

Project No: TM-2404000025P
Report No.: TMWK2404001048KR

FCC ID: WHD-IGMG8224D

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RADIO TEST REPORT

FCC 47 CFR PART 15 SUBPART C

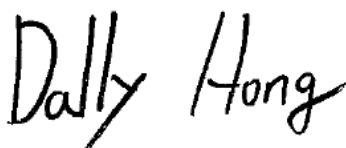
Test Standard	FCC Part 15.247
Product name	Industrial Gateway Router
Brand Name	ORing
Model No.	IGMG-8224D-D5G, IDS-8224D, IGAP-840D, IGR-40D
Test Result	Pass
Statements of Conformity	Determination of compliance is based on the results of the compliance measurement, not taking into account measurement 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:



Dally Hong
Sr. Engineer

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.

除非另有說明，此報告結果僅對測試之樣品負責，同時此樣品僅保留90天。本報告未經本公司書面許可，不可部份複製。

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Revision History

Rev.	Issue Date	Revisions	Effect Page	Revised By
00	January 24, 2025	Initial Issue	ALL	Peggy Tsai

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1. GENERAL INFORMATION

1.1 EUT INFORMATION

Applicant	ORing Industrial Networking Corp 3F., No. 542-2, Zhongzheng Road, Xindian District, New Taipei City 231, Taiwan (R.O.C)
Manufacturer	ORing Industrial Networking Corp 3F., No. 542-2, Zhongzheng Road, Xindian District, New Taipei City 231, Taiwan (R.O.C)
Equipment	Industrial Gateway Router
Model No.	IGMG-8224D-D5G, IDS-8224D, IGAP-840D, IGR-40D
Model Discrepancy	Difference of the those model number (list on this report) are just for marketing purpose only
Trade Name	ORing
Received Date	April 3, 2024
Date of Test	September 3 ~ October 8, 2024
Power Operation	Powered from Adapter UMEC / UP0451H-12PP I/P: 100-240Vac, 50/60Hz, 2A MAX O/P: 12Vdc, 3.75A
HW Version	V 1.0
SW Version	V 1.0
EUT Serial #	022105D00007

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.
3. Disclaimer: The variant model numbers / trademarks are assessed as identical in hardware and software to each other, hence all variants are fully covered by the test results in this test report without further verification test.

1.2 EUT CHANNEL INFORMATION

Frequency Range	802.11b/g/n HT 20: 2412MHz ~ 2462MHz 802.11n HT 40: 2422MHz ~ 2452MHz
Modulation Type	1. IEEE 802.11b mode: CCK 2. IEEE 802.11g mode: OFDM 3. IEEE 802.11n HT 20 MHz mode : OFDM 4. IEEE 802.11n HT 40 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 4. IEEE 802.11n HT 40 MHz mode : 7 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 ☐ Coils
Antenna Trade / Model	Wanshih Electronic Co., Ltd. / WSS023
Antenna Gain	Chain 0: 1.99 dBi Chain 1: 1.99 dBi
Antenna Connector	N/A

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.

1.4 MEASUREMENT UNCERTAINTY

PARAMETER	UNCERTAINTY
AC Powerline Conducted Emission	+/- 2.21 dB
Channel Bandwidth	+/- 2.79 dB
RF output power (Power Meter + Power sensor)	+/- 0.24 dB
Power Spectral density	+/- 2.74 dB
Conducted Bandedge	+/- 2.74 dB
Conducted Spurious Emission	+/- 2.74 dB
Radiated Emission_9kHz-30MHz	+/- 3.492 dB
Radiated Emission_30MHz-200MHz	+/- 3.62 dB
Radiated Emission_200MHz-1GHz	+/- 3.899 dB
Radiated Emission_1GHz-6GHz	+/- 5.063 dB
Radiated Emission_6GHz-18GHz	+/- 5.122 dB
Radiated Emission_18GHz-26GHz	+/- 3.032 dB
Radiated Emission_26GHz-40GHz	+/- 3.271 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	Ray Li 、 Tony Chao	-
RF Conducted	Jerry Chang	-

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

1.6 INSTRUMENT CALIBRATION

Conducted FCC/IC/NCC					
Name of Equipment	Manufacturer	Model	Serial Number	Calibration Date	Calibration Due
Power Sensor	Anritsu	MA2411B	1911387	2024-07-19	2025-07-18
Power Meter	Anritsu	ML2496A	2136002	2024-07-19	2025-07-18
EXA Signal Analyzer	Keysight	N9010B	MY55460167	2024-01-03	2025-01-02
Attenuator	Marvelous Microwave Inc	MVE2213-10	08	2023-11-07	2024-11-06
DC Block	Marvelous Microwave Inc	MVE6411	MVE-001	2024-08-08	2025-08-07
Software	Radio Test Software Ver. 21				

966A_Radiated					
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	2024-08-07	2025-08-06
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
Site Validation	CCS	966A	N/A	2024-08-03	2025-08-02
Software	e3 V9-210616c				

Remark:

- Each piece of equipment is scheduled for calibration once a year.
- 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
Software	e3 V6-110812				

Remark:

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

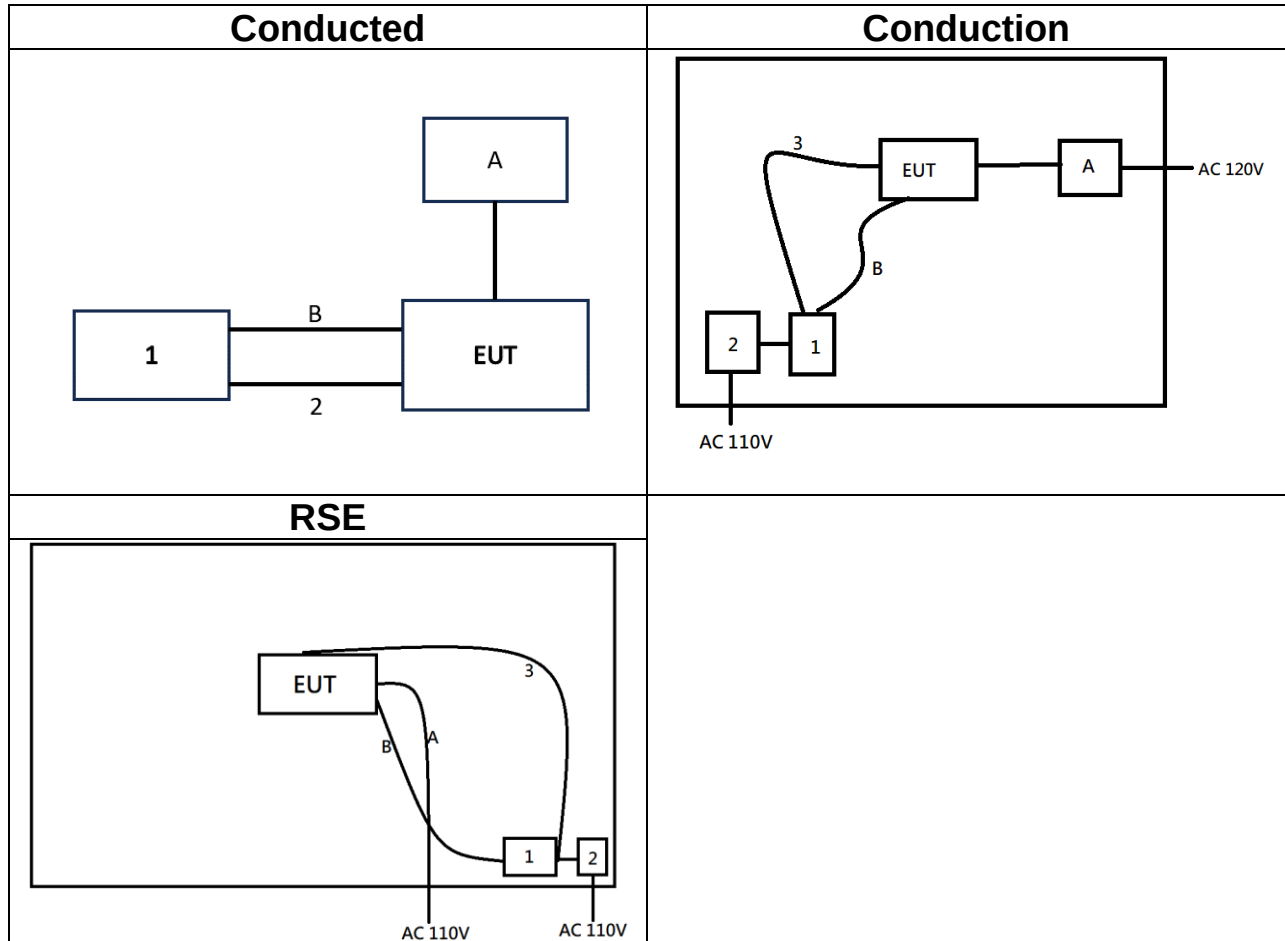
1.7 SUPPORT AND EUT ACCESSORIES EQUIPMENT

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

Support Equipment (Conducted)					
No.	Equipment	Brand	Model	Series No.	FCC ID
1	NB(B)	Lenovo	T470	N/A	N/A
2	Lan Cable	RASTO REC4	R-PCC004	N/A	N/A
A	Adapter	UMEC	UP0451H-12PP	N/A	N/A
B	USB to Serial Uart TTL	Silicon Labs	CP2102	N/A	N/A

Support Equipment (RSE & Conduction)					
No.	Equipment	Brand	Model	Series No.	FCC ID
1	NB(D)	Lenovo	ThinkPad X260	N/A	N/A
2	Adapter	Lenovo	ADLX45DLC3A	N/A	N/A
3	RJ45	Atake	AC6-FL10	N/A	N/A
A	Adapter	UMEC	UP0451H-12PP	N/A	N/A
B	USB to Serial Uart TTL	Silicon Labs	CP2102	N/A	N/A

1.8 TEST SET UP DIAGRAM



1.9 TEST PROGRAM

The EUT connection corresponds to the surrounding fixture control board. This EUT uses "TeraTerm" and "QRCT4" software to set the frequency, modulation, and power to allow the sample to continuously transmit.

1.10 TEST METHODOLOGY AND APPLIED STANDARDS

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 D01.

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

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 IEEE 802.11n HT40 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 IEEE 802.11n HT40 mode : 1. Lowest Channel : 2422MHz 2. Middle Channel : 2437MHz 3. Highest Channel : 2452MHz
Operation Transmitter	IEEE 802.11b mode :1T1R IEEE 802.11g mode :1T1R IEEE 802.11n HT20 mode : 2T2R IEEE 802.11n HT40 mode : 2T2R

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.

