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Report No.:
KES-EM-20T0047
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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 : 2AK20BEYONSENSEPRE
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

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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 GHz (Wifi)
Power	DC 5 V (USB)
Dimension	(65 x 35 x 23) mm

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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 Electronics (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)

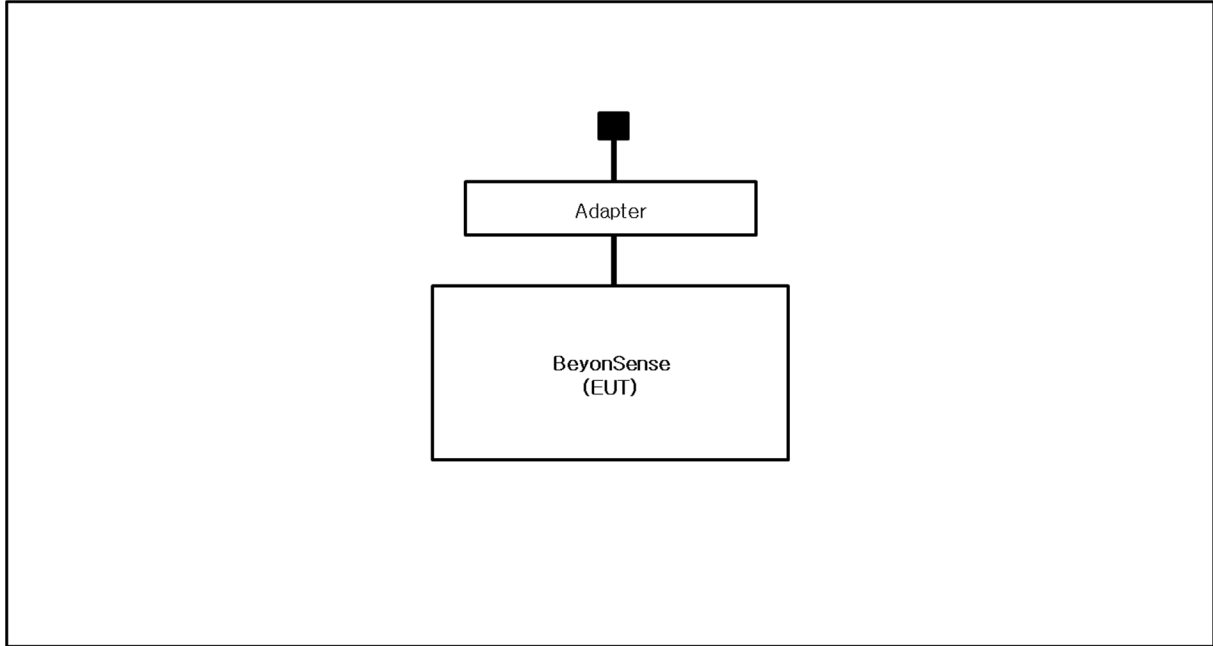
Test mode	operating
Charge	1. Connect the EUT and Adapter and check charge led status on EUT.
Operating	1. Connect the EUT and SmartPhone wirelessly and check network status on SmartPhone. 2. During the test, the EUT operation was confirmed with SmartPhone LCD.

