

Partial FCC Test Report (Spot Check)

Report No.: RF200424C06-1

FCC ID: 2ARXKVHE09-4GL

Test Model: VHE09-4GL

Series Model: VHE09XXXXX (X=A-Z, 0-9, blank or "-")

Received Date: Apr. 24, 2020

Test Date: Jun. 02 ~ Jun. 11, 2020

Issued Date: Jun. 17, 2020

Applicant: Veea Inc

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Issued By: Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch
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**FCC Registration /
Designation Number:** 788550 / TW0003



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Release Control Record

Issue No.	Description	Date Issued
RF200424C06-1	Original release.	Jun. 17, 2020

1 Certificate of Conformity

Product: veeaHub

Brand: 

Test Model: VHE09-4GL

Series Model: VHE09XXXXX (X=A-Z, 0-9, blank or "-")

Sample Status: Engineering sample

Applicant: Veea Inc

Test Date: Jun. 02 ~ Jun. 11, 2020

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 RF characteristics under the conditions specified in this report.

Prepared by :  , **Date:** Jun. 17, 2020
Polly Chien / Specialist

Approved by :  , **Date:** Jun. 17, 2020
Bruce Chen / Senior Project Engineer

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 -0.35dB at 0.52523MHz.
15.407(b) (1/2/3/4(i/ii)/6)	Radiated Emissions & Band Edge Measurement	Pass	Meet the requirement of limit. Minimum passing margin is -1.7dB at 5650.00MHz & 5925.00MHz.
15.407(a)(1/2/3)	Max Average Transmit Power	Pass	Meet the requirement of limit.
---	Occupied Bandwidth Measurement	-	Reference only.
15.407(a)(1/2/3)	Peak Power Spectral Density	Pass	Meet the requirement of limit.
15.407(e)	6dB bandwidth	N/A	Refer to note 1
15.407(g)	Frequency Stability	N/A	Refer to note 1
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:

1. This report is a partial report. Therefore, only Output Power, AC Power Conducted Emission and Radiated Emissions above 1GHz were verified and recorded in this report. Other testing data please refer to the original BV CPS report no.: RF181115C24-4 & RF181115C24B.
2. 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) (\pm)
Conducted Emissions at mains ports	150kHz ~ 30MHz	2.79 dB
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	2.29 dB
	18GHz ~ 40GHz	2.29 dB

2.2 Modification Record

There were no modifications required for compliance.

3 General Information

3.1 General Description of EUT

Product	veeaHub
Brand	
Test Model	VHE09-4GL
Series Model	VHE09XXXXX (X=A-Z, 0-9, blank or "-")
Model Difference	Marketing purposes
Sample Status	Engineering sample
Power Supply Rating	48Vdc (Adapter and PoE)
Modulation Type	256QAM, 64QAM, 16QAM, QPSK, BPSK
Modulation Technology	OFDM
Transfer Rate	802.11a: 54/48/36/24/18/12/9/6Mbps 802.11n: up to 600Mbps 802.11ac: up to 3466.7Mbps
Operating Frequency	5180~5240MHz, 5260~5320MHz, 5500~5720MHz, 5745~5825MHz
Number of Channel	5180 ~ 5240MHz: 4 for 802.11a, 802.11n (HT20), 802.11ac (VHT20) 2 for 802.11n (HT40), 802.11ac (VHT40) 1 for 802.11ac (VHT80), 802.11ac (VHT80+VHT80) 5260~5320MHz: 802.11a, 802.11n (HT20), 802.11ac (VHT20): 4 802.11n (HT40), 802.11ac (VHT40): 2 802.11ac (VHT80): 1 5500~5720MHz: 802.11a, 802.11n (HT20), 802.11ac (VHT20): 12 802.11n (HT40), 802.11ac (VHT40): 6 802.11ac (VHT80): 3 5745 ~ 5825MHz: 5 for 802.11a, 802.11n (HT20), 802.11ac (VHT20) 2 for 802.11n (HT40), 802.11ac (VHT40) 1 for 802.11ac (VHT80), 802.11ac (VHT80+VHT80)
Output Power	CDD Mode: 5180~5240MHz: 782.833mW 5260~5320MHz: 217.015mW 5500~5720MHz: 230.862mW 5745~5825MHz: 922.157mW Beamforming Mode: 5180~5240MHz: 195.735mW 5260~5320MHz: 54.262mW 5500~5720MHz: 56.106mW 5745~5825MHz: 219.522mW
Antenna Type	Chip antenna with 2.1dBi gain
Antenna Connector	NA
Accessory Device	Adapter
Cable Supplied	NA

Note:

1. This report is a supplementary report to the original BV CPS report no.: RF181115C24-4 & RF181115C24B. Exhibit prepared for FCC Spot Check Verification report, the format, test items and amount of spot-check test data are decided by applicant's engineering judgment, for more details please refer to declaration letter exhibit. Therefore, only Output Power, AC Power Conducted Emission and Radiated Emissions above 1GHz were verified and recorded in this report. AC Power Conducted Emission and Radiated Emission tests according to original report radiated emission worst channel.
2. The EUT incorporates a MIMO function. Physically, the EUT provides 4 completed transmitter and 4 receivers.

Band	Modulation Mode	CDD Mode	Beamforming Mode	TX Function
5GHz	802.11a	Support	Not Support	4TX
	802.11n (HT20)	Support	Support	4TX
	802.11n (HT40)	Support	Support	4TX
	802.11ac (VHT20)	4TX	Support	4TX
	802.11ac (VHT40)	4TX	Support	4TX
	802.11ac (VHT80)	Support	Support	4TX
	802.11ac (VHT80+VHT80)	Support	Support	2TX+2TX

* The modulation and bandwidth are similar for 802.11n mode for HT20/HT40 and 802.11ac mode for VHT20/VHT40. After pre-testing, 802.11ac (VHT20/VHT40) power is lower than 802.11n (HT20/HT40), therefore 802.11n (HT20/HT40) is the worst case to representative mode in test report. (Final test mode refer section 3.2.1)

3. The EUT uses following adapter and PoE.

Adapter	
Brand	EDAC Power Electronics Co., Ltd.
Model	EA1062SGR-480
Input Power	100-240Vac ~2.5A, 50-60Hz
Output Power	48Vdc / 1.35A
Power Line	1.2m DC cable with one core

PoE (Support unit)	
Model	APOE02-WM
Output Power	48Vdc

4. WLAN, zigbee, Bluetooth and LoRa technology can transmit at same time.
5. 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.

3.2 Description of Test Modes

5180 ~ 5240MHz:

4 channels are provided for 802.11a, 802.11n (HT20), 802.11ac (VHT20):

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

2 channels are provided for 802.11n (HT40), 802.11ac (VHT40):

Channel	Frequency	Channel	Frequency
38	5190 MHz	46	5230 MHz

1 channel is provided for 802.11ac (VHT80), 802.11ac (VHT80+VHT80):

Channel	Frequency
42	5210MHz

5260~5320MHz:

4 channels are provided for 802.11a, 802.11n (HT20), 802.11ac (VHT20):

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

2 channels are provided for 802.11n (HT40), 802.11ac (VHT40):

Channel	Frequency	Channel	Frequency
54	5270 MHz	62	5310 MHz

1 channel is provided for 802.11ac (VHT80):

Channel	Frequency
58	5290 MHz

5500~5720MHz:

12 channels are provided for 802.11a, 802.11n (HT20), 802.11ac (VHT20):

Channel	Frequency	Channel	Frequency
100	5500 MHz	124	5620 MHz
104	5520 MHz	128	5640 MHz
108	5540 MHz	132	5660 MHz
112	5560 MHz	136	5680 MHz
116	5580 MHz	140	5700 MHz
120	5600 MHz	144	5720 MHz

6 channels are provided for 802.11n (HT40), 802.11ac (VHT40):

Channel	Frequency	Channel	Frequency
102	5510 MHz	126	5630 MHz
110	5550 MHz	134	5670 MHz
118	5590 MHz	142	5710 MHz

3 channels are provided for 802.11ac (VHT80):

Channel	Frequency	Channel	Frequency
106	5530 MHz	138	5690 MHz
122	5610 MHz		

5745 ~ 5825MHz:

5 channels are provided for 802.11a, 802.11n (HT20), 802.11ac (VHT20):

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

2 channels are provided for 802.11n (HT40), 802.11ac (VHT40):

Channel	Frequency	Channel	Frequency
151	5755MHz	159	5795MHz

1 channel is provided for 802.11ac (VHT80), 802.11ac (VHT80+VHT80):

Channel	Frequency
155	5775MHz

3.2.1 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable to			Description
	RE \geq 1G	PLC	P	
A	√	√	√	Power from adapter
B	-	√	-	Power from PoE

