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RF Exposure Evaluation Report

Application No.:	KSCR2406001000AT
FCC ID:	2APJ4-MA188
Applicant:	MeiG Smart Technology Co., Ltd
Address of Applicant:	2nd Floor,Office Building,No.5 Lingxia Road,Fenghuang,Fuyong Street,Bao'an District,Shenzhen
Manufacturer:	MeiG Smart Technology Co., Ltd
Address of Manufacturer:	2nd Floor,Office Building,No.5 Lingxia Road,Fenghuang,Fuyong Street,Bao'an District,Shenzhen
Equipment Under Test (EUT):	
EUT Name:	Wireless communication module
Model No.:	MA188
Trade Mark:	MEIGLink
Standard(s) :	FCC Rules 47 CFR §2.1091 KDB 447498 D04 interim General RF Exposure Guidance v01
Date of Receipt:	2024-06-04
Date of Test:	2024-07-08 to 2024-07-11
Date of Issue:	2024-07-11
Test Result:	**Pass***

* In the configuration tested, the EUT complied with the standards specified above.

Revision Record			
Version	**Description**	***Date***	***Remark***
00	Original	2024-07-11	/

Authorized for issue by:				
Tested By		 **Maker Qi /Project Engineer**		
Approved By		 **Terry Hou /Reviewer**		

2 Contents

3 General Information

3.1 General Description of E.U.T.

Power supply:	DC 3.3V-4.3V

3.2 Details of E.U.T.

2.4GHz Wi-Fi

Operation Frequency:	802.11b/g/n(HT20)/ax(HEW20): 2412MHz to 2462MHz; 802.11n(HT40)/ax(HEW40): 2422MHz to 2452MHz
Modulation Type:	802.11b: DSSS (CCK, DQPSK, DBPSK), 802.11g/n: OFDM (64QAM, 16QAM, QPSK, BPSK), 802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024-QAM)
Number of Channels:	802.11b/g/n(HT20)/ax(HEW20):11;802.11n(HT40)/ax(HEW40):7
Channel Spacing:	5MHz
Antenna Type:	External Antenna
Antenna Gain:	Ant1:3.95dBi(Provided by the manufacturer) Ant2:3.95dBi(Provided by the manufacturer) Directional gain: 3.95dBi(Provided by the manufacturer)

5GHz Wi-Fi

Operation Frequency/Number of channels (20MHz):	5180-5240MHz (4 Channels); U-NII-2A: 5260-5320MHz (4 Channels); U-NII-2C: 5500-5700MHz (11 Channels); U-NII-3: 5745-5825MHz (5 Channels)
Operation Frequency/Number of channels/(40MHz):	5190-5230MHz (2 Channels); U-NII-2A: 5270-5310MHz (2 Channels); U-NII-2C: 5510-5670MHz (5 Channels); U-NII-3: 5755-5795MHz (2 Channels)
Operation Frequency/Number of channels (80MHz):	5210MHz (1 Channel); U-NII-2A: 5290MHz (1 Channels); U-NII-2C: 5530-5610MHz (2 Channels); U-NII-3: 5775MHz (1 Channel)
Modulation Type:	802.11a/n: OFDM (BPSK, QPSK, 16QAM, 64QAM); 802.11ac: OFDM (BPSK, QPSK, 16QAM, 64QAM, 256QAM); 802.11ax: OFDMA (BPSK, QPSK, 16QAM, 64QAM, 256QAM, 1024-QAM)
Channel Spacing:	802.11a/n/ac/ax 20: 20MHz; 802.11n/ac/ax 40: 40MHz; 802.11ac/ax 80: 80MHz
DFS Function:	Slave without Radar detection
Antenna Type:	External Antenna
Antenna Gain:	5150MHz-5250MHz ANT1&2:2.70dBi(Provided by the manufacturer) 5250MHz-5350MHz ANT1&2:2.07dBi(Provided by the manufacturer) 5470MHz-5725MHz ANT1&2:1.48dBi(Provided by the manufacturer) 5725MHz-5850MHz ANT1&2:1.48dBi(Provided by the manufacturer)
Directional Gain:	5150MHz-5250MHz ANT1&2:2.70dBi(Provided by the manufacturer) 5250MHz-5350MHz ANT1&2:2.07dBi(Provided by the manufacturer) 5470MHz-5725MHz ANT1&2:1.48dBi(Provided by the manufacturer) 5725MHz-5850MHz ANT1&2:1.48dBi(Provided by the manufacturer)

3.3 Test Location

All tests were performed at:

Compliance Certification Services (Kunshan) Inc.

