EMC TEST REPORT

Test Report No.	:	KES-EM-20T0587
Date of Issue	:	Sep. 09, 2020
Product name	:	SHIELDPAD
Model/Type No.	:	RADOne
Variant Mode	:	-
Applicant	:	M1 INTERNATIONAL INC.
Applicant Address	:	2F-201, 17, Daedeok-daero 1284beon-gil, Daedeok-gu, Daejeon, Republic of Korea
Manufacturer	:	M1 INTERNATIONAL INC.
Manufacturer Address	:	2F-201, 17, Daedeok-daero 1284beon-gil, Daedeok-gu, Daejeon, Republic of Korea
FCC ID	:	2AW66-RADONE
Date of Receipt	:	Aug. 14, 2020
Test date	:	Sep. 01, 2020 ~ Sep. 02, 2020
Test Results	:	☒ In Compliance ☐ Not in Compliance

Tested by

Dae Hyun, Kim
EMC Test Engineer

Reviewed by

Dong-Hun, Jang
EMC Technical Manager

REPORT REVISION HISTORY

Date	Test Report No.	Revision History
Sep. 09, 2020	KES-EM-20T0587	Issued

TABLE OF CONTENTS

1.0 General Product Description

Main Specifications of EUT are:

Ltem	Spec
Operating Frequency	(2 402 ~ 2 480) MHz (Bluetooth)
Power	Charge : DC 5 V (USB) Operating : DC 3.7 V (Battery)
Dimension	(53 x 44 x 21) ㎜
Weight	60 g

1.1 Test Voltage & Frequency

Unless indicated otherwise on the individual data sheet or test results, the test voltage and frequency was as indicated below.

Voltage ☐ 230 Vac ☒ 120 Vac ☐ 24 Vac ☐ 12 Vdc ☐ DC 3 V (Battery)

Frequency ☐ 50 Hz ☒ 60 Hz ☐ Hz

1.2 Variant Model Differences

Not applicable

1.3 Device Modifications

Not applicable

1.4 Equipment Under Test

Description	Model Number	Serial Number	Manufacturer	Remarks
SHIELDPAD	RADOne	-	M1 INTERNATIONAL INC.	EUT

1.5 Support Equipments

Description	Model Number	Serial Number	Manufacturer	Remarks
SmartPhone	SM-N920	-	Samsung Electronics Co., Ltd	-
Adapter	A1401	-	Flextronics Power Systems (Dongguan) Co., Ltd	-

1.6 External I/O Cabling

■ Bluetooth Mode

Start		END		Cable Spec.	
Description	I/O Port	Description	I/O Port	Length	Shield
SHIELDPAD (EUT)	Wireless	SmartPhone	Wireless	-	-

* Unshielded=U, Shielded=S

■ Operating Mode

Start		END		Cable Spec.	
Description	I/O Port	Description	I/O Port	Length	Shield
SHIELDPAD (EUT)	-	-	-	-	-

* Unshielded=U, Shielded=S

■ Charge Mode

Start		END		Cable Spec.	
Description	I/O Port	Description	I/O Port	Length	Shield
SHIELDPAD (EUT)	USB C Type	Adapter	USB	1.0	U

* Unshielded=U, Shielded=S

1.7 EUT Operating Mode(s)

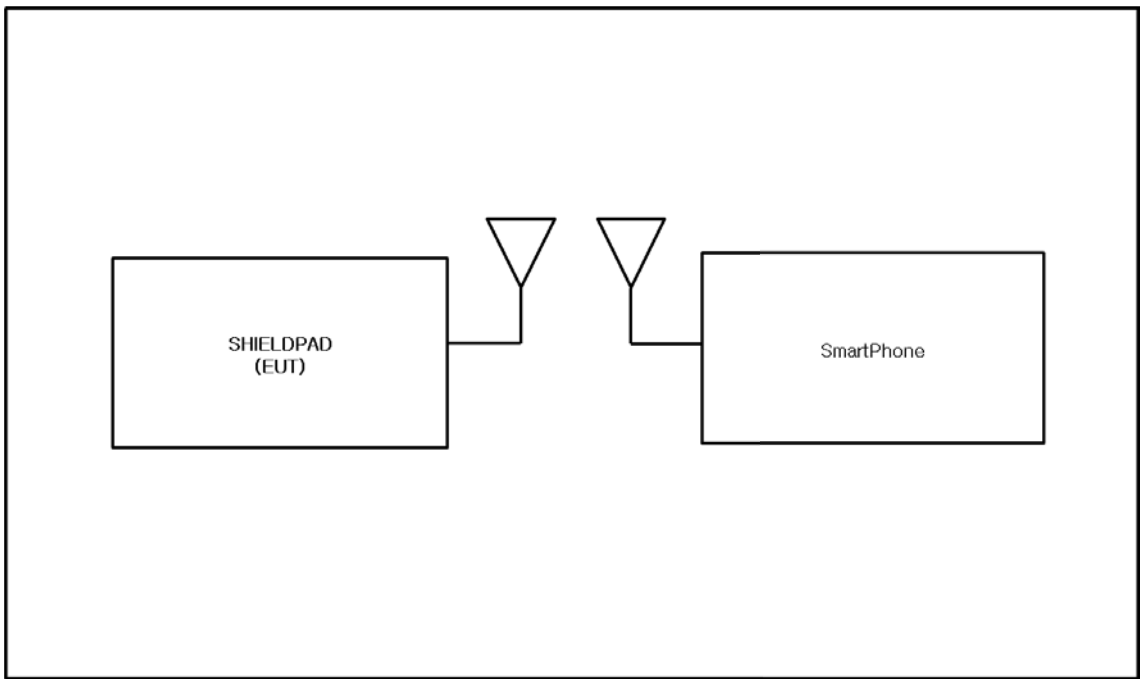
Test mode	operating
Bluetooth	1. Connect the EUT and Smartphone Wirelessly. 2. The operation of EUT was confirmed through the application of SmartPhone.
Operating	1. Checked the normal operation status on the LCD screen.
Charge	1. Connect the EUT and adapter 2. During the test, the charging LED of EUT was checked.

EUT Test operating S/W		
Name	Version	Manufacture Company
SHIELDPAD	-	M1 INTERNATIONAL INC.

