FCC Part 15 Subpart E §15.407
RSS-210 ISSUE No. :8

Test Report

Equipment Under Test	**Pico projector**
Model Name	**Pico Pro**
Applicant	**CELLUON, INC.**
FCC ID	**TCLPICOPRO**
IC Number	**10211A-PICOPRO**
Manufacturer	**CELLUON, INC.**
Date of Test(s)	**2015. 01. 19 ~ 2015. 02. 03**
Date of Issue	**2015. 02. 05**

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

Issue to	Issue by
CELLUON, INC. Ace High-End Tower 1101 235-2, Guro-Dong, Guro-Gu, Seoul, Korea, 152-740 Tel.: +82-2-6220-3886 Fax: +82-2-6220-3899	**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
--	Feb. 05, 2015	Initial	--

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1. General information

1.1. Details of applicant

Applicant	:	CELLUON, INC.
Address	:	Ace High-End Tower 1101 235-2, Guro-Dong, Guro-Gu, Seoul, Korea, 152-742
Contact Person	:	Chun Bae, Park
Telephone	:	+82-2-6220-3886
Fax	:	+82-2-6220-3899

1.2. Summary of test results

The EUT has been tested according to the following specifications;

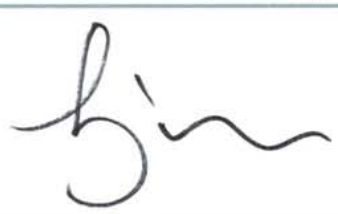
Section in FCC part 15	Section in RSS-GEN, RSS-210	Description	Result
§15.205(a) §15.209(a) §15.407(b)(1)	2.2 2.6 A9.3(2)	Transmitter radiated spurious emissions, Conducted spurious emission	C
§15.107	7.2.2	Conducted power line test	C
§15.407(a)(1)	A9.2(2)	26 dB and 99% BANDWIDTH	C
§15.407(a)(1)	A9.2(2)	Output power	C
§15.407(a)(1)	A9.2(2)	Peak power spectral density	C
§15.407(a)(1)	-	Peak excursion	C
§15.407(g)	A2.1	frequency stability	C
§1.1307(b)(1)	RSS GEN 5.5 RSS-102	RF exposure evaluation	C

The sample was tested according to the following specification:
ANSI C63.4-2009, FCC Public Notice KDB789033 D01 v01r04.
TEST SITE REGISTRATION NUMBER:
FCC(670686),(610755) / IC(6432B-1), (5799A-1)

※ 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	Pico projector
Model Name	Pico Pro
FCC ID	TCLPICOPRO
IC Number	10211-PICOPRO
Serial Number	N/A
Power supply	DC 3.8V
Frequency range	5 180 ㎒ ~ 5 240 ㎒ (Normal, N_20 ㎒) 5 190 ㎒ ~ 5 230 ㎒ (N_40 ㎒)
Modulation technique	OFDM
Number of channels	4 (Normal, N_20 ㎒) 2 (N_40 ㎒)
RF Input Output port type	2x2 MIMO (2tx / 2rx)
Antenna gain	3.11 ㏈i (Max.)
Test Site Registration Number	FCC (670686), (610755)
	IC (6432B-1), (5799A-1)

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	ESU26	100196/026	1 year	2015-12-22
Signal Generator	R&S	SMBV100	257379	1 year	2015-09-29
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 Ridge Horn Antenna	R&S	HF906	100236	2 year	2015-02-28
Horn Antenna	AH Systems	SAS-572	269	2 year	2015-09-06
Double Ridge Horn Antenna	ETS LINDGREN	3116B	133350	2 year	2016-02-26
Bi - Log Antenna	AH Systems	SAS-521-7	128	2 year	2015-10-04
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	ETS LINDGREN	6502	00118166	2 year	2015-09-27

※ Remark;
Support equipment

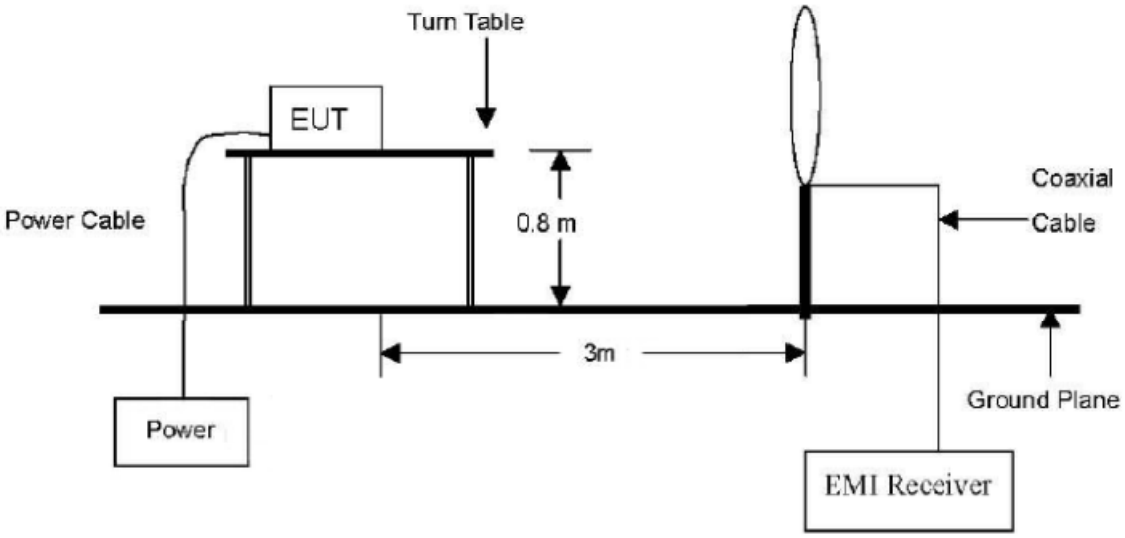
Description	Manufacturer	Model	Serial number
NOTEBOOK	DELL	Lattitude E5440	8HCMN12

4. Transmitter radiated spurious emissions and conducted spurious emissions

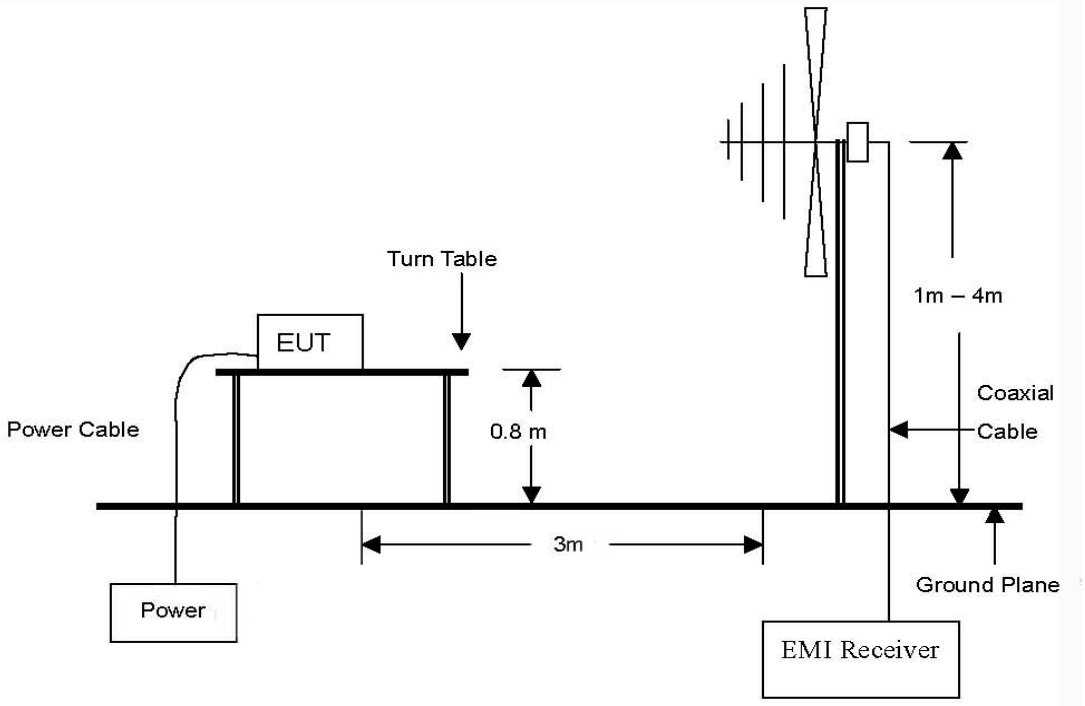
4.1. Test setup

4.1.1. Transmitter radiated spurious emissions

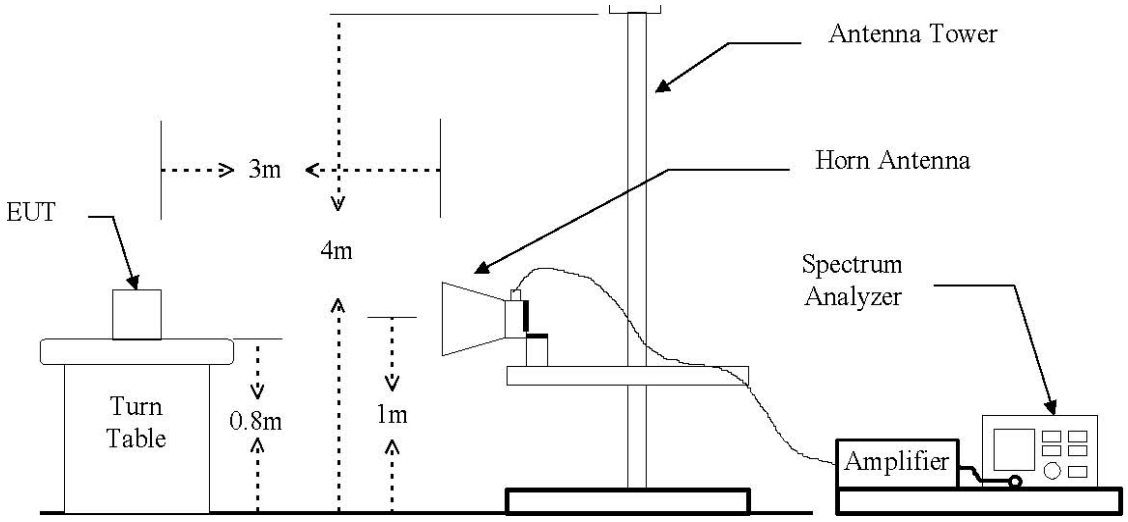
The diagram below shows the test setup that is utilized to make the measurements for emission from 9kHz to 30MHz Emissions.



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

For transmitters operating in the 5.15 ~ 5.25 ㎓ band : all emissions outside of the 5.15 ~ 5.35 ㎓ band shall not exceed an EIRP of -27 ㏈m/㎒

$$E=\frac{1000000\sqrt{30P}}{3}$$ ㎶/m, where P is the eirp (Watts)

EIRP (㏈m)	Field Strength at 3m (㏈㎶/m)
-27	68

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:

㎒	㎒	㎒	㎓
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			

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 ㎓.

4.3.2. 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 = 1 ㎒, VBW = 1 ㎒.

4.4. Test result

Ambient temperature: 23 ℃
Relative humidity: 43 % 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.

Operation mode: Normal mode
A. Low channel (5 180 ㎒)

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 (5 220 ㎒)

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 (5 240 ㎒)

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.

Operation mode: N_20MHz mode

A. Low channel (5 180 ㎒)

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. Middle channel (5 220 ㎒)

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.								

C. High channel (5 240 ㎒)

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.								

Operation mode: N_40MHz mode

A. Low channel (5 190 ㎒)

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. High channel (5 230 ㎒)

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.								

※ 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.

Operation mode: Normal mode

Radiated emissions			Ant.	Correction factors	Total	Limit	
Frequency (㎒)	Reading (㏈㎶)	Detector mode	Pol.	Ant. Factor + Cable Loss (㏈)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
47.70	46.45	PK	V	-16.83	29.62	40.00	10.38
79.70	48.33	PK	V	-20.80	27.53	40.00	12.47
375.00	51.57	PK	H	-11.17	40.40	46.00	5.60
500.00	50.30	PK	H	-8.48	41.82	46.00	4.18
594.02	41.14	PK	H	-5.80	35.34	46.00	10.66
668.28	41.50	PK	H	-4.10	37.40	46.00	8.60
Above 700.00	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: N_20MHz mode

Radiated emissions			Ant.	Correction factors	Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	Ant. Factor + Cable Loss (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
47.70	45.99	PK	V	-16.83	29.16	40.00	10.84
79.70	46.72	PK	V	-20.80	25.92	40.00	14.08
375.00	50.35	PK	H	-11.17	39.18	46.00	6.82
500.00	50.77	PK	H	-8.48	42.29	46.00	3.71
594.02	41.43	PK	H	-5.80	35.63	46.00	10.37
668.28	41.16	PK	H	-4.10	37.06	46.00	8.94
Above 700.00	Not detected	-	-	-	-	-	-

Operation mode: N_40MHz mode

Radiated emissions			Ant.	Correction factors	Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	Ant. Factor + Cable Loss (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
47.70	45.85	PK	V	-16.83	29.02	40.00	10.98
79.70	47.67	PK	V	-20.80	26.87	40.00	13.13
375.00	51.05	PK	H	-11.17	39.88	46.00	6.12
500.00	50.88	PK	H	-8.48	42.40	46.00	3.60
594.02	41.03	PK	H	-5.80	35.23	46.00	10.77
668.28	41.22	PK	H	-4.10	37.12	46.00	8.88
Above 700.00	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.

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.

Operation mode: Normal mode

A. Low channel (5 180 ㎒)

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

B. Middle channel (5 220 ㎒)

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

C. High channel (5 240 ㎒)

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

※ 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.

Operation mode: N_20MHz mode

A. Low channel (5 180 ㎒)

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

B. Middle channel (5 220 ㎒)

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

C. High channel (5 240 ㎒)

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

※ 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.

Operation mode: N_40MHz mode

A. Low channel (5 190 ㎒)

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

B. High channel (5 230 ㎒)

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

※ 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. Restricted Band

A. 4.5 – 5.15 ㎓ measurement

Operation mode: Normal mode
*** Low channel (5 180 ㎒)**

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
4799.60	44.04	Peak	H	33.91	40.50	37.45	74.00	36.55
4799.60	30.61	Average	H	33.91	40.50	24.02	54.00	29.98
4799.60	40.60	Peak	V	33.91	40.50	34.01	74.00	39.99
4799.60	28.43	Average	V	33.91	40.50	21.84	54.00	32.16

Operation mode: N_20MHz mode
*** Low channel (5 180 ㎒)**

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
4656.62	43.37	Peak	H	33.91	40.50	36.78	74.00	37.22
4656.62	30.57	Average	H	33.91	40.50	23.98	54.00	30.02
4656.62	41.17	Peak	V	33.91	40.50	34.58	74.00	39.42
4656.62	29.39	Average	V	33.91	40.50	22.8	54.00	31.20

Operation mode: N_40MHz mode
*** Low channel (5 190 ㎒)**

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	Ant. factor (dB/m)	Amp + CL (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
4552.21	41.53	Peak	H	33.91	40.50	34.94	74.00	39.06
4552.21	28.46	Average	H	33.91	40.50	21.87	54.00	32.13
4552.21	39.66	Peak	V	33.91	40.50	33.07	74.00	40.93
4552.21	25.34	Average	V	33.91	40.50	18.75	54.00	35.25

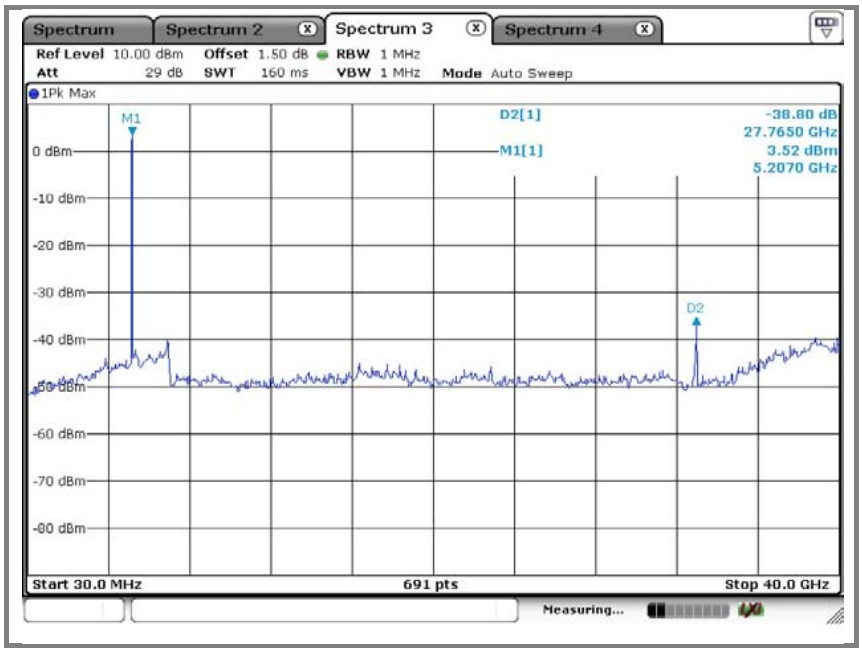
※ Remark
Actual = Reading + Ant. Factor + Amp + CL (Cable loss)

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

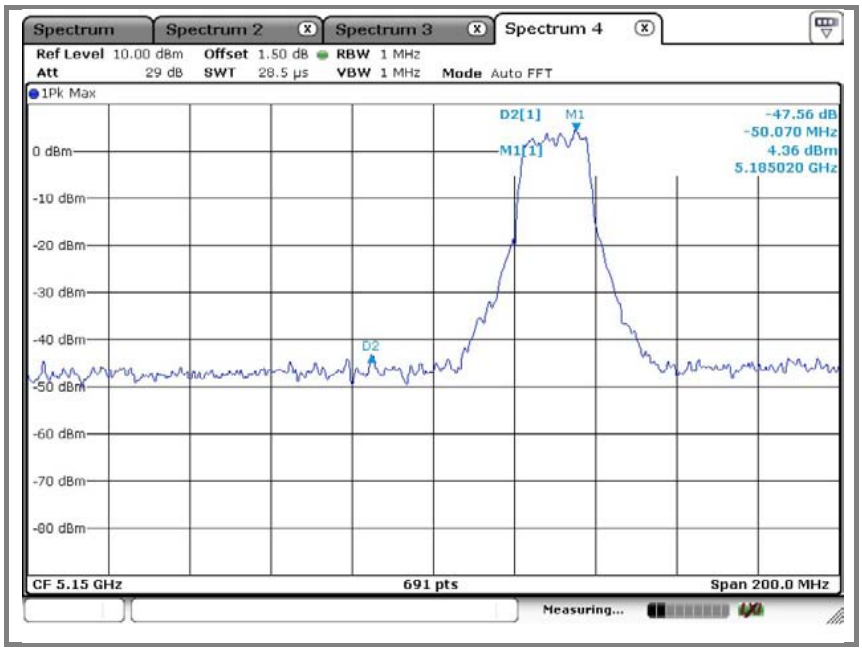
Operation mode: Normal mode (Ant 1)

A. Low channel (5 180 ㎒)

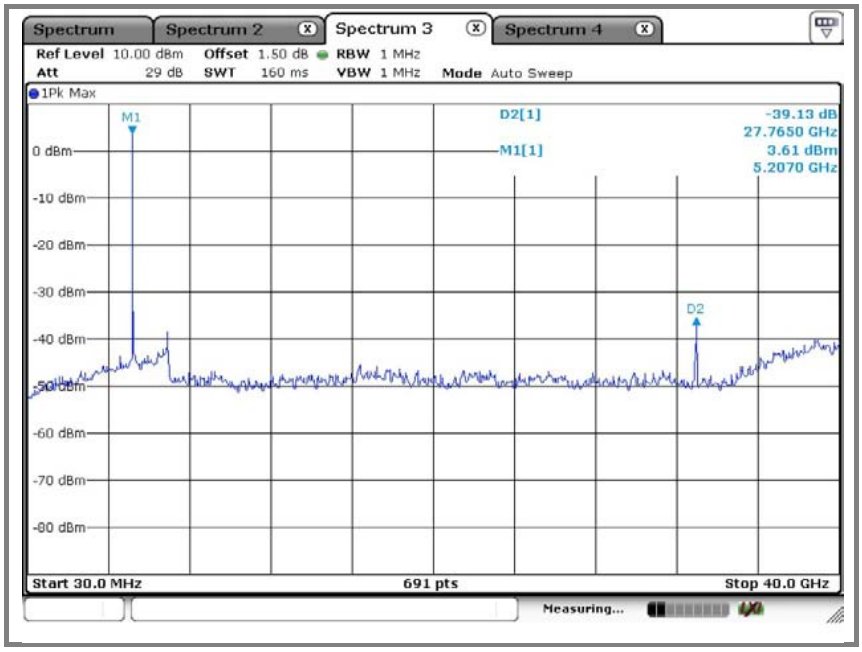
Unwanted Emission data



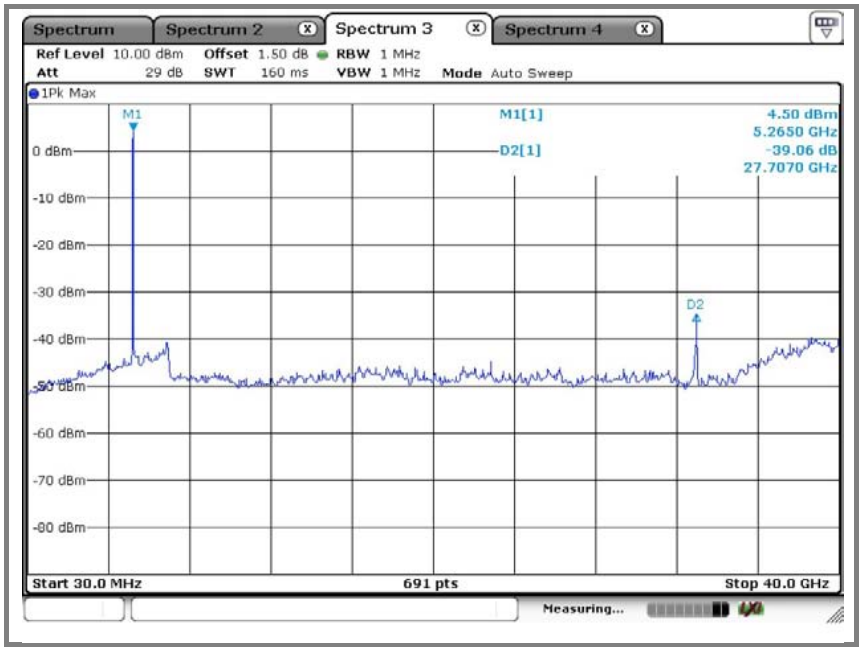
Band-edge data



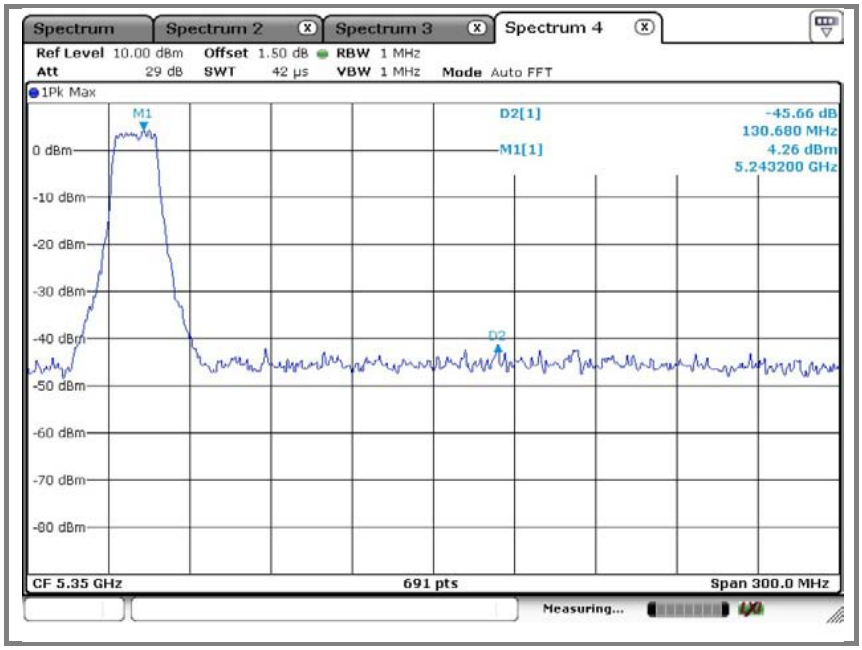
B. Middle channel (5 220 ㎒)



