

TEST REPORT

CERTIFICATE OF CONFORMITY

Standard: 47 CFR FCC Part 15, Subpart E (Section 15.407)

Report No.: RFBEBB-WTW-P22120035

FCC ID: 2ANKPIPW611TX

Product: Wireless Extender for USB Cameras / Microphones / Speakers

Brand: MCT

Model No.: IPW611, IPW612, IPW611-TX, IPW612-TX

Received Date: 2022/11/30

Test Date: 2022/12/15 ~ 2023/1/3

Issued Date: 2023/3/8

Applicant: Magic Control Technology Corporation

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

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Test Location: No. 47-2, 14th Ling, Chia Pau Vil., Lin Kou Dist., New Taipei City, Taiwan

FCC Registration / 198487 / TW2021

Designation Number:

Approved by: Jeremy Lin, **Date:** 2023/3/8
Jeremy Lin / Project Engineer

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Prepared by : Jessica Cheng / Senior Specialist



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Release Control Record

Issue No.	Description	Date Issued
RFBEBB-WTW-P22120035	Original release.	2023/3/8

1 Certificate

Product: Wireless Extender for USB Cameras / Microphones / Speakers

Brand: MCT

Model: IPW611, IPW612, IPW611-TX, IPW612-TX

Sample Status: PVT_sample

Applicant: Magic Control Technology Corporation

Test Date: 2022/12/15 ~ 2023/1/3

Standard: 47 CFR FCC Part 15, Subpart E (Section 15.407)

Measurement ANSI C63.10-2013

procedure: KDB 789033 D02 General UNII Test Procedure New Rules v02r01

KDB 662911 D01 Multiple Transmitter Output v02r01

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.

2 Summary of Test Results

47 CFR FCC Part 15, Subpart E (Section 15.407)			
Clause	Test Item	Result	Remark
15.407(a)(1/2/3)	RF Output Power	Pass	Meet the requirement of limit.
15.407(a)(1/2/3)	Power Spectral Density	Pass	Meet the requirement of limit.
15.407(e)	6 dB Bandwidth	Pass	Meet the requirement of limit. (U-NII-3 Band only)
---	Occupied Bandwidth	-	Reference only.
15.407(g)	Frequency Stability	Pass	Meet the requirement of limit.
15.407(b)(9)	AC Power Conducted Emissions	Pass	Minimum passing margin is -20.26 dB at 0.73984 MHz
15.407(b)(9)	Unwanted Emissions below 1 GHz	Pass	Minimum passing margin is -3.1 dB at 67.22 MHz
15.407(b)(1/2/3/4(i)/10)	Unwanted Emissions above 1 GHz	Pass	Minimum passing margin is -1.0 dB at 5150.00 MHz
15.203	Antenna Requirement	Pass	Antenna connector is ipex not a standard connector

Note: 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:

Parameter	Specification	Uncertainty (±)
AC Power Conducted Emissions	150 kHz ~ 30 MHz	3.00 dB
Unwanted Emissions below 1 GHz	9 kHz ~ 30 MHz	2.38 dB
	30 MHz ~ 1 GHz	5.7 dB
Unwanted Emissions above 1 GHz	1 GHz ~ 6 GHz	4.83 dB
	6 GHz ~ 18 GHz	5.37 dB
	18 GHz ~ 40 GHz	5.24 dB

The other instruments specified are routine verified to remain within the calibrated levels, no measurement uncertainty is required to be calculated.

2.2 Supplementary Information

There is not any deviation from the test standards for the test method, and no modifications required for compliance.


3 General Information

3.1 General Description of EUT

Product	Wireless Extender for USB Cameras / Microphones / Speakers
Brand	MCT
Model	IPW611, IPW612, IPW611-TX, IPW612-TX
Status of EUT	PVT_sample
Power Supply Rating	DC 5V
Modulation Type	256QAM
Modulation Technology	OFDM
Transfer Rate	866.7Mbps
Operating Frequency	5.18 GHz ~ 5.24 GHz 5.745 GHz ~ 5.825 GHz
Number of Channel	2
Output Power	5.21 GHz : 20.728 mW (13.17 dBm) 5.775 GHz : 63.616 mW (18.04 dBm)
EUT Category	Indoor Access Point

Note:

1. All models are listed as below.

Brand	Model	Difference	Accessory Device	Description
MCT	IPW611, IPW612, IPW611-TX, IPW612-TX	Marketing differentiation	Adapter	<p>► TX (Transmitter IO Ports) Device priority : 3.5mm Speaker > USB™ Speaker/Microphone > USB™ Camera with Speaker/Microphone</p> 

During the test, the **model: IPW611-TX** was selected as the representative one and therefore only its test data was recorded in this report.

2. The EUT uses following accessories.

Adapter		
Brand	Model	Specification
DEE VAN ENTERPRISE CO.LTD	DSA-18PFCA-05 050300	AC Input : 100-240V~50/60Hz 0.6A DC Output : +5.0V_3.0A_15W DC Output Cable : 1.5M Plug : 2pin

3. 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 Antenna Description of EUT

1. The antenna information is listed as below.

Antenna No.	Gain (dBi)				Antenna Type	Connector Type
	5150 MHz	5250 MHz	5750 MHz	5850 MHz		
1	2.56	2.58	3.47	3.5	Dipole	ipex
2	2.85	2.66	2.12	1.85	Dipole	ipex

* Detail antenna specification please refer to antenna datasheet and/or antenna measurement report.

2. The EUT incorporates a MIMO function:

5 GHz Band		
Modulation Mode	TX & RX Configuration	
802.11ac (VHT80)	2TX	2RX

3.3 Channel List

FOR 5180 ~ 5240 MHz

1 channel is provided for 802.11ac (VHT80):

Channel	Frequency
42	5210 MHz

FOR 5745 ~ 5825 MHz:

1 channel is provided for 802.11ac (VHT80):

Channel	Frequency
155	5775 MHz

3.4 Test Mode Applicability and Tested Channel Detail

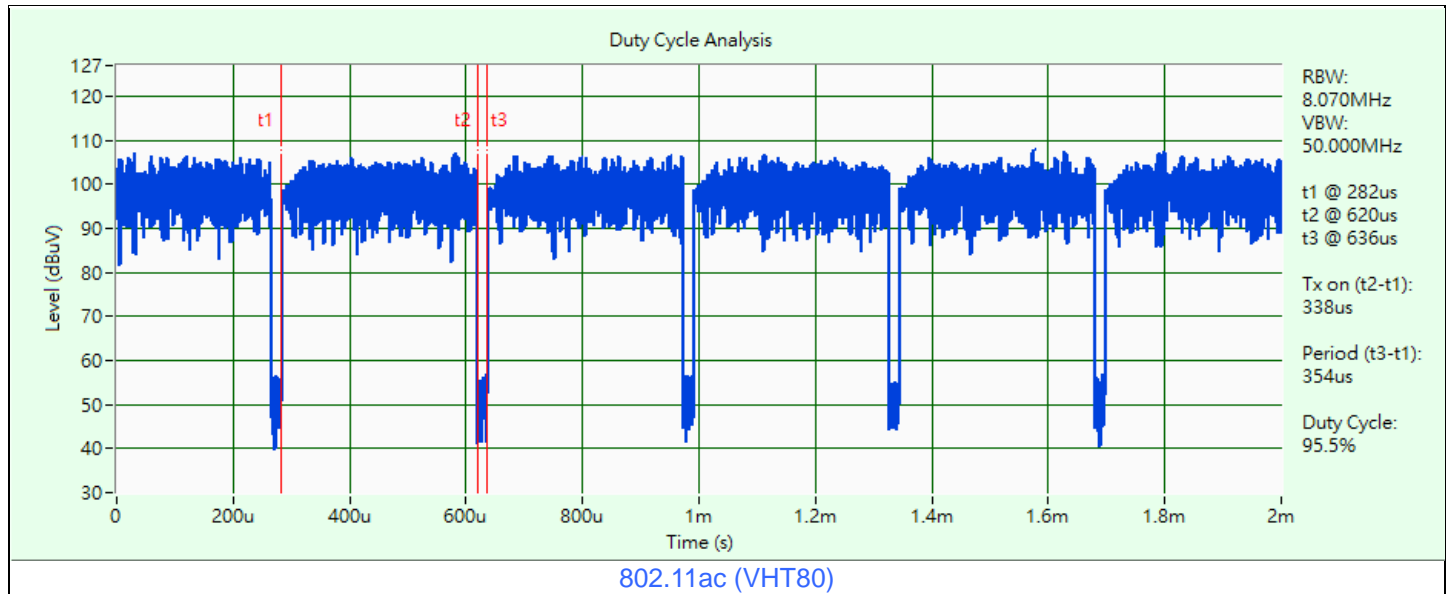
Pre-Scan:	1. EUT can be used in the following ways: XYZ 3-axis. Pre-scan in these ways and find the worst case as a representative test condition.
Worst Case:	1. X/ Y/ Z Worst Condition: X Axis for Unwanted Emission above 1GHz and Unwanted Emission below 1GHz.