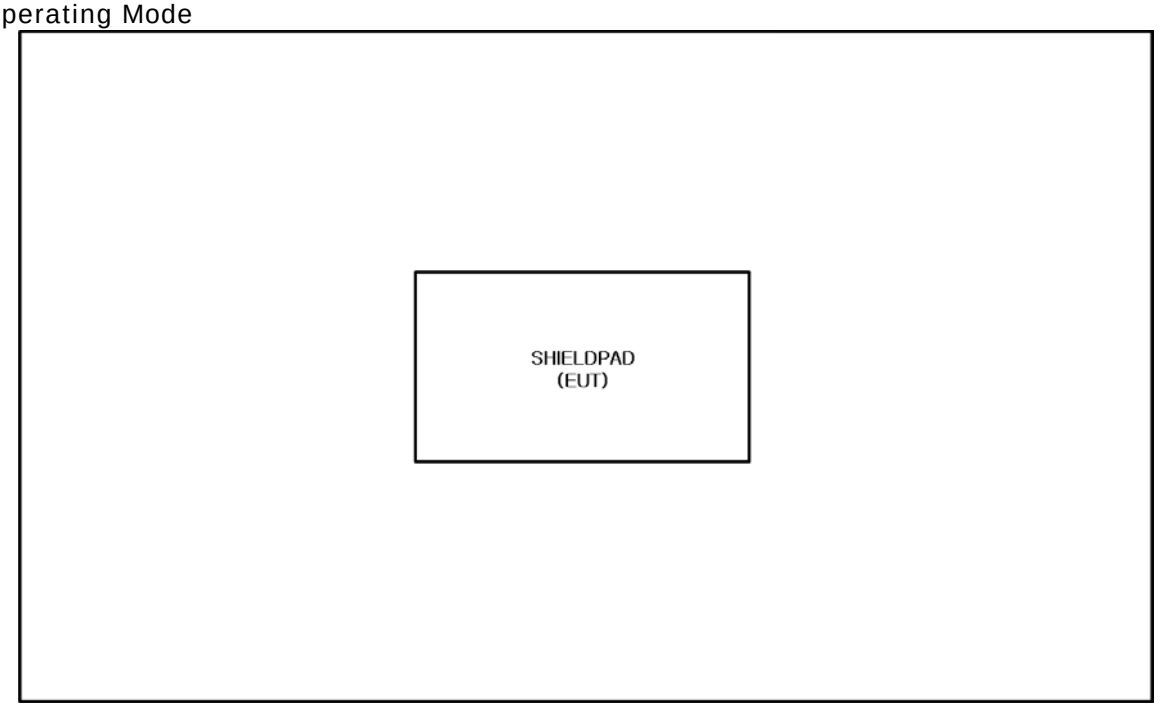
1.8 Configuration

■ AC Main
□ DC Main

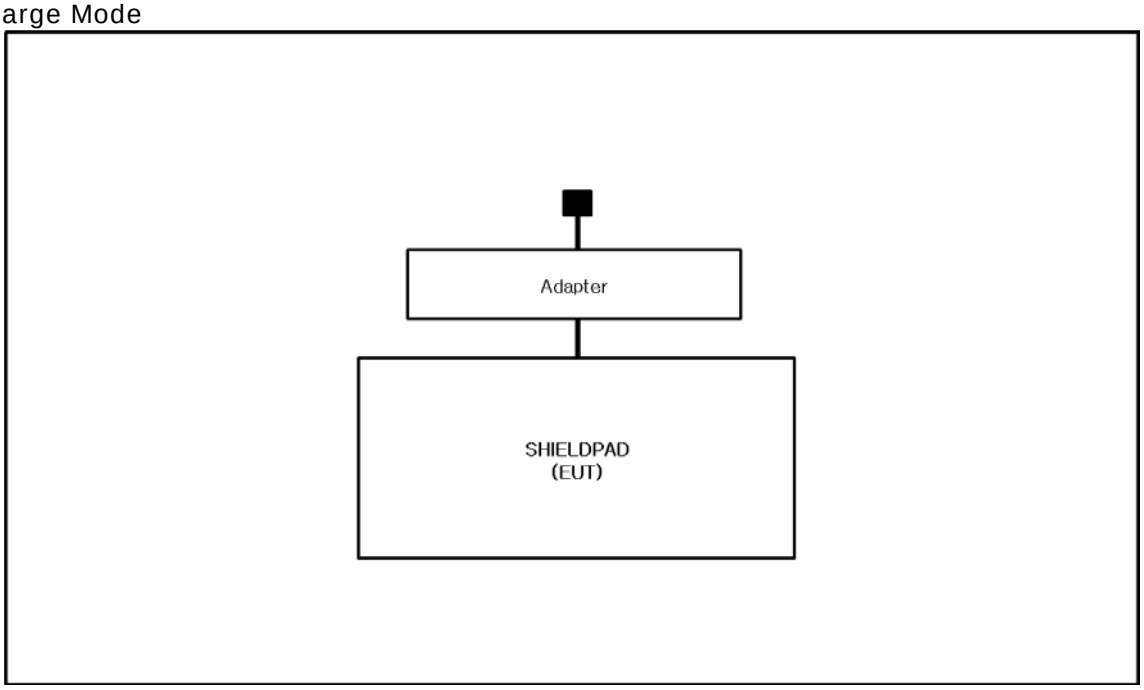
■ Bluetooth Mode



■ Operating Mode



■ Charge Mode



1.9 Remarks when standards applied

N/A

1.10 Calibration Details of Equipment Used for Measurement

Test equipment and test accessories are calibrated on regular basis. The maximum time between calibrations is one year or what is recommended by the manufacturer, whichever is less.

1.11 Test Facility

The measurement facility is located at 473-21 Gayeo-ro, Yeoju-si, Gyeonggi-do, 12658, Korea. The sites are constructed in conformance with the requirements of ANSI C63.4:2014 and CISPR 16-1-4:2012

1.12 Measurement Procedure

- Conducted Emissions

The conducted emission levels were measured on each current-carrying line with the spectrum analyzer operating in the CISPR quasi-peak mode (or peak mode if applicable). The initial step in collecting conducted data is a spectrum analyzer peak scan of the measurement range. If the conducted emission exceed the average limit with the instrument set to the quasi-peak mode, the measurements are made in the average mode. The emission spectrum was scanned from 150 ㎑ to 30 ㎒. The highest emission amplitudes relative to the appropriate limits were measured and have been recorded. Quasi-peak readings are distinguished with a "QP".

