



Test report No. : 4789507582-US-R6-V0
Page : 1 of 34
Issued date : Dec. 17, 2020
FCC ID : 2AWKZ-QCNFA324

CO-LOCATION RADIO TEST REPORT

Product : 2x2 802.11 A/B/G/N/AC WIFI+ Bluetooth Module

Model Name : QCNFA324

FCC ID : 2AWKZ-QCNFA324

Test Regulation : FCC 47 CFR PART 15 Supât C (Section 15.247)
FCC 47 CFR PART 15 Subpart E (Section 15.407)
FCC 47 CFR PART 22H, 24E, 27

Received Date : Jun. 9, 2020

Test Date : Nov. 10, 2020 ~ Nov. 12, 2020

Issued Date : Dec. 17, 2020

Applicant : ENLI INCORPORATION
4F., No. 42, Aly. 5, Ln. 12, Sec. 3, Bade Rd., Songshan
Dist., Taipei 10559, Taiwan

Issued By : Underwriters Laboratories Taiwan Co., Ltd.
Building B and Building E, No. 372-7, Sec. 4, Zhongxing
Rd., Zhudong Township, Hsinchu County, Taiwan



The results reported herein have been performed in accordance with the laboratory's terms of accreditation. This report shall not be reproduced except in full without the written approval of the Laboratory. The results in this report are responsible of the test sample(s) provided by the client only and are not to be used to indicate applicability to other similar products.

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Test report No. : 4789507582-US-R6-V0
Page : 2 of 34
Issued date : Dec. 17, 2020
FCC ID : 2AWKZ-QCNFA324

REVISION HISTORY

Original Test Report No.: 4789507582-US-R6-V0

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Building B and Building E, P.O. 5727,
Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Table Of Contents

1. Attestation of Test Results	4
2. Summary of Test Results	5
3. Test Methodology and Reference Procedures.....	6
4. Facilities and Accreditation.....	6
5. Measurement Uncertainty	7
6. Equipment under Test	8
6.1. Description of EUT	8
6.2. Test Condition.....	11
6.3. Description Of Available Antennas	11
6.4. Test Mode Applicability and Tested Channel Detail.....	12
7. Test Equipment.....	13
8. Description of Test Setup.....	15
9. Test Results.....	16
9.1. Radiated Spurious Emission	16
9.2. AC Power Line Conducted Emission	28
Appendix I Radiated Spurious Emission Measurement.....	34

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Test report No. : 4789507582-US-R6-V0
Page : 4 of 34
Issued date : Dec. 17, 2020
FCC ID : 2AWKZ-QCNFA324

1. Attestation of Test Results

APPLICANT: ENLI INCORPORATION
4F., No. 42, Aly. 5, Ln. 12, Sec. 3, Bade Rd., Songshan Dist.,
Taipei 10559, Taiwan

MANUFACTURER ENLI INCORPORATION
4F., No. 42, Aly. 5, Ln. 12, Sec. 3, Bade Rd., Songshan Dist.,
Taipei 10559, Taiwan

EUT DESCRIPTION: 2x2 802.11 A/B/G/N/AC WIFI+ Bluetooth Module

BRAND: ENLI

MODEL: QCNFA324

SAMPLE STAGE: Identical Prototype

DATE of TESTED: Nov. 10, 2020 ~ Nov. 12, 2020

APPLICABLE STANDARDS

STANDARD

FCC 47 CFR PART 15 Subpart C (Section 15.247)

FCC 47 CFR PART 15 Subpart E (Section 15.407)

FCC 47 CFR PART 22H, 24E, 27

Underwriters Laboratories Taiwan Co., Ltd. tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by Underwriters Laboratories Taiwan Co., Ltd. based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by Underwriters Laboratories Taiwan Co., Ltd. and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by Underwriters Laboratories Taiwan Co., Ltd. will constitute fraud and shall nullify the document. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government.

Prepared By:

Sally Lu
Project Handler

Date : Dec. 17, 2020

Approved and Authorized By:

Waternal Guan
Engineer

Date : Dec. 17, 2020

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Test report No. : 4789507582-US-R6-V0
Page : 5 of 34
Issued date : Dec. 17, 2020
FCC ID : 2AWKZ-QCNFA324

2. Summary of Test Results

Summary of Test Results		
FCC Clause	Test Items	Result
15.205 / 15.209 / 15.247(d) / 15.407(b) (1/2/3/4(i/ii)/6) / 2.1053 / 22.917 / 24.238 / 27.53	Radiated Spurious Emission	PASS
15.207 15.407(b)(6)	AC Power Conducted Emission	PASS

Note:

1. The Radiated Spurious Emissions test plots were recorded in Appendix I.

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

Facsimile (FAX) : +886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



3. Test Methodology and Reference Procedures

The tests documented in this report were performed in accordance with 47 CFR FCC Part 2, KDB558074 D01 Meas Guidance v05r02, KDB 789033 D02 General UNII Test Procedure New Rules v02r01, KDB 971168 D01 Power Meas License Digital Systems v03, KDB414788 D01 Radiated Test Site v01r01, ANSI C63.10-2013 ANSI C63.26-2015, ANSI/TIA-603-E and KDB 662911 D01 Multiple Transmitter Output v02r01.

4. Facilities and Accreditation

Test Location	Underwriters Laboratories Taiwan Co., Ltd.
Address	Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan
Accreditation Certificate	Underwriters Laboratories Taiwan Co., Ltd. is accredited by TAF, Laboratory Code 3398. The full scope of accreditation can be viewed at http://accreditation.taftw.org.tw/taf/public/basic/viewApplyItems.action?unitNo=3398

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

Facsimile (FAX) : +886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



5. Measurement Uncertainty

For statement of conformity, accuracy method (Section 8.2.4 and 8.2.5 of ISO Guide 98-4) was applied as decision rule for measurement in this test report.

The following uncertainties have been calculated to provide a confidence level of 95 % using a coverage factor k=2.

