



TEST REPORT



Report No. : KES-EM242656

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1. Client

Applicant : Ratio Co.,Ltd.

Applicant Address : Rm. 506, 330, Seongam-ro, Mapo-gu, Seoul, Republic of Korea

2. Sample Description

Product name : trimmTwo

Model/Type No. : trimmTwo

Variant Model : -

Manufacturer : Ratio Co.,Ltd.

Manufacturer Address : Rm. 506, 330, Seongam-ro, Mapo-gu, Seoul, Republic of Korea

3. FCC ID : 2BK32-TRIMMTWO

4. Date of Receipt : Aug. 01, 2024

5. Test date : Aug. 09, 2024

6. Date of Issue : Sep. 03, 2024

7. Test Results : In Compliance

Tested by

Seon Ho, Choi
EMC Test Engineer

Reviewed by

Dong Hun, Jang
EMC Technical Manager



REPORT REVISION HISTORY

Date	Test Report No.	Revision History
Sep. 03, 2024	KES-EM242656	Issued

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1.0 General Product Description

Main Specifications of EUT are:

Division	Specificity	
Internal highest clock frequency		Exceeded 108 MHz
Power	Rated Power	Charge : DC 5 V (USB) Operating : DC 3.7 V (Battery, 200 mAh)
	Test Power	AC 230 V, 50 Hz
Wireless Function		Bluetooth, GPS reception, ANT+
Port		Charging Contact Port 1 EA
Unused Port		N/A
Components		EUT 1 EA



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.

AC 120 V, 60 Hz (AC/DC Adapter Input Power) Battery

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
trimmTwo	trimmTwo	-	Ratio Co., Ltd	EUT

1.5 Support Equipments

Description	Model Number	Serial Number	Manufacturer	Remarks
Adapter	IMD-QC30	-	DONGGUAN CITILAND ELECTRONICS CO, LTD.	-
Smart Phone	SM-P610	-	Samsung Electronics Co., Ltd.	-
Sensor	-	-	Ratio Co., Ltd	-
GPS Reradiating Antenna	VRA-400	-	VW tech. corp.	-
GPS Reradiating Antenna Adapter	SD10009-1001	-	TAESIN	-



1.6 External I/O Cabling

Start		END		Cable Spec.	
Description	I/O Port	Description	I/O Port	Length	Shield
trimmTwo (EUT)	USB C Type	Adapter	USB	1.2	U
	Wireless	Smart Phone	Wireless	-	-
	Wireless	Sensor	Wireless	-	--
	Wireless	GPS Reradiating Antenna	Wireless	-	-