3.2 THE WORST MODE OF MEASUREMENT

AC Power Line Conduction Emission	
Test Condition	AC Power line conduction emission for line and neutral
Power supply Mode	Mode 1: EUT Power by Adapter
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 Adapter
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 Adapter
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(X-Plane) were recorded in this report

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3.3 EUT DUTY CYCLE

Temperature: 20.1 ~ 24.5°C

Test date: September 3 ~
October 8, 2024

Humidity: 46 ~ 65% RH

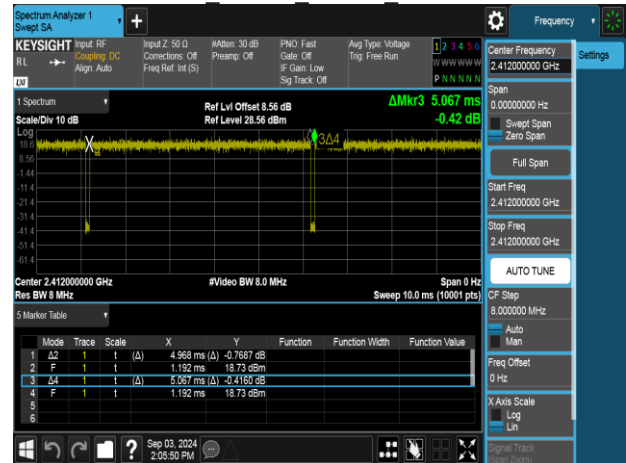
Tested by: Jerry Chang

Mode	Duty Cycle (%) = Ton / (Ton+Toff)	Duty Factor (dB) =10*log (1/Duty Cycle)	1/T (kHz)	VBW setting (kHz)
802.11b	99.35	0.03	0.08	0.01
802.11g	95.84	0.18	0.49	1.00
802.11n_20	98.05	0.09	0.20	0.01
802.11n_40	96.21	0.17	0.41	1.00

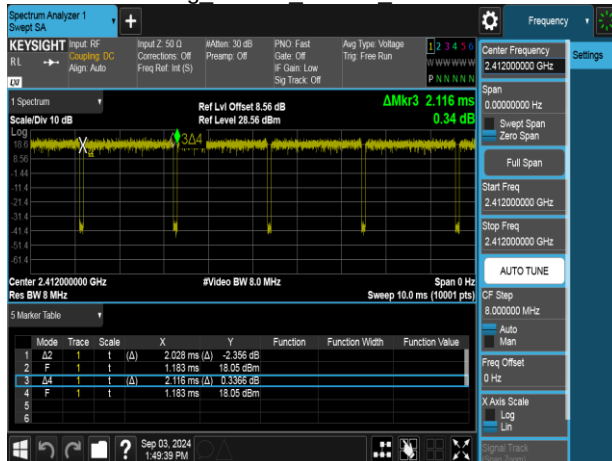
802.11b 20MHz Chain1 2412MHz



802.11n 20MHz Chain0 2412MHz



802.11g 20MHz Chain1 2412MHz



802.11n 40MHz Chain0 2422MHz



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

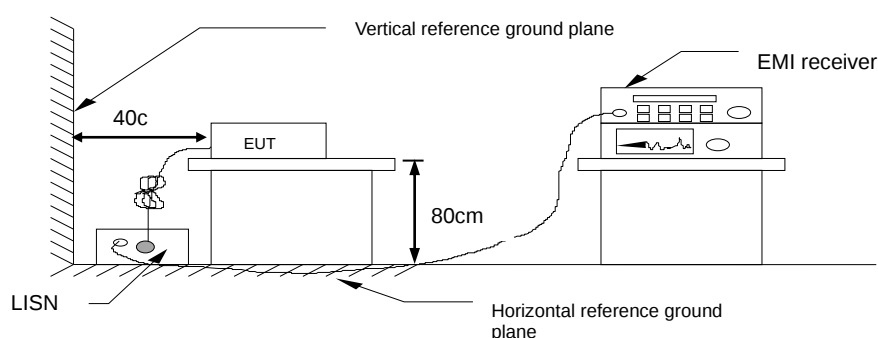
* Decreases with the logarithm of the frequency.

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

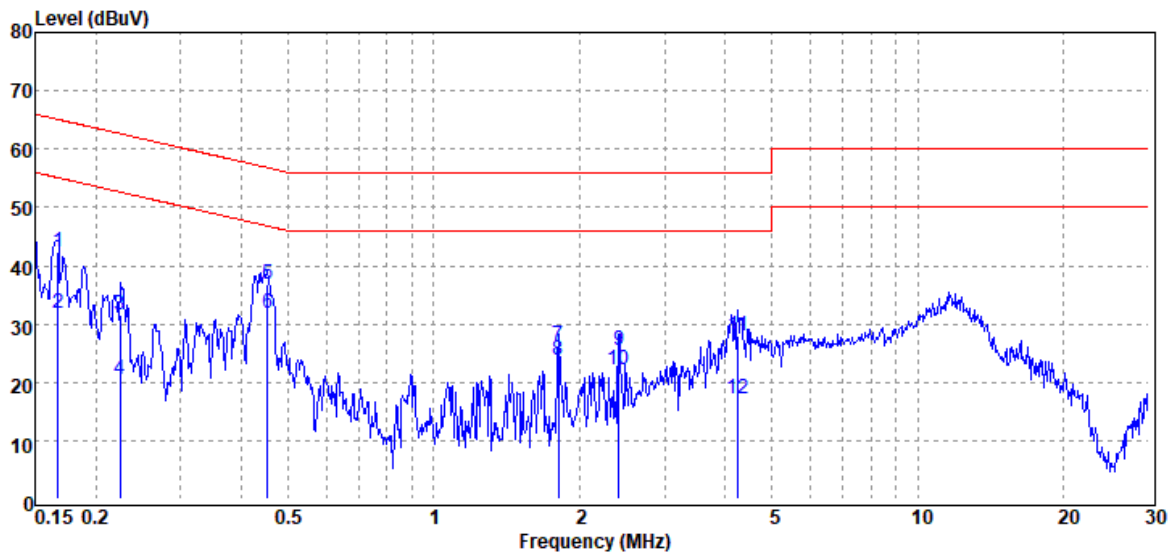


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4.1.4 Test Result

Project No	: TM-2404000025P	Test Date	: 2024-09-09
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
0.167	QP	42.04	0.22	42.26	65.10	-22.84
0.167	Average	31.75	0.22	31.97	55.10	-23.13
0.225	QP	31.29	0.39	31.68	62.63	-30.95
0.225	Average	19.98	0.39	20.37	52.63	-32.26
0.453	QP	36.46	0.38	36.84	56.83	-19.99
0.453	Average	31.52	0.38	31.90	46.83	-14.93
1.809	QP	26.05	0.18	26.23	56.00	-29.77
1.809	Average	23.69	0.18	23.87	46.00	-22.13
2.413	QP	25.40	0.20	25.60	56.00	-30.40
2.413	Average	21.96	0.20	22.16	46.00	-23.84
4.255	QP	27.73	0.24	27.97	56.00	-28.03
4.255	Average	16.95	0.24	17.19	46.00	-28.81

Note: 1. Actual FS= Spectrum Read Level + Factor

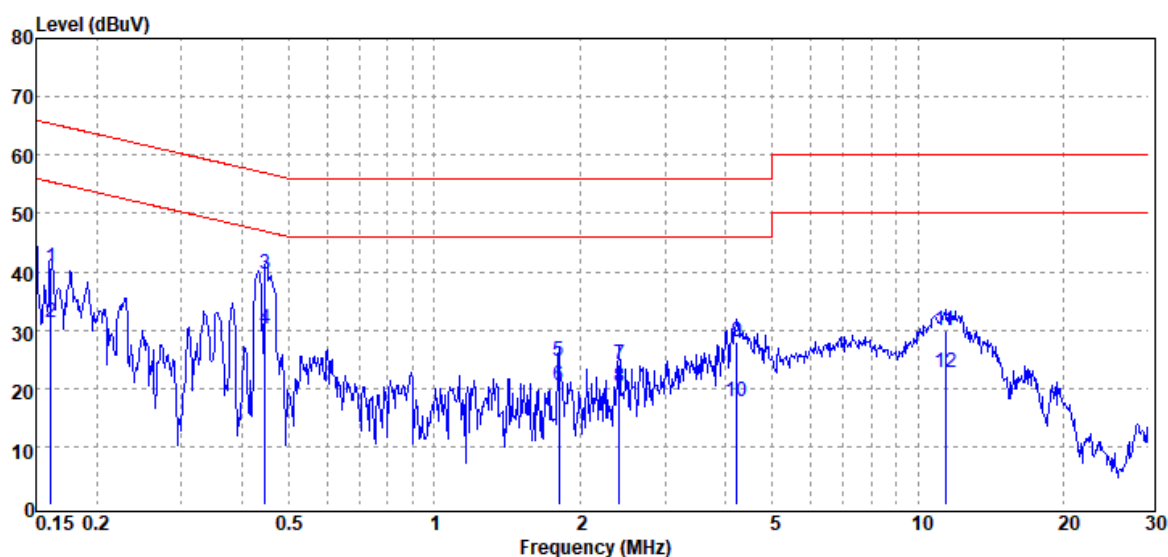
Note: 2. Margin= Actual FS - Limit

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Project No : TM-2404000025P
Operation Mode : 2.4G
Test Chamber : Conduction
Probe : NEUTRAL
Note :

Test Date : 2024-09-09
Temp./Humi. : 23.4°C / 54%
Engineer : Ben Yang
Test Voltage : AC 120V/60Hz



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Read Level dBμV	Factor dB	Actual FS dBμV	Limit dBμV	Margin dB
0.161	QP	40.49	0.16	40.65	65.42	-24.77
0.161	Average	31.01	0.16	31.17	55.42	-24.25
0.447	QP	39.34	0.35	39.69	56.93	-17.24
0.447	Average	29.88	0.35	30.23	46.93	-16.70
1.811	QP	24.50	0.16	24.66	56.00	-31.34
1.811	Average	20.37	0.16	20.53	46.00	-25.47
2.408	QP	23.99	0.18	24.17	56.00	-31.83
2.408	Average	20.03	0.18	20.21	46.00	-25.79
4.229	QP	27.69	0.21	27.90	56.00	-28.10
4.229	Average	17.60	0.21	17.81	46.00	-28.19
11.377	QP	29.58	0.36	29.94	60.00	-30.06
11.377	Average	22.36	0.36	22.72	50.00	-27.28

