TEST REPORT

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Suwon-si, Gyeonggi-do, 16677, Korea
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KCTL

1. Client

- Name : Kaonbroadband CO., Ltd
- Address : 884-3, Seongnam-daero, Bundang-gu, Seongnam-si, Gyeonggi-do, Republic of Korea
- Date of Receipt : 2020-03-18

2. Use of Report : Certification

3. Name of Product / Model : GPON Gateway / PG2141

4. Manufacturer / Country of Origin : Kaonbroadband CO., Ltd / Korea

5. FCC ID : 2AXCW-PG2141

6. Date of Test : 2020-04-17 to 2020-07-03

7. Location of Test : ■ Permanent Testing Lab □ On Site Testing (Address: Address of testing location)

8. Test method used : FCC Part 15 Subpart C, 15.247

9. Test Results : Refer to the test result in the test report

Affirmation	Tested by Name : Euijung Kim (Signature)	Technical Manager Name : Heesu Ahn (Signature)

2020-09-14

KCTL Inc.

REPORT REVISION HISTORY

Date	Revision	Page No
2020-08-27	Originally issued	-
2020-09-10	Updated	8
2020-09-14	Updated	23, 155

Note. The report No. KR20-SRF0201-A is superseded by the report No. KR20-SRF0201-B.

General remarks for test reports

Nothing significant to report.

CONTENTS

1. General information

Client	:	Kaonbroadband CO., Ltd
Address	:	884-3, Seongnam-daero, Bundang-gu, Seongnam-si, Gyeonggi-do, Republic of Korea
Manufacturer	:	Kaonbroadband CO., Ltd
Address	:	884-3, Seongnam-daero, Bundang-gu, Seongnam-si, Gyeonggi-do, Republic of Korea
Laboratory	:	KCTL Inc.
Address	:	65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea
Accreditations	:	FCC Site Designation No: KR0040, FCC Site Registration No: 687132
		VCCI Registration No. : R-20080, G-20078, C-20059, T-20056
		Industry Canada Registration No. : 8035A
		KOLAS No.: KT231

2. Device information

Equipment under test	:	GPON Gateway
Model	:	PG2141
Frequency range	:	2 412 ㎒ ~ 2 462 ㎒ (802.11b/g/n_HT20)
		2 422 ㎒ ~ 2 452 ㎒ (802.11n_HT40)
		UNII-1: 5 180 ㎒ ~ 5 240 ㎒ (11a/n_HT20/ac_VHT20)
		UNII-1: 5 190 ㎒ ~ 5 230 ㎒ (11n_HT40/ac_VHT40)
		UNII-1: 5 210 ㎒ (11ac_VHT80)
		UNII-2A: 5 260 ㎒ ~ 5 320 ㎒ (11a/n_HT20/ac_VHT20)
		UNII-2A: 5 270 ㎒ ~ 5 310 ㎒ (11n_HT40/ac_VHT40)
		UNII-2A: 5 290 ㎒ (11ac_VHT80)
		UNII-2C: 5 500 ㎒ ~ 5 720 ㎒ (11a/n_HT20/ac_VHT20)
		UNII-2C: 5 510 ㎒ ~ 5 710 ㎒ (11n_HT40/ac_VHT40)
		UNII-2C: 5 530 ㎒ ~ 5 690 ㎒ (11ac_VHT80)
		UNII-3: 5 745 ㎒ ~ 5 825 ㎒ (11a/n_HT20/ac_VHT20)
		UNII-3: 5 755 ㎒ ~ 5 795 ㎒ (11n_HT40/ac_VHT40)
		UNII-3: 5 775 ㎒ (11ac_VHT80)
Modulation technique	:	DSSS (802.11b)
		OFDM (802.11a/g/n_HT20/ HT40/ac_VHT20/ VHT40/ VHT80)
Number of channels	:	11 ch (802.11b/g/n_HT20)_2.4 ㎓ Band
		9 ch (802.11n_HT40)_2.4 ㎓ Band
		UNII-1: 4 ch (20 ㎒), 2 ch (40 ㎒), 1 ch (80 ㎒)
		UNII-2A: 4 ch (20 ㎒), 2 ch (40 ㎒), 1 ch (80 ㎒)
		UNII-2C: 12 ch (20 ㎒), 6 ch (40 ㎒), 3 ch (80 ㎒)
		UNII-3: 5 ch (20 ㎒), 2 ch (40 ㎒), 1 ch (80 ㎒)
Power source	:	DC 12 V
Antenna specification	:	PCB Antenna
		2.4G ANT 0: 1.90 ㏈i, ANT 1: 1.90 ㏈i, ANT 2: 1.90 ㏈i
		UNII-1 ANT 0: 1.50 ㏈i, ANT 1: 1.60 ㏈i, ANT 2: 1.60 ㏈i, ANT 3: 1.70 ㏈i
		UNII-2A ANT 0: 1.60 ㏈i, ANT 1: 1.50 ㏈i, ANT 2: 1.50 ㏈i, ANT 3: 1.60 ㏈i
		UNII-2C ANT 0: 1.80 ㏈i, ANT 1: 2.00 ㏈i, ANT 2: 2.00 ㏈i, ANT 3: 1.70 ㏈i

		UNII-3 ANT 0: 2.00 dBi, ANT 1: 1.70 dBi, ANT 2: 1.70 dBi, ANT 3: 1.60 dBi
Software version	:	PG2141_OrigSDK.FCC_v1.0.15.w
Hardware version	:	REV1.0
Operation temperature	:	22 ℃

2.1. Accessory information

Equipment	Manufacturer	Model	Serial No.	FCC ID
AC Adapter	MOSO Technology Co., Ltd.	MSA-C2000IS 12.0-24Y-DE	N/A	N/A

2.2. Frequency/channel operations

This device contains the following capabilities:
2.4 ㎓ WIFI: WLAN 802.11b/g/n(HT20,HT40)
5 ㎓ WIFI: WLAN 802.11a/g/n(HT20,HT40)/ac(VHT20,VHT40,VHT80)

Ch.	Frequency (㎒)
01	2 412
.	.
.	.
06	2 437
.	.
.	.
11	2 462

Table 2.2.1. 802.11b/g/n(HT20) mode

Ch.	Frequency (㎒)
03	2 422
.	.
.	.
06	2 437
.	.
.	.
09	2 452

Table 2.2.2. 802.11n(HT40) mode

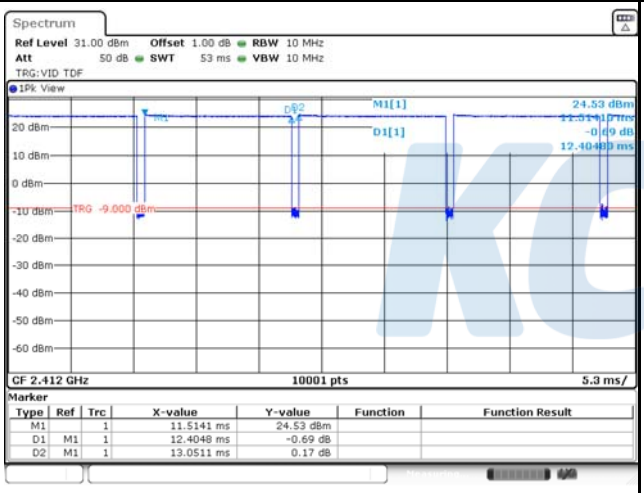
2.3. Duty Cycle Factor

Test mode	T_{on} time (ms)	Period (ms)	Duty cycle		Duty cycle factor (dB)
			(Linear)	(%)	
802.11b	12.404 8	13.051 1	0.950 5	95.05	0.22
802.11g	2.049 3	2.154 6	0.951 1	95.11	0.22
802.11n_HT20	1.906 2	2.004 3	0.951 1	95.11	0.22
802.11n_HT40	0.994	1.042	0.906 0	90.60	0.43

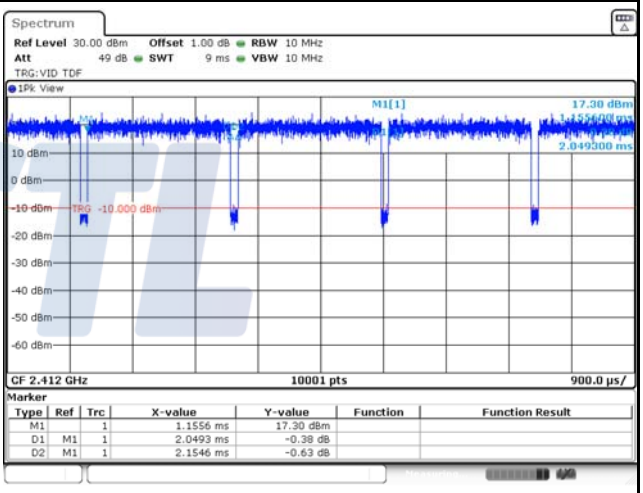
Notes.

1. Duty cycle (Linear) = T_{on} time / Period
2. DCF(Duty cycle factor) = 10log(1/duty cycle)
3. DCF is not applied as a continuous transmitter when the duty cycle is 98% or more.

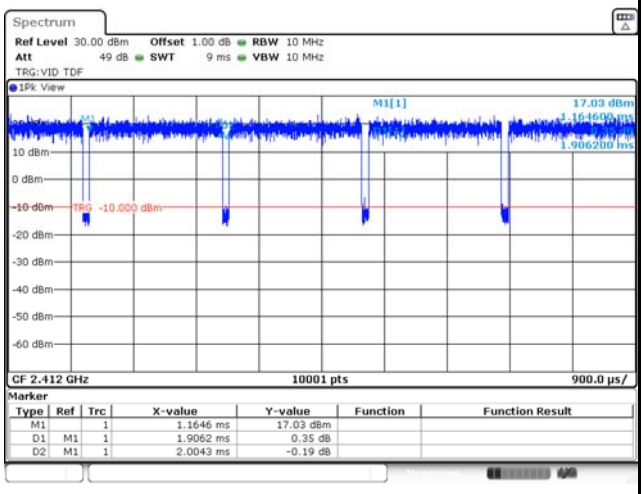
802.11b



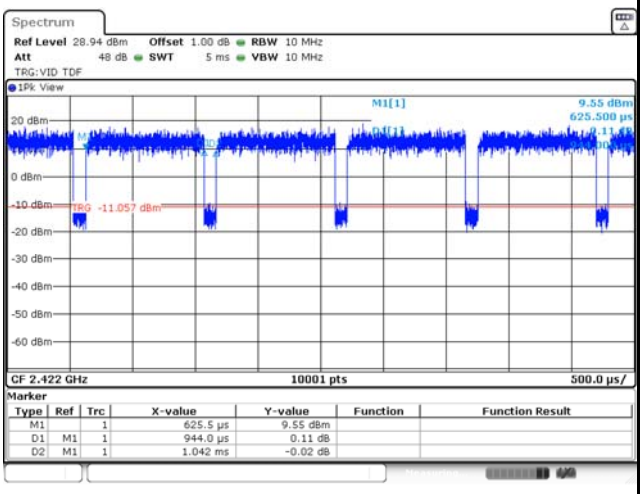
802.11g



802.11n_HT20



802.11n_HT40



2.4. Power level setup in software

Power level setup in software					
Test Mode	Frequency	Sortware Setup			
		ANT 0	ANT 1	ANT 2	3TX MIMO
802.11b	2 412 ㎒	87	87	87	81
	2 437 ㎒	88	88	88	83
	2 462 ㎒	87	87	87	81
802.11g	2 412 ㎒	69	69	69	60
	2 437 ㎒	82	82	82	60
	2 462 ㎒	69	69	69	60
802.11n HT20	2 412 ㎒	68	68	68	60
	2 437 ㎒	82	82	82	60
	2 462 ㎒	68	68	68	60
802.11n HT40	2 422 ㎒	60	60	60	56
	2 437 ㎒	82	82	82	56
	2 452 ㎒	60	60	60	56

3. Antenna requirement

Requirement of FCC part 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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

- The transmitter has permanently attached PCB Antenna (internal antenna) on board.
- The E.U.T Complies with the requirement of §15.203, §15.247.

3.1 Antenna information

Mode	SISO			CDD	MIMO
	ANT 0	ANT 1	ANT 2	ANT 0 + 1 + 2	ANT 0 + 1 + 2
802.11b	√	√	√	√	√
802.11g	√	√	√	√	√
802.11n HT20	√	√	√	√	√
802.11n HT40	√	√	√	√	√

√ = Support, ×= Not support

Note.
1. This device employs SISO and CDD, MIMO technology output power as ANT 0 and ANT 1 and ANT 2.

3.2 Directional Gain Calculations

According to clause F), 2), f), (iii) of KDB 662911 D01 Multiple Transmitter Output, Directional gain may be calculated by using the formulas as below.

3.2.1. Directional Antenna Gain with equal gain

ANT 0 Gain (dBi)	ANT 1 Gain (dBi)	ANT 2 Gain (dBi)	PSD Directional Gain (dBi)	Power Directional Gain (dBi)
1.90	1.90	1.90	6.67	1.90

Note.
1. If all transmit signals are completely correlated, then

Directional gain = $G_{ANT\,MAX}$ + Array Gain.

- For PSD measurements on all devices Array gain = 10 log (N_{ANT} / N_{SS}) dB
- For Power measurements on IEEE 802.11 devices Array gain = 0 dB For $N_{ANT} \leq 4$.

4. Summary of tests

FCC Part section(s)	Parameter	Test condition	Test results
15.247(b)(3)	Maximum peak output power	Conducted	Pass
15.247(e)	Peak power spectral density		Pass
15.247(a)(2)	6 dB channel bandwidth		Pass
15.247(d)	Spurious emission & Band-edge		Pass
15.207(a)	Conducted emissions		Pass
15.247(d), 15.205(a), 15.209(a)	Spurious emission	Radiated	Pass
	Band-edge, restricted band		Pass

Notes:

1. All modes of operation and data rates were investigated. The test results shown in the following sections represent the worst case emissions.
2. According to exploratory test no any obvious emission were detected from 9 ㎑ to 30 ㎒. Although these tests were performed other than open field site, adequate comparison measurements were confirmed against 30 m open field site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field site based on KDB 414788.
3. The fundamental of the EUT was investigated in three orthogonal orientations X, Y and Z. It was determined that X orientation was worst-case orientation. Therefore, all final radiated testing was performed with the EUT in X orientation
4. The test procedure(s) in this report were performed in accordance as following.
   - ANSI C63.10-2013
   - KDB 558074 D01 v05r02
   - KDB 662911 D01 v02r01
5. The worst-case data rate were:
   802.11b mode : 1Mbps
   802.11g mode : 6Mbps
   802.11n HT20 mode : MCS0
   802.11n HT40 mode : MCS0

5. Measurement uncertainty

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013.

All measurement uncertainty values are shown with a coverage factor of k=2 to indicated a 95 % level of confidence. The measurement data shown herein meets of exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded uncertainty (±)	
Conducted RF power	1.76 dB	
Conducted spurious emissions	4.03 dB	
Radiated spurious emissions	9 kHz ~ 30 MHz:	2.28 dB
	30 MHz ~ 300 MHz	4.98 dB
	300 MHz ~ 1 000 MHz	5.14 dB
	1 GHz ~ 6 GHz	6.70 dB
	Above 6 GHz	6.60 dB
Conducted emissions	9 kHz ~ 150 kHz	3.66 dB
	150 kHz ~ 30 MHz	3.26 dB

6. Measurement results explanation example

The offset level is set in the spectrum analyzer to compensate the RF cable loss factor between EUT conducted output port and spectrum analyzer.
With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

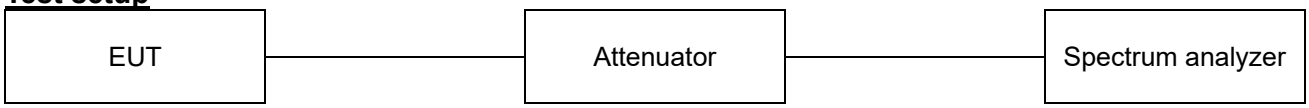
Frequency (㎒)	Factor(㏈)	Frequency (㎒)	Factor(㏈)
30	9.43	9 000	12.59
100	10.00	10 000	12.72
200	10.38	11 000	12.85
300	10.46	12 000	13.03
400	10.55	13 000	13.13
500	10.62	14 000	13.38
600	10.66	15 000	13.57
700	10.72	16 000	13.53
800	10.83	17 000	13.63
900	10.86	18 000	13.68
1 000	10.88	19 000	13.75
2 000	11.24	20 000	13.85
3 000	11.53	21 000	14.03
4 000	11.72	22 000	14.14
5 000	11.97	23 000	14.53
6 000	12.13	24 000	14.40
7 000	12.26	25 000	14.37
8 000	12.44	26 000	14.93

Note.
Offset(㏈) = RF cable loss(㏈) + Attenuator(㏈)

7. Test results

7.1. 6 dB Bandwidth(DTS Channel Bandwidth)

Test setup



Limit

According to §15.247(a)(2) Systems using digital modulation techniques may operate in the 902–928 ㎒, 2 400–2 483.5 ㎒, and 5 725–5 850 ㎒ bands. The minimum 6 ㏈ bandwidth shall be at least 500 ㎑.

Test procedure

ANSI C63.10-2013 - Section 11.8

Test settings

DTS bandwidth

One of the following procedures may be used to determine the modulated DTS bandwidth.

Option 1

1) Set RBW = 100 ㎑.
2) Set the video bandwidth (VBW) ≥ 3 x RBW.
3) Detector = Peak.
4) Trace mode = max hold.
5) Sweep = auto couple.
6) Allow the trace to stabilize.
7) Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 ㏈ relative to the maximum level measured in the fundamental emission.

Option 2

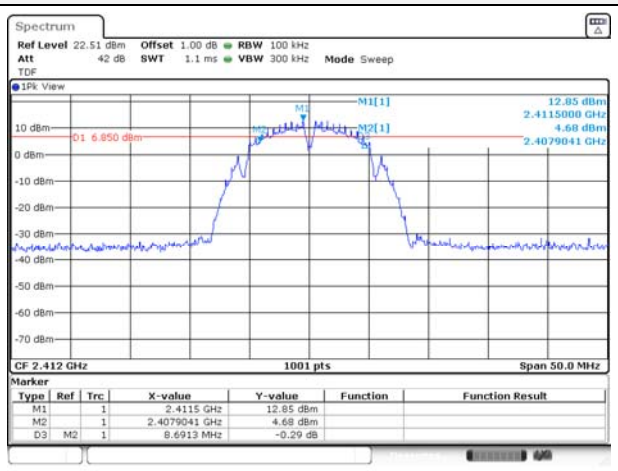
The automatic bandwidth measurement capability of an instrument may be employed using the X dB bandwidth mode with X set to 6 ㏈, if the functionality described in 11.8.1 (i.e., RBW = 100 ㎑, VBW ≥ 3 × RBW, and peak detector with maximum hold) is implemented by the instrumentation function. When using this capability, care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥6 ㏈.

Test results

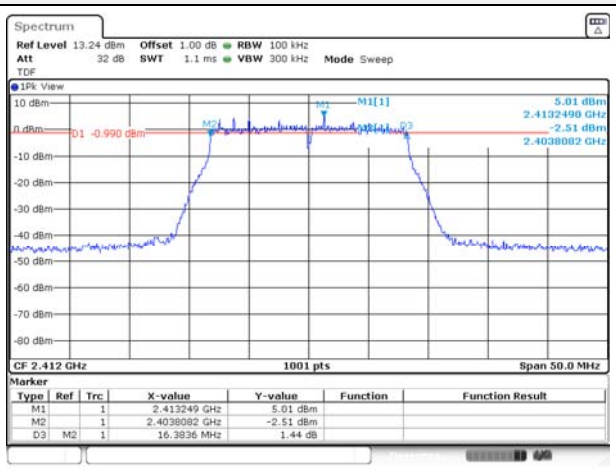
Test mode	Frequency(㎒)	6 dB bandwidth(㎒)		
		ANT 0	ANT 1	ANT 2
802.11b	2 412	8.69	9.14	8.64
	2 437	8.64	8.14	8.69
	2 462	8.64	9.14	9.09
802.11g	2 412	16.38	16.43	16.43
	2 437	16.43	16.43	16.43
	2 462	16.43	16.43	16.43
802.11n HT20	2 412	17.63	17.63	17.63
	2 437	17.68	17.63	17.63
	2 462	17.68	17.68	17.68
802.11n HT40	2 422	36.26	36.26	36.26
	2 437	36.26	36.16	36.26
	2 452	36.26	36.26	36.26