Following channel(s) was (were) selected for the final test as listed below:

Test Item	Mode	Signal Mode	Tested Channel	Modulation	Data Rate Parameter
RF Output Power / Power Spectral Density	802.11ac (VHT80)	CDD	42, 155	BPSK	MCS0
6 dB Bandwidth	802.11ac (VHT80)	CDD	155	BPSK	MCS0
Occupied Bandwidth	802.11ac (VHT80)	CDD	42, 155	BPSK	MCS0
Frequency Stability	802.11ac (VHT80)	-	42	un-modulation	-
AC Power Conducted Emissions	802.11ac (VHT80)	CDD	155	BPSK	MCS0
Unwanted Emissions below 1 GHz	802.11ac (VHT80)	CDD	155	BPSK	MCS0
Unwanted Emissions above 1 GHz	802.11ac (VHT80)	CDD	42, 155	BPSK	MCS0

3.5 Duty Cycle of Test Signal

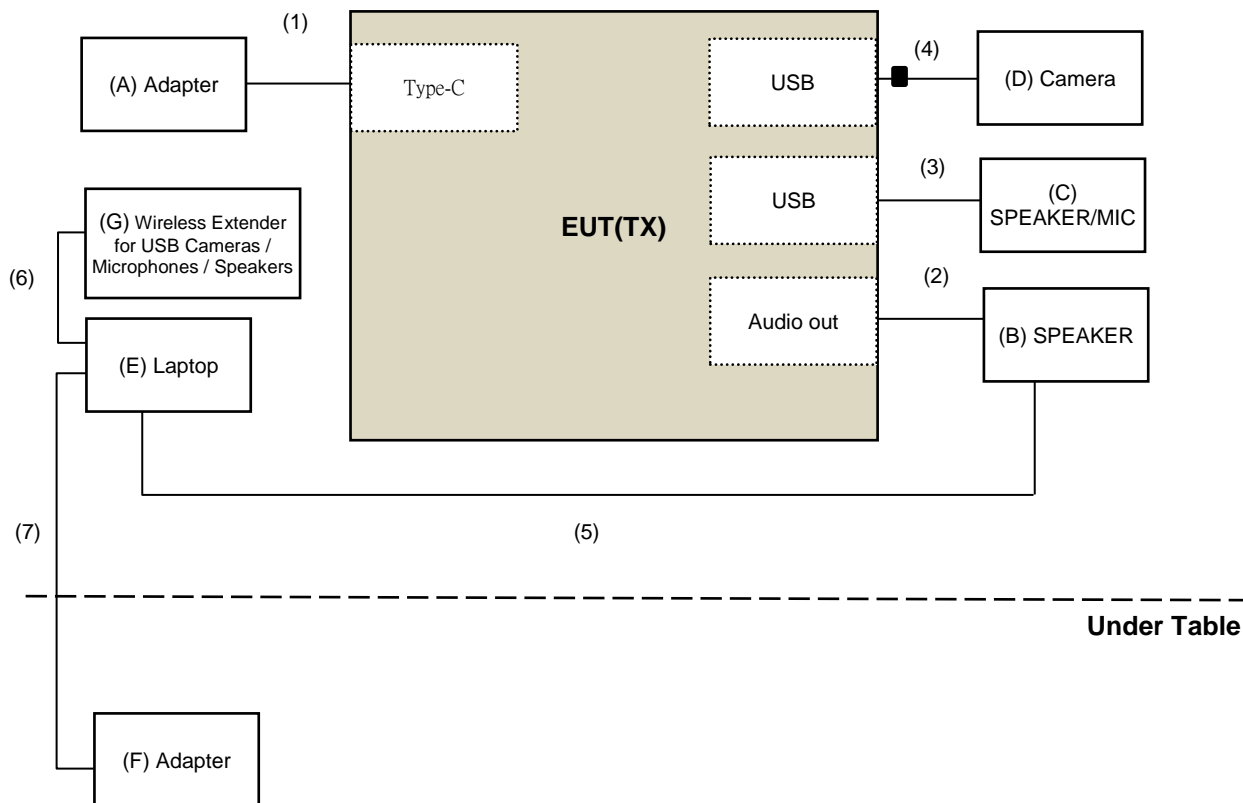
802.11ac (VHT80): Duty cycle = $0.338 \text{ ms} / 0.354 \text{ ms} \times 100\% = 95.5\%$, duty factor = $10 * \log (1/\text{Duty cycle}) = 0.20 \text{ dB}$



3.6 Test Program Used and Operation Descriptions

Controlling software (MT7612E_AP_QA_Tool_UIV1.0.3.24_DLLV1.0.3.26) has been activated to set the EUT under transmission condition continuously at specific channel frequency.

3.7 Connection Diagram of EUT and Peripheral Devices



3.8 Configuration of Peripheral Devices and Cable Connections

ID	Product	Brand	Model No.	Serial No.	FCC ID	Remarks
A	Adapter	DEE VAN ENTERPRISE	DSA-18PFCA-05050300	N/A	N/A	Supplied by applicant
B	SPEAKER	Logitech	S00179	N/A	N/A	Supplied by applicant
C	SPEAKER/MIC	Jabra	PHS001U	N/A	N/A	Supplied by applicant
D	Camera	Logitech	C922 PRO	N/A	N/A	Supplied by applicant
E	Laptop	Lenovo	80WG	YD01YRC9	N/A	Provided by Lab
F	Adapter	LENOVO	ADLX65CLGU2A	N/A	N/A	Provided by Lab
G	Wireless Extender for USB Cameras / Microphones / Speakers	MCT	IPW611-RX	N/A	2ANKPIPW611RX	Supplied by applicant

ID	Cable Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1	Type-C Cable	1	1.5	Y	0	Supplied by applicant
2	Audio (3.5") cable	1	1.2	N	0	Supplied by applicant
3	USB Cable	1	1	Y	0	Supplied by applicant
4	USB Cable	1	0.9	Y	1	Supplied by applicant
5	USB Cable	1	1.2	Y	0	Supplied by applicant
6	Type-C Cable	1	0.165	Y	0	Supplied by applicant
7	DC Cable	1	2	Y	0	Provided by Lab

4 Test Instruments

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

4.1 RF Output Power

Description Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
MIMO Powermeasurement Test set (4X4) KEYSIGHT	U2021XA	U2021XA_001	2022/6/13	2023/6/12
MXG Vector Signal Generator KEYSIGHT	N5182B	MY53052658	2022/5/9	2023/5/8
Peak Power meter Anritsu	ML2495A	1232003	2022/1/9	2023/1/8
Pulse Power Sensor Anritsu	MA2411B	1207333	2022/1/9	2023/1/8
Spectrum Analyzer KEYSIGHT	N9030A	MY54490260	2022/7/14	2023/7/13
Spectrum Analyzer R&S	FSV40	101042	2022/9/5	2023/9/4
		101544	2022/5/9	2023/5/8
Temperature & Humidity Chamber TERCHY	MHU-225AU	920409	2022/6/27	2023/6/26
Voltage Meter FLUKE	179	89610322	2022/10/3	2023/10/2

Notes:

1. The test was performed in LK - Oven
2. Tested Date: 2023/1/3

4.2 Power Spectral Density

Refer to section 4.1 to get information of the instruments.

4.3 6 dB Bandwidth

Refer to section 4.1 to get information of the instruments.

4.4 Occupied Bandwidth

Refer to section 4.3 to get information of the instruments.

4.5 Frequency Stability

Refer to section 4.3 to get information of the instruments.

