ELECTROMAGNETIC EMISSION COMPLIANCE REPORT FOR LOW-POWER, NON-LICENSED TRANSMITTER

Test Report No.	**: OT-206-RWD-040**
AGR No.	**: A205A-294**
Applicant	**: LG Electronics USA, Inc.**
Address	**: 111 Sylvan Ave, North Building, Englewood Cliffs, New Jersey, 07632, United States**
Manufacturer	**: LG Electronics Inc.**
Address	**: 222 LG-ro Jinwi-myeon, Pyeongtaek-si, Gyeonggi-do, Korea**
Type of Equipment	**: Bluetooth Earbud**
FCC ID.	**: ZNFHBSFN6**
Model Name	**: HBS-FN6**
Multiple Model Name	**: HBS-FN5W, HBS-FN5U, HBS-FN4**
Serial number	**: N/A**
Total page of Report	**: 32 pages (including this page)**
Date of Incoming	**: June 12, 2020**
Date of issue	**: June 18, 2020**

SUMMARY

The equipment complies with the regulation; ***FCC PART 15 SUBPART C Section 15.247***

This test report only contains the result of a single test of the sample supplied for the examination.

It is not a generally valid assessment of the features of the respective products of the mass-production.

Reviewed by: Tae-Ho, Kim / Senior Manager, ONETECH Corp.

Approved by: Ki-Hong, Nam / General Manager, ONETECH Corp.

ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

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ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

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Revision History

Rev. No.	Issue Report No.	Issued Date	Revisions	Section Affected
0	OT-205-RWD-019	May 11, 2020	Initial Release	All
1	OT-206-RWD-040	June 18, 2020	Change RF Matching Part. Class II Permissive Change.	All

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1. VERIFICATION OF COMPLIANCE

Applicant	: LG Electronics USA, Inc.
Address	: 111 Sylvan Ave, North Building, Englewood Cliffs, New Jersey, 07632, United States
Contact Person	: Kyung-Su, Han / Director, Standards & Compliance
Telephone No.	: 201-266-2215
FCC ID	: ZNFHBSFN6
Model Name	: HBS-FN6
Brand Name	: -
Serial Number	: N/A
Date	: June 18, 2020

EQUIPMENT CLASS	DSS – PART 15 SPREAD SPECTRUM TRANSMITTER
E.U.T. DESCRIPTION	Bluetooth Earbud
THIS REPORT CONCERNS	Class II Permissive Change
MEASUREMENT PROCEDURES	ANSI C63.10: 2013
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC PART 15 SUBPART C Section 15.247 KDB 558074 D01 15.247 Meas Guidance v05r02
Modifications on the Equipment to Achieve Compliance	None
Final Test was Conducted On	10 m, Semi Anechoic Chamber

-. The above equipment was tested by ONETECH Corp. for compliance with the requirement set forth in the FCC Rules and Regulations. This said equipment in the configuration described in this report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

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2. TEST SUMMARY

2.1 Test items and results

SECTION	TEST ITEMS	RESULTS
15.247 (a) (1)	Carrier Frequency Separation	N/A (See Note)
15.247 (a) (1) (iii)	Minimum Number of Hopping Channels	N/A (See Note)
15.247 (a) (1) (iii)	Average Time of Occupancy	N/A (See Note)
15.247 (b) (1)	Maximum Peak Conducted Output Power	N/A (See Note)
15.247 (d)	100 kHz Bandwidth Outside the Frequency Band	N/A (See Note)
15.247 (d)	Radiated Emission which fall in the Restricted Band	Met the Limit / PASS
15.209	Radiated Emission Limits, General Requirement	Met the Limit / PASS
15.207	Conducted Limits	N/A (See Note)
15.203	Antenna Requirement	N/A (See Note)

Note: This test was not performed, FCC ID: ZNFHBSFN6 already granted on May 14, 2020

2.2 Additions, deviations, exclusions from standards

No additions, deviations or exclusions have been made from standard.

2.3 Related Submittal(s) / Grant(s)

Class II Permissive Change

Following modification(s) is/are made on the product, which was already granted on May 14, 2020

RF Matching Part Before	RF Matching Part After
L10(3.9 nH)	L10(1.2 nH),
C4(0.6 pF)	C4(NC)
C5(1.2 pF)	C5(NC)
L8(0 R)	L8(NC)

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2.4 Purpose of the test

To determine whether the equipment under test fulfills the requirements of the regulation stated in FCC PART 15 SUBPART C Section 15.247.

2.5 Test Methodology

Both conducted and radiated testing was performed according to the procedures in ANSI C63.10: 2013. Radiated testing was performed at a distance of 3 m from EUT to the antenna.

2.6 Test Facility

The Onetech Corp. has been designated to perform equipment testing in compliance with ISO/IEC 17025.

The Electromagnetic compatibility measurement facilities are located at 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea.

-. Site Filing:

VCCI (Voluntary Control Council for Interference) – Registration No. R-4112/ C-14617/ G-10666/ T-11842

ISED (Innovation, Science and Economic Development Canada) – Registration No. Site# 3736A-3

KOLAS (Korea Laboratory Accreditation Scheme) - Accreditation NO. KT085

FCC (Federal Communications Commission) - Accreditation No. KR0013

RRA (Radio Research Agency) – Designation No. KR0013

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3. GENERAL INFORMATION

3.1 Product Description

The LG Electronics USA, Inc., Model HBS-FN6 (referred to as the EUT in this report) is a Bluetooth Earbud. The product specification described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	Bluetooth Earbud		
Temperature Range	0 °C ~ 35 °C		
OPERATING FREQUENCY	Bluetooth LE	2 402 MHz ~ 2 480 MHz	
	Bluetooth	2 402 MHz ~ 2 480 MHz	
MODULATION TYPE	Bluetooth LE	1 Mbps	GFSK
		Coded_125 kbps	GFSK
	Bluetooth	1 Mbps	GFSK
		2 Mbps	π/4-DQPSK
RF OUTPUT POWER	Bluetooth LE	1 Mbps	5.78 dBm(Bluetooth Earbud LEFT)
			6.15 dBm(Bluetooth Earbud RIGHT)
		Coded_125 kbps	5.95 dBm(Bluetooth Earbud LEFT)
			6.05 dBm(Bluetooth Earbud RIGHT)
	Bluetooth	1 Mbps	5.38 dBm(Bluetooth Earbud LEFT)
			5.03 dBm(Bluetooth Earbud RIGHT)
		2 Mbps	7.55 dBm(Bluetooth Earbud LEFT)
			7.24 dBm(Bluetooth Earbud RIGHT)
ANTENNA TYPE	FPCB Antenna		
ANTENNA GAIN	1.23 dBi		
List of each Osc. or crystal Freq.(Freq. >= 1 MHz)	40 MHz		

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3.2 Alternative type(s)/model(s); also covered by this test report.

-. The following lists consist of the added model and their differences.

Model Name	Differences	Tested
HBS-FN6	Basic Model (Wireless Charging: O / UV-C LED: O)	☑
HBS-FN5W	The models are identical to basic model but the use function is different. (Wireless Charging: O / UV-C LED: X)	☐
HBS-FN5U	The models are identical to basic model but the use function is different. (Wireless Charging: X / UV-C LED: O)	☐
HBS-FN4	The models are identical to basic model but the use function is different. (Wireless Charging: X / UV-C LED: X)	☐

Note: 1. Applicant consigns only basic model to test. Therefore this test report just guarantees the units, which have been tested.