Test Item	Measurement Frequency Range	K	U(dB)
Conducted disturbance at mains terminals ports	0.15MHz ~ 30MHz	2	1.5
Radiated disturbance below 1 GHz	30MHz ~ 1GHz	2	5.4
Radiated disturbance above 1 GHz	1GHz ~ 40GHz	2	4.7

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



6. Equipment under Test

6.1. Description of EUT

Product	2x2 802.11 A/B/G/N/AC WIFI+ Bluetooth Module	
Brand Name	ENLI	
Model Name	QCNFA324	
Operating Frequency	BT EDR	2402MHz ~ 2480MHz
	5G WLAN	5180 ~ 5240 MHz, 5260 ~ 5320 MHz 5500 ~ 5700 MHz, 5745 ~ 5825 MHz
Modulation	BT EDR	GFSK, $\pi/4$ -DQPSK, 8DPSK
	5G WLAN	CCK, DQPSK, DBPSK for DSSS 256QAM, 64QAM, 16QAM, QPSK, BPSK for OFDM
Transfer Rate	BT EDR	Up to 3 Mbps
	5G WLAN	802.11a: up to 54 Mbps 802.11n: up to MCS15 802.11ac: up to MCS9

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Test report No. : 4789507582-US-R6-V0
Page : 9 of 34
Issued date : Dec. 17, 2020
FCC ID : 2AWKZ-QCNFA324

Number of Channel	5G WLAN 5180 ~ 5240 MHz	4 for 802.11a, 802.11n (HT20), 802.11ac (VHT20)
		2 for 802.11n (HT40), 802.11 ac (VHT40)
		1 for 802.11ac (VHT80)
	5G WLAN 5260 ~ 5320 MHz	4 for 802.11a, 802.11n (HT20), 802.11ac (VHT20)
		2 for 802.11n (HT40), 802.11 ac (VHT40)
		1 for 802.11ac (VHT80)
	5G WLAN 5500 ~ 5700 MHz	8 for 802.11a, 802.11n (HT20), 802.11ac (VHT20)
		3 for 802.11n (HT40), 802.11 ac (VHT40)
		1 for 802.11ac (VHT80)
	5G WLAN 5745 ~ 5825 MHz	5 for 802.11a, 802.11n (HT20), 802.11ac (VHT20)
		2 for 802.11n (HT40), 802.11 ac (VHT40)
		1 for 802.11ac (VHT80)
Normal Voltage	Bluetooth EDR	79
	Bluetooth LE	40
S/N	E4AAEA8A1CE1	
Software Version	N/A	

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Note:

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

Modulation Mode	Tx,Rx Function
802.11b	1TX,1RX
802.11g	1TX,1RX
802.11a	1TX,1RX
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

* The modulation and bandwidth are similar for 802.11n mode for HT20 / HT40 and 802.11ac mode for VHT20 / VHT40, therefore investigated worst case to representative mode in test report.

2. The EUT contains following accessory.

Product	Brand	Model	Ant. Type	Frequency Band (MHz)	Antenna Gain(dBi)
Ant 1	ANJIE Electronics	AEDQ4S-B0003	Dipole	2400 ~ 2500	5
				5150 ~ 5250	5.1
				5250 ~ 5350	5.1
				5470 ~ 5725	5.3
				5725 ~ 5850	5.3
Ant 2	ANJIE Electronics	AJDP2J-C0012	PIFA	2400 ~ 2500	3.62
				5150 ~ 5250	5
				5250 ~ 5350	5
				5470 ~ 5725	6
				5725 ~ 5850	5.8

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

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Test report No. : 4789507582-US-R6-V0
Page : 11 of 34
Issued date : Dec. 17, 2020
FCC ID : 2AWKZ-QCNFA324

6.2. Test Condition

Test Item	Test Site No.	Environmental Condition	Input Power	Test Date	Tested by
Radiated Spurious Emission	966-2	22~26°C / 62~68%RH	120Vac / 60 Hz	Nov. 10, 2020 ~ Nov. 12, 2020	Mike Cai
AC power Line Conducted Emission	SR1	23~25°C / 63~68%RH	120Vac / 60 Hz	Nov. 10, 2020 ~ Nov. 12, 2020	Mike Cai

FCC Test Firm Registration Number: 498077

6.3. Description Of Available Antennas

Ant. No.	Brand Name	Model Name	Ant. Type	Frequency Band (MHz)	Ant. Gain (dBi)
1	ANJIE Electronics	AEDQ4S-B0003	Dipole	2400 ~ 2500	5
				5150 ~ 5250	5.1
				5250 ~ 5350	5.1
				5470 ~ 5725	5.3
				5725 ~ 5850	5.3
2	ANJIE Electronics	AJDP2J-C0012	PIFA	2400 ~ 2500	3.62
				5150 ~ 5250	5
				5250 ~ 5350	5
				5470 ~ 5725	6
				5725 ~ 5850	5.8

Note: The above antenna information was provided from customer and for more detailed features description, please refer the manufacturer's specification or user's manual.

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



6.4. Test Mode Applicability and Tested Channel Detail

- The fundamental of the EUT was investigated in three orthogonal axes X-Y/Y-Z/-X-Z, it was determined that Y-Z axis was worst-case. Therefore, all final radiated testing was performed with the EUT in Y-Z axis.
- For below 30MHz testing, investigation was done on three antenna orientations (parallel, perpendicular, and ground-parallel), parallel and perpendicular are the worst orientations, therefore testing was performed on these two orientations only.
- For AC power line conducted emissions, the pre-scan has been determined by AC power 120Vac/60Hz (worst case)
- The radiated emission of the simultaneous operation (Bluetooth & 5GHz WLAN, Bluetooth & 2.4GHz WLAN) have been evaluated and no non-compliance found. For radiated emissions, the pre-scan has been determined by Bluetooth & 5GHz WLAN (worst case). The detail combinations of transmitters / frequencies / modes as below table.

Test item	Mode	Frequency Band (MHz)	Modulation Technology	Available Channel	Test Channel	Data Rate	Antenna Type	
Radiated Emissions	BT	2402-2480	GFSK	0 to 78	78+38	DH5	Dipole	
	802.11n (HT40)	5180-5240	OFDM	36 to 48		MCS0		
		5260-5320		52 to 64				
		5500-5720		100 to 144				
		5745-5825		149 to 165				
	BT	2402-2480	GFSK	0 to 78	78+140	DH5	PIFA	
	802.11n (HT20)	5180-5240	OFDM	36 to 48		MCS0		
		5260-5320		52 to 64				
		5500-5720		100 to 144				
		5745-5825		149 to 165				
AC Power Line Conducted Emission	BT	2402-2480	GFSK	0 to 78	78+38	DH5	Dipole	
	802.11n (HT40)	5180-5240	OFDM	36 to 48		MCS0		
		5260-5320		52 to 64				
		5500-5720		100 to 144				
		5745-5825		149 to 165				
	BT	2402-2480	GFSK	0 to 78	78+140	DH5	PIFA	
	802.11n (HT20)	5180-5240	OFDM	36 to 48		MCS0		
		5260-5320		52 to 64				
		5500-5720		100 to 144				
		5745-5825		149 to 165				

