

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

Test Report No. : W174R-D028
AGR No. : A173A-081
Applicant : Samsung Electronics Co Ltd
Address : 19 Chapin Rd., Building D, Pine Brook, New Jersey, 07058
Manufacturer : Samsung Electronics Co Ltd
Address : 19 Chapin Rd., Building D, Pine Brook, New Jersey, 07058
Type of Equipment : AWG (Advanced Wireless Gateway)
FCC ID. : A3LGXMC990CL
Model Name : GX-MC990CL
Serial number : N/A
Total page of Report : 12 pages (including this page)
Date of Incoming : March 10, 2017
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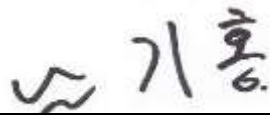
SUMMARY

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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REVISION HISTORY

Issued Report No.	Issued Date	Revisions	Effect Section
W174R-D028	April 11, 2017	Initial Issue	All

DOCUMENT HISTORY

Revision No.	Issued Date	Revisions	Effect Section
Original	April 11, 2017	Initial Issue	-
Revision 01	May 15, 2017	Revise Data (Section 2.1 Product Description, Section 5. Calculated MPE Safe Distance)	Section 2.1, Section 5
Revision 02	May 19, 2017	Revise Data (Section 5. Calculated MPE Safe Distance)	Section 5.0
Revision 03	May 23, 2017	Revise Data (Section 5. Calculated MPE Safe Distance)	Section 5.0

1. VERIFICATION OF COMPLIANCE

Applicant : Samsung Electronics Co Ltd
 Address : 19 Chapin Rd., Building D, Pine Brook, New Jersey, 07058
 Contact Person : Chan Ho Youn / General Manager
 Telephone No. : 973-808-6362
 FCC ID : A3LGXMC990CL
 Model Name : GX-MC990CL
 Brand Name : -
 Serial Number : N/A
 Date : April 11, 2017

EQUIPMENT CLASS	DTS – DIGITAL TRNSMISSION SYSTEM
E.U.T. DESCRIPTION	AWG (Advanced Wireless Gateway)
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
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.

2. GENERAL INFORMATION

2.1 Product Description

The Samsung Electronics Co Ltd, Model GX-MC990CL (referred to as the EUT in this report) is a AWG (Advanced Wireless Gateway). Product specification information described herein was obtained from product data sheet or user’s manual.

DEVICE TYPE	AWG (Advanced Wireless Gateway)		
FREQUENCY RANGE	WLAN 2.4 GHz Band	2 412 MHz ~ 2 462 MHz (802.11b/g/n(HT20))	
		2 422 MHz ~ 2 452 MHz (802.11n(HT40))	
	WLAN 5 GHz Band	5 150 MHz ~ 5 250 MHz Band	5 180 MHz ~ 5 240 MHz (802.11a/n(HT20)/ac(VHT20))
			5 190 MHz ~ 5 230 MHz (802.11n(HT40)/ac(VHT40))
			5 210 MHz (802.11ac(VHT80))
		5 725 MHz ~ 5 850 MHz Band	5 745 MHz ~ 5 825 MHz (802.11a/n(HT20)/ac(VHT20))
5 755 MHz ~ 5 795 MHz (802.11n(HT40)/ac(VHT40))			
		5 775 MHz (802.11ac(VHT80))	
MAX. RF OUTPUT POWER	WLAN 2.4 GHz Band	Antenna 0	Wi-Fi 802.11b (16.38 dBm) Wi-Fi 802.11g (20.09 dBm) Wi-Fi 802.11n(HT20) (20.12 dBm) Wi-Fi 802.11n(HT40) (21.87 dBm)
		Antenna 1	Wi-Fi 802.11b (16.46 dBm) Wi-Fi 802.11g (20.26 dBm) Wi-Fi 802.11n(HT20) (21.20 dBm) Wi-Fi 802.11n(HT40) (22.39 dBm)
		Antenna 2	Wi-Fi 802.11b (16.56 dBm) Wi-Fi 802.11g (20.99 dBm) Wi-Fi 802.11n(HT20) (21.28 dBm) Wi-Fi 802.11n(HT40) (21.74 dBm)
		Multiple transmit	Wi-Fi 802.11b (21.24 dBm) Wi-Fi 802.11g (25.24 dBm) Wi-Fi 802.11n(HT20) (25.67 dBm) Wi-Fi 802.11n(HT40) (26.78 dBm)

