TEST REPORT

KCTL Inc.
65, Sinwon-ro, Yeongtong-gu,
Suwon-si, Gyeonggi-do, 443-390, Korea
TEL: 82 70 5008 1021
FAX: 82 505 299 8311

http://www.kctl.co.kr

1. Applicant

Name:	THINKWARE SYSTEMS CORPORATION
Address:	9FL., Samwhan Hipex, 240, Pangyoyeok-ro, Bundang-gu, Seongnam-si, Gyeonggi-do, South Korea

2. Sample Description:

FCC ID:	2ADTG-F770
IC ID:	12594A-F770
Type of equipment:	THINKWARE DASH CAM
Basic Model:	F770

3. Date of Test: May 20 ~ May 26, 2016

4. Test standard used: FCC Part 15 Subpart C 15.247
RSS-247 Issue 1 May 2015
RSS GEN Issue 4 November 2014

5. Test Results

Test Item:	Refer to page 7
Result:	Refer to page 8 ~ page 71
Measurement Uncertainty:	Refer to page 7

This result shown in this report refer only to the sample(s) tested unless otherwise stated.

Affirmation	Tested by Name: DO WON, AHN	Technical Manager Name: CHANG MIN, KIM

2016. 05. 30

KCTL Inc.

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1. Client information

Applicant:	THINKWARE SYSTEMS CORPORATION
Address:	9FL., Samwhan Hipex, 240, Pangyoyeok-ro, Bundang-gu, Seongnam-si, Gyeonggi-do, South Korea
Telephone number:	+82-2-589-9705
Facsimile number:	+82-2-589-9600
Contact person:	Chan-Uk Heo / heocu87@thinkware.co.kr

Manufacturer:	THINKWARE SYSTEMS CORPORATION
Address:	9FL., Samwhan Hipex, 240, Pangyoyeok-ro, Bundang-gu, Seongnam-si, Gyeonggi-do, South Korea

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2. Laboratory information

Address

KCTL Inc.
480-5, Sin-dong, Yeongtong-gu, Suwon-si, Gyeonggi-do, Korea
Telephone Number: +82-70-5008-1016 Facsimile Number: +82-505-299-8311

Certificate

KOLAS No.: KT231
FCC Site Designation No: KR0040
FCC Site Registration No: 687132
VCCI Site Registration No.: R-3327, G-198, C-3706, T-1849
IC Site Registration No.:8035A-2

SITE MAP

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3. Description of E.U.T.

3.1 Basic description

Applicant	THINKWARE SYSTEMS CORPORATION
Address of Applicant	9FL., Samwhan Hipex, 240, Pangyoyeok-ro, Bundang-gu, Seongnam-si, Gyeonggi-do, South Korea
Manufacturer	THINKWARE SYSTEMS CORPORATION
Address of Manufacturer	9FL., Samwhan Hipex, 240, Pangyoyeok-ro, Bundang-gu, Seongnam-si, Gyeonggi-do, South Korea
Type of equipment	THINKWARE DASH CAM
Basic Model	F770
Serial number	N/A

3.2 General description

Frequency Range	2 412 ㎒ ~ 2 462 ㎒ (802.11b/g/n_HT20) 2 422 ㎒ ~ 2 452 ㎒ (802.11n_HT40)
Type of Modulation	DSSS (802.11b), OFDM (802.11g/n_HT20/n_HT40)
The number of channels	11 ch (802.11b/g/n_HT20) 7 ch (802.11n_HT40)
Type of Antenna	Dielectric Chip Antenna
Antenna Gain	3.15 ㏈i
Transmit Power	21.43 ㏈m
Power supply	DC 12~24 Ⅴ
Product SW/HW version	ALPS&ROCKY V4.0 / Ver 1.00.00
Radio SW/HW version	Ver1.2 / driver 4.1.8
Test SW Version	Tera Term Pro
RF power setting in TEST SW	802.11b: 15, 802.11g: 13, 802.11n HT20: 12, 802.11n HT40: 12

Note : The above EUT information was declared by the manufacturer.

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3.3 Test frequency

	802.11n_HT20	802.11n_HT40
Lowest frequency	2 412 ㎒	2 422 ㎒
Middle frequency	2 437 ㎒	2 437 ㎒
Highest frequency	2 462 ㎒	2 452 ㎒

3.4 Test Voltage

Mode	Voltage
Norminal Voltage	DC 12~24 Ⅴ

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4. Summary of test results

4.1 Standards & results

FCC Rule Reference	IC Rule Reference	Parameter	Report Section	Test Result
15.203, 15.247(b)(4)	-	Antenna Requirement	5.1	C
15.247(b)(3)	RSS-247, 5.4(4)	Maximum Peak Output Power	5.2	C
15.247(e)	RSS-247, 5.2	Peak Power Spectral Density	5.3	C
15.247(a)(2)	RSS-247, 5.2	6 dB Channel Bandwidth	5.4	C
-	RSS-247, 5.2	Occupied Bandwidth	5.4	C
15.247(d), 15.205(a), 15.209(a)	RSS-247, 5.5 RSS-GEN, 8.9, 10	Spurious Emission, Band Edge and Restricted bands	5.5	C
15.207(a)	RSS-GEN, 8.8	Conducted Emissions	5.6	N/A1)

Note: C = complies
NC = Not complies
NT = Not tested
NA = Not Applicable

N/A1): This test is not applicable because the EUT falls into the automotive device and it's not to be connected to the public utility(AC) power line.

* The general test methods used to test this device is ANSI C63.10:2013

4.2 Uncertainty

Measurement Item	Expanded Uncertainty U = *k*Uc (*k* = 2)	
Conducted RF power	1.44 dB	
Conducted Spurious Emissions	1.52 dB	
Radiated Spurious Emissions	30 ㎒ ~ 300 ㎒:	+ 4.94 dB, - 5.06 dB
		+ 4.93 dB, - 5.05 dB
	300 ㎒ ~ 1 000 ㎒:	+ 4.97 dB, - 5.08 dB
		+ 4.84 dB, - 4.96 dB
	1 ㎓ ~ 25 ㎓:	+ 6.03 dB, - 6.05 dB
Conducted Emissions	9 ㎑ ~ 150 ㎑:	3.75 dB
	150 ㎑ ~ 30 ㎒:	3.36 dB

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5. Test results

5.1 Antenna Requirement

5.1.1 Regulation

According to §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 manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

And 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 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi 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 dB that the directional gain of the antenna exceeds 6 dBi.

5.1.2 Result

-Complied

The transmitter has permanently attached chip antenna(internal antenna) on PCB board.

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5.2 Maximum Peak Output Power

5.2.1 Regulation

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.

5.2.2 Measurement Procedure

These test measurement settings are specified in section 9.0 of 558074 D01 DTS Meas Guidance.

5.2.2.1 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.

5.2.2.2 RBW ≥ DTS bandwidth

This procedure shall be used when the measurement instrument has available a resolution bandwidth that is greater than the DTS bandwidth.

a) Set the RBW ≥ DTS bandwidth.
b) Set VBW ≥ 3 x RBW.
c) Set span ≥ 3 x 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.

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5.2.3 Test Result

- Complied

*** 802.11b**

Channel	Frequency (㎒)	Result (dBm)	Limit (dBm)	Margin (dB)	Avarage Power (dBm)
Lowest	2 412	17.96	30.00	12.04	13.68
Middle	2 437	17.23	30.00	12.77	13.81
Highest	2 462	17.01	30.00	12.99	13.77

*** 802.11g**

Channel	Frequency (㎒)	Result (dBm)	Limit (dBm)	Margin (dB)	Avarage Power (dBm)
Lowest	2 412	21.22	30.00	8.78	10.94
Middle	2 437	21.43	30.00	8.57	11.20
Highest	2 462	21.35	30.00	8.65	11.14

*** 802. 11n HT20**

Channel	Frequency (㎒)	Result (dBm)	Limit (dBm)	Margin (dB)	Avarage Power (dBm)
Lowest	2 412	20.24	30.00	9.76	9.99
Middle	2 437	20.72	30.00	9.28	10.35
Highest	2 462	21.31	30.00	8.69	11.11

*** 802. 11n HT40**

Channel	Frequency (㎒)	Result (dBm)	Limit (dBm)	Margin (dB)	Avarage Power (dBm)
Lowest	2 422	20.01	30.00	9.99	9.32
Middle	2 437	20.46	30.00	9.54	9.76
Highest	2 452	20.23	30.00	9.77	9.86

NOTE:

1. We took the insertion loss of the cable loss into consideration within the measuring instrument.

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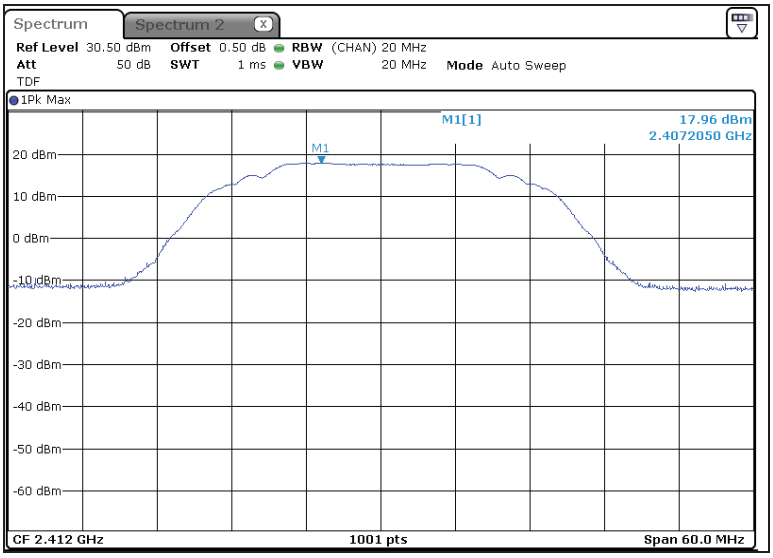
5.2.4 Test Plot

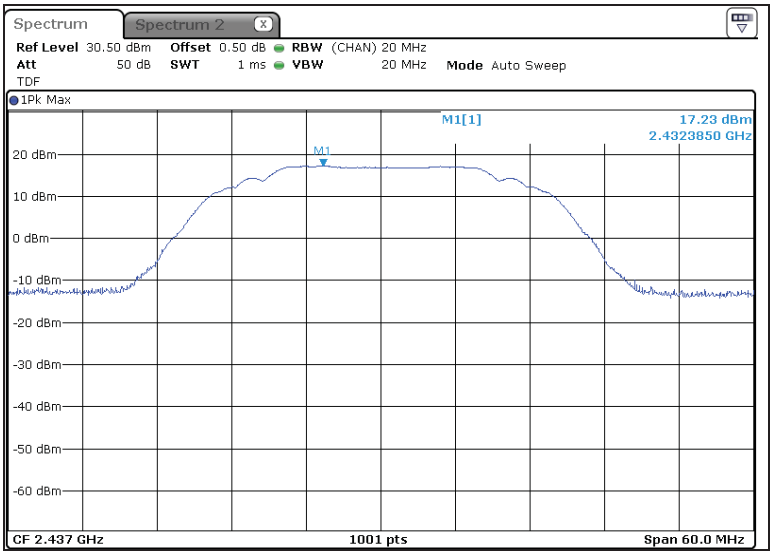
Figure 1. Plot of Maximum Peak Output Power

*** 802.11b**

Lowest Channel (2 412 ㎒)



Middle Channel (2 437 ㎒)



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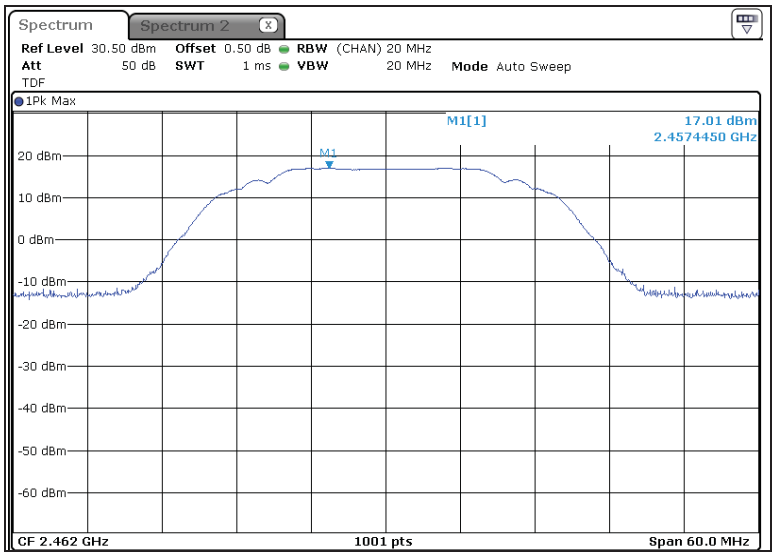
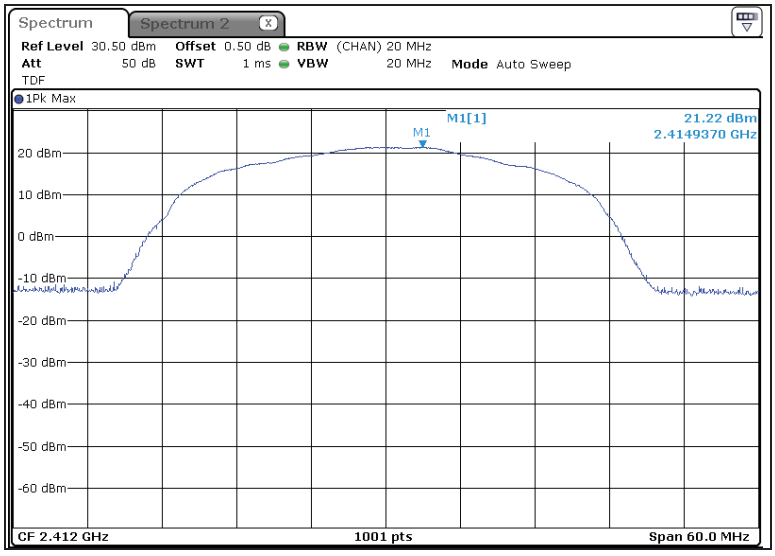
Highest Channel (2 462 ㎒)



*** 802.11g**

Lowest Channel (2 412 ㎒)



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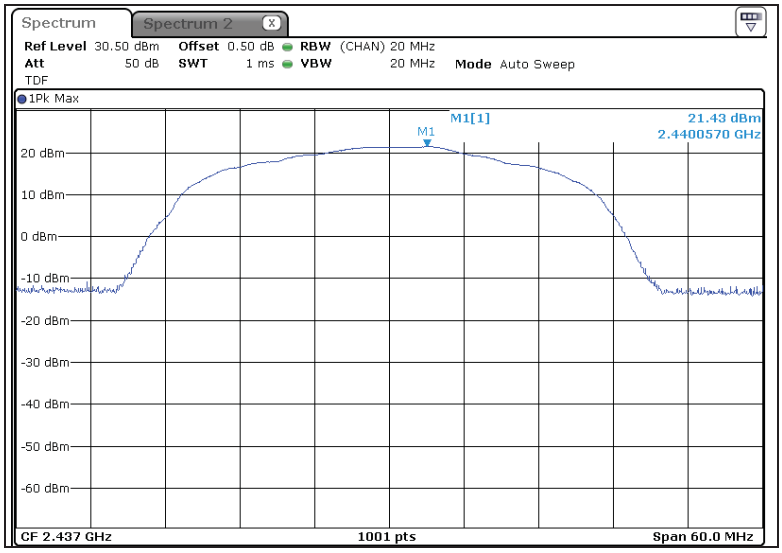
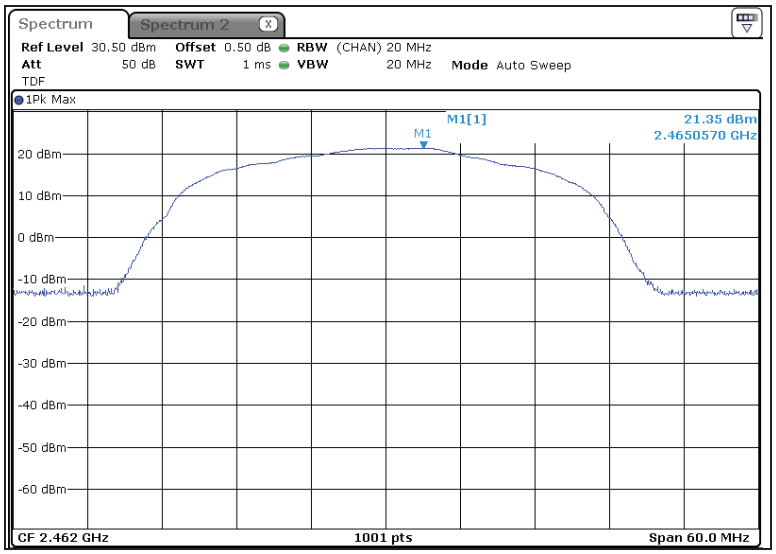
Middle Channel (2 437 ㎒)



Highest Channel (2 462 ㎒)



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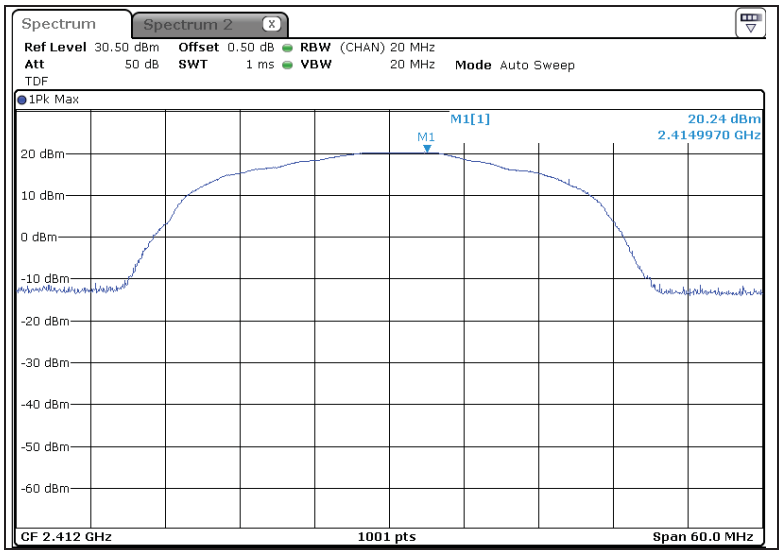
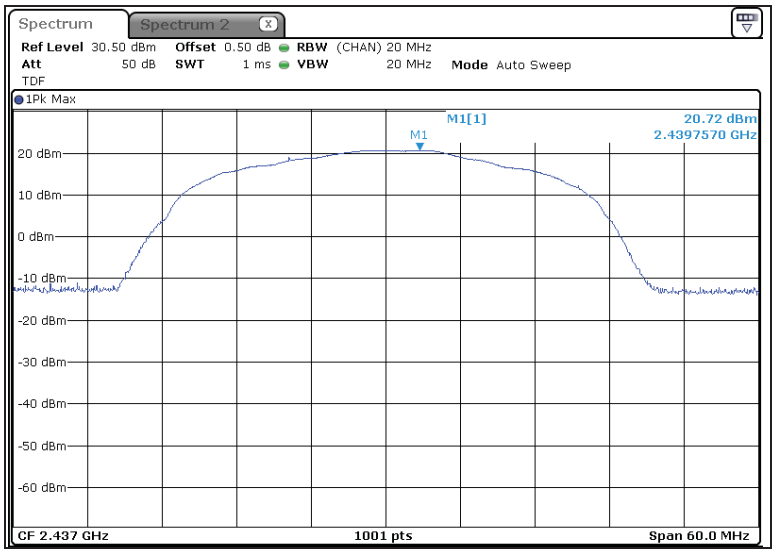
*** 802.11n HT20**

