

RADIO TEST REPORT

No. 1405683STO-001 Ed. 3

RF performance

EQUIPMENT UNDER TEST

Equipment : Wireless sensor unit
Tested model : S7001
Additional model: S7002
Manufacturer : Creowave Oy
Tested by request of : Creowave Oy

SUMMARY

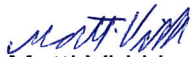
Referring to the emission limits and the operating mode during the tests specified in this report the equipment complies with the requirements according to

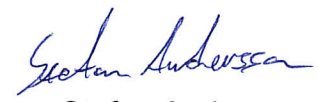
47 CFR Part 15, Subpart C, Intentional radiators, section 15.247

RSS-Gen Issue 4 (2014) RSS-210 Issue 8 (2010)

Test methods according to ANSI C63.10 (2009) and ANSI C63.4 (2009)

Date of issue: 2015-03-18

Tested by: 
Matti Virkki

Approved by: 
Stefan Andersson

Laboratories are accredited by the Swedish Board for Accreditation and Conformity Assessment (SWEDAC) under the terms of Swedish legislation. The accredited laboratory activities meet the requirements in SS-EN ISO/IEC 17025 (2005). This report may not be reproduced other than in full, except with the prior written approval by Intertek Semko.

This report is for the exclusive use of Intertek's Client and is provided pursuant to the agreement between Intertek and its Client. Intertek's responsibility and liability are limited to the terms and conditions of the agreement. Intertek assumes no liability to any party, other than to the Client in accordance with the agreement, for any loss, expense or damage occasioned by the use of this report. Only the Client is authorized to permit copying or distribution of this report and then only in its entirety. Any use of the Intertek name or one of its marks for the sale or advertisement of the tested material, product or service must first be approved in writing by Intertek. The observations and test results in this report are relevant only to the sample tested. This report by itself does not imply that the material, product, or service is or has ever been under an Intertek certification program.

Revision History

Edition	Date	Description
1	2014-07-03	First release
2	2015-02-10	Update to model names and RSS-GEN issue 4 update
3	2015-03-18	Ch. 26 removed. Re-measured band edge and Ch. 25

CONTENTS

	Page
1 CLIENT INFORMATION.....	5
2 EQUIPMENT UNDER TEST (EUT).....	5
2.1 IDENTIFICATION OF THE EUT ACCORDING TO THE MANUFACTURER/CLIENT DECLARATION.....	5
2.2 ADDITIONAL HARDWARE INFORMATION ABOUT THE EUT.....	6
2.3 ADDITIONAL SOFTWARE INFORMATION ABOUT THE EUT	6
2.4 PERIPHERAL EQUIPMENT	6
2.5 TEST SIGNALS	6
2.6 MODIFICATION DURING THE TESTS	6
3 TEST SPECIFICATIONS.....	7
3.1 STANDARDS	7
3.2 ADDITIONS, DEVIATIONS AND EXCLUSIONS FROM STANDARDS AND ACCREDITATION	7
3.3 TEST SITE.....	7
3.4 TEST SET-UP	7
3.5 TEST CONDITIONS	7
4 TEST SUMMARY.....	8
5 RADIATED EMISSIONS MEASUREMENTS FROM 30 MHZ TO 1000MHZ.....	9
5.1 REQUIREMENT	9
5.2 TEST SETUP DETAILS	9
5.3 TEST DATA.....	10
5.4 TEST EQUIPMENT	12
6 RADIATED EMISSIONS MEASUREMENTS ABOVE 1 GHZ.....	13
6.1 REQUIREMENT	13
6.2 TEST SETUP DETAILS	14
6.3 TEST DATA.....	15
6.4 ANTENNA GAIN	19
6.5 BAND EDGE	20
6.6 TEST EQUIPMENT	21
7 OCCUPIED BANDWIDTH.....	22
7.1 REQUIREMENT	22
7.2 TEST SET-UP	22
7.3 TEST DATA.....	22
7.4 TEST EQUIPMENT	23
8 CONDUCTED PEAK OUTPUT POWER	24
8.1 REQUIREMENT	24
8.2 TEST SET-UP	24
8.3 TEST DATA.....	24
8.4 TEST EQUIPMENT	26
9 PEAK POWER SPECTRAL DENSITY.....	27
9.1 REQUIREMENT	27
9.2 TEST SET-UP	27
9.3 TEST DATA.....	27
9.4 TEST EQUIPMENT	28

10	TRANSMITTER DWELL TIME AND DUTY CYCLE AVERAGING FACTOR	29
10.1	REQUIREMENT	29
10.2	TEST SET-UP	29
10.3	TEST DATA.....	29
10.4	TEST EQUIPMENT	30
11	BAND EDGE CONDUCTED	31
11.1	REQUIREMENT	31
11.2	TEST SET-UP	31
11.3	TEST DATA.....	31
11.4	TEST EQUIPMENT	32
12	CONDUCTED SPURIOUS EMISSION.....	33
12.1	REQUIREMENT	33
12.2	TEST SET-UP	33
12.3	TEST DATA.....	33
12.4	TEST EQUIPMENT	36
13	UNCERTAINTIES SUMMARY.....	37
14	PHOTO OF THE EUT.....	38

1 CLIENT INFORMATION

The EUT has been tested by request of

Company: Creowave Oy
Yrttpellontie 10H
90230 Oulu
Finland

Name of contact: Taisto Soikkeli

2 EQUIPMENT UNDER TEST (EUT)

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

Equipment: Wireless sensor unit
Tested model: S7001
Additional model: S7002
Brand name: Creowave
Serial number: S7-1234567893
Manufacturer: Creowave Oy

Transmitter frequency range: 2405 –2475 MHz

Receiver frequency range: 2405 – 2475 MHz

Frequency agile or hopping: ☐ Yes ☒ No

Antenna: ☐ Internal antenna ☒ External antenna

Antenna connector: ☐ None, internal antenna ☒ Yes, type SMB

Antenna gain: 4.8 dBi

Rating RF output power: 18.24 dBm (measured conducted)

Type of modulation:

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: <-20°C to +55°C

Power rating: 2 x 3,6 V Lithium battery

Transmitter standby mode supported: ☒ Yes ☐ No

2.2 Additional hardware information about the EUT

The EUT consists of the following units:

Unit	Part number	Serial number
Sensor unit	S7001	1234567893
2 x Lithium battery	SW-DO2	
Antenna	Bulgin Buccaneer Antenna PX0407	

2.3 Additional software information about the EUT

During the tests the EUT supported the following software:

Software	Version / Release	Comment
CTRL. SW	3468	

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	Inventory number
PC	HP / Compaq NC6320	S12913

2.5 Test signals

Continuous signal with O-QPSK modulation on 3 channel 2405, 2440 and 2475 MHz.
Signal with normal duty cycle for duty cycle measurement.

2.6 Modification during the tests

No modifications have been 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-210 Issue 8 (2010)

Test methods in:

ANSI C63.10-2009: American National Standard for Testing Unlicensed Wireless Devices

3.2 Additions, deviations and exclusions from standards and accreditation

No additions, deviations or exclusions have been made from standards and accreditation.

3.3 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 #
BJÖRKHALLEN	Semi-anechoic 3m	2042G-1
RADIOHALLEN	Fully-anechoic 3m	--

3.4 Test set-up

Unless otherwise specified EUT antenna port was connected to spectrum analyser via rf-cable and 10 dB attenuator.

3.5 Test conditions

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

Parameter	Normal	Extreme
Supplying voltage, V	3.6	-
Air temperature, °C	22	-

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	NA		Class A
Radiated test below 30 MHz	NA		
Radiated emissions measurements from 30 to 1000 MHz	Pass	5	
Determination of radiated and antenna conducted emissions above 1 GHz	Pass	6	
Frequency Stability Test	NA		
Occupied bandwidth and band-edge tests	Pass	7	
Output Power average symbol envelope power	NA		
Power Spectral Density < 40 GHz	Pass	9	
Power Spectral Density > 40 GHz	NA		
In-situ measurements	NA		
Polar plot, main lobe and variation on radiated emissions test	NA		
Device-specific tests			
Determining the average value of pulsed emissions per 15.35(c)	Pass	10	
Determination of frequency hopping compliance per 47 CFR 15.247	NA		
Determination of digital modulation compliance per 47 CFR 15.247	Pass	7	
Determination of peak conducted output unlicensed wireless device power [15.247(b), 15.255]	Pass	8	
Determination of antenna gains, including those emitting in multiple directions (15.247)	Pass	6	
Determination of compliance with RF exposure limits	Pass		

NT = Not Tested, by request of the Client

NA = Not Applicable

Notes:

1. The measured result is below the upper limit, but by a margin less than half of the uncertainty interval. It is therefore not possible to state compliance based on the 95% level of confidence. However, the result indicates that compliance is more probable than non-compliance.
2. The measured result is above the upper limit, but by a margin less than half of the uncertainty interval. It is therefore not possible to state non-compliance based on the 95% level of confidence. However, the result indicates that non-compliance is more probable than compliance.

5 RADIATED EMISSIONS MEASUREMENTS FROM 30 MHZ TO 1000MHZ

Date of test:	2014-06-18	Test location:	Björk hallen
EUT Serial:	1234567893	Ambient temp.	23 °C
Tested by:	Matti Virkki	Relative humidity	35 %
Test result:	Pass	Margin:	6.54 dB

5.1 Requirement

In restricted bands Reference: FCC §15.209, IC RSS-210 Table 3

Outside the restricted bands: FCC 15.247 (d), RSS-210 A8.5

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

5.2 Test setup details

EUT was placed on non-conductive table 80 cm above the ground plane. EUT serial cable was connected to the PC.