- Radiated Electric Field Emissions

The test was done at a SEMI ANECHOIC CHAMBER with quasi-peak detector. The final test data was measured using a Quasi-Peak detector below 1㎓ at 10 m or 3 m distance and a Peak and Average detector above 1 ㎓ at 3 m distance. Test was proceeded worst case test mode and cable configuration.
Measurements were made with the antenna positioned in both the horizontal and vertical planes of polarization. The antenna height was varied from 1 m to 4 m and the EUT was rotated 360° to find the maximum emitting point for each frequency.

Measurement procedures was In accordance with ANSI C63.4-2014 7.3.3, 7.3.4, 8.3.1.1, 8.3.1.2, 8.3.2.1, 8.3.2.2

1.13 Laboratory Accreditations and Listings

Country	Agency	Scope of Accreditation	Logo
KOREA	RRA	EMI (3 m & 10 m Semi-Aechoic Chamber ,10 m Open Area and conducted test site) EMS (ESD, RS, EFT/Burst, Surge, CS, Magnetic, Dips and interruptions)	KR0100
International	KOLAS	EMI (3 m & 10 m Semi-Aechoic Chamber , and conducted test site) EMS (ESD, RS, EFT/Burst, Surge, CS, Magnetic, Dips and interruptions)	KT489
USA	FCC	3 m & 10 m Semi-Aechoic Chamber, 10 m Open Area and Conducted test site to perform FCC Part 15/18 measurements.	KR0100
Canada	ISED	3 m & 10 m Semi-Aechoic Chamber and Conducted test site	23298-1
JAPAN	VCCI	Mains Ports Conducted Interference Measurement, Telecommunication Ports Conducted Disturbance Measurement and Radiation 10 meter site, Facility for measuring radiated disturbance above 1 GHz	R-20056, C-20036 T-20040, G-20057
Europe	TÜ V SÜ D	EMI (3 m & 10 m Semi-Aechoic Chamber , 10 m Open Area and conducted test site) EMS (ESD, RS, EFT/Burst, Surge, CS, Magnetic, Dips and interruptions)	CARAT 001633 0004

2.0 Test Regulations

The emissions tests were performed according to following regulations:

☐ EMC – Directive 2014/30/EU

☐ EN 61000-6-3:2011

☐ EN 61000-6-1:2007

☐ EN 61000-6-4:2007 +A1:2011

☐ EN 61000-6-2:2005

☐ EN 55011:2007 +A1:2010 ☐ Group 1 ☐ Group 2
☐ Class A ☐ Class B

☐ EN 55014-1:2006 +A2:2011

☐ EN 55014-2:1997 +A2:2008

☐ EN 55015:2013

☐ EN 55032:2015 ☐ Class A ☐ Class B

☐ EN 55024:2010

☐ EN 50130-4:2011 +A1:2014

☐ EN 61000-3-2:2014

☐ EN 61000-3-3:2013

☐ EN 61326-1:2013

☐ VCCI-CISPR 32:2016	☐ Class A	☐ Class B
☐ AS/NZS CISPR32:2015	☐ Class A	☐ Class B
☒ 47 CFR Part 15, Subpart B		
☐ CISPR 22:2009 +A1:2010	☐ Class A	☐ Class B
☒ ANSI C63.4-2014	☐ Class A	☒ Class B
☐ IC Regulation ICES-003 : 2016		
☐ CAN/CSA CISPR 22-10	☐ Class A	☐ Class B
☐ ANSI C63.4-2014	☐ Class A	☐ Class B

☐ RE– Directive 2014/53/EU

☐ EN 301 489-1 V1.9.2

- ☐ Equipment for fixed use
- ☐ Equipment for vehicular use
- ☐ Equipment for portable use

☐ EN 301 489-3 V1.6.1

☐ EN 301 489-17 V2.2.1

☐ EN 60945:2002

2.1 Conducted Emissions at Mains Power Ports

Test Date
Sep. 01, 2020

Test Location
Electro wave Shieldroom #6

Test Equipment

Used	Description	Model Number	Manufacturer	Serial Number	Cal. Due
☒	EMI Test S/W	EMC32	R & S	9.12.00	-
☒	EMI TEST RECEIVER	ESR3	R & S	101783	01, 20, 2021
☒	LISN	ENV216	R & S	101787	01, 02, 2021
☐	LISN	ESH2-Z5	R & S	100450	01, 02, 2021
☒	PULSE LIMITER	ESH3-Z2	R & S	101915	01, 02, 2021

Test Conditions
Temperature: 23,0 ℃
Relative Humidity: 53,8 % R.H.

Frequency Range of Measurement
150 ㎑ to 30 ㎒

Instrument Settings
IF Band Width: 9 ㎑

Test Results
The requirements are:

☒ PASS
☐ NOT PASS
☐ NOT APPLICABLE

Remarks
See Appendix A for test data.

2.2 Radiated Electric Field Emissions(Below 1 ㎓)

Test Date
Sep. 02, 2020

Test Location
☐ OPEN AREA TEST SITE #2 ☒ SEMI ANECHOIC CHAMBER #5

Test Equipment

Used	Description	Model Number	Manufacturer	Serial Number	Cal. Due
☒	EMI Test S/W	EP5/RE	TOYO Corporation	6.0.120	-
☒	EMI TEST RECEIVER	ESU26	R & S	100552	04, 01, 2021
☒	BILOG ANTENNA	VULB 9168	SCHWARZBECK	9168-461	05, 26, 2022
☒	AMPLIFIER	310N	SONOMA INSTRUMENT	401123	06, 08, 2021
☒	ATTENUATOR	F04-C1206-01	SRT	20022403	05, 06, 2021

Test Conditions
Temperature: 22,8 ℃
Relative Humidity: 50,6 % R.H.