MAX. RF OUTPUT POWER	WLAN 5 GHz Band	5 150 MHz ~ 5 250 MHz Band	Antenna 0	Wi-Fi 802.11a (14.17 dBm) Wi-Fi 802.11n(HT20) (13.67 dBm) Wi-Fi 802.11n(HT40) (14.90 dBm) Wi-Fi 802.11ac(HT80) (1.62 dBm)
			Antenna 1	Wi-Fi 802.11a (12.41 dBm) Wi-Fi 802.11n(HT20) (12.69 dBm) Wi-Fi 802.11n(HT40) (14.14 dBm) Wi-Fi 802.11ac(HT80) (0.97 dBm)
			Antenna 2	Wi-Fi 802.11a (12.05 dBm) Wi-Fi 802.11n(HT20) (12.35 dBm) Wi-Fi 802.11n(HT40) (13.97 dBm) Wi-Fi 802.11ac(HT80) (0.59 dBm)
			Antenna 3	Wi-Fi 802.11a (13.14 dBm) Wi-Fi 802.11n(HT20) (13.63 dBm) Wi-Fi 802.11n(HT40) (15.06 dBm) Wi-Fi 802.11ac(HT80) (2.32 dBm)
			Multiple transmit	Wi-Fi 802.11a (18.99 dBm) Wi-Fi 802.11n(HT20) (19.14 dBm) Wi-Fi 802.11n(HT40) (20.56 dBm) Wi-Fi 802.11ac(HT80) (7.45 dBm)
			Antenna 0	Wi-Fi 802.11a (11.45 dBm) Wi-Fi 802.11n(HT20) (15.49 dBm) Wi-Fi 802.11n(HT40) (12.28 dBm) Wi-Fi 802.11ac(HT80) (3.65 dBm)
	WLAN 5 GHz Band	5 725 MHz ~ 5 850 MHz Band	Antenna 1	Wi-Fi 802.11a (12.65 dBm) Wi-Fi 802.11n(HT20) (15.78 dBm) Wi-Fi 802.11n(HT40) (13.38 dBm) Wi-Fi 802.11ac(HT80) (4.45 dBm)
			Antenna 2	Wi-Fi 802.11a (13.94 dBm) Wi-Fi 802.11n(HT20) (15.99 dBm) Wi-Fi 802.11n(HT40) (12.71 dBm) Wi-Fi 802.11ac(HT80) (3.85 dBm)
			Antenna 3	Wi-Fi 802.11a (14.78 dBm) Wi-Fi 802.11n(HT20) (13.93 dBm) Wi-Fi 802.11n(HT40) (13.38 dBm) Wi-Fi 802.11ac(HT80) (4.90 dBm)
			Multiple transmit	Wi-Fi 802.11a (19.41 dBm) Wi-Fi 802.11n(HT20) (22.01 dBm) Wi-Fi 802.11n(HT40) (18.98 dBm) Wi-Fi 802.11ac(HT80) (10.26 dBm)

MODULATION TYPE	WLAN 2.4 GHz Band	DSSS Modulation(DBPSK/DQPSK/CCK) OFDM Modulation(BPSK/QPSK/16QAM/64QAM)	
	WLAN 5 GHz Band	OFDM Modulation(BPSK/QPSK/16QAM/64QAM)	
ANTENNA TYPE	WLAN 2.4 GHz Band	1.60 dBi	
	WLAN 5 GHz Band	5 150 MHz ~ 5 250 MHz Band	2.80 dBi
		5 725 MHz ~ 5 850 MHz Band	5.0 dBi
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)		40 MHz, 54 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 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 $P \text{ (mW)} = P \text{ (W)} / 1 000$, $d \text{ (cm)} = 0.01 * d \text{ (m)}$

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

Where

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

MAX. RF OUTPUT POWER	WLAN 2.4 GHz Band	Antenna 0	Wi-Fi 802.11b (16.38 dBm) Wi-Fi 802.11g (20.09 dBm) Wi-Fi 802.11n(HT20) (20.12 dBm) Wi-Fi 802.11n(HT40) (21.87 dBm)
		Antenna 1	Wi-Fi 802.11b (16.46 dBm) Wi-Fi 802.11g (20.26 dBm) Wi-Fi 802.11n(HT20) (21.20 dBm) Wi-Fi 802.11n(HT40) (22.39 dBm)
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		Multiple transmit	Wi-Fi 802.11b (21.24 dBm) Wi-Fi 802.11g (25.24 dBm) Wi-Fi 802.11n(HT20) (25.67 dBm) Wi-Fi 802.11n(HT40) (26.78 dBm)

