FCC Part 15, Subpart C
Test Report

FCC ID:	2AAGF-WILLEN
Applicant:	Zound Industries International AB
Address:	Centralplan 15 SE-111 20 Stockholm Sweden
Manufacturer:	Zound Industries International AB
Address:	Centralplan 15 SE-111 20 Stockholm Sweden
Product:	Portable Loudspeaker
Brand:	Marshall
Test Model(s):	WILLEN
Series Model(s):	N/A
Test Date:	Jan. 12, 2022 ~ Feb. 11, 2022
Issued Date:	Feb. 17, 2022
Issued By:	Hwa-Hsing (Dongguan) Testing Co., Ltd.
Address:	No.101, Bld. N1, Yuyuan 2Rd, Yuyuan Industrial Park, HuangJiang Town, Dongguan, China
Test Firm Registration No.:	915896
Standards:	47 CFR FCC Part 15, Subpart C (Section 15.247) ANSI C63.10:2013

The above equipment has been tested by **Hwa-Hsing (Dongguan) Testing Co., Ltd.**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's EMC characteristics under the conditions specified in this report.

Prepared by : Candy Zhang

Candy Zhang/ Report Engineer

Reviewed by : Tank Tan

Tank Tan/ Project Engineer

Approved by :

Harry Li/ Technical Director

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Release Control Record

Issue No.	Description	**Date Issued**
210427EL31-RF-US-02	Original Release	Feb. 17, 2022

1. Summary of Test Results

47 CFR FCC Part 15, Subpart C (Section 15.247) KDB 558074 D01 15.247 Meas Guidance v05r02 ANSI C63.10:2013			
Clause	Test Item	Result	Remarks
15.207	AC Power Conducted Emission	Pass	Meet the requirement of limit.
15.205 & 209	Radiated Emissions	Pass	Meet the requirement of limit.
15.247(d)	Band Edge Measurement	Pass	Meet the requirement of limit.
15.247(d)	Antenna Port Emission	Pass	Meet the requirement of limit.
15.247(a)(2)	6dB Bandwidth	Pass	Meet the requirement of limit.
---	Occupied Bandwidth Measurement	Pass	Reference only
15.247(b)	Conducted power	Pass	Meet the requirement of limit.
15.247(e)	Power Spectral Density	Pass	Meet the requirement of limit.
15.203	Antenna Requirement	Pass	No antenna connector is used. The device is professionally installed

Note: The EUT has been verified to comply with the requirements of FCC Part 15, Subpart B, Class B (DoC). The test report has been issued separately.

1.1 Measurement Uncertainty

Where relevant, the following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2:
The listed uncertainties are the worst cases uncertainty for the entire range of measurement. Please note that the uncertainty values are provided for informational purposes only and are not used in determining the PASS/FAIL results.

Measurement	Frequency	Expended Uncertainty (k=2) (±)
Conducted Emissions at mains ports	150kHz ~ 30MHz	2.66 dB
Radiated Emissions up to 1 GHz	9KHz ~ 30MHz	2.16 dB
	30MHz ~ 1000MHz	3.47 dB
Radiated Emissions above 1 GHz	1GHz ~ 18GHz	4.84 dB
	18GHz ~ 40GHz	4.67 dB

1.2 Modification Record

There were no modifications required for compliance.

2. General Information

2.1 General Description of EUT

Product	Portable Loudspeaker
Brand	Marshall
Test Model(s)	WILLEN
Series Model(s)	N/A
Status of EUT	Engineering prototype
Power Supply Rating	DC 3.7V from Li-ion Battery or DC 5V from USB port
Modulation Type	BT-LE(GFSK)
Transfer Rate	1/2Mbps
Operating Frequency	2402 ~ 2480MHz
Number of Channel	40
Maximum Output Power	1.348dBm
Antenna Type	FPCB Antenna
Antenna Gain	3.69dBi Maximum peak Gain
Antenna Connector	I-PEX
Accessory Device	N/A
Data Cable Supplied	USB Cable: Unshielded,50cm

Note:

1. Please refer to the EUT photo document (Reference No.: 210427EL31-1&2) for detailed product photo.
2. The above EUT information is declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or User's Manual.

2.2 Description of Test Channels

40 channels are provided to this EUT:

Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)	Channel	Freq. (MHz)
0	2402	10	2422	20	2442	30	2462
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	19	2440	29	2460	39	2480

2.3 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable test items	X-Axis	Y-Axis	Z-Axis	Voltage Supply
Radiated	AC Power Conducted Emission	N/A	N/A	N/A	DC 5V
Radiated	Radiated Emissions	√	√	√	
Antenna Port Conducted Measurement	Band Edge Measurement	N/A	N/A	N/A	
	Antenna Port Emission	N/A	N/A	N/A	
	6dB Bandwidth	N/A	N/A	N/A	
	Occupied Bandwidth Measurement	N/A	N/A	N/A	
	Conducted power	N/A	N/A	N/A	
	Power Spectral Density	N/A	N/A	N/A	

1. *: The EUT had been pre-tested on the positioned of each 3 Axis. The worst case was found when positioned on **Z-plane**.
2. "N/A" means no effect.

Test Condition:

Applicable test items	Environmental Conditions	Power supply	Tested by
AC Power Conducted Emission	22.2deg. C, 56%RH	DC 5V	King Ye
Radiated Emissions	22.2deg. C, 56%RH	DC 5V	King Ye
Antenna Port Conducted Measurement	25deg. C, 65%RH	DC 5V	Dragon Long

- Pre-Scan has been conducted to determine the worst-case mode from all possible combinations between available modulations, data rates and antenna ports (if EUT with antenna diversity architecture). Following channel(s) was (were) selected for the final test as listed below.

Radiated Emission Test (Above 1GHz):

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type	Data Rate (Mbps)
-	0 to 39	0, 19, 39	GFSK	1
-	0 to 39	0, 19, 39	GFSK	2

Radiated Emission Test (Below 1GHz):

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type	Data Rate (Mbps)
-	0 to 39	0	GFSK	1

Power Line Conducted Emission Test:

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type	Data Rate (Mbps)
-	0 to 39	0, 19, 39	GFSK	1

Antenna Port Conducted Measurement:

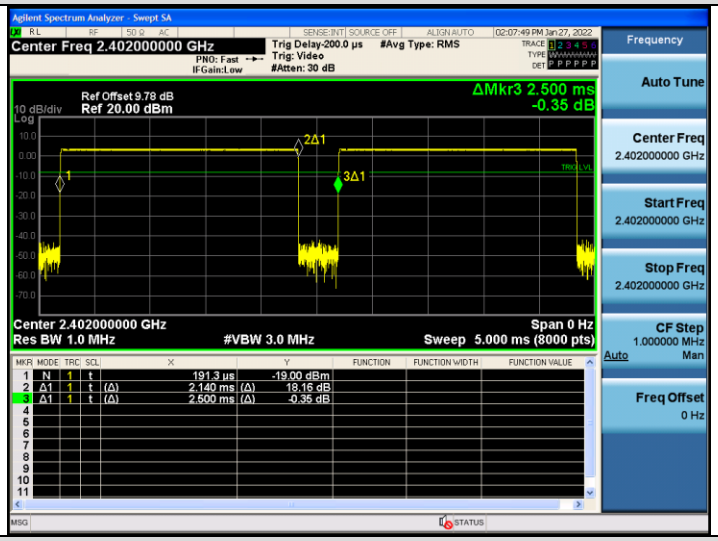
*This item includes all test value of each mode, but only includes spectrum plot of worst value of each mode.

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type	Data Rate (Mbps)
-	0 to 39	0, 19, 39	GFSK	1
-	0 to 39	0, 19, 39	GFSK	2

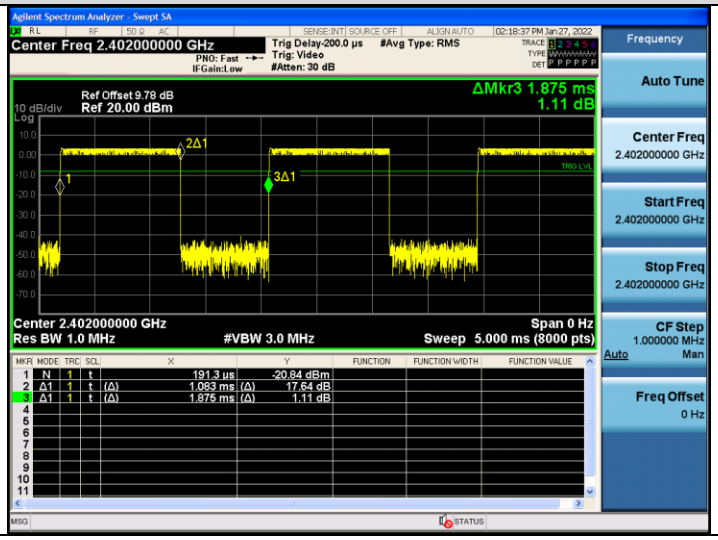
2.4 Duty Cycle of Test Signal

Test Mode	Channel	Transmission Duration [ms]	Transmission Period [ms]	Duty Cycle [%]
GFSK-1MHz	2402	1.08	1.88	57.77
	2440	1.08	1.88	57.77
	2480	1.08	1.88	57.77
GFSK-2MHz	2402	2.14	2.50	85.60
	2440	2.14	2.50	85.60
	2480	2.14	2.50	85.60

GFSK-1MHz



GFSK-2MHz



2.5 Description of Support Units

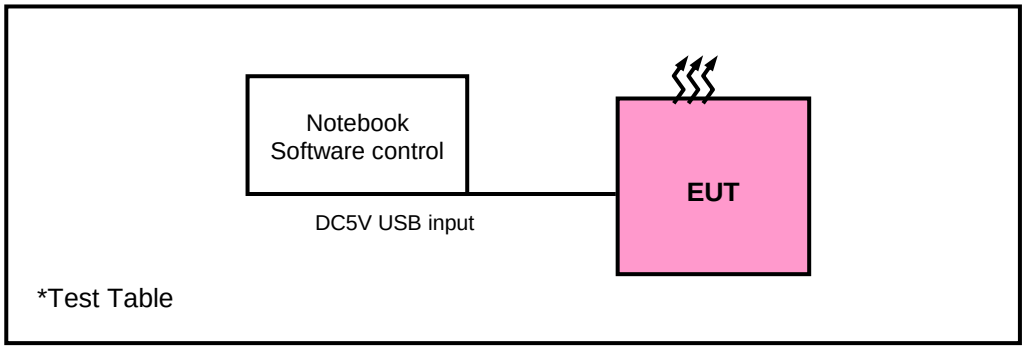
The EUT has been tested as an independent unit together with other necessary accessories or support units. The following support units or accessories were used to form a representative test configuration during the tests.

No.	Product	Brand	Model No.	Serial No.	FCC ID
1.	Notebook	Lenovo	ThinkPad X280	SL10P97665	N/A
2.	Adapter	UGREEN	CD132	30599	N/A
3.	Mobile Phone	SAMSUNG	SCH-I699	801A2A38	N/A

Insert Cable Connections to/from EUT provided by test team.

No.	Signal Cable Description of The Above Support Units
1.	USB serial cable Un-shielding 1.2m

2.6 Configuration of System under Test



3. Test Types and Results

3.1 Radiated Emission and Band-edge Measurement

3.1.1 Limits of radiated emission and band-edge measurement

Radiated emissions which fall in the restricted bands must comply with the radiated emission limits specified as below table. Other emissions shall be at least 20dB below the highest level of the desired power:

Frequencies (MHz)	Field Strength (microvolts/meter)	Measurement Distance (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
* DTS emissions in non-restricted frequency bands Subclause 11.11 of ANSI C63.10 is applicable. * DTS emissions in restricted frequency bands Subclause 11.12 of ANSI C63.10 is applicable		

Note:

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

3.1.2 Test Instruments

Radiated emission below 30MHz:

Equipment	Manufacturer	Model No.	Serial No.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESR 7	101961	2023/01/12
3m Semi-anechoic Chamber	MAORUI	9m*6m*6m	NSEMC003	2022/04/14
Test software	FARAD	FARAD	EZ_EMCV1.1.4.2	N/A
Loop Antenna	EMCI	HLA 6121	45745	2022/04/13
Preamplifier	EMCI	EMC001340	980201	2022/09/12
Antenna Tower	MF	MFA-440H	NA	NA
Turn Table	MF	MFT-201SS	NA	NA
Antenna Tower&Turn Table Controller	MF	MF-7802	NA	NA

Frequency Range below 1GHz:

Equipment	Manufacturer	Model No.	Serial No.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESR 7	101961	2023/01/12
Broadband antenna	Schwarzbeck	VULB 9168	00937	2022/04/15
3m Semi-anechoic Chamber	MAORUI	9m*6m*6m	NSEMC003	2022/04/14
Signal Amplifier	Com-power	PAM-103	18020051	2022/03/14
Attenuator	Rohde&Schwarz	TS2GA-6dB	18101101	N/A
Test software	FARAD	FARAD	EZ_EMCV1.1.4.2	N/A

Frequency Range 1-18GHz:

Equipment	Manufacturer	Model No.	Serial No.	Next Cal.
3m Semi-anechoic Chamber	MAORUI	9m*6m*6m	NSEMC003	2022/04/14
Horn Antenna	Schwarzbeck	BBHA 9170	01959	2022/04/15
Broadband Coaxial Preamplifier	Schwarzbeck	BBV 9718	00025	2022/03/14
Spectrum	Keysight	N9020A	MY51240612	2022/09/12
Antenna Tower	MF	MFA-440H	NA	NA
Turn Table	MF	MFT-201SS	NA	NA
Antenna Tower&Turn Table Controller	MF	MF-7802	NA	NA

Frequency Range 18-40GHz:

Equipment	Manufacturer	Model No.	Serial No.	Next Cal.
3m Semi-anechoic Chamber	MAORUI	9m*6m*6m	NSEMC003	2022/04/14
Spectrum Analyzer	Rohde&Schwarz	FSV-40N	101783	2022/03/14
Horn Antenna	Schwarzbeck	BBHA 9170	BBHA9170242	2022/04/15
Pre-Amplifier	EMCI	EMC 184045	980102	2022/03/14
Antenna Tower	MF	MFA-440H	NA	NA
Turn Table	MF	MFT-201SS	NA	NA
Antenna Tower&Turn Table Controller	MF	MF-7802	NA	NA

Note: 1. The calibration interval of the above test instruments is 12/24months and the calibrations are traceable to CEPREI/CHINA.

2. The test was performed in 966.

3.1.3 Test Procedures

a. Peak emission levels are measured by setting the instrument as follow:

1) RBW & VBW setting as a function of frequency:

Frequency	RBW	VBW
9kHz~150kHz	200Hz	600Hz
0.15MHz~30MHz	9kHz	30kHz
30MHz~1000MHz	120kHz	300kHz
>1000MHz	1MHz	3MHz

2) Detector = peak.
3) Sweep time = auto.
4) Trace mode = max hold.
5) Allow sweeps to continue until the trace stabilizes. (Note that the required measurement time may be lengthened for low-duty-cycle applications.)

Note: If the peak-detected amplitude can be shown to comply with the average limit, then it is not necessary to perform a separate average measurement

b. Average emission levels are measured by setting the instrument as follow:

- **Trace averaging with continuous EUT transmission at full power**

If the EUT can be configured or modified to transmit continuously (D ≥ 98%). then the average emission levels shall be measured using the following method (with EUT transmitting continuously):

1) RBW=1 MHz (unless otherwise specified).
2) VBW ≥ 3 *RBW.
3) Detector =RMS
4) Sweep time = auto.
5) Perform a trace average of at least 100 traces.

- **Trace averaging across ON and OFF times of the EUT transmissions followed by duty cycle correction**

If continuous transmission of the EUT (D ≥ 98%) cannot be achieved and the duty cycle is constant (duty cycle variations are less than ±2%). then the following procedure shall be used

1) The EUT shall be configured to operate at the maximum achievable duty cycle.
2) Measure the duty cycle D of the transmitter output signal as described in 11.6.
3) RBW=1 MHz (unless otherwise specified).
4) VBW ≥ 3 *RBW.
5) Detector =RMS
6) Sweep time = auto.
7) Perform a trace average of at least 100 traces.

A correction factor shall be added to the measurement results prior to comparing with the emission limit to compute the emission level that would have been measured had the test been performed at 100% duty cycle. The correction factor is computed as follows:

*If power averaging (rms) mode was used in step 5). then the applicable correction factor is [10 10g (1/ D)], where D is the duty cycle.