* Unshielded = U, Shielded = S

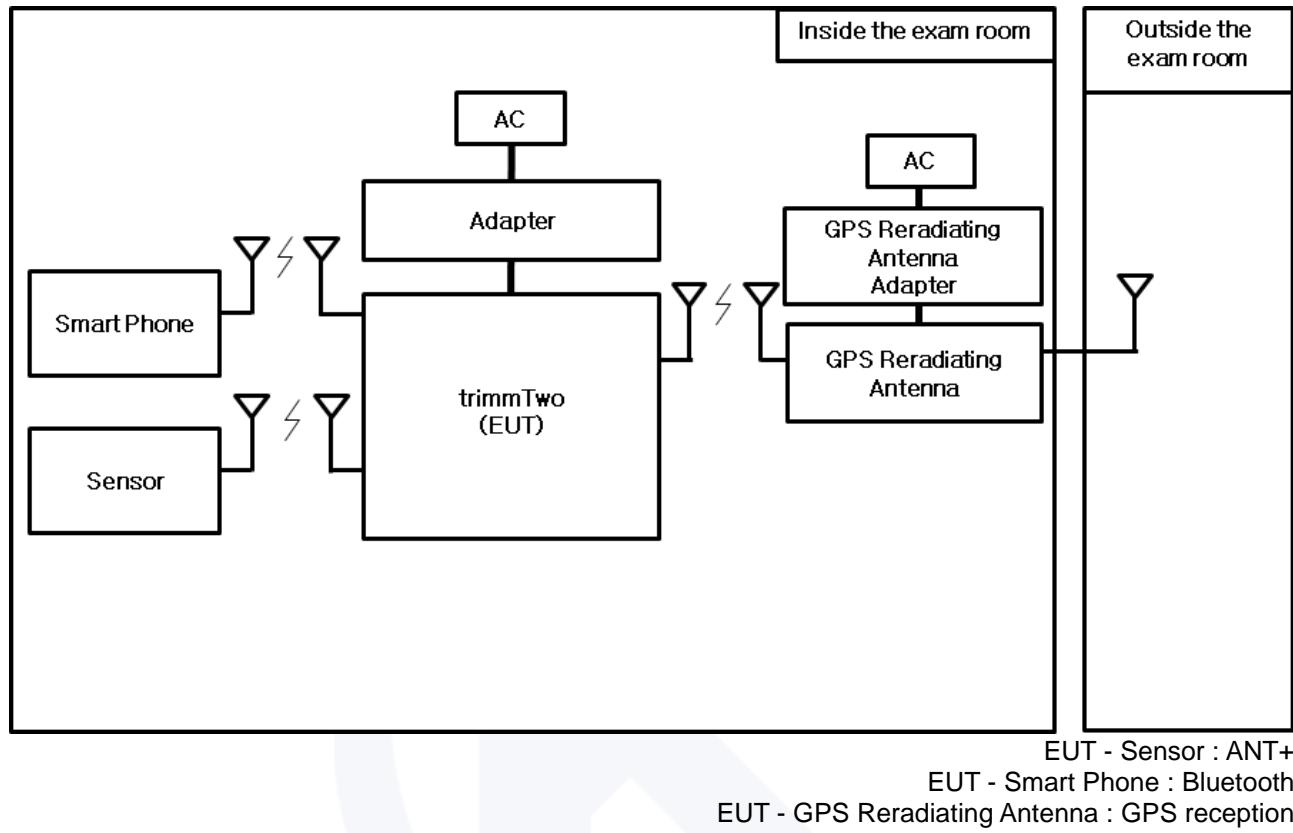
1.7 EUT Operating Mode(s)

The test equipment and smartphone were connected Bluetooth, normal operation was confirmed through the app installed on the smartphone, and the test was conducted with GPS activated.

EUT Test operating S/W		
Name	Version	Manufacture Company
trimm Cycling	3.1.64	Ratio Co.,Ltd.



1.8 Configuration





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, Republic of. The sites are constructed in conformance with the requirements of ANSI C63.4a-2017 and CISPR 16-1-4:2019

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 kHz to 30 MHz. 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 GHz at 10 m or 3 m distance and a Peak and Average detector above 1 GHz 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-Anechoic Chamber and conducted test site) EMS (ESD, RS, EFT/Burst, Surge, CS, Magnetic, Dips and interruptions)	 KR0100
International	KOLAS	EMI (3 m & 10 m Semi-Anechoic Chamber and conducted test site) EMS (ESD, RS, EFT/Burst, Surge, CS, Magnetic, Dips and interruptions)	 KT489
USA	FCC	3 m & 10 m Semi-Anechoic Chamber Conducted test site to perform FCC Part 15/18 measurements.	 KR0100
Canada	ISED	3 m & 10 m Semi-Anechoic Chamber and Conducted test site	 23298
JAPAN	VCCI	EMI (3 m & 10 m Semi-Anechoic Chamber and conducted test site)	 C-20136, T-20137, R-20181, G-20176
Europe	TÜV SÜD	EMI (3 m & 10 m Semi-Anechoic Chamber and conducted test site) EMS (ESD, RS, EFT/Burst, Surge, CS, Magnetic, Dips and interruptions)	 CARAT 001633 0008



2.0 Test Regulations

The emissions tests were performed according to following regulations:

