Nemko Korea Co., Ltd.

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FCC and IC EVALUATION REPORT FOR CERTIFICATION

Applicant :

Healcerion Co., Ltd
804ho, 38-21, Digital-ro 31-gil, Guro-gu, Seoul, 08376, Republic of KOREA
Attn. : Minji Bang

Dates of Issue : December 18, 2017
Test Report No. : NK-17-R-218
Test Site : Nemko Korea Co., Ltd.

FCC ID **IC**	**2ADXVSWM500** **12712A-SWM500**
Brand Name	**Healcerion Co., Ltd**
Contact Person	**Healcerion Co., Ltd** **804ho, 38-21, Digital-ro 31-gil, Guro-gu,** **Seoul, 08376, Republic of KOREA** **Minji Bang** **Telephone No. : 82-2-6342-6326**

Applied Standard: FCC 47 CFR Part 15.247 and IC RSS-247 Issue 2
Classification: Digital Transmission System (DTS)
EUT Type: Wifi Module

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.

Dec. 18. 2017

Tested By : Yonghwan Kim
Engineer

Dec 18. 2017

Reviewed By : Deokha Ryu
Technical Manager

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1. SCOPE

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 IC RSS-247 Issue2.

Responsible Party :	Healcerion Co., Ltd 804ho, 38-21, Digital-ro 31-gil, Guro-gu, Seoul, 08376, Republic of KOREA
Contact Person :	Minji Bang
Manufacturer :	Healcerion Co., Ltd 804ho, 38-21, Digital-ro 31-gil, Guro-gu, Seoul, 08376, Republic of KOREA

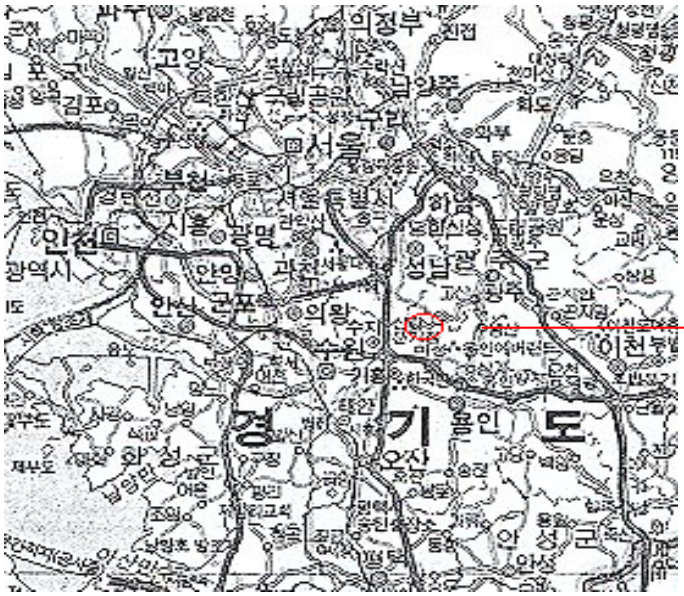
- FCC ID: 2ADXVSWM500
- IC: 12712A-SWM500
- Model: SWM-500
- HVIN: SWM500
- Brand Name: Healcerion Co., Ltd
- EUT Type: Wifi Module
- Classification: Digital Transmission System (DTS)
- Applied Standard: FCC 47 CFR Part 15.247 and IC RSS-247 Issue 2
- Test Procedure(s): ANSI C63.10-2013 and FCC guidance of Guidance 558074 D01 DTS Meas Guidance v04
- Dates of Test: October 12, 2017 ~ December 11, 2017
- Place of Test: Nemko Korea Co., Ltd.

2. INTRODUCTION

2.1 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 from **Healcerion Co., Ltd FCC ID : 2ADXVSWM500** and **IC : 12712A-SWM500.**

These measurement tests were conducted at ***Nemko Korea Co., Ltd. EMC Laboratory*** .
The site address 155 & 159, Osan-Ro, Mohyeon-Myeon, Cheoin-Gu, Yongin-Si, Gyeonggi-Do 16885 KOREA, REPULIC OF.
The area of Nemko Korea Corporation Ltd. EMC Test Site is located in a mountain area at
80 km (48 miles) southeast and Incheon International Airport (Incheon Airport), 30 km (18miles) south-southeast from central Seoul.
It is located in the valley surrounded by mountains in all directions where ambient radio signal conditions are quiet and a favorable area to measure the radio frequency interference on open field test site for the computing and ISM devices manufactures.
The detailed description of the measurement facility was found to be in compliance with the requirements of ANSI C63.4-2014 according to §2.948.



Nemko Korea Co., Ltd.
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Fig. 1. The map above shows the Seoul in Korea vicinity area.
The map also shows Nemko Korea Corporation Ltd. EMC Lab. and Incheon Airport.

2.2 Accreditation and listing

Accreditation type		Accreditation number
	CAB Accreditation for DOC	Designation No. KR0026
	KOLAS Accredited Lab. (Korea Laboratory Accreditation Scheme)	Registration No. 155
Industry Canada	Canada IC Registered site	Site No. 2040E
	VCCI registration site(RE/CE/Telecom CE)	Member No. 2118
	EMC CBTL	-
	KCC(RRL)Designated Lab.	Registration No. KR0026

3. TEST CONDITIONS & EUT INFORMATION

3.1 Operation During Test

The EUT is the SISO transceiver which is module supporting the 802.11n mode (802.11n(20,40MHz) : 1TX/1RX).
The Laptop was used to control the EUT to transmit the wanted TX channel continuously (dutycycle 100%) by the testing program (TeraTerm) supported by manufacturer. The Laptop was removed after controlling the EUT to transmit the wanted signal.
The operating voltage of EUT was 3.3 Vdc, 1.8Vdc supplied from jig board.
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.

3.1.1 Table of test power setting

Frequency	Mode	Power setting Level
2412 MHz ~ 2462 MHz	802.11n (20 MHz)	11
	802.11n (40 MHz)	10

3.1.2 Table of test channels

Frequency band	Mode	Test Channel (CH)	Frequency (MHz)
2.4 GHz	802.11n (20 MHz)	1	2412
		6	2437
		11	2462
	802.11n (40 MHz)	3	2422
		6	2437
		9	2452

3.1.3 Antenna information:

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

3.1.4 Additional Information Related to Testing

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

3.1.5 Table of test modes

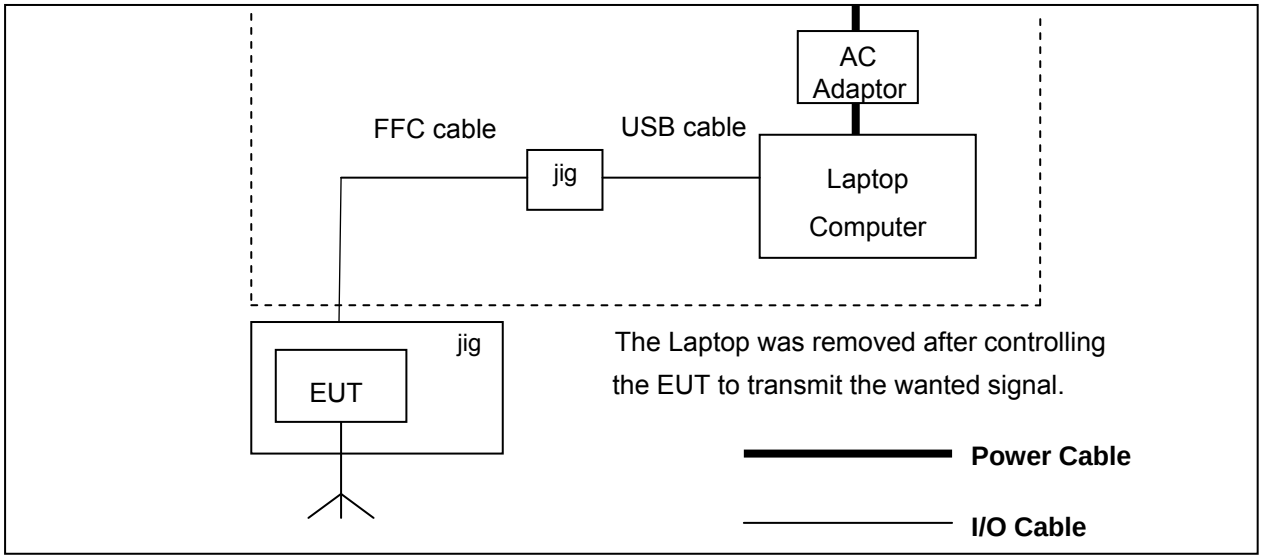
Test Items	Mode	*Data rate (Mbps)	Test Channel (CH)
Radiated Emissions	802.11n	MCS0	11
6 dB Bandwidth	802.11n (20 MHz)	MCS0	1/6/11
	802.11n (40 MHz)	MCS0	3/6/9
Maximum Conducted Output Power	802.11n (20 MHz)	MCS0	1/6/11
	802.11n (40 MHz)	MCS0	3/6/9
Power Spectral Density	802.11n (20 MHz)	MCS0	1/6/11
	802.11n (40 MHz)	MCS0	3/6/9
Conducted Spurious Emission, Radiated Spurious Emission, Band edge Emission	802.11n (20 MHz)	MCS0	1/6/11
	802.11n (40 MHz)	MCS0	3/6/9

*The worst data rate was determined by the conducted output power that generates the highest emission performing pre-scan testing in all data rates of each mode.

3.2 Support Equipment

EUT	Healcerion Co., Ltd Model : SWM-500	S/N: N/A
Laptop Computer	LG Model : 14Z970	FCC DOC S/N : 701NZFQ065883
AC/DC Adapter	LG Model : LCAP48-WK 1.5 m unshielded power cable	FCC DOC S/N : N/A

3.3 Setup Drawing



3.4 EUT Information

The EUT is the **Healcerion Co., Ltd Wifi Module FCC ID: 2ADXVSWM500, IC: 12712A-SWM500.**

Specifications:

EUT Type	Wifi Module
Model Name	SWM-500
Brand Name	Healcerion Co., Ltd.
Frequency of Operation	802.11n (20 MHz) : 2412 MHz ~ 2462 MHz 802.11n (40 MHz) : 2422 MHz ~ 2452 MHz
Maximum Conducted Output Power	802.11n (20 MHz) : 7.07 dBm 802.11n (40 MHz) : 6.68 dBm
FCC Classification	Digital Transmission System (DTS)
Number of Channels	802.11b,g,n (20 MHz): 11 CH 802.11n (40 MHz): 7 CH
Modulations	OFDM(BPSK,QPSK,16QAM,64QAM) for 802.11n
Antenna Gain (peak)	2.5 dBi
Antenna Setup	802.11n (20, 40MHz) : 1TX / 1RX
Voltage	3.3 Vdc, 1.8 Vdc
Temperature Range	-20 ℃ ~ +50 ℃
Size (L x W x H)	About 20 mm x 25 mm x 1 mm
Weight	About 1 g
HVIN (Hardware Version Number)	SWM500
FVIN (Firmware Version Identification Number)	SWM500_1.0
Remarks	-

4. SUMMARY OF TEST RESULTS

The EUT has been tested according to the following specification:

Name of Test	FCC Paragraph No.	IC Paragraph No.	Result	Remark
Radiated Emission	15.209	RSS-GEN Issue 4 8.9	Complies	
6 dB Bandwidth	15.247(a)(2)	RSS-247 Issue 2 5.2	Complies	
Maximum Conducted Output Power	15.247(b)(3)	RSS-247 Issue 2 5.4	Complies	
Power Spectral Density	15.247(e)	RSS-247 Issue 2 5.2	Complies	
Conducted Spurious Emission	15.247(d)	RSS-247 Issue 2 5.5	Complies	
Radiated Spurious Emission	15.247(d)	RSS-247 Issue 2 5.5	Complies	
Maximum Permissible Exposure	1.1307(b)	RSS-102 Issue 5	Complies	

5. RECOMMENDATION/CONCLUSION

The data collected shows that the **Healcerion Co., Ltd Wifi Module FCC ID: 2ADXVSWM500, IC: 12712A-SWM500** is in compliance with Part 15.247 of the FCC Rule and RSS-247 Issue 2 of the IC Specification.

6. ANTENNA REQUIREMENTS

§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.

The antenna of the **Healcerion Co., Ltd Wifi Module FCC ID: 2ADXVSWM500, IC: 12712A-SWM500** is **permanently attached** and there are no provisions for connection to an external antenna. It complies with the requirement of §15.203.

7. DESCRIPTION OF TESTS

7.1 Radiated Emissions

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(Rohde&Schwarz, HFH2-Z2) and 30 to 1000 MHz using Trilog broadband test antenna(Schwarzbeck, VULB 9163). Above 1 GHz, Horn antenna (Schwarzbeck BBHA 9120D: up to 18 GHz, Q-par Angus QSH20S20 : 18 to 26.5 GHz) 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.

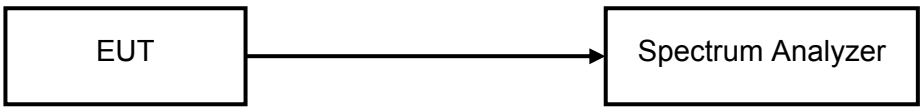
At frequencies below 1000 MHz, measurements performed using the CISPR quasi-peak detection. At frequencies above 1000 MHz, measurements performed using the peak and average measurement procedures described in KDB “558074 D01 DTS Meas Guidance v04” in section 12.2.4 and 12.2.5.3. Peak emission levels 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 = 1kHz, 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) and RSS-GEN Issue 4 8.9

7.2 6 dB Bandwidth

Test Setup

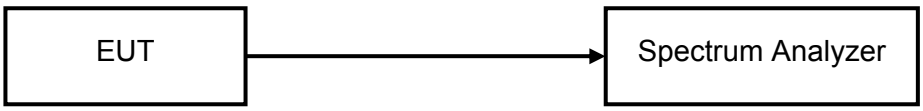


Test Procedure

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

7.3 Maximum Conducted Output Power (average)

Test Setup

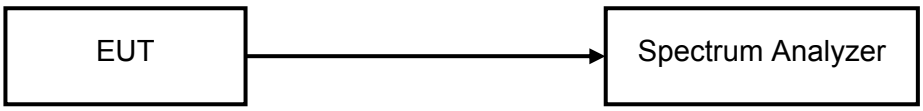


Test Procedure

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 1MHz
VBW ≥ 3 x RBW.
Number of points in sweep ≥ 2 x span / RBW
Sweep time = auto couple
Detector = RMS
Trace average at least 100 traces in power averaging mode.
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.

7.4 Maximum Power Spectral Density (average)

Test Setup



Test Procedure

EUTs Maximum Power Spectral Density (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.

Center frequency = DTS channel center frequency

Span = at least 1.5 times the DTS bandwidth

RBW : 3 kHz $\leq$ RBW $\leq$ 100 kHz

VBW $\geq$ 3 x RBW

Detector = power averaging (RMS)

Ensure that the number of measurement points = sweep $\geq$ 2 x span / RBW

Sweep time = auto couple

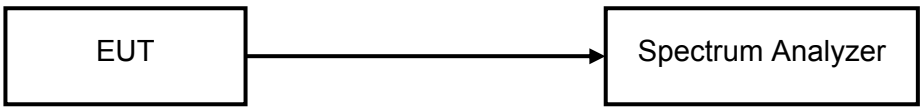
Employ trace averaging (RMS) = minimum of 100 traces

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

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

7.5 Conducted Spurious Emissions

Test Setup



Test Procedure

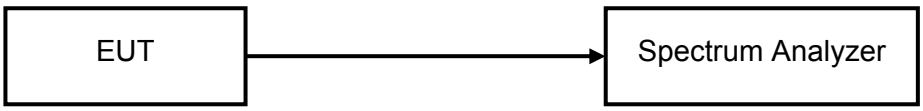
EUTs Conducted spurious emissions are measured at low, middle, high channels with a spectrum analyzer connected to the antenna terminal while the EUTs operating at its maximum power control level. The spectrum analyzer setting is as follows.

1) Reference Level
Center frequency = DTS channel center frequency
Span ≥ 1.5 x DTS bandwidth
RBW = 100 kHz
VBW ≥ 3 x 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 ≥ 3 x 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.

7.6 Duty Cycle

Test Setup



Test Procedure

EUTs duty cycle are measured at middle channel 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 = Center frequency of the transmission
Span = zero
RBW = 8 MHz
VBW = 8 MHz
Detector = peak
Sweep time = at least 3 ms
Sweep mode = Single
The marker function on the spectrum analyzer is used to determine the duty cycle.

