

Partial FCC Test Report

Report No.: RF161130C01-1

FCC ID: TX2-RTL8822BE

Test Model: RTL8822BE

Received Date: Nov. 30, 2016

Test Date: Dec. 07, 2016 ~ Dec. 10, 2016

Issued Date: Dec. 20, 2016

Applicant: Realtek Semiconductor Corp.

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Issued By: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch

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(R.O.C)

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33383, Taiwan, R.O.C.



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Release Control Record

Issue No.	Description	Date Issued
RF161130C01-1	Original Release	Dec. 20, 2016

1 Certificate of Conformity

Product: 802.11a/b/g/n/ac/ RTL8822BE Combo module

Brand: REALTEK

Test Model: RTL8822BE

Sample Status: Production Unit


Applicant: Realtek Semiconductor Corp.

Test Date: Dec. 07, 2016 ~ Dec. 10, 2016

Standards: 47 CFR FCC Part 15, Subpart E (Section 15.407)
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 EMC characteristics under the conditions specified in this report.

Prepared by :

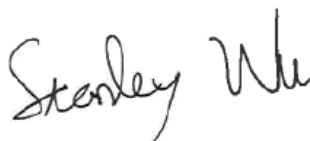


Date:

Dec. 20, 2016

Rona Chen / Specialist

Approved by :



Date:

Dec. 20, 2016

Stanley Wu / Assistant Manager

2 Summary of Test Results

47 CFR FCC Part 15, Subpart E (Section 15.407)			
FCC Clause	Test Item	Result	Remarks
15.407(b)(6)	AC Power Conducted Emissions	Pass	Meet the requirement of limit. Minimum passing margin is -16.43 dB at 0.16955 MHz.
15.407(b) (1/2/3/4(i/ii)/6)	Radiated Emissions	Pass	Meet the requirement of limit. Minimum passing margin is -4.46 dB at 5145.2 MHz.
	Band Edge Measurement	N/A	Refer to Note
15.407(a)(1/2/3)	Max Average Transmit Power	N/A	Refer to Note
15.407(a)(1/2/3)	Peak Power Spectral Density	N/A	Refer to Note
15.407(e)	6 dB Bandwidth	N/A	Refer to Note
15.407(g)	Frequency Stability	N/A	Refer to Note
15.203	Antenna Requirement	Pass	No antenna connector is used.

*For U-NII-3 band compliance with rule part 15.407(b)(4)(i), the OOB test plots were recorded in Annex A.

Note: Test item for AC Power Conducted Emission and Radiated Emissions are performed for this report. For other test data, please refer to SPORTON Report No.: FR651715AB for module (Brand: REALTEK, Model: RTL8822BE).

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) (±)
Conducted Emissions at mains ports	150 kHz ~ 30 MHz	2.44 dB
Radiated Emissions up to 1 GHz	30 MHz ~ 200 MHz	2.93 dB
	200 MHz ~ 1000 MHz	2.95 dB
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	802.11a/b/g/n/ac/ RTL8822BE Combo module
Brand	REALTEK
Test Model	RTL8822BE
Status of EUT	Production Unit
Power Supply Rating	5.0 Vdc (Host equipment)
Modulation Type	256QAM, 64QAM, 16QAM, QPSK, BPSK
Modulation Technology	OFDM
Transfer Rate	802.11a: 54.0/ 48.0/ 36.0/ 24.0/ 18.0/ 12.0/ 9.0/ 6.0 Mbps 802.11n: up to MCS7 802.11ac: up to V9
Operating Frequency	5180 ~ 5240 MHz, 5260 ~ 5320 MHz, 5500 ~ 5700 MHz, 5745 ~ 5825 MHz
Number of Channel	5180 ~ 5240 MHz: 4 for 802.11a, 802.11n (HT20) 2 for 802.11n (HT40) 1 for 802.11ac (VHT80) 5260 ~ 5320 MHz: 4 for 802.11a, 802.11n (HT20) 2 for 802.11n (HT40) 1 for 802.11ac (VHT80) 5500 ~ 5700 MHz: 11 for 802.11a, 802.11n (HT20) 5 for 802.11n (HT40) 2 for 802.11ac (VHT80) 5745 ~ 5825 MHz: 5 for 802.11a, 802.11n (HT20) 2 for 802.11n (HT40) 1 for 802.11ac (VHT80)
Antenna Type	Refer to SPORTON Report No.: FR651715AB
Antenna Connector	N/A
Accessory Device	N/A
Data Cable Supplied	N/A

Note:

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

Modulation Mode	Tx Function
802.11a	2TX
802.11n (HT20)	2TX
802.11n (HT40)	2TX
802.11ac (HT20)	2TX
802.11ac (HT40)	2TX
802.11ac (VHT80)	2TX

* The modulation and bandwidth are similar for 802.11n mode for HT20 / HT40 and 802.11ac mode for HT20 / HT40, therefore investigated worst case to representative mode in test report. (Final test mode refer section 3.2.1)

2. The EUT is authorized for use in specific End-product. Please refer to below for more details.

Product	Brand	Model
Notebook Computer	Lenovo	TP00080B

3. The information of antenna which collocated in the End-product is listed as below.

Antenna Type	Manufacturer	Parts Number	Antenna Gain (dBi)			
			5180 ~ 5240 MHz	5260 ~ 5320 MHz	5500 ~ 5700 MHz	5745 ~ 5825 MHz
PIFA	High-Tek	WLAN Main Antenna: DC33001RM00	Main: 1.10	Main: 1.10	Main: 2.63	Main: 2.90
		WLAN Aux Antenna: DC33001RM10	Aux.: 1.06	Aux.: 1.06	Aux.: 0.41	Aux.: 0.33
	Tongda	WLAN Main Antenna: DC33001RN00	Main: 1.35	Main: 1.35	Main: 1.44	Main: 1.26
		WLAN Aux Antenna: DC33001RN10	Aux.: 0.16	Aux.: 0.16	Aux.: 1.00	Aux.: 0.88

* Due to the type of these two antennas is the same, only the Antenna (High-Tek) which has the worst gain is chosen for final test.