47 CFR Part 15, Subpart B

ANSI C63.4a-2017

Class A

Class B



2.1 Conducted Emissions at Mains Power Ports

Test Date

Aug. 09, 2024

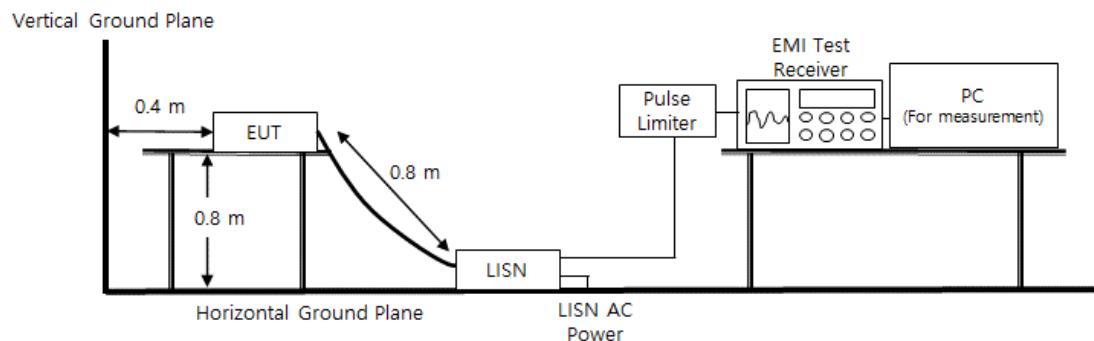
Test Location

SHIELD ROOM #6

Test Equipment

Used	Description	Model Number	Manufacturer	Serial Number	Cal. Due	calibration interval
<input checked="" type="checkbox"/>	EMI Test S/W	EMC32	R & S	9.12.00	-	-
<input checked="" type="checkbox"/>	EMI TEST RECEIVER	ESR3	R & S	101783	11, 08, 2024	1 Year
<input checked="" type="checkbox"/>	LISN	ENV216	R & S	101787	11, 08, 2024	1 Year
<input checked="" type="checkbox"/>	LISN	ESH2-Z5	R & S	100450	11, 08, 2024	1 Year
<input checked="" type="checkbox"/>	PULSE LIMITER	ESH3-Z2	R & S	101915	11, 08, 2024	1 Year

Diagram of test setup





Test Conditions

Temperature: (23,9 ± 0,1) °C
Relative Humidity: (46,5 ± 0,2) % R.H.

Frequency Range of Measurement

150 kHz to 30 MHz

Instrument Settings

IF Band Width: 9 kHz

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 GHz)

