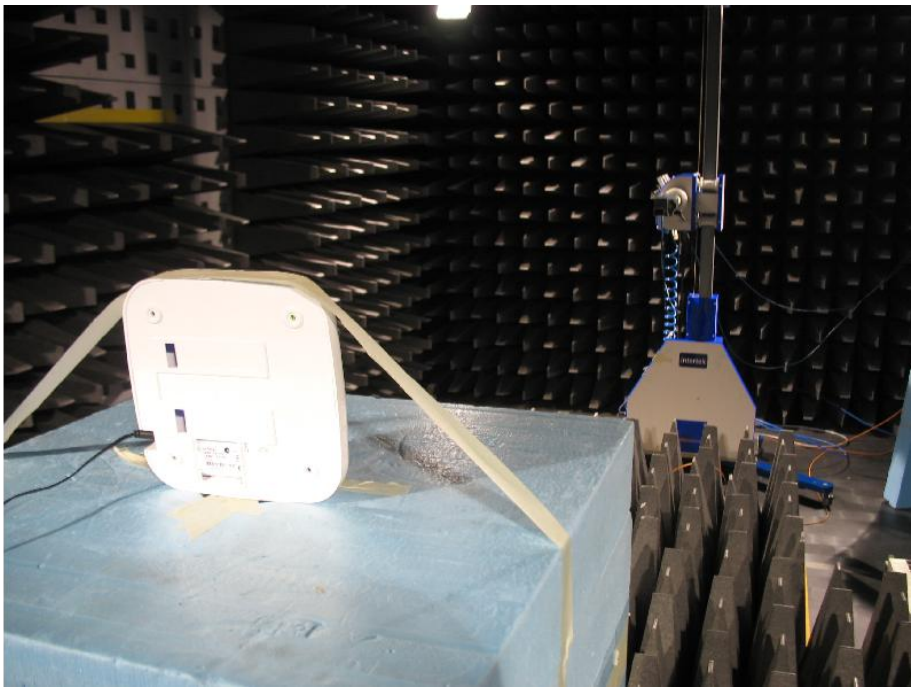
Frequency MHz	Average limit dBμV/m	Peak limit dBμV/m
	< 20 dB from carrier	< 20 dB from carrier

7.2 Test setup details

Operation mode: continuous transmission, modulating.



