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

Test Report No.	: OT-18N-RWD-051
AGR No.	: A18NA-143
Applicant	: Samsung Electronics Co Ltd
Address	: 19 Chapin Rd., Building D, Pine Brook, New Jersey, 07058, United States
Manufacturer	: Samsung Electronics Co Ltd
Address	: Maetan dong 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do 16677, Korea
Type of Equipment	: Wi-Fi/BT Transceiver
FCC ID.	: A3LWCP731M
Model Name	: WCP731M
Serial number	: N/A
Total page of Report	: 14 pages (including this page)
Date of Incoming	: November 19, 2018
Date of issue	: November 29, 2018

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.

Reviewed by: _____   Approved by: _____

Ki-Hong, Nam / Chief Engineer   Keun-Young, Choi / Vice President
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-18N-RWD-051	2018.11.29	Initial Release	All

1. VERIFICATION OF COMPLIANCE

Applicant   : Samsung Electronics Co Ltd

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Manufacturer   : Samsung Electronics Co Ltd

Address   : Maetan dong 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do 16677, Korea

Factory 1   : WISOL HA NOI COMPANY LIMITED

Address   : No. 26, Street 05, Vsip Bac Ninh Industrial Park, Phu Chan Commont, Tu Son Town, Bac Ninh Province, Viet Nam.

Factory 2   : Shenzhen Zowee Technology Co., Ltd.

Address   : Floor 5 & 6, Block 5, Science & Technology Park of Privately Owned Enterprises, Pingshan, Xili, Nanshan District, Shenzhen, Guangdong Province, P.R. China

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Contact Person : minhyung, cho / Senior Engineer

Telephone No. : +82-31-277-2688

FCC ID   : A3LWCP731M

Model Name   : WCP731M

Brand Name   :

Serial Number : N/A

Date   : November 29, 2018

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM
E.U.T. DESCRIPTION	Modular Transmitter, Wi-Fi/BT Transceiver
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.10: 2013
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 DTS Meas Guidance v04
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 WCP731M (referred to as the EUT in this report) is a Wi-Fi/BT Transceiver. The product specification described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	Wi-Fi/BT Transceiver		
Temperature Range	-20 ℃ ~ 50 ℃		
OPERATING FREQUENCY	Bluetooth LE	2 402 MHz ~ 2 480 MHz	
	Bluetooth	2 402 MHz ~ 2 480 MHz	
	WLAN 2.4 GHz	2 412 MHz ~ 2 472 MHz (802.11b/g/n(HT20))	
		2 422 MHz ~ 2 462 MHz (802.11n(HT40))	
MODULATION TYPE	Bluetooth LE	GFSK	
	Bluetooth	GFSK for 1Mbps, π/4-DQPSK for 2Mbps, 8-DPSK for 3Mbps	
	WLAN 2.4 GHz	802.11b: DSSS Modulation(DBPSK/DQPSK/CCK) 802.11g/n(HT20)/n(HT40): OFDM Modulation(BPSK/QPSK/16QAM/64QAM)	
RF OUTPUT POWER'	Bluetooth LE	1 Mbps	10.10 dBm
		2 Mbps	10.05 dBm
	Bluetooth	1 Mbps	10.06 dBm
		2 Mbps	9.29 dBm
		3 Mbps	9.35 dBm
	WLAN 2.4 GHz	Antenna 0	22.23 dBm(802.11b) 17.70 dBm(802.11g) 17.12 dBm(802.11n_HT20) 14.34 dBm(802.11n_HT40)
		Antenna 1	22.68 dBm(802.11b) 18.20 dBm(802.11g) 17.54 dBm(802.11n_HT20) 15.04 dBm(802.11n_HT40)
		Multiple Antenna	20.97 dBm(802.11g) 20.35 dBm(802.11n_HT20) 17.71 dBm(802.11n_HT40)

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MODULATION TYPE	Bluetooth LE	GFSK
	Bluetooth	GFSK for 1Mbps, π/4-DQPSK for 2Mbps, 8-DPSK for 3Mbps
	WLAN 2.4 G	DSSS Modulation(DBPSK/DQPSK/CCK)
		OFDM Modulation(BPSK/QPSK/16QAM/64QAM)
ANTENNA TYPE	Metal Antenna	
ANTENNA GAIN	Bluetooth LE	-1.12 dBi
	Bluetooth	
	WLAN 2.4 GHz	Antenna 0
		Antenna 1
		Multiple Antenna
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	40 MHz	

Antenna 0	1.10 dBi
Antenna 1	2.85 dBi
Multiple Antenna	5.07 dBi

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

-. None

4. 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

4.2 EUT Description

Kind of EUT	Wi-Fi/BT Transceiver
Device Category	☐ Portable (< 20 cm separation) ☐ Mobile (> 20 cm separation) ■ Others
Exposure Evaluation Applied	■ MPE ☐ SAR ☐ N/A

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4.3 Calculated MPE Safe Distance for WLAN

4.3.1 DATA for Antenna 0

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			
2 400 ~ 2 483.5	802.11b	22.0 ± 0.5	22.50	177.83	1.10	1.29	4.27	0.045 6	1.00
	802.11g	17.5 ± 0.5	18.00	63.10			2.54	0.016 2	1.00
	802.11n_ HT20	17.0 ± 0.5	17.50	56.23			2.40	0.014 4	1.00
	802.11n_ HT40	14.5 ± 0.5	15.00	31.62			1.80	0.008 1	1.00

According to above table, for 2 400 ~ 2483.5 MHz Band, safe distance,

$D = 0.282 * \sqrt{(177.83 * 1.29)/1.00} = 4.27$ cm.

