

FCC Part 15 Subpart C §15.247

Test Report

Equipment Under Test	Harmonix Wireless OWL
Model Name	HDX5GHz-Tx1000
Applicant	Harmonix Co., Ltd.
FCC ID	SWCHDX5GHZ-TX1000
Manufacturer	Harmonix Co., Ltd.
Date of Test(s)	2013. 10. 08 ~2013. 10. 30
Date of Issue	2013. 11. 18

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
--	Oct 17, 2013	Initial	--
1	Nov 18, 2013	Revised Restricted Band & antenna requirement	Raymond.kim

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1. General information

1.1. Details of applicant

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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 §15.209 §15.247(d)	Transmitter radiated spurious emissions, Conducted spurious emission	C
§15.247(a)(2)	6 dB Bandwidth	C
§15.247(b)(e)	Maximum Peak Output Power	C
§15.247(e)	Transmitter Power Spectral Density	C
§1.1307(b)(1)	RF exposure evaluation	C

The sample was tested according to the following specification:

ANSI C63.4-2003

FCC Public Notice KDB 558074 D01 v03r01



TEST SITE REGISTRATION NUMBER:

FCC(670686)

※ Abbreviation

C Complied
 N/A Not applicable
 F Fail

Approval Signatories

Test and Report Completed by :	Report Approval by :
	
Raymond Kim Test Engineer MOVON CORPORATION	Issac Jin Technical Manager MOVON CORPORATION

2. EUT Description

Kind of product	Harmonix Wireless OWL
Model Name	HDX5GHz-Tx1000
Serial Number	N/A
Power supply	DC 12 V
Frequency range	5 180 MHz ~ 5 220 MHz, 5 735 MHz ~ 5 815 MHz
Modulation technique	DSSS (11Mbps)
Number of channels	3 / 5
Antenna gain	3.238 dB i (Max.)
Test Site Registration Number	FCC(670686)

2.1. Declarations by the manufacturer

None

2.2. Details of modification

None

3. Measurement equipment

Equipment	Manufacturer	Model	Serial number	Calibration Interval	Calibration due.
EMI Test Receiver	R&S	ESIB26	100196/026	1 year	2013-12-14
Signal Generator	R&S	SMR27	100089	1 year	2013-12-13
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 Redge Horn Antenna	R&S	HF906	100236	2 year	2015-02-28
Ultra Broadband Antenna	R&S	HL562	100170	1 year	2013-12-13
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

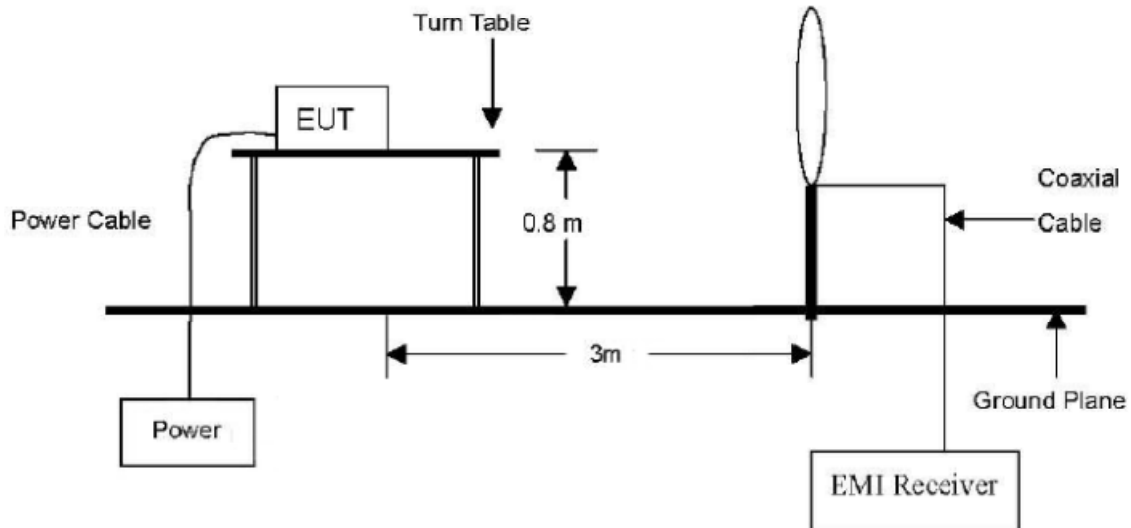
Description	Manufacturer	Model	Serial number
Notebook computer	HP.	HP Mini 110-3721TU	5CB1351VK9