Where RE \geq 1G: Radiated Emission above 1GHz & Bandedge Measurement P: Conducted Output Power Measurement
 PLC: Power Line Conducted Emission

Note: The antenna 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 1GHz):

- 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	Frequency Band (MHz)	Available Channel	Tested Channel	Modulation Technology	Data Rate (Mbps)
A	802.11ac (VHT80)	5745-5825	155	155	OFDM	29.3

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	Mode	Frequency Band (MHz)	Available Channel	Tested Channel	Modulation Technology	Data Rate (Mbps)
A, B	802.11ac (VHT80)	5745-5825	155	155	OFDM	29.3

Conducted Output Power 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	Frequency Band (MHz)	Available Channel	Tested Channel	Modulation Technology	Data Rate (Mbps)
CDD mode						
A	802.11a	5180-5240	36 to 48	36, 40, 48	OFDM	6.0
	802.11n (HT20)		36 to 48	36, 40, 48	OFDM	6.5
	802.11n (HT40)		38 to 46	38, 46	OFDM	13.5
	802.11ac (VHT80)		42	42	OFDM	29.3
A	802.11a	5260-5320	52 to 64	52, 60, 64	OFDM	6.0
	802.11n (HT20)		52 to 64	52, 60, 64	OFDM	6.5
	802.11n (HT40)		54 to 62	54, 62	OFDM	13.5
	802.11ac (VHT80)		58	58	OFDM	29.3

EUT Configure Mode	Mode	Frequency Band (MHz)	Available Channel	Tested Channel	Modulation Technology	Data Rate (Mbps)
A	802.11a	5500-5720	100 to 144	100, 116, 140, 144	OFDM	6.0
	802.11n (HT20)		100 to 144	100, 116, 140, 144	OFDM	6.5
	802.11n (HT40)		102 to 142	102, 110, 134, 142	OFDM	13.5
	802.11ac (VHT80)		106 to 138	106, 122, 138	OFDM	29.3
A	802.11a	5745-5825	149 to 165	149, 157, 165	OFDM	6.0
	802.11n (HT20)		149 to 165	149, 157, 165	OFDM	6.5
	802.11n (HT40)		151 to 159	151, 159	OFDM	13.5
	802.11ac (VHT80)		155	155	OFDM	29.3
A	802.11ac (VHT80+VHT80)	5180-5240 5745-5825	42+155	42+155	OFDM	58.5
Beamforming Mode						
A	802.11n (HT20)	5180-5240	36 to 48	36, 40, 48	OFDM	6.5
	802.11n (HT40)		38 to 46	38, 46	OFDM	13.5
	802.11ac (VHT80)		42	42	OFDM	29.3
A	802.11n (HT20)	5260-5320	52 to 64	52, 60, 64	OFDM	6.5
	802.11n (HT40)		54 to 62	54, 62	OFDM	13.5
	802.11ac (VHT80)		58	58	OFDM	29.3
A	802.11n (HT20)	5500-5720	100 to 144	100, 116, 140, 144	OFDM	6.5
	802.11n (HT40)		102 to 142	102, 110, 134, 142	OFDM	13.5
	802.11ac (VHT80)		106 to 138	106, 122, 138	OFDM	29.3
A	802.11n (HT20)	5745-5825	149 to 165	149, 157, 165	OFDM	6.5
	802.11n (HT40)		151 to 159	151, 159	OFDM	13.5
	802.11ac (VHT80)		155	155	OFDM	29.3
A	802.11ac (VHT80+VHT80)	5180-5240 5745-5825	42+155	42+155	OFDM	58.5

Test Condition:

Applicable to	Environmental Conditions	Input Power	Tested by
RE _≥ 1G	23 deg. C, 67% RH	120Vac, 60Hz	Adair Peng
PLC	25 deg. C, 68% RH	120Vac, 60Hz 48Vdc	Jones Chang
P	25 deg. C, 60% RH	120Vac, 60Hz	Jisyong Wang

3.3 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.

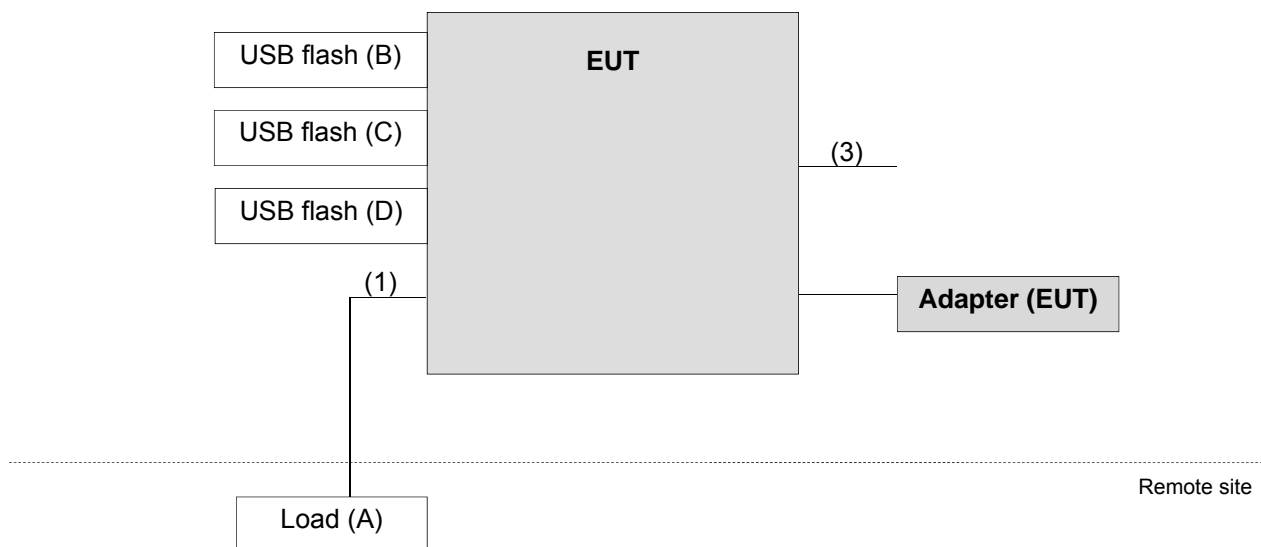
ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A.	Load	NA	NA	NA	NA	-
B.	USB Flash	HP	v250W	04	NA	-
C.	USB Flash	HP	v250W	05	NA	-
D.	USB Flash	HP	v250W	09	NA	-
E.	PoE	NA	APOE02-WM	NA	NA	Provided by manufacturer

Note: All power cords of the above support units are non-shielded (1.8m).

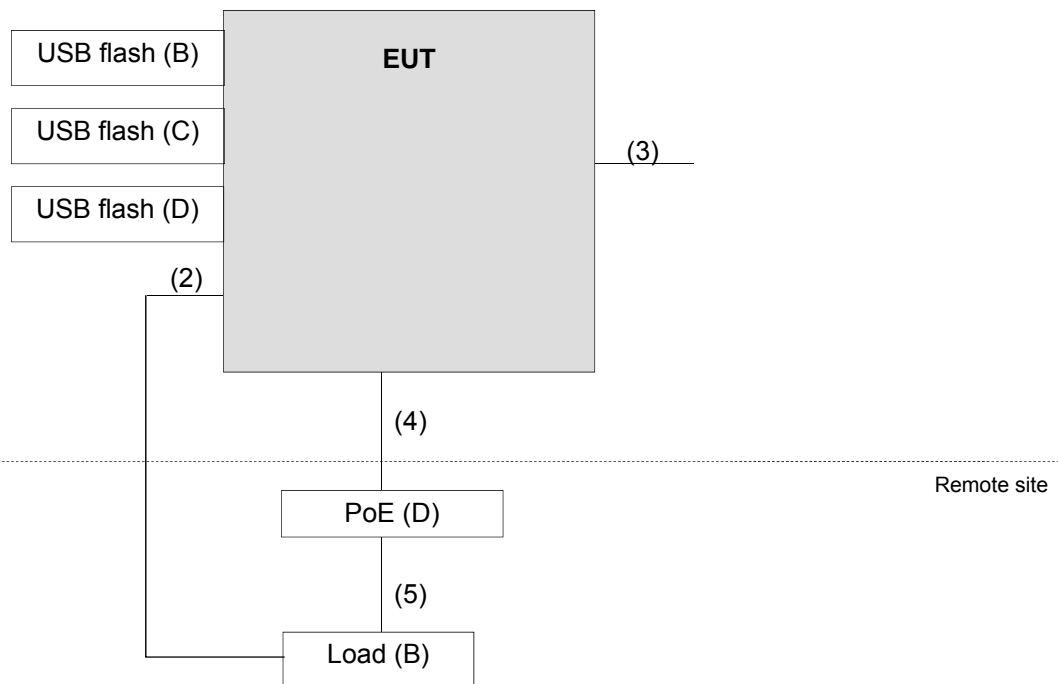
ID	Cable Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1.	LAN cable	2	1.5	N	0	RJ45, Cat5e
2.	LAN cable	1	1.5	N	0	RJ45, Cat5e
3.	Console cable	1	2	N	0	-
4.	LAN cable	1	1.5	N	0	RJ45, Cat5e
5.	LAN cable	1	1.5	N	0	RJ45, Cat5e

3.3.1 Configuration of System under Test

Test Mode A



Test Mode B



3.4 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 E (15.407)

ANSI C63.10:2013

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

References Test Guidance:

KDB 789033 D02 General UNII Test Procedure New Rules v02r01

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.

