

TEST REPORT

CERTIFICATE OF CONFORMITY

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

Report No.: RFBENL-WTW-P22070904-4

FCC ID: RYK-WNFQ269AXB

Product: 802.11ax/ac/a/b/g/n Wi-Fi + BT M.2 card

Brand: Sparklan

Model No.: WNFQ-269AX(BT)

Received Date: 2022/7/31

Test Date: 2022/10/25 ~ 2023/1/11

Issued Date: 2023/2/6

Applicant: SparkLAN Communications, Inc.

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

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Test Location: E-2, No.1, Li Hsin 1st Road, Hsinchu Science Park, Hsinchu City 300, Taiwan

FCC Registration / 723255 / TW2022

Designation Number:

Approved by: _____, **Date:** 2023/2/6
May Chen / Manager

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Prepared by : Vivian Huang / Specialist



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Release Control Record

Issue No.	Description	Date Issued
RFBENL-WTW-P22070904-4	Original release.	2023/2/6

1 Certificate

Product: 802.11ax/ac/a/b/g/n Wi-Fi + BT M.2 card

Brand: Sparklan

Test Model: WNFQ-269AX(BT)

Sample Status: Engineering sample

Applicant: SparkLAN Communications, Inc.

Test Date: 2022/10/25 ~ 2023/1/11

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

Measurement ANSI C63.10-2013

procedure: KDB 291074 D02 EMC Measurement v01

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)(3)	RF Output Power	Pass	Meet the requirement of limit.
15.407(a)(3)	Power Spectral Density	NA	Refer to Note 1 below
15.407(b)(9)	AC Power Conducted Emissions	NA	Refer to Note 1 below
15.407(b)(9)	Unwanted Emissions below 1 GHz	NA	Refer to Note 1 below
15.407(b)(5) 15.407(b)(10)	Unwanted Emissions above 1 GHz	Pass	Minimum passing margin is -6.0 dB at 5895.00 MHz
15.407(e)	6 dB Bandwidth	NA	Refer to Note 1 below
15.407(g)	Frequency Stability	NA	Refer to Note 1 below
15.403	Operational restrictions U-NII 4 devices	NA	Refer to Note 1 below
15.203	Antenna Requirement	Pass	No antenna connector is used.

Notes:

1. RF Output Power & Unwanted Emissions above 1 GHz were performed for this addendum. The others testing data refer to original test report (Original FCC ID: J9C-QCNFA765, Report No.: RF201119E01-7).
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:

Parameter	Specification	Expanded Uncertainty (k=2) (±)
Unwanted Emissions above 1 GHz	1 GHz ~ 18 GHz	5.0 dB
	18 GHz ~ 40 GHz	5.3 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	802.11ax/ac/a/b/g/n Wi-Fi + BT M.2 card
Brand	Sparklan
Test Model	WNFQ-269AX(BT)
Status of EUT	Engineering sample
Power Supply Rating	3.3Vdc from host equipment
Modulation Type	64QAM, 16QAM, QPSK, BPSK for OFDM 1024QAM for OFDM in 11ac mode 4096QAM for OFDMA in 11ax mode
Modulation Technology	OFDM, OFDMA
Transfer Rate	802.11a: up to 54 Mbps 802.11n: up to 300 Mbps 802.11ac: up to 2166.7 Mbps 802.11ax: up to 2969.7 Mbps
Operating Frequency	5.815 ~ 5.885 GHz
Number of Channel	802.11a, 802.11n (HT20), 802.11ac (VHT20), 802.11ax (HE20): 3 802.11n (HT40), 802.11ac (VHT40), 802.11ax (HE40): 2 802.11ac (VHT80), 802.11ax (HE80): 1 802.11ac (VHT160), 802.11ax (HE160): 1
Output Power	EIRP: 409.261 mW (26.12 dBm)
EUT Category	Client device

Note:

- This report is prepared for FCC class II permissive change. The difference compared with the original design is as the following:
◆ Add Dipole antenna (Refer to section 3.2).
- According to above conditions, only RF Output Power & Unwanted Emissions above 1 GHz needs to be performed. And all data are verified to meet the requirements.
- This device of WLAN (2.4GHz & 5GHz U-NII-1 Band) can support hotspot mode.
- Simultaneously transmission condition.

Condition	Technology	
1	WLAN(2.4GHz)	WLAN(6GHz)
2	WLAN(2.4GHz)	WLAN(5GHz)
3	WLAN(2.4GHz)	WLAN(5.9GHz)
4	WLAN(6GHz)	Bluetooth
5	WLAN(5GHz)	Bluetooth
6	WLAN(5.9GHz)	Bluetooth

Note: The emission of the simultaneous operation has been evaluated and no non-compliance was found.

- The device of WLAN (2.4GHz) and Bluetooth technology can't transmit simultaneously, it was used timely shared coexistence technology.
- The module has two variant designs as following table:

SKU No.	Description
SKU #1	M.2 2230 E-key
SKU #2	M.2 2230 AE-key
From the above variants designs, the worst case was found in SKU #1 . Therefore only the test data of the mode was recorded in this report.	

7. The product provides option to depopulate external LNA (Low-Noise amplifier) from 5GHz/6GHz receive path. This test report covers variation of with/without external LNA and test was conducted to confirm not change in RF compliance and EMC. And worst case was found in without external LNA.
8. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.

3.2 Antenna Description of EUT

1. The antenna information is listed as below.

Original									
Antenna Set	RF Chain No.	Brand	Model	Antenna Net Gain (dBi)	Frequency Range	Cable Loss (dB)	Antenna Type	Connector Type	Cable Length
1	Chain0/1	HONGBO	260-25094	3.53	2.4~2.4835 GHz	0.76	PIFA	i-pex(MHF 4L)	300mm
				3.06	5.15~5.25 GHz	1.16			
				3.07	5.25~5.35 GHz	1.18			
				4.81	5.47~5.725 GHz	1.2			
				4.2	5.725~5.850 GHz	1.27			
2	Chain0/1	HONGBO	260-25083	5.09	5.850~5.895 GHz	1.29	PIFA	i-pex(MHF 4L)	300mm
				5.14	5.925~6.425 GHz	1.32			
				5.09	6.425~6.525 GHz	1.35			
				5.16	6.525~6.875 GHz	1.4			
				5.12	6.875~7.125 GHz	1.45			
3	Chain0/1	HONGBO	260-25084	3.22	2.4~2.4835 GHz	0.5	Monopole	i-pex(MHF 4L)	200mm
				3.35	5.150~5.250 GHz	0.76			
				3.42	5.250~5.350 GHz	0.78			
				4.77	5.470~5.725 GHz	0.81			
				4.72	5.725~5.850 GHz	0.85			
				4.71	5.850~5.895 GHz	0.86			
				4.75	5.925~6.425 GHz	0.87			
				4.29	6.425~6.525 GHz	0.91			
				4.81	6.525~6.875 GHz	0.96			
				4.74	6.875~7.125 GHz	0.98			
Newly									
Antenna Set	RF Chain No.	Brand	Model	Antenna Net Gain (dBi)	Frequency Range	Antenna Type	Connector Type	Cable Length	
4	Chain0/1	SparkLAN	AD-510AX	2.27	2.4~2.4835 GHz	Dipole	RP-SMA (M)	150mm	
				2.88	5.150~5.825 GHz				
				2.6	5.850~5.895 GHz				
				3.23	5.925~6.425 GHz				
				3.34	6.425~6.525 GHz				
				3.52	6.525~6.875 GHz				
				3.52	6.875~7.125 GHz				
5	Chain0/1	SparkLAN	AD-103AG (UHW0935A4)	2.02	2.4~2.4835 GHz	Dipole	RP-SMA (M)	150mm	
				2.03	5.150~5.850 GHz				
				1.9	5.850~5.895 GHz				
6	Chain0/1	SparkLAN	AD-302N	3.14	2.4~2.4835 GHz	Dipole	RP-SMA (M)	150mm	
				2.87	5.150~5.850 GHz				
				1.63	5.850~5.895 GHz				

