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FCC & IC EVALUATION REPORT FOR CERTIFICATION

Project No. : NK-24-R-201**Dates of receipt :** May 3, 2024**Applicant :** DRTECH Corporation**Dates of Issue :** October 7, 2024

Suite No. 1,2 Floor / Suite No. 2,3 Floor, 29,

Test Site :

Dunchon-daero 541 beon-gil, Jungwon-gu,

Nemko Korea Co., Ltd.

Seongnam-si, , Gyeonggi-do, 13216, Korea

FCC ID :

RNH-TOP8812BU

IC :

29808-TOP8812BU

FCC Applicant :

DRTECH Corporation

IC Applicant :

Drtech Corporation

Brand Name :

DRTECH

Model:

TOP-8812BU

EUT Type:

WiFi Module

Classification:

FCC Part 15 Digital Transmission System (DTS)

Date of Test:

May 14, 2024 ~ September 3, 2024

Applied Standard:

FCC 47 CFR Part 15.247

RSS-Gen Issue 5, RSS-247 Issue 3

The device bearing the brand name and model specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with the measurement procedures specified in ANSI C63.10-2013. The client should not use it to claim product endorsement by TAF or any government agencies. The test results in the report only apply to the tested sample.

I attest to the accuracy of data and all measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.



Tested By : Wonjae Song

Reviewed By : Hoonpyo Lee

Test Engineer

Technical Manager

Revision History

Rev.	Issue Date	Revisions	Revised By
00	October 7, 2024	Initial issue	Wonjae Song

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1. INTRODUCTION

1.1 Test facility

The measurement procedure described in American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz (ANSI C63.4-2014), the American National Standard for Testing Unlicensed Wireless Devices (ANSI C63.10-2013) was used in determining radiated and conducted emissions emanating.

These measurement tests were conducted at **Nemko Korea Co., Ltd.**

The site address 165-51, Yurim-ro, Cheoin-gu, Yongin-si, Gyeonggi-do, 17042, Rep. of Korea.

1.2 Accreditation and listing

Accreditation type		Accreditation number
	CAB Accreditation for DOC	Designation No. KR0026
	KOLAS Accredited Lab. (Korea Laboratory Accreditation Scheme)	Registration No. KT155
	Canada IC Registered site	Site No. 29506
	VCCI registration site(RE/CE/Telecom CE)	Member No. 2118
	EMC CBTL	TL124
	KCC(RRL)Designated Lab.	Registration No. KR0026

2. EUT INFORMATION & TEST CONDITIONS

2.1 EUT Information

2.1.1 Specifications

EUT Type	WiFi Module
Model Name	TOP-8812BU
Frequency of Operation	2 412 MHz to 2 472 MHz : 802.11b /802.11g /802.11n HT20 2 422 MHz to 2 462 MHz : 802.11n HT40
Maximum Conducted Output Power	802.11b : 16.54 dBm 802.11g : 14.61 dBm 802.11n (20 MHz) : 15.22 dBm 802.11n (40 MHz) : 13.28 dBm
Number of Channels	2 412 MHz to 2 472 MHz : 13 ch 2 422 MHz to 2 462 MHz : 9 ch
Modulations	CCK, BPSK, QPSK, 16QAM, 64QAM
Antenna Gain (peak)	APDR-600WT : -5.5 dB i APDR-600WS : -3.6 dB i
Antenna Setup	2TX / 2RX
EUT Rated Voltage	DC 3.3 V
EUT Test Voltage	DC 5.0 V
HVIN (Hardware Version Number)	TOP8812BU
FVIN (Firmware Version Identification Number)	GEN_HW3.00.00_V3_SW0.0.01
Remarks	-

2.2 Operation During Test

The EUT is the transceiver which is module supporting the 802.11a/b/g/n/ac mode(802.11a/b/g/n(20,40 MHz)/ac(20,40,80 MHz) : 2TX/2RX).

The Laptop was used to control the EUT to transmit the wanted TX channel continuously (duty cycle > 98%) by the testing program(MPtool version 3.3.5) which manufacturer supported.

The cable and attenuator loss from 30 MHz to 26 GHz was reflected in spectrum analyzer with correction factor for all conducted testing.

The EUT was tested at the lowest, middle and the highest channels with the maximum output power in accordance with the manufacturer's specifications. The worst data were recorded in the report.

2.2.1 Table of Test power setting

Frequency [MHz]	Mode	Power setting Level (SISO)	Power setting Level (MIMO)
2 412	802.11b	50	-
2 442		50	-
2 472		50	-
2 412	802.11g	50	-
2 442		50	-
2 472		50	-
2 412	802.11n HT20	50	50
2 442		50	50
2 472		50	50
2 422	802.11n HT40	45	45
2 442		45	45
2 462		45	45

2.2.2 Table of Test frequency

Frequency band	Modulation	Test Channel (CH)	Frequency (MHz)
2.4 GHz	802.11b,g,n(HT20)	1	2 412
		6	2 437
		11	2 462
	802.11n(HT40)	3	2 422
		6	2 437
		9	2 452

2.2.3 Antenna Information

Frequency band	Mode	Data rate	Antenna TX mode	Support CDD	Support MIMO
2.4 GHz	802.11b,g	All	■ 1TX, □ 2TX	□ Yes, ■ No	□ Yes, ■ No
	802.11n (20MHz)	MCS 0~7	■ 1TX, ■ 2TX	■ Yes, □ No	□ Yes, ■ No
		MCS 8~15	□ 1TX, ■ 2TX	□ Yes, ■ No	■ Yes, □ No
	802.11n (40MHz)	MCS 0~7	■ 1TX, ■ 2TX	■ Yes, □ No	□ Yes, ■ No
		MCS 8~15	□ 1TX, ■ 2TX	□ Yes, ■ No	■ Yes, □ No

2.2.4 Additional Information Related to Testing

The cable and attenuator loss from 30 MHz to 26.5 GHz was reflected in spectrum analyzer with correction factor for all conducted testing.

2.2.5 Worst-case Configuration and Mode

Radiated emission below 1GHz was performed with the EUT set to transmit at the channel with highest output power as worst-case scenario.

Radiated emission above 1GHz was performed with the EUT set to transmit low/mid/high channels.

The emissions (Band-edge & spurious emissions) were investigated in three orthogonal orientations X, Y and Z.

Accordingly, the orientation was determined and tested as shown in the table below:

Test Items	X	Y	Z
Band-edge	O	-	-
Spurious emissions	O	-	-

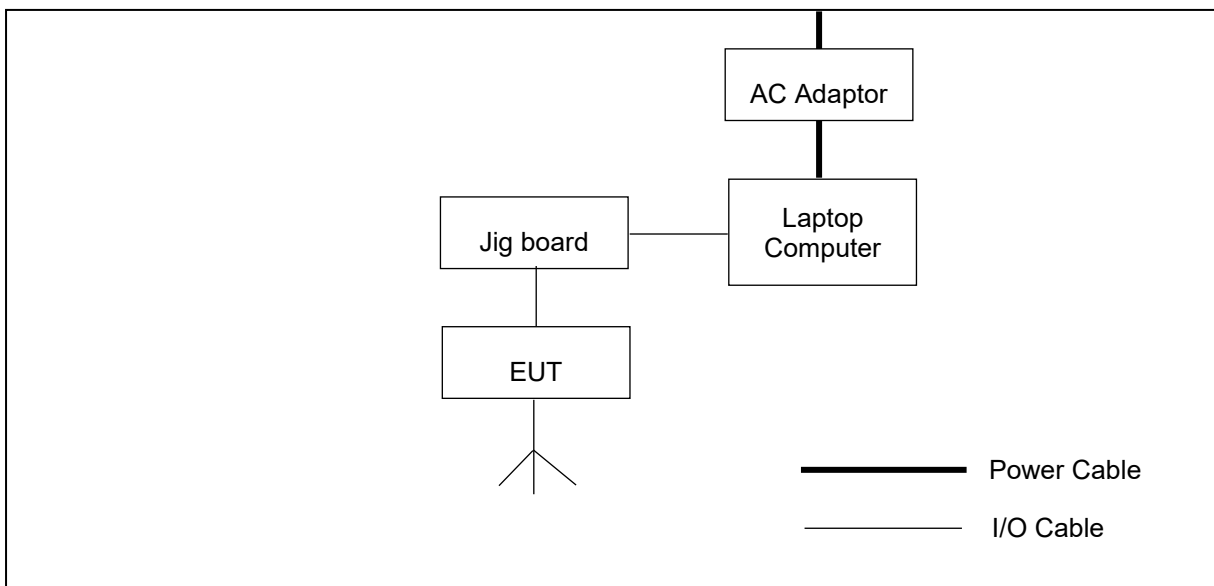
2.2.6 Additional model covered by this report

- N/A

2.3 Support Equipment

EUT	DRTECH Corporation Model : TOP-8812BU	S/N: N/A
Laptop Computer	HP Model : G62-355TU	FCC DOC S/N : CNF0489WDT
AC Adapter	HP Model : PPP009D	FCC DOC S/N : WBGSV0ACXZH162

2.4 Setup Drawing



3. ANTENNA REQUIREMENTS

Measurement and determination of electromagnetic emissions (EME) of radio frequency devices including intentional and/or unintentional radiators for compliance with the technical rules and regulations of the Federal Communications Commission under FCC part 15 and RSS-Gen.

§15.203 of the FCC Rules part 15 Subpart C

: 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.

RSS-Gen Section 6.8

: The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the compliance of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below)

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type.

The transmitter has attached PCB antenna on board.

Used Antenna	
Model name	2 402 MHz ~ 2 480 MHz
	Max. peak gain (dBi)
APDR-600WT	-5.5
APDR-600S	-3.6

4. SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specification:

Name of Test	FCC Paragraph No.	IC Paragraph No.	Test Limit	Test Condition	Result	Remark
6dB Bandwidth	15.247(a)(2)	RSS-247 (5.2)(a)	> 500 kHz	Conducted	Complies	-
Occupied Bandwidth	-	RSS-Gen (6.7)				
Peak Output Power	15.247(b)(3)	RSS-247 (5.4)(d)	< 1 Watt < 4 Watt(e.i.r.p.)		Complies	-
Power Spectral Density	15.247(e)	RSS-247 (5.2)(b)	< 8 dBm/3 kHz		Complies	-
Band Edge / Conducted Spurious Emission	15.247(d)	RSS-247 (5.5)	≥ 30 dBc		Complies	-
Radiated Spurious Emission	15.205, 15.209	RSS-Gen (8.9),(8.10)	< 74 dBμV/m (PK) < 54 dBμV/m (AV) Radiated limits detailed in 15.209	Radiated	Complies	-
AC Line Conducted Emission	15.207	RSS-Gen (8.8)	FCC 15.207 Limits	Line Conducted	Complies	-

5. TEST METHODOLOGY

1. FCC CFR 47 Part 2.
2. FCC CFR 47 Part 15.
3. KDB 558074 D01 15.247 Meas Guidance v05r02.
4. RSS-Gen Issue 5
5. RSS-247 Issue 3
6. ANSI C63.10-2013.

6. DESCRIPTION OF TESTS

6.1 6 dB Bandwidth / Occupied Bandwidth

Test Setup



Test Measurement Method

ANSI C63.10-2013, Section 11.8.2 Option 2
KDB 558074 D01 v05r02, Section 8.2
RSS-Gen section 6.7

Test Procedure

- 6 dB Bandwidth (DTS Chanel Bandwidth)

EUTs 6 dB bandwidth is measured at low, middle, high channels with a spectrum analyzer connected to the antenna terminal while the EUTs operating at its maximum power control level. The spectrum analyzer setting is as follows.

RBW = 100 kHz

VBW > 3 x RBW

Detector = Peak

Trace mode = max hold

Sweep = auto couple

Allow trace to fully stabilize.

The bandwidth measurement function on the spectrum analyzer is used to measure the 6 dB bandwidth.

6.2 Maximum Conducted Output Power(average)

Test Setup



Test Measurement Method

ANSI C63.10-2013, Section 11.9.2.2

KDB 558074 D01 v05r02, Section 8.3.1.1

Test Procedure

EUTs Maximum Conducted Output Power(average) is measured at low, middle, high channels with a spectrum analyzer connected to the antenna terminal while the EUTs operating at its maximum power control level.

The spectrum analyzer setting is as follows.

Measure the duty cycle, x , of the transmitter output signal.

Span to at least 1.5 times the OBW.

RBW = 1 – 5 % of the OBW, not to exceed 1 MHz

VBW $\geq$ 3 x RBW

Number of points in sweep $\geq$ 2 x span / RBW

Sweep time = auto couple

Detector = RMS

Trace average at least 100 traces in power averaging mode.

Add $10 \log(1/x)$, where x is the duty cycle.

Compute power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function, with band limits set equal to the OBW band edges.

6.3 Power Spectral Density

Test Setup



Test Measurement Method

ANSI C63.10-2013, Section 11.10.5 Method AVGPS
KDB 558074 D01 v05r02, Section 8.4

Test Procedure

EUTs Power Spectral Density is measured at low, middle, high channels with a spectrum analyzer connected to the antenna terminal while the EUTs operating at its maximum power control level.

The spectrum analyzer setting is as follows.

Center frequency = DTS channel center frequency

Span = 1.5 times the DTS channel bandwidth

$3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$

$\text{VBW} \geq 3 \times \text{RBW}$

Detector = RMS

Sweep time = auto couple

Trace mode = max hold

Allow the trace to stabilize.

Add $10 \log(1/x)$, where x is the duty cycle.

The peak search function on the spectrum analyzer is used to determine the maximum amplitude level within the RBW.

6.4 Band Edge / Conducted Spurious Emissions

Test Setup



Test Measurement Method

ANSI C63.10-2013, Section 11.11.3

KDB 558074 D01 v05r02, Section 8.5, Section 8.7.2

Test Procedure

EUTs Conducted spurious emissions are measured at low, middle, high channels with a spectrum analyzer connected to the antenna terminal while the EUTs operating at its maximum power control level. The spectrum analyzer setting is as follows.

1) Reference Level

Center frequency = DTS channel center frequency

Span $\geq 1.5 \times$ DTS bandwidth

RBW = 100 kHz

VBW $\geq 3 \times$ RBW

Detector = peak

Sweep time = auto couple

Trace mode = max hold

Allow trace to fully stabilize.

Use the peak marker function to determine the maximum PSD level.

Note that the channel found to contain the maximum PSD level can be used to establish the reference level.

2) Unwanted Emissions

Set the center frequency and span to encompass frequency range to be measured.

RBW = 100 kHz

VBW $\geq 3 \times$ RBW

Detector = peak

Sweep time = auto couple

Trace mode = max hold

Allow trace to fully stabilize.

Use the peak marker function to determine the maximum amplitude level.

6.5 Radiated Emissions

Test Measurement Method

ANSI C63.10-2013, Section 6.6.4.3, Section 11.11, Section 11.12
KDB 558074 D01 v05r02, Section 8.6, Section 8.7

Test Procedure

The measurement was performed at the test site that is specified in accordance with ANSI C63.10-2013. The spurious emission was scanned from 9 kHz to 30 MHz using Loop Antenna and 30 to 1000 MHz using Trilog broadband test antenna. Above 1 GHz, Horn antenna was used.

For emissions testing at below 1GHz, The test equipment was placed on turntable with 0.8 m above ground. For emission measurements above 1 GHz, The test equipment was placed on turntable with 1.5 m above ground. Sufficient time for the EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The EUT, cable, wire arrangement and mode of operation that has the highest amplitude relative to the limit was selected. Then, the turn table was rotated from 0° to 360° and an antenna mast was moved from 1 m to 4 m height to maximize the suspected highest amplitude signal. The final maximized level was recorded.

At frequencies below 1000 MHz, measurements performed using the CISPR quasi-peak detection. At frequencies above 1000 MHz, measurements performed using the peak and average measurement procedures described in ANSI 63.10-2013 section 11.12. Peak emission levels were measured by setting the analyzer RBW = 1 MHz, VBW = 3 MHz, Detector = Peak, Trace mode = max hold. Average emission levels were measured by setting the analyzer RBW = 1 MHz, VBW = 10 kHz, Detector = Peak, Trace mode = max hold. Allow max hold to run for at least 50 times (1/duty cycle) traces.

Frequency (MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009–0.490	2400/F(kHz)	300
0.490–1.705	24000/F(kHz)	30
1.705–30.0	30	30
30–88	100	3
88–216	150	3
216–960	200	3
Above 960	500	3

Radiated Emissions Limits per 47 CFR 15.209(a) & RSS-Gen (8.9)

6.6 AC Line Conducted Emissions

Test Measurement Method

ANSI C63.10-2013, Section 6.2

Test Procedure

The Line conducted emission test facility is located inside a 4 x 7 x 2.5 meter shielded enclosure.

It is manufactured by EM engineering. The shielding effectiveness of the shielded room is in accordance with MIL-STD-285 or NSA 65-6. A 1 m x 1.5 m wooden table 0.8 m height is placed 0.4 m away from the vertical wall and 1.5 m away from the side of wall of the shielded room. Rohde & Schwarz (ENV216) of the 50 ohm/50 μ H Line Impedance Stabilization Network (LISN) are bonded to the shielded room. The EUT is powered from the Rohde & Schwarz LISN. Power to the LISNs are filtered by high-current high insertion loss Power line filters. The purpose of filter is to attenuate ambient signal interference and this filter is also bonded to shielded enclosure. All electrical cables are shielded by tinned copper zipper tubing with inner diameter of 1 / 2 ". If DC power device, power will be derived from the source power supply it normally will be powered from and this supply lines will be connected to the LISNs, All interconnecting cables more than 1 meter were shortened by non-inductive bundling (serpentine fashion) to a 1 meter length. Sufficient time for EUT, support equipment, and test equipment was allowed in order for them to warm up to their normal operating condition. The RF output of the LISN was connected to the spectrum analyzer to determine the frequency producing the maximum EME from the EUT. The spectrum was scanned from 150 kHz to 30 MHz with 200 msec sweep time. The frequency producing the maximum level was re-examined using the EMI test receiver. (Rohde & Schwarz ESCI). The detector functions were set to CISPR quasi-peak mode & average mode. The bandwidth of receiver was set to 9 kHz. The EUT, support equipment, and interconnecting cables were arranged and manipulated to maximize each EME emission. Each emission was maximized by; switching power lines; varying the mode of operation or resolution; clock or data exchange speed; scrolling H pattern to the EUT and of support equipment, and powering the monitor from the floor mounted outlet box and computer aux AC outlet, if applicable; whichever determined the worst case emission.

Each EME reported was calibrated using the R&S signal generator.

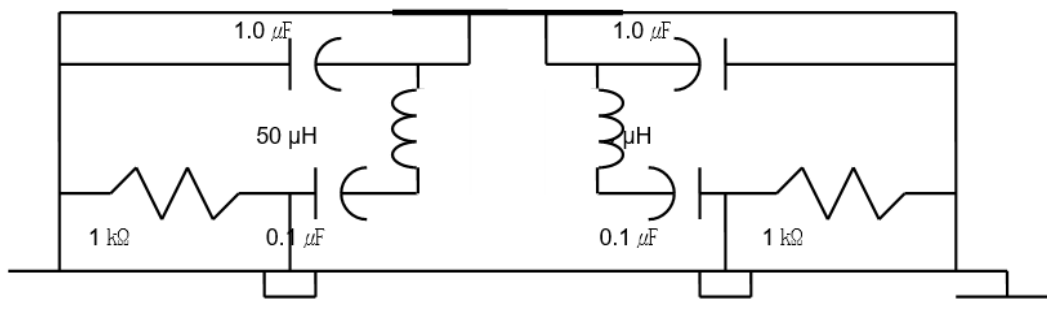


Fig. 2. LISN Schematic Diagram

7. TEST DATA

7.1 6 dB Bandwidth / Occupied Bandwidth

FCC §15.247(a)(2)
RSS-247 (5.2)(a), RSS-Gen (6.7)

Test Mode : Set to Lowest channel, Middle channel and Highest channel

Result

- 6 dB Bandwidth

Mode	Channel No.	Frequency (MHz)	6 dB Bandwidth (MHz)	Minimum Bandwidth Limit (kHz)
802.11b	1	2 412	8.43	500
	6	2 437	7.91	500
	11	2 462	8.43	500
802.11g	1	2 412	16.44	500
	6	2 437	16.46	500
	11	2 462	16.41	500
802.11n(20M)	1	2 412	17.68	500
	6	2 437	17.67	500
	11	2 462	17.68	500
802.11n(40M)	3	2 422	36.46	500
	6	2 437	36.45	500
	9	2 452	36.44	500

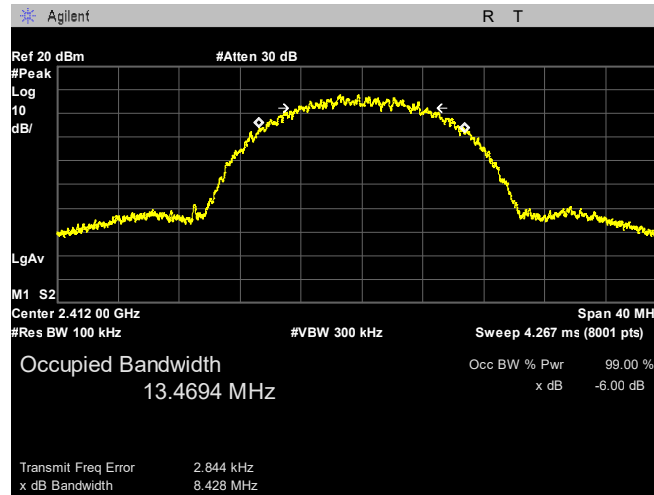
- Occupied Bandwidth

Mode	Channel No.	Frequency (MHz)	Occupied Bandwidth (MHz)	Limit (MHz)
802.11b	1	2 412	13.47	-
	6	2 437	13.47	-
	11	2 462	13.48	-
802.11g	1	2 412	16.37	-
	6	2 437	16.38	-
	11	2 462	16.37	-
802.11n(20M)	1	2 412	17.57	-
	6	2 437	17.57	-
	11	2 462	17.58	-
802.11n(40M)	3	2 422	36.16	-
	6	2 437	36.16	-
	9	2 452	36.16	-

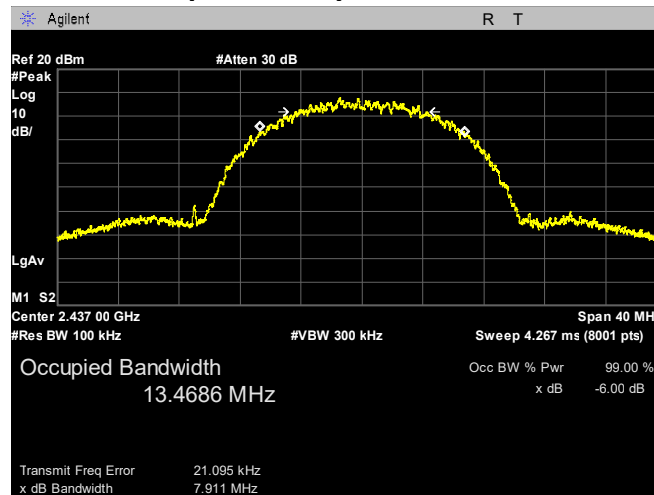
PLOTS OF EMISSIONS

802.11b mode_6dB Bandwidth, Occupied Bandwidth

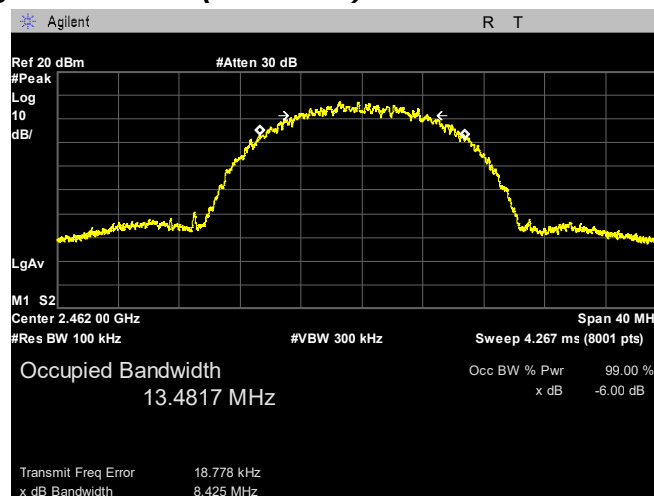
Lowest Channel (2 412 MHz)



Middle Channel (2 437 MHz)

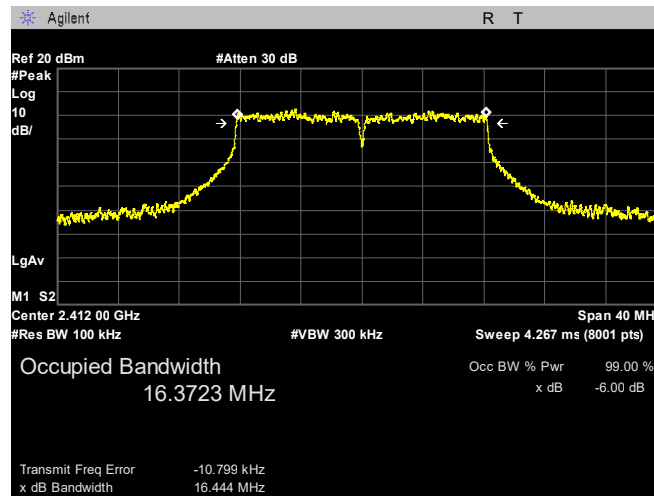


Highest Channel (2 462 MHz)

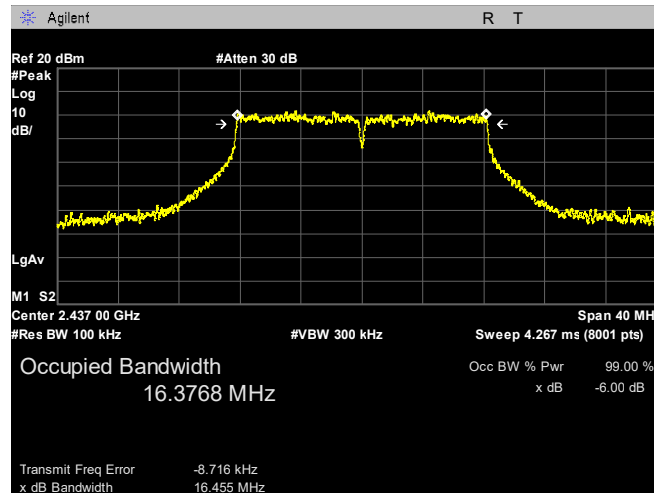


802.11g mode_6dB Bandwidth, Occupied Bandwidth

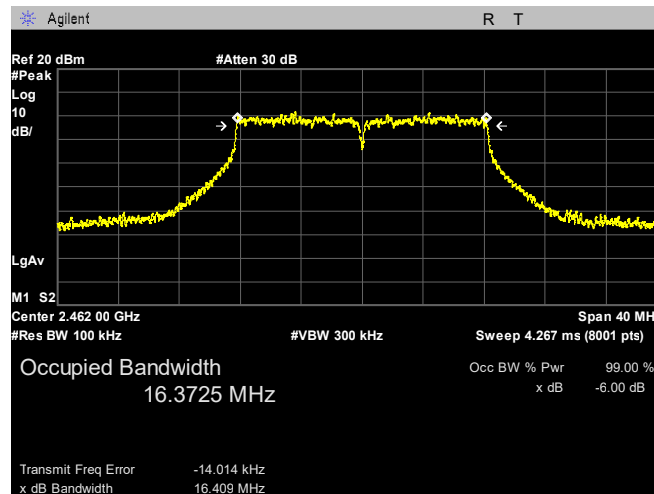
Lowest Channel (2 412 MHz)



