RADIO TEST REPORT
FCC 47 CFR PART 15 SUBPART C

Test Standard	**FCC Part 15.247**
Product name	**802.11a/b/g/n/ac 1x1 with BT 5.0 SiP Module**
Brand Name	**USI**
Model No.	**WM-BAC-BM-25-UFL**
Test Result	**Pass**
Statements of Conformity	**Determination of compliance is based on the results of the compliance measurement, not taking into account measurement instrumentation uncertainty.**

The test Result was tested by Compliance Certification Services Inc. The test data, data evaluation, test procedures, and equipment configurations shown in this report were given in ANSI C63.10: 2013 and compliance standards.

The test results of this report relate only to the tested sample (EUT) identified in this report.
The test Report of full or partial shall not copy. Without written approval of Compliance Certification Services Inc. (Wugu Laboratory)

Approved by:

Sehni Hu
Supervisor

Unless otherwise stated the results shown in this test report refer only to the sample(s) tested and such sample(s) are retained for 90 days only.
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Revision History

Rev.		Issue Date		Revisions	Effect Page	Revised By
00		August 28, 2024		Initial Issue	ALL	Peggy Tsai

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1. GENERAL INFORMATION

1.1 EUT INFORMATION

Applicant	Universal Global Scientific Industrial Co., Ltd. No. 141, Lane 351, Sec. 1, Taiping Road, Tsaotuen, Nantou County 542007, Taiwan
Manufacturer	Universal Global Scientific Industrial Co., Ltd. No. 141, Lane 351, Sec. 1, Taiping Road, Tsaotuen, Nantou County 542007, Taiwan
Equipment	802.11a/b/g/n/ac 1x1 with BT 5.0 SiP Module
Model No.	WM-BAC-BM-25-UFL
Model Discrepancy	N/A
Trade Name	USI
Received Date	July 12, 2024
Date of Test	July 12 ~ 30, 2024
Power Operation	Power from Power supply: DC 3.6V
HW Version	V30
FW Version	dhd-1.363.125.25

Remark:
1. For more details, please refer to the User's manual of the EUT.
2. Disclaimer: Antenna information is provided by the applicant, test results of this report are applicable to the sample EUT received.

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1.2 EUT CHANNEL INFORMATION

Frequency Range	802.11b/g/n HT 20: 2412MHz ~ 2462MHz
Modulation Type	1. IEEE 802.11b mode: CCK 2. IEEE 802.11g mode: OFDM 3. IEEE 802.11n HT 20 MHz mode : OFDM
Number of channel	1. IEEE 802.11b mode: 11 Channels 2. IEEE 802.11g mode: 11 Channels 3. IEEE 802.11n HT 20 MHz mode : 11 Channels

Remark:
Refer as ANSI C63.10: 2013 clause 5.6.1 Table 4 for test channels

Number of frequencies to be tested		
Frequency range in which device operates	**Number of frequencies**	**Location in frequency range of operation**
☐ 1 MHz or less	1	Middle
☐ 1 MHz to 10 MHz	2	1 near top and 1 near bottom
☒ More than 10 MHz	3	1 near top, 1 near middle, and 1 near bottom

1.3 ANTENNA INFORMATION

Antenna Type	☐ PIFA ☐ PCB ☐ Dipole ☒ FPC Antenna
Antenna Brand / Model	Amphenol / ST0224-10-401-A
Antenna Gain	Gain: 2.10 dBi
Antenna Connector	I-PEX MHF 1

Notes:
1.The antenna(s) of the EUT are permanently attached and there are no provisions for connection to an external antenna. So the EUT complies with the requirements of §15.203.

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1.4 MEASUREMENT UNCERTAINTY

PARAMETER	UNCERTAINTY
AC Powerline Conducted Emission	± 2.213 dB
Channel Bandwidth	± 2.7 %
RF output power (Power Meter + Power sensor)	± 0.243 dB
Power Spectral density	± 2.739 dB
Conducted Bandedge	± 2.739 dB
Conducted Spurious Emission	± 2.742 dB
Radiated Emission_9kHz-30MHz	± 3.761 dB
Radiated Emission_30MHz-200MHz	± 3.473 dB
Radiated Emission_200MHz-1GHz	± 3.946 dB
Radiated Emission_1GHz-6GHz	± 4.797 dB
Radiated Emission_6GHz-18GHz	± 4.803 dB
Radiated Emission_18GHz-26GHz	± 3.459 dB
Radiated Emission_26GHz-40GHz	± 3.297 dB

Remark:
1.This uncertainty represents an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2
2. ISO/IEC 17025 requires that an estimate of the measurement uncertainties associated with the emissions test results be included in the report.

1.5 FACILITIES AND TEST LOCATION

All measurement facilities used to collect the measurement data are located at

☒ No.11, Wugong 6th Rd., Wugu Dist., New Taipei City, Taiwan.

CAB identifier: TW1309

Test site	Test Engineer	Remark
AC Conduction Room	Ben Yang	-
Radiation	Tony Chao、Ray Li	-
RF Conducted	Marco Chan	-

Remark: The lab has been recognized as the FCC accredited lab. under the KDB 974614 D01 and is listed in the FCC pubic Access Link (PAL) database, FCC Registration No. :444940, the FCC Designation No.:TW1309

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1.6 INSTRUMENT CALIBRATION

Conducted_FCC/IC/NCC (All)					
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
Power Supply	GWINSTEK	SPS-3610	GPE880163	2023-11-16	2024-11-15
Power Sensor	Anritsu	MA2411B	1726104	2024-04-16	2025-04-15
Power Sensor	Anritsu	MA2412B	1726107	2024-04-16	2025-04-15
Power Meter	Anritsu	ML2496A	1804001	2024-04-16	2025-04-15
EXA Signal Analyzer	Keysight	N9010B	MY55460167	2024-01-03	2025-01-02
Attenuator	Marvelous Microwave Ine	MVE2213-10	08	2023-11-07	2024-11-06
Software	Radio Test Software Ver. 21				

966A_Radiated Wi-Fi 2.4GHz					
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
Signal Analyzer	KEYSIGHT	N9010A	MY52220817	2024-03-15	2025-03-14
Thermo-Hygro Meter	WISEWIND	1206	D07	2023-12-08	2024-12-07
Active Loop Antenna	SCHWARZBECK	FMZB 1513-60	1513-60-028	2023-12-13	2024-12-12
Bi-Log Antenna	Sunol Sciences	JB3	A030105	2024-07-12	2025-07-11
Preamplifier	EMEC	EM330	060609	2024-02-21	2025-02-20
Cable	Huber+Suhner	104PEA	20995+21000+182330	2024-02-21	2025-02-20
Horn Antenna	ETC	MCTD 1209	DRH13M02003	2023-12-28	2024-12-27
Preamplifier	HP	8449B	3008A00965	2023-12-22	2024-12-21
Cable	EMCI	EMC101G	221213+221011+221012	2023-10-17	2024-10-16
Attenuator	Mini-Circuits	BW-S9W5	BWS9W5-09-966A-01	2024-02-07	2025-02-06
High Pass Filters	Titan Microwave	T04H30001800070S01	22011402-4	2024-06-12	2025-06-13
Horn Antenna	SCHWARZBECK	BBHA9170	1047	2023-12-13	2024-12-12
Pre-Amplifier	EMCI	EMC184045SE	980860	2023-12-12	2024-12-11
Turn Table	CCS	CC-T-1F	N/A	N.C.R	N.C.R
Controller	CCS	CC-C-1F	N/A	N.C.R	N.C.R
Antenna Tower	CCS	CC-A-1F	N/A	N.C.R	N.C.R
Software	e3 V9-210616c				

Remark:
1. Each piece of equipment is scheduled for calibration once a year.
2. N.C.R. = No Calibration Required.

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AC Mains Conduction					
Name of Equipment	**Manufacturer**	**Model**	**Serial Number**	**Calibration Date**	**Calibration Due**
EMI Test Receiver	R&S	ESCI	100064	2024-06-14	2025-06-13
LISN	TESEQ	LN2-16N	22012	2024-02-29	2025-02-27
Cable	Woken	SFL402	185A	2024-07-08	2025-07-07
Power Supply	GWINISTEK	SPS-3610	GPE880163	2023-10-16	2024-10-15
Software	e3 V6-110812				

Remark:
1. Each piece of equipment is scheduled for calibration once a year.
2. N.C.R. = No Calibration Required.

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1.7 SUPPORT AND EUT ACCESSORIES EQUIPMENT

EUT Accessories Equipment						
No.	Equipment	Brand	Model	Series No.	FCC ID	IC
C	Test Kit	N/A	N/A	N/A	N/A	N/A

Support Equipment (Conducted)					
No.	Equipment	Brand	Model	Series No.	FCC ID
1	Monitor	Viewsonic	VS16263	N/A	N/A
2	HDMI Cable	UGREEN	HD104	N/A	N/A
A	DC Cable	N/A	N/A	N/A	N/A
B	Micro USB Cable	N/A	N/A	N/A	N/A
D	PC	ASUS	D320MT	N/A	N/A

Support Equipment (RSE & Conduction)					
No.	Equipment	Brand	Model	Series No.	FCC ID
1	Monitor	View sonic	VS16263	N/A	N/A
2	MOUSE	Lenovo	300 USB	N/A	N/A
3	KeyBoard	Logitech	K120	N/A	N/A
4	DC Power Source	GWINSTEK	SPS-3610	GPE880163	N/A
5	DC Cable	MISUMI	MCR3S-RE	N/A	N/A
6	HDMI Cable	UGREEN	HD104	N/A	N/A
A	PC	ASUS	D320MT	N/A	N/A
B	Test Kit	N/A	N/A	N/A	N/A

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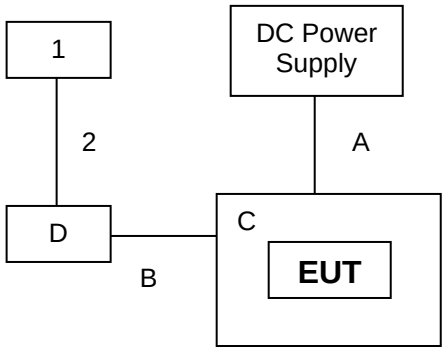
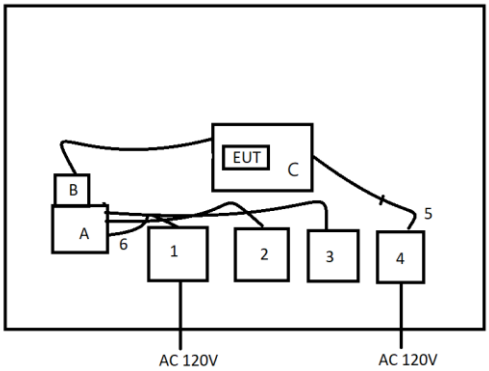
1.8 TEST SETUP DIAGRAM

Conducted	RSE & Conduction
	

1.9 TEST PROGRAM

The EUT connection corresponds to the surrounding fixture control board.
This EUT uses the Linux system setup command to set the frequency, modulation, and power to allow the sample to continuously transmit (including frequency hopping mode and Co-Location).

1.10 TEST PROGRAM

The test methodology, setups and results comply with all requirements in accordance with ANSI C63.10:2013, FCC Part 2, FCC Part 15.247, KDB 558074.

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2. TEST SUMMARY

FCC Standard Section	Report Section	Test Item	Result
15.203	1.3	Antenna Requirement	Pass
15.207(a)	4.1	AC Conducted Emission	Pass
15.247(a)(2)	4.2	6 dB Bandwidth	Pass
-	4.2	Occupied Bandwidth (99%)	Pass
15.247(b)(3)	4.3	Output Power Measurement	Pass
15.247(e)	4.4	Power Spectral Density	Pass
15.247(d)	4.5	Conducted Band Edge	Pass
15.247(d)	4.5	Conducted Emission	Pass
15.247(d) 15.205, 15.209	4.6	Radiation Band Edge	Pass
15.247(d) 15.205, 15.209	4.6	Radiation Spurious Emission	Pass

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3. DESCRIPTION OF TEST MODES

3.1 THE WORST MODE OF OPERATING CONDITION

Operation mode	IEEE 802.11b mode :1Mbps IEEE 802.11g mode :6Mbps IEEE 802.11n HT20 mode :MCS0
Test Channel Frequencies	**IEEE 802.11b mode :** 1. Lowest Channel : 2412MHz 2. Middle Channel : 2437MHz 3. Highest Channel : 2462MHz **IEEE 802.11g mode :** 1. Lowest Channel : 2412MHz 2. Middle Channel : 2437MHz 3. Highest Channel : 2462MHz **IEEE 802.11n HT20 mode :** 1. Lowest Channel : 2412MHz 2. Middle Channel : 2437MHz 3. Highest Channel : 2462MHz
Operation Transmitter	IEEE 802.11b mode :1T1R IEEE 802.11g mode :1T1R IEEE 802.11n HT20 mode : 1T1R

Remark:
1. EUT pre-scanned data rate of output power for each mode, the worst data rate were recorded in this report.
2. Based on FCC Part 15.31(m), the laboratory conducts a comprehensive evaluation of ch low, ch middle, and ch high. Other additional channels only evaluate the radiated restricted bands of operation and powers.

