FCC RADIO TEST REPORT

FCC ID	:	**U8G-P1AX13**
Equipment	:	**Peplink Pepwave Wireless Product**
Brand Name	:	peplink PEPWAVE
Model Name	:	**MAX HD1 Dome Pro** **MAX-HD1-DOM-PRO-5GH** **MAX HD2 Dome Pro** **MAX-HD2-DOM-PRO-LTEA-Q**
Applicant	:	**PISMO LABS TECHNOLOGY LIMITED** **A8, 5/F, HK Spinners Industrial Building, Phase 6, 481 Castle Peak Road, Cheung Sha Wan, Hong Kong**
Manufacturer	:	**PISMO LABS TECHNOLOGY LIMITED** **A8, 5/F, HK Spinners Industrial Building, Phase 6, 481 Castle Peak Road, Cheung Sha Wan, Hong Kong**
Standard	:	**FCC Part 15 Subpart E §15.407**

The product was received on Jul. 05, 2022 and testing was performed from Sep. 11, 2023 to Sep. 13, 2023. We, Sporton International Inc. Wensan Laboratory, would like to declare that the tested sample has been evaluated in accordance with the test procedures and has been in compliance with the applicable technical standards.

The test results in this variant report apply exclusively to the tested model / sample. Without written approval from Sporton International Inc. Wensan Laboratory, the test report shall not be reproduced except in full.

Louis Wu

Approved by: Louis Wu

Sporton International Inc. Wensan Laboratory
No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.)

TEL: 886-3-327-0868
FAX: 886-3-327-0855

Table of Contents

History of this test report

Report No.	Version	Description	Issue Date
FR261637-01	01	Initial issue of report	Sep. 18, 2023

Summary of Test Result

Report Clause	Ref Std. Clause	Test Items	Result (PASS/FAIL)	Remark
3.1	15.403(i)	26dB Bandwidth	Pass	-
3.1	2.1049	99% Occupied Bandwidth	Reporting only	-
3.2	15.407(a)	Maximum Conducted Output Power	Pass	-
3.3	15.407(a)	Power Spectral Density	Pass	-
3.4	15.407(b)	Unwanted Emissions	Pass	0.90 dB under the limit at 176.34 MHz
-	15.207	AC Conducted Emission	Not Required	-
3.5	15.203	Antenna Requirement	Pass	-

Note:

1. Not required means after assessing, test items are not necessary to carry out.
2. This is a variant report by changing SW settings. All the test cases were performed on original report which can be referred to Sporton Report Number FR261637B. Based on the original report, only worst case was verified.

Conformity Assessment Condition:
1. The test results (PASS/FAIL) with all measurement uncertainty excluded are presented against the regulation limits or in accordance with the requirements stipulated by the applicant/manufacturer who shall bear all the risks of non-compliance that may potentially occur if measurement uncertainty is taken into account.
2. The measurement uncertainty please refer to each test result in the section “Measurement Uncertainty”.
Disclaimer:
1. The product specifications of the EUT presented in the test report that may affect the test assessments are declared by the manufacturer who shall take full responsibility for the authenticity.
2. The purpose of different model name is for marketing purpose.

Reviewed by: Lewis Ho
Report Producer: Clio Lo

1 General Description

1.1 Product Feature of Equipment Under Test

Product Feature	
General Specs LTE/5G NR, Wi-Fi 2.4GHz 802.11b/g/n/ac/ax, Wi-Fi 5GHz 802.11a/n/ac/ax, and GPS **Antenna Type** WWAN: Omni-directional Antenna WLAN: Omni-directional Antenna GPS: Directional Antenna **Sample information** Sample 1: MAX HD1 Dome Pro and MAX-HD1-DOM-PRO-5GH with WWAN Module 1 (EM9191) Sample 2: MAX HD2 Dome Pro and MAX-HD2-DOM-PRO-LTEA-Q with WWAN Module 2 (LN920A12-WW)	
Integrated WWAN Module 1	**Brand Name:** Sierra **Model Name:** EM9191 **FCC ID:** N7NEM91
Integrated WWAN Module 2	**Brand Name:** Telit **Model Name:** LN920A12-WW **FCC ID:** RI7LN920

Antenna information		
5150 MHz ~ 5250 MHz	Peak Gain (dBi)	Ant. 5: 5.9 Ant. 6: 4.9

Remark: The EUT's information above is declared by manufacturer. Please refer to Disclaimer in report summary.

1.1.1 Antenna Directional Gain

<For CDD Mode>

Follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01 F)2)f)ii)

Directional gain = G_{ANT} + Array Gain, where Array Gain is as follows:

For power measurements on IEEE 802.11 devices,

Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$.

G_{ANT} is set equal to the gain of the antenna having the highest gain.

For PSD measurements, the directional gain calculation.

$$DirectionalGain = 10 \cdot \log \left[\frac{\sum_{j=1}^{N_{SS}} \left\{ \sum_{k=1}^{N_{ANT}} g_{j,k} \right\}^2}{N_{ANT}} \right]$$

where

Each antenna is driven by no more than one spatial stream;
N_{SS} = the number of independent spatial streams of data;
N_{ANT} = the total number of antennas
$g_{j,k} = 10^{G_k / 20}$ if the kth antenna is being fed by spatial stream j, or zero if it is not;
G_k is the gain in dBi of the kth antenna.

As minimum N_{SS}=1 is supported by EUT, the formula can be simplified as:

Directional gain = $10*\log[(10^{G1/20} + 10^{G2/20} + \ldots + 10^{GN/20})^2 / N_{ANT}]$ dBi

Where G1, G2….GN denote single antenna gain.

The directional gain “DG” is calculated as following table.

	Ant 5 (dBi)	Ant 6 (dBi)	DG for Power (dBi)	DG for PSD (dBi)	Power Limit Reduction (dB)	PSD Limit Reduction (dB)
Band I	5.90	4.90	5.90	8.42	0.00	2.42

Calculation example:

If a device has two antenna, G_{ANT1}= 5.9dBi; G_{ANT2}=4.9dBi

Directional gain of power measurement = max(5.9, 4.9) + 0 = 5.9 dBi

Directional gain of PSD derived from formula which is

10 x log { { [10^ (5.90 dBi / 20) + 10^ (4.90 dBi / 20)] ^ 2 } / 2 }

= 8.42 dBi

Power and PSD limit reduction = Composite gain – 6dBi, (min = 0)

1.2 Modification of EUT

No modifications made to the EUT during the testing.

1.3 Testing Location

Test Site	Sporton International Inc. Wensan Laboratory
Test Site Location	No.58, Aly. 75, Ln. 564, Wenhua 3rd, Rd., Guishan Dist., Taoyuan City 333010, Taiwan (R.O.C.) TEL: +886-3-327-0868 FAX: +886-3-327-0855
Test Site No.	**Sporton Site No.**
	TH05-HY, 03CH16-HY

Note: The test site complies with ANSI C63.4 2014 requirement.

FCC designation No.: TW3786

1.4 Applicable Standards

According to the specifications declared by the manufacturer, the EUT must comply with the requirements of the following standards:

- FCC Part 15 Subpart E
- FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.
- FCC KDB 414788 D01 Radiated Test Site v01r01.
- FCC KDB 662911 D01 Multiple Transmitter Output v02r01.
- ANSI C63.10-2013

Remark:

1. All the test items were validated and recorded in accordance with the standards without any modification during the testing.
2. The TAF code is not including all the FCC KDB listed without accreditation.

2 Test Configuration of Equipment Under Test

a. The EUT has been associated with peripherals and configuration operated in a manner tended to maximize its emission characteristics in a typical application. Frequency range investigated: radiation emission (9 kHz to the 10th harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower).

2.1 Carrier Frequency and Channel

Frequency Band	Channel	Freq. (MHz)	Channel	Freq. (MHz)
5150-5250 MHz Band 1 (U-NII-1)	36	5180	44	5220
	38*	5190	46*	5230
	40	5200	48	5240
	42#	5210		

Note:

1. The above Frequency and Channel with "*" are 802.11n HT40 and 802.11ac VHT40 and 802.11ax HE40.
2. The above Frequency and Channel with "#" are 802.11ac VHT80 and 802.11ax HE80.

2.2 Test Mode

The SISO mode conducted power is covered by MIMO mode per chain, so only the MIMO mode is tested.

The power for 802.11n and 802.11ac mode is smaller than 802.11ax mode, so all other conducted and radiated test is covered by 802.11ax mode.

The final test modes include the worst data rates for each modulation shown in the table below.

MIMO Mode

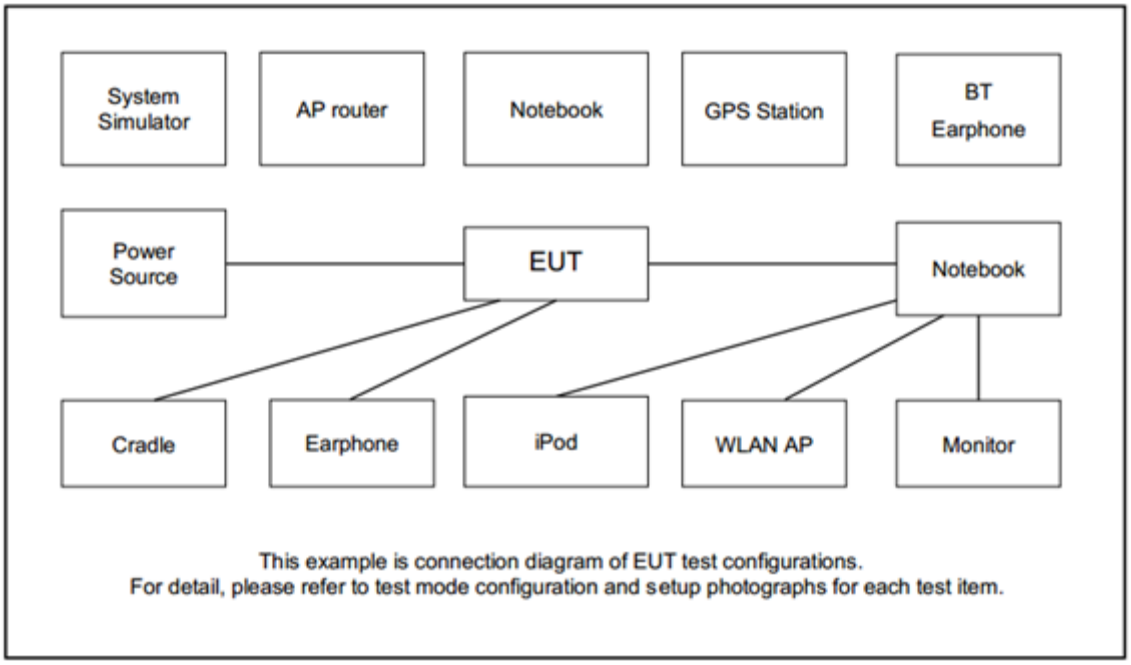
Modulation	Data Rate
802.11a	**6 Mbps**
802.11n HT20 (Covered by HE20)	**MCS0**
802.11n HT40 (Covered by HE40)	**MCS0**
802.11ac VHT20 (Covered by HE20)	**MCS0**
802.11ac VHT40 (Covered by HE40)	**MCS0**
802.11ac VHT80 (Covered by HE80)	**MCS0**
802.11ax HE20	**MCS0**
802.11ax HE40	**MCS0**
802.11ax HE80	**MCS0**

Remark: The conducted power level of each chain in MIMO mode is equal or higher than SISO mode.

