

TEST REPORT

Applicant: Franklin Technology Inc.
Address: 906 JEI Platz, 186, Gasan digital 1-ro, Geumcheon-gu, Seoul 08502 Korea
Equipment Type: Mobile Hotspot
Model Name: RG2100
Brand Name: N/A
FCC ID: XHG-RG2100
Test Standard: 47 CFR Part 15 Subpart C (refer to section 3.1)
Sample Arrival Date: Nov. 14, 2023
Test Date: Nov. 15, 2023 - Nov. 20, 2023
Date of Issue: Nov. 29, 2023

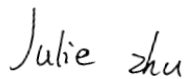
ISSUED BY:

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(Technical Director)



Revision History		
Version	Issue Date	Revisions
<u>Rev. 01</u>	<u>Nov. 29, 2023</u>	<u>Initial Issue</u>

TABLE OF CONTENTS

1	GENERAL INFORMATION.....	4
1.1	Test Laboratory	4
1.2	Test Location	4
2	PRODUCT INFORMATION	5
2.1	Applicant Information	5
2.2	Manufacturer Information.....	5
2.3	General Description for Equipment under Test (EUT).....	5
2.4	Technical Information	6
3	SUMMARY OF TEST RESULTS	9
3.1	Test Standards	9
3.2	Test Verdict	9
4	GENERAL TEST CONFIGURATIONS	10
4.1	Test Environments.....	10
4.2	Test Equipment List.....	10
4.3	Test Software List.....	10
4.4	Measurement Uncertainty.....	11
4.5	Description of Test Setup	11
4.6	Measurement Results Explanation Example.....	14
5	TEST ITEMS	15
5.1	Antenna Requirements	15
5.2	Output Power	16
5.3	Occupied Bandwidth.....	18
5.4	Conducted Spurious Emission.....	19
5.5	Band Edge (Authorized-band band-edge).....	21

5.6	Conducted Emission.....	23
5.7	Radiated Spurious Emission.....	24
5.8	Band Edge (Restricted-band band-edge).....	29
5.9	Power Spectral density (PSD)	30
ANNEX A	TEST RESULT	31
A.1	Output Power	31
A.2	Occupied Bandwidth.....	43
A.3	Conducted Spurious Emissions	43
A.4	Band Edge (Authorized-band band-edge).....	43
A.5	Conducted Emissions	43
A.6	Radiated Emission.....	44
A.7	Band Edge (Restricted-band band-edge).....	47
A.8	Power Spectral Density (PSD).....	75
ANNEX B	TEST SETUP PHOTOS	76
ANNEX C	EUT EXTERNAL PHOTOS.....	76
ANNEX D	EUT INTERNAL PHOTOS.....	76

1 GENERAL INFORMATION

1.1 Test Laboratory

Name	Shenzhen BALUN Technology Co., Ltd.
Address	Block B, 1/F, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Phone Number	+86 755 6685 0100

1.2 Test Location

Name	Shenzhen BALUN Technology Co., Ltd.
Location	<input checked="" type="checkbox"/> Block B, 1/F, Baisha Science and Technology Park, Shahe Xi Road, Nanshan District, Shenzhen, Guangdong Province, P. R. China
	<input type="checkbox"/> 1/F, Building B, Ganghongji High-tech Intelligent Industrial Park, No. 1008, Songbai Road, Yangguang Community, Xili Sub-district, Nanshan District, Shenzhen, Guangdong Province, P. R. China
Accreditation Certificate	The laboratory is a testing organization accredited by FCC as a accredited testing laboratory. The designation number is CN1196.

2 PRODUCT INFORMATION

2.1 Applicant Information

Applicant	Franklin Technology Inc.
Address	906 JEI Platz, 186, Gasan digital 1-ro, Geumcheon-gu, Seoul 08502 Korea

2.2 Manufacturer Information

Manufacturer	Franklin Technology Inc.
Address	906 JEI Platz, 186, Gasan digital 1-ro, Geumcheon-gu, Seoul 08502 Korea

2.3 General Description for Equipment under Test (EUT)

EUT Name	Mobile Hotspot
Model Name Under Test	RG2100
Series Model Name	N/A
Description of Model name differentiation	N/A
Hardware Version	P1
Software Version	RG2100.TM.1639
Dimensions (Approx.)	130.0x84.0x18.9(mm)
Weight (Approx.)	235g

2.4 Technical Information

Network and Wireless connectivity	WIFI 802.11a, 802.11b, 802.11g, 802.11n, 802.11ac and 802.11ax U-NII-1/3
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The requirement for the following technical information of the EUT was tested in this report:

Frequency Range	802.11b/g/n/ax(20 MHz): 2.412 GHz - 2.462 GHz $f_c = 2412 \text{ MHz} + (N-1)*5 \text{ MHz}$, where - f_c = "Operating Frequency" in MHz, - N = "Channel Number" with the range from 1 to 11.	
Modulation Type	DSSS, OFDM, OFDMA	
Product Type	<input type="checkbox"/> Mobile <input checked="" type="checkbox"/> Portable <input type="checkbox"/> Fix Location	
Antenna System (eg., MIMO, Smart Antenna)	Cyclic Delay Diversity (CDD) for 802.11b/g Multi Input Multi Output (MIMO) for 802.11n/ax	
Categorization as Correlated or Completely Uncorrelated	Categorization as Correlated for 802.11b/g Categorization as Uncorrelated for 802.11n/ax	
Antenna Type	PIFA Antenna	
Antenna Gain	SISO-1	-2.21 dBi
	SISO-2	-2.41 dBi
Total directional gain	For power spectral density(PSD) measurements	Correlated: 0.70 dBi Formulas: Directional gain = $10 \log[(10^{G1/20} + 10^{G2/20} + \dots + 10^{GN/20})^2 / \text{NANT}] \text{ dBi}$ Uncorrelated: -2.30 dBi Formulas: Directional gain = $10 \log[(10^{G1/10} + 10^{G2/10} + \dots + 10^{GN/10}) / \text{NANT}] \text{ dBi}$
	For power measurements	Correlated: 0.70 dBi Formulas: Directional gain = $10 \log[(10^{G1/20} + 10^{G2/20} + \dots + 10^{GN/20})^2 / \text{NANT}] \text{ dBi}$ Uncorrelated: -2.30 dBi Formulas: Directional gain = $10 \log[(10^{G1/10} + 10^{G2/10} + \dots + 10^{GN/10}) / \text{NANT}] \text{ dBi}$
	For Conducted Out-of-Band and Spurious Measurements	Correlated: 0.70 dBi Formulas: Directional gain = $10 \log[(10^{G1/20} + 10^{G2/20} + \dots + 10^{GN/20})^2 / \text{NANT}] \text{ dBi}$ Uncorrelated: -2.30 dBi Formulas: Directional gain = $10 \log[(10^{G1/10} + 10^{G2/10} + \dots + 10^{GN/10}) / \text{NANT}] \text{ dBi}$

	$10^{GN/10}$)/NANTJ dBi
About the Product	Only the WIFI 802.11b, 802.11g, 802.11n (HT20), 802.11ax (HE20) was tested in this report.

Mode	Antenna		
	SISO-1	SISO-1	MIMO
802.11b	√	√	√
802.11g	√	√	√
802.11n20	√	√	√
802.11ax20	√	√	√

Note: All the configurations were tested, but only the worst data was shown in this report.

Modulation technology	Modulation Type	Transfer Rate (Mbps)(Single RF path)
DSSS (802.11b)	DBPSK	1
	DQPSK	2
	CCK	5.5/11
OFDM (802.11g)	BPSK	6/9
	QPSK	12/18
	16QAM	24/36
	64QAM	48/54
OFDM (802.11n-20 MHz)	BPSK	6.5/7.2
	QPSK	13/19.5/14.4/21.7
	16QAM	26/39/28.9/43.3
	64QAM	52/58.5/65/57.8/65/72.2
OFDMA (802.11ax-20 MHz)	BPSK	4
	QPSK	16/24/17/26
	16QAM	33/49/34/52
	64QAM	65/73/81/69/77/86
	256QAM	98/108/103/115
	1024QAM	122/135/129/143

Note: Preliminary tests were performed in different data rate in above table to find the worst radiated emission. The data rate shown in the table below is the worst-case rate with respect to the specific test item. Investigation has been done on all the possible configurations for searching the worst cases. The following table is a list of the test modes shown in this test report.

Test Items	Mode	Data Rate	Channel
Output Power	11b/11g/11n20/ax20	1/6/6.5/4 Mbps	1/6/11
Occupied Bandwidth	11b/11g/11n20/ax20	1/6/6.5/4 Mbps	1/6/11
Conducted Spurious Emission	11b/11g/11n20/ax20	1/6/6.5/4 Mbps	1/6/11
Conducted Emission	11b/11g/11n20/ax20	1/6/6.5/4 Mbps	1/6/11
Radiated Spurious Emission	11b/11g/11n20/ax20	1/6/6.5/4 Mbps	1/6/11
Band Edge	11b/11g/11n20/ax20	1/6/6.5/4 Mbps	1/6/11
Power spectral density (PSD)	11b/11g/11n20/ax20	1/6/6.5/4 Mbps	1/6/11

Note: The above EUT information in section 2.4 was declared by manufacturer and for more detailed features description, please refer to the manufacturer's specifications or user's manual.

3 SUMMARY OF TEST RESULTS

3.1 Test Standards

No.	Identity	Document Title
1	47 CFR Part 15, Subpart C	Intentional radiators of radio frequency equipment
2	KDB Publication 662911 D01v02r01	Emissions Testing of Transmitters with Multiple Outputs in the Same Band (e.g., MIMO, Smart Antenna, etc)
3	ANSI C63.10-2013	American National Standard of Procedures for Compliance Testing of Unlicensed Wireless Devices
4	KDB Publication 558074 D01v05r02	GUIDANCE FOR COMPLIANCE MEASUREMENTS ON DIGITAL TRANSMISSION SYSTEM, FREQUENCY HOPPING SPREAD SPECTRUM SYSTEM, AND HYBRID SYSTEM DEVICES OPERATING UNDER SECTION 15.247 OF THE FCC RULES

3.2 Test Verdict

No.	Description	FCC PART No.	Test Result	Verdict
1	Antenna Requirement	15.203	N/A	Pass ^{Note 1}
2	Output Power	15.247 (b)	ANNEX A.1	Pass
3	Occupied Bandwidth	15.247 (a)	ANNEX A.2	Pass
4	Conducted Spurious Emission	15.247 (d)	ANNEX A.3	Pass
5	Band Edge(Authorized-band band-edge)	15.247 (d)	ANNEX A.4	Pass
6	Conducted Emission	15.207	ANNEX A.5	Pass
7	Radiated Spurious Emission	15.209; 15.247 (d)	ANNEX A.6	Pass
8	Band Edge(Restricted-band band-edge)	15.209; 15.247 (d)	ANNEX A.7	Pass
9	Power spectral density (PSD)	15.247 (e)	ANNEX A.8	Pass

Note 1: The EUT has a permanently and irreplaceable attached antenna, which complies with the requirement FCC 15.203.

Note 2: Compared with the EUT of test report FR262007-01A, the changes of the EUT of this report as below:

1. Changed the supplier of 2.4G and 5G WIFI FEM.

Other hardware circuit and software are the same as EUT referred in test report FR262007-01A.

Therefore, only the 3 test items, which include Output Power, Radiated Spurious Emission, Band Edge(Restricted-band band-edge), were tested in this report, others test data please refer report FR262007-01A, which was issued by Sporton International Inc. (Kunshan) on Sep. 09, 2022.

4 GENERAL TEST CONFIGURATIONS

4.1 Test Environments

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

Relative Humidity	48% to 68%	
Atmospheric Pressure	100 kPa to 102 kPa	
Temperature	NT (Normal Temperature)	+21.6°C to +23.6°C
Working Voltage of the EUT	NV (Normal Voltage)	3.8 V

4.2 Test Equipment List

Description	Manufacturer	Model	Serial No.	Cal. Date	Cal. Due
Spectrum Analyzer	KEYSIGHT	N9020A	MY50330200	2023.05.16	2024.05.15
Power Sensor	KEYSIGHT	U2063XA	MY58000251	2023.07.12	2024.07.11
Spectrum Analyzer	ROHDE&SCHWARZ	FSV-40	101544	2022.12.28	2023.12.27
Spectrum Analyzer	KEYSIGHT	N9020A	MY52510065	2023.09.05	2024.09.04
Signaling Unit	ROHDE&SCHWARZ	CMW500	171150	2023.06.19	2024.06.18
Test Antenna-Horn(1-18 GHz)	SCHWARZBECK	BBHA 9120D	01631	2022.02.03	2025.02.02
Test Antenna-Horn (18-40 GHz)	A-INFO	LB- 180400KF	J211060273	2021.07.02	2024.07.01
Anechoic Chamber	RAINFORD	9m*6m*6m	144	2022.02.19	2024.09.03
Amplifier	COM-MV	ZT30- 1000M	18110850	2023.09.05	2024.09.04
Amplifier	COM-MV	LSCX_LNA 1-12G-01	180602	2023.09.05	2024.09.04
Amplifier	COM-MV	XKu_LNA7- 18G-01	180601	2023.09.05	2024.09.04
Amplifier	COM-MV	KA LNA18 40G-01	18050001	2022.12.07	2023.12.06

4.3 Test Software List

Description	Manufacturer	Software Version	Serial No.	Applicable test Setup
BL410R	BALUN	V2.1.1.488	N/A	The section 4.5.1
BL410E	BALUN	V22.930	N/A	The section 4.5.2&4.5.3&4.5.4&4.5.5

4.4 Measurement Uncertainty

The following measurement uncertainty levels have been estimated for tests performed on the EUT as specified in CISPR 16-4-2.

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

Parameters	Uncertainty
Occupied Channel Bandwidth	2.8%
RF output power, conducted	1.28 dB
Power Spectral Density, conducted	1.30 dB
Unwanted Emissions, conducted	1.84 dB
All emissions, radiated	5.36 dB
Temperature	0.8°C
Humidity	4%

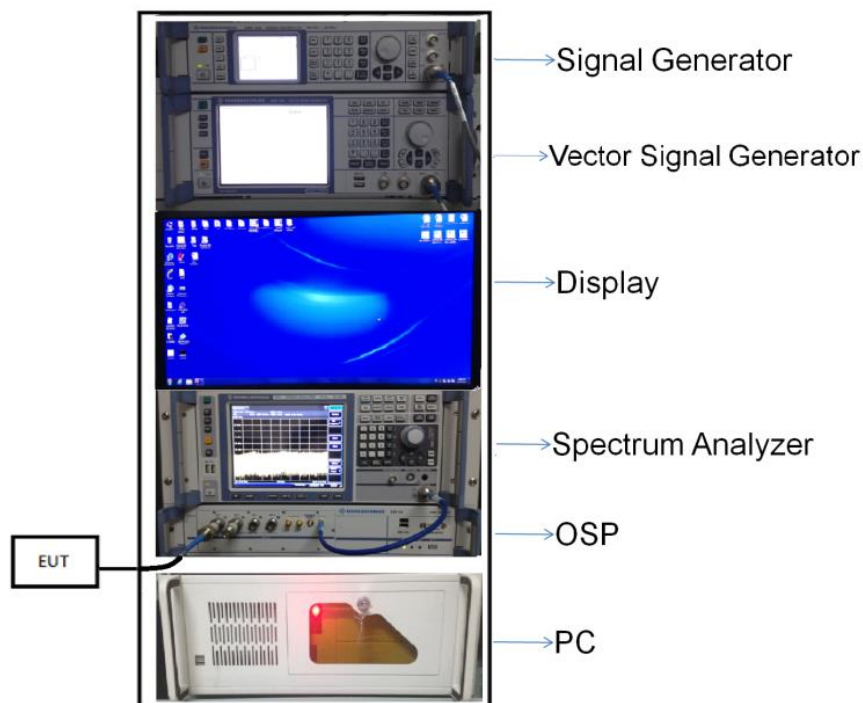
4.5 Description of Test Setup

4.5.1 For Antenna Port Test

$$\text{Conducted value (dBm)} = \text{Measurement value (dBm)} + \text{cable loss (dB)}$$

For example: the measurement value is 10 dBm and the cable 0.5dBm used, then the final result of EUT:

$$\text{Conducted value (dBm)} = 10 \text{ dBm} + 0.5 \text{ dB} = 10.5 \text{ dBm}$$



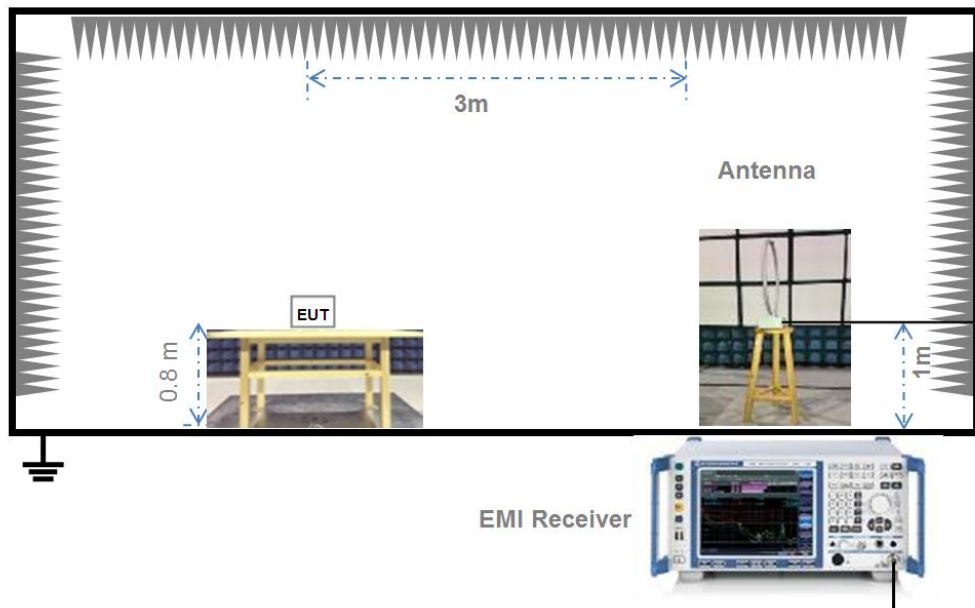
(Diagram 1)

4.5.2 For AC Power Supply Port Test



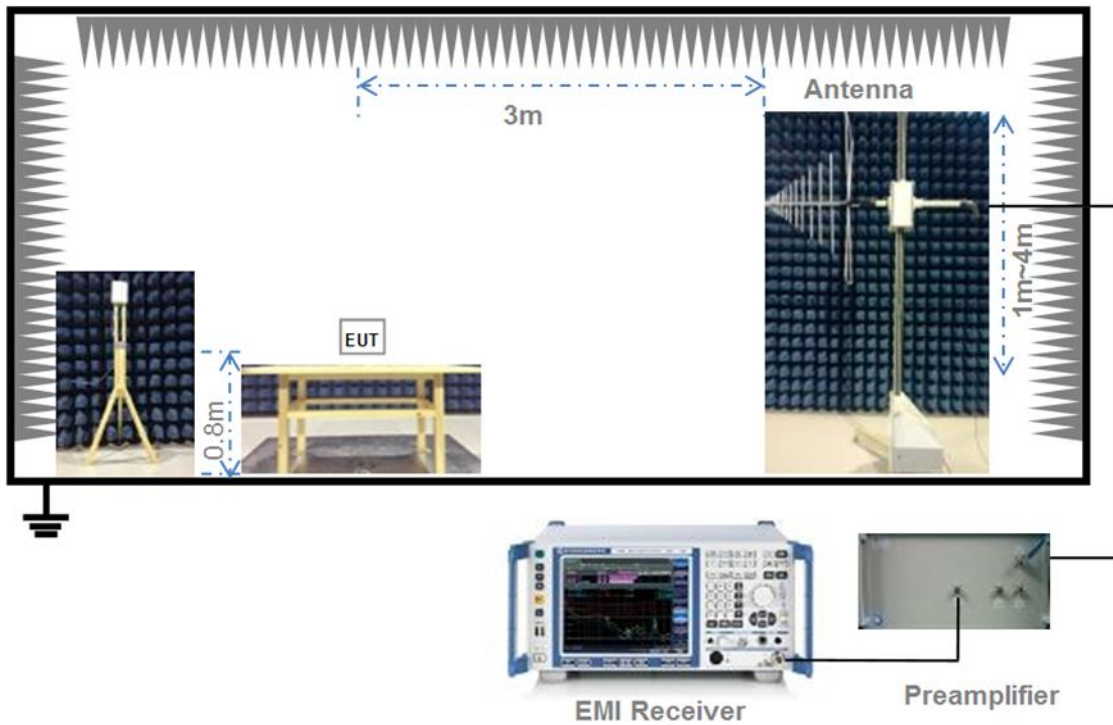
(Diagram 2)

