Testing Laboratory 3787

RADIO EXPOSURE TEST REPORT

FCC ID	:	MSQ-RTAX5D00
Equipment	:	ROG Rapture Quad-band Gaming Router
Brand Name	:	ASUS
Model Name	:	GT-AXE16000
Applicant	:	ASUSTeK COMPUTER INC. 1F., No. 15, Lide Rd., Beitou Dist., Taipei City 112, Taiwan
Standard	:	47 CFR Part 2.1091

The product was received on Aug. 16, 2023, and testing was started from Aug. 18, 2023 and completed on Mar. 04, 2024. 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 variant 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

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History of this test report

Report No.	Version	Description	Issued Date
FA1N0529-07	01	Initial issue of report	Apr. 01, 2024

Summary of Test Result

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

Conformity Assessment Condition:
1. The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacturer who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account. 2. The measurement uncertainty please refer to each test result in the chapter "Measurement Uncertainty".
Disclaimer:
The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.

Reviewed by: Sam Chen

Report Producer: Wendy Pan

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)
6GHz	5925-7125	5955-7025	802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024QAM)

1.2 Antenna Information

For EUT 5

Ant.	Port				Brand Name	Model Name	Antenna Type	Connector	Gain (dBi)
	WLAN 2.4GHz	WLAN 5GHz UNII 1& UNII 2A	WLAN 5GHz UNII 2C& UNII 3	WLAN 6GHz					
1	2	2	-	-	WALSIN	RFPCA311406IMLB901	PCB	I-PEX	Note2
2	1	1	-	-	WALSIN	RFDPA181121IMLB901	Dipole	I-PEX	
3	4	4	-	-	WALSIN	RFDPA181121IMLB902	Dipole	I-PEX	
4	3	3	-	-	WALSIN	RFDPA181105IMLB901	Dipole	I-PEX	
5	-	-	4	-	WALSIN	RFPCA191412IM5B901	PCB	I-PEX	
6	-	-	3	-	WALSIN	RFDPA181108IM5B901	Dipole	I-PEX	
7	-	-	2	-	WALSIN	RFDPA181119IM5B901	Dipole	I-PEX	
8	-	-	1	-	WALSIN	RFDPA181125IM5B901	Dipole	I-PEX	
9	-	-	-	4	WALSIN	RFPCA170920IM6B901	PCB	I-PEX	
10	-	-	-	3	WALSIN	RFPCA222024IMLB901	PCB	I-PEX	
11	-	-	-	2	WALSIN	RFDPA181119IM6B901	Dipole	I-PEX	
12	-	-	-	1	WALSIN	RFDPA181110IM6B901	Dipole	I-PEX	

Note1: The above information was declared by manufacturer.

Note2:

Mode 1: 2G5GL-external antenna Vertical

Band (MHz)	2400-2483.5	5150-5250	5250-5350
Frequency (Hz)	**2.45G**	**5.2G**	**5.3G**
Ant. 1 Max Gain (dBi)	2.46	3.34	3.41
Ant. 2 Max Gain (dBi)	2.3	4.72	3.84
Ant. 3 Max Gain (dBi)	3.43	3.61	3.43
Ant. 4 Max Gain (dBi)	2.12	4.5	4.7
DG [1SS] (dBi)	4.53	6.17	6.32
DG [2SS] (dBi)	3.43	4.72	4.7
DG [4SS] (dBi)	3.43	4.72	4.7

Mode 2: 2G5GL-external antenna Horizontal

Band (MHz)	2400-2483.5	5150-5250	5250-5350
Frequency (Hz)	**2.45G**	**5.2G**	**5.3G**
Ant. 1 Max Gain (dBi)	2.46	3.34	3.41
Ant. 2 Max Gain (dBi)	3.54	4.16	4.71
Ant. 3 Max Gain (dBi)	4.36	3.44	3.32
Ant. 4 Max Gain (dBi)	3.47	4.31	4.69
DG [1SS] (dBi)	5	4.76	4.75
DG [2SS] (dBi)	4.36	4.31	4.71
DG [4SS] (dBi)	4.36	4.31	4.71

Mode 3: 5GH-external antenna Vertical

Band (MHz)	5470-5725	5725-5850
Frequency (Hz)	**5.6G**	**5.785G**
Ant. 5 Max Gain (dBi)	2.56	1.18
Ant. 6 Max Gain (dBi)	4.83	4.59
Ant. 7 Max Gain (dBi)	4.4	4.62
Ant. 8 Max Gain (dBi)	3.82	3.91
DG [1SS] (dBi)	6.97	6.48
DG [2SS] (dBi)	4.83	4.62
DG [4SS] (dBi)	4.83	4.62

