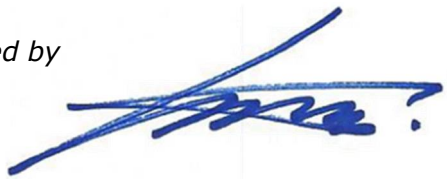
EMC TEST REPORT

Test Report No.	:	KES-EM-20T0047
Date of Issue	:	Jan. 30, 2020
Product name	:	BeyonSense
Model/Type No.	:	BeyonSense Pre
Variant Mode	:	-
Applicant	:	STRATIO, INC.
Applicant Address	:	106, Myeongdal-ro, Seocho-gu, Seoul, Republic of Korea
Manufacturer	:	STRATIO, INC.
Manufacturer Address	:	106, Myeongdal-ro, Seocho-gu, Seoul, Republic of Korea
FCC ID	:	2AK2OBEYONSENSEPRE
Date of Receipt	:	Dec. 13, 2019
Test date	:	Dec. 26, 2019 ~ Dec. 27, 2019
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
Jan. 30, 2020	KES-EM-20T0047	Issued

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1.0 General Product Description

Main Specifications of EUT are:

Item	spec
Operating Frequency	2.4 ㎓ (Wifi)
Power	DC 5 V (USB)
Dimension	(65 x 35 x 23) ㎜

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 ☐ 12 Vdc ☐ DC 3.7 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
BeyonSense	BeyonSense Pre	-	STRATIO, INC.	EUT

1.5 Support Equipments

Description	Model Number	Serial Number	Manufacturer	Remarks
SmartPhone	A1586	-	Apple	-
Adapter	MCS-04KD	-	Dongdo Electroncs (Yantal) Co., Ltd	-

1.6 External I/O Cabling

■ Charge Mode

Start		END		Cable Spec.	
Description	**I/O Port**	**Description**	**I/O Port**	**Length**	**Shield**
BeyonSense (EUT)	Micro 5 Pin	Adapter	USB	1.0	U

■ Operating Mode

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

1.7 EUT Operating Mode(s)

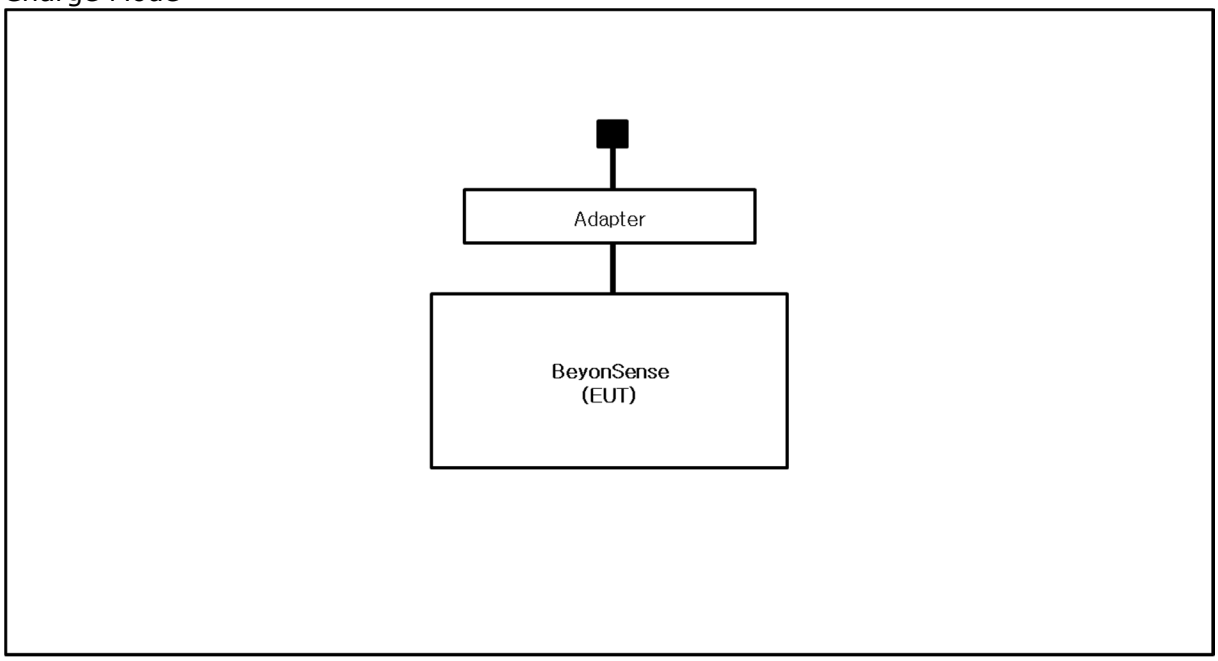
Test mode	operating
Charge	1. Connect the EUT and Adapter and check charge led status on EUT.
Operating	1. Connect the EUT and SmartPhone wirelessly and check network status on SmartPhone. 2. During the test, the EUT operation was confirmed with SmartPhone LCD.