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

2. The EUT incorporates a MIMO function:

5.9 GHz Band		
MODULATION MODE	TX & RX CONFIGURATION	
802.11a	2TX	2RX
802.11n (HT20)	2TX	2RX
802.11n (HT40)	2TX	2RX
802.11ac (VHT20)	2TX	2RX
802.11ac (VHT40)	2TX	2RX
802.11ac (VHT80)	2TX	2RX
802.11ac (VHT160)	2TX	2RX
802.11ax (HE20)	2TX	2RX
802.11ax (HE40)	2TX	2RX
802.11ax (HE80)	2TX	2RX
802.11ax (HE160)	2TX	2RX
802.11ax (RU26/52/106/242/484/996/1992)	2TX	2RX

Note:

1. The EUT support Beamforming and non-beamforming mode, therefore both mode were investigated and the worst case scenario was identified. The worst case data (non-beamforming mode) were presented in test report.
2. The modulation and bandwidth are similar for 802.11n mode for 20MHz (40MHz), 802.11ac mode for 20MHz (40MHz, 80MHz, 160MHz) and 802.11ax mode for 20MHz (40MHz, 80MHz, 160MHz), therefore the manufacturer will control the power for 802.11n/ac mode is the same as the 802.11ax mode or more lower than it and investigated worst case to representative mode in test report.

3.3 Channel List

For U-NII-4

3 channels are provided for 802.11a, 802.11n (HT20), 802.11ac (VHT20), 802.11ax (HE20):

Channel	Frequency	Channel	Frequency	Channel	Frequency
*169	5845 MHz	173	5865 MHz	177	5885 MHz

2 channels are provided for 802.11n (HT40), 802.11ac (VHT40), 802.11ax (HE40):

Channel	Frequency	Channel	Frequency
*167	5835 MHz	175	5875 MHz

1 channel is provided for 802.11ac (VHT80), 802.11ax (HE80):

Channel	Frequency
*171	5855 MHz

1 channel is provided for 802.11n, 802.11ac, 802.11ax (HE160):

Channel	Frequency
*163	5815 MHz

Note: * U-NII-3 & -4 span channels.

3.4 Test Mode Applicability and Tested Channel Detail

Worst Case:	1. The EUT had been pre-tested on the positioned of each 3 axis. The worst case was found when positioned on X-plane
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Following channel(s) was (were) selected for the final test as listed below:

Test Item	Mode	Tested Channel	Modulation	Data Rate Parameter	RU Configuration
RF Output Power	802.11a	169, 173, 177	BPSK	6Mb/s	-
	802.11ac (VHT20)	169, 173, 177	BPSK	MCS0	-
	802.11ac (VHT40)	167, 175	BPSK	MCS0	-
	802.11ac (VHT80)	171	BPSK	MCS0	-
	802.11ac (VHT160)	163	BPSK	MCS0	-
	802.11ax (HE20)	169, 173, 177	BPSK	MCS0	-
	802.11ax (HE40)	167, 175	BPSK	MCS0	-
	802.11ax (HE80)	171	BPSK	MCS0	-
	802.11ax (HE160)	163	BPSK	MCS0	-
	20 MHz Preamble 802.11ax (RU26)	169, 173, 177	BPSK	MCS0	26/0, 26/4, 26/8
	20 MHz Preamble 802.11ax (RU52)	169, 173, 177	BPSK	MCS0	52/37, 52/38, 52/40
	20 MHz Preamble 802.11ax (RU106)	169, 173, 177	BPSK	MCS0	106/53, 106/54
Unwanted Emissions above 1 GHz	802.11ax (HE20)	177	BPSK	MCS0	-
	802.11ax (HE40)	175	BPSK	MCS0	-
	802.11ax (HE160)	163	BPSK	MCS0	-
	20 MHz Preamble 802.11ax (RU106)	177	BPSK	MCS0	106/54

Note: The unwanted emissions above 1GHz were performed in radiated measurement with maximum antenna gain of dipole antenna.

