



# **FCC Radio Test Report** FCC ID:2AFAX-BDSX

The report concerns: Original Grant

Report Reference No 19	EAFS12022 4591
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Date Sample(s) Received.....: 2019-12-04

Date of Tested.....: 2019-12-04~2019-12-19

Date of issue....: 2019-12-20

Testing Laboratory .....: DongGuan ShuoXin Electronic Technology Co., Ltd.

Zone A, 1F, No. 6, XinGang Road YuanGang Street,

XinAn District, ChangAn Town, DongGuan City, Address .....:

GuangDong, China

BOOMPODS (HK) LTD. Applicant's name .....:

RM 303-304 Hankow Centre 5-15. Hankow Road Address .....:

T.S.T. Kowloon, HONG KONG.

Dongguan Linyar Technology Co.,Ltd. Manufacturer....:

true wireless earphone Equipment....:

N/A Trade Mark .....:

boombuds x Model ....:

Ratings ....: I/P: DC 3.7V by Li-ion Battery

Charging by micro-usb DC 5V

Responsible Engineer:

Authorized Signatory:



Table of Contents	Page
1 . TEST REPORT DECLARE	5
2 . SUMMARY OF TEST RESULTS	6
2.1 MEASUREMENT UNCERTAINTY	7
3. GENERAL INFORMATION	8
3.1 GENERAL DESCRIPTION OF EUT	8
3.2 DESCRIPTION OF TEST MODES	10
3.3 PARAMETERS OF TEST SOFTWARE	11
3.4 BLOCKDIAGRAMSHOWINGTHECONFIGURATIONOFSYSTEMTESTED	11
3.5 SUPPORT UNITS	11
3.6 TEST ENVIRONMENT CONDITIONS	12
4 .AC POWER LINE CONDUCTED EMISSIONS TEST	13
4.1 LIMIT	13
4.2 TEST PROCEDURE	13
4.3 MEASUREMENT INSTRUMENTS LIST	13
4.4 TESTSETUP	14
4.5 EUT OPERATING CONDITIONS 4.6 TEST RESULTS	14 15
5 . RADIATED EMISSION TEST	17
5.1 LIMIT 5.2 TEST PROCEDURE AND SETTING	17 18
5.2 TEST PROCEDURE AND SETTING  5.3 MEASUREMENT INSTRUMENTS LIST	19
5.4 TESTSETUP	19
5.5 EUT OPERATING CONDITIONS	20
5.6 TEST RESULTS - 9 KHZ TO 30MHZ	21
5.7 TEST RESULTS- 30 MHZ TO 1000MHZ	22
5.8 TEST RESULTS - ABOVE 1000MHZ(BAND EDGE)	24
5.9 TEST RESULTS - ABOVE 1000MHZ(HARMONIC)	32
6 .NUMBER OF HOPPING FREQUENCY	44
6.1 LIMIT	44
6.2 TEST PROCEDURE AND SETTING	44
6.3 MEASUREMENT INSTRUMENTS LIST	44
6.4 TEST SETUP	44



Table of Contents	Page
6.5 EUT OPERATION CONDITIONS	44
6.6 TEST RESULTS	45
7 .AVERAGE TIME OF OCCUPANCY	46
7.1 LIMIT	46
7.2 TEST PROCEDURE AND SETTING	46
7.3 MEASUREMENT INSTRUMENTS LIST	46
7.4 TEST SETUP	46
7.5 EUT OPERATION CONDITIONS	46
7.6 TEST RESULTS	47
8 .HOPPING CHANNEL SEPARATION MEASUREMENT	49
8.1 LIMIT	49
8.2 TEST PROCEDURE AND SETTING	49
8.3 MEASUREMENT INSTRUMENTS LIST	49
8.4 TEST SETUP	49
8.5 EUT OPERATION CONDITIONS	49
8.6 TEST RESULTS	50
9 .BANDWIDTH TEST	52
9.1 LIMIT	52
9.2 TEST PROCEDURE AND SETTING	52
9.3 MEASUREMENT INSTRUMENTS LIST	52
9.4 TEST SETUP	52
9.5 EUT OPERATION CONDITIONS	52
9.6 TEST RESULTS	53
10 .MAXIMUM OUTPUT POWER	55
10.1 LIMIT	55
10.2 TEST PROCEDURE AND SETTING	55
10.3 MEASUREMENT INSTRUMENTS LIST	55
10.4 TEST SETUP	55
10.5 EUT OPERATION CONDITIONS	55
10.6 TEST RESULTS	56
11 .CONDUCTED SPURIOUS EMISSION	59
11.1 LIMIT	59
11.2 TEST PROCEDURE AND SETTING	59
11.3 MEASUREMENT INSTRUMENTS LIST	59





Table of Contents	Page
44.4.TEOT.OETUD	
11.4 TEST SETUP	59
11.5 EUT OPERATION CONDITIONS 11.6 TEST RESULTS	59
11.0 IESI RESULIS	60



# 1. TEST REPORT DECLARE

Applicant	BOOMPODS (HK) LTD.
Address	RM 303-304 Hankow Centre 5-15, Hankow Road T.S.T. Kowloon, HONG KONG.
Manufacturer	Dongguan Linyar Technology Co.,Ltd.
Address	No.2,PujiangRoad,DaningCommunity,Humen,Dongguan,Guangdong,China.
Factory	Dongguan Linyar Technology Co.,Ltd.
Address	No.2,PujiangRoad,DaningCommunity,Humen,Dongguan,Guangdong,China.
Equipment Name	true wireless earphone
Model No.	boombuds x
Trade Mark	N/A
Standard	FCC Part15, Subpart C (15.247) ANSI C63.10-2013

### 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.



# 2. SUMMARY OF TEST RESULTS

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

Standard(s	) Section	Test Item	Judgment	Remark
FCC	ISED	lest itelli	Judgment	Kelliaik
15.207		AC Power Line Conducted Emissions	PASS	
15.247(d) 15.205(a) 15.209(a)		Radiated Emission	PASS	
15.247(a)(1)(iii)		Number of Hopping Frequency	PASS	
15.247(a)(1)(iii)		Average Time Of Occupancy	PASS	
15.247(a)(1)		Hopping Channel Separation	PASS	
15.247(a)(1)		Bandwidth	PASS	
15.247(a)(1)		Maximum Output Power	PASS	
15.247(d)		Conducted Spurious Emission	PASS	
		Frequency Stability	N/A	
15.203	-	Antenna Requirement	PASS	Note(2)

### Note:

- (1) "N/A" denotes test is not applicable in this test report
- (2) The device what use a permanently attached antenna were considered sufficient to comply with the provisions of 15.203.



# **2.1MEASUREMENT UNCERTAINTY**

Test Item	Uncertainty
Uncertainty for Conductionemission 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)
Officertainty for Radiation Emission test (30km/2-200km/2)	4.60 dB (Polarize: H)
Upportainty for Padiation Emission toot (200MHz 10Hz)	6.10 dB (Polarize: V)
Uncertainty for Radiation Emission test (200MHz-1GHz)	5.08 dB (Polarize: H)
Uncertainty for Dadiction Emission test (1011-0011-)	5.01 dB (Polarize: V)
Uncertainty for Radiation Emission test (1GHz-6GHz)	5.01 dB (Polarize: H)
Upportainty for Padiation Emission tost (60Hz 190Hz)	5.26 dB (Polarize: V)
Uncertainty for Radiation Emission test (6GHz-18GHz)	5.26 dB (Polarize: H)
Lineartainty for Dadiction Emission toot (1901 - 4001 -)	5.06 dB (Polarize: V)
Uncertainty for Radiation Emission test (18GHz-40GHz)	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. GENERAL INFORMATION