4. The End-product contains following accessory devices.

Product	Brand	Model	Description
Adapter	Lenovo	ADL135NLC3A	I/P: 100-240 Vac, 50-60 Hz, 2.5 A O/P: 20 Vdc, 6.75 A
Battery	Lenovo	SB10J78988	11.1 Vdc, 3.87 Ah
WLAN Module	REALTEK	RTL8822BE	--

5. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.

3.2 Description of Test Modes

For 5180 ~ 5240 MHz

4 channels are provided for 802.11a, 802.11n (HT20):

Channel	Frequency (MHz)	Channel	Frequency (MHz)
36	5180	44	5220
40	5200	48	5240

2 channels are provided for 802.11n (HT40):

Channel	Frequency (MHz)	Channel	Frequency (MHz)
38	5190	46	5230

1 channel is provided for 802.11ac (VHT80):

Channel	Frequency (MHz)
42	5210

For 5260 ~ 5320 MHz

4 channels are provided for 802.11a, 802.11n (HT20):

Channel	Frequency (MHz)	Channel	Frequency (MHz)
52	5260	60	5300
56	5280	64	5320

2 channels are provided for 802.11n (HT40):

Channel	Frequency (MHz)	Channel	Frequency (MHz)
54	5270	62	5310

1 channel is provided for 802.11ac (VHT80):

Channel	Frequency (MHz)
58	5290

For 5500 ~ 5700 MHz

11 channels are provided for 802.11a, 802.11n (HT20):

Channel	Frequency (MHz)	Channel	Frequency (MHz)
100	5500	124	5620
104	5520	128	5640
108	5540	132	5660
112	5560	136	5680
116	5580	140	5700
120	5600		

5 channels are provided for 802.11n (HT40):

Channel	Frequency (MHz)	Channel	Frequency (MHz)
102	5510	126	5630
110	5550	134	5670
118	5590		

2 channels are provided for 802.11ac (VHT80):

Channel	Frequency (MHz)	Channel	Frequency (MHz)
106	5530	122	5610

For 5745 ~ 5825 MHz:

5 channels are provided for 802.11a, 802.11n (HT20):

Channel	Frequency (MHz)	Channel	Frequency (MHz)
149	5745	161	5805
153	5765	165	5825
157	5785		

2 channels are provided for 802.11n (HT40):

Channel	Frequency (MHz)	Channel	Frequency (MHz)
151	5755	159	5795

1 channel is provided for 802.11ac (VHT80):

Channel	Frequency (MHz)
155	5775

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable To			Description
	RE \geq 1G	RE<1G	PLC	
-	√	√	√	-

Where **RE \geq 1G**: Radiated Emission above 1 GHz **RE<1G**: Radiated Emission below 1 GHz
PLC: Power Line Conducted Emission

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	Frequency Band (MHz)	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
-	5180-5240	802.11ac (VHT80)	42	42	OFDM	BPSK	V0
-	5260-5320	802.11ac (HT40)	54 to 62	62	OFDM	BPSK	MCS0
-	5500-5700	802.11ac (VHT80)	106 to 122	106	OFDM	BPSK	V0
-	5745-5825	802.11ac (VHT80)	155	155	OFDM	BPSK	V0

Radiated Emission Test (Below 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	Frequency Band (MHz)	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
-	5180-5240	802.11ac (VHT80)	42	42	OFDM	BPSK	V0
-	5260-5320	802.11ac (HT40)	54 to 62	62	OFDM	BPSK	V0
-	5500-5700	802.11ac (VHT80)	106 to 122	106	OFDM	BPSK	V0
-	5745-5825	802.11ac (VHT80)	155	155	OFDM	BPSK	V0

Power Line Conducted Emission Test:

- ☒ 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	Frequency Band (MHz)	Mode	Available Channel	Tested Channel	Modulation Technology	Modulation Type	Data Rate (Mbps)
-	5180-5320	802.11ac (VHT80)	42	42	OFDM	BPSK	V0

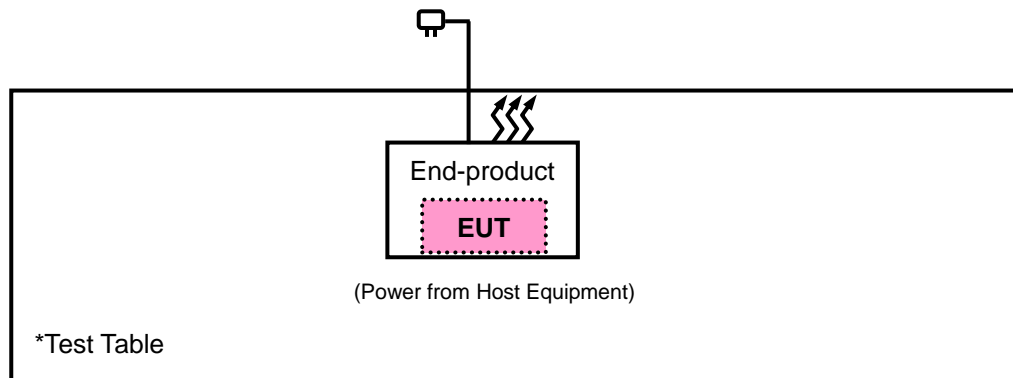
Test Condition:

Applicable To	Environmental Conditions	Input Power	Tested by
RE \geq 1G	25 deg. C, 65 % RH	120 Vac, 60 Hz	Gavin Wu
RE<1G	25 deg. C, 65 % RH	120 Vac, 60 Hz	Gavin Wu
PLC	25 deg. C, 65 % RH	120 Vac, 60 Hz	Toby Tian

3.3 Description of Support Units

The EUT has been tested as an independent unit together with other necessary accessories or support units.

3.3.1 Configuration of System under Test



3.4 General Description of Applied Standards

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

FCC Part 15, Subpart E (15.407)

789033 D02 General UNII Test Procedures New Rules v01r03

644545 D01 Guidance for IEEE 802 11ac v01r02

662911 D01 Multiple Transmitter Output v02r01

ANSI C63.10-2013

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

Note: The EUT has been verified to comply with the requirements of FCC Part 15, Subpart B, Class B (DoC).
The test report has been issued separately.

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 Limits of Unwanted Emission Out of the Restricted Bands

Applicable To		Limit	
789033 D02 General UNII Test Procedures New Rules v01r03		Field Strength at 3 m	
		PK: 74 (dBμV/m)	AV: 54 (dBμV/m)
Frequency Band	Applicable To	EIRP Limit	Equivalent Field Strength at 3 m
5150~5250 MHz	15.407(b)(1)	PK: -27 (dBm/MHz)	PK: 68.2 (dBμV/m)
5250~5350 MHz	15.407(b)(2)		
5470~5725 MHz	15.407(b)(3)		
5725~5850 MHz	15.407(b)(4)(i)	PK:-27 (dBm/MHz) ^{*1} PK:10 (dBm/MHz) ^{*2} PK:15.6 (dBm/MHz) ^{*3} PK:27 (dBm/MHz) ^{*4}	PK: 68.2 (dBμV/m) ^{*1} PK:105.2 (dBμV/m) ^{*2} PK: 110.8 (dBμV/m) ^{*3} PK:122.2 (dBμV/m) ^{*4}
	15.407(b)(4)(ii)	Emission limits in section 15.247(d)	

^{*1} beyond 75 MHz or more above of the band edge.

^{*2} below the band edge increasing linearly to 10 dBm/MHz at 25 MHz above.

^{*3} below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above.

^{*4} from 5 MHz above or below the band edge increasing linearly to a level of 27 dBm/MHz at the band edge.

Note:

The following formula is used to convert the equipment isotropic radiated power (eirp) to field strength:

$$E = \frac{1000000\sqrt{30P}}{3} \mu\text{V/m, where } P \text{ is the eirp (Watts).}$$

4.1.3 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date of Calibration	Due Date of Calibration
Test Receiver Agilent	N9038A	MY51210203	Jan. 21, 2016	Jan. 20, 2017
Spectrum Analyzer Agilent	N9010A	MY52220314	Nov. 16, 2016	Nov. 15, 2017
Spectrum Analyzer ROHDE & SCHWARZ	FSU43	101261	Dec. 17, 2015	Dec. 16, 2016
BILOG Antenna SCHWARZBECK	VULB9168	9168-472	Jan. 07, 2016	Jan. 06, 2017
HORN Antenna SCHWARZBECK	BBHA 9120 D	9120D-969	Jan. 04, 2016	Jan. 03, 2017
HORN Antenna SCHWARZBECK	BBHA 9170	9170-480	Jan. 08, 2016	Jan. 07, 2017
Loop Antenna	EM-6879	269	Aug. 11, 2016	Aug. 10, 2017
Preamplifier EMCI	EMC 012645	980115	Oct. 21, 2016	Oct. 20, 2017
Preamplifier EMCI	EMC 184045	980116	Oct. 21, 2016	Oct. 20, 2017
Preamplifier EMCI	EMC 330H	980112	Oct. 21, 2016	Oct. 20, 2017
Power Meter Anritsu	ML2495A	1232002	Sep. 08, 2016	Sep. 07, 2017
Power Sensor Anritsu	MA2411B	1207325	Sep. 08, 2016	Sep. 07, 2017
RF signal cable HUBER+SUHNNER	SUCOFLEX 104	309219/4 2950114	Oct. 21, 2016	Oct. 20, 2017
RF signal cable HUBER+SUHNNER	SUCOFLEX 104	250130/4	Oct. 21, 2016	Oct. 20, 2017
RF Coaxial Cable Worken	8D-FB	Cable-Ch10-01	Oct. 21, 2016	Oct. 20, 2017
Software BV ADT	E3 6.120103	NA	NA	NA
Antenna Tower MF	MFA-440H	NA	NA	NA
Turn Table MF	MFT-201SS	NA	NA	NA
Antenna Tower & Turn Table Controller MF	MF-7802	NA	NA	NA

- Note: 1. The calibration interval of the above test instruments is 12 / 24 months and the calibrations are traceable to NML/ROC and NIST/USA.
2. The test was performed in HwaYa Chamber 10.
3. The horn antenna and preamplifier (model: EMC 184045) are used only for the measurement of emission frequency above 1 GHz if tested.
4. The FCC Site Registration No. is 690701.
5. The IC Site Registration No. is IC7450F-10.

