

FCC CERTIFICATION TEST REPORT

FOR

Applicant	:	Optoma Corporation
Address	:	12F., No. 213, Sec. 3, Beixin Rd., Xindian Dist., New Taipei City, Taiwan
Equipment under Test	:	True Wireless Earphones
Model No.	:	APBEFREEB
Trade Mark	:	Optoma
Manufacturer	:	Optoma Corporation
Address	:	12F., No. 213, Sec. 3, Beixin Rd., Xindian Dist., New Taipei City, Taiwan

Issued By: Dongguan Dongdian Testing Service Co., Ltd.

Add: No. 17, Zongbu Road 2, Songshan Lake Sci&Tech, Industry Park, Dongguan City,
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TEST REPORT DECLARE

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FCC ID : 2ABRC-APBEFREEB

Test Standard Used:

FCC Rules and Regulations Part 15 Subpart C; ANSI C63.10:2013.

We Declare:

The equipment described above is tested by Dongguan Dongdian Testing Service Co., Ltd. and in the configuration tested the equipment complied with the standards specified above (class B). The test results are contained in this test report and Dongguan Dongdian Testing Service Co., Ltd. is assumed of full responsibility for the accuracy and completeness of these tests.

After test and evaluation, our opinion is that the equipment provided for test compliance with the requirement of the above FCC standards.

Report No.:	DDT-R17Q0706-2E6		
Date of Receipt:	Jul. 07, 2017	Date of Test:	Jul. 07, 2017 ~ Aug. 01, 2017

Prepared By:

Damon Hu

Damon Hu/Engineer

Approved By:



Kevin Feng/EMC Manager

Note: This report applies to above tested sample only. This report shall not be reproduced in parts without written approval of Dongguan Dongdian Testing Service Co., Ltd.

1. Summary of test results

Description of Test Item	Standard	Limits	Results
Power Line Conducted Emission Test	FCC Part 15: 15.207 ANSI C63.10:2013	Class B	PASS
Radiated Emission Test	FCC Part 15: 15.209 ANSI C63.10:2013	Class B	PASS
20dB Bandwidth	FCC Part 15: 15.215 ANSI C63.10:2013	N/A	PASS

Note: N/A means not applicable.

2. General test information

2.1. Description of EUT

EUT* Name	: True Wireless Earphones
Model Number	: APBEFREEB
EUT function description	: Please reference user manual of this device
Power supply	: DC 3.7V built-in battery
Operation frequency	: 10.579MHz
Modulation	: 8-DPSK-PTCM
Data rate	: 596kbps
Sample Type	: Series production

Note: EUT is the ab. of equipment under test.

2.2. Accessories of EUT

Description of Accessories	Manufacturer	Model number	Serial No.	Other
N/A	N/A	N/A	N/A	N/A

2.3. Assistant equipment used for test

Assistant equipment	Manufacturer	Model number	Serial No.	Other
N/A	N/A	N/A	N/A	N/A

2.4. Block diagram EUT configuration for test

TX mode

2.5. Test environment conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature range:	21-25°C
Humidity range:	40-75%
Pressure range:	86-106kPa

2.6. Deviations of test standard

No Deviation

2.7. Test laboratory

Dongguan Dongdian Testing Service Co., Ltd

Add: No. 17, Zongbu Road 2, Songshan Lake Sci&Tech, Industry Park, Dongguan City, Guangdong Province, China, 523808 Tel: +86-0769-89201699 <http://www.dgddt.com>

CNAS Accreditation No. L6451; A2LA Accreditation No. 3870.01

Designation Number: CN1182; Test Firm Registration Number: 540522

Industry Canada site registration number: 10288A-1

2.8. Measurement uncertainty

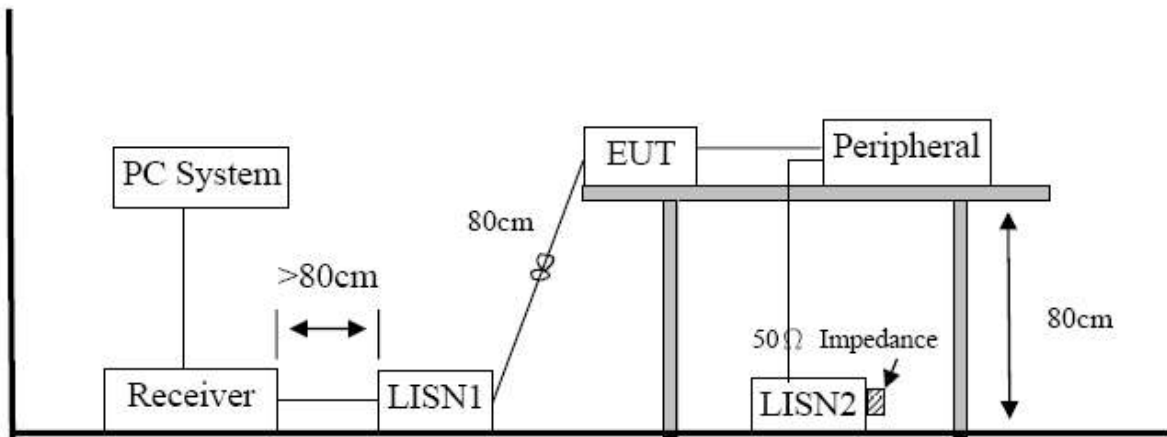
Test Item	Uncertainty
Uncertainty for Conduction emission test	3.32dB (150KHz-30MHz)
	3.72dB (9KHz-150KHz)
Uncertainty for Radiation Emission test (30MHz-1GHz)	4.70 dB (Antenna Polarize: V)
	4.84 dB (Antenna Polarize: H)
Uncertainty for Radiation Emission test (1GHz-18GHz)	4.10dB(1-6GHz)
	4.40dB (6GHz-18Gz)
Note: This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.	

