FCC Part 15 Subpart C §15.247

Test Report

Equipment Under Test	**RECO**
Model Name	**RECO**
Applicant	**Perples,Inc.**
FCC ID	**2AD2GRECO**
Manufacturer	**Perples,Inc.**
Date of Test(s)	**2015. 01. 20 ~ 2015. 01. 29**
Date of Issue	**2015. 02. 13**

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

Issue to	Issue by
Perples,Inc. Level3 Laluce Building 607-1 Yeoksam-1-dong Gangnam-gu Seoul Korea 135-907 Tel.: +82-02-2051-8383 Fax: +82-02-6442-2051	**MOVON CORPORATION** 498-2, Geumeo-ro, Pogok-eup, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea, 449-812 Tel.: +82-31-338-8837 Fax: +82-31-338-8847

Revision history

Revision	Date of issue	Description	Revised by
--	February 13, 2015	Initial	--

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1. General information

1.1. Details of applicant & Manufacturer

Applicant	:	Perples,Inc.
Address	:	Level3 Laluce Building 607-1 Yeoksam-1-dong Gangnam-gu Seoul 135-907
Contact Person	:	Seonggwan Lee
Telephone	:	+ 82-02-2051-8383
Fax	:	+ 82-02-6442-2051

1.3. 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 Conducted 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:
FCC Parts 15.247; ANSI C-63.4-2009
FCC Public Notice KDB 558074 D01 v03r02
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 :
	
Jungmoo Her Test Engineer MOVON CORPORATION	Issac Jin Technical Manager MOVON CORPORATION

2. EUT Description

Kind of product	RECO
FCC ID	2AD2GRECO
Model Name	RECO
Serial Number	N/A
Power supply	DC 3.0V
Frequency range	2 402 ㎒ ~ 2 480 ㎒
Modulation technique	O-QPSK
Number of channels	40
Antenna gain	-5.82 ㏈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	2015-12-11
Signal Generator	R&S	SMR27	100089	1 year	2015-12-11
Spectrum Analyzer	R&S	FSV-40	100832	1 year	2015-08-13
Power Meter	Agilent	E4416A	GB41290645	1 year	2015-09-29
Power Sensor	Agilent	9327A	US40441490	1 year	2015-07-09
Double Redge Horn Antenna	R&S	HF906	100236	2 year	2015-02-28
Biolog Antenna	A.H.System	SAS-521-7	127	2 year	2015-07-25
Power Amplifier	MITEQ	AM-1431	1497315	1 year	2015-09-29
Power Amplifier	MITEQ	AFS43-01002600	1374382	1 year	2015-09-29
High Pass Filter	Wainwright	WHK3.0/18G-10SS	508	1 year	2015-09-29
DC Power Supply	HP	6674A	3637A01351	1 year	2015-09-29
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	SCHWARZBECK	FMZB 1516	151602/94	1 year	2016-01-06
Two LINE-V-BETWORK	R&S	ESH3-Z5	100296	1 year	2015-12-11
Two LINE-V-BETWORK	Rolf Heine	NNB-2/16Z	99023	1 year	2015-12-11
Horn Antenna	AH Systems	SAS-572	269	2 year	2015-09-06

※ Remark;
Support equipment

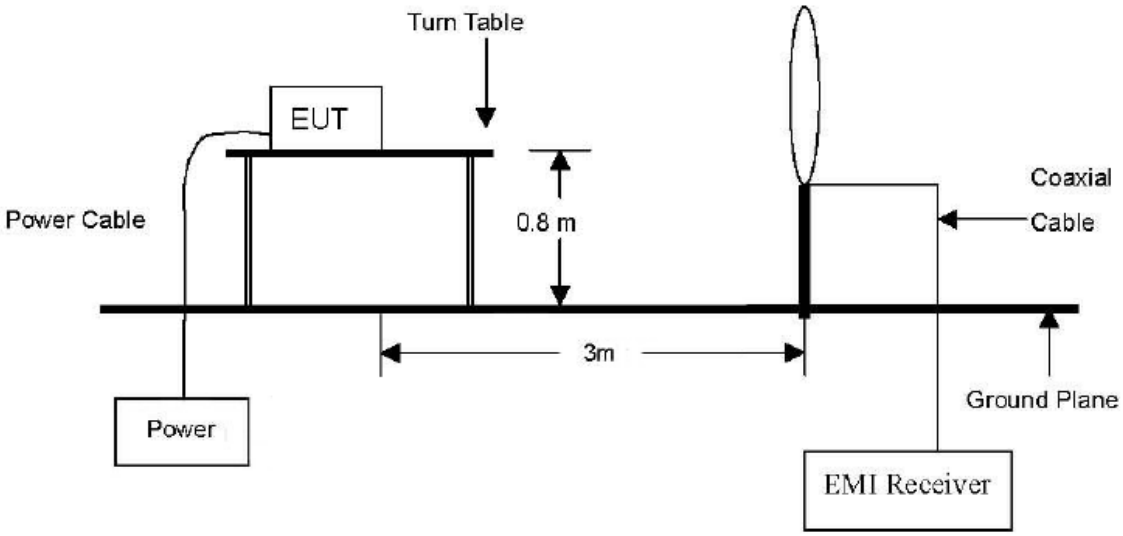
Description	Manufacturer	Model	Serial number
Notebook computer	DELL	Lattitude D510	-

