

FCC/ISED - TEST REPORT

Report Number : **709502409836-00A** Date of Issue: December 26,2024

Model : TYAUX-F2

Product Type : Wi-Fi and Bluetooth Module

Applicant : Hangzhou Tuya Information Technology Co.,Ltd

Address : Room 301,Building 1,Huace Center,Xihu District,
Hangzhou,Zhejiang, China

Manufacturer : Hangzhou Tuya Information Technology Co.,Ltd

Address : Room 301,Building 1,Huace Center,Xihu District,
Hangzhou,Zhejiang, China

Test Result : **n Positive** **o Negative**

Total pages including
Appendices : 71



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2 Report Modification Record

Alterations and additions to this report will be issued to the holders of each copy in the form of a complete document.

Issue	Description of Change	Date of Issue
709502409836-00A	First Issue	12/26/2024

3 Details about the Test Laboratory

Test Site 1

Company name: TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch
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FCC Registration No.: 820234

FCC Designation Number: CN1183

ISED CAB identifier: CN0101

IC Registration No.: 31668

4 Description of the Equipment under Test

Product: Wi-Fi and Bluetooth Module

PMN / HVIN / Model no.: TYAUX-F2

FCC ID: 2ANDL-TYAUX-F2

IC: 23243-TYAUXF2

Rating: 3.0-3.6V DC

RF Transmission Frequency: Wi-Fi:2412-2462MHz
Bluetooth LE:2402~2480MHz

No. of Operated Channel: 2.4GHz WIFI: 11 for 802.11b/g/n(HT20)
2.4GHz BLE: 40

Modulation: Direct Sequence Spread Spectrum (DSSS) for 802.11b
Orthogonal Frequency Division Multiplexing (OFDM) for
802.11g/n; 2.4GHz BLE: GFSK

Channel list:

802.11b/g/n(HT20)			
Ch	Fre(MHz)	Ch	Fre(MHz)
1	2412	7	2442
2	2417	8	2447
3	2422	9	2452
4	2427	10	2457
5	2432	11	2462
6	2437		

Bluetooth Low Energy							
Ch	Fre(MHz)	Ch	Fre(MHz)	Ch	Fre(MHz)	Ch	Fre(MHz)
0	2402	10	2422	20	2442	30	2462
1	2404	11	2424	21	2444	31	2464
2	2406	12	2426	22	2446	32	2466
3	2408	13	2428	23	2448	33	2468
4	2410	14	2430	24	2450	34	2470
5	2412	15	2432	25	2452	35	2472
6	2414	16	2434	26	2454	36	2474
7	2416	17	2436	27	2456	37	2476
8	2418	18	2438	28	2458	38	2478
9	2420	19	2440	29	2460	39	2480



Hardware Version: V1.0.0

Software Version: V3.5.0

Antenna type: Onboard PCB antenna

Antenna Gain: 1.68dBi

Description of the EUT: The Equipment Under Test (EUT) is a Wi-Fi and Bluetooth module which support 2.4GHz Wi-Fi and BLE 4.2(support 1Mbps data rate). We tested it and listed the worst data in this report.

Test sample no.: SHA-866932-1 (RF radiated); SHA-866932-2 (RF conducted)

The sample's mentioned in this report is/are submitted/ supplied/ manufactured by client. The laboratory therefore assumes no responsibility for accuracy of information on the brand name, model number, origin of manufacture, consignment or any information supplied.

5 Summary of Test Standards

Test Standards	
FCC Part 15 Subpart C 10-1-2023 Edition	PART 15 - RADIO FREQUENCY DEVICES Subpart C - Intentional Radiators
RSS-Gen Issue 5 April 2018 + Amendment 1 March 2019 + Amendment 2 February 2021	General Requirements for Compliance of Radio Apparatus
RSS-247 Issue 3 August 2023	Digital Transmission Systems (DTSS), Frequency Hopping Systems (FHSS) and License-Exempt Local Area Network (LE- LAN) Devices

All the test methods were according to KDB 558074 D01 15.247 Meas Guidance v05r02 Measurement Guidance and ANSI C63.10-2020.