C. High channel (5 240 ㎒)



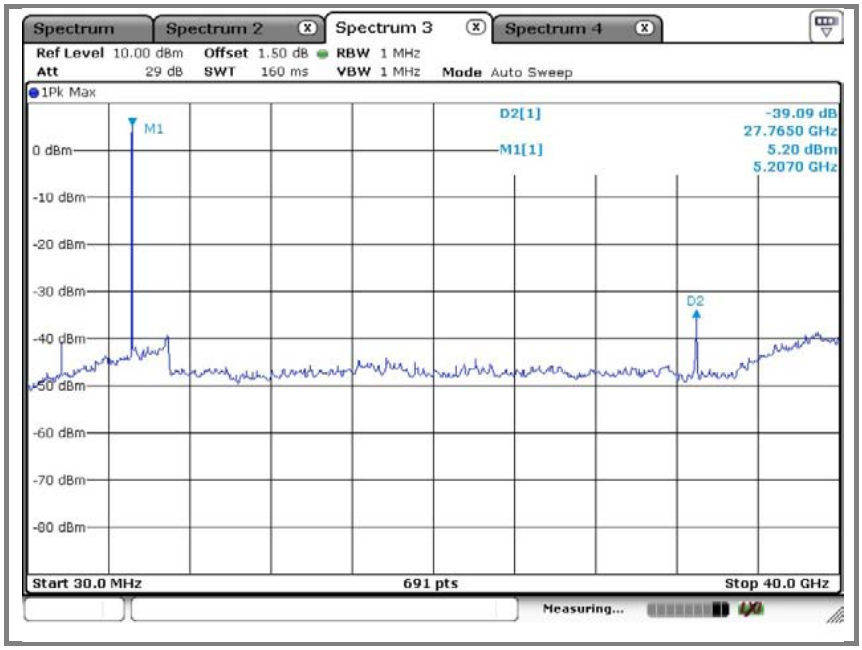
Band-edge data



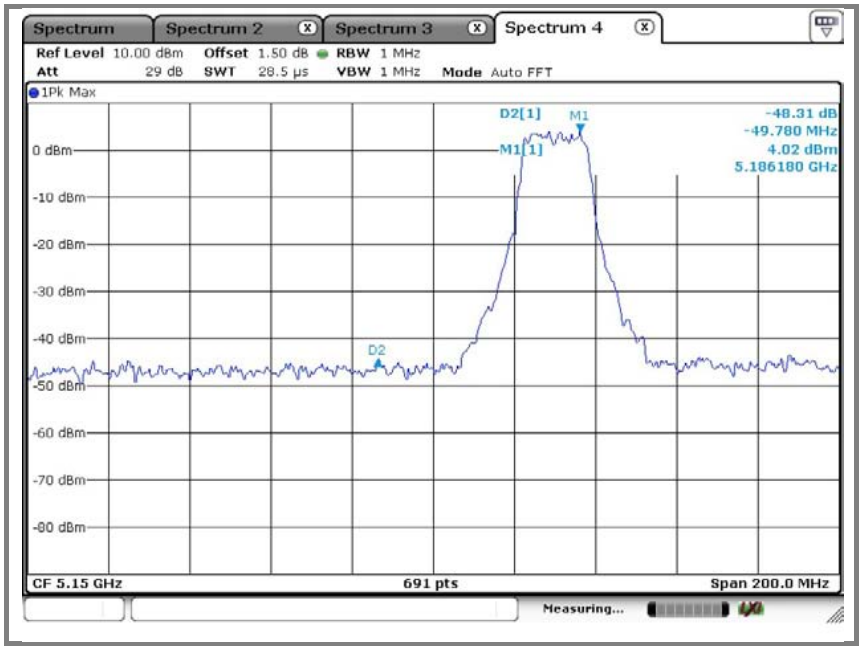
Operation mode: Normal mode (Ant 2)

A. Low channel (5 180 ㎒)

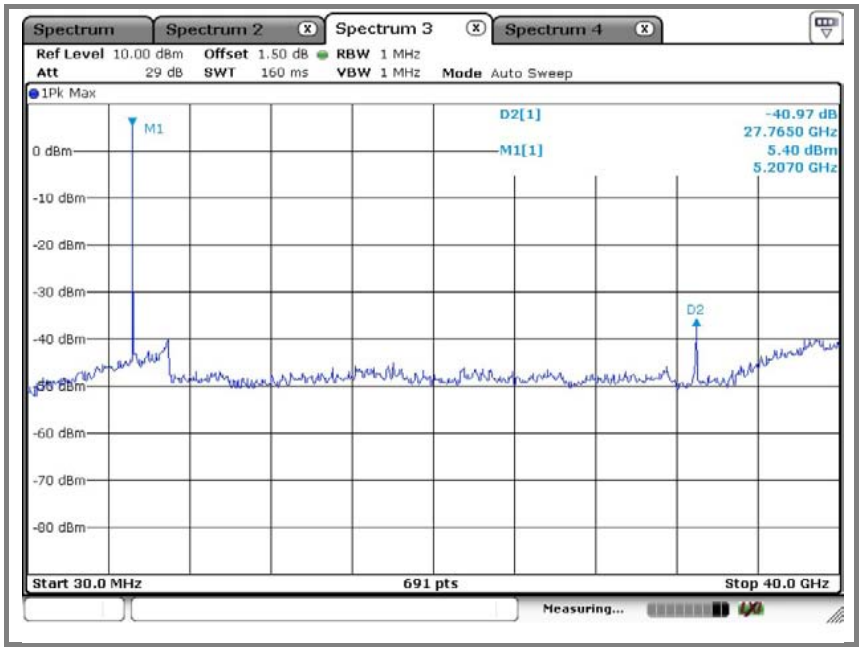
Unwanted Emission data



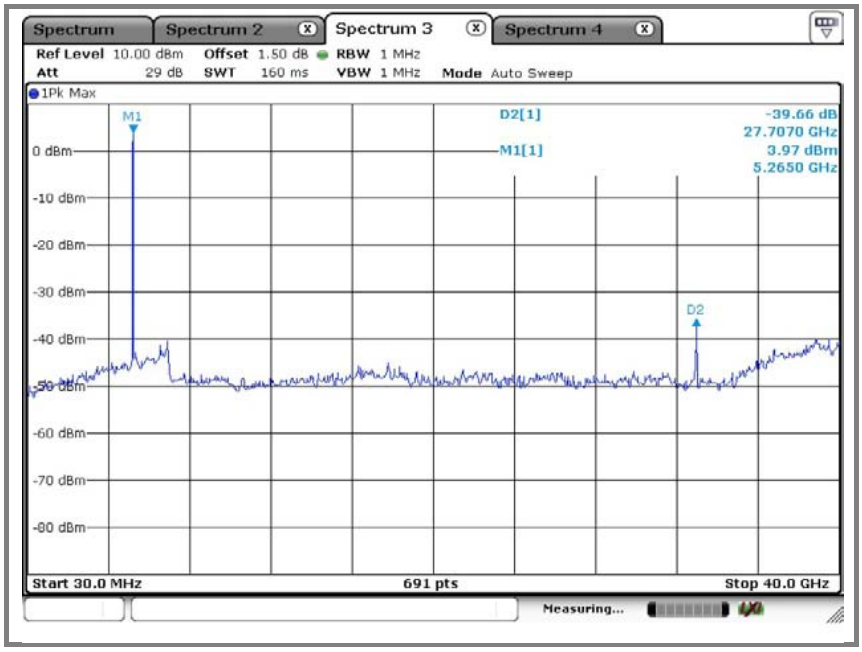
Band-edge data



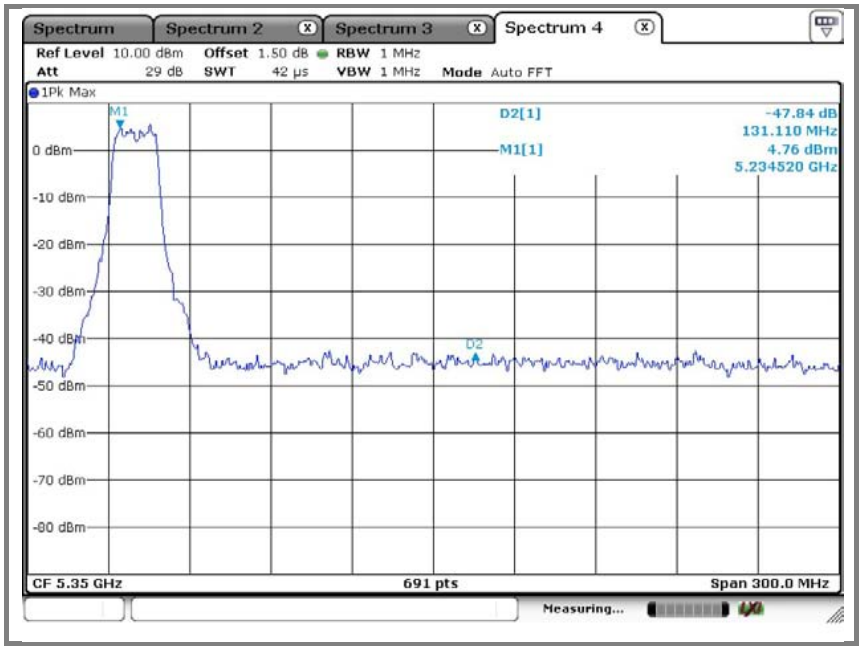
B. Middle channel (5 220 ㎒)



C. High channel (5 240 ㎒)



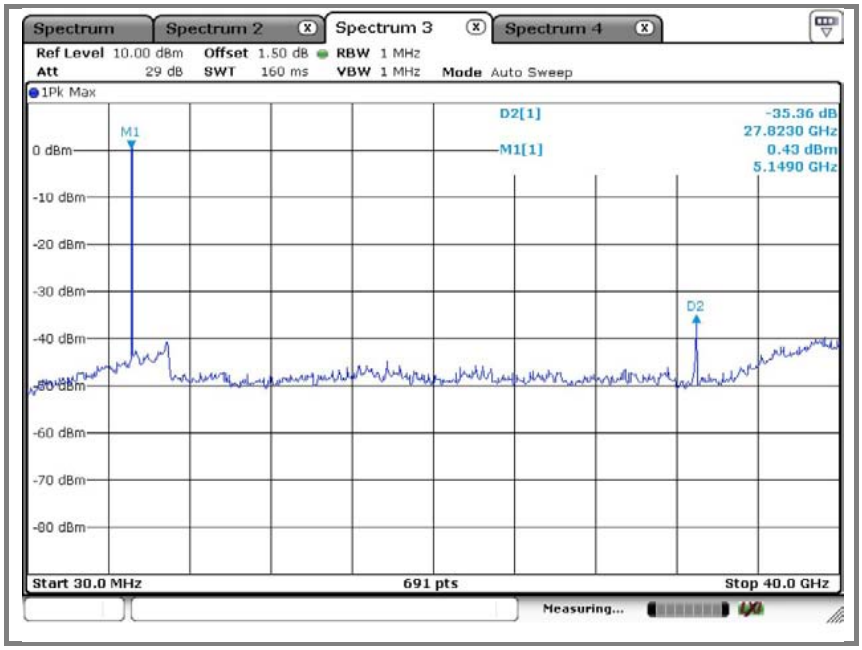
Band-edge data



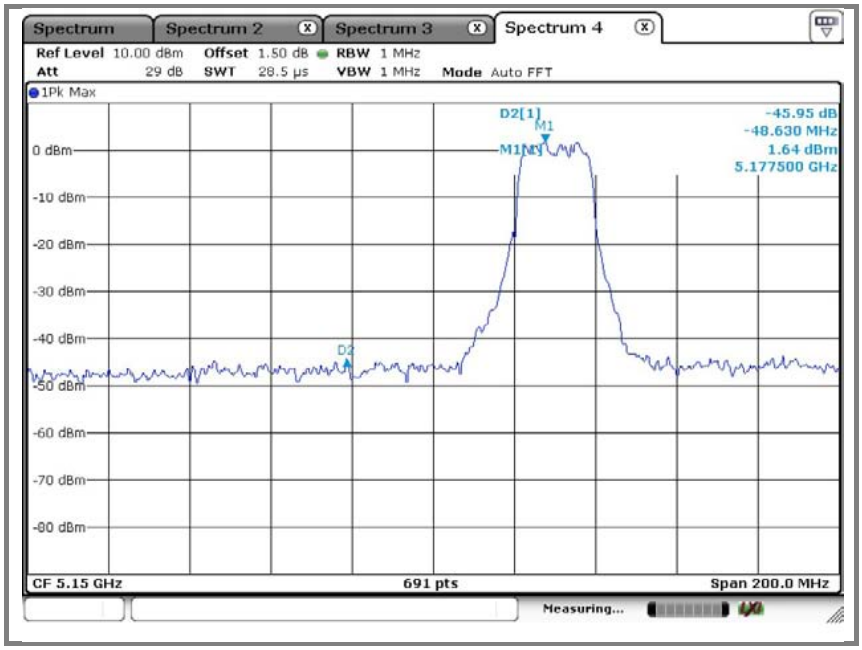
Operation mode: N_20MHz mode (MIMO)

A. Low channel (5 180 ㎒)

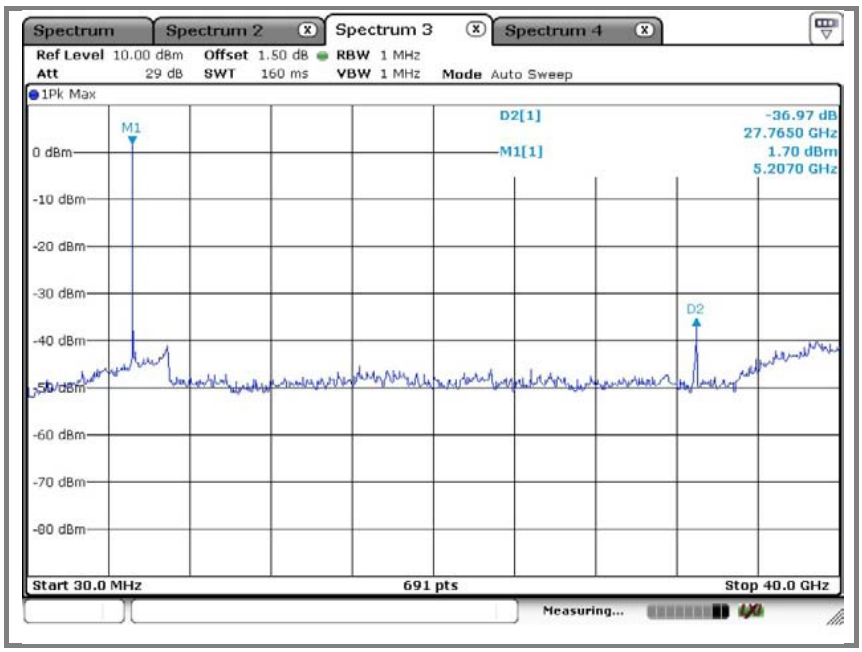
Unwanted Emission data



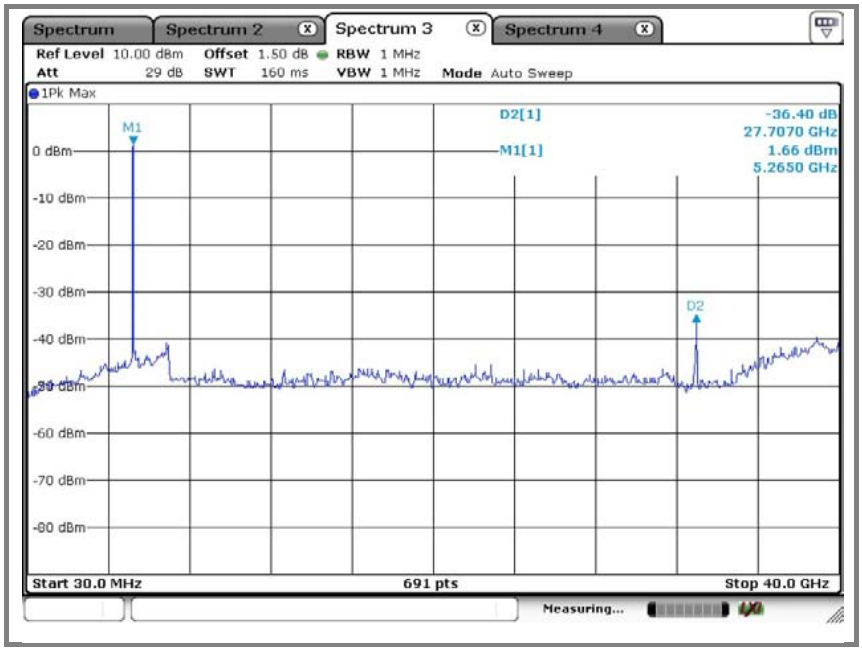
Band-edge data



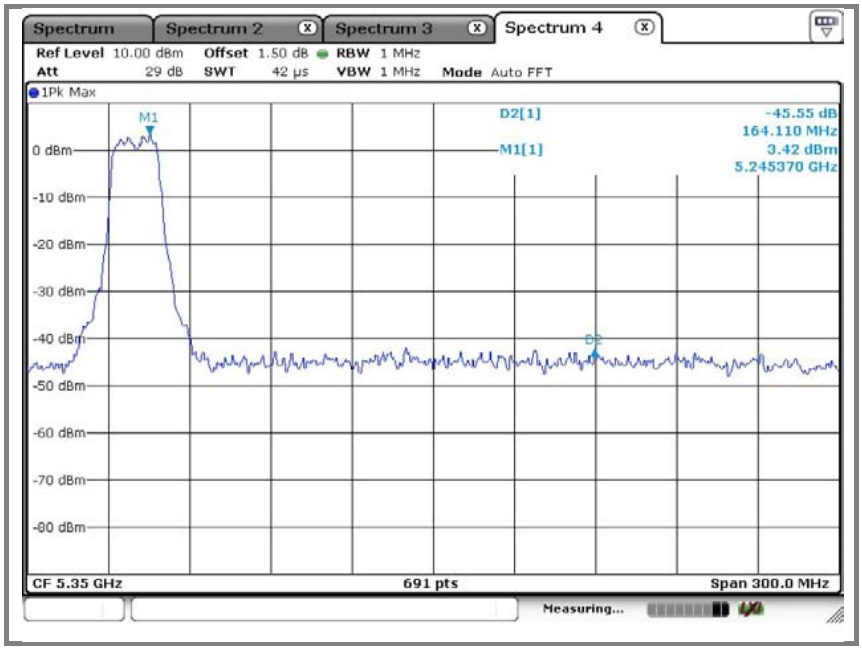
B. Middle channel (5 220 ㎒)