Test Date

Aug. 09, 2024

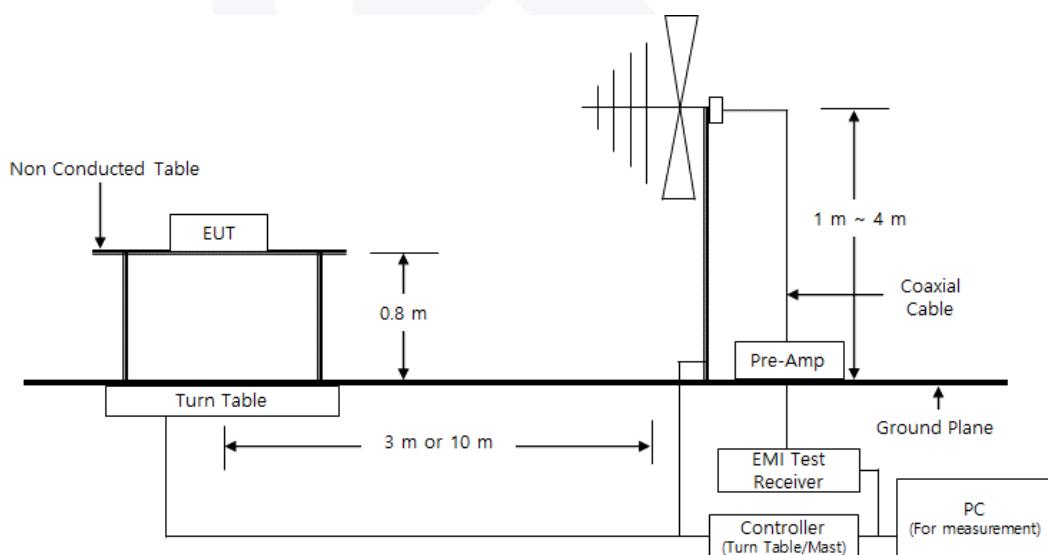
Test Location

SEMI ANECHOIC CHAMBER #6

Test Equipment

Used	Description	Model Number	Manufacturer	Serial Number	Cal. Due	calibration interval
<input checked="" type="checkbox"/>	EMI Test S/W	ES10/RE	TOYO Corporation	2022.01.000	-	-
<input checked="" type="checkbox"/>	EMI TEST RECEIVER	ESR7	R & S	101190	07, 29, 2025	1 Year
<input checked="" type="checkbox"/>	AMPLIFIER	310N	SONOMA INSTRUMENT	401123	02, 13, 2025	1 Year
<input checked="" type="checkbox"/>	TRILOG-BROADBAND ANTENNA	VULB9163	Schwarzbeck	714	04, 19, 2026	2 Year
<input checked="" type="checkbox"/>	ATTENUATOR	6806.17.A	HUBER+SUHNER	-	02, 13, 2025	1 Year

Diagram of test setup





Test Conditions

Temperature: (23,8 ± 0,2) °C
Relative Humidity: (47,1 ± 0,4) % R.H.

Frequency Range of Measurement

30 MHz to 1 GHz

Instrument Settings

IF Band Width: 120 kHz

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 GHz)

Test Date

Aug. 09, 2024

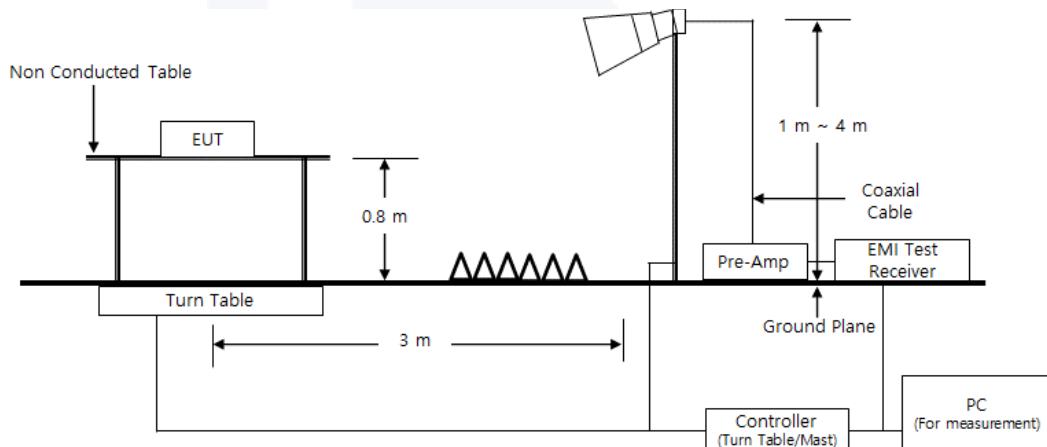
Test Location

SEMI ANECHOIC CHAMBER #5

Test Equipment

Used	Description	Model Number	Manufacturer	Serial Number	Cal. Due	calibration interval
<input checked="" type="checkbox"/>	EMI Test S/W	ES10/RE	TOYO Corporation	2022.01.000	-	-
<input checked="" type="checkbox"/>	EMI TEST RECEIVER	ESU26	Rohde & Schwarz	100552	02, 13, 2025	1 Year
<input checked="" type="checkbox"/>	HORN ANTENNA	BBHA 9120D	SCHWARZBECK	9120D-1802	11, 03, 2024	1 Year
<input checked="" type="checkbox"/>	PREAMPLIFIER	8449B	HP	3008A00538	04, 30, 2025	1 Year
<input checked="" type="checkbox"/>	ATTENUATOR	8491B	HP	23094	02, 13, 2025	1 Year

Diagram of test setup





Test Conditions

Temperature: (23,8 ± 0,2) °C
Relative Humidity: (46,2 ± 0,2) % R.H.

Frequency Range of Measurement

1 GHz to 12,5 GHz

Instrument Settings

IF Band Width: 1 MHz

Test Results

The requirements are:

- PASS
- NOT PASS
- NOT APPLICABLE

Remarks

See Appendix A for test data.

The Average of the test data is the cispr average result.

