FCC Maximum Permissible RF Exposure (MPE) Estimation Report

In accordance with the requirements of

FCC 47 CFR Part 2(2.1091), ANSI/IEEE C95.1-1992 and

KDB 447498 D01

Product Name：	WiFi Module
Trademark：	MINEWSEMI
Model Name：	MS12SF1
Family Model：	MS12SF18
Report No.：	S23102400705004
FCC ID：	2BDJ6-MS12SF1

Prepared for

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TEST RESULT CERTIFICATION

Applicant's name	:	SHENZHEN MINEWSEMI CO., LTD
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Manufacturer's Name	:	SHENZHEN MINEWSEMI CO., LTD
Address	:	3rd Floor,I Building, Gangzhilong Science Park, NO.6, Qinglong Road,Longhua District, Shenzhen

Product description

Product name	:	MINEWSEMI
Trademark	:	N/A
Model and/or type reference	:	MS12SF1
Family Model	:	MS12SF18
Standards	:	FCC 47 CFR Part 1(1.1310) FCC 47 CFR Part 2(2.1091) ANSI/IEEE C95.1-1992 KDB 447498 D01

This device described above has been tested by Shenzhen NTEK. Testing has shown that this device is capable of compliance with MPE specified in FCC 47 CFR Part 2(2.1091) and ANSI/IEEE C95.1-1992. The test results in this report apply only to the tested sample of the stated device/equipment. Other similar device/equipment will not necessarily produce the same results due to production tolerance and measurement uncertainties.

Date of Test

Date (s) of performance of tests: Oct. 24, 2023 ~ Mar 31 , 2024

Date of Issue: Jun 04 , 2024

Test Result: **Pass**

Prepared By (Test Engineer) : Mary Hu (Project Engineer)

Approved By (Lab Manager) : Alex Li (Manager)

※ ※ Revision History ※ ※

Report No.	Version	Description	Issued Date
S23102400705004	Rev.01	Initial issue of report	Jun 20 , 2024

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1 General Information

1.1 RF Exposure Requirements

1.1.1 RF Exposure Limits

Table - Limits For Maximum Permissible Exposure (MPE)

Frequency range (MHz)	Electric field strength (V/m)	Magnetic field strength (A/m)	Power density (mW/cm^2)	Averaging time (minutes)
(A) Limits for Occupational/Controlled Exposure				
0.3-3.0	614	1.63	*100	6
3.0-30	1842/f	4.89/f	$*900/f^2$	6
30-300	61.4	0.163	1.0	6
300-1,500			f/300	6
1,500-100,000			5	6
(B) Limits for General Population/Uncontrolled Exposure				
0.3-1.34	614	1.63	*100	30
1.34-30	824/f	2.19/f	$*180/f^2$	30
30-300	27.5	0.073	0.2	30
300-1,500			f/1500	30
1,500-100,000			1.0	30
f = frequency in MHz * = Plane-wave equivalent power density				

A rough estimation of the expected exposure in power flux density on a given point can be made with the following equation:

$$S = \frac{P_t * G_t}{4 * \pi * R^2}$$

Where:

S = Power density (mW/cm^2)
P_t = Conducted output power (dBm)
G_t = numeric gain of the antenna in the direction of interest relative to an isotropic radiator (dBi)
R= distance to the centre of radiation of the antenna (cm)
EIRP = $P_t * G_t$

The antenna of the product, under normal use condition is at least 20 cm away from the body of the user. Warning statement to the user for keeping at least 20cm separation distance and the prohibition of operating to a person has been printed on the user's manual. Therefore, the S of the device is calculated with R=20cm, and if it is below the limit S, then we can conclude the device complies with the rules.

1.1.2 Additional Description

An estimation of MPE in this application for product is used to ensure if it complies to the rules of the standard in the regulation list above.
Maximum permissible exposure (MPE) refers to the RF energy that is acceptable for human exposure. It is broken down into two categories, Occupational/controlled and General population/uncontrolled.
Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure.
General population/uncontrolled exposures apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or cannot exercise control over their exposure.
We analysis if it comply with the limits for General population/uncontrolled exposure. The FCC's MPE limits for field strength and power density are given in 47CFR 1.1310(Table below).These limits are generally based on recommended exposure guidelines published by the National Council on Radiation Protection and Measurements (NCRP), and also partly based on guidelines recommended by the American National Standards Institute (ANSI) in Section 4.1 of ANSI/IEEE C95.1.

