FCC Test Report

Report No.:	RF200717C08-2
FCC ID:	2AKCZ-101
Test Model:	APL57-0F2, APL57-101 (refer to item 3.1 for more details)
Received Date:	Jul. 17, 2020
Test Date:	Nov. 02, 2021 (for beamforming power) Mar. 11, 2022 (for radiated emissions & band edge measurement)
Issued Date:	Mar. 14, 2022
Applicant:	SonicWall Inc.
Address:	1033 McCarthy Blvd., Milpitas, CA 95035, USA
Issued By:	Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch Lin Kou Laboratories
Lab Address:	No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan
Test Location:	No.19, Hwa Ya 2nd Rd., Wen Hwa Vil., Kwei Shan Dist., Taoyuan City 33383, Taiwan
FCC Registration / Designation Number:	788550 / TW0003

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Release Control Record

Issue No.	Description	Date Issued
RF200717C08-2	Original Release	Mar. 14, 2022

1 Certificate of Conformity

Product:	Wireless Network Security Appliance
Brand:	SONICWALL
Test Model:	APL57-0F2, APL57-101 (refer to item 3.1 for more details)
Sample Status:	Engineering Sample
Applicant:	SonicWall Inc.
Test Date:	Nov. 02, 2021 (for beamforming power) Mar. 11, 2022 (for radiated emissions & band edge measurement)
Standards:	47 CFR FCC Part 15, Subpart C (Section 15.247) ANSI C63.10:2013

The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's RF characteristics under the conditions specified in this report.

Prepared by : Vera Huang , **Date:** Mar. 14, 2022

Vera Huang / Specialist

Approved by : Jeremy Lin , **Date:** Mar. 14, 2022

Jeremy Lin / Project Engineer

2 Summary of Test Results

47 CFR FCC Part 15, Subpart C (Section 15.247)			
FCC Clause	**Test Item**	**Result**	**Remarks**
15.207	AC Power Conducted Emission	N/A	Refer to Note 1 as below
15.205 / 15.209 / 15.247(d)	Radiated Emissions and Band Edge Measurement	Pass	Meet the requirement of limit. Minimum passing margin is -1.5 dB at 2483.50 MHz.
15.247(d)	Antenna Port Emission	N/A	Refer to Note 1 as below
15.247(a)(2)	6 dB Bandwidth	N/A	Refer to Note 1 as below
---	Occupied Bandwidth Measurement	N/A	Refer to Note 1 as below
15.247(b)	Conducted power	Pass	Meet the requirement of limit.
15.247(e)	Power Spectral Density	N/A	Refer to Note 1 as below
15.203	Antenna Requirement	Pass	No antenna connector is used.

Note:

1. Only beamforming power, radiated emissions above 1GHz tests, and band edge measurement were performed for this addendum. Please refer to BV CPS report no.: RF200717C08 for other testing data.
2. For 2.4G band compliance with rule 15.247(d)of the band-edge items, the test plots were recorded in Annex A. Test Procedures refer to report 4.1.3.
3. Determining compliance based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.

2.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:

Measurement	**Frequency**	**Expanded Uncertainty (k=2) (±)**
Radiated Emissions above 1 GHz	1 GHz ~ 18 GHz	2.26 dB
	18 GHz ~ 40 GHz	1.94 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	Wireless Network Security Appliance
Brand	SONICWALL
Test Model	APL57-0F2, APL57-101
Model Difference	Refer to note for more details
Status of EUT	Engineering Sample
Power Supply Rating	12 Vdc (adapter)
Modulation Type	CCK, DQPSK, DBPSK for DSSS 64QAM, 16QAM, QPSK, BPSK for OFDM
Modulation Technology	DSSS, OFDM
Transfer Rate	802.11b: 11.0 / 5.5 / 2.0 / 1.0 Mbps 802.11g: 54.0 / 48.0 / 36.0 / 24.0 / 18.0 / 12.0 / 9.0 / 6.0 Mbps 802.11n: up to 300Mbps
Operating Frequency	2412 ~ 2462 MHz
Number of Channel	11 for 802.11b, 802.11g, 802.11n (HT20) 7 for 802.11n (HT40)
Output Power	Beamforming Mode: 99.488mW
Antenna Type	Refer to Note as below
Antenna Connector	Refer to Note as below
Accessory Device	Refer to Note as below
Data Cable Supplied	Refer to Note as below

Note:

1. This report is issued as a supplementary report to BV CPS report no.: RF200717C08. The difference compared with the original report is updating beamforming power. Therefore, only beamforming power, radiated emissions above 1GHz tests, and band edge measurement were verified and recorded in the report.
2. The following models are provided to this EUT. The model 'APL57-0F2' was chosen for final tests.
   (a) The EUT using the same PCB Layout.
   (b) Due to series models, the parts are different as below:

Model	APL57-0F2	APL57-101
PSE Out	N/A	N/A
Copper Ports	x8 GbE	x8 GbE
SFP Ports	x2 SFP (Max: 2.5Gbps)	NO
mPCIe WiFi Module	2x2 11ac Wave 2 (Module)	2x2 11ac Wave 2 (Module)
WiFi SPEC	2.4G+5G 11ac+abgn support Beamforming	2.4G+5G 11ac+abgn support Beamforming
ANT for WiFi	x2 ANTs (EXT)	x2 ANTs (EXT)
Console (RJ45)	YES	YES
USB Port	3.0 x2	3.0 x2
FAN(s)	YES	YES
Outer covering	Metal	Metal
CPU	1.4GHz	1.2GHz

3. The EUT incorporates a MIMO function. Physically, the EUT provides two completed transmitters and two receivers.

Modulation Mode	Tx Function	Beamforming
802.11b	2TX	Not Support
802.11g	2TX	Not Support
802.11n (HT20)	2TX	Support
802.11n (HT40)	2TX	Support

4. The EUT uses following antennas.

Ant. Type	Dipole					
Ant. Connector	RP-SMA					
Frequency (MHz)	**2400**	**2450**	**2500**	**5150**	**5550**	**5850**
Peak Gain (dBi)	3.19	3.10	3.05	5.85	5.73	5.03

* The max. gain was chosen for final tests.