4.1.4 Test Procedures

- a. The EUT was placed on the top of a rotating table 0.8 meters (for below 1 GHz) / 1.5 meters (for above 1 GHz) 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 quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
- f. 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:

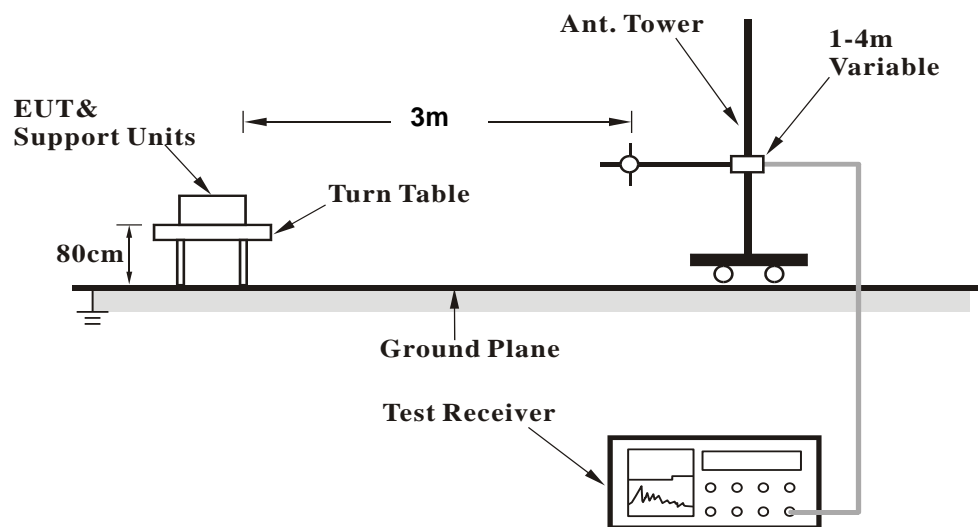
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz & 360 kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1 GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 1/T for RMS Average (Duty cycle < 98 %) for Peak detection at frequency above 1 GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz (Duty cycle ≥ 98 %) for Average detection (AV) at frequency above 1 GHz.
5. All modes of operation were investigated and the worst-case emissions are reported.

4.1.5 Deviation from Test Standard

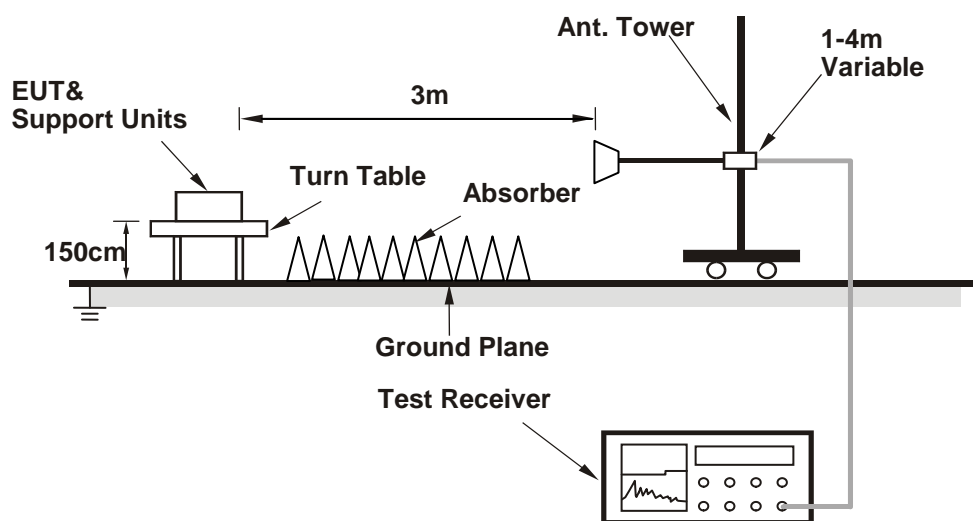
No deviation.

4.1.6 Test Set Up

<Frequency Range below 1 GHz>



<Frequency Range above 1 GHz>



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

4.1.7 EUT Operating Conditions

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

4.1.8 Test Results

Above 1 GHz Data :

802.11ac (VHT80)

EUT Test Condition		Measurement Detail	
Channel	Channel 42	Frequency Range	1 GHz ~ 40 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Gavin Wu

Antenna Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emissino Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
5145.2	49.54	49.34	54	-4.46	31.32	6.2	37.32	152	197	Average
5145.5	60.21	60.01	74	-13.79	31.32	6.2	37.32	152	197	Peak
5210	85.93	85.68			31.37	6.24	37.36	152	197	Average
5210	93.45	93.2			31.37	6.24	37.36	152	197	Peak
5410.61	50.5	49.84	74	-23.5	31.52	6.32	37.18	152	197	Peak
5436.24	39.96	39.22	54	-14.04	31.55	6.32	37.13	152	197	Average
*10420	54.3	58.3	68.2	-13.9	39.27	9.09	52.36	113	211	Peak
Antenna Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emissino Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
5145.2	46.03	45.83	54	-7.97	31.32	6.2	37.32	129	188	Average
5148.65	56.81	56.61	74	-17.19	31.32	6.2	37.32	129	188	Peak
5210	84.71	84.46			31.37	6.24	37.36	129	188	Average
5210	91.5	91.25			31.37	6.24	37.36	129	188	Peak
5439.54	39.97	39.21	54	-14.03	31.55	6.34	37.13	129	188	Average
5443.17	51.57	50.81	74	-22.43	31.55	6.34	37.13	129	188	Peak
*10420	53.68	57.68	68.2	-14.52	39.27	9.09	52.36	100	351	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Margin value = Emission level – Limit value
- 5210 MHz: Fundamental Frequency
- *: Out of Restricted Band

