

RF EXPOSURE EVALUATION REPORT

Product Name: WiFi/BT Module
Trade Mark: msi
Model No. / HVIN: MWH540S
Add. Model No. / HVIN: N/A
Report Number: 24112914988RFC-5
Test Standards: FCC 47 CFR Part 1 Subpart I
RSS-102 Issue 6
FCC ID: I4L-MWH540S
IC: 3715A-MWH540S
Test Result: PASS
Date of Issue: January 7, 2025

Prepared for:

Micro-Star Int'l Co., Ltd.
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Version

Version No.	Date	Description
V1.0	January 7, 2025	Original



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1. GENERAL INFORMATION

1.1 CLIENT INFORMATION

Applicant:	Micro-Star Int'l Co., Ltd.
Address of Applicant:	No. 69, Lide St., Zhonghe Dist., New Taipei City 235, Taiwan
Manufacturer:	Micro-Star Int'l Co., Ltd.
Address of Manufacturer:	No. 69, Lide St., Zhonghe Dist., New Taipei City 235, Taiwan

1.2 EUT INFORMATION

Product Name:	WiFi/BT Module
Model No.:	MWH540S
Trade Mark:	msi
DUT Stage:	Identical Prototype
Sample Received Date:	November 11, 2024
Remark: The above EUT's information was provided by customer. Please refer to the specifications or user's manual for more detailed description.	

1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

EUT Supports Function: (Provided by the customer)	2.4 GHz ISM Band:	IEEE 802.11b/g/n	
		Bluetooth V5.0	
	5 GHz U-NII Bands:	5 150 MHz to 5 350 MHz	IEEE 802.11a/n/ac
		5 470 MHz to 5 725 MHz	IEEE 802.11a/n/ac
		5 725 MHz to 5 875 MHz	IEEE 802.11a/n/ac

1.4 OTHER INFORMATION

None.

1.5 GENERAL DESCRIPTION OF APPLIED STANDARDS

The EUT is a RF product, according to the specifications of the manufacturers. It must comply with the requirements of the following standards:

FCC 47 CFR Part 1 Subpart I

All test items have been performed and recorded as per the above standards

1.6 DEVIATION FROM STANDARDS

None.

1.7 ABNORMALITIES FROM STANDARD CONDITIONS

None.

1.8 OTHER INFORMATION REQUESTED BY THE CUSTOMER

None.

2. EQUIPMENT LIST

Please refer to the RF test report.

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3. MPE EVALUATION

3.1 REFERENCE DOCUMENTS FOR EVALUATION

No.	Identity	Document Title
1	FCC 47 CFR Part 1 Subpart I	PROCEDURES IMPLEMENTING THE NATIONAL ENVIRONMENTAL POLICY ACT OF 1969
2	KDB 447498 D01 General RF Exposure Guidance v06	RF EXPOSURE PROCEDURES AND EQUIPMENT AUTHORIZATION POLICIES FOR MOBILE AND PORTABLE DEVICES
3	KDB 662911 D01 Multiple Transmitter Output v02r01	Emissions Testing of Transmitters with Multiple Outputs in the Same Band

3.2 MPE COMPLIANCE REQUIREMENT

3.2.1 Limits

3.2.1.1 FCC 47 CFR Part 1 Subpart I

According to §1.1307(b)(1), system operating under the provisions of this section shall be operating in a manner that the public is not exposed to radio frequency energy level in excess limit for maximum permissible exposure.

Limits for Occupational / Controlled Exposure

Frequency range (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm ²)	Averaging Times 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/f)*	6
30-300	61.4	0.163	1.0	6
300-1500	/	/	F/300	6
1500-100000	/	/	5	6

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/cm ²)	Averaging Times 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/f)*	30
30-300	27.5	0.073	0.2	30
300-1500	/	/	F/1500	30
1500-100000	/	/	1	30

Note: f = frequency in MHz: * = Plane-wave equivalents power density.

3.2.1.2 RSS-102 Issue 6

According to RSS-102 Issue 6, system operating under the provisions of this section shall be operating in a manner that the public is not exposed to radio frequency energy level in excess limit for maximum permissible exposure.