Mode 4: 5GH-external antenna Horizontal

Band (MHz)	5470-5725	5725-5850
Frequency (Hz)	**5.6G**	**5.785G**
Ant. 5 Max Gain (dBi)	2.56	1.18
Ant. 6 Max Gain (dBi)	4.84	4.77
Ant. 7 Max Gain (dBi)	3.62	4.56
Ant. 8 Max Gain (dBi)	4.15	4.12
DG [1SS] (dBi)	5.83	5.27
DG [2SS] (dBi)	4.84	4.77
DG [4SS] (dBi)	4.84	4.77

Mode 5: 6G-external antenna Vertical

Band (MHz)	6175	6475	6695	6995
Frequency (Hz)	**6.175G**	**6.475G**	**6.695G**	**6.995G**
Ant. 9 Max Gain (dBi)	3.1	3.04	2.87	2.01
Ant. 10 Max Gain (dBi)	2.8	2.63	3.57	4.12
Ant. 11 Max Gain (dBi)	4.49	3.97	4.38	4.34
Ant. 12 Max Gain (dBi)	4.65	3.76	4.1	4.29
DG [1SS] (dBi)	5.66	5.2	5.58	5.35
DG [2SS] (dBi)	4.65	3.97	4.38	4.34
DG [4SS] (dBi)	4.65	3.97	4.38	4.34

Mode 6: 6G-external antenna Horizontal

Band (MHz)	6175	6475	6695	6995
Frequency (Hz)	**6.175G**	**6.475G**	**6.695G**	**6.995G**
Ant. 9 Max Gain (dBi)	3.1	3.04	2.87	2.01
Ant. 10 Max Gain (dBi)	2.8	2.63	3.57	4.12
Ant. 11 Max Gain (dBi)	4.88	4.49	4.92	4.59
Ant. 12 Max Gain (dBi)	4.53	4.43	4.26	4.31
DG [1SS] (dBi)	4.99	4.63	4.64	4.41
DG [2SS] (dBi)	4.88	4.49	-	-
DG [4SS] (dBi)	4.88	4.49	-	-

Note3: The directional gain is measured which follows the procedure of KDB 662911 D03.
Only the highest gain antenna was selected from each different antenna mode of antenna to test and record in this report.

For 2.4GHz function:
For IEEE 802.11b/g/n/VHT/ax (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.
For 5GHz function:
For IEEE 802.11a/n/ac/ax (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.
For 6GHz function:
For IEEE 802.11ax (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 Components Source Information

Component	Main Source	Second Source
5G pre filter	Brand: Qorvo Model: QPQ1904	-
DDR4	Brand: SAMSUNG Density: 512MB	Brand: SAMSUNG Density: 1GB
Transformer of 1Gbps LAN	Brand: NETSWAP Model: NS777202	Brand: MINGTEK Model: HN8001VG
MLCC on the path of the CPU (Location: C124, C126, C127, C128)	Brand: WALSIN Model: 0201X104K160CT	Brand: TAIYO YUDEN Model: EMK063BJ104KP-F

Note: The above information was declared by manufacturer.

1.3.1 Table for EUT Information

EUT	5G pre filter	DDR4	Transformer of 1Gbps LAN	MLCC on the path of the CPU (Location: C124, C126, C127, C128)
EUT 1	Second Source	Main Source	Main Source	Main Source
EUT 2	Main Source	Main Source	Main Source	Main Source
EUT 3	Second Source	Second Source	Main Source	Main Source
EUT 4	Second Source	Second Source	Second Source	Main Source
EUT 5	Main Source	Second Source	Main Source	Second Source

Note: The above information was declared by manufacturer.

1.4 Table for EUT Supports Function

Function	Support Type	Remark
AP Router	Master	Support 2.4GHz/5GHz/6GHz
Bridge	Slave without radar detection	Support 2.4GHz/5GHz
Repeater	Master	Support 2.4GHz/5GHz
Mesh	Master	Support 2.4GHz/5GHz/6GHz

Note: The above information was declared by manufacturer.

1.5 Table for Permissive Change

This product is an extension of original one reported under Sporton project number: FA1N0529

Below is the table for the change of the product with respect to the original one.