No.10 Weiye Rd, Innovation park, Eco&Tec, Development Zone, Kunshan City, Jiangsu, China.

Tel: +86 512 5735 5888 Fax: +86 512 5737 0818

No tests were sub-contracted.

Note:

1.SGS is not responsible for wrong test results due to incorrect information (e.g. max. clock frequency, highest internal frequency, antenna gain, cable loss, etc) is provided by the applicant. (if applicable).

2.SGS is not responsible for the authenticity, integrity and the validity of the conclusion based on results of the data provided by applicant. (if applicable).

3. Sample source: sent by customer.

3.4 Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

• A2LA

Compliance Certification Services (Kunshan) Inc. is accredited by the American Association for Laboratory Accreditation (A2LA). Certificate No. 2541.01.

• FCC

Compliance Certification Services (Kunshan) Inc. has been recognized as an accredited testing laboratory. Designation Number: CN1172.

• ISED

Compliance Certification Services (Kunshan) Inc. has been recognized by Innovation, Science and Economic Development Canada (ISED) as an accredited testing laboratory. Company Number: 2324E

• VCCI

The 3m and 10m Semi-anechoic chamber and Shielded Room of Compliance Certification Services (Kunshan) Inc. has been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: R-20134, R-11600, C-11707, T-11499, G-10216 respectively.

4 FCC Radiofrequency radiation exposure limits

Test exemptions apply for devices used in general population/uncontrolled exposure environments, according to the SAR-based, or MPE-based exemption thresholds.

4.1 Blanket 1 mW Blanket Exemption

The 1 mW Blanket Exemption of §1.1307(b)(3)(i)(A) applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power of no more than 1 mW, regardless of separation distance.

The 1-mW blanket exemption applies at separation distances less than 0.5 cm, including where there is no separation. This exemption shall not be used in conjunction with other exemption criteria other than those for multiple RF sources in paragraph §1.1307(b)(3)(ii)(A).

The 1-mW exemption is independent of service type and covers the full range of 100 kHz to 100 GHz, but it shall not be used in conjunction with other exemption criteria or in devices with higher-power transmitters operating in the same time-averaging period. Exposure from such higher-power transmitters would invalidate the underlying assumption that exposure from the lower-power transmitter is the only contributor to SAR in the relevant volume of tissue.

4.2 MPE-based Exemption

General frequency and separation-distance dependent MPE-based effective radiated power (ERP) thresholds are in Table B.1 [Table 1 of §1.1307(b)(1)(i)(C)] to support an exemption from further evaluation from 300 kHz through 100 GHz.

Table B.1—Thresholds For Single RF Sources Subject to Routine Environmental Evaluation

RF Source Frequency			Minimum Distance			Threshold ERP
f_L MHz		f_H MHz	$\lambda_L / 2\pi$		$\lambda_H / 2\pi$	W
0.3	–	1.34	159 m	–	35.6 m	1,920 R^2
1.34	–	30	35.6 m	–	1.6 m	3,450 R^2/f^2
30	–	300	1.6 m	–	159 mm	3.83 R^2
300	–	1,500	159 mm	–	31.8 mm	0.0128 R^2f
1,500	–	100,000	31.8 mm	–	0.5 mm	19.2R^2
Subscripts L and H are low and high; λ is wavelength. From §1.1307(b)(3)(i)(C), modified by adding Minimum Distance columns.						

The table applies to any RF source (i.e. single fixed, mobile, and portable transmitters) and specifies power and distance criteria for each of the five frequency ranges used for the MPE limits. These criteria apply at separation distances from any part of the radiating structure of at least λ/2π. The thresholds are based on the general population MPE limits with a single perfect reflection, outside of the reactive near-field, and in the main beam of the radiator.