Lowest Channel (2 412 ㎒)



Middle Channel (2 437 ㎒)



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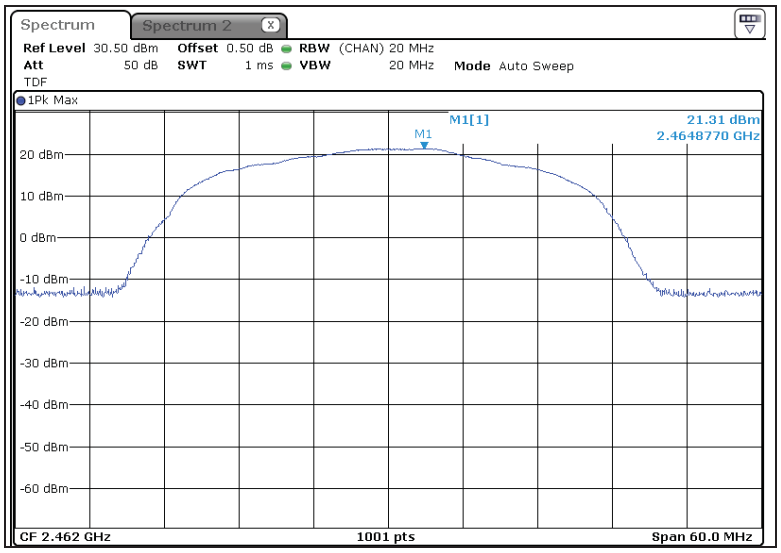
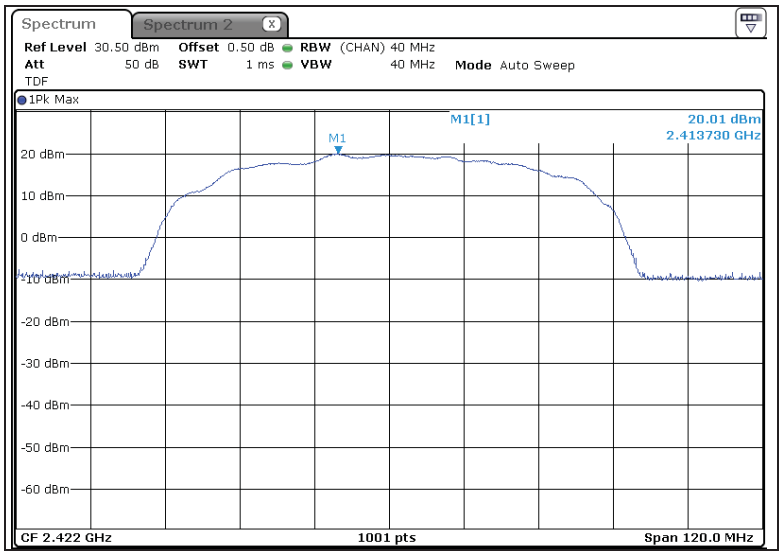
Highest Channel (2 462 ㎒)



*** 802.11n HT40**

Lowest Channel (2 422 ㎒)



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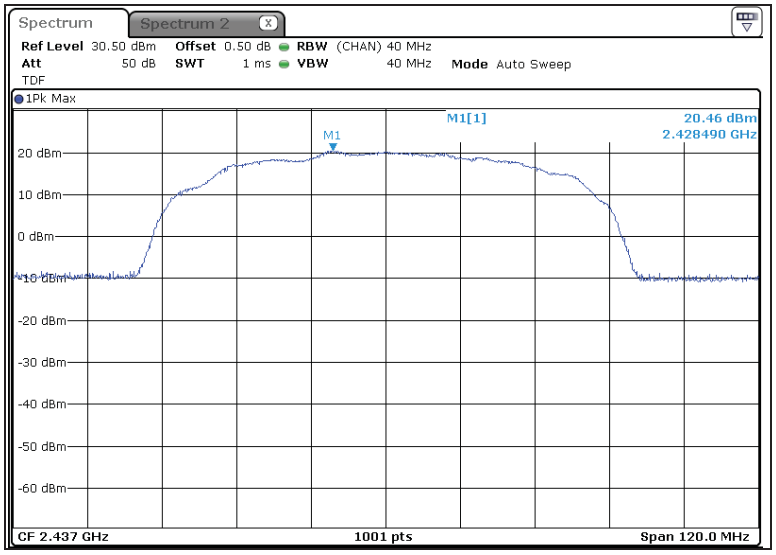
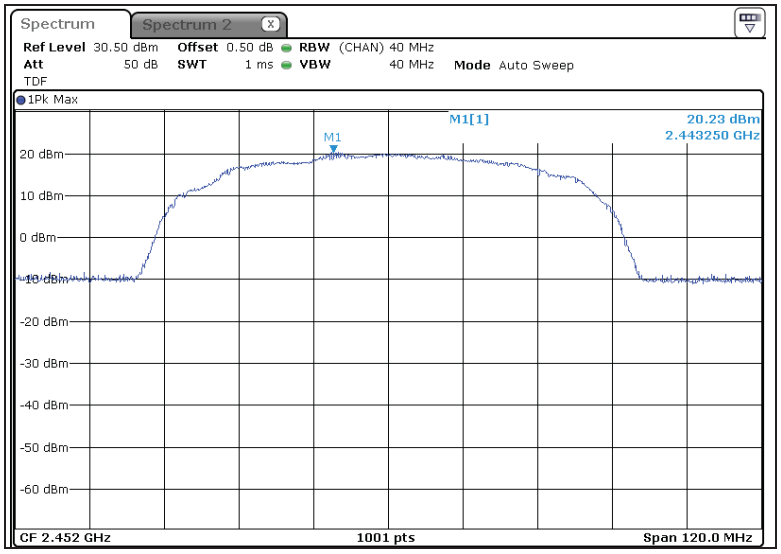
Middle Channel (2 437 ㎒)



Highest Channel (2 452 ㎒)



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5.3 Peak Power Spectral Density

5.3.1 Regulation

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 ㎑ 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.

5.3.2 Measurement Procedure

These test measurement settings are specified in section 10.0 of 558074 D01 DTS Meas Guidance.

5.3.2.1 Method PKPSD (peak PSD)

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance, and is optional if the maximum conducted (average) output power was used to demonstrate compliance.

1) Set analyzer center frequency to DTS channel center frequency.

2) Set the span to 1.5 times the DTS bandwidth.

3) Set the RBW to: 3 ㎑ ≤ RBW ≤ 100 ㎑.

4) Set the VBW ≥ 3 x RBW.

5) Detector = peak.

6) Sweep time = auto couple.

7) Trace mode = max hold.

8) Allow trace to fully stabilize.

9) Use the peak marker function to determine the maximum amplitude level within the RBW.

10) If measured value exceeds limit, reduce RBW (no less than 3 ㎑) and repeat.

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5.3.3 Test Result

- Complied

*** 802.11b**

Channel	Result (RBW=100 kHz) [dBm]	Result (RBW=3 kHz) [dB m]	Limit	Margin [dBm]
Lowest	13.05	-7.21	8 dBm/3 ㎑	15.21
Middle	12.75	-7.86	8 dBm/3 ㎑	15.86
Highest	13.11	-7.31	8 dBm/3 ㎑	15.31

*** 802.11g**

Channel	Result (RBW=100 kHz) [dBm]	Result (RBW=3 kHz) [dB m]	Limit	Margin [dBm]
Lowest	6.34	-8.27	8 dBm/3 ㎑	16.27
Middle	5.89	-8.51	8 dBm/3 ㎑	16.51
Highest	6.71	-7.76	8 dBm/3 ㎑	15.76

*** 802.11n HT20**

Channel	Result (RBW=100 kHz) [dBm]	Result (RBW=3 kHz) [dB m]	Limit	Margin [dBm]
Lowest	5.86	-8.02	8 dBm/3 ㎑	16.02
Middle	4.96	-8.86	8 dBm/3 ㎑	16.86
Highest	5.57	-8.45	8 dBm/3 ㎑	16.45

*** 802.11n HT40**

Channel	Result (RBW=100 kHz) [dBm]	Result (RBW=3 kHz) [dB m]	Limit	Margin [dBm]
Lowest	3.19	-7.54	8 dBm/3 ㎑	15.54
Middle	2.16	-9.07	8 dBm/3 ㎑	17.07
Highest	2.62	-8.46	8 dBm/3 ㎑	16.46

NOTE:

1. We took the insertion loss of the cable loss into consideration within the measuring instrument.

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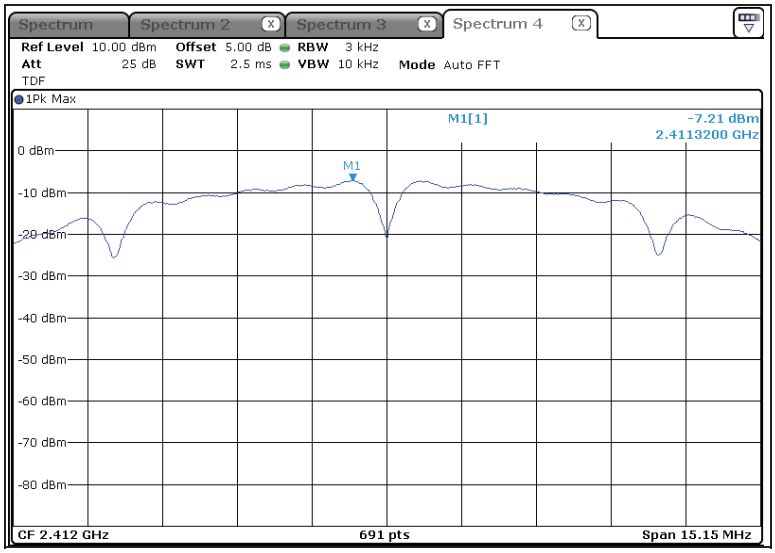
5.3.4 Test Plot

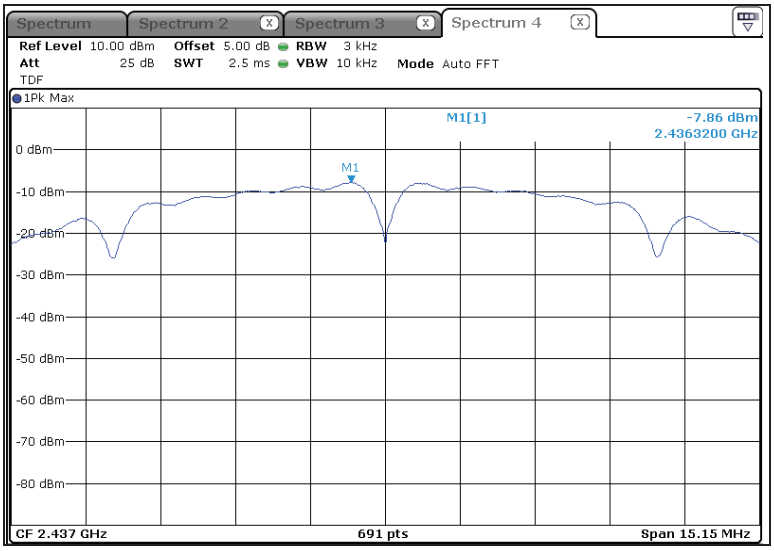
Figure 2. Plot of the Power Density

*** 802.11b**

Lowest Channel (2 412 ㎒)



Middle Channel (2 437 ㎒)



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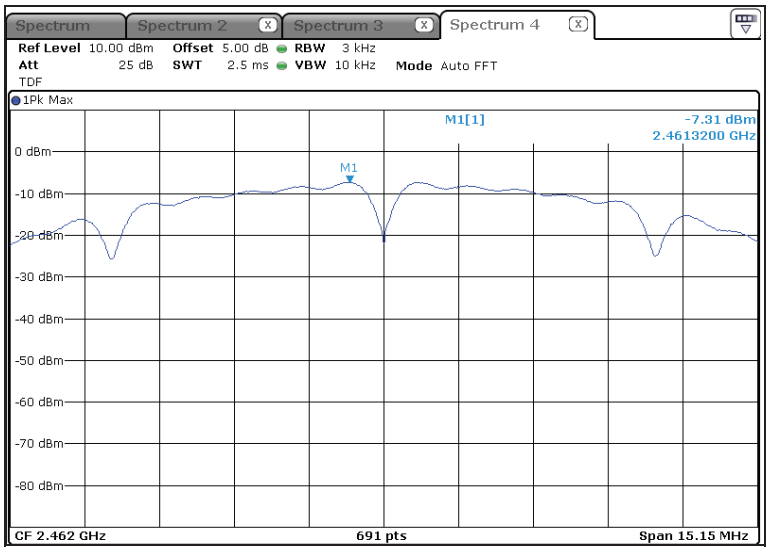
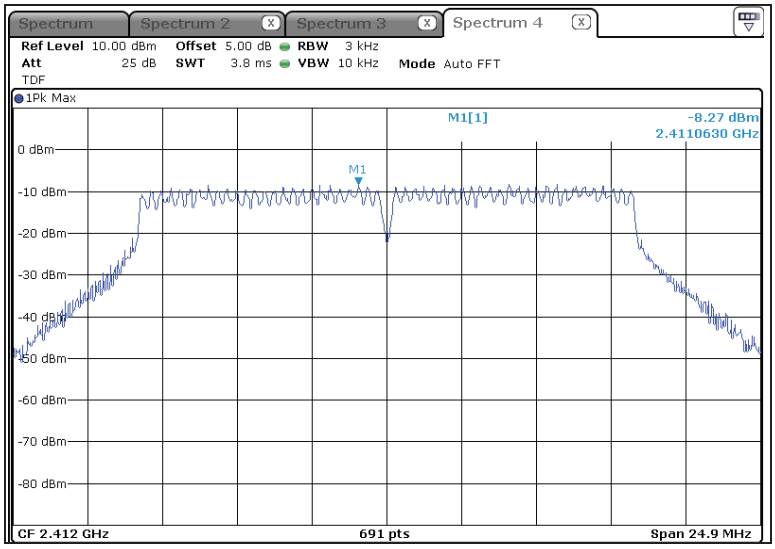
Highest Channel (2 462 ㎒)



*** 802.11g**

Lowest Channel (2 412 ㎒)



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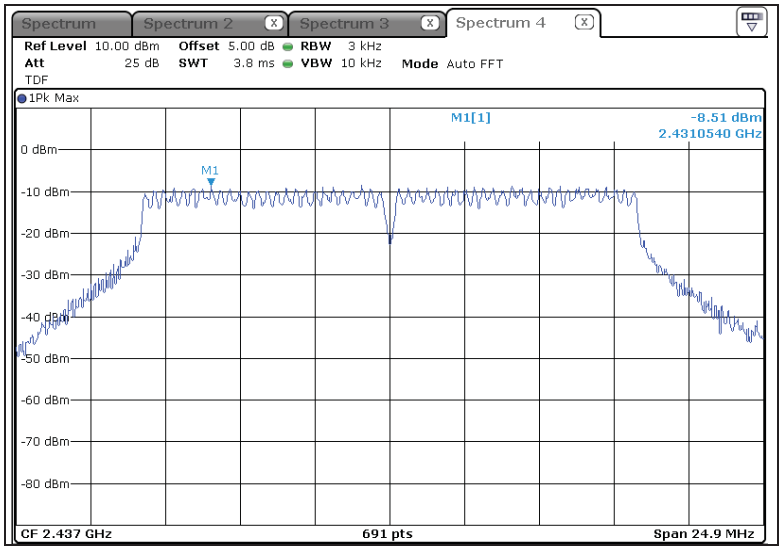
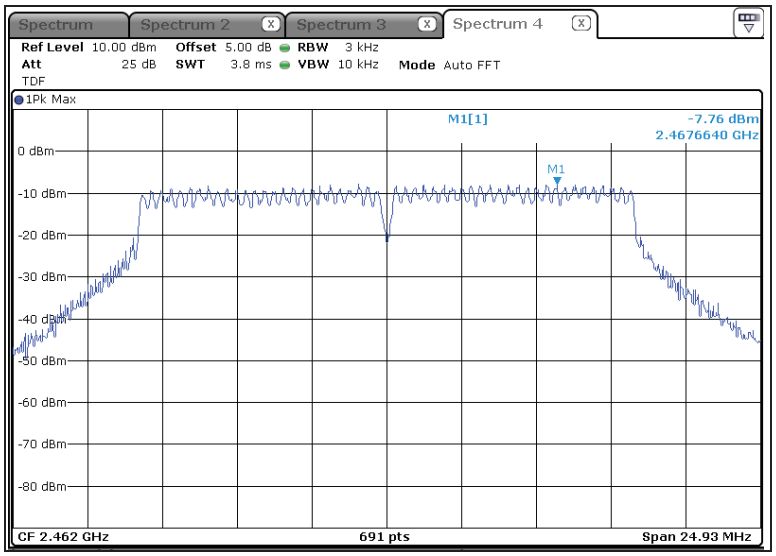
Middle Channel (2 437 ㎒)



Highest Channel (2 462 ㎒)



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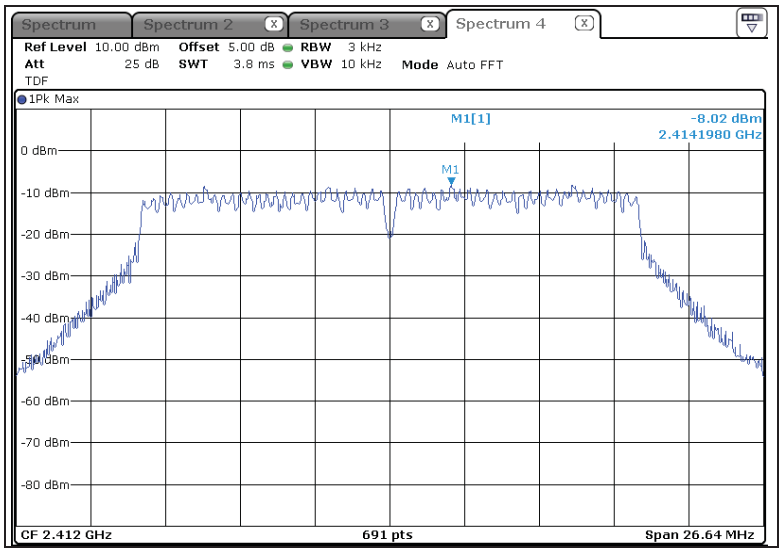
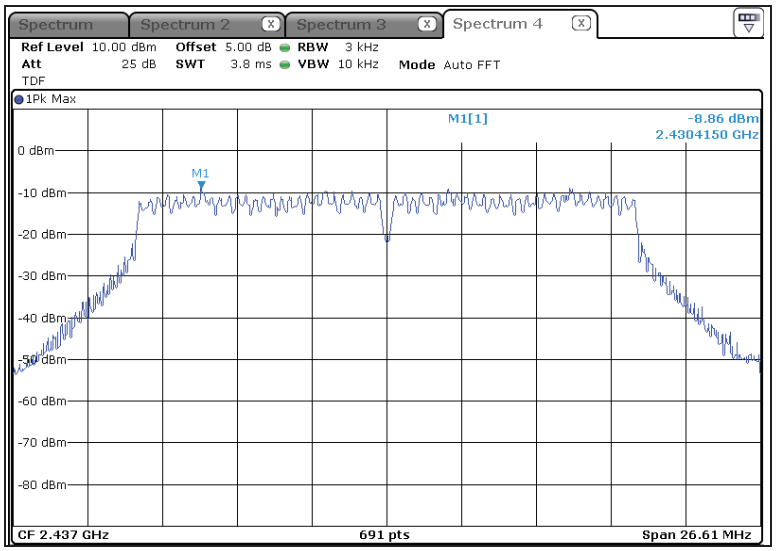
*** 802.11n HT20**

