

FCC Part 15 Subpart B&C §15.247

Test Report

Equipment Under Test	Car Audio
Model Name	HAGM1006
Applicant	Humax Automotive Co., Ltd.
FCC ID	YRN-HAGM1006
Manufacturer	Humax Automotive Co., Ltd.
Date of Test(s)	2014. 03. 18 ~ 2013. 04. 02
Date of Issue	2014. 04. 08

In the configuration tested, the EUT complied with the standards specified above.

Issue to	Issue by
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Revision history

Revision	Date of issue	Description	Revised by
--	Apr. 08, 2014	Initial	--

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1. Attestation of test results

1.1. Details of applicant

Applicant : Humax Automotive Co., Ltd.
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1.2. Summary of test results

The EUT has been tested according to the following specifications;

Section in FCC part 15	Description	Result
§15.205(a) §15.209 §15.247(d)	Transmitter radiated spurious emissions, Conducted spurious emission	C
§15.247(a)(1)	20 dB bandwidth and 99 % bandwidth	C
§15.247(b)(1)	Maximum peak output power	C
§15.247(a)(1)	Frequency separation	C
§15.247(a)(1)(iii)	Number of hopping frequency	C
§15.247(a)(1)(iii)	Time of occupancy(Dwell time)	C
§15.247(i) §1.1307(b)(1)	RF exposure evaluation	C

The sample was tested according to the following specification:

FCC Parts 15.247; ANSI C-63.4-2003

FCC Public Notice DA 00-705

TEST SITE REGISTRATION NUMBER:

FCC(67068)

※ Abbreviation

C Complied
 N/A Not applicable
 F Fail

Approval Signatories

Test and Report Completed by :	Report Approval by :
	
Jungmoo Her Test Engineer MOVON CORPORATION	Issac Jin Technical Manager MOVON CORPORATION

2. EUT Description

Kind of product	Car audio
Model Name	HAGM1006
Serial Number	N/A
Power supply	DC 14.4V
Frequency range	2 402 MHz ~ 2 480 MHz
Modulation technique	GFSK(1Mbps), $\pi/4$ DQPSK(2Mbps), 8DPSK(3Mbps)
Number of channels	79
Antenna gain	-1.72 dBi (Max.)
TEST SITE REGISTRATION NUMBER	FCC(67068)

2.1. Declarations by the manufacturer

None

2.2. Details of modification

None

3. Frequency Hopping System Requirements

3.1. Standard Applicable

According to FCC Part 15.247(a)(1), The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

(g) Frequency hopping spread spectrum systems are not required to employ all available hopping channels during each transmission. However, the system, consisting of both the transmitter and the receiver, must be designed to comply with all of the regulations in this section should the transmitter be presented with a continuous data (or information) stream. In addition, a system employing short transmission bursts must comply with the definition of a frequency hopping system and must distribute its transmissions over the minimum number of hopping channels specified in this section.

(h) The incorporation of intelligence within a frequency hopping spread spectrum system that permits the system to recognize other users within the spectrum band so that it individually and independently chooses and adapts its hopsets to avoid hopping on occupied channels is permitted. The coordination of frequency hopping systems in any other manner for the express purpose of avoiding the simultaneous occupancy of individual hopping frequencies by multiple transmitters is not permitted.

3.2 EUT Pseudorandom Frequency Hopping Sequence

The channel is represented by a pseudo-random hopping sequence hopping through the 79 RF channels. The hopping sequence is unique for the piconet and is determined by the Bluetooth device address of the master; the phase in the hopping sequence is determined by the Bluetooth clock of the master. The channel is divided into time slots where each slot corresponds to an RF hop frequency. Consecutive hops correspond to different RF hop frequencies. The nominal hop rate is 1 600 hops/s.

Example of a 79 hopping sequence in data mode:
40,21,44,23,42,53,46,55,48,33,52,35,50,65,54...

Each frequency used equally on the average by each transmitter.
The system receiver have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shift frequencies in synchronization with the transmitted signals.

4. Measurement equipment

Equipment	Manufacturer	Model	Serial number	Calibration Interval	Calibration due.
EMI Test Receiver	R&S	ESIB26	100196/026	1 year	2014-12-14
Signal Generator	R&S	SMR27	100089	1 year	2014-12-13
Spectrum Analyzer	R&S	FSV-40	100832	1 year	2014-10-04
Power Meter	Agilent	E4416A	GB41290645	1 year	2014-10-04
Power Sensor	Agilent	9327A	US40441490	1 year	2014-10-04
Double Ridge Horn Antenna	R&S	HF906	100236	2 year	2015-02-28
Horn Antenna	AH Systems	SAS-572	269	2 year	2015-09-06
Bi - Log Antenna	AH Systems	SAS-521-7	128	2 year	2015-10-04
Power Amplifier	MITEQ	AM-1431	1497315	1 year	2014-10-04
Power Amplifier	MITEQ	AFS43-01002600	1374382	1 year	2014-10-04
High Pass Filter	Wainwright	WHK3.0/18G-10SS	508	1 year	2014-10-04
DC Power Supply	HP	6674A	3637A01351	1 year	2014-10-04
Controller	INNCO	CO2000	co200/064/6961003/L	N/A	N/A
Antenna Master	INNCO	MA4000	MA4000/038/6961003/L	N/A	N/A
Loop Antenna	ETS LINDGREN	6502	00118166	2 year	2015-09-27

※ Remark;
Support equipment

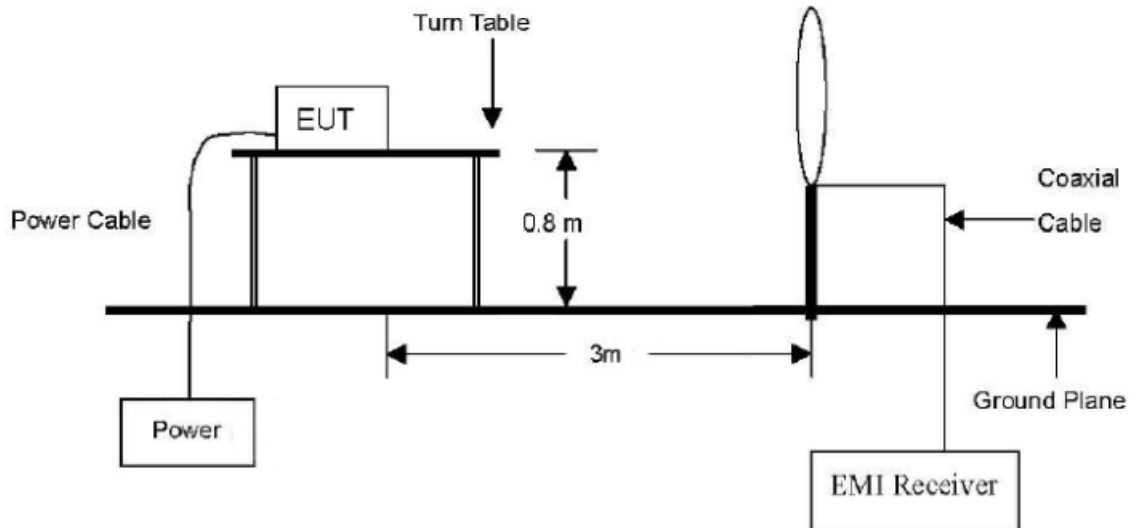
Description	Manufacturer	Model	Serial number
-	-	-	-