Ch. #		Band I：5150-5250 MHz
		802.11ax HE80
L	Low	-
M	Middle	42
H	High	-

Remark: For Radiated Test Cases, the tests were performed Sample 1

2.3 Connection Diagram of Test System



2.4 Support Unit used in test configuration and system

Item	Equipment	Brand Name	Model Name	FCC ID	Data Cable	Power Cord
1.	Device	PEPWAVE	MAX BR1 Mini R6	N/A	N/A	N/A
2.	POE Adapter	Billion	BP035-560054QAX	FCC DoC	N/A	N/A

2.5 EUT Operation Test Setup

The RF test items, utility “QSPR Version 5.0-00197” was installed in Notebook which was programmed in order to make the EUT get into the engineering modes to provide channel selection, power level, data rate and the application type and for continuous transmitting signals.

2.6 Measurement Results Explanation Example

For all conducted test items:

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

Example :

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

Offset = RF cable loss + attenuator factor.

Following shows an offset computation example with cable loss 4.2 dB and 10 dB attenuator.

Offset(dB) = RF cable loss(dB) + attenuator factor(dB).

= 4.2 + 10 = 14.2 (dB)

3 Test Result

3.1 26dB & 99% Occupied Bandwidth Measurement

3.1.1 Description of 26dB & 99% Occupied Bandwidth

This section is for reporting purpose only.

There is no restriction limits for bandwidth.

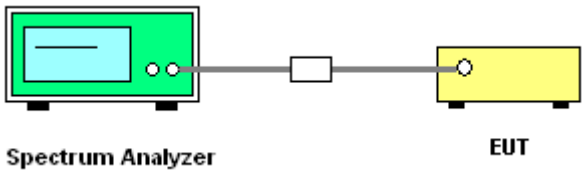
3.1.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.1.3 Test Procedures

1. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01. Section C) Emission bandwidth
2. Set RBW = approximately 1% of the emission bandwidth.
3. Set the VBW > RBW.
4. Detector = Peak.
5. Trace mode = max hold
6. Measure the maximum width of the emission that is 26 dB down from the peak of the emission. Compare this with the RBW setting of the analyzer. Readjust RBW and repeat measurement as needed until the RBW/EBW ratio is approximately 1%.
7. For 99% Bandwidth Measurement, the spectrum analyzer's resolution bandwidth (RBW) is set 1-5% of the emission bandwidth and set the Video bandwidth (VBW) ≥ 3 * RBW.
8. Measure and record the results in the test report.

3.1.4 Test Setup

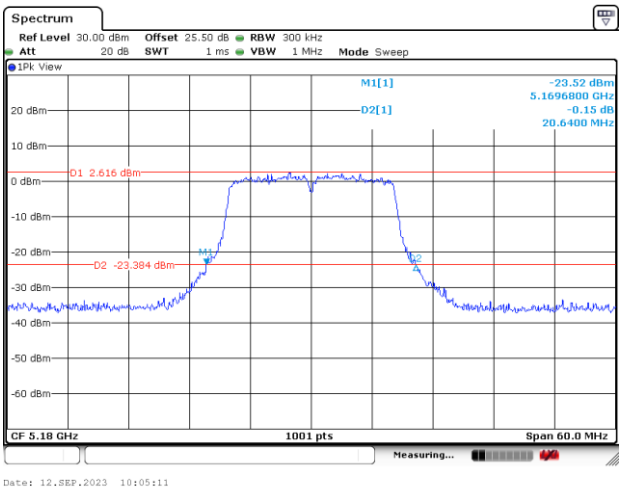
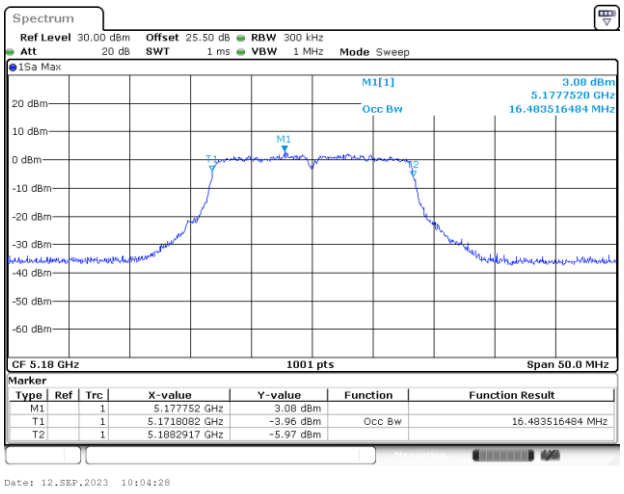


3.1.5 Test Result of 26dB & 99% Occupied Bandwidth

Please refer to Appendix A.

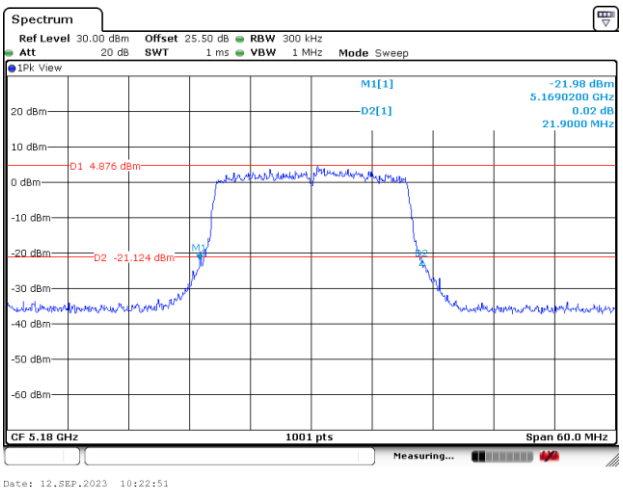
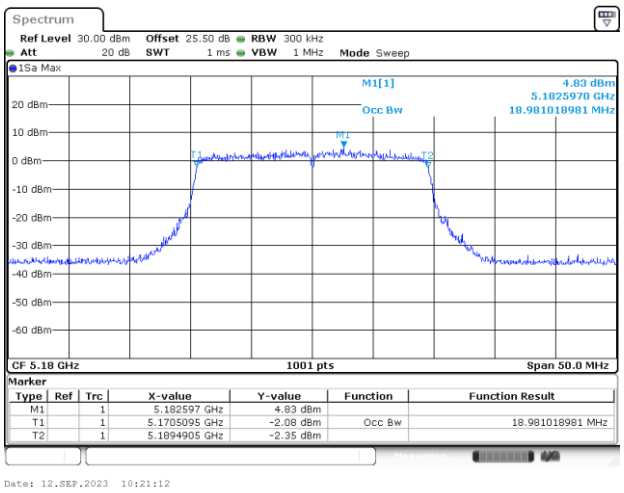
MIMO <Ant. 5+6>

<802.11a>

26dB Bandwidth	99% Occupied Bandwidth
	

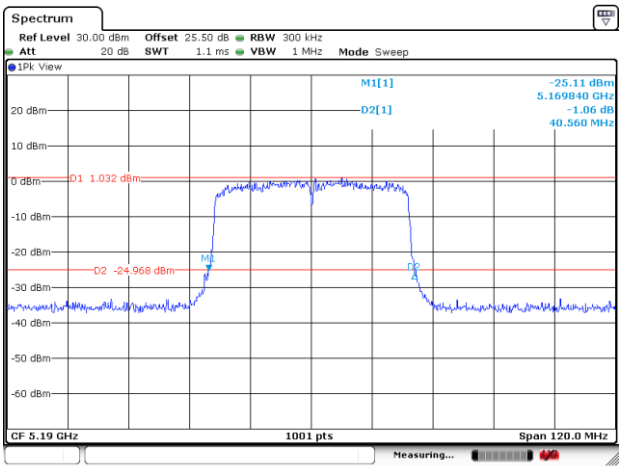
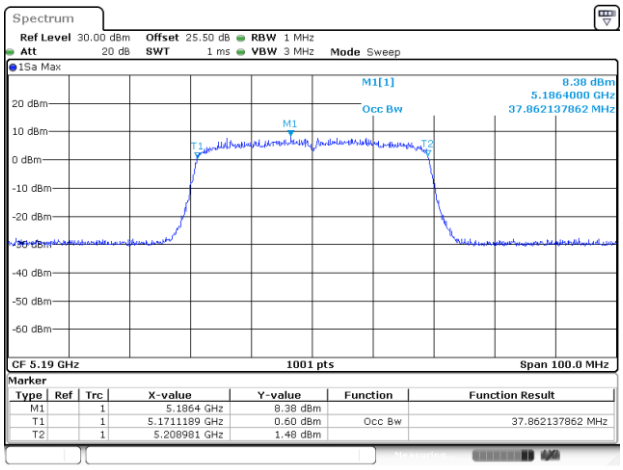
Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