Middle Channel (2 437 MHz)

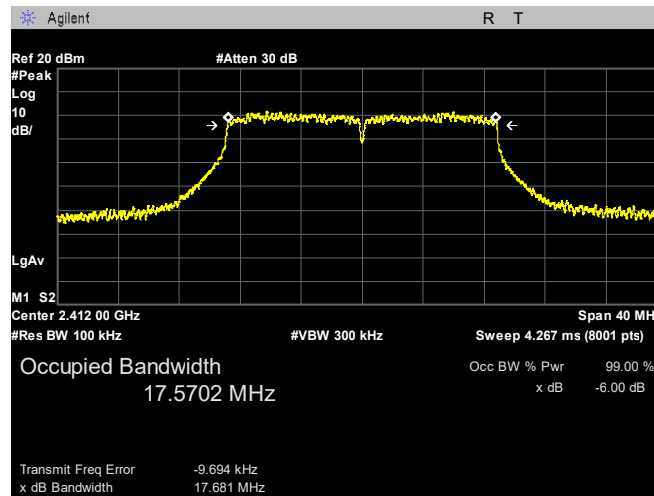


Highest Channel (2 462 MHz)

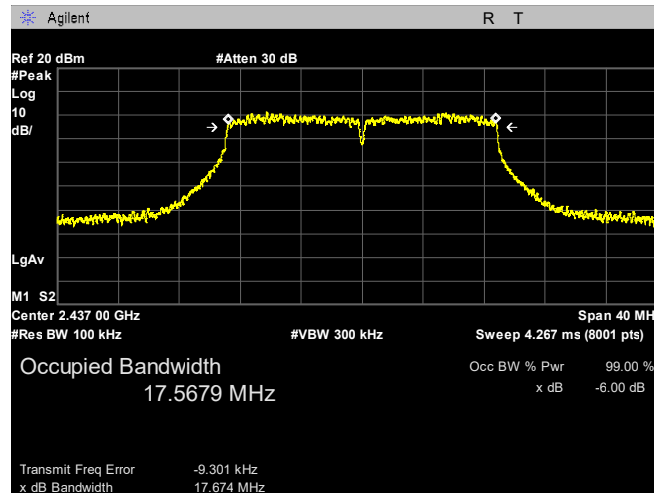


802.11n(20 MHz) mode_6dB Bandwidth, Occupied Bandwidth

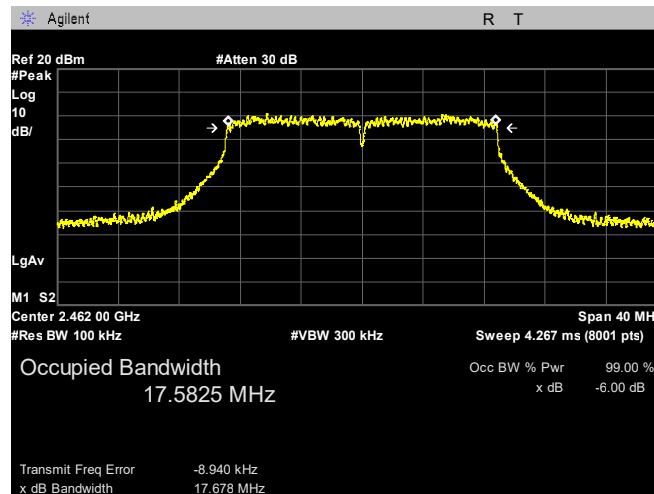
Lowest Channel (2 412 MHz)



Middle Channel (2 437 MHz)

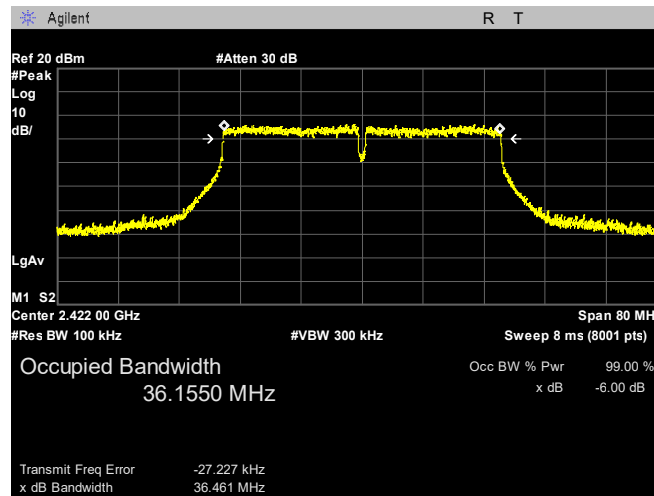


Highest Channel (2 462 MHz)

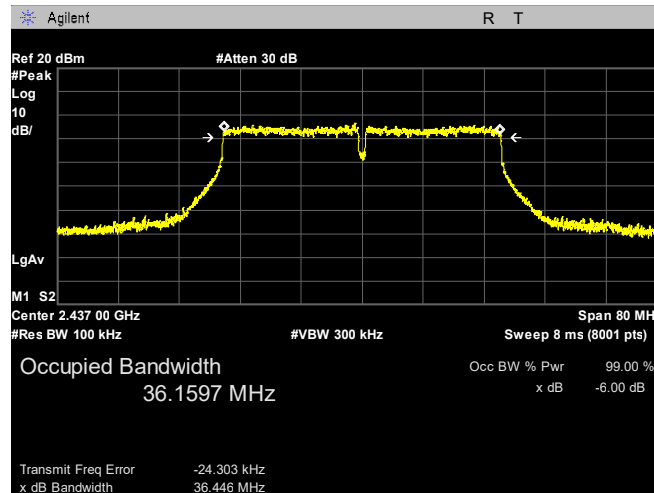


802.11n(40 MHz) mode_6dB Bandwidth, Occupied Bandwidth

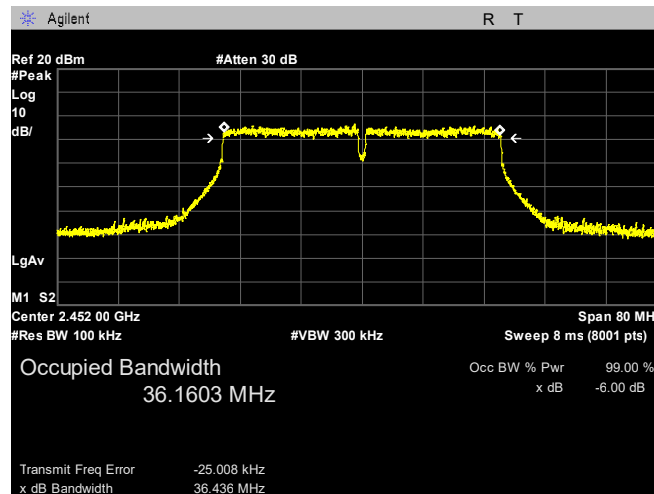
Lowest Channel (2 422 MHz)



Middle Channel (2 437 MHz)



Highest Channel (2 452 MHz)



7.2 Maximum Conducted Output Power(average) and E.I.R.P

FCC §15.247(b)(3)

RSS-247(5.4)(d)

Test Mode : Set to Lowest channel, Middle channel and Highest channel

Result

802.11b mode_1Tx

Ch	Frequency (MHz)	Measured Conducted Power (dBm)	Duty Factor (dB)	*Measured Conducted Power (dBm)	Limit (dBm)	e.i.r.p. (dBm)	Limit (dBm)
		1Tx		Total output power			
1	2 412	16.29	0.25	16.54	30.00	12.94	36.00
6	2 437	16.15	0.25	16.40	30.00	12.80	36.00
11	2 462	15.86	0.25	16.11	30.00	12.51	36.00

802.11g mode_1Tx

Ch	Frequency (MHz)	Measured Conducted Power (dBm)	Duty Factor (dB)	*Measured Conducted Power (dBm)	Limit (dBm)	e.i.r.p. (dBm)	Limit (dBm)
		1Tx		Total output power			
1	2 412	13.53	1.08	14.61	30.00	11.01	36.00
6	2 437	13.34	1.08	14.42	30.00	10.82	36.00
11	2 462	13.08	1.10	14.18	30.00	10.58	36.00

802.11n(20 MHz) mode_1Tx

Ch	Frequency (MHz)	Measured Conducted Power (dBm)	Duty Factor (dB)	*Measured Conducted Power (dBm)	Limit (dBm)	e.i.r.p. (dBm)	Limit (dBm)
		1Tx		Total output power			
1	2 412	13.61	1.06	14.67	30.00	11.07	36.00
6	2 437	13.28	1.06	14.34	30.00	10.74	36.00
11	2 462	13.07	1.08	14.15	30.00	10.55	36.00

802.11n(40 MHz) mode_1Tx

Ch	Frequency (MHz)	Measured Conducted Power (dBm)	Duty Factor (dB)	*Measured Conducted Power (dBm)	Limit (dBm)	e.i.r.p. (dBm)	Limit (dBm)
		1Tx		Total output power			
3	2 422	11.36	1.68	13.04	30.00	9.44	36.00
6	2 437	11.33	1.68	13.01	30.00	9.41	36.00
9	2 452	11.14	1.68	12.82	30.00	9.22	36.00

802.11n(20 MHz) mode_2Tx

Ch	Frequency (MHz)	Measured Conducted Power (dBm)		Duty Factor (dB)	*Measured Conducted Power (dBm)	Limit (dBm)	e.i.r.p. (dBm)	Limit (dBm)
		Ant 1	Ant 2		Total output power			
1	2 412	11.73	10.44	1.08	15.22	30.00	11.62	36.00
6	2 437	10.99	10.69	1.08	14.93	30.00	11.33	36.00
11	2 462	10.69	10.10	1.08	14.52	30.00	10.92	36.00

802.11n(40 MHz) mode_2Tx

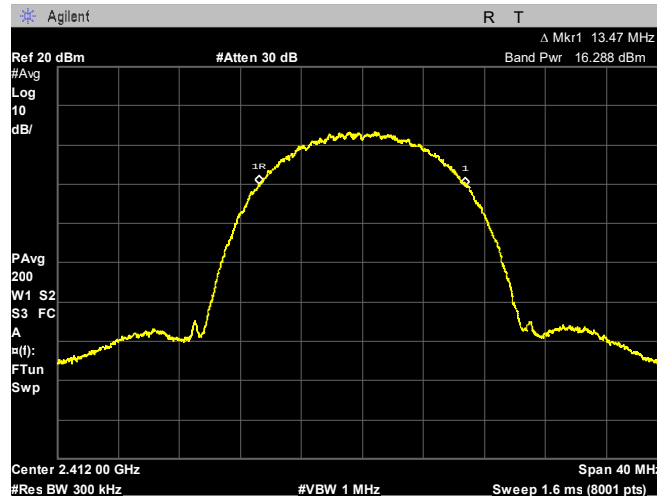
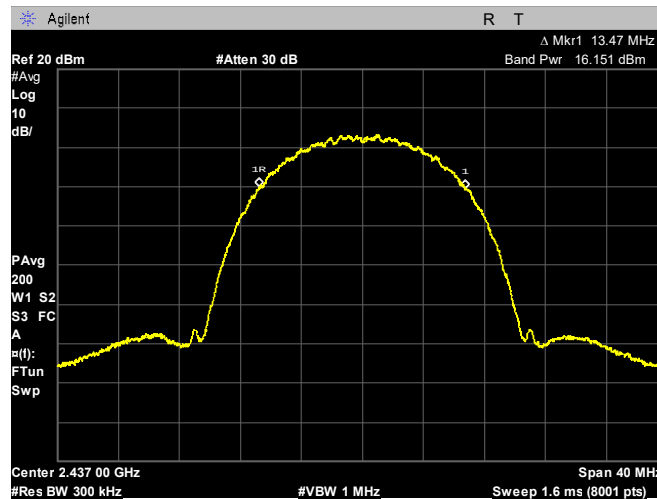
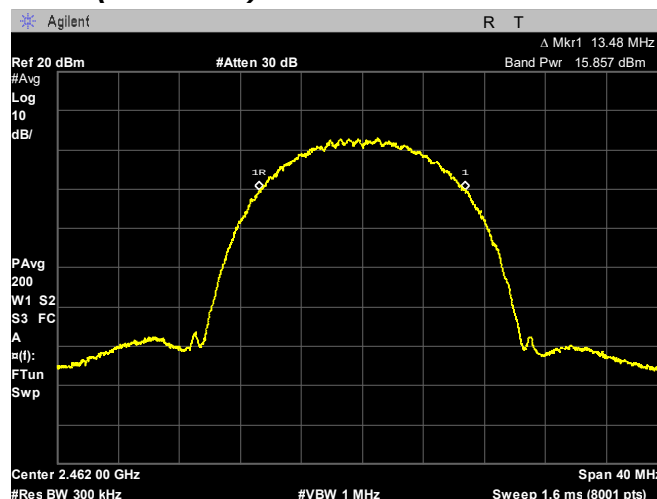
Ch	Frequency (MHz)	Measured Conducted Power (dBm)		Duty Factor (dB)	*Measured Conducted Power (dBm)	Limit (dBm)	e.i.r.p. (dBm)	Limit (dBm)
		Ant 1	Ant 2		Total output power			
3	2 422	9.15	7.94	1.68	13.28	30.00	9.68	36.00
6	2 437	8.73	7.81	1.68	12.99	30.00	9.39	36.00
9	2 452	8.34	8.26	1.68	12.99	30.00	9.39	36.00

Notes:

1. *Maximum Conducted(average) Power = Measured conducted power + Duty Factor
2. The following equation was used for spectrum offset :
Spectrum offset (dB) = Attenuator (dB) + Cable Loss (dB) + SMA Type Connector Loss (dB)

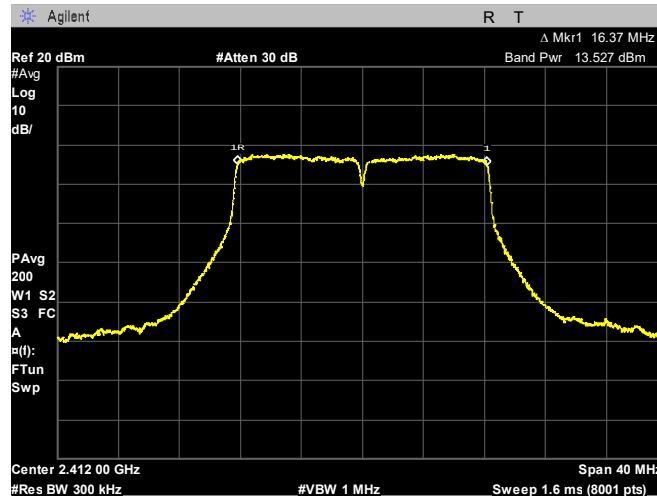
PLOTS OF EMISSIONS

802.11b mode 1Tx

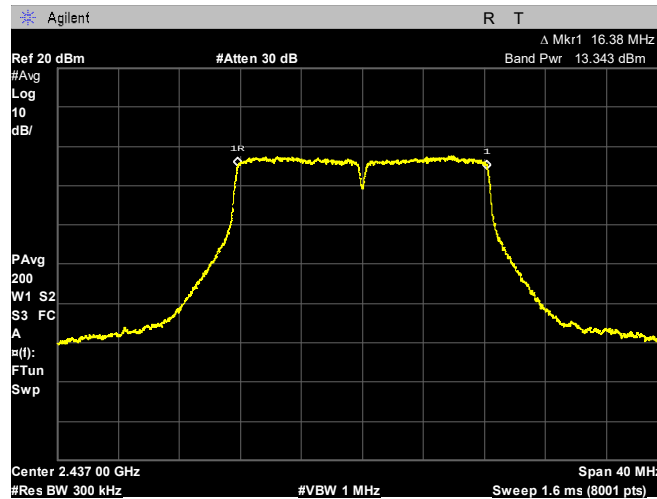
Lowest Channel (2 412 MHz)

Middle Channel (2 437 MHz)

Highest Channel (2 462 MHz)


802.11g mode 1Tx

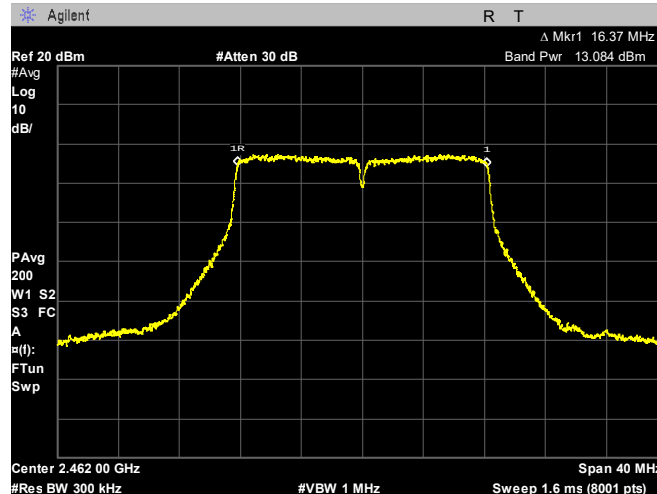
Lowest Channel (2 412 MHz)



Middle Channel (2 437 MHz)

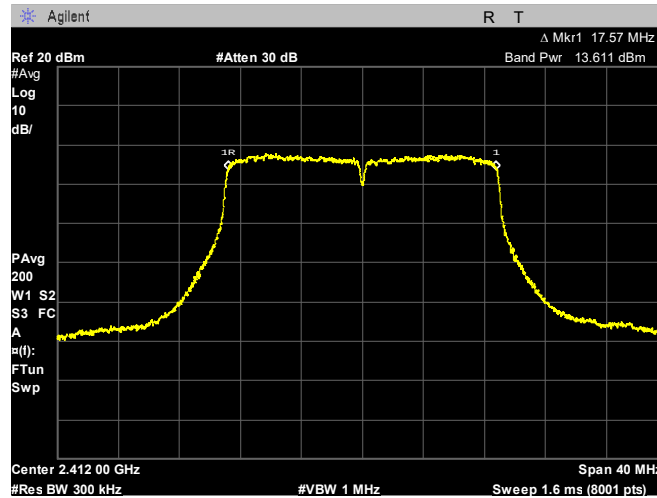


Highest Channel (2 462 MHz)

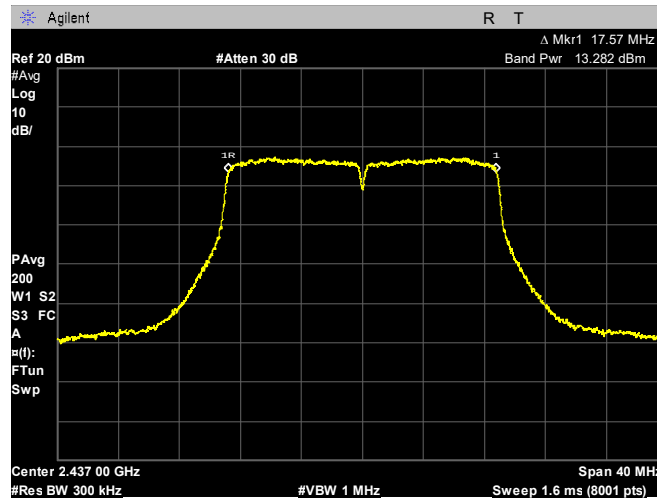


802.11n(20 MHz) mode 1Tx

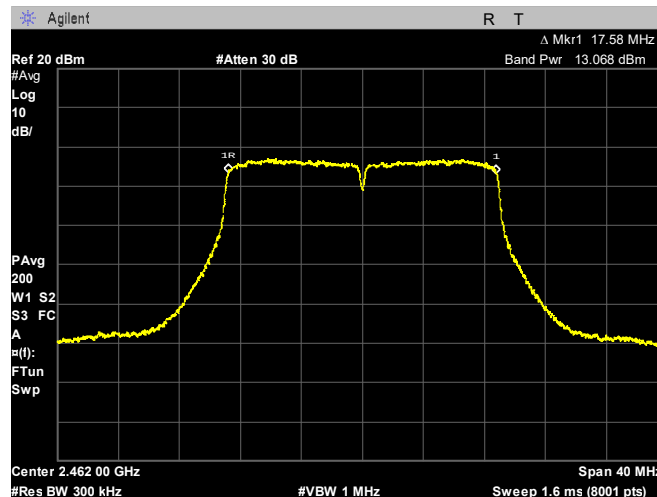
Lowest Channel (2 412 MHz)



Middle Channel (2 437 MHz)

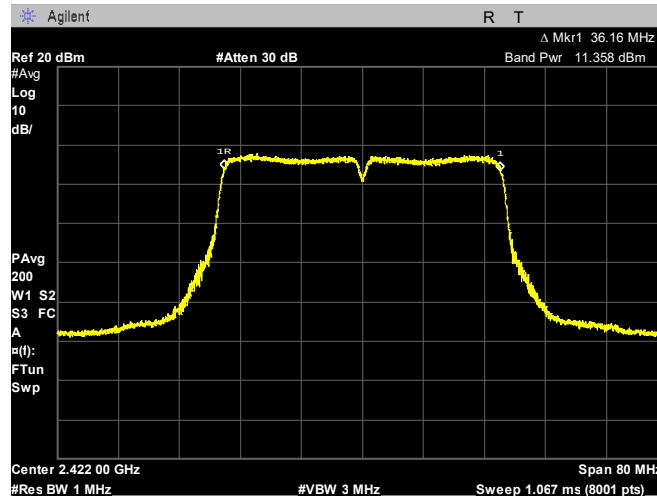


Highest Channel (2 462 MHz)

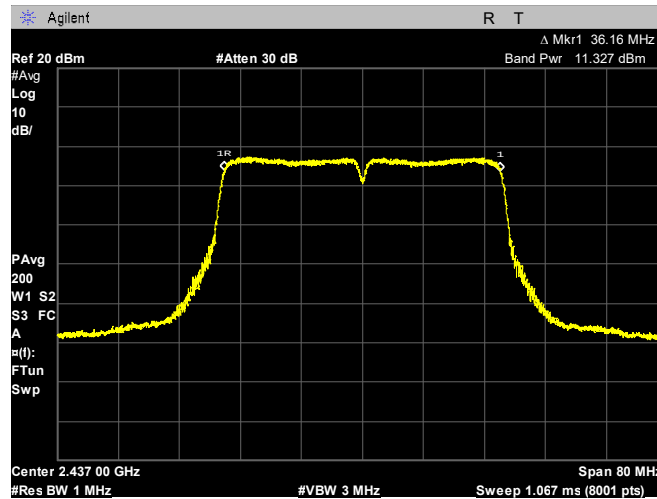


802.11n(40 MHz) mode 1Tx

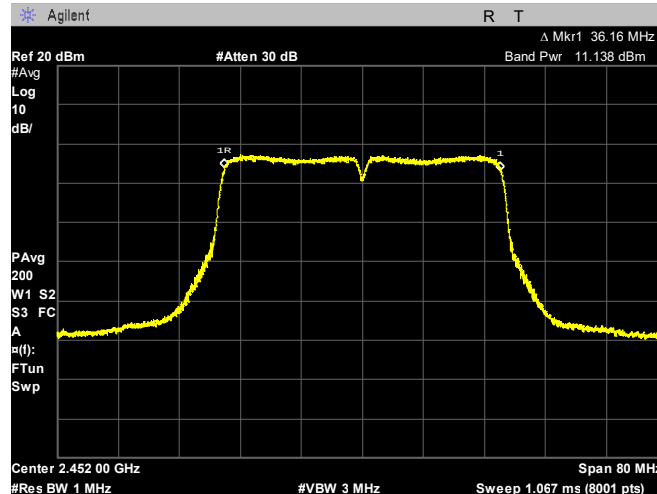
Lowest Channel (2 422 MHz)



Middle Channel (2 437 MHz)

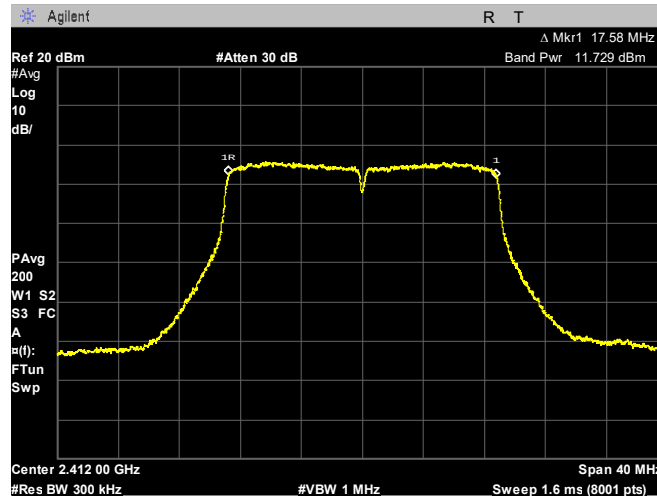


Highest Channel (2 452 MHz)