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



7. Test Equipment

Test Equipment List					
Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
Radiated Spurious Emission					
Spectrum Analyzer	Keysight	N9010A	MY56070827	Nov. 13, 2019	1 year
EMI Test Receiver	Rohde & Schwarz	ESR7	101754	Dec. 17, 2019	1 year
Loop Antenna	ETS lindgren	6502	00213440	Dec. 19, 2019	1 year
Trilog-Broadband Antenna with 5dB Attenuator	Schwarzbeck	VULB 9168 & N-6-05	774 & AT-N0538	Jan. 3, 2020	1 year
Trilog-Broadband Antenna with 5dB Attenuator	Schwarzbeck	VULB 9168 & N-6-05	773 & AT-N0539	Feb. 11, 2020	1 year
Horn Antenna (1-18 GHz)	Schwarzbeck	BBHA 9120 D	01690	Jan. 3, 2020	1 year
Horn Antenna (1-18 GHz)	Schwarzbeck	BBHA 9120 D	01686	Dec. 27, 2019	1 year
Horn Antenna (18-40 GHz)	Schwarzbeck	BBHA 9170	781	Dec. 27, 2019	1 year
Horn Antenna (18-40 GHz)	Schwarzbeck	BBHA 9170	759	Nov. 30, 2020	1 year
Preamplifier (30-1000 MHz)	EMCI	EMC330E	980405	Jun. 9, 2020	1 year
Preamplifier (1-18 GHz)	EMCI	EMC051835BE	980406	Feb. 4, 2020	1 year
Preamplifier (18-40GHz)	EMCI	EMC184040SEE	980426	May 19, 2020	1 year
Signal Generator	Keysight	N5173B	MY53271122	Jan. 14,2020	1 year
Cables	Hanyitek	K1K50-UP0264-K1K50-2500	170214-4 & 170425-2	Jul. 2, 2020	1 year
Cables	Hanyitek	K1K50-UP0264-K1K50-2500	170214-1 & 170214-2	Jan. 8, 2020	1 year

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Test report No. : 4789507582-US-R6-V0
Page : 14 of 34
Issued date : Dec. 17, 2020
FCC ID : 2AWKZ-QCNFA324

Test Equipment List					
Equipment	Manufacturer	Model No.	Serial No.	Cal. Date	Cal. Interval
AC power Line Conducted Emission					
EMI Test Receiver	Rohde & Schwarz	ESR7	101753	Nov. 19, 2019	1 year
Two-Line V-Network	Rohde & Schwarz	ENV216	102136	Aug. 19, 2020	1 year
Impuls-Begrenzer Pulse Limiter	Rohde & Schwarz	ESH3-Z2	102219-Qt	Aug. 12, 2020	1 year
Cables	HARBOUR INDUSTRIES	LL142	170205-5000-1	Feb. 5, 2020	1 year

UL Software		
Description	Name	Version
Radiated measurement	EZ_EMCA	1.1.4.2
AC power Line Conducted Emission	EZ_EMCA	1.1.4.2

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

Facsimile (FAX) : +886-3-583-7948

Doc No: 17-EM-F0876 / 5.0

8. Description of Test Setup

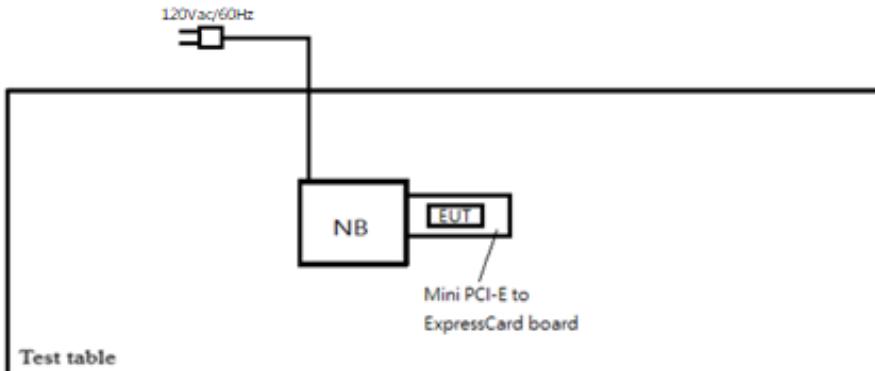
Support Equipment

Equipment	Brand Name	Model Name	S/N	Remark
Notebook	Lenovo	T430	PBE38AK	N/A
Mini PCI-E to ExpressCard board	N/A	N/A	N/A	N/A

Test Setup

Controlled using a bespoke application (QCARCT V3.0.203.0) on a test Notebook. The application was used to enable a continuous transmission mode and to select the test channels, data rates, modulation schemes and power setting as required.

Setup Diagram for Test



Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



9. Test Results

9.1. Radiated Spurious Emission

Requirements

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

Frequency(MHz)	Field strength (microvolts/meter)	Measurement distance (meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Note:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dB_uV/m) = 20 log Emission level (uV/m).
3. 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.

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Test report No. : 4789507582-US-R6-V0
Page : 17 of 34
Issued date : Dec. 17, 2020
FCC ID : 2AWKZ-QCNFA324

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	
Frequency Band	Applicable To	EIRP Limit	Equivalent Field Strength at 3m
5150~5250 MHz	15.407(b)(1)		
5250~5350 MHz	15.407(b)(2)	PK:-27 (dBm/MHz)	PK:68.2(dB μ V/m)
5470~5725 MHz	15.407(b)(3)		
5725~5850 MHz	15.407(b)(4)(i)	PK:-27 (dBm/MHz) ^{*1} PK:10 (dBm/MHz) ^{*2} PK:15.6 (dBm/MHz) ^{*3} PK:27 (dBm/MHz) ^{*4}	PK: 68.2(dB μ V/m) ^{*1} PK:105.2 (dB μ V/m) ^{*2} PK: 110.8(dB μ V/m) ^{*3} PK:122.2 (dB μ V/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:

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

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Test Procedures

[For 9 kHz ~ 30 MHz]

- a. The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter chamber room. 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. For measurement below 30MHz, the initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured. If the emission level of the EUT measured by the peak detector is lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

Note:

1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 9kHz at frequency below 30MHz.