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

$$S = P * G / (4\pi * R^2) = 177.83 * 1.29 / (4 * 3.14 * 20^2) = 0.045\ 6$$

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

Tested by: Tae-Ho, Kim / Senior Manager

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4.3.2 DATA for Antenna 1

According to above equation, the following result was obtained.

Operating Freq. Band (MHz)	Operating Mode	Target Power W/tolerance (dBm)	Max tune up power (dBm)	Max tune up power (mW)	Antenna Gain Log	Antenna Gain Linear	Safe Distance (cm)	Power Density (mW/cm²) @ 20 cm Separation	Limit (mW/cm²)
2 400 ~ 2 483.5	802.11b	22.5 ± 0.5	23.00	199.53	2.85	1.93	5.53	0.076 6	1.00
	802.11g	18.0 ± 0.5	18.50	70.79			3.29	0.027 2	1.00
	802.11n_ HT20	17.5 ± 0.5	18.00	63.10			3.11	0.024 2	1.00
	802.11n_ HT40	15.0 ± 0.5	15.50	35.48			2.33	0.013 6	1.00

According to above table, for 2 400 ~ 2483.5 MHz Band, safe distance,

$$D = 0.282 * \sqrt{(199.53 * 1.93)/1.00} = 5.53 \text{ cm.}$$

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

$$S = P * G / (4\pi * R^2) = 199.53 * 1.93 / (4 * 3.14 * 20^2) = 0.076\ 6$$

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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4.3.3 DATA for Multiple Transmit

According to above equation, the following result was obtained.

Operating Freq. Band (MHz)	Operating Mode	Target Power W/tolerance	Max tune up power		Power Density (mW/cm²) @ 20 cm Separation	Sum Power Density (mW/cm²) @ 20 cm Separation	Limit (mW/cm²)
		(dBm)	(dBm)	(mW)			
2 400 ~ 2 483.5	802.11g	17.5 ± 0.5	18.00	63.10	0.016 2	0.043 4	1.00
		18.0 ± 0.5	18.50	70.79	0.027 2		
	802.11n_ HT20	17.0 ± 0.5	17.50	56.23	0.014 4	0.038 6	1.00
		17.5 ± 0.5	18.00	63.10	0.024 2		
	802.11n_ HT40	14.5 ± 0.5	15.00	31.62	0.008 1	0.021 7	1.00
		15.0 ± 0.5	15.50	35.48	0.013 6		

WLAN 2.4 GHz(802.11 g) = (0.016 2/1) + (0.027 2/1) = 0.043 4

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4.4 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	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	1 Mbps	10.0 ± 0.5	10.50	11.22	-1.12	0.77	0.83	0.001 7	1.00
	2 Mbps	10.0 ± 0.5	10.50	11.22			0.83	0.001 7	1.00

According to above table, for 2 402 ~ 2480 MHz Band(1 Mbps), safe distance,

D = 0.282 * $\sqrt{(11.22 * 0.77)/1.00}$ = 0.83 cm.

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

$$S = P * G / (4\pi * R^2) = 11.22 * 0.77 / (4 * 3.14 * 20^2) = 0.001\ 7$$

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

Tested by: Tae-Ho, Kim / Senior Manager

4.5 Calculated MPE Safe Distance 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	1 Mbps	10.0 ± 0.5	10.50	11.22			0.83	0.001 7	1.00
	2 Mbps	9.0 ± 0.5	9.50	8.91	-1.12	0.77	0.74	0.001 4	1.00
	3 Mbps	9.5 ± 0.5	10.00	10.00			0.78	0.001 5	1.00

According to above table, for 2 402 ~ 2480 MHz Band(1 Mbps), safe distance,

D = 0.282 * $\sqrt{(11.22 * 0.77)/1.00}$ = 0.83 cm.

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

S = P * G / (4π * R²) = 11.22 * 0.77 / (4 * 3.14 * 20^2) = 0.001 7

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

Tested by: Tae-Ho, Kim / Senior Manager

4.6 DATA for Intermodulation Transmit

According to above equation, the following result was obtained.

Operating Freq. Band (MHz)	Operating Mode	Target Power W/tolerance (dBm)	Max tune up power		Power Density (mW/cm²) @ 20 cm Separation	Sum Power Density (mW/cm²) @ 20 cm Separation	Limit (mW/cm²)
			(dBm)	(mW)			
Bluetooth + WLAN 2 G	Bluetooth (1 Mbps)	10.0 ± 0.5	10.50	11.22	0.001 7	0.078 3	1.00
	WLAN 2 G (802.11 b_Ant 0)	22.5 ± 0.5	23.00	199.53	0.076 6		
Bluetooth LE + WLAN 2 G	Bluetooth LE (1 Mbps)	10.0 ± 0.5	10.50	11.22	0.001 7	0.078 3	1.00
	WLAN 2 G (802.11 b_Ant 1)	22.5 ± 0.5	23.00	199.53	0.076 6		

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