**If linear voltage averaging mode was used in step f). then the applicable correction factor is [20 10g (1/D)], where D is the duty cycle.

***If a specific emission is demonstrated to be continuous (D > 98%) rather than turning ON and OFF with the transmit cycle, then no duty cycle correction is required for that

- **Reduced VBW Averaqing across ON and OFF times of the EUT transmissions with max hold**

If continuous transmission of the EUT (D > 98%) cannot be achieved and the duty cycle is not constant (duty cycle variations exceed ±2%), then the following procedure shall be used:

1) RBW = 1 MHz.
2) VBW ≥ 1/T.
3) Detector =peak
4) Sweep time = auto.
5) Trace mode = max hold.
6) Allow max hold to run for at least [50 x (1/ D)] traces

c. The EUT was placed on the top of a rotating table 0.8 meters (below 1GHz) / 1.5 meters (1-18GHz) / 1.5 meters (18-40GHz) above the reference ground. The table was rotated 360 degrees to determine the position of the highest radiation.
d. The EUT was set 3 meters away from the interference-receiving antenna (Below 1GHz) & (Above 1-18GHz), which was mounted on the top of a variable-height antenna tower. The EUT was set 1meters away from the interference-receiving antenna (18-40GHz).
e. The height of antenna is varied from one meter to four meters above the ground to determine the maximum value of the field strength. Both horizontal and vertical polarizations of the antenna are set to make the measurement.
f. For each suspected emission, the EUT was arranged to its worst case and then the antenna was tuned to heights from 1 meter to 4 meters and the rotatable table was turned from 0 degrees to 360 degrees to find the maximum reading.
g. The test-receiver system was set to quasi-peak detect function and specified bandwidth with maximum hold mode when the test frequency is below 1 GHz.
h. The test-receiver system was set to peak and average detected function and specified bandwidth with maximum hold mode when the test frequency is above 1 GHz. If the peak reading value also meets average limit, measurement with the average detector is unnecessary.

Note:

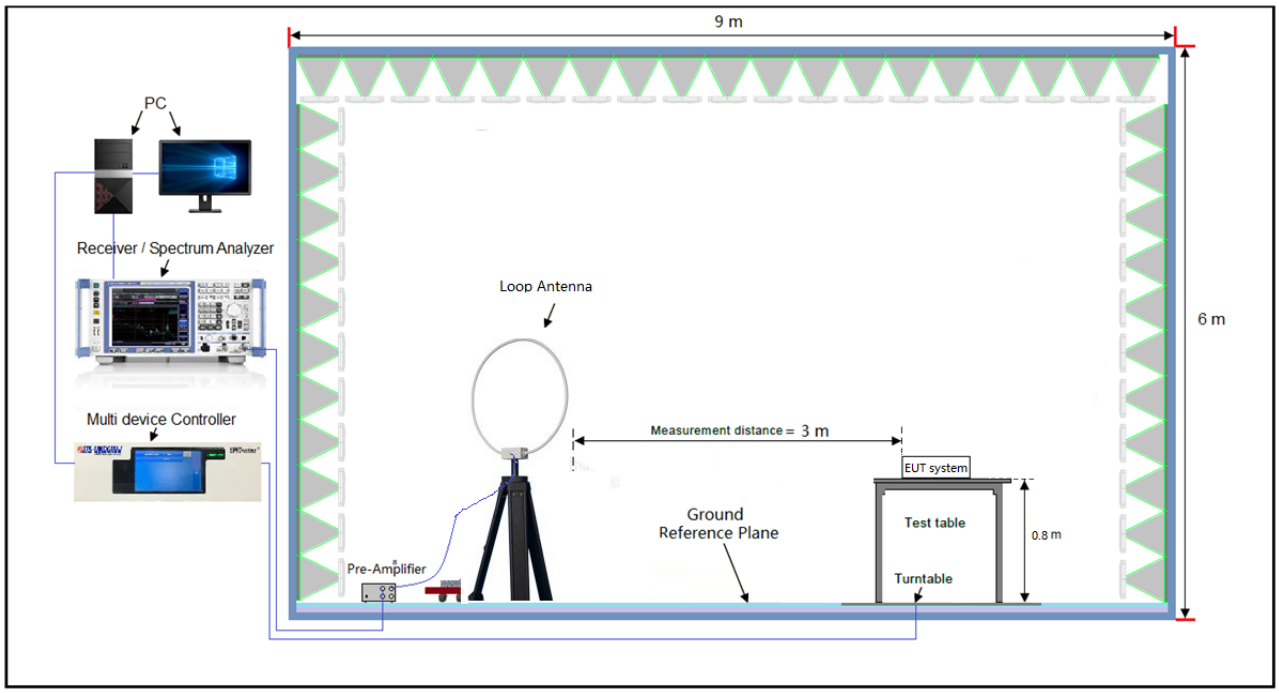
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz & 360kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth =3 MHz for Peak detection (PK) at frequency above 1GHz.
3. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth =1/T for Average (Duty cycle < 98 %) detection at frequency above 1 GHz.
4. The resolution bandwidth of test receiver/spectrum analyzer is 1MHz and the video bandwidth is =10Hz (Duty cycle ≥ 98%) for Average detection (AV) at frequency above 1GHz.
5. All modes of operation were investigated and the worst-case emissions are reported.

3.1.4 Deviation from Test Standard

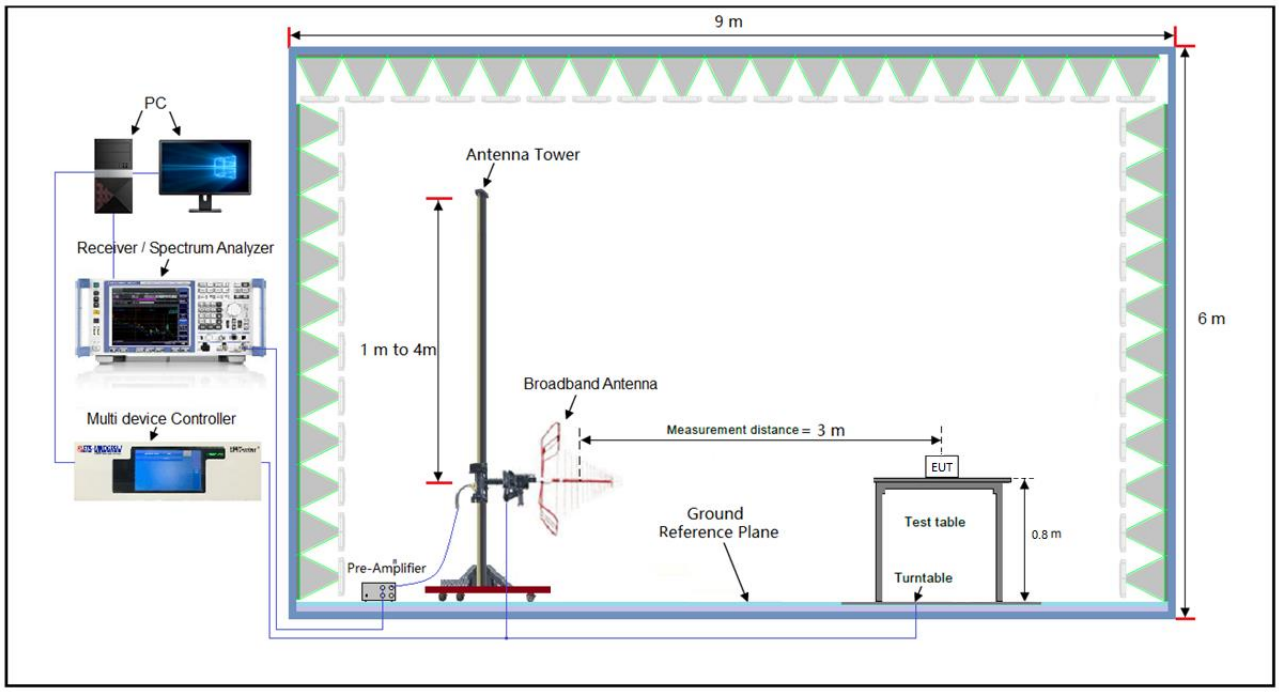
No deviation.

3.1.5 Test Setup

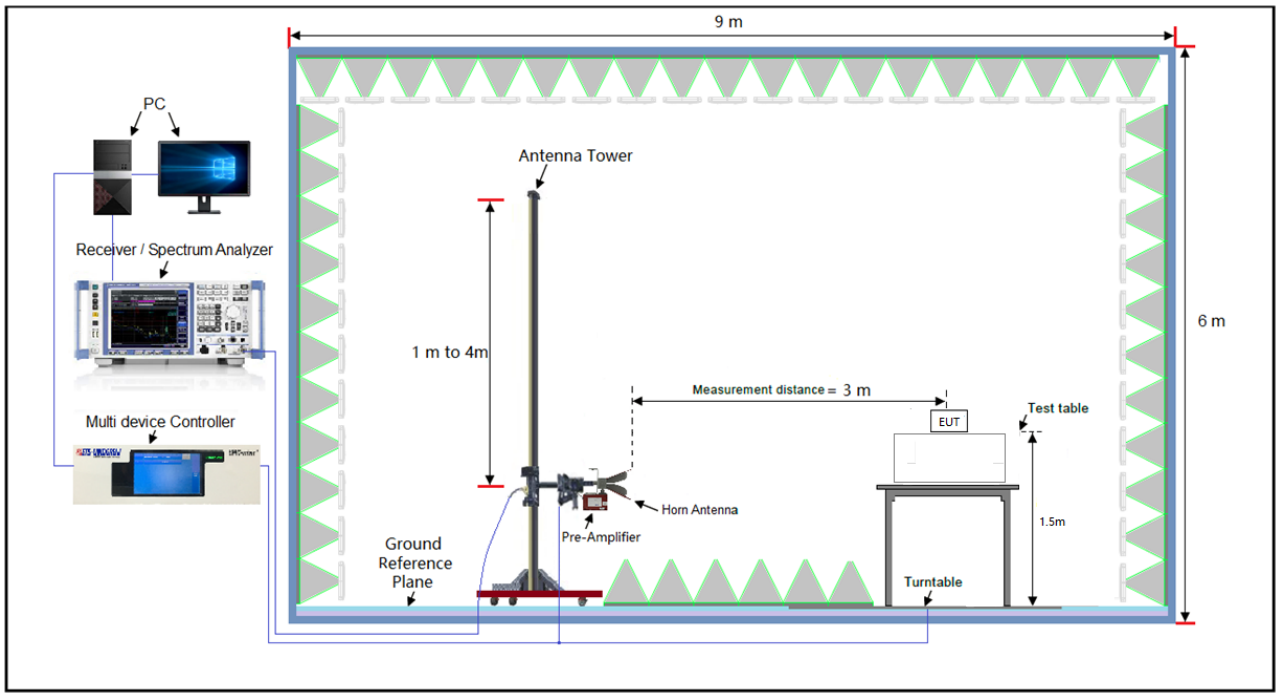
Radiated emission below 30MHz:



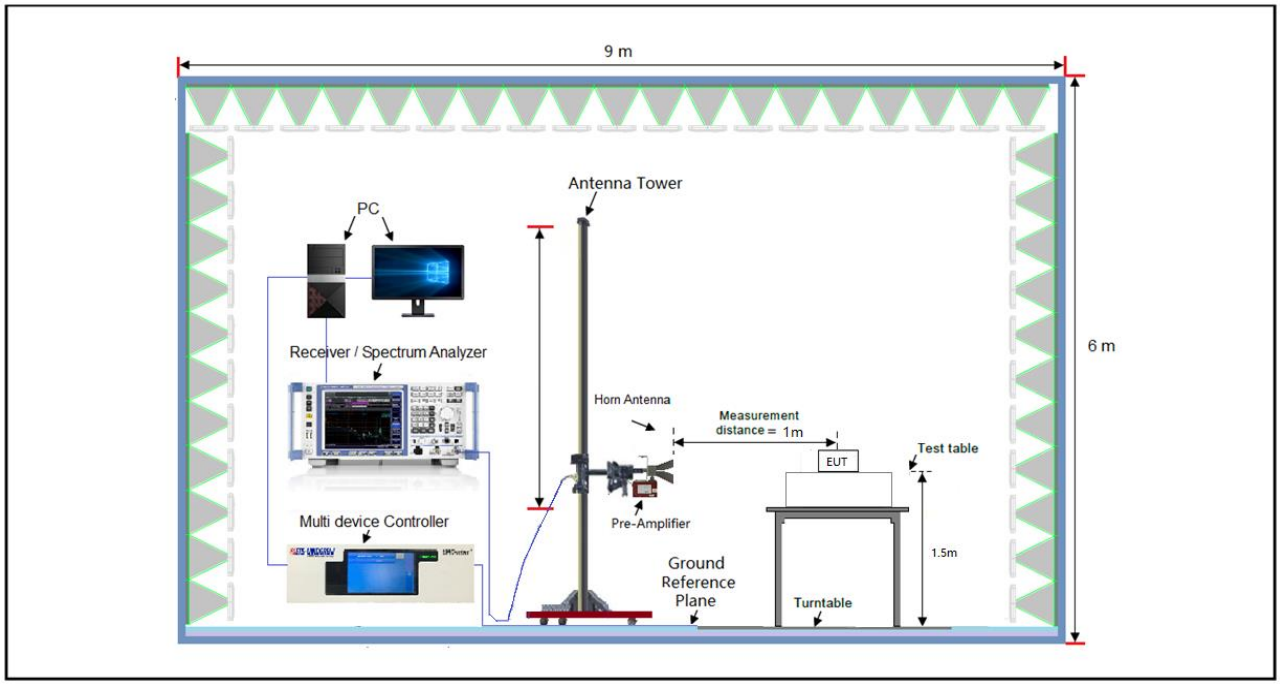
Frequency Range below 1GHz:



Frequency Range 1-18GHz:



Frequency Range 18-40GHz:



For the actual test configuration, please refer to the attached file (Test Setup Photo).

3.1.6 EUT Operating Conditions

a. Placed the EUT on the testing table.

b. Set the EUT under transmission condition continuously at specific channel frequency.

3.1.7 Test Results

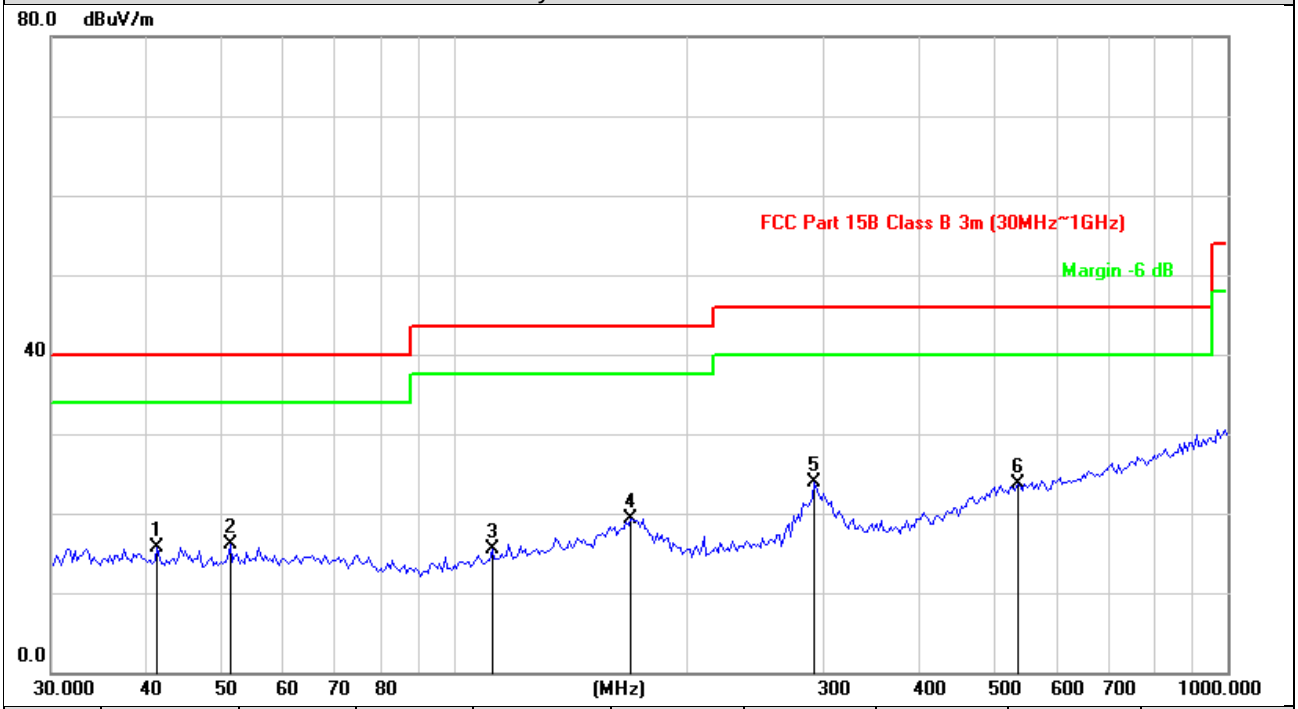
9kHz ~ 30MHz Data:

The amplitude of spurious emissions attenuated more than 20dB below the permissible value is not required to be report.