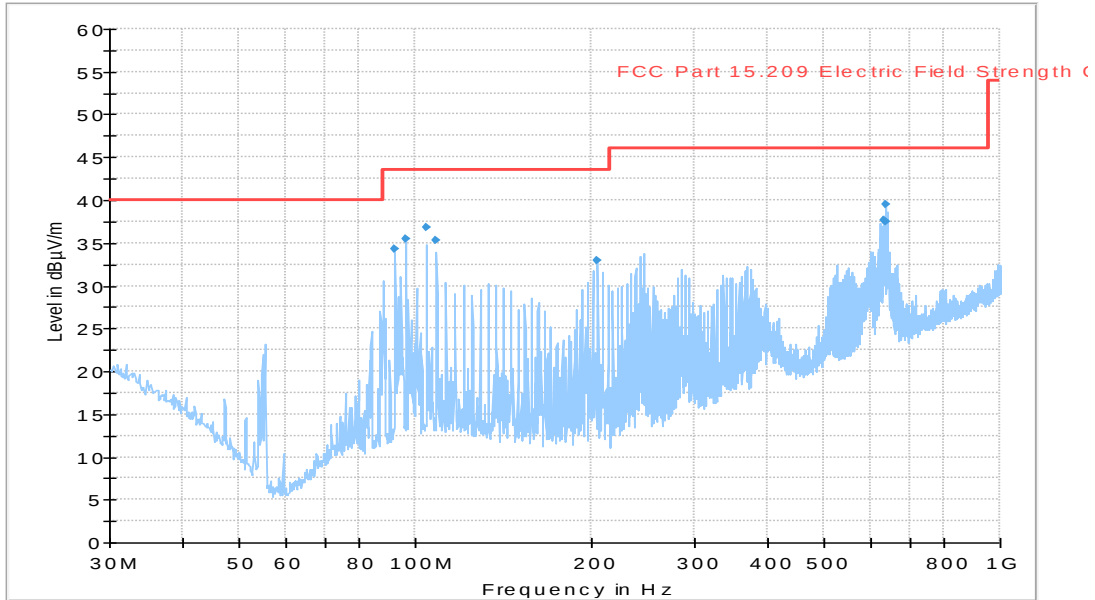
Test set-up photo:



5.3 Test data

Overview sweeps performed with peak detectors, ch 11

Full Spectrum

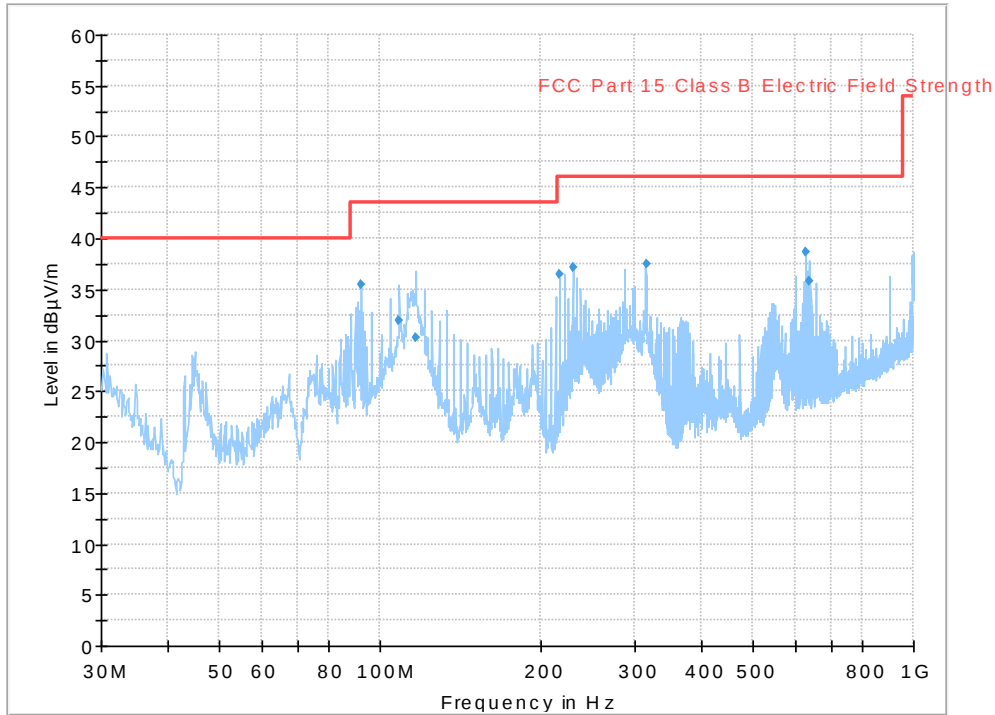


Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
92.224	34.21	43.52	9.31	1000.0	120.000	344.0	H	264.0
96.312	35.47	43.52	8.05	1000.0	120.000	134.0	H	269.0
104.568	36.83	43.52	6.69	1000.0	120.000	273.0	H	83.0
108.657	35.28	43.52	8.24	1000.0	120.000	255.0	H	89.0
205.030	32.92	43.52	10.60	1000.0	120.000	145.0	H	228.0
631.483	37.61	46.02	8.41	1000.0	120.000	143.0	H	221.0
635.551	39.48	46.02	6.54	1000.0	120.000	138.0	H	217.0
639.639	37.50	46.02	8.52	1000.0	120.000	141.0	H	228.0

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

Overview sweeps performed with peak detectors, ch 18

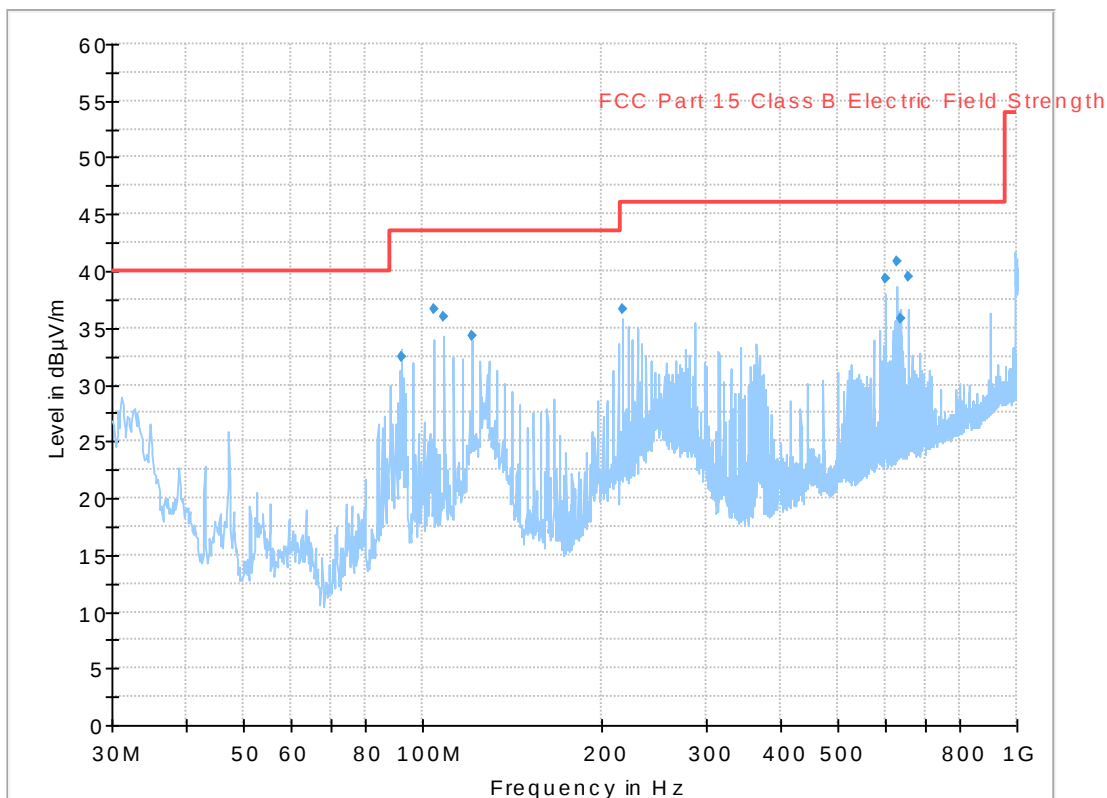
Full Spectrum



Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
92.264	35.43	43.52	8.09	1000.0	120.000	319.0	H	248.0
108.657	31.91	43.52	11.61	1000.0	120.000	124.0	V	244.0
116.833	30.25	43.52	13.27	1000.0	120.000	103.0	V	104.0
217.314	36.39	46.02	9.63	1000.0	120.000	118.0	H	156.0
229.619	37.14	46.02	8.88	1000.0	120.000	135.0	H	152.0
314.989	37.43	46.02	8.59	1000.0	120.000	109.0	H	101.0
629.979	38.62	46.02	7.40	1000.0	120.000	128.0	H	135.0
635.491	35.86	46.02	10.16	1000.0	120.000	144.0	V	178.0

Overview sweeps performed with peak detectors, ch 25

Full Spectrum



Frequency (MHz)	QuasiPeak (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
92.284569	32.36	43.52	11.16	1000.0	120.000	100.0	H	233.0
104.588818	36.68	43.52	6.84	1000.0	120.000	254.0	H	79.0
108.657235	35.98	43.52	7.54	1000.0	120.000	239.0	H	250.0
120.961683	34.26	43.52	9.26	1000.0	120.000	281.0	H	210.0
217.354469	36.59	46.02	9.43	1000.0	120.000	109.0	H	161.0
601.342405	39.28	46.02	6.74	1000.0	120.000	137.0	H	215.0
629.979720	40.81	46.02	5.21	1000.0	120.000	129.0	H	204.0
635.591343	35.83	46.02	10.19	1000.0	120.000	142.0	V	172.0
658.617435	39.50	46.02	6.52	1000.0	120.000	134.0	H	209.0

5.4 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Measurement software	Rohde & Schwarz	EMC 32	--	--
Receiver	Rohde & Schwarz	ESI	32291	7/2014
UltraLog antenna	Rohde & Schwarz	HL 562	30711	12/2014
Hornantenna	Rohde & Schwarz	HF907	32307	6/2015
Pre amplifier	Rohde & Schwarz	TS-PRE1	32306	7/2014
Switch unit	Rohde & Schwarz	OSP130	32300	7/2014
Filter unit	Rohde & Schwarz	OSP-F7-B	32301	--

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

6 RADIATED EMISSIONS MEASUREMENTS ABOVE 1 GHZ

Date of test:	2014-06-19	Test location:	Björkhallen
EUT Serial:	C7-1234567893	Ambient temp.	23 C
Tested by:	Matti Virkki	Relative humidity	35 %
Test result:	Pass	Margin:	1.29 dB

6.1 Requirement

Spurious emission:

Reference: FCC §15.209, IC RSS-210 Table 3

In 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

Outside the restricted bands: FCC 15.247 (d), RSS-210 A8.5

Carrier – 20 dB.