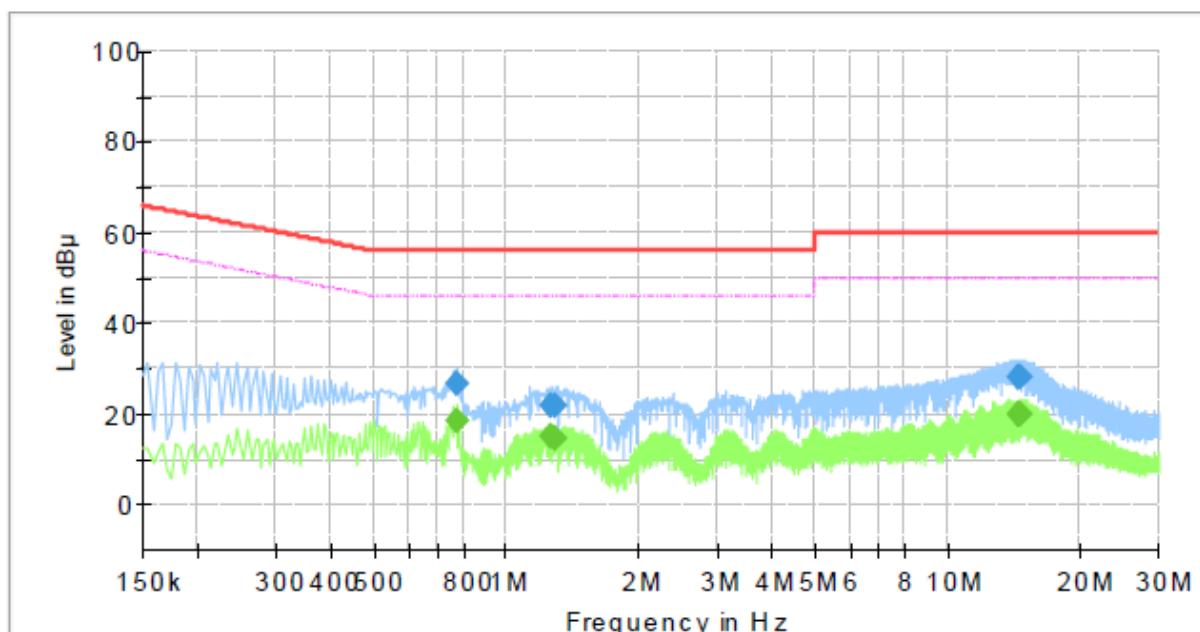


APPENDIX A – TEST DATA

Conducted Emissions at Mains Power Ports HOT LINE

Common Information

Test Description: Conducted Emission
Job No.: KES-EM242656
Phase: L
Mode:
Operator Name: KES