# 3.1 GENERAL DESCRIPTION OF EUT

Equipment	true wireless earphone		
Brand Name	N/A		
Test Model	boombuds x		
Series Model	1		
Model Difference(s)	1		
Hardware Version	V2.1		
Software Version	V1.1		
Power Rating	Charging by micro-usb DC 5V DC 3.7V by Li-ion Battery		
Operation Frequency	2402 MHz ~ 2480 MHz		
Modulation Technology	GFSK, π/4-DQPSK, 8-DPSK		
Bit Rate of Transmitter	1Mbps /2Mbps /3Mbps		
Antenna Information	Antenna Type: Chip	Maximum Peak Gain:3.19dBi	
Max. Output Power	1Mbps: 1.895 dBm (0.001547 W 2Mbps: 3.031 dBm (0.002010 W 3Mbps: 3.048 dBm (0.002017 W	ý)	

# Note:

1. For a more detailed features description, please refer to the manufacturer's specifications or the user's manual.





# 2. Channel List:

Channel	Frequency (MHz)	Channel	Frequency (MHz)	Channel	Frequency (MHz)
00	2402	27	2429	54	2456
01	2403	28	2430	55	2457
02	2404	29	2431	56	2458
03	2405	30	2432	57	2459
04	2406	31	2433	58	2460
05	2407	32	2434	59	2461
06	2408	33	2435	60	2462
07	2409	34	2436	61	2463
08	2410	35	2437	62	2464
09	2411	36	2438	63	2465
10	2412	37	2439	64	2466
11	2413	38	2440	65	2467
12	2414	39	2441	66	2468
13	2415	40	2442	67	2469
14	2416	41	2443	68	2470
15	2417	42	2444	69	2471
16	2418	43	2445	70	2472
17	2419	44	2446	71	2473
18	2420	45	2447	72	2474
19	2421	46	2448	73	2475
20	2422	47	2449	74	2476
21	2423	48	2450	75	2477
22	2424	49	2451	76	2478
23	2425	50	2452	77	2479
24	2426	51	2453	78	2480
25	2427	52	2454		
26	2428	53	2455		



### 3.2 DESCRIPTION OF TEST MODES

The test system was pre-tested based on the consideration of all possible combinations of EUT operation mode.

Pretest Mode	Description
Mode 1	TX Mode <b>note (1)</b>
Mode 2	TX Mode Channel 00 _3Mbps

Following mode(s) was (were) found to be the worst case(s) and selected for the final test.

AC power line conducted emissions test		
Final Test Mode	Description	
Mode 2	TX Mode Channel 00 _3Mbps	

Radiated emissions test - Below 1GHz		
Final Test Mode	Description	
Mode 2	TX Mode Channel 00 _3Mbps	

Radiated emissions test - Above 1GHz				
Final Test Mode Description				
Mode 1 TXMode NOTE (1)				

Conducted test				
Final Test Mode Description				
Mode 1	TX Mode <b>note (1)</b>			

#### Note:

- (1) The measurements are performed at the high, middle, low available channels.
- (2) The measurements for Hopping Channel Separation, Bandwidth and Maximum Output Powerwere tested during 1Mbps, 2Mbps and 3Mbps, the worst case are 1Mbps and 3Mbps, onlyworst case was documented.

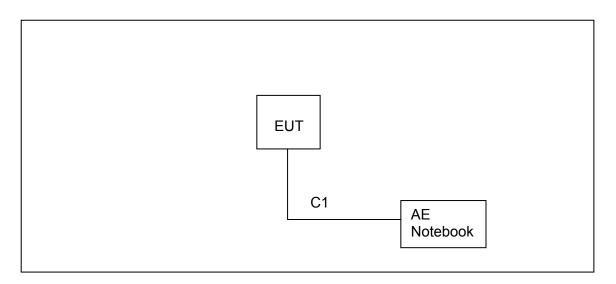


### 3.3PARAMETERS OF TEST SOFTWARE

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

Test Software	BT-Tool				
Frequency (MHz)	2402	2441	2480		
Parameters(1Mbps)	7	7	7		
Parameters(2Mbps)	7	7	7		
Parameters(3Mbps)	7	7	7		

### 3.4BLOCKDIAGRAMSHOWINGTHECONFIGURATIONOFSYSTEMTESTED



### **3.5SUPPORT UNITS**

Item	Equipment	Brand	Model No.	Series No.
AE	Notebook	ACER	MS2367	32807810766

Item	Cable Type	Shielded Type	Ferrite Core	Length
C1	DC Cable	NO	NO	0.8m





# **3.6TEST ENVIRONMENT CONDITIONS**

Test Item	Temperature	Humidity	Test Voltage
AC Power Line Conducted Emissions	25°C	53%	DC 5V
Radiated Emissions-9K-30MHz	25°C	60%	DC 3.7V
Radiated Emissions-30 MHz to 1GHz	24°C	68%	DC 3.7V
Radiated Emissions-Above 1000 MHz	24°C	68%	DC 3.7V
Number of Hopping Frequency	24.8°C	40.9%	DC 3.7V
Average Time Of Occupancy	24.8°C	40.9%	DC 3.7V
Hopping Channel Separation	24.8°C	40.9%	DC 3.7V
Bandwidth	24.8°C	40.9%	DC 3.7V
Maximum Output Power	24.8°C	40.9%	DC 3.7V
Conducted Spurious Emission	24.8°C	40.9%	DC 3.7V



### 4.AC POWER LINE CONDUCTED EMISSIONS TEST

#### 4.1LIMIT

Fraguency of Emission (MHz)	Limit (dBμV)			
Frequency of Emission (MHz)	Quasi-peak	Average		
0.15 - 0.50	66 to 56*	56 to 46*		
0.50 - 5.0	56	46		
5.0 - 30.0	60	50		

#### Note:

(1) The tighter limit applies at the band edges.

(2) The limit of " \* " marked band means the limitation decreases linearly with the logarithm of the frequency in the range.

The following table is the setting of the receiver

Receiver Parameters	Setting
Attenuation	10 dB
Start Frequency	0.15 MHz
Stop Frequency	30 MHz
IF Bandwidth	9 kHz

#### **4.2TEST PROCEDURE**

- a. The EUT was placed 0.8 meters from the horizontal ground plane with EUT being connected to the power mains through a line impedance stabilization network (LISN). All other support equipmentpowered from additional LISN(s). The LISN provide 50 Ohm/ 50uH of coupling impedance for the measuring instrument.
- b. Interconnecting cables that hang closer than 40 cm to the groundplane shall be folded back and forth in the center forming a bundle 30 to 40 cm long.
- c. I/O cables that are not connected to a peripheral shall be bundled in the center. The end of the cable may be terminated, if required, using the correct terminating impedance. The overall length shall not exceed 1 m.
- d. LISN at least 80 cm from nearest part of EUT chassis.

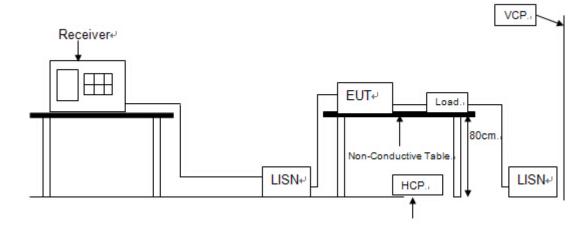
#### **4.3MEASUREMENT INSTRUMENTS LIST**

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Pulse Limiter	MTS-systemtec hnik	MTS-IMP-136	261115-010-0024	12/11/2020
2	EMI Test Receiver	R&S	ESCI	101308	12/13/2020
3	LISN	AFJ	LS16	16011103219	06/09/2020
4	LISN	Schwarzbeck	NSLK 8127	8127-432	12/11/2020
5	Measurement Software	Farad	EZ-EMC (Ver.ATT-03A)	N/A	N/A

Report No.: 19EAFS12022 4591



# **4.4TESTSETUP**



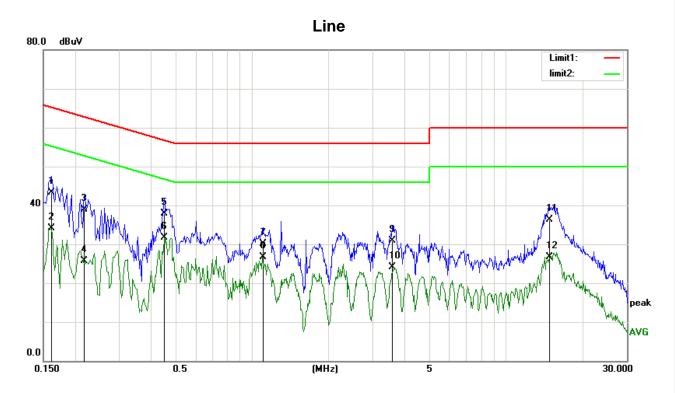
# **4.5EUT OPERATING CONDITIONS**

The EUT was configured for testing in a typical function (as a customer would normally use it), EUT was programmed to be in continuouslytransmitting data or hopping on mode.