C. High channel (5 240 ㎒)



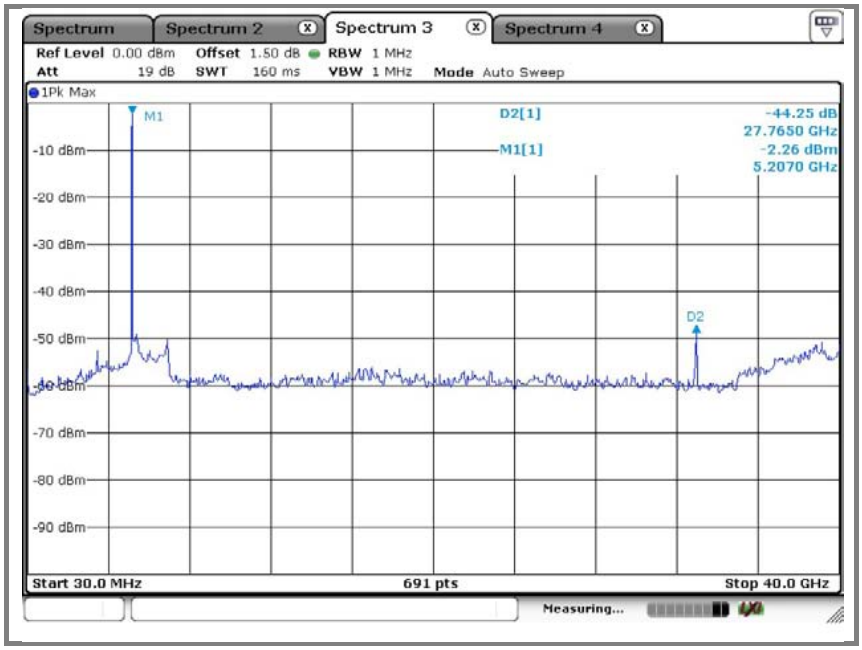
Band-edge data



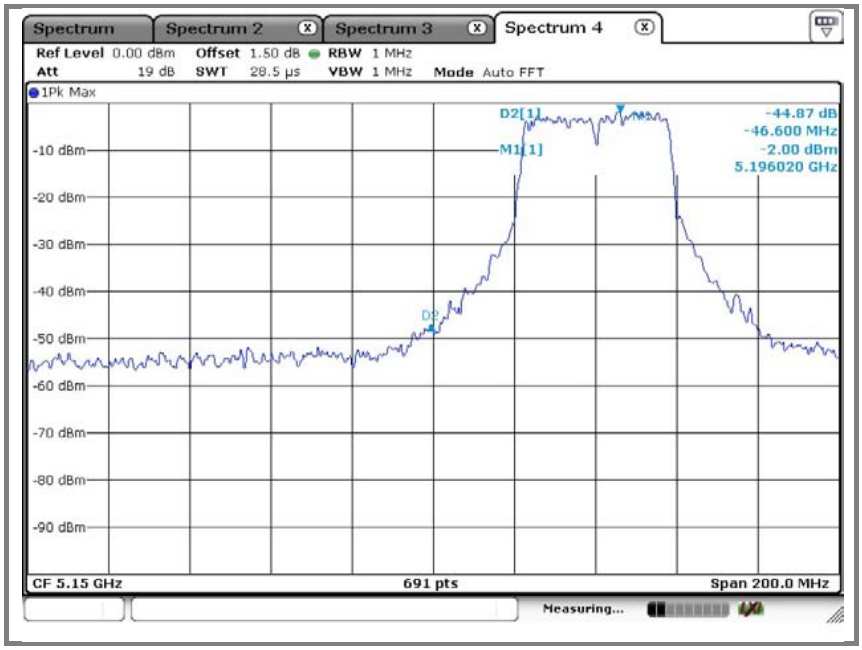
Operation mode: N_40MHz mode (MIMO)

A. Low channel (5 190 ㎒)

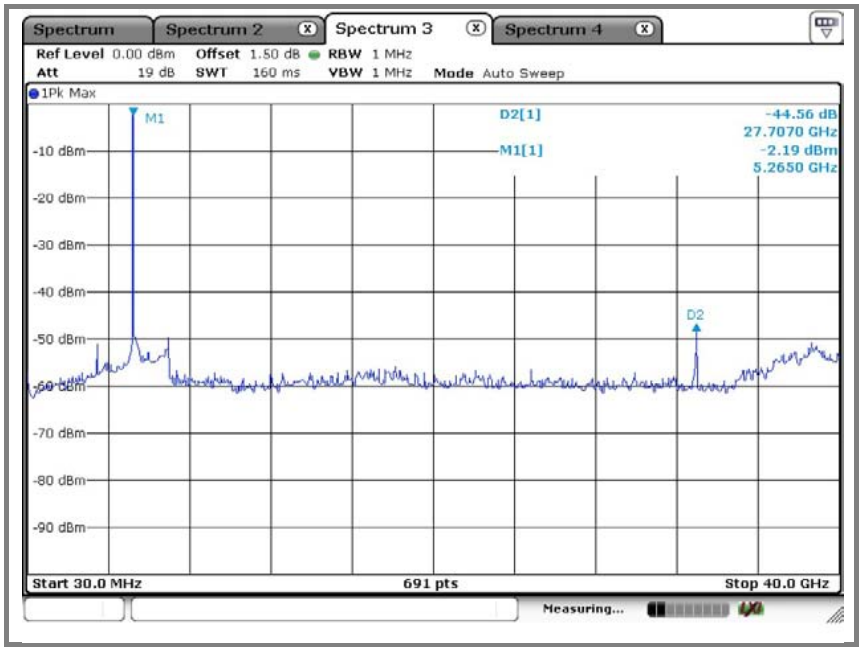
Unwanted Emission data



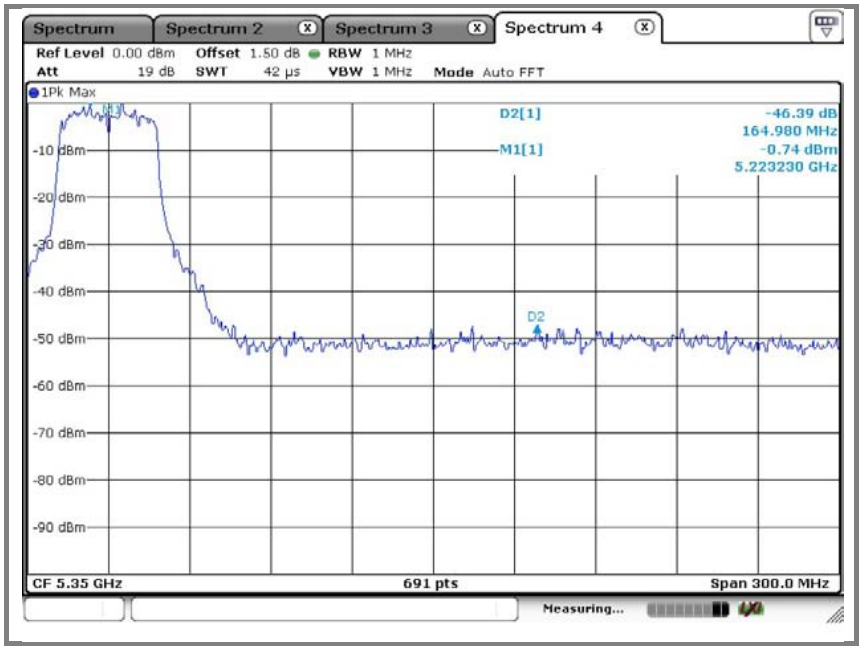
Band-edge data



B. High channel (5 230 ㎒)

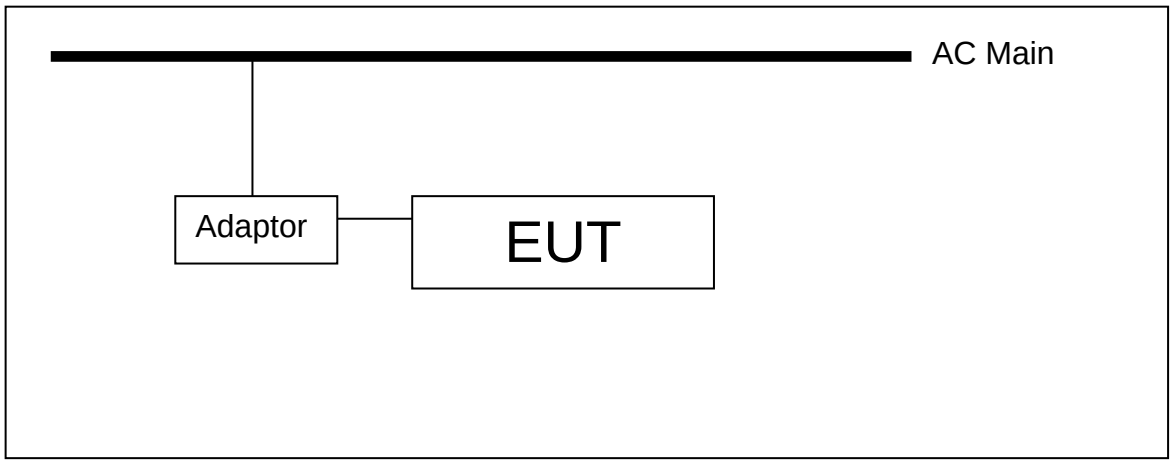


Band-edge data



4.4.6. Conducted power line test

4.4.6.1 Test setup



4.4.6.2 Limit

According to §15.107(a) for an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies, within the band 150 ㎑ to 30 ㎒, shall not exceed the limits in the following table, as measured using a 50 uH/ 50 ohm line impedance stabilization network (LISN).
Compliance with the provision of this paragraph shall on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower applies at the boundary between the frequencies ranges.

Frequency of Emission (㎒)	Conducted limit (dB㎶/m)	
	Quasi-peak	Average
0.15 – 0.50	66 - 56*	56 - 46*
0.50 – 5.00	56	46
5.00 – 30.0	60	50

※ Remark

Decreases with the logarithm of the frequency.

4.4.6.3 Test procedures

The test procedure is performed in a 6.5 m × 3.6 m × 3.6 m (L × W × H) shielded room. The EUT along with its peripherals were placed on a 1.0 m(W) × 1.5 m(L) and 0.8 m in height wooden table and the EUT was adjusted to maintain a 0.4 meter space from a vertical reference plane.
The EUT was connected to power mains through a line impedance stabilization network (LISN) which provides 50 ohm coupling impedance for measuring instrument and the chassis ground was bounded to the horizontal ground plane of shielded room. All peripherals were connected to the second LISN and the chassis ground also bounded to the horizontal ground plane of shielded room. The excess power cable between the EUT and the LISN was bundled. The power cables of peripherals were unbundled. All connecting cables of EUT and peripherals were moved to find the maximum emission.

4.4.6.4 Test results

Ambient temperature: 23 ℃
Relative humidity: 42 % R.H.

Frequency range: 0.15 ㎒ ~ 30 ㎒
Measured bandwidth: 9 ㎑

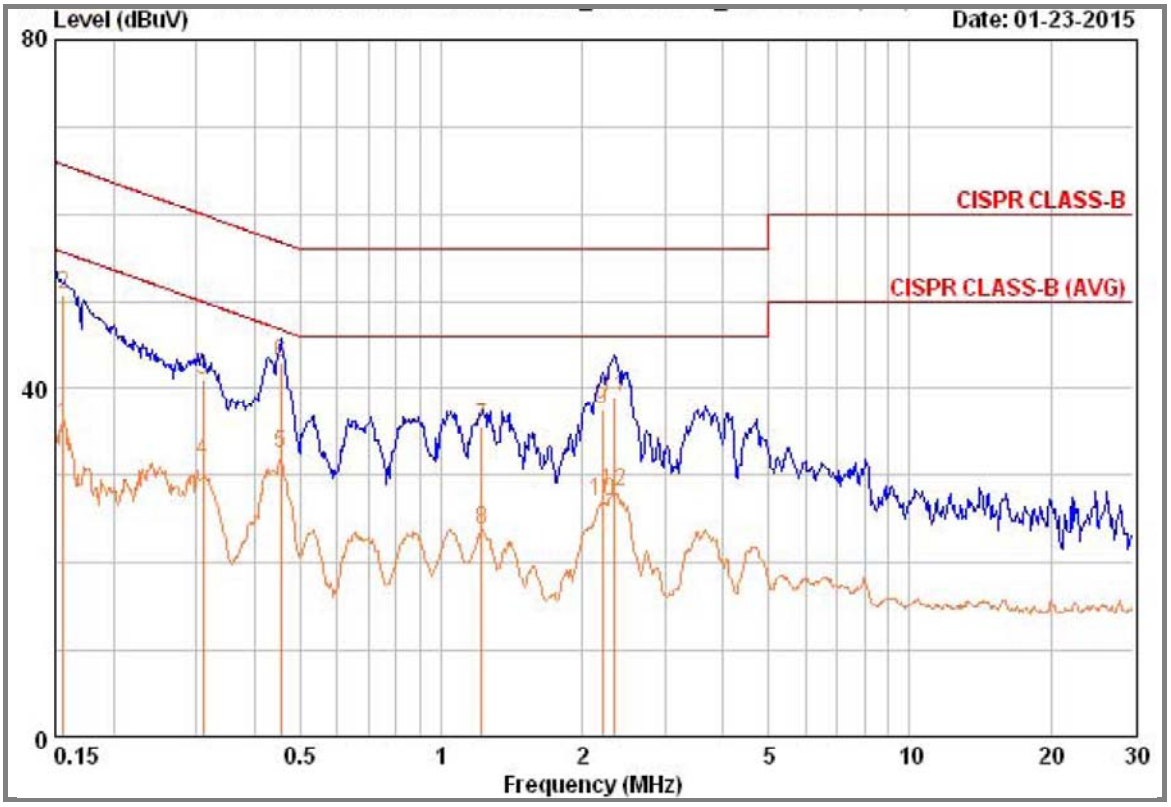
Freq. (㎒)	Line	Q-Peak		
		Level(dB㎶/m)	Limit(dB㎶/m)	Margin(dB)
0.155	N	49.76	65.73	15.97
0.156	H	50.76	65.67	14.92
0.451	N	38.54	56.86	18.32
0.454	H	42.93	56.80	13.87
2.212	H	37.43	56.00	18.57
2.346	H	38.94	56.00	17.06

Freq. (㎒)	Line	Average		
		Level(dB㎶/m)	Limit(dB㎶/m)	Margin(dB)
0.310	H	31.61	49.97	18.36
0.451	N	32.04	46.86	14.82
0.454	H	32.43	46.80	14.37
2.212	H	27.13	46.00	18.87
2.346	H	28.04	46.00	17.96
2.357	N	27.85	46.00	18.15

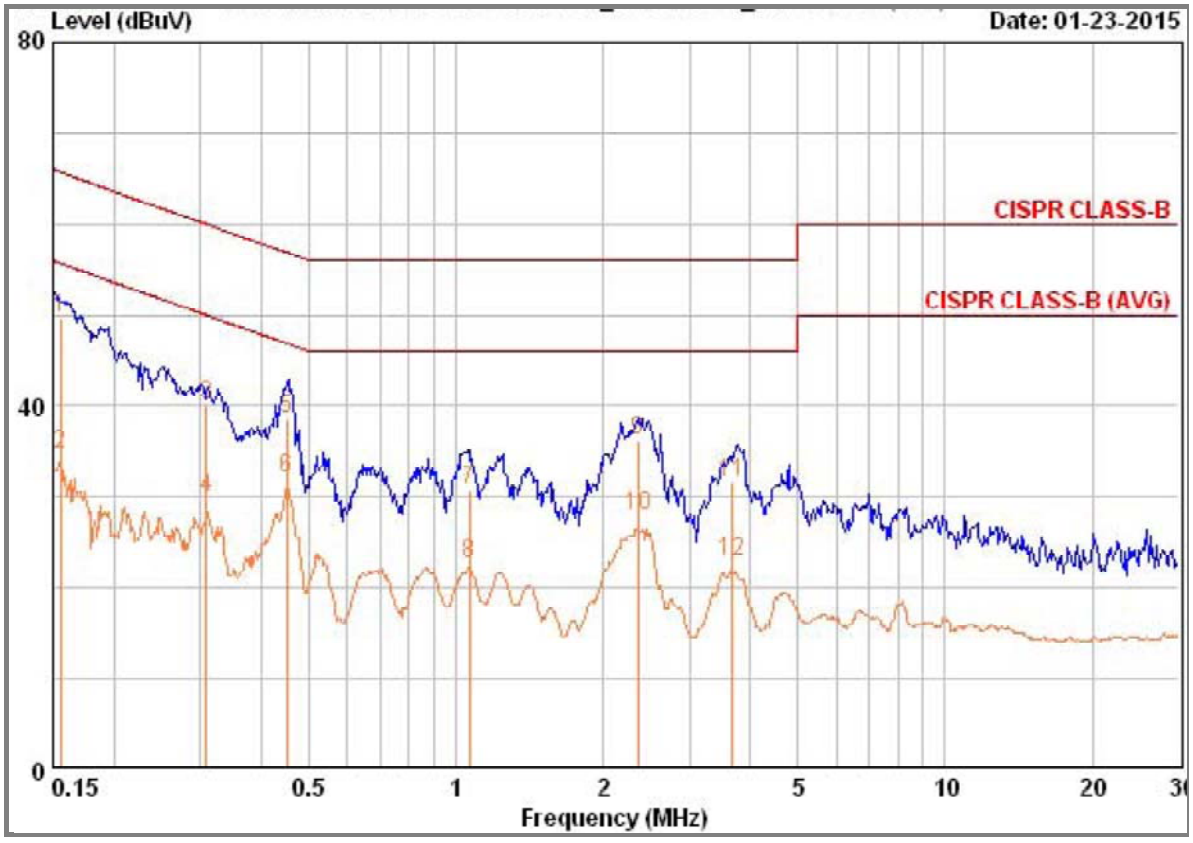
※ Remark
Line(H): Hot
Line(N): Neutral

Plot of conducted power line

Test mode: Hot

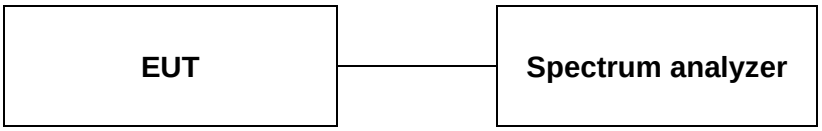


Test mode: Neutral



5. 26 dB and 99% bandwidth

5.1. Test setup



5.2. Limit
Not applicable

5.3. Test procedure (KDB 789033)
1. The signal analyzer's automatic bandwidth measurement capability was used to per Form the 26dB bandwidth measurement. The "X" dB bandwidth parameter was set to X = 26. The automatic bandwidth measurement function also has the capability of Stimultaneously measuring the 99% occupied bandwidth. The bandwidth measurement Was not influenced by any intermediate power nulls in the fundamental emission.
2. Set the spectrum analyzer as,
   RBW = approximately 1% of the emission bandwidth
   VBW > RBW
   Detector = Peak
   Trace mode = max hold
3. Repeat until all the rest channels are investigated.

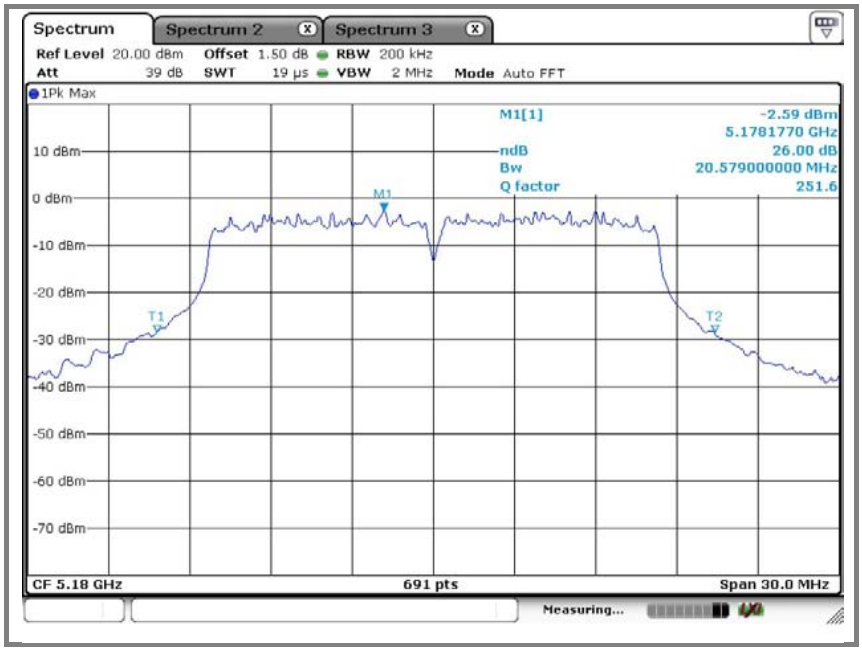
5.4. Test results

Ambient temperature: 22 ℃
Relative humidity: 40 % R.H.