4. Transmitter radiated spurious emissions and conducted spurious emissions

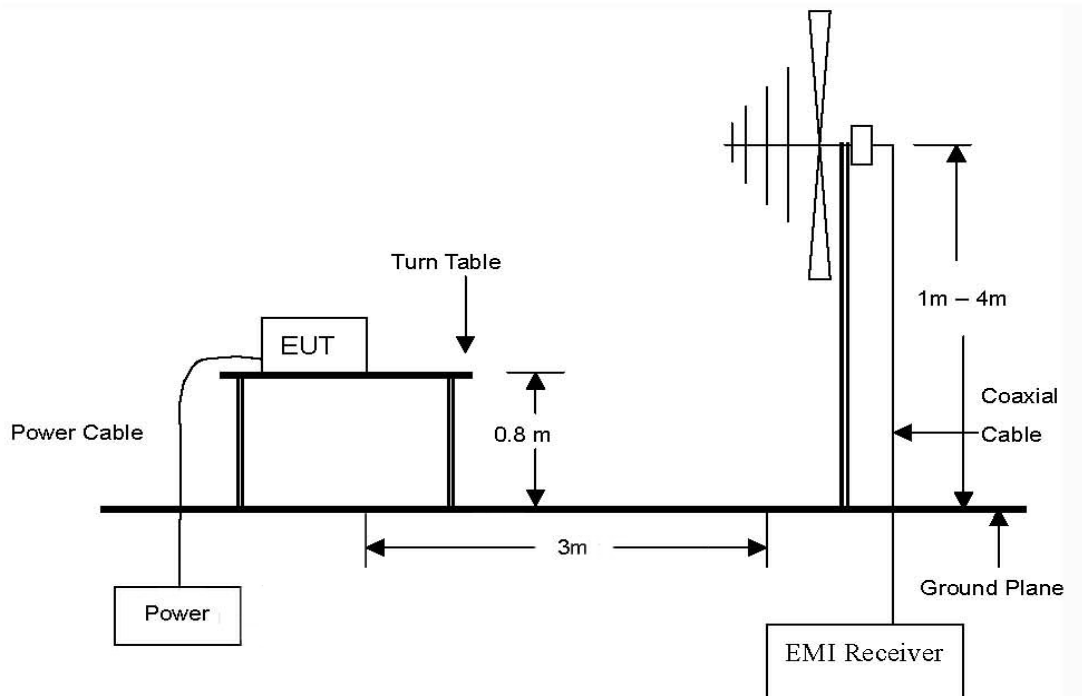
4.1. Test setup

4.1.1. Transmitter radiated spurious emissions

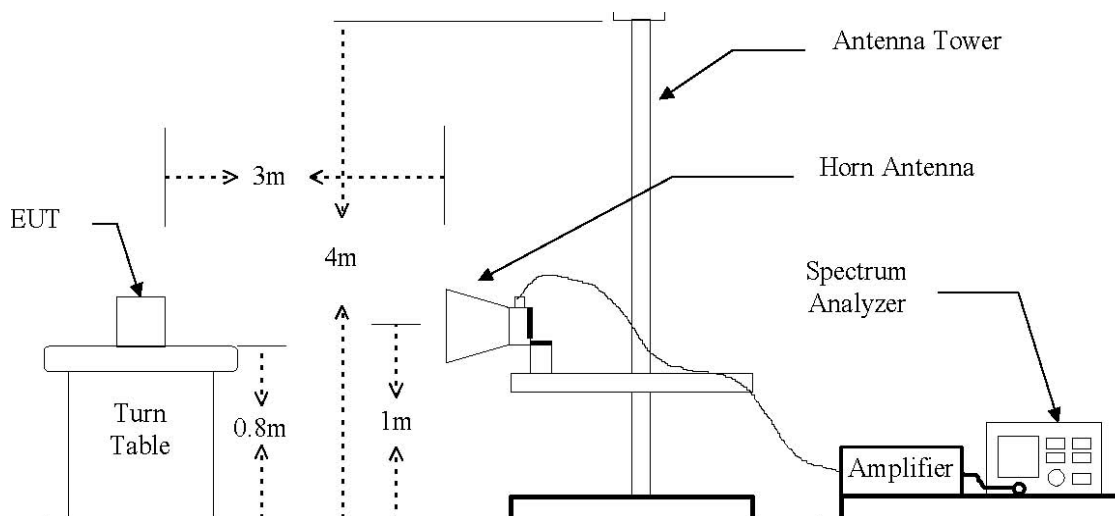
The diagram below shows the test setup that is utilized to make the measurements for emission from 9kHz to 30MHz Emissions.



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 40 GHz emissions.



4.2. 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 in 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 §15.209(a), must also comply the radiated emission limits specified in section §15.209(a) (see section §15.205(c))

According to §15.209(a), Except as provided elsewhere in this Subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

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

According to §15.205(a), Except as provided elsewhere in this Subpart, the emissions from Restricted bands of operation shall not exceed the field strength levels specified in the following table:

MHz	MHz	MHz	GHz
0.090 – 0.110	16.42 – 16.423	399.9 – 410	4.5 – 5.15
0.495 – 0.505	16.694 75 – 16.695 25	608 – 614	5.35 – 5.46
2.173 5 – 2.190 5	16.804 25 -16.804 75	960 – 1240	7.25 – 7.75
4.125 – 4.128	25.5 – 25.67	1300 – 1427	8.025 – 8.5
4.177 25 – 4.177 75	37.5 – 38.25	1435 – 1626.5	9.0 – 9.2
4.207 25 – 4.207 75	73 – 74.6	1645.5 – 1646.5	9.3 – 9.5
6.215 – 6.218	74.8 – 75.2	1660 – 1710	10.6 – 12.7
6.267 75 – 6.268 25	108 – 121.94	1718.8 – 1722.2	13.25 – 13.4
6.311 75 – 6.312 25	123 – 138	2200 – 2300	14.47 – 14.5
8.291 – 8.294	149.9 – 150.05	2310 – 2390	15.35 – 16.2
9.362 – 8.366	156.524 75 – 156.525 25	2483.5 – 2500	17.7 – 21.4
8.376 25 – 8.386 75	156.7 – 156.9	2655 – 2900	22.01 – 23.12
8.414 25 – 8.414 75	162.012 5 – 167.17	3260 – 3267	23.6 – 24.0
12.29 – 12.293	167.72 – 173.2	3332 - 3339	31.2 – 31.8
12.519 75 – 12.520 25	240 – 285	3345.8 – 3358	36.43 – 36.5
12.576 75 – 12.577 25	322 -335.4	3600 – 4400	
13.36 – 13.41			

*Remark

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

4.3. Test procedures

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

4.3.1. 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.

4.3.2. Test procedures for conducted spurious emissions

All data rates and modes were investigated for conducted spurious emissions. Only the conducted emissions of the configuration that produced the worst case emissions are reported in this section.

Per the guidance of KDB 558074, section 5.4.1.1, the reference level for out of band emissions is established from the plots of this section since the band edge emissions are measured with a RBW of 100 kHz. This reference level is then used as the limit in subsequent plots for out of band spurious emissions shown in section 4.4.4. The limit for out of band spurious emission at the band edge is 30 dB below the fundamental emission level measured in a 100 kHz bandwidth.

4.4. Test result

Ambient temperature: 22 °C

Relative humidity: 49 % R.H.

4.4.1. 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

A. Low channel (5 735 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 (5 775 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 (5 815 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.

