TEST REPORT

Part 15 Subpart E 15.407

Equipment under test mini-PCIe WiFi Module

Model name WiMi300

FCC ID ZD7- WIMI300

Applicant Nimbus, Inc.

Manufacturer Nimbus, Inc.

Date of test(s) 2014.03.20 ~ 2014.04.11

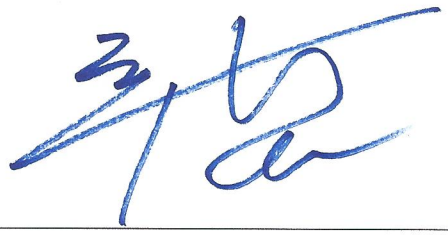
Date of issue 2014.04.15

Issued to

Nimbus, Inc.
Suite 619 Hanshin S-meca
1359 Gwanpyeong-dong, Yuse, Dajeon, 305-509, South Korea
Tel: +82-42-330-0755 / Fax: +82-42-936-0752

Issued by

KES Co., Ltd.
C-3701, Simin-daero 365-40, Dongan-gu, Anyang-si,
Gyeonggi-do,431-716, Korea
473-29, Gayeo-ro, Yeoju-si, Gyeonggi-do, Korea
Tel: +82-31-425-6200 / Fax: +82-31-424-0450

Test and report completed by :	Report approval by :
	
Byeong-Geol Chu Test engineer	Jeff Do Technical manager

Revision history

Revision	Date of issue	Test report No.	Description
-	2014.04.15	KES-RF-14T0020	Initial

TABLE OF CONTENTS

1. General information

1.1. EUT description

Equipment under test	mini-PCIe WiFi Module
Model name	WiMi300
Serial number	N/A
Frequency range	5190 ㎒ ~ 5230 ㎒(802.11an HT40), 5755 ㎒ ~ 5795 ㎒(802.11n HT40)
Modulation technique	OFDM (BPSK, QPSK, 16QAM, 64QAM)
Number of channels	5190 ㎒ ~ 5230 ㎒ : 2 ch, 5755 ㎒ ~ 5795 ㎒ : 2ch
Antenna type & gain	Dipole antenna // 5.62 dBi
Power source	Power Adapter (AC 100-240 V 50/60 Hz // DC 12 V)

1.2. Test frequency

	Low channel	**Middle channel**	**High channel**
Frequency (㎒)	5 190	-	5 230

1.3. Information about derivative model

N/A

1.4. Device modifications

N/A

1.5 Device information

- The device shall be used only 802.11n (HT 40).

1.6. Test facility

C-3701, Simin-daero 365-40, Dongan-gu, Anyang-si, Gyeonggi-do,431-716, Korea
473-29, Gayeo-ro, Yeoju-si, Gyeonggi-do, Korea

The open area test site is constructed in conformance with the requirements ANSI C63.4-2003/2009.

1.7. Laboratory accreditations and listings

Country	Agency	Scope of accreditation	Certificate No.
USA	FCC	3 & 10 meter Open Area Test Sites and one conducted site to perform FCC Part 15/18 measurements.	343818
KOREA	KC	EMI (10 meter Open Area Test Site and two conducted sites) Radio (3 & 10 meter Open Area Test Sites and one conducted site)	KR0100
CANADA	IC	3 & 10 meter Open Area Test Sites and one conducted site	4769B-1

1.8. Directional antenna gain for MIMO (uncorrelated)

ANT1 Gain (dBi)	ANT2 Gain (dBi)	ANT3 Gain (dBi)	Total Gain (dBi)
5.62	5.62	5.62	5.62

Ant Gain = 10 log[($10^{G1/10}$ + $10^{G2/10}$+ $10^{G3/10}$) /N] = 5.62 dBi

2. Summary of tests

Reference	Parameter	Test results
15.205 15.209 15.407(b)	General field strength limit (Restricted bands and radiated emission limit)	Pass
15.407(b)	Undesirable emission	Pass
15.407(a)	Emission bandwidth (26㏈ bandwidth)	Pass
15.407(a)	Maximum conducted output power	Pass
15.407(a)	Peak power spectral density	Pass
15.407(a)	Peak excursion	Pass
15.407(g)	Frequency stability	Pass
15.207	AC conducted emissions	Pass

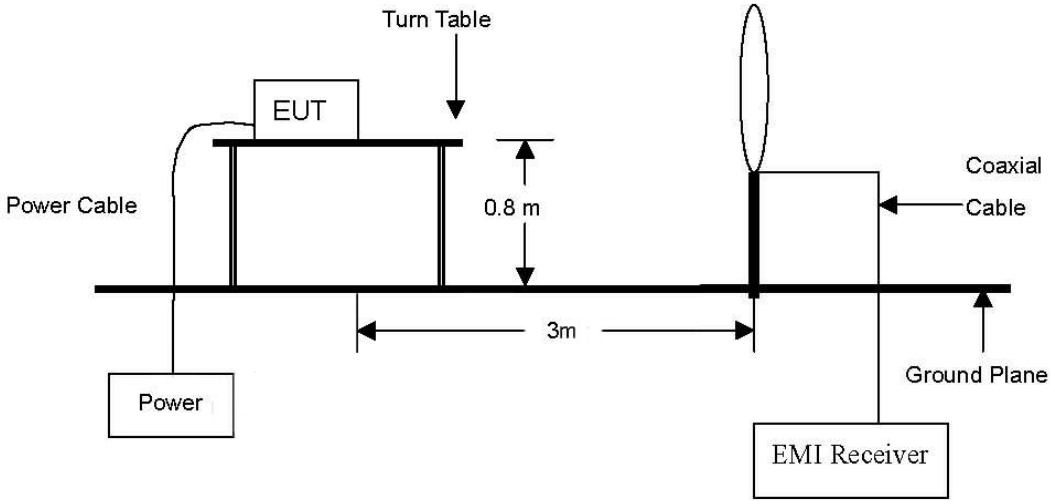
Test procedures;
The measurement procedures described in the American National Standard for Methods of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9 ㎑ to 40 ㎓ (ANSI C63.4-2003/2009), the guidance provided in KDB 789033 D01_v01r03 and KDB 662911 D01 v02r01 were used in the measurement of the EUT.

3. Test results

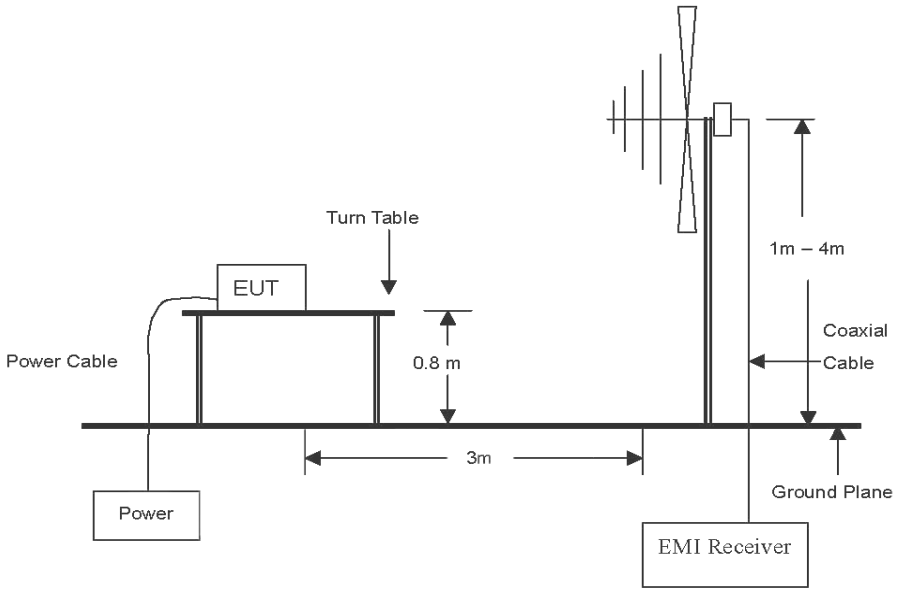
3.1 Radiated spurious emissions

Test setup

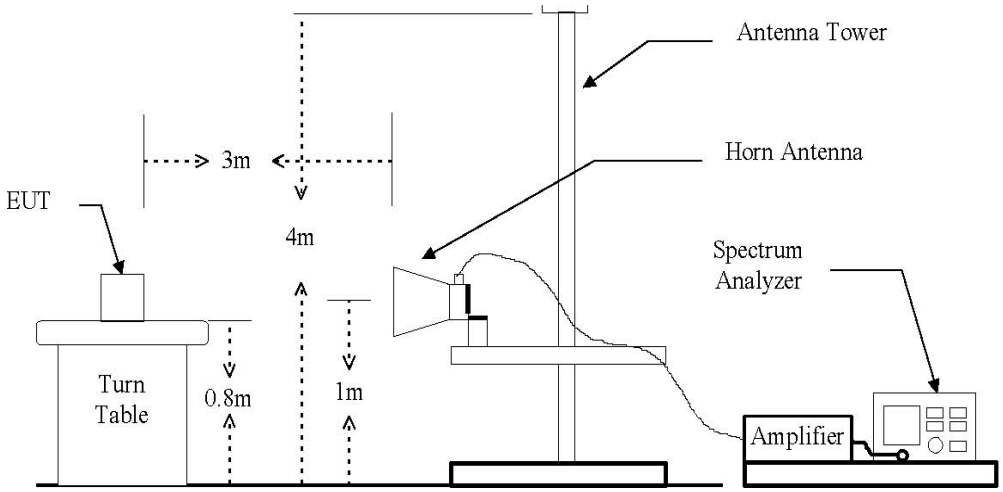
The diagram below shows the test setup that is utilized to make the measurements for emission from 9 ㎑ to 30 ㎒ Emissions.



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.



Test procedure

Radiated emissions from the EUT were measured according to the dictates in section H) of KDB 789033 D01_v01r03 and ANSI C63.4-2003/2009

1. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter anechoic chamber test site or open area test site. The table was rotated 360 degrees to determine the position of the highest radiation.
2. During performing radiated emission below 1㎓, the EUT was set 3 meters away from the interference receiving antenna, which was mounted on the top of a variable height antenna tower. During performing radiated emission above 1 ㎓, the EUT was set 3 meter away from the interference receiving antenna.
3. The antenna is a broadband antenna, and its height is varied from 1 meter to 4 meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the table was turned from 0 degrees to 360 degrees to find the maximum reading.
5. The test receiver system was set to peak detect function and specified bandwidth with maximum hold mode.
6. If the emission level of the EUT in peak mode was 10 ㏈lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have10 ㏈ margin would be retested one by one using peak,quasi-peak or average method as specified and then reported in a data sheet

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

The spectrum analyzer is set to:
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 200 ㎐ for Quasi-peak detection (QP) at frequency below 9 ㎑~ 150 ㎑.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 9 ㎑ for Quasi-peak detection (QP) at frequency below 150 ㎑~ 30 ㎒.
3. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer 120 ㎑ for Peak detection (PK) or Quasi-peak detection (QP) at frequency below 1 ㎓.
4. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 ㎒ and video bandwidth is 3 ㎒ for Peak detection at frequency above 1 ㎓.
5. The resolution bandwidth of test receiver/spectrum analyzer is 1 ㎒ and the video bandwidth is 3 ㎒ for Average detection (AV) at frequency above 1 ㎓. (Detect mode: RMS(power), Averaging 100)

To get a maximum emission level from the EUT, the EUT is manipulated through three orthogonal planes.