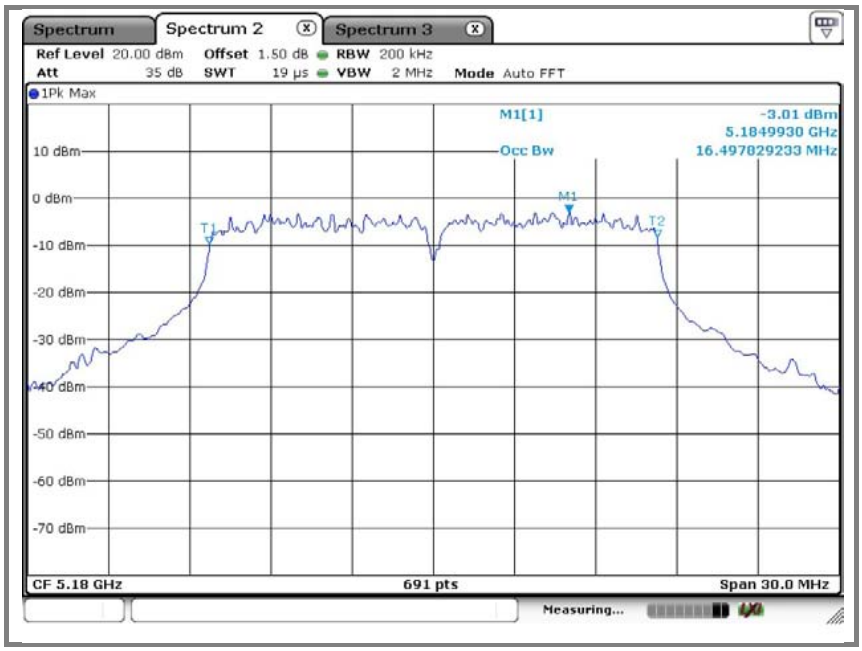
Mode	Frequency(㎒)	26 dB bandwidth(㎒)	99% bandwidth(㎒)
Normal (Ant 1)	5 180	20.58	16.50
	5 220	21.06	16.54
	5 240	20.06	16.54
Normal (Ant 2)	5 180	20.36	16.45
	5 220	20.71	16.45
	5 240	20.23	16.50
N_20㎒ (MIMO)	5 180	21.01	17.63
	5 220	20.49	17.58
	5 240	21.71	17.67
N_40㎒ (MIMO)	5 190	42.33	36.18
	5 230	41.90	36.11

Operation mode: Normal mode (Ant 1)

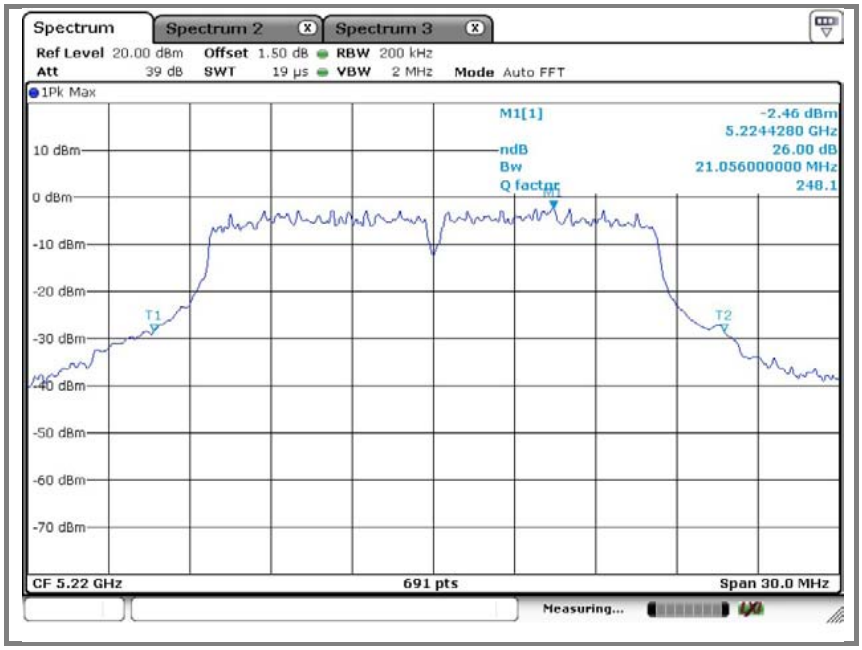
A. Low channel (5 180 ㎒) - 26 ㏈ bandwidth



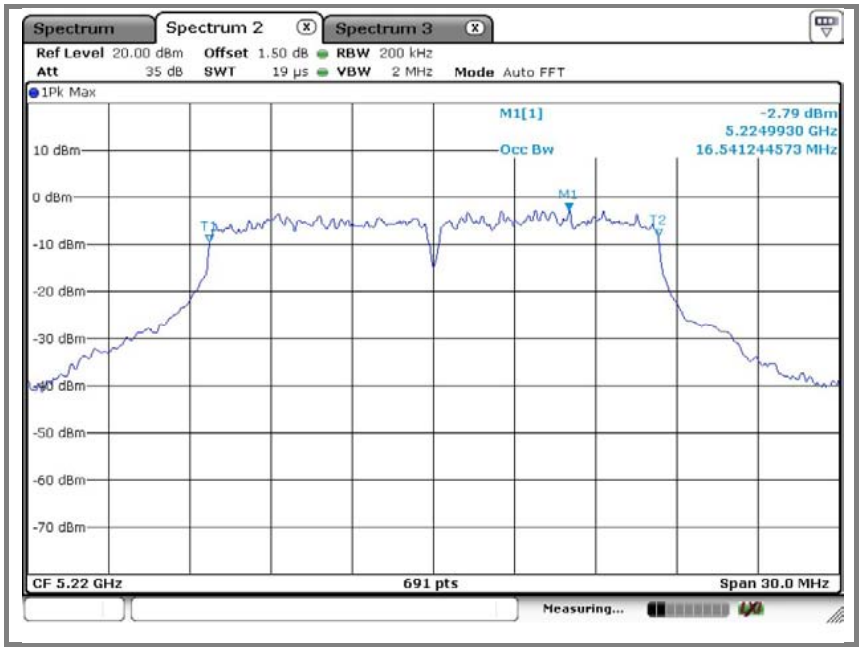
A. Low channel (5 180 ㎒) – 99% bandwidth



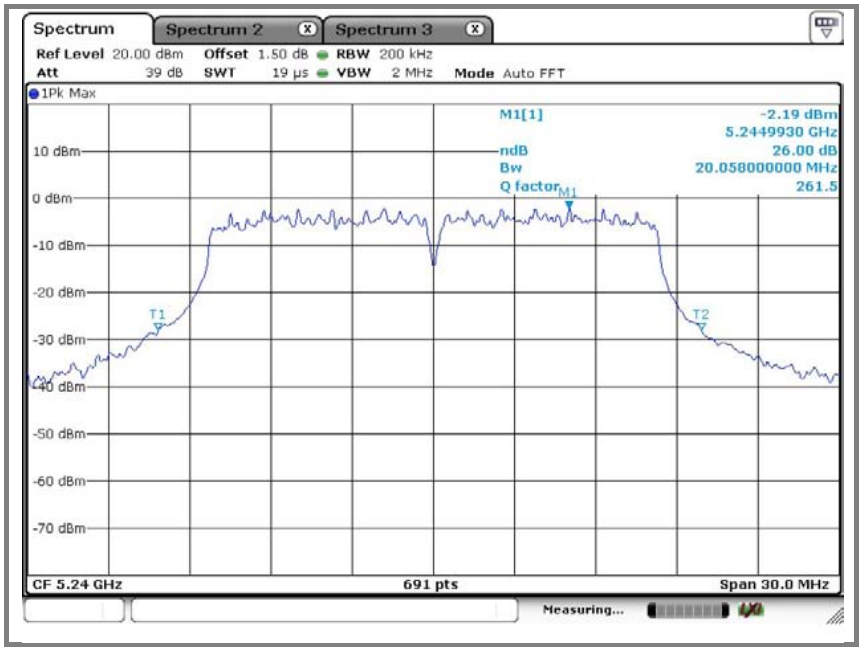
B. Middle channel (5 220 ㎒) - 26 ㏈ bandwidth



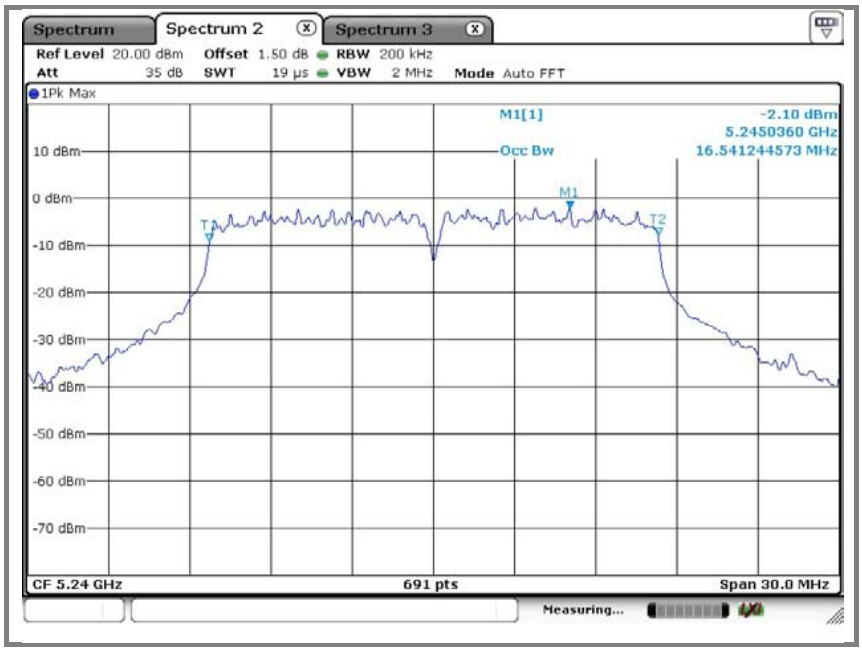
B. Middle channel (5 220 ㎒) – 99% bandwidth



C. High channel (5 240 ㎒) - 26 ㏈ bandwidth

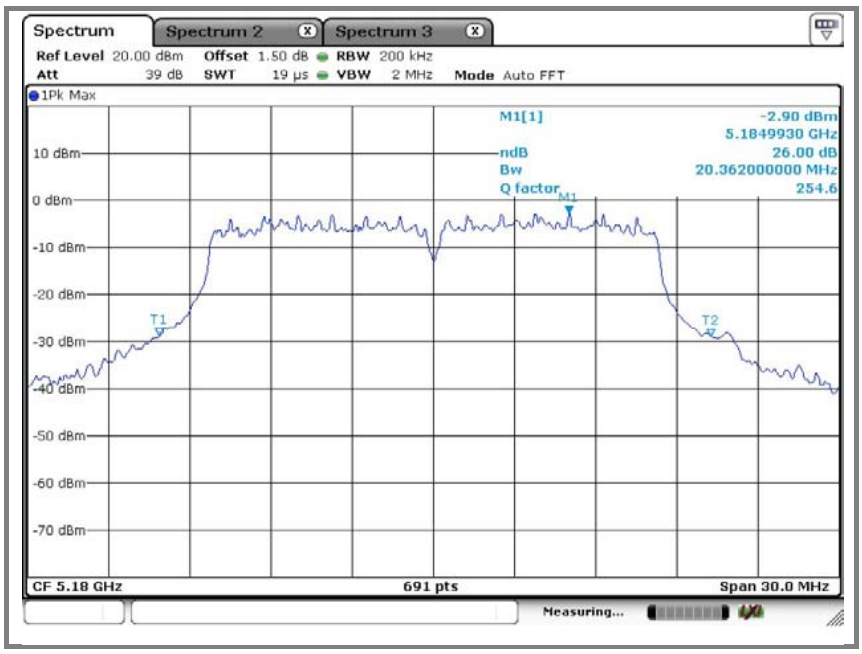


C. High channel (5 240 ㎒) – 99% bandwidth

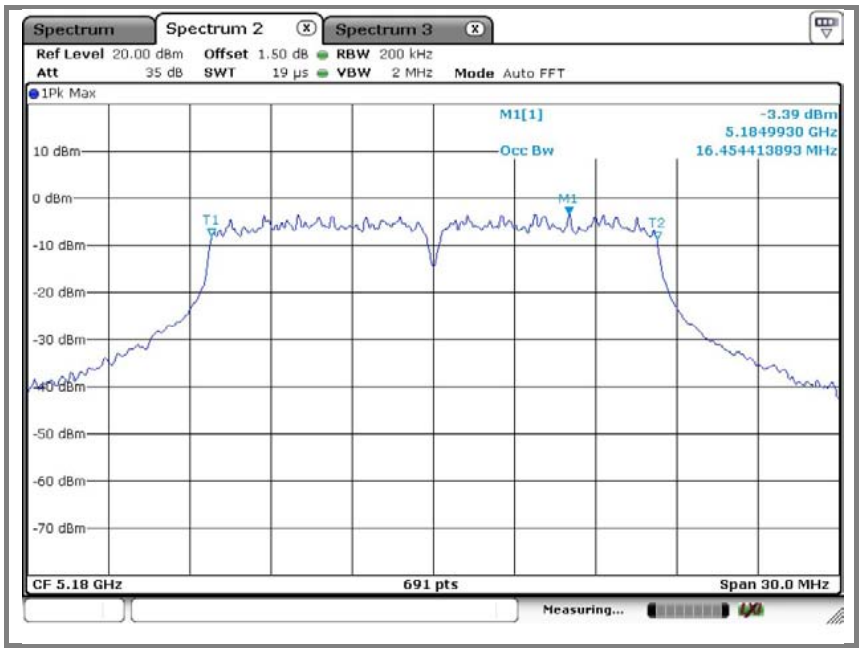


Operation mode: Normal mode (Ant 2)

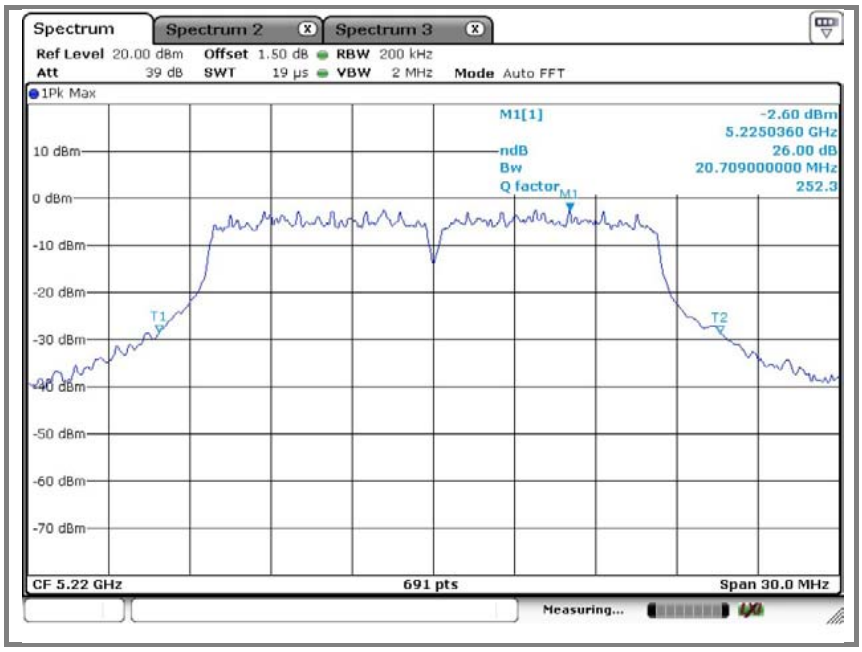
A. Low channel (5 180 ㎒) - 26 ㏈ bandwidth



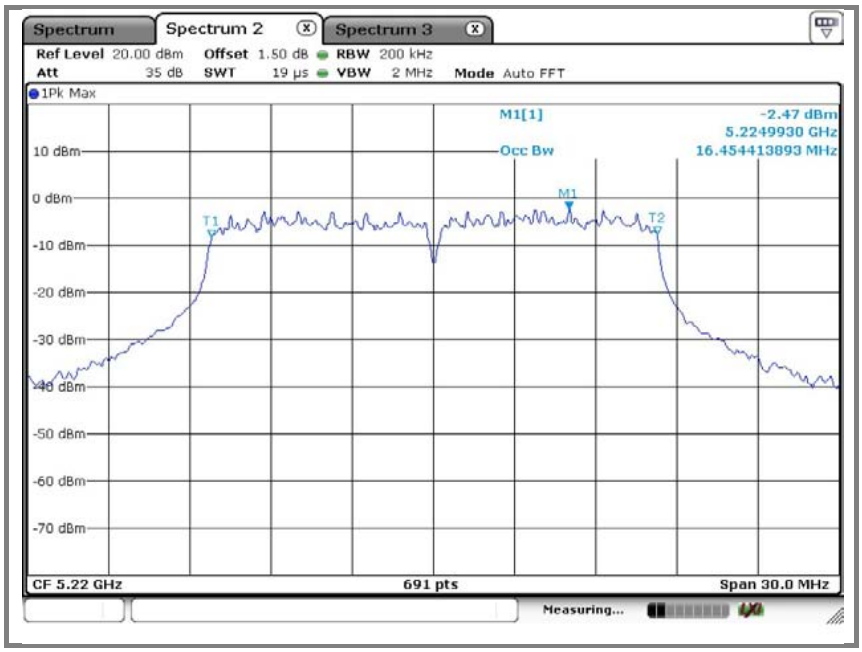
A. Low channel (5 180 ㎒) – 99% bandwidth



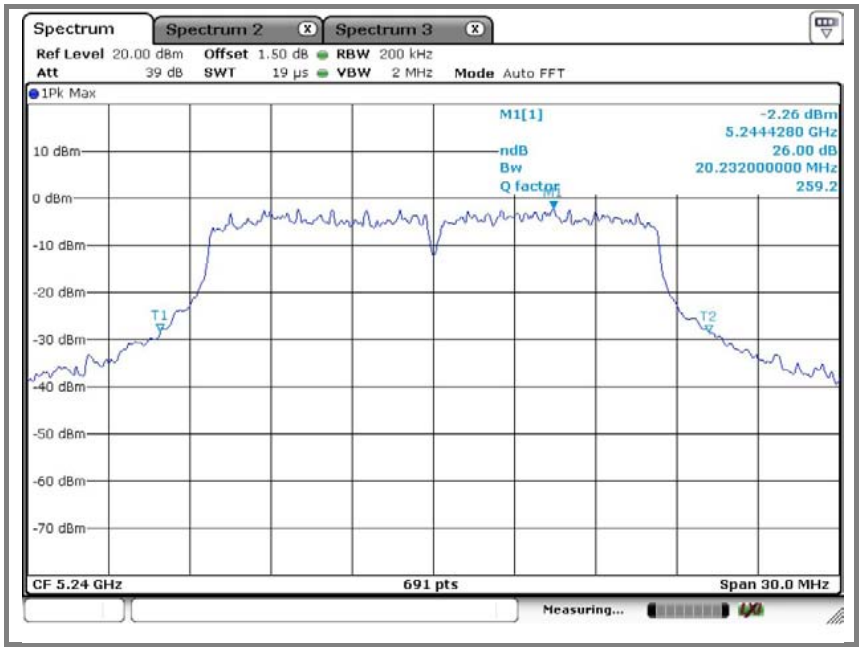
B. Middle channel (5 220 ㎒) - 26 ㏈ bandwidth



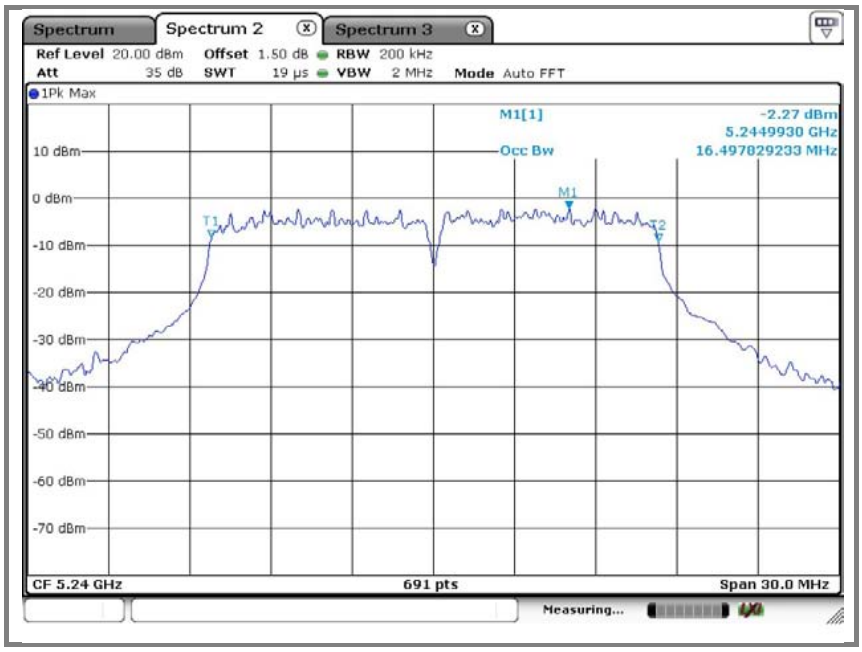
B. Middle channel (5 220 ㎒) – 99% bandwidth



C. High channel (5 240 ㎒) - 26 ㏈ bandwidth

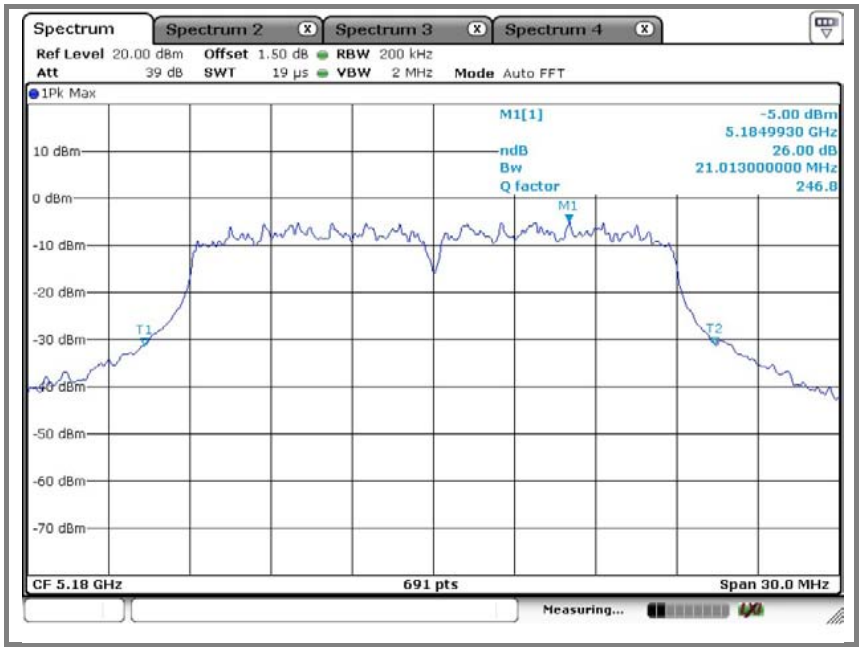


C. High channel (5 240 ㎒) – 99% bandwidth

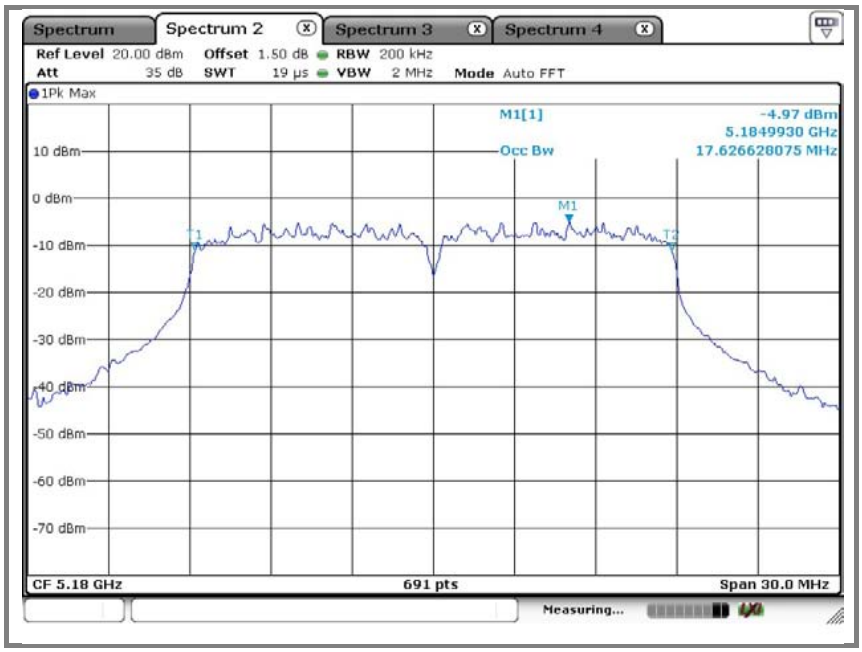


Operation mode: N_20MHz mode (MIMO)