4.6 AC Power Conducted Emissions

Description Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
50 ohm terminal LYNICS	0900510	E1-011285	2022/9/19	2023/9/18
		E1-011286	2022/9/19	2023/9/18
50 Ohms Terminator LYNICS	0900510	E1-01-305	2022/2/9	2023/2/8
Attenuator STI	STI02-2200-10	NO.4	2022/9/2	2023/9/1
DC LISN R&S	ESH3-Z6	100219	2022/8/2	2023/8/1
		844950/018	2022/8/2	2023/8/1
DC LISN Schwarzbeck	NNLK 8121	8121-808	2022/4/29	2023/4/28
High Voltage Probe Schwarzbeck	TK9420	00982	2022/12/14	2023/12/13
Isolation Transformer Erika Fiedler	D-65396	017	2022/9/8	2023/9/7
LISN R&S	ENV216	101196	2022/5/24	2023/5/23
LISN Schwarzbeck	NNLK 8121	8121-00759	2022/8/18	2023/8/17
		8121-731	2022/5/26	2023/5/25
	NNLK8129	8129229	2022/6/8	2023/6/7
	NSLK 8128	8128-244	2022/11/8	2023/11/7
RF Coaxial Cable Commate	5D-FB	Cable-CO5-01	2022/1/28	2023/1/27
Software BVADT	Cond_V7.3.7.4	N/A	N/A	N/A
Test Receiver R&S	ESR3	102412	2022/12/21	2023/12/20

Notes:

1. The test was performed in Linkou Conduction 5.
2. Tested Date: 2022/12/26

4.7 Unwanted Emissions below 1 GHz

Description Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
* LOOP ANTENNA EMCI	LPA600	270	2021/9/2	2023/9/1
Bi_Log Antenna Schwarzbeck	VULB 9168	137	2022/10/21	2023/10/20
Coupling/Dcoupling Network Schwarzbeck	CDNE-M2	00097	2022/6/1	2023/5/31
	CDNE-M3	00091	2022/6/1	2023/5/31
Pre_Amplifier EMCI	EMC001340	980269	2022/6/28	2023/6/27
Pre_Amplifier HP	8447D	2432A03504	2022/2/17	2023/2/16
RF Coaxial Cable Pacific	8D-FB	Cable-CH6-02	2022/6/30	2023/6/29
Software BVADT	Radiated_V7.7.1.1.1	N/A	N/A	N/A
	Radiated_V8.7.08	N/A	N/A	N/A
Spectrum Analyzer R&S	FSV40	101544	2022/5/9	2023/5/8
Test Receiver Agilent	N9038A	MY51210129	2022/4/8	2023/4/7
		MY51210137	2022/6/9	2023/6/8
Tower ADT	AT100	0306	N/A	N/A
Turn Table ADT	TT100	0306	N/A	N/A

Notes:

- * The calibration interval of the above test instruments is 24 months and the calibrations are traceable to NML/ROC and NIST/USA
- The test was performed in Linkou 966 Chamber 6 (CH 6).
- Tested Date: 2022/12/26

4.8 Unwanted Emissions above 1 GHz

Description Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
Band Pass Filter MICRO-TRONICS	BRM17690	005	2022/5/26	2023/5/25
Boresight antenna tower fixture BV	BAF-02	6	N/A	N/A
High Pass Filter Wainwright Instruments	WHK 3.1/18G-10SS	SN 8	2022/5/26	2023/5/25
Horn Antenna EMCO	3115	00028257	2022/11/13	2023/11/12
Horn Antenna ETS-Lindgren	3117-PA	00215857	2022/11/13	2023/11/12
Horn Antenna Schwarzbeck	BBHA 9170	212	2022/10/20	2023/10/19
Notch Filter MICRO-TRONICS	BRC50703-01	010	2022/5/26	2023/5/25
Pre-amplifier HP	8449B	3008A01201	2022/2/17	2023/2/16
Pre-amplifier (18GHz-40GHz) EMCI	EMC184045B	980175	2022/9/3	2023/9/2
Pre_Amplifier EMCI	EMC0126545	980076	2022/2/17	2023/2/16
	EMC184045B	980235	2022/2/17	2023/2/16
RF Coaxial Cable EM	EM102-KMKM-3.5+1M	EM102-KMKM-3.5+1M-01	2022/7/7	2023/7/6
RF Coaxial Cable EMCI	EMC104	190801	2022/7/7	2023/7/6
		190804	2022/7/7	2023/7/6
RF Coaxial Cable HUBER SUHNER	SF-104	Cable-CH6-01	2022/9/20	2023/9/19
Software BVADT	Radiated_V7.7.1.1.1	N/A	N/A	N/A
	Radiated_V8.7.08	N/A	N/A	N/A
Spectrum Analyzer R&S	FSV40	101042	2022/9/5	2023/9/4
		101544	2022/5/9	2023/5/8
Test Receiver Agilent	N9038A	MY51210129	2022/4/8	2023/4/7
Tower ADT	AT100	0306	N/A	N/A
Turn Table ADT	TT100	0306	N/A	N/A

Notes:

1. The test was performed in Linkou 966 Chamber 6 (CH 6).
2. Tested Date: 2022/12/15

5 Limits of Test Items

5.1 RF Output Power

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)

Operation Band	Limit
U-NII-3	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 $N_{ANT} \leq 4$;

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.

5.2 Power Spectral Density

Operation Band	EUT Category	Limit
U-NII-1	Outdoor Access Point	17 dBm/MHz
	Fixed point-to-point Access Point	
	Indoor Access Point	
	Mobile and Portable client device	11 dBm/MHz

Operation Band	Limit
U-NII-3	30 dBm/500 kHz

5.3 6 dB Bandwidth

Within the 5.725-5.850 GHz band, the minimum 6 dB bandwidth of U-NII devices shall be at least 500 kHz.

5.4 Occupied Bandwidth

The results are for reference only.

5.5 Frequency Stability

The frequency of the carrier signal shall be maintained within band of operation.

5.6 AC Power Conducted Emissions

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

Notes:

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.

5.7 Unwanted Emissions below 1 GHz

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

Notes:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).

5.8 Unwanted Emissions above 1 GHz

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)
Above 960	500	3

Notes:

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.

Limits of unwanted emission out of the restricted bands

Applicable To	Limit	
789033 D02 General UNII Test Procedure New Rules v02r01	Field Strength at 3 m	
	PK: 74 (dBµV/m)	AV: 54 (dBµV/m)

For transmitters operating in the 5.15-5.25 GHz band:

Applicable To	EIRP Limit	Equivalent Field Strength at 3 m
15.407(b)(1)	PK: -27 (dBm/MHz)	PK: 68.2 (dBµV/m)

For transmitters operating in the 5.725-5.850 GHz band:

Applicable To	EIRP Limit	Equivalent Field Strength at 3 m
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}

^{*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.

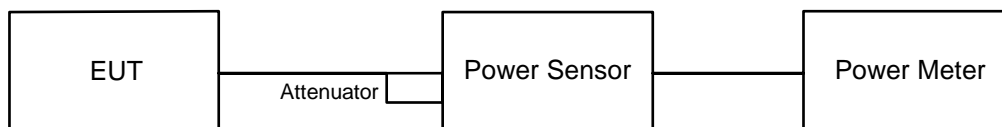
Note: The following formula is used to convert the equipment isotropic radiated power (eirp) to field strength:

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

6 Test Arrangements

6.1 RF Output Power

6.1.1 Test Setup

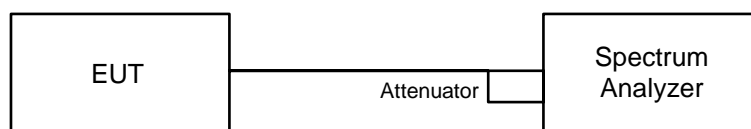


6.1.2 Test Procedure

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 and set the detector to average. Duty factor is not added to measured value.

6.2 Power Spectral Density

6.2.1 Test Setup



6.2.2 Test Procedure

For specified measurement bandwidth 1 MHz:

Method SA-2

- Set span to encompass the entire emission bandwidth (EBW) of the signal.
- Set RBW = 1 MHz, Set VBW \geq 3 MHz, Detector = RMS
- Sweep points \geq $[2 \times \text{span} / \text{RBW}]$. (This gives bin-to-bin spacing \leq RBW / 2, so that narrowband signals are not lost between frequency bins.)
- Sweep time = auto, trigger set to "free run".
- Trace average at least 100 traces in power averaging mode.
- Use the peak search function on the instrument to find the peak of the spectrum and record its value.
- Record the max value and add $10 \log (1/\text{duty cycle})$.

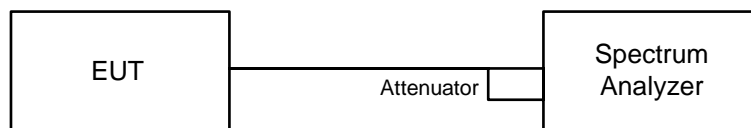
For specified measurement bandwidth 500 kHz:

Method SA-2

- Set span to encompass the entire emission bandwidth (EBW) of the signal.
- Set RBW = 300 kHz, Set VBW \geq 1 MHz, Detector = RMS
- Scale the observed power level to an equivalent value in 500 kHz by adjusting (increasing) the measured power by a bandwidth correction factor (BWCF) where $\text{BWCF} = 10 \log(500 \text{ kHz}/300 \text{ kHz})$
- Sweep points \geq $[2 \times \text{span} / \text{RBW}]$. (This gives bin-to-bin spacing \leq RBW / 2, so that narrowband signals are not lost between frequency bins.)
- Sweep time = auto, trigger set to "free run".
- Trace average at least 100 traces in power averaging mode.
- Use the peak search function on the instrument to find the peak of the spectrum and record its value.
- Record the max value and add $10 \log (1/\text{duty cycle})$.

