FCC RF Exposure Test Report

Report No.	:	**W7L-P23120015SA01**
Applicant	:	**Particle Industries,Inc**
Address	:	**325 9th Street, San Francisco, CA 94103, United States Of America**
Product	:	**M SoM**
Brand Name	:	**Particle**
Model Name	:	**M404**
FCC ID	:	**2AEMI-M404**
Standards	:	**FCC Part 2 (Section 2.1091)** **KDB 447498 D01 General RF Exposure Guidance v06**
Sample Received Date	:	**Dec. 27, 2023**
Date of Testing	:	**Dec. 27, 2023 ~ Jan. 26, 2024**

CERTIFICATION: The above equipment have been tested by **BV 7LAYERS COMMUNICATIONS TECHNOLOGY (SHENZHEN) CO., LTD.**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's SAR characteristics under the conditions specified in this report. It should not be reproduced except in full, without the written approval of our laboratory. The client should not use it to claim product certification, approval, or endorsement by A2LA or any government agencies.

Prepared By : Jerry Chen / Engineer

Approved By : Luke Lu / Manager

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Release Control Record

Report No.	Reason for Change	Date Issued
W7L-P23120015SA01	Initial release	Feb. 26, 2024

1. Description of Equipment Under Test

EUT Type	M SoM
Brand Name	Particle
Model Name	M404
Tx Frequency Bands (Unit: MHz)	GSM850 : 824.2 ~ 848.8 GSM1900 : 1850.2 ~ 1909.8 LTE Band 2 : 1850.7 MHz ~ 1909.3 MHz LTE Band 4 : 1710.7 MHz ~ 1754.3 MHz LTE Band 5 : 824.7 MHz ~ 848.3 MHz LTE Band 12 : 699.7 MHz ~ 715.3 MHz LTE Band 13 : 779.5 MHz ~ 784.5 MHz LTE Band 25 : 1850.7MHz ~ 1914.3MHz LTE Band 26 : 814.7MHz ~ 848.3MHz LTE Band 66 : 1710.7 MHz ~ 1779.3 MHz WLAN : 2412 ~ 2462, 5180 ~ 5240, 5260 ~ 5320, 5500 ~ 5700, 5745 ~ 5825 Bluetooth : 2402 ~ 2480
Uplink Modulations	GSM & GPRS : GMSK EDGE : 8PSK LTE : QPSK, 16QAM, 64QAM 802.11b : DSSS 802.11a/g/n : OFDM Bluetooth : GFSK
Antenna Type	WLAN: PCB Antenna WWAN: Fixed External Antenna
EUT Stage	Production Unit

Note:

1. The above EUT information is declared by manufacturer and for more detailed features description please refers to the manufacturer's specifications or User's Manual.
2. Antenna gain and EUT conducted cable loss are provided by the customer, and the laboratory will record the results based on these items that involve these two parameters.

2. MPE(Maximum Permissible Exposure) Assessment

2.1 Introduction

According to 47 CFR §2.1091, a mobile device is defined as a transmitting device designed to be used in other than fixed locations and to generally be used in such a way that a separation distance of at least 20 cm is normally maintained between the transmitting antenna and the body of the user or nearby persons. In this context, the term "fixed location" means that the device is physically secured at one location and is not able to be easily moved to another location. Transmitting devices designed to be used by consumers or workers that can be easily re-located, such as wireless devices associated with a personal computer, are considered to be mobile devices if they meet the 20 cm separation requirement. The limits to be used for MPE evaluation are specified in §1.1310. All unlicensed personal communications service (PCS) devices and unlicensed NII devices shall be subject to the limits for general population/uncontrolled exposure.

2.2 RF Radiation Exposure Limits

According to 47 CFR §1.1310, the criteria listed in below table shall be used to evaluate the environmental impact of human exposure to RF radiation as specified in §1.1307(b), except in the case of portable devices which shall be evaluated according to the provisions of §2.1093.

Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm^2)	Averaging Time (min)
(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 – 100000	-	-	5	6
(B) Limits for General Population / Uncontrolled Exposures				
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 – 100000	-	-	1.0	30

Limits for maximum permissible exposure (MPE)

Notes:

1. f = frequency in MHz
2. 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 they are made aware of the potential for exposure.

3. 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.