Limit

According to 15.209(a), for an intentional radiator devices, the general required of field strength of radiated emissions from unintentional radiators at a distance of 3 meters shall not exceed the following values：

Frequency (㎒)	Distance (Meters)	Radiated (㎶/m)
0.009 ~ 0.490	300	2 400 / F(㎑)
0.490 ~ 1.705	30	24 000 / F(㎑)
1.705 ~ 30.0	30	30
30 ~ 88	3	100**
88 ~ 216	3	150**
216 ~ 960	3	200**
Above 960	3	500

**Except as provided in paragraph (g), fundamental emissions from intentional radiators operating under this Section shall not be located in the frequency bands 54 ~ 72 ㎒, 76 ~ 88 ㎒, 174 ~ 216 ㎒ or 470 ~ 806 ㎒. However, operation within these frequency bands is permitted under other sections of this Part, e.g., Sections 15.231 and 15.241.

According to 15.205(a), only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	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
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	([2])

According to 15.205(b), Except as provided in paragraphs (d) and (e) of this section, the field strength of emissions appearing within these frequency bands shall not exceed the limits shown in § 15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in § 15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in § 15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in § 15.35 apply to these measurements.

According to 15.407(b),
(b) Undesirable emission limits: Except as shown in paragraph (b)(6) of this section, the peak emissions outside of the frequency bands of operation shall be attenuated in accordance with the following limits:
(1) For transmitters operating in the 5.15–5.25 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of –27 dBm/MHz.
(2) For transmitters operating in the 5.25–5.35 GHz band: all emissions outside of the 5.15–5.35 GHz band shall not exceed an EIRP of –27 dBm/MHz. Devices operating in the 5.25–5.35 GHz band that generate emissions in the 5.15–5.25 GHz band must meet all applicable technical requirements for operation in the 5.15–5.25 GHz band (including indoor use) or alternatively meet an out-of-band emission EIRP limit of –27 dBm/MHz in the 5.15–5.25 GHz band.
(3) For transmitters operating in the 5.47–5.725 GHz band: all emissions outside of the 5.47–5.725 GHz band shall not exceed an EIRP of –27 dBm/MHz.
(4) For transmitters operating in the 5.725–5.825 GHz band: all emissions within the frequency range from the band edge to 10 MHz above or below the band edge shall not exceed an EIRP of –17 dBm/MHz; for frequencies 10 MHz or greater above or below the band edge, emissions shall not exceed an EIRP of –27 dBm/MHz.
(5) The emission measurements shall be performed using a minimum resolution bandwidth of 1 MHz. A lower resolution bandwidth may be employed near the band edge, when necessary, provided the measured energy is integrated to show the total power over 1 MHz.
(6) Unwanted emissions below 1 GHz must comply with the general field strength limits set forth in § 15.209. Further, any U-NII devices using an AC power line are required to comply also with the conducted limits set forth in § 15.207.

*EIRP[dBm] = E[dBμV/m] - 95.2
EIRP of –27 dBm/MHz = 68.3 dBμV/m (3m)

Test results (Below 30 ㎒)

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

Radiated emissions		Ant.	Correction factors			Total	Limit	
Frequency (㎒)	Reading (㏈㎶)	Pol.	Ant. factor (㏈/m)	Cable loss (㏈)	F_d (㏈)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
Not detected for above 30 ㎒								

Note.

1. All spurious emission at channels are almost the same below 30 ㎒, so that high channel was chosen at representative in final test.
2. Actual = Reading + Ant. factor + Cable loss + F_d
3. $F_d = 40\log(D_m / D_s)$
   Where:
   F_d = Distance factor in ㏈
   D_m = Measurement distance in meters
   D_s = Specification distance in meters

Test results (Below 1 000 ㎒)

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

Radiated emissions		Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (㏈㎶)	Pol.	Ant. factor (㏈/m)	Cable loss (㏈)	Actual (㏈㎶/m)	Limit (㏈㎶/m)	Margin (㏈)
107.4	27.22	V	9.76	1.98	38.96	43.5	4.54
216.6	26.24	V	10.50	3.21	39.95	46.0	6.05
371.5	20.11	H	14.96	4.62	39.69	46.0	6.31
405.9	20.38	H	15.71	4.93	41.02	46.0	4.98
449.5	14.19	H	16.65	5.24	36.08	46.0	9.92
512.6	16.34	H	17.98	5.66	39.98	46.0	6.02

Note.

1. All spurious emission at channels are almost the same below 1 ㎓, so that high channel was chosen at representative in final test.
2. Actual = Reading + Ant. factor + Cable loss
3. Detector mode: Quasi peak
4. To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes.

Test results (Above 1 000 ㎒)

The frequency spectrum from 1 ㎓ to 40 ㎓ was investigated. No Emissions were found above 20 dB below the limit.

Low channel

Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	AFCL (dB)	DCF (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
5 147.56	50.88	PK	H	16.16	-	67.04	74.00	6.96
5 149.91	34.78	Avg	H	16.16	0.22	51.16	54.00	2.84
5 149.91	44.40	PK	V	16.16	-	60.56	74.00	13.44
5 149.47	30.38	Avg	V	16.16	0.22	46.76	54.00	7.24
5 424.55	45.04	PK	H	16.60	-	61.64	74.00	12.36
5 424.48	31.48	Avg	H	16.60	-	48.08	54.00	5.92

High channel

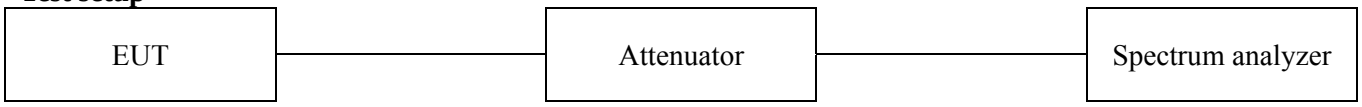
Radiated emissions			Ant.	Correction factors		Total	Limit	
Frequency (㎒)	Reading (dB㎶)	Detector mode	Pol.	AFCL (dB)	DCF (dB)	Actual (dB㎶/m)	Limit (dB㎶/m)	Margin (dB)
5 422.30	46.34	PK	H	16.60	-	62.94	74.00	11.06
5 422.41	31.44	Avg	H	16.60	-	48.04	54.00	5.96

Note.

1. Measuring frequencies from 1 ㎓ to the 10th harmonic of highest fundamental frequency.
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 + AFCL(Ant. factor – Amp. gain + Cable loss) + DCF(Duty cycle Correction Factor)
5. DCF(Duty cycle Correction Factor) = 10log(1/Duty cycle)
6. EIRP[dBm] = E[dB㎶/m] - 95.2, EIRP of –27 dBm/MHz = 68.3 dB㎶/m (3m)
7. To get a maximum emission level from the EUT, the EUT was moved throughout the XY, XZ and YZ planes.

3.2. Emission bandwidth (26dB bandwidth)

Test setup



Test procedure

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.

KDB 789033 D01_v01r03 – section C).

1) Set RBW = approximately 1% of the emission bandwidth.
2) Set the VBW > RBW.
3) Detector = Peak.
4) Trace mode = max hold.
5) Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.

Note: The automatic bandwidth measurement capability of a spectrum analyzer or EMI receiver may be employed if it implements the functionality described above.

Limit

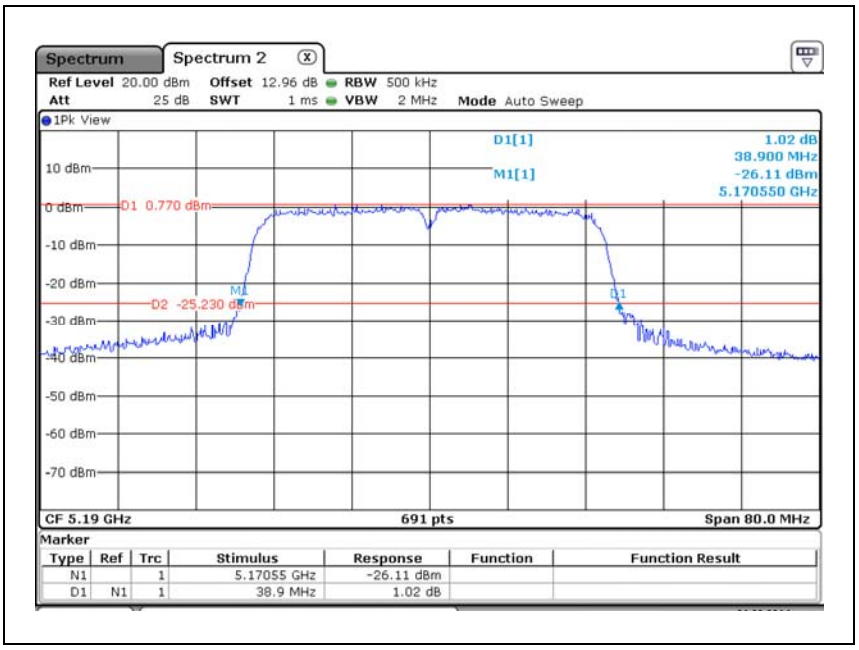
N/A

Test results

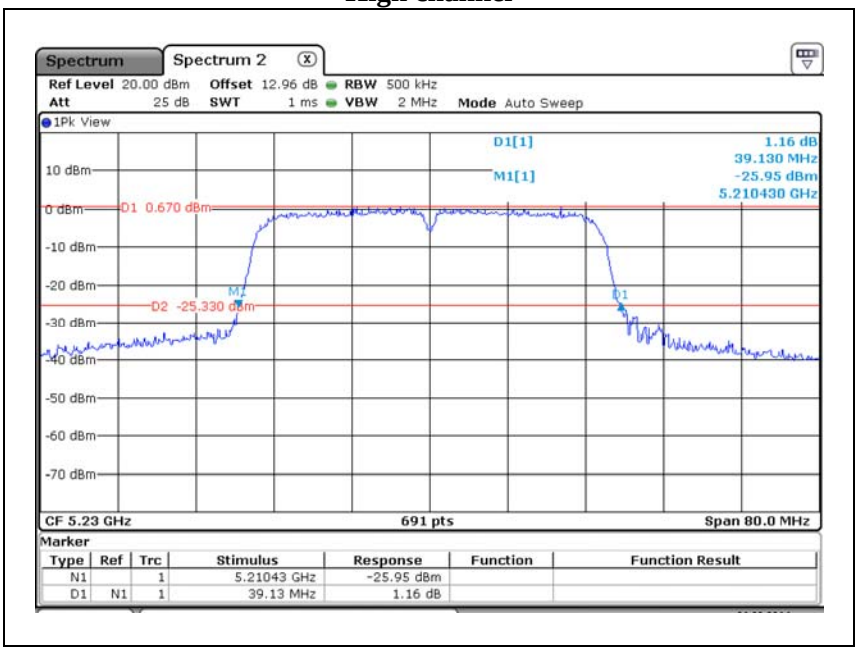
Antenna port	Frequency(㎒)	26 dB bandwidth(㎒)	Limit(㎒)
1	5 190	38.90	N/A
	5 230	39.13	
2	5 190	38.44	
	5 230	38.67	
3	5 190	38.67	
	5 230	38.90	