6.3 6 dB Bandwidth

6.3.1 Test Setup

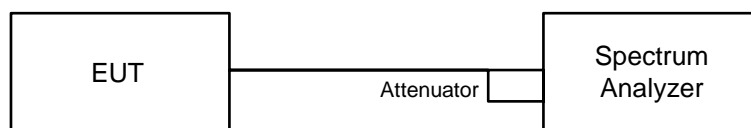


6.3.2 Test Procedure

- Set resolution bandwidth (RBW) = 100 kHz.
- Set the video bandwidth (VBW) $\geq 3 \times$ RBW, Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- Measure the maximum width of the emission that is constrained by the frequencies associated with the two amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

6.4 Occupied Bandwidth

6.4.1 Test Setup

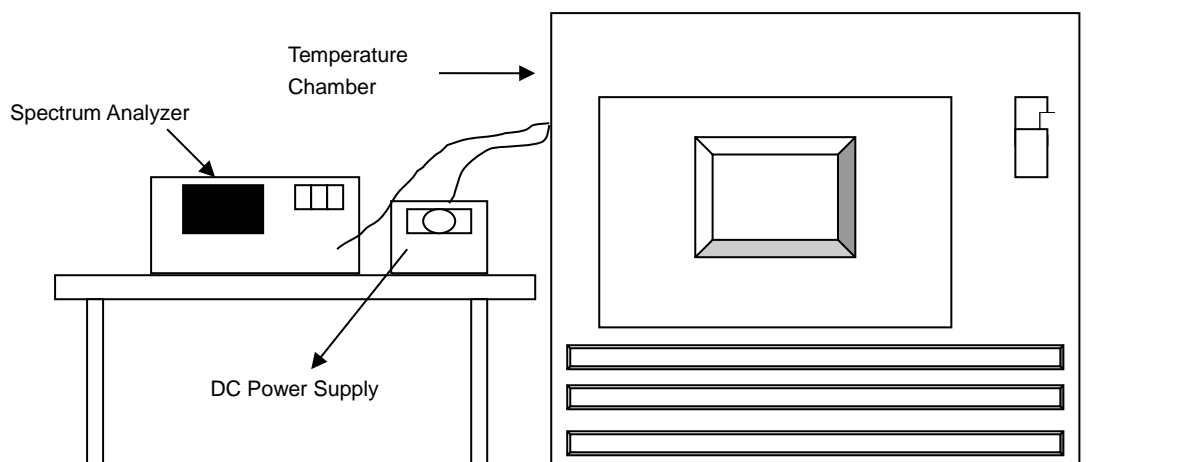


6.4.2 Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth and set the detector to Sampling. The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5% of the total mean power of a given emission.

6.5 Frequency Stability

6.5.1 Test Setup

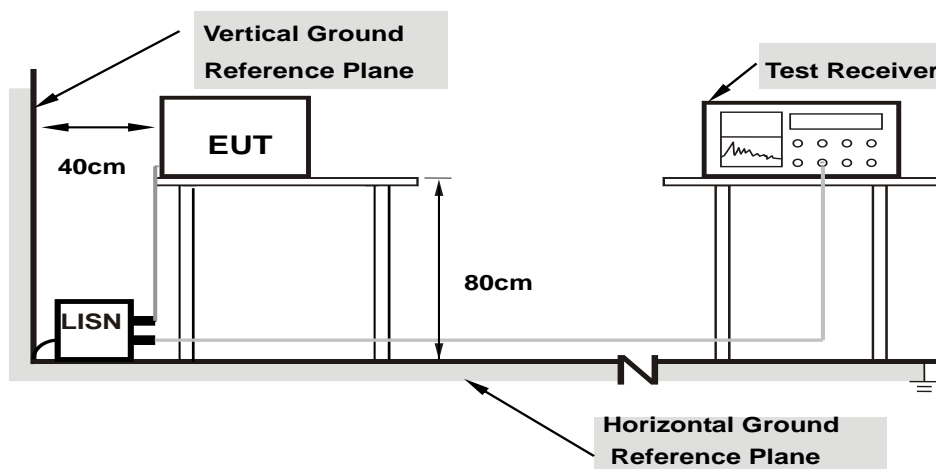


6.5.2 Test Procedure

- The EUT was placed inside the environmental test chamber and powered by nominal DC voltage.
- Turn the EUT on and couple its output to a spectrum analyzer.
- Turn the EUT off and set the chamber to the highest temperature specified.
- Allow sufficient time (approximately 30 min) for the temperature of the chamber to stabilize, turn the EUT on and measure the operating frequency after 2, 5, and 10 Minutes.
- Repeat step (d) with the temperature chamber set to the next desired temperature until measurements down to the lowest specified temperature have been completed.
- The test chamber was allowed to stabilize at +20 degree C for a minimum of 30 Minutes. The supply voltage was then adjusted on the EUT from 85% to 115% and the frequency record.

6.6 AC Power Conducted Emissions

6.6.1 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).

6.6.2 Test Procedure

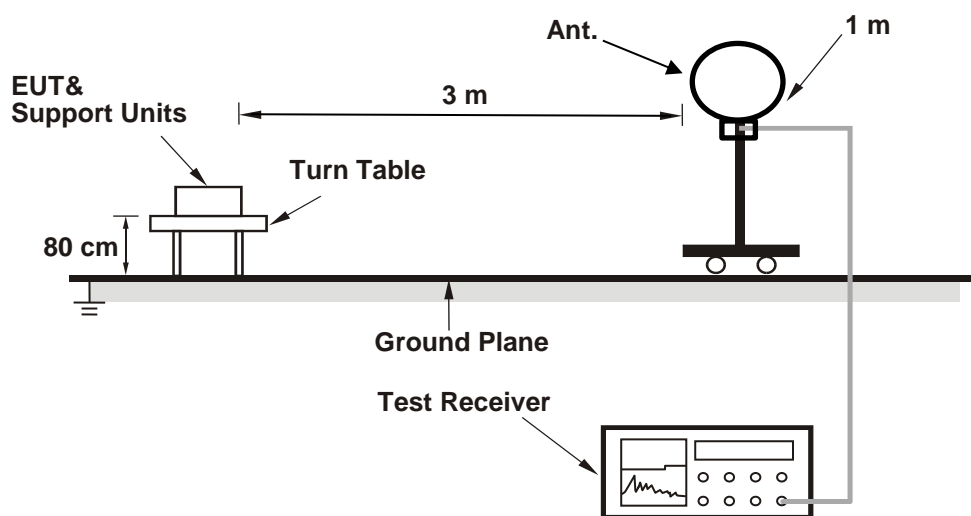
- The EUT was placed on a 0.8 meter to the top of table and placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/ 50 uH 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: The resolution bandwidth and video bandwidth of test receiver is 9 kHz for quasi-peak detection (QP) and average detection (AV) at frequency 0.15 MHz-30 MHz.

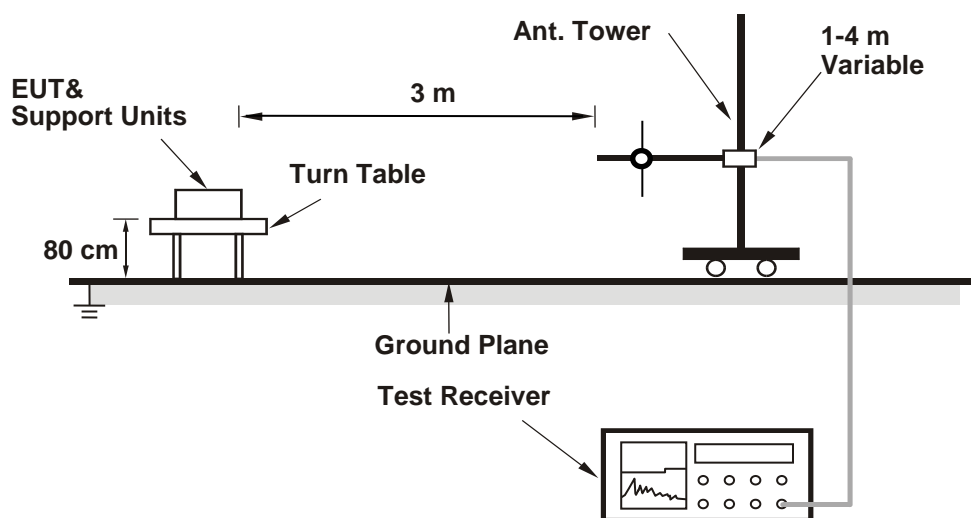
6.7 Unwanted Emissions below 1 GHz

6.7.1 Test Setup

For Radiated emission below 30 MHz



For Radiated emission above 30 MHz



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

6.7.2 Test Procedure

For Radiated emission below 30 MHz

- a. The EUT was placed on the top of a rotating table 0.8 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. Parallel, perpendicular, and ground-parallel orientations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case 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, except for the frequency band (9 kHz to 90 kHz and 110 kHz to 490 kHz) set to average detect function and peak detect function.