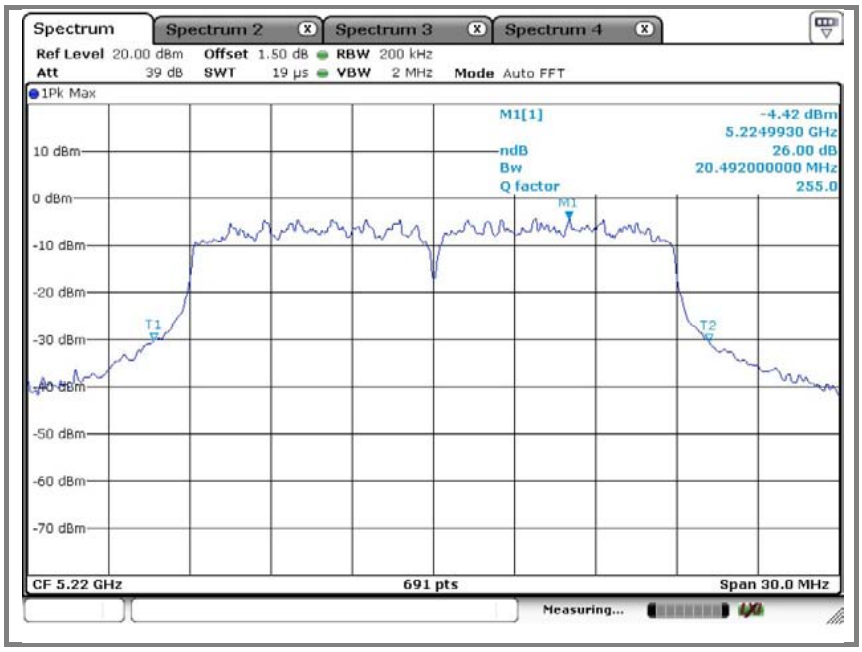
A. Low channel (5 180 ㎒) - 26 ㏈ bandwidth



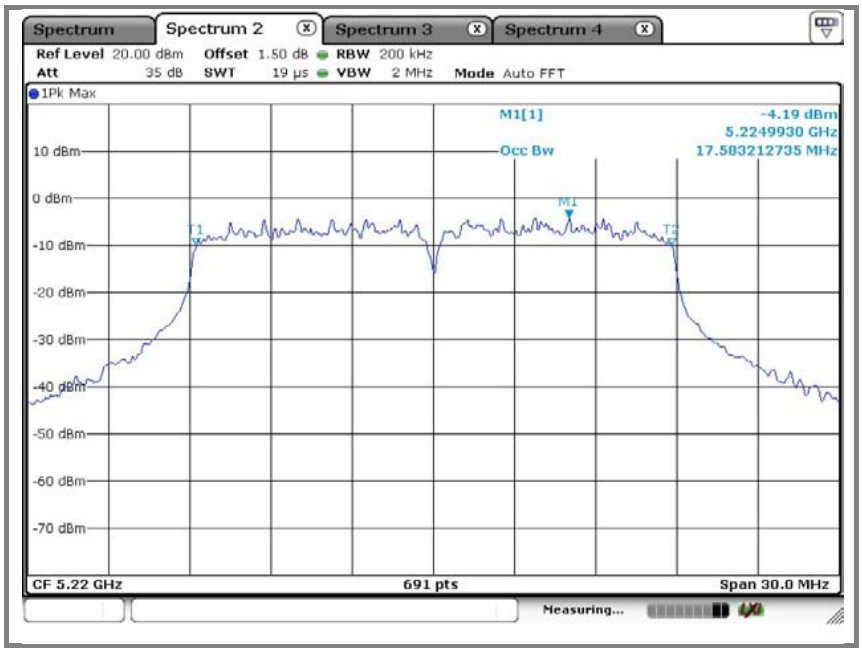
A. Low channel (5 180 ㎒) – 99% bandwidth



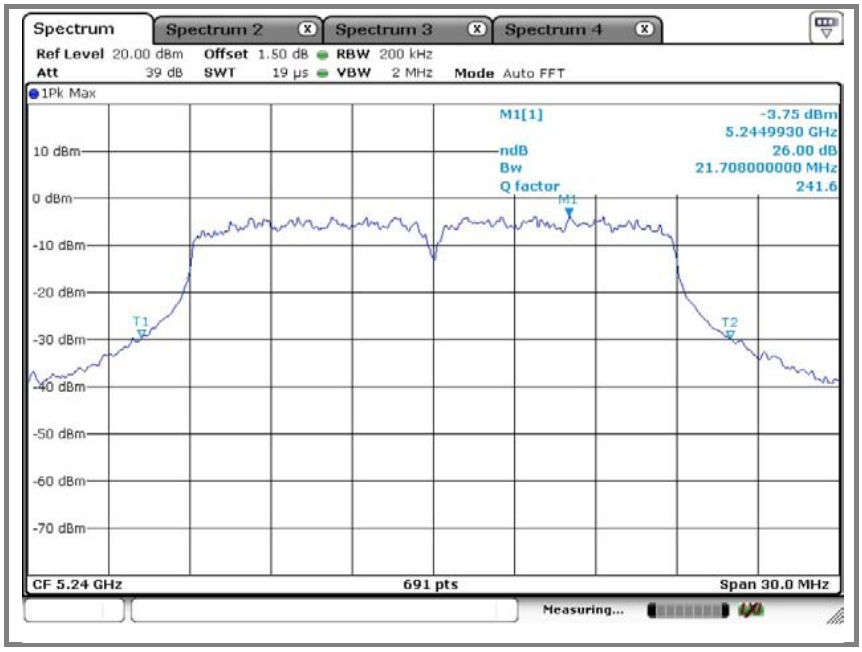
B. Middle channel (5 220 ㎒) - 26 ㏈ bandwidth



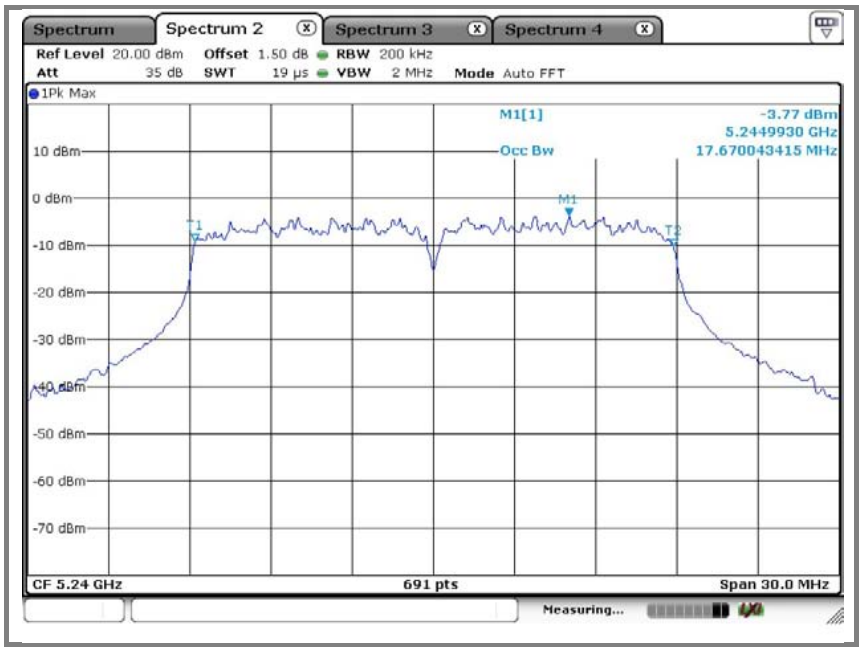
B. Middle channel (5 220 ㎒) – 99% bandwidth



C. High channel (5 240 ㎒) - 26 ㏈ bandwidth

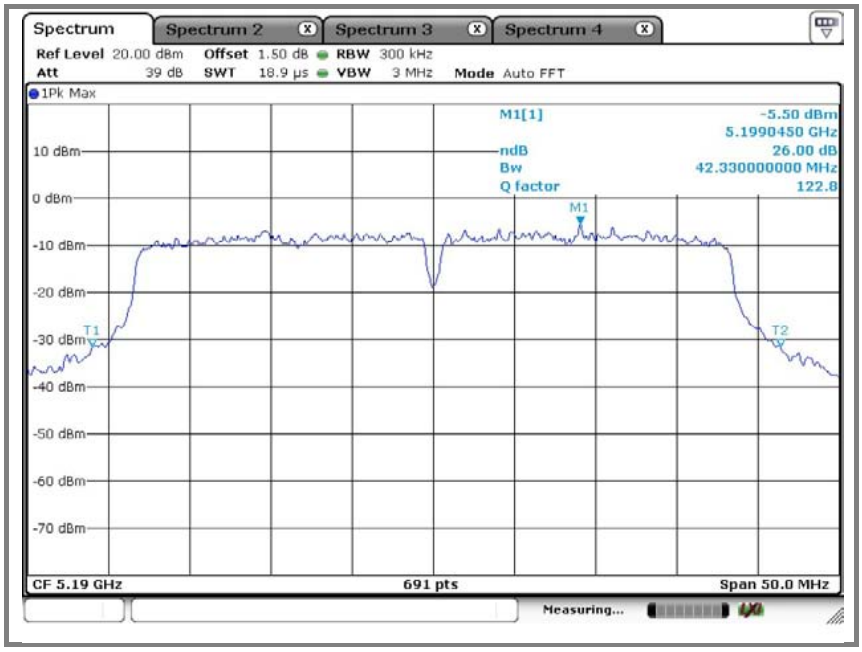


C. High channel (5 240 ㎒) – 99% bandwidth

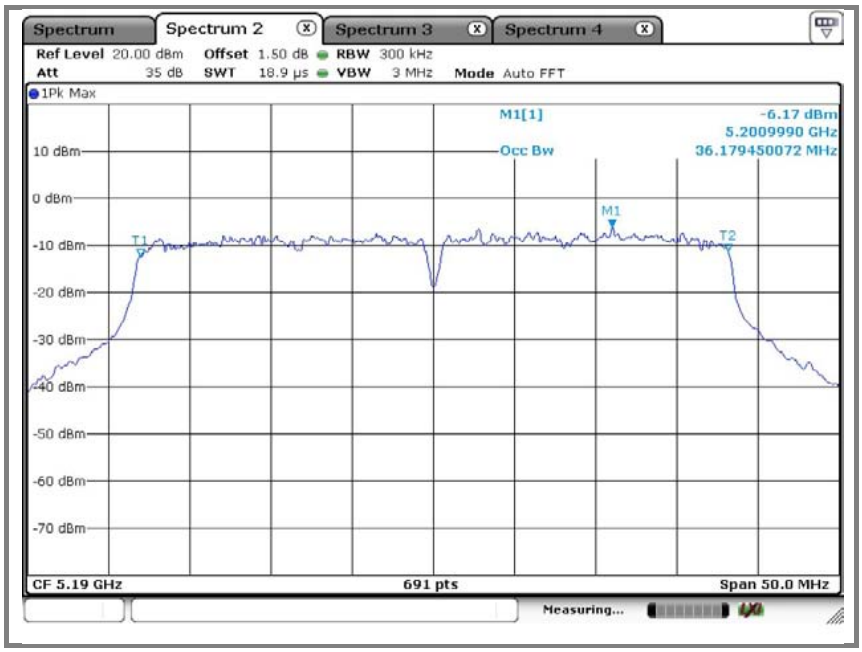


Operation mode: N_40MHz mode (MIMO)

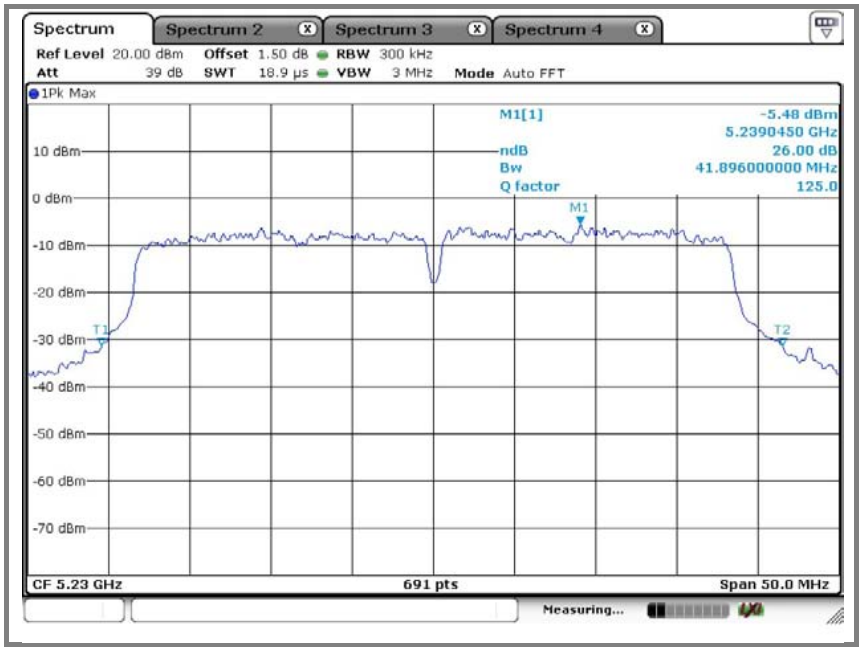
A. Low channel (5 190 ㎒) - 26 ㏈ bandwidth



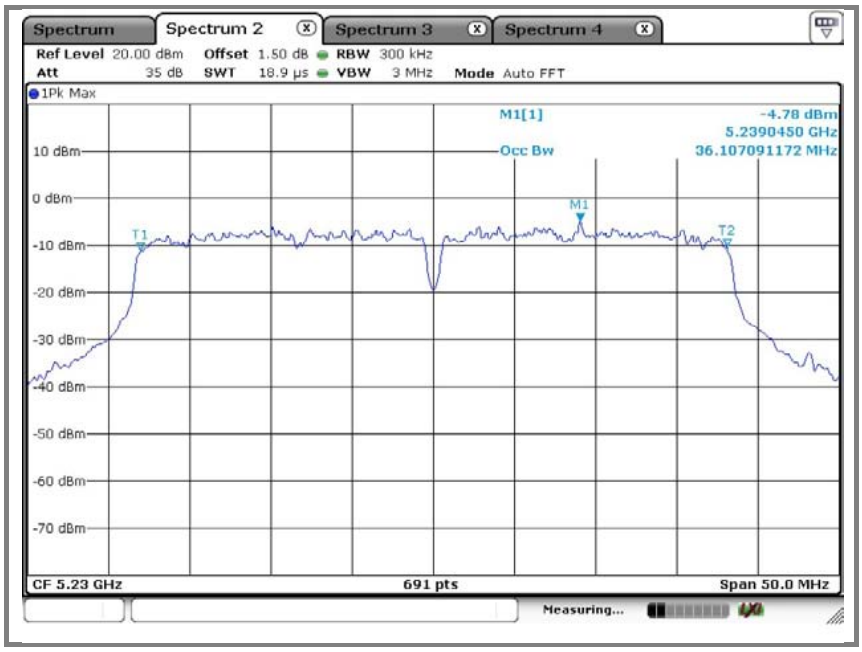
A. Low channel (5 190 ㎒) – 99% bandwidth



B. High channel (5 230 ㎒) - 26 ㏈ bandwidth

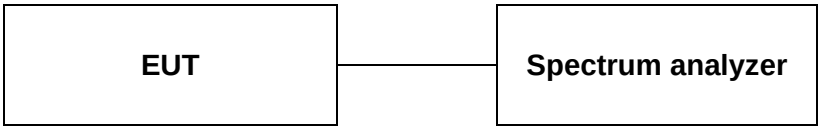


B. High channel (5 230 ㎒) – 99% bandwidth



6. Output power

6.1. Test setup.



6.2. Limit

For the 5.15-5.25 ㎓ band, the maximum conducted output power over the frequency band of operation shall not exceed the lesser of 50 ㎽ or 4 ㏈m + 10 log B, where B is the 26 ㏈ emission bandwidth in ㎒. If transmitting antennas of directional gain greater than 6 ㏈i are used, both the peak transmit power and the peak power spectral density shall be reduced by the amount in ㏈ that the directional gain of the antenna exceeds 6 ㏈i.

6.3. Test procedure (KDB 789033)

1. Place the EUT on the table and set it in the transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the Spectrum analyzer as RBW = 1 ㎒, VBW ≥ 3 ㎒, Span = Auto, Channel BW = 26 ㏈ bandwidth, Number of points in sweep ≥ 2 span / RBW, Detector = RMS(power averaging)

6.4. Test results

Ambient temperature: 22 ℃
Relative humidity: 40 % R.H.

Limit

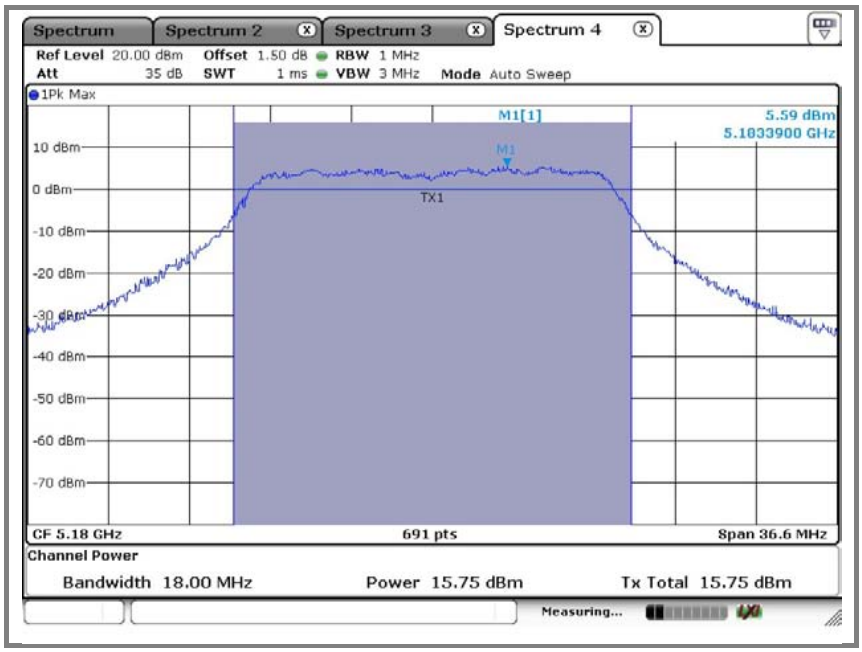
Mode	Frequency (㎒)	Fixed Limit (㏈m)	B (㎒)	4+10LogB (㏈m)	Antenna gain (㏈i)	Limit (㏈m)
Normal (Ant1)	5 180	17	20.58	17.13	3.11	18
	5 220	17	21.06	17.23		
	5 240	17	20.06	17.02		
Normal (Ant2)	5 180	17	20.36	17.09		18
	5 220	17	20.71	17.16		
	5 240	17	20.23	17.06		
N_20MHz (MIMO)	5 180	17	21.01	17.22		18
	5 220	17	20.49	17.12		
	5 240	17	21.71	17.37		
N_40MHz (MIMO)	5 190	17	42.33	20.27		21
	5 230	17	41.90	20.22		

Result

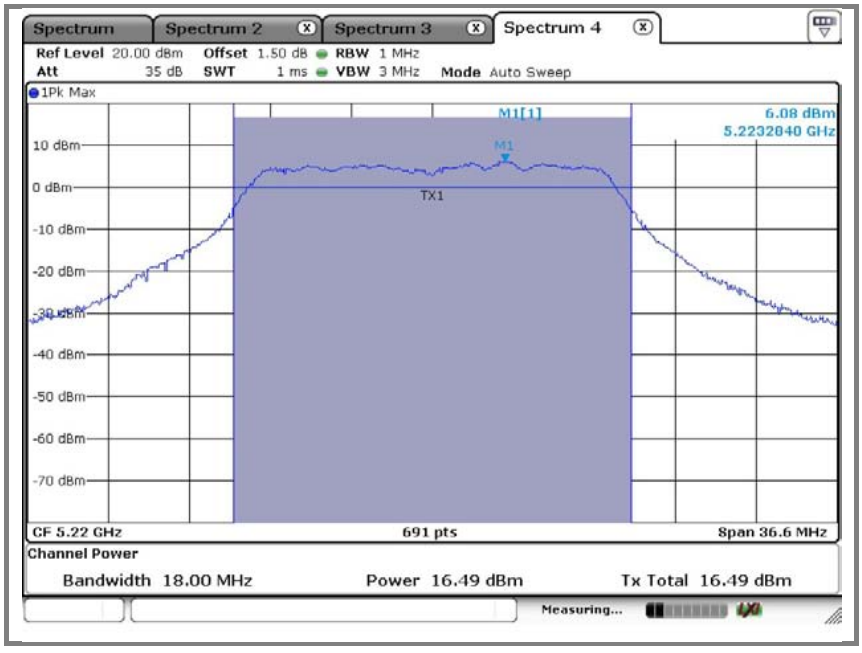
Mode	Frequency (㎒)	Output power (㏈m)	Limit (㏈m)
Normal (Ant1)	5 180	15.75	18
	5 220	16.49	
	5 240	16.78	
Normal (Ant2)	5 180	15.89	18
	5 220	16.47	
	5 240	16.77	
N_20MHz (MIMO)	5 180	13.55	18
	5 220	14.29	
	5 240	14.58	
N_40MHz (MIMO)	5 190	13.60	21
	5 230	13.94	

Operation mode: Normal mode (Ant 1)