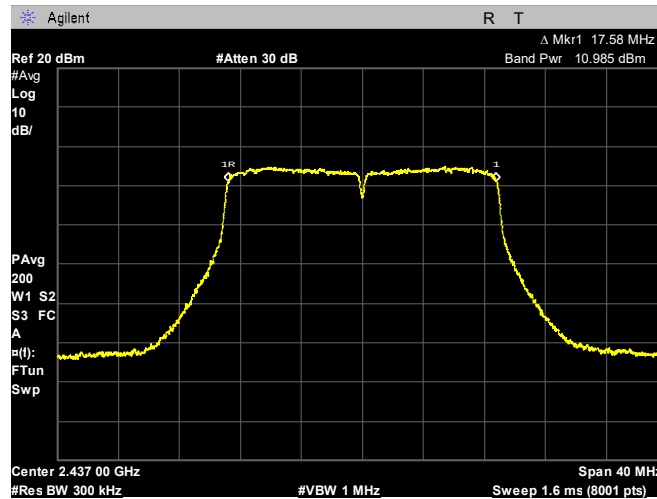


802.11n(20 MHz) mode 2Tx

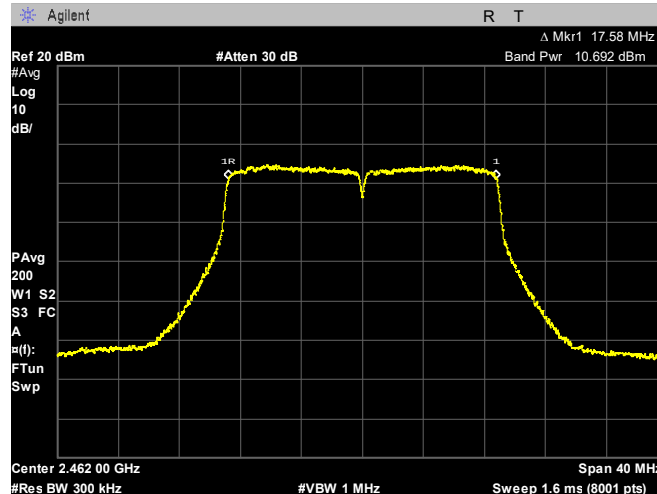
Lowest Channel (2 412 MHz), Chain 0



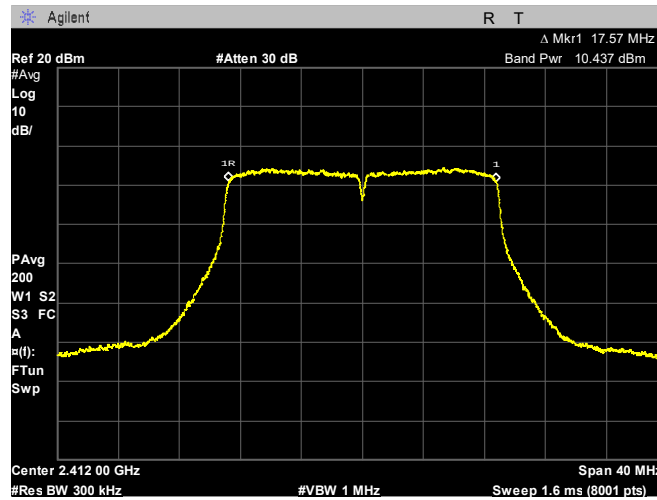
Middle Channel (2 437 MHz), Chain 0



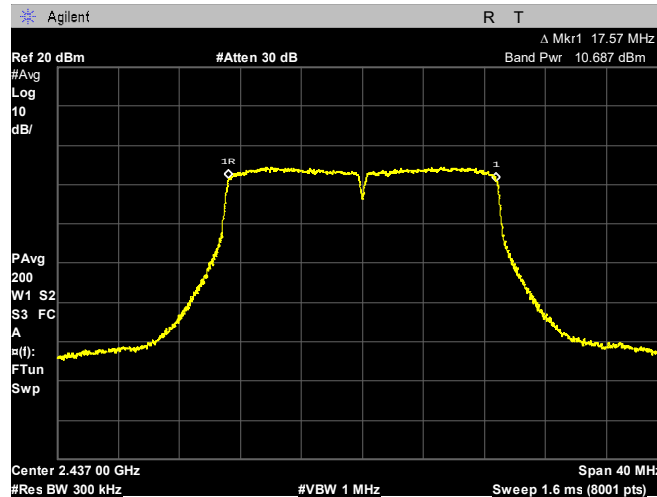
Highest Channel (2 462 MHz), Chain 0



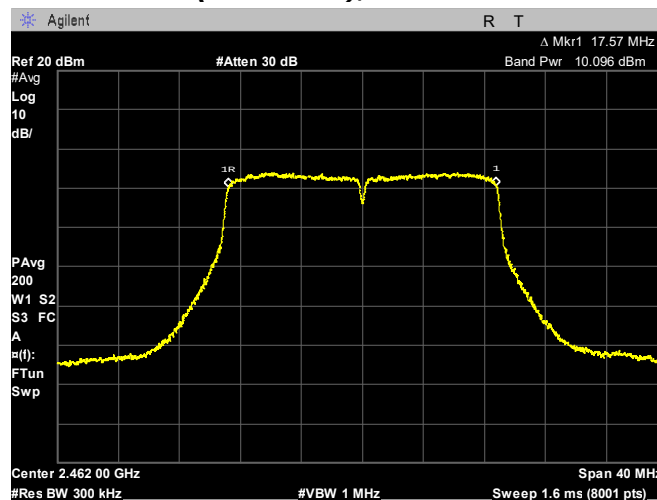
Lowest Channel (2 412 MHz), Chain 1



Middle Channel (2 437 MHz), Chain 1

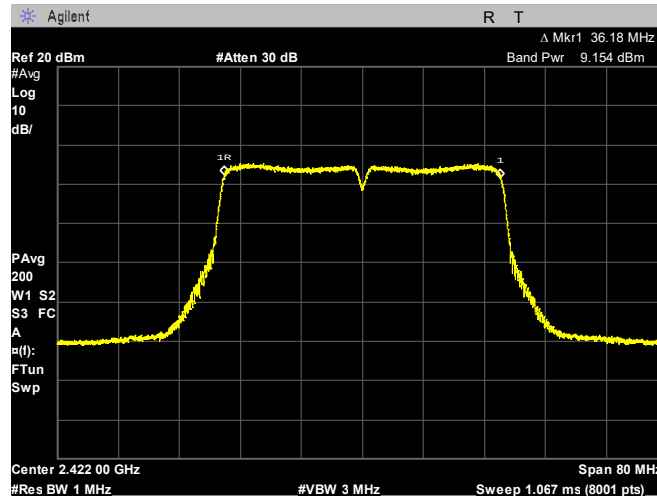


Highest Channel (2 462 MHz), Chain 1

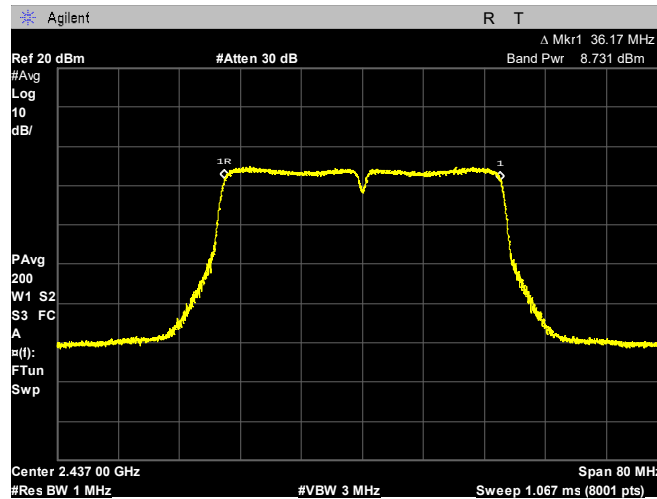


802.11n(40 MHz) mode 2Tx

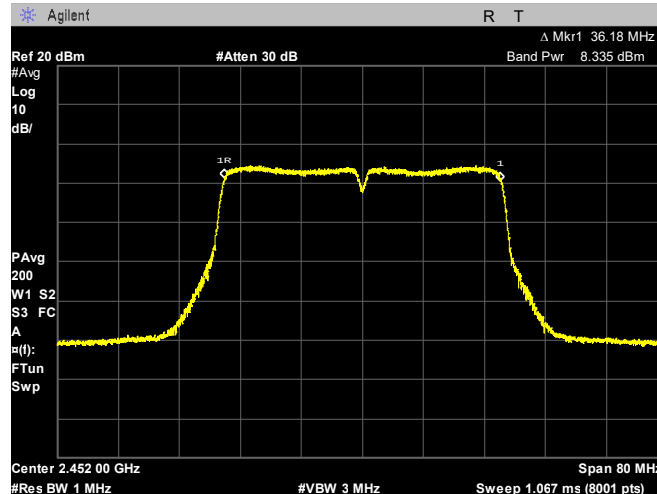
Lowest Channel (2 422 MHz), Chain 0



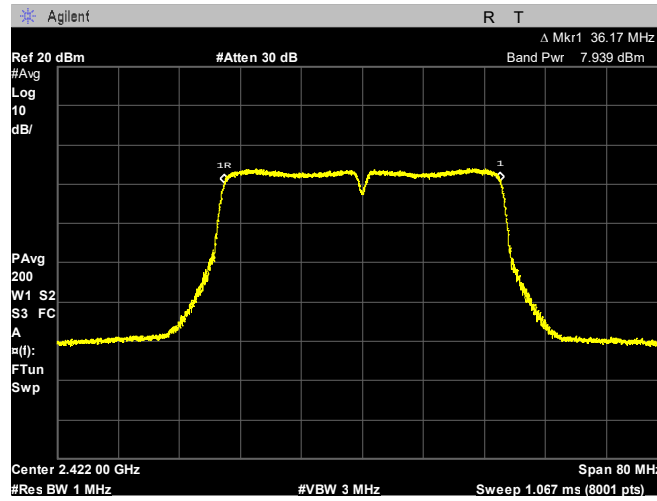
Middle Channel (2 437 MHz), Chain 0



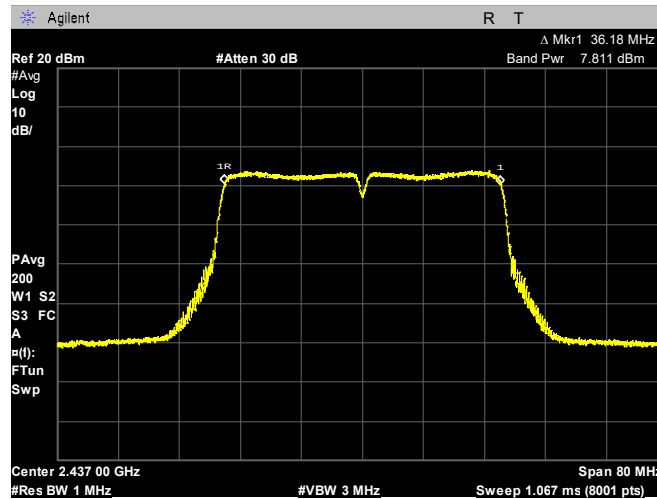
Highest Channel (2 452 MHz), Chain 0



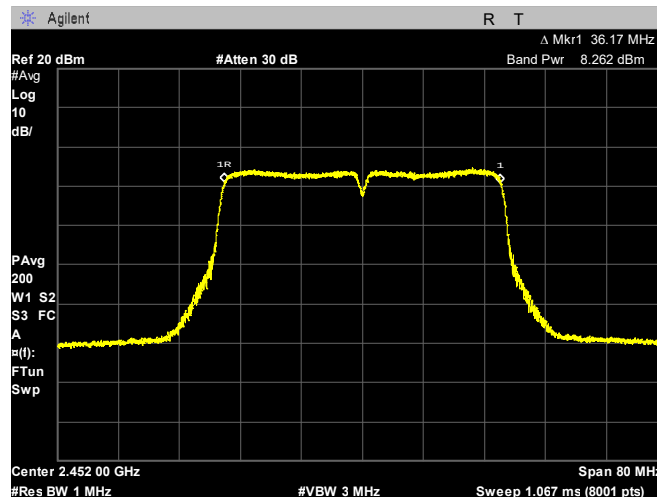
Lowest Channel (2 422 MHz), Chain 1



Middle Channel (2 437 MHz), Chain 1



Highest Channel (2 452 MHz), Chain 1



7.3 Power Spectral Density

FCC §15.247(e)

RSS-247(5.2)(b)

Test Mode : Set to Lowest channel, Middle channel and Highest channel

Result

802.11b mode_1Tx

Ch	Frequency (MHz)	Measured PSD (dBm/100kHz)	Duty Factor (dB)	Maximum PSD (dBm/100kHz)	Limit (dBm/3kHz)
1	2 412	0.33	0.25	0.58	8.00
6	2 437	-0.08	0.25	0.17	8.00
11	2 462	-0.49	0.25	-0.24	8.00

802.11g mode_1Tx

Ch	Frequency (MHz)	Measured PSD (dBm/100kHz)	Duty Factor (dB)	Maximum PSD (dBm/100kHz)	Limit (dBm/3kHz)
1	2 412	-5.65	1.08	-4.57	8.00
6	2 437	-6.21	1.08	-5.13	8.00
11	2 462	-6.39	1.08	-5.29	8.00

802.11n(20 MHz) mode_1Tx

Ch	Frequency (MHz)	Measured PSD (dBm/100kHz)	Duty Factor (dB)	Maximum PSD (dBm/100kHz)	Limit (dBm/3kHz)
1	2 412	-5.32	1.06	-4.26	8.00
6	2 437	-5.76	1.06	-4.70	8.00
11	2 462	-6.48	1.08	-5.40	8.00

802.11n(40 MHz) mode_1Tx

Ch	Frequency (MHz)	Measured PSD (dBm/100kHz)	Duty Factor (dB)	Maximum PSD (dBm/100kHz)	Limit (dBm/3kHz)
3	2 422	-11.49	1.68	-9.81	8.00
6	2 437	-11.42	1.68	-9.74	8.00
9	2 452	-11.46	1.68	-9.78	8.00

802.11n(20 MHz) mode_2Tx

Ch	Frequency (MHz)	Measured PSD (dBm/100kHz)	Duty Factor (dB)	Maximum PSD (dBm/100kHz)	Limit (dBm/3kHz)
1	2 412	-3.71	1.08	-2.63	8.00
6	2 437	-5.08	1.08	-4.00	8.00
11	2 462	-5.51	1.10	-4.41	8.00

802.11n(40 MHz) mode_2Tx

Ch	Frequency (MHz)	Measured PSD (dBm/100kHz)	Duty Factor (dB)	Maximum PSD (dBm/100kHz)	Limit (dBm/3kHz)
3	2 422	-10.00	1.68	-8.32	8.00
6	2 437	-10.93	1.68	-9.25	8.00
9	2 452	-11.58	1.68	-9.90	8.00

Notes:

1. The following equation was used for spectrum offset:

Spectrum offset (dB) = Attenuator (dB) + Cable Loss (dB) + SMA Type Connector Loss (dB)

2. "Measure and add $10 \log(N_{ANT})$ dB, where N_{ANT} is the number of outputs" was used for measuring in-band Total PSD.

Total PSD = Measured PSD + duty factor + $10 \log(N_{ANT})$

3. For CDD transmission, directional gain is. **-0.59 dBi**. For MIMO transmission, directional gain is **-3.6 dBi**.

Directional gain was calculated according to KDB662911 D01 Multiple Transmitter Output v02r01.

For PSD measurements on all devices employing CDD, directional gain is as follows,

Directional gain = G_{ANT} + Array Gain = -3.6 dBi + 3.01 dB = -0.59 dBi

Array Gain = $10 \log(N_{ANT}/N_{SS})$ dB = $10 \log(2/1)$ = 3.01 dB.

where N_{SS} = the number of independent spatial streams of data and G_{ANT} is the antenna gain in dBi.

For CDD mode of this device, $N_{SS}=1$.

For PSD measurements on all devices employing MIMO, directional gain is as follows,

Directional gain = G_{ANT} + $10 \log(N_{ANT}/N_{SS})$ dBi = -3.6 dBi + $10 \log(2/2)$ dB = -3.6 dBi.

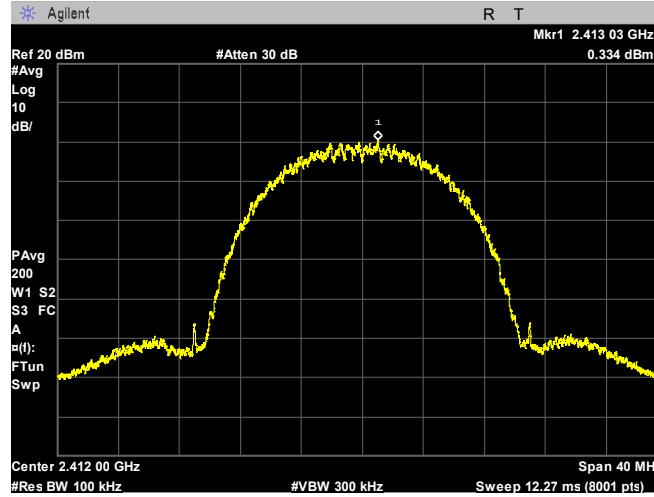
where N_{SS} = the number of independent spatial streams of data and G_{ANT} is the antenna gain in dBi

For this device, MIMO mode means SM-MIMO(Spatial Multiplexing) transmission and $N_{SS}=2$.

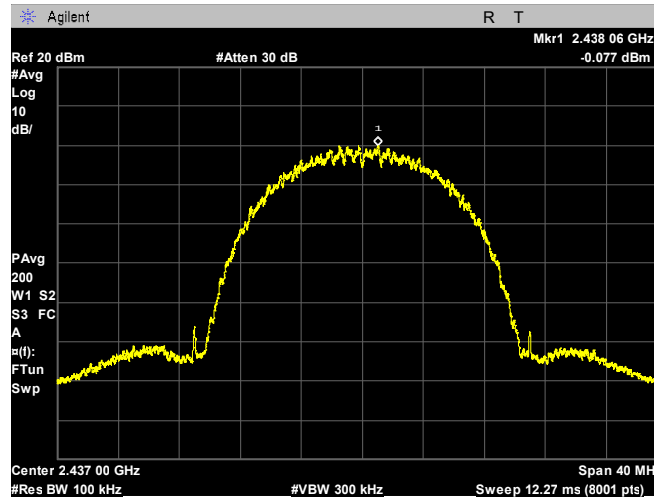
PLOTS OF EMISSIONS

802.11b mode 1Tx

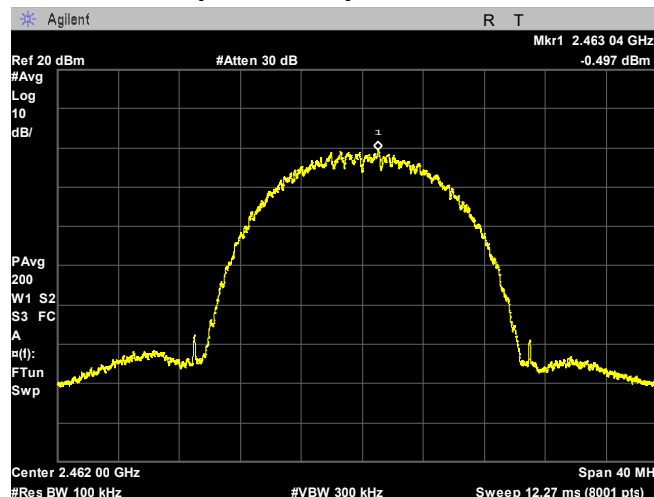
Lowest Channel (2 412 MHz)



Middle Channel (2 437 MHz)

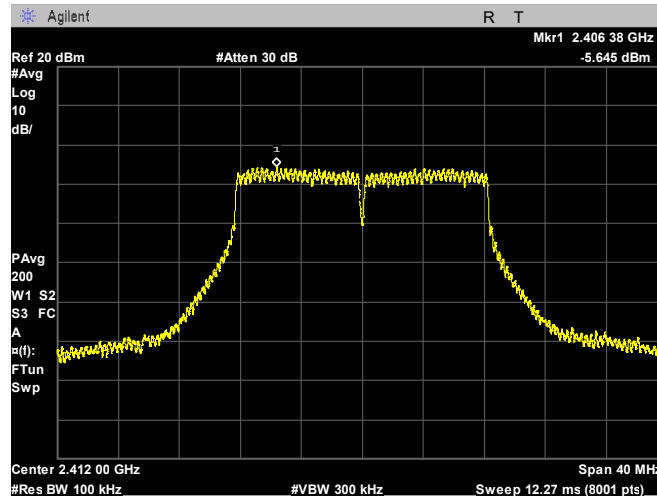


Highest Channel (2 462 MHz)

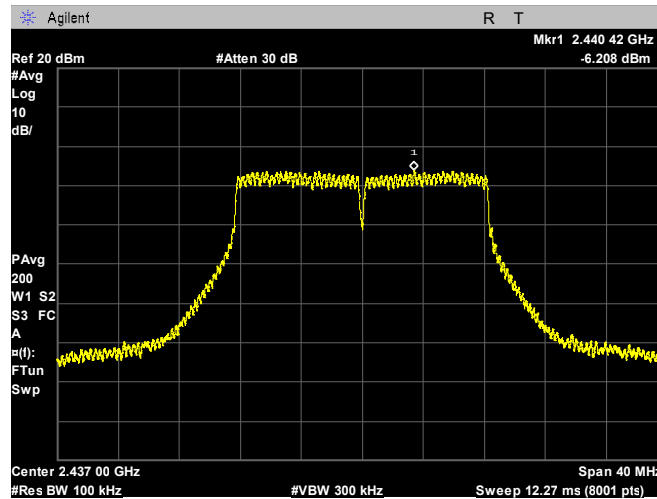


802.11g mode 1Tx

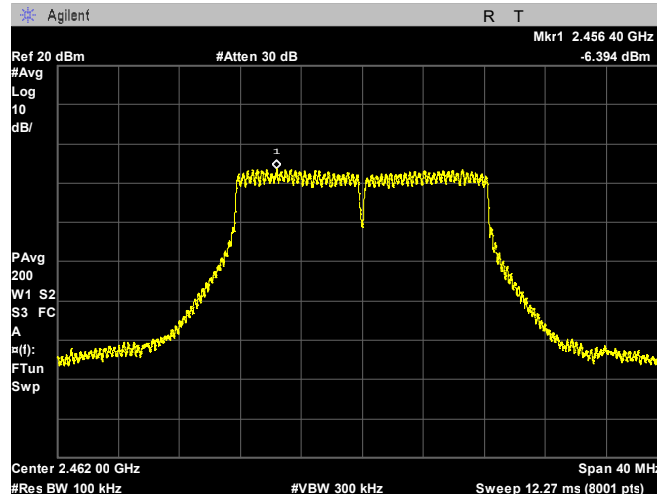
Lowest Channel (2 412 MHz)



Middle Channel (2 437 MHz)

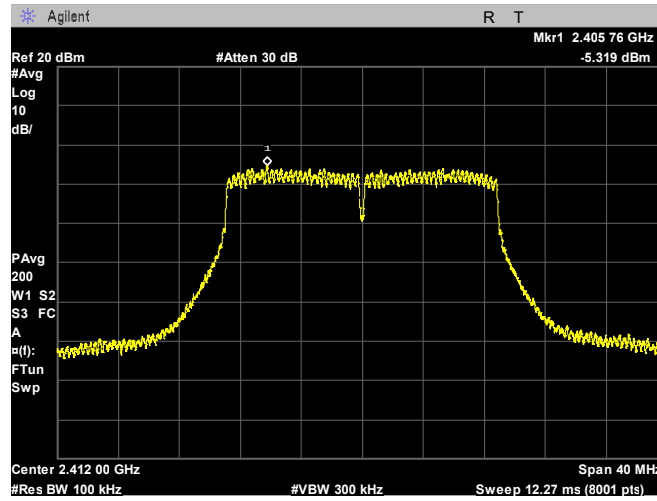


Highest Channel (2 462 MHz)

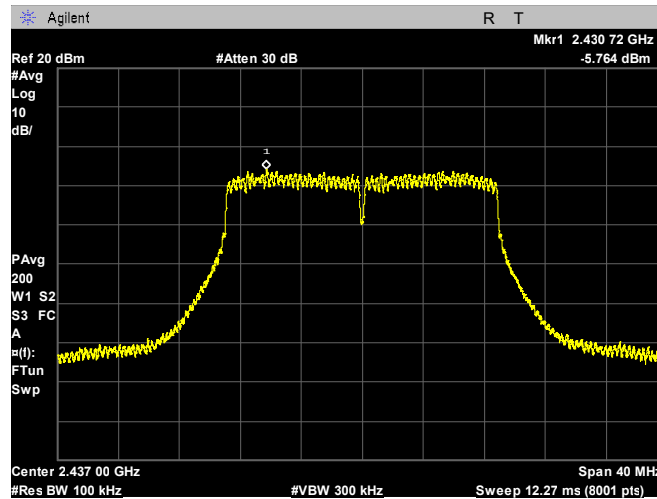


802.11n(20 MHz) mode 1Tx

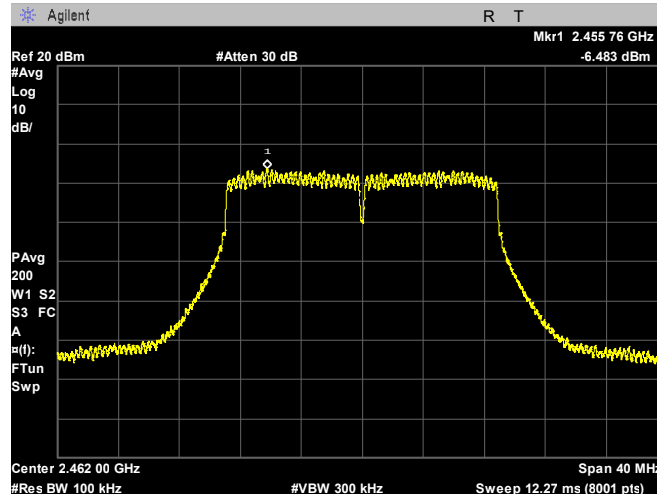
Lowest Channel (2 412 MHz)



Middle Channel (2 437 MHz)

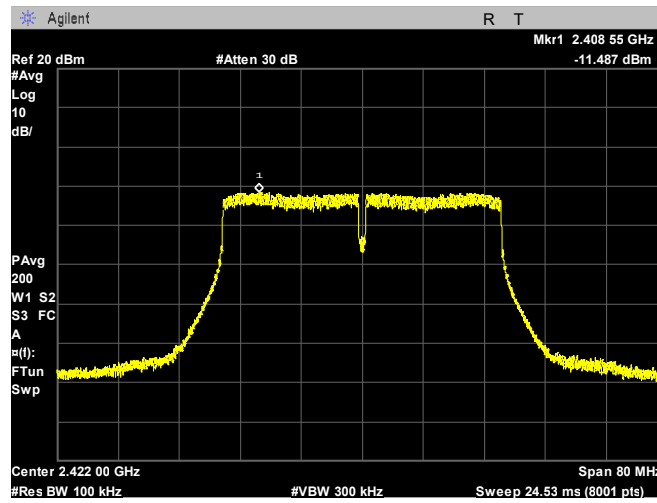


Highest Channel (2 462 MHz)

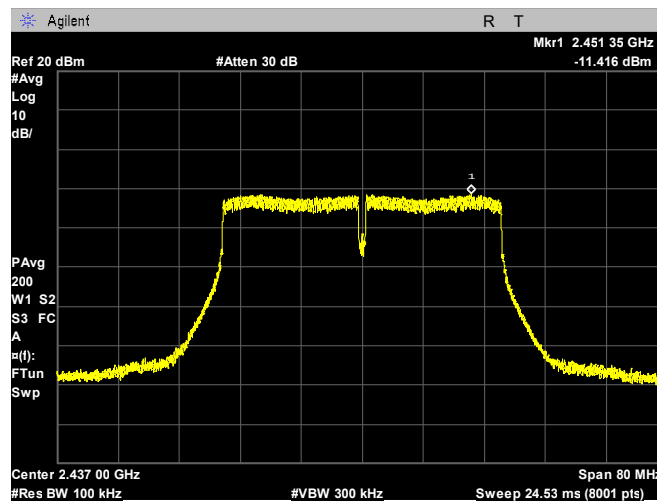


802.11n(40 MHz) mode 1Tx

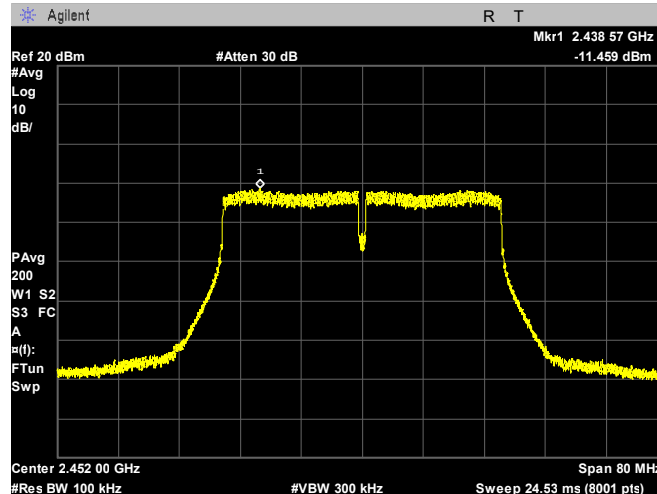
Lowest Channel (2 422 MHz)



Middle Channel (2 437 MHz)