4.5.3 For Radiated Test (Below 30 MHz)



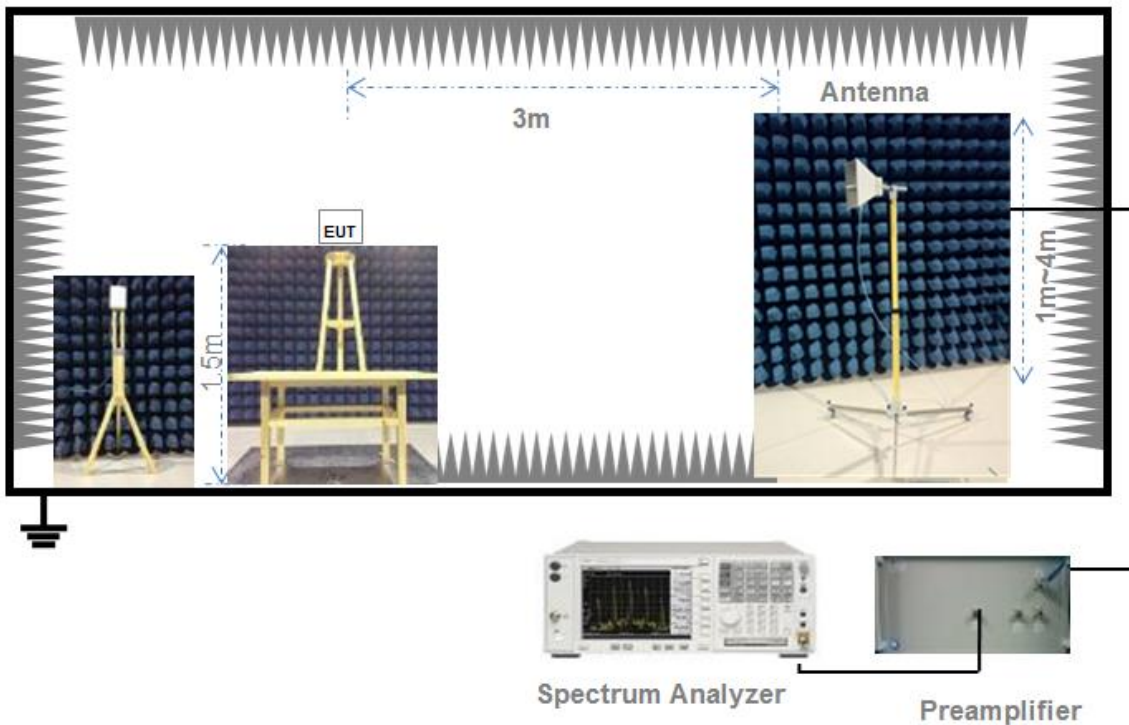
(Diagram 3)

4.5.4 For Radiated Test (30 MHz-1 GHz)



(Diagram 4)

4.5.5 For Radiated Test (Above 1 GHz)



(Diagram 5)

4.6 Measurement Results Explanation Example

4.6.1 For conducted test items:

The offset level is set in the spectrum analyzer to compensate the RF cable loss and attenuator between EUT conducted output port and spectrum analyzer. With the offset compensation, the spectrum analyzer reading level is exactly the EUT RF output level.

The spectrum analyzer offset is derived from RF cable loss and attenuator factor.

Offset = RF cable loss + attenuator factor.

4.6.2 For radiated band edges and spurious emission test:

$$E = \text{EIRP} - 20 \log D + 104.8$$

where:

E = electric field strength in dB μ V/m,

EIRP = equivalent isotropic radiated power in dBm

D = specified measurement distance in meters.

EIRP = Measure Conducted output power Value (dBm) + Maximum transmit antenna gain (dBi) + the appropriate maximum ground reflection factor (dB)

5 TEST ITEMS

5.1 Antenna Requirements

5.1.1 Relevant Standards

FCC §15.203

An intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the use of a standard antenna jack or electrical connector is prohibited. This requirement does not apply to carrier current devices or to devices operated under the provisions of § 15.211, § 15.213, § 15.217, § 15.219, or § 15.221. Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

If directional gain of transmitting antennas is greater than 6 dBi, the power shall be reduced by the same level in dB comparing to gain minus 6 dBi. For the fixed point-to-point operation, the power shall be reduced by one dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the FCC rule.

5.1.2 Antenna Anti-Replacement Construction

The Antenna Anti-Replacement as following method:

Protected Method	Description
The antenna is embedded in the product.	An embedded-in antenna design is used.

Reference Documents	Item
Photo	Please refer to the EUT Photo documents.

5.1.3 Antenna Gain

The antenna peak gain of EUT is less than 6 dBi. Therefore, it is not necessary to reduce maximum peak output power limit.

5.2 Output Power

5.2.1 Test Limit

FCC § 15.247(b)

For systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements.

5.2.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.2.3 Test Procedure

Maximum peak conducted output power

The maximum peak conducted output power may be measured using a broadband peak RF power meter. The power meter shall have a video bandwidth that is greater than or equal to the DTS bandwidth and shall utilize a fast-responding diode detector.

Maximum conducted (average) output power (Reporting Only)

a) As an alternative to spectrum analyzer or EMI receiver measurements, measurements may be performed

using a wideband RF power meter with a thermocouple detector or equivalent if all of the conditions listed below are satisfied.

- 1) The EUT is configured to transmit continuously, or to transmit with a constant duty factor.
- 2) At all times when the EUT is transmitting, it shall be transmitting at its maximum power control level.
- 3) The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.

b) If the transmitter does not transmit continuously, measure the duty cycle (x) of the transmitter output signal as

described in Section 6.0.

c) Measure the average power of the transmitter. This measurement is an average over both the on and off periods of the transmitter.

d) Adjust the measurement in dBm by adding $10\log(1/x)$, where x is the duty cycle to the measurement result.

Measurements of duty cycle

The zero-span mode on a spectrum analyzer or EMI receiver if the response time and spacing between bins on the sweep are sufficient to permit accurate measurements of the on and off times of the transmitted signal.

Set the center frequency of the instrument to the center frequency of the transmission.

Set $RBW \geq OBW$ if possible; otherwise, set RBW to the largest available value.

Set $VBW \geq RBW$. Set detector = peak or average.

The zero-span measurement method shall not be used unless both RBW and VBW are $> 50/T$ and the number of sweep points across duration T exceeds 100. (For example, if VBW and/or RBW are limited to 3 MHz, then the zero-span method of measuring duty cycle shall not be used if $T \leq 16.7$ microseconds.)

5.2.4 Test Result

Please refer to ANNEX A.1.

5.3 Occupied Bandwidth

5.3.1 Limit

FCC §15.247(a)

Make the measurement with the spectrum analyzer's resolution bandwidth (RBW) = 100 kHz. In order to make an accurate measurement, set the span greater than RBW. The 6 dB bandwidth must be greater than 500 kHz.

5.3.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.3.3 Test Procedure

Use the following spectrum analyzer settings:

Set RBW = 100 kHz.

Set the video bandwidth (VBW) \geq 3 RBW.

Detector = Peak.

Trace mode = max hold.

Sweep = auto couple.

Allow the trace to stabilize.

Measure the maximum width of the emission that is constrained by the frequencies associated with the two outermost amplitude points (upper and lower frequencies) that are attenuated by 6 dB relative to the maximum level measured in the fundamental emission.

5.3.4 Test Result

Please refer to ANNEX A.2.

5.4 Conducted Spurious Emission

5.4.1 Limit

FCC §15.247(d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

5.4.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.4.3 Test Procedure

The DTS rules specify that in any 100 kHz bandwidth outside of the authorized frequency band, the power shall be attenuated according to the following conditions:

- a) If the maximum peak conducted output power procedure was used to demonstrate compliance as described in 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 demonstrate compliance as described in 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).
- c) In either case, attenuation to levels below the 15.209 general radiated emissions limits is not required.

The following procedures shall be used to demonstrate compliance to these limits. Note that these procedures can be used in either an antenna-port conducted or radiated test set-up. Radiated tests must conform to the test site requirements and utilize maximization procedures defined herein.

Reference level measurement

Establish a reference level by using the following procedure:

Set instrument center frequency to DTS channel center frequency.

Set the span to ≥ 1.5 times the DTS bandwidth.

Set the RBW = 100 kHz.

Set the VBW $\geq 3 \times$ RBW.

Detector = peak.

Sweep time = auto couple.

Trace mode = max hold.

Allow trace to fully stabilize.

Use the peak marker function to determine the maximum PSD level.

Emission level measurement

Use the following spectrum analyzer settings:

Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.

Set the RBW = 100 kHz.

Set the VBW $\geq 3 \times$ RBW.

Detector = peak.

Sweep time = auto couple.

Trace mode = max hold.

Allow trace to fully stabilize.

Use the peak marker function to determine the maximum amplitude level.

Ensure that the amplitude of all unwanted emissions outside of the authorized frequency band (excluding restricted frequency bands) are attenuated by at least the minimum requirements specified in 11.1 a) or 11.1 b). Report the three highest emissions relative to the limit.

5.4.4 Test Result

Please refer to ANNEX A.3.

5.5 Band Edge (Authorized-band band-edge)

5.5.1 Limit

FCC §15.247(d)

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement.

5.5.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.5.3 Test Procedure

The following procedures may be used to determine the peak or average field strength or power of an unwanted emission that is within 2 MHz of the authorized band edge. If a peak detector is utilized, use the procedure described in 13.2.1. Use the procedure described in 13.2.2 when using an average detector and the EUT can be configured to transmit continuously (i.e., duty cycle $\geq 98\%$). Use the procedure described in 13.2.3 when using an average detector and the EUT cannot be configured to transmit continuously but the duty cycle is constant (i.e., duty cycle variations are less than ± 2 percent). Use the procedure described in 13.2.4 when using an average detector for those cases where the EUT cannot be configured to transmit continuously and the duty cycle is not constant (duty cycle variations equal or exceed 2 percent).

When using a peak detector to measure unwanted emissions at or near the band edge (within 2 MHz of the authorized band), the following integration procedure can be used.

Set instrument center frequency to the frequency of the emission to be measured (must be within 2 MHz of the authorized band edge).

Set span to 2 MHz

RBW = 100 kHz.

VBW $\geq 3 \times$ RBW.

Detector = peak.

Sweep time = auto.

Trace mode = max hold.

Allow sweep to continue until the trace stabilizes (required measurement time may increase for low duty cycle applications)

Compute the power by integrating the spectrum over 1 MHz using the analyzer's band power measurement function with band limits set equal to the emission frequency (femission) ± 0.5 MHz. If the instrument does not have a band power function, then sum the amplitude levels (in power units) at 100 kHz intervals extending across the 1 MHz spectrum defined by femission ± 0.5 MHz.

Standard method(The 99% OBW of the fundamental emission is without 2 MHz of the authorized band):

Span: Wide enough to capture the peak level of the emission operating on the channel closest to the band edge, as well as any modulation products that fall outside of the authorized band of operation.

Reference level: As required to keep the signal from exceeding the maximum instrument input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than $[10 \log (\text{OBW}/\text{RBW})]$ below the reference level. Specific guidance is given in 4.1.5.2.

Attenuation: Auto (at least 10 dB preferred).

Sweep time: Coupled.

Resolution bandwidth: 100 kHz.

Video bandwidth: 300 kHz.

Detector: Peak.

Trace: Max hold.

5.5.4 Test Result

Please refer to ANNEX A.4.

5.6 Conducted Emission

5.6.1 Limit

FCC §15.207

For an intentional radiator that is designed to be connected to the public utility (AC) power line, the radio frequency voltage that is conducted back onto the AC power line on any frequency within the band 150 kHz to 30 MHz shall not exceed the limits in the following table, as measured using a 50 μ H/50 Ω line impedance stabilization network (LISN).

Frequency range (MHz)	Conducted Limit (dB μ V)	
	Quai-peak	Average
0.15 - 0.50	66 to 56	56 to 46
0.50 - 5	56	46
0.50 - 30	60	50

5.6.2 Test Setup

See section 4.5.2 for test setup description for the AC power supply port. The photo of test setup please refer to ANNEX B.

5.6.3 Test Procedure

The maximum conducted interference is searched using Peak (PK), if the emission levels more than the AV and QP limits, and that have narrow margins from the AV and QP limits will be re-measured with AV and QP detectors. Tests for both L phase and N phase lines of the power mains connected to the EUT are performed. Refer to recorded points and plots below.

Devices subject to Part 15 must be tested for all available U.S. voltages and frequencies (such as a nominal 120 VAC, 50/60 Hz and 240 VAC, 50/60 Hz) for which the device is capable of operation. A device rated for 50/60 Hz operation need not be tested at both frequencies provided the radiated and line conducted emissions are the same at both frequencies.

5.6.4 Test Result

Please refer to ANNEX A.5.

5.7 Radiated Spurious Emission

5.7.1 Limit

FCC §15.209&15.247(d)

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

According to FCC section 15.209 (a), except as provided elsewhere in this subpart, the emissions from an intentional radiator shall not exceed the field strength levels specified in the following table:

Frequency (MHz)	Field Strength ($\mu\text{V}/\text{m}$)	Measurement Distance (m)
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

Note:

- For Above 1000 MHz, the emission limit in this paragraph is based on measurement instrumentation employing an average detector, measurement using instrumentation with a peak detector function, corresponding to 20dB above the maximum permitted average limit.
- For above 1000 MHz, limit field strength of harmonics: 54dBuV/m@3m (AV) and 74dBuV/m@3m (PK).

5.7.2 Test Setup

See section 4.5.3 to 4.5.5 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.7.3 Test Procedure

Since the emission limits are specified in terms of radiated field strength levels, measurements performed to demonstrate compliance have traditionally relied on a radiated test configuration. Radiated measurements remain the principal method for demonstrating compliance to the specified limits; however antenna-port conducted measurements are also now acceptable to demonstrate compliance (see below for details). When radiated measurements are utilized, test site requirements and procedures for maximizing and measuring radiated emissions that are described in ANSI C63.10 shall be followed.

Antenna-port conducted measurements may also be used as an alternative to radiated measurements for demonstrating compliance in the restricted frequency bands. If conducted measurements are performed, then proper impedance matching must be ensured and an additional radiated test for cabinet/case spurious emissions is required.

General Procedure for conducted measurements in restricted bands

- a) Measure the conducted output power (in dBm) using the detector specified (see guidance regarding measurement procedures for determining quasi-peak, peak, and average conducted output power, respectively).
- b) Add the maximum transmit antenna gain (in dBi) to the measured output power level to determine the EIRP level (see guidance on determining the applicable antenna gain)
- c) Add the appropriate maximum ground reflection factor to the EIRP level (6 dB for frequencies ≤ 30 MHz, 4.7 dB for frequencies between 30 MHz and 1000 MHz, inclusive and 0 dB for frequencies > 1000 MHz).
- d) For devices with multiple antenna-ports, measure the power of each individual chain and sum the EIRP of all chains in linear terms (e.g., Watts, mW).
- e) Convert the resultant EIRP level to an equivalent electric field strength using the following relationship:

$$E = \text{EIRP} - 20\log D + 104.8$$

where:

E = electric field strength in dB μ V/m,

EIRP = equivalent isotropic radiated power in dBm

D = specified measurement distance in meters.

- f) Compare the resultant electric field strength level to the applicable limit.
- g) Perform radiated spurious emission test.

Quasi-Peak measurement procedure

The specifications for measurements using the CISPR quasi-peak detector can be found in Publication 16 of the International Special Committee on Radio Frequency Interference (CISPR) of the International Electrotechnical Commission.

As an alternative to CISPR quasi-peak measurement, compliance can be demonstrated to the applicable emission limits using a peak detector.

Peak power measurement procedure

Peak emission levels are measured by setting the instrument as follows:

- a) RBW = as specified in Table 1.
- b) VBW $\geq 3 \times$ RBW.
- c) Detector = Peak.
- d) Sweep time = auto.
- e) Trace mode = max hold.
- f) Allow sweeps to continue until the trace stabilizes. (Note that the required measurement time may be

longer for low duty cycle applications).

Table 1—RBW as a function of frequency

Frequency	RBW
9-150 kHz	200-300 Hz
0.15-30 MHz	9-10 kHz
30-1000 MHz	100-120 kHz
> 1000 MHz	1 MHz

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.

Trace averaging across on and off times of the EUT transmissions followed by duty cycle correction

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

- a) The EUT shall be configured to operate at the maximum achievable duty cycle.
- b) Measure the duty cycle, x , of the transmitter output signal as described in section 6.0.
- c) RBW = 1 MHz (unless otherwise specified).
- d) VBW $\geq 3 \times$ RBW.
- e) Detector = RMS, if $\text{span}/(\# \text{ of points in sweep}) \leq (\text{RBW}/2)$. Satisfying this condition may require increasing the number of points in the sweep or reducing the span. If this condition cannot be satisfied, then the detector mode shall be set to peak.
- f) Averaging type = power (i.e., RMS).
 - 1) As an alternative, the detector and averaging type may be set for linear voltage averaging.
 - 2) Some instruments require linear display mode in order to use linear voltage averaging. Log or dB averaging shall not be used.
- g) Sweep time = auto.
- h) Perform a trace average of at least 100 traces.
- i) A correction factor shall be added to the measurement results prior to comparing to the emission limit in order to compute the emission level that would have been measured had the test been performed at 100 percent duty cycle. The correction factor is computed as follows:
 - 1) If power averaging (RMS) mode was used in step f), then the applicable correction factor is $10 \log(1/x)$, where x is the duty cycle.
 - 2) If linear voltage averaging mode was used in step f), then the applicable correction factor is $20 \log(1/x)$, where x is the duty cycle.
 - 3) If a specific emission is demonstrated to be continuous (≥ 98 percent duty cycle) rather than turning on and off with the transmit cycle, then no duty cycle correction is required for that emission.

NOTE: Reduction of the measured emission amplitude levels to account for operational duty factor is not permitted. Compliance is based on emission levels occurring during transmission - not on an average across on and off times of the transmitter.

Determining the applicable transmit antenna gain

A conducted power measurement will determine the maximum output power associated with a restricted band emission; however, in order to determine the associated EIRP level, the gain of the transmitting antenna (in dBi) must be added to the measured output power (in dBm).

Since the out-of-band characteristics of the EUT transmit antenna will often be unknown, the use of a conservative antenna gain value is necessary. Thus, when determining the EIRP based on the measured conducted power, the upper bound on antenna gain for a device with a single RF output shall be selected as the maximum in-band gain of the antenna across all operating bands, or 2 dBi, whichever is greater. However, for devices that operate in multiple frequency bands while using the same transmit antenna, the highest gain of the antenna within the operating band nearest in frequency to the restricted band emission being measured may be used in lieu of the overall highest gain when the emission is at a frequency that is within 20 percent of the nearest band edge frequency, but in no case shall a value less than 2 dBi be used.