Notes:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 200 Hz at frequency below 150 kHz.
2. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9 kHz or 10 kHz at frequency (150 kHz to 30 MHz).
3. All modes of operation were investigated and the worst-case emissions are reported.

For Radiated emission above 30 MHz

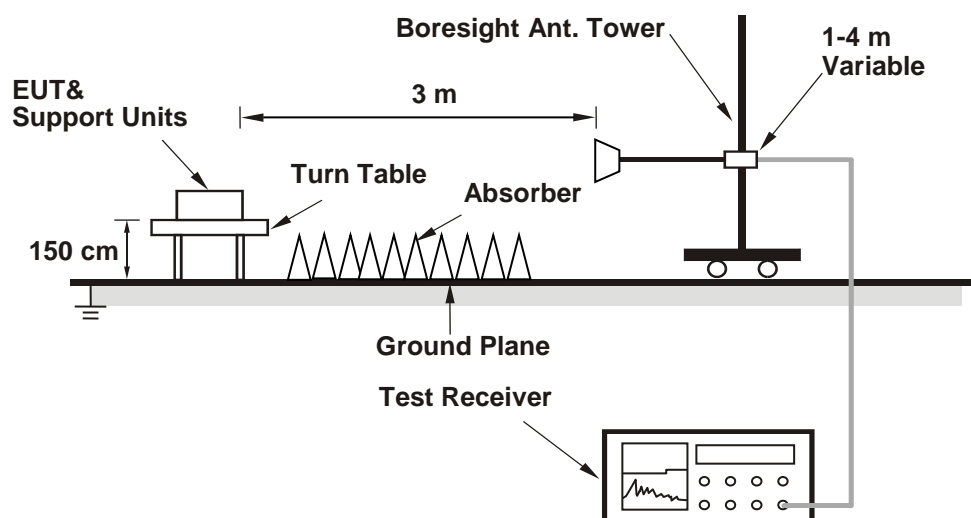
- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at 3 meter chamber room for test. The table was rotated 360 degrees to determine the position of the highest radiation.
- b. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the 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 quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.

Notes:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
2. All modes of operation were investigated and the worst-case emissions are reported.

6.8 Unwanted Emissions above 1 GHz

6.8.1 Test Setup



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

6.8.2 Test Procedure

- 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.
- The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna tower.
- 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.
- 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.
- The test-receiver system was set to peak and average detects 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.

Notes:

- The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for Peak detection (PK) and Average detection (AV) at frequency above 1 GHz.
- For fundamental and harmonic signal measurement, the resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is $\geq 1/T$ (Duty cycle $< 98\%$) or 10 Hz (Duty cycle $\geq 98\%$) for Average detection (AV) at frequency above 1 GHz.
- All modes of operation were investigated and the worst-case emissions are reported.

7 Test Results of Test Item

7.1 RF Output Power

Input Power:	120 Vac, 60 Hz	Environmental Conditions:	25°C, 76% RH	Tested By:	Waydi Tuan
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802.11ac (VHT80)

Chan.	Chan. Freq. (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)	Power Limit (dBm)	Test Result
		Chain 0	Chain 1				
42	5210	10.20	10.11	20.728	13.17	30	Pass
155	5775	15.08	14.97	63.616	18.04	30	Pass

Notes:

1. Directional gain is the maximum gain of antennas.
2. For U-NII-1, the maximum gain is 2.85 dBi < 6 dBi, so the output power limit shall not be reduced.
3. For U-NII-3, the maximum gain is 3.5 dBi < 6 dBi, so the output power limit shall not be reduced.

7.2 Power Spectral Density

Input Power:	120 Vac, 60 Hz	Environmental Conditions:	25°C, 76% RH	Tested By:	Waydi Tuan
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802.11ac (VHT80)

Chan.	Chan. Freq. (MHz)	PSD w/o Duty Factor (dBm/MHz)		Duty Factor (dB)	Total PSD (dBm/MHz)	Max. PSD Limit (dBm/MHz)	Test Result
		Chain 0	Chain 1				
42	5210	-9.09	-9.18	0.20	-5.92	17.00	Pass

Notes:

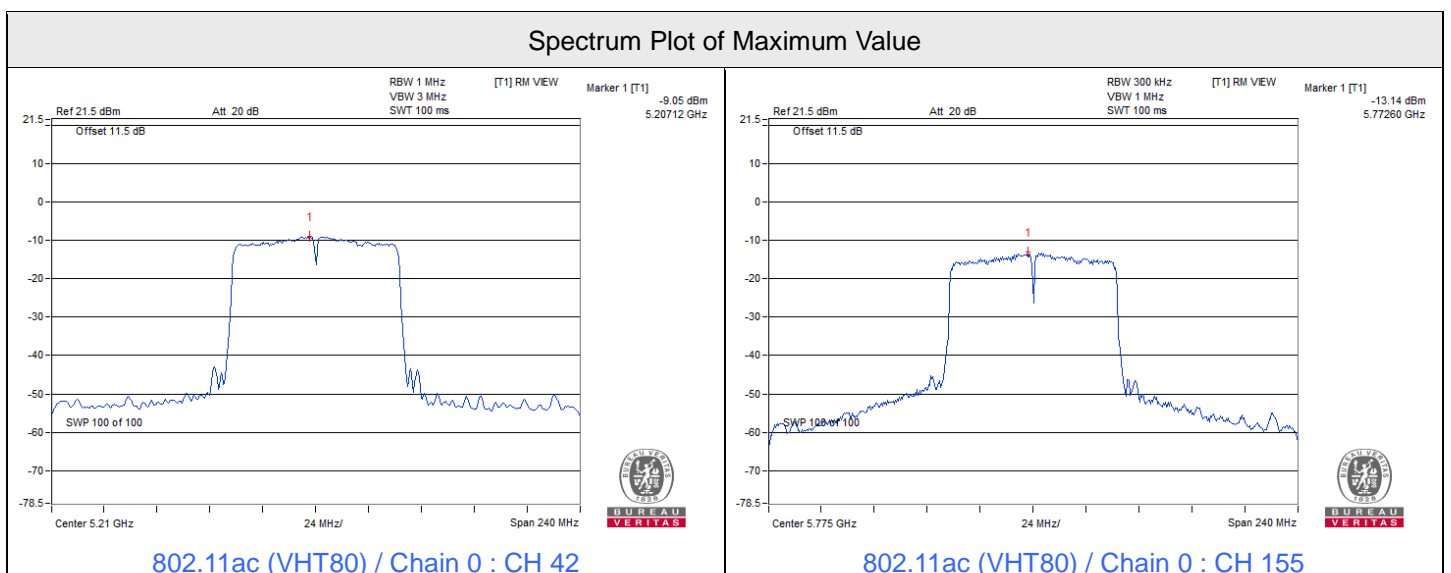
- Method E) 2) a) of power density measurement of KDB 662911 is using for calculating total power density. Total power density is summing entire spectra across corresponding frequency bins on the various outputs by computer.
- Directional gain = $10 \log[(10^{\text{Chain0}/20} + 10^{\text{Chain1}/20})^2 / 2]$
- For U-NII-1, the directional gain is 5.73 dBi < 6dBi, so the power density limit shall not be reduced.

802.11ac (VHT80)

TX chain	Channel	Freq. (MHz)	PSD w/o Duty Factor (dBm/300kHz)	PSD w/o Duty Factor (dBm/500kHz)	10 log (N=2) dB	Duty Factor (dB)	Total PSD With Duty Factor (dBm/500kHz)	PSD Limit (dBm/500kHz)	Test Result
Chain 0	155	5775	-13.14	-10.92	3.01	0.2	-7.71	30	Pass
Chain 1	155	5775	-13.35	-11.13	3.01	0.2	-7.92	30	Pass

Notes:

- Method E) 2) c) Measure and add 10 log(NANT) dB of KDB 662911 is using for calculating total power density.
- Directional gain = $10 \log[(10^{\text{Chain0}/20} + 10^{\text{Chain1}/20})^2 / 2]$
- For U-NII-3, the directional gain is 5.85 dBi < 6 dBi, so the power density limit shall not be reduced.