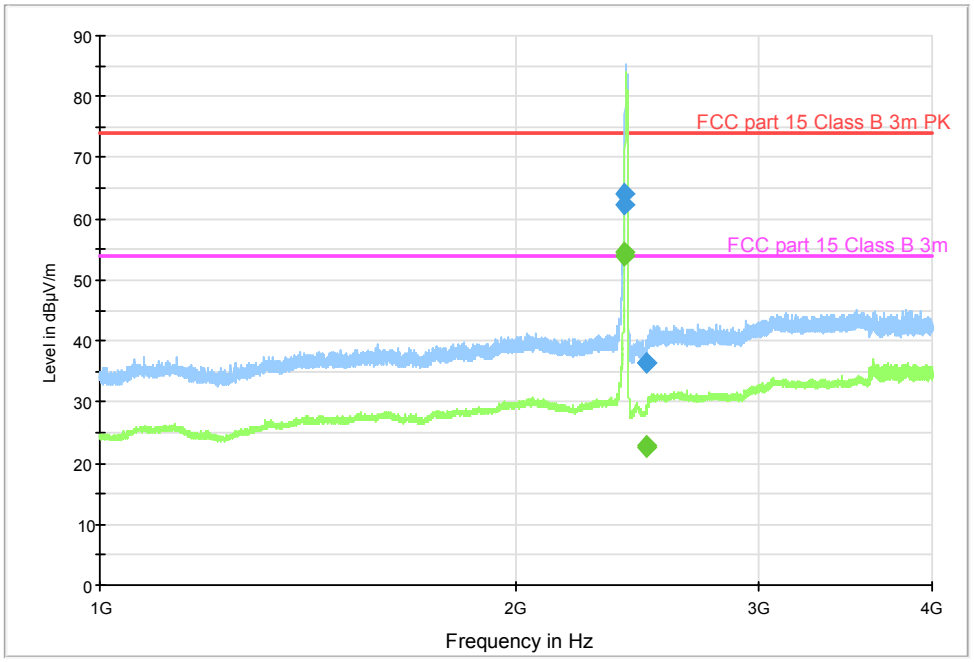
Test set-up photo: 1 -18 GHz



Test set-up photo: 18 – 26.5 GHz preliminary sweep

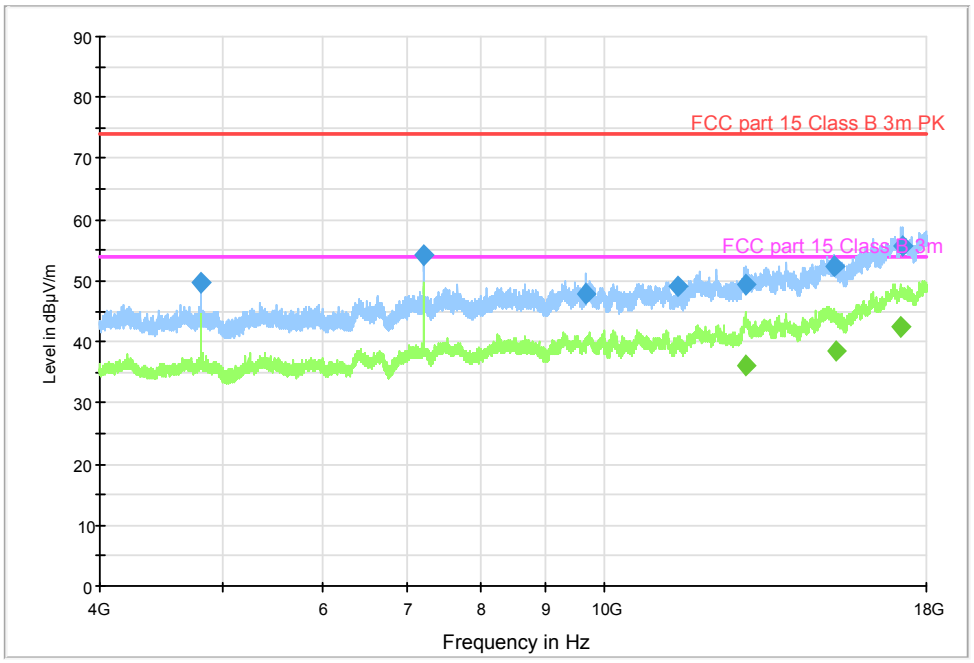
7.3 Test data

FCC 1 G - 4 G class B 3m ESU40 Continuous TT rotation

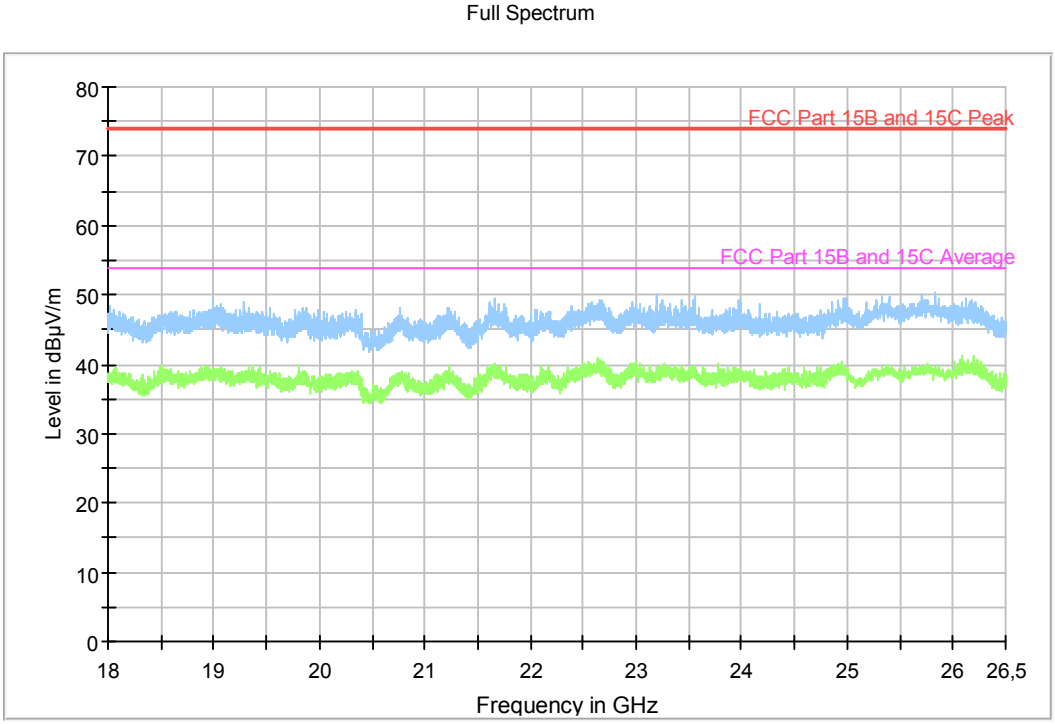


Overview sweeps performed with peak detectors, Frequency range 1 – 4 GHz

FCC 4 G - 18 G class B 3m ESU40 Continuous TT rotation



Overview sweeps performed with peak detectors, Frequency range 4 – 18 GHz



Overview sweeps performed with peak detectors, Frequency range 18-26.5 GHz

Frequency MHz	Disturbance Level dBµV/m	RBW kHz	Detector QP / AVG / Peak	Limit dBµV Peak	Margin dB	Azimuth deg	Antenna height cm	Pol. V / H
2400.0	62.4	1000	Peak	74	11.6	23	188	H
2400.1	64.1	1000	Peak	74	9.9	23	194	H
2483.5	36.4	1000	Peak	74	37.6	36.4	215	V
4809.1	49.6	1000	Peak	74	24.4	36.4	224	V
7213.5	54.1	1000	Peak	74	19.9	24.0	159.0	H
9688.7	47.8	1000	Peak	74	26.2	243.0	145.0	H
11443.7	49.2	1000	Peak	74	24.8	55.0	100.0	V
12967.8	49.5	1000	Peak	74	24.5	99.0	262.0	V
15218.9	52.5	1000	Peak	74	21.5	35.0	283.0	V
17214.6	55.6	1000	Peak	74	18.4	317.0	100.0	H

Measured level [dBµV/m] = Analyser reading [dBµV] + cable loss [dB] – preamplifier gain [dB] + antenna factor [dB/m]

Frequency MHz	Disturbance Level dBµV/m	RBW kHz	Detector QP / AVG / Peak	Limit dBµV AVG	Margin dB	Azimuth deg	Antenna height cm	Pol. V / H
2400.0	33.5	1000	AVG	54	20.5	23	188	H
2400.1	35.2	1000	AVG	54	54.8	23	194	H
2483.5	7.5	1000	AVG	54	46.5	36.4	215	V
4809.1	20.7	1000	AVG	54	33.3	36.4	224	V
7213.5	25.2	1000	AVG	54	28.8	24.0	159.0	H
9688.7	18.9	1000	AVG	54	35.1	243.0	145.0	H
11443.7	20.3	1000	AVG	54	33.7	55.0	100.0	V
12967.8	23.5	1000	AVG	54	30.5	99.0	262.0	V
15218.9	23.6	1000	AVG	54	30.4	35.0	283.0	V
17214.6	26.7	1000	AVG	54	27.3	317.0	100.0	H

Level is calculated from peak value using 20 LOG (Ton/100ms) = -28.87 dB correction factor.