Carrier:

Reference: FCC §15.217 (b)(3)(4), IC RSS-210 A8.4

For systems employing digital modulation techniques operating in the bands 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz, the maximum peak conducted output power shall not exceed 1 W. the e.i.r.p. shall not exceed 4 W.

6.2 Test setup details

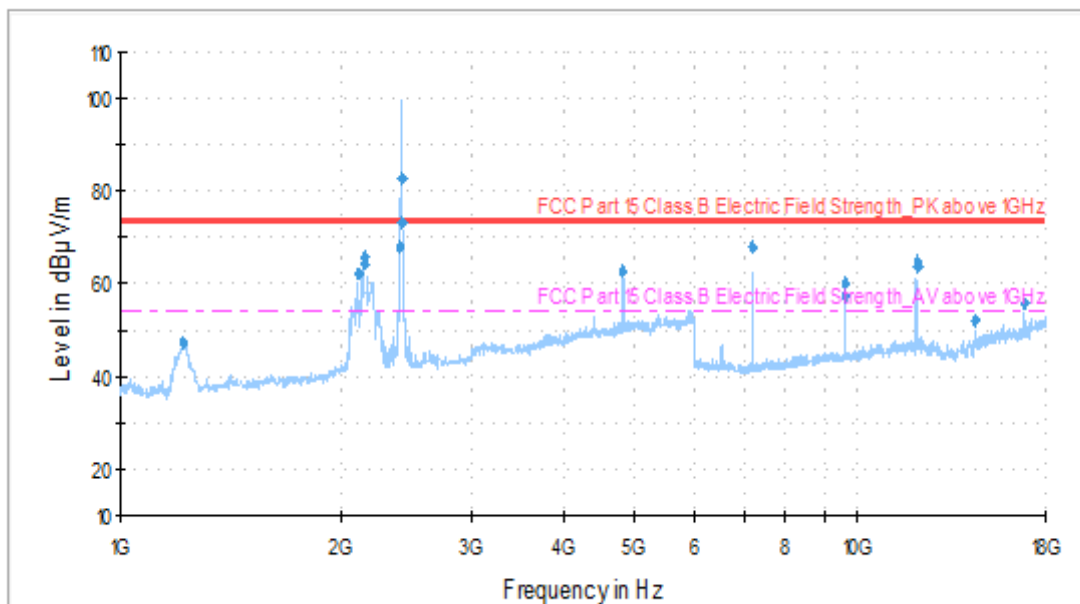
EUT was placed on non-conductive table 80 cm above the ground plane.
Absorbers were placed on floor between EUT and antenna.

Test set-up photo:



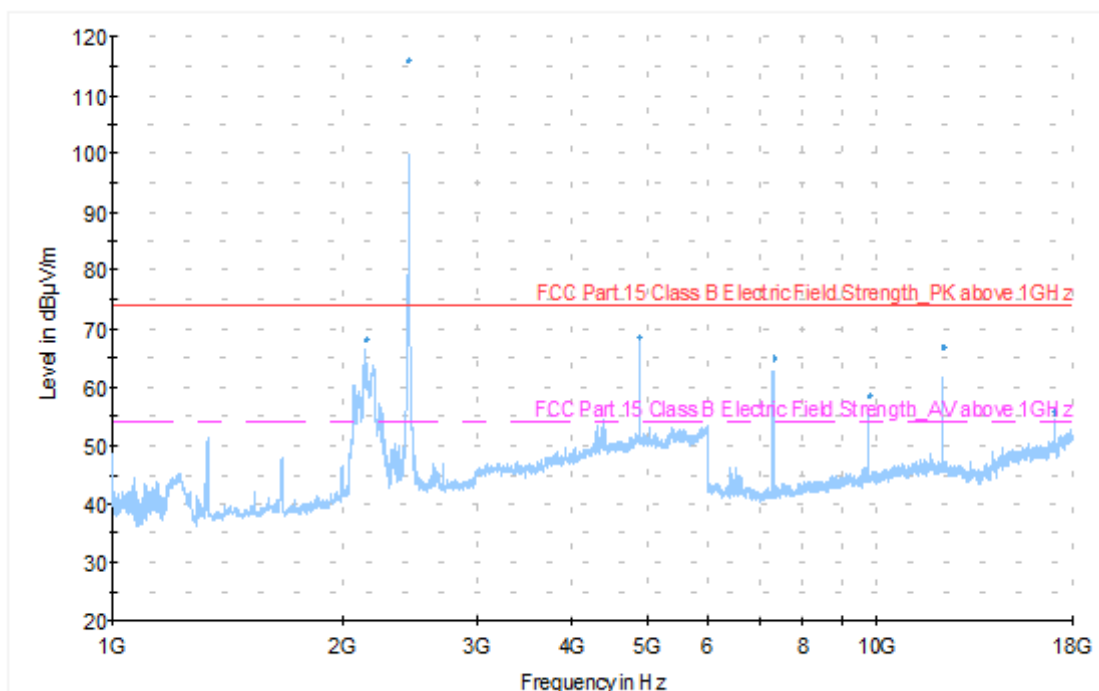
6.3 Test data

Overview sweeps performed with peak detectors, Frequency range 1 – 18 GHz Ch. 11



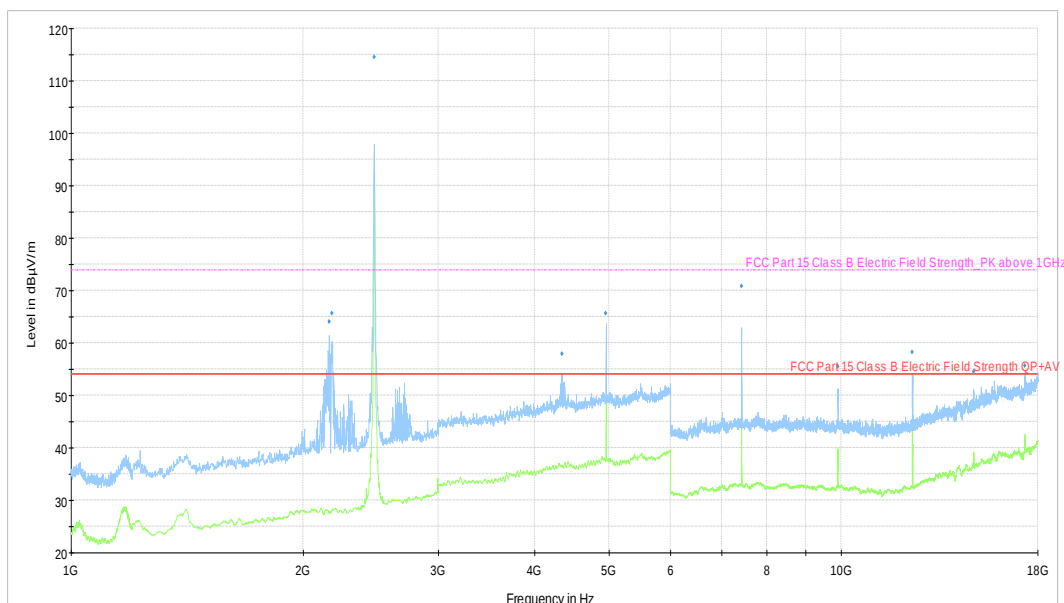
Frequency (MHz)	Peak (dBμV/m)	Avg (dBμV/m)	Limit Peak (dBμV/m)	Limit Avg (dBμV/m)	Margin (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
1216.232	47.59	27.59	74.00	54.00	26.31	1000.000	102.0	H	88.0
2099.000	61.99	41.99	74.00	54.00	11.91	1000.000	114.0	V	217.0
2405.000	117.5	97.1	---	---	---	1000.000	200.0	V	137
2143.088	64.09	44.09	74.00	54.00	9.81	1000.000	300.0	V	134.0
2144.688	65.54	45.54	74.00	54.00	8.36	1000.000	284.0	V	136.0
2388.757	68.01	48.01	74.00	54.00	5.89	1000.000	164.0	V	83.0
2404.605	114.30	---	---	---	---	1000.000	271.0	V	0.0
2404.609	114.30	---	---	---	---	1000.000	274.0	V	0.0
2410.841	72.95	---	---	---	---	1000.000	100.0	V	248.0
4811.219	62.80	42.80	74.00	54.00	11.10	1000.000	201.0	V	137.0
4811.223	62.80	42.80	74.00	54.00	11.10	1000.000	200.0	V	116.0
7216.632	67.83	47.83	74.00	54.00	6.07	1000.000	171.0	V	3.0
7216.832	67.68	47.68	74.00	54.00	6.22	1000.000	170.0	V	3.0
9618.238	60.04	40.04	74.00	54.00	13.86	1000.000	182.0	V	341.0
9622.438	57.44	37.44	74.00	54.00	16.46	1000.000	204.0	V	304.0
12028.052	64.94	44.94	74.00	54.00	8.96	1000.000	113.0	V	345.0
12028.244	63.67	43.67	74.00	54.00	10.23	1000.000	145.0	V	267.0
12028.248	64.94	44.94	74.00	54.00	8.96	1000.000	117.0	V	345.0
14427.453	52.29	32.29	74.00	54.00	21.61	1000.000	120.0	V	0.0
16832.079	55.79	35.79	74.00	54.00	18.11	1000.000	122.0	V	342.0
16838.867	55.70	35.70	74.00	54.00	18.20	1000.000	115.0	V	343.0
16839.079	55.95	35.95	74.00	54.00	17.95	1000.000	119.0	V	320.0