5. Transmitter radiated spurious emissions and conducted spurious emissions

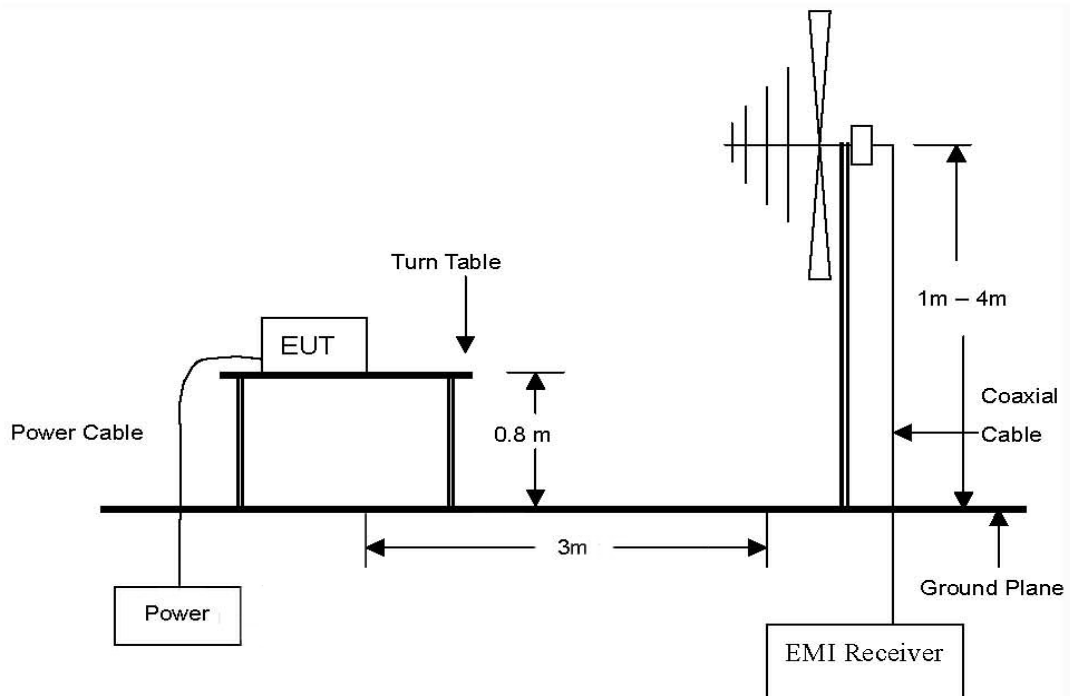
5.1. Test setup

5.1.1. Transmitter radiated spurious emissions

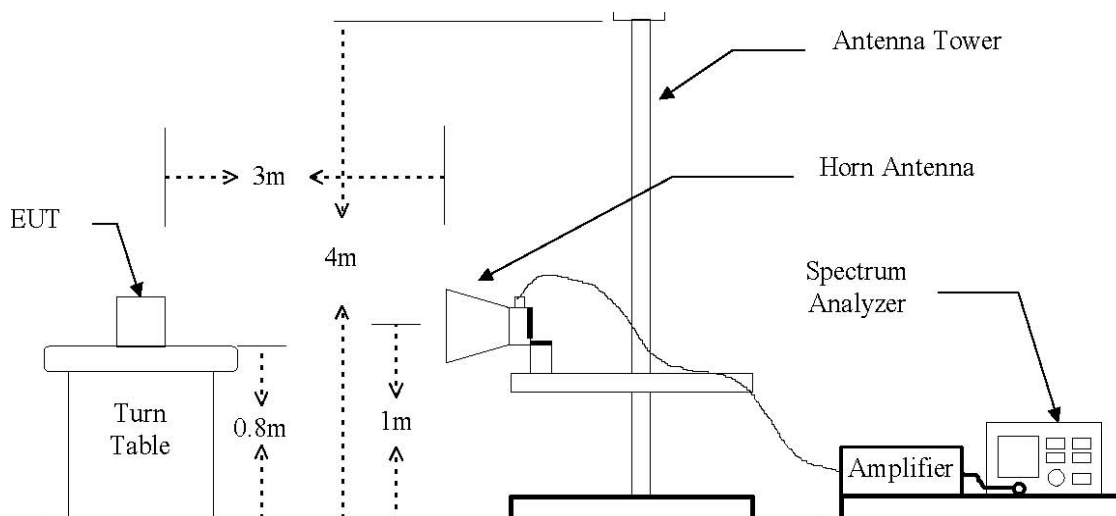
The diagram below shows the test setup that is utilized to make the measurements for emission from 9kHz to 30MHz Emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 30 MHz to 1 GHz emissions.



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 GHz to 24 GHz emissions.



5.2. Limit

According to §15.247(d), 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 within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph(b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in section §15.209(a) is not required. In addition, radiated emission which in the restricted band, as define in section §15.205(a), must also comply the radiated emission limits specified in section §15.209(a) (see section §15.205(c))

According to § 15.109(a), for an intentional radiator devices, the general required of field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values :

Frequency (MHz)	Distance (Meters)	Radiated at 3M (dBμV/m)	Radiated (μV/m)
0.009–0.490	300	See the remark	2400/F(kHz)
0.490–1.705	30		24000/F(kHz)
1.705–30.0	30		30
30 - 88	3	40.0	100
88 – 216	3	43.5	150
216 – 960	3	46.0	200
Above 960	3	54.0	500

*Remark

- Emission level in dB uV/m = 20 log (uV/m)
- Measurement was performed at an antenna to the closed point of EUT distance of meters.
- Distance extrapolation factor = 40log(Specific distance/ test distance) (dB)
Limit line=Specific limits(dB uV) + distance extrapolation factor.

5.3. Test procedures

Radiated emissions from the EUT were measured according to the dictates of ANSI C63.4:2003

In case of the air temperature of the test site is out of the range is 10 to 40°C before the testing proceeds the warm-up time of EUT maintain adequately

5.3.1. Test procedures for radiated spurious emissions

1. The EUT is placed on a turntable, which is 0.8 m above ground plane.
2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level.
3. EUT is set 3 m away from the receiving antenna, which is varied from 1m to 4m to find out the highest emissions.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. And also, each emission was to be maximized by changing the polarization of receiving antenna both horizontal and vertical.
6. Repeat above procedures until the measurements for all frequencies are complete.

※ **Remark;**

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 10 kHz for Peak detection (PK) at frequency below 30 MHz
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Peak detection (PK) or Quasi-peak detection (QP) at frequency below 1 GHz.
3. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 MHz for Peak detection and frequency above 1 GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz for Average detection (AV) at frequency above 1 GHz.

5.3.2. Test procedures for conducted spurious emissions

1. The transmitter output was connected to the spectrum analyzer through an attenuator.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW = 100 kHz, VBW = 100 kHz.

5.4. Test result

Ambient temperature: 23°C

Relative humidity: 51 % R.H.

5.4.1. Spurious radiated emission

The frequency spectrum from 9kHz to 30 MHz was investigated. Emission levels are not reported much lower than the limits by over 20 dB. All reading values are peak values.

To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes.

Operation mode: BASIC

A. Low channel (2 402 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detector mode	Pol.	Ant. factor (dB/m)	CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
No other emissions were detected at a level greater than 20dB below limit.								

B. Middle channel (2 441 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detector mode	Pol.	Ant. factor (dB/m)	CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
No other emissions were detected at a level greater than 20dB below limit.								

C. High channel (2 480 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detector mode	Pol.	Ant. factor (dB/m)	CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
No other emissions were detected at a level greater than 20dB below limit.								

※ Remark

1. Actual = Reading + Ant. factor + CL (Cable loss)
2. Distance extrapolation factor = 40 log (specific distance / test distance) (dB)
3. Limit line = specific Limits (dBuV) + Distance extrapolation factor
4. 15.31 Measurement standards.

The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

Operation mode: EDR

A. Low channel (2 402 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
No other emissions were detected at a level greater than 20dB below limit.								

B. Middle channel (2 441 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
No other emissions were detected at a level greater than 20dB below limit.								

C. High channel (2 480 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
No other emissions were detected at a level greater than 20dB below limit.								

※ **Remark**

1. Actual = Reading + Ant. factor + CL (Cable loss)
2. Distance extrapolation factor = 40 log (specific distance / test distance) (dB)
3. Limit line = specific Limits (dB μ V) + Distance extrapolation factor
4. 15.31 Measurement standards.

The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

5.4.2. Spurious radiated emission

The frequency spectrum from 30 MHz to 1 000 MHz was investigated. Emission levels are not reported much lower than the limits by over 20 dB. All reading values are peak values.

To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes.

Operation mode: BASIC

A. Low channel (2 402 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detector mode	Pol.	Ant. factor (dB/m)	CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
33.88	2.71	Peak	V	16.16	0.53	19.40	40.00	20.60
90.00	16.81	Peak	V	9.55	0.76	27.12	43.50	16.38
300.00	10.05	Peak	V	15.44	1.24	26.73	46.00	19.27
350.00	10.78	Peak	V	16.18	1.33	28.29	46.00	17.71
400.00	10.21	Peak	V	16.92	1.41	28.54	46.00	17.46
504.00	8.06	Peak	V	18.37	1.57	28.00	46.00	18.00
Above 600.00	Not detected							

※ **Remark**

1. Actual = Reading + Ant. factor + CL (Cable loss)
2. 15.31 Measurement standards.

The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

B. Middle channel (2 441 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
33.88	2.33	Peak	V	16.16	0.53	19.02	40.00	20.98
90.00	16.54	Peak	V	9.55	0.76	26.85	43.50	16.65
300.00	10.21	Peak	V	15.44	1.24	26.89	46.00	19.11
350.00	11.55	Peak	V	16.18	1.33	29.06	46.00	16.94
400.00	12.60	Peak	V	16.92	1.41	30.93	46.00	15.07
504.00	11.72	Peak	V	18.37	1.57	31.66	46.00	14.34
Above 600.00	Not detected							

C. High channel (2 480 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
33.88	3.52	Peak	V	16.16	0.53	20.21	40.00	19.79
90.00	18.48	Peak	V	9.55	0.76	28.79	43.50	14.71
300.00	12.71	Peak	V	15.44	1.24	29.39	46.00	16.61
350.00	10.06	Peak	V	16.18	1.33	27.57	46.00	18.43
400.00	13.33	Peak	V	16.92	1.41	31.66	46.00	14.34
504.00	12.05	Peak	V	18.37	1.57	31.99	46.00	14.01
Above 600.00	Not detected							

※ Remark

1. Actual = Reading + Ant. factor + CL (Cable loss)
2. 15.31 Measurement standards.

The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

Operation mode: EDR

A. Low channel (2 402 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
33.88	2.48	Peak	V	16.16	0.53	19.17	40.00	20.83
90.00	15.51	Peak	V	9.55	0.76	25.82	43.50	17.68
300.00	13.30	Peak	H	15.44	1.24	29.98	46.00	16.02
350.00	12.48	Peak	H	16.18	1.33	29.99	46.00	16.01
400.00	11.09	Peak	V	16.92	1.41	29.42	46.00	16.58
504.00	10.26	Peak	V	18.37	1.57	30.2	46.00	15.80
Above 600.00	Not detected							

B. Middle channel (2 441 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
33.88	3.11	Peak	V	16.16	0.53	19.8	40.00	20.20
90.00	13.41	Peak	V	9.55	0.76	23.72	43.50	19.78
300.00	16.04	Peak	H	15.44	1.24	32.72	46.00	13.28
350.00	11.05	Peak	H	16.18	1.33	28.56	46.00	17.44
400.00	12.21	Peak	V	16.92	1.41	30.54	46.00	15.46
504.00	10.47	Peak	V	18.37	1.57	30.41	46.00	15.59
Above 600.00	Not detected							

※ **Remark**

1. Actual = Reading + Ant. factor + CL (Cable loss)
2. 15.31 Measurement standards.

The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

C. High channel (2 480 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detector mode	Pol.	Ant. factor (dB/m)	CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
33.88	2.09	Peak	V	16.16	0.53	18.78	40.00	21.22
90.00	10.16	Peak	V	9.55	0.76	20.47	43.50	23.03
300.00	12.33	Peak	H	15.44	1.24	29.01	46.00	16.99
350.00	10.46	Peak	H	16.18	1.33	27.97	46.00	18.03
400.00	11.20	Peak	V	16.92	1.41	29.53	46.00	16.47
504.00	12.08	Peak	V	18.37	1.57	32.02	46.00	13.98
Above 600.00	Not detected							

※ Remark

1. Actual = Reading + Ant. factor + Amp + CL(Cable loss)

2. 15.31 Measurement standards.