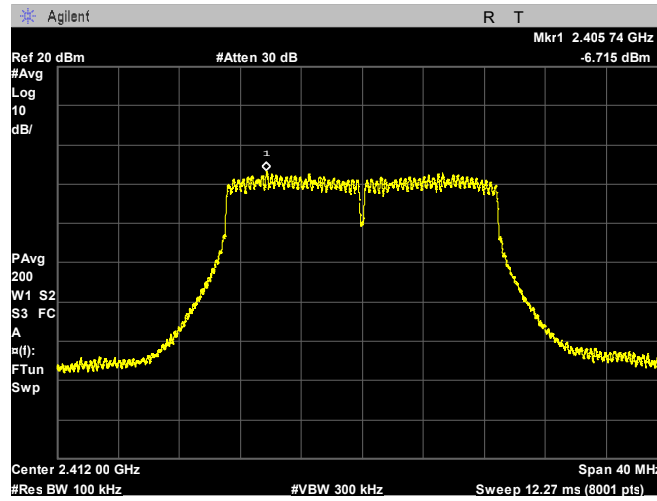


Highest Channel (2 452 MHz)

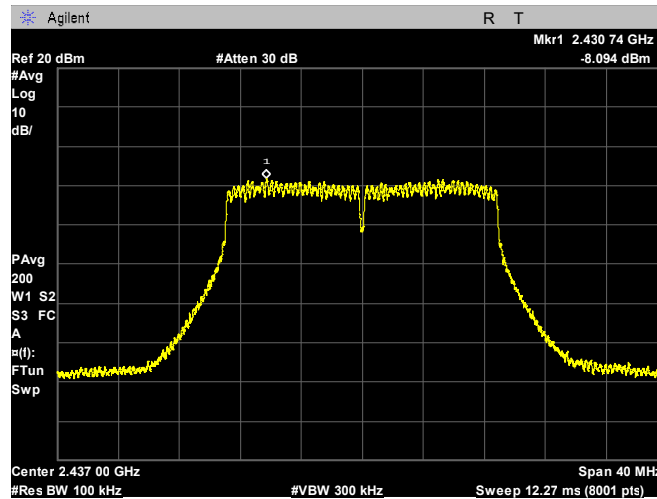


802.11n(20 MHz) mode 2Tx

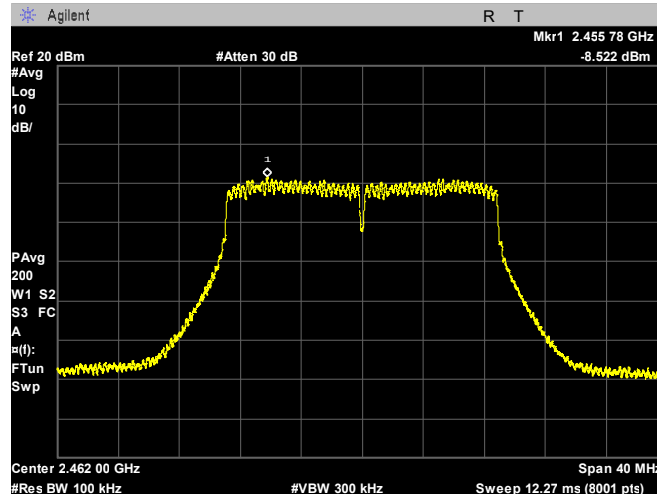
Lowest Channel (2 412 MHz)



Middle Channel (2 437 MHz)

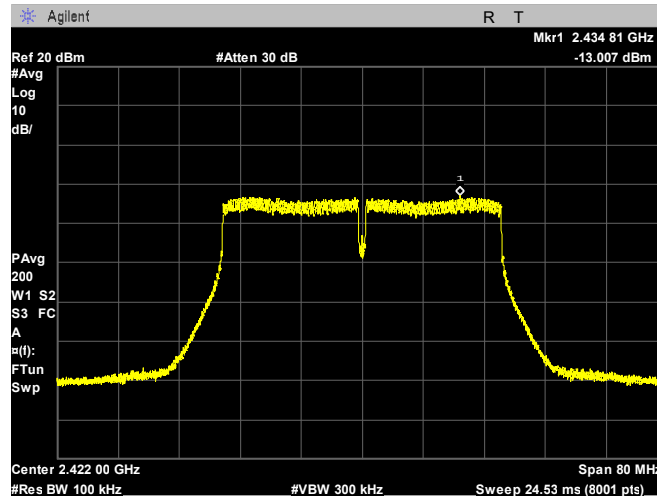


Highest Channel (2 462 MHz)

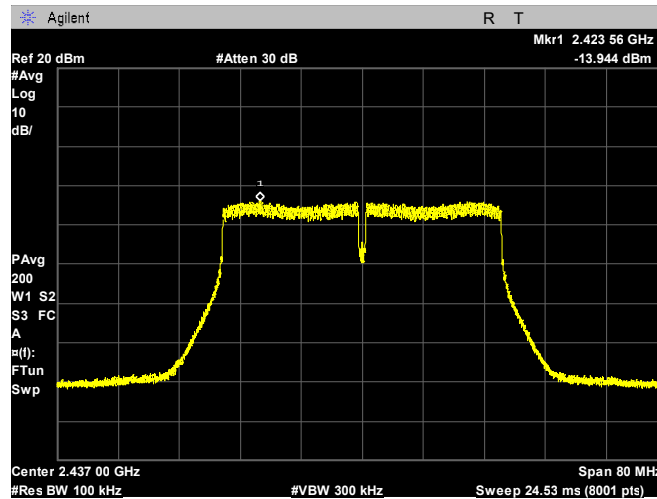


802.11n(40 MHz) mode 2Tx

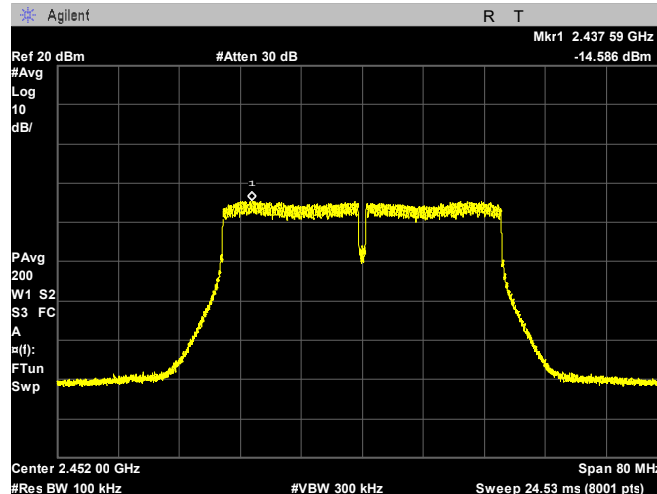
Lowest Channel (2 422 MHz)



Middle Channel (2 437 MHz)



Highest Channel (2 452 MHz)



7.4 Band Edge / Conducted Spurious Emissions

FCC §15.247(d)
RSS-247(5.5)

Test Mode : Set to Lowest channel, Middle channel and Highest channel

Result

802.11b mode_1Tx

Channel	Frequency (MHz)	Reference Level (dBm/100kHz)	Conducted Spurious Emissions (dBc)	Limit (dBc)
1	2 412	7.62	More than 30 dBc	30
6	2 437	7.37	More than 30 dBc	30
11	2 462	7.04	More than 30 dBc	30

802.11g mode_1Tx

Channel	Frequency (MHz)	Reference Level (dBm/100kHz)	Conducted Spurious Emissions (dBc)	Limit (dBc)
1	2 412	2.38	More than 30 dBc	30
6	2 437	1.90	More than 30 dBc	30
11	2 462	1.59	More than 30 dBc	30

802.11n(20 MHz) mode_1Tx

Channel	Frequency (MHz)	Reference Level (dBm/100kHz)	Conducted Spurious Emissions (dBc)	Limit (dBc)
1	2 412	2.09	More than 30 dBc	30
6	2 437	1.19	More than 30 dBc	30
11	2 462	1.04	More than 30 dBc	30

802.11n(40 MHz) mode_1Tx

Channel	Frequency (MHz)	Reference Level (dBm/100kHz)	Conducted Spurious Emissions (dBc)	Limit (dBc)
3	2 422	-3.24	More than 30 dBc	30
6	2 437	-3.32	More than 30 dBc	30
9	2 452	-3.44	More than 30 dBc	30

802.11n(20 MHz) mode_2Tx

Channel	Frequency (MHz)	Reference Level (dBm/100kHz)		Conducted Spurious Emissions (dBc)	Limit (dBc)
		Ant 1	Ant 2		
1	2 412	0.09	-1.46	More than 30 dBc	30
6	2 437	-0.63	-1.02	More than 30 dBc	30
11	2 462	-0.92	-1.96	More than 30 dBc	30

802.11n(40 MHz) mode_2Tx

Channel	Frequency (MHz)	Reference Level (dBm/100kHz)		Conducted Spurious Emissions (dBc)	Limit (dBc)
		Ant 1	Ant 2		
3	2 422	-5.48	-6.72	More than 30 dBc	30
6	2 437	-5.99	-7.07	More than 30 dBc	30
9	2 452	-6.53	-6.47	More than 30 dBc	30

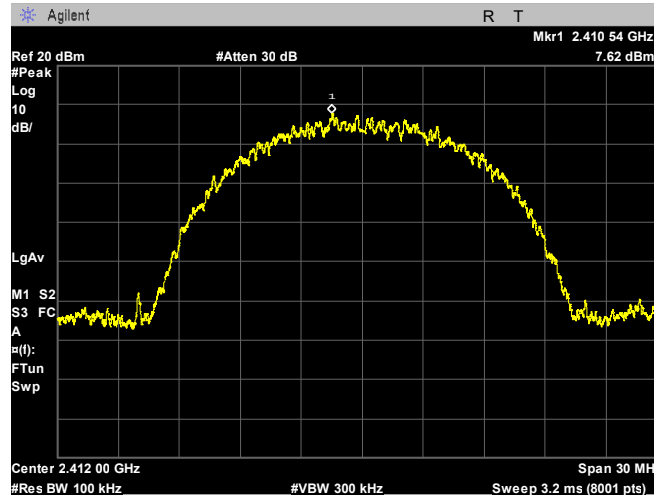
Notes:

The cable and attenuator loss from 30 MHz to 26.5 GHz was reflected in spectrum analyzer with correction factor for the spurious emissions test.

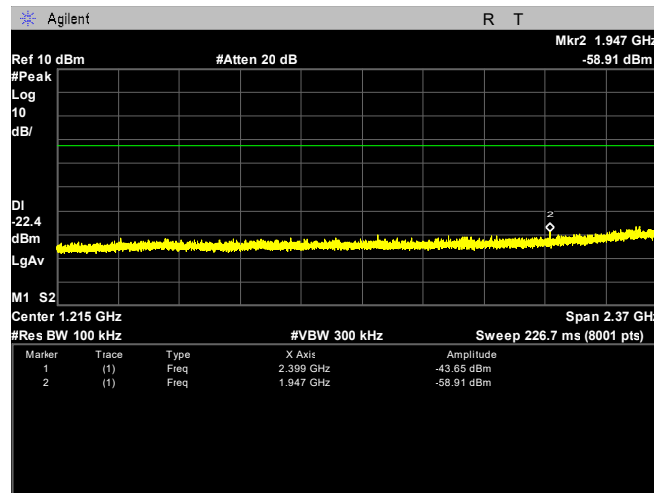
PLOTS OF EMISSIONS

802.11b mode 1Tx

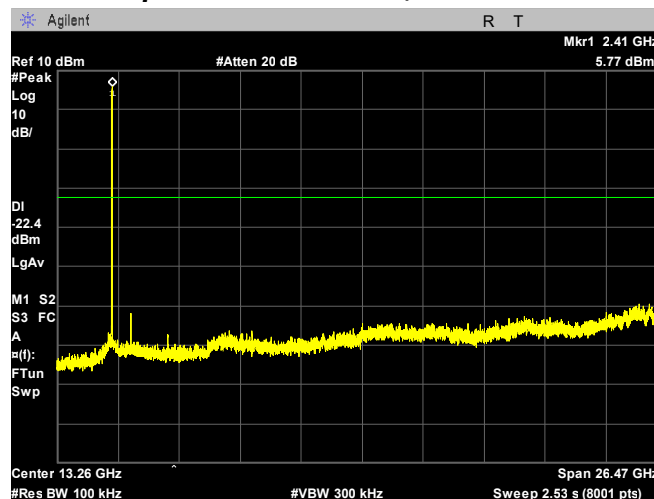
Reference Level, Lowest Channel (2 412 MHz)



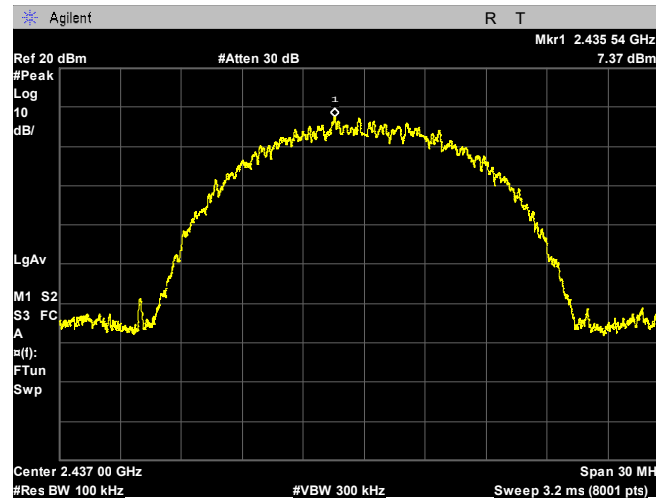
Band Edge, Lowest Channel (2 412 MHz)



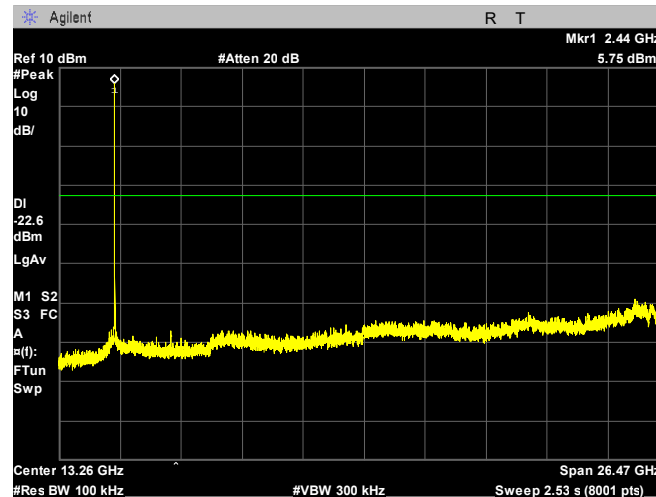
Conducted Spurious Emissions, Lowest Channel (2 412 MHz)



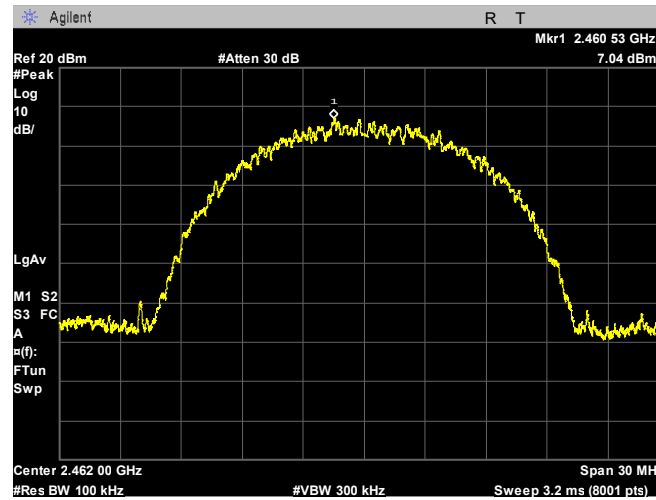
Reference Level, Middle Channel (2 437 MHz)



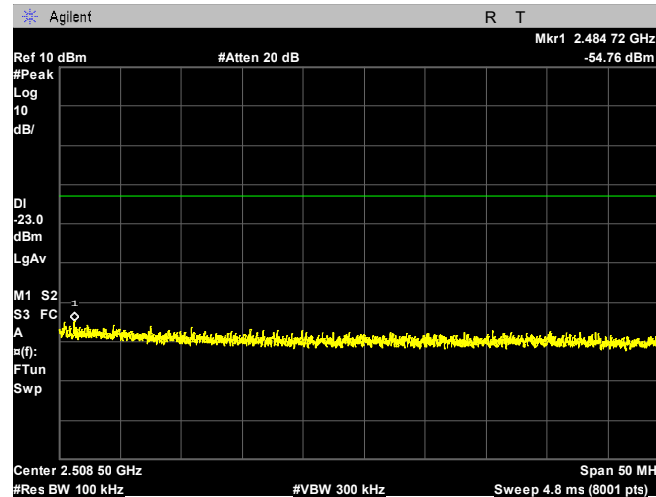
Conducted Spurious Emissions, Middle Channel (2 437 MHz)



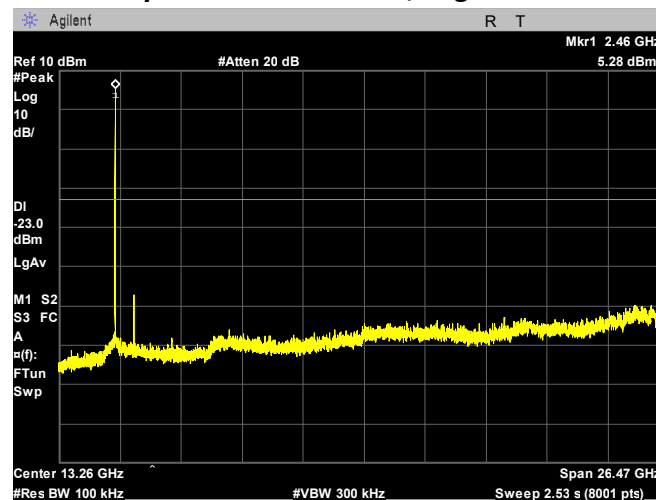
Reference Level, Highest Channel (2 462 MHz)



Band Edge, Highest Channel (2 462 MHz)

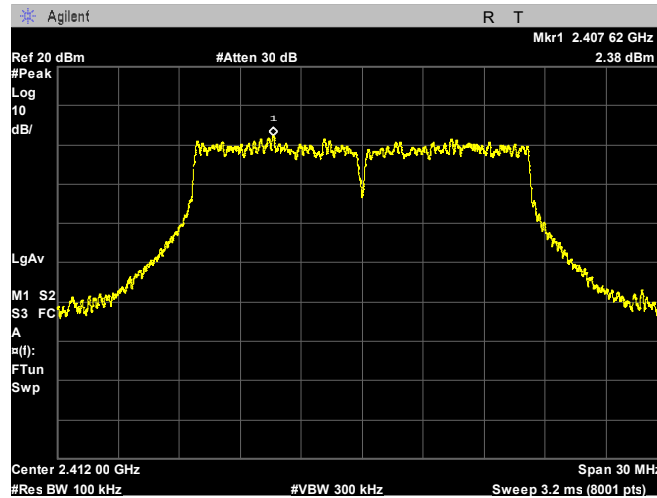


Conducted Spurious Emissions, Highest Channel (2 462 MHz)

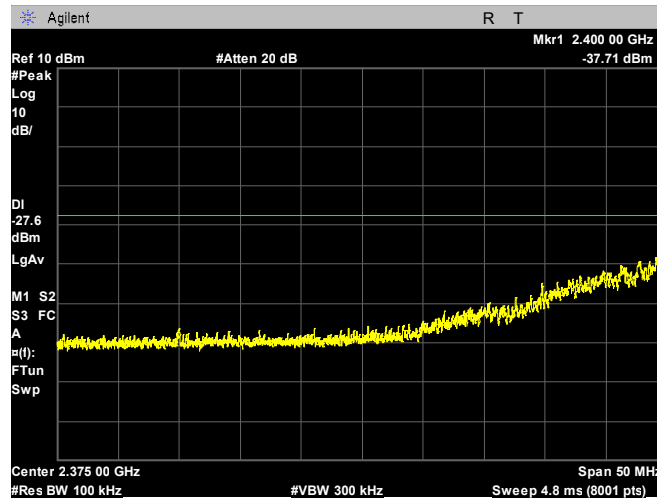


802.11g mode 1Tx

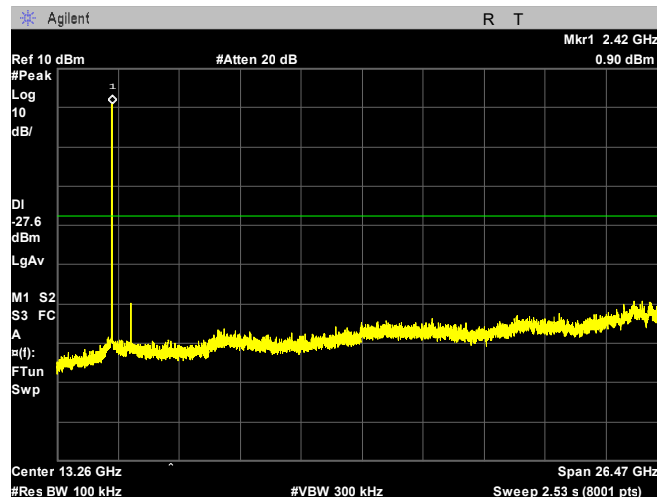
Reference Level, Lowest Channel (2 412 MHz)



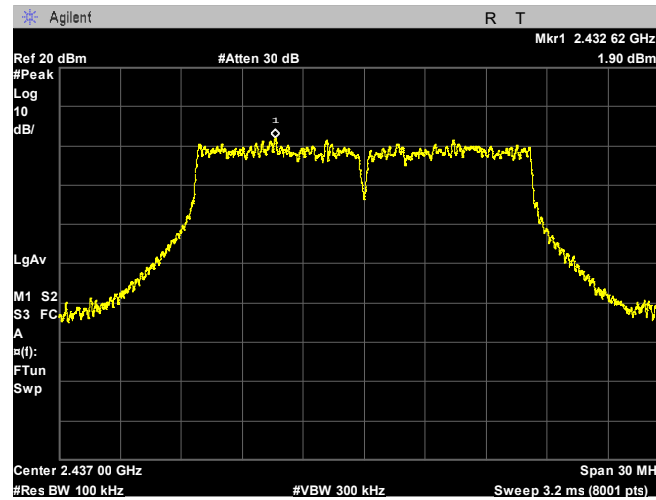
Band Edge, Lowest Channel (2 412 MHz)



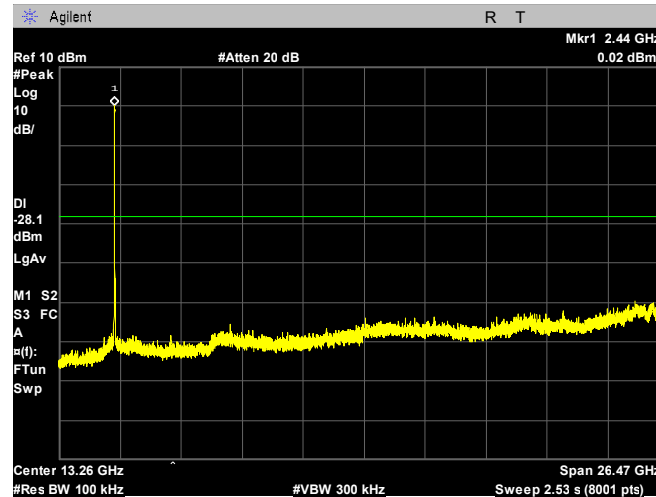
Conducted Spurious Emissions, Lowest Channel (2 412 MHz)



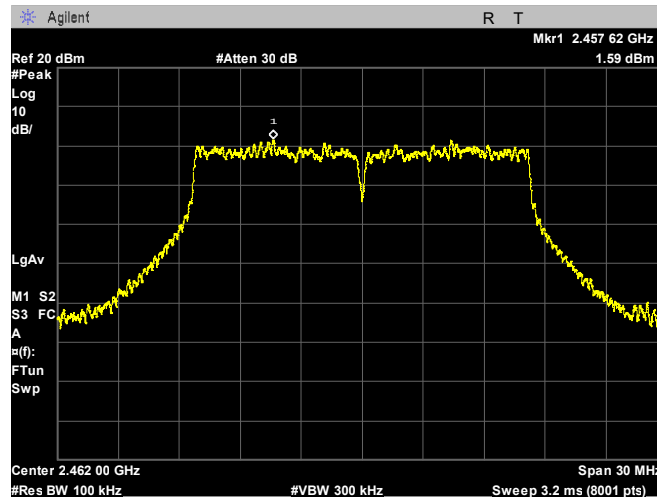
Reference Level, Middle Channel (2 437 MHz)



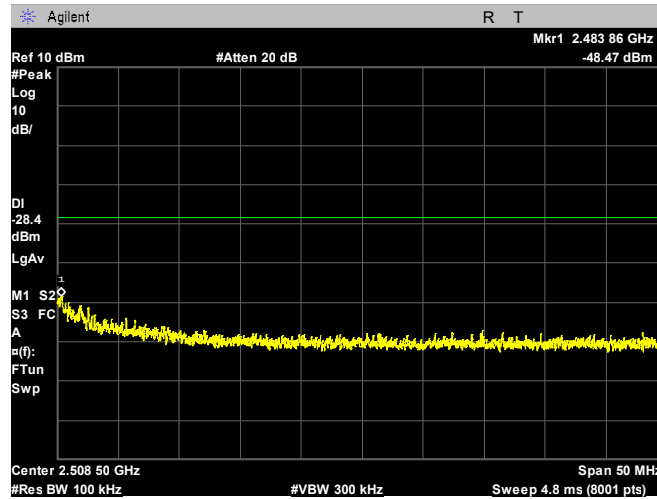
Conducted Spurious Emissions, Middle Channel (2 437 MHz)



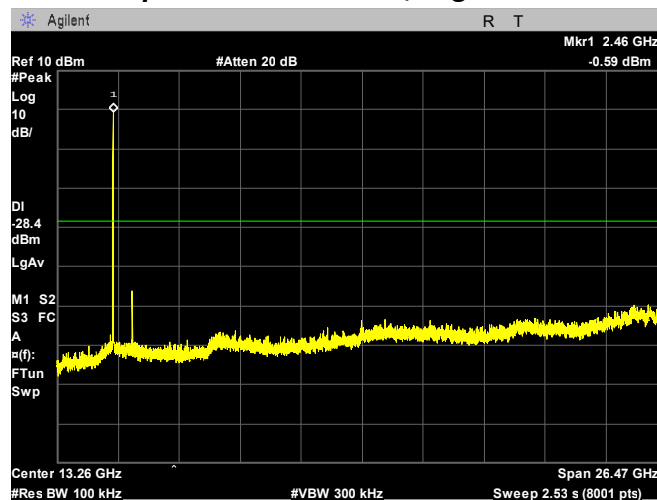
Reference Level, Highest Channel (2 462 MHz)



Band Edge, Highest Channel (2 462 MHz)

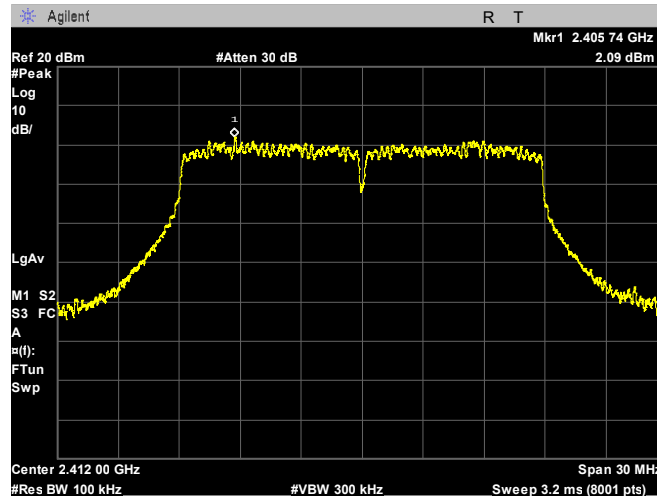


Conducted Spurious Emissions, Highest Channel (2 462 MHz)