ANT 0

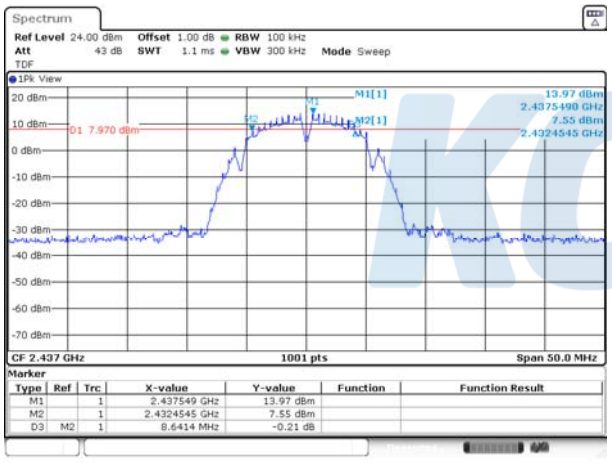
802.11b / 2 412 ㎒



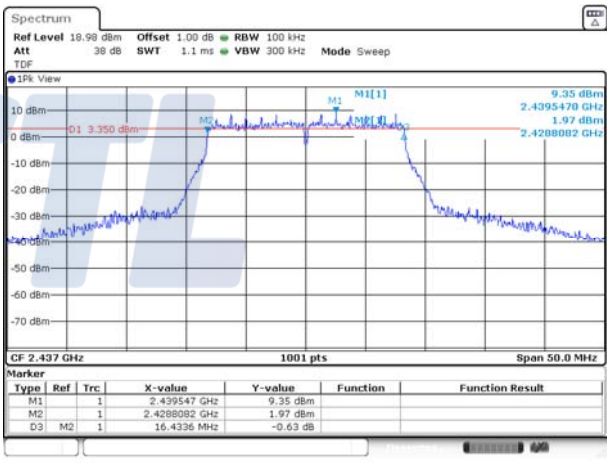
802.11g / 2 412 ㎒



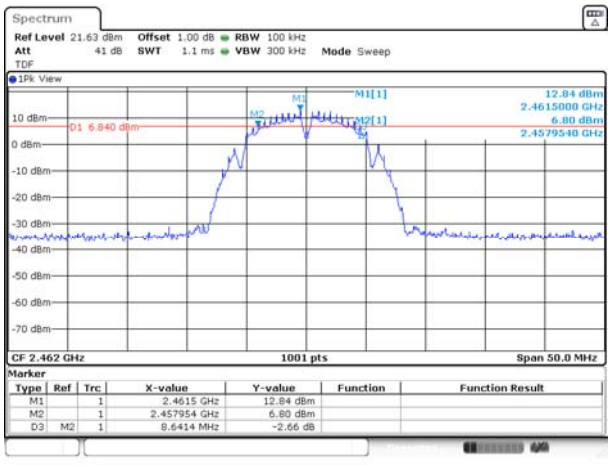
802.11b / 2 437 ㎒



802.11g / 2 437 ㎒



802.11b / 2 462 ㎒



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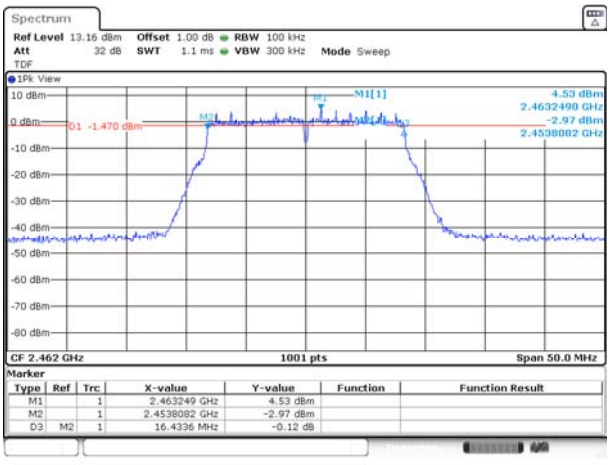
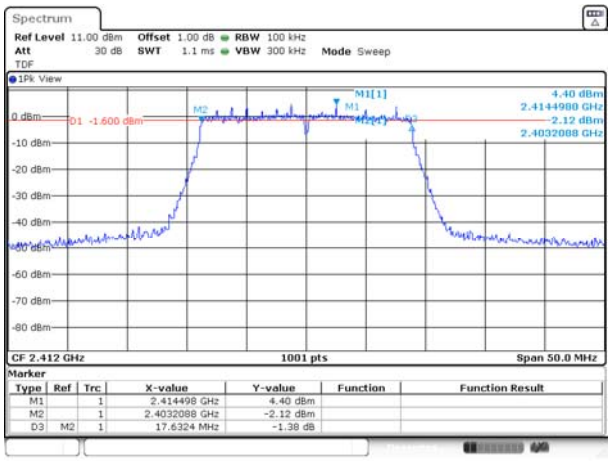
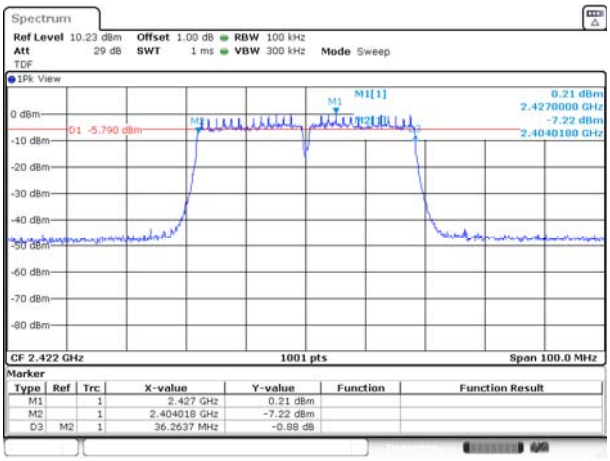


802.11n HT20 / 2 412 ㎒



802.11n HT40 / 2 422 ㎒



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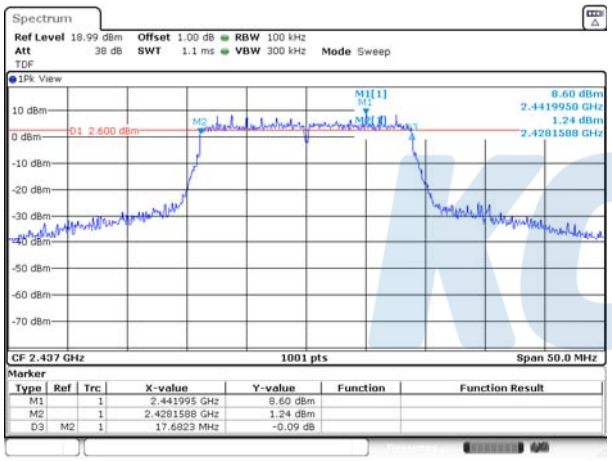
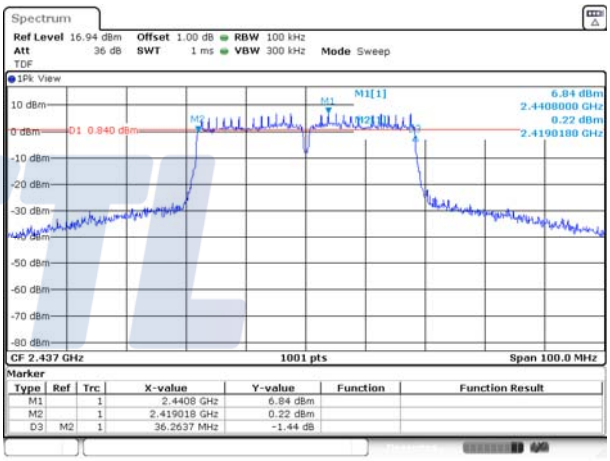


802.11n HT40 / 2 437 ㎒



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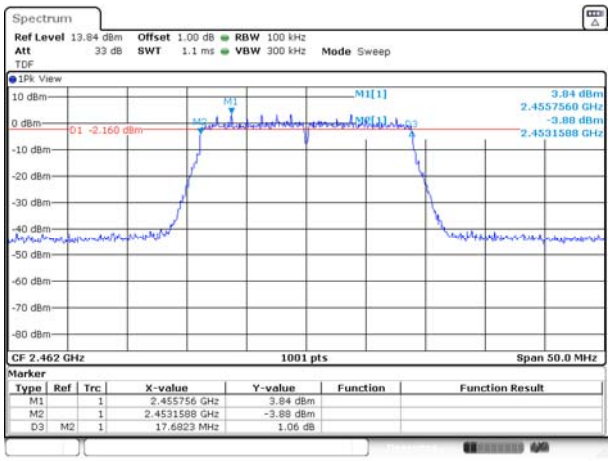
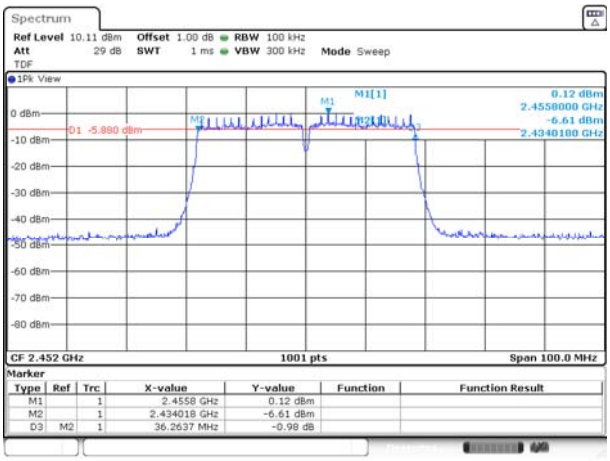
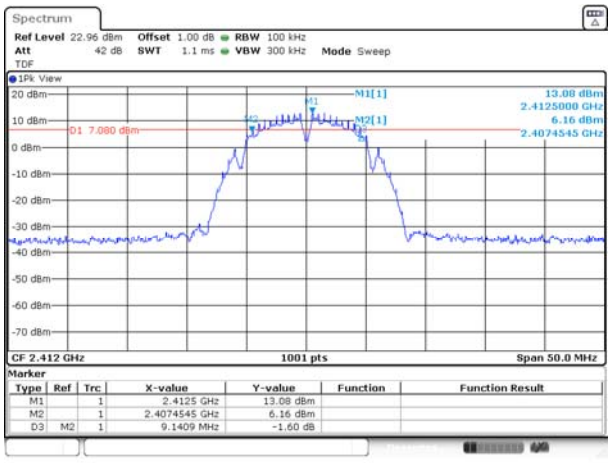


802.11n HT40 / 2 452 ㎒

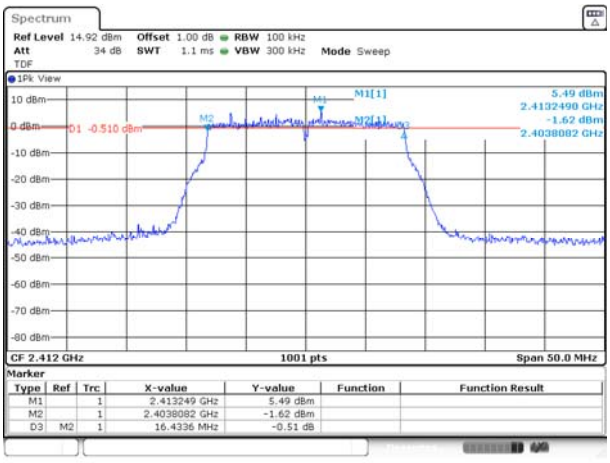


ANT 1

802.11b / 2 412 ㎒



802.11g / 2 412 ㎒



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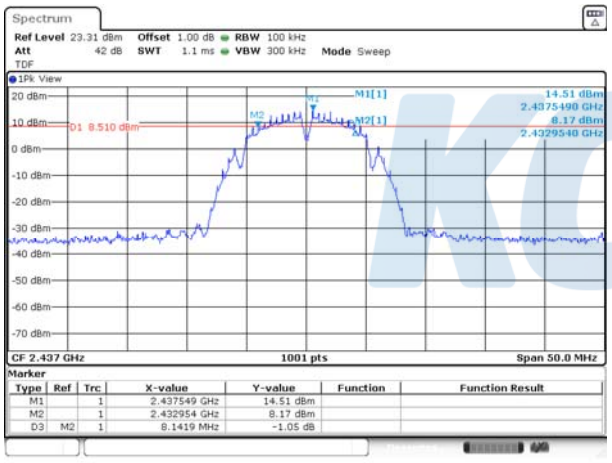

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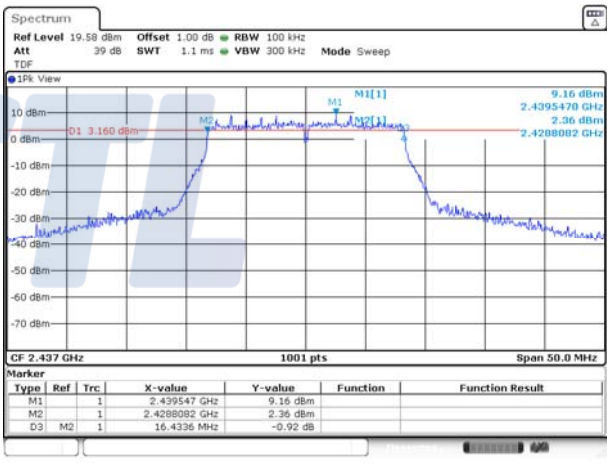

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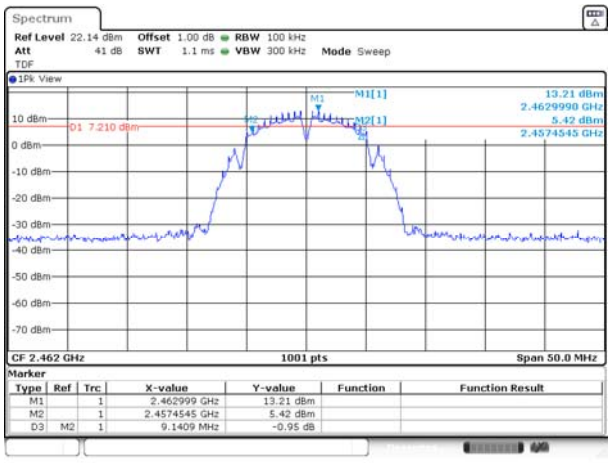

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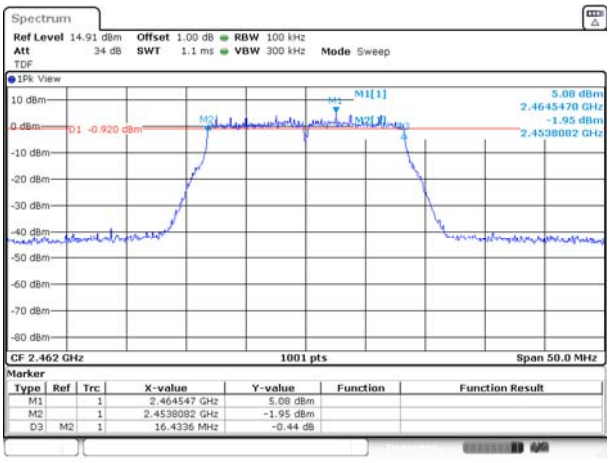
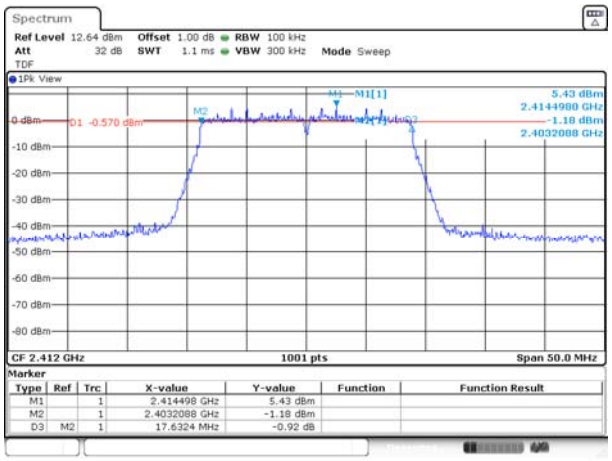
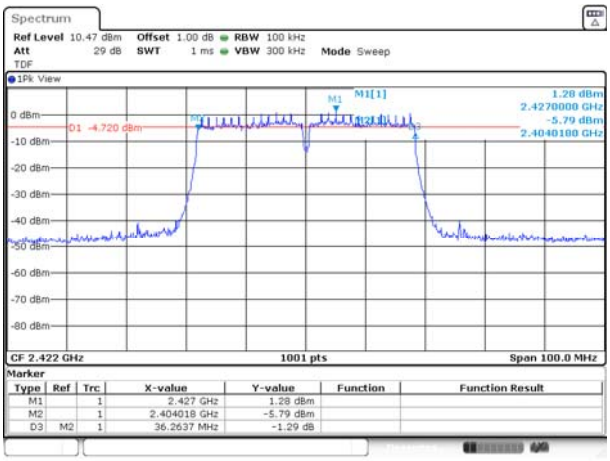


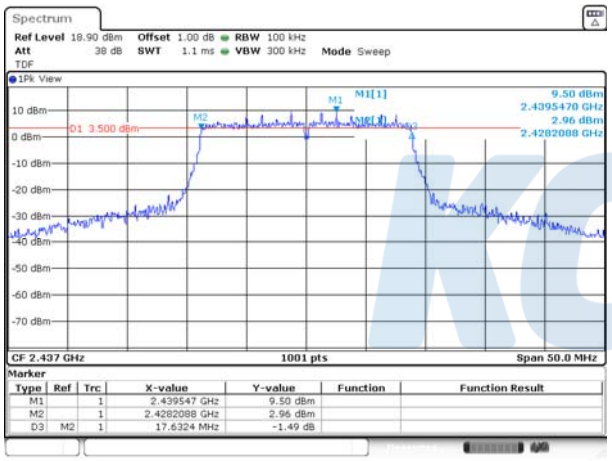
802.11n HT20 / 2 412 ㎒



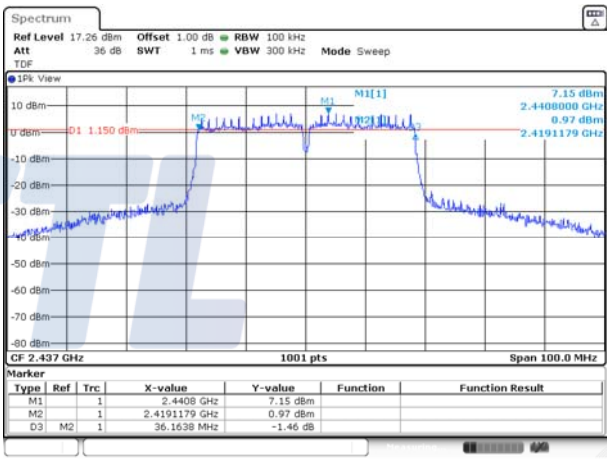
802.11n HT40 / 2 422 ㎒



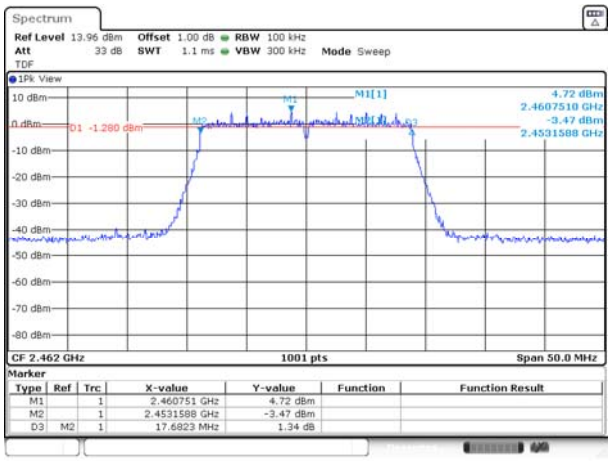
802.11n HT20 / 2 437 ㎒



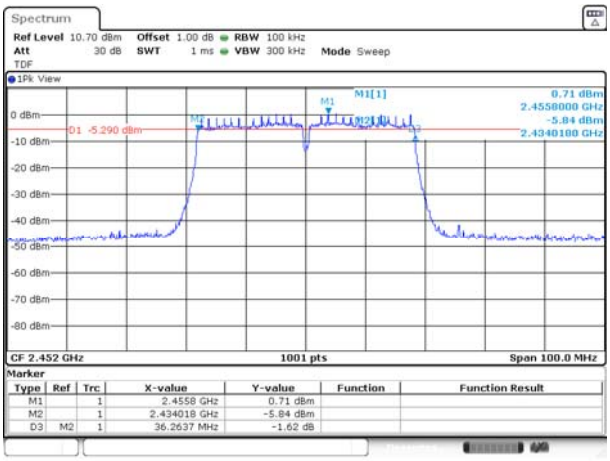
802.11n HT40 / 2 437 ㎒



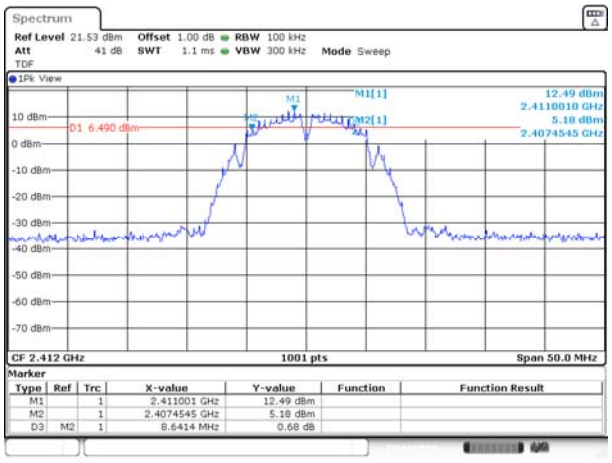
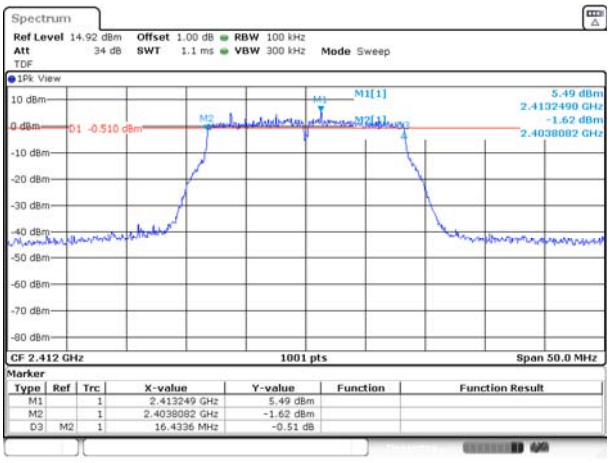
802.11n HT20 / 2 462 ㎒