3. Equipment Used during Test

Equipment	Manufacturer	Model No.	Serial No.	Last Cal.	Cal. Interval
Conducted disturbance at mains terminals					
Test Receiver	R&S	ESU8	100316	Oct. 16, 2016	1 Year
V-Network	R&S	ESH3-Z6	100694	Oct. 16, 2016	1 Year
V-Network	R&S	ESH3-Z6	100690	Oct. 16, 2016	1 Year
LISN 1	R&S	ENV216	101109	Oct. 16, 2016	1 Year
LISN 2	R&S	ESH2-Z5	100309	Oct. 16, 2016	1 Year
Pulse Limiter	R&S	ESH3-Z2	101242	Oct. 16, 2016	1 Year
CE Cable 1	HUBSER	ESU8/RF2	W10.01	Oct. 16, 2016	1 Year
Test software	Audix	E3	V 6.11111b	/	/
RE/RF in chamber					
EMI Test Receiver	R&S	ESU8	100316	Oct. 16, 2016	1Year
Spectrum analyzer	R&S	FSU26	1166.1660.26	Oct. 16, 2016	1Year
Trilog Broadband Antenna	Schwarzbeck	VULB9163	9163-462	Oct. 27, 2016	1 Year
Active Loop antenna	Schwarzbeck	FMZB-1519	1519-038	Oct. 16, 2016	1 Year
Double Ridged Horn Antenna	R&S	HF907	100276	Oct. 12, 2016	1 Year
Pre-amplifier	A.H.	PAM-0118	360	Oct. 16, 2016	1 Year
RF Cable	HUBSER	CP-X2	W11.03	Oct. 16, 2016	1Year
RF Cable	HUBSER	CP-X1	W12.02	Oct. 16, 2016	1 Year
MI Cable	HUBSER	C10-01-01-1M	1091629	Oct. 16, 2016	1 Year
Test software	Audix	E3	V 6.11111b	/	/

4. Power Line Conducted Emission Test

4.1. Block diagram of test setup



4.2. Power Line Conducted Emission Limits(Class B)

Frequency	Quasi-Peak Level dB(μ V)	Average Level dB(μ V)
150kHz ~ 500kHz	66 ~ 56*	56 ~ 46*
500kHz ~ 5MHz	56	46
5MHz ~ 30MHz	60	50

Note 1: * Decreasing linearly with logarithm of frequency.

Note 2: The lower limit shall apply at the transition frequencies.

4.3. Test Procedure

The EUT and Support equipment, if needed, were put placed on a non-metallic table, 80cm above the ground plane.

All I/O cables were positioned to simulate typical actual usage as per ANSI C63.4.

All support equipment power received from a second LISN.

Emissions were measured on each current carrying line of the EUT using an EMI Test Receiver connected to the LISN powering the EUT.

The Receiver scanned from 150 kHz to 30MHz for emissions in each of the test modes.

During the above scans, the emissions were maximized by cable manipulation.

The test mode(s) described in clause 2.4 were scanned during the preliminary test.

After the preliminary scan, we found the test mode producing the highest emission level.

The EUT configuration and worse cable configuration of the above highest emission levels were recorded for reference of the final test.

EUT and support equipment were set up on the test bench as per the configuration with highest emission level in the preliminary test.

A scan was taken on both power lines, Neutral and Line, recording at least the six highest emissions. Emission frequency and amplitude were recorded into a computer in which correction factors were used to

calculate the emission level and compare reading to the applicable limit.

The test data of the worst-case condition(s) was recorded.

The bandwidth of test receiver is set at 9 KHz.

4.4. Test Result

PASS. (See below detailed test result)