4. Transmitter radiated spurious emissions and conducted spurious emissions

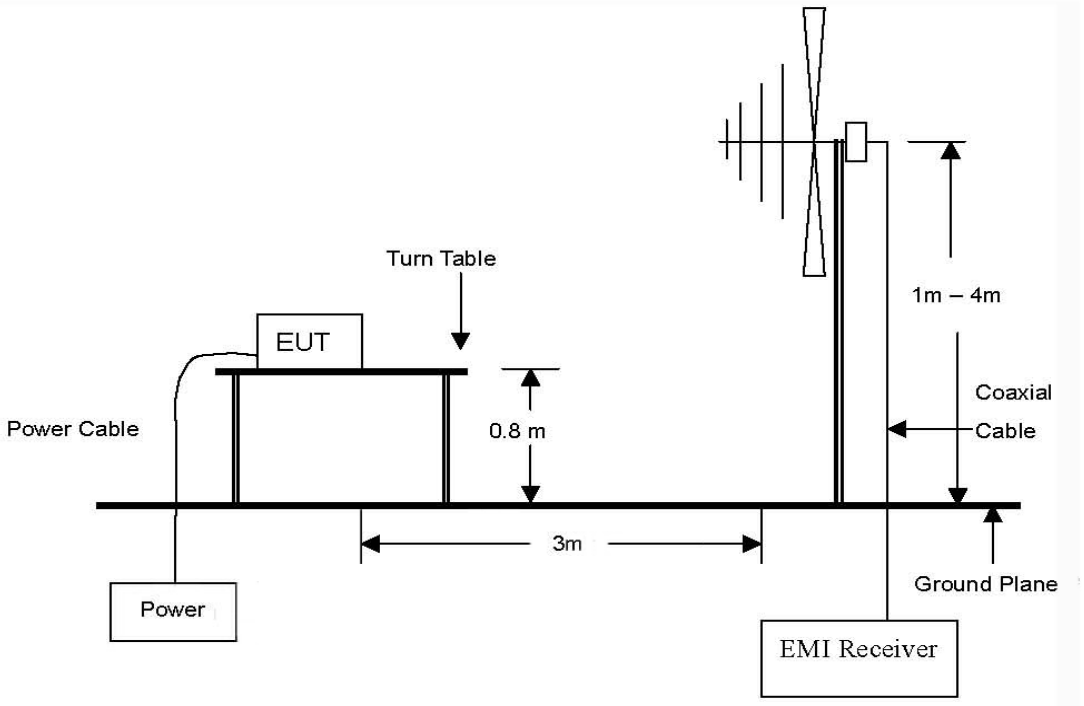
4.1. Test setup

4.1.1. Transmitter radiated spurious emissions

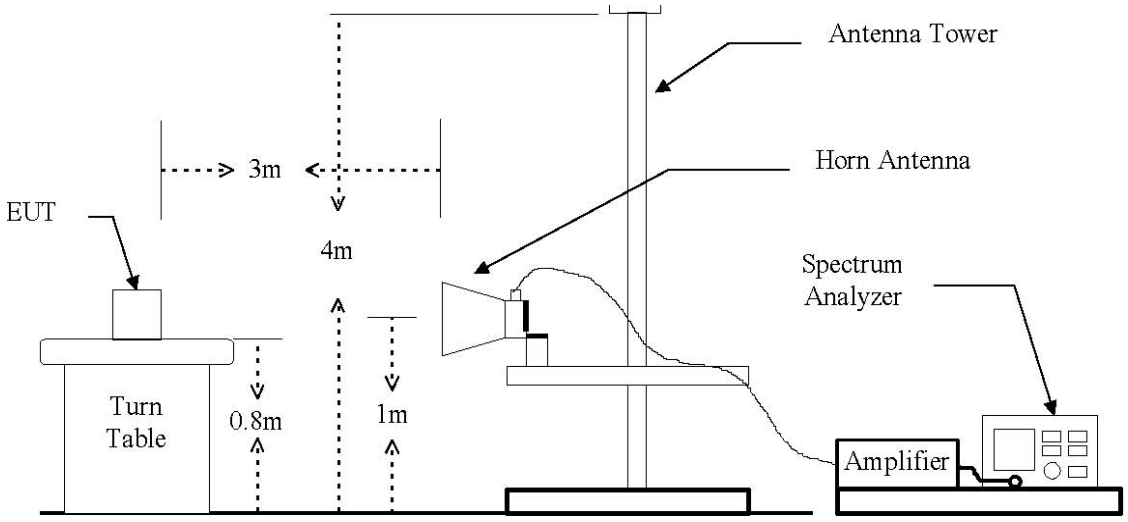
The diagram below shows the test setup that is utilized to make the measurements for emission from 9kHz to 30MHz Emissions.



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



The diagram below shows the test setup that is utilized to make the measurements for emission from 1 ㎓ to 40 ㎓ emissions.



4.2. Limit

According to §15.247(d), in any 100 ㎑ 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 ㏈ below that in the 100 ㎑ 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 ㏈ instead of 20 ㏈. 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 (㎒)	Distance (Meters)	Radiated at 3M (㏈㎶/m)	Radiated (㎶/m)
0.009–0.490	300	See the remark	2400/F(㎑)
0.490–1.705	30		24000/F(㎑)
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 ㎑ for Peak detection (PK) at frequency below 30 ㎒
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 ㎑ for Peak detection (PK) or Quasi-peak detection (QP) at frequency below 1 ㎓.
3. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 ㎒ for Peak detection and frequency above 1 ㎓.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1 ㎒z and the video bandwidth is 10 ㎐ for Average detection (AV) at frequency above 1 ㎓.

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 ㎑. 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 ㏈ below the fundamental emission level measured in a 100 ㎑ bandwidth.

4.4. Test result

Ambient temperature: 23 ℃
Relative humidity: 40 % R.H.

4.4.1. Spurious radiated emission

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

A. Low channel (2 402 ㎒)

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

B. Middle channel (2 440 ㎒)

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

C. High channel (2 480 ㎒)

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (㏈㎶)	Detector mode	Pol.	Ant. factor (㏈/m)	CL (㏈)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
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 ㎒ to 1 000 ㎒ was investigated. Emission levels are not reported much lower than the limits by over 20 ㏈. 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.