- Antenna port 1

Low channel

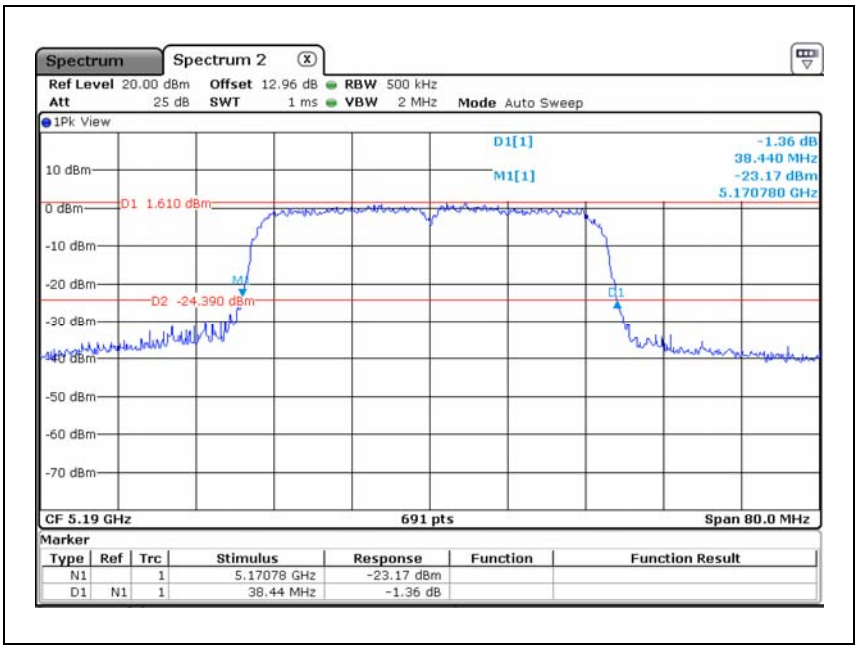


High channel

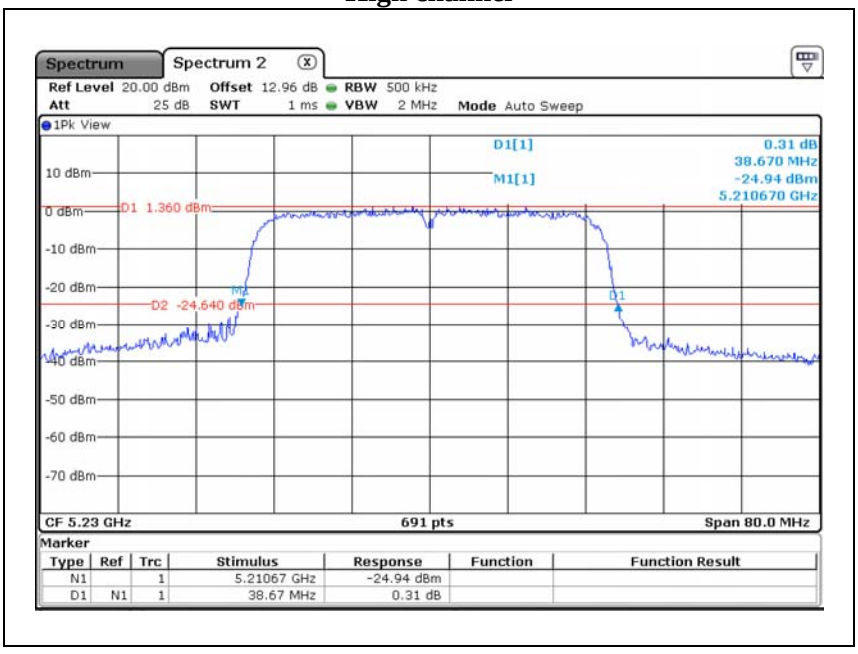


- Antenna port 2

Low channel

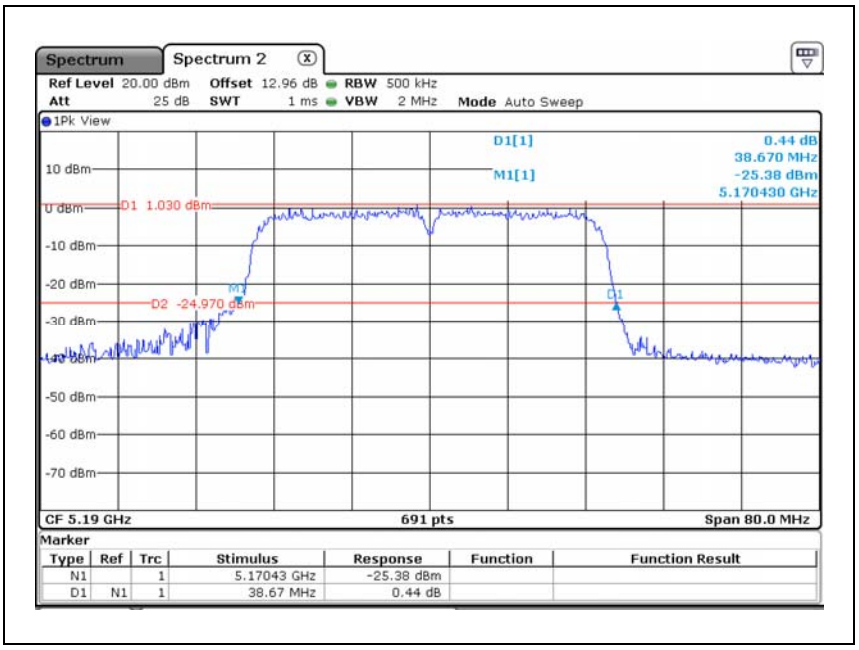


High channel

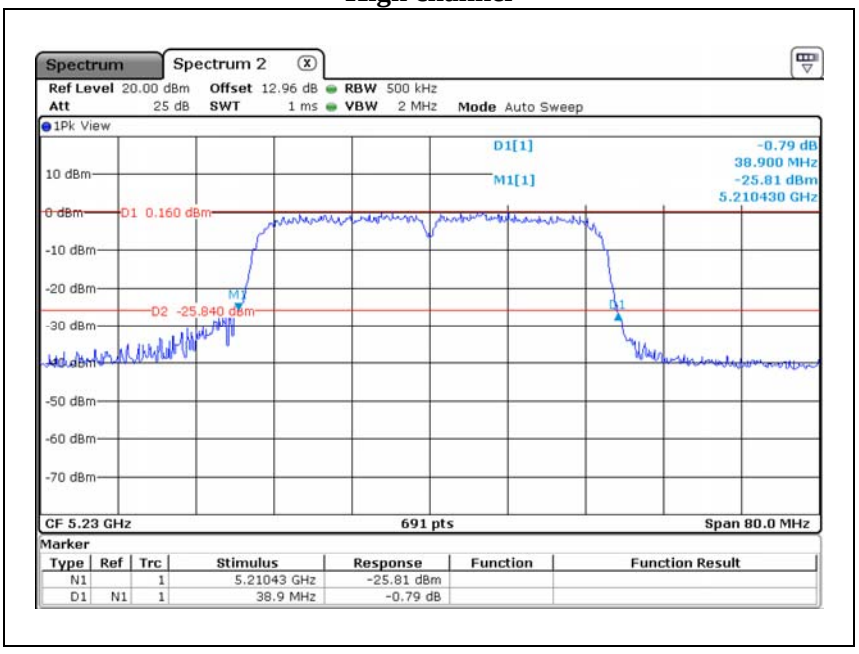


- Antenna port 3

Low channel

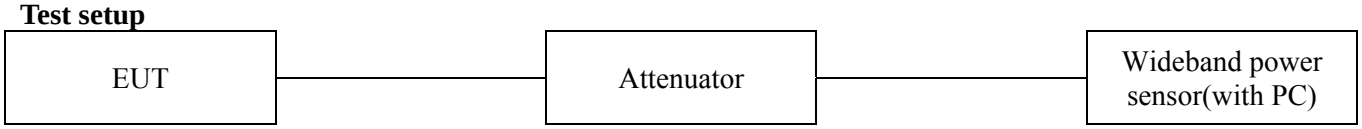


High channel



3.3. Maximum conducted output power

Test setup



Test procedure

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.

KDB 789033 D01_v01r03 – section E) 3) b)
Measurements may be performed using a wideband gated RF power meter provided that the gate parameters are adjusted such that the power is measured only when the EUT is transmitting at its maximum power control level. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.

Limit

(1) For the band 5.15–5.25 ㎓, 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 ㎒. In addition, the peak power spectral density shall not exceed 4 ㏈m in any 1–MHz band. If transmitting antennas of directional gain greater than 6 ㏈i are used, both the maximum conducted output power and the peak power spectral density shall be reduced by the amount in ㏈ that the directional gain of the antenna exceeds 6 ㏈i.

-Limit caculation

Power Limit (㎽) Least 26 dB BW (㎒)	Calculation Limit (㏈m)	Limit (㏈m)
50	16.98	16.98
38.44	19.84	

Pre-scanned maximum output power

Preliminary tests were performed in different data rate as below table and the highest power data rates were chosen for full test in the following section to demonstrate compliance to the FCC limit line.