EUT Test operating S/W		
Name	**Version**	**Manufacture Company**
BeyonSense	1.1.10	STRATIO INC

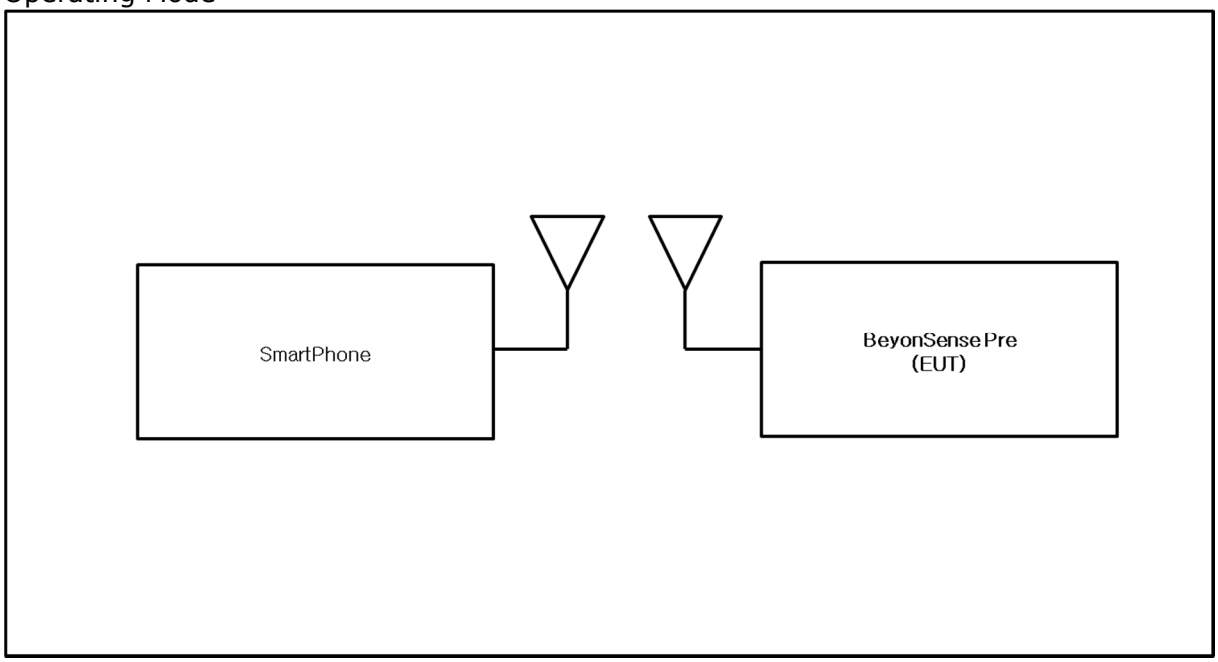
1.8 Configuration

■ AC Main
□ DC Main

■ Charge Mode



■ Operating 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	**TÜV SÜD**	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 0003

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 ☐ Class A	☐ Group 2 ☐ 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 V-3 / 2015.04**	☐ Class A	☐ Class B
☐ **AS/NZS:2013**	☐ 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
Dec. 27, 2019