# **4.6TEST RESULTS**

Test Mode: TX Mode Channel 00 \_3Mbps



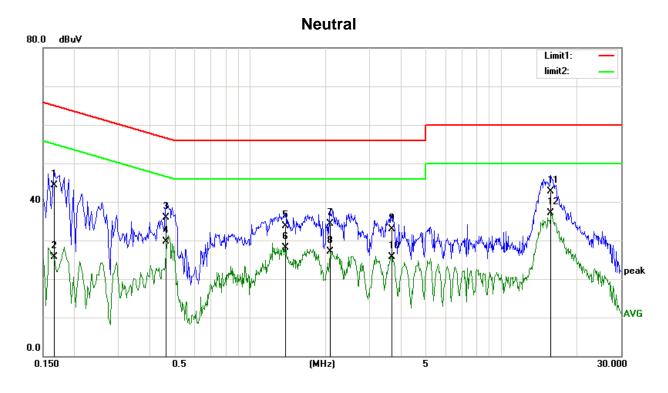
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)	
1	0.1620	31.87	11.39	43.26	65.36	-22.10	QP
2	0.1620	22.67	11.39	34.06	55.36	-21.30	AVG
3	0.2180	27.98	11.00	38.98	62.89	-23.91	QP
4	0.2180	14.69	11.00	25.69	52.89	-27.20	AVG
5	0.4500	27.75	10.24	37.99	56.87	-18.88	QP
6	0.4500	21.52	10.24	31.76	46.87	-15.11	AVG
7	1.1019	19.92	10.10	30.02	56.00	-25.98	QP
8	1.1019	16.54	10.10	26.64	46.00	-19.36	AVG
9	3.5780	20.70	10.15	30.85	56.00	-25.15	QP
10	3.5780	13.94	10.15	24.09	46.00	-21.91	AVG
11	14.9059	26.08	10.17	36.25	60.00	-23.75	QP
12	14.9059	16.63	10.17	26.80	50.00	-23.20	AVG

### Remarks:

- (1) Measurement Value = Reading Level + Correct Factor.(2) Margin Level = Measurement Value Limit Value.



Test Mode: TX Mode Channel 00 \_3Mbps



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV)	Factor(dB)	(dBuV)	(dBuV)	(dB)	
1	0.1660	32.89	11.36	44.25	65.15	-20.90	QP
2	0.1660	14.29	11.36	25.65	55.15	-29.50	AVG
3	0.4660	25.74	10.22	35.96	56.58	-20.62	QP
4	0.4660	19.47	10.22	29.69	46.58	-16.89	AVG
5	1.3819	23.59	10.10	33.69	56.00	-22.31	QP
6	1.3819	17.99	10.10	28.09	46.00	-17.91	AVG
7	2.0819	24.14	10.11	34.25	56.00	-21.75	QP
8	2.0819	16.95	10.11	27.06	46.00	-18.94	AVG
9	3.6779	22.70	10.15	32.85	56.00	-23.15	QP
10	3.6779	15.63	10.15	25.78	46.00	-20.22	AVG
11	15.7460	32.53	10.16	42.69	60.00	-17.31	QP
12	15.7460	27.00	10.16	37.16	50.00	-12.84	AVG

# Remarks:

- (1) Measurement Value = Reading Level + Correct Factor.(2) Margin Level = Measurement Value Limit Value.



### 5. RADIATED EMISSION TEST

#### **5.1LIMIT**

In case the emission fall within the restricted band specified on15.205(a), then the 15.209(a) limit in the table below has to be followed.

# LIMITS OF RADIATED EMISSION MEASUREMENT (9 kHz-1000MHz)

Frequency	Field Strength	Measurement Distance
(MHz)	(microvolts/meter)	(meters)
0.009-0.490	2400/F(kHz)	300
0.490-1.705	24000/F(kHz)	30
1.705-30.0	30	30
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

### LIMITS OF RADIATED EMISSION MEASUREMENT (9 kHz-30 MHz)

Frequency	Magnetic field strength (H-Field)	Measurement Distance
(MHz)	(μA/m)	(meters)
0.009-0.490	6.37/F(kHz)	300
0.490-1.705	6.37/F(kHz)	30
1.705-30.0	0.08	30

### LIMITS OF RADIATED EMISSION MEASUREMENT (30 MHz-1000MHz)

Frequency	Field Strength
(MHz)	(μV/m at 3m)
30-88	100
88-216	150
216-960	200
Above 960	500

# LIMITS OF RADIATED EMISSION MEASUREMENT (Above 1000MHz)

Frequency (MHz)	(dBuV/m at 3 m)			
Frequency (Miriz)	Peak	Average		
Above 1000	74	54		

#### Note:

- (1) The limit for radiated test was performed according to FCC PART 15C
- (2) The tighter limit applies at the band edges.
- (3) Emission level (dBuV/m)=20log Emission level (uV/m).

Report No.: 19EAFS12022 4591



#### **5.2TEST PROCEDURE AND SETTING**

- a. The measuring distance of 3 m shall be used for measurements. The EUT was placed on the top of a rotating table 0.8 meter above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.(below 1GHz)
- b. The measuring distance of 3 m shall be used for measurements. The EUT was placed on the top of a rotating table 1.5 meter above the ground at a 3 meter semi-anechoic chamber. The table was rotated 360 degrees to determine the position of the highest radiation.(above 1GHz)
- c. The height of the equipment or of the substitution antenna shall be 0.8m or 1.5m; the height of the test antenna shall vary between 1 m to 4 m. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
- d. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights find the maximum reading (used Bore sight function).
- e. The receiver system was set to peak and average detect function and specified bandwidth with maximum hold mode when the test frequency is above 1GHz.
- f. The initial step in collecting radiated emission data is a receiver peak detector mode pre-scanning the measurement frequency range. Significant peaks are then marked and then Quasi Peak detector mode re-measured.
- g. All readings are Peak unless otherwise stated QP in column of Note. Peak denotes that the Peak reading compliance with the QP Limits and then QP Mode measurement didn't perform. (below 1GHz)
- h. All readings are Peak Mode value unless otherwise stated AVG in column of Note. If the Peak Mode Measured value compliance with the Peak Limits and lower than AVG Limits, the EUT shall be deemed to meet both Peak & AVG Limits and then only Peak Mode was measured, but AVG Mode didn't perform. (above 1GHz)
- i: Measurement Value = Reading Level + Correct Factor.
   Correct Factor = Antenna Factor + Cable Loss Amplifier Gain + Attenuator
   Margin Level = Measurement Value Limit Value.