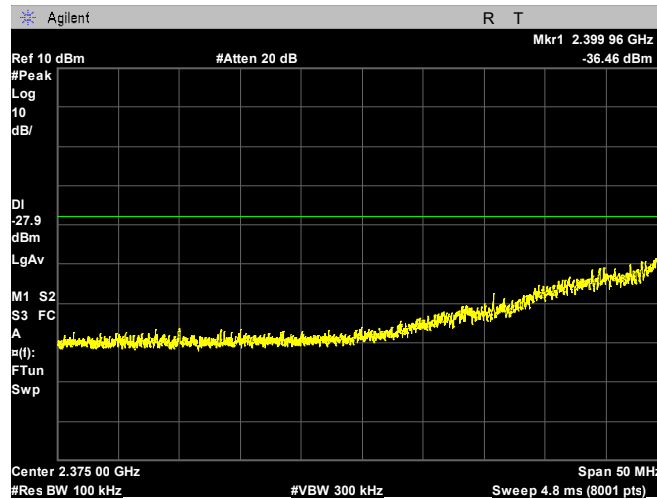


802.11n(20 MHz) mode 1Tx

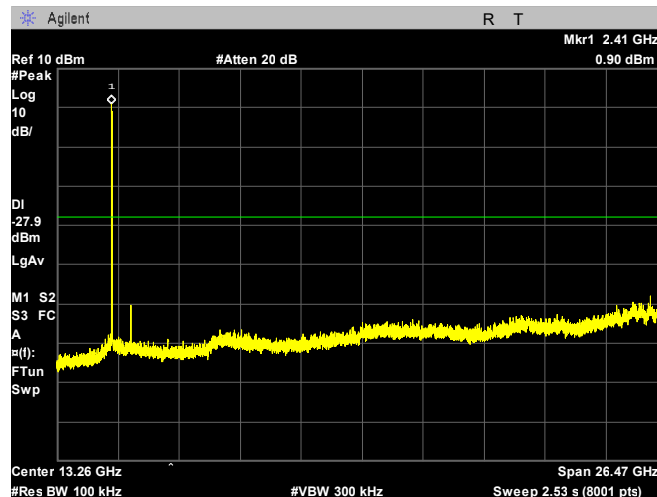
Reference Level, Lowest Channel (2 412 MHz)



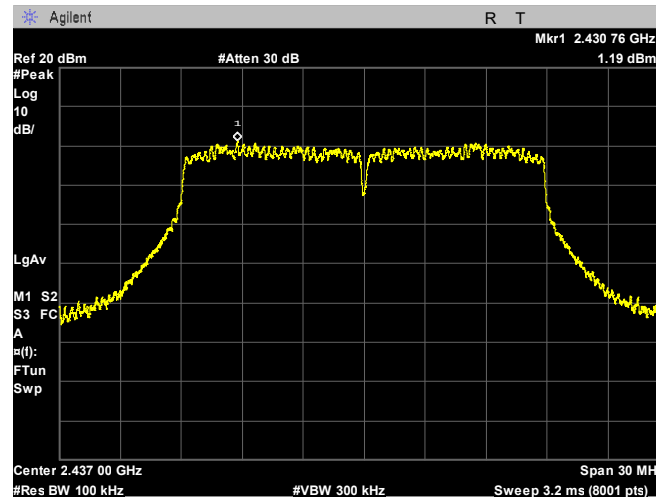
Band Edge, Lowest Channel (2 412 MHz)



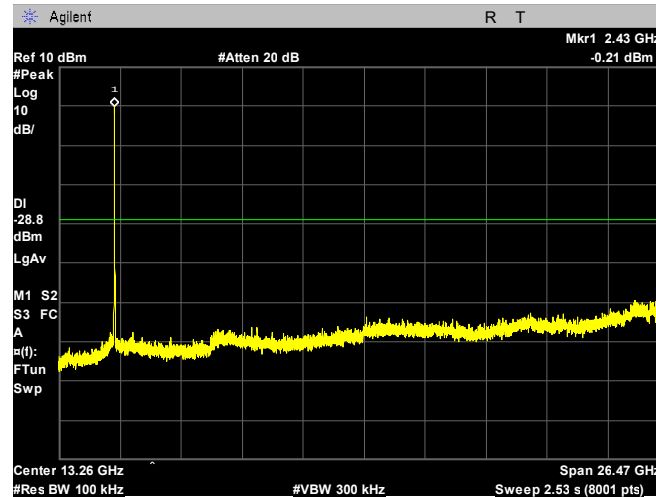
Conducted Spurious Emissions, Lowest Channel (2 412 MHz)



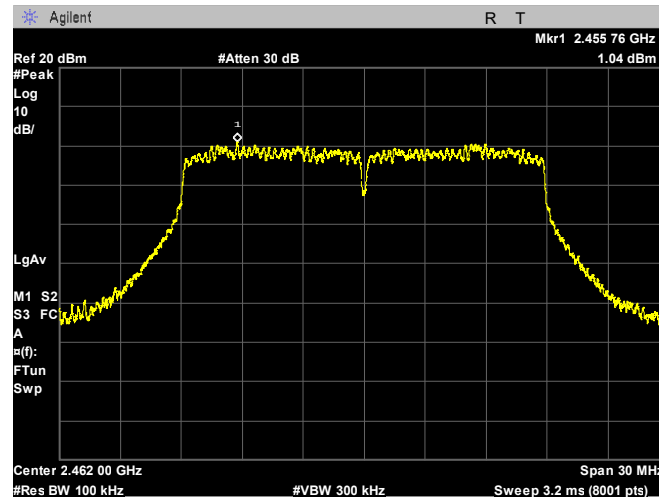
Reference Level, Middle Channel (2 437 MHz)



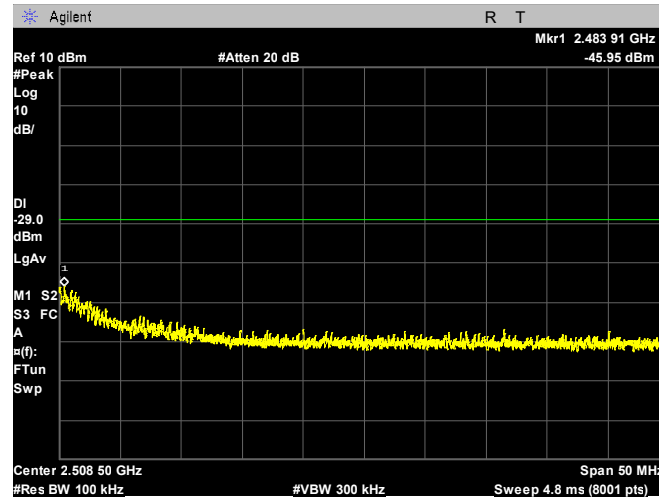
Conducted Spurious Emissions, Middle Channel (2 437 MHz)



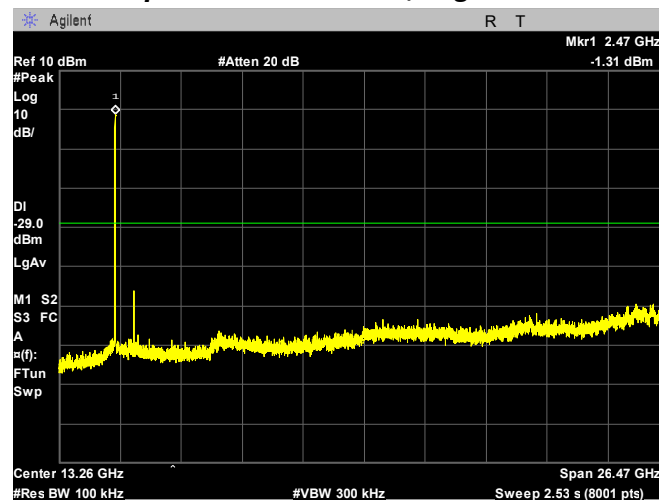
Reference Level, Highest Channel (2 462 MHz)



Band Edge, Highest Channel (2 462 MHz)

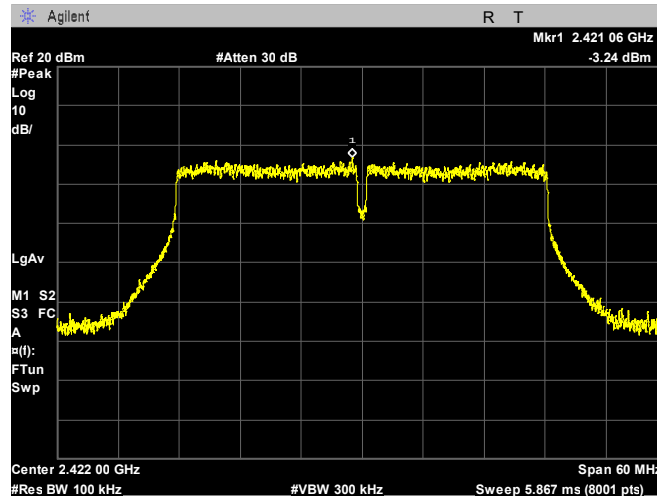


Conducted Spurious Emissions, Highest Channel (2 462 MHz)

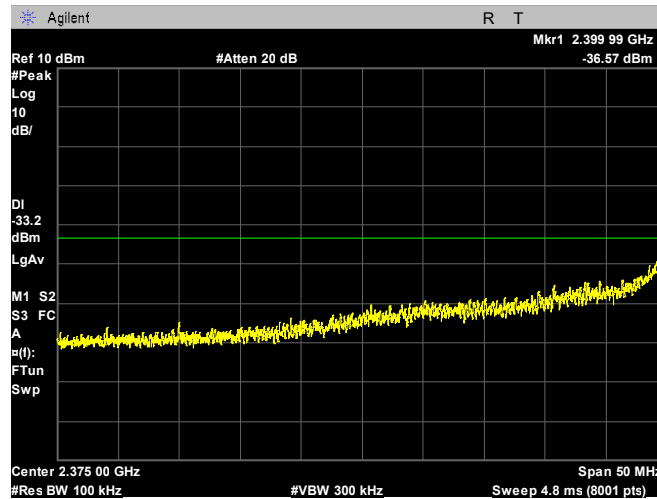


802.11n(40 MHz) mode 1Tx

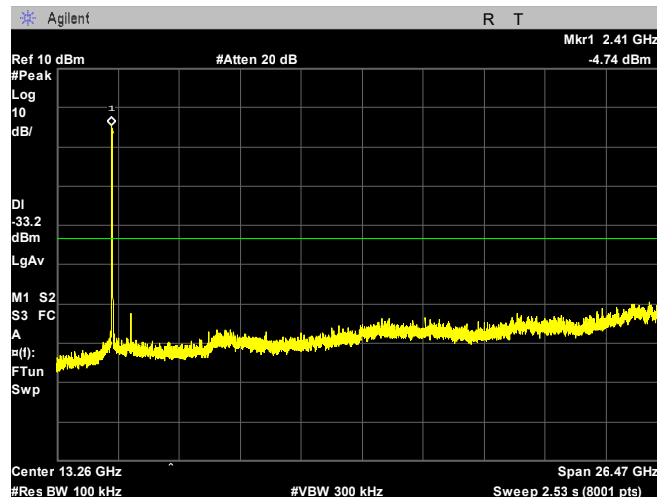
Reference Level, Lowest Channel (2 422 MHz)



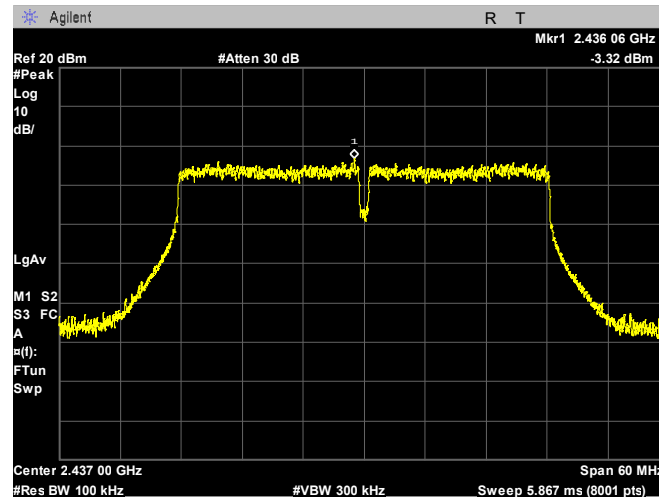
Band Edge, Lowest Channel (2 422 MHz)



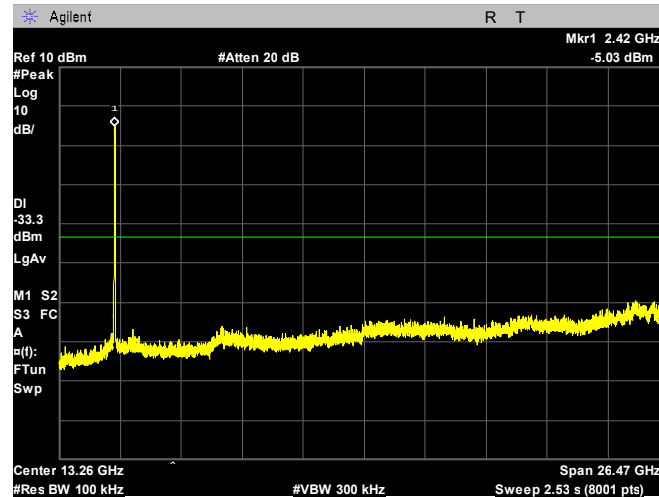
Conducted Spurious Emissions, Lowest Channel (2 422 MHz)



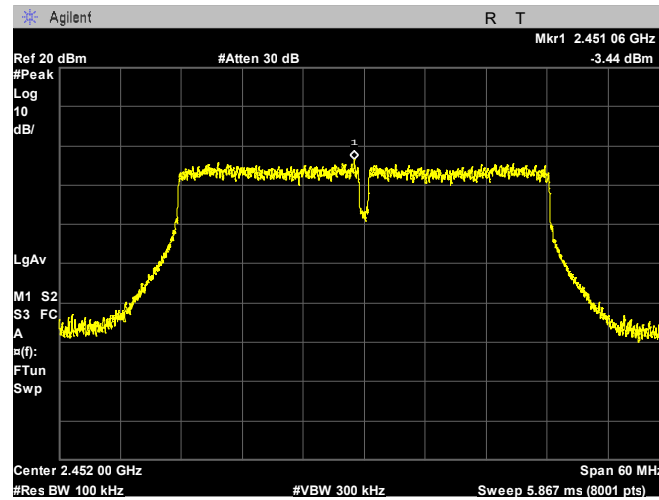
Reference Level, Middle Channel (2 437 MHz)



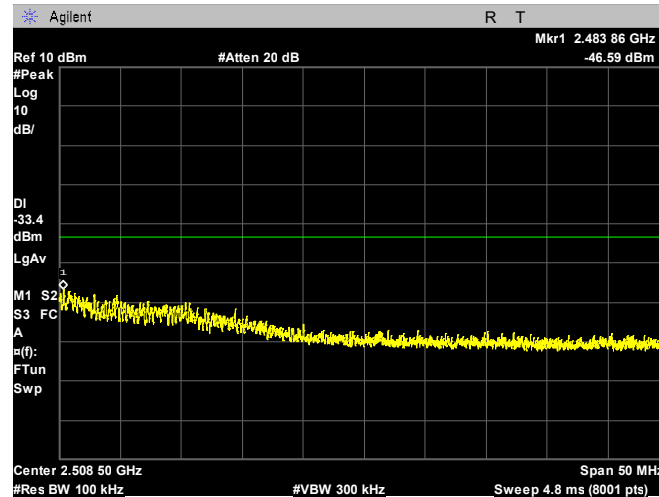
Conducted Spurious Emissions, Middle Channel (2 437 MHz)



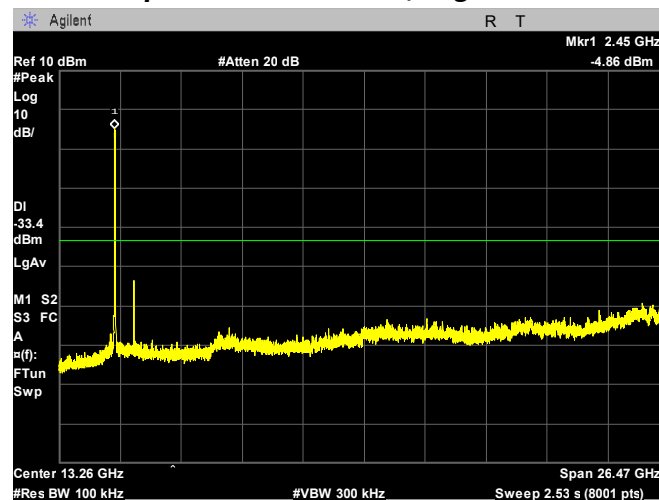
Reference Level, Highest Channel (2 452 MHz)



Band Edge, Highest Channel (2 452 MHz)

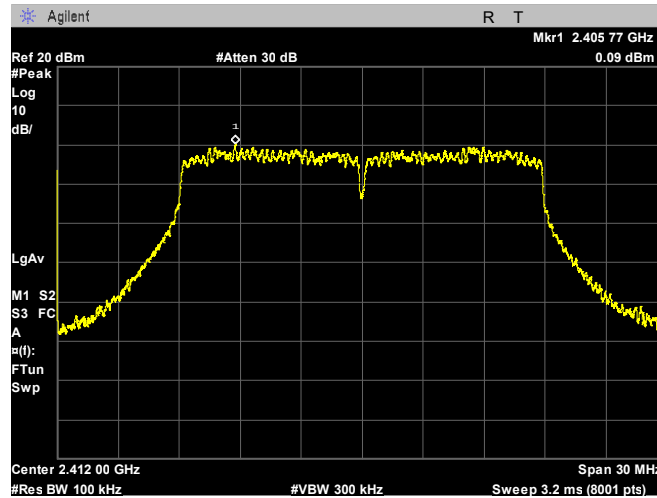


Conducted Spurious Emissions, Highest Channel (2 452 MHz)

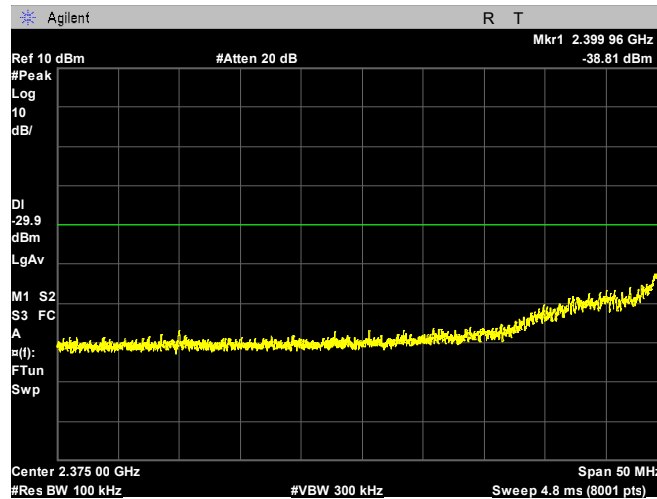


802.11n(20 MHz) mode 2Tx

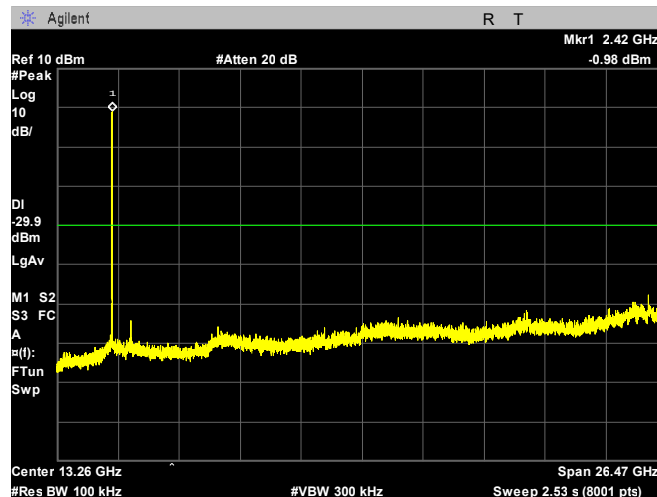
Reference Level, Lowest Channel (2 412 MHz), Chain 0



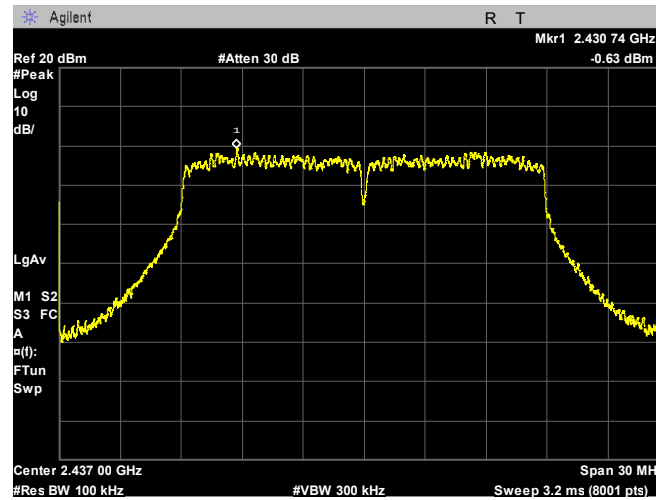
Band Edge, Lowest Channel (2 412 MHz), Chain 0



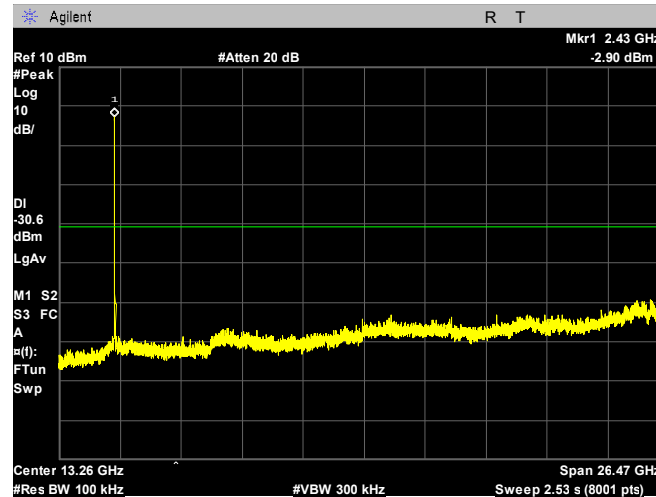
Conducted Spurious Emissions, Lowest Channel (2 412 MHz), Chain 0



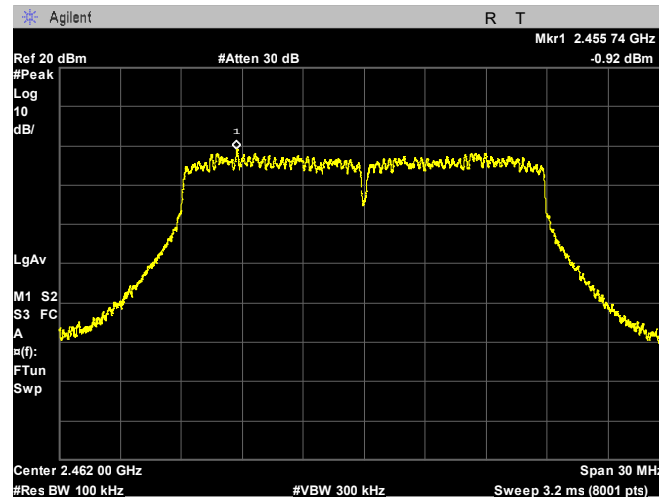
Reference Level, Middle Channel (2 437 MHz), Chain 0



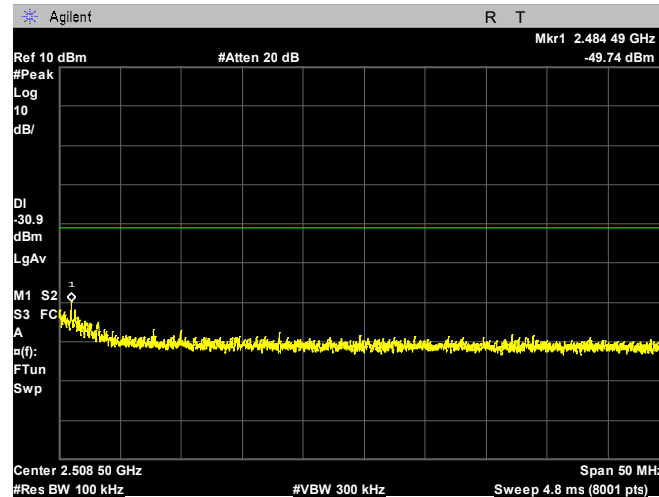
Conducted Spurious Emissions, Middle Channel (2 437 MHz), Chain 0



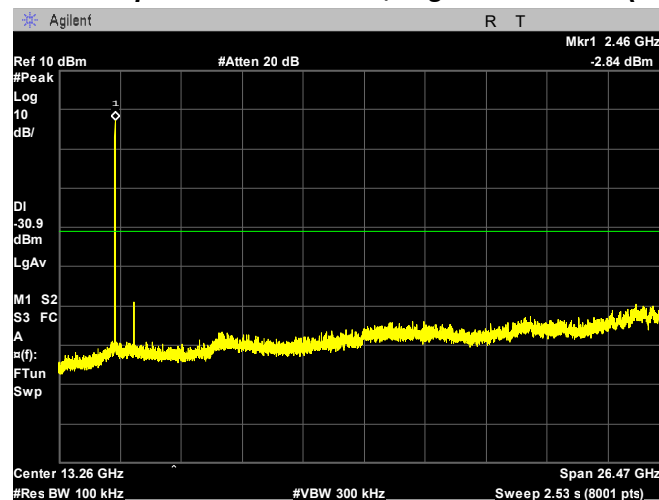
Reference Level, Highest Channel (2 462 MHz), Chain 0



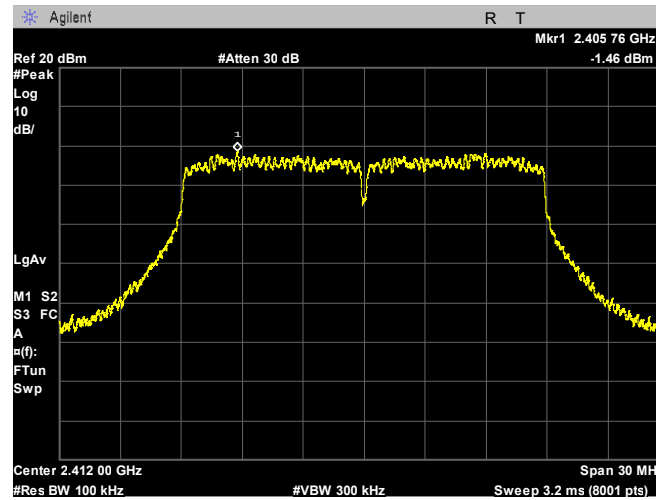
Band Edge, Highest Channel (2 462 MHz), Chain 0