According to RSS-102 Issue 6, system operating under the provisions of this section shall be operating in a manner that the public is not exposed to radio frequency energy level in excess limit for maximum permissible exposure.

RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 cm, except when the device operates as follows:

- below 20 MHz⁶ and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1 W (adjusted for tune-up tolerance);
- at or above 20 MHz and below 48 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $4.49/f^{0.5}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 48 MHz and below 300 MHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- at or above 300 MHz and below 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than $1.31 \times 10^{-2} f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in MHz;
- at or above 6 GHz and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance).

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

3.2.2 Test Procedure

Software provided by client enabled the EUT to transmit and receive data at lowest, middle and highest channel individually.

3.3 MPE CALCULATION METHOD

FCC 47 CFR Part 1 Subpart I

$$S = PG/4\pi R^2 = EIRP/4\pi R^2$$

S = power density (in appropriate units, e.g., mw/cm²)

P = power input to the antenna (in appropriate units, e.g., mw)

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor is normally numeric gain.

R = 20cm distance to the center of radiation of the antenna (in appropriate units, e.g., cm)

3.4 MPE CALCULATION RESULTS

Note: For the test results, the EUT had been tested with all conditions. But only the worst case was shown in test report.

3.4.1 MPE Results for FCC 47 CFR Part 1 Subpart I

Operating Mode		Freq.	Ant.	Declared maximum conducted Average output power	Max. positive tolerance according manufacturer	Max. Antenna Gain	Calculated maximum EIRP	Declared maximum EIRP	MPE Limit	MPE Value
		(MHz)		(dBm)		(dBi)	(dBm)	(mW)		(mW/cm ²)
SISO	IEEE 802.11b	2412-2462	1/2	14.5	2	3.38	19.88	97.2747	1	0.0194
	IEEE 802.11g	2412-2462	1/2	13.5	2	3.38	18.88	77.2681	1	0.0154
	IEEE 802.11a	5180-5240	1/2	14.0	2	3.19	19.19	82.9851	1	0.0165
		5260-5320	1/2	14.0	2	3.72	19.72	93.7562	1	0.0187
		5500-5700	1/2	14.0	2	3.98	19.98	99.5405	1	0.0198
		5745-5825	1/2	14.0	2	4.04	20.04	100.9253	1	0.0201
	LE	2402-2480	1	6.0	2	3.38	11.38	13.7404	1	0.0027
EDR		2402-2480	1	4.0	2	3.38	9.38	8.6696	1	0.0017

Operating Mode		Freq.	Ant.	Declared maximum conducted Average output power	Max. positive tolerance according manufacturer	Antenna Gain	Calculated maximum EIRP	Declared maximum EIRP	MPE Limit	MPE Value	MIMO	
		(MHz)		(dBm)		(dBi)	(dBm)	(mW)		(mW/cm ²)	Value	Limit
MIMO	IEEE 802.11n-HT20	2412-2462	1	13.5	2	3.38	18.88	77.2681	1	0.0154	0.0308	1
			2	13.5	2	3.38	18.88	77.2681	1	0.0154		
	IEEE 802.11n-HT40	2422-2452	1	13.5	2	3.38	18.88	77.2681	1	0.0154	0.0308	1
			2	13.5	2	3.38	18.88	77.2681	1	0.0154		
	IEEE 802.11n-HT20 802.11ac-VHT20	5180-5240	1	13.5	2	3.19	18.69	73.9605	1	0.0147	0.0294	1
			2	13.5	2	3.19	18.69	73.9605	1	0.0147		
		5260-5320	1	13.5	2	3.72	19.22	83.5603	1	0.0166	0.0332	1
			2	13.5	2	3.72	19.22	83.5603	1	0.0166		
		5500-5700	1	13.5	2	3.98	19.48	88.7156	1	0.0176	0.0352	1
			2	13.5	2	3.98	19.48	88.7156	1	0.0176		
		5745-5825	1	13.5	2	4.04	19.54	89.9498	1	0.0179	0.0358	1
			2	13.5	2	4.04	19.54	89.9498	1	0.0179		
	IEEE 802.11n-HT40	5190-5230	1	13.5	2	3.19	18.69	73.9605	1	0.0147	0.0294	1
			2	13.5	2	3.19	18.69	73.9605	1	0.0147		