Spectrum Parameter	Setting		
Attenuation	Auto		
Start Frequency	1000 MHz		
Stop Frequency	10th carrier harmonic		
RBW / VBW	RBW 1MHz VBW 3MHz peak detector for Pk value		
(Emission in restricted band)	RMS detector for AV value		

Receiver Parameter	Setting
Attenuation	Auto
Start ~ Stop Frequency	9 kHz~90 kHz for PK/AVG detector
Start ~ Stop Frequency	90 kHz~110 kHz for QP detector
Start ~ Stop Frequency	110 kHz~490 kHz for PK/AVG detector
Start ~ Stop Frequency	490 kHz~30 MHz for QP detector
Start ~ Stop Frequency	30MHz~1000MHz for QP detector

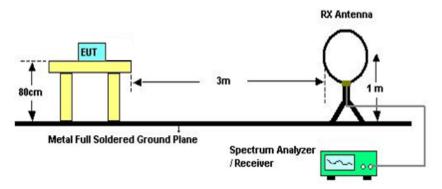


# **5.3MEASUREMENT INSTRUMENTS LIST**

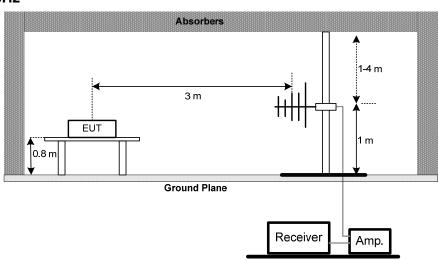
Ite	Kind of Equipment	Type No.	Manufacturer	Serial No.	Calibrated
m					until
1	EMI Test Receiver	ESCI	R&S	101307	12/12/2020
2	Spectrum Analyzer	E4407B	Agilent	US40240708	11/17/2020
3	Loop antenna	FMZB1519	SCHWARZBECK K	1519-062	12/14/2020
4	Broadband antenna	VULB9168	SCHWARZBECK	VULB9168-192	03/22/2020
5	HORN ANTENNA	BBHA9120D	SCHWARZBECK	BBHA 9120D 1065	04/22/2020
6	Preamplifier Amplifier	8447F	HP	3113A05680	12/11/2020
7	PRE-AMPLIFIER	EMC011830	CY	980136	12/11/2020
8	RF Cable	Test Cable 4	R&S	4	12/11/2020
9	RF Cable	Test Cable 5	R&S	5	12/11/2020
10	RF Cable	Test Cable 9	R&S	9	04/22/2020
11	RF Cable	Test Cable 10	R&S	10	12/11/2020

# **5.4TESTSETUP**

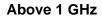
# 9 kHz-30 MHz

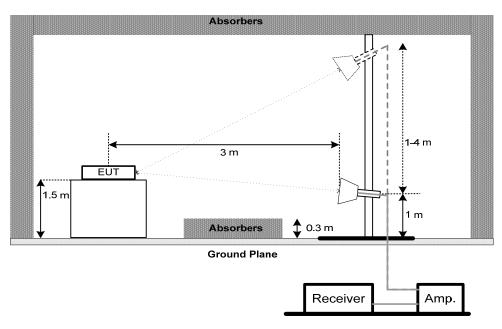


# 30 MHz to 1 GHz









# **5.5EUT OPERATING CONDITIONS**

The EUT was programmed to be in continuously transmitting mode.



# 5.6TEST RESULTS - 9 kHz TO 30MHz

EUT:	true wireless earphone	Model No.:	boombuds x
Temperature:	24℃	Relative Humidity:	55%
Distance:	3m	Test Power:	DC 5V
Polarization:		Test Result:	Pass
Test Mode:	TX Mode Channel 00 3Mbps	Test By:	Sky Peng

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

### Note:

The amplitude of spurious emissions which are attenuated by more than 20dB below the permissible value

has no need to be reported.

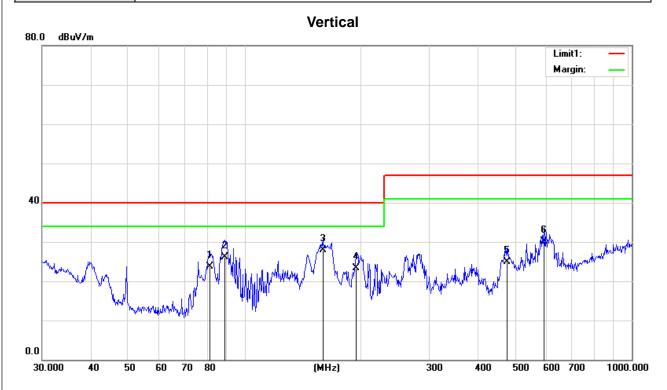
Distance extrapolation factor =20 log (specific distance/test distance)(dB);

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



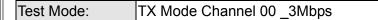
# 5.7TEST RESULTS- 30 MHz TO 1000MHz

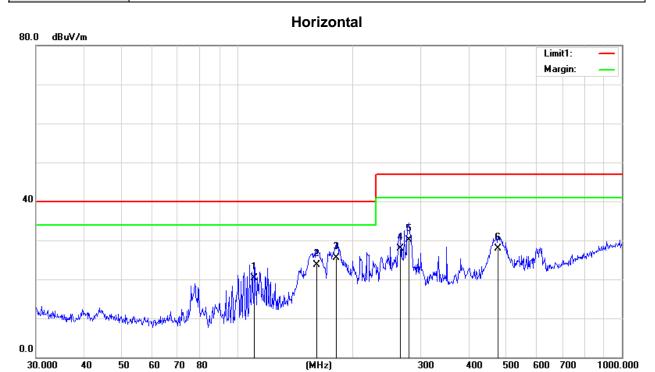
Test Mode: TX Mode Channel 00 \_3Mbps



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	81.4969	39.18	-15.49	23.69	40.00	-16.31	QP
2	88.9637	41.24	-15.19	26.05	40.00	-13.95	QP
3	159.2250	39.61	-11.76	27.85	40.00	-12.15	QP
4	193.7727	34.95	-11.62	23.33	40.00	-16.67	QP
5	477.1693	30.89	-6.00	24.89	47.00	-22.11	QP
6	593.0497	33.57	-3.55	30.02	47.00	-16.98	QP





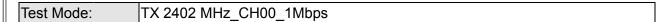


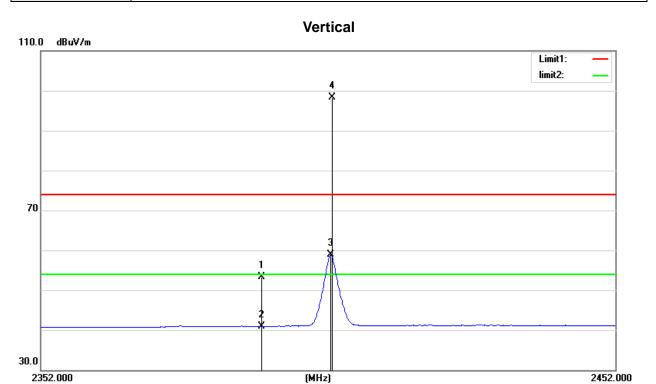
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	110.9571	34.46	-14.23	20.23	40.00	-19.77	QP
2	160.9089	36.16	-12.47	23.69	40.00	-16.31	QP
3	180.6488	35.21	-9.76	25.45	40.00	-14.55	QP
4	265.6757	32.93	-4.95	27.98	47.00	-19.02	QP
5	280.0237	35.08	-5.06	30.02	47.00	-16.98	QP
6	475.4991	34.37	-6.38	27.99	47.00	-19.01	QP





# 5.8TEST RESULTS - ABOVE 1000MHz(BAND EDGE)





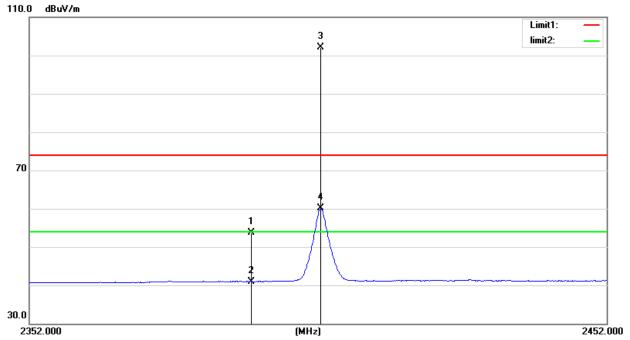
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2390.000	21.65	31.62	53.27	74.00	-20.73	peak
2	2390.000	9.31	31.62	40.93	54.00	-13.07	AVG
3	2402.000	27.21	31.64	58.85	/	/	AVG
4	2402.200	66.65	31.65	98.30	/	/	peak