Frequency (㎒) / Ant port	Output power(dBm)															
	Data rate(Mbps)															
	Mcs0	Mcs1	Mcs2	Mcs3	Mcs4	Mcs5	Mcs6	Mcs7	Mcs8	Mcs9	Mcs10	Mcs11	Mcs12	Mcs13	Mcs14	Mcs15
5 190 /ant 1	12.24	12.22	12.16	12.18	12.10	12.05	12.03	12.01	12.20	12.17	12.14	12.10	12.04	12.07	11.98	11.95
5 230 /ant 1	12.45	12.40	12.41	12.37	12.30	12.33	12.29	12.28	12.44	12.40	12.34	12.30	12.27	12.25	12.21	12.22
5 190 /ant 2	11.34	11.31	11.25	11.20	11.17	11.22	11.18	11.13	11.29	11.24	11.20	11.17	11.15	11.20	11.11	11.10
5 230 /ant 2	11.50	11.43	11.45	11.37	11.30	11.34	11.29	11.27	11.47	11.43	11.40	11.35	11.30	11.27	11.25	11.24
5 190 /ant 3	10.55	10.51	10.53	10.41	10.37	10.31	10.24	10.25	10.51	10.47	10.45	10.40	10.33	10.24	10.20	10.19
5 230 /ant 3	10.67	10.62	10.57	10.55	10.57	10.51	10.47	10.40	10.63	10.60	10.55	10.42	10.47	10.43	10.40	10.38

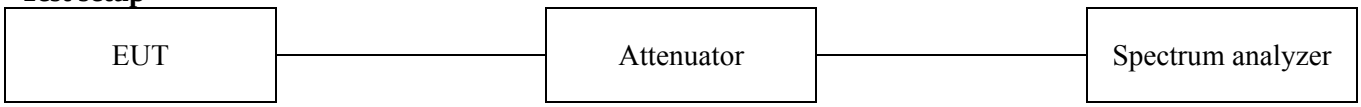
Test results

Frequency (㎒)	Conducted power (dBm)				Limit (dBm)
	Ant. 1	Ant. 2	Ant. 3	Total	
5 190	12.24	11.34	10.55	16.20	16.98
5 230	12.45	11.50	10.67	16.37	16.98

Ant Gain = 10 log [($10^{G1/10} + 10^{G2/10} + 10^{G3/10}$) /N] = 5.62 dBi < 6 dBi, so no need to reduce the limit.
Total = 10 log ($10^{Ant1/10} + 10^{ANT2/10} + 10^{ANT3/10}$)

3.4. Peak power spectral density

Test setup



Test procedure

KDB 789033 D01_v01r03 – section F)

Measurement procedure

1) Create an average power spectrum for the EUT operating mode being tested by following the instructions in section E)2) for measuring maximum conducted output power using a spectrum analyzer or EMI receiver: select the appropriate test method (SA-1, SA-2, SA-3, or alternatives to each) and apply it up to, but not including, the step labeled, “Compute power…”. (This procedure is required even if the maximum conducted output power measurement was performed using a power meter, method PM.)
2) Use the peak search function on the instrument to find the peak of the spectrum.
3) Make the following adjustments to the peak value of the spectrum, if applicable:
If Method SA-2 or SA-2 Alternative was used, add 10 log(1/x), where x is the duty cycle, to the peak of the spectrum.

Limit

For the band 5.15~5.25 ㎓, the peak power spectral density shall not exceed 4 ㏈m in any 1 ㎒ band.

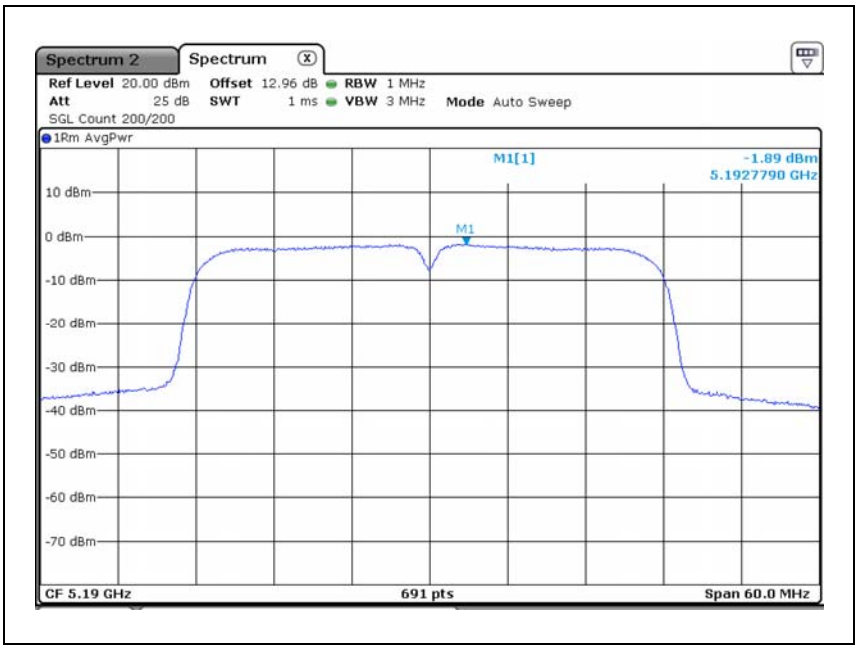
Test results

Frequency (㎒)	Measured (dBm)			DCF (dB)	Calculated (dBm)			Total (dBm)	Limit (dBm)
	Ant. 1	Ant. 2	Ant. 3		Ant. 1	Ant. 2	Ant. 3		
5 190	-1.89	-2.80	-2.55	0.22	-1.67	-2.58	-2.33	2.60	4
5 230	-1.49	-2.54	-2.69	0.22	-1.27	-2.32	-2.47	2.78	4

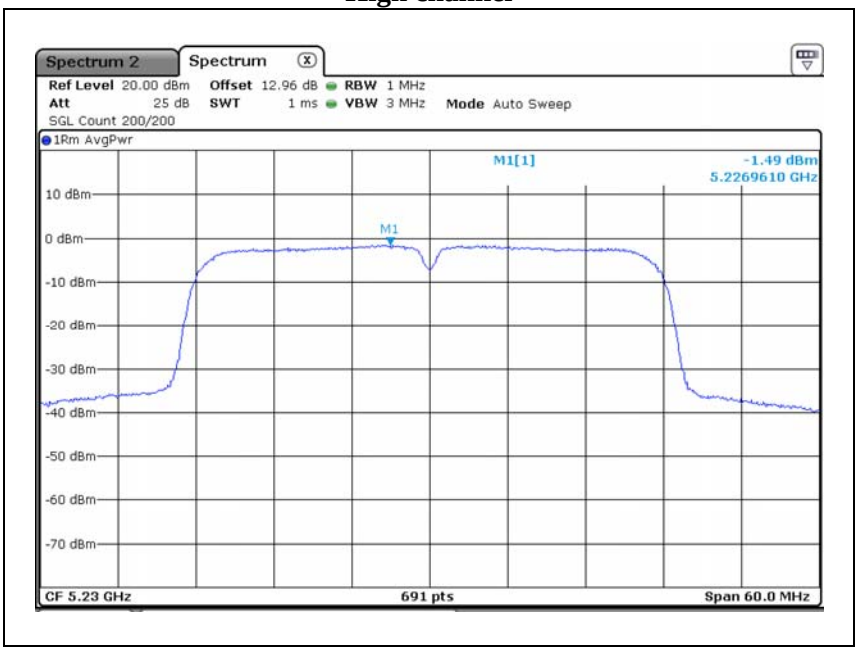
DCF (Duty cycle Correction Factor) = 10log(1/Duty cycle)
Calculated = Measured + DCF
Total = 10 log (10 $^{\text{calculated Ant1/10}}$ + 10 $^{\text{calculated ANT2/10}}$ + 10 $^{\text{calculated ANT3/10}}$)
Ant Gain = 10 log [($10^{G1/10}$ + $10^{G2/10}$ + $10^{G3/10}$) /N] = 5.62 dBi < 6 dBi, so no need to reduce the limit.