[For above 30 MHz]

- 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. For measurement below 1GHz, the initial step in collecting conducted emission data is a spectrum analyzer peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured. If the emission level of the EUT measured by the peak detector is lower than the applicable limit, the peak emission level will be reported. Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.
- f. 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.

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

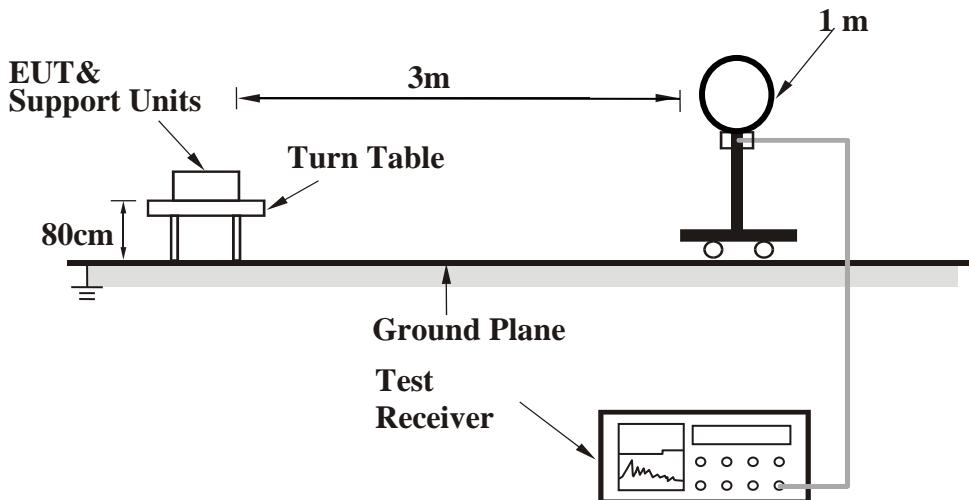
Doc No: 17-EM-F0876 / 5.0

Note:

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

Test Setup

<Frequency Range 9 kHz ~ 30 MHz>



Underwriters Laboratories Taiwan Co., Ltd.

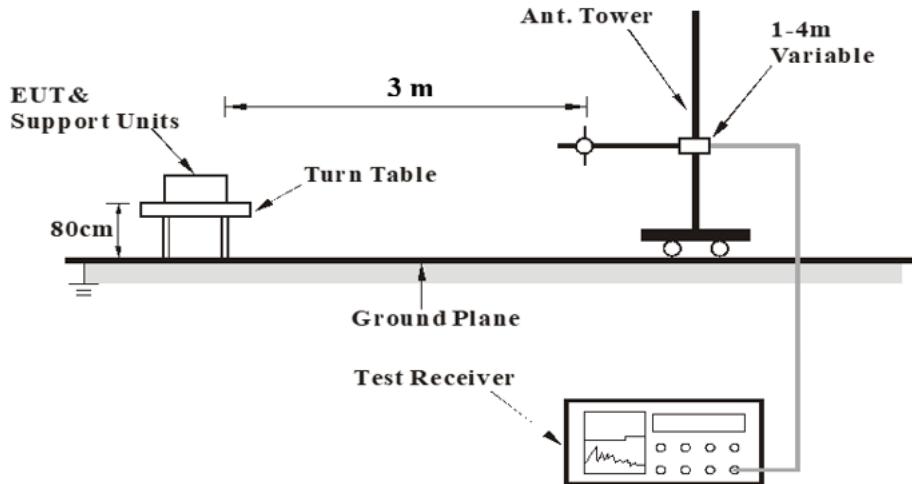
Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

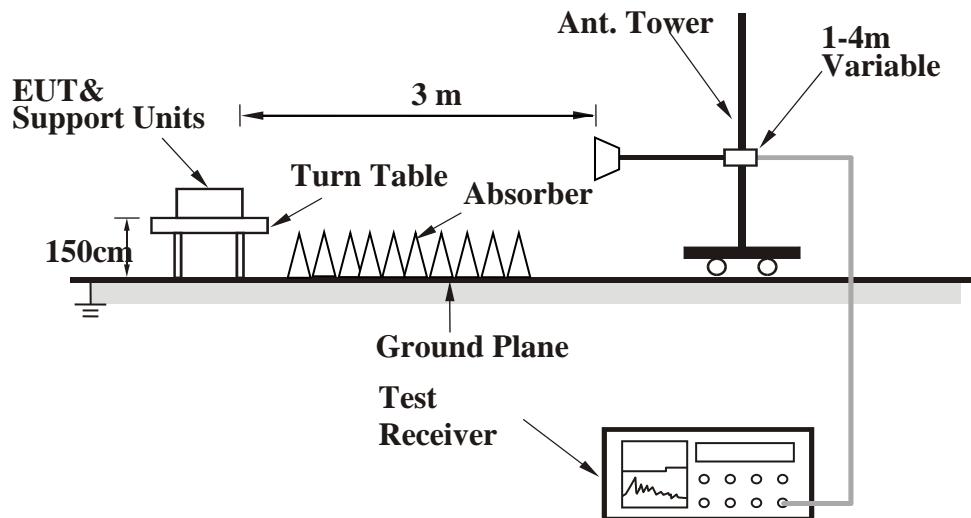
Facsimile (FAX) : +886-3-583-7948

Doc No: 17-EM-F0876 / 5.0

<Frequency Range 30 MHz ~ 1 GHz >



<Frequency Range above 1 GHz>



For the actual test configuration, please refer to the Setup Configurations.

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

Facsimile (FAX) : +886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Test report No. : 4789507582-US-R6-V0
Page : 21 of 34
Issued date : Dec. 17, 2020
FCC ID : 2AWKZ-QCNFA324

Test Data

Above 1GHz Data

Dipole Antenna

802.11n (HT40) + Bluetooth EDR

EUT Test Condition		Measurement Detail		
Channel	Channel 38 + Channel 78	Frequency Range	1 GHz ~ 40 GHz	

Antenna Polarity & Test Distance: Horizontal at 3 m							
Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
*	4960	45.56	3.75	49.31	74	-24.69	Peak
*	10380	27.59	18.99	46.58	68.2	-21.62	Peak
Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
*	4960	46.5	3.75	50.25	74	-23.75	Peak
*	10380	27.48	18.99	46.47	68.2	-21.73	Peak

Remarks:

1. Result value (dBuV/m) = Reading value (dBuV/m) + Correction Factor (dB/m).
2. Margin(dB) = Result value (dBuV/m) - Limit value (dBuV/m).
3. Correction Factor (dB/m) = Antenna Factor (dBuV/m) + Cable Loss (dB) - Preamp Factor (dB).
4. "@" : Fundamental Frequency.
5. "*" : The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
6. The other emission levels were very low against the limit.