Test Location
Electro wave Shieldroom #6

Test Equipment

Used	Description	Model Number	Manufacturer	Serial Number	Cal. Due	calibration interval
☒	EMI Test S/W	EMC32	R & S	9.12.00	-	-
☒	EMI TEST RECEIVER	ESR3	R & S	101781	04, 22, 2020	1 Year
☒	LISN	ENV216	R & S	101787	01, 04, 2020 (01, 02, 2021)	1 Year
☐	LISN	ESH2-Z5	R & S	100450	04,22,2020 (01, 02, 2021)	1 Year
☒	PULSE LIMITER	ESH3-Z2	R & S	101915	11,25,2020 (01, 02, 2021)	1 Year

Test Conditions
Temperature: 21.8 ℃
Relative Humidity: 47.5 % 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
Dec. 27, 2019

Test Location
☐ OPEN AREA TEST SITE #2 ☒ SEMI ANECHOIC CHAMBER #4(10 m)

Test Equipment

Used	Description	Model Number	Manufacturer	Serial Number	Cal. Due	calibration interval
☒	EMI Test S/W	EP5/RE	TOYO Corporation	6.0.0	-	-
☒	EMI TEST RECEIVER	ESU26	R & S	100551	04, 09, 2020	1 Year
☒	AMPLIFIER	SCU 01	R & S	100603	11, 25, 2020	1 Year
☒	TRILOG-BROADBAND ANTENNA	VULB9163	Schwarzbeck	715	11, 29, 2020	2 Year
☒	ATTENUATOR	8491A	HP	32173	03, 11, 2020	1 Year

Test Conditions
Temperature: 22.6 ℃
Relative Humidity: 47.4 % 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.
- The EUT tested three orthogonals (X, Y, Z) axes to determine the orientation that maximum or near-maximum emission level.
- It was determined that X orientation(Charging mode) and Z orientation(Operation mode) was worst-case orientation; therefore, al final radiated testing was performed with the EUT in X orientation(Charging mode) and Z orientation(Operation mode)

2.3 Radiated Electric Field Emissions(Above 1 ㎓)

Test Date
Dec. 26, 2019

Test Location
SEMI ANECHOIC CHAMBER #4(10 m)

Test Equipment

Used	Description	Model Number	Manufacturer	Serial Number	Cal. Due	calibration interval
☒	EMI Test S/W	EP5/RE	TOYO Corporation	6.0.0	-	-
☒	EMI TEST RECEIVER	ESU26	R & S	100551	04, 09, 2020	1 Year
☒	PREAMPLIFIER	8449B	AGILENT	3008A01742	01, 08, 2020 (01, 02, 2021)	1 Year
☒	HORN ANTENNA	BBHA 9120D	SCHWARZBECK	9120D-1802	03, 11, 2020	2 Year

Test Conditions
Temperature: 22.6 ℃
Relative Humidity: 47.4 % 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.
- The EUT tested three orthogonals (X, Y, Z) axes to determine the orientation that maximum or near-maximum emission level.
- It was determined that X orientation(Charging mode) and Z orientation(Operation mode) was worst-case orientation; therefore, al final radiated testing was performed with the EUT in X orientation(Charging mode) and Z orientation(Operation mode)