802.11ac (HT40)

EUT Test Condition		Measurement Detail	
Channel	Channel 62	Frequency Range	1 GHz ~ 40 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Gavin Wu

Antenna Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
5125.4	39.7	39.49	54	-14.3	31.31	6.2	37.3	165	196	Average
5143.1	50.41	50.19	74	-23.59	31.32	6.2	37.3	165	196	Peak
5310	88.42	87.89			31.45	6.27	37.19	165	196	Average
5310	94.85	94.32			31.45	6.27	37.19	165	196	Peak
5350	45.12	44.53	54	-8.88	31.48	6.29	37.18	165	196	Average
5350.22	55.96	55.37	74	-18.04	31.48	6.29	37.18	165	196	Peak
10620	45.96	49.55	54	-8.04	39.59	9.16	52.34	104	114	Average
10620	55.34	58.93	74	-18.66	39.59	9.16	52.34	104	114	Peak
Antenna Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
5118.8	50.57	50.39	74	-23.43	31.29	6.19	37.3	193	187	Peak
5126	39.68	39.47	54	-14.32	31.31	6.2	37.3	193	187	Average
5310	87.42	86.89			31.45	6.27	37.19	193	187	Average
5310	93.76	93.23			31.45	6.27	37.19	193	187	Peak
5350	44.99	44.4	54	-9.01	31.48	6.29	37.18	193	187	Average
5350	56.39	55.8	74	-17.61	31.48	6.29	37.18	193	187	Peak
10620	45.86	49.45	54	-8.14	39.59	9.16	52.34	100	105	Average
10620	55.2	58.79	74	-18.8	39.59	9.16	52.34	100	105	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Margin value = Emission level – Limit value
- 5310 MHz: Fundamental Frequency
- *: Out of Restricted Band

802.11ac (VHT80)

EUT Test Condition		Measurement Detail	
Channel	Channel 106	Frequency Range	1 GHz ~ 40 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Gavin Wu

Antenna Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
5450.64	57.89	57.07	74	-16.11	31.56	6.34	37.08	128	247	Peak
5459.76	46.69	45.87	54	-7.31	31.56	6.34	37.08	128	247	Average
*5470	56.48	55.65	68.2	-11.72	31.57	6.34	37.08	128	247	Peak
5530	84.34	83.38			31.63	6.42	37.09	128	247	Average
5530	91.51	90.55			31.63	6.42	37.09	128	247	Peak
*5725	49.99	48.71	68.2	-18.21	31.96	6.75	37.43	128	247	Peak
11060	45.74	49.69	54	-8.26	40.16	9.46	53.57	125	62	Average
11060	54.01	57.96	74	-19.99	40.16	9.46	53.57	125	62	Peak
Antenna Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
5450.64	58.17	57.35	74	-15.83	31.56	6.34	37.08	187	6	Peak
5459.12	48.02	47.2	54	-5.98	31.56	6.34	37.08	187	6	Average
*5470	58.34	57.51	68.2	-9.86	31.57	6.34	37.08	187	6	Peak
5530	86.59	85.63			31.63	6.42	37.09	187	6	Average
5530	94.52	93.56			31.63	6.42	37.09	187	6	Peak
*5725	49.95	48.73	68.2	-18.25	31.96	6.69	37.43	187	6	Peak
11060	45.83	49.78	54	-8.17	40.16	9.46	53.57	105	223	Average
11060	55.04	58.99	74	-18.96	40.16	9.46	53.57	105	223	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Margin value = Emission level – Limit value
- 5530 MHz: Fundamental Frequency
- *: Out of Restricted Band

802.11ac (VHT80)

EUT Test Condition		Measurement Detail	
Channel	Channel 155	Frequency Range	1 GHz ~ 40 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Average (AV)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Gavin Wu

<Spurious Emission>

Antenna Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emissino Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
5775	91.78	90.42			32.04	6.82	37.5	128	245	Average
5775	98.82	97.46			32.04	6.82	37.5	128	245	Peak
11550	45.86	49.2	54	-8.14	39.81	10.09	53.24	148	73	Average
11550	54.3	57.64	74	-19.7	39.81	10.09	53.24	148	73	Peak
Antenna Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emissino Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
5775	92.03	90.67			32.04	6.82	37.5	144	192	Average
5775	99.32	97.96			32.04	6.82	37.5	144	192	Peak
11550	46.16	49.5	54	-7.84	39.81	10.09	53.24	109	241	Average
11550	55.76	59.1	74	-18.24	39.81	10.09	53.24	109	241	Peak