802.11n HT40 / 2 452 ㎒



ANT 2

802.11b / 2 412 ㎒	802.11g / 2 412 ㎒
	
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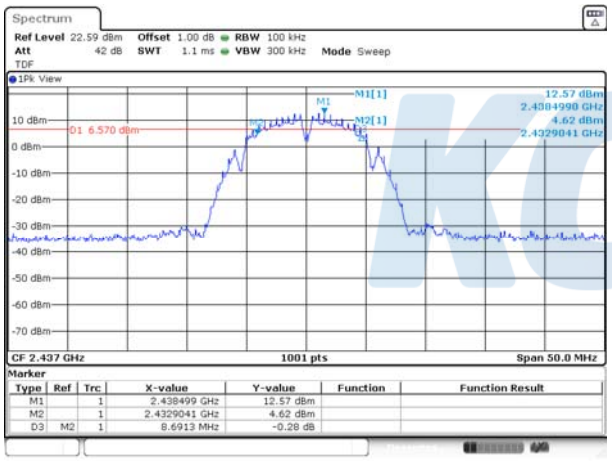
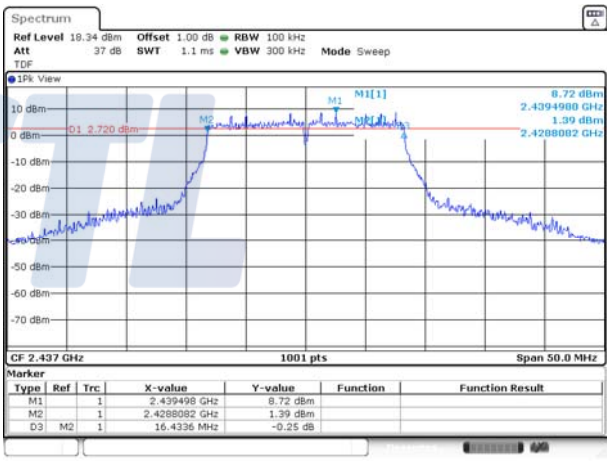
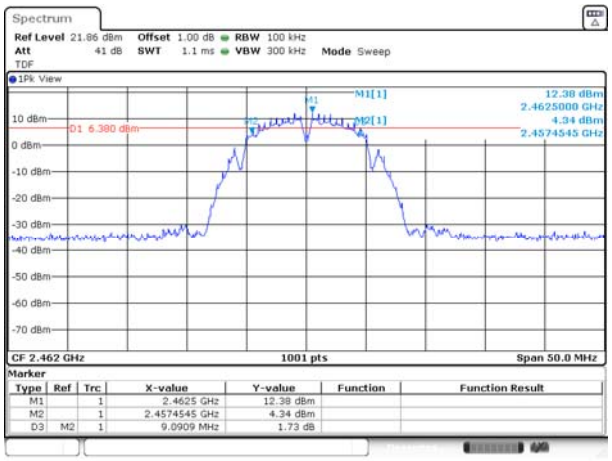
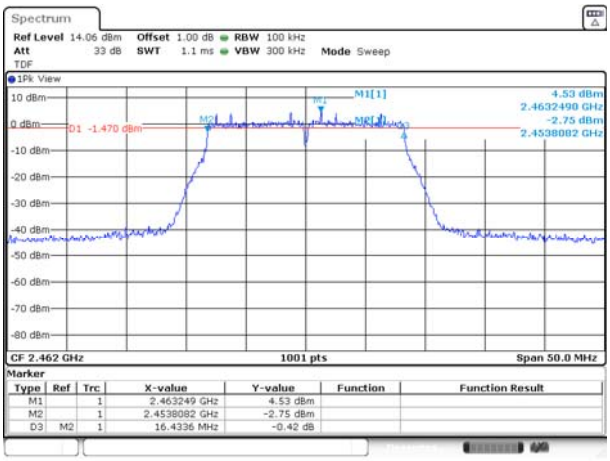
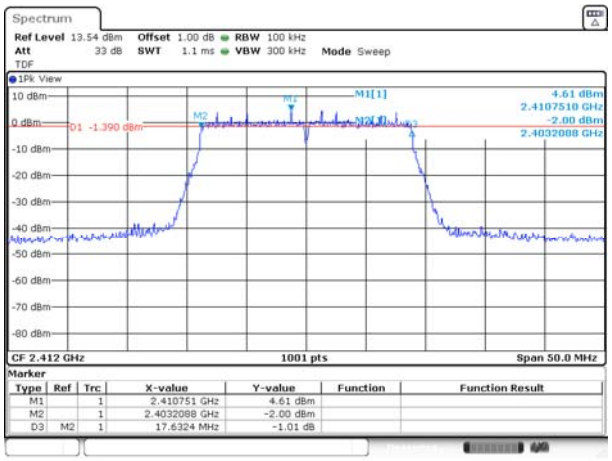
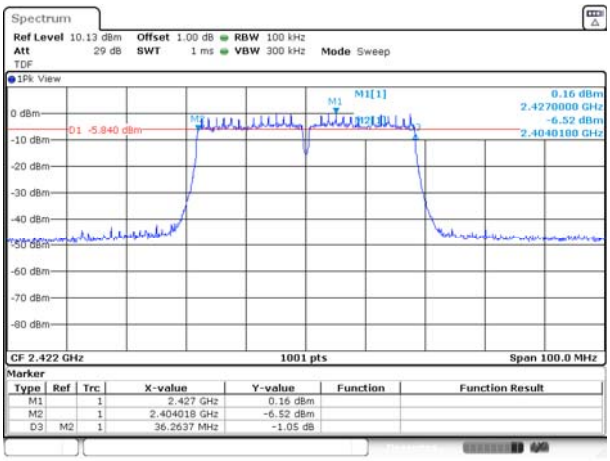
	
802.11b / 2 462 ㎒	**802.11g / 2 462 ㎒**
	

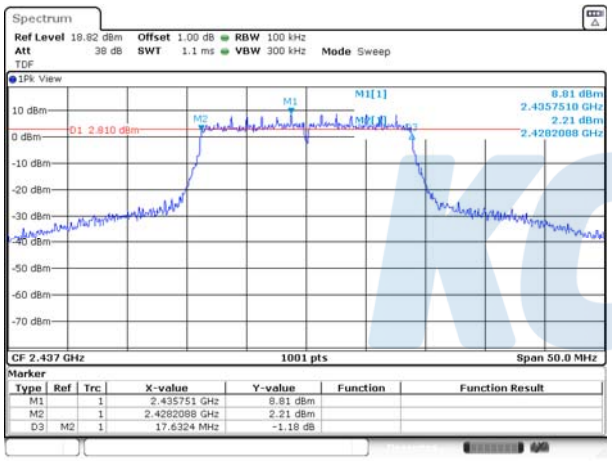
802.11n HT20 / 2 412 ㎒



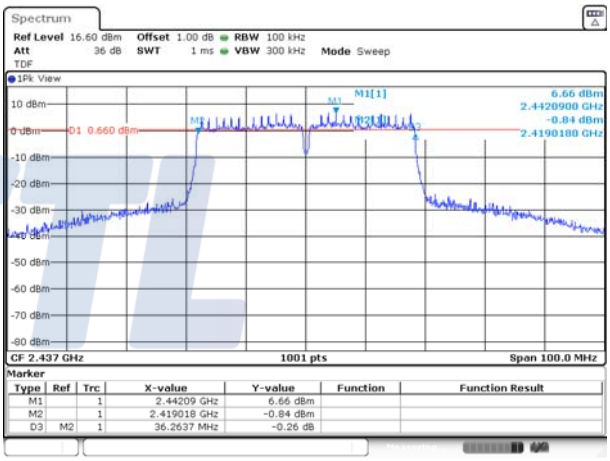
802.11n HT40 / 2 422 ㎒



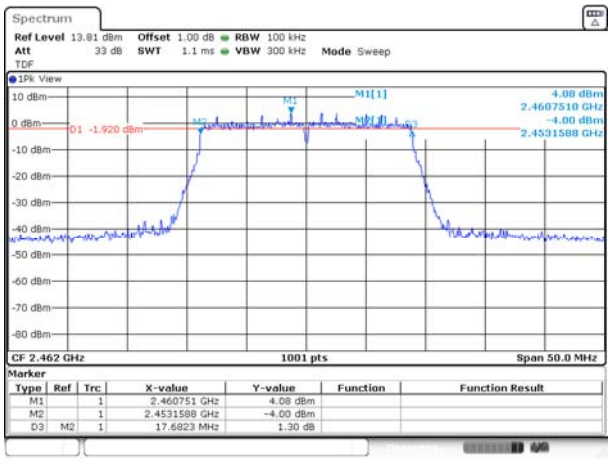
802.11n HT20 / 2 437 ㎒



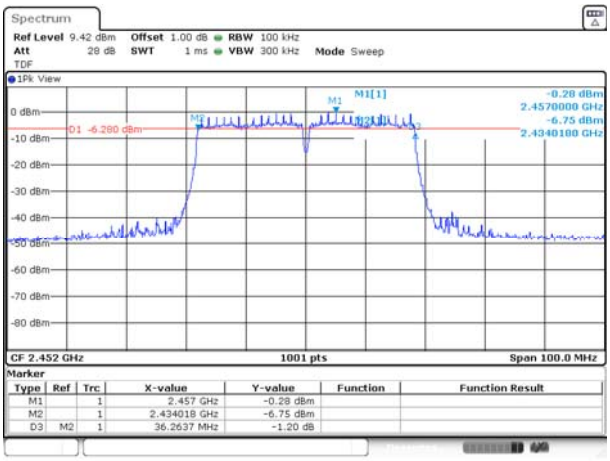
802.11n HT40 / 2 437 ㎒



802.11n HT20 / 2 462 ㎒

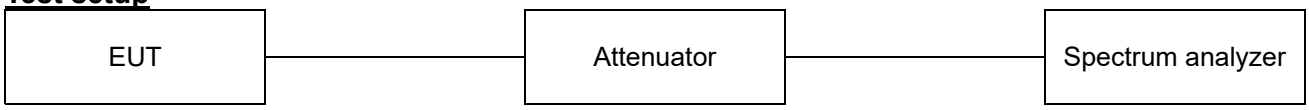


802.11n HT40 / 2 452 ㎒



7.2. Maximum peak output power

Test setup



Limit

According to §15.247(b)(3), For systems using digital modulation in the 902-928 ㎒, 2 400-2 483.5 ㎒, and 5 725-5 850 ㎒ bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

According to §15.247(b)(4) The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 ㏈i. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 ㏈i are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in ㏈ that the directional gain of the antenna exceeds 6 ㏈i.

Test procedure

ANSI C63.10 - Section 11.9
Used test method is section 11.9.1.2 and 11.9.2.2.4

Test settings

General

Section 15.247 permits the maximum conducted (average) output power to be measured as an alternative to the maximum peak conducted output power for demonstrating compliance to the limit. When this option is exercised, the measured power is to be referenced to the OBW rather than the DTS bandwidth (see ANSI C63.10 for measurement guidance).

When using a spectrum analyzer or EMI receiver to perform these measurements, it shall be capable of utilizing a number of measurement points in each sweep that is greater than or equal to twice the span/RBW to set a bin-to-bin spacing of ≤ RBW/2 so that narrowband signals are not lost between frequency bins.

If possible, configure or modify the operation of the EUT so that it transmits continuously at its maximum power control level. The intent is to test at 100 % duty cycle; however a small reduction in duty cycle (to no lower than 98 %) is permitted, if required by the EUT for amplitude control purposes. Manufacturers are expected to provide software to the test lab to permit such continuous operation.

If continuous transmission (or at least 98 % duty cycle) cannot be achieved due to hardware limitations (e.g., overheating), the EUT shall be operated at its maximum power control level, with the transmit duration as long as possible, and the duty cycle as high as possible during which sweep triggering/signal gating techniques may be used to perform the measurement over the transmission duration.

11.9.1. Maximum peak conducted output power

One of the following procedures may be used to determine the maximum peak conducted output power of a DTS EUT.

11.9.1.1. RBW ≥ DTS bandwidth

The following procedure shall be used when an instrument with a resolution bandwidth that is greater than the DTS bandwidth is available to perform the measurement:

a) Set the RBW ≥ DTS bandwidth.
b) Set VBW ≥ [3 × RBW].
c) Set span ≥ [3 × RBW].
d) Sweep time = auto couple.
e) Detector = peak.
f) Trace mode = max hold.
g) Allow trace to fully stabilize.
h) Use peak marker function to determine the peak amplitude level.

11.9.1.3. PKPM1 Peak power meter method

The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall use a fast-responding diode detector.

11.9.2.3.1. Measurement using a power meter (PM)

Method AVGPM is a measurement using an RF average power meter, as follows:

a) As an alternative to spectrum analyzer or EMI receiver measurements, measurements may be performed using a wideband RF power meter with a thermocouple detector or equivalent if all of the conditions listed below are satisfied:
   1) The EUT is configured to transmit continuously, or to transmit with a constant duty cycle.
   2) At all times when the EUT is transmitting, it shall be transmitting at its maximum power control level.
   3) The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.

b) If the transmitter does not transmit continuously, measure the duty cycle, D, of the transmitter output signal as described in 11.6.

c) Measure the average power of the transmitter. This measurement is an average over both the ON and OFF periods of the transmitter.

d) Adjust the measurement in dBm by adding [10 log(1/D)], where D is the duty cycle

Notes:

A peak responding power sensor is used, where the power sensor system video bandwidth is greater than the occupied bandwidth of the EUT.

Test results

SISO

Test mode	Frequency (㎒)	Conducted output power (dBm)						Limit (dBm)
		ANT 0		ANT 1		ANT 2		
		Peak	Average	Peak	Average	Peak	Average	
802.11b	2 412	25.29	21.07	25.69	21.60	25.09	20.72	30
	2 437	25.99	21.64	25.79	21.84	25.09	20.78	
	2 462	25.09	20.69	25.19	21.20	24.69	20.18	
802.11g	2 412	26.59	15.79	26.99	16.51	26.39	15.90	
	2 437	28.60	19.68	28.80	20.20	28.39	19.38	
	2 462	26.19	15.27	26.79	16.15	25.89	15.30	
802.11n HT20	2 412	26.29	15.40	26.89	16.18	26.19	15.40	
	2 437	28.60	19.62	28.90	20.27	28.60	19.38	
	2 462	26.29	14.94	26.59	15.75	25.49	14.85	
802.11n HT40	2 422	24.14	13.53	24.17	13.60	23.71	13.18	
	2 437	28.27	19.89	28.22	20.22	28.15	19.47	
	2 452	24.62	13.35	24.43	13.71	24.30	12.93	

MIMO

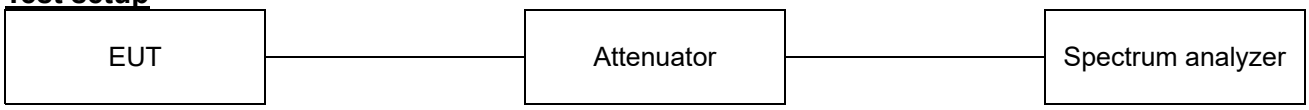
Test mode	Frequency (㎒)	Conducted output power (dBm)								Limit (dBm)
		ANT 0		ANT 1		ANT 2		MIMO		
		Peak	Average	Peak	Average	Peak	Average	Peak	Average	
802.11b	2 412	23.28	18.98	23.69	19.41	23.18	18.61	28.16	23.78	30
	2 437	23.89	19.36	24.09	19.73	23.48	18.91	28.60	24.12	
	2 462	23.08	18.55	23.28	18.87	23.08	18.09	27.92	23.29	
802.11g	2 412	24.29	12.85	24.29	13.43	24.29	12.94	29.06	17.85	
	2 437	24.39	12.71	24.49	13.12	24.29	12.65	29.16	17.60	
	2 462	23.89	12.38	24.49	13.13	23.79	12.53	28.84	17.46	
802.11n HT20	2 412	24.59	12.95	24.79	13.37	24.09	12.83	29.27	17.82	
	2 437	24.29	12.67	24.79	13.03	24.29	12.64	29.23	17.55	
	2 462	23.79	12.35	24.49	13.06	23.79	12.29	28.81	17.35	
802.11n HT40	2 422	22.87	11.93	22.90	12.60	22.53	11.55	27.54	16.82	
	2 437	22.44	11.55	22.97	12.25	22.15	11.31	27.30	16.49	
	2 452	21.55	11.52	22.58	12.49	22.18	11.34	26.90	16.58	

Notes:

1. Peak (dBm) = $10\log(10^{(ANT\ 0/10)} + 10^{(ANT\ 1/10)} + 10^{(ANT\ 2/10)})$
2. Average (dBm) = $10\log(10^{(ANT\ 0/10)} + 10^{(ANT\ 1/10)} + 10^{(ANT\ 2/10)})$ + Duty Factor (dB)

7.3. Peak Power Spectral Density

Test setup



Limit

According to §15.247(e), for digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

Test procedure

ANSI C63.10 - Section 11.10

Test settings

Method AVGPSD-2

Method AVGPSD-2 uses trace averaging across ON and OFF times of the EUT transmissions, followed by duty cycle correction.
The following procedure is applicable when the EUT cannot be configured to transmit continuously (i.e.,D < 98%), when sweep triggering/signal gating cannot be used to measure only when the EUT is transmitting at its maximum power control level, and when the transmission duty cycle is constant (i.e., duty cycle variations are less than ±2%):

1) Measure the duty cycle (D) of the transmitter output signal as described in 11.6.
2) Set instrument center frequency to DTS channel center frequency.
3) Set span to at least 1.5 times the OBW.
4) Set RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
5) Set VBW ≥ [3 × RBW].
6) Detector = power averaging (rms) or sample detector (when rms not available).
7) Ensure that the number of measurement points in the sweep ≥ [2 × span / RBW].
8) Sweep time = auto couple.
9) Do not use sweep triggering; allow sweep to “free run.”
10) Employ trace averaging (rms) mode over a minimum of 100 traces.
11) Use the peak marker function to determine the maximum amplitude level.
12) Add [10 log (1 / D)], where D is the duty cycle measured in step a), to the measured PSD to compute the average PSD during the actual transmission time.
13) If measured value exceeds requirement specified by regulatory agency, then reduce RBW (but no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span to meet the minimum measurement point requirement as the RBW is reduced).

Test results

SISO

Test mode	Frequency (㎒)	Power Spectral Density Result (dBm/3 ㎑)			Limit (dBm/3 ㎑)
		ANT 0	ANT 1	ANT 2	
802.11b	2 412	-0.42	0.45	-1.63	8.00
	2 437	0.25	1.02	-0.82	
	2 462	0.54	0.46	-0.57	
802.11g	2 412	-8.84	-8.73	-8.98	
	2 437	-4.41	-4.68	-5.41	
	2 462	-9.18	-8.74	-9.30	
802.11n HT20	2 412	-9.15	-8.65	-9.34	
	2 437	-4.05	-4.18	-5.46	
	2 462	-10.21	-9.97	-10.26	
802.11n HT40	2 422	-14.82	-13.47	-12.97	
	2 437	-7.97	-8.12	-8.71	
	2 452	-14.50	-13.46	-14.78	

MIMO

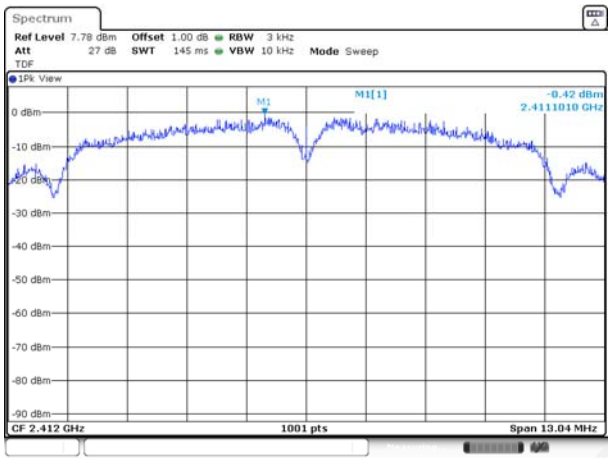
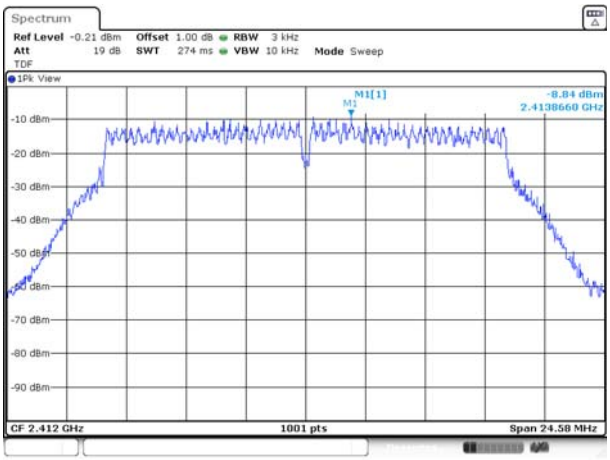
Test mode	Frequency (㎒)	Power Spectral Density Result (dBm/3 ㎑)				Limit (dBm/3 ㎑)
		ANT 0	ANT 1	ANT 2	MIMO[1)]	
802.11b	2 412	-3.17	-0.91	-3.49	2.41	7.33
	2 437	-1.84	-1.85	-3.22	2.51	
	2 462	-2.97	-3.09	-4.05	1.43	
802.11g	2 412	-12.82	-12.70	-13.69	-8.28	
	2 437	-12.72	-12.32	-13.26	-7.98	
	2 462	-13.88	-12.92	-13.91	-8.77	
802.11n HT20	2 412	-12.84	-12.18	-12.07	-7.58	
	2 437	-12.69	-11.11	-13.76	-7.61	
	2 462	-13.49	-11.98	-14.45	-8.41	
802.11n HT40	2 422	-16.76	-15.84	-17.46	-11.86	
	2 437	-16.39	-15.97	-16.59	-11.54	
	2 452	-16.24	-15.41	-16.96	-11.39	

Notes:

1. MIMO Result Calculation:

MIMO (dB m/ 3 ㎑) = $10\log(10^{(\text{ANT Green}/10)} + 10^{(\text{ANT Gray}/10)} + 10^{(\text{ANT Black}/10)})$