30MHz ~ 1GHz Worst-Case Data:

Test Channel	Channel 0	Frequency Range	30MHz ~ 1GHz
Detector Function	Peak (PK) Quasi-peak (QP)	Tested By	Jim Xu

Antennal Polarity &Test Distance: Horizontal at 3m



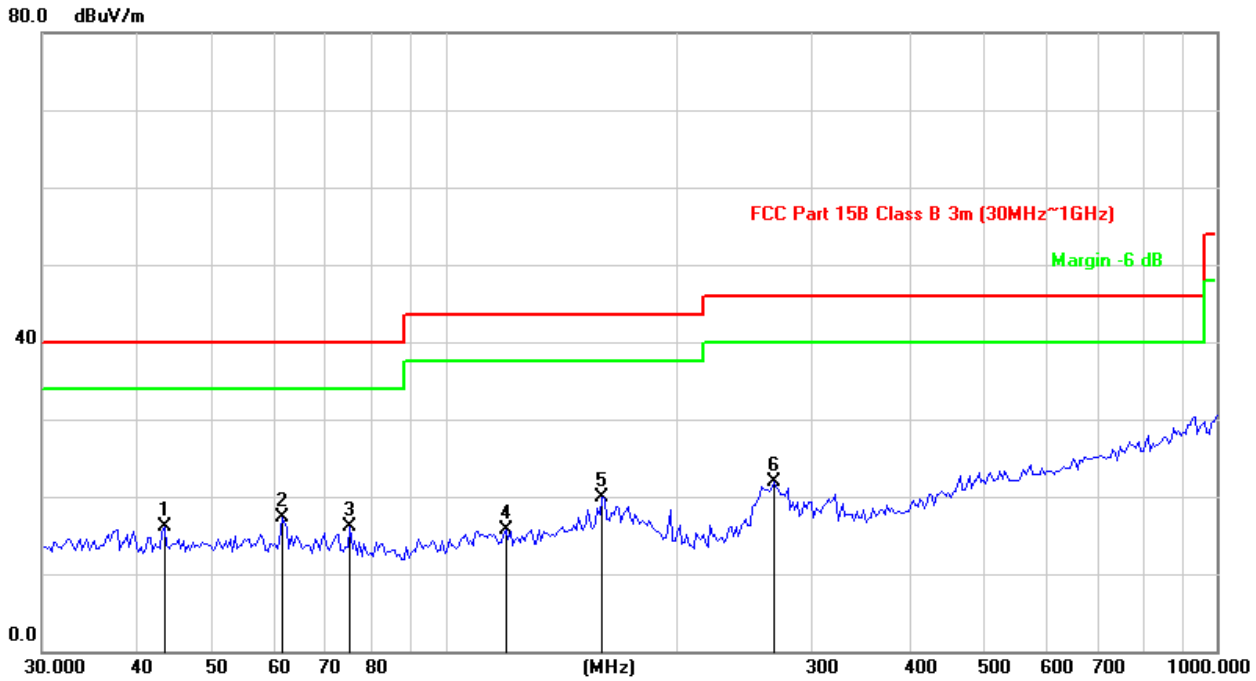
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Height (cm)	Table Angle (Degree)
1	41.1580	32.35	-16.73	15.62	40.00	-24.38	peak	200	129
2	51.1756	32.91	-16.81	16.10	40.00	-23.90	peak	300	278
3	111.6398	32.41	-16.88	15.53	43.50	-27.97	peak	200	133
4	168.9970	32.05	-12.69	19.36	43.50	-24.14	peak	200	248
5	292.3643	38.22	-14.36	23.86	46.00	-22.14	peak	200	169
6	535.0376	32.08	-8.45	23.63	46.00	-22.37	peak	300	86

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
2. Margin value = Emission level – Limit value

Test Channel	Channel 0	Frequency Range	30MHz ~ 1GHz
Detector Function	Peak (PK) Quasi-peak (QP)	Tested By	Jim Xu

Antennal Polarity& Test Distance: Vertical at 3m



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Height (cm)	Table Angle (Degree)
1	43.2333	32.86	-16.74	16.12	40.00	-23.88	peak	100	137
2	61.4343	34.26	-16.90	17.36	40.00	-22.64	peak	200	289
3	75.3208	33.49	-17.38	16.11	40.00	-23.89	peak	100	302
4	119.7672	31.80	-16.10	15.70	43.50	-27.80	peak	200	144
5	159.7586	33.02	-13.04	19.98	43.50	-23.52	peak	100	264
6	266.8395	36.78	-14.89	21.89	46.00	-24.11	peak	100	59

Remarks:

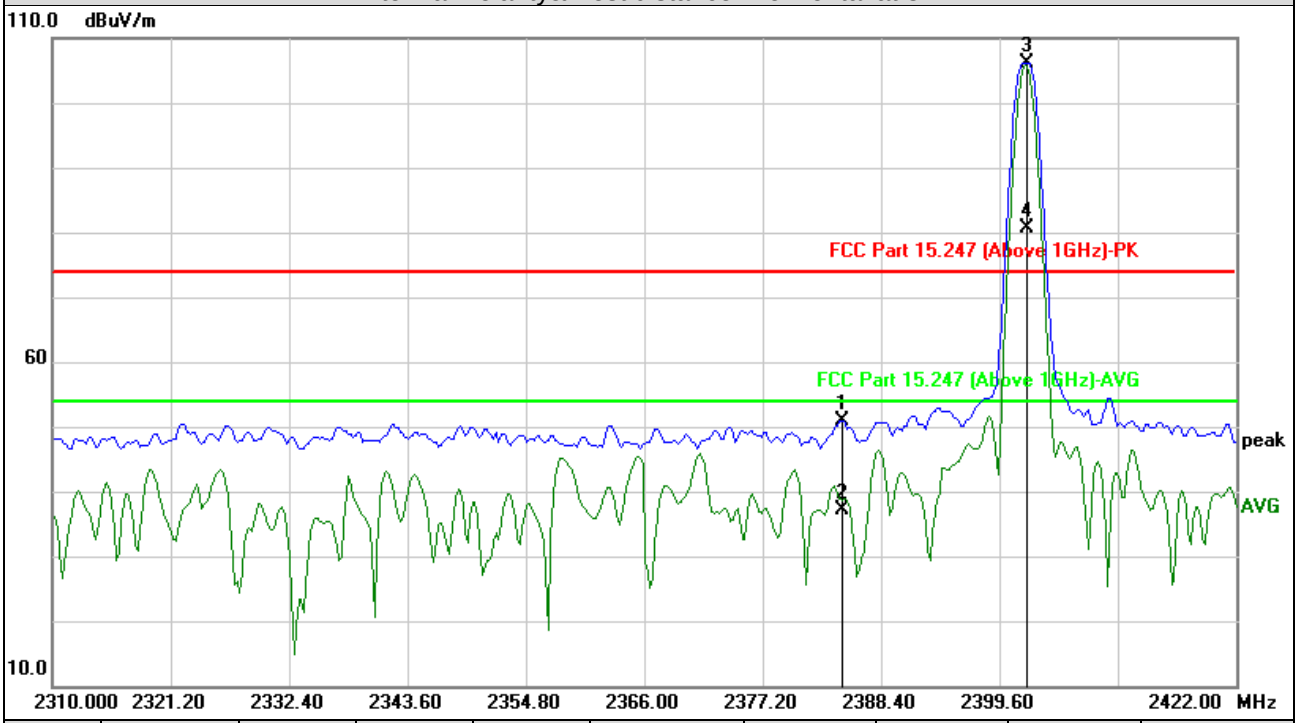
1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
2. Margin value = Emission level – Limit value

Above 1GHz Data:

BLE-1Mbps

Test channel	Channel 0	Frequency Range	1GHz ~ 25GHz
Detector Function	Peak (PK) Average (AVG)	Tested By	Jim Xu

Antennal Polarity& Test distance: Horizontal at 3 M



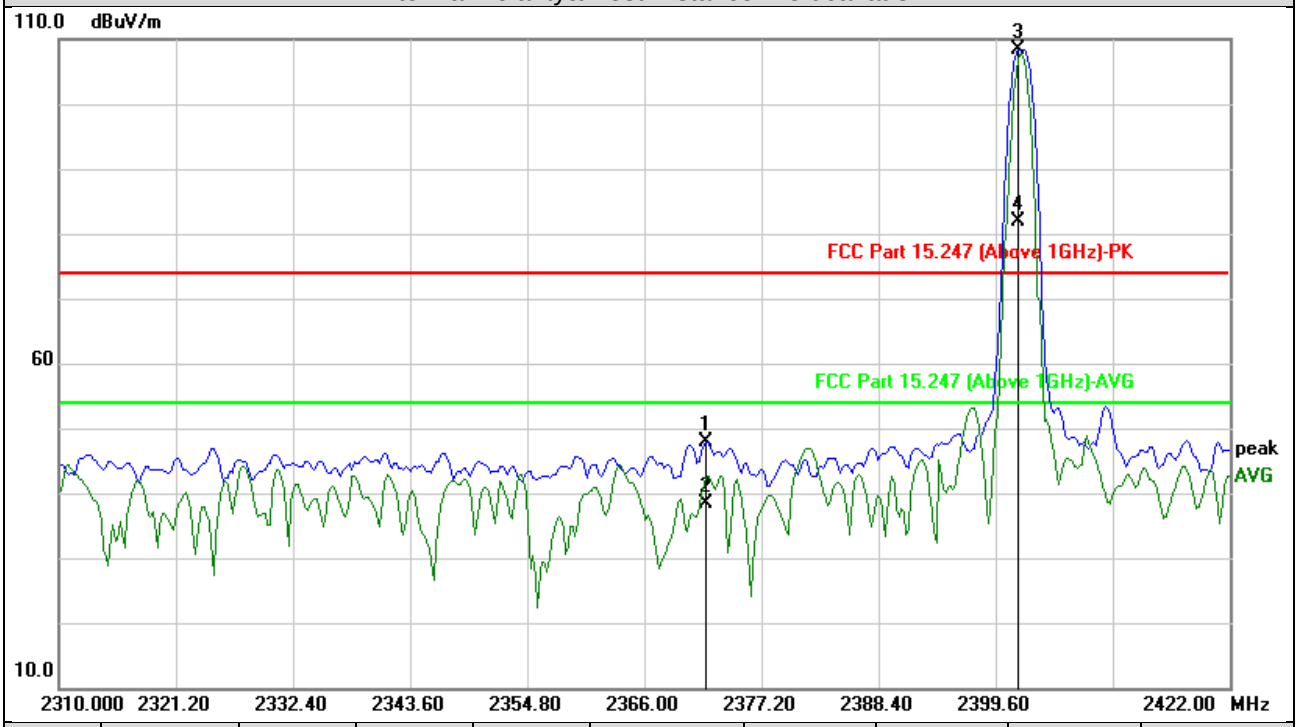
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Height (cm)	Table Angle (Degree)
1	2384.742	52.61	-1.73	50.88	74.00	-23.12	peak	100	234
2	2384.742	38.92	-1.73	37.19	54.00	-16.81	AVG	100	234
3 #	2402.249	107.82	-1.73	106.09			peak	100	234
4 #	2402.249	82.27	-1.73	80.54			AVG	100	234
5	4804.000	43.91	3.75	47.66	74.00	-26.34	peak	318	131
6	4804.000	30.78	3.75	34.53	54.00	-19.47	AVG	318	131
7	7206.000	41.49	8.14	49.63	74.00	-24.37	peak	100	231
8	7206.000	31.27	8.14	39.41	54.00	-14.59	AVG	100	231

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
2. Margin value = Emission level – Limit value
3. #2402MHz: Fundamental frequency.

Test channel	Channel 0	Frequency Range	1GHz ~ 25GHz
Detector Function	Peak (PK) Average (AVG)	Tested By	Jim Xu

Antennal Polarity& Test Distance: Vertical at 3m



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Height (cm)	Table Angle (Degree)
1	2371.948	49.64	-1.73	47.91	74.00	-26.09	peak	100	124
2	2371.948	40.08	-1.73	38.35	54.00	-15.65	AVG	100	124
3 #	2401.800	110.03	-1.73	108.30			peak	100	124
4 #	2401.800	83.58	-1.73	81.85			AVG	100	124
5	4804.000	47.70	3.75	51.45	74.00	-22.55	peak	213	179
6	4804.000	37.06	3.75	40.81	54.00	-13.19	AVG	213	179
7	7206.000	42.07	8.14	50.21	74.00	-23.79	peak	100	258
8	7206.000	31.34	8.14	39.48	54.00	-14.52	AVG	100	258

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
2. Margin value = Emission level – Limit value
3. #2402MHz: Fundamental frequency.

Test channel	Channel 19	Frequency Range	1GHz ~ 25GHz
Detector Function	Peak (PK) Average (AVG)	Tested By	Jim Xu

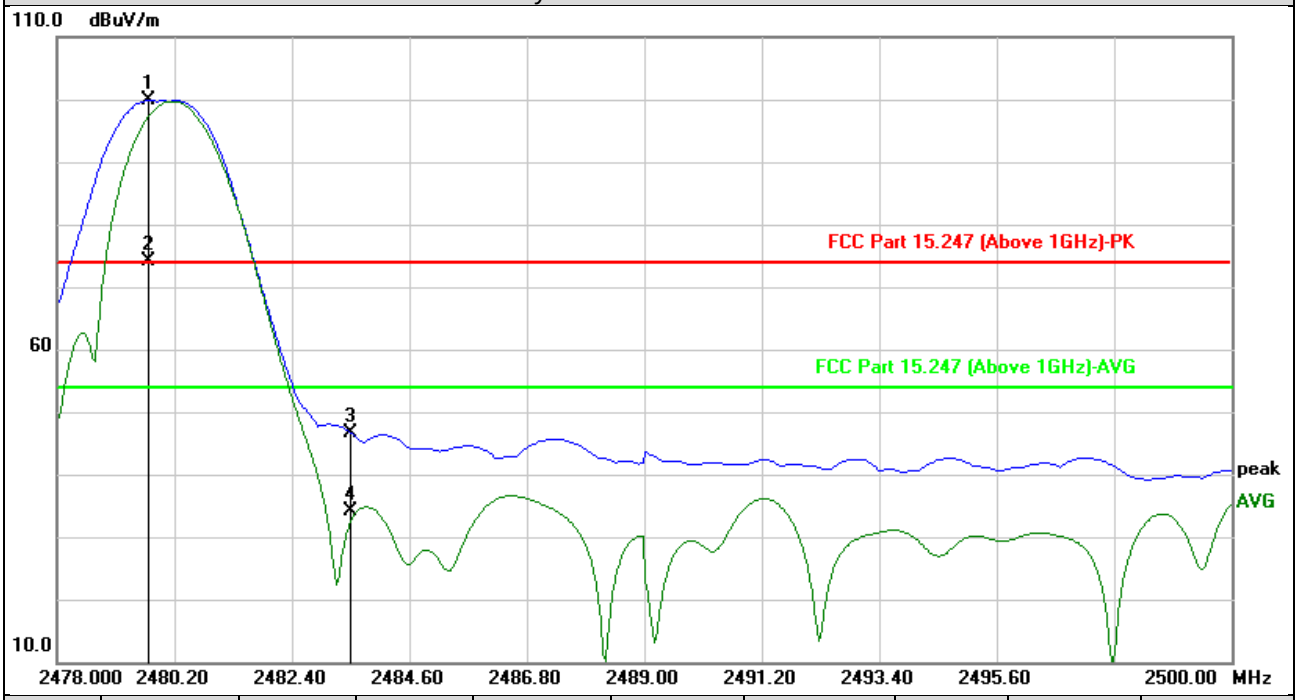
Antennal Polarity& Test Distance: Horizontal at 3m									
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Height (cm)	Table Angle (Degree)
1#	2440.000	105.77	-1.71	104.06			peak	100	294
2#	2440.000	79.35	-1.71	77.64			AVG	100	294
3	4880.000	43.02	3.97	46.99	74.00	-27.01	peak	100	123
4	4880.000	31.75	3.97	35.72	54.00	-18.28	AVG	100	123
5	7320.000	42.34	8.29	50.63	74.00	-23.37	peak	100	277
6	7320.000	29.24	8.29	37.53	54.00	-16.47	AVG	100	277
Antennal Polarity& Test Distance: Vertical at 3 M									
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Height (cm)	Table Angle (Degree)
1#	2440.000	107.86	-1.71	106.15			peak	100	266
2#	2440.000	80.35	-1.71	78.64			AVG	100	266
3	4880.000	45.51	3.97	49.48	74.00	-24.52	peak	100	131
4	4880.000	34.70	3.97	38.67	54.00	-15.33	AVG	100	131
5	7320.000	41.48	8.29	49.77	74.00	-24.23	peak	100	174
6	7320.000	29.87	8.29	38.16	54.00	-15.84	AVG	100	174

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
2. Margin value = Emission level – Limit value
3. #2440MHz: Fundamental frequency.