<802.11ax HE20>

26dB Bandwidth	99% Occupied Bandwidth
	

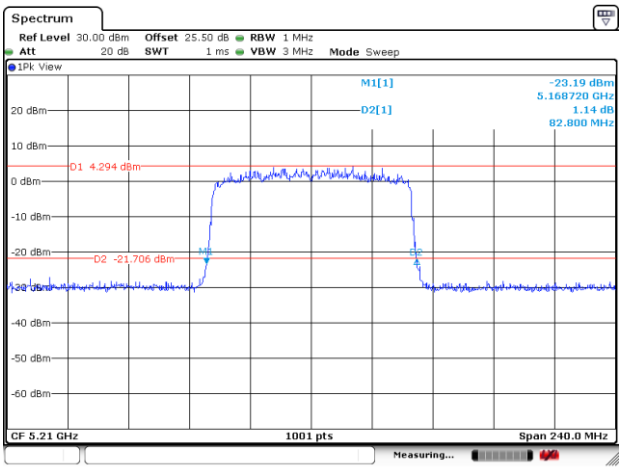
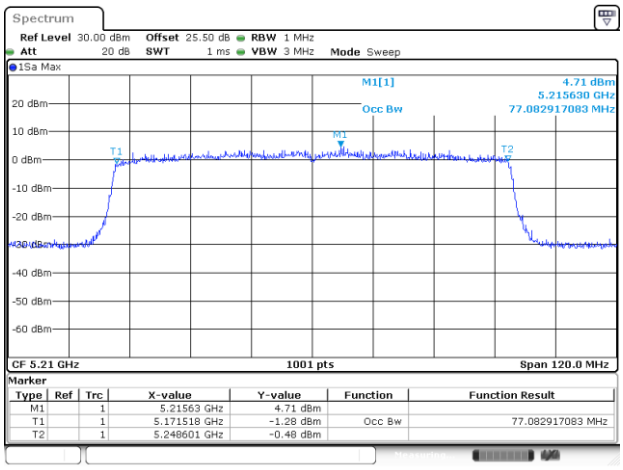
Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

<802.11ax HE40>

26dB Bandwidth	99% Occupied Bandwidth
	

Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

<802.11ax HE80>

26dB Bandwidth	99% Occupied Bandwidth
	

Note: The occupied channel bandwidth is maintained within the band of operation for all of the modulations.

3.2 Maximum Conducted Output Power Measurement

3.2.1 Limit of Maximum Conducted Output Power

<FCC 14-30 CFR 15.407>

For the 5.15–5.25 GHz bands:

For an outdoor access point operating in the band 5.15–5.25 GHz, the maximum conducted output power over the frequency band of operation shall not exceed 1 W provided the maximum antenna gain does not exceed 6 dBi.

If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The maximum e.i.r.p. at any elevation angle above 30 degrees as measured from the horizon must not exceed 125 mW (21 dBm).

3.2.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

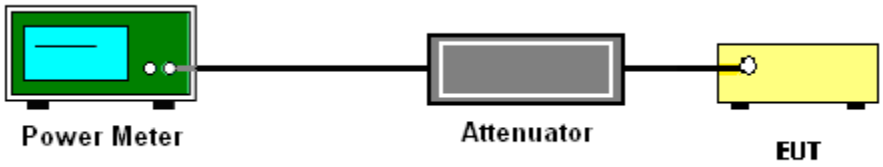
3.2.3 Test Procedures

The testing follows Method PM-G of FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.

Method PM-G (Measurement using a gated RF average power meter):

1. Measurement is performed using a wideband RF power meter.
2. The EUT is configured to transmit at its maximum power control level.
3. Measure the average power of the transmitter.
4. Since the measurement is made only during the ON time of the transmitter, no duty cycle correction factor is required.
5. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01

3.2.4 Test Setup



3.2.5 Test Result of Maximum Conducted Output Power

Please refer to Appendix A.

3.3 Power Spectral Density Measurement

3.3.1 Limit of Power Spectral Density

<FCC 14-30 CFR 15.407>

For the 5.15–5.25 GHz bands:

For an outdoor access point operating in the band 5.15–5.25 GHz, the maximum power spectral density shall not exceed 17 dBm in any 1 megahertz band.

If transmitting antennas of directional gain greater than 6 dBi are used, both the maximum conducted output power and the maximum power spectral density shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

3.3.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.3.3 Test Procedures

The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01.

Section F) Maximum power spectral density.

 # Method SA-3 #

(power averaging (rms) detection with max hold):

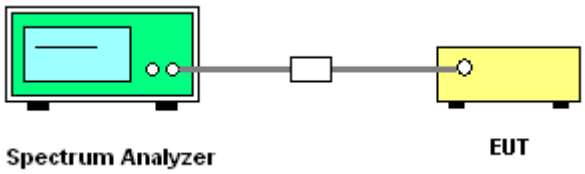
- Set span to encompass the entire emission bandwidth (EBW) of the signal.
- Set RBW = 1 MHz.
- Set VBW ≥ 3 MHz.
- Number of points in sweep ≥ 2 Span / RBW.
- Sweep time ≤ (number of points in sweep) × T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.
  Detector = power averaging (rms).
- Trace mode = max hold.
- Allow max hold to run for at least 60 seconds, or longer as needed to allow the trace to stabilize.

1. The RF output of EUT is connected to the spectrum analyzer by a low loss cable.
2. Each plot has already offset with cable loss, and attenuator loss. Measure the PPSD and record it.
3. For MIMO mode, calculation method follows FCC KDB 662911 D01 Multiple Transmitter Output v02r01.

   Method (a): Measure and sum the spectra across the outputs.

   The total final Power Spectral Density is from a device with 2 transmitter outputs. The spectrum measurements of the individual outputs are all performed with the same span and number of points; the spectrum value in the first spectral bin of output 1 is summed with that in the first spectral bin of output 2 to obtain the value for the first frequency bin of the summed spectrum.

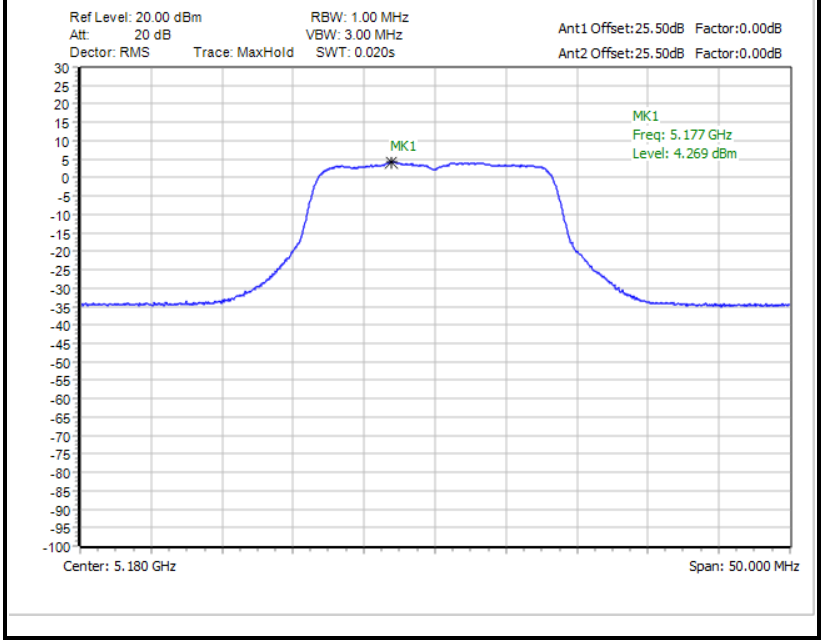
3.3.4 Test Setup



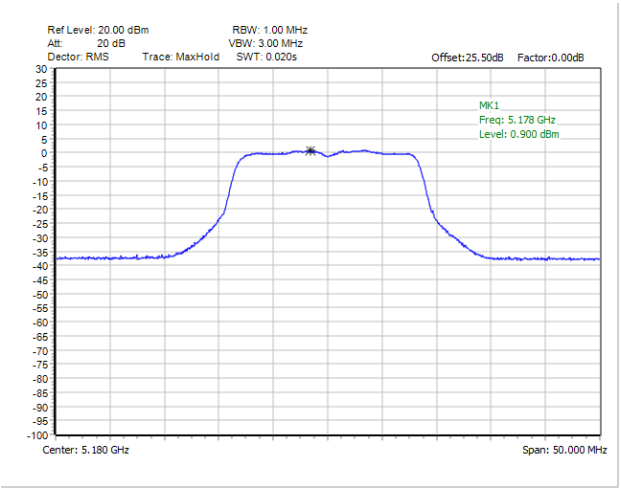
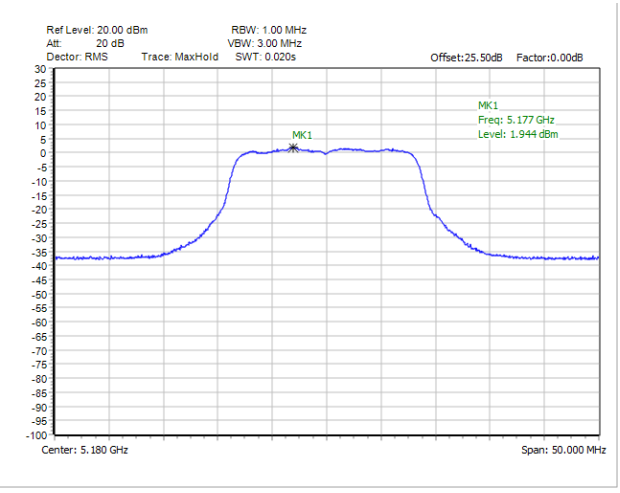
3.3.5 Test Result of Power Spectral Density

Please refer to Appendix A.

