



FCC Part 15, Subpart C Test Report

FCC ID: 2BBQK-WILLENII

Applicant: Marshall Group AB

Address: Centralplan 15 111 20 Stockholm Sweden

Manufacturer: Marshall Group AB

Address: Centralplan 15 111 20 Stockholm Sweden

Product: PORTABLE LOUDSPEAKER

Brand: Marshall

Test Model(s): WILLEN II

Series Model(s): N/A

Test Date: Oct. 13, 2023 ~ Dec. 14, 2023

Issued Date: Jan. 22, 2024

Issued By: Hwa-Hsing (Dongguan) Testing Co., Ltd.

Address: No.101, Building N1, Yuyuan 2 Road, Yuyuan Industrial Park,
HuangJiang Town, Dongguan City, People's Republic of 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 :

Nature Lee

Nature Lee

Reviewed by :

Dragon Long

Dragon Long

Approved by :

Scott He

Scott He

"This report is for your exclusive use. Any copying or replication of this report to or for any other person or entity, or use of our name or trademark, is permitted only with our prior written permission. This report sets forth our findings solely with respect to the test samples identified herein. Our report includes all the tests requested by you and the results thereof based upon the information that you provided to us. The report would be invalid without specific stamp of test institute and the signatures of tester and approver."

Lab: [Hwa-Hsing \(Dongguan\) Testing Co., Ltd.](#)
Address: [No.101, Building N1, Yuyuan 2 Road, Yuyuan Industrial Park, HuangJiang Town, Dongguan City, People's Republic of China](#)

Tel: [0769-83078199](tel:0769-83078199)
Web.: www.hwa-hsing.com
E-Mail: customerservice.dg@hwa-hsing.com

Release
Ver. 1.5

Table of Contents

Release Control Record	4
1. Summary of Test Results	5
1.1 Measurement Uncertainty.....	5
1.2 Modification Record	5
2. General Information	6
2.1 General Description of EUT	6
2.2 Description of Test Channels.....	7
2.3 Test Mode Applicability and Tested Channel Detail	7
2.4 Description of Support Units	9
2.5 Configuration of System under Test	9
2.6 Duty Cycle of Test Signal	10
3. Test Types and Results	11
3.1 Radiated Emission and Band-edge Measurement.....	11
3.1.1 Limits of radiated emission and band-edge measurement	11
3.1.2 Test Instruments	12
3.1.3 Test Procedures	13
3.1.4 Deviation from Test Standard.....	14
3.1.5 Test Setup	15
3.1.6 EUT Operating Conditions.....	16
3.1.7 Test Results.....	17
3.2 Conducted Emission Measurement.....	29
3.2.1 Limits of Conducted Emission Measurement.....	29
3.2.2 Test Instruments	29
3.2.3 Test Procedures	30
3.2.4 Test Setup	30
3.2.5 EUT Operating Condition	30
3.2.6 Deviation from Test Standard.....	30
3.2.7 Test Results.....	31
3.3 6dB Bandwidth Measurement.....	33
3.3.1 Limits of 6dB Bandwidth Measurement.....	33
3.3.2 Test Setup	33
3.3.3 Test Instruments	33
3.3.4 Test Procedure	34
3.3.5 Deviation from Test Standard.....	34
3.3.6 EUT Operating Conditions.....	34
3.3.7 Test Result.....	35
3.4 Occupied Bandwidth Measurement.....	37
3.4.1 Test Setup	37
3.4.2 Test Instruments	37
3.4.3 Test Procedure	37
3.4.4 Deviation from Test Standard.....	37
3.4.5 EUT Operating Conditions.....	37
3.4.6 Test Results.....	38
3.5 Conducted Output Power Measurement	40
3.5.1 Limits of Conducted Output Power Measurement.....	40
3.5.2 Test Setup	40
3.5.3 Test Instruments	40
3.5.4 Test Procedures	40
3.5.5 Deviation from Test Standard.....	42
3.5.6 EUT Operating Conditions.....	42
3.5.7 Test Results.....	43

Test Report No.: 23091201-RF-US-02

3.6	Power Spectral Density Measurement	46
3.6.1	Limits of Power Spectral Density Measurement.....	46
3.6.2	Test Setup	46
3.6.3	Test Instruments	46
3.6.4	Test Procedure	47
3.6.5	Deviation from Test Standard.....	47
3.6.6	EUT Operating Condition	47
3.6.7	Test Results.....	48
3.7	Conducted Out of Band Emission Measurement	50
3.7.1	Limits of Conducted Out of Band Emission Measurement.....	50
3.7.2	Test Setup	50
3.7.3	Test Instruments	50
3.7.4	Test Procedure	51
3.7.5	Deviation from Test Standard.....	51
3.7.6	EUT Operating Condition	51
3.7.7	Test results	52
4.	Pictures of Test Arrangements	56
5.	Test Instruments.....	57
	Appendix – Information on The Testing Laboratories.....	58

Test Report No.: 23091201-RF-US-02

Release Control Record

Issue No.	Description	Date Issued
23091201-RF-US-02	Original Release	Jan. 22, 2024

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	Expanded Uncertainty (k=2) (±)
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
Test Model(s)	WILLEN II
Sample No.	HS2310130001
Series Model(s)	N/A
Status of EUT	Engineering Prototype
Power Supply Rating	DC 5V from USB or DC 3.6V from battery
Modulation Type	GFSK for DTS
Transfer Rate	1 Mbps, 2Mbps
Operating Frequency	1M: 2402 ~ 2480MHz 2M: 2404 ~ 2478MHz
Number of Channel	40
Maximum Output Power	4.193dBm (Peak)
Antenna Type	PIFA Antenna
Antenna Gain	Ant 1: 4.22dBi Gain or Ant 2: 4.18dBi Gain
Antenna Connector	I-PEX
Accessory Device	USB-C Cable: Unshielded, 80cm

Note:

1. Please refer to the EUT photo document (Reference No.: 23091201-01&02) 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.
3. For the test results, the EUT had been tested with all conditions, and only the worst case was shown in the test report.
4. Bluetooth can be selected with different PIFA antennas, ANT1&ANT2, the difference between the antennas is the antenna gain and the manufacturer. During the test, the antenna ANT1 with the largest gain is selected for test and recorded in the test report.

Ant. No.	Vendor	Antenna Type	Operation Frequency Range (MHz)	Gain(dBi)
1	RF link	PIFA Antenna	2.4GHz	4.22
2	SOUTH STAR	PIFA Antenna	2.4GHz	4.18

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

Note: BLE 2M does not open channels 0, 12, and 39.

2.3 Test Mode Applicability and Tested Channel Detail

EUT Configure Mode	Applicable test items	X-Axis	Y-Axis	Z-Axis	Voltage Supply
Conducted	AC Power Conducted Emission	N/A	N/A	N/A	DC5V from adapter via AC120V input
Radiated	Radiated Emissions	√	√	√	DC 3.6V from battery
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	

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

Test Condition:

Applicable test items	Environmental Conditions	Test Date	Tested by
Radiated Emissions	24.0deg. C, 55%RH	Nov. 24, 2023	Hua
Antenna Port Conducted Measurement	25.3deg. C, 54%RH	Dec. 12, 2023	Dragon Long

Lab: [Hwa-Hsing \(Dongguan\) Testing Co., Ltd.](#)

Address: [No.101, Building N1, Yuyuan 2 Road, Yuyuan Industrial Park, HuangJiang Town, Dongguan City, People's Republic of China](#)

Tel: [0769-83078199](tel:0769-83078199)

Web.: www.hwa-hsing.com

E-Mail: customerservice.dg@hwa-hsing.com

Release

[Ver. 1.5](#)

Test Report No.: 23091201-RF-US-02

- 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)
-	1 to 38	1, 19, 38	GFSK	2
-	0 to 39	0, 19, 39	GFSK	1

Radiated Emission Test (Below 1GHz):

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type	Data Rate (Mbps)
-	1 to 38	38	GFSK	2
-	0 to 39	39	GFSK	1

Power Line Conducted Emission Test:

EUT Configure Mode	Available Channel	Tested Channel	Modulation Type	Data Rate (Mbps)
-	1 to 38	38	GFSK	2
-	0 to 39	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)
-	1 to 38	1, 19, 38	GFSK	2
-	0 to 39	0, 19, 39	GFSK	1

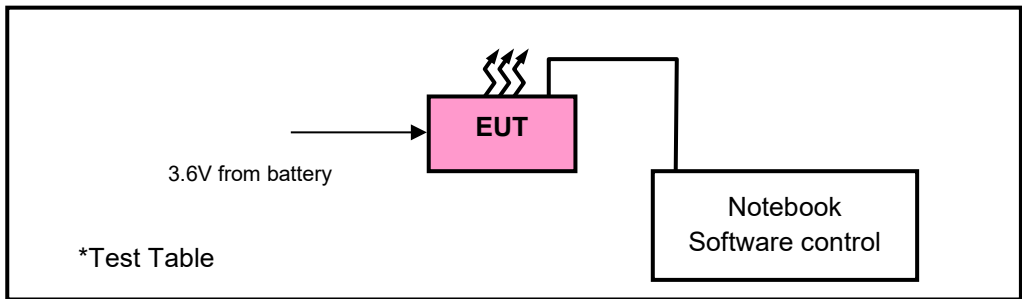
2.4 Description of Support Units

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	HUAWEI	NbD-WFH9	EUPEM21725002655	N/A
2	Notebook	DELL	Inspiron 14R Aluminum Edition	6WPG9-63PV4-RBPF2-T6RHW-W9GBP	N/A

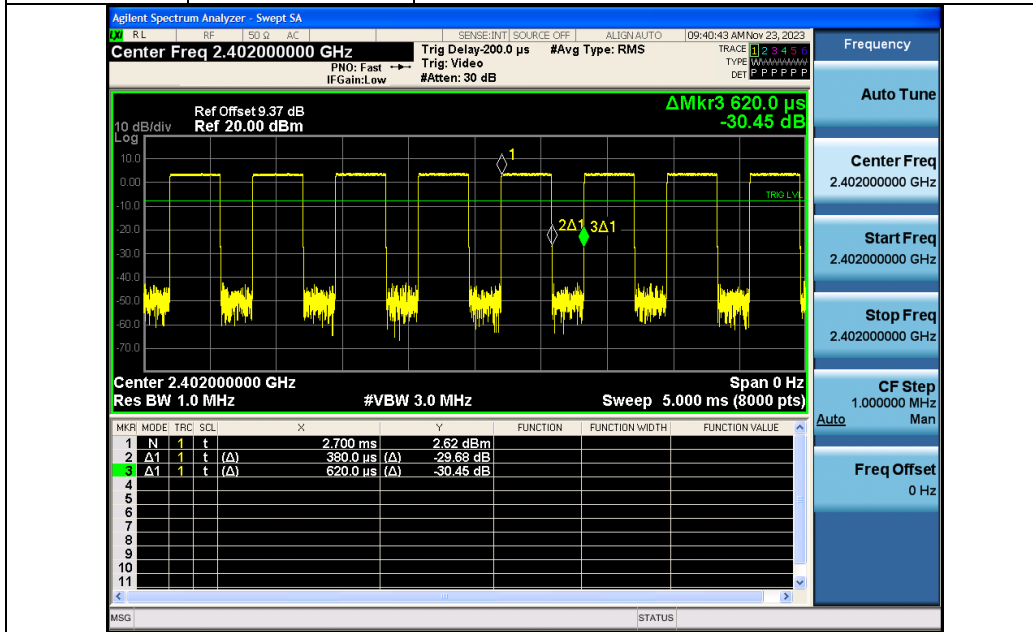
No.	Signal Cable Description of The Above Support Units
1.	USB extension cord: Unshielded, Detachable 1.2m;

2.5 Configuration of System under Test

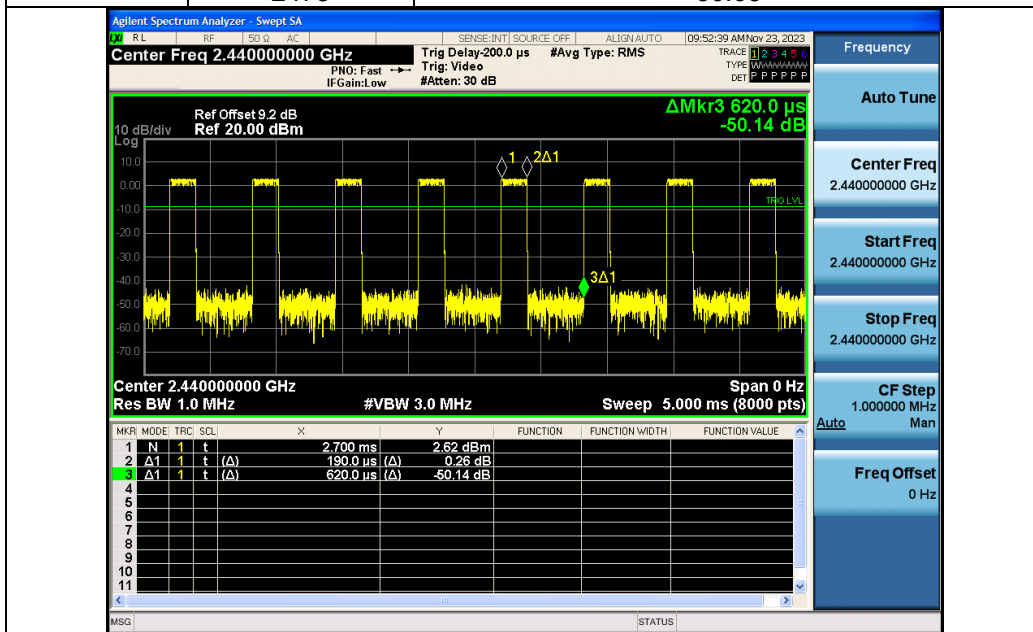


2.6 Duty Cycle of Test Signal

Test Mode	Channel	Duty Cycle [%]
GFSK-1MHz	2402	61.29
	2440	61.29
	2480	61.29



Test Mode	Channel	Duty Cycle [%]
GFSK-2MHz	2404	30.65
	2440	30.65
	2478	30.65



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	ESR7	100962	2023-12-27
3m Semi-anechoic Chamber	MAORUI	9m*6m*6m	NSEMC003	2026-03-12**
Test software	FARAD	FARAD	EZ EMCV1.1.4.2	N/A
Loop Antenna	EMCI	HLA 6121	56735	2024-05-04*
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.
3m Semi-anechoic Chamber	MAORUI	9m*6m*6m	NSEMC003	2026-03-12**
EMI Test Receiver	Rohde&Schwarz	ESPI 7	101978	2023-12-27
Broadband antenna	Schwarzbeck	VULB 9168	00937	2024-08-18
Signal Amplifier	Com-power	PAM-103	18020051	2024-08-06
Attenuator	Rohde&Schwarz	TS2GA-6dB	18101101	N/A
Test software	FARAD	FARAD	EZ EMCV1.1.4.2	N/A

Frequency Range above 1GHz:

Equipment	Manufacturer	Model No.	Serial No.	Next Cal.
3m Semi-anechoic Chamber	MAORUI	9m*6m*6m	NSEMC003	2026-03-12**
Horn Antenna	Schwarzbeck	BBHA 9120D	02202	2024-08-27*
Broadband Coaxial Pre-amplifier	Schwarzbeck	BBV 9718	25	2024-08-06
Spectrum	Keysight	N9020A	MY51240612	2024-08-06
Pre-Amplifier	EMCI	EMC 184045SE	9870709	2023-12-27
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 months or 24 months (*) or 36 months (**).
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 ($D \geq 98\%$), 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 ($D \geq 98\%$) cannot be achieved and the duty cycle is constant (duty cycle variations are less than $\pm 2\%$), 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 $[10 \log(1/D)]$, where D is the duty cycle.