7.4 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Measurement receiver	Rohde & Schwarz	ESU40	S13178	7/16
Test software	Rohde & Schwarz	EMC32	-	-
Horn antenna	Rohde & Schwarz	HF907	31245	11/16
Pre-amplifier	Bonn electronic		31246	7/16
2.4-2.4835 MHz Band reject filter			12389	7/2018
4GHz High pass filter	-	-	5133	-
Spectrum analyzer	Rohde & Schwarz	FSIQ40	12793	7/2016
Pre-amplifier			12335	7/2016
Horn antenna	Rohde & Schwarz		30099	10/2016

8 RECEIVER RADIATED EMISSION

Date of test:	2013-4-9/2013-3-28	Test location:	Björk hallen / Big chamber
EUT Serial:	-	Ambient temp.	25/20 °C
Tested by:	Matti Virkki	Relative humidity	31/16 %
Test result:	Pass	Margin	12.6 dB

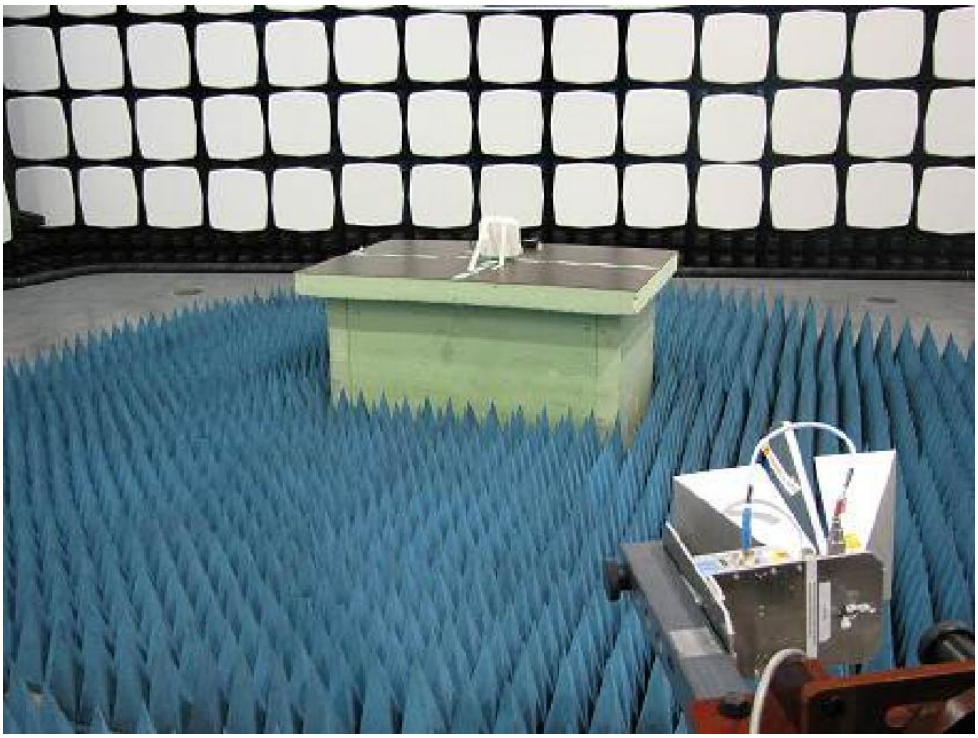
8.1 Requirement

Reference: FCC §15.109, RSS-gen table 2 ICES-003 6.2
Method ANSI C63.4 2014

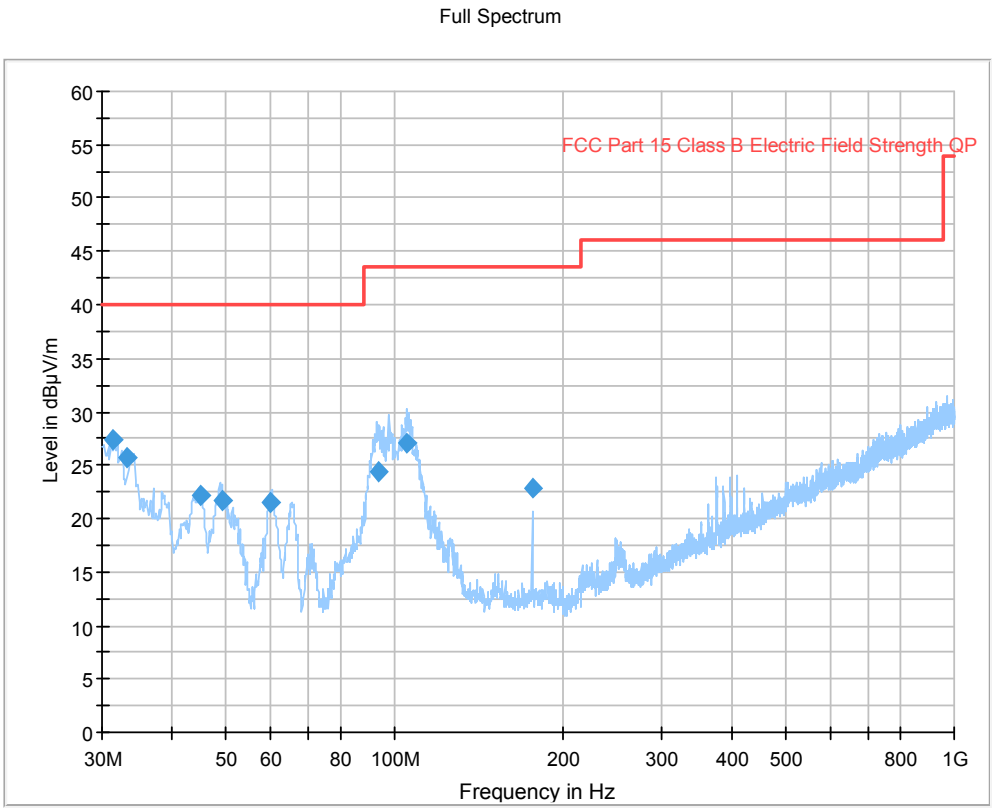
Frequency (MHz)	Field strength (dBμV/m)	Measurement distance (m)
30 – 88	40.0	3
88 – 216	43.5	3
216 – 960	46.0	3
960 –	54.0	3