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

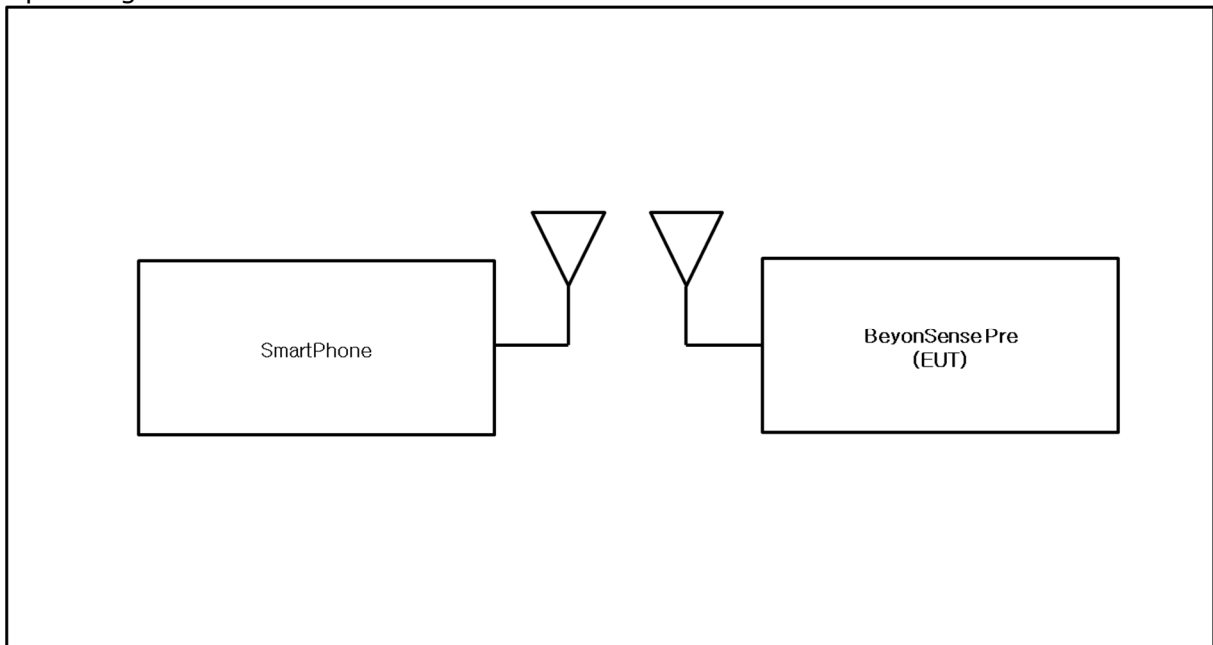
1.8 Configuration

- AC Main
- DC Main

■ Charge Mode



■ Operating Mode



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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, Yeosu-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 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 1GHz 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-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

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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



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- | | | |
|----------------------------------------------------------------------|----------------------------------|---------------------------------------------|
| <input type="checkbox"/> VCCI V-3 / 2015.04 | <input type="checkbox"/> Class A | <input type="checkbox"/> Class B |
| <input type="checkbox"/> AS/NZS:2013 | <input type="checkbox"/> Class A | <input type="checkbox"/> Class B |
| <input checked="" type="checkbox"/> 47 CFR Part 15, Subpart B | | |
| <input type="checkbox"/> CISPR 22:2009 +A1:2010 | <input type="checkbox"/> Class A | <input type="checkbox"/> Class B |
| <input checked="" type="checkbox"/> ANSI C63.4-2014 | <input type="checkbox"/> Class A | <input checked="" type="checkbox"/> Class B |
| <input type="checkbox"/> IC Regulation ICES-003 : 2016 | | |
| <input type="checkbox"/> CAN/CSA CISPR 22-10 | <input type="checkbox"/> Class A | <input type="checkbox"/> Class B |
| <input type="checkbox"/> ANSI C63.4-2014 | <input type="checkbox"/> Class A | <input type="checkbox"/> Class B |
| <input type="checkbox"/> RE- Directive 2014/53/EU | | |
| <input type="checkbox"/> EN 301 489-1 V1.9.2 | | |
| <input type="checkbox"/> Equipment for fixed use | | |
| <input type="checkbox"/> Equipment for vehicular use | | |
| <input type="checkbox"/> Equipment for portable use | | |
| <input type="checkbox"/> EN 301 489-3 V1.6.1 | | |
| <input type="checkbox"/> EN 301 489-17 V2.2.1 | | |
| <input type="checkbox"/> EN 60945:2002 | | |

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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
<input checked="" type="checkbox"/>	EMI Test S/W	EMC32	R & S	9.12.00	-	-
<input checked="" type="checkbox"/>	EMI TEST RECEIVER	ESR3	R & S	101781	04, 22, 2020	1 Year
<input checked="" type="checkbox"/>	LISN	ENV216	R & S	101787	01, 04, 2020 (01, 02, 2021)	1 Year
<input type="checkbox"/>	LISN	ESH2-Z5	R & S	100450	04, 22, 2020 (01, 02, 2021)	1 Year
<input checked="" type="checkbox"/>	PULSE LIMITER	ESH3-Z2	R & S	101915	11, 25, 2020 (01, 02, 2021)	1 Year

Test Conditions

Temperature: 21.8 °C
Relative Humidity: 47.5 % 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