See KDB 662911 for guidance on calculating the additional array gain term when determining the effective antenna gain for a EUT with multiple outputs occupying the same or overlapping frequency ranges in the same band.

Radiated spurious emission test

An additional consideration when performing conducted measurements of restricted band emissions is that unwanted emissions radiating from the EUT cabinet, control circuits, power leads, or intermediate circuit elements will likely go undetected in a conducted measurement configuration. To address this concern, a radiated test shall be performed to ensure that emissions emanating from the EUT cabinet (rather than the antenna port) also comply with the applicable limits.

For these cabinet radiated spurious emission measurements the EUT transmit antenna may be replaced with a termination matching the nominal impedance of the antenna. Procedures for performing radiated measurements are specified in ANSI C63.10. All detected emissions shall comply with the applicable limits.

The measurement frequency range is from 30 MHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

5.7.4 Test Result

Please refer to ANNEX A.6.

5.8 Band Edge (Restricted-band band-edge)

5.8.1 Limit

FCC §15.209&15.247(d)

Radiated emission outside the frequency band attenuation below the general limits specified in FCC section 15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in FCC section 15.205(a), must also comply with the radiated emission limits specified in FCC section 15.209(a).

5.8.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.8.3 Test Procedure

The measurement frequency range is from 9 kHz to the 10th harmonic of the fundamental frequency. The Turn Table is actuated to turn from 0° to 360°, and both horizontal and vertical polarizations of the Test Antenna are used to find the maximum radiated power. Mid channels on all channel bandwidth verified. Only the worst RB size/offset presented.

The power of the EUT transmitting frequency should be ignored.

All Spurious Emission tests were performed in X, Y, Z axis direction. And only the worst axis test condition was recorded in this test report.

Use the following spectrum analyzer settings:

Span = wide enough to fully capture the emission being measured

RBW = 1 MHz for $f \geq 1$ GHz, 100 kHz for $f < 1$ GHz

VBW \geq RBW

Sweep = auto

Detector function = peak

Trace = max hold

For measurement below 1GHz, If the emission level of the EUT measured by the peak detector is 3 dB lower than the applicable limit, the peak emission level will be reported, Otherwise, the emission measurement will be repeated using the quasi-peak detector and reported.

For transmitters operating above 1 GHz repeat the measurement with an average detector.

5.8.4 Test Result

Please refer to ANNEX A.7.

5.9 Power Spectral density (PSD)

5.9.1 Limit

FCC §15.247(e)

The same method of determining the conducted output power shall be used to determine the power spectral density. If a peak output power is measured, then a peak power spectral density measurement is required. If an average output power is measured, then an average power spectral density measurement should be used.

5.9.2 Test Setup

See section 4.5.1 for test setup description for the antenna port. The photo of test setup please refer to ANNEX B.

5.9.3 Test Procedure

Set analyzer center frequency to DTS channel center frequency.

Set the span to 1.5 times the DTS bandwidth.

Set the RBW to: $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.

Set the VBW $\geq 3 \text{ RBW}$.

Detector = peak.

Sweep time = auto couple.

Trace mode = max hold.

Allow trace to fully stabilize.

Use the peak marker function to determine the maximum amplitude level within the RBW.

If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.

5.9.4 Test Result

Please refer to ANNEX A.8.

ANNEX A TEST RESULT

A.1 Output Power

Note: All the configurations were pre tested, only the worst configuration has been reported in this report.

Duty Cycle

Test Mode	On Time (ms)	On+Off time (ms)	Duty Cycle
802.11b	0.663	0.676	98.08%
802.11g	1.974	1.992	99.10%
802.11n-20 MHz	5.424	5.444	99.63%
802.11ax-20 MHz	5.416	5.436	99.63%

MIMO-1

Peak Power Test Data

802.11b Mode:

Channel	Measured Output Peak Power		Limit		Verdict
	dBm	mW	dBm	mW	
CH1	18.54	71.45	30	1000	Pass
CH6	19.91	97.95			Pass
CH11	19.61	91.41			Pass

802.11g Mode:

Channel	Measured Output Peak Power		Limit		Verdict
	dBm	mW	dBm	mW	
CH1	20.12	102.80	30	1000	Pass
CH2	20.87	122.18			Pass
CH3	20.77	119.40			Pass
CH4	21.33	135.83			Pass
CH5	21.67	146.89			Pass
CH6	23.16	207.01			Pass
CH7	20.87	122.18			Pass
CH8	20.85	121.62			Pass
CH9	20.76	119.12			Pass
CH10	20.48	111.69			Pass
CH11	20.11	102.57			Pass

802.11n-20 MHz Mode:

Channel	Measured Output Peak Power		Limit		Verdict
	dBm	mW	dBm	mW	
CH1	20.69	117.22	30	1000	Pass
CH2	21.12	129.42			Pass
CH3	21.67	146.89			Pass
CH4	22.12	162.93			Pass
CH5	22.34	171.40			Pass
CH6	23.56	226.99			Pass
CH7	21.24	133.05			Pass
CH8	21.64	145.88			Pass
CH9	21.01	126.18			Pass
CH10	20.74	118.58			Pass
CH11	20.31	107.40			Pass

802.11ax-20 MHz(SU) Mode:

Channel	Measured Output Peak Power		Limit		Verdict
	dBm	mW	dBm	mW	
CH1	19.46	88.31	30	1000	Pass
CH6	19.24	83.95			Pass
CH11	19.43	87.70			Pass

Average Power Test Data

802.11b Mode:

Channel	Measured Output Average Power		Limit		Verdict
	dBm	mW	dBm	mW	
CH1	15.72	37.33	30	1000	Pass
CH6	16.83	48.19			Pass
CH11	16.85	48.42			Pass

802.11g Mode:

Channel	Measured Output Average Power		Limit		Verdict
	dBm	mW	dBm	mW	
CH1	12.51	17.82	30	1000	Pass
CH2	13.38	21.78			Pass
CH3	13.24	21.09			Pass
CH4	13.67	23.28			Pass
CH5	14.07	25.53			Pass
CH6	15.89	38.82			Pass
CH7	13.57	22.75			Pass
CH8	13.56	22.70			Pass
CH9	13.14	20.61			Pass
CH10	13.09	20.37			Pass
CH11	12.38	17.30			Pass

802.11n-20 MHz Mode:

Channel	Measured Output Average Power		Limit		Verdict
	dBm	mW	dBm	mW	
CH1	13.04	20.14	30	1000	Pass
CH2	14.98	31.48			Pass
CH3	15.33	34.12			Pass
CH4	15.86	38.55			Pass
CH5	15.88	38.73			Pass
CH6	16.92	49.20			Pass
CH7	14.97	31.41			Pass
CH8	12.04	16.00			Pass
CH9	14.87	30.69			Pass
CH10	13.01	20.00			Pass
CH11	11.35	13.65			Pass

802.11ax-20 MHz(SU) Mode:

Channel	Measured Output Average Power		Limit		Verdict
	dBm	mW	dBm	mW	
CH1	9.64	9.20	30	1000	Pass
CH6	10.02	10.05			Pass
CH11	9.46	8.83			Pass

MIMO-2Peak Power Test Data

802.11b Mode:

Channel	Measured Output Peak Power		Limit		Verdict
	dBm	mW	dBm	mW	
CH1	19.65	92.26	30	1000	Pass
CH6	21.01	126.18			Pass
CH11	20.16	103.75			Pass

802.11g Mode:

Channel	Measured Output Peak Power		Limit		Verdict
	dBm	mW	dBm	mW	
CH1	21.21	132.13	30	1000	Pass
CH2	21.11	129.12			Pass
CH3	21.24	133.05			Pass
CH4	21.31	135.21			Pass
CH5	21.45	139.64			Pass
CH6	22.21	166.34			Pass
CH7	21.09	128.53			Pass
CH8	21.04	127.06			Pass
CH9	23.98	250.03			Pass
CH10	21.12	129.42			Pass
CH11	21.24	133.05			Pass

802.11n-20 MHz Mode:

Channel	Measured Output Peak Power		Limit		Verdict
	dBm	mW	dBm	mW	
CH1	21.87	153.82	30	1000	Pass
CH2	21.16	130.62			Pass
CH3	22.23	167.11			Pass
CH4	22.45	175.79			Pass
CH5	22.31	170.22			Pass
CH6	24.54	284.45			Pass
CH7	22.34	171.40			Pass
CH8	22.74	187.93			Pass
CH9	21.31	135.21			Pass
CH10	21.05	127.35			Pass
CH11	20.34	108.14			Pass

802.11ax-20 MHz(SU) Mode:

Channel	Measured Output Peak Power		Limit		Verdict
	dBm	mW	dBm	mW	
CH1	19.75	94.41	30	1000	Pass
CH6	19.43	87.70			Pass
CH11	19.37	86.50			Pass

Average Power Test Data

802.11b Mode:

Channel	Measured Output Average Power		Limit		Verdict
	dBm	mW	dBm	mW	
CH1	16.42	43.85	30	1000	Pass
CH6	17.96	62.52			Pass
CH11	16.97	49.77			Pass

802.11g Mode:

Channel	Measured Output Average Power		Limit		Verdict
	dBm	mW	dBm	mW	
CH1	12.97	19.82	30	1000	Pass
CH2	14.08	25.59			Pass
CH3	14.02	25.23			Pass
CH4	14.05	25.41			Pass
CH5	13.52	22.49			Pass
CH6	15.96	39.45			Pass
CH7	13.04	20.14			Pass
CH8	13.54	22.59			Pass
CH9	13.96	24.89			Pass
CH10	14.03	25.29			Pass
CH11	12.56	18.03			Pass

802.11n-20 MHz Mode:

Channel	Measured Output Average Power		Limit		Verdict
	dBm	mW	dBm	mW	
CH1	13.97	24.95	30	1000	Pass
CH2	15.65	36.73			Pass
CH3	16.04	40.18			Pass
CH4	15.64	36.64			Pass
CH5	15.58	36.14			Pass
CH6	16.98	49.89			Pass
CH7	14.45	27.86			Pass
CH8	14.85	30.55			Pass
CH9	14.93	31.12			Pass
CH10	13.85	24.27			Pass
CH11	11.42	13.87			Pass

802.11ax-20 MHz(SU) Mode:

Channel	Measured Output Average Power		Limit		Verdict
	dBm	mW	dBm	mW	
CH1	9.98	9.95	30	1000	Pass
CH6	10.01	10.02			Pass
CH11	10.31	10.74			Pass

MIMOPeak Power Test Data

802.11b Mode:

Channel	Measured Output Peak Power		Limit		Verdict
	dBm	mW	dBm	mW	
CH1	22.14	163.71	30	1000	Pass
CH6	23.51	224.13			Pass
CH11	22.90	195.16			Pass

802.11g Mode:

Channel	Measured Output Peak Power		Limit		Verdict
	dBm	mW	dBm	mW	
CH1	23.71	234.93	30	1000	Pass
CH2	24.00	251.30			Pass
CH3	24.02	252.44			Pass
CH4	24.33	271.04			Pass
CH5	24.57	286.53			Pass
CH6	25.72	373.36			Pass
CH7	23.99	250.71			Pass
CH8	23.96	248.68			Pass
CH9	25.67	369.16			Pass
CH10	23.82	241.11			Pass
CH11	23.72	235.61			Pass

802.11n-20 MHz Mode:

Channel	Measured Output Peak Power		Limit		Verdict
	dBm	mW	dBm	mW	
CH1	24.33	271.04	30	1000	Pass
CH2	24.15	260.04			Pass
CH3	24.97	314.00			Pass
CH4	25.30	338.72			Pass
CH5	25.34	341.61			Pass
CH6	27.09	511.43			Pass
CH7	24.84	304.44			Pass
CH8	25.24	333.81			Pass
CH9	24.17	261.39			Pass
CH10	23.91	245.93			Pass
CH11	23.34	215.54			Pass

802.11ax-20 MHz(SU) Mode:

Channel	Measured Output Peak Power		Limit		Verdict
	dBm	mW	dBm	mW	
CH1	22.62	182.71	30	1000	Pass
CH6	22.35	171.65			Pass
CH11	22.41	174.20			Pass

Average Power Test Data

802.11b Mode:

Channel	Measured Output Average Power		Limit		Verdict
	dBm	mW	dBm	mW	
CH1	19.09	81.18	30	1000	Pass
CH6	20.44	110.71			Pass
CH11	19.92	98.19			Pass

802.11g Mode:

Channel	Measured Output Average Power		Limit		Verdict
	dBm	mW	dBm	mW	
CH1	15.76	37.64	30	1000	Pass
CH2	16.75	47.36			Pass
CH3	16.66	46.32			Pass
CH4	16.87	48.69			Pass
CH5	16.81	48.02			Pass
CH6	18.94	78.26			Pass
CH7	16.32	42.89			Pass
CH8	16.56	45.29			Pass
CH9	16.58	45.49			Pass
CH10	16.60	45.66			Pass
CH11	15.48	35.33			Pass

802.11n-20 MHz Mode:

Channel	Measured Output Average Power		Limit		Verdict
	dBm	mW	dBm	mW	
CH1	16.54	45.08	30	1000	Pass
CH2	18.34	68.21			Pass
CH3	18.71	74.30			Pass
CH4	18.76	75.19			Pass
CH5	18.74	74.87			Pass
CH6	19.96	99.09			Pass
CH7	17.73	59.27			Pass
CH8	16.68	46.54			Pass
CH9	17.91	61.81			Pass
CH10	16.46	44.26			Pass
CH11	14.40	27.51			Pass

802.11ax-20 MHz(SU) Mode:

Channel	Measured Output Average Power		Limit		Verdict
	dBm	mW	dBm	mW	
CH1	12.82	19.16	30	1000	Pass
CH6	13.03	20.07			Pass
CH11	12.92	19.57			Pass

A.2 Occupied Bandwidth

Note: The Occupied Bandwidth please refer to the Report No. FR262007-01A, which issued by Sporton International Inc. (Kunshan) on Sep. 09, 2022, Section **Appendix A. Conducted Test Results**.

A.3 Conducted Spurious Emissions

Note: The Conducted Spurious Emissions please refer to the Report No. FR262007-01A, which issued by Sporton International Inc. (Kunshan) on Sep. 09, 2022, Section **Appendix A. Conducted Test Results**.

A.4 Band Edge (Authorized-band band-edge)

Note: The Band Edge (Authorized-band band-edge) please refer to the Report No. FR262007-01A, which issued by Sporton International Inc. (Kunshan) on Sep. 09, 2022, Section **Appendix A. Conducted Test Results**.

A.5 Conducted Emissions

Note: The Conducted Emissions please refer to the Report No. FR262007-01A, which issued by Sporton International Inc. (Kunshan) on Sep. 09, 2022, Section **Appendix A. Conducted Test Results**.

A.6 Radiated Emission

Note ¹: The symbol of "--" in the table which means not application.

Note ²: For the test data above 1 GHz, According the ANSI C63.10-2013, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

Note ³: The low frequency, which started from 9 kHz to 30 MHz, was pre-scanned and the result which was 20 dB lower than the limit line per 15.31(o) was not reported.

Note ⁴: The below 1 GHz please refer to the Report No. FR262007-01A, which issued by Sporton International Inc. (Kunshan) on Sep. 09, 2022, Section **Appendix A. Radiated Emission**

Test Data and Plots

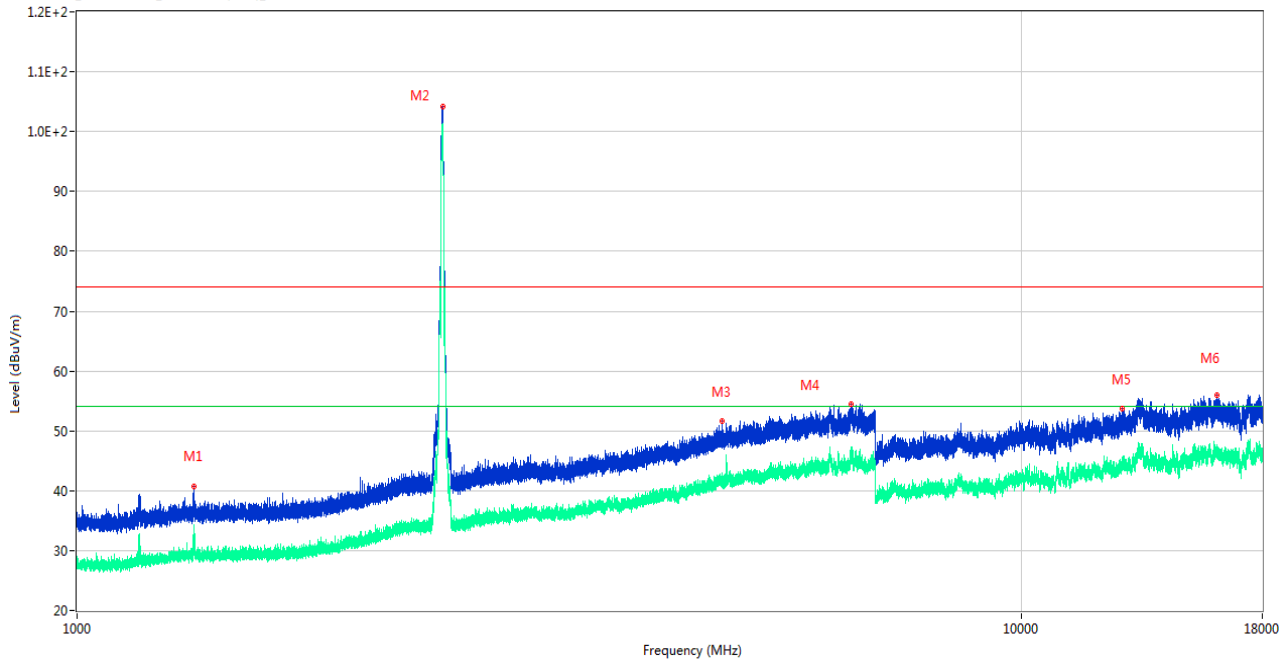
Note 1: The marked spikes near 2400 MHz with circle should be ignored because they are Fundamental signal.

Note 2: The spurious above 18G is noise only, do not show on the report.