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Test report No. : 4789507582-US-R6-V0
Page : 22 of 34
Issued date : Dec. 17, 2020
FCC ID : 2AWKZ-QCNFA324

PIFA Antenna

802.11n (HT20) + Bluetooth EDR

EUT Test Condition		Measurement Detail					
Channel	Channel 140 + Channel 78	Frequency Range		1 GHz ~ 40 GHz			

Antenna Polarity & Test Distance: Horizontal at 3 m							
Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
*	4960	42.11	3.75	45.86	74	-28.14	Peak
*	11400	28.32	20.5	48.82	74	-25.18	Peak

Antenna Polarity & Test Distance: Vertical at 3 m							
Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
*	4960	46.86	3.75	50.61	74	-23.39	Peak
*	11400	28.91	20.5	49.41	74	-24.59	Peak

Remarks:

1. Result value (dBuV/m) = Reading value (dBuV/m) + Correction Factor (dB/m).
2. Margin(dB) = Result value (dBuV/m) - Limit value (dBuV/m).
3. Correction Factor (dB/m) = Antenna Factor (dBuV/m) + Cable Loss (dB) - Preamp Factor (dB).
4. "@" : Fundamental Frequency.
5. "*" : The peak result complies with AVG limit, AVG result is deemed to comply with AVG limit.
6. The other emission levels were very low against the limit.

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

Facsimile (FAX) : +886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Test report No. : 4789507582-US-R6-V0
Page : 23 of 34
Issued date : Dec. 17, 2020
FCC ID : 2AWKZ-QCNFA324

9 kHz ~ 30 MHz Data:

For 9 kHz to 30 MHz radiated emission have performed all modes of operation were investigated. The amplitude of spurious emissions attenuated more than 20 dB below the permissible value is not required to be report.

No non-compliance noted:

KDB 414788 D01 OATS and Chamber Correlation Justification

- Base on FCC 15.31 (f) (2): measurements may be performed at a distance closer than that specified in the regulations; however, an attempt should be made to avoid making measurements in the near field.
- OATs and chamber correlation testing had been performed and chamber measured test results is the worst case test result.

Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30m open area test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

Facsimile (FAX) : +886-3-583-7948

Doc No: 17-EM-F0876 / 5.0

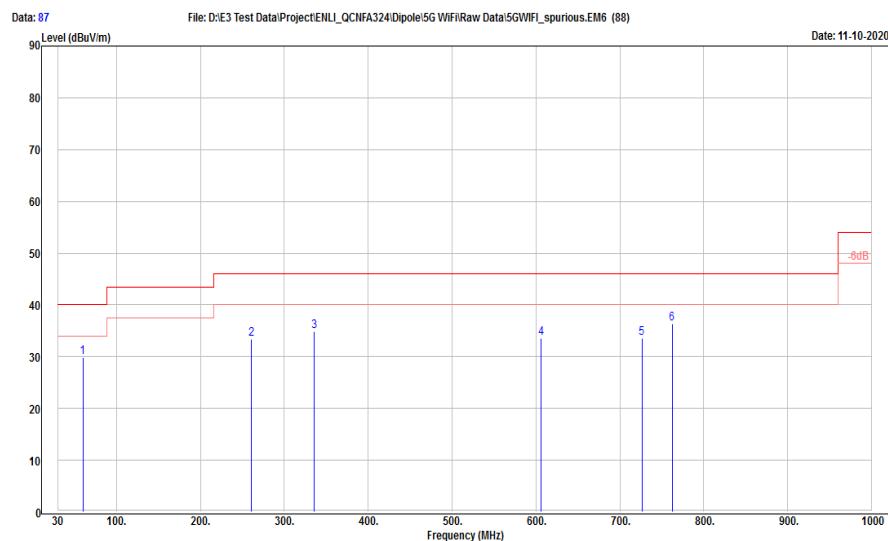
30 MHz ~ 1 GHz Data

Dipole Antenna

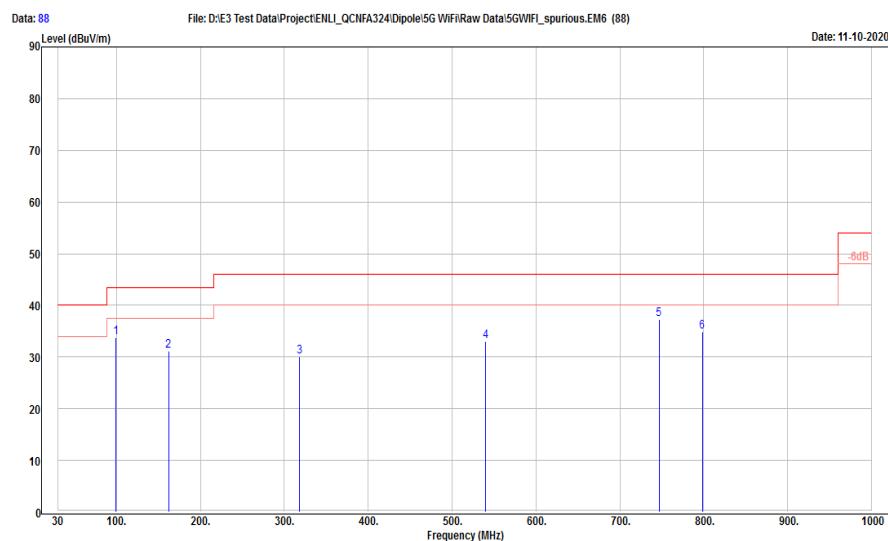
802.11n (HT40) + Bluetooth EDR

EUT Test Condition		Measurement Detail	
Channel	Channel 38 + Channel 78	Frequency Range	30 MHz ~ 1 GHz

Horizontal



Vertical



Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Antenna Polarity & Test Distance: Horizontal at 3 m							
Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
-	60.12	41.77	-11.93	29.84	40	-10.16	Peak
-	260.79	44.9	-11.43	33.47	46	-12.53	Peak
-	335.58	43.78	-8.95	34.83	46	-11.17	Peak
-	606.24	35.83	-2.22	33.61	46	-12.39	Peak
-	726.51	33.54	0.07	33.61	46	-12.39	Peak
-	762.46	35.52	0.94	36.46	46	-9.54	Peak