Test channel	Channel 39	Frequency Range	1GHz ~ 25GHz
Detector Function	Peak (PK) Average (AVG)	Tested By	Jim Xu

Antennal Polarity& Test Distance: Horizontal at 3 M



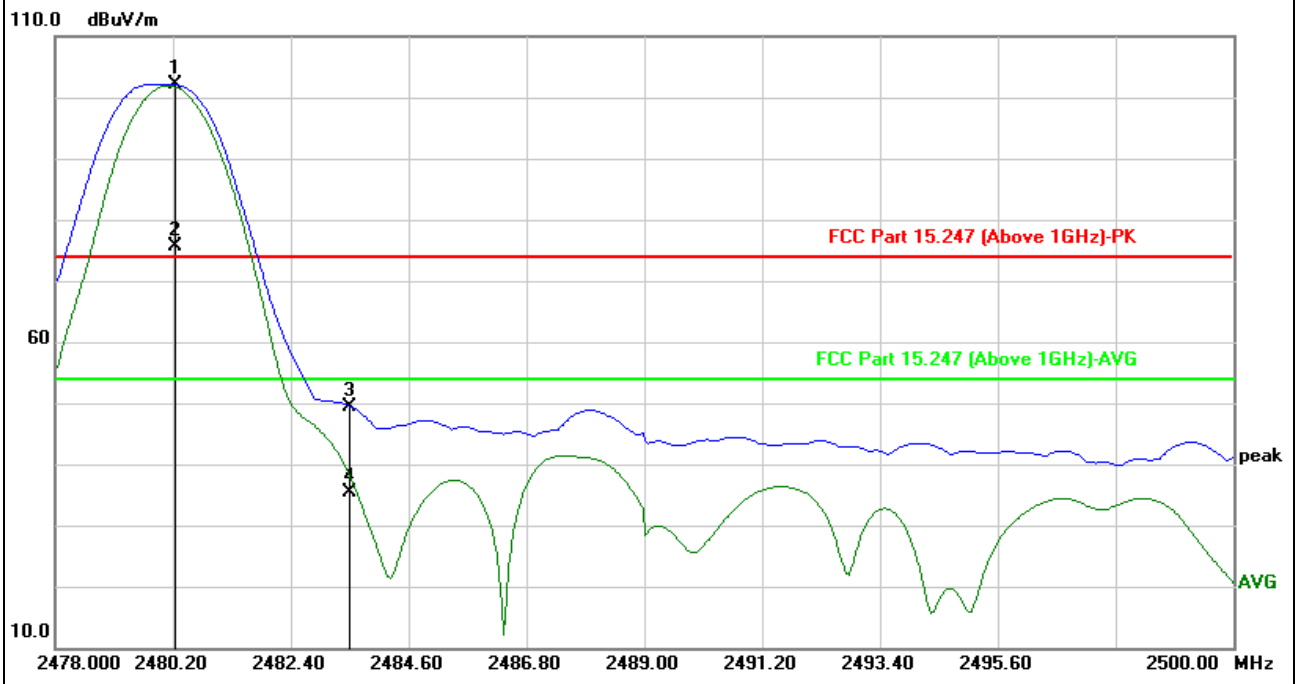
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Height (cm)	Table Angle (Degree)
1#	2479.719	102.11	-2.29	99.82			peak	265	244
2#	2479.719	76.36	-2.29	74.07			AVG	265	244
3	2483.500	48.99	-2.29	46.70	74.00	-27.30	peak	265	244
4	2483.500	36.41	-2.29	34.12	54.00	-19.88	AVG	265	244
5	4960.000	42.59	4.20	46.79	74.00	-27.21	peak	100	215
6	4960.000	32.23	4.20	36.43	54.00	-17.57	AVG	100	215
7	7440.000	42.19	8.43	50.62	74.00	-23.38	peak	100	154
8	7440.000	30.84	8.43	39.27	54.00	-14.73	AVG	100	154

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
2. Margin value = Emission level – Limit value
3. #2480MHz: Fundamental frequency.

Test channel	Channel 39	Frequency Range	1GHz ~ 25GHz
Detector Function	Peak (PK) Average (AVG)	Tested By	Jim Xu

Antennal Polarity& Test Distance: Vertical at 3 M



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Height (cm)	Table Angle (Degree)
1#	2480.249	104.39	-2.29	102.10			peak	100	196
2#	2480.249	78.00	-2.29	75.71			AVG	100	196
3	2483.500	51.77	-2.29	49.48	74.00	-24.52	peak	100	196
4	2483.500	37.73	-2.29	35.44	54.00	-18.56	AVG	100	196
5	4960.000	45.06	4.20	49.26	74.00	-24.74	peak	205	180
6	4960.000	35.52	4.20	39.72	54.00	-14.28	AVG	205	180
7	7440.000	42.00	8.43	50.43	74.00	-23.57	peak	100	123
8	7440.000	31.02	8.43	39.45	54.00	-14.55	AVG	100	123

Remarks:

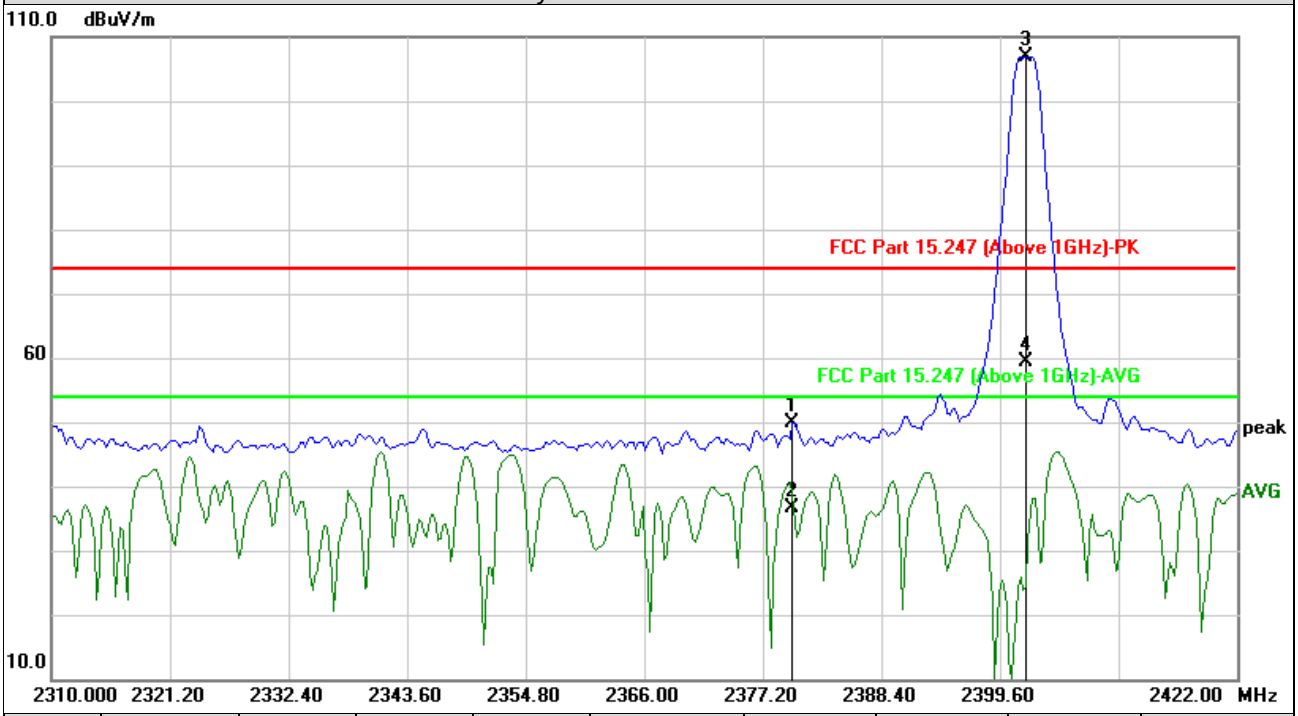
4. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
5. Margin value = Emission level – Limit value
6. #2480MHz: Fundamental frequency.

Above 1GHz Data:

BLE-2Mbps

Test channel	Channel 0	Frequency Range	1GHz ~ 25GHz
Detector Function	Peak (PK) Average (AVG)	Tested By	Jim Xu

Antennal Polarity& Test distance: Horizontal at 3 M



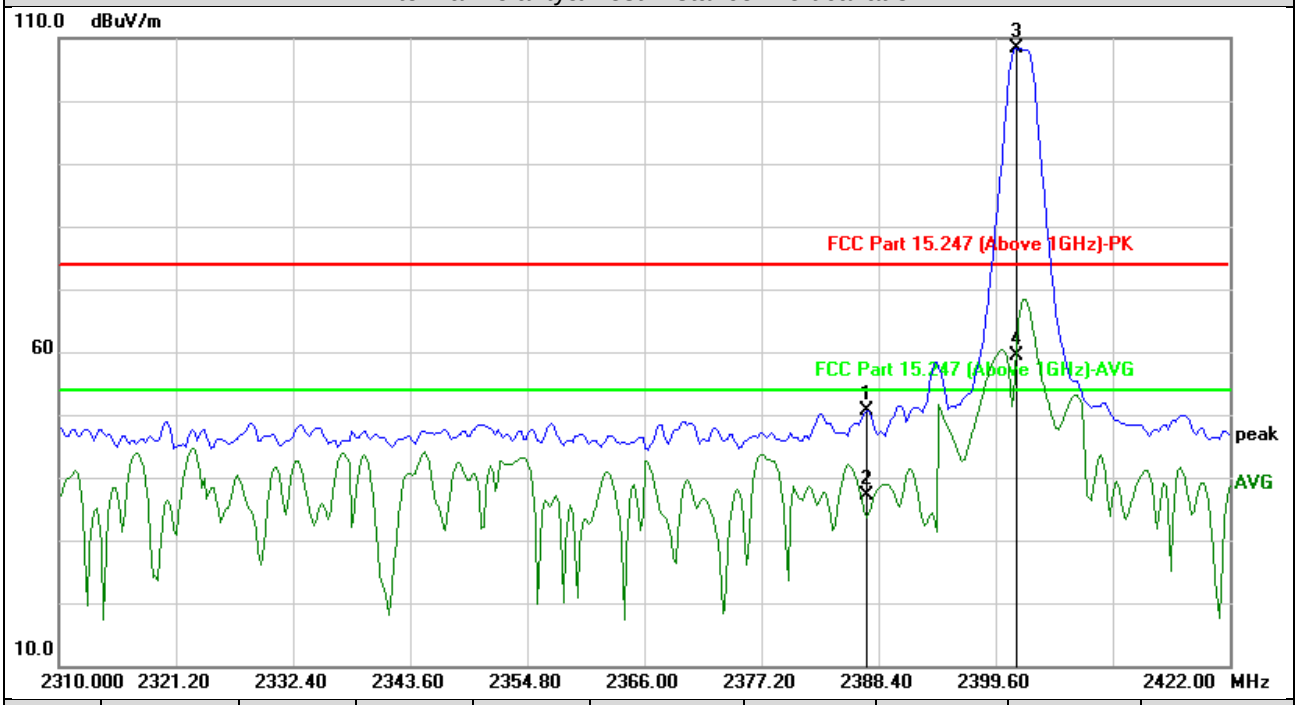
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Height (cm)	Table Angle (Degree)
1	2380.028	51.73	-1.73	50.00	74.00	-24.00	peak	137	235
2	2380.028	38.41	-1.73	36.68	54.00	-17.32	AVG	137	235
3#	2402.024	108.54	-1.73	106.81			peak	137	235
4#	2402.024	61.20	-1.73	59.47			AVG	137	235
5	4804.000	46.07	3.75	49.82	74.00	-24.18	peak	100	173
6	4804.000	33.40	3.75	37.15	54.00	-16.85	AVG	100	173
7	7206.000	40.89	8.14	49.03	74.00	-24.97	peak	100	189
8	7206.000	27.92	8.14	36.06	54.00	-17.94	AVG	100	189

Remarks:

4. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
5. Margin value = Emission level – Limit value
6. #2402MHz: Fundamental frequency.

Test channel	Channel 0	Frequency Range	1GHz ~ 25GHz
Detector Function	Peak (PK) Average (AVG)	Tested By	Jim Xu

Antennal Polarity& Test Distance: Vertical at 3m



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Height (cm)	Table Angle (Degree)
1	2387.210	52.32	-1.73	50.59	74.00	-23.41	peak	100	113
2	2387.210	38.97	-1.73	37.24	54.00	-16.76	AVG	100	113
3#	2401.575	110.04	-1.73	108.31			peak	100	113
4#	2401.575	61.18	-1.73	59.45			AVG	100	113
5	4804.000	46.93	3.75	50.68	74.00	-23.32	peak	100	164
6	4804.000	34.67	3.75	38.42	54.00	-15.58	AVG	100	164
7	7206.000	42.51	8.14	50.65	74.00	-23.35	peak	100	259
8	7206.000	28.62	8.14	36.76	54.00	-17.24	AVG	100	259

Remarks:

4. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
5. Margin value = Emission level – Limit value
6. #2402MHz: Fundamental frequency.

