TEST REPORT

KOSTEC Co., Ltd.28(175-20, Annyeong-dong) 406-gil sejaro, Hwaseong-si, Gyeonggi-do, Korea Tel:031-222-4251, Fax:031-222-4252Report No.: KST-FCR-190008
1. Applicant
• Name : BSL Co., Ltd.
Address : Suite 103, 104 GanwonTechno Park ChuncheonVenture 2nd Factory Sinbuk-ro 61 -14, Shinbuk-eup Chuncheon-si Gangwon-do, Zip Code 24206, Republic of Korea
2. Test Item
Product Name: TWS Hearing Device
Model Name: EM-V100
• Brand: -
• FCC ID: Q32-EMV100
3. Manufacturer
Name : BSL Co., Ltd.
Address : Suite 103, 104 GanwonTechno Park ChuncheonVenture 2nd Factory Sinbuk-ro 61 -14, Shinbuk-eup Chuncheon-si Gangwon-do, Zip Code 24206, Republic of Korea
4. Manufactory
Name : EM-TECH VIETNAM CO., LTD
Address : Yen Phong Industrials Zone Bac ninh province Vietnam
5. Date of Test : 2019. 04. 16. ~ 2019. 04. 17.
6. Test Method Used : 558074 D01 15.247 Meas Guidance v05 ANSI C 63.10-2013
7. Test Result : Compliance
8. Note: None
Supplementary Information
The device bearing the brand name and FCC ID specified above has been shown to comply with the applicable technical standards as indicated in the measurement report and was tested in accordance with measurement procedures specified in <u>ANSI C 63.10-2013</u> .
We attest to the accuracy of data and all measurements reported herein were performed by KOSTEC Co., Ltd. and were made under Chief Engineer's supervision. We assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.
The results shown in this test report refer only to the sample(s) tested unless otherwise stated. This test report is not related to KOLAS accreditation.
Affirmation Tested by Technical Manager
Affirmation Name : Choo, Kwang-Yeol (Signature) Name : Park, Gyeong-Hyeon (Signature)
2019. 04. 19.
KOSTEC Co., Ltd.



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1. GENERAL INFORMATION

1.1 Test Facility

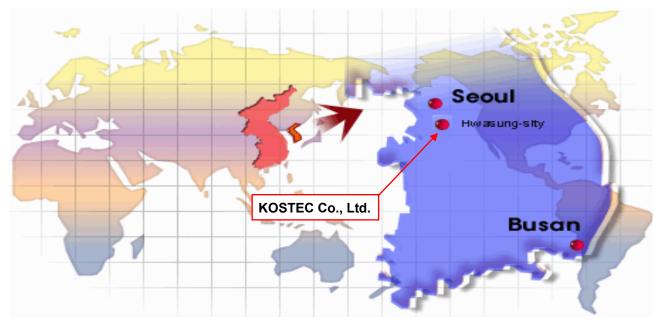
Test laboratory and address

KOSTEC Co., Ltd. 128(175-20,Annyeong-dong)406-gil sejaro, Hwaseong-si Gyeonggi-do, Korea

Registration information

KOLAS No. : 232 FCC/IC Designation No. : KR0041

1.2 Location





1.3 Revision History of test report

Rev.	Revisions	Effect page	Reviewed	Date
-	Initial issue	All	Gyeong Hyeon, Park	2019. 04. 19



2. EQUIPMENT DESCRIPTION

The product specification described herein was declared by manufacturer. And refer to user's manual for the details.

Equipment Name	TWS Hearing Device
Model No	EM-V100
Usage	TWS Hearing Device
Serial Number	Proto type
Modulation type	GFSK
Emission Type	F1D
Maximum output power	6.55 dBm
Operated Frequency	2 402 MHz ~ 2 480 MHz
Channel Number	40
Operation temperature	10 °C ~ 40 °C
Power Source	DC 3.7 V(Li-ion Polymer Battery)
Antenna Description	Internal FPC Antenna, gain : -6.53 dBi(Left), -5.57 dBi(Right)
Remark	 The device was operating at its maximum output power for all measurements. The radiation measurements are performed in X, Y, Z axis positioning. Only the worst case (X) is shown in the report. The above DUT's information was declared by manufacturer. Please refer to the specifications or user manual for more detailed description.
FCC ID	Q32-EMV100



3. SYSTEM CONFIGURATION FOR TEST

3.1 Characteristics of equipment

TWS Hearing Device

3.2 Used peripherals list

Description	Model No.	el No. Serial No.		Remark
Notebook	NT300E4S	0T4391JJ800909K	Samsung Electronics	-
Adapter	PA-1400-96	CN60BA4400313AD2 VHJFP086	LITE-ON TECHNOLOGY CHANGZHOU CO.,LTD	For notebook

3.3 Product Modification

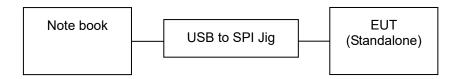
N/A

3.4 Operating Mode

Constantly transmitting with a modulated carrier at maximum power on the low, middle and high channels.

3.5 Test Setup of EUT

The measurements were taken in continuous transmit mode using the test mode which controlled by CSR Bluetest3. The test command and the test Jig and cables were provided by the applicant.





3.6 Parameters of Test Software Setting

During testing, Channel & Power Controlling Software provided by the customer was used to control the operating channel as well as the output power level. The RF output power selection is for the setting of RF output power expected by the customer and is going to be fixed on the firmware of the final end product.

TX Power setting value during test

Pond	Rand Bate TX Power setting value				
Band	Rate	Low CH	Middle CH	High CH	
2.4 GHz band	37 Byte	default	default	default	

Test Program : CSR Bluetest3 – v3.1.4.758

SlueTest3					×
Test Mode BLE TEST TX BLE TEST RX BLE TEST END Set PIO Read PIO Provoke Fault Read chip version Set Xtal Offset	^	-Test Arguments — Channel (0-39) Length (0-37) Bit pattern (0-7)	0 37 0	Close Help Execute Cold Rese Warm Rese	
Test Results ☐ Save to file C:₩Users₩MT8821C Opening ₩₩,₩csr0, Transport active. (gem) (Hardware ID 0x;		Local₩CSR Ltd,₩BI	lay∶	CBER	^



Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
0	2 402	10	2 422	20	2 442	30	2 462
1	2 404	11	2 424	21	2 444	31	2 464
2	2 406	12	2 426	22	2 446	32	2 466
3	2 408	13	2 428	23	2 448	33	2 468
4	2 410	14	2 430	24	2 450	34	2 470
5	2 412	15	2 432	25	2 452	35	2 472
6	2 414	16	2 434	26	2 454	36	2 474
7	2 416	17	2 436	27	2 456	37	2 476
8	2 418	18	2 438	28	2 458	38	2 478
9	2 420	19	2 440	29	2 460	39	2 480

