RF Exposure Evaluation Report

APPLICANT	:	**Franklin Technology Inc.**
EQUIPMENT	:	**5G RF module**
MODEL NAME	:	**M2500**
FCC ID	:	**XHG-M2500**
STANDARD	:	**47 CFR Part 2.1091**

The product evaluation date was started from Aug. 08, 2022 and completed on Aug. 19, 2022. We, Sporton International Inc. (Kunshan), would like to declare that the device has been evaluated in accordance with 47 CFR Part2.1091, and pass the limit. Without written approval of Sporton International Inc. (Kunshan), the test report shall not be reproduced except in full.

Si Zhang

Approved by: Si Zhang

Sporton International Inc. (Kunshan)
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People's Republic of China

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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA262007	Rev. 01	Initial issue of report.	Aug. 23, 2022

1. Administration Data

1.1. Testing Laboratory

Sporton International Inc. (Kunshan) is accredited to ISO/IEC 17025:2017 by American Association for Laboratory Accreditation with Certificate Number 5145.02.

Testing Laboratory			
Test Firm	Sporton International Inc. (Kunshan)		
Test Site Location	No. 1098, Pengxi North Road, Kunshan Economic Development Zone Jiangsu Province 215300 People's Republic of China TEL : +86-512-57900158 FAX : +86-512-57900958		
Test Site No.	Sporton Site No.	FCC Designation No.	FCC Test Firm Registration No.
	SAR01-KS	CN1257	314309

Applicant	
Company Name	Franklin Technology Inc.
Address	906 JEI Platz, 186, Gasan digital 1-ro, Gumcheon-Gu, Seoul, South Korea, 08502

Manufacturer	
Company Name	Franklin Technology Inc.
Address	906 JEI Platz, 186, Gasan digital 1-ro, Gumcheon-Gu, Seoul, South Korea, 08502

2. Guidance Applied

According to the specifications of the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC 47 CFR Part 2.1091
- KDB 447498 D04 Interim General RF Exposure Guidance v01
- FCC 47 CFR Part 1.1307

3. Description of Equipment Under Test (EUT)

Product Feature & Specification	
EUT Type	5G RF module
Model Name	M2500
FCC ID	XHG-M2500
Wireless Technology and Frequency Range	WCDMA Band II: 1850 MHz ~ 1910 MHz WCDMA Band IV: 1710 MHz ~ 1755 MHz WCDMA Band V: 824 MHz ~ 849 MHz LTE Band 2 : 1850 MHz ~ 1910 MHz LTE Band 4 : 1710 MHz ~ 1755 MHz LTE Band 5 : 824 MHz ~ 849 MHz LTE Band 12 : 699 MHz ~ 716 MHz LTE Band 25 : 1850 MHz ~ 1915 MHz LTE Band 26 : 814 MHz ~ 849 MHz LTE Band 66 : 1710 MHz ~ 1780 MHz LTE Band 41: 2496 MHz ~ 2690 MHz LTE Band 48: 3550 MHz ~ 3700 MHz LTE Band 71: 663 MHz ~ 698 MHz 5G NR n25 : 1850 MHz ~1915 MHz 5G NR n41 : 2496 MHz ~ 2690 MHz 5G NR n48 : 3550 MHz ~ 3700 MHz 5G NR n66 : 1710 MHz – 1780 MHz 5G NR n71 : 663 MHz – 698 MHz 5G NR n77 : 3450 MHz ~ 3550 MHz, 3700 MHz ~ 3980 MHz
Mode	RMC 12.2Kbps HSDPA HSUPA DC-HSDPA HSPA+(16QAM uplink is supported) LTE: QPSK, 16QAM 5G NR : CP-OFDM / DFT-s-OFDM, PI/2 BPSK, QPSK, 16QAM, 64QAM, 256QAM
Antenna Gain	Ant0: WCDMA Band II : -1.66 dBi WCDMA Band IV : -1.56 dBi WCDMA Band V : -0.66 dBi LTE Band 2 : -1.66 dBi LTE Band 4 : -1.56 dBi LTE Band 5 : -0.66 dBi LTE Band 12 : -1.43 dBi LTE Band 25 : -1.66 dBi LTE Band 26 : -0.66 dBi LTE Band 66: -1.56 dBi LTE Band 41: -2.99 dBi LTE Band 71: -2.75 dBi 5G NR n25 : -1.66 dBi 5G NR n41 : -2.99 dBi 5G NR n66: -1.56 dBi 5G NR n71: -2.75 dBi Ant2: 5G NR n25 : -1.54 dBi 5G NR n66: -1.19 dBi Ant3: 5G NR n41 : -2.18 dBi Ant4: LTE Band 48: -1.71 dBi 5G NR n48: -1.71 dBi 5G NR n77: -1.49 dBi
Antenna Type	WWAN: PIFA Antenna
HW Version	P1
SW Version	RG2100.TM.1354
EUT Stage	Identical Prototype

Remark:

1. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.
2. 5GNR n25/41/66/71 supports NSA and SA mode, 5GNR n48/77 only supports SA mode.
3. The EN-DC mode combination could be referred to the product spec.
4. This device supports HPUE for LTE Band 41 and 5GNR n41/77 with class 2 power level, so HPUE has been performed to do MPE analysis.

