TEST REPORT

KCTL Inc.
65, Sinwon-ro, Yeongtong-gu,
Suwon-si, Gyeonggi-do, 16677, Korea
TEL: 82-31-285-0894 FAX: 82-505-299-8311
www.kctl.co.kr

1. Client

- Name : Samsung Electronics Co., Ltd.
- Address : 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea
- Date of Receipt : 2021-03-29

2. Use of Report : Certification

3. Name of Product / Model : WiFi Module / CWBR720M

4. Manufacturer / Country of Origin : Samsung Electronics Co., Ltd. / Korea

5. FCC ID : A3LCWBR720M

6. IC Certificate No. : 649E-CWBR720M

7. Date of Test : 2021-03-31 to 2021-04-26

8. Location of Test : ■ Permanent Testing Lab ☐ On Site Testing
(Address:65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea)

9. Test method used : 47 CRF Part 1.1310
RSS-102 Issue 5 Mar 2015

10. Test Result : Refer to the test result in the test report

Affirmation	Tested by Name : Euijung Kim (Signature)	Technical Manager Name : Hyeonsu Jang (Signature)

2021-05-12

KCTL Inc.

REPORT REVISION HISTORY

Date	Revision	Page No
2021-05-12	Originally issued	-

General remarks for test reports

Statement concerning the uncertainty of the measurement systems used for the tests

(may be required by the product standard or client)

☐ **Internal procedure used for type testing through which traceability of the measuring uncertainty has been established:**

Procedure number, issue date and title:

Calculations leading to the reported values are on file with the testing laboratory that conducted the testing.

☒ **Statement not required by the standard or client used for type testing**

CONTENTS

1. General information

Client	:	Samsung Electronics Co., Ltd.
Address	:	129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea
Manufacturer	:	Samsung Electronics Co., Ltd.
Address	:	129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Rep. of Korea
Laboratory	:	KCTL Inc.
Address	:	65, Sinwon-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 16677, Korea
Accreditations	:	FCC Site Designation No: KR0040, FCC Site Registration No: 687132 VCCI Registration No. : R-20080, G-20078, C-20059, T-20056 CAB Identifier: KR0040, ISED Number: 8035A KOLAS No.: KT231

2. Device information

Equipment under test	:	WiFi Module
Model	:	CWBR720M
Modulation technique	:	WIFI(802.11a/b/g/n/ac)_DSSS, OFDM
Number of channels	:	2.4 GHz band: 13 ch (20 ㎒), 9 ch (40 ㎒), UNII-1: 4 ch (20 ㎒), 2 ch (40 ㎒), 1 ch (80 ㎒) UNII-2A: 4 ch (20 ㎒), 2 ch (40 ㎒), 1 ch (80 ㎒) UNII-2C: 12 ch (20 ㎒), 6 ch (40 ㎒), 3 ch (80 ㎒) UNII-3: 5 ch (20 ㎒), 2 ch (40 ㎒), 1 ch (80 ㎒)
Power source	:	DC 5.0 V
Antenna type	:	Metal Antenna
Antenna gain	:	2.4 ㎓ band ANT 1: 1.60 dBi, ANT 2: 1.60 dBi UNII-1 ANT 1: 1.70 dBi, ANT 2: 1.70 dBi UNII-2A ANT 1: 1.20 dBi, ANT 2: 1.20 dBi UNII-2C ANT 1: 1.10 dBi, ANT 2: 1.10 dBi UNII-3 ANT 1: 1.00 dBi, ANT 2: 1.00 dBi
Frequency range	:	2.4 ㎓ band: 2 412 ㎒ ~ 2 472 ㎒ (802.11b/g/n_HT20) 2.4 ㎓ band: 2 422 ㎒ ~ 2 462 ㎒ (802.11n_HT40) UNII-1: 5 180 ㎒ ~ 5 240 ㎒ (802.11a/n/ac_HT20/VHT20) UNII-1: 5 190 ㎒ ~ 5 230 ㎒ (802.11n/ac_HT40/VHT40) UNII-1: 5 210 ㎒ (802.11ac_VHT80) UNII-2A: 5 260 ㎒ ~ 5 320 ㎒ (802.11a/n/ac_HT20/VHT20) UNII-2A: 5 270 ㎒ ~ 5 310 ㎒ (802.11n/ac_HT40/VHT40) UNII-2A: 5 290 ㎒ (802.11ac_VHT80) UNII-2C: 5 500 ㎒ ~ 5 720 ㎒ (802.11a/n/ac_HT20/VHT20) UNII-2C: 5 510 ㎒ ~ 5 710 ㎒ (802.11n/ac_HT40/VHT40) UNII-2C: 5 530 ㎒ ~ 5 690 ㎒ (802.11ac_VHT80) UNII-3: 5 745 ㎒ ~ 5 825 ㎒ (802.11a/n/ac_HT20/VHT20) UNII-3: 5 755 ㎒ ~ 5 795 ㎒ (802.11n/ac_HT40/VHT40) UNII-3: 5 775 ㎒ (802.11ac_VHT80)
Software version	:	v1.0
Hardware version	:	v1.0
Test device serial No.	:	Conducted(88571DEEBB81) Radiated(88571DEEBB3A)
Operation temperature	:	-10 ℃ ~ 70 ℃