3.5 Duty Cycle of Test Signal

802.11a: Duty cycle = 1.975 ms / 1.996 ms x 100% = 98.9%

802.11ax (HE20): Duty cycle = 5.344 ms / 5.371 ms x 100% = 99.5%

802.11ax (HE40): Duty cycle = 5.413 ms / 5.436 ms x 100% = 99.6%

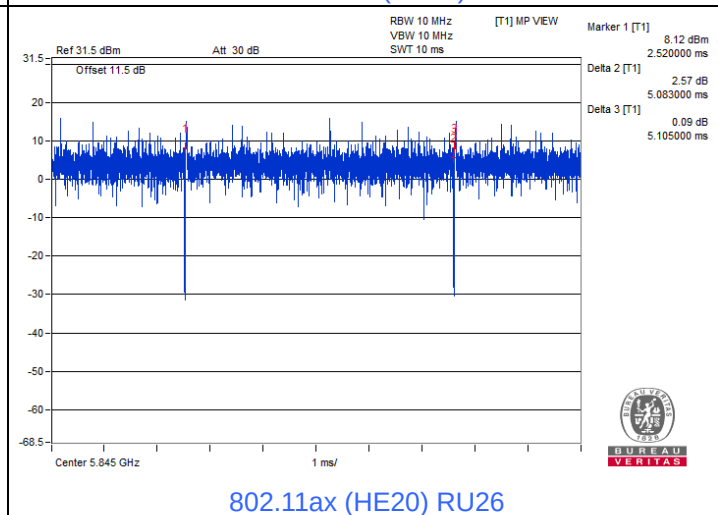
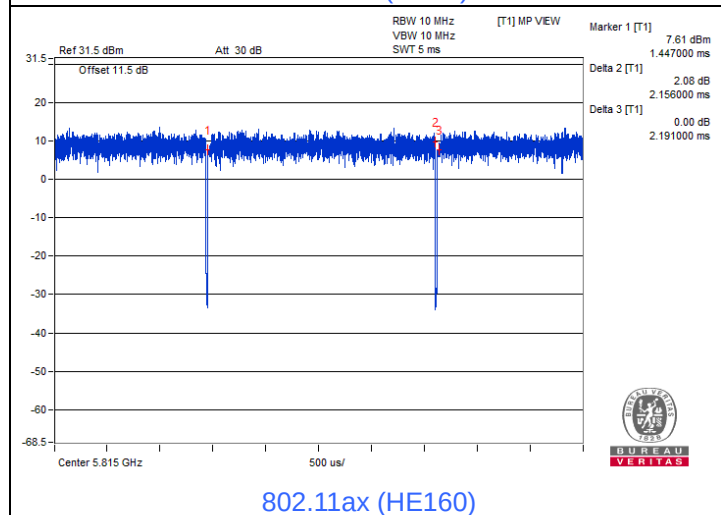
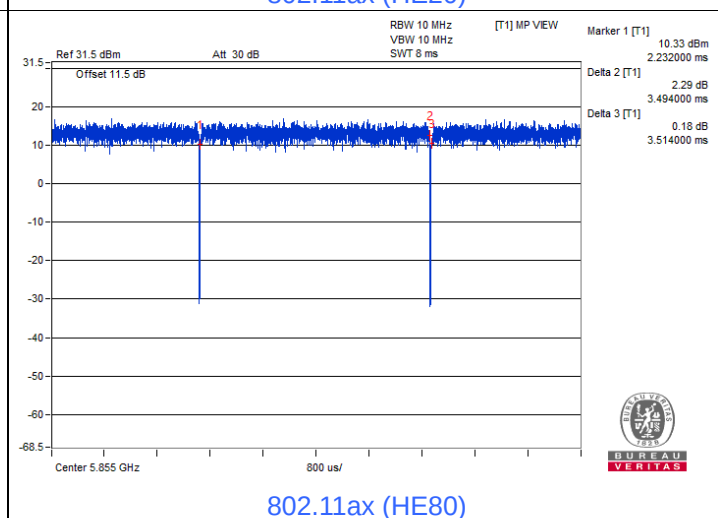
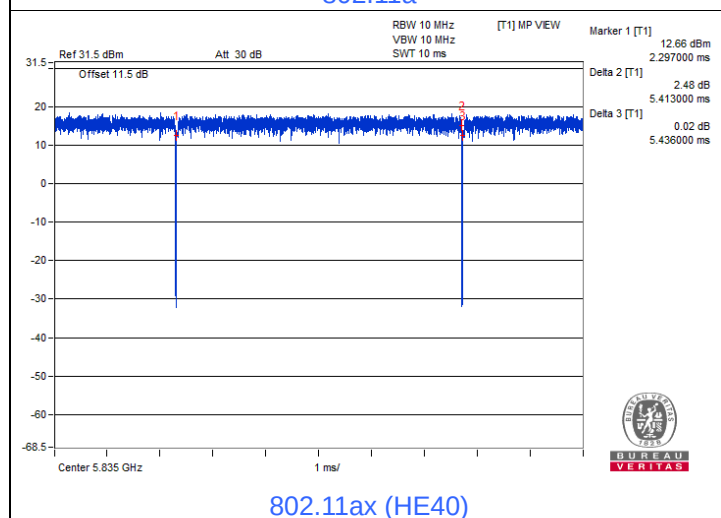
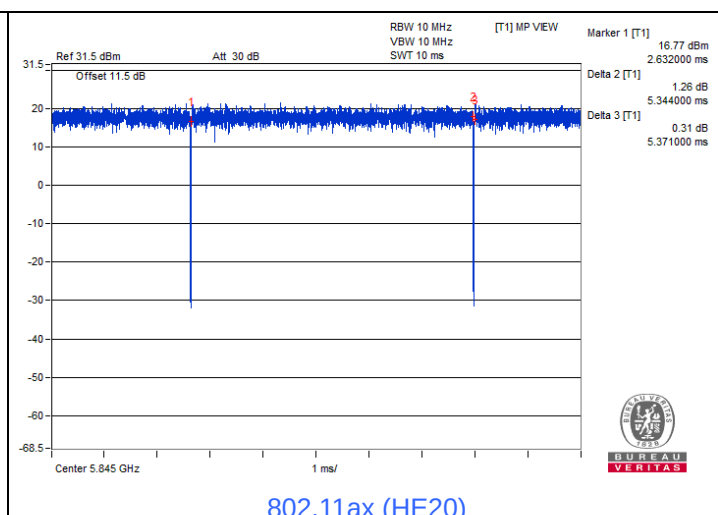
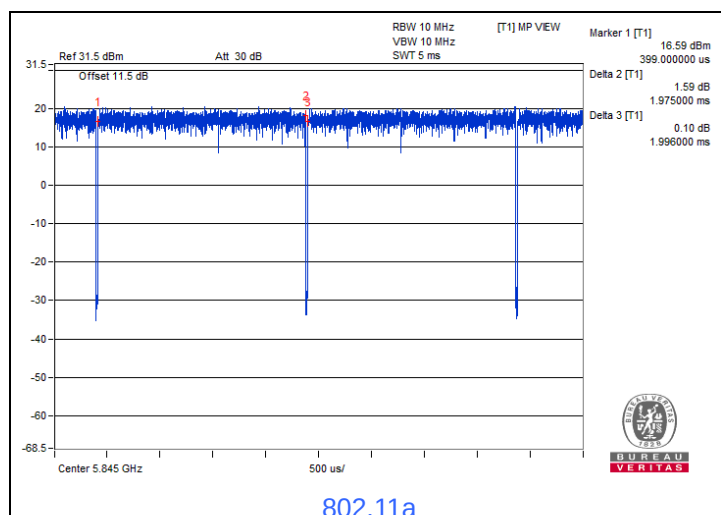
802.11ax (HE80): Duty cycle = 3.494 ms / 3.514 ms x 100% = 99.4%