The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

5.4.3. SPURIOUS RADIATED EMISSION

The frequency spectrum above 1 000 MHz was investigated. Emission levels are not reported much lower than the limits by over 20 dB.

Operation mode: BASIC

A. Low channel (2 402 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
1 399.10	70.73	Peak	H	24.57	43.50	51.80	74.00	22.20
1 399.10	59.46	Average	H	24.57	43.50	40.53	54.00	13.47
1 399.10	68.11	Peak	V	24.57	43.50	49.18	74.00	24.82
1 399.10	56.52	Average	V	24.57	43.50	37.59	54.00	16.41
4 828.10	71.65	Peak	H	33.26	44.10	60.81	74.00	13.19
4 828.10	60.12	Average	H	33.26	44.10	49.28	54.00	4.72
4 828.10	70.92	Peak	V	33.26	44.10	60.08	74.00	13.92
4 828.10	59.89	Average	V	33.26	44.10	49.05	54.00	4.95
7 740.00	68.98	Peak	H	35.66	43.20	61.44	74.00	12.56
7 740.00	55.24	Average	H	35.66	43.20	47.70	54.00	6.30
7 740.00	65.33	Peak	V	35.66	43.20	57.79	74.00	16.21
7 740.00	51.91	Average	V	35.66	43.20	44.37	54.00	9.63
Above 8 000.00	Not detected							

B. Middle channel (2 441 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2 247.00	71.83	Peak	H	28.86	43.65	57.04	74.00	16.96
2 247.00	62.10	Average	H	28.86	43.65	47.31	54.00	6.69
2 247.00	70.59	Peak	V	28.86	43.65	55.80	74.00	18.20
2 247.00	59.94	Average	V	28.86	43.65	45.15	54.00	8.85
4 824.00	73.40	Peak	H	33.26	44.10	62.56	74.00	11.44
4 824.00	63.81	Average	H	33.26	44.10	52.97	54.00	1.03
4 824.00	71.12	Peak	V	33.26	44.10	60.28	74.00	13.72
4 824.00	60.65	Average	V	33.26	44.10	49.81	54.00	4.19
7 727.00	68.88	Peak	H	35.66	43.20	61.34	74.00	12.66
7 727.00	56.63	Average	H	35.66	43.20	49.09	54.00	4.91
7 727.00	62.34	Peak	V	35.66	43.20	54.80	74.00	19.20
7 727.00	50.31	Average	V	35.66	43.20	42.77	54.00	11.23
Above 8 000.00	Not detected							

C. High channel (2 480 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dBμV)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 127.10	71.95	Peak	H	28.86	43.65	57.16	74.00	16.84
2 127.10	62.31	Average	H	28.86	43.65	47.52	54.00	6.48
2 127.10	71.70	Peak	V	28.86	43.65	56.91	74.00	17.09
2 127.10	61.59	Average	V	28.86	43.65	46.80	54.00	7.20
4 817.30	71.07	Peak	H	33.26	44.10	60.23	74.00	13.77
4 817.30	62.49	Average	H	33.26	44.10	51.65	54.00	2.35
4 817.30	71.14	Peak	V	33.26	44.10	60.30	74.00	13.70
4 817.30	61.86	Average	V	33.26	44.10	51.02	54.00	2.98
7 789.40	67.84	Peak	H	35.66	43.20	60.30	74.00	13.70
7 789.40	54.71	Average	H	35.66	43.20	47.17	54.00	6.83
7 789.40	66.46	Peak	V	35.66	43.20	58.92	74.00	15.08
7 789.40	52.52	Average	V	35.66	43.20	44.98	54.00	9.02
Above 8 000.00	Not detected							

※ Remark

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental Frequency.
2. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit.
4. Actual = Reading + Ant. factor + Amp + CL (Cable loss)
5. 15.31 Measurement standards.
The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

Operation mode: EDR

A. Low channel (2 402 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2 205.60	69.54	Peak	H	28.86	43.65	54.75	74.00	19.25
2 205.60	58.76	Average	H	28.86	43.65	43.97	54.00	10.03
2 205.60	68.48	Peak	V	28.86	43.65	53.69	74.00	20.31
2 205.60	57.22	Average	V	28.86	43.65	42.43	54.00	11.57
4 825.10	70.87	Peak	H	33.26	44.10	60.03	74.00	13.97
4 825.10	59.15	Average	H	33.26	44.10	48.31	54.00	5.69
4 825.10	68.24	Peak	V	33.26	44.10	57.40	74.00	16.60
4 825.10	56.59	Average	V	33.26	44.10	45.75	54.00	8.25
7 765.20	71.01	Peak	H	35.66	43.20	63.47	74.00	10.53
7 765.20	59.25	Average	H	35.66	43.20	51.71	54.00	2.29
7 765.20	69.21	Peak	V	35.66	43.20	61.67	74.00	12.33
7 765.20	56.62	Average	V	35.66	43.20	49.08	54.00	4.92
Above 8 000.00	Not detected							

B. Middle channel (2 441 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2 306.10	69.33	Peak	H	28.86	43.65	54.54	74.00	19.46
2 306.10	60.92	Average	H	28.86	43.65	46.13	54.00	7.87
2 306.10	67.27	Peak	V	28.86	43.65	52.48	74.00	21.52
2 306.10	57.44	Average	V	28.86	43.65	42.65	54.00	11.35
4 868.50	73.86	Peak	H	33.26	44.10	63.02	74.00	10.98
4 868.50	62.15	Average	H	33.26	44.10	51.31	54.00	2.69
4 868.50	72.75	Peak	V	33.26	44.10	61.91	74.00	12.09
4 868.50	62.06	Average	V	33.26	44.10	51.22	54.00	2.78
7 651.50	68.20	Peak	H	35.66	43.20	60.66	74.00	13.34
7 651.50	56.94	Average	H	35.66	43.20	49.40	54.00	4.60
7 651.50	67.91	Peak	V	35.66	43.20	60.37	74.00	13.63
7 651.50	56.23	Average	V	35.66	43.20	48.69	54.00	5.31
Above 8 000.00	Not detected							

C. High channel (2 480 MHz)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2 060.30	73.79	Peak	H	28.86	43.65	59.00	74.00	15.00
2 060.30	65.37	Average	H	28.86	43.65	50.58	54.00	3.42
2 060.30	72.21	Peak	V	28.86	43.65	57.42	74.00	16.58
2 060.30	64.92	Average	V	28.86	43.65	50.13	54.00	3.87
4 863.50	71.86	Peak	H	33.26	44.10	61.02	74.00	12.98
4 863.50	60.55	Average	H	33.26	44.10	49.71	54.00	4.29
4 863.50	71.70	Peak	V	33.26	44.10	60.86	74.00	13.14
4 863.50	60.06	Average	V	33.26	44.10	49.22	54.00	4.78
7 875.50	69.83	Peak	H	35.66	43.20	62.29	74.00	11.71
7 875.50	58.32	Average	H	35.66	43.20	50.78	54.00	3.22
7 875.50	68.48	Peak	V	35.66	43.20	60.94	74.00	13.06
7 875.50	57.61	Average	V	35.66	43.20	50.07	54.00	3.93
Above 8 000.00	Not detected							

※ **Remark**

1. Measuring frequencies from 1 GHz to the 10th harmonic of highest fundamental Frequency.
2. Radiated emissions measured in frequency above 1 000 MHz were made with an instrument using peak/average detector mode.
3. Average test would be performed if the peak result were greater than the average limit.
4. Actual = Reading + Ant. factor + Amp + CL (Cable loss)
5. 15.31 Measurement standards.
The amplitude of spurious emissions from intentional radiators and emissions from unintentional radiators which are attenuated more than 20 dB below the permissible value need not be reported unless specifically required elsewhere in this part.

5.4.4. Band Edge

Operation mode: Basic

A. 2 310 - 2 390 MHz measurement

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2 339.00	74.69	Peak	H	28.86	43.65	59.90	74.00	14.10
2 339.00	60.69	Average	H	28.86	43.65	45.90	54.00	8.10
2 339.00	71.72	Peak	V	28.86	43.65	56.93	74.00	17.07
2 339.00	56.46	Average	V	28.86	43.65	41.67	54.00	12.33

B. 2 483.5 – 2 500 MHz measurement

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2 490.27	72.05	Peak	H	28.86	43.65	57.26	74.00	16.74
2 490.27	58.84	Average	H	28.86	43.65	44.05	54.00	9.95
2 490.27	70.72	Peak	V	28.86	43.65	55.93	74.00	18.07
2 490.27	56.92	Average	V	28.86	43.65	42.13	54.00	11.87

Operation mode: EDR

A. 2 310 - 2 390 MHz measurement

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2 343.52	72.84	Peak	H	28.86	43.65	58.05	74.00	15.95
2 343.52	60.76	Average	H	28.86	43.65	45.97	54.00	8.03
2 343.52	72.08	Peak	V	28.86	43.65	57.29	74.00	16.71
2 343.52	59.53	Average	V	28.86	43.65	44.74	54.00	9.26

