FCC RADIO TEST REPORT

For

FCC ID: 2ATYB-X2

Report Reference No. ..... :	19EFAS07058 0561
Date of issue ..... :	2019-07-12
Testing Laboratory ..... :	DongGuan ShuoXin Electronic Technology Co., Ltd.
Address ..... :	Zone A, 1F, No. 6, XinGang Road YuanGang Street, XinAn District, ChangAn Town, DongGuan City, GuangDong, China
Applicant's name……..:	Mia Technologies Limited
Address……..:	Room 2212 Building A,Huihai Square Chuangye RD,Long Hua New District,Shenzhen,Guang Dong Province,China
Manufacturer……..:	Mia Technologies Limited

Test specification:

Test item description..... :	TWS Earphones
Trade Mark..... :	MIA
Model/Type reference..... :	X2, BSTBT005, BSHP14, T11, X12, T19, T31, T7, T11S, X12P, T30, X1
Ratings..... :	INPUT: DC5V (Charging Case) or DC3.7V from battery (Earphones)

Responsible Engineer : Smile Wang

Smile Wang

Authorized Signatory: King Wang

King Wang

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TEST REPORT DECLARE

Applicant	:	Mia Technologies Limited
Address	:	Room 2212 Building A,Huihai Square Chuangye RD,Long Hua New District,Shenzhen,Guang Dong Province,China 518000
Equipment under Test	:	TWS Earphones
Model No	:	X2, BSTBT005, BSHP14, T11, X12, T19, T31, T7, T11S, X12P, T30, X1
Trade Mark	:	MIA
Manufacturer	:	Mia Technologies Limited
Address	:	Room 2212 Building A,Huihai Square Chuangye RD,Long Hua New District,Shenzhen,Guang Dong Province,China 518000

Test Standard Used: FCC Rules and Regulations Part 15 Subpart C (15.247)

Test procedure used: ANSI C63.10:2013, 558074 V05.

We Declare:

The equipment described above is tested by DongGuan ShuoXin Electronic Technology Co., Ltd. and in the configuration tested the equipment complied with the standards specified above. The test results are contained in this test report and DongGuan ShuoXin Electronic Technology 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:	19EFAS07058 0561		
Date of Test:	2019-07-09	**Date of Report**:	2019-07-12

Note: This report applies to above tested sample only. This report shall not be reproduced in parts without written approval of DongGuan ShuoXin Electronic Technology Co., Ltd.

1. Summary of test Standards and results

The EUT have been tested according to the applicable standards as referenced below.

Description of Test Item	Standard	Results
6dB Bandwidth And 99% Occupied Bandwidth	FCC Part 15.247 (a)(2)	PASS
Peak Output Power	FCC Part 15.247(b)(3)	PASS
Power Spectral Density	FCC Part 15.247(e)	PASS
Spurious Emissions at Antenna Port	FCC Part 15.247(d)	PASS
Spurious Emissions	FCC Part 15.205, 15.209, FCC Part 15.247(d)	PASS
100 kHz Bandwidth of Frequency Band Edge	FCC Part 15.247(d)	PASS
AC Line Conducted Emissions	FCC Part 15.207 (a)	PASS
Antenna requirement	FCC Part 15: 15.203	PASS

2. GENERAL TEST INFORMATION

2.1. Description of EUT

EUT* Name	:	TWS Earphones
Model Number	:	X2
Trade Mark	:	MIA
EUT function description	:	TWS Earphones with BT function.
Power supply	:	INPUT: DC5V (Charging Case) or DC3.7V from battery (Earphones)
Adaptor		N/A
Operation frequency	:	2.402 ~2.480 GHz
Modulation	:	GFSK
Antenna Type	:	Internal Antenna, maximum PK gain: 1dBi
FVIN		NA
Date of Receipt	:	2019/07/09
Sample Type	:	N/A

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

2.2. Accessories of EUT

Description of Accessories	Manufacturer	Model number or Type	Other
/	/	/	/

2.3. Assistant equipment used for test

Description of Assistant equipment	Manufacturer	Model number or Type	Other
Adapter	NOKIA	/	/

2.4. Block diagram of EUT configuration for test

EUT

EUT was connected to control to a special test jig provided by manufacturer which has a standard RSS-232 connector to connect to Notebook, and the Notebook will run a special test software "MP_v1.1.1" provided by manufacturer to control EUT work in test mode as blow table.

Tested mode, channel, and data rate information			
Mode	data rate (Mpbs) (see Note)	Channel	Frequency (MHz)
BLE	1	Low :CH00	2402
	1	Middle: CH19	2440
	1	High: CH39	2480
	2	Low :CH00	2402
	2	Middle: CH19	2440
	2	High: CH39	2480
Note: According exploratory test, EUT will have maximum output power in those data rate, so those data rate were used for all test.			

2.5. Test environment conditions

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

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

2.6. Measurement uncertainty

Test Item	Uncertainty
Uncertainty for Conduction emission test (9kHz-150kHz)	3.7 dB
Uncertainty for Conduction emission test (150kHz-30MHz)	3.3 dB
Uncertainty for Radiation Emission test (30MHz-200MHz)	4.60 dB (Polarize: V)
	4.60 dB (Polarize: H)
Uncertainty for Radiation Emission test (200MHz-1GHz)	6.10 dB (Polarize: V)
	5.08 dB (Polarize: H)
Uncertainty for Radiation Emission test (1GHz-6GHz)	5.01 dB (Polarize: V)
	5.01 dB (Polarize: H)
Uncertainty for Radiation Emission test (6GHz-18GHz)	5.26 dB (Polarize: V)
	5.26 dB (Polarize: H)
Uncertainty for Radiation Emission test (18GHz-40GHz)	5.06 dB (Polarize: V)
	5.06 dB (Polarize: H)
Uncertainty for radio frequency	±0.048kHz
Uncertainty for conducted RF Power	±0.32dB

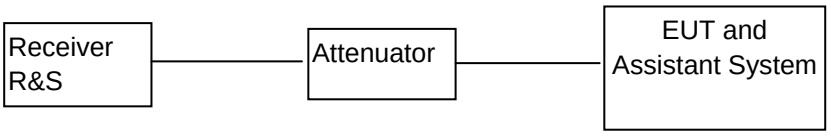
Note：This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2.

3. 6dB Bandwidth and 99% Occupied Bandwidth

3.1. Test equipment

Item	Equipment	Manufacturer	Model No.	Serial No.	Calibrated until	Calibrated Date
1	Spectrum analyzer	KEYSIGHT	N9010A	MY55150427	05/25/2020	05/26/2019
2	Attenuator	Mini-Circuits	BW-S10W2	101109	12/17/2019	12/18/2018
3	RF Cable	Micable	C10-01-01-1	100309	12/17/2019	12/18/2018
4	Spectrum analyzer	R&S	FSV40	101470	06/28/2020	06/29/2019

3.2. Block diagram of test setup



3.3. Limits

For direct sequence systems, the minimum 6dB bandwidth shall be at least 500 KHz

3.4. Test Procedure

(1) Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.

(2) Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.

(3) Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emission bandwidth.

(4) Repeat above procedures until all frequencies measured were complete.

3. Test Result

1M PHY

EUT Set Mode	CH or Frequency	6 dB bandwidth	99% dB bandwidth	Limt	Conclusion
		Result (MHz)	Result (MHz)	>500KHz	PASS
BLE	CH 00	0.659	/	>500KHz	PASS
	CH 19	0.660	/		PASS
	CH 39	0.659	/		PASS

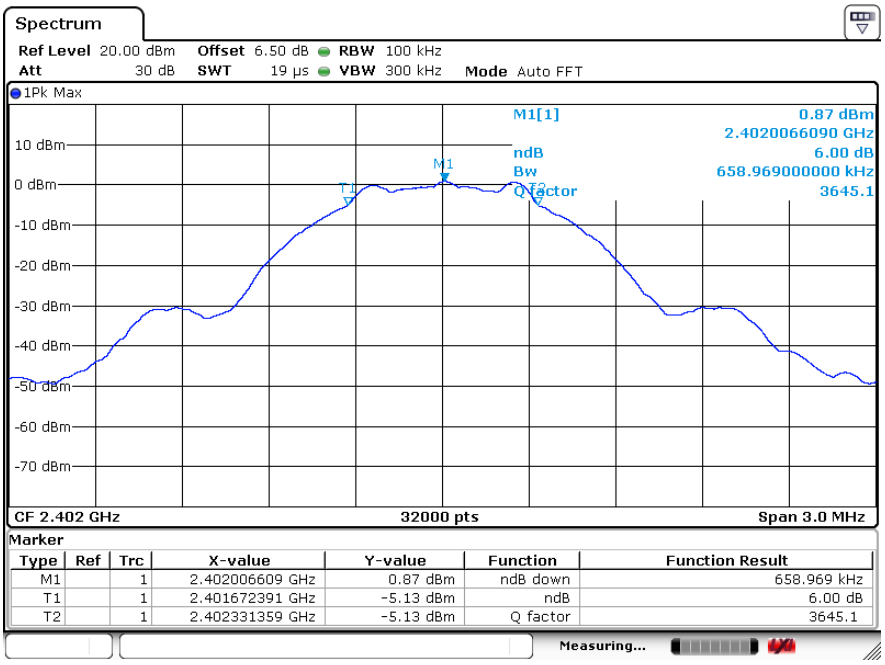
2M PHY

EUT Set Mode	CH or Frequency	6 dB bandwidth	99% dB bandwidth	Limt	Conclusion
		Result (MHz)	Result (MHz)	>500KHz	PASS
BLE	CH 00	1.122	/	>500KHz	PASS
	CH 19	1.120	/		PASS
	CH 39	1.133	/		PASS