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Operating Mode		Freq.	Ant.	Declared maximum conducted Average output power	Max. positive tolerance according manufacturer	Antenna Gain	Calculated maximum EIRP	Declared maximum EIRP	MPE Limit	MPE Value	MIMO	
		(MHz)		(dBm)		(dBi)	(dBm)	(mW)	(mW/cm ²)		Value	Limit
802.11ac-VHT40	5270-5310	1	13.5	2	3.72	19.22	83.5603	1	0.0166	0.0332	1	
		2	13.5	2	3.72	19.22	83.5603	1	0.0166			
	5510-5670	1	13.5	2	3.98	19.48	88.7156	1	0.0176	0.0352	1	
		2	13.5	2	3.98	19.48	88.7156	1	0.0176			
	5755-5795	1	13.5	2	4.04	19.54	89.9498	1	0.0179	0.0358	1	
		2	13.5	2	4.04	19.54	89.9498	1	0.0179			
	IEEE 802.11ac-VHT80	5210	1	13.5	2	3.19	18.69	73.9605	1	0.0147	0.0294	1
			2	13.5	2	3.19	18.69	73.9605	1	0.0147		
		5290	1	13.5	2	3.72	19.22	83.5603	1	0.0166	0.0332	1
			2	13.5	2	3.72	19.22	83.5603	1	0.0166		
		5530	1	13.5	2	3.98	19.48	88.7156	1	0.0176	0.0352	1
			2	13.5	2	3.98	19.48	88.7156	1	0.0176		
		5775	1	13.5	2	4.04	19.54	89.9498	1	0.0179	0.0358	1
			2	13.5	2	4.04	19.54	89.9498	1	0.0179		

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3.4.1 MPE Results for RSS-102 Issue 6

Operating Mode		Freq.	Ant.	Declared maximum conducted avg output power	Max. positive tolerance according manufacturer	Antenna Gain	Calculated maximum EIRP	Declared maximum EIRP	Limit
		(MHz)		(dBm)		(dBi)	(dBm)	(W)	(W)
SISO	IEEE 802.11b	2412-2462	1/2	14.5	2	3.38	19.88	0.0973	2.6840
	IEEE 802.11g	2412-2462	1/2	13.5	2	3.38	18.88	0.0773	2.6840
	IEEE 802.11a	5180-5240	1/2	14.0	2	3.19	19.19	0.0830	4.5253
		5260-5320	1/2	14.0	2	3.72	19.72	0.0938	4.5729
		5500-5700	1/2	14.0	2	3.98	19.98	0.0995	4.7145
		5745-5825	1/2	14.0	2	4.04	20.04	0.1009	4.8570
LE		2402-2480	1	6.0	2	3.38	11.38	0.0137	2.6764
EDR		2402-2480	1	4.0	4.0	2	3.38	0.0087	2.6764

Operating Mode		Freq.	Ant.	Declared maximum conducted avg output power	Max. positive Tolerance according manufacturer	Antenna Gain	Calculated maximum EIRP	Declared maximum EIRP	Limit	MIMO	
		(MHz)		(dBm)		(dBi)	(dBm)	(W)	(W)	Value	Limit
MIMO	IEEE 802.11n-HT20	2412-2462	1	13.5	2	3.38	18.88	0.0773	2.6840	0.0576	1
			2	13.5	2	3.38	18.88	0.0773	2.6840		
	IEEE 802.11n-HT40	2422-2452	1	13.5	2	3.38	18.88	0.0773	2.7030	0.0572	1
			2	13.5	2	3.38	18.88	0.0773	2.7030		
	IEEE 802.11n-HT20 802.11ac-VHT20	5180-5240	1	13.5	2	3.19	18.69	0.0740	4.5253	0.0327	1
			2	13.5	2	3.19	18.69	0.0740	4.5253		
		5260-5320	1	13.5	2	3.72	19.22	0.0836	4.5729	0.0366	1
			2	13.5	2	3.72	19.22	0.0836	4.5729		
		5500-5700	1	13.5	2	3.98	19.48	0.0887	4.7145	0.0376	1
			2	13.5	2	3.98	19.48	0.0887	4.7145		
		5745-5825	1	13.5	2	4.04	19.54	0.0899	4.8570	0.0370	1
			2	13.5	2	4.04	19.54	0.0899	4.8570		
	IEEE 802.11n-HT40	5190-5230	1	13.5	2	3.19	18.69	0.0740	4.5312	0.0327	1
			2	13.5	2	3.19	18.69	0.0740	4.5312		
		5270-5310	1	13.5	2	3.72	19.22	0.0836	4.5789	0.0365	1
			2	13.5	2	3.72	19.22	0.0836	4.5789		
		5510-5670	1	13.5	2	3.98	19.48	0.0887	4.7204	0.0376	1
			2	13.5	2	3.98	19.48	0.0887	4.7204		
		5755-5795	1	13.5	2	4.04	19.54	0.0899	4.8628	0.0370	1