3.7 Table for Carrier Frequencies



3.8 Used Test Equipment List

No.	Instrument	Model	S/N	Manufacturer	Due to cal date	Cal interval	used
1	T & H Chamber	PL-3J	15003623	ESPEC	2019.11.12	1 year	
2	T & H Chamber	SH-662	93000067	ESPEC CORP	2019.09.28	1 year	
3	Spectrum Analyzer	8563EC	3046A00527	Agilent Technology	2020.01.25	1 year	
4	Signal Analyzer	FSV13	101247	Rohde & Schwarz	2020.01.24	1 year	
5	Spectrum Analyzer	FSV30	20-353063	Rohde& Schwarz	2020.01.25	1 year	\square
6	Signal Analyzer	N9010A	MY56070441	Agilent Technologies	2019.05.25	1 year	
7	EMI Test Receiver	ESCI7	100823	Rohde& Schwarz	2020.01.22	1 year	\square
8	EMI Test Receiver	ESI	837514/004	Rohde& Schwarz	2019.09.03	1 year	\square
9	Vector Signal Analyzer	89441A	3416A02620	Agilent Technology	2020.01.25	1 year	
10	Network Analyzer	8753ES	US39172348	AGILENT	2019.09.03	1 year	
11	EPM Series Power meter	E4418B	GB39512547	Agilent Technology	2020.01.23	1 year	
12	RF Power Sensor	E9300A	MY41496631	Agilent Technology	2020.01.23	1 year	
13	Microwave Frequency Counter	5352B	2908A00480	Agilent Technology	2020.01.24	1 year	
14	Audio Analyzer	8903B	3514A16919	Agilent Technology	2020.01.23	1 year	
15	Audio Telephone Analyzer	DD-5601CID	520010281	CREDIX	2020.01.23	1 year	
16	Modulation Analyzer	8901A	3041A0576	H.P	2020.01.24	1 year	
17	Digital storage Oscilloscope	TDS3052	B015962	Tektronix	2019.09.04	1 year	
18	ESG-D Series Signal Generator	E4436B	US39260458	Agilent Technology	2020.01.25	1 year	
19	Vector Signal Generator	SMBV100A	257557	Rohde & Schwarz	2020.01.25	1 year	
20	GNSS Signal Generator	TC-2800A	2800A000494	TESCOM CO., LTD.	2020.01.24	1 year	
21	Signal Generator	SMB100A	179628	Rohde & Schwarz	2019.05.09	1 year	
22	SLIDAC	None	0207-4	Myoung sung Ele.	2020.01.23	1 year	
23	DC Power supply	DRP-5030	9028029	Digital Electronic Co.,Ltd	2020.01.23	1 year	
24	DC Power supply	E3610A	KR24104505	Agilent Technology	2020.01.23	1 year	
25	DC Power supply	UP-3005T	68	Unicon Co.,Ltd	2020.01.23	1 year	
26	DC Power Supply	SM 3400-D	114701000117	DELTAELEKTRONIKA	2020.01.22	1 year	
27	DC Power supply	6632B	MY43004005	Agilent Technology	2020.01.23	1 year	
28	DC Power Supply	6632B	MY43004137	Agilent Technology	2020.01.23	1 year	
29	Termination	1433-3	LM718	WEINSCHEL	2019.07.09	1 year	
30	Termination	1432-3	QR946	AEROFLEX/WEINSCHEL	2019.07.09	1 year	
31	Attenuator	24-30-34	BX5630	Aeroflex / Weinschel	2019.12.19	1 year	
32	Attenuator	8498A	3318A09485	HP	2020.01.24	1 year	
33	Step Attenuator	8494B	3308A32809	HP	2020.01.24	1 year	
34	RF Step Attenuator	RSP	100091	Rohde & Schwarz	2020.01.24	1 year	
35	Attenuator	18B50W-20F	64671	INMET	2020.01.24	1 year	
36	Attenuator	10 dB	1	Rohde & Schwarz	2020.01.24	1 year	
37	Attenuator	10 dB	2	Rohde & Schwarz	2019.05.04	1 year	
38	Attenuator	10 dB	3	Rohde & Schwarz	2019.05.04	1 year	
39	Attenuator	10 dB	4	Rohde & Schwarz	2019.05.04	1 year	
40	Attenuator	54A-10	74564	WEINSCHEL	2019.09.04	1 year	
40	Attenuator	56-10	66920	WEINSCHEL	2019.05.09	1 year	
41		48-20-11	BV2658	Aeroflex/Weinschel			
42	Attenuator Attenuator	48-30-33-LIM	BL5350	Weinschel Corp.	2019.08.06	1 year	
43	Power divider	48-30-33-LIM 11636B	51212	HP	2019.07.09	1 year	
		KPDSU3W	00070365		2020.01.28	1 year	
45	3Way Power divider			KMW	2019.09.03	1 year	
46	4Way Power divider	70052651	173834	KRYTAR	2020.01.28	1 year	
47	3Way Power divider	1580	SQ361	WEINSCHEL	2019.05.09	1 year	
48	OSP	OSP120	101577	Rohde & Schwarz	2019.05.04	1 year	
49	White noise audio filter	ST31EQ	101902	SoundTech	2019.09.04	1 year	



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No.	Instrument	Model	S/N	Manufacturer	Next Cal Date	Cal interval	used
50	Dual directional coupler	778D	17693	HEWLETT PACKARD	2020.01.24	1 year	
51	Dual directional coupler	772D	2839A00924	HEWLETT PACKARD	2020.01.24	1 year	
52	Band rejection filter	3TNF-0006	26	DOVER Tech	2020.01.24	1 year	
53	Band rejection filter	3TNF-0007	311	DOVER Tech	2020.01.24	1 year	
54	Band rejection filter	WTR-BRF2442-84NN	09020001	WAVE TECH Co.,LTD	2020.01.24	1 year	\square
55	Band rejection filter	WRCJV12-5695-5725-5825- 5855-50SS	1	Wainwright Instruments GmbH	2019.05.04	1 year	
56	Band rejection filter	WRCJV12-5120-5150-5350- 5380-40SS	4	Wainwright Instruments GmbH	2019.05.04	1 year	
57	Band rejection filter	WRCGV10-2360-2400-2500- 2540-50SS	2	Wainwright Instruments GmbH	2019.05.04	1 year	
58	Band rejection filter	CTF-155M-S1	001	RF One Electronics	2019.09.06	1 year	
59	Band rejection filter	CTF-435M-S1	001	RF One Electronics	2019.09.06	1 year	
60	Highpass Filter	WHJS1100-10EF	1	WAINWRIGHT	2020.01.24	1 year	
61	Highpass Filter	WHJS3000-10EF	1	WAINWRIGHT	2020.01.24	1 year	
62	Highpass Filter	WHNX6-5530-7000-26500- 40CC	2	Wainwright Instruments GmbH	2019.05.09	1 year	
63	Highpass Filter	WHNX6-2370-3000-26500- 40CC	4	Wainwright Instruments GmbH	2019.05.09	1 year	
64	WideBand Radio Communication Tester	CMW500	102276	Rohde & Schwarz	2020.01.24	1 year	
65	Bluetooth Tester	TC-3000B	3000B6A0166	TESCOM CO., LTD.	2020.01.24	1 year	
66	Loop Antenna	6502	9203-0493	EMCO	2019.05.29	2 year	\square
67	BiconiLog Antenna	3142B	1745	EMCO	2020.05.10	2 year	\square
68	Biconical Antenna	VUBA9117	9117-342	Schwarz beck	2020.03.12	2 year	
69	Trilog-Broadband Antenna	VULB 9168	9168-606	SCHWARZBECK	2020.09.14	2 year	
70	Horn Antenna	3115	2996	EMCO	2020.02.14	2 year	\square
71	Horn Antenna	3115	9605-4834	EMCO	2020.03.12	2 year	
72	Horn Antenna	BBHA9170	743	SCHWARZBECK	2021.01.22	2 year	
73	PREAMPLIFIER(3)	8449B	3008A00149	Agilent	2019.09.05	1 year	
74	AMPLIFIER(10)	TK-PA6S	120009	TESTEK	2020.01.22	1 year	\square
75	AMPLIFIER	TK-PA18	150003	TESTEK	2020.01.24	1 year	\boxtimes
76	AMPLIFIER	TK-PA1840H	160010-L	TESTEK	2020.01.22	1 year	\boxtimes
77	AMPLIFIER	8447D	2944A07881	H.P	2020.01.24	1 year	