Final Result

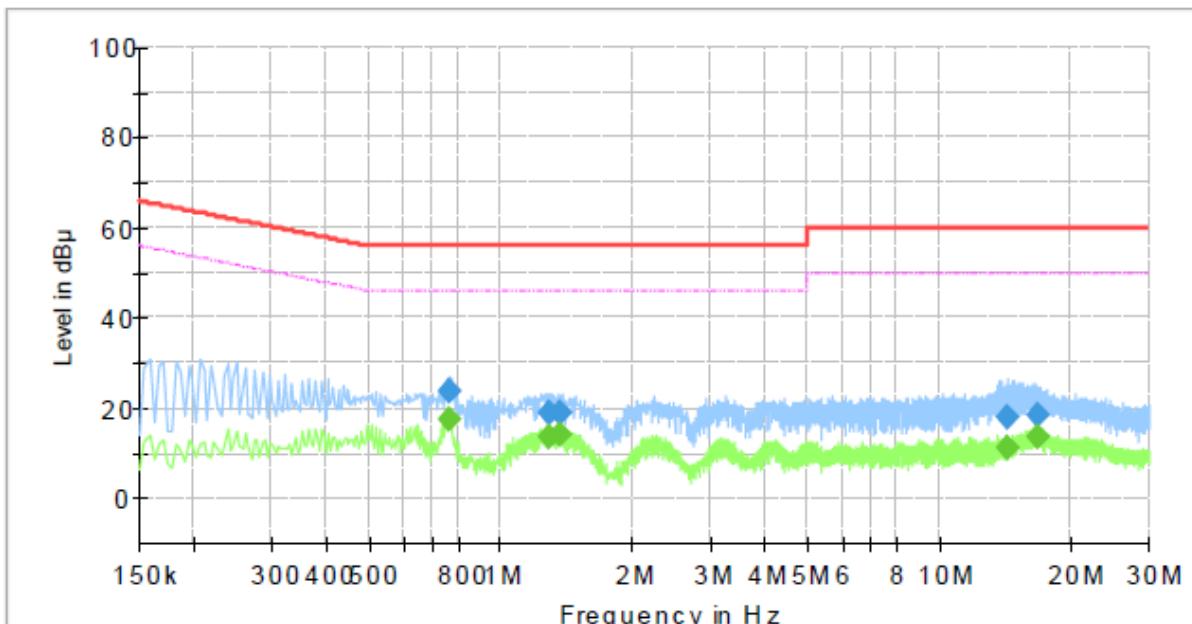
Frequency (MHz)	QuasiPeak (dB μ V)	CAverage (dB μ V)	Limit (dB μ V)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.770000	---	18.48	46.00	27.52	1000.0	9.000	L1	19.8
0.770000	26.82	---	56.00	29.18	1000.0	9.000	L1	19.8
1.270000	---	14.99	46.00	31.01	1000.0	9.000	L1	19.8
1.270000	21.94	---	56.00	34.06	1000.0	9.000	L1	19.8
1.298000	---	14.67	46.00	31.33	1000.0	9.000	L1	19.8
1.298000	21.74	---	56.00	34.26	1000.0	9.000	L1	19.8
14.518000	---	19.86	50.00	30.14	1000.0	9.000	L1	20.9
14.518000	28.25	---	60.00	31.75	1000.0	9.000	L1	20.9
14.694000	---	20.10	50.00	29.90	1000.0	9.000	L1	20.9
14.694000	28.17	---	60.00	31.83	1000.0	9.000	L1	20.9



NEUTRAL LINE

Common Information

Test Description: Conducted Emission
 Job No.: KES-EM242656
 Phase: N
 Mode:
 Operator Name: KES



Final Result

Frequency (MHz)	QuasiPeak (dB μ V)	CAverage (dB μ V)	Limit (dB μ V)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.762000	---	17.30	46.00	28.70	1000.0	9.000	N	19.8
0.762000	23.79	---	56.00	32.21	1000.0	9.000	N	19.8
1.286000	---	13.66	46.00	32.34	1000.0	9.000	N	19.8
1.286000	18.88	---	56.00	37.12	1000.0	9.000	N	19.8
1.374000	---	13.99	46.00	32.01	1000.0	9.000	N	19.8
1.374000	19.08	---	56.00	36.92	1000.0	9.000	N	19.8
14.294000	---	11.14	50.00	38.86	1000.0	9.000	N	20.9
14.294000	17.78	---	60.00	42.22	1000.0	9.000	N	20.9
16.794000	---	13.55	50.00	36.45	1000.0	9.000	N	21.0
16.794000	18.62	---	60.00	41.38	1000.0	9.000	N	21.0