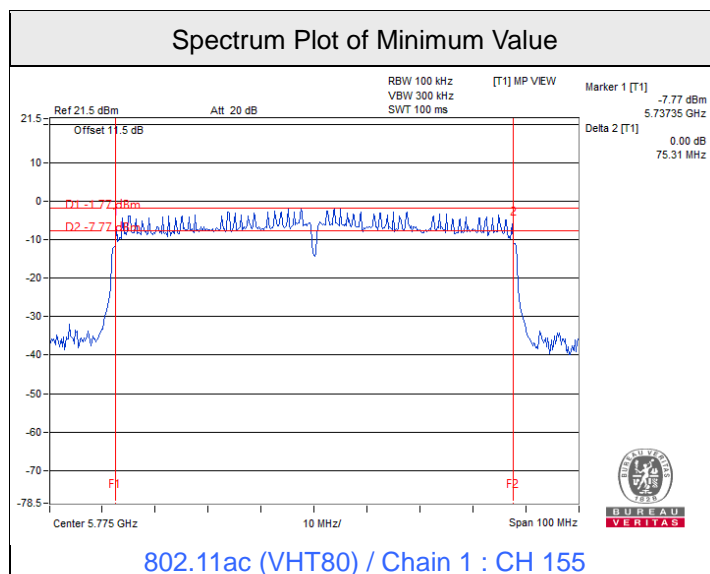


7.3 6 dB Bandwidth

Input Power:	120 Vac, 60 Hz	Environmental Conditions:	25°C, 76% RH	Tested By:	Waydi Tuan
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802.11ac (VHT80)

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)		Minimum Limit (MHz)	Test Result
		Chain 0	Chain 1		
155	5775	75.32	75.31	0.5	Pass

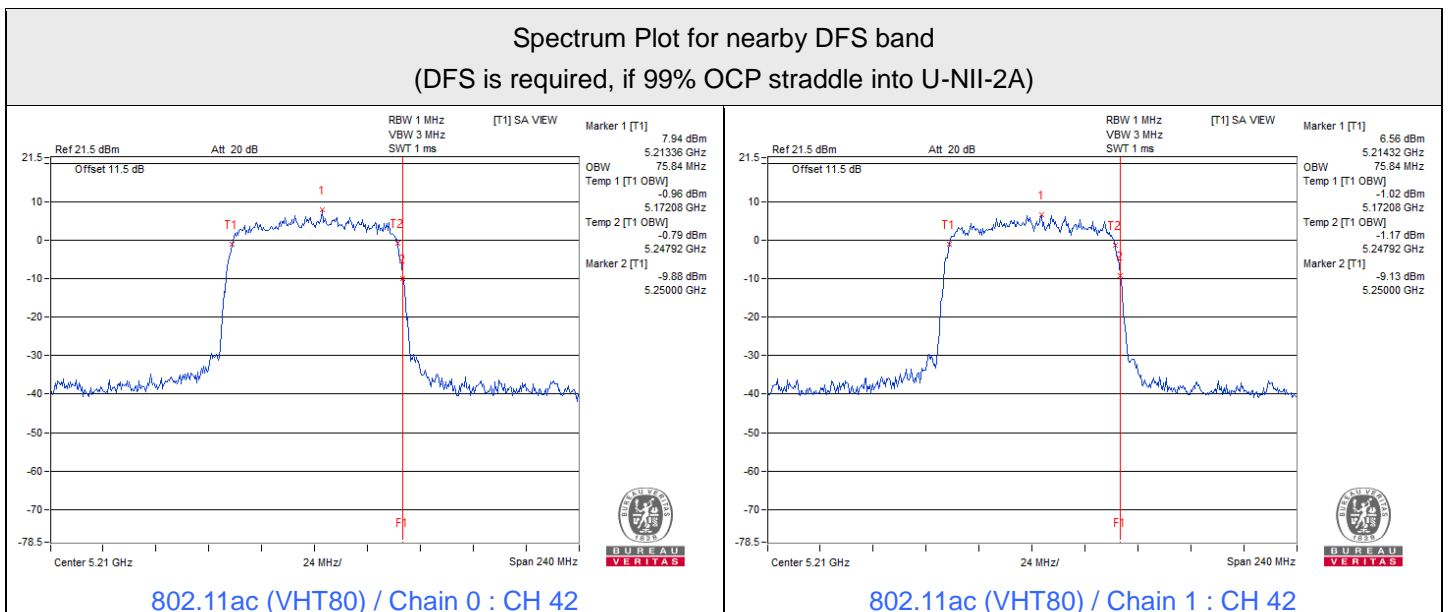
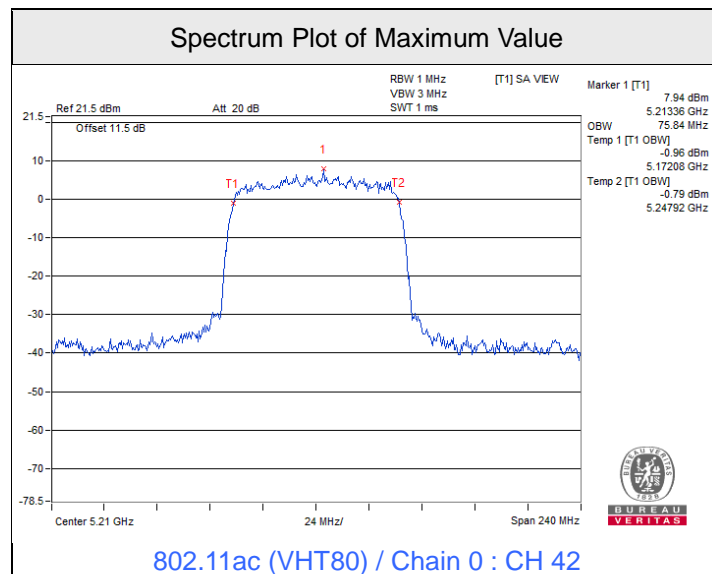


7.4 Occupied Bandwidth

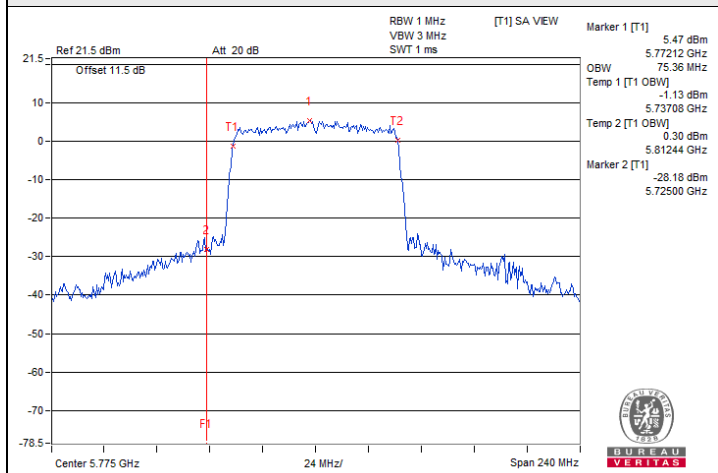
Input Power:	120 Vac, 60 Hz	Environmental Conditions:	25°C, 76% RH	Tested By:	Waydi Tuan
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802.11ac (VHT80)

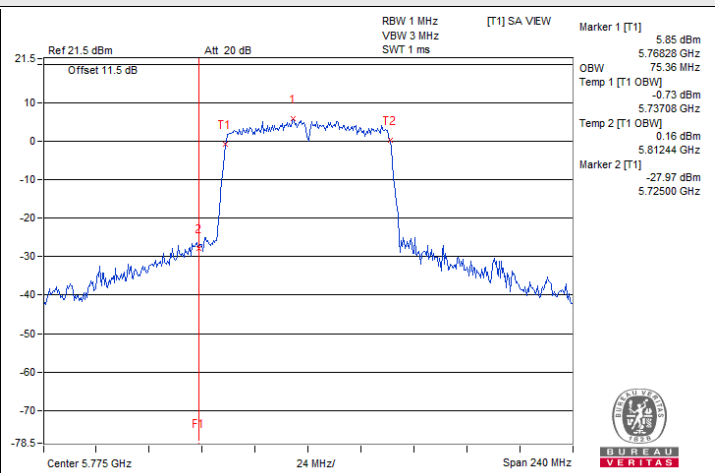
Channel	Frequency (MHz)	Occupied Bandwidth (MHz)	
		Chain 0	Chain 1
42	5210	75.84	75.84
155	5775	75.36	75.36



Spectrum Plot for nearby DFS band (DFS is required, if 99% OCP straddle into U-NII-2C)



802.11ac (VHT80) / Chain 0 : CH 155



802.11ac (VHT80) / Chain 1 : CH 155

7.5 Frequency Stability

Input Power:	120 Vac, 60 Hz	Environmental Conditions:	25°C, 76% RH	Tested By:	Waydi Tuan
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802.11ac (VHT80)