The results of the duty cycle measurement according to the above test procedure.

	Data rate	On time (ms)	On + Off time (ms)	Duty Cycle (%)	Duty Factor (dB)
n(20MHz)mode	MCS0	-	-	100	-
n(40MHz)mode	MCS0	-	-	100	-

8. TEST DATA

8.1 Radiated Emissions

FCC §15.209, IC RSS-Gen Issue 4 8.9

Frequency (MHz)	Reading (dBµV/m)	Pol* (H/V)	Antenna Heights (cm)	Turntable Angles (°)	AF+CL+Amp (dB)**	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
395.96	51.05	H	100	277	-18.3	32.8	46.0	13.3
483.96	57.26	H	177	138	-16.5	40.8	46.0	5.2
571.96	54.70	H	170	303	-14.4	40.3	46.0	5.7
659.96	45.49	H	330	327	-13.1	32.4	46.0	13.6
748.02	46.37	H	100	148	-12.3	34.1	46.0	11.9
881.88	49.24	H	410	12	-10.6	38.6	46.0	7.4

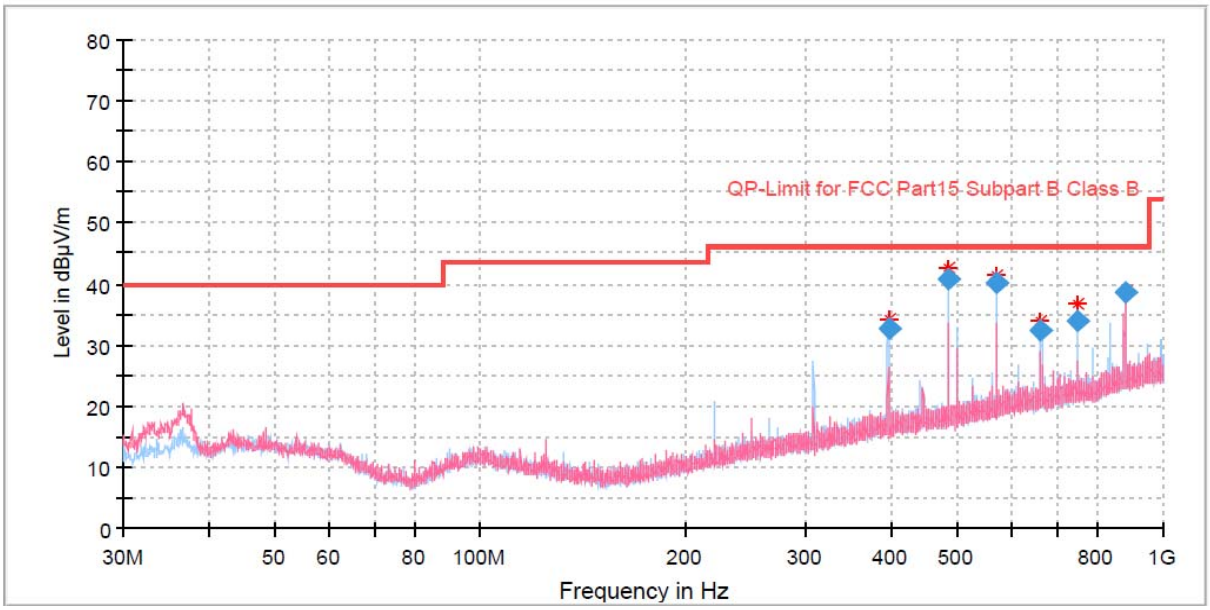
Radiated Measurements at 3meters

Notes:

1. *All modes were measured and the worst-case emission was reported.*
2. *The radiated limits are shown on Table 1. Above 1 GHz the limit is 500 µV/m.*
3. **Pol. H = Horizontal, V = Vertical*
4. ***AF + CL + Amp. = Antenna Factor + Cable Loss + Amplifier.*
5. *Measurements using CISPR quasi-peak mode below 1 GHz.*
6. *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.*
7. *Highest channel (2462MHz) in n (20MHz) mode is the worst case.*
8. *No emission found between lowest internal used/generated frequency to 30MHz (9kHz~30MHz).*
9. *The limit is on the FCC §15.209 and RSS-Gen Issue4 8.9.*

PLOTS OF EMISSIONS

Radiated emission below 1GHz_ n mode 2462 MHz



8.2 6 dB Bandwidth

FCC §15.247(a)(2), IC RSS-247 Issue 2 5.2

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

802.11n (20 MHz) mode

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limit (MHz)	Margin (MHz)
Lowest	2412	17.62	0.50	17.12
Middle	2437	17.82	0.50	17.32
Highest	2462	17.80	0.50	17.30

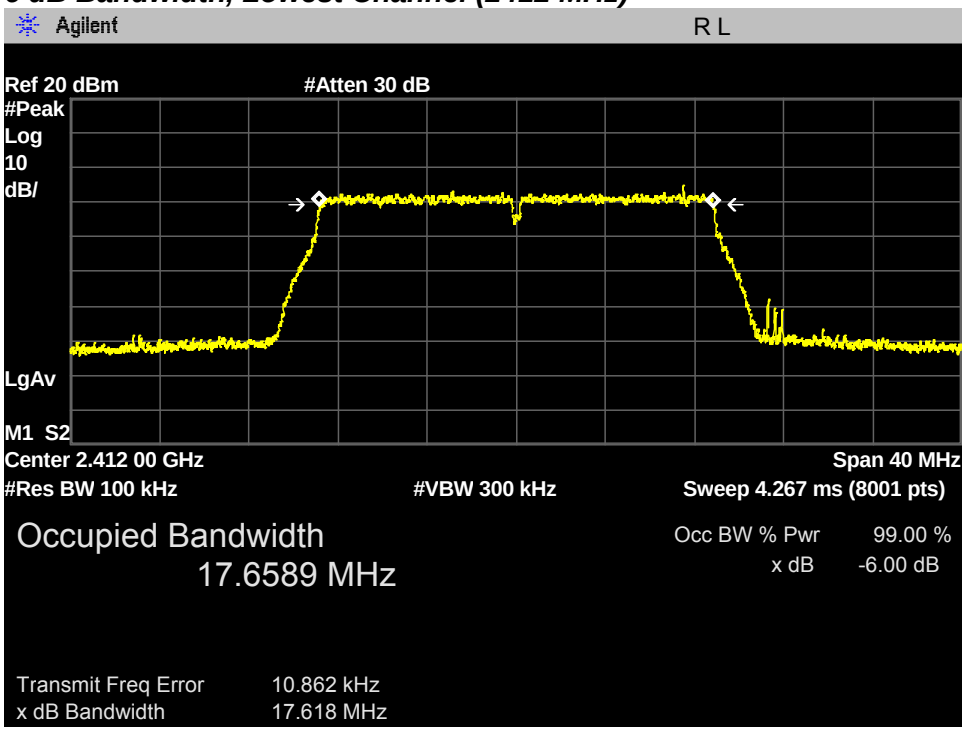
802.11n (40 MHz) mode

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Limit (MHz)	Margin (MHz)
Lowest	2412	36.55	0.50	36.05
Middle	2437	36.39	0.50	35.89
Highest	2462	36.48	0.50	35.98

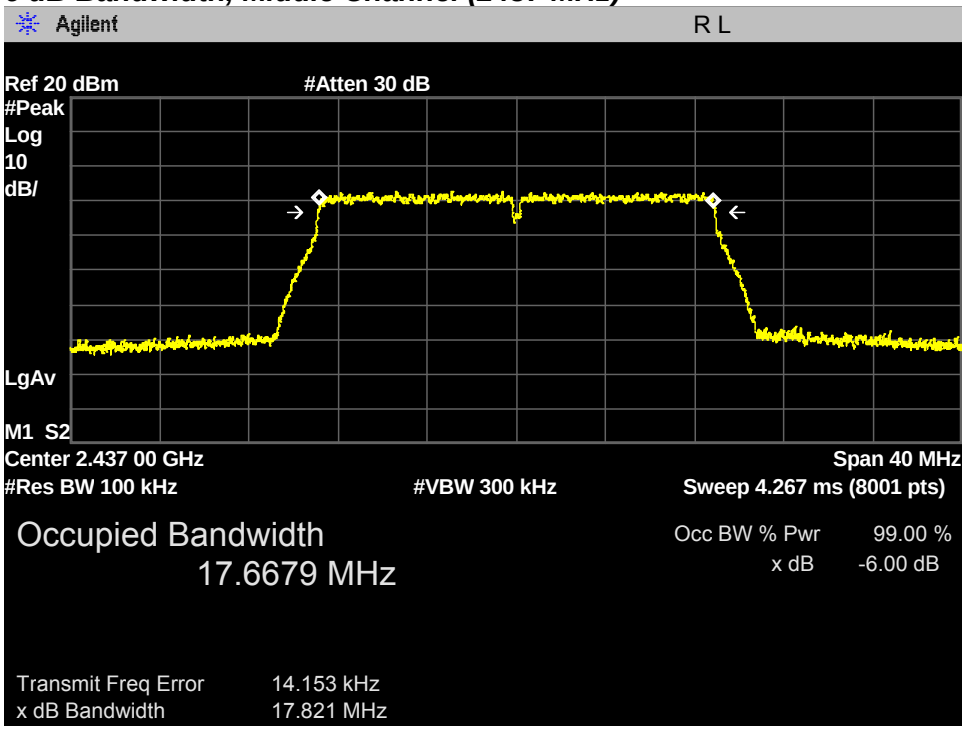
PLOTS OF EMISSIONS

802.11n (20 MHz) mode

6 dB Bandwidth, Lowest Channel (2412 MHz)

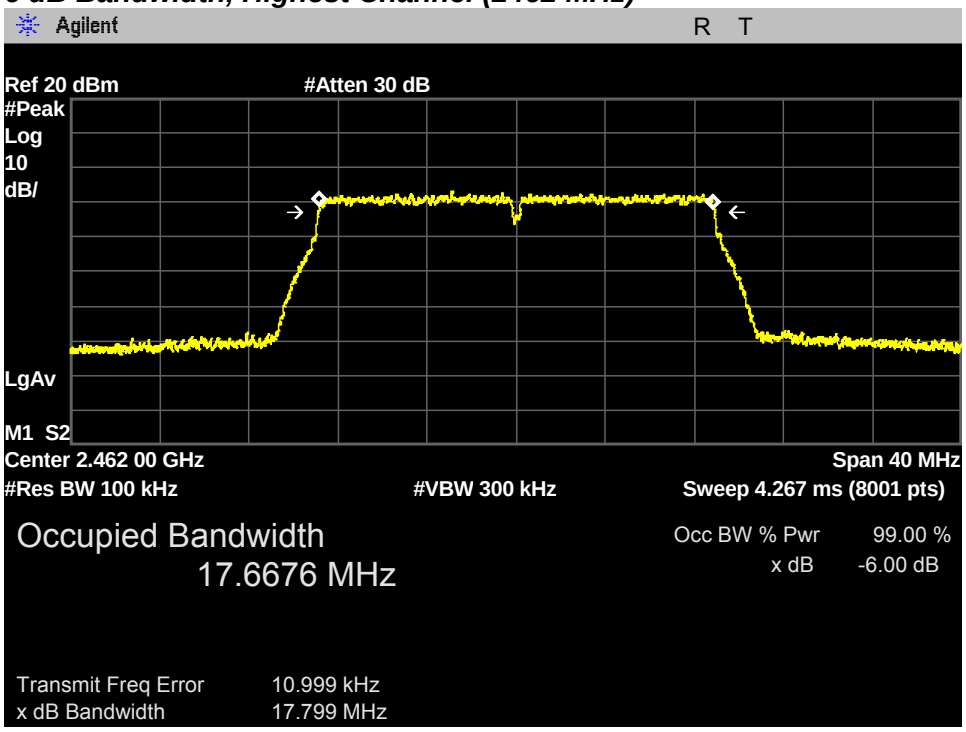


6 dB Bandwidth, Middle Channel (2437 MHz)



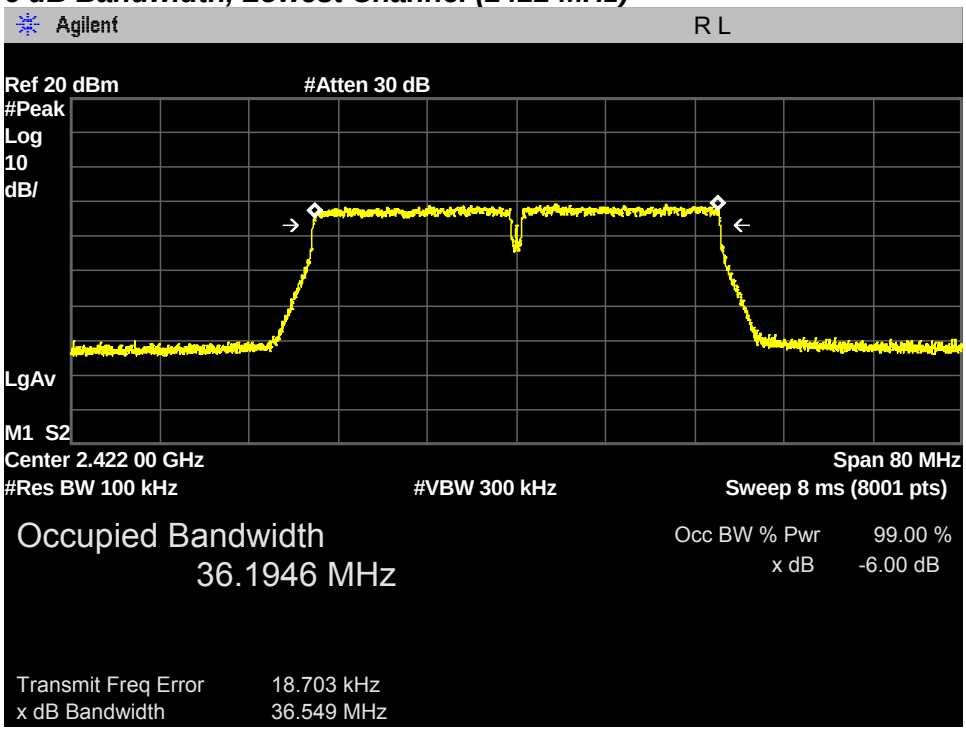
PLOTS OF EMISSIONS

6 dB Bandwidth, Highest Channel (2462 MHz)



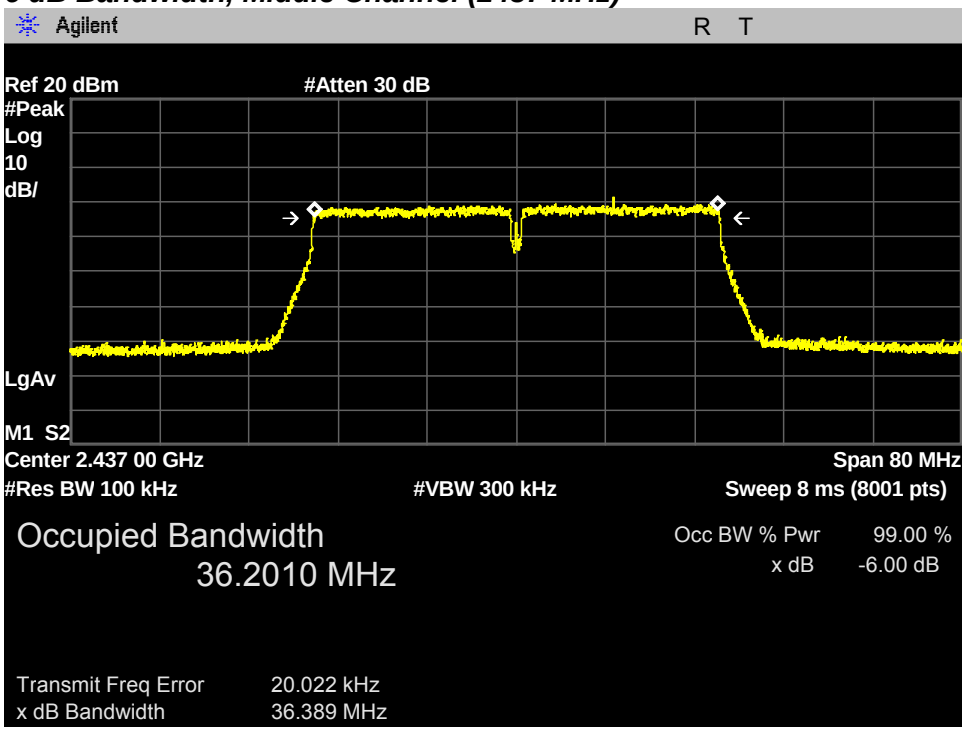
802.11n (40 MHz) mode

6 dB Bandwidth, Lowest Channel (2422 MHz)