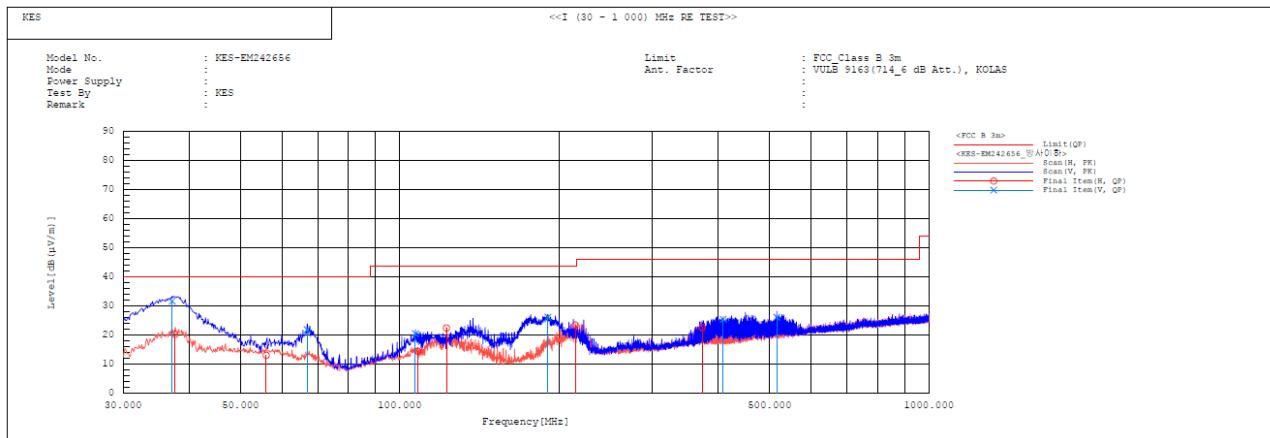
◆ Calculation

QuasiPeak[dB μ V] / CAverage [dB μ V] = Reading Value[dB μ V] + 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)****Final Result**

No.	Frequency	Pol	Reading	c.f	Result	Limit	Margin	Height	Angle	Remark
	[MHz]		[dB(μV)]	[dB(1/m)]	[dB (μV/m)]	[dB(μV/m)]	[dB]	[cm]	[deg]	
1	37.154	V	44.9	-13.3	31.6	40.0	8.4	100.0	286.5	
2	37.639	H	33.4	-13.2	20.2	40.0	19.8	400.0	122.7	
3	55.948	H	24.8	-11.8	13.0	40.0	27.0	396.0	164.2	
4	66.860	V	36.1	-14.3	21.8	40.0	18.2	103.0	22.8	
5	107.115	V	33.9	-13.5	20.4	43.5	23.1	196.0	110.9	
6	108.206	H	27.9	-13.5	14.4	43.5	29.1	206.0	65.6	
7	122.635	H	36.9	-14.5	22.4	43.5	21.1	208.0	43.8	
8	190.778	V	39.1	-13.0	26.1	43.5	17.4	100.0	175.1	
9	214.664	H	35.4	-11.9	23.5	43.5	20.0	301.0	75.9	
10	373.016	H	30.1	-7.5	22.6	46.0	23.4	296.0	120.9	
11	409.028	V	32.5	-7.1	25.4	46.0	20.6	198.0	160.5	
12	515.970	V	30.9	-4.8	26.1	46.0	19.9	102.0	308.1	

◆ Calculation

$$\text{Result(QP)} [\text{dB}(\mu\text{V}/\text{m})] = (\text{Reading(QP)} [\text{dB}(\mu\text{V})] + \text{c.f} [\text{dB}(1/\text{m})])$$

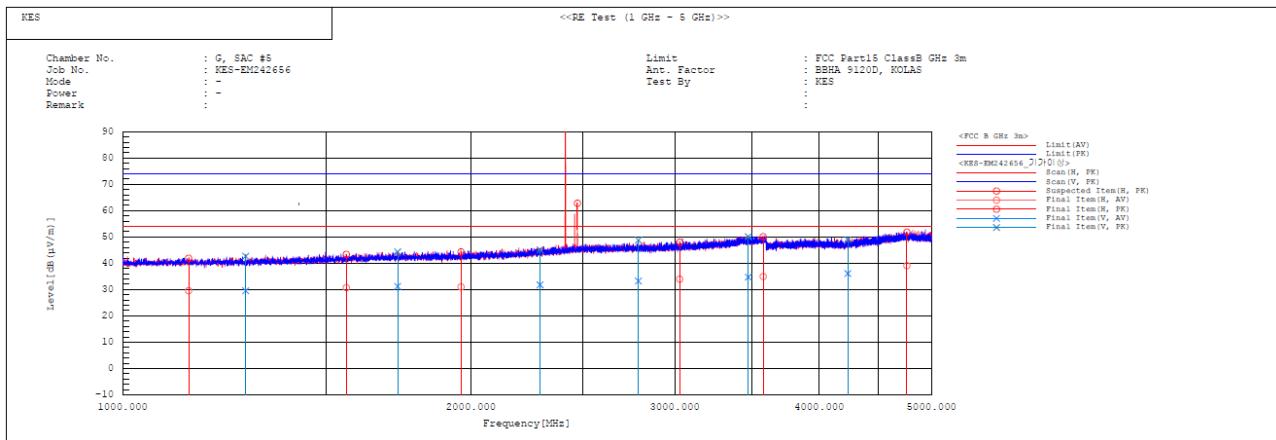
$$\text{Margin(QP)} [\text{dB}] = \text{Limit} [\text{dB}(\mu\text{V}/\text{m})] - \text{Result(QP)} [\text{dB}(\mu\text{V}/\text{m})]$$