APPENDIX A – TEST DATA

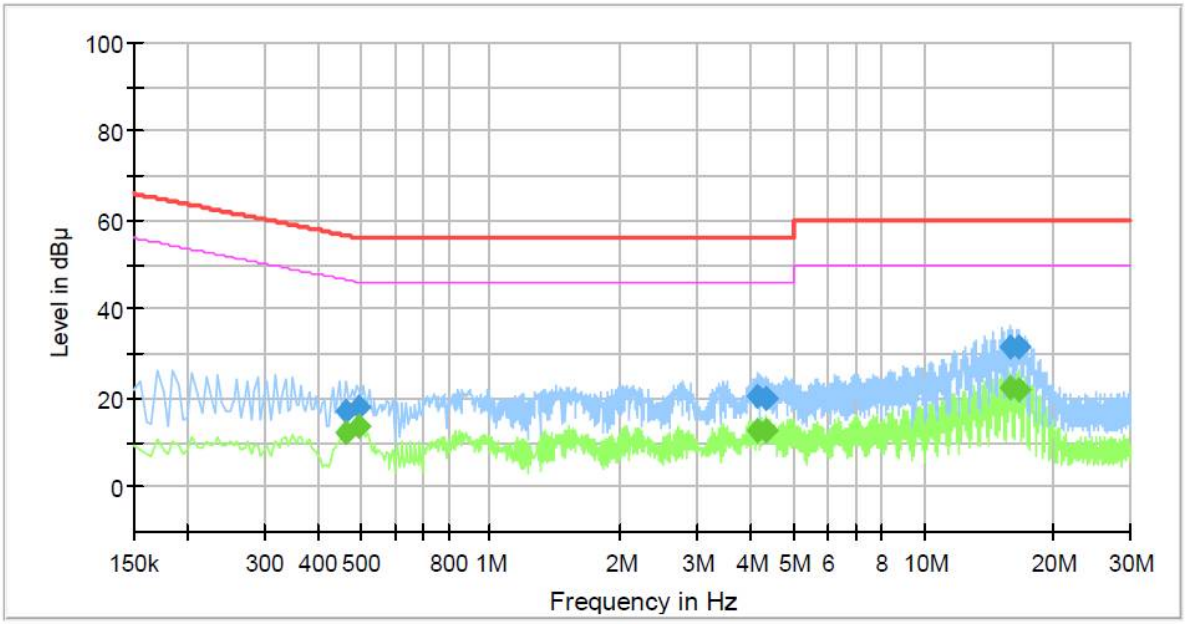
Conducted Emissions at Mains Power Ports

■ Charge Mode

HOT LINE

Common Information

Test Description:	Conducted Emission
Model No.:	BeyonSense Pre
Phase:	
Mode:	Charge / FCC
Operator Name:	KES



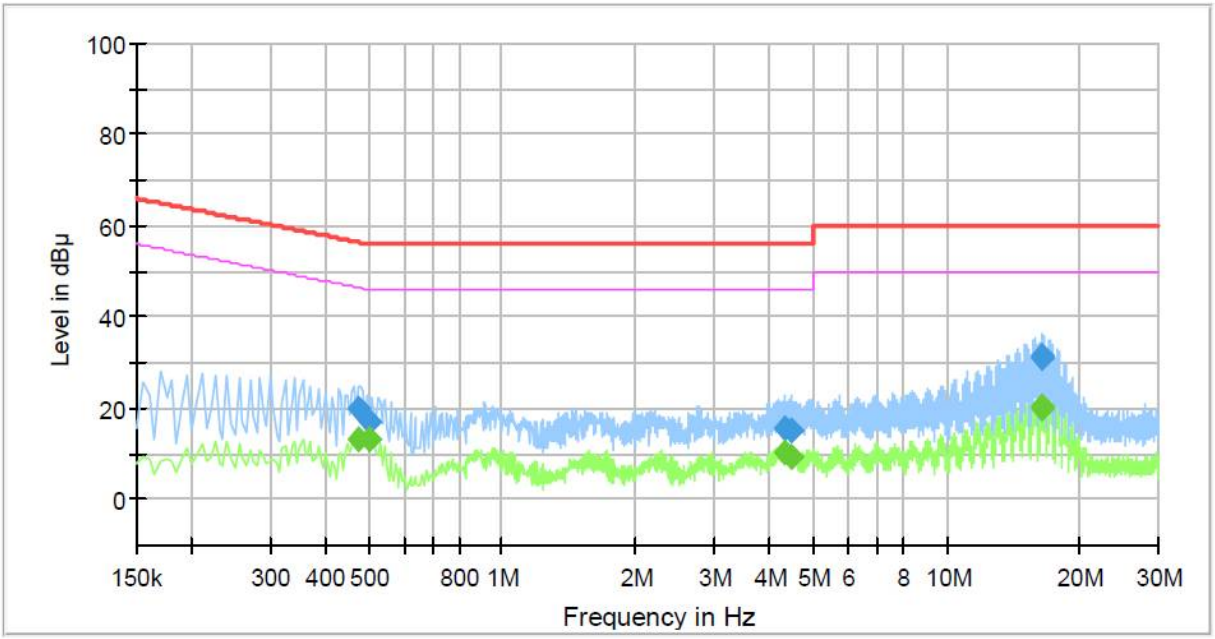
Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.465000	---	12.26	46.60	34.34	1000.0	9.000	L1	19.6
0.465000	17.08	---	56.60	39.52	1000.0	9.000	L1	19.6
0.495000	---	13.75	46.08	32.33	1000.0	9.000	L1	19.6
0.495000	17.79	---	56.08	38.29	1000.0	9.000	L1	19.6
4.150000	---	12.75	46.00	33.25	1000.0	9.000	L1	19.7
4.150000	20.46	---	56.00	35.54	1000.0	9.000	L1	19.7
4.320000	---	12.63	46.00	33.37	1000.0	9.000	L1	19.7
4.320000	19.89	---	56.00	36.11	1000.0	9.000	L1	19.7
15.870000	---	22.11	50.00	27.89	1000.0	9.000	L1	19.9
15.870000	31.63	---	60.00	28.37	1000.0	9.000	L1	19.9
16.570000	---	22.07	50.00	27.93	1000.0	9.000	L1	19.9
16.570000	31.58	---	60.00	28.42	1000.0	9.000	L1	19.9