2. The Applicant/manufacturer is responsible for the compliance of all variants.

4. EUT MODIFICATIONS

-. None

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5. SYSTEM TEST CONFIGURATION

5.1 Justification

This device was configured for testing in a typical way as a normal customer is supposed to be used. During the test, the following components were installed inside of the EUT.

-. Charging case

DEVICE TYPE	MANUFACTURER	MODEL/PART NUMBER	FCC ID
Main Board	LG Electronics Inc.	HBS-FN6 CRADLE MAIN	N/A
Battery	Spring power technology(ShenZhen)Co., Ltd	N/A	N/A

-. Bluetooth Earbud

DEVICE TYPE	MANUFACTURER	MODEL/PART NUMBER	FCC ID
Main Board	LG Electronics Inc.	HBS-FN6 Main L	N/A
Sub Board	N/A	N/A	N/A
Touch Sensor	N/A	N/A	N/A
Speaker	N/A	HBS-FN6 RCV L	N/A
MIC	N/A	HBS-FN6_FPCB_TERMINAL	N/A
Battery	N/A	N/A	N/A
Antenna Board	N/A	HBS-FN6	N/A

5.2 Peripheral equipment

Defined as equipment needed for correct operation of the EUT, but not considered as tested:

Model	Manufacturer	Description	Connected to
HBS-FN6	LG Electronics Inc.	Bluetooth Earbud (EUT)	-
HP ProtectSmart	HP	Notebook PC	Jig Board
PPP009C	LIE-ON TECHNOLOGY (CHANGZHOU)CO.,LTD.	AC Adaptor	Notebook PC
UMFT234XD	FTDI Chip	Jig Board	EUT

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5.3 Mode of operation during the test

For the testing, software used to control the EUT for staying in continuous transmitting is programmed.

For final testing, the EUT was set at 2 402 MHz, 2 441 MHz, and 2 480 MHz to get a maximum emission levels from the EUT. The EUT was moved throughout the XY, XZ, and YZ planes and the worst case is “XZ” axis, but the worst data was recorded in this report.

<RF Output Power Table>

Mode	RF Output Power[dBm]			
	Approved Report		Present Report	
	Earbud Left	Earbud Right	Earbud Left	Earbud Right
Bluetooth [1 Mbps]	5.38	5.03	5.24	5.12
Bluetooth [2 Mbps]	7.55	7.24	7.61	7.30
Bluetooth LE [1 Mbps]	5.78	6.15	5.85	6.08
Bluetooth LE Coded [125 kbps]	5.95	6.05	5.99	6.01

* Since there is no difference with the RF output power(Less than 3 dB) of the approved report, So only tested Radiated Spurious Emission.

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-. Duty Cycle(Bluetooth Earbud LEFT)

Mode	Tx On Time [ms]	Tx Off Time [ms]	Duty Cycle [%]	Correction Factor [dB]
Bluetooth [1 Mbps]	-	-	100.00	-
Bluetooth [2 Mbps]	-	-	100.00	-

Note – Duty Cycle : (Tx On Time / (Tx On Time + Tx Off Time)) * 100

Correction Factor : 10 * Log(1 / (Duty Cycle / 100))

-. Duty Cycle(Bluetooth Earbud RIGHT)

Mode	Tx On Time [ms]	Tx Off Time [ms]	Duty Cycle [%]	Correction Factor [dB]
Bluetooth [1 Mbps]	-	-	100.00	-
Bluetooth [2 Mbps]	-	-	100.00	-

Note – Duty Cycle : (Tx On Time / (Tx On Time + Tx Off Time)) * 100

Correction Factor : 10 * Log(1 / (Duty Cycle / 100))

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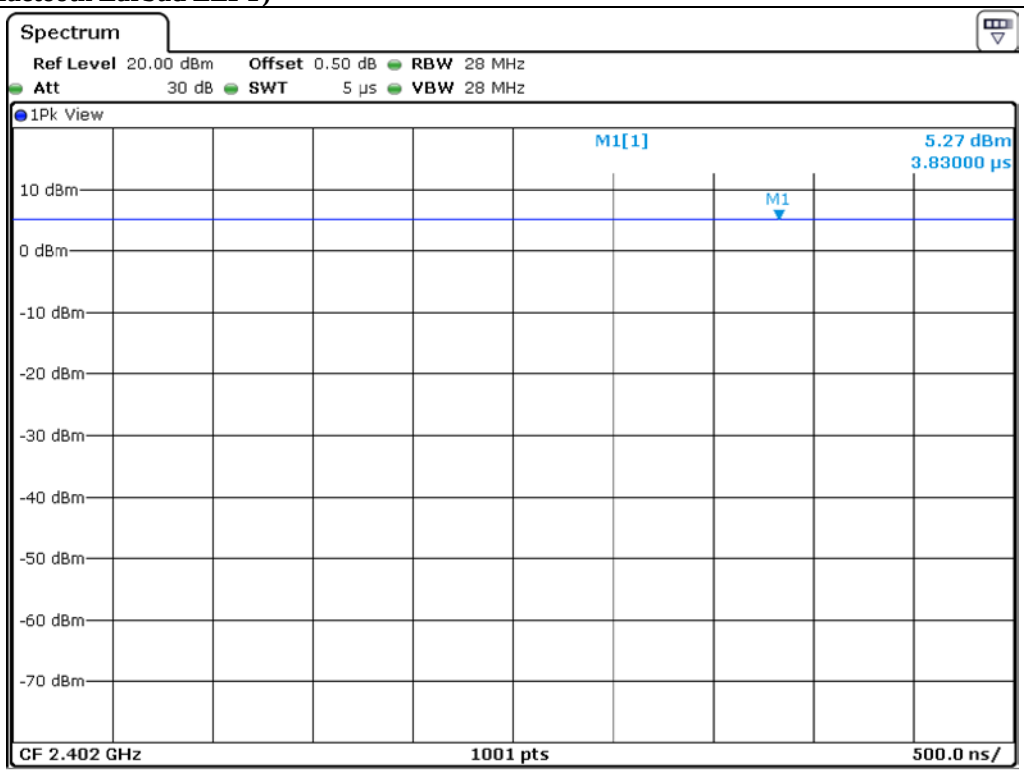
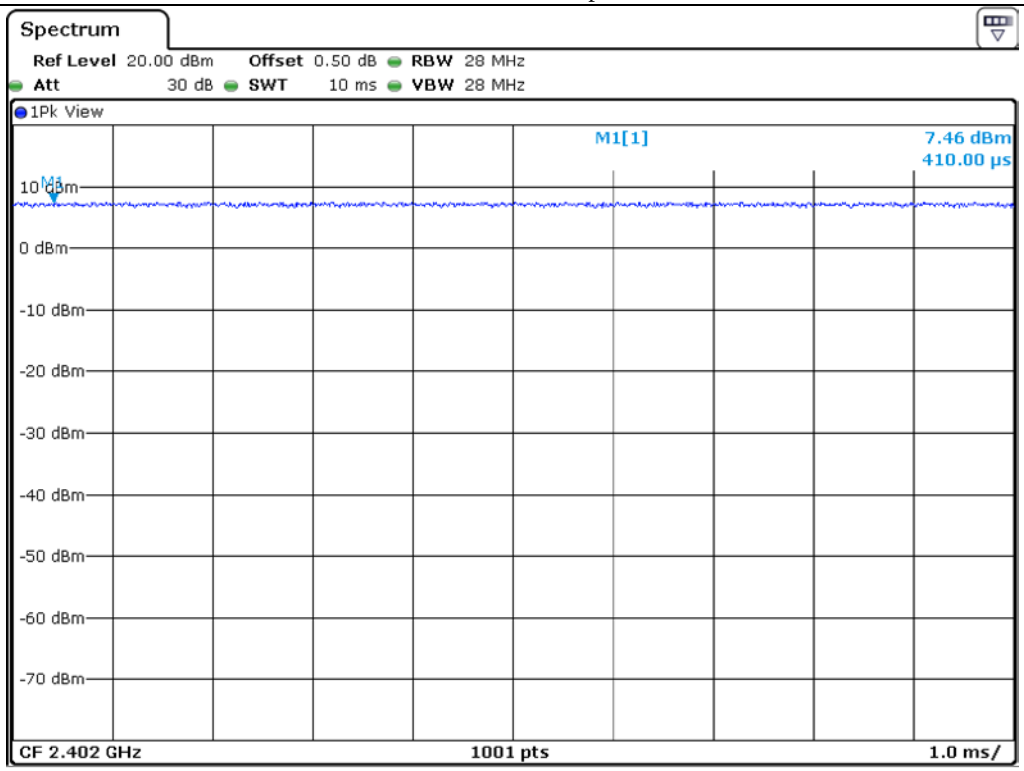
-. Test Plot(Bluetooth Earbud LEFT)



