FCC & ISED TEST REPORT

Product Name:	True wireless headphones with Noise Canceling
Trade Mark:	PHILIPS or PHILIPS
Model No./HVIN:	TAT4507JH
Add. Model No.:	TAT4507, TAT4507JHxx/yy, TAT4507xx/yy (xx=AA-ZZ or blank denoted different color; yy=00-99 denoted different country destination)
Report Number:	220325011RFC-1
Test Standards:	FCC 47 CFR Part 15 Subpart C RSS-247 Issue 2 RSS-Gen Issue 5
FCC ID:	2AR2STAT4507JH
IC:	24589-TAT4507JH
Test Result:	PASS
Date of Issue:	May 27, 2022

Prepared for:

MMD Hong Kong Holding Limited
Unit 1006, 10th Floor, C-Bons International Center, 108 Wai Yip Street, Kwun Tong, Kowloon, Hong Kong

Prepared by:

Shenzhen UnionTrust Quality and Technology Co., Ltd.
Unit D/E of 9/F and 16/F, Block A, Building 6, Baoneng science and technology park, Longhua district, Shenzhen, China
TEL: +86-755-2823 0888
FAX: +86-755-2823 0886

Prepared by:	Kieron Luo Project Engineer	Reviewed by:	Eric Yu Project Supervisor
Approved by:	Kevin Liang Assistant Manager	Date:	May 27, 2022

Version

Version No.	Date	Description
V1.0	May 27, 2022	Original

CONTENTS

1. GENERAL INFORMATION 4
   1.1 CLIENT INFORMATION 4
   1.2 EUT INFORMATION 4
      1.2.1 GENERAL DESCRIPTION OF EUT 4
      1.2.2 DESCRIPTION OF ACCESSORIES 4
   1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD 5
   1.4 OTHER INFORMATION 5
   1.5 DESCRIPTION OF SUPPORT UNITS 5
   1.6 TEST LOCATION 5
   1.7 TEST FACILITY 6
   1.8 DEVIATION FROM STANDARDS 6
   1.9 ABNORMALITIES FROM STANDARD CONDITIONS 6
   1.10 OTHER INFORMATION REQUESTED BY THE CUSTOMER 6
   1.11 MEASUREMENT UNCERTAINTY 7
2. TEST SUMMARY 8
3. EQUIPMENT LIST 9
4. TEST CONFIGURATION 10
   4.1 ENVIRONMENTAL CONDITIONS FOR TESTING 10
      4.1.1 NORMAL OR EXTREME TEST CONDITIONS 10
      4.1.2 RECORD OF NORMAL ENVIRONMENT 10
   4.2 TEST CHANNELS 10
   4.3 EUT TEST STATUS 10
   4.4 PRE-SCAN 11
   4.5 TEST SETUP 11
      4.5.1 FOR RADIATED EMISSIONS TEST SETUP 11
      4.5.2 FOR CONDUCTED EMISSIONS TEST SETUP 13
      4.5.3 FOR CONDUCTED RF TEST SETUP 13
   4.6 SYSTEM TEST CONFIGURATION 14
   4.7 DUTY CYCLE 15
5. RADIO TECHNICAL REQUIREMENTS SPECIFICATION 16
   5.1 REFERENCE DOCUMENTS FOR TESTING 16
   5.2 ANTENNA REQUIREMENT 16
   5.3 CONDUCTED PEAK OUTPUT POWER 17
   5.4 6 DB BANDWIDTH & OCCUPIED BANDWIDTH 18
   5.5 POWER SPECTRAL DENSITY 20
   5.6 CONDUCTED OUT OF BAND EMISSION 22
   5.7 RADIATED SPURIOUS EMISSIONS 25
   5.8 BAND EDGE MEASUREMENTS (RADIATED) 32

APPENDIX 1 PHOTOS OF TEST SETUP 37
APPENDIX 2 PHOTOS OF EUT CONSTRUCTIONAL DETAILS 37

1. GENERAL INFORMATION

1.1 CLIENT INFORMATION

Applicant:	MMD Hong Kong Holding Limited
Address of Applicant:	Unit 1006, 10th Floor, C-Bons International Center, 108 Wai Yip Street, Kwun Tong, Kowloon, Hong Kong
Manufacturer:	MMD Hong Kong Holding Limited
Address of Manufacturer:	Unit 1006, 10th Floor, C-Bons International Center, 108 Wai Yip Street, Kwun Tong, Kowloon, Hong Kong

1.2 EUT INFORMATION

1.2.1 General Description of EUT

Product Name:	True wireless headphones with Noise Canceling	
Model No. / HVIN:	TAT4507JH	
Add. Model No.:	TAT4507, TAT4507JHxx/yy, TAT4507xx/yy (xx=AA-ZZ or blank denoted different color; yy=00-99 denoted different country destination)	
Trade Mark:	PHILIPS or PHILIPS	
DUT Stage:	Production Unit	
EUT Supports Function: (Provided by the customer)	2.4 GHz ISM Band:	Bluetooth 5.2
Software Version:	V1.2 (Provided by the customer)	
Hardware Version:	V0.26 (Provided by the customer)	
Sample Received Date:	March 25, 2022	
Sample Tested Date:	April 20, 2022 to April 26, 2022	
Note: The additional model TAT4507, TAT4507JHxx/yy, TAT4507xx/yy (xx=AA-ZZ or blank denoted different color; yy=00-99 denoted different country destination) is identical with the test model TAT4507JH except the model number for marketing purpose.		

1.2.2 Description of Accessories

Cable	
Description:	USB Type-C Plug Cable
Cable Type:	Unshielded without ferrite
Length:	0.55 Meter

Battery (Charging case)	
Model No.:	952125
Battery Type:	Lithium-ion Rechargeable Battery
Rated Voltage:	3.7 Vdc
Limited Charge Voltage:	4.25 Vdc
Rated Capacity:	450 mAh

Battery (Earbuds)	
Model No.:	1144
Battery Type:	Lithium-ion Rechargeable Battery
Rated Voltage:	3.7 Vdc
Limited Charge Voltage:	4.25 Vdc
Rated Capacity:	40 mAh

1.3 PRODUCT SPECIFICATION SUBJECTIVE TO THIS STANDARD

Frequency Band:	2400 MHz to 2483.5 MHz		
Frequency Range:	2402 MHz to 2480 MHz		
Bluetooth Version:	Bluetooth LE		
Type of Modulation:	GFSK		
Number of Channels:	40		
Channel Separation:	2 MHz		
Antenna Type:	FPCB Antenna		
Antenna Gain: (Provided by the customer)	2.43 dBi (Left Earbuds)		
	2.49 dBi (Right Earbuds)		
Maximum Peak Power:	Left Earbuds	LE	6.78 dBm
	Right Earbuds	LE	4.03 dBm
Normal Test Voltage:	3.7 Vdc		

1.4 OTHER INFORMATION

Operation Frequency Each of Channel
f = 2402 + 2k MHz, k = 0,…,39
Note: **f** is the operating frequency (MHz); **k** is the operating channel.

1.5 DESCRIPTION OF SUPPORT UNITS

The EUT has been tested with associated equipment below.

1) Support Equipment

Description	Manufacturer	Model No.	Serial Number	Supplied by
Notebook	DELL	Latitude 3400	16238087894	UnionTrust
Mouse	DELL	MS111	CN-011D3V-738	UnionTrust

2) Support Cable

Cable No.	Description	Connector	Length	Supplied by
1	Antenna Cable	SMA	0.10 Meter	UnionTrust
2	serial port	USB	0.20 Meter	UnionTrust

1.6 TEST LOCATION

Shenzhen UnionTrust Quality and Technology Co., Ltd.

Address: Unit D/E of 9/F and 16/F, Block A, Building 6, Baoneng science and technology park, Longhua district, Shenzhen, China
Telephone: +86 (0) 755 2823 0888
Fax: +86 (0) 755 2823 0886

1.7 TEST FACILITY

The test facility is recognized, certified, or accredited by the following organizations:

CNAS-Lab Code: L9069
The measuring equipment utilized to perform the tests documented in this report has been calibrated once a year or in accordance with the manufacturer's recommendations, and is traceable under the ISO/IEC 17025 to international or national standards. Equipment has been calibrated by accredited calibration laboratories.

A2LA-Lab Certificate No.: 4312.01
Shenzhen UnionTrust Quality and Technology Co., Ltd. has been accredited by A2LA for technical competence in the field of electrical testing, and proved to be in compliance with ISO/IEC 17025 General Requirements for the Competence of Testing and Calibration Laboratories and any additional program requirements in the identified field of testing.

ISED Wireless Device Testing Laboratories
CAB identifier: CN0032

FCC Accredited Lab.
Designation Number: CN1194
Test Firm Registration Number: 259480

1.8 DEVIATION FROM STANDARDS

None.

1.9 ABNORMALITIES FROM STANDARD CONDITIONS

None.

1.10 OTHER INFORMATION REQUESTED BY THE CUSTOMER

None.

1.11 MEASUREMENT UNCERTAINTY

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the Product as specified in CISPR 16-4-2. This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

No.	Item	Measurement Uncertainty
1	Conducted emission 9KHz-150KHz	±3.2 dB
2	Conducted emission 150KHz-30MHz	±2.7 dB
3	Radiated emission 9KHz-30MHz	± 4.7 dB
4	Radiated emission 30MHz-1GHz	± 4.6 dB
5	Radiated emission 1GHz-18GHz	± 4.4 dB
6	Radiated emission 18GHz-26GHz	± 4.6 dB
7	Radiated emission 26GHz-40GHz	± 4.6 dB
8	RF Power, Conducted	± 0.69 dB
9	Transmission Time	± 0.19 %
10	Occupied Bandwidth	± 1.86 %
11	Power Spectral Density, conducted	± 0.6 dB
12	Radio Frequency	± 6.5 x 10-8
13	Conducted out of band emission	± 2.7 dB

2. TEST SUMMARY

Test Cases			
Test Item	**Test Requirement**	**Test Method**	**Result**
Antenna Requirement	FCC 47 CFR Part 15 Subpart C Section 15.203/15.247 (c) RSS-Gen Issue 5, Section 6.8	N/A	PASS
AC Power Line Conducted Emission	FCC 47 CFR Part 15 Subpart C Section 15.207 RSS-Gen Issue 5, Section 8.8	ANSI C63.10-2013 Clause 6.2	N/A NOTE 2
Conducted Peak Output Power	FCC 47 CFR Part 15 Subpart C Section 15.247 (b)(3) RSS-247 Issue 2, Section 5.4(d)	ANSI C63.10-2013 Clause 11.9.1.3	PASS
6dB Bandwidth	FCC 47 CFR Part 15 Subpart C Section 15.247 (a)(2) RSS-247 Issue 2, Section 5.2(a)	ANSI C63.10-2013 Clause 11.8.1	PASS
Occupied Bandwidth	RSS-Gen Issue 5, Section 6.7	RSS-Gen Issue 5, Section 6.7	PASS
Power Spectral Density	FCC 47 CFR Part 15 Subpart C Section 15.247 (e) RSS-247 Issue 2, Section 5.2(b)	ANSI C63.10-2013 Clause 11.10.2	PASS
Conducted Out of Band Emission	FCC 47 CFR Part 15 Subpart C Section 15.247(d) RSS-247 Issue 2, Section 5.5	ANSI C63.10-2013 Clause 11.11	PASS
Radiated Spurious Emissions	FCC 47 CFR Part 15 Subpart C Section 15.205/15.209 RSS-Gen Issue 5, Section 6.13/8.9/8.10	ANSI C63.10-2013 Clause 11.11 & Clause 11.12	PASS
Band Edge Measurements (Radiated)	FCC 47 CFR Part 15 Subpart C Section 15.205/15.209 RSS-247 Issue 2, Section 5.5	ANSI C63.10-2013 Clause 11.13	PASS

Note:

1) N/A: In this whole report not applicable.
2) This EUT is charged by AC adapter to the battery, when charging, it doesn't transmitting while charging.