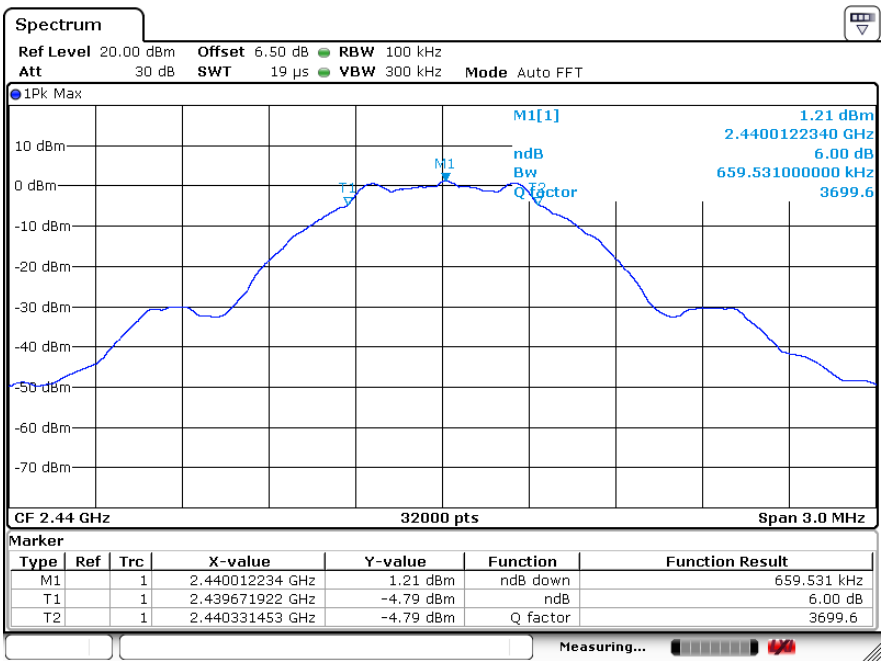
3.6. Original test data

1M PHY

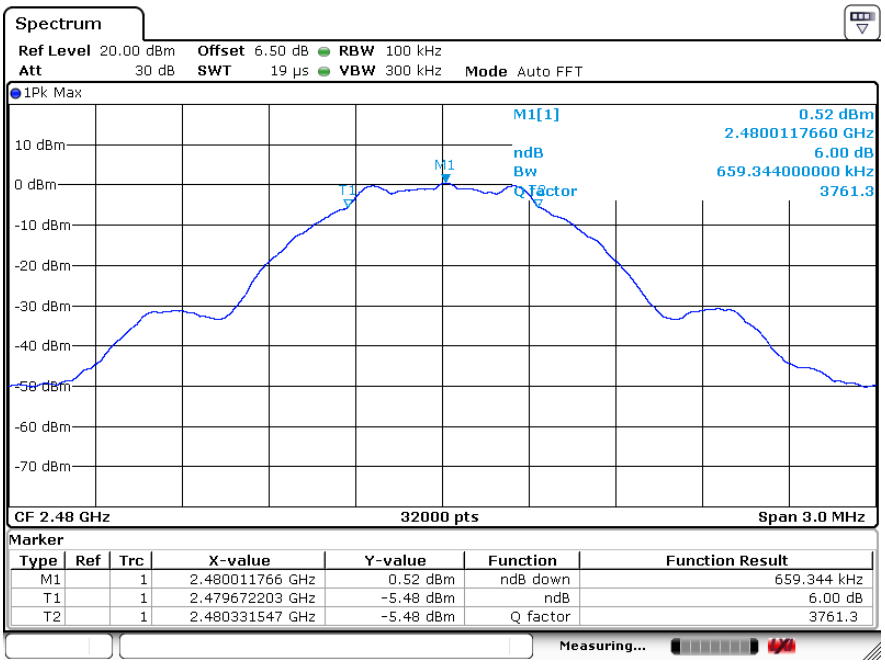
CH00



CH19

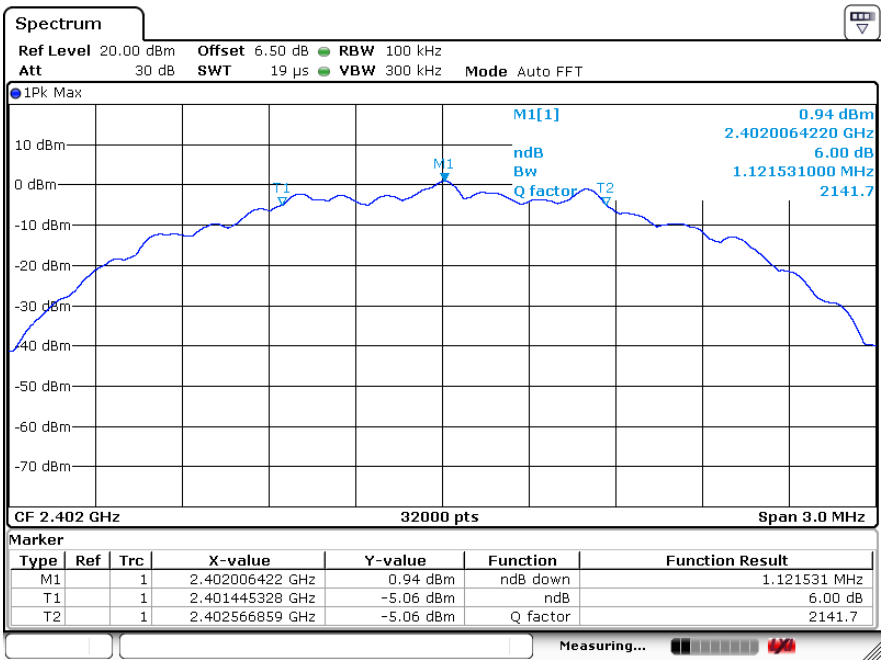


CH39

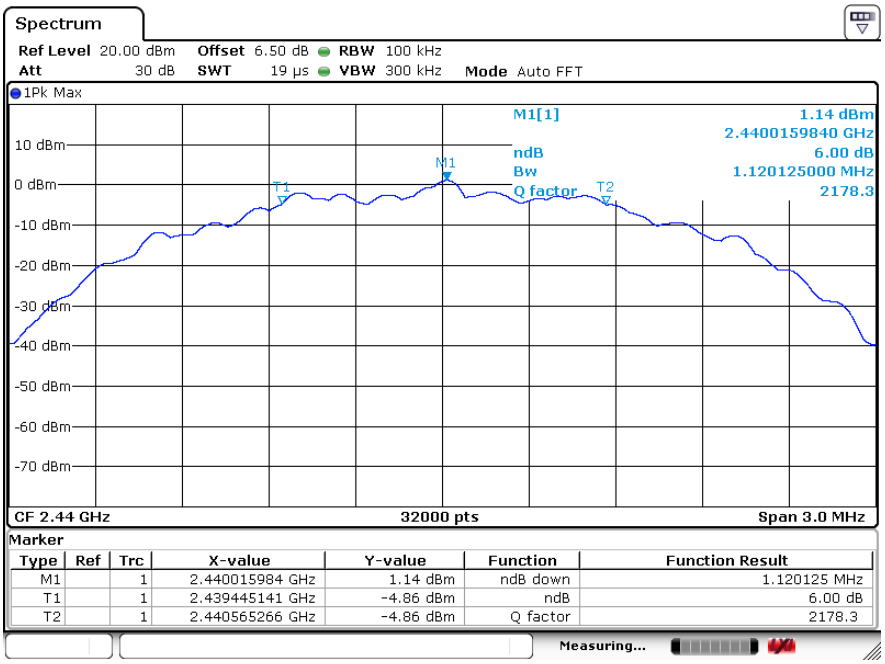


2M PHY

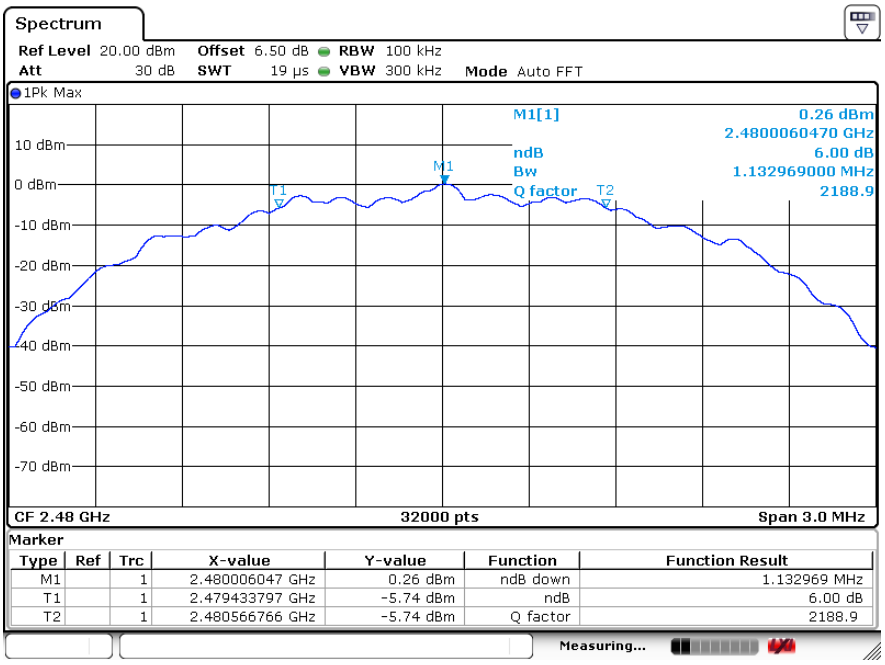
CH00



CH19


Spectrum
Ref Level 20.00 dBm Offset 6.50 dB RBW 100 kHz
Att 30 dB SWT 19 µs VBW 300 kHz Mode Auto FFT
1Pk Max
M1[1] 1.14 dBm
2.4400159840 GHz
ndB 6.00 dB
Bw 1.120125000 MHz
Q factor 2178.3
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.44 GHz
32000 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.440015984 GHz 1.14 dBm ndB down 1.120125 MHz
T1 1 2.439445141 GHz -4.86 dBm ndB 6.00 dB
T2 1 2.440565266 GHz -4.86 dBm Q factor 2178.3
Measuring...

CH39

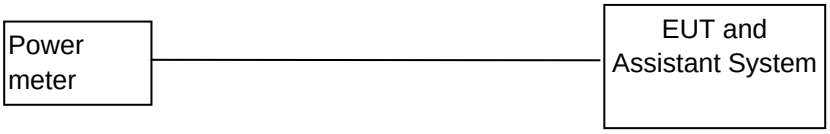

Spectrum
Ref Level 20.00 dBm Offset 6.50 dB RBW 100 kHz
Att 30 dB SWT 19 µs VBW 300 kHz Mode Auto FFT
1Pk Max
M1[1] 0.26 dBm
2.4800060470 GHz
ndB 6.00 dB
Bw 1.132969000 MHz
Q factor 2188.9
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.48 GHz
32000 pts
Span 3.0 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.480006047 GHz 0.26 dBm ndB down 1.132969 MHz
T1 1 2.479433797 GHz -5.74 dBm ndB 6.00 dB
T2 1 2.480566766 GHz -5.74 dBm Q factor 2188.9
Measuring...

4. Maximum Peak Output Power

4.1. Test equipment

Item	Equipment	Manufacturer	Model No.	Serial No.	Calibrated until	Calibrated Date
1	Power meter	Agilent	E4417A	MY45100473	05/26/2020	05/27/2017
2	Wireband Power sensor	Agilent	E4427A	MY5100041	12/17/2019	12/18/2018
3	RF Cable	Micable	C10-01-01-1	100309	12/17/2019	12/18/2018
4	Spectrum analyzer	R&S	FSV40	101470	06/28/2020	06/29/2019

4.2. Block diagram of test setup



4.3. Limits

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz bands: 1 Watt. 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 as appropriate, by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

4.4. Test Procedure

1. Place the EUT on a bench and set it in transmitting mode. .
2. A wide band power meter with a matched thermocouple detector was used to directly measure the output power from the RF output port of the EUT in continuously transmitting mode.
3. The measurement shall be repeated at the lowest, the middle, and the highest channel of the stated frequency range.

4.5. TEST RESULT

1M PHY

EUT Set Mode	CH	Result(dBm) Peak	Total Power (dBm)	Limit	Conclusion
BLE	CH 00	1.03	/	30dBm	PASS
	CH 19	1.26	/	30dBm	PASS
	CH 39	0.53	/	30dBm	PASS

2M PHY

EUT Set Mode	CH	Result(dBm) Peak	Total Power (dBm)	Limit	Conclusion
BLE	CH 00	1.18	/	30dBm	PASS
	CH 19	1.39	/	30dBm	PASS
	CH 39	0.69	/	30dBm	PASS

5. Power Spectral Density

5.1. Test equipment

Item	Equipment	Manufacturer	Model No.	Serial No.	Calibrated until	Calibrated Date
1	Spectrum analyzer	KEYSIGHT	N9010A	MY55150427	05/26/2020	05/27/2019
2	Attenuator	Mini-Circuits	BW-S10W2	101109	12/17/2019	12/18/2018
3	RF Cable	Micable	C10-01-01-1	100309	12/17/2019	12/18/2018
4	Spectrum analyzer	R&S	FSV40	101470	06/28/2020	06/29/2019

5.2. Block diagram of test setup

5.3. Limits

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

5.4. TEST PROCEDURE

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generatorl.
2. Position the EUT was set without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range
3. According to KDB 558074 D01 DTS Meas Guidance v05, set the RBW = 3 kHz, VBW = 30 kHz, Set the span to 1.5 times the DTS channel bandwidth.
4. Use the peak marker function to determine the maximum power level in any 3 kHz band segment within the fundamental EBW

5.5. Test Result

1M PHY

EUT Set Mode	CH	Result(dBm)	Total (dBm)	Limit (dBm)	Conclusion
BLE	CH 00	-15.28	/	8	PASS
	CH 19	-15.30	/	8	PASS
	CH 39	-15.71	/	8	PASS

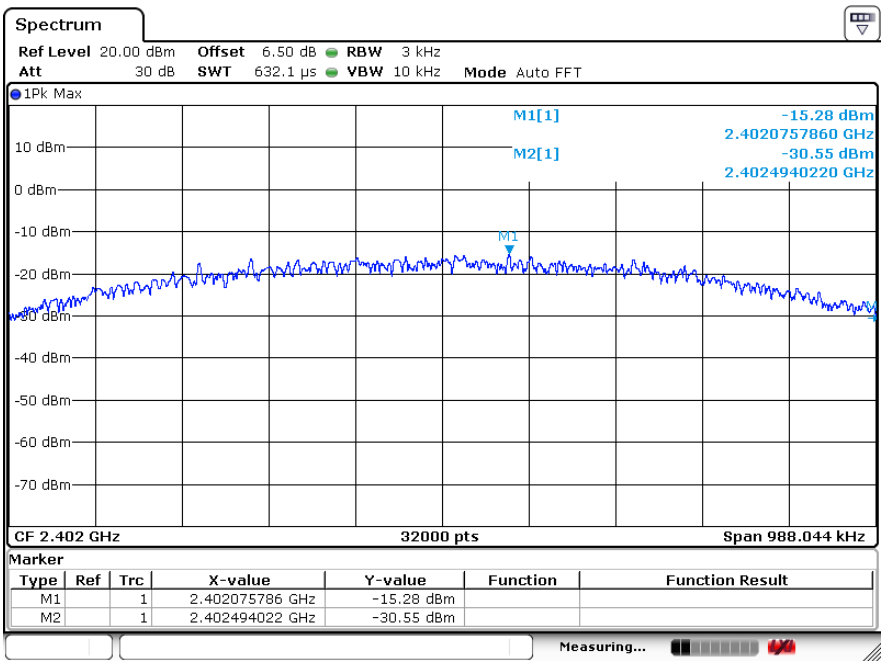
2M PHY

EUT Set Mode	CH	Result(dBm)	Total (dBm)	Limit (dBm)	Conclusion
BLE	CH 00	-17.30	/	8	PASS
	CH 19	-16.89	/	8	PASS
	CH 39	-17.21	/	8	PASS