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

**Radiated Electric Field Emissions(Above 1 GHz)**

- (1 ~ 5) GHz



Final Result

No.	Frequency	Pol	Reading AV	Reading PK	c.f.	Result AV	Result PK	Limit AV	Limit PK	Margin AV	Margin PK	Height [cm]	Angle [deg]	Remark
	[MHz]		[dB (uV)]	[dB (uV)]		[dB (1/m)]	[dB (1/m)]	[dB (uV/m)]	[dB (uV/m)]	[dB]	[dB]			
1	1140.447	H	30.7	43.0	-1.1	29.6	41.9	54.0	74.0	24.4	32.1	305.0	238.5	
2	1277.995	V	29.9	43.1	-0.4	29.5	42.7	54.0	74.0	24.5	31.3	109.0	126.6	
3	1560.937	H	29.7	42.4	1.0	30.7	43.4	54.0	74.0	23.3	30.6	301.0	32.3	
4	1728.485	V	29.5	42.6	1.7	31.2	44.3	54.0	74.0	22.8	29.7	193.0	209.5	
5	1960.972	H	28.3	41.6	2.7	31.0	44.3	54.0	74.0	23.0	29.7	400.0	329.6	
6	2294.798	V	27.8	41.1	4.0	31.8	45.1	54.0	74.0	22.2	28.9	100.0	206.8	
7	2791.236	V	27.7	43.2	5.6	33.3	46.8	54.0	74.0	20.7	25.2	107.0	264.3	
8	3030.771	H	27.7	41.7	6.3	34.0	48.0	54.0	74.0	20.0	26.0	400.0	183.4	
9	3474.154	V	27.8	43.2	6.9	34.7	50.1	54.0	74.0	19.3	23.9	100.0	59.1	
10	3577.421	H	27.8	42.9	7.2	35.0	50.1	54.0	74.0	19.0	23.9	386.0	211.5	
11	4234.306	V	26.8	39.6	9.3	36.1	49.9	54.0	74.0	17.9	25.1	103.0	206.8	
12	4763.230	H	27.6	40.3	11.5	39.1	51.8	54.0	74.0	14.9	22.2	308.0	61.6	
13	2413.600	H	-----	-----	4.4	-----	-----	-----	-----	-----	-----	100.0	241.2	
14	2472.800	H	-----	-----	4.7	-----	-----	-----	-----	-----	-----	100.0	343.3	

* Exclusion bands

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



- (5 ~ 12,4) GHz

- PK

Frequency (MHz)	Reading PK (dBuV)	Polarization	Height (m)	ANT Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
6 739.400	40.800	H	1.000	35.200	9.400	34.730	50.670	74.000	23.330
8 022.500	40.100	V	1.000	37.220	10.140	34.100	53.360	74.000	20.640

- CISPR AV

Frequency (MHz)	Reading CISPR AV (dBuV)	Polarization	Height (m)	ANT Factor (dB)	Cable Loss (dB)	Preamp Factor (dB)	Result (dBuV/m)	Limit (dBuV/m)	Margin (dB)
6 739.400	28.600	H	1.000	35.200	9.400	34.730	38.470	54.000	15.530
8 022.500	28.100	V	1.000	37.220	10.140	34.100	41.360	54.000	12.640

◆ Calculation

$$\text{Result(PK/CAV)} [\text{dB}(\mu\text{V}/\text{m})] = (\text{Reading(PK/CAV)} [\text{dB}(\mu\text{V})] + \text{c.f}[\text{dB}(1/\text{m})])$$

$$\text{Margin(PK/CAV)} [\text{dB}] = \text{Limit} [\text{dB}(\mu\text{V}/\text{m})] - \text{Result(PK/CAV)} [\text{dB}(\mu\text{V}/\text{m})]$$

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: Margin value