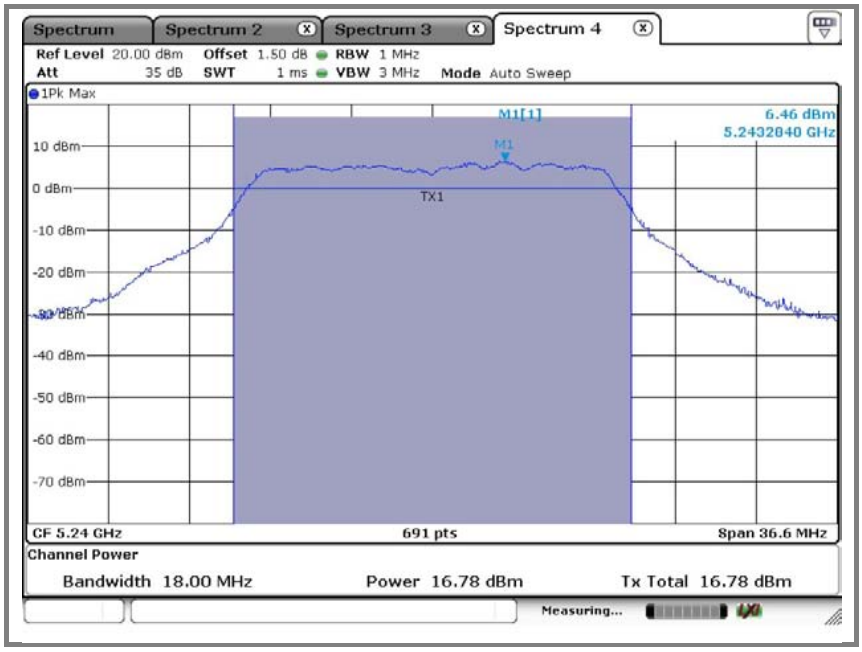
A. Low channel (5 180 ㎒)



B. Middle channel (5 220 ㎒)

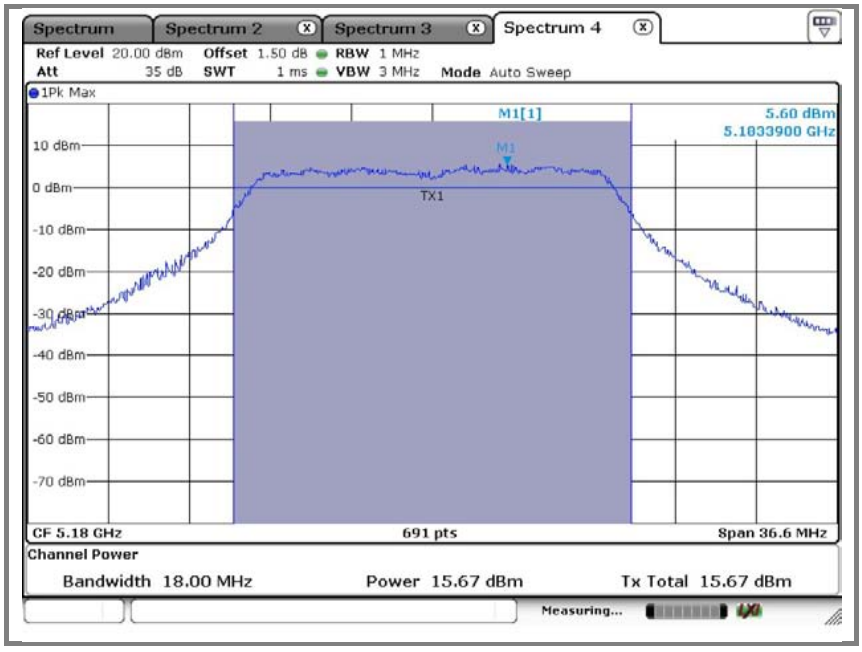


C. High channel (5 240 ㎒)

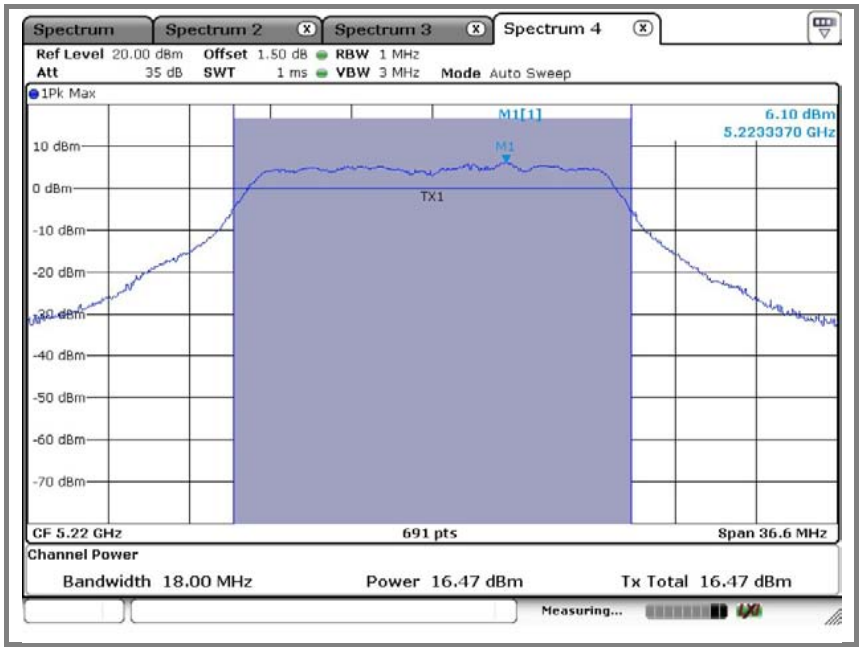


Operation mode: Normal mode (Ant 2)

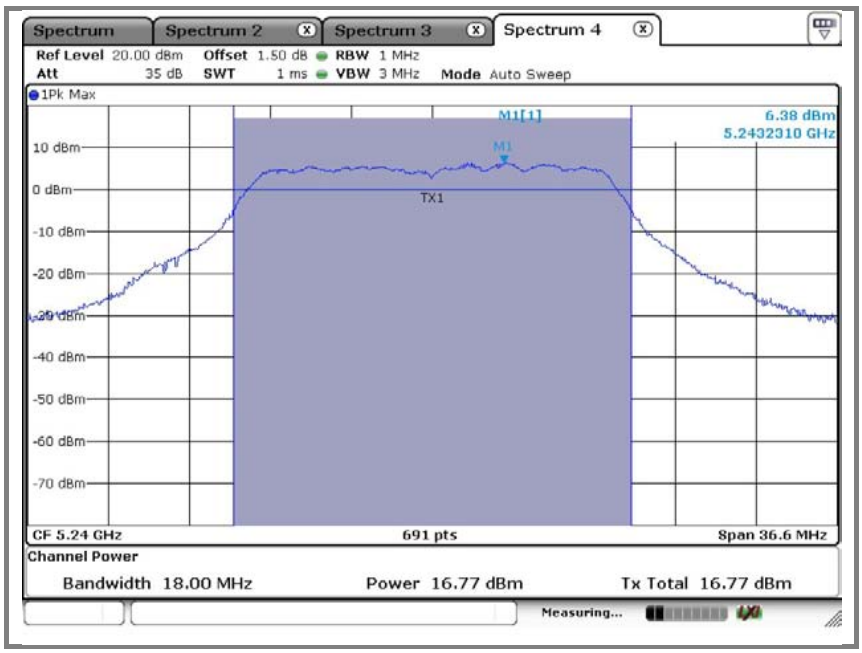
A. Low channel (5 180 ㎒)



B. Middle channel (5 220 ㎒)

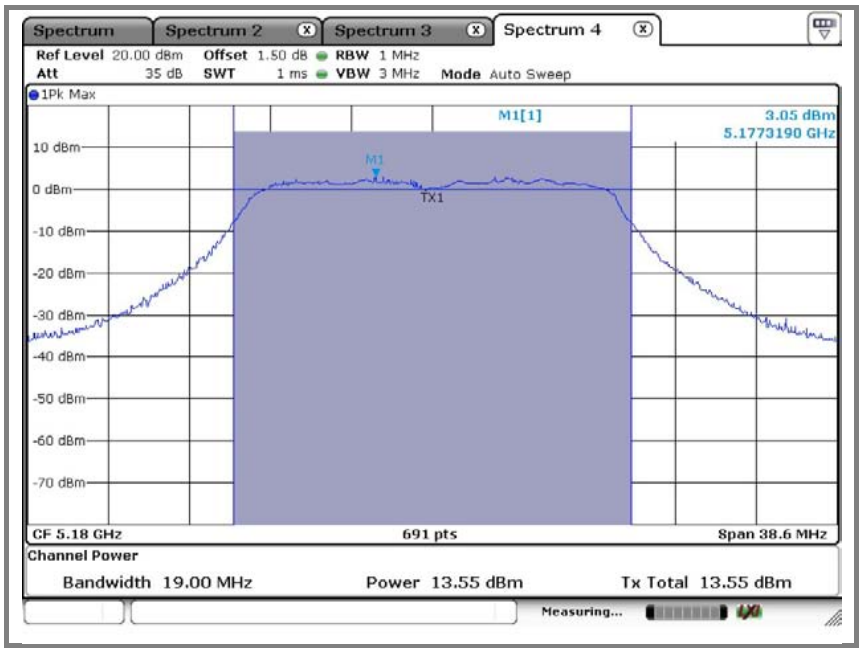


C. High channel (5 240 ㎒)

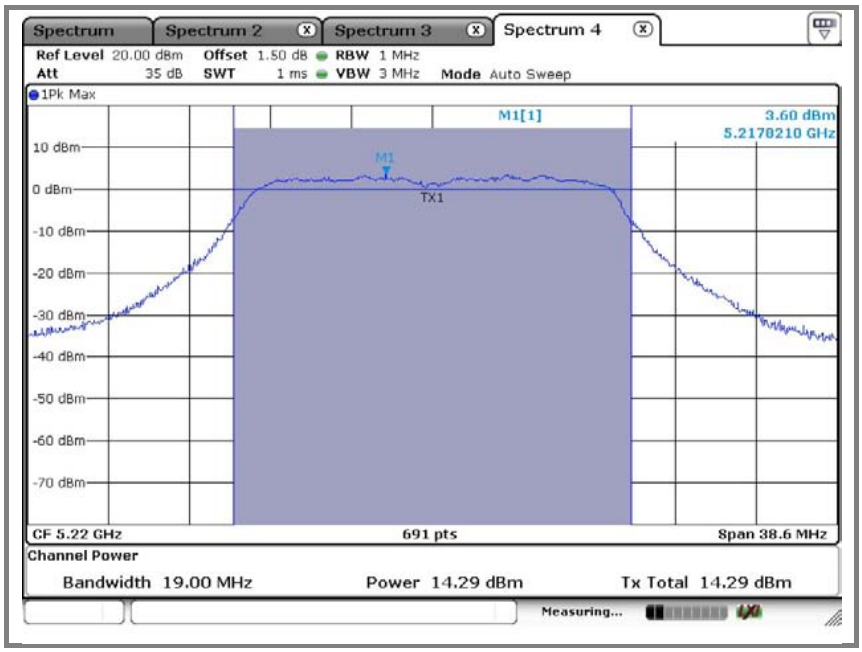


Operation mode: N_20MHz mode (MIMO)

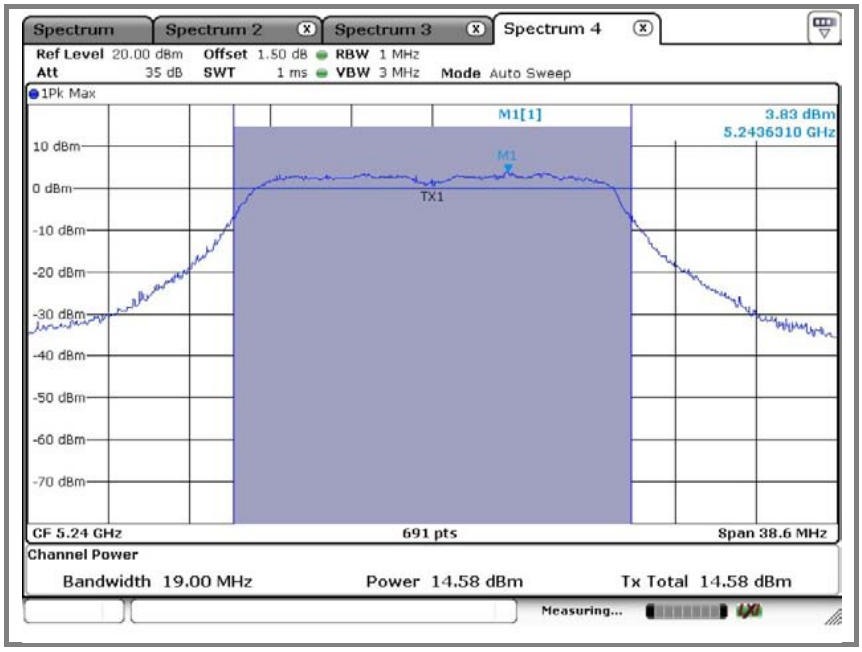
A. Low channel (5 180 ㎒)



B. Middle channel (5 220 ㎒)

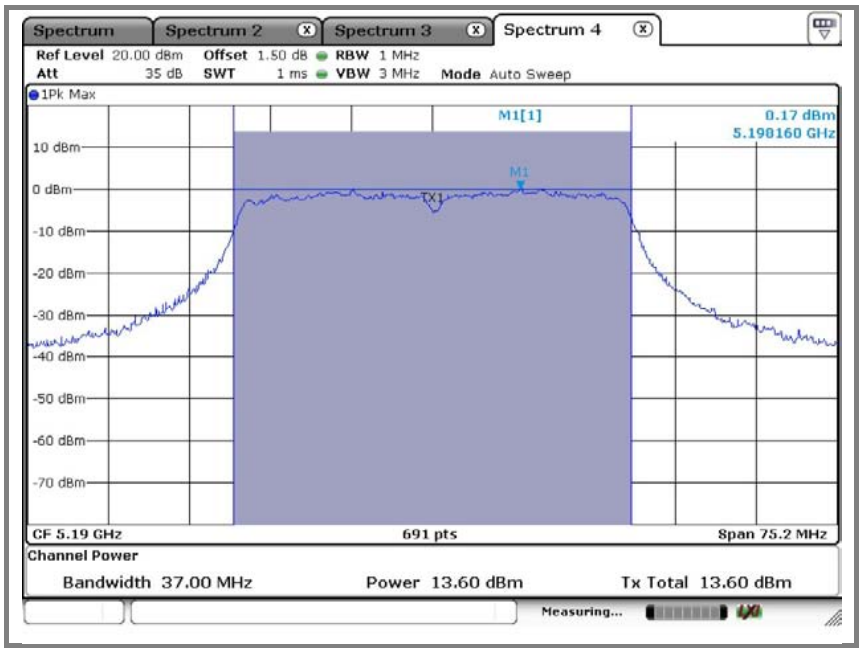


C. High channel (5 240 ㎒)

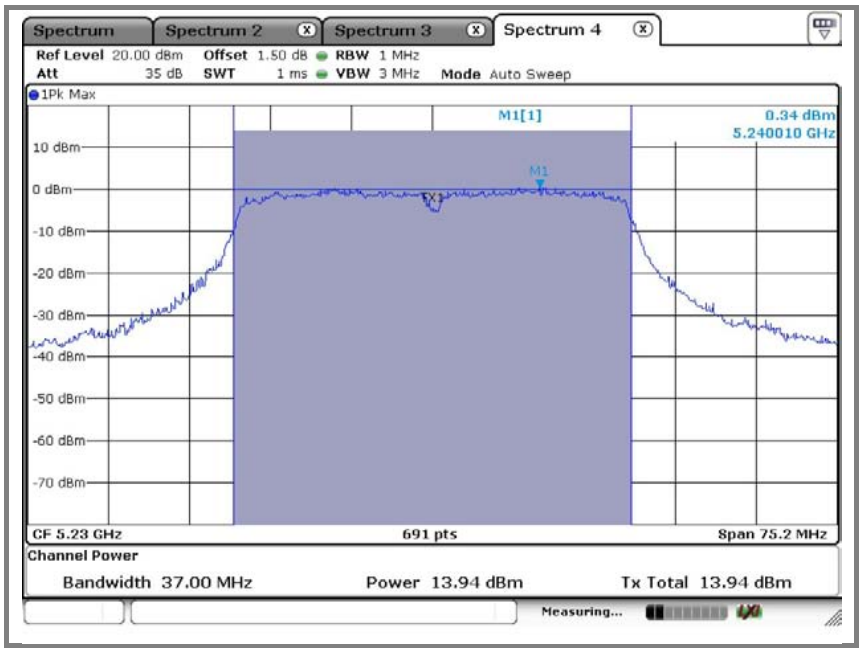


Operation mode: N_40MHz mode (MIMO)

A. Low channel (5 190 ㎒)

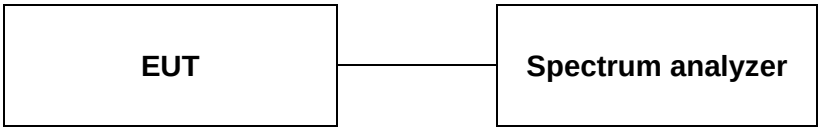


B. High channel (5 230 ㎒)



7. Peak power spectral density

7.1. Test setup



7.2. Test Overview and Limit

The spectrum analyzer was connected to the antenna terminal whilw the EUT was operation at its maximum duty cycle (>98%), at its maximum power control level, as defined in KDB 789033 v01r03, and at the appropriate frequencies, Method SA-1, as defined in KDB 789033 v01r03, was used to measure the power spectral density.

In the 5 150- 5 250 ㎒ band, the maximum permissible power spectral density is 4 ㏈m / ㎒

7.3. Test procedure (KDB 789033)

1. Analyzer was set to the center frequency of the UNII channel under investigation
2. Span was set to encompass the entire emission bandwidth of the signal
2. RBW = 1 ㎒, VBW = 3 ㎒
3. Number of sweep points > 2 x (span/RBW)
4. Sweep time = auto
5. Detector = power averaging (RMS)
6. Trigger was set to free run since the EUT was operating at a duty cycle > 98%
7. Trace was averaged over 100 sweeps
8. The peak search function of the spectrum analyzer was used to find the peak of the spectrum.

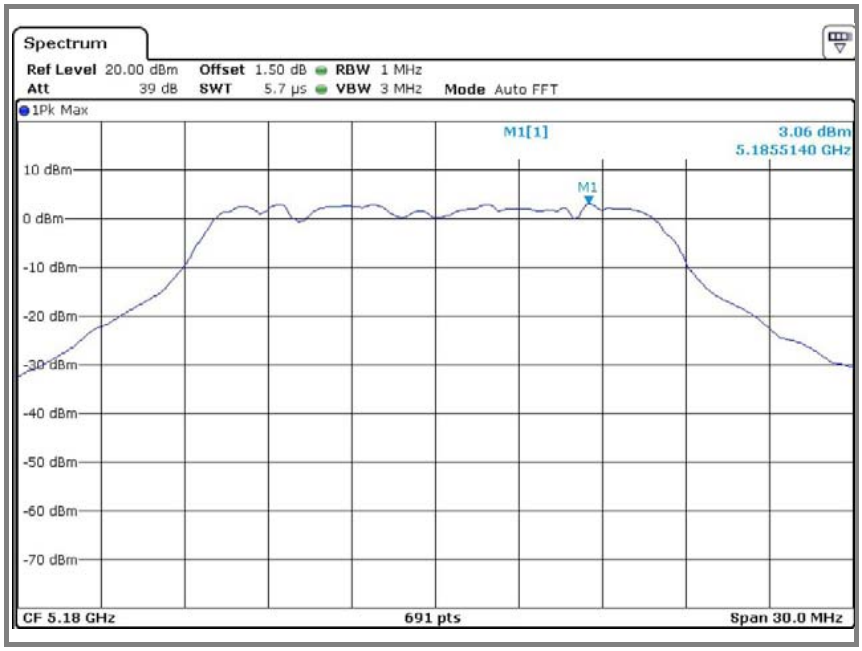
7.4. Test results

Ambient temperature: 22 ℃
Relative humidity: 40 % R.H.