B. 2 483.5 – 2 500 MHz measurement

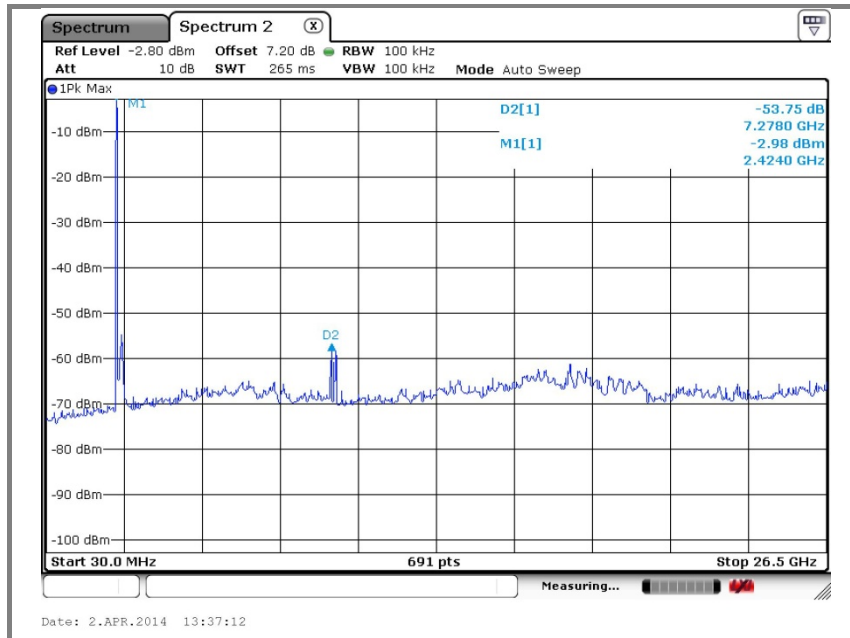
Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (MHz)	Reading (dB μ V)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB μ V/m)	Limit (dB μ V/m)	Margin (dB)
2 490.74	73.23	Peak	H	28.86	43.65	58.44	74.00	15.56
2 490.74	60.36	Average	H	28.86	43.65	45.57	54.00	8.43
2 490.74	71.89	Peak	V	28.86	43.65	57.10	74.00	16.90
2 490.74	58.82	Average	V	28.86	43.65	44.03	54.00	9.97