4.4.2. 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 mode

A. Low channel (5 735 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)
49.44	24.77	PK	V	7.85	1.97	34.59	40.00	5.41
199.12	25.12	PK	H	10.48	4.04	39.64	43.50	3.86
224.39	18.98	PK	V	12.85	4.28	36.11	46.00	9.89
241.88	22.21	PK	V	14.60	4.45	41.26	46.00	4.74
269.10	20.36	PK	V	14.65	4.70	39.71	46.00	6.29
296.31	26.30	PK	V	13.56	4.95	44.81	46.00	1.19
350.74	11.01	PK	H	14.87	5.44	31.32	46.00	14.68
399.34	16.27	PK	V	16.26	5.88	38.41	46.00	7.59
479.04	8.22	PK	H	17.51	6.60	32.33	46.00	13.67
Above 500	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 (5 775 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)
49.44	24.54	PK	V	7.85	1.97	34.36	40.00	5.64
199.12	25.25	PK	H	10.48	4.04	39.77	43.50	3.73
224.39	18.92	PK	V	12.85	4.28	36.05	46.00	9.95
241.88	22.24	PK	V	14.60	4.45	41.29	46.00	4.71
269.10	20.38	PK	V	14.65	4.70	39.73	46.00	6.27
296.31	25.87	PK	V	13.56	4.95	44.38	46.00	1.62
350.74	11.02	PK	H	14.87	5.44	31.33	46.00	14.67
399.34	16.21	PK	V	16.26	5.88	38.35	46.00	7.65
479.04	8.34	PK	H	17.51	6.60	32.45	46.00	13.55
Above 500	Not detected							

※ Remark

- Actual = Reading + Ant. factor + CL (Cable loss)
- 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 (5 815 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)
49.44	24.94	PK	V	7.85	1.97	34.76	40.00	5.24
199.12	25.34	PK	H	10.48	4.04	39.86	43.50	3.64
224.39	18.34	PK	V	12.85	4.28	35.47	46.00	10.53
241.88	22.09	PK	V	14.60	4.45	41.14	46.00	4.86
269.10	20.15	PK	V	14.65	4.70	39.50	46.00	6.50
296.31	26.10	PK	V	13.56	4.95	44.61	46.00	1.39
350.74	11.34	PK	H	14.87	5.44	31.65	46.00	14.35
399.34	16.58	PK	V	16.26	5.88	38.72	46.00	7.28
479.04	9.00	PK	H	17.51	6.60	33.11	46.00	12.89
Above 500	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.

4.4.3. 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.

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

Operation mode: Basic mode

A. Low channel (5 735 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)
No other emissions were detected at a level greater than 20dB below limit.								

B. Middle channel (5 775 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)
No other emissions were detected at a level greater than 20dB below limit.								

C. High channel (5 815 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)
No other emissions were detected at a level greater than 20dB below limit.								

※ Remark

1. Measuring frequencies from 1 GHz to the 40 GHz.
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.

4.4.4. Restricted Band

A. 10.6 – 12.7 GHz measurement

* Low channel (5 735 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)
11 470	61.57	Peak	H	37.74	-34.67	64.64	74.00	9.36
11 470	47.05	Average	H	37.74	-34.67	50.12	54.00	3.88
11 470	61.94	Peak	V	37.74	-34.67	65.01	74.00	8.99
11 470	47.13	Average	V	37.74	-34.67	50.20	54.00	3.80

* Mid channel (5 775 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)
11 550	62.34	Peak	H	37.74	-34.67	65.41	74.00	8.59
11 550	47.22	Average	H	37.74	-34.67	50.29	54.00	3.71
11 550	61.58	Peak	V	37.74	-34.67	64.65	74.00	9.35
11 550	47.18	Average	V	37.74	-34.67	50.25	54.00	3.75

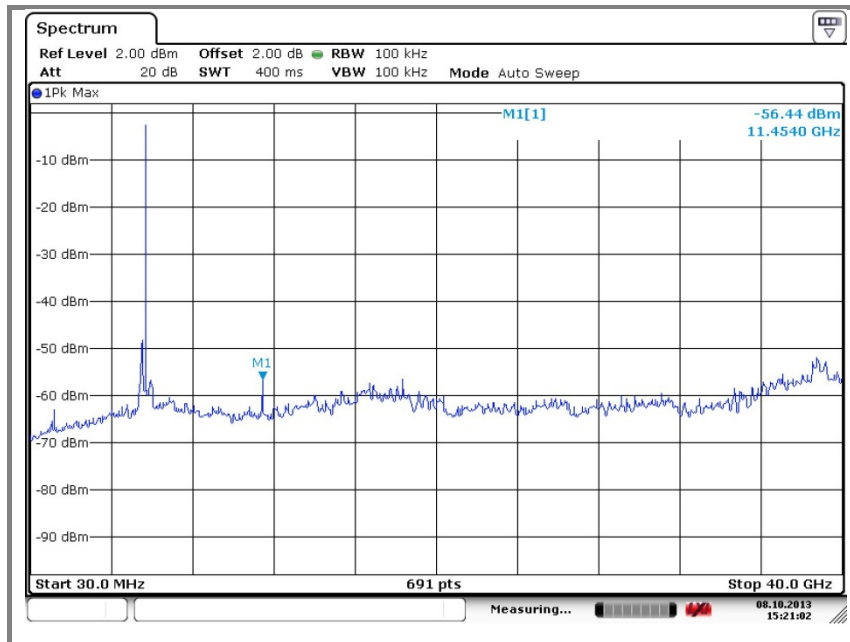
* High channel (5 815 MHz)

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)
11 630	62.33	Peak	H	37.74	-34.67	65.40	74.00	8.60
11 630	47.54	Average	H	37.74	-34.67	50.61	54.00	3.39
11 630	61.11	Peak	V	37.74	-34.67	64.18	74.00	9.82
11 630	47.43	Average	V	37.74	-34.67	50.50	54.00	3.50