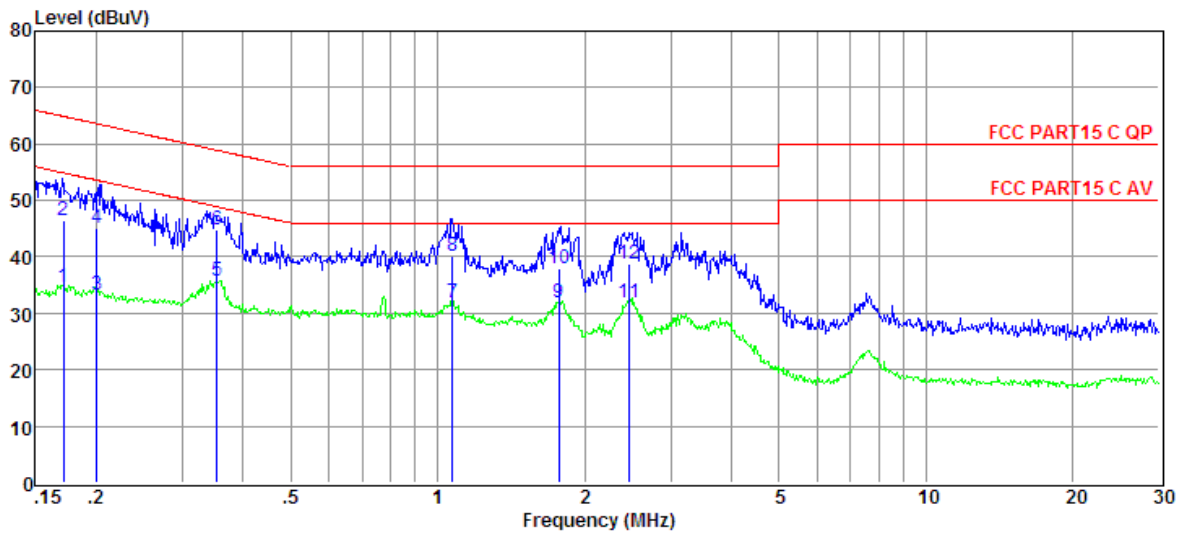
Note1: All emissions not reported below are too low against the prescribed limits.

Note2: “----” means Peak detection; “-----” means Average detection

TR-4-E-010 Conducted Emission Test Result

Test Site : DDT 1# Shield Room E:\2017 CE report data\17Q0706-2\CE.EM6
Test Date : 2017-07-07 **Tested By** : Aaron
EUT : True wireless earphone **Model Number** : APBEFREEB
Power Supply : AC 120V/60Hz **Test Mode** : Tx mode
Condition : Temp:24.5°C,Humi:55%,
LISN : 2016 ENV216/NEUTRAL
 Press:100.1kPa
Memo :

Data: 2



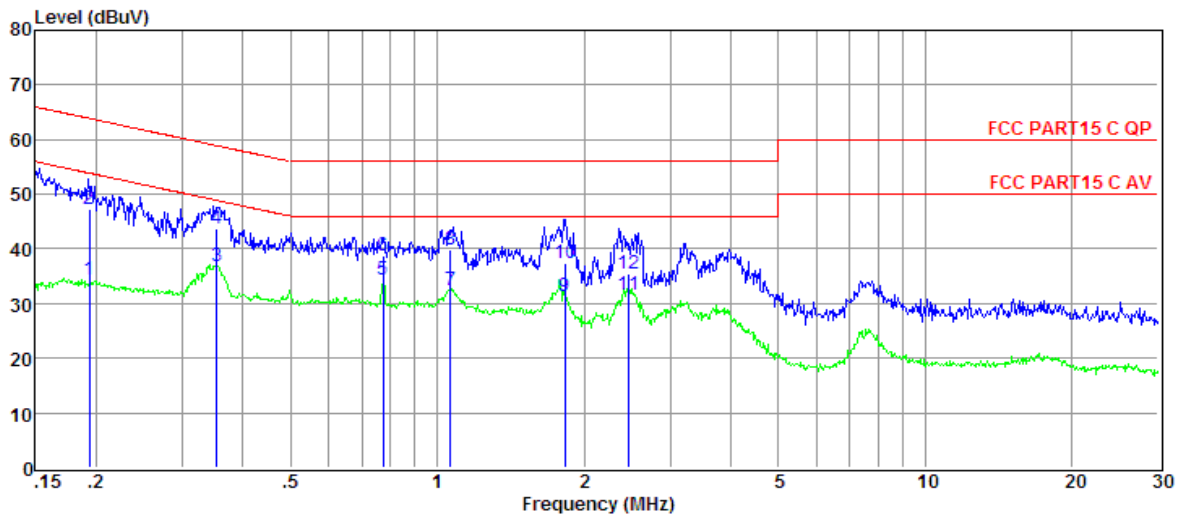
Item (Mark)	Freq. (MHz)	Read Level (dBμV)	LISN Factor (dB)	Cable Loss (dB)	Pulse Limiter Factor (dB)	Result Level (dBμV)	Limit Line (dBμV)	Over Limit (dB)	Detector	Phase
1	0.17	15.19	9.61	0.02	9.86	34.68	54.90	-20.22	Average	NEUTRAL
2	0.17	26.93	9.61	0.02	9.86	46.42	64.90	-18.48	QP	NEUTRAL
3	0.20	13.86	9.61	0.02	9.86	33.35	53.58	-20.23	Average	NEUTRAL
4	0.20	25.50	9.61	0.02	9.86	44.99	63.58	-18.59	QP	NEUTRAL
5	0.35	16.16	9.61	0.02	9.86	35.65	48.87	-13.22	Average	NEUTRAL
6	0.35	25.22	9.61	0.02	9.86	44.71	58.87	-14.16	QP	NEUTRAL
7	1.07	12.33	9.61	0.03	9.86	31.83	46.00	-14.17	Average	NEUTRAL
8	1.07	20.63	9.61	0.03	9.86	40.13	56.00	-15.87	QP	NEUTRAL
9	1.77	12.25	9.62	0.04	9.87	31.78	46.00	-14.22	Average	NEUTRAL
10	1.77	18.37	9.62	0.04	9.87	37.90	56.00	-18.10	QP	NEUTRAL
11	2.47	12.44	9.63	0.04	9.87	31.98	46.00	-14.02	Average	NEUTRAL
12	2.47	19.24	9.63	0.04	9.87	38.78	56.00	-17.22	QP	NEUTRAL

- Note: 1. Result Level = Read Level + LISN Factor + Pulse Limiter Factor + Cable loss.
 2. If QP Result complies with AV limit, AV Result is deemed to comply with AV limit.
 3. Test setup: RBW: 200 Hz (9 kHz—150 kHz), 9 kHz (150 kHz—30 MHz).
 4. Step size: 80Hz (0.009MHz-0.15MHz), 4 kHz (0.15MHz-30MHz), Scan time: auto.