A. Low channel (2 402 ㎒)

Radiated emissions			Ant.	Correction factors (Ant. Factor + C.L)	Total	Limit	
Frequency (㎒)	Reading (㏈㎶)	Detector mode	Pol.		Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
55.27	19.60	Peak	V	8.67	28.27	40	11.73
117.47	12.69	Peak	V	18.24	30.93	43.5	12.57
142.74	7.97	Peak	V	21.96	29.93	43.5	13.57
255.49	8.23	Peak	H	20.08	28.31	46	17.69
426.55	6.25	Peak	V	23.42	29.67	46	16.33
628.71	2.52	Peak	V	28.15	30.67	46	15.33
Above 700	Not detected	-	-	-	-	-	-

B. Middle channel (2 440 ㎒)

Radiated emissions			Ant.	Correction factors (Ant. Factor + C.L)	Total	Limit	
Frequency (㎒)	Reading (㏈㎶)	Detector mode	Pol.		Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
55.27	19.56	Peak	V	8.67	28.23	40	11.77
117.47	12.54	Peak	V	18.24	30.78	43.5	12.72
142.74	7.84	Peak	V	21.96	29.8	43.5	13.7
255.49	8.25	Peak	H	20.08	28.33	46	17.67
426.55	6.33	Peak	V	23.42	29.75	46	16.25
628.71	2.63	Peak	V	28.15	30.78	46	15.22
Above 700	Not detected	-	-	-	-	-	-

C. High channel (2 480 ㎒)

Radiated emissions			Ant.	Correction factors (Ant. Factor + C.L)	Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.		Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
55.27	19.51	Peak	V	8.67	28.18	40	11.82
117.47	12.58	Peak	V	18.24	30.82	43.5	12.68
142.74	7.77	Peak	V	21.96	29.73	43.5	13.77
255.49	8.13	Peak	H	20.08	28.21	46	17.79
426.55	6.28	Peak	V	23.42	29.7	46	16.3
628.71	2.66	Peak	V	28.15	30.81	46	15.19
Above 700	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 ㎒ was investigated. Emission levels are not reported much lower than the limits by over 20 ㏈.
To get a maximum emission levels from the EUT, the EUT was moved throughout the XY, XZ, and YZ planes.

A. Low channel (2 402 ㎒)

Radiated emissions			Ant.	Correction factors (Ant. Factor + C.L)	Total	Limit	
Frequency (㎒)	Reading (㏈㎶)	Detector mode	Pol.		Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
4 804	48.94	Average	H	44.10	38.10	54.00	15.90
Above 5 000	Not detected	-	-	-	-	-	-

B. Middle channel (2 440 ㎒)

Radiated emissions			Ant.	Correction factors (Ant. Factor + C.L)	Total	Limit	
Frequency (㎒)	Reading (㏈㎶)	Detector mode	Pol.		Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
4 882	46.29	Average	H	44.10	35.45	54.00	18.55
Above 5 000	Not detected	-	-	-	-	-	-

C. High channel (2 480 ㎒)

Radiated emissions			Ant.	Correction factors (Ant. Factor + C.L)	Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.		Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
4 960	48.19	Average	H	44.10	37.35	54.00	16.65
Above 5 000	Not detected	-	-	-	-	-	-

※ Remark

1. Measuring frequencies from 1 ㎓ to the 40 ㎓.
2. Radiated emissions measured in frequency above 1 000 ㎒ 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. Band Edge

A. 2 310 - 2 390 ㎒ measurement

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

B. 2 483.5 – 2 500 ㎒ measurement

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

4.4.6. Out of Band Emissions in non-restricted frequency band

4.4.6.1. Test requirements and limit

The peak output power measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 20 dBc). If maximum conducted (average) output power was used to demonstrate compliance as described in 9.2, then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 30 dBc). In either case, attenuation to levels below the 15.209 general radiated emissions limits is not required.

4.4.6.2. Test procedure

1. Set the center frequency and span to encompass frequency range to be measured.
2. Set the RBW = 100 kHz(See below note for actual setting)
3. Set the VBW ≥3 x RBW (See below note for actual setting)
4. Detector = peak.
5. Sweep time = auto couple.
6. Trace mode = max hold.
7.Allow the trace to stabilize.
8. Use the peak marker function to determine the maximum amplitude level.

(Note:This test item was tested with below settings.)

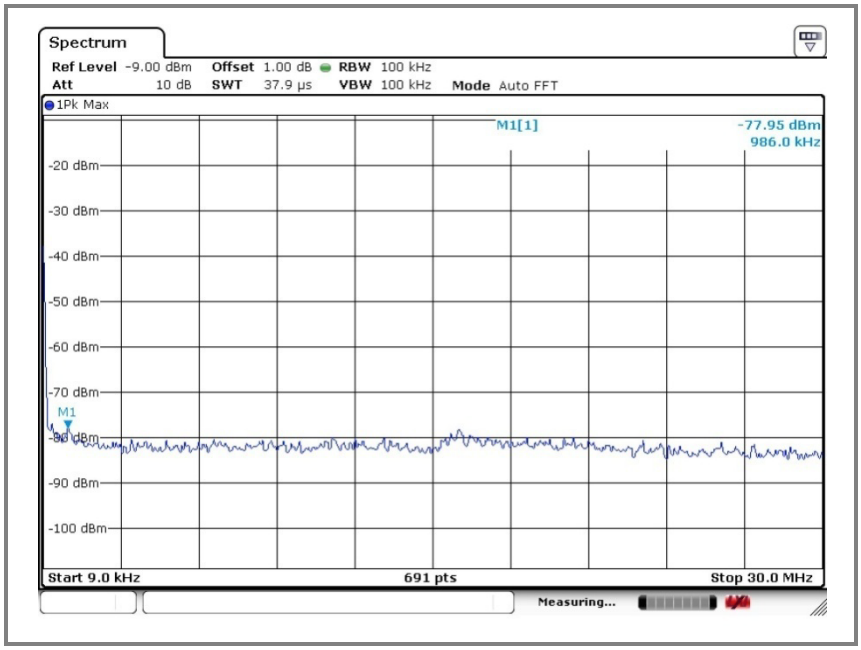
- RBW= 100kHz, VBW= 100kHz for frequency range: 9 kHz ~ 30 MHz
- RBW= 100MHz, VBW= 100MHz for frequency range: 30 MHz ~26.5 GHz

If the emission level with above setting was close to the limit (ie, less than 3 dB margin) then zoom scan is required using RBW = 100 kHz, VBW = 100 kHz, SPAN = 100 MHz and BINS = 2001 to get accurate emission level within 100 kHz BW.