- Antenna port 1

Low channel

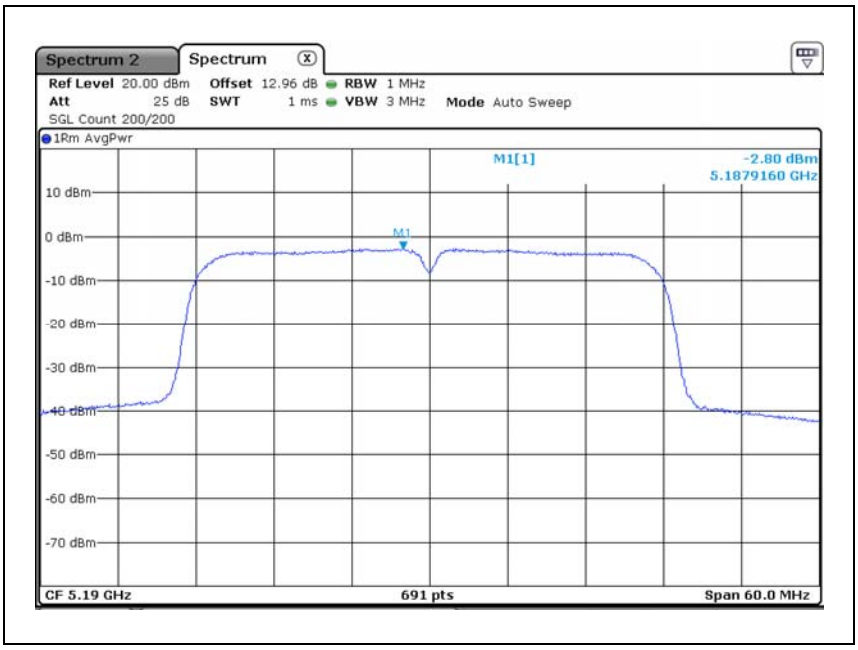


High channel

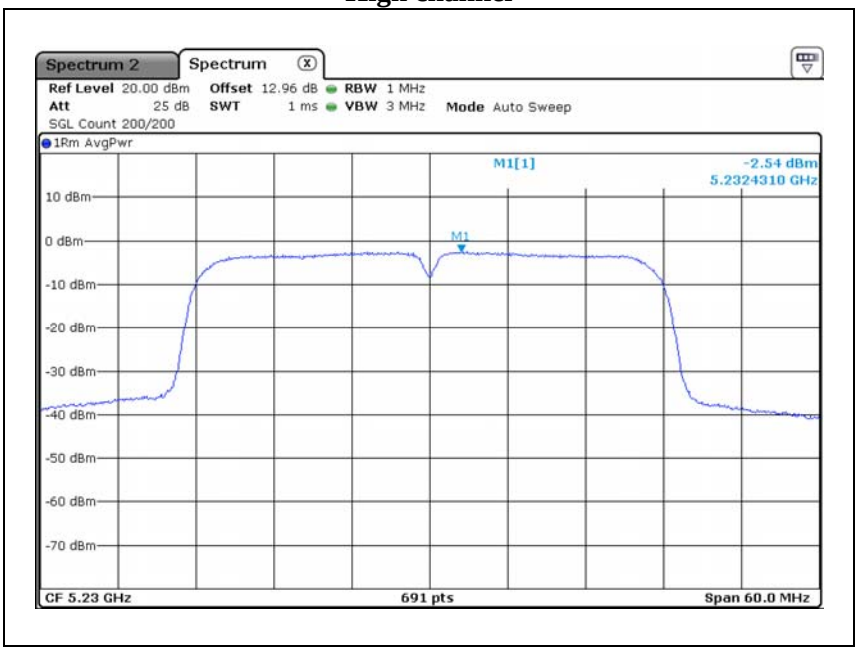


- Antenna port 2

Low channel

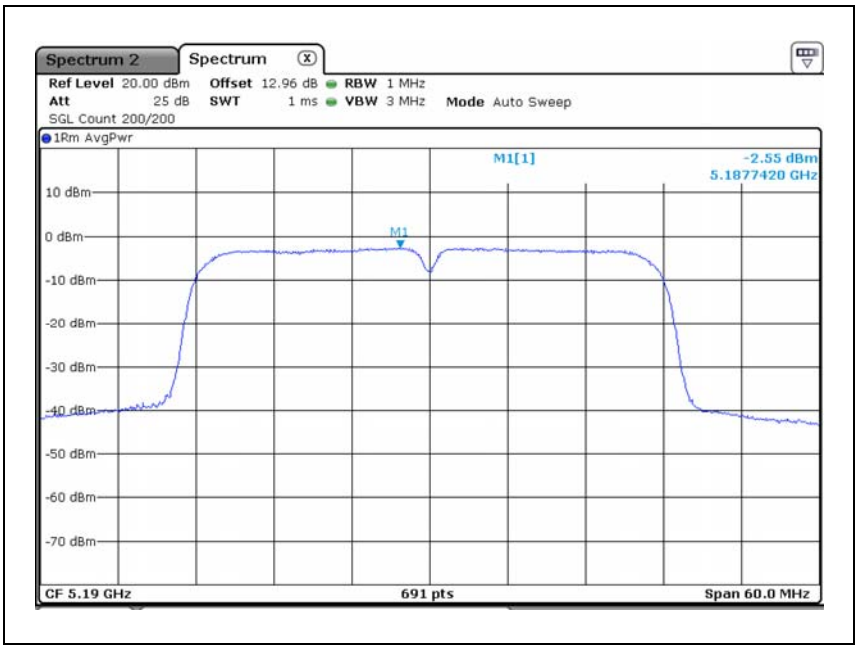


High channel

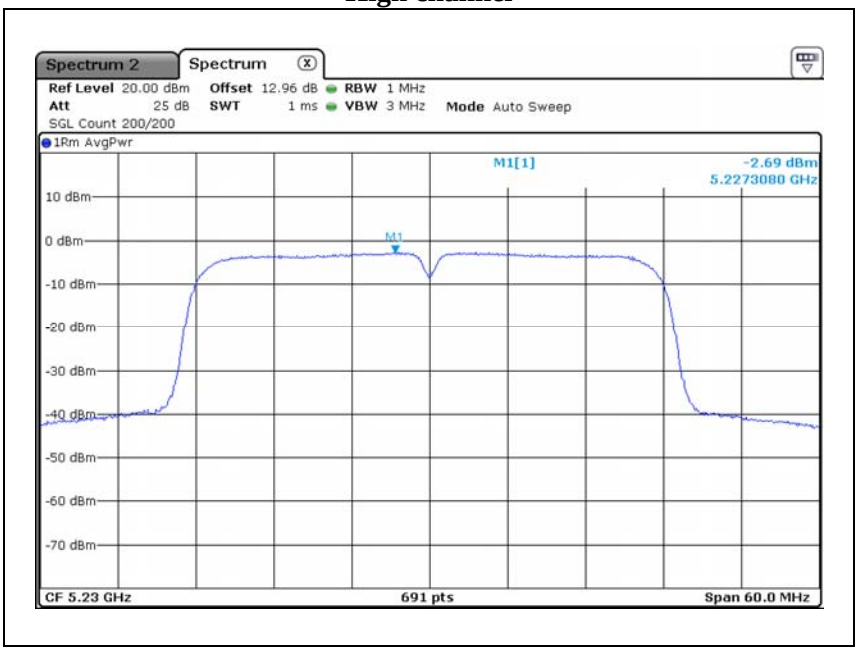


- Antenna port 3

Low channel

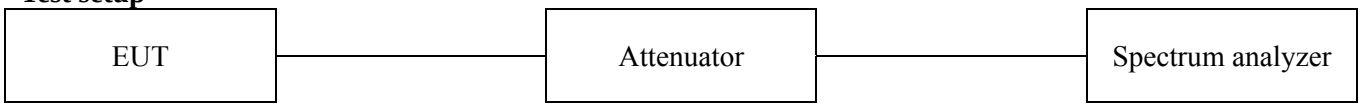


High channel



3.5. Peak excursion

Test setup



Test procedure

KDB 789033 D01_v01r03 – section G)

Measurement procedure

1) Compliance with the peak excursion requirement of Section 15.407(a)(6) shall be demonstrated by confirming that the ratio of the maximum of the peak-max-hold spectrum to the maximum of the average spectrum for continuous transmission does not exceed 13 ㏈. (Earlier procedures that required computing the ratio of the two spectra at each frequency across the emission bandwidth can lead to unintended failures at band edges and will no longer be required.)
2) Set the spectrum analyzer or EMI receiver span to view the entire emission bandwidth.
3) Find the maximum of the peak-max-hold spectrum.
 a) Set RBW = 1 ㎒.
 b) VBW ≥ 3 ㎒.
 c) Detector = peak.
 d) Trace mode = max-hold.
 e) Allow the sweeps to continue until the trace stabilizes.
 f) Use the peak search function to find the peak of the spectrum.
4) Use the procedure found under F) to measure the PPSD.
5) Compute the ratio of the maximum of the peak-max-hold spectrum to the PPSD.

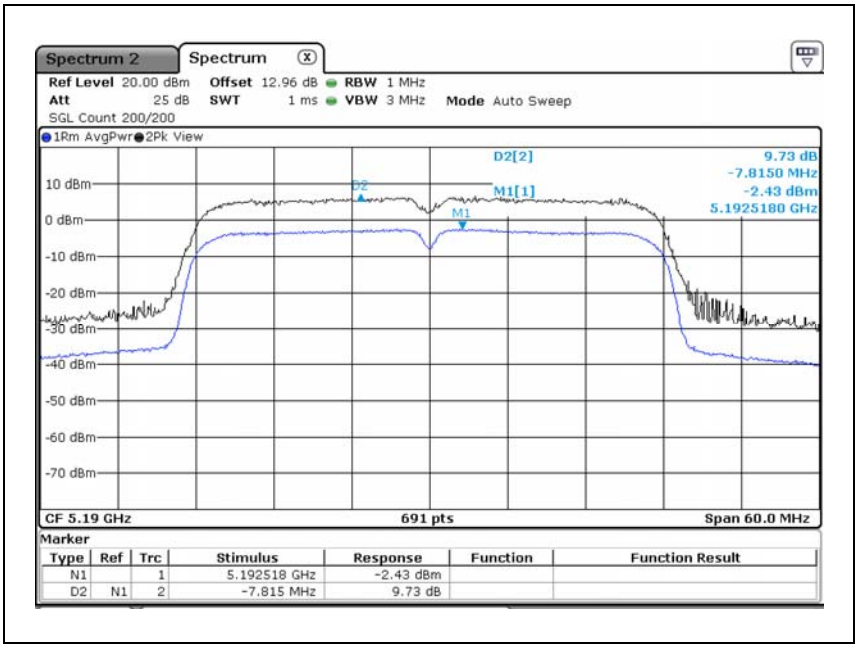
Limit

The ratio of the peak excursion of the modulation envelope (using Peak hold) to the maximum conducted output power shall not exceed 13 ㏈/㎒

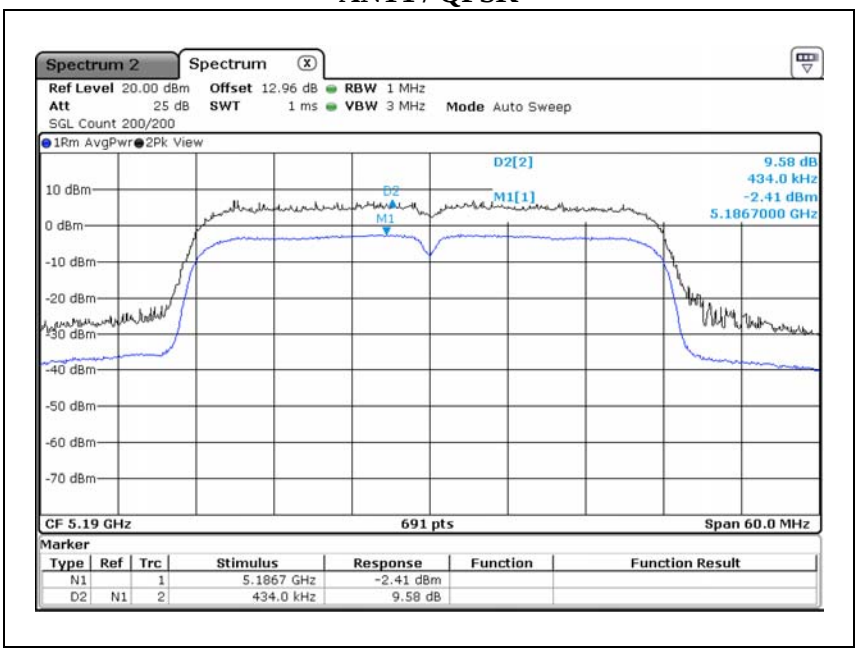
Test results

Frequency (㎒)	Modulation Type	Measured (dB)			Limit (dB)
		Ant. 1	Ant. 2	Ant. 3	
5 190	BPSK	9.73	10.02	10.30	13
	QPSK	9.58	9.20	9.66	
	16QAM	9.68	9.68	9.66	
	64QAM	10.54	10.62	10.61	