Note: 1. Actual FS= Spectrum Read Level + Factor

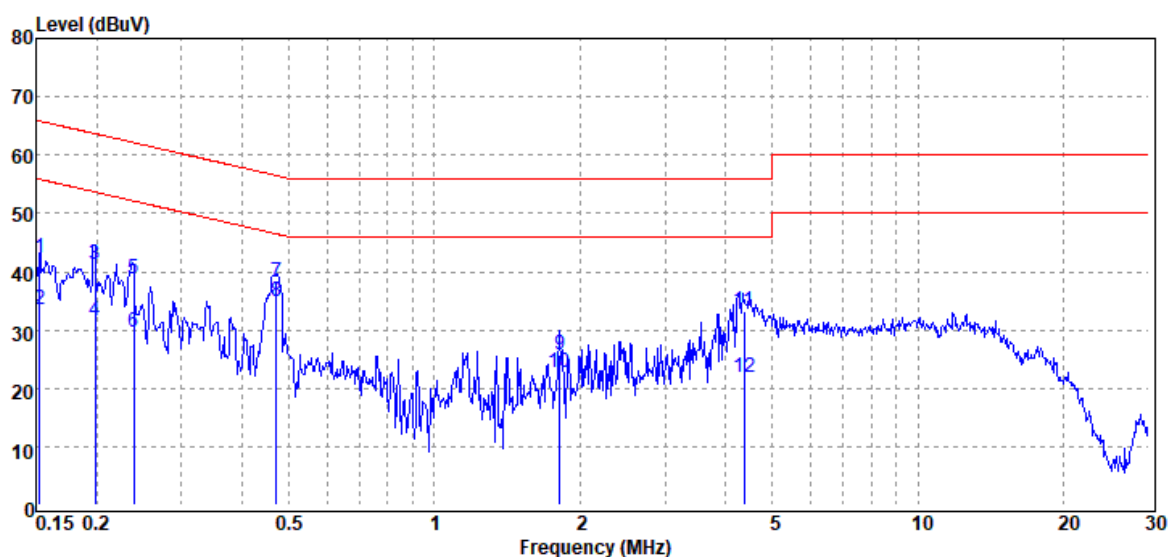
Note: 2. Margin= Actual FS - Limit

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Project No : TM-2404000025P
Operation Mode : 2.4G
Test Chamber : Conduction
Probe : LINE
Note :

Test Date : 2024-09-09
Temp./Humi. : 23.4°C / 54%
Engineer : Ben Yang
Test Voltage : AC 230V/60Hz



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Read Level dBμV	Factor dB	Actual FS dBμV	Limit dBμV	Margin dB
0.153	QP	42.33	0.14	42.47	65.85	-23.38
0.153	Average	33.40	0.14	33.54	55.85	-22.31
0.199	QP	40.76	0.38	41.14	63.67	-22.53
0.199	Average	31.21	0.38	31.59	53.67	-22.08
0.239	QP	38.26	0.39	38.65	62.13	-23.48
0.239	Average	29.18	0.39	29.57	52.13	-22.56
0.472	QP	37.93	0.38	38.31	56.48	-18.17
0.472	Average	34.63	0.38	35.01	46.48	-11.47
1.813	QP	25.70	0.18	25.88	56.00	-30.12
1.813	Average	22.54	0.18	22.72	46.00	-23.28
4.367	QP	32.92	0.25	33.17	56.00	-22.83
4.367	Average	21.59	0.25	21.84	46.00	-24.16

Note: 1. Actual FS= Spectrum Read Level + Factor

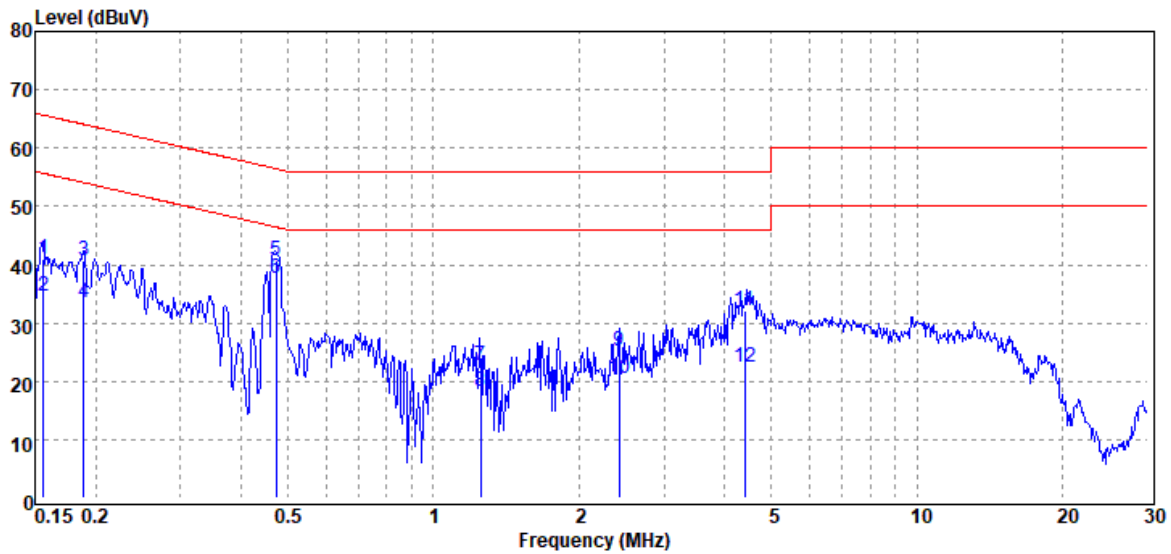
Note: 2. Margin= Actual FS - Limit

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Project No : TM-2404000025P
Operation Mode : 2.4G
Test Chamber : Conduction
Probe : NEUTRAL
Note :

Test Date : 2024-09-09
Temp./Humi. : 23.4°C / 54%
Engineer : Ben Yang
Test Voltage : AC 230V/60Hz



Freq. MHz	Detector Mode PK/QP/AV	Spectrum Read Level dBμV	Factor dB	Actual FS dBμV	Limit dBμV	Margin dB
0.156	QP	40.93	0.14	41.07	65.66	-24.59
0.156	Average	34.51	0.14	34.65	55.66	-21.01
0.189	QP	40.41	0.30	40.71	64.08	-23.37
0.189	Average	33.17	0.30	33.47	54.08	-20.61
0.473	QP	40.31	0.35	40.66	56.46	-15.80
0.473	Average	37.21	0.35	37.56	46.46	-8.90
1.251	QP	22.56	0.14	22.70	56.00	-33.30
1.251	Average	18.04	0.14	18.18	46.00	-27.82
2.418	QP	25.03	0.18	25.21	56.00	-30.79
2.418	Average	20.31	0.18	20.49	46.00	-25.51
4.409	QP	31.81	0.23	32.04	56.00	-23.96
4.409	Average	22.29	0.23	22.52	46.00	-23.48

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

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
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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.

4.2.4 Test Result

Temperature: 20.1 ~ 24.5°C

Test date:

September 3 ~
October 8, 2024

Humidity: 46 ~ 65% RH

Tested by:

Jerry Chang

802.11b Ch1

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	8594.00	≥ 500	PASS
2437	9560.00	≥ 500	PASS
2462	8613.00	≥ 500	PASS

802.11g Ch1

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	15970.00	≥ 500	PASS
2437	16390.00	≥ 500	PASS
2462	16290.00	≥ 500	PASS

802.11n_HT_20M Ch0

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	17610.00	≥ 500	PASS
2437	17620.00	≥ 500	PASS
2462	17560.00	≥ 500	PASS

802.11n_HT_20M Ch1

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2412	16990.00	≥ 500	PASS
2437	17640.00	≥ 500	PASS
2462	17600.00	≥ 500	PASS

802.11n_HT_40M Ch0

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2422	33890.00	≥ 500	PASS
2437	35480.00	≥ 500	PASS
2452	35200.00	≥ 500	PASS

802.11n_HT_40M Ch1

Freq. (MHz)	6dB BW (kHz)	Limit (kHz)	Result
2422	35160.00	≥ 500	PASS
2437	35510.00	≥ 500	PASS
2452	35170.00	≥ 500	PASS