3. EQUIPMENT LIST

Radiated Emission Test Equipment List						
Used	**Equipment**	**Manufacturer**	**Model No.**	**Serial Number**	**Cal. date (mm dd, yyyy)**	**Cal. Due date (mm dd, yyyy)**
☒	3m SAC	ETS-Lindgren	3m	Euroshiedpn-CT001270-1317	Jan. 22, 2021	Jan. 21, 2024
☒	Loop Antenna	ETS-Lindgren	6502	00202525	Nov. 11, 2021	Nov. 10, 2022
☒	Receiver	ROHDE & SCHWARZ	ESIB26	100114	Nov. 5, 2021	Nov. 4, 2022
☒	Broadband Antenna (Pre-amplifier)	ETS-Lindgren	3142E	00201566	Apr. 30, 2021	Apr. 29, 2023
☒	Pre-amplifier	HP	8447F	2805A02960	Nov. 5, 2021	Nov. 4, 2022
☒	6dB Attenuator	Talent	RA6A5-N-18	18103001	Nov. 11, 2021	Nov. 10, 2023
☒	Double-Ridged Waveguide Horn Antenna (Pre-amplifier)	ETS-Lindgren	3117-PA	00201541	Apr. 30, 2021	Apr. 29, 2023
☒	Pre-amplifier	ETS-Lindgren	00118385	00201874	Nov. 6, 2021	Nov. 5, 2022
☐	Double-Ridged Waveguide Horn Antenna (Pre-amplifier)	ETS-Lindgren	3116C-PA	00202652	Nov. 14, 2020	Nov. 13, 2022
☐	Pre-amplifier	ETS-Lindgren	00118384	202652	Nov. 14, 2020	Nov. 13, 2022
☒	Multi device Controller	ETS-LINDGREN	7006-001	00160105	N/A	N/A
☒	Test Software	Audix	e3	Software Version: 9.160323		

Conducted RF test Equipment List						
Used	**Equipment**	**Manufacturer**	**Model No.**	**Serial Number**	**Cal. date (mm dd, yyyy)**	**Cal. Due date (mm dd, yyyy)**
☒	EXA Spectrum Analyzer	KEYSIGHT	N9010A	MY51440197	Nov. 5, 2021	Nov. 4, 2022
☒	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430035	Nov. 5, 2021	Nov. 4, 2022
☒	USB Wideband Power Sensor	KEYSIGHT	U2021XA	MY55430023	Nov. 5, 2021	Nov. 4, 2022
☒	MXG X-Series RF Vector Signal Generator	KEYSIGHT	N5182B	MY51350267	Nov. 5, 2021	Nov. 4, 2022
☒	Wideband Radio Communication Tester	R&S	CMW500	120932	Apr. 22, 2021	Apr. 21, 2022
☒	Test Software	AutomationTestSystem	ECIT	Software Version: 1.0.7515.16529		

4. TEST CONFIGURATION

4.1 ENVIRONMENTAL CONDITIONS FOR TESTING

4.1.1 Normal or Extreme Test Conditions

Environment Parameter	Selected Values During Tests		
Test Condition	Ambient		
	Temperature (°C)	Voltage (V)	Relative Humidity (%)
NT/NV	+15 to +35	3.7	20 to 75
Remark: 1) NV: Normal Voltage; NT: Normal Temperature			

4.1.2 Record of Normal Environment

Test Item	Temperature (°C)	Relative Humidity (%)	Pressure (kPa)	Sample No.	Tested by
AC Power Line Conducted Emission	N/A	N/A	N/A	N/A	N/A
Conducted Peak Output Power	25.0	41.0	101.8	220325008-A01/14	Evan Ouyang
6dB Bandwidth & Occupied Bandwidth	25.0	41.0	101.8	220325008-A01/14	Evan Ouyang
Power Spectral Density	25.0	41.0	101.8	220325008-A01/14	Evan Ouyang
Conducted Out of Band Emission	25.0	41.0	101.8	220325008-A01/14	Evan Ouyang
Radiated Spurious Emissions	24.1	51.0	100.2	220325008-A03/14	Fire Huo
Band Edge Measurements (Radiated)	24.1	51.0	100.2	220325008-A03/14	Fire Huo

4.2 TEST CHANNELS

Type of Modulation	Tx/Rx Frequency	Test RF Channel Lists		
		Lowest(L)	Middle(M)	Highest(H)
GFSK	2402 MHz to 2480 MHz	Channel 0	Channel 19	Channel 39
		2402 MHz	2440 MHz	2480 MHz

4.3 EUT TEST STATUS

Type of Modulation	Tx Function	Description
GFSK	1Tx	1. Keep the EUT in continuously transmitting with modulation test single.

Power Setting
Power Setting: not applicable, test used software default power level.

Test Software
Test software name: Non Signaling test tool (20210115)

4.4 PRE-SCAN

Left Earbuds

Type of Modulation	GFSK Conducted Average Power (dBm)		
Channel	Channel 0	Channel 19	Channel 39
Power (dBm)	4.23	4.51	4.65

Right Earbuds

Type of Modulation	GFSK Conducted Average Power (dBm)		
Channel	Channel 0	Channel 19	Channel 39
Power (dBm)	1.58	1.73	1.75

