Maximum Permissible Exposure Report

FCC ID:	2AEUPBHAMS001			
Product name	Motion Sensor			
Model number	5SM1S8			
Power supply	DC 4.5 by Battery (3*AAA)			
Modulation Type	GFSK for Bluetooth V5.0 (BT LE)			
Channel Number	40 channels for Bluetooth V5.0 (BT LE)			
Channel Spacing	2MHz for Bluetooth V5.0 (BT LE)			
Antonno Tuno	PCB Antenna for Bluetooth			
Antenna Type	Internal Antenna for LoRa			
Antenna Gain	1.1 dBi (Max) for Bluetooth			
Antenna Gain	1.1 dBi (Max) for LoRa			
Hardware version	C20 V2.2 20181011			
Software version	Ver1.7.5-16			
Bluetooth Operation frequency	2402 MHz- 2480 MHz			
LoRa Operation frequency	902.5 MHz - 927.5 MHz			
LoRa Channel number	27			
LoRa Modulation Type	CSS			
Exposure category	General population/uncontrolled environment			
EUT Type	Production Unit			
Device Type	Mobile Device			

1. Product Information

2. Evaluation Method

Systems operating under the provisions of FCC 47 CFR section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines. In accordance with 47 CFR FCC Part 2 Subpart J, section 2.1091 this device has been defined as mobile device whereby a distance of 0.2m normally can be maintained between the user and the device, and below RF Permissible Exposure limit shall comply with.

In accordance with KDB447498D01 for Simultaneous transmission MPE test exclusion applies when the sum of the MPE ratios for all simultaneous transmitting antennas incorporated in a host device, based on the calculated/estimated, numerically modelled or measured field strengths or power density, is \leq 1.0. The MPE ratio of each antenna is determined at the minimum test separation distance required by the operating configurations and exposure conditions of the host device, according to the ratio of field strengths or power density to MPE limit, at the test frequency. Either the maximum peak or spatially averaged results from measurements or numerical simulations may be used to determine the MPE ratios. Spatial averaging does not apply when MPE is estimated using simple calculations based on far-field plane-wave equivalent conditions. The antenna installation and operating requirements for the host device must meet the minimum test separation distances required by all antennas, in both standalone and simultaneous transmission operations, to satisfy compliance.

3. Limit

3. 1 Refer Evaluation Method

ANSI C95.1–1999: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

FCC KDB publication 447498 D01 General 1 RF Exposure Guidance v06: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.

FCC CFR 47 part1 1.1310: Radiofrequency radiation exposure limits.

FCC CFR 47 part2 2.1091: Radiofrequency radiation exposure evaluation: mobile devices

3. 2 Limit

Limits for Maximum Permissible Exposure (MPE)/Controlled Exposure								
Frequency	Frequency Electric Field		Power Density	Averaging Time				
Range (MHz)	Range (MHz) Strength (V/m)		(mW/cm²)	(minute)				
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 - 1500	/	/	f/300	6				
1500 – 100,000 /		/	5	6				
Limits	for Maximum Perm	issible Exposure (MF	PE)/Uncontrolled Exp	osure				
Frequency	Electric Field	Magnetic Field	Power Density	Averaging Time				
Range (MHz)	Strength (V/m)	Strength (A/m)	(mW/cm²)	(minute)				
	Limits for O	ccupational/Controll	ed Exposure					
0.3 - 3.0 614		1.63	(100) *	30				
3.0 - 30	3.0-30 824/f		(180/f²)*	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

*=Plane-wave equivalent power density

4. MPE Calculation Method

Predication of MPE limit at a given distance Equation from page 18 of OET Bulletin 65, Edition 97-01

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

Where: S=power density

P=power input to antenna

G=power gain of the antenna in the direction of interest relative to an isotropic radiator R=distance to the center of radiation of the antenna

5. Antenna Information

5SM1S8 can only use antennas certificated as follows provided by manufacturer;

Internal Identification	Antenna type and antenna number	Operate frequency band	Maximum antenna gain	Note
Antenna 0	PCB Antenna	2000 MHz – 2500 MHz	1.1 dBi	BT Antenna
Antenna 1	Internal Antenna	900 MHz – 1000 MHz	1.1 dBi	ROLA Antenna

6. Conducted Power

Mode	Channel	Frequency (MHz)	Maximum Peak Power (dBm)
	0	2402	0.298
GFSK (BT LE)	19	2440	0.510
	39	2480	-0.502
	0	902.5	13.524
LORA	13	915.0	16.459
	26	927.5	16.719

7. Manufacturing Tolerance

GFSK (BT LE) (Peak)							
Channel	Channel 0	Channel 19	Channel 39				
Target (dBm)	1.0	1.0	0				
Tolerance ±(dB)	1.0	1.0	1.0				
	LoRa (Peak)						
Channel	Channel 0	Channel 13	Channel 26				
Target (dBm) 14.0		17.0	17.0				
Tolerance ±(dB)	1.0	1.0	1.0				

8. Measurement Results

8.1 Standalone MPE Evaluation

As declared by the Applicant, the EUT is a wireless device used in a fix application, at least 20 cm from any body part of the user or nearby persons; from the maximum EUT RF output power, the minimum separation distance, r =20cm, as well as the gain of the used antenna refer to antenna information, the RF power density can be obtained.

[Antenna 0]

	Output	power	Antenna	Antenna	Duty	MPE	MPE
Modulation Type	dBm	mW	Gain (dBi)	Gain (linear)	Duty Cycle	(mW/cm ²)	Limits (mW/cm ²)
GFSK (BT LE)	2.00	1.5849	1.10	1.2882	100%	0.0004	1.0000

[Antenna 1]

	Output	power	Antenna	Antenna	Dutv	MPE	MPE
Modulation Type	dBm	mW	Gain (dBi)	Gain (linear)	Cycle	(mW/cm ²)	Limits (mW/cm ²)
LORA	18.00	63.0957	1.10	1.2882	100%	0.0162	0.6013

Remark:

1. Output power including tune-up tolerance;

2. MPE evaluate distance is 20cm from user manual provide by manufacturer;

8.2 Simultaneous Transmission MPE

The sample support one BT and one LoRa modular also share difference antennas, they can transmit at same time, need consider simultaneous transmission;

[Antenna 0 + Antenna 1]

MPE Antenna 0 Ratios MPE Antenna 1 Ratios		∑MPE ratios	Limit	Results
0.0003	0.0269	0.1	1.0	PASS

9. Conclusion

The measurement results comply with the FCC Limit per 47 CFR 2.1091 for the uncontrolled RF Exposure of mobile device.

-----THE END OF REPORT------