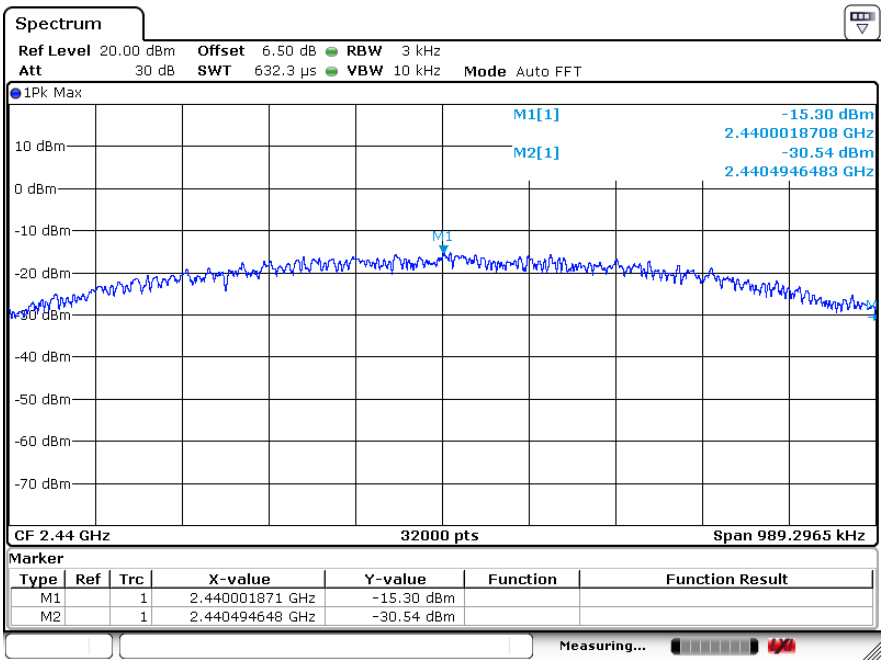
5.6. Original test data

1M PHY

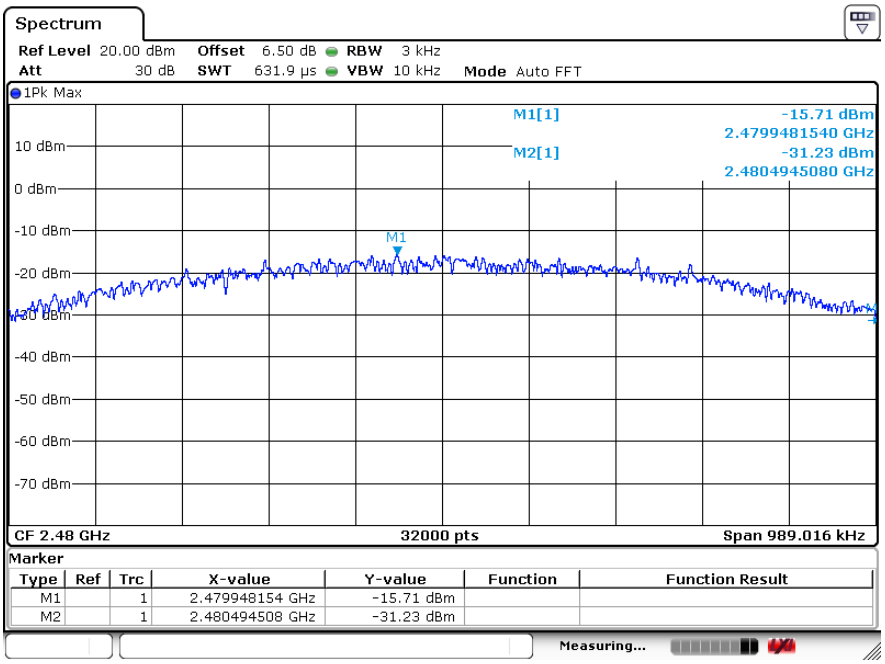
CH00



CH19

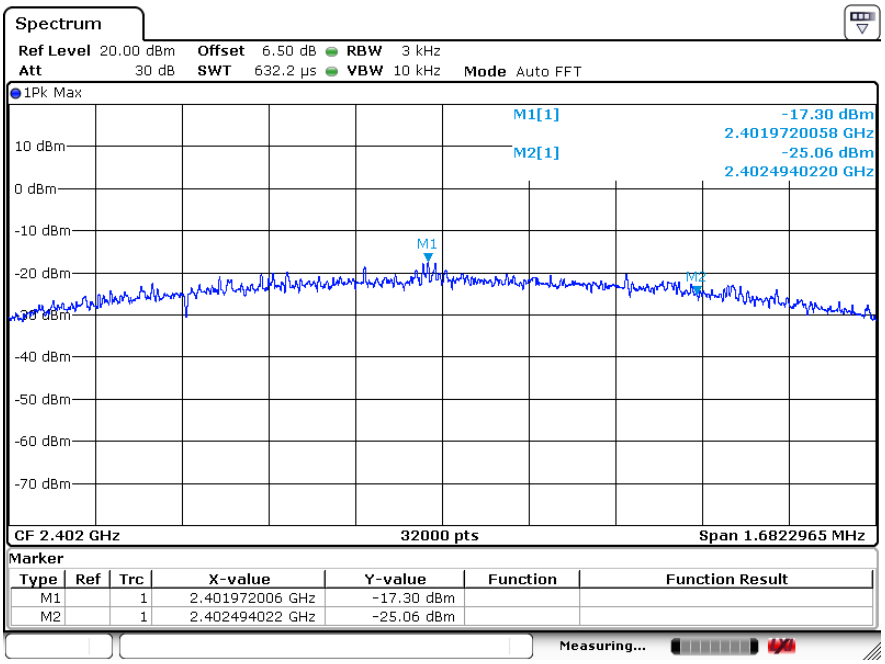


CH39

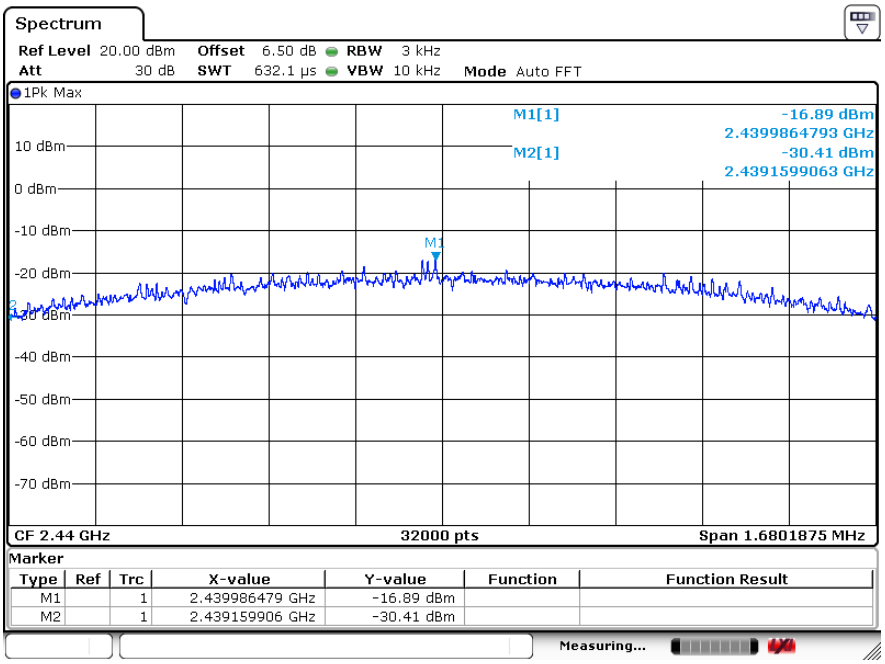


2M PHY

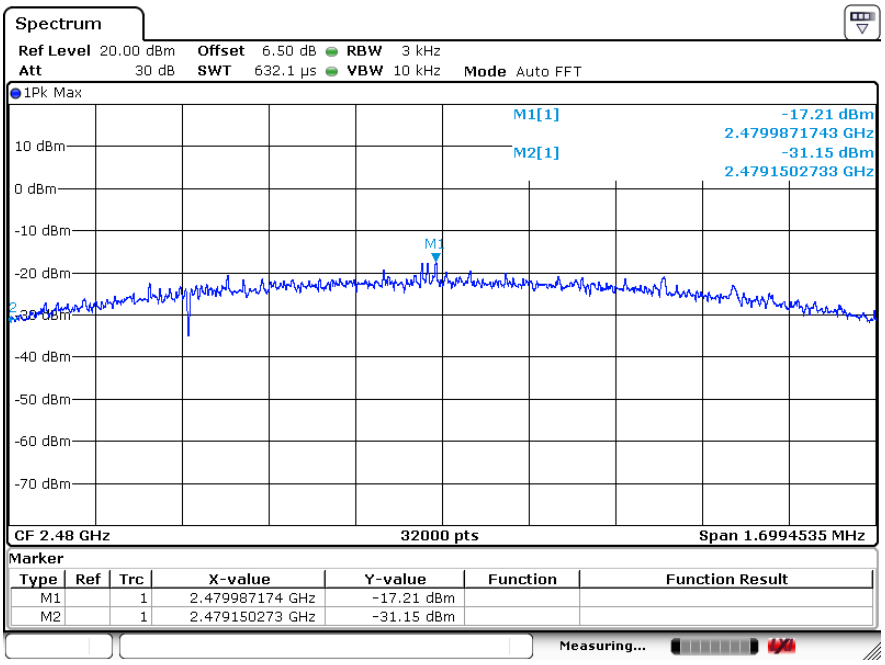
CH00



CH19


Spectrum
Ref Level 20.00 dBm Offset 6.50 dB RBW 3 kHz
Att 30 dB SWT 632.1 µs VBW 10 kHz Mode Auto FFT
1Pk Max
M1[1] -16.89 dBm
2.4399864793 GHz
M2[1] -30.41 dBm
2.4391599063 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.44 GHz
32000 pts
Span 1.6801875 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.439986479 GHz -16.89 dBm
M2 1 2.439159906 GHz -30.41 dBm
Measuring...

CH39


Spectrum
Ref Level 20.00 dBm Offset 6.50 dB RBW 3 kHz
Att 30 dB SWT 632.1 µs VBW 10 kHz Mode Auto FFT
1Pk Max
M1[1] -17.21 dBm
2.4799871743 GHz
M2[1] -31.15 dBm
2.4791502733 GHz
10 dBm
0 dBm
-10 dBm
-20 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
CF 2.48 GHz
32000 pts
Span 1.6994535 MHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.479987174 GHz -17.21 dBm
M2 1 2.479150273 GHz -31.15 dBm
Measuring...

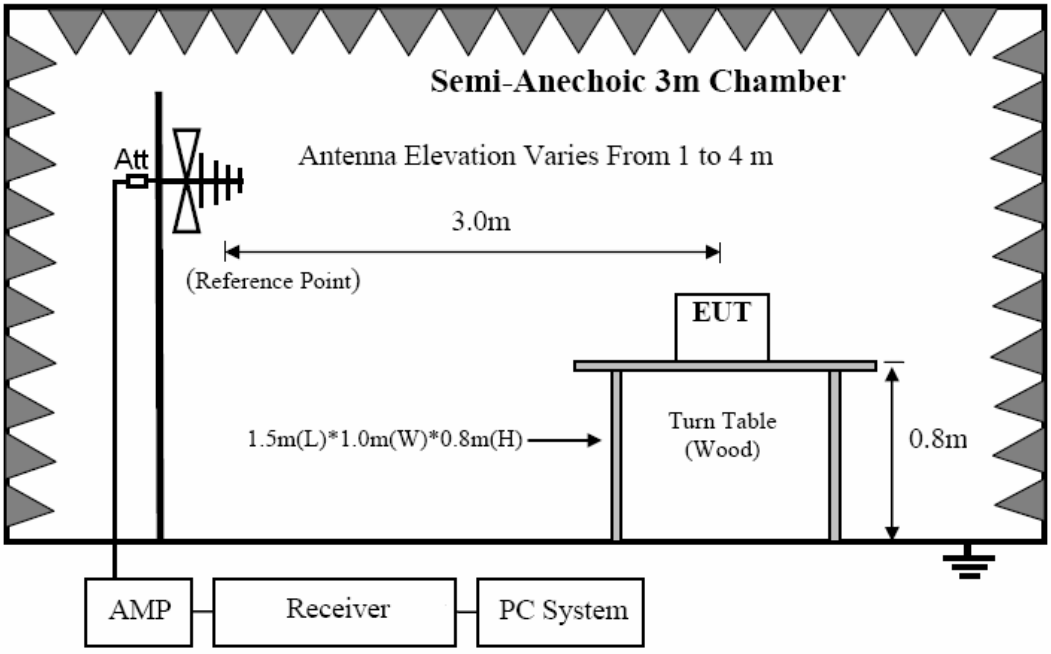
6. Spurious Emissions

6.1. Test equipment

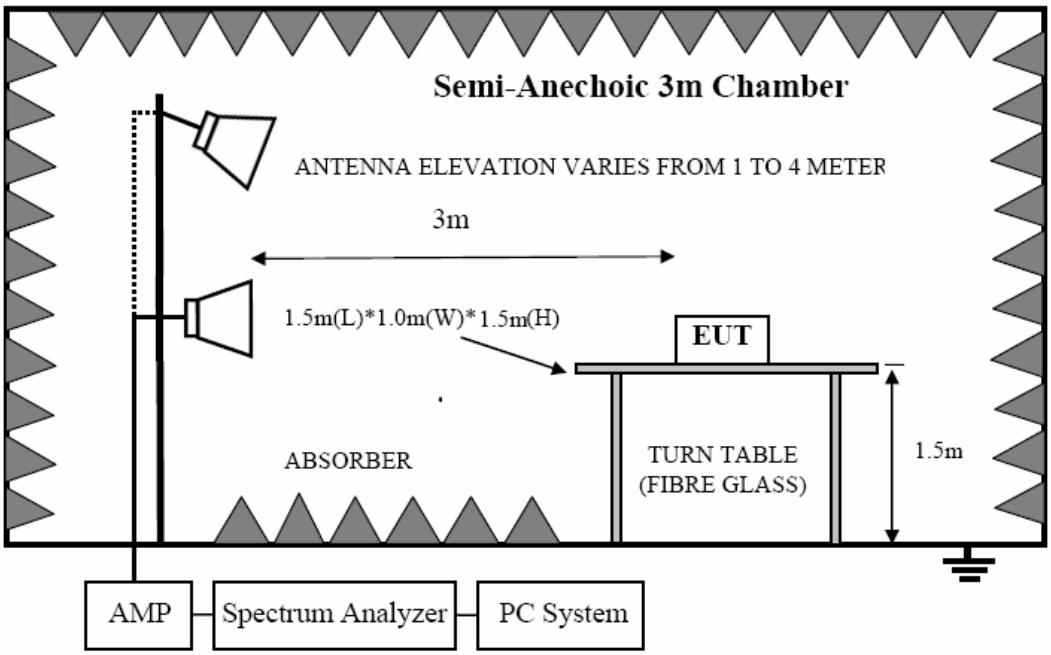
Item	Equipment	Manufacturer	Model No.	Serial No.	Calibrated until	Calibrated Date
1	EMI Test Receiver	R&S	ESCI	101307	12/17/2019	12/18/2018
2	Spectrum analyzer	Agilent	E4407B	US40240708	07/04/2020	07/05/2019
3	Trilog Broadband Antenna	Schwarzbeck	VULB9168	VULB9168 -192	03/04/2020	03/05/2018
4	Double Ridged Horn Antenna	SCHWARZBEC K	BBHA 9120D1065	100276	12/17/2019	12/18/2018
5	Double Ridged Horn Antenna	SCHWARZBEC K	BBHA 9120D1065	100546	12/17/2019	12/18/2018
6	Dipole antenna	Schwarzbeck	UHAP	1101	12/17/2019	12/18/2018
7	Dipole antenna	Schwarzbeck	VHAP	1118	12/17/2019	12/18/2018
8	Pre-Amplifier	CY	EMC011830	980136	12/17/2019	12/18/2018
9	Pre-amplifier	HP	8447F	3113A05680	12/17/2019	12/18/2018
10	RF Cable	R&S	R01	10403	12/17/2019	12/18/2018
11	RF Cable	R&S	R02	10512	12/17/2019	12/18/2018
12	RF Cable	R&S	R01	10454	12/17/2019	12/18/2018
13	RF Cable	R&S	R02	10343	12/17/2019	12/18/2018
14	6 dB Attenuator	EMEC	ATT6000-6-N N	N/A	11/21/2019	11/22/2018
15	Turn Table	UC	UC3000	N/A	N/A	N/A
16	Antenna Mast	UC	UC3000	N/A	N/A	N/A
17	MeasurementSoft ware	Farad	EZ-EMC (Ver.ATT-03 A)	N/A	N/A	N/A
18	Spectrum analyzer	R&S	FSV40	101470	06/28/2020	06/29/2019
19	Loop antenna	TESEQ	HLA6120	20129	12/17/2019	12/18/2018

6.2. Block diagram of test setup

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



In 3m Anechoic Chamber Test Setup Diagram for frequency above 1GHz



Note: For harmonic emissions test a appropriate high pass filter was inserted in the input port of AMP.

6.3. Limit

6.3.1 FCC 15.205 Restricted frequency band

MHz	MHz	MHz	GHz
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
[1]0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 - 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2690 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 - 12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 - 12.57725	322 - 335.4	3600 - 4400	([2])

6.3.2 FCC 15.209 Limit

FREQUENCY MHz	DISTANCE Meters	FIELD STRENGTHS LIMIT	
		μV/m	dB(μV)/m
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)	

6.3.3 Limit for this EUT

The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.10:2013. The specification used was the FCC 15.209, and FCC 15.247 limits.

6.4. TEST PROCEDURE

(1) EUT was placed on a non-metallic table, 80 cm above the ground plane inside a semi-anechoic chamber.

(2) Setup EUT and assistant system according clause 2.4 and 8.2

(3) Test antenna was located 3m from the EUT on an adjustable mast. Below pre-scan procedure was first performed in order to find prominent radiated emissions.

(a) Change work frequency or channel of device if practicable.

(b) Change modulation type of device if practicable.