4.5 TEST SETUP

4.5.1 For Radiated Emissions test setup

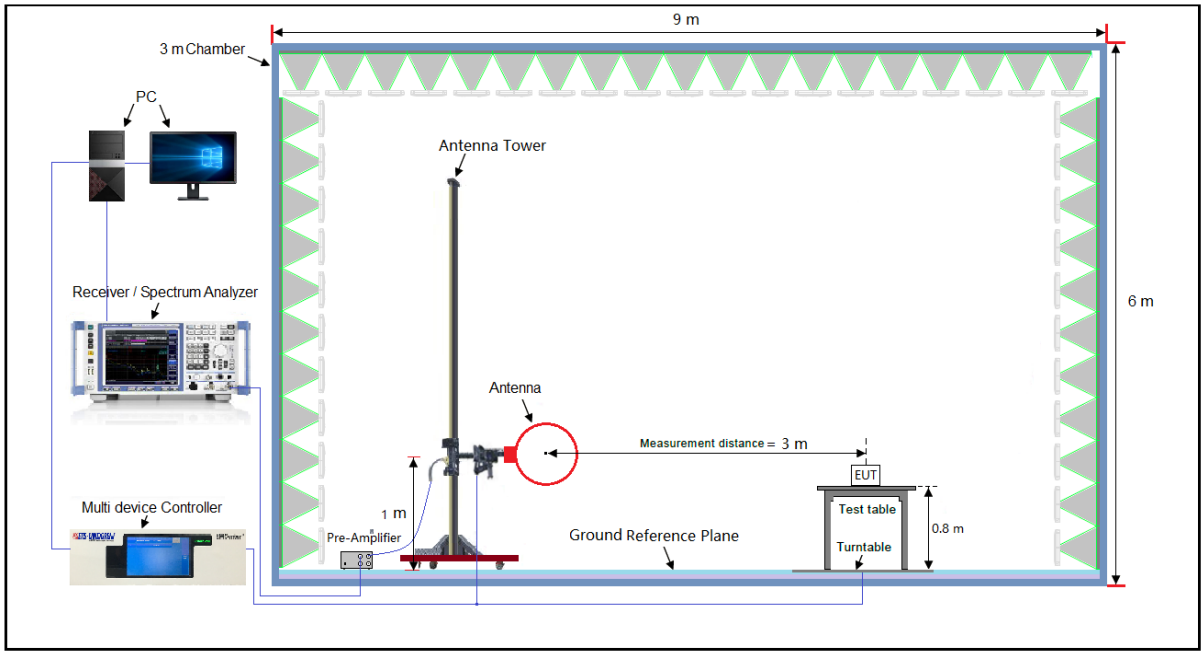


Figure 1. Below 30MHz

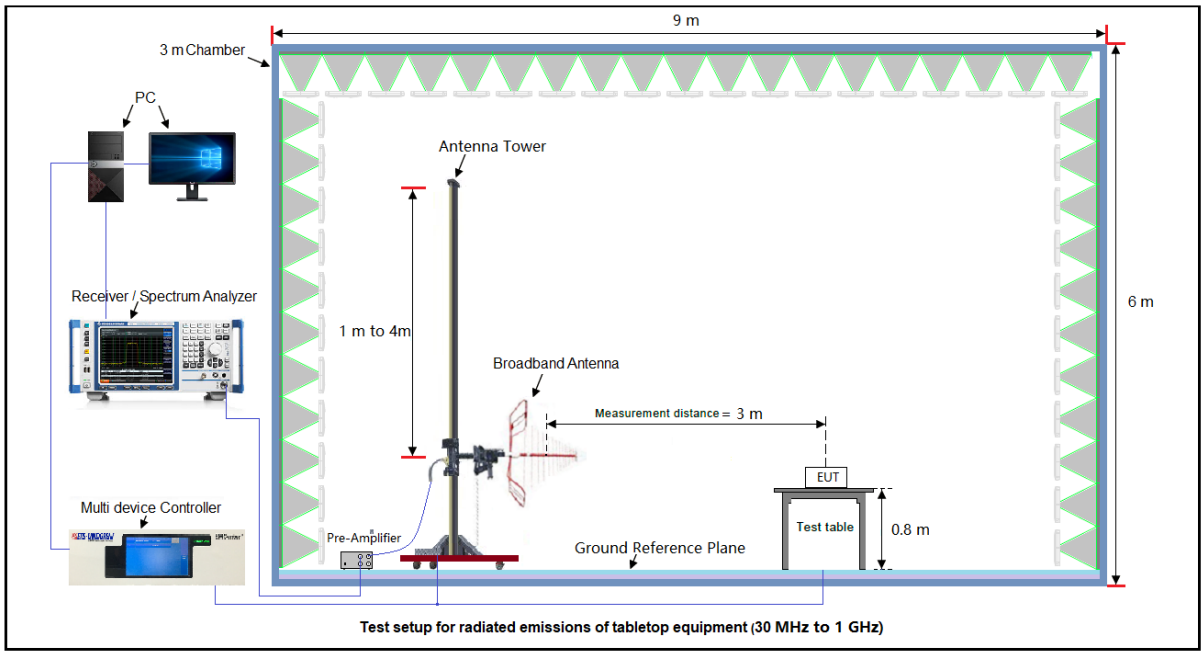


Figure 2. 30MHz to 1GHz

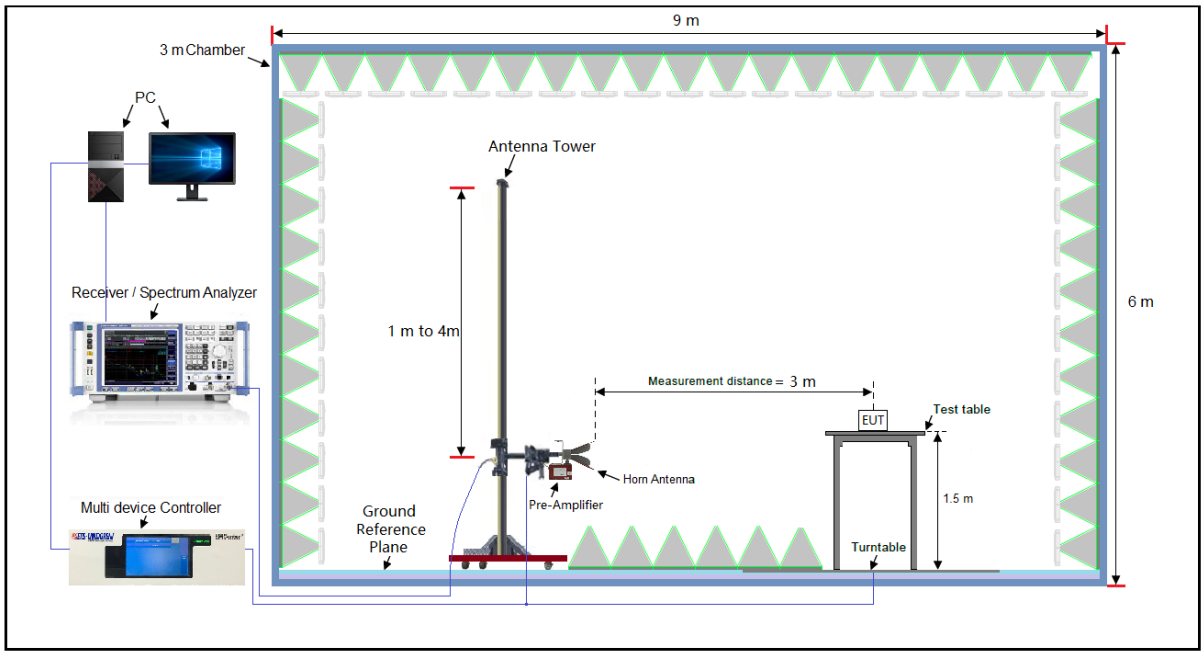
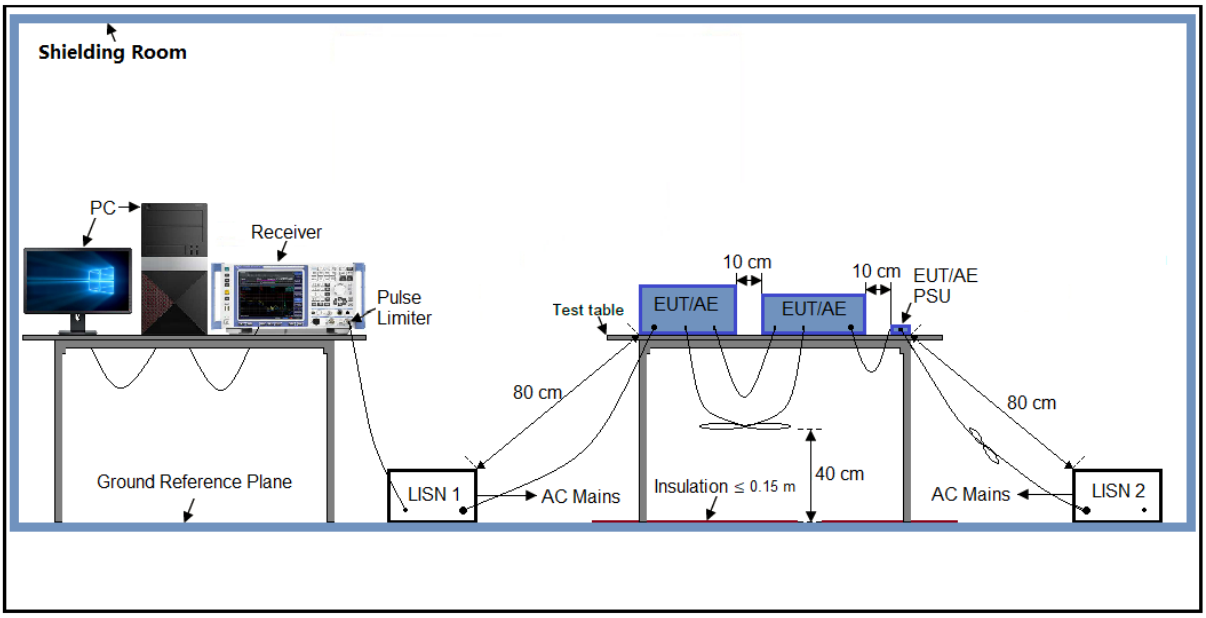
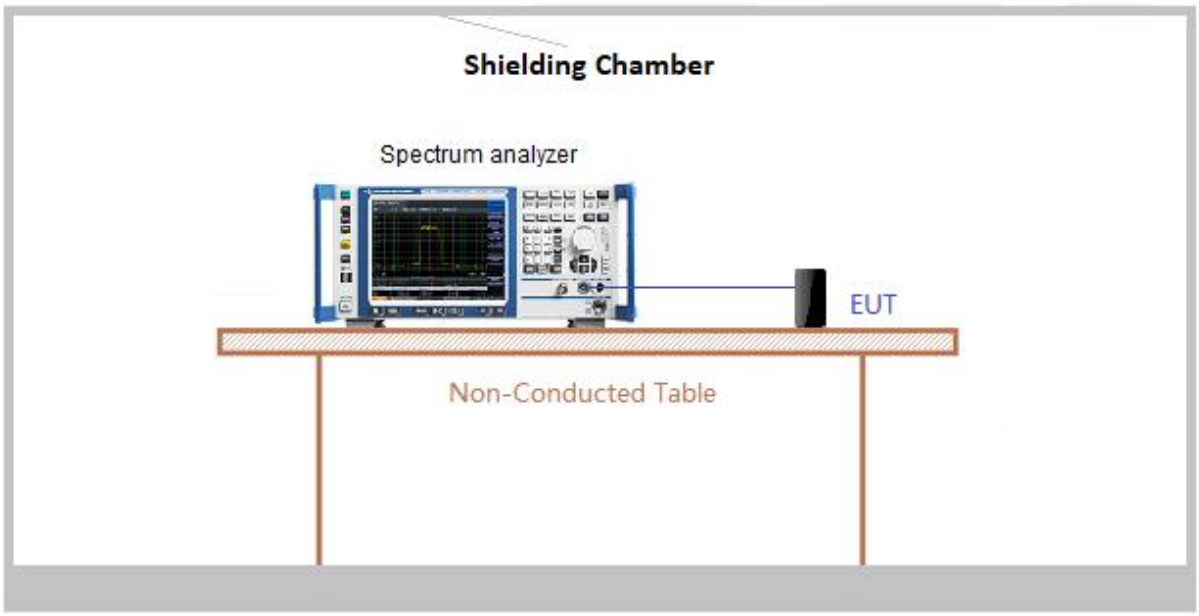


Figure 3. Above 1GHz

4.5.2 For Conducted Emissions test setup



4.5.3 For Conducted RF test setup



4.6 SYSTEM TEST CONFIGURATION

For emissions testing, the equipment under test (EUT) setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing. During testing, radiated emission were performed with the EUT set to transmit at the channel with highest output power as worst-case scenario. It was powered by a 3.7V battery. Only the worst case data were recorded in this test report.

The signal is maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters. Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance. Therefore, all final radiated testing was performed with the EUT in (see table below) orientation.

Frequency	Mode	Antenna Port	Worst-case axis positioning
Above 1GHz	1TX	Chain 0	Y axis

All readings are extrapolated back to the equivalent three-meter reading using inverse scaling with distance. Analyzer resolution is 100 kHz or greater for frequencies below 1000 MHz. The resolution is 1 MHz or greater for frequencies above 1000 MHz. The spurious emissions more than 20 dB below the permissible value are not reported.

Radiated emission measurement were performed from the lowest radio frequency signal generated in the device which is greater than 9 kHz to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

4.7 DUTY CYCLE

Test Procedure: ANSI C63.10-2013 Clause 11.6.

Test Results

LE

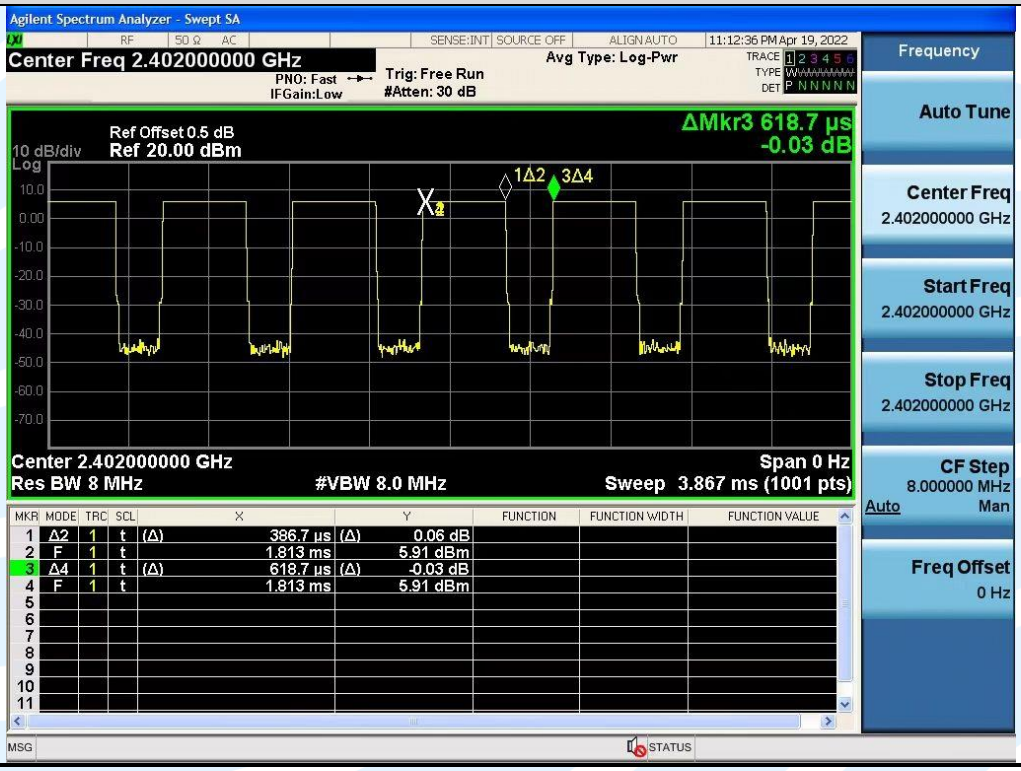
Type of Modulation	On Time (msec)	Period (msec)	Duty Cycle (linear)	Duty Cycle (%)	Duty Cycle Factor (dB)	1/ T Minimum VBW (kHz)	Average Factor (dB)
GFSK	0.3867	0.6187	0.63	62.50	2.04	2.59	-4.08

Remark:

1) Duty cycle= On Time/ Period;
2) Duty Cycle factor = 10 * log(1/ Duty cycle);
3) Average factor = 20 $\log_{10}$ Duty Cycle.

The test plot as follows

GFSK



5. RADIO TECHNICAL REQUIREMENTS SPECIFICATION

5.1 REFERENCE DOCUMENTS FOR TESTING

No.	Identity	Document Title
1	FCC 47 CFR Part 2	Frequency allocations and radio treaty matters; general rules and regulations
2	FCC 47 CFR Part 15	Radio Frequency Devices
3	RSS-247 Issue 2	Digital Transmission Systems (DTSs), Frequency Hopping Systems (FHSs) and Licence-Exempt Local Area Network (LE-LAN) Devices
4	RSS-Gen Issue 5	General Requirements for Compliance of Radio Apparatus
5	ANSI C63.10-2013	American National Standard for Testing Unlicesed Wireless Devices
6	KDB 558074 D01 15.247 Meas Guidance v05r02	Guidance for compliance measurements on Digital Transmission Systems, Frequency Hopping Spread Spectrum system, and Hybrid system devices operating under Section 15.247 of the FCC rules

5.2 ANTENNA REQUIREMENT

Standard Requirement
15.203 requirement: 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. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator, the manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. **15.247(b) (4) requirement:** The conducted output power limit specified in paragraph (b) of this section is based on the use of antennas with directional gains that do not exceed 6 dBi. Except as shown in paragraph (c) of this section, if transmitting antennas of directional gain greater than 6 dBi are used, the conducted output power from the intentional radiator shall be reduced below the stated values in paragraphs (b)(1), (b)(2), and (b)(3) of this section, as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi. **RSS-Gen Issue 5, Section 6.8 requirement:** According to RSS-Gen Issue 5, Section 6.8, a transmitter can only be sold or operated with antennas with which it was certified. A transmitter may be certified with multiple antenna types. An antenna type comprises antennas having similar in-band and out-of-band radiation patterns.
EUT Antenna:
Antenna in the interior of the equipment and no consideration of replacement. The gain of the left Earbuds antenna is 2.43 dBi, right Earbuds antenna is 2.49 dBi.

5.3 CONDUCTED PEAK OUTPUT POWER

Test Requirement: FCC 47 CFR Part 15 Subpart C Section15.247 (b)(3)
RSS-247 Issue 2, Section 5.4(d)

Test Method: ANSI C63.10-2013 Clause 11.9.1.3

Limit: For DTSs employing digital modulation techniques operating in the band 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1W.

Test Procedure:
1. Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the power meter.
2. Measure out each test modes' peak or average output power, record the power level.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.4.3 for details.

Instruments Used: Refer to section 3 for details

Test Results: Pass

Left Earbuds

Type of Modulation	Channel	Frequency (MHz)	Maximum Conducted Peak Power (dBm)	Maximum Conducted Peak Power (mW)
GFSK	0	2402	6.52	4.49
	19	2440	**6.78**	**4.76**
	39	2480	6.74	4.72

Right Earbuds

Type of Modulation	Channel	Frequency (MHz)	Maximum Conducted Peak Power (dBm)	Maximum Conducted Peak Power (mW)
GFSK	0	2402	3.85	2.43
	19	2440	**4.03**	**2.53**
	39	2480	3.99	2.51

Note: The gain of the left Earbuds antenna is 2.43 dBi, right Earbuds antenna is 2.49 dBi less than 6dBi maximum permission antenna gain value based on 1 watt peak output power limit.