**If linear voltage averaging mode was used in step f). then the applicable correction factor is $[20 \log(1/D)]$, 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 Averaging 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 $\pm 2\%$), then the following procedure shall be used:

- 1) RBW = 1 MHz.
 - 2) VBW $\geq 1/T$.
 - 3) Detector = peak
 - 4) Sweep time = auto.
 - 5) Trace mode = max hold.
 - 6) Allow max hold to run for at least $[50 \times (1/D)]$ traces
- c. The EUT was placed on the top of a rotating table 0.8 meters (below 1GHz) / 1.5 meters (Above 1GHz) 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 1GHz), which was mounted on the top of a variable-height antenna tower.
- 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:

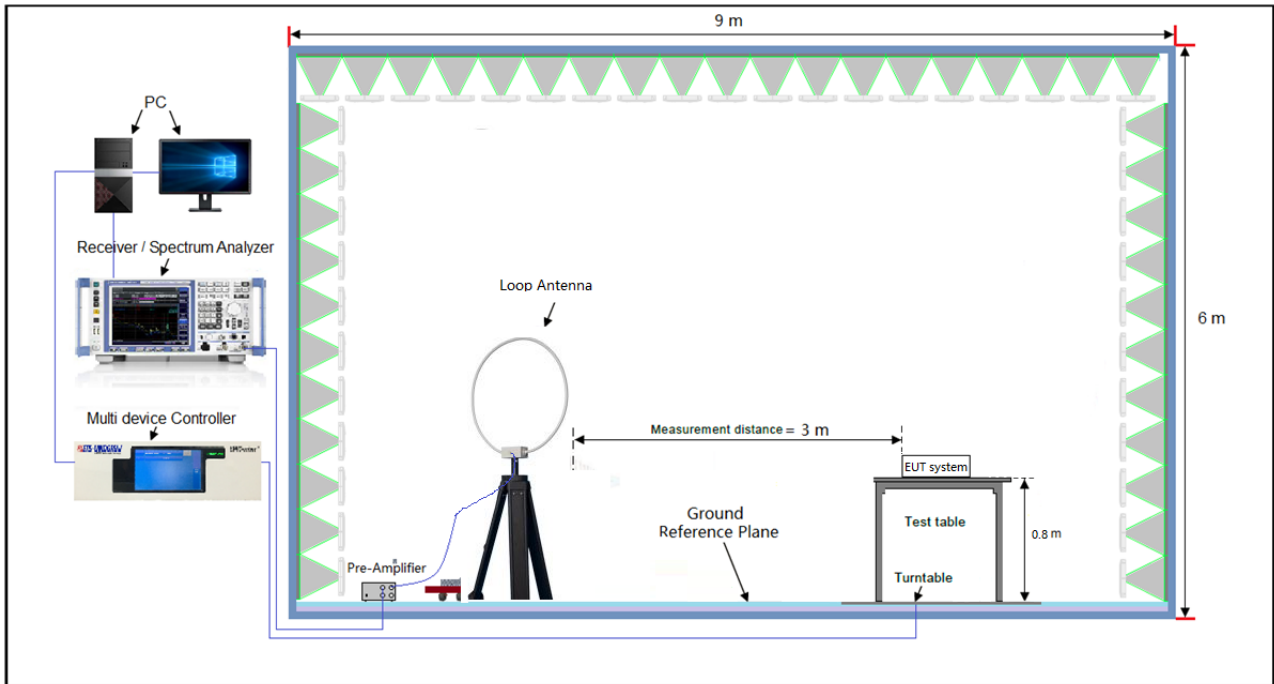
1. The resolution bandwidth and video bandwidth of test receiver/spectrum analyzer is 120 kHz & 360kHz for Quasi-peak detection (QP) at frequency below 1 GHz.
2. The resolution bandwidth of test receiver/spectrum analyzer is 1 MHz and the video bandwidth = 3 MHz for Peak detection (PK) at frequency above 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 $\geq 98\%$) 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

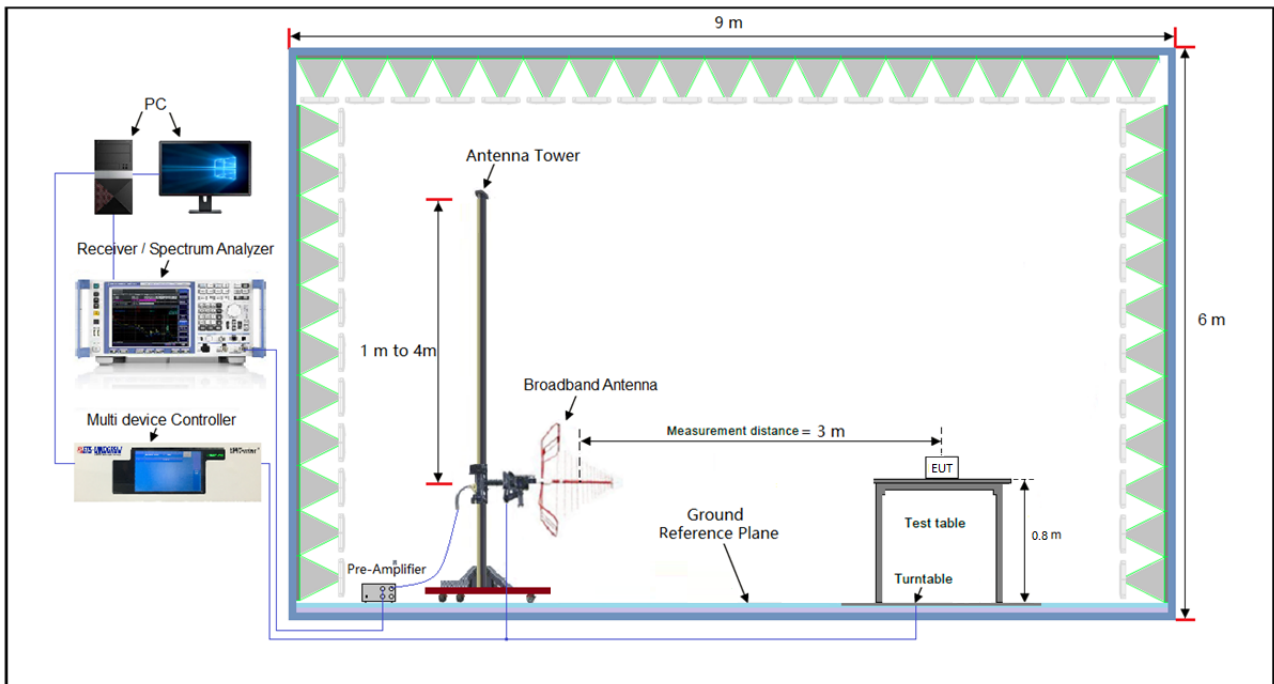
No deviation.

3.1.5 Test Setup

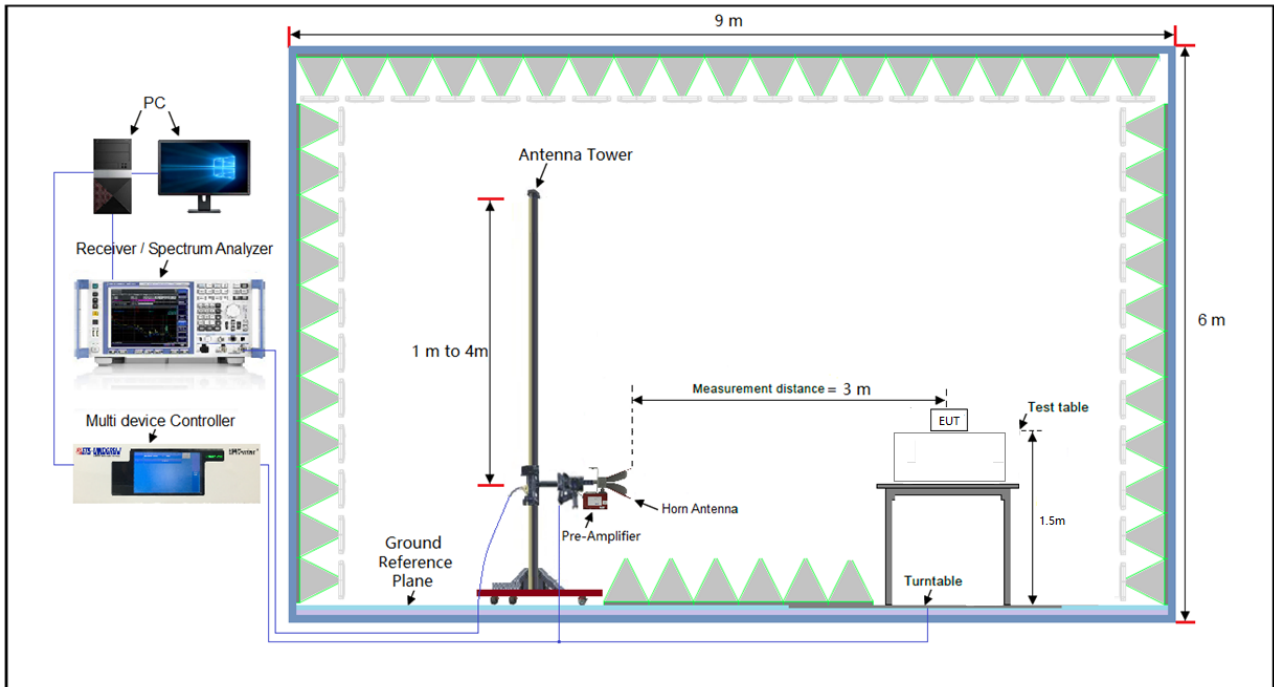
Radiated emission below 30MHz:



Frequency Range below 1GHz:



Frequency Range above 1GHz:



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.

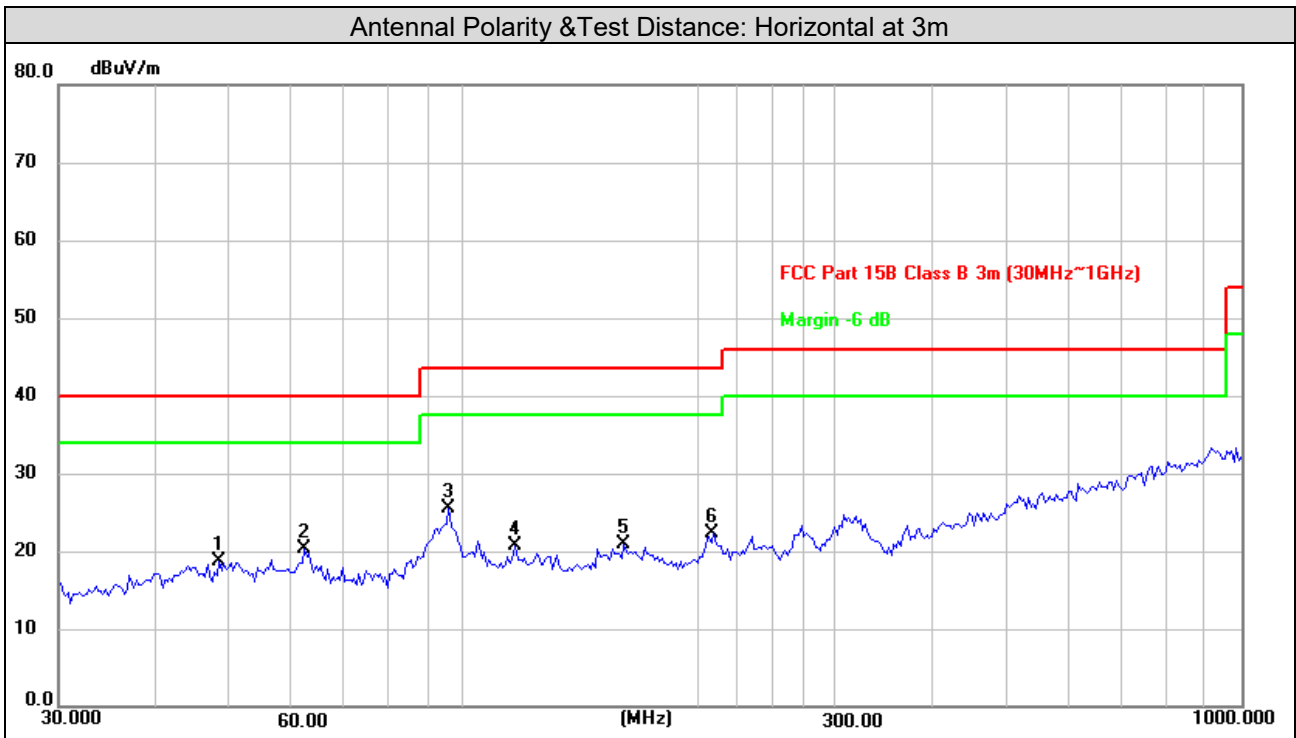
3.1.7 Test Results

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 39	Frequency Range	30MHz ~ 1GHz
Detector Function	Peak (PK) Quasi-peak (QP)	Tested By	Hua