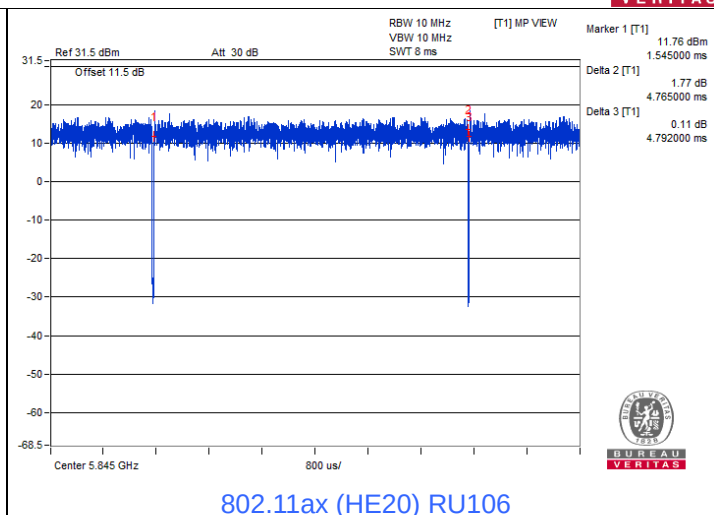
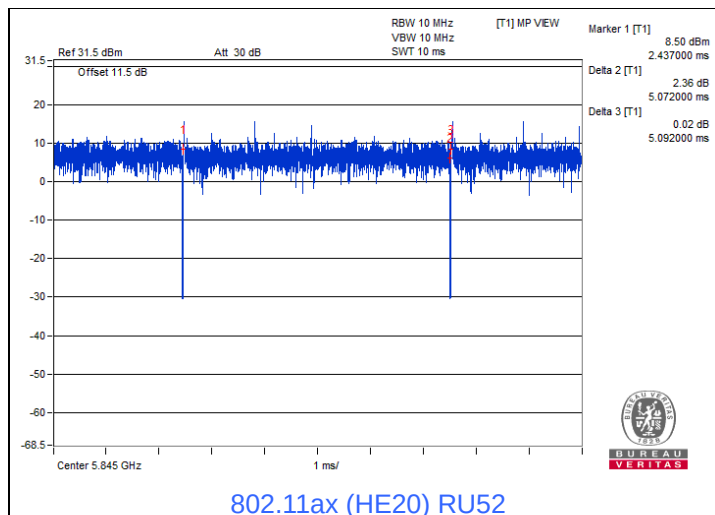
802.11ax (HE160): Duty cycle = 2.156 ms / 2.191 ms x 100% = 98.4%

802.11ax (HE20) RU26: Duty cycle = 5.083 ms / 5.105 ms x 100% = 99.6%

802.11ax (HE20) RU52: Duty cycle = 5.072 ms / 5.092 ms x 100% = 99.6%

802.11ax (HE20) RU106: Duty cycle = 4.765 ms / 4.792 ms x 100% = 99.4%

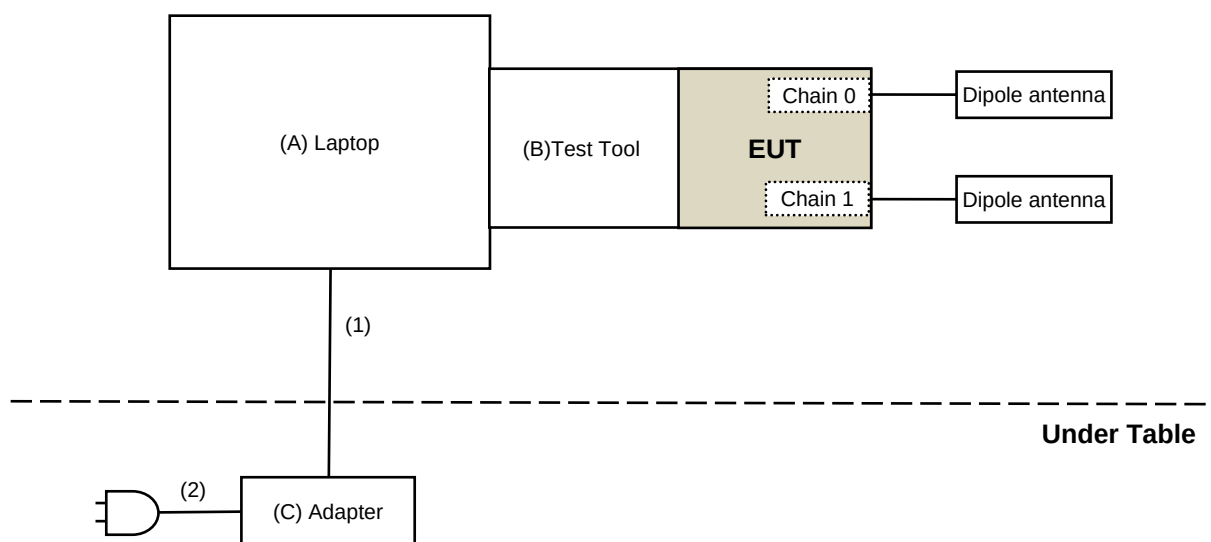




3.6 Test Program Used and Operation Descriptions

Controlling software (qdart_conn.win.1.0_installer_00083.1) 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	Laptop	Dell	E5420	FHP35S1	N/A	Provided by Lab
B	Test Tool	Fast Line	N/A	N/A	N/A	Supplied by applicant
C	Adapter	Dell	FA65NE0-00	N/A	N/A	Provided by Lab

ID	Cable Descriptions	Qty.	Length (m)	Shielding (Yes/No)	Cores (Qty.)	Remarks
1	DC Cable	1	1.8	No	0	Provided by Lab
2	AC Cable	1	1	No	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
Attenuator WOKEN	MDCS18N-10	MDCS18N-10-01	2022/4/5	2023/4/4
Power Meter Anritsu	ML2495A	1529002	2022/6/22	2023/6/21
Pulse Power Sensor Anritsu	MA2411B	1726434	2022/6/22	2023/6/21
Software	ADT_RF Test Software V6.6.5.4	NA	NA	NA

Notes:

1. The test was performed in Oven room 2.
2. Tested Date: 2022/10/25

4.2 Unwanted Emissions above 1 GHz

Description Manufacturer	Model No.	Serial No.	Calibrated Date	Calibrated Until
Antenna Tower & Turn Table Max-Full	MF-7802	MF780208406	N/A	N/A
Fix tool for Boresight antenna tower BV	FBA-01	FBA_SIP01	N/A	N/A
Horn Antenna Schwarzbeck	BBHA 9170	9170-739	2022/11/13	2023/11/12
	BBHA9120-D	9120D-406	2022/11/13	2023/11/12
Pre_Amplifier EMCI	EMC12630SE	980384	2022/12/28	2023/12/27
	EMC184045SE	980387	2022/12/28	2023/12/27
RF Cable EMCI	EMC104-SM-SM-6000	210201	2022/5/10	2023/5/9
RF Cable-Frequency range: 1- 40GHz EMCI	EMC102-KM-KM-1200	160924	2022/12/28	2023/12/27
RF Coaxial Cable EMCI	EMC-KM-KM-4000	200214	2022/3/8	2023/3/7
	EMC104-SM-SM-1500	180504	2022/4/25	2023/4/24
	EMC104-SM-SM-2000	180601	2022/6/6	2023/6/5
Software	ADT_Radiated_V8.7.08	N/A	N/A	N/A
Spectrum Analyzer KEYSIGHT	N9030B	MY57142938	2022/4/26	2023/4/25
Test Receiver KEYSIGHT	N9038A	MY59050100	2022/6/20	2023/6/19

Notes:

1. The test was performed in 966 Chamber No. 3.
2. Tested Date: 2023/1/11

5 Limits of Test Items

5.1 RF Output Power

Device Category	Limit (Max Average Power)
Indoor access point	EIRP 36 dBm
Subordinate device	EIRP 36 dBm
Client device	EIRP 30 dBm
Note: For all U-NII-4 and U-NII-3 & -4 span channels shall met above EIRP values.	