# Horizontal

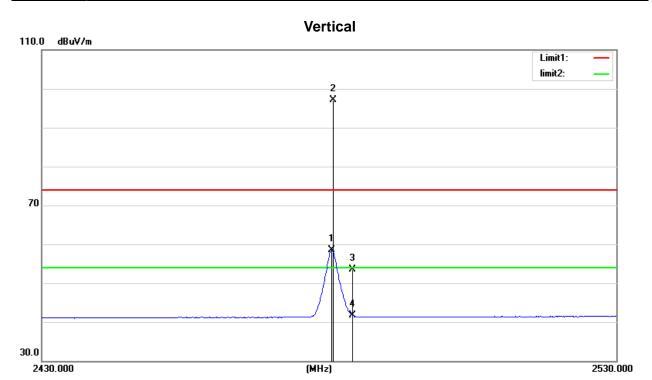


No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2390.000	22.00	31.62	53.62	74.00	-20.38	peak
2	2390.000	9.37	31.62	40.99	54.00	-13.01	AVG
3	2401.900	70.43	31.64	102.07	/	/	peak
4	2402.000	28.47	31.64	60.11	/	/	AVG





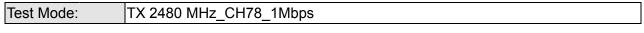


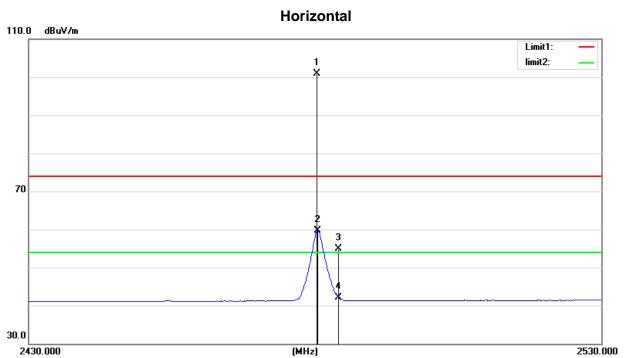


No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2479.900	26.65	31.88	58.53	/	/	AVG
2	2480.200	65.14	31.88	97.02	/	/	peak
3	2483.500	21.70	31.89	53.59	74.00	-20.41	peak
4	2483.500	9.82	31.89	41.71	54.00	-12.29	AVG





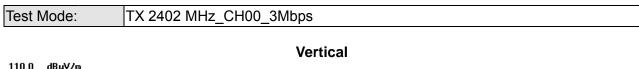


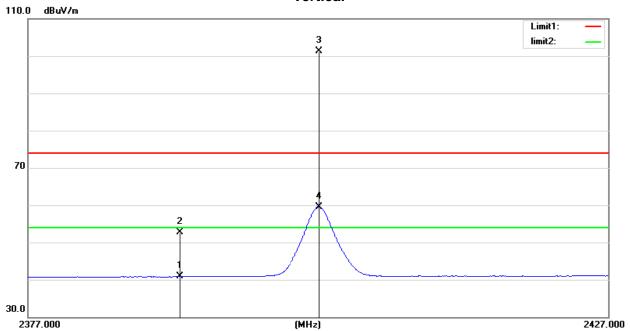


No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2479.800	68.93	31.88	100.81	/	/	peak
2	2480.000	27.85	31.88	59.73	/	/	AVG
3	2483.500	22.97	31.89	54.86	74.00	-19.14	peak
4	2483.500	10.29	31.89	42.18	54.00	-11.82	AVG









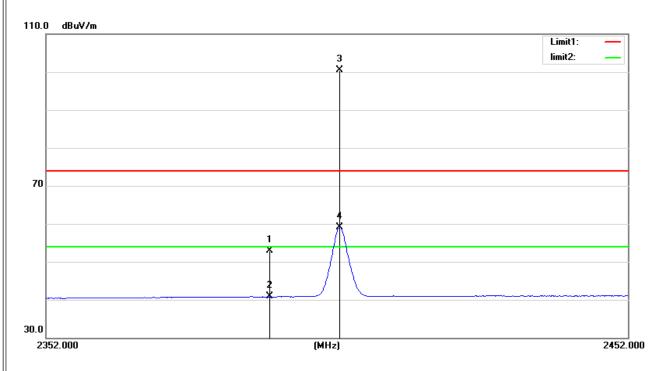
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2390.000	9.19	31.62	40.81	54.00	-13.19	AVG
2	2390.000	21.13	31.62	52.75	74.00	-21.25	peak
3	2401.950	69.76	31.64	101.40	/	/	peak
4	2402.000	27.83	31.64	59.47	/	/	AVG





Test Mode: TX 2402 MHz\_CH00\_3Mbps

# Horizontal

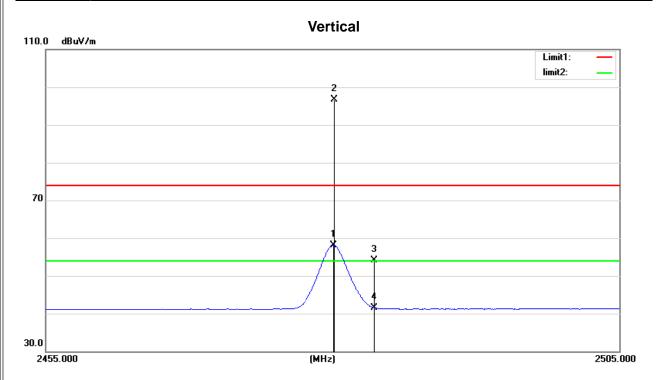


No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2390.000	21.29	31.62	52.91	74.00	-21.09	peak
2	2390.000	9.19	31.62	40.81	54.00	-13.19	AVG
3	2401.900	68.94	31.64	100.58	/	/	peak
4	2402.000	27.51	31.64	59.15	/	/	AVG





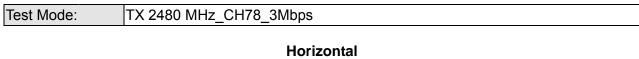


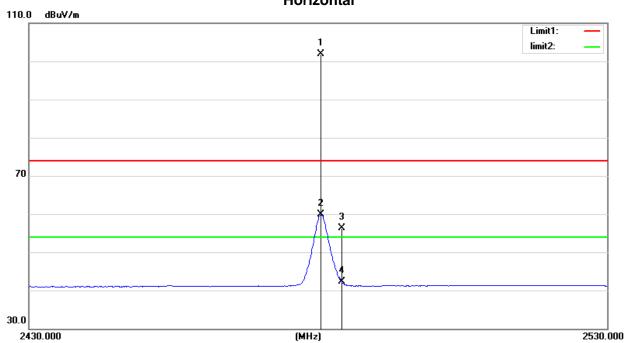


No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2480.000	26.20	31.88	58.08	/	/	AVG
2	2480.050	64.84	31.88	96.72	/	/	peak
3	2483.500	22.30	31.89	54.19	74.00	-19.81	peak
4	2483.500	9.66	31.89	41.55	54.00	-12.45	AVG









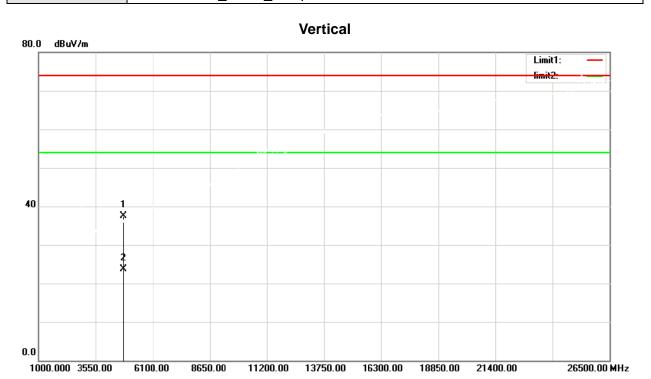
No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	2480.000	70.02	31.88	101.90	/	/	peak
2	2480.000	27.96	31.88	59.84	/	/	AVG
3	2483.500	24.37	31.89	56.26	74.00	-17.74	peak
4	2483.500	10.33	31.89	42.22	54.00	-11.78	AVG