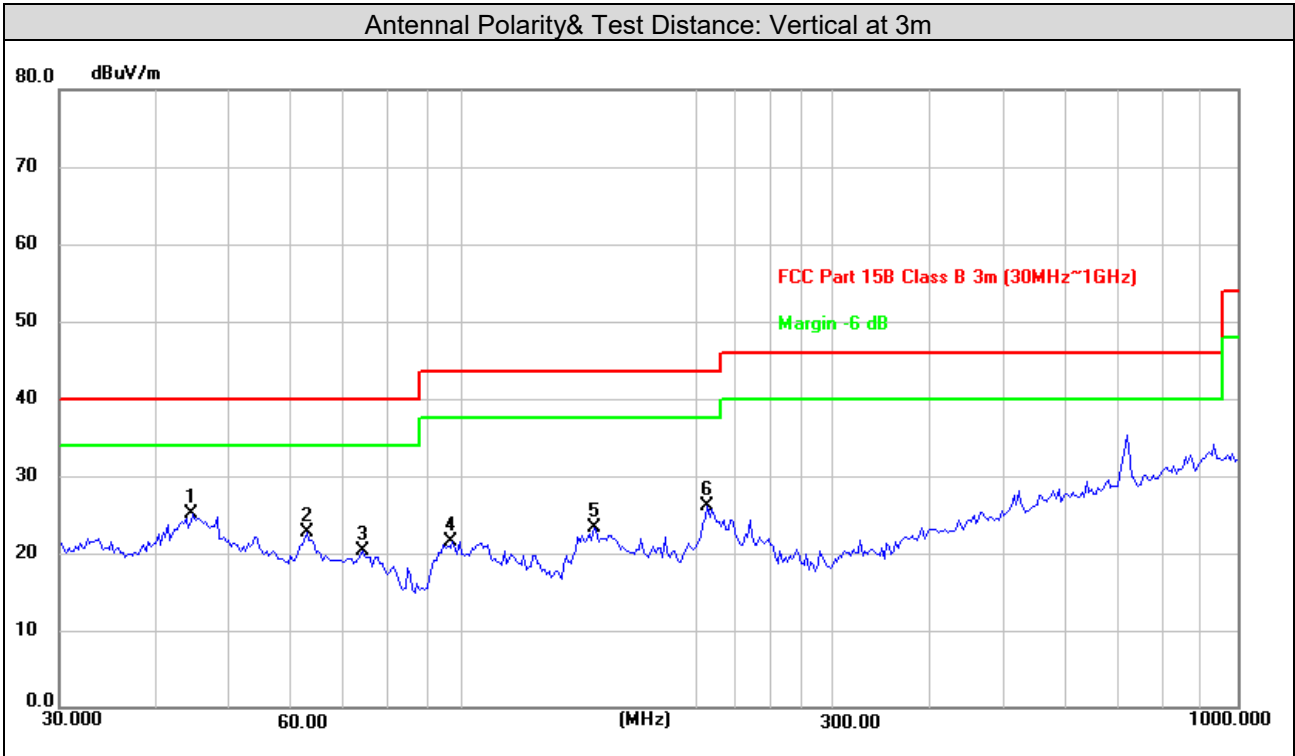


No.	Frequency (MHz)	Reading (dBUV)	Factor (dB)	Emission Level (dBUV/m)	Limit (dBUV/m)	Margin (dB)	Detector	Antenna Height (cm)	Table Angle (Degree)
1	48.3318	32.79	-14.15	18.64	40.00	-21.36	peak	211	306
2	62.2128	34.77	-14.46	20.31	40.00	-19.69	peak	189	317
3	95.4270	44.54	-19.09	25.45	43.50	-18.05	peak	166	347
4	116.1321	36.11	-15.34	20.77	43.50	-22.73	peak	154	66
5	160.3456	33.64	-12.71	20.93	43.50	-22.57	peak	234	323
6	209.3129	39.31	-16.94	22.37	43.50	-21.13	peak	168	141

Remarks:

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

Test Channel	Channel 39	Frequency Range	30MHz ~ 1GHz
Detector Function	Peak (PK) Quasi-peak (QP)	Tested By	Hua



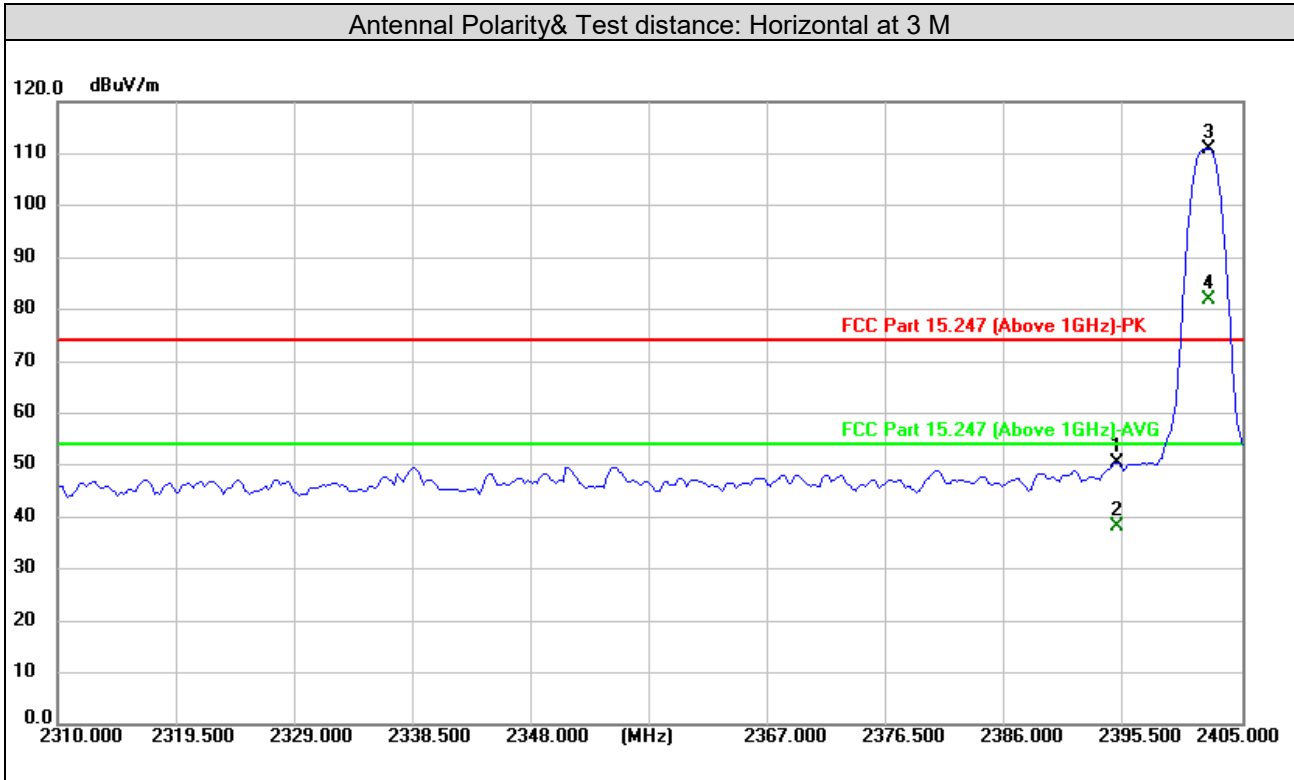
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Height (cm)	Table Angle (Degree)
1	44.7433	39.60	-14.42	25.18	40.00	-14.82	peak	115	166
2	62.6507	37.12	-14.51	22.61	40.00	-17.39	peak	100	325
3	74.1351	37.21	-16.87	20.34	40.00	-19.66	peak	133	81
4	96.7749	40.29	-18.87	21.42	43.50	-22.08	peak	142	254
5	147.4036	37.76	-14.42	23.34	43.50	-20.16	peak	106	121
6	206.3976	43.23	-17.14	26.09	43.50	-17.41	peak	127	163

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	Hua



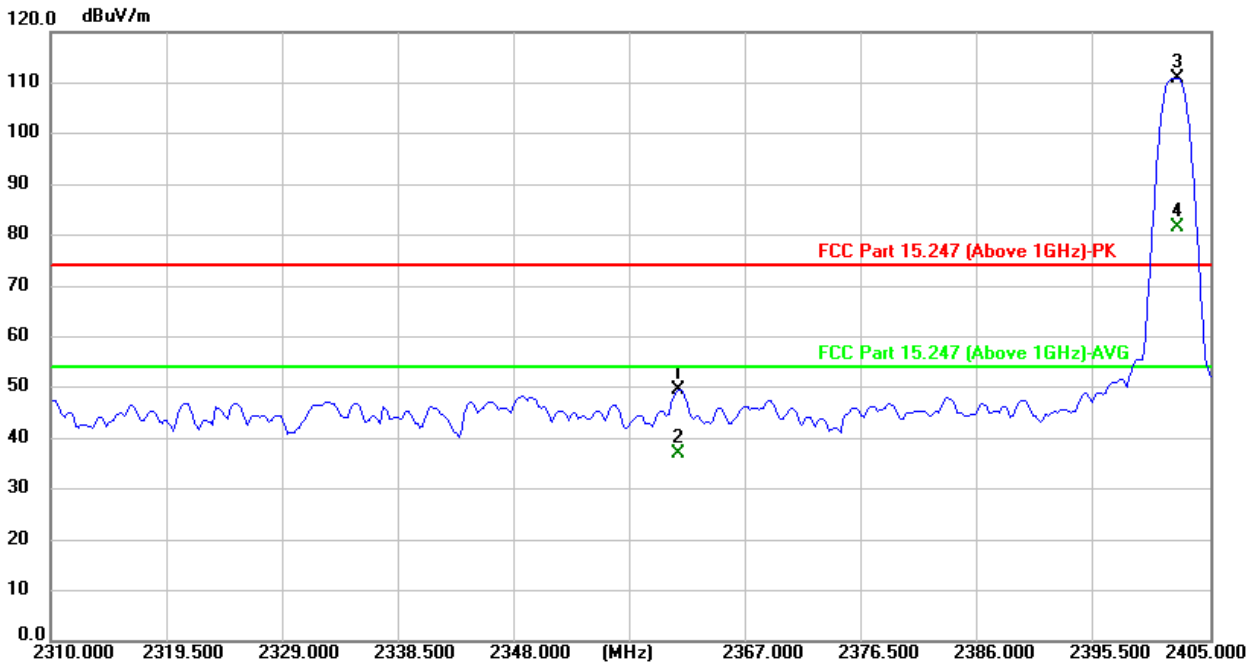
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Height (cm)	Table Angle (Degree)
1	2394.910	50.95	-0.40	50.55	74.00	-23.45	peak	106	334
2	2394.910	38.56	-0.40	38.16	54.00	-15.84	AVG	106	334
3 #	2402.335	111.18	-0.39	110.79			peak	106	334
4 #	2402.335	82.09	-0.39	81.70			AVG	106	334
5	4804.000	50.70	5.30	56.00	74.00	-18.00	peak	153	335
6	4804.000	38.78	5.30	44.08	54.00	-9.92	AVG	153	335
7	7206.000	48.49	12.40	60.89	74.00	-13.11	peak	205	166
8	7206.000	35.47	12.40	47.87	54.00	-6.13	AVG	205	166

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	Hua

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	2361.593	49.95	-0.47	49.48	74.00	-24.52	peak	114	134
2	2361.593	37.36	-0.47	36.89	54.00	-17.11	AVG	114	134
3 #	2402.335	111.34	-0.39	110.95			peak	114	134
4 #	2402.335	81.80	-0.39	81.41			AVG	114	134
5	4804.000	51.44	5.30	56.74	74.00	-17.26	peak	100	330
6	4804.000	41.64	5.30	46.94	54.00	-7.06	AVG	100	330
7	7206.000	47.37	12.40	59.77	74.00	-14.23	peak	110	326
8	7206.000	35.42	12.40	47.82	54.00	-6.18	AVG	110	326

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	Hua

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	112.89	-0.31	112.58			peak	114	49
2#	2440.000	83.33	-0.31	83.02			AVG	114	49
3	4880.000	51.76	6.25	58.01	74.00	-15.99	peak	100	343
4	4880.000	41.73	6.25	47.98	54.00	-6.02	AVG	100	343
5	7323.000	47.60	12.65	60.25	74.00	-13.75	peak	134	225
6	7323.000	35.21	12.65	47.86	54.00	-6.14	AVG	134	225

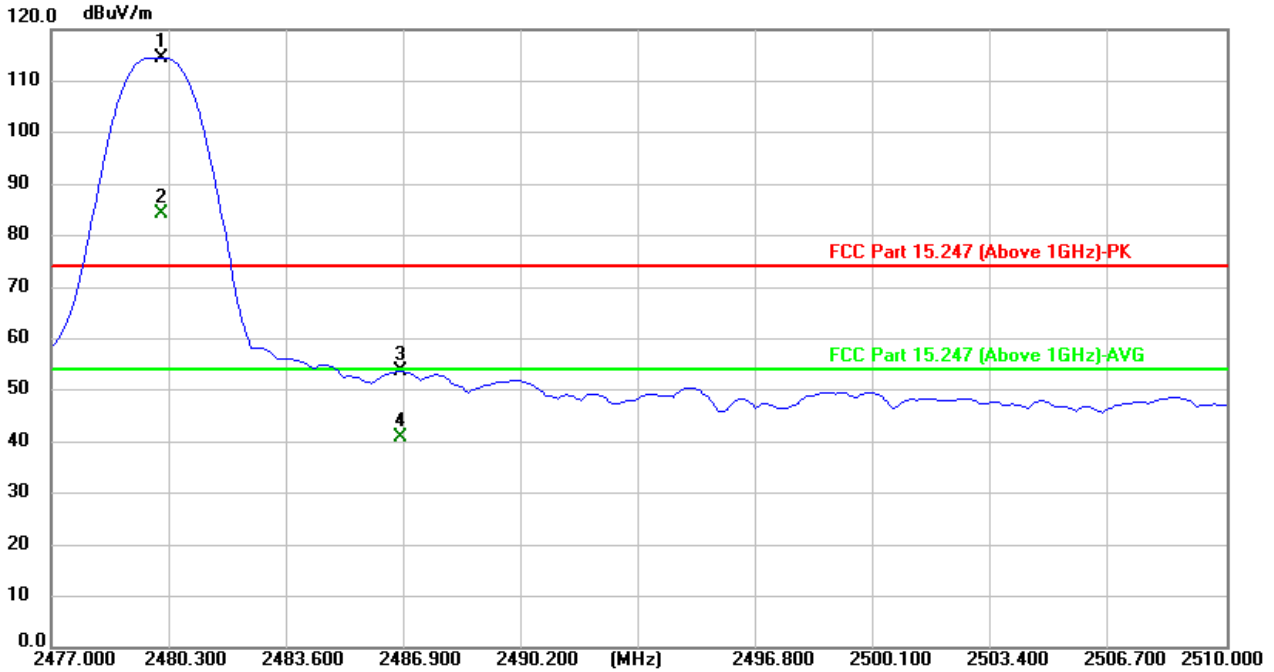
Antennal Polarity& Test Distance: Vertical at 3 M									
No.	Frequency (MHz)	Reading (dBUV)	Factor (dB)	Emission Level (dBUV/m)	Limit (dBUV/m)	Margin (dB)	Detector	Antenna Height (cm)	Table Angle (Degree)
1#	2440.000	111.39	-0.31	111.08			peak	100	130
2#	2440.000	82.37	-0.31	82.06			AVG	100	130
3	4880.000	51.31	6.25	57.56	74.00	-16.44	peak	100	229
4	4880.000	40.99	6.25	47.24	54.00	-6.76	AVG	100	229
5	7320.000	46.99	12.65	59.64	74.00	-14.36	peak	102	117
6	7320.000	35.20	12.65	47.85	54.00	-6.15	AVG	102	117