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
<input checked="" type="checkbox"/>	EMI Test S/W	EP5/RE	TOYO Corporation	6.0.0	-	-
<input checked="" type="checkbox"/>	EMI TEST RECEIVER	ESU26	R & S	100551	04, 09, 2020	1 Year
<input checked="" type="checkbox"/>	AMPLIFIER	SCU 01	R & S	100603	11, 25, 2020	1 Year
<input checked="" type="checkbox"/>	TRILOG-BROADBAND ANTENNA	VULB9163	Schwarzbeck	715	11, 29, 2020	2 Year
<input checked="" type="checkbox"/>	ATTENUATOR	8491A	HP	32173	03, 11, 2020	1 Year

Test Conditions

Temperature: 22.6 °C
Relative Humidity: 47.4 % 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.
- The EUT tested three orthogonal (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, all 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 GHz)

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
<input checked="" type="checkbox"/>	EMI Test S/W	EP5/RE	TOYO Corporation	6.0.0	-	-
<input checked="" type="checkbox"/>	EMI TEST RECEIVER	ESU26	R & S	100551	04, 09, 2020	1 Year
<input checked="" type="checkbox"/>	PREAMPLIFIER	8449B	AGILENT	3008A017 42	01, 08, 2020 (01, 02, 2021)	1 Year
<input checked="" type="checkbox"/>	HORN ANTENNA	BBHA 9120D	SCHWARZBECK	9120D- 1802	03, 11, 2020	2 Year

Test Conditions

Temperature: 22.6 °C
Relative Humidity: 47.4 % R.H.

Frequency Range of Measurement

1 GHz to 12.4 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 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, all final radiated testing was performed with the EUT in X orientation(Charging mode) and Z orientation(Operation mode)

APPENDIX A – TEST DATA

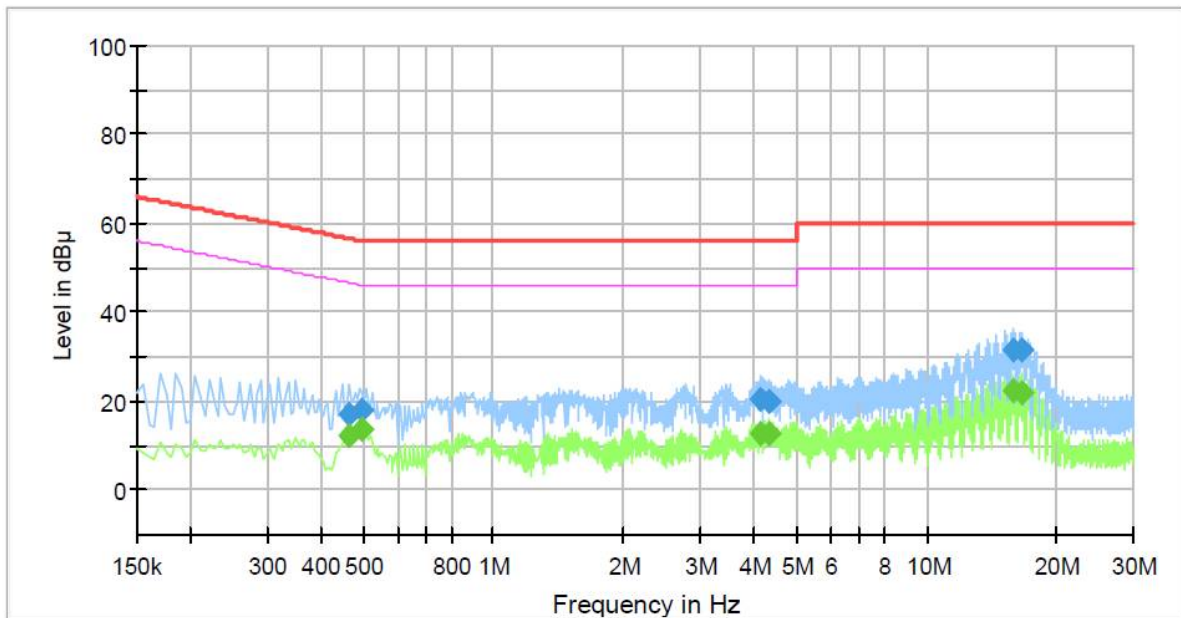
Conducted Emissions at Mains Power Ports