5.2 Unwanted Emissions above 1 GHz

- (i) For an indoor access point or subordinate device, all emissions at or above 5.895 GHz shall not exceed an e.i.r.p. of 15 dBm/MHz and shall decrease linearly to an e.i.r.p. of -7 dBm/MHz at or above 5.925 GHz.
- (ii) For a client device, all emissions at or above 5.895 GHz shall not exceed an e.i.r.p. of -5 dBm/MHz and shall decrease linearly to an e.i.r.p. of -27 dBm/MHz at or above 5.925 GHz.
- (iii) For a client device or indoor access point or subordinate device, all emissions below 5.725 GHz shall not exceed an e.i.r.p. of -27 dBm/MHz at 5.65 GHz increasing linearly to 10 dBm/MHz at 5.7 GHz, and from 5.7 GHz increasing linearly to a level of 15.6 dBm/MHz at 5.72 GHz, and from 5.72 GHz increasing linearly to a level of 27 dBm/MHz at 5.725 GHz.

Note:

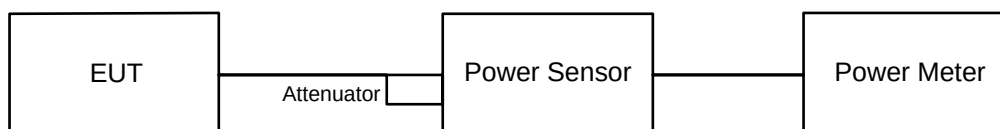
The following formula is used to convert the equipment isotropic radiated power (eirp) to field strength:

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

6 Test Arrangements

6.1 RF Output Power

6.1.1 Test Setup

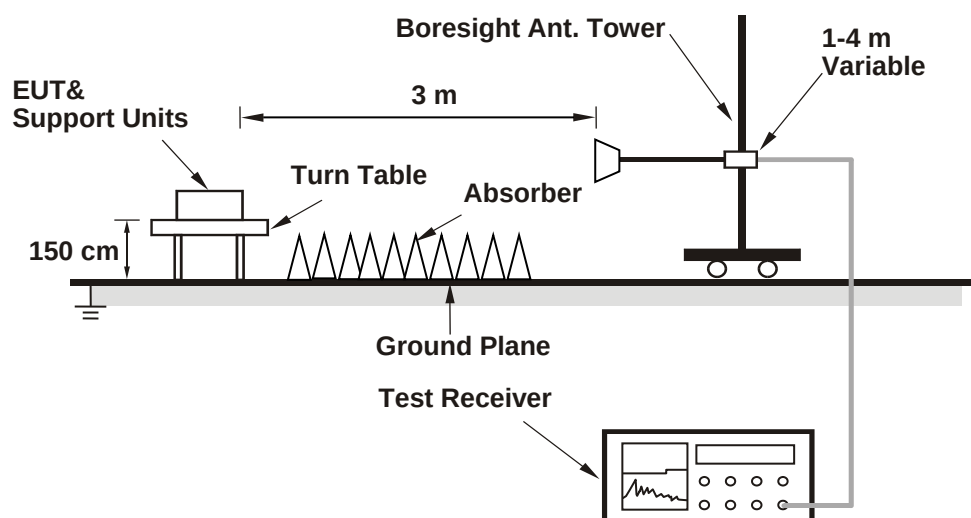


6.1.2 Test Procedure

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 Unwanted Emissions above 1 GHz

6.2.1 Test Setup



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

6.2.2 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:	3.3 Vdc	Environmental Conditions:	24°C, 60% RH	Tested By:	Eric Peng
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802.11a

Chan.	Chan. Freq. (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)	Directional Gain (dBi)	EIRP (mW)	EIRP (dBm)	EIRP Limit (dBm)	Test Result
		Chain 0	Chain 1							
169	5845	12.21	13.16	37.336	15.72	8.10	240.991	23.82	30	Pass
173	5865	12.24	13.12	37.261	15.71	8.10	240.436	23.81	30	Pass
177	5885	12.26	12.93	36.46	15.62	8.10	235.505	23.72	30	Pass

Notes:

1. Directional gain = gain of antenna element + 10 log (2 of TX antenna elements)
2. The directional gain is 8.1 dBi

802.11ac (VHT20)

Chan.	Chan. Freq. (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)	Directional Gain (dBi)	EIRP (mW)	EIRP (dBm)	EIRP Limit (dBm)	Test Result
		Chain 0	Chain 1							
169	5845	12.40	13.24	38.464	15.85	8.10	248.313	23.95	30	Pass
173	5865	12.39	13.45	39.469	15.96	8.10	254.683	24.06	30	Pass
177	5885	12.55	12.98	37.85	15.78	8.10	244.343	23.88	30	Pass

Notes:

1. Directional gain = gain of antenna element + 10 log (2 of TX antenna elements)
2. The directional gain is 8.1 dBi

802.11ac (VHT40)

Chan.	Chan. Freq. (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)	Directional Gain (dBi)	EIRP (mW)	EIRP (dBm)	EIRP Limit (dBm)	Test Result
		Chain 0	Chain 1							
167	5835	14.32	15.35	61.316	17.88	8.10	396.278	25.98	30	Pass
175	5875	14.30	15.29	60.722	17.83	8.10	391.742	25.93	30	Pass

Notes:

1. Directional gain = gain of antenna element + 10 log (2 of TX antenna elements)
2. The directional gain is 8.1 dBi

802.11ac (VHT80)

Chan.	Chan. Freq. (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)	Directional Gain (dBi)	EIRP (mW)	EIRP (dBm)	EIRP Limit (dBm)	Test Result
		Chain 0	Chain 1							
171	5855	13.84	14.71	53.79	17.31	8.10	347.536	25.41	30	Pass

Notes:

1. Directional gain = gain of antenna element + 10 log (2 of TX antenna elements)
2. The directional gain is 8.1 dBi

802.11ac (VHT160)

Chan.	Chan. Freq. (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)	Directional Gain (dBi)	EIRP (mW)	EIRP (dBm)	EIRP Limit (dBm)	Test Result
		Chain 0	Chain 1							
163	5815	12.68	13.47	40.768	16.10	8.10	263.027	24.2	30	Pass

Notes:

1. Directional gain = gain of antenna element + 10 log (2 of TX antenna elements)
2. The directional gain is 8.1 dBi

802.11ax (HE20)