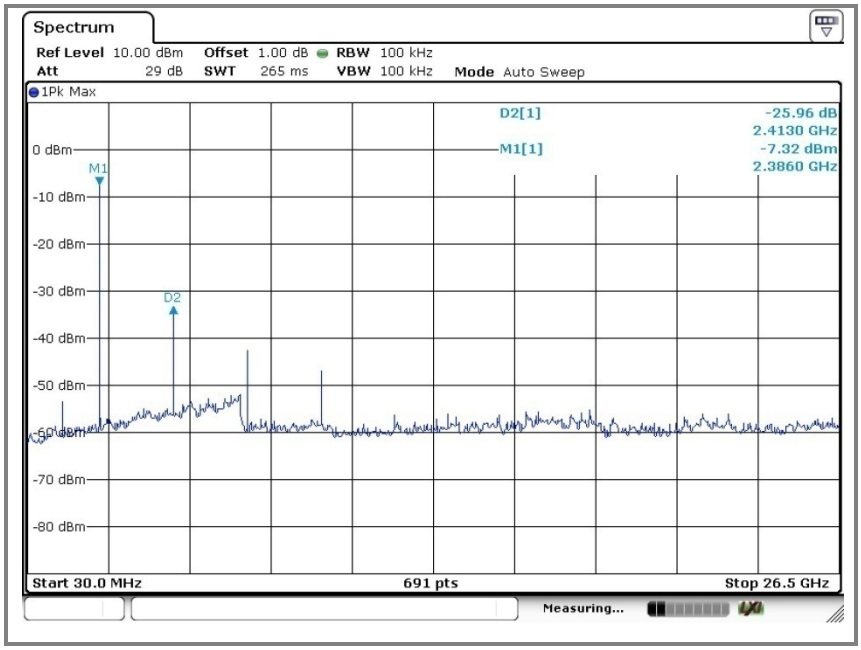
4.4.6.3. Test results : **Comply** (refer to Next page – test plots)