Antenna Polarity & Test Distance: Vertical at 3 m							
Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
-	99.13	50.21	-16.38	33.83	43.5	-9.67	Peak
-	162.04	42.19	-11.1	31.09	43.5	-12.41	Peak
-	318.09	39.39	-9.28	30.11	46	-15.89	Peak
-	540.22	36.33	-3.27	33.06	46	-12.94	Peak
-	746.86	36.72	0.66	37.38	46	-8.62	Peak
-	798.24	34.06	0.9	34.96	46	-11.04	Peak

Remarks:

1. Result value (dBuV/m) = Reading value (dBuV/m) + Correction Factor (dB/m).
2. Margin(dB) = Result value (dBuV/m) - Limit value (dBuV/m).
3. Correction Factor (dB/m) = Antenna Factor (dBuV/m) + Cable Loss (dB) - Preamp Factor (dB).
4. The peak result complies with QP limit, QP result is deemed to comply with QP limit.
5. The other emission levels were very low against the limit.

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



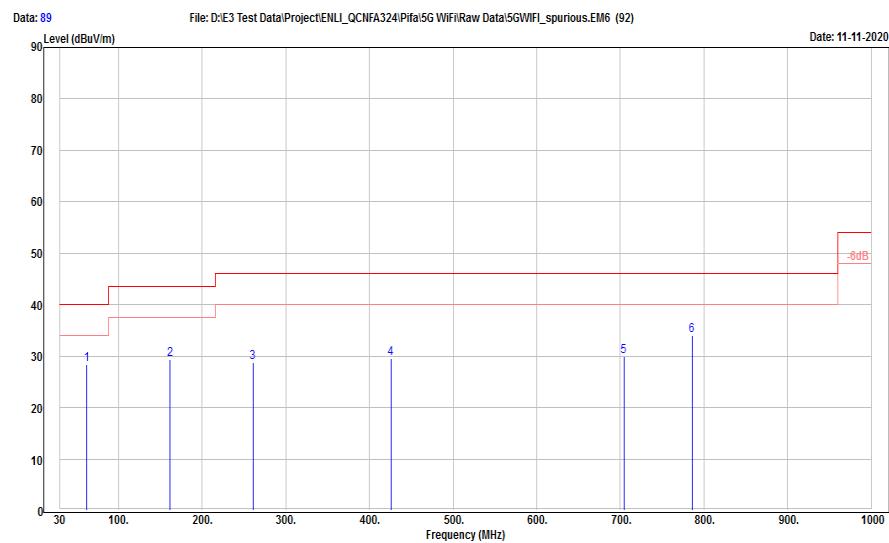
Test report No. : 4789507582-US-R6-V0
Page : 26 of 34
Issued date : Dec. 17, 2020
FCC ID : 2AWKZ-QCNFA324

PIFA Antenna

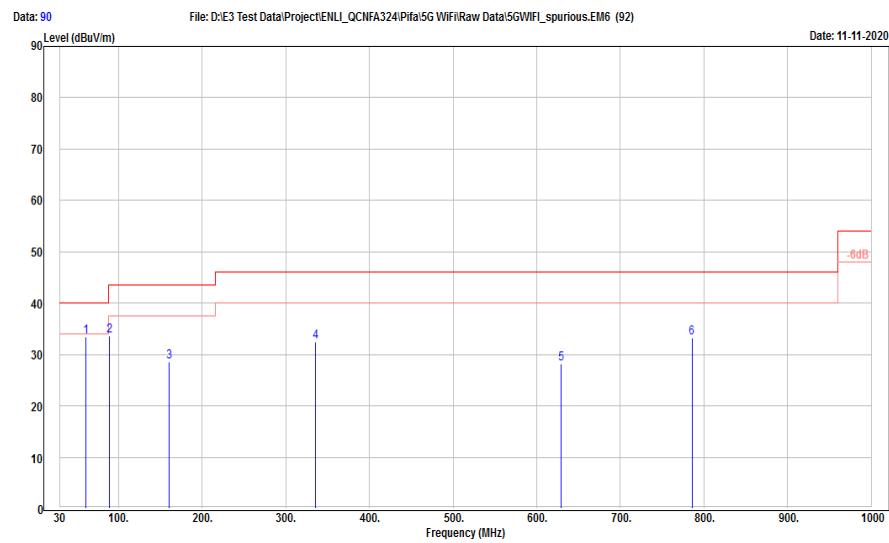
802.11n (HT40) + Bluetooth EDR

EUT Test Condition		Measurement Detail	
Channel	Channel 140 + Channel 78	Frequency Range	30 MHz ~ 1 GHz

Horizontal



Vertical



Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Antenna Polarity & Test Distance: Horizontal at 3 m							
Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
-	62.01	40.71	-12.3	28.41	40	-11.59	Peak
-	161.92	40.36	-11.1	29.26	43.5	-14.24	Peak
-	260.86	40.18	-11.43	28.75	46	-17.25	Peak
-	425.76	35.91	-6.35	29.56	46	-16.44	Peak
-	704.15	30.34	-0.4	29.94	46	-16.06	Peak
-	785.63	33.4	0.69	34.09	46	-11.91	Peak

Antenna Polarity & Test Distance: Vertical at 3 m							
Notation	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	dB/m	(dBuV/m)	(dBuV/m)	(dB)	
-	61.04	45.5	-12.12	33.38	40	-6.62	Peak
-	89.17	51.37	-17.68	33.69	43.5	-9.81	Peak
-	160.95	39.67	-11.11	28.56	43.5	-14.94	Peak
-	335.55	41.35	-8.95	32.4	46	-13.6	Peak
-	629.46	29.65	-1.41	28.24	46	-17.76	Peak
-	785.63	32.48	0.69	33.17	46	-12.83	Peak

Remarks:

1. Result value (dBuV/m) = Reading value (dBuV/m) + Correction Factor (dB/m).
2. Margin(dB) = Result value (dBuV/m) - Limit value (dBuV/m).
3. Correction Factor (dB/m) = Antenna Factor (dBuV/m) + Cable Loss (dB) - Preamp Factor (dB).
4. The peak result complies with QP limit, QP result is deemed to comply with QP limit.
5. The other emission levels were very low against the limit.

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



9.2. AC Power Line Conducted Emission

Requirements

Frequency (MHz)	Conducted limit (dB μ V)	
	Quasi-peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30	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.

Test Procedures

- a. 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.
- b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
- c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit - 20dB) was not recorded.