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3.2 THE WORST MODE OF MEASUREMENT

AC Power Line Conducted Emission	
Test Condition	AC Power line conducted emission for line and neutral
Power supply Mode	Mode 1: EUT Power by DC power Supply
Worst Mode	☒ Mode 1 ☐ Mode 2 ☐ Mode 3 ☐ Mode 4

Radiated Emission Measurement Above 1G	
Test Condition	Radiated Emission Above 1G
Power supply Mode	Mode 1: EUT power by Power Supply
Worst Mode	☒ Mode 1 ☐ Mode 2 ☐ Mode 3 ☐ Mode 4
Worst Position	☐ Placed in fixed position. ☐ Placed in fixed position at X-Plane (E2-Plane) ☐ Placed in fixed position at Y-Plane (E1-Plane) ☒ Placed in fixed position at Z-Plane (H-Plane)

Radiated Emission Measurement Below 1G	
Test Condition	Radiated Emission Below 1G
Power supply Mode	Mode 1: EUT power by Power Supply
Worst Mode	☒ Mode 1 ☐ Mode 2 ☐ Mode 3 ☐ Mode 4

Radiated Emission Measurement [Co-Location]	
Test Condition	Radiated Emission [Co-Location]
Power supply Mode	Mode 1: EUT Power by Wi-Fi 2.4G+BLE_1M Mode 2: EUT Power by Wi-Fi 2.4G+BT BR Mode 3: EUT Power by Wi-Fi 5G+BLE_1M Mode 4: EUT Power by Wi-Fi 5G+BT BR
Worst Mode	☐ Mode 1 ☐ Mode 2 ☐ Mode 3 ☒ Mode 4

Remark:

1. The worst mode was record in this test report.
2. AC power line conducted emission were performed the EUT transmit at the highest output power channel as worse case.
3. EUT pre-scanned in three axis ,X,Y, Z and two polarity, for radiated measurement. The worst case(Z -Plane) were recorded in this report

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3.3 EUT DUTY CYCLE

Temperature: 22.1 ~ 25.2℃ **Test date:** July 12 ~ 30, 2024

Humidity: 50 ~ 60% RH **Tested by:** Marco Chan

Mode	Duty Cycle (%) = Ton / (Ton+Toff)	Duty Factor (dB) =10*log (1/Duty Cycle)	1/T (kHz)	VBW setting (kHz)
802.11b	99.23	0.03	0.08	0.01
802.11g	95.25	0.21	0.48	1.00
802.11n_20	94.91	0.23	0.52	1.00

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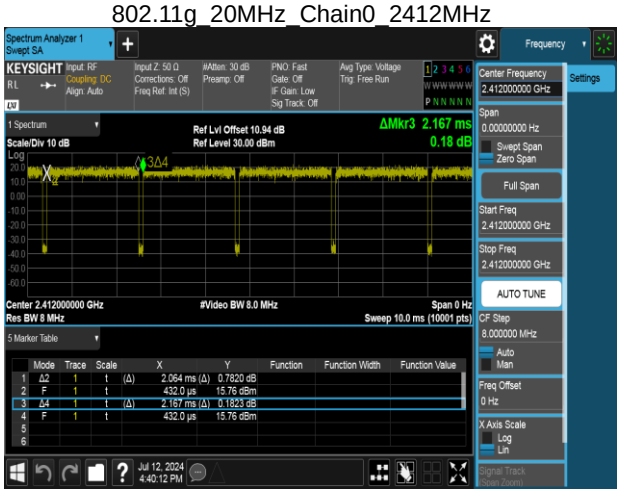
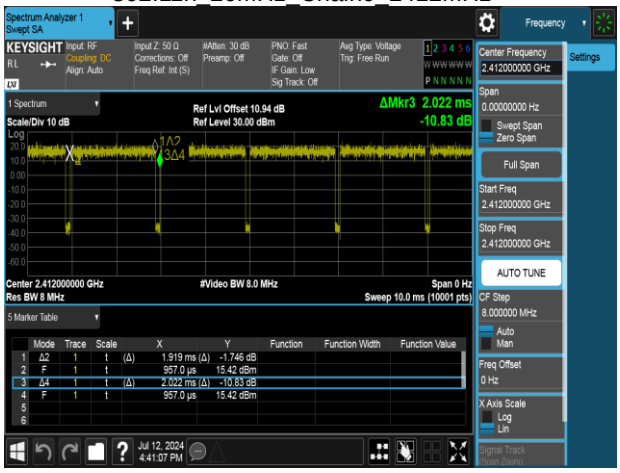
802.11b_20MHz_Chain0_2412MHz

802.11g_20MHz_Chain0_2412MHz



802.11n_20MHz_Chain0_2412MHz



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4. TEST RESULT

4.1 AC POWER LINE CONDUCTED EMISSION

4.1.1 Test Limit

According to §15.207(a)(2),

Frequency Range (MHz)	Limits(dBμV)	
	Quasi-peak	Average
0.15 to 0.50	66 to 56*	56 to 46*
0.50 to 5	56	46
5 to 30	60	50

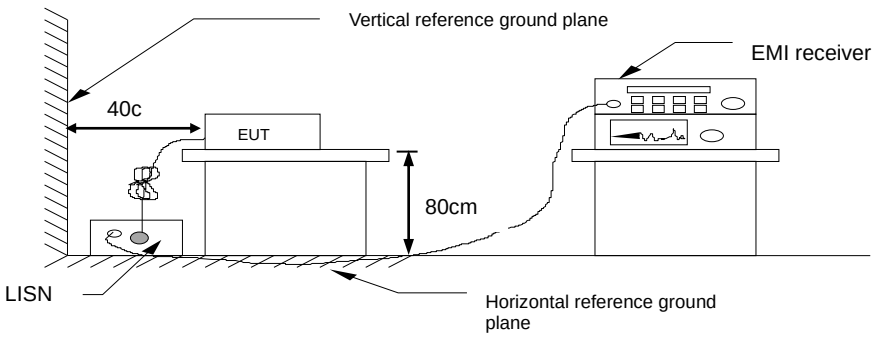
* Decreases with the logarithm of the frequency.

4.1.2 Test Procedure

Test method Refer as ANSI C63.10: 2013 clause 6.2,

1. The EUT was placed on a non-conducted table, which is 0.8m above horizontal ground plane and 0.4m above vertical ground plane.
2. EUT connected to the line impedance stabilization network (LISN)
3. Receiver set RBW of 9kHz and Detector Peak, and note as quasi-peak and average.
4. Maximum procedure was performed on the six highest emissions to ensure EUT compliance.
5. Recorded Line for Neutral and Line.

4.1.3 Test Setup



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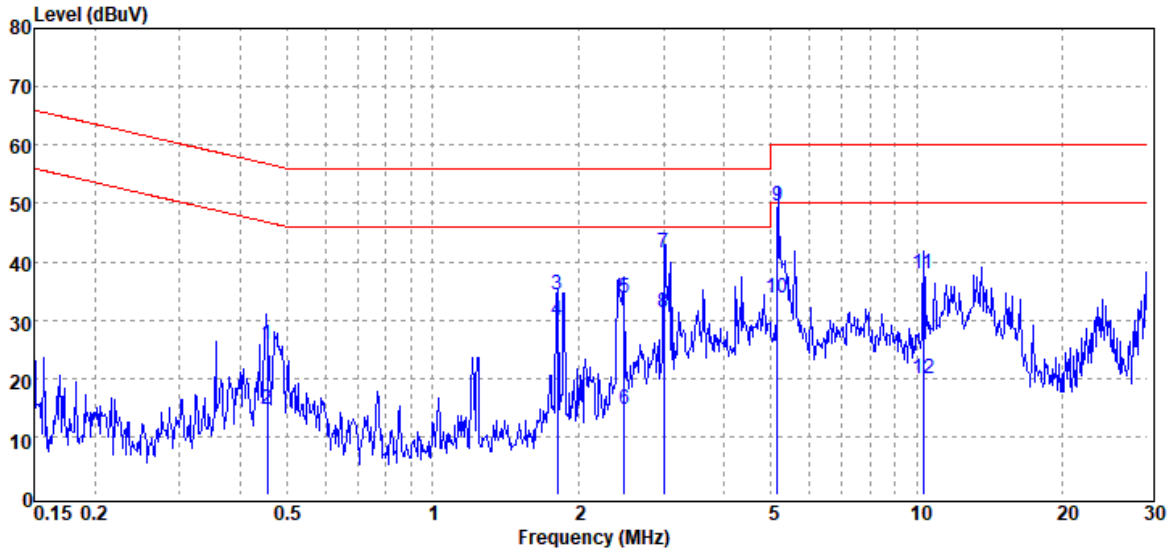
4.1.4 Test Result

Project No	: TM-2407000112P	Test Date	: 2024-07-22
Operation Mode	: 2.4G	Temp./Humi.	: 23.4°C/ 54%
Test Chamber	: Conduction	Engineer	: Ben Yang
Probe	: LINE	Test Voltage	: AC 120V/60Hz
Note	:		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Read Level dBµV	Factor dB	Actual FS dBµV	Limit dBµV	Margin dB
0.456	QP	25.38	0.38	25.76	56.77	-31.01
0.456	Average	14.34	0.38	14.72	46.77	-32.05
1.812	QP	34.06	0.18	34.24	56.00	-21.76
1.812	Average	29.82	0.18	30.00	46.00	-16.00
2.485	QP	33.48	0.20	33.68	56.00	-22.32
2.485	Average	14.34	0.20	14.54	46.00	-31.46
3.006	QP	41.34	0.22	41.56	56.00	-14.44
3.006	Average	30.94	0.22	31.16	46.00	-14.84
5.158	QP	49.21	0.27	49.48	60.00	-10.52
5.158	Average	33.41	0.27	33.68	50.00	-16.32
10.301	QP	37.53	0.36	37.89	60.00	-22.11
10.301	Average	19.59	0.36	19.95	50.00	-30.05

Note: 1. Actual FS= Spectrum Read Level + Factor
Note: 2. Margin= Actual FS - Limit

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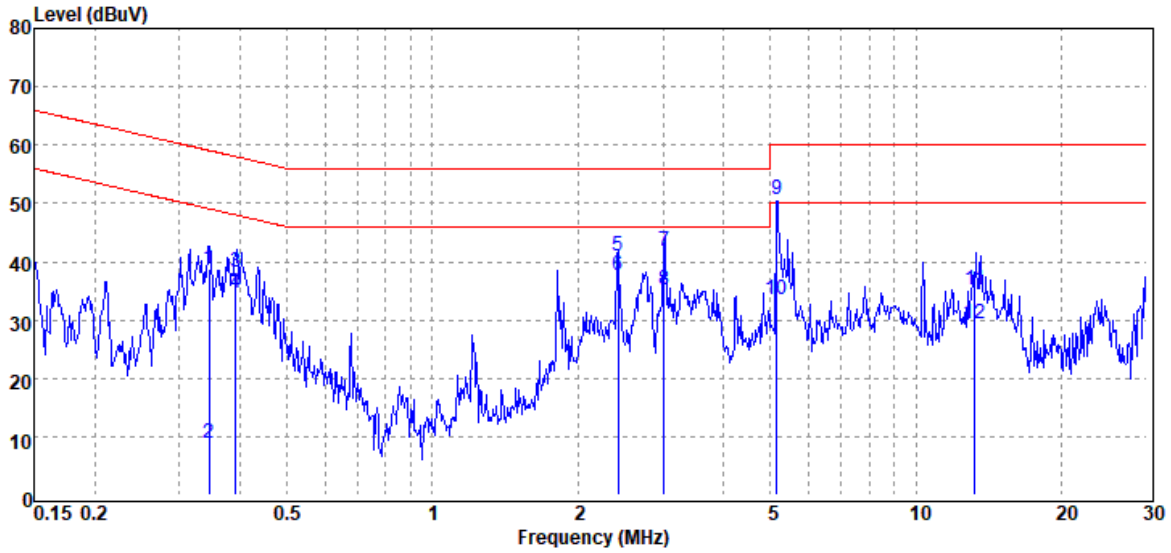
Project No	: TM-2407000112P	Test Date	: 2024-07-22
Operation Mode	: 2.4G	Temp./Humi.	: 23.4°C/ 54%
Test Chamber	: Conduction	Engineer	: Ben Yang
Probe	: NEUTRAL	Test Voltage	: AC 120V/60Hz
Note	:		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Read Level dBµV	Factor dB	Actual FS dBµV	Limit dBµV	Margin dB
0.346	QP	38.51	0.35	38.86	59.06	-20.20
0.346	Average	8.55	0.35	8.90	49.06	-40.16
0.392	QP	37.95	0.35	38.30	58.03	-19.73
0.392	Average	34.23	0.35	34.58	48.03	-13.45
2.417	QP	40.79	0.18	40.97	56.00	-15.03
2.417	Average	37.34	0.18	37.52	46.00	-8.48
3.016	QP	41.67	0.19	41.86	56.00	-14.14
3.016	Average	34.90	0.19	35.09	46.00	-10.91
5.155	QP	50.32	0.25	50.57	60.00	-9.43
5.155	Average	33.28	0.25	33.53	50.00	-16.47
13.253	QP	34.80	0.38	35.18	60.00	-24.82
13.253	Average	28.95	0.38	29.33	50.00	-20.67

Note: 1. Actual FS= Spectrum Read Level + Factor
Note: 2. Margin= Actual FS - Limit

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4.2 6dB BANDWIDTH AND OCCUPIED BANDWIDTH (99%)

4.2.1 Test Limit

According to §15.247(a)(2),

6 dB Bandwidth ：

Limit	Shall be at least 500kHz

Occupied Bandwidth(99%) ： For reporting purposes only.