Frequency Stability Versus Temperature									
Operating Frequency: 5210 MHz									
Temp. (°C)	Power Supply (Vdc)	0 Minute		2 Minutes		5 Minutes		10 Minutes	
		Measured Frequency (MHz)	Test Result	Measured Frequency (MHz)	Test Result	Measured Frequency (MHz)	Test Result	Measured Frequency (MHz)	Test Result
40	5	5209.9854	Pass	5209.9894	Pass	5209.9863	Pass	5209.9853	Pass
30	5	5210.0238	Pass	5210.0248	Pass	5210.0276	Pass	5210.0275	Pass
20	5	5210.0114	Pass	5210.0141	Pass	5210.0111	Pass	5210.0124	Pass
10	5	5210.0228	Pass	5210.0245	Pass	5210.0231	Pass	5210.0235	Pass
0	5	5210.0245	Pass	5210.0243	Pass	5210.0237	Pass	5210.0255	Pass

Frequency Stability Versus Voltage									
Operating Frequency: 5210 MHz									
Temp. (°C)	Power Supply (Vdc)	0 Minute		2 Minutes		5 Minutes		10 Minutes	
		Measured Frequency (MHz)	Test Result	Measured Frequency (MHz)	Test Result	Measured Frequency (MHz)	Test Result	Measured Frequency (MHz)	Test Result
20	5.75	5210.0176	Pass	5210.0198	Pass	5210.017	Pass	5210.0176	Pass
	5	5210.0114	Pass	5210.0141	Pass	5210.0111	Pass	5210.0124	Pass
	4.25	5210.0052	Pass	5210.0055	Pass	5210.007	Pass	5210.0039	Pass

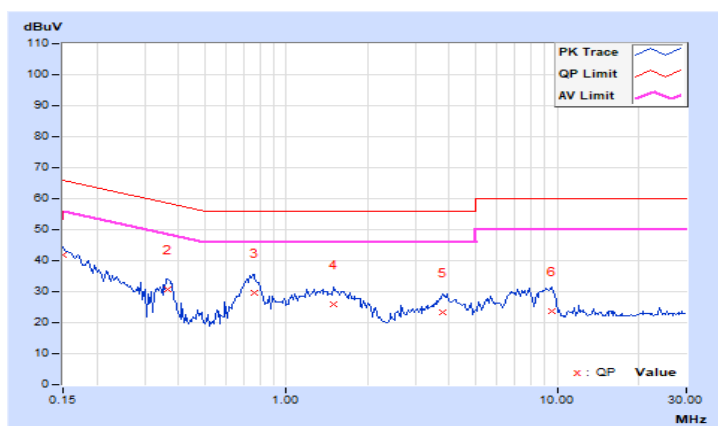
7.6 AC Power Conducted Emissions

RF Mode	802.11ac (VHT80)	Channel	CH 155 : 5775 MHz
Frequency Range	150 kHz ~ 30 MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9 kHz
Input Power	120 Vac, 60 Hz	Environmental Conditions	25°C, 75% RH
Tested By	Ian Chang		

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	0.15000	9.93	31.75	18.93	41.68	28.86	66.00	56.00	-24.32	-27.14
2	0.36484	9.94	20.83	17.02	30.77	26.96	58.62	48.62	-27.85	-21.66
3	0.76328	9.96	19.63	12.84	29.59	22.80	56.00	46.00	-26.41	-23.20
4	1.49609	10.00	15.82	12.24	25.82	22.24	56.00	46.00	-30.18	-23.76
5	3.78516	10.11	13.21	5.20	23.32	15.31	56.00	46.00	-32.68	-30.69
6	9.55078	10.36	13.38	6.43	23.74	16.79	60.00	50.00	-36.26	-33.21

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

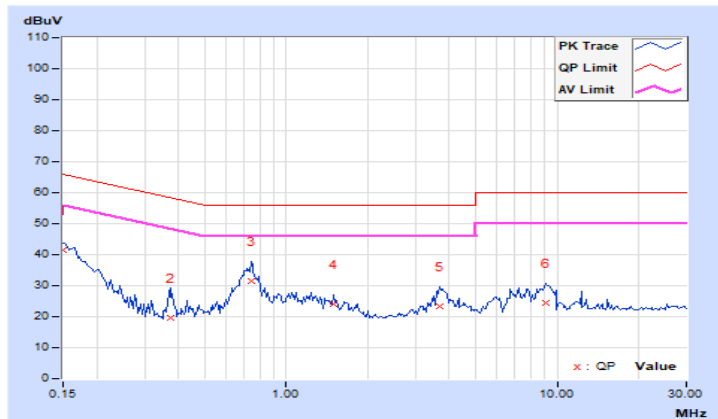


RF Mode	802.11ac (VHT80)	Channel	CH 155 : 5775 MHz
Frequency Range	150 kHz ~ 30 MHz	Detector Function & Resolution Bandwidth	Quasi-Peak (QP) / Average (AV), 9 kHz
Input Power	120 Vac, 60 Hz	Environmental Conditions	25°C, 75% RH
Tested By	Ian Chang		

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	0.15000	9.94	31.67	15.42	41.61	25.36	66.00	56.00	-24.39	-30.64
2	0.37266	9.96	9.72	4.29	19.68	14.25	58.44	48.44	-38.76	-34.19
3	0.73984	9.98	21.43	15.76	31.41	25.74	56.00	46.00	-24.59	-20.26
4	1.48828	10.01	13.89	10.31	23.90	20.32	56.00	46.00	-32.10	-25.68
5	3.69141	10.12	13.22	4.10	23.34	14.22	56.00	46.00	-32.66	-31.78
6	9.07031	10.33	14.12	7.52	24.45	17.85	60.00	50.00	-35.55	-32.15

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



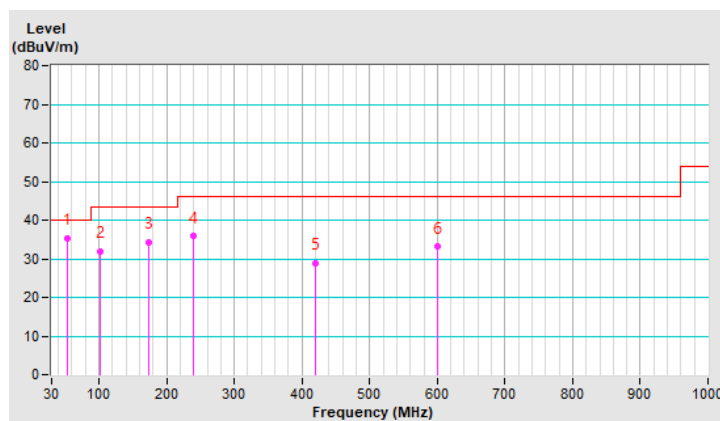
7.7 Unwanted Emissions below 1 GHz

RF Mode	802.11ac (VHT80)	Channel	CH 155 : 5775 MHz
Frequency Range	30 MHz ~ 1 GHz	Detector Function & Bandwidth	(QP) RB = 120kHz
Input Power	120 Vac, 60 Hz	Environmental Conditions	24°C, 69% RH
Tested By	Ian Chang		

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	53.64	35.4 QP	40.0	-4.6	2.09 H	185	43.7	-8.3
2	102.14	31.9 QP	43.5	-11.6	2.34 H	210	44.5	-12.6
3	173.92	34.2 QP	43.5	-9.3	2.63 H	238	42.8	-8.6
4	239.88	35.8 QP	46.0	-10.2	2.89 H	263	44.2	-8.4
5	420.30	28.9 QP	46.0	-17.1	3.12 H	286	31.9	-3.0
6	600.72	33.1 QP	46.0	-12.9	3.56 H	330	32.0	1.1

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 of frequency range 30 MHz ~ 1 GHz.
5. The emission levels were very low against the limit of frequency range 9 kHz ~ 30 MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.