Frequency Range of Measurement
30 ㎒ to 1 ㎓

Instrument Settings
IF Band Width: 120 ㎑

Test Results
The requirements are:

☒ PASS
☐ NOT PASS
☐ NOT APPLICABLE

Remarks
See Appendix A for test data.

2.3 Radiated Electric Field Emissions(Above 1 ㎓)

Test Date
Aug. 02, 2020

Test Location
SEMI ANECHOIC CHAMBER #5

Test Equipment

Used	Description	Model Number	Manufacturer	Serial Number	Cal. Due
☒	EMI Test S/W	EP5/RE	TOYO Corporation	6.0.120	-
☒	EMI TEST RECEIVER	ESU26	Rohde & Schwarz	100552	04, 01, 2021
☒	HORN ANTENNA	BBHA 9120D	SCHWARZBECK	9120D-1802	12, 13, 2020
☒	PREAMPLIFIER	8449B	AGILENT	8008A01640	04, 01, 2021

Test Conditions
Temperature: 22,8 ℃
Relative Humidity: 50,6 % R.H.

Frequency Range of Measurement
1 ㎓ to 12.4 ㎓

Instrument Settings
IF Band Width: 1 ㎒

Test Results
The requirements are:

☒ PASS
☐ NOT PASS
☐ NOT APPLICABLE

Remarks
See Appendix A for test data.

APPENDIX A – TEST DATA

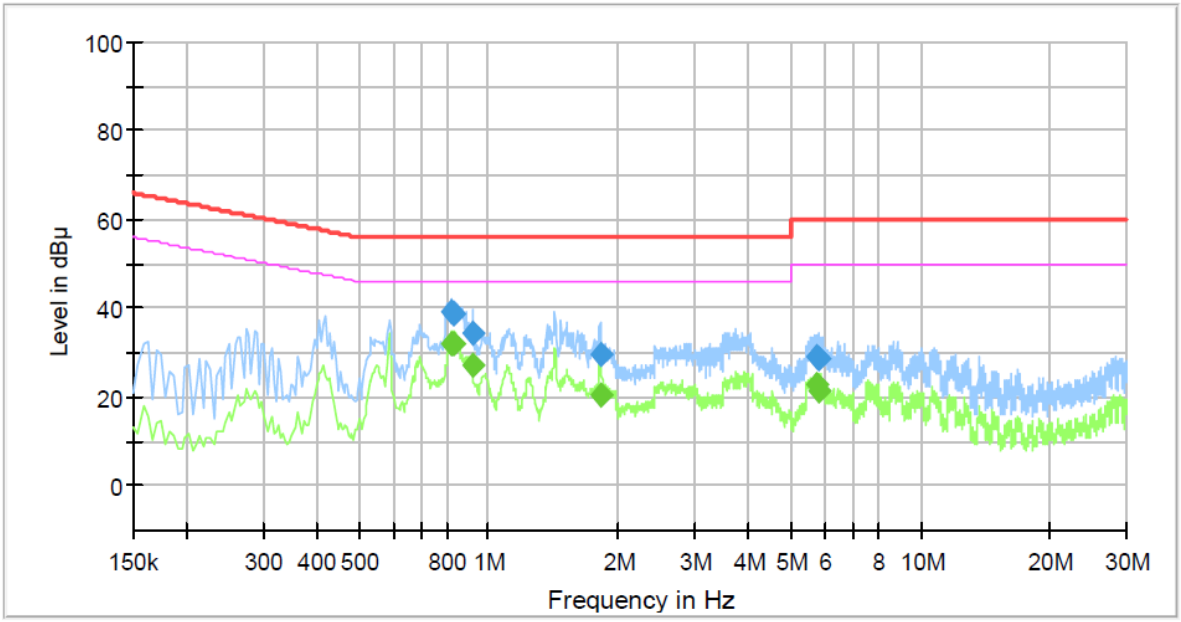
Conducted Emissions at Mains Power Ports

■ Charge Mode

HOT LINE

Common Information

Test Description:	Conducted Emission
Model No.:	RADOne
Phase:	
Mode:	Charge(FCC)
Operator Name:	KES



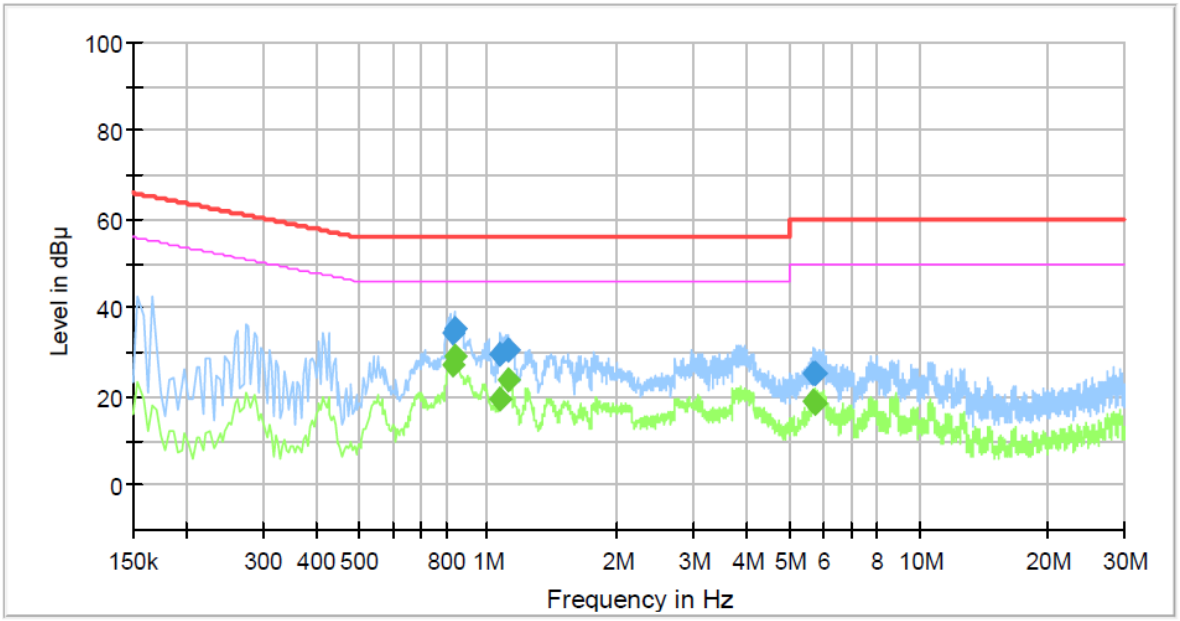
Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.818000	---	31.92	46.00	14.08	1000.0	9.000	L1	20.1
0.818000	39.25	---	56.00	16.75	1000.0	9.000	L1	20.1
0.830000	---	31.99	46.00	14.01	1000.0	9.000	L1	20.1
0.830000	38.69	---	56.00	17.31	1000.0	9.000	L1	20.1
0.918000	---	27.16	46.00	18.84	1000.0	9.000	L1	20.2
0.918000	34.58	---	56.00	21.42	1000.0	9.000	L1	20.2
1.814000	---	20.28	46.00	25.72	1000.0	9.000	L1	20.4
1.814000	29.43	---	56.00	26.57	1000.0	9.000	L1	20.4
5.734000	---	22.98	50.00	27.02	1000.0	9.000	L1	19.8
5.734000	29.19	---	60.00	30.81	1000.0	9.000	L1	19.8
5.794000	---	21.20	50.00	28.80	1000.0	9.000	L1	19.8
5.794000	28.49	---	60.00	31.51	1000.0	9.000	L1	19.8