BANDWIDTH 99%

802.11b Ch1

Freq. (MHz)	99% BW (MHz)
2412	13.432
2437	14.502
2462	13.985

802.11g Ch1

Freq. (MHz)	99% BW (MHz)
2412	16.514
2437	16.498
2462	16.379

802.11n_HT20M Ch0

Freq. (MHz)	99% BW (MHz)
2412	17.650
2437	17.635
2462	17.527

802.11n_HT20M Ch1

Freq. (MHz)	99% BW (MHz)
2412	17.660
2437	17.670
2462	17.571

802.11n_HT40M Ch0

Freq. (MHz)	99% BW (MHz)
2422	35.730
2437	36.036
2452	35.887

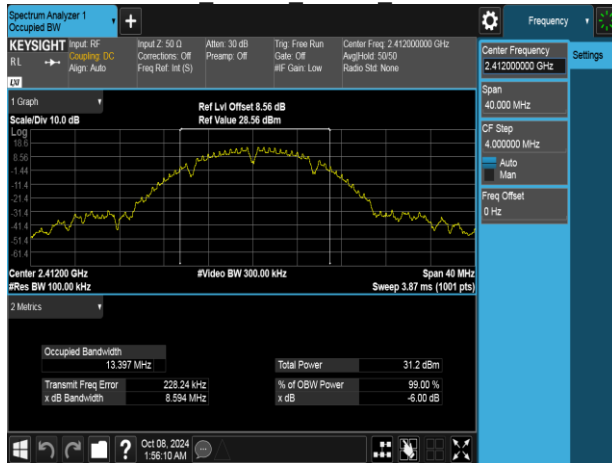
802.11n_HT40M Ch1

Freq. (MHz)	99% BW (MHz)
2422	35.816
2437	36.046
2452	35.955

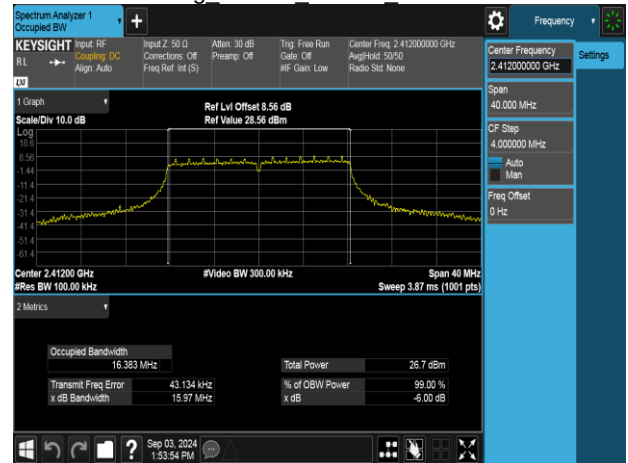
Test Data

6dB BANDWIDTH

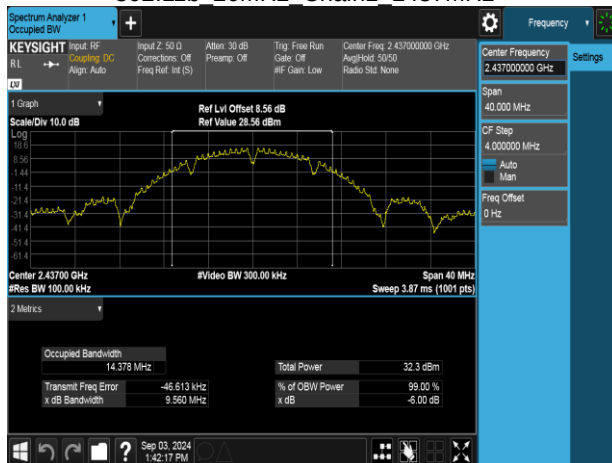
802.11b 20MHz Chain1 2412MHz



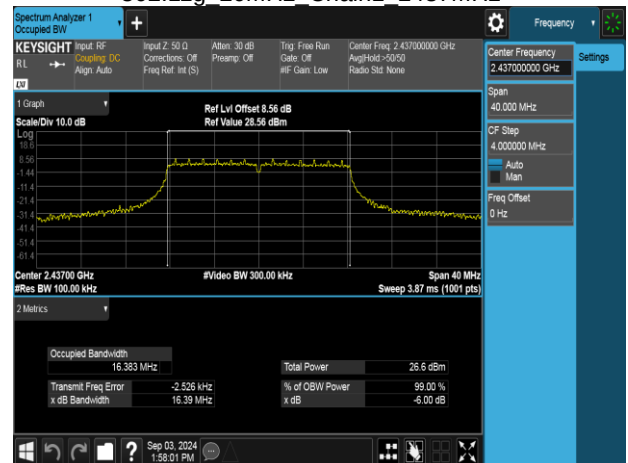
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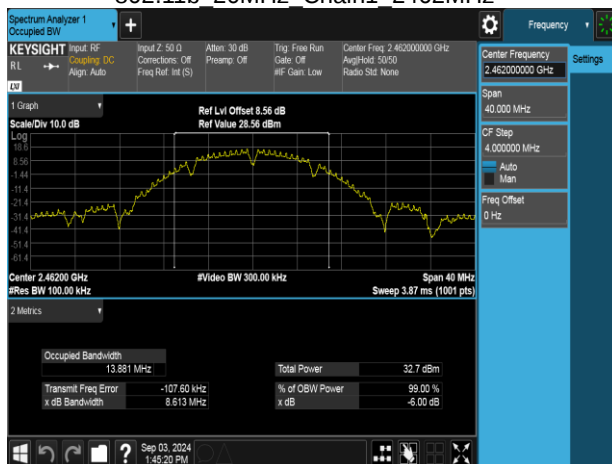
802.11b 20MHz Chain1 2437MHz



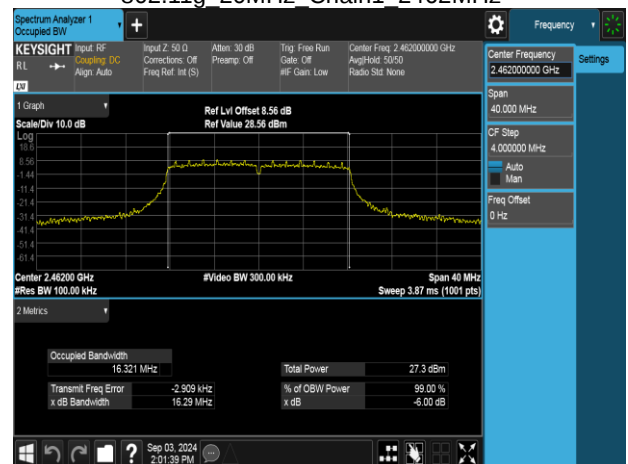
802.11g 20MHz Chain1 2437MHz



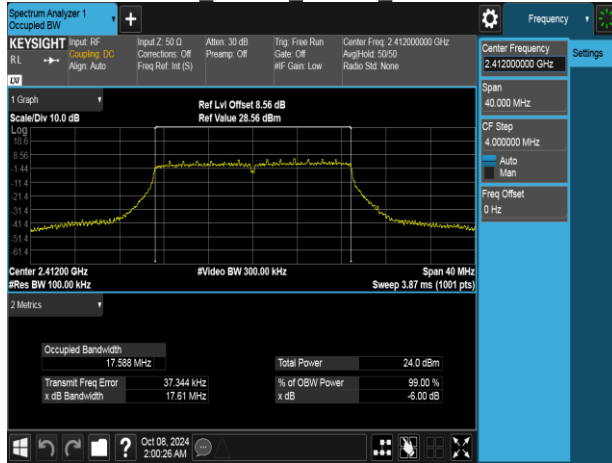
802.11b 20MHz Chain1 2462MHz



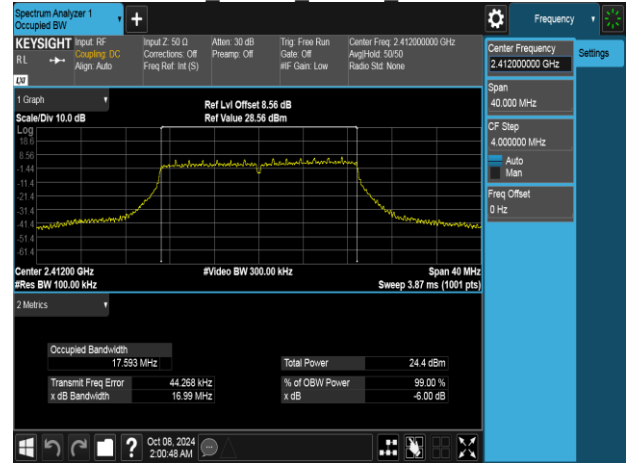
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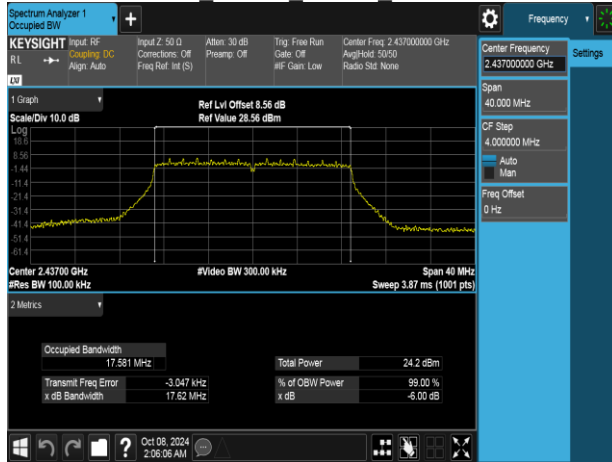
802.11n 20MHz Chain0 2412MHz



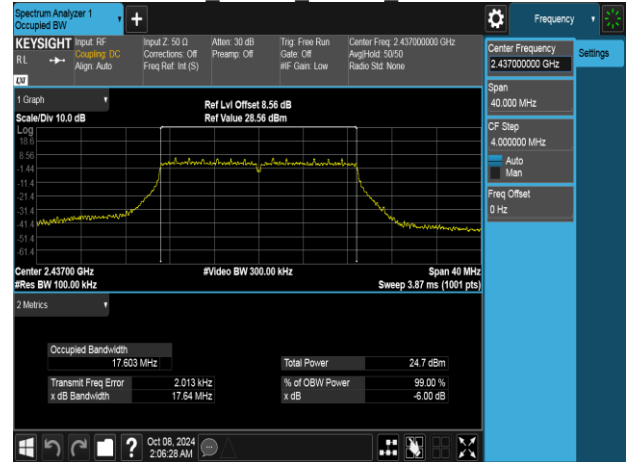
802.11n 20MHz Chain1 2412MHz



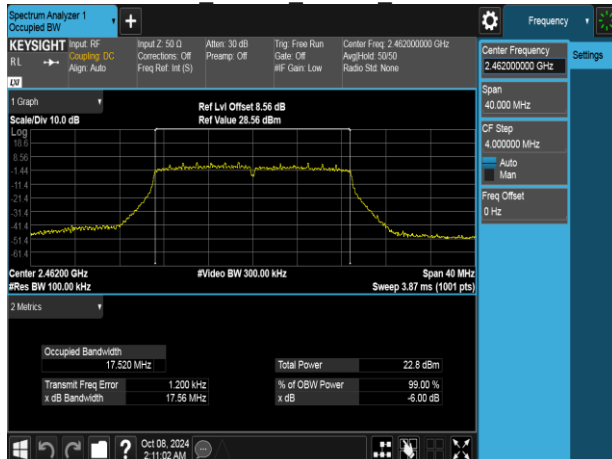
802.11n 20MHz Chain0 2437MHz



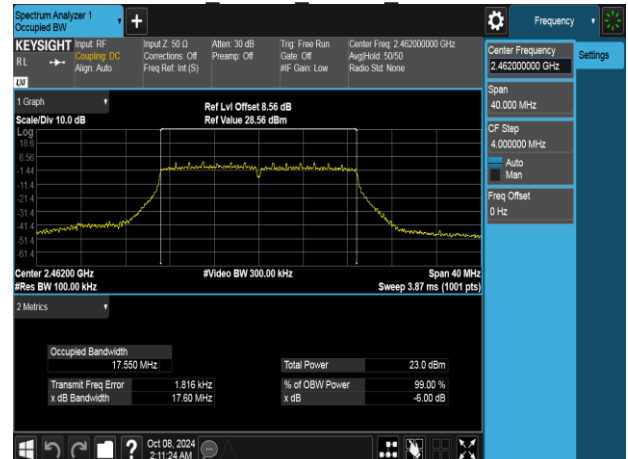
802.11n 20MHz Chain1 2437MHz



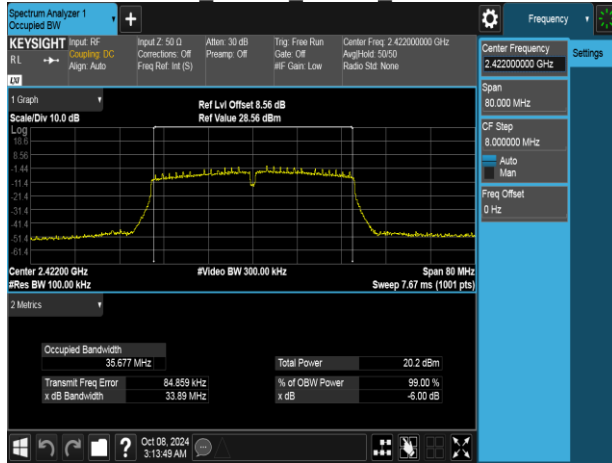
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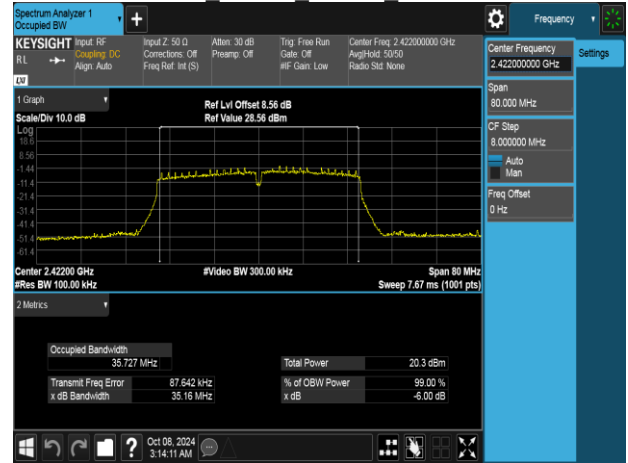
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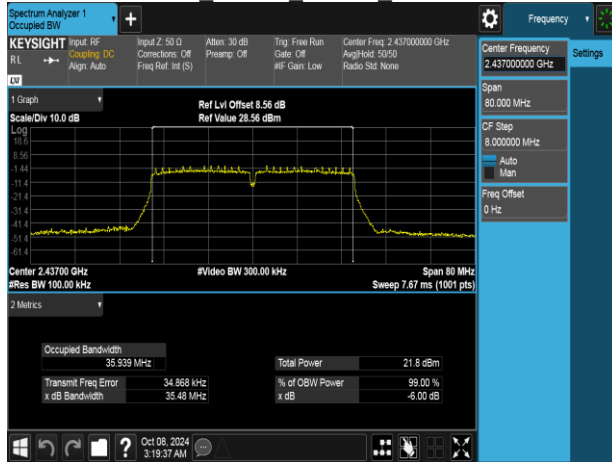
802.11n 40MHz Chain0 2422MHz