3.9 Used Test Cable List

No.	Model	S/N	Manufacturer	Specifications	Usage	used
1	SMS112-GL200sD-SMS112-1M	None	GigaLane	9 kHz ~ 26.5 GHz(1 M)	For conducted	
2	SMS112-GL200sD-SMS112-1M	None	GigaLane	9 kHz ~ 26.5 GHz(1 M)	For conducted	
3	SMS112-GL200sD-SMS112-1M	None	GigaLane	9 kHz ~ 26.5 GHz(1 M)	For conducted	
4	L-502W	None	CANARE	9 kHz ~ 3 GHz(1 M)	For conducted	
5	L-502W	None	CANARE	9 kHz ~ 3 GHz(1 M)	For conducted	
6	L-502W	None	CANARE	9 kHz ~ 3 GHz(1 M)	For conducted	
7	SUCOFLEX 126E	MY2202/26E	SUHNER	9 kHz ~ 26.5 GHz(1 M)	For conducted	
8	SUCOFLEX 126E	MY2203/26E	SUHNER	9 kHz ~ 26.5 GHz(1 M)	For conducted	
9	SUCOFLEX 126E	MY2204/26E	SUHNER	9 kHz ~ 26.5 GHz(1 M)	For conducted	\boxtimes
10	SUCOFLEX 126E	MY2205/26E	SUHNER	9 kHz ~ 26.5 GHz(1 M)	For conducted	
11	SUCOFLEX 126E	MY2206/26E	SUHNER	9 kHz ~ 26.5 GHz(1 M)	For conducted	
12	SUCOFLEX 126E	MY2207/26E	SUHNER	9 kHz ~ 26.5 GHz(1 M)	For conducted	
13	SUCOFLEX 102	MY5433/2	SUHNER	9 kHz ~ 40 GHz(1 M)	For conducted	
14	SUCOFLEX 102	MY5434/2	SUHNER	9 kHz ~ 40 GHz(1 M)	For conducted	
15	SUCOFLEX 102	MY5435/2	SUHNER	9 kHz ~ 40 GHz(1 M)	For conducted	
16	SUCOFLEX 102	MY5436/2	SUHNER	9 kHz ~ 40 GHz(1 M)	For conducted	
17	SUCOFLEX100	None	SUHNER	9 kHz ~ 26.5 GHz(8 M)	For radiated(below 6 GHz)	\square
18	SUCOFLEX102	MY2709/2	SUHNER	9 kHz ~ 40 GHz(5 M)	For radiated(above 6 GHz)	\square
19	SUCOFLEX 102	801434/2	SUHNER	9 kHz ~ 40 GHz(2 M)	For conducted	
20	SUCOFLEX 102	801435/2	SUHNER	9 kHz ~ 40 GHz(2 M)	For conducted	
21	SUCOFLEX 102	801436/2	SUHNER	9 kHz ~ 40 GHz(2 M)	For conducted	
22	SUCOFLEX 102	801437/2	SUHNER	9 kHz ~ 40 GHz(2 M)	For conducted	



4. SUMMARY TEST RESULTS

Description of Test	FCC Rule	Reference Clause	Used	Test Result
Max. Conducted output power	15.247(b)(3)	Clause 5.1	\boxtimes	Compliance
Power spectral density	15.247(e)	Clause 5.2	\boxtimes	Compliance
6 dB spectrum Bandwidth	15.247(a)(2)	Clause 5.3	\boxtimes	Compliance
Band edge of RF conducted emissions	15.247(d)	Clause 5.4	\boxtimes	Compliance
Spurious RF radiated emissions	15.247(d), 15.209(a)	Clause 5.5	\boxtimes	Compliance
Antenna requirement	15.203, 15.247(b)	Clause 5.6	\boxtimes	Compliance
AC Power Conducted emissions	15.207	Clause 5.7	\boxtimes	Compliance
Compliance/pass : The ELIT complies wi	the the eccential requirements in	n the standard		

Compliance/pass : The EUT complies with the essential requirements in the standard.

Not Compliance : The EUT does not comply with the essential requirements in the standard.

N/A : The test was not applicable in the standard.

Procedure Reference

FCC CFR 47, Part 15. Subpart C-15.247 558074 D01 15.247 Meas Guidance v05 ANSI C 63.10-2013



5. MEASUREMENT RESULTS

5.1 Max. Conducted output power

5.1.1 Standard Applicable [FCC §15.247(b)(3)]

FCC

For systems using digital modulation in the 902 ~ 928 MHz, 2 400 ~ 2 483.5 MHz, and 5 725 ~ 5 850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power.

5.1.2 Test Environment conditions

• Ambient temperature : (21 ~ 22) °C • Relative Humidity : (49 ~ 51) % R.H.

5.1.3 Measurement Procedure

The transmitter output was connected to the spectrum analyzer with an attenuator. The maximum peak output power was measured and recorded with the spectrum analyzer. EUT was programmed to be in continuously transmitting mode. Max. Conducted output power test was performed using a test receiver in accordance with ANSI C63.10-2013 Section 11.9.1

The spectrum analyzer is set to the as follows :

- Set RBW≥DTS bandwidth
- Set the VBW \geq 3 x RBW.
- Set the span 3 x RBW.
- Sweep time = auto couple.
- Detector = peak.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level.
- 5.1.4 Test setup





5.1.5 Measurement Result

-Left ear

Channel	Frequency	Conducted Power	Limit	Test Results
Channel	[MHz]	[dBm]	[dBm]	iesi Results
0	2 402	6.55	30	Compliance
19	2 440	6.55	30	Compliance
39	2 480	6.06	30	Compliance

-Right ear

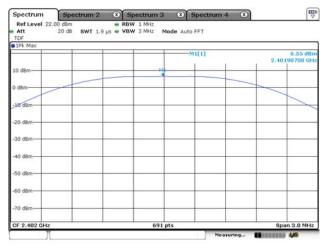
Channel	Frequency	Conducted Power	Limit	Test Results
Channel	[MHz]	[dBm]	[dBm]	Test Results
0	2 402	6.39	30	Compliance
19	2 440	6.47	30	Compliance
39	2 480	6.08	30	Compliance