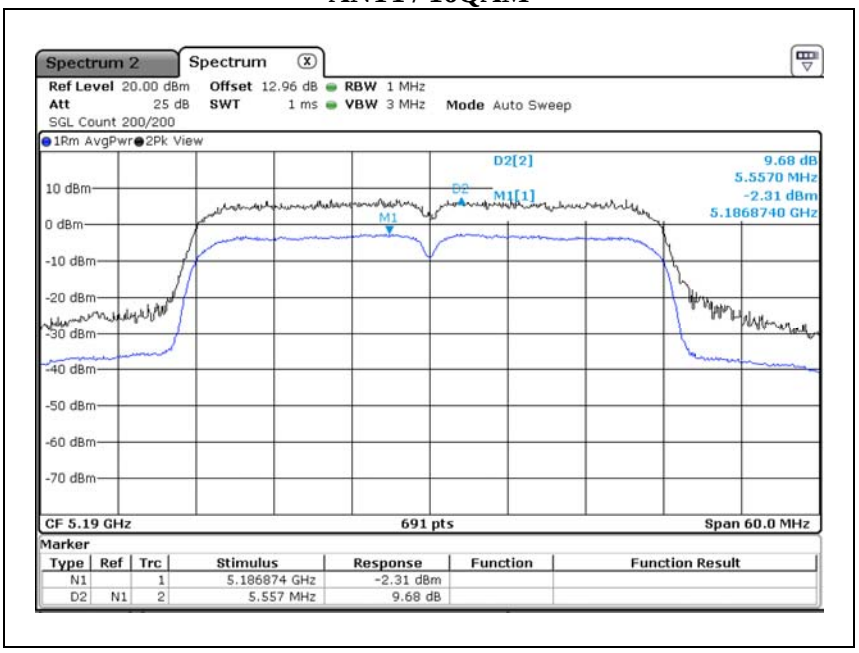
ANT1 / BPSK



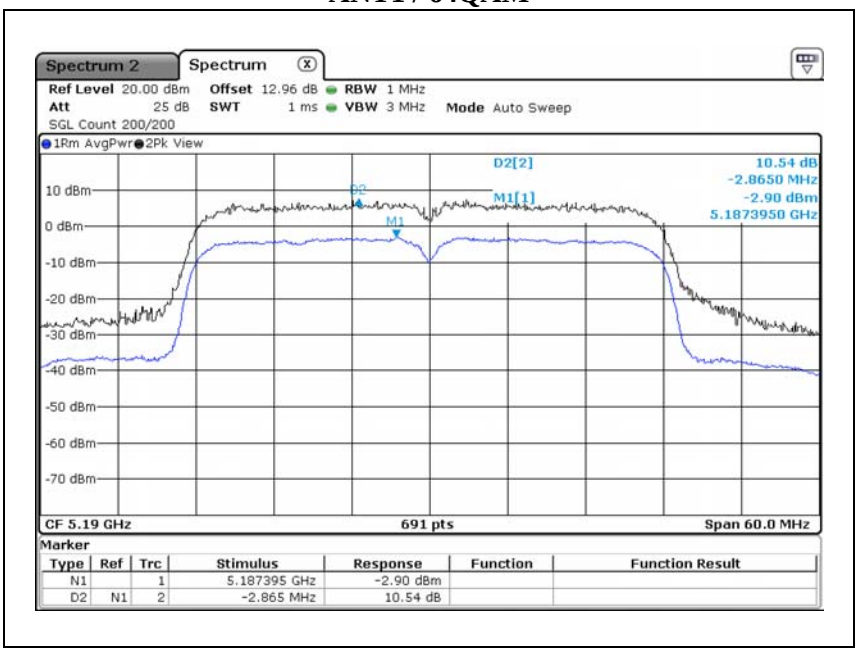
ANT1 / QPSK



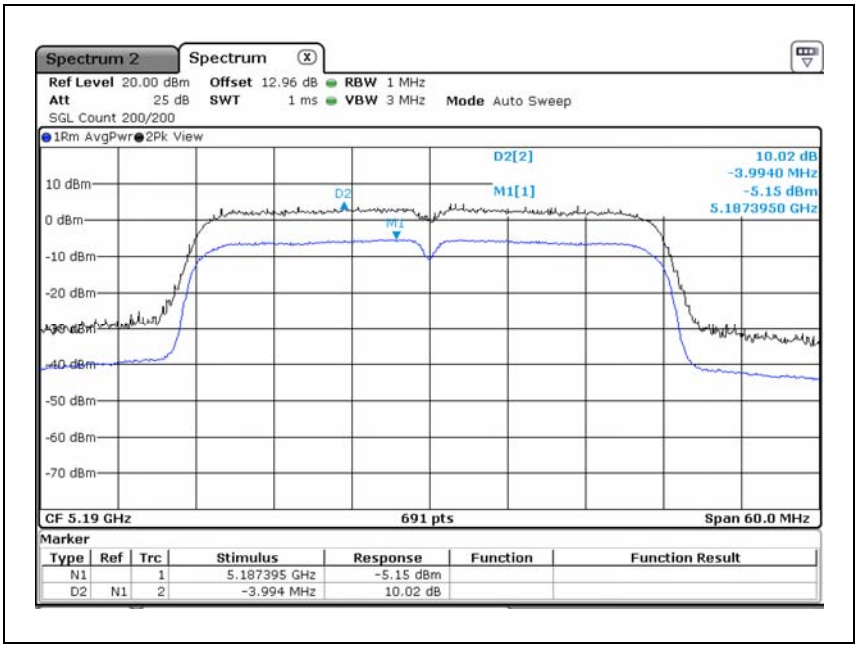
ANT1 / 16QAM



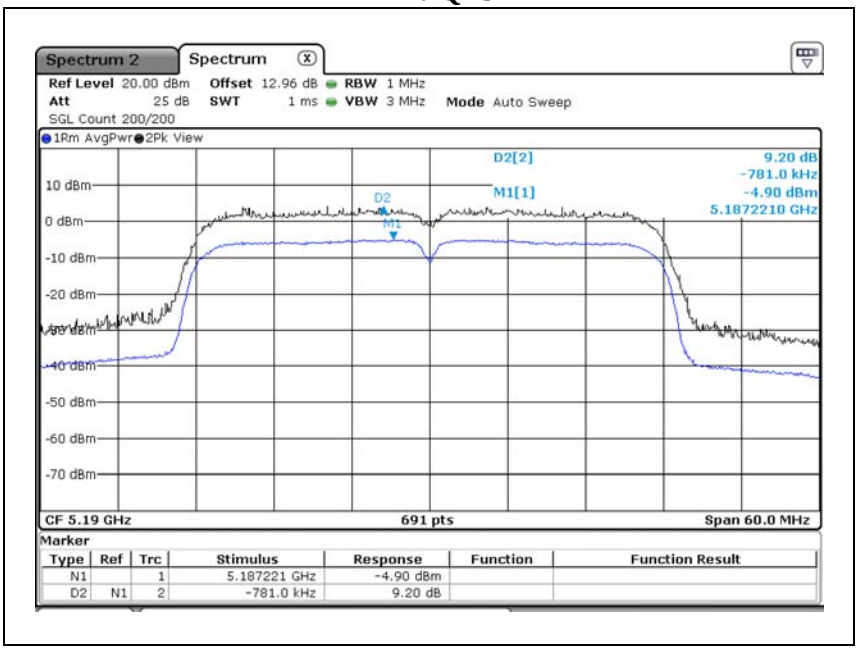
ANT1 / 64QAM



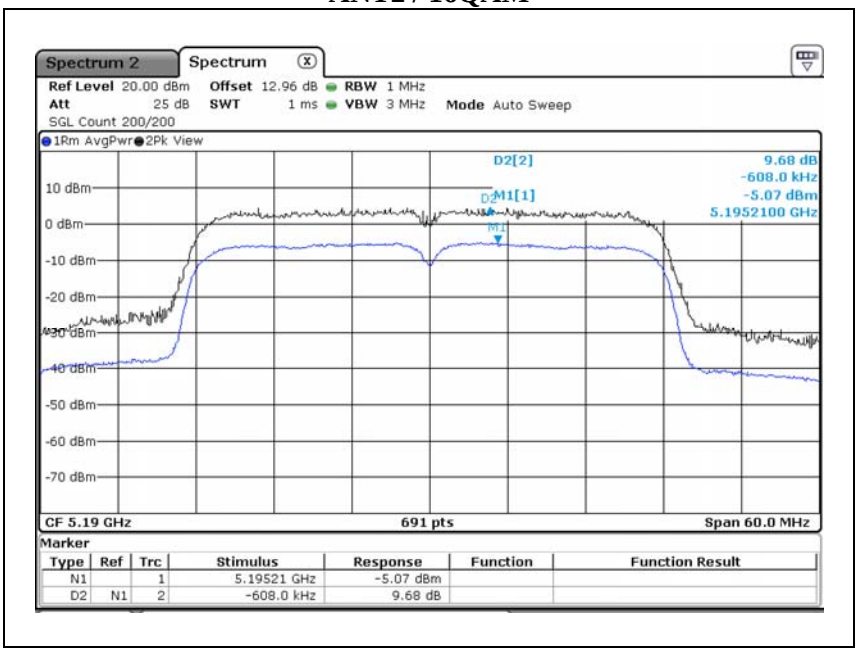
ANT2 / BPSK



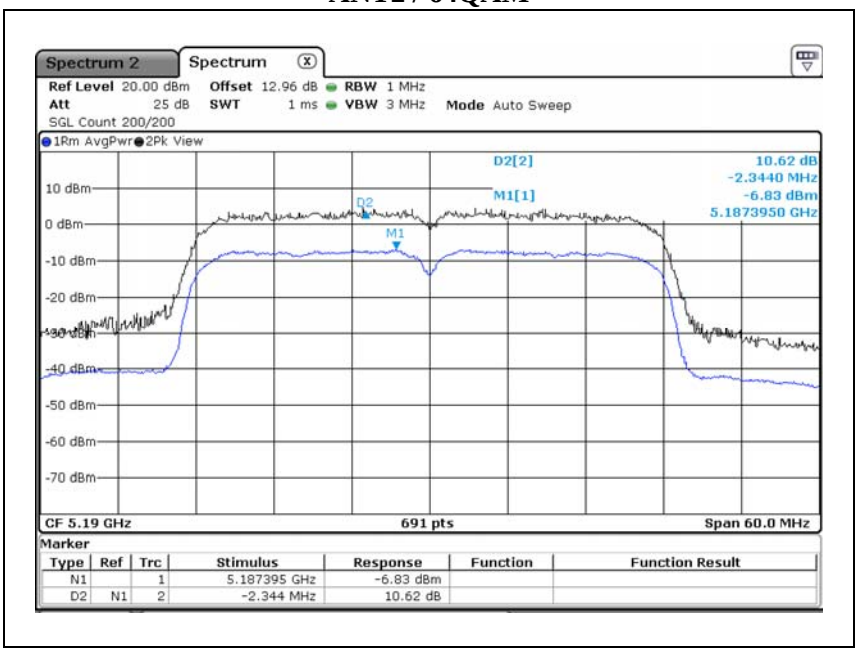
ANT2 / QPSK



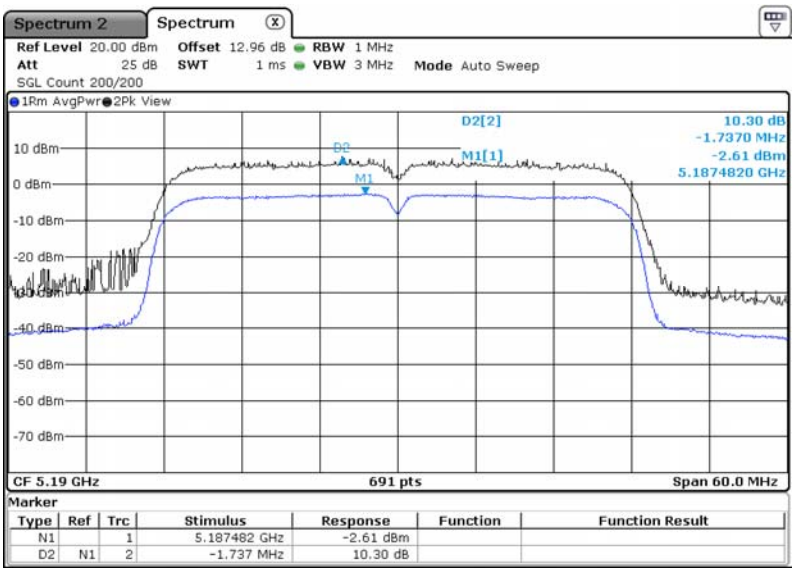
ANT2 / 16QAM



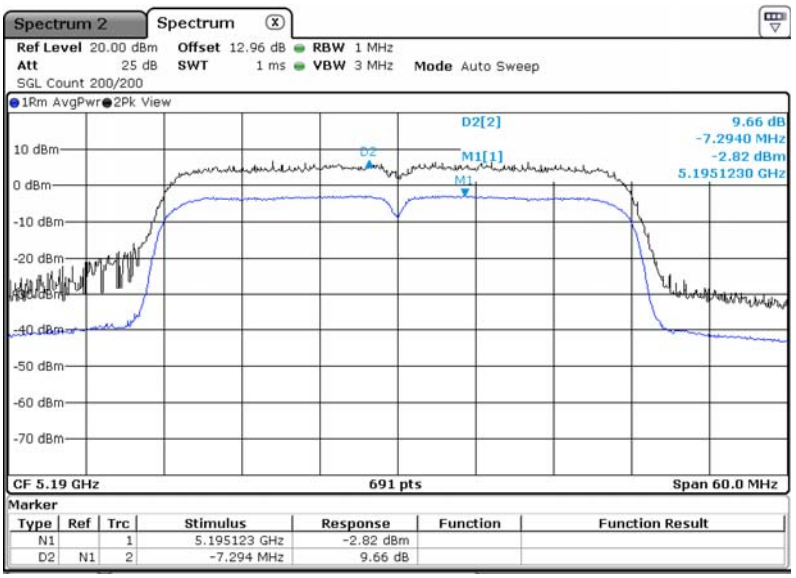
ANT2 / 64QAM



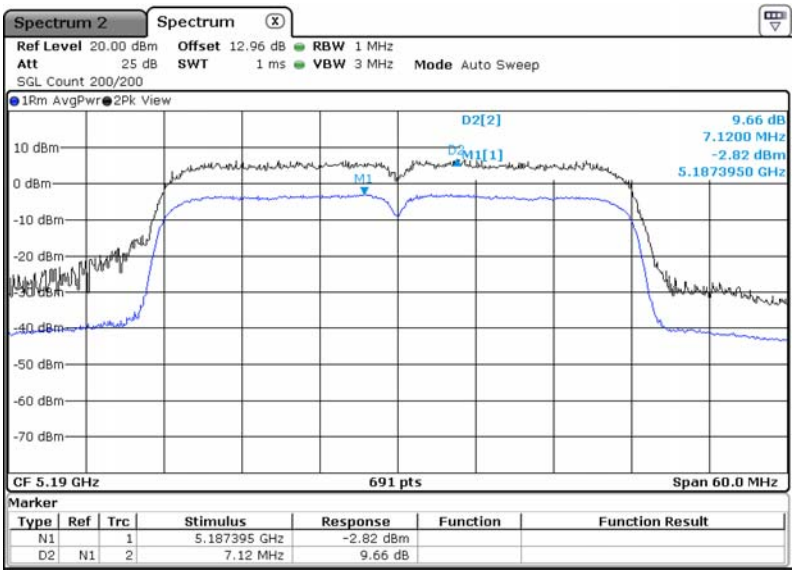
ANT3 / BPSK



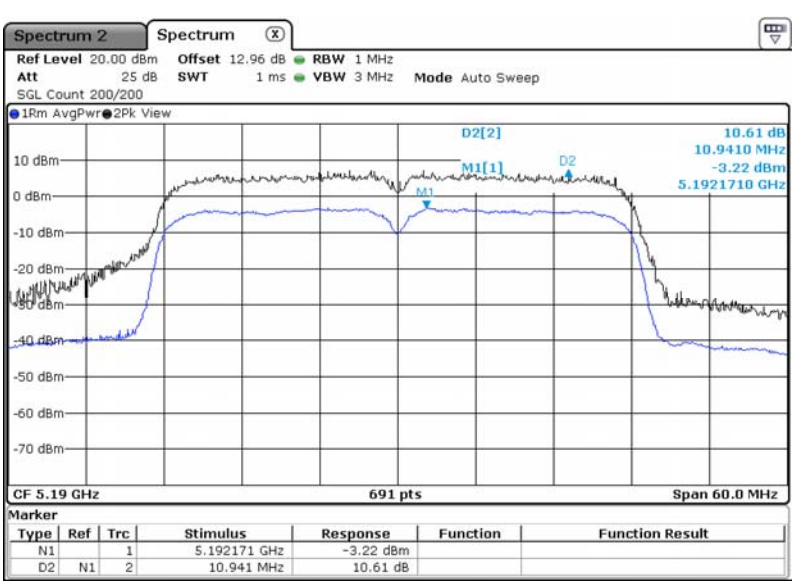
ANT3 / QPSK



ANT3 / 16QAM

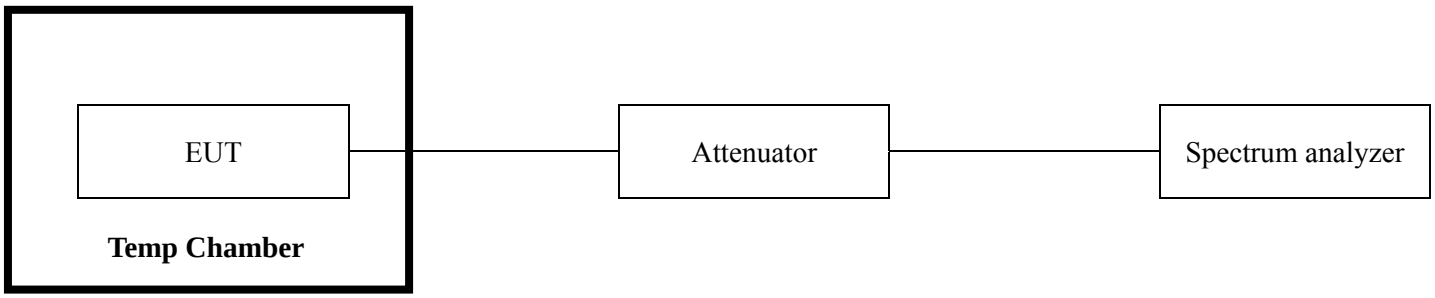


ANT3 / 64QAM



3.6. Frequency Stability

Test setup



Test procedure

Measurement procedure

1) The EUT was placed inside the environmental test chamber and powered by nominal AC voltage.
2) Turn the EUT on and couple its output to a spectrum analyzer.
3) Turn the EUT off and set the chamber to the highest temperature specified.
4) Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize, turn the EUT on and measure the operating frequency.
5) Repeat step 2 and 3 with the temperature chamber set to the lowest temperature.
6) The test chamber was allowed to stabilize at +20 degree C for a minimum of 30 minutes. The supply voltage was then adjusted on the EUT from 85% to 115% and the frequency record.

Limit