■ 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

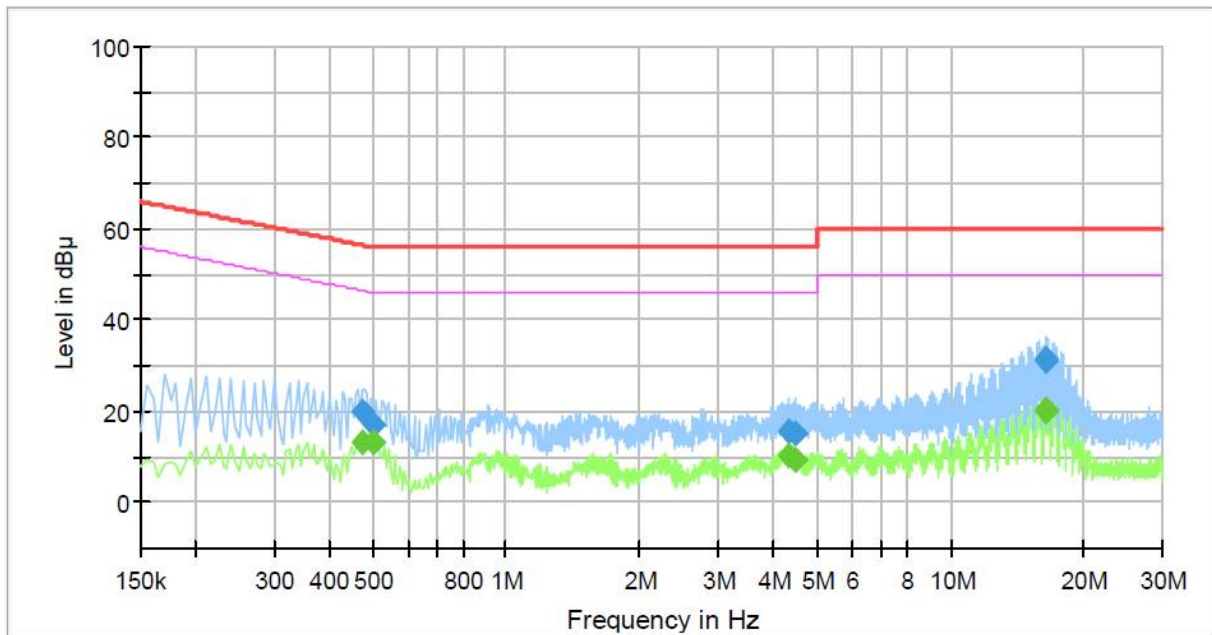
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NEUTRAL LINE

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

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◆ 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))

Uncertainty of measurement

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

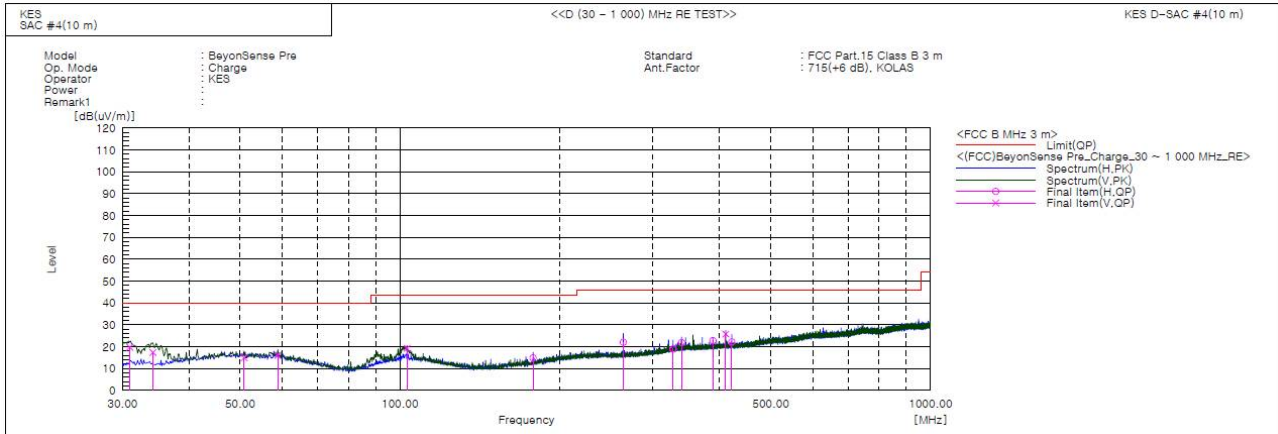
Neutral Line : Uncertainty of measurement 2.38 dB
(Confidence level: Approx. 95 %, $k=2$)