# 5.9TEST RESULTS - ABOVE 1000MHz(HARMONIC)

Test Mode: TX 2402 MHz\_CH00\_1Mbps



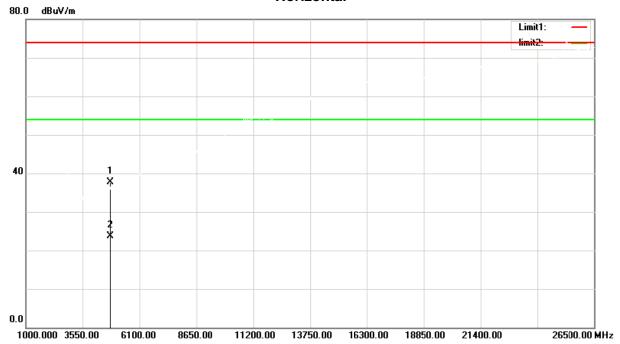
N	0.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
		(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	1	4804.000	40.77	-3.33	37.44	74.00	-36.56	peak
2	2	4804.000	27.02	-3.33	23.69	54.00	-30.31	AVG





Test Mode: TX 2402 MHz\_CH00\_1Mbps

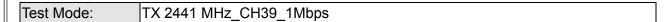
# Horizontal

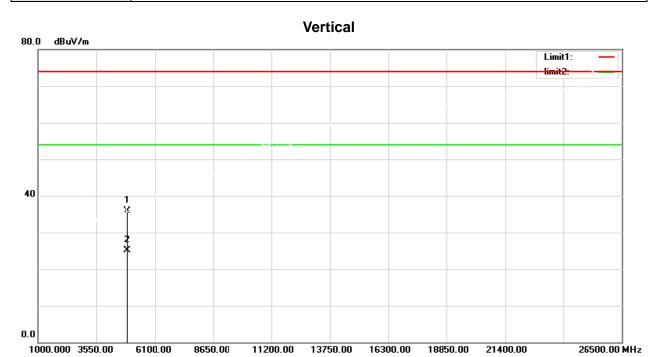


No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	4804.000	41.02	-3.33	37.69	74.00	-36.31	peak
2	4804.000	27.02	-3.33	23.69	54.00	-30.31	AVG









	No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
		(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
Ī	1	4882.000	38.90	-3.03	35.87	74.00	-38.13	peak
	2	4882.000	28.15	-3.03	25.12	54.00	-28.88	AVG



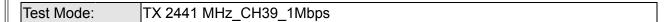
0.0

1000.000 3550.00

6100.00

8650.00







No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	4882.000	39.13	-3.03	36.10	74.00	-37.90	peak
2	4882.000	26.69	-3.03	23.66	54.00	-30.34	AVG

16300.00 18850.00

21400.00

26500.00 MHz

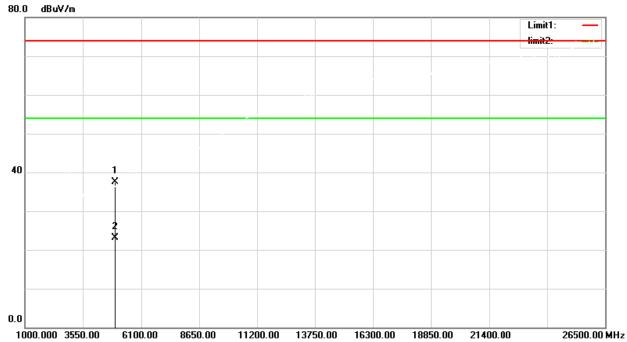
11200.00 13750.00





Test Mode: TX 2480 MHz\_CH78\_1Mbps





No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	4960.000	40.28	-2.74	37.54	74.00	-36.46	peak
2	4960.000	25.84	-2.74	23.10	54.00	-30.90	AVG





Test Mode: TX 2480 MHz\_CH78\_1Mbps

# Horizontal

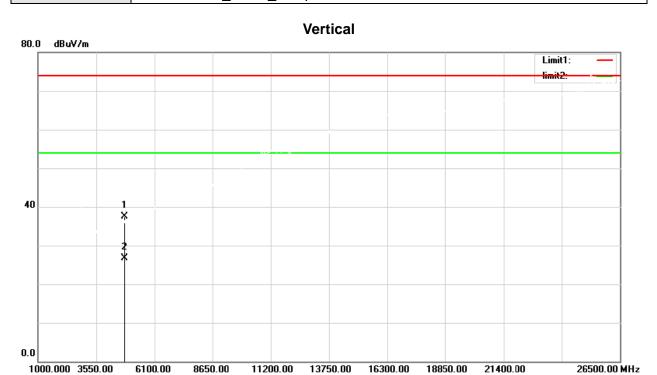


ı	No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
		(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
	1	4960.000	38.88	-2.74	36.14	74.00	-37.86	peak
ĺ	2	4960.000	25.85	-2.74	23.11	54.00	-30.89	AVG





Test Mode: TX 2402 MHz\_CH00\_3Mbps



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	4804.000	40.89	-3.33	37.56	74.00	-36.44	peak
2	4804.000	29.99	-3.33	26.66	54.00	-27.34	AVG





Test Mode: TX 2402 MHz\_CH00\_3Mbps

# Horizontal

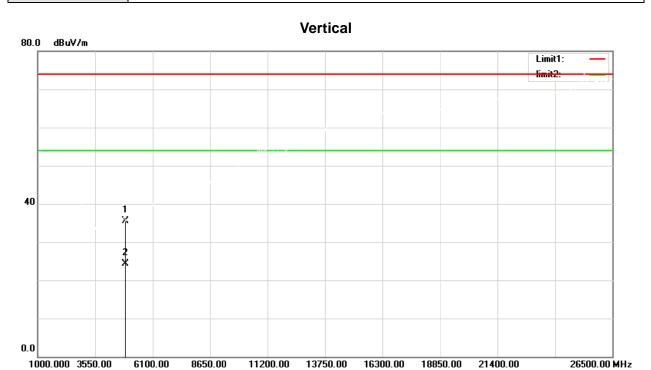


No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	4804.000	41.18	-3.33	37.85	74.00	-36.15	peak
2	4804.000	29.02	-3.33	25.69	54.00	-28.31	AVG





Test Mode: TX 2441 MHz\_CH39\_3Mbps



No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
	(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
1	4882.000	38.48	-3.03	35.45	74.00	-38.55	peak
2	4882.000	27.29	-3.03	24.26	54.00	-29.74	AVG





Test Mode: TX 2441 MHz\_CH39\_3Mbps

# Horizontal

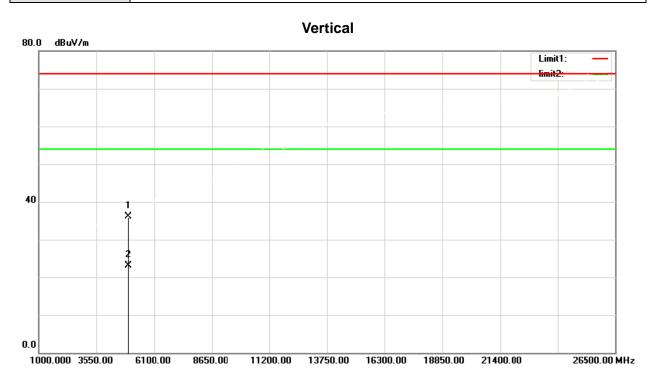


Į	No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
		(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
	1	4882.000	38.50	-3.03	35.47	74.00	-38.53	peak
	2	4882.000	28.39	-3.03	25.36	54.00	-28.64	AVG





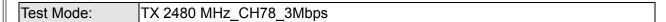
Test Mode: TX 2480 MHz\_CH78\_3Mbps



(MHz)         (dBuV/m)         Factor(dB/m)         (dBuV/m)         (dBuV/m)         (dB)           1         4960.000         38.85         -2.74         36.11         74.00         -37.89         p	nark
1 4960.000 38.85 -2.74 36.11 74.00 -37.89 p	
	ak
2 4960.000 25.84 -2.74 23.10 54.00 -30.90 A	/G











l	No.	Frequency	Reading	Correct	Result	Limit	Margin	Remark
		(MHz)	(dBuV/m)	Factor(dB/m)	(dBuV/m)	(dBuV/m)	(dB)	
ĺ	1	4960.000	38.57	-2.74	35.83	74.00	-38.17	peak
ĺ	2	4960.000	25.87	-2.74	23.13	54.00	-30.87	AVG



# **6.NUMBER OF HOPPING FREQUENCY**

#### 6.1LIMIT

FCC Part15, Subpart C (15.247)				
Section	Test Item			
15.247(a)(1)(iii)	Number of Hopping Frequency			

#### **6.2TEST PROCEDURE AND SETTING**

- a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- b. Spectrum Setting: RBW=100 kHz, VBW=100 kHz, Sweep time = Auto.