5. The EUT consumes power from the following adapters.

Product	Brand	Model	Description
Adapter 1	Sunny COMPUTER TECHNOLOGY CO.,LTD.	SYS1546-3612-T3	I/P: 100-240 Vac, 50-60 Hz, 1.5 A O/P: 12 Vdc, 3 A 1.85m power cable with 1 core
Adapter 2 (Support unit only)	BILLION	BA040-120300MAX	I/P: 100-240 Vac, 50/60 Hz, 1 A O/P: 12 Vdc, 3 A 1.46m power cable without core

* After the pretesting, the adapter 1 was chosen for final test.

6. WLAN 2.4GHz & WLAN 5GHz technology cannot transmit at same time.
7. Spurious emission of the simultaneous operation (2.4GHz and 5GHz) has been evaluated and no non-compliance was found.
8. The above Antenna information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications, the laboratory shall not be held responsible.
9. The above EUT information is declared by manufacturer and for more detailed features description, please refers to the manufacturer's specifications or user's manual.

3.2 Description of Test Modes

11 channels are provided for 802.11b, 802.11g and 802.11n (HT20):

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2412	7	2442
2	2417	8	2447
3	2422	9	2452
4	2427	10	2457
5	2432	11	2462
6	2437		

7 channels are provided for 802.11n (HT40):

Channel	Frequency (MHz)	Channel	Frequency (MHz)
3	2422	7	2442
4	2427	8	2447
5	2432	9	2452
6	2437		

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable To		Description
	RE≥1G	APCM	
-	√	√	-

Where **RE≥1G:** Radiated Emission above 1 GHz **APCM:** Antenna Port Conducted Measurement
NOTE: The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on **Y-plane**.

Radiated Emission Test (Above 1 GHz):

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
-	802.11n (HT20)	1 to 11	1, 6, 11	OFDM	BPSK	6.5
-	802.11n (HT40)	3 to 9	3, 6, 9	OFDM	BPSK	13.5

Bandedge Measurement:

☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
-	802.11n (HT20)	1 to 11	1, 11	OFDM	BPSK	6.5
-	802.11n (HT40)	3 to 9	3, 9	OFDM	BPSK	13.5

Antenna Port Conducted Measurement:

☒ This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.
☒ Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture).
☒ Following channel(s) was (were) selected for the final test as listed below.

EUT Configure Mode	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
-	802.11n (HT20)	1 to 11	1, 6, 11	OFDM	BPSK	6.5
-	802.11n (HT40)	3 to 9	3, 6, 9	OFDM	BPSK	13.5

Test Condition:

Applicable To	Environmental Conditions	Input Power	Tested by
RE≥1G	23 deg. C, 66 % RH	120 Vac, 60 Hz	Titan Hsu
APCM	25 deg. C, 60 % RH	120 Vac, 60 Hz	Ivan Tseng

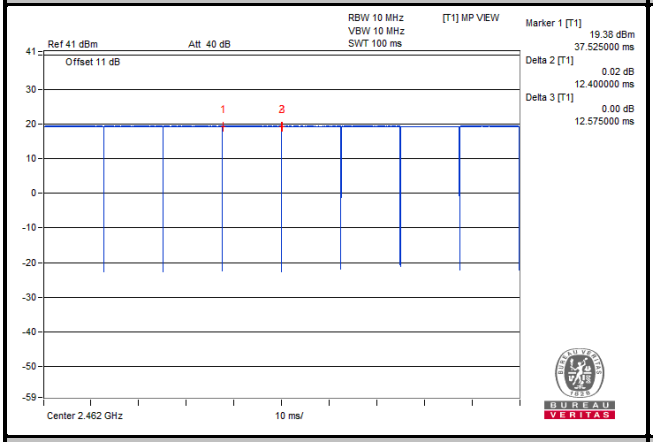
3.3 Duty Cycle of Test Signal

Duty cycle of test signal is < 98 %, duty factor shall be considered.

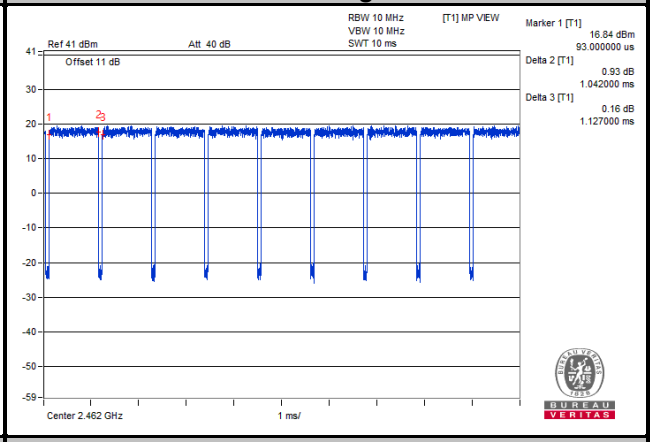
802.11n (HT20): Duty cycle = 4.975/5.087 = 0.978, Duty factor = 10 * log(1/0.978) = 0.10

802.11n (HT40): Duty cycle = 2.425/2.515 = 0.964, Duty factor = 10 * log(1/0.964) = 0.16