<Ouf of Band Emission (OOBE)>

Antenna Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emissino Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
*5626	55.42	54.29	68.2	-12.78	31.79	6.56	37.22	128	245	Peak
5656.975	55.63	54.5	73.38	-17.75	31.85	6.62	37.34	128	245	Peak
5917.9	56.03	54.26	73.44	-17.41	32.26	7.01	37.5	128	245	Peak
*5933.125	57.61	55.81	68.2	-10.59	32.29	7.01	37.5	128	245	Peak
Antenna Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emissino Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
*5641.75	56.03	54.87	68.2	-12.17	31.82	6.62	37.28	144	192	Peak
5652.775	56.83	55.64	70.26	-13.43	31.85	6.62	37.28	144	192	Peak
5915.8	58.41	56.64	74.98	-16.57	32.26	7.01	37.5	144	192	Peak
*5933.65	57.78	55.98	68.2	-10.42	32.29	7.01	37.5	144	192	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Margin value = Emission level – Limit value
- 5775 MHz: Fundamental Frequency
- *: Out of Restricted Band

9 kHz ~ 30 MHz DATA:

The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

30 MHz ~ 1 GHz WORST-CASE DATA:

802.11ac (VHT80)

EUT Test Condition		Measurement Detail	
Channel	Channel 42	Frequency Range	30 MHz ~ 1 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Quasi-peak (QP)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Gavin Wu

Antenna Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
43.58	20.11	36.96	40	-19.89	13.59	0.67	31.11	117	138	Peak
221.09	22.6	42.68	46	-23.4	10.26	1.38	31.72	115	80	Peak
263.77	24.81	43.32	46	-21.19	11.88	1.53	31.92	103	89	Peak
359.8	27.44	43.24	46	-18.56	14.38	1.79	31.97	133	70	Peak
551.86	28.69	39.98	46	-17.31	18.5	2.18	31.97	132	337	Peak
647.89	31.89	41.38	46	-14.11	20.19	2.35	32.03	114	234	Peak
Antenna Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
30	27.55	46.13	40	-12.45	11.98	0.58	31.14	107	217	Peak
263.77	22.47	40.98	46	-23.53	11.88	1.53	31.92	111	347	Peak
390.84	33.45	48.49	46	-12.55	15.12	1.89	32.05	132	58	Peak
551.86	30.16	41.45	46	-15.84	18.5	2.18	31.97	105	60	Peak
647.89	37.55	47.04	46	-8.45	20.19	2.35	32.03	111	247	Peak
696.39	33.54	42.13	46	-12.46	20.77	2.45	31.81	124	120	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Margin value = Emission level – Limit value

802.11ac (HT40)

EUT Test Condition		Measurement Detail	
Channel	Channel 62	Frequency Range	30 MHz ~ 1 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Quasi-peak (QP)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Gavin Wu

Antenna Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
209.45	29.49	50	43.5	-14.01	9.77	1.33	31.61	130	20	Peak
231.76	31.33	51.04	46	-14.67	10.71	1.42	31.84	139	287	Peak
359.8	29.85	45.65	46	-16.15	14.38	1.79	31.97	117	70	Peak
422.85	30.47	44.78	46	-15.53	15.79	1.94	32.04	126	284	Peak
647.89	33.63	43.12	46	-12.37	20.19	2.35	32.03	116	169	Peak
683.78	32.44	41.24	46	-13.56	20.62	2.42	31.84	103	300	Peak
Antenna Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
43.58	23.2	40.05	40	-16.8	13.59	0.67	31.11	126	196	Peak
312.27	26.38	43.41	46	-19.62	13.24	1.67	31.94	107	305	Peak
390.84	32.37	47.41	46	-13.63	15.12	1.89	32.05	133	125	Peak
422.85	32.89	47.2	46	-13.11	15.79	1.94	32.04	116	161	Peak
593.57	35.67	46.15	46	-10.33	19.46	2.24	32.18	139	128	Peak
647.89	40.58	50.07	46	-5.42	20.19	2.35	32.03	128	183	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Margin value = Emission level – Limit value

802.11ac (VHT80)

EUT Test Condition		Measurement Detail	
Channel	Channel 106	Frequency Range	30 MHz ~ 1 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Quasi-peak (QP)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Gavin Wu

Antenna Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
165.8	22.09	40.61	43.5	-21.41	12.15	1.12	31.79	124	148	Peak
359.8	29.48	45.28	46	-16.52	14.38	1.79	31.97	115	332	Peak
422.85	30.88	45.19	46	-15.12	15.79	1.94	32.04	135	25	Peak
560.59	27.49	38.65	46	-18.51	18.7	2.2	32.06	113	339	Peak
647.89	33.4	42.89	46	-12.6	20.19	2.35	32.03	115	325	Peak
696.39	32.72	41.31	46	-13.28	20.77	2.45	31.81	100	147	Peak
Antenna Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
30.97	24.52	42.91	40	-15.48	12.14	0.59	31.12	137	153	Peak
312.27	24.97	42	46	-21.03	13.24	1.67	31.94	124	198	Peak
399.57	32.96	47.85	46	-13.04	15.33	1.91	32.13	130	170	Peak
551.86	31.7	42.99	46	-14.3	18.5	2.18	31.97	135	241	Peak
647.89	39.21	48.7	46	-6.79	20.19	2.35	32.03	119	183	Peak
696.39	35.49	44.08	46	-10.51	20.77	2.45	31.81	118	197	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Margin value = Emission level – Limit value

802.11ac (VHT80)