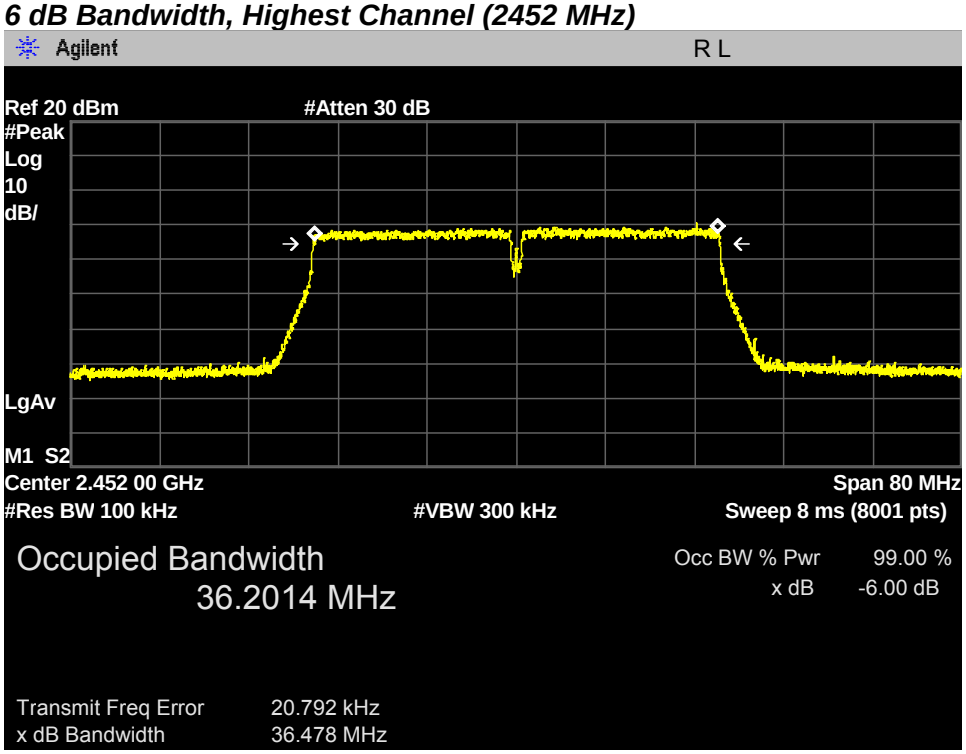


PLOTS OF EMISSIONS

6 dB Bandwidth, Middle Channel (2437 MHz)



6 dB Bandwidth, Highest Channel (2452 MHz)



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

FCC §15.247(b)(3), IC RSS-247 Issue 2 5.4

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

802.11n (20MHz) mode

Channel	Frequency (MHz)	Maximum Conducted Power (dBm)	Limit (dBm)	Margin (dBm)	E.I.R.P (dBm)	E.I.R.P Limit (dBm)	E.I.R.P Margin (dBm)
Lowest	2412	7.07	30.00	22.93	9.57	36.00	26.43
Middle	2437	6.98	30.00	23.02	9.48	36.00	26.52
Highest	2462	6.98	30.00	23.02	9.48	36.00	26.52

802.11n (40MHz) mode

Channel	Frequency (MHz)	Maximum Conducted Power (dBm)	Limit (dBm)	Margin (dBm)	E.I.R.P (dBm)	E.I.R.P Limit (dBm)	E.I.R.P Margin (dBm)
Lowest	2422	6.44	30.00	23.56	8.94	36.00	27.06
Middle	2437	6.68	30.00	23.32	9.18	36.00	26.82
Highest	2452	6.33	30.00	23.67	8.83	36.00	27.17

TEST DATA

Note:

1. *E.I.R.P was calculated by following equation according to KDB412172 D01 Determining ERP and EIRP v01r01.*

   E.I.R.P = P_T + G_T – Lc

   P_T = transmitter outputpower (dBm)

   *G_T = Gain of the transmitting antenna in dBi, Peak antenna gain is **2.5 dBi.***

   L_C = Signal attenuation in the connecting cable between the transmitter and antenna in dB. This factor of an integral antenna is negligible.

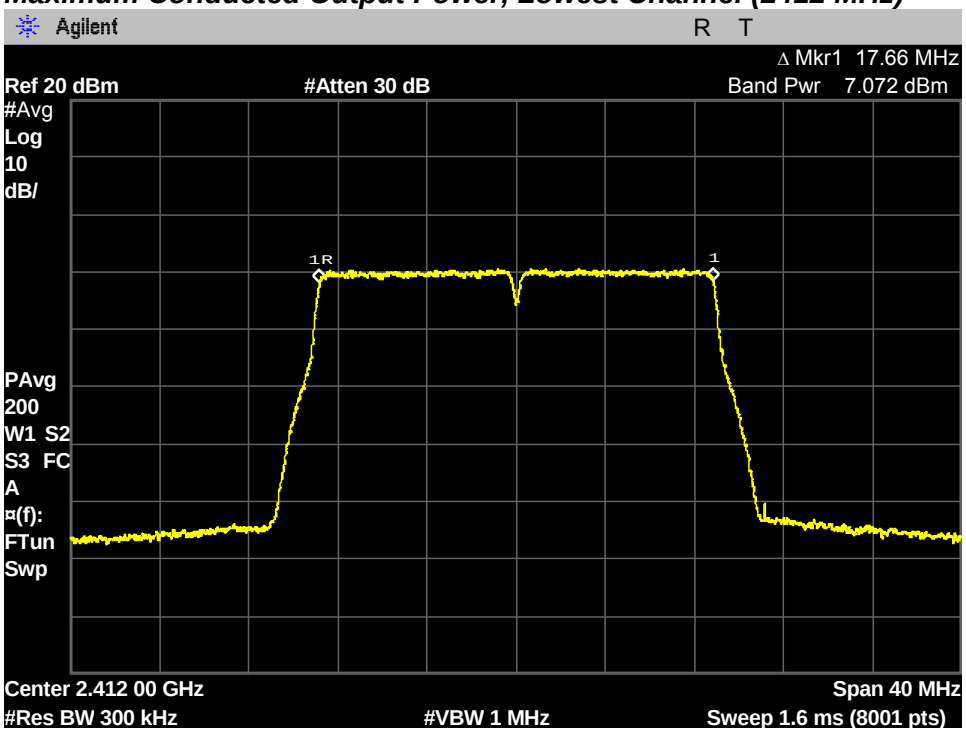
2. *The following equation was used for spectrum offset:*

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

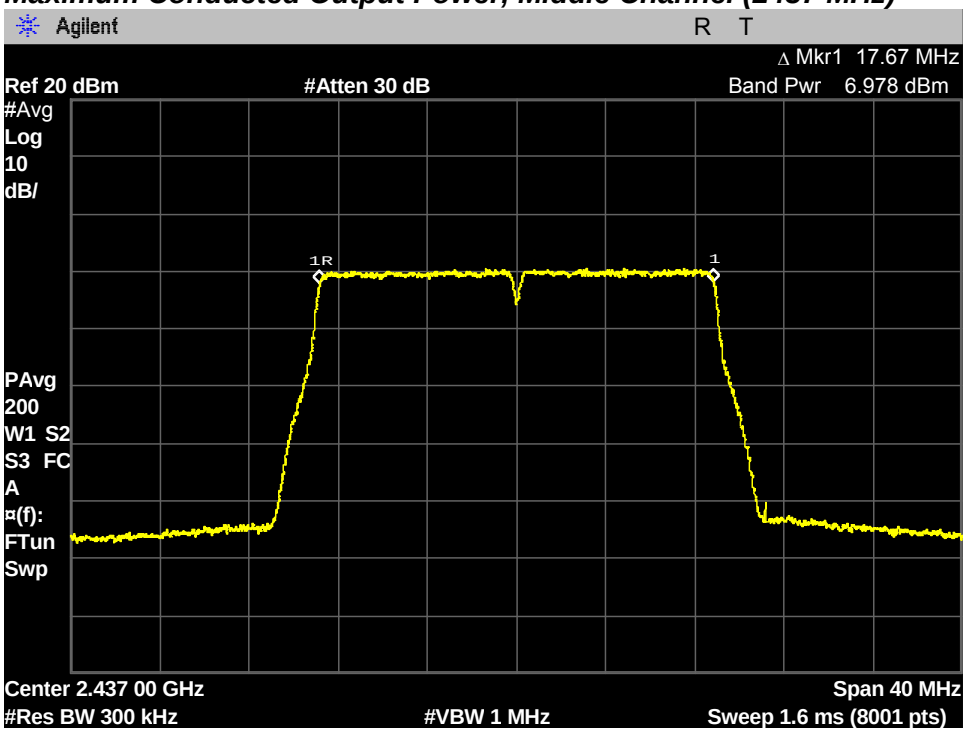
PLOT OF TEST DATA

802.11n (20 MHz) mode

Maximum Conducted Output Power, Lowest Channel (2412 MHz)

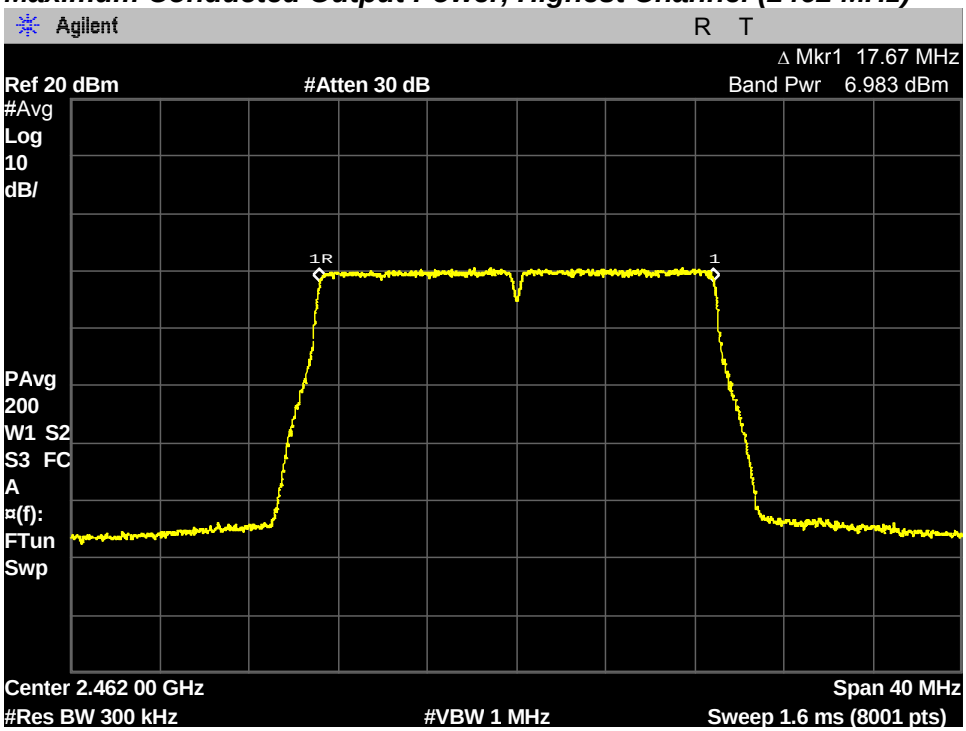


Maximum Conducted Output Power, Middle Channel (2437 MHz)



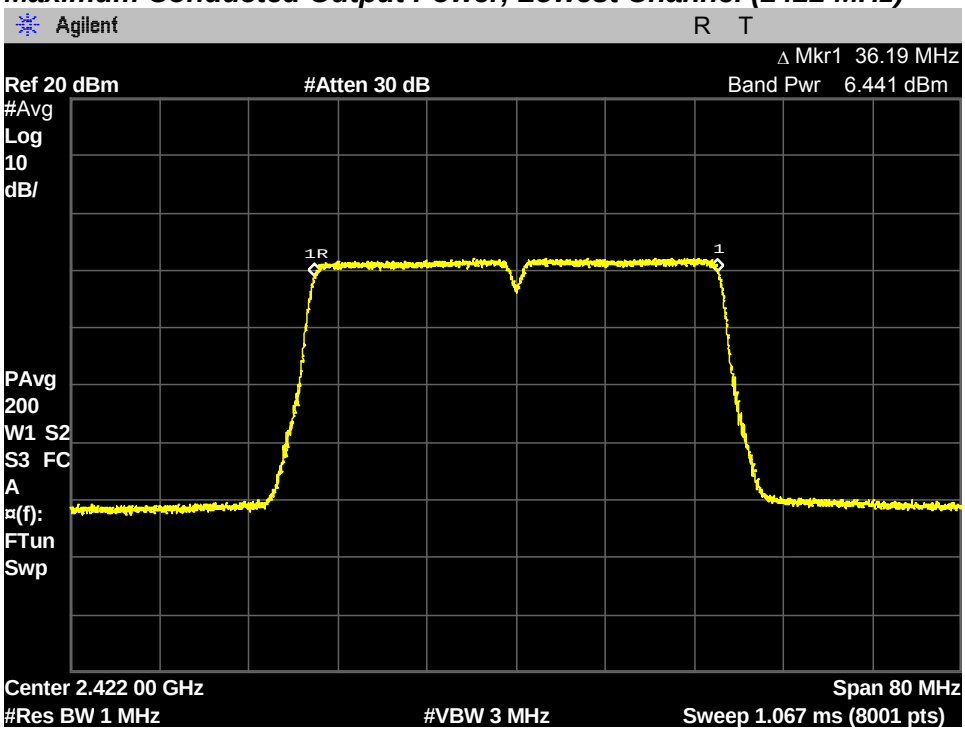
PLOT OF TEST DATA

Maximum Conducted Output Power, Highest Channel (2462 MHz)



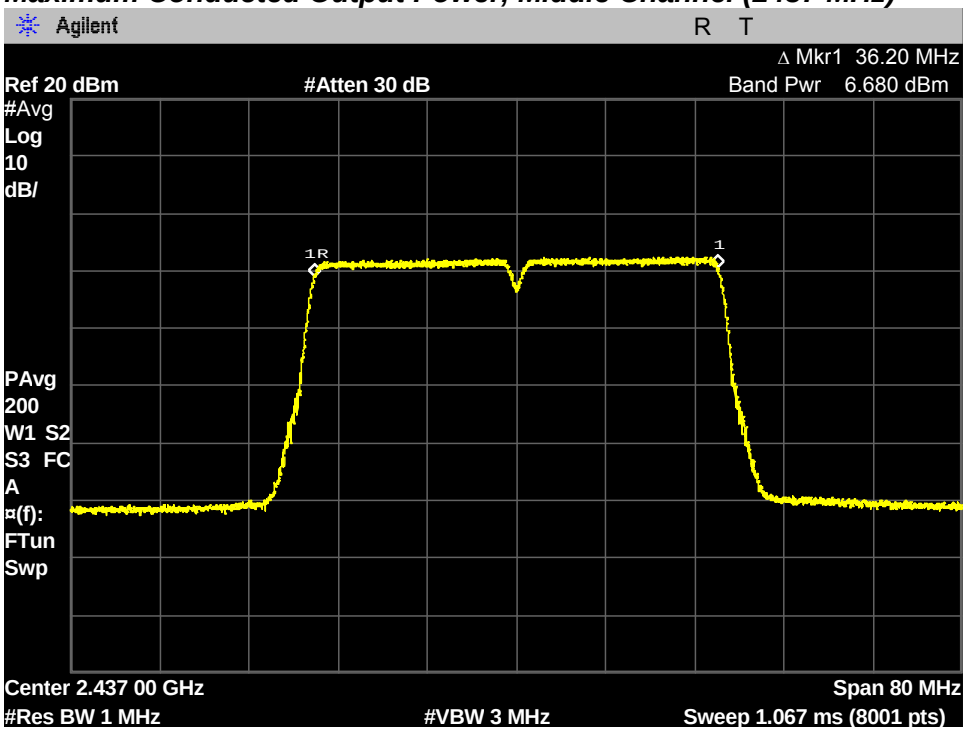
802.11n (40 MHz) mode

Maximum Conducted Output Power, Lowest Channel (2422 MHz)