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	Hua

Antenna Polarity& Test Distance: Horizontal at 3 M

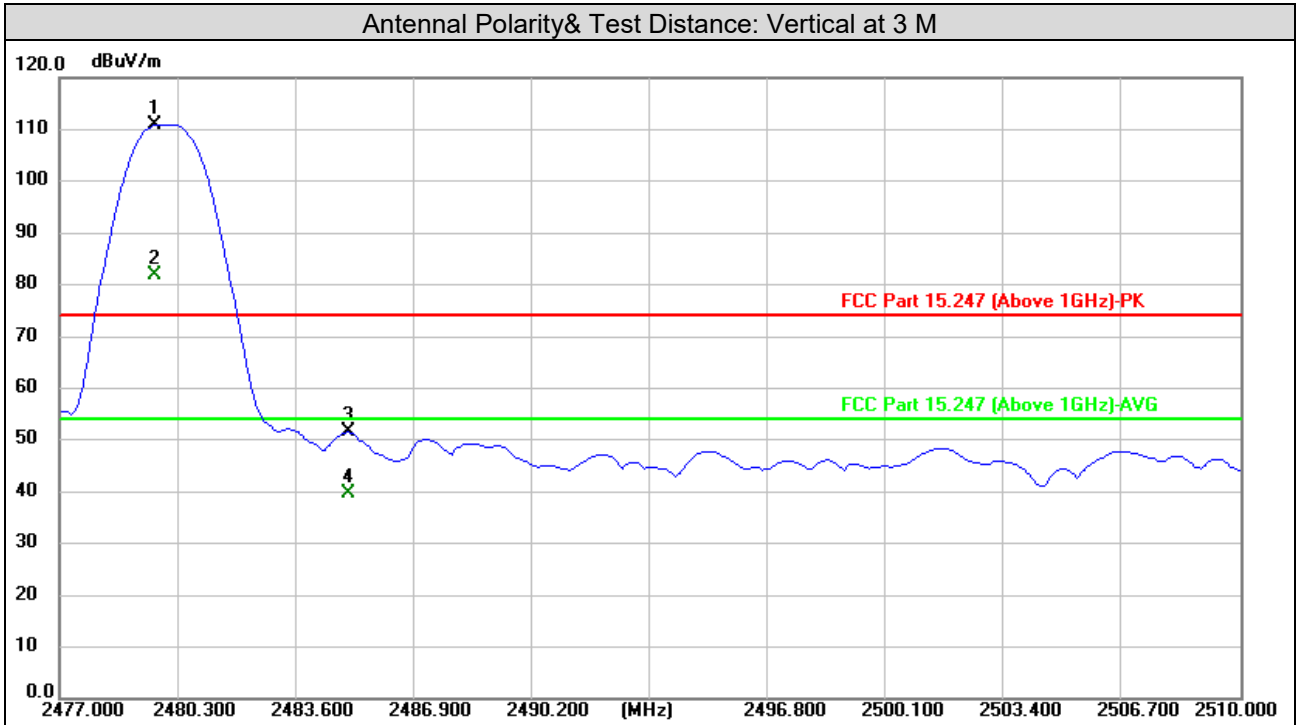


No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Height (cm)	Table Angle (Degree)
1#	2480.174	114.76	-0.21	114.55			peak	100	46
2#	2480.174	84.41	-0.21	84.20			AVG	100	46
3	2486.788	53.80	-0.19	53.61	74.00	-20.39	peak	100	46
4	2486.788	41.05	-0.19	40.86	54.00	-13.14	AVG	100	46
5	4960.000	52.70	6.16	58.86	74.00	-15.14	peak	100	341
6	4960.000	42.74	6.16	48.90	54.00	-5.10	AVG	100	341
7	7440.000	46.87	12.91	59.78	74.00	-14.22	peak	127	56
8	7440.000	35.12	12.91	48.03	54.00	-5.97	AVG	127	56

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	Hua



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#	2479.711	111.13	-0.21			36.92	peak	133	132
2#	2479.711	81.98	-0.21			27.77	AVG	133	132
3	2485.068	51.69	-0.19	51.50	74.00	-22.50	peak	133	132
4	2485.068	39.86	-0.19	39.67	54.00	-14.33	AVG	133	132
5	4960.000	49.40	6.16	55.56	74.00	-18.44	peak	100	26
6	4960.000	37.09	6.16	43.25	54.00	-10.75	AVG	100	26
7	7440.000	47.92	12.91	60.83	74.00	-13.17	peak	112	234
8	7440.000	35.19	12.91	48.10	54.00	-5.90	AVG	112	234

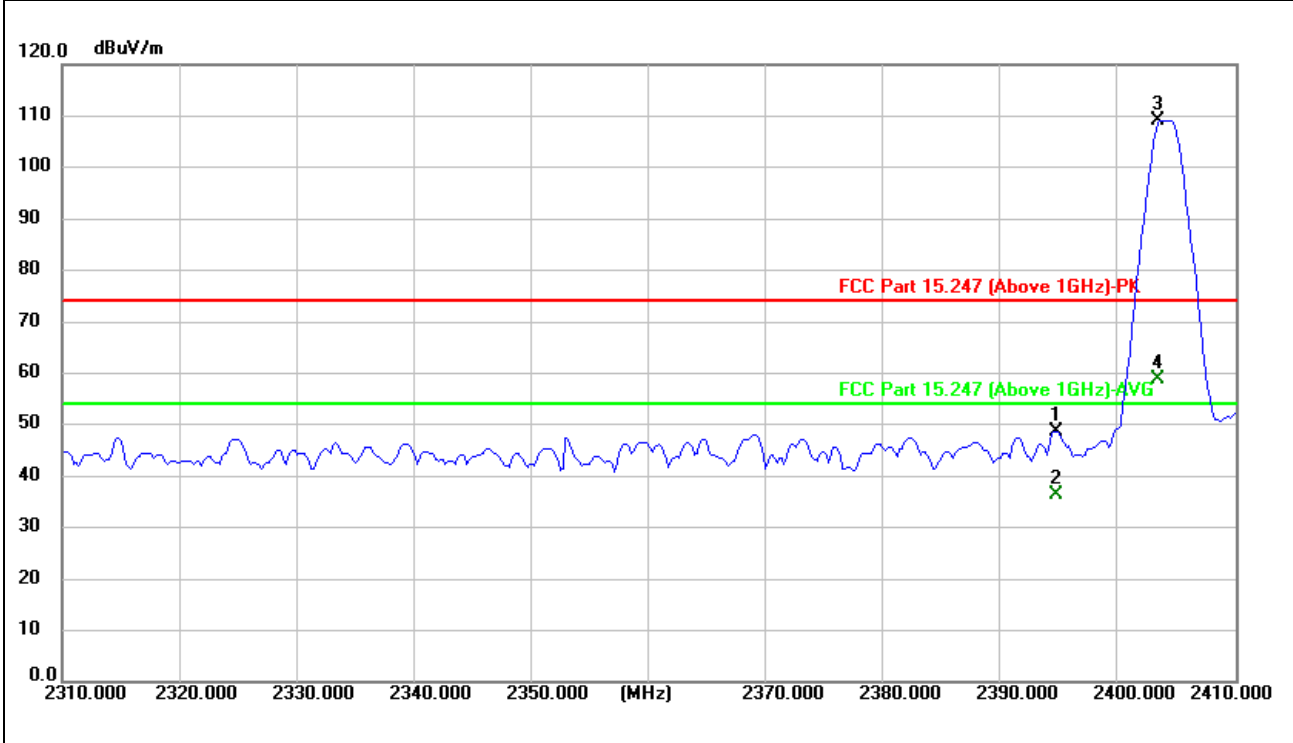
Remarks:

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

Above 1GHz Data:
BLE-2Mbps

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

Antennal Polarity& Test distance: Horizontal at 3 M



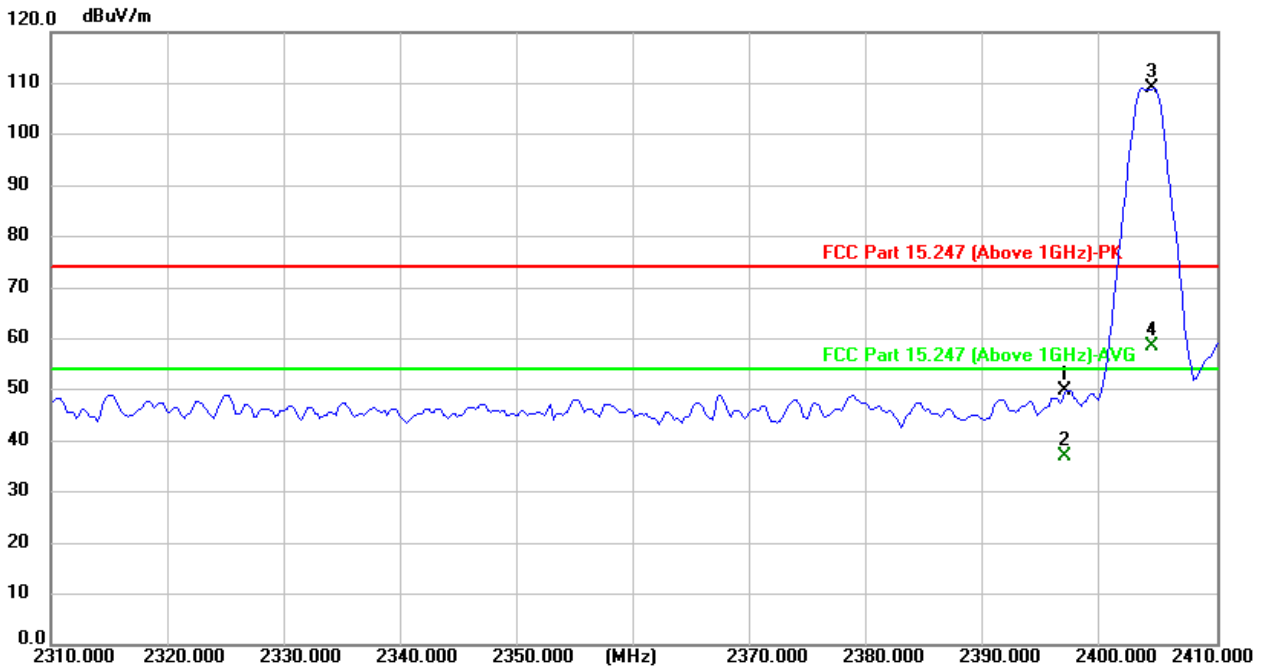
No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Height (cm)	Table Angle (Degree)
1	2394.770	49.17	-0.40	48.77	74.00	-25.23	peak	274	48
2	2394.770	36.89	-0.40	36.49	54.00	-17.51	AVG	274	48
3 #	2403.587	109.60	-0.38	109.22			peak	274	48
4 #	2403.587	59.27	-0.38	58.89			AVG	274	48
5	4808.000	51.20	5.35	56.55	74.00	-17.45	peak	132	344
6	4808.000	39.77	5.35	45.12	54.00	-8.88	AVG	132	344
7	7212.000	47.12	12.42	59.54	74.00	-14.46	peak	153	102
8	7212.000	35.60	12.42	48.02	54.00	-5.98	AVG	153	102

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 1	Frequency Range	1GHz ~ 25GHz
Detector Function	Peak (PK) Average (AVG)	Tested By	Hua

Antenna 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	2397.174	50.22	-0.39	49.83	74.00	-24.17	peak	121	146
2	2397.174	37.35	-0.39	36.96	54.00	-17.04	AVG	121	146
3 #	2404.589	109.37	-0.37	109.00			peak	121	146
4 #	2404.589	58.78	-0.37	58.41			AVG	121	146
5	4808.000	50.86	5.35	56.21	74.00	-17.79	peak	122	331
6	4808.000	39.22	5.35	44.57	54.00	-9.43	AVG	122	331
7	7212.000	48.34	12.42	60.76	74.00	-13.24	peak	134	251
8	7212.000	35.61	12.42	48.03	54.00	-5.97	AVG	134	251

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	Hua

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	112.34	-0.31	112.03			peak	374	341
2#	2440.000	60.71	-0.31	60.40			AVG	374	341
3	4880.000	52.16	6.25	58.41	74.00	-15.59	peak	112	13
4	4880.000	40.16	6.25	46.41	54.00	-7.59	AVG	112	13
5	7320.000	47.19	12.65	59.84	74.00	-14.16	peak	126	205
6	7320.000	35.18	12.65	47.83	54.00	-6.17	AVG	126	205

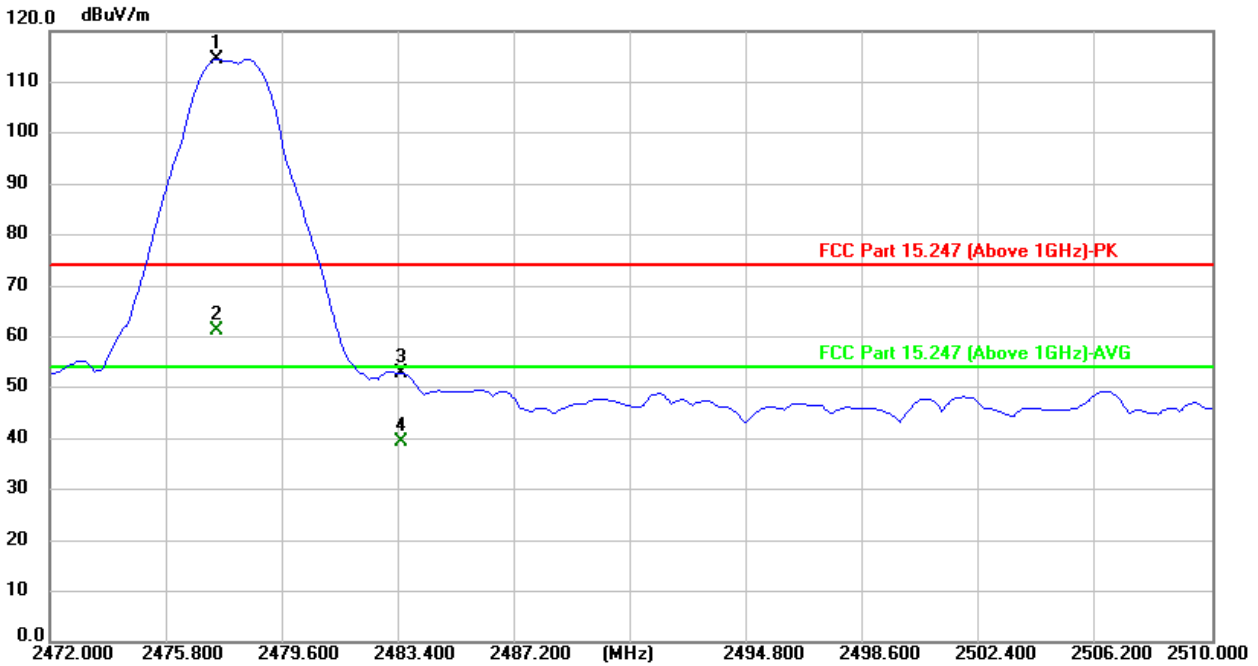
Antennal Polarity& Test Distance: Vertical at 3 M									
No.	Frequency (MHz)	Reading (dBuV)	Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Height (cm)	Table Angle (Degree)
1#	2440.000	112.56	-0.31	112.25			peak	104	135
2#	2440.000	60.85	-0.31	60.54			AVG	104	135
3	4880.000	50.68	6.25	56.93	74.00	-17.07	peak	102	330
4	4880.000	38.30	6.25	44.55	54.00	-9.45	AVG	102	330
5	7320.000	46.45	12.65	59.10	74.00	-14.90	peak	100	287
6	7320.000	35.31	12.65	47.96	54.00	-6.04	AVG	100	287

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 38	Frequency Range	1GHz ~ 25GHz
Detector Function	Peak (PK) Average (AVG)	Tested By	Hua