Overview sweeps performed with peak detectors, Frequency range 1 – 18 GHz Ch. 18



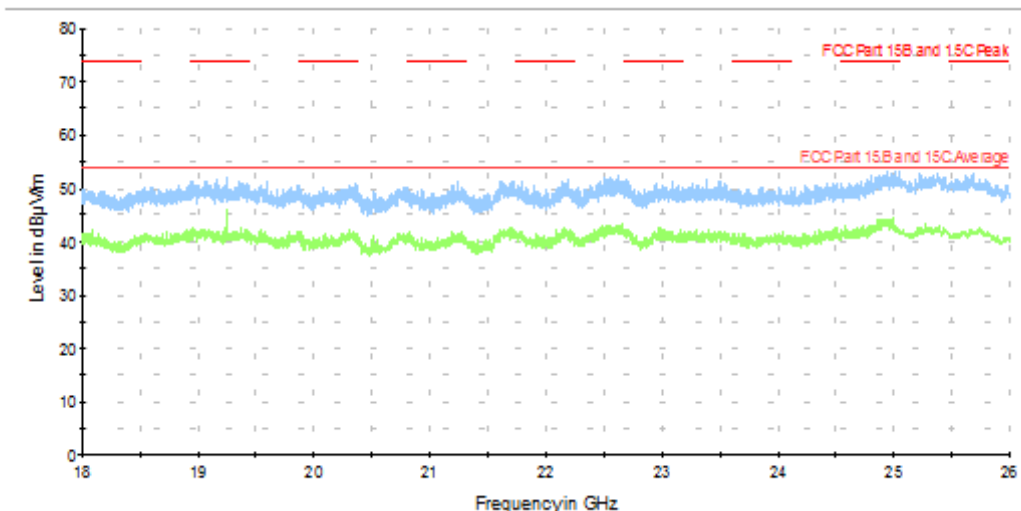
Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
2139.688577	68.09	---	73.90	5.81	1000.0	1000.000	264.0	V	111.0
2139.688577	---	29.68	54.00	24.32	1000.0	1000.000	264.0	V	111.0
2440.481764	117.10	---	---	---	1000.0	1000.000	300.0	V	0.0
2440.481764	---	97.10	---	---	1000.0	1000.000	300.0	V	0.0
4879.163527	68.50	---	73.90	5.40	1000.0	1000.000	102.0	V	222.0
4879.163527	---	48.50	54.00	5.50	1000.0	1000.000	102.0	V	222.0
7318.837275	---	44.87	54.00	9.13	1000.0	1000.000	225.0	V	268.0
7318.837275	64.87	---	73.90	9.03	1000.0	1000.000	225.0	V	268.0
9762.327054	---	38.31	54.00	15.69	1000.0	1000.000	130.0	V	92.0
9762.327054	58.31	---	73.90	15.59	1000.0	1000.000	130.0	V	92.0
12198.796794	---	46.83	54.00	14.38	1000.0	1000.000	168.0	V	55.0
12198.796794	66.83	---	73.90	7.07	1000.0	1000.000	168.0	V	55.0
17077.152305	55.62	---	73.90	18.28	1000.0	1000.000	284.0	H	0.0
17077.152305	---	35.62	54.00	18.38	1000.0	1000.000	284.0	H	0.0

Overview sweeps performed with peak detectors, Frequency range 1 – 18 GHz Ch. 25

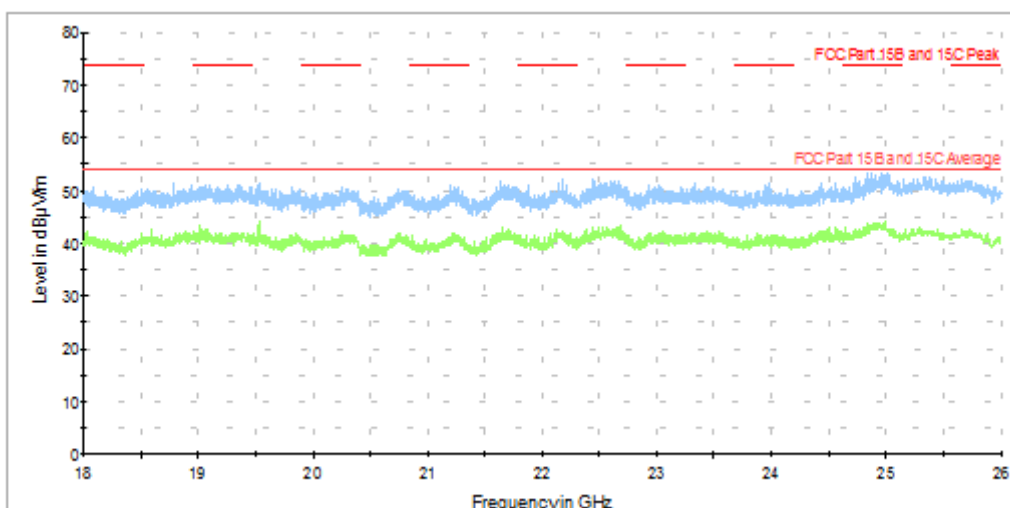


Frequency (MHz)	MaxPeak (dBµV/m)	Average (dBµV/m)	Limit (dBµV/m)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
2161.924649	64.10	---	74.00	9.90	1000.0	1000.000	177.0	V	288.0
2161.924649	---	44.10	54.00	9.90	1000.0	1000.000	177.0	V	288.0
2180.760722	65.63	---	74.00	8.37	1000.0	1000.000	188.0	V	71.0
2180.760722	---	45.63	54.00	8.37	1000.0	1000.000	188.0	V	71.0
2474.549900	114.57	---	---	---	1000.0	1000.000	314.0	V	176.0
2474.549900	---	94.57	---	---	1000.0	1000.000	314.0	V	176.0
4340.885371	57.90	---	74.00	16.10	1000.0	1000.000	108.0	V	290.0
4340.885371	---	37.90	54.00	16.10	1000.0	1000.000	108.0	V	290.0
4949.299800	---	45.67	54.00	8.33	1000.0	1000.000	180.0	V	310.0
4949.299800	65.67	---	74.00	8.33	1000.0	1000.000	180.0	V	310.0
7426.845691	---	50.79	54.00	3.21	1000.0	1000.000	334.0	H	228.0
7426.845691	70.79	---	74.00	3.21	1000.0	1000.000	334.0	H	228.0
9898.399599	55.49	---	74.00	18.51	1000.0	1000.000	345.0	H	225.0
9898.399599	---	35.49	54.00	18.51	1000.0	1000.000	345.0	H	225.0
12372.945491	---	38.18	54.00	15.82	1000.0	1000.000	350.0	V	119.0
12372.945491	58.18	---	74.00	15.82	1000.0	1000.000	350.0	V	119.0
14847.695391	---	34.51	54.00	19.49	1000.0	1000.000	146.0	H	182.0
14847.695391	54.51	---	74.00	19.49	1000.0	1000.000	146.0	H	182.0
17329.245291	55.64	---	74.00	18.36	1000.0	1000.000	204.0	H	224.0
17329.245291	---	35.64	54.00	18.36	1000.0	1000.000	204.0	H	224.0

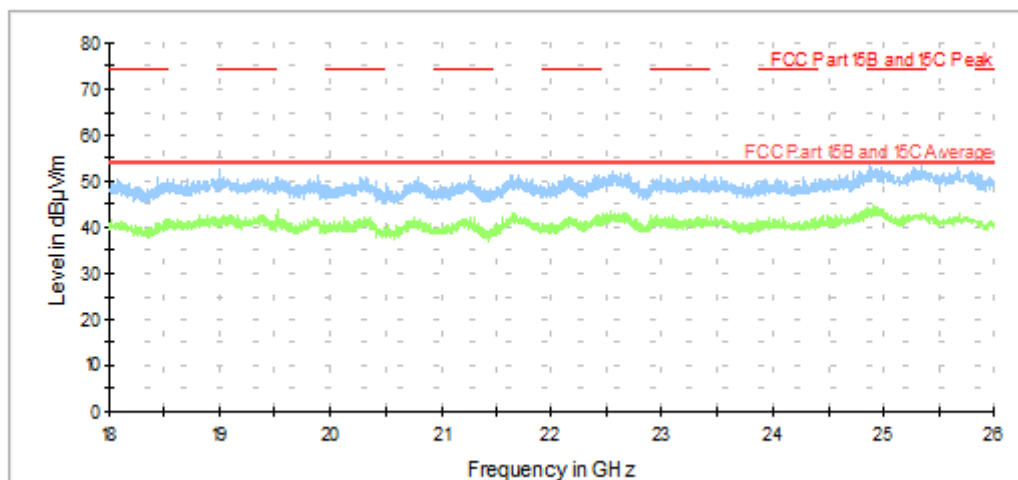
Overview sweeps performed with peak detectors, Frequency range 1 – 18 GHz Ch. 11



Overview sweeps performed with peak detectors, Frequency range 18 – 26 GHz Ch. 18



Overview sweeps performed with peak detectors, Frequency range 18 – 26 GHz Ch. 25



6.4 Antenna gain

Measured maximum transmitter field strength is converted to EIRP using following formula
 $P=(Ed)^2/(30)$.