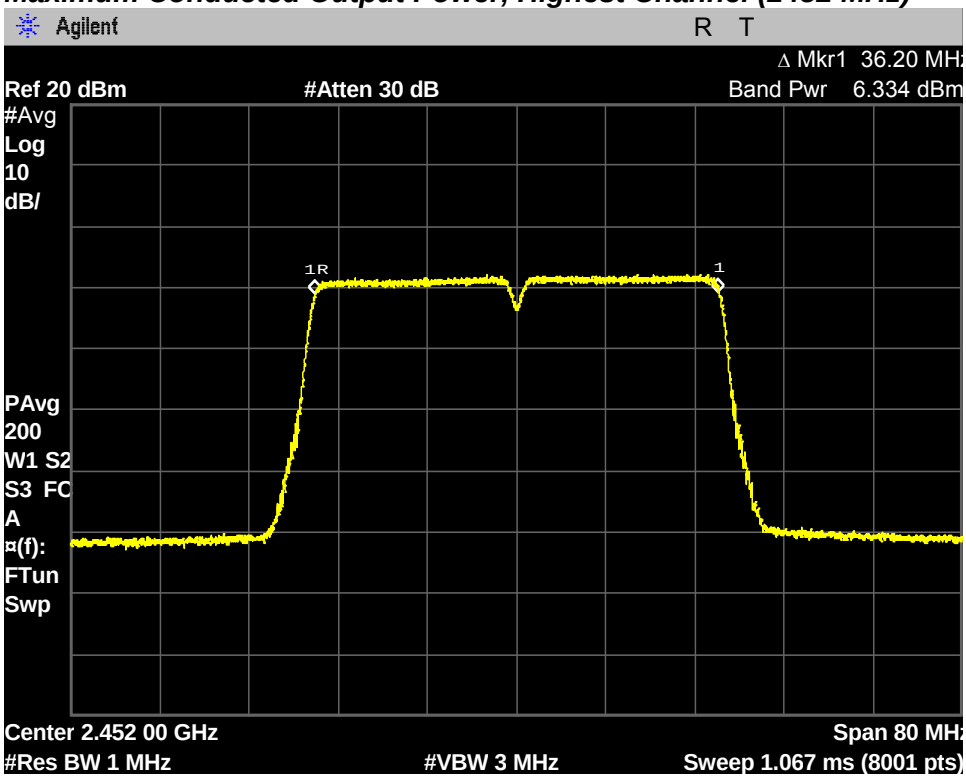


PLOT OF TEST DATA

Maximum Conducted Output Power, Middle Channel (2437 MHz)



Maximum Conducted Output Power, Highest Channel (2452 MHz)



8.4 Maximum Power Spectral Density (average)

FCC §15.247(e), IC RSS-247 Issue 2 5.2

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

802.11n (20 MHz) mode

Channel	Frequency (MHz)	Maximum PSD (dBm)	Limit (dBm)	Margin (dBm)
Lowest	2412	-13.05	8.00	21.05
Middle	2437	-13.35	8.00	21.35
Highest	2462	-13.37	8.00	21.37

802.11n (40 MHz) mode

Channel	Frequency (MHz)	Maximum PSD (dBm)	Limit (dBm)	Margin (dBm)
Lowest	2422	-16.77	8.00	24.77
Middle	2437	-16.70	8.00	24.70
Highest	2452	-16.90	8.00	24.90

Note:

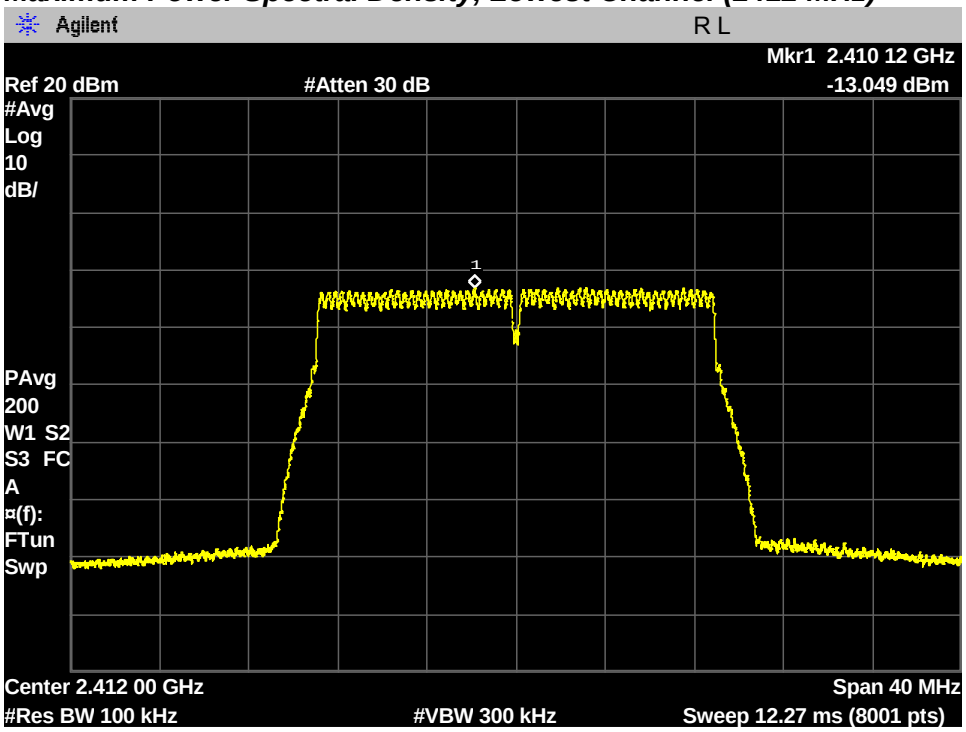
The following equation was used for spectrum offset:

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

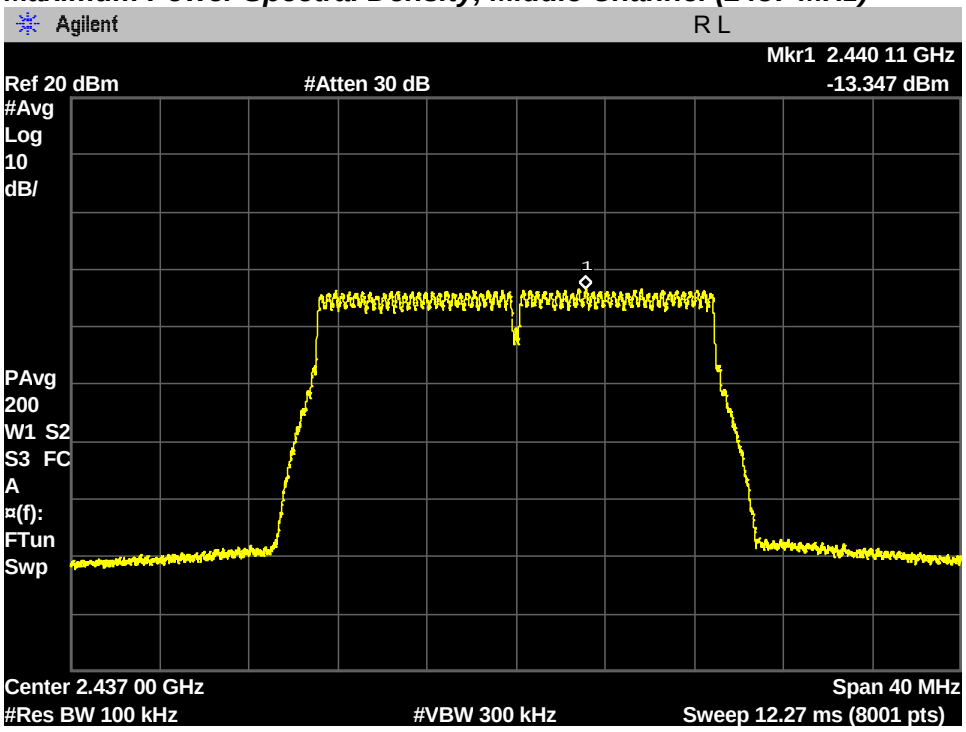
PLOT OF TEST DATA

802.11n (20 MHz) mode

Maximum Power Spectral Density, Lowest Channel (2412 MHz)

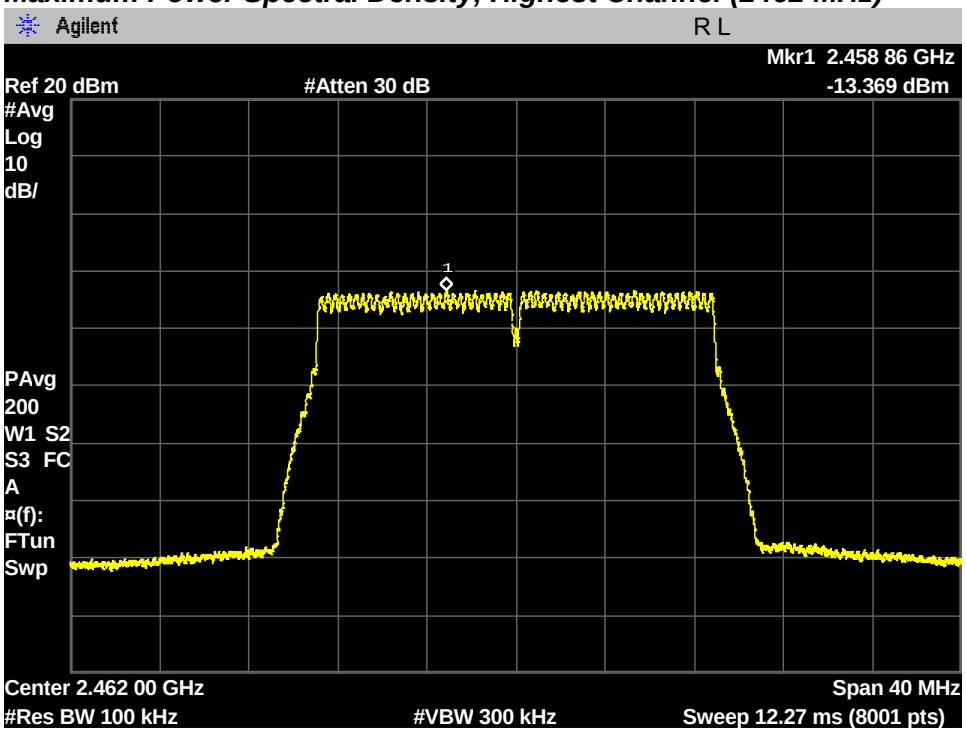


Maximum Power Spectral Density, Middle Channel (2437 MHz)



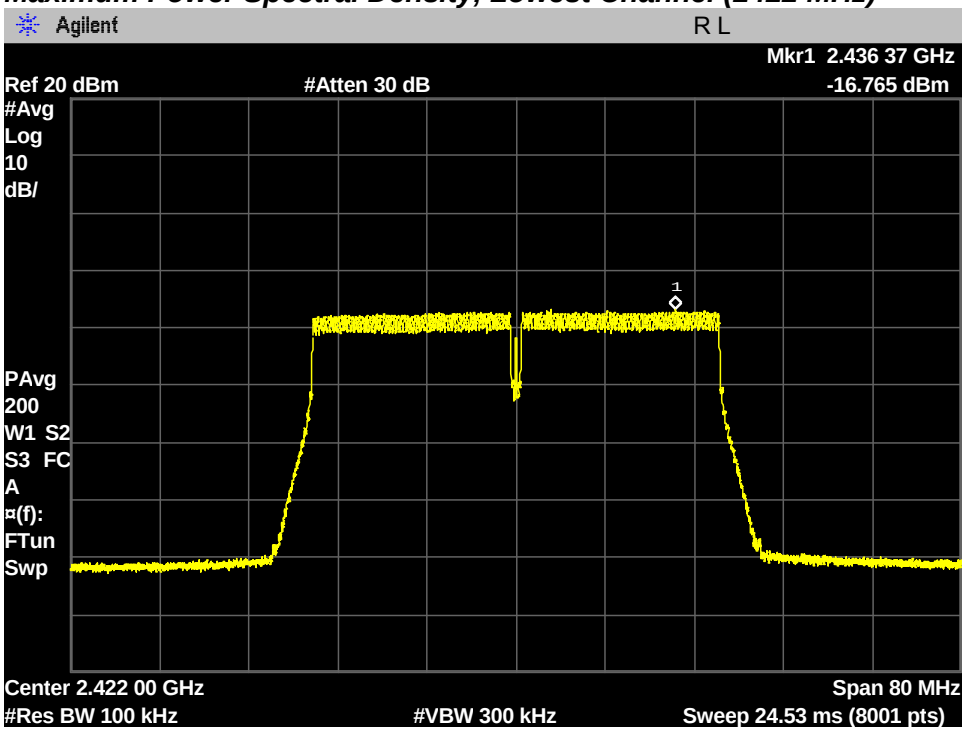
PLOT OF TEST DATA

Maximum Power Spectral Density, Highest Channel (2462 MHz)



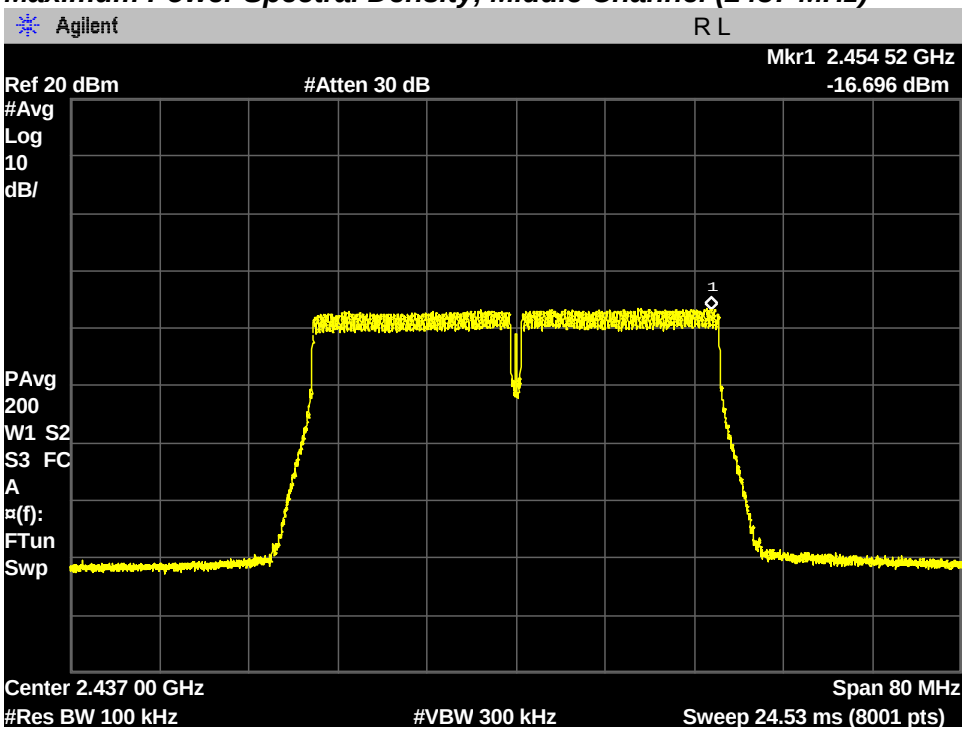
802.11n (40 MHz) mode

Maximum Power Spectral Density, Lowest Channel (2422 MHz)

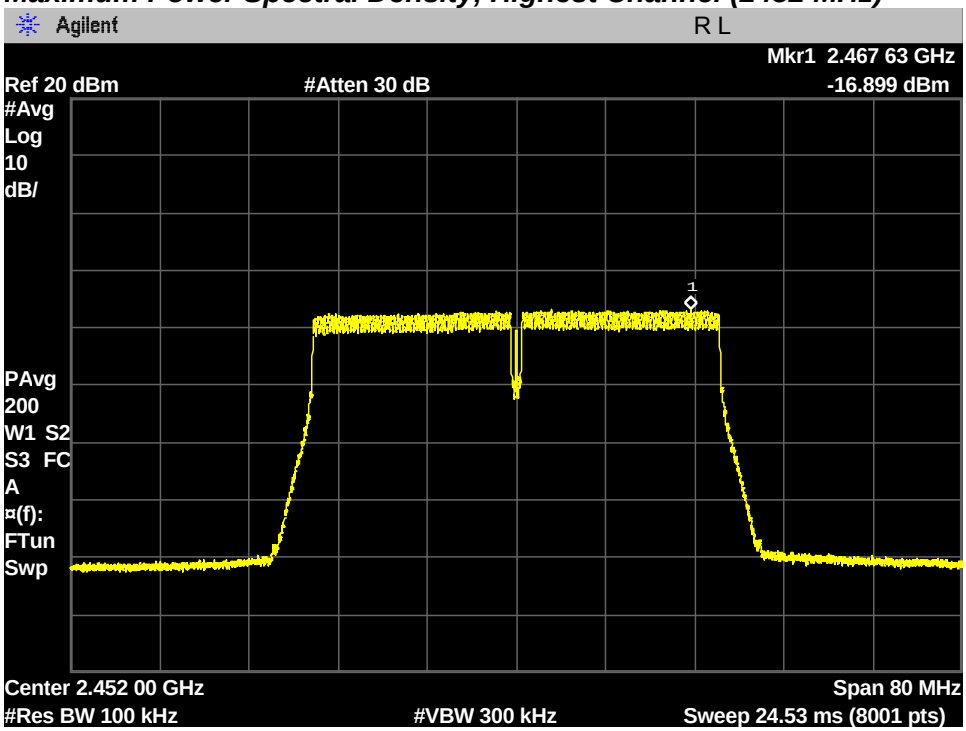


PLOT OF TEST DATA

Maximum Power Spectral Density, Middle Channel (2437 MHz)