Spectrum Parameters	Setting
Attenuation	Auto
Span Frequency	> Operating Frequency Range
RBW	100kHz
VBW	300kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

#### **6.3MEASUREMENT INSTRUMENTS LIST**

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum analyzer	KEYSIGHT	N9010A	MY55150427	2020/05/27
2	Attenuator	Mini-Circuits	BW-S10W2	101109	2020/12/12
3	RF Cable	Mi-cable	C10-01-01-1	100309	2020/12/12

#### **6.4TEST SETUP**

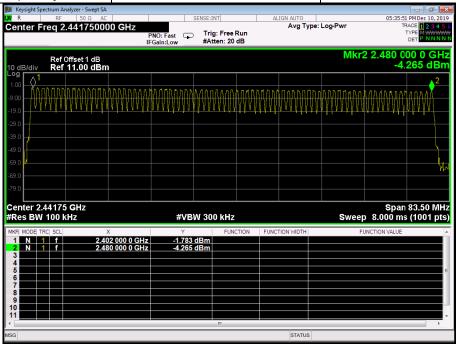
EUT	SPECTRUM
	ANALYZER

#### **6.5EUT OPERATION CONDITIONS**

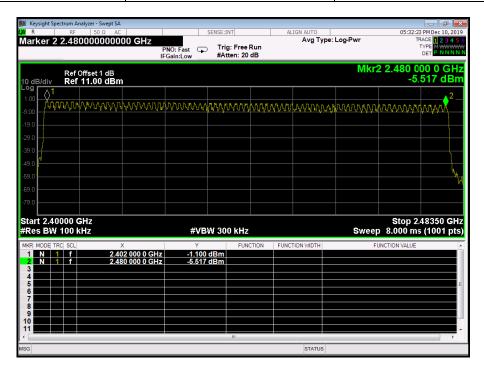


#### **6.6 TEST RESULTS**

	Hopping Mode_1Mbps	
Number of Hopping	Measurement result(CH)	Limit(CH)
Frequency	79	≥15



Hopping Mode_3Mbps				
Number of Hopping	Measurement result(CH)	Limit(CH)		
Frequency	79	≥15		





#### 7.AVERAGE TIME OF OCCUPANCY

# 7.1LIMIT

FCC Part15, Subpart C (15.247)		
Section Test Item Limit		
15.247(a)(1)(iii)	Average Time of Occupancy	0.4sec

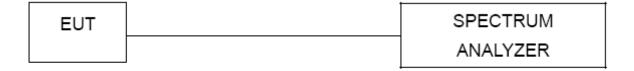
#### 7.2TEST PROCEDURE AND SETTING

- a. The transmitter output (antenna port) was connected to the spectrum analyzer
- b. Set RBW of spectrum analyzer to 1MHz and VBW to 1MHz
- c. Use a video trigger with the trigger level set to enabletriggering only on full pulses
- d. Sweep Time is more than once pulse time
- e. Set the center frequency on any frequency would be measure and set the frequency span to zero span
- f. Measure the maximum time duration of one single pulse
- g. Set the EUT for DH1, DH3 and DH5 packet transmitting
- h. Measure the maximum time duration of one single pulse
- i. DH1 Packet permit maximum 1600 / 79 / 2 = 10.12 hops per second in each channel (1 time slot TX, 1 time slot RX). So, the dwell time is the time duration of the pulse times  $10.12 \times 31.6 = 320$  within 31.6 seconds
- j. DH3 Packet permit maximum 1600 / 79 / 4 = 5.06 hops per second in each channel (3 time slotsTX, 1 time slot RX).So, the dwell time is the time duration of the pulse times 5.06 x 31.6 = 160 within 31.6 seconds
- k. DH5 Packet permit maximum 1600/ 79 / 6 = 3.37 hops per second in each channel (5 time slotsTX, 1 time slot RX).So, the dwell time is the time duration of the pulse times 3.37 x 31.6 = 106.6 within 31.6 seconds

#### 7.3MEASUREMENT INSTRUMENTS LIST

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum analyzer	KEYSIGHT	N9010A	MY55150427	2020/05/27
2	Attenuator	Mini-Circuits	BW-S10W2	101109	2020/12/12
3	RF Cable	Mi-cable	C10-01-01-1	100309	2020/12/12

# 7.4TEST SETUP



#### 7.5EUT OPERATION CONDITIONS

Report No.: 19EAFS12022 4591



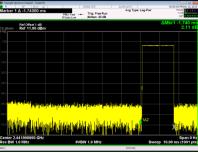
# 7.6 TEST RESULTS

	TX Mode_1Mbps				
Mode	Channel Frequency	Pulse Time	Dwell Time	Limit	
141000	(MHz)	(ms)	(ms)	(ms)	
DH1	2441	0.420	134.4	400	
DH3	2441	1.740	278.4	400	
DH5	2441	3.040	324.3	400	

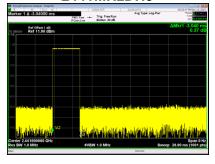
# 2441MHzDH1



# 2441MHzDH3



# 2441MHzDH5





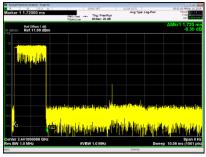


TX Mode_3Mbps				
Mode	Channel Frequency	Pulse Time	Dwell Time	Limit
Mode	(MHz)	(ms)	(ms)	(ms)
DH1	2441	0.42	134.4	400
DH3	2441	1.72	375.2	400
DH5	2441	3.12	332.8	400

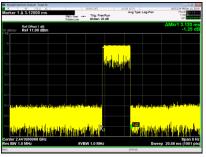
# 2441MHzDH1



# 2441MHzDH3



# 2441MHzDH5





#### **8.HOPPING CHANNEL SEPARATION MEASUREMENT**

#### 8.1LIMIT

Frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

#### **8.2TEST PROCEDURE AND SETTING**

- a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- b. Span = wide enough to capture the peaks of two adjacent channels

Resolution (or IF) Bandwidth (RBW)  $\geq$  1% of the span

Video (or Average) Bandwidth (VBW) ≥ RBW

Sweep = Auto

Detector function = Peak

Trace = Max Hold

Spectrum Parameter	Setting	
Attenuation	Auto	
Span Frequency	> Measurement Bandwidth or Channel Separation	
RBW	30 kHz	
VBW	100 kHz	
Detector	Peak	
Trace	Max Hold	
Sweep Time	Auto	

#### **8.3MEASUREMENT INSTRUMENTS LIST**

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum analyzer	KEYSIGHT	N9010A	MY55150427	2020/05/27
2	Attenuator	Mini-Circuits	BW-S10W2	101109	2020/12/12
3	RF Cable	Mi-cable	C10-01-01-1	100309	2020/12/12