2.1. Frequency/channel operations

This device contains the following capabilities:
WLAN 2.4 ㎓_802.11b/g/n(HT20/40)
WLAN 5 ㎓_802.11a/n(HT20/40)/ac(VHT20/40/80)

Ch.	Frequency (㎒)
01	2 412
. .	. .
06	2 437
. .	. .
11	2 462
12	2 467
13	2 472

Table 2.1.1. 802.11b/g/n_HT20 mode

Ch.	Frequency (㎒)
03	2 422
. .	. .
06	2 437
. .	. .
09	2 452
10	2 457
11	2 462

Table 2.1.2. 802.11n_HT40 mode

UNII-1		UNII-2A		UNII-2C		UNII-3	
Ch.	Frequency (㎒)	Ch.	Frequency (㎒)	Ch.	Frequency (㎒)	Ch.	Frequency (㎒)
36	5 180	52	5 260	100	5 500	149	5 745
40	5 200	56	5 280	116	5 580	157	5 785
48	5 240	64	5 320	144	5 720	165	5 825

Table 2.1.3. 802.11a/n/ac_HT20/VHT20 mode

UNII-1		UNII-2A		UNII-2C		UNII-3	
Ch.	Frequency (㎒)	Ch.	Frequency (㎒)	Ch.	Frequency (㎒)	Ch.	Frequency (㎒)
38	5 190	54	5 270	102	5 510	151	5 755
46	5 230	62	5 310	110	5 550	159	5 795
				142	5 710		

Table 2.1.4. 802.11n/ac_HT40/VHT40 mode

UNII-1		UNII-2A		UNII-2C		UNII-3	
Ch.	Frequency (㎒)	Ch.	Frequency (㎒)	Ch.	Frequency (㎒)	Ch.	Frequency (㎒)
42	5 210	58	5 290	106	5 530	155	5 775
				138	5 690		

Table 2.1.5. 802.11ac_VHT80 mode

3. Measurement uncertainty

The measurement uncertainties shown below were calculated in accordance with the requirements of ANSI C63.10-2013.

All measurement uncertainty values are shown with a coverage factor of k=2 to indicated a 95 % level of confidence. The measurement data shown herein meets of exceeds the U_{CISPR} measurement uncertainty values specified in CISPR 16-4-2 and thus, can be compared directly to specified limits to determine compliance.