Antenna Polarity& Test Distance: Horizontal at 3 M

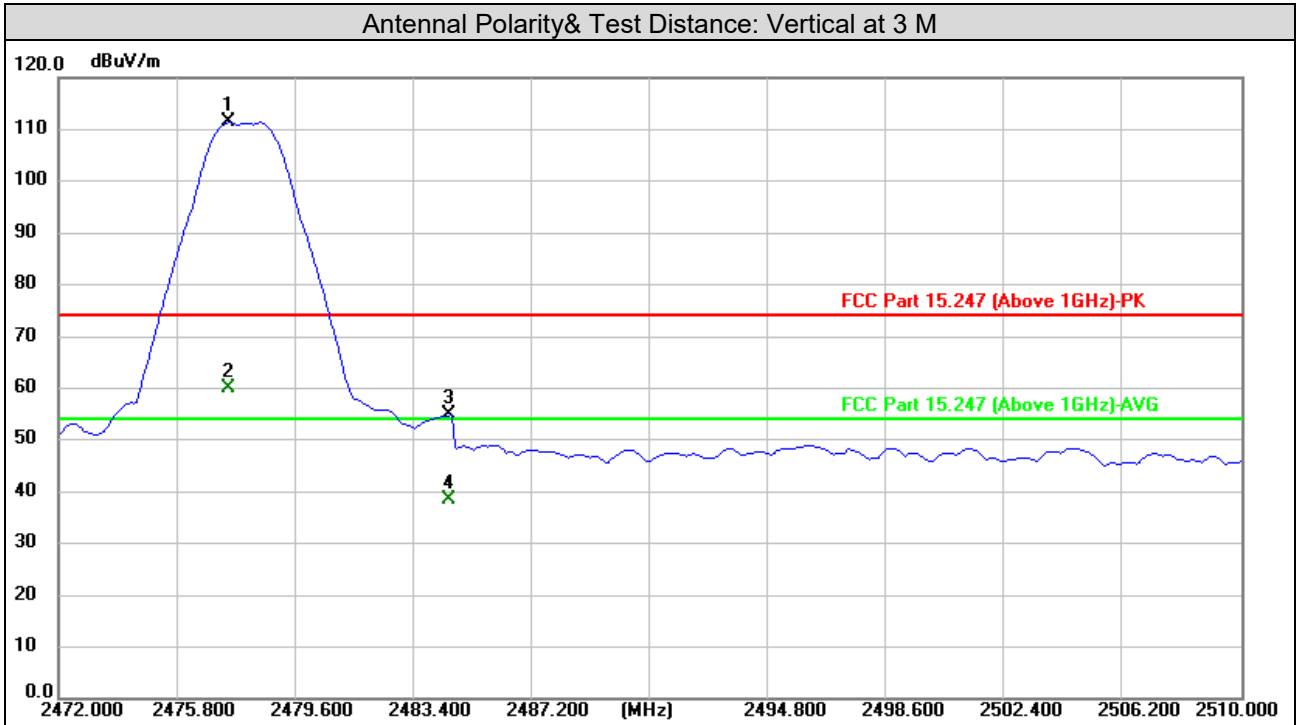


No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB)	Emission Level (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector	Antenna Height (cm)	Table Angle (Degree)
1#	2477.483	114.63	-0.22	114.41			peak	100	51
2#	2477.483	61.27	-0.22	61.05			AVG	100	51
3	2483.575	52.92	-0.20	52.72	74.00	-21.28	peak	100	51
4	2483.575	39.66	-0.20	39.46	54.00	-14.54	AVG	100	51
5	4956.000	52.95	6.19	59.14	74.00	-14.86	peak	100	13
6	4956.000	39.99	6.19	46.18	54.00	-7.82	AVG	100	13
7	7434.000	46.83	12.90	59.73	74.00	-14.27	peak	215	126
8	7434.000	35.02	12.90	47.92	54.00	-6.08	AVG	215	126

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 38	Frequency Range	1GHz ~ 25GHz
Detector Function	Peak (PK) Average (AVG)	Tested By	Hua



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#	2477.483	111.59	-0.22	111.37			peak	100	139
2#	2477.483	60.27	-0.22	60.05			AVG	100	139
3	2484.641	54.99	-0.19	54.80	74.00	-19.20	peak	100	139
4	2484.641	38.52	-0.19	38.33	54.00	-15.67	AVG	100	139
5	4956.000	50.39	6.19	56.58	74.00	-17.42	peak	100	183
6	4956.000	38.73	6.19	44.92	54.00	-9.08	AVG	100	183
7	7434.000	46.21	12.90	59.11	74.00	-14.89	peak	115	310
8	7434.000	35.03	12.90	47.93	54.00	-6.07	AVG	115	310

Remarks:

1. Emission Level = Read Level + Factor (Antenna Factor + Cable Loss - Preamp Factor)
2. Margin value = Emission level – Limit value
3. #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 to 0.50MHz.

3.2.2 Test Instruments

Equipment	Manufacturer	Model No.	Serial No.	Next Cal.
EMI Test Receiver	Rohde&Schwarz	ESR 7	101962	2023-12-27
Artificial Mains Network	Rohde&Schwarz	ENV216	3560.6550.15	2023-12-27
Test software	FARAD	EZ_EMV V1.1.4.2	N/A	N/A
Broadcast test system	R&S	SFU	100410	2024-08-06

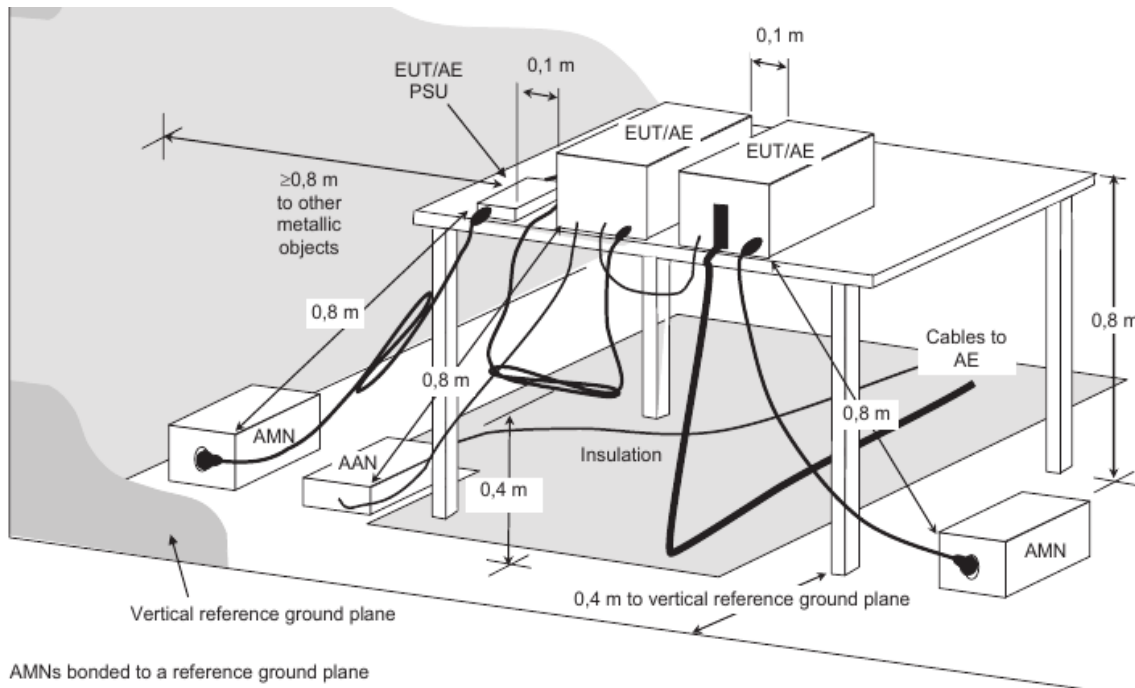
- Note: 1. The calibration interval of the above test instruments is 12 months.
2. The test was performed in Shielded Room.

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 Test Setup



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

3.2.5 EUT Operating Condition

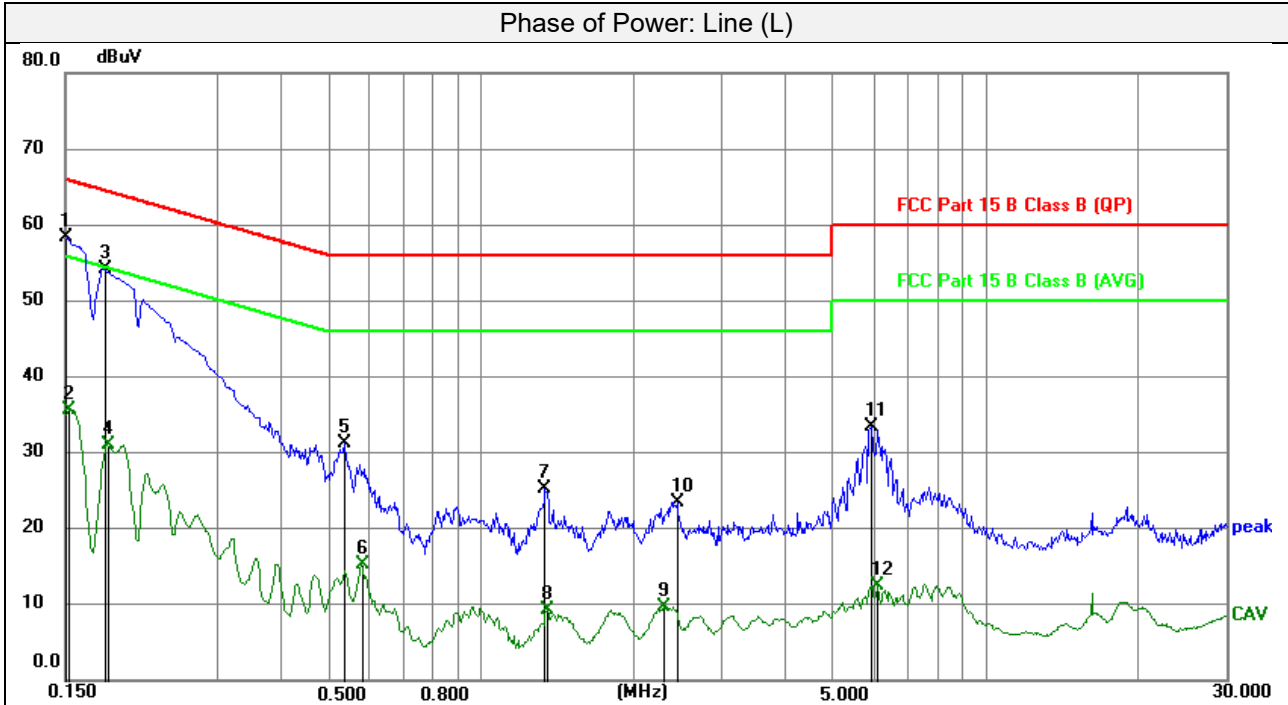
Set the EUT under transmission condition continuously at specific channel frequency.

3.2.6 Deviation from Test Standard

No deviation.

3.2.7 Test Results

Frequency Range	150kHz ~ 30MHz	Detector Function & Resolution andwidth	Quasi-Peak (QP) / Average (AV), 9kHz
-----------------	----------------	---	--------------------------------------

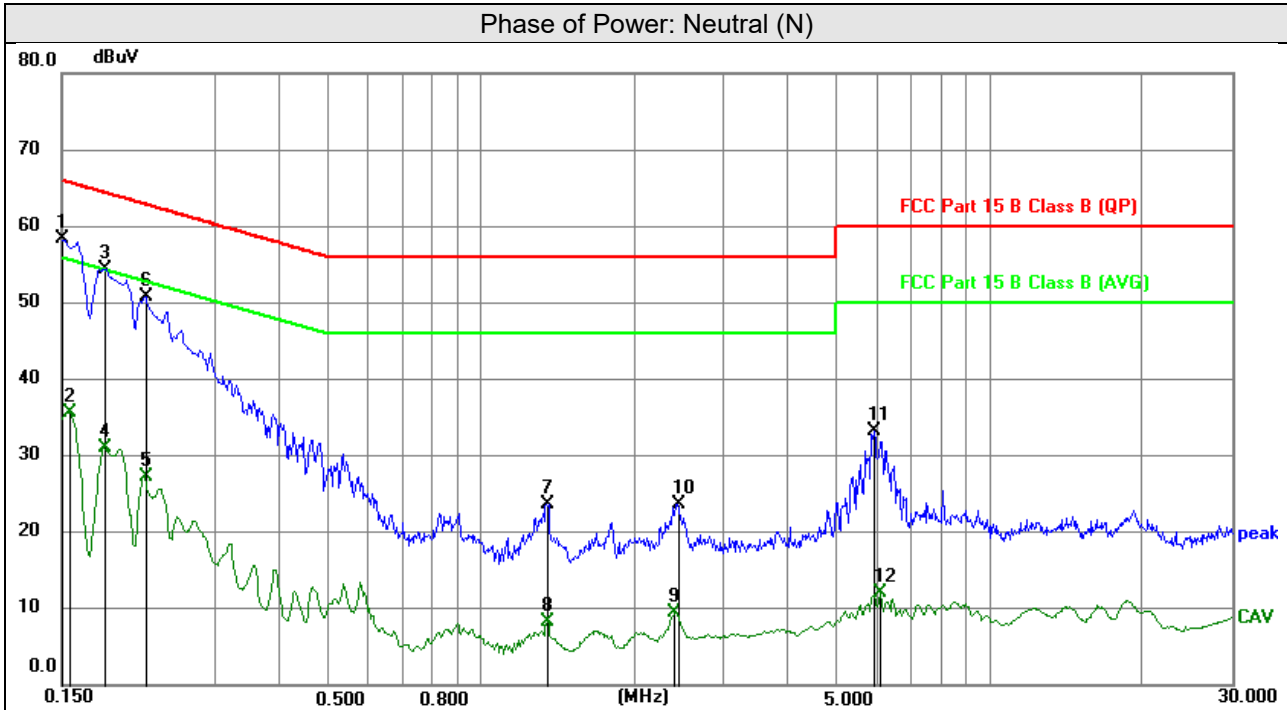


No.	Frequency (MHz)	Reading (dBuV)	Correction Factor (dB)	Emission Level (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.1500	48.07	10.19	58.26	66.00	-7.74	peak
2	0.1522	25.42	10.18	35.60	55.88	-20.28	AVG
3	0.1792	43.99	10.16	54.15	64.52	-10.37	peak
4	0.1815	20.80	10.15	30.95	54.42	-23.47	AVG
5	0.5369	21.19	10.10	31.29	56.00	-24.71	peak
6	0.5819	5.25	10.10	15.35	46.00	-30.65	AVG
7	1.3447	15.20	10.05	25.25	56.00	-30.75	peak
8	1.3560	-0.78	10.05	9.27	46.00	-36.73	AVG
9	2.3077	-0.43	10.09	9.66	46.00	-36.34	AVG
10	2.4517	13.40	10.09	23.49	56.00	-32.51	peak
11	5.9325	23.38	10.00	33.38	60.00	-26.62	peak
12	6.1215	2.44	10.00	12.44	50.00	-37.56	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 andwidth	Quasi-Peak (QP) / Average (AV), 9kHz
-----------------	----------------	---	--------------------------------------



No.	Frequency (MHz)	Reading (dBuV)	Correct Factor (dB)	Emission Level (dBuV)	Limit (dBuV)	Margin (dB)	Remark
1	0.1500	48.08	10.19	58.27	66.00	-7.73	peak
2	0.1545	25.37	10.18	35.55	55.75	-20.20	AVG
3	0.1815	44.28	10.15	54.43	64.42	-9.99	peak
4	0.1815	20.78	10.15	30.93	54.42	-23.49	AVG
5	0.2175	17.06	10.15	27.21	52.91	-25.70	AVG
6	0.2198	40.56	10.15	50.71	62.83	-12.12	peak
7	1.3515	13.58	10.06	23.64	56.00	-32.36	peak
8	1.3560	-1.78	10.06	8.28	46.00	-37.72	AVG
9	2.4157	-0.57	10.10	9.53	46.00	-36.47	AVG
10	2.4360	13.56	10.10	23.66	56.00	-32.34	peak
11	5.9325	23.20	9.99	33.19	60.00	-26.81	peak
12	6.1192	2.09	10.00	12.09	50.00	-37.91	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.