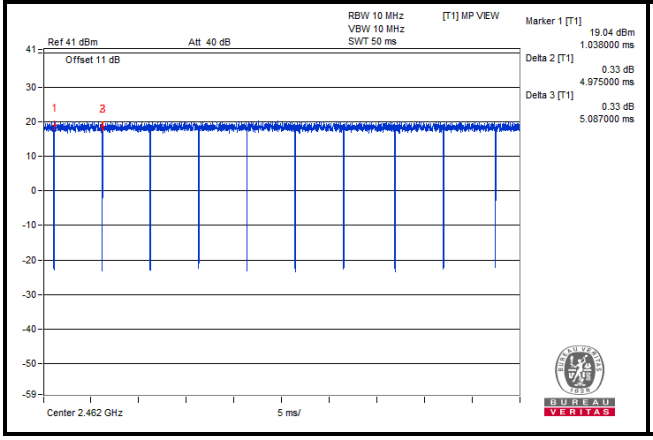
802.11b



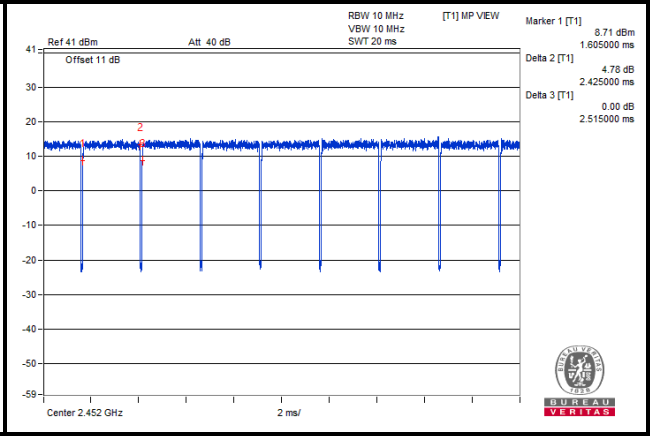
802.11g



802.11n (HT20)



802.11n (HT40)



3.4 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

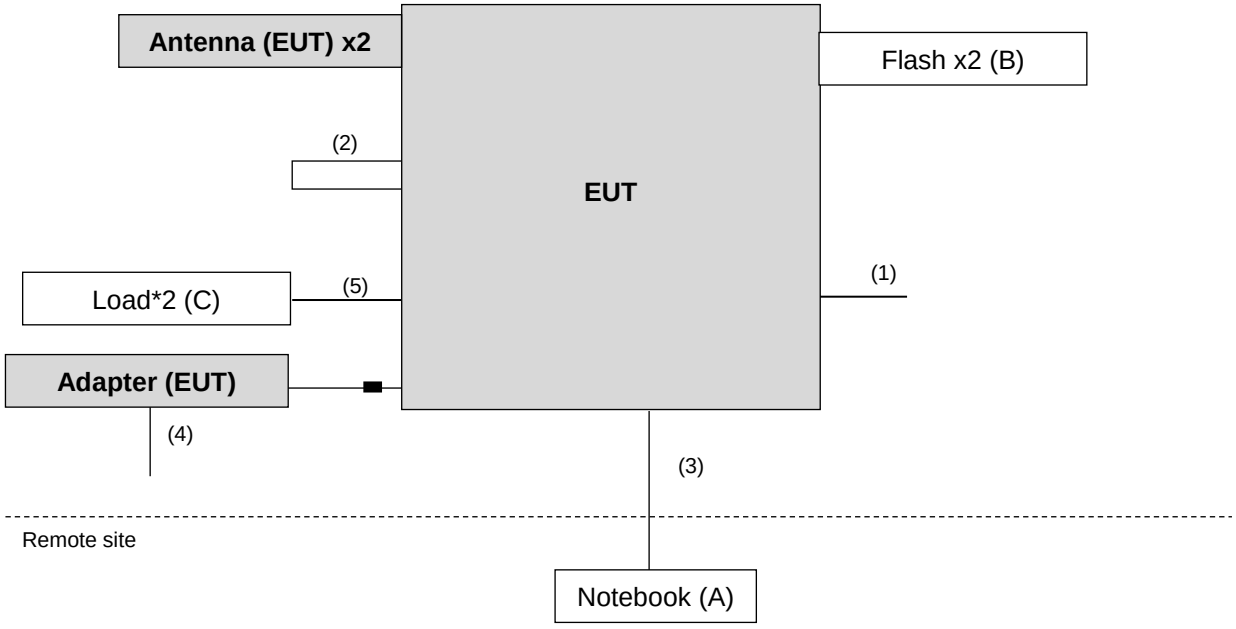
ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
1.	Notebook	DELL	E5410	1HC2XM1	FCC DoC Approved	-
2.	Flash	HP	v250W	05	NA	-
	Flash	HP	v250W	03	NA	-
3.	Load*2	NA	NA	NA	NA	-

Note:

1. All power cords of the above support units are non-shielded (1.8m).
2. Item A acted as a communication partner to transfer data.

ID	Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	Console cable	1	1.15	N	0	Accessory of EUT
2.	Fiber cable	1	3	N	0	Provided by client
3.	LAN cable	1	6	N	0	RJ45, Cat5e
4.	Power cord	1	0.9	N	0	Accessory of EUT
5.	LAN cable	7	1.5	N	0	RJ45, Cat5e

3.4.1 Configuration of System under Test



3.5 General Description of Applied Standards and References

The EUT is a RF Product. According to the specifications of the manufacturer, it must comply with the requirements of the following standards and references:

Test Standard:

FCC Part 15, Subpart C (15.247)
ANSI C63.10-2013

All test items have been performed and recorded as per the above standards.

References Test Guidance:

KDB 558074 D01 Meas Guidance v05r02
KDB 662911 D01 Multiple Transmitter Output v02r01

All test items have been performed as a reference to the above KDB test guidance.