#### **8.4TEST SETUP**

EUT	SPECTRUM
	ANALYZER

### **8.5EUT OPERATION CONDITIONS**

Report No.: 19EAFS12022 4591



# 8.6 TEST RESULTS

TX Mode_1Mbps				
Channel	Frequency	Channel	Limit	Result
Charine	(MHz)	Separation(MHz)	(MHz)	Nesuit
CH00	2402	0.996	>(25KHz or 2/3*20dB	PASS
CHOO	2402	0.990	Bandwidth)	PAGG
CH39	2441	0.996	>(25KHz or 2/3*20dB	PASS
CHOS	2441	0.990	Bandwidth)	PASS
CH78	2480	1.002	>(25KHz or 2/3*20dB	PASS
CHIO	2400	1.002	Bandwidth)	PASS









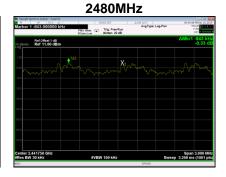




	TX Mode_3Mbps			
Channel	Frequency (MHz)	Channel Separation(MHz)	Limit (MHz)	Result
	(1011 12)	Separation(ivii iz)	,	
CH00	2402	0.999	>(25KHz or 2/3*20dB Bandwidth)	PASS
CH39	2441	0.999	>(25KHz or 2/3*20dB Bandwidth)	PASS
CH78	2480	0.843	>(25KHz or 2/3*20dB Bandwidth)	PASS









# **9.BANDWIDTH TEST**

#### **9.1LIMIT**

FCC Part15, Subpart C (15.247)			
Section Test Item			
15.247(a)(1)	Bandwidth		

#### 9.2TEST PROCEDURE AND SETTING

- a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- b. Spectrum Setting: RBW= 30 kHz, VBW=100 kHz, Sweep Time = Auto.

Spectrum Parameter	Setting
Attenuation	Auto
Span Frequency	> Measurement Bandwidth
RBW	30kHz
VBW	100kHz
Detector	Peak
Trace	Max Hold
Sweep Time	Auto

#### 9.3MEASUREMENT INSTRUMENTS LIST

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum analyzer	KEYSIGHT	N9010A	MY55150427	2020/05/27
2	Attenuator	Mini-Circuits	BW-S10W2	101109	2020/12/12
3	RF Cable	Mi-cable	C10-01-01-1	100309	2020/12/12

### 9.4TEST SETUP

EUT	SPECTRUM
	ANALYZER

# 9.5EUT OPERATION CONDITIONS

Report No.: 19EAFS12022 4591



# 9.6 TEST RESULTS

TX Mode_1Mbps						
Channel	Frequency	20dB Bandwidth	99 % Emission Bandwidth	Result		
	(MHz)	(MHz)	(MHz)			
CH00	2402	0.8772	0.8132	PASS		
CH39	2441	0.8768	0.8122	PASS		
CH78	2480	0.8825	0.8174	PASS		

# 2402MHz The state of the state









TX Mode_3Mbps						
Channel	Frequency	20dB Bandwidth	99 % Emission Bandwidth	Result		
	(MHz)	(MHz)	(MHz)			
CH00	2402	1.206	1.1386	PASS		
CH39	2441	1.249	1.1448	PASS		
CH78	2480	1.204	1.1344	PASS		





# 2441MHz



# 2480MHz





#### **10.MAXIMUM OUTPUT POWER**

#### **10.1LIMIT**

FCC Part15 , Subpart C (15.247)				
Section Test Item Limit				
15.247(a)(1)	Maximum Output Power	0.125Watt or 21dBm		

#### Note:

Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB band width of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

#### **10.2TEST PROCEDURE AND SETTING**

- a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- b. Spectrum Setting: RBW= 1MHz/3MHz, VBW= 3MHz/8MHz, Sweep time = Auto.

#### 10.3MEASUREMENT INSTRUMENTS LIST

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum analyzer	KEYSIGHT	N9010A	MY55150427	2020/05/27
2	Attenuator	Mini-Circuits	BW-S10W2	101109	2020/12/12
3	RF Cable	Mi-cable	C10-01-01-1	100309	2020/12/12

#### **10.4TEST SETUP**

EUT	SPECTRUM
	ANALYZER

#### **10.5EUT OPERATION CONDITIONS**





# **10.6 TEST RESULTS**

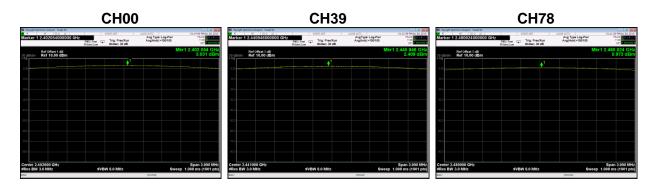
TX Mode_1Mbps						
Channel	Frequency	Output Power	Output Power	Result		
Channel	(MHz)	(dBm)	(W)	Result		
CH00	2402	1.895	0.001547	PASS		
CH39	2441	1.162	0.001307	PASS		
CH78	2480	0.297	0.001071	PASS		
Limit	21dBm /0.125W					







TX Mode_2Mbps						
Channal	Frequency	Output Power	Output Power	Result		
Channel	(MHz)	(dBm)	(W)	Result		
CH00	2402	3.031	0.002010	PASS		
CH39	2441	2.409	0.001741	PASS		
CH78	2480	0.973	0.001251	PASS		
Limit	21dBm /0.125W					







TX Mode_3Mbps						
Channal	Frequency	Output Power	Output Power	Result		
Channel	(MHz)	(dBm)	(W)	Result		
CH00	2402	3.048	0.002017	PASS		
CH39	2441	2.406	0.001740	PASS		
CH78	2480	1.617	0.001451	PASS		
Limit	21dBm /0.125W					



Report No.: 19EAFS12022 4591



#### 11.CONDUCTED SPURIOUS EMISSION

#### **11.1LIMIT**

#### For FCC

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak Output Power limits. If the transmitter complies with the Output 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 Section 15.209(a) is not required.

#### For ISED

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced 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 that the transmitter demonstrates compliance with the peak Output Power limits. If the transmitter complies with the Output Power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

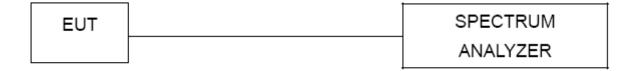
#### 11.2TEST PROCEDURE AND SETTING

- a. The EUT was directly connected to the spectrum analyzer and antenna output port as show in the block diagram below.
- b Spectrum Setting: RBW= 100 kHz, VBW=300 kHz, Sweep time = Auto.

#### 11.3MEASUREMENT INSTRUMENTS LIST

Item	Kind of Equipment	Manufacturer	Type No.	Serial No.	Calibrated until
1	Spectrum analyzer	KEYSIGHT	N9010A	MY55150427	2020/05/27
2	Attenuator	Mini-Circuits	BW-S10W2	101109	2020/12/12
3	RF Cable	Mi-cable	C10-01-01-1	100309	2020/12/12

#### 11.4TEST SETUP

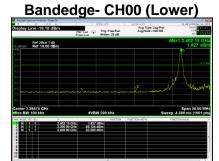


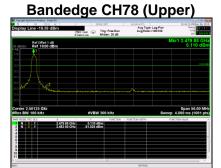
#### 11.5EUT OPERATION CONDITIONS



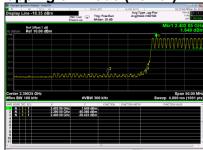
# 11.6TEST RESULTS

TX Mode\_1Mbps





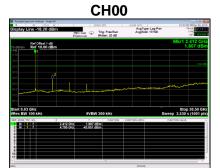


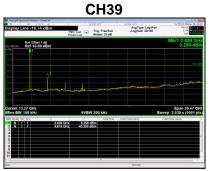


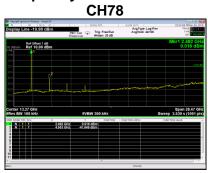




# CH00 – 10th Harmonic of the fundamental frequency



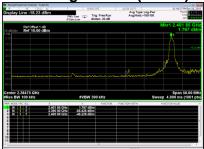






# TX Mode\_3Mbps

# Bandedge- CH00 (Lower)



# Bandedge CH78 (Upper)



Hopping on mode (Lower)



Hopping on mode (Upper)



CH00 - 10th Harmonic of the fundamental frequency







**CH78** 

#### **END OF TEST REPORT**