5.46 DB BANDWIDTH & OCCUPIED BANDWIDTH

Test Requirement: FCC 47 CFR Part 15 Subpart C Section 15.247 (a)(2)
RSS-247 Issue 2, Section 5.2(a)
RSS-Gen Issue 5, Section 6.7

Test Method: ANSI C63.10-2013 Clause 11.8.1
RSS-Gen Issue 5, Section 6.7

Limit: For digital transmission systems, the minimum 6 dB bandwidth shall be 500 kHz.

Test Procedure: Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
Use the following spectrum analyzer settings:

6dB Bandwidth
a) Set RBW = 100 kHz.
b) Set the video bandwidth (VBW) ≥ 3 x RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.
g) 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.

Occupied Bandwidth
a) Set RBW = 1% to 5% of the occupied bandwidth
b) Set the video bandwidth (VBW) ≥ 3 x RBW.
c) Detector = Peak.
d) Trace mode = max hold.
e) Sweep = auto couple.
f) Allow the trace to stabilize.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

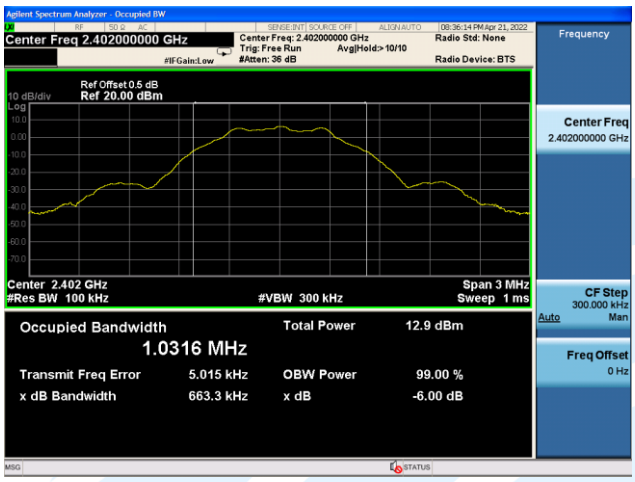
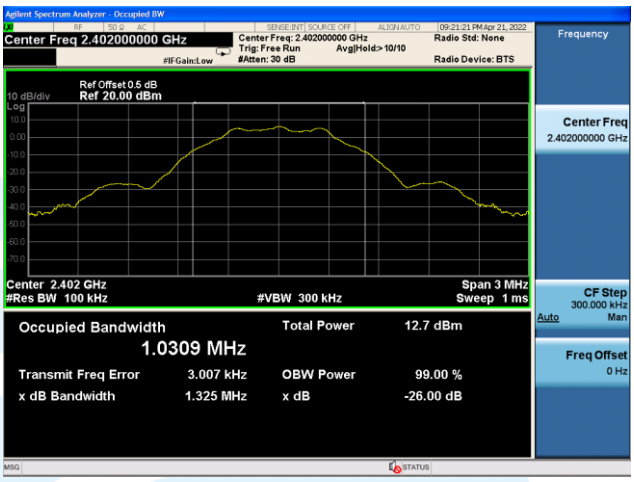
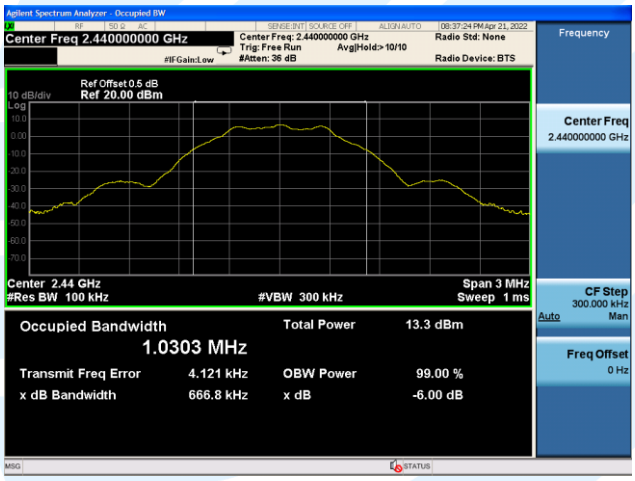
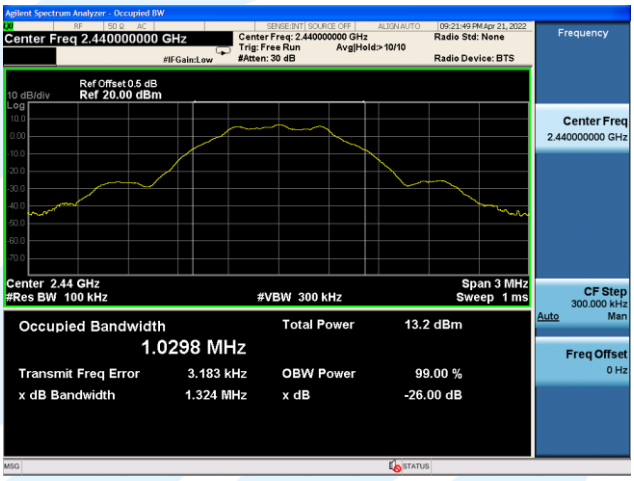
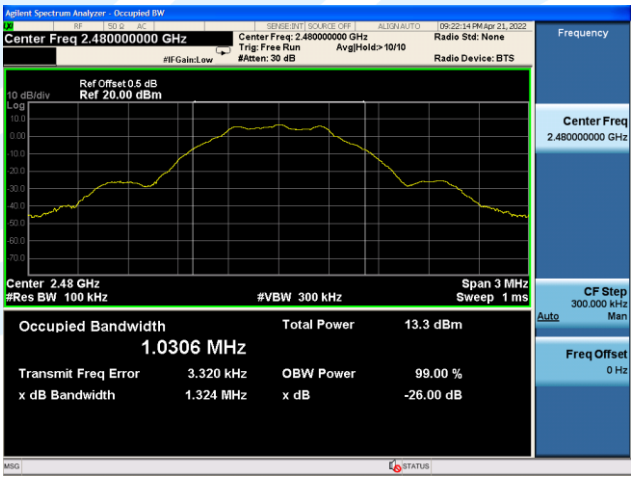
Test Setup: Refer to section 4.4.3 for details.

Instruments Used: Refer to section 3 for details

Test Results:

Type of Modulation	Channel	Frequency (MHz)	6 dB Bandwidth (MHz)	Occupied Bandwidth (MHz)	6 dB Bandwidth Limit	Pass / Fail
GFSK	0	2402	0.6633	1.0309	> 500 kHz	Pass
	19	2440	0.6668	1.0298	> 500 kHz	Pass
	39	2480	0.6631	1.0306	> 500 kHz	Pass

The test plots as follows:

6 dB Bandwidth	Occupied Bandwidth
Lowest Channel	
	
Middle Channel	
	
Highest Channel	
	

5.5 POWER SPECTRAL DENSITY

Test Requirement: FCC 47 CFR Part 15 Subpart C Section 15.247 (e)
RSS-247 Issue 2, Section 5.2(b)

Test Method: ANSI C63.10-2013 Clause 11.10.2

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

Test Procedure: Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer.
Use the following spectrum analyzer settings:

a) Set analyzer center frequency to DTS channel center frequency.
b) Set the span to 1.5 times the DTS bandwidth.
c) Set the RBW to: 3 kHz ≤ RBW ≤ 100 kHz.
d) Set the VBW ⩾ 3 x RBW.
e) Detector = peak.
f) Sweep time = auto couple.
g) Trace mode = max hold.
h) Allow trace to fully stabilize.
i) Use the peak marker function to determine the maximum amplitude level within the RBW.
j) If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.

Test Setup: Refer to section 4.4.3 for details.

Instruments Used: Refer to section 3 for details

Test Results:

Type of Modulation	Channel	Frequency (MHz)	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result (Pass / Fail)
GFSK	0	2402	-9.187	8	Pass
	19	2440	-8.864	8	Pass
	39	2480	-8.742	8	Pass

The test plots as follows:

Lowest Channel	Middle Channel

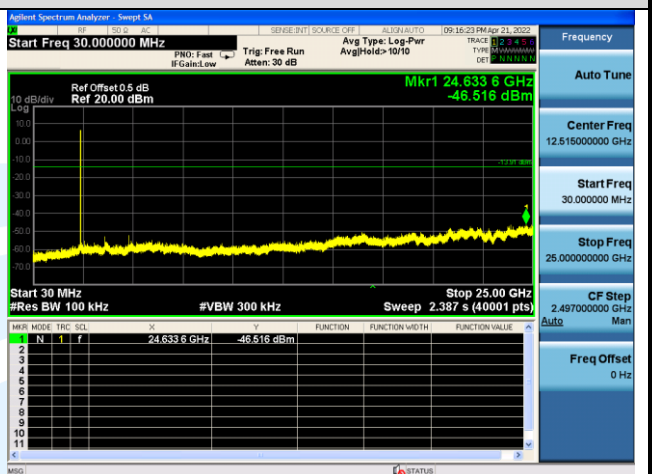
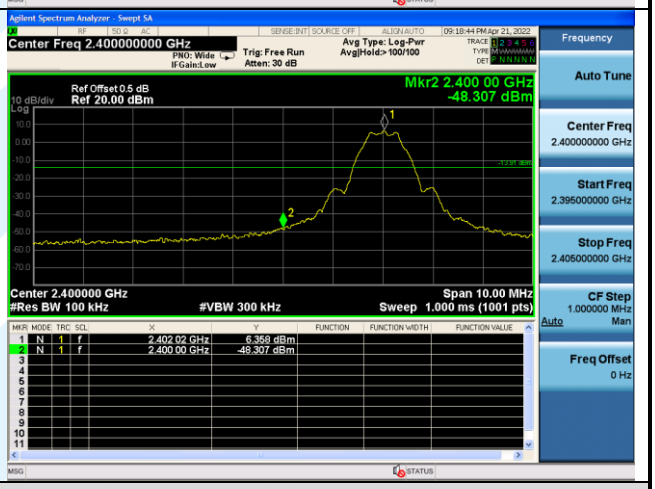
Highest Channel

5.6 CONDUCTED OUT OF BAND EMISSION

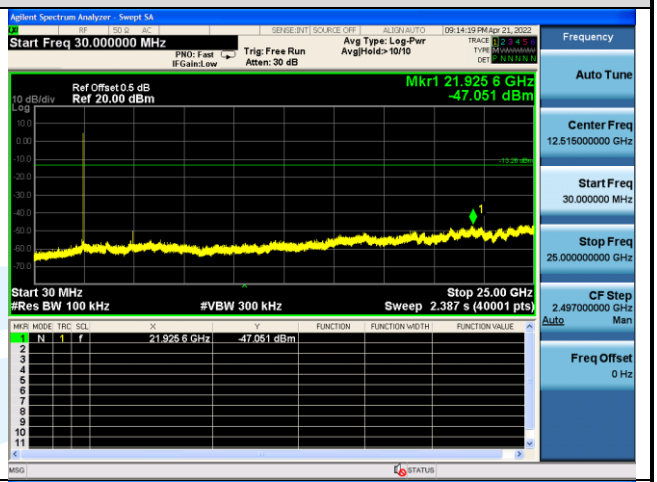
Test Requirement:	FCC 47 CFR Part 15 Subpart C Section 15.247(d) RSS-247 Issue 2, Section 5.5
Test Method:	ANSI C63.10-2013 Clause 11.11
Limit:	In any 100kHz bandwidth outside the frequency bands in which the spread spectrum intentional radiator in operating, the radio frequency power that is produced by the intentional radiator shall be at least 20dB below that in the 100kHz bandwidth within the band that contains the highest level of the desired power.
Test Procedure:	Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to the spectrum analyzer. Use the following spectrum analyzer settings: **Step 1: Reference level measurement** a) Set instrument center frequency to DTS channel center frequency. b) Set the span to ≥ 1.5 times the DTS bandwidth. c) Set the RBW = 100 kHz. d) Set the VBW ≥ 3 x RBW. e) Detector = peak. f) Sweep time = auto couple. g) Trace mode = max hold. h) Allow trace to fully stabilize. i) Use the peak marker function to determine the maximum PSD level. Note that the channel found to contain the maximum PSD level can be used to establish the reference level. **Step 2: Emission level measurement** a) Set RBW = 100 kHz. b) Set VBW ≥ 300 kHz. c) Detector = peak. d) Sweep = auto couple. e) Trace Mode = max hold. f) Allow trace to fully stabilize. g) Use the peak marker function to determine the maximum amplitude level. Note: The cable loss and attenuator loss were offset into measure device as an amplitude offset.
Test Setup:	Refer to section 4.4.3 for details.
Instruments Used:	Refer to section 3 for details
Test Results:	Pass

The test plot as follows:

LE

In-Band Reference Level	Out of Band Emission
Lowest Channel	
	 
Middle Channel	

Highest Channel



5.7 RADIATED SPURIOUS EMISSIONS

Test Requirement: FCC 47 CFR Part 15 Subpart C Section 15.205/15.209
RSS-Gen Issue 5, Section 6.13/8.9/8.10

Test Method: ANSI C63.10-2013 Clause 11.11 & Clause 11.12

Receiver Setup:

Frequency	RBW
0.009 MHz-0.150 MHz	200/300 kHz
0.150 MHz -30 MHz	9/10 kHz
30 MHz-1 GHz	100/120 kHz
Above 1 GHz	1 MHz

Limits:

Spurious Emissions

Frequency	Field strength (microvolt/meter)	Limit (dBμV/m)	Remark	Measurement distance (m)
0.009 MHz-0.490 MHz	2400/F(kHz)	--	--	300
0.490 MHz-1.705 MHz	24000/F(kHz)	--	--	30
1.705 MHz-30 MHz	30	--	--	30
30 MHz-88 MHz	100	40.0	Quasi-peak	3
88 MHz-216 MHz	150	43.5	Quasi-peak	3
216 MHz-960 MHz	200	46.0	Quasi-peak	3
960MHz-1GHz	500	54.0	Quasi-peak	3
Above 1 GHz	500	54.0	Average	3

Remark:

1. The lower limit shall apply at the transition frequencies.
2. Emission level (dBuV/m) = 20 log Emission level (uV/m).
3. For frequencies above 1000 MHz, the field strength limits are based on average detector, however, the peak field strength of any emission shall not exceed the maximum permitted average limits, specified above by more than 20 dB under any condition of modulation.