SISO ANT 0

802.11b / 2 412 ㎒	802.11g / 2 412 ㎒
	
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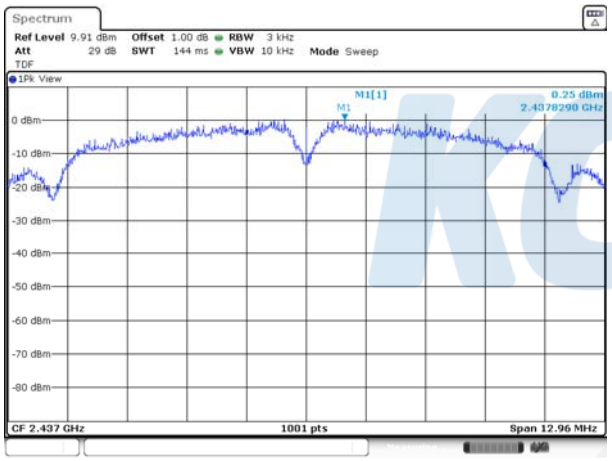	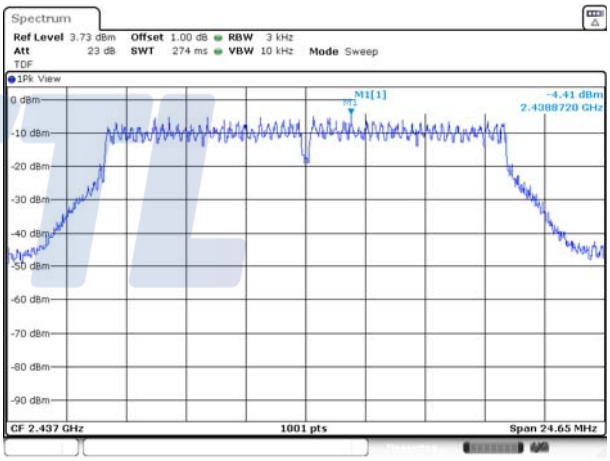
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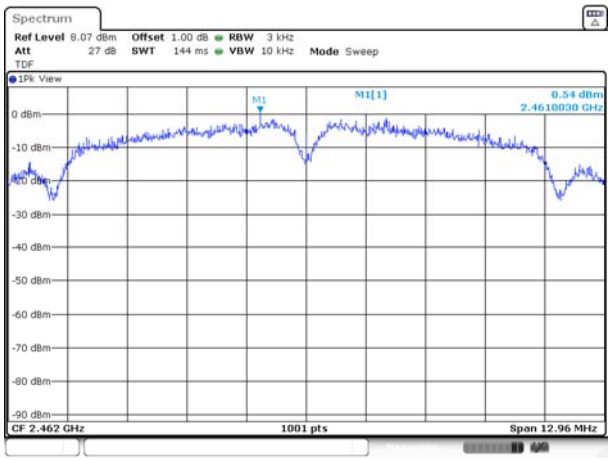
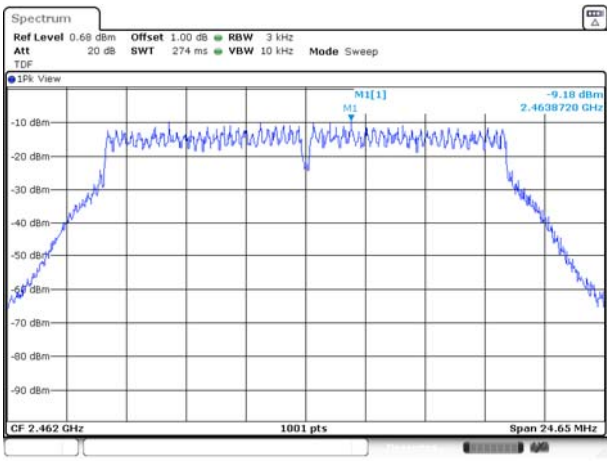
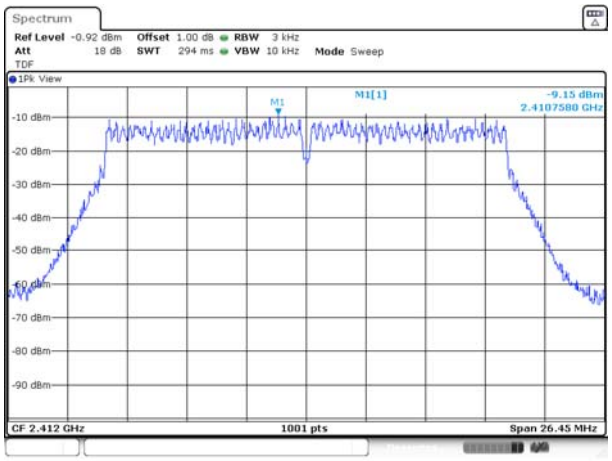
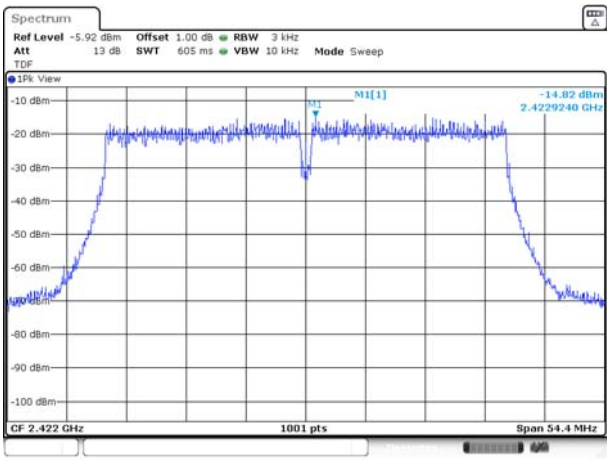
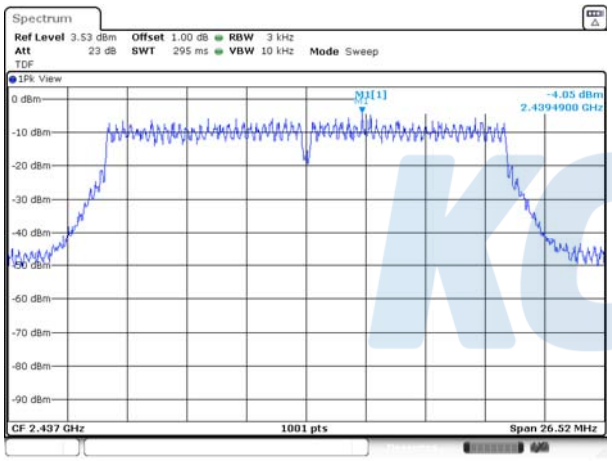
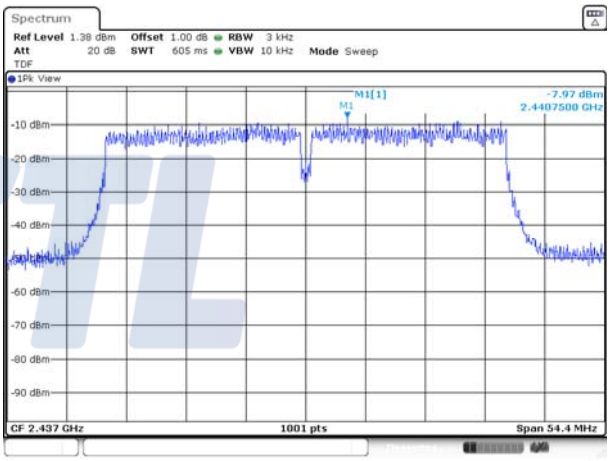
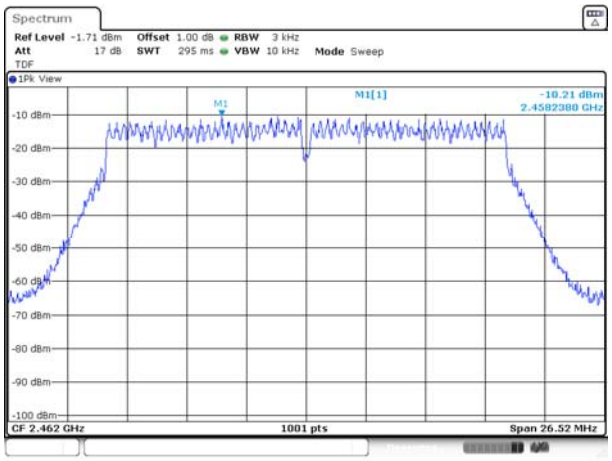
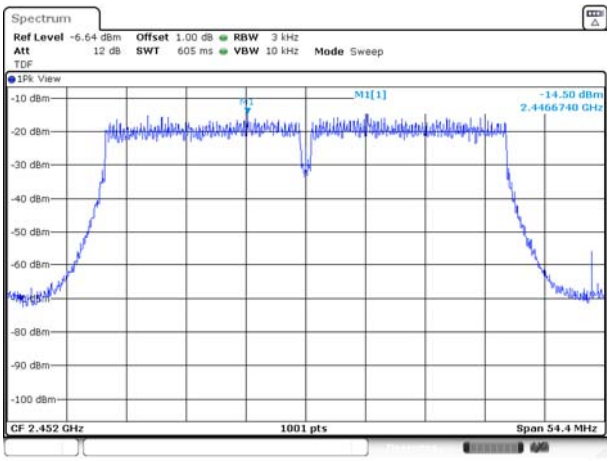
	

802.11n HT20 / 2 412 ㎒	802.11n HT40 / 2 422 ㎒
	
802.11n HT20 / 2 437 ㎒	**802.11n HT40 / 2 437 ㎒**
	
802.11n HT20 / 2 462 ㎒	**802.11n HT40 / 2 452 ㎒**
	

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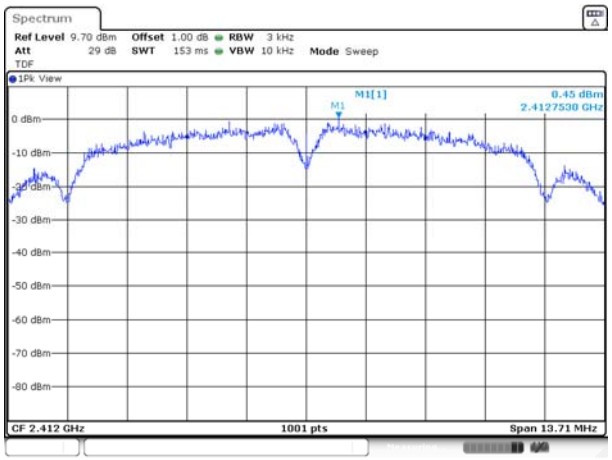
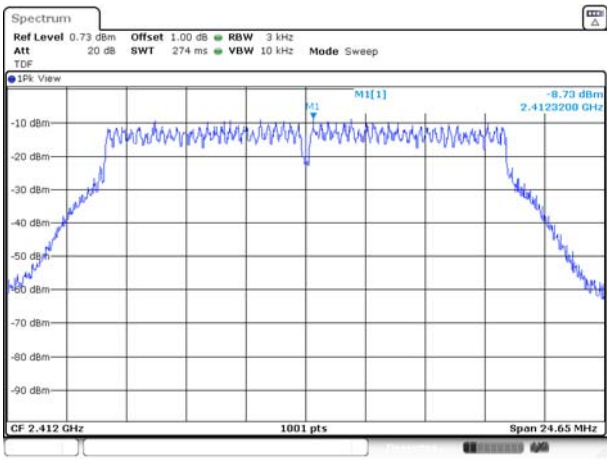
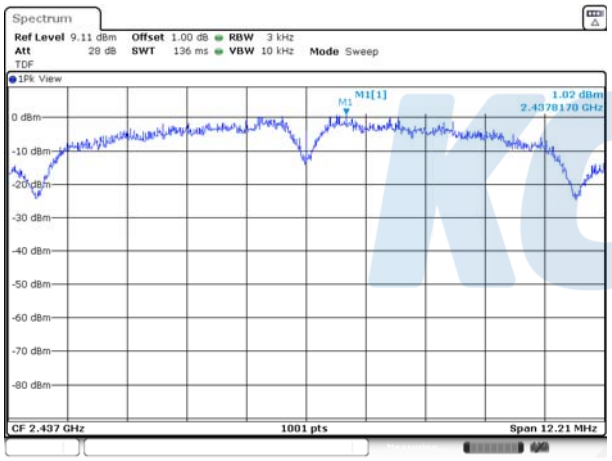
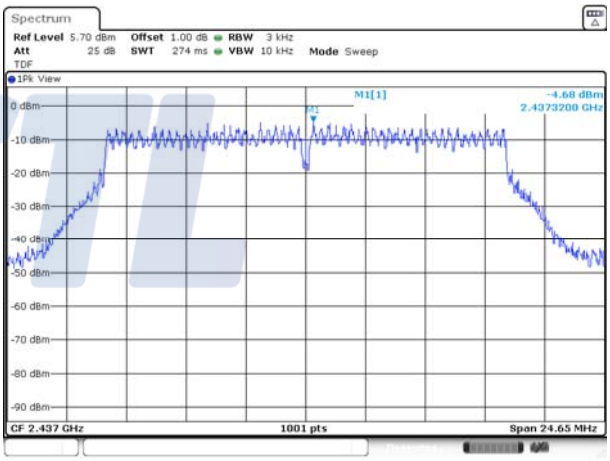
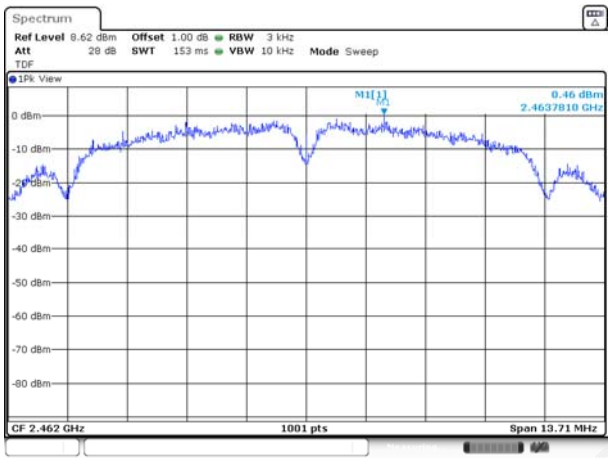
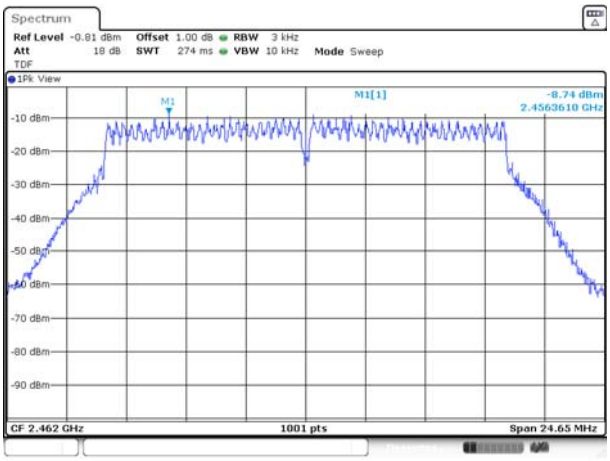
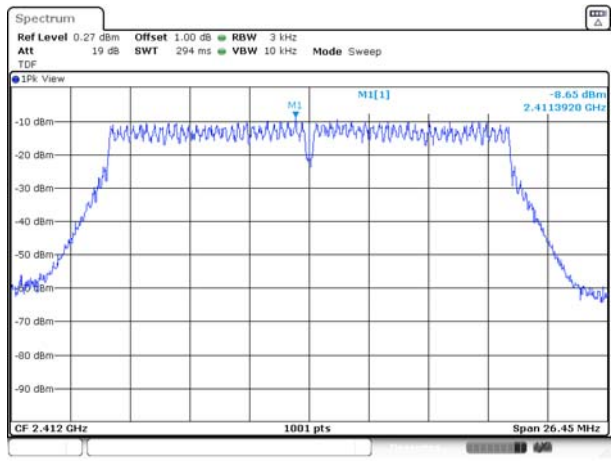
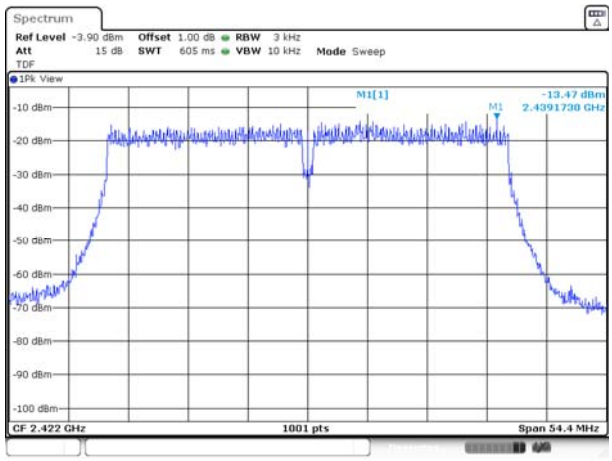
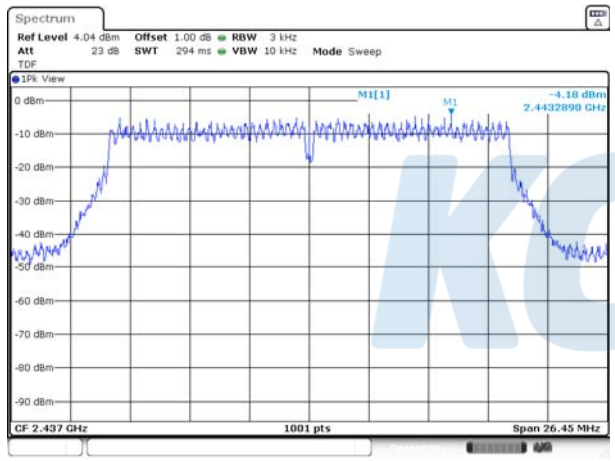
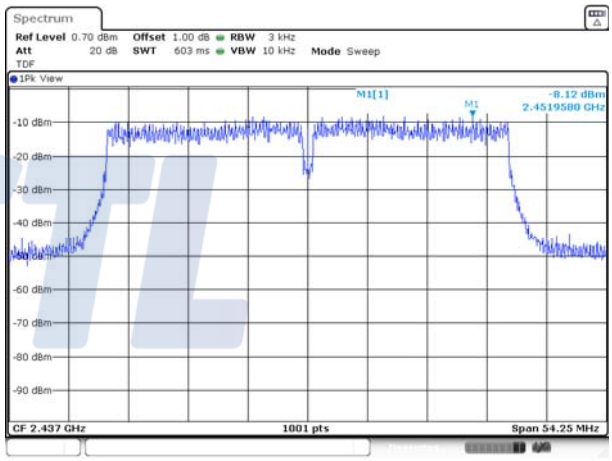
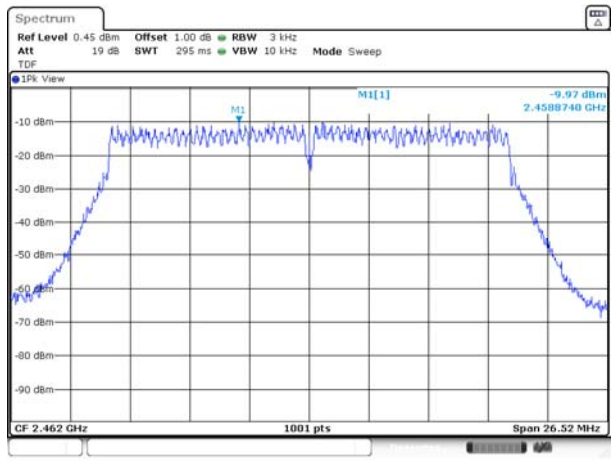
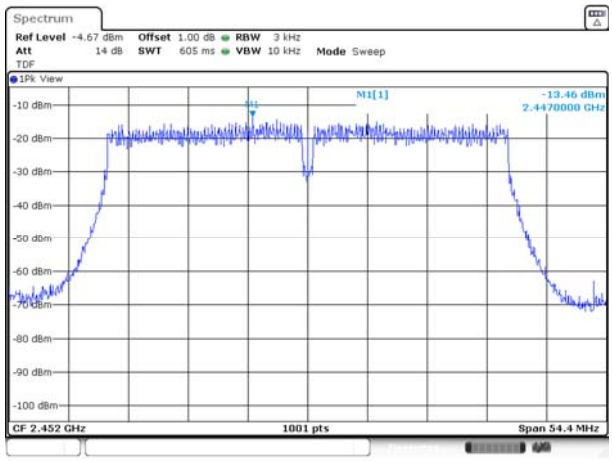
802.11b / 2 412 ㎒	802.11g / 2 412 ㎒
	