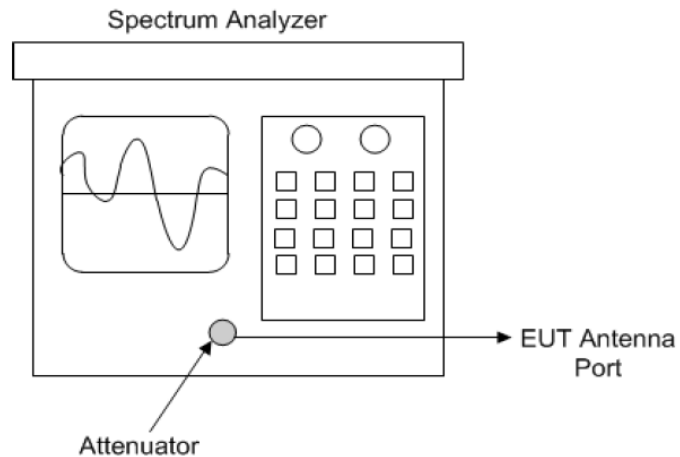
3.3 6dB Bandwidth Measurement

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) $\geq 3 \times$ 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 $\geq 3 \times$ 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			
Operation Channel	Frequency	Occupied Bandwidth (MHz)	
		Result	Limit
0	2402MHz	0.688	>0.5
19	2440MHz	0.688	>0.5
39	2480MHz	0.684	>0.5

BLE-2Mbps			
Operation Channel	Frequency	Occupied Bandwidth (MHz)	
		Result	Limit
1	2404MHz	1.228	>0.5
19	2440MHz	1.220	>0.5
38	2478MHz	1.280	>0.5



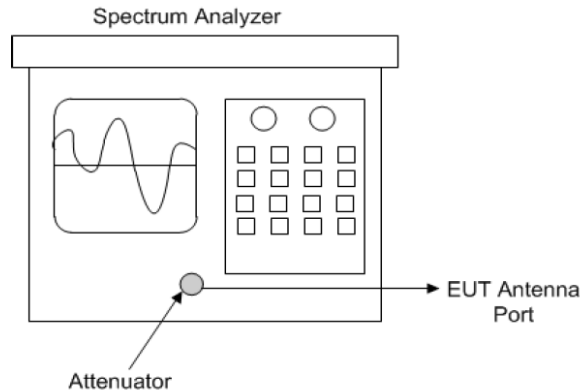
Lab: [Hwa-Hsing \(Dongguan\) Testing Co., Ltd.](#)
 Address: [No.101, Building N1, Yuyuan 2 Road, Yuyuan Industrial Park, HuangJiang Town, Dongguan City, People's Republic of China](#)

Tel: [0769-83078199](tel:0769-83078199)
 Web.: www.hwa-hsing.com
 E-Mail: customerservice.dg@hwa-hsing.com

Release
 Ver. 1.5

3.4 Occupied Bandwidth Measurement

3.4.1 Test Setup



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.

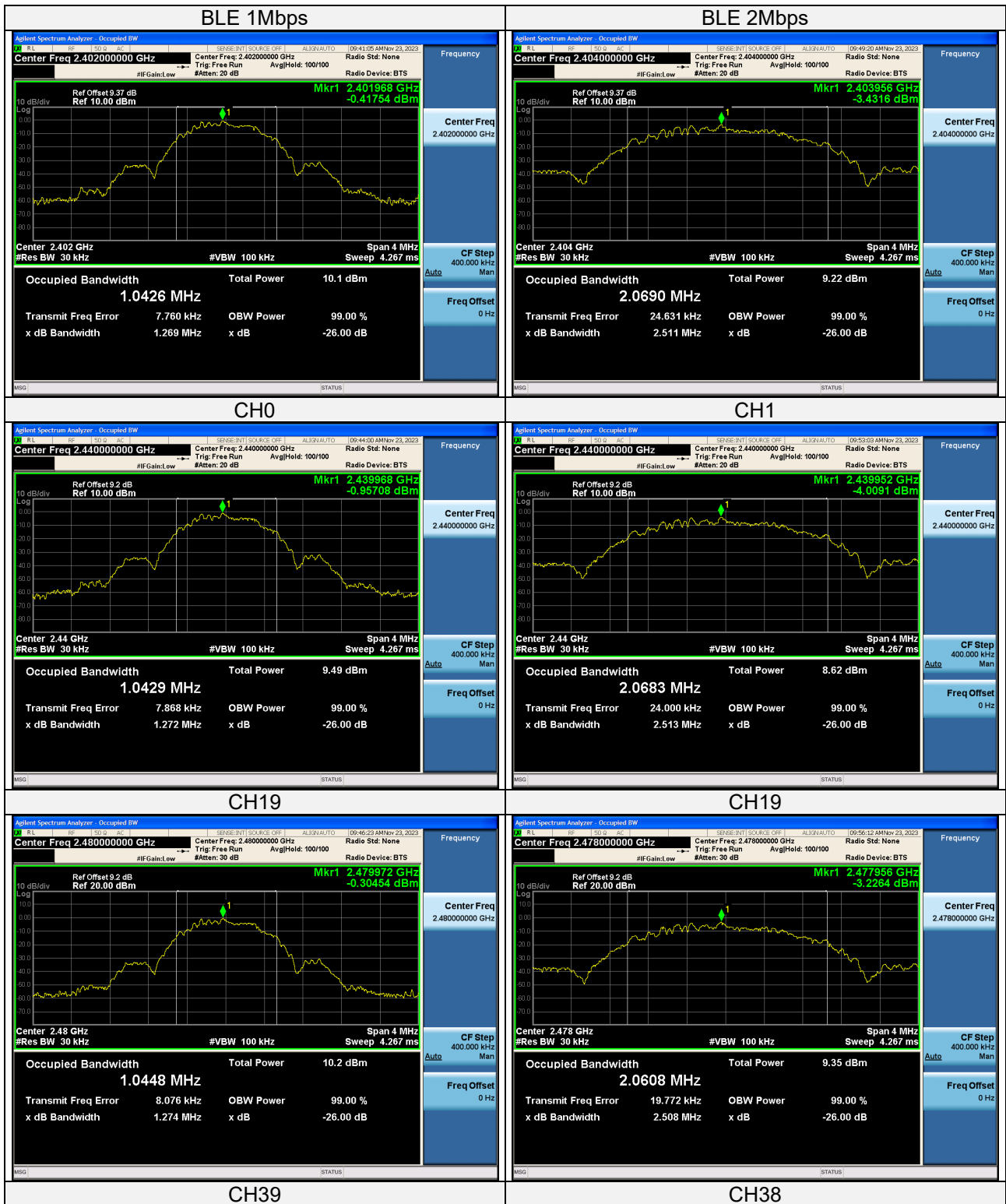
3.4.5 EUT Operating Conditions

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			
Operation Channel	Frequency	Occupied Bandwidth (MHz)	
		Result	Limit
0	2402MHz	1.0426	2400~2483.5
19	2440MHz	1.0429	2400~2483.5
39	2480MHz	1.0448	2400~2483.5

BLE-2Mbps			
Operation Channel	Frequency	Occupied Bandwidth (MHz)	
		Result	Limit
1	2404MHz	2.0690	2400~2483.5
19	2440MHz	2.0683	2400~2483.5
38	2478MHz	2.0608	2400~2483.5



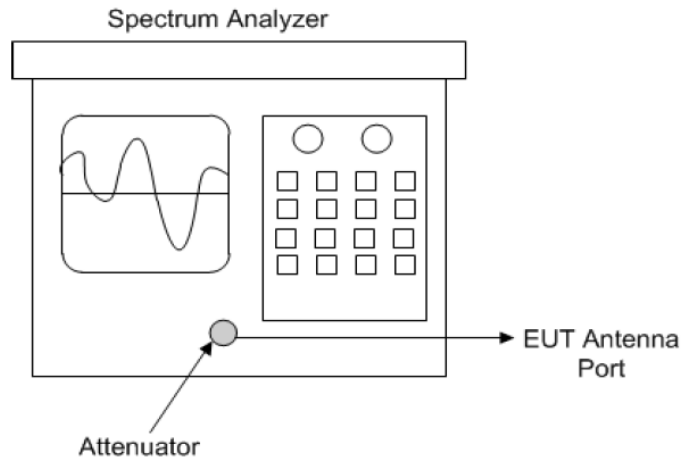
3.5 Conducted Output Power Measurement

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:

- 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.
- 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%.
- 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.

Test Report No.: 23091201-RF-US-02

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

Maximum peak conducted output power

The following procedure shall be used when an instrument with a resolution bandwidth that is greater than the DTS bandwidth is available to perform the measurement:

- a) Set the RBW > DTS bandwidth.
- b) Set VBW > [3 x RBW]
- c) Set span > [3 x RBW]
- d) Sweep time = auto couple.
- e) Detector = peak
- f) Trace mode = max hold.
- g) Allow trace to fully stabilize.
- h) Use peak marker function to determine the peak amplitude level.

Test Report No.: 23091201-RF-US-02

 Maximum conducted (average) output power (Method AVGSA-2):

- 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 $\geq 3 \times$ RBW
 - 5* Number of points in sweep $\geq 2 \times$ span /RBW. (This gives bin-to-bin spacing \leq RBW / 2. so that narrowband signals are not lost between frequency bins).
 - 6* Sweep time \leq (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

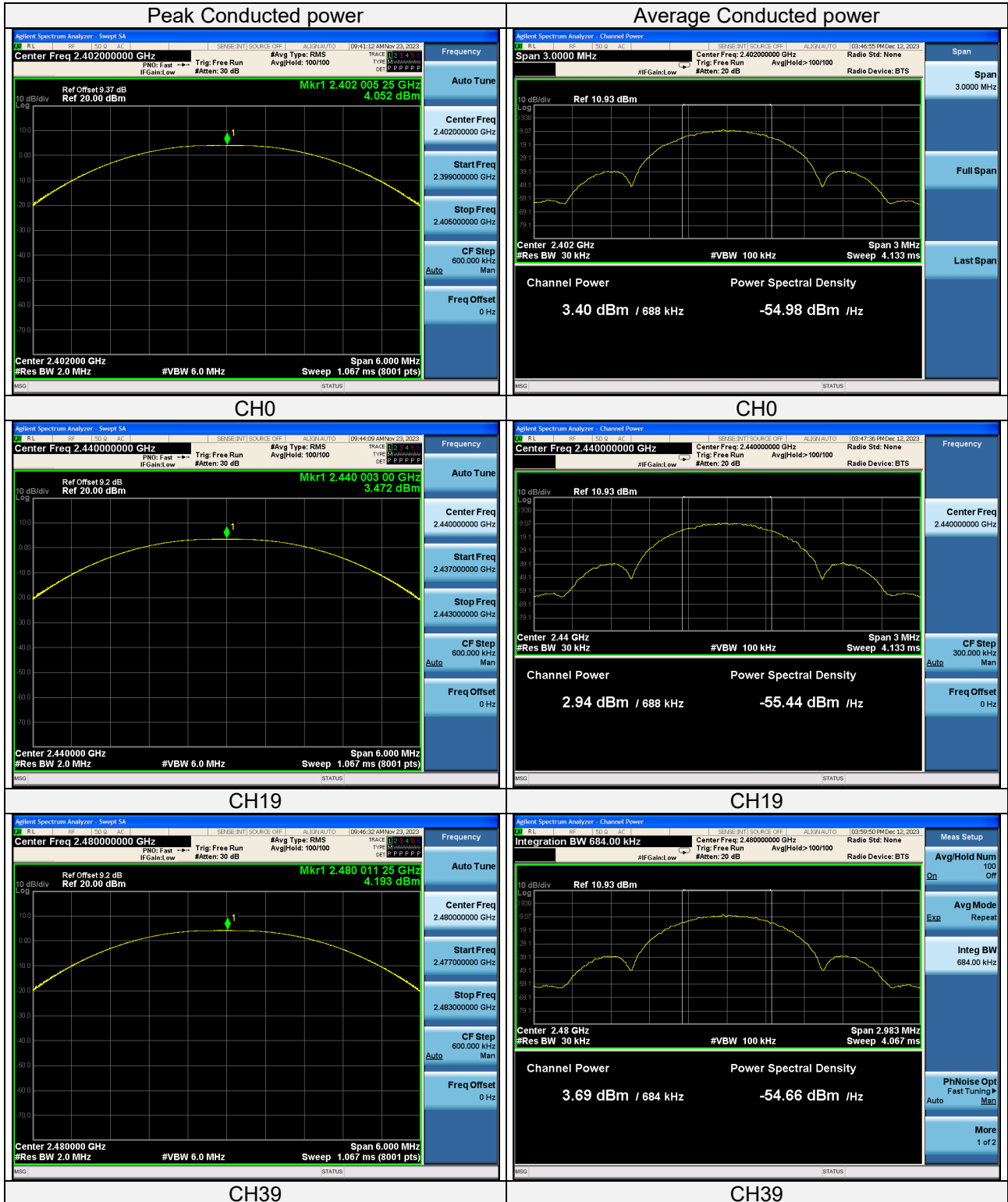
BLE-1Mbps						
Peak Power						
Channel	Freq.	RF Output Power		Limit (mW)		Verdict
No.	(MHz)	(dBm)	(mW)	Rss-247	FCC	
0	2402	4.052	2.542	<125	<1000	Pass
19	2440	3.472	2.224	<125	<1000	Pass
39	2480	4.193	2.626	<125	<1000	Pass

BLE-1Mbps						
Average Power						
Channel	Freq.	RF Output Power		Limit (mW)		Verdict
No.	(MHz)	(dBm)	(mW)	Rss-247	FCC	
0	2402	3.400	2.188	<125	<1000	Pass
19	2440	2.940	1.968	<125	<1000	Pass
39	2480	3.690	2.339	<125	<1000	Pass