8.2 Test setup details

Operation mode: normal receiver on.
Test set-up photo:

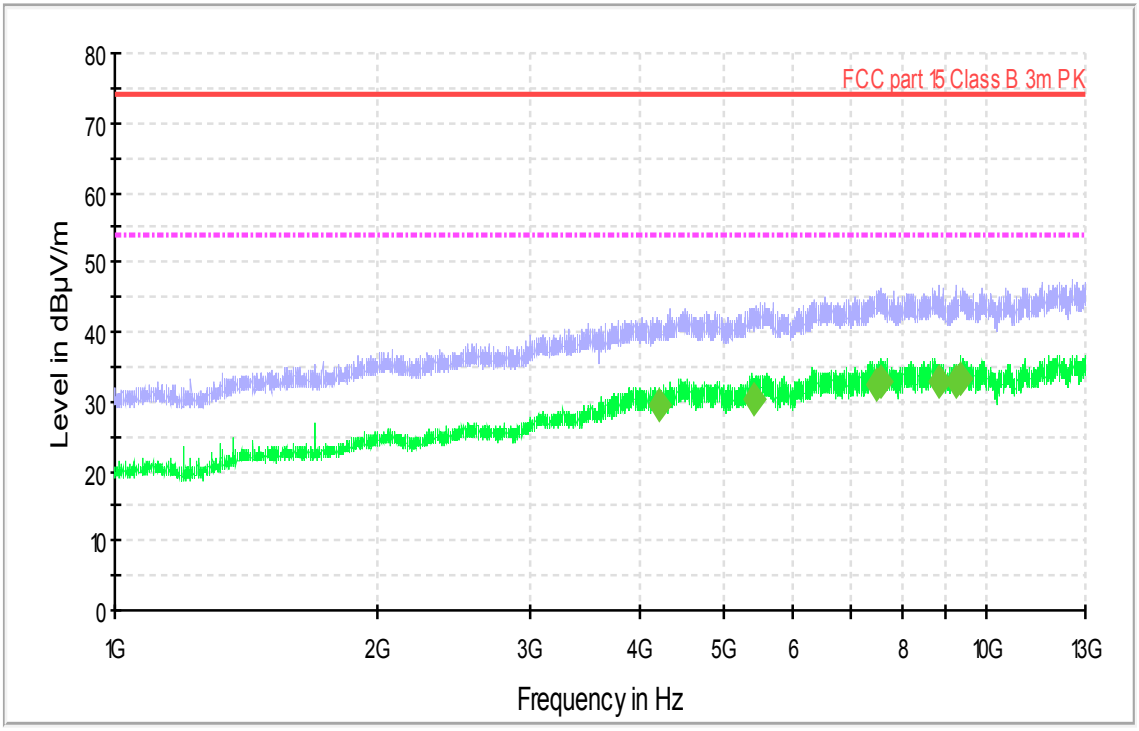


8.3 Test data 30MHz-1GHz



Frequency MHz	Disturbance Level dBµV/m	RBW kHz	Detector QP	Limit dBµV/m	Pol.	Azimuth deg	Antenna height cm	Margin dB
31.28	27.4	120	QP	40.00	V	68.0	103.0	12.6
33.20	25.8	120	QP	40.00	V	175.0	100.0	14.2
44.96	22.2	120	QP	40.00	V	133.0	100.0	17.8
49.05	21.7	120	QP	40.00	V	103.0	103.0	18.3
60.24	21.5	120	QP	40.00	V	336.0	205.0	18.5
93.18	24.3	120	QP	43.50	V	45.0	143.0	19.2
105.13	27.0	120	QP	43.50	H	83.0	225.0	16.5
176.01	22.8	120	QP	43.50	H	276.0	134.0	20.7

8.4 Test data 1-13 GHz



Frequency MHz	Disturbance Level dBµV/m	RBW kHz	Detector AV	Limit dBµV/m	Pol.	Azimuth deg	Antenna height cm	Margin dB
4214.16	43.0	1000	AV	54.0	V	101.0	121.0	31.0
5410.40	43.6	1000	AV	54.0	V	262.0	287.0	30.4
7490.44	45.8	1000	AV	54.0	H	190.0	177.0	28.2
7555.04	46.8	1000	AV	54.0	H	73.0	194.0	27.2
8832.86	47.3	1000	AV	54.0	H	231.0	288.0	26.7
9234.46	46.1	1000	AV	54.0	H	237.0	164.0	27.9
9350.01	46.5	1000	AV	54.0	H	93.0	146.0	27.5

9 VARIATION OF RADIATED SIGNAL LEVEL

Date of test:	2013-4-9	Test location:	EMC center
EUT Serial:		Ambient temp.	22 °C
Tested by:	Matti Virkki	Relative humidity	10 %
Test result:	Pass		