MIMO

1 GHz to 18 GHz, ANT H 802.11b Middle Channel

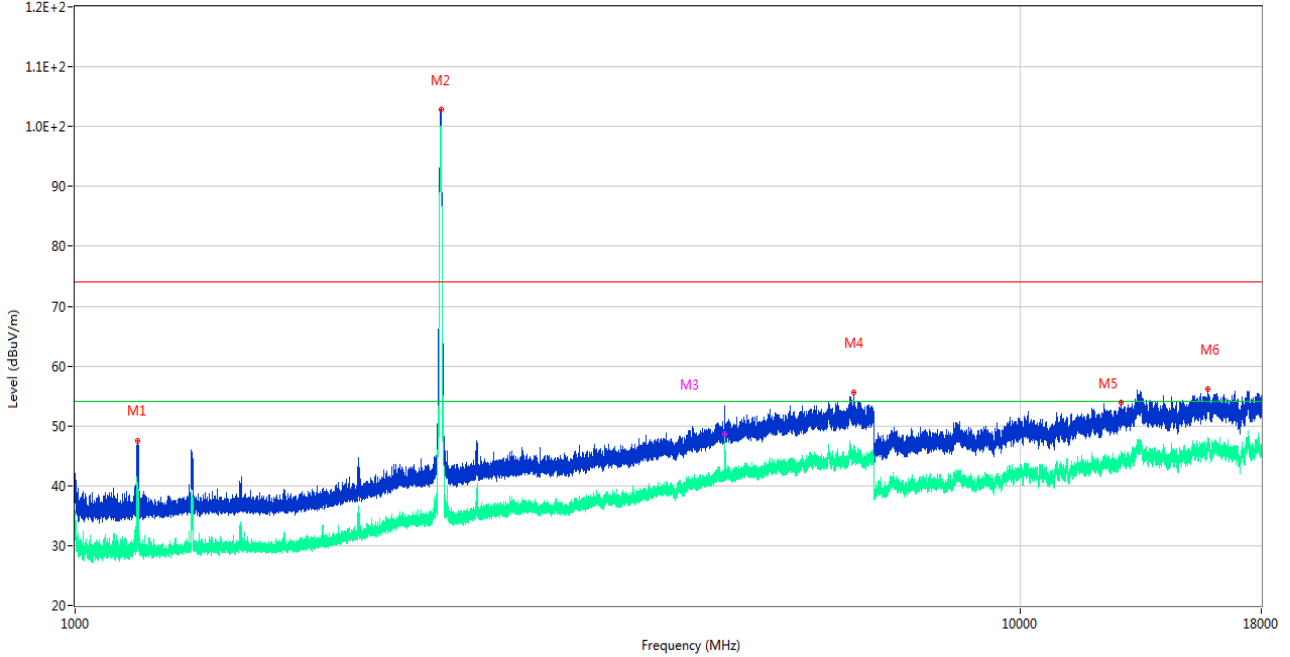
RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1330.000	40.80	-17.53	74.0	33.20	Peak	123.00	200	Horizontal	Pass
1**	1330.000	29.33	-17.53	54.0	24.67	AV	123.00	200	Horizontal	Pass
2	2438.100	104.26	-12.45	74.0	-30.26	Peak	83.00	150	Horizontal	N/A
2**	2438.100	101.24	-12.45	54.0	-47.24	AV	83.00	150	Horizontal	N/A
3	4821.000	51.55	-3.31	74.0	22.45	Peak	283.00	150	Horizontal	Pass
3**	4821.000	41.59	-3.31	54.0	12.41	AV	283.00	150	Horizontal	Pass
4	6610.800	54.50	1.48	74.0	19.50	Peak	294.00	100	Horizontal	Pass
4**	6610.800	46.23	1.48	54.0	7.77	AV	294.00	100	Horizontal	Pass
5	12804.076	53.68	0.96	74.0	20.32	Peak	332.00	200	Horizontal	Pass
5**	12804.076	44.02	0.96	54.0	9.98	AV	332.00	200	Horizontal	Pass
6	16096.088	56.04	1.30	74.0	17.96	Peak	351.00	300	Horizontal	Pass
6**	16096.088	45.87	1.30	54.0	8.13	AV	351.00	300	Horizontal	Pass

1 GHz to 18 GH, ANT V 802.11b Middle Channel

RE Test case_FCC Part 15C_FCC 15.247(2.4G)_1GHz-18GHz



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	1163.900	47.53	-17.97	74.0	26.47	Peak	68.00	300	Vertical	Pass
1**	1163.900	35.37	-17.97	54.0	18.63	AV	68.00	300	Vertical	Pass
2	2438.100	102.81	-12.45	74.0	-28.81	Peak	43.00	200	Vertical	N/A
2**	2438.100	99.97	-12.45	54.0	-45.97	AV	43.00	200	Vertical	N/A
3	4874.000	51.83	-3.29	74.0	22.17	Peak	146.00	150	Vertical	Pass
3**	4874.000	48.71	-3.29	54.0	5.29	AV	146.00	150	Vertical	Pass
4	6673.000	55.59	0.18	74.0	18.41	Peak	263.00	200	Vertical	Pass
4**	6673.000	45.45	0.18	54.0	8.55	AV	263.00	200	Vertical	Pass
5	12800.925	53.83	1.06	74.0	20.17	Peak	71.00	400	Vertical	Pass
5**	12800.925	43.76	1.06	54.0	10.24	AV	71.00	400	Vertical	Pass
6	15796.575	56.08	2.22	74.0	17.92	Peak	90.00	200	Vertical	Pass
6**	15796.575	46.89	2.22	54.0	7.11	AV	90.00	200	Vertical	Pass

A.7 Band Edge (Restricted-band band-edge)

Note ¹: The lowest and highest channels are tested to verify the band edge emissions. Please refer to the following the plots for emissions values.

Note ²: The test data all are tested in the vertical and horizontal antenna which the trace is max hold. So these plots have shown the worst case.

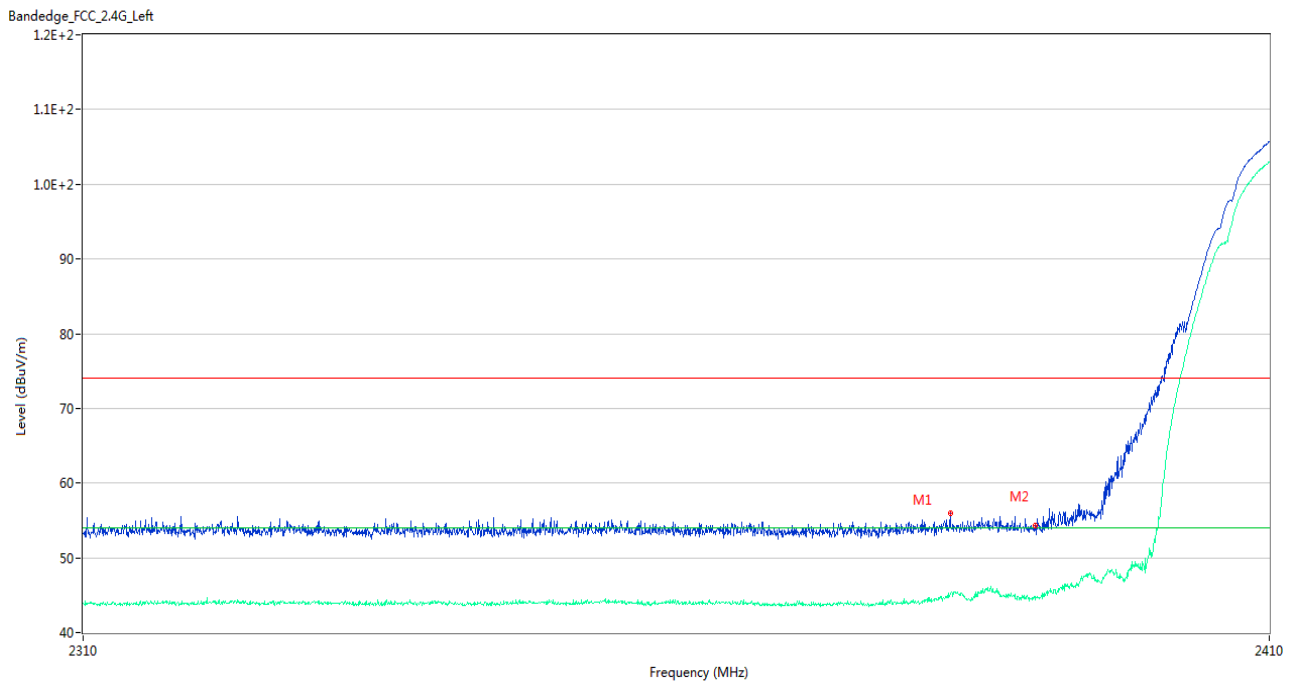
Note ³: According the ANSI C63.10-2013, where limits are specified for both average and peak (or quasi-peak) detector functions, if the peak (or quasi-peak) measured value complies with the average limit, it is unnecessary to perform an average measurement.

Note ⁴: All the configurations were pre tested, only the worst configuration has been reported in this report.

Test Data and Plots

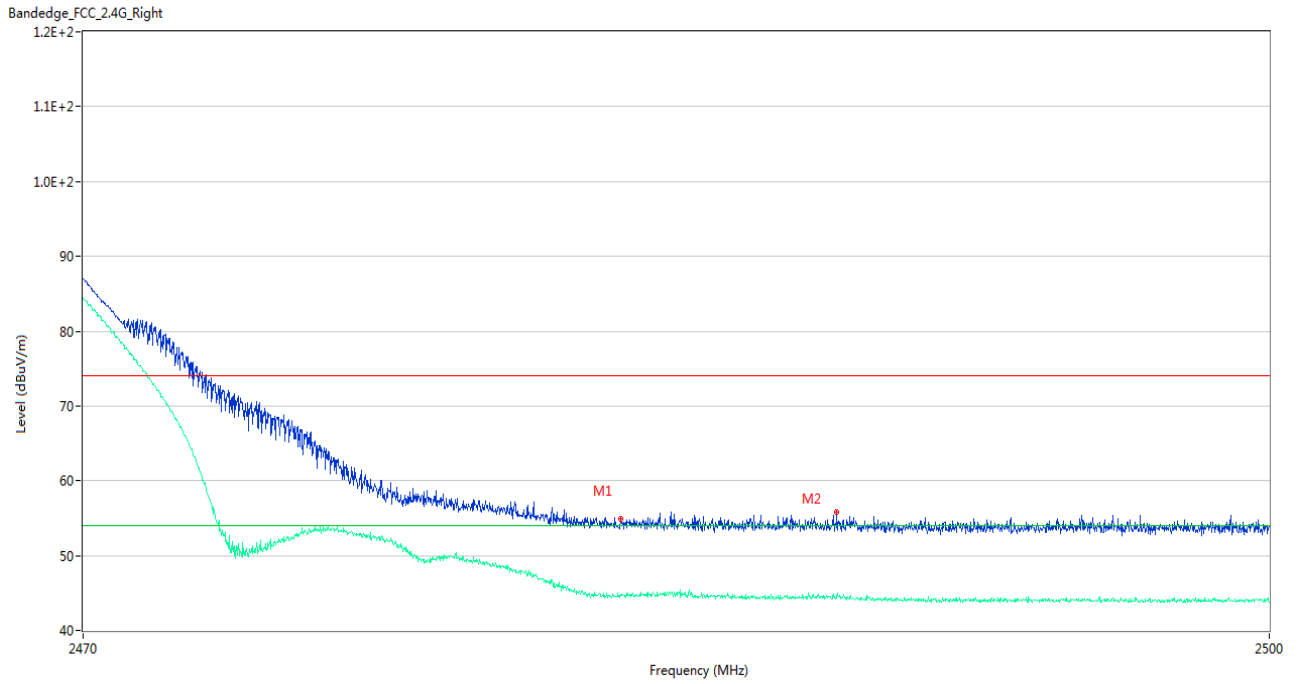
MIMO

802.11b CHANNEL 1



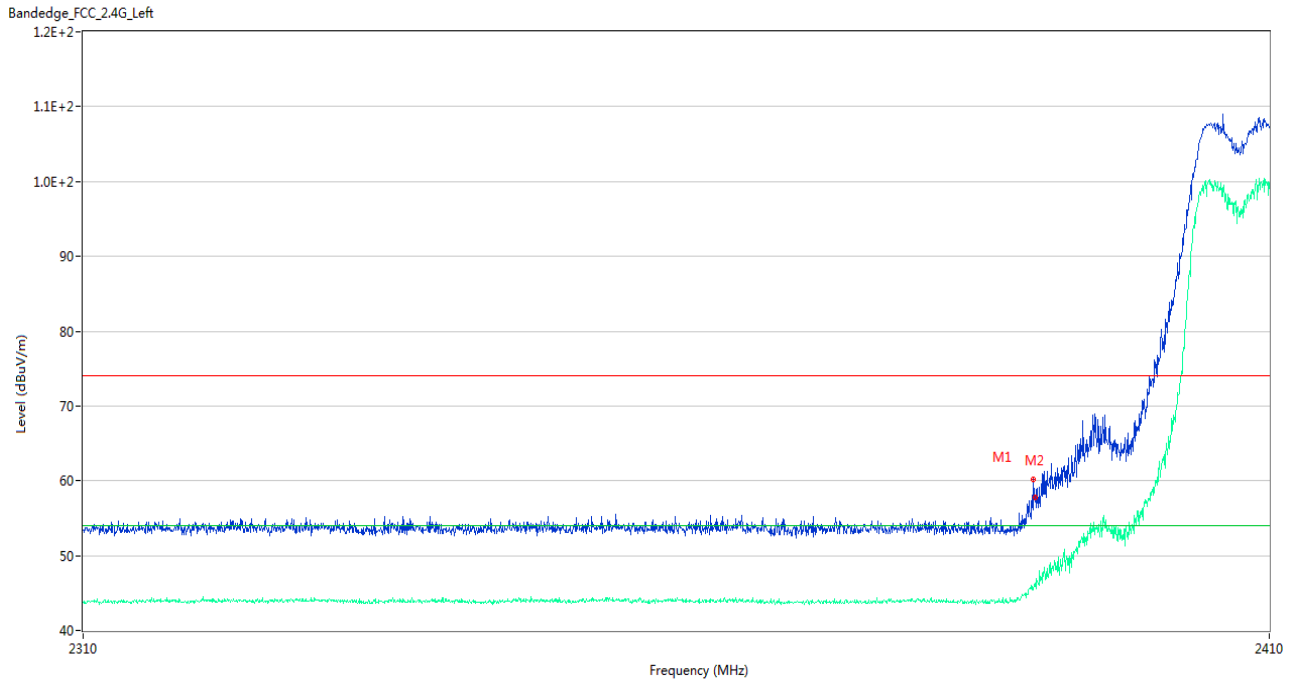
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2382.700	55.93	-0.64	74.0	18.07	Peak	93.00	150	Horizontal	Pass
1**	2382.700	45.20	-0.64	54.0	8.80	AV	93.00	150	Horizontal	Pass
2	2389.950	54.27	-0.59	74.0	19.73	Peak	300.00	150	Horizontal	Pass
2**	2389.950	44.84	-0.59	54.0	9.16	AV	300.00	150	Horizontal	Pass

802.11b CHANNEL 11



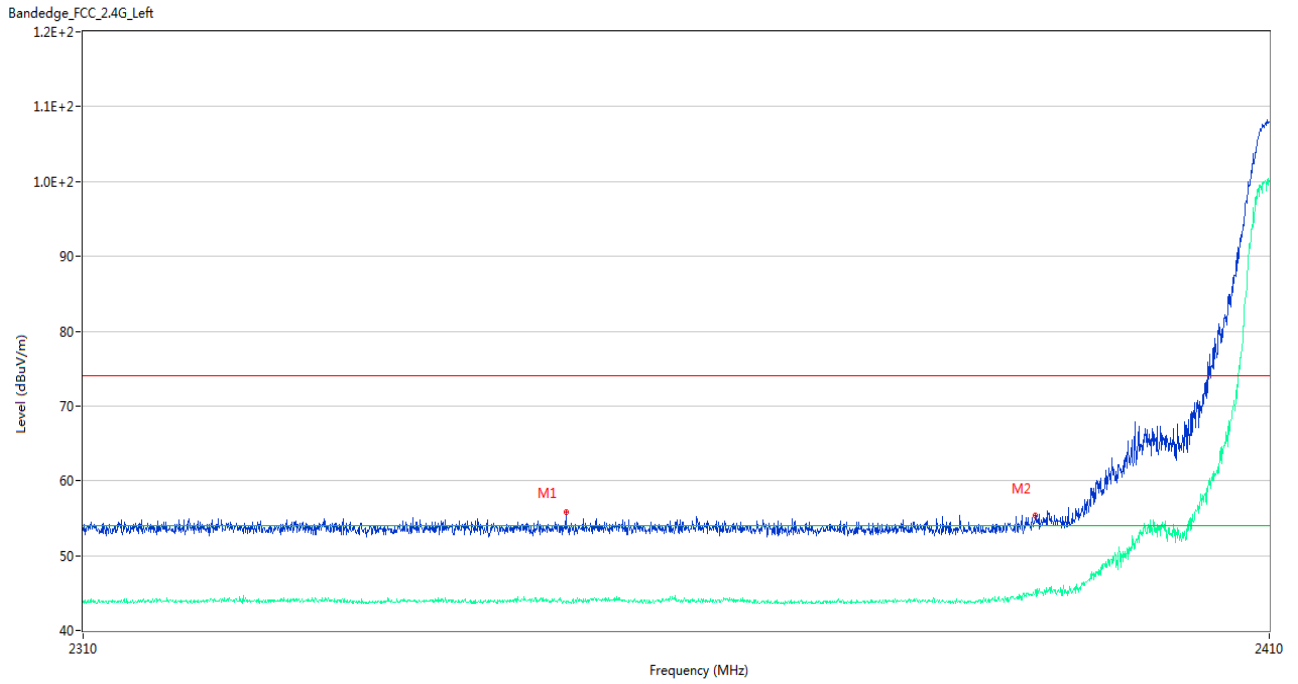
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2483.560	54.88	-0.06	74.0	19.12	Peak	64.00	100	Horizontal	Pass
1**	2483.560	44.70	-0.06	54.0	9.30	AV	64.00	100	Horizontal	Pass
2	2489.020	55.84	-0.10	74.0	18.16	Peak	232.00	200	Horizontal	Pass
2**	2489.020	44.39	-0.10	54.0	9.61	AV	232.00	200	Horizontal	Pass

802.11g CHANNEL 1



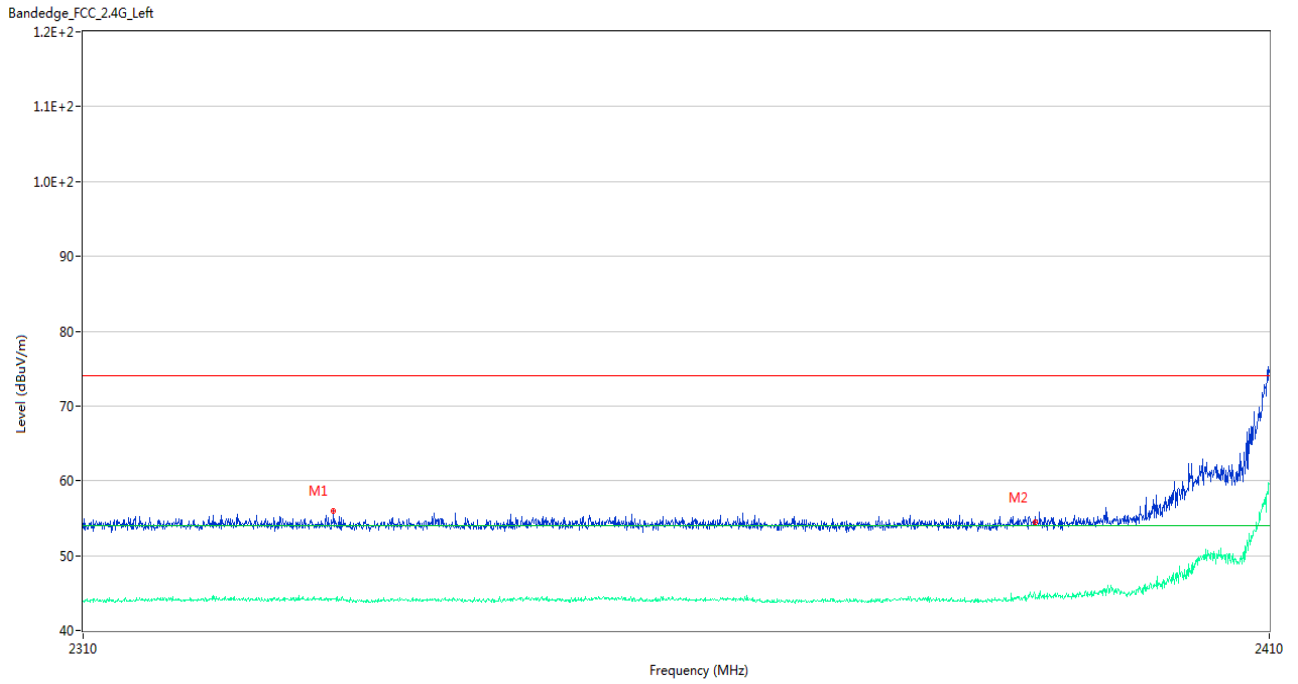
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2389.800	60.16	-0.60	74.0	13.84	Peak	256.00	150	Horizontal	Pass
1**	2389.800	45.35	-0.60	54.0	8.65	AV	256.00	150	Horizontal	Pass
2	2389.950	57.76	-0.59	74.0	16.24	Peak	5.00	200	Horizontal	Pass
2**	2389.950	46.34	-0.59	54.0	7.66	AV	5.00	200	Horizontal	Pass