BLE-2Mbps						
Peak Power						
Channel	Freq.	RF Output Power		Limit (mW)		Verdict
No.	(MHz)	(dBm)	(mW)	Rss-247	FCC	
1	2404	4.007	2.516	<125	<1000	Pass
19	2440	3.412	2.194	<125	<1000	Pass
38	2478	4.112	2.578	<125	<1000	Pass

BLE-2Mbps						
Average Power						
Channel	Freq.	RF Output Power		Limit (mW)		Verdict
No.	(MHz)	(dBm)	(mW)	Rss-247	FCC	
1	2404	2.780	1.897	<125	<1000	Pass
19	2440	2.530	1.791	<125	<1000	Pass
38	2478	3.160	2.070	<125	<1000	Pass

1Mbps

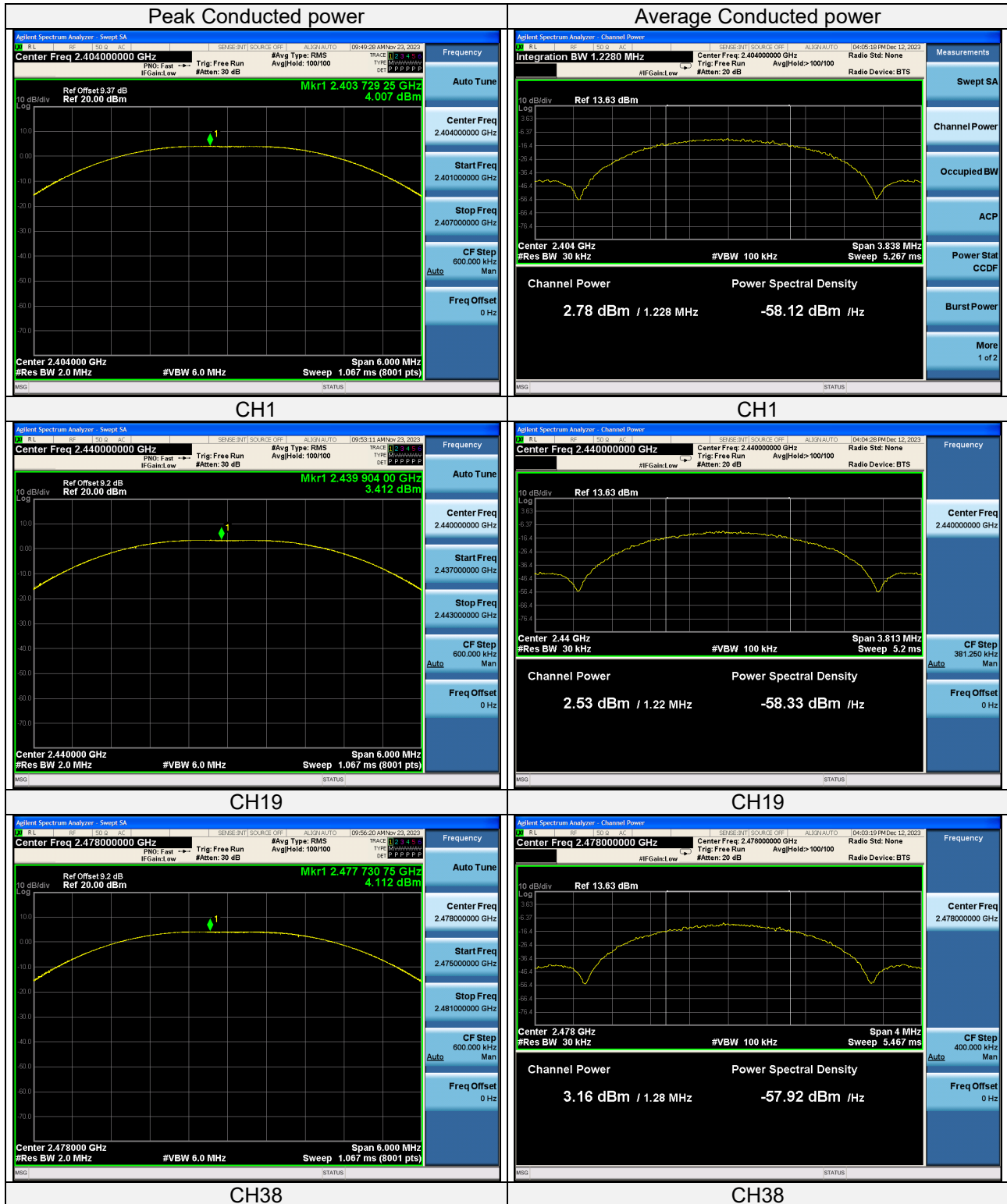


Lab: [Hwa-Hsing \(Dongguan\) Testing Co., Ltd.](#)
 Address: [No.101, Building N1, Yuyuan 2 Road, Yuyuan Industrial Park, HuangJiang Town, Dongguan City, People's Republic of China](#)

Tel: [0769-83078199](tel:0769-83078199)
 Web.: www.hwa-hsing.com
 E-Mail: customerservice.dg@hwa-hsing.com

Release
 Ver. 1.5

2Mbps



Lab: [Hwa-Hsing \(Dongguan\) Testing Co., Ltd.](#)
 Address: [No.101, Building N1, Yuyuan 2 Road, Yuyuan Industrial Park, HuangJiang Town, Dongguan City, People's Republic of China](#)

Tel: [0769-83078199](tel:0769-83078199)
 Web.: www.hwa-hsing.com
 E-Mail: customerservice.dg@hwa-hsing.com

Release
 Ver. 1.5

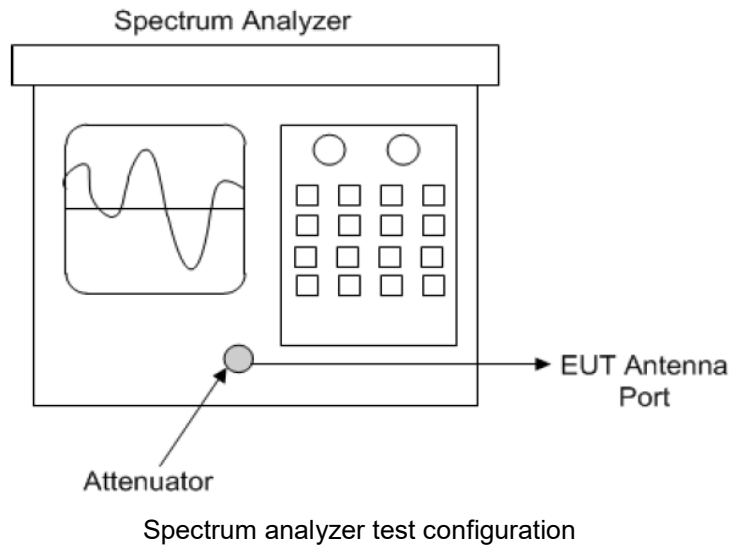
3.6 Power Spectral Density Measurement

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



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 $D \geq 98\%$).
 - 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 $\pm 2\%$.
- 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 $\pm 2\%$),

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.

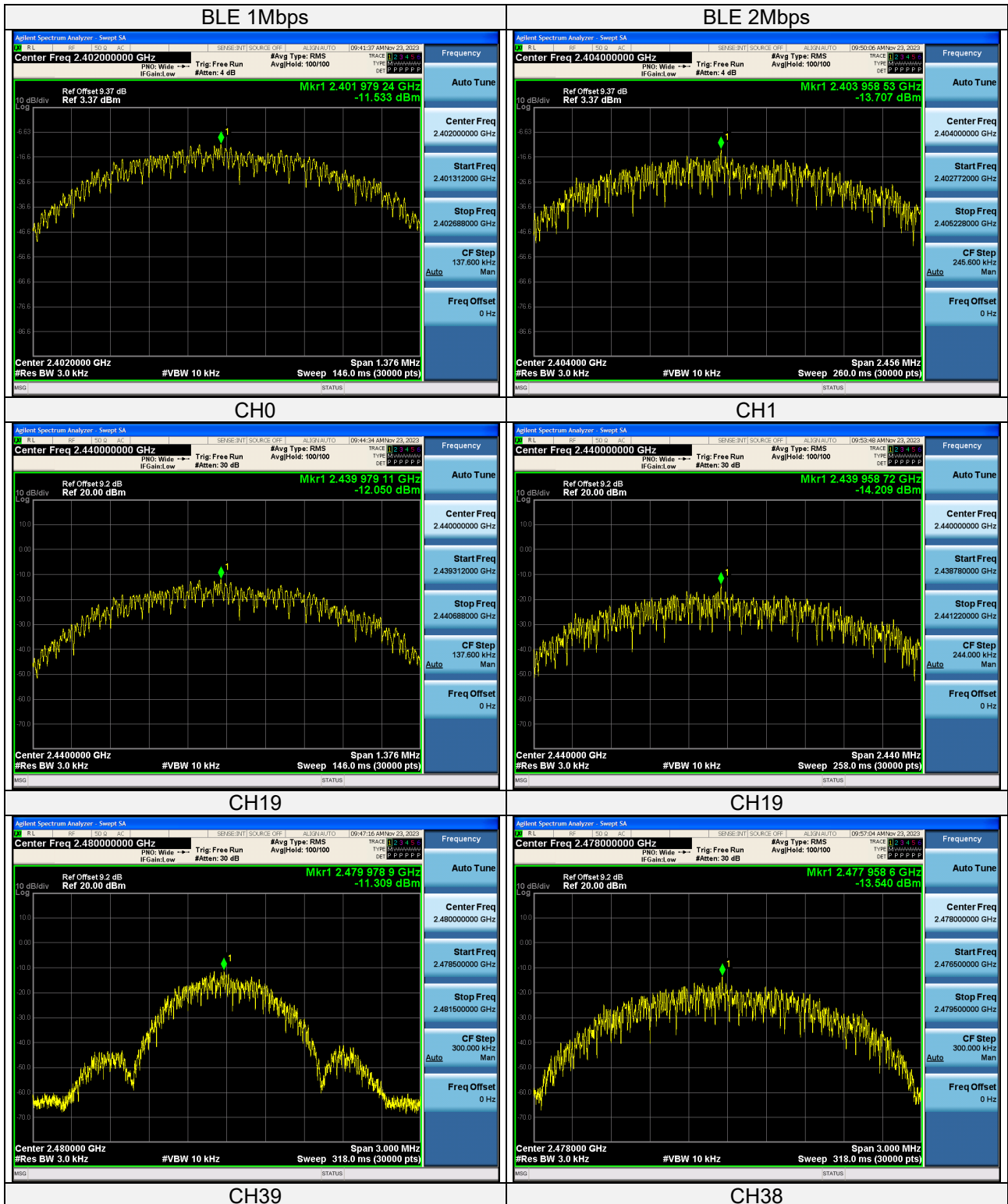
3.6.6 EUT Operating Condition

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		Power Density	
Test Channel	Channel Frequency	Test Result (dBm/3kHz)	Limit (dBm/3kHz)
0	2402MHz	-11.53	<8
19	2440MHz	-12.05	<8
39	2480MHz	-11.31	<8

BLE-2Mbps		Power Density	
Test Channel	Channel Frequency	Test Result (dBm/3kHz)	Limit (dBm/3kHz)
1	2404MHz	-13.71	<8
19	2440MHz	-14.21	<8
38	2478MHz	-13.54	<8



Lab: [Hwa-Hsing \(Dongguan\) Testing Co., Ltd.](#)
 Address: [No.101, Building N1, Yuyuan 2 Road, Yuyuan Industrial Park, HuangJiang Town, Dongguan City, People's Republic of China](#)

Tel: [0769-83078199](tel:0769-83078199)
 Web.: www.hwa-hsing.com
 E-Mail: customerservice.dg@hwa-hsing.com

Release
 Ver. 1.5

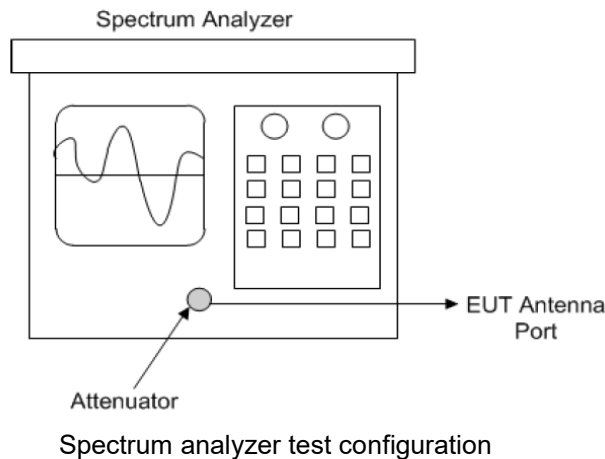
3.7 Conducted Out of Band Emission Measurement

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



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 $\geq 3 \times$ 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.

