

EMF TEST REPORT

Test Report No. : OT-232-RWD-031
Reception No. : 2212004035
Applicant : CHIPSEN. Co., Ltd
Address : B1 C-17, 15, Gyeongin-ro 53-gil, Guro-gu, Seoul, Korea
Manufacturer : CHIPSEN. Co., Ltd
Address : B1 C-17, 15, Gyeongin-ro 53-gil, Guro-gu, Seoul, Korea
Type of Equipment : Wireless Communication Module
FCC ID. : 2APB6-BOT-TMA50
Model Name : BoT-TMA50
Multiple Model Name : BoT-TMA50D, BoT-TMA50DU, BoT-TMA50DS
Serial number : N/A
Total page of Report : 7 pages (including this page)
Date of Incoming : February 07, 2023
Date of issue : February 27, 2023

SUMMARY

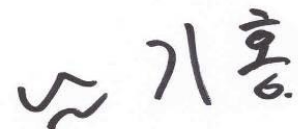
The equipment complies with the regulation; *FCC CFR 47 PART 2.1091*

This test report only contains the result of a single test of the sample supplied for the examination.

It is not a generally valid assessment of the features of the respective products of the mass-production.

This report is not correlated with the "KS Q ISO/IEC 17025 and KOLAS accreditation" of Korean Laboratory Accreditation Scheme.





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Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-232-RWD-031	February 27, 2023	Initial Release	All

1. VERIFICATION OF COMPLIANCE

Applicant : CHIPSEN. Co., Ltd
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 Contact Person : Young Min Park / Senior Engineer
 Telephone No. : +82-10-7144-0729
 FCC ID : 2APB6-BOT-TMA50
 Model Name : BoT-TMA50
 Brand Name : N/A
 Serial Number : N/A
 Date : February 27, 2023

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM
E.U.T. DESCRIPTION	Wireless Communication Module
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	KDB 447498 D01 General RF Exposure Guidance v06
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
Modifications on the Equipment to Achieve Compliance	None

-. The above equipment was tested by ONETECH Corp. for compliance with the requirement set forth in the FCC Rules and Regulations. This said equipment in the configuration described in this report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

2. GENERAL INFORMATION

2.1 Product Description

The CHIPSEN. Co., Ltd, Model BoT-TMA50 (referred to as the EUT in this report) is a Wireless Communication Module. The product specification described herein was obtained from product data sheet or user’s manual.

Device Type	Wireless Communication Module		
Temperature Range	-40 °C ~ +85 °C		
Operating Frequency	2 402 MHz ~ 2 480 MHz		
MAX. RF OUTPUT POWER	Bluetooth LE	1 Mbps	11.93 dBm
		2 Mbps	12.77 dBm
Number of Channel	Bluetooth LE	40 Channels	
Modulation Type	Bluetooth LE	GFSK	
Antenna Type	Chip Antenna		
Antenna Gain	3.50 dBi		
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	32 MHz		
Rated Supply Voltage	DC 3.3 V		

2.2 Alternative type(s)/model(s); also covered by this test report.

-. The following lists consist of the added model and their differences.

Model Name	Differences	Tested
BoT-TMA50	Basic Model	<input checked="" type="checkbox"/>
BoT-TMA50D	This model is identical to the basic model except for added Pin Header board surrounding Module.	<input checked="" type="checkbox"/>
BoT-TMA50DU	This model is identical to the basic model except for mounted Pin Header board including U.FL connector and added PCB Antenna	<input checked="" type="checkbox"/>
BoT-TMA50DS	This model is identical to the basic model except for mounted Pin Header board including SMA connector and added Dipole Antennas	<input checked="" type="checkbox"/>

Note: 1. For multiple models, Only radiated emission test has been performed.

2. The Applicant/manufacturer is responsible for the compliance of all variants.

3. EUT MODIFICATIONS

-. None

4. MAXIMUM PERMISSIBLE EXPOSURE

4.1 RF Exposure Calculation

According to the FCC rule 1.1310 table 1B, the limit for the maximum permissible RF exposure for an uncontrolled environment are $f/1500$ mW/cm² for the frequency range between 300 MHz and 1 500 MHz and 1.0 mW/cm² for the frequency range between 1 500 MHz and 100 000 MHz.

The electric field generated for a 1 mW/cm² exposure is calculated as follows:

$$E = \sqrt{(30 * P * G) / d}, \text{ and } S = E^2 / Z = E^2 / 377, \text{ because } 1 \text{ mW/cm}^2 = 10 \text{ W/m}^2$$

Where

S = Power density in mW/cm², Z = Impedance of free space, 377 Ω

E = Electric field strength in V/m, G = Numeric antenna gain, and d = distance in meter

Combining equations and rearranging the terms to express the distance as a function of the remaining variable

$$d = \sqrt{(30 * P * G) / (377 * 10 S)}$$

Changing to units of mW and cm, using P (mW) = P (W) / 1 000, d (cm) = 0.01 * d (m)

$$d = 0.282 * \sqrt{(P * G) / S}$$

Where

d = distance in cm, P = Power in mW, G = Numeric antenna gain, and S = Power density in mW/cm²

4.2 EUT Description

Kind of EUT	Wireless Communication Module
Device Category	<input type="checkbox"/> Portable (< 20 cm separation) <input type="checkbox"/> Mobile (> 20 cm separation) <input checked="" type="checkbox"/> Others
Exposure Evaluation Applied	<input checked="" type="checkbox"/> MPE <input type="checkbox"/> SAR <input type="checkbox"/> N/A

4.3 Calculated MPE Safe Distance for Bluetooth LE

According to above equation, the following result was obtained.

Operating Freq. Band (MHz)	Operating Mode	Target Power W/tolerance (dBm)	Max tune up power		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm ²) @ 20 cm Separation	Limit (mW/cm ²)
			(dBm)	(mW)	Log	Linear			
2 402 ~ 2 480	1 Mbps	11.93 ± 1.0	12.93	19.63	3.50	2.24	1.87	0.009	1
	2 Mbps	12.77 ± 1.0	13.77	23.82			2.06	0.011	1

According to above table, for 2 402 MHz ~ 2 480 MHz Band(2 Mbps), safe distance,

$$D = 0.282 * \sqrt{(23.82 * 2.24)/1.00} = 0.011 \text{ cm.}$$

For getting power density at 20 cm separation in above table, following formula was used.

$$S = P * G / (4\pi * R^2) = 23.82 * 2.24 / (4 * \pi * 20^2) = 0.011$$

Where:

S = Power Density,

P = Power input to the external antenna (Output power from the EUT antenna port (dBm) – cable loss (dB)),

G = Gain of Transmit Antenna (linear gain), R = Distance from Transmitting Antenna