Test channel	Channel 19	Frequency Range	1GHz ~ 25GHz
Detector Function	Peak (PK) Average (AVG)	Tested By	Jim Xu

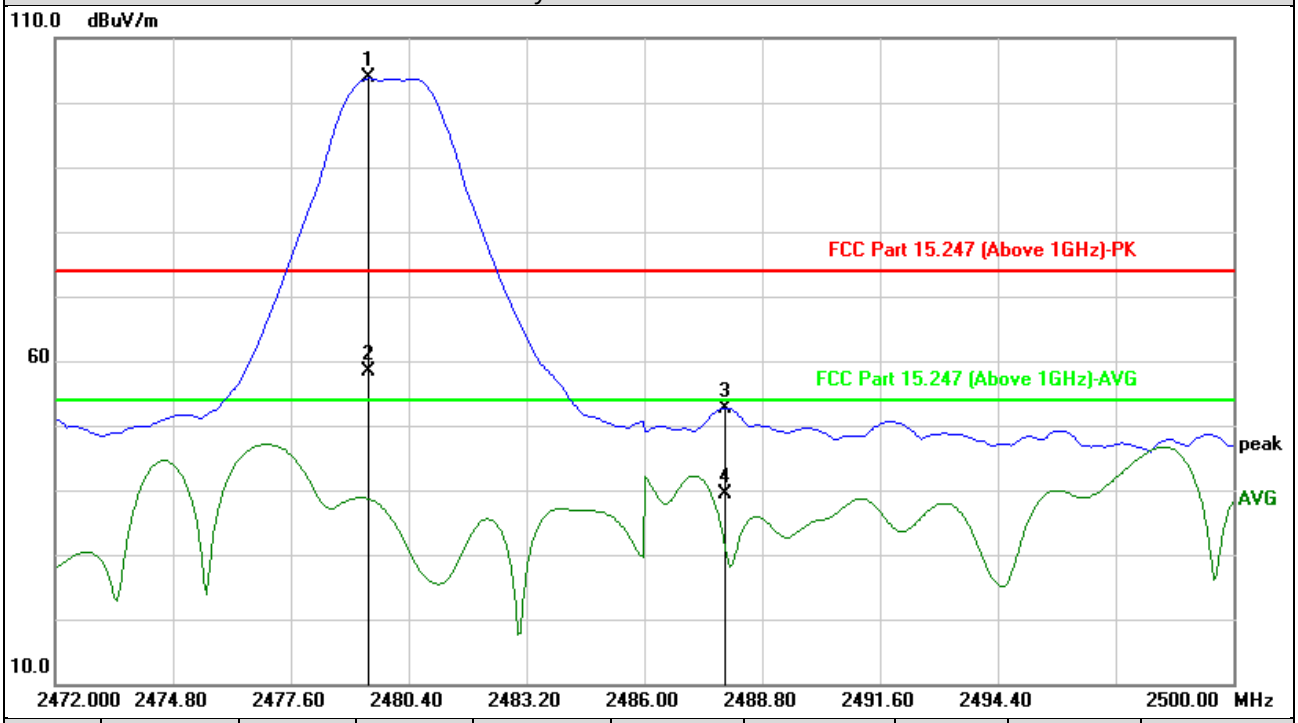
Antennal Polarity& Test Distance: Horizontal at 3m									
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Height (cm)	Table Angle (Degree)
1#	2440.000	106.40	-1.71	104.69			peak	100	154
2#	2440.000	60.18	-1.71	58.47			AVG	100	154
3	4880.000	46.91	3.97	50.88	74.00	-23.12	peak	100	284
4	4880.000	33.34	3.97	37.31	54.00	-16.69	AVG	100	284
5	7320.000	41.34	8.29	49.63	74.00	-24.37	peak	100	223
6	7320.000	27.67	8.29	35.96	54.00	-18.04	AVG	100	223
Antennal Polarity& Test Distance: Vertical at 3 M									
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Height (cm)	Table Angle (Degree)
1#	2440.000	109.84	-1.71	108.13			peak	100	215
2#	2440.000	61.27	-1.71	59.56			AVG	100	215
3	4880.000	46.45	3.97	50.42	74.00	-23.58	peak	100	183
4	4880.000	34.67	3.97	38.64	54.00	-15.36	AVG	100	183
5	7320.000	40.77	8.29	49.06	74.00	-24.94	peak	100	249
6	7320.000	29.47	8.29	37.76	54.00	-16.24	AVG	100	249

Remarks:

4. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
5. Margin value = Emission level – Limit value
6. #2440MHz: Fundamental frequency.

Test channel	Channel 39	Frequency Range	1GHz ~ 25GHz
Detector Function	Peak (PK) Average (AVG)	Tested By	Jim Xu

Antennal Polarity& Test Distance: Horizontal at 3 M



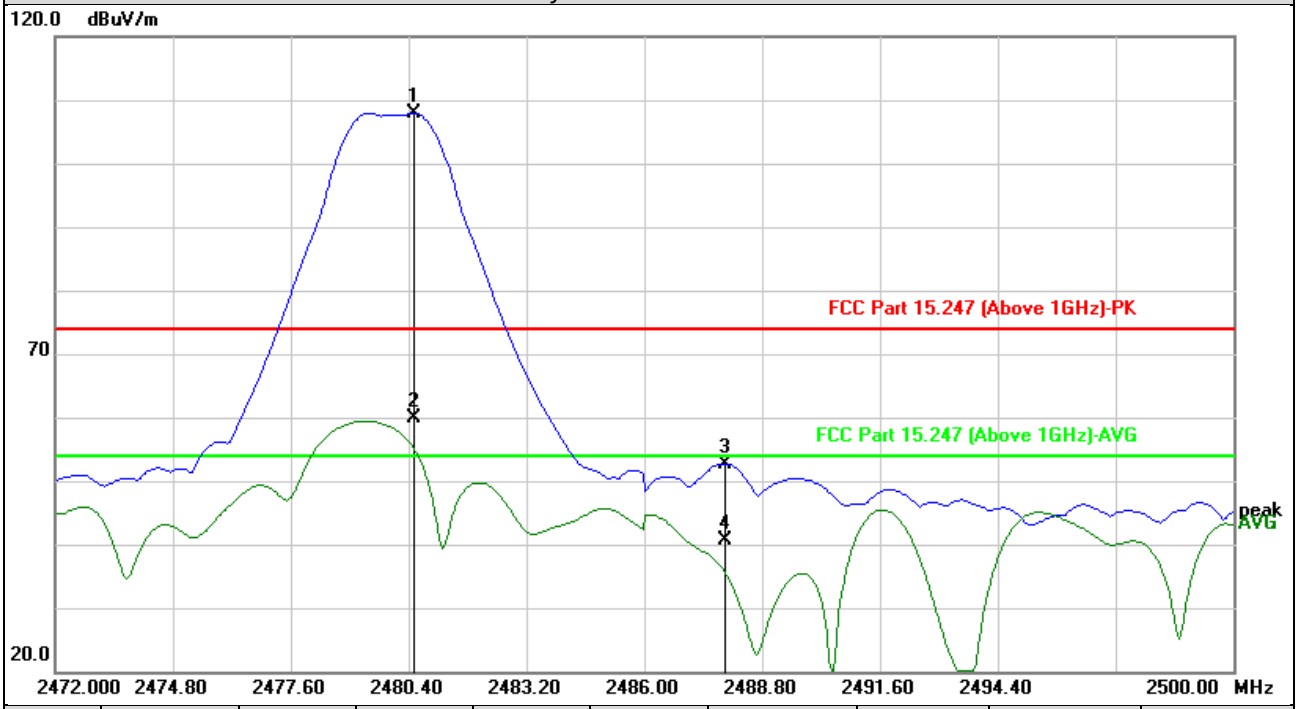
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Height (cm)	Table Angle (Degree)
1#	2479.463	105.45	-1.68	103.77			peak	100	219
2#	2479.463	60.01	-1.68	58.33			AVG	100	219
3	2487.936	54.32	-1.69	52.63	74.00	-21.37	peak	100	219
4	2487.936	41.09	-1.69	39.40	54.00	-14.60	AVG	100	219
5	4960.000	46.27	4.20	50.47	74.00	-23.53	peak	100	189
6	4960.000	34.05	4.20	38.25	54.00	-15.75	AVG	100	189
7	7440.000	42.52	8.43	50.95	74.00	-23.05	peak	100	248
8	7440.000	29.27	8.43	37.70	54.00	-16.30	AVG	100	248

Remarks:

7. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
8. Margin value = Emission level – Limit value
9. #2480MHz: Fundamental frequency.

Test channel	Channel 39	Frequency Range	1GHz ~ 25GHz
Detector Function	Peak (PK) Average (AVG)	Tested By	Jim Xu

Antennal Polarity& Test Distance: Vertical at 3 M



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Height (cm)	Table Angle (Degree)
1#	2480.529	109.67	-1.68	107.99			peak	100	198
2#	2480.529	61.48	-1.68	59.80			AVG	100	198
3	2487.936	54.38	-1.69	52.69	74.00	-21.31	peak	100	198
4	2487.936	42.42	-1.69	40.73	54.00	-13.27	AVG	100	198
5	4960.000	46.70	4.20	50.90	74.00	-23.10	peak	100	195
6	4960.000	34.20	4.20	38.40	54.00	-15.60	AVG	100	195
7	7440.000	41.77	8.43	50.20	74.00	-23.80	peak	100	279
8	7440.000	29.17	8.43	37.60	54.00	-16.40	AVG	100	279

Remarks:

10.Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)

11.Margin value = Emission level – Limit value

12.#2480MHz: Fundamental frequency.

3.2 Conducted Emission Measurement

3.2.1 Limits of Conducted Emission Measurement

Frequency (MHz)	Conducted Limit (dBuV)	
	Quasi-Peak	Average
0.15 - 0.5	66 - 56	56 - 46
0.50 - 5.0	56	46
5.0 - 30.0	60	50

Note: 1. The lower limit shall apply at the transition frequencies.
2. The limit decreases in line with the logarithm of the frequency in the range of 0.15 to0.50MHz.

3.2.2 Test Instruments

Description & Manufacturer	Model No.	Serial No.	Due Date of Calibration
EMI Test Receiver Rohde&Schwarz	ESCI3	101418	2022/09/12
Artificial Mains Network Rohde&Schwarz	ENV216	3560.6550.15	2022/09/12
Test software FARAD	EZ_EMC V1.1.4.2	N/A	N/A
Hygrothermograph Yuhuaze	HTC-1	NA	2022/09/12
Digital Multimeter FLUKE	15B+	43512617WS	2022/09/12

Note: 1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA.
2. The test was performed in Shielded Room 1.

3.2.3 Test Procedures

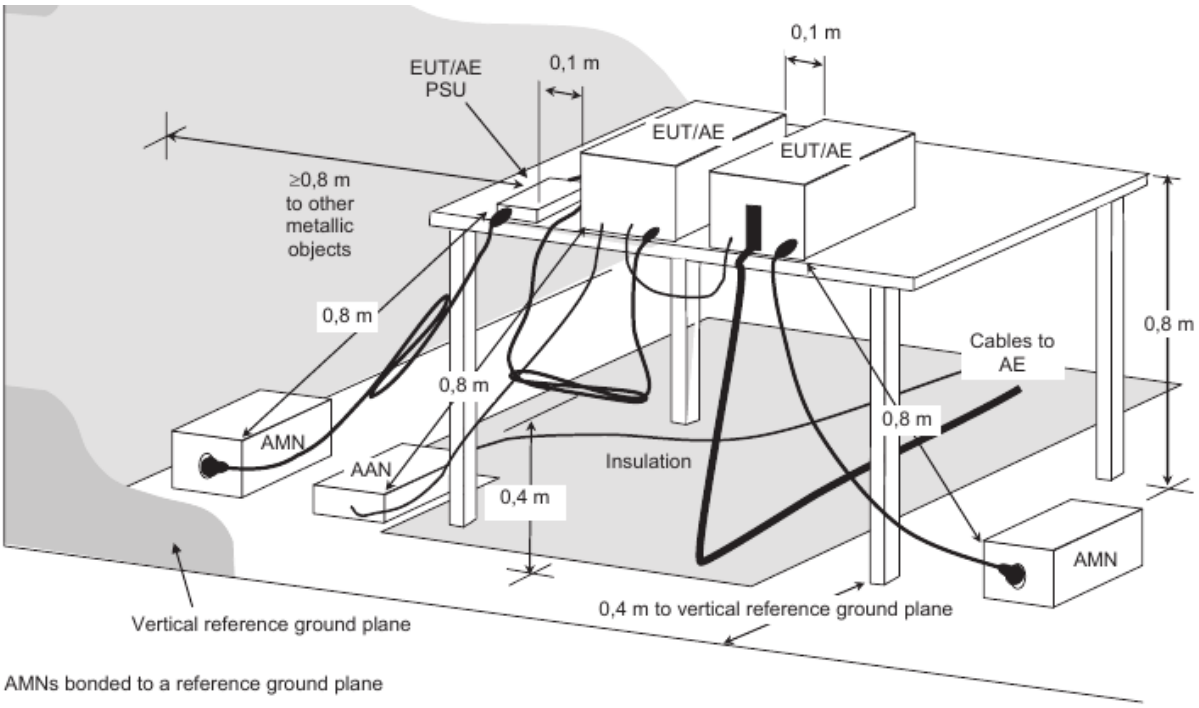
a. The EUT was placed 0.4 meters from the conducting wall of the shielded room with EUT being connected to the power mains through a line impedance stabilization network (LISN). Other support units were connected to the power mains through another LISN. The two LISNs provide 50 ohm/50uH of coupling impedance for the measuring instrument.
b. Both lines of the power mains connected to the EUT were checked for maximum conducted interference.
c. The frequency range from 150kHz to 30MHz was searched. Emission levels under (Limit – 20dB) was not recorded.

Note: All modes of operation were investigated and the worst-case emissions are reported.

3.2.4 Deviation from Test Standard

No deviation.

3.2.5 Test setup



AMNs bonded to a reference ground plane

3.2.6 EUT Operating Conditions

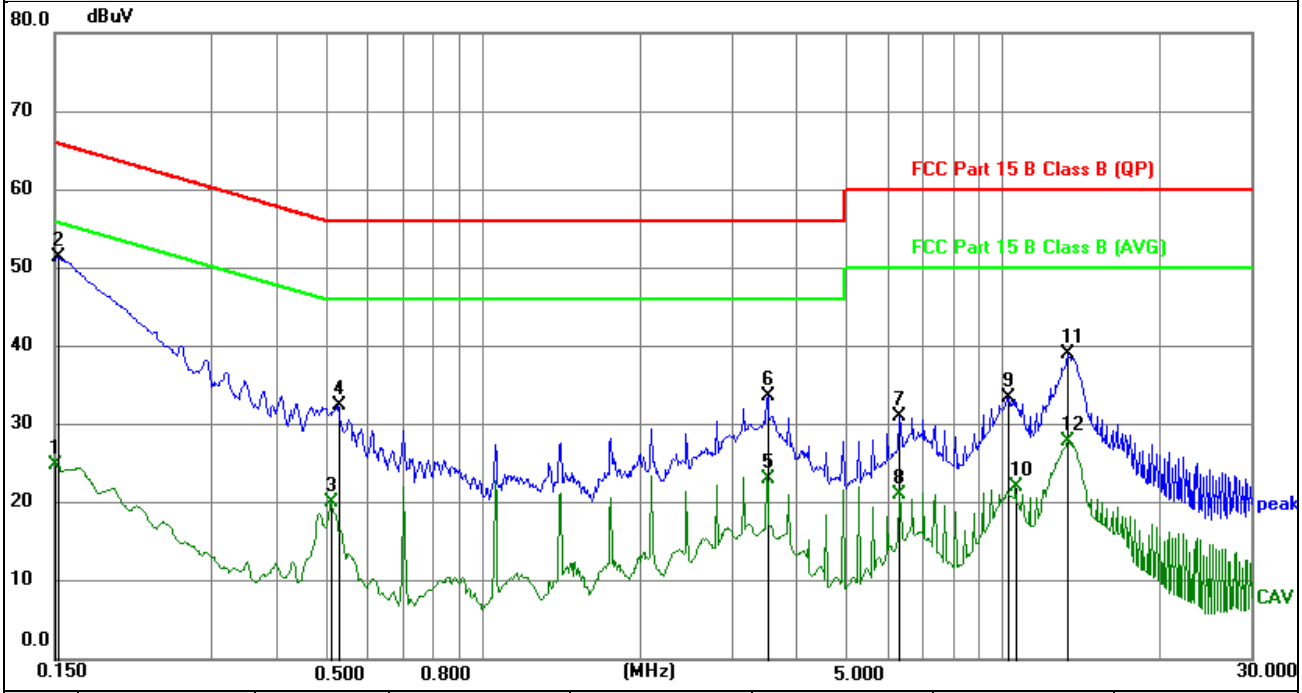
a. Placed the EUT on the testing table.

b. Set the EUT under transmission condition continuously at specific channel frequency.