4.2.2 Test Procedure

Test method Refer as KDB 558074 D01 and ANSI C63.10: 2013 clause 6.9.2,

1. The EUT RF output connected to the spectrum analyzer by RF cable.
2. Setting maximum power transmit of EUT
3. SA set RBW = 100kHz, VBW = 300kHz and Detector = Peak, to measurement 6 dB Bandwidth.
4. SA set RBW = 1% ~ 5% OBW, VBW = three times the RBW and Detector = Peak, to measurement 99% Bandwidth
5. Measure and record the result of 6 dB Bandwidth and 99% Bandwidth. in the test report.

4.2.3 Test Setup

Refer to section 1.8.

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4.2.4 Test Result

Temperature:	22.1 ~ 25.2℃	**Test date:**	July 12 ~ 30, 2024
Humidity:	50 ~ 60% RH	**Tested by:**	Marco Chan

6dB BANDWIDTH

802.11b Ch0

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	8137.00	≧ 500	PASS
2437	**9053.00**	≧ 500	PASS
2462	8588.00	≧ 500	PASS

802.11g Ch0

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	15370.00	≧ 500	PASS
2437	**16350.00**	≧ 500	PASS
2462	15830.00	≧ 500	PASS

802.11n_HT_20M Ch0

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	15510.00	≧ 500	PASS
2437	15520.00	≧ 500	PASS
2462	**16500.00**	≧ 500	PASS

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BANDWIDTH 99%

802.11b Ch0

Freq. (MHz)	99% BW (MHz)
2412	12.183
2437	**12.333**
2462	12.138

802.11g Ch0

Freq. (MHz)	99% BW (MHz)
2412	16.653
2437	**16.982**
2462	16.750

802.11n_HT20M Ch0

Freq. (MHz)	99% BW (MHz)
2412	**17.875**
2437	17.822
2462	17.872

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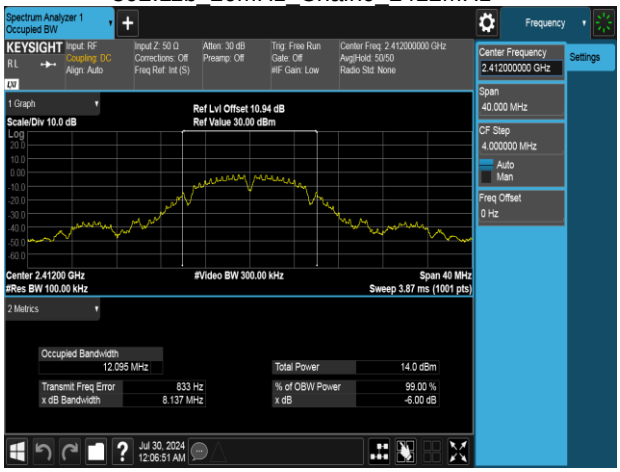
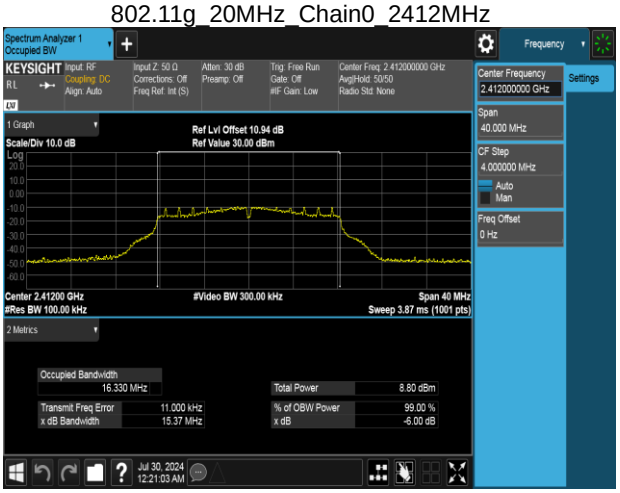
Test Data

6dB BANDWIDTH

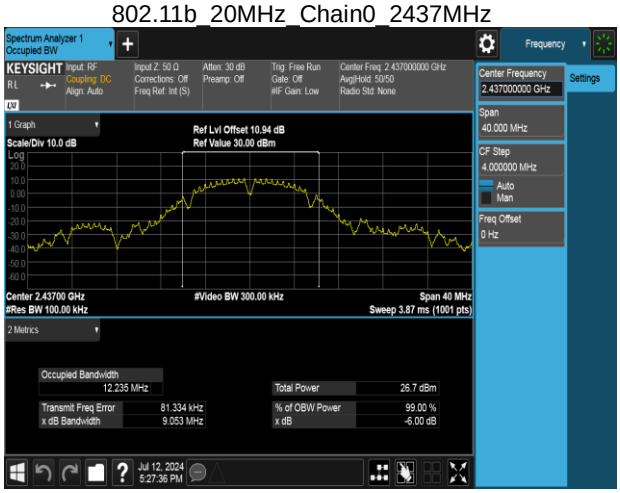
802.11b_20MHz_Chain0_2412MHz



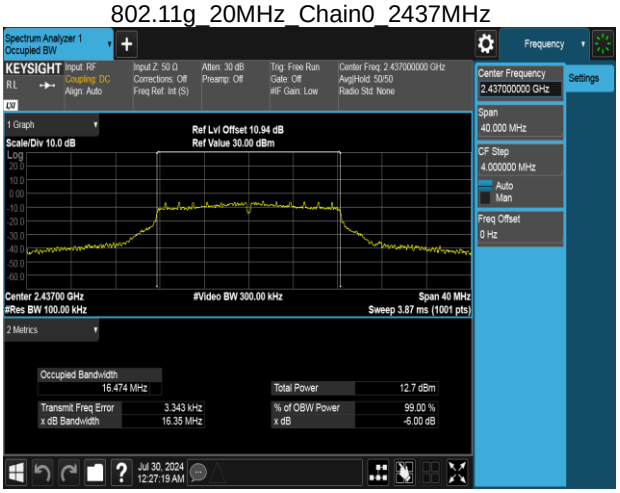
802.11g_20MHz_Chain0_2412MHz



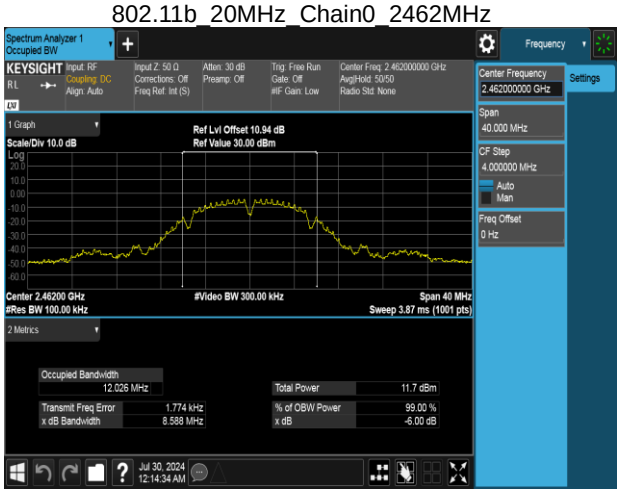
802.11b_20MHz_Chain0_2437MHz



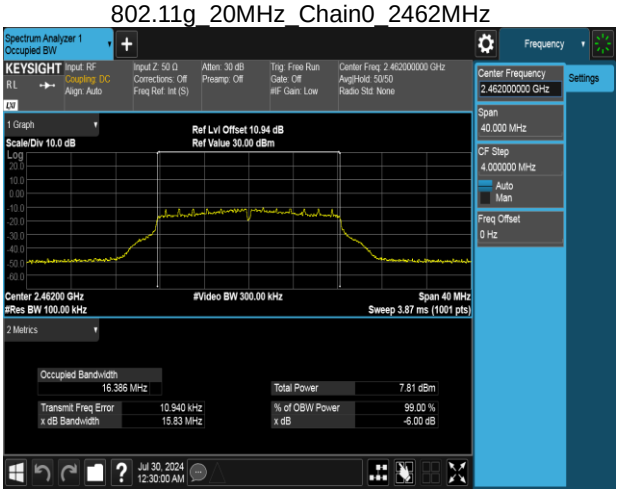
802.11g_20MHz_Chain0_2437MHz



802.11b_20MHz_Chain0_2462MHz



802.11g_20MHz_Chain0_2462MHz



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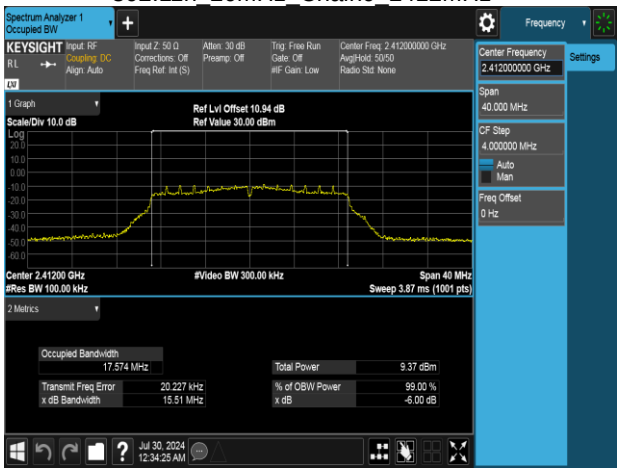
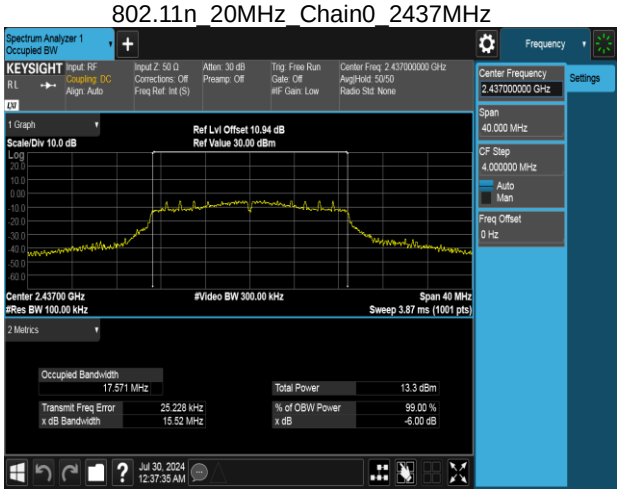
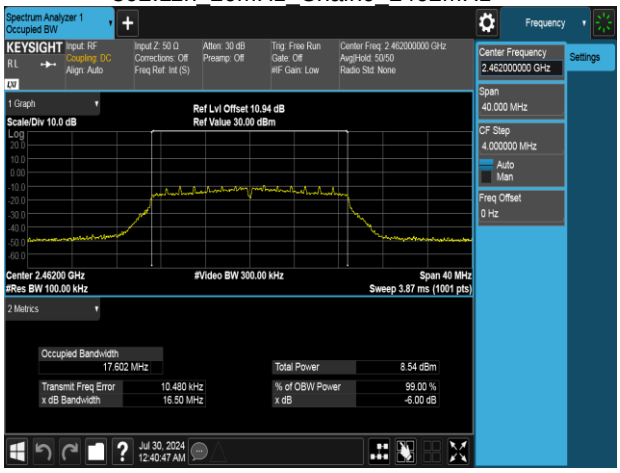
802.11n_20MHz_Chain0_2412MHz



802.11n_20MHz_Chain0_2437MHz



802.11n_20MHz_Chain0_2462MHz



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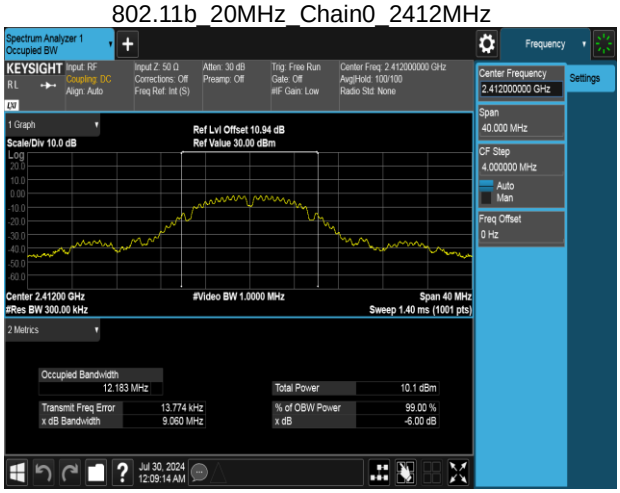
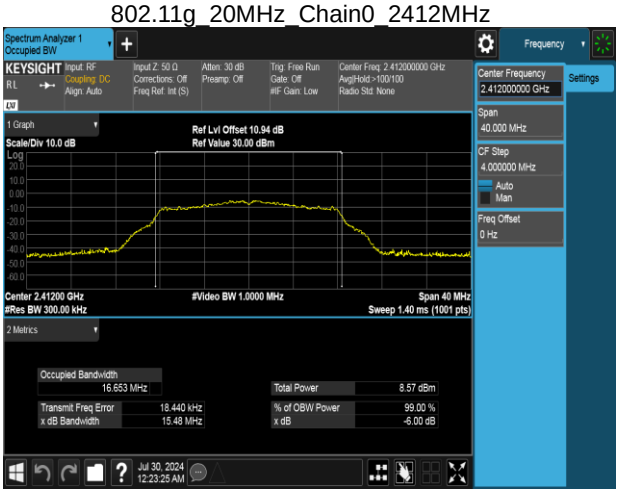
BANDWIDTH 99%