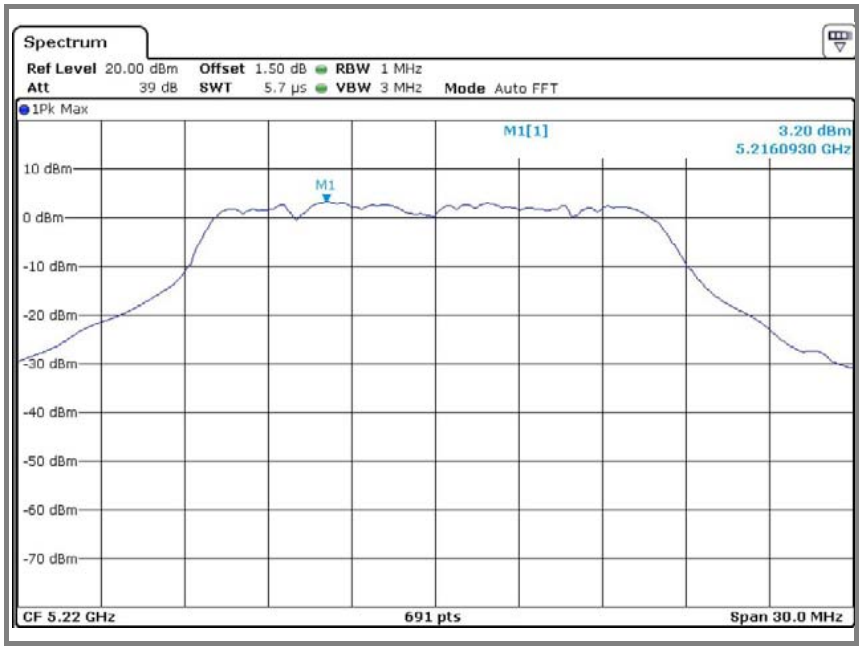
Mode	Frequency (㎒)	PPSD (㏈m)	Limit (㏈ m)
Normal (Ant 1)	5 180	3.06	4
	5 220	3.20	
	5 240	3.30	
Normal (Ant 2)	5 180	2.88	4
	5 220	3.47	
	5 240	3.53	
N_20MHz (MIMO)	5 180	2.06	4
	5 220	2.62	
	5 240	3.44	
N_40MHz (MIMO)	5 190	-0.39	4
	5 230	-0.69	

Operation mode: Normal mode (Ant 1)

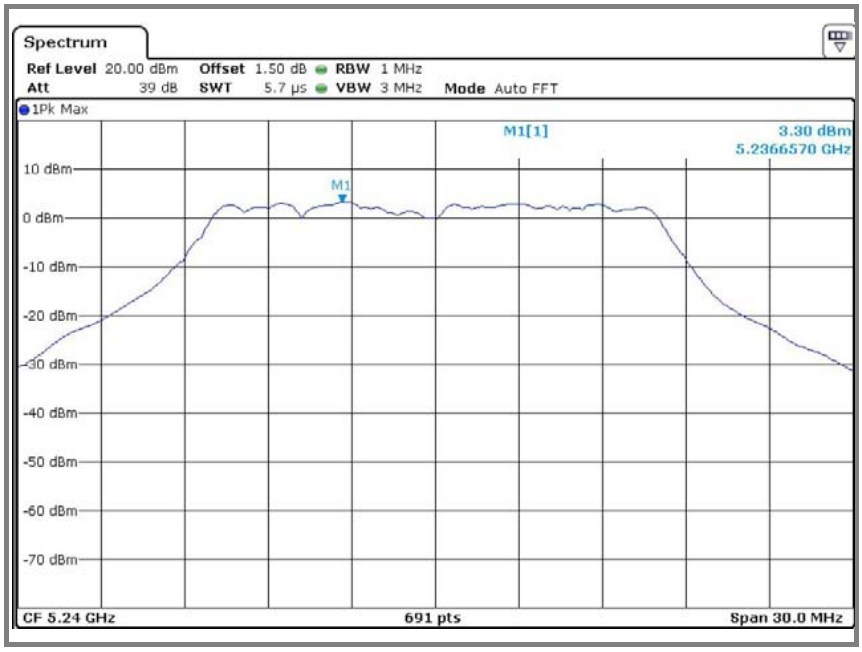
A. Low channel (5 180 ㎒)



B. Middle channel (5 220 ㎒)

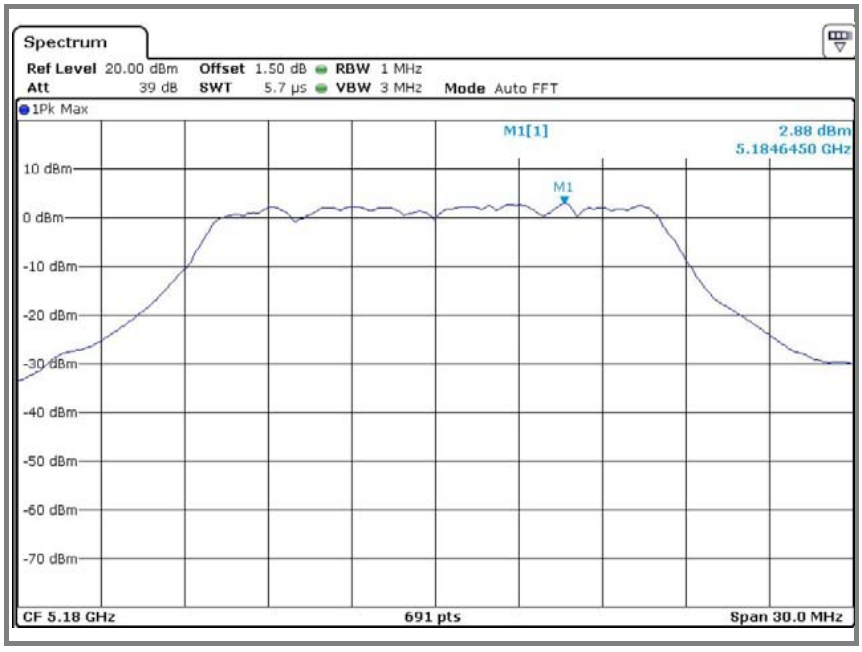


C. High channel (5 240 ㎒)

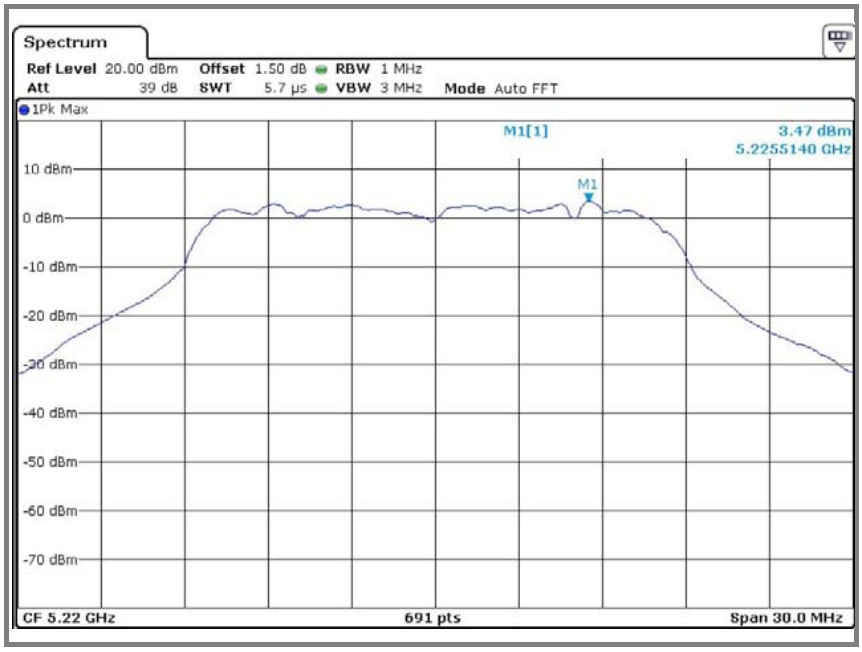


Operation mode: Normal mode (Ant 2)

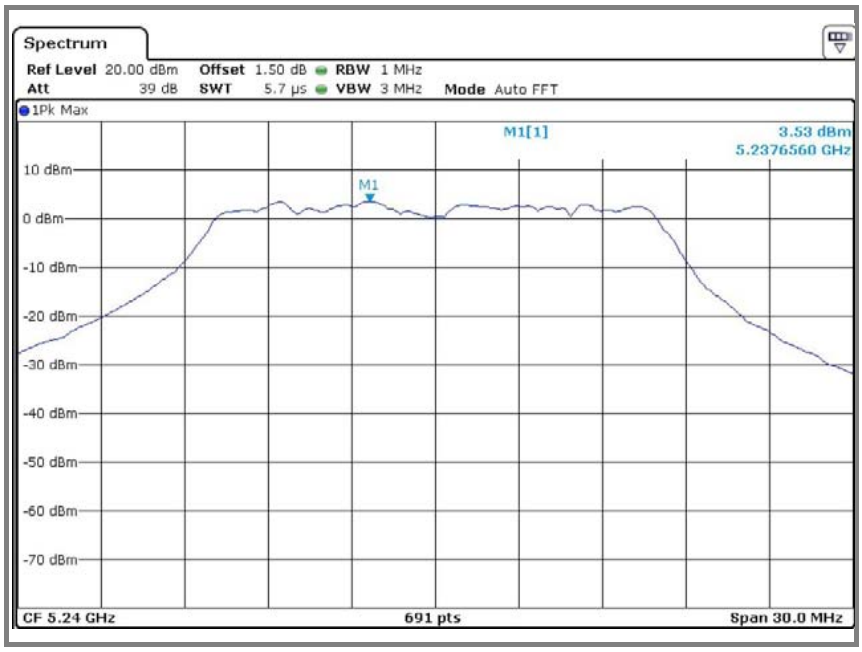
A. Low channel (5 180 ㎒)



B. Middle channel (5 220 ㎒)

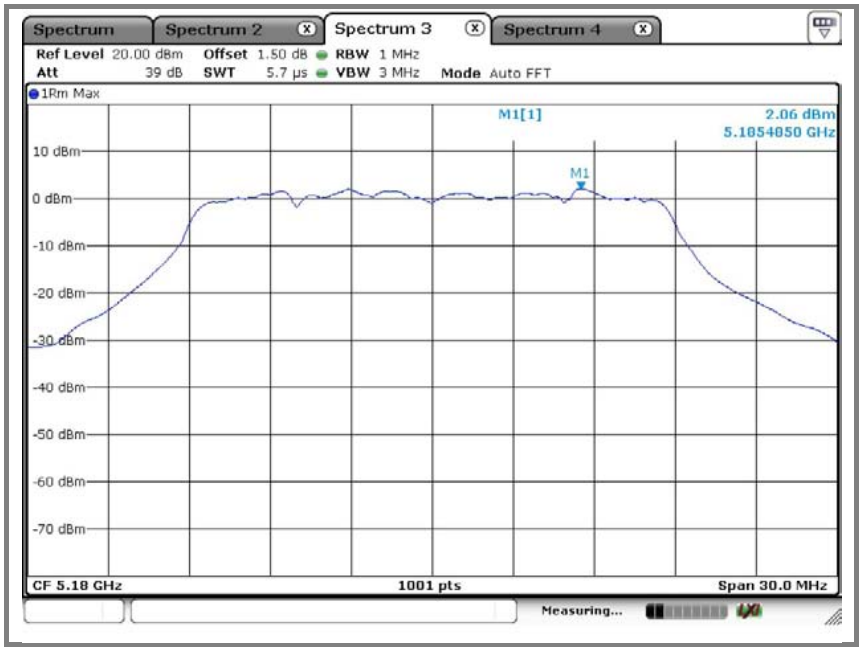


C. High channel (5 240 ㎒)

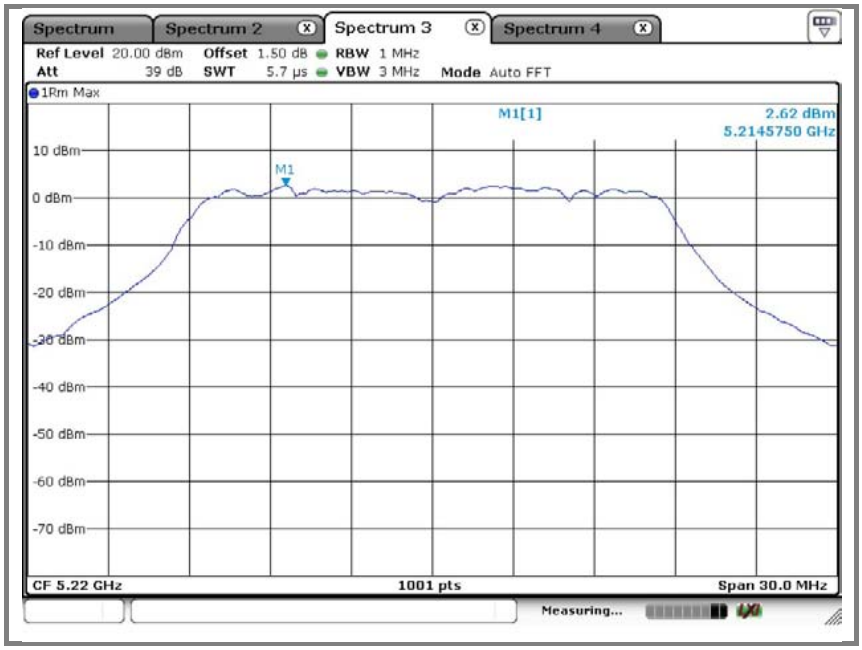


Operation mode: N_20MHz mode (MIMO)

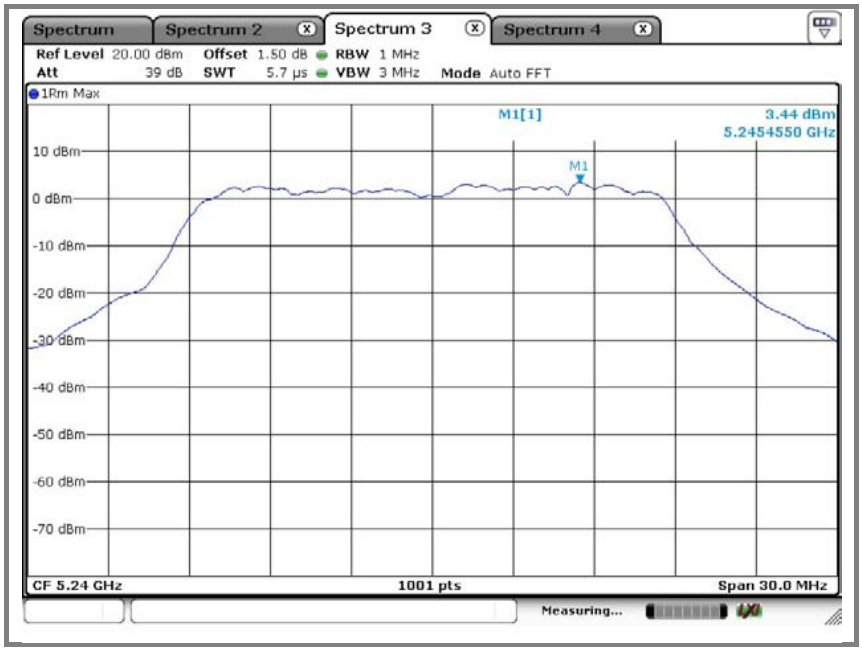
A. Low channel (5 180 ㎒)



B. Middle channel (5 220 ㎒)

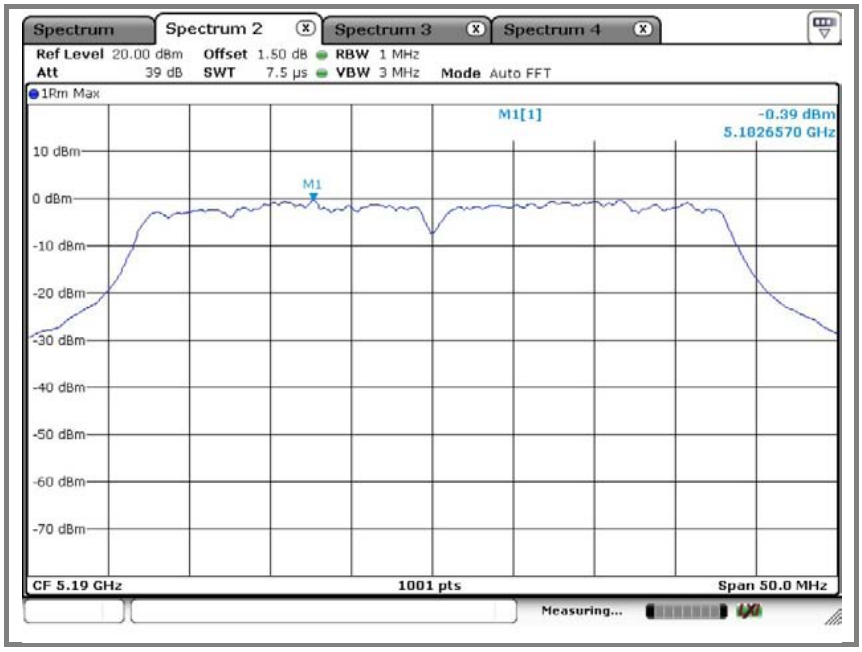


C. High channel (5 240 ㎒)

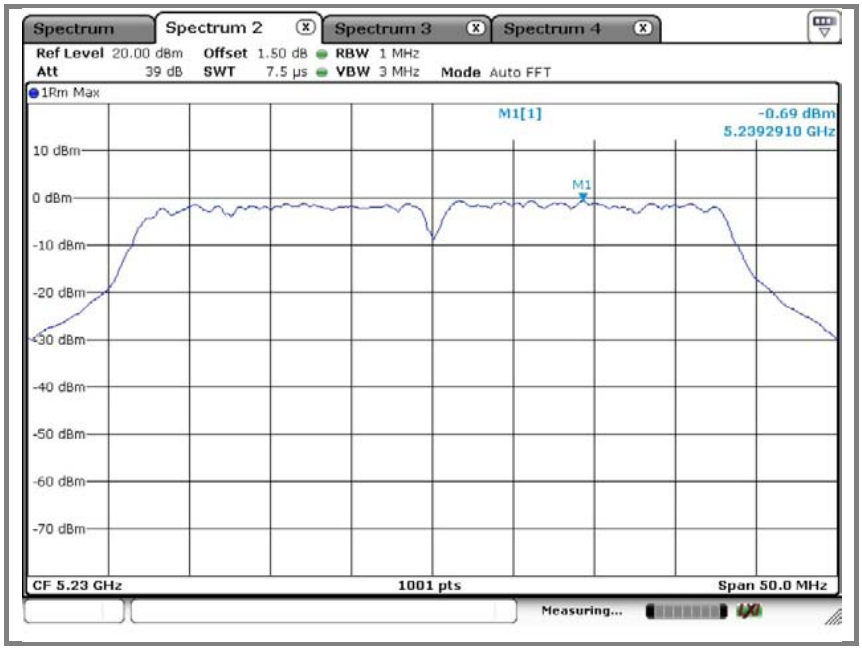


Operation mode: N_40MHz mode (MIMO)

A. Low channel (5 190 ㎒)

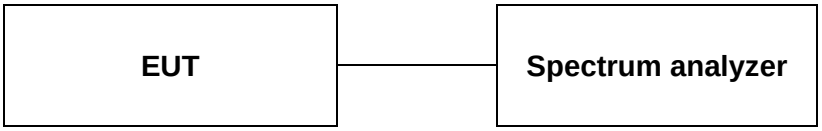


B. High channel (5 230 ㎒)



8. Peak excursion

8.1. Test setup



8.2. Limit

The ratio of the peak excursion of.the modulation envelope(measured using a peak hold function) to the peak transmit power (measured as specified above) shall not exceed 13 ㏈ across any 1 ㎒ bandwidth or the emission bandwidth whichever is less. The maximum antenna

8.3. Test procedure

1. Place the EUT on the table and set it in transmitting mode.
   Remove the antenna from the EUT and then connect a low loss RF cable from the antenna the port to the Spectrum analyzer
2. Set spectrum analyzer as ;
   RBW = 1 ㎒, VBW = 3 ㎒, Span = 30 ㎒, Detector mode: average, Trace 1: Max hold & View
3. Set spectrum analyzer as ;
   RBW = 1 ㎒, VBW = 300㎑, Span = 30 ㎒, Detector mode: peak, Trace 2: Max hold
4. Record the max reading.
5. Repeat the above procedure until the measurements for all frequencies are completed.

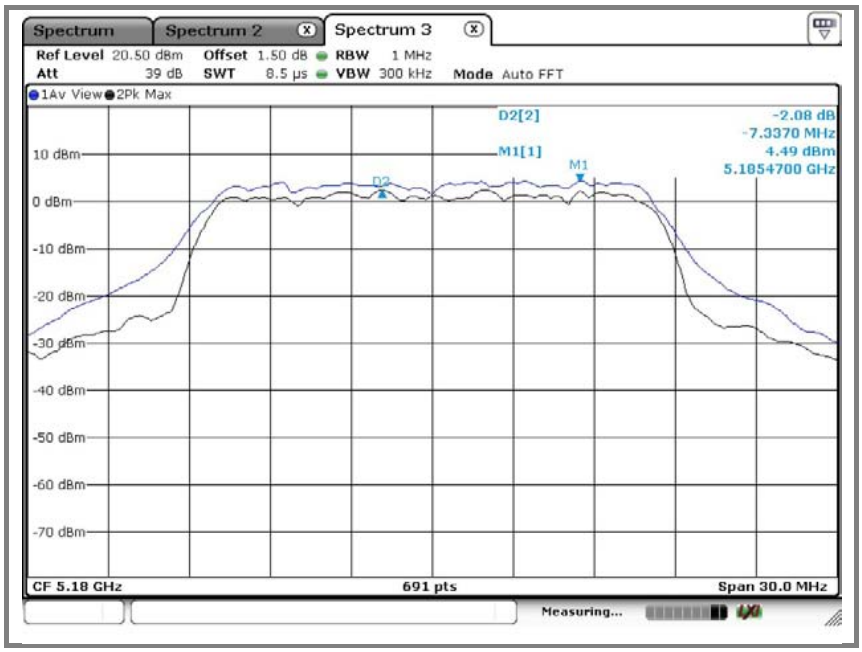
8.4. Test results

Ambient temperature: 22 ℃
Relative humidity: 40 % R.H.