Modifications	Performance Checking
1. Adding a second transformer source of 1Gbps LAN and combination as EUT 4. (Brand name: MINGTEK / Model name: HN8001VG) 2. Removing Manufacturer name and address. 3. Updating the Components Source information of main source (512MB) and Second source (1GB) for DDR4.	After evaluating, it does not affect the test.
4. Adding EUT 5, the difference with EUT 3 is the following: a. With 5G pre filter. b. Add the second source for MLCC on the path of the CPU (Location: C124, C126, C127, C128). c. Updating the measurement method of antenna gain for EUT 5. d. Revising the distance from "28cm" to "52cm" for EUT 5.	MPE

1.6 Accessories

Accessories				
Equipment Name	**Brand Name**	**Model Name**	**Rating**	**Remark**
Adapter 1	AcBel	ADD011	INPUT: 100-240V~ 1.7A, 50-60Hz OUTPUT: +19.5V, 3.33A, 65.0W MAX.	With the DC cable: Non-shielded, 1.5m
Adapter 2	AcBel	ADD011	INPUT: 100-240V~ 1.7A, 50-60Hz OUTPUT: +19.5V, 3.33A, 65.0W MAX.	With the DC cable: Non-shielded, 1.5m
Adapter 3	DELTA	ADP-65GD	INPUT: AC100-240V ~ 50-60Hz, 1.5A OUTPUT: +19V, 3.42A.	With the DC cable: Non-shielded, 1.8m
Adapter 4	DELTA	ADP-65DE B	INPUT: 100-240V~1.5A, 50-60Hz OUTPUT: 19.0V, 3.42A, 65.0W	With the DC cable: Non-shielded, 1.5m
Adapter 5	DELTA	ADP-65DE B	INPUT: 100-240V ~ 1.5A, 50-60Hz OUTPUT: 19.0V, 3.42A, 65.0W	With the DC cable: Non-shielded, 1.5m
Others				
RJ-45 cable*1: Shielded, 1.5m				
Power cord*1: Non-shielded, 0.9m				

Note1: Adapter 1 & Adapter 2 and Adapter 4 & Adapter 5 are identical except for the S/N; Therefore, Adapter 1 and Adapter 4 were selected to test and recorded in this report.

Note2: Refer to photographs of EUT for the detail information of difference between Adapter 1 & Adapter 2 and Adapter 4 & Adapter 5.

1.7 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

1.8 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 52 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)	ERP (dBm)	Tolerance (dB)	Tune-up ERP (mW)	Distance (cm)	Option	TL ERP (mW)	TL Ratio
2.4G;D1D	5.00	29.75	32.60	0.50	2041.738	52	C	5191.7	0.3934
5.2G;D1D	6.17	29.71	33.73	0.11	2421.029	52	C	5191.7	0.4665
5.3G;D1D	6.32	23.59	27.76	0.08	608.135	52	C	5191.7	0.1172
5.6G;D1D	6.97	22.99	27.81	0.03	608.135	52	C	5191.7	0.1172
5.8G;D1D	6.48	29.45	33.78	0.06	2421.029	52	C	5191.7	0.4665
6.2G;D1D	4.88	-	24.69	0.50	330.370	52	C	5191.7	0.0637
6.4G;D1D	4.49	-	24.74	0.50	334.195	52	C	5191.7	0.0644
6.7G;D1D	4.38	-	24.68	0.50	329.610	52	C	5191.7	0.0635
7.0G;D1D	4.34	-	24.06	0.50	285.759	52	C	5191.7	0.0551

Simultaneous Transmission Analysis Mode:

1. EUT 5 + WLAN 2.4GHz + WLAN 5GHz (UNII 2C/UNII 3) + WLAN 6GHz

Mode	DG (dBi)	Power (dBm)	ERP (dBm)	Tolerance (dB)	Tune-up ERP (mW)	Distance (cm)	Option	TL ERP (mW)	TL Ratio
Co-TX Mode: 1	-	-	-	-	-	-	-	-	-
2.4G;D1D	5.00	29.75	32.60	0.50	2041.738	52	C	5191.7	0.3934
5.8G;D1D	6.48	29.45	33.78	0.06	2421.029	52	C	5191.7	0.4665
6.4G;D1D	4.49	-	24.74	0.50	334.195	52	C	5191.7	0.0644
Sum TL Ratio_C	0.9243								
Ratio Limit	1								

2. EUT 5 + WLAN 5GHz (UNII 1/UNII 2A) + WLAN 5GHz (UNII 2C/UNII 3) + WLAN 6GHz

Mode	DG (dBi)	Power (dBm)	ERP (dBm)	Tolerance (dB)	Tune-up ERP (mW)	Distance (cm)	Option	TL ERP (mW)	TL Ratio
Co-TX Mode: 1	-	-	-	-	-	-	-	-	-
5.2G;D1D	6.17	29.71	33.73	0.11	2421.029	52	C	5191.7	0.4665
5.8G;D1D	6.48	29.45	33.78	0.06	2421.029	52	C	5191.7	0.4665
6.4G;D1D	4.49	-	24.74	0.50	334.195	52	C	5191.7	0.0644
Sum TL Ratio_C	0.9974								
Ratio Limit	1								

Note: The above antenna gain was declared by manufacturer.

———THE END———