E = field strength V/m

D = measurement distance

P = Power W

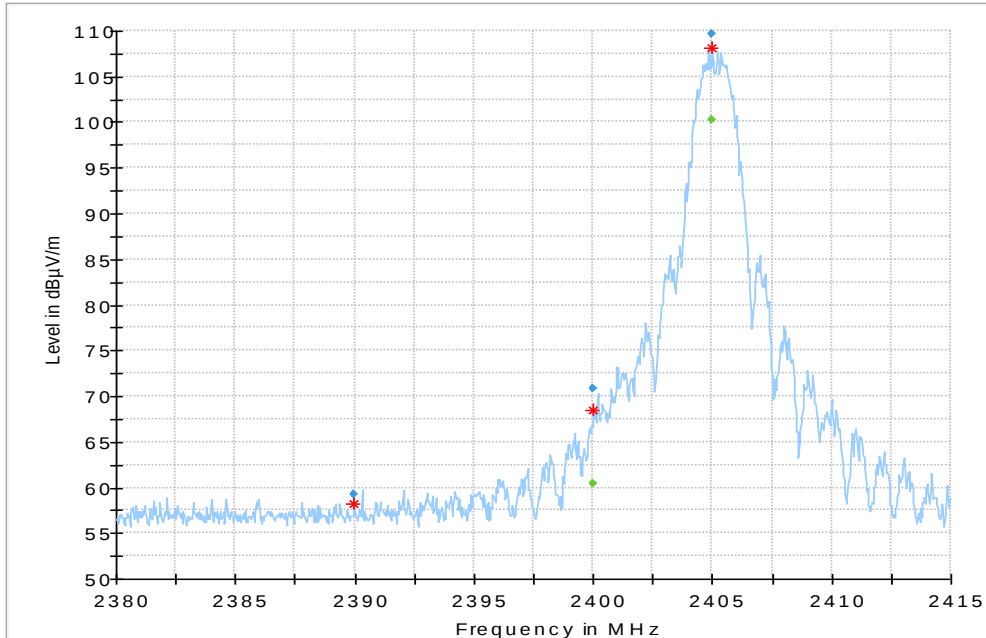
Frequency (MHz)	MaxPeak (dBμV/m)	EIRP/MHz (dBm)
2405	117.5	22.27
2440	117.1	21.87
2475	114.6	19.37

Highest conducted power / MHz is 16.8 dBm / MHz Antenna gain <6dBi

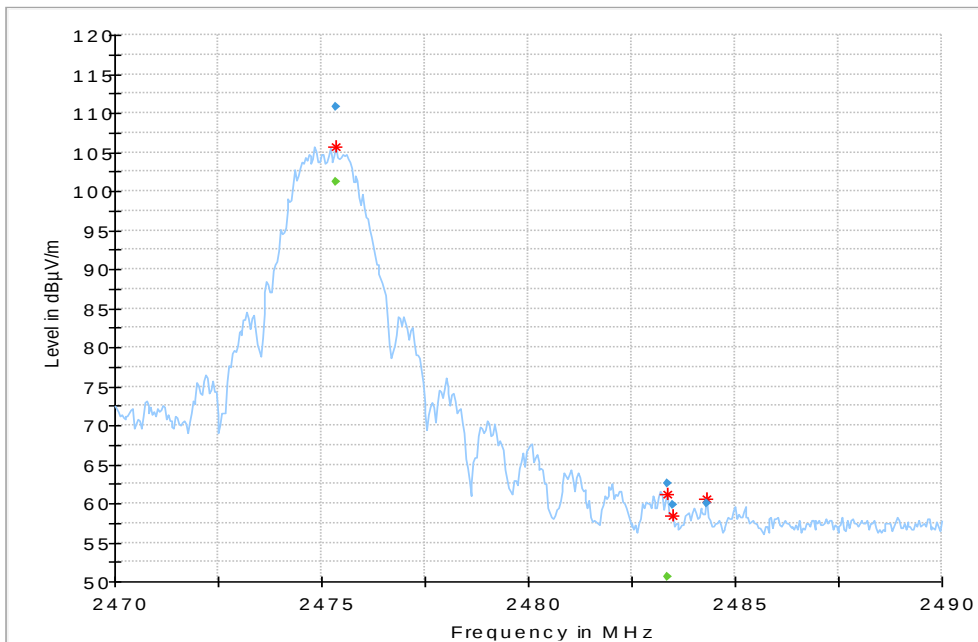
6.5 Band edge

Screen shots marker delta measurement

Full Spectrum



Full Spectrum



Marker delta with 100 kHz RBW

Frequency (MHz)	MaxPeak (dBμV/m)	attenuation (dB)	Bandwidth (kHz)	Height (cm)	Pol	Azimuth (deg)
2405.000000	109.67	---	100.000	275	V	235.0
2400.000000	70.77	39.9	100.000	275	V	8.0
2389.960000	59.21	50.46	100.000	101	V	7.0
2475.360000	110.82	---	100.000	266.0	V	173.0
2483.500000	62.46	48,36	100.000	263.0	V	217.0
2484.320000	59.98	50,84	100.000	166.0	V	330.0

Final band edge result with 1MHz RBW

Frequency (MHz)	MaxPeak (dBμV/m)	Average (dBμV/m)
2405.000000	117.5	---
2400.000000	77.6	57.6
2389.960000	67.04	47.6
2475.360000	114.6	---
2483.500000	66.24	46.24
2484.320000	63.76	43.76

6.6 Test equipment

Measurement software	Rohde & Schwarz	EMC 32	--	--
Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Measurement software	Rohde & Schwarz	EMC 32	--	--
Receiver	Rohde & Schwarz	ESI	32291	7/2014
UltraLog antenna	Rohde & Schwarz	HL 562	30711	12/2014
Hornantenna	Rohde & Schwarz	HF907	32307	6/2015
Pre amplifier	Rohde & Schwarz	TS-PRE1	32306	7/2014
Switch unit	Rohde & Schwarz	OSP130	32300	7/2014
Switch unit	Rohde & Schwarz	OSP-F7-B	32301	--

7 OCCUPIED BANDWIDTH

Date of test:	2015-03-17	Test location:	EMC Center
EUT Serial:	1234567893	Ambient temp.	22°C
Tested by:	Matti Virkki	Relative humidity	39%
Test result:	Pass	Margin:	861.5 kHz

7.1 Requirement

Reference: FCC §15.247(a)(2), RSS-210 A8.2 (a)

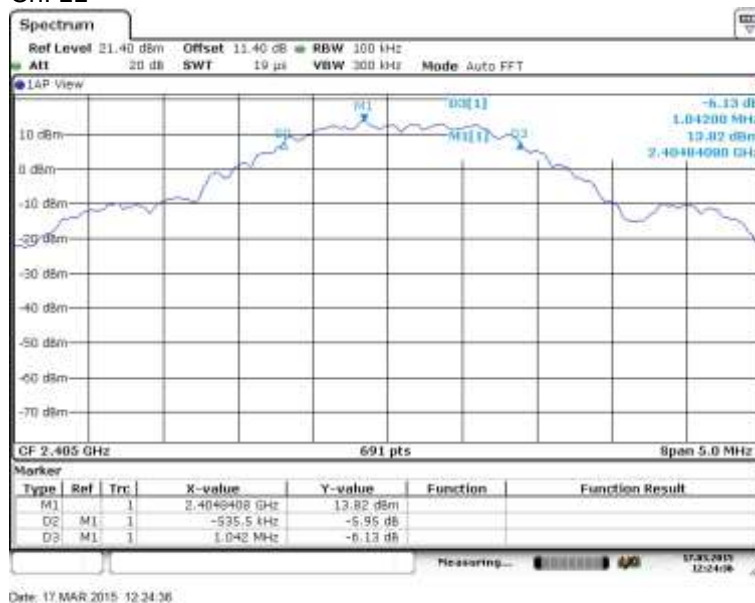
Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

7.2 Test set-up

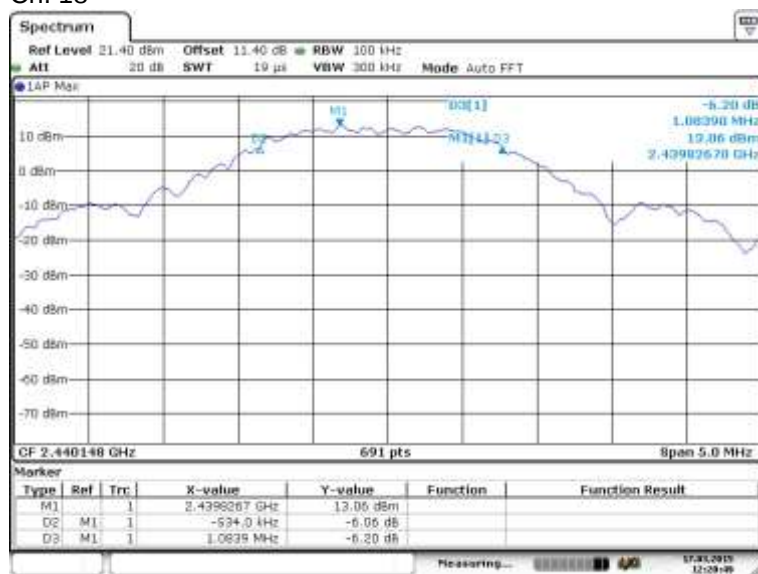
EUT antenna port was connected to spectrum analyser via rf-cable and 10 dB attenuator. Analyser's Reference level offset was used to compensate cable and attenuator losses.