Chan.	Chan. Freq. (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)	Directional Gain (dBi)	EIRP (mW)	EIRP (dBm)	EIRP Limit (dBm)	Test Result
		Chain 0	Chain 1							
169	5845	12.62	13.46	40.463	16.07	8.10	261.216	24.17	30	Pass
173	5865	12.64	13.67	41.646	16.20	8.10	269.153	24.3	30	Pass
177	5885	12.63	13.06	38.553	15.86	8.10	248.886	23.96	30	Pass

Notes:

1. Directional gain = gain of antenna element + 10 log (2 of TX antenna elements)
2. The directional gain is 8.1 dBi

802.11ax (HE40)

Chan.	Chan. Freq. (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)	Directional Gain (dBi)	EIRP (mW)	EIRP (dBm)	EIRP Limit (dBm)	Test Result
		Chain 0	Chain 1							
167	5835	14.48	15.49	63.454	18.02	8.10	409.261	26.12	30	Pass
175	5875	14.45	15.44	62.856	17.98	8.10	405.509	26.08	30	Pass

Notes:

1. Directional gain = gain of antenna element + 10 log (2 of TX antenna elements)
2. The directional gain is 8.1 dBi

802.11ax (HE80)

Chan.	Chan. Freq. (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)	Directional Gain (dBi)	EIRP (mW)	EIRP (dBm)	EIRP Limit (dBm)	Test Result
		Chain 0	Chain 1							
171	5855	14.06	14.94	56.657	17.53	8.10	365.595	25.63	30	Pass

Notes:

1. Directional gain = gain of antenna element + 10 log (2 of TX antenna elements)
2. The directional gain is 8.1 dBi

802.11ax (HE160)

Chan.	Chan. Freq. (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)	Directional Gain (dBi)	EIRP (mW)	EIRP (dBm)	EIRP Limit (dBm)	Test Result
		Chain 0	Chain 1							
163	5815	12.95	13.75	43.438	16.38	8.10	280.543	24.48	30	Pass

Notes:

1. Directional gain = gain of antenna element + 10 log (2 of TX antenna elements)
2. The directional gain is 8.1 dBi

802.11ax (HE20) RU26

Chan.	Chan. Freq. (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)	Directional Gain (dBi)	EIRP (mW)	EIRP (dBm)	EIRP Limit (dBm)	Test Result
		Chain 0	Chain 1							
169	5845	5.52	6.39	7.92	8.99	8.10	51.168	17.09	30	Pass
173	5865	5.31	6.58	7.946	9.00	8.10	51.286	17.1	30	Pass
177	5885	5.09	6.56	7.757	8.90	8.10	50.119	17	30	Pass

Notes:

1. Directional gain = gain of antenna element + 10 log (2 of TX antenna elements)
2. The directional gain is 8.1 dBi

802.11ax (HE20) RU52

Chan.	Chan. Freq. (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)	Directional Gain (dBi)	EIRP (mW)	EIRP (dBm)	EIRP Limit (dBm)	Test Result
		Chain 0	Chain 1							
169	5845	8.76	9.12	15.682	11.95	8.10	101.158	20.05	30	Pass
173	5865	8.22	9.61	15.779	11.98	8.10	101.859	20.08	30	Pass
177	5885	8.39	9.08	14.993	11.76	8.10	96.828	19.86	30	Pass

Notes:

1. Directional gain = gain of antenna element + 10 log (2 of TX antenna elements)
2. The directional gain is 8.1 dBi

802.11ax (HE20) RU106

Chan.	Chan. Freq. (MHz)	Average Power (dBm)		Total Power (mW)	Total Power (dBm)	Directional Gain (dBi)	EIRP (mW)	EIRP (dBm)	EIRP Limit (dBm)	Test Result
		Chain 0	Chain 1							
169	5845	11.21	12.18	29.733	14.73	8.10	191.867	22.83	30	Pass
173	5865	11.16	12.12	29.355	14.68	8.10	189.671	22.78	30	Pass
177	5885	11.81	12.20	31.766	15.02	8.10	205.116	23.12	30	Pass

Notes:

1. Directional gain = gain of antenna element + 10 log (2 of TX antenna elements)
2. The directional gain is 8.1 dBi

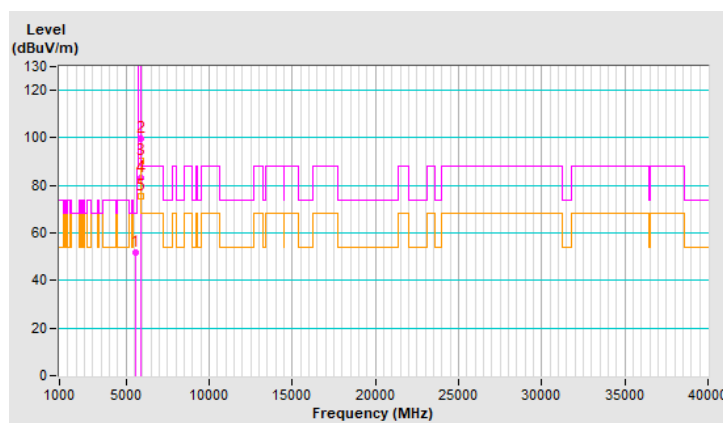
7.2 Unwanted Emissions above 1 GHz

RF Mode	802.11ax (HE20)	Channel	CH 177 : 5885 MHz
Frequency Range	1 GHz ~ 40 GHz	Detector Function & Bandwidth	(PK) RB = 1 MHz, VB = 3 MHz (AV) RB = 1 MHz, VB = 10 Hz
Input Power (System)	120 Vac, 60 Hz	Environmental Conditions	23°C, 70% RH
Tested By	Ryan Du		

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	#5606.67	51.6 PK	68.2	-16.6	1.00 H	195	46.7	4.9
2	*5885.00	99.9 PK			1.00 H	195	94.4	5.5
3	*5885.00	90.3 AV			1.00 H	195	84.8	5.5
4	#5895.00	83.3 PK	110.2	-26.9	1.00 H	195	77.8	5.5
5	#5895.00	75.4 AV	90.2	-14.8	1.00 H	195	69.9	5.5

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency, the limit was restricted at the RF Output Power.
6. " # ": The radiated frequency is out of the restricted band.