802.11g CHANNEL 2



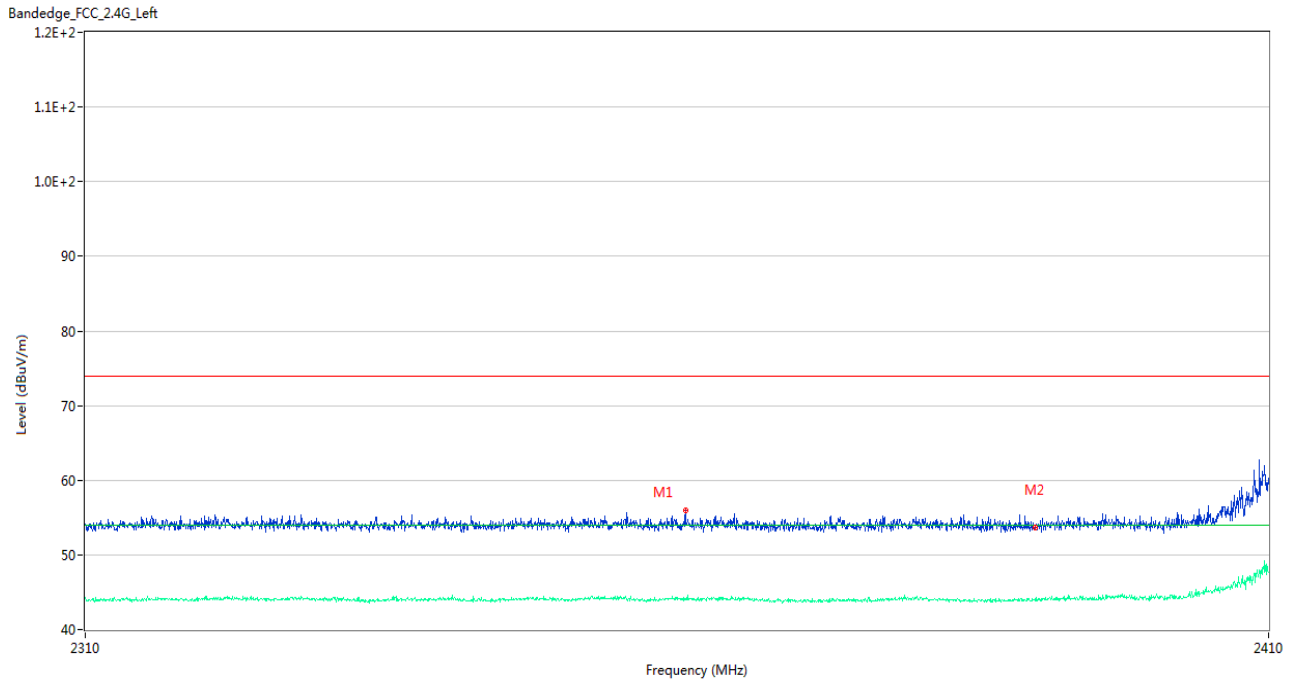
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2350.200	55.77	-0.54	74.0	18.23	Peak	163.00	150	Horizontal	Pass
1**	2350.200	43.90	-0.54	54.0	10.10	AV	163.00	150	Horizontal	Pass
2	2389.950	55.43	-0.59	74.0	18.57	Peak	285.00	150	Horizontal	Pass
2**	2389.950	45.45	-0.59	54.0	8.55	AV	285.00	150	Horizontal	Pass

802.11g CHANNEL 3



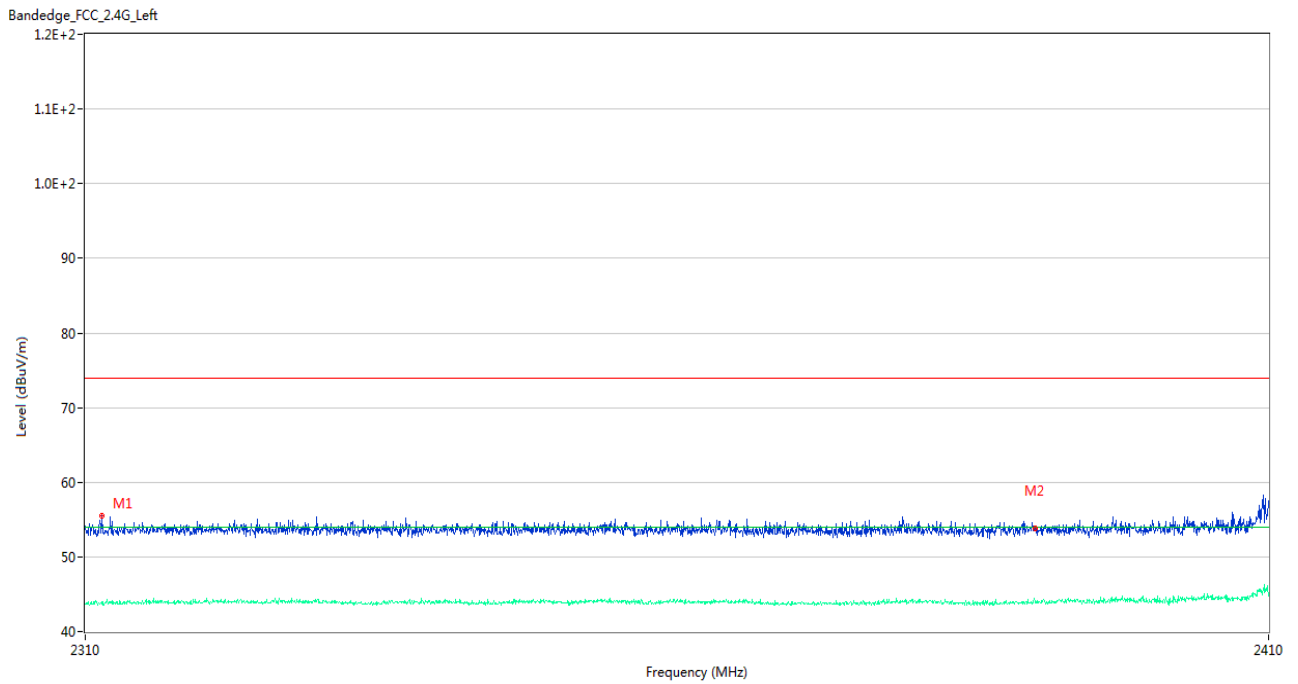
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2330.750	56.01	-0.67	74.0	17.99	Peak	0.00	200	Horizontal	Pass
1**	2330.750	44.18	-0.67	54.0	9.82	AV	0.00	200	Horizontal	Pass
2	2389.950	54.43	-0.59	74.0	19.57	Peak	0.00	100	Horizontal	Pass
2**	2389.950	44.27	-0.59	54.0	9.73	AV	0.00	100	Horizontal	Pass

802.11g CHANNEL 4



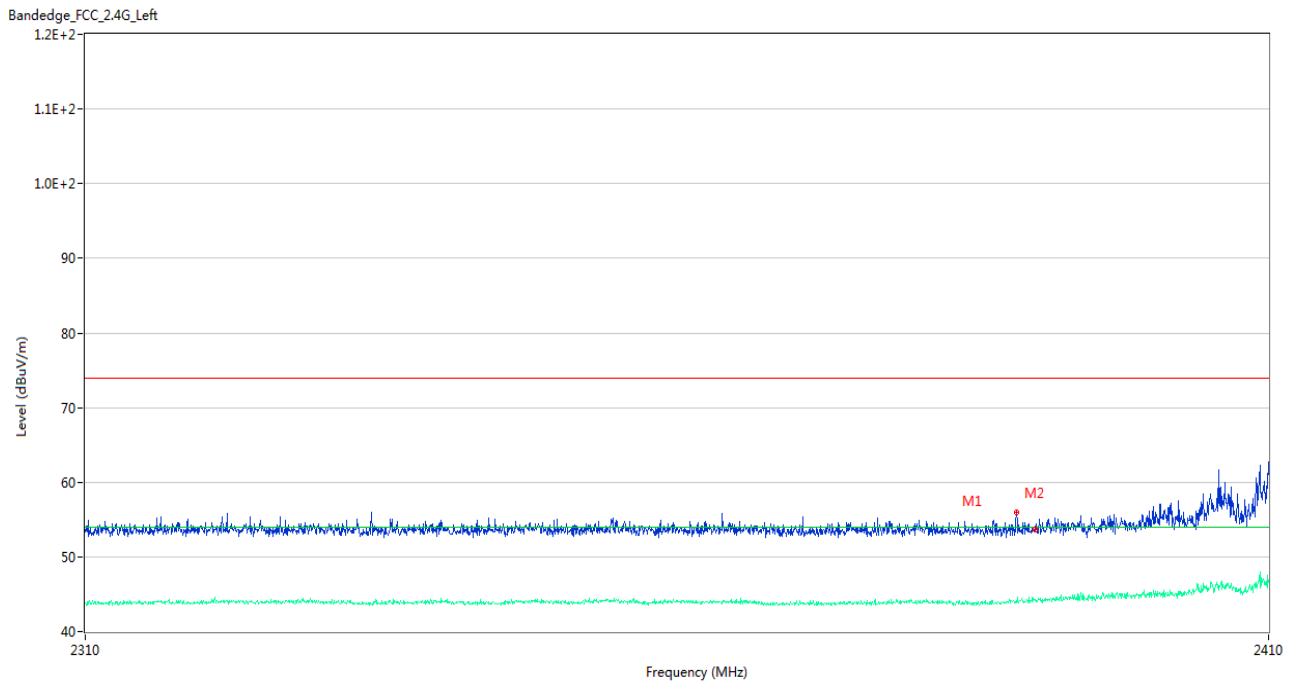
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2360.200	55.94	-0.27	74.0	18.06	Peak	358.00	200	Horizontal	Pass
1**	2360.200	44.15	-0.27	54.0	9.85	AV	358.00	200	Horizontal	Pass
2	2389.950	53.68	-0.59	74.0	20.32	Peak	79.00	200	Horizontal	Pass
2**	2389.950	43.98	-0.59	54.0	10.02	AV	79.00	200	Horizontal	Pass

802.11g CHANNEL 5



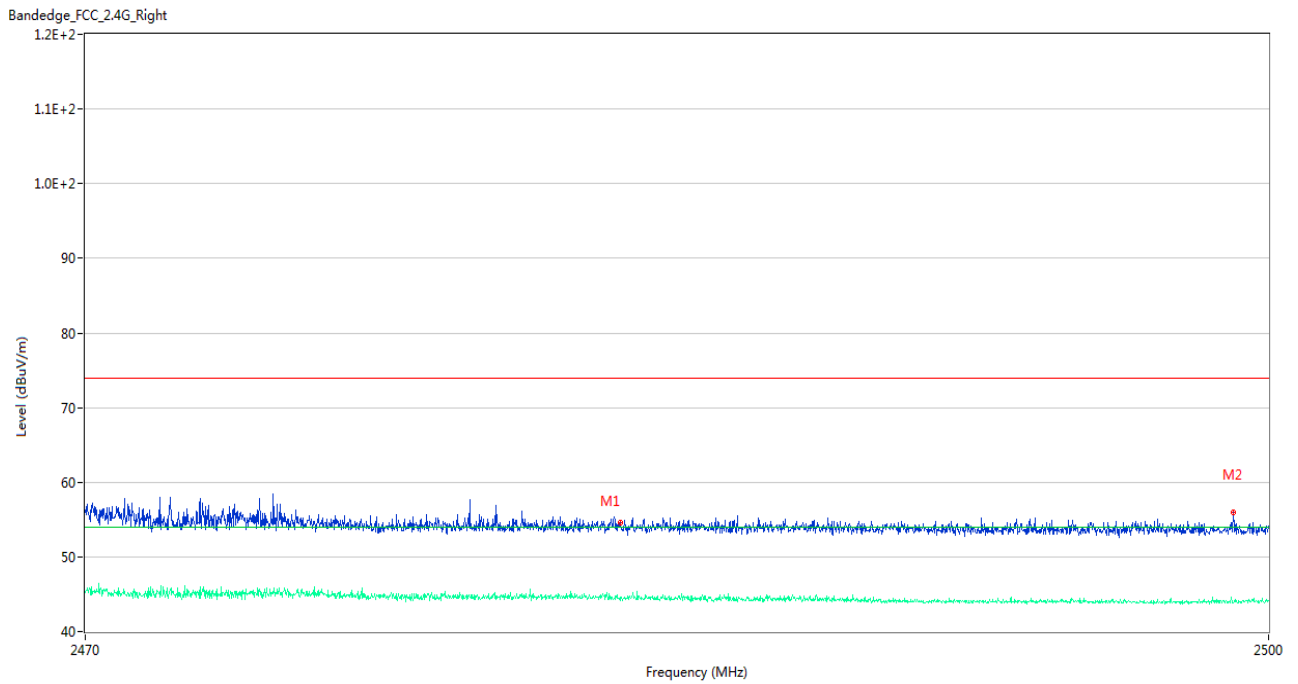
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2311.400	55.47	-0.98	74.0	18.53	Peak	285.00	150	Horizontal	Pass
1**	2311.400	43.94	-0.98	54.0	10.06	AV	285.00	150	Horizontal	Pass
2	2389.950	53.89	-0.59	74.0	20.11	Peak	183.00	100	Horizontal	Pass
2**	2389.950	43.91	-0.59	54.0	10.09	AV	183.00	100	Horizontal	Pass

802.11g CHANNEL 6



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2388.350	55.96	-0.64	74.0	18.04	Peak	247.00	200	Horizontal	Pass
1**	2388.350	43.83	-0.64	54.0	10.17	AV	247.00	200	Horizontal	Pass
2	2389.950	53.61	-0.59	74.0	20.39	Peak	96.00	100	Horizontal	Pass
2**	2389.950	44.25	-0.59	54.0	9.75	AV	96.00	100	Horizontal	Pass

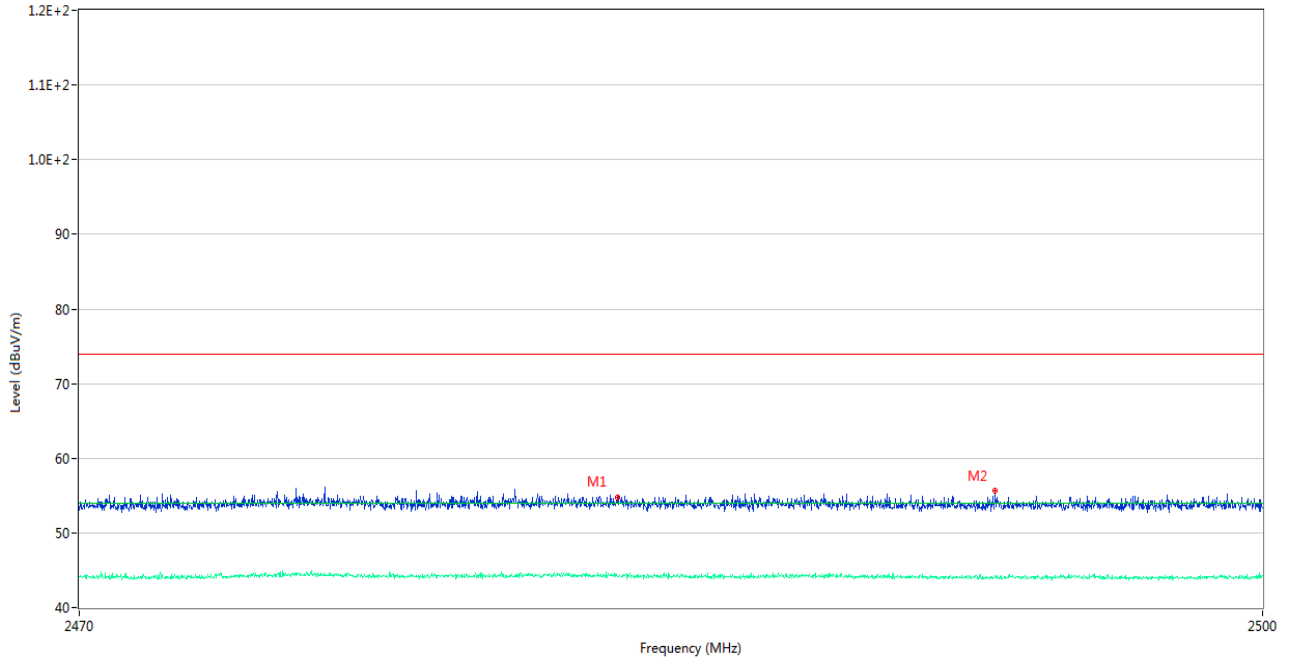
802.11g CHANNEL 6



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2483.530	54.55	-0.05	74.0	19.45	Peak	201.00	150	Horizontal	Pass
1**	2483.530	44.54	-0.05	54.0	9.46	AV	201.00	150	Horizontal	Pass
2	2499.100	56.02	-0.17	74.0	17.98	Peak	85.00	150	Horizontal	Pass
2**	2499.100	43.87	-0.17	54.0	10.13	AV	85.00	150	Horizontal	Pass

802.11g CHANNEL 7

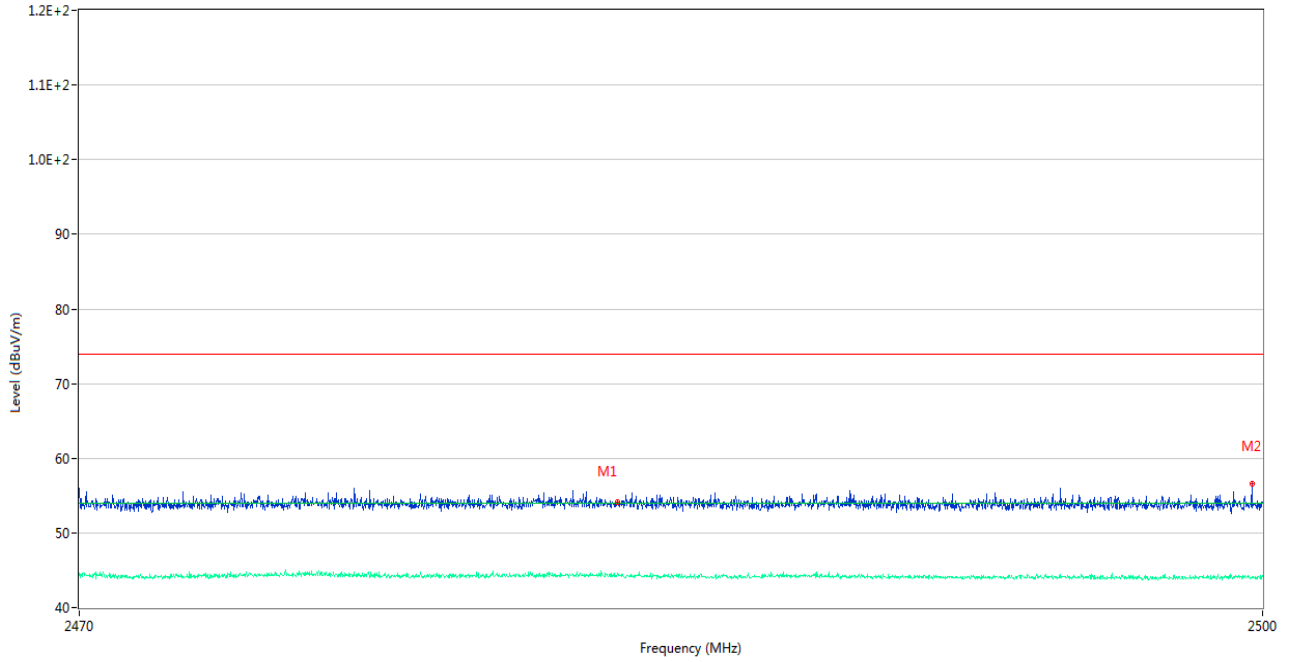
Bandedge_FCC_2.4G_Right



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2483.590	54.69	-0.06	74.0	19.31	Peak	160.00	200	Horizontal	Pass
1**	2483.590	44.16	-0.06	54.0	9.84	AV	160.00	200	Horizontal	Pass
2	2493.190	55.67	-0.23	74.0	18.33	Peak	155.00	150	Horizontal	Pass
2**	2493.190	44.24	-0.23	54.0	9.76	AV	155.00	150	Horizontal	Pass