Test Setup: Refer to section 4.4.1 for details.

Test Procedures:

1. From 30 MHz to 1GHz test procedure as below:

1) The EUT was placed on the top of a rotating table 0.8 meters above the ground at a 3 meter semi-anechoic camber. The table was rotated 360 degrees 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 tower.
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 (for the test frequency of below 30MHz, the antenna was tuned to heights 1 meter) and the rota table table was turned from 0 degrees to 360 degrees to find the maximum reading.
5) The test-receiver system was set to Peak Detect Function and Specified Bandwidth with Maximum Hold Mode.
6) If the emission level of the EUT in peak mode was 10dB lower than the limit specified, then testing could be stopped and the peak values of the EUT would be reported. Otherwise the emissions that did not have 10dB margin would be re-tested one by one using peak, quasi-peak or average method as specified and then reported in a data sheet.

2. Above 1GHz test procedure as below:

1) Different between above is the test site, change from Semi- Anechoic Chamber to fully Anechoic Chamber and change form table 0.8 meter to 1.5 meter(Above 18GHz the distance is 1 meter and table is 1.5 meter).

2) Test the EUT in the lowest channel ,middle channel, the Highest channel
3) The radiation measurements are performed in X, Y, Z axis positioning for Transmitting mode, and found the Y axis positioning which it is worse case.
4) Repeat above procedures until all frequencies measured was complete.

Equipment Used: Refer to section 3 for details.

Test Result: Pass

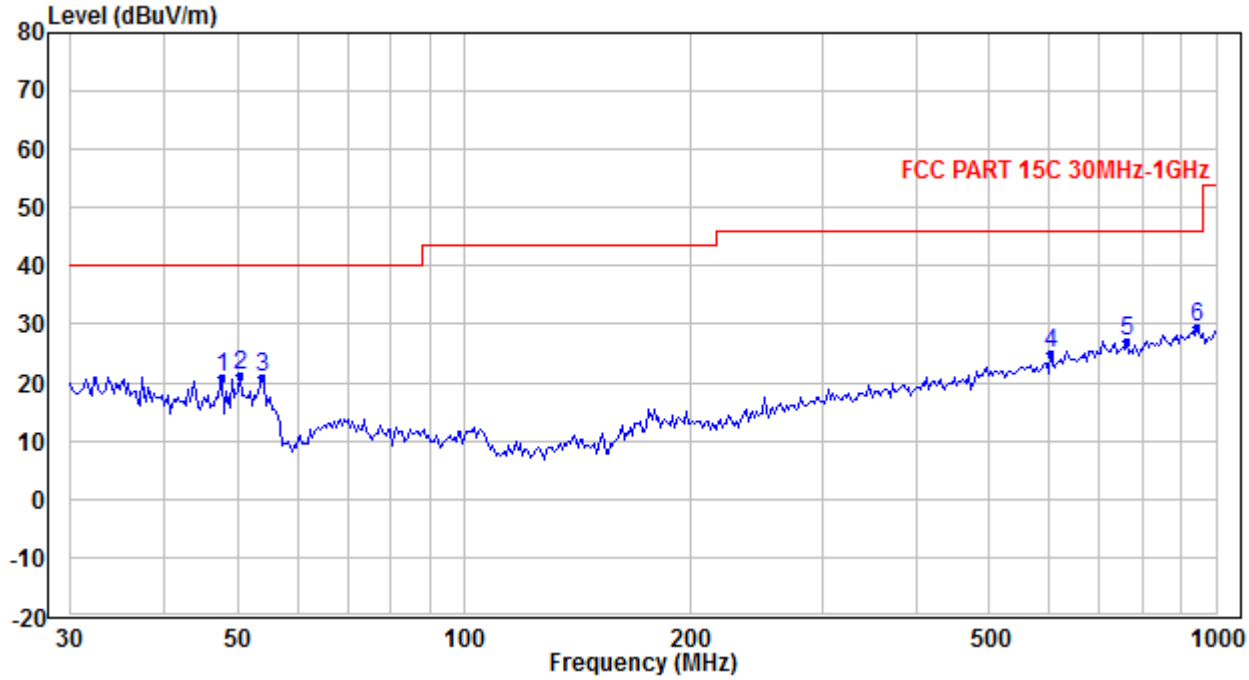
The measurement data as follows:

Radiated Emission Test Data (9 KHz ~ 30 MHz):
The amplitude of spurious emissions attenuated more than 20 dB below the permissible value need not be reported.

Left Earbuds

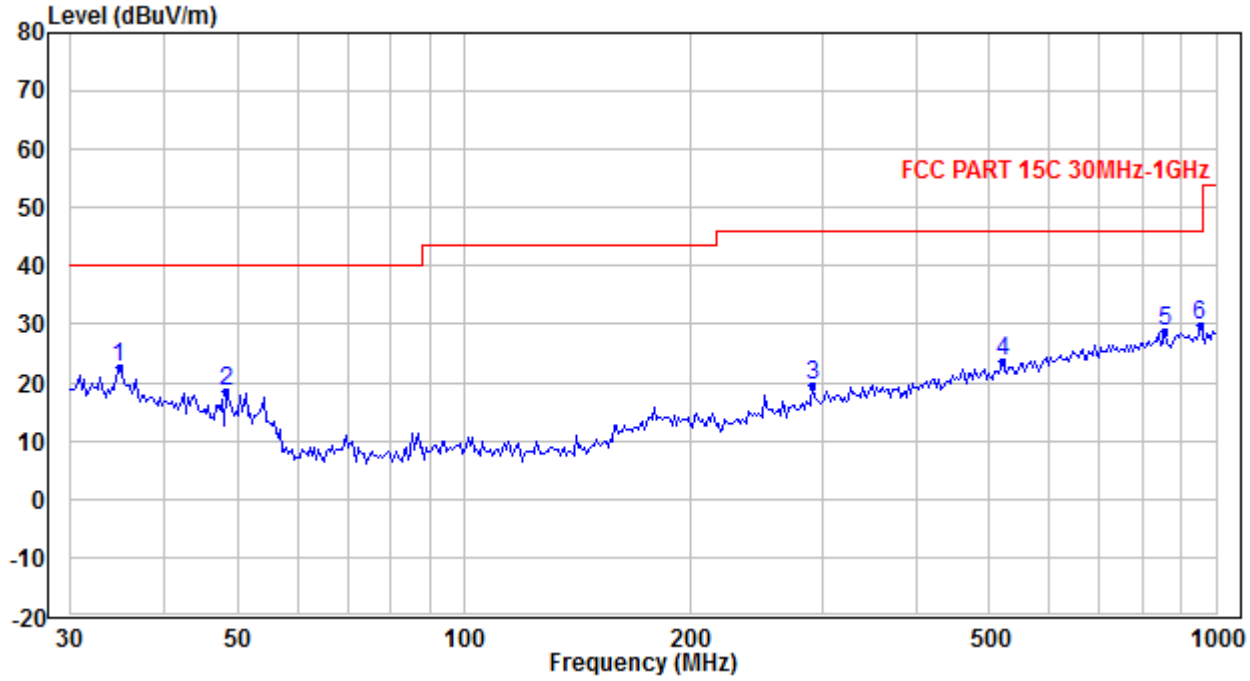
Radiated Emission Test Data (30 MHz ~ 1 GHz):
Worst-Case Configuration

Horizontal



No.	Frequency (MHz)	Reading (dBμV/m)	Correction factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
1	47.703	34.02	-13.04	20.98	40.00	-19.02	QP
2	50.461	35.86	-14.73	21.13	40.00	-18.87	QP
3	53.756	37.58	-16.61	20.97	40.00	-19.03	QP
4	602.929	25.66	-0.72	24.94	46.00	-21.06	QP
5	760.287	25.30	1.94	27.24	46.00	-18.76	QP
6	945.334	24.96	4.61	29.57	46.00	-16.43	QP

Vertical



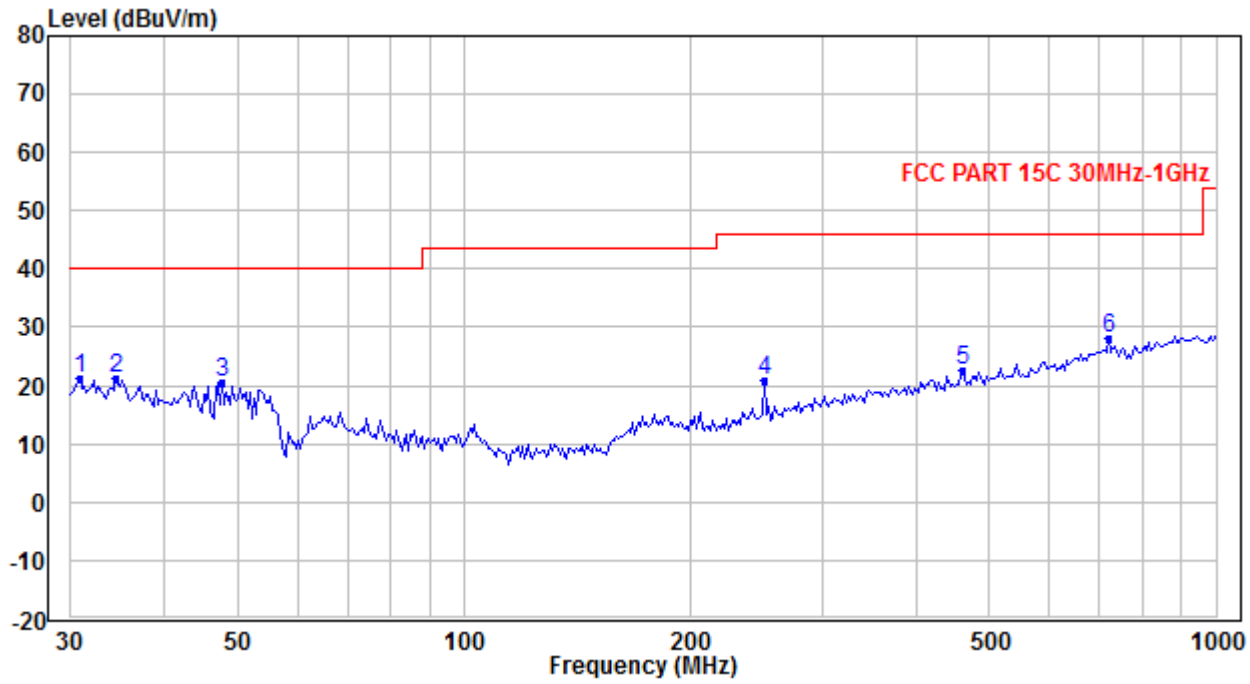
No.	Frequency (MHz)	Reading (dBμV/m)	Correction factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
1	34.770	26.92	-4.43	22.49	40.00	-17.51	QP
2	48.378	31.97	-13.61	18.36	40.00	-21.64	QP
3	290.317	26.16	-6.76	19.40	46.00	-26.60	QP
4	520.208	26.34	-2.53	23.81	46.00	-22.19	QP
5	856.760	25.17	3.53	28.70	46.00	-17.30	QP
6	952.000	25.04	4.66	29.70	46.00	-16.30	QP

