

TEST REPORT

of

FCC CFR 47 part 1, 1.1307(b), 1.1310

FCC ID: A3LATKM102000

Equipment Under Test : ARTIK-1020
 Model Name : ATKM102000
 Variant Model Name : ATKM102001, ATKM102002
 Applicant : Samsung Electronics Co., Ltd.
 Manufacturer : Samsung Electro-Mechanics Co., Ltd.
 Date of Test(s) : 2016.04.29 ~ 2016.05.02
 Date of Issue : 2016.06.16

In the configuration tested, the EUT complied with the standards specified above.

Tested By:



 Jungmin Yang

Date:

2016.06.16

Approved By:



 Hyunchoe You

Date:

2016.06.16

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1. General Information

1.1. Testing Laboratory

SGS Korea Co., Ltd. (Gunpo Laboratory)

-Wireless Div. 2FL, 10-2, LS-ro 182beon-gil, Gunpo-si, Gyeonggi-do, Korea, 15807

All SGS services are rendered in accordance with the applicable SGS conditions of service available on request and accessible at <http://www.sgs.com/en/Terms-and-Conditions.aspx>.

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1.2. Details of applicant

Applicant : Samsung Electronics Co., Ltd.

Address : 1, Samsung-ro, Giheung-gu, Yongin-si, Gyeonggi-do, 17113 Korea

Contact Person : Lee, Jae-Hyuk

Phone No. : +82 10 8848 6628

1.3. Description of EUT

Kind of Product	ARTIK-1020	
Model Name	ATKM102000	
Variant Model Name	ATKM102001, ATKM102002	
Power Supply	DC 4.2 V	
Frequency Range	2 402 MHz ~ 2 480 MHz (Bluetooth, Bluetooth Low Energy), 2 405 MHz ~ 2 475 MHz (Zigbee), 2 412 MHz ~ 2 462 MHz (11b/g/n_HT20), 2 422 MHz ~ 2 452 MHz (11n_HT40), 5 745 MHz ~ 5 825 MHz (Band 3: 11a/n_HT20, 11ac_VHT20), 5 755 MHz ~ 5 795 MHz (Band 3: 11n_HT40, 11ac_VHT40), 5 775 MHz (Band 3: 11ac_VHT80), 5 180 MHz ~ 5 220 MHz (Band 1: 11a/n_HT20, 11ac_VHT20), 5 190 MHz (Band 1: 11n_HT40, 11ac_VHT40), 5 260 MHz ~ 5 320 MHz (Band 2A: 11a/n_HT20, 11ac_VHT20), 5 270 MHz ~ 5 310 MHz (Band 2A: 11n_HT40, 11ac_VHT40), 5 290 MHz (Band 2A: 11ac_VHT80), 5 500 MHz ~ 5 720 MHz (Band 2C: 11a/n_HT20, 11ac_VHT20), 5 510 MHz ~ 5 710 MHz (Band 2C: 11n_HT40, 11ac_VHT40), 5 530 MHz ~ 5 690 MHz (Band 2C: 11ac_VHT80)	
Modulation Technique	DSSS, OFDM, GFSK, $\pi/4$ DQPSK, 8DPSK	
Number of Channels	79 channel (Bluetooth), 40 channel (Bluetooth Low Energy), 15 channel (Zigbee), 11 channel (11b/g/n_HT20), 7 channel (11n_HT40), 5 channel (Band 3: 11a/n_HT20, 11ac_VHT20), 2 channel (Band 3: 11n_HT40, 11ac_VHT40), 1 channel (Band 3: 11ac_VHT80), 3 channel (Band 1: 11a/n_HT20, 11ac_VHT20), 1 channel (Band 1: 11n_HT40, 11ac_VHT40), 4 channel (Band 2A: 11a/n_HT20, 11ac_VHT20), 2 channel (Band 2A: 11n_HT40, 11ac_VHT40), 1 channel (Band 2A: 11ac_VHT80), 9 channel (Band 2C: 11a/n_HT20, 11ac_VHT20), 4 channel (Band 2C: 11n_HT40, 11ac_VHT40), 2 channel (Band 2C: 11ac_VHT80)	
Antenna Type	Dipole antenna	
Antenna Gain	Port#1	2 402 MHz ~ 2 480 MHz: 2.7 dB i, 2 412 MHz ~ 2 462 MHz (MIMO): 2.7 dB i, 5 180 MHz ~ 5 320 MHz (MIMO): 2.7 dB i, 5 500 MHz ~ 5 720 MHz (MIMO): 2.7 dB i, 5 745 MHz ~ 5 825 MHz (MIMO): 2.7 dB i
	Port#2	2 412 MHz ~ 2 462 MHz (MIMO): 2.7 dB i, 5 180 MHz ~ 5 320 MHz (MIMO): 2.7 dB i, 5 500 MHz ~ 5 720 MHz (MIMO): 2.7 dB i, 5 745 MHz ~ 5 825 MHz (MIMO): 2.7 dB i
	Port#3	2 405 MHz ~ 2 475 MHz: 2.7 dB i
H/W Version	V0.5_R04	
S/W Version	1020GC0F-3AF-01Q0	