A. Low channel (2 402 ㎒)

Emission level measurement 1

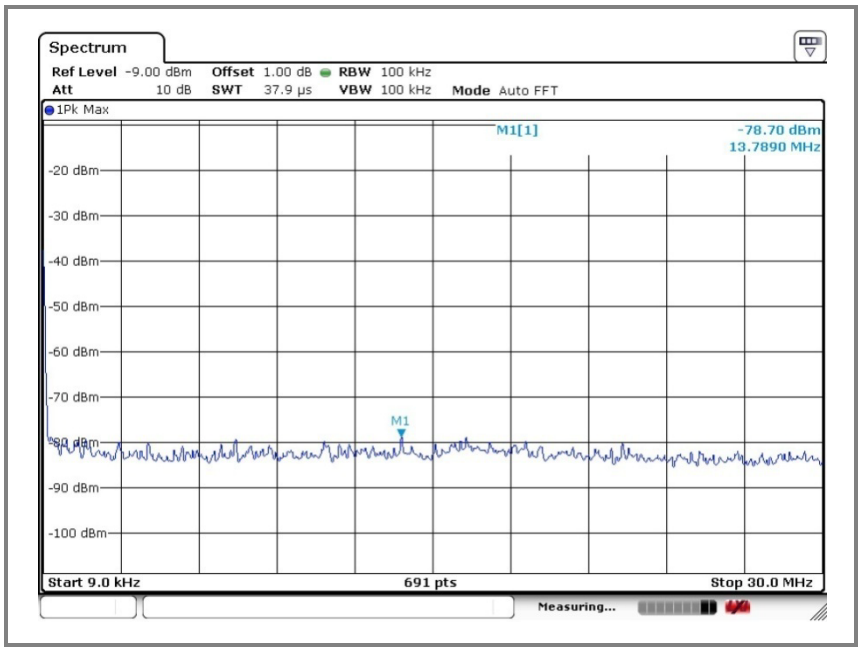


Emission level measurement 2

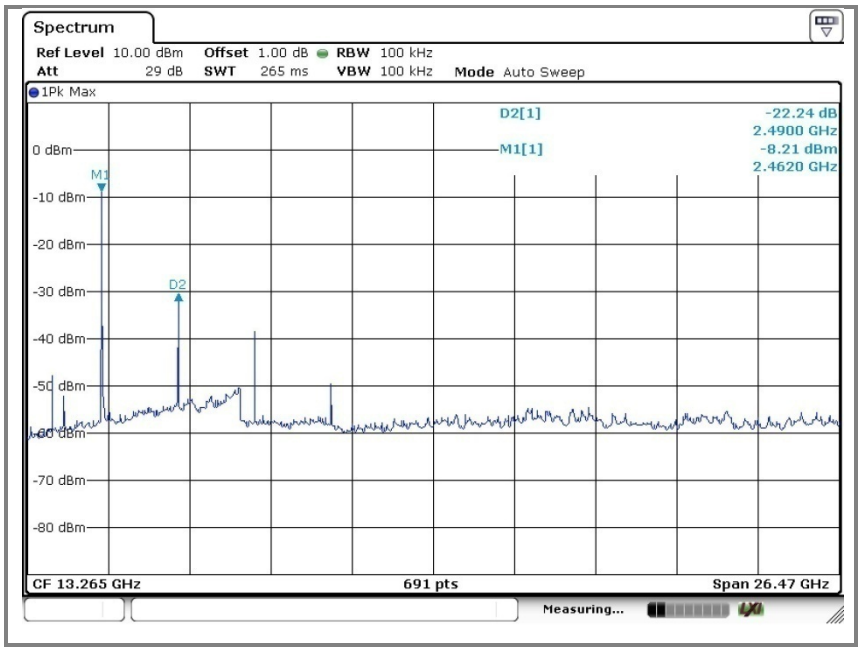


B. Middle channel (2 440 ㎒)

Emission level measurement 1

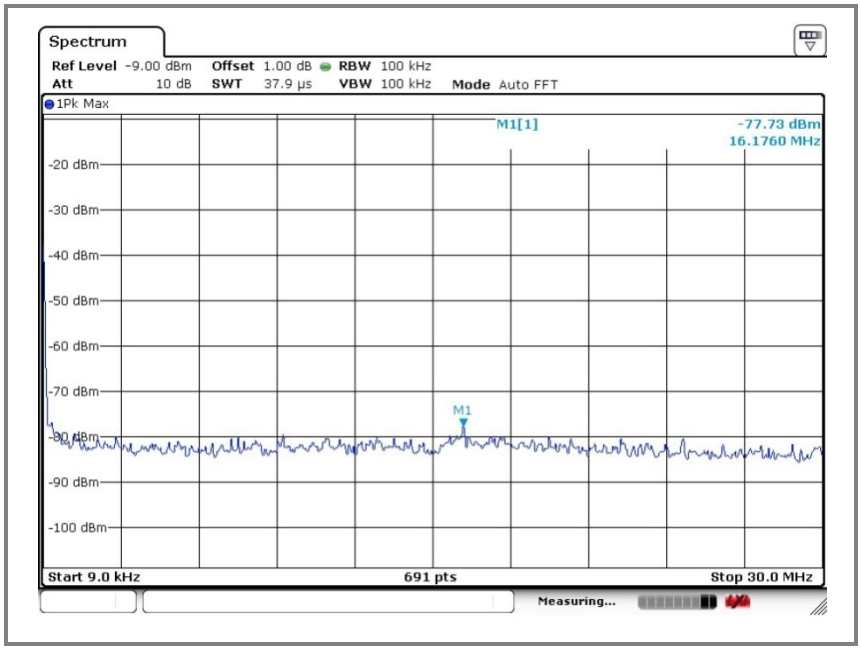


Emission level measurement 2

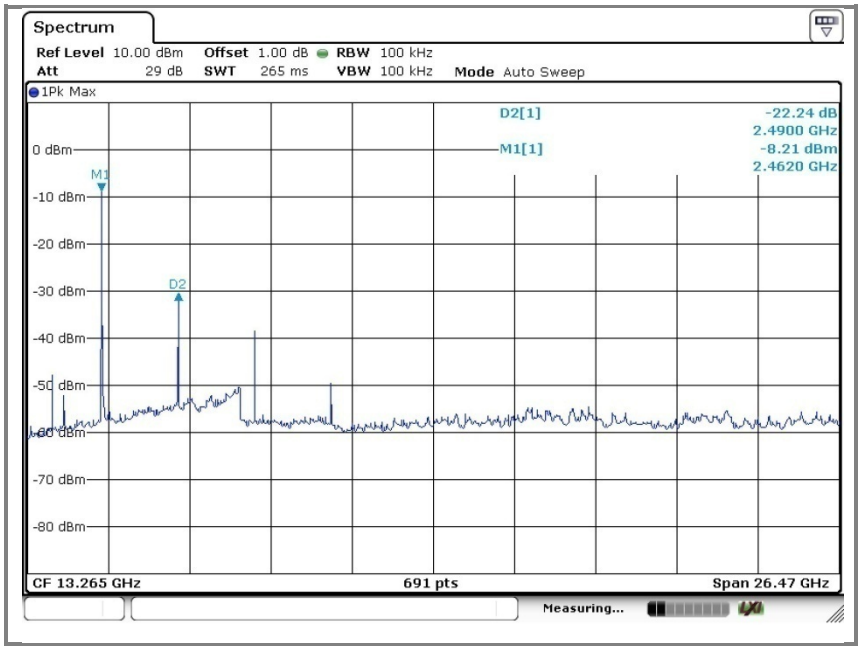


C. High channel (2 480 ㎒)

Emission level measurement 1

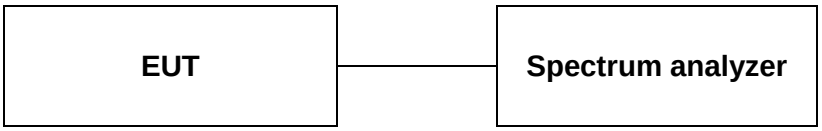


ission level measurement 2



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 ㎒, 2 400~2 483.5 ㎒, and 5 725~5 825 ㎒ bands. The minimum of 6 dB Bandwidth shall be at least 500 ㎑

5.3. Test procedure

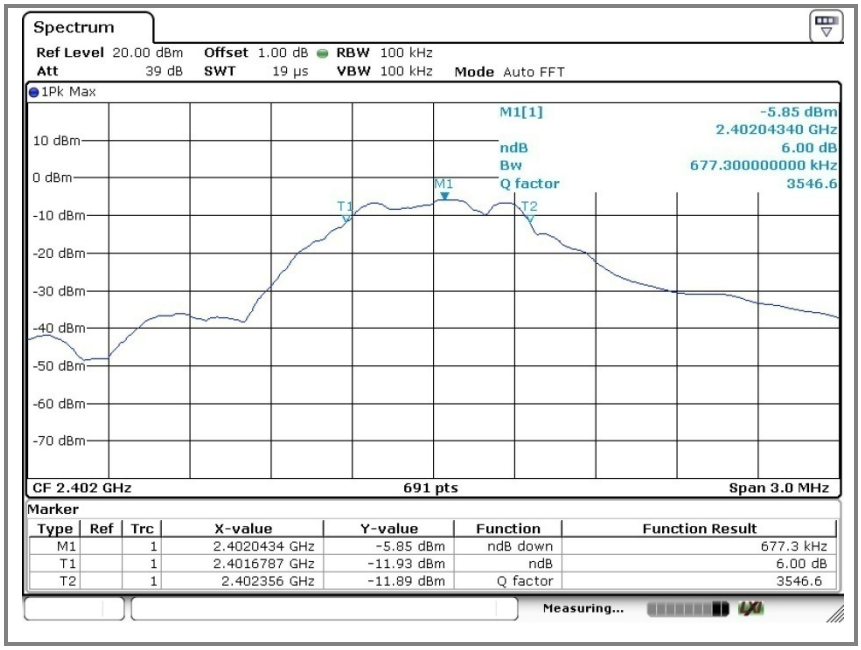
1. The 6 dB band width was measured with a spectrum analyzer connected to RF antenna connector (conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency. The analyzer center frequency was set to the EUT carrier frequency, using the analyzer. Display Line and 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 ㎑, VBW = 100 ㎑, Span = 5 ㎒.

