Testing Laboratory 3787

RADIO EXPOSURE TEST REPORT

FCC ID	:	MSQ-RTAX5Q00
Equipment	:	Wireless-AX5700 Dual-band Gigabit Router
Brand Name	:	ASUS
Model Name	:	RT-AX86U Pro
Applicant	:	ASUSTeK COMPUTER INC. 1F., No. 15, Lide Rd., Beitou, Taipei City 112, Taiwan
Manufacturer (1)	:	Compal Networking(KunShan) CO., LTD No.520,Nan Bang RD., Economic & Technical Development Zone, KunShan,JiangSu,China
Manufacturer (2)	:	ARCADYAN TECHNOLOGY (VIETNAM) CO., LTD. Land plot No. D4-5-6, Thang Long Industrial Park (Vinh Phuc), Thien Ke Commune, Binh Xuyen District, Vinh Phuc Province, Vietnam
Standard	:	47 CFR Part 2.1091

The product was received on Mar. 17, 2022, and testing was started from Mar. 30, 2022 and completed on Aug. 17, 2022. We, Sporton International Inc. Hsinchu Laboratory, would like to declare that the tested sample has been evaluated in accordance with the procedures given in 47 CFR Part 2.1091 and shown compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International Inc. Hsinchu Laboratory, the test report shall not be reproduced except in full.

Approved by: Sam Chen

Sporton International Inc. Hsinchu Laboratory
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Photographs of EUT v01

History of this test report

Report No.	Version	Description	Issued Date
FA230333	01	Initial issue of report	Sep. 05, 2022

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
2	-	Exposure evaluation	PASS	-

Declaration of Conformity:
1. The test results with all measurement uncertainty excluded are presented in accordance with the regulation limits or requirements declared by manufacturers. It's means measurement values may risk exceeding the limit of regulation standards, if measurement uncertainty is include in test results. 2. The measurement uncertainty please refer to report "Measurement Uncertainty".
Comments and Explanations:
The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.

Reviewed by: Sam Chen

Report Producer: Viola Huang

1 General Description

1.1 EUT General Information

RF General Information			
Evaluation Mode	**Frequency Range (MHz)**	**Operating Frequency (MHz)**	**Modulation Type**
2.4GHz WLAN	2400-2483.5	2412-2462	802.11b: DSSS (DBPSK, DQPSK, CCK) 802.11g/n: OFDM (BPSK, QPSK, 16QAM, 64QAM) VHT: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM) 802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)
5GHz WLAN	5150-5250 5250-5350 5470-5725 5725-5850	5180-5250 5250-5320 5500-5720 5745-5825	802.11a/n: OFDM (BPSK, QPSK, 16QAM, 64QAM) 802.11ac: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM) 802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)

1.2 Antenna Information

Ant.	2.4GHz Port	5GHz Port	Brand	Model Name	Antenna Type	Connector	Gain (dBi)
1	3	3	M.gear	C660-510490-A	Metal Dipole Antenna	Reversed-SMA	Note 1
2	2	1	M.gear	C660-510490-A	Metal Dipole Antenna	Reversed-SMA	
3	1	4	M.gear	C660-510490-A	Metal Dipole Antenna	Reversed-SMA	
4	-	2	M.gear	C660-510579-A	PCB Antenna	I-PEX	

Note 1:

Ant.	Antenna Gain (dBi)				
	2.4GHz	UNII 1	UNII 2A	UNII 2C	UNII 3
1	1.66	1.9	1.9	1.9	1.9
2	1.66	1.9	1.9	1.9	1.9
3	1.66	1.9	1.9	1.9	1.9
4	-	3	3	3	3

Note 2: The above information was declared by manufacturer.

Note 3: The EUT has four antennas.

Note 4: Directional gain information

Type	Maximum Output Power	Power Spectral Density
Non-BF	Directional gain = Max.gain + array gain. For power measurements on IEEE 802.11 devices Array Gain = 0 dB (i.e., no array gain) for N ANT ≤ 4	$Directional\ Gain = 10 \cdot \log\left[\frac{\sum_{j=1}^{N_{sp}}\left\{\sum_{k=1}^{N_{ant}} g_{j,k}\right\}^2}{N_{ANT}}\right]$
BF	$Directional\ Gain = 10 \cdot \log\left[\frac{\sum_{j=1}^{N_{sp}}\left\{\sum_{k=1}^{N_{ant}} g_{j,k}\right\}^2}{N_{ANT}}\right]$	$Directional\ Gain = 10 \cdot \log\left[\frac{\sum_{j=1}^{N_{sp}}\left\{\sum_{k=1}^{N_{ant}} g_{j,k}\right\}^2}{N_{ANT}}\right]$

Ex.