Manufacturers of U-NII devices are responsible for ensuring frequency stability such that an emission is maintained within the band of operation under all conditions of normal operation as specified in the users manual.

Test results (Center Frequency : 5190 ㎒)

AC Input(Vac)	Temp (°C)	Frequency(㎐)	Dev(%)
120	25	5 189 926 408	-0.001 417 958
	70	5 189 910 715	-0.001 720 328
	60	5 189 924 822	-0.001 448 516
	50	5 189 926 770	-0.001 410 983
	40	5 189 934 258	-0.001 266 705
	30	5 189 941 635	-0.001 124 566
	20	5 189 974 217	-0.000 496 782
	10	5 189 990 439	-0.000 184 220
	0	5 189 998 144	-0.000 035 761
138	25	5 189 931 943	-0.001 311 310
102	25	5 189 927 160	-0.001 403 468

-Test port : ANT1

3.7. AC conducted emissions

Frequency range of measurement
150 ㎑ to 30 ㎒

Instrument settings
IF Band Width: 9 ㎑

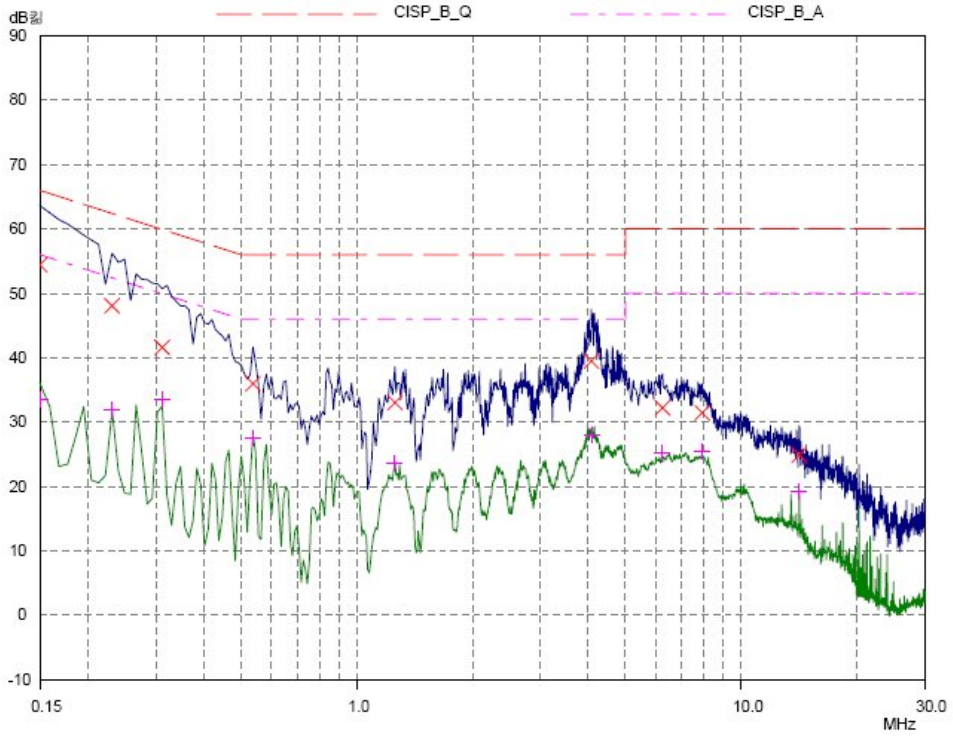
Test procedures
The EUT was placed on a non-metallic table 0.8m above the metallic, grounded floor and 0.4m from the reference ground plane wall. The distance to other metallic surfaces was at least 0.8m. Amplitude measurements were performed with a quasi-peak detector and an average detector.

Limit
According to 15.207(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 50uH/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

Note.
a) Decreases with the logarithm of the frequency.
b) All AC Conducted emission at channels are almost the same, so that high channel was chosen at representative in final test.