NEUTRAL LINE

Common Information

Test Description:	Conducted Emission
Model No.:	RADOne
Phase:	
Mode:	Charge(FCC)
Operator Name:	KES



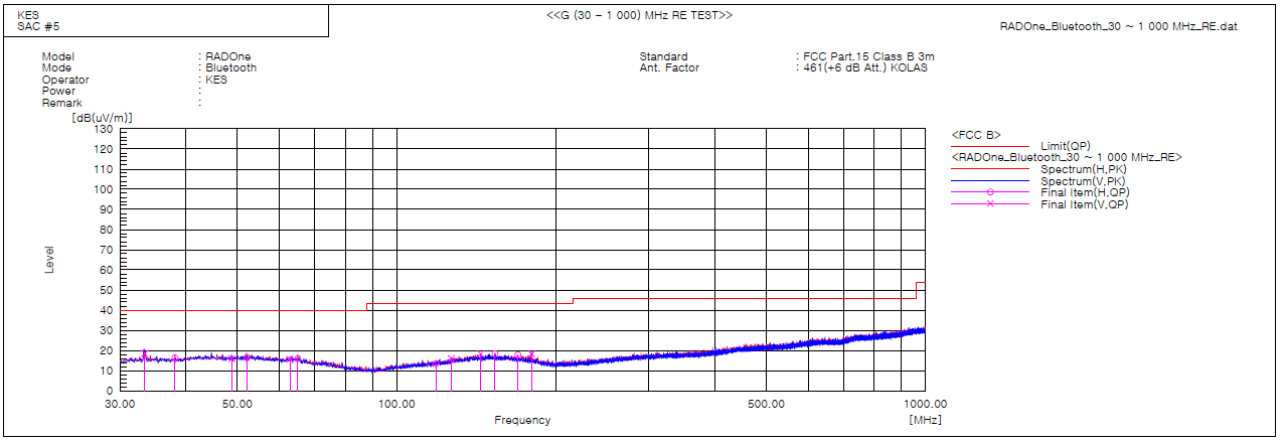
Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	Average (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.830000	---	27.00	46.00	19.00	1000.0	9.000	N	20.1
0.830000	34.52	---	56.00	21.48	1000.0	9.000	N	20.1
0.834000	---	29.04	46.00	16.96	1000.0	9.000	N	20.1
0.834000	35.12	---	56.00	20.88	1000.0	9.000	N	20.1
1.070000	---	19.33	46.00	26.67	1000.0	9.000	N	20.2
1.070000	29.63	---	56.00	26.37	1000.0	9.000	N	20.2
1.110000	---	23.79	46.00	22.21	1000.0	9.000	N	20.2
1.110000	30.47	---	56.00	25.53	1000.0	9.000	N	20.2
5.714000	---	19.01	50.00	30.99	1000.0	9.000	N	19.8
5.714000	25.17	---	60.00	34.83	1000.0	9.000	N	19.8
5.718000	---	18.41	50.00	31.59	1000.0	9.000	N	19.8
5.718000	25.27	---	60.00	34.73	1000.0	9.000	N	19.8

♦ Calculation
QuasiPeak[dBuV] / CAverage [dBuV] = Reading Value[dBuV] + Corr. [dB]
QuasiPeak / CAverage : The Final Value
Reading Value : Not shown in the table.
Corr. : Correction values (LISN FACTOR + (Cable Loss + Pulse Limiter FACTOR))

Radiated Electric Field Emissions(Below 1 GHz)