For mobile devices that are not exempt per Table B.1 [Table 1 of §1.1307(b)(1)(i)(C)] at distances from 20 cm to 40 cm and in 0.3 GHz to 6 GHz, evaluation of compliance with the exposure limits in §1.1310 is necessary if the ERP of the device is greater than ERP_{20cm} in Formula (B.1) [repeated from §2.1091(c)(1); also in §1.1307(b)(1)(i)(B)].

$$P_{\text{th}}\,(\text{mW}) = ERP_{20\,\text{cm}}\,(\text{mW}) = \begin{cases} 2040f & 0.3\ \text{GHz} \le f < 1.5\ \text{GHz} \\ 3060 & 1.5\ \text{GHz} \le f \le 6\ \text{GHz} \end{cases} \qquad \text{(B. 1)}$$

If the ERP is not easily obtained, then the available maximum time-averaged power may be used (i.e., without consideration of ERP only if the physical dimensions of the radiating structure(s) do not exceed the electrical length of λ/4 or if the antenna gain is less than that of a half-wave dipole.

SAR-based exemptions are constant at separation distances between 20 cm and 40 cm to avoid discontinuities in the threshold when transitioning between SAR-based and MPE-based exemption criteria at 40 cm, considering the importance of reflections.

Limit calculation			
Frequency range	Frequency(MHz)	R(λ/2π)(m)	Threshold ERP(W)
300~1500MHz	**915**	0.0522	0.032
1500~100000MHz	**2462**	0.0194	0.007

4.3 SAR-based Exemption

SAR-based thresholds are derived based on frequency, power, and separation distance of the RF source. The formula defines the thresholds in general for either available maximum time-averaged power or maximum time-averaged ERP, whichever is greater.

If the ERP of a device is not easily determined, such as for a portable device with a small form factor, the applicant may use the available maximum time-averaged power exclusively if the device antenna or radiating structure does not exceed an electrical length of λ/4.

As for devices with antennas of length greater than λ/4 where the gain is not well defined, but always less than that of a half-wave dipole (length λ/2), the available maximum time-averaged power generated by the device may be used in place of the maximum time-averaged ERP, where that value is not known.

The separation distance is the smallest distance from any part of the antenna or radiating structure for all persons, during operation at the applicable ERP. In the case of mobile or portable devices, the separation distance is from the outer housing of the device where it is closest to the antenna.

The SAR-based exemption formula of §1.1307(b)(3)(i)(B), repeated here as Formula (B.2), applies for single fixed, mobile, and portable RF sources with available maximum time-averaged power or effective radiated power (ERP), whichever is greater, of less than or equal to the threshold P_{th} (mW).

This method shall only be used at separation distances from 0.5 cm to 40 cm and at frequencies from 0.3 GHz to 6 GHz (inclusive). P_{th} is given by Formula (B.2).

$$P_{\text{th}}\,(\text{mW}) = \begin{cases} ERP_{20\,\text{cm}}(d/20\ \text{cm})^{x} & d \le 20\ \text{cm} \\ ERP_{20\,\text{cm}} & 20\ \text{cm} < d \le 40\ \text{cm} \end{cases} \qquad \text{(B. 2)}$$

where

$$x = -\log_{10}\left(\frac{60}{ERP_{20\,\text{cm}}\sqrt{f}}\right)$$

and f is in GHz, d is the separation distance (cm), and $ERP_{20\text{cm}}$ is per Formula (B.1).

Example values shown in Table B.2 are for illustration only.

Table B.2—Example Power Thresholds (mW)

Frequency (MHz)	Distance(mm)									
	5	10	15	20	25	30	35	40	45	50
300	39	65	88	110	129	148	166	184	201	217
450	22	44	67	89	112	135	158	180	203	226
835	9	25	44	66	90	116	145	175	207	240
1900	3	12	26	44	66	92	122	157	195	236
2450	3	10	22	38	59	83	111	143	179	219
3600	2	8	18	32	49	71	96	125	158	195
5800	1	6	14	25	40	58	80	106	136	169

For 2.4G WiFi

Limit calculation				
Frequency range(GHz)	Frequency(GHz)	X	Distance(cm)	Pth (mW)
1.5~6	**2.462**	1.903	**20**	**3060.000**

For 5G WiFi

Limit calculation				
Frequency range(GHz)	Frequency(GHz)	X	Distance(cm)	Pth (mW)
1.5~6	**5.825**	2.090	**20**	**3060.000**