Bluetooth_1 Mbps



Bluetooth_2 Mbps

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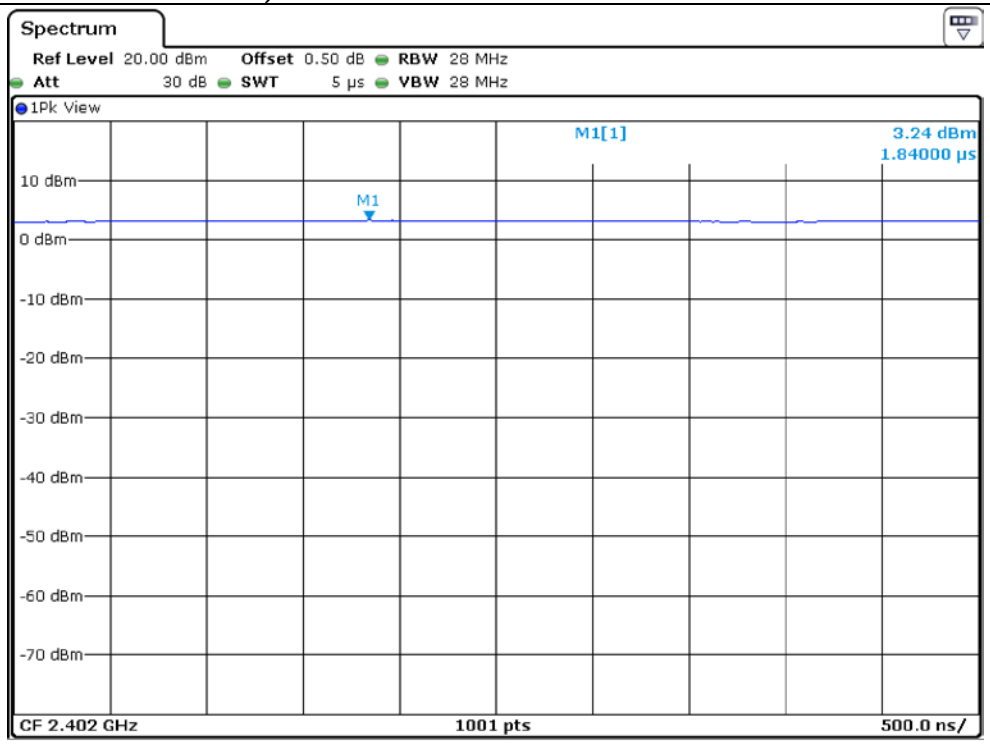
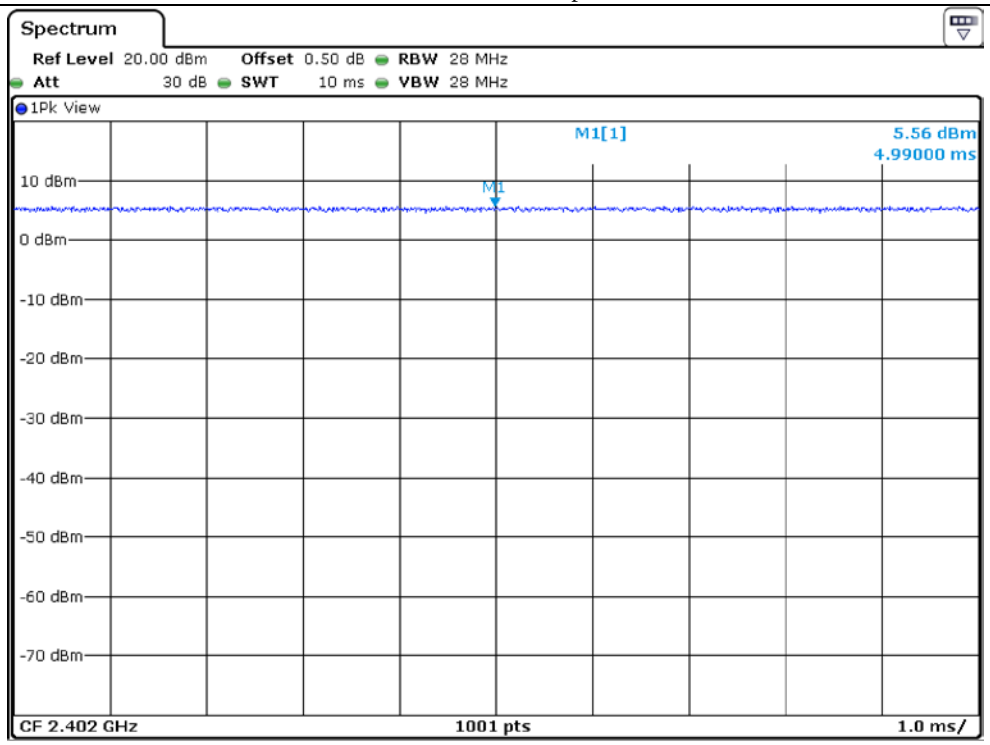
-. Test Plot(Bluetooth Earbud RIGHT)



Bluetooth_1 Mbps



Bluetooth_2 Mbps

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-. Channel List(Bluetooth)

Channel	Frequency[MHz]	Channel	Frequency[MHz]	Channel	Frequency[MHz]
1	2 402.00	28	2 429.00	54	2 456.00
2	2 403.00	29	2 430.00	55	2 457.00
3	2 404.00	30	2 431.00	56	2 458.00
4	2 405.00	31	2 432.00	57	2 459.00
5	2 406.00	32	2 433.00	58	2 460.00
6	2 407.00	33	2 434.00	59	2 461.00
7	2 408.00	34	2 435.00	60	2 462.00
8	2 409.00	35	2 436.00	61	2 463.00
9	2 410.00	36	2 437.00	62	2 464.00
10	2 411.00	37	2 438.00	63	2 465.00
11	2 412.00	38	2 439.00	64	2 466.00
12	2 413.00	39	2 440.00	65	2 467.00
13	2 414.00	40	2 441.00	66	2 468.00
14	2 415.00	41	2 442.00	67	2 469.00
15	2 416.00	42	2 443.00	68	2 470.00
16	2 417.00	43	2 444.00	69	2 471.00
17	2 418.00	44	2 445.00	70	2 472.00
18	2 419.00	45	2 446.00	71	2 473.00
19	2 420.00	46	2 447.00	72	2 474.00
20	2 421.00	47	2 448.00	73	2 475.00
21	2 422.00	48	2 449.00	74	2 476.00
22	2 423.00	49	2 450.00	75	2 477.00
23	2 424.00	50	2 451.00	76	2 478.00
24	2 425.00	51	2 452.00	77	2 479.00
25	2 426.00	52	2 453.00	78	2 480.00
26	2 427.00	53	2 454.00		
27	2 428.00	54	2 455.00		