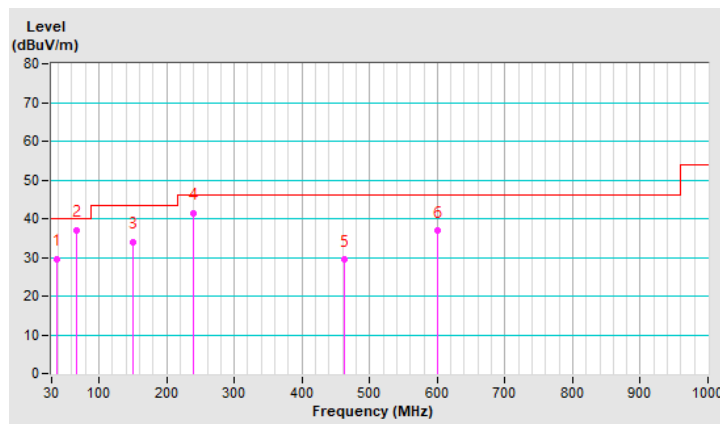


RF Mode	802.11ac (VHT80)	Channel	CH 155 : 5775 MHz
Frequency Range	30 MHz ~ 1 GHz	Detector Function & Bandwidth	(QP) RB = 120kHz
Input Power	120 Vac, 60 Hz	Environmental Conditions	24°C, 69% RH
Tested By	Ian Chang		

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	38.12	29.5 QP	40.0	-10.5	1.89 V	94	38.9	-9.4
2	67.22	36.9 QP	40.0	-3.1	2.19 V	124	47.0	-10.1
3	150.64	34.0 QP	43.5	-9.5	2.70 V	174	41.9	-7.9
4	239.88	41.4 QP	46.0	-4.6	2.96 V	200	49.8	-8.4
5	462.98	29.4 QP	46.0	-16.6	3.35 V	238	31.4	-2.0
6	600.72	36.8 QP	46.0	-9.2	3.63 V	266	35.7	1.1

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 of frequency range 30 MHz ~ 1 GHz.
5. The emission levels were very low against the limit of frequency range 9 kHz ~ 30 MHz: the amplitude of spurious emissions attenuated more than 20 dB below the permissible value to be report.



7.8 Unwanted Emissions above 1 GHz

RF Mode	802.11ac (VHT80)	Channel	CH 42 : 5210 MHz
Frequency Range	1 GHz ~ 40 GHz	Detector Function & Bandwidth	(PK) RB = 1 MHz, VB = 3 MHz (AV) RB = 1 MHz, VB = 3 kHz
Input Power	120 Vac, 60 Hz	Environmental Conditions	21°C, 59% RH
Tested By	Ian Chang		

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	5150.00	62.5 PK	74.0	-11.5	1.51 H	239	55.0	7.5
2	5150.00	53.0 AV	54.0	-1.0	1.51 H	239	45.5	7.5
3	*5210.00	94.3 PK			1.51 H	239	86.6	7.7
4	*5210.00	86.7 AV			1.51 H	239	79.0	7.7
5	5350.00	58.6 PK	74.0	-15.4	1.51 H	239	50.0	8.6
6	5350.00	48.7 AV	54.0	-5.3	1.51 H	239	40.1	8.6
7	#10420.00	55.5 PK	68.2	-12.7	2.78 H	4	39.8	15.7
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	5150.00	61.2 PK	74.0	-12.8	2.18 V	163	53.7	7.5
2	5150.00	51.8 AV	54.0	-2.2	2.18 V	163	44.3	7.5
3	*5210.00	98.5 PK			2.18 V	163	90.8	7.7
4	*5210.00	90.0 AV			2.18 V	163	82.3	7.7
5	5350.00	60.0 PK	74.0	-14.0	2.18 V	163	51.4	8.6
6	5350.00	49.4 AV	54.0	-4.6	2.18 V	163	40.8	8.6
7	#10420.00	60.7 PK	68.2	-7.5	2.93 V	115	45.0	15.7

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, the limit was restricted at the RF Output Power.
6. " # " : The radiated frequency is out of the restricted band.



RF Mode	802.11ac (VHT80)	Channel	CH 155 : 5775 MHz
Frequency Range	1 GHz ~ 40 GHz	Detector Function & Bandwidth	(PK) RB = 1 MHz, VB = 3 MHz (AV) RB = 1 MHz, VB = 3 kHz
Input Power	120 Vac, 60 Hz	Environmental Conditions	21°C, 59% RH
Tested By	Ian Chang		

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	#5636.58	58.2 PK	68.2	-10.0	1.81 H	11	50.0	8.2
2	*5775.00	100.7 PK			1.81 H	11	92.7	8.0
3	*5775.00	92.5 AV			1.81 H	11	84.5	8.0
4	#5939.57	59.7 PK	68.2	-8.5	1.81 H	11	51.4	8.3
5	11550.00	57.1 PK	74.0	-16.9	1.69 H	252	39.7	17.4
6	11550.00	46.0 AV	54.0	-8.0	1.69 H	252	28.6	17.4

Antenna Polarity & Test Distance : Vertical at 3 m

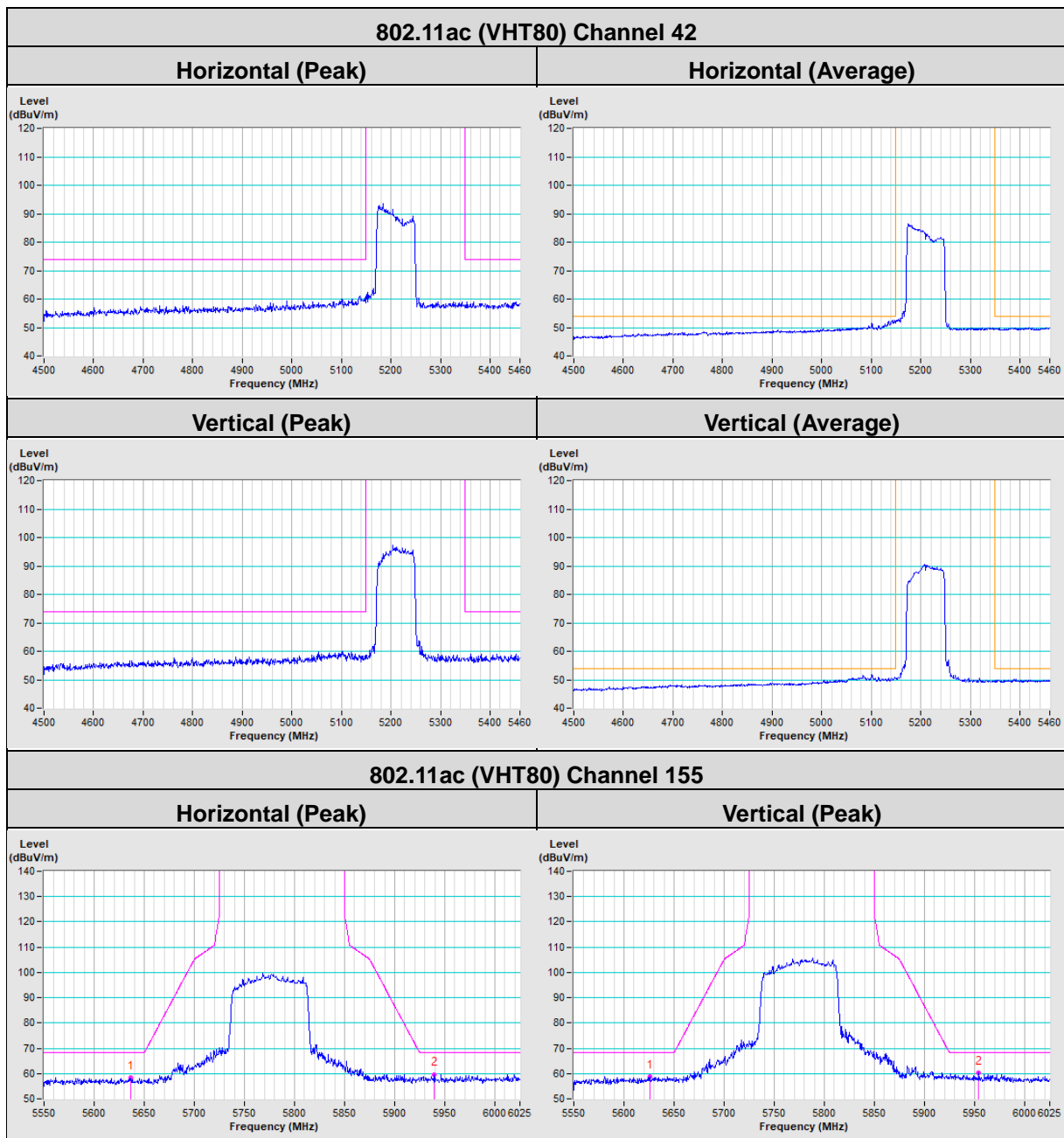
No	Frequency (MHz)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Antenna Height (m)	Table Angle (Degree)	Raw Value (dBuV)	Correction Factor (dB/m)
1	#5625.80	58.8 PK	68.2	-9.4	2.47 V	102	50.5	8.3
2	*5775.00	106.4 PK			2.47 V	102	98.4	8.0
3	*5775.00	98.7 AV			2.47 V	102	90.7	8.0
4	#5954.02	60.2 PK	68.2	-8.0	2.47 V	102	51.9	8.3
5	11550.00	58.1 PK	74.0	-15.9	2.75 V	287	40.7	17.4
6	11550.00	47.0 AV	54.0	-7.0	2.75 V	287	29.6	17.4

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, the limit was restricted at the RF Output Power.



Plot of Band Edge



8 Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo)

9 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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