802.11b / 2 437 ㎒	**802.11g / 2 437 ㎒**
	
802.11b / 2 462 ㎒	**802.11g / 2 462 ㎒**
	

802.11n HT20 / 2 412 ㎒	802.11n HT40 / 2 422 ㎒
	
802.11n HT20 / 2 437 ㎒	**802.11n HT40 / 2 437 ㎒**
	
802.11n HT20 / 2 462 ㎒	**802.11n HT40 / 2 452 ㎒**
	

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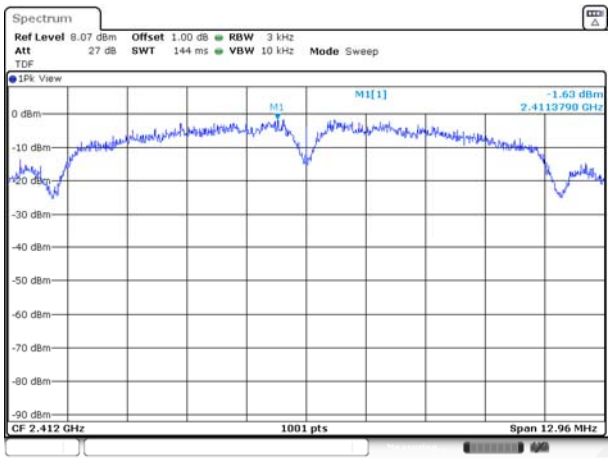
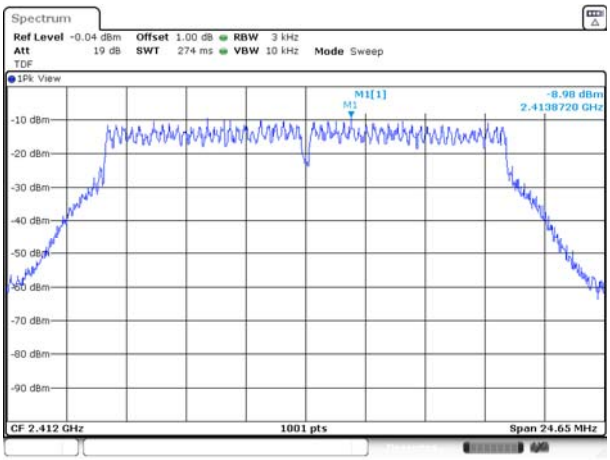
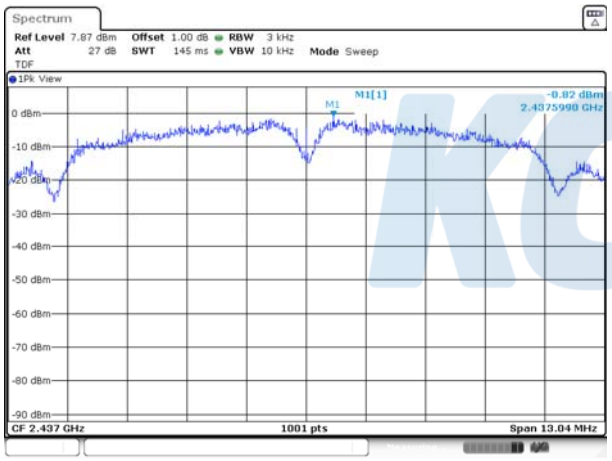
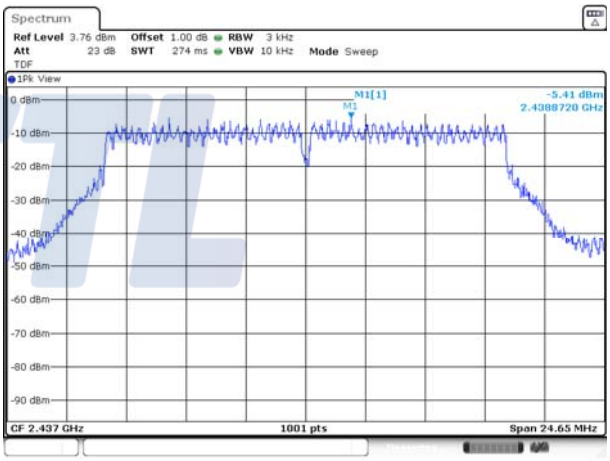
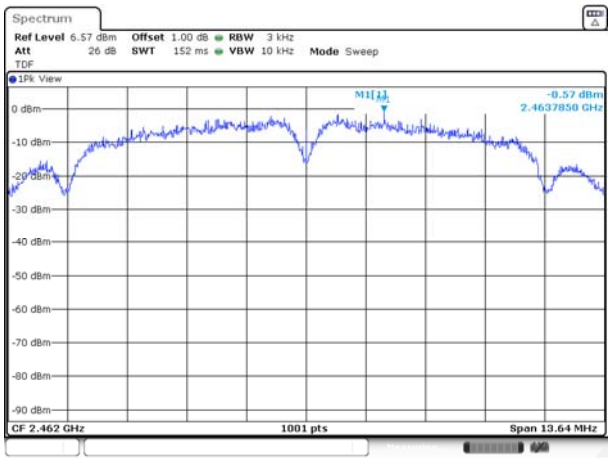
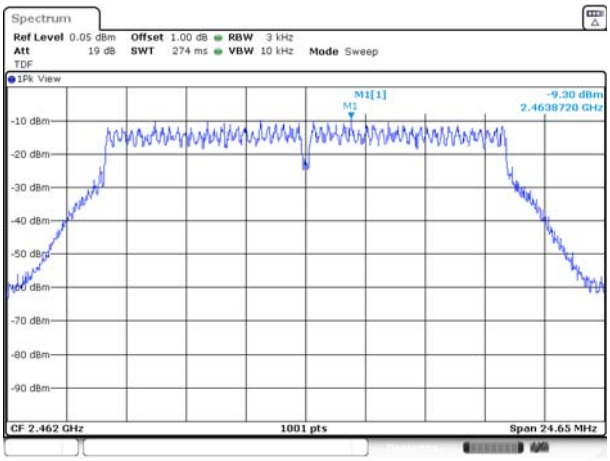
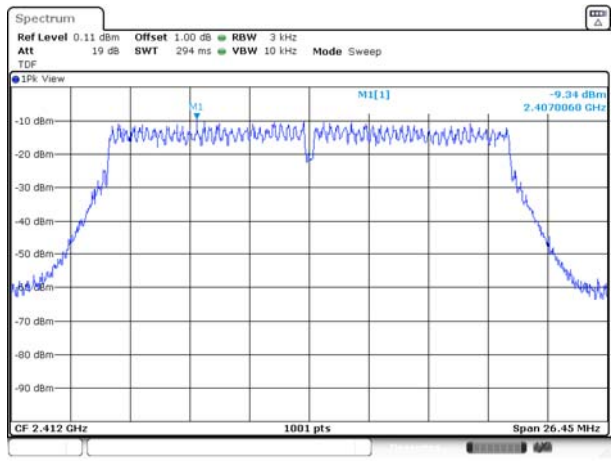
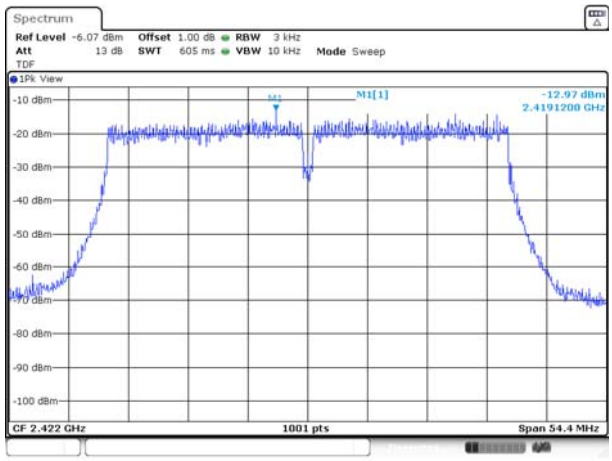
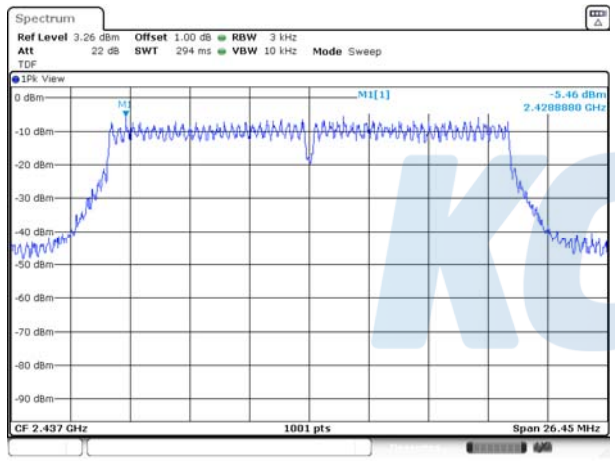
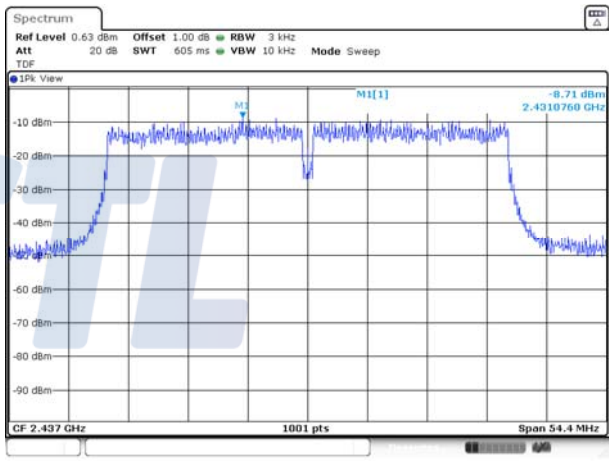
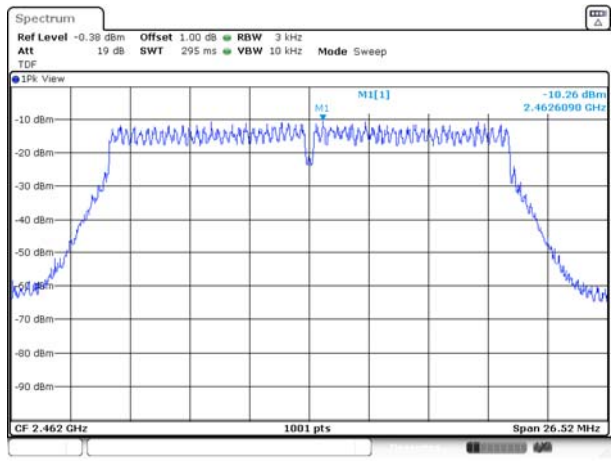
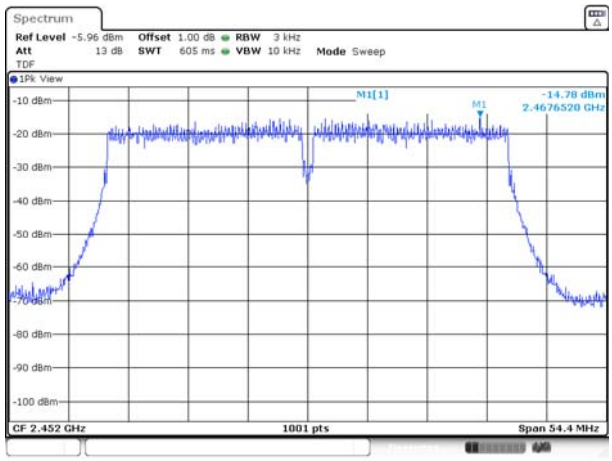
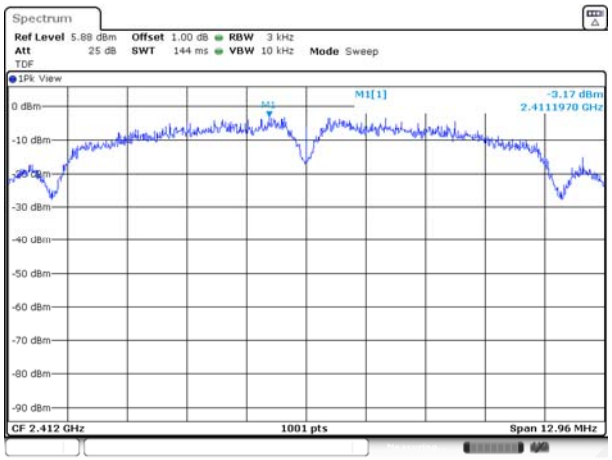
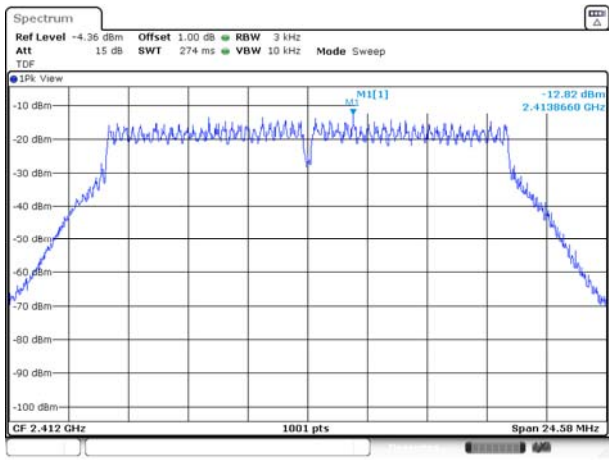
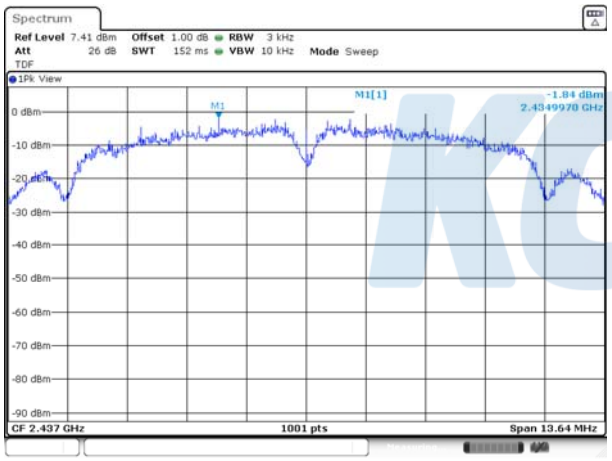
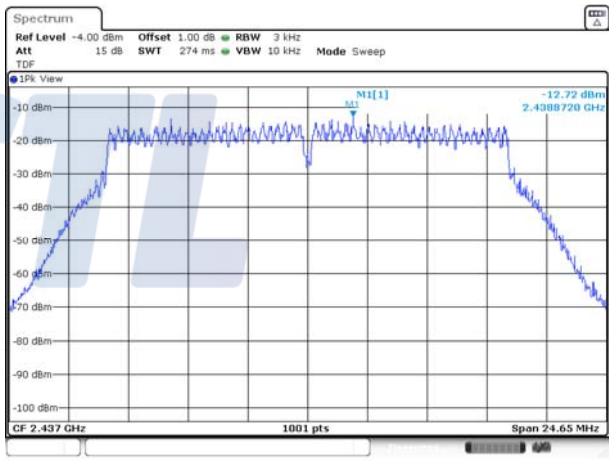
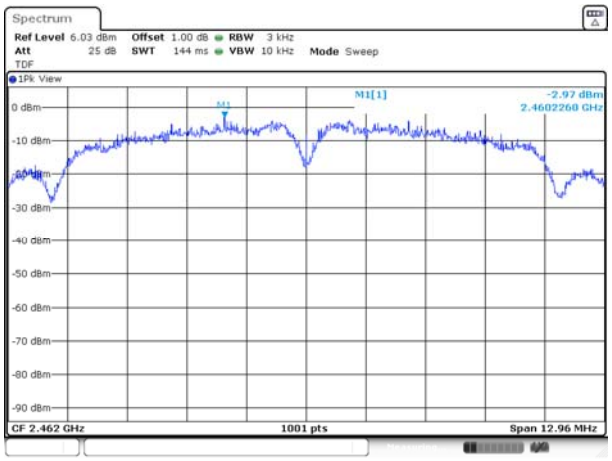
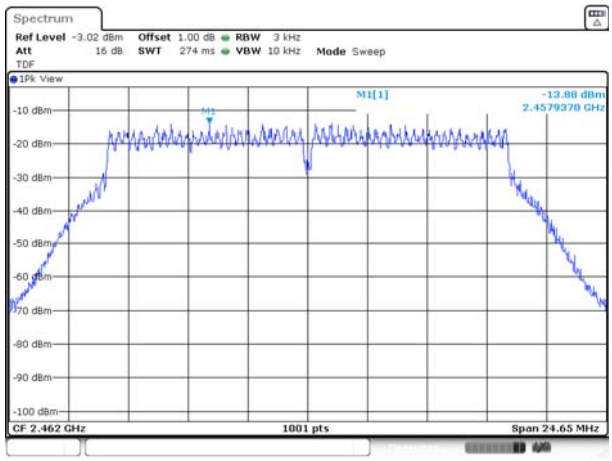
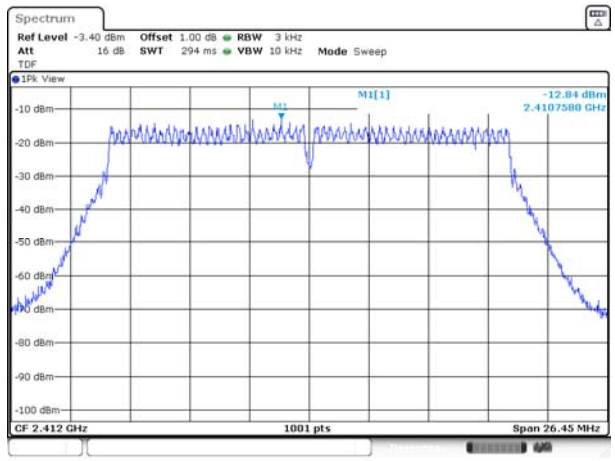
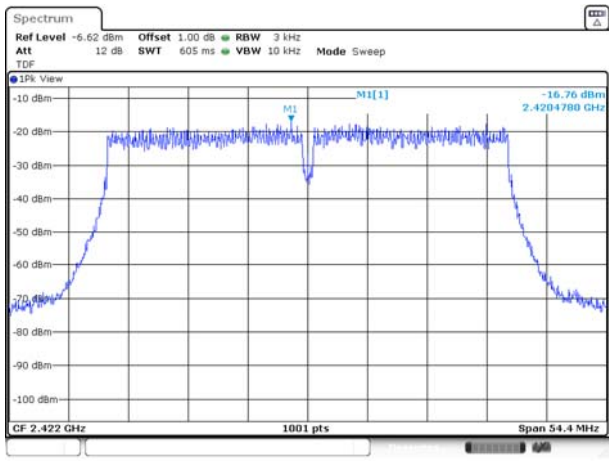
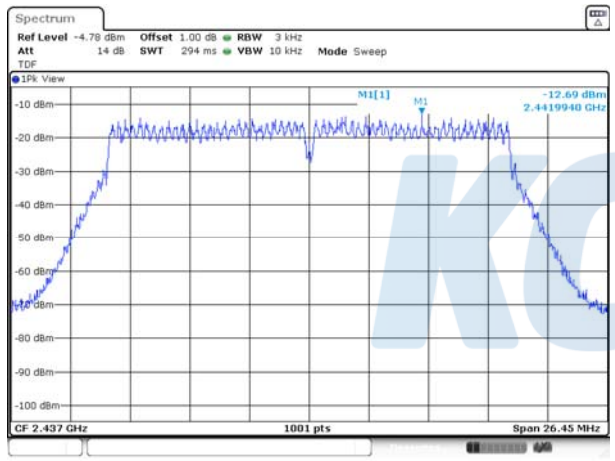
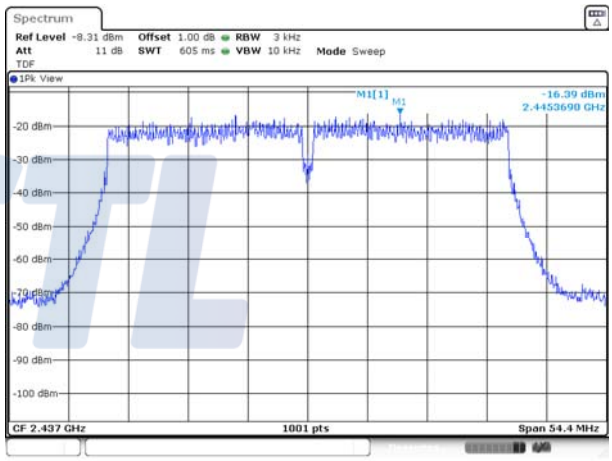
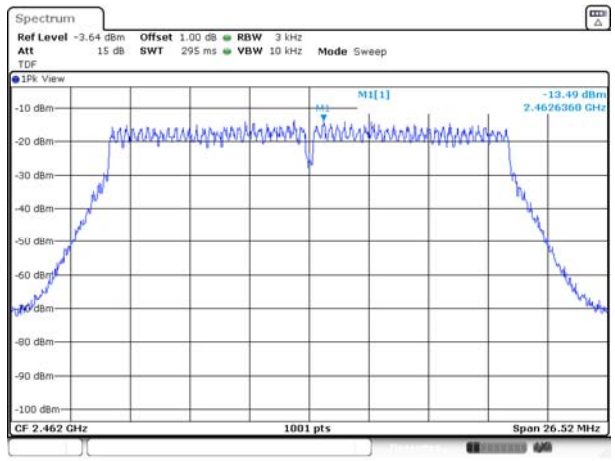
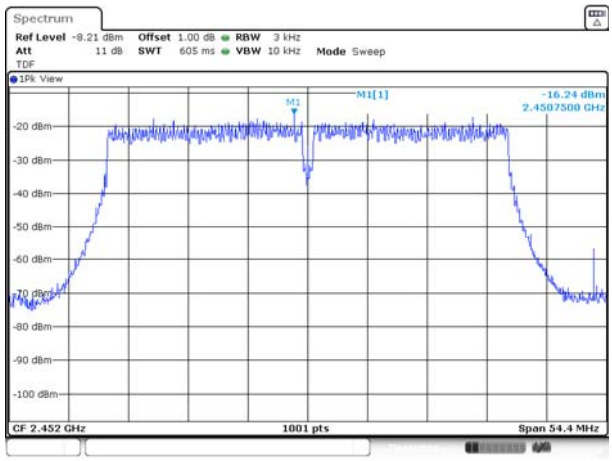
802.11b / 2 412 ㎒	802.11g / 2 412 ㎒
	
802.11b / 2 437 ㎒	**802.11g / 2 437 ㎒**
	
802.11b / 2 462 ㎒	**802.11g / 2 462 ㎒**
	

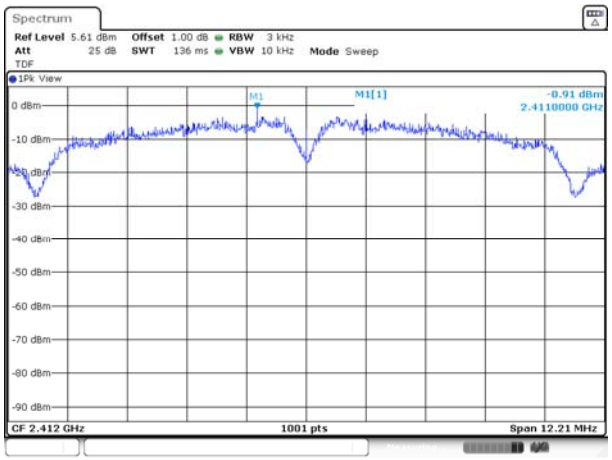
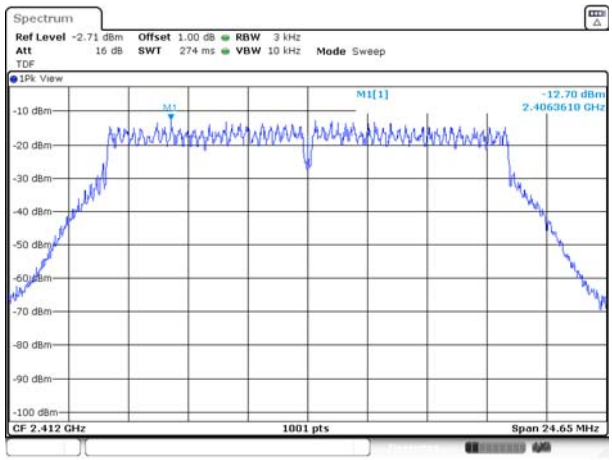
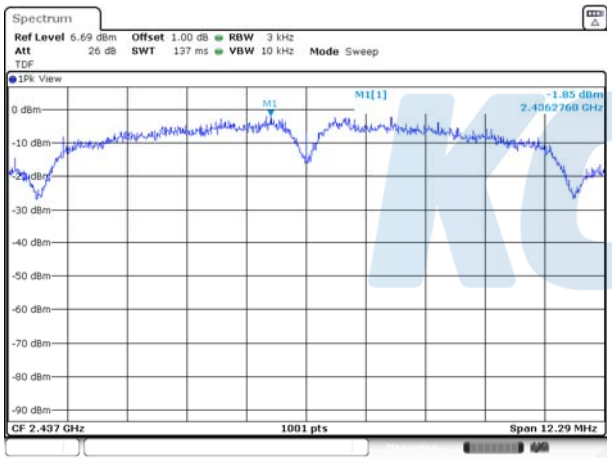
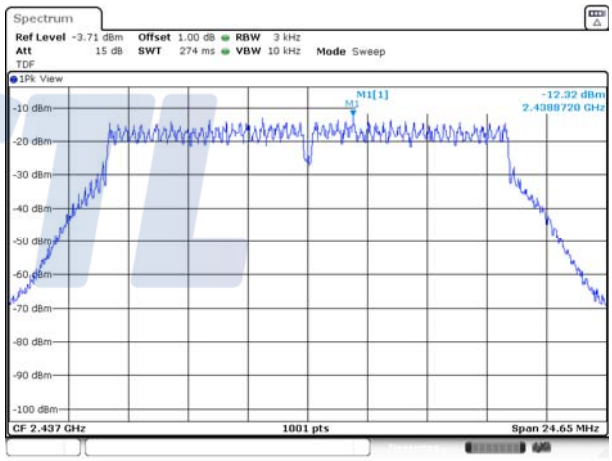
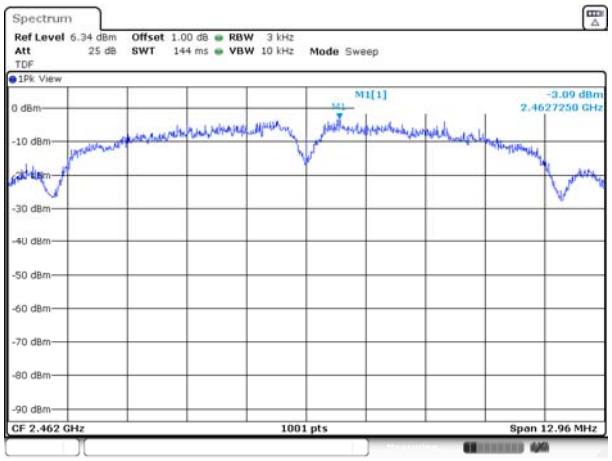
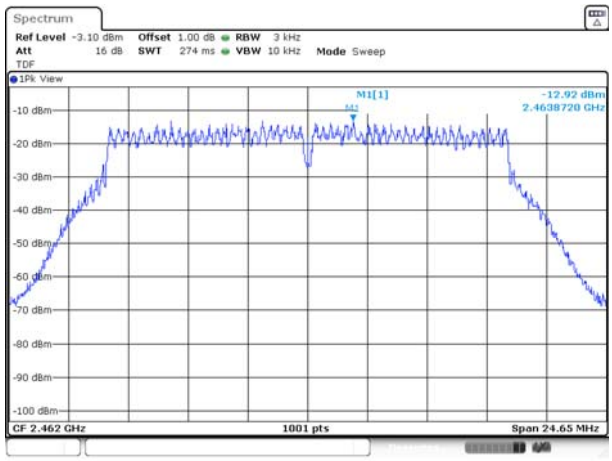
802.11n HT20 / 2 412 ㎒	802.11n HT40 / 2 422 ㎒
	