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-. Channel List(Bluetooth LE)

Channel	Frequency[MHz]	Channel	Frequency[MHz]	Channel	Frequency[MHz]
0	2 402.00	14	2 430.00	28	2 458.00
1	2 404.00	15	2 432.00	29	2 460.00
2	2 406.00	16	2 434.00	30	2 462.00
3	2 408.00	17	2 436.00	31	2 464.00
4	2 410.00	18	2 438.00	32	2 466.00
5	2 412.00	19	2 440.00	33	2 468.00
6	2 414.00	20	2 442.00	34	2 470.00
7	2 416.00	21	2 444.00	35	2 472.00
8	2 418.00	22	2 446.00	36	2 474.00
9	2 420.00	23	2 448.00	37	2 476.00
10	2 422.00	24	2 450.00	38	2 478.00
11	2 424.00	25	2 452.00	39	2 480.00
12	2 426.00	26	2 454.00		
13	2 428.00	27	2 456.00		

5.4 Configuration of Test System

Radiated Emission Test: Preliminary radiated emissions test were conducted using the procedure in ANSI C63.10: 2013 to determine the worse operating conditions. Final radiated emission tests were conducted at 10 meter Semi Anechoic Chamber.

The turntable was rotated through 360 degrees and the EUT was tested by positioned three orthogonal planes to obtain the highest reading on the field strength meter. Once maximum reading was determined, the search antenna was raised and lowered in both vertical and horizontal polarization.

5.5 Antenna Requirement

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

Antenna Construction:

The antenna of the EUT is a FPCB Antenna on the main board in the EUT, so no consideration of replacement by the user.

6. PRELIMINARY TEST

6.1 General Radiated Emissions Tests

During Preliminary Test, the following operating mode was investigated.

Operation Mode	The Worse operating condition (Please check one only)
Transmitting Mode	X

7. 100 kHz BANDWIDTH OUTSIDE THE FREQUENCY BAND

7.1 Operating environment

Temperature : 23 °C

Relative humidity : 45 % R.H.

7.2 Test set-up for conducted measurement

The antenna output of the EUT was connected to the spectrum analyzer. The resolution and video bandwidth is set to 100 kHz, and peak detection was used.

7.3 Test set-up for radiated measurement

The radiated emissions measurements were performed on the 10 m semi anechoic chamber. The EUT was placed on turntable approximately 1.5 m above the ground plane.

The frequency spectrum from 30 MHz to 26.5 GHz was scanned and maximum emission levels at each frequency recorded. The system was rotated 360°, and the antenna was varied in the height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for horizontal and vertical polarization of the receiving antenna.

7.4 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	FSV40	Rohde & Schwarz	Signal Analyzer	101009	Feb. 21, 2020 (1Y)
■ -	ESW	Rohde & Schwarz	EMI Test Receiver	101851	Aug. 07, 2019 (1Y)
■ -	310N	Sonoma Instrument	Pre-Amplifier	312544	Mar. 16, 2020 (1Y)
■ -	BBV 9718 B	Schwarzbeck	Broadband Preamplifier	00009	Mar. 16, 2020 (1Y)
■ -	SCU40A	Rohde & Schwarz	Signal Conditioning unit	100436	Feb. 20, 2020 (1Y)
■ -	SCU18	Rohde & Schwarz	Signal Conditioning unit	102266	Jul. 24, 2019(1Y)
■ -	DT3000-3t	Innco System	Turn Table	DT3000/093	N/A
■ -	MA-4000XPET	Innco System	Antenna Master	MA4000/509	N/A
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	777	Apr. 08, 2020 (2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	9120D-1366	Jul. 16, 2019 (1Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Jan. 07, 2020(1Y)

All test equipment used is calibrated on a regular basis.

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7.5 Test data for Transmitting mode radiated emission

7.5.1 Radiated Emission which fall in the Restricted Band

7.5.1.1 Test data for 1 Mbps

7.5.1.1.2 Test data for Bluetooth Earbud LEFT

-. Test Date : June 15, 2020 ~ June 17, 2020

-. Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode
1 MHz and RMS Detector for Average Mode

-. Video bandwidth : 3 MHz for Peak and Average Mode

-. Measurement distance : 3 m

-. Duty Cycle : 100.00 %

-. Result : PASSED

Frequency (MHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	C.F (dB)	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
Test Data for Low Channel									
2 364.312	14.12	Peak	H	26.94	9.20	-	50.26	74.00	23.74
2 311.318	3.50	Average	H			-	39.64	54.00	14.36
2 351.976	14.76	Peak	V			-	50.90	74.00	23.10
2 310.430	3.38	Average	V			-	39.52	54.00	14.48
Test Data for High Channel									
2 484.716	15.65	Peak	H	27.47	9.49	-	52.61	74.00	21.39
2 483.508	3.99	Average	H			-	40.95	54.00	13.05
2 494.738	15.50	Peak	V			-	52.46	74.00	21.54
2 483.508	3.15	Average	V			-	40.11	54.00	13.89

Tabulated test data for Restricted Band

Remark: “H”: Horizontal, “V”: Vertical

Margin (dB) = Limits (dBµV/m) - Total Level (dBµV/m)

Total Level = Reading + Antenna Factor + Cable Loss + Correction Factor

Tested by: Hyung-Kwon, Oh / Manager

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7.5.1.1.3 Test data for Bluetooth Earbud RIGHT

-. Test Date : June 15, 2020 ~ June 17, 2020

-. Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode

1 MHz and RMS Detector for Average Mode

-. Video bandwidth : 3 MHz for Peak and Average Mode

-. Measurement distance : 3 m

-. Duty Cycle : 100.00 %

-. Result : PASSED

Frequency (MHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	C.F (dB)	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
Test Data for Low Channel									
2 364.330	13.58	Peak	H	26.94	9.20	-	49.72	74.00	24.28
2 311.328	3.56	Average	H			-	39.70	54.00	14.30
2 351.850	14.48	Peak	V			-	50.62	74.00	23.38
2 310.450	4.22	Average	V			-	40.36	54.00	13.64
Test Data for High Channel									
2 484.753	15.60	Peak	H	27.47	9.49	-	52.56	74.00	21.44
2 483.516	4.30	Average	H			-	41.26	54.00	12.74
2 494.770	15.56	Peak	V			-	52.52	74.00	21.48
2 483.508	2.79	Average	V			-	39.75	54.00	14.25

Tabulated test data for Restricted Band

Remark: “H”: Horizontal, “V”: Vertical

Margin (dB) = Limits (dBµV/m) - Total Level (dBµV/m)

Total Level = Reading + Antenna Factor + Cable Loss + Correction Factor

Tested by: Hyung-Kwon, Oh / Manager

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7.5.1.2 Test data for 2 Mbps