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Radiated Electric Field Emissions(Below 1 GHz)

■ Charge Mode



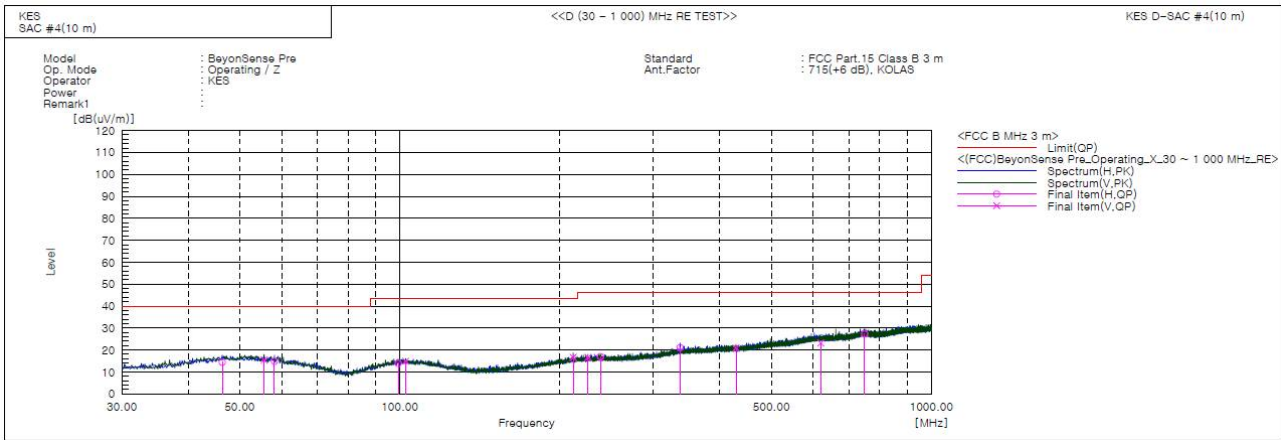
Final Result

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	

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■ 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

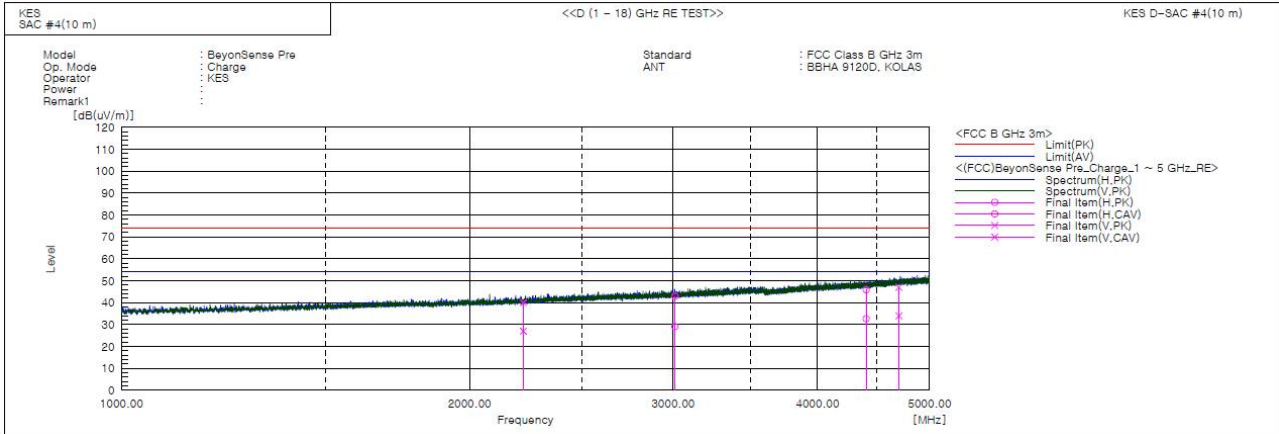
(Confidence level: Approx. 95 %, k=2)