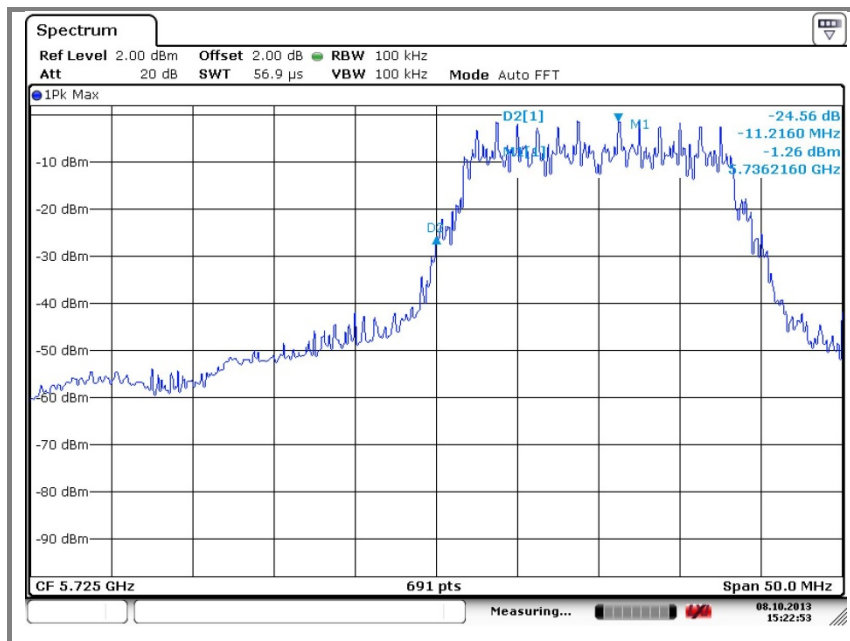
4.4.5. Spurious RF conducted emissions: Plot of spurious RF conducted emission

Operation mode: Basic mode

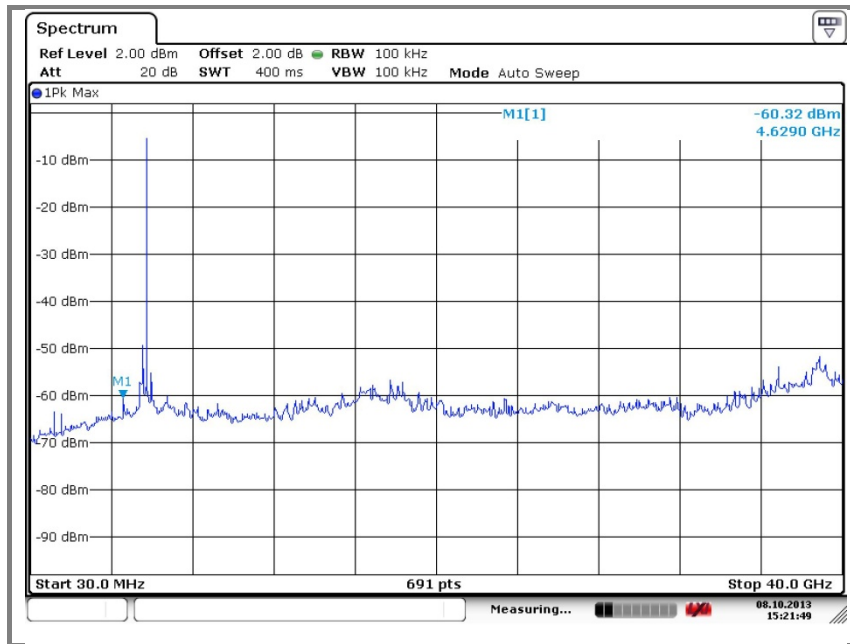
A. Low channel (5 735 MHz)



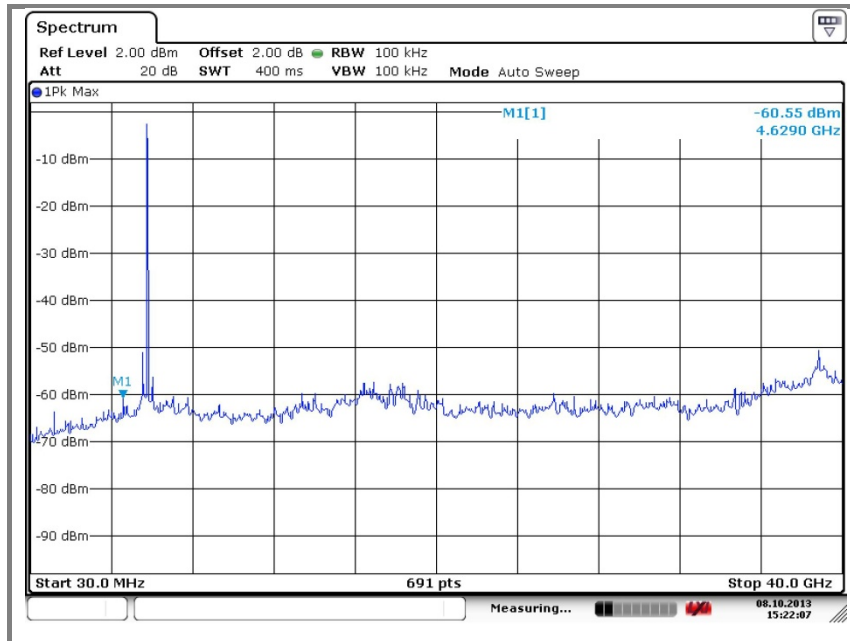
Band-edge data



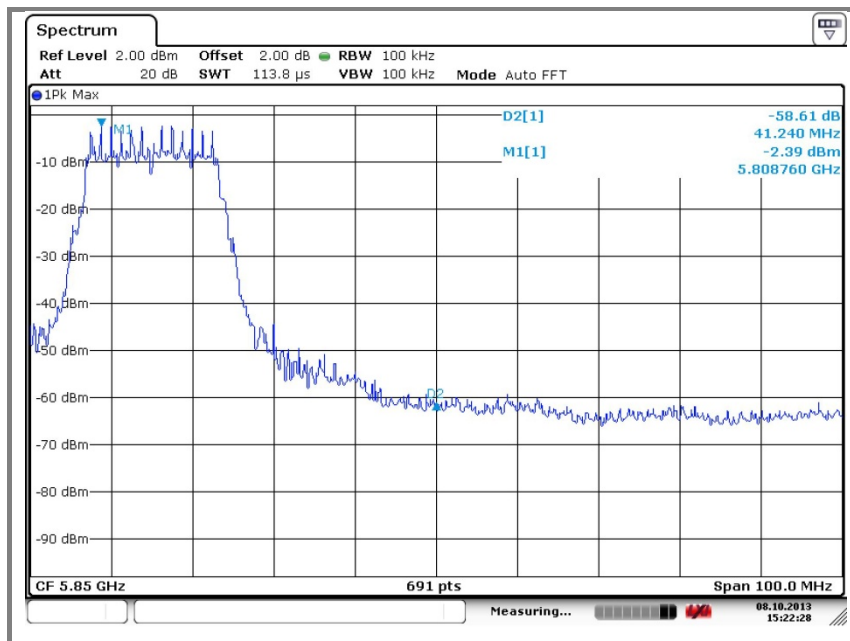
B. Middle channel (5 775 MHz)