5 Measurement and Calculation

5.1 Maximum transmit power

The Power Data is based on the RF Test Report KSCR240600100001, KSCR240600100002

2.4GHz Wi-Fi

Test Mode	Test Frequency (MHz)	Ant 1 Antenna Power (dBm)	Ant 2 Antenna Power (dBm)	MIMO Power(dBm)	Ant 1 Antenna Power (mW)	Ant 2 Antenna Power (mW)	MIMO Power (mW)
802.11b	2412	18.64	18.57	/	73.11	71.94	/
	2437	22.11	9.36	/	162.55	8.63	/
	2462	18.44	18.52	/	69.82	71.12	/
802.11g	2412	23.73	23.49	/	236.05	223.36	/
	2437	24.48	23.92	/	**280.54**	246.60	/
	2462	23.60	23.72	/	229.09	235.50	/
802.11n (HT20)	2412	23.23	23.20	26.23	210.38	208.93	419.76
	2437	24.02	23.78	26.91	252.35	238.78	490.91
	2462	23.45	23.74	26.61	221.31	236.59	458.14
802.11n (HT40)	2422	23.49	23.50	26.51	223.36	223.87	447.71
	2437	23.41	23.32	26.38	219.28	214.78	434.51
	2452	22.99	22.63	25.82	199.07	183.23	381.94
802.11ax (HEW20)	2412	23.96	24.60	27.30	248.89	288.40	537.03
	2437	24.32	24.45	27.40	270.40	278.61	**549.54**
	2462	23.07	25.11	27.22	202.77	**324.34**	527.23
802.11ax (HEW40)	2422	23.83	23.80	26.83	241.55	239.88	481.95
	2437	23.78	23.61	26.71	238.78	229.61	468.81
	2452	22.75	23.12	25.95	188.36	205.12	393.55

5GHz Wi-Fi

Test Mode	Test Frequency (MHz)	Ant 1 Antenna Power (dBm)	Ant 2 Antenna Power (dBm)	MIMO Power(dBm)	Ant 1 Antenna Power (mW)	Ant 2 Antenna Power (mW)	MIMO Power (mW)
802.11a	5180	14.47	13.83	/	27.99	24.15	/
	5200	13.91	13.34	/	24.60	21.58	/
	5240	13.85	14.11	/	24.27	25.76	/
	5260	13.31	13.97	/	21.43	24.95	/
	5300	13.64	14.74	/	23.12	29.79	/
	5320	13.53	14.89	/	22.54	30.83	/
	5500	13.15	14.58	/	20.65	28.71	/
	5580	14.54	12.94	/	28.44	19.68	/
	5700	14.27	13.13	/	26.73	20.56	/
	5745	13.22	13.35	/	20.99	21.63	/
	5785	12.64	13.99	/	18.37	25.06	/
	5825	13.68	14.65	/	23.33	29.17	/
802.11n (HT20)	5180	14.45	14.04	17.26	27.86	25.35	53.21
	5200	13.68	13.43	16.57	23.33	22.03	45.39
	5240	13.69	14.18	16.95	23.39	26.18	49.55
	5260	13.13	14.16	16.69	20.56	26.06	46.67
	5300	13.54	14.87	17.27	22.59	30.69	53.33
	5320	13.44	15.34	17.50	22.08	**34.20**	56.23
	5500	13.14	14.71	17.01	20.61	29.58	50.23
	5580	15.19	13.83	17.57	**33.04**	24.15	**57.15**
	5700	14.29	13.31	16.84	26.85	21.43	48.31
	5745	13.27	13.61	16.45	21.23	22.96	44.16
	5785	12.73	14.61	16.78	18.75	28.91	47.64
	5825	13.76	14.75	17.29	23.77	29.85	53.58
802.11n (HT40)	5190	13.44	12.92	16.20	22.08	19.59	41.69
	5230	13.29	13.33	16.32	21.33	21.53	42.85
	5270	12.62	14.03	16.39	18.28	25.29	43.55
	5310	13.02	14.51	16.84	20.04	28.25	48.31
	5510	12.62	14.00	16.37	18.28	25.12	43.35
	5550	13.88	13.64	16.77	24.43	23.12	47.53
	5670	14.03	12.65	16.40	25.29	18.41	43.65
	5755	12.38	13.02	15.72	17.30	20.04	37.33
	5795	12.36	13.67	16.07	17.22	23.28	40.46
802.11ac (VHT80)	5210	12.76	11.63	15.24	18.88	14.55	33.42
	5290	12.03	13.38	15.77	15.96	21.78	37.76
	5530	12.56	12.93	15.76	18.03	19.63	37.67
	5610	13.28	11.88	15.65	21.28	15.42	36.73
	5775	11.39	12.27	14.86	13.77	16.87	30.62
802.11ax (HEW20)	5180	14.53	14.10	17.33	28.38	25.70	54.08
	5200	13.88	13.38	16.65	24.43	21.78	46.24
	5240	13.80	14.15	16.99	23.99	26.00	50.00
	5260	13.30	14.14	16.75	21.38	25.94	47.32
	5300	13.65	14.83	17.29	23.17	30.41	53.58
	5320	12.88	14.81	16.96	19.41	30.27	49.66
	5500	13.20	14.73	17.04	20.89	29.72	50.58
	5580	14.65	13.24	17.01	29.17	21.09	50.23
	5700	13.96	13.09	16.56	24.89	20.37	45.29
	5745	13.40	13.52	16.47	21.88	22.49	44.36
	5785	12.75	14.50	16.72	18.84	28.18	46.99