NEUTRAL LINE

Common Information

Test Description:	Conducted Emission
Model No.:	BeyonSense Pre
Phase:	
Mode:	Charge / FCC
Operator Name:	KES



Final_Result

Frequency (MHz)	QuasiPeak (dBµV)	CAverage (dBµV)	Limit (dBµV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.475000	---	12.99	46.43	33.44	1000.0	9.000	N	19.6
0.475000	19.87	---	56.43	36.56	1000.0	9.000	N	19.6
0.500000	---	12.96	46.00	33.04	1000.0	9.000	N	19.6
0.500000	17.20	---	56.00	38.80	1000.0	9.000	N	19.6
4.340000	---	10.35	46.00	35.65	1000.0	9.000	N	19.7
4.340000	15.65	---	56.00	40.35	1000.0	9.000	N	19.7
4.470000	---	9.38	46.00	36.62	1000.0	9.000	N	19.7
4.470000	15.07	---	56.00	40.93	1000.0	9.000	N	19.7
16.395000	---	19.75	50.00	30.25	1000.0	9.000	N	19.9
16.395000	31.01	---	60.00	28.99	1000.0	9.000	N	19.9
16.460000	---	20.18	50.00	29.82	1000.0	9.000	N	19.9
16.460000	31.58	---	60.00	28.42	1000.0	9.000	N	19.9

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

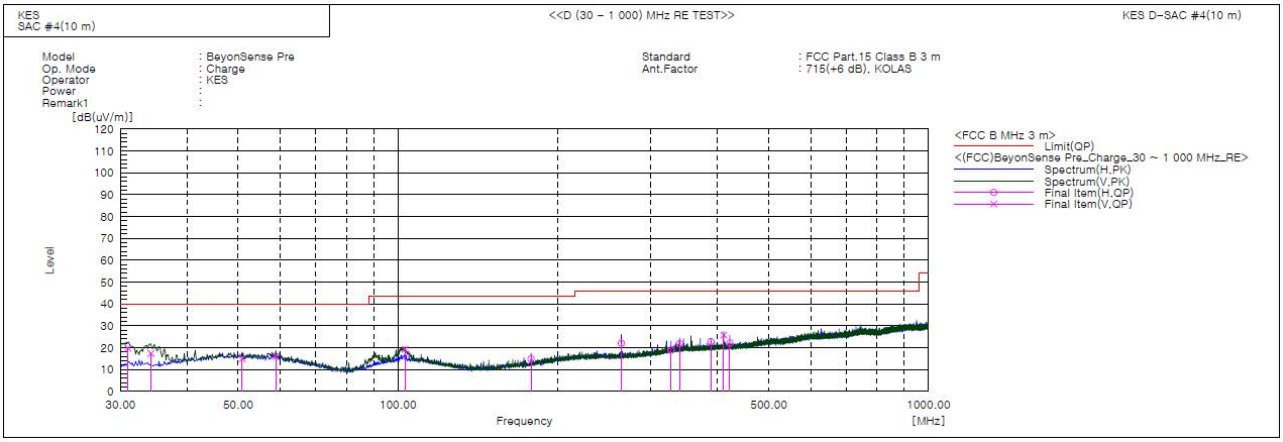
Uncertainty of measurement

HOT Line : Uncertainty of measurement 2.38 ㏈
(Confidence level: Approx. 95 %, *k*=2)