802.11n HT20 / 2 437 ㎒	**802.11n HT40 / 2 437 ㎒**
	
802.11n HT20 / 2 462 ㎒	**802.11n HT40 / 2 452 ㎒**
	

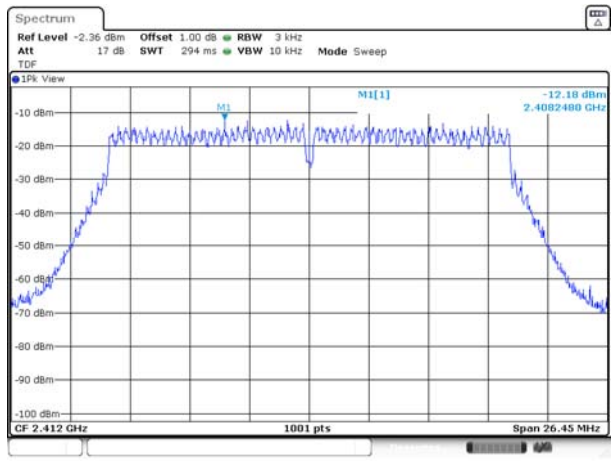
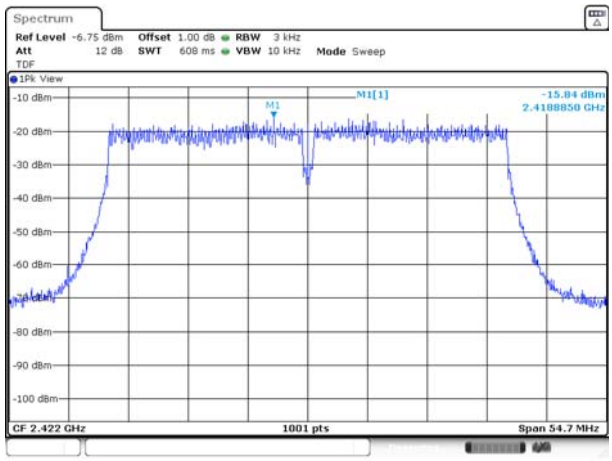
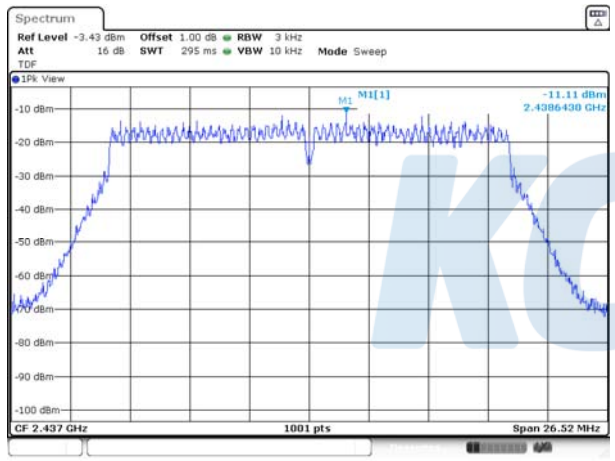
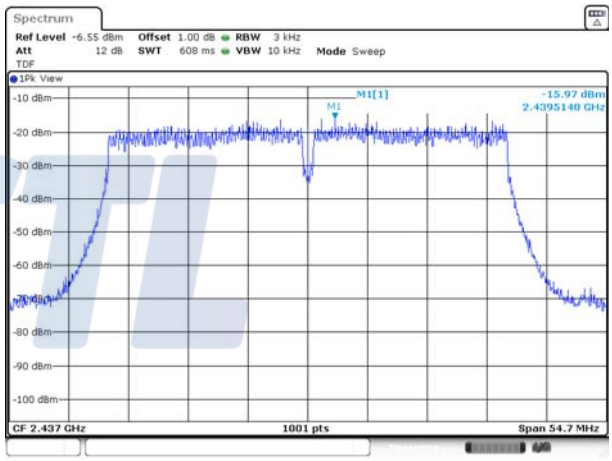
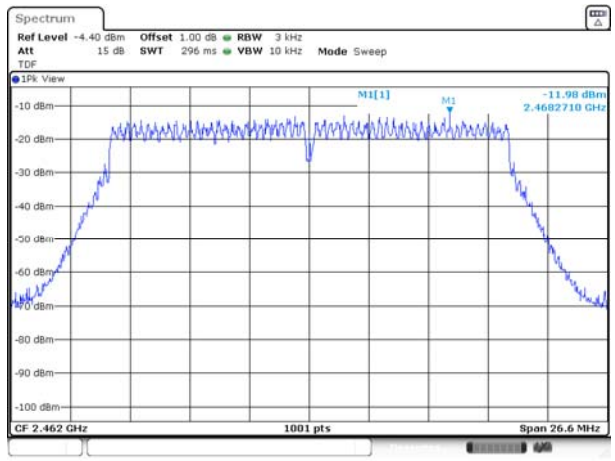
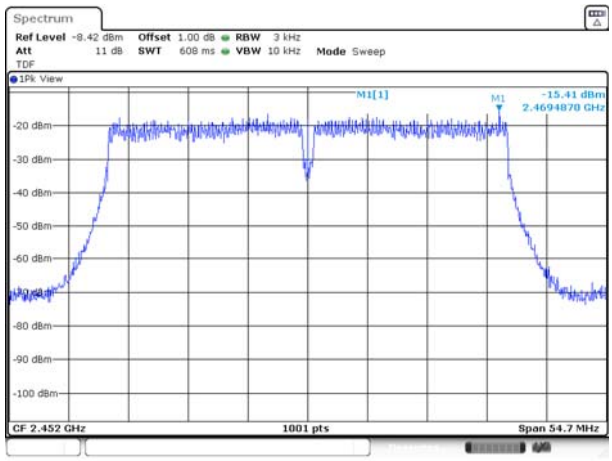
MIMO ANT 0

802.11b / 2 412 ㎒	802.11g / 2 412 ㎒
	
802.11b / 2 437 ㎒	**802.11g / 2 437 ㎒**
	
802.11b / 2 462 ㎒	**802.11g / 2 462 ㎒**
	

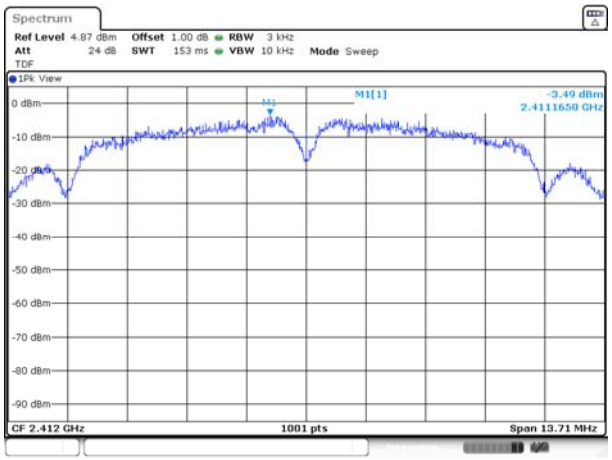
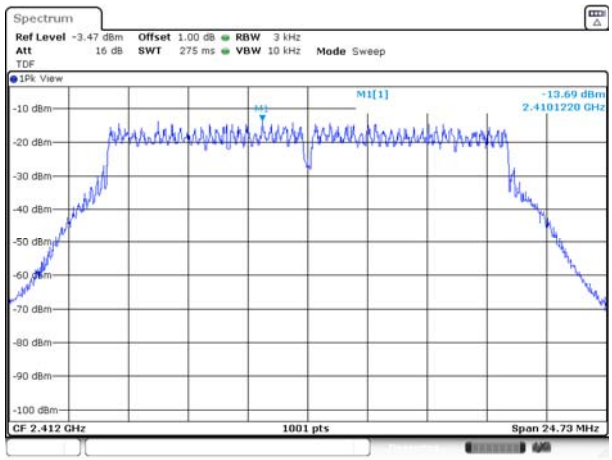
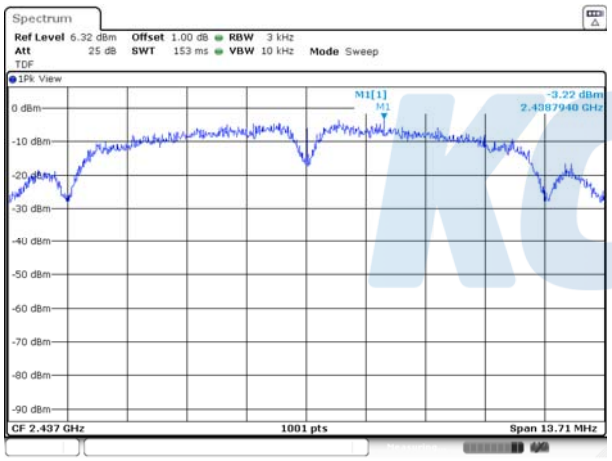
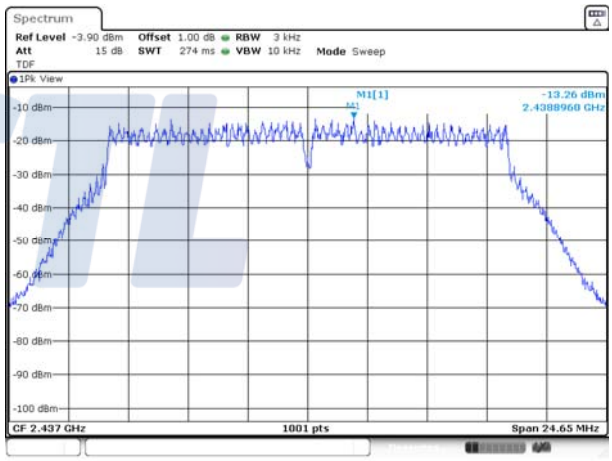
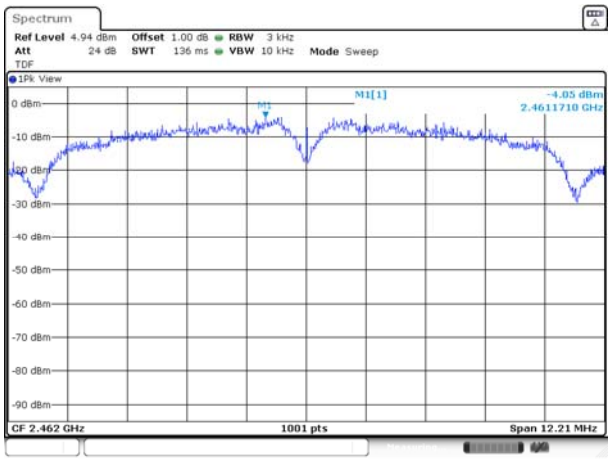
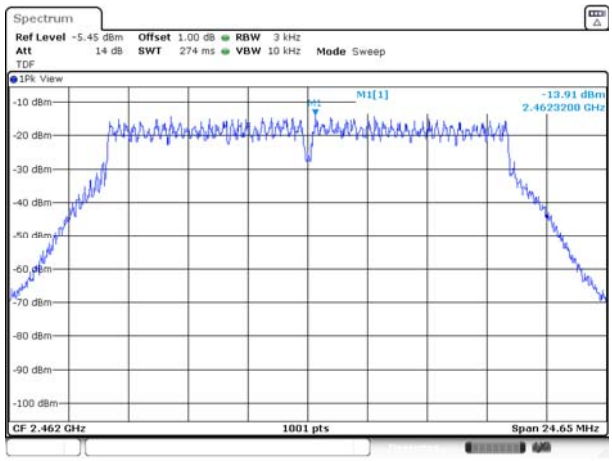
802.11n HT20 / 2 412 ㎒	802.11n HT40 / 2 422 ㎒
	
802.11n HT20 / 2 437 ㎒	**802.11n HT40 / 2 437 ㎒**
	
802.11n HT20 / 2 462 ㎒	**802.11n HT40 / 2 452 ㎒**
	

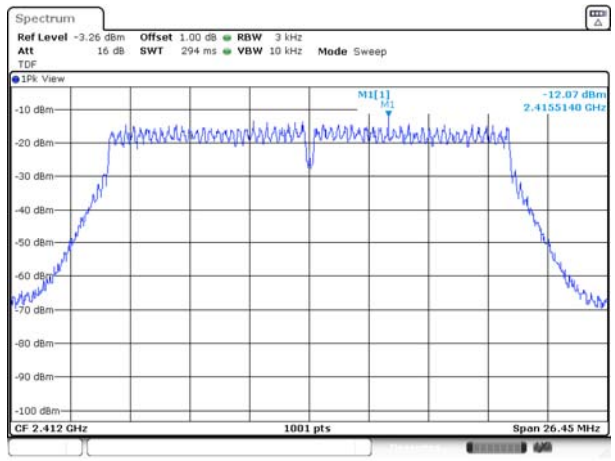
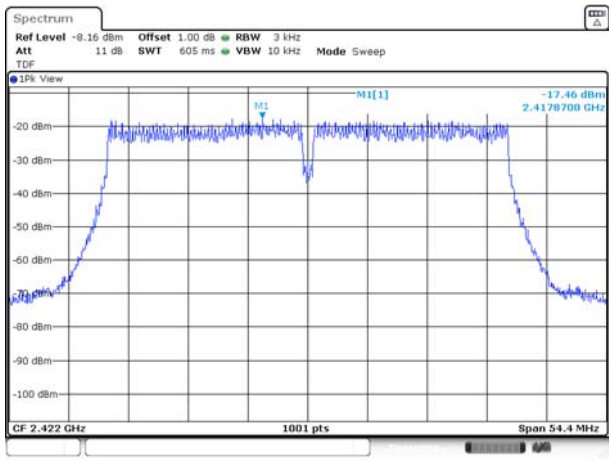
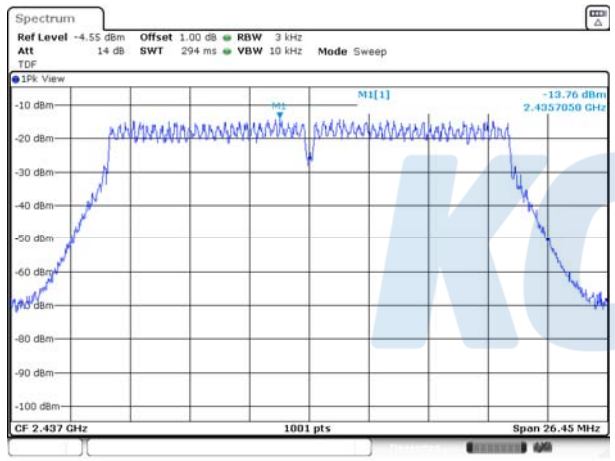
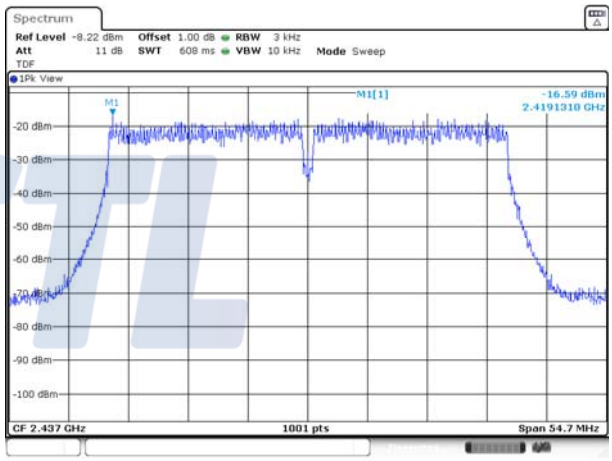
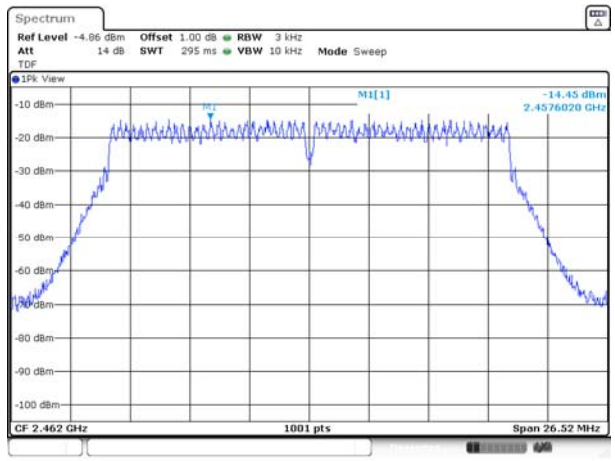
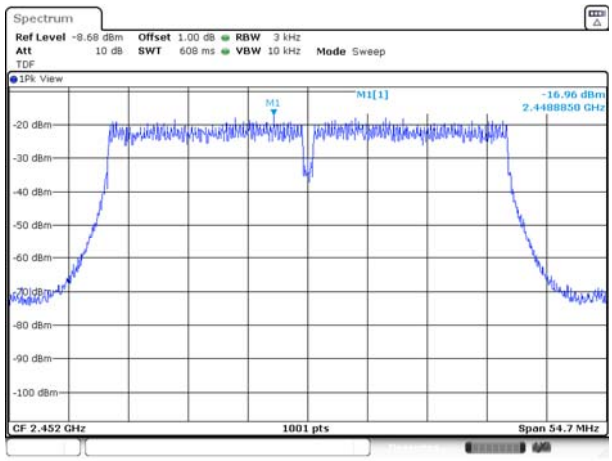
MIMO ANT 1

802.11b / 2 412 ㎒	802.11g / 2 412 ㎒
	
802.11b / 2 437 ㎒	**802.11g / 2 437 ㎒**
	
802.11b / 2 462 ㎒	**802.11g / 2 462 ㎒**
	

802.11n HT20 / 2 412 ㎒	802.11n HT40 / 2 422 ㎒
	
802.11n HT20 / 2 437 ㎒	**802.11n HT40 / 2 437 ㎒**
	
802.11n HT20 / 2 462 ㎒	**802.11n HT40 / 2 452 ㎒**
	

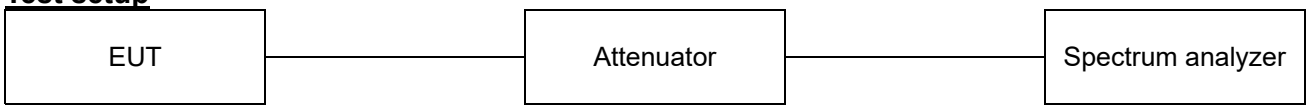
MIMO ANT 2

802.11b / 2 412 ㎒	802.11g / 2 412 ㎒
	
802.11b / 2 437 ㎒	**802.11g / 2 437 ㎒**
	
802.11b / 2 462 ㎒	**802.11g / 2 462 ㎒**
	

802.11n HT20 / 2 412 ㎒	802.11n HT40 / 2 422 ㎒
	
802.11n HT20 / 2 437 ㎒	**802.11n HT40 / 2 437 ㎒**
	
802.11n HT20 / 2 462 ㎒	**802.11n HT40 / 2 452 ㎒**
	

7.5. Conducted Spurious Emission

Test setup



Limit

According to §15.247(d), In any 100 ㎑ bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 ㎑ bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).
Limit : 30 dBc

Test procedure
ANSI C63.10-2013 - Section 11.11.3

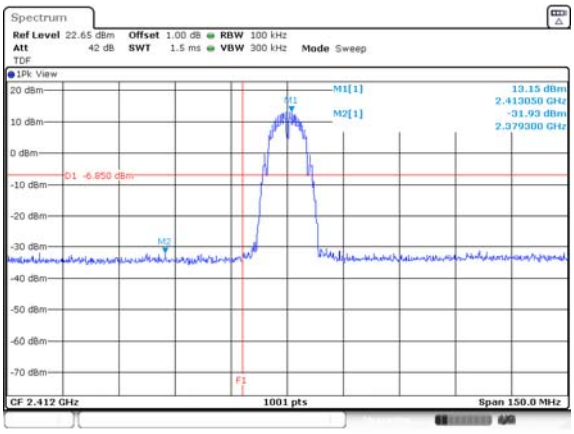
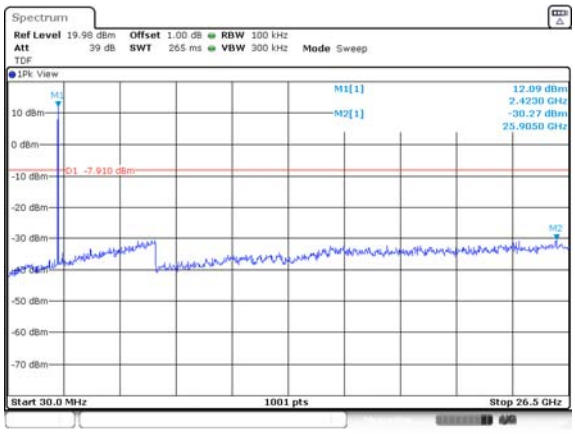
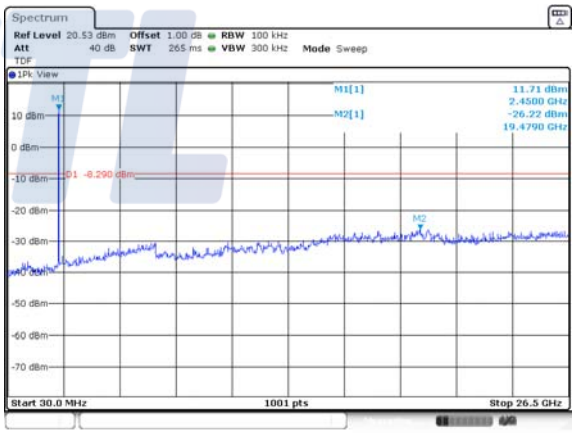
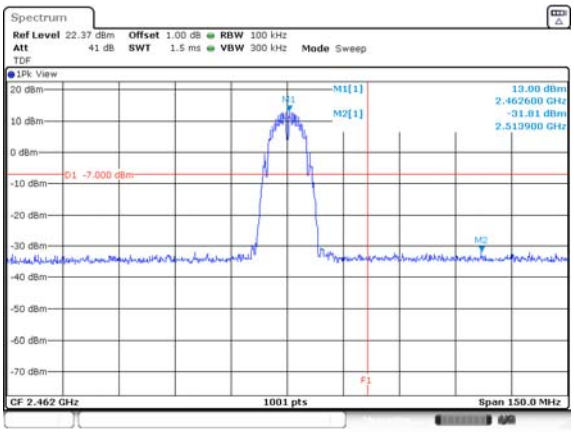
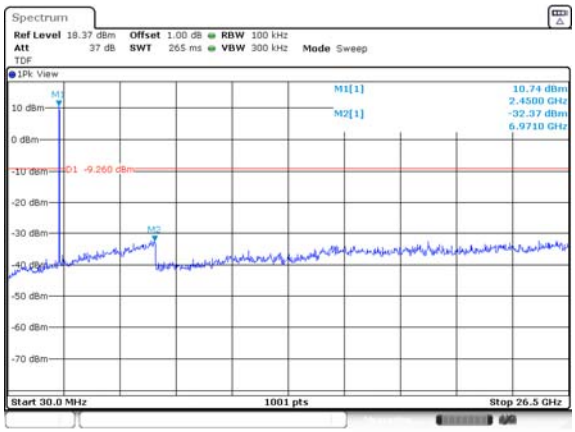
Test settings
Establish an emission level by using the following procedure:

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

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) is attenuated by at least the minimum requirements specified in 11.11. Report the three highest emissions relative to the limit.