6.4. Test results

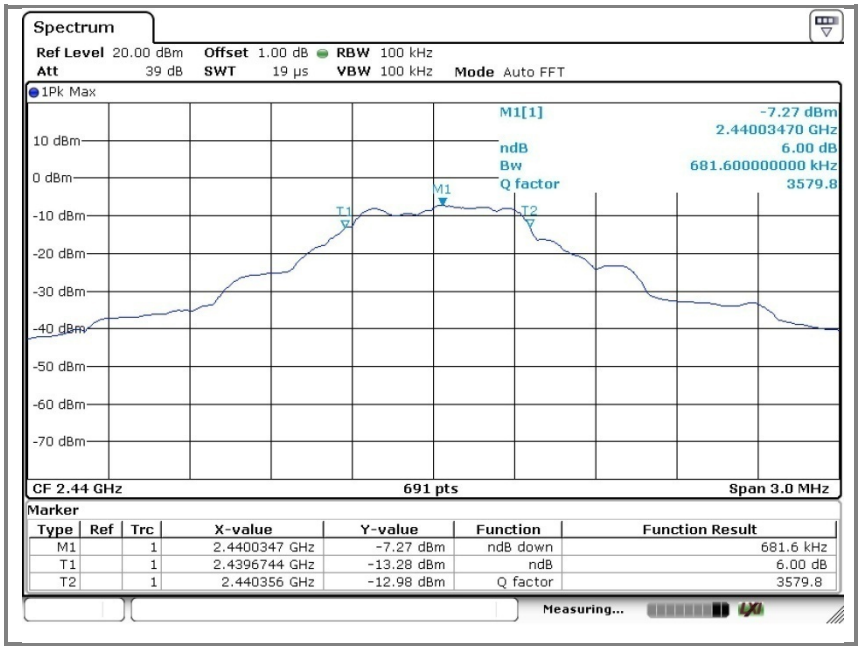
Ambient temperature: 23 ℃
Relative humidity: 51 % R.H.

Frequency(㎒)	6 dB bandwidth(㎒)
2 402	0.68
2 440	0.68
2 480	0.69

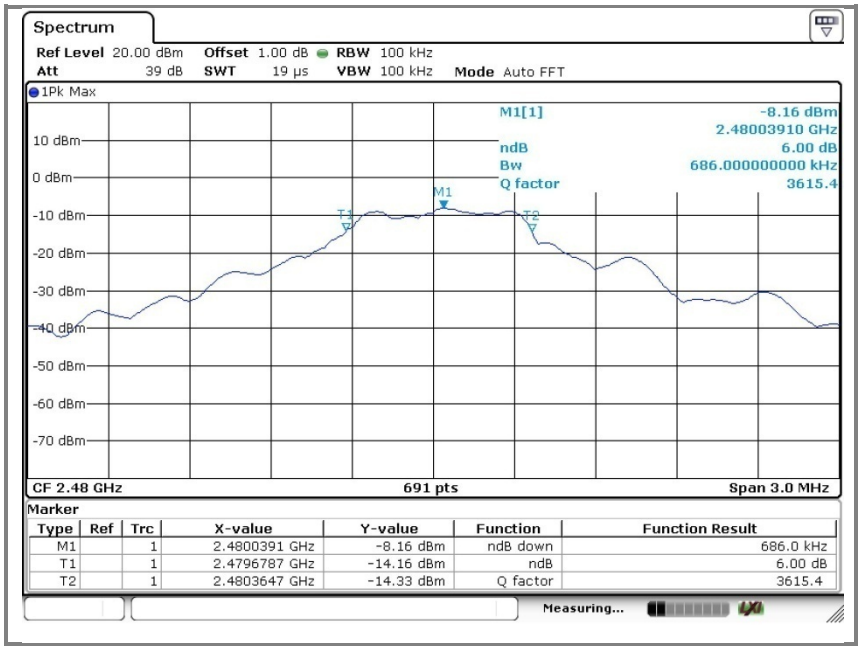
A. Low channel (2 406 ㎒)



B. Middle channel (2 438 ㎒)

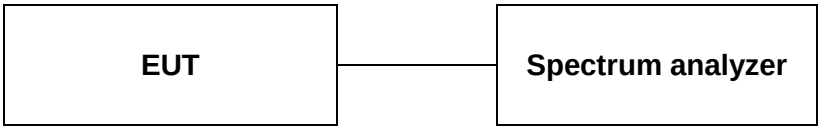


C. High channel (2 474 ㎒)



6. Maximum Output Power Measurement

6.1. Test Setup.



6.2. Limit

The maximum peak output power of the intentional radiator shall not exceed the following:
1. §15.247(a)(1), Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 ㎑ or the 6 ㏈ bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 ㎽
2. §15.247(b)(1), For frequency hopping systems operating in the 2 400 – 2 483.5 ㎒ employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5 725 – 5 805 ㎒ band: 1 Watt.

6.3 Test procedure

Maximum Peak Conducted Output Power is measured using the following procedure (RBW ≥ DTS bandwidth).
1. Set the RBW ≥ DTS bandwidth.
2. Set VBW ≥ 3 x RBW. / Set span ≥ 3 x RBW.
4. Sweep time = auto couple
5. Detector = peak
6. Trace mode = max hold
7. Allow trace to fully stabilize
8. Use peak marker function to determine the peak amplitude level.

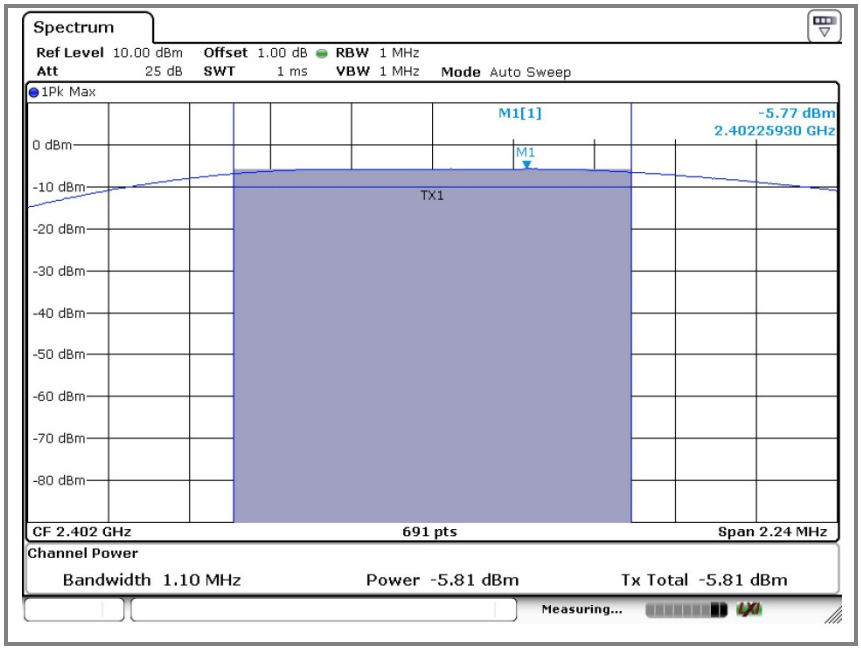
6.4 Test results

Ambient temperature: 23 ℃
Relative humidity: 51 % R.H.