9.1 Requirement

Reference: FCC §15.31 (e))
Variation nominal operating voltage ±15 %

9.2 Test data

Test Conditions		
Temperature °C	Voltage V AC	Carrier level dBm
Nominal (20)	85% of nominal = 102	1.52
	Nominal = 120	1.52
	115% of nominal = 138	1.52

9.3 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyzer	Rohde & Schwarz	FSIQ40	12793	7/2013

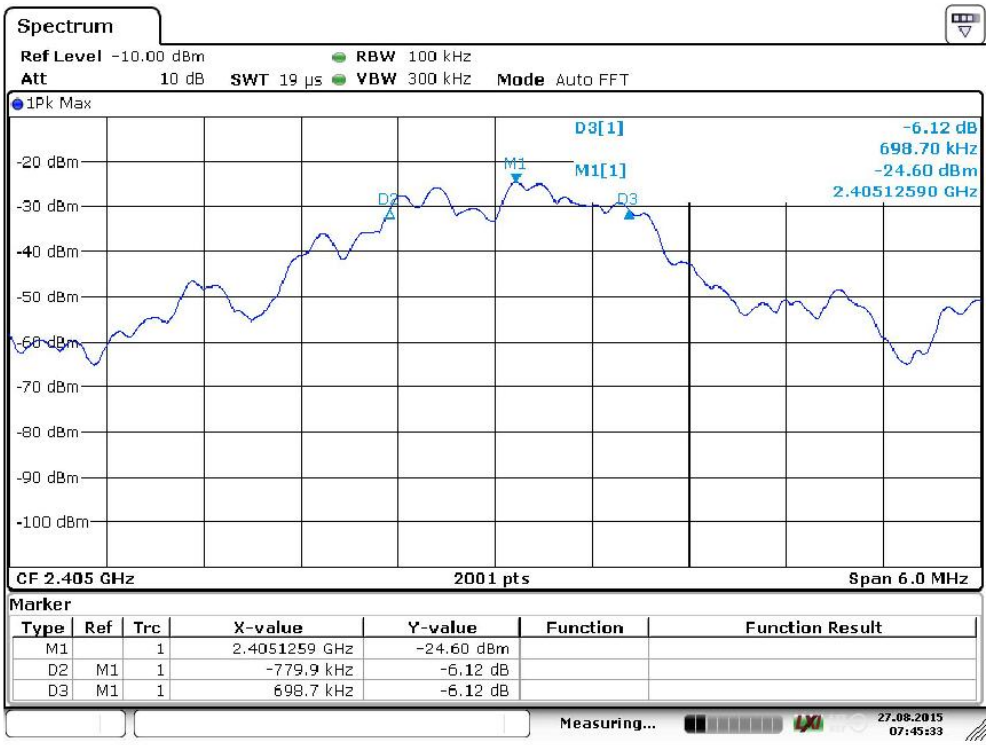
10 6DB OCCUPIED BANDWIDTH TEST

Date of test:	2015-8-27	Test location:	EMC Center
EUT Serial:	-	Ambient temp.	22 °C
Tested by:	Matti Virkki	Relative humidity	43 %
Test result:	Pass	Margin:	978.6

10.1 Requirement

The minimum 6 dB bandwidth shall be at least 500 kHz.
Reference: FCC §15.247(a)(2) RSS-247 5.2(1)
Method: ANSI C63.10-2013: section 11.8

10.2 Test data



Date: 27.AUG.2015 07:45:33

Result	Limit	Margin
1478.6	>500 kHz	978.6 kHz

10.3 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyzer	Rohde & Schwarz	FSV	S32594	7/16

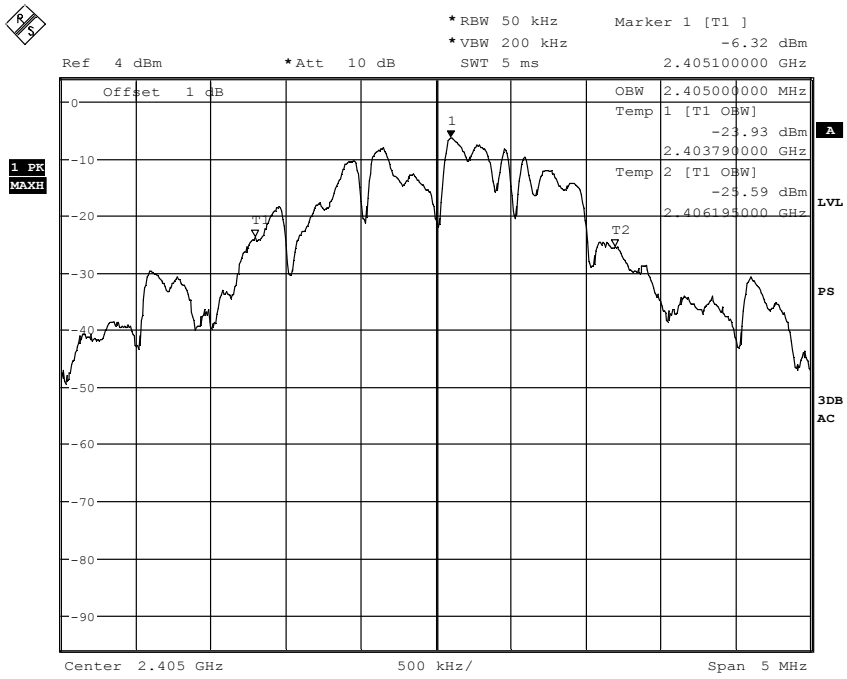
11 99% OCCUPIED BANDWIDTH

Date of test:	2013-3-20	Test location:	EMC Center
EUT Serial:	-	Ambient temp.	21 °C
Tested by:	Matti Virkki	Relative humidity	15 %
Test result:	Pass	Margin:	-