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:

- The lower limit shall apply at the transition frequencies.
- Emission level (dBuV/m) = 20 log Emission level (uV/m).
- For frequencies above 1000MHz, 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 20dB under any condition of modulation.

Limits of unwanted emission out of the restricted bands

Applicable To		Limit	
789033 D02 General UNII Test Procedure New Rules v02r01		Field Strength at 3m	
		PK: 74 (dBµV/m)	AV: 54 (dBµV/m)
Frequency Band	Applicable To	EIRP Limit	Equivalent Field Strength at 3m
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	<input checked="" type="checkbox"/> 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}
	<input type="checkbox"/> 15.407(b)(4)(ii)	Emission limits in section 15.247(d)	
^{*1} beyond 75 MHz or more above of the band edge. ^{*3} below the band edge increasing linearly to a level of 15.6 dBm/MHz at 5 MHz above.		^{*2} below the band edge increasing linearly to 10 dBm/MHz at 25 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:

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

4.1.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver ROHDE & SCHWARZ	ESCI	100424	Dec. 31, 2019	Dec. 30, 2020
Spectrum Analyzer ROHDE & SCHWARZ	FSP40	100269	Jun. 10, 2019	Jun. 09, 2020
			Jun. 09, 2020	Jun. 08, 2021
HORN Antenna SCHWARZBECK	9120D	209	Nov. 24, 2019	Nov. 23, 2020
HORN Antenna SCHWARZBECK	BBHA 9170	BBHA9170241	Nov. 24, 2019	Nov. 23, 2020
Loop Antenna TESEQ	HLA 6121	45745	Jul. 01, 2019	Jun. 30, 2020
Preamplifier Agilent (Below 1GHz)	8447D	2944A10738	Aug. 20, 2019	Aug. 19, 2020
Preamplifier KEYSIGHT (Above 1GHz)	8449B	3008A01976	Aug. 20, 2019	Aug. 19, 2020
RF Coaxial Cable WOKEN With 5dB PAD	8D-FB	Cable-CH3-01	Aug. 20, 2019	Aug. 19, 2020
RF signal cable HUBER+SUHNER	SUCOFLEX 104	Cable-CH3-03 (223653/4)	Aug. 20, 2019	Aug. 19, 2020
RF signal cable HUBER+SUHNER& EMCI	SUCOFLEX 104&EMC104-SM- SM-8000	Cable-CH3-03 (309224+170907)	Aug. 20, 2019	Aug. 19, 2020
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
Pre-amplifier (18GHz-40GHz) EMC	EMC184045B	980175	Sep. 05, 2019	Sep. 04, 2020
USB Wideband Power Sensor KEYSIGHT	U2021XA	MY55050005/MY5519 0004/MY55190007/MY 55210005	Jul. 15, 2019	Jul. 14, 2020

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.

4.1.3 Test Procedures

For Radiated emission above 30MHz

- a. The EUT was placed on the top of a rotating table 0.8 meters (for 30MHz ~ 1GHz) / 1.5 meters (for above 1GHz) 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 detect 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:

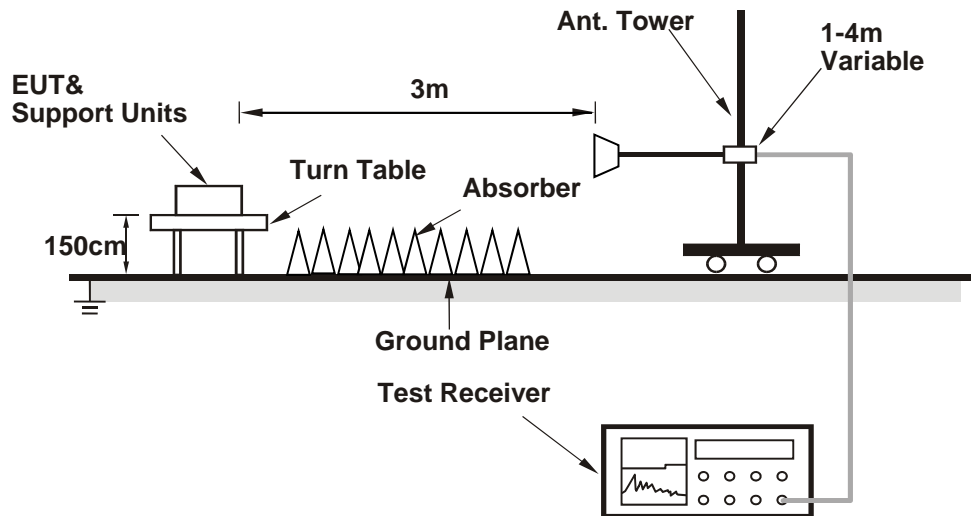
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120kHz for Quasi-peak detection (QP) at frequency below 1GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is $\geq 1/T$ (Duty cycle < 98%) or 10Hz (Duty cycle $\geq 98\%$) for Average detection (AV) at frequency above 1GHz.
4. 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

For Radiated emission above 1GHz



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

4.1.6 EUT Operating Conditions

- a. Set the EUT under transmission condition continuously at specific channel frequency.

4.1.7 Test Results

Above 1GHz data:

802.11ac (VHT80)

CHANNEL	TX Channel 155	DETECTOR FUNCTION	Peak (PK)
FREQUENCY RANGE	1GHz ~ 40GHz		Average (AV)

ANTENNA POLARITY & TEST DISTANCE: HORIZONTAL AT 3 M

NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	#5648.72	65.5 PK	68.2	-2.7	1.31 H	8	61.0	4.5
2	#5650.00	66.5 PK	68.2	-1.7	1.27 H	1	62.1	4.4
3	*5775.00	115.4 PK			1.31 H	8	75.3	40.1
4	*5775.00	104.3 AV			1.31 H	8	64.2	40.1
5	#5925.00	64.1 PK	68.2	-4.1	1.35 H	11	58.8	5.3
6	#5927.56	60.6 PK	68.2	-7.6	1.31 H	8	55.3	5.3
7	11550.00	62.0 PK	74.0	-12.0	1.57 H	101	43.3	18.7
8	11550.00	48.3 AV	54.0	-5.7	1.57 H	101	29.6	18.7

ANTENNA POLARITY & TEST DISTANCE: VERTICAL AT 3 M

NO.	FREQ. (MHz)	EMISSION LEVEL (dBuV/m)	LIMIT (dBuV/m)	MARGIN (dB)	ANTENNA HEIGHT (m)	TABLE ANGLE (Degree)	RAW VALUE (dBuV)	CORRECTION FACTOR (dB/m)
1	#5642.95	60.9 PK	68.2	-7.3	1.35 V	359	56.4	4.5
2	#5650.00	66.1 PK	68.2	-2.1	1.53 V	3	61.7	4.4
3	*5775.00	112.1 PK			1.35 V	359	72.0	40.1
4	*5775.00	101.2 AV			1.35 V	359	61.1	40.1
5	#5925.00	66.5 PK	68.2	-1.7	1.49 V	353	61.2	5.3
6	#5927.56	60.8 PK	68.2	-7.4	1.35 V	359	55.5	5.3
7	11550.00	60.2 PK	74.0	-13.8	1.53 V	331	41.5	18.7
8	11550.00	47.5 AV	54.0	-6.5	1.53 V	331	28.8	18.7

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.
6. " # ": The radiated frequency is out of the restricted band.

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 0.50MHz.

4.2.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Due
Test Receiver ROHDE & SCHWARZ	ESR3	102412	Feb. 17, 2020	Feb. 16, 2021
RF signal cable (with 10dB PAD) Woken	5D-FB	Cable-cond2-01	Sep. 05, 2019	Sep. 04, 2020
LISN ROHDE & SCHWARZ (EUT)	ESH2-Z5	100100	Jan. 20, 2020	Jan. 19, 2021
LISN ROHDE & SCHWARZ (Peripheral)	ESH3-Z5	100312	Aug. 13, 2019	Aug. 12, 2020
Software ADT	BV ADT_Cond_ V7.3.7.4	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 2 (Conduction 2).