4 Test Types and Results

4.1 Radiated Emission and Bandedge Measurement

4.1.1 Limits of Radiated Emission and Bandedge Measurement

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 20 dB below the highest level of the desired power:

Frequencies (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

NOTE:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any condition of modulation.

4.1.2 Test Instruments

<For radiated emissions & band edge measurement>
Test Date: Mar. 11, 2022

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
Test Receiver ROHDE & SCHWARZ	ESR3	102579	Jul. 05, 2021	Jul. 04, 2022
Spectrum Analyzer ROHDE & SCHWARZ	FSP40	100269	Jun. 07, 2021	Jun. 06, 2022
BILOG Antenna SCHWARZBECK	VULB9168	9168-171	Oct. 29, 2021	Oct. 28, 2022
HORN Antenna SCHWARZBECK	9120D	9120D-408	Nov. 14, 2021	Nov. 13, 2022
HORN Antenna SCHWARZBECK	BBHA 9170	BBHA9170241	Oct. 26, 2021	Oct. 25, 2022
Loop Antenna EMCI	EM-6879	269	Sep. 16, 2021	Sep. 15, 2022
Preamplifier Agilent (Below 1GHz)	8447D	2944A10738	Jul. 24, 2021	Jul. 23, 2022
Preamplifier Agilent (Above 1GHz)	8449B	3008A02465	Mar. 22, 2021	Mar. 21, 2022
RF Coaxial Cable WOKEN With 5dB PAD	8D-FB	Cable-CH3-01	Jul. 24, 2021	Jul. 23, 2022
RF signal cable HUBER+SUHNER	SUCOFLEX 104	Cable-CH3-03 (223653/4)	Jul. 24, 2021	Jul. 23, 2022
RF signal cable HUBER+SUHNER& EMCI	SUCOFLEX 104&EMC104-SM-SM-8000	Cable-CH3-03 (309224+170907)	Jul. 24, 2021	Jul. 23, 2022
Software BV ADT	ADT_Radiated_ V7.6.15.9.5	NA	NA	NA
Antenna Tower inn-co GmbH	MA 4000	013303	NA	NA
Antenna Tower Controller BV ADT	AT100	AT93021702	NA	NA
Turn Table BV ADT	TT100	TT93021702	NA	NA
Turn Table Controller BV ADT	SC100	SC93021702	NA	NA
Boresight Antenna Fixture	FBA-01	FBA-SIP01	NA	NA
USB Wideband Power Sensor KEYSIGHT	U2021XA	MY55050005/MY55190004/MY55190007/MY55210005	Jul. 12, 2021	Jul. 11, 2022

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in HwaYa Chamber 3.

<For beamforming power>
Test Date: Nov. 02, 2021

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
Spectrum Analyzer ROHDE & SCHWARZ	FSP40	100269	Jun. 07, 2021	Jun. 06, 2022
USB Wideband Power Sensor KEYSIGHT	U2021XA	MY55050005/MY55190004/MY55190007/MY55210005	Jul. 12, 2021	Jul. 11, 2022

Note: The calibration interval of the above test instruments is 12 months and the calibrations are traceable to NML/ROC and NIST/USA.

4.1.3 Test Procedures

For Radiated Emission above 30 MHz

a. The EUT was placed on the top of a rotating table 1.5 meters above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
c. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
e. The test-receiver system was set to peak and average detected function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

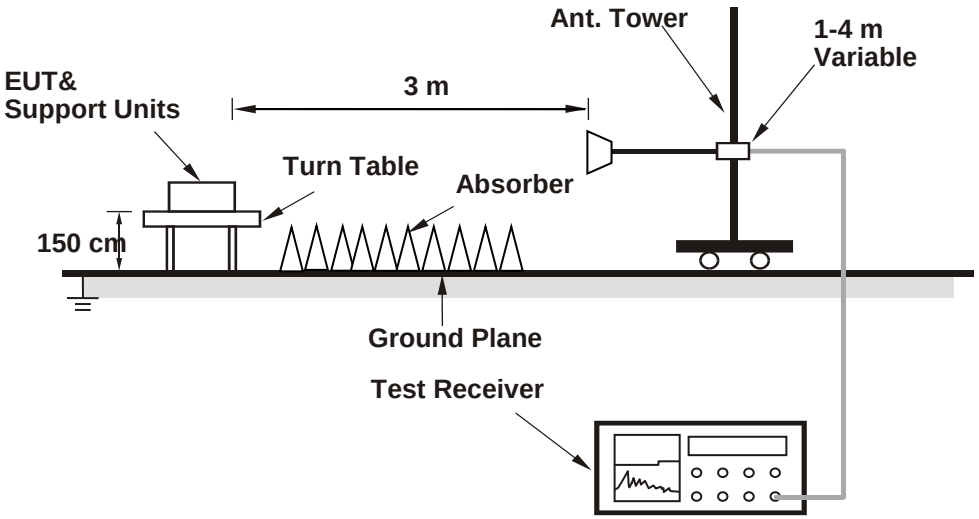
1. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is ≥ 1/T (Duty cycle < 98 %) or 10 Hz (Duty cycle ≥ 98 %) for Average detection (AV) at frequency above 1 GHz. (11n (HT20): RBW = 1 MHz, VBW = 1 kHz ; 11n (HT40): RBW = 1 MHz, VBW = 1 kHz)
3. All modes of operation were investigated and the worst-case emissions are reported.

4.1.4 Deviation from Test Standard

No deviation.

4.1.5 Test Set Up

<Radiated Emission above 1 GHz>



For the actual test configuration, please refer to the attached file (Test Setup Photo).

4.1.6 EUT Operating Conditions

a. Placed the EUT on a testing table.
b. Use the software to control the EUT under transmission condition continuously at specific channel frequency.

