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

Test Report No.	: OT-218-RWD-111
Reception No.	: 2107003430
Applicant	: Samsung Electronics Co., Ltd.
Address	: 1, Samsung-ro, Giheung-gu, Yongin-si, Gyeonggi-do, Korea
Manufacturer	: Samsung Electronics Co., Ltd.
Address	: 1, Samsung-ro, Giheung-gu, Yongin-si, Gyeonggi-do, Korea
Type of Equipment	: IoT Module
FCC ID.	: 2AR3A-ITM-G2
Model Name	: ITM-G2
Serial number	: N/A
Total page of Report	: 8 pages (including this page)
Date of Incoming	: August 20, 2021
Date of issue	: August 31, 2021

SUMMARY

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

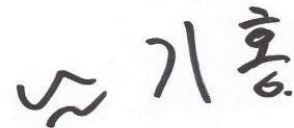This test report only contains the result of a single test of the sample supplied for the examination.

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

Tested by	Reviewed by	Approved by
Hyung-Kwon, Oh / Manager	Tae-Ho, Kim / Senior Manager	Ki-Hong, Nam / General Manager
ONETECH Corp.	ONETECH Corp.	ONETECH Corp.

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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-111	August 31, 2021	Initial Release	All

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1. VERIFICATION OF COMPLIANCE

Applicant   : Samsung Electronics Co., Ltd.

Address   : 1, Samsung-ro, Giheung-gu, Yongin-si, Gyeonggi-do, Korea

Contact Person : Moungjin, Jang / Staff Engineer

Telephone No.   : +070-7142-1361

FCC ID   : 2AR3A-ITM-G2

Model Name   : ITM-G2

Brand Name   : -

Serial Number   : N/A

Date   : August 31, 2021

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM
E.U.T. DESCRIPTION	IoT Module
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 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 Samsung Electronics Co., Ltd., Model ITM-G2 (referred to as the EUT in this report) is a IoT Module. The product specification described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	IoT Module	
Temperature Range	-20 °C ~ 50 °C	
OPERATING FREQUENCY	Bluetooth LE	2 402 MHz ~ 2 480 MHz
	Zigbee	2 405 MHz ~ 2 480 MHz
MODULATION TYPE	Bluetooth LE	GFSK
	Zigbee	O-QPSK
RF OUTPUT POWER	Bluetooth LE	Coded_125 kbps: 8.08 dBm Coded_500 kbps: 8.10 dBm 1 Mpbs: 8.01 dBm 2 Mpbs: 8.03 dBm
	Zigbee	7.19 dBm
Number of Channel	Bluetooth LE	40 Channel
	Zigbee	16 Channel
ANTENNA TYPE	PCB Antenna	
ANTENNA GAIN	-0.80 dBi	
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

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 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

Kind of EUT	IoT Module
Device Category	☐ Portable (< 20 cm separation) ☐ Mobile (> 20 cm separation) ■ Others
Exposure Evaluation Applied	■ MPE ☐ SAR ☐ N/A

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4.2 Test Result for Bluetooth

According to above equation, the following result was obtained.

Operating Freq. Band (MHz)	Operating Mode	Target Power W/tolerance	Max tune up power		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm²) @ 20 cm Separation	Limit (mW/ cm²)
		(dBm)	(dBm)	(mW)	Log	Linear			
2 402 ~ 2 480	LE Coded_125 kbps	8.0 ± 0.5	8.50	7.08	-0.80	0.83	0.68	0.001 2	1.00
	LE Coded_500 kbps	8.0 ± 0.5	8.50	7.08			0.68	0.001 2	1.00
	LE 1 M_1 Mbps	8.0 ± 0.5	8.50	7.08			0.68	0.001 2	1.00
	LE 2 M_2 Mbps	8.0 ± 0.5	8.50	7.08			0.68	0.001 2	1.00

According to above table, for 2 402 MHz ~ 2 480 MHz Band(LE Coded_125 kbps), safe distance,

$$D = 0.282 * \sqrt{(7.08 * 0.83) /1.00} = 0.68 \text{ cm}$$

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

$$S = P * G / (4\pi * R^2) = 7.08 * 0.83 / (4 * 3.14 * 20^2) = 0.001\ 2$$

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

4.3 Test Result for Zigbee

According to above equation, the following result was obtained.

Operating Freq. Band (MHz)	Operating Mode	Target Power W/tolerance	Max tune up power		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm²) @ 20 cm Separation	Limit (mW/ cm²)
		(dBm)	(dBm)	(mW)	Log	Linear			
2 405 ~ 2 480	Zigbee	7.00 ± 0.5	7.50	5.62	-0.80	0.83	0.61	0.000 9	1.00

According to above table, for 2 400 ~ 2 483.5 MHz Band, safe distance,

$$D = 0.282 * \sqrt{(5.62 * 0.83)/1.00} = 0.61 \text{ cm}$$

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

$$S = P * G / (4\pi * R^2) = 5.62 * 0.83 / (4 * 3.14 * 20^2) = 0.000\ 9$$

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

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