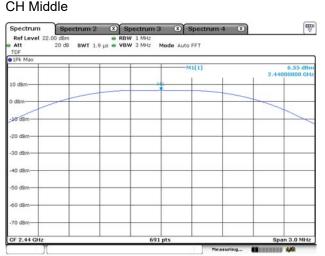
5.1.6 Test Plot

Left ear

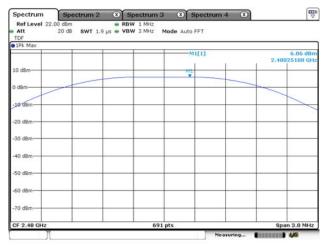
CH Low



CH Middle



CH High



Right ear

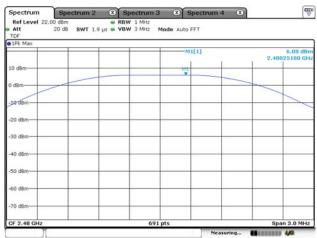
CH Low



CH Middle

Ref Level 22. Att	00 d8m 20 d8 SWT 1.	 RBW 1 MH 9 μs VBW 3 MH 	iz iz Mode Auto FFT		
1Pk Max					
			-M1[1]	2	6.47 dBi 44000000 GH
10 dBm			14		
0 dBm					
-10 dBm					
-20 d8m					
-30 d8m	_				_
-40 d8m					-
-50 dBm	_				
-60 d8m					
-70 d8m					
CF 2.44 GHz			691 pts		Span 3.0 MHz

CH High



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5.2 Power spectral density

5.2.1 Standard Applicable [FCC §15.247(e)]

FCC

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmit

5.2.2 Test Environment conditions

• Ambient temperature : (21 ~ 22) °C • Relative Humidity : (49 ~ 51) % R.H.

5.2.3 Measurement Procedure

The power spectral density conducted from the intentional radiator was measured with a spectrum analyzer connected to the antenna terminal, while EUT had the highest, middle and the lowest available channels. After the trace being stable, Use the marker-to-peak function to set the marker to the peak of the emission. The indicated level is the peak power spectral density. Power spectral density test was performed using a test receiver in accordance with ANSI C63.10-2013 Section 11.10.2

The spectrum analyzer is set to the as follows :

- Set analyzer center frequency to DTS channel center frequency.
- Set the span to 1.5 times the DTS bandwidth.
- Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- Set the VBW \geq 3 x RBW.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level within the RBW.
- If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

5.2.4 Test setup





5.2.5 Measurement Result

-Left ear

Channel	Frequency [MHz]	Result Value [dBm/3kHz]	Limit [dBm/3kHz]	Test Results
0	2 402	-11.46	8	Compliance
19	2 440	-11.61	8	Compliance
39	2 480	-12.12	8	Compliance

-Right ear

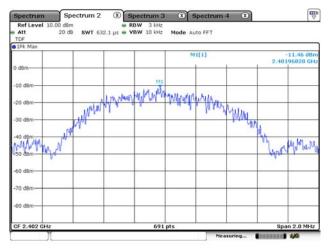
Channel	Frequency [MHz]	Result Value [dBm/3kHz]	Limit [dBm/3kHz]	Test Results
0	2 402	-11.10	8	Compliance
19	2 440	-11.04	8	Compliance
39	2 480	-11.52	8	Compliance



5.2.6 Test Plot

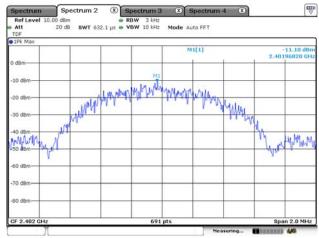
Left ear

CH Low

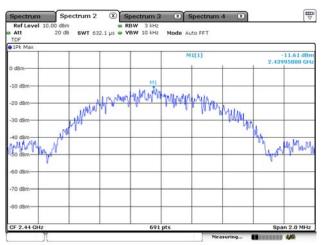


Right ear

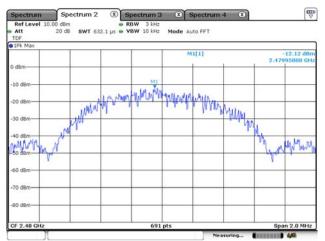
CH Low



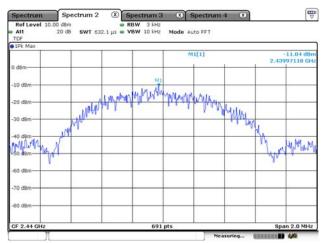
CH Middle



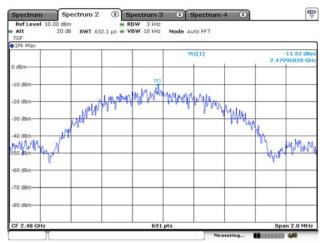
CH High



CH Middle



CH High



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5.3 6 dB spectrum Bandwidth

5.3.1 Standard Applicable [FCC §15.247(a)(2)]

FCC

Systems using digital modulation techniques may operate in the 902 ~ 928 MHz, 2400 ~ 2483.5 MHz, and 5725 ~ 5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

5.3.2 Test Environment conditions

• Ambient temperature : (21 ~ 22) °C • Relative Humidity : (49 ~ 51) % R.H.

5.3.3 Measurement Procedure

1. The transmitter output (antenna port) was connected to the spectrum analyzer in peak hold mode.

2. The resolution bandwidth of 100 kHz and the video bandwidth of 100 kHz were used.

3. Measured the spectrum width with power higher than 6 dB below carrier. 6 dB spectrum Bandwidth test was performed using a test receiver in accordance with ANSI C63.10-2013 Section 11.8.1

The spectrum analyzer is set to the as follows :

- Set RBW = 100 kHz.
- Set the video bandwidth (VBW) \geq 3 x RBW.
- Detector = Peak.
- Trace mode = max hold.
- Sweep = auto couple.
- · Allow the trace to stabilize.

• Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

5.3.4 Test setup





5.3.5 Measurement Result

-Left ear

Channel	Frequency [MHz]	6 dB Bandwidth [MHz]	99 % Bandwidth [MHz]	Limit [MHz]	Test Results
0	2 402	0.729	1.068	>0.5	Compliance
19	2 440	0.729	1.068	>0.5	Compliance
39	2 480	0.729	1.064	>0.5	Compliance

-Right ear

Channel	Frequency [MHz]	6 dB Bandwidth [MHz]	99 % Bandwidth [MHz]	Limit [MHz]	Test Results
0	2 402	0.725	1.064	>0.5	Compliance
19	2 440	0.725	1.059	>0.5	Compliance
39	2 480	0.721	1.059	>0.5	Compliance