Maximum Power Spectral Density, Highest Channel (2452 MHz)



8.5 Conducted Spurious Emissions

FCC §15.247(d), IC RSS-247 Issue 2 5.5

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

802.11n (20 MHz) mode

Channel	Frequency (MHz)	Reference Level (dBm)	Conducted Spurious Emissions (dBc)	Limit (dBc)
Low	2412	-6.70	More than 30 dBc	30
Middle	2437	-7.05	More than 30 dBc	30
High	2462	-6.93	More than 30 dBc	30

802.11n (40 MHz) mode

Channel	Frequency (MHz)	Reference Level (dBm)	Conducted Spurious Emissions (dBc)	Limit (dBc)
Low	2422	-11.01	More than 30 dBc	30
Middle	2437	-10.26	More than 30 dBc	30
High	2452	-8.17	More than 30 dBc	30

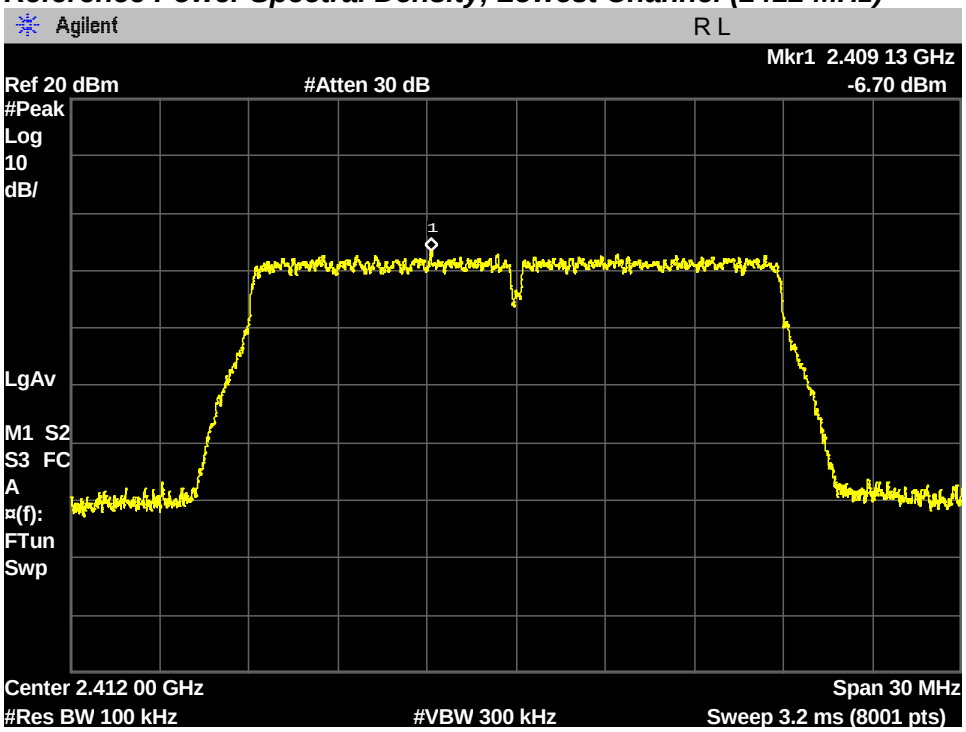
Notes:

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.

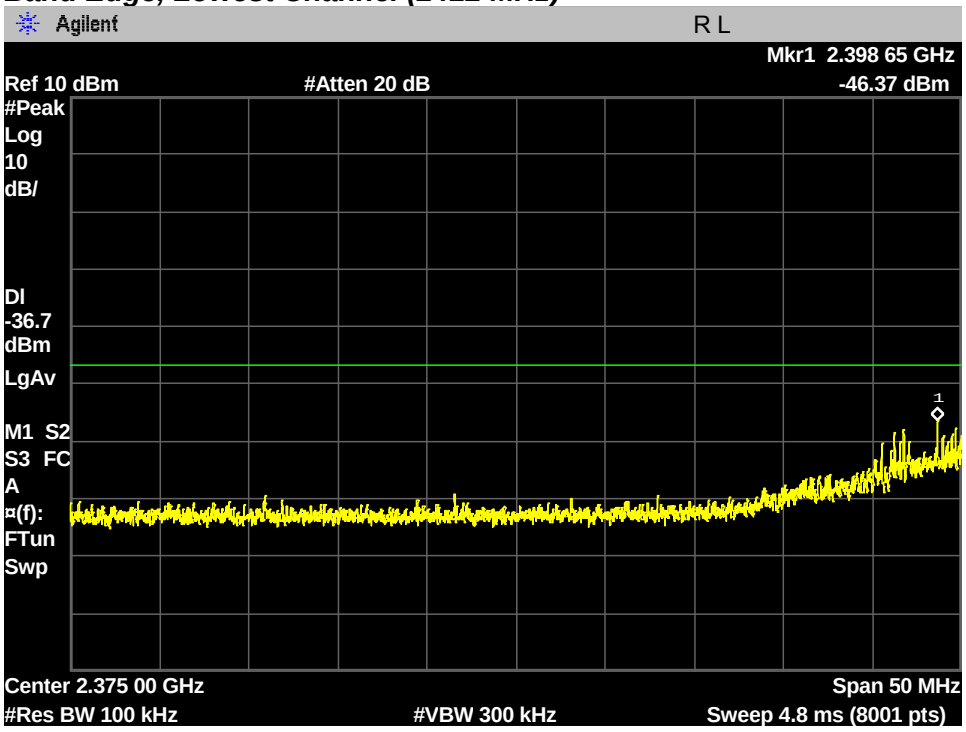
PLOT OF TEST DATA

802.11n (20 MHz) mode

Reference Power Spectral Density, Lowest Channel (2412 MHz)

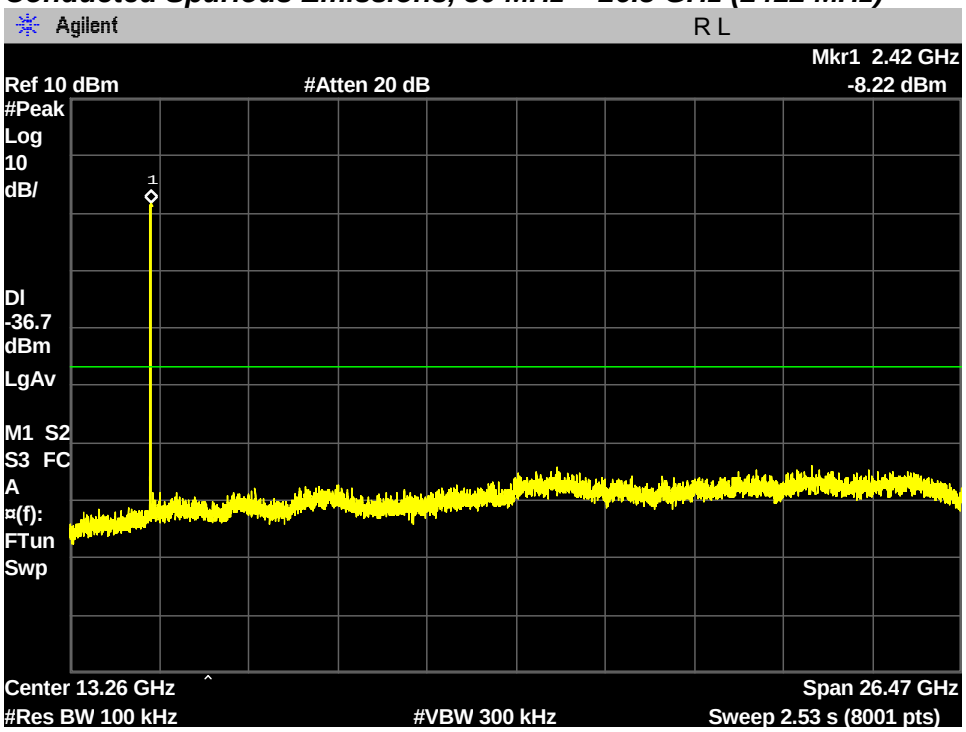


Band Edge, Lowest Channel (2412 MHz)

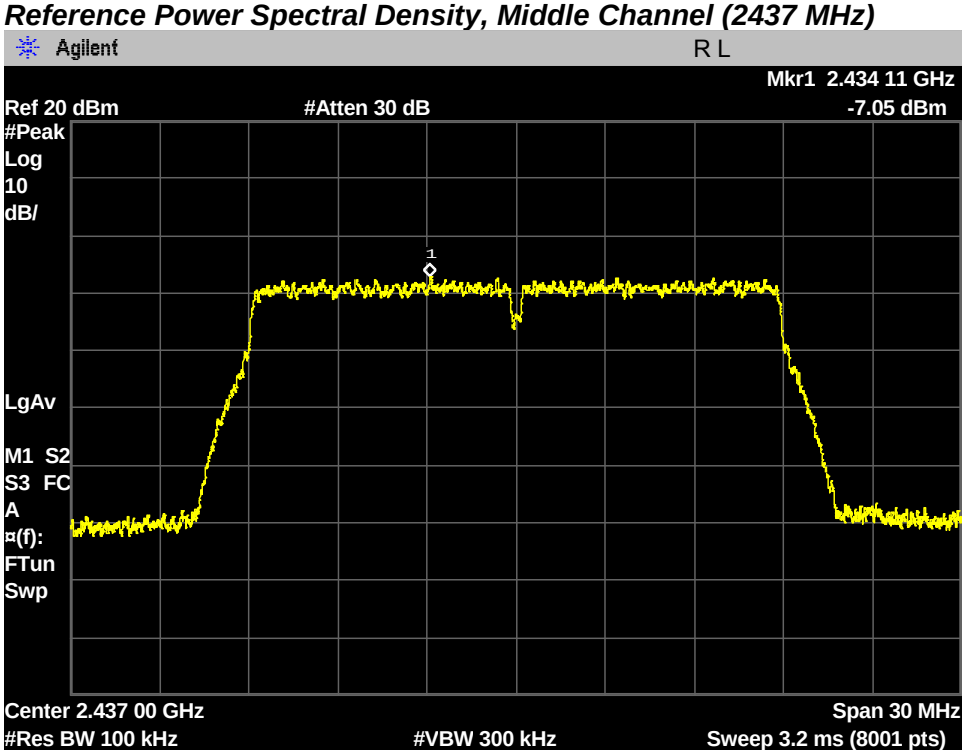


PLOT OF TEST DATA

Conducted Spurious Emissions, 30 MHz ~ 26.5 GHz (2412 MHz)

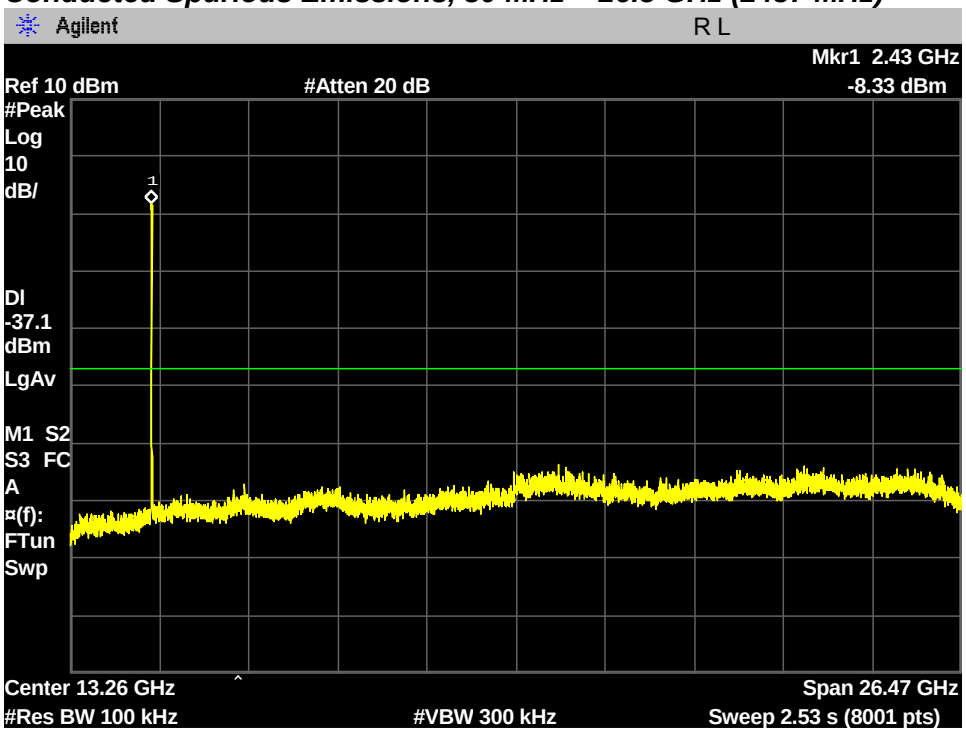


Reference Power Spectral Density, Middle Channel (2437 MHz)

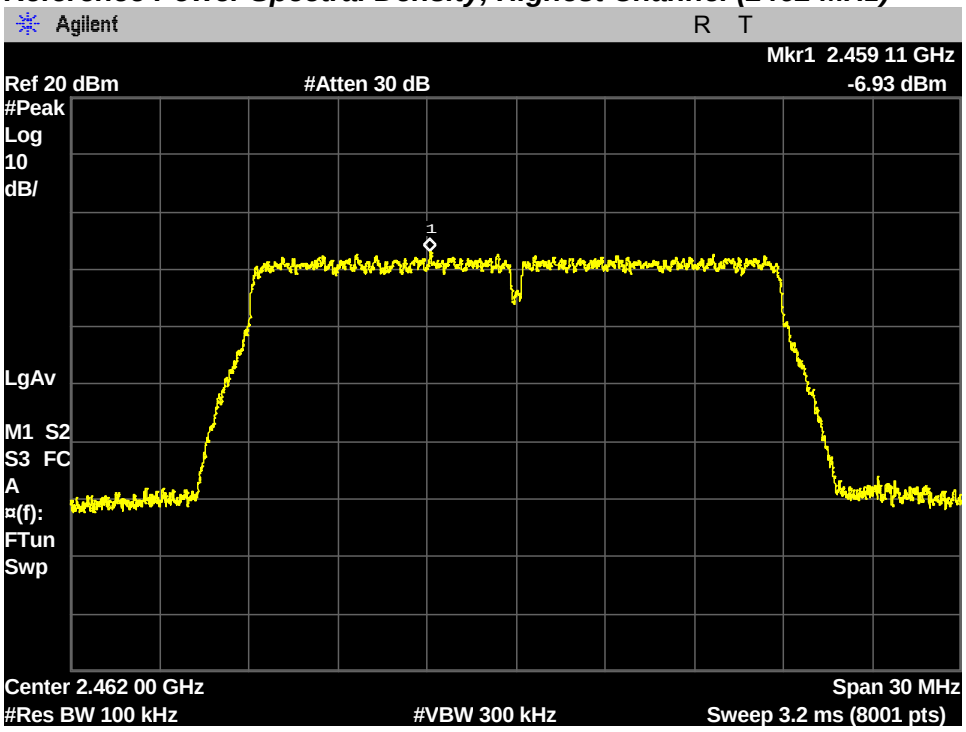


PLOT OF TEST DATA

Conducted Spurious Emissions, 30 MHz ~ 26.5 GHz (2437 MHz)