2.3 MPE Assessment Method

Calculations can be made to predict RF field strength and power density levels around typical RF sources. For example, in the case of a single radiating antenna, a prediction for power density in the far-field of the antenna can be made by use of the general Equations below. This equation is generally accurate in the far-field of an antenna but will over-predict power density in the near field, where they could be used for making a "worst case" or conservative prediction.

$$\text{Power Density (S)} = \frac{PG}{4\pi R^2} = \frac{EIRP}{4\pi R^2}$$

Where
S = Power Density, unit in mW/cm^2
P = Power input to the antenna, unit in mW
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, unit in cm
EIRP = Effective isotropically radiated power

2.4 MPE Calculation for Standalone Operations

The manufacturer expects that the radiated component of this device will not close to the human body during normal usage and the warning statement was also stated in the user instruction. Since the transmitting antenna will be kept at least 20 cm away from the human body, the MPE level is calculated based on this condition and the result is listed in below table.

CALCULATION FOR MAXIMUM E.I.R.P

Band	Antenna Gain (dBi)	Maximum Power (dBm)	Average EIRP (mW)	Power Density (mW/cm^2)	Limit (mW/cm^2)	Power Density / Limit	Result (PASS / FAIL)
Bluetooth LE	3	8.5	14.13	0.003	1.000	0.003	Pass
2.4GHz WLAN	3	17.0	100.00	0.020	1.000	0.020	Pass
5.2GHz WLAN	6.8	15.0	151.36	0.030	1.000	0.030	Pass
5.3GHz WLAN	6.8	18.5	338.84	0.067	1.000	0.067	Pass
5.5GHz WLAN	6.8	17	239.88	0.048	1.000	0.048	Pass
5.8GHz WLAN	6.8	18.5	338.84	0.067	1.000	0.067	Pass
GSM 850	2.8	34.0	602.56	0.120	0.549	0.218	Pass
GSM 1900	5.3	29.0	338.84	0.067	1.000	0.067	Pass
LTE Band 2	5.3	25.0	1071.52	0.213	1.000	0.213	Pass
LTE Band 4	5.3	25.0	1071.52	0.213	1.000	0.213	Pass
LTE Band 5	2.8	25.0	602.56	0.120	0.549	0.218	Pass
LTE Band 12	2.8	25.0	602.56	0.120	0.466	0.257	Pass
LTE Band 13	2.8	25.0	602.56	0.120	0.518	0.232	Pass
LTE Band 25	5.3	25.0	1071.52	0.213	1.000	0.213	Pass
LTE Band 26 for Part22	2.8	25.0	602.56	0.120	0.550	0.218	Pass
LTE Band 26 for Part90	2.8	25.0	602.56	0.120	0.543	0.221	Pass
LTE Band 66	5.3	25.0	1071.52	0.213	1.000	0.213	Pass

2.5 CONCLUSION OF SIMULTANEOUS TRANSMITTER

Both of the WLAN and WWAN can transmit simultaneously, the formula of calculated the MPE is:

CPD1/LPD1+CPD2/LPD2+……etc. < 1
CPD = Calculation power density
LPD = Limit of power density

Band	Antenna Gain (dBi)	Maximum Tune up Power (dBm)	Average EIRP (mW)	Power Density (mW/cm^2)	Power Density / Limit	Σ(Power Density / Limit)	Limit	Result
LTE Band 26 for Part22	2.8	34.0	602.56	0.120	0.218	0.288	1.000	PASS
5.8GHz WLAN	6.8	18.5	338.84	0.067	0.067			
Bluetooth LE	3	8.5	14.13	0.003	0.003			

Summary:
Since the ERP (effective radiated power) operated at < 1.5 GHz is less than 1.5 watts and > 1.5 GHz is less than 3 watts, the routine environmental evaluation is not required, and the MPE result calculated for this device complies with the MPE limit as specified in 47 CFR §1.1310.

3. Information on the Testing Laboratories

We, BV 7LAYERS COMMUNICATIONS TECHNOLOGY (SHENZHEN) CO., LTD., were founded in 2015 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

Add: Room B37, Warehouse A5, No.3 Chiwan 4th Road, Zhaoshang Street, Nanshan District Shenzhen, Guangdong, People's Republic of China
Tel: 86-755-8869-6566
Fax: 86-755-8869-6577

Email: customerservice.sw@ bureauveritas.com
Web Site: www.bureauveritas.com

The road map of all our labs can be found in our web site also.

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