

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

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company.

INDEX

<u>Table of Contents</u>	Page
1. General Information -----	3
2. RF Exposure Evaluation -----	5

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company.

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>.

Telephone : +82 31 688 0901

FAX : +82 31 688 0921

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	

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company.

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.

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company.

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.

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company.

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

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company.

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".

The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report cannot be reproduced, except in full, without prior written permission of the Company.