3. The VCCI Site Registration No. is C-12047.

4.2.3 Test Procedures

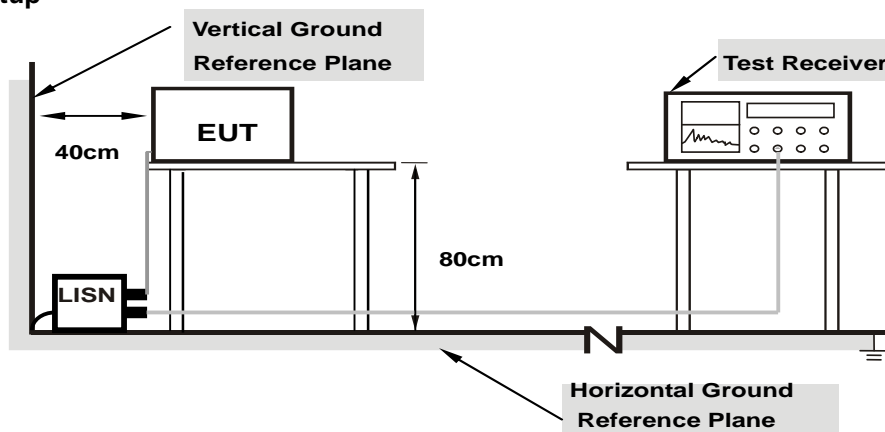
- The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50uH of coupling impedance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

NOTE: The resolution bandwidth and video bandwidth of test receiver is 9kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15MHz-30MHz.

4.2.4 Deviation from Test Standard

No deviation.

4.2.5 Test Setup



Note: 1.Support units were connected to second LISN.

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

4.2.6 EUT Operating Conditions

Same as 4.1.6.

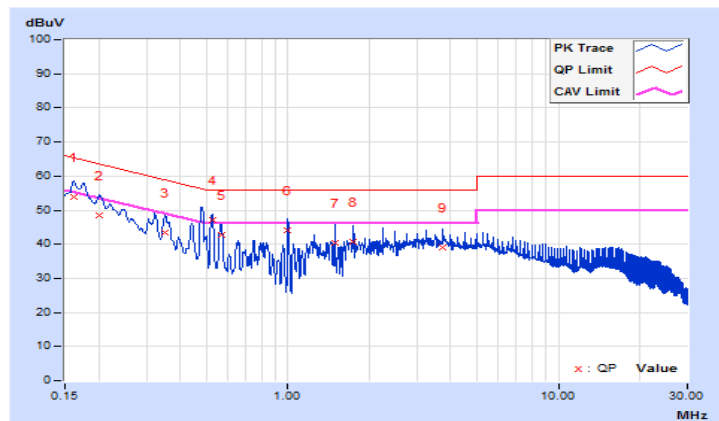
4.2.7 Test Results

Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
Test Mode	A		

No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
			1	0.16125	10.25	43.50	30.42	53.75	40.67	65.40
2	0.20175	10.27	38.12	25.12	48.39	35.39	63.54	53.54	-15.15	-18.15
3	0.35250	10.31	32.98	27.06	43.29	37.37	58.90	48.90	-15.61	-11.53
4	0.52523	10.34	36.85	35.31	47.19	45.65	56.00	46.00	-8.81	-0.35
5	0.56625	10.35	32.51	31.18	42.86	41.53	56.00	46.00	-13.14	-4.47
6	0.99825	10.42	33.67	30.62	44.09	41.04	56.00	46.00	-11.91	-4.96
7	1.49775	10.45	29.89	27.00	40.34	37.45	56.00	46.00	-15.66	-8.55
8	1.74975	10.46	30.19	28.19	40.65	38.65	56.00	46.00	-15.35	-7.35
9	3.74526	10.58	28.63	24.40	39.21	34.98	56.00	46.00	-16.79	-11.02

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.

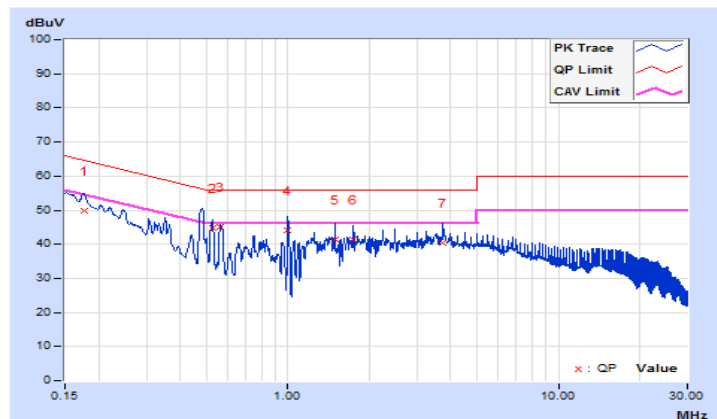


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
Test Mode	A		

No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
			1	0.17700	10.24	39.60	30.37	49.84	40.61	64.63
2	0.52800	10.33	34.51	30.81	44.84	41.14	56.00	46.00	-11.16	-4.86
3	0.56545	10.33	34.94	33.09	45.27	43.42	56.00	46.00	-10.73	-2.58
4	0.99825	10.42	33.62	30.49	44.04	40.91	56.00	46.00	-11.96	-5.09
5	1.49775	10.44	31.00	27.03	41.44	37.47	56.00	46.00	-14.56	-8.53
6	1.74975	10.46	31.00	27.98	41.46	38.44	56.00	46.00	-14.54	-7.56
7	3.74550	10.60	29.68	24.54	40.28	35.14	56.00	46.00	-15.72	-10.86

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.

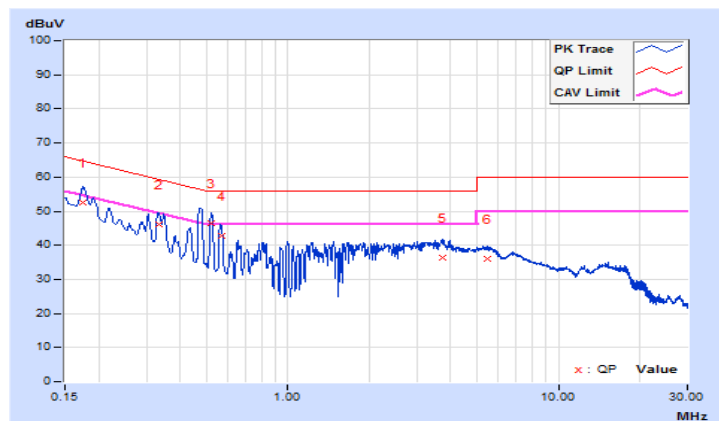


Phase	Line (L)	Detector Function	Quasi-Peak (QP) / Average (AV)
Test Mode	B		

No	Freq. [MHz]	Corr. Factor (dB)	Reading Value [dB (uV)]		Emission Level [dB (uV)]		Limit [dB (uV)]		Margin (dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
			1	0.17466	10.25	42.26	30.62	52.51	40.87	64.74
2	0.33225	10.30	35.88	29.23	46.18	39.53	59.39	49.39	-13.21	-9.86
3	0.52104	10.34	36.04	34.97	46.38	45.31	56.00	46.00	-9.62	-0.69
4	0.56850	10.35	32.52	30.05	42.87	40.40	56.00	46.00	-13.13	-5.60
5	3.73875	10.58	25.76	16.82	36.34	27.40	56.00	46.00	-19.66	-18.60
6	5.44425	10.63	25.39	16.04	36.02	26.67	60.00	50.00	-23.98	-23.33

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.

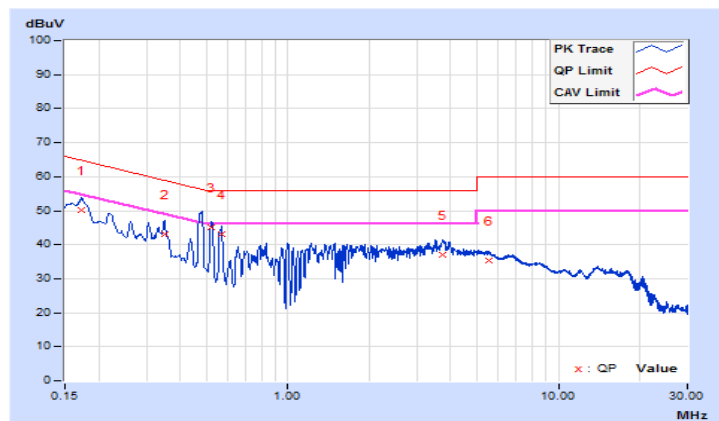


Phase	Neutral (N)	Detector Function	Quasi-Peak (QP) / Average (AV)
Test Mode	B		

No	Freq. [MHz]	Corr. Factor (dB)	Reading Value		Emission Level		Limit		Margin	
			[dB (uV)]		[dB (uV)]		[dB (uV)]		(dB)	
			Q.P.	AV.	Q.P.	AV.	Q.P.	AV.	Q.P.	AV.
1	0.17250	10.23	39.82	31.96	50.05	42.19	64.84	54.84	-14.79	-12.65
2	0.35025	10.29	32.97	28.48	43.26	38.77	58.96	48.96	-15.70	-10.19
3	0.52350	10.32	34.86	32.45	45.18	42.77	56.00	46.00	-10.82	-3.23
4	0.56850	10.33	32.69	29.98	43.02	40.31	56.00	46.00	-12.98	-5.69
5	3.71400	10.60	26.28	14.64	36.88	25.24	56.00	46.00	-19.12	-20.76
6	5.55900	10.67	24.83	12.84	35.50	23.51	60.00	50.00	-24.50	-26.49

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.



