

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

Test Report No. : W168R-D015
AGR No. : A165A-160
Applicant : Samsung Electronics Co Ltd
Address : 19 Chapin Rd., Building D, Pine Brook, New Jersey, 07058
Manufacturer : Samsung Electronics Co Ltd
Address : 129, Samsung-ro, Yeongtong-gu, Suwon-si, Gyeonggi-do, 443-742, Rep of Korea
Type of Equipment : WLAN Access Point
FCC ID. : A3LWEA514I
IC Certification No. : 649E-WEA514I
Model Name : WEA514i
Multiple Model Name : N/A
Serial number : N/A
Total page of Report : 22 pages (including this page)
Date of Incoming : May 19, 2016
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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: 

 Jae-Ho, Lee / Chief Engineer
 ONETECH Corp.

Approved by: 

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 ONETECH Corp.

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Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
W168R-D015	August 04, 2016	Initial Issue	All

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
 Fax No. : 973-808-6361
 FCC ID : A3LWEA514I
 IC Certification No. : 649E-WEA514I
 Model Name : WEA514i
 Serial Number : N/A
 Date : August 04, 2016

EQUIPMENT CLASS	UNII -Unlicensed National Information infrastructure
E.U.T. DESCRIPTION	WLAN Access Point
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
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 WEA514i (referred to as the EUT in this report) is a WLAN Access Point. Product specification information described herein was obtained from product data sheet or user’s manual.

DEVICE TYPE	WLAN Access Point	
OPERATING FREQUENCY	WLAN 2.4 GHz	2 412 MHz ~ 2 462 MHz (802.11b/g/n(HT20))
	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))
	5 250 MHz ~ 5 350 MHz Band	5 260 MHz ~ 5 320 MHz 802.11a/n(HT20)/ac(VHT20))
		5 270 MHz ~ 5 310 MHz (802.11n(HT40)/ac(VHT40))
		5 290 MHz (802.11ac(VHT80))
	5 470 MHz ~ 5 725 MHz Band	5 500 MHz ~ 5 700 MHz 802.11a/n(HT20)/ac(VHT20))
		5 510 MHz ~ 5 670 MHz (802.11n(HT40)/ac(VHT40))
		5 530 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))		
MODULATION TYPE	WLAN 2.4 G	DSSS Modulation(DBPSK/DQPSK/CCK) OFDM Modulation(BPSK/QPSK/16QAM/64QAM)
	WLAN 5 G	OFDM Modulation(BPSK/QPSK/16QAM/64QAM)
ANTENNA TYPE	PIFA Antenna	
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	40 MHz	

Antenna Gain

-. 2.4 GHz Band

Service Port	Antenna Gain	802.11b/g/n20	Ant 0	2.71
			Ant 1	2.11
			Ant 2	3.06
			Ant 3	2.66
	Directional Antenna Gain	802.11b/g/n20	Ant 0 + 1	5.43
			Ant 0 + 2	5.90
			Ant 0 + 3	5.70
			Ant 1 + 2	5.62
			Ant 1 + 3	5.40
			Ant 2 + 3	5.87
			Ant 0 + 1 + 2	7.42
			Ant 0 + 1 + 3	7.27
			Ant 0 + 2 + 3	7.58
			Ant 1 + 2 + 3	7.40
			Ant 0 + 1 + 2 + 3	8.67

-UNII 1

Service Port	Antenna Gain	802.11 a/n/ac	Ant 0	5.06
			Ant 1	5.38
			Ant 2	4.99
			Ant 3	5.59
	Directional Antenna Gain	802.11 a/n/ac	Ant 0 + 1	8.23
			Ant 0 + 2	8.04
			Ant 0 + 3	8.34
			Ant 1 + 2	8.20
			Ant 1 + 3	8.50
			Ant 2 + 3	8.31
			Ant 0 + 1 + 2	9.92
			Ant 0 + 1 + 3	10.12
			Ant 0 + 2 + 3	9.99
			Ant 1 + 2 + 3	10.10
			Ant 0 + 1 + 2 + 3	11.28