7.3 Test data

Ch. 11



Ch. 18



Date: 17 MAR 2015 12:20:50

Ch. 25



Date: 16 MAR 2015 13:44:52

Frequency MHz	6 dB bandwidth kHz	Limit kHz	Margin kHz
2405	1577.1	500	1077.1
2440	1617.9	500	1017.9
2475	1568.2	500	1068.2

7.4 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyser	Rohde & Schwarz	FSV	32594	7/2015
Rf-attenuator	H+S	5910_N-010 10dB	32696	7/2015

8 CONDUCTED PEAK OUTPUT POWER

Date of test:	2014-06-17 / 2015-03-17	Test location:	EMC Center
EUT Serial:	1234567893	Ambient temp.	22°C
Tested by:	Matti Virkki	Relative humidity	39%
Test result:	Pass	Margin:	11.76

8.1 Requirement

Reference: FCC §15.247(b)(3), RSS-210 A8.4.4

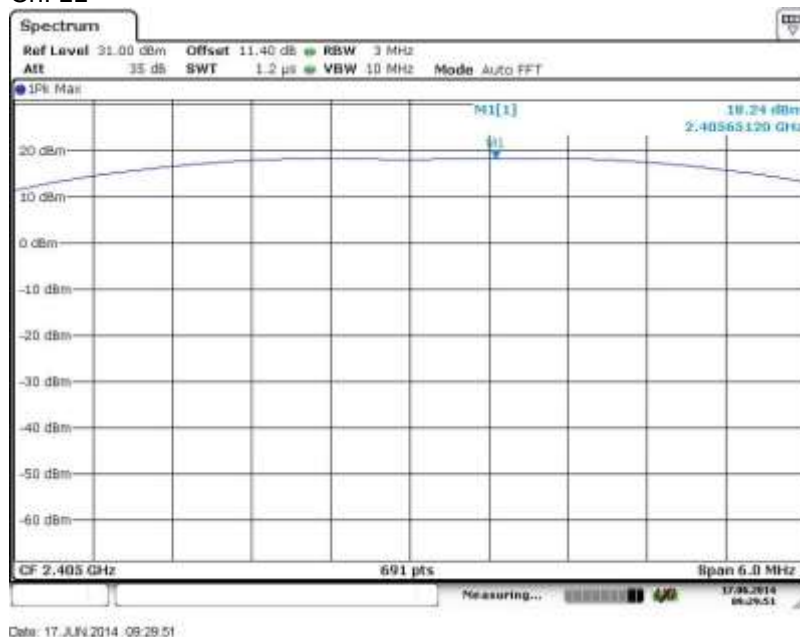
For systems employing digital modulation techniques operating in the bands 902–928 MHz, 2400–2483.5 MHz and 5725–5850 MHz, the maximum peak conducted output power shall not exceed 1 W.

8.2 Test set-up

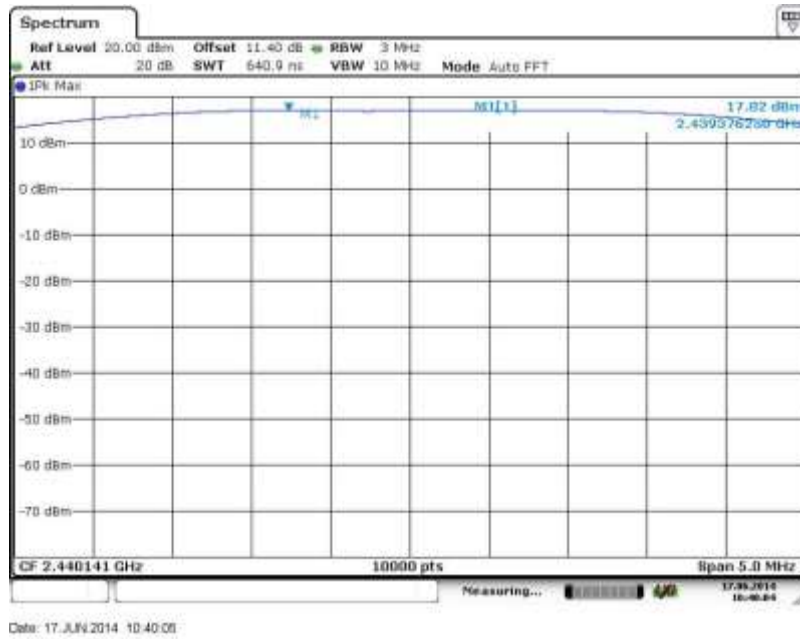
EUT antenna port was connected to spectrum analyser via rf-cable and 10 dB attenuator. Analyser's Reference level offset was used to compensate cable and attenuator losses.

8.3 Test data

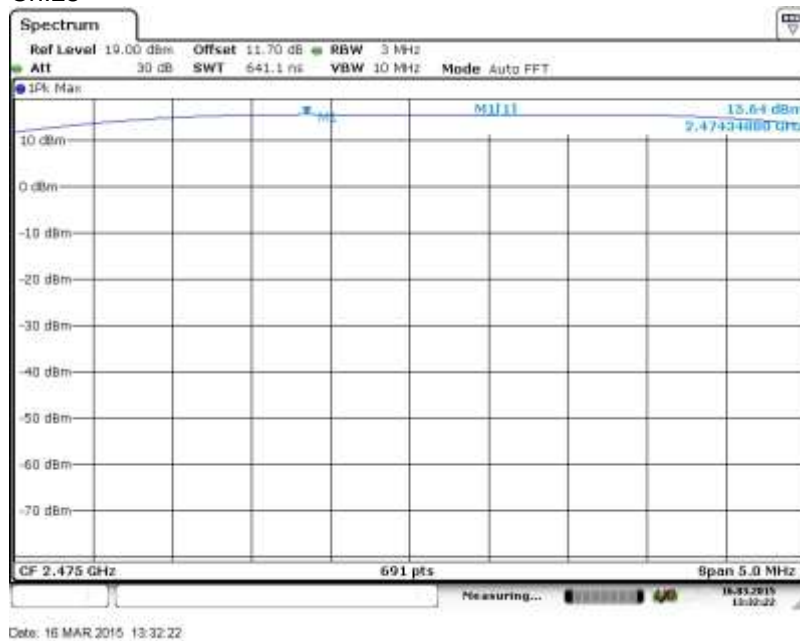
Ch. 11



Ch.18



Ch.25



Frequency MHz	Peak power dBm	Limit dBm	Margin dB
2405	18.24	30	11.76
2440	17.02	30	12.98
2475	15.64	30	14.37

8.4 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyser	Rohde & Schwarz	FSV	32594	7/2015
Rf-attenuator	H+S	5910 N-010 10dB	32696	7/2015

9 PEAK POWER SPECTRAL DENSITY

Date of test:	2014-06-17 / 2015-03-17	Test location:	EMC Center
EUT Serial:	1234567893	Ambient temp.	22°C
Tested by:	Matti Virkki	Relative humidity	39%
Test result:	Pass	Margin:	0.89

9.1 Requirement

Reference: FCC §15.247(e), RSS-210 A8.2 (b)

For digitally modulated systems, the 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.

9.2 Test set-up

EUT antenna port was connected to spectrum analyser via rf-cable and 10 dB attenuator. Analyser's Reference level offset was used to compensate cable and attenuator losses.

9.3 Test data

Ch. 11



Ch. 18



Date: 17 JUN 2014 10:30:03

Ch. 25



Date: 16 MAR 2015 13:33:50

Frequency MHz	Peak power spectral density dBm/3kHz	Limit dBm/3kHz	Margin dB
2405	7.11	8	0.89
2440	5.41	8	2.59
2475	4.07	8	3.93

9.4 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyser	Rohde & Schwarz	FSV	32594	7/2015
Rf-attenuator	H+S	5910_N-010 10dB	32696	7/2015

10 TRANSMITTER DWELL TIME AND DUTY CYCLE AVERAGING FACTOR

Date of test:	2014-06-25	Test location:	EMC Center
EUT Serial:	1234567893	Ambient temp.	22°C
Tested by:	Matti Virkki	Relative humidity	39%

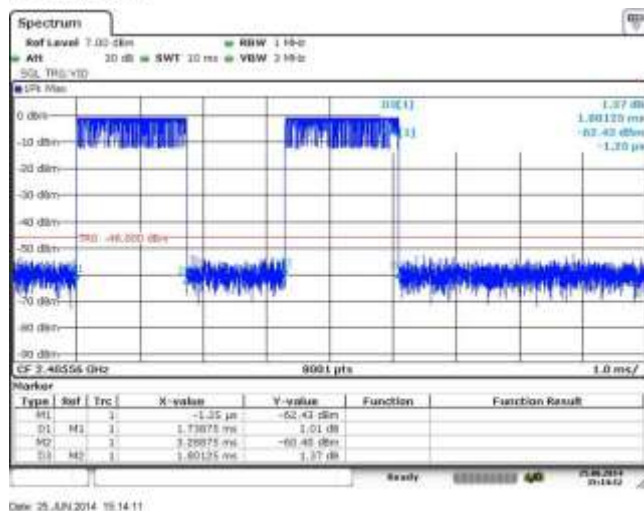
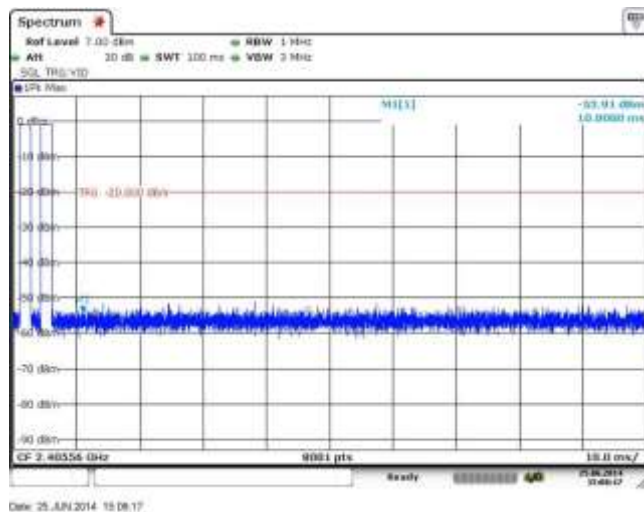
10.1 Requirement

Transmitter dwell time is measured for transmitter spurious emission duty cycle averaging.