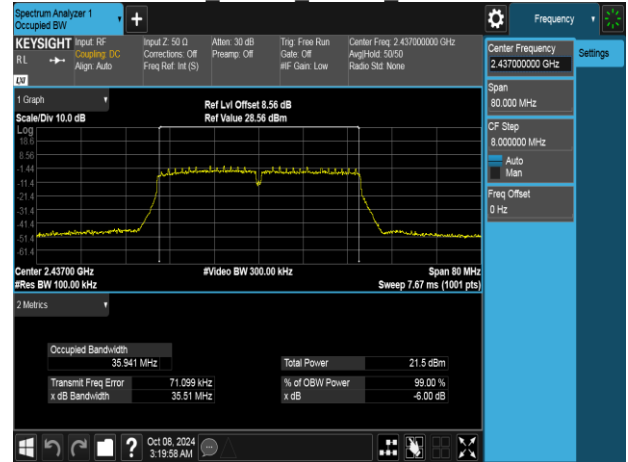
802.11n 40MHz Chain1 2422MHz



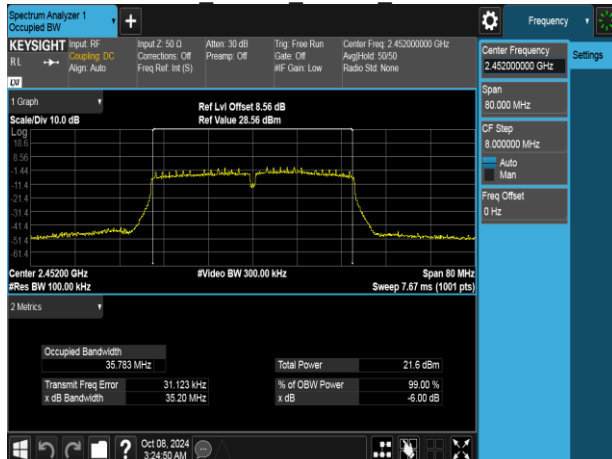
802.11n 40MHz Chain0 2437MHz



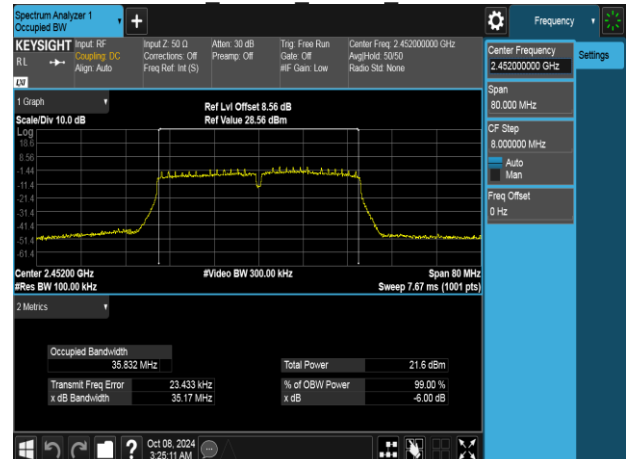
802.11n 40MHz Chain1 2437MHz



802.11n 40MHz Chain0 2452MHz



802.11n 40MHz Chain1 2452MHz

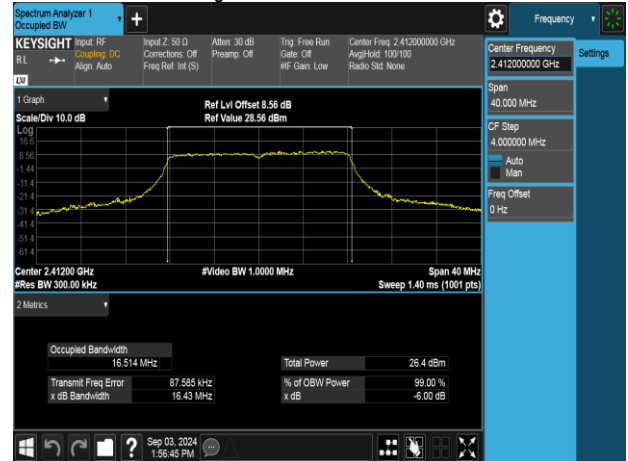


BANDWIDTH 99%

802.11b_20MHz_Chain1_2412MHz



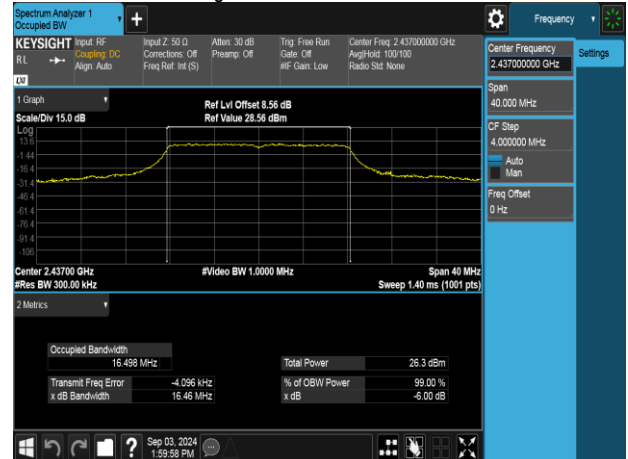
802.11g_20MHz_Chain1_2412MHz



802.11b_20MHz_Chain1_2437MHz



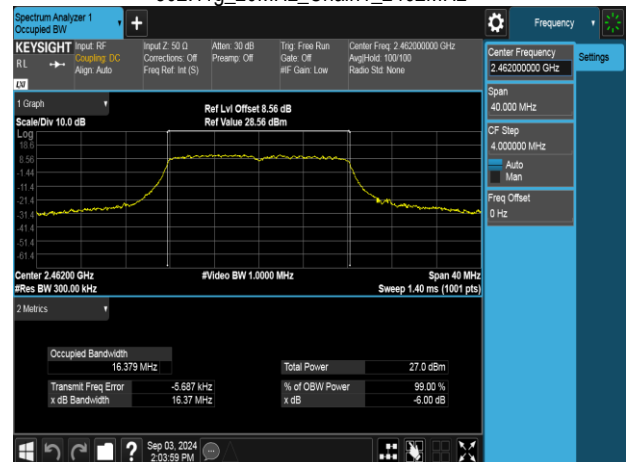
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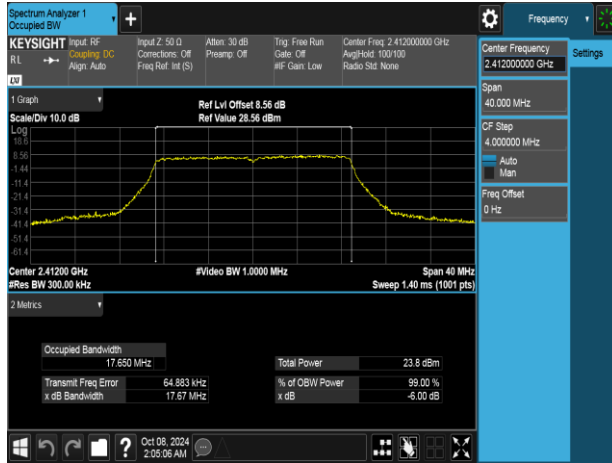
802.11b_20MHz_Chain1_2462MHz