5.4.5. Spurious RF conducted emissions: Plot of spurious RF conducted emission

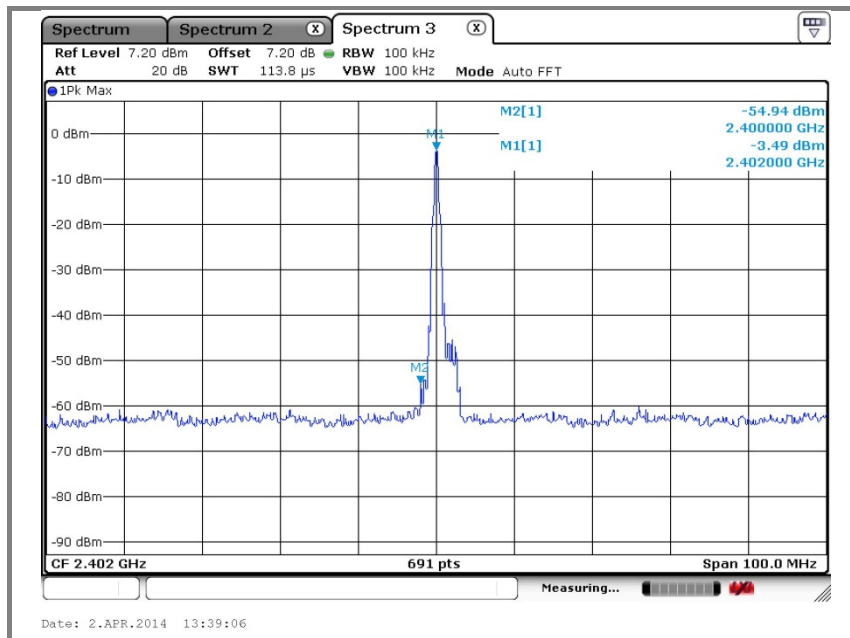
Operation mode: BASIC

A. Low channel (2 402 MHz)

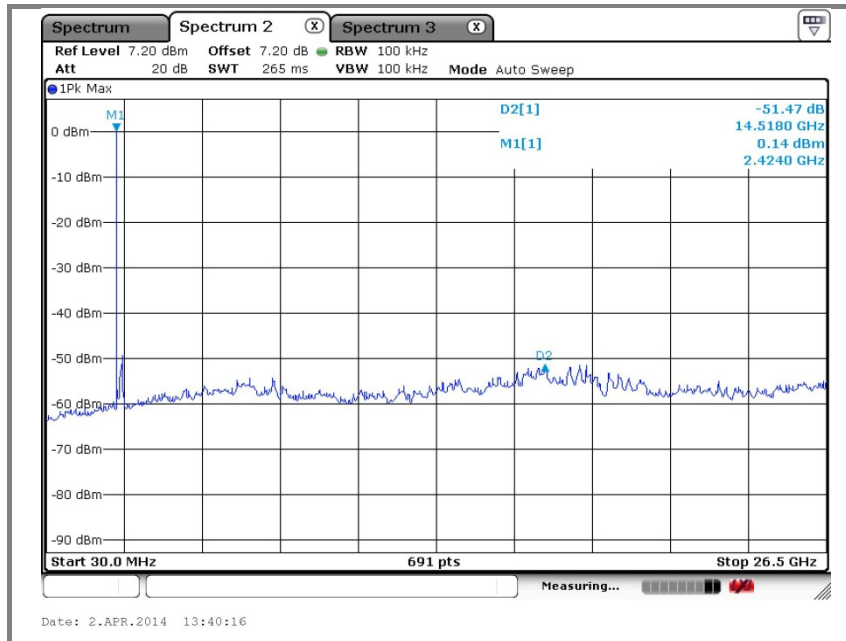
Unwanted Emission data



Band-edge data

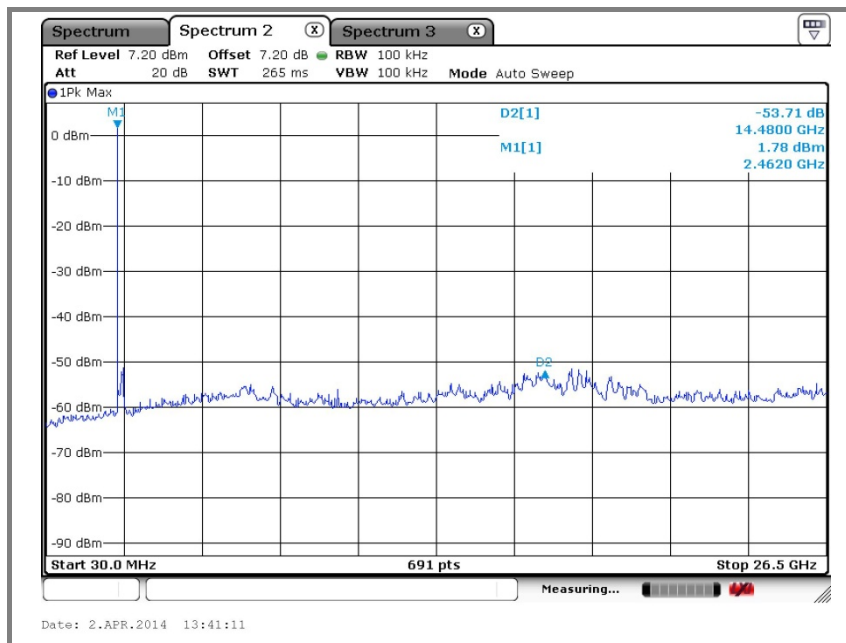


B. Middle channel (2 441 MHz)
Unwanted Emission data

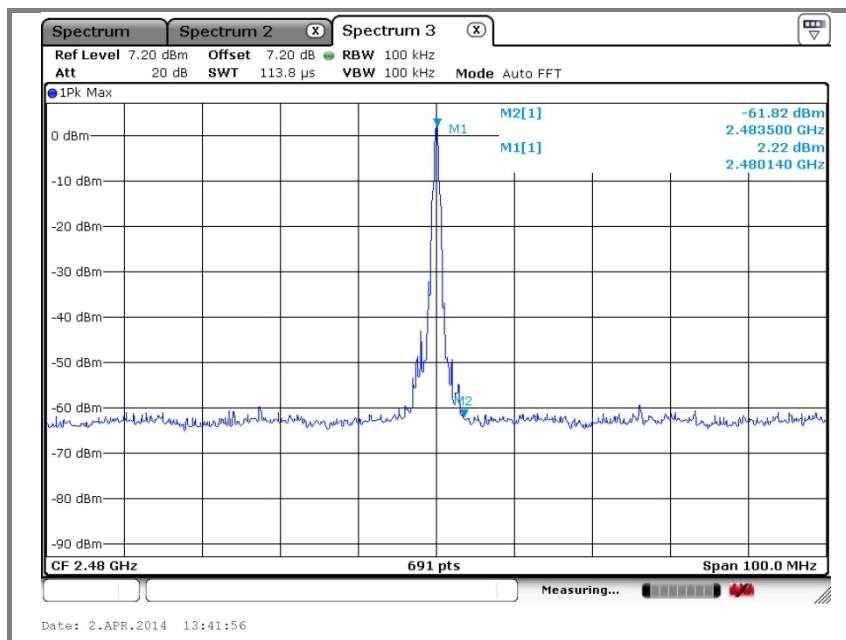


C. High channel (2 480 MHz)

Unwanted Emission data



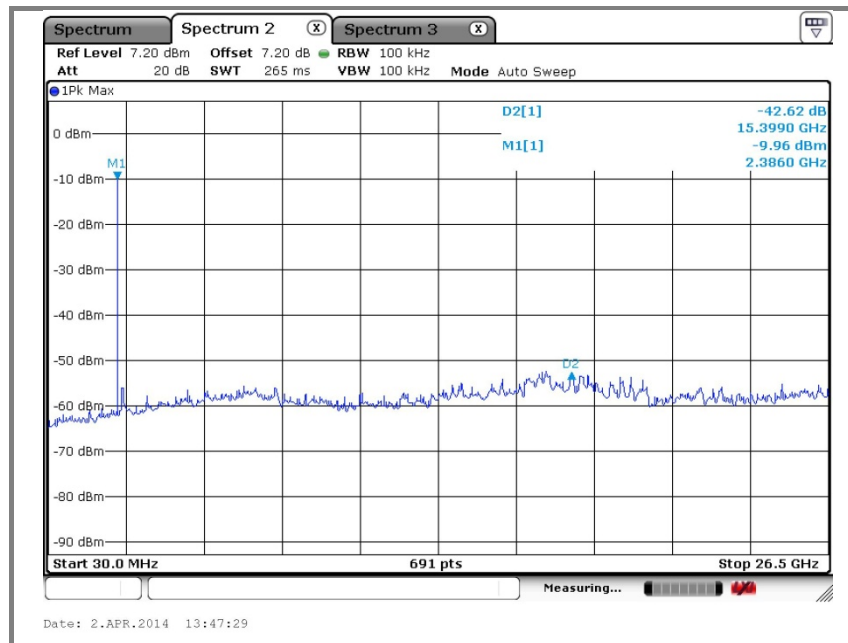
Band-edge data



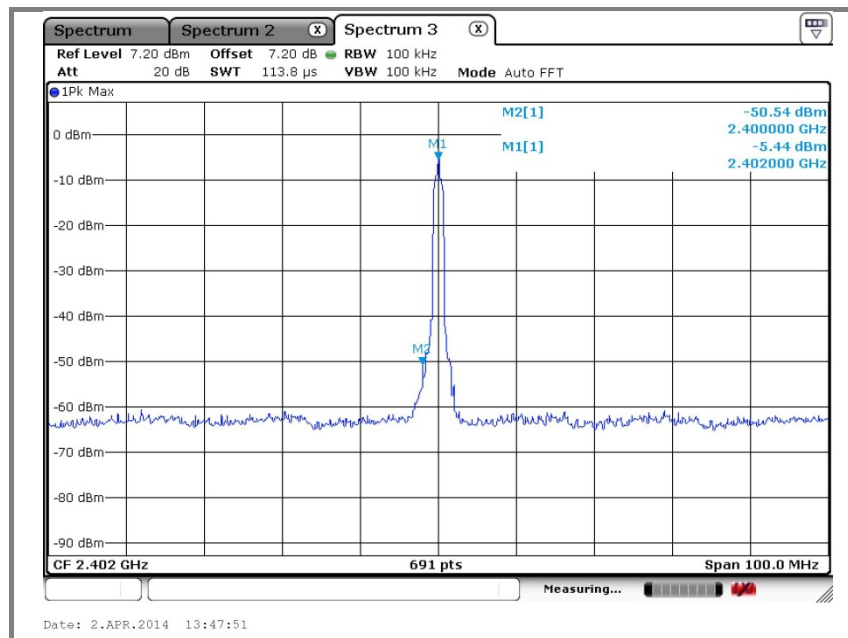
Operation mode: EDR

A. Low channel(2 402 MHz)

Unwanted Emission data

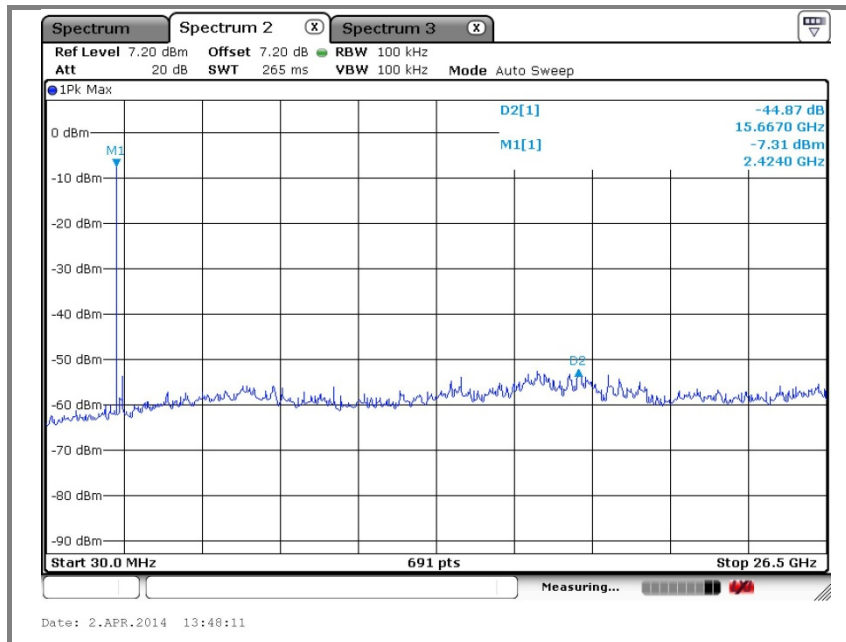


Band-edge data



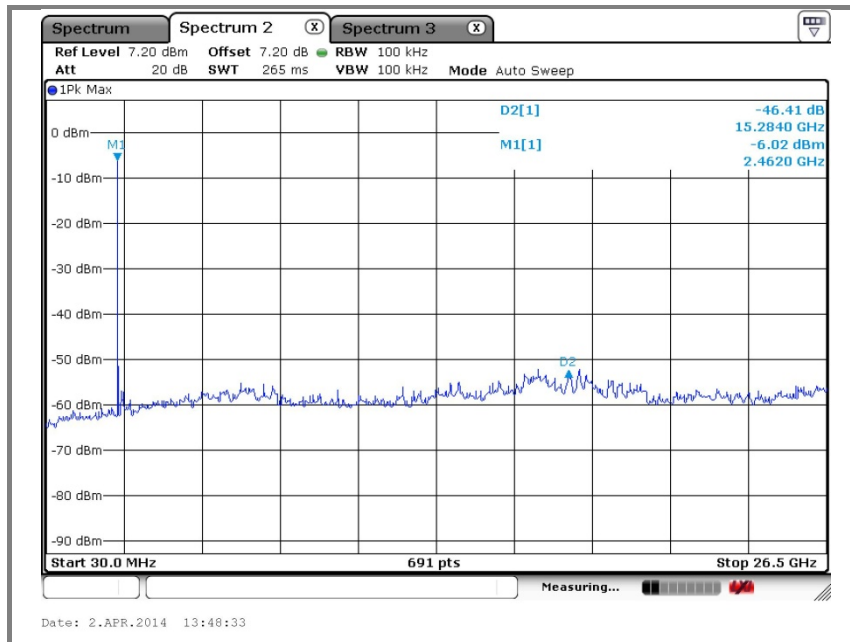
B. Middle channel(2 441 MHz)

Unwanted Emission data

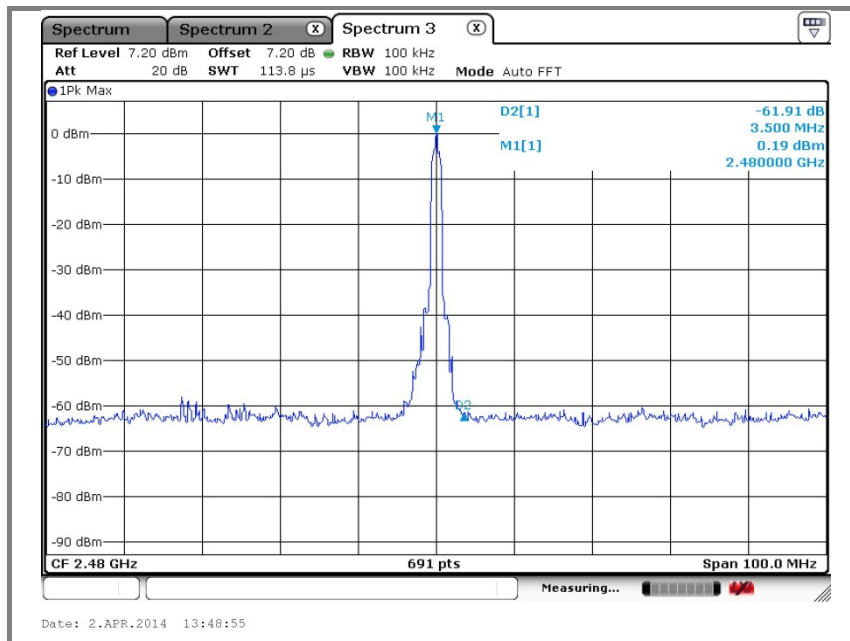


C. High channel(2 480 MHz)

Unwanted Emission data

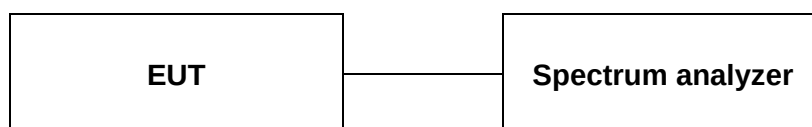


Band-edge data



6. 20 dB bandwidth measurement & 99 % bandwidth measurement

6.1. Test setup



7.2. Limit

Not applicable

7.3. Test procedure

1. The 20 dB band width was measured with a spectrum analyzer connected to RF antenna connector (conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency. The analyzer center frequency was set to the EUT carrier frequency, using the analyzer. Display Line and Marker Delta functions, the 20 dB band width of the emission was determined.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW = 10 kHz, VBW = 10 kHz, Span = 5 MHz.