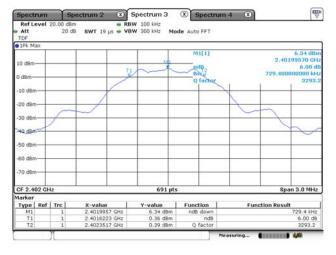


Report No.: KST-FCR-190008

5.3.6 Test Plot

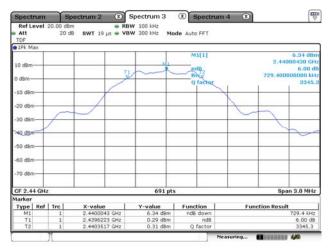
Left ear

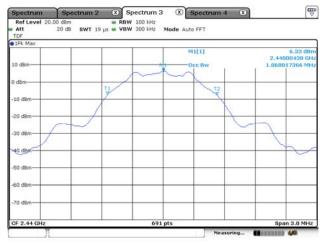
CH Low



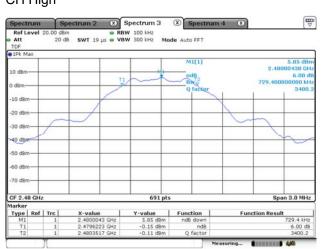


CH Middle





CH High





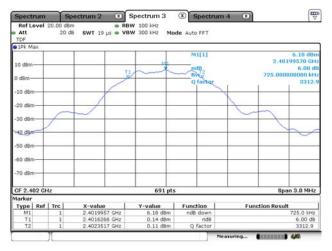
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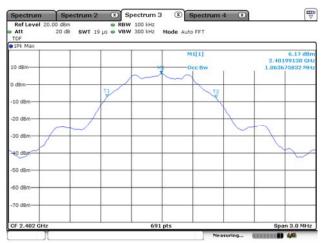


Report No.: KST-FCR-190008

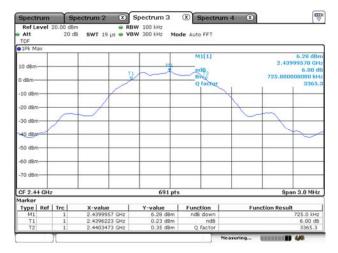
Right ear

CH Low



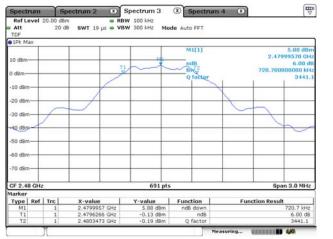


CH Middle





CH High







5.4 Band-edge Compliance of RF Conducted emissions

5.4.1 Standard Applicable [FCC §15.247(d)]

FCC

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on RF conducted.

5.4.2 Test Environment conditions

• Ambient temperature : (21 ~ 22) °C • Relative Humidity : (49 ~ 51) % R.H.

5.4.3 Measurement Procedure

- (1) Pre-calibration for the spectrum analyzer has to be done first through a reference CW signal from signal generator.
- (2) Reference frequency generated from the signal generator is supply to spectrum analyzer input port via RF cable and attenuator, and then, it's applied to offset value on spectrum analyzer.
- (3) Remove the antenna from the EUT and then, connected to spectrum analyzer via a dc Block, suitable low loss RF cable and attenuator.
- (4) Place the EUT on the table and set on the emission at the band-edge,
- (5) After the trace being stable, Use the marker-to-peak function to move the marker to the peak of the in-band emission.
- (6) The marker-delta value now displayed must comply with the limit specified in above standard.

Band-edge test was performed using a test receiver in accordance with ANSI C63.10-2013 Section 11.13.2

The spectrum analyzer is set to the as follows :

- Span : Wide enough to capture the peak level of the emission operating on the channel closet to the Band-edge, as well as any modulation products which fall outside of the authorized band of operation
- RBW : 100 kHz (≥ 1 % of the span)
- VBW : ≥ RBW
- Sweep : auto
- Detector function : peak
- Trace : Max hold

5.4.4 Test setup

Please refer 5.3.4

5.4.5 Measurement Result

-Left ear

Setting Channel		Test Results			
Settin		Measured value [dB]	Limit [dB]	Result	
CH 0	~ 2 400 MHz	-54.60	≤ 20 than PSD level	Compliance	
CH 39	2 483.5 MHz ~	-54.80		Compliance	

-Right ear

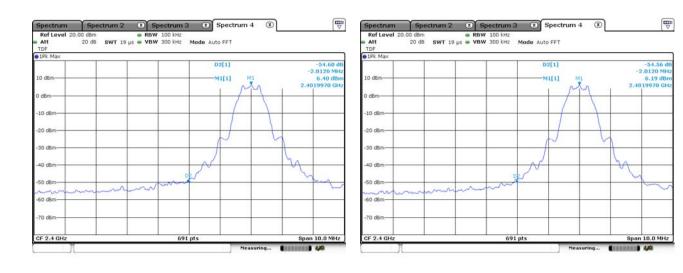
Setting Channel		Test Results			
Setur		Measured value [dB]	Limit [dB]	Result	
CH 0	~ 2 400 MHz	-54.56	≤ 20 than PSD level	Compliance	
CH 39	2 483.5 MHz ~	-54.59	S 20 that PSD level	Compliance	



5.4.6 Test Plot (Band-edge)

Left ear

Right ear



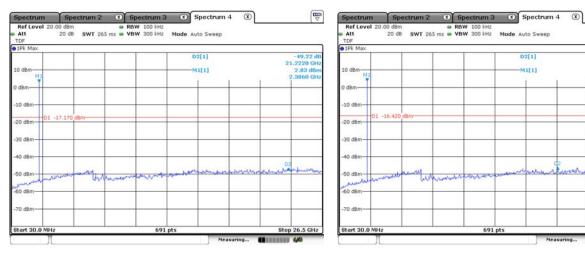




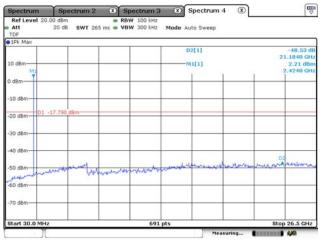
Test Plot (Conducted spurious emissions)

Left ear

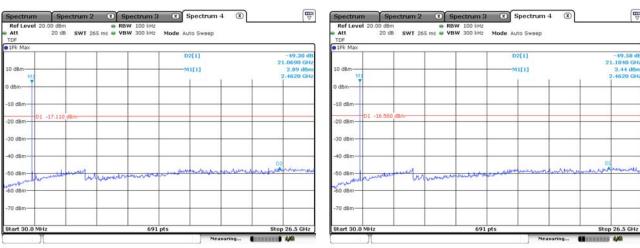
CH Low



CH Middle



CH High



Note: It is not recorded on the report that the reading of emissions are attenuated more than 20 dB below the permissible limits

Start 30.0

1 -16.4

Right ear

 Ref Level
 20.00 dBm
 @ RBW
 100 kHz

 Att
 20 dB
 SWT 265 ms
 WBW 300 kHz
 Mode
 Auto Sweep

D2[1]

M1[1]

CH Low

• 1Pk Ma

10 dBr

0 dBm

-10 dB

20 dBm

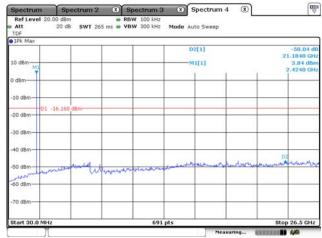
-30 dBn

-50 dB

60 dBm

In

CH Middle



691 pt

CH High

-45 16.2420 5 3.58 dB/ 960 G/

6.5 GHz

3.44 d



5.5 Spurious RF Radiated emissions

5.5.1 Standard Applicable [FCC §15.247(d)]

FCC

All other emissions outside these bands shall not exceed the general radiated emission limits specified in §15.209(a). And according to §15.33(a)(1), for an intentional radiator operates below 10 GHz, the frequency Range of measurements: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, Whichever is lower. In addition, radiated emissions which fall in the restricted bands, as defined in Sec. 15.205(a), must also comply with the radiated emission limits specified in Sec. 15.209(a)