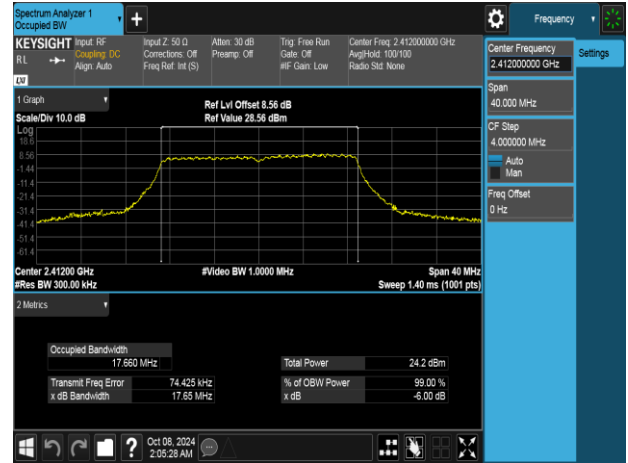
802.11g_20MHz_Chain1_2462MHz



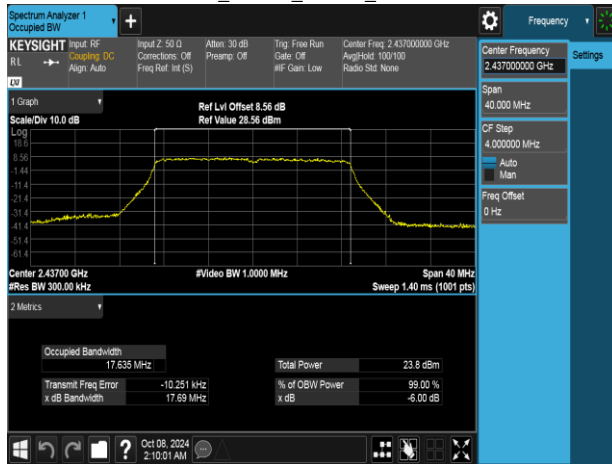
802.11n_20MHz_Chain0_2412MHz



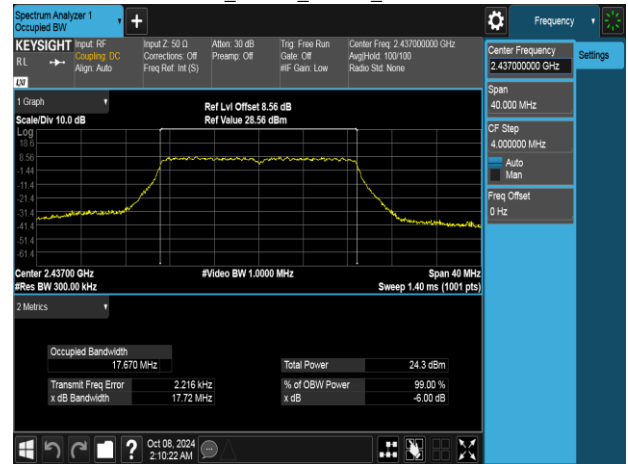
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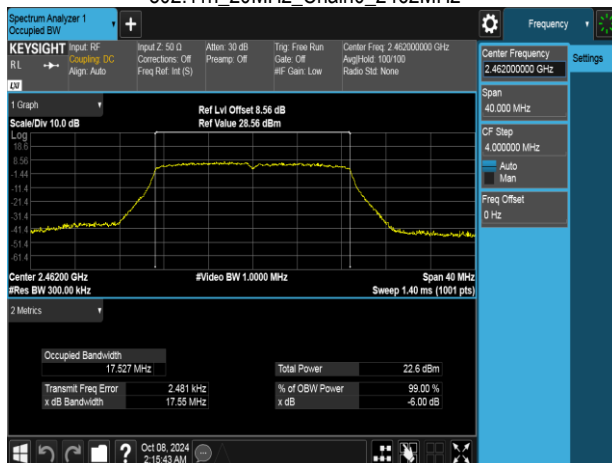
802.11n_20MHz_Chain0_2437MHz



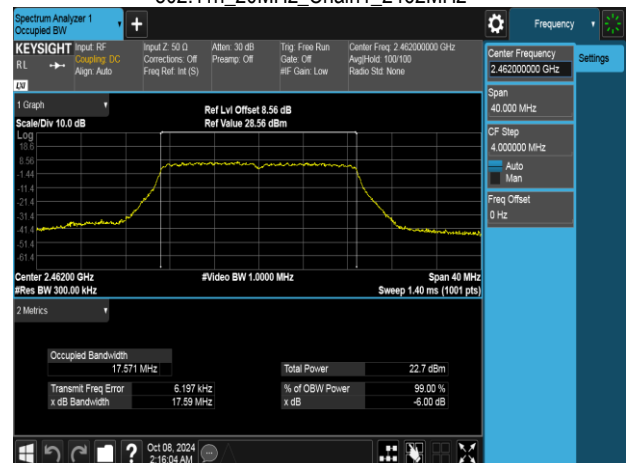
802.11n_20MHz_Chain1_2437MHz



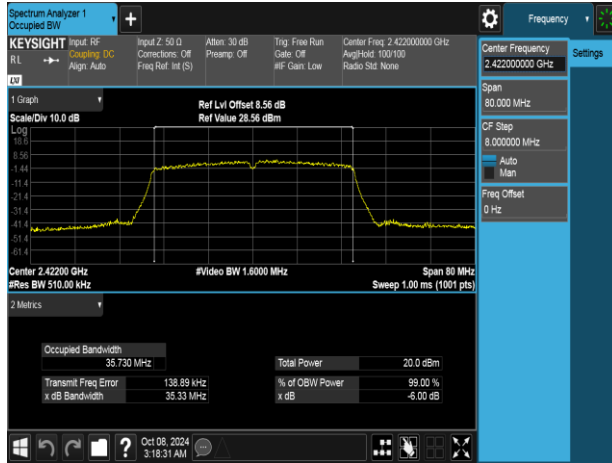
802.11n_20MHz_Chain0_2462MHz



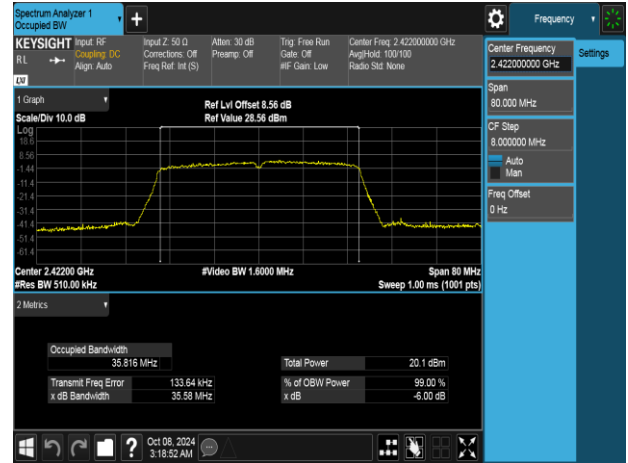
802.11n_20MHz_Chain1_2462MHz



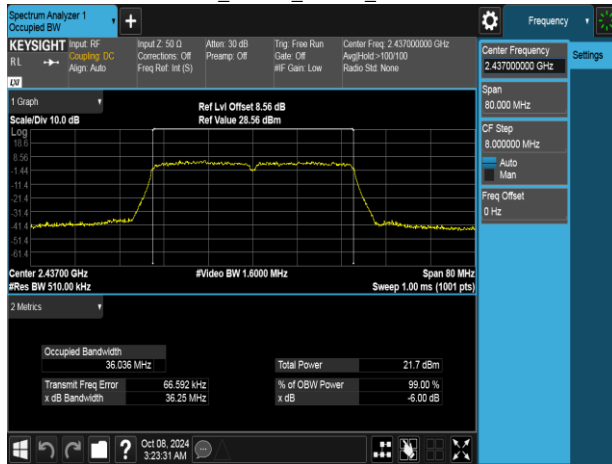
802.11n_40MHz_Chain0_2422MHz



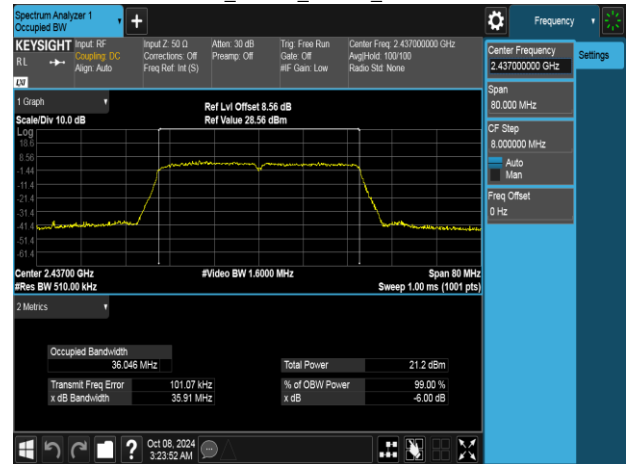
802.11n_40MHz_Chain1_2422MHz



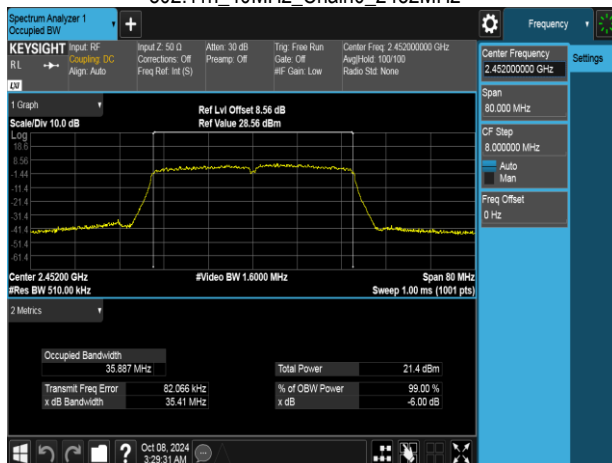
802.11n_40MHz_Chain0_2437MHz



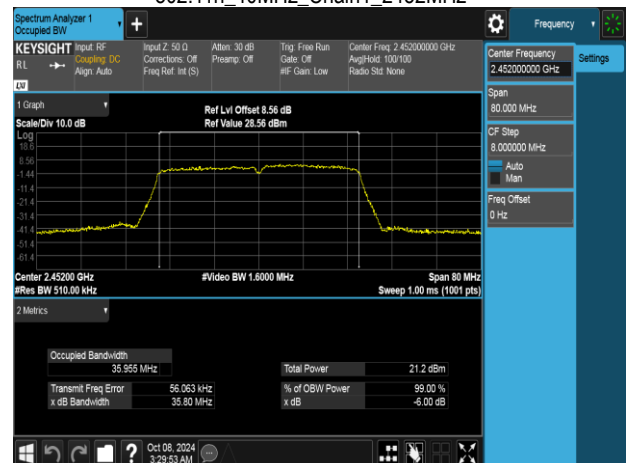
802.11n_40MHz_Chain1_2437MHz



802.11n_40MHz_Chain0_2452MHz



802.11n_40MHz_Chain1_2452MHz



4.3 OUTPUT POWER MEASUREMENT

4.3.1 Test Limit

According to §15.247(b),

FCC

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 :
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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.

4.3.4 Test Result

Temperature: 20.1 ~ 24.5°C

Test date: September 3 ~
October 8, 2024

Humidity: 46 ~ 65% RH

Tested by: Jerry Chang

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	25	347.54	25.41	30.00	PASS
6	2437	1	25	424.62	26.28	30.00	PASS
11	2462	1	24	399.02	26.01	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	25	268.43	24.29	30.00	PASS
6	2437	1	25	254.00	24.05	30.00	PASS
11	2462	1	24	221.73	23.46	30.00	PASS
802.11b Ch1							
CH	Freq. (MHz)	Data Rate	Power Setting	Peak Output Power (mW)	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	1	25	501.19	27.00	30.00	PASS
6	2437	1	25	481.95	26.83	30.00	PASS
11	2462	1	24	433.51	26.37	30.00	PASS
802.11b Ch1							
CH	Freq. (MHz)	Data Rate	Power Setting	Avg. Output Power (mW)	Avg. Output Power (dBm)	Limit (dBm)	RESULT
1	2412	1	25	289.62	24.62	30.00	PASS
6	2437	1	25	281.08	24.49	30.00	PASS
11	2462	1	24	242.57	23.85	30.00	PASS