-UNII 2A

Service Port	Antenna Gain	802.11 a/n/ac	Ant 0	4.68
			Ant 1	5.36
			Ant 2	5.01
			Ant 3	5.94
	Directional Antenna Gain	802.11 a/n/ac	Ant 0 + 1	8.04
			Ant 0 + 2	7.86
			Ant 0 + 3	8.37
			Ant 1 + 2	8.20
			Ant 1 + 3	8.67
			Ant 2 + 3	8.51
			Ant 0 + 1 + 2	9.80
			Ant 0 + 1 + 3	10.13
			Ant 0 + 2 + 3	10.01
			Ant 1 + 2 + 3	10.22
			Ant 0 + 1 + 2 + 3	11.29

-UNII 2C

Service Port	Antenna Gain	802.11 a/n/ac	Ant 0	5.08
			Ant 1	5.33
			Ant 2	4.59
			Ant 3	5.32
	Directional Antenna Gain	802.11 a/n/ac	Ant 0 + 1	8.22
			Ant 0 + 2	7.85
			Ant 0 + 3	8.21
			Ant 1 + 2	7.99
			Ant 1 + 3	8.34
			Ant 2 + 3	7.98
			Ant 0 + 1 + 2	9.78
			Ant 0 + 1 + 3	10.02
			Ant 0 + 2 + 3	9.78
			Ant 1 + 2 + 3	9.86
			Ant 0 + 1 + 2 + 3	11.11

-UNII 3

Service Port	Antenna Gain	802.11 a/n/ac	Ant 0	4.64
			Ant 1	4.49
			Ant 2	4.00
			Ant 3	4.19
	Directional Antenna Gain	802.11 a/n/ac	Ant 0 + 1	7.58
			Ant 0 + 2	7.34
			Ant 0 + 3	7.43
			Ant 1 + 2	7.26
			Ant 1 + 3	7.35
			Ant 2 + 3	7.11
			Ant 0 + 1 + 2	9.16
			Ant 0 + 1 + 3	9.22
			Ant 0 + 2 + 3	9.06
			Ant 1 + 2 + 3	9.00
			Ant 0 + 1 + 2 + 3	10.36

MAX. RF OUTPUT POWER

-. Service Port

Band	Mode	Ant 0 (dBm)	Ant 1 (dBm)	Ant 2 (dBm)	Ant 3 (dBm)	Ant 0+1+2+3 (dBm)
WLAN 2.4 GHz	802.11b	19.15	19.34	18.50	18.46	24.90
	802.11g	18.96	19.40	19.26	19.31	25.26
	802.11n(HT20)	18.35	18.43	18.51	18.38	24.44
UNII1	802.11a	6.91	6.55	5.82	5.15	12.18
	802.11n(HT20)	8.67	7.55	7.71	6.76	13.60
	802.11n(HT40)	9.46	9.45	9.40	8.67	15.28
	802.11ac(VHT20)	8.76	7.89	7.50	6.67	13.70
	802.11ac(VHT40)	10.22	9.77	9.65	8.70	15.64
	802.11ac(VHT80)	9.61	9.18	8.76	7.79	14.91
UNII2A	802.11a	11.92	10.90	11.82	10.99	17.43
	802.11n(HT20)	12.33	11.18	11.89	10.36	17.50
	802.11n(HT40)	11.07	10.77	11.24	10.01	16.81
	802.11ac(VHT20)	11.69	11.19	11.50	10.68	17.30
	802.11ac(VHT40)	11.66	11.01	11.40	10.17	17.12
	802.11ac(VHT80)	9.59	11.65	11.73	10.65	17.01
UNII2C	802.11a	10.31	9.82	10.03	8.78	15.79
	802.11n(HT20)	12.02	11.57	12.06	10.67	17.47
	802.11n(HT40)	11.61	11.38	11.33	11.29	17.17
	802.11ac(VHT20)	10.74	10.51	10.58	9.56	16.31
	802.11ac(VHT40)	11.90	11.39	11.63	10.49	17.32
	802.11ac(VHT80)	6.50	7.10	7.50	5.88	12.81
UNII3	802.11a	14.69	13.36	13.96	12.30	19.68
	802.11n(HT20)	13.24	12.89	13.04	12.30	18.90
	802.11n(HT40)	15.17	14.74	14.56	13.80	20.62
	802.11ac(VHT20)	14.36	13.32	13.35	12.43	19.44
	802.11ac(VHT40)	17.72	18.33	18.24	17.97	24.09
	802.11ac(VHT80)	7.10	14.61	14.55	13.80	20.56