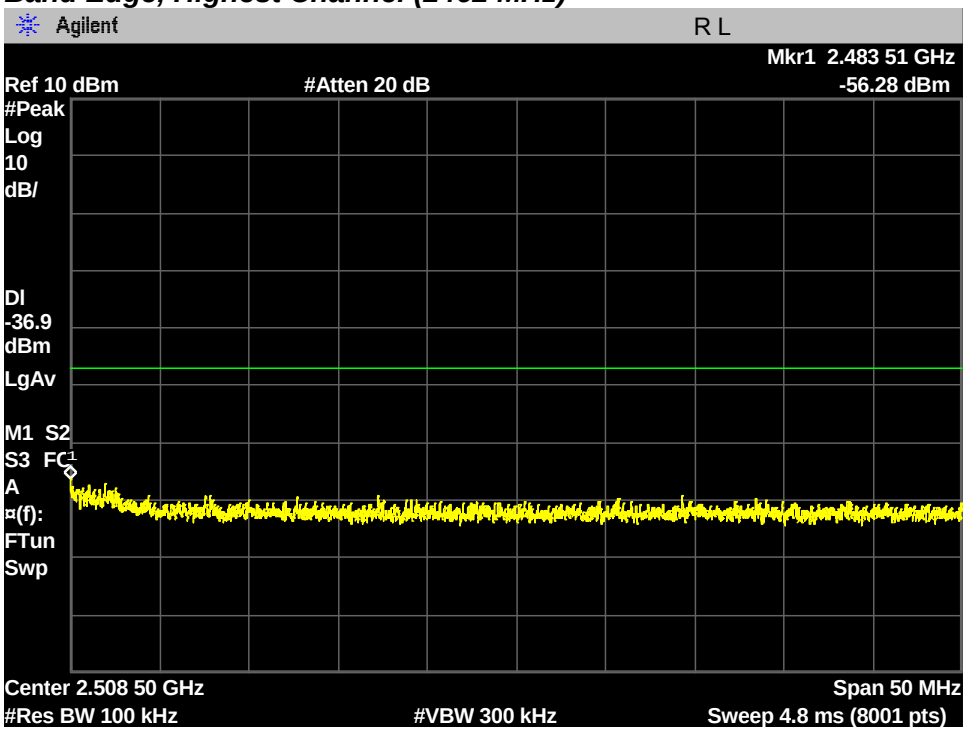


Reference Power Spectral Density, Highest Channel (2462 MHz)

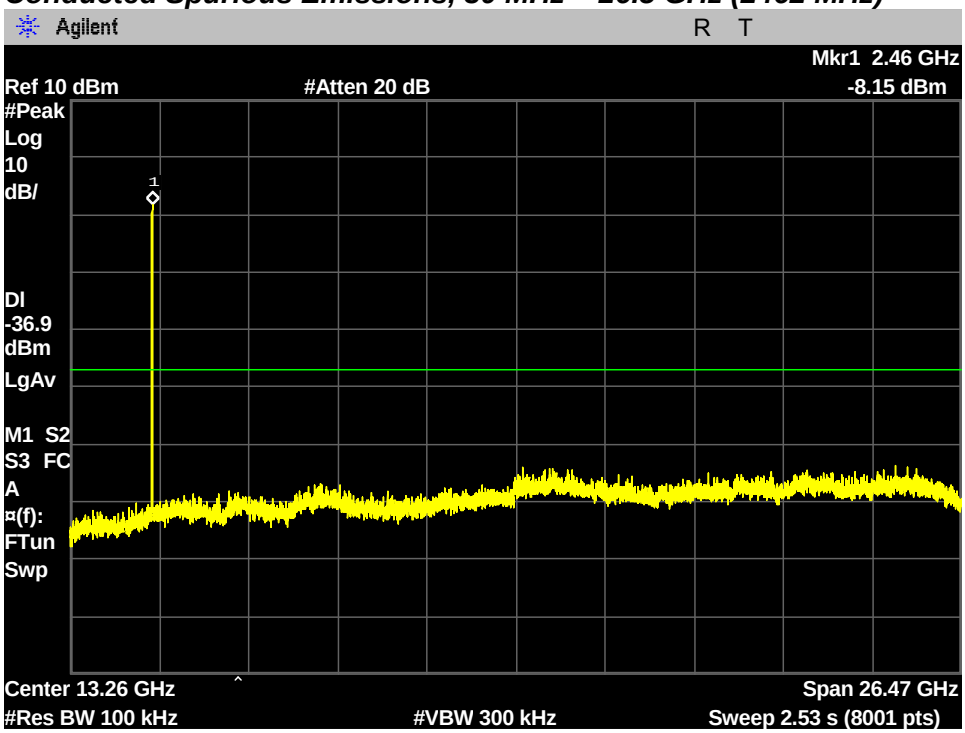


PLOT OF TEST DATA

Band Edge, Highest Channel (2462 MHz)



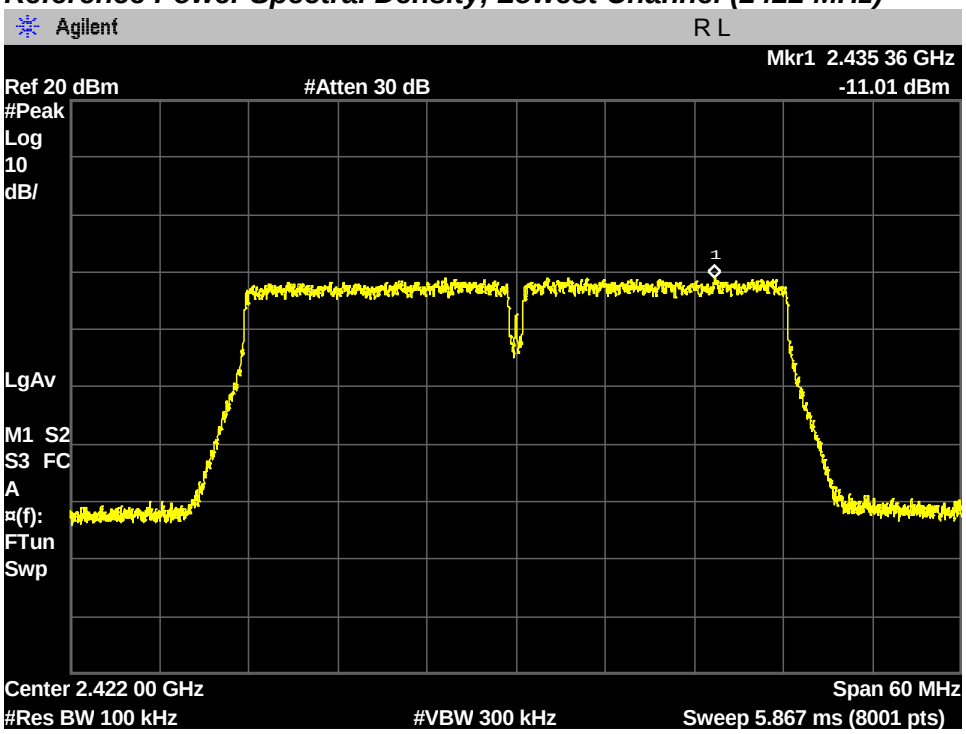
Conducted Spurious Emissions, 30 MHz ~ 26.5 GHz (2462 MHz)



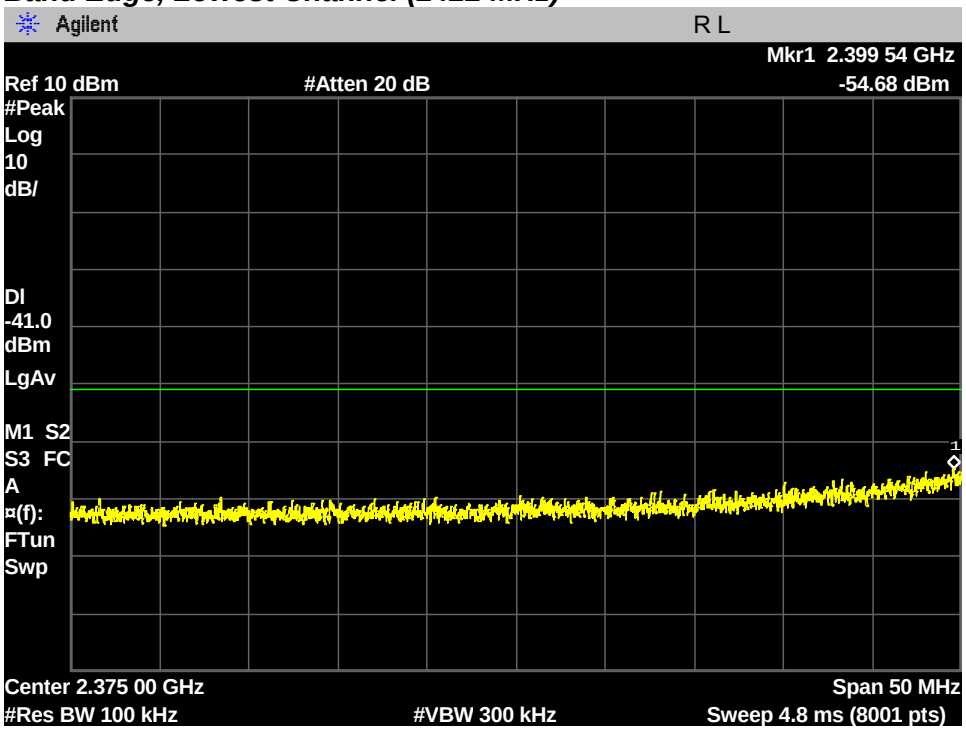
PLOT OF TEST DATA

802.11n (40 MHz) mode

Reference Power Spectral Density, Lowest Channel (2422 MHz)

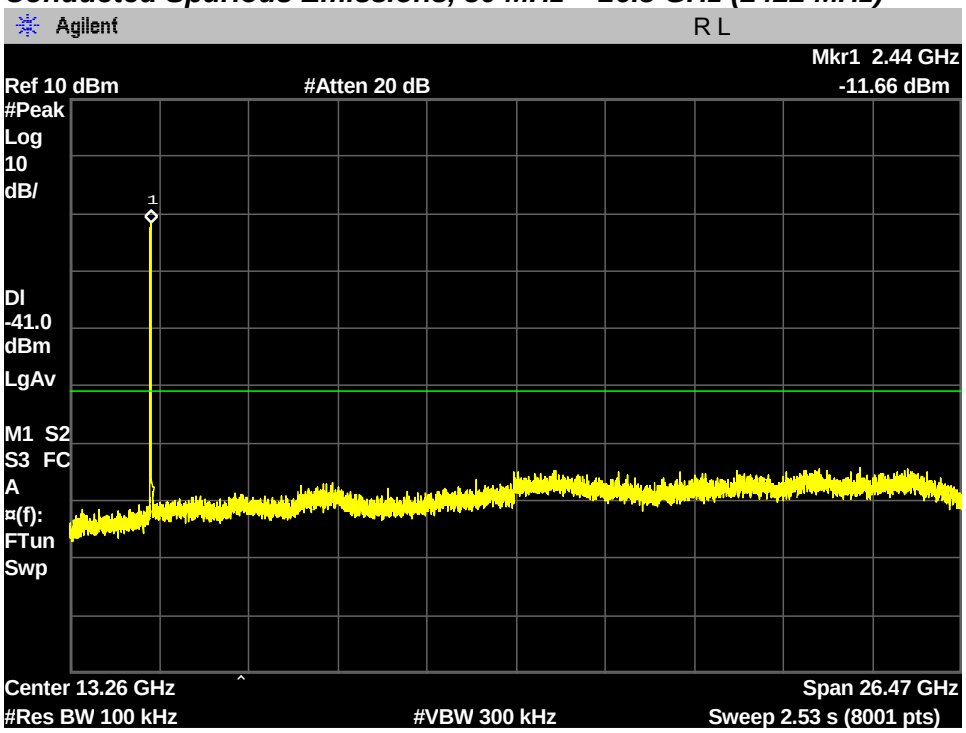


Band Edge, Lowest Channel (2422 MHz)

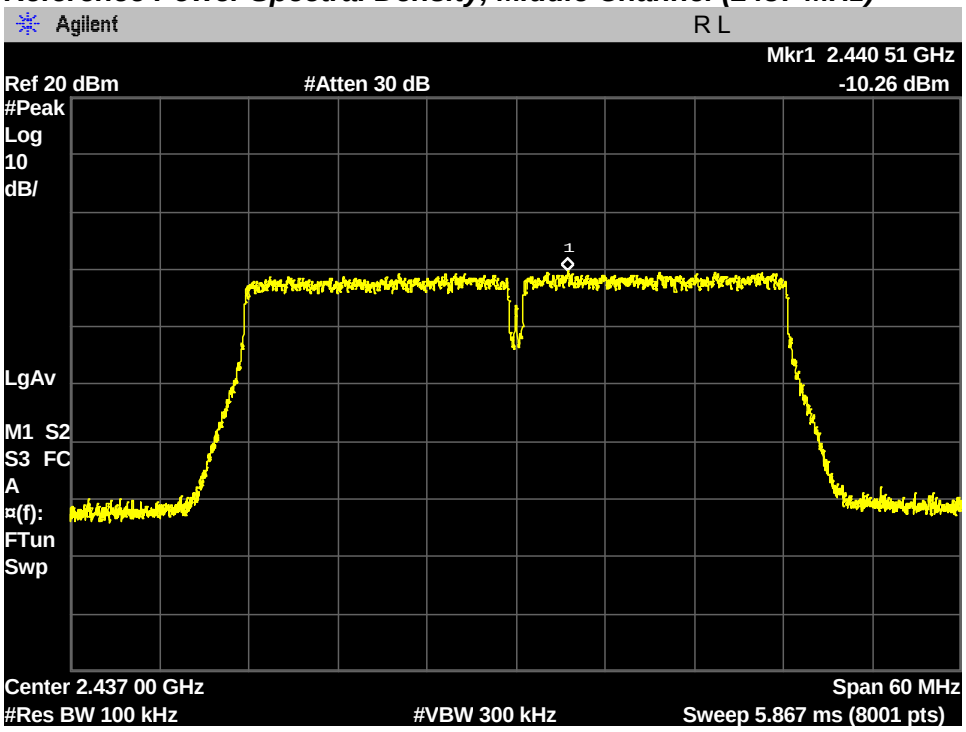


PLOT OF TEST DATA

Conducted Spurious Emissions, 30 MHz ~ 26.5 GHz (2422 MHz)

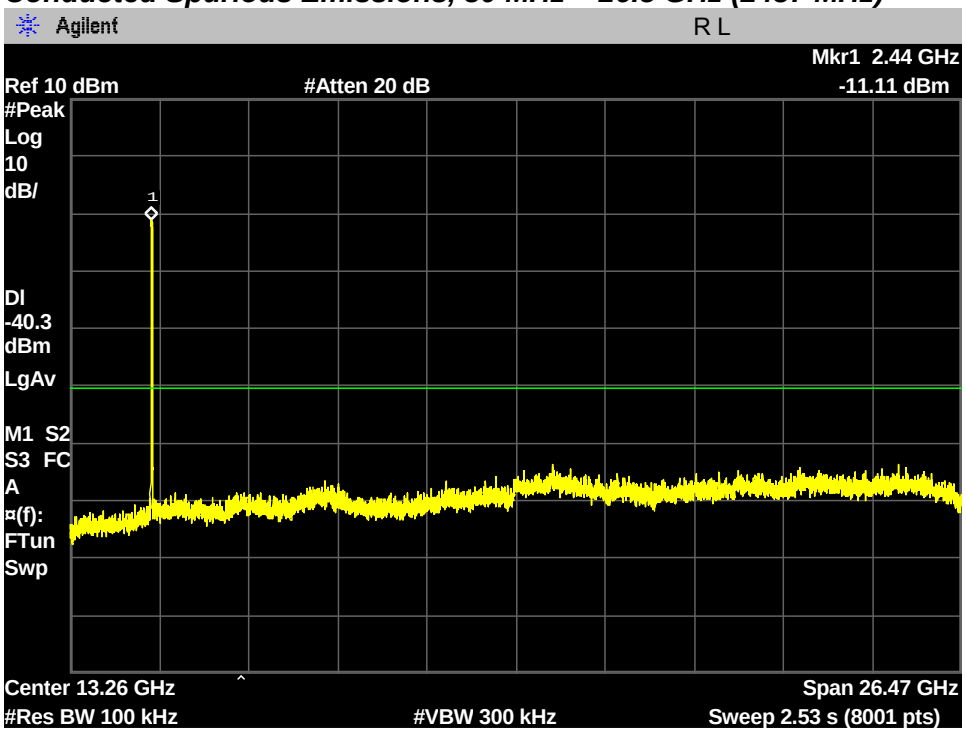


Reference Power Spectral Density, Middle Channel (2437 MHz)