11.1 Requirement

Reference RSS-GEN 6.6
Method: Spectrum analyser's occupied power bandwidth function was used to calculate the 99% bandwidth

11.2 Test data



Date: 20.MAR.2013 12:59:42

Result	Limit	Margin
2405.0 kHz	-	-

11.3 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyzer	Rohde & Schwarz	ESU40	S13178	7/13

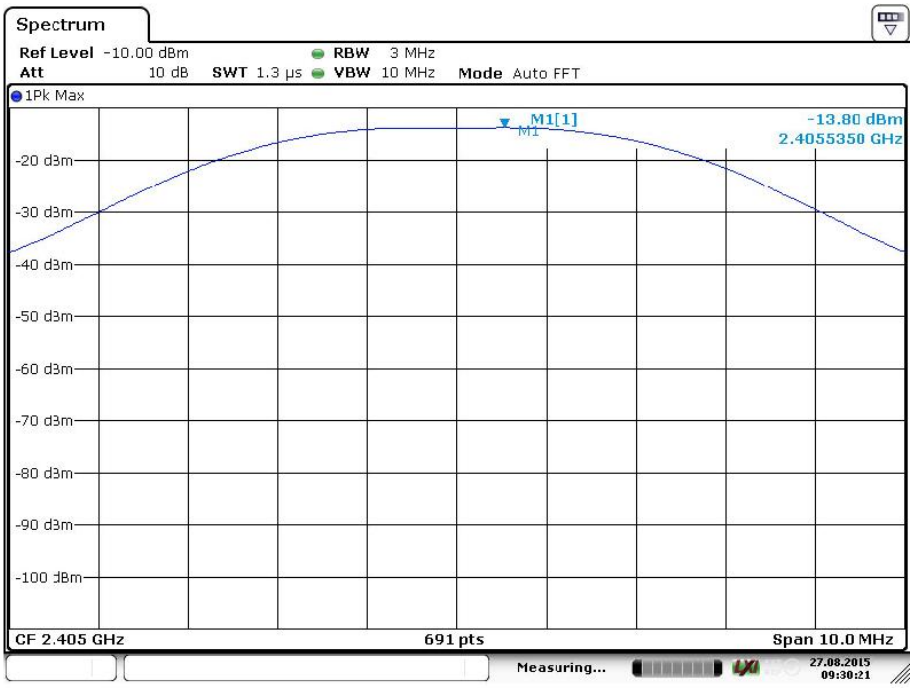
12 CONDUCTED OUTPUT POWER

Date of test:	2015-8-28	Test location:	EMC Center
EUT Serial:	-	Ambient temp.	22 °C
Tested by:	Matti Virkki	Relative humidity	43 %
Test result:	Pass	Margin:	28.5 dB

12.1 Requirement

The maximum peak conducted output power of the intentional radiator shall not exceed 1 watt.
Reference: FCC §15.247(b)(3) RSS-247 5.4 (4)
Method: ANSI C63.10-2013 section 11.9

12.2 Test data



Date: 27.AUG.2015 09:30:20

Analyser reading dBm	Cable + attenuator losses dB	Result dBm	Limit	Margin
-13.80	15.3	1.5	30 dBm = 1W	28.5 dB

12.3 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyzer	Rohde & Schwarz	FSV	S32594	7/16

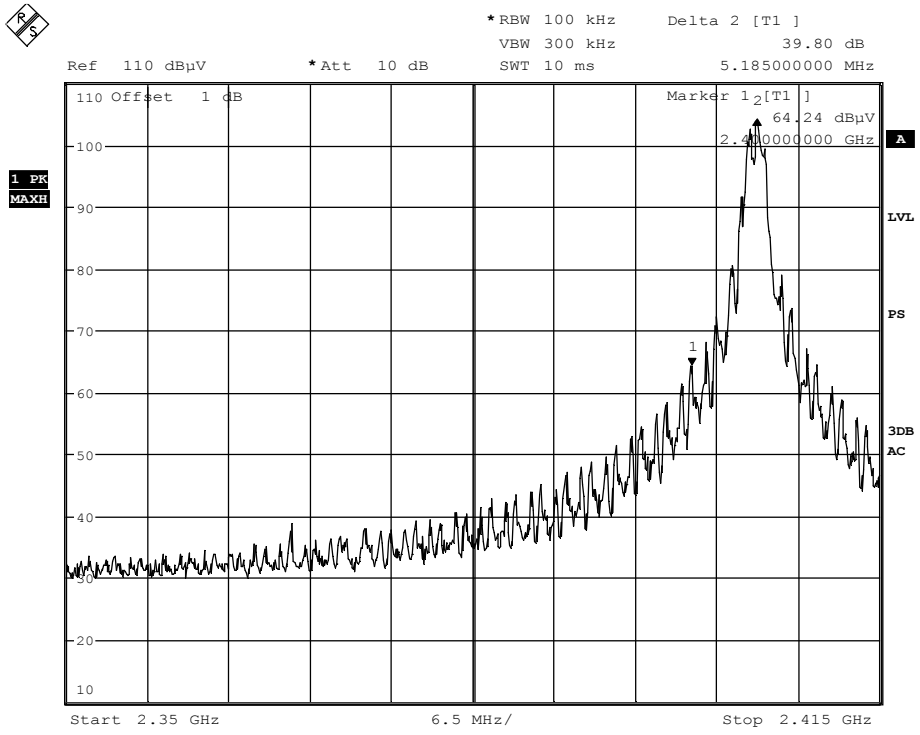
13 BANDEDGE MEASUREMENT

Date of test:	2013-3-20	Test location:	EMC Center
EUT Serial:	-	Ambient temp.	21 °C
Tested by:	Matti Virkki	Relative humidity	15 %
Test result:	Pass	Margin:	19.80 dB