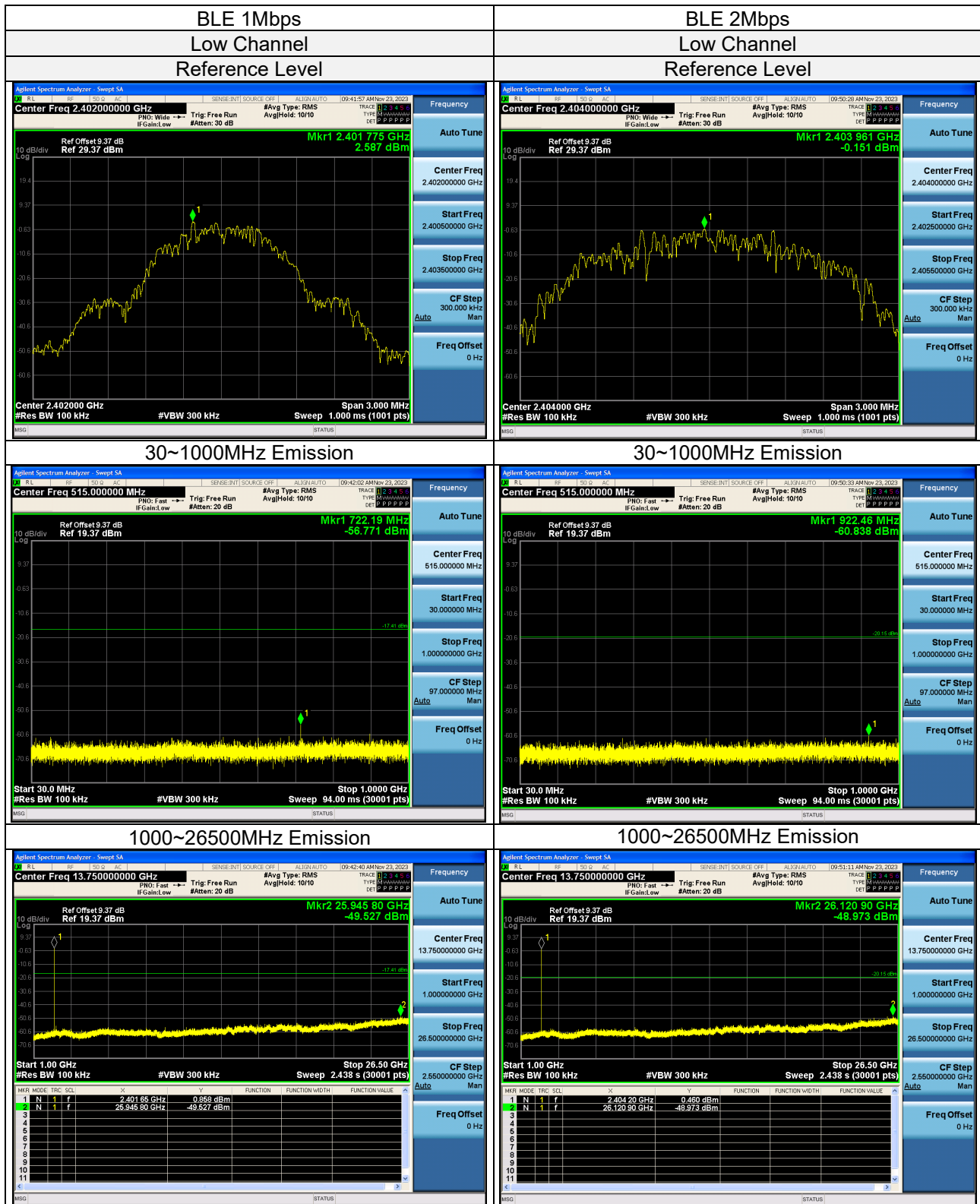
3.7.5 Deviation from Test Standard

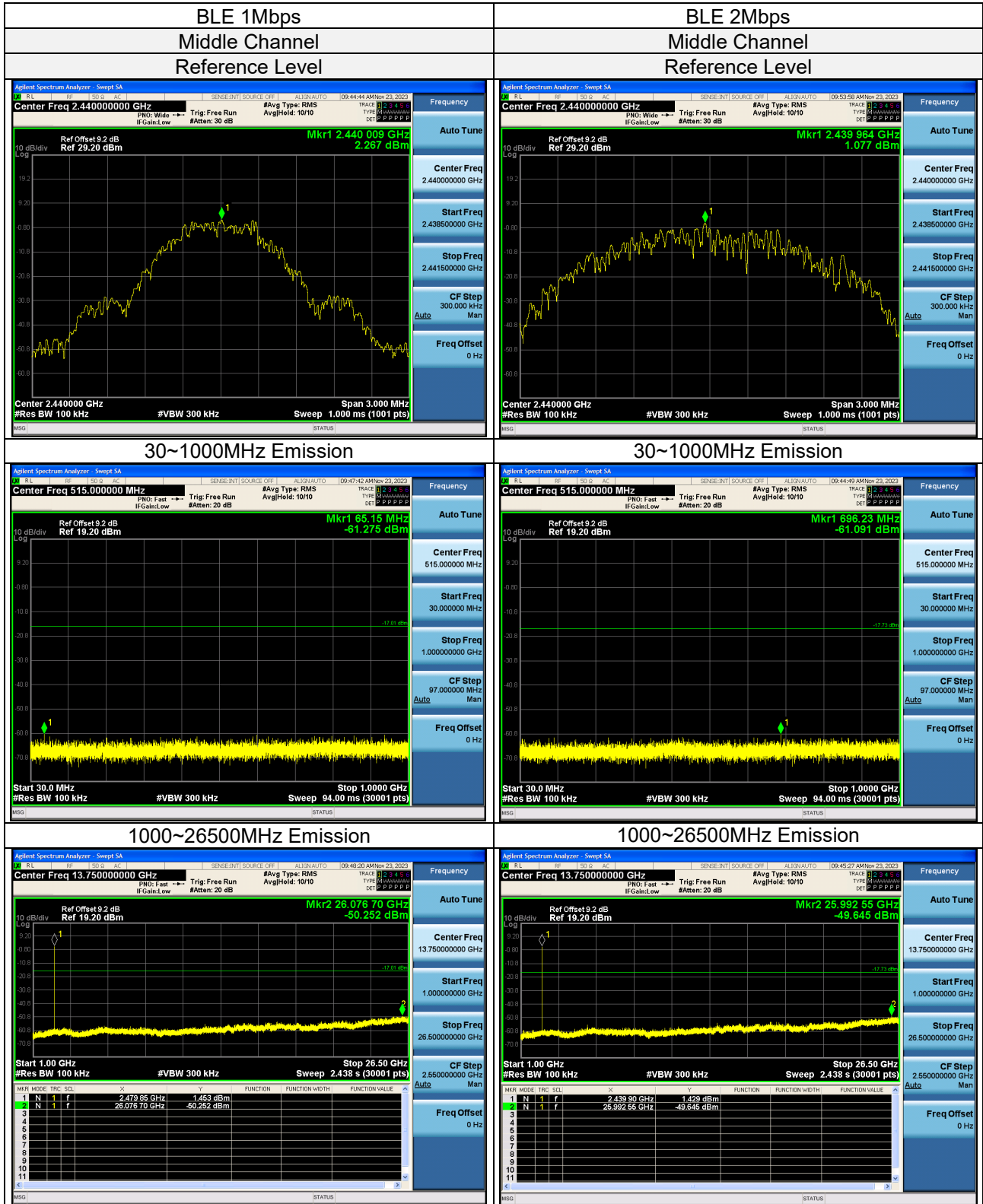
No deviation.

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

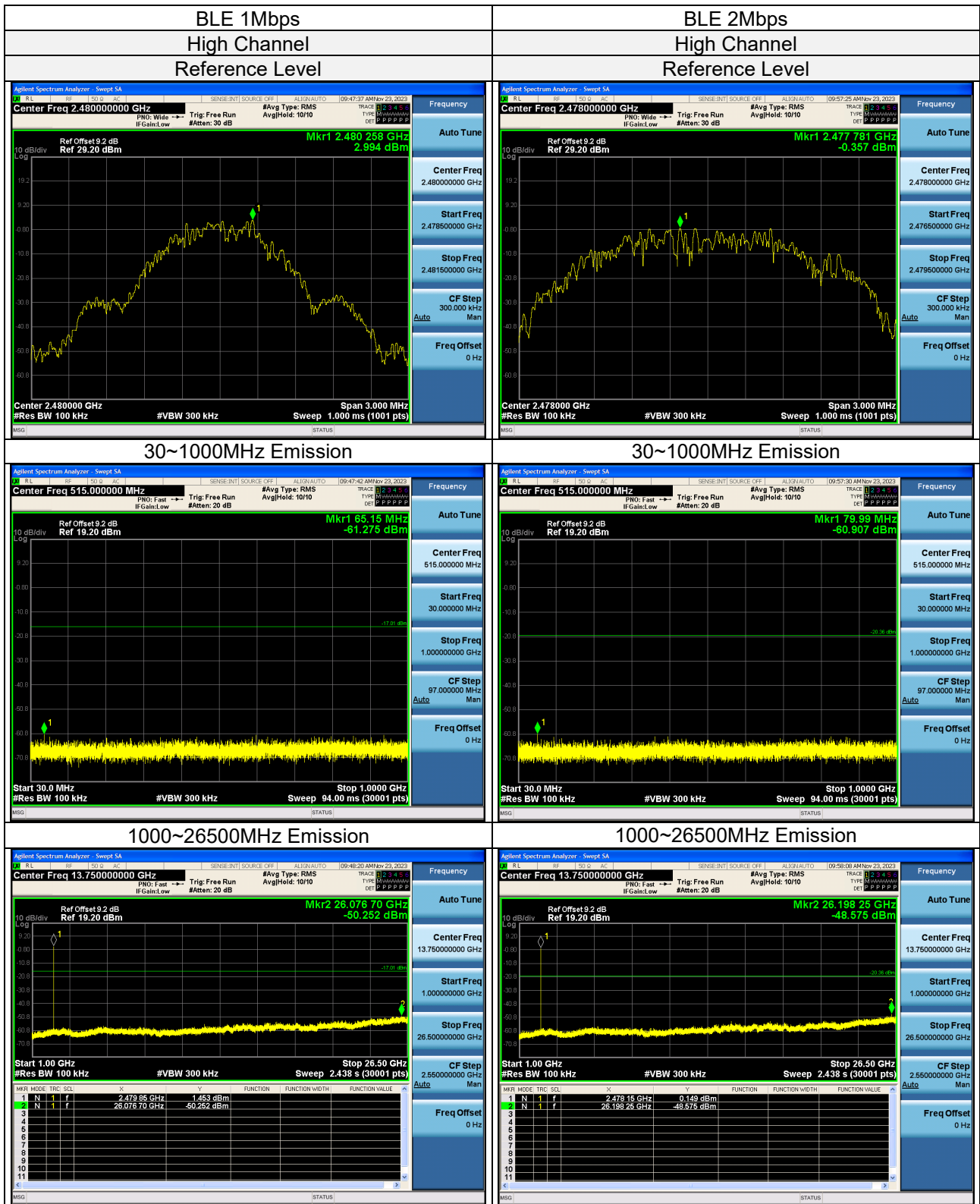




Lab: [Hwa-Hsing \(Dongguan\) Testing Co., Ltd.](#)
 Address: [No.101, Building N1, Yuyuan 2 Road, Yuyuan Industrial Park, HuangJiang Town, Dongguan City, People's Republic of China](#)

Tel: [0769-83078199](tel:0769-83078199)
 Web.: www.hwa-hsing.com
 E-Mail: customerservice.dg@hwa-hsing.com

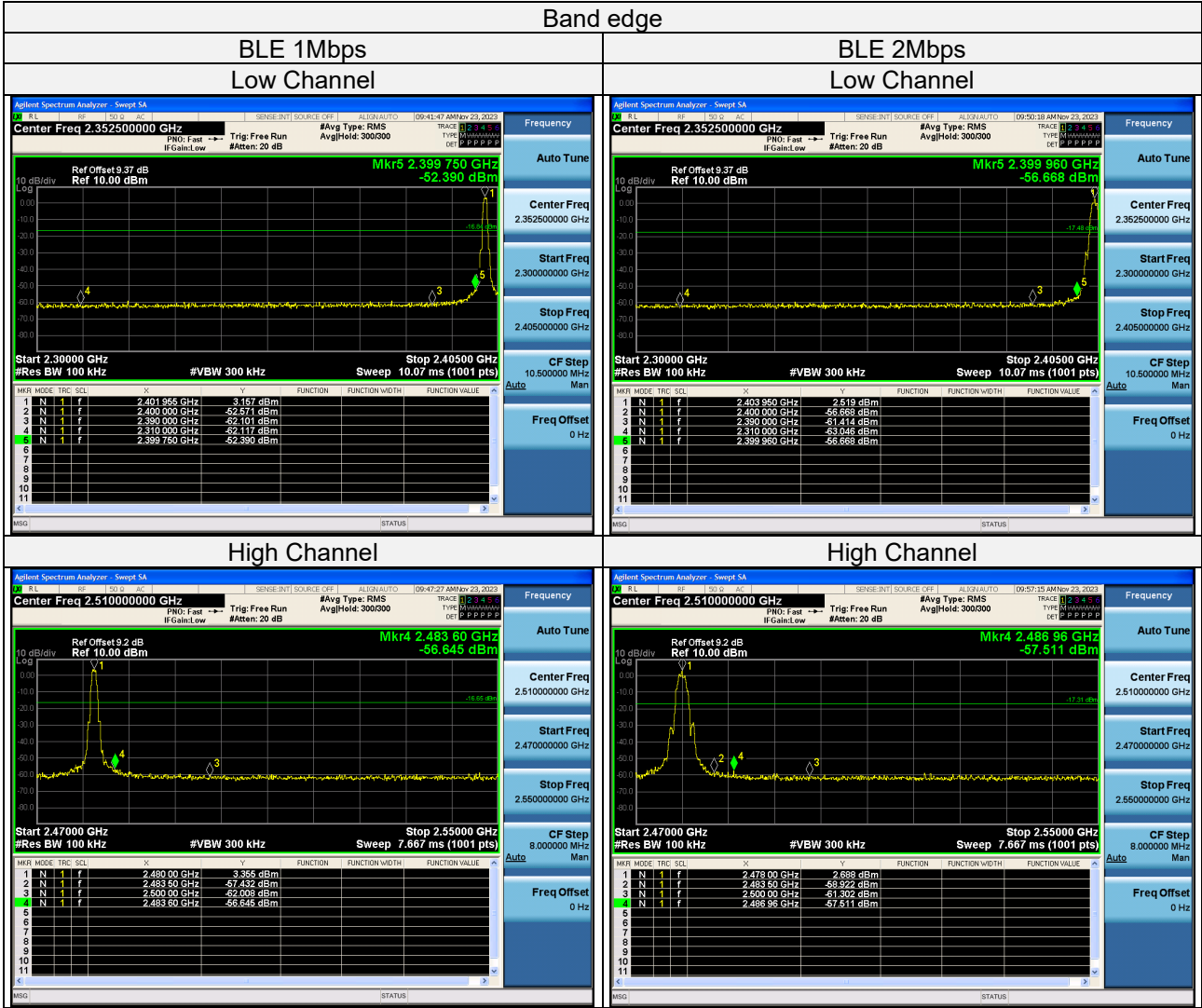
Release
 Ver. 1.5



Lab: [Hwa-Hsing \(Dongguan\) Testing Co., Ltd.](#)
 Address: [No.101, Building N1, Yuyuan 2 Road, Yuyuan Industrial Park, HuangJiang Town, Dongguan City, People's Republic of China](#)

Tel: [0769-83078199](tel:0769-83078199)
 Web.: www.hwa-hsing.com
 E-Mail: customerservice.dg@hwa-hsing.com

Release
 Ver. 1.5



Lab: [Hwa-Hsing \(Dongguan\) Testing Co., Ltd.](#)
 Address: [No.101, Building N1, Yuyuan 2 Road, Yuyuan Industrial Park, HuangJiang Town, Dongguan City, People's Republic of China](#)

Tel: [0769-83078199](tel:0769-83078199)
 Web.: www.hwa-hsing.com
 E-Mail: customerservice.dg@hwa-hsing.com

Release
 Ver. 1.5

4. Pictures of Test Arrangements

Please refer to the attached file (Test Setup Photo).

5. Test Instruments

Equipment	Manufacturer	Model No.	Serial No.	Next Cal.Date
Spectrum	Keysight	N9020A	MY51240612	2024-08-06
Spectrum Analyzer	Rohde&Schwarz	FSV-40N	101783	2023-12-27
Power Meter 10Hz~18GHz	Tonscend	JS0806-2	188060126	2024-08-06
Signal generator	Keysight	E4421B	GB40051020	2024-03-15
Universal Switch Control Unit	Rohde&Schwarz	CMW500	12010002k50	2023-12-27
Test Software	Tonscend	JS0806-2	NA	NA
Humidity tester	Jingchuang	GSP-8A	CMA22B000592	2024-01-15

- Note: 1. The calibration interval of the above test instruments is 12 months.
2. The test was performed in RF Chamber.

Appendix – Information on The Testing Laboratories

We, [Hwa-Hsing \(Dongguan\) Testing 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, Building N1, Yuyuan 2 Road, Yuyuan Industrial Park, HuangJiang Town, Dongguan City, People's Republic of China](#)

Contact Tel: [0769-83078199](tel:0769-83078199)

Email: Customerservice.dg@hwa-hsing.com

Web Site: www.hwa-hsing.com

--- END ---