Neutral Line : Uncertainty of measurement 2.38 ㏈
(Confidence level: Approx. 95 %, *k*=2)

Radiated Electric Field Emissions(Below 1 ㎓)

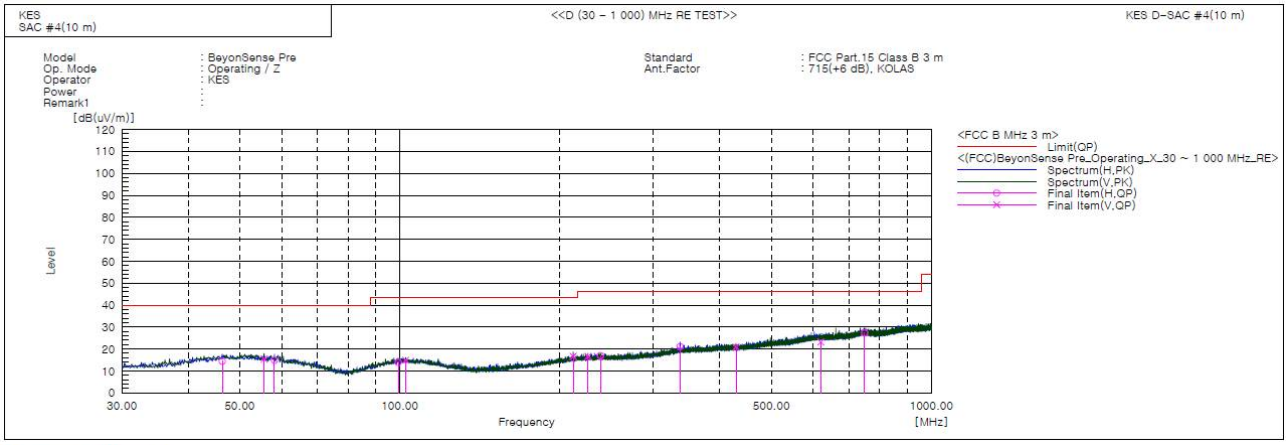
■ Charge Mode



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	30.970	V	45.4	-25.6	19.8	40.0	20.2	102.0	354.0	
2	34.244	V	42.9	-25.5	17.4	40.0	22.6	116.0	83.0	
3	50.855	V	36.9	-21.9	15.0	40.0	25.0	100.0	325.0	
4	58.858	V	38.9	-22.9	16.0	40.0	24.0	109.0	166.0	
5	103.114	V	42.6	-23.3	19.3	43.5	24.2	116.0	262.0	
6	178.289	H	39.9	-25.0	14.9	43.5	28.6	332.0	95.0	
7	263.649	H	43.2	-21.1	22.1	46.0	23.9	374.0	55.0	
8	326.941	H	37.5	-18.5	19.0	46.0	27.0	222.0	314.0	
9	339.430	H	39.8	-17.9	21.9	46.0	24.1	240.0	325.0	
10	388.900	H	39.7	-16.9	22.8	46.0	23.2	322.0	270.0	
11	411.089	V	42.4	-16.6	25.8	46.0	20.2	209.0	162.0	
12	422.123	H	38.7	-16.5	22.2	46.0	23.8	300.0	75.0	