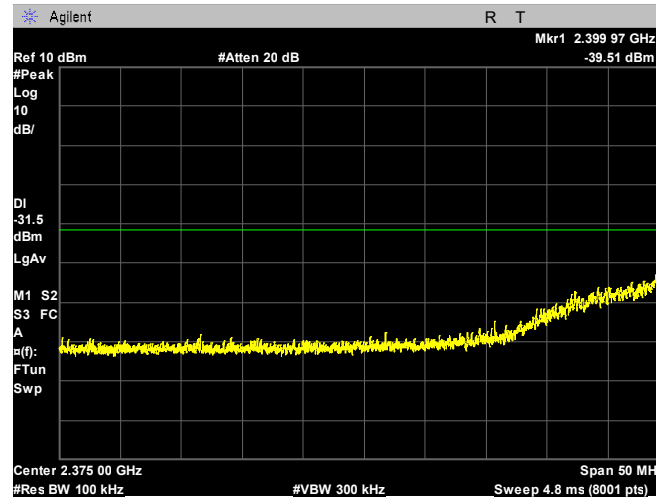
Conducted Spurious Emissions, Highest Channel (2 462 MHz), Chain 0



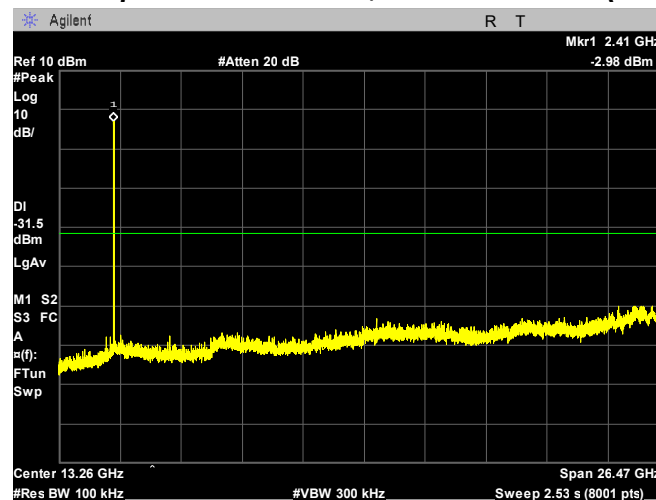
Reference Level, Lowest Channel (2 412 MHz), Chain 1



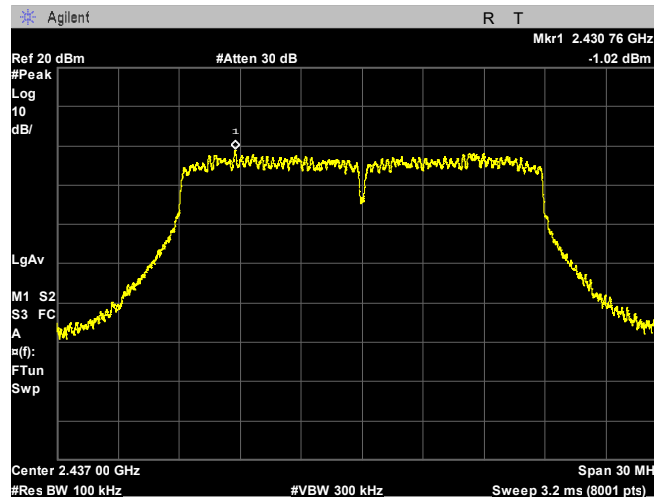
Band Edge, Lowest Channel (2 412 MHz), Chain 1



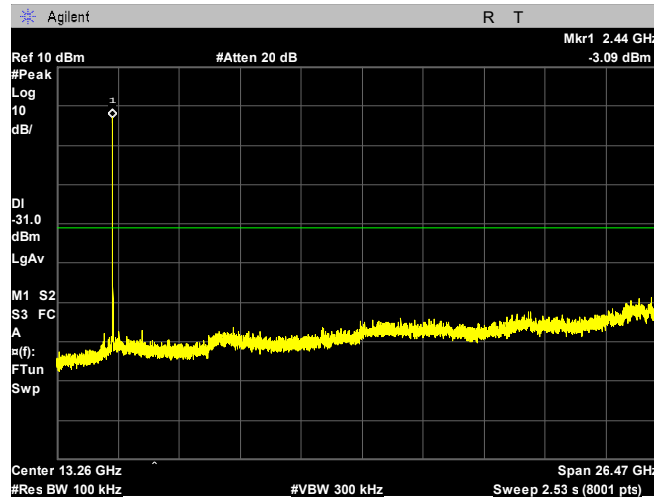
Conducted Spurious Emissions, Lowest Channel (2 412 MHz), Chain 1



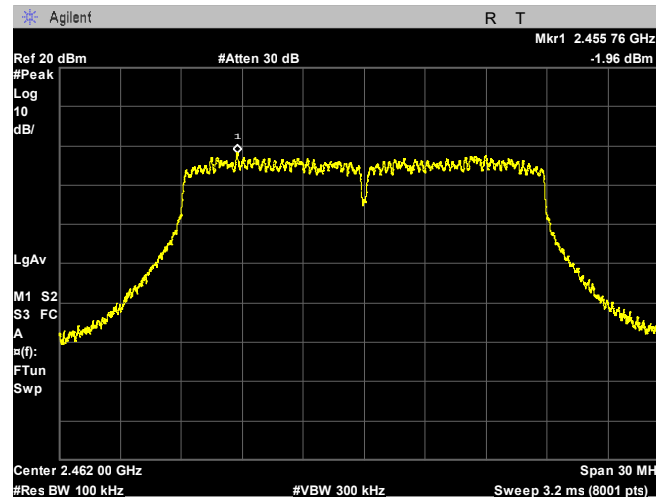
Reference Level, Middle Channel (2 437 MHz), Chain 1



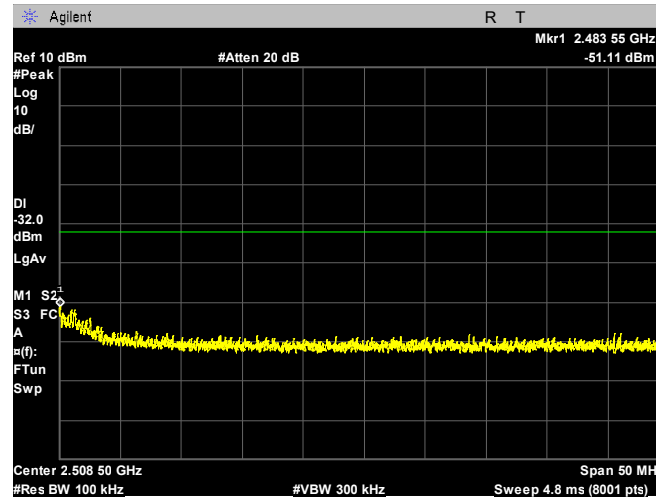
Conducted Spurious Emissions, Middle Channel (2 437 MHz), Chain 1



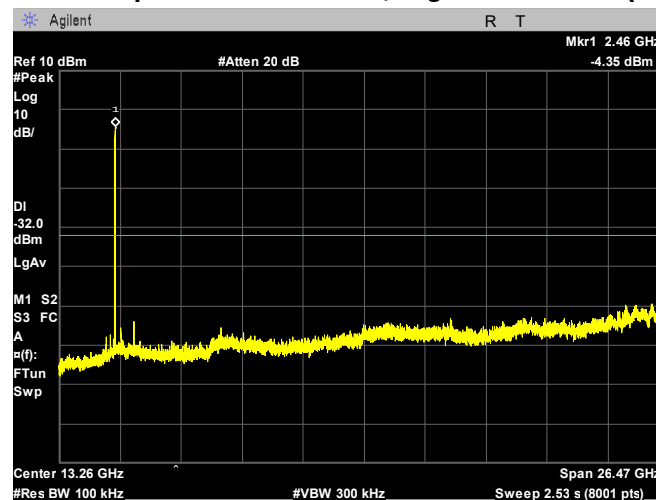
Reference Level, Highest Channel (2 462 MHz), Chain 1



Band Edge, Highest Channel (2 462 MHz), Chain 1

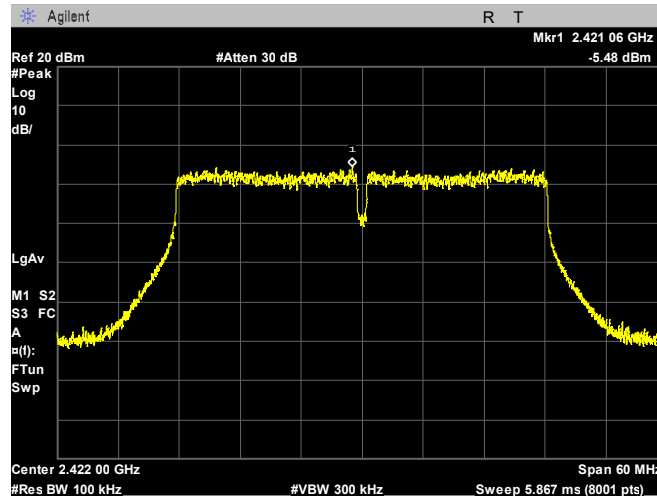


Conducted Spurious Emissions, Highest Channel (2 462 MHz), Chain 1

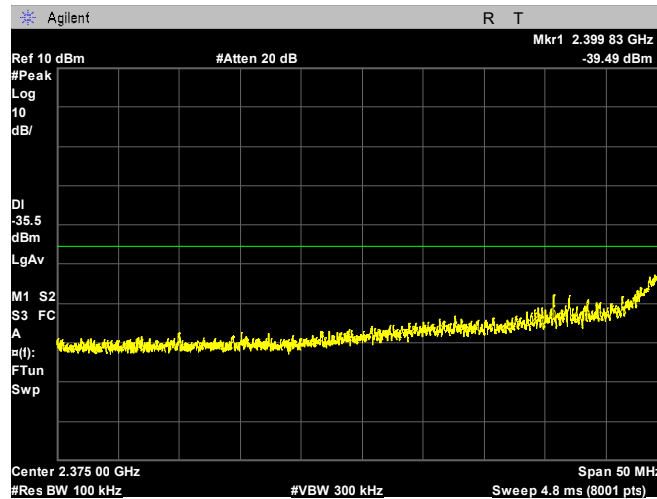


802.11n(40 MHz) mode 2Tx

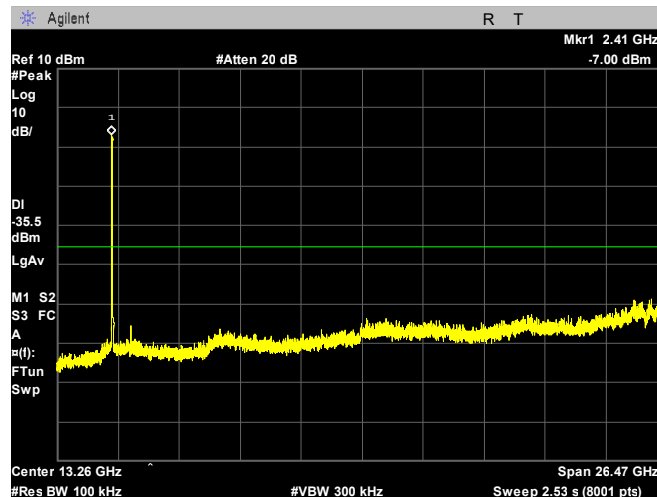
Reference Level, Lowest Channel (2 422 MHz), Chain 0



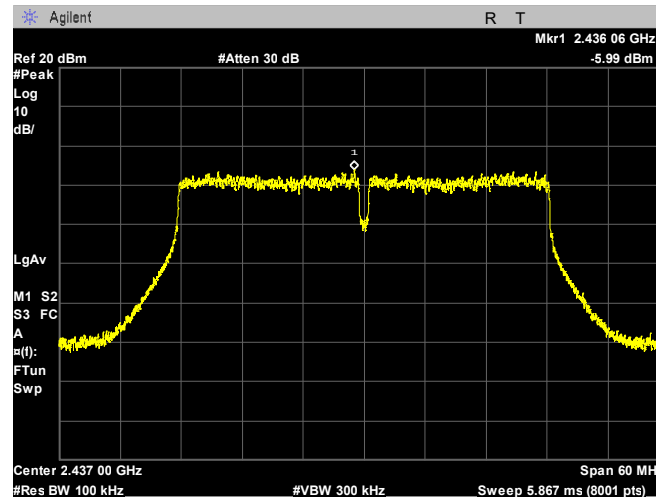
Band Edge, Lowest Channel (2 422 MHz), Chain 0



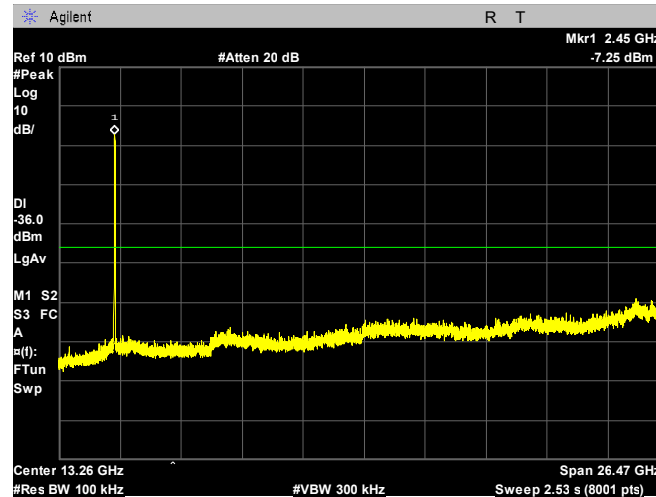
Conducted Spurious Emissions, Lowest Channel (2 422 MHz), Chain 0



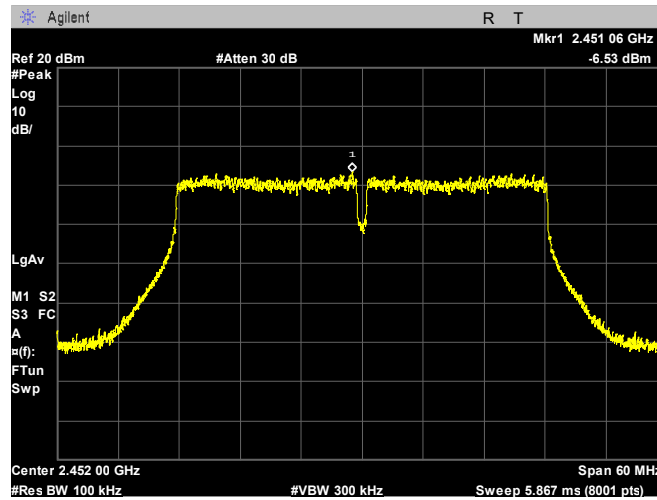
Reference Level, Middle Channel (2 437 MHz), Chain 0



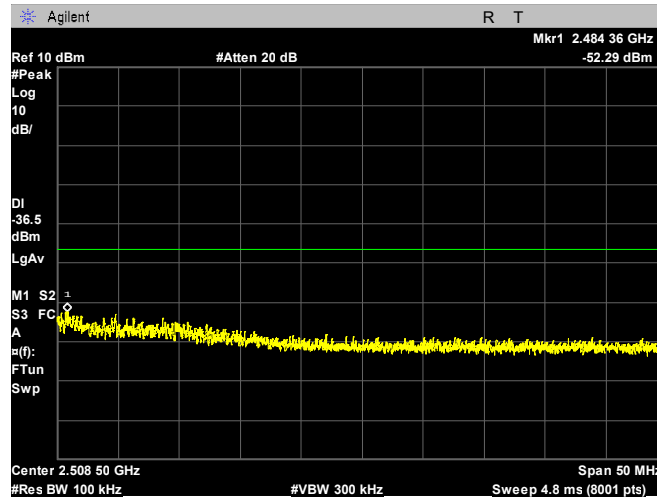
Conducted Spurious Emissions, Middle Channel (2 437 MHz), Chain 0



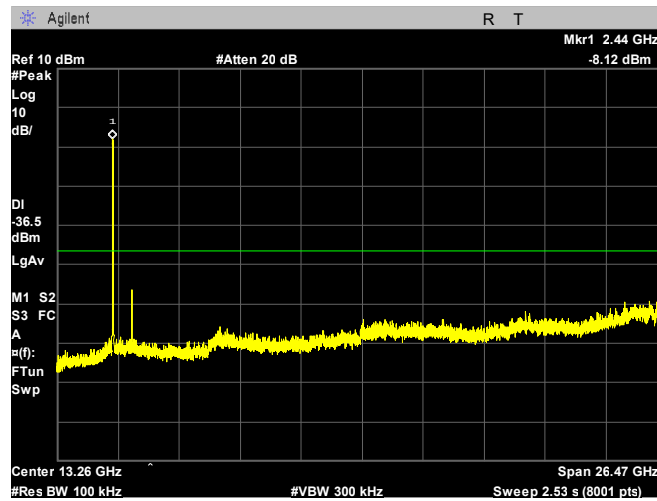
Reference Level, Highest Channel (2 452 MHz), Chain 0



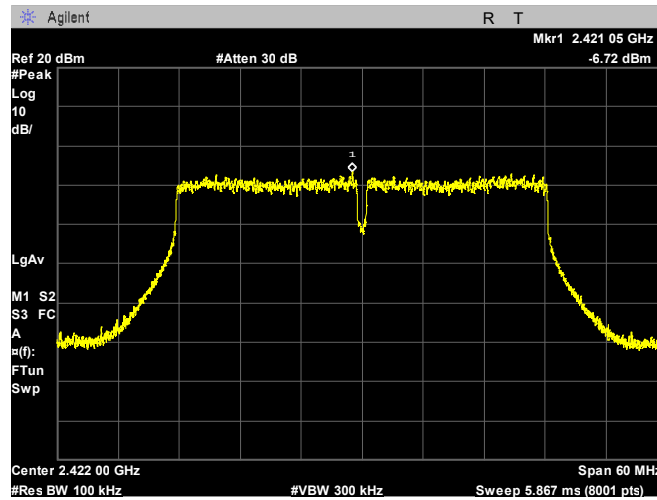
Band Edge, Highest Channel (2 452 MHz), Chain 0



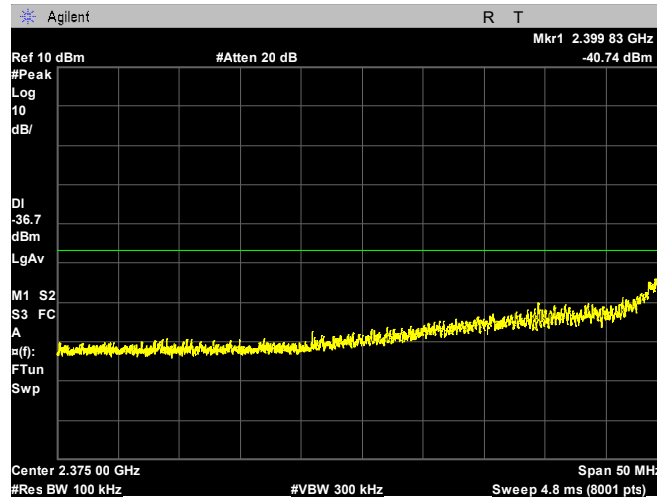
Conducted Spurious Emissions, Highest Channel (2 452 MHz), Chain 0



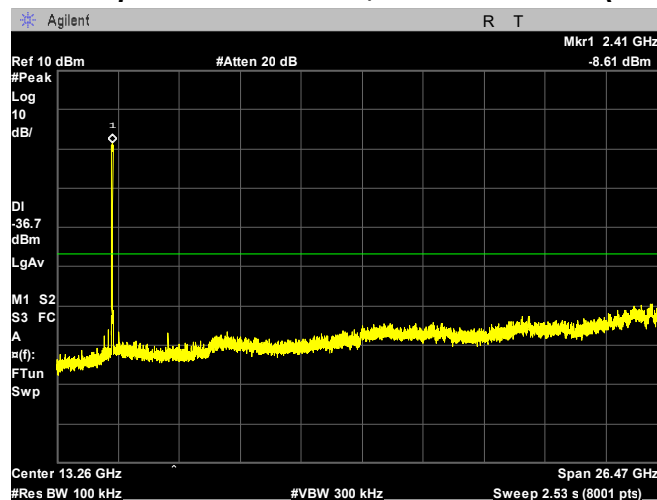
Reference Level, Lowest Channel (2 412 MHz), Chain 1



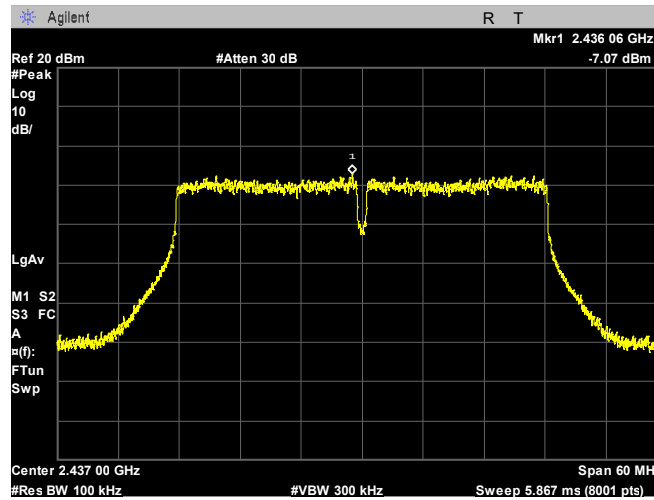
Band Edge, Lowest Channel (2 412 MHz), Chain 1



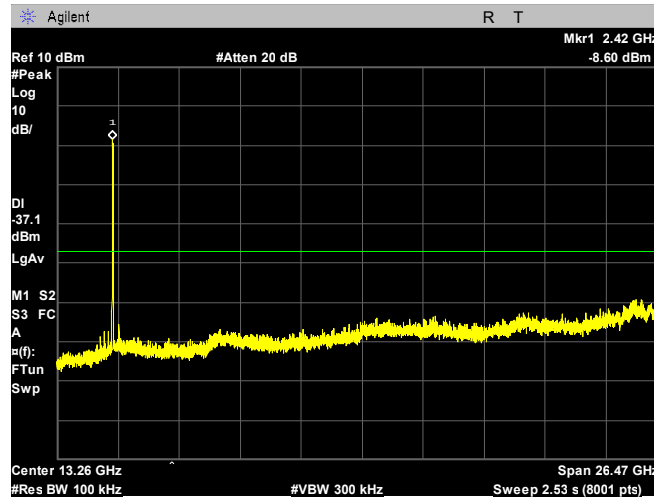
Conducted Spurious Emissions, Lowest Channel (2 412 MHz), Chain 1



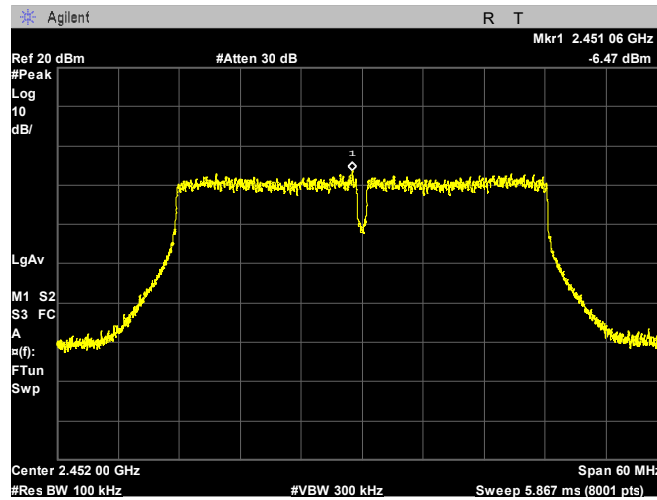
Reference Level, Middle Channel (2 437 MHz), Chain 1



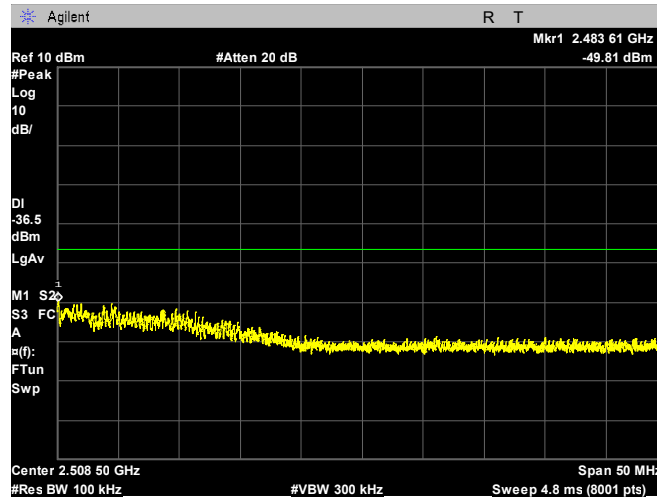
Conducted Spurious Emissions, Middle Channel (2 437 MHz), Chain 1



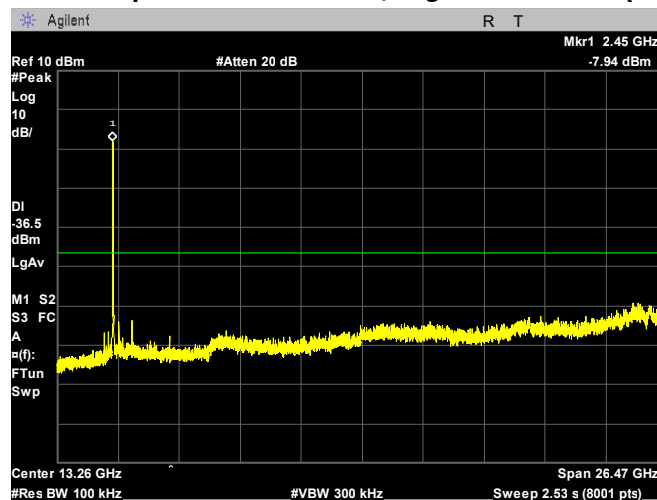
Reference Level, Highest Channel (2 452 MHz), Chain 1



Band Edge, Highest Channel (2 452 MHz), Chain 1



Conducted Spurious Emissions, Highest Channel (2 452 MHz), Chain 1



7.5 Radiated Spurious Emissions

FCC §15.205, §15.209, §15.247(d)
RSS-Gen (8.9),(8.10)

Test Mode : Set to Lowest channel, Middle channel and Highest channel

Result

802.11 b mode

Lowest channel (2 412 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	Mode*	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4 824.08	56.51	H	PK	5.9	62.41	74.00	11.59
4 823.08	43.89	H	AV	5.9	49.80	54.00	4.20
***6 432.04	45.45	V	PK	9.0	54.47	74.00	19.53
***6 432.04	41.62	V	AV	9.0	50.64	54.00	3.36
***7 235.40	48.99	V	PK	10.1	59.09	74.00	14.91
***7 232.64	37.54	V	AV	10.1	47.64	54.00	6.36
***9 647.00	40.56	H	PK	12.9	53.48	74.00	20.52
***9 647.92	34.13	V	AV	12.9	47.05	54.00	6.95
12 587.90	37.98	H	PK	15.8	53.79	74.00	20.21
12 680.00	28.87	V	AV	16.2	45.03	54.00	8.97

Middle channel (2 437 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	Mode*	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
***1 399.20	52.97	V	PK	-9.5	43.51	74.00	30.49
***2 000.55	55.30	V	PK	-4.8	50.54	74.00	23.46
***2 368.50	54.39	V	PK	-3.6	50.83	74.00	23.17
***2 252.25	42.31	V	AV	-4.5	37.85	54.00	16.15
4 873.96	53.73	H	PK	5.9	59.67	74.00	14.33
4 872.24	41.99	H	AV	6.0	47.95	54.00	6.05
***6 498.64	43.79	V	PK	9.2	52.95	74.00	21.05
***6 498.80	37.72	V	AV	9.2	46.88	54.00	7.12
7 311.24	45.53	V	PK	10.3	55.87	74.00	18.13
7 309.36	35.13	V	AV	10.4	45.49	54.00	8.51
11 999.90	38.77	H	PK	15.5	54.25	74.00	19.75