3.2.7 Test Results

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Power supply	DC5V from USB	Environmental Conditions	25℃, 60%RH

Phase of Power: Line (L)



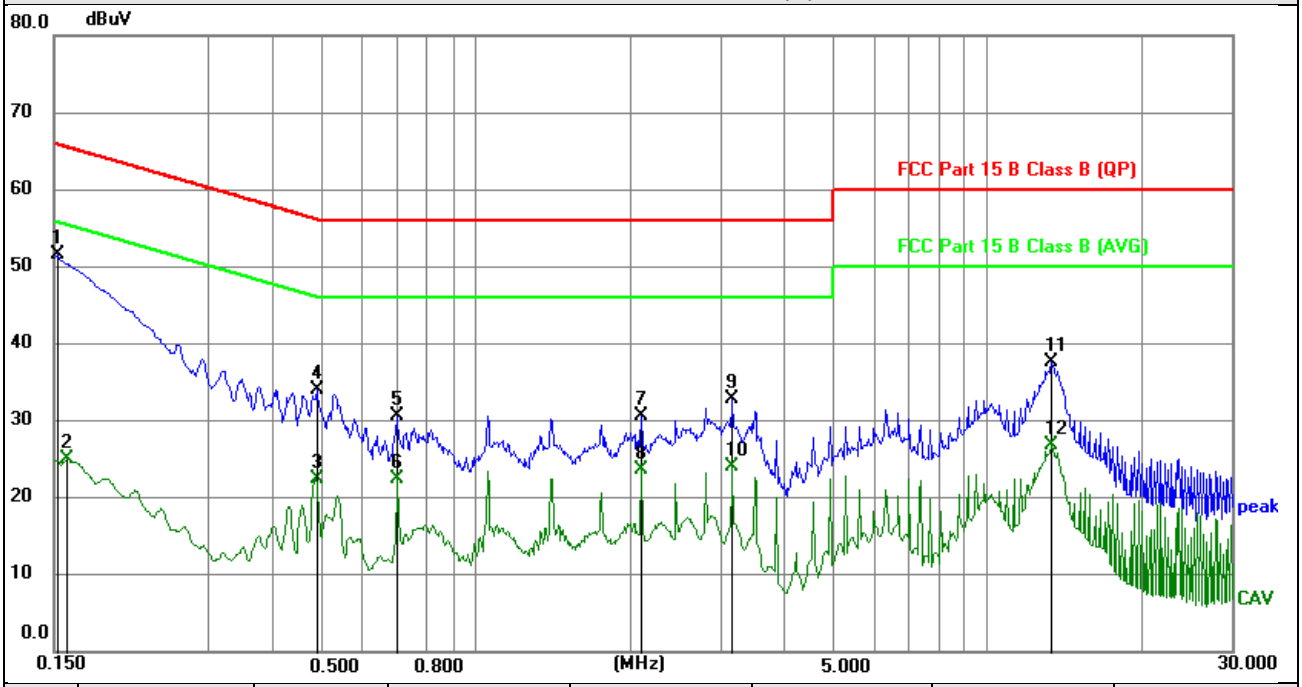
No	Frequency	Reading	Correction Factor	Emission Level	Limit	Margin	Remark
	(MHz)	(dBuV)	dB	(dBuV)	(dBuV)	(dB)	Detector
1	0.1500	14.73	10.19	24.92	56.00	-31.08	AVG
2	0.1522	41.28	10.18	51.46	65.88	-14.42	peak
3	0.5122	10.01	10.10	20.11	46.00	-25.89	AVG
4	0.5280	22.33	10.10	32.43	56.00	-23.57	peak
5	3.5273	12.90	10.10	23.00	46.00	-23.00	AVG
6	3.5295	23.45	10.10	33.55	56.00	-22.45	peak
7	6.3510	21.06	10.00	31.06	60.00	-28.94	peak
8	6.3510	10.98	10.00	20.98	50.00	-29.02	AVG
9	10.2323	23.32	10.11	33.43	60.00	-26.57	peak
10	10.5833	11.89	10.12	22.01	50.00	-27.99	AVG
11	13.4070	28.87	10.22	39.09	60.00	-20.91	peak
12	13.4070	17.59	10.22	27.81	50.00	-22.19	AVG

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution bandwidth	Quasi-Peak (QP) / Average (AV), 9kHz
Power supply	DC5V from USB	Environmental Conditions	25℃, 60%RH

Phase of Power: Neutral (N)



No.	Frequency	Reading	Correction Factor	Emission Level	Limit	Margin	Remark
	(MHz)	(dBuV)	dB	(dBuV)	(dBuV)	(dB)	Detector
1	0.1522	41.34	10.18	51.52	65.88	-14.36	peak
2	0.1590	14.79	10.17	24.96	55.52	-30.56	AVG
3	0.4875	12.37	10.11	22.48	46.21	-23.73	AVG
4	0.4897	23.84	10.11	33.95	56.17	-22.22	peak
5	0.7035	20.62	10.10	30.72	56.00	-25.28	peak
6	0.7056	12.39	10.10	22.49	46.00	-23.51	AVG
7	2.1165	20.47	10.10	30.57	56.00	-25.43	peak
8	2.1165	13.56	10.10	23.66	46.00	-22.34	AVG
9	3.1762	22.63	10.09	32.72	56.00	-23.28	peak
10	3.1762	13.96	10.09	24.05	46.00	-21.95	AVG
11	13.4070	27.34	10.25	37.59	60.00	-22.41	peak
12	13.4070	16.66	10.25	26.91	50.00	-23.09	AVG

Remarks:

1. Q.P. and AV. are abbreviations of quasi-peak and average individually.
2. The emission levels of other frequencies were very low against the limit.
3. Margin value = Emission level – Limit value
4. Correction factor = Insertion loss + Cable loss
5. Emission Level = Correction Factor + Reading Value.

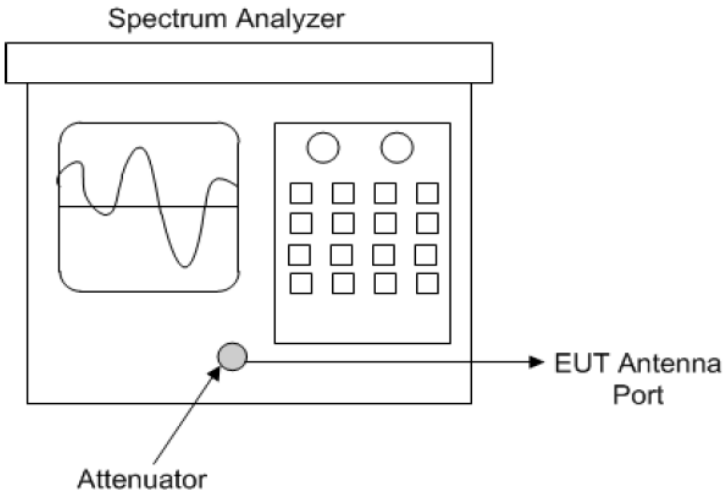
3.3 6dB Bandwidth Measurement

3.3.1 Limits of 6dB Bandwidth Measurement

The minimum of 6dB Bandwidth Measurement is 0.5MHz.

3.3.2 Test Setup

Subclause 11.8 of ANSI C63.10 is applicable.



Spectrum analyzer test configuration

3.3.3 Test Instruments

Refer to section 5 to get information of above instrument.

3.3.4 Test Procedure

Option 1:

a. Set resolution bandwidth (RBW) = 30kHz
b. Set the video bandwidth (VBW) ≥ 3 x RBW
c. Detector = Peak.
d. Trace mode = max hold.
e. Sweep = auto couple.
f. Allow the trace to stabilize.
g. Measure the maximum width of the emission that is constrained by the frequencies associated with the two amplitude points (upper and lower) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission

Option 2:

The automatic bandwidth measurement capability of an instrument may be employed using the dB bandwidth mode with *X* set to 6 dB. if the functionality described in 11.8.1 (i.e. RBW= 100 kHz. VBW ≥ 3*RBW. and peak detector with maximum hold) is implemented by the instrumentation function. When using this capability. care shall be taken so that the bandwidth measurement is not influenced by any intermediate power nulls in the fundamental emission that might be ≥6 dB

3.3.5 Deviation from Test Standard

No deviation.

3.3.6 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

3.3.7 Test Result

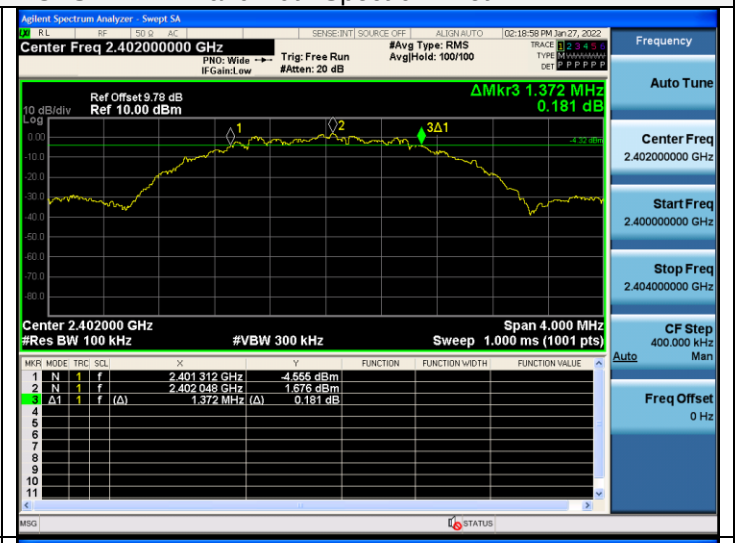
BLE-1Mbps

Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
0	2402	0.764	0.5	Pass
19	2440	0.744	0.5	Pass
39	2480	0.752	0.5	Pass

BLE-2Mbps

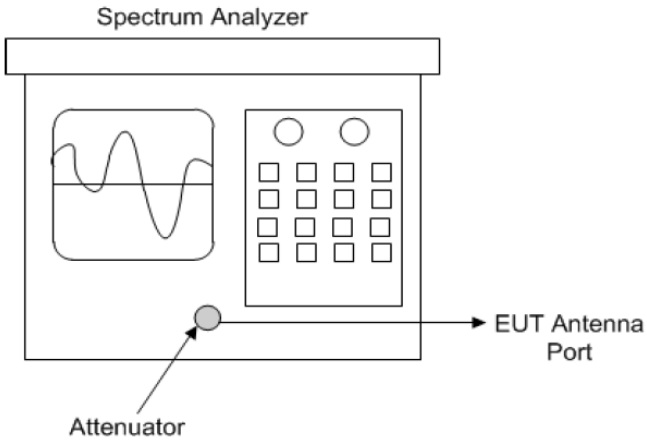
Channel	Frequency (MHz)	6dB Bandwidth (MHz)	Minimum Limit (MHz)	Pass / Fail
0	2402	1.372	0.5	Pass
19	2440	1.292	0.5	Pass
39	2480	1.292	0.5	Pass

GFSK 1MHz Bandwidth Spectrum Plot	
Channel 0	
Channel 19	
Channel 39	

GFSK 2MHz Bandwidth Spectrum Plot	
Channel 0	
Channel 19	
Channel 39	

3.4 Occupied Bandwidth Measurement

3.4.1 Test Setup



Spectrum analyzer test configuration

3.4.2 Test Instruments

Refer to section 5 to get information of above instrument.

3.4.3 Test Procedure

The transmitter output was connected to the spectrum analyzer through an attenuator. The bandwidth of the fundamental frequency was measured by spectrum analyzer with resolution bandwidth in the range of 1% to 5% of the anticipated emission bandwidth, and a video bandwidth at least 3x the resolution bandwidth and set the detector to peak. The width of a frequency band such that, below the lower and above the upper frequency limits, the mean powers emitted are each equal to a specified percentage 0.5 %of the total mean power of a given emission.

3.4.4 Deviation from Test Standard

No deviation.

3.4.5 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

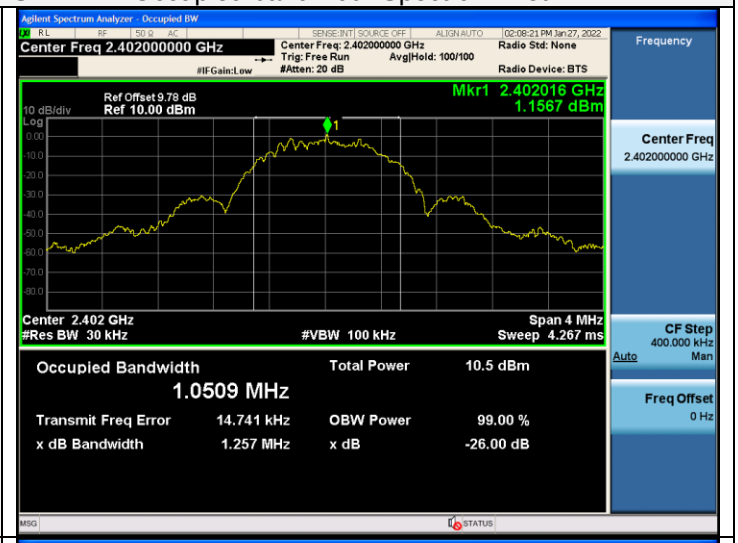
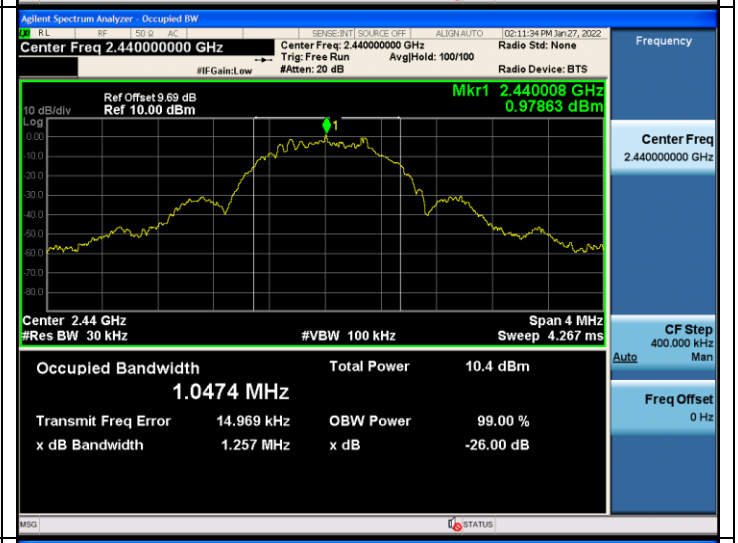
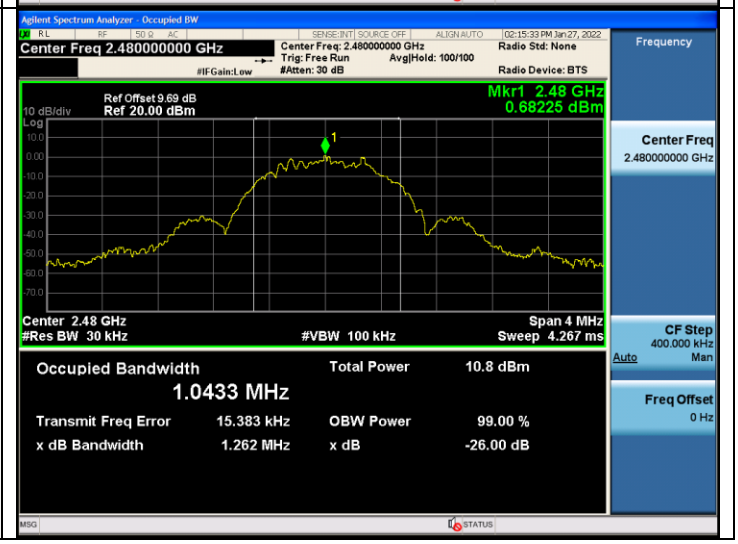
3.4.6 Test Results