C. High channel (5 815 MHz)



Band-edge data



5. 6 dB bandwidth

5.1. Test setup



5.2. Limit

According to §15.247(a)(2), systems using digital modulation techniques may operate in the 902~928 MHz, 2 400~2 483.5 MHz, and 5 725~5 825 MHz bands. The minimum of 6 dB Bandwidth shall be at least 500 kHz

5.3. Test procedure

1. The 6 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 6 dB band width of the emission was determined.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using RBW = 100 kHz, VBW = 100 kHz, Span = 5 MHz.

5.4. Test results

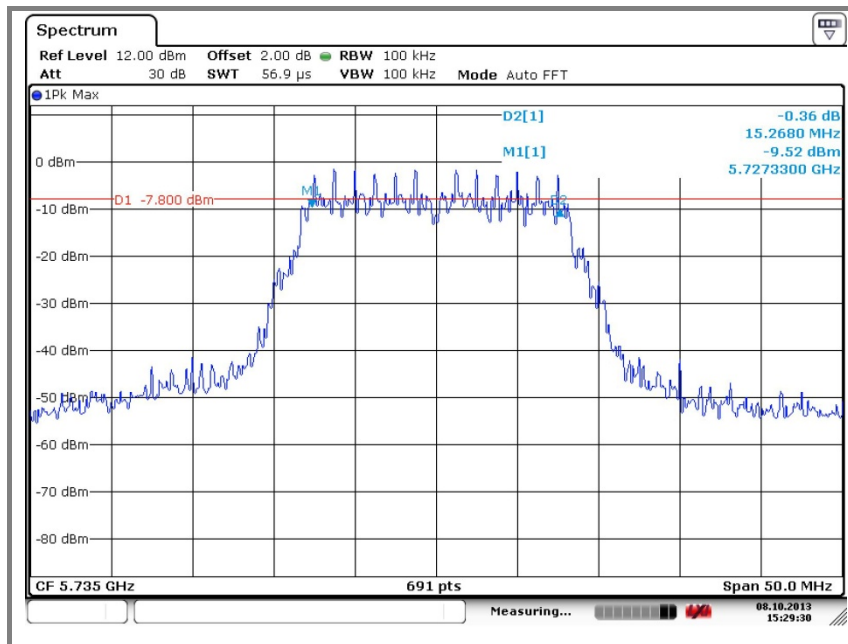
Ambient temperature: 23 °C

Relative humidity: 45 % R.H.

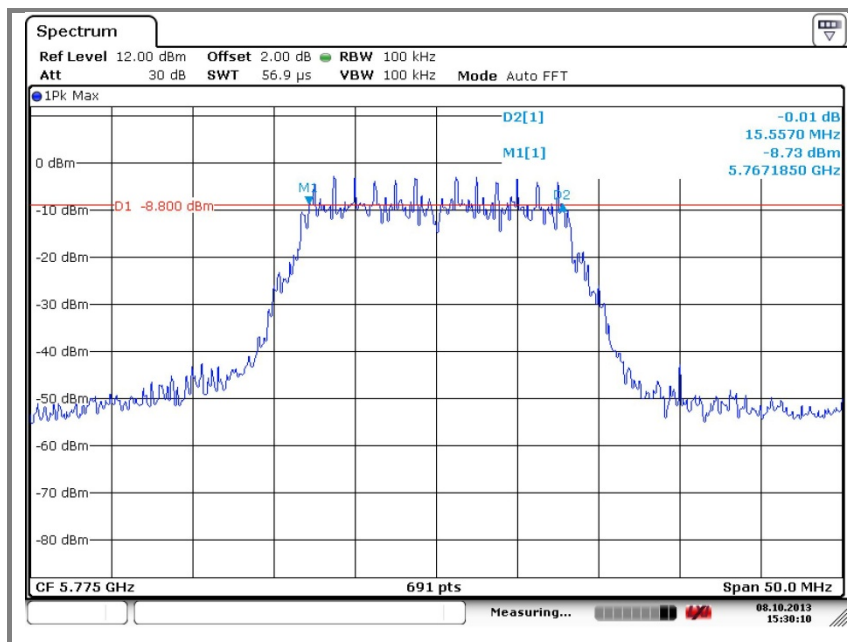
Frequency(MHz)	6 dB bandwidth(MHz)
5 735	15.268
5 775	15.557
5 815	15.412

Operation mode: Basic mode

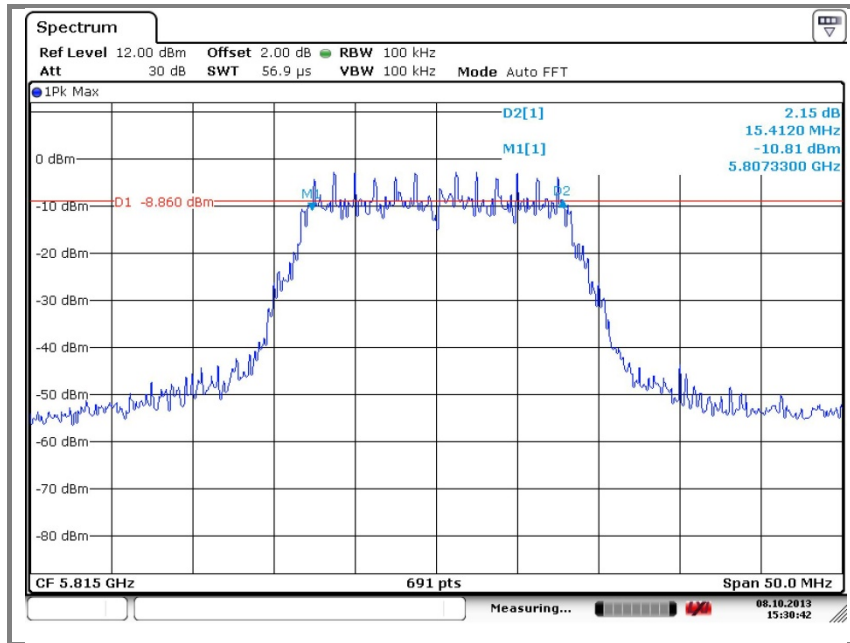
A. Low channel (5 735 MHz)