NOTE:

1. 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.

Underwriters Laboratories Taiwan Co., Ltd.

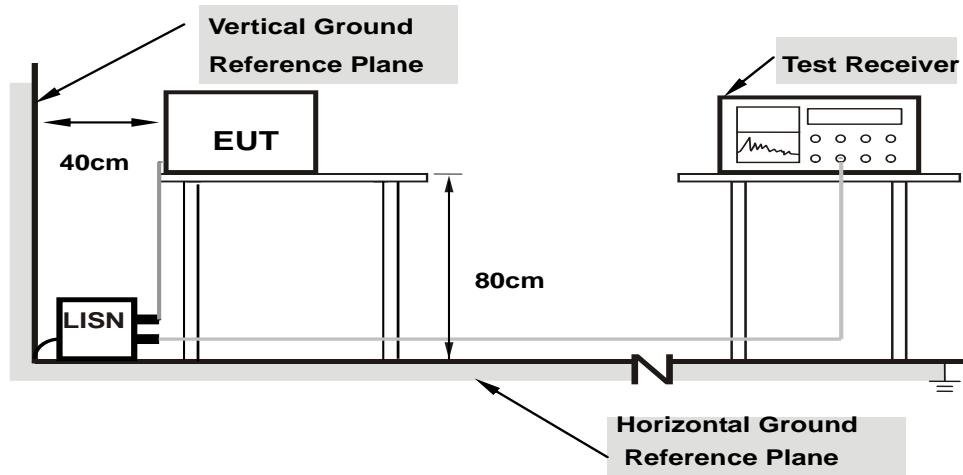
Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0

Test Setup



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

For the actual test configuration, please refer to the Setup Configurations.

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

Facsimile (FAX) : +886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



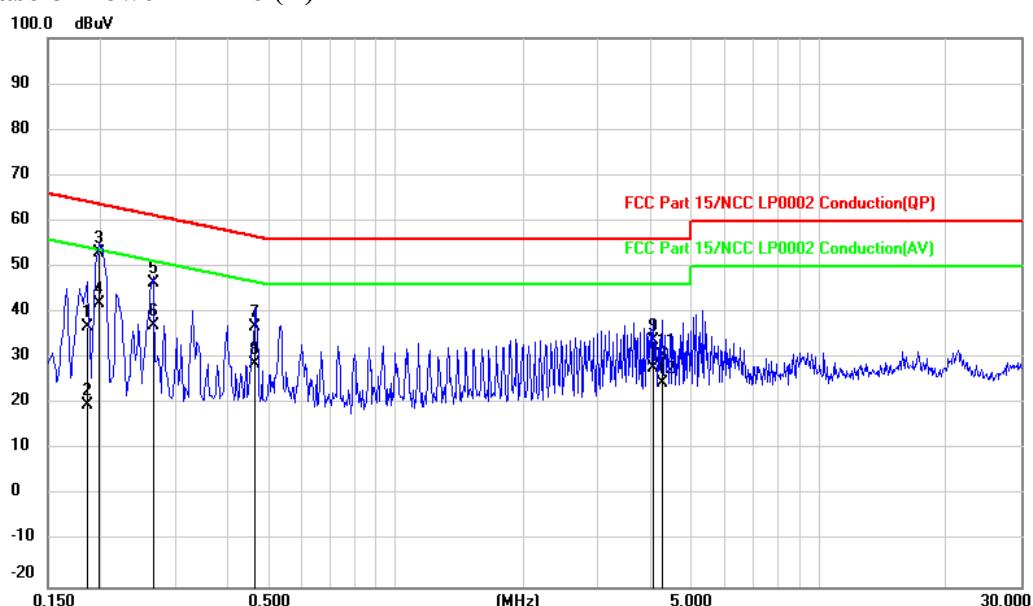
Test report No. : 4789507582-US-R6-V0
Page : 30 of 34
Issued date : Dec. 17, 2020
FCC ID : 2AWKZ-QCNFA324

Test Data

802.11n (HT40) + Bluetooth EDR

EUT Test Condition		Measurement Detail	
Channel	Channel 38 + Channel 78	Frequency Range	150 kHz ~ 30 MHz

Phase of Power : Line (L)



Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

Facsimile (FAX) : +886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	dB	(dBuV)	(dBuV)	(dB)	
1	0.1860	17.26	19.53	36.79	64.21	-27.42	QP
2	0.1860	0.17	19.53	19.70	54.21	-34.51	AVG
3	0.1980	33.59	19.53	53.12	63.69	-10.57	QP
4	0.1980	22.55	19.53	42.08	53.69	-11.61	AVG
5	0.2660	26.93	19.53	46.46	61.24	-14.78	QP
6	0.2660	17.59	19.53	37.12	51.24	-14.12	AVG
7	0.4660	17.31	19.51	36.82	56.58	-19.76	QP
8	0.4660	9.14	19.51	28.65	46.58	-17.93	AVG
9	4.0540	14.41	19.58	33.99	56.00	-22.01	QP
10	4.0540	8.24	19.58	27.82	46.00	-18.18	AVG
11	4.2540	11.11	19.58	30.69	56.00	-25.31	QP
12	4.2540	5.05	19.58	24.63	46.00	-21.37	AVG

Remarks:

1. Result value (dBuV) = Reading value (dBuV) + Correction Factor (dB)
2. Margin(dB) = Result value (dBuV) - Limit value (dBuV)
3. Correction Factor(dB) = Insertion loss(dB) + Cable loss(dB)
4. The other emission levels were very low against the limit.