Right Earbuds

Radiated Emission Test Data (30 MHz ~ 1 GHz):

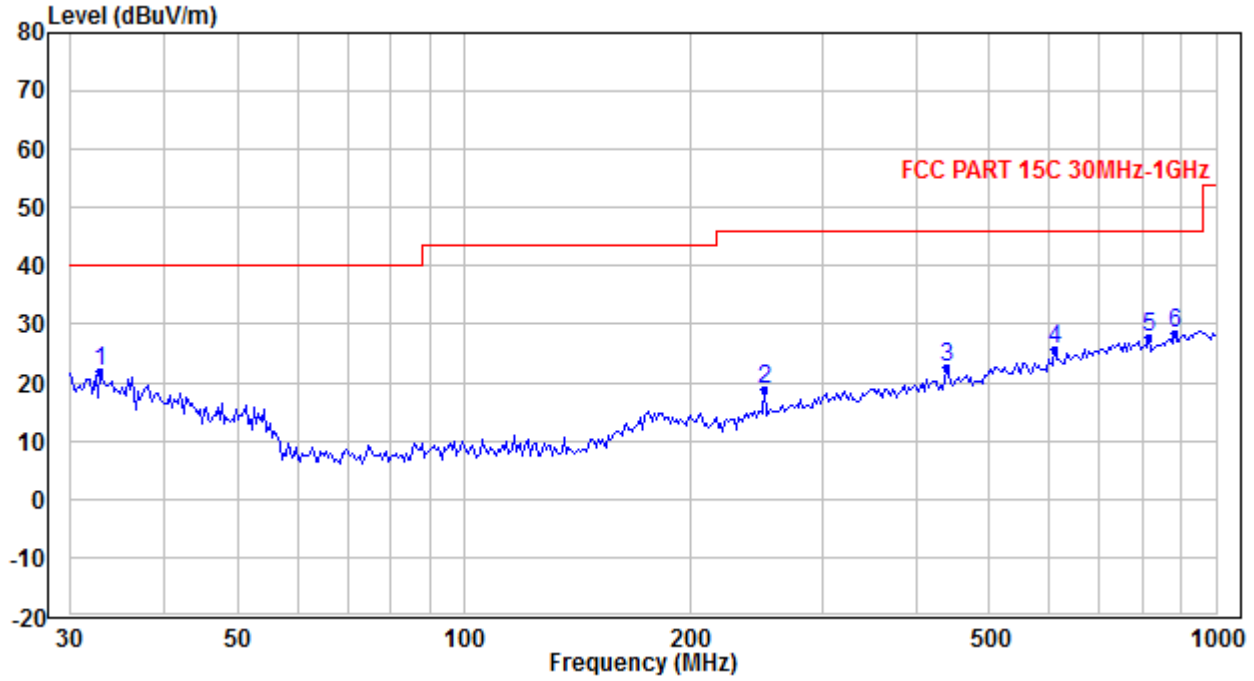
Worst-Case Configuration

Horizontal



No.	Frequency (MHz)	Reading (dBμV/m)	Correction factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
1	30.855	25.85	-4.54	21.31	40.00	-18.69	QP
2	34.527	25.74	-4.60	21.14	40.00	-18.86	QP
3	47.703	33.63	-13.04	20.59	40.00	-19.41	QP
4	250.486	29.67	-8.82	20.85	46.00	-25.15	QP
5	461.631	26.13	-3.62	22.51	46.00	-23.49	QP
6	718.725	26.28	1.74	28.02	46.00	-17.98	QP

Vertical



No.	Frequency (MHz)	Reading (dBμV/m)	Correction factor (dB/m)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector
1	32.870	26.88	-4.81	22.07	40.00	-17.93	QP
2	250.486	27.82	-8.82	19.00	46.00	-27.00	QP
3	439.473	26.93	-4.35	22.58	46.00	-23.42	QP
4	611.462	26.45	-0.60	25.85	46.00	-20.15	QP
5	815.635	25.30	2.58	27.88	46.00	-18.12	QP
6	881.184	24.30	4.00	28.30	46.00	-17.70	QP

Left Earbuds

Radiated Emission Test Data (Above 1GHz):

Lowest Channel:

No.	Frequency (MHz)	Reading (dBμV/m)	Correction factor (dB)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Antenna Polaxis
1	4804.00	39.78	-2.34	37.44	74.00	-36.56	Peak	Horizontal
2	4804.00	28.99	-2.34	26.65	54.00	-27.35	Average	Horizontal
3	7206.00	40.14	1.43	41.57	74.00	-32.43	Peak	Horizontal
4	7206.00	26.69	1.43	28.12	54.00	-25.88	Average	Horizontal
5	4804.00	41.46	-2.34	39.12	74.00	-34.88	Peak	Vertical
6	4804.00	29.26	-2.34	26.92	54.00	-27.08	Average	Vertical
7	7206.00	39.19	1.43	40.62	74.00	-33.38	Peak	Vertical
8	7206.00	27.77	1.43	29.20	54.00	-24.80	Average	Vertical

Middle Channel:

No.	Frequency (MHz)	Reading (dBμV/m)	Correction factor (dB)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Antenna Polaxis
1	4880.00	40.14	-2.30	37.84	74.00	-36.16	Peak	Horizontal
2	4880.00	28.43	-2.30	26.13	54.00	-27.87	Average	Horizontal
3	7320.00	39.14	1.61	40.75	74.00	-33.25	Peak	Horizontal
4	7320.00	28.87	1.61	30.48	54.00	-23.52	Average	Horizontal
5	4880.00	37.59	-2.30	35.29	74.00	-38.71	Peak	Vertical
6	4880.00	28.35	-2.30	26.05	54.00	-27.95	Average	Vertical
7	7320.00	40.68	1.61	42.29	74.00	-31.71	Peak	Vertical
8	7320.00	28.67	1.61	30.28	54.00	-23.72	Average	Vertical

Highest Channel:

No.	Frequency (MHz)	Reading (dBμV/m)	Correction factor (dB)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Antenna Polaxis
1	4960.00	41.02	-2.25	38.77	74.00	-35.23	Peak	Horizontal
2	4960.00	28.49	-2.25	26.24	54.00	-27.76	Average	Horizontal
3	7440.00	38.63	1.81	40.44	74.00	-33.56	Peak	Horizontal
4	7440.00	28.61	1.81	30.42	54.00	-23.58	Average	Horizontal
5	4960.00	39.34	-2.25	37.09	74.00	-36.91	Peak	Vertical
6	4960.00	28.57	-2.25	26.32	54.00	-27.68	Average	Vertical
7	7440.00	39.38	1.81	41.19	74.00	-32.81	Peak	Vertical
8	7440.00	28.67	1.81	30.48	54.00	-23.52	Average	Vertical

Right Earbuds

Radiated Emission Test Data (Above 1GHz):

Lowest Channel:

No.	Frequency (MHz)	Reading (dBμV/m)	Correction factor (dB)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Antenna Polaxis
1	4804.00	41.21	-2.34	38.87	74.00	-35.13	Peak	Horizontal
2	4804.00	28.34	-2.34	26.00	54.00	-28.00	Average	Horizontal
3	7206.00	40.10	1.43	41.53	74.00	-32.47	Peak	Horizontal
4	7206.00	28.02	1.43	29.45	54.00	-24.55	Average	Horizontal
5	4804.00	39.91	-2.34	37.57	74.00	-36.43	Peak	Vertical
6	4804.00	29.26	-2.34	26.92	54.00	-27.08	Average	Vertical
7	7206.00	39.32	1.43	40.75	74.00	-33.25	Peak	Vertical
8	7206.00	27.02	1.43	28.45	54.00	-25.55	Average	Vertical

Middle Channel:

No.	Frequency (MHz)	Reading (dBμV/m)	Correction factor (dB)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Antenna Polaxis
1	4880.00	39.70	-2.30	37.40	74.00	-36.60	Peak	Horizontal
2	4880.00	28.51	-2.30	26.21	54.00	-27.79	Average	Horizontal
3	7320.00	38.57	1.61	40.18	74.00	-33.82	Peak	Horizontal
4	7320.00	28.87	1.61	30.48	54.00	-23.52	Average	Horizontal
5	4880.00	39.76	-2.30	37.46	74.00	-36.54	Peak	Vertical
6	4880.00	25.59	-2.30	23.29	54.00	-30.71	Average	Vertical
7	7320.00	41.42	1.61	43.03	74.00	-30.97	Peak	Vertical
8	7320.00	28.93	1.61	30.54	54.00	-23.46	Average	Vertical

Highest Channel:

No.	Frequency (MHz)	Reading (dBμV/m)	Correction factor (dB)	Result (dBμV/m)	Limit (dBμV/m)	Margin (dB)	Detector	Antenna Polaxis
1	4960.00	39.64	-2.25	37.39	74.00	-36.61	Peak	Horizontal
2	4960.00	28.72	-2.25	26.47	54.00	-27.53	Average	Horizontal
3	7440.00	38.76	1.81	40.57	74.00	-33.43	Peak	Horizontal
4	7440.00	28.94	1.81	30.75	54.00	-23.25	Average	Horizontal
5	4960.00	40.70	-2.25	38.45	74.00	-35.55	Peak	Vertical
6	4960.00	28.64	-2.25	26.39	54.00	-27.61	Average	Vertical
7	7440.00	39.67	1.81	41.48	74.00	-32.52	Peak	Vertical
8	7440.00	28.67	1.81	30.48	54.00	-23.52	Average	Vertical

Remark:

1. Correct Factor = Antenna Factor + Cable Loss - Amplifier Gain, the value was added to Original Receiver Reading by the software automatically.
2. Result = Reading + Correct Factor.
3. Margin = Result – Limit

5.8 BAND EDGE MEASUREMENTS (RADIATED)

Test Requirement: FCC 47 CFR Part 15 Subpart C Section 15.205/15.209
RSS-247 Issue 2, Section 5.5

Test Method: ANSI C63.10-2013 Clause 11.13

Limits:

Radiated emissions which fall in the restricted bands, as defined in section 15.205(a), must also comply with the radiated emission limits specified in section 15.209(a).

Frequency	Limit (dBμV/m @3m)	Remark
30 MHz-88 MHz	40.0	Quasi-peak Value
88 MHz-216 MHz	43.5	Quasi-peak Value
216 MHz-960 MHz	46.0	Quasi-peak Value
960 MHz-1 GHz	54.0	Quasi-peak Value
Above 1 GHz	54.0	Average Value
	74.0	Peak Value

Test Setup: Refer to section 4.4.1 for details.

Test Procedures:

Radiated band edge measurements at 2390 MHz and 2483.5 MHz were made with the unit transmitting in the low end of the channel range and the high end closest to the restricted bands respectively. The emissions were made on the 966 Semi-Chamber. Use (resolution bandwidth (RBW) = 1 MHz, video bandwidth (VBW) = 3 MHz for peak levels and RBW = 1 MHz and VBW = 10 Hz or 1/T for average levels).

1. Use radiated spurious emission test procedure described in clause 5.10. The transmitter output (antenna port) was connected to the test receiver.
2. Set the PK and AV limit line.
3. Record the fundamental emission and emissions out of the band-edge.
4. Determine band-edge compliance as required.