TR-4-E-010 Conducted Emission Test Result

Test Site : DDT 1# Shield Room E:\2017 CE report data\17Q0706-2\CE.EM6
Test Date : 2017-07-07 **Tested By** : Aaron
EUT : True wireless earphone **Model Number** : APBEFREEB
Power Supply : AC 120V/60Hz **Test Mode** : Tx mode
Condition : Temp:24.5°C,Humi:55%,
LISN : 2016 ENV216/LINE
 Press:100.1kPa
Memo :

Data: 4



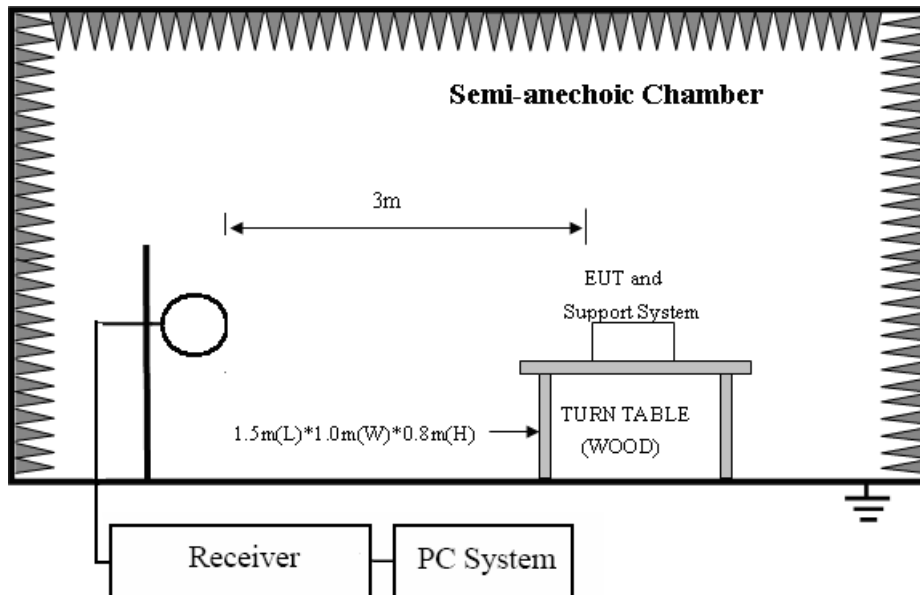
Item (Mark)	Freq. (MHz)	Read Level (dBμV)	LISN Factor (dB)	Cable Loss (dB)	Pulse Limiter Factor (dB)	Result Level (dBμV)	Limit Line (dBμV)	Over Limit (dB)	Detector	Phase
1	0.19	14.91	9.61	0.02	9.86	34.40	53.89	-19.49	Average	LINE
2	0.19	27.68	9.61	0.02	9.86	47.17	63.89	-16.72	QP	LINE
3	0.35	17.21	9.61	0.02	9.86	36.70	48.87	-12.17	Average	LINE
4	0.35	24.27	9.61	0.02	9.86	43.76	58.87	-15.11	QP	LINE
5	0.78	14.93	9.61	0.03	9.86	34.43	46.00	-11.57	Average	LINE
6	0.78	19.20	9.61	0.03	9.86	38.70	56.00	-17.30	QP	LINE
7	1.07	13.08	9.61	0.03	9.86	32.58	46.00	-13.42	Average	LINE
8	1.07	20.23	9.61	0.03	9.86	39.73	56.00	-16.27	QP	LINE
9	1.83	11.74	9.63	0.04	9.87	31.28	46.00	-14.72	Average	LINE
10	1.83	17.96	9.63	0.04	9.87	37.50	56.00	-18.50	QP	LINE
11	2.47	12.07	9.64	0.04	9.87	31.62	46.00	-14.38	Average	LINE
12	2.47	15.95	9.64	0.04	9.87	35.50	56.00	-20.50	QP	LINE

- Note: 1. Result Level = Read Level + LISN Factor + Pulse Limiter Factor + Cable loss.
 2. If QP Result complies with AV limit, AV Result is deemed to comply with AV limit.
 3. Test setup: RBW: 200 Hz (9 kHz—150 kHz), 9 kHz (150 kHz—30 MHz).
 4. Step size: 80Hz (0.009MHz-0.15MHz), 4 kHz (0.15MHz-30MHz), Scan time: auto.