Highest channel (2 462 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	Mode*	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 373.30	54.81	V	PK	-4.2	50.61	74.00	23.39
***3 282.30	48.17	H	PK	1.0	49.21	74.00	24.79
***3 282.70	44.01	H	AV	1.0	45.05	54.00	8.95
4 923.96	50.60	H	PK	6.2	56.79	74.00	17.21
4 923.04	39.39	H	AV	6.2	45.57	54.00	8.43
***6 565.34	43.98	V	PK	9.4	53.41	74.00	20.59
***6 565.50	37.09	V	AV	9.4	46.52	54.00	7.48
7 385.40	44.55	V	PK	10.3	54.81	74.00	19.19
7 388.00	34.45	V	AV	10.2	44.69	54.00	9.31
12 012.59	42.09	V	PK	15.4	57.51	74.00	16.49

802.11 g mode

Lowest channel (2 412 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	Mode*	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 258.75	59.55	V	PK	-4.3	55.28	74.00	18.72
***2 391.70	60.60	H	PK	-1.8	58.77	74.00	15.23
***3 215.96	45.98	H	PK	1.5	47.47	74.00	26.53
***3 216.00	37.88	H	AV	1.5	39.37	54.00	14.63
4 824.48	49.03	H	PK	5.9	54.93	74.00	19.07
4 824.32	40.06	H	AV	5.9	45.96	54.00	8.04
***6 432.02	43.71	H	PK	9.0	52.73	74.00	21.27
***6 431.98	37.06	H	AV	9.0	46.08	54.00	7.92
***7 226.56	44.65	H	PK	10.1	54.75	74.00	19.25
***7 231.16	32.99	V	AV	10.1	43.09	54.00	10.91
10 749.89	42.56	H	PK	13.8	56.40	74.00	17.60
12 321.05	42.20	H	PK	15.5	57.74	74.00	16.26

Middle channel (2 437 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	Mode*	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
4 868.08	47.86	H	PK	6.0	53.85	74.00	20.15
4 873.88	38.27	H	AV	5.9	44.21	54.00	9.79
***6 498.56	44.18	V	PK	9.2	53.34	74.00	20.66
***6 498.64	37.16	V	AV	9.2	46.32	54.00	7.68
7 306.48	42.63	V	PK	10.4	53.01	74.00	20.99
7 311.88	32.20	V	AV	10.3	42.54	54.00	11.46
9 747.80	41.57	H	PK	13.1	54.65	74.00	19.35
9 747.92	35.15	V	AV	13.1	48.23	54.00	5.77
12 626.69	40.99	H	PK	15.8	56.83	74.00	17.17

Highest channel (2 462 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	Mode*	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
***3 282.68	51.60	H	PK	1.0	52.64	74.00	21.36
***3 282.68	48.24	H	AV	1.0	49.28	54.00	4.72
4 929.56	48.77	V	PK	6.2	54.97	74.00	19.03
4 923.80	34.91	H	AV	6.2	41.10	54.00	12.90
***6 565.22	44.18	V	PK	9.4	53.61	74.00	20.39
***6 565.46	37.37	V	AV	9.4	46.80	54.00	7.20
7 385.96	41.67	V	PK	10.3	51.93	74.00	22.07
12 437.70	37.80	V	PK	15.5	53.33	74.00	20.67
12 682.15	31.80	H	AV	16.2	47.97	54.00	6.03

802.11 n(20 MHz) mode

Lowest channel (2 412 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	Mode*	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 331.20	58.38	V	PK	-3.9	54.45	74.00	19.55
4 824.00	40.12	V	PK	5.9	46.02	74.00	27.98
4 824.00	32.96	V	AV	5.9	38.86	54.00	15.14
12 664.60	37.57	V	PK	16.0	53.61	74.00	20.39
12 266.10	31.65	H	AV	15.6	47.24	54.00	6.76

Middle channel (2 437 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	Mode*	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
***2 128.80	58.24	V	PK	-4.7	53.59	74.00	20.41
4 874.36	46.88	H	PK	5.9	52.82	74.00	21.18
4 874.48	35.14	H	AV	5.9	41.08	54.00	12.92
***6 498.64	44.22	H	PK	9.2	53.38	74.00	20.62
***6 499.04	37.34	V	AV	9.2	46.50	54.00	7.50
12 628.50	37.36	V	PK	15.8	53.20	74.00	20.80
12 222.30	29.82	H	AV	15.7	45.49	54.00	8.51

Highest channel (2 462 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	Mode*	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
***2 937.07	55.08	V	PK	-1.1	53.94	74.00	20.06
***3 282.89	49.29	H	PK	1.0	50.32	74.00	23.68
***3 282.78	45.07	H	AV	1.0	46.11	54.00	7.89
4 924.00	40.15	H	PK	6.2	46.34	74.00	27.66
***6 565.48	44.21	V	PK	9.4	53.64	74.00	20.36
***6 565.64	38.79	V	AV	9.4	48.23	54.00	5.77
7 386.13	39.94	H	PK	10.3	50.20	74.00	23.80
12 205.60	29.40	H	AV	15.7	45.11	54.00	8.89

802.11 n(40 MHz) mode

Lowest channel (2 422 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	Mode*	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
***1 992.53	57.40	V	PK	-4.9	52.51	74.00	21.49
***2 944.80	55.18	V	PK	-1.1	54.12	74.00	19.88
4 844.00	38.78	H	PK	6.0	44.78	74.00	29.22
4 844.00	31.39	V	AV	6.0	37.39	54.00	16.61
***6 453.45	44.78	V	PK	8.8	53.60	74.00	20.40
***6 453.69	36.79	V	AV	8.8	45.61	54.00	8.39
11 574.50	38.71	H	PK	15.1	53.81	74.00	20.19
12 689.67	31.34	V	AV	16.2	47.57	54.00	6.43

Middle channel (2 437 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	Mode*	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
***1 997.93	57.11	V	PK	-4.8	52.33	74.00	21.67
***2 977.27	55.19	H	PK	-1.1	54.14	74.00	19.86
4 874.00	39.86	H	PK	5.9	45.80	74.00	28.20
4 874.00	33.72	H	AV	5.9	39.66	54.00	14.34
***6 498.91	43.40	V	PK	9.2	52.56	74.00	21.44
***6 498.99	37.95	H	AV	9.2	47.11	54.00	6.89
12 606.07	41.63	H	PK	15.8	57.47	74.00	16.53
12 454.98	32.03	V	AV	15.6	47.58	54.00	6.42

Highest channel (2 452 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	Mode*	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
***1 997.07	58.07	V	PK	-4.8	53.27	74.00	20.73
***2 138.93	58.36	H	PK	-4.6	53.77	74.00	20.23
2 940.13	54.74	V	PK	-1.1	53.63	74.00	20.37
***3 269.61	50.17	H	PK	1.1	51.28	74.00	22.72
***3 269.53	45.14	H	AV	1.1	46.25	54.00	7.75
***6 539.00	44.13	V	PK	9.0	53.16	74.00	20.84
***6 539.04	38.35	V	AV	9.0	47.38	54.00	6.62
12 669.10	37.53	H	PK	16.1	53.60	74.00	20.40
12 664.90	31.41	H	AV	16.0	47.45	54.00	6.55

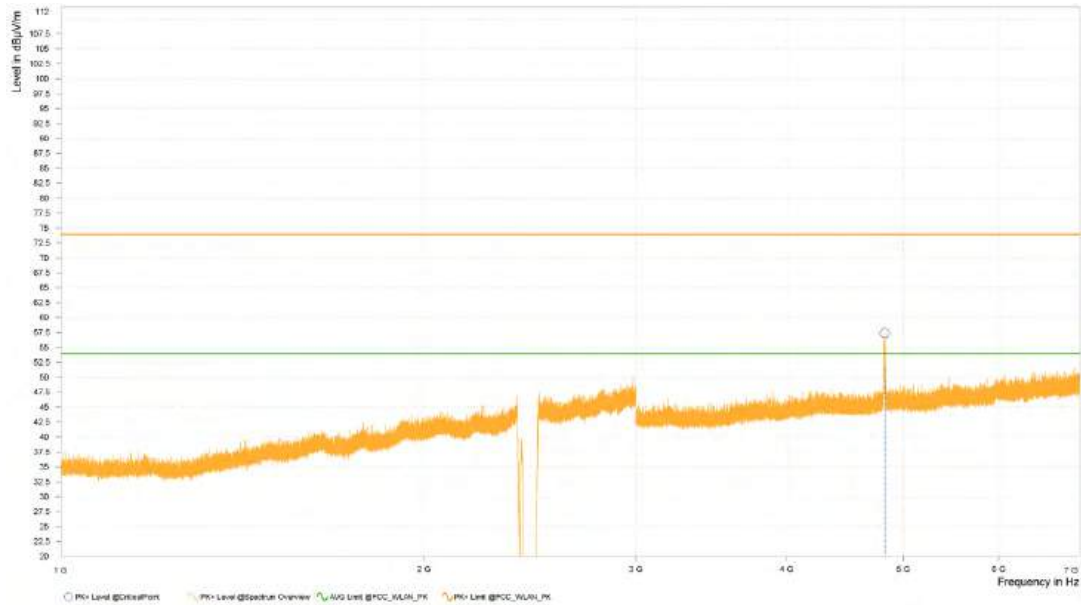
Notes:

1. *Pol. : H = Horizontal, V = Vertical, Mode : PK = Peak, AV = Average
2. **AF + CL + Amp. = Antenna Factor + Cable Loss + Amplifier.
3. ***Non-restricted band
4. Nothing detected above 18GHz
5. Other spurious was under 20 dB below Fundamental.
6. 802.11 b mode Lowest channel (2 412 MHz) was the worst condition.
7. The radiated emissions testing were made by rotating EUT through three orthogonal axes and rotating the receive antenna with horizontal, vertical polarization.
8. Peak emissions were measured using RBW = 1 MHz, VBW = 3 MHz, Detector = Peak.
9. Average emissions were measured using RBW = 1 MHz, VBW = 10 kHz, Detector = Peak.
10. The spectrum was measured from 1 GHz to 10th harmonic and the worst-case emissions were reported.

PLOTS OF EMISSIONS

Worst Case

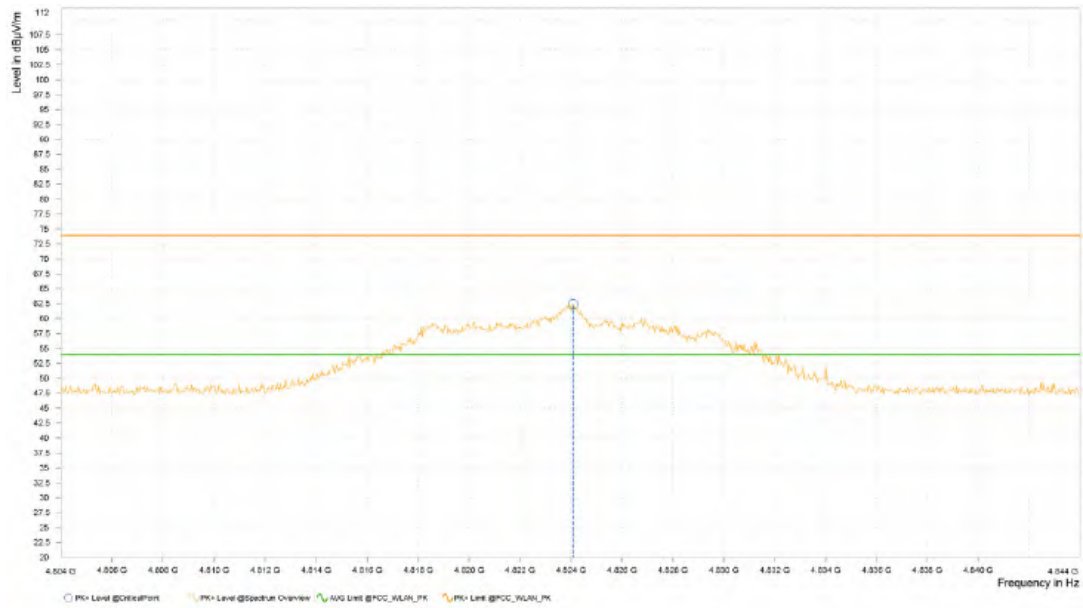
802.11 b mode Lowest Channel (2 412 MHz) : 1 GHz to 7 GHz_Peak



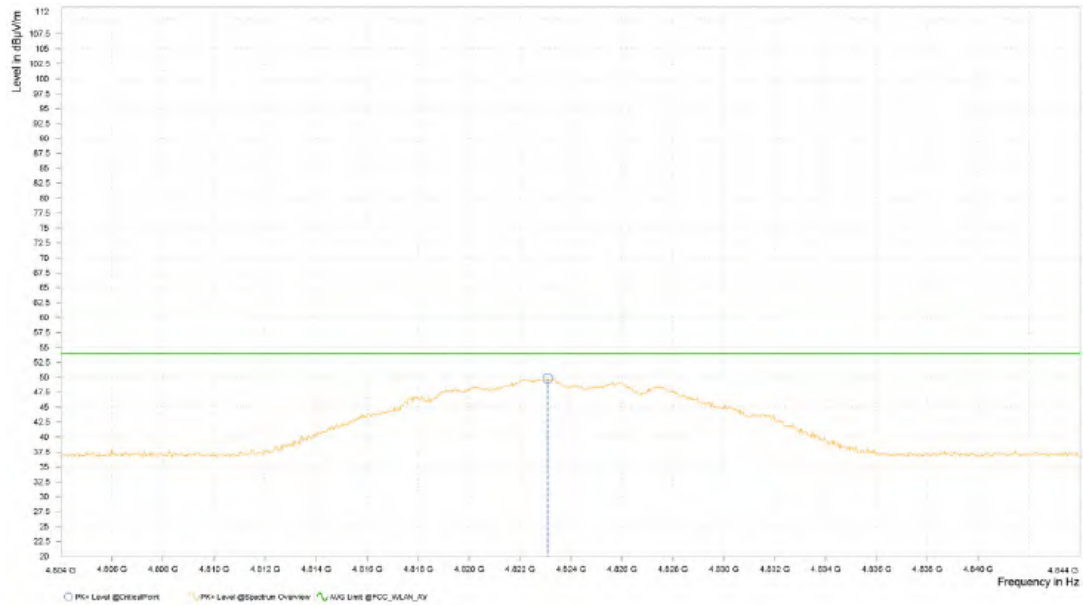
802.11 b mode Lowest Channel (2 412 MHz) : 1 GHz to 7 GHz_Average



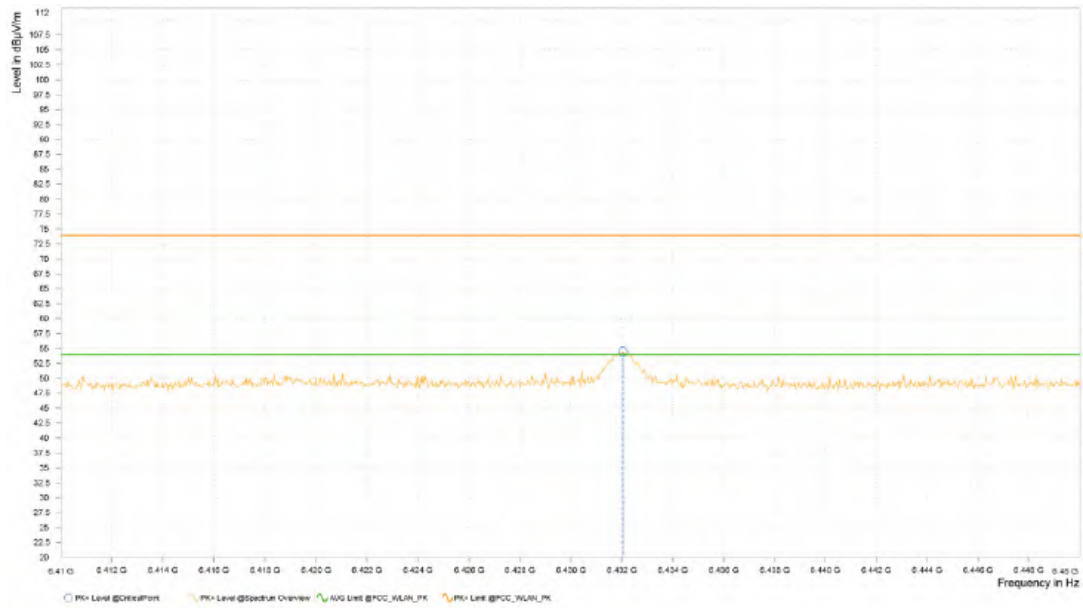
802.11 b mode Lowest Channel (2 412 MHz) : 4 824 MHz Zoom scan_Peak



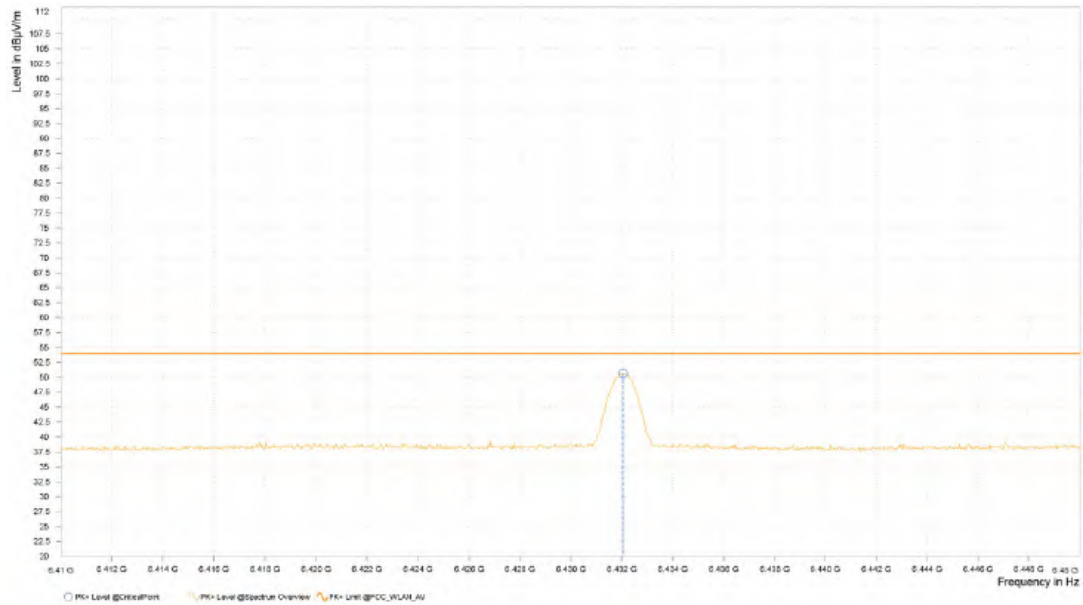
802.11 b mode Lowest Channel (2 412 MHz) : 4 824 MHz Zoom scan_Average



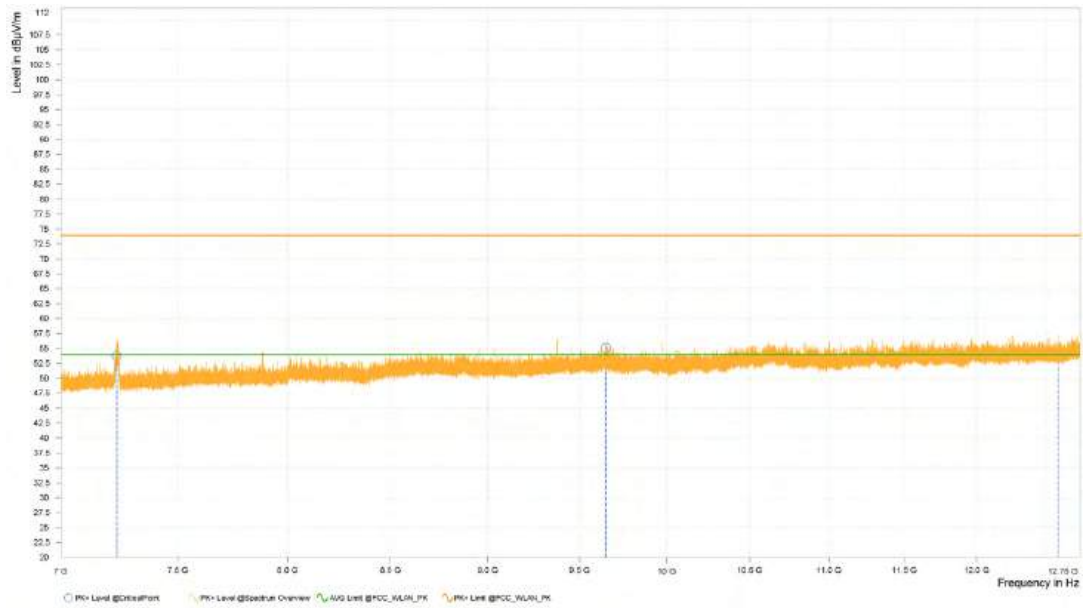
802.11 b mode Lowest Channel (2 412 MHz) : 6 400 MHz Zoom scan_Peak



802.11 b mode Lowest Channel (2 412 MHz) : 6 400 MHz Zoom scan_Average



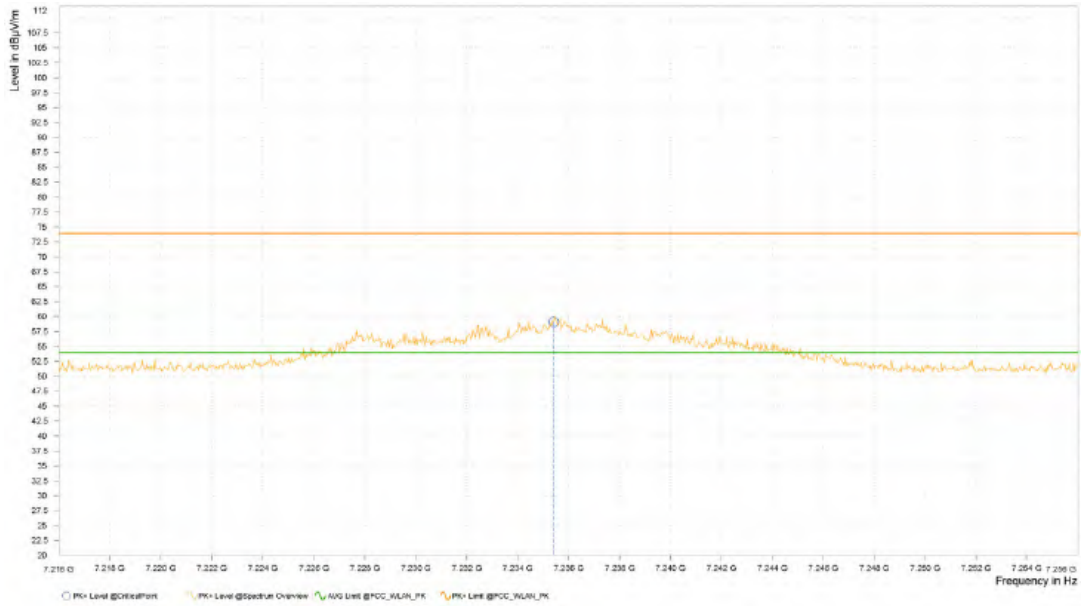
802.11 b mode Lowest Channel (2 412 MHz) : 7 GHz to 12.75 GHz_Peak



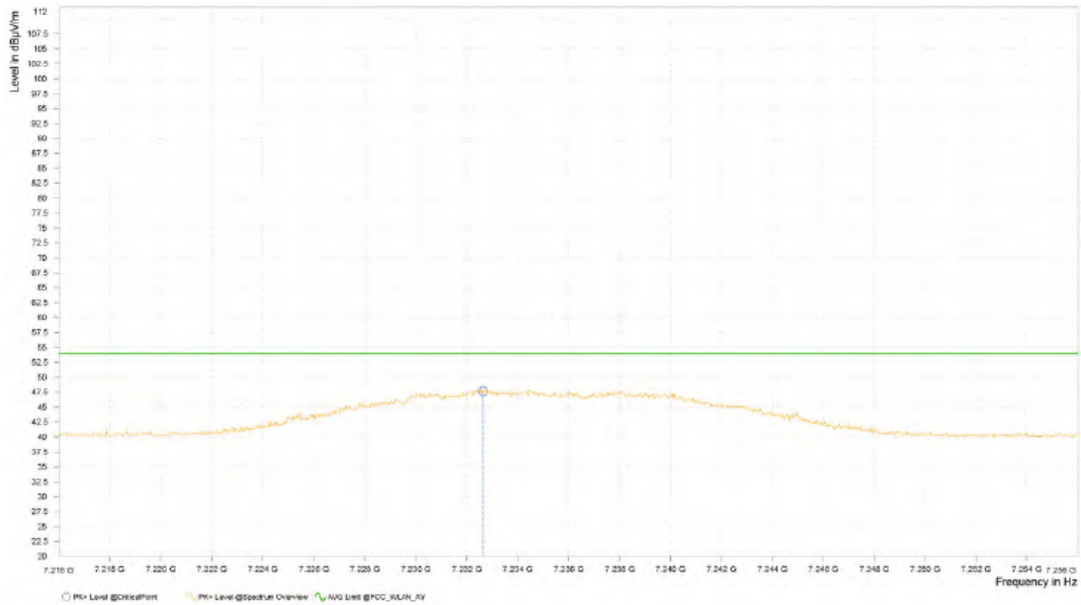
802.11 b mode Lowest Channel (2 412 MHz) : 7 GHz to 12.75 GHz_Average



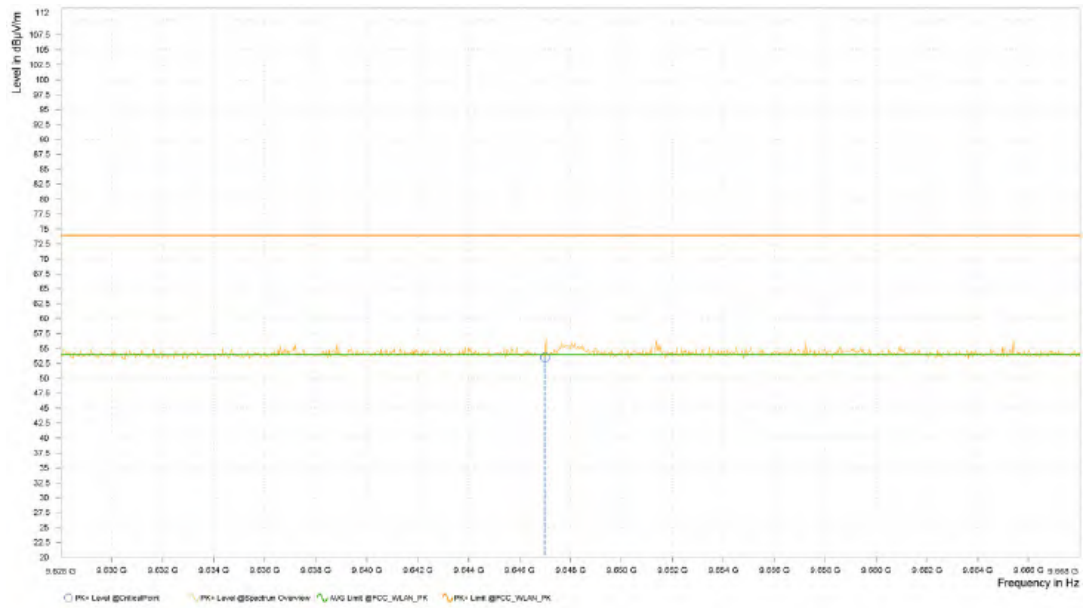
802.11 b mode Lowest Channel (2 412 MHz) : 7 236 MHz Zoom scan_Peak