■ 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	46.369	H	36.7	-22.3	14.4	40.0	25.6	339.0	336.0	
2	55.584	V	37.8	-22.4	15.4	40.0	24.6	110.0	48.0	
3	58.130	H	37.6	-22.8	14.8	40.0	25.2	315.0	166.0	
4	99.355	H	37.2	-23.3	13.9	43.5	29.6	374.0	270.0	
5	102.629	V	38.2	-23.3	14.9	43.5	28.6	157.0	151.0	
6	211.996	V	38.7	-22.0	16.7	43.5	26.8	103.0	135.0	
7	226.061	V	38.1	-21.5	16.6	46.0	29.4	100.0	209.0	
8	238.671	H	38.3	-21.3	17.0	46.0	29.0	255.0	193.0	
9	336.884	H	39.1	-18.0	21.1	46.0	24.9	304.0	317.0	
10	429.276	V	37.3	-16.4	20.9	46.0	25.1	109.0	251.0	
11	619.396	V	34.6	-11.4	23.2	46.0	22.8	138.0	213.0	
12	749.013	H	36.6	-9.3	27.3	46.0	18.7	209.0	242.0	

♦ 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

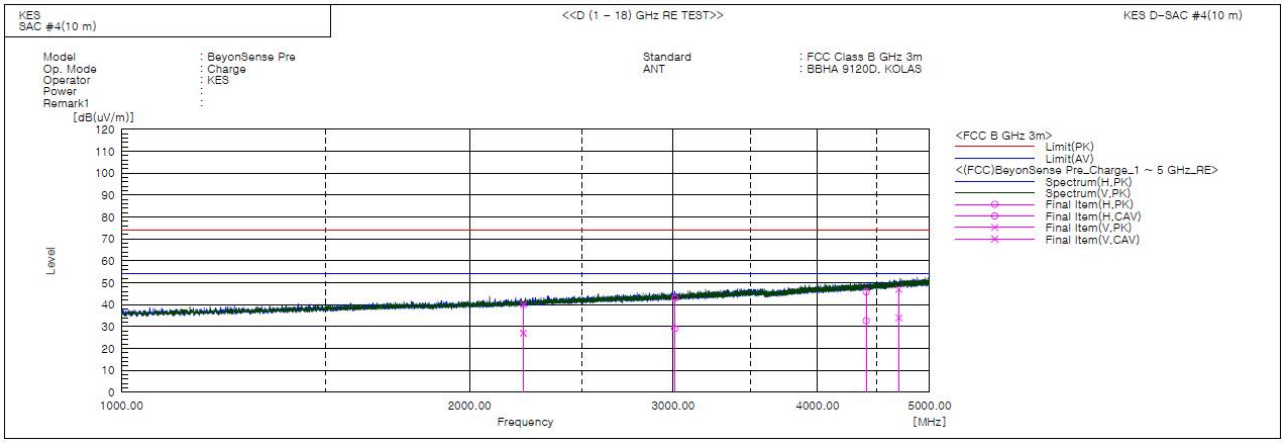
Uncertainty of measurement

Horizontal : Uncertainty of measurement 4.16 dB
(Confidence level: Approx. 95 %, *k*=2)

Vertical : Uncertainty of measurement 4.24 dB
(Confidence level: Approx. 95 %, *k*=2)

Radiated Electric Field Emissions(Above 1 ㎓)