1.2 EUT Description

Device Information			
Product Name	WiFi Module		
Trade Name	N/A		
Model Name	MS12SF1		
Family Model	MS12SF18		
Model Difference	All models are the same circuit and RF module, except for model names.		
FCC ID	2BDJ6-MS12SF1		
Device Phase	Identical Prototype		
Exposure Category	General population / Uncontrolled environment		
Antenna Type	BLE: PCB Antenna, WIFI 2.4G/5G: External rod antenna		
Antenna Gain	BLE: 2.7dBi,WIFI:2.4G:4.01dBi, WIFI 5.2G:5.78 dBi, WIFI 5.8G:2.24 dBi		
Device Operating Configurations			
Supporting Mode(s)	BLE/WLAN 2.4G/5.2G/5.8G		
Test Modulation	WLAN(DSSS/OFDM)		
Operating Frequency Range(s)	Band	Tx (MHz)	Rx (MHz)
	BT	2402-2480	
	WLAN 2.4G	2412-2462	
	WLAN 5.2G	5180-5240	
	WLAN 5.8G	5745-5825	

1.3 Test specification(s)

FCC 47 CFR Part 1(1.1310)
FCC 47 CFR Part 2(2.1091)
ANSI/IEEE C95.1-1992
KDB 447498 D01 General RF Exposure Guidance

1.4 Ambient Condition

Ambient temperature	20°C – 24°C
Relative Humidity	30% – 70%

2 RF Output Power

BLE

Condition	Mode	Frequency (MHz)	Antenna	Conducted Power (dBm)	Limit (dBm)	Verdict
NVNT	BLE 1M	2402	Ant1	-0.53	30	Pass
NVNT	BLE 1M	2440	Ant1	-0.53	30	Pass
NVNT	BLE 1M	2480	Ant1	-0.75	30	Pass

Condition	Mode	Frequency (MHz)	Antenna	Conducted Power (dBm)	Limit (dBm)	Verdict
NVNT	BLE 2M	2402	Ant1	-0.5	30	Pass
NVNT	BLE 2M	2440	Ant1	-0.5	30	Pass
NVNT	BLE 2M	2480	Ant1	-0.74	30	Pass

2.4Gwifi

Condition	Mode	Frequency (MHz)	Antenna	Conducted Power (dBm)	Limit (dBm)	Verdict
NVNT	b	2412	Ant1	15.87	30	Pass
NVNT	b	2437	Ant1	15.74	30	Pass
NVNT	b	2462	Ant1	15.63	30	Pass
NVNT	g	2412	Ant1	14.68	30	Pass
NVNT	g	2437	Ant1	14.58	30	Pass
NVNT	g	2462	Ant1	14.49	30	Pass
NVNT	n20	2412	Ant1	12.96	30	Pass
NVNT	n20	2437	Ant1	12.8	30	Pass
NVNT	n20	2462	Ant1	12.65	30	Pass
NVNT	ax20	2412	Ant1	13.71	30	Pass
NVNT	ax20	2437	Ant1	13.64	30	Pass
NVNT	ax20	2462	Ant1	13.39	30	Pass