6 Summary of Test Results

Technical Requirements							
FCC Part 15 Subpart C & RSS-247 Issue 3/RSS-Gen Issue 5							
Test Condition			Pages	Test Site	Test Result		
					Pass	Fail	N/A
§15.207	RSS-GEN 8.8	Conducted emission AC power port	13-17	Site 1	☒	☐	☐
§15.247 (b) (3)	RSS-247 5.4(d)	Conducted peak output power & e.i.r.p	18	Site 1	☒	☐	☐
§15.247(a)(1)	RSS-247 5.1(a) & RSS-Gen 6.7	20dB bandwidth and 99% Occupied Bandwidth	---	---	☐	☐	☒
§15.247(a)(1)	RSS-247 5.1(b)	Carrier frequency separation	---	---	☐	☐	☒
§15.247(a)(1)(iii)	RSS-247 5.1(d)	Number of hopping frequencies	---	---	☐	☐	☒
§15.247(a)(1)(iii)	RSS-247 5.1(d)	Dwell Time - Average Time of Occupancy	---	---	☐	☐	☒
§15.247(a)(2)	RSS-247 5.2(a) & RSS-GEN 6.7	6dB bandwidth and 99% Occupied Bandwidth	19-25	Site 1	☒	☐	☐
§15.247(e)	RSS-247 5.2(b)	Power spectral density	26-29	Site 1	☒	☐	☐
§15.247(e)	RSS-247 5.5	Spurious RF conducted emissions	30-39	Site 1	☒	☐	☐
§15.247(d)	RSS-247 5.5	Band edge	40-46	Site 1	☒	☐	☐
§15.247(d) & §15.209 & §15.205	RSS-247 5.5 & RSS-Gen 6.13	Spurious radiated emissions for transmitter	47-67	Site 1	☒	☐	☐
§15.203	RSS-Gen 6.8	Antenna requirement	See note 1		☒	☐	☐

Remark 1: N/A – Not Applicable.

Note 1: The EUT uses PCB antenna, which gain is 1.68dBi. In accordance to §15.203 and RSS-Gen 6.8, it is considered sufficiently to comply with the provisions of this section.



7 General Remarks

Remarks

This submittal(s) (test report) is intended for FCC ID: 2ANDL-TYAUX-F2, IC: 23243-TYAUXF2 complies with Section 15.207,15.209,15.231,15.247 of the FCC Part 15, Subpart C Rules and RSS-247, RSS-GEN.

This report is only for the 2.4GHz Wi-Fi test report, for the 2.4GHz BLE test report please refer to 709502409836-00B.

SUMMARY:

All tests according to the regulations cited on page 5 were

n - Performed

o - **Not** Performed

The Equipment under Test

n - **Fulfills** the general approval requirements.

o - **Does not** fulfill the general approval requirements.

Sample Received Date: November 22, 2024

Testing Start Date: November 25, 2024

Testing End Date: December 24, 2024

-TÜV SÜD Certification and Testing (China) Co., Ltd. Shanghai Branch

Reviewed by:

Hui TONG
Review Engineer

Prepared by:



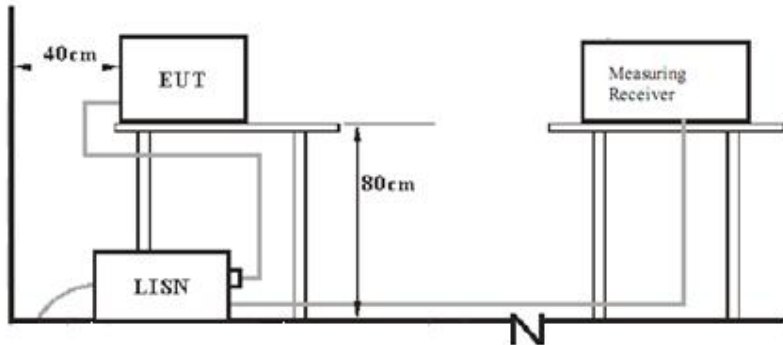
Jiayi XU
Project Engineer

Tested by:

Chengjie GUO
Test Engineer

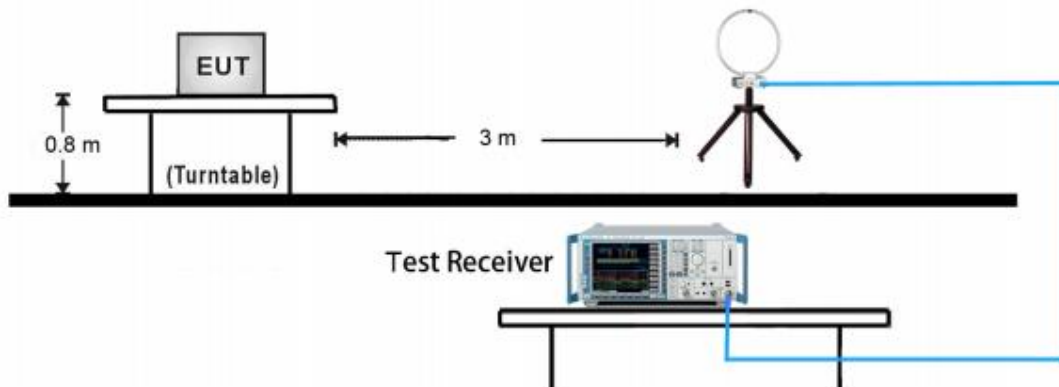
8 Test Setups

8.1 AC Power Line Conducted Emission test setups

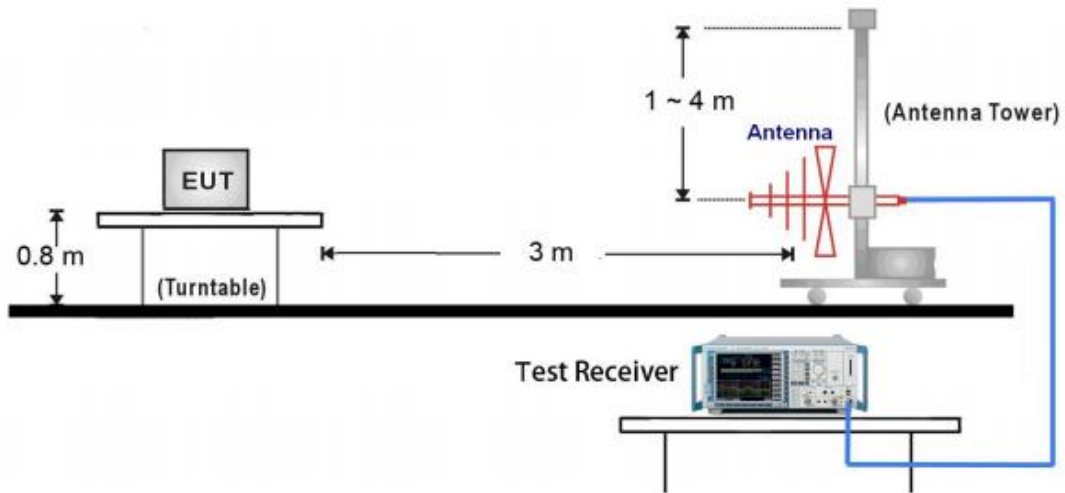


8.2 Radiated test setups

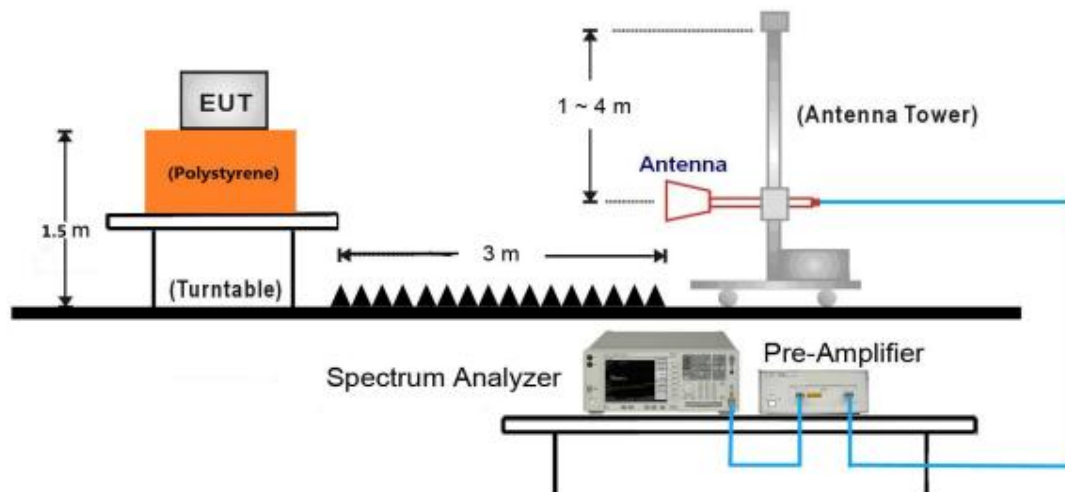
9kHz ~ 30MHz Test Setup:



30MHz ~ 1GHz Test Setup:

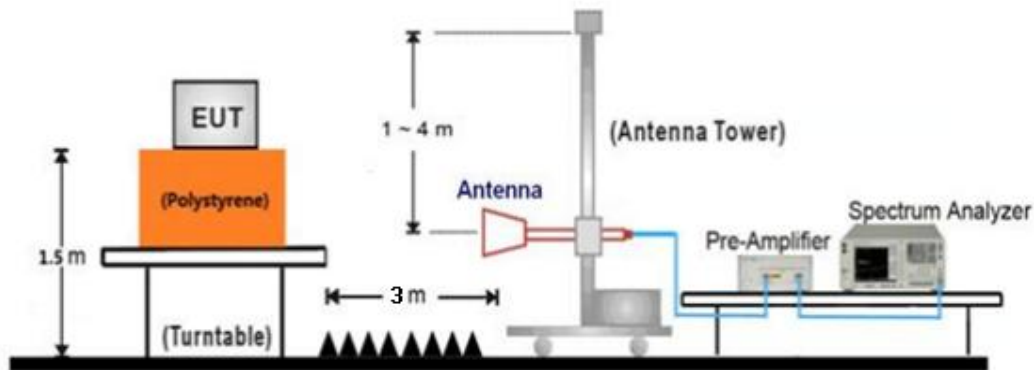


1GHz ~ 18GHz Test Setup:



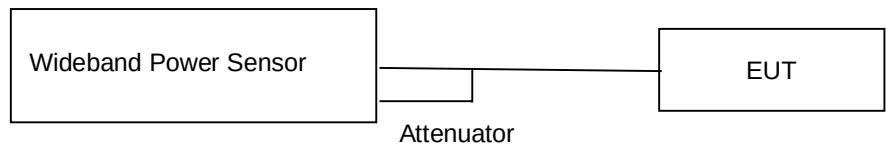


18GHz ~ 25GHz Test Setup:

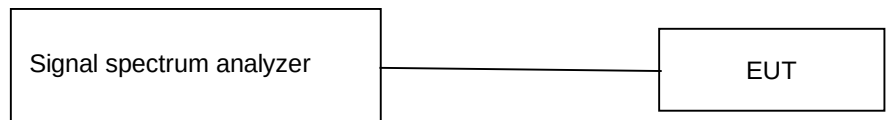


8.3 Conducted RF test setups

For Conducted peak output power



For other test items



9 Systems test configuration

Auxiliary Equipment Used during Test:

DESCRIPTION	MANUFACTURER	MODEL NO.(SHIELD)	S/N(LENGTH)
Notebook	Lenovo	E470	PF-OU5TS7 17/09

Test software: AmebaZ2_mptool_1V3

Test Mode Applicability and Tested Channel Detail:

Mode	Tested Channel	Data Rate (Mbps)	Modulation	Index Value (Power level setting)
802.11b	1	1	CCK	86
	6	1	CCK	84
	11	1	CCK	83
802.11g	1	6	OFDM	88
	6	6	OFDM	92
	11	6	OFDM	82
802.11n HT20	1	MCS0	OFDM	88
	6	MCS0	OFDM	94
	11	MCS0	OFDM	82

Non-hopping mode: The system was configured to operate at a signal channel transmitting. The test software allows the configuration and operation at the worst-case duty and the highest transmit power.

10 Technical Requirement

10.1 Conducted Emission

Test Method

1. The EUT was placed on a table, which is 0.8m above ground plane
2. The power line of the EUT is connected to the AC mains through a Artificial Mains Network (A.M.N.).
3. Maximum procedure was performed to ensure EUT compliance
4. A EMI test receiver is used to test the emissions from both sides of AC line

Limit

According to §15.207 & RSS-GEN 8.8, conducted emissions limit as below:

Frequency MHz	QP Limit dB μ V	AV Limit dB μ V
0.150-0.500	66-56*	56-46*
0.500-5	56	46
5-30	60	50