EUT Test Condition		Measurement Detail	
Channel	Channel 155	Frequency Range	30 MHz ~ 1 GHz
Input Power	120 Vac, 60 Hz	Detector Function	Peak (PK) Quasi-peak (QP)
Environmental Conditions	25 deg. C, 65 % RH	Tested By	Gavin Wu

Antenna Polarity & Test Distance: Horizontal at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
157.07	23.11	41.06	43.5	-20.39	12.72	1.13	31.8	135	39	Peak
245.34	29.62	48.73	46	-16.38	11.28	1.48	31.87	108	304	Peak
359.8	29.68	45.48	46	-16.32	14.38	1.79	31.97	140	253	Peak
423.82	30.31	44.58	46	-15.69	15.81	1.95	32.03	101	167	Peak
591.63	32.36	42.87	46	-13.64	19.41	2.24	32.16	105	344	Peak
683.78	35.33	44.13	46	-10.67	20.62	2.42	31.84	128	231	Peak
Antenna Polarity & Test Distance: Vertical at 3 m										
Frequency (MHz)	Emission Level (dBuV/m)	Read Level (dBuV)	Limit (dBuV/m)	Margin (dB)	Antenna Factor (dB/m)	Cable Loss (dB)	Preamp Factor (dB)	Antenna Height (cm)	Table Angle (Degree)	Remark
184.23	23.42	43.5	43.5	-20.08	10.46	1.23	31.77	107	232	Peak
247.28	22.76	41.82	46	-23.24	11.36	1.48	31.9	139	213	Peak
399.57	34.34	49.23	46	-11.66	15.33	1.91	32.13	109	115	Peak
599.39	36.26	46.65	46	-9.74	19.59	2.26	32.24	130	119	Peak
647.89	38.91	48.4	46	-7.09	20.19	2.35	32.03	125	2	Peak
696.39	35.05	43.64	46	-10.95	20.77	2.45	31.81	112	7	Peak

Remarks:

- Emission Level = Read Level + Antenna Factor + Cable Loss - Preamp Factor
Margin value = Emission level – Limit value

4.2 Conducted Emission Measurement

4.2.1 Limits of Conducted Emission Measurement

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

Note: 1. The lower limit shall apply at the transition frequencies.

2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to 0.50 MHz.

4.2.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Date Of Calibration	Due Date Of Calibration
Test Receiver ROHDE & SCHWARZ	ESCI	100613	Nov. 21, 2016	Nov. 20, 2017
RF signal cable (with 10dB PAD) Woken	5D-FB	Cable-cond1-01	Dec. 26, 2015	Dec. 25, 2016
LISN ROHDE & SCHWARZ (EUT)	ESH3-Z5	835239/001	Feb. 26, 2016	Feb. 25, 2017
LISN ROHDE & SCHWARZ (Peripheral)	ESH3-Z5	100311	Jul. 28, 2016	Jul. 27, 2017
Software ADT	BV ADT_Conc_ V7.3.7.3	NA	NA	NA

- 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 Shielded Room 1.
 3. The VCCI Site Registration No. is C-2040.

4.2.3 Test Procedures

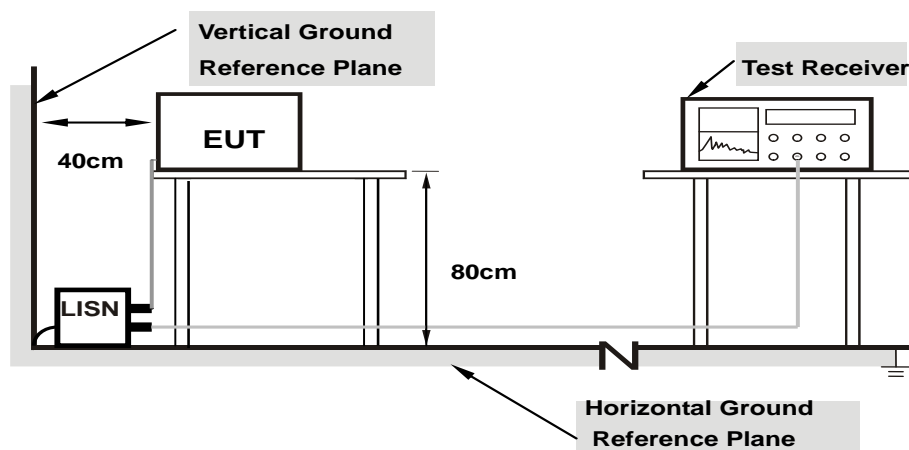
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance for the measuring instrument.
- Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- The frequency range from 150 kHz to 30 MHz was searched. Emission levels under (Limit -20 dB) was not recorded.

Note: All modes of operation were investigated and the worst-case emissions are reported.

4.2.4 Deviation from Test Standard

No deviation.