10.2 Test set-up

EUT antenna port was connected to spectrum analyser via rf-cable and 10 dB attenuator.

10.3 Test data



Ton/100ms	Duty cycle averaging factor 20LOG(Ton/100ms)	Averaging factor to be used
2.54 ms	-31.90 dB	-20 dB

10.4 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyser	Rohde & Schwarz	FSV	32594	7/2015
Rf-attenuator	H+S	5910 N-010 10dB	32696	7/2014

11 BAND EDGE CONDUCTED

Date of test:	2014-06-27 / 2015-03-16	Test location:	EMC Center
EUT Serial:	1234567893	Ambient temp.	22°C
Tested by:	Matti Virkki	Relative humidity	39%
Test result:	Pass	Margin:	20.08

11.1 Requirement

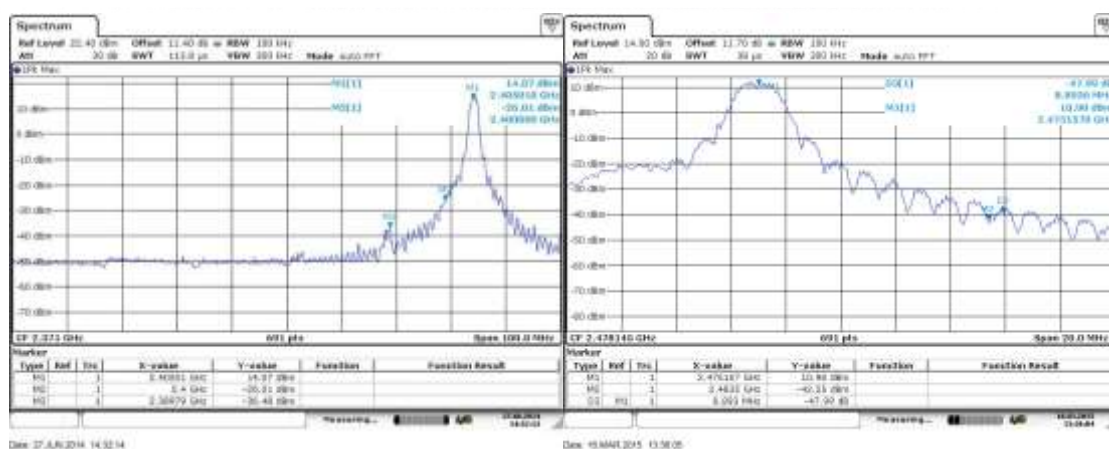
Reference: FCC §15.247(d), RSS-210 A8.5

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits.

11.2 Test set-up

EUT antenna port was connected to spectrum analyser via rf-cable and 10 dB attenuator. Analyser's Reference level offset was used to compensate cable and attenuator losses.

11.3 Test data



Frequency MHz	Level dBm/100kHz	Attenuation from carrier dB	Margin dB
2389.79	-36.48	50.55	30.55
2400.000	-26.01	40.08	20.08
2483.500	-42.25	53.23	33.23
2483.98	-37.01	47.99	27.99

11.4 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyser	Rohde & Schwarz	FSV	32594	7/2015
Rf-attenuator	H+S	5910 N-010 10dB	32696	7/2015

12 CONDUCTED SPURIOUS EMISSION

Date of test:	2014-06-17 / 2015-3-17	Test location:	EMC Center
EUT Serial:	1234567893	Ambient temp.	22°C
Tested by:	Matti Virkki	Relative humidity	39%
Test result:	Pass	Margin:	35.2 dB

12.1 Requirement

Reference: FCC §15.247(d), RSS-210 A8.5

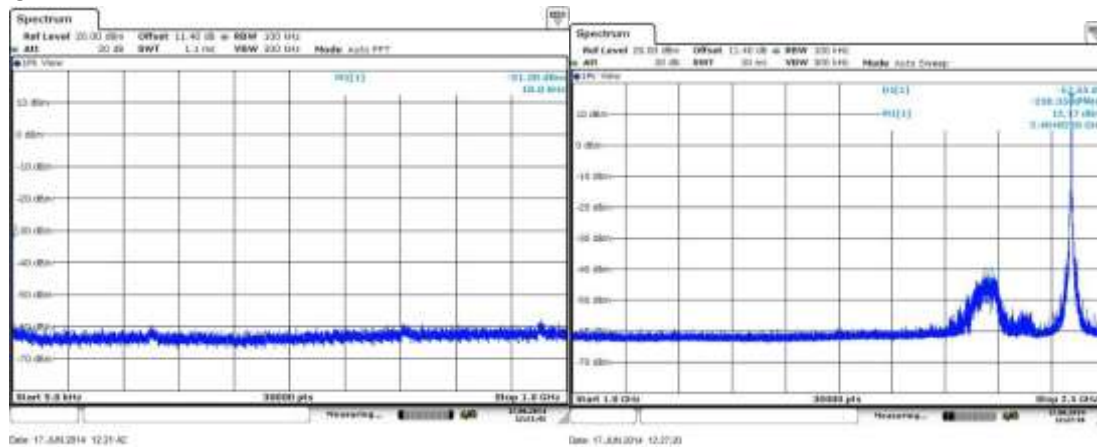
In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits.

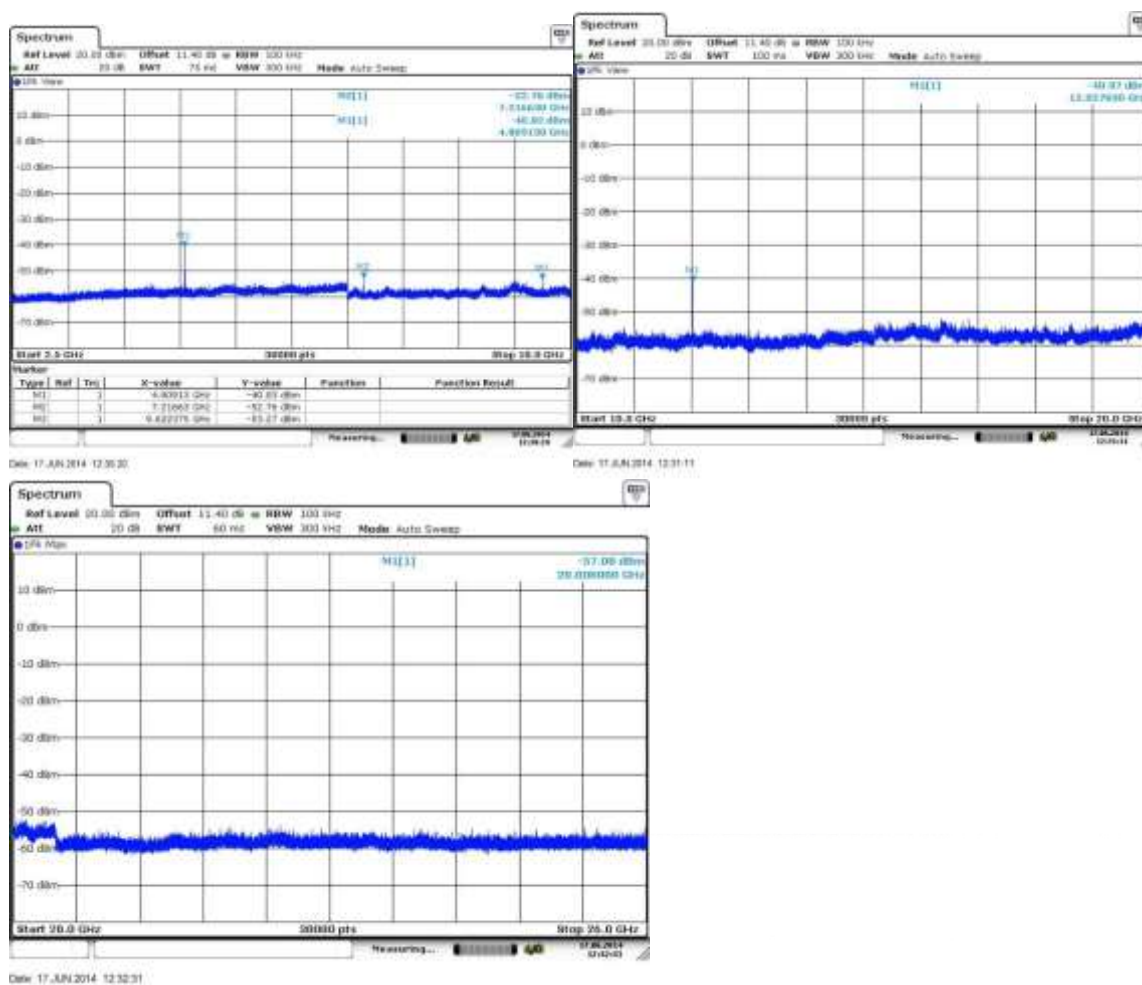
12.2 Test set-up

EUT antenna port was connected to spectrum analyser via rf-cable and 10 dB attenuator.