Directional Gain (NSS1) formula : $Directional\ Gain = 10 \cdot \log\left[\frac{\sum_{j=1}^{N_{sp}}\left\{\sum_{k=1}^{N_{ant}} g_{j,k}\right\}^2}{N_{ANT}}\right]$

$NSS1(g1,1) = 10^{G1/20}$; $NSS1(g1,2) = 10^{G2/20}$; $NSS1(g1,2) = 10^{G3/20}$;

$gj,k = (Nss1(g1,1) + Nss1(g1,2) + Nss1(g1,3))^2$

$DG = 10 \log[(Nss1(g1,1) + Nss1(g1,2) + Nss1(g1,3))^2 / N_{ANT}] => 10 \log[(10^{G1/20} + 10^{G2/20} + 10^{G3/20})^2 / N_{ANT}]$

Where ;

G1 = 10 ; G2 = 10 ; G3 = 10 ; G4 = 10 ;

external dipole 3TX Vertical

internal PCB dipole 1TX Horizontal

Calculated using external dipole

2.4G G1 = 1.66 dBi; G2 = 1.66 dBi; G3 = 1.66 dBi; 3T1S DG = 6.43 dBi; 3T2S DG = 3.42 dBi

5G G1 = 1.9 dBi; G2 = 1.9 dBi; G3 = 1.9 dBi; 3T1S DG = 6.67 dBi; 3T2S DG = 4.91 dBi

For 2.4GHz function:
For IEEE 802.11 b/g/n/VHT/ax mode (3TX/3RX)
Port 1, Port 2 and Port 3 can be used as transmitting/receiving antenna.
Port 1, Port 2 and Port 3 could transmit/receive simultaneously.
For 5GHz function:
For IEEE 802.11a/n/ac/ax mode (4TX/4RX)
Port 1, Port 2, Port 3 and Port 4 can be used as transmitting/receiving antenna.
Port 1, Port 2, Port 3 and Port 4 could transmit/receive simultaneously.

1.3 Table for EUT supports function

Function	Supports type
AP Router	Master
Bridge	Client without radar detection
Repeater	Master
Mesh	Master

Note: The AP Router mode has been tested and recorded in this test report.

1.4 Accessories

Accessories			
Equipment Name	**Brand Name**	**Model Name**	**Rating**
Adapter 1	AcBel	ADH011	INPUT: 100-240V, 1.4A, 50-60Hz OUTPUT: 19.5V, 2.31A, 45.0W MAX
Adapter 2	AcBel	ADH011	INPUT: 100-240V, 1.4A, 50-60Hz OUTPUT: 19.5V, 2.31A, 45.0W MAX
Adapter 3	LEI	MU36D1120300-A1	INPUT: 100-240V, 50/60Hz, 1.0A OUTPUT: 12V, 3A
Adapter 4	APD	WA-36N12FU	INPUT: 100-240V, 50-60Hz, 0.9A Max OUTPUT: 12.0V, 3.0A
Adapter 5	LEI	MU36B1120300-A1	INPUT: 100-240V, 50/60Hz, 1A OUTPUT: 12V, 3A
Others			
RJ-45 cable*1, non-shielded, 1.5m			
Power cord*1, non-shielded, 0.9m (Only for adapter 1 and adapter 2 use)			

Note: The difference between Adapter 1 & Adapter 2 is only for difference agents, there is only adapter 1 tested and recorded in this report.

1.5 Applicable Standards

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- 47 CFR Part 2.1091
- KDB 447498 D04 Interim General RF Exposure Guidance v01

The following reference test guidance is not within the scope of accreditation of TAF.

- 47 CFR Part 1.1307
- 47 CFR Part 1.1310

1.6 Testing Location

Testing Location Information		
Test Lab.：Sporton International Inc. Hsinchu Laboratory		
Hsinchu	ADD: No.8, Ln. 724, Bo'ai St., Zhubei City, Hsinchu County 302010, Taiwan (R.O.C.)	
(TAF: 3787)	TEL: 886-3-656-9065	FAX: 886-3-656-9085
	Test site Designation No. TW3787 with FCC.	
	Conformity Assessment Body Identifier (CABID) TW3787 with ISED.	