Lowest Channel (2 412 ㎒)



Middle Channel (2 437 ㎒)



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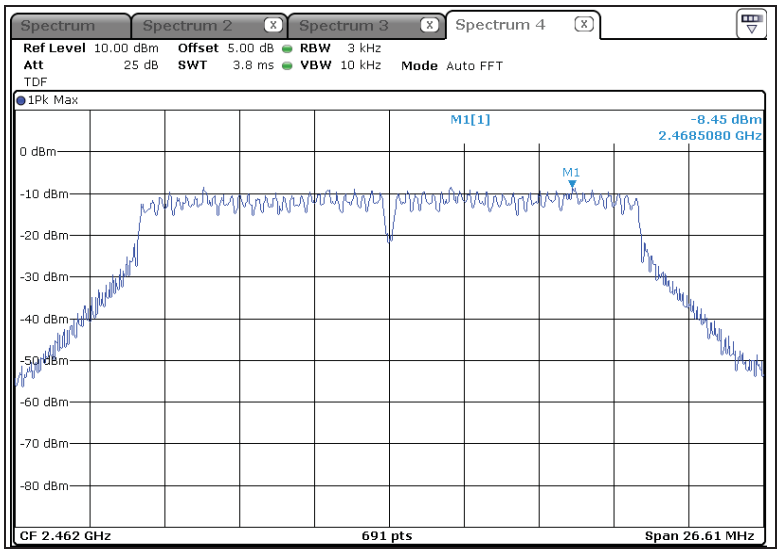
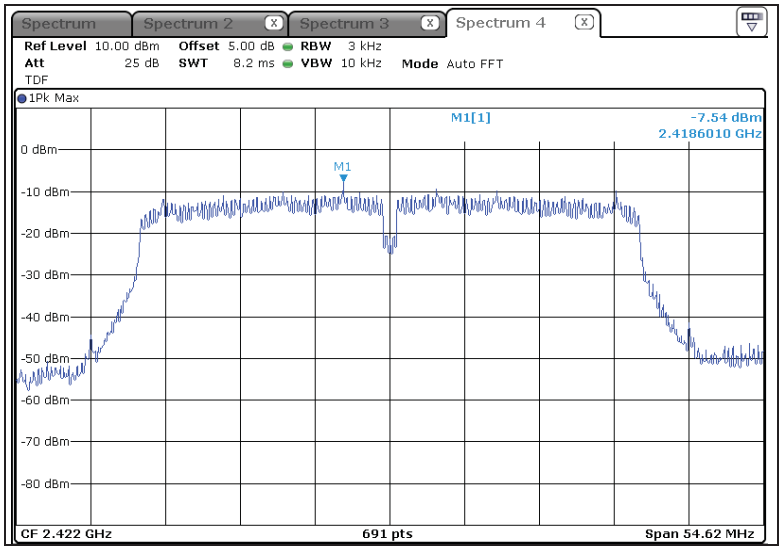
Highest Channel (2 462 ㎒)



*** 802.11n HT40**

Lowest Channel (2 422 ㎒)



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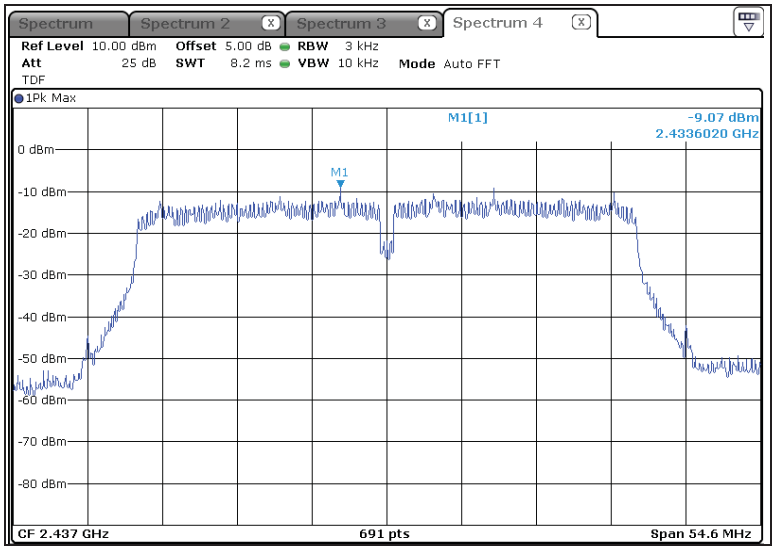
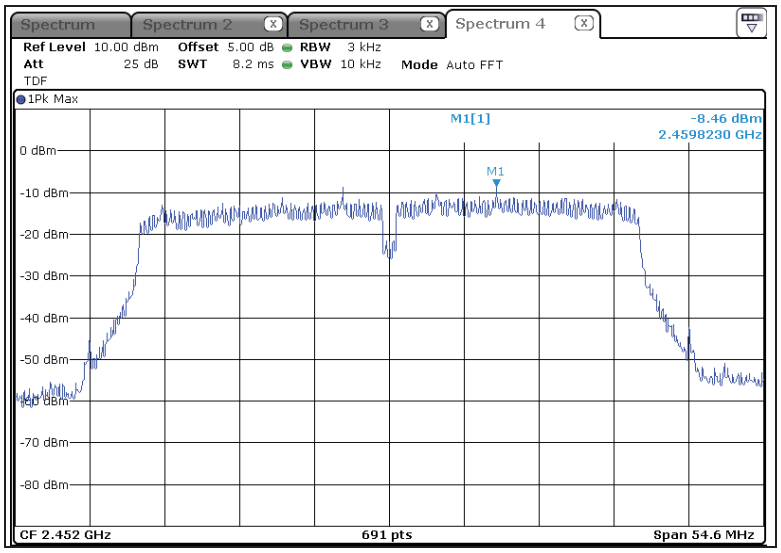
Middle Channel (2 437 ㎒)



Highest Channel (2 452 ㎒)



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5.4 6 dB Bandwidth(DTS Channel Bandwidth)

5.4.1 Regulation

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 ㎑.

5.4.2 Measurement Procedure

These test measurement settings are specified in section 8.0 of 558074 D01 DTS Meas Guidance.

5.4.2.1 DTS Channel 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.

5.4.2.2 DTS Channel Bandwidth Measurement Procedure-Option 2

The automatic bandwidth measurement capability of an instrument may be employed using the X ㏈ bandwidth mode with X set to 6 ㏈, if the functionality described above (i.e., RBW = 100 ㎑, VBW ≥ 3 x RBW, 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 ㏈.

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5.4.3 Test Result

- Complied

*** 802.11b**

Channel	Frequency [㎒]	6 dB Bandwidth [㎒]	Min. Limit [㎒]	Occupied Bandwidth (99 % BW) [㎒]
Lowest	2 412	10.10	0.50	14.99
Middle	2 437	10.10	0.50	14.93
Highest	2 462	10.10	0.50	14.99

*** 802.11g**

Channel	Frequency [㎒]	6 dB Bandwidth [㎒]	Min. Limit [㎒]	Occupied Bandwidth (99 % BW) [㎒]
Lowest	2 412	16.60	0.50	16.56
Middle	2 437	16.60	0.50	16.50
Highest	2 462	16.62	0.50	16.50

*** 802.11n HT20**

Channel	Frequency [㎒]	6 dB Bandwidth [㎒]	Min. Limit [㎒]	Occupied Bandwidth (99 % BW) [㎒]
Lowest	2 412	17.76	0.50	17.71
Middle	2 437	17.74	0.50	17.66
Highest	2 462	17.74	0.50	17.66

*** 802.11n HT40**

Channel	Frequency [㎒]	6 dB Bandwidth [㎒]	Min. Limit [㎒]	Occupied Bandwidth (99 % BW) [㎒]
Lowest	2 422	36.41	0.50	35.89
Middle	2 437	36.40	0.50	35.77
Highest	2 452	36.40	0.50	35.89

NOTE:
1. We took the insertion loss of the cable loss into consideration within the measuring instrument.

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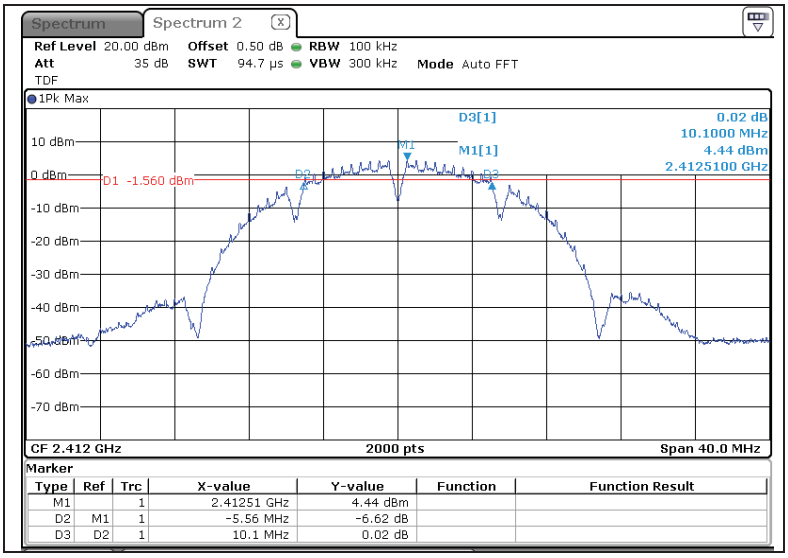
5.4.4 Test Plot

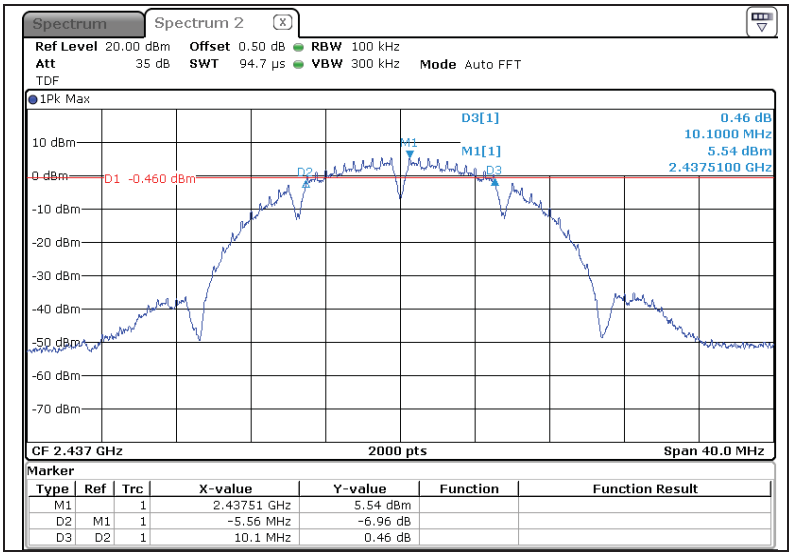
Figure 3. Plot of the 6 dB Bandwidth & Occupied Bandwidth

*** 802.11b_6 dB Bandwidth**

Lowest Channel (2 412 ㎒)



Middle Channel (2 437 ㎒)



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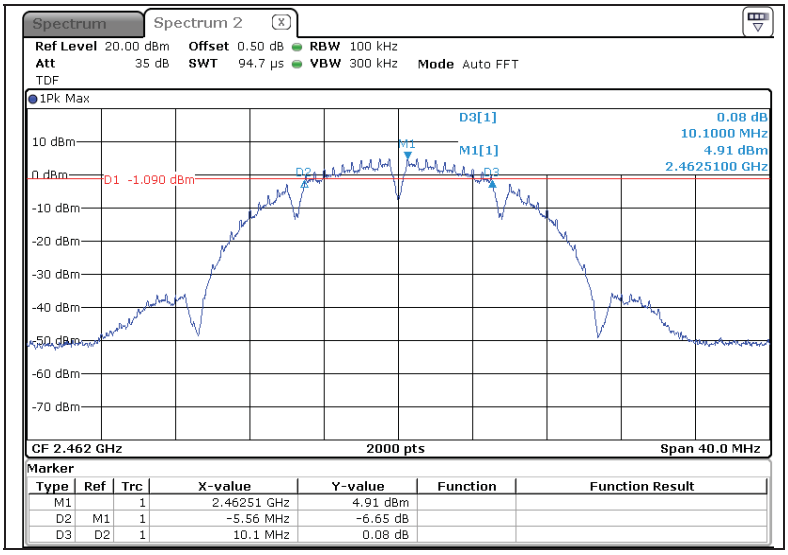
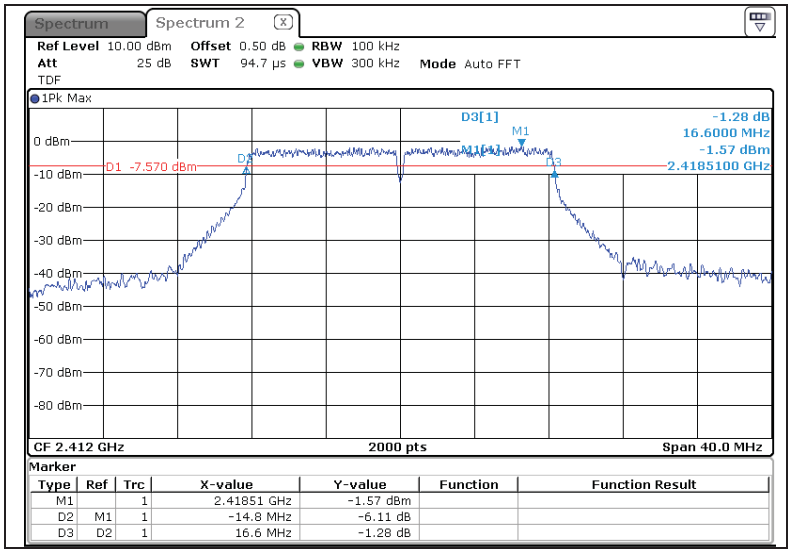
Highest Channel (2 462 ㎒)



*** 802.11g_6 dB Bandwidth**

Lowest Channel (2 412 ㎒)



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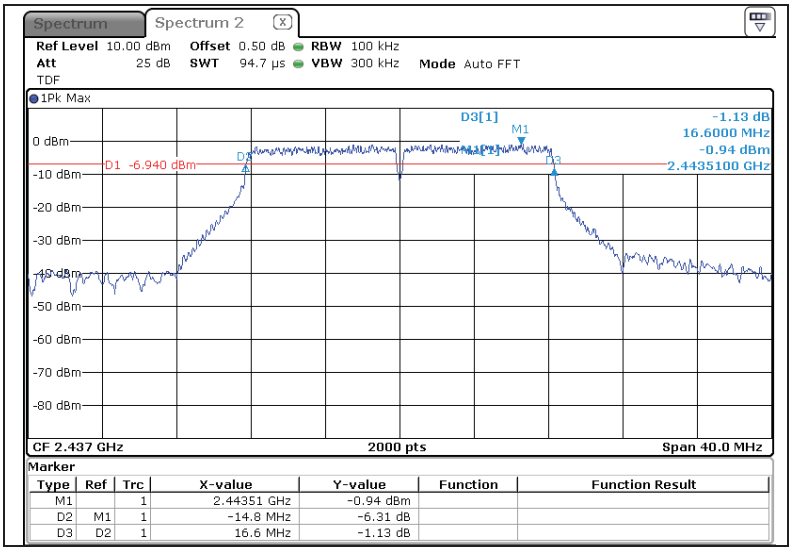
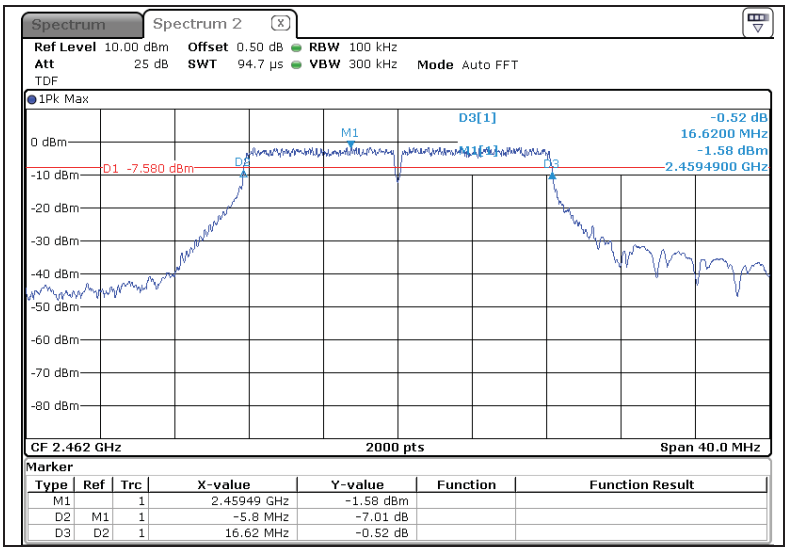
Middle Channel (2 437 ㎒)



Highest Channel (2 462 ㎒)