12.3 Test data

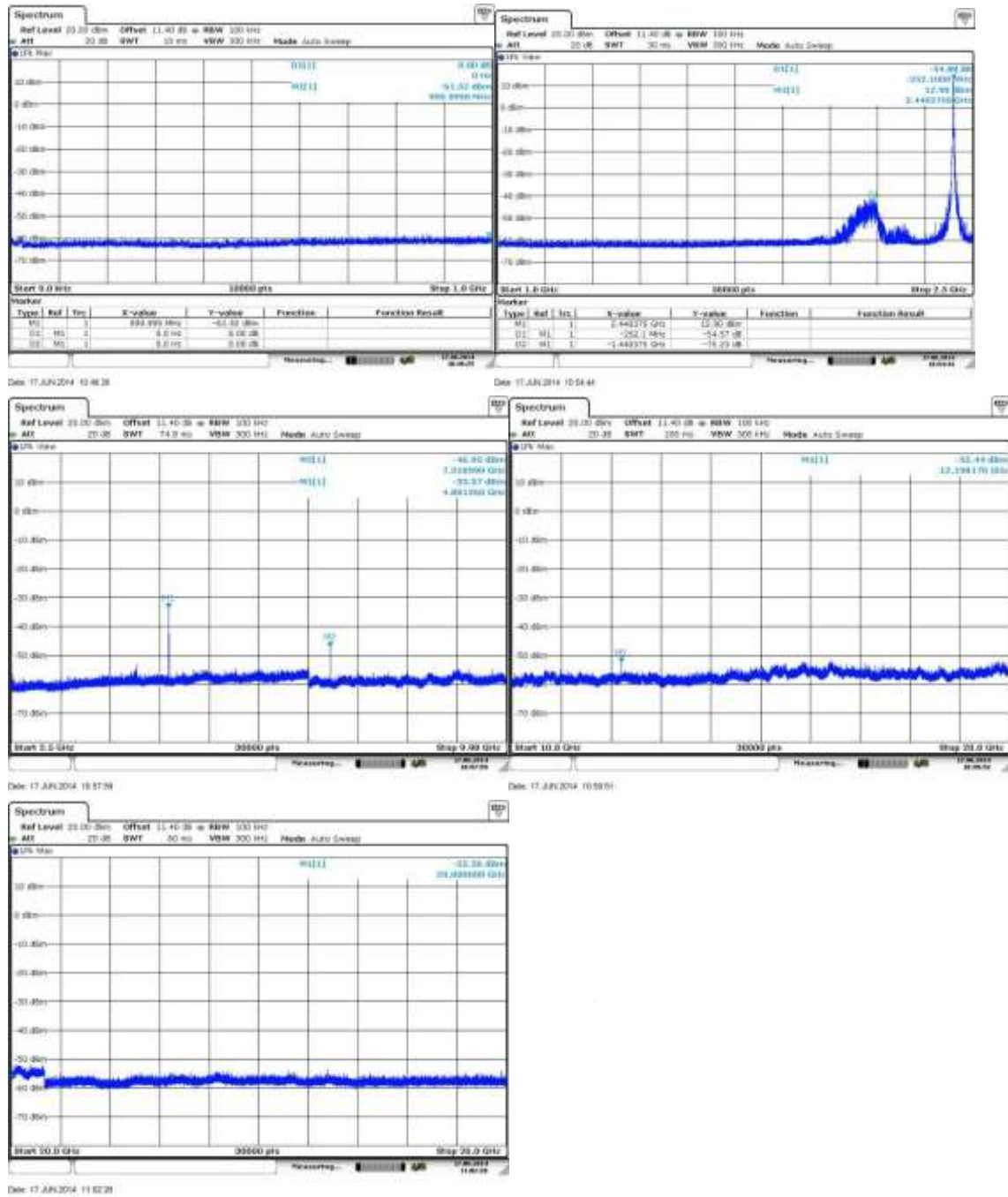
Ch 11





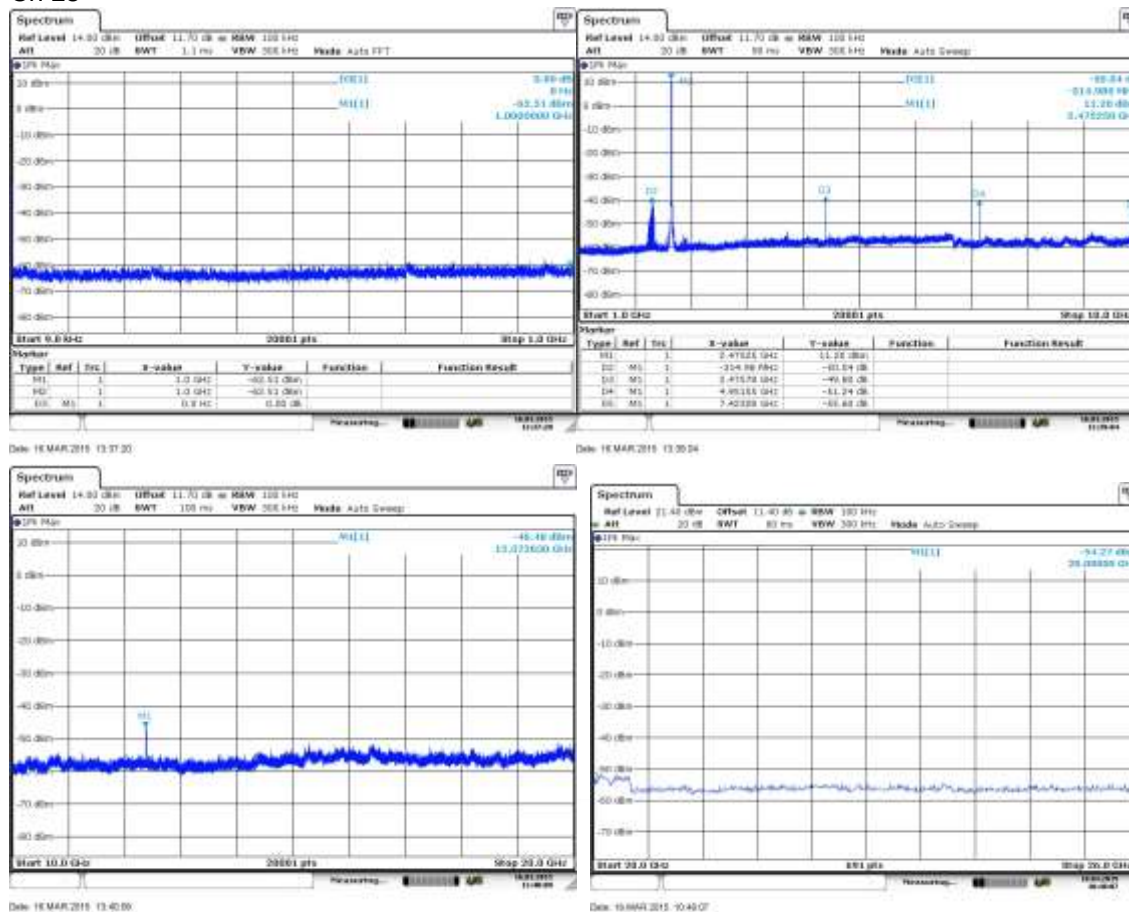
Frequency MHz	level dBm / 100 kHz	Spurious emission attenuation from carrier dB	Margin dB
2404.825	15.17	-	-
2174.467	-42.38	57.55	37.55
4809.130	-40.03	55.20	35.20
7216.63	-52.76	67.93	47.93
9622.375	-53.27	68.44	48.44
12027.830	-40.97	56.14	36.14

Ch 18



Frequency MHz	level dBm / 100 kHz	Spurious emission attenuation from carrier	Margin dB
2440.375	12.90	-	-
2174.467	-41.62	54.52	34.52
4880.126	-33.57	46.47	26.47
7318.990	-46.95	59.85	39.85
12198.170	-52.44	65.34	45.34

Ch 25



Frequency MHz	level dBm / 100 kHz	Spurious emission attenuation from carrier	Margin dB
2489.825	12.58	-	-
2162.875	-40.95	53.53	33.53
4961.135	-35.43	46.47	26.47
7441.875	-47.27	59.85	39.85
12402.830	-52.76	65.34	45.34

12.4 Test equipment

Equipment type	Manufacturer	Model	Inv. No.	Cal. due date
Spectrum analyser	Rohde & Schwarz	FSV	32594	7/2015
Rf-attenuator	H+S	5910_N-010 10dB	32696	7/2015

13 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

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
Frequency range 26,5 GHz - 40 GHz	± 3,6 dB

Output power

Analog signals, conducted:

RF-power meter	± 0,6 dB
Spectrum analyser	± 3,5 dB

Analog signals, radiated:

25 MHz - 1000 MHz	± 3,7 dB
1 GHz - 18 GHz	± 3,4 dB

Digital signals, conducted

± 0,6 dB

Digital signals, radiated:

25 MHz - 1000 MHz	± 3,7 dB
1 GHz - 18 GHz	± 3,4 dB

Peak power density

Conducted:

8593E	± 2,5 dB
8566B	± 2,7 dB

Radiated:

8593E & 8566B, 25 - 1000 MHz	± 4,5 dB
8593E & 8566B, 1 - 18 GHz	± 4,7 dB

14 PHOTO OF THE EUT