<802.11a>

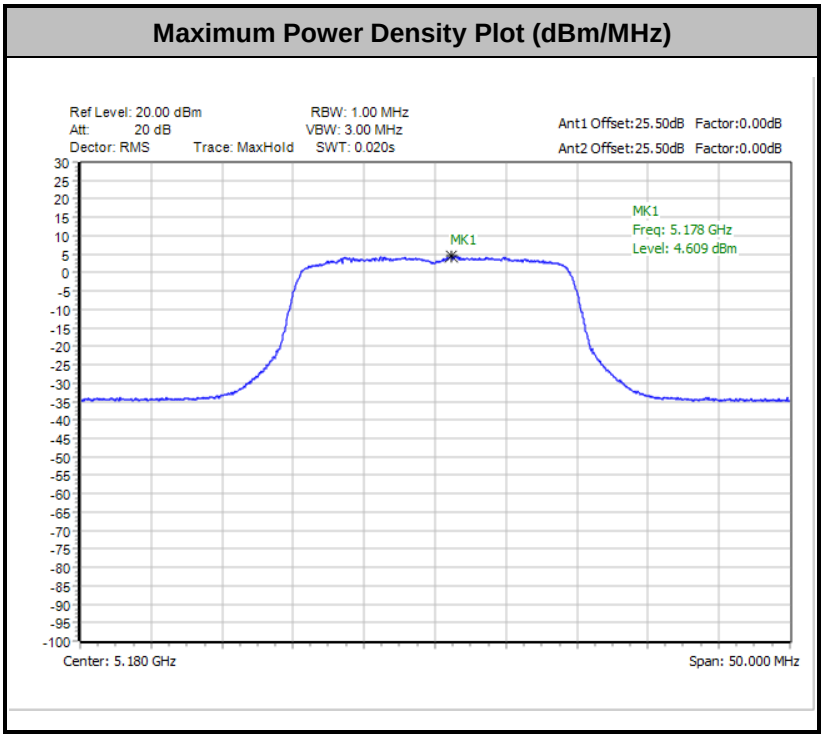
Maximum Power Density Plot (dBm/MHz)


Remark: The test plot is showing a bin by bin combined result mathematically adds two traces.

Maximum Power Density Plot Trace 1 (Ant 5)	Maximum Power Density Plot Trace 2 (Ant 6)
	

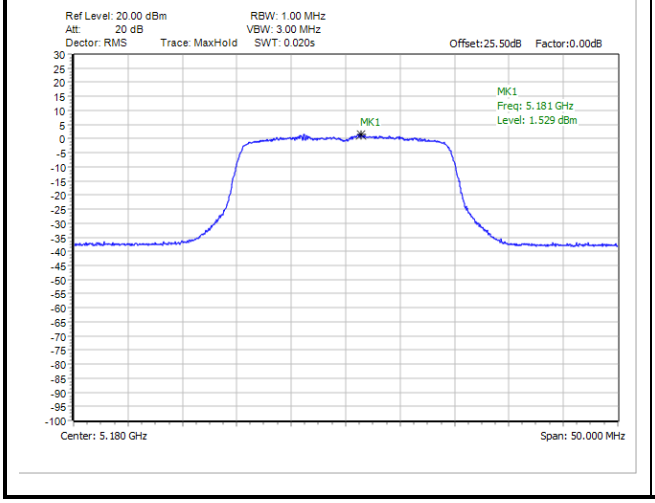
<802.11ax HE20>

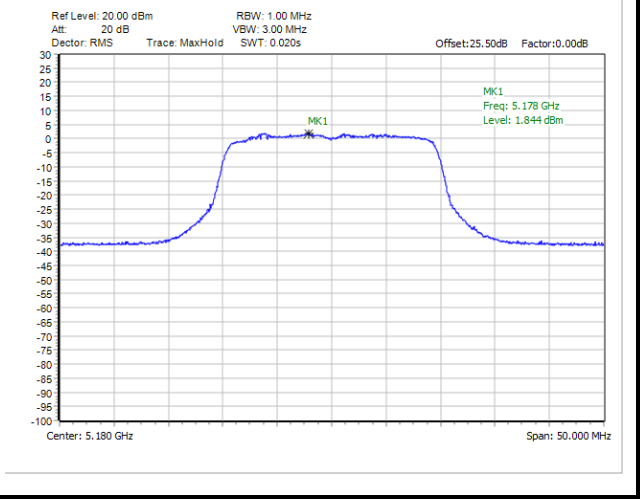
Maximum Power Density Plot (dBm/MHz)



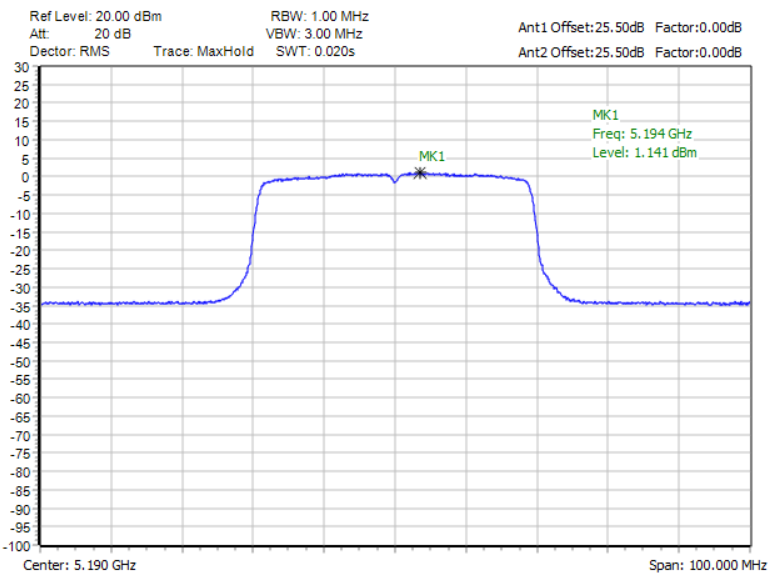
Remark: The test plot is showing a bin by bin combined result mathematically adds two traces.

Maximum Power Density Plot Trace 1 (Ant 5)	Maximum Power Density Plot Trace 2 (Ant 6)

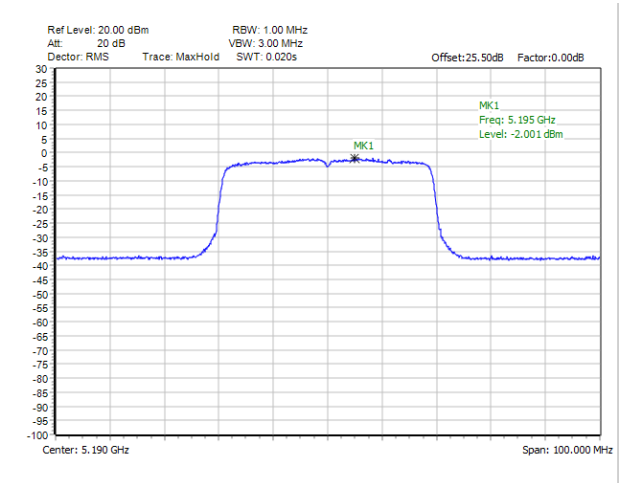
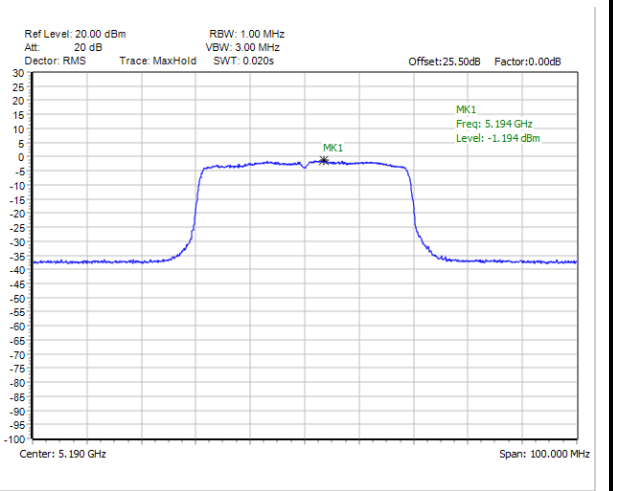




<802.11ax HE40>

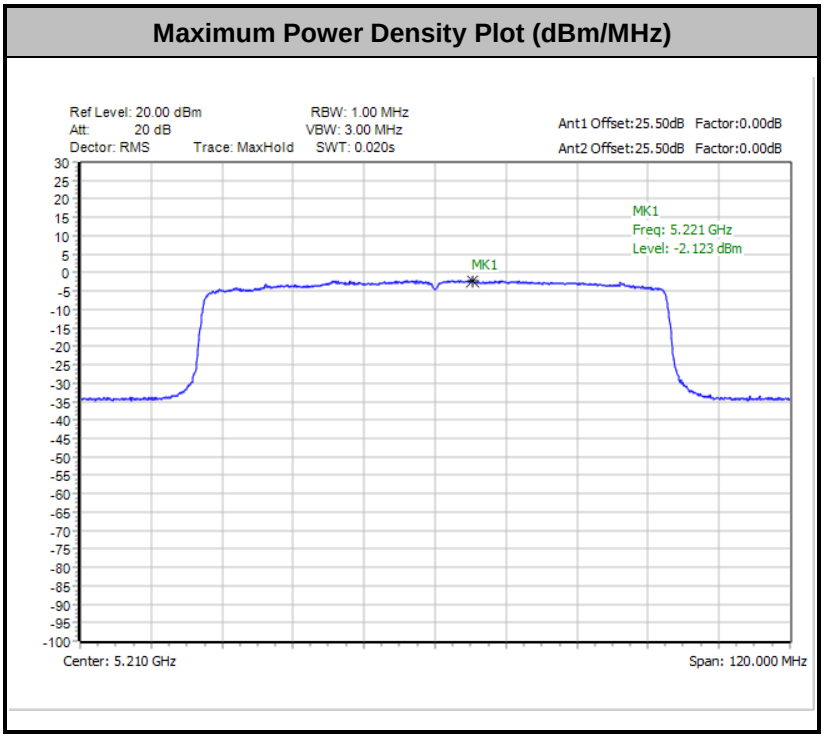
Maximum Power Density Plot (dBm/MHz)


Remark: The test plot is showing a bin by bin combined result mathematically adds two traces.