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Operating Mode		Freq.	Ant.	Declared maximum conducted avg output power	Max. positive Tolerance according manufacturer	Antenna Gain	Calculated maximum EIRP	Declared maximum EIRP	Limit	MIMO	
		(MHz)		(dBm)		(dBi)	(dBm)	(W)	(W)	Value	Limit
IEEE 802.11ac-VHT80		5210	2	13.5	2	4.04	19.54	0.0899	4.8628	0.0326	1
			1	13.5	2	3.19	18.69	0.0740	4.5432		
		5290	2	13.5	2	3.19	18.69	0.0740	4.5432	0.0364	1
			1	13.5	2	3.72	19.22	0.0836	4.5907		
		5530	2	13.5	2	3.72	19.22	0.0836	4.5907	0.0375	1
			1	13.5	2	3.98	19.48	0.0887	4.7321		
		5775	2	13.5	2	3.98	19.48	0.0887	4.7321	0.0369	1
			1	13.5	2	4.04	19.54	0.0899	4.8743		
			2	13.5	2	4.04	19.54	0.0899	4.8743		
			1	13.5	2	4.04	19.54	0.0899	4.8743		

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3.4.2 Simultaneous Multi-band Transmission MPE Analysis

3.4.2.1 List of Mode for Simultaneous Multi-band Transmission

No.	Configurations	Support/Not Support
1	WLAN + Bluetooth	Support

3.4.2.1 Results for transmit simultaneously

➤ FCC 47 CFR Part 1 Subpart I

No.	Configurations	Maximum MPE Ratios		Transmit simultaneously	Limit	Results
		Max. WLAN MPE Ratios	Max. BT MPE ratios			
1	WWAN + BT	0.0385	0.0027	0.0412	1	PASS

Note 1: According to KDB 447498 D01 General RF Exposure Guidance v06, At the transmit simultaneously calculation method is as follows:

$$\text{Transmit simultaneously MPE} = \Sigma \text{ of MPE ratios}$$

$$\text{MPE ratios} = \text{Field strengths or power density} / \text{MPE limit at the test frequency}$$

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No.	Configurations	Maximum MPE Ratios		Transmit simultaneously	Limit	Results
		Max. WLAN MPE Ratios	Max. BT MPE ratios			
1	WWAN + BT	0.0576	0.0051	0.0627	1	PASS

Note 1: According to KDB 447498 D01 General RF Exposure Guidance v06, At the transmit simultaneously calculation method is as follows:

$$\text{Transmit simultaneously MPE} = \Sigma \text{ of MPE ratios}$$

$$\text{MPE ratios} = \text{Field strengths or power density} / \text{MPE limit at the test frequency}$$

APPENDIX 1 PHOTOS OF TEST SETUP

N/A

APPENDIX 2 PHOTOS OF EUT CONSTRUCTIONAL DETAILS

Refer to Appendix 2 for EUT external and internal Photos.

*** End of Report ***

The test report is effective only with both signature and specialized stamp. The result(s) shown in this report refer only to the sample(s) tested. Without written approval of UnionTrust, this report can't be reproduced except in full.