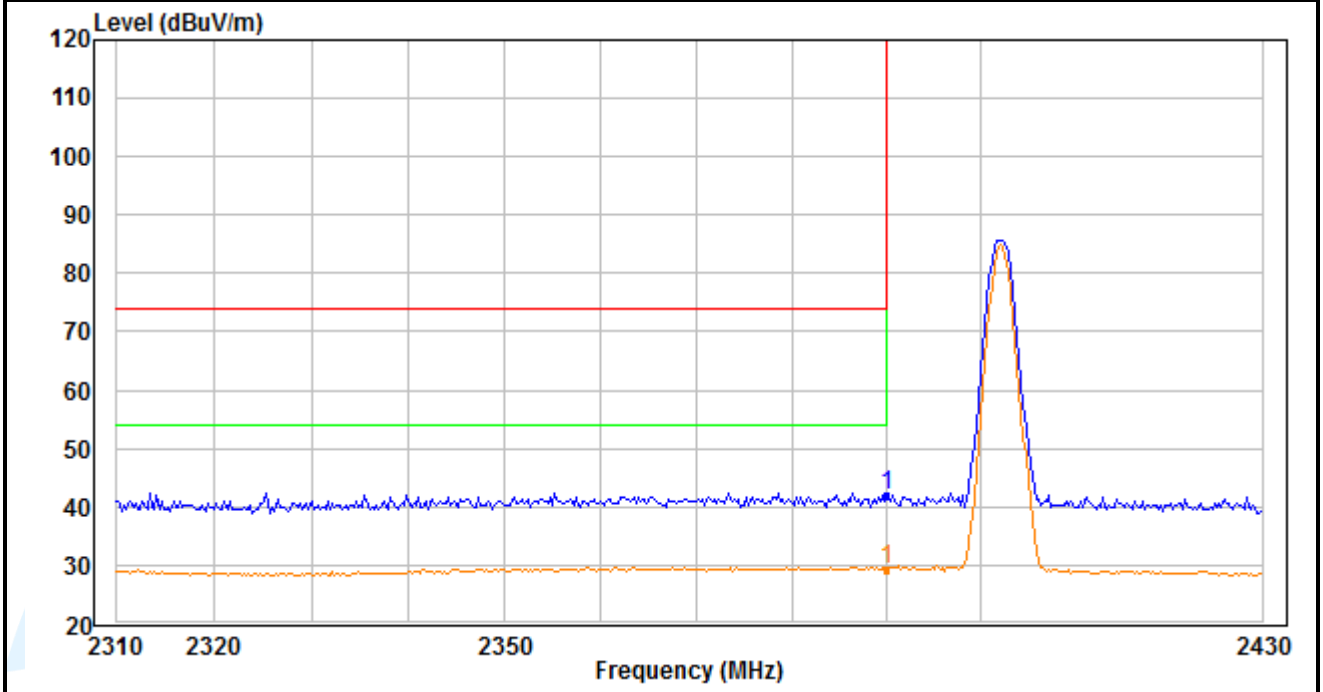
Equipment Used: Refer to section 3 for details.

Test Result: Pass

The measurement data as follows:

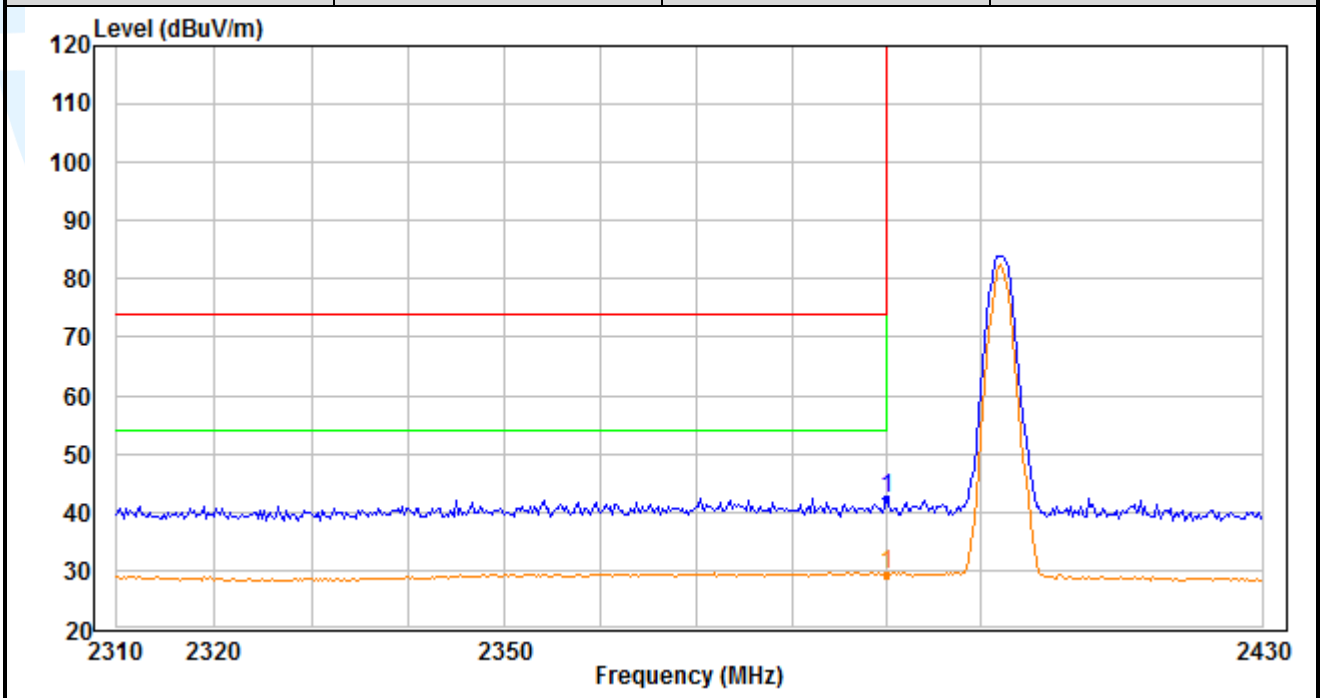
Left Earbuds

Test Channel:	Lowest Channel	Ant. Polar. :	Horizontal



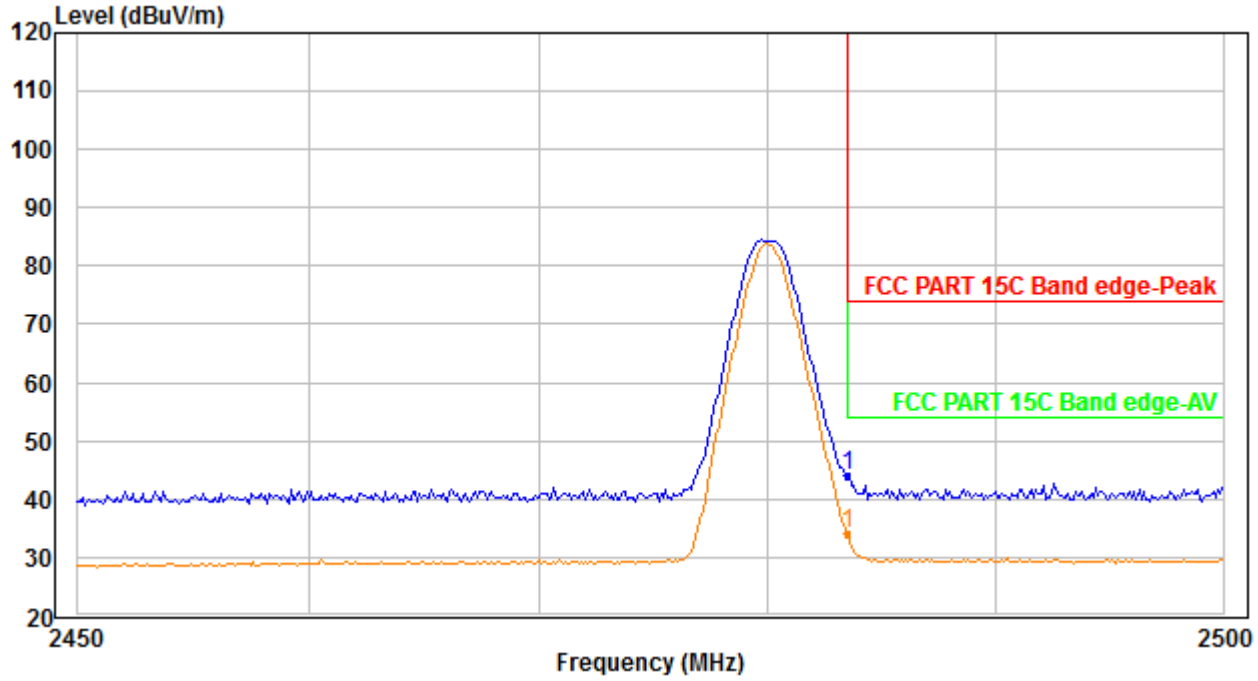
Frequency (MHz)	Peak level (dBμV/m)	Peak Limit (dBμV/m)	AV level (dBμV/m)	AV Limit (dBμV/m)	Conclusion
2390.0000	42.06	74.00	29.31	54.00	Pass

Test Channel:	Lowest Channel	Ant. Polar. :	Vertical



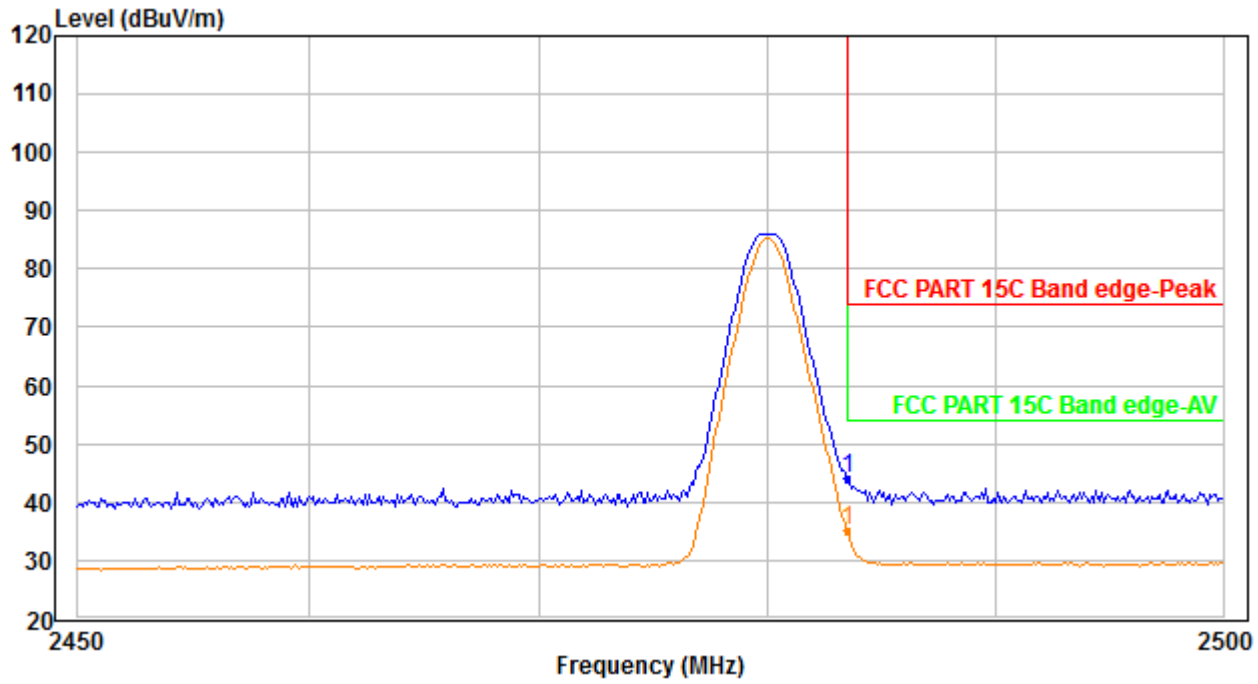
Frequency (MHz)	Peak level (dBμV/m)	Peak Limit (dBμV/m)	AV level (dBμV/m)	AV Limit (dBμV/m)	Conclusion
2390.0000	42.45	74.00	29.41	54.00	Pass

Test Channel:	Highest Channel	Ant. Polar. :	Horizontal



Frequency (MHz)	Peak level (dBμV/m)	Peak Limit (dBμV/m)	AV level (dBμV/m)	AV Limit (dBμV/m)	Conclusion
2483.5000	44.20	74.00	33.92	54.00	Pass