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. Output Power	Service Port	2.4 GHz Band	802.11b (24.90 @ Ant. 0+1+2+3) 802.11g (25.26 @ Ant. 0+1+2+3) 802.11n(HT20) (24.44 @ Ant. 0+1+2+3)
		UNII1	802.11a (12.18 @ Ant. 0+1+2+3) 802.11n(HT20) (13.60 @ Ant. 0+1+2+3) 802.11n(HT40) (15.28 @ Ant. 0+1+2+3) 802.11ac(VHT20) (13.70 @ Ant. 0+1+2+3) 802.11ac(VHT40) (15.64 @ Ant. 0+1+2+3) 802.11ac(VHT80) (14.91 @ Ant. 0+1+2+3)
		UNII2A	802.11a (17.43 @ Ant. 0+1+2+3) 802.11n(HT20) (17.50 @ Ant. 0+1+2+3) 802.11n(HT40) (16.81 @ Ant. 0+1+2+3) 802.11ac(VHT20) (17.30 @ Ant. 0+1+2+3) 802.11ac(VHT40) (17.12 @ Ant. 0+1+2+3) 802.11ac(VHT80) (17.01 @ Ant. 0+1+2+3)
		UNII2C	802.11a (15.79 @ Ant. 0+1+2+3) 802.11n(HT20) (17.47 @ Ant. 0+1+2+3) 802.11n(HT40) (17.17 @ Ant. 0+1+2+3) 802.11ac(VHT20) (16.31 @ Ant. 0+1+2+3) 802.11ac(VHT40) (17.32 @ Ant. 0+1+2+3) 802.11ac(VHT80) (12.81 @ Ant. 0+1+2+3)
		UNII3	802.11a (19.68 @ Ant. 0+1+2+3) 802.11n(HT20) (18.90 @ Ant. 0+1+2+3) 802.11n(HT40) (20.62 @ Ant. 0+1+2+3) 802.11ac(VHT20) (19.44 @ Ant. 0+1+2+3) 802.11ac(VHT40) (24.09 @ Ant. 0+1+2+3) 802.11ac(VHT80) (20.56 @ Ant. 0+1+2+3)

-. 2.4 GHz Band Antenna Gain

Service Port	Antenna Gain	802.11b/g/n20	Ant 0	2.71
			Ant 1	2.11
			Ant 2	3.06
			Ant 3	2.66
	Directional Antenna Gain	802.11b/g/n20	Ant 0 + 1	5.43
			Ant 0 + 2	5.90
			Ant 0 + 3	5.70
			Ant 1 + 2	5.62
			Ant 1 + 3	5.40
			Ant 2 + 3	5.87
			Ant 0 + 1 + 2	7.42
			Ant 0 + 1 + 3	7.27
			Ant 0 + 2 + 3	7.58
			Ant 1 + 2 + 3	7.40
			Ant 0 + 1 + 2 + 3	8.67

-UNII 1 Antenna Gain

Service Port	Antenna Gain	802.11 a/n/ac	Ant 0	5.06
			Ant 1	5.38
			Ant 2	4.99
			Ant 3	5.59
	Directional Antenna Gain	802.11 a/n/ac	Ant 0 + 1	8.23
			Ant 0 + 2	8.04
			Ant 0 + 3	8.34
			Ant 1 + 2	8.20
			Ant 1 + 3	8.50
			Ant 2 + 3	8.31
			Ant 0 + 1 + 2	9.92
			Ant 0 + 1 + 3	10.12
			Ant 0 + 2 + 3	9.99
			Ant 1 + 2 + 3	10.10
			Ant 0 + 1 + 2 + 3	11.28