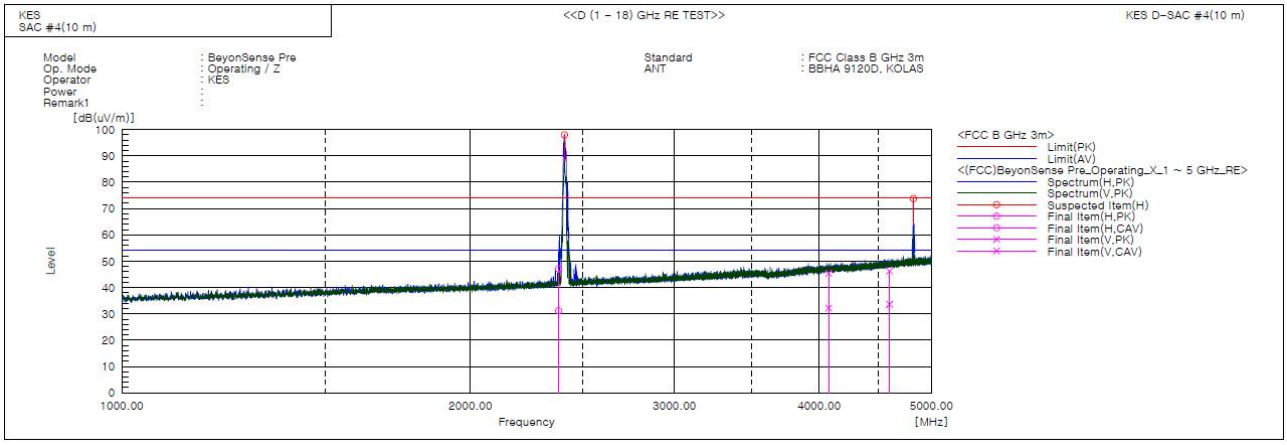
■ Charge Mode



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	2226.550	V	39.5	26.5	0.5	40.0	27.0	74.0	54.0	34.0	27.0	112.0	71.0	
2	3010.880	H	39.1	25.3	3.8	42.9	29.1	74.0	54.0	31.1	24.9	324.0	103.0	
3	4407.295	H	36.7	23.5	9.2	45.9	32.7	74.0	54.0	28.1	21.3	337.0	67.0	
4	4703.715	V	36.6	23.6	10.4	47.0	34.0	74.0	54.0	27.0	20.0	295.0	278.0	

■ Operating Mode – (1 ~ 5) GHz

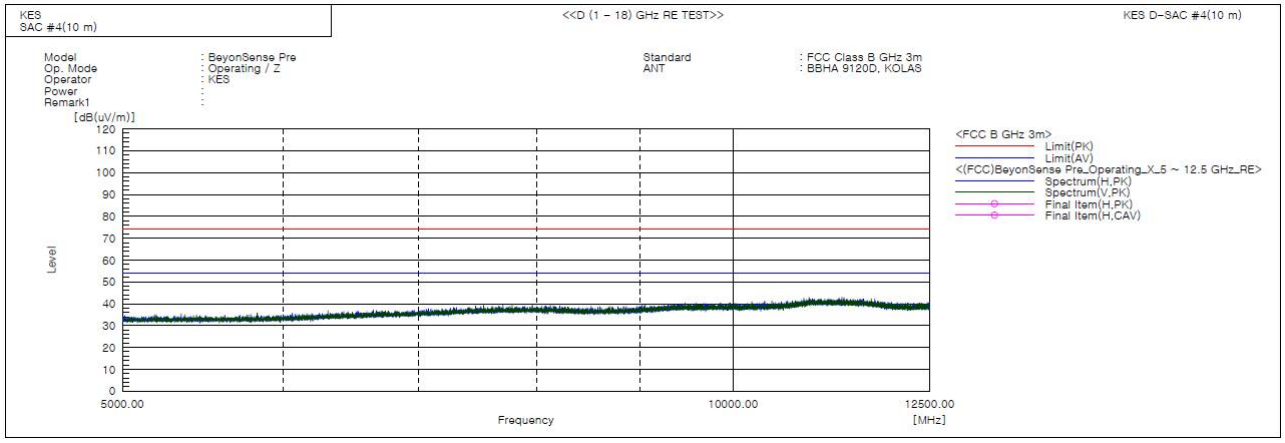


Final Result

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	2383.565	H	45.8	29.9	1.3	47.1	31.2	74.0	54.0	26.9	22.8	324.0	223.0	
2	4076.595	V	37.4	24.2	8.0	45.4	32.2	74.0	54.0	28.6	21.8	139.0	176.0	
3	4600.855	V	36.3	23.6	10.0	46.3	33.6	74.0	54.0	27.7	20.4	108.0	8.0	
4	2411.000	H	--------	--------	1.4	--------	--------	74.0	54.0	--------	--------	100.0	154.0	
5	4824.500	H	--------	--------	10.8	--------	--------	74.0	54.0	--------	--------	100.0	244.0	

* Operating Mode Exclusion Bands
- Fundamental Frequency: 2.4 GHz
- Harmonic Frequency : 4.8 GHz

– (5 ~ 12.5) GHz



* No spurious emission were detected above 5 GHz.

♦ 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 5.76 dB
(Confidence level: Approx. 95 %, *k*=2)