Test results

SISO ANT 0

802.11b	
Conducted band-edge / 2 412 ㎒	**Conducted spurious / 2 412 ㎒**
	
	Conducted spurious / 2 437 ㎒
Blank	
Conducted band-edge / 2 462 ㎒	**Conducted spurious / 2 462 ㎒**
	

802.11g	
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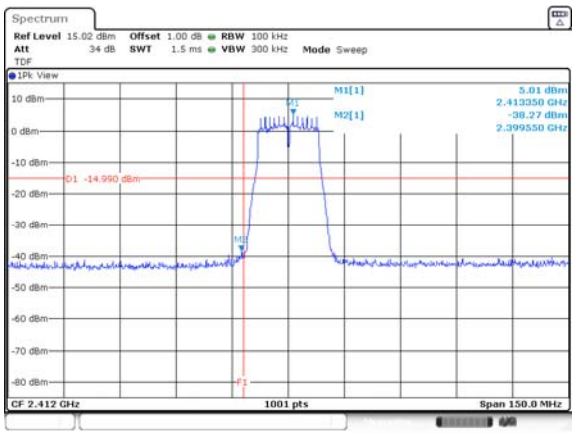
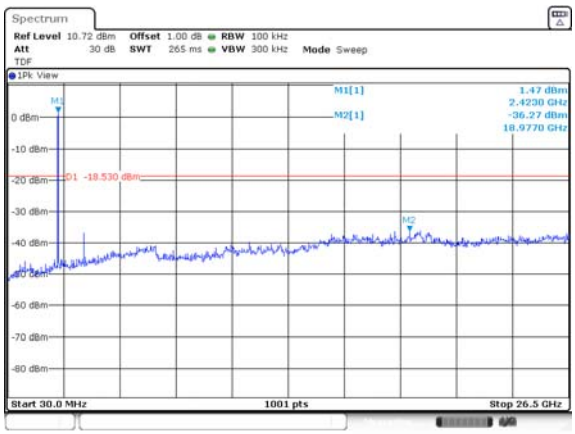
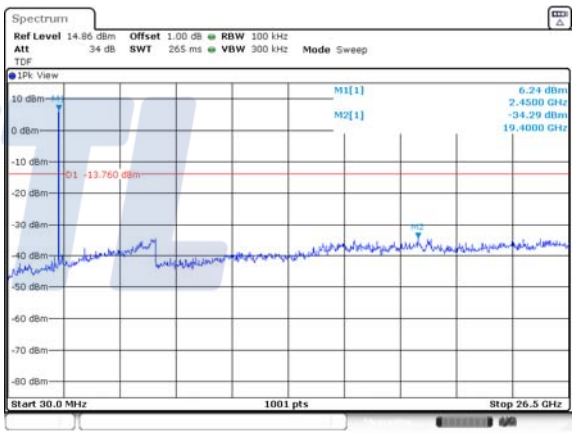
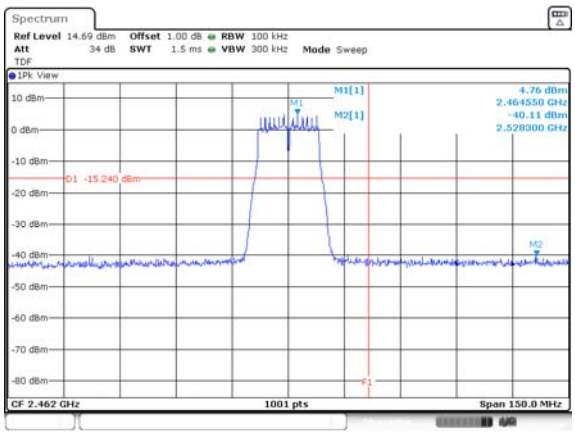
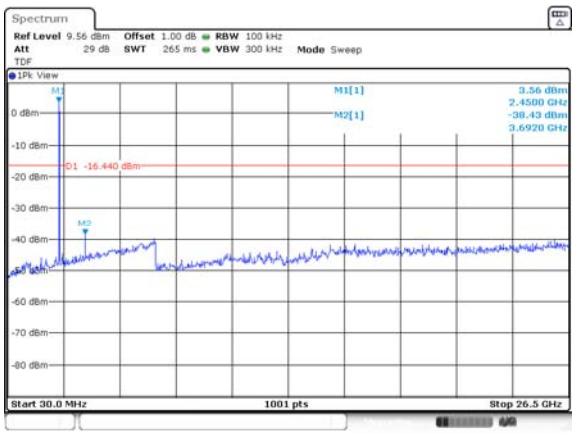
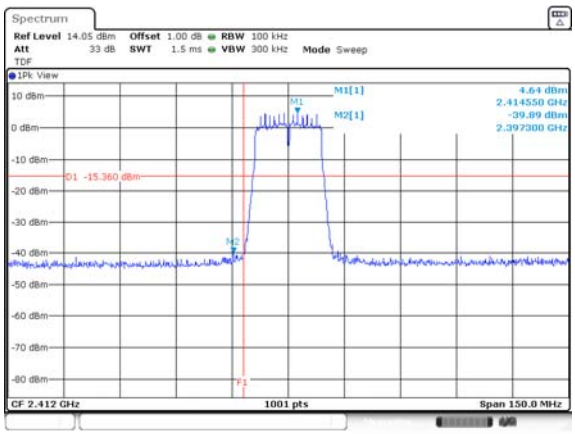
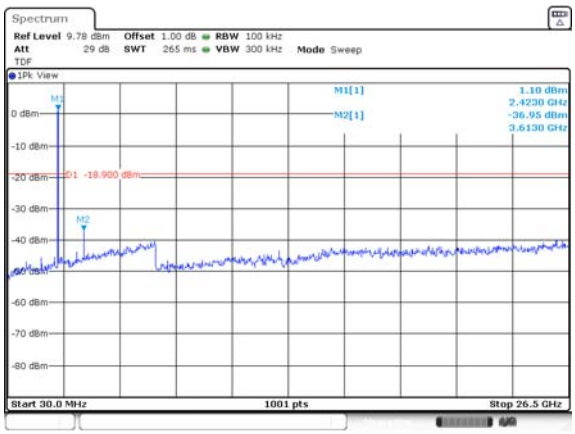
	
	Conducted spurious / 2 437 ㎒
Blank	
Conducted band-edge / 2 462 ㎒	**Conducted spurious / 2 462 ㎒**
	

802.11n HT20

Conducted band-edge / 2 412 ㎒



Conducted spurious / 2 412 ㎒



Conducted spurious / 2 437 ㎒

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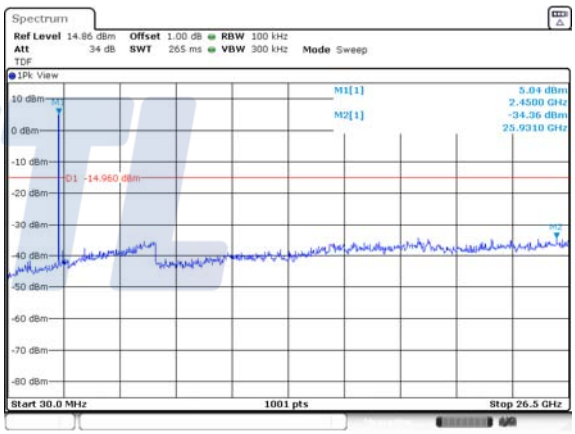
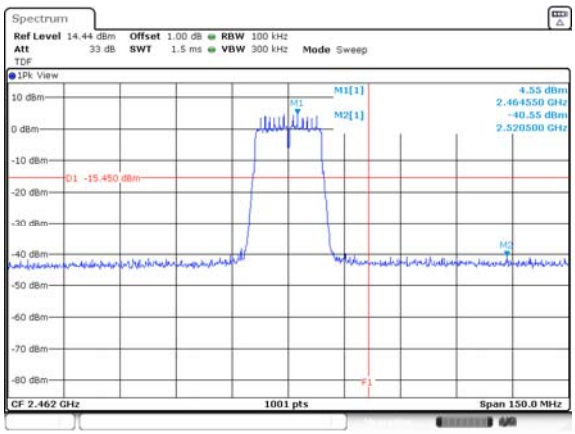
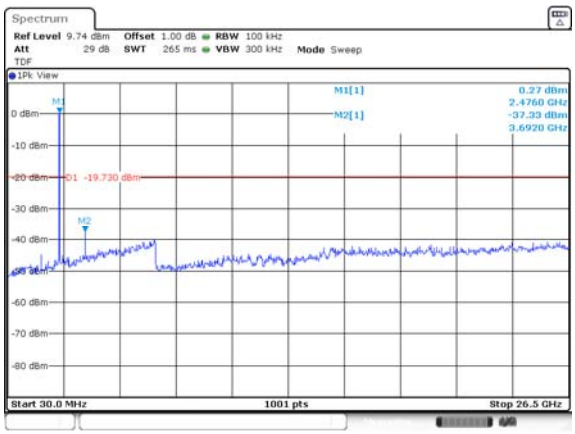


Conducted band-edge / 2 462 ㎒

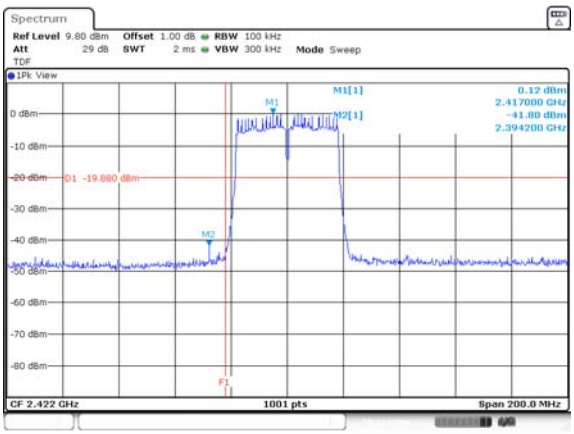


Conducted spurious / 2 462 ㎒

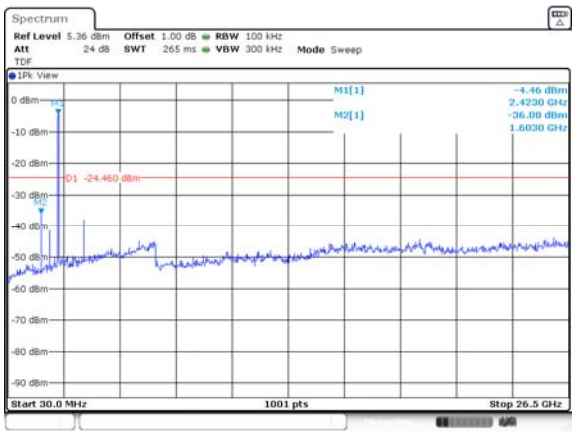


802.11n HT40

Conducted band-edge / 2 422 ㎒



Conducted spurious / 2 422 ㎒



Conducted spurious / 2 437 ㎒

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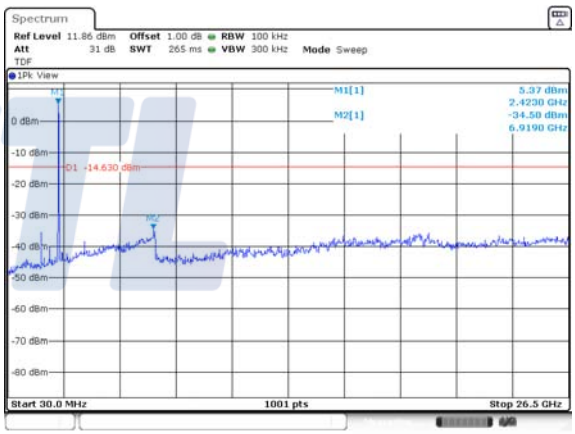
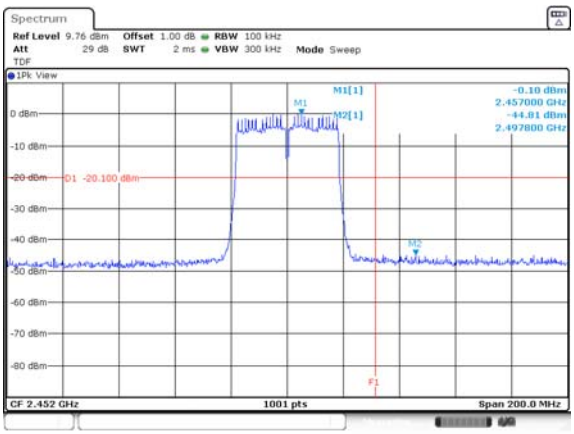
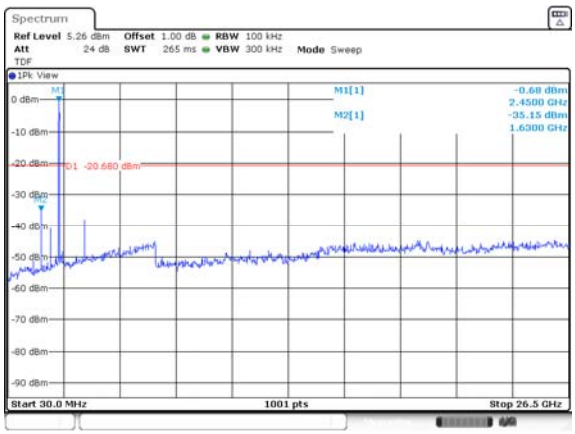


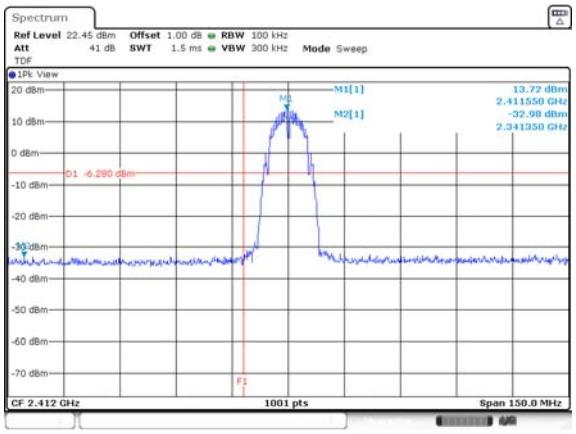
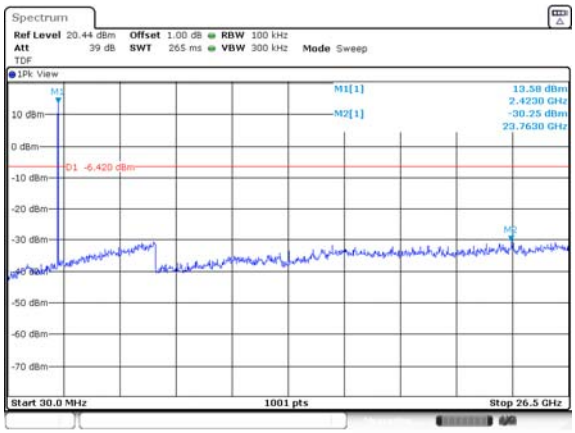
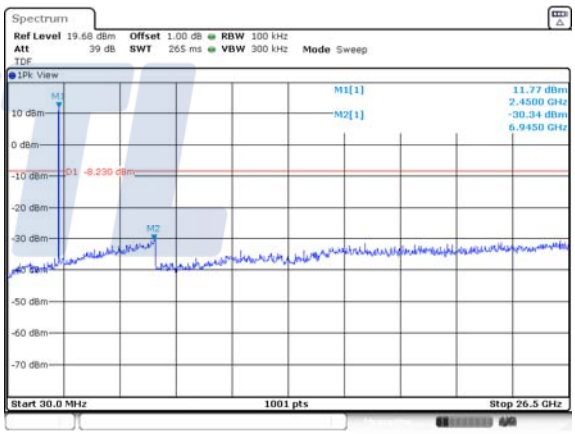
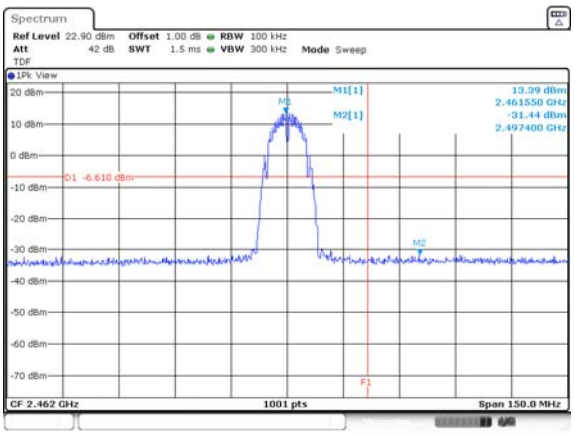
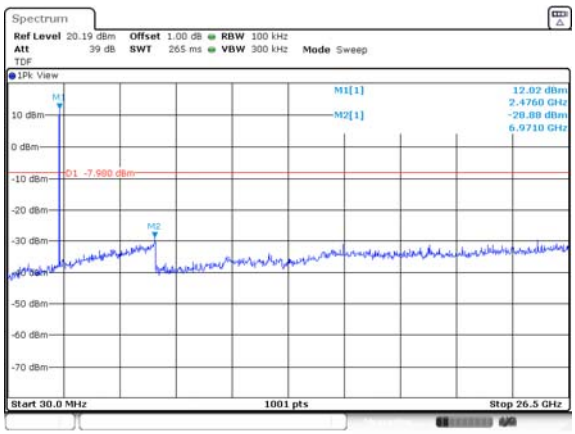
Conducted band-edge / 2 452 ㎒



Conducted spurious / 2 452 ㎒



SISO ANT 1

802.11b	
Conducted band-edge / 2 412 ㎒	**Conducted spurious / 2 412 ㎒**
	
,	
	Conducted spurious / 2 437 ㎒
Blank	
Conducted band-edge / 2 462 ㎒	**Conducted spurious / 2 462 ㎒**
	

