ELECTROMAGNETIC EMISSION COMPLIANCE REPORT FOR LOW-POWER, NON-LICENSED TRANSMITTER

Test Report No. : **OT-218-RWD-079**

Reception No. : **2108003530**

Applicant : **ROBOTIS**

Address : **37, Magokjungang 5-ro 1-gil, Gangseo-gu, Seoul, South Korea**

Manufacturer : **ROBOTIS**

Address : **37, Magokjungang 5-ro 1-gil, Gangseo-gu, Seoul, South Korea**

Type of Equipment : **Controller**

FCC ID. : **SOD-CM-151**

Model Name : **CM-151**

Multiple Model Name : **N/A**

Serial number : **N/A**

Total page of Report : **7 pages (including this page)**

Date of Incoming : **August 04, 2021**

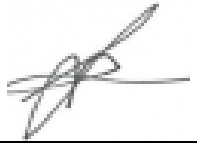
Date of issue : **August 20, 2021**

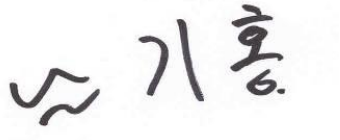
SUMMARY

The equipment complies with the regulation; ***FCC PART 15 SUBPART C Section 15.247***

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.





Tested by	Reviewed by	Approved by
Joon-Woo, Kim / Assistant Manager	Tae-Ho, Kim / Senior Manager	Ki-Hong, Nam / General Manager
ONETECH Corp.	ONETECH Corp.	ONETECH Corp.

ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

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ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-218-RWD-079	August 20, 2021	Initial Release	All

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1. VERIFICATION OF COMPLIANCE

Applicant : ROBOTIS

Address : 37, Magokjungang 5-ro 1-gil, Gangseo-gu, Seoul, South Korea

Contact Person : Eunsung Lee / Research Engineer

Telephone No. : +82-70-8671-2600

FCC ID : SOD-CM-151

Model Name : CM-151

Brand Name : -

Serial Number : N/A

Date : August 20, 2021

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM
E.U.T. DESCRIPTION	Controller
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2020
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC PART 15 SUBPART C Section 15.247 KDB 558074 D01 15.247 Meas Guidance v05r02
Modifications on the Equipment to Achieve Compliance	None
Final Test was Conducted On	3 m, Semi Anechoic Chamber

-. 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.

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2. GENERAL INFORMATION

2.1 Product Description

The ROBOTIS, Model CM-151 (referred to as the EUT in this report) is a Controller. The product specification described herein was obtained from product data sheet or user's manual.

Device Type	Controller
Temperature Range	-5 °C ~ 70 °C
Operating Frequency	2 402 MHz ~ 2 480 MHz
RF Output Power	-7.78 dBm
Number of Channel	40 Channel
Modulation Type	DSSS Modulation(GFSK)
Antenna Type	Chip Antenna
Antenna Gain	2.80 dBi
Electrical Rating	DC 3.7 V
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	32 MHz

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

-. None

3. EUT MODIFICATIONS

-. None

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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:

$E = \sqrt{(30 * P * G)} / d$, and $S = E^2 / Z = E^2 / 377$, because 1 mW/cm² = 10 W/m²

Where

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

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

Combing 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	Controller
Device Category	☐ Portable (< 20 cm separation) ☐ Mobile (> 20 cm separation) ■ Others
Exposure Evaluation Applied	■ MPE ☐ SAR ☐ N/A

4.3 Calculated MPE Safe Distance for Bluetooth LE

According to above equation, the following result was obtained.

Operating Mode	Target Power W/tolerance (dBm)	Max tune up power		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm²) @ 20 cm Separation	Limit (mW/cm²)
		(dBm)	(mW)	Log	Linear			
1 Mbps	-8.0 ± 1.0	-7.00	0.20	2.80	1.91	0.17	0.000 1	1.00

According to above table, for 2 402 ~ 2480 MHz Band, safe distance,

D = 0.282 * $\sqrt{(0.20 * 1.91)}$/1.00 = 0.17 cm.

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

S = P * G / (4π * R²) = 0.20 * 1.91 / (4 * π * 20^2) = 0.000 1

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