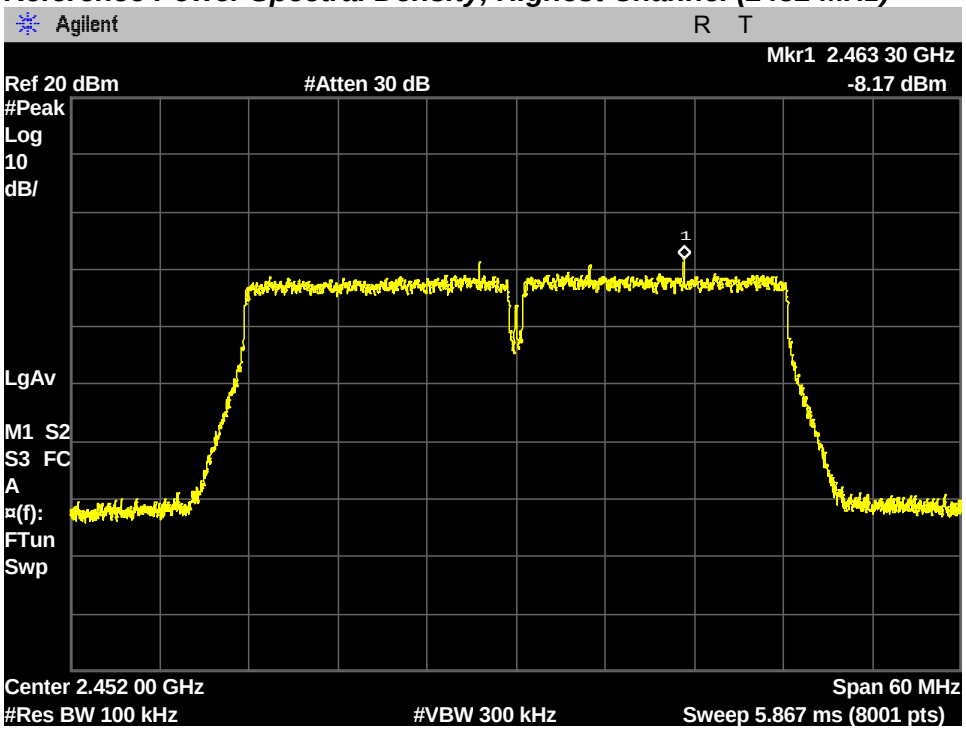


PLOT OF TEST DATA

Conducted Spurious Emissions, 30 MHz ~ 26.5 GHz (2437 MHz)

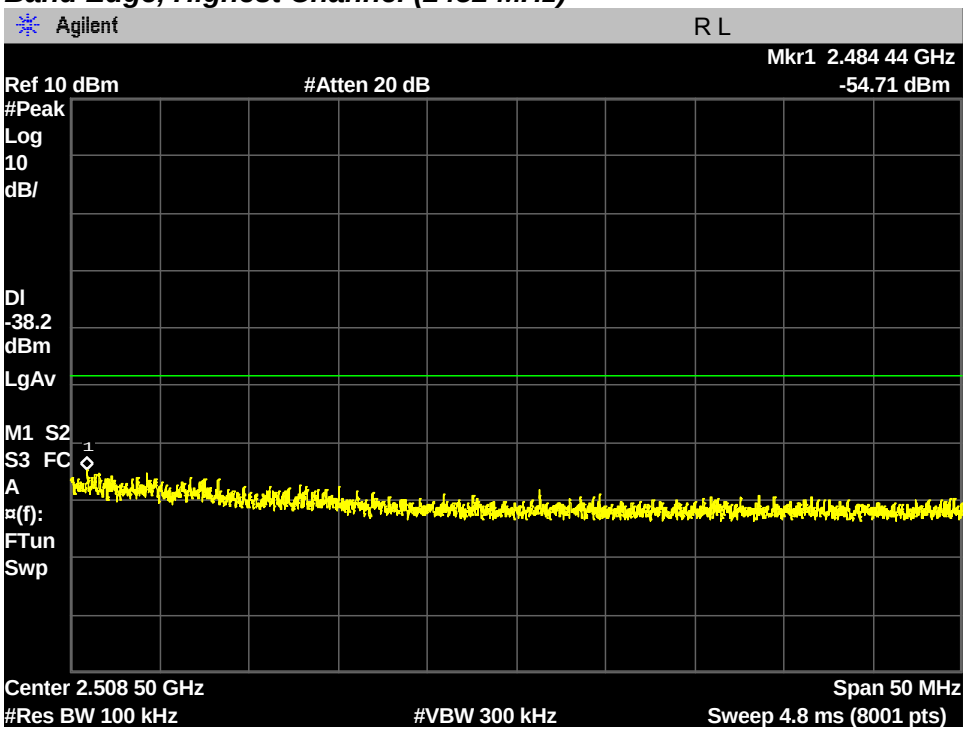


Reference Power Spectral Density, Highest Channel (2452 MHz)

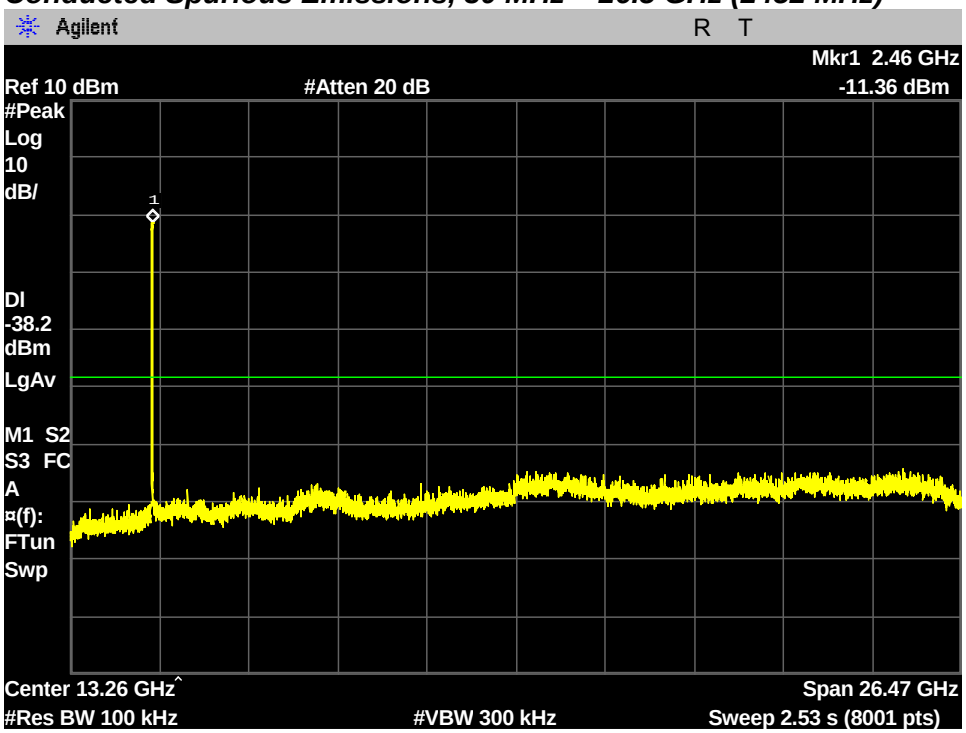


PLOT OF TEST DATA

Band Edge, Highest Channel (2452 MHz)



Conducted Spurious Emissions, 30 MHz ~ 26.5 GHz (2452 MHz)



8.6 Radiated Spurious Emissions

FCC §15.247(d), IC RSS-247 Issue 2 5.5

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

802.11n (20 MHz) mode

Lowest Channel

Frequency (MHz)	Reading (dBµV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
4378.17	43.3	H	peak	2.0	45.3	74.0	28.7

Middle Channel

Frequency (MHz)	Reading (dBµV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
4897.17	40.9	H	peak	2.2	43.1	74.0	30.9

Highest Channel

Frequency (MHz)	Reading (dBµV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
4927.83	43.6	H	peak	2.4	46.0	74.0	28.0

802.11n (40 MHz) mode

Lowest Channel

Frequency (MHz)	Reading (dBµV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1100.00	53.9	V	peak	-10.4	43.5	74.0	30.5

Middle Channel

Frequency (MHz)	Reading (dBµV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
1099.75	54.4	V	peak	-10.4	44.0	74.0	30.0

Highest Channel

Frequency (MHz)	Reading (dBµV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
4916.17	41.1	V	peak	2.4	43.5	74.0	30.5

Note:

*1. *Pol. H = Horizontal V = Vertical*

*2. **AF + CL + Amp. = Antenna Factor + Cable Loss + Amplifier.*

3. Average measurement was not performed because peak-detected emission complies with the average limit.

4. Other spurious was under 30 dB below Fundamental.

5. Highest channel (2462MHz) in n (20MHz) mode was the worst condition.

6. 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.

7. Peak emissions were measured using RBW = 1 MHz, VBW = 3 MHz, Detector = Peak.

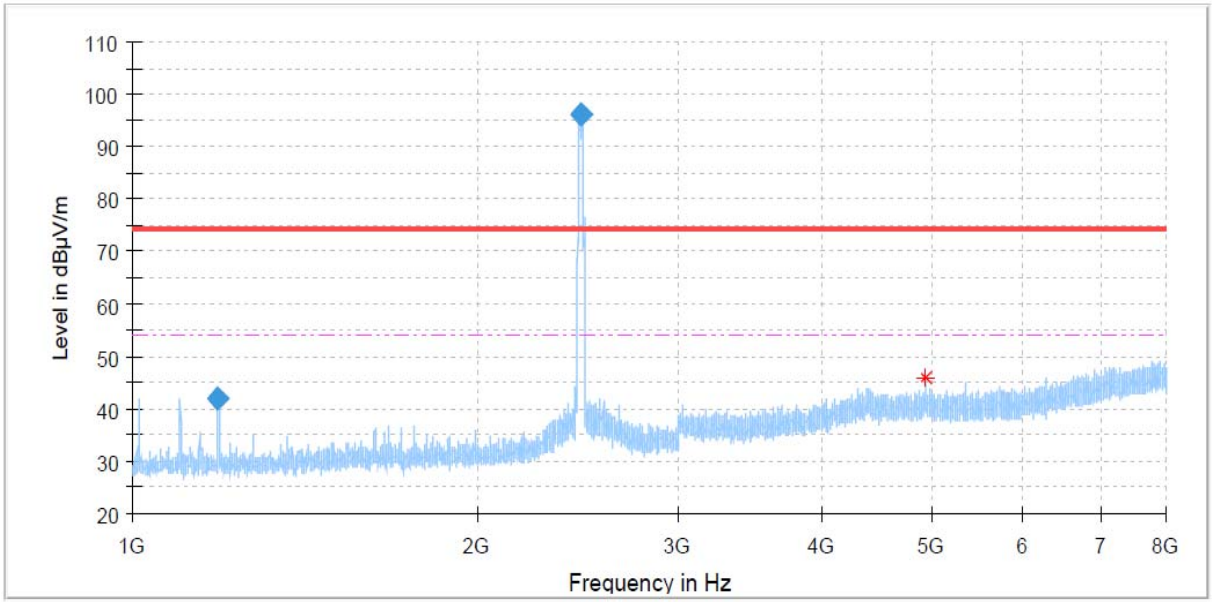
8. The spectrum was measured from 9 kHz to 10th harmonic and the worst-case emissions were reported. No significant emissions were found beyond the 3nd harmonic for this device.