(c) Change power supply range from 85% to 115% of the rated supply voltage

(d) Rotated EUT though three orthogonal axes to determine the attitude of EUT arrangement produces highest emissions

(4) Spectrum frequency from 9MHz to 25GHz (tenth harmonic of fundamental frequency) was investigated, and no any obvious emission were detected from 9KHz to 30MHz and 18GHz to 25GHz, so below final test was performed with frequency range from 30MHz to 18GHz.

(5) For final emissions measurements at each frequency of interest, the EUT were rotated and the antenna height was varied between 1m and 4m in order to maximize the emission. Measurements in both horizontal and vertical polarities were made and the data was recorded. In order to find the maximum emission, the relative positions of equipments and all of the interface cables were changed according to ANSI C63.10 2013 on Radiated Emission test.

(6) For emissions from 30MHz to 1GHz, Quasi-Peak values were measured with EMI Receiver and the bandwidth of Receiver is 120 KHz.

(7) For emissions above 1GHz, both Peak and Average level were measured with Spectrum Analyzer, and the RBW is set at 1MHz, VBW is set at 3MHz for Peak measure, Detector is at PK; RBW is set at 1MHz, VBW is set at 3MHz for Average measure, Detector is at RMS.

6.5. TEST RESULT

Below 30M

EUT:	TWS Earphones	**Model No.:**	X2
Temperature:	24℃	**Relative Humidity:**	55%
Distance:	3m	**Test Power:**	3.7Vdc
Polarization:	--	**Test Result:**	Pass
Test Mode:	Keep TX Mode	**Test By:**	smile

Freq.	Reading	Limit	Margin	State
(MHz)	(dBuV/m)	(dBuV/m)	(dB)	P/F
--	--	--	--	P
--	--	--	--	P

Note:

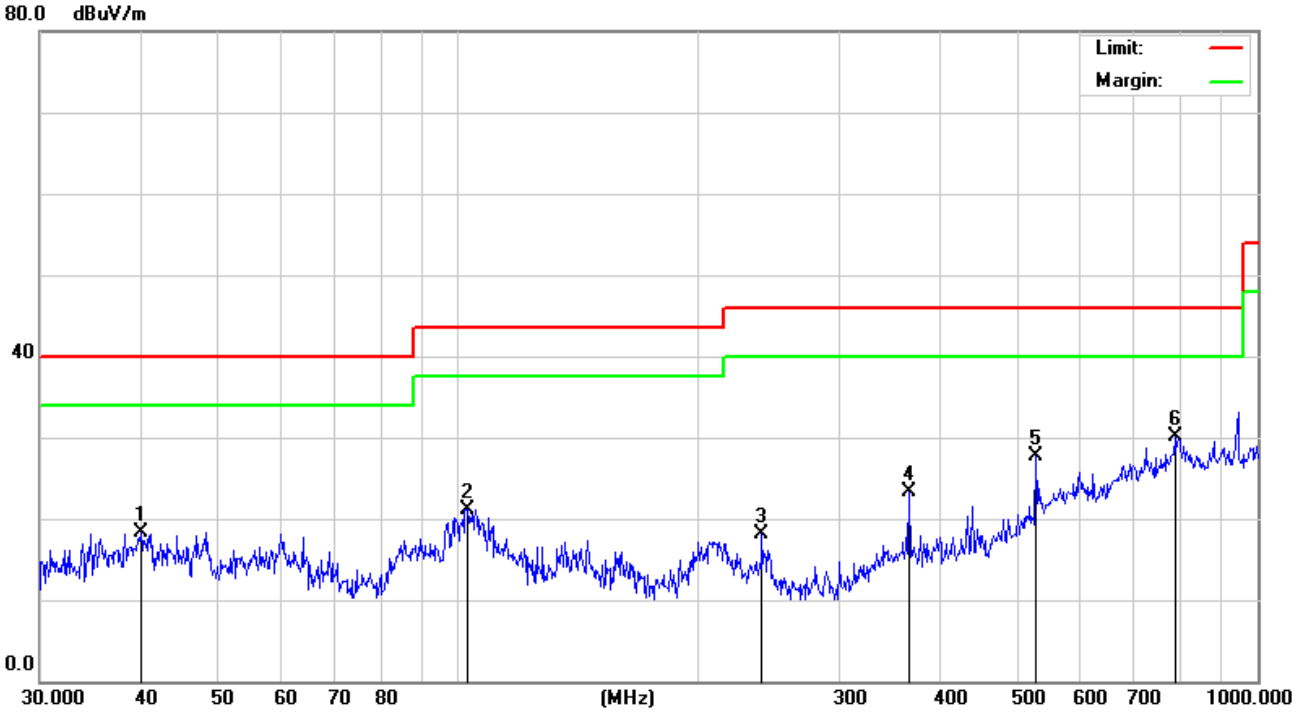
The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value has no need to be reported.

Distance extrapolation factor =20 log (specific distance/test distance)(dB);

Limit line = specific limits(dBuv) + distance extrapolation factor

Between 30M – 1000 MHz

EUT:	TWS Earphones	**Model No.:**	X2
Temperature:	24	**Relative Humidity:**	55%
Distance:	3m	**Test Power:**	3.7VDC
Polarization:	Vertical	**Test Result:**	Pass
Standard:	(RE)FCC PART 15 class B 3m	**Test By:**	smile
Test Mode:	Keep TX Mode（1M worst mode）		

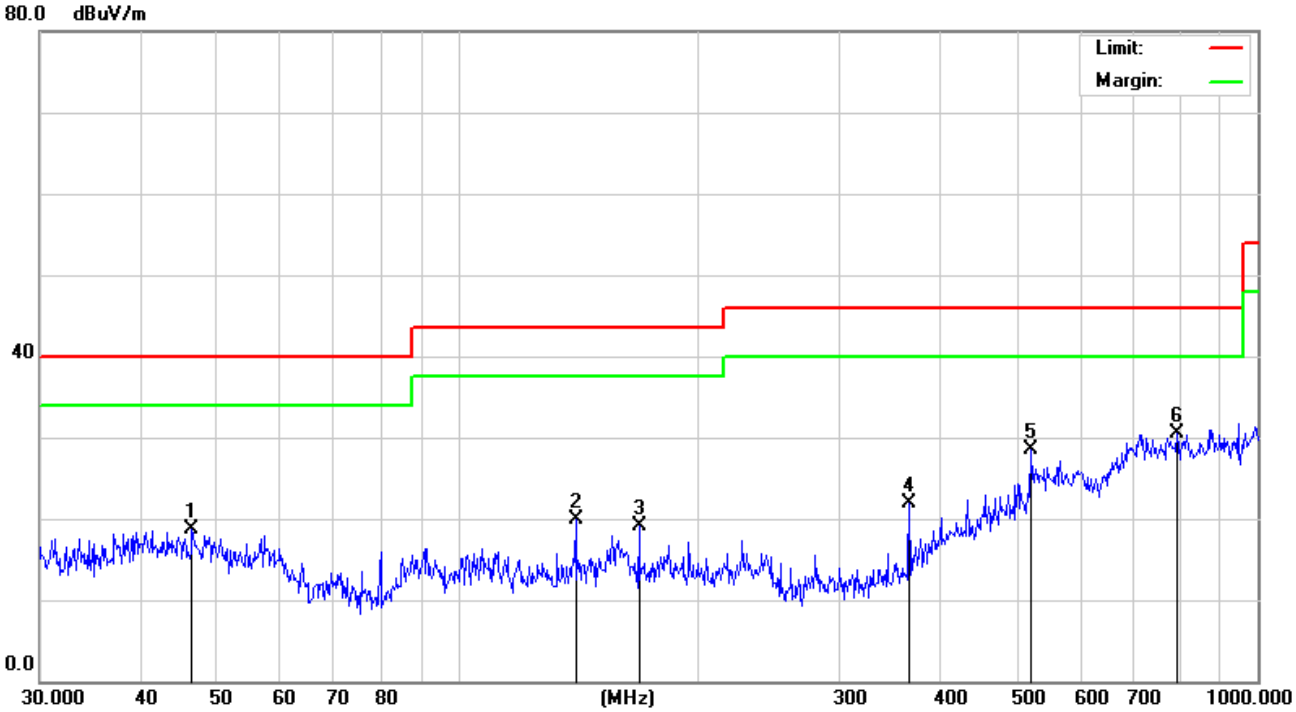


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		40.1347	22.55	-4.20	18.35	40.00	-21.65	QP
2		102.7192	29.37	-8.18	21.19	43.50	-22.31	QP
3		239.9874	24.69	-6.52	18.17	46.00	-27.83	QP
4		366.8231	27.59	-4.25	23.34	46.00	-22.66	QP
5		528.2458	27.38	0.32	27.70	46.00	-18.30	QP
6	*	787.8513	22.77	7.41	30.18	46.00	-15.82	QP

The test result is calculated as the following:

(1) Result = Reading + Correct Factor
(2) Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain + Attenuator
(3) Margin = Result - Limit

EUT:	TWS Earphones	**Model No.:**	X2
Temperature:	24	**Relative Humidity:**	55%
Distance:	3m	**Test Power:**	3.7VDC
Polarization:	Horizontal	**Test Result:**	Pass
Standard:	(RE)FCC PART 15 class B 3m	**Test By:**	smile
Test Mode:	Keep TX Mode （1M worst mode）		



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		46.5030	21.18	-2.56	18.62	40.00	-21.38	QP
2		140.3420	26.94	-6.99	19.95	43.50	-23.55	QP
3		168.4138	26.63	-7.47	19.16	43.50	-24.34	QP
4		366.8231	27.97	-6.03	21.94	46.00	-24.06	QP
5		520.8881	25.42	3.08	28.50	46.00	-17.50	QP
6	*	793.3958	22.90	7.55	30.45	46.00	-15.55	QP

The test result is calculated as the following:

(1) Result = Reading + Correct Factor
(2) Correct Factor = Antenna Factor + Cable Loss – Amplifier Gain + Attenuator
(3) Margin = Result - Limit

Between 1000M – 25000 MHz

Test Site	:	3m Chamber			
EUT	:	TWS Earphones	**Tested By**	:	Smile
Power Supply	:	3.7Vdc	**Model Number**	:	X2
Condition	:	Temp:24.5'C,Humi:55%, Press:100.1kPa	**Test Mode**	:	Tx mode（1M worst mode）
Memo	:	BLE	**Antenna/ Distance**	:	3m

Frequency	**Receiver**		**Rx Antenna**		**Corrected Amplitude**	**FCC 15.247**	
(MHz)	**Reading (dBμV)**	**Detector (PK/QP/AV)**	**Polar (H/V)**	**Factor (dB)**	**(dBμV/m)**	**Limit (dBμV/m)**	**Margin (dB)**
Low Channel (2402MHZ)							
4804	41.91	PK	H	5.06	46.97	74	-27.03
4804	30.16	AV	H	5.06	35.22	54	-18.78
4804	40.82	PK	V	5.06	45.88	74	-28.12
4804	30.11	AV	V	5.06	35.17	54	-18.83
Middle Channel (2440MHZ)							
4880	41.45	PK	H	5.14	46.59	74	-27.41
4880	30.03	AV	H	5.14	35.17	54	-18.83
4880	42.77	PK	V	5.14	47.91	74	-26.09
4880	30.09	AV	V	5.14	35.23	54	-18.77
High Channel (2480MHZ)							
4960	40.96	PK	H	5.22	46.18	74	-27.82
4960	30.25	AV	H	5.22	35.47	54	-18.53
4960	40.89	PK	V	5.22	46.11	74	-27.89
4960	30.39	AV	V	5.22	35.61	54	-18.39

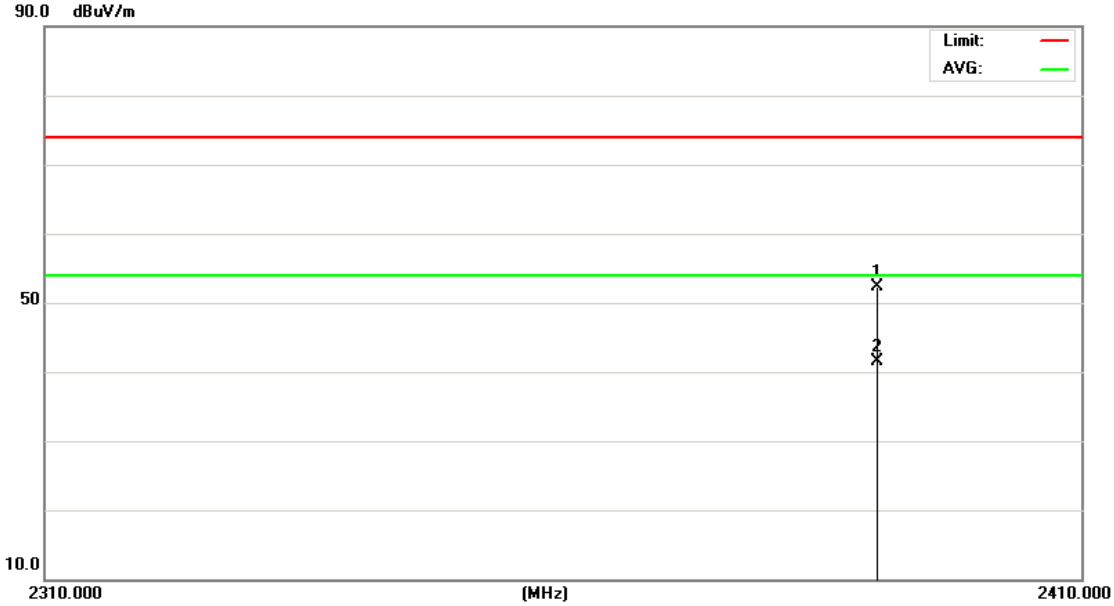
The test result is calculated as the following:

(1) Corrected Amplitude = Read Level + Antenna Factor + Cable loss -Amplifier Gain
(2) Margin= Corrected Amplitude-Limit

TEST RESULTS (Restricted Bands Requirements)

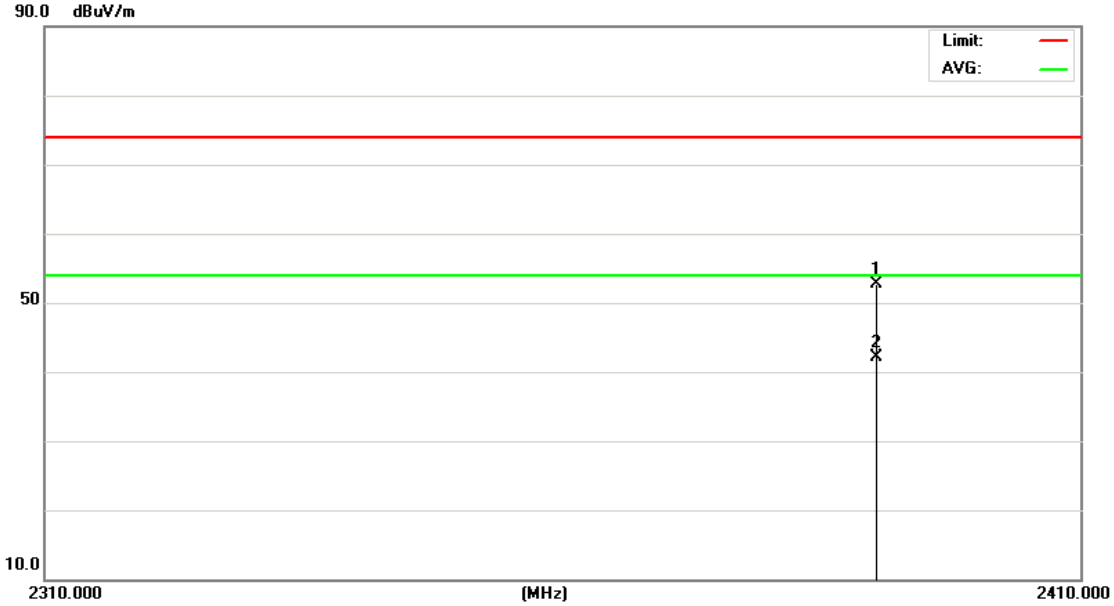
EUT：	TWS Earphones	Model Name ：	X2
Temperature：	25 ℃	Test Data	2019-07-11
Pressure：	1010 hPa	Relative Humidity：	60%
Test Mode ：	TX(1Mbps worst mode)	Test Voltage ：	DC 3.7V
RBW/VBW	1MHz/1MHz for Peak, 1MHz/10Hz for Average.		
Note：	1. The transmitter was setup to transmit at the lowest channel. Then the field strength was measured at 2310-2390 MHz. 2. The transmitter was setup to transmit at the highest channel. Then the field strength was measured at 2483.5-2500 MHz. 3. The data of 2390MHz and 2483.5MHz was the worst.		