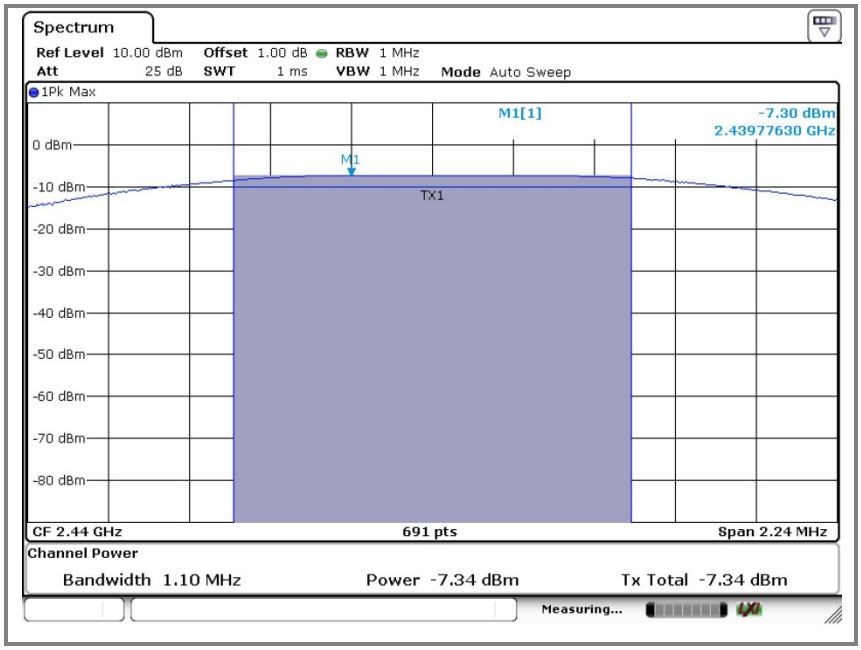
Frequency (㎒)	Conducted power (㏈m)	Limit (㏈m)
2 402	-5.77	30
2 440	-7.30	
2 480	-8.09	

**note: Refer to next page (test plots)*

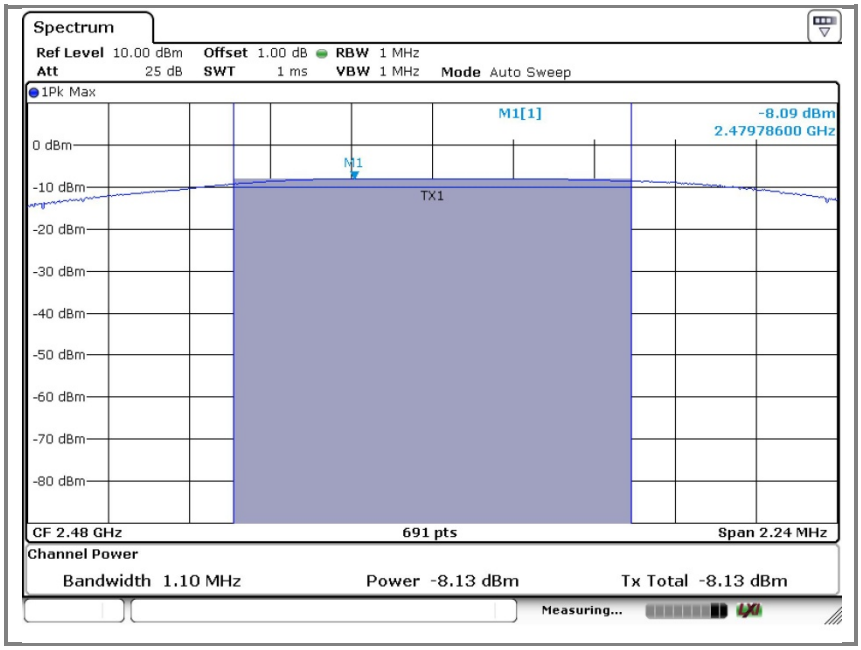
A. Low channel (2 402 ㎒)



B. Middle channel (2 440 ㎒)

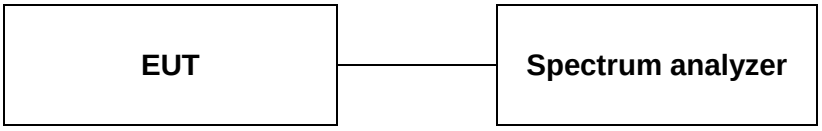


C. High channel (2 480 ㎒)



7. Power Spectral Density Measurement

7.1. Test setup



7.2. Limit

< 8dBm @ 3kHz BW

7.3. Test procedure (PKPSD)

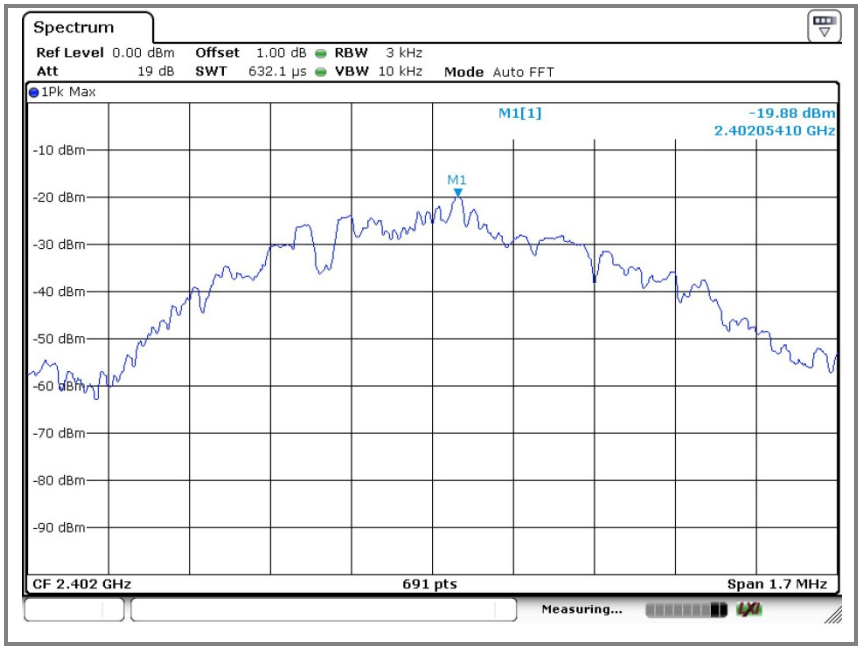
1. The RF power output was measured with a Spectrum analyzer connected to the RF Antenna connector(conducted measurement) while EUT was operating in transmit mode at the appropriate center frequency, A spectrum analyzer was used to record the shape of the transmit signal.
2. The bandwidth of the fundamental frequency was measured with the spectrum analyzer using;
   Span = 1.5 times the DTS bandwidth
   RBW = 3㎑ ≤ RBW ≤ 100㎑
   VBW ≥ 3 x RBW, Sweep = Auto couple
   Detector function = peak, Trace = max hold