Comments and Explanations:
1. The declared of product specification for EUT presented in the report are provided by the manufacturer, and the manufacturer takes all the responsibilities for the accuracy of product specification.
2. The maximum RF output tune up power, antenna gain also the safe distance used for evaluate RF exposure were declared by manufacturer.

4. Maximum RF average output tune up power among production units

<WCDMA>

Ant0:

Mode		Maximum Average power(dBm)
WCDMA	Band II	24.00
	Band IV	24.00
	Band V	25.00

<LTE>

Ant0:

Mode		Maximum Average power(dBm)
LTE	Band 2	23.00
	Band 4	23.50
	Band 5	23.50
	Band 12	24.00
	Band 25	23.00
	Band 26	24.00
	Band 41 PC3	24.00
	Band 41 PC2	27.00
	Band 66	23.50
	Band 71	24.00

Ant4:

Mode		Maximum Average power(dBm)
LTE	Band 48	23.00

<5GNR>

Ant0:

Mode		Maximum Average power(dBm)
5GNR	n25	24.50
	n41 PC3	24.00
	n41 PC2	26.00
	n66	24.00
	n71	24.50

Ant2:

Mode		Maximum Average power(dBm)
5GNR	n25	24.50
	n66	24.00

Ant3:

Mode		Maximum Average power(dBm)
5GNR	n41 PC3	24.00
	n41 PC2	26.00

Ant4:

Mode		Maximum Average power(dBm)
5GNR	n48	21.50
	n77 PC3	24.00
	n77 PC2	26.00

5. RF Exposure Limit Introduction

1. Per 1.1307(b)(3), (i) For single RF sources (i.e., any single fixed RF source, mobile device, or portable device, as defined in paragraph (b)(2) of this section): A single RF source is exempt if:

(A) The available maximum time-averaged power is no more than 1 mW, regardless of separation distance. This exemption may not be used in conjunction with other exemption criteria other than those in paragraph (b)(3)(ii)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(ii)(A);

(B) Or the available maximum time-averaged power or effective radiated power (ERP), whichever is greater, is less than or equal to the threshold Pth (mW) described in the following formula. This method shall only be used at separation distances (cm) from 0.5 centimeters to 40 centimeters and at frequencies from 0.3 GHz to 6 GHz (inclusive). Pth is given by:

$$\mathrm{P}_{th}\ (\mathrm{mW}) = \begin{cases} \mathrm{ERP}_{20\ cm}\ (\mathrm{d}/20\ \mathrm{cm})^{x} & d \le 20\ cm \\ \mathrm{ERP}_{20\ cm} & 20\ cm < d \le 40\ cm \end{cases} \quad [1]$$

$$\text{Where} \quad \mathrm{x} = -\log_{10}\left(\frac{60}{ERP_{20\ cm}\sqrt{f}}\right) \text{ and f is in GHz} \quad [2]$$

$$\text{and } \mathrm{ERP}_{20\ cm}\ (\mathrm{mW}) = \begin{cases} 2040\mathrm{f} & 0.3\ GHz < f \le 1.5\ GHz \\ 3060 & 1.5\ GHz < f \le 6\ GHz \end{cases} \quad [3]$$

(C) Or using Table 1 and the minimum separation distance (R in meters) from the body of a nearby person for the frequency (f in MHz) at which the source operates, the ERP (watts) is no more than the calculated value prescribed for that frequency. For the exemption in Table 1 to apply, R must be at least λ/2π, where λ is the free-space operating wavelength in meters. If the ERP of a single RF source is not easily obtained, then the available maximum time-averaged power may be used in lieu of ERP 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 (1.64 linear value)

Table 1 to § 1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	1,920 R^2
1.34-30	3,450 R^2 /f^2
30-300	3.83 R^2
300-1,500	0.0128 R^2 f
1,500-100,000	19.2 R^2

2. For multiple RF sources: Multiple RF sources are exempt if:

(A) The available maximum time-averaged power of each source is no more than 1 mW and there is a separation distance of two centimeters between any portion of a radiating structure operating and the nearest portion of any other radiating structure in the same device, except if the sum of multiple sources is less than 1 mW during the time-averaging period, in which case they may be treated as a single source (separation is not required). This exemption may not be used in conjunction with other exemption criteria other than those is paragraph (b)(3)(i)(A) of this section. Medical implant devices may only use this exemption and that in paragraph (b)(3)(i)(A).