802.11g Ch0							
CH	Freq. (MHz)	Data Rate	Power Setting	Peak Output Power (mW)	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	6	18	368.13	25.66	30.00	PASS
6	2437	6	18	365.59	25.63	30.00	PASS
11	2462	6	19	487.53	26.88	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	18	51.93	17.15	30.00	PASS
6	2437	6	18	52.41	17.19	30.00	PASS
11	2462	6	19	64.93	18.12	30.00	PASS
802.11g Ch1							
CH	Freq. (MHz)	Data Rate	Power Setting	Peak Output Power (mW)	Peak Output Power (dBm)	Limit (dBm)	RESULT
1	2412	6	18	387.26	25.88	30.00	PASS
6	2437	6	18	373.25	25.72	30.00	PASS
11	2462	6	19	494.31	26.94	30.00	PASS
802.11g Ch1							
CH	Freq. (MHz)	Data Rate	Power Setting	Avg. Output Power (mW)	Avg. Output Power (dBm)	Limit (dBm)	RESULT
1	2412	6	18	56.81	17.54	30.00	PASS
6	2437	6	18	59.35	17.73	30.00	PASS
11	2462	6	19	78.42	18.94	30.00	PASS

802.11n_HT20M_2TX									
CH	Freq. (MHz)	Data Rate	Power Setting	Peak Output Power (dBm)		Total Peak Output Power (mW)	Total Peak Output Power (dBm)	Limit (dBm)	RESULT
				Ch0	Ch1				
1	2412	MCS0	17	24.14	24.64	550.49	27.41	30.00	PASS
6	2437	MCS0	17	24.62	25.05	609.62	27.85	30.00	PASS
11	2462	MCS0	15	23.53	23.74	462.02	26.65	30.00	PASS
802.11n_HT20M_2TX									
CH	Freq. (MHz)	Data Rate	Power Setting	Avg. Output Power (dBm)		Total Avg. Output Power (mW)	Total Avg. Output Power (dBm)	Limit (dBm)	RESULT
				Ch0	Ch1				
1	2412	MCS0	17	16.44	16.76	91.39	19.61	30.00	PASS
6	2437	MCS0	17	16.50	16.92	93.78	19.72	30.00	PASS
11	2462	MCS0	15	15.38	15.50	69.92	18.45	30.00	PASS
802.11n_HT40M_2TX									
CH	Freq. (MHz)	Data Rate	Power Setting	Peak Output Power (dBm)		Total Peak Output Power (mW)	Total Peak Output Power (dBm)	Limit (dBm)	RESULT
				Ch0	Ch1				
3	2422	MCS0	13	21.38	21.35	273.86	24.38	30.00	PASS
6	2437	MCS0	14	22.29	22.57	350.15	25.44	30.00	PASS
9	2452	MCS0	14	22.79	22.92	385.99	25.87	30.00	PASS
802.11n_HT40M_2TX									
CH	Freq. (MHz)	Data Rate	Power Setting	Avg. Output Power (dBm)		Total Avg. Output Power (mW)	Total Avg. Output Power (dBm)	Limit (dBm)	RESULT
				Ch0	Ch1				
3	2422	MCS0	13	12.61	12.66	36.67	15.64	30.00	PASS
6	2437	MCS0	14	13.59	13.92	47.49	16.77	30.00	PASS
9	2452	MCS0	14	13.71	14.00	48.59	16.87	30.00	PASS

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 :
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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.

4.4.4 Test Result

Temperature: 20.1 ~ 24.5°C

Test date:

September 3 ~
October 8, 2024

Humidity: 46 ~ 65% RH

Tested by:

Jerry Chang

Gain			1.99	dBi
			SISO	
POWER DENSITY 802.11b				
Freq. (MHz)	Ch1 PSD	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
2412	1.23	1.23	8.00	PASS
2437	1.53	1.53	8.00	PASS
2462	2.69	2.69	8.00	PASS

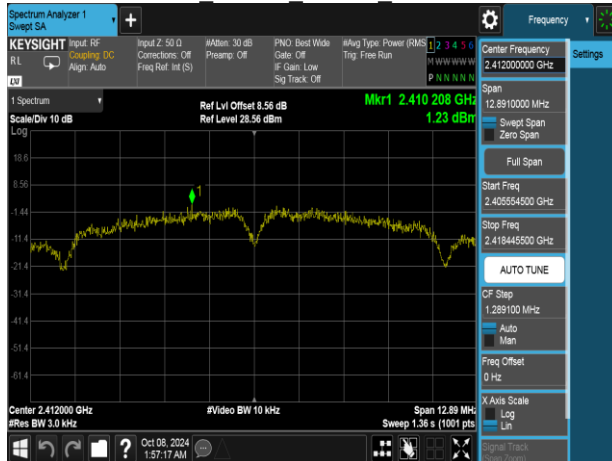
Gain			1.99	dBi
			SISO	
POWER DENSITY 802.11g				
Freq. (MHz)	Ch1 PSD	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
2412	-3.72	-3.72	8.00	PASS
2437	-5.25	-5.25	8.00	PASS
2462	-3.93	-3.93	8.00	PASS

POWER DENSITY 802.11n HT20					
Freq. (MHz)	Ch0 PSD	Ch1 PSD	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
2412	-9.15	-7.52	-5.25	8.00	PASS
2437	-8.68	-8.54	-5.60	8.00	PASS
2462	-8.26	-8.35	-5.30	8.00	PASS

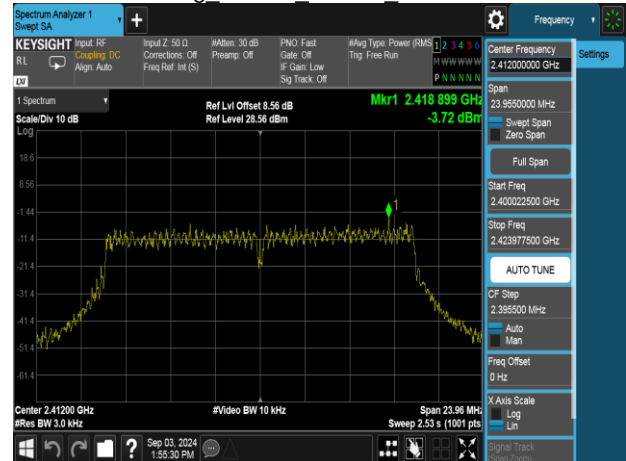
POWER DENSITY 802.11n HT40					
Freq. (MHz)	Ch0 PSD	Ch1 PSD	PSD (dBm/3kHz)	Limit (dBm/3kHz)	Result
2422	-14.49	-14.44	-11.45	8.00	PASS
2437	-14.39	-14.06	-11.21	8.00	PASS
2452	-13.94	-13.80	-10.86	8.00	PASS