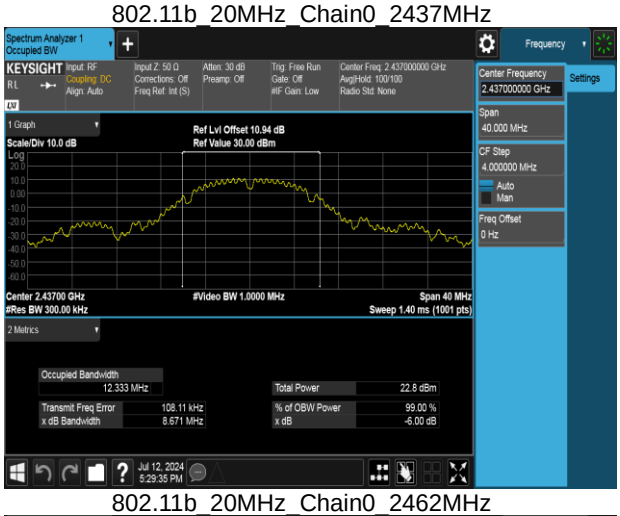
802.11b_20MHz_Chain0_2412MHz



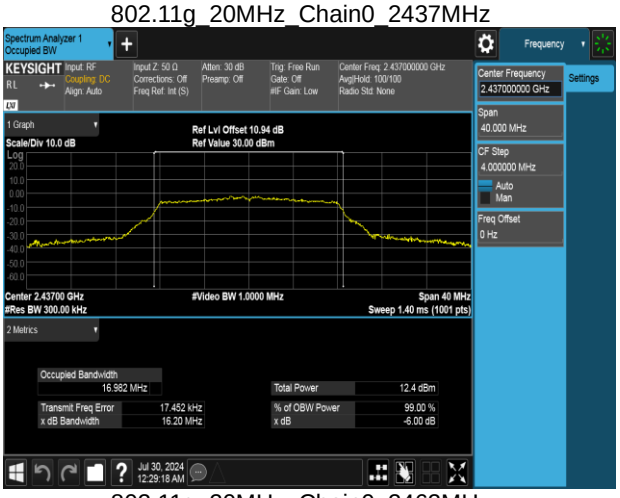
802.11g_20MHz_Chain0_2412MHz



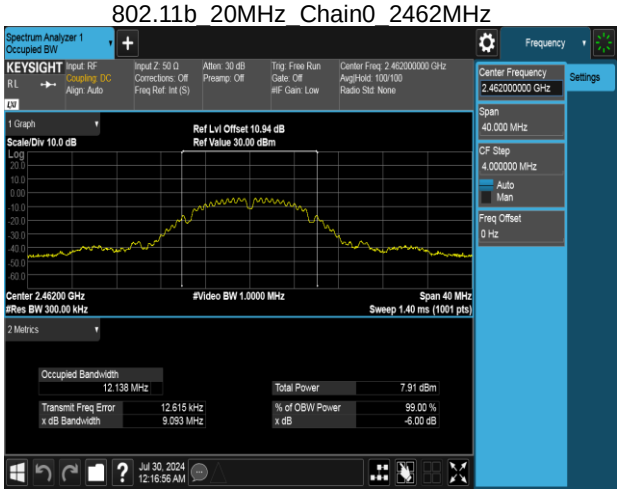
802.11b_20MHz_Chain0_2437MHz



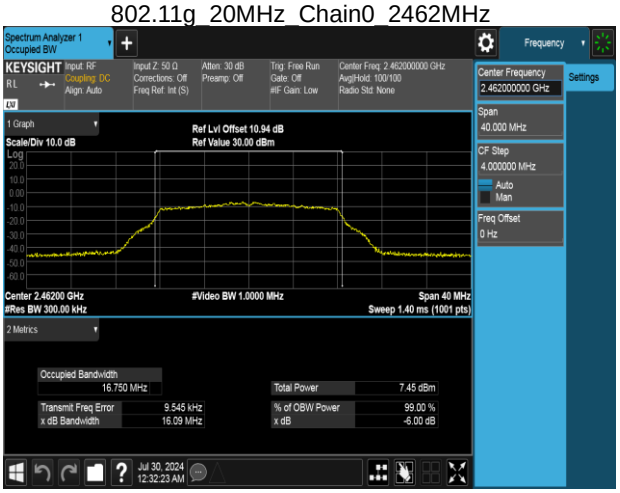
802.11g_20MHz_Chain0_2437MHz



802.11b_20MHz_Chain0_2462MHz



802.11g_20MHz_Chain0_2462MHz



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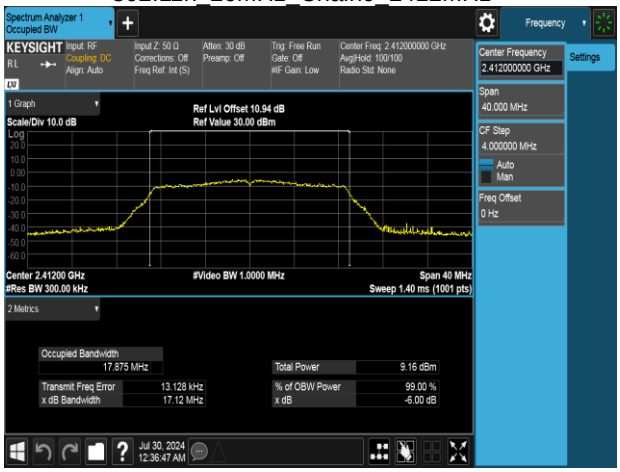
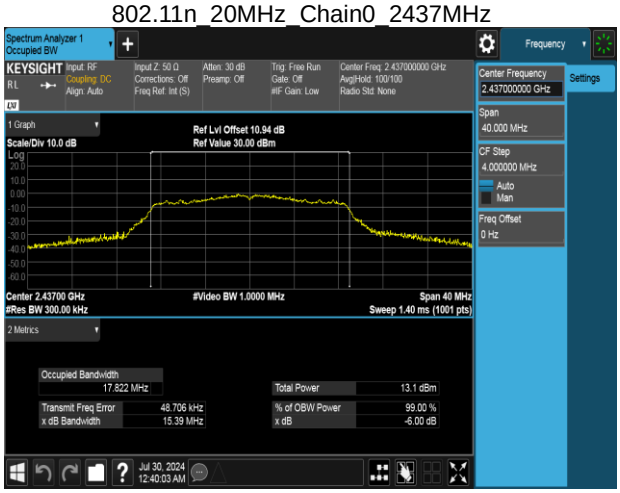
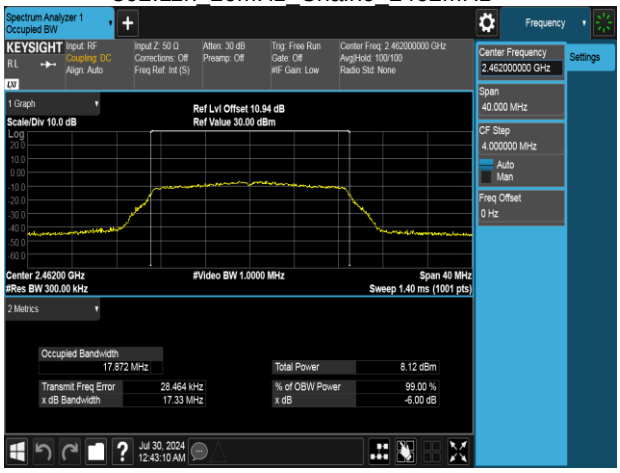
802.11n_20MHz_Chain0_2412MHz



802.11n_20MHz_Chain0_2437MHz



802.11n_20MHz_Chain0_2462MHz



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4.3 OUTPUT POWER MEASUREMENT

4.3.1 Test Limit

According to §15.247(b),

Peak output power：

For systems using digital modulation in the 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt(30 dBm) and the e.i.r.p. shall not exceed 4Watt(36 dBm), base on the use of antennas with directional gain not exceed 6 dBi If transmitting antennas of directional gain greater than 6dBi are used the peak output power the conducted output power from the intentional radiator shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi. In case of point-to-point operation, the limit has to be reduced by 1dB for every 3 dB that the directional gain of the antenna exceeds 6 dBi.

Limit	☒ Antenna not exceed 6 dBi：30dBm ☐ Antenna with DG greater than 6 dBi： [Limit = 30 – (DG – 6)] ☐ Point-to-point operation：

Average output power：For reporting purposes only.

4.3.2 Test Procedure

Test method Refer as KDB 558074 D01.

1. The EUT RF output connected to the power meter by RF cable.
2. Setting maximum power transmit of EUT.
3. The path loss was compensated to the results for each measurement.
4. Measure and record the result of Peak output power and Average output power. in the test report.

4.3.3 Test Setup

Refer to section 1.8.

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4.3.4 Test Result

Temperature: 22.1 ~ 25.2℃ **Test date:** July 12 ~ 30, 2024

Humidity: 50 ~ 60% RH **Tested by:** Marco Chan

Peak & Average output power：

802.11b Ch0							
CH	Freq. (MHz)	Data Rate	Power Setting	Peak Output Power (mW)	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	1	74	101.39	20.06	30.00	PASS
2	2417	1	80	142.56	21.54	30.00	PASS
6	2437	1	81	153.11	**21.85**	30.00	PASS
8	2447	1	81	150.31	21.77	30.00	PASS
9	2452	1	79	130.02	21.14	30.00	PASS
10	2457	1	74	95.72	19.81	30.00	PASS
11	2462	1	65	59.02	17.71	30.00	PASS
802.11b Ch0							
CH	Freq. (MHz)	Data Rate	Power Setting	Avg. Output Power (mW)	Avg. Output Power (dBm)	Limit (dBm)	RESULT
1	2412	1	74	52.16	17.17	30.00	PASS
2	2417	1	80	75.40	18.77	30.00	PASS
6	2437	1	81	77.87	**18.91**	30.00	PASS
8	2447	1	81	75.57	18.78	30.00	PASS
9	2452	1	79	65.82	18.18	30.00	PASS
10	2457	1	74	48.12	16.82	30.00	PASS
11	2462	1	65	30.09	14.78	30.00	PASS

Note: Measured by power meter, cable loss + Duty cycle factor has been offseted to the power meter for Avg. power and cable loss has been offseted for Peak power measurement.

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802.11g Ch0							
CH	Freq. (MHz)	Data Rate	Power Setting	Peak Output Power (mW)	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	6	53	164.44	22.16	30.00	PASS
2	2417	6	59	198.61	22.98	30.00	PASS
3	2422	6	61	207.97	23.18	30.00	PASS
4	2427	6	64	212.32	23.27	30.00	PASS
5	2432	6	71	220.80	23.44	30.00	PASS
6	2437	6	71	229.61	**23.61**	30.00	PASS
8	2447	6	71	225.42	23.53	30.00	PASS
9	2452	6	69	222.33	23.47	30.00	PASS
10	2457	6	62	216.77	23.36	30.00	PASS
11	2462	6	49	139.64	21.45	30.00	PASS
802.11g Ch0							
CH	Freq. (MHz)	Data Rate	Power Setting	Avg. Output Power (mW)	Avg. Output Power (dBm)	Limit (dBm)	RESULT
1	2412	6	53	16.68	12.22	30.00	PASS
2	2417	6	59	20.80	13.18	30.00	PASS
3	2422	6	61	22.55	13.53	30.00	PASS
4	2427	6	64	26.43	14.22	30.00	PASS
5	2432	6	71	38.38	15.84	30.00	PASS
6	2437	6	71	40.38	**16.06**	30.00	PASS
8	2447	6	71	37.51	15.74	30.00	PASS
9	2452	6	69	34.21	15.34	30.00	PASS
10	2457	6	62	24.11	13.82	30.00	PASS
11	2462	6	49	12.98	11.13	30.00	PASS

Note: Measured by power meter, cable loss + Duty cycle factor has been offseted to the power meter for Avg. power and cable loss has been offseted for Peak power measurement.