7.5.1.2.1 Test data for Bluetooth Earbud LEFT

-. Test Date : June 15, 2020 ~ June 17, 2020

-. Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode

1 MHz and RMS Detector for Average Mode

-. Video bandwidth : 3 MHz for Peak and Average Mode

-. Measurement distance : 3 m

-. Duty Cycle : 100.00 %

-. Result : PASSED

Frequency (MHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	C.F (dB)	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
Test Data for Low Channel									
2 310.057	14.03	Peak	H	26.94	9.20	-	50.17	74.00	23.83
2 310.063	3.36	Average	H			-	39.50	54.00	14.50
2 311.950	14.28	Peak	V			-	50.42	74.00	23.58
2 310.590	3.36	Average	V			-	39.50	54.00	14.50
Test Data for High Channel									
2 483.508	15.71	Peak	H	27.47	9.49	-	52.67	74.00	21.33
2 483.510	4.36	Average	H			-	41.32	54.00	12.68
2 483.917	14.60	Peak	V			-	51.56	74.00	22.44
2 483.526	2.94	Average	V			-	39.90	54.00	14.10

Tabulated test data for Restricted Band

Remark: “H”: Horizontal, “V”: Vertical

Margin (dB) = Limits (dBµV/m) - Total Level (dBµV/m)

Total Level = Reading + Antenna Factor + Cable Loss + Correction Factor

Tested by: Hyung-Kwon, Oh / Manager

ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

7.5.1.2.2 Test data for Bluetooth Earbud RIGHT

-. Test Date : June 15, 2020 ~ June 17, 2020

-. Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode

1 MHz and RMS Detector for Average Mode

-. Video bandwidth : 3 MHz for Peak and Average Mode

-. Measurement distance : 3 m

-. Duty Cycle : 100.00 %

-. Result : PASSED

Frequency (MHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	C.F (dB)	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
Test Data for Low Channel									
2 310.136	13.42	Peak	H	26.94	9.20	-	49.56	74.00	24.44
2 310.133	3.60	Average	H			-	39.74	54.00	14.26
2 311.764	13.80	Peak	V			-	49.94	74.00	24.06
2 310.650	3.52	Average	V			-	39.66	54.00	14.34
Test Data for High Channel									
2 483.508	15.96	Peak	H	27.47	9.49	-	52.92	74.00	21.08
2 483.508	4.90	Average	H			-	41.86	54.00	12.14
2 483.917	15.20	Peak	V			-	52.16	74.00	21.84
2 483.508	3.51	Average	V			-	40.47	54.00	13.53

Tabulated test data for Restricted Band

Remark: “H”: Horizontal, “V”: Vertical

Margin (dB) = Limits (dBµV/m) - Total Level (dBµV/m)

Total Level = Reading + Antenna Factor + Cable Loss + Correction Factor

Tested by: Hyung-Kwon, Oh / Manager

ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

7.5.2 Spurious & Harmonic Radiated Emission above 1 GHz

7.5.2.1 Test data for 1 Mbps

7.5.2.1.1 Test data for Bluetooth Earbud LEFT

-. Test Date : June 12, 2020 ~ June 15, 2020

-. Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode for the emissions fall in restricted band,
1 MHz and RMS Detector for Average Mode for the emissions fall in restricted band
100 kHz for Peak Mode for the emissions outside restricted band

-. Video bandwidth : 3 MHz for Peak and Average Mode

-. Frequency range : 1 GHz ~ 26.5 GHz

-. Measurement distance : 3 m

-. Duty Cycle : 100.00 %

-. Result : PASSED

Frequency (MHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	C.F (dB)	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
Test Data for Low Channel									
4 804.00	16.03	Peak	H	28.84	10.31	-	55.18	74.00	18.82
	4.17	Average	H			-	43.32	54.00	10.68
	15.90	Peak	V			-	55.05	74.00	18.95
	4.26	Average	V			-	43.41	54.00	10.59
Test Data for Middle Channel									
4 882.00	16.11	Peak	H	28.01	10.43	-	54.55	74.00	19.45
	4.14	Average	H			-	42.58	54.00	11.42
	15.88	Peak	V			-	54.32	74.00	19.68
	4.57	Average	V			-	43.01	54.00	10.99
Test Data for High Channel									
4 960.00	16.09	Peak	H	29.15	10.81	-	56.05	74.00	17.95
	4.89	Average	H			-	44.85	54.00	9.15
	15.66	Peak	V			-	55.62	74.00	18.38
	4.71	Average	V			-	44.67	54.00	9.33

Tabulated test data for Restricted Band

Remark: “H”: Horizontal, “V”: Vertical

Margin (dB) = Limits (dBµV/m) - Total Level (dBµV/m)

Total Level = Reading + Antenna Factor + Cable Loss + Correction Factor

Tested by: Hyung-Kwon, Oh / Manager

ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

7.5.2.1.2 Test data for Bluetooth Earbud RIGHT

-. Test Date : June 15, 2020 ~ June 17, 2020

-. Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode for the emissions fall in restricted band,
1 MHz and RMS Detector for Average Mode for the emissions fall in restricted band
100 kHz for Peak Mode for the emissions outside restricted band

-. Video bandwidth : 3 MHz for Peak and Average Mode

-. Frequency range : 1 GHz ~ 26.5 GHz

-. Measurement distance : 3 m

-. Duty Cycle : 100.00 %

-. Result : PASSED

Frequency (MHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	C.F (dB)	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
Test Data for Low Channel									
4 804.00	16.97	Peak	H	28.84	10.31	-	56.12	74.00	17.88
	4.46	Average	H			-	43.61	54.00	10.39
	15.06	Peak	V			-	54.21	74.00	19.79
	4.26	Average	V			-	43.41	54.00	10.59
Test Data for Middle Channel									
4 882.00	16.40	Peak	H	28.01	10.43	-	54.84	74.00	19.16
	4.19	Average	H			-	42.63	54.00	11.37
	15.03	Peak	V			-	53.47	74.00	20.53
	4.14	Average	V			-	42.58	54.00	11.42
Test Data for High Channel									
4 960.00	16.94	Peak	H	29.15	10.81	-	56.90	74.00	17.10
	5.31	Average	H			-	45.27	54.00	8.73
	15.84	Peak	V			-	55.80	74.00	18.20
	5.02	Average	V			-	44.98	54.00	9.02

Tabulated test data for Restricted Band

Remark: “H”: Horizontal, “V”: Vertical

Margin (dB) = Limits (dBµV/m) - Total Level (dBµV/m)

Total Level = Reading + Antenna Factor + Cable Loss + Correction Factor

Tested by: Hyung-Kwon, Oh / Manager

ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

7.5.2.2 Test data for 2 Mbps

7.5.2.2.1 Test data for Bluetooth Earbud LEFT

-. Test Date : June 15, 2020 ~ June 17, 2020

-. Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode for the emissions fall in restricted band,
1 MHz and RMS Detector for Average Mode for the emissions fall in restricted band
100 kHz for Peak Mode for the emissions outside restricted band

-. Video bandwidth : 3 MHz for Peak and Average Mode

-. Frequency range : 1 GHz ~ 26.5 GHz

-. Measurement distance : 3 m

-. Duty Cycle : 100.00 %

-. Result : PASSED

Frequency (MHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	C.F (dB)	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
Test Data for Low Channel									
4 804.00	15.06	Peak	H	28.84	10.31	-	54.21	74.00	19.79
	4.39	Average	H			-	43.54	54.00	10.46
	16.69	Peak	V			-	55.84	74.00	18.16
	5.24	Average	V			-	44.39	54.00	9.61
Test Data for Middle Channel									
4 882.00	16.40	Peak	H	28.01	10.43	-	54.84	74.00	19.16
	4.44	Average	H			-	42.88	54.00	11.12
	15.56	Peak	V			-	54.00	74.00	20.00
	4.92	Average	V			-	43.36	54.00	10.64
Test Data for High Channel									
4 960.00	17.04	Peak	H	29.15	10.81	-	57.00	74.00	17.00
	4.64	Average	H			-	44.60	54.00	9.40
	15.99	Peak	V			-	55.95	74.00	18.05
	4.85	Average	V			-	44.81	54.00	9.19