Vertical



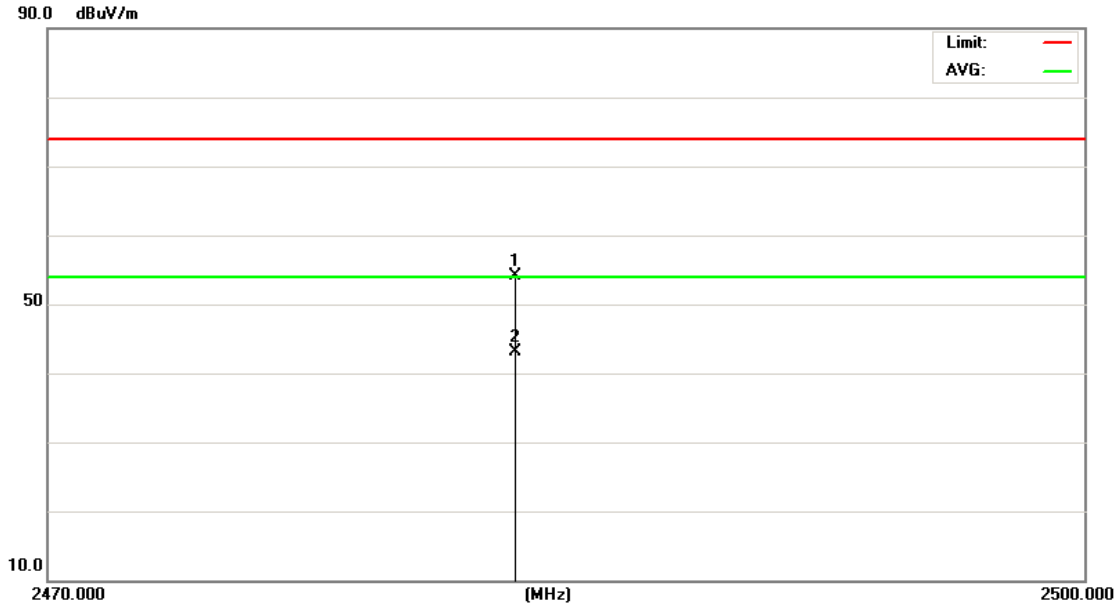
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		2390.000	58.04	-5.79	52.25	74.00	-21.75	peak
2	*	2390.000	47.25	-5.79	41.46	54.00	-12.54	AVG

Horizontal



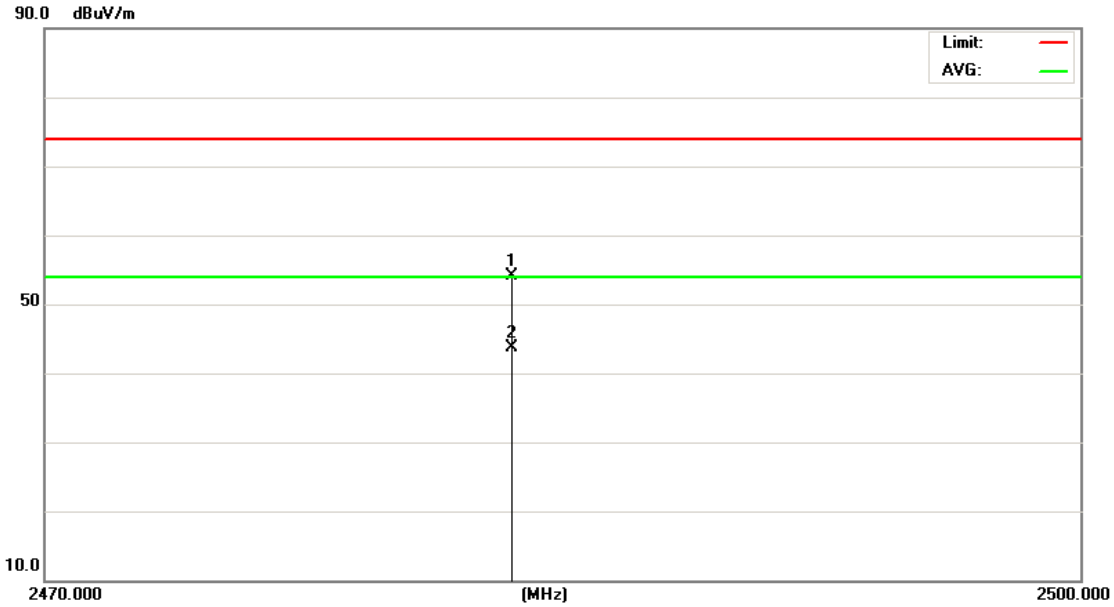
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		2390.000	58.47	-5.79	52.68	74.00	-21.32	peak
2	*	2390.000	47.91	-5.79	42.12	54.00	-11.88	AVG

Vertical



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		2483.500	59.05	-4.98	54.07	74.00	-19.93	peak
2	*	2483.500	48.11	-4.98	43.13	54.00	-10.87	AVG

Horizontal



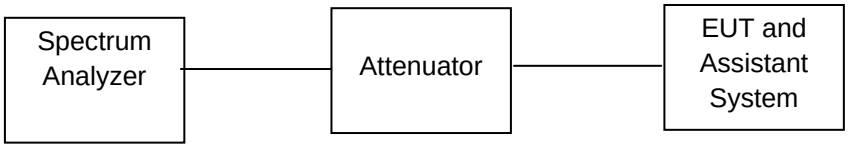
No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV/m	dBuV/m	dB	Detector
1		2483.500	59.16	-4.98	54.18	74.00	-19.82	peak
2	*	2483.500	48.78	-4.98	43.80	54.00	-10.20	AVG

7. 100 kHz Bandwidth of Frequency Band Edge

7.1. Test equipment

Item	Equipment	Manufacturer	Model No.	Serial No.	Calibrated until	Calibrated Date
1	Spectrum analyzer	KEYSIGHT	N9010A	MY55150427	05/25/2020	05/26/2020
2	Attenuator	Mini-Circuits	BW-S10W2	101109	12/17/2019	12/18/2018
3	RF Cable	Micable	C10-01-01-1	100309	12/17/2019	12/18/2018
4	Spectrum analyzer	R&S	FSV40	101470	06/28/2020	06/29/2019

7.2. Block diagram of test setup



7.3. Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

7.4. Test Procedure

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to a EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set both RBW and VBW of spectrum analyzer to 100 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
4. Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
5. Repeat above procedures until all measured frequencies were complete.

7.5. Test result

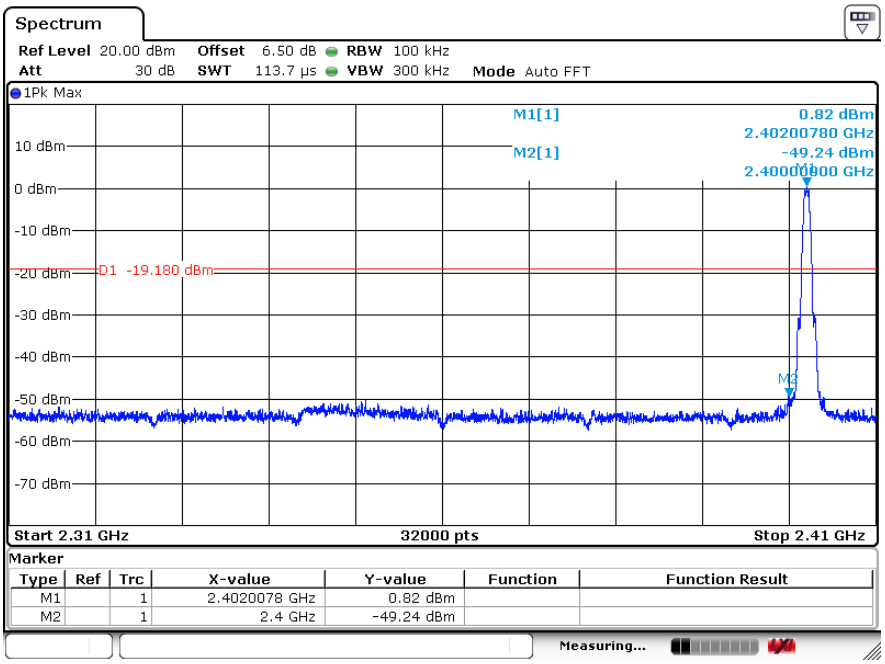
1M PHY

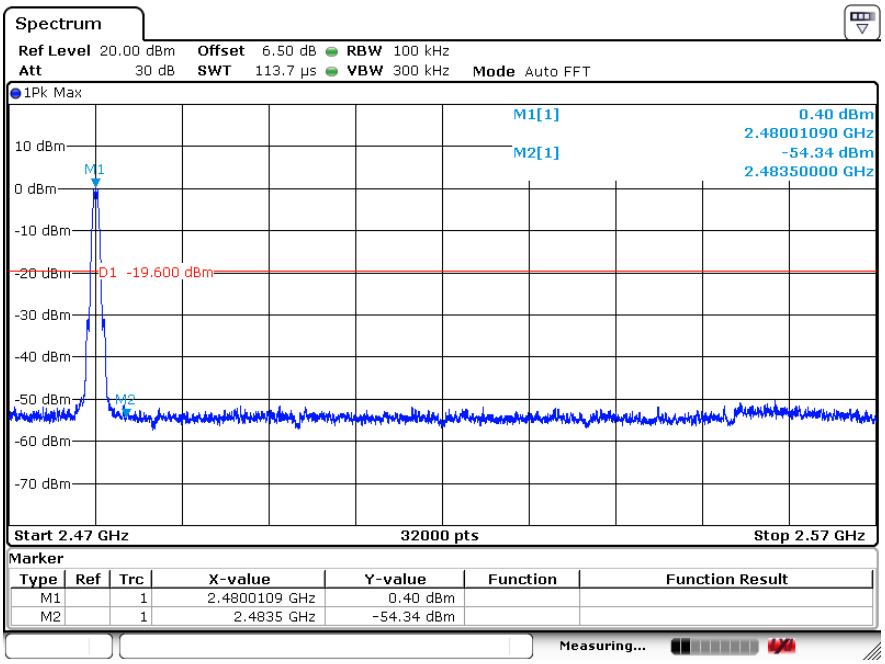
Frequency Band	Delta Peak to band emission (dBc)	＞Limit (dBc)	Result
BLE Mdoe			
2390	50.06	20	Pass
2483.5	54.74	20	Pass

2M PHY

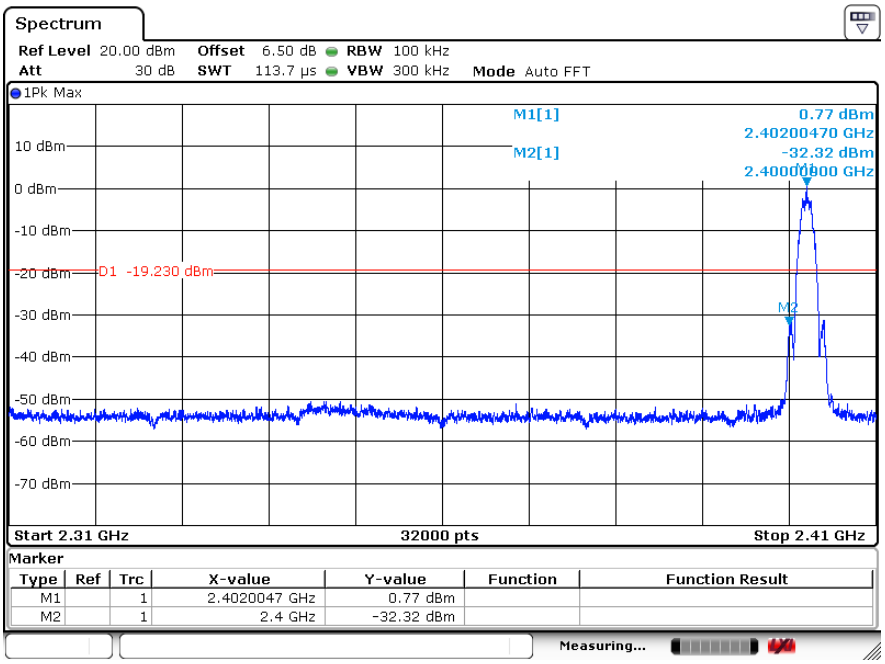
Frequency Band	Delta Peak to band emission (dBc)	＞Limit (dBc)	Result
BLE Mdoe			
2390	33.09	20	Pass
2483.5	52.61	20	Pass