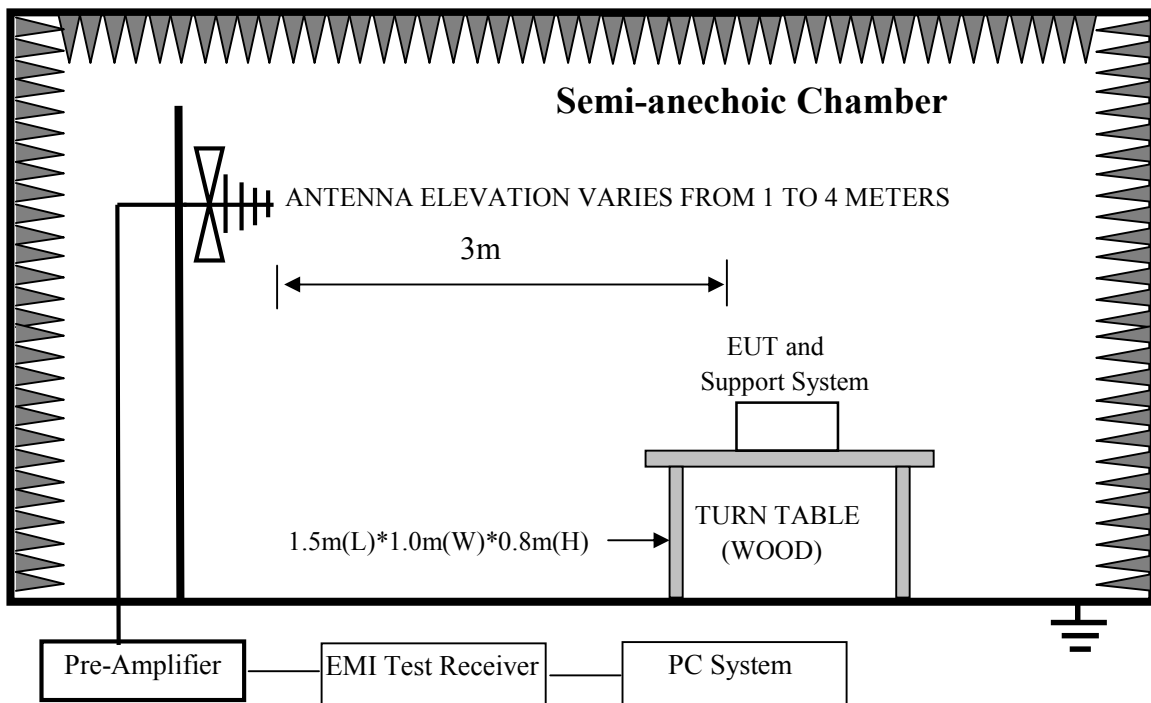
5. Radiated emission test

5.1. Block diagram of test setup

In 3m Anechoic Chamber Test Setup Diagram for 9kHz-30MHz



In 3m Anechoic Chamber Test Setup Diagram for below 1GHz



5.2. Radiated emission limit

FREQUENCY MHz	DISTANCE Meters	FIELD STRENGTHS LIMIT	
		$\mu\text{V}/\text{m}$	$\text{dB}(\mu\text{V})/\text{m}$
0.009 ~ 0.490	300	2400/F(KHz)	67.6-20log(F)
0.490 ~ 1.705	30	24000/F(KHz)	87.6-20log(F)
1.705 ~ 30.0	30	30	29.54
30 ~ 88	3	100	40.0
88 ~ 216	3	150	43.5
216 ~ 960	3	200	46.0
960 ~ 1000	3	500	54.0
Above 1000	3	74.0 dB(μV)/m (Peak) 54.0 dB(μV)/m (Average)	

Note: (1) The emission limits shown in the above table are based on measurements employing a CISPR QP detector except for the frequency bands 9-90KHz, 110-490KHz and above 1000MHz. Radiated emissions limits in these three bands are based on measurements employing an average detector.

(2) At frequencies below 30MHz, measurement may be performed at a distance closer than that specified, and the limit at closer measurement distance can be extrapolated by below formula:

$$\text{Limit}_{3\text{m}}(\text{dB}\mu\text{V}/\text{m}) = \text{Limit}_{30\text{m}}(\text{dB}\mu\text{V}/\text{m}) + 40\text{Log}(30\text{m}/3\text{m})$$

(3) Limit for this EUT

All the emissions appearing within 15.205 restricted frequency bands shall not exceed the limits shown in 15.209, all the other emissions shall be at least 20dB below the fundamental emissions, or comply with 15.209 limits.

5.3. Test Procedure

Procedure of Preliminary Test

The EUT and Support equipment, if needed, were put placed on a non-metallic table, 80cm above the ground plane.

Configuration EUT to simulate typical usage as described in clause 2.4 and test equipment as described in clause 4.2 of this report.

All I/O cables were positioned to simulate typical actual usage as per ANSI C63.4.

Mains cables, telephone lines or other connections to auxiliary equipment located outside the test are shall drape to the floor, be fitted with ferrite clamps or ferrite tubes placed on the floor at the point where the cable reaches the floor and then routed to the place where they leave the turntable. No extension cords shall be used to mains receptacle.

The antenna was placed at 3 meter away from the EUT as stated in ANSI C63.4. The antenna connected to the Spectrum Analyzer via a cable and at times a pre-amplifier would be used.