4.1.7 Test Results

Above 1 GHz Data：

RF Mode	TX 802.11n (HT20)	Channel	CH 1：2412 MHz
Frequency Range	1GHz ~ 25GHz	Detector Function	Peak (PK) Average (AV)

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	2390.00	64.0 PK	74.0	-10.0	1.55 H	338	29.9	34.1
2	2390.00	52.2 AV	54.0	-1.8	1.55 H	338	18.1	34.1
3	*2412.00	116.0 PK			1.52 H	332	81.9	34.1
4	*2412.00	104.7 AV			1.52 H	332	70.6	34.1
5	4824.00	48.5 PK	74.0	-25.5	1.66 H	195	34.9	13.6
6	4824.00	34.5 AV	54.0	-19.5	1.66 H	195	20.9	13.6
Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	2390.00	60.5 PK	74.0	-13.5	3.92 V	266	57.3	3.2
2	2390.00	48.5 AV	54.0	-5.5	3.92 V	266	45.3	3.2
3	*2412.00	110.2 PK			3.96 V	254	76.1	34.1
4	*2412.00	100.1 AV			3.96 V	254	66.0	34.1
5	4824.00	48.6 PK	74.0	-25.4	1.66 V	30	35.0	13.6
6	4824.00	34.2 AV	54.0	-19.8	1.66 V	30	20.6	13.6

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

RF Mode	TX 802.11n (HT20)	Channel	CH 6：2437 MHz
Frequency Range	1GHz ~ 25GHz	Detector Function	Peak (PK) Average (AV)

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*2437.00	115.8 PK			2.06 H	331	81.5	34.3
2	*2437.00	105.3 AV			2.06 H	331	71.0	34.3
3	4874.00	48.8 PK	74.0	-25.2	1.55 H	196	35.2	13.6
4	4874.00	34.5 AV	54.0	-19.5	1.55 H	196	20.9	13.6
Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*2437.00	110.2 PK			3.88 V	258	75.9	34.3
2	*2437.00	99.1 AV			3.88 V	258	64.8	34.3
3	4874.00	48.6 PK	74.0	-25.4	1.75 V	45	35.0	13.6
4	4874.00	34.7 AV	54.0	-19.3	1.75 V	45	21.1	13.6

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

RF Mode	TX 802.11n (HT20)	Channel	CH 11：2462 MHz
Frequency Range	1GHz ~ 25GHz	Detector Function	Peak (PK) Average (AV)

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*2462.00	114.7 PK			1.38 H	335	80.4	34.3
2	*2462.00	103.3 AV			1.38 H	335	69.0	34.3
3	2483.50	64.2 PK	74.0	-9.8	1.36 H	333	29.9	34.3
4	2483.50	52.2 AV	54.0	-1.8	1.36 H	333	17.9	34.3
5	4924.00	49.0 PK	74.0	-25.0	1.55 H	188	35.6	13.4
6	4924.00	35.0 AV	54.0	-19.0	1.55 H	188	21.6	13.4
Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*2462.00	105.5 PK			3.88 V	255	71.2	34.3
2	*2462.00	94.1 AV			3.88 V	255	59.8	34.3
3	2483.50	61.0 PK	74.0	-13.0	2.99 V	265	26.7	34.3
4	2483.50	48.6 AV	54.0	-5.4	2.99 V	265	14.3	34.3
5	4924.00	48.3 PK	74.0	-25.7	1.55 V	48	34.9	13.4
6	4924.00	34.8 AV	54.0	-19.2	1.55 V	48	21.4	13.4

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

RF Mode	TX 802.11n (HT40)	Channel	CH 3：2422 MHz
Frequency Range	1GHz ~ 25GHz	Detector Function	Peak (PK) Average (AV)

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	2390.00	65.5 PK	74.0	-8.5	1.45 H	335	31.4	34.1
2	2390.00	52.4 AV	54.0	-1.6	1.45 H	335	18.3	34.1
3	*2422.00	110.0 PK			2.00 H	322	75.9	34.1
4	*2422.00	100.1 AV			2.00 H	322	66.0	34.1
5	4844.00	48.2 PK	74.0	-25.8	1.58 H	205	34.6	13.6
6	4844.00	34.6 AV	54.0	-19.4	1.58 H	205	21.0	13.6
Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	2390.00	61.0 PK	74.0	-13.0	3.99 V	265	26.9	34.1
2	2390.00	49.2 AV	54.0	-4.8	3.99 V	265	15.1	34.1
3	*2422.00	104.5 PK			3.95 V	253	70.4	34.1
4	*2422.00	94.6 AV			3.95 V	253	60.5	34.1
5	4844.00	48.0 PK	74.0	-26.0	1.77 V	25	34.4	13.6
6	4844.00	34.3 AV	54.0	-19.7	1.77 V	25	20.7	13.6

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

RF Mode	TX 802.11n (HT40)	Channel	CH 6：2437 MHz
Frequency Range	1GHz ~ 25GHz	Detector Function	Peak (PK) Average (AV)