Tabulated test data for Restricted Band

Remark: “H”: Horizontal, “V”: Vertical

Margin (dB) = Limits (dBµV/m) - Total Level (dBµV/m)

Total Level = Reading + Antenna Factor + Cable Loss + Correction Factor

Tested by: Hyung-Kwon, Oh / Manager

ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

7.5.2.2.2 Test data for Bluetooth Earbud RIGHT

-. Test Date : June 15, 2020 ~ June 17, 2020

-. Resolution bandwidth : 1 MHz and Peak Detector for Peak Mode for the emissions fall in restricted band,
1 MHz and RMS Detector for Average Mode for the emissions fall in restricted band
100 kHz for Peak Mode for the emissions outside restricted band

-. Video bandwidth : 3 MHz for Peak and Average Mode

-. Frequency range : 1 GHz ~ 26.5 GHz

-. Measurement distance : 3 m

-. Duty Cycle : 100.00 %

-. Result : PASSED

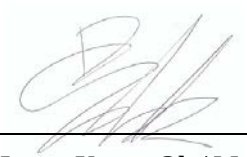
Frequency (MHz)	Reading (dBµV)	Detector Mode	Ant. Pol. (H/V)	Ant. Factor	Cable Loss	C.F (dB)	Total (dBµV/m)	Limits (dBµV/m)	Margin (dB)
Test Data for Low Channel									
4 804.00	16.11	Peak	H	28.84	10.31	-	55.26	74.00	18.74
	4.77	Average	H			-	43.92	54.00	10.08
	15.78	Peak	V			-	54.93	74.00	19.07
	5.21	Average	V			-	44.36	54.00	9.64
Test Data for Middle Channel									
4 882.00	16.68	Peak	H	28.01	10.43	-	55.12	74.00	18.88
	5.23	Average	H			-	43.67	54.00	10.33
	15.71	Peak	V			-	54.15	74.00	19.85
	5.03	Average	V			-	43.47	54.00	10.53
Test Data for High Channel									
4 960.00	16.23	Peak	H	29.15	10.81	-	56.19	74.00	17.81
	5.76	Average	H			-	45.72	54.00	8.28
	15.96	Peak	V			-	55.92	74.00	18.08
	5.38	Average	V			-	45.34	54.00	8.66

Tabulated test data for Restricted Band

Remark: “H”: Horizontal, “V”: Vertical

Margin (dB) = Limits (dBµV/m) - Total Level (dBµV/m)

Total Level = Reading + Antenna Factor + Cable Loss + Correction Factor



Tested by: Hyung-Kwon, Oh / Manager

ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

8. RADIATED EMISSION TEST

8.1 Operating environment

Temperature : 23 °C

Relative humidity : 45 % R.H.

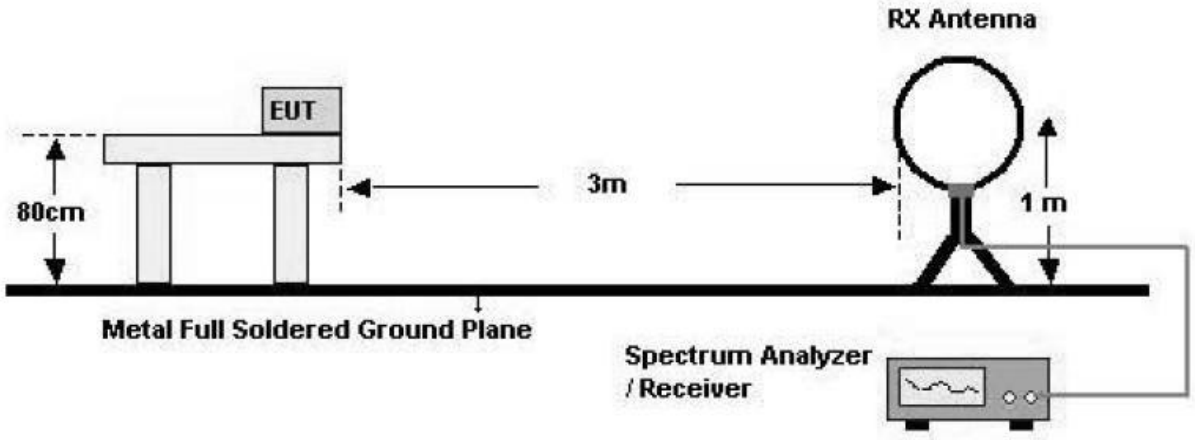
8.2 Test set-up

The radiated emissions measurements were on the 10 m semi anechoic chamber. The EUT and other support equipment were placed on a non-conductive turntable above the ground plane. The interconnecting cables from outside test site were inserted into ferrite clamps at the point where the cables reach the turntable.

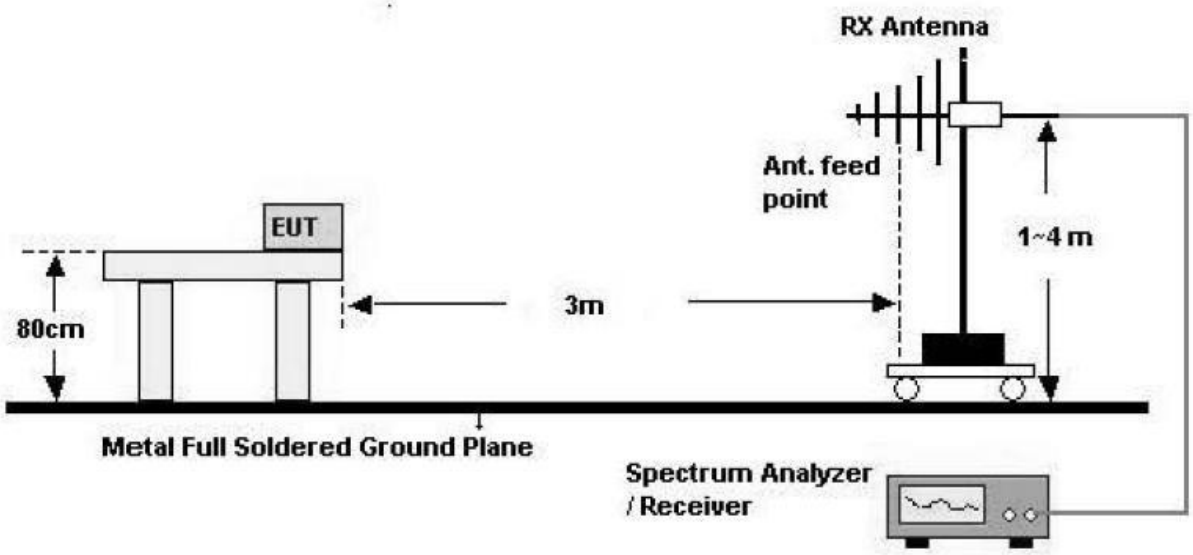
The frequency spectrum from 30 MHz to 26.5 GHz was scanned and emission levels maximized at each frequency recorded. The system was rotated 360°, and the antenna was varied in height between 1.0 m and 4.0 m in order to determine the maximum emission levels. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