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802.11n_HT_20M Ch0							
CH	Freq. (MHz)	Data Rate	Power Setting	Peak Output Power (mW)	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	MCS0	57	192.31	22.84	30.00	PASS
2	2417	MCS0	62	217.27	23.37	30.00	PASS
3	2422	MCS0	65	221.82	23.46	30.00	PASS
4	2427	MCS0	68	226.99	23.56	30.00	PASS
5	2432	MCS0	74	244.34	23.88	30.00	PASS
6	2437	MCS0	74	246.60	**23.92**	30.00	PASS
9	2452	MCS0	74	239.33	23.79	30.00	PASS
10	2457	MCS0	71	225.42	23.53	30.00	PASS
11	2462	MCS0	53	160.32	22.05	30.00	PASS
802.11n_HT_20M Ch0							
CH	Freq. (MHz)	Data Rate	Power Setting	Avg. Output Power (mW)	Avg. Output Power (dBm)	Limit (dBm)	RESULT
1	2412	MCS0	57	18.48	12.67	30.00	PASS
2	2417	MCS0	62	22.58	13.54	30.00	PASS
3	2422	MCS0	65	25.69	14.10	30.00	PASS
4	2427	MCS0	68	29.83	14.75	30.00	PASS
5	2432	MCS0	74	41.37	16.17	30.00	PASS
6	2437	MCS0	74	43.52	**16.39**	30.00	PASS
9	2452	MCS0	74	43.02	16.34	30.00	PASS
10	2457	MCS0	71	37.04	15.69	30.00	PASS
11	2462	MCS0	53	14.28	11.55	30.00	PASS

Note: Measured by power meter, cable loss + Duty cycle factor has been offseted to the power meter for Avg. power and cable loss has been offseted for Peak power measurement.

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4.4 POWER SPECTRAL DENSITY

4.4.1 Test Limit

According to §15.247(e),

For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

Limit	☒ Antenna not exceed 6 dBi：8dBm ☐ Antenna with DG greater than 6 dBi： [Limit = 8 – (DG – 6)] ☐ Point-to-point operation：

4.4.2 Test Procedure

Test method Refer as KDB 558074 D01

1. The EUT RF output connected to the spectrum analyzer by RF cable.
2. Setting maximum power transmit of EUT
3. SA set RBW = 3kHz, VBW = 10kHz, Span = 1.5 times DTS Bandwidth (6 dB BW), Detector = Peak, Sweep Time = Auto and Trace = Max hold.
4. The path loss were compensated to the results for each measurement by SA.
5. Mark the maximum level.
6. Measure and record the result of power spectral density. in the test report.

4.4.3 Test Setup

Refer to section 1.8.

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4.4.4 Test Result

Temperature: 22.1 ~ 25.2℃ **Test date:** July 12 ~ 30, 2024

Humidity: 50 ~ 60% RH **Tested by:** Marco Chan

POWER DENSITY 802.11b				
Freq. (MHz)	Ch0 PSD	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
2412	-15.9	-15.87	8.00	PASS
2437	-2.12	-2.12	8.00	PASS
2462	-18.1	-18.09	8.00	PASS

POWER DENSITY 802.11g				
Freq. (MHz)	Ch0 PSD	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
2412	-20.9	-20.86	8.00	PASS
2437	-18.4	-18.44	8.00	PASS
2462	-23.3	-23.28	8.00	PASS

POWER DENSITY 802.11n HT20				
Freq. (MHz)	Ch0 PSD	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
2412	-22	-21.96	8.00	PASS
2437	-17.5	-17.51	8.00	PASS
2462	-23.00	-23.00	8.00	PASS

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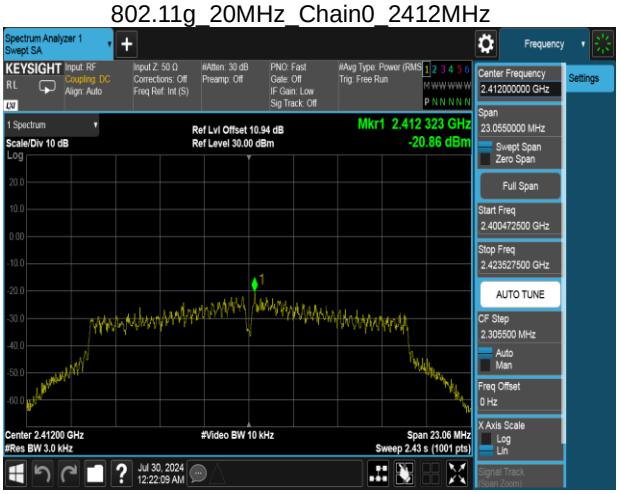
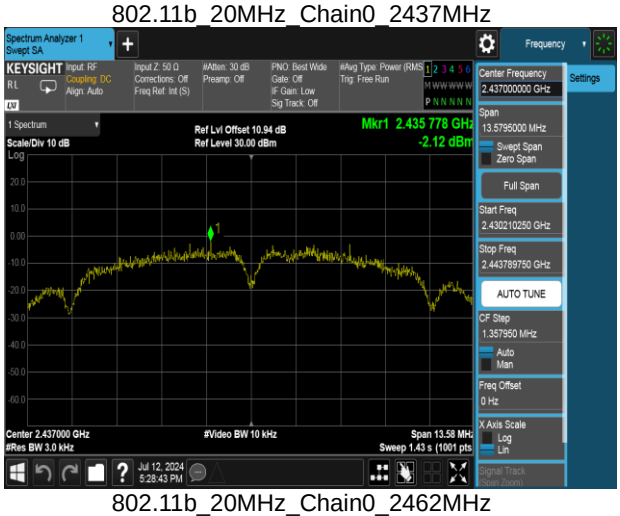
Test Data

802.11b_20MHz_Chain0_2412MHz

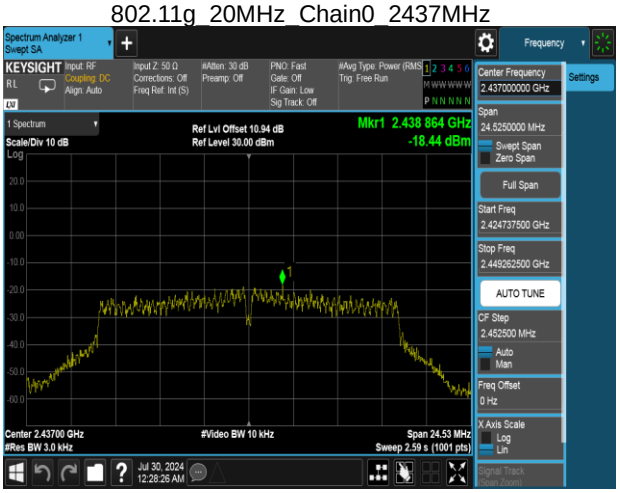
802.11g_20MHz_Chain0_2412MHz



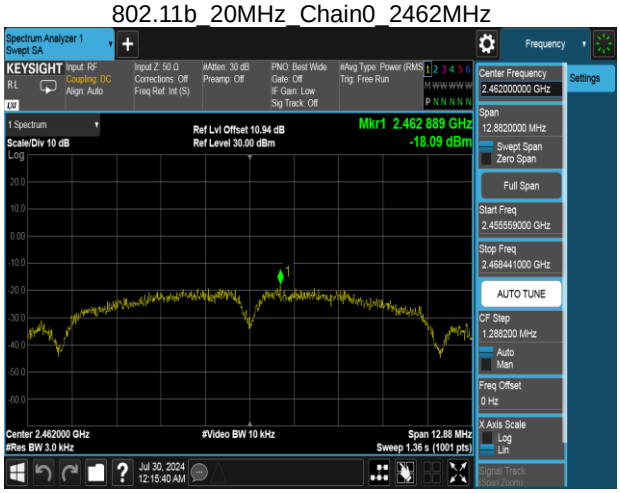
802.11b_20MHz_Chain0_2437MHz



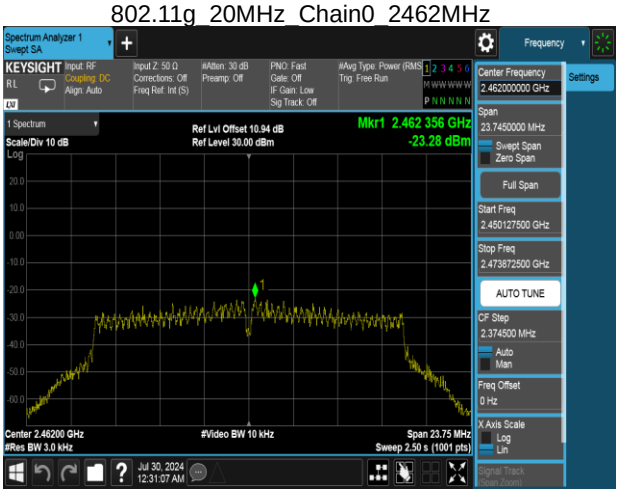
802.11g_20MHz_Chain0_2437MHz



802.11b_20MHz_Chain0_2462MHz



802.11g_20MHz_Chain0_2462MHz



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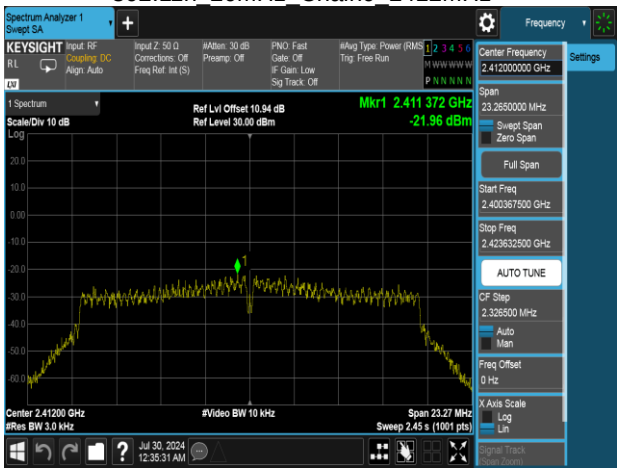
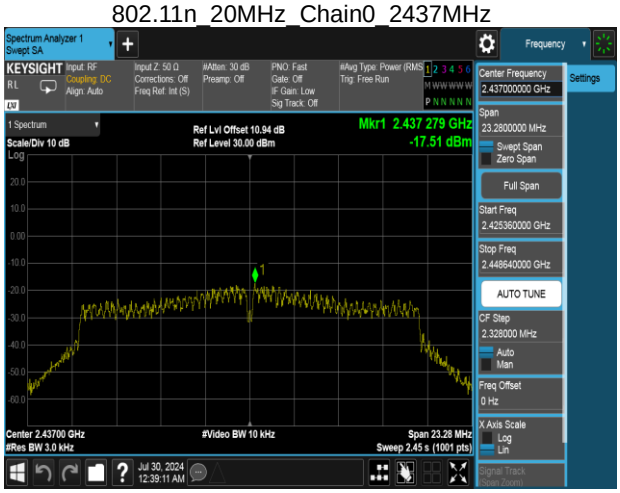
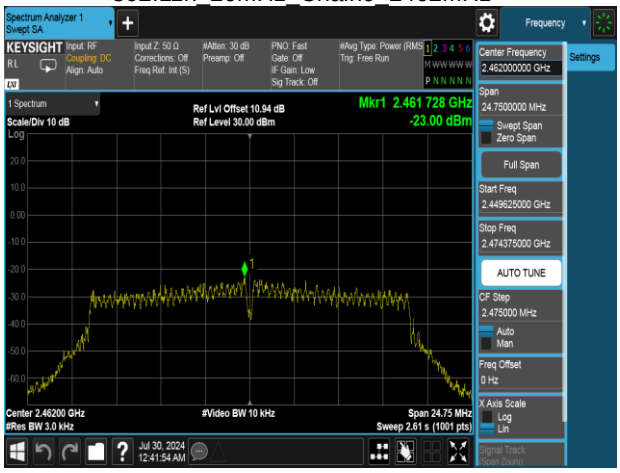
802.11n_20MHz_Chain0_2412MHz



802.11n_20MHz_Chain0_2437MHz



802.11n_20MHz_Chain0_2462MHz



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4.5 CONDUCTED BANDEDGE AND SPURIOUS EMISSION

4.5.1 Test Limit

According to §15.247(d),

In any 100 kHz bandwidth outside the authorized frequency band,

Non-restricted bands shall be attenuated at least 20 dB/30 dB relative to the maximum PSD level in 100 kHz by RF conducted or a radiated measurement which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a).

4.5.2 Test Procedure

Test method Refer as KDB 662911 D01, KDB 558074 D01.

1. EUT RF output port connected to the SA by RF cable, and the path loss was compensated to result.

2. SA setting, RBW=100kHz, VBW=300kHz, Detector=Peak, Trace mode = max hold, SWT = Auto.

3. In any 100 kHz bandwidth outside the authorized frequency band, shall be attenuated at least 20 dB relative to the maximum in-band peak PSD level in 100 kHz when conducted power procedure is used. f the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, the attenuation required under this paragraph shall be 30 dB instead of 20 dB.

4.5.3 Test Setup

Refer to section 1.8.