§15.209 and RSS-Gen limits for radiated emissions measurements (distance at 3 m)

Frequency Band [MHz]	DISTANCE [Meters]	Limit [#V/m]	Limit [dB µV/m]	Detector
0.009 ~ 0.490	300	2400/F(kHz)	67.6-20log(F)	Peak
0.490 ~ 1.705	30	24000/F(kHz)	87.6-20log(F)	Peak
1.705 ~ 30.0	30	30	29.54	Peak
30 - 88	3	100 **	40.00	Quasi peak
88 - 216	3	150 **	43.52	Quasi peak
216 - 960	3	200 **	46.02	Quasi peak
Above 960	3	500	54.00	Average
Above 1000	3	74.0 dB	μ√/m (Peak), 54.0 dB μ√/m	(Average)
** fundamental emissions from intentional radiators operation under this Section shall not be located in the frequency bands 54-72 MHz, 76-88 MHz, 174-216 MHz, or 470-806 MHz. However, operation within these Frequency bands is permitted under other sections of this Part Section 15.231 and 15.241				

§15.205. Restrict Band of Operation for FCC

[MHz]	[MHz]	[MHz]	[GHz]
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
0.495 - 0.505**	16.694 75 - 16.695 25	608 - 614	5.35 - 5.46
2.173 5 - 2.190 5	16.804 25 - 16.804 75	960 – 1 240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1 300 – 1 427	8.025 - 8.
4.177 25 - 4.177 75	37.5 -38.25	1 435 – 1 626.5	9.0 - 9.2
4.207 25 - 4.207 75	73 - 74.6	1 645.5 – 1 646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1 660 – 1 710	10.6 - 12.7
6.267 75 - 6.268 25	108 - 121.94	1 718.8 -1 722.2	13.25 - 13.4
6.311 75 - 6.312 25	123 - 138	2 200 – 2 300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2 310 – 2 390	15.35 - 16.2
8.362 - 8.366	156.524 75 - 156.525 25	2 483.5 – 2 500	17.7 - 21.4
8.376 25 - 8.38 6 75	156.7 - 156.9	2 690 – 2 900	22.01 - 23.12
8.414 25 - 8.414 75	162.012 5 - 167.17	3 260 – 3 267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3 332 – 3 339	31.2 - 31.8
12.519 75 - 12.520 25	240 - 285	3 345.8 – 3 358	36.43 - 36.5
12.576 75 - 12.577 25	322 - 335.4	3 600 – 4 400	Above 38.6
13.36 - 13.41			

** Until February 1, 1999, this restricted band shall be 0.490-0.510



[MHz]	[MHz]	[MHz]	[GHz]
0.090 - 0.110	12.519 75 - 12.520 25	399.9 - 410	5.35 - 5.46
2.173 5 - 2.190 5	12.576 75 - 12.577 25	608 - 614	7.25 - 7.75
3.020 - 3.026	13.36 - 13.41	960 - 1 427	8.025 - 8.
4.125 - 4.128	16.42 - 16.423	1 435 - 1 626.5	9.0 - 9.2
4.177 25 - 4.177 75	16.694 75 - 16.695 25	1 645.5 - 1 646.5	9.3 - 9.5
4.207 25 - 4.207 75	16.804 25 - 16.804 75	1 660 - 1 710	10.6 - 12.7
5.677 - 5.683	25.5 - 25.67	1 718.8 -1 722.2	13.25 - 13.4
6.215 - 6.218	37.5 -38.25	2 200 - 2 300	14.47 - 14.5
6.26775-6.26825	73 - 74.6	2 310 - 2 390	15.35 - 16.2
6.31175–6.31225	74.8 - 75.2	2 655 - 2 900	17.7 - 21.4
8.291 - 8.294	108 - 138	3 260 - 3 267	22.01 - 23.12
8.362 - 8.366	156.524 75 - 156.525 25	3 332 - 3 339	23.6 - 24.0
8.376 25 - 8.38 6 75	156.7 - 156.9	3 345.8 - 3 358	31.2 - 31.8
8.414 25 - 8.414 75	240 - 285	3 500 - 4 400	36.43 - 36.5
12.29 - 12.293	322 - 335.4	4 500 - 5 150	Above 38.6

§15.205. Restrict Band of Operation for IC

5.5.2 Test Environment conditions

• Ambient temperature : (21 ~ 22) °C • Relative Humidity : (49 ~ 51) % R.H.

5.5.3 Measurement Procedure

The measurements procedure of the Spurious RF Radiated emissions is as following describe method.

1. The EUT was placed on the top of a rotating table (0.8 meters for below 1 GHz and 1.5 meters for above 1 GHz) above the ground at a 3 meter camber. The table was rotated 360 degree to determine the position of the highest radiation.

2. The EUT was set 3 meters away from the interference-receiving antenna, which was mounted on the top of a variable-height antenna master.

3. The antenna height is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both Horizontal and vertical polarizations of the antenna are set to make the measurement. 4. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotating table was turned from 0 - 360 degrees to find the maximum reading.

5. The measuring receiver was set to peak detector and specified bandwidth with max hold function.

6. Low, Middle and high channels were measured, and radiation measurements are performed in X. Y. Z axis positioning. And found the worst axis position and only the test worst case mode is recorded in the report.

- The measurement results are obtained as described below: Result(dBµV/m) = Reading(dBµV) + Antenna factor(dB/m)+ CL(dB) + other applicable factor (dB)
- The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 3 MHz for RMS Average (Duty cycle < 98 %) for Average detection (AV) at frequency above 1 GHz, then the measurement results was added to a correction factor (10 log(1/duty cycle)).
- The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth is 10 Hz (Duty cycle ≥ 98 %) for Average detection (AV) at frequency above 1 GHz.

According to §15.33 (a)(1), Frequency range of radiated measurement is performed the tenth harmonic.