4.3 Transmit Power Measurement

4.3.1 Limits of Transmit Power Measurement

Operation Band	EUT Category		LIMIT
U-NII-1		Outdoor Access Point	1 Watt (30 dBm) (Max. e.i.r.p \leq 125mW(21 dBm) at any elevation angle above 30 degrees as measured from the horizon)
		Fixed point-to-point Access Point	1 Watt (30 dBm)
	√	Indoor Access Point	1 Watt (30 dBm)
		Mobile and Portable client device	250mW (24 dBm)
U-NII-2A		√	250mW (24 dBm) or 11 dBm+10 log B*
U-NII-2C		√	250mW (24 dBm) or 11 dBm+10 log B*
U-NII-3		√	1 Watt (30 dBm)

*B is the 26 dB emission bandwidth in megahertz

Per KDB 662911 Method of conducted output power measurement on IEEE 802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$;

Array Gain = 0 dB (i.e., no array gain) for channel widths ≥ 40 MHz for any N_{ANT} ;

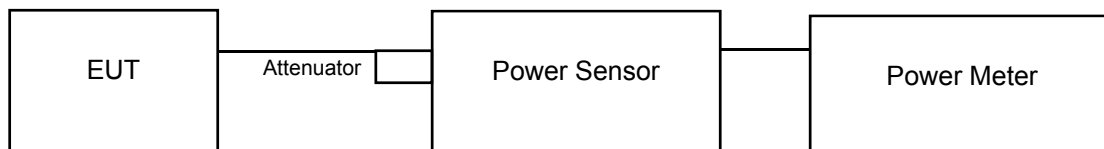
Array Gain = $5 \log(N_{ANT}/N_{SS})$ dB or 3 dB, whichever is less for 20-MHz channel widths with $N_{ANT} \geq 5$.

For power measurements on all other devices: Array Gain = $10 \log(N_{ANT}/N_{SS})$ dB.

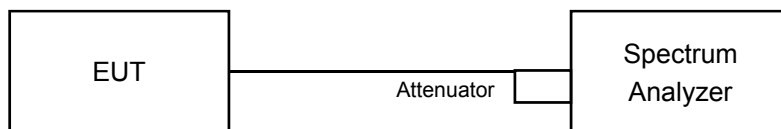
4.3.2 Test Setup

For Power Output

802.11a, 802.11n (HT20), 802.11n (HT40)



802.11ac (VHT80), 802.11ac (VHT80+VHT80)



4.3.3 Test Instruments

Refer to section 4.1.2 to get information of above instrument.

4.3.4 Test Procedure

For Average Power Measurement

For 802.11a, 802.11n (HT20), 802.11n (HT40)

Method PM is used to perform output power measurement, trigger and gating function of wide band power meter is enabled to measure max output power of TX on burst. Duty factor is not added to measured value.

For 802.11ac (VHT80), 802.11ac (VHT80+VHT80)

- a. Set span to encompass the entire 26 dB EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal.
- b. Set sweep trigger to “free run”.
- c. Set RBW = 1 MHz
- d. Set VBW \geq 3 MHz
- e. Number of points in sweep \geq 2 Span / RBW
- f. Sweep time \leq (number of points in sweep) * T
- g. Using emission bandwidth to determine the frequency span for integration the channel bandwidth.
- h. Detector = RMS
- i. Trace mode = max hold
- j. Allow max hold to run for at least 60 seconds, or longer as needed to allow the trace to stabilize.
- k. Compute power by integrating the spectrum across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the signal using the instrument’s band power measurement function with band limits set equal to the EBW (or occupied bandwidth) band edges. If the instrument does not have a band power function, sum the spectrum levels (in power units) at 1 MHz intervals extending across the EBW (or, alternatively, the entire 99% occupied bandwidth) of the spectrum.

4.3.5 Deviation from Test Standard

No deviation.

4.3.6 EUT Operating Conditions

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

4.3.7 Test Result

Power Output:

CDD Mode

802.11a

Channel	Frequency (MHz)	Maximum Conducted Power (dBm)				Total Power (mW)	Total Power (dBm)	Power Limit (dBm)	Pass / Fail
		Chain 0	Chain 1	Chain 2	Chain 3				
36	5180	20.03	21.15	20.34	20.93	463.033	26.66	30.00	Pass
40	5200	21.89	22.78	21.76	22.67	679.091	28.32	30.00	Pass
48	5240	21.03	21.44	20.98	21.33	527.226	27.22	30.00	Pass
52	5260	15.11	15.82	15.12	15.35	137.414	21.38	23.93	Pass
60	5300	15.37	15.92	15.04	15.31	139.397	21.44	23.95	Pass
64	5320	15.31	15.42	14.83	14.93	130.323	21.15	23.96	Pass
100	5500	15.93	15.85	15.04	15.59	145.772	21.64	23.88	Pass
116	5580	15.88	15.19	14.53	14.92	131.188	21.18	23.87	Pass
140	5700	16.12	14.83	14.22	14.51	126.008	21.00	23.88	Pass
144	5720 For 5500~5720MHz	13.05	13.66	11.98	12.46	80.070	19.03	22.67	Pass
144	5720 For 5745~5825MHz	7.73	6.76	4.96	7.31	20.002	13.01	30.00	Pass
149	5745	24.73	23.77	22.50	23.20	922.157	29.65	30.00	Pass
157	5785	24.65	23.63	22.35	23.18	902.179	29.55	30.00	Pass
165	5825	19.77	18.55	17.11	18.15	283.173	24.52	30.00	Pass

Note: Gain = 2.1dBi < 6dBi, so the limit no need to be reduced.

For 5260~5320MHz, 5500~5720MHz

Chain 0

1. $11\text{dBm} + 10\log(20.43) = 24.10 > 24\text{dBm}$
2. $11\text{dBm} + 10\log(20.03) = 24.01 > 24\text{dBm}$
3. $11\text{dBm} + 10\log(20.31) = 24.07 > 24\text{dBm}$
4. $11\text{dBm} + 10\log(19.91) = 23.99 < 24\text{dBm}$
5. $11\text{dBm} + 10\log(19.71) = 23.94 < 24\text{dBm}$
6. $11\text{dBm} + 10\log(20.16) = 24.04 > 24\text{dBm}$
7. $11\text{dBm} + 10\log(5725.00 - 5709.84) = 22.80 < 24\text{dBm}$

Chain 1

1. $11\text{dBm} + 10\log (19.66) = 23.93 < 24\text{dBm}$
2. $11\text{dBm} + 10\log (19.76) = 23.95 < 24\text{dBm}$
3. $11\text{dBm} + 10\log (19.78) = 23.96 < 24\text{dBm}$
4. $11\text{dBm} + 10\log (19.42) = 23.88 < 24\text{dBm}$
5. $11\text{dBm} + 10\log (19.39) = 23.87 < 24\text{dBm}$
6. $11\text{dBm} + 10\log (20.24) = 24.06 > 24\text{dBm}$
7. $11\text{dBm} + 10\log (5725.00 - 5709.87) = 22.79 < 24\text{dBm}$

Chain 2

1. $11\text{dBm} + 10\log (19.79) = 23.96 < 24\text{dBm}$
2. $11\text{dBm} + 10\log (20.00) = 24.01 > 24\text{dBm}$
3. $11\text{dBm} + 10\log (19.97) = 24.00 < 24\text{dBm}$
4. $11\text{dBm} + 10\log (19.50) = 23.90 < 24\text{dBm}$
5. $11\text{dBm} + 10\log (19.67) = 23.93 < 24\text{dBm}$
6. $11\text{dBm} + 10\log (19.42) = 23.88 < 24\text{dBm}$
7. $11\text{dBm} + 10\log (5725.00 - 5710.28) = 22.67 < 24\text{dBm}$