4.5.4 Test Result

Temperature:	22.1 ~ 25.2℃	**Test date:**	July 12 ~ 30, 2024
Humidity:	50 ~ 60% RH	**Tested by:**	Marco Chan

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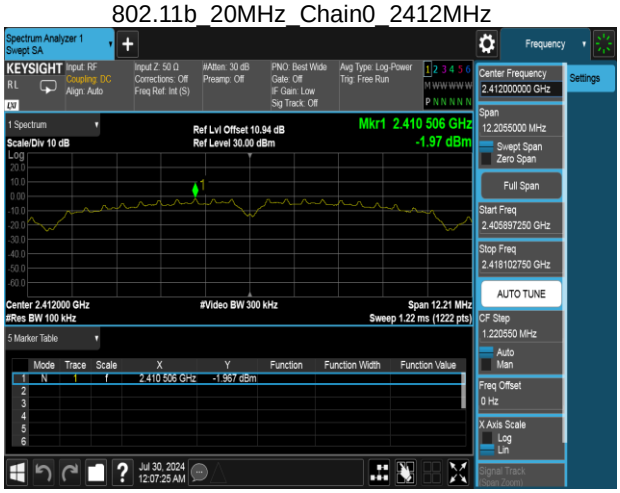
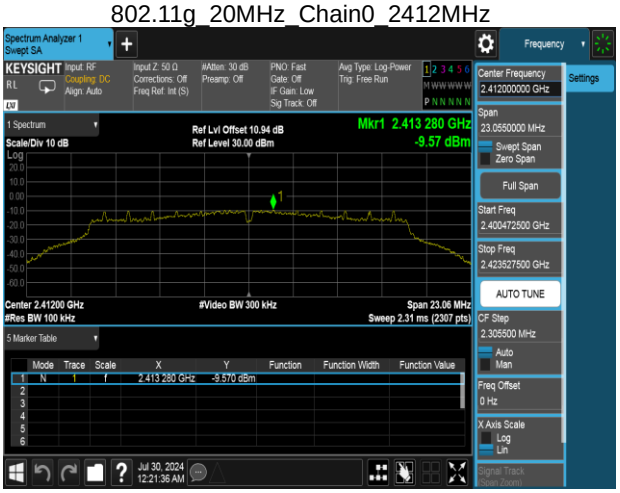
Reference Level

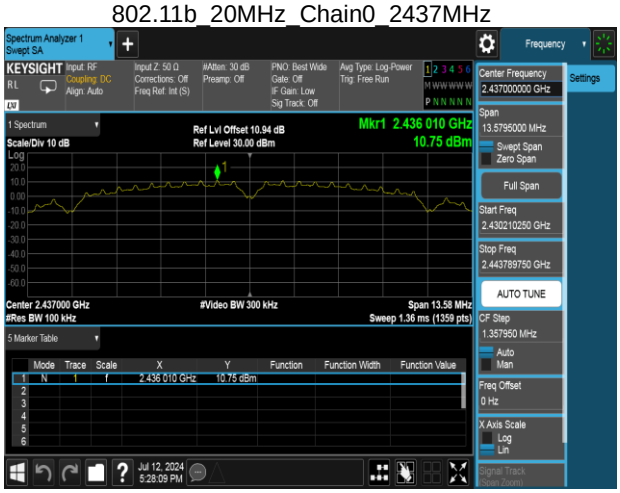
802.11b_20MHz_Chain0_2412MHz



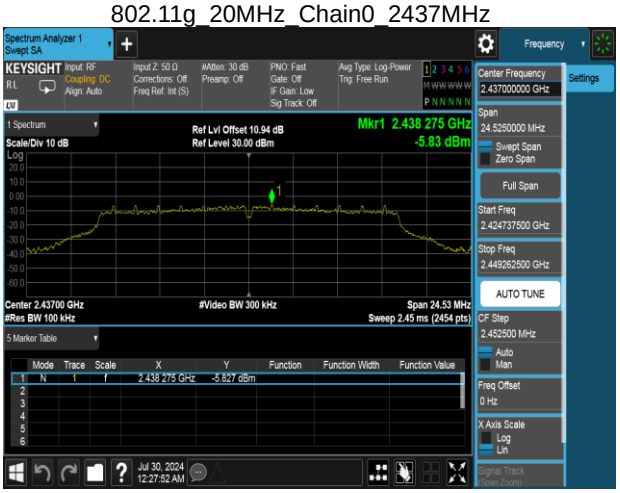
802.11g_20MHz_Chain0_2412MHz



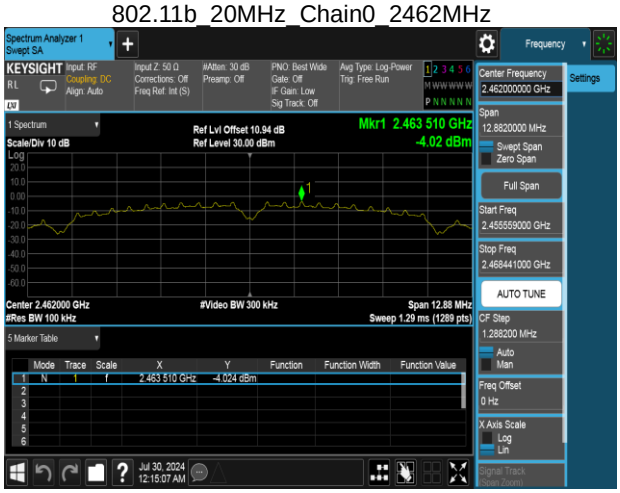
802.11b_20MHz_Chain0_2437MHz



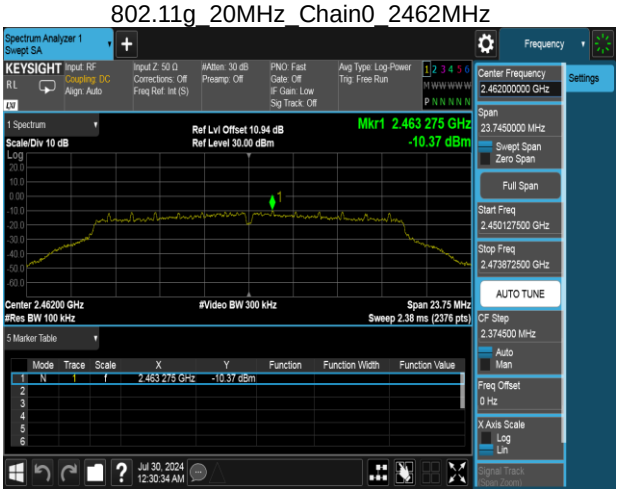
802.11g_20MHz_Chain0_2437MHz



802.11b_20MHz_Chain0_2462MHz



802.11g_20MHz_Chain0_2462MHz



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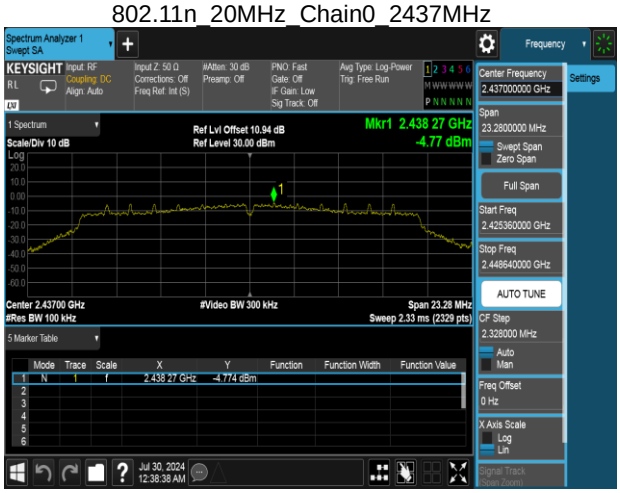
802.11n_20MHz_Chain0_2412MHz

802.11n_20MHz_Chain0_2437MHz



802.11n_20MHz_Chain0_2462MHz

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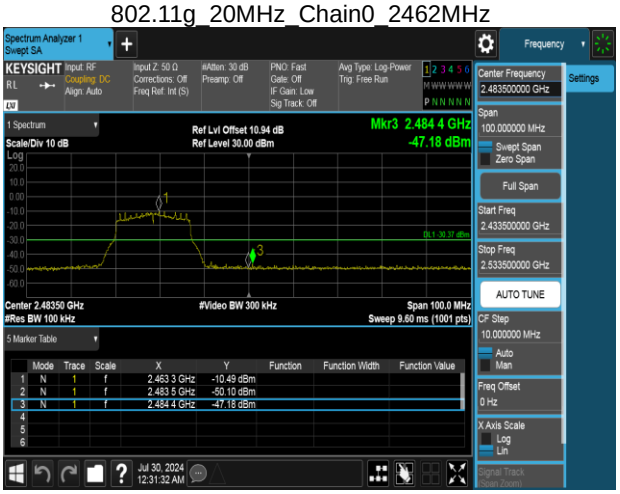
Band Edge

802.11b_20MHz_Chain0_2412MHz

802.11g_20MHz_Chain0_2462MHz



802.11b_20MHz_Chain0_2462MHz

802.11n_20MHz_Chain0_2412MHz

802.11g_20MHz_Chain0_2412MHz

802.11n_20MHz_Chain0_2462MHz

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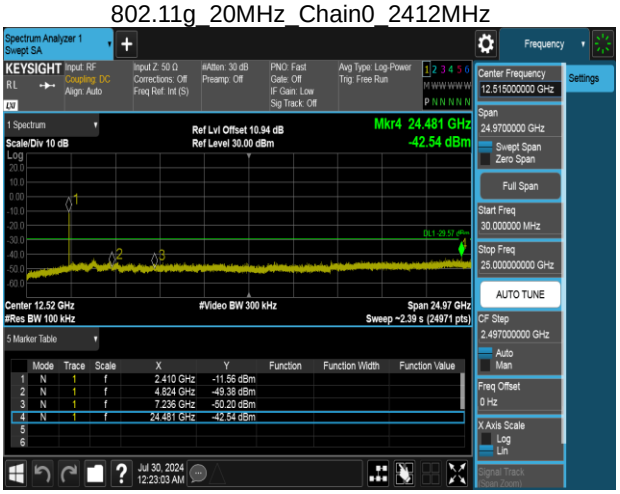
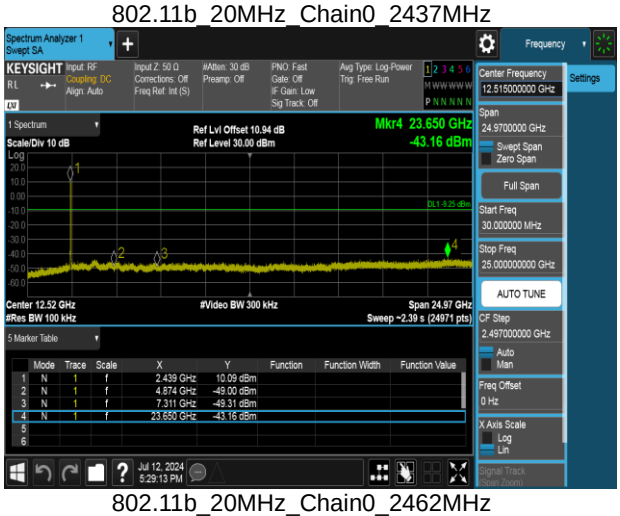
Spurious Emission