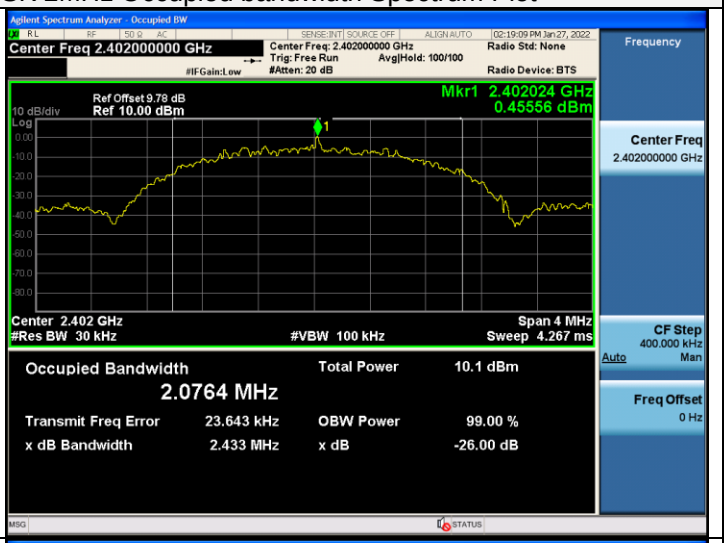
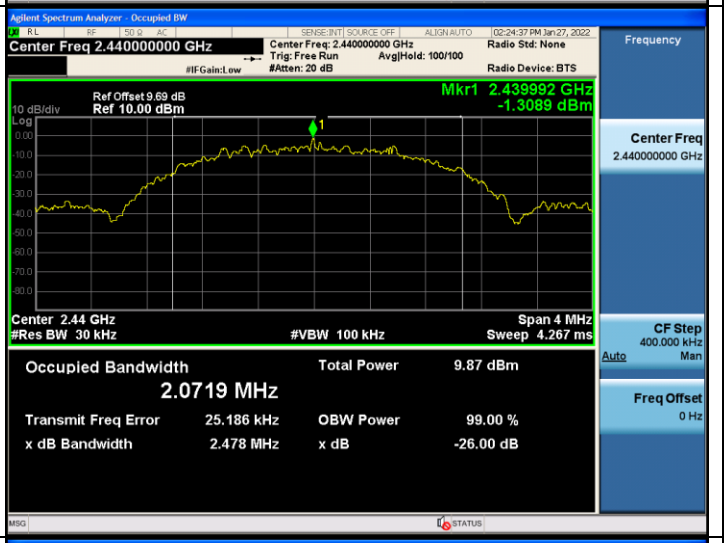
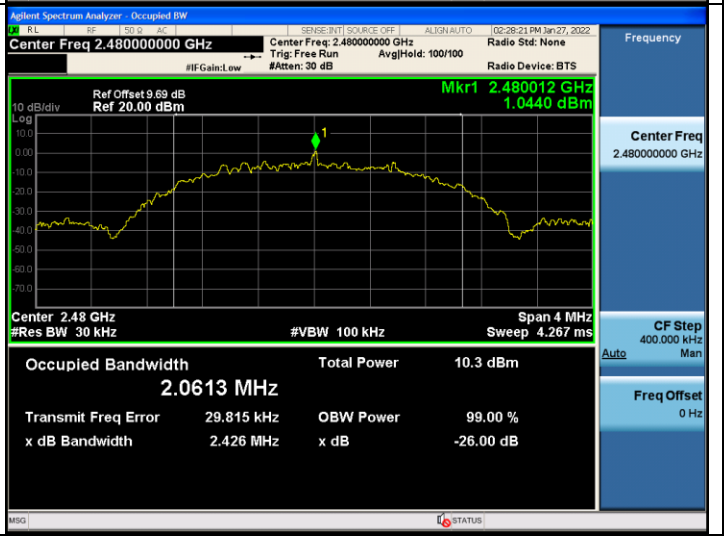
BLE-1Mbps

Channel	Frequency (MHz)	Occupied Bandwidth (MHz)	Pass / Fail
0	2402	1.0509	Pass
19	2440	1.0474	Pass
39	2480	1.0433	Pass

BLE-2Mbps

Channel	Frequency (MHz)	Occupied Bandwidth (MHz)	Pass / Fail
0	2402	2.0764	Pass
19	2440	2.0719	Pass
39	2480	2.0613	Pass

GFSK 1MHz Occupied bandwidth Spectrum Plot	
Channel 0	
Channel 19	
Channel 39	

GFSK 2MHz Occupied bandwidth Spectrum Plot	
Channel 0	
Channel 19	
Channel 39	

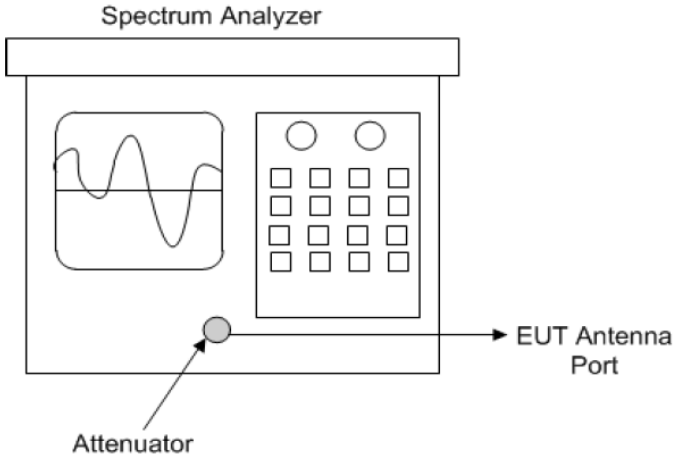
3.5 Conducted Output Power Measurement

3.5.1 Limits of Conducted Output Power Measurement

For systems using digital modulation in the 2400–2483.5 MHz bands: 1 Watt (30dBm)

3.5.2 Test Setup

- Measurement using a spectrum analyzer (SA) Subclause 11.9.2.2 of ANSI C63.10 is applicable



Spectrum analyzer output power test configuration

3.5.3 Test Instruments

Refer to section 5 to get information of above instrument.

3.5.4 Test Procedures

Measurement using a spectrum analyzer (SA)，Selection of test method：

The proper test method is selected based on the following criteria:

a) **Method AVGSA-1 or method AVGSA-1A (alternative)** shall be applied if either of the following conditions can be satisfied:
1) The EUT transmits continuously (or with a D> 98%).
2) Sweep triggering can be implemented in such a way that the device transmits at the maximum power control level throughout the duration of each of the instrument sweeps to be averaged. This condition can generally be achieved by triggering the instrument's sweep if the duration of the sweep (with the instrument configured as in method AVGSA-1) is equal to or shorter than the duration T of each transmission from the EUT, and if those transmissions exhibit full power throughout their durations.

b) **Method AVGSA-2 or method AVGSA-2A (alternative)** shall be applied if the conditions of the preceding item a) cannot be achieved and the transmissions exhibit a constant duty cycle during the measurement duration. Duty cycle will be considered to be constant if variations are less than +2%.

c) **Method AVGSA-3 or method AVGSA-3A** (alternative) shall be applied if the conditions of the preceding item a) and item b) cannot be achieved.

Method AVGSA-3 or method AVGSA-3A:

a) Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
b) 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.
c) SA Setting:
1* Set span to at least 1.5 times the OBW
2* Set sweep trigger to "free run."
3* Set RBW= 1% to 5% of the OBW. not to exceed 1MHz.
4* Set VBW ≥ 3 x RBW
5* Number of points in sweep≥ 2 x span /RBW. (This gives bin-to-bin spacing ≤ RBW / 2. so that narrowband signals are not lost between frequency bins).
6* Sweep time ≤ (number of points in sweep) x T. where T is defined in 11.6. If this gives a sweep time less than the auto sweep time of the instrument. then method AVGSA-3 shall not be used (use AVGSA-3A). The purpose of this step is so that the averaging time in each bin is less than or equal to the minimum time of a transmission.
7* Detector =RMS (power averaging).
8* Trace mode =max hold.
9* Allow max hold to run for at least 60 s or longer as needed to allow the trace to stabilize.
10* Compute power by integrating the spectrum across the OBW of the signal using the instrument's band power measurement function with band limits set equal to the OBW band edges. If the instrument does not have a band power function. then sum the spectrum levels (in power units) at intervals equal to the RBW extending across the entire OBW
d. Measure the captured power within the band and recording the plot.
e. Repeat above procedures until all frequencies required were complete.

3.5.5 Deviation from Test Standard

No deviation.

3.5.6 EUT Operating Conditions

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

3.5.7 Test Results

BLE-1Mbps

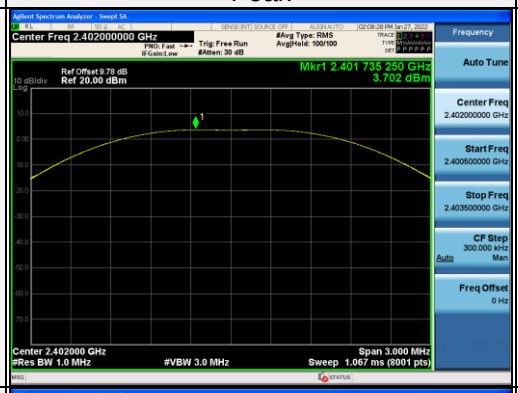
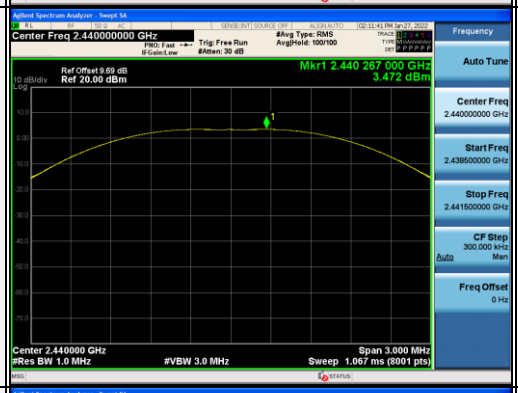
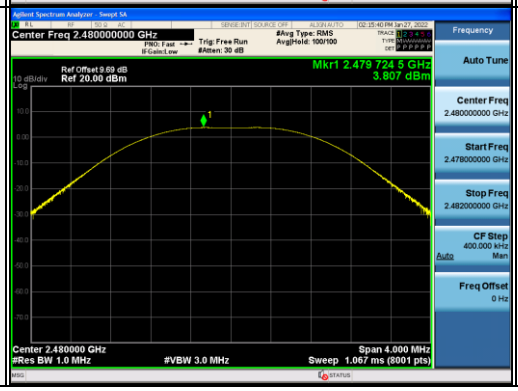
Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Limit (dBm)	Pass / Fail
0	2402	2.35	3.702	30	Pass
19	2440	2.22	3.472	30	Pass
39	2480	2.40	3.807	30	Pass

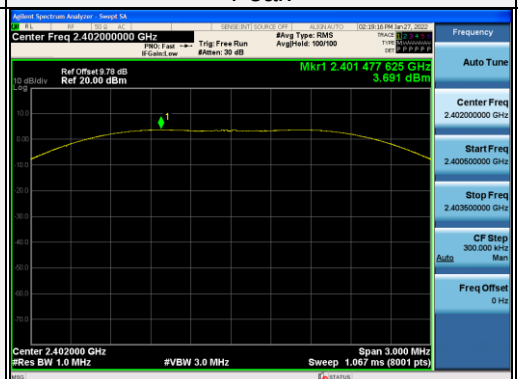
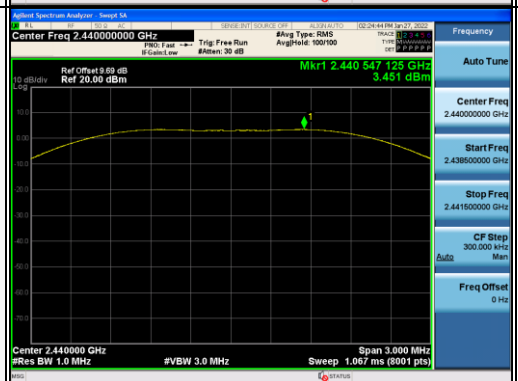
Channel	Frequency (MHz)	Average Power (mW)	Average Power (dBm)	Limit (dBm)	Pass / Fail
0	2402	1.35	1.313	30	Pass
19	2440	1.27	1.055	30	Pass
39	2480	1.36	**1.348**	30	Pass

BLE-2Mbps

Channel	Frequency (MHz)	Peak Power (mW)	Peak Power (dBm)	Limit (dBm)	Pass / Fail
0	2402	2.34	3.691	30	Pass
19	2440	2.21	3.451	30	Pass
39	2480	2.41	3.821	30	Pass

Channel	Frequency (MHz)	Average Power (mW)	Average Power (dBm)	Limit (dBm)	Pass / Fail
0	2402	1.21	0.826	30	Pass
19	2440	1.19	0.743	30	Pass
39	2480	1.27	1.039	30	Pass

GFSK 1MHz Power Spectrum Plot		
Channel	Peak	Average
Channel 0		
Channel 19		
Channel 39		

GFSK 2MHz Power Spectrum Plot		
Channel	Peak	Average
Channel 0		
Channel 19		
Channel 39		

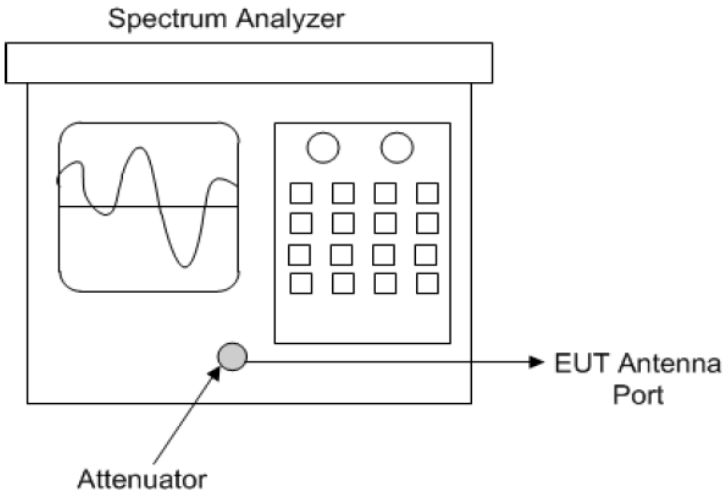
3.6 Power Spectral Density Measurement

3.6.1 Limits of Power Spectral Density Measurement

The Maximum of Power Spectral Density Measurement is 8dBm/3kHz.

3.6.2 Test Setup

- DTS maximum power spectral density level in the fundamental emission Subclause 11.10 of ANSI C63.10 is applicable



Spectrum analyzer test configuration

3.6.3 Test Instruments

Refer to section 5 to get information of above instrument.

3.6.4 Test Procedure

a. **Method AVGPSD-1 or method AVGPSD-1A (alternative)** shall be applied if either of the following conditions can be satisfied:
   1) The EUT transmits continuously (or with a D ≥98%).
   2) Sweep triggering can be implemented in such a way that the device transmits at the maximum power control level throughout the duration of each of the instrument sweeps to be averaged. This condition can generally be achieved by triggering the instrument's sweep if the duration of the sweep is equal to or shorter than the duration I of each transmission from the EUT, and if those transmissions exhibit full power throughout these durations.

b. **Method AVGPSD-2 or method AVGPSD-2A (alternative)** shall be applied if the conditions of the preceding item a) cannot be achieved. and the transmissions exhibit a constant duty cycle during the measurement duration. Duty cycle will be considered to be constant if variations are less than ±2%.

c. **Method AVGPSD-3 or method AVGPSD-3A (alternative)** shall be applied if the conditions of the preceding paragraphs a) and b) cannot be achieved.

Method AVGPSD-3:

Method AVGPSD-3 uses mms detection across ON and OFE times of the EUT with max hold. The following procedure is applicable when the EUT cannot be configured to transmit continuously (i.e. D<98%), when sweep triggering/signal gating cannot be used to measure only when the EUT is transmitting at its maximum power control level. and when the transmission duty cycle is not constant (i.e., duty cycle variations exceed ±2%),

SA Setting:

a. Set the instrument span to a minimum of 1.5 times the OBW.
b. Set sweep trigger to "free run."
c. Set the RBW = 3 kHz, VBW =10 kHz,
d. Detector = RMS (power averaging).
e. Sweep time = Auto couple,
f. Allow max hold to run for at least 60 s or longer as needed to allow the trace to stabilize.
g. Use the peak marker function to determine the maximum PSD level

- If the measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat (note that this may require zooming in on the emission of interest and reducing the span to meet the minimum measurement point requirement as the RBW is reduced).

3.6.5 Deviation from Test Standard

No deviation.