	5825	13.49	14.52	17.05	22.34	28.31	50.70
802.11ax (HEW40)	5190	13.38	12.86	16.14	21.78	19.32	41.11
	5230	13.32	13.26	16.30	21.48	21.18	42.66
	5270	12.33	13.71	16.08	17.10	23.50	40.55
	5310	12.58	14.07	16.40	18.11	25.53	43.65
	5510	12.21	13.57	15.95	16.63	22.75	39.36
	5550	13.54	13.24	16.40	22.59	21.09	43.65
	5670	13.91	12.43	16.24	24.60	17.50	42.07
	5755	12.19	12.79	15.51	16.56	19.01	35.56
	5795	12.16	13.38	15.82	16.44	21.78	38.19
802.11ax (HEW80)	5210	12.94	11.92	15.47	19.68	15.56	35.24
	5290	11.81	13.26	15.61	15.17	21.18	36.39
	5530	12.34	12.69	15.53	17.14	18.58	35.73
	5610	13.10	11.70	15.47	20.42	14.79	35.24
	5775	11.38	12.29	14.87	13.74	16.94	30.69

5.2 RF Exposure Calculation

2.4GHz Wi-Fi

The Max Conducted Peak Output Power is 280.54 mW for antenna1, 324.34mW for antenna2, 549.54 mW for Mimo.
The best case gain of the antenna is 3.95dBi for antenna1 and 3.95dBi for antenna2.
Directional gain:3.95dBi.
3.95dBi logarithmic terms convert to numeric result is nearly 2.48.
3.95dBi logarithmic terms convert to numeric result is nearly 2.48.
3.95dBi logarithmic terms convert to numeric result is nearly 2.48.
According to the formula. calculate the EIRP test result:
Antenna1: EIRP= P x G = 280.54 mW x 2.48= 695.74mW < 3060mW
Antenna2: EIRP= P x G = 324.34 mW x 2.48= 804.36mW < 3060mW
In MIMO mode: EIRP= P x G = 549.54 mW x 2.48= 1362.86mW< 3060mW

5GHz Wi-Fi

The Max Conducted Peak Output Power is 33.04 mW for antenna1, 34.20mW for antenna2, 57.15 mW for Mimo.
The best case gain of the antenna is 2.70dBi for antenna1 and 2.70dBi for antenna2.
Directional gain:2.70dBi.
2.70dBi logarithmic terms convert to numeric result is nearly 1.86.
2.70dBi logarithmic terms convert to numeric result is nearly 1.86.
2.70dBi logarithmic terms convert to numeric result is nearly 1.86.
According to the formula. calculate the EIRP test result:
Antenna1: EIRP= P x G = 33.04 mW x 1.86= 61.45mW < 3060mW
Antenna2: EIRP= P x G = 34.20 mW x 1.86= 63.61mW < 3060mW
In MIMO mode: EIRP= P x G = 57.15 mW x 1.86= 106.30mW< 3060mW

Remark: we used the maximum power between the conducted power and ERP/EIRP to perform RF exposure exemption evaluation.

	Evaluation method	Exempt Limit(mW)	Verdict
☐	Blanket 1 mW Blanket Exemption	1mW	N/A
☐	MPE-based Exemption(ERP)	7mW(ERP) (2.4GHz Band)	N/A
☒	SAR-based Exemption(P_{th})	3060mW(ERP) (1.5GHz~6GHz)	Yes

The 2.4GHz Wi-Fi and 5GHz Wi-Fi can simultaneously transmit, and the maximum rate of MPE is 1362.86/3060+106.30/3060=0.48<=1. So, the device is to qualify for SAR test exemption, the exemption report is in lieu of the SAR report

--End of the Report--