802.11g CHANNEL 8

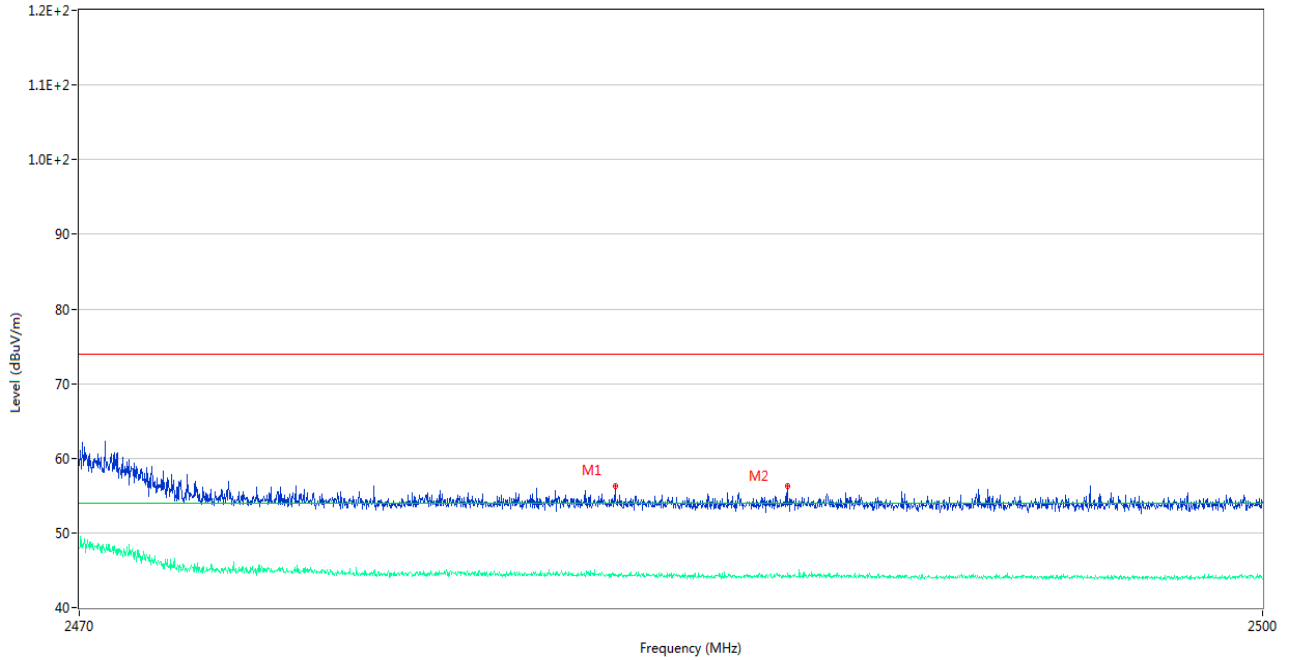
Bandedge_FCC_2.4G_Right



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2483.590	54.12	-0.06	74.0	19.88	Peak	174.00	200	Horizontal	Pass
1**	2483.590	44.41	-0.06	54.0	9.59	AV	174.00	200	Horizontal	Pass
2	2499.730	56.59	-0.12	74.0	17.41	Peak	182.00	150	Horizontal	Pass
2**	2499.730	43.97	-0.12	54.0	10.03	AV	182.00	150	Horizontal	Pass

802.11g CHANNEL 9

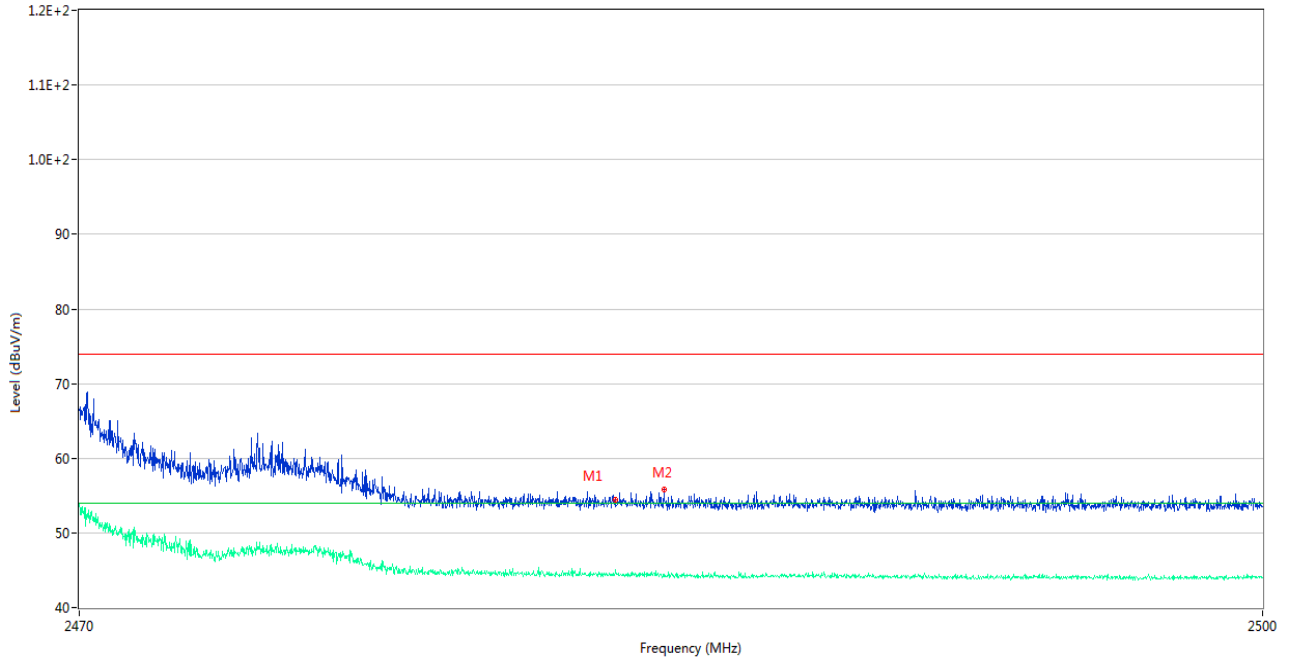
Bandedge_FCC_2.4G_Right



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2483.545	56.32	-0.06	74.0	17.68	Peak	130.00	100	Horizontal	Pass
1**	2483.545	44.39	-0.06	54.0	9.61	AV	130.00	100	Horizontal	Pass
2	2487.910	56.31	-0.11	74.0	17.69	Peak	82.00	200	Horizontal	Pass
2**	2487.910	44.20	-0.11	54.0	9.80	AV	82.00	200	Horizontal	Pass

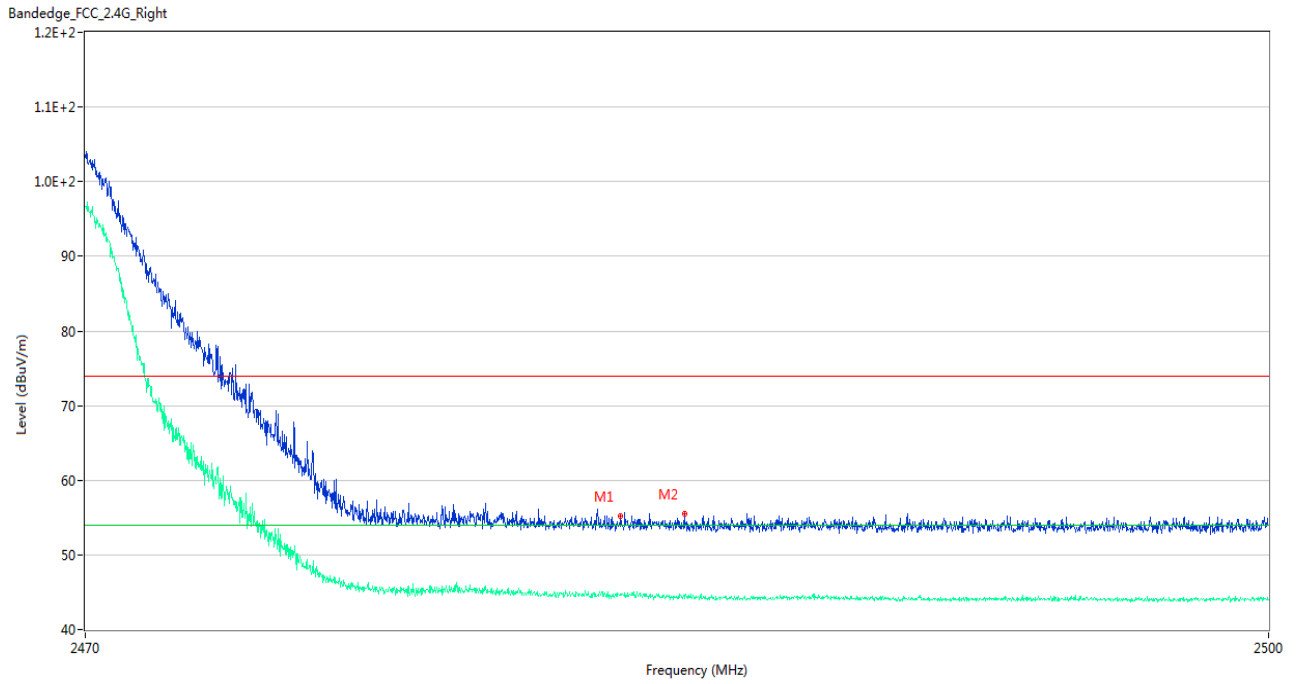
802.11g CHANNEL 10

Bandedge_FCC_2.4G_Right



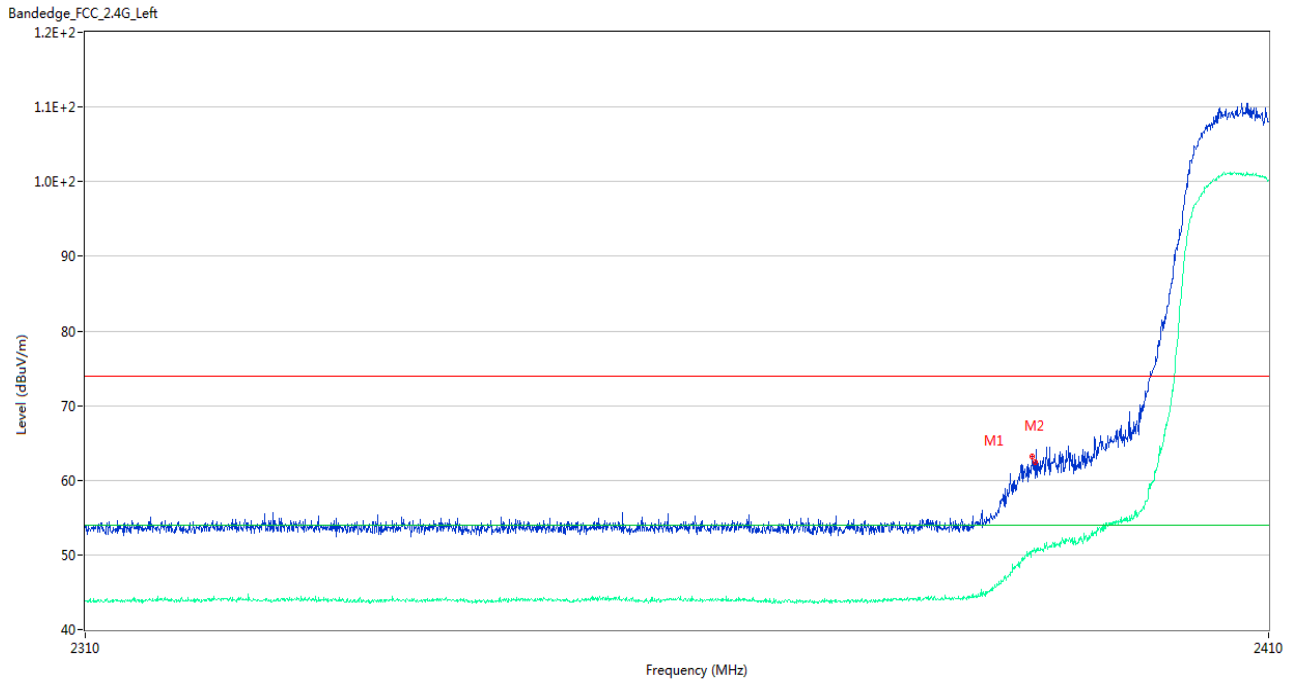
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2483.545	54.50	-0.06	74.0	19.50	Peak	0.00	150	Horizontal	Pass
1**	2483.545	44.60	-0.06	54.0	9.40	AV	0.00	150	Horizontal	Pass
2	2484.775	55.86	-0.15	74.0	18.14	Peak	197.00	100	Horizontal	Pass
2**	2484.775	44.47	-0.15	54.0	9.53	AV	197.00	100	Horizontal	Pass

802.11g CHANNEL 11



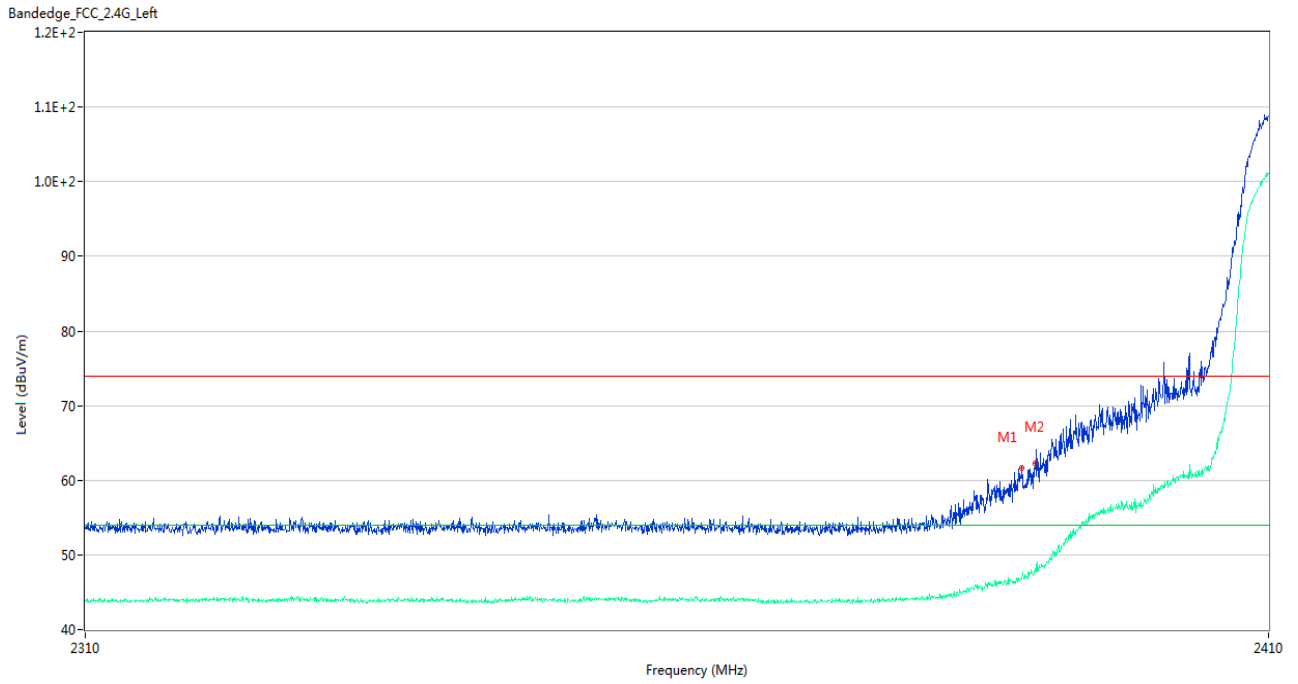
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2483.530	55.16	-0.05	74.0	18.84	Peak	4.00	200	Horizontal	Pass
1**	2483.530	44.62	-0.05	54.0	9.38	AV	4.00	200	Horizontal	Pass
2	2485.150	55.56	-0.16	74.0	18.44	Peak	18.00	100	Horizontal	Pass
2**	2485.150	44.12	-0.16	54.0	9.88	AV	18.00	100	Horizontal	Pass

802.11n20 CHANNEL 1



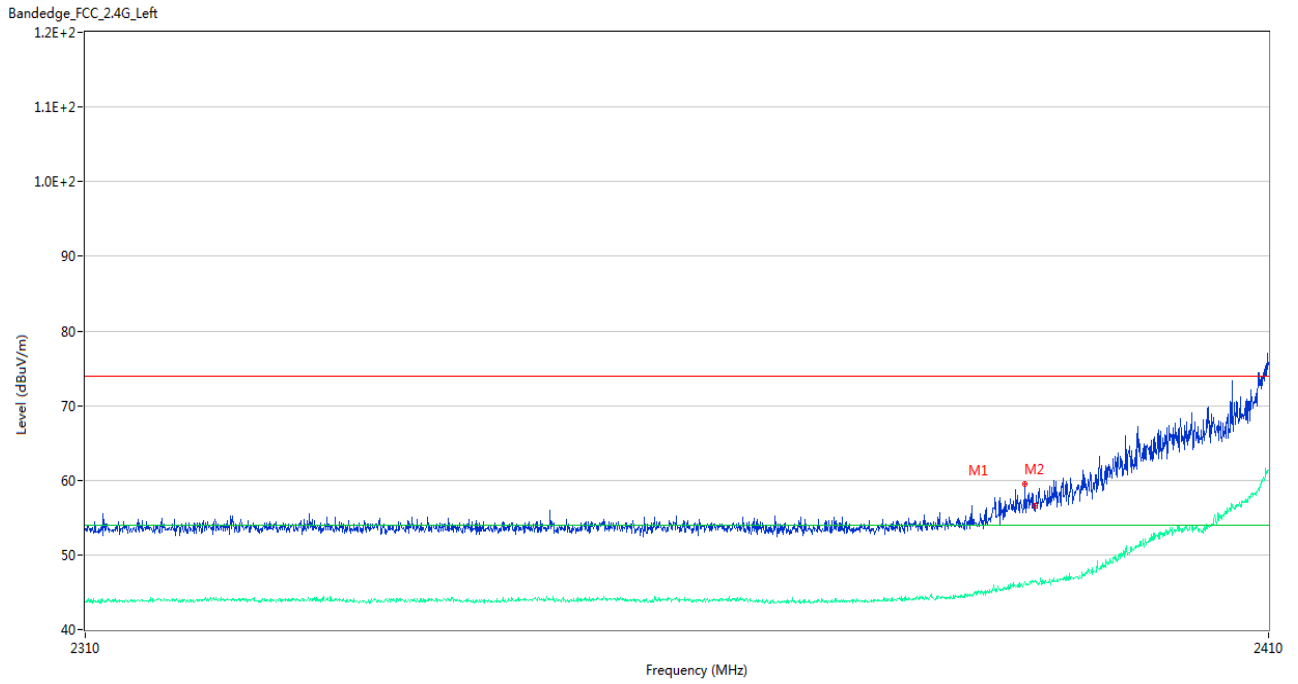
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2389.650	63.25	-0.60	74.0	10.75	Peak	315.00	200	Horizontal	Pass
1**	2389.650	50.47	-0.60	54.0	3.53	AV	315.00	200	Horizontal	Pass
2	2389.950	62.40	-0.59	74.0	11.60	Peak	256.00	100	Horizontal	Pass
2**	2389.950	50.61	-0.59	54.0	3.39	AV	256.00	100	Horizontal	Pass