5.2G wifi

Condition	Mode	Frequency (MHz)	Antenna	Conducted Power (dBm)	Duty Factor (dB)	Total Power (dBm)	Limit (dBm)	Verdict
NVNT	a	5180	Ant1	9.53	0.73	10.26	23.39	Pass
NVNT	a	5200	Ant1	10.18	0.88	11.06	23.39	Pass
NVNT	a	5240	Ant1	9.63	1.21	10.84	23.39	Pass
NVNT	n20	5180	Ant1	8.74	0.8	9.54	23.39	Pass
NVNT	n20	5200	Ant1	9.2	0.83	10.03	23.39	Pass
NVNT	n20	5240	Ant1	8.8	0.9	9.7	23.39	Pass
NVNT	ac20	5180	Ant1	9.53	1.01	10.54	23.39	Pass
NVNT	ac20	5200	Ant1	9.85	0.82	10.67	23.39	Pass
NVNT	ac20	5240	Ant1	9.57	0.78	10.35	23.39	Pass
NVNT	ax20	5180	Ant1	10.71	0.86	11.57	23.39	Pass
NVNT	ax20	5200	Ant1	11	0.95	11.95	23.39	Pass
NVNT	ax20	5240	Ant1	10.79	0.9	11.69	23.39	Pass

5.8G wifi

Condition	Mode	Frequency (MHz)	Antenna	Conducted Power (dBm)	Duty Factor (dB)	Total Power (dBm)	Limit (dBm)	Verdict
NVNT	a	5745	Ant1	9.14	0.68	9.82	29.39	Pass
NVNT	a	5785	Ant1	8.85	0.69	9.54	29.39	Pass
NVNT	a	5825	Ant1	8.4	0.68	9.08	29.39	Pass
NVNT	n20	5745	Ant1	8.52	0.71	9.23	29.39	Pass
NVNT	n20	5785	Ant1	8.16	0.74	8.9	29.39	Pass
NVNT	n20	5825	Ant1	7.7	0.72	8.42	29.39	Pass
NVNT	ac20	5745	Ant1	9.2	0.72	9.92	29.39	Pass
NVNT	ac20	5785	Ant1	8.81	0.74	9.55	29.39	Pass
NVNT	ac20	5825	Ant1	8.36	0.71	9.07	29.39	Pass
NVNT	ax20	5745	Ant1	10.12	0.81	10.93	29.39	Pass
NVNT	ax20	5785	Ant1	9.89	1.05	10.94	29.39	Pass
NVNT	ax20	5825	Ant1	9.41	0.8	10.21	29.39	Pass

3 RF Exposure Evaluation

3.1 Max Operation in BT

BLE

Mode	Maximum output power (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm^2)	MPE Limit (mW/cm^2)	Conclusion
BLE 1M	-0.53	2.7	2.17	1.65	20	0.000328	1	Pass
BLE 2M	-0.5	2.7	2.20	1.66	20	0.000330	1	Pass

3.2 Max Operation in WLAN 2.4G

Mode	Maximum output power (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm^2)	MPE Limit (mW/cm^2)	Conclusion
WIFI 2.4G	15.87	4.01	19.88	97.27	20	0.01935	1	Pass

3.3 Max Operation in WLAN 5G

Mode	Maximum output power (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm^2)	MPE Limit (mW/cm^2)	Conclusion
WIFI 5.2G	11.95	5.78	17.73	59.29	20	0.01180	1	Pass
WIFI 5.8G	10.94	2.24	13.18	20.80	20	0.00414	1	Pass

SIMULTANEOUS TRANSMISSIONS

When a number of sources at different frequencies, and/or broadband sources, contribute to the total exposure, it becomes necessary to weigh each contribution relative to the MPE. To comply with the MPE, the fraction of the MPE in terms of E^2, H^2 (or power density) incurred within each frequency interval should be determined and the sum of all such fractions should not exceed unity. In order to ensure compliance with the MPE for a controlled environment, the sum of the ratios of the power density to the corresponding MPE should not exceed unity. That is

$$\sum_{i=1}^{n} \frac{S_i}{MPE_i} \leq 1$$

Mode	Tune-up limit (dBm)	Gain (dBi)	EIRP (dBm)	EIRP (mW)	R(cm)	S (mW/cm2)	MPE Limit (mW/cm2)	Calculation result	Conclusion
BLE(2M)+WIFI 2.4G	15.87	4.01	19.88	97.27	20	0.019352	1	0.019682	Pass
	-0.5	2.7	2.2	1.66	20	0.000330	1		

Max. SIMULTANEOUS TRANSMISSIONS for BLE(2M)+WIFI 2.4G

Note:

1. NO simultaneous transmissions are possible for this device of WIFI2.4G +WIFI5G

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