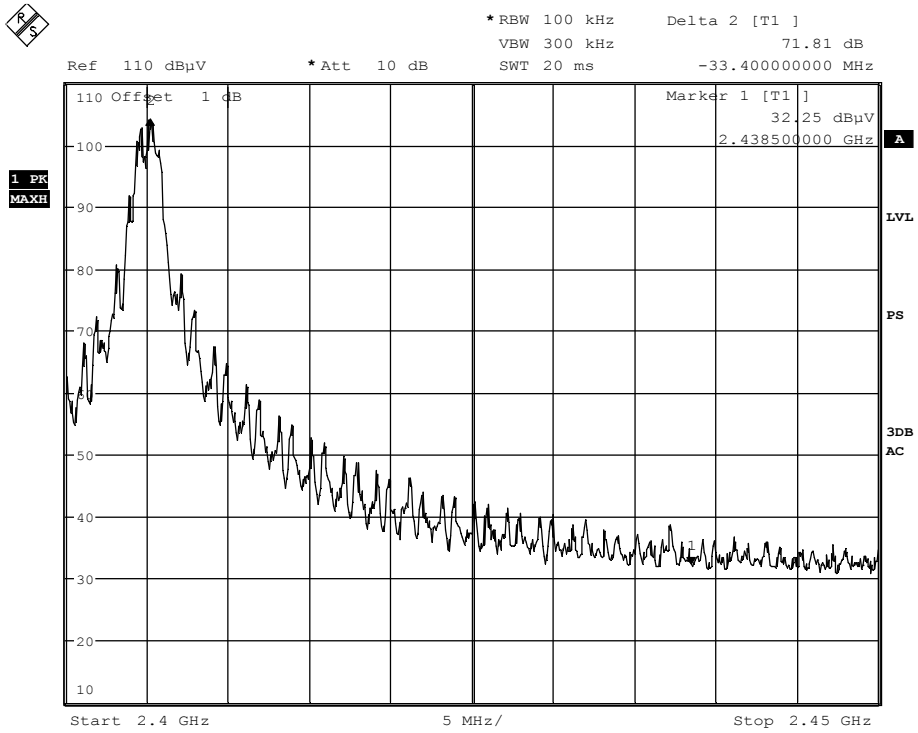
13.1 Requirement

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth
Reference: FCC §15.247(d) RSS-247 5.5
Method: ANSI C63.10-2013: section 11.13.3.2

13.2 Test data



Date: 20.MAR.2013 13:12:23



Date: 20.MAR.2013 13:14:05

Result		Limit	Margin
Lower edge 39.80 dB	Upper edge 71.81 dB	20 dB	19.80dB

13.3 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyzer	Rohde & Schwarz	ESU40	S13178	7/13

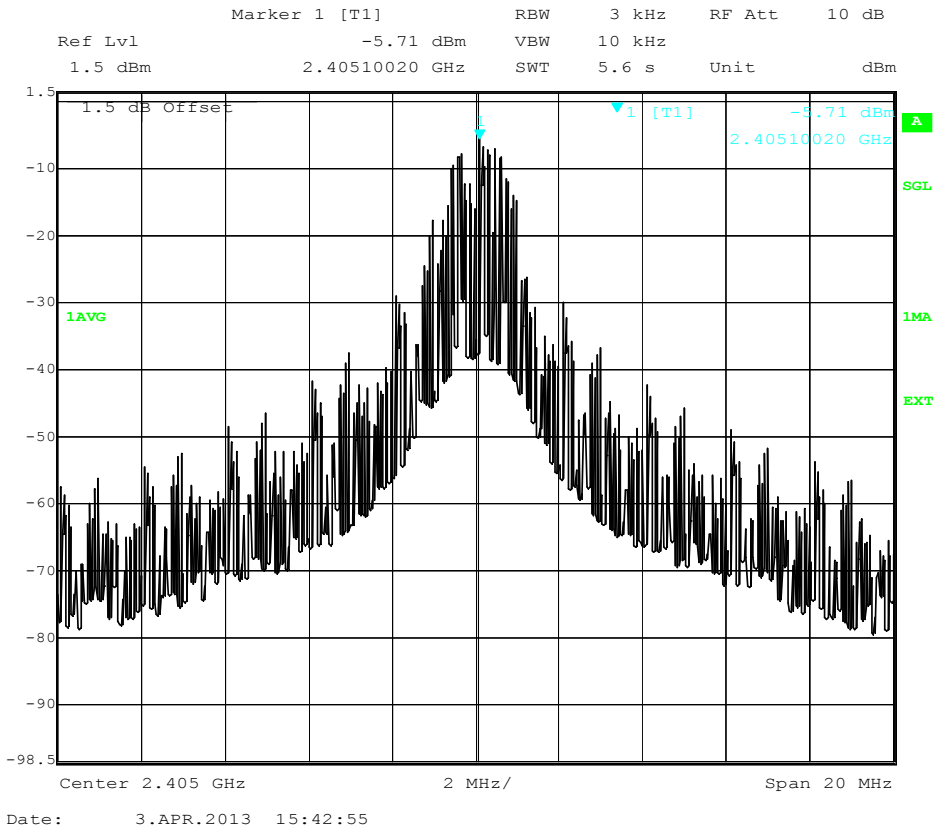
14 POWER SPECTRAL DENSITY

Date of test:	2013-04-03	Test location:	EMC Center
EUT Serial:	-	Ambient temp.	22 °C
Tested by:	Matti Virkki	Relative humidity	19 %
Test result:	Pass	Margin:	13.71 dB