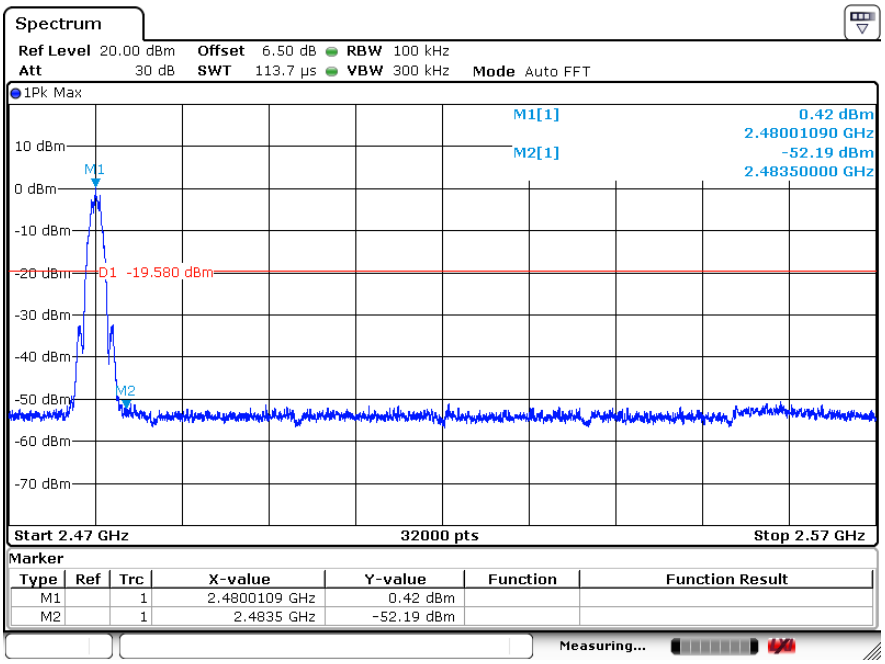
1M PHY


Spectrum
Ref Level 20.00 dBm Offset 6.50 dB RBW 100 kHz
Att 30 dB SWT 113.7 µs VBW 300 kHz Mode Auto FFT
1Pk Max
M1[1] 0.82 dBm
2.40200780 GHz
M2[1] -49.24 dBm
2.40000000 GHz
D1 -19.180 dBm
Start 2.31 GHz 32000 pts Stop 2.41 GHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.4020078 GHz 0.82 dBm
M2 1 2.4 GHz -49.24 dBm
Measuring...


Spectrum
Ref Level 20.00 dBm Offset 6.50 dB RBW 100 kHz
Att 30 dB SWT 113.7 µs VBW 300 kHz Mode Auto FFT
1Pk Max
M1[1] 0.40 dBm
2.48001090 GHz
M2[1] -54.34 dBm
2.48350000 GHz
D1 -19.600 dBm
Start 2.47 GHz 32000 pts Stop 2.57 GHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.4800109 GHz 0.40 dBm
M2 1 2.4835 GHz -54.34 dBm
Measuring...

2M PHY


Spectrum
Ref Level 20.00 dBm Offset 6.50 dB RBW 100 kHz
Att 30 dB SWT 113.7 µs VBW 300 kHz Mode Auto FFT
1Pk Max
M1[1] 0.77 dBm
2.40200470 GHz
M2[1] -32.32 dBm
2.40000000 GHz
D1 -19.230 dBm
Start 2.31 GHz 32000 pts Stop 2.41 GHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.4020047 GHz 0.77 dBm
M2 1 2.4 GHz -32.32 dBm
Measuring...


Spectrum
Ref Level 20.00 dBm Offset 6.50 dB RBW 100 kHz
Att 30 dB SWT 113.7 µs VBW 300 kHz Mode Auto FFT
1Pk Max
M1[1] 0.42 dBm
2.48001090 GHz
M2[1] -52.19 dBm
2.48350000 GHz
D1 -19.580 dBm
Start 2.47 GHz 32000 pts Stop 2.57 GHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.4800109 GHz 0.42 dBm
M2 1 2.4835 GHz -52.19 dBm
Measuring...

8. Conducted Spurious Emissions

8.1. Test Equipment

Item	Equipment	Manufacturer	Model No.	Serial No.	Calibrated until	Calibrated Date
1	Spectrum analyzer	KEYSIGHT	N9010A	MY55150427	05/26/2020	05/27/2019
2	Attenuator	Mini-Circuits	BW-S10W2	101109	12/17/2019	12/18/2018
3	RF Cable	Micable	C10-01-01-1	100309	12/17/2019	12/18/2018
4	Spectrum analyzer	R&S	FSV40	101470	06/28/2020	06/29/2019

8.2. 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.

8.3. Test Procedure

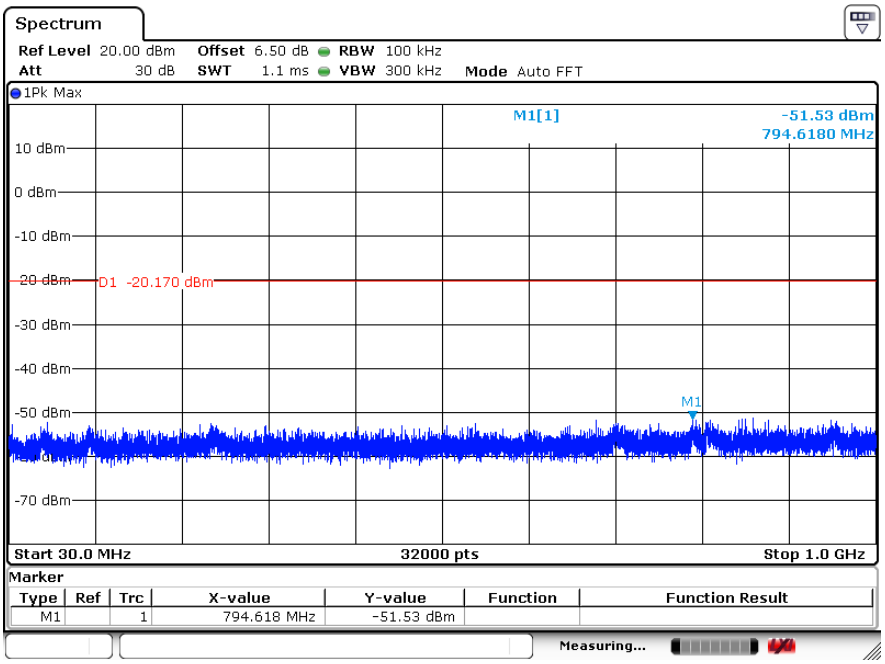
The transmitter output was connected to a spectrum analyzer, The resolution bandwidth is set to 100 kHz, The video bandwidth is set to 300 kHz and measure all the emissions detected.

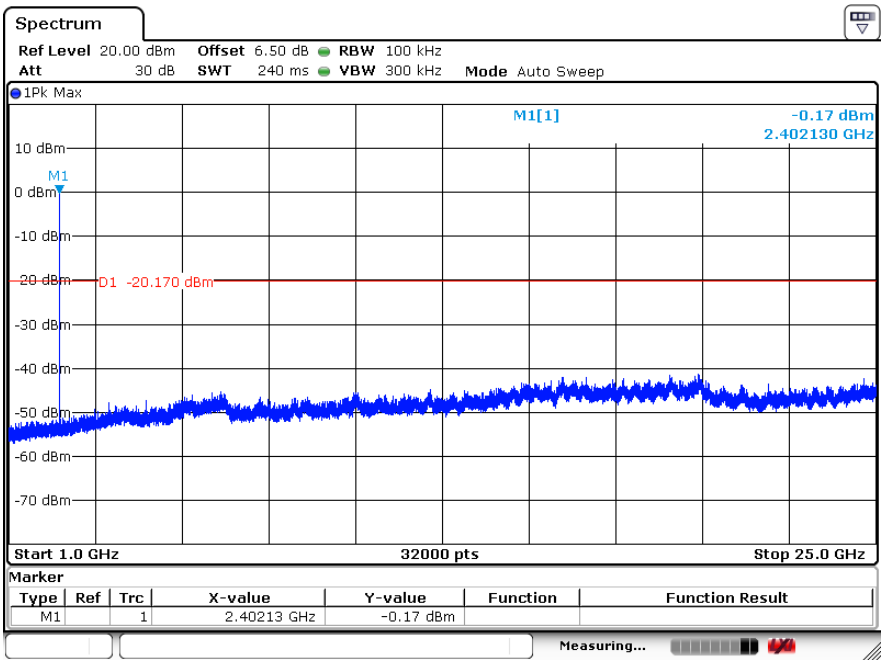
8.4. Test result

PASS (**See below detailed test result**.)

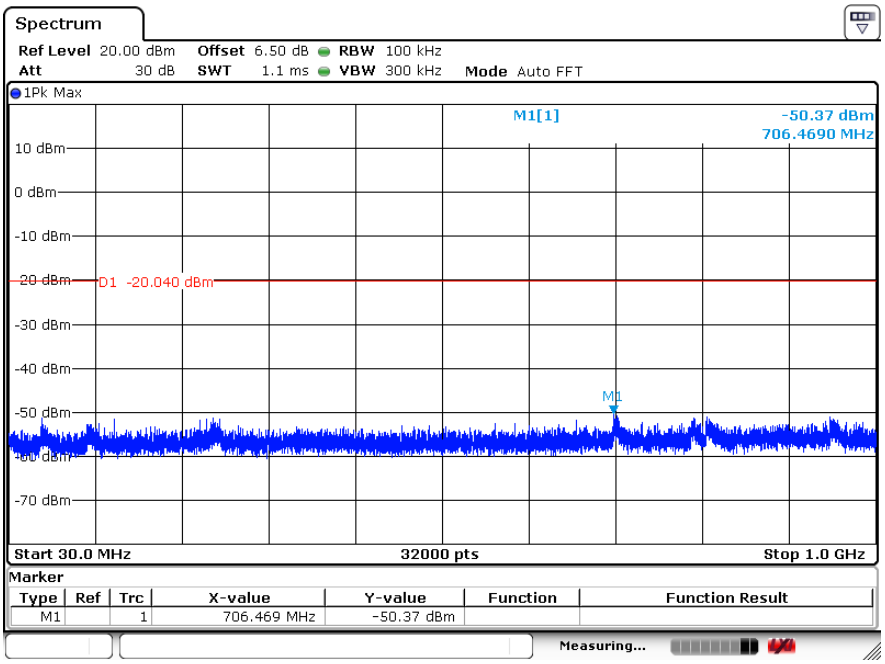
1M PHY

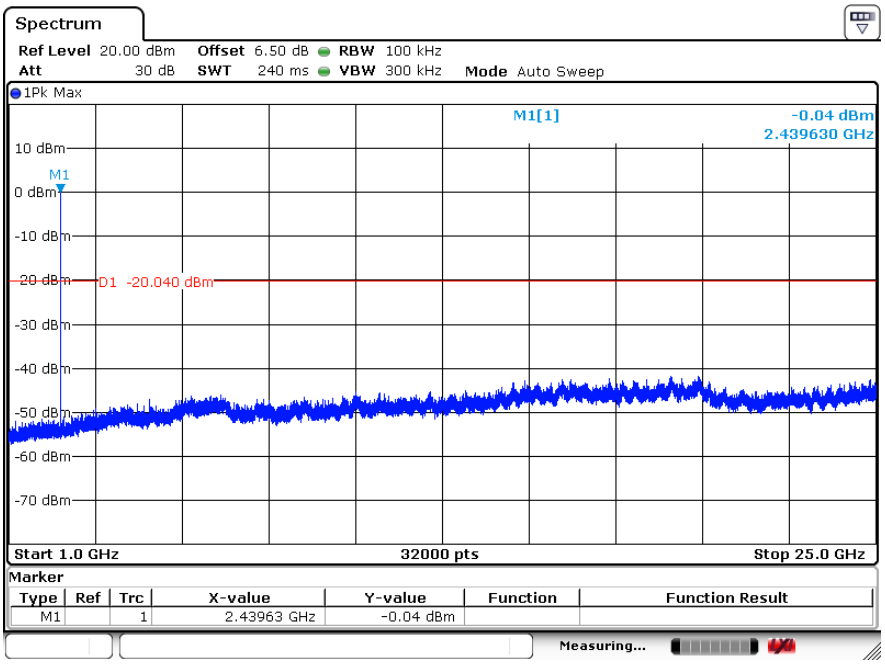
CH00



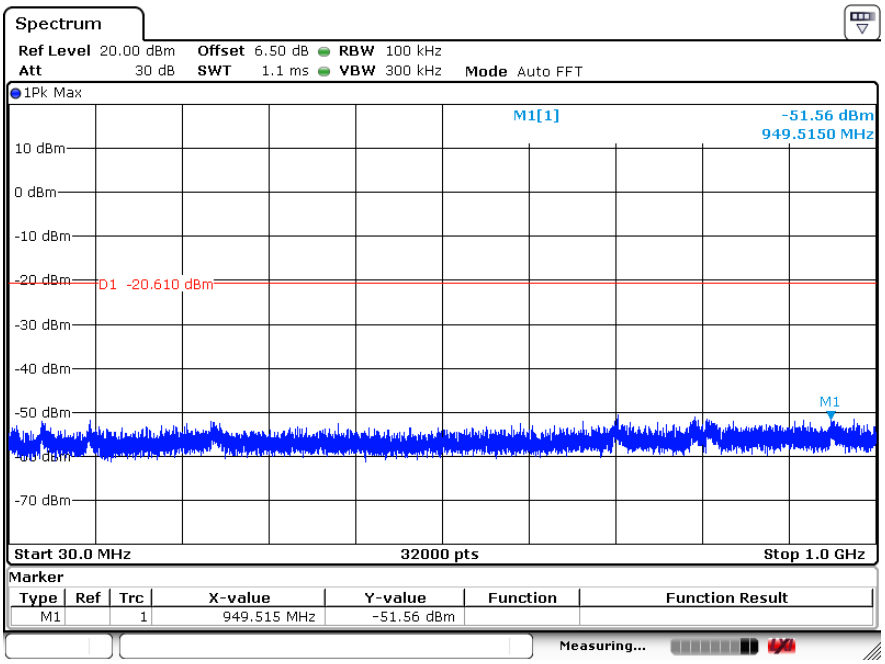


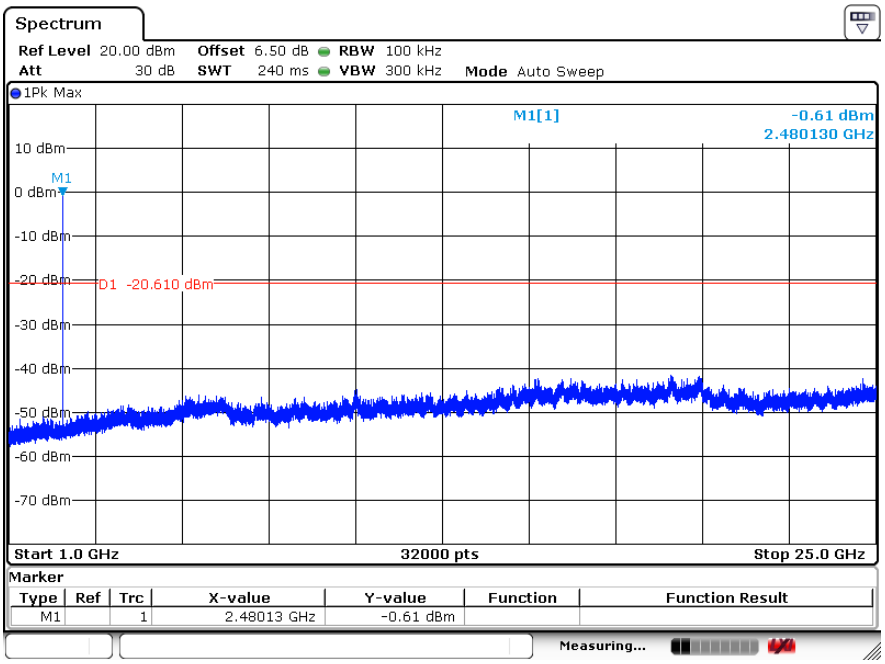
CH19


Spectrum
Ref Level 20.00 dBm Offset 6.50 dB RBW 100 kHz
Att 30 dB SWT 1.1 ms VBW 300 kHz Mode Auto FFT
1Pk Max
M1[1] -50.37 dBm
706.4690 MHz
10 dBm
0 dBm
-10 dBm
-20 dBm
D1 -20.040 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
Start 30.0 MHz 32000 pts Stop 1.0 GHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 706.469 MHz -50.37 dBm
Measuring...