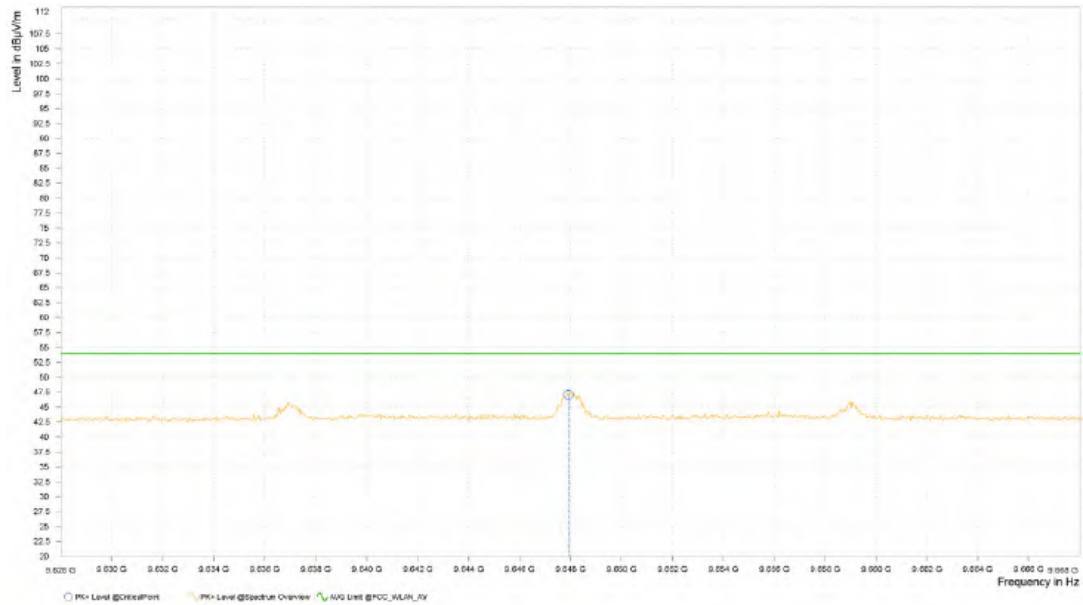
802.11 b mode Lowest Channel (2 412 MHz) : 7 236 MHz Zoom scan_Average



802.11 b mode Lowest Channel (2 412 MHz) : 9 648 MHz Zoom scan_Peak



802.11 b mode Lowest Channel (2 412 MHz) : 9 648 MHz Zoom scan_Average



7.6 Radiated Band Edge

FCC §15.205, §15.209

RSS-Gen (8.9),(8.10)

Test Mode : Set to Lowest channel and Highest channel

Result

802.11 b mode

Lowest Channel (2 412 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	Mode*	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 329.49	57.52	V	PK	-5.5	52.06	74.00	21.94
2 333.80	43.76	V	AV	-5.4	38.32	54.00	15.68
2 390.00	50.39	V	PK	-5.2	45.20	74.00	28.00
2 390.00	39.50	H	AV	-5.2	34.31	54.00	19.69

Highest Channel (2 462 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	Mode*	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 483.50	48.59	V	PK	-4.7	43.85	74.00	30.15
2 483.50	38.92	V	AV	-4.7	34.18	54.00	19.82
2 487.06	56.83	V	PK	-4.7	52.13	74.00	21.87
2 497.09	43.06	V	AV	-4.6	38.50	54.00	15.50

802.11 g mode

Lowest Channel (2 412 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	Mode*	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 309.35	59.44	V	PK	-5.5	53.92	74.00	20.08
2 360.62	44.51	V	AV	-5.2	39.31	54.00	14.69
2 389.99	60.18	H	PK	-5.2	54.99	74.00	19.01
2 389.99	43.90	H	AV	-5.2	38.71	54.00	15.29

Highest Channel (2 462 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	Mode*	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 483.50	49.81	H	PK	-4.7	45.07	74.00	28.93
2 483.50	39.61	V	AV	-4.7	34.87	54.00	19.13
2 498.23	56.10	V	PK	-4.5	51.56	74.00	22.44
2 492.29	42.84	V	AV	-4.6	38.20	54.00	15.80

802.11 n(20 MHz) mode

Lowest Channel (2 412 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	Mode*	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 371.37	58.58	V	PK	-5.1	53.44	74.00	20.56
2 382.67	43.65	V	AV	-5.2	38.49	54.00	15.53
2 389.99	54.85	H	PK	-5.2	49.66	74.00	24.34
2 389.99	42.16	H	AV	-5.2	36.97	54.00	17.03

Highest Channel (2 462 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	Mode*	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 483.50	54.63	H	PK	-4.7	49.89	74.00	24.11
2 483.50	42.00	H	AV	-4.7	37.26	54.00	16.74
2 484.70	57.34	H	PK	-4.7	52.61	74.00	21.39
2 483.66	42.98	H	AV	-4.7	38.24	54.00	15.76

802.11 n(40 MHz) mode

Lowest Channel (2 422 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	Mode*	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 332.35	57.57	V	PK	-5.5	52.12	74.00	21.88
2 347.11	44.04	V	AV	-5.4	38.67	54.00	15.33
2 389.99	53.46	H	PK	-5.2	48.27	74.00	25.73
2 389.99	41.55	H	AV	-5.2	36.36	54.00	17.64

Highest Channel (2 452 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	Mode*	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
2 483.50	53.84	H	PK	-4.7	49.10	74.00	24.90
2 483.50	42.35	H	AV	-4.7	37.61	54.00	16.39
2 494.44	57.27	V	PK	-4.6	52.66	74.00	21.34
2 484.41	44.62	H	AV	-4.7	39.89	54.00	14.11

Notes:

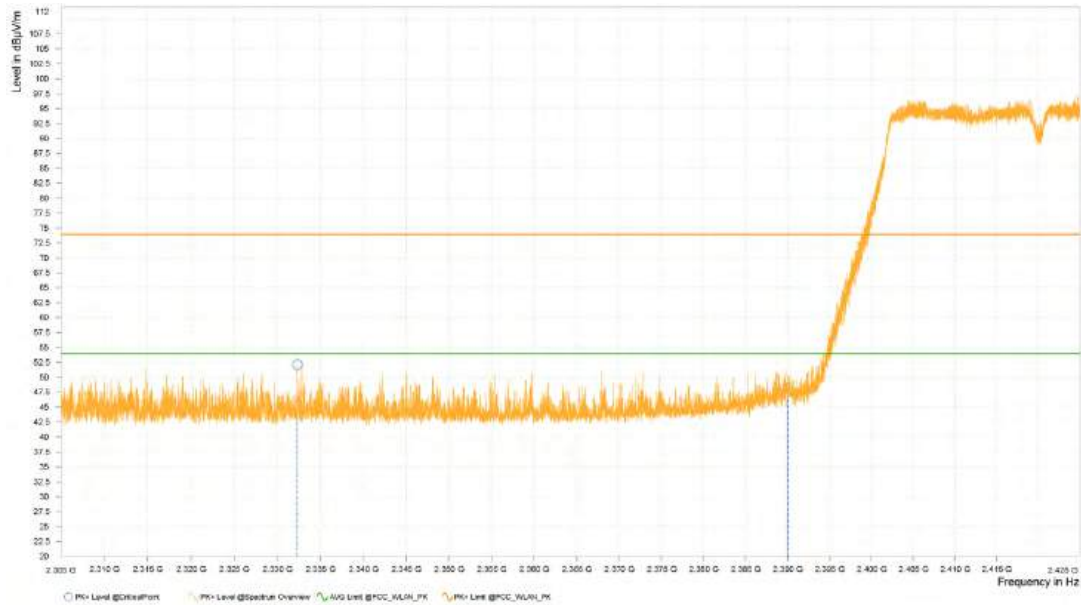
- *Pol. : H = Horizontal, V = Vertical, Mode : PK = Peak, AV = Average
- **AF + CL + Amp. = Antenna Factor + Cable Loss + Amplifier.
- 802.11 n(40 MHz) mode Highest channel (2 452 MHz) was the worst condition.
- Other spurious was under 20 dB below Fundamental.
- The radiated emissions testing were made by rotating EUT through three orthogonal axes and rotating the receive antenna with horizontal, vertical polarization.
- Peak emissions were measured using RBW = 1 MHz, VBW = 3 MHz, Detector = Peak.
- Average emissions were measured using RBW = 1 MHz, VBW = 10 kHz, Detector = Peak.

PLOTS OF EMISSIONS

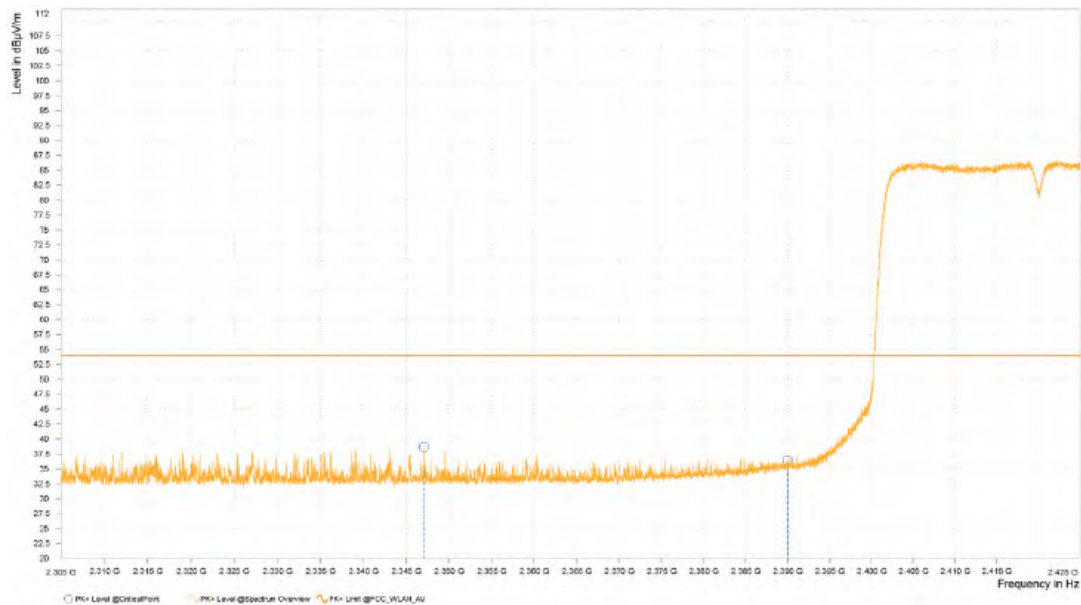
Worst Case

802.11 n(40 MHz) mode

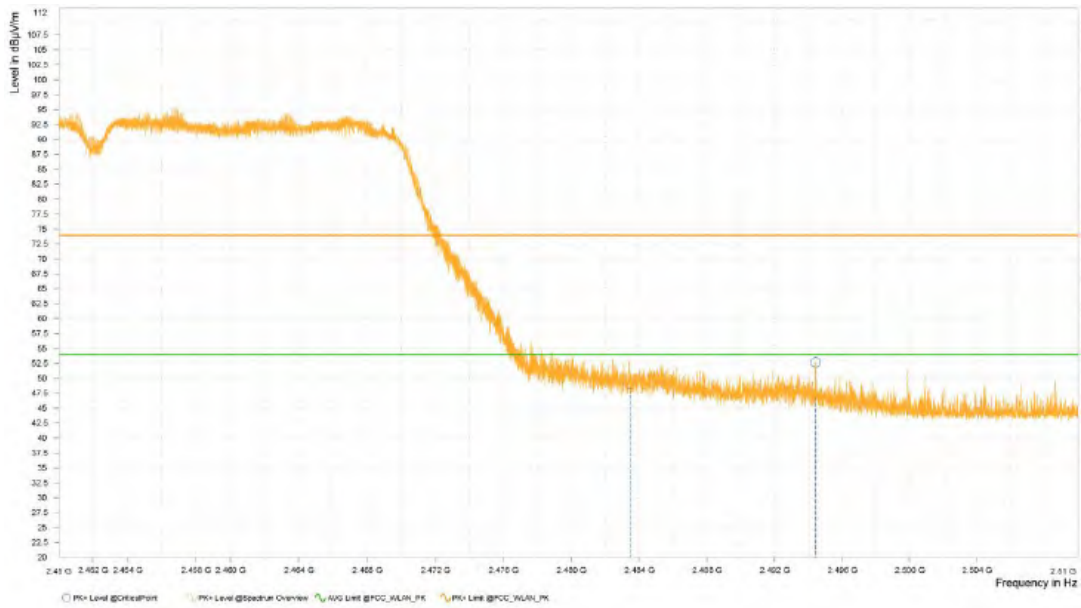
Lowest Channel (2 422 MHz)_Peak



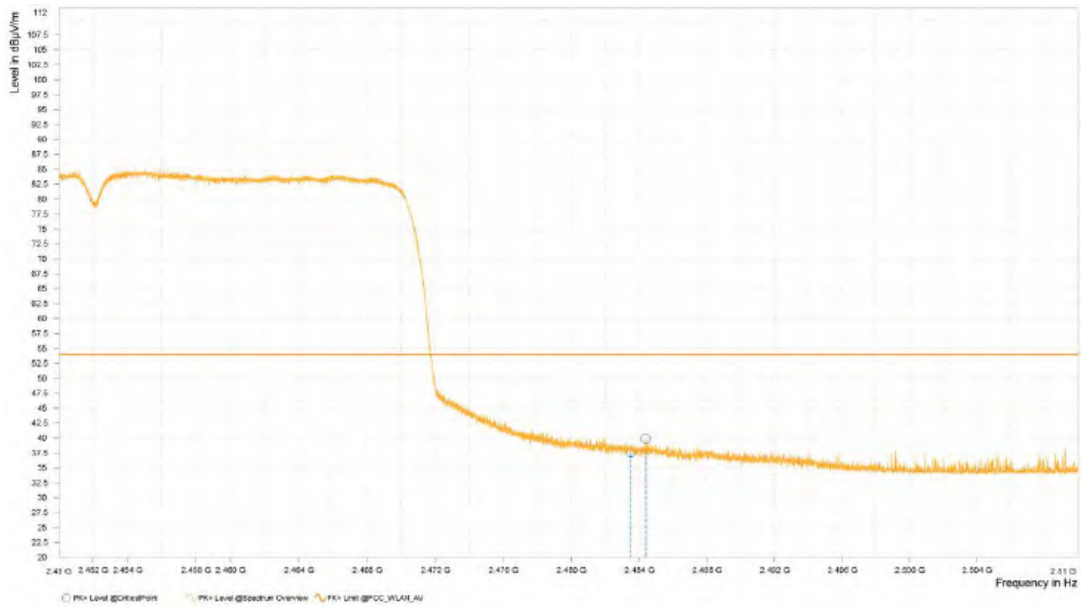
Lowest Channel (2 422 MHz)_Average



Highest Channel (2 452 MHz)_Peak



Highest Channel (2 452 MHz)_Average



7.7 Radiated Emissions_Below 1GHz

FCC §15.209
RSS-Gen (8.9)

Result

802.11b mode Lowest Channel (2 412 MHz)

Frequency (MHz)	Reading (dBμV)	Pol* (H/V)	Mode*	AF+CL+Amp (dB)**	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)
36.63	32.51	V	QP	-8.3	24.22	40.00	15.78
109.38	27.28	H	QP	-7.1	20.23	43.50	23.27
196.61	29.15	V	QP	-6.1	23.10	43.50	20.40
216.40	40.23	H	QP	-6.5	33.69	46.00	12.31
240.04	42.34	H	QP	-4.8	37.59	46.00	8.41
716.99	29.98	H	QP	2.6	32.61	46.00	13.39

Radiated Measurements at 3meters

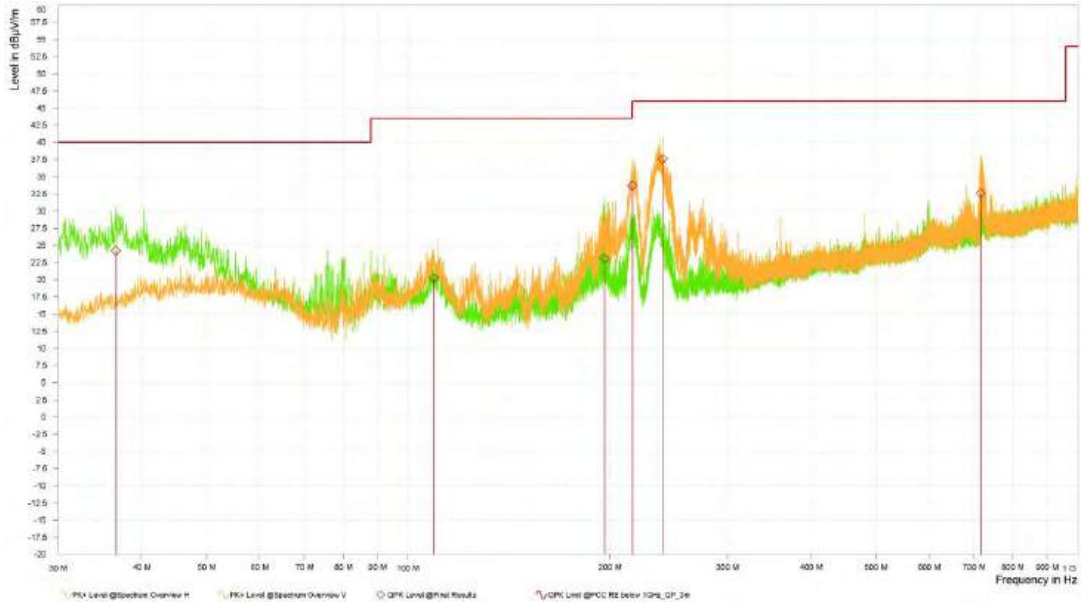
Notes:

- The worst-case emission was reported.
- *Pol. : H = Horizontal, V = Vertical, Mode : PK = Peak, QP = Qusi-Peak
- **AF + CL + Amp. = Antenna Factor + Cable Loss + Amplifier.
- Measurements using CISPR quasi-peak mode below 1 GHz.
- The radiated emissions testing were made by rotating EUT through three orthogonal axes and rotating the receive antenna with horizontal, vertical polarization. The worst data was recorded.
- No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz).
Per FCC part 15.31(o), test results were not reported.
Although these tests were performed other than open field test site, adequate comparison measurements were confirmed against 30 m open are test site.
Therefore, sufficient tests were made to demonstrate that the alternative site produces results that correlate with the one of tests made in an open field based on KDB 414788.
- The limit is on the FCC §15.209.

PLOTS OF EMISSIONS

Worst Case

Radiated emission below 1GHz, Lowest Channel (2 412 MHz)



7.8 AC Line Conducted

FCC §15.207
RSS-Gen(8.8)

Result :

802.11 b mode, Lowest Channel (2 412 MHz)

Final Result

Frequency (MHz)	QuasiPeak (dBμV)	CAverage (dBμV)	Limit (dBμV)	Margin (dB)	Bandwidth (kHz)	Line	Corr. (dB)
0.159950	---	22.92	54.95	32.03	9.000	L1	9.9
0.159950	53.92	---	64.95	11.04	9.000	L1	9.9
0.209700	---	29.39	52.83	23.43	9.000	L1	9.9
0.209700	50.42	---	62.83	12.40	9.000	L1	9.9
0.251988	47.25	---	61.38	14.13	9.000	N	9.6
0.251988	---	31.49	51.38	19.89	9.000	N	9.6
0.251988	47.10	---	61.38	14.29	9.000	N	9.6
0.251988	---	31.36	51.38	20.02	9.000	N	9.6
0.279350	44.18	---	60.57	16.39	9.000	N	9.6
0.279350	---	24.37	50.57	26.20	9.000	N	9.6
3.625038	42.19	---	56.00	13.81	9.000	L1	9.7
3.625038	---	32.40	46.00	13.60	9.000	L1	9.7
17.679413	---	31.74	50.00	18.26	9.000	N	9.9
17.679413	41.97	---	60.00	18.03	9.000	N	9.9

Line Conducted Emission Tabulated Data

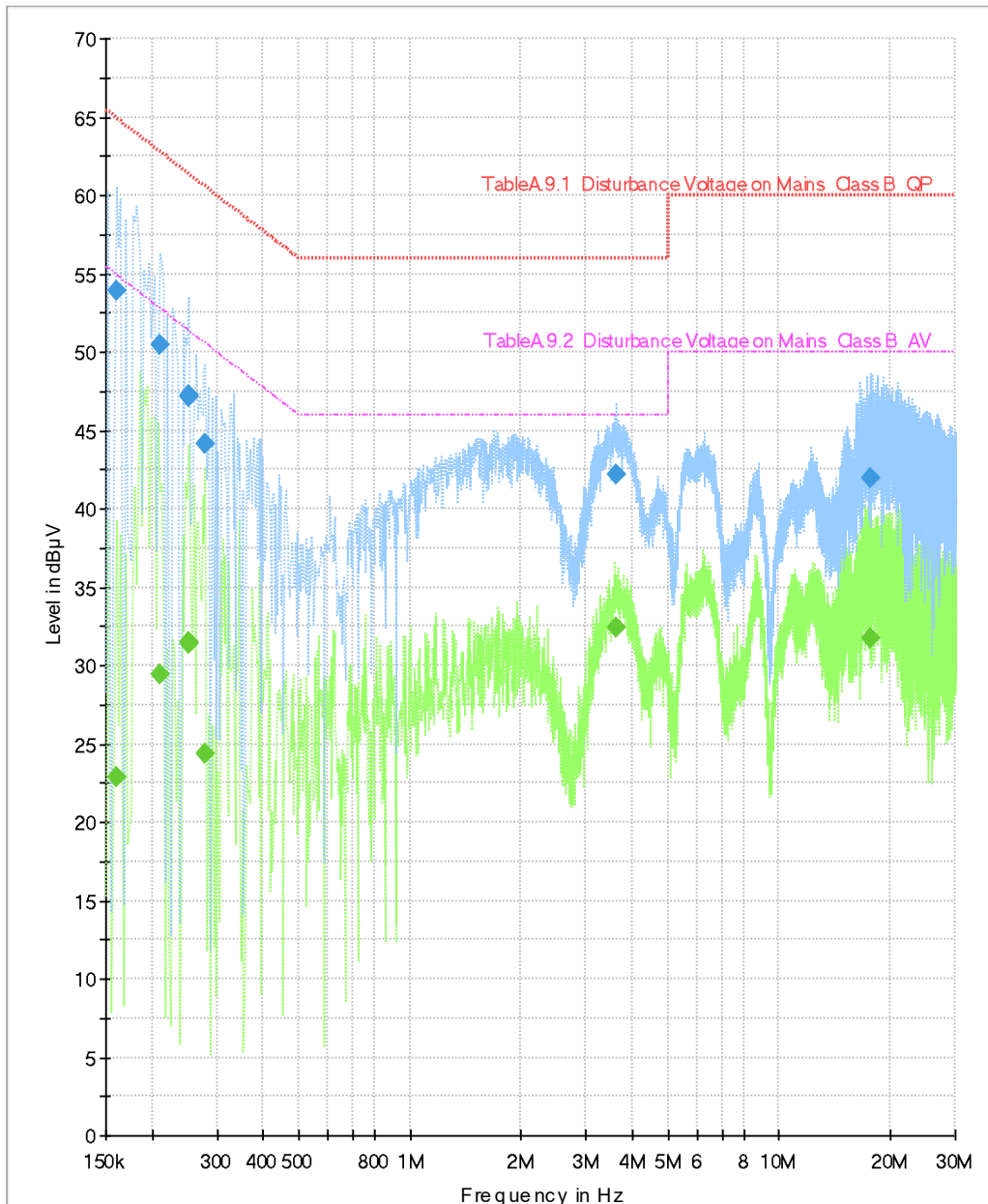
Notes:

1. Measurement using CISPR quasi-peak mode & average mode.
2. The worst channel was investigated and the worst-case emission are reported. See attached Plots.
3. Lowest channel (2 412 MHz) is the worst case.
4. *) Factor = LISN + Cable loss
5. **) LINE : L = Line, N = Neutral
6. The limit is on the FCC §15.207

PLOTS OF EMISSIONS

Worst Case

AC Line Conducted emission, 802.11 b mode, Lowest Channel (2 412 MHz)



8. TEST EQUIPMENT

No.	Instrument	Manufacture	Model	Serial No.	Calibration Date	Next Calibration Date
1	DIGITAL MULTIMETER	EZ DIGITAL	DM-334	2111395	2023-10-11	2024-10-11
2	Humidity Temperature	Lutron	MHB-382SD	AK.26553	2023-10-18	2024-10-18
3	Spectrum Analyzer	Agilent	E4440A	MY44303257	2023-10-10	2024-10-10
4	System DC Power Supply	H.P	6654A	3639A02419	2024-03-28	2025-03-28
5	10 dB Attenuator	API technologies corp	40A2W-10	1917	2024-01-10	2025-01-10
6	Signal Generator	R&S	SMB100A	175861	2024-03-29	2025-03-29
7	EMI TEST RECEIVER	R&S	ESW44	103318	2024-01-08	2025-01-08
8	Trilog-Broadband antenna	Schwarzbeck	VULB9163	01431	2022-11-16	2024-11-16
9	DOUBLE RIDGED HORN ANTENNA	R&S	HF907	103175	2024-01-11	2025-01-11
10	Horn Antenna	Q-par Angus	QMS-00208	17519	2024-03-29	2025-03-29
11	Horn Antenna	Steatite Antennas	QMS-00225	32226	2024-01-11	2025-01-11
12	AMPLIFIER	HP	8447F	2805A03406	2024-01-09	2025-01-09
13	Signal Conditioning Unit	R&S	SCU-18F	101056	2024-01-09	2025-01-09
14	Signal Conditioning Unit	R&S	SCU26F	100750	2024-01-11	2025-01-11
15	Open Switch and Control Unit	R&S	OSP220	102977	N/A	N/A
16	WiFi Filter Bank	R&S	U082	N/A	N/A	N/A
17	HYGROMETER	O-230	DRETEC	N/A	2024-01-12	2025-01-12
18	EMI TEST RECEIVER	R&S	ESR3	102930	2024-07-02	2025-07-02
19	TWO-LINE V-NETWORK	R&S	ENV216	102829	2024-07-03	2025-07-03

9. ACCURACY OF MEASUREMENT & DECISION RULE

9.1 Uncertainty Calculation

The Measurement Uncertainties stated were calculated in accordance with the requirements of measurement uncertainty contained in CISPR 16-4-2 with the confidence level of 95%

PARAMETER	UNCERTAINTY
Radiated Disturbance, Below 30 MHz	4.50 dB
Radiated Disturbance, 30 MHz to 1 GHz	4.40 dB
Radiated Disturbance, Above 1 GHz	4.58 dB

9.2 Decision rule

The choice of whether or not to include the measurement uncertainty of the measuring system used in the test in the conformance determination.:

- ☐ Application of internal procedures used in type testing where traceability of measurement uncertainty is established.
- ☒ Applying the decision that the standard used for type testing does not require it.

END REPORT