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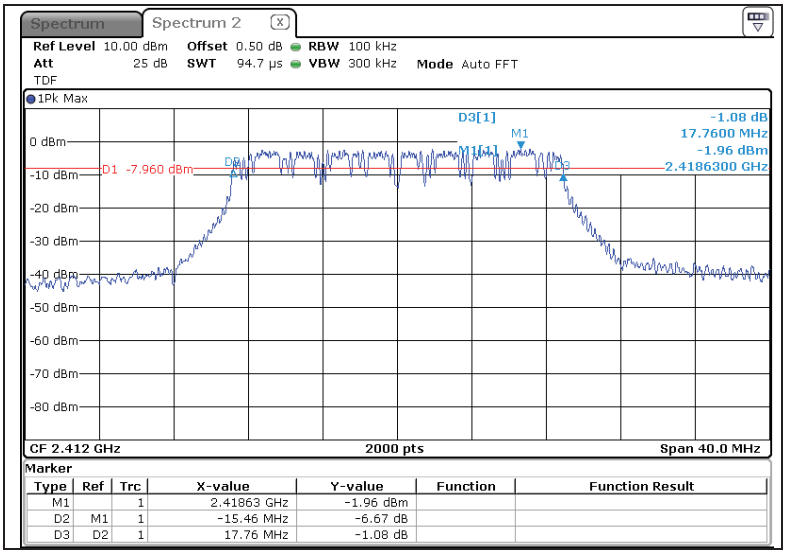
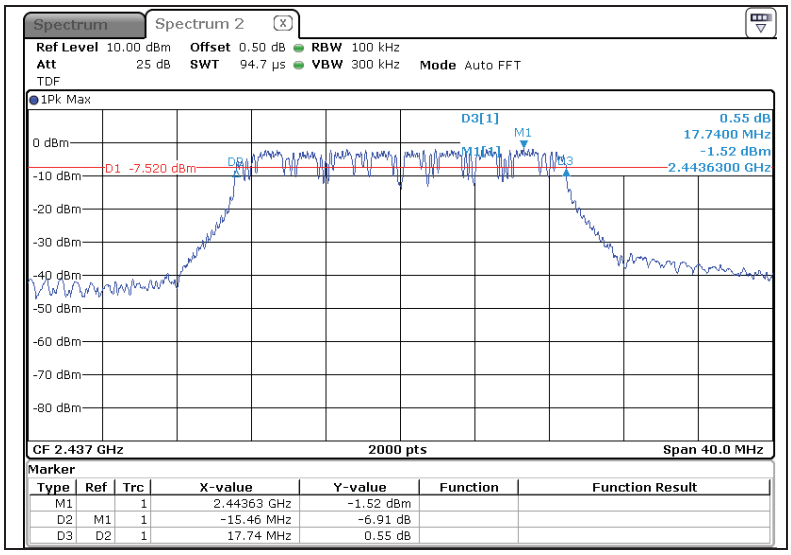
*** 802.11n HT20_6 dB Bandwidth**

Lowest Channel (2 412 ㎒)



Middle Channel (2 437 ㎒)



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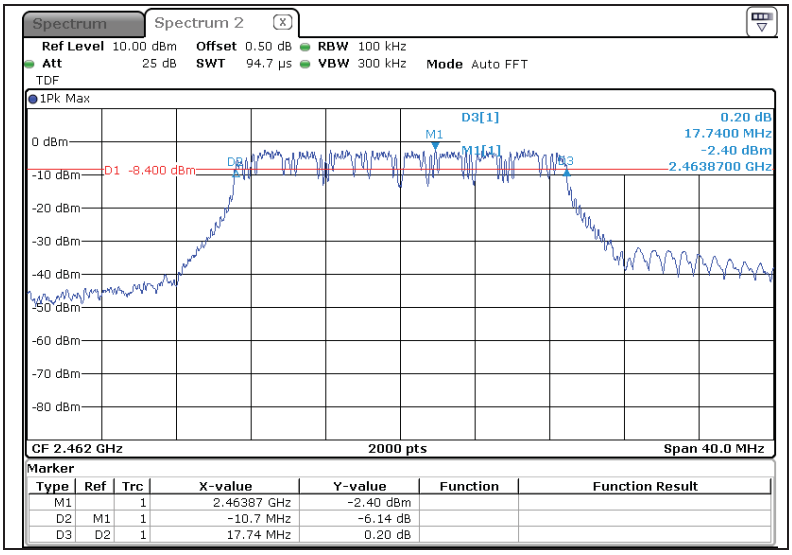
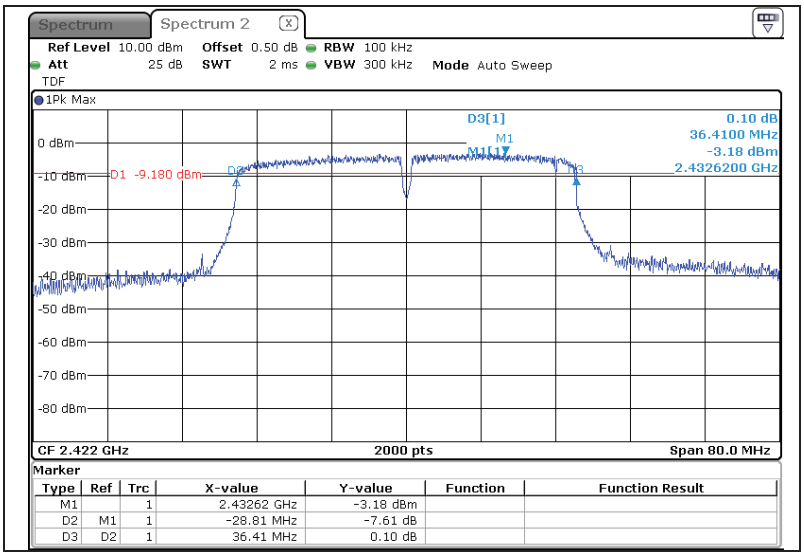
Highest Channel (2 462 ㎒)



* 802.11n HT40_6 ㏈ Bandwidth

Lowest Channel (2 422 ㎒)



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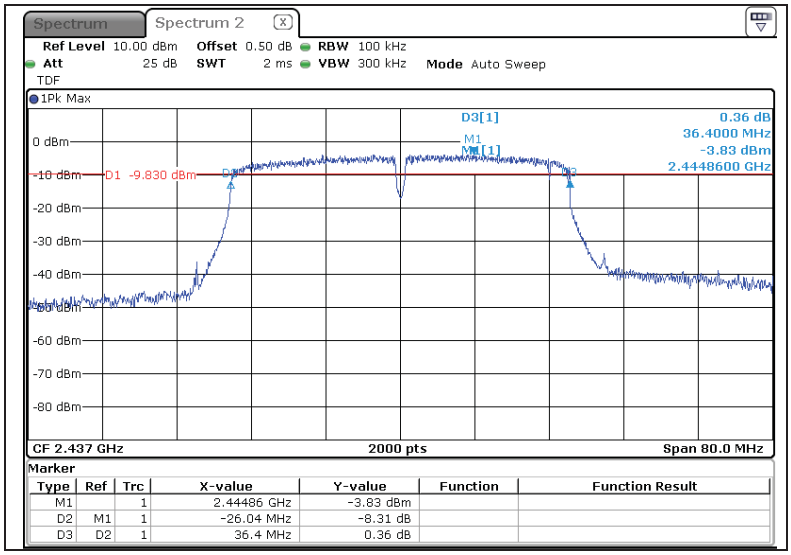
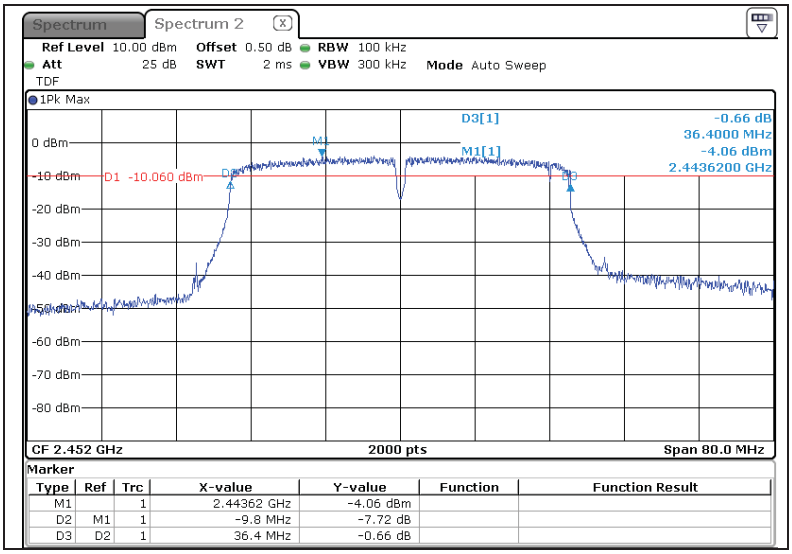
Middle Channel (2 437 ㎒)



Highest Channel (2 452 ㎒)



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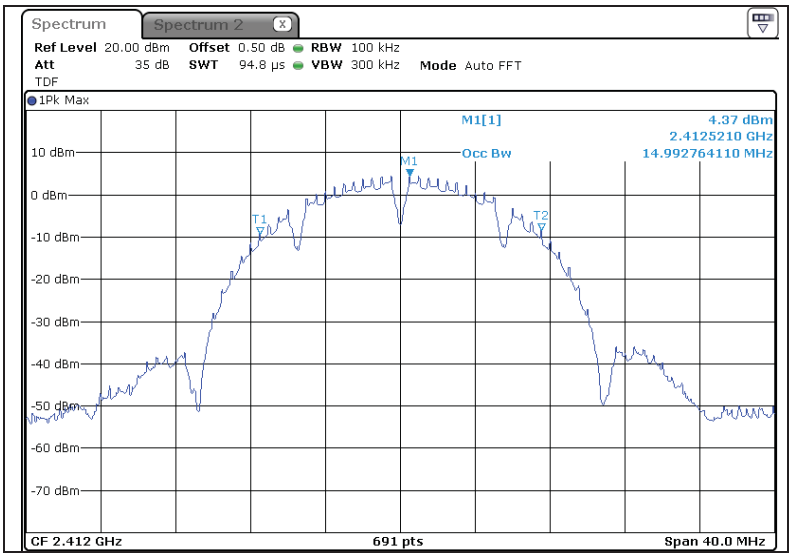
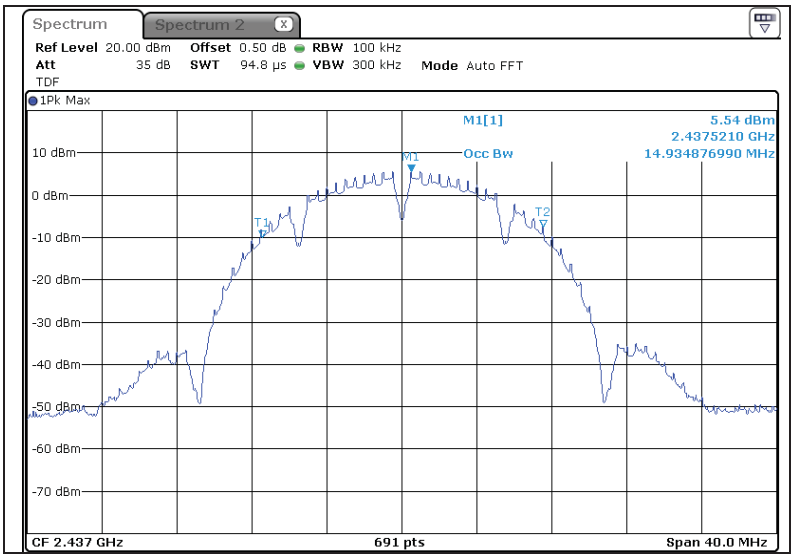
*** 802.11b_Occupied Bandwidth**

Lowest Channel (2 412 ㎒)



Middle Channel (2 437 ㎒)



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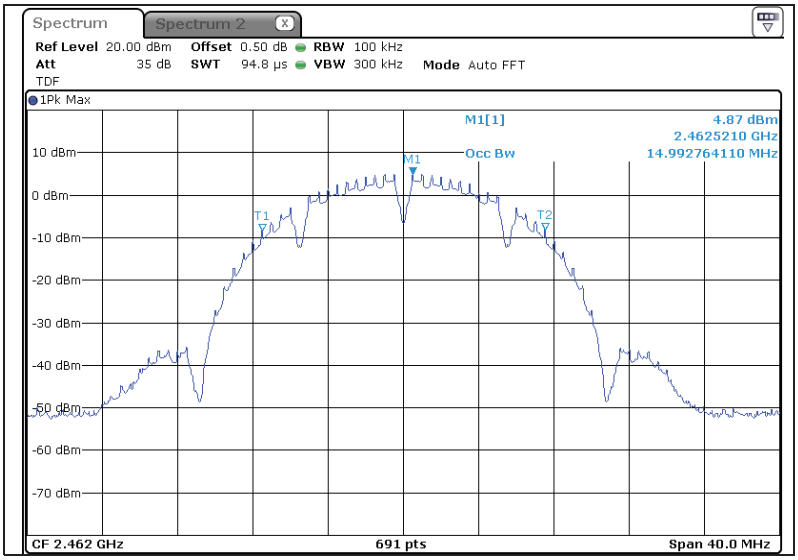
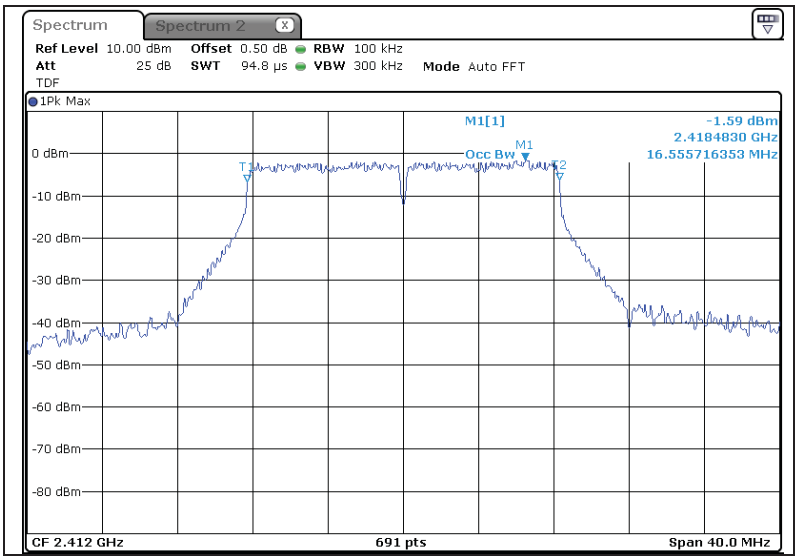
Highest Channel (2 462 ㎒)



*** 802.11g_Occupied Bandwidth**

Lowest Channel (2 412 ㎒)



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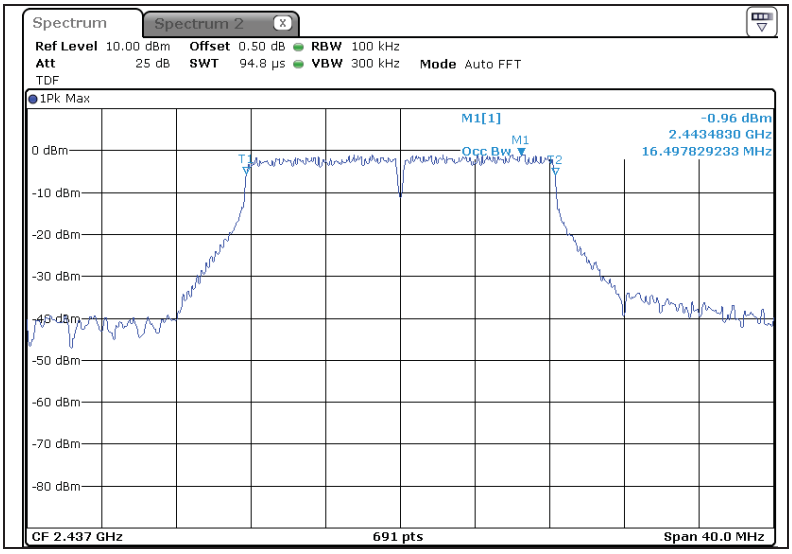
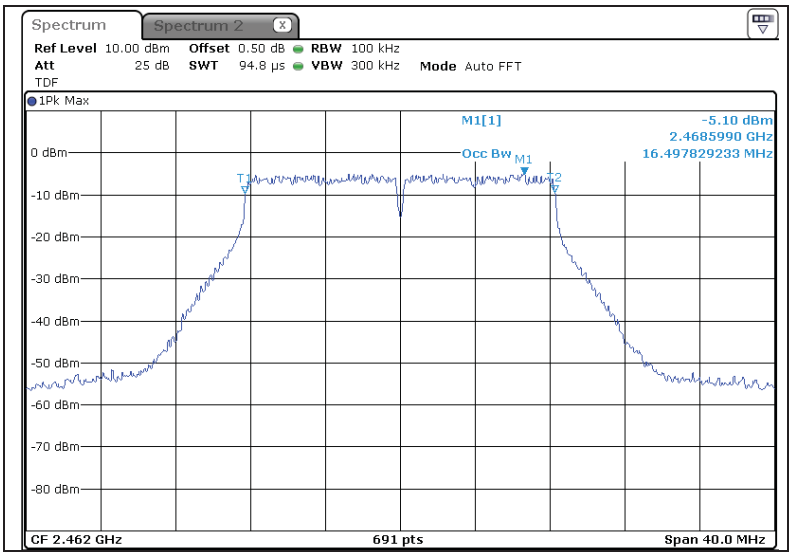
Middle Channel (2 437 ㎒)



Highest Channel (2 462 ㎒)



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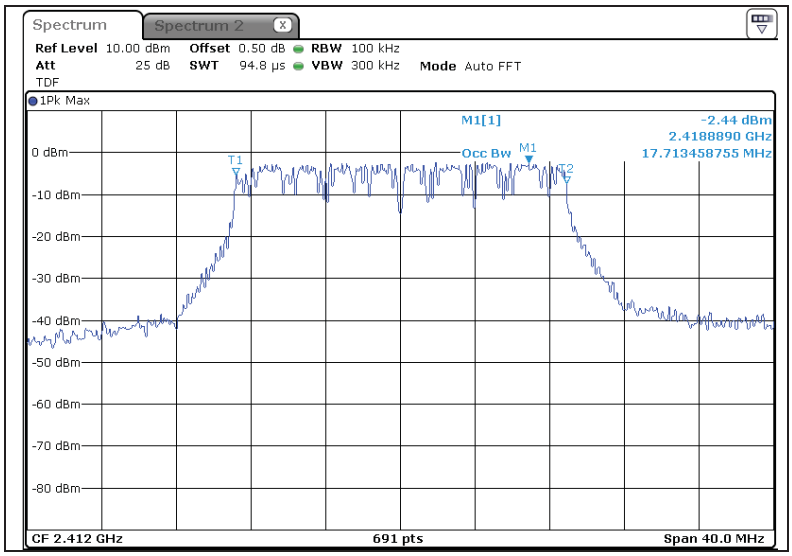
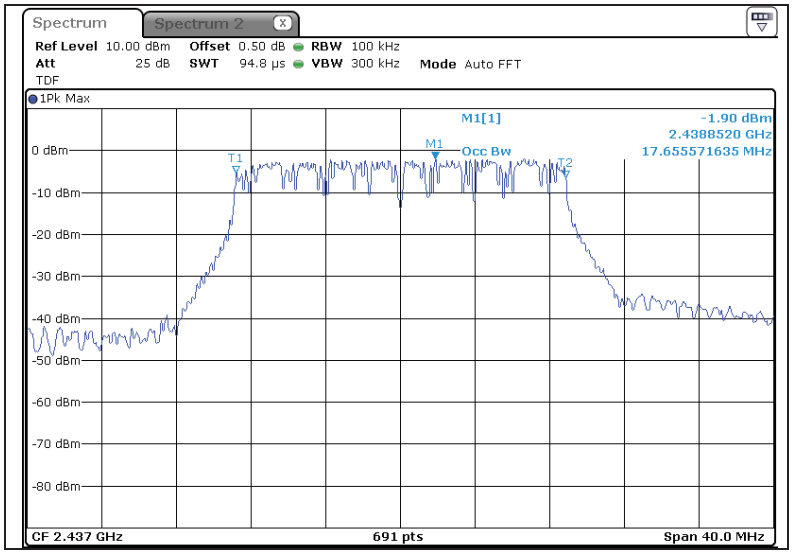
*** 802.11n HT20_Occupied Bandwidth**