802.11b_20MHz_Chain0_2412MHz

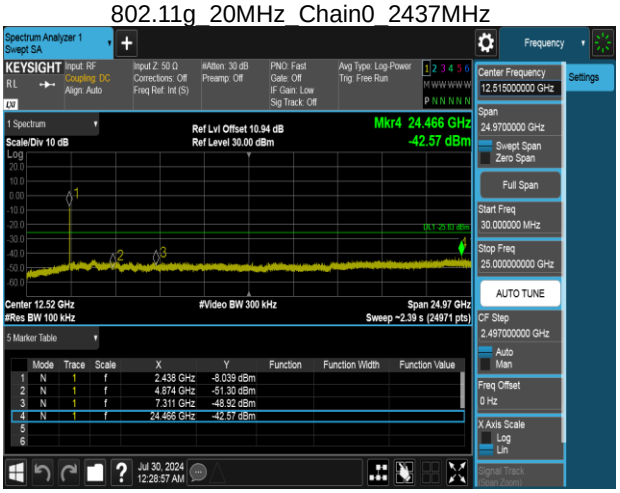
802.11g_20MHz_Chain0_2412MHz



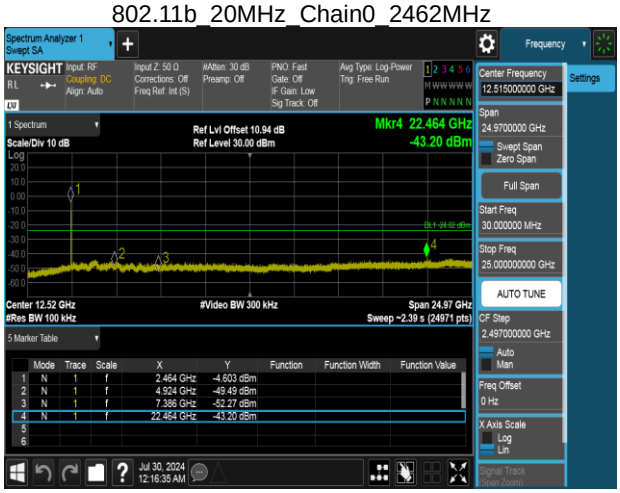
802.11b_20MHz_Chain0_2437MHz



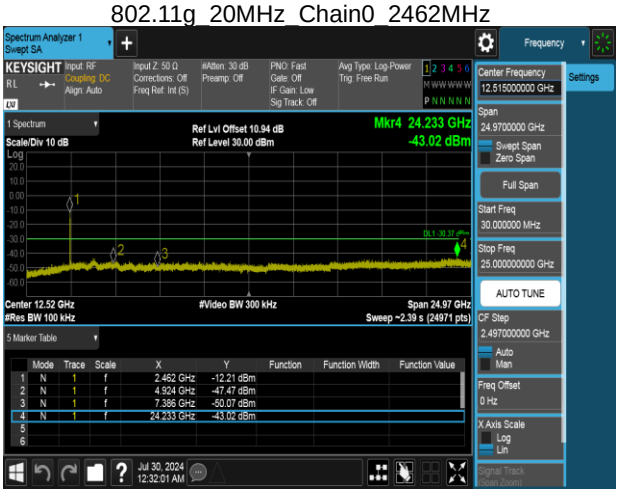
802.11g_20MHz_Chain0_2437MHz



802.11b_20MHz_Chain0_2462MHz



802.11g_20MHz_Chain0_2462MHz



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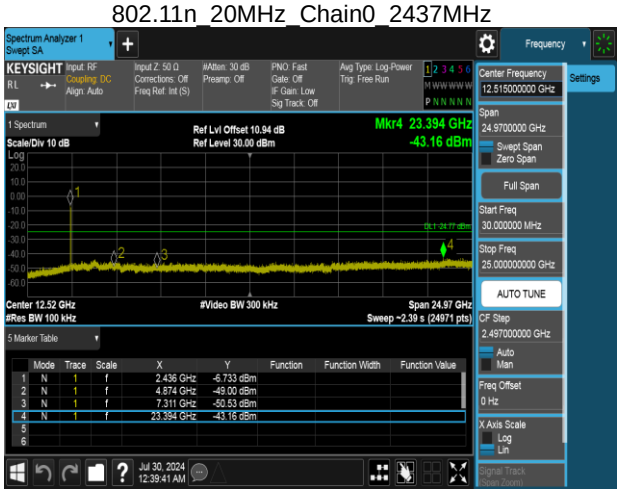
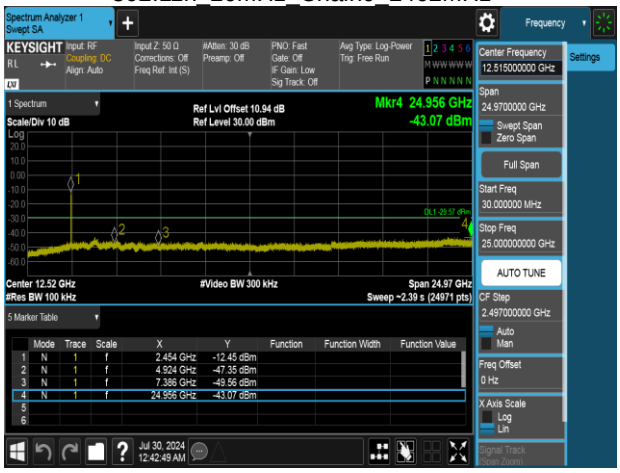
802.11n_20MHz_Chain0_2412MHz

802.11n_20MHz_Chain0_2437MHz



802.11n_20MHz_Chain0_2462MHz



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4.6 RADIATION BANDEDGE AND SPURIOUS EMISSION

4.6.1 Test Limit

FCC according to §15.247(d), §15.209 and §15.205,

In any 100 kHz bandwidth outside the authorized frequency band, all harmonic and spurious must be least 20 dB below the highest emission level with the authorized frequency band. Radiation emission which fall in the restricted bands must also follow the FCC section 15.209 as below limit in table.

Below 30 MHz

Frequency	Field Strength (microvolts/m)	Magnetic H-Field (microamperes/m)	Measurement Distance (metres)
9-490 kHz	2,400/F (F in kHz)	2,400/F (F in kHz)	300
490-1,705 kHz	24,000/F (F in kHz)	24,000/F (F in kHz)	30
1.705-30 MHz	30	N/A	30

Above 30 MHz

Frequency	Field Strength (microvolts/m)	Measurement Distance (metres)
30-88	100	3
88-216	150	3
216-960	200	3
Above 960	500	3

Remark:
Although these tests were performed other than open area test site, adequate comparison measurements were confirmed against 30 m open are test site. Therefore sufficient tests were made to demonstrate that the alternative site produces results that correlate with the ones of tests made in an open field based on KDB 414788.

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4.6.2 Test Procedure

Test method Refer as ANSI C63.10:2013.

1. The EUT is placed on a turntable, Above 1 GHz is 1.5m and below 1 GHz is 0.8m above ground plane. The EUT Configured un accordance with ANSI C63.10: 2013, and the EUT set in a continuous mode.

2. The turntable shall be rotated for 360 degrees to determine the position of maximum emission level. And EUT is set 3m away from the receiving antenna, which is scanned from 1m to 4m above the ground plane to find out the highest emissions. Measurement are made polarized in both the vertical and the horizontal positions with antenna.

3. Span shall wide enough to full capture the emission measured. The SA from 9kHz to 26.5GHz set to the low, Mid and High channels with the EUT transmit.

4. No emission found between lowest internal used/generated frequency to 30MHz (9KHz~30MHz).

Radiated emission below 30MHz is measured in a 9m*6m*6m semi-ane choic chamber, the measurements correspond to those obtained at an open-field test site. There is a comparison data of both open-field test site and semi-Anechoic chamber, and the result came out very similar.

5. The SA setting following：

(1) Below 30MHz：

(1.1) 9KHz-490KHz : RBW=200Hz / VBW=1kHz / Sweep=AUTO

(1.2) 490KHz-30MHz : RBW=10kHz / VBW=30kHz / Sweep=AUTO

(2) 30MHz to 1GHz：RBW = 100kHz, VBW ≥ 3*RBW, Sweep = Auto,

Detector = Peak, Trace = Max hold.

(3) Above 1GHz：

(3.1) For Peak measurement：RBW = 1MHz, VBW ≥ 3 RBW, Sweep = Auto, Detector = Peak, Trace = Max hold.

(3.2) For Average measurement：RBW = 1MHz, VBW

˙If Duty Cycle ≥ 98%, VBW=10Hz.

˙If Duty Cycle < 98%, VBW=1/T.

6. Data result：

Actual FS=Spectrum Reading Level + Factor

Margin=Actual FS- Limit

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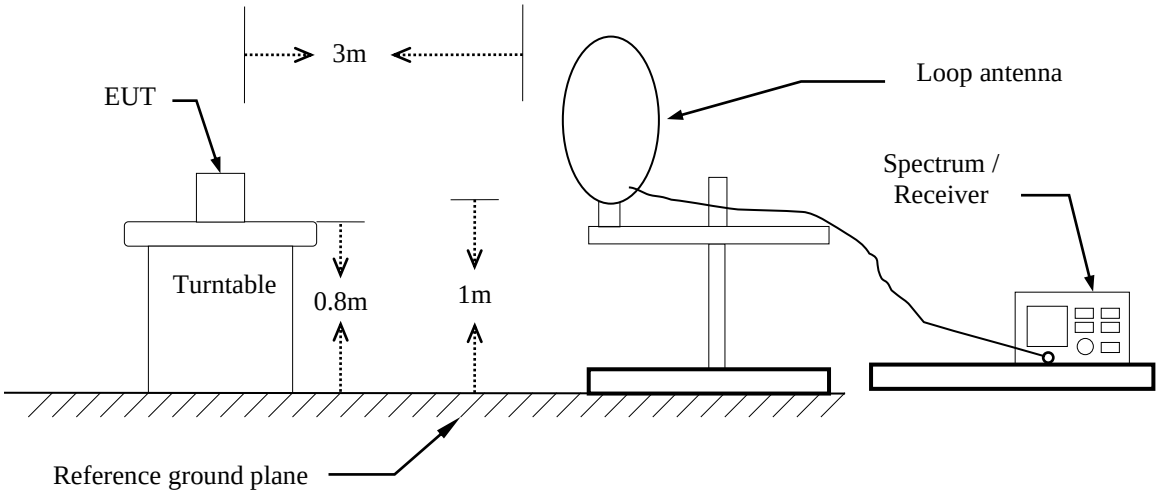
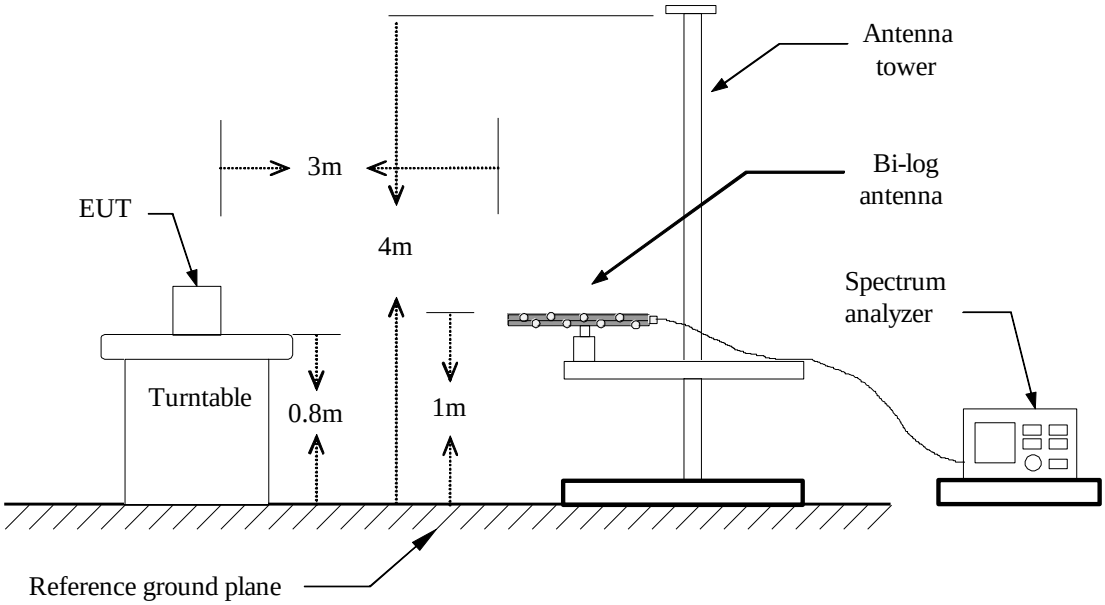
4.6.3 Test Setup

9kHz ~ 30MHz



30MHz ~ 1GHz



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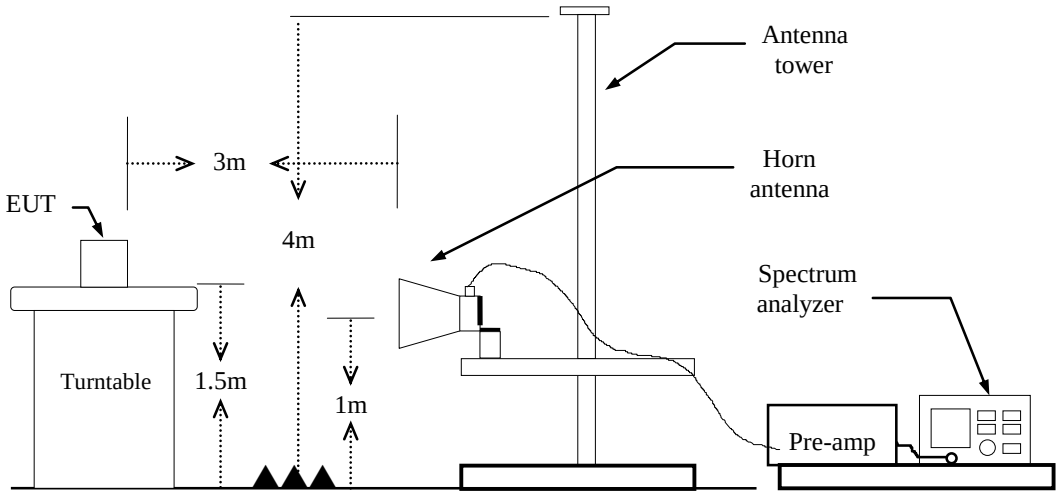
Above 1 GHz



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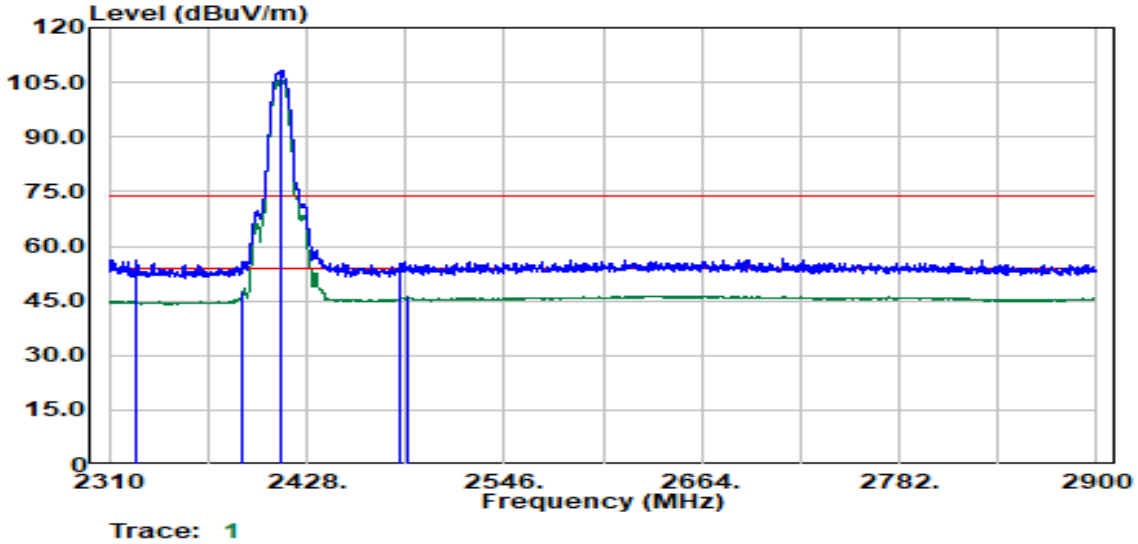
4.6.4 Test Result