3.6.6 EUT Operating Condition

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

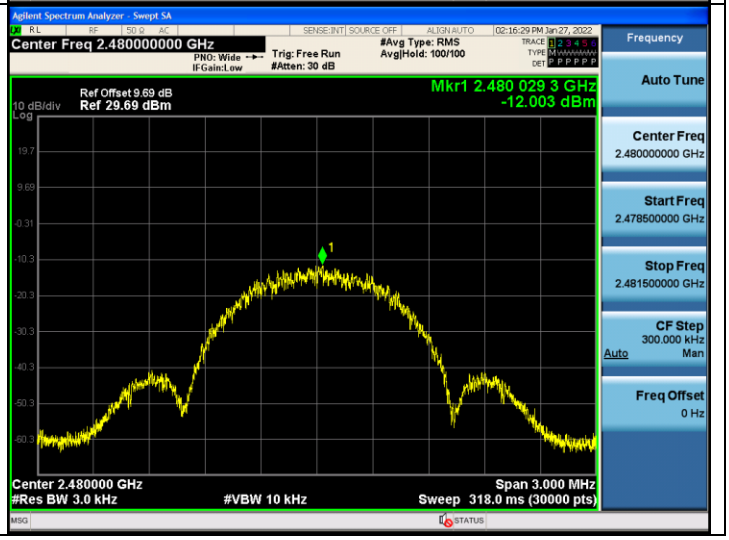
3.6.7 Test Results

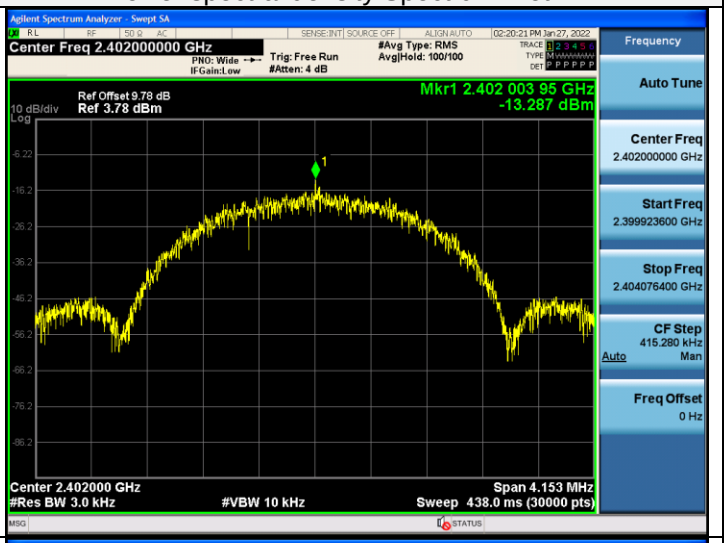
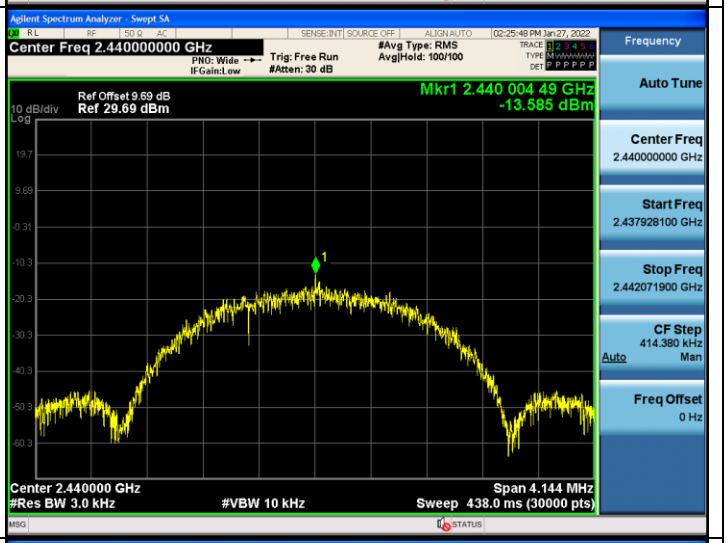
BLE-1Mbps

Channel	Frequency (MHz)	PSD (dBm/10kHz)	Limit (dBm/3kHz)	Pass / Fail
0	2402	-12.17	8	Pass
19	2440	-12.38	8	Pass
39	2480	-12.00	8	Pass

BLE-2Mbps

Channel	Frequency (MHz)	PSD (dBm/10kHz)	Limit (dBm/3kHz)	Pass / Fail
0	2402	-13.29	8	Pass
19	2440	-13.59	8	Pass
39	2480	-13.04	8	Pass

GFSK 1MHz Power spectral density Spectrum Plot	
Channel 0	
Channel 19	
Channel 39	

GFSK 2MHz Power spectral density Spectrum Plot	
Channel 0	
Channel 19	
Channel 39	

3.7 Conducted Out of Band Emission Measurement

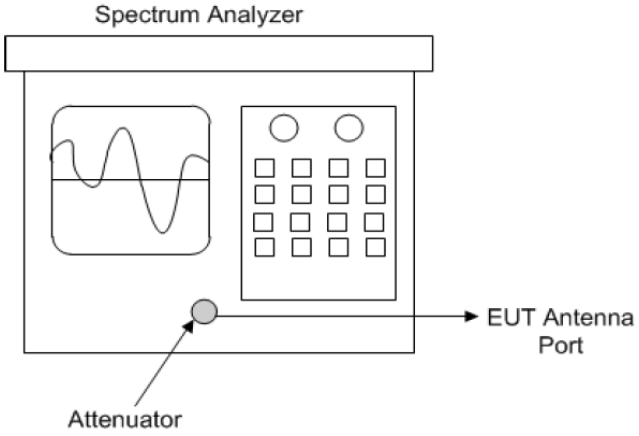
3.7.1 Limits of Conducted Out of Band Emission Measurement

a. **If the maximum peak conducted output power procedure was used to determine compliance as described in 11.9.1**, then the peak output power measured in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 20 dBc).

b. **If maximum conducted (average) output power was used to determine compliance as described in 11.9.2**. then the peak power in any 100 kHz bandwidth outside of the authorized frequency band shall be attenuated by at least 30 dB relative to the maximum in-band peak PSD level in 100 kHz (i.e., 30 dBc).

3.7.2 Test Setup

- DTS emissions in non-restricted frequency bands Subclause 11.11 of ANSI C63.10 is applicable.
- DTS emissions in restricted frequency bands Subclause 11.12 of ANSI C63.10 is applicable



Spectrum analyzer test configuration

3.7.3 Test Instruments

Refer to section 5 to get information of above instrument.

3.7.4 Test Procedure

a. Establish a reference level by using the following procedure:

1) Set instrument center frequency to DTS channel center frequency.
2) Set the span to 21.5 times the DTS bandwidth)
3) Set the RBW= 100 kHz)
4) Set the VBW ≥3 x RBW
5) Detector = peak
6) Sweep time = auto coupling
7) Trace mode =max hold
8) Allow trace to fully stabilize
9) Use the peak marker function to determine the maximum PSD level.

Note that the channel found to contain the maximum PSD level can be used to establish the reference level.

b. Establish an emission level by using the following procedure:

1) Set the center frequency and span to encompass frequency range to be measured.
2) Set the RBW = 100 kHz
3) Set the VBW ≥ 300 kHz.
4) Detector = peak.
5) Sweep time = auto couple.
6) Trace mode = max hold.
7) Allow trace to fully stabilize.
8) Use the peak marker function to determine the maximum power level in any 100 kHz band segment within the fundamental EBW.

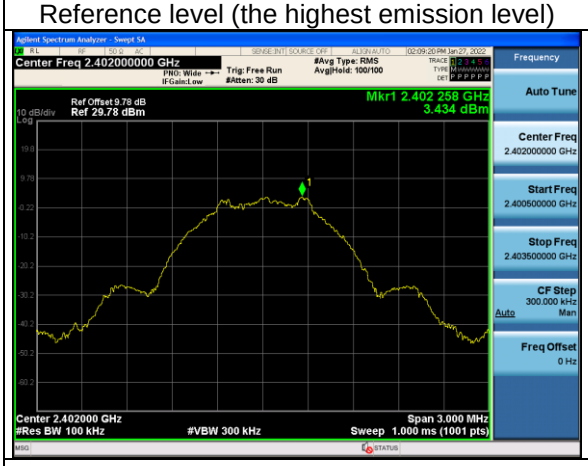
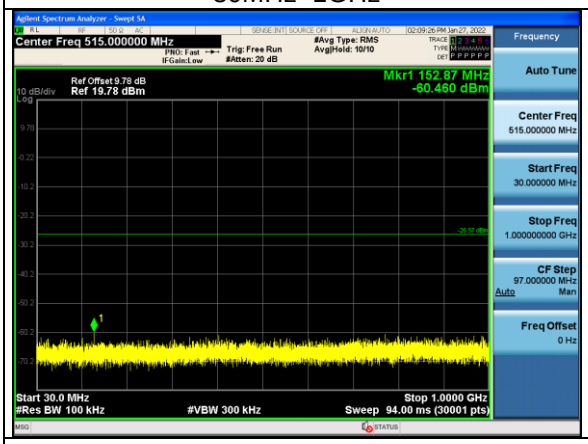
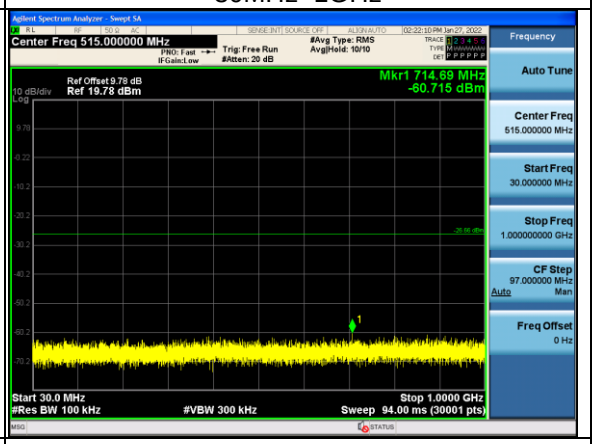
3.7.5 Deviation from Test Standard

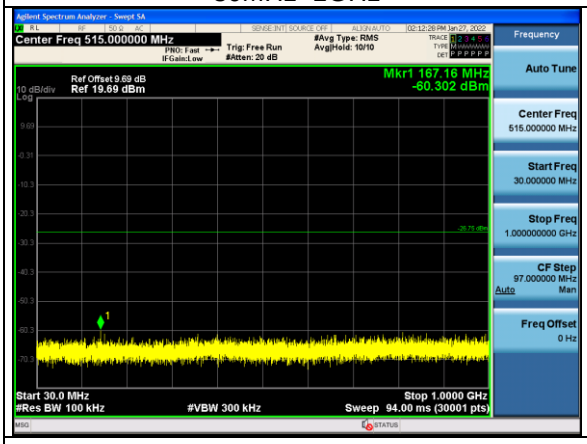
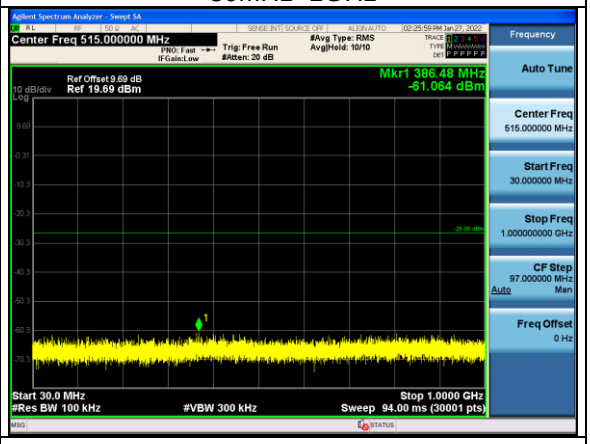
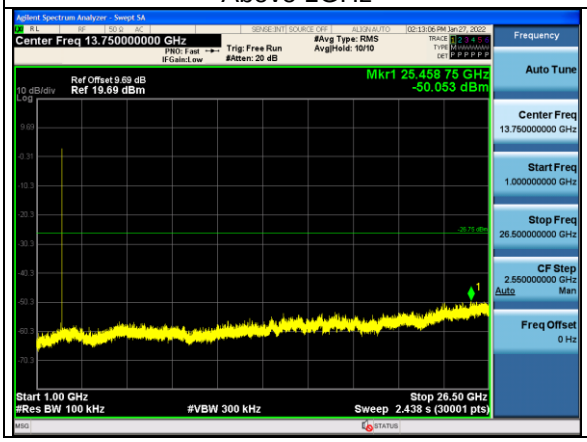
No deviation.

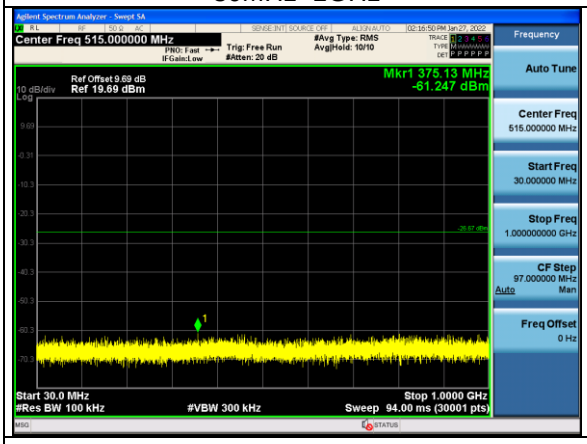
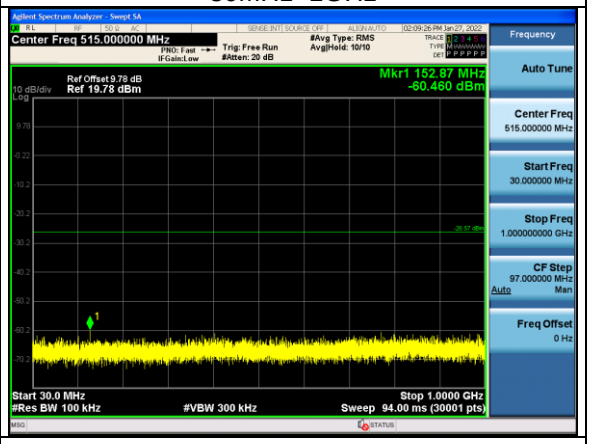
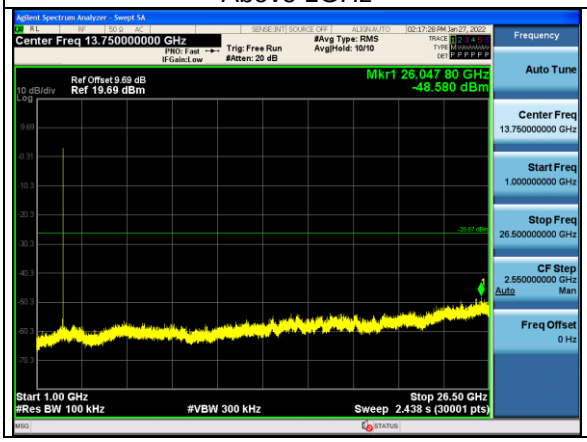
3.7.6 EUT Operating Condition

The software provided by client to enable the EUT under transmission condition continuously at lowest, middle and highest channel frequencies individually.

3.7.7 Test results

BLE-1Mbps	BLE-2Mbps
CH 0	CH 0
Reference level (the highest emission level)	Reference level (the highest emission level)
	
30MHz~1GHz	30MHz~1GHz
	
Above 1GHz	Above 1GHz
	

BLE-1Mbps	BLE-2Mbps
CH 19	CH 19
Reference level (the highest emission level)	Reference level (the highest emission level)
	
30MHz~1GHz	30MHz~1GHz
	
Above 1GHz	Above 1GHz
	

BLE-1Mbps	BLE-2Mbps
CH 39	CH 39
Reference level (the highest emission level)	Reference level (the highest emission level)
	
30MHz~1GHz	30MHz~1GHz
	
Above 1GHz	Above 1GHz
	

4. Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo: 210427EL31-3).

5. Test Instruments

Description & Manufacturer	Model No.	Serial No.	Due Date of Calibration
Spectrum Keysight	N9020A	MY51240612	2022/09/12
Spectrum Analyzer Rohde&Schwarz	FSV-40N	101783	2022/09/12
Power Meter 10Hz~18GHz Tonscend	JS0806-2	188060126	2022/09/12
Signal generator Keysight	E4421B	GB40051020	2022/09/12
Signal generator Keysight	N5182A	MY47420944	2022/09/12
Test Software Tonscend	JS0806-2	NA	NA
Hygrothermograph Yuhuaze	HTC-1	NA	2022/09/12

Note:

1. The calibration interval of the above test instruments is 12 months and the calibrations are traceable to CEPREI/CHINA.
2. The test was performed in Chamber 1.

Appendix – Information on The Testing Laboratories

We, Hwa-Hsing (Dongguan) Co., Ltd., A global provider of TESTING and CERTIFICATION services for consumer products, electronic products and wireless information technology products. Adhering to the core values “HONEST and TRUSTWORTHY, OBJECTIVE and IMPARTIALITY, RIGOROUS and AFFICIENT”, commitment to provide professional, perfect and efficient comprehensive ONE-STOP solution of TESTING and CERTIFICATION services for Manufacturers, Buyers, Traders, Brands, Retailers. Assist client to better manage risk, protect their brands, reduce costs and cut time to over 150 markets in global. Our laboratories are FCC recognized accredited test firms and accredited and approved according to ISO/IEC 17025.

If you have any comments, please feel free to contact us at the following:

Lab Address: No.101, Bld N1, Yuyuan 2Rd, Yuyuan Industrial Park, HuangJiang Town, Dongguan, China
Contact Tel: 0769-83078199
Email: Customerservice.dg@hwa-hsing.com
Web Site: www.hwa-hsing.com

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