Maximum Power Density Plot Trace 1 (Ant 5)	Maximum Power Density Plot Trace 2 (Ant 6)
	

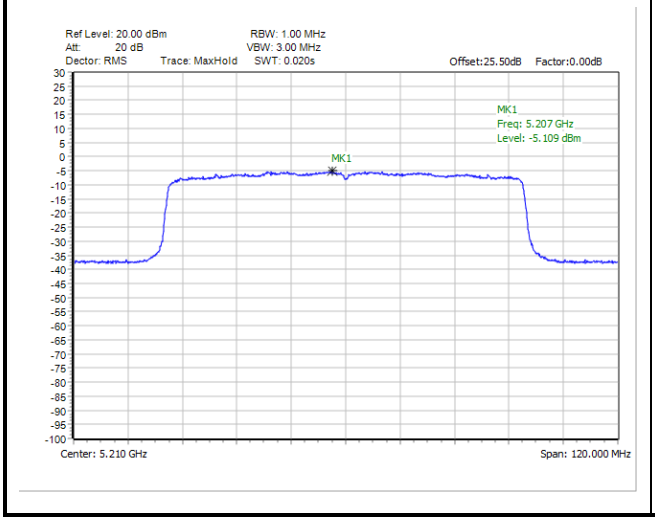
<802.11ax HE80>

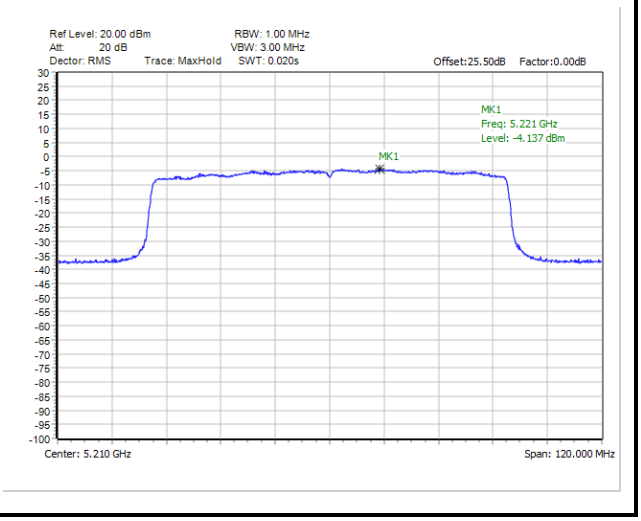
Maximum Power Density Plot (dBm/MHz)



Remark: The test plot is showing a bin by bin combined result mathematically adds two traces.

Maximum Power Density Plot Trace 1 (Ant 5)	Maximum Power Density Plot Trace 2 (Ant 6)





3.4 Unwanted Emissions Measurement

This section is to measure unwanted emissions through radiated measurement for band edge spurious emissions and out of band emissions measurement.

3.4.1 Limit of Unwanted Emissions

(1) For transmitters operating in the 5150-5250 MHz band: all emissions outside of the 5150-5350 MHz band shall not exceed an EIRP of –27dBm/MHz.

(2) Unwanted spurious emissions falls in restricted bands shall comply with the general field strength limits as below table:

Frequency (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

Note: The following formula is used to convert the EIRP to field strength.

$$E=\frac{1000000\sqrt{30P}}{3}$$ μV/m, where P is the eirp (Watts)

EIRP (dBm)	Field Strength at 3m (dBμV/m)
- 27	68.3

(3) KDB789033 D02 v02r01 G)2)c)

(i) Sections 15.407(b)(1-3) specifies the unwanted emissions limit for the U-NII-1 and U-NII-2 bands. As specified, emissions above 1000 MHz that are outside of the restricted bands are subject to a peak emission limit of −27 dBm/MHz.
(ii) Section 15.407(b)(4) specifies the unwanted emissions limit for the U-NII-3 band. A band emissions mask is specified in Section 15.407(b)(4)(i). The emission limits are based on the use of a peak detector.

3.4.2 Measuring Instruments

Please refer to the measuring equipment list in this test report.

3.4.3 Test Procedures

1. The testing follows FCC KDB 789033 D02 General UNII Test Procedures New Rules v02r01. Section G) Unwanted emissions measurement.

(1) Procedure for Unwanted Emissions Measurements Below 1000 MHz

- RBW = 120 kHz
- VBW = 300 kHz
- Detector = Peak
- Trace mode = max hold

(2) Procedure for Peak Unwanted Emissions Measurements Above 1000 MHz

- RBW = 1 MHz
- VBW ≥ 3 MHz
- Detector = Peak
- Sweep time = auto
- Trace mode = max hold

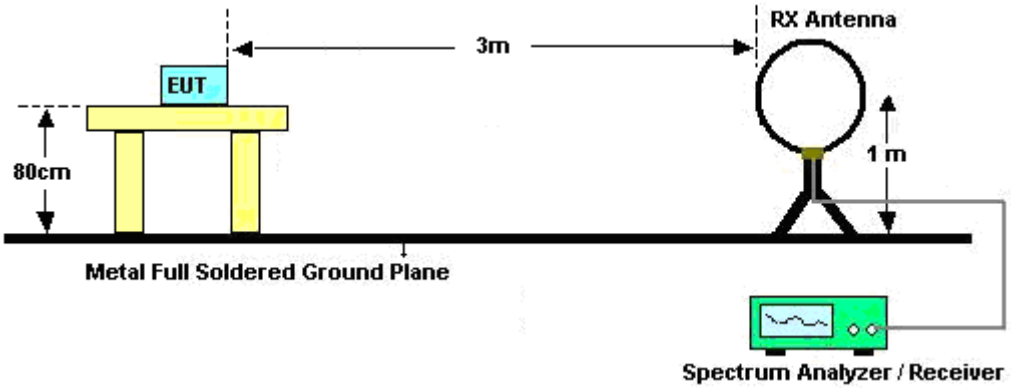
(3) Procedures for Average Unwanted Emissions Measurements Above 1000 MHz

- RBW = 1 MHz
- VBW = 10 Hz, when duty cycle is no less than 98 percent.
- VBW ≥ 1/T, when duty cycle is less than 98 percent where T is the minimum transmission duration over which the transmitter is on and is transmitting at its maximum power control level for the tested mode of operation.

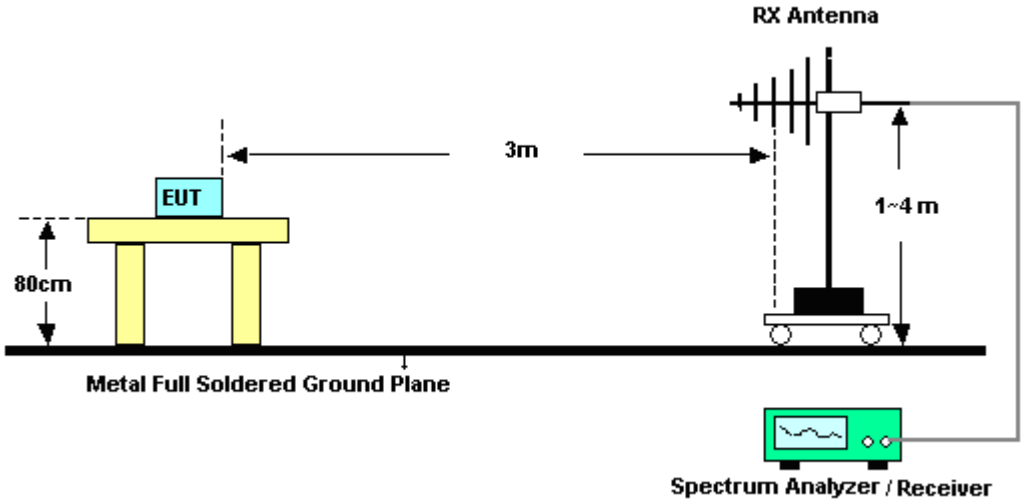
2. The EUT is placed on a turntable with 0.8 meter for frequency below 1 GHz and 1.5 meter for frequency above 1 GHz respectively above ground.
3. The EUT is set 3 meters away from the receiving antenna which is mounted on the top of a variable height antenna tower.
4. The antenna is a broadband antenna and its height is adjusted between one meter and four meters above ground to find the maximum value of the field strength for both horizontal polarization and vertical polarization of the antenna.
5. For each suspected emission, the EUT is arranged to its worst case and then adjust the antenna tower (from 1 m to 4 m) and turntable (from 0 degree to 360 degrees) to find the maximum reading.
6. Radiated testing below 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading. When there is no suspected emission found and the emission level is with at least 6 dB margin against QP limit line, the position is marked as "-".
7. Radiated testing above 1 GHz is performed by adjusting the antenna tower from 1 m to 4 m and by rotating the turn table from 0 degree to 360 degrees to find the peak maximum hold reading for scanning all frequencies. When there is no suspected emission found and the harmonic emission level is with at least 6 dB margin against average limit line, the position is marked as "-".

3.4.4 Test Setup

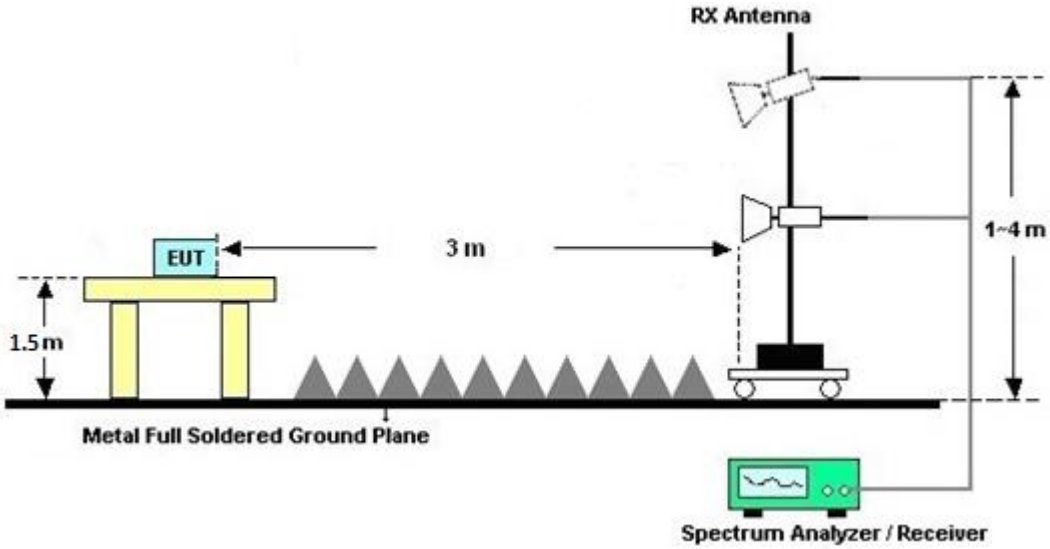
For radiated emissions below 30MHz



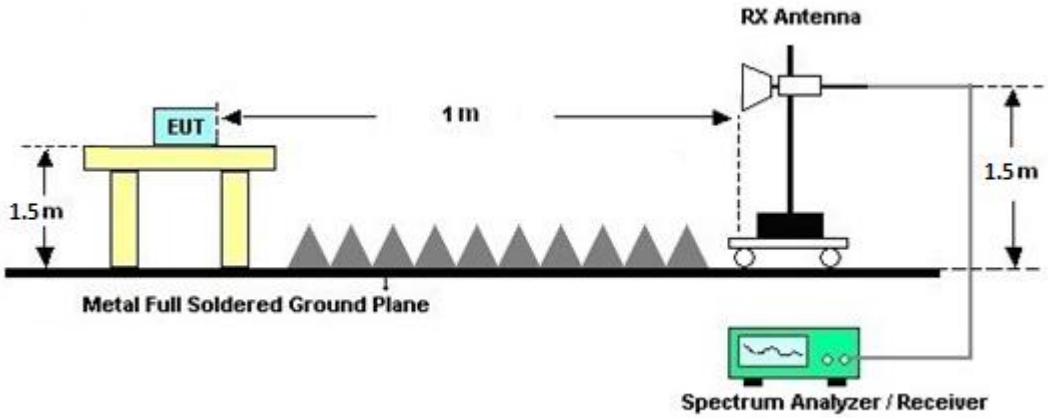
For radiated emissions from 30MHz to 1GHz



For radiated test from 1GHz to 18GHz



For radiated test above 18GHz



3.4.5 Test Results of Radiated Spurious Emissions (9 kHz ~ 30 MHz)

The low frequency, which starts from 9 kHz to 30 MHz, is pre-scanned and the result which is 20 dB lower than the limit line is not reported.