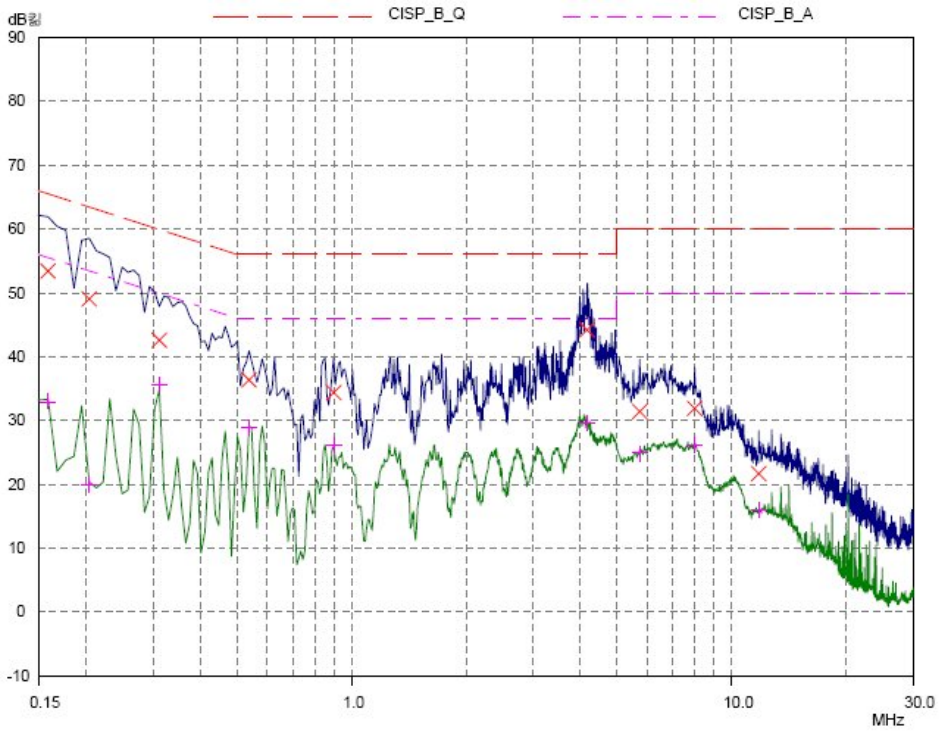
Test results



Frequency MHz	QP Level dBㅔ	QP Limit dBㅔ	QP Delta dB
0.15	54.42	66.00	11.58
0.231	48.04	62.41	14.37
0.312	41.58	59.92	18.34
0.537	35.96	56.00	20.04
1.257	33.03	56.00	22.97
4.074	39.47	56.00	16.53
6.242	32.19	60.00	27.81
7.916	31.42	60.00	28.58
14.153	24.86	60.00	35.14

Frequency MHz	AV Level dBㅔ	AV Limit dBㅔ	AV Delta dB
0.15	33.43	56.00	22.57
0.231	31.84	52.41	20.57
0.312	33.53	49.92	16.39
0.537	27.41	46.00	18.59
1.257	23.62	46.00	22.38
4.074	27.87	46.00	18.13
6.242	25.16	50.00	24.84
7.916	25.43	50.00	24.57
14.153	19.28	50.00	30.72

Note: Hot Line
Both Cable loss and LISN factor are included in measurement level(QP Level or AV Level).



Frequency MHz	QP Level dBµV	QP Limit dBµV	QP Delta dB
0.159	53.40	65.52	12.12
0.204	49.06	63.45	14.39
0.312	42.56	59.92	17.36
0.537	36.34	56.00	19.66
0.897	34.37	56.00	21.63
4.16399	44.18	56.00	11.82
5.729	31.40	60.00	28.60
7.997	31.88	60.00	28.12
11.777	21.67	60.00	38.33

Frequency MHz	AV Level dBµV	AV Limit dBµV	AV Delta dB
0.159	32.93	55.52	22.59
0.204	19.88	53.45	33.57
0.312	35.68	49.92	14.24
0.537	28.94	46.00	17.06
0.897	26.05	46.00	19.95
4.16399	29.48	46.00	16.52
5.729	24.86	50.00	25.14
7.997	26.09	50.00	23.91
11.777	16.04	50.00	33.96

Note: Neutral Line
Both Cable loss and LISN factor are included in measurement level(QP Level or AV Level).

Appendix A. Measurement equipment

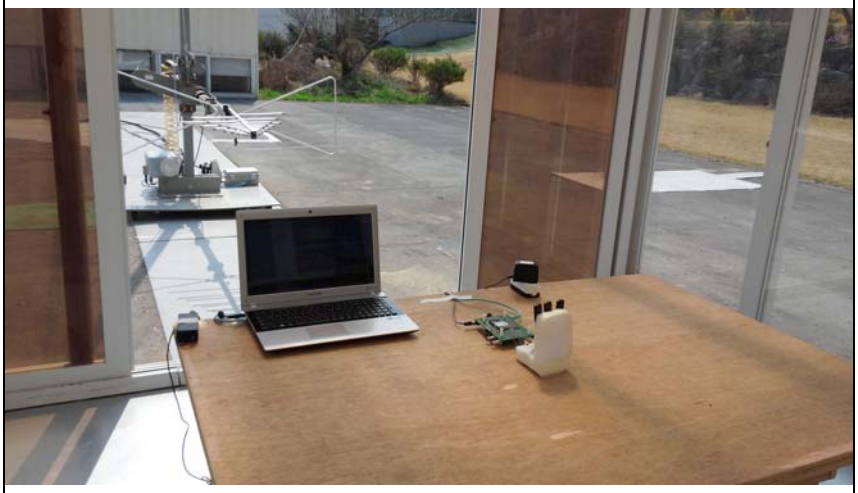
Equipment	Manufacturer	Model	Serial No.	Calibration interval	Calibration due.
Spectrum analyzer	R&S	FSV30	101389	1 year	2014.05.06
Spectrum analyzer	R&S	FSW43	100637	1 year	2014.07.26
Wideband Power Sensor	R&S	NRP-Z81	1137.9009.02-101886-ds	1 year	2015.01.07
Vector signal generator	R&S	SMBV2100A	1407.6004K02	1 year	2015.01.06
8360B Series Swept Signal Generator	HP	83630B	3844A00786	1 year	2014.05.06
Loop antenna	R&S	HFH2-Z2.335.4711.52	826532	2 years	2015.04.25
Trilog-broadband antenna	Schwarzbeck	VULB 9168	9168-385	2 years	2015.05.09
Horn antenna	A.H.	SAS-571	414	2 years	2015.02.28
Horn antenna	Schwarzbeck	BBHA 9170	BBHA9170551	2 years	2015.09.04
Preamplifier	HP	8447F	2805A02570	1 year	2014.05.06
Brodband coaxial preamplifier	Schwarzbeck Mess-Elektronik	BB9718	9168-385	2 years	2014.09.23
Preamplifier	Schwarzbeck	BBV 9721	9721-003	2 years	2015.09.04
Attenuator	HP	8494B	2630A12857	1 year	2014.05.06
EMI Test Receiver	LIG NEX1	ISA-80	L0912K014	1 year	2014.11.15
EMI Test Receiver	R & S	ESHS10	862970/018	1 year	2014.05.06
LISN	SCHWARZBECK	2823-568-1	8126157	1 year	2015.01.29
HIGH PASS FILTER	WAINWRIGHT INSTRUMENT	WHNX6.0/26.5G-6SS	1	1 year	2015.02.11
LOW PASS FILTER	WEINSCHEL	WLK1.0/18G-10TT	1	1 year	2014.08.05

Peripheral devices

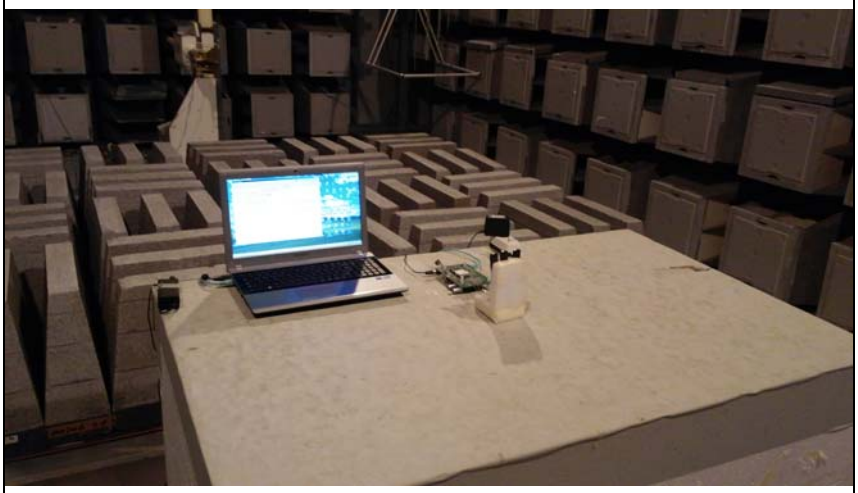
Device	Manufacturer	Model No.	Serial No.
Notebook(Laptop)	Samsung Electronics	RV518	HTK991NC600207R

Appendix B. Test setup photo

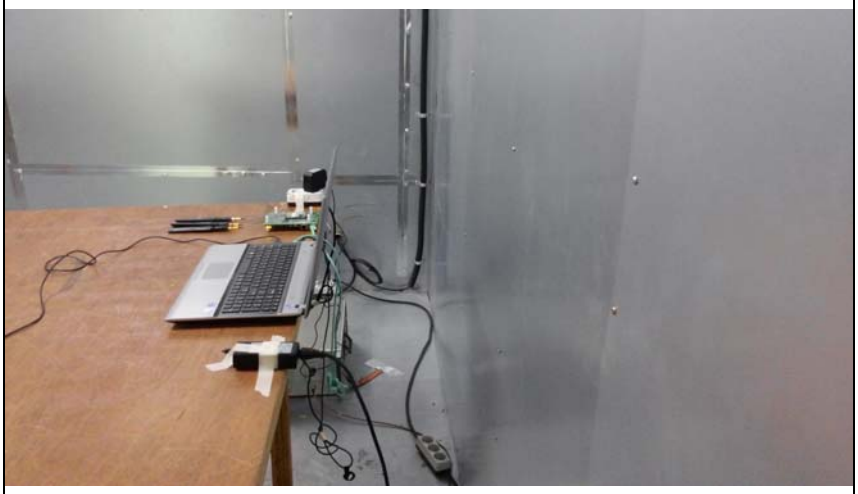
Radiated Emission (30MHz~1GHz)



Radiated Emission (Above 1GHz)



AC conducted Emission



Appendix C. Duty Cycle

Frequency (㎒)	Data rate	Duty cycle(X) = Tx_{on} time / (Tx_{on} time + Tx_{off} time)		
		Tx_{on} time (㎳)	Tx_{off} time (㎳)	X
5190	MCS0	0.646	0.033	0.951