- Test Configuration

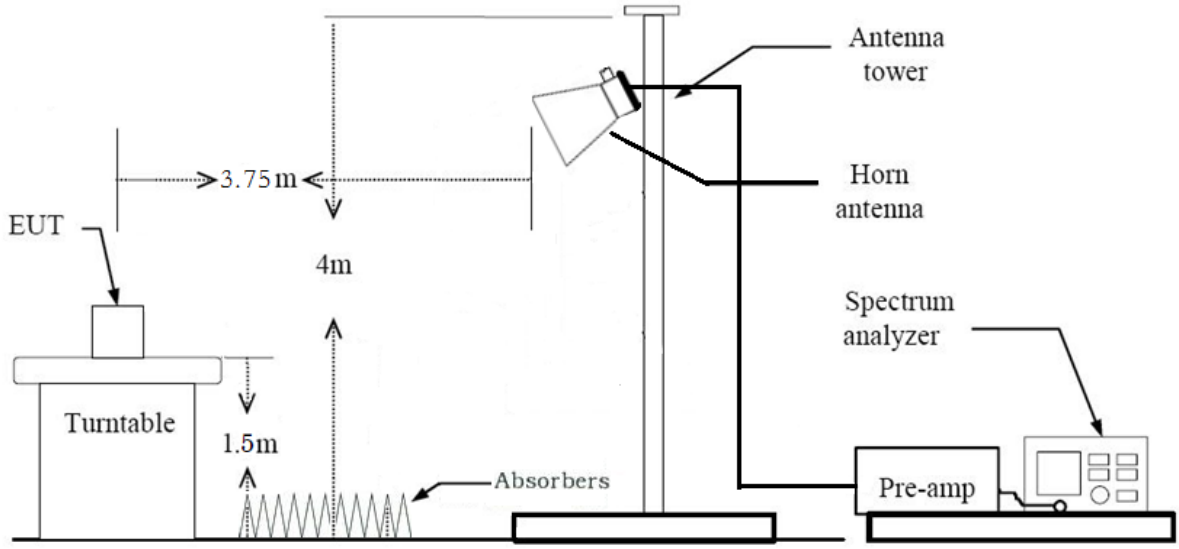
1. Below 30 MHz



2. 30 MHz - 1 GHz



3. Above 1 GHz



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8.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal.
■ -	FSV40	Rohde & Schwarz	Signal Analyzer	101009	Feb. 21, 2020 (1Y)
■ -	ESW	Rohde & Schwarz	EMI Test Receiver	101851	Aug. 07, 2019 (1Y)
■ -	310N	Sonoma Instrument	Pre-Amplifier	312544	Mar. 16, 2020 (1Y)
■ -	BBV 9718 B	Schwarzbeck	Broadband Preamplifier	00009	Mar. 16, 2020 (1Y)
■ -	SCU40A	Rohde & Schwarz	Signal Conditioning unit	100436	Feb. 20, 2020 (1Y)
■ -	SCU18	Rohde & Schwarz	Signal Conditioning unit	102266	Jul. 24, 2019(1Y)
■ -	DT3000-3t	Innco System	Turn Table	DT3000/093	N/A
■ -	MA-4000XPET	Innco System	Antenna Master	MA4000/509	N/A
■ -	VULB9163	Schwarzbeck	TRILOG Broadband Antenna	777	Apr. 08, 2020 (2Y)
■ -	BBHA9120D	Schwarzbeck	Horn Antenna	9120D-1366	Jul. 16, 2019 (1Y)
■ -	BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Jan. 07, 2020(1Y)

All test equipment used is calibrated on a regular basis.

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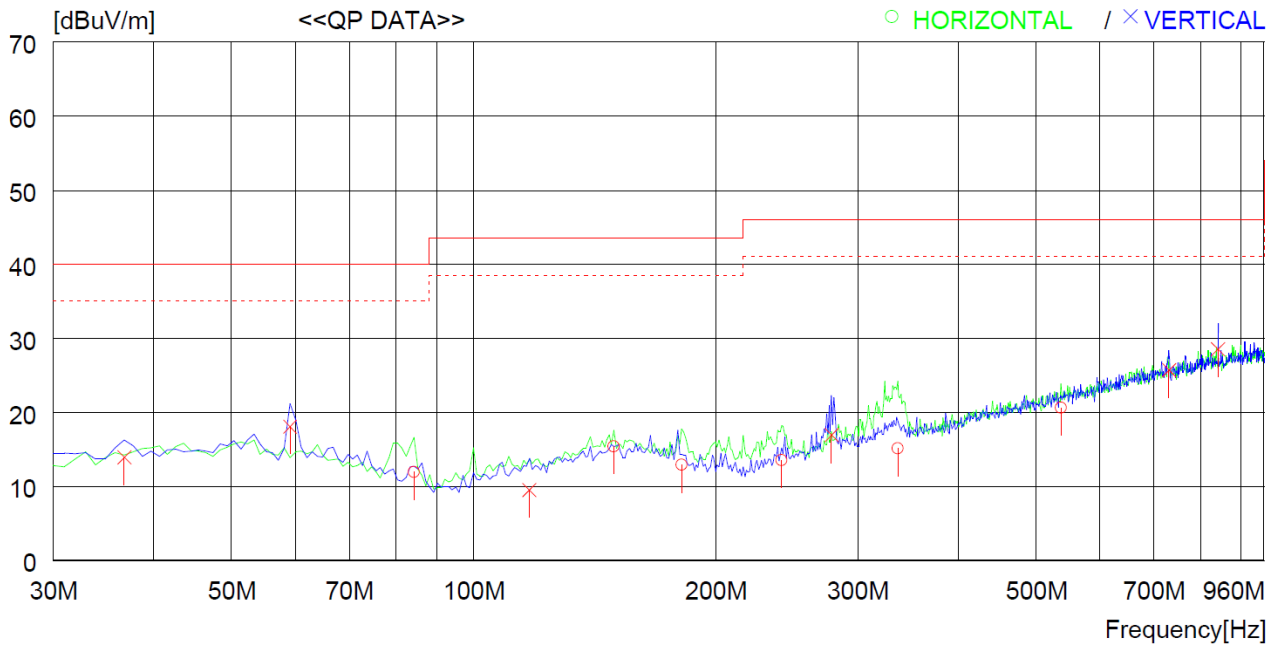
8.4 Test data for Bluetooth Earbud LEFT

8.4.1 Test data for 30 MHz ~ 960 MHz

-. Test Date : June 15, 2020 ~ June 17, 2020

-. Resolution bandwidth : 120 kHz

-. Measurement distance : 3 m



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal ------										
1	84.320	28.2	14.3	1.9	32.5	11.9	40.0	28.1	300	131
2	149.310	26.6	18.9	2.4	32.5	15.4	43.5	28.1	200	359
3	181.320	25.4	17.4	2.6	32.5	12.9	43.5	30.6	400	228
4	241.460	25.6	17.3	3.0	32.4	13.5	46.0	32.5	200	359
5	336.520	24.0	20.1	3.5	32.5	15.1	46.0	30.9	100	91
6	537.310	24.6	24.3	4.4	32.7	20.6	46.0	25.4	400	122
----- Vertical ------										
7	36.790	26.6	18.5	1.3	32.5	13.9	40.0	26.1	100	359
8	59.100	29.8	19.1	1.7	32.5	18.1	40.0	21.9	100	359
9	117.300	23.3	16.5	2.2	32.5	9.5	43.5	34.0	200	0
10	278.320	27.3	18.8	3.2	32.4	16.9	46.0	29.1	200	341
11	731.304	25.7	27.2	5.3	32.5	25.7	46.0	20.3	200	214
12	841.881	26.5	28.5	5.6	32.1	28.5	46.0	17.5	300	225

Tested by: Hyung-Kwon, Oh / Manager

ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

8.4.2 Test data for Below 30 MHz

-. Test Date : June 15, 2020 ~ June 17, 2020

-. Resolution bandwidth : 200 Hz (from 9 kHz to 0.15 MHz), 9 kHz (from 0.15 MHz to 30 MHz)

-. Frequency range : 9 kHz ~ 30 MHz

-. Measurement distance : 3 m

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Factor (dB/m)	Cable Loss	Amp Gain	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
Emission from the EUT more than 20 dB below the limit in each frequency range.								