802.11n20 CHANNEL 2



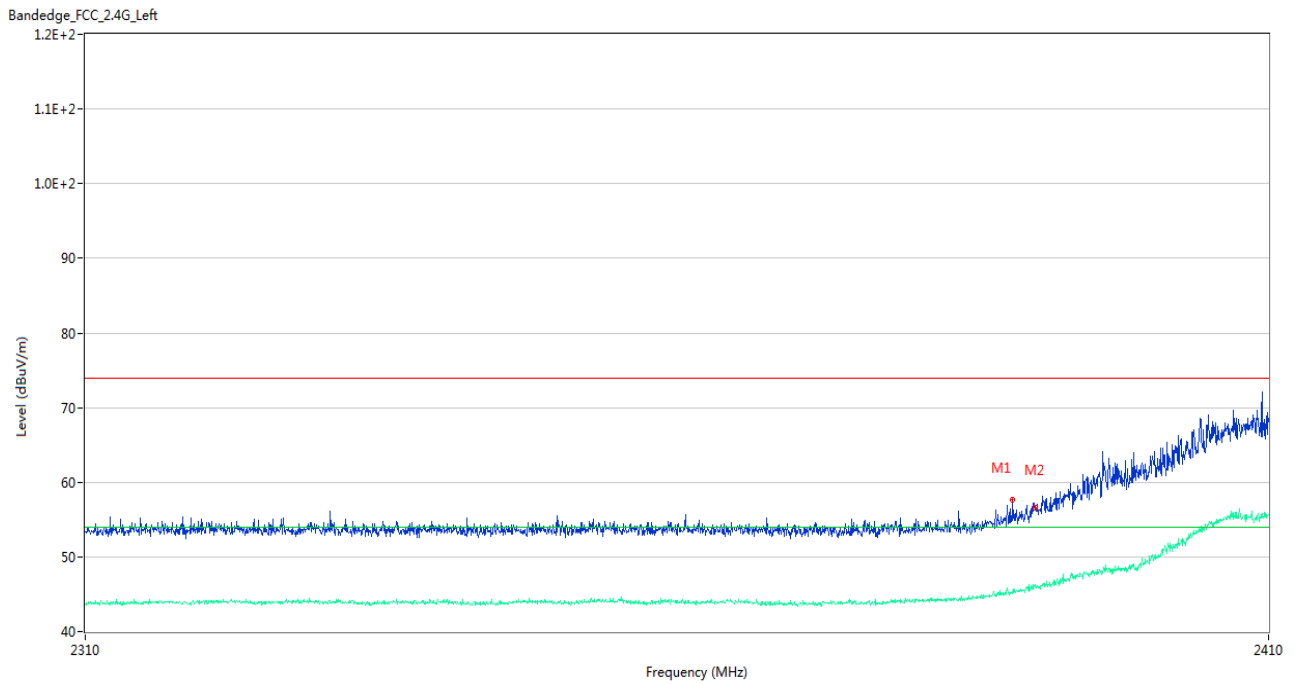
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2388.800	61.70	-0.63	74.0	12.30	Peak	70.00	100	Horizontal	Pass
1**	2388.800	46.72	-0.63	54.0	7.28	AV	70.00	100	Horizontal	Pass
2	2389.950	62.19	-0.59	74.0	11.81	Peak	74.00	100	Horizontal	Pass
2**	2389.950	47.97	-0.59	54.0	6.03	AV	74.00	100	Horizontal	Pass

802.11n20 CHANNEL 3



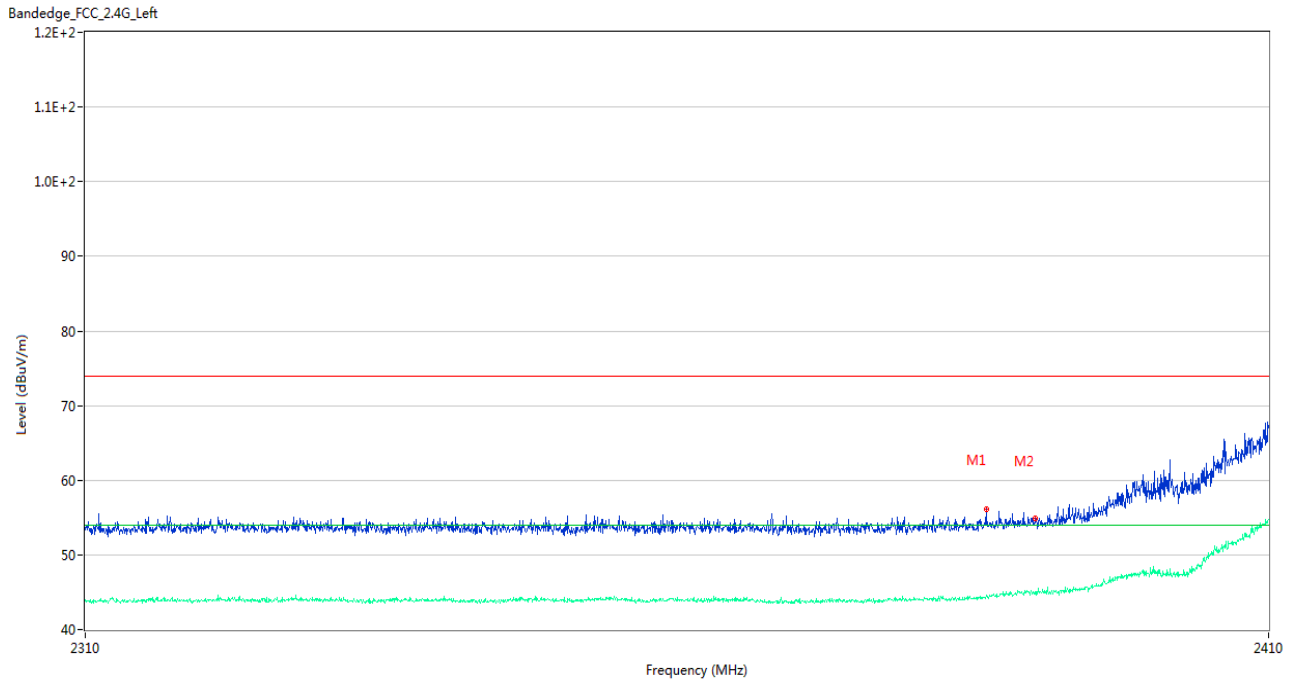
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2389.100	59.52	-0.62	74.0	14.48	Peak	249.00	200	Horizontal	Pass
1**	2389.100	46.42	-0.62	54.0	7.58	AV	249.00	200	Horizontal	Pass
2	2389.950	56.51	-0.59	74.0	17.49	Peak	305.00	100	Horizontal	Pass
2**	2389.950	46.43	-0.59	54.0	7.57	AV	305.00	100	Horizontal	Pass

802.11n20 CHANNEL 4



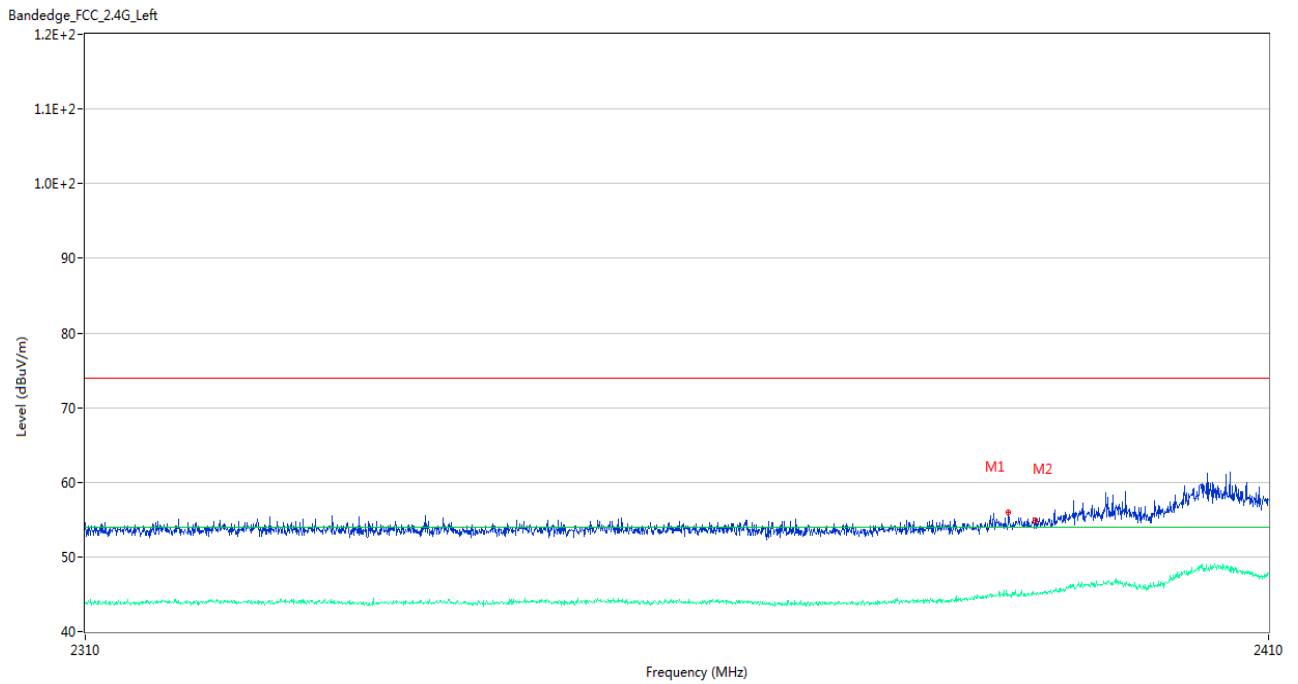
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2388.000	57.69	-0.66	74.0	16.31	Peak	310.00	200	Horizontal	Pass
1**	2388.000	45.12	-0.66	54.0	8.88	AV	310.00	200	Horizontal	Pass
2	2389.950	56.58	-0.59	74.0	17.42	Peak	72.00	100	Horizontal	Pass
2**	2389.950	46.26	-0.59	54.0	7.74	AV	72.00	100	Horizontal	Pass

802.11n20 CHANNEL 5



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2385.750	56.05	-0.72	74.0	17.95	Peak	79.00	150	Horizontal	Pass
1**	2385.750	44.55	-0.72	54.0	9.45	AV	79.00	150	Horizontal	Pass
2	2389.950	54.92	-0.59	74.0	19.08	Peak	275.00	150	Horizontal	Pass
2**	2389.950	44.88	-0.59	54.0	9.12	AV	275.00	150	Horizontal	Pass

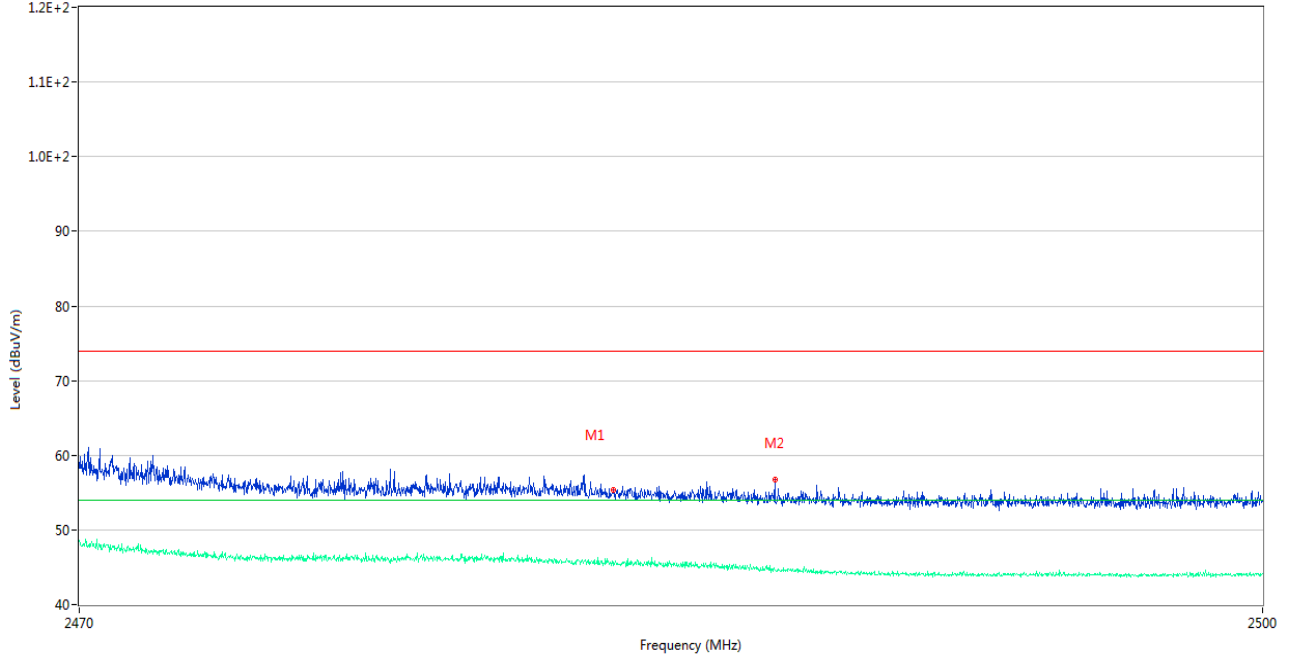
802.11n20 CHANNEL 6



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2387.650	55.96	-0.67	74.0	18.04	Peak	115.00	200	Horizontal	Pass
1**	2387.650	44.98	-0.67	54.0	9.02	AV	115.00	200	Horizontal	Pass
2	2389.950	54.95	-0.59	74.0	19.05	Peak	244.00	150	Horizontal	Pass
2**	2389.950	45.10	-0.59	54.0	8.90	AV	244.00	150	Horizontal	Pass

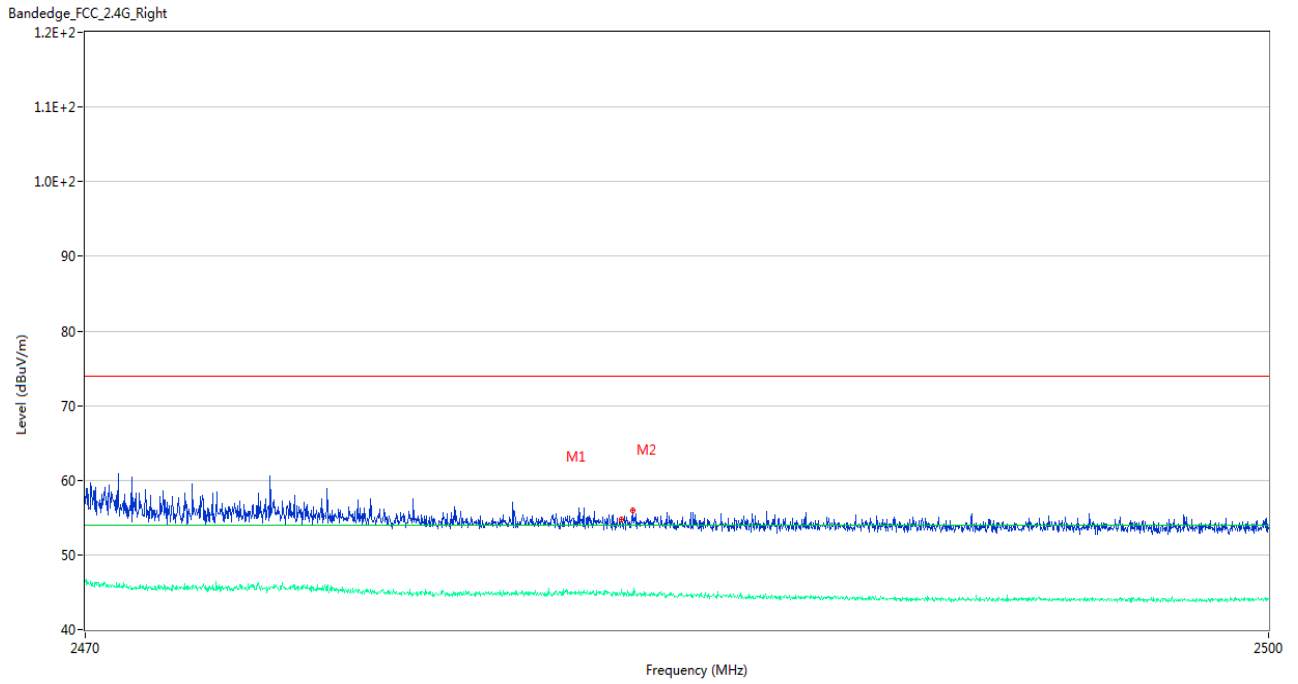
802.11n20 CHANNEL 6

Bandedge_FCC_2.4G_Right



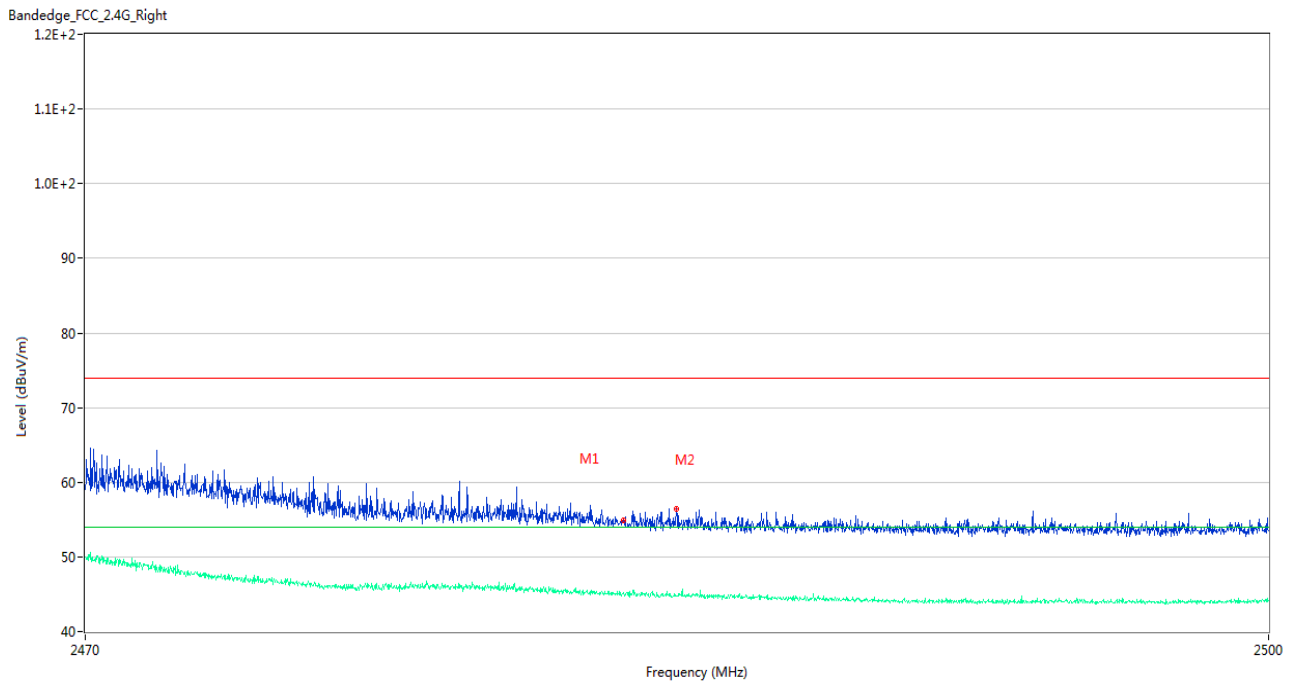
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2483.500	55.34	-0.05	74.0	18.66	Peak	81.00	150	Horizontal	Pass
1**	2483.500	45.70	-0.05	54.0	8.30	AV	81.00	150	Horizontal	Pass
2	2487.595	56.71	-0.14	74.0	17.29	Peak	188.00	100	Horizontal	Pass
2**	2487.595	44.58	-0.14	54.0	9.42	AV	188.00	100	Horizontal	Pass