Test Data

802.11b 20MHz Chain1_2412MHz



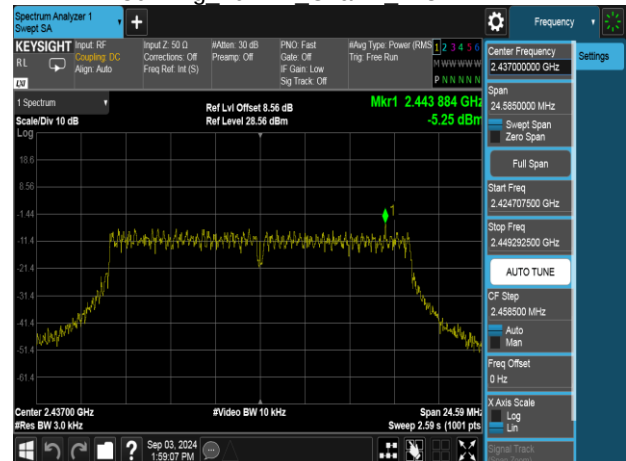
802.11g 20MHz Chain1_2412MHz



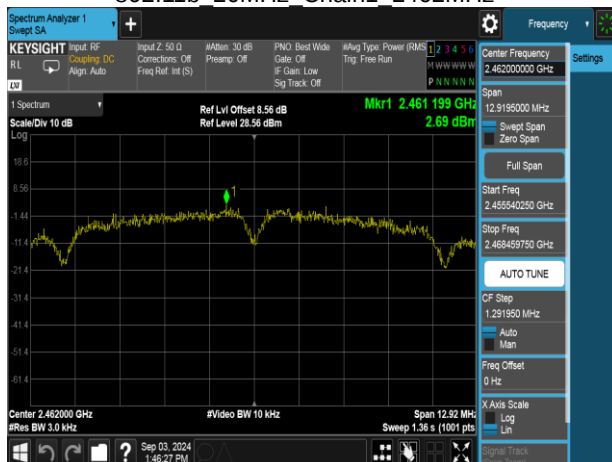
802.11b 20MHz Chain1_2437MHz



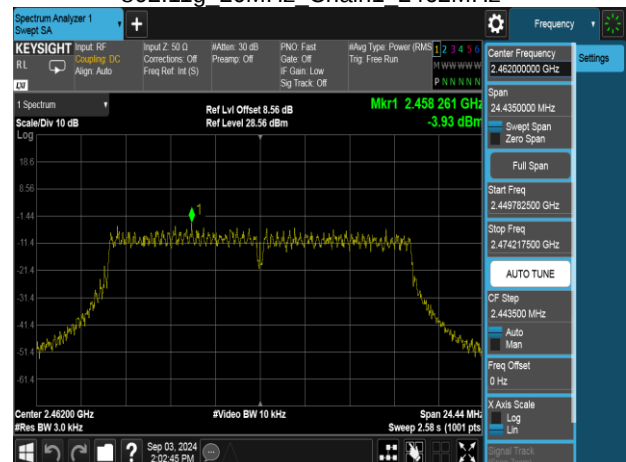
802.11g 20MHz Chain1_2437MHz



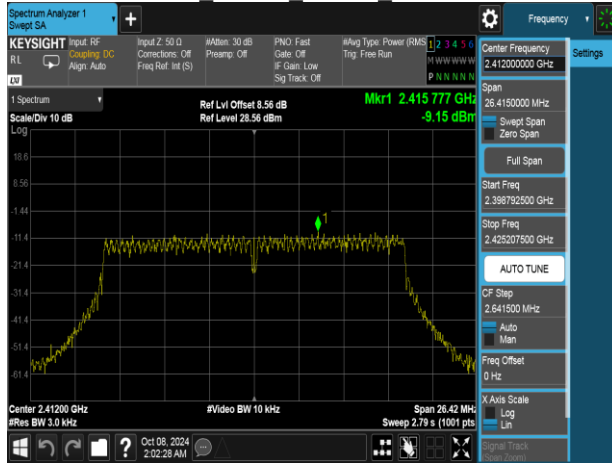
802.11b 20MHz Chain1_2462MHz



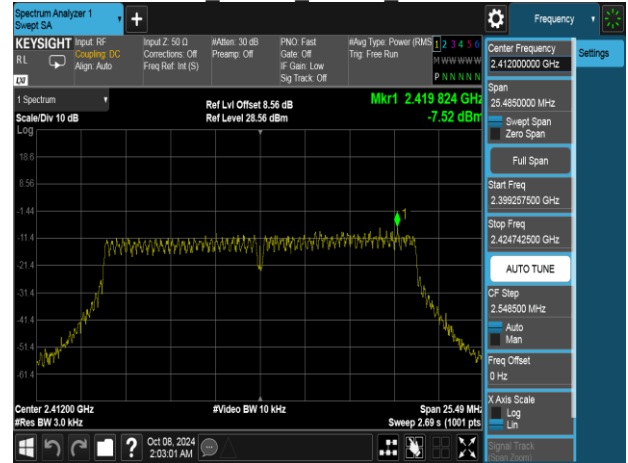
802.11g 20MHz Chain1_2462MHz



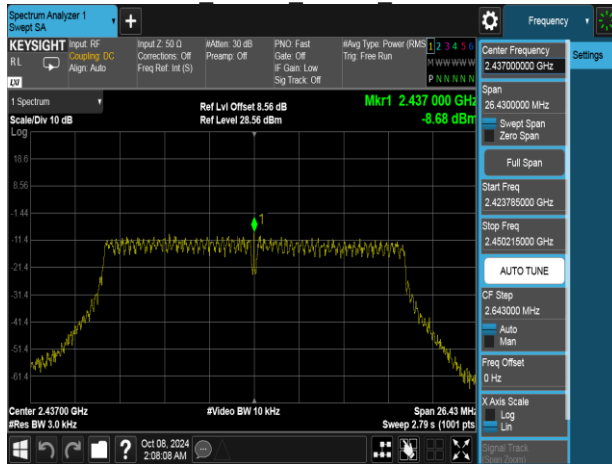
802.11n 20MHz Chain0 2412MHz



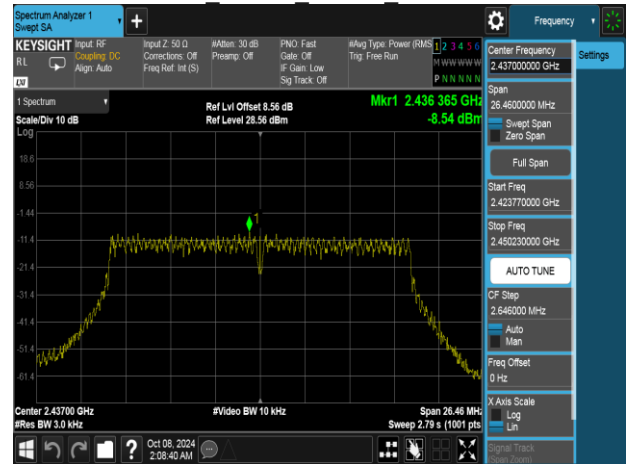
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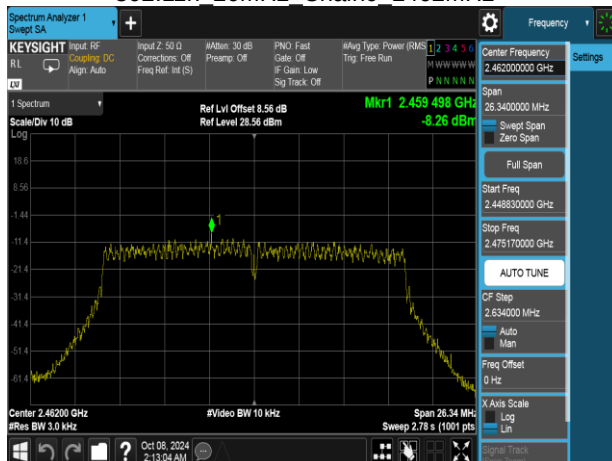
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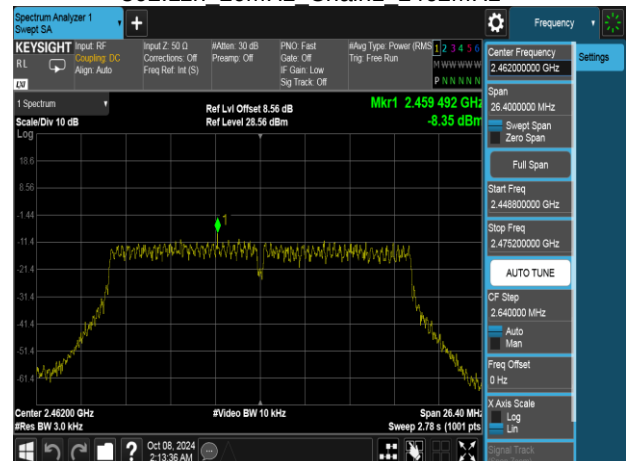
802.11n 20MHz Chain1 2437MHz



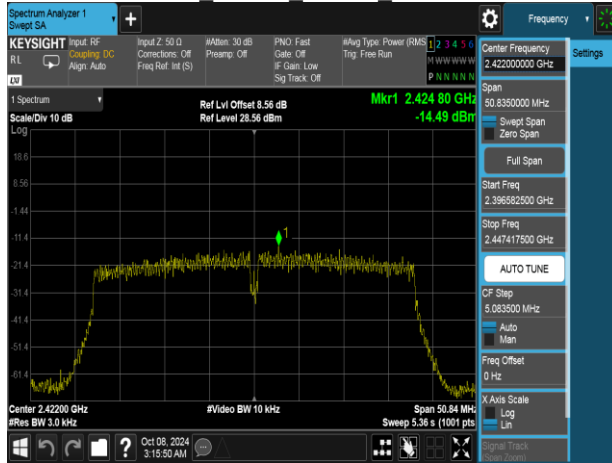
802.11n 20MHz Chain0 2462MHz



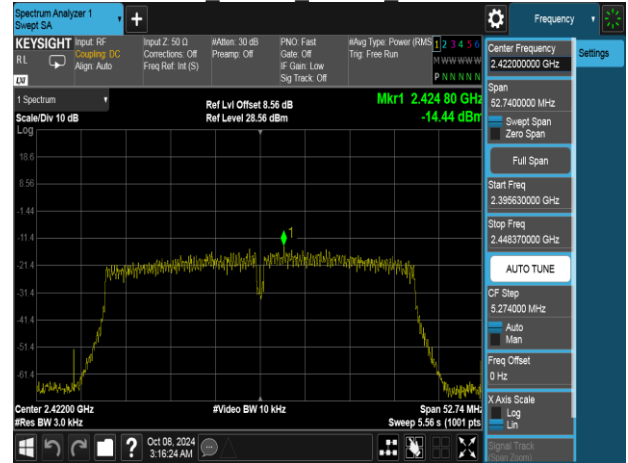
802.11n 20MHz Chain1 2462MHz



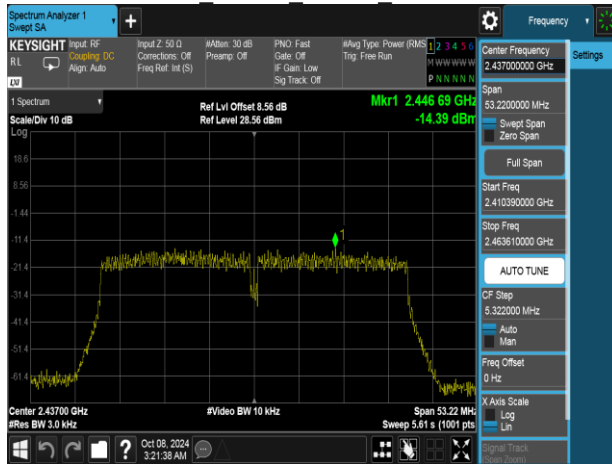
802.11n 40MHz Chain0 2422MHz



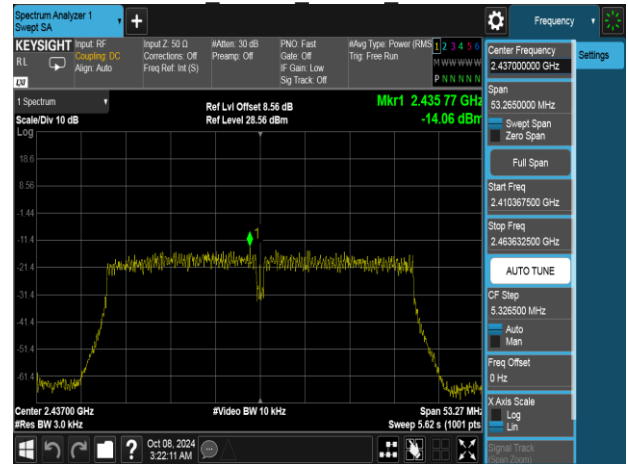
802.11n 40MHz Chain1 2422MHz



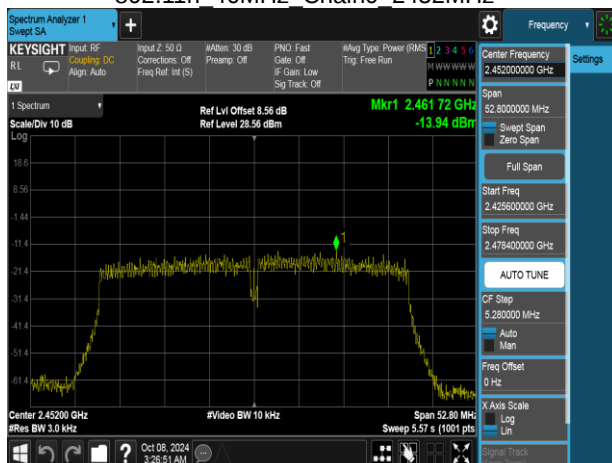
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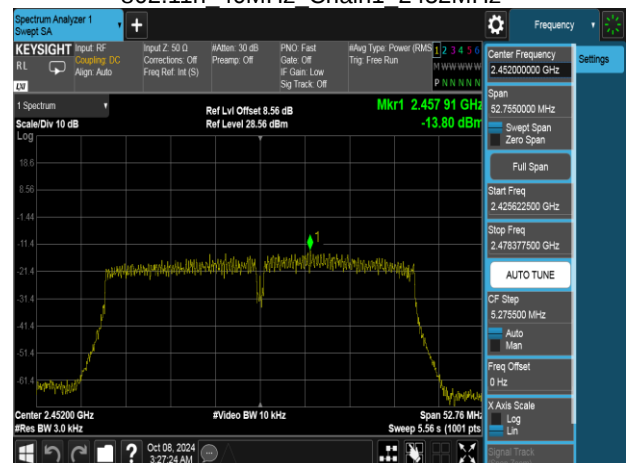
802.11n 40MHz Chain1 2437MHz



802.11n 40MHz Chain0 2452MHz



802.11n 40MHz Chain1 2452MHz



4.5 CONDUCTED BANDEDGE AND SPURIOUS EMISSION

4.5.1 Test Limit

According to §15.247(d) and RSS-247 section 5.5,

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. If 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: 20.1 ~ 24.5°C

Test date:

September 3 ~
October 8, 2024

Humidity: 46 ~ 65% RH

Tested by:

Jerry Chang