Parameter	Expanded uncertainty (±)
Conducted RF power	1.3 dB

4. RF Exposure

FCC

Regulation

This document is prepared to show compliance with the RF Exposure requirements as required in §1.1310 of the FCC rules and Regulations.
The limit for Maximum Permissible Exposure (MPE), specified in FCC §1.1310, is listed in Table 1-1.
According to FCC §1.1310: the criteria listed in the following table shall be used to evaluate the environmental impact of human exposure to radio-frequency (RF) radiation as specified in §1.1307(b).

Table 1 – Limits for Maximum Permissible Exposure (MPE)

Frequency Range (㎒)	Electric Field Strength [V/m]	Magnetic Field Strength [A/m]	Power Density [㎽/㎠]	Averaging Time [minute]
(A) Limits for Occupational / Controlled Exposure				
0.3 ~ 3.0	614	1.63	*100	6
3.0 ~ 30	1842/f	4.89/f	*900/f^2	6
30 ~ 300	61.4	0.163	1.0	6
300 ~ 1 500	/	/	f/300	6
1 500 ~ 15 000	/	/	5	6
(B) Limits for General Population / Uncontrolled Exposure				
0.3 ~ 1.34	614	1.63	*100	30
1.34 ~ 30	824/f	2.19/f	*180/f^2	30
30 ~ 300	27.5	0.073	0.2	30
300 ~ 1 500	/	/	f/1 500	30
1 500 ~ 15 000	/	/	1.0	30

*f=frequency in ㎒, *= plane-wave equivalent power density*

Per the guidance of KDB 680106, the E-field and H-field limits shown in the table above are extended down to 100 ㎑

IC

RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

According to RSS-102 Issue 5, Paragraph "4. Exposure Limits", Industry of Canada has adopted the RF field strength limits stablished in Healths Canada's RF exposure guideline, Safety code 6:

Frequency Range (㎒)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m^2)	Reference Period (minutes)
0.003-10^{21}	83	90	-	Instantaneous*
0.1-10	-	0.73/ f	-	6**
1.1-10	87/ $f^{0.5}$	-	-	6**
10-20	27.46	0.0728	2	6
20-48	58.07/ $f^{0.25}$	0.1540/ $f^{0.25}$	8.944/ $f^{0.5}$	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 f 0.3417	0.008335 f 0.3417	0.02619f0.6834	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ $f^{1.2}$
150000-300000	0.158 $f^{0.5}$	4.21 x 10^{-4} $f^{0.5}$	6.67 x 10^{-5} f	616000/ $f^{1.2}$

Note: f is frequency in ㎒.
*Based on nerve stimulation (NS).
** Based on specific absorption rate (SAR).

Exemption Limits for Routine Evaluation – RF Exposure Evaluation

According to RSS-102 Issue 5 section 2.5.2, RF exposure evaluation is required if the separation distance between the user and/or bystander and the device's radiating element is greater than 20 ㎝, except when the device operates as follows:

- Below 20 ㎒ and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1W (adjusted for tune-up tolerance);
- At or above 20 ㎒ and below 48 ㎒ and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 4.49/ $f^{0.5}$ W (adjusted for tune-up tolerance), where f is in ㎒;
- At or above 48 ㎒ and below 300 ㎒ and the source-bands, time-averaged maximum e.i.r.p. of the device is equal to or less than 0.6 W (adjusted for tune-up tolerance);
- At or above 300 ㎒ and below 6 ㎓ and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1.31×10^{-2} $f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in ㎒;
- At or above 6 ㎓ and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 5 W (adjusted for tune-up tolerance.)

In these cases, the information contained in the RF exposure technical brief may be limited to information that demonstrates how the e.i.r.p. was derived.