There is adequate comparison measurement of both open-field test site and alternative test site - semi-Anechoic chamber according to 414788 D01 Radiated Test Site v01r01, and the result came out very similar.

3.4.6 Test Result of Radiated Spurious at Band Edges

Please refer to Appendix B and C.

3.4.7 Duty Cycle

Please refer to Appendix D.

3.4.8 Test Result of Radiated Spurious Emissions (30MHz ~ 10th Harmonic)

Please refer to Appendix B and C.

3.5 Antenna Requirements

3.5.1 Standard Applicable

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 rule.

3.5.2 Antenna Anti-Replacement Construction

An embedded-in antenna design is used.

4 List of Measuring Equipment

Instrument	Brand Name	Model No.	Serial No.	Characteristics	Calibration Date	Test Date	Due Date	Remark
Loop Antenna	Rohde & Schwarz	HFH2-Z2	100488	9 kHz~30 MHz	Sep. 20, 2022	Sep.13, 2023	Sep. 19, 2023	Radiation (03CH16-HY)
Preamplifier	EMEC	EM18G40G	060801	1GHz~18GHz	Jun. 27, 2023	Sep.13, 2023	Jun. 26, 2024	Radiation (03CH16-HY)
SHF-EHF Horn Antenna	SCHWARZBECK	BBHA9170	00993	18GHz-40GHz	Nov. 24, 2022	Sep.13, 2023	Nov. 23, 2023	Radiation (03CH16-HY)
Amplifier	SONOMA	310N	371607	9kHz~1GHz	Jul. 03, 2023	Sep.13, 2023	Jul. 02, 2024	Radiation (03CH16-HY)
Bilog Antenna	TESEQ	CBL 6111D & 00802N1D01N-06	47020 & 06	30MHz~1GHz	Oct. 08, 2022	Sep.13, 2023	Oct. 07, 2023	Radiation (03CH16-HY)
EMI Test Receiver	Keysight	N9038A(MXE)	MY57290111	3Hz~26.5GHz	Dec. 15, 2022	Sep.13, 2023	Dec. 14, 2023	Radiation (03CH16-HY)
EMI Test Receiver	Keysight	N9010B	MY60241055	3Hz~26.5GHz	Jul. 21, 2022	Sep.13, 2023	Jul. 20, 2023	Radiation (03CH16-HY)
Horn Antenna	SCHWARZBECK	BBHA 9120 D	9120D-1522	1GHz~18GHz	Mar. 23, 2023	Sep.13, 2023	Mar. 22, 2024	Radiation (03CH16-HY)
Preamplifier	Keysight	83017A	MY53270264	1GHz~26.5GHz	Dec. 09, 2022	Sep.13, 2023	Dec. 08, 2023	Radiation (03CH16-HY)
Preamplifier	EMEC	EM1G18G	060812	1GHz~18GHz	Dec. 26, 2022	Sep.13, 2023	Dec. 25, 2023	Radiation (03CH16-HY)
RF Cable	HUBER + SUHNER	SUCOFLEX 102/SUCOFLEX 104	EC-A5-300-5757,805935/4,802434/4	30MHz~18GHz	Aug. 08, 2023	Sep.13, 2023	Aug. 07, 2024	Radiation (03CH16-HY)
Controller	ChainTek	3000-1	N/A	Control Turn table & Ant Mast	N/A	Sep.13, 2023	N/A	Radiation (03CH16-HY)
Antenna Mast	ChainTek	MBS-520-1	N/A	1m~4m	N/A	Sep.13, 2023	N/A	Radiation (03CH16-HY)
Turn Table	ChainTek	T-200-S-1	N/A	0~360 Degree	N/A	Sep.13, 2023	N/A	Radiation (03CH16-HY)
Software	Audix	E3 6.2009-8-24	RK-001136	N/A	N/A	Sep.13, 2023	N/A	Radiation (03CH16-HY)
Hygrometer	TECPEL	DTM-303A	TP201996	N/A	Nov. 17, 2022	Sep. 11, 2023~ Sep. 12, 2023	Nov. 16, 2023	Conducted (TH05-HY)
USB Power Sensor	DARE	RPR3006W	15I00041SNO10 (NO:248)	10MHz~6GHz	Jan. 05, 2023	Sep. 11, 2023~ Sep. 12, 2023	Jan. 04, 2024	Conducted (TH05-HY)
Signal Analyzer	Rohde & Schwarz	FSV40	101909	10Hz~40GHz	Aug. 09, 2023	Sep. 11, 2023~ Sep. 12, 2023	Aug. 08, 2024	Conducted (TH05-HY)

5 Measurement Uncertainty

Uncertainty of Radiated Emission Measurement (30 MHz ~ 1000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**6.5 dB**

Uncertainty of Radiated Emission Measurement (1000 MHz ~ 6000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**4.6 dB**

Uncertainty of Radiated Emission Measurement (6000 MHz ~ 18000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**4.5 dB**

Uncertainty of Radiated Emission Measurement (18000 MHz ~ 40000 MHz)

Measuring Uncertainty for a Level of Confidence of 95% (U = 2Uc(y))	**5.6 dB**

Appendix A. Test Result of Conducted Test Items

Test Engineer:	Sylvia Li	Temperature:	21~25	°C
Test Date:	2023/09/11~2023/09/12	Relative Humidity:	51~54	%

TEST RESULTS DATA
26dB and 99% OBW

U-NII-1 MIMO														
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	99% Bandwidth (MHz)		26 dB Bandwidth (MHz)		IC 99% Bandwidth Power Limit (dBm)		IC 99% Bandwidth EIRP Limit (dBm)			Note
					Ant 5	Ant 6	Ant 5	Ant 6	Ant 5	Ant 6	Ant 5	Ant 6		
11a	6Mbps	2	36	5180	16.48	16.48	20.64	20.88	-		22.17			
11a	6Mbps	2	44	5220	16.48	16.43	20.82	20.88	-		22.16			
11a	6Mbps	2	48	5240	16.53	16.43	20.82	20.94	-		22.16			

Report Number : FR261637-01

TEST RESULTS DATA
Average Power Table

FCC U-NII-1 MIMO														
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Conducted Power (dBm)			DG (dBi)		FCC EIRP Power (dBm)		FCC EIRP Limit (dBm)		Pass/Fail
					Ant 5	Ant 6	SUM	Ant 5	Ant 6	Ant 5	Ant 6	Ant 5	Ant 6	
11a	6Mbps	2	36	5180	11.40	12.10	14.77	5.90		20.67		21		Pass
11a	6Mbps	2	44	5220	11.10	12.30	14.75	5.90		20.65		21		Pass
11a	6Mbps	2	48	5240	11.10	12.10	14.64	5.90		20.54		21		Pass
HT20	MCS0	2	36	5180	11.40	12.20	14.83	5.90		20.73		21		Pass
HT20	MCS0	2	44	5220	11.10	12.40	14.81	5.90		20.71		21		Pass
HT20	MCS0	2	48	5240	11.10	12.10	14.64	5.90		20.54		21		Pass
HT40	MCS0	2	38	5190	11.40	12.20	14.83	5.90		20.73		21		Pass
HT40	MCS0	2	46	5230	11.50	12.20	14.87	5.90		20.77		21		Pass
VHT20	MCS0	2	36	5180	11.50	12.30	14.93	5.90		20.83		21		Pass
VHT20	MCS0	2	44	5220	11.20	12.50	14.91	5.90		20.81		21		Pass
VHT20	MCS0	2	48	5240	11.20	12.20	14.74	5.90		20.64		21		Pass
VHT40	MCS0	2	38	5190	11.50	12.30	14.93	5.90		20.83		21		Pass
VHT40	MCS0	2	46	5230	11.60	12.30	14.97	5.90		20.87		21		Pass
VHT80	MCS0	2	42	5210	11.20	12.10	14.68	5.90		20.58		21		Pass

TEST RESULTS DATA
Power Spectral Density

FCC U-NII-1 MIMO													
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	Average Power Density (dBm/MHz)			Average PSD Limit (dBm/MHz)		DG (dBi)			Pass /Fail
					Ant 5	Ant 6	SUM	Ant 5	Ant 6	Ant 5	Ant 6		
11a	6Mbps	2	36	5180			4.27	14.58		8.42			Pass
11a	6Mbps	2	44	5220			4.07	14.58		8.42			Pass
11a	6Mbps	2	48	5240			3.98	14.58		8.42			Pass

TEST RESULTS DATA
26dB and 99% OBW

U-NII-1 MIMO														
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	RU Config.	99% Bandwidth (MHz)		26 dB Bandwidth (MHz)		IC 99% Bandwidth Power Limit (dBm)		IC 99% Bandwidth EIRP Limit (dBm)			Note
						Ant 5	Ant 6	Ant 5	Ant 6	Ant 5	Ant 6	Ant 5	Ant 6		
HE20	MCS0	2	36	5180	Full	18.98	18.98	21.90	22.08	-		22.78			
HE20	MCS0	2	44	5220	Full	18.93	18.93	21.78	22.08	-		22.77			
HE20	MCS0	2	48	5240	Full	18.93	18.98	21.48	21.60	-		22.77			
HE40	MCS0	2	38	5190	Full	37.86	37.96	40.56	41.04	-		23.01			
HE40	MCS0	2	46	5230	Full	37.96	38.06	40.80	41.40	-		23.01			
HE80	MCS0	2	42	5210	Full	77.08	77.08	82.80	82.80	-		23.01			