-UNII 2A Antenna Gain

Service Port	Antenna Gain	802.11 a/n/ac	Ant 0	4.68
			Ant 1	5.36
			Ant 2	5.01
			Ant 3	5.94
	Directional Antenna Gain	802.11 a/n/ac	Ant 0 + 1	8.04
			Ant 0 + 2	7.86
			Ant 0 + 3	8.37
			Ant 1 + 2	8.20
			Ant 1 + 3	8.67
			Ant 2 + 3	8.51
			Ant 0 + 1 + 2	9.80
			Ant 0 + 1 + 3	10.13
			Ant 0 + 2 + 3	10.01
			Ant 1 + 2 + 3	10.22
			Ant 0 + 1 + 2 + 3	11.29

-UNII 2C Antenna Gain

Service Port	Antenna Gain	802.11 a/n/ac	Ant 0	5.08
			Ant 1	5.33
			Ant 2	4.59
			Ant 3	5.32
	Directional Antenna Gain	802.11 a/n/ac	Ant 0 + 1	8.22
			Ant 0 + 2	7.85
			Ant 0 + 3	8.21
			Ant 1 + 2	7.99
			Ant 1 + 3	8.34
			Ant 2 + 3	7.98
			Ant 0 + 1 + 2	9.78
			Ant 0 + 1 + 3	10.02
			Ant 0 + 2 + 3	9.78
			Ant 1 + 2 + 3	9.86
			Ant 0 + 1 + 2 + 3	11.11

-UNII 3 Antenna Gain

Service Port	Antenna Gain	802.11a/n/ac	Ant 0	4.64
			Ant 1	4.49
			Ant 2	4.00
			Ant 3	4.19
	Directional Antenna Gain	802.11a/n/ac	Ant 0 + 1	7.58
			Ant 0 + 2	7.34
			Ant 0 + 3	7.43
			Ant 1 + 2	7.26
			Ant 1 + 3	7.35
			Ant 2 + 3	7.11
			Ant 0 + 1 + 2	9.16
			Ant 0 + 1 + 3	9.22
			Ant 0 + 2 + 3	9.06
			Ant 1 + 2 + 3	9.00
Ant 0 + 1 + 2 + 3	10.36			
Exposure Evaluation Applied		<input checked="" type="checkbox"/> MPE <input type="checkbox"/> SAR <input type="checkbox"/> N/A		

2.4GHz & 5GHz can not transmit at the same time.

5. Calculated MPE Safe Distance

5.1 Test data for Multiple Antenna (Service Port)

According to above equation, the following result was obtained.

Operating Freq. Band	Operating Mode	Target Power W/tolerance	Max tune up power		Antenna Gain		Safe Distance (cm)	Power Density (mW/cm ²) @ 30 cm Separation	Limit (mW/cm ²)
		(dBm)	(dBm)	(mW)	Log	Linear			
5 150 ~ 5 250	802.11ac(VHT40)	15.64 ± 0.5	16.14	41.11	11.280	13.428	6.63	0.048 8	1.00
5 250 ~ 5 350	802.11n(HT20)	17.50 ± 0.5	18.00	63.10	11.290	13.459	8.22	0.075 1	1.00
5 470 ~5 725	802.11n(HT20)	17.47 ± 0.5	17.97	62.66	11.110	12.912	8.02	0.071 5	1.00
5 725 ~5 850	802.11ac(VHT40)	24.09 ± 0.5	24.59	287.74	10.360	10.864	15.77	0.276 4	1.00

According to above table, for 5 725 ~ 5 850 MHz Band, safe distance,

$$D = 0.282 * \sqrt{(287.74 * 10.864)/1.00} = 15.77 \text{ cm.}$$

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

$$S = P * G / (4\pi * R^2) = 287.74 * 10.864 / (4 * 3.14 * 30^2) = 0.276 4$$

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

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) @ 30 cm Separation	Limit (mW/cm ²)
		(dBm)	(dBm)	(mW)	Log	Linear			
2 400 ~ 2 483.5	802.11g	25.26 ± 0.5	25.76	376.70	8.67	7.362	14.85	0.245 2	1.00
5 725 ~5 850	802.11ac(VHT40)	24.09 ± 0.5	24.59	287.74	10.360	10.864	15.77	0.276 4	1.00

2.4 GHz band + 5 GHz band = (0.245 2 / 1) + (0.276 4 / 1) = 0.521 6

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