4.1. Test results

FCC

MPE (Maximum Permissive Exposure) Prediction

Predication of MPE limit at a given distance: Equation from page 18 of OET Bulletin 65, Edition 97-01

$$S = PG/4\pi R^2 \quad \left(\Rightarrow R = \sqrt{PG/4\pi S}\right)$$

S = power density [㎽/㎠]
P = Power input to antenna [㎽]
G = Power gain of the antenna in the direction of interest relative to an isotropic radiator
R = distance to the center of radiation of the antenna [㎝]

IC

RF Exposure evaluation

At or above 300 ㎒ and below 6 ㎓ and the source-based, time-averaged maximum e.i.r.p. of the device is equal to or less than 1.31 x 10^{-2} $f^{0.6834}$ W (adjusted for tune-up tolerance), where f is in ㎒;

Calculation Result of RF exposure (FCC)

Maximum tune-up tolerance (Worst Case)

RF	Mode	Frequency [㎒]	Max Tune-up Power [dBm]	Ant Gain [dBi]	Power density at 20 ㎝ [㎽/㎠]	Limit [㎽/㎠]
WLAN 2.4 ㎓ (Ant1 - SISO)	11b	2 462	18	1.60	0.018 14	1.000
WLAN 2.4 ㎓ (Ant2 - SISO)	11b	2 462	18	1.60	0.018 14	1.000
WLAN 2.4 ㎓ (MIMO)	11n_HT20	2 437	20	4.61	0.057 51	1.000
WLAN 5 ㎓ (Ant1 - SISO)	11n_HT20	5 500	17	1.10	0.012 84	1.000
WLAN 5 ㎓ (Ant2 - SISO)	11ac_VHT40	5 670	16	1.10	0.010 20	1.000
WLAN 5 ㎓ (MIMO)	11ac_VHT40	5 230	18	4.71	0.037 13	1.000

- Simultaneous Transmission (Worst configuration)

RF	Mode	Frequency [㎒]	Max Tune-up Power [dBm]	Ant Gain [dBi]	Power density at 20 ㎝ [㎽/㎠]	Limit [㎽/㎠]
WLAN 2.4 ㎓ (Ant2 11b 2 462 ㎒) + WLAN 5 ㎓ (Ant1 11n_HT20 5 500 ㎒)					0.030 99	1.000

Note.

1. The power density P_d (5th column) at a distance of 20 ㎝ calculated from the friis transmission Formula is far below the limit of 1 ㎽/㎠.
2. Simultaneous transmission of RF Exposure test exclusion for worst case configuration.

- 2.4G WLAN: the ratio is 0.018 14 / 1
- 5G WLAN: the ratio is 0.012 84 / 1
- 2.4G WLAN + 5G WLAN Power density: ((0.018 14 / 1) + (0.012 84 / 1))

Calculation Results of RF exposure (IC)

Maximum tune-up tolerance (Worst Case)

RF	Mode	Frequency [㎒]	Max Tune-up Power [dBm]	Ant Gain [dBi]	E.I.R.P		Limit [W]
					[dBm]	[W]	
WLAN 2.4 ㎓ (Ant1 - SISO)	11b	2 462	18	1.60	19.90	0.097 7	2.721 93
WLAN 2.4 ㎓ (Ant2 - SISO)	11b	2 462	18	1.60	19.10	0.081 3	2.721 93
WLAN 2.4 ㎓ (MIMO)	11n_HT20	2 437	20	4.61	24.52	0.283 1	2.703 01
WLAN 5 ㎓ (Ant1 - SISO)	11n_HT20	5 500	17	1.10	17.40	0.055 0	4.714 49
WLAN 5 ㎓ (Ant2 - SISO)	11ac_VHT40	5 670	16	1.10	18.90	0.077 6	4.813 60
WLAN 5 ㎓ (MIMO)	11ac_VHT40	5 230	18	4.71	22.71	0.186 6	4.555 07

5. Measurement Equipment

Equipment Name	Manufacturer	Model No.	Serial No.	Next Cal. Date
Spectrum Analyzer	R&S	FSV30	100810	21.07.29
Attenuator	API Inmet	40AH2W-10	17	22.05.11
Pulse Power Meter	ANRITSU	ML2495A	1608009	21.07.29
Pulse Power Sensor	ANRITSU	MA2411B	1726174	21.07.29

End of test report