TEST RESULTS DATA
Average Power Table

FCC U-NII-1 MIMO															
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	RU Config.	Average Conducted Power (dBm)			DG (dBi)		FCC EIRP Power (dBm)		FCC EIRP Limit (dBm)		Pass/Fail
						Ant 5	Ant 6	SUM	Ant 5	Ant 6	Ant 5	Ant 6	Ant 5	Ant 6	
HE20	MCS0	2	36	5180	Full	11.60	12.40	15.03	5.90		20.93		21		Pass
HE20	MCS0	2	44	5220	Full	11.30	12.60	15.01	5.90		20.91		21		Pass
HE20	MCS0	2	48	5240	Full	11.30	12.30	14.84	5.90		20.74		21		Pass
HE40	MCS0	2	38	5190	Full	11.60	12.40	15.03	5.90		20.93		21		Pass
HE40	MCS0	2	46	5230	Full	11.70	12.40	15.07	5.90		20.97		21		Pass
HE80	MCS0	2	42	5210	Full	11.30	12.20	14.78	5.90		20.68		21		Pass

TEST RESULTS DATA
Power Spectral Density

FCC U-NII-1 MIMO													
Mod.	Data Rate	NTX	CH.	Freq. (MHz)	RU Config.	Average Power Density (dBm/MHz)			Average PSD Limit (dBm/MHz)		DG (dBi)		Pass /Fail
						Ant 5	Ant 6	SUM	Ant 5	Ant 6	Ant 5	Ant 6	
HE20	MCS0	2	36	5180	Full			4.61	14.58		8.42		Pass
HE20	MCS0	2	44	5220	Full			4.51	14.58		8.42		Pass
HE20	MCS0	2	48	5240	Full			4.29	14.58		8.42		Pass
HE40	MCS0	2	38	5190	Full			1.14	14.58		8.42		Pass
HE40	MCS0	2	46	5230	Full			1.06	14.58		8.42		Pass
HE80	MCS0	2	42	5210	Full			-2.12	14.58		8.42		Pass

Appendix B. Radiated Spurious Emission

Test Engineer :	Bill Chang	Temperature :	20~25°C
		Relative Humidity :	55~61%

Band 1 - 5150~5250MHz

WIFI 802.11ax HE80 Full (Band Edge @ 3m)

WIFI Ant.	Note	Frequency	Level	Margin	Limit Line	Read Level	Antenna Factor	Path Loss	Preamp Factor	Ant Pos	Table Pos	Peak Avg.	Pol.
5+6		(MHz)	(dBµV/m)	(dB)	(dBµV/m)	(dBµV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
		5148.72	55.17	-18.83	74	40.29	33	11.35	29.47	194	213	P	H
		5147.94	47.54	-6.46	54	32.66	33	11.35	29.47	194	213	A	H
	*	5210	97.85	-	-	82.99	32.98	11.41	29.53	194	213	P	H
	*	5210	89.55	-	-	74.69	32.98	11.41	29.53	194	213	A	H
		5452.16	53.67	-20.33	74	38.91	32.9	11.62	29.76	194	213	P	H
		5459.72	44.42	-9.58	54	29.65	32.9	11.63	29.76	194	213	A	H
802.11ax													H
HE80 Full													H
CH 42		5148.46	57.38	-16.62	74	42.5	33	11.35	29.47	326	360	P	V
5210MHz		5149.76	50.31	-3.69	54	35.43	33	11.35	29.47	326	360	A	V
	*	5210	101.8	-	-	86.94	32.98	11.41	29.53	326	360	P	V
	*	5210	93.56	-	-	78.7	32.98	11.41	29.53	326	360	A	V
		5454.12	53.55	-20.45	74	38.79	32.9	11.62	29.76	326	360	P	V
		5375.72	44.71	-9.29	54	29.97	32.9	11.52	29.68	326	360	A	V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against Peak and Average limit line.

Band 1 5150~5250MHz

WIFI 802.11ax HE80 Full (Harmonic @ 3m)

WIFI Ant. 5+6	Note	Frequency (MHz)	Level (dBµV/m)	Margin (dB)	Limit Line (dBµV/m)	Read Level (dBµV)	Antenna Factor (dB/m)	Path Loss (dB)	Preamp Factor (dB)	Ant Pos (cm)	Table Pos (deg)	Peak Avg. (P/A)	Pol. (H/V)
		10420	46.4	-21.8	68.2	58.19	38.7	16.64	67.13	-	-	P	H
		15630	46.51	-27.49	74	55.88	37.28	20.1	66.75	-	-	P	H
													H
													H
													H
													H
													H
													H
													H
													H
802.11ax													H
HE80 Full													H
CH 42		10420	46.65	-21.55	68.2	58.44	38.7	16.64	67.13	-	-	P	V
5210MHz		15630	46	-28	74	55.37	37.28	20.1	66.75	-	-	P	V
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against Peak and Average limit line.
3. The emission position marked as "-" means no suspected emission found with sufficient margin against limit line or noise floor only.

Emission above 18GHz

WIFI 802.11ax HE80 Full (SHF @ 1m)

WIFI	Note	Frequency	Level	Margin	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.					Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
5+6		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11ax HE80 Full SHF		38488	43.72	-24.48	68.2	57.92	43.41	-0.5	57.11	-	-	P	H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
													H
		36192	43.3	-24.9	68.2	59.8	43.32	-1.1	58.72	-	-	P	V
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against limit line.
3. The emission position marked as "-" means no suspected emission found with sufficient margin against limit line or noise floor only.

Emission below 1GHz

WIFI 802.11ax HE80 Full (LF @ 3m)

WIFI	Note	Frequency	Level	Margin	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.					Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
5+6		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11ax HE80 Full LF		138.27	38.96	-4.54	43.5	52.11	17.58	1.69	32.42	189	285	Q	H
		176.34	42.6	-0.9	43.5	57.82	15.26	1.87	32.35	154	63	Q	H
		230.88	42.83	-3.17	46	56.74	16.29	2.21	32.41	100	35	Q	H
		475	38.5	-7.5	46	44.42	23.49	3.2	32.61	-	-	P	H
		589.1	36.47	-9.53	46	40.4	25.17	3.64	32.74	-	-	P	H
		885.9	37.1	-8.9	46	36.14	28.42	4.55	32.01	-	-	P	H
													H
													H
													H
													H
													H
													H
		46.2	33.63	-6.37	40	49.11	16.04	0.95	32.47	100	182	Q	V
		110.24	42.05	-1.45	43.5	55.94	16.98	1.52	32.39	100	307	Q	V
		135.3	41.1	-2.4	43.5	54.33	17.51	1.67	32.41	100	307	Q	V
		232.28	38	-8	46	51.76	16.44	2.21	32.41	100	10	Q	V
		475.7	36.62	-9.38	46	42.52	23.5	3.21	32.61	-	-	P	V
		766.2	36.96	-9.04	46	37.59	27.62	4.26	32.51	-	-	P	V
		885.9	33.79	-12.21	46	32.83	28.42	4.55	32.01	-	-	P	V
													V
													V
													V
													V
													V

Remark

1. No other spurious found.
2. All results are PASS against limit line.
3. The emission position marked as “-” means no suspected emission found and emission level has at least 6dB margin against limit or emission is noise floor only.

Note symbol

*	**Fundamental Frequency** which can be ignored. However, the level of any unwanted emissions shall not exceed the level of the fundamental frequency.
!	Test result is **Margin limit** line.
P/A	**P**eak or **A**v
H/V	**H**orizontal or **V**ertical

A calculation example for radiated spurious emission is shown as below:

WIFI	Note	Frequency	Level	Margin	Limit	Read	Antenna	Path	Preamp	Ant	Table	Peak	Pol.
Ant.					Line	Level	Factor	Loss	Factor	Pos	Pos	Avg.	
5+6		(MHz)	(dBμV/m)	(dB)	(dBμV/m)	(dBμV)	(dB/m)	(dB)	(dB)	(cm)	(deg)	(P/A)	(H/V)
802.11a CH 36 5180MHz		5150	55.45	-18.55	74	54.51	32.22	4.58	35.86	103	308	P	H
		5150	43.54	-10.46	54	42.6	32.22	4.58	35.86	103	308	A	H

1. Path Loss(dB) = Cable loss(dB) + Filter loss(dB) + Attenuator loss(dB)
2. Level(dBμV/m) = Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)
3. Margin (dB) = Level(dBμV/m) – Limit Line(dBμV/m)

For Peak Limit @ 5150MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 54.51(dBμV) – 35.86 (dB)

= 55.45 (dBμV/m)

2. Margin (dB)

= LevμV/m) – Limit Line(dBμV/m)

= 55.45(dBμV/m) – 74(dBμV/m)

= -18.55(dB)

For Average Limit @ 5150MHz:

1. Level(dBμV/m)

= Antenna Factor(dB/m) + Path Loss(dB) + Read Level(dBμV) - Preamp Factor(dB)

= 32.22(dB/m) + 4.58(dB) + 42.6(dBμV) – 35.86 (dB)

= 43.54 (dBμV/m)

2. Margin (dB) = Level(dBμV/m) – Limit Line(dBμV/m)

= 43.54 (dBμV/m) – 54(dBμV/m)

= -10.46(dB)

Both peak and average measured complies with the limit line, so test result is "PASS".