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	2390.00	61.2 PK	74.0	-12.8	2.55 H	345	27.1	34.1
2	2390.00	50.3 AV	54.0	-3.7	2.55 H	345	16.2	34.1
3	*2437.00	110.2 PK			1.33 H	325	75.9	34.3
4	*2437.00	100.1 AV			1.33 H	325	65.8	34.3
5	2483.50	65.5 PK	74.0	-8.5	1.15 H	325	31.2	34.3
6	**2483.50**	**52.5 AV**	**54.0**	**-1.5**	**1.15 H**	**325**	**18.2**	**34.3**
7	4874.00	48.5 PK	74.0	-25.5	1.75 H	188	34.9	13.6
8	4874.00	34.6 AV	54.0	-19.4	1.75 H	188	21.0	13.6
Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	2390.00	61.0 PK	74.0	-13.0	3.88 V	261	26.9	34.1
2	2390.00	48.5 AV	54.0	-5.5	3.88 V	261	14.4	34.1
3	*2437.00	105.7 PK			3.95 V	253	71.4	34.3
4	*2437.00	95.2 AV			3.95 V	253	60.9	34.3
5	2483.50	61.0 PK	74.0	-13.0	3.95 V	258	26.7	34.3
6	2483.50	49.2 AV	54.0	-4.8	3.95 V	258	14.9	34.3
7	4874.00	48.8 PK	74.0	-25.2	1.75 V	42	35.2	13.6
8	4874.00	34.3 AV	54.0	-19.7	1.75 V	42	20.7	13.6

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

RF Mode	TX 802.11n (HT40)	Channel	CH 9：2452 MHz
Frequency Range	1GHz ~ 25GHz	Detector Function	Peak (PK) Average (AV)

Antenna Polarity & Test Distance : Horizontal at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*2452.00	109.8 PK			2.15 H	325	75.5	34.3
2	*2452.00	99.6 AV			2.15 H	325	65.3	34.3
3	2483.50	65.5 PK	74.0	-8.5	2.88 H	335	31.2	34.3
4	2483.50	52.2 AV	54.0	-1.8	2.88 H	335	17.9	34.3
5	4904.00	48.5 PK	74.0	-25.5	1.62 H	182	35.0	13.5
6	4904.00	35.0 AV	54.0	-19.0	1.62 H	182	21.5	13.5
Antenna Polarity & Test Distance : Vertical at 3 m								
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	*2452.00	102.0 PK			3.95 V	235	67.7	34.3
2	*2452.00	92.2 AV			3.95 V	235	57.9	34.3
3	2483.50	64.0 PK	74.0	-10.0	3.85 V	244	29.7	34.3
4	2483.50	49.0 AV	54.0	-5.0	3.85 V	244	14.7	34.3
5	4904.00	48.2 PK	74.0	-25.8	1.65 V	33	34.7	13.5
6	4904.00	34.5 AV	54.0	-19.5	1.65 V	33	21.0	13.5

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency.

4.2 Conducted Output Power Measurement

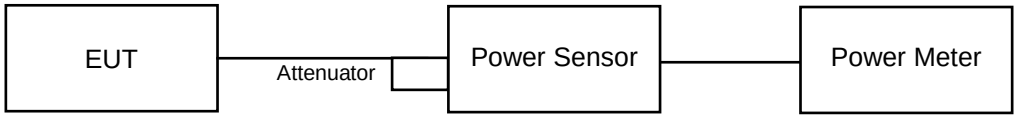
4.2.1 Limits of Conducted Output Power Measurement

For systems using digital modulation in the 2400–2483.5 MHz bands: 1 Watt (30 dBm)
Per KDB 662911 D01 Multiple Transmitter Output Method of conducted output power measurement on IEEE 802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for NANT ≤ 4;
Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 40 MHz for any NANT;
Array Gain = 5 log(NANT/NSS) dB or 3 dB, whichever is less for 20 MHz channel widths with NANT ≥ 5.

For power measurements on all other devices: Array Gain = 10 log(NANT/NSS) dB.

4.2.2 Test Setup



4.2.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.2.4 Test Procedures

An Average power sensor was used on the output port of the EUT. A power meter was used to read the response of the average power sensor. Record the power level.

4.2.5 Deviation from Test Standard

No deviation.

4.2.6 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

4.2.7 Test Results

Beamforming Mode

802.11n (HT20)

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
1	2412	14.82	14.91	61.313	17.88	29.80	Pass
6	2437	16.82	17.11	**99.488**	**19.98**	29.80	Pass
11	2462	13.85	13.93	48.983	16.90	29.80	Pass

Note: Directional gain = 3.19dBi +10log(2) = 6.20dBi>6dBi, so the limit shall be reduced to 30-(6.20-6) = 29.80dBm.

802.11n (HT40)

Channel	Frequency (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)	Limit (dBm)	Pass / Fail
		Chain 0	Chain 1				
3	2422	13.47	13.39	44.06	16.44	29.80	Pass
6	2437	13.11	13.37	42.191	16.25	29.80	Pass
9	2452	12.35	12.45	34.758	15.41	29.80	Pass

Note: Directional gain = 3.19dBi +10log(2) = 6.20dBi>6dBi, so the limit shall be reduced to 30-(6.20-6) = 29.80dBm.

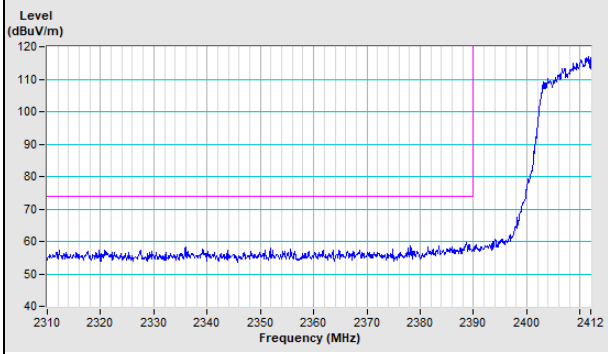
5 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