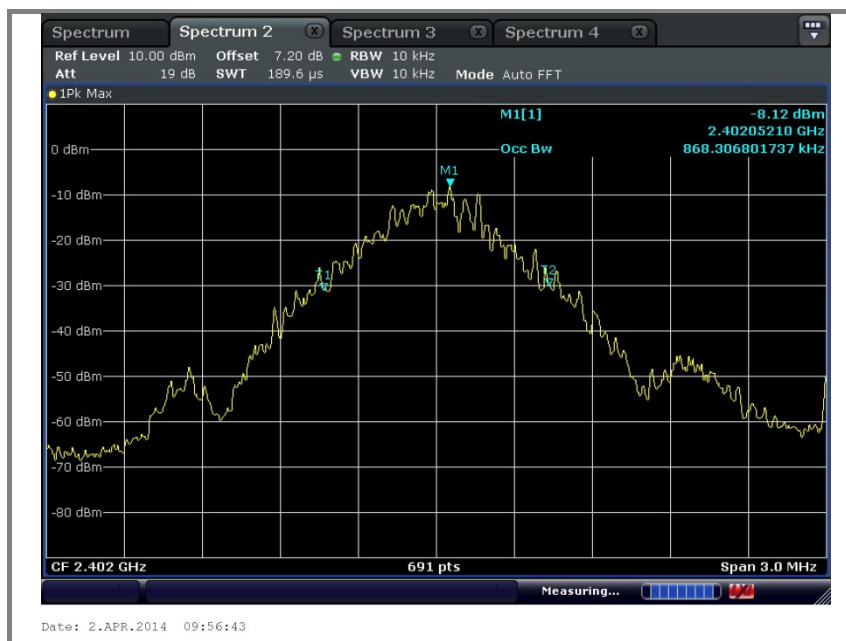
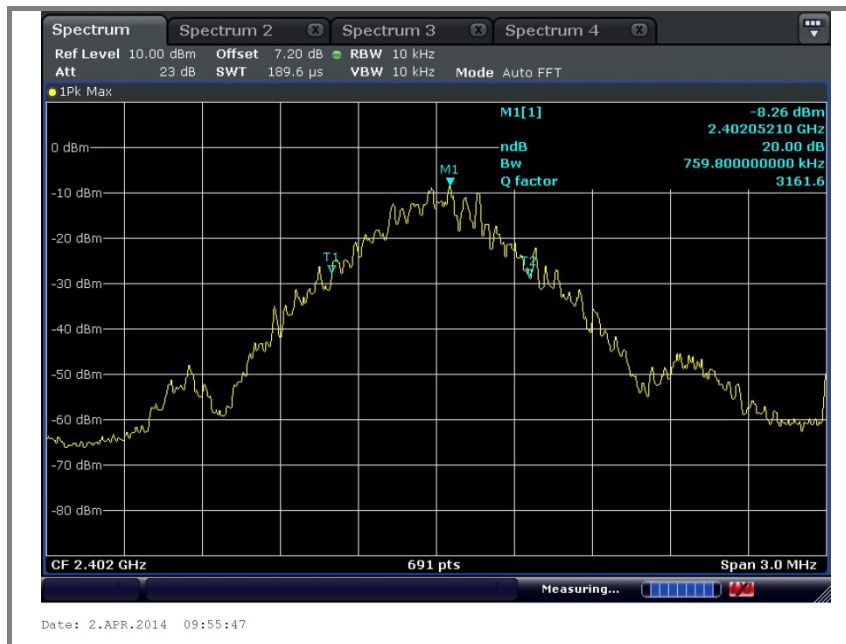
7.4. Test results

Ambient temperature: 23 °C
Relative humidity: 51 % R.H.

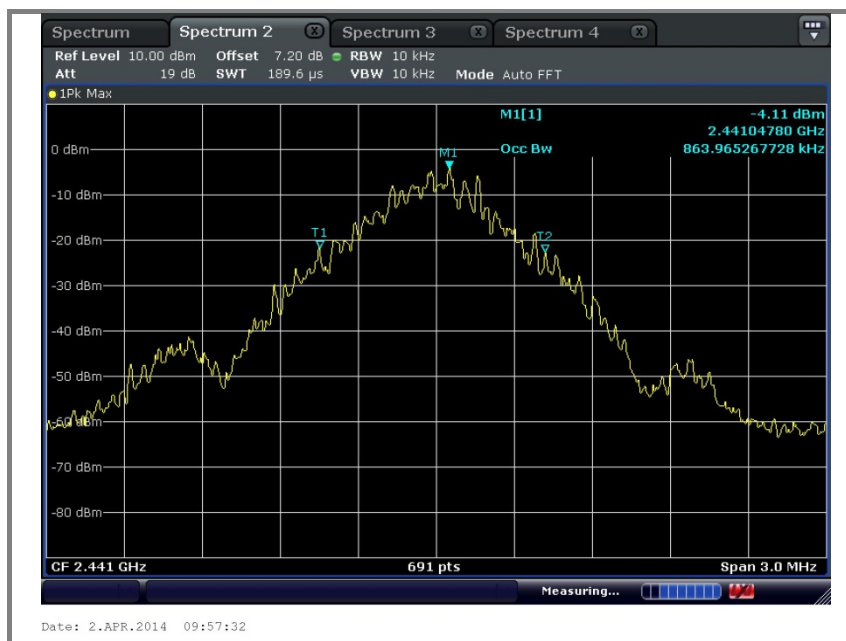
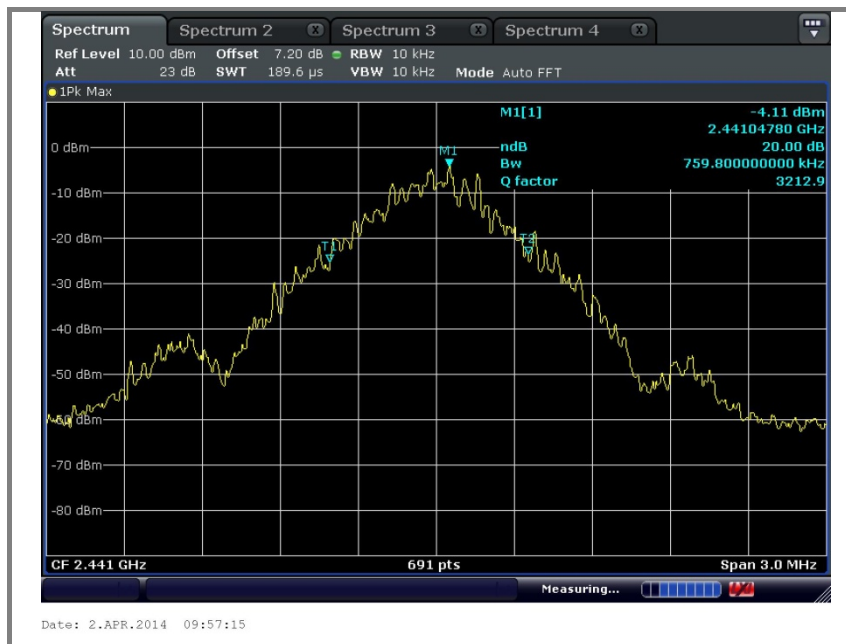
Operation mode	Frequency(MHz)	20 dB bandwidth(MHz)	99 % bandwidth(MHz)
BASIC	2 402	0.760	0.868
	2 441	0.760	0.864
	2 480	0.760	0.868
EDR	2 402	1.268	1.172
	2 441	1.263	1.177
	2 480	1.263	1.177

Operation mode: BASIC

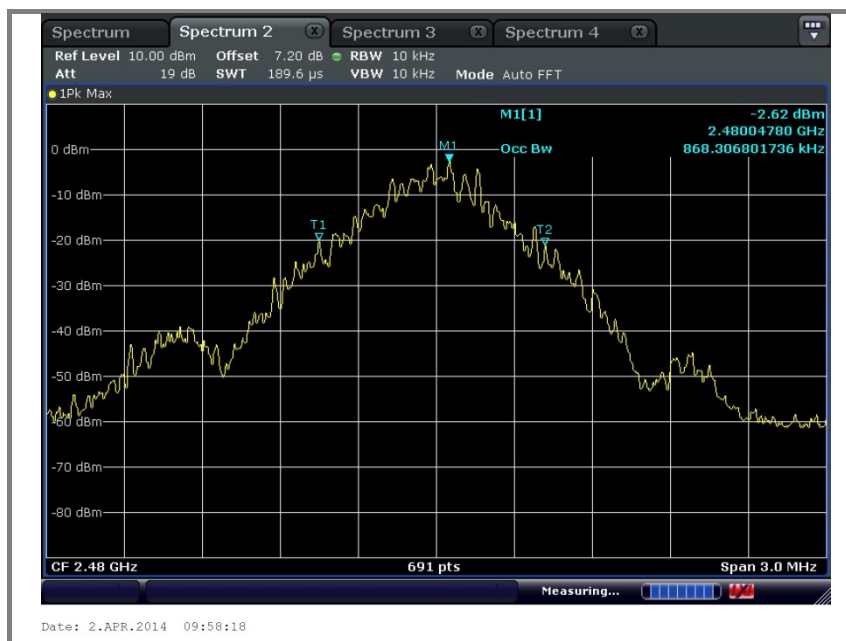
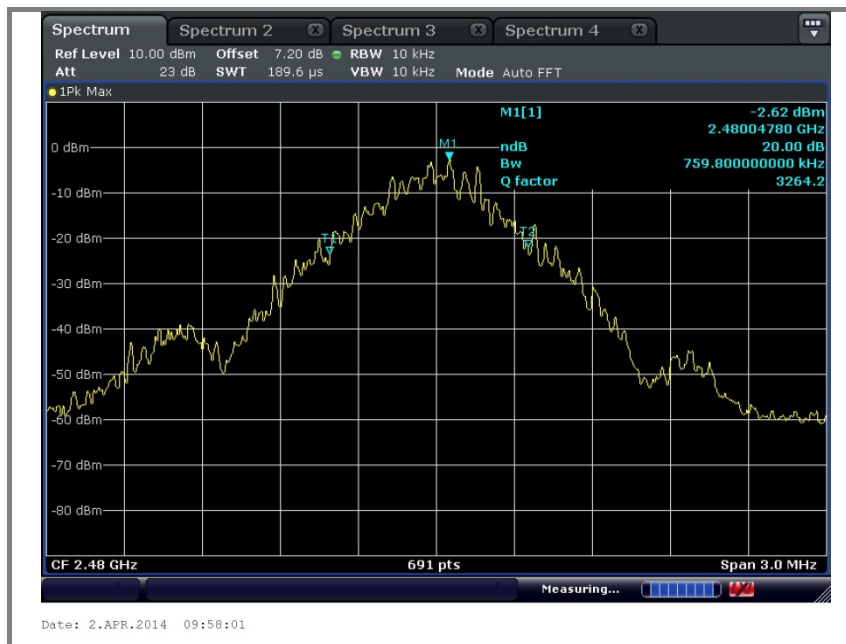
A. Low channel (2 402 MHz) – 20 dB bandwidth & 99 % bandwidth