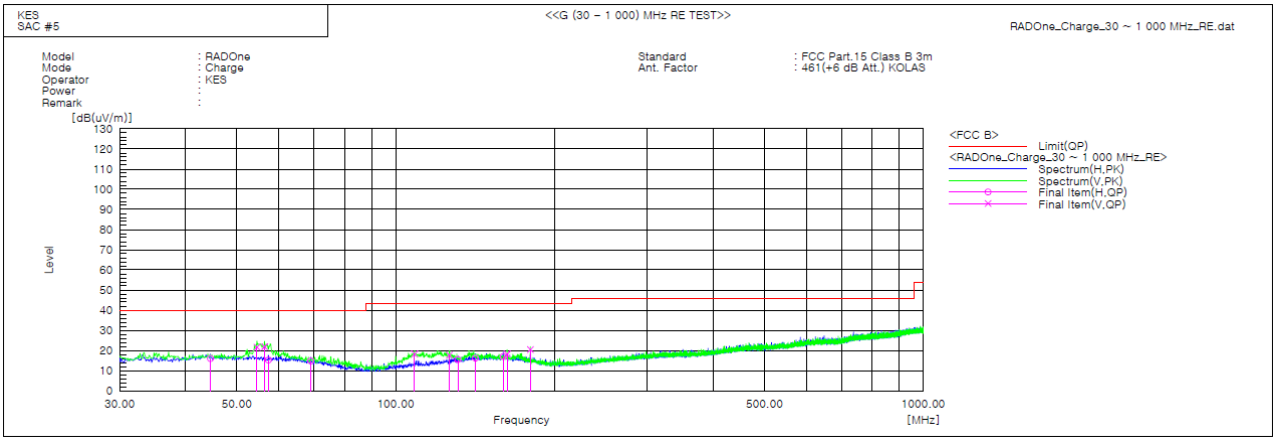
■ Bluetooth Mode



Final Result

No.	Frequency [MHz]	(P)	Reading QP [dB(uV)]	c.f [dB(1/m)]	Result QP [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]	Remark
1	33.395	V	32.7	-14.1	18.6	40.0	21.4	121.0	356.9	
2	38.124	H	30.0	-13.6	16.4	40.0	23.6	168.0	4.4	
3	48.794	V	28.9	-12.9	16.0	40.0	24.0	102.0	296.0	
4	52.068	H	29.5	-13.1	16.4	40.0	23.6	177.0	263.6	
5	62.865	V	29.5	-13.8	15.7	40.0	24.3	149.8	161.5	
6	65.041	H	30.2	-14.2	16.0	40.0	24.0	389.0	180.6	
7	118.634	H	28.9	-15.5	13.4	43.5	30.1	245.0	78.0	
8	126.879	V	30.6	-14.5	16.1	43.5	27.4	137.0	341.7	
9	144.218	V	31.1	-12.8	18.3	43.5	25.2	241.0	25.5	
10	153.433	H	31.1	-12.7	18.4	43.5	25.1	365.0	59.7	
11	169.680	H	31.1	-13.3	17.8	43.5	25.7	400.0	317.9	
12	179.986	V	32.6	-14.3	18.3	43.5	25.2	126.0	175.2	

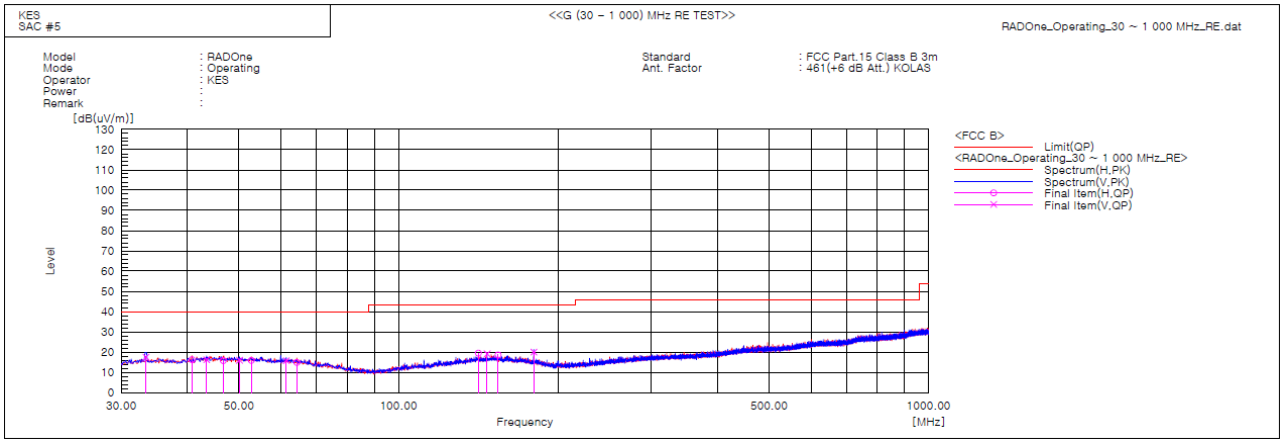
■ Charge Mode



Final Result

No.	Frequency [MHz]	(P)	Reading QP [dB(uV)]	c.f [dB(1/m)]	Result QP [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]	Remark
1	44.550	H	28.7	-12.7	16.0	40.0	24.0	335.0	104.1	
2	54.614	V	34.9	-13.2	21.7	40.0	18.3	121.0	312.0	
3	56.433	V	35.2	-13.3	21.9	40.0	18.1	104.0	85.6	
4	57.403	H	28.6	-13.3	15.3	40.0	24.7	364.0	124.0	
5	69.043	H	29.7	-14.9	14.8	40.0	25.2	289.0	194.0	
6	108.570	V	34.7	-16.4	18.3	43.5	25.2	102.0	3.1	
7	126.394	V	32.3	-14.6	17.7	43.5	25.8	120.0	337.2	
8	131.251	H	29.4	-13.9	15.5	43.5	28.0	319.0	205.9	
9	141.550	H	29.1	-12.9	16.2	43.5	27.3	391.0	170.2	
10	159.859	H	29.8	-12.8	17.0	43.5	26.5	222.0	213.8	
11	162.648	V	31.1	-12.9	18.2	43.5	25.3	117.0	258.0	
12	179.986	V	34.8	-14.3	20.5	43.5	23.0	126.0	274.7	

■ Operating Mode



Final Result

No.	Frequency [MHz]	(P)	Reading QP [dB(uV)]	c.f [dB(1/m)]	Result QP [dB(uV/m)]	Limit QP [dB(uV/m)]	Margin QP [dB]	Height [cm]	Angle [deg]	Remark
1	33.395	V	31.7	-14.1	17.6	40.0	22.4	132.0	41.3	
2	40.791	H	29.5	-13.2	16.3	40.0	23.7	344.0	100.3	
3	43.459	V	29.1	-12.8	16.3	40.0	23.7	144.0	12.1	
4	46.733	H	28.5	-12.7	15.8	40.0	24.2	387.0	308.4	
5	50.128	V	29.0	-13.0	16.0	40.0	24.0	111.0	72.4	
6	52.795	H	29.0	-13.1	15.9	40.0	24.1	325.0	70.8	
7	61.404	V	29.4	-13.6	15.8	40.0	24.2	229.0	40.5	
8	64.314	H	28.9	-14.0	14.9	40.0	25.1	367.0	355.3	
9	141.429	H	32.4	-12.9	19.5	43.5	24.0	316.0	189.4	
10	146.885	V	31.9	-12.7	19.2	43.5	24.3	132.0	316.4	
11	154.039	H	31.3	-12.7	18.6	43.5	24.9	222.0	303.0	
12	179.986	V	34.3	-14.3	20.0	43.5	23.5	127.0	145.4	