802.11g	
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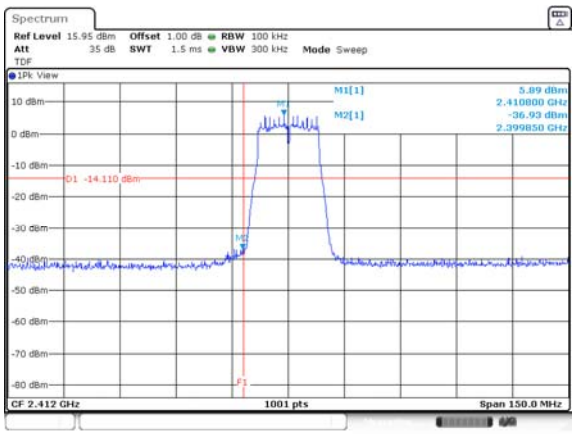
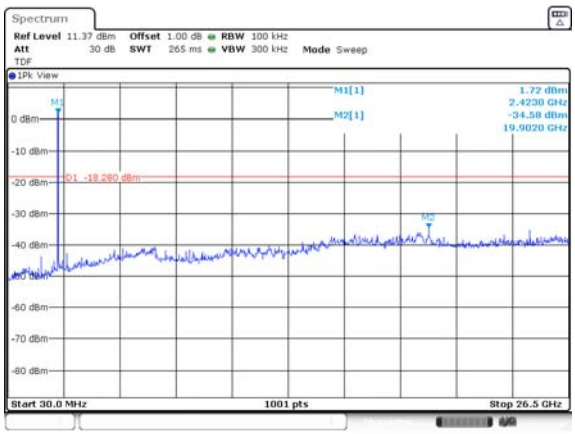
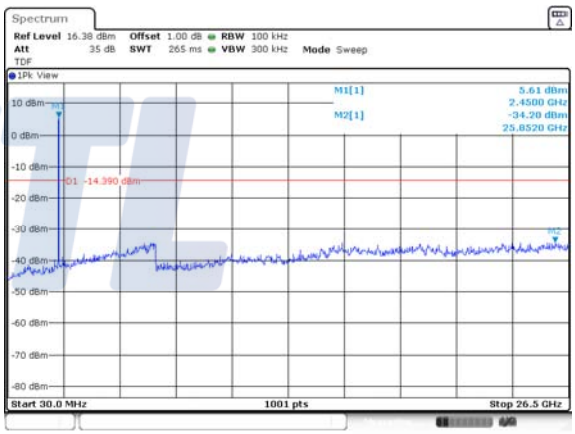
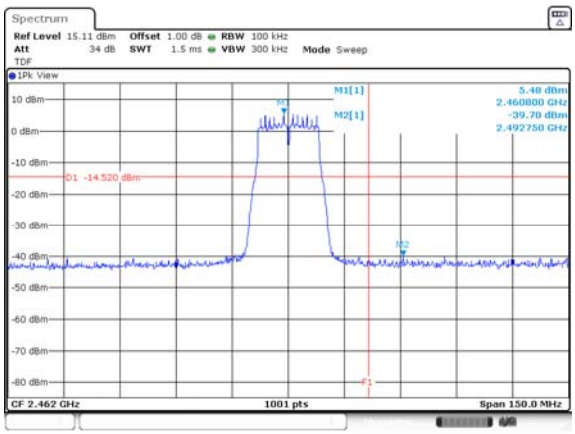
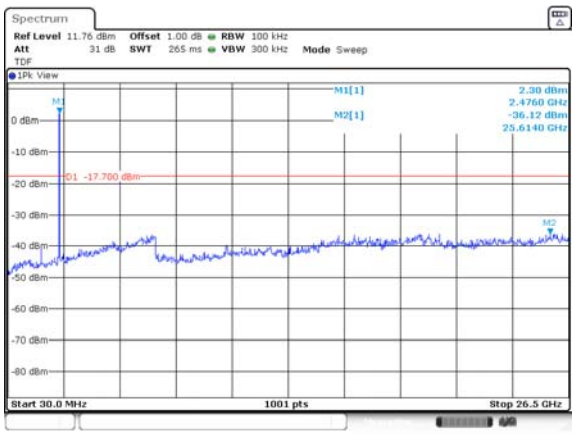
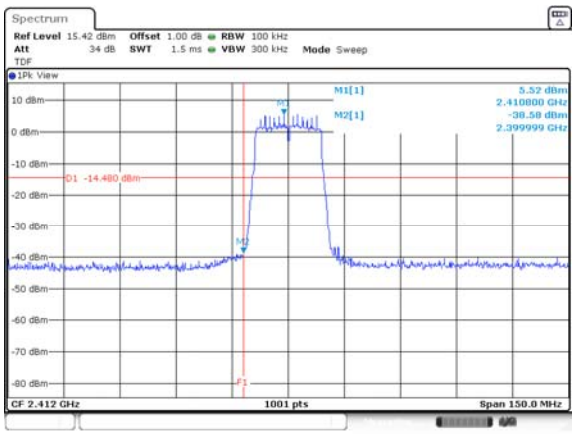
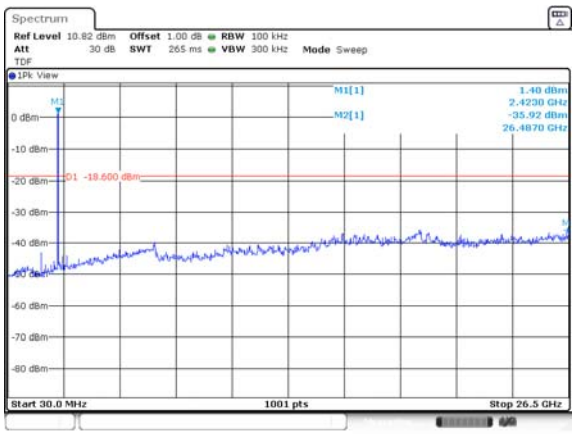
	
	Conducted spurious / 2 437 ㎒
Blank	
Conducted band-edge / 2 462 ㎒	**Conducted spurious / 2 462 ㎒**
	

802.11n HT20

Conducted band-edge / 2 412 ㎒



Conducted spurious / 2 412 ㎒



Conducted spurious / 2 437 ㎒

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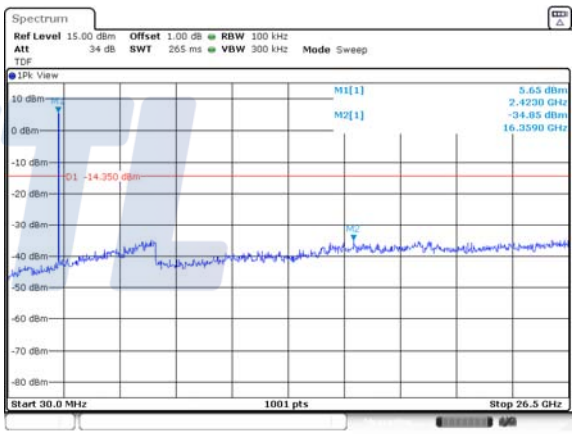
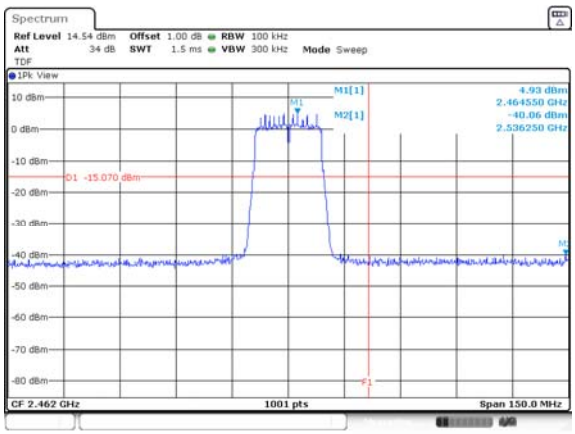
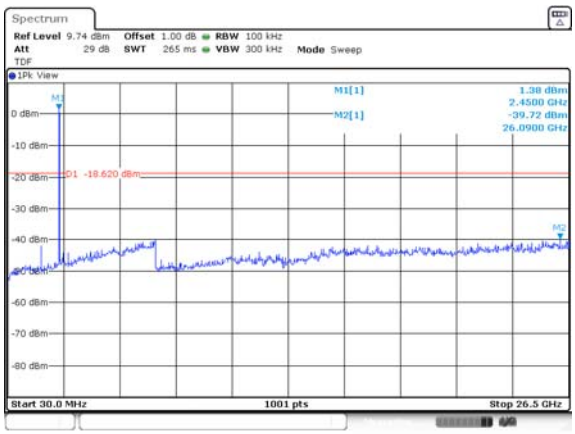


Conducted band-edge / 2 462 ㎒

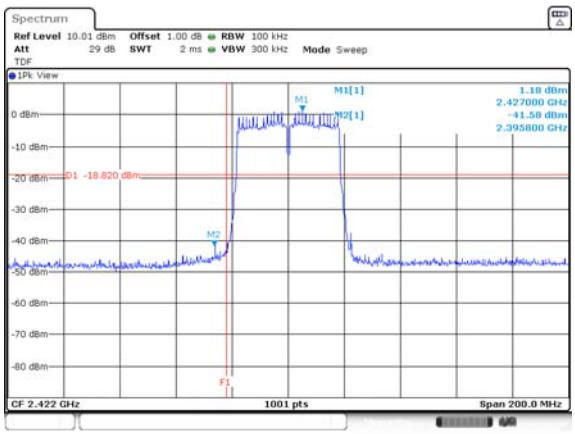


Conducted spurious / 2 462 ㎒

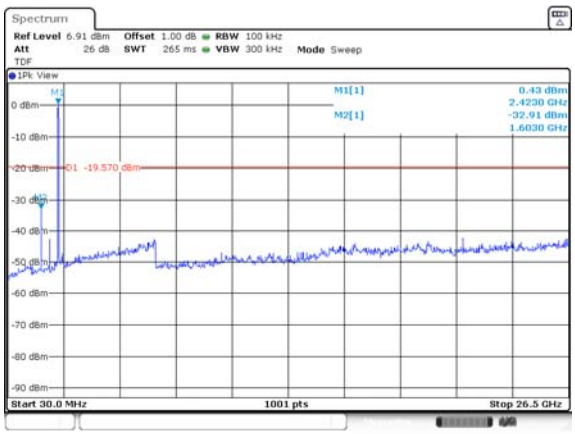


802.11n HT40

Conducted band-edge / 2 422 ㎒



Conducted spurious / 2 422 ㎒



Conducted spurious / 2 437 ㎒

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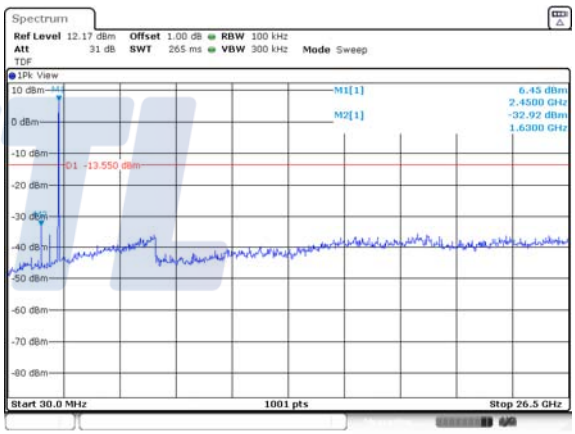
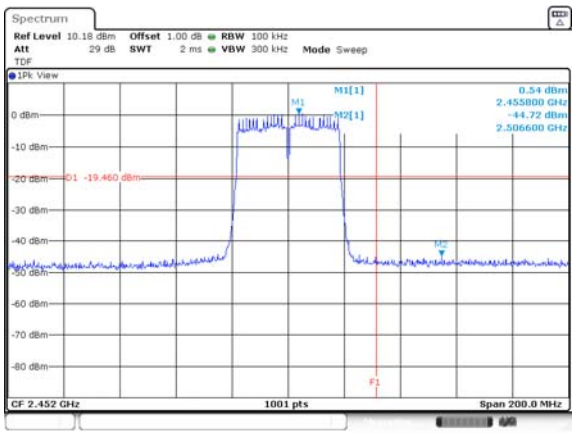
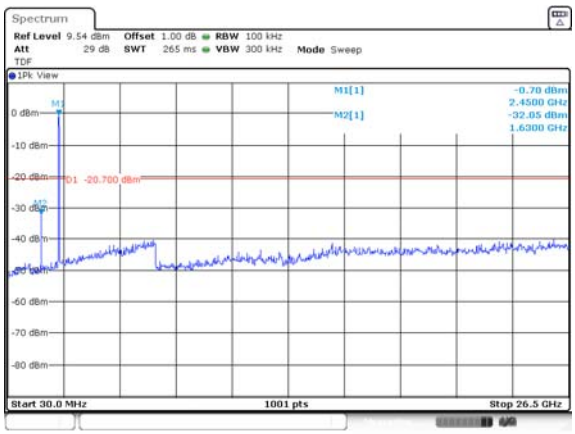


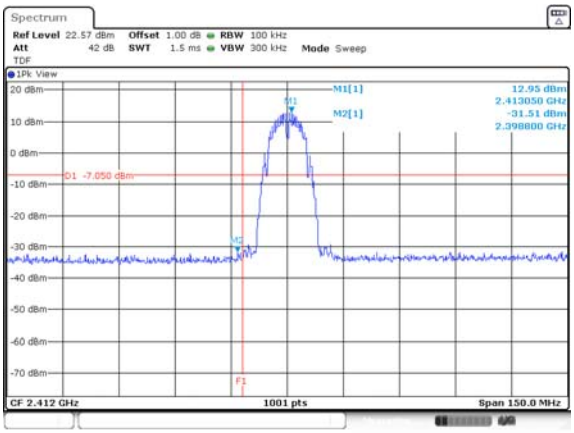
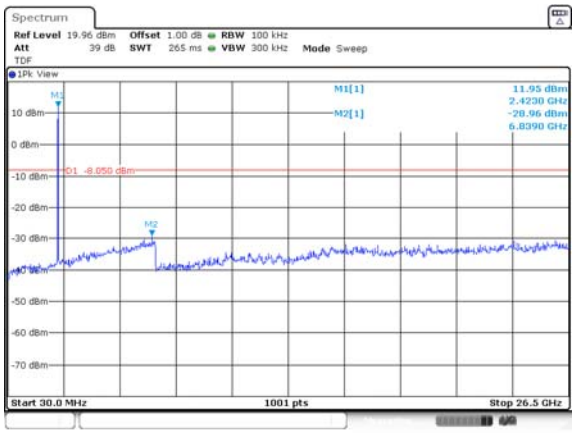
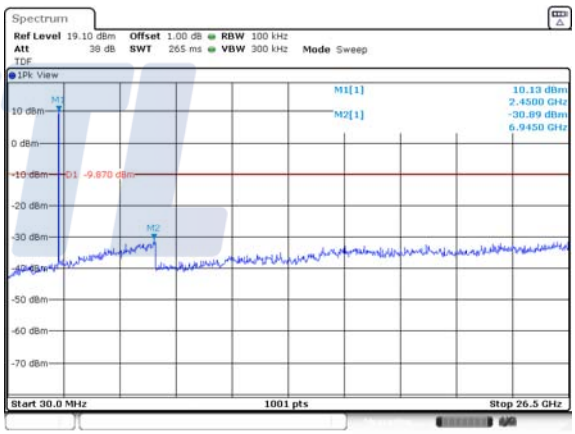
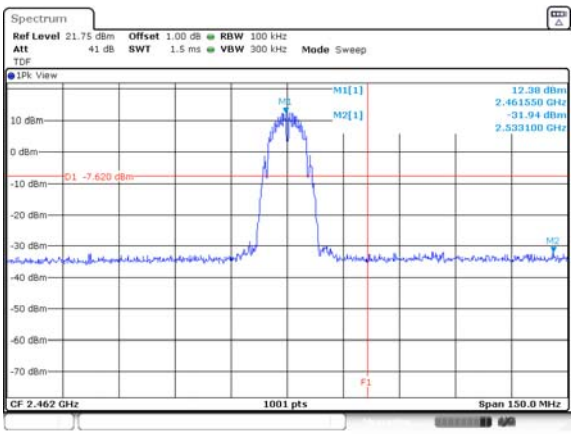
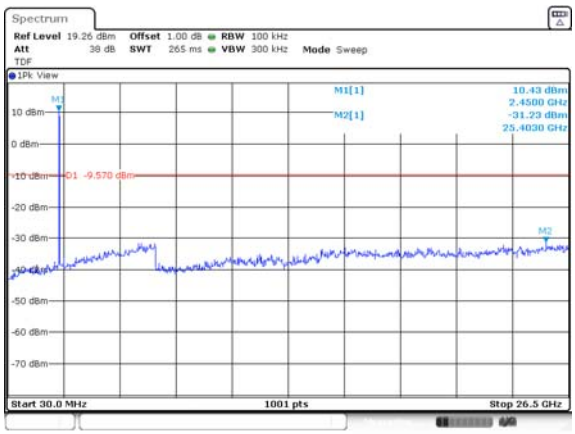
Conducted band-edge / 2 452 ㎒

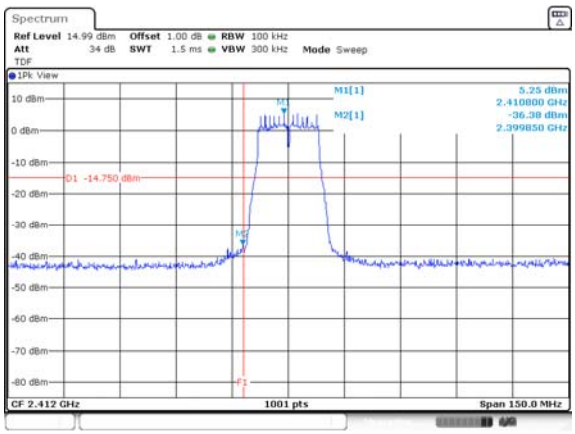
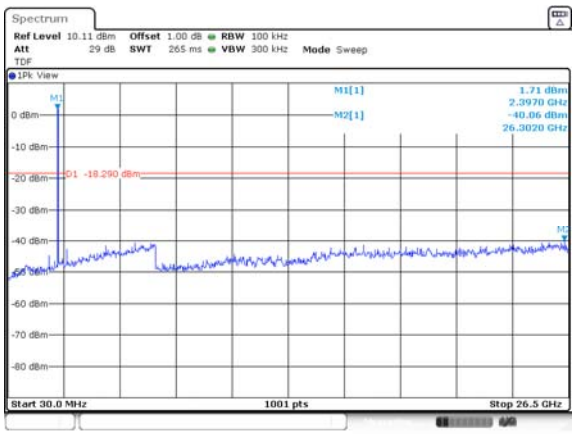
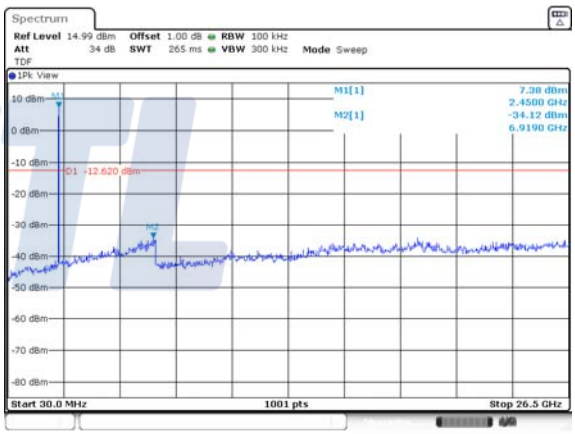
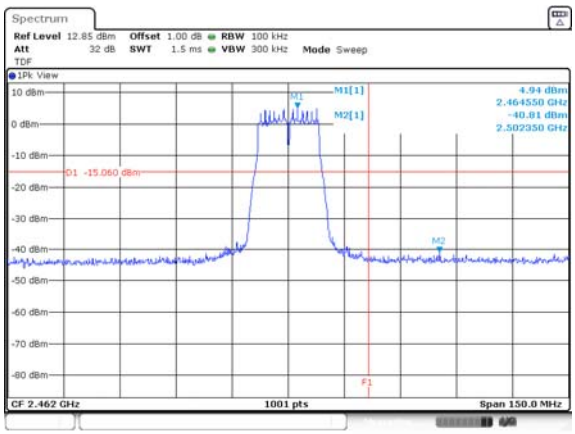
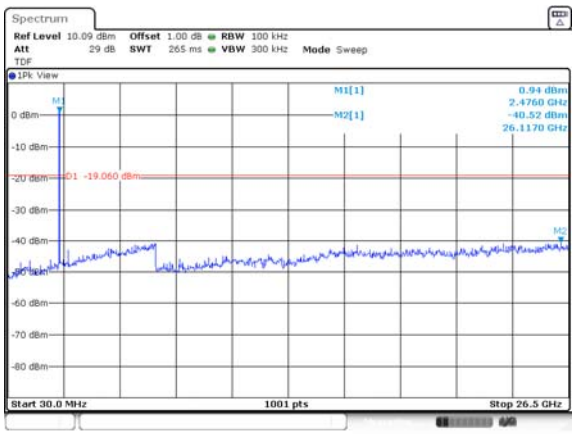


Conducted spurious / 2 452 ㎒



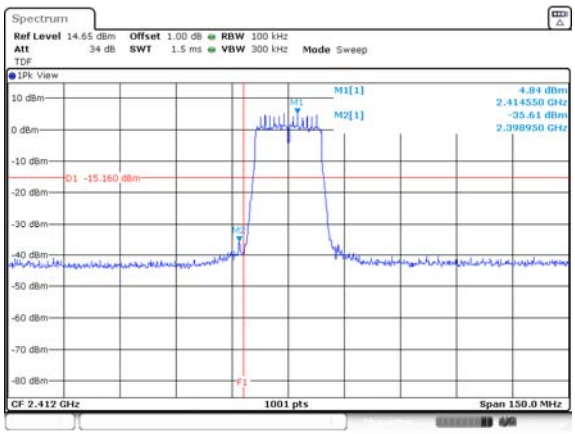
SISO ANT 2

802.11b	
Conducted band-edge / 2 412 ㎒	**Conducted spurious / 2 412 ㎒**
	
	Conducted spurious / 2 437 ㎒
Blank	
Conducted band-edge / 2 462 ㎒	**Conducted spurious / 2 462 ㎒**
	

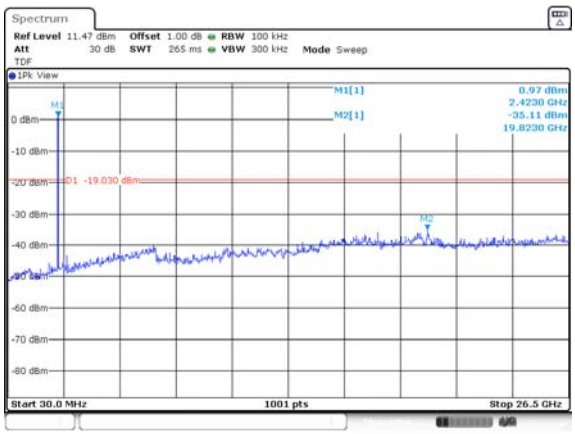
802.11g	
Conducted band-edge / 2 412 ㎒	**Conducted spurious / 2 412 ㎒**
	
	Conducted spurious / 2 437 ㎒
Blank	
Conducted band-edge / 2 462 ㎒	**Conducted spurious / 2 462 ㎒**
	

802.11n HT20

Conducted band-edge / 2 412 ㎒



Conducted spurious / 2 412 ㎒



Conducted spurious / 2 437 ㎒

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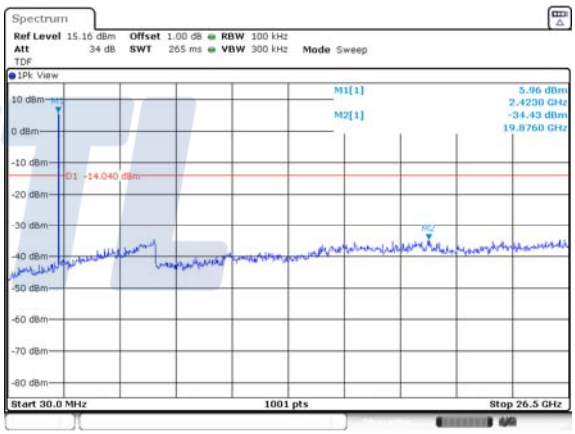
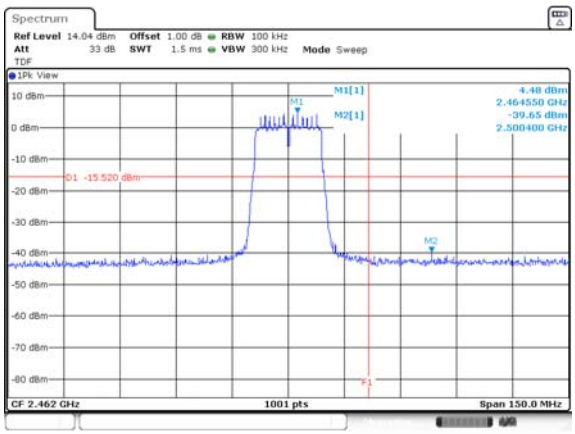


Conducted band-edge / 2 462 ㎒



Conducted spurious / 2 462 ㎒