14.1 Requirement

Power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.
Reference: FCC §15.247(e) RSS 247 5.2 (2)
Method: ANSI C63.10-2013: section 11.10.2

14.2 Test data



Result	Limit	Margin
-5.71 dBm/3kHz	8 dBm/3kHz	13.71 dB

14.3 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyzer	Rohde & Schwarz	ESIQ40	12793	7/2013

15 DUTY CYCLE

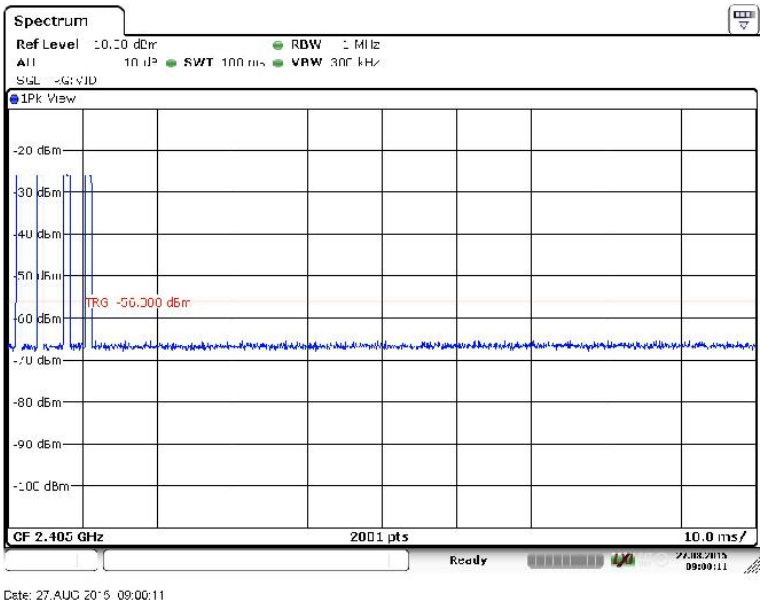
Date of test:	2015-08-28	Test location:	EMC Center
EUT Serial:	-	Ambient temp.	22 °C
Tested by:	Matti Virkki	Relative humidity	19 %
Test result:	Pass	Margin:	13.71 dB

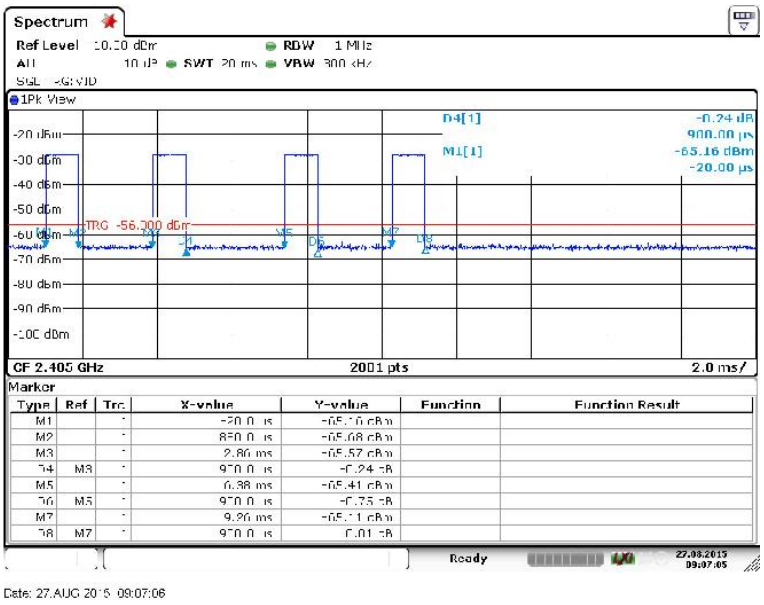
15.1 Requirement

To obtain emission average value from measured peak values transmitter duty cycle over 100 ms was measured and correction factor 20 LOG (Ton / 100 ms) calculated.

Reference: FCC §15.35(c) RSS-Gen 6.10
Method: Method: ANSI C63.10-2013: section 7.5

15.2 Test data





Transmitter on time	Correction factor
4 * 900 µs = 3.6 ms	-28.87 dB

15.3 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyzer	Rohde & Schwarz	FSV	S32594	7/2016

16 UNCERTAINTIES SUMMARY

The measurement uncertainty describes the overall uncertainty of the given measured value during operation of the EUT.
Measurement uncertainty is calculated in accordance with EA-4/02-1997.
The measurement uncertainty is given with a confidence of 95% (k=2).

Radiated disturbance, field strength, 30 MHz - 1000 MHz	
30 to 300 MHz at 3 m	± 4,7 dB
200 to 1000 MHz at 3 m	± 4,8 dB
Radiated disturbance, field strength, 1 to 40 GHz in Semi Anechoic Chambers "Stora Hallen"and "Björkhallen"	
1 to 18 GHz with filter or attenuator	± 5,4 dB
1 to 18 GHz without filter or attenuator	± 5,2 dB
18 to 26 GHz without filter or attenuator	± 5,5 dB
26 to 40 GHz without filter or attenuator	± 5,6 dB
Radiated disturbance, field strength, 1 to 40 GHz in Fully Anechoic Chamber "Radiohallen"	
18 to 26,5 GHz without filter or attenuator	± 5,4 dB
Conducted disturbances at the antenna port on radio equipment	
Frequency range 9 kHz – 1 GHz	± 0,9 dB
Frequency range 1 GHz – 7 GHz	± 1,4 dB
Frequency range 7 GHz -18GHz	± 2,4 dB
Frequency range 18 GHz -26,5GHz	± 3,0 dB
Output power	
Digital signals, conducted	± 0,6 dB

17 PHOTO OF THE EUT

-- END OF REPORT --