7.4. Test results

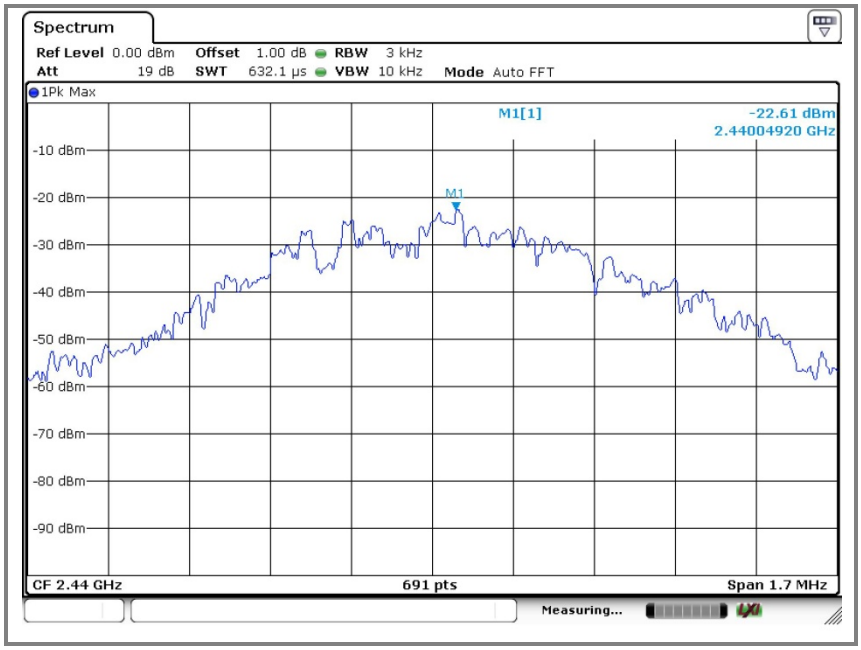
Ambient temperature: 23 ℃
Relative humidity: 51 % R.H.

Frequency (㎒)	Peak output power(㏈m)	Limit (㏈m)
2 402	-19.88	8
2 440	-22.61	
2 480	-23.16	

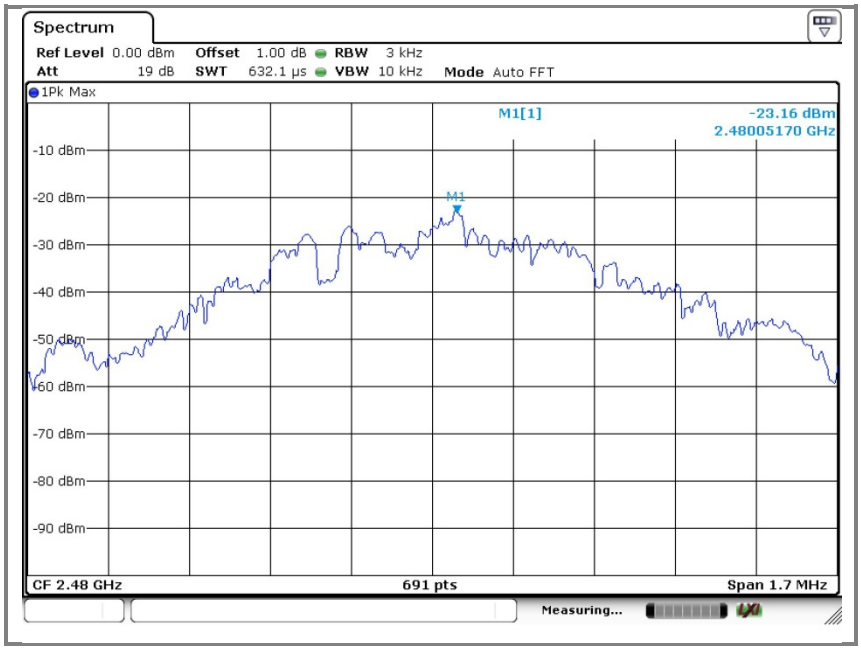
A. Low channel (2 406 ㎒)



B. Middle channel (2 438 ㎒)



C. High channel (2 474 ㎒)



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.

8.2. Antenna Connected Construction

Antenna used in this product is PCB Pattern antenna, Antenna gain is 3.66 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 (㎒)	Electric field strength(V/m)	Magnetic field strength (A/m)	Power density (㎽/㎠)	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
1 500 – 100 000	--	--	1	30

9.2. Friis transmission formula : Pd=(Pout*G)\(4*pi*R2)

Where
Pd= Power density in ㎽/㎠
Pout=output power to antenna in ㎽
G= Numeric gain of the antenna relative to isotropic antenna
Pi=3.1416
R= distance between observation point and center of the radiator in cm
Pd the limit of MPE, 1 ㎽/㎠. 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

Antenna gain: -5.82 dBi

Frequency (㎒)	Output Peak power to antenna (dBm)	Antenna gain (dBi)	Antenna Gain (dBi) Numeric	Power density at 20 ㎝ (㎽/㎠)	Power density Limits (㎽/㎠)
2 402	-5.77	-5.82	0.26	0.000 3	1
2 440	-7.30	-5.82	0.26	0.000 2	
2 480	-8.09	-5.82	0.26	0.000 2	

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