Chain 3

1. $11\text{dBm} + 10\log (19.91) = 23.99 < 24\text{dBm}$
2. $11\text{dBm} + 10\log (19.87) = 23.98 < 24\text{dBm}$
3. $11\text{dBm} + 10\log (19.86) = 23.97 < 24\text{dBm}$
4. $11\text{dBm} + 10\log (19.79) = 23.96 < 24\text{dBm}$
5. $11\text{dBm} + 10\log (19.89) = 23.98 < 24\text{dBm}$
6. $11\text{dBm} + 10\log (20.16) = 24.04 > 24\text{dBm}$
7. $11\text{dBm} + 10\log (5725.00 - 5709.99) = 22.76 < 24\text{dBm}$

802.11n (HT20)

Channel	Frequency (MHz)	Maximum Conducted Power (dBm)				Total Power (mW)	Total Power (dBm)	Power Limit (dBm)	Pass / Fail
		Chain 0	Chain 1	Chain 2	Chain 3				
36	5180	19.11	20.18	19.18	20.13	371.535	25.70	30.00	Pass
40	5200	21.94	22.75	21.75	22.71	680.942	28.33	30.00	Pass
48	5240	22.03	22.59	21.89	22.55	675.552	28.30	30.00	Pass
52	5260	15.35	16.02	15.39	15.66	145.678	21.63	24.00	Pass
60	5300	15.55	16.10	15.25	15.67	147.025	21.67	24.00	Pass
64	5320	15.78	15.75	15.51	15.71	148.230	21.71	24.00	Pass
100	5500	16.01	16.02	15.35	15.65	150.901	21.79	24.00	Pass
116	5580	15.87	15.40	14.56	15.15	134.621	21.29	24.00	Pass
140	5700	16.23	15.18	14.73	14.91	135.628	21.32	24.00	Pass
144	5720 For 5500~5720MHz	13.53	13.70	12.40	13.29	84.692	19.28	22.84	Pass
144	5720 For 5745~5825MHz	8.55	8.89	6.78	8.28	26.400	14.22	30.00	Pass
149	5745	24.39	23.45	22.21	22.93	858.775	29.34	30.00	Pass
157	5785	24.40	23.23	21.95	22.85	835.228	29.22	30.00	Pass
165	5825	20.11	18.77	17.22	18.55	302.238	24.80	30.00	Pass

Note: Gain = 2.1dBi < 6dBi, so the limit no need to be reduced.

For 5260~5320MHz, 5500~5720MHz

Chain 0

1. $11\text{dBm} + 10\log(20.65) = 24.14 > 24\text{dBm}$
2. $11\text{dBm} + 10\log(20.60) = 24.13 > 24\text{dBm}$
3. $11\text{dBm} + 10\log(20.65) = 24.14 > 24\text{dBm}$
4. $11\text{dBm} + 10\log(20.55) = 24.12 > 24\text{dBm}$
5. $11\text{dBm} + 10\log(20.66) = 24.15 > 24\text{dBm}$
6. $11\text{dBm} + 10\log(20.71) = 24.16 > 24\text{dBm}$
7. $11\text{dBm} + 10\log(5725.00 - 5709.71) = 22.84 < 24\text{dBm}$

Chain 1

1. $11\text{dBm} + 10\log(20.54) = 24.12 > 24\text{dBm}$
2. $11\text{dBm} + 10\log(20.58) = 24.13 > 24\text{dBm}$
3. $11\text{dBm} + 10\log(20.59) = 24.13 > 24\text{dBm}$
4. $11\text{dBm} + 10\log(20.44) = 24.10 > 24\text{dBm}$
5. $11\text{dBm} + 10\log(20.42) = 24.10 > 24\text{dBm}$
6. $11\text{dBm} + 10\log(20.83) = 24.18 > 24\text{dBm}$
7. $11\text{dBm} + 10\log(5725.00 - 5709.66) = 22.85 < 24\text{dBm}$

Chain 2

1. $11\text{dBm} + 10\log(20.72) = 24.16 > 24\text{dBm}$
2. $11\text{dBm} + 10\log(20.83) = 24.18 > 24\text{dBm}$
3. $11\text{dBm} + 10\log(20.78) = 24.17 > 24\text{dBm}$
4. $11\text{dBm} + 10\log(20.75) = 24.17 > 24\text{dBm}$
5. $11\text{dBm} + 10\log(20.72) = 24.16 > 24\text{dBm}$
6. $11\text{dBm} + 10\log(20.58) = 24.13 > 24\text{dBm}$
7. $11\text{dBm} + 10\log(5725.00 - 5709.71) = 22.84 < 24\text{dBm}$

Chain 3

1. $11\text{dBm} + 10\log(20.51) = 24.11 > 24\text{dBm}$
2. $11\text{dBm} + 10\log(20.56) = 24.13 > 24\text{dBm}$
3. $11\text{dBm} + 10\log(20.52) = 24.12 > 24\text{dBm}$
4. $11\text{dBm} + 10\log(20.48) = 24.11 > 24\text{dBm}$
5. $11\text{dBm} + 10\log(20.51) = 24.11 > 24\text{dBm}$
6. $11\text{dBm} + 10\log(20.68) = 24.15 > 24\text{dBm}$
7. $11\text{dBm} + 10\log(5725.00 - 5709.70) = 22.84 < 24\text{dBm}$

802.11n (HT40)

Channel	Frequency (MHz)	Maximum Conducted Power (dBm)				Total Power (mW)	Total Power (dBm)	Power Limit (dBm)	Pass / Fail
		Chain 0	Chain 1	Chain 2	Chain 3				
38	5190	19.66	20.69	19.61	20.32	408.748	26.11	30.00	Pass
46	5230	22.77	23.22	22.53	23.11	782.833	28.94	30.00	Pass
54	5270	17.10	17.76	16.76	17.33	212.489	23.27	24.00	Pass
62	5310	17.22	17.74	16.68	17.25	211.799	23.26	24.00	Pass
102	5510	17.65	17.80	16.78	17.30	219.812	23.42	24.00	Pass
110	5550	17.87	17.69	16.93	17.28	222.757	23.48	24.00	Pass
134	5670	18.03	17.35	16.61	17.03	214.138	23.31	24.00	Pass
142	5710 For 5500~5720MHz	15.39	16.21	14.74	15.99	150.698	21.78	24.00	Pass
142	5710 For 5745~5825MHz	4.90	4.76	5.49	4.90	13.132	11.18	30.00	Pass
151	5755	24.34	23.66	22.43	22.99	877.970	29.43	30.00	Pass
159	5795	24.49	23.56	22.25	22.94	872.845	29.41	30.00	Pass

Note: Gain = 2.1dBi < 6dBi, so the limit no need to be reduced.

For 5260~5320MHz, 5500~5720MHz

Chain 0

1. 11dBm + 10log (40.73) = 27.09 > 24dBm
2. 11dBm + 10log (40.80) = 27.10 > 24dBm
3. 11dBm + 10log (40.70) = 27.09 > 24dBm
4. 11dBm + 10log (40.87) = 27.11 > 24dBm
5. 11dBm + 10log (40.74) = 27.10 > 24dBm
6. 11dBm + 10log (5725.00 - 5689.83) = 26.46 > 24dBm

Chain 1

1. 11dBm + 10log (40.75) = 27.10 > 24dBm
2. 11dBm + 10log (40.55) = 27.07 > 24dBm
3. 11dBm + 10log (40.74) = 27.10 > 24dBm
4. 11dBm + 10log (40.88) = 27.11 > 24dBm
5. 11dBm + 10log (40.78) = 27.10 > 24dBm
6. 11dBm + 10log (5725.00 - 5689.71) = 26.47 > 24dBm

Chain 2

1. 11dBm + 10log (40.61) = 27.08 > 24dBm
2. 11dBm + 10log (40.47) = 27.07 > 24dBm
3. 11dBm + 10log (40.80) = 27.10 > 24dBm
4. 11dBm + 10log (40.81) = 27.10 > 24dBm
5. 11dBm + 10log (40.66) = 27.09 > 24dBm
6. 11dBm + 10log (5725.00 - 5689.81) = 26.46 > 24dBm

Chain 3

1. $11\text{dBm} + 10\log(40.59) = 27.08 > 24\text{dBm}$
2. $11\text{dBm} + 10\log(40.53) = 27.07 > 24\text{dBm}$
3. $11\text{dBm} + 10\log(40.48) = 27.07 > 24\text{dBm}$
4. $11\text{dBm} + 10\log(40.48) = 27.07 > 24\text{dBm}$
5. $11\text{dBm} + 10\log(40.51) = 27.07 > 24\text{dBm}$
6. $11\text{dBm} + 10\log(5725.00 - 5689.90) = 26.45 > 24\text{dBm}$

802.11ac (VHT80)

Channel	Frequency (MHz)	Maximum Conducted Power (dBm)				Total Power (mW)	Total Power (dBm)	Power Limit (dBm)	Pass / Fail
		Chain 0	Chain 1	Chain 2	Chain 3				
42	5210	19.54	20.22	19.35	19.89	378.744	25.78	30.00	Pass
58	5290	17.25	17.71	16.93	17.45	217.015	23.36	24.00	Pass
106	5530	17.94	17.91	17.03	17.51	230.862	23.63	24.00	Pass
122	5610	18.28	17.59	16.89	17.06	224.391	23.51	24.00	Pass
138	5690 For 5500~5720MHz	15.02	15.31	14.59	14.89	133.782	21.26	24.00	Pass
138	5690 For 5745~5825MHz	0.51	1.04	-0.38	0.79	4.8148	6.83	30.00	Pass
155	5775	21.29	21.08	19.19	19.40	432.900	26.36	30.00	Pass

Note: Gain = 2.1dBi < 6dBi, so the limit no need to be reduced.