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

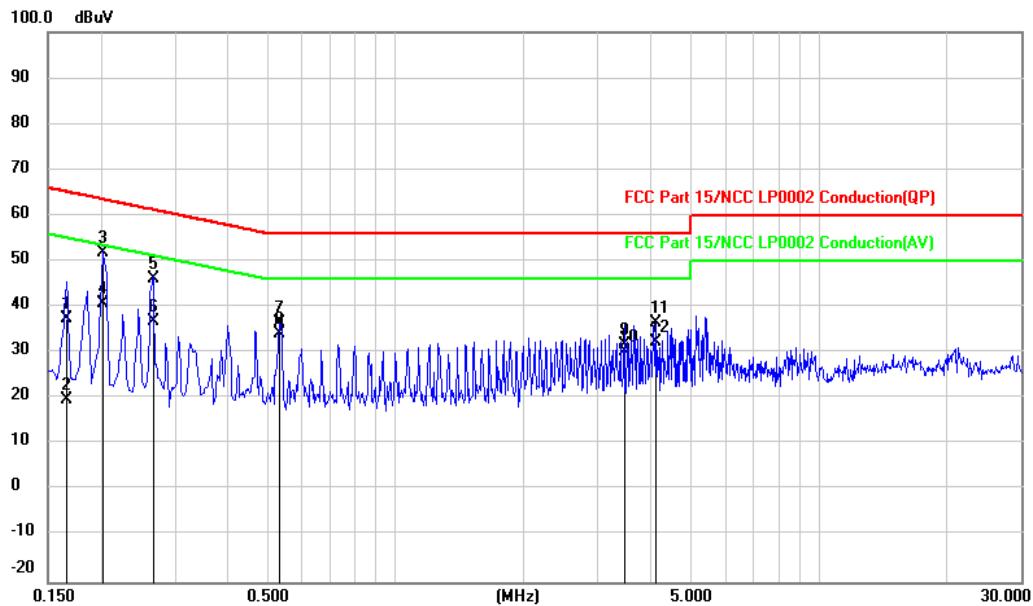
Facsimile (FAX) : +886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



Test report No. : 4789507582-US-R6-V0
Page : 32 of 34
Issued date : Dec. 17, 2020
FCC ID : 2AWKZ-QCNFA324

Phase of Power : Neutral (N)



Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone : +886-2-7737-3000

Facsimile (FAX) : +886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	dB	(dBuV)	(dBuV)	(dB)	
1	0.1660	17.90	19.54	37.44	65.16	-27.72	QP
2	0.1660	0.15	19.54	19.69	55.16	-35.47	AVG
3	0.2020	32.17	19.53	51.70	63.53	-11.83	QP
4	0.2020	21.16	19.53	40.69	53.53	-12.84	AVG
5	0.2660	26.66	19.53	46.19	61.24	-15.05	QP
6	0.2660	17.39	19.53	36.92	51.24	-14.32	AVG
7	0.5299	17.03	19.52	36.55	56.00	-19.45	QP
8	0.5299	14.52	19.52	34.04	46.00	-11.96	AVG
9	3.4580	12.33	19.56	31.89	56.00	-24.11	QP
10	3.4580	10.78	19.56	30.34	46.00	-15.66	AVG
11	4.1220	16.94	19.58	36.52	56.00	-19.48	QP
12	4.1220	12.90	19.58	32.48	46.00	-13.52	AVG

Remarks:

1. Result value (dBuV) = Reading value (dBuV) + Correction Factor (dB)
2. Margin(dB) = Result value (dBuV) - Limit value (dBuV)
3. Correction Factor(dB) = Insertion loss(dB) + Cable loss(dB)
4. The other emission levels were very low against the limit.

Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0



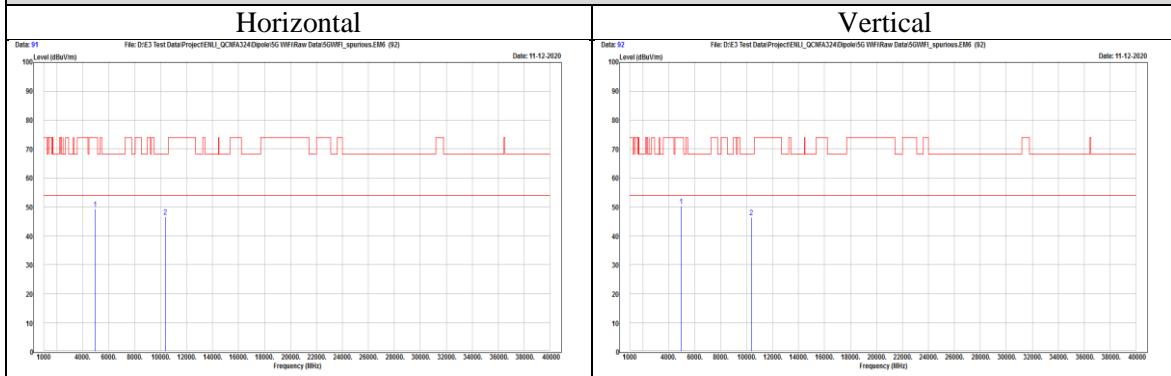
Test report No. : 4789507582-US-R6-V0
Page : 34 of 34
Issued date : Dec. 17, 2020
FCC ID : 2AWKZ-QCNFA324

Appendix I Radiated Spurious Emission Measurement

Dipole Antenna

802.11n (HT40) + Bluetooth EDR

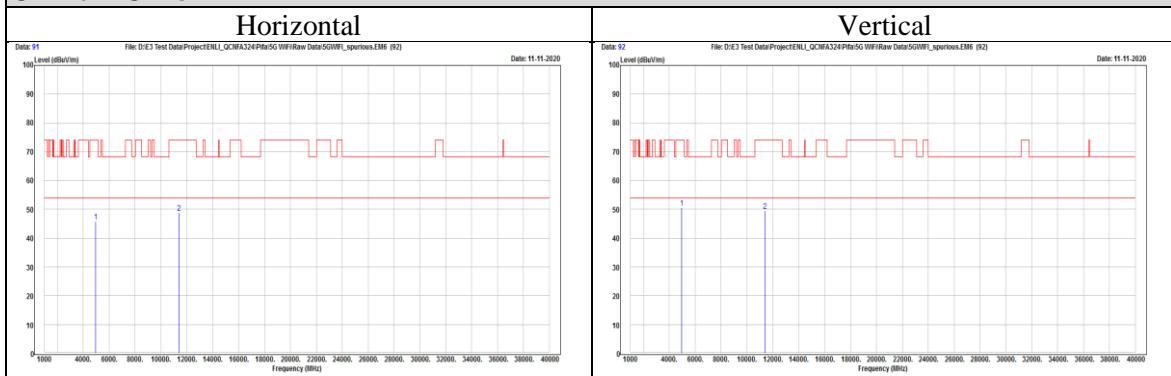
Ch38 + Ch78



PIFA Antenna

802.11n (HT20) + Bluetooth EDR

Ch140 + Ch78



Underwriters Laboratories Taiwan Co., Ltd.

Building B and Building E, No. 372-7, Sec. 4, Zhongxing Rd., Zhudong Township, Hsinchu County, Taiwan

Telephone :+886-2-7737-3000

Facsimile (FAX) :+886-3-583-7948

Doc No: 17-EM-F0876 / 5.0