The Analyzer / Receiver quickly scanned from 30MHz to 1000MHz. The EUT test program was started. Emissions were scanned and measured rotating the EUT to 360 degrees and positioning the antenna 1 to 4 meters above the ground plane, in both the vertical and the horizontal polarization, to maximize the emission reading level.

The test mode(s) described in clause 2.4 were scanned during the preliminary test:

After the preliminary scan, we found the test mode producing the highest emission level. The EUT and cable configuration, antenna position, polarization and turntable position of the above highest emission

level were recorded for the final test.

Procedure of Final Test

EUT and support equipment were set up on the turntable as per the configuration with highest emission level in the preliminary test.

The Analyzer / Receiver scanned from 30MHz to 1000MHz. Emissions were scanned and measured rotating the EUT to 360 degrees, varying cable placement and positioning the antenna 1 to 4 meters above the ground plane, in both the vertical and the horizontal polarization, to maximize the emission reading level.

Recorded at least the six highest emissions. Emission frequency, amplitude, antenna position, polarization and turntable position were recorded into a computer in which correction factors were used to calculate the emission level and compare reading to the applicable limit and only Q.P. reading is presented.

The test data of the worst-case condition(s) was recorded.

The bandwidth setting of the test receiver is 120 kHz.

5.4. Test result

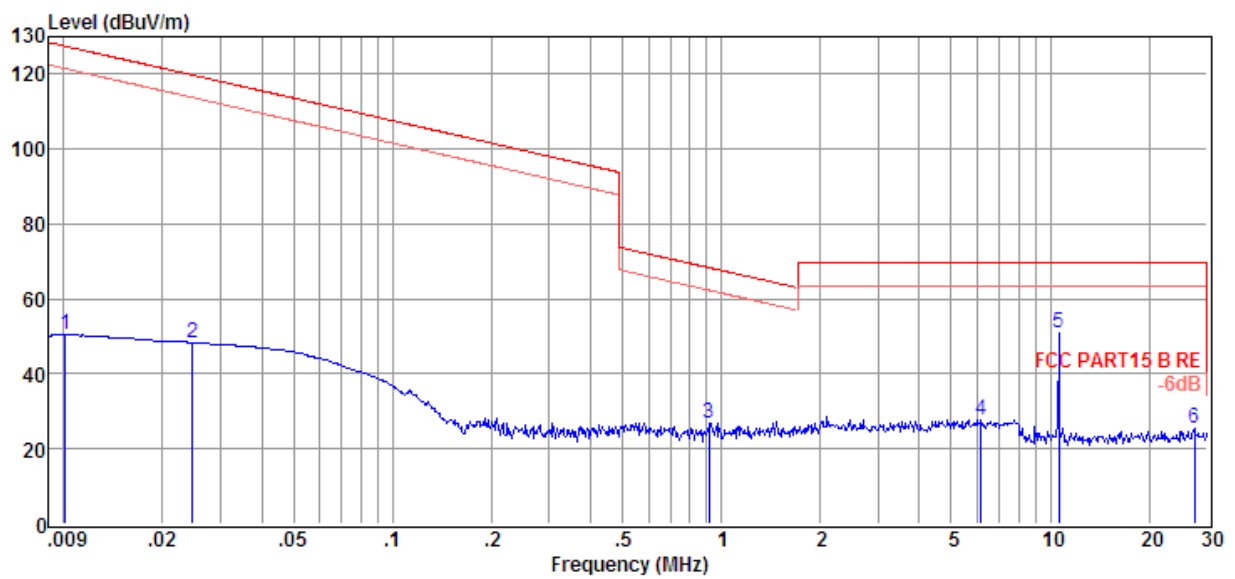
PASS. (See below detailed test result)

Note: All emissions not reported below are too low against the prescribed limits.

TR-4-E-009 Radiated Emission Test Result

Test Site	: DDT 3m Chamber 1#	Tested By	: Jerry
Test Date	: 2017-08-01	Model Number	: APBEFREEB
EUT	: True Wireless Earphones	Test Mode	: TX
Power Supply	: Battery	Antenna/Distance	: 2016 FMZB1519/3m
Condition	: Temp:24.5°C,Humi:55%, Press:100.1kPa		
Memo	:		

Data: 3



Item (Mark)	Freq. (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss dB	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector
1	0.01	27.35	20.09	3.07	50.51	127.51	-77.00	Peak
2	0.02	25.81	19.49	3.07	48.37	119.77	-71.40	Peak
3	0.92	4.51	19.33	3.10	26.94	68.37	-41.43	Peak
4	6.17	5.13	19.31	3.28	27.72	69.50	-41.78	Peak
5	10.579	28.77	18.99	3.39	51.15	69.50	-18.35	Peak
6	27.44	3.64	18.40	3.63	25.67	69.50	-43.83	Peak