Band Edge Test Data

Project No.	:TM-2407000112P	Test Date	:2024-07-15
Operation Band	:802.11b	Temp./Humi.	:24.6/57
Frequency	:2412 MHz	Antenna Pol.	:VERTICAL
Operation Mode	:Bandedge	Engineer	:Tony Chao
EUT Pol	:H	Test Chamber	: 966A
Setting	:74		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Read Level dBµV	Factor dB	Actual FS dBµV/m	Limit dBµV/m	Margin dB
2326.01	Peak	50.20	6.17	56.37	74.00	-17.63
2390.00	Average	41.13	6.28	47.41	54.00	-6.59
2412.00	Peak	101.71	6.31	108.02	- -	- -
2412.00	Average	99.11	6.31	105.41	- -	- -
2483.50	Peak	48.84	6.71	55.55	74.00	-18.45
2488.33	Average	39.42	6.78	46.20	54.00	-7.80

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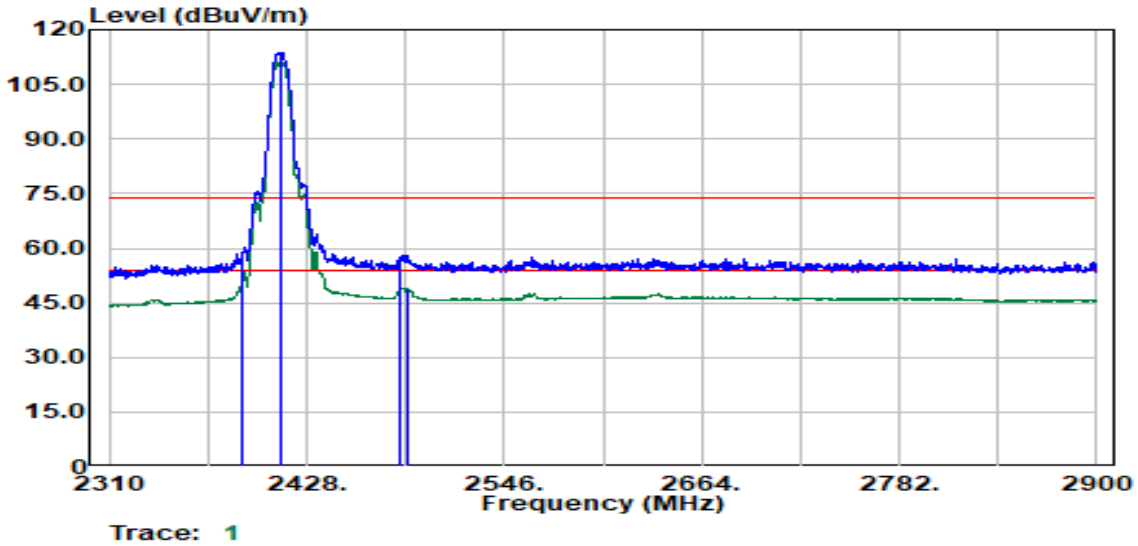
Project No.	:TM-2407000112P	Test Date	:2024-07-15
Operation Band	:802.11b	Temp./Humi.	:24.6/57
Frequency	:2412 MHz	Antenna Pol.	:HORIZONTAL
Operation Mode	:Bandedge	Engineer	:Tony Chao
EUT Pol	:H	Test Chamber	: 966A
Setting	:74		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Read Level dBµV	Factor dB	Actual FS dBµV/m	Limit dBµV/m	Margin dB
2390.00	Peak	52.62	6.28	58.90	74.00	-15.10
2390.00	Average	46.12	6.28	52.40	54.00	-1.60
2412.00	Peak	107.41	6.31	113.71	- -	- -
2412.00	Average	104.82	6.31	111.13	- -	- -
2483.50	Peak	51.14	6.71	57.85	74.00	-16.15
2488.08	Average	42.18	6.78	48.95	54.00	-5.05

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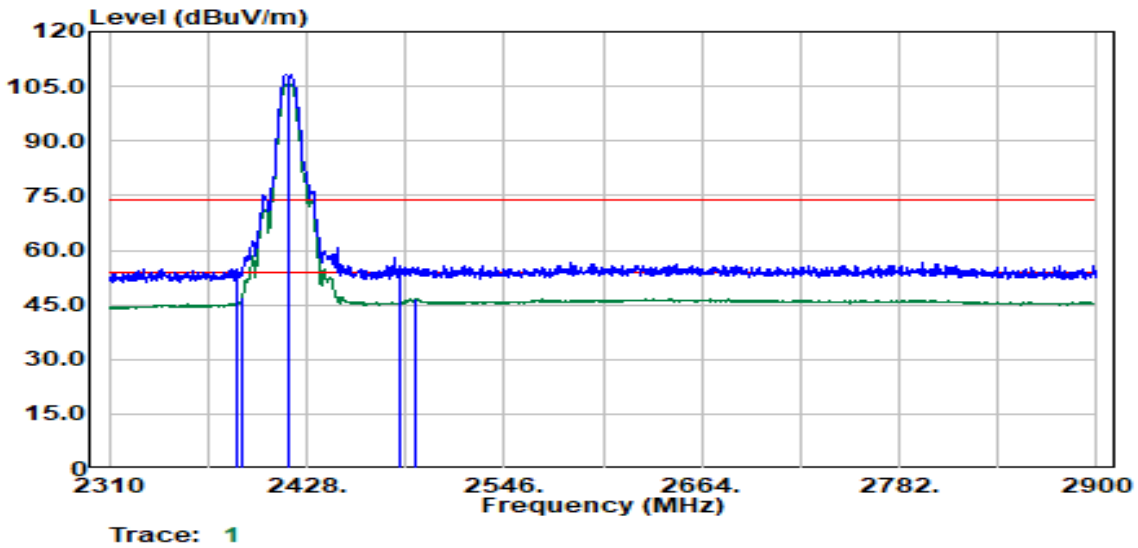
Project No.	:TM-2407000112P	Test Date	:2024-07-27
Operation Band	:802.11b	Temp./Humi.	:24.6/57
Frequency	:2417 MHz	Antenna Pol.	:VERTICAL
Operation Mode	:Bandedge	Engineer	:Tony Chao
EUT Pol	:H	Test Chamber	: 966A
Setting	:80		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Read Level dBµV	Factor dB	Actual FS dBµV/m	Limit dBµV/m	Margin dB
2385.65	Peak	48.58	6.19	54.77	74.00	-19.23
2389.90	Average	40.63	6.28	46.91	54.00	-7.09
2417.00	Peak	101.99	6.31	108.30	- -	- -
2417.00	Average	99.35	6.31	105.66	- -	- -
2483.50	Peak	48.62	6.71	55.33	74.00	-18.67
2493.52	Average	39.72	6.82	46.54	54.00	-7.46

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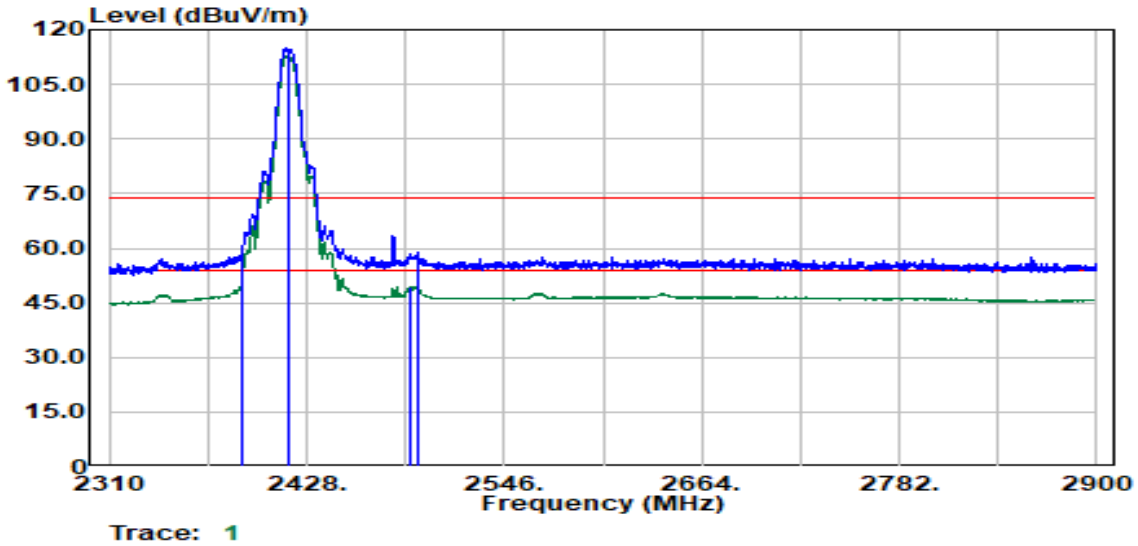
Project No.	:TM-2407000112P	Test Date	:2024-07-27
Operation Band	:802.11b	Temp./Humi.	:24.6/57
Frequency	:2417 MHz	Antenna Pol.	:HORIZONTAL
Operation Mode	:Bandedge	Engineer	:Tony Chao
EUT Pol	:H	Test Chamber	: 966A
Setting	:80		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Read Level dBµV	Factor dB	Actual FS dBµV/m	Limit dBµV/m	Margin dB
2389.90	Peak	53.83	6.28	60.11	74.00	-13.89
2389.90	Average	46.12	6.28	52.40	54.00	-1.60
2417.00	Peak	108.71	6.31	115.03	- -	- -
2417.00	Average	106.26	6.31	112.58	- -	- -
2490.52	Average	42.63	6.80	49.43	54.00	-4.57
2493.77	Peak	52.03	6.82	58.85	74.00	-15.15

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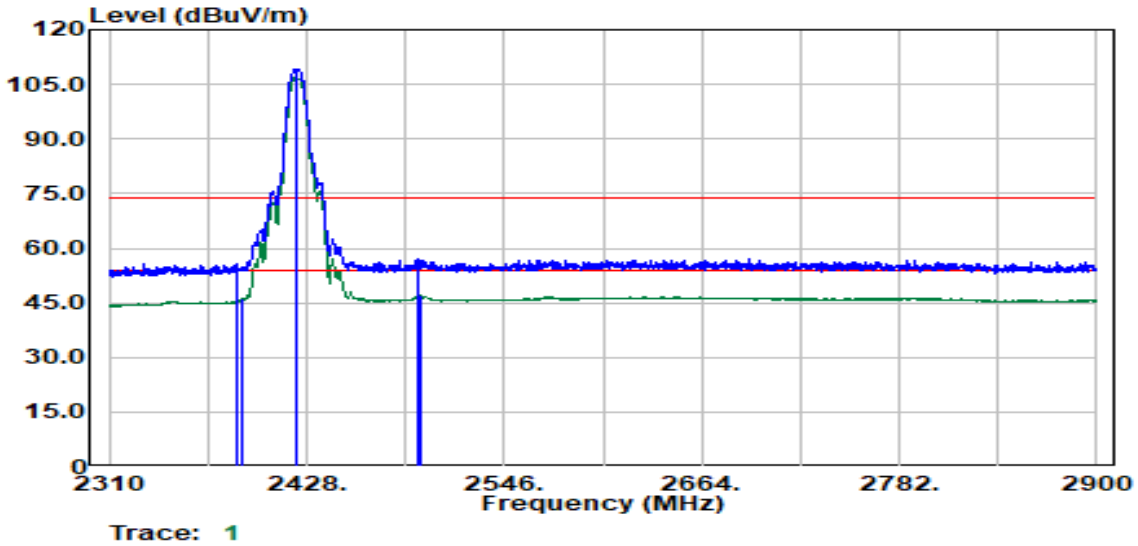
Project No.	:TM-2407000112P	Test Date	:2024-07-27
Operation Band	:802.11b	Temp./Humi.	:24.6/57
Frequency	:2422 MHz	Antenna Pol.	:VERTICAL
Operation Mode	:Bandedge	Engineer	:Tony Chao
EUT Pol	:H	Test Chamber	: 966A
Setting	:81		



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Read Level dBµV	Factor dB	Actual FS dBµV/m	Limit dBµV/m	Margin dB
2386.15	Peak	49.56	6.20	55.76	74.00	-18.24
2389.65	Average	39.98	6.27	46.25	54.00	-7.75
2422.00	Peak	102.85	6.34	109.19	- -	- -
2422.00	Average	100.38	6.34	106.72	- -	- -
2494.77	Peak	50.02	6.82	56.84	74.00	-17.16
2495.76	Average	40.27	6.82	47.10	54.00	-6.90

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