B. Middle channel (2 441 MHz) – 20 dB bandwidth & 99 % bandwidth

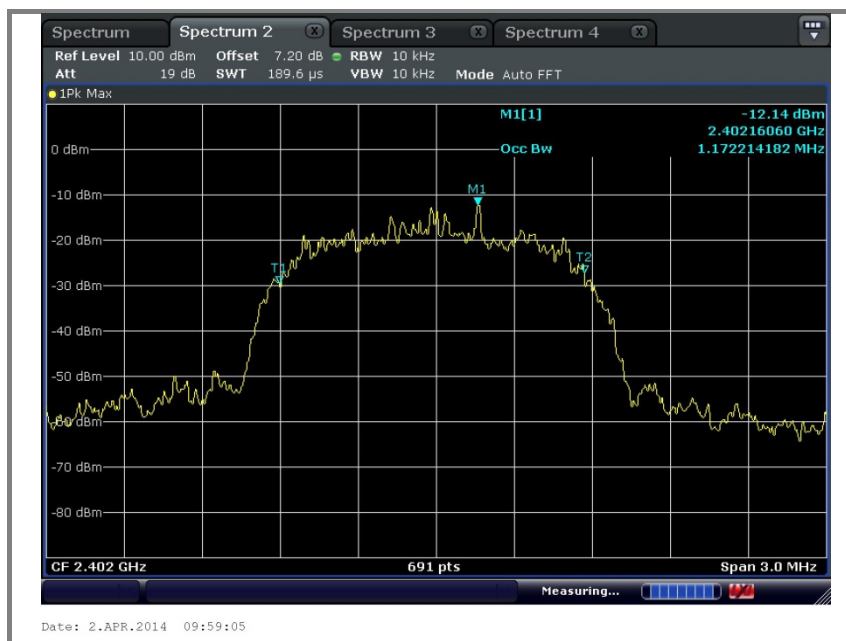
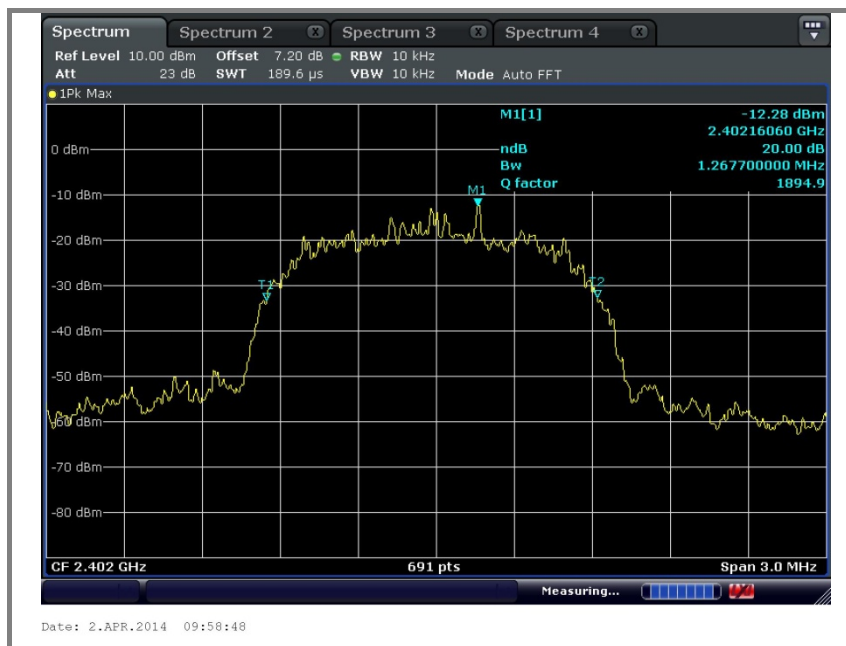


C. High channel (2 480 MHz) – 20 dB bandwidth & 99 % bandwidth

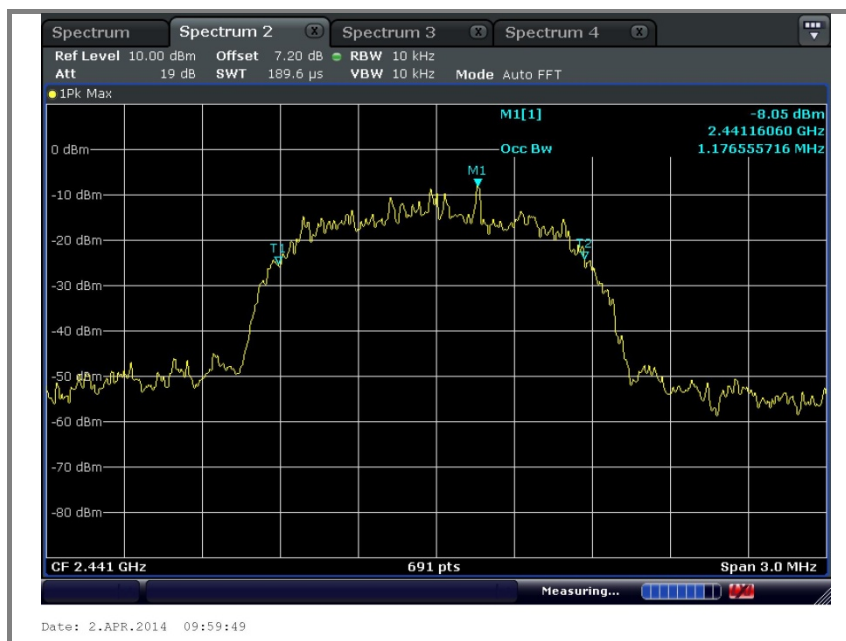
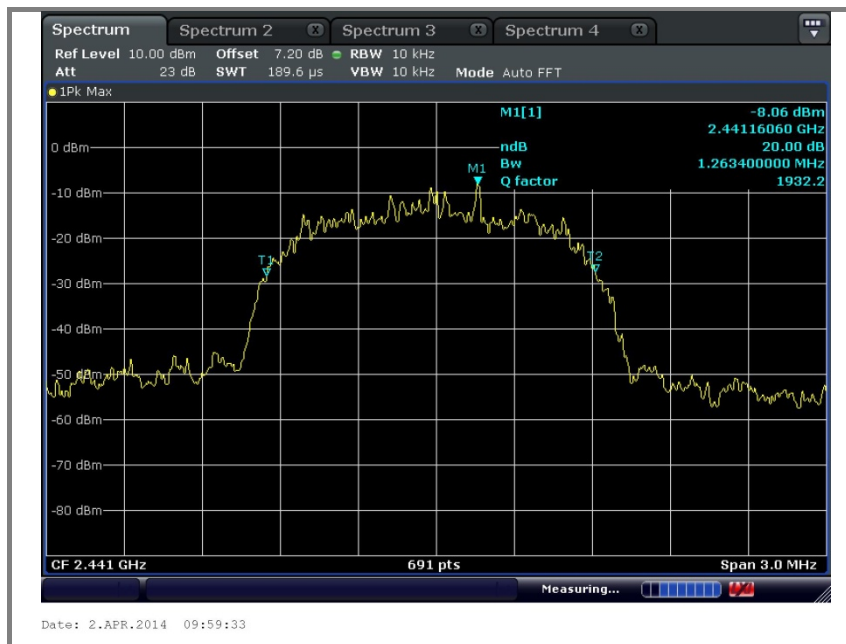


Operation mode: EDR

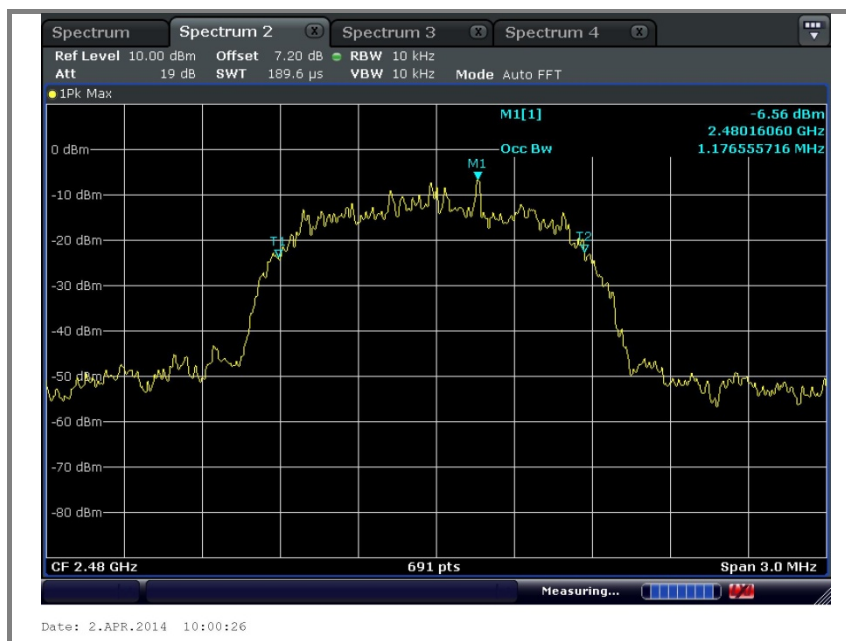
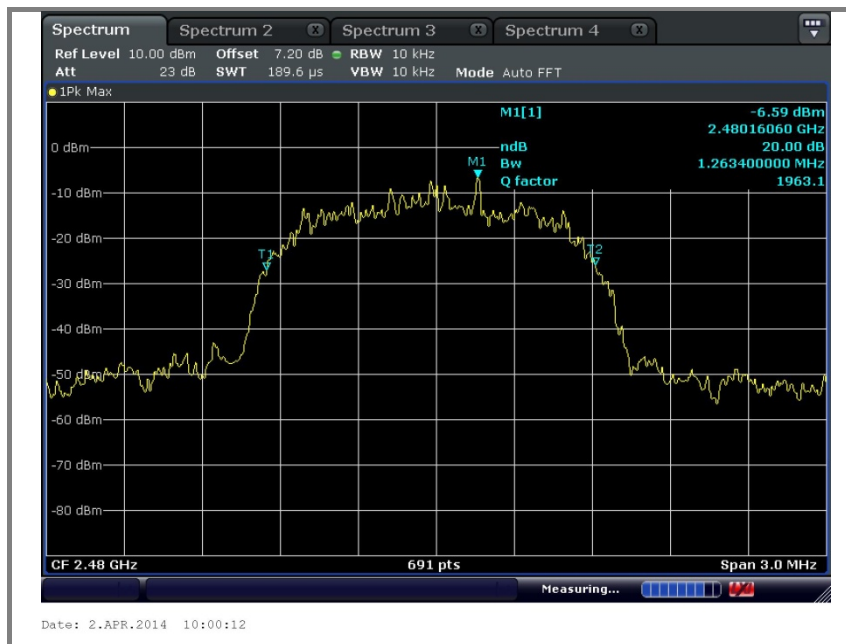
A. Low channel(2 402 MHz)– 20 dB bandwidth & 99 % bandwidth