♦ Calculation – SAC #4(10 m)
Result(QP) [dB(μV/m)] = (Reading(QP)[dB(μV)] + c.f[dB(1/m)]
Margin(QP)[dB] = Limit[dB(μV/m)] - Result(QP) [dB(μV/m)]
Reading(QP) : Reading value, Result(QP) : Reading value + Factor value
Limit(QP) : Limit value, c.f : (ANT Factor + Cable Loss - Preamp Factor), Margin: Margin value

Uncertainty of measurement

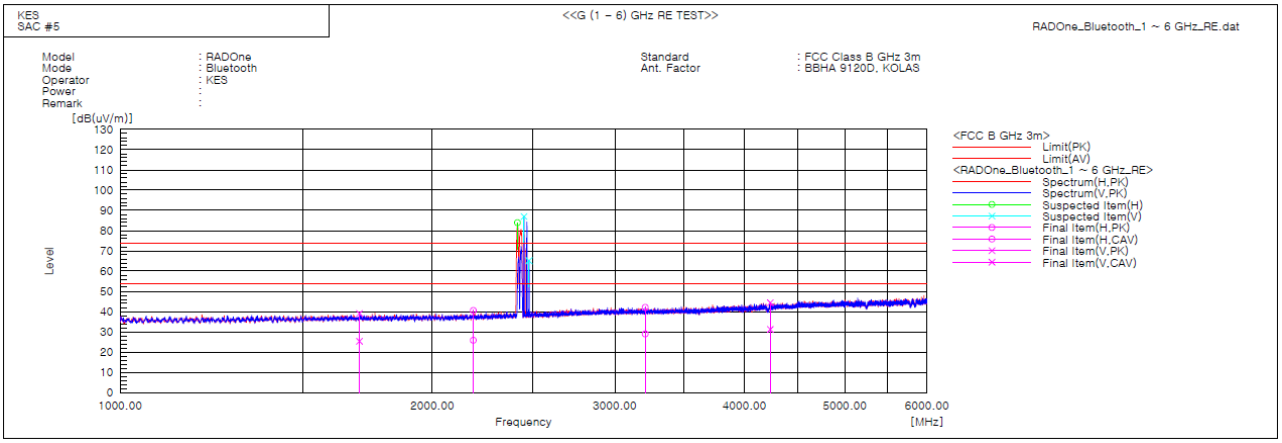
Horizontal : Uncertainty of measurement 4.40 dB
(Confidence level: Approx. 95 %, k=2)

Vertical : Uncertainty of measurement 4.36 dB
(Confidence level: Approx. 95 %, k=2)

Radiated Electric Field Emissions(Above 1 GHz)

■ Bluetooth Mode

- (1 ~ 6) GHz



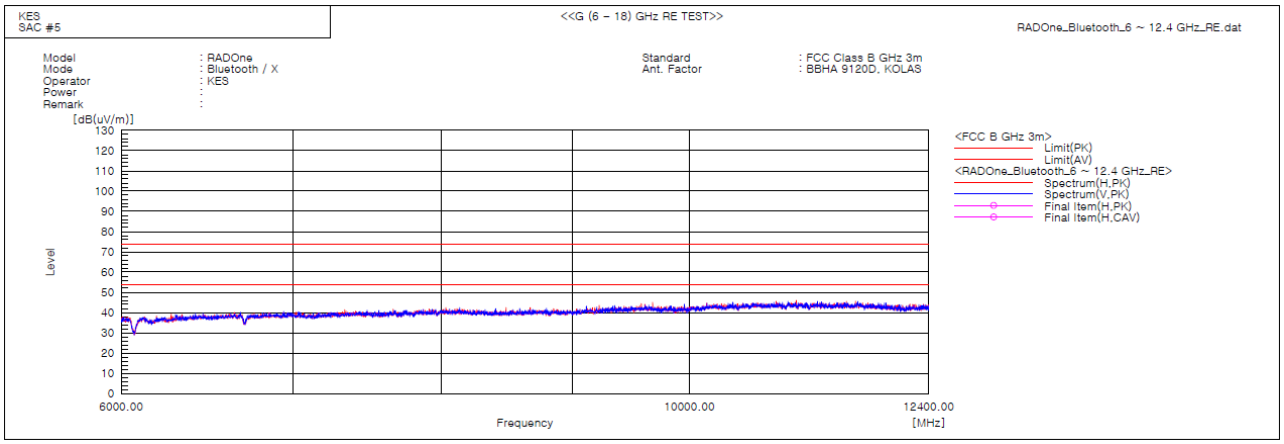
Final Result

No.	Frequency [MHz]	(P)	Reading PK [dB(uV)]	Reading CAV [dB(uV)]	c.f [dB(1/m)]	Result PK [dB(uV/m)]	Result CAV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Margin PK [dB]	Margin CAV [dB]	Height [cm]	Angle [deg]	Remark
1	1701.250	V	45.9	32.3	-6.9	39.0	25.4	74.0	54.0	35.0	28.6	99.7	74.0	
2	2190.625	H	46.0	31.3	-5.5	40.5	25.8	74.0	54.0	33.5	28.2	99.7	345.5	
3	3210.000	H	44.2	31.1	-2.1	42.1	29.0	74.0	54.0	31.9	25.0	99.7	261.0	
4	4236.875	V	43.6	30.5	0.8	44.4	31.3	74.0	54.0	29.6	22.7	99.7	165.8	
5	2416.250	H	--------	--------	-4.7	--------	--------	74.0	54.0	--------	--------	400.2	100.2	
6	2451.875	V	--------	--------	-4.6	--------	--------	74.0	54.0	--------	--------	149.9	37.3	
7	2479.375	V	--------	--------	-4.5	--------	--------	74.0	54.0	--------	--------	400.2	106.2	