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Radiated Electric Field Emissions(Above 1 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	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	

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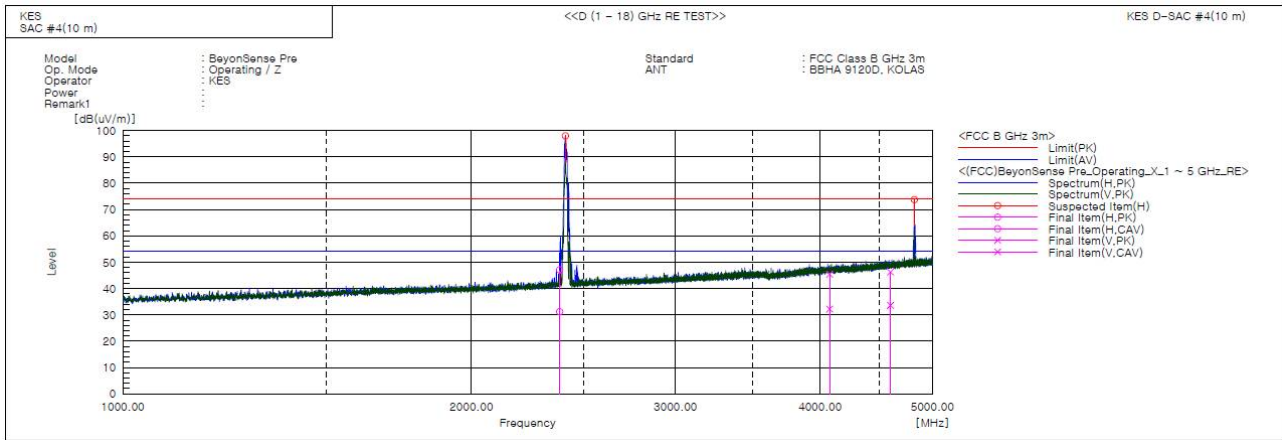


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■ Operating Mode – (1 ~ 5) GHz



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	

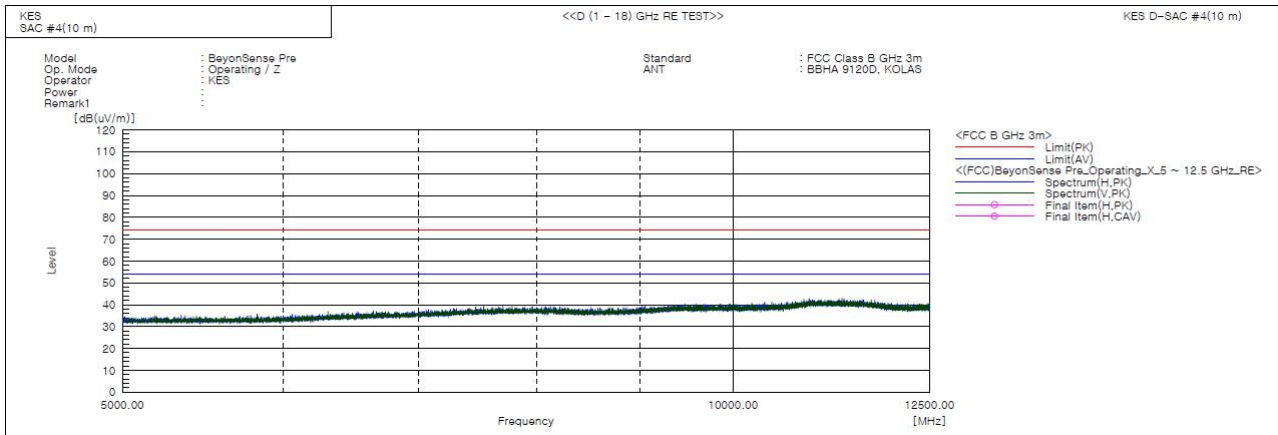
* Operating Mode Exclusion Bands

- Fundamental Frequency: 2.4 GHz
- Harmonic Frequency : 4.8 GHz

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- (5 ~ 12.5) GHz



* No spurious emission were detected above 5 GHz.

◆ 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: Marjin value

Uncertainty of measurement

Uncertainty of measurement 5.76 dB
(Confidence level: Approx. 95 %, k=2)

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