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1.4. Test report revision

Revision	Report number	Date of Issue	Description
0	F690501/RF-RTL009777	2016.05.02	Initial
1	F690501/RF-RTL009777-1	2016.06.16	Add U-NII 2A and 2C of 1.3 "Description of EUT"

1.5. Information of variant models

Model		Information
Basic Model	ATKM102000	H/W - PCB Layout and Out-line are the exactly same between both models. (PCB : Common used for both models) - PMIC, RF TRCV and Memory are the exactly same between both models. - Main Chip has perfectly same specifications except security features. (Main Chip does not support security features) S/W - ATKM102000, ATKM102001, ATKM102002 has same FW. - User can update FW if they need.
		H/W - Same to main model except security features. (Main Chip support Secure Boot) S/W - Same to main model.
Variant Model	ATKM102001	H/W - Same to main model except security features. (Main Chip support Secure Boot) S/W - Same to main model.
	ATKM102002	H/W - Same to main model except security features. (Main Chip support Secure Boot & Secure JTAG) S/W - Same to main model.

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2. RF Exposure Evaluation

2.1. Environmental evaluation and exposure limit according to FCC CFR 47 part 1, 1.1307(b), 1.1310

LIMITS FOR MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Frequency Range (MHz)	Electric Field Strength(V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Average Time
(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 – 100 000	-	-	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/1500	30
<u>1 500 – 100 000</u>	-	-	<u>1.0</u>	<u>30</u>

2.1.1. Friis transmission formula: $P_d = (P_{out} * G) / (4 * \pi * R^2)$

Where P_d = power density in mW/cm²

P_{out} = output power to antenna in mW

G = gain of antenna in linear scale

π = 3.1416

R = distance between observation point and center of the radiator in cm

P_d the limit of MPE, 1 mW/cm². If we know the maximum gain of the antenna and the total power input to the antenna, through the calculation, we will know the distance where the MPE limit is reached.

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2.1.2. Test Result of RF Exposure Evaluation

Test Item : RF Exposure Evaluation Data

Test Mode : Normal Operation

2.1.3. Output Power into Antenna & RF Exposure Evaluation Distance

Bluetooth

- Maximum tune up tolerance

Channel	Channel Frequency (MHz)	Output Average Power to Antenna (dB m)	Antenna Gain (dB i)	Power Density at 20 cm (mW/cm ²)	Limits (mW/cm ²)
0	2 402	15	2.7	0.011 715	1

Bluetooth Low Energy

- Maximum tune up tolerance

Channel	Channel Frequency (MHz)	Output Average Power to Antenna (dB m)	Antenna Gain (dB i)	Power Density at 20 cm (mW/cm ²)	Limits (mW/cm ²)
0	2 402	10	2.7	0.003 705	1

Zigbee

- Maximum tune up tolerance

Channel	Channel Frequency (MHz)	Output Average Power to Antenna (dB m)	Antenna Gain (dB i)	Power Density at 20 cm (mW/cm ²)	Limits (mW/cm ²)
1	2 405	8	2.7	0.002 337	1

WLAN (2.4G)

- Maximum tune up tolerance

Channel	Channel Frequency (MHz)	Output Average Power to Antenna (dB m)	Antenna Gain (dB i)	Power Density at 20 cm (mW/cm ²)	Limits (mW/cm ²)
1	2 412	21	2.7	0.046 637	1

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WLAN (5G)
- Maximum tune up tolerance

Channel	Channel Frequency (MHz)	Output Average Power to Antenna (dB m)	Antenna Gain (dB i)	Power Density at 20 cm (mW/cm ²)	Limits (mW/cm ²)
36	5 180	16	2.7	0.014 748	1

Note :

The power density Pd (5th column) at a distance of 20 cm calculated from the friis transmission formula is far below the limit of 1 mW/cm².

Simultaneous transmission MPE test exclusion

Bluetooth: the ratio is 0.011 715 / 1

Bluetooth Low Energy: the ratio is 0.003 705 / 1

Zigbee: the ratio is 0.002 337 / 1

WLAN: the ratio is 0.046 637 / 1

Confirm the sum result of individual MPEs ratio is ≤ 1.0 ;

$$(0.011\ 715 / 1) + (0.003\ 705 / 1) + (0.002\ 337 / 1) + (0.046\ 637 / 1) = 0.064\ 394 \leq 1.0$$

So this device meets the KDB447498 D01 v06 section 7.2 requirement of "Simultaneous transmission MPE test exclusion".

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