Lowest Channel (2 412 ㎒)



Middle Channel (2 437 ㎒)



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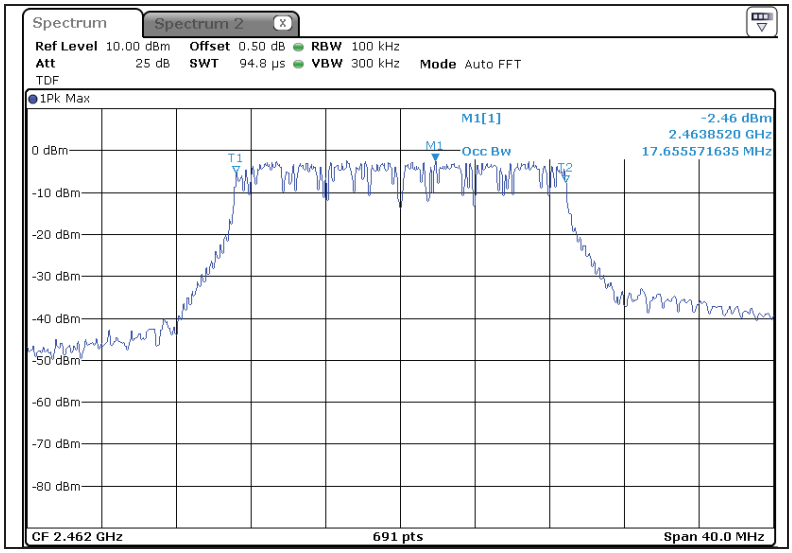
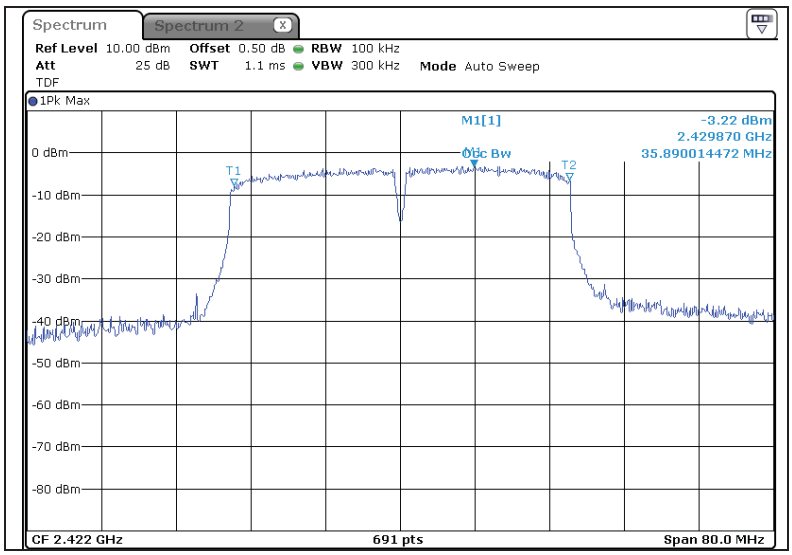
Highest Channel (2 462 ㎒)



*** 802.11n HT40_Occupied Bandwidth**

Lowest Channel (2 422 ㎒)



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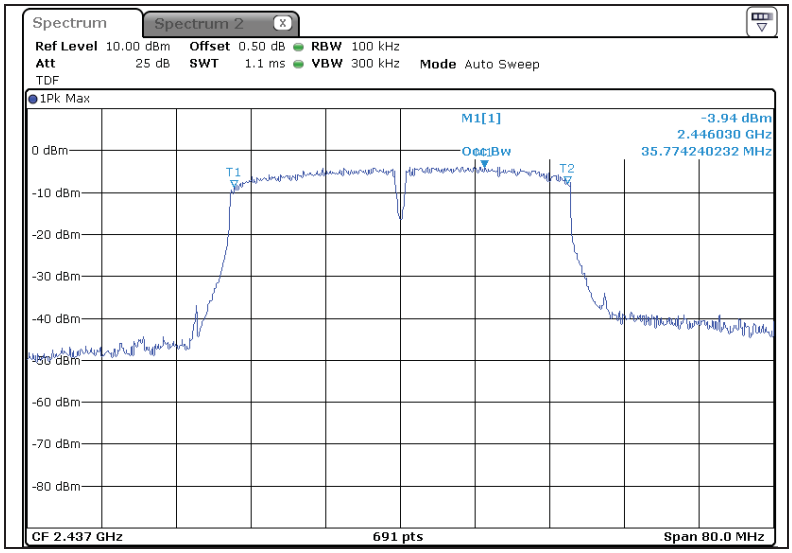
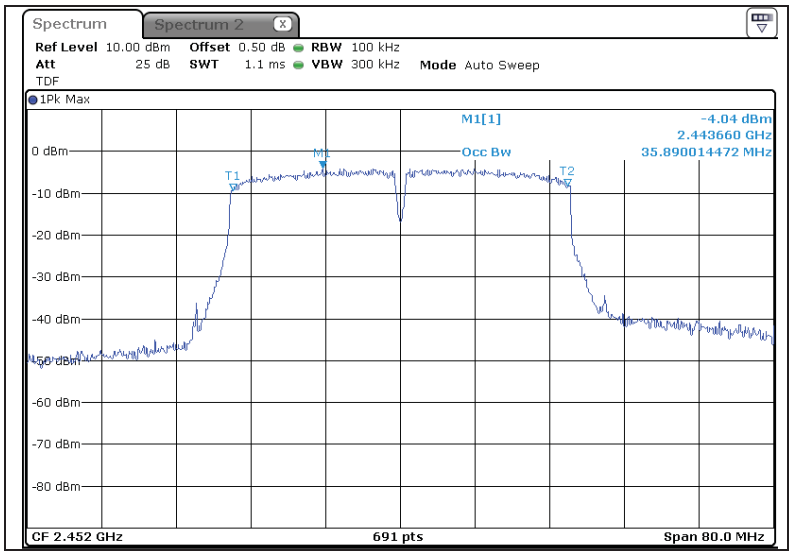
Middle Channel (2 437 ㎒)



Highest Channel (2 452 ㎒)



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5.5 Spurious Emission, Band Edge, and Restricted bands

5.5.1 Regulation

According to §15.247(d), in any 100 ㎑ bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 ㏈ below that in the 100 ㎑ bandwidth within the band that contains the highest level of the desired power, based 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 ㏈ instead of 20 ㏈. Attenuation below the general limits specified in Section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in Section 15.205(a), must also comply with the radiated emission limits specified in Section 15.209(a) (see Section 15.205(c)).

According to §15.209(a), Except as provided elsewhere in this subpart, the emissions from an intentional radiator shall notexceed the field strength levels specified in the following table:

Frequency (㎒)	Field strength (㎶/m)	Measurement distance (m)
0.009 - 0.490	2 400/F(㎑)	300
0.490 - 1.705	24 000/F(㎑)	30
1.705 - 30	30	30
30 - 88	100**	3
88 - 216	150**	3
216 - 960	200**	3
Above 960	500	3

**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., §§15.231 and 15.241.

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

MHz	MHz	MHz	GHz
0.009 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
0.495 - 0.505	16.694 75 - 16.695 25	608 - 614	5.35 - 5.46
2.173 5 - 2.190 5	16.804 25 - 16.804 75	960 – 1 240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1 300 – 1 427	8.025 - 8.5
4.177 25 - 4.177 75	37.5 - 38.25	1 435 – 1 626.5	9.0 - 9.2
4.207 25 - 4.207 75	73 - 74.6	1 645.5 – 1 646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1 660 – 1 710	10.6 - 12.7
6.267 75 - 6.268 25	108 - 121.94	1 718.8 – 1 722.2	13.25 - 13.4
6.311 75 - 6.312 25	123 - 138	2 200 – 2 300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2 310 – 2 390	15.35 - 16.2
8.362 - 8.366	156.524 75 - 156.525 25	2 483.5 – 2 500	17.7 - 21.4
8.376 25 - 8.386 75	156.7 - 156.9	2 690 – 2 900	22.01 - 23.12
8.414 25 - 8.414 75	162.012 5 - 167.17	3 260 – 3 267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3 332 – 3 339	31.2 - 31.8
12.519 75 - 12.520 25	240 - 285	3 345.8 – 3 358	36.43 - 36.5
12.576 75 - 12.577 25	322 - 335.4	3 600 – 4 400	Above 38.6
13.36 - 13.41			

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 1 000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1 000 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.

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5.5.2 Measurement Procedure

5.5.2.1 Band-edge Compliance of RF Conducted Emissions

5.5.2.1.1 Reference Level Measurement

Establish a reference level by using the following procedure:

1) Set instrument center frequency to DTS channel center frequency.
2) Set the span to ≥ 1.5 times the DTS bandwidth.
3) Set the RBW = 100 ㎑.
4) Set the VBW ≥ 3 x RBW.
5) Detector = peak.
6) Sweep time = auto couple.
7) Trace mode = max hold.
8) Allow trace to fully stabilize.
9) Use the peak marker function to determine the maximum PSD level.

5.5.2.1.2 Emissions Level Measurement

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) Ensure that the number of measurement points ≥ span/RBW
6) Sweep time = auto couple.
7) Trace mode = max hold.
8) Allow trace to fully stabilize.
9) 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) are attenuated by at least the minimum requirements specified in 11.1 a) or 11.1 b). Report the three highest emissions relative to the limit.

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5.5.2.2 Conducted Spurious Emissions

Set the spectrum analyzer as follows:

1) Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
2) RBW = 100 ㎑
3) VBW ≥ RBW
4) Sweep = auto
5) Detector function = peak
6) Trace = max hold
7) Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.
8) Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.

5.5.2.3 Radiated Spurious Emissions

1) The preliminary and final rdiated measurements were performed to determine the frequency producing the maximum emissions in at a 10m semi-anechoic chamber. The EUT was tested at a distance 3 meters.
2) The EUT was placed on the top of the 0.8-meter height, 1 × 1.5 meter non-metallic table. To find the maximum emission levels, the height of a measuring antenna was changed and the turntable was rotated 360°.
3) The antenna polarization was also changed from vertical to horizontal. The spectrum was scanned from 9 ㎑ to 30 ㎒ using the loop antenna, and from 30 to 1 000 ㎒ using the Bi-Log antenna, and from 1 000 ㎒ to 26 500 ㎒ using the horn antenna.
4) Each frequency found during preliminary measurements was re-examined and investigated. The test-receiver system was set up to average, peak, and quasi-peak detector function with specified bandwidth.
5) The 0.8m height is for below 1 G testing, and 1.5m is for above 1G testing.

Note

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 ㎑ for Peak detection (PK) and Quasi-peak detection (QP) at frequency below 1 ㎓.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 1 ㎒ for Peak detection and frequency above 1 ㎓.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 ㎒ and the video bandwidth is 1 ㎑(≥1/T) for Average detection (AV) at frequency above 1 ㎓. **(**where T = pulse width)

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5.5.3 Test Result

- Complied

1. Band edge & Conducted Spurious Emissions was shown in figure 4.
   Note: We took the insertion loss of the cable into consideration within the measuring instrument.
2. Measured value of the Field strength of spurious Emissions (Radiated)
3. It tested x,y and z – 3 axis each, mentioned only worst case data at this report.

※ Noise was not measured. (Margin was more than 20 ㏈)
Worst value of noise floor was recorded.

*** Below 1 ㎓ data (worst-case: 802.11g)**

Middle channel (2 437 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(㎶)]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
Quasi-Peak DATA. Emissions below 30 ㎒							
Below 30.00	Not Detected	-	-	-	-	-	-
Quasi-Peak DATA. Emissions below 1 ㎓							
143.98	120	H	48.00	-18.60	29.40	43.50	14.10
240.01	120	H	51.20	-13.80	37.40	46.00	8.60
336.04	120	H	54.10	-11.00	43.10	46.00	2.90
432.07	120	H	45.40	-8.50	36.90	46.00	9.10
527.97	120	V	48.90	-6.50	42.40	46.00	3.60
624.00	120	H	43.50	-4.30	39.20	46.00	6.80
720.03	120	H	45.70	-3.60	42.10	46.00	3.90
816.06	120	H	44.60	-1.70	42.90	46.00	3.10
Above 900.00	**Not Detected**	-	-	-	-	-	-

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*** Above 1 ㎓ data**

802.11b_Lowest channel (2 412 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(㎶)]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓							
*1 956.75	1 000	V	50.50	1.60	52.10	74.00	21.90
2 388.25	1 000	H	46.50	3.50	50.00	74.00	24.00
4 824.38	1 000	H	39.70	8.90	48.60	74.00	25.40
6 969.38	1 000	H	37.80	13.60	51.40	74.00	22.60
9 120.00	1 000	H	38.00	16.60	54.60	74.00	19.40
12 144.37	1 000	V	37.00	22.20	59.20	74.00	14.80
14 745.00	1 000	V	37.90	24.20	62.10	74.00	11.90
Above 15 000.00	Not Detected	-	-	-	-	-	-
Average DATA. Emissions above 1 ㎓							
*1 956.75	1 000	V	32.90	1.60	34.50	54.00	19.50
2 388.25	1 000	H	35.00	3.50	38.50	54.00	15.50
4 824.38	1 000	H	36.70	8.90	45.60	54.00	8.40
6 969.38	1 000	H	28.30	13.60	41.90	54.00	12.10
9 120.00	1 000	H	27.70	16.60	44.30	54.00	9.70
12 144.37	1 000	V	23.00	22.20	45.20	54.00	8.80
14 745.00	1 000	V	22.80	24.20	47.00	54.00	7.00
Above 15 000.00	Not Detected	-	-	-	-	-	-

* This Asterisk means restricted band.

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802.11b_Middle channel (2 437 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(㎶)]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓							
4 873.13	1 000	H	44.40	8.60	53.00	74.00	21.00
7 286.25	1 000	H	36.90	14.40	51.30	74.00	22.70
9 945.00	1 000	H	37.30	17.30	54.60	74.00	19.40
12 230.62	1 000	H	37.30	22.40	59.70	74.00	14.30
13 822.50	1 000	H	37.80	23.70	61.50	74.00	12.50
14 610.00	1 000	V	38.30	23.80	62.10	74.00	11.90
Above 15 000.00	Not Detected	-	-	-	-	-	-
Average DATA. Emissions above 1 ㎓							
4 873.13	1 000	H	42.00	8.60	50.60	54.00	3.40
7 286.25	1 000	H	27.20	14.40	41.60	54.00	12.40
9 945.00	1 000	H	26.00	17.30	43.30	54.00	10.70
12 230.62	1 000	H	22.30	22.40	44.70	54.00	9.30
13 822.50	1 000	H	21.90	23.70	45.60	54.00	8.40
14 610.00	1 000	V	23.10	23.80	46.90	54.00	7.10
Above 15 000.00	Not Detected	-	-	-	-	-	-

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802.11b_Highest channel (2 462 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(㎶)]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓							
*2 484.50	1 000	H	47.00	3.60	50.60	74.00	23.40
4 923.75	1 000	H	45.30	9.20	54.50	74.00	19.50
6 982.50	1 000	H	37.20	13.80	51.00	74.00	23.00
9 202.50	1 000	H	37.20	16.60	53.80	74.00	20.20
9 811.87	1 000	H	37.60	16.90	54.50	74.00	19.50
12 232.50	1 000	H	37.60	22.20	59.80	74.00	14.20
Above 13 000.00	Not Detected	-	-	-	-	-	-
Average DATA. Emissions above 1 ㎓							
*2 484.50	1 000	H	44.00	3.60	47.60	54.00	6.40
4 923.75	1 000	H	41.10	9.20	50.30	54.00	3.70
6 982.50	1 000	H	28.70	13.80	42.50	54.00	11.50
9 202.50	1 000	H	27.20	16.60	43.80	54.00	10.20
9 811.87	1 000	H	28.40	16.90	45.30	54.00	8.70
12 232.50	1 000	H	24.20	22.20	46.40	54.00	7.60
Above 13 000.00	Not Detected	-	-	-	-	-	-

* This Asterisk means restricted band.

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802.11g_Lowest channel (2 412 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(㎶)]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓							
* 2 389.75	1 000	H	49.00	3.50	52.50	74.00	21.50
4 823.54	1 000	H	37.60	9.40	47.00	74.00	27.00
7 014.38	1 000	H	34.10	13.90	48.00	74.00	26.00
9 513.75	1 000	H	35.50	16.10	51.60	74.00	22.40
12 151.87	1 000	H	35.20	22.00	57.20	74.00	16.80
14 904.37	1 000	H	37.60	24.60	62.20	74.00	11.80
16 211.25	1 000	V	39.40	28.10	67.50	74.00	6.50
Above 17 000.00	Not Detected	-	-	-	-	-	-
Average DATA. Emissions above 1 ㎓							
* 2 389.75	1 000	H	37.30	3.50	40.80	54.00	13.20
4 823.54	1 000	H	34.90	9.40	44.30	54.00	9.70
7 014.38	1 000	H	28.20	13.90	42.10	54.00	11.90
9 513.75	1 000	H	27.50	16.10	43.60	54.00	10.40
12 151.87	1 000	H	22.30	22.00	44.30	54.00	9.70
14 904.37	1 000	H	22.10	24.60	46.70	54.00	7.30
16 211.25	1 000	V	19.20	28.10	47.30	54.00	6.70
Above 17 000.00	Not Detected	-	-	-	-	-	-

* This Asterisk means restricted band.