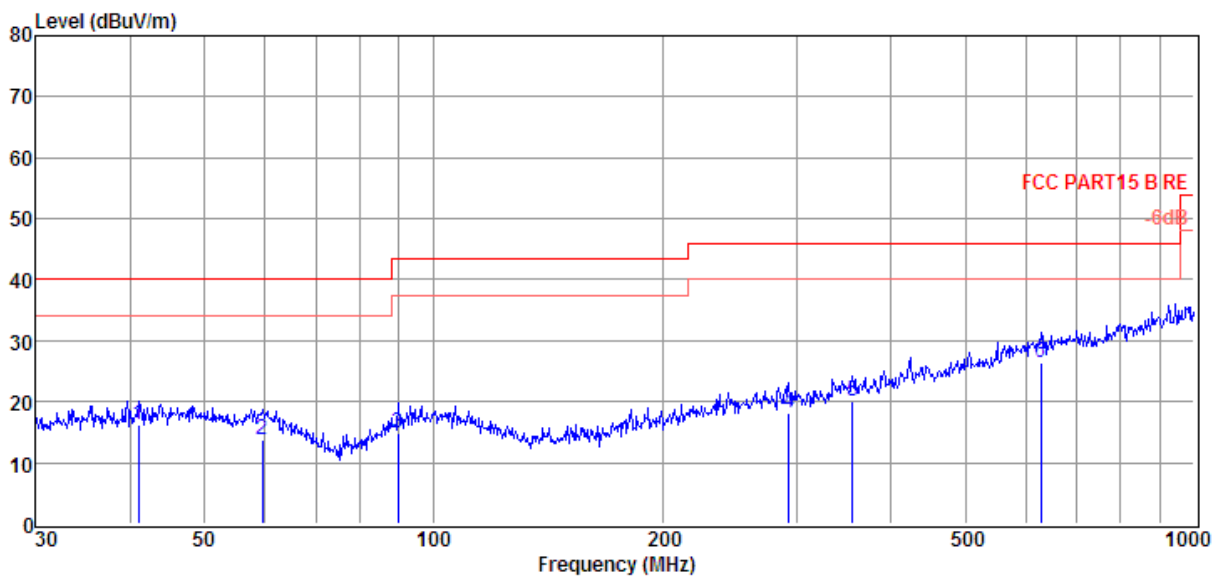
Note: 1. Result Level = Read Level + Antenna Factor + Cable loss.

2. If Peak Result complies with QP limit, QP Result is deemed to comply with QP limit.

TR-4-E-009 Radiated Emission Test Result

Test Site : DDT 3m Chamber 1# D:\2017 RE1# Report Data\17Q0706-2\RE.EM6
Test Date : 2017-07-18 **Tested By** : Jerry
EUT : True Wireless Earphones **Model Number** : APBEFREEB
Power Supply : Battery **Test Mode** : TX
Condition : Temp:24.5°C,Humi:55%,
 : Press:100.1kPa **Antenna/Distance** : 2016 VULB9163 1#/3m/VERTICAL
Memo :

Data: 1



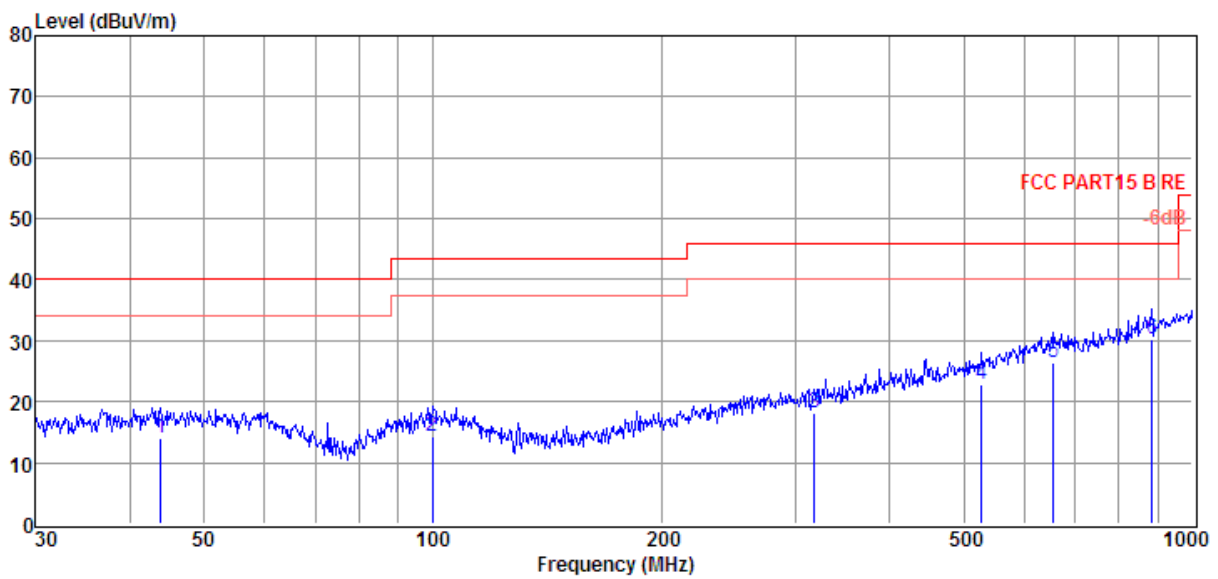
Item (Mark)	Freq. (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
1	40.99	0.06	12.30	3.80	16.16	40.00	-23.84	QP	VERTICAL
2	59.65	-2.02	11.70	3.98	13.66	40.00	-26.34	QP	VERTICAL
3	89.91	-0.14	10.67	4.22	14.75	43.50	-28.75	QP	VERTICAL
4	293.08	-0.59	13.44	5.35	18.20	46.00	-27.80	QP	VERTICAL
5	355.43	-0.29	14.86	5.61	20.18	46.00	-25.82	QP	VERTICAL
6	629.48	0.26	19.40	6.60	26.26	46.00	-19.74	QP	VERTICAL

Note: 1. Result Level = Read Level + Antenna Factor + Cable loss.
 2. If Peak Result complies with QP limit, QP Result is deemed to comply with QP limit.
 3. Test setup: RBW: 120 kHz, VBW: 300 kHz, Sweep time: auto.