2 Maximum Permissible Exposure

2.1 Limit of Maximum Permissible Exposure

(A) Limits for Occupational / Controlled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm²)	Averaging Time |E|²,|H|² or S (minutes)
0.3-3.0	614	1.63	*(100)	<6
3.0-30	1842/f	4.89/f	*(900/f²)	<6
30-300	61.4	0.163	1.0	<6
300-1500	-	-	f/300	<6
1500-100,000	-	-	5	<6

(B) Limits for General Population / Uncontrolled Exposure

Frequency Range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/ cm²)	Averaging Time |E|²,|H|² or S (minutes)
0.3-1.34	614	1.63	*(100)	<30
1.34-30	824/f	2.19/f	*(180/f²)	<30
30-300	27.5	0.073	0.2	<30
300-1500	-	-	f/1500	<30
1500-100,000	-	-	1.0	<30

Note: f = frequency in MHz ; *Plane-wave equivalent power density

2.2 MPE Calculation Method

The MPE was calculated at 51 cm to show compliance with the power density limit.

The following formula was used to calculate the Power Density:

E (V/m) = $\frac{\sqrt{30 \times P \times G}}{d}$ Power Density: *Pd* (W/m²) = $\frac{E^2}{377}$

E = Electric field (V/m)

P = RF output power (W)

G = EUT Antenna numeric gain (numeric)

d = Separation distance between radiator and human body (m)

The formula can be changed to

Pd = $\frac{30 \times P \times G}{377 \times d^2}$

2.3 MPE Exemption

Option (A): 1.1307(b)(3)(i)(A): Available maximum time-averaged power is < 1 mW

Option (B): 1.1307(b)(3)(i)(B): Device operates between 300 MHz and 6 GHz and the maximum time-averaged power or effective radiated power (ERP), whichever is greater, <= Pth.

$$P_{th}\ (\text{mW}) = \begin{cases} ERP_{20\ cm}(d/20\ \text{cm})^{x} & d \le 20\ \text{cm} \\ ERP_{20\ cm} & 20\ \text{cm} < d \le 40\ \text{cm} \end{cases}$$

Where

$$x = -\log_{10}\left(\frac{60}{ERP_{20\ cm}\sqrt{f}}\right) \text{ and } f \text{ is in GHz;}$$

and

$$ERP_{20\ cm}\ (\text{mW}) = \begin{cases} 2040f & 0.3\ \text{GHz} \le f < 1.5\ \text{GHz} \\ 3060 & 1.5\ \text{GHz} \le f \le 6\ \text{GHz} \end{cases}$$

d = the separation distance (cm);

Option (C): 1.1307(b)(3)(i)(C): ERP is below a threshold calculated based on the distance R between the person and the antenna / radiating structure, where R > λ / 2 π.

Single RF Sources Subject to Routine Environmental Evaluation	
RF Source frequency (MHz)	**Threshold ERP (watts)**
0.3-1.34	1,920 R^2.
1.34-30	3,450 R^2/f^2.
30-300	3.83 R^2.
300-1,500	0.0128 R^2f.
1,500-100,000	19.2R^2.
Note: R is in meters, f is in MHz.	

2.4 Calculated Result and Limit

Exposure Environment: General Population / Uncontrolled Exposure

Mode	DG (dBi)	Power (dBm)	EIRP (dBm)	Tolerance (dB)	Tune-up EIRP (dBm)	Tune-up EIRP (W)	Distance (cm)	S (mW/cm^2)	S Limit (mW/cm^2)
2.4G;D1D	6.43	29.54	35.97	0.02	35.99	3.97192	51	0.12152	1.00000
5.2G;D1D	6.67	29.31	35.98	0.01	35.99	3.97192	51	0.12152	1.00000
5.3G;D1D	6.67	23.28	29.95	0.04	29.99	0.99770	51	0.03052	1.00000
5.6G;D1D	6.67	23.29	29.96	0.03	29.99	0.99770	51	0.03052	1.00000
5.8G;D1D	6.67	29.31	35.98	0.01	35.99	3.97192	51	0.12152	1.00000

MPE Exemption Option C							
Frequency (MHz)	λ/2π (m)	R (m)	Tune-up EIRP (dBm)	Tune-up ERP (dBm)	Tune-up ERP (W)	ERP Threshold (W)	MPE Exemption
2437	0.0196	0.51	35.99	33.84	2.421	4.994	Complies
5745	0.0083		35.99	33.84	2.421	4.994	Complies

Simultaneous Transmission Analysis Mode: WLAN 2.4GHz + WLAN 5GHz

Simultaneous Transmissions Option C							
Frequency (MHz)	R (m)	Tune-up EIRP (dBm)	Tune-up ERP (dBm)	Tune-up ERP (W)	ERP Threshold (W)	Simultaneous Transmissions	Simultaneous Transmissions Limit
2437	0.5	35.99	33.84	2.421	4.994	0.97	<= 1
5745		35.99	33.84	2.421	4.994		

THE END