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802.11g_Middle channel (2 437 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(㎶)]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓							
4 884.38	1 000	H	45.20	9.10	54.30	74.00	19.70
6 937.50	1 000	H	38.40	13.70	52.10	74.00	21.90
9 920.62	1 000	H	37.50	17.30	54.80	74.00	19.20
11 767.50	1 000	H	38.10	21.40	59.50	74.00	14.50
13 833.75	1 000	V	38.30	24.20	62.50	74.00	11.50
14 880.00	1 000	V	36.20	24.50	60.70	74.00	13.30
Above 15 000.00	Not Detected	-	-	-	-	-	-
Average DATA. Emissions above 1 ㎓							
4 884.38	1 000	H	38.40	9.10	47.50	54.00	6.50
6 937.50	1 000	H	27.20	13.70	40.90	54.00	13.10
9 920.62	1 000	H	26.10	17.30	43.40	54.00	10.60
11 767.50	1 000	H	23.90	21.40	45.30	54.00	8.70
13 833.75	1 000	V	22.30	24.20	46.50	54.00	7.50
14 880.00	1 000	V	22.40	24.50	46.90	54.00	7.10
Above 15 000.00	Not Detected	-	-	-	-	-	-

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802.11g_Highest channel (2 462 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(㎶)]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓							
* 2 484.00	1 000	H	54.80	3.60	58.40	74.00	15.60
4 921.88	1 000	H	40.50	9.20	49.70	74.00	24.30
7 203.75	1 000	H	37.00	14.30	51.30	74.00	22.70
9 103.12	1 000	H	37.90	16.80	54.70	74.00	19.30
12 277.50	1 000	H	37.70	22.20	59.90	74.00	14.10
13 886.25	1 000	H	37.90	24.30	62.20	74.00	11.80
Above 14 000.00	Not Detected	-	-	-	-	-	-
Average DATA. Emissions above 1 ㎓							
* 2 484.00	1 000	H	41.80	3.60	45.40	54.00	8.60
4 921.88	1 000	H	36.40	9.20	45.60	54.00	8.40
7 203.75	1 000	H	27.10	14.30	41.40	54.00	12.60
9 103.12	1 000	H	25.80	16.80	42.60	54.00	11.40
12 277.50	1 000	H	22.80	22.20	45.00	54.00	9.00
13 886.25	1 000	H	22.00	24.30	46.30	54.00	7.70
Above 14 000.00	Not Detected	-	-	-	-	-	-

* This Asterisk means restricted band.

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802.11n HT20_Lowest channel (2 412 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(㎶)]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓							
*2 390.00	1 000	H	46.00	3.50	49.50	74.00	24.50
4 823.13	1 000	H	38.00	9.40	47.40	74.00	26.60
7 198.13	1 000	H	35.90	14.30	50.20	74.00	23.80
9 742.50	1 000	H	34.70	16.70	51.40	74.00	22.60
12 013.12	1 000	H	34.20	21.80	56.00	74.00	18.00
13 848.75	1 000	V	38.40	24.20	62.60	74.00	11.40
Above 14 000.00	Not Detected	-	-	-	-	-	-
Average DATA. Emissions above 1 ㎓							
*2 390.00	1 000	H	38.10	3.50	41.60	54.00	12.40
4 823.13	1 000	H	32.50	9.40	41.90	54.00	12.10
7 198.13	1 000	H	26.70	14.30	41.00	54.00	13.00
9 742.50	1 000	H	25.90	16.70	42.60	54.00	11.40
12 013.12	1 000	H	22.40	21.80	44.20	54.00	9.80
13 848.75	1 000	V	22.30	24.20	46.50	54.00	7.50
Above 14 000.00	Not Detected	-	-	-	-	-	-

* This Asterisk means restricted band.

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802. 11n HT20_Middle channel (2 437 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(㎶)]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓							
4 884.38	1 000	H	49.00	9.10	58.10	74.00	15.90
7 138.13	1 000	H	37.70	14.20	51.90	74.00	22.10
9 110.62	1 000	H	37.60	16.80	54.40	74.00	19.60
12 176.25	1 000	H	37.40	22.10	59.50	74.00	14.50
14 458.12	1 000	V	37.90	24.10	62.00	74.00	12.00
15 534.37	1 000	H	40.20	27.40	67.60	74.00	6.40
Above 16 000.00	Not Detected	-	-	-	-	-	-
Average DATA. Emissions above 1 ㎓							
4 884.38	1 000	H	39.00	9.10	48.10	54.00	5.90
7 138.13	1 000	H	28.90	14.20	43.10	54.00	10.90
9 110.62	1 000	H	25.50	16.80	42.30	54.00	11.70
12 176.25	1 000	H	22.20	22.10	44.30	54.00	9.70
14 458.12	1 000	V	22.60	24.10	46.70	54.00	7.30
15 534.37	1 000	H	20.20	27.40	47.60	54.00	6.40
Above 16 000.00	Not Detected	-	-	-	-	-	-

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802.11n HT20_Highest channel (2 462 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(㎶)]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓							
*2 483.50	1 000	H	47.20	3.60	50.80	74.00	23.20
4 923.75	1 000	H	39.00	9.20	48.20	74.00	25.80
6 954.38	1 000	H	37.50	13.80	51.30	74.00	22.70
9 941.25	1 000	V	39.00	17.40	56.40	74.00	17.60
12 296.25	1 000	V	37.50	22.20	59.70	74.00	14.30
14 328.75	1 000	H	38.60	24.20	62.80	74.00	11.20
Above 15 000.00	Not Detected	-	-	-	-	-	-
Average DATA. Emissions above 1 ㎓							
*2 483.50	1 000	H	39.20	3.60	42.80	54.00	11.20
4 923.75	1 000	H	31.00	9.20	40.20	54.00	13.80
6 954.38	1 000	H	28.10	13.80	41.90	54.00	12.10
9 941.25	1 000	V	26.30	17.40	43.70	54.00	10.30
12 296.25	1 000	V	23.40	22.20	45.60	54.00	8.40
14 328.75	1 000	H	22.30	24.20	46.50	54.00	7.50
Above 15 000.00	Not Detected	-	-	-	-	-	-

* This Asterisk means restricted band.

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802.11n HT40_Lowest channel (2 422 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(㎶)]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓							
*2 388.50	1 000	H	44.30	3.50	47.80	74.00	26.20
4 876.88	1 000	H	38.50	9.10	47.60	74.00	26.40
5 913.75	1 000	H	34.00	12.40	46.40	74.00	27.60
6 666.63	1 000	H	34.60	13.00	47.60	74.00	26.40
7 824.38	1 000	H	35.00	14.90	49.90	74.00	24.10
8 902.50	1 000	V	34.80	16.70	51.50	74.00	22.50
Above 9 000.00	Not Detected	-	-	-	-	-	-
Average DATA. Emissions above 1 ㎓							
*2 388.50	1 000	H	39.60	3.50	43.10	54.00	10.90
4 876.88	1 000	H	32.30	9.10	41.40	54.00	12.60
5 913.75	1 000	H	30.10	12.40	42.50	54.00	11.50
6 666.63	1 000	H	30.10	13.00	43.10	54.00	10.90
7 824.38	1 000	H	30.70	14.90	45.60	54.00	8.40
8 902.50	1 000	V	30.00	16.70	46.70	54.00	7.30
Above 9 000.00	Not Detected	-	-	-	-	-	-

* This Asterisk means restricted band.

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802. 11n HT40_Middle channel (2 437 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(㎶)]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓							
4 884.38	1 000	H	46.00	9.10	55.10	74.00	18.90
7 175.63	1 000	V	34.60	14.20	48.80	74.00	25.20
9 240.00	1 000	V	35.80	16.50	52.30	74.00	21.70
11 424.37	1 000	H	35.50	20.80	56.30	74.00	17.70
14 240.62	1 000	H	35.40	24.30	59.70	74.00	14.30
15 860.62	1 000	H	38.10	27.70	65.80	74.00	8.20
Above 16 000.00	Not Detected	-	-	-	-	-	-
Average DATA. Emissions above 1 ㎓							
4 884.38	1 000	H	38.20	9.10	47.30	54.00	6.70
7 175.63	1 000	V	28.50	14.20	42.70	54.00	11.30
9 240.00	1 000	V	26.80	16.50	43.30	54.00	10.70
11 424.37	1 000	H	23.90	20.80	44.70	54.00	9.30
14 240.62	1 000	H	22.30	24.30	46.60	54.00	7.40
15 860.62	1 000	H	19.80	27.70	47.50	54.00	6.50
Above 16 000.00	Not Detected	-	-	-	-	-	-

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802.11n HT40_Highest channel (2 452 ㎒)

Frequency [㎒]	Receiver Bandwidth [㎑]	Pol. [V/H]	Reading [dB(㎶)]	Factor [dB]	Result [dB(㎶/m)]	Limit [dB(㎶/m)]	Margin [dB]
Peak DATA. Emissions above 1 ㎓							
*2 487.00	1 000	H	42.80	3.60	46.40	74.00	27.60
4 888.13	1 000	V	42.40	9.10	51.50	74.00	22.50
6 988.13	1 000	V	34.90	13.90	48.80	74.00	25.20
9 262.50	1 000	V	35.70	16.40	52.10	74.00	21.90
12 215.62	1 000	H	34.40	22.10	56.50	74.00	17.50
14 623.12	1 000	H	36.30	24.10	60.40	74.00	13.60
Above 15 000.00	Not Detected	-	-	-	-	-	-
Average DATA. Emissions above 1 ㎓							
*2 487.00	1 000	H	37.80	3.60	41.40	54.00	12.60
4 888.13	1 000	V	34.30	9.10	43.40	54.00	10.60
6 988.13	1 000	V	27.40	13.90	41.30	54.00	12.70
9 262.50	1 000	V	26.00	16.40	42.40	54.00	11.60
12 215.62	1 000	H	22.50	22.10	44.60	54.00	9.40
14 623.12	1 000	H	22.70	24.10	46.80	54.00	7.20
Above 15 000.00	Not Detected	-	-	-	-	-	-

* This Asterisk means restricted band.

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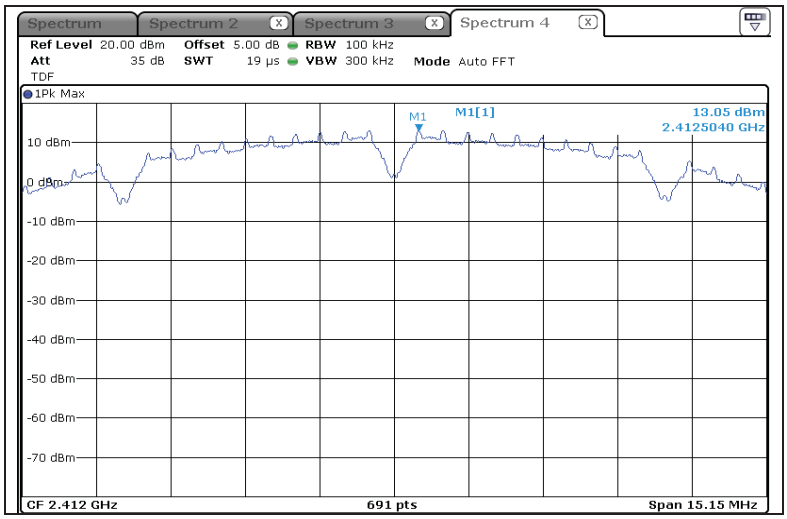
5.7.4 Test Plot

Figure 4. Plot of the Band-edge & Conducted Spurious Emissions

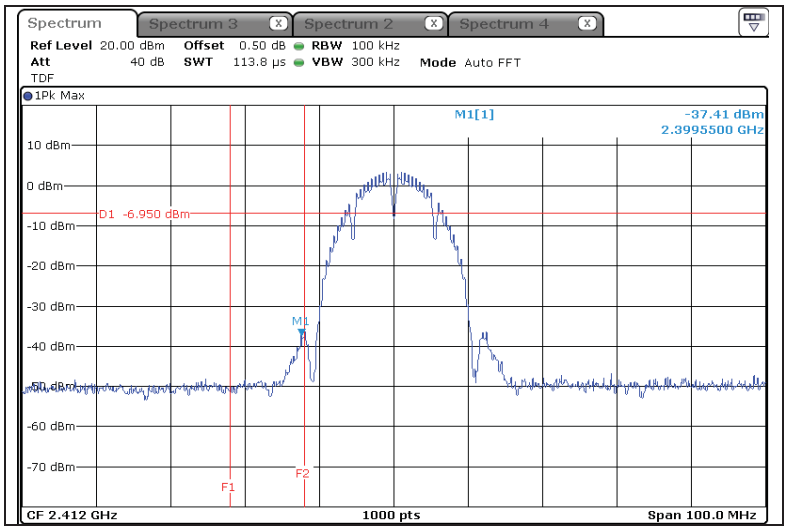
*** 802.11b**

Lowest Channel (2 412 ㎒)

Reference



Band-edge



* Result of 2 400.0 ㎒ (F1:2 390 ㎒, F2:2 400 ㎒)

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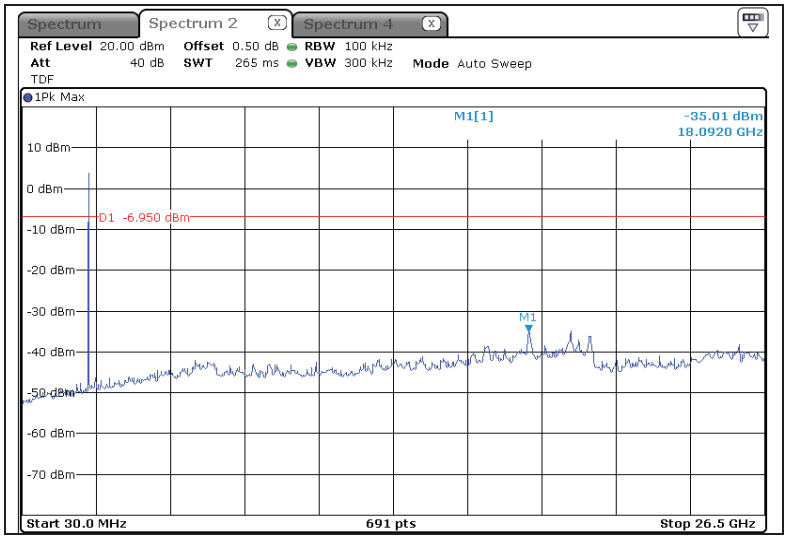
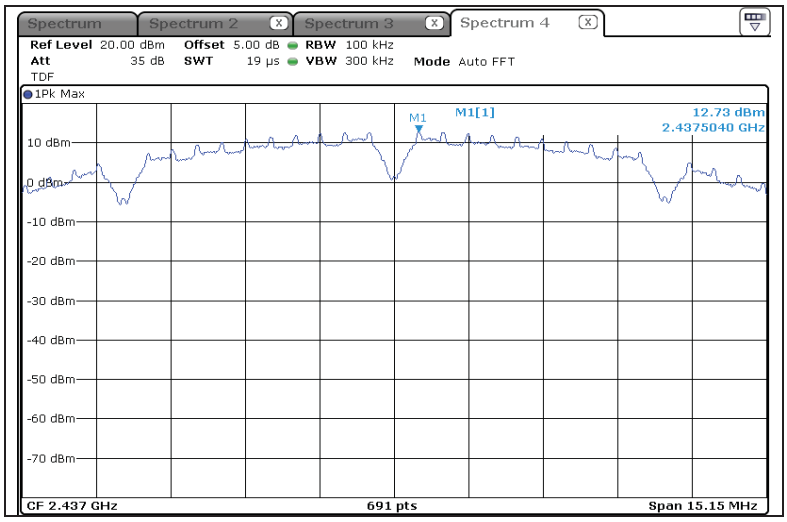
Conducted Spurious Emissions



Middle Channel (2 437 ㎒)

Reference



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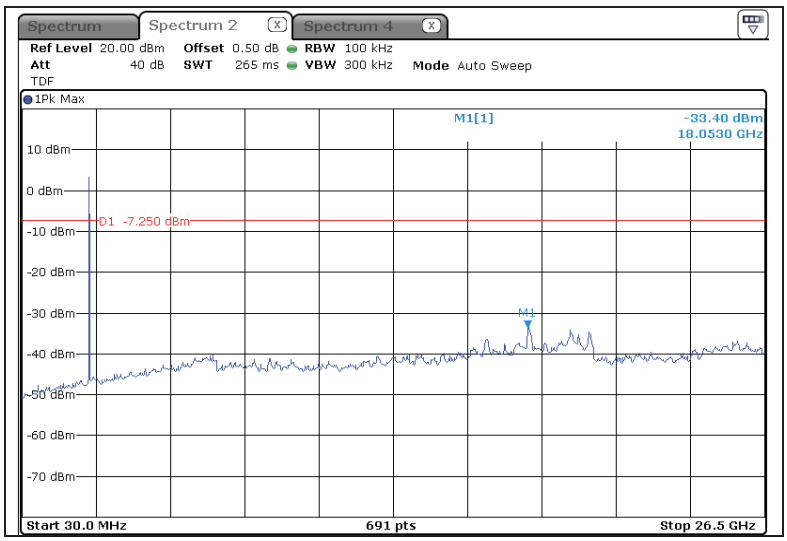
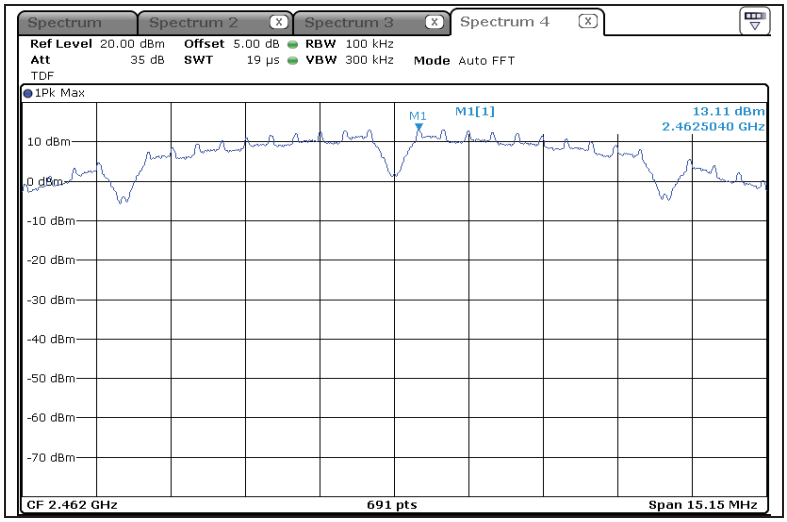
Conducted Spurious Emissions



Highest Channel (2 462 ㎒)