TR-4-E-009 Radiated Emission Test Result

Test Site : DDT 3m Chamber 1# D:\2017 RE1# Report Data\17Q0706-2\RE.EM6
Test Date : 2017-07-18 **Tested By** : Jerry
EUT : True Wireless Earphones **Model Number** : APBEFREEB
Power Supply : Battery **Test Mode** : TX
Condition : Temp:24.5°C,Humi:55%,
 : Press:100.1kPa **Antenna/Distance** : 2016 VULB9163 1#/3m/HORIZONTAL
Memo :

Data: 2



Item (Mark)	Freq. (MHz)	Read Level (dBμV)	Antenna Factor (dB/m)	Cable Loss (dB)	Result Level (dBμV/m)	Limit Line (dBμV/m)	Over Limit (dB)	Detector	Polarization
1	43.81	-2.22	12.41	3.83	14.02	40.00	-25.98	QP	HORIZONTAL
2	99.88	-2.06	11.99	4.30	14.23	43.50	-29.27	QP	HORIZONTAL
3	317.70	-1.13	13.68	5.46	18.01	46.00	-27.99	QP	HORIZONTAL
4	528.25	-0.92	17.60	6.27	22.95	46.00	-23.05	QP	HORIZONTAL
5	656.53	0.08	19.57	6.69	26.34	46.00	-19.66	QP	HORIZONTAL
6	884.50	0.80	22.00	7.38	30.18	46.00	-15.82	QP	HORIZONTAL

- Note: 1. Result Level = Read Level + Antenna Factor + Cable loss.
 2. If Peak Result complies with QP limit, QP Result is deemed to comply with QP limit.
 3. Test setup: RBW: 120 kHz, VBW: 300 kHz, Sweep time: auto.

6. 20dB Bandwidth

6.1. Block diagram of test setup

Same as section 5.1

6.2. Limits

Intentional radiators operating under the alternative provisions to the general emission limits, as contained in § 15.217 through 15.257 and in Subpart E of this part, must be designed to ensure that the 20 dB bandwidth of the emission, or whatever bandwidth may otherwise be specified in the specific rule section under which the equipment operates, is contained within the frequency band designated in the rule section under which the equipment is operated.

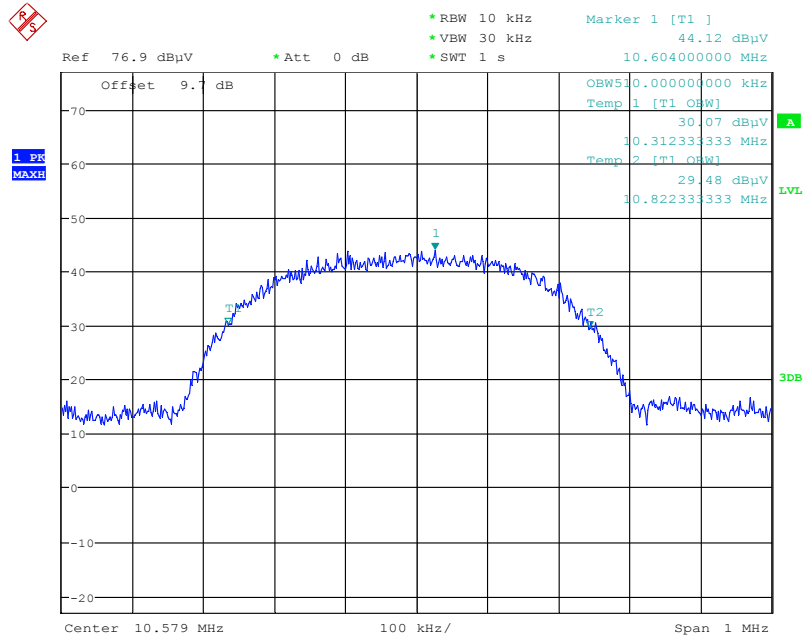
6.3. Test Procedure

- (1) Connect EUT's antenna output to spectrum analyzer by RF cable.
- (2) The bandwidth of the fundamental frequency was measured by spectrum analyzer with 10 kHz RBW and 30 kHz VBW. The 20dB bandwidth is defined as the total spectrum the power of which is higher than peak power minus 20dB.

6.4. Test Result

Mode	Freq. (MHz)	20dB bandwidth Result (MHz)	99% bandwidth Result (MHz)	Conclusion
8-DPSK	10.579	0.51	/	PASS
Test Date: Jun. 12, 2017		Test Engineer: Damon Hu		

6.5. Original test data



END OF REPORT