For 5260~5320MHz, 5500~5720MHz

Chain 0

1. $11\text{dBm} + 10\log(83.88) = 30.23 > 24\text{dBm}$
2. $11\text{dBm} + 10\log(84.05) = 30.24 > 24\text{dBm}$
3. $11\text{dBm} + 10\log(84.14) = 30.25 > 24\text{dBm}$
4. $11\text{dBm} + 10\log(5725.00 - 5648.11) = 29.85 > 24\text{dBm}$

Chain 1

1. $11\text{dBm} + 10\log(83.62) = 30.22 > 24\text{dBm}$
2. $11\text{dBm} + 10\log(83.90) = 30.23 > 24\text{dBm}$
3. $11\text{dBm} + 10\log(83.99) = 30.24 > 24\text{dBm}$
4. $11\text{dBm} + 10\log(5725.00 - 5648.38) = 29.84 > 24\text{dBm}$

Chain 2

1. $11\text{dBm} + 10\log(84.17) = 30.25 > 24\text{dBm}$
2. $11\text{dBm} + 10\log(84.28) = 30.25 > 24\text{dBm}$
3. $11\text{dBm} + 10\log(84.35) = 30.26 > 24\text{dBm}$
4. $11\text{dBm} + 10\log(5725.00 - 5648.12) = 29.85 > 24\text{dBm}$

Chain 3

1. $11\text{dBm} + 10\log(83.80) = 30.23 > 24\text{dBm}$
2. $11\text{dBm} + 10\log(83.61) = 30.22 > 24\text{dBm}$
3. $11\text{dBm} + 10\log(83.75) = 30.22 > 24\text{dBm}$
4. $11\text{dBm} + 10\log(5725.00 - 5648.65) = 29.82 > 24\text{dBm}$

802.11ac (VHT80+VHT80)

Channel	Frequency (MHz)	Maximum Conducted Power (dBm)				Total Power (mW)	Total Power (dBm)	Power Limit (dBm)	Pass / Fail
		Chain 0	Chain 1	Chain 2	Chain 3				
42	5210	19.32	19.98	-	-	185.048	22.67	30.00	Pass
155	5775	-	-	18.35	18.78	143.900	21.58	30.00	Pass

Beamforming Mode

802.11n (HT20)

Channel	Frequency (MHz)	Maximum Conducted Power (dBm)				Total Power (mW)	Total Power (dBm)	Power Limit (dBm)	Pass / Fail
		Chain 0	Chain 1	Chain 2	Chain 3				
36	5180	13.09	14.16	13.16	14.11	92.896	19.68	27.88	Pass
40	5200	15.92	16.73	15.73	16.69	170.259	22.31	27.88	Pass
48	5240	16.01	16.57	15.87	16.53	168.911	22.28	27.88	Pass
52	5260	9.33	10.00	9.37	9.64	36.424	15.61	21.88	Pass
60	5300	9.53	10.08	9.23	9.65	36.761	15.65	21.88	Pass
64	5320	9.76	9.73	9.49	9.69	37.062	15.69	21.88	Pass
100	5500	9.99	10.00	9.33	9.63	37.730	15.77	21.88	Pass
116	5580	9.85	9.38	8.54	9.13	33.661	15.27	21.88	Pass
140	5700	10.21	9.16	8.71	8.89	33.911	15.30	21.88	Pass
144	5720 For 5500~5720MHz	13.53	13.70	12.40	13.29	84.692	19.28	20.72	Pass
144	5720 For 5745~5825MHz	8.55	8.89	6.78	8.28	26.400	14.22	27.88	Pass
149	5745	18.37	17.43	16.19	16.91	214.724	23.32	27.88	Pass
157	5785	18.38	17.21	15.93	16.83	208.836	23.20	27.88	Pass
165	5825	14.09	12.75	11.20	12.53	75.570	18.78	27.88	Pass

Note:

5260~5320MHz & 5500~5700MHz: Directional Gain = $2.1\text{dBi} + 10\log(4) = 8.12\text{dBi} > 6\text{dBi}$, so the conducted power limit shall be reduced to $24 - (8.12 - 6) = 21.88\text{dBm}$

5180~5240MHz & 5745~5825MHz: Directional Gain = $2.1\text{dBi} + 10\log(4) = 8.12\text{dBi} > 6\text{dBi}$, so the conducted power limit shall be reduced to $30 - (8.12 - 6) = 27.88\text{dBm}$

For 5260~5320MHz, 5500~5720MHz

Chain 0

1. $11\text{dBm} + 10\log(20.65) = 24.14 > 21.88\text{dBm}$
2. $11\text{dBm} + 10\log(20.60) = 24.13 > 21.88\text{dBm}$
3. $11\text{dBm} + 10\log(20.65) = 24.14 > 21.88\text{dBm}$
4. $11\text{dBm} + 10\log(20.55) = 24.12 > 21.88\text{dBm}$
5. $11\text{dBm} + 10\log(20.66) = 24.15 > 21.88\text{dBm}$
6. $11\text{dBm} + 10\log(20.71) = 24.16 > 21.88\text{dBm}$
7. $11\text{dBm} + 10\log(5725.00 - 5709.71) = 22.84 > 21.88\text{dBm}$

Chain 1

1. $11\text{dBm} + 10\log(20.54) = 24.12 > 21.88\text{dBm}$
2. $11\text{dBm} + 10\log(20.58) = 24.13 > 21.88\text{dBm}$
3. $11\text{dBm} + 10\log(20.59) = 24.13 > 21.88\text{dBm}$
4. $11\text{dBm} + 10\log(20.44) = 24.10 > 21.88\text{dBm}$
5. $11\text{dBm} + 10\log(20.42) = 24.10 > 21.88\text{dBm}$
6. $11\text{dBm} + 10\log(20.83) = 24.18 > 21.88\text{dBm}$
7. $11\text{dBm} + 10\log(5725.00 - 5709.66) = 22.85 > 21.88\text{dBm}$

Chain 2

1. $11\text{dBm} + 10\log(20.72) = 24.16 > 21.88\text{dBm}$
2. $11\text{dBm} + 10\log(20.83) = 24.18 > 21.88\text{dBm}$
3. $11\text{dBm} + 10\log(20.78) = 24.17 > 21.88\text{dBm}$
4. $11\text{dBm} + 10\log(20.75) = 24.17 > 21.88\text{dBm}$
5. $11\text{dBm} + 10\log(20.72) = 24.16 > 21.88\text{dBm}$
6. $11\text{dBm} + 10\log(20.58) = 24.13 > 21.88\text{dBm}$
7. $11\text{dBm} + 10\log(5725.00 - 5709.71) = 22.84 > 21.88\text{dBm}$

Chain 3

1. $11\text{dBm} + 10\log(20.51) = 24.11 > 21.88\text{dBm}$
2. $11\text{dBm} + 10\log(20.56) = 24.13 > 21.88\text{dBm}$
3. $11\text{dBm} + 10\log(20.52) = 24.12 > 21.88\text{dBm}$
4. $11\text{dBm} + 10\log(20.48) = 24.11 > 21.88\text{dBm}$
5. $11\text{dBm} + 10\log(20.51) = 24.11 > 21.88\text{dBm}$
6. $11\text{dBm} + 10\log(20.68) = 24.15 > 21.88\text{dBm}$
7. $11\text{dBm} + 10\log(5725.00 - 5709.70) = 22.84 > 21.88\text{dBm}$

802.11n (HT40)

Channel	Frequency (MHz)	Maximum Conducted Power (dBm)				Total Power (mW)	Total Power (dBm)	Power Limit (dBm)	Pass / Fail
		Chain 0	Chain 1	Chain 2	Chain 3				
38	5190	13.64	14.67	13.59	14.30	102.201	20.09	27.88	Pass
46	5230	16.75	17.20	16.51	17.09	195.735	22.92	27.88	Pass
54	5270	11.08	11.74	10.74	11.31	53.130	17.25	21.88	Pass
62	5310	11.20	11.72	10.66	11.23	52.957	17.24	21.88	Pass
102	5510	11.63	11.78	10.76	11.28	54.961	17.40	21.88	Pass
110	5550	11.85	11.67	10.91	11.26	55.697	17.46	21.88	Pass
134	5670	12.01	11.33	10.59	11.01	53.541	17.29	21.88	Pass
142	5710 For 5500~5720MHz	10.45	9.42	8.63	9.01	36.258	15.59	21.88	Pass
142	5710 For 5745~5825MHz	4.90	4.76	5.49	4.90	13.132	11.18	27.88	Pass
151	5755	18.32	17.64	16.41	16.97	219.522	23.41	27.88	Pass
159	5795	18.47	17.54	16.23	16.92	218.241	23.39	27.88	Pass