Reference



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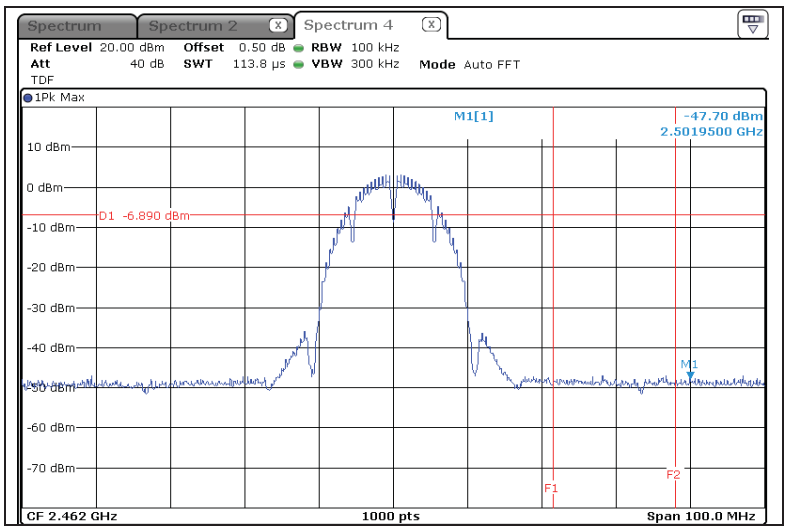
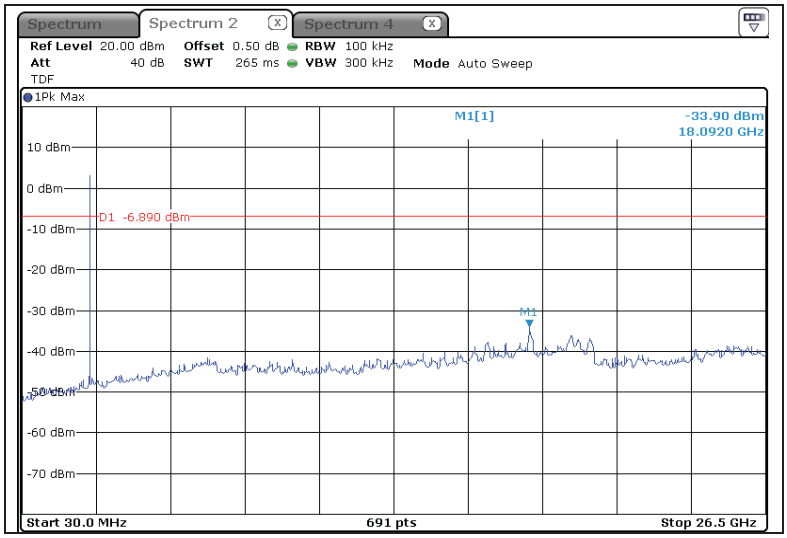
Band-edge



* Result of 2 483.5 ㎒ (F1:2 483.5 ㎒, F2:2 500 ㎒)

Conducted Spurious Emissions



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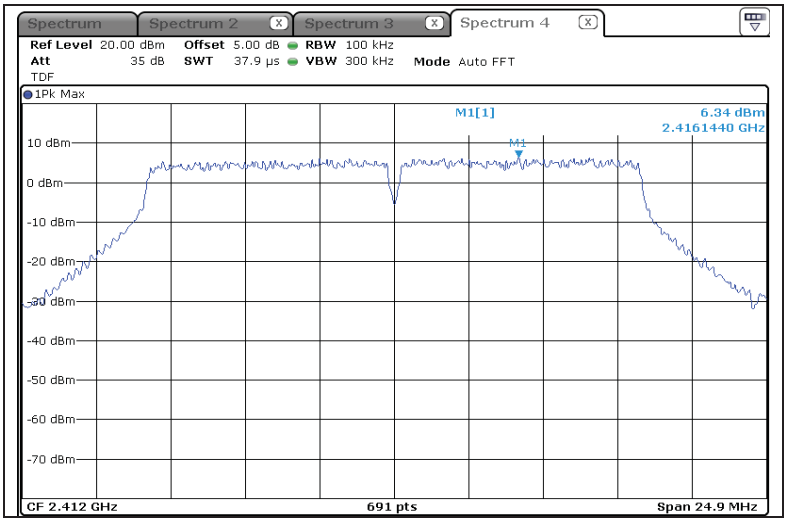
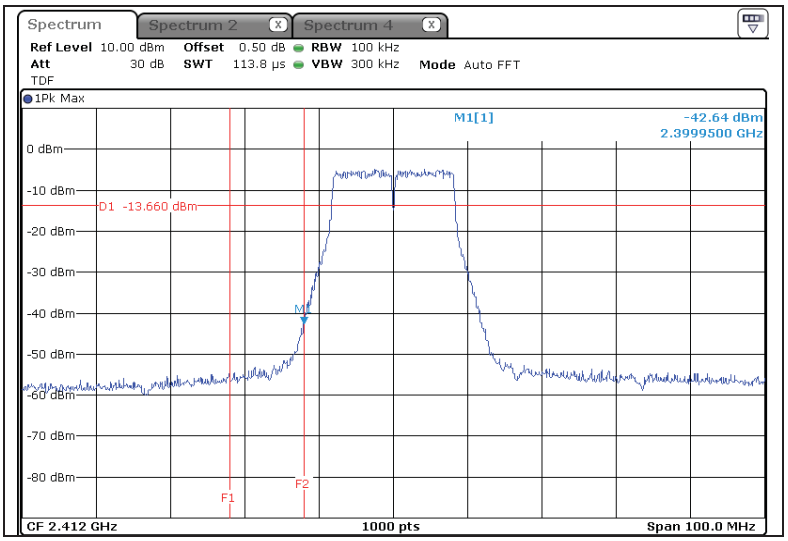
*** 802.11g**

Lowest Channel (2 412 ㎒)

Reference



Band-edge



* Result of 2 400.0 ㎒ (F1:2 390 ㎒, F2:2 400 ㎒)

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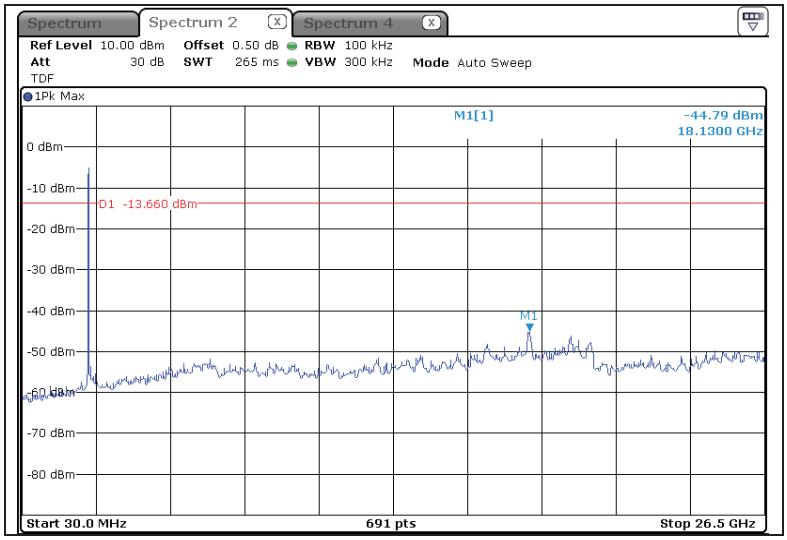
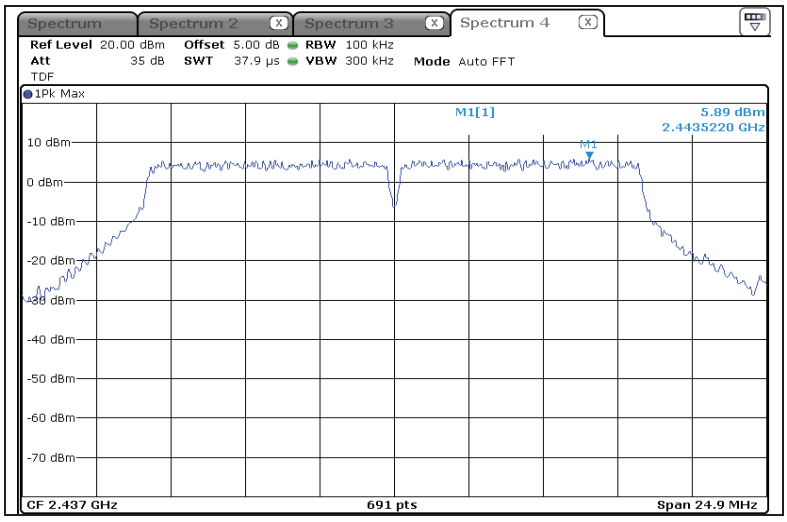
Conducted Spurious Emissions



Middle Channel (2 437 ㎒)

Reference



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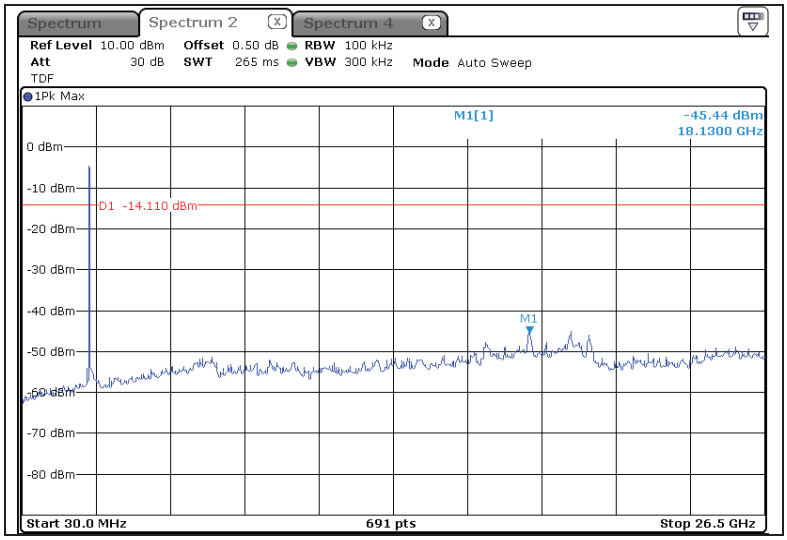
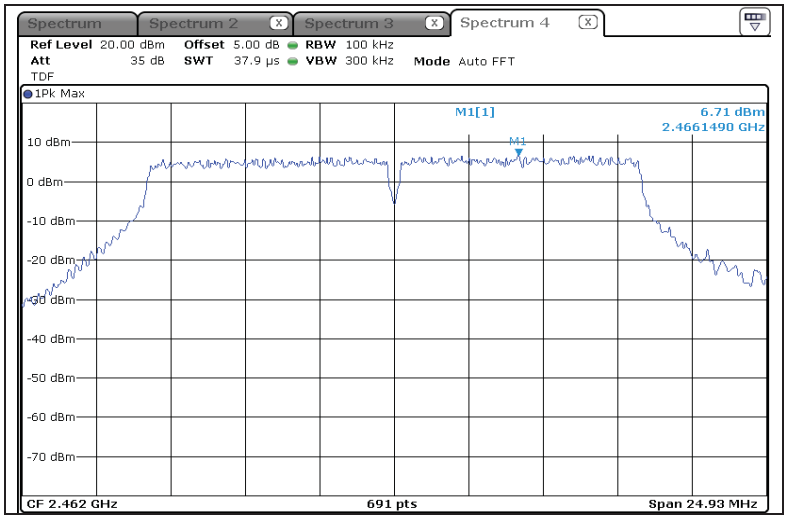
Conducted Spurious Emissions



Highest Channel (2 462 ㎒)

Reference



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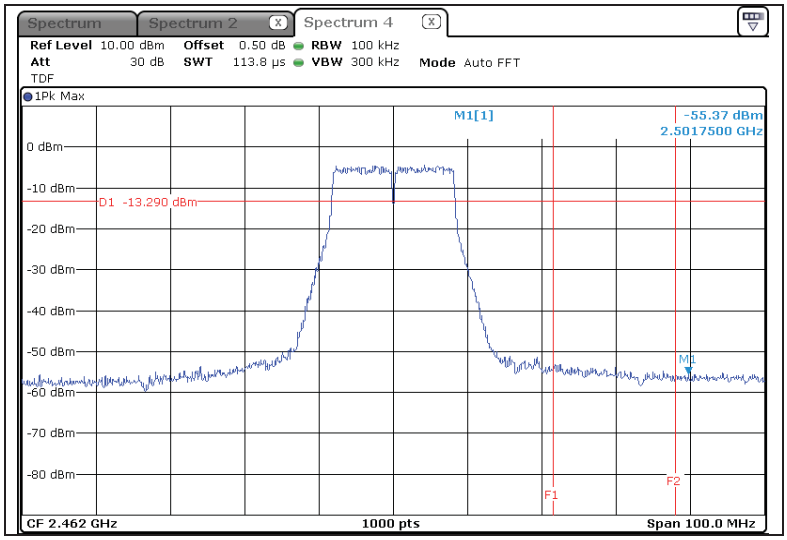
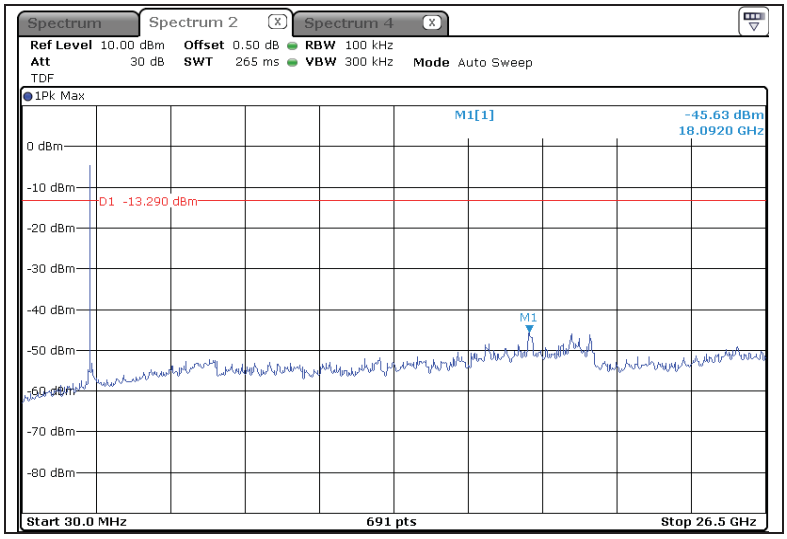
Band-edge



* Result of 2 483.5 ㎒ (F1:2 483.5 ㎒, F2:2 500 ㎒)

Conducted Spurious Emissions



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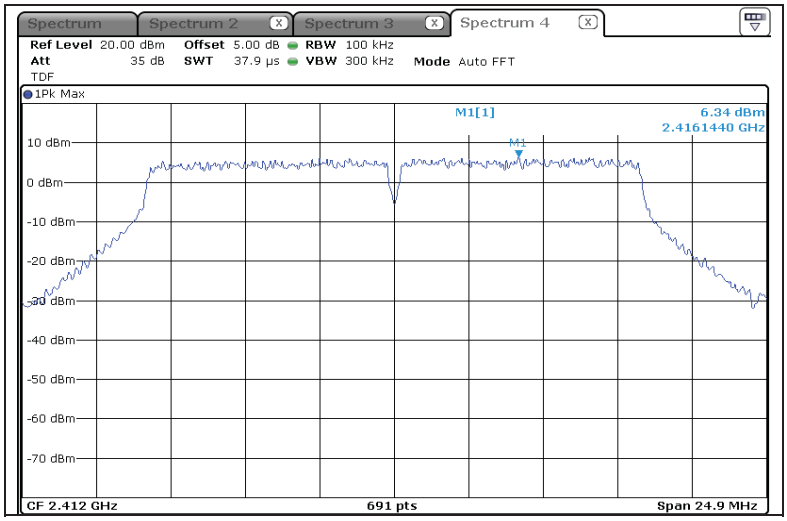
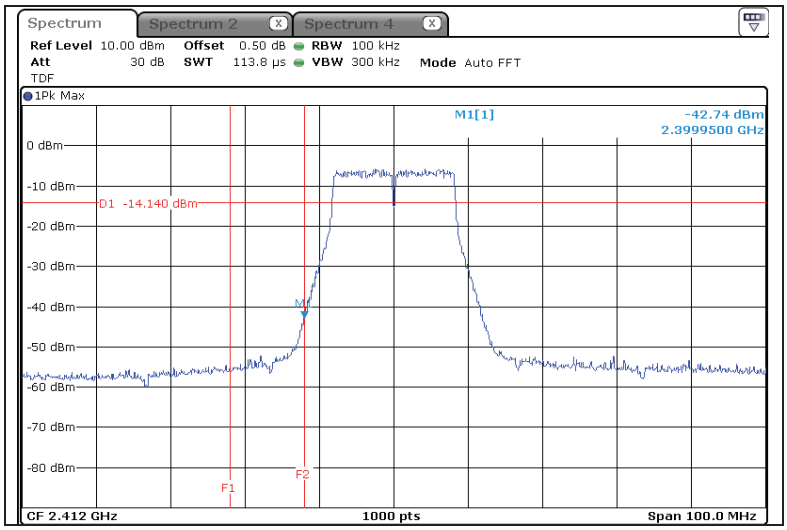
*** 802.11n HT20**

Lowest Channel (2 412 ㎒)

Reference



Band-edge



* Result of 2 400.0 ㎒ (F1:2 390 ㎒, F2:2 400 ㎒)

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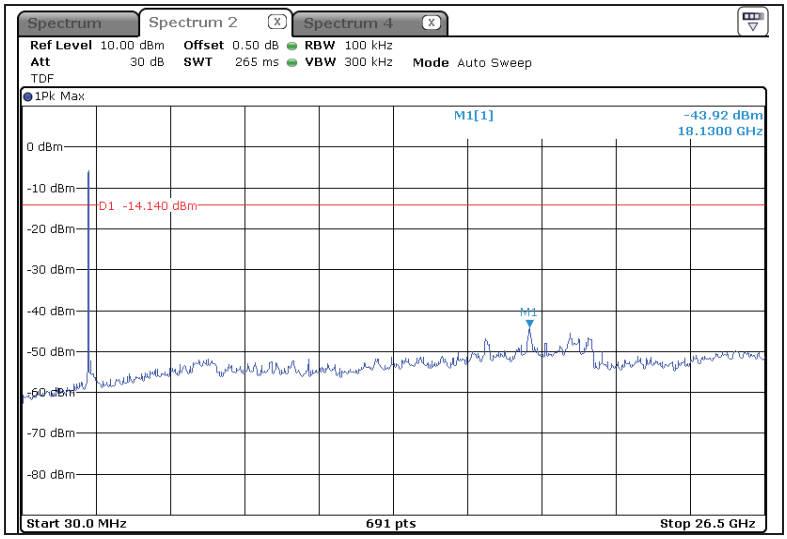
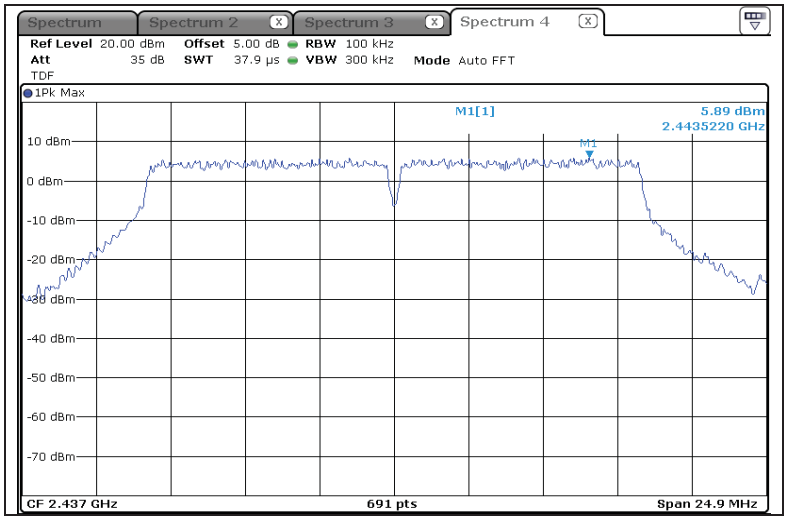
Conducted Spurious Emissions



Middle Channel (2 437 ㎒)