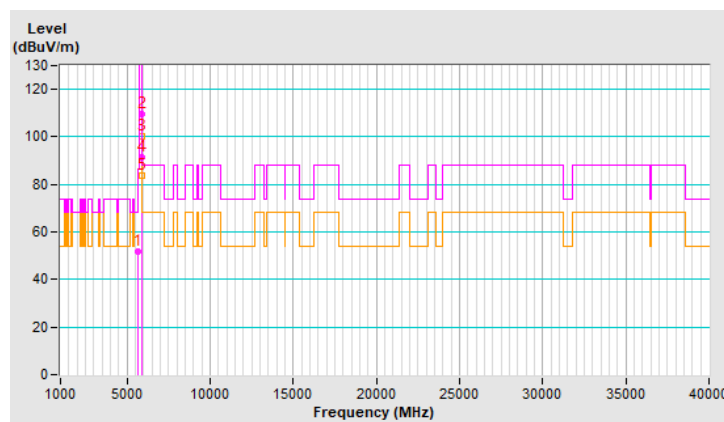


RF Mode	802.11ax (HE20)	Channel	CH 177 : 5885 MHz
Frequency Range	1 GHz ~ 40 GHz	Detector Function & Bandwidth	(PK) RB = 1 MHz, VB = 3 MHz (AV) RB = 1 MHz, VB = 10 Hz
Input Power (System)	120 Vac, 60 Hz	Environmental Conditions	23°C, 70% RH
Tested By	Ryan Du		

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	#5650.00	52.0 PK	68.2	-16.2	1.12 V	113	46.9	5.1
2	*5885.00	109.7 PK			1.12 V	113	104.2	5.5
3	*5885.00	100.0 AV			1.12 V	113	94.5	5.5
4	#5895.00	91.6 PK	110.2	-18.6	1.12 V	113	86.1	5.5
5	#5895.00	83.6 AV	90.2	-6.6	1.12 V	113	78.1	5.5

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * " : Fundamental frequency, the limit was restricted at the RF Output Power.
6. " # " : The radiated frequency is out of the restricted band.

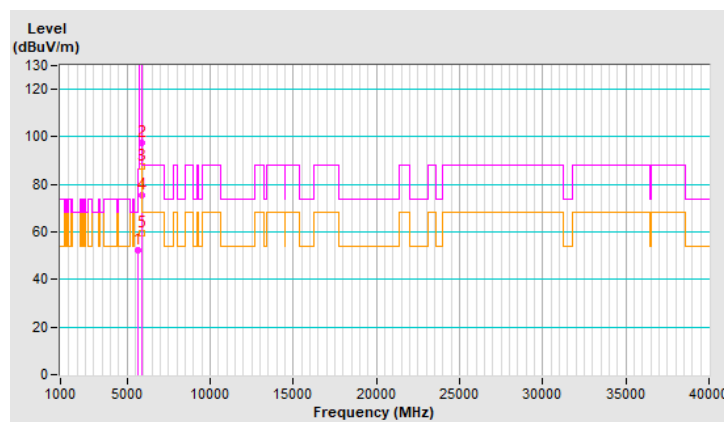


RF Mode	802.11ax (HE40)	Channel	CH 175 : 5875 MHz
Frequency Range	1 GHz ~ 40 GHz	Detector Function & Bandwidth	(PK) RB = 1 MHz, VB = 3 MHz (AV) RB = 1 MHz, VB = 10 Hz
Input Power (System)	120 Vac, 60 Hz	Environmental Conditions	23°C, 70% RH
Tested By	Ryan Du		

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	#5619.44	52.2 PK	68.2	-16.0	1.00 H	192	47.3	4.9
2	*5875.00	97.6 PK			1.00 H	192	92.1	5.5
3	*5875.00	87.5 AV			1.00 H	192	82.0	5.5
4	#5895.00	75.2 PK	110.2	-35.0	1.00 H	192	69.7	5.5
5	#5895.00	59.6 AV	90.2	-30.6	1.00 H	192	54.1	5.5

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * " : Fundamental frequency, the limit was restricted at the RF Output Power.
6. " # " : The radiated frequency is out of the restricted band.

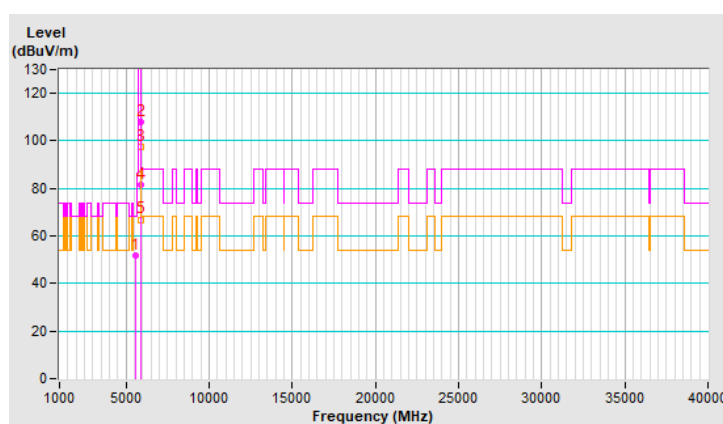


RF Mode	802.11ax (HE40)	Channel	CH 175 : 5875 MHz
Frequency Range	1 GHz ~ 40 GHz	Detector Function & Bandwidth	(PK) RB = 1 MHz, VB = 3 MHz (AV) RB = 1 MHz, VB = 10 Hz
Input Power (System)	120 Vac, 60 Hz	Environmental Conditions	23°C, 70% RH
Tested By	Ryan Du		

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	#5612.84	51.7 PK	68.2	-16.5	2.25 V	212	46.8	4.9
2	*5875.00	107.9 PK			2.25 V	212	102.4	5.5
3	*5875.00	97.3 AV			2.25 V	212	91.8	5.5
4	#5895.00	81.7 PK	110.2	-28.5	2.25 V	212	76.2	5.5
5	#5895.00	66.9 AV	90.2	-23.3	2.25 V	212	61.4	5.5

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * " : Fundamental frequency, the limit was restricted at the RF Output Power.
6. " # " : The radiated frequency is out of the restricted band.

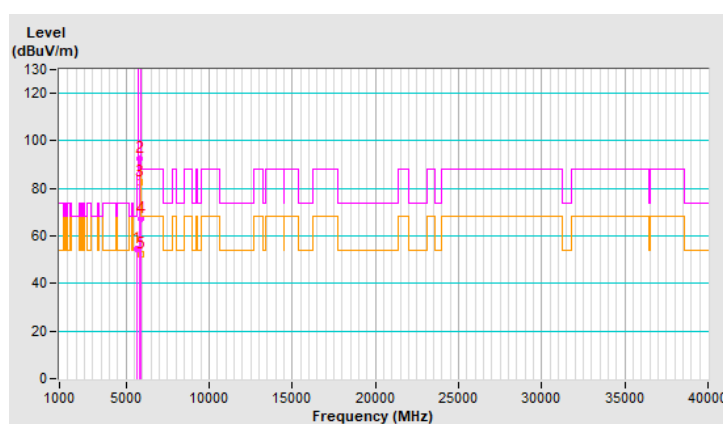


RF Mode	802.11ax (HE160)	Channel	CH 163 : 5815 MHz
Frequency Range	1 GHz ~ 40 GHz	Detector Function & Bandwidth	(PK) RB = 1 MHz, VB = 3 MHz (AV) RB = 1 MHz, VB = 10 Hz
Input Power (System)	120 Vac, 60 Hz	Environmental Conditions	23°C, 70% RH
Tested By	Ryan Du		

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	#5643.72	54.5 PK	68.2	-13.7	1.02 H	193	49.5	5.0
2	*5815.00	92.5 PK			1.02 H	193	87.2	5.3
3	*5815.00	82.7 AV			1.02 H	193	77.4	5.3
4	#5895.00	67.0 PK	110.2	-43.2	1.02 H	193	61.5	5.5
5	#5895.00	52.3 AV	90.2	-37.9	1.02 H	193	46.8	5.5

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency, the limit was restricted at the RF Output Power.
6. " # ": The radiated frequency is out of the restricted band.