B. Middle channel(2 441 MHz)– 20 dB bandwidth & 99 % bandwidth

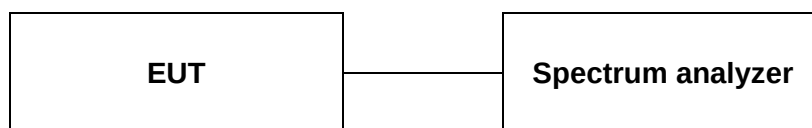


C. High channel(2 480 MHz)– 20 dB bandwidth & 99 % bandwidth



7. Maximum peak output power measurement

7.1. Test setup.



8.2. Limit

The maximum peak output power of the intentional radiator shall not exceed the following:

- §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW
- §15.247(b)(1), For frequency hopping systems operating in the 2 400 – 2 483.5 MHz employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5 725 – 5 805 MHz band: 1 Watt.

8.3. Test procedure

- The RF power output was measured with a Spectrum analyzer connected to the RF Antenna connector(conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency, A spectrum analyzer was used to record the shape of the transmit signal.
- The bandwidth of the fundamental frequency was measured with the spectrum analyzer using;
Span = approximately 5 times the 20 dB bandwidth, centered on a hopping channel
RBW ≥ 20 dB BW, VBW ≥ RBW, Sweep = auto, Detector function = peak, Trace = max hold

8.4. TEST RESULTS

Ambient temperature: 23 °C

Relative humidity: 51 % R.H.

Operation mode	Frequency(MHz)	Peak output power(dBm)	Limit(dBm)
BASIC	2 402	-2.60	30
	2 441	1.60	30
	2 480	3.08	30
EDR	2 402	-3.32	30
	2 441	0.89	30
	2 480	2.30	30

※Remark

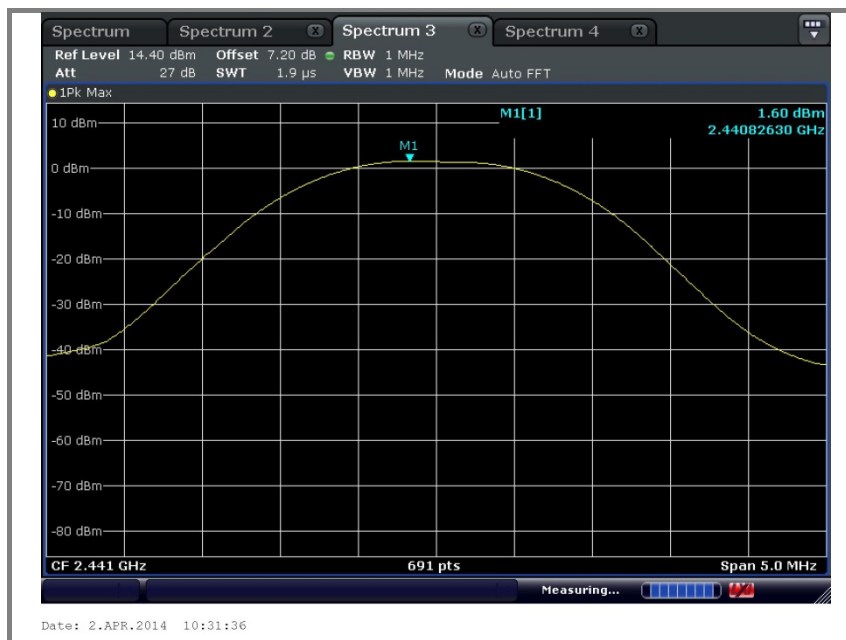
directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the gain of the antenna exceeds 6 dBi.

Operation mode: BASIC

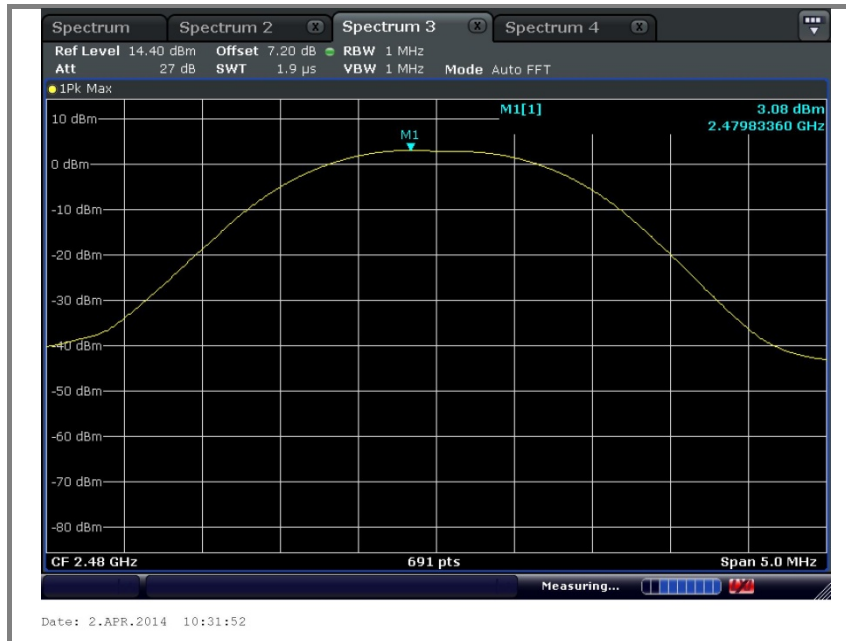
A. Low channel (2 402 MHz)



B. Middle channel (2 441 MHz)

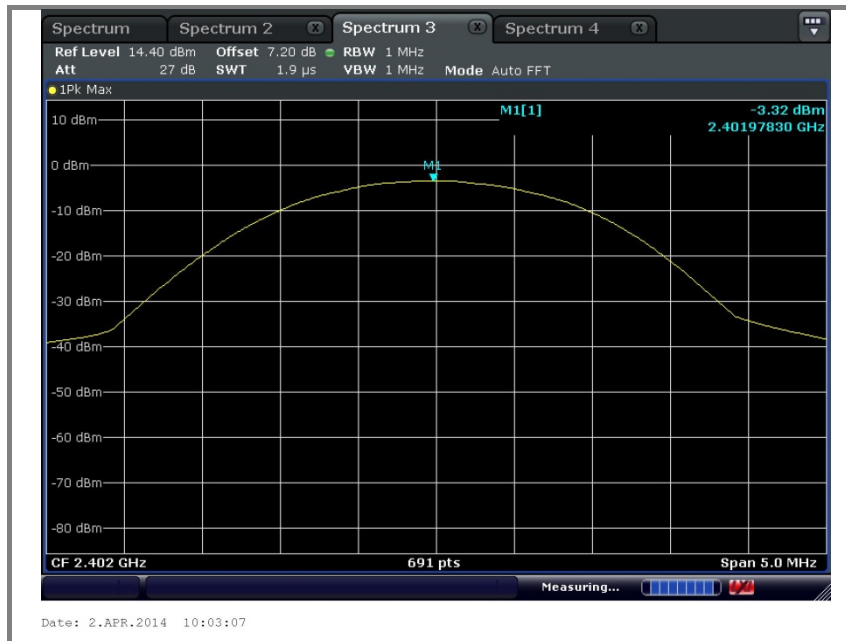


C. High channel (2 480 MHz)

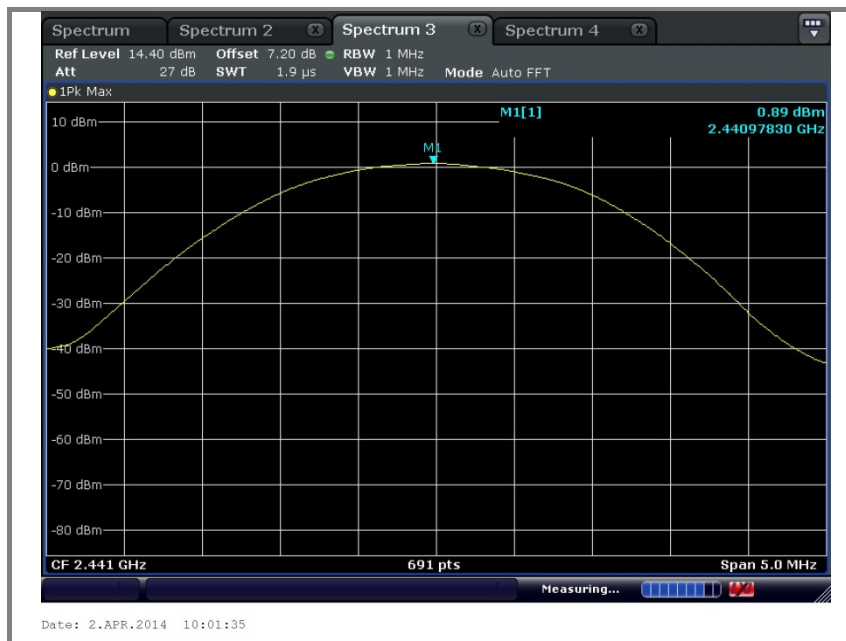


Operation mode: EDR

A. Low channel (2 402 MHz)



B. Middle channel (2 441 MHz)



C. High channel (2 480 MHz)