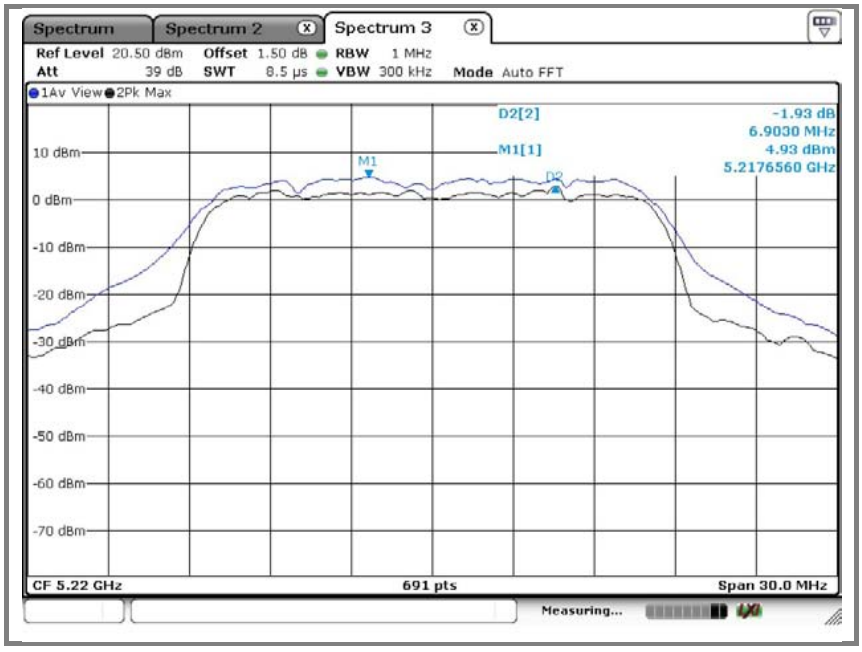
Mode	Frequency (㎒)	Peak excursion (㏈)	Limit (㏈)
Normal (Ant 1)	5 180	2.08	13
	5 220	1.93	
	5 240	2.34	
Normal (Ant 2)	5 180	2.28	13
	5 220	1.96	
	5 240	2.72	
N_20MHz (MIMO)	5 180	2.17	13
	5 220	0.94	
	5 240	2.91	
N_40MHz (MIMO)	5 190	3.00	13
	5 230	1.81	

Operation mode: Normal mode (Ant 1)

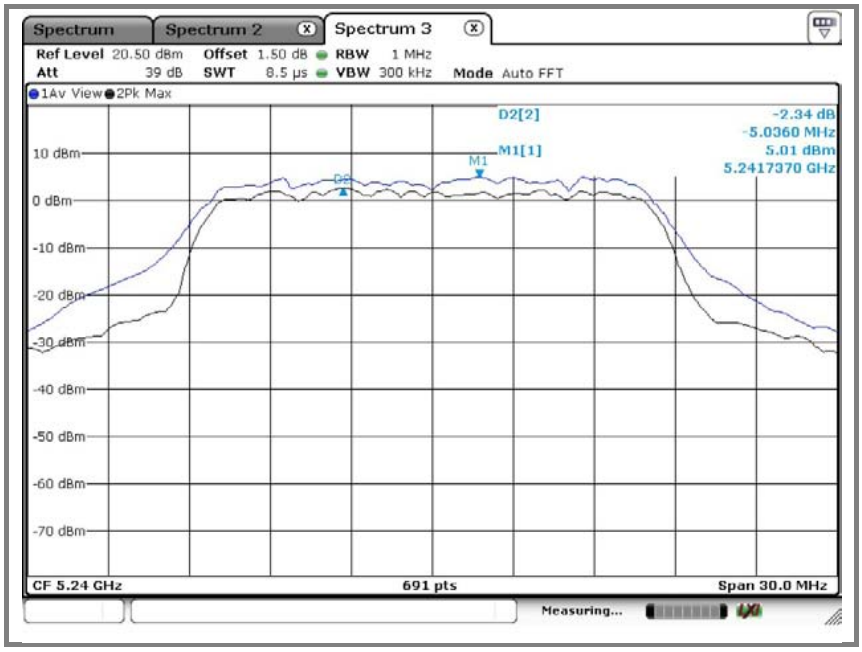
A. Low channel (5 180 ㎒)



B. Middle channel (5 220 ㎒)

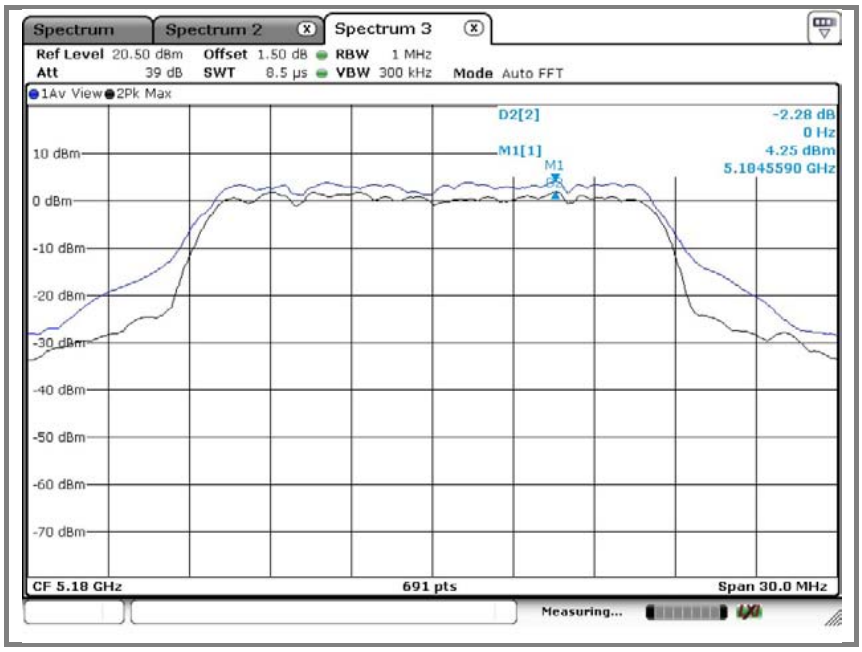


C. High channel (5 240 ㎒)

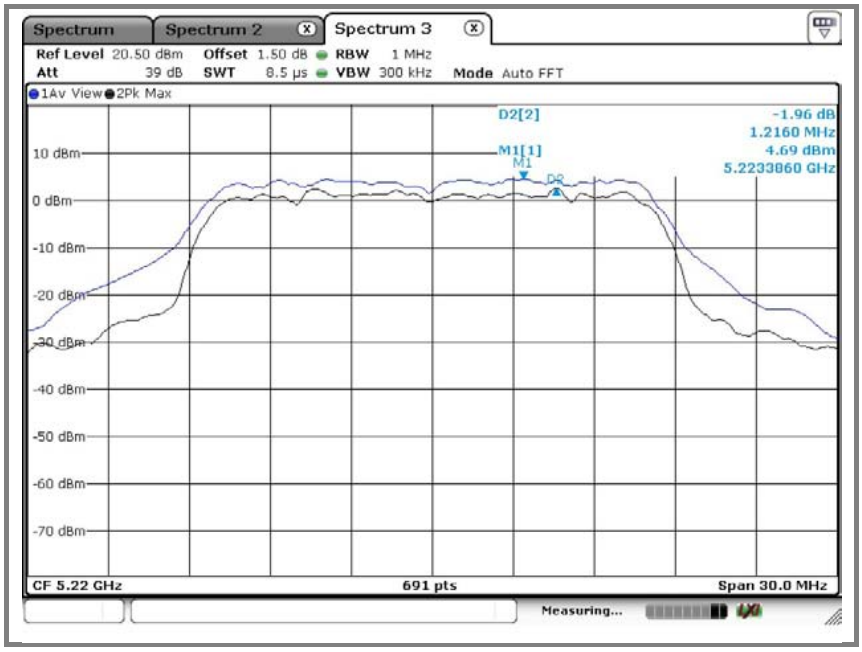


Operation mode: Normal mode (Ant 2)

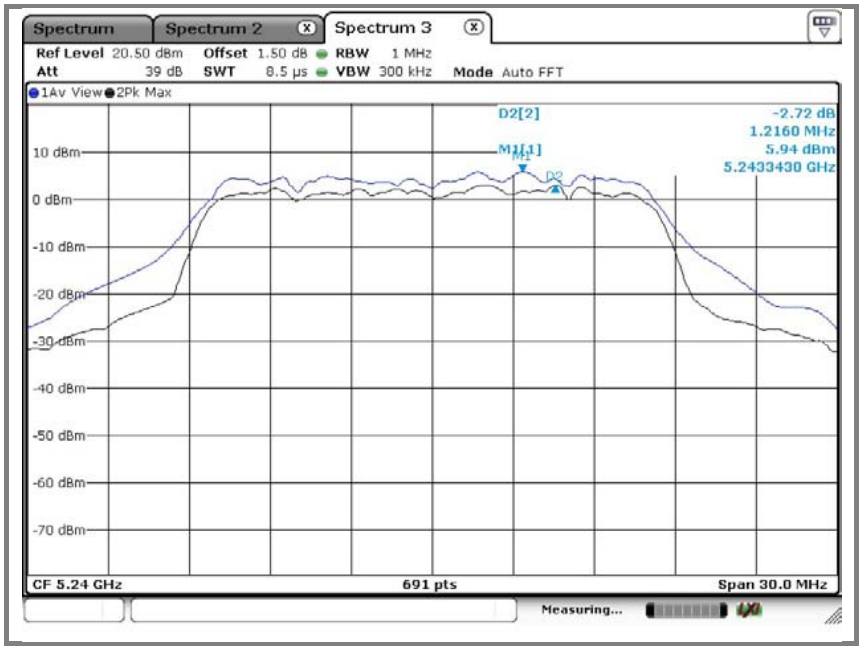
A. Low channel (5 180 ㎒)



B. Middle channel (5 220 ㎒)

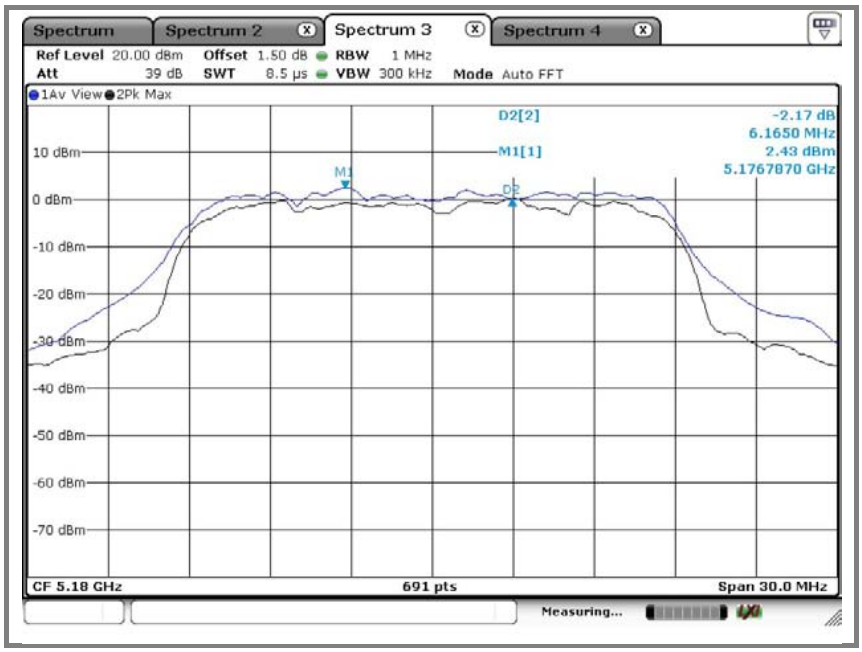


C. High channel (5 240 ㎒)

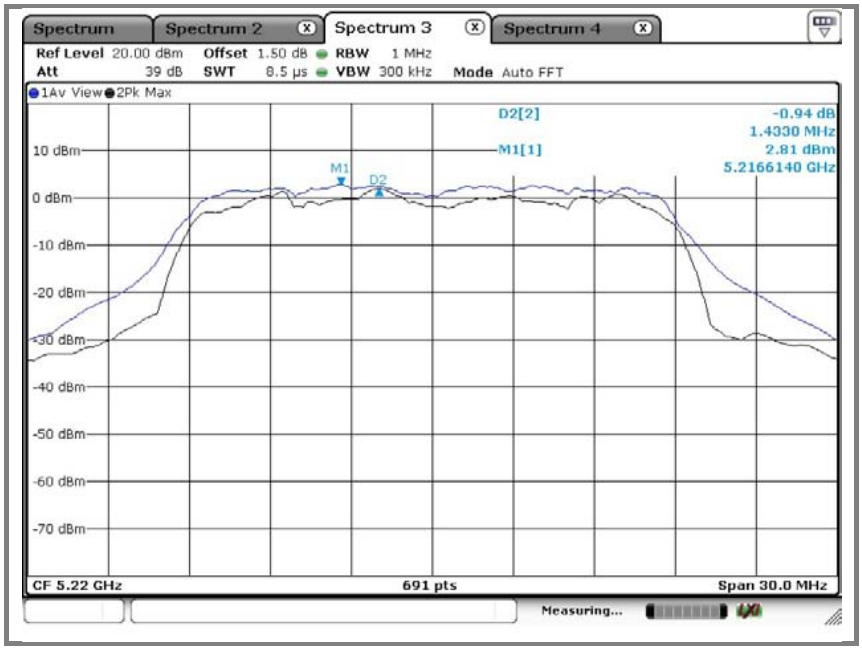


Operation mode: N_20MHz mode (MIMO)

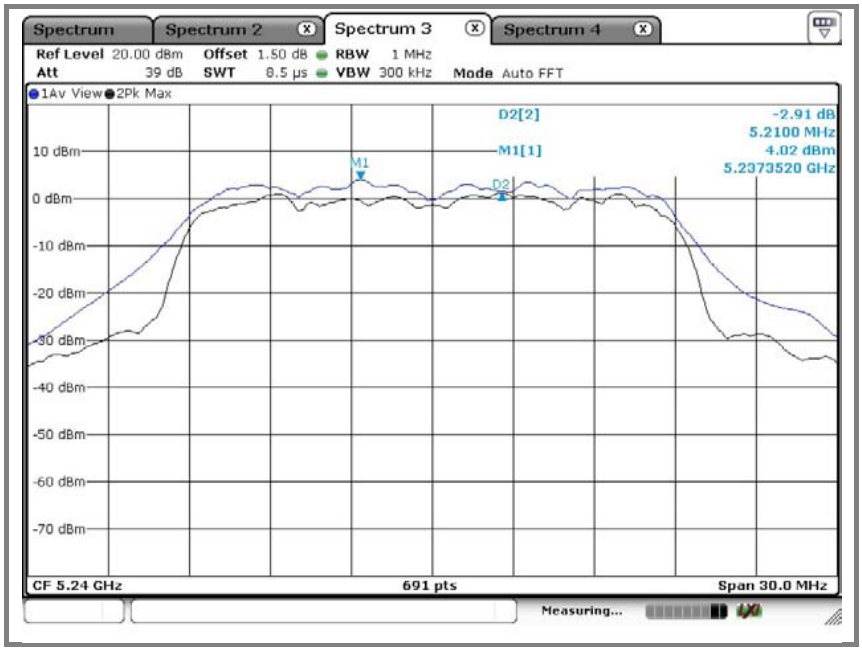
A. Low channel (5 180 ㎒)



B. Middle channel (5 220 ㎒)

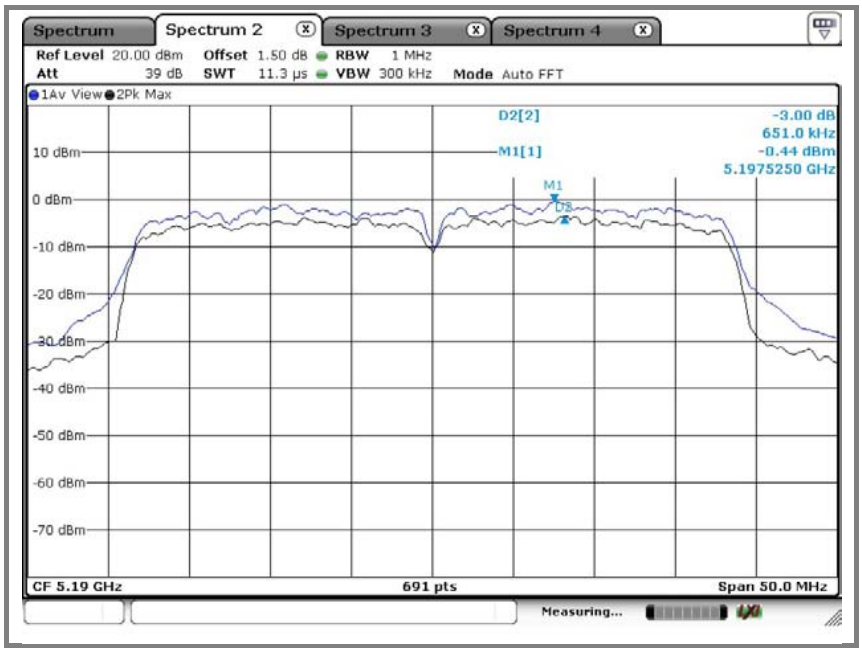


C. High channel (5 240 ㎒)

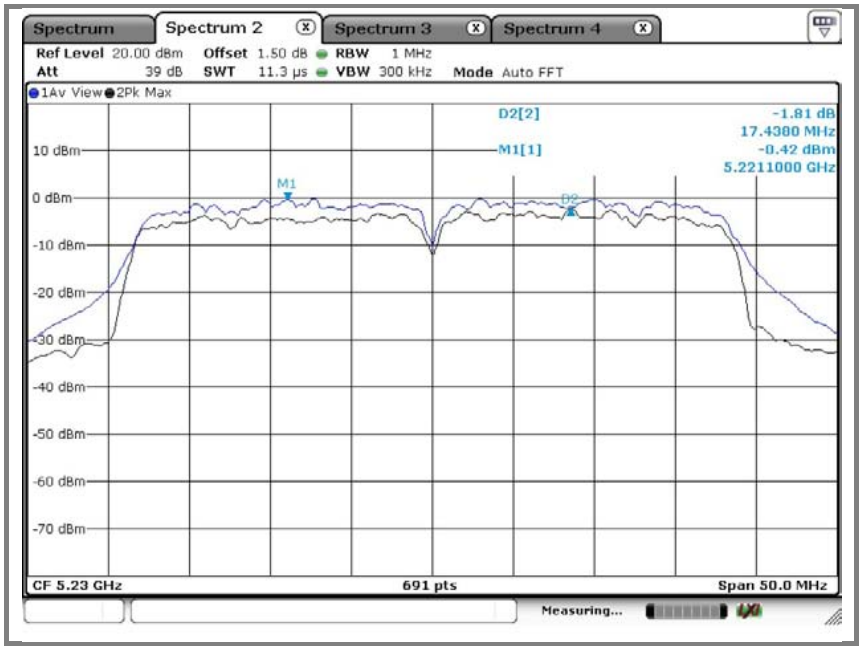


Operation mode: N_40MHz mode (MIMO)

A. Low channel (5 190 ㎒)

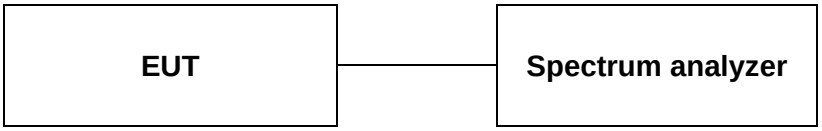


B. High channel (5 230 ㎒)



9. Frequency stability

9.1. Test setup



9.2. Limit

Not applicable

9.3. Test procedure

The frequency stability of the transmitter is measured by:

a) Temperature: The temperature is varied from -20℃ to +60℃ using an environmental chamber.
b) Primary Supply Voltage: The primary supply voltage is varied from 85% to 115% of the voltage normally at the input to the device or at the power supply terminals if cables are not normally supplied.

1. Place the EUT on the table and set it in the transmitting mode.
2. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
3. Set the Spectrum analyzer as RBW = 10㎑, VBW = 10㎑, Sweep time = Auto

9.4. Test results

Operation mode: Normal mode

Operation Frequency : 5 240 ㎒ (Worst case – Ant 1)

VOLTAGE (%)	POWER (VDC)	TEMP (dB)	FREQ (Hz)	Deviation (%)	Deviation (ppm)
100%	3.8	+20($_{Ref}$)	5240 019 545	0.000 373	3.73
100%		-20	5240 019 648	0.000 375	3.75
100%		-10	5240 019 732	0.000 377	3.77
100%		0	5240 019 153	0.000 366	3.66
100%		10	5240 018 776	0.000 358	3.58
100%		20	5240 018 312	0.000 349	3.49
100%		25	5240 018 948	0.000 362	3.62
100%		30	5240 018 702	0.000 357	3.57
100%		40	5240 019 500	0.000 372	3.72
100%		50	5240 019 123	0.000 365	3.65
100%		60	5240 019 356	0.000 369	3.69
85%	3.23	20	5240 019 733	0.000 377	3.77
115%	4.37	20	5240 018 024	0.000 344	3.44

Operation mode: N_20MHz mode

Operation Frequency : 5 240 ㎒ (Worst case)

VOLTAGE (%)	POWER (VDC)	TEMP (dB)	FREQ (Hz)	Deviation (%)	Deviation (ppm)
100%	3.8	+20($_{Ref}$)	5240 018 433	0.000 352	3.52
100%		-20	5240 018 671	0.000 356	3.56
100%		-10	5240 018 159	0.000 347	3.47
100%		0	5240 018 431	0.000 352	3.52
100%		10	5240 019 015	0.000 363	3.63
100%		20	5240 018 776	0.000 358	3.58
100%		25	5240 018 451	0.000 352	3.52
100%		30	5240 018 109	0.000 346	3.46
100%		40	5240 018 344	0.000 350	3.50
100%		50	5240 018 129	0.000 346	3.46
100%		60	5240 018 705	0.000 357	3.57
85%	3.23	20	5240 019 128	0.000 365	3.65
115%	4.37	20	5240 018 696	0.000 357	3.57

Operation mode: N_40MHz mode

Operation Frequency : 5 230 ㎒ (Worst case)

VOLTAGE (%)	**POWER** (VDC)	TEMP (dB)	**FREQ** (Hz)	**Deviation** (%)	**Deviation** (ppm)
100%	3.8	+20($_{Ref}$)	5230 014 365	0.000 275	2.75
100%		-20	5230 014 482	0.000 277	2.77
100%		-10	5230 014 233	0.000 272	2.72
100%		0	5230 014 156	0.000 271	2.71
100%		10	5230 014 125	0.000 270	2.70
100%		20	5230 015 310	0.000 293	2.93
100%		25	5230 015 366	0.000 294	2.94
100%		30	5230 015 152	0.000 290	2.90
100%		40	5230 015 082	0.000 288	2.88
100%		50	5230 014 984	0.000 287	2.87
100%		60	5230 014 525	0.000 278	2.78
85%	3.23	20	5230 014 389	0.000 275	2.75
115%	4.37	20	5230 014 277	0.000 273	2.73

10. Antenna requirement

10.1. 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.

10.2. Antenna Connected Construction

Antenna used in this product is Internal antenna (PCB pattern Antenna) gain of 3.11 dBi.

11. RF exposure evaluation

11.1. 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

11.2. 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.

11.2. Test result of RF exposure evaluation

Test Item : RF Exposure evaluation data
Test Mode : Normal operation

11.3. Output power into antenna & RF exposure evaluation distance

Mode	Frequency (㎒)	Output Peak power to antenna (dBm)	Antenna gain (dBi)	Antenna Gain (dBi) Numeric	Power density at 20 ㎝ (㎽/㎠)	Power density Limits (㎽/㎠)
Normal (Ant 1)	5 180	15.75	3.11	2.05	0.015	1
	5 220	16.49			0.018	
	5 240	16.78			0.019	
Normal (Ant 2)	5 180	15.89	3.11	2.05	0.016	1
	5 220	16.47			0.018	
	5 240	16.77			0.019	
N_20MHz (MIMO)	5 180	13.55	3.11	2.05	0.009	1
	5 220	14.29			0.011	
	5 240	14.58			0.012	
N_40MHz (MIMO)	5 190	13.60	3.11	2.05	0.009	1
	5 230	13.94			0.010	

※ 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 ㎽/㎠ .