MAX. RF OUTPUT POWER	WLAN 5 GHz Band	5 150 MHz ~ 5 250 MHz Band	Antenna 0	Wi-Fi 802.11a (14.17 dBm) Wi-Fi 802.11n(HT20) (13.67 dBm) Wi-Fi 802.11n(HT40) (14.90 dBm) Wi-Fi 802.11ac(HT80) (1.62 dBm)
			Antenna 1	Wi-Fi 802.11a (12.41 dBm) Wi-Fi 802.11n(HT20) (12.69 dBm) Wi-Fi 802.11n(HT40) (14.14 dBm) Wi-Fi 802.11ac(HT80) (0.97 dBm)
			Antenna 2	Wi-Fi 802.11a (12.05 dBm) Wi-Fi 802.11n(HT20) (12.35 dBm) Wi-Fi 802.11n(HT40) (13.97 dBm) Wi-Fi 802.11ac(HT80) (0.59 dBm)
			Antenna 3	Wi-Fi 802.11a (13.14 dBm) Wi-Fi 802.11n(HT20) (13.63 dBm) Wi-Fi 802.11n(HT40) (15.06 dBm) Wi-Fi 802.11ac(HT80) (2.32 dBm)
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			Antenna 0	Wi-Fi 802.11a (11.45 dBm) Wi-Fi 802.11n(HT20) (15.49 dBm) Wi-Fi 802.11n(HT40) (12.28 dBm) Wi-Fi 802.11ac(HT80) (3.65 dBm)
	WLAN 5 GHz Band	5 725 MHz ~ 5 850 MHz Band	Antenna 1	Wi-Fi 802.11a (12.65 dBm) Wi-Fi 802.11n(HT20) (15.78 dBm) Wi-Fi 802.11n(HT40) (13.38 dBm) Wi-Fi 802.11ac(HT80) (4.45 dBm)
			Antenna 2	Wi-Fi 802.11a (13.94 dBm) Wi-Fi 802.11n(HT20) (15.99 dBm) Wi-Fi 802.11n(HT40) (12.71 dBm) Wi-Fi 802.11ac(HT80) (3.85 dBm)
			Antenna 3	Wi-Fi 802.11a (14.78 dBm) Wi-Fi 802.11n(HT20) (13.93 dBm) Wi-Fi 802.11n(HT40) (13.38 dBm) Wi-Fi 802.11ac(HT80) (4.90 dBm)
			Multiple transmit	Wi-Fi 802.11a (19.41 dBm) Wi-Fi 802.11n(HT20) (22.01 dBm) Wi-Fi 802.11n(HT40) (18.98 dBm) Wi-Fi 802.11ac(HT80) (10.26 dBm)

5. Calculated MPE Safe Distance

5.1 Test data for Multiple Antenna

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/cm ²) @ 20 cm Separation	Limit (mW/cm ²)
		(dBm)	(dBm)	(mW)	Log	Linear			
2 400 ~ 2 483.5	802.11n[HT40]	26.28 ± 0.5	26.78	476.43	1.60	1.45	7.40	0.137 1	1.00

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

$$D = 0.282 * \sqrt{(476.43 * 1.45)/1.00} = 7.40 \text{ cm}$$

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

$$S = P * G / (4\pi * R^2) = 476.43 * 1.45 / (4 * 3.14 * 20^2) = 0.137 1$$

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

5.2 Calculation Result Of Maximum Conducted Power

Operating Freq. Band	Operating Mode	Target Power W/tolerance	Max tune up power		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm ²) @ 20 cm Separation	Limit (mW/cm ²)
		(dBm)	(dBm)	(mW)	Log	Linear			
2 400 ~ 2 483.5	802.11n[HT40]	26.28 ± 0.5	26.78	476.43	1.60	1.45	7.40	0.137 1	1.00
5 725 ~ 5 850	802.11n[HT20]	21.51 ± 0.5	22.01	158.85	11.02	12.65	12.64	0.399 9	1.00

$$2.4 \text{ GHz band} + 5 \text{ GHz band} = (0.137 1 / 1) + (0.399 9 / 1) = 0.537 0$$

- Therefore the maximum calculations of above situations are less than the “1” limit.



Tested by: Hyung-Kwon, Oh / Engineer