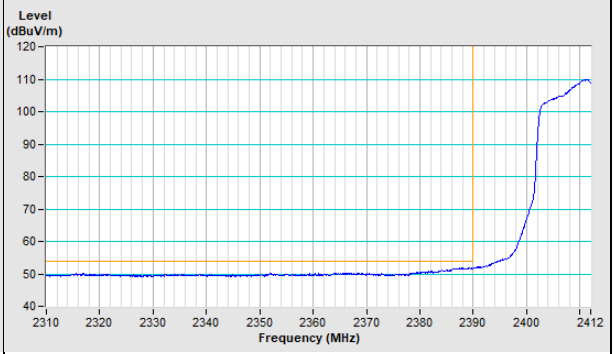
Annex A- Band Edge Measurement

802.11n (HT20) Channel 1

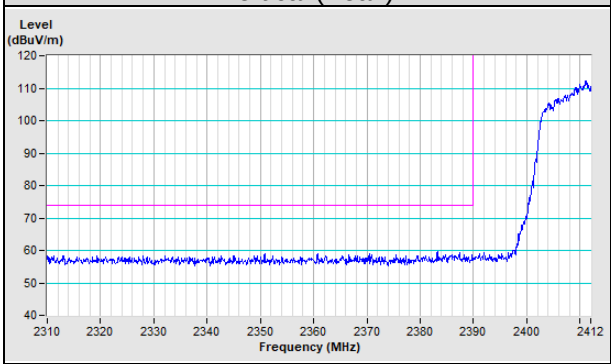
Horizontal (Peak)



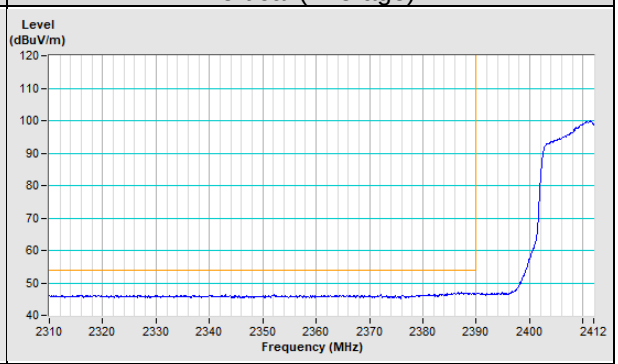
Horizontal (Average)



Vertical (Peak)

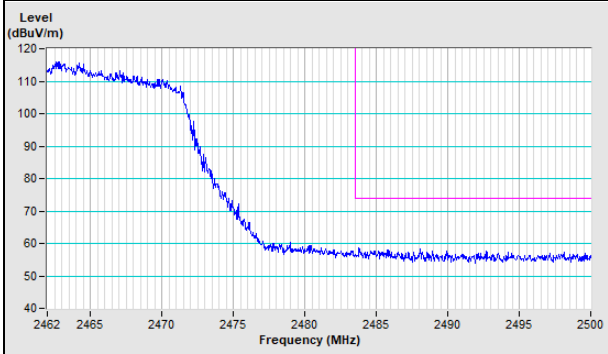


Vertical (Average)

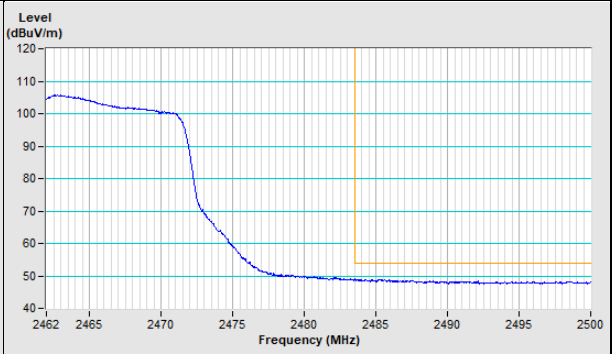


802.11n (HT20) Channel 11

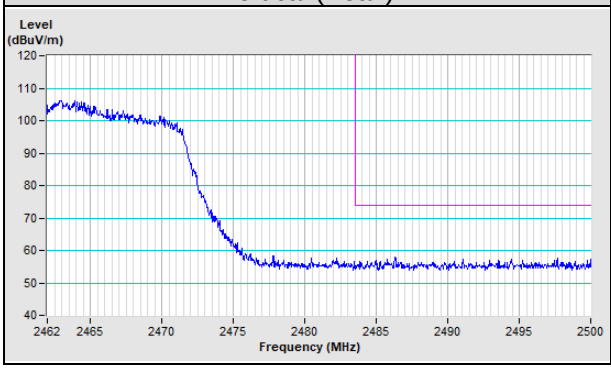
Horizontal (Peak)



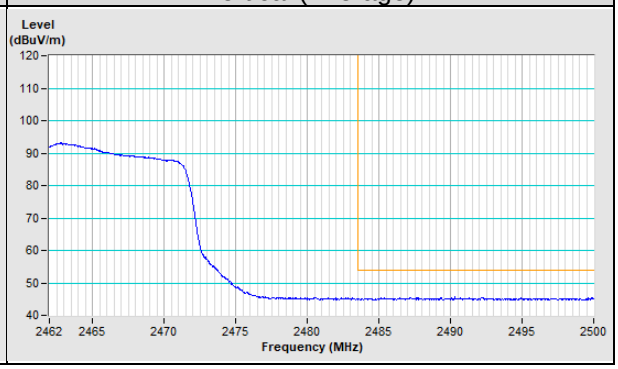
Horizontal (Average)