Spectrum
Ref Level 20.00 dBm Offset 6.50 dB RBW 100 kHz
Att 30 dB SWT 240 ms VBW 300 kHz Mode Auto Sweep
1Pk Max
M1[1] -0.04 dBm
2.439630 GHz
10 dBm
M1
0 dBm
-10 dBm
-20 dBm
D1 -20.040 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
Start 1.0 GHz 32000 pts Stop 25.0 GHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.43963 GHz -0.04 dBm
Measuring...

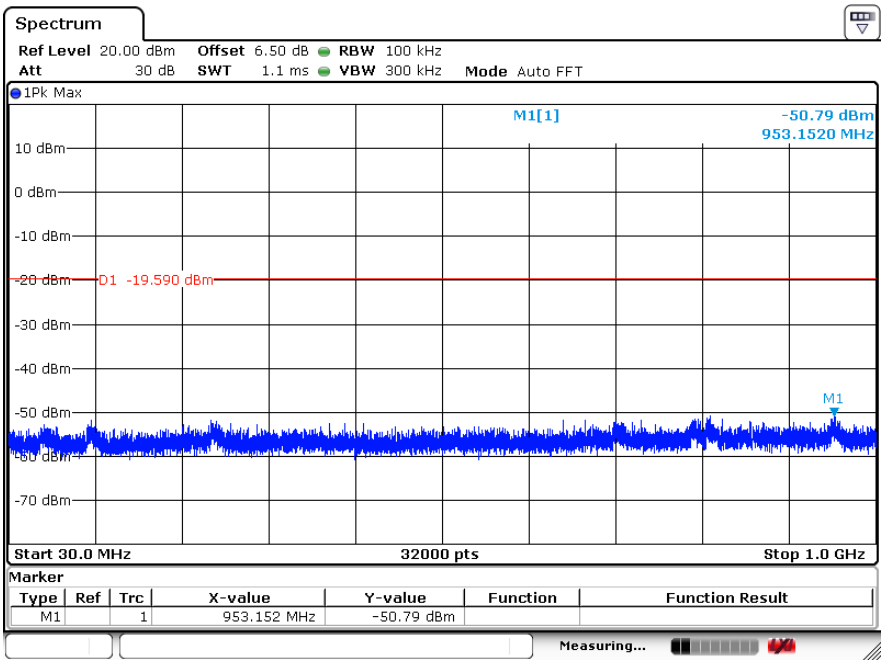
CH39

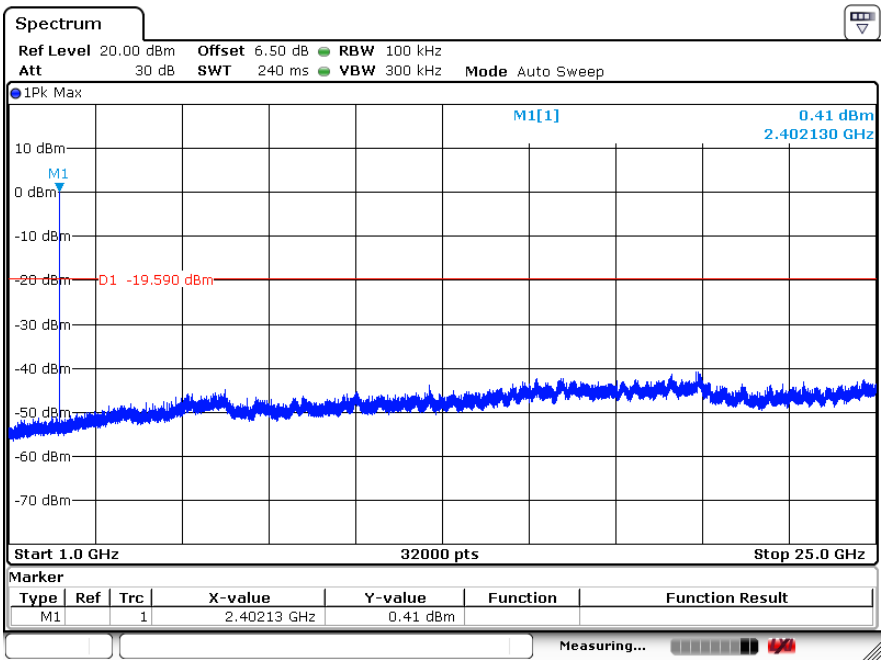

Spectrum
Ref Level 20.00 dBm Offset 6.50 dB RBW 100 kHz
Att 30 dB SWT 1.1 ms VBW 300 kHz Mode Auto FFT
1Pk Max
M1[1] -51.56 dBm
949.5150 MHz
10 dBm
0 dBm
-10 dBm
-20 dBm
D1 -20.610 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
Start 30.0 MHz 32000 pts Stop 1.0 GHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 949.515 MHz -51.56 dBm
Measuring...


Spectrum
Ref Level 20.00 dBm Offset 6.50 dB RBW 100 kHz
Att 30 dB SWT 240 ms VBW 300 kHz Mode Auto Sweep
1Pk Max
M1[1] -0.61 dBm
2.480130 GHz
10 dBm
M1
0 dBm
-10 dBm
-20 dBm
D1 -20.610 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
Start 1.0 GHz 32000 pts Stop 25.0 GHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.48013 GHz -0.61 dBm
Measuring...

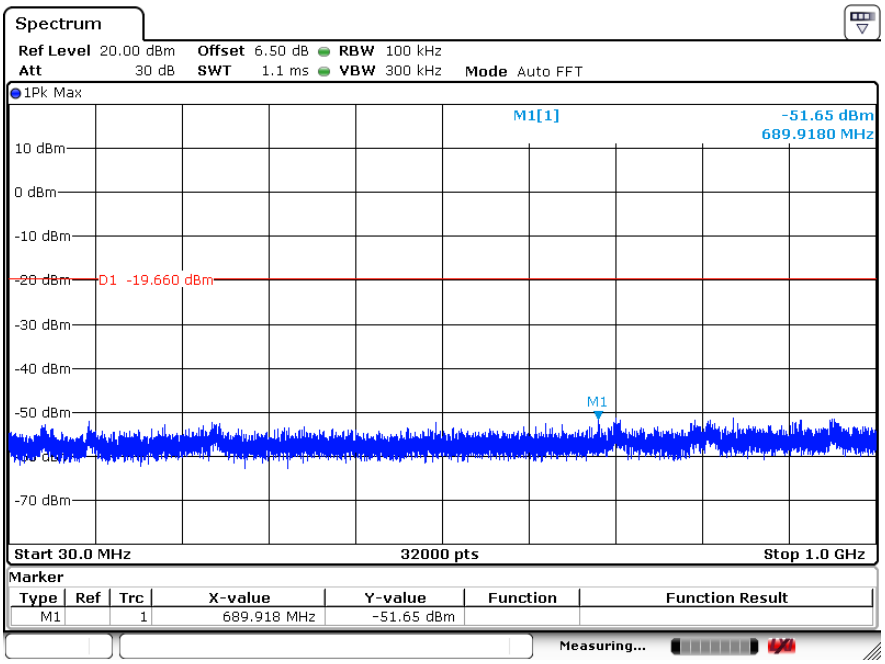
2M PHY

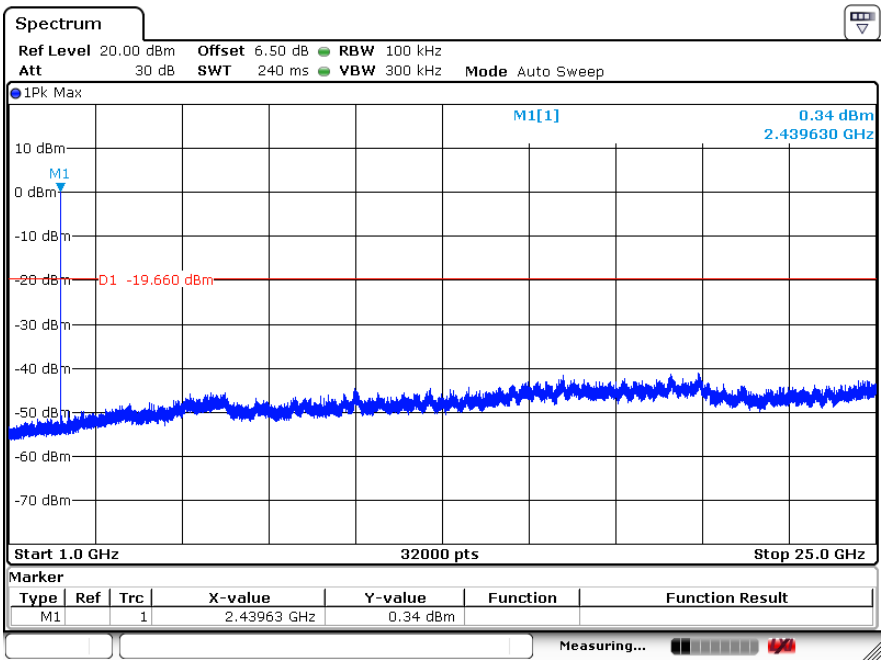
CH00


Spectrum
Ref Level 20.00 dBm Offset 6.50 dB RBW 100 kHz
Att 30 dB SWT 1.1 ms VBW 300 kHz Mode Auto FFT
1Pk Max
M1[1] -50.79 dBm
953.1520 MHz
10 dBm
0 dBm
-10 dBm
-20 dBm
D1 -19.590 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
M1
Start 30.0 MHz 32000 pts Stop 1.0 GHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 953.152 MHz -50.79 dBm
Measuring...

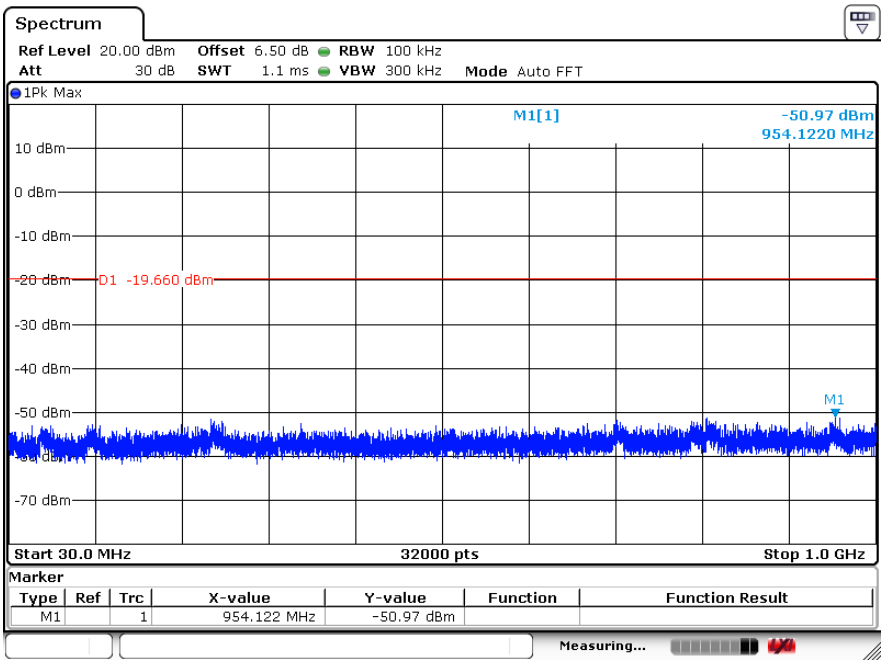

Spectrum
Ref Level 20.00 dBm Offset 6.50 dB RBW 100 kHz
Att 30 dB SWT 240 ms VBW 300 kHz Mode Auto Sweep
1Pk Max
M1[1] 0.41 dBm
2.402130 GHz
10 dBm
M1
0 dBm
-10 dBm
-20 dBm
D1 -19.590 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
Start 1.0 GHz 32000 pts Stop 25.0 GHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.40213 GHz 0.41 dBm
Measuring...

