



SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen Branch

SZEMC-TRF-01 Rev. A/1

Report No.: SZCR241100407407

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RF EXPOSURE EVALUATION REPORT

Application No.: SZCR2411004074AT
Applicant: Shenzhen Mammotion Innovation Co., Limited
Address of Applicant: 9th Floor, Building A3, Nanshan Zhiyuan, No. 1001 Xueyuan Avenue, Changyuan Community, Taoyuan Street, Nanshan District, Shenzhen
Manufacturer: Shenzhen Mammotion Innovation Co., Limited
Address of Manufacturer: 9th Floor, Building A3, Nanshan Zhiyuan, No. 1001 Xueyuan Avenue, Changyuan Community, Taoyuan Street, Nanshan District, Shenzhen
Factory: DONGGUAN SHINGI ELECTRONICS CO., LTD
Address of Factory: No. 1 Yadi South Road, Qiaotou Town, Dongguan City, Guangdong Province, China.
Equipment Under Test (EUT):
EUT Name: YUKA mini
Model No.: 800, 700, 600, 500 ♣
♣ Please refer to section 3 of this report which indicates which model was actually tested and which were electrically identical.
Trade Mark: MAMMOTION
FCC ID: 2BFWS-YUKAMN
Standard(s) : FCC Rules 47 CFR §2.1091
KDB 447498 D04 interim General RF Exposure Guidance v01
Date of Receipt: 2024-11-01
Date of Test: 2024-11-29 to 2024-12-04
Date of Issue: 2024-12-12

Evaluation Result:	Pass*
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* In the configuration evaluated, the EUT complied with the standards specified above.

Keny Xu

Keny Xu
EMC Laboratory Manager



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Shenzhen Branch EMC Laboratory

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Revision Record				
Version	Chapter	Date	Modifier	Remark
01		2024-12-12		Original

Authorized for issue by:				
		Benson Wang		
		Benson Wang/Project Engineer		
		Eric Fu		
		Eric Fu/Reviewer		

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3 General Information

3.1 General Description of E.U.T.

Product Type:	<input type="checkbox"/> Portable device
	<input checked="" type="checkbox"/> Mobile device
	<input type="checkbox"/> Fixed device

3.2 Details of E.U.T.

Power supply:	<p>Powered by Rechargeable Li-ion Battery.</p> <p>Battery1 information</p> <p>Model: MWBT06S02P-01</p> <p>Nominal Voltage: 21.6Vdc</p> <p>Rated Capacity: 6.1Ah/131.76Wh</p> <p>Battery2 information</p> <p>Model: MWBT06S01P-03</p> <p>Nominal Voltage: 21.6Vdc</p> <p>Rated Capacity: 2.4Ah/51.84Wh</p> <p>Battery3 information</p> <p>Model: MWBT06S02P-03</p> <p>Nominal Voltage: 21.6Vdc</p> <p>Rated Capacity: 4.5Ah/97.2Wh</p> <p>Battery4 information</p> <p>Model: MWBT06S01P-04</p> <p>Nominal Voltage: 21.6Vdc</p> <p>Rated Capacity: 2.4Ah/51.84Wh</p> <p>Charging station information</p> <p>Model: CHG2300</p> <p>Input: 28Vdc, 60.2W</p> <p>Output: 28Vdc, 2.15A</p> <p>Charging station adapter information</p> <p>Model: TS-A060-2802151</p> <p>Input: 100-240VAC, 50/60Hz 1.5A Max</p> <p>Output: 28.0Vdc, 2.15A, 60.2W</p>
Cable(s):	<p>AC cable of adapter: 185cm unshielded</p> <p>DC cable of adapter to EUT: 705cm unshielded</p> <p>DC Cable of charge station to RTK:220cm unshielded</p>

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For BLE:	
Operation Frequency:	2402MHz to 2480MHz
Bluetooth Version:	5.2
Modulation Type:	GFSK
Number of Channels:	40
Channel Spacing:	2MHz
Antenna Type:	PIFA Antenna
Antenna Gain:	2.5dBi
For 2.4G WIFI:	
Operation Frequency:	802.11b/g/n(HT20): 2412MHz to 2462MHz; 802.11n(HT40): 2422MHz to 2452MHz
Modulation Type:	802.11b: DSSS (CCK, DQPSK, DBPSK); 802.11g/n: OFDM (64QAM, 16QAM, QPSK, BPSK)
Number of Channels:	802.11b/g/n(HT20):11; 802.11n(HT40):7
Channel Spacing:	5MHz
Antenna Type:	PIFA Antenna
Antenna Gain:	2.5dBi
For 5G WIFI:	
Operation Frequency / Number of channels (20MHz):	U-NII-2A: 5260-5320MHz (4 Channels); U-NII-2C: 5500-5700MHz (8 Channels); U-NII-3: 5745-5825MHz(5 Channels)
Operation Frequency / Number of channels(40MHz):	U-NII-2A: 5270-5310MHz (2 Channels); U-NII-2C: 5510-5670MHz (3 Channels); U-NII-3: 5755-5795MHz (2 Channels)
Modulation Type:	802.11a: OFDM (64QAM, 16QAM, QPSK, BPSK); 802.11n: OFDM (BPSK, QPSK, 16QAM, 64QAM);
Channel Spacing:	802.11a/n 20: 20MHz; 802.11n 40: 40MHz
DFS Function:	Slave without Radar detection
Antenna Type:	PIFA Antenna
Antenna Gain:	3.1dBi



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For Lora:	
Operation Frequency:	902.5-927.5MHz
Modulation Type:	Lora
Number of Channels:	26
Antenna Type:	PIFA Antenna
Antenna Gain:	1.6dBi
Operation Frequency:	902.5-927.5MHz
Modulation Type:	Lora (FHSS)
Number of Channels:	26
Antenna Type:	PIFA Antenna
Antenna Gain:	1.6dBi

Remark: The information in this section is provided by the applicant or manufacturer, SGS is not liable to the accuracy, suitability, reliability or/and integrity of the information.