B. Middle channel (5 775 MHz)

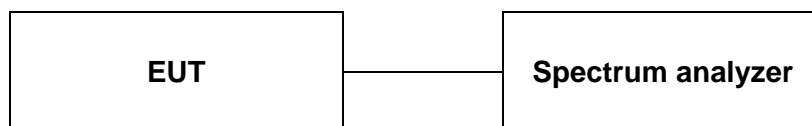


C. High channel (5 815 MHz)



6. Maximum Peak Output Power Measurement

6.1. Test setup.



6.2. 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 6 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.

6.3. 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 = auto
RBW = 1 MHz, VBW ≥ RBW, Sweep = auto, Detector function = peak, Trace = max hold

6.4. Test results

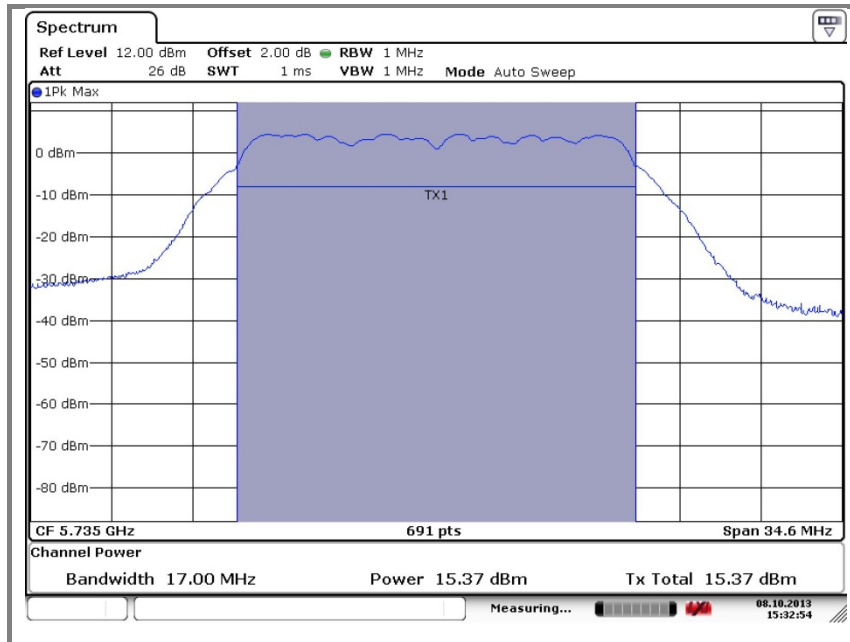
Ambient temperature: 23 °C

Relative humidity: 45 % R.H.

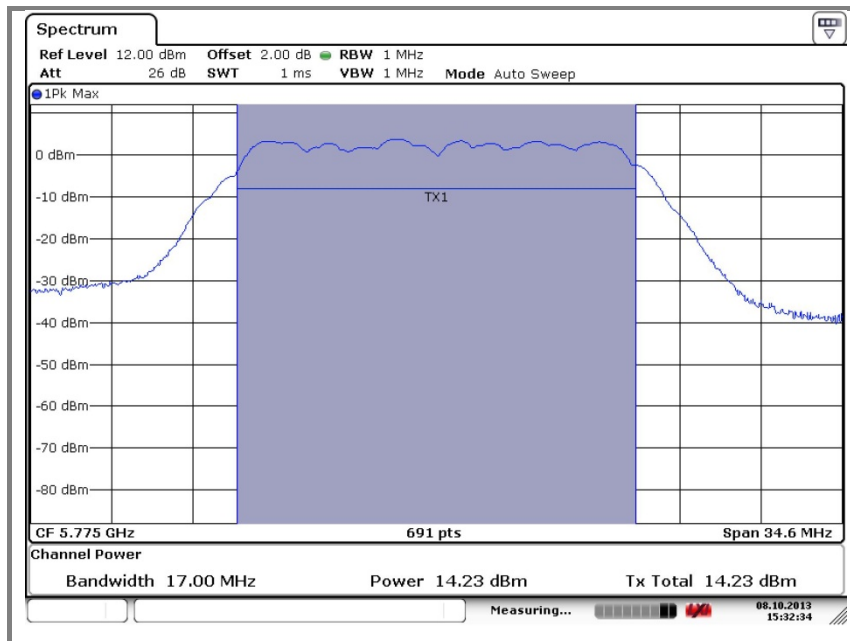
Frequency (MHz)	Peak output power (dBm)	Limit (dBm)
5 735	15.37	30
5 775	14.23	
5 815	14.22	