Appendix C. Radiated Spurious Emission Plots

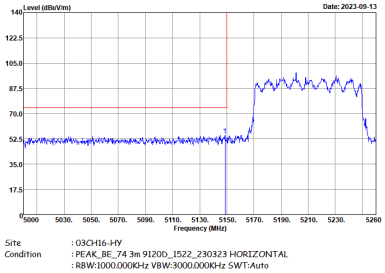
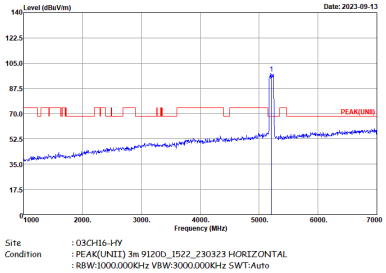
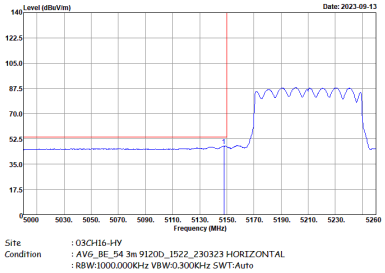
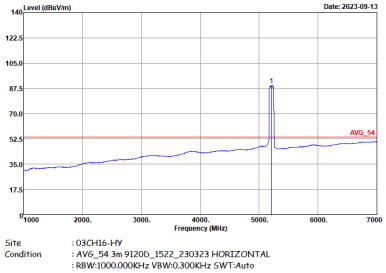
Test Engineer :	Bill Chang	**Temperature :**	20~25°C
		Relative Humidity :	55~61%

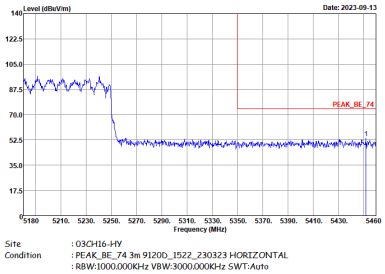
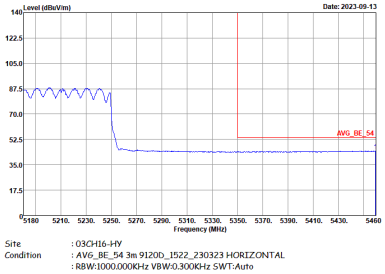
Note symbol

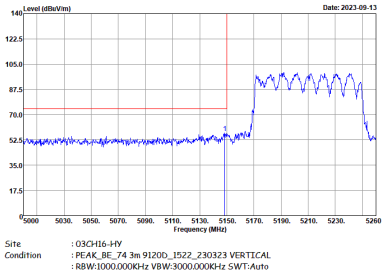
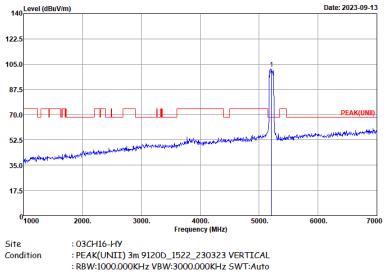
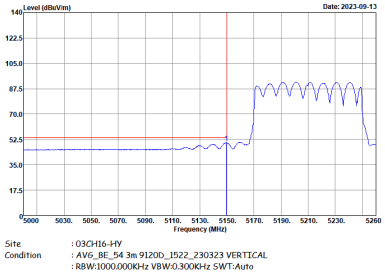
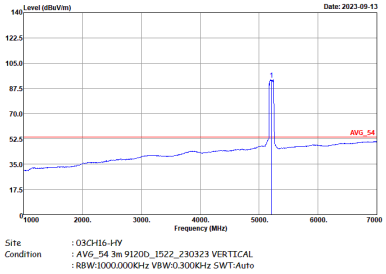
-L	**Low channel location**
-R	**High channel location**

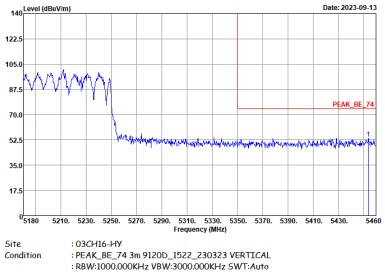
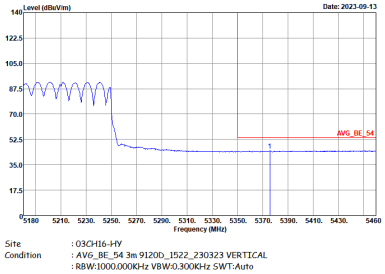
Band 1 - 5150~5250MHz

WIFI 802.11ax HE80 Full (Band Edge @ 3m)

WIFI	Band 1 5150~5250MHz Band Edge @ 3m	
ANT	802.11ax HE80 Full CH42 5210MHz - L	
5+6	Horizontal	Fundamental
Peak		
Avg.		

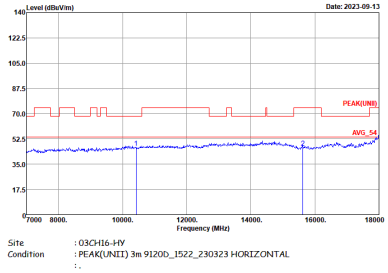
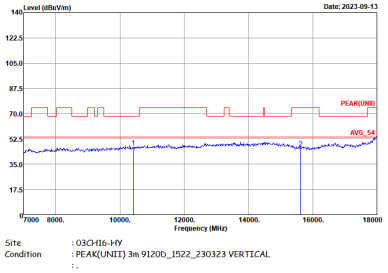
WIFI	Band 1 5150~5250MHz Band Edge @ 3m	
ANT	802.11ax HE80 Full CH42 5210MHz - R	
5+6	Horizontal	Fundamental
Peak		Left blank
Avg.		Left blank

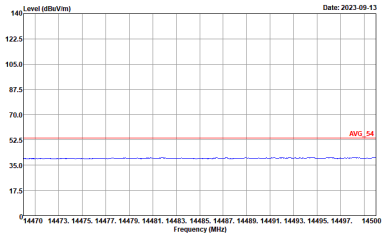
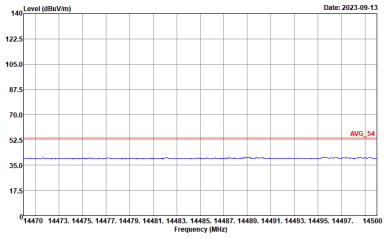
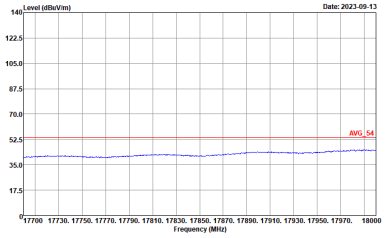
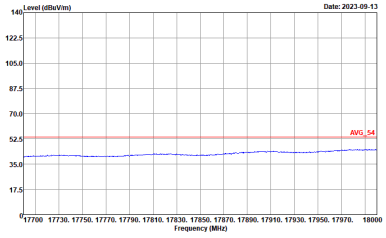
WIFI	Band 1 5150~5250MHz Band Edge @ 3m	
ANT	802.11ax HE80 Full CH42 5210MHz - L	
5+6	Vertical	Fundamental
Peak		
Avg.		

WIFI	Band 1 5150~5250MHz Band Edge @ 3m	
ANT	802.11ax HE80 Full CH42 5210MHz - R	
5+6	Vertical	Fundamental
Peak		Left blank
Avg.		Left blank

Band 1 - 5150~5250MHz

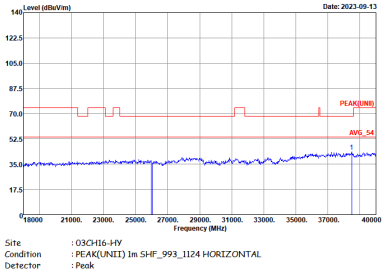
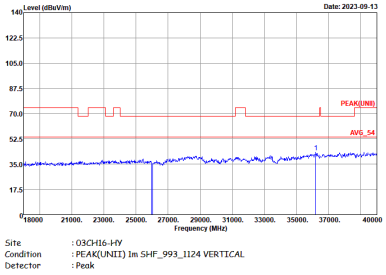
WIFI 802.11ax HE80 Full (Harmonic @ 3m)

WIFI	Band 1 5150~5250MHz Harmonic @ 3m	
ANT	802.11ax HE80 Full CH42 5210MHz	
5+6	Horizontal	Vertical
Peak Avg.		

WIFI	Band 1 5150~5250MHz Harmonic @ 3m	
ANT	802.11ax HE80 Full CH42 5210MHz	
5+6	Horizontal	Vertical
14.47G ~14.5G Avg.		
17.7G ~18G Avg		

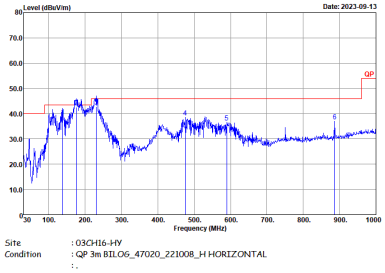
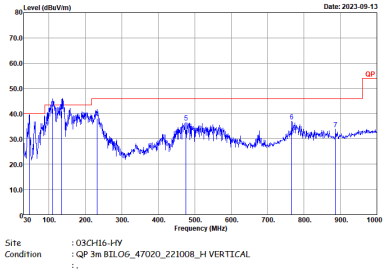
Emission above 18GHz

5GHz WIFI 802.11ax HE80 Full (SHF @ 1m)

WIFI	5GHz WIFI	
ANT	802.11ax HE80 Full SHF	
5+6	Horizontal	Vertical
Peak Avg.		

Emission below 1GHz

5GHz WIFI 802.11ax HE80 Full (LF)

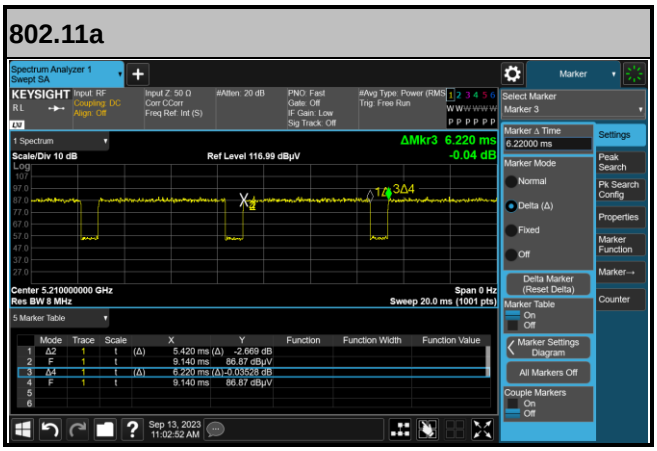
WIFI	5GHz WIFI	
ANT	802.11ax HE80 Full LF	
5+6	Horizontal	Vertical
QP / Peak		

Appendix D. Duty Cycle Plots

Antenna	Band	Duty Cycle(%)	T(us)	1/T(kHz)	VBW Setting
5+6	5GHz 802.11ax HE80 Full RU	87.14	5420	0.18	300Hz

MIMO <Ant. 5+6>

802.11a



———THE END———