Declaration of EUT Family Grouping:

Model No.: 800, 700, 600, 500

Only the model 800 was tested, since according to the declaration from the applicant, the electrical circuit design, PCB layout, components used, internal wiring and functions were identical for all the above models, with only difference on battery. The battery model which 800 use is MWBT06S02P-01; The battery model which 700 use is MWBT06S02P-03; The battery model which 600/500 use are MWBT06S01P-03 and MWBT06S01P-04.

3.3 Separation Distance

Minimum test separation distance:	20cm
Remark: This minimum test separation distance is determined by the smallest distance from the antenna and radiating structures or outer surface of the device, according to the host form factor, exposure conditions and platform requirements, to any part of the body or extremity of a user or bystander.	



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3.4 Test Location

All tests were performed at:

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Tel: +86 755 2601 2053 Fax: +86 755 2671 0594

No tests were sub-contracted.

3.5 Test Facility

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

• A2LA (Certificate No. 3816.01)

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory is accredited by the American Association for Laboratory Accreditation(A2LA). Certificate No. 3816.01.

• VCCI (Member No. 1937)

The 3m Fully-anechoic chamber for above 1GHz, 10m Semi-anechoic chamber for below 1GHz, Shielded Room for Mains Port Conducted Interference Measurement and Telecommunication Port Conducted Interference Measurement of SGS-CSTC Standards Technical Services Co., Ltd. Shenzhen EMC laboratory have been registered in accordance with the Regulations for Voluntary Control Measures with Registration No.: G-20026, R-14188, C-12383 and T-11153 respectively.

• FCC –Designation Number: CN1336

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized as an accredited testing laboratory.

Designation Number: CN1336. Test Firm Registration Number: 787754.

• Innovation, Science and Economic Development Canada

SGS-CSTC Standards Technical Services Co., Ltd., Shenzhen EMC Laboratory has been recognized by ISED as an accredited testing laboratory.

CAB identifier: CN0006.

IC#: 4620C.

3.6 Deviation from Standards

None

3.7 Abnormalities from Standard Conditions

None



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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 ² f
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 $\lambda/2\pi$. 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 $ERP_{20\text{cm}}$ in Formula (B.1) [repeated from §2.1091(c)(1); also in §1.1307(b)(1)(i)(B)].

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

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 $\lambda/4$ 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)	$R(\lambda/2\pi)(\text{m})$	Threshold ERP(W)
300~1500MHz	915	0.0522	0.032
1500~100000MHz	2480	0.0193	0.007



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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 $\lambda/4$.

As for devices with antennas of length greater than $\lambda/4$ where the gain is not well defined, but always less than that of a half-wave dipole (length $\lambda/2$), 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).

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

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).

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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

Limit calculation				
Frequency range(GHz)	Frequency(GHz)	X	Distance(cm)	Pth (mW)
0.3~1.5	0.915	1.474	0.5	8.133
1.5~6	2.48	1.905	0.5	2.717



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2. According to FCC Part1.1310: The criteria listed in the following table shall be used to evaluate the environment impact of human exposure to radio frequency (RF) radiation as specified in part1.1307(b)

TABLE 1—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 Exposures				
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
300–1500 .....	.....	.....	f/300	6
1500–100,000 .....	.....	.....	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
300–1500 .....	.....	.....	f/1500	30
1500–100,000 .....	.....	.....	1.0	30

F= Frequency in MHz

Friis Formula

Friis transmission formula: $P_d = (P_{out} * G) / (4 * \pi * R^2)$

Where

P_d = power density in mW/cm²

P_{out} = output power to antenna in mW

G = gain of antenna in linear scale

π = 3.1416

R = distance between observation point and center of the radiator in cm

P_d is the limit of MPE, 1 mW/cm². If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance r where the MPE limit is reached.



5 Measurement and Calculation

Test Mode	Maximum EIRP [dBm]	Power Density (mW/cm ²)	Limit (mW/cm ²)	Ratio	Verdict
BLE	9.31	0.002	1	0.002	Pass
2.4G Wi-Fi	19.16	0.016	1	0.016	Pass
5G Wi-Fi	20.13	0.020	1	0.02	Pass
Lora FHSS	21.37	0.028	0.618	0.045	Pass
WCDMA Band II	31.5	0.315	1	0.315	Pass
WCDMA Band IV	29.50	0.177	1	0.177	Pass
WCDMA Band V	31.50	0.281	0.551	0.510	Pass
LTE Band 2	31.00	0.251	1	0.251	Pass
LTE Band 4	29.00	0.158	1	0.158	Pass
LTE Band 5	31.00	0.251	0.55	0.456	Pass
LTE Band 12	31.00	0.251	0.466	0.539	Pass
LTE Band 17	31.00	0.251	0.471	0.533	Pass
LTE Band 13	31.00	0.251	0.520	0.483	Pass
LTE Band 66	29.00	0.158	1	0.158	Pass
LTE Band 71	31.00	0.251	0.444	0.565	Pass

Remark: WCDMA and LTE data are form MPE report of LTE module (FCC ID: ZMONL668AM00).

Simultaneous transmission

Test Mode	5G Wi-Fi	Lora	LTE Band 71	Total Ratio	Limit	Verdict
Ratio	0.02	0.045	0.565	0.63	1.0	Pass

So, the device is to qualify for SAR test exemption, the exemption report is in lieu of the SAR report.

- End of the Report -