Operation mode: Basic mode

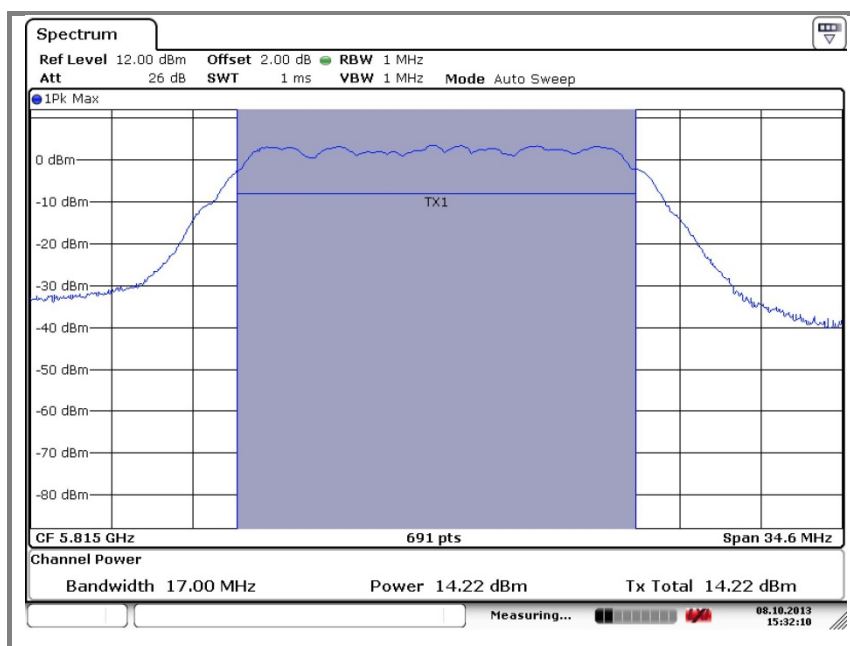
A. Low channel (5 735 MHz)



B. Middle channel (5 775 MHz)

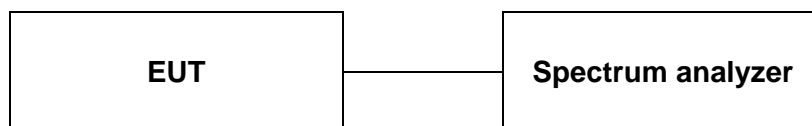


C. High channel (5 815 MHz)



7. Power Spectral Density Measurement

7.1. Test setup



7.2. Limit

< 8dBm @ 3kHz BW

7.3. Test procedure (PKPSD)

1. 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.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using;
 Span = 1.5 times the DTS bandwidth
 $RBW = 3\text{kHz} \leq RBW \leq 100\text{kHz}$
 $VBW \geq 3 \times RBW$, Sweep = Auto couple
 Detector function = peak, Trace = max hold

7.4. Test results

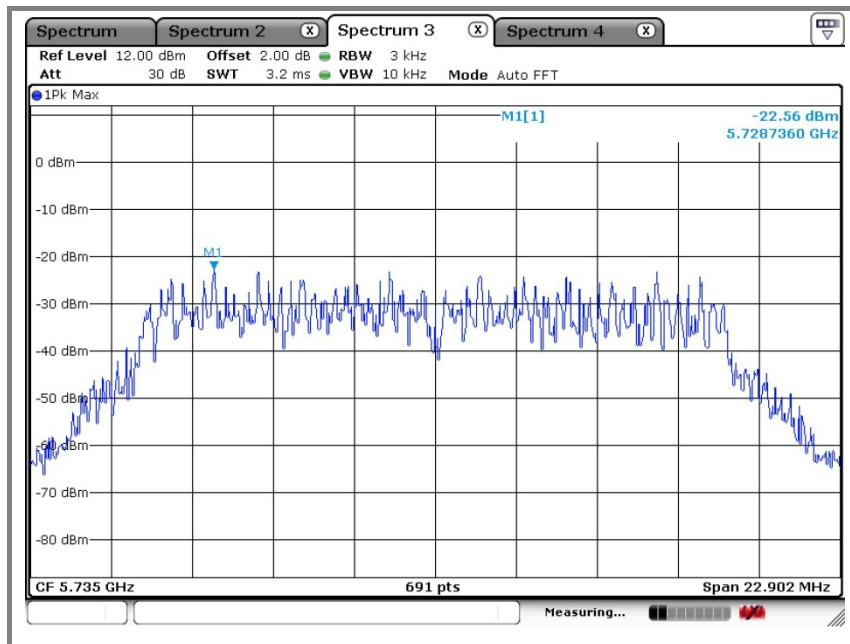
Ambient temperature: 23 °C

Relative humidity: 45 % R.H.

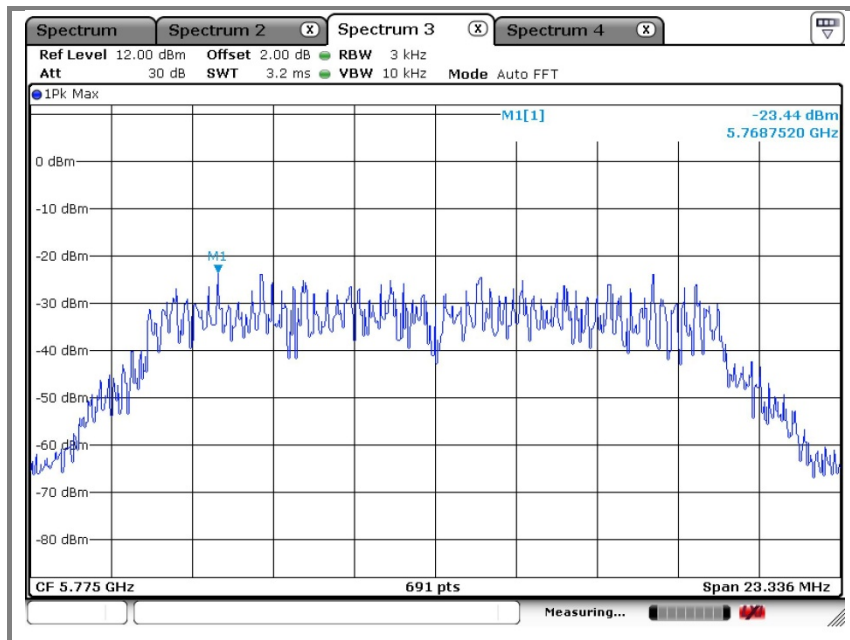
Operation mode	Frequency (MHz)	Peak output power(dBm)	Limit (dBm)
Basic	5 735	-22.56	8
	5 775	-23.44	
	5 815	-24.56	