Note:

5260~5320MHz & 5500~5700MHz: Directional Gain = 2.1dBi + 10log(4)=8.12dBi > 6dBi , so the conducted power limit shall be reduced to 24-(8.12-6)=21.88dBm

5180~5240MHz & 5745~5825MHz: Directional Gain = 2.1dBi + 10log(4)=8.12dBi > 6dBi , so the conducted power limit shall be reduced to 30-(8.12-6)=27.88dBm

For 5260~5320MHz, 5500~5720MHz

Chain 0

1. 11dBm + 10log (40.73) = 27.09 > 21.88dBm
2. 11dBm + 10log (40.80) = 27.10 > 21.88dBm
3. 11dBm + 10log (40.70) = 27.09 > 21.88dBm
4. 11dBm + 10log (40.87) = 27.11 > 21.88dBm
5. 11dBm + 10log (40.74) = 27.10 > 21.88dBm
6. 11dBm + 10log (5725.00 - 5689.83) = 26.46 > 21.88dBm

Chain 1

1. 11dBm + 10log (40.75) = 27.10 > 21.88dBm
2. 11dBm + 10log (40.55) = 27.07 > 21.88dBm
3. 11dBm + 10log (40.74) = 27.10 > 21.88dBm
4. 11dBm + 10log (40.88) = 27.11 > 21.88dBm
5. 11dBm + 10log (40.78) = 27.10 > 21.88dBm
6. 11dBm + 10log (5725.00 - 5689.71) = 26.47 > 21.88dBm

Chain 2

1. $11\text{dBm} + 10\log(40.61) = 27.08 > 21.88\text{dBm}$
2. $11\text{dBm} + 10\log(40.47) = 27.07 > 21.88\text{dBm}$
3. $11\text{dBm} + 10\log(40.80) = 27.10 > 21.88\text{dBm}$
4. $11\text{dBm} + 10\log(40.81) = 27.10 > 21.88\text{dBm}$
5. $11\text{dBm} + 10\log(40.66) = 27.09 > 21.88\text{dBm}$
6. $11\text{dBm} + 10\log(5725.00 - 5689.81) = 26.46 > 21.88\text{dBm}$

Chain 3

1. $11\text{dBm} + 10\log(40.59) = 27.08 > 21.88\text{dBm}$
2. $11\text{dBm} + 10\log(40.53) = 27.07 > 21.88\text{dBm}$
3. $11\text{dBm} + 10\log(40.48) = 27.07 > 21.88\text{dBm}$
4. $11\text{dBm} + 10\log(40.48) = 27.07 > 21.88\text{dBm}$
5. $11\text{dBm} + 10\log(40.51) = 27.07 > 24\text{dBm}$
6. $11\text{dBm} + 10\log(5725.00 - 5689.90) = 26.45 > 21.88\text{dBm}$

802.11ac (VHT80)

Channel	Frequency (MHz)	Maximum Conducted Power (dBm)				Total Power (mW)	Total Power (dBm)	Power Limit (dBm)	Pass / Fail
		Chain 0	Chain 1	Chain 2	Chain 3				
42	5210	13.52	14.20	13.33	13.87	94.700	19.76	27.88	Pass
58	5290	11.23	11.69	10.91	11.43	54.262	17.34	21.88	Pass
106	5530	11.92	11.89	11.01	11.49	57.724	17.61	21.88	Pass
122	5610	12.26	11.57	10.87	11.04	56.106	17.49	21.88	Pass
138	5690 For 5500~5720MHz	15.02	15.31	14.59	14.89	133.782	21.26	21.88	Pass
138	5690 For 5745~5825MHz	0.51	1.04	-0.38	0.79	4.8148	6.83	27.88	Pass
155	5775	15.27	15.06	13.17	13.38	108.240	20.34	27.88	Pass

Note:

5260~5320MHz & 5500~5700MHz: Directional Gain = 2.1dBi + 10log(4)=8.12dBi > 6dBi , so the conducted power limit shall be reduced to 24-(8.12-6)=21.88dBm

5180~5240MHz & 5745~5825MHz: Directional Gain = 2.1dBi + 10log(4)=8.12dBi > 6dBi , so the conducted power limit shall be reduced to 30-(8.12-6)=27.88dBm

For 5260~5320MHz, 5500~5720MHz

Chain 0

1. 11dBm + 10log (83.88) = 30.23 > 21.88dBm
2. 11dBm + 10log (84.05) = 30.24 > 21.88dBm
3. 11dBm + 10log (84.14) = 30.25 > 21.88dBm
4. 11dBm + 10log (5725.00 - 5648.11) = 29.85 > 21.88dBm

Chain 1

1. 11dBm + 10log (83.62) = 30.22 > 21.88dBm
2. 11dBm + 10log (83.90) = 30.23 > 21.88dBm
3. 11dBm + 10log (83.99) = 30.24 > 21.88dBm
4. 11dBm + 10log (5725.00 - 5648.38) = 29.84 > 21.88dBm

Chain 2

1. 11dBm + 10log (84.17) = 30.25 > 21.88dBm
2. 11dBm + 10log (84.28) = 30.25 > 21.88dBm
3. 11dBm + 10log (84.35) = 30.26 > 21.88dBm
4. 11dBm + 10log (5725.00 - 5648.12) = 29.85 > 21.88dBm

Chain 3

1. 11dBm + 10log (83.80) = 30.23 > 21.88dBm
2. 11dBm + 10log (83.61) = 30.22 > 21.88dBm
3. 11dBm + 10log (83.75) = 30.22 > 21.88dBm
4. 11dBm + 10log (5725.00 - 5648.65) = 29.82 > 21.88dBm

802.11ac (VHT80+VHT80)

Channel	Frequency (MHz)	Maximum Conducted Power (dBm)				Total Power (mW)	Total Power (dBm)	Power Limit (dBm)	Pass / Fail
		Chain 0	Chain 1	Chain 2	Chain 3				
42	5210	13.30	13.96	-	-	46.269	16.65	30.00	Pass
155	5775	-	-	12.33	12.76	35.980	15.56	30.00	Pass

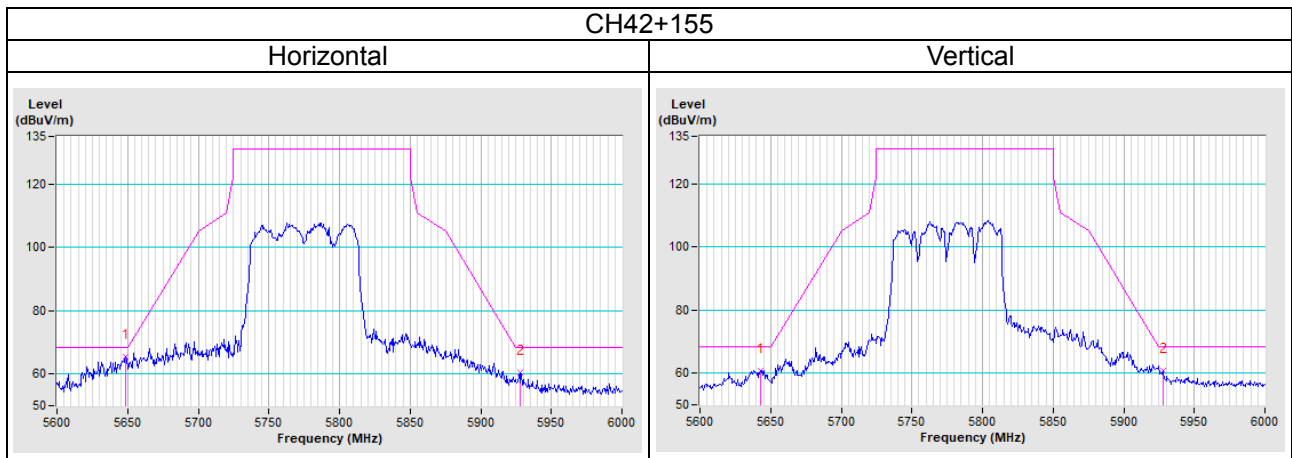
*Directional Gain = 2.1dBi + 10log(2)= 5.11dBi < 6dBi, so the limit no need to reduce.

5 Pictures of Test Arrangements

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

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

802.11ac (VHT80+VHT80)



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 and approved 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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