* Exclusion bands

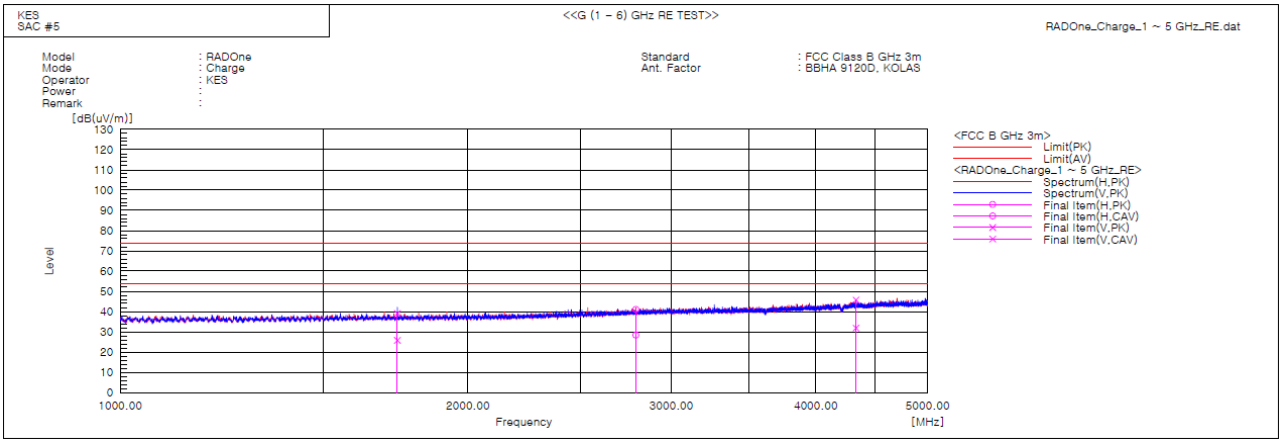
- Fundamental Frequency : (2 402 ~ 2 480) MHz

- (6 ~ 12.4) GHz



- No spurious emission were dectected above 5 GHz.

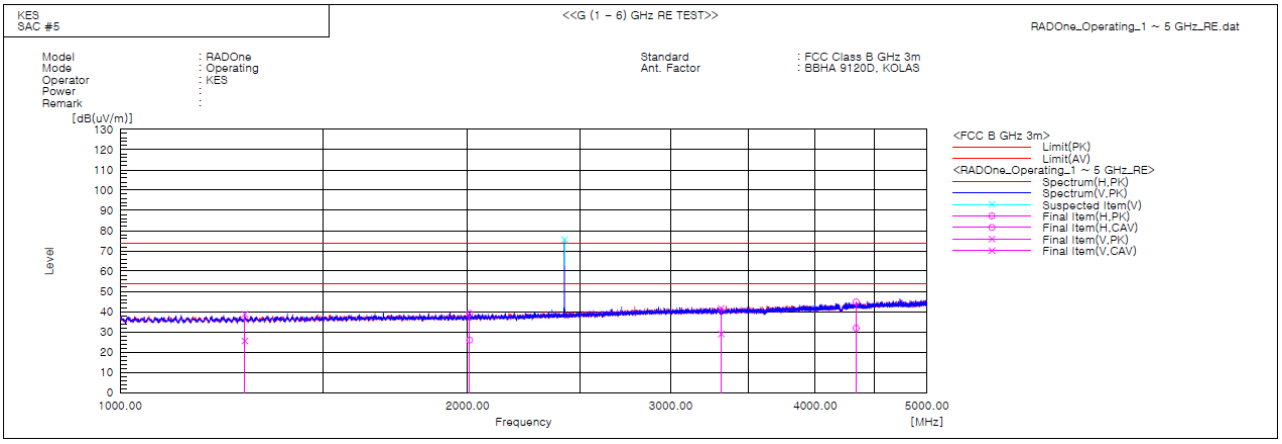
■ Charge Mode



Final Result

No.	Frequency [MHz]	(P)	Reading PK [dB(uV)]	Reading CAV [dB(uV)]	c.f [dB(1/m)]	Result PK [dB(uV/m)]	Result CAV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Margin PK [dB]	Margin CAV [dB]	Height [cm]	Angle [deg]	Remark
1	1737.500	V	46.0	32.6	-6.8	39.2	25.8	74.0	54.0	34.8	28.2	124.0	167.3	
2	2795.000	H	44.2	31.5	-3.1	41.1	28.4	74.0	54.0	32.9	25.6	266.0	0.4	
3	4335.000	V	44.6	30.7	1.2	45.8	31.9	74.0	54.0	28.2	22.1	102.0	239.2	

■ Operating Mode



Final Result

No.	Frequency [MHz]	(P)	Reading PK [dB(uV)]	Reading CAV [dB(uV)]	c.f [dB(1/m)]	Result PK [dB(uV/m)]	Result CAV [dB(uV/m)]	Limit PK [dB(uV/m)]	Limit AV [dB(uV/m)]	Margin PK [dB]	Margin CAV [dB]	Height [cm]	Angle [deg]	Remark
1	1282.500	V	47.4	34.2	-8.6	38.8	25.6	74.0	54.0	35.2	28.4	143.0	272.8	
2	2008.125	H	45.1	31.9	-6.0	39.1	25.9	74.0	54.0	34.9	28.1	343.0	16.0	
3	3316.250	V	43.6	30.8	-1.9	41.7	28.9	74.0	54.0	32.3	25.1	108.0	233.0	
4	4341.250	H	43.6	30.6	1.2	44.8	31.8	74.0	54.0	29.2	22.2	111.0	182.8	
5	2426.250	V	--------	--------	-4.6	--------	--------	74.0	54.0	--------	--------	100.0	65.6	

♦ Calculation

Result(PK/CAV) [dB(μV/m)] = (Reading(PK/CAV)[dB(μV)] + c.f[dB(1/m)]

Margin(PK/CAV)[dB] = Limit[dB(μV/m)] - Result(PK/CAV) [dB(μV/m)]

Reading(PK/CAV) : Reading value, Result(PK/CAV) : Reading value + Factor value

Limit(QP) : Limit value, c.f : (ANT Factor + Cable Loss - Preamp Factor), Margin: Marjin value

Uncertainty of measurement

Uncertainty of measurement 5.94 dB
(Confidence level: Approx. 95 %, k=2)