Operation mode: Basic mode

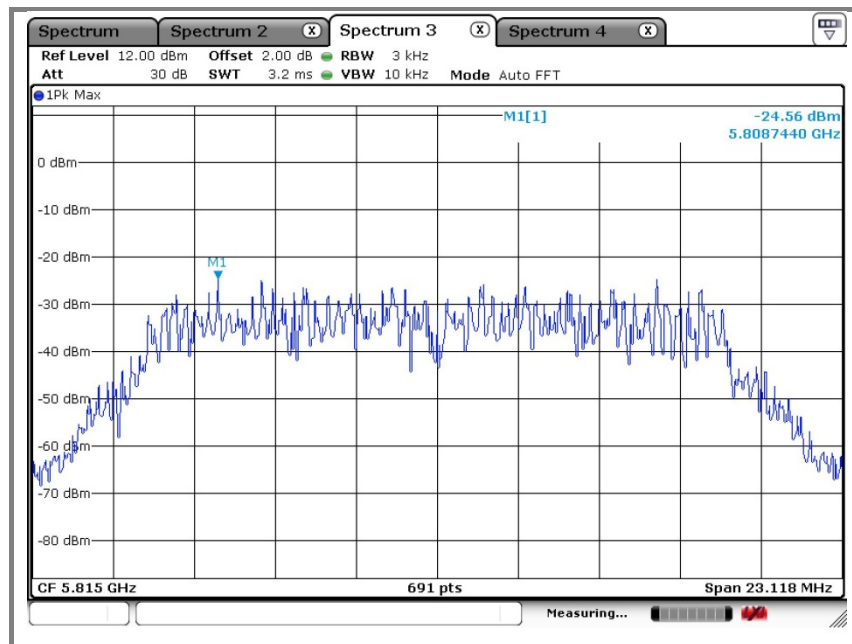
A. Low channel (5 735 MHz)



B. Middle channel (5 775 MHz)



C. High channel (5 815 MHz)



8. Antenna requirement

8.1. Standard Applicable

For intentional device, according to FCC 47 CFR Section §15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. And according to FCC 47 CFR Section §15.247 (b) if transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in 4.8dBi that the gain of the antenna exceeds 6 dBi.

8.2. Antenna Connected Construction

Antenna used in this product is RP-SMA type (Dipole Antenna) gain of 3.238 dBi.

9. RF exposure evaluation

9.1. Environmental evaluation and exposure limit according to FCC CFR 47 part 1, 1.1307(b), 1.1310

According to §15.247(e)(i) and §1.1307(b)(1), systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines. According to KDB 447498 (2)(a)(i)

Limits for maximum permissible exposure (MPE)

Frequency range (MHz)	Electric field strength(V/m)	Magnetic field strength (A/m)	Power density (mW/cm ²)	Average time
(A) Limits for Occupational / Control exposures				
300 – 1 500	--	--	F/300	6
1 500 – 100 000	--	--	5	6
(B) Limits for General Population / Uncontrol Exposures				
300 – 1 500	--	--	F/1 500	6
<u>1 500 – 100 000</u>	--	--	<u>1</u>	<u>30</u>

9.2. Friis transmission formula : $P_d = (P_{out} * G) / (4 * \pi * R^2)$

Where

P_d = Power density in mW/cm²

P_{out} = output power to antenna in mW

G = Numeric gain of the antenna relative to isotropic antenna

π = 3.1416

R = distance between observation point and center of the radiator in cm

P_d the limit of MPE, 1 mW/cm². If we know the maximum gain of the antenna and total power input to the antenna, through the calculation, we will know the distance where the MPE limit is reached.

9.3. Test result of RF exposure evaluation

Test Item : RF Exposure evaluation data

Test Mode : Normal operation

9.4. Output power into antenna & RF exposure evaluation distance

Frequency (MHz)	Output Peak power to antenna (dBm)	Antenna gain (dBi)	Antenna Gain (dBi) Numeric	Power density at 20 cm (mW/cm ²)	Power density Limits (mW/cm ²)
5 735	15.37	3.238	2.11	0.014 4	1
5 775	14.23	3.238	2.11	0.011 1	
5 815	14.22	3.151	2.07	0.010 9	

※ Remark

The power density Pd (5th column) at a distance of 20 cm calculated from the friis transmission formula is far below the limit of 1 mW/cm².

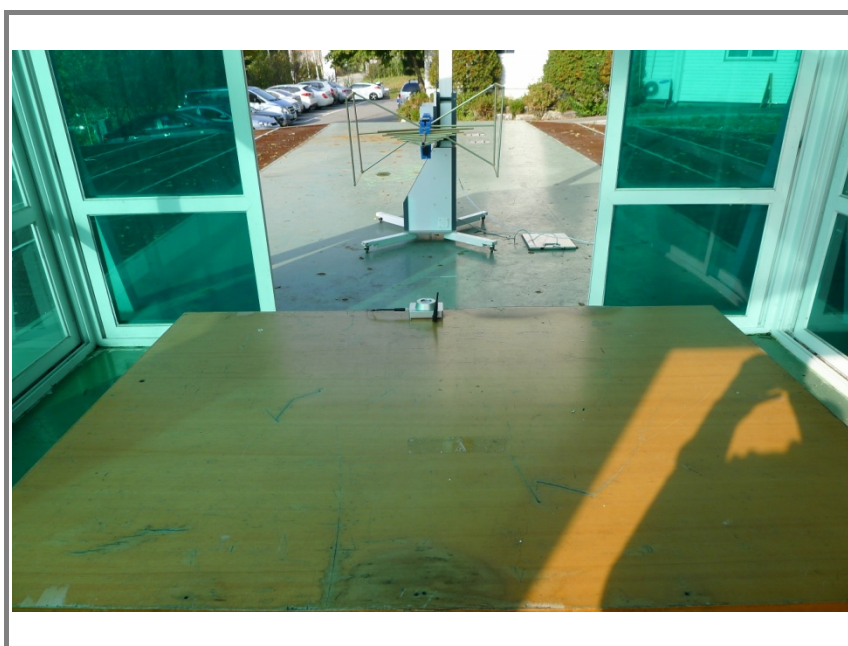
10. Test setup photo of EUT**Photo of radiated spurious emission at below 30 MHz****Photo of radiated spurious emission at 30 MHz ~ 1 000 MHz**

Photo of radiated spurious emission at above 1 000 MHz