Reference



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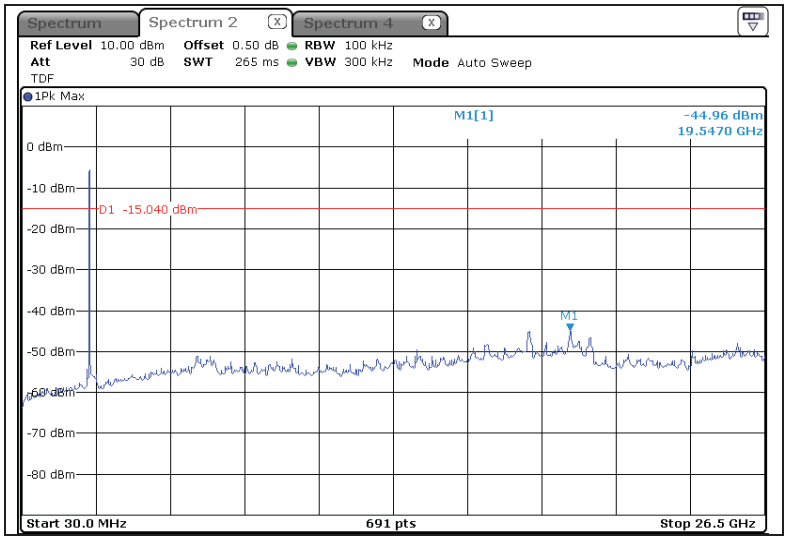
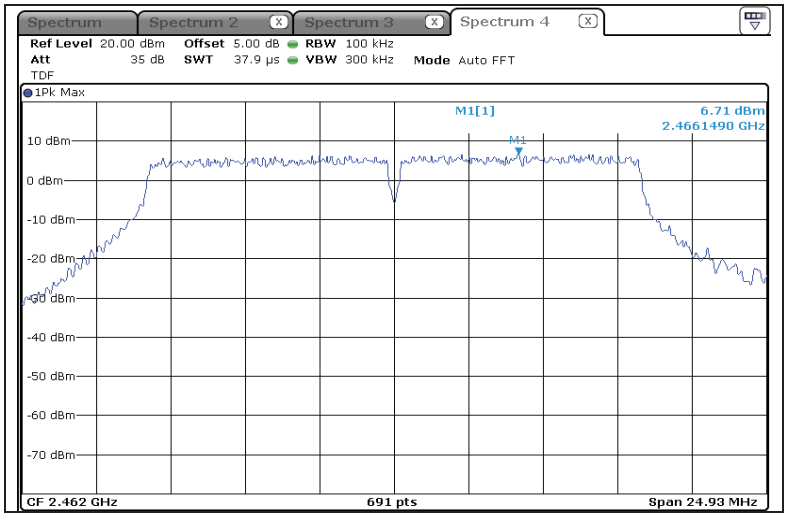
Conducted Spurious Emissions



Highest Channel (2 462 ㎒)

Reference



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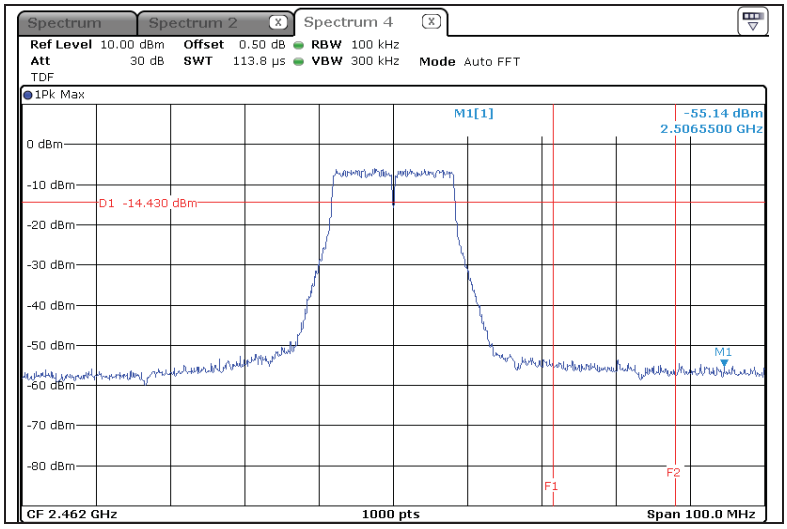
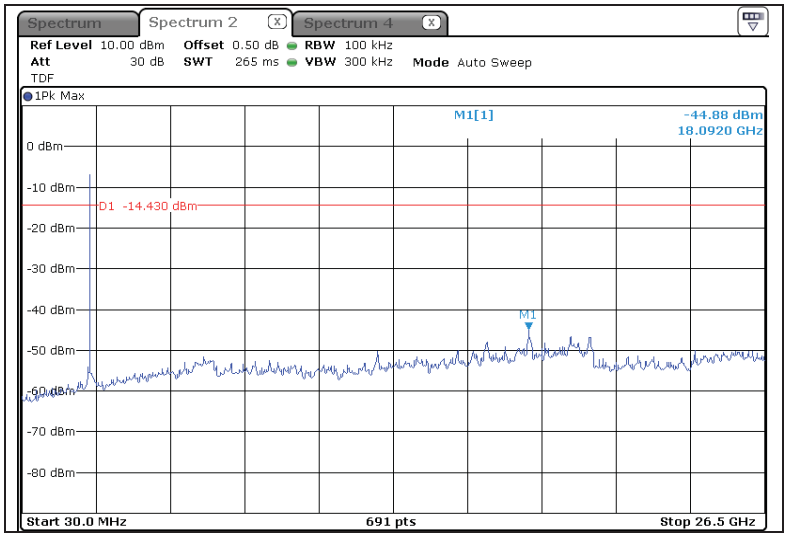
Band-edge



* Result of 2 483.5 ㎒ (F1:2 483.5 ㎒, F2:2 500 ㎒)

Conducted Spurious Emissions



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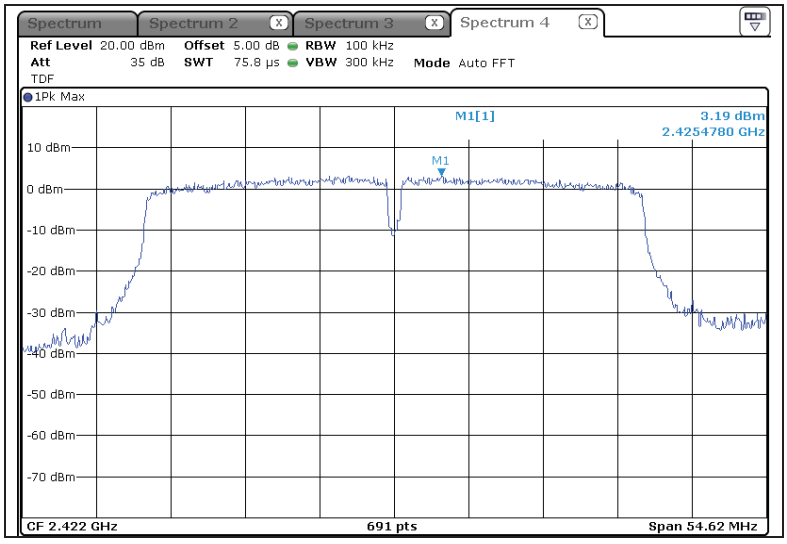
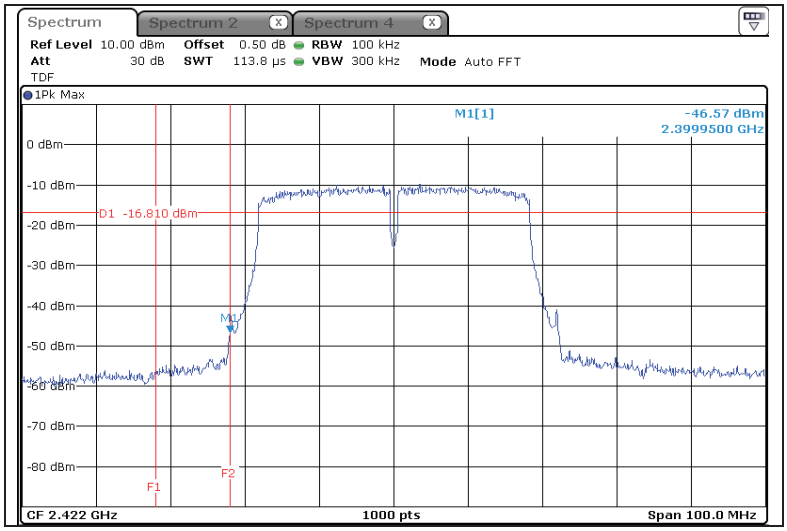
*** 802.11n HT40**

Lowest Channel (2 422 ㎒)

Reference



Band-edge



* Result of 2 400.0 ㎒ (F1:2 390 ㎒, F2:2 400 ㎒)

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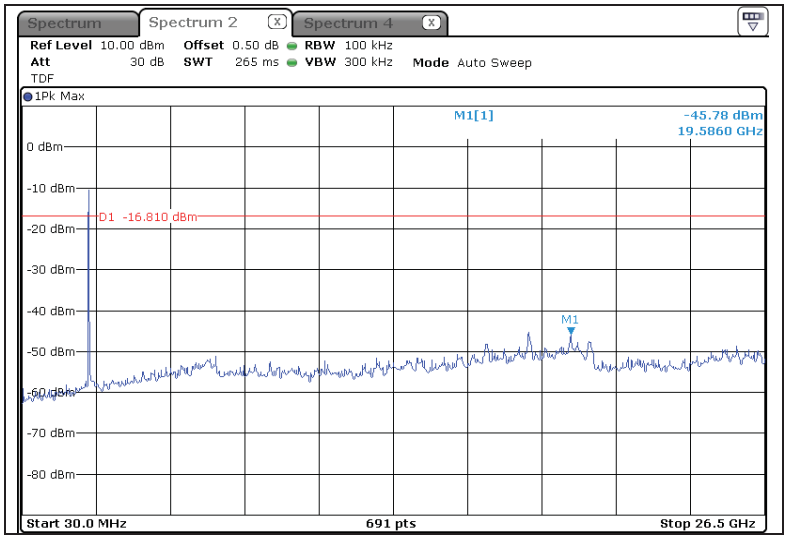
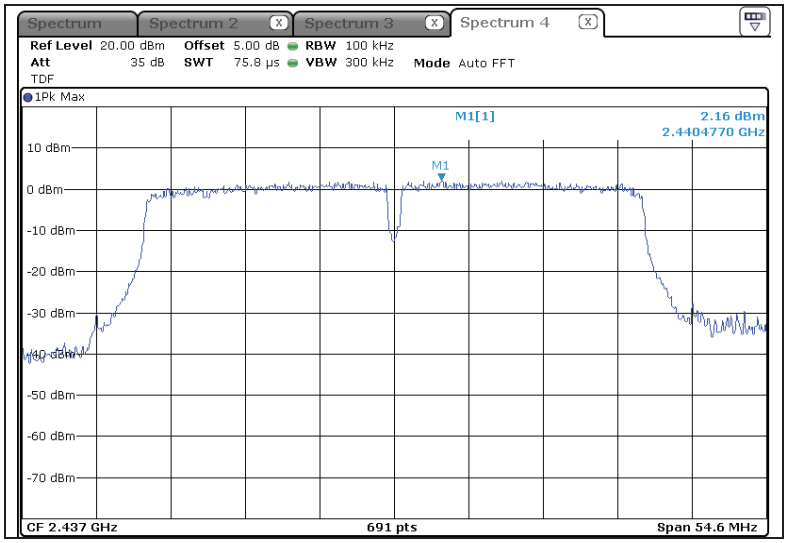
Conducted Spurious Emissions



Middle Channel (2 437 ㎒)

Reference



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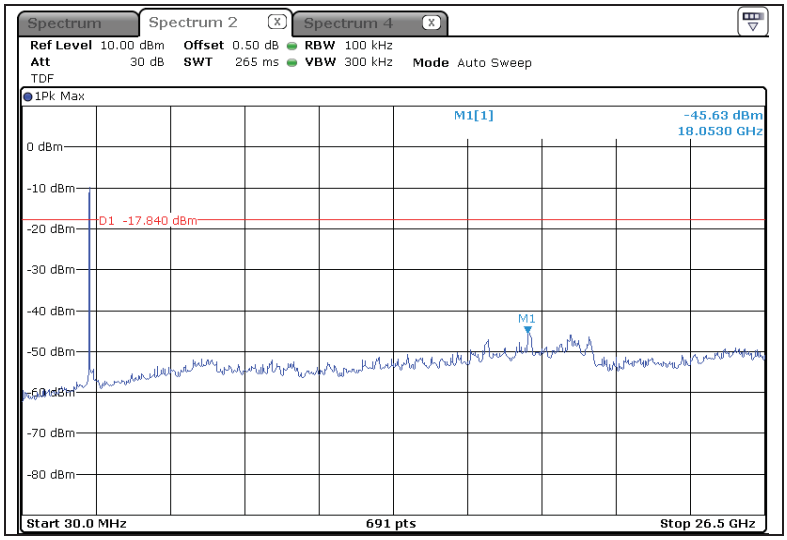
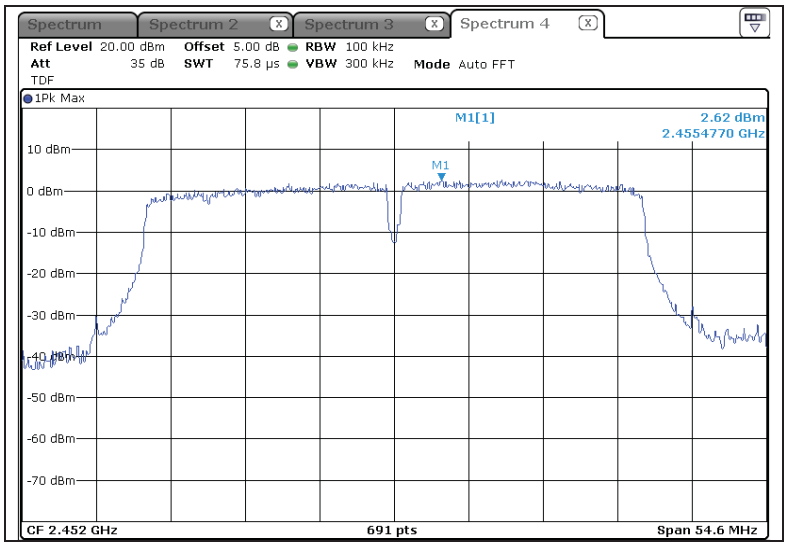
Conducted Spurious Emissions



Highest Channel (2 452 ㎒)

Reference



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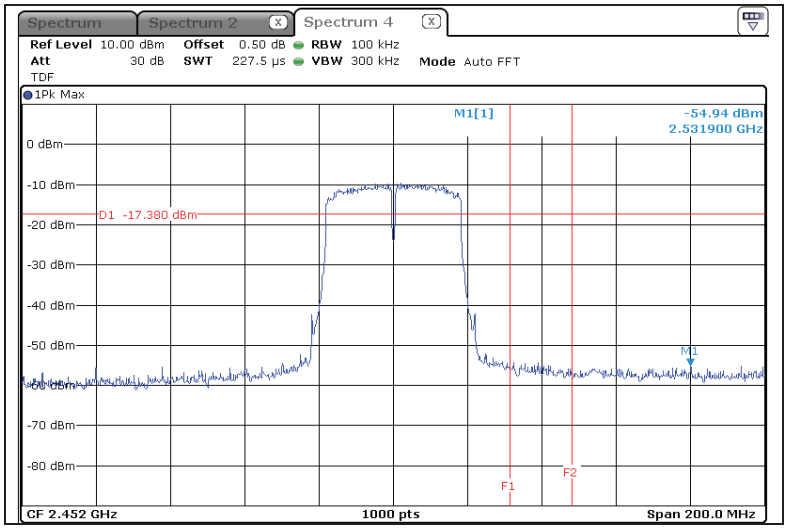
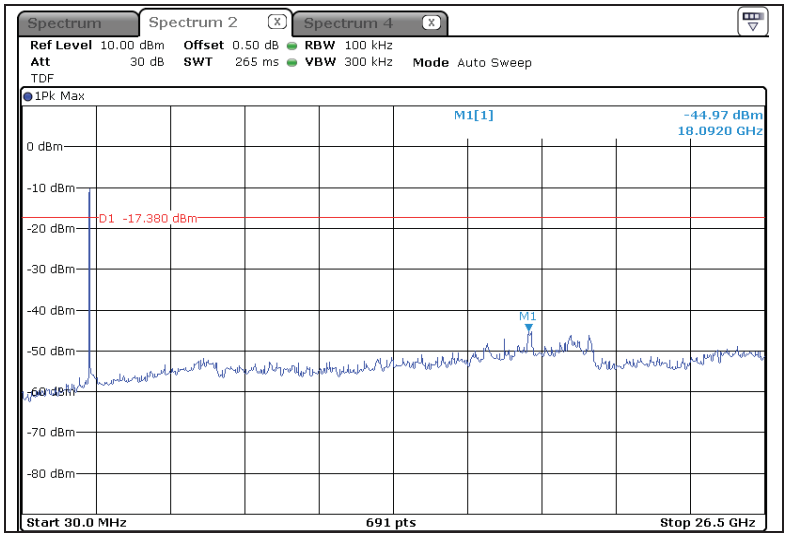
Band-edge



* Result of 2 483.5 ㎒ (F1:2 483.5 ㎒, F2:2 500 ㎒)

Conducted Spurious Emissions



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6. Test equipment used for test

	Description	Manufacturer	Model No.	Serial No.	Next Cal Date.
■	Test Receiver	R & S	ESR7	101078	17.02.26
■	Bi-Log Antenna	SCHWARZBECK	VULB 9168	583	16.06.19
■	Amplifier	SONOMA INSTRUMENT	310N	188280	17.04.07
■	Attenuator	EM TEST	ATT6/80	P1402129094	17.04.08
■	Turn Table	MATURO	CO2000-SOFT	-	-
■	Antenna Mast	MATURO	AM4.0	079/3440509	-
■	Broadband Preamplifier	SCHWARZBECK	BBV9718	9718-233	17.01.09
■	LOOP Antenna	R & S	HFH2-Z2	100355	18.03.03
■	Horn antenna	ETS.lindgren	3116	86632	16.11.05
■	Horn antenna	ETS.lindgren	3117	155787	16.11.25
■	Broadband Preamplifier	SCHWARZBECK	BBV9721	2	17.05.03
■	DC Power Supply	AGILENT	E3632A	KR73001026	17.01.07
■	Spectrum Analyzer	R & S	FSV30	101437	16.11.03
■	Vector Signal Generator	R & S	SMBV100A	257566	17.01.07
■	Signal Generator	R & S	SMR40	100007	16.06.15
■	Wideband Power Sensor	R & S	NRP-Z81	102398	17.02.11
■	Highpass Filter	Wainwright Instruments GmbH	WHKX3.0/ 18G-12SS	44	17.02.01
■	Attenuator	HP	8491A	18591	17.05.03
■	Spectrum Analyzer	R & S	FSV30	100914	16.11.03

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