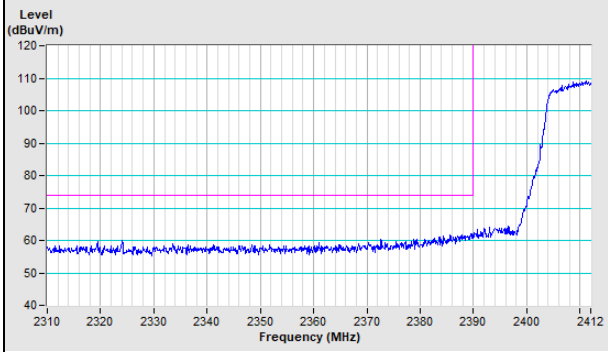
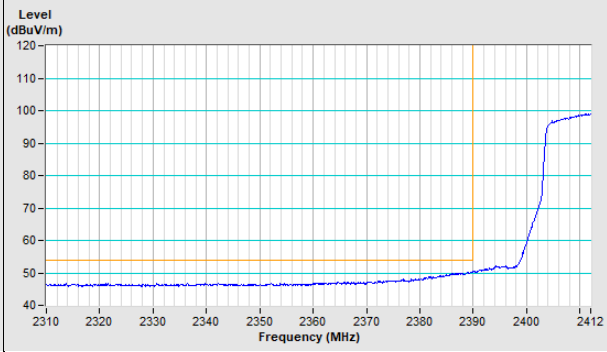
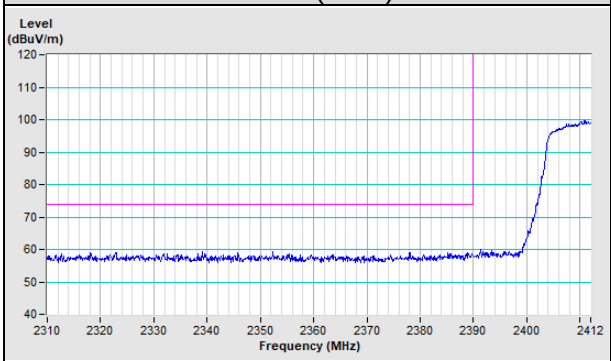
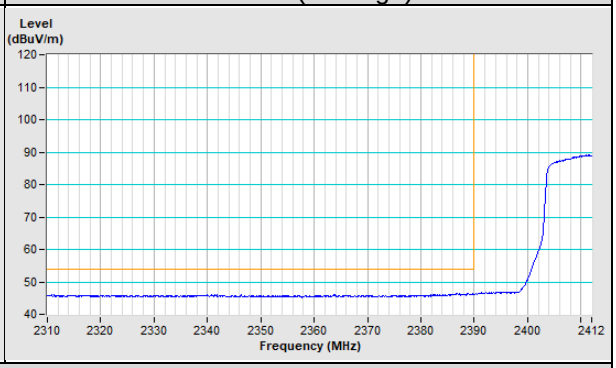
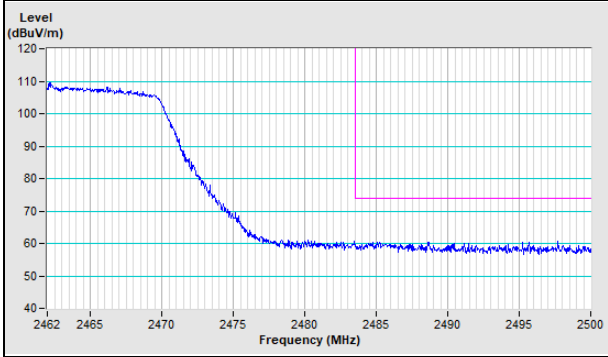
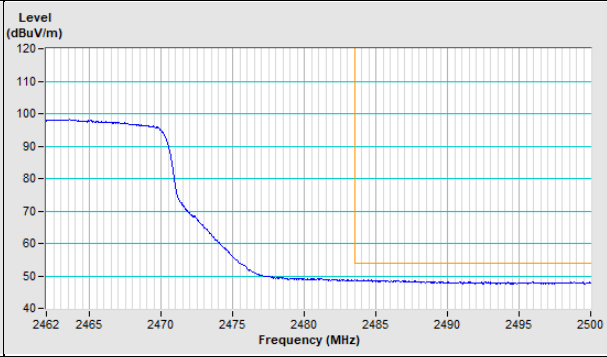
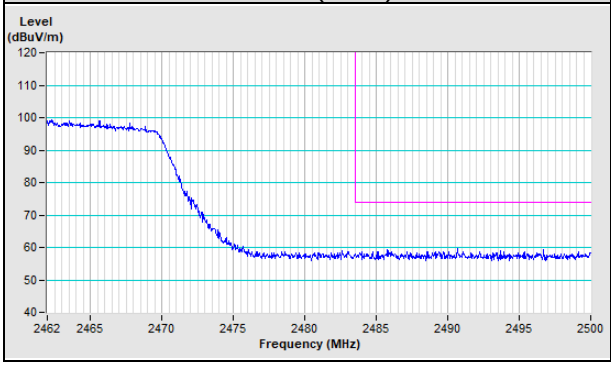
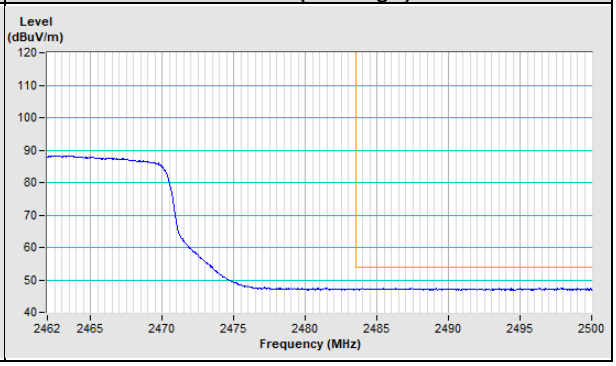


Vertical (Peak)



Vertical (Average)



802.11n (HT40) Channel 3	
Horizontal (Peak)	Horizontal (Average)
	
Vertical (Peak)	Vertical (Average)
	
802.11n (HT40) Channel 9	
Horizontal (Peak)	Horizontal (Average)
	
Vertical (Peak)	Vertical (Average)
	

Appendix – Information of the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are FCC recognized accredited test firms and accredited according to ISO/IEC 17025.

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The address and road map of all our labs can be found in our web site also.

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