4.2.5 Test Setup



- Note:**
- Support units were connected to second LISN.
 - Both of LISNs (AMN) are 80 cm from EUT and at least 80 from other units and other metal planes

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

4.2.6 EUT Operating Conditions

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

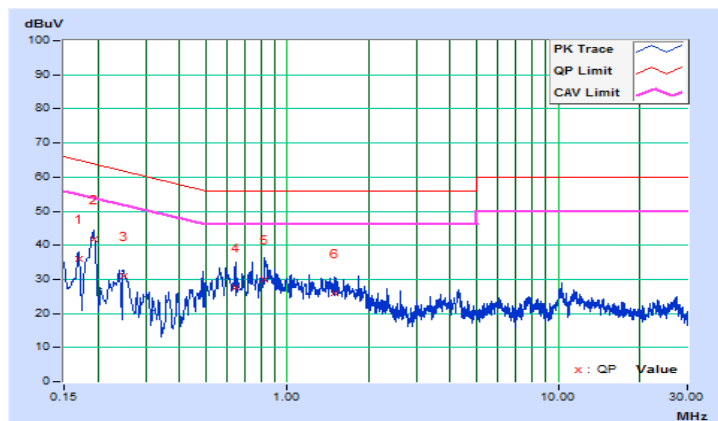
4.2.7 Test Results

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25°C, 65%RH
Tested by	Toby Tian	Test Date	2016/12/8

Phase Of Power : Line (L)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.16955	10.02	26.11	11.80	36.13	21.82	64.98	54.98	-28.85	-33.16
2	0.19305	10.03	31.83	17.98	41.86	28.01	63.90	53.90	-22.04	-25.89
3	0.24796	10.05	20.90	10.68	30.95	20.73	61.83	51.83	-30.88	-31.10
4	0.64266	10.15	17.57	7.56	27.72	17.71	56.00	46.00	-28.28	-28.29
5	0.82669	10.18	19.77	10.09	29.95	20.27	56.00	46.00	-26.05	-25.73
6	1.49113	10.23	15.63	9.01	25.86	19.24	56.00	46.00	-30.14	-26.76

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

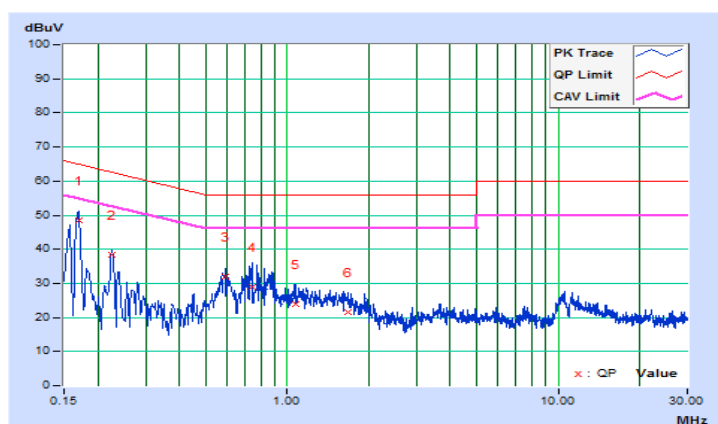


Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Input Power	120Vac, 60Hz	Environmental Conditions	25°C, 65%RH
Tested by	Toby Tian	Test Date	2016/12/8

Phase Of Power : Neutral (N)										
No	Frequency (MHz)	Correction Factor (dB)	Reading Value (dBuV)		Emission Level (dBuV)		Limit (dBuV)		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.16955	10.03	38.52	23.92	48.55	33.95	64.98	54.98	-16.43	-21.03
2	0.22434	10.05	28.33	17.80	38.38	27.85	62.66	52.66	-24.28	-24.81
3	0.58792	10.16	21.70	7.81	31.86	17.97	56.00	46.00	-24.14	-28.03
4	0.74432	10.18	18.82	8.26	29.00	18.44	56.00	46.00	-27.00	-27.56
5	1.06885	10.21	13.75	6.76	23.96	16.97	56.00	46.00	-32.04	-29.03
6	1.67099	10.26	11.15	5.13	21.41	15.39	56.00	46.00	-34.59	-30.61

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

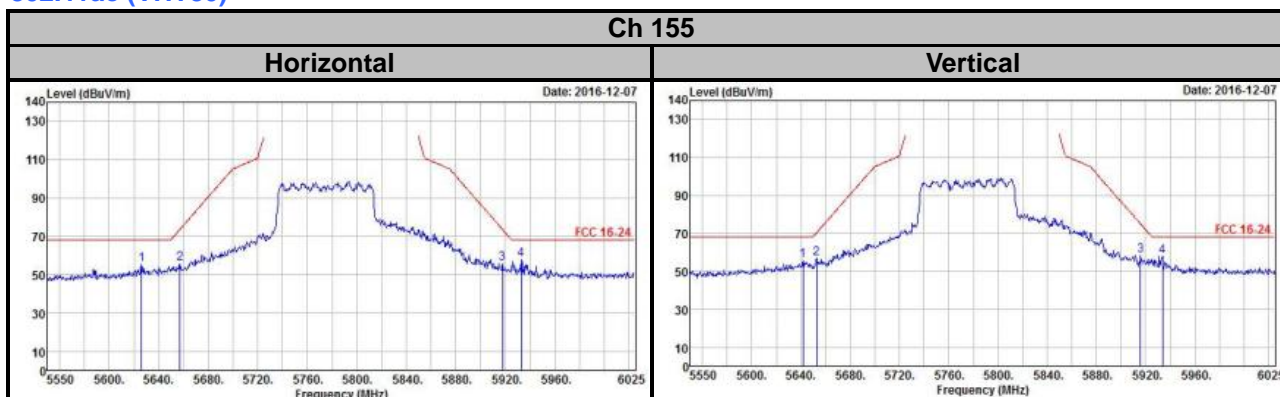


5 Pictures of Test Arrangements

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

Annex A- Radiated Out of Band Emisison (OOBE) Measurement (For U-NII-3 band)

802.11ac (VHT80)



Appendix – Information on 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 accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

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Web Site: www.bureauveritas-adt.com

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

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