Above test was performed in accordance with ANSI C63.10-2013 Section 6.10.5 & 6.4, 6.5, 6.6

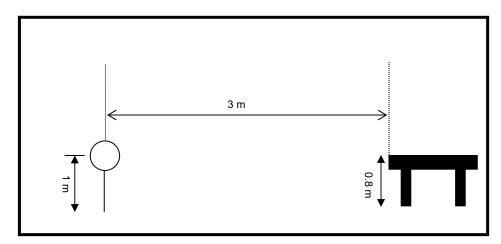
5.5.4 Measurement Uncertainty

Radiated Emission measurement: Below 1 GHz: 3.66 dB (CL: Approx 95 %, k=2) Above 1 GHz: 4.04 dB (CL: Approx 95 %, k=2)

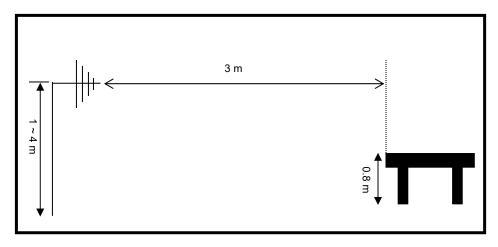


5.5.5 Test Configuration

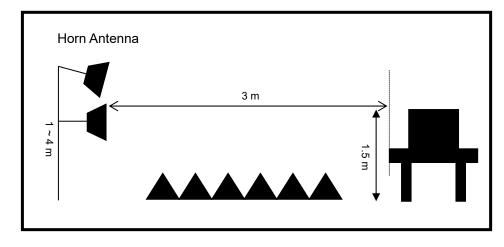
Radiated emission setup, below 30 MHz



Radiated emission setup, below 1 000 MHz



Radiated emission setup, above 1 GHz





5.5.6 Measurement Result

Above 1 GHz_Left ear

CH0 (2 402 MHz)

Freq.		iding ∛/m)	Table	,	Antenn	а	CL	AMP		Result ⊮/m)		mit ∛/m)	Mg (d		Result
(GHz)	PK	AV	(Deg)	Height (m)	Pol. (H/V)	Fctr. (^{dB} /m)	(dB)	(dB)	PK	AV	PK	AV	PK	AV	Result
2.362	54.23	50.71	180	1.0	Н	28.21	7.60	-41.89	48.15	44.63	74	54	25.85	9.37	Compliance
2.362	51.13	45.11	160	1.0	V	28.21	7.60	-41.89	45.05	39.03	74	54	28.95	14.97	Compliance

* band-edge emissions.

CH19 (2 440 MHz)

Freq.		ding ∜/m)	Table	,	Antenn	а	CL	AMP		Result ⊮/m)		nit ∛/m)	Mç (d		Result
(GHz)	PK	AV	(Deg)	Height (m)	Pol. (H/V)	Fctr. (^{dB} /m)	(dB)	(dB)	PK	AV	PK	AV	PK	AV	Result
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Compliance

CH39 (2 480 MHz)

Freq.		ding V/m)	Table	,	Antenn	а	CL	AMP		Result ⊮/m)		nit ∛/m)	M ç (d		Deput
(GHz)	PK	AV	(Deg)	Height (m)	Pol. (H/V)	Fctr. (^{dB} /m)	(dB)	(dB)	PK	AV	PK	AV	PK	AV	Result
2.485	52.50	40.00	180	1.0	Н	28.57	8.03	-42.24	46.86	34.36	74	54	27.14	19.64	Compliance
2.488	56.73	43.12	180	1.0	V	28.58	8.05	-42.25	51.11	37.50	74	54	22.89	16.50	Compliance

* Restrict band & Band-edge emissions.

%Note

• Above 1 GHz is measured average and peak detector mode on Spectrum analyzer in accordance with FCC Rule15.35

• Limit: 54 dBµV/m(Average), 74 dBµV /m(Peak), Attenuated more than 20 dB below the permissible value.

• It is not recorded on the report that the reading of emissions are attenuated more than 20 dB below the permissible

For the below 30 MHz and above 2.484 GHz, measured any other signal is not detected on test receiver

• The transmitter radiated spectrum was investigated from 9 kHz to 26.5 GHz.



Above 1 GHz_Right ear

CH0 (2 402 MHz)

Free	q.	Read (dB⊯	•	Table	,	Antenna	а	CL	AMP		Result ⊮/m)		mit ∛/m)	Mg (d		Result
(GHz		PK	AV	(Deg)	Height (m)	Pol. (H/V)	Fctr. (^{dB} /m)	(dB)	(dB)	PK	AV	PK	AV	PK	AV	Result
2.36	62 5	54.37	51.13	160	1.0	Н	28.21	7.60	-41.89	48.29	45.05	74	54	25.71	8.95	Compliance
2.36	52 5	52.29	45.31	160	1.0	V	28.21	7.60	-41.89	46.21	39.23	74	54	27.79	14.77	Compliance

* band-edge emissions.

CH19 (2 440 MHz)

Freq.		ding V/m)	Table	,	Antenn	а	CL	AMP		Result ⊮/m)		nit ∛/m)	M ç (d		Result
(GHz)	PK	AV	(Deg)	Height (m)	Pol. (H/V)	Fctr. (^{dB} /m)	(dB)	(dB)	PK	AV	PK	AV	PK	AV	Result
-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Compliance

CH39 (2 480 MHz)

Freq.		ding V/m)	Table	,	Antenn	а	CL	AMP		Result ⊮/m)		nit ∛/m)	Mų (d		Result
(GHz)	PK	AV	(Deg)	Height (m)	Pol. (H/V)	Fctr. (^{dB} /m)	(dB)	(dB)	PK	AV	PK	AV	PK	AV	Result
2.484	52.67	39.60	170	1.0	Н	28.57	8.02	-42.23	47.03	33.96	74	54	26.97	20.04	Compliance
2.488	55.86	42.30	160	1.0	V	28.58	8.05	-42.25	50.24	36.68	74	54	23.76	17.32	Compliance

* Restrict band & Band-edge emissions.

%Note

• Above 1 GHz is measured average and peak detector mode on Spectrum analyzer in accordance with FCC Rule15.35

• Limit: 54 dBµV/m(Average), 74 dBµV /m(Peak), Attenuated more than 20 dB below the permissible value.

• It is not recorded on the report that the reading of emissions are attenuated more than 20 dB below the permissible

limits or the field strength is too small to measured.

• For the below 30 MHz and above 2.484 GHz, measured any other signal is not detected on test receiver

• The transmitter radiated spectrum was investigated from 9 kHz to 26.5 GHz.



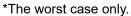
Below 1 GHz_Left/Right ear

Freq. (MHz)	Reading (dB <i>⊭</i> ∛/m)	Table (Deg)	Height	Antenna Pol.	Fctr.	CL (dB)	AMP (dB)	Meas Result (dB⊉//m)	Limit (dB <i>⊭</i> ∛/m)	Mgn (dB)	Result
			(m)	(H/V)	(dB/m)			,			
45.00	53.92	180	1.0	V	10.30	0.81	-42.06	22.97	40.0	17.03	Compliance
193.52	59.42	160	1.0	Н	10.02	1.79	-41.50	29.73	43.5	13.77	Compliance
235.61	59.54	180	1.5	Н	12.09	2.03	-41.41	32.25	46.0	13.75	Compliance
467.44	57.68	160	1.5	Н	17.62	3.07	-40.62	37.75	46.0	8.25	Compliance
506.70	49.63	180	1.5	V	18.73	3.19	-40.46	31.09	46.0	14.91	Compliance
533.13	51.56	180	1.0	V	19.26	3.28	-40.31	33.79	46.0	12.21	Compliance
Freq.(M^{\pm}) : Measurement frequency, Reading($^{dB}\mu^{J}/m$) : Indicated value for test receiver, Table (Deg) : Directional degree of Turn table Antenna (Height, Pol, Fctr) : Antenna Height, Polarization and Factor, Cbl(dB) : Cable loss, Pre AMP(dB) : Preamplifier gain($^{dB}\mu^{J}/m$) : Meas Result ($^{dB}\mu^{J}/m$) : Reading($^{dB}\mu^{J}/m$) : Antenna factor (^{dB}m) + Cl (dB) - Pre AMP(dB)											