(B) In the case of ¦xed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation.

$$\sum_{i=1}^{a} \frac{P_i}{P_{th,i}} + \sum_{j=1}^{b} \frac{ERP_j}{ERP_{th,j}} + \sum_{j=1}^{b} \frac{Evaluated_k}{Exposure\ Limit_k} \leq 1$$

a. a = number of fixed, mobile, or portable RF sources claiming exemption using the § 1.1307(b)(3)(i)(B) formula for *P*th, including existing exempt transmitters and those being added.

b. b = number of fixed, mobile, or portable RF sources claiming exemption using the applicable § 1.1307(b)(3)(i)(C) Table 1 formula for Threshold ERP, including existing exempt transmitters and those being added.

c. c = number of existing fixed, mobile, or portable RF sources with known evaluation for the specified minimum distance.

d. *Pi,* the available maximum time-averaged power or the ERP, whichever is greater, for fixed, mobile, or portable RF source *i* at a distance between 0.5 cm and 40 cm (inclusive)

e. *P*th,*i* the exemption threshold power (*P*th) according to the § 1.1307(b)(3)(i)(B) formula for fixed, mobile, or portable RF source *i*.

f. *ERPj* the available maximum time-averaged power or the ERP, whichever is greater, of fixed, mobile, or portable RF source *j*.

g. *ERP*th,*j* exemption threshold ERP for fixed, mobile, or portable RF source *j*, at a distance of at least λ/2π, according to the applicable § 1.1307(b)(3)(i)(C) Table 1 formula at the location in question.

h. *Evaluatedk* the maximum reported SAR or MPE of fixed, mobile, or portable RF source *k* either in the device or at the transmitter site from an existing evaluation.

i. *Exposure Limitk* either the general population/uncontrolled maximum permissible exposure (MPE) or specific absorption rate (SAR) limit for each fixed, mobile, or portable sources RF source k, as applicable from § 1.1310 of this chapter.

j. The relationship between EIRP and ERP is: ERP (dBm) = EIRP - 2.15, Where EIRP is the sum of the conducted power (dBm) and the antenna gain (dBi)

The sum of the ratios of the applicable terms for SAR-based, MPE-based and measured SAR or MPE shall be less than 1, to determine simultaneous transmission exposure compliance

6. Radio Frequency Radiation Exposure Evaluation

6.1. Standalone assessment

Band	Antenna Gain (dBi)	Maximum Conducted Power (dBm)	Maximum EIRP (dBm)	Maximum ERP (dBm)	Maximum ERP (mW)	Separation Distance (cm)	Part1.1307 option(b) Threshold (mW)	Part1.1307 option(b) P/Pth
WCDMA Band 2	-1.66	24.00	22.34	20.19	104.47	20	3060.000	0.082
WCDMA Band 4	-1.56	24.00	22.44	20.29	106.91	20	3060.000	0.082
WCDMA Band 5	-0.66	25.00	24.34	22.19	165.58	20	1680.960	0.188
LTE Band 2	-1.66	23.00	21.34	19.19	82.99	20	3060.000	0.065
LTE Band 4	-1.56	23.50	21.94	19.79	95.28	20	3060.000	0.073
LTE Band 5	-0.66	23.50	22.84	20.69	117.22	20	1680.960	0.133
LTE Band 12	-1.43	24.00	22.57	20.42	110.15	20	1425.960	0.176
LTE Band 25	-1.66	23.00	21.34	19.19	82.99	20	3060.000	0.065
LTE Band 26	-0.66	24.00	23.34	21.19	131.52	20	1660.560	0.151
LTE Band 41	-2.99	27.00	24.01	21.86	153.46	20	3060.000	0.164
LTE Band 48	-1.71	23.00	21.29	19.14	82.04	20	3060.000	0.065
LTE Band 66	-1.56	23.50	21.94	19.79	95.28	20	3060.000	0.073
LTE Band 71	-2.75	24.00	21.25	19.10	81.28	20	1352.520	**0.186**
5G NR n25	-1.54	24.50	22.96	20.81	120.50	20	3060.000	0.092
5G NR n41	-2.18	26.00	23.82	21.67	146.89	20	3060.000	0.130
5G NR n66	-1.19	24.00	22.81	20.66	116.41	20	3060.000	0.082
5G NR n48	-1.71	21.50	19.79	17.64	58.08	20	3060.000	0.046
5G NR n71	-2.75	24.50	21.75	19.60	91.20	20	1352.520	**0.208**
5G NR n77	-1.49	26.00	24.51	22.36	172.19	20	3060.000	0.130

Note:

1. Chose the maximum power to do MPE analysis.
2. Chose the maximum RF output tune up power of all antennas among same frequency WWAN bands and the maximum antenna gain to perform MPE calculation conservatively.

6.2. Collocated assessment

LTE P/Pth Ratio	5GNR P/Pth Ratio	Sum of the Ratio LTE + 5GNR
0.186	0.208	0.394

Note:

1. For colocation analysis, LTE Band 71 is chosen for summation due to the highest (P/Pth Ratio) among all LTE WWAN wireless modes.
2. For colocation analysis, 5GNR n71 is chosen for summation due to the highest (P/Pth Ratio) among all 5GNR modes.
3. According to Part1.1307 (b)(3)(i)(B), the P/Pth Ratio is using for Sim-Tx analysis, above table was showing summation ratio is smaller than 1.

Conclusion:

According to 47 CFR §1.1307(b)(3)(i)(B), the RF exposure analysis concludes that the RF Exposure is FCC compliant.

------THE END------