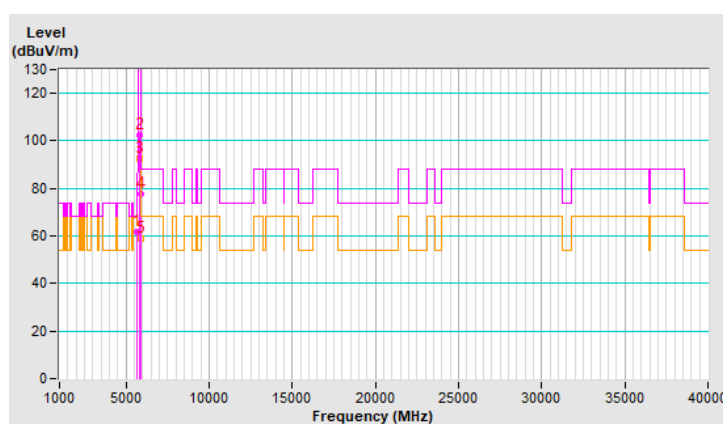


RF Mode	802.11ax (HE160)	Channel	CH 163 : 5815 MHz
Frequency Range	1 GHz ~ 40 GHz	Detector Function & Bandwidth	(PK) RB = 1 MHz, VB = 3 MHz (AV) RB = 1 MHz, VB = 10 Hz
Input Power (System)	120 Vac, 60 Hz	Environmental Conditions	23°C, 70% RH
Tested By	Ryan Du		

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	#5650.00	61.5 PK	68.2	-6.7	2.15 V	92	56.4	5.1
2	*5815.00	102.2 PK			2.15 V	92	96.9	5.3
3	*5815.00	92.4 AV			2.15 V	92	87.1	5.3
4	#5895.00	77.5 PK	110.2	-32.7	2.15 V	92	72.0	5.5
5	#5895.00	58.9 AV	90.2	-31.3	2.15 V	92	53.4	5.5

Remarks:

1. Emission Level(dBuV/m) = Raw Value(dBuV) + Correction Factor(dB/m)
2. Correction Factor(dB/m) = Antenna Factor(dB/m) + Cable Factor(dB) – Pre-Amplifier Factor(dB)
3. Margin value = Emission Level – Limit value
4. The other emission levels were very low against the limit.
5. " * ": Fundamental frequency, the limit was restricted at the RF Output Power.
6. " # ": The radiated frequency is out of the restricted band.

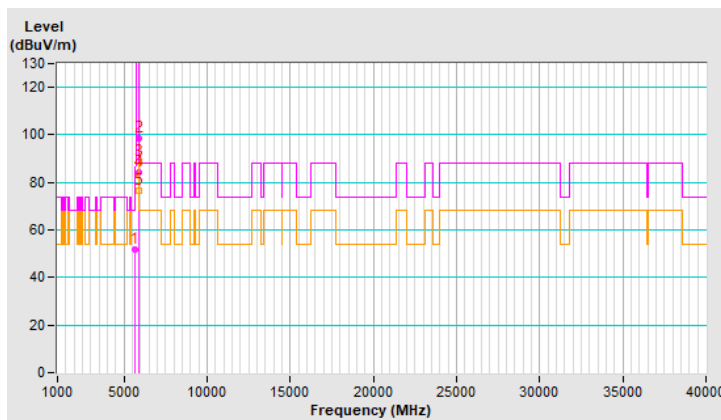


RF Mode	20 MHz Preamble 802.11ax (RU106)	Channel	CH 177 : 5885 MHz
Frequency Range	1 GHz ~ 40 GHz	Detector Function & Bandwidth	(PK) RB = 1 MHz, VB = 3 MHz (AV) RB = 1 MHz, VB = 10 Hz
Input Power (System)	120 Vac, 60 Hz	Environmental Conditions	23°C, 70% RH
Tested By	Ryan Du		

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	#5648.36	51.9 PK	68.2	-16.3	1.05 H	201	48.9	3.0
2	*5885.00	98.7 PK			1.00 H	195	95.3	3.4
3	*5885.00	88.5 AV			1.00 H	195	85.1	3.4
4	#5895.00	84.5 PK	110.2	-25.7	1.05 H	201	81.1	3.4
5	#5895.00	76.4 AV	90.2	-13.8	1.05 H	201	73.0	3.4

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

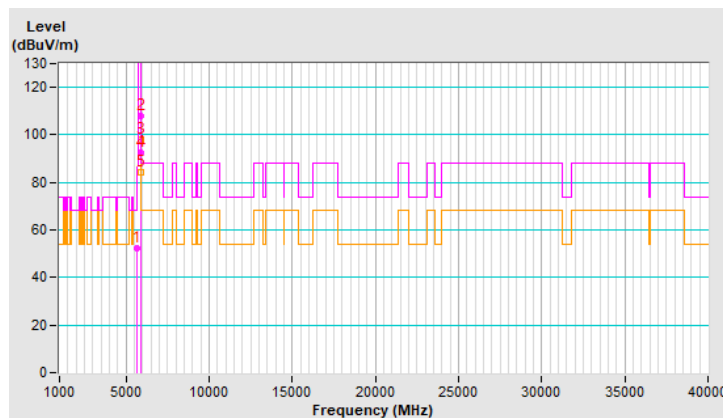


RF Mode	20 MHz Preamble 802.11ax (RU106)	Channel	CH 177 : 5885 MHz
Frequency Range	1 GHz ~ 40 GHz	Detector Function & Bandwidth	(PK) RB = 1 MHz, VB = 3 MHz (AV) RB = 1 MHz, VB = 10 Hz
Input Power (System)	120 Vac, 60 Hz	Environmental Conditions	23°C, 70% RH
Tested By	Ryan Du		

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	#5649.01	52.3 PK	68.2	-15.9	1.23 V	119	49.3	3.0
2	*5885.00	107.9 PK			1.12 V	113	104.5	3.4
3	*5885.00	98.2 AV			1.12 V	113	94.8	3.4
4	#5895.00	92.3 PK	110.2	-17.9	1.23 V	119	88.9	3.4
5	#5895.00	84.2 AV	90.2	-6.0	1.23 V	119	80.8	3.4

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



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.

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

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Web Site: <http://ee.bureauveritas.com.tw>

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

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