8.4.3 Test data for above 1 GHz

-. Test Date : June 15, 2020 ~ June 17, 2020

-. Resolution bandwidth : 1 MHz for Peak and Average Mode

-. Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode

-. Frequency range : 1 GHz ~ 26.5 GHz

-. Measurement distance : 3 m

Frequency (MHz)	Reading (dBμV)	Ant. Pol. (H/V)	Ant. Factor (dB/m)	Cable Loss	Amp Gain	Emission Level(dBμV/m)	Limits (dBμV/m)	Margin (dB)
Emission from the EUT more than 20 dB below the limit in each frequency range.								

Tested by: Hyung-Kwon, Oh / Manager

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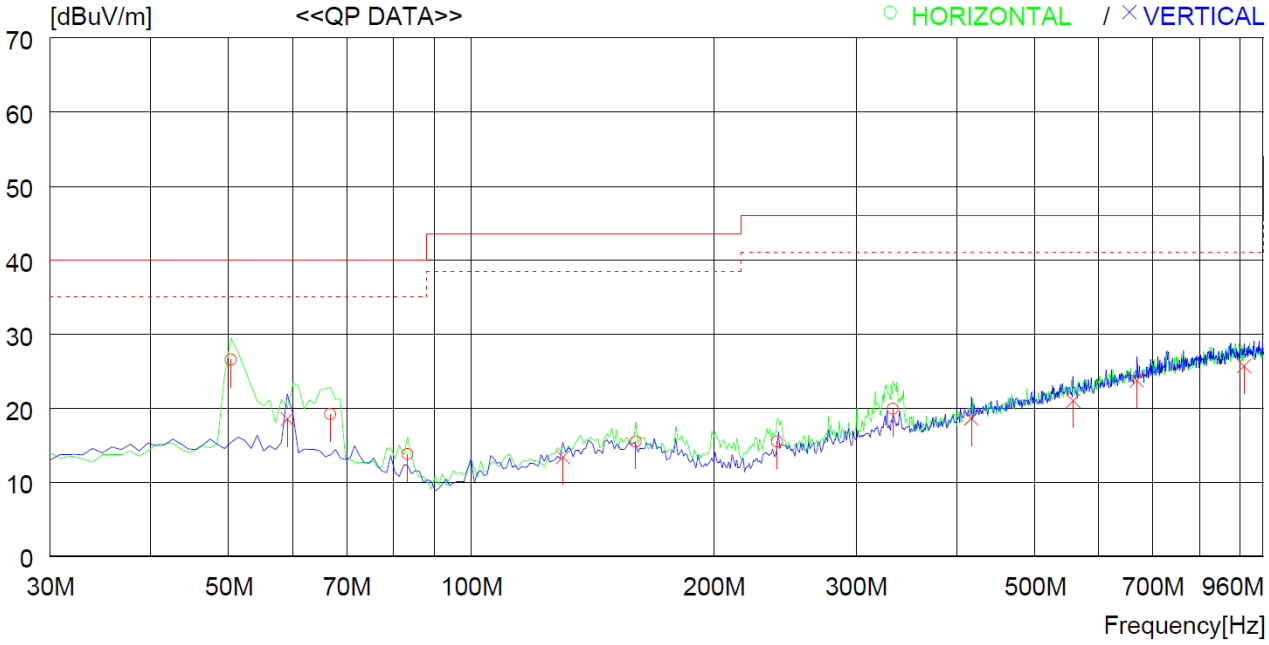
8.5 Test data for Bluetooth Earbud RIGHT

8.5.1 Test data for 30 MHz ~ 960 MHz

-. Test Date : June 15, 2020 ~ June 17, 2020

-. Resolution bandwidth : 120 kHz

-. Measurement distance : 3 m



No.	FREQ [MHz]	READING QP [dBuV]	ANT FACTOR [dB]	LOSS [dB]	GAIN [dB]	RESULT [dBuV/m]	LIMIT [dBuV/m]	MARGIN [dB]	ANTENNA [cm]	TABLE [DEG]
----- Horizontal ------										
1	50.370	37.8	19.7	1.5	32.5	26.5	40.0	13.5	200	359
2	66.860	31.8	18.2	1.7	32.5	19.2	40.0	20.8	200	359
3	83.350	29.9	14.5	1.9	32.5	13.8	40.0	26.2	100	359
4	159.980	26.5	19.1	2.4	32.5	15.5	43.5	28.0	200	359
5	239.520	27.7	17.2	3.0	32.4	15.5	46.0	30.5	100	82
6	333.610	28.8	20.1	3.5	32.5	19.9	46.0	26.1	100	0
----- Vertical ------										
7	59.100	30.2	19.1	1.7	32.5	18.5	40.0	21.5	100	178
8	129.910	26.1	17.6	2.2	32.5	13.4	43.5	30.1	100	359
9	417.031	25.2	22.0	3.9	32.5	18.6	46.0	27.4	100	336
10	557.679	24.3	24.8	4.5	32.6	21.0	46.0	25.0	200	172
11	669.226	24.8	26.4	5.1	32.6	23.7	46.0	22.3	300	244
12	908.809	22.3	29.1	5.9	31.6	25.7	46.0	20.3	100	359

Tested by: Hyung-Kwon, Oh / Manager

ONETECH Corp.: 43-14, Jinsaegol-gil, Chowol-eup, Gwangju-si, Gyeonggi-do, 12735, Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

8.5.2 Test data for Below 30 MHz

-. Test Date : June 15, 2020 ~ June 17, 2020

-. Resolution bandwidth : 200 Hz (from 9 kHz to 0.15 MHz), 9 kHz (from 0.15 MHz to 30 MHz)

-. Frequency range : 9 kHz ~ 30 MHz

-. Measurement distance : 3 m

Frequency (MHz)	Reading (dBµV)	Ant. Pol. (H/V)	Ant. Factor (dB/m)	Cable Loss	Amp Gain	Emission Level(dBµV/m)	Limits (dBµV/m)	Margin (dB)
Emission from the EUT more than 20 dB below the limit in each frequency range.								

8.5.3 Test data for above 1 GHz

-. Test Date : June 15, 2020 ~ June 17, 2020

-. Resolution bandwidth : 1 MHz for Peak and Average Mode

-. Video bandwidth : 1 MHz for Peak Mode, 10 Hz for Average Mode

-. Frequency range : 1 GHz ~ 26.5 GHz

-. Measurement distance : 3 m

Frequency (MHz)	Reading (dBµV)	Ant. Pol. (H/V)	Ant. Factor (dB/m)	Cable Loss	Amp Gain	Emission Level(dBµV/m)	Limits (dBµV/m)	Margin (dB)
Emission from the EUT more than 20 dB below the limit in each frequency range.								

Tested by: Hyung-Kwon, Oh / Manager

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