PLOTS OF EMISSIONS

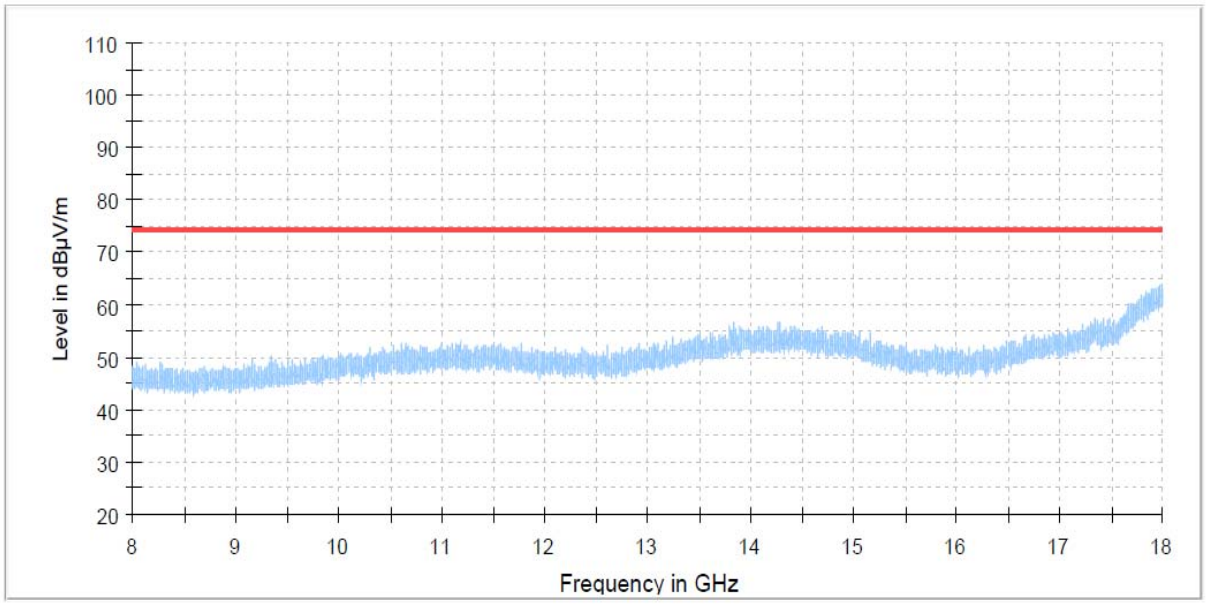
Worst Case

802.11n (20 MHz) mode

Highest channel : 1 GHz to 8 GHz_Peak

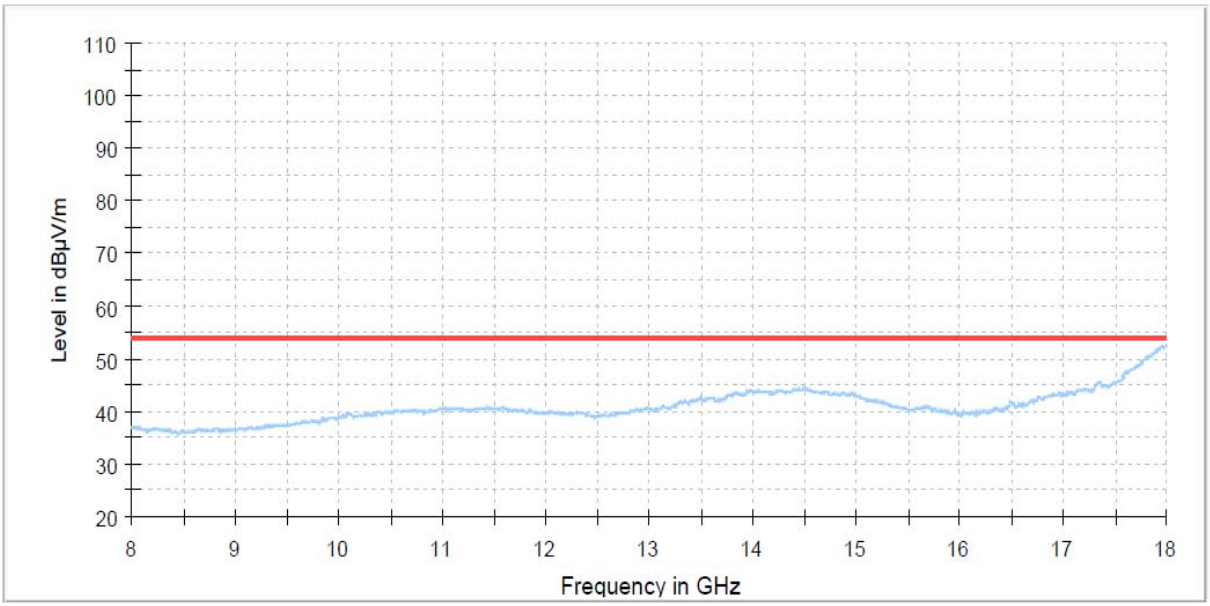


Highest channel : 8 GHz to 18 GHz_Peak

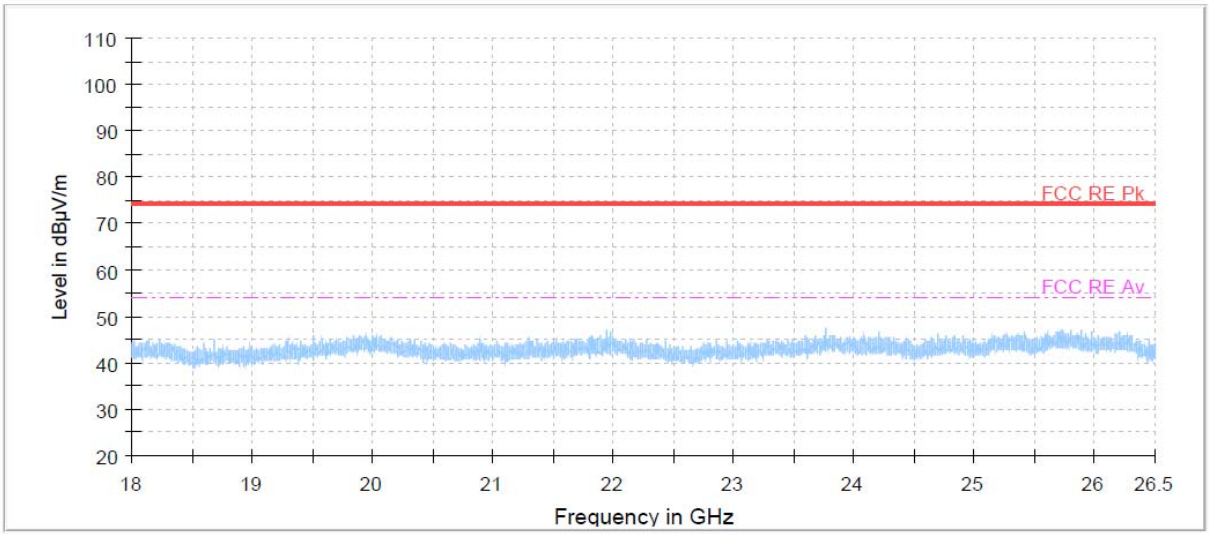


PLOTS OF EMISSIONS

Highest channel : 8 GHz to 18 GHz_Average



Highest channel : 18 GHz to 26.5 GHz_Peak



8.7 Radiated Band Edge

FCC §15.247(d), IC RSS-247 Issue 2 5.5

Test Mode : Set to Lowest channel and Highest channel

802.11n (20 MHz) mode

Lowest Channel

Frequency (MHz)	Reading (dBµV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2389.48	73.4	H	peak	-8.3	65.1	74.0	8.9
2389.48	52.3	H	average	-8.3	44.0	54.0	10.0
2390.00	70.5	H	peak	-8.3	62.2	74.0	11.8
2390.00	54.1	H	average	-8.3	45.8	54.0	8.2

Highest Channel

Frequency (MHz)	Reading (dBµV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2483.50	69.2	H	peak	-8.1	61.1	74.0	12.9
2483.50	51.9	H	average	-8.1	43.8	54.0	10.3
2484.70	69.6	H	peak	-8.1	61.5	74.0	12.5
2484.70	50.2	H	average	-8.1	42.1	54.0	11.9

802.11n (40 MHz) mode

Lowest Channel

Frequency (MHz)	Reading (dBµV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2388.73	72.3	H	peak	-8.4	63.9	74.0	10.1
2388.73	54.6	H	average	-8.4	46.2	54.0	7.8
2390.00	66.0	H	peak	-8.3	57.7	74.0	16.3
2390.00	55.2	H	average	-8.3	46.9	54.0	7.1

Highest Channel

Frequency (MHz)	Reading (dBµV)	Pol* (H/V)	mode	AF+CL+Amp (dB)**	Result (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2483.50	66.6	H	peak	-8.1	58.5	74.0	15.6
2483.50	54.6	H	average	-8.1	46.5	54.0	7.5
2487.53	70.1	H	peak	-8.1	62.0	74.0	12.0
2487.53	52.6	H	average	-8.1	44.5	54.0	9.5

Note:

*1. *Pol. H = Horizontal V = Vertical*

*2. **AF + CL + Amp. = Antenna Factor + Cable Loss + Amplifier.*

3. Other spurious was under 30 dB below Fundamental.

4. Lowest channel (2422MHz) in n (40MHz) mode was the worst condition.

5. 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.

6. Peak emissions were measured using RBW = 1 MHz, VBW = 3 MHz, Detector = Peak.

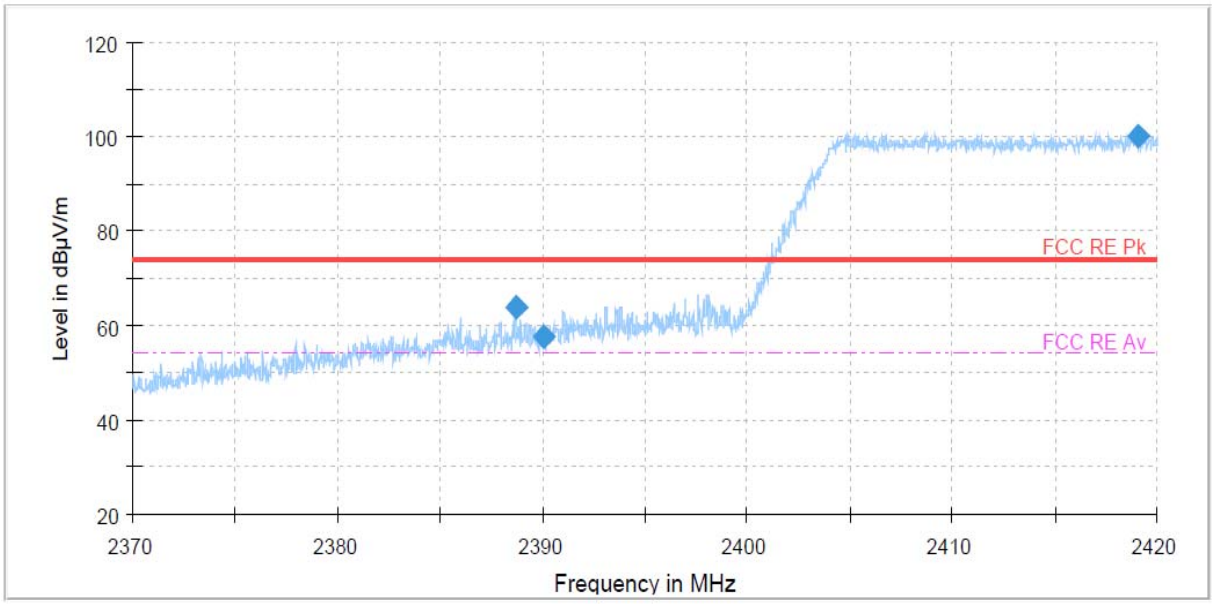
7. Average emissions were measured using RBW = 1 MHz, VBW = 1 kHz, Detector = Peak, as specified in "12.2.5.3 Average Power Measurement Procedures" in "558074 D01 DTS Meas Guidance v04".

PLOT OF TEST DATA

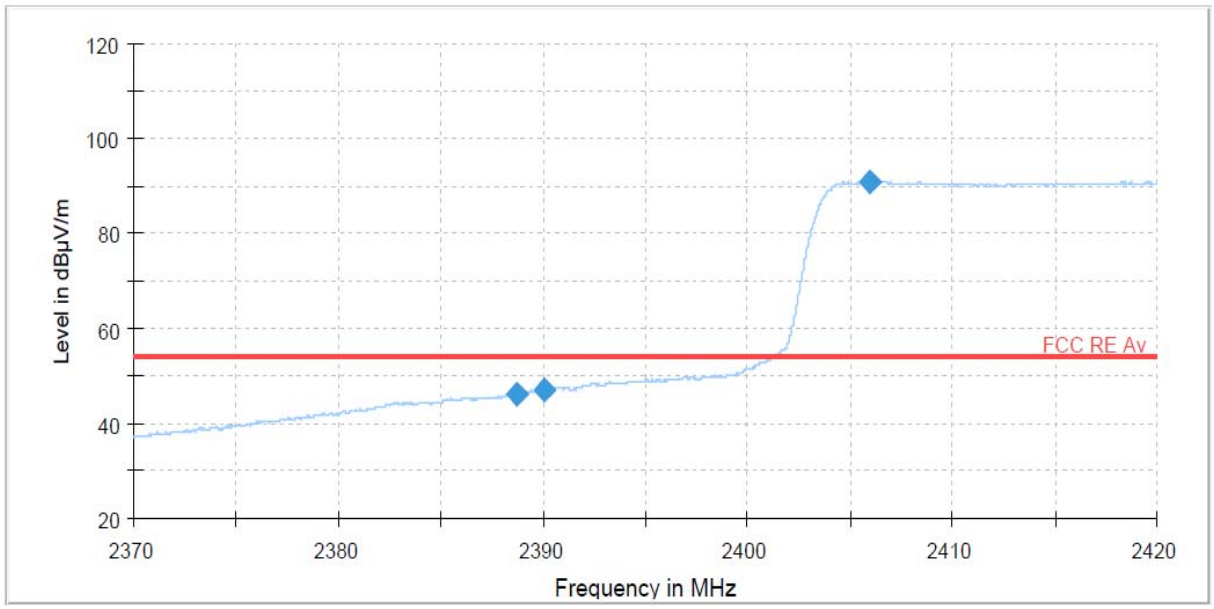
Worst Case

802.11n (40 MHz) mode

Lowest channel _Peak



Lowest channel _Average



9. TEST EQUIPMENT

No.	Instrument	Manufacturer	Model	Serial No.	Calibration Date	Calibration Interval
1	*Test Receiver	R & S	ESU 40	100202	Apr. 04 2017	1 year
2	Test Receiver	R & S	ESCS30	100302	Oct. 12 2017	1 year
3	*Attenuator	PASTERNACK	PE7395-10	1441-1	Jul. 13 2017	1 year
4	*Attenuator	FAIRVIEW	SA3N5W-06	N/A	Jan. 09 2017	1 year
5	*Attenuator	FAIRVIEW	SA3N5W-10	N/A	Apr. 03 2017	1 year
6	*Attenuator	WEINSCHEL	56-10	58765	Oct. 10 2017	1 year
7	*Amplifier	R & S	SCU 01	10029	Apr. 03 2017	1 year
8	*Amplifier	R & S	SCU18F	180025	Apr. 03 2017	1 year
9	*Amplifier	R & S	SCU26	10011	Jul. 13 2017	1 year
10	Amplifier	R & S	SCU40	100380	Jul. 13 2017	1 year
11	Pre Amplifier	HP	8449B	3008A00107	Jan. 10 2017	1 year
12	Spectrum Analyzer	R & S	FSW43	100732	Apr. 11 2017	1 year
13	*Spectrum Analyzer	Agilent	E4440A	MY44303257	Oct. 13 2017	1 year
14	*Spectrum Analyzer	R & S	FSW43	104084	Apr. 04 2017	1 year
15	*Loop Antenna	R & S	HFH2-Z2	100279	Feb. 22 2016	2 year
16	*Horn Antenna	SCHWARZBECK	BBHA9120D	9120D-508	Feb. 13 2017	2 year
17	*Horn Antenna	Q-par Angus	QSH20S20	8179	Aug. 01 2017	2 year
18	Horn Antenna	Q-par Angus	QSH22K20	8180	Aug. 02 2017	2 year
19	*Trilog-Broadband Antenna	SCHWARZBECK	VULB 9163	9163-454	Feb. 11 2016	2 year
20	LISN	R & S	ESH3-Z5	833874/006	Oct. 12 2017	1 year
21	ESH2-Z5 Artiticial Mains Network	R & S	ESH2-Z5	100227	Apr. 04 2017	1 year
22	*Position Controller	INNCO	CO2000	12480406/L	N/A	N/A
23	*Controller	INNCO	CO3000	CO3000/937/38330516/L	N/A	N/A
24	*Turn Table	INNCO	DS1200S	N/A	N/A	N/A
25	*Turn Table	INNCO	DT2000-2t	N/A	N/A	N/A
26	*Antenna Mast	INNCO	MA4000	N/A	N/A	N/A
27	*TILT Antenna Mast	INNCO	MA4640-XP-EP	N/A	N/A	N/A
28	*Open Switch And Control Unit	R & S	OSP-120	100081	N/A	N/A
29	*Open Switch And Control Unit	R & S	OSP-120	101766	N/A	N/A
30	*Shielded Room	Seo-Young EMC	N/A	N/A	N/A	N/A
31	*Anechoic Chamber	Seo-Young EMC	N/A	N/A	N/A	N/A
32	*WiFi Filter Bank	R & S	U083	N/A	N/A	N/A
33	*WiFi Filter Bank	R & S	U082	N/A	N/A	N/A

*) Test equipment used during the test

10. ACCURACY OF MEASUREMENT

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%

1. Conducted Uncertainty Calculation

Source of Uncertainty	*Xi*	Uncertainty of *Xi*		Coverage factor *k*	*u(Xi)* (dB)	*Ci*	*Ci u(Xi)* (dB)
		Value (dB)	Probability Distribution				
Receiver reading	***RI***	± 0.1	normal 1	1.000	0.1	1	0.1
Attenuation AMN-Receiver	***LC***	± 0.08	normal 2	2.000	0.04	1	0.04
AMN Voltage division factor	***LAMN***	± 0.8	normal 2	2.000	0.4	1	0.4
Sine wave voltage	***dVSW***	± 2.00	normal 2	2.000	1.00	1	1.00
Pulse amplitude response	***dVPA***	± 1.50	rectangular	1.732	0.87	1	0.87
Pulse repetition rate response	***dVPR***	± 1.50	rectangular	1.732	0.87	1	0.87
Noise floor proximity	***dVNF***	± 0.00	-	-	0.00	1	0.00
AMN Impedance	***dZ***	± 1.80	triangular	2.449	0.73	1	0.73
ⓐ Mismatch	***M***	+ 0.70	U-Shaped	1.414	0.49	1	0.49
ⓑ Mismatch	***M***	- 0.80	U-Shaped	1.414	- 0.56	1	- 0.56
Measurement System Repeatability	***RS***	0.05	normal 1	1.000	0.05	1	0.05
Remark	ⓐ: AMN-Receiver Mismatch : + ⓑ: AMN-Receiver Mismatch : -						
Combined Standard Uncertainty	Normal			± 1.88			
Expended Uncertainty U	Normal (*k* = 2)			± 3.76			

2. Radiation Uncertainty Calculation

Source of Uncertainty	Xi	Uncertainty of Xi		Coverage factor k	u(Xi) (dB)	Ci	Ci u(Xi) (dB)
		Value (dB)	Probability Distribution				
Measurement System Repeatability	**RS**	0.34	normal 1	1.00	0.34	1	0.34
Receiver reading	**Ri**	± 0.02	normal 2	2.00	0.01	1	0.01
Sine wave voltage	**dVsw**	± 0.17	normal 2	2.00	0.09	1	0.09
Pulse amplitude response	**dVpa**	± 0.92	normal 2	2.00	0.46	1	0.46
Pulse repetition rate response	**dVpr**	± 0.35	normal 2	2.00	0.18	1	0.18
Noise floor proximity	**dVnf**	± 0.50	normal 2	2.00	0.25	1	0.25
Antenna Factor Calibration	**AF**	± 2.00	rectangular	$\sqrt{3}$	1.15	1	1.15
Cable Loss	**CL**	± 1.00	normal 2	2.00	0.50	1	0.50
Antenna Directivity	**AD**	± 0.00	rectangular	$\sqrt{3}$	0.00	1	0.00
Antenna Factor Height Dependence	**AH**	± 2.00	rectangular	$\sqrt{3}$	1.15	1	1.15
Antenna Phase Centre Variation	**AP**	± 0.20	rectangular	$\sqrt{3}$	0.12	1	0.12
Antenna Factor Frequency Interpolation	**Ai**	± 0.25	rectangular	$\sqrt{3}$	0.14	1	0.14
Site Imperfections	**Si**	± 4.00	triangular	$\sqrt{6}$	1.63	1	1.63
Measurement Distance Variation	**DV**	± 0.60	rectangular	$\sqrt{3}$	0.35	1	0.35
Antenna Balance	**Dbal**	± 0.90	rectangular	$\sqrt{3}$	0.52	1	0.52
Cross Polarisation	**DCross**	± 0.00	rectangular	$\sqrt{3}$	0.00	1	0.18
Mismatch	**M**	+ 0.98 - 1.11	U-Shaped	$\sqrt{2}$	0.74	1	0.74
EUT Volume Diameter	**Vd**	0.33	normal 1	1.00	0.33	1	0.11
Remark							
Combined Standard Uncertainty	Normal						
Expended Uncertainty U	Normal (k = 2)						