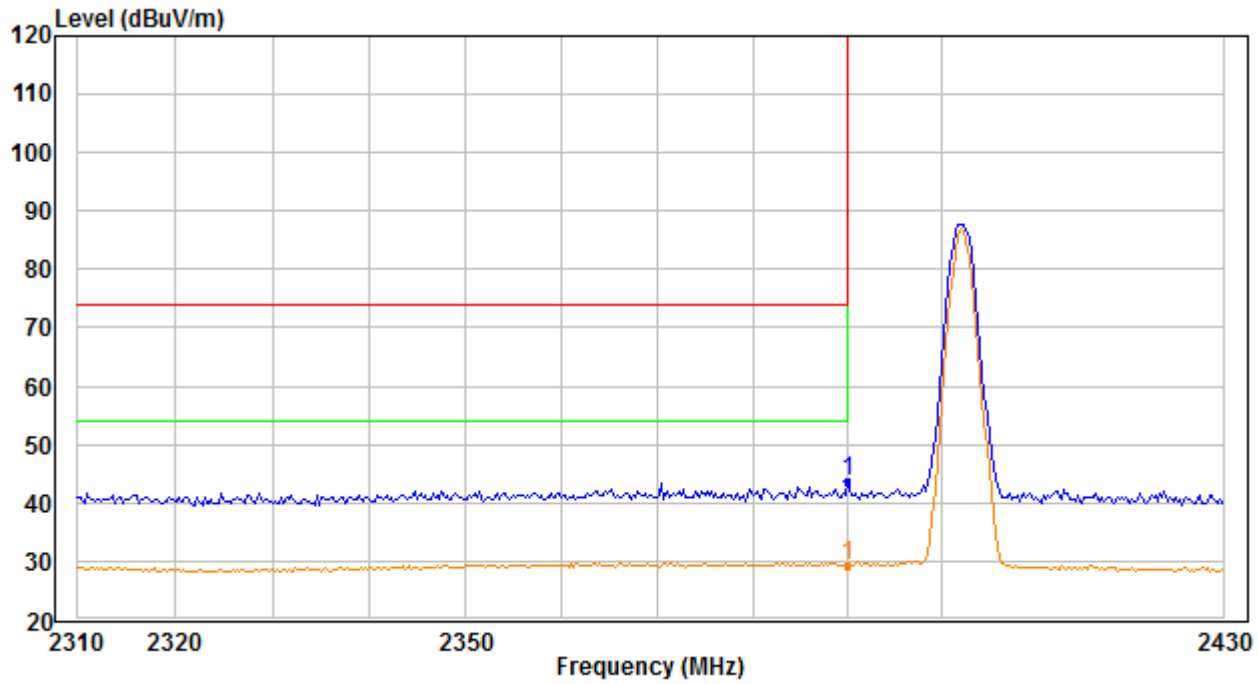
Test Channel:	Highest Channel	Ant. Polar. :	Vertical



Frequency (MHz)	Peak level (dBμV/m)	Peak Limit (dBμV/m)	AV level (dBμV/m)	AV Limit (dBμV/m)	Conclusion
2483.5000	44.12	74.00	35.17	54.00	Pass

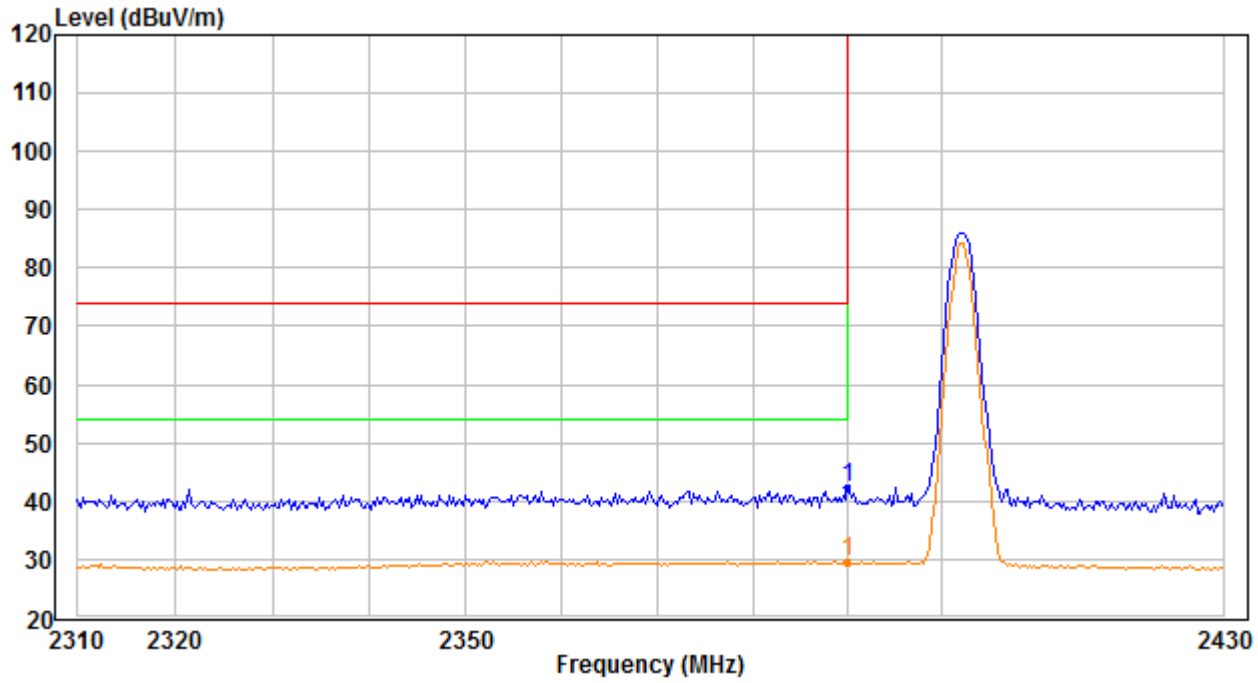
Right Earbuds

Test Channel:	Lowest Channel	Ant. Polar. :	Horizontal



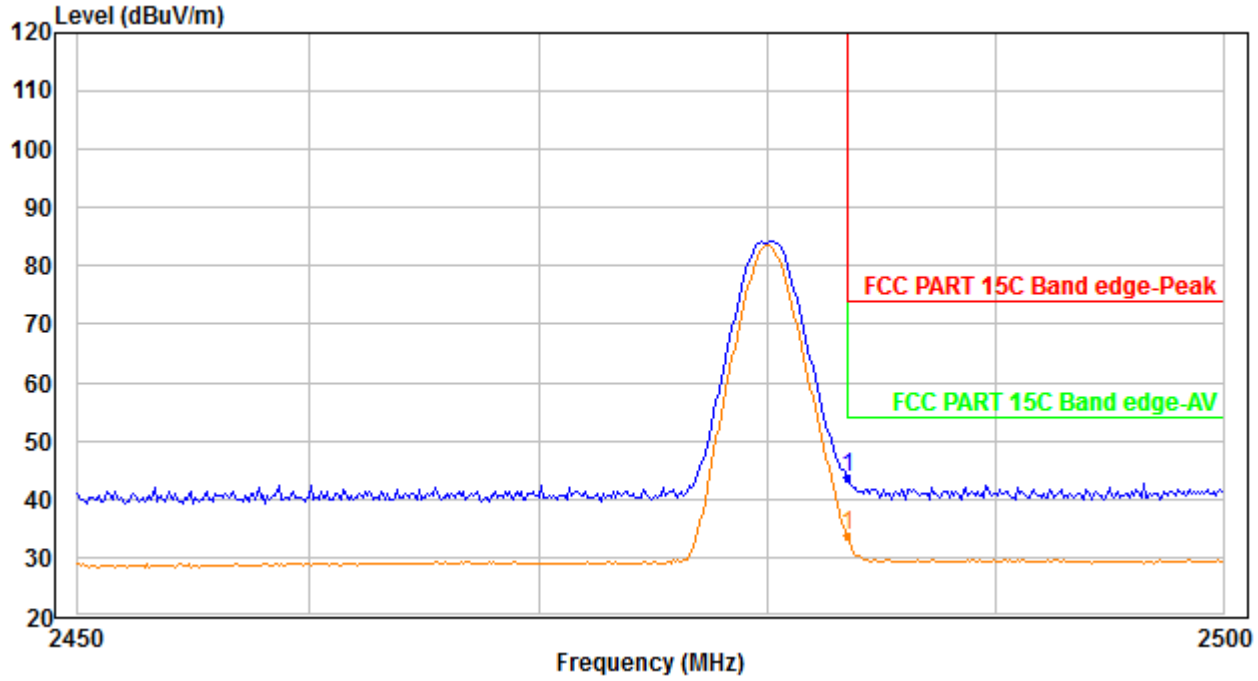
Frequency (MHz)	Peak level (dBμV/m)	Peak Limit (dBμV/m)	AV level (dBμV/m)	AV Limit (dBμV/m)	Conclusion
2390.0000	43.57	74.00	29.26	54.00	Pass

Test Channel:	Lowest Channel	Ant. Polar. :	Vertical



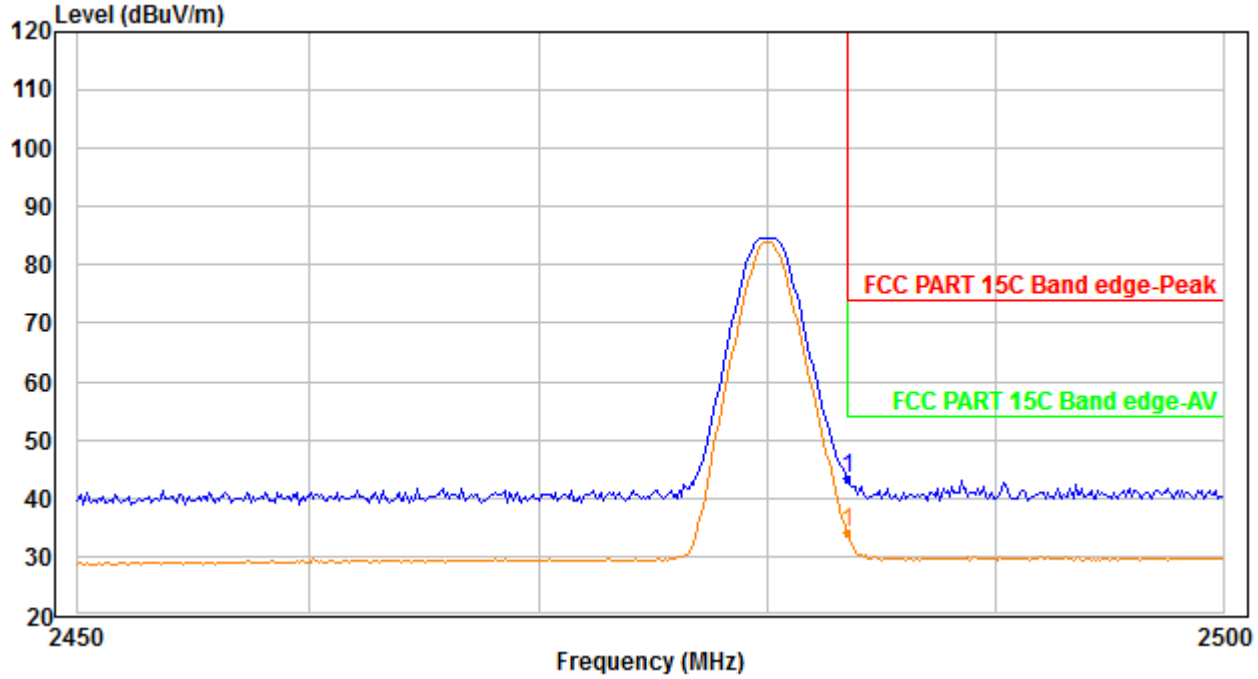
Frequency (MHz)	Peak level (dBμV/m)	Peak Limit (dBμV/m)	AV level (dBμV/m)	AV Limit (dBμV/m)	Conclusion
2390.0000	42.17	74.00	29.47	54.00	Pass

Test Channel:	Highest Channel	Ant. Polar. :	Horizontal



Frequency (MHz)	Peak level (dBμV/m)	Peak Limit (dBμV/m)	AV level (dBμV/m)	AV Limit (dBμV/m)	Conclusion
2483.5000	43.67	74.00	33.70	54.00	Pass

Test Channel:	Highest Channel	Ant. Polar. :	Vertical



Frequency (MHz)	Peak level (dBμV/m)	Peak Limit (dBμV/m)	AV level (dBμV/m)	AV Limit (dBμV/m)	Conclusion
2483.5000	43.28	74.00	34.19	54.00	Pass

APPENDIX 1 PHOTOS OF TEST SETUP

See test photos attached in Appendix 1 for the actual connections between Product and support equipment.

APPENDIX 2 PHOTOS OF EUT CONSTRUCTIONAL DETAILS

Refer to Appendix 2 for EUT external and internal photos.

*** End of Report ***

The test report is effective only with both signature and specialized stamp. The result(s) shown in this report refer only to the sample(s) tested. Without written approval of UnionTrust, this report can't be reproduced except in full.