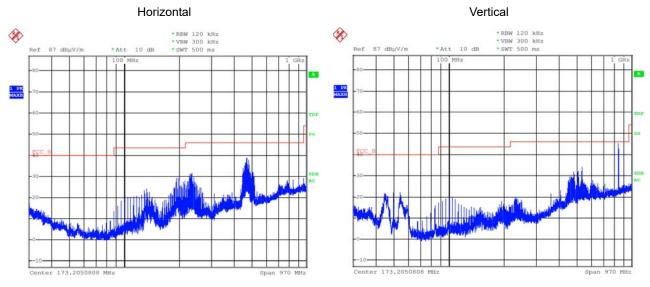


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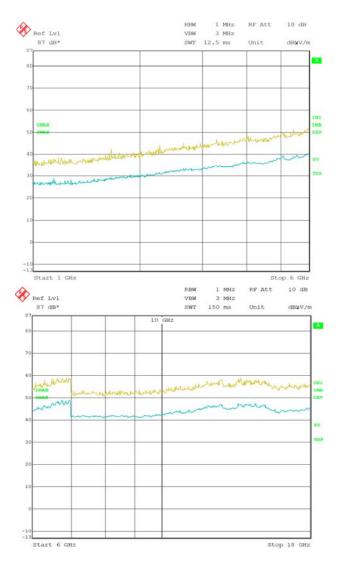
5.5.7 Plots



Below 1 GHz

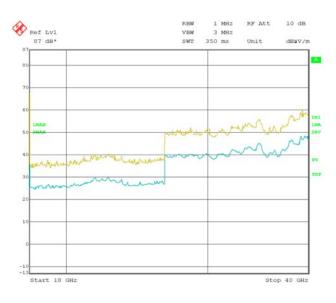


Above 1 GHz





Report No.: KST-FCR-190008





5.6 Antenna requirement

5.6.1 Standard applicable [FCC §15.203]

For intentional device, according to §15.203, an intentional radiator shall be designed to ensure that no antenna other than furnished by responsible party shall be used with the device.

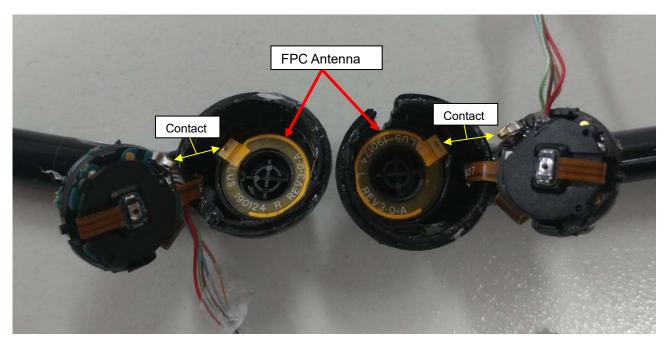
The use of a permanently attached antenna or of an antenna that user a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section.

The manufacturer may design the unit so that broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited.

5.6.2 Antenna details

Frequency Band	Antenna Type	Gain [dBi]	Results
2.4 GHz	Internal FPC antenna	-6.53 dBi(Left), -5.57 dBi(Right)	Compliance

The device complies with paragraph 15.203 of FCC rules because the antenna is in a permanently sealed enclosure(Enclosure sealed method: Adhesive) and is unable to be removed or adjusted by the consumer.





5.7 AC Power Conducted emissions

5.7.1 Standard Applicable [FCC §15.207(a)]

For intentional radiator that is designed to be connected to the public utility(AC)power line, the radio frequency. Voltage that is conducted back onto the AC power line on any frequencies hopping mode within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 µH/50 ohms line Impedance stabilization network(LISN). Compliance with the provisions of this paragraph shall be based on the measurement of the radio frequency voltage between each power line and ground at the power terminal. The lower limit applies at the boundary between the frequency ranges.

§15.207 limits for AC line conducted emissions;

Frequency of Emission(14)	Conducted	I Limit (dBμV)
Frequency of Emission(Mb)	Quasi-peak	Average
0.15 ~ 0.5	66 to 56 *	56 to 46 *
0.5 ~ 5	56	46
5 ~ 30	60	50

* Decreases with the logarithm of the frequency

5.7.2 Test Environment conditions

• Ambient temperature : (21 ~ 22) °C • Relative Humidity : (49 ~ 51) % R.H.

5.7.3 Measurement Procedure

EUT was placed on a non- metallic table height of 0.8 m above the reference ground plane. Cables connected to EUT were fixed to cause maximum emission. Test was made with the antenna positioned in both the horizontal and vertical planes of polarization. The measurement antenna was varied in height above the conducting ground plane to obtain the Maximum signal strength.

5.7.4 Used equipment

Equipment	Model No.	Serial No.	Manufacturer	Next cal date	Cal interval	Used
Test receiver	ESCS30	100111	Rohde & Schwarz	2020. 01. 22	1 year	\boxtimes
Pulse Limiter	ESH3-Z2	100097	Rohde & Schwarz	2020. 01. 22	1 year	\boxtimes
LIEN	ESH2-Z5	100044	R&S	2020. 01. 22	1 year	
LISN	ESH3-Z5	100147	R&S	2020. 01. 22	1 year	\boxtimes

*Test Program: "ESXS-K1 V2.2"

Measurement uncertainty 0.15 ~ 30 MHz : ±3.34 (CL: Approx 95 %, k=2)



5.7.5 Measurement Result

Erog	Fa	ictor			QP			CISPR AV	
Freq.	[dB]	POL	Limit	Reading	Result	Limit	Reading	Result
[MHz]	LISN	CABLE +P/L	FOL	[dB <i>µ</i> V]					
0.232	0.08	10.00	L	62.38	18.82	18.90	52.38	13.04	13.12
0.533	0.08	10.04	L	56.00	19.11	19.19	46.00	16.07	16.15
0.560	0.08	10.04	L	56.00	19.88	19.96	46.00	16.94	17.02
0.584	0.08	10.04	L	56.00	19.94	20.02	46.00	17.33	17.41
0.599	0.08	10.04	L	56.00	17.11	17.19	46.00	15.01	15.09
0.154	0.09	9.98	Ν	65.79	22.80	22.89	55.79	16.04	16.13
0.189	0.09	9.99	Ν	64.08	16.14	16.23	54.08	13.11	13.20
1.482	0.12	10.07	Ν	56.00	11.28	11.40	46.00	12.00	12.12
7.877	0.31	10.33	Ν	60.00	13.12	13.43	50.00	12.25	12.56
9.025	0.33	10.36	Ν	60.00	12.96	13.29	50.00	12.20	12.53

* LISN: LISN insertion Loss, Cable: Cable Loss, P/L:pulse limiter factor

* L: Line. Live, N: Line. Neutral

* Reading: test receiver reading value (with cable loss & pulse limiter factor)

* Result = LISN + Reading