802.11n20 CHANNEL 7



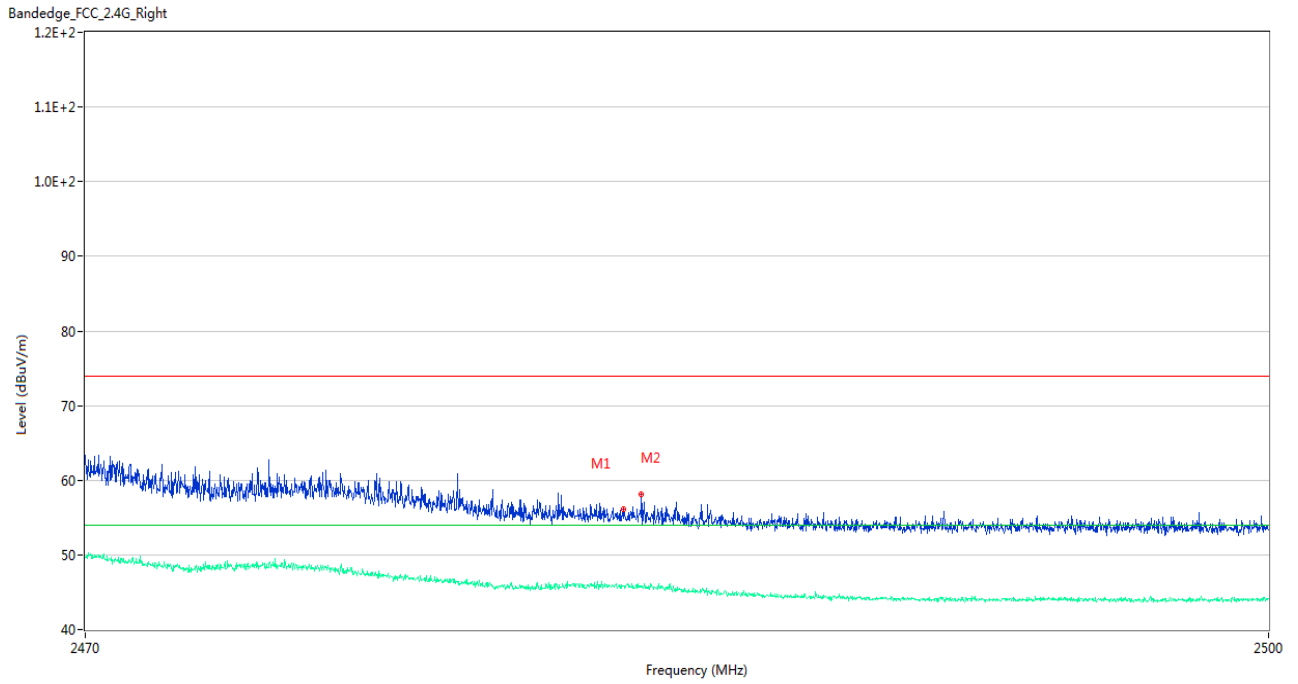
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2483.560	54.76	-0.06	74.0	19.24	Peak	241.00	150	Horizontal	Pass
1**	2483.560	45.39	-0.06	54.0	8.61	AV	241.00	150	Horizontal	Pass
2	2483.830	55.89	-0.08	74.0	18.11	Peak	70.00	200	Horizontal	Pass
2**	2483.830	44.71	-0.08	54.0	9.29	AV	70.00	200	Horizontal	Pass

802.11n20 CHANNEL 8



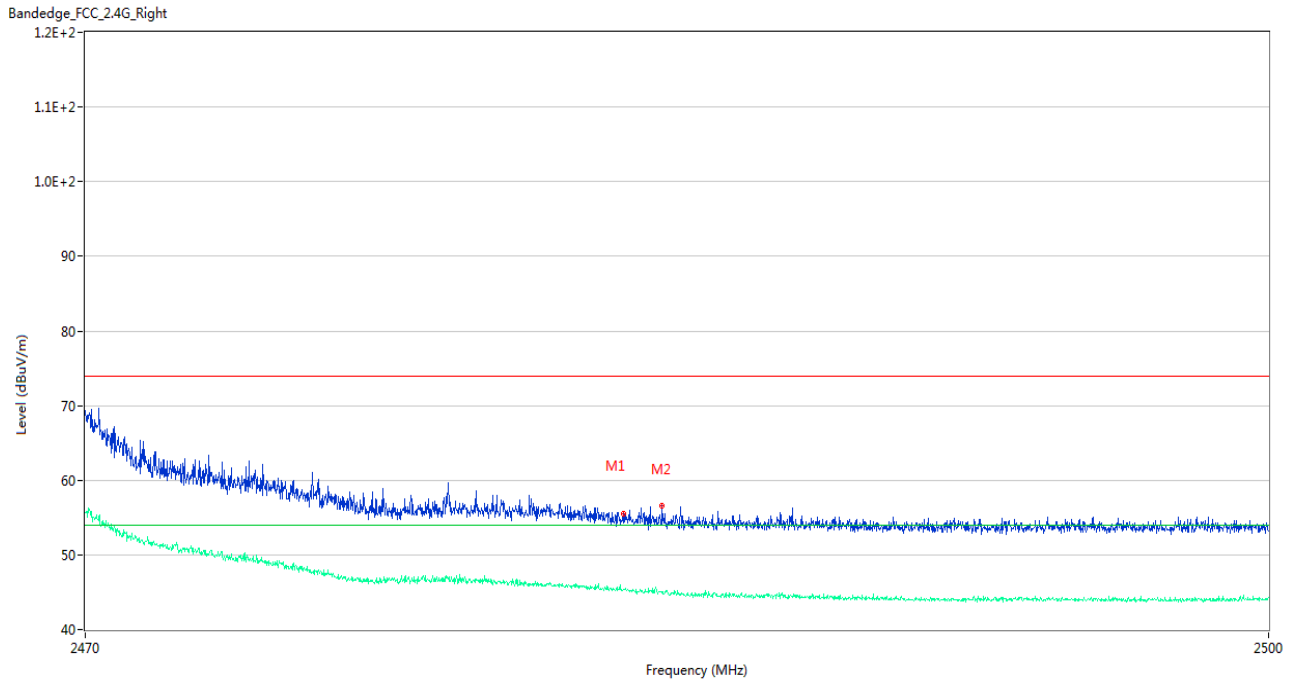
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2483.590	54.89	-0.06	74.0	19.11	Peak	60.00	100	Horizontal	Pass
1**	2483.590	45.21	-0.06	54.0	8.79	AV	60.00	100	Horizontal	Pass
2	2484.940	56.46	-0.16	74.0	17.54	Peak	6.00	100	Horizontal	Pass
2**	2484.940	44.82	-0.16	54.0	9.18	AV	6.00	100	Horizontal	Pass

802.11n20 CHANNEL 9



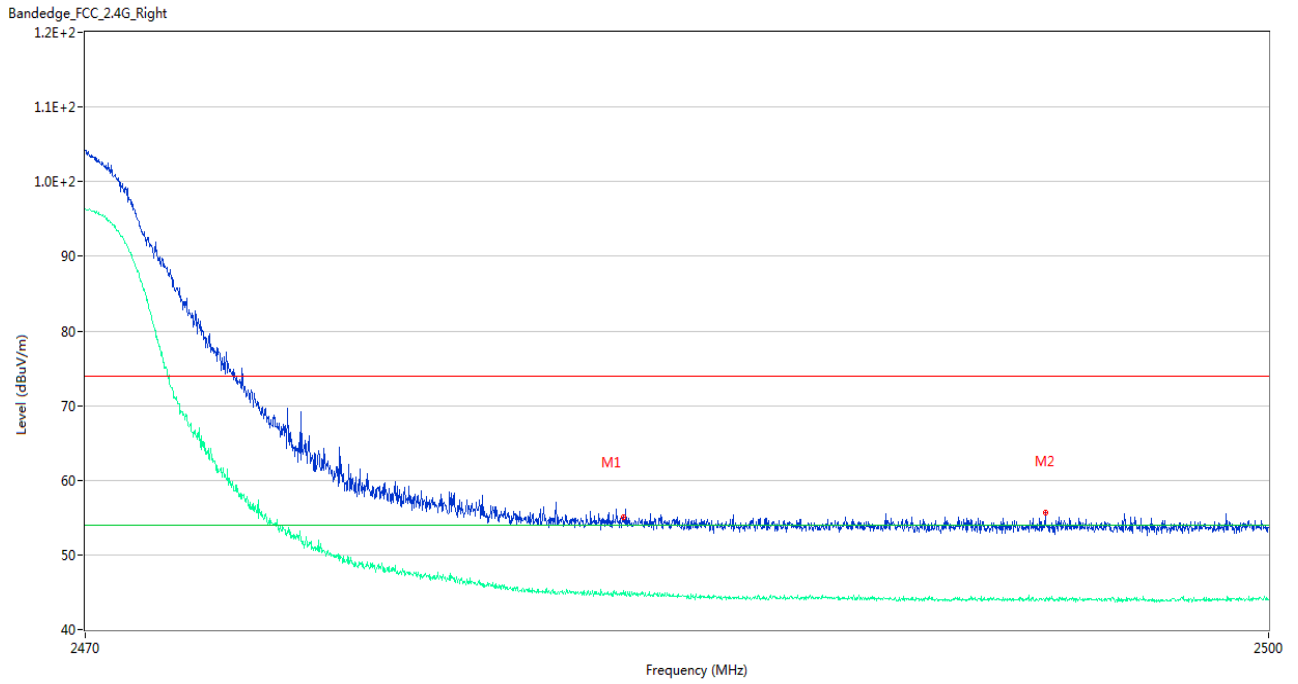
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2483.590	56.05	-0.06	74.0	17.95	Peak	310.00	100	Horizontal	Pass
1**	2483.590	45.77	-0.06	54.0	8.23	AV	310.00	100	Horizontal	Pass
2	2484.055	58.19	-0.10	74.0	15.81	Peak	88.00	200	Horizontal	Pass
2**	2484.055	45.80	-0.10	54.0	8.20	AV	88.00	200	Horizontal	Pass

802.11n20 CHANNEL 10



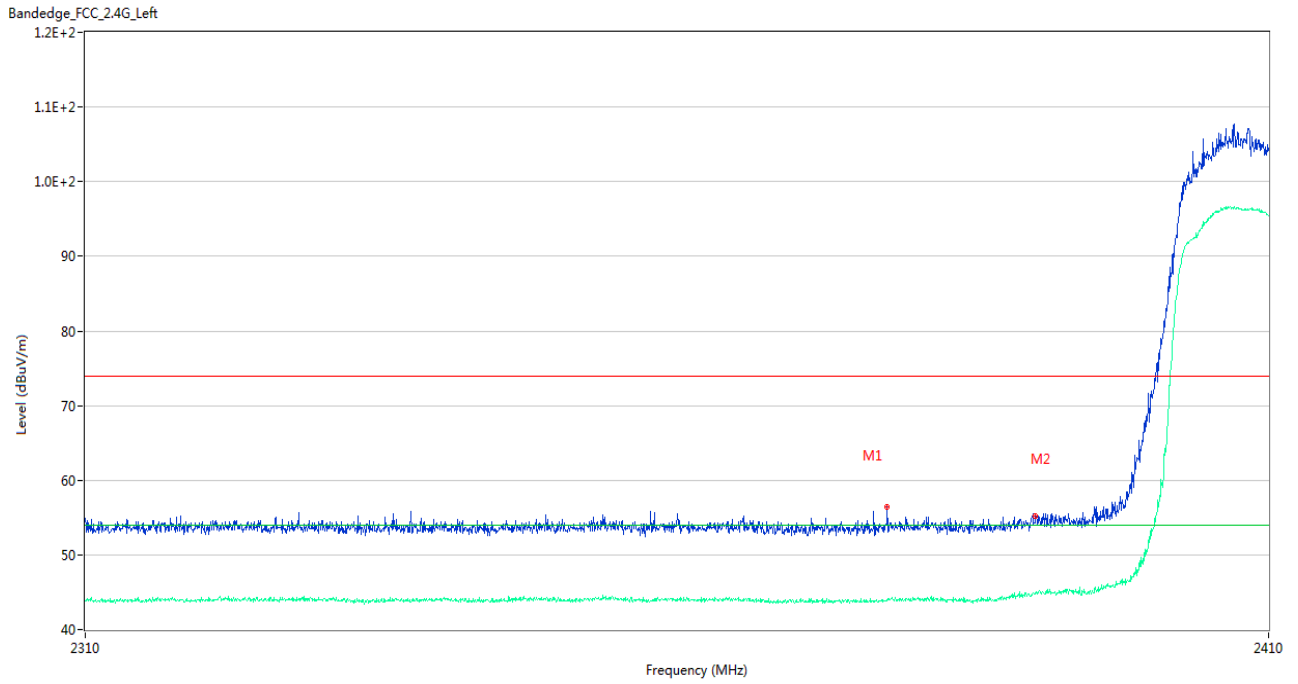
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2483.590	55.46	-0.06	74.0	18.54	Peak	254.00	100	Horizontal	Pass
1**	2483.590	45.40	-0.06	54.0	8.60	AV	254.00	100	Horizontal	Pass
2	2484.580	56.52	-0.14	74.0	17.48	Peak	318.00	200	Horizontal	Pass
2**	2484.580	44.91	-0.14	54.0	9.09	AV	318.00	200	Horizontal	Pass

802.11n20 CHANNEL 11



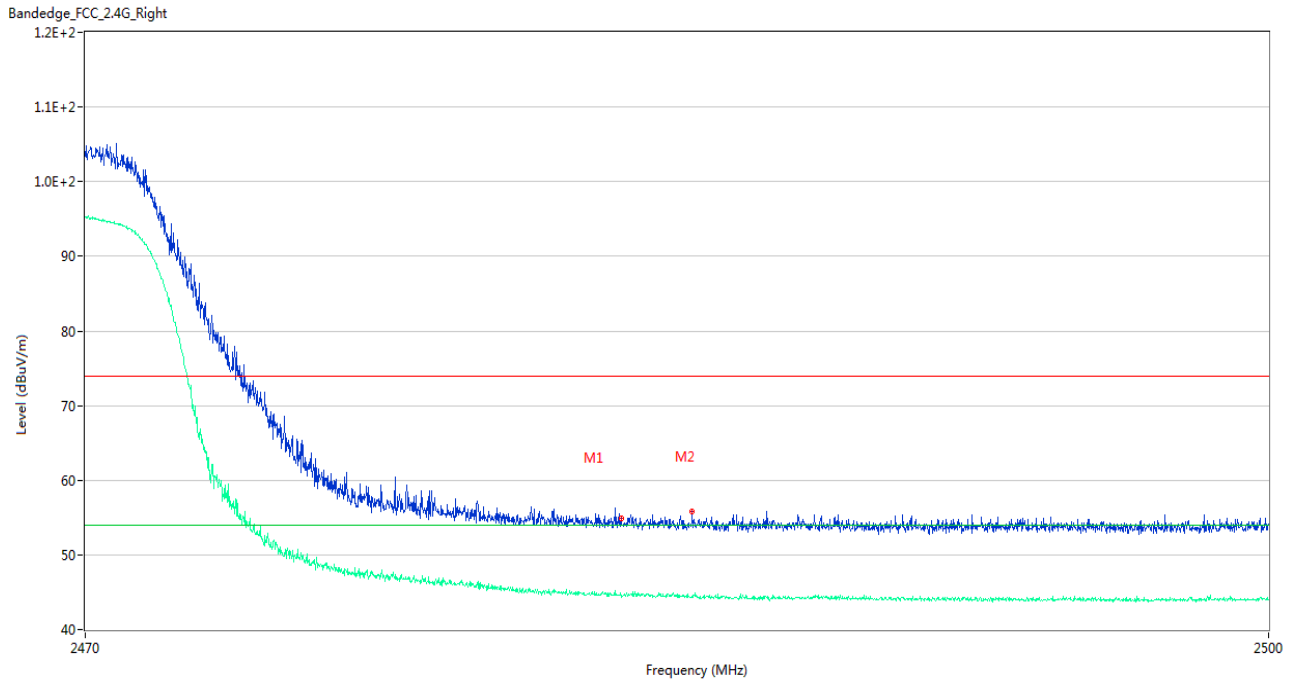
No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2483.590	55.00	-0.06	74.0	19.00	Peak	85.00	150	Horizontal	Pass
1**	2483.590	45.17	-0.06	54.0	8.83	AV	85.00	150	Horizontal	Pass
2	2494.315	55.68	-0.21	74.0	18.32	Peak	192.00	150	Horizontal	Pass
2**	2494.315	44.17	-0.21	54.0	9.83	AV	192.00	150	Horizontal	Pass

802.11ax20(SU) CHANNEL 1



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2377.300	56.37	-0.58	74.0	17.63	Peak	198.00	200	Horizontal	Pass
1**	2377.300	43.87	-0.58	54.0	10.13	AV	198.00	200	Horizontal	Pass
2	2389.950	55.13	-0.59	74.0	18.87	Peak	62.00	200	Horizontal	Pass
2**	2389.950	44.99	-0.59	54.0	9.01	AV	62.00	200	Horizontal	Pass

802.11ax20(SU) CHANNEL 11



No.	Frequency (MHz)	Results (dBuV/m)	Factor (dB)	Limit (dBuV/m)	Margin (dB)	Detector	Table (Degree)	Height (cm)	Antenna	Verdict
1	2483.545	54.88	-0.06	74.0	19.12	Peak	282.00	150	Horizontal	Pass
1**	2483.545	44.65	-0.06	54.0	9.35	AV	282.00	150	Horizontal	Pass
2	2485.345	55.77	-0.17	74.0	18.23	Peak	298.00	100	Horizontal	Pass
2**	2485.345	44.22	-0.17	54.0	9.78	AV	298.00	100	Horizontal	Pass

A.8 Power Spectral Density (PSD)

Note: The Power Spectral Density (PSD) please refer to the Report No. FR262007-01A, which issued by Sporton International Inc. (Kunshan) on Sep. 09, 2022, Section **Appendix A. Conducted Test Results**.

ANNEX B TEST SETUP PHOTOS

Please refer the document “BL-SZ23B0635-AR.PDF”.

ANNEX C EUT EXTERNAL PHOTOS

Please refer the document “BL-SZ23B0635-AW.PDF”.

ANNEX D EUT INTERNAL PHOTOS

Please refer the document “BL-SZ23B0635-AI.PDF”.

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--END OF REPORT--