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: **Hyunchae 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
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1.2. Details of applicant

Applicant : Samsung Electronics Co., Ltd.
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Contact Person : Lee, Jae-Hyuk
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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 ㎒ ~ 2 480 ㎒ (Bluetooth, Bluetooth Low Energy), 2 405 ㎒ ~ 2 475 ㎒ (Zigbee), 2 412 ㎒ ~ 2 462 ㎒ (11b/g/n_HT20), 2 422 ㎒ ~ 2 452 ㎒ (11n_HT40), 5 745 ㎒ ~ 5 825 ㎒ (Band 3: 11a/n_HT20, 11ac_VHT20), 5 755 ㎒ ~ 5 795 ㎒ (Band 3: 11n_HT40, 11ac_VHT40), 5 775 ㎒ (Band 3: 11ac_VHT80), 5 180 ㎒ ~ 5 220 ㎒ (Band 1: 11a/n_HT20, 11ac_VHT20), 5 190 ㎒ (Band 1: 11n_HT40, 11ac_VHT40), 5 260 ㎒ ~ 5 320 ㎒ (Band 2A: 11a/n_HT20, 11ac_VHT20), 5 270 ㎒ ~ 5 310 ㎒ (Band 2A: 11n_HT40, 11ac_VHT40), 5 290 ㎒ (Band 2A: 11ac_VHT80), 5 500 ㎒ ~ 5 720 ㎒ (Band 2C: 11a/n_HT20, 11ac_VHT20), 5 510 ㎒ ~ 5 710 ㎒ (Band 2C: 11n_HT40, 11ac_VHT40), 5 530 ㎒ ~ 5 690 ㎒ (Band 2C: 11ac_VHT80)
Modulation Technique		DSSS, OFDM, GFSK, π/4DQPSK, 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 ㎒ ~ 2 480 ㎒: 2.7 ㏈i, 2 412 ㎒ ~ 2 462 ㎒ (MIMO): 2.7 ㏈i, 5 180 ㎒ ~ 5 320 ㎒ (MIMO): 2.7 ㏈i, 5 500 ㎒ ~ 5 720 ㎒ (MIMO): 2.7 ㏈i, 5 745 ㎒ ~ 5 825 ㎒ (MIMO): 2.7 ㏈i
	Port#2	2 412 ㎒ ~ 2 462 ㎒ (MIMO): 2.7 ㏈i, 5 180 ㎒ ~ 5 320 ㎒ (MIMO): 2.7 ㏈i, 5 500 ㎒ ~ 5 720 ㎒ (MIMO): 2.7 ㏈i, 5 745 ㎒ ~ 5 825 ㎒ (MIMO): 2.7 ㏈i
	Port#3	2 405 ㎒ ~ 2 475 ㎒: 2.7 ㏈i
H/W Version		V0.5_R04
S/W Version		1020GC0F-3AF-01Q0

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.
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.

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 (㎒)	Electric Field Strength(V/m)	Magnetic Field Strength (A/m)	Power Density (㎽/㎠)	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
1 500 – 100 000	-	-	**1.0**	**30**

2.1.1. Friis transmission formula: Pd = (Pout*G)/(4*pi*R^2)

Where Pd = power density in ㎽/㎠

Pout = output power to antenna in ㎽

G = gain of antenna in linear scale

Pi = 3.1416

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

Pd the limit of MPE, 1 ㎽/㎠. 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.

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 (㎒)	Output Average Power to Antenna (dB m)	Antenna Gain (dB i)	Power Density at 20 ㎝ (㎽/㎠)	Limits (㎽/㎠)
0	2 402	15	2.7	0.011 715	1

Bluetooth Low Energy

- Maximum tune up tolerance

Channel	Channel Frequency (㎒)	Output Average Power to Antenna (dB m)	Antenna Gain (dB i)	Power Density at 20 ㎝ (㎽/㎠)	Limits (㎽/㎠)
0	2 402	10	2.7	0.003 705	1

Zigbee

- Maximum tune up tolerance

Channel	Channel Frequency (㎒)	Output Average Power to Antenna (dB m)	Antenna Gain (dB i)	Power Density at 20 ㎝ (㎽/㎠)	Limits (㎽/㎠)
1	2 405	8	2.7	0.002 337	1

WLAN (2.4G)

- Maximum tune up tolerance

Channel	Channel Frequency (㎒)	Output Average Power to Antenna (dB m)	Antenna Gain (dB i)	Power Density at 20 ㎝ (㎽/㎠)	Limits (㎽/㎠)
1	2 412	21	2.7	0.046 637	1

WLAN (5G)

- Maximum tune up tolerance

Channel	Channel Frequency (㎒)	Output Average Power to Antenna (dB m)	Antenna Gain (dB i)	Power Density at 20 ㎝ (㎽/㎠)	Limits (㎽/㎠)
36	5 180	16	2.7	0.014 748	1

Note :

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

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 ≤ 1.0

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