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

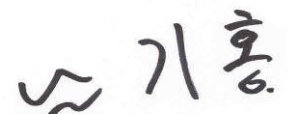|	
Test Report No.	: OT-182-RWD-051
AGR No.	: A182A-203
Applicant	: Samsung Electronics Co Ltd
Address	: 19 Chapin Rd., Building D, Pine Brook, New Jersey, 07058, United States
Manufacturer	: Samsung Electronics Co., Ltd.
Address	: Maetan dong 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do 16677, Korea
Type of Equipment	: Wi-Fi Transceiver
FCC ID.	: A3LWDN221M
Model Name	: WDN221M
Multiple Model Name	: N/A
Serial number	: N/A
Total page of Report	: 10 pages (including this page)
Date of Incoming	: February 12, 2018
Date of issue	: February 26, 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: _____
Ki-Hong, Nam / Asst, Chief Engineer
ONETECH Corp.

Approved by: _____
Keun-Young, Choi / Vice President
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

Issued Report No.	Issued Date	Revisions	Effect Section
OT-182-RWD-051	February 26, 2018	Initial Issue	All

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1. VERIFICATION OF COMPLIANCE

Applicant   : Samsung Electronics Co Ltd

Address   : 19 Chapin Rd., Building D, Pine Brook, New Jersey, 07058, United States

Contact Person   : minhyung cho / Senior Engineer

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

FCC ID   : A3LWDN221M

Model Name   : WDN221M

Serial Number   : N/A

Date   : February 26, 2018

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM
E.U.T. DESCRIPTION	Modular Transmitter, Wi-Fi 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 WDN221M (referred to as the EUT in this report) is a Wi-Fi Transceiver. Product specification information described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	Wi-Fi Transceiver	
Operating Frequency	2 412 MHz ~ 2 472 MHz (802.11b/g/n(HT20))	
	2 422 MHz ~ 2 462 MHz (802.11n(HT40))	
RF Output Power	Antenna 0	Wi-Fi 802.11b (18.56 dBm)
		Wi-Fi 802.11g (17.60 dBm)
		Wi-Fi 802.11n(HT20) (18.50 dBm)
		Wi-Fi 802.11n(HT40) (19.37 dBm)
	Antenna 1	Wi-Fi 802.11b (20.16 dBm)
		Wi-Fi 802.11g (18.99 dBm)
		Wi-Fi 802.11n(HT20) (19.12 dBm)
		Wi-Fi 802.11n(HT40) (18.36 dBm)
	Antenna 0 + Antenna 1	Wi-Fi 802.11n(HT20) (21.41 dBm)
		Wi-Fi 802.11n(HT40) (21.81 dBm)
Modulation Type	DSSS Modulation(DBPSK/DQPSK/CCK)	
	OFDM Modulation(BPSK/QPSK/16QAM/64QAM)	
Antenna Type	Antenna 0	1.54 dBi
	Antenna 1	0.59 dBi
	Antenna 0 + Antenna 1	4.10 dBi
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	40 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:

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

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

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4.2 EUT Description

Kind of EUT	Wi-Fi Transceiver	
Operating Frequency Band	■ WLAN: 2 412 MHz ~ 2 472 MHz	
	■ WLAN: 2 422 MHz ~ 2 462 MHz	
Device Category	□ Portable (< 20 cm separation)	
	□ Mobile (> 20 cm separation)	
	■ Others	
Exposure Evaluation Applied	■ MPE	
	□ SAR	
	□ N/A	
RF Output Power	Antenna 0	Wi-Fi 802.11b (18.56 dBm)
		Wi-Fi 802.11g (17.60 dBm)
		Wi-Fi 802.11n(HT20) (18.50 dBm)
		Wi-Fi 802.11n(HT40) (19.37 dBm)
	Antenna 1	Wi-Fi 802.11b (20.16 dBm)
		Wi-Fi 802.11g (18.99 dBm)
		Wi-Fi 802.11n(HT20) (19.12 dBm)
		Wi-Fi 802.11n(HT40) (18.36 dBm)
	Antenna 0 + Antenna 1	Wi-Fi 802.11n(HT20) (21.41 dBm)
		Wi-Fi 802.11n(HT40) (21.81 dBm)
Antenna Type	Antenna 0	1.54 dBi
	Antenna 1	0.59 dBi
	Antenna 0 + Antenna 1	4.10 dBi

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4.3 Calculated MPE Safe Distance for Antenna 0

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	18.50 ± 0.5	19.00	79.43	1.54	1.43	3.00	0.022 5	1.00
	802.11g	17.50 ± 0.5	18.00	63.10			2.67	0.017 9	1.00
	802.11n_ HT20	18.50 ± 0.5	19.00	79.43			3.00	0.022 5	1.00
	802.11n_ HT40	19.50 ± 0.5	20.00	100.00			3.37	0.028 4	1.00

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

$D = 0.282 * \sqrt{(100.00 * 1.43)/1.00} = 3.37$ cm

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

$S = P * G / (4\pi * R^2) = 100.00 * 1.43 / (4 * 3.14 * 20^2) = 0.028\ 4$

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: Hyung-Kwon, Oh / Assistant Manager

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4.4 Calculated MPE Safe Distance for Antenna 1

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	20.00 ± 0.5	20.50	112.20	0.59	1.15	3.20	0.025 6	1.00
	802.11g	19.00 ± 0.5	19.50	89.13			2.85	0.020 3	1.00
	802.11n_ HT20	19.00 ± 0.5	19.50	89.13			2.85	0.020 3	1.00
	802.11n_ HT40	18.50 ± 0.5	19.00	79.43			2.69	0.018 1	1.00

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

$$D = 0.282 * \sqrt{(112.20 * 1.15)/1.00} = 3.20 \text{ cm}$$

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

$$S = P * G / (4\pi * R^2) = 112.20 * 1.15 / (4 * 3.14 * 20^2) = 0.025 6$$

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: Hyung-Kwon, Oh / Assistant Manager

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4.5 Calculated MPE Safe Distance for Multiple Antenna (Antenna 0 + 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)
	802.11n_ HT20	21.50 ± 0.5	22.00	158.49	4.10	2.57	5.69	0.081 1	1.00
	802.11n_ HT40	22.00 ± 0.5	22.50	177.83			6.03	0.091 0	1.00

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

$D = 0.282 * \sqrt{(177.83 * 2.57)/1.00} = 6.03$ cm

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

$S = P * G / (4\pi * R^2) = 177.83 * 2.57 / (4 * 3.14 * 20^2) = 0.091\ 0$

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: Hyung-Kwon, Oh / Assistant Manager

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