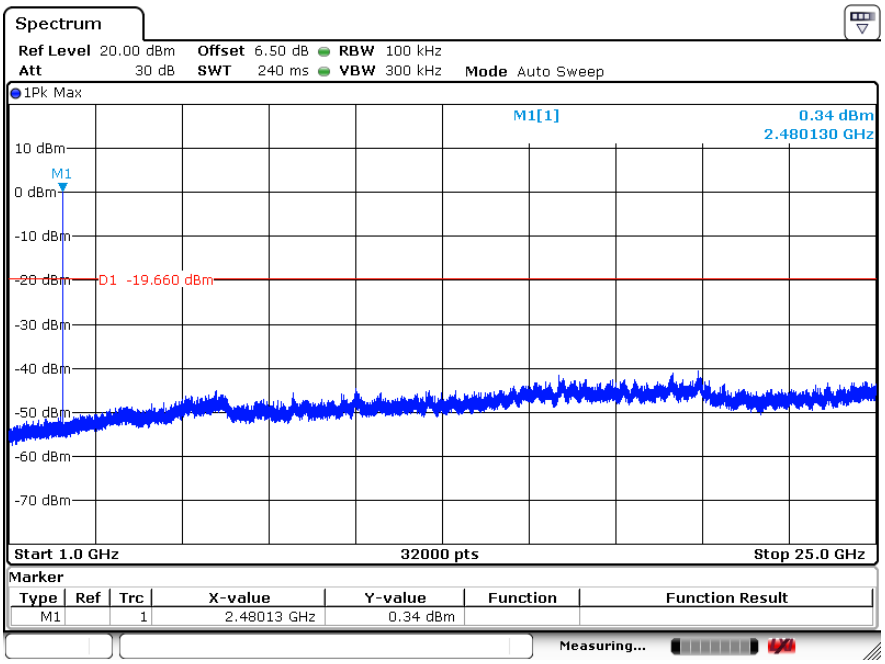
CH19


Spectrum
Ref Level 20.00 dBm Offset 6.50 dB RBW 100 kHz
Att 30 dB SWT 1.1 ms VBW 300 kHz Mode Auto FFT
1Pk Max
M1[1] -51.65 dBm
689.9180 MHz
10 dBm
0 dBm
-10 dBm
-20 dBm
D1 -19.660 dBm
-30 dBm
-40 dBm
-50 dBm
M1
-70 dBm
Start 30.0 MHz 32000 pts Stop 1.0 GHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 689.918 MHz -51.65 dBm
Measuring...


Spectrum
Ref Level 20.00 dBm Offset 6.50 dB RBW 100 kHz
Att 30 dB SWT 240 ms VBW 300 kHz Mode Auto Sweep
1Pk Max
M1[1] 0.34 dBm
2.439630 GHz
10 dBm
M1
0 dBm
-10 dBm
-20 dBm
D1 -19.660 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
Start 1.0 GHz 32000 pts Stop 25.0 GHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.43963 GHz 0.34 dBm
Measuring...

CH39


Spectrum
Ref Level 20.00 dBm Offset 6.50 dB RBW 100 kHz
Att 30 dB SWT 1.1 ms VBW 300 kHz Mode Auto FFT
1Pk Max
M1[1] -50.97 dBm
954.1220 MHz
10 dBm
0 dBm
-10 dBm
-20 dBm
D1 -19.660 dBm
-30 dBm
-40 dBm
-50 dBm
-70 dBm
M1
Start 30.0 MHz 32000 pts Stop 1.0 GHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 954.122 MHz -50.97 dBm
Measuring...

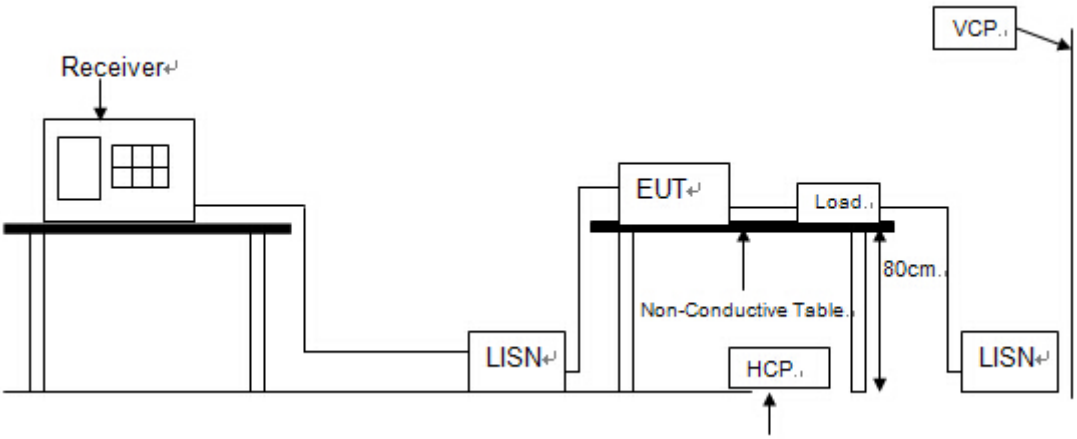

Spectrum
Ref Level 20.00 dBm Offset 6.50 dB RBW 100 kHz
Att 30 dB SWT 240 ms VBW 300 kHz Mode Auto Sweep
1Pk Max
M1[1] 0.34 dBm
2.480130 GHz
10 dBm
M1
0 dBm
-10 dBm
-20 dBm
D1 -19.660 dBm
-30 dBm
-40 dBm
-50 dBm
-60 dBm
-70 dBm
Start 1.0 GHz 32000 pts Stop 25.0 GHz
Marker
Type Ref Trc X-value Y-value Function Function Result
M1 1 2.48013 GHz 0.34 dBm
Measuring...

9 Power Line Conducted Emission

9.1 Test equipment

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Pulse Limiter	MTS-systemtechnik	MTS-IMP-136	261115-010-0024	12/17/2019
2	EMI Test Receiver	R&S	ESCI	101308	12/17/2019
3	LISN	AFJ	LS16	16011103219	12/17/2019
4	LISN	Schwarzbeck	NSLK 8127	8127-432	12/17/2019
5	Measurement Software	Farad	EZ-EMC (Ver.ATT-03A)	N/A	N/A
6	MeasurementSoftware	Farad	EZ-EMC (Ver.ATT-03A)	N/A	N/A

9.2 Block diagram of test setup



9.3 Power Line Conducted Emission Limits(Class B)

Frequency	Quasi-Peak Level dB(μV)	Average Level dB(μV)
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.

9.4 Test Procedure

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 10.2 of this report.

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.

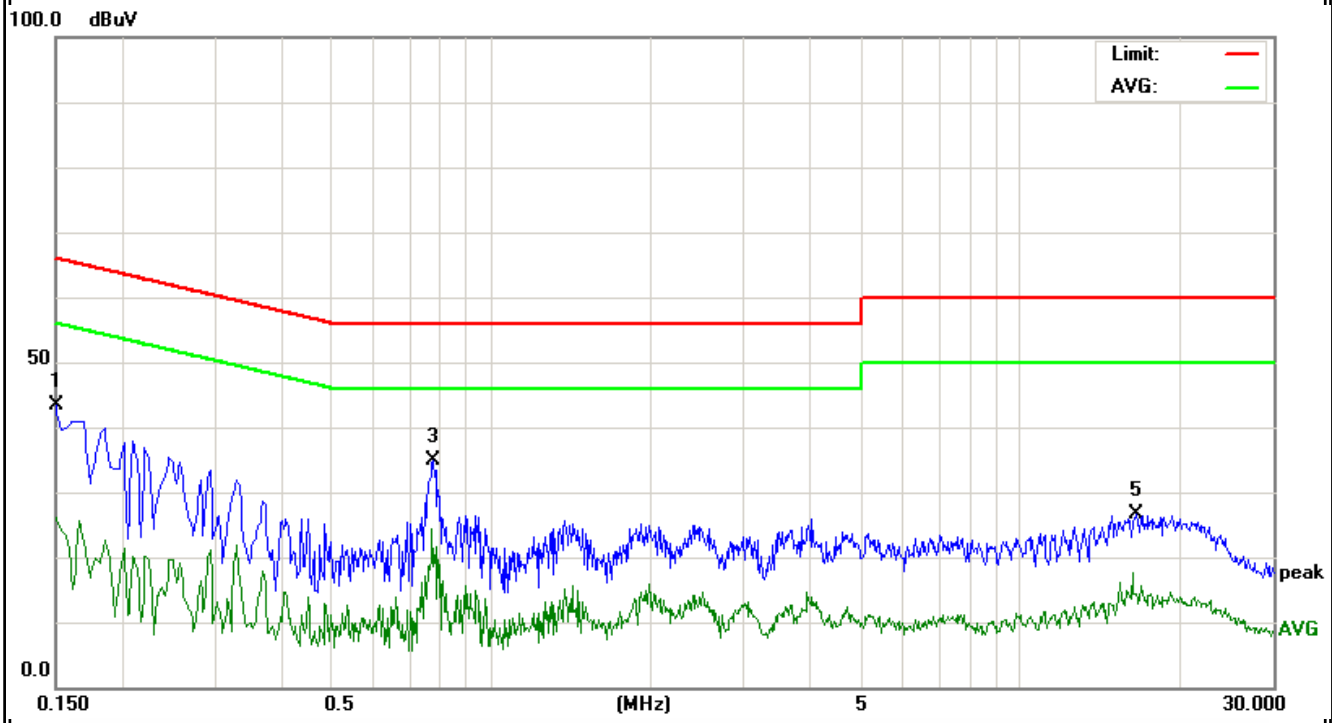
9.5 Test Result

PASS. (See below detailed test result)

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

NOTE2: "-----" MEANS PEAK DETECTION; "-----" MANS AVERAGE DETECTION

EUT:	**TWS Earphones**	**Model No.:**	**X2**
Temperature:	**23℃**	**Relative Humidity:**	**52%**
		Test Power:	**AC 120V/60Hz**
Probe:	**N**	**Test Result:**	**Pass**
Test Time:	**2019-07-11**	**Test By:**	
Standard:	**(CE)FCC PART 15 class B_QP**		
Test Mode:	**TX** (1M worst mode)		
Note:			

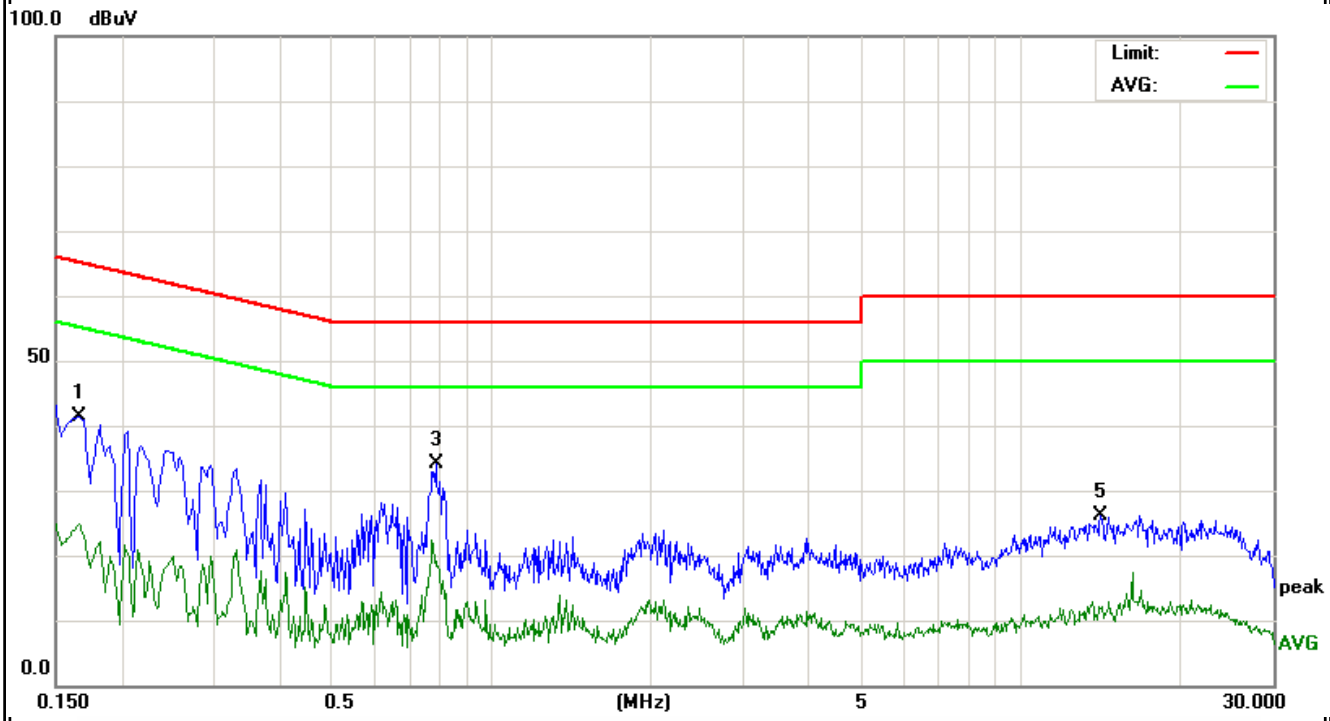


No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		0.1500	31.36	11.94	43.30	65.99	-22.69	peak
2		0.1500	14.21	11.94	26.15	55.99	-29.84	AVG
3	*	0.7780	24.95	9.97	34.92	56.00	-21.08	peak
4		0.7780	14.34	9.97	24.31	46.00	-21.69	AVG
5		16.5260	15.89	10.63	26.52	60.00	-33.48	peak
6		16.5260	6.98	10.63	17.61	50.00	-32.39	AVG

The test result is calculated as the following:

(1) Result = Reading + Correct Factor
(2) Correct Factor = (LISN, ISN, PLC or Current Probe) Factor + Cable Loss +Attenuator
(3) Margin = Result - Limit

EUT:	**TWS Earphones**	**Model No.:**	**X2**
Temperature:	**23℃**	**Relative Humidity:**	**52%**
		Test Power:	**AC 120V/60Hz**
Probe:	**L1**	**Test Result:**	**Pass**
Test Time:	**2019-07-11**	**Test By:**	
Standard:	**(CE)FCC PART 15 class B_QP**		
Test Mode:	**TX** (1M worst mode)		
Note:			



No.	Mk.	Freq.	Reading Level	Correct Factor	Measure-ment	Limit	Over	
		MHz	dBuV	dB	dBuV	dBuV	dB	Detector
1		0.1660	29.70	11.61	41.31	65.15	-23.84	peak
2		0.1660	13.33	11.61	24.94	55.15	-30.21	AVG
3	*	0.7860	24.21	9.96	34.17	56.00	-21.83	peak
4		0.7860	12.37	9.96	22.33	46.00	-23.67	AVG
5		14.1540	15.75	10.39	26.14	60.00	-33.86	peak
6		14.1540	6.91	10.39	17.30	50.00	-32.70	AVG

The test result is calculated as the following:

(1) Result = Reading + Correct Factor
(2) Correct Factor = (LISN, ISN, PLC or Current Probe) Factor + Cable Loss +Attenuator
(3) Margin = Result - Limit

10. Antenna Requirements

10.1. Limit

For intentional device, according to FCC 47 CFR 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. And according to FCC 47 CFR Section 15.247 (b), if transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6dBi.

10.2. Result

The antennas used for this product are built-in undetachable Internal antenna and that no antenna other than that furnished by the responsible party shall be used with the device, the maximum peak gain of the transmit antenna is only 1dBi. The EUT has an internal antenna, the directional gain of antenna is 1 dBi, and the antenna connector is designed with permanent attachment and no consideration of replacement. Therefore the EUT is considered sufficient to comply with the provision.