Decreasing linearly with logarithm of the frequency

Conducted Emission

150k-30MHz Conducted Emission Test

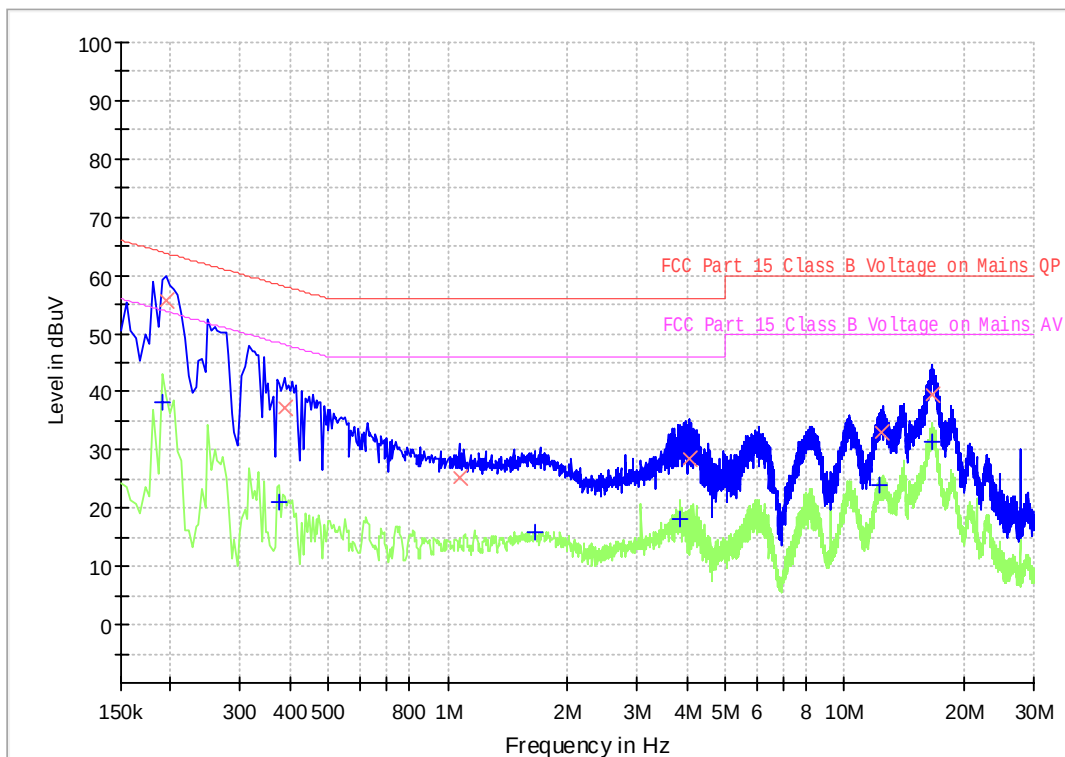
EUT Information

EUT Name: Wi-Fi and Bluetooth Module
Model: TYAUX-F2
Client: Hangzhou Tuya Information Co., Ltd
Op Cond: Power on, TX_2437MHz at N20 mode, AC 120V/60Hz
Operator: Chengjie Guo
Standard: FCC Part 15.207(a)
Comment: Phase L
Sample No.: SHA-866932-2

Scan Setup: Voltage with 2-Line-LISN pre [EMI conducted]

Hardware Setup: Voltage with 2-Line-LISN
Receiver: [ESR 3]
Level Unit: dBuV

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
9 kHz - 150 kHz	100 Hz	PK+	200 Hz	0.02 s	0 dB
150 kHz - 30 MHz	4.5 kHz	PK+; AVG	9 kHz	0.01 s	0 dB





Final Result

Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.186000	---	40.82	54.21	13.39	1000.0	9.000	L1	19.5
0.186000	50.81	---	64.21	13.40	1000.0	9.000	L1	19.5
0.424500	---	28.96	47.36	18.40	1000.0	9.000	L1	19.5
0.501000	42.84	---	56.00	13.16	1000.0	9.000	L1	19.5
1.923000	37.41	---	56.00	18.59	1000.0	9.000	L1	19.5
1.932000	---	25.58	46.00	20.42	1000.0	9.000	L1	19.5
2.629500	35.80	---	56.00	20.20	1000.0	9.000	L1	19.5
3.619500	---	24.91	46.00	21.09	1000.0	9.000	L1	19.5
6.301500	---	26.78	50.00	23.22	1000.0	9.000	L1	19.7
6.459000	33.30	---	60.00	26.70	1000.0	9.000	L1	19.7
21.525000	---	24.49	50.00	25.51	1000.0	9.000	L1	20.7
21.619500	31.84	---	60.00	28.16	1000.0	9.000	L1	20.7

Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)
 Factor (dB) = Cable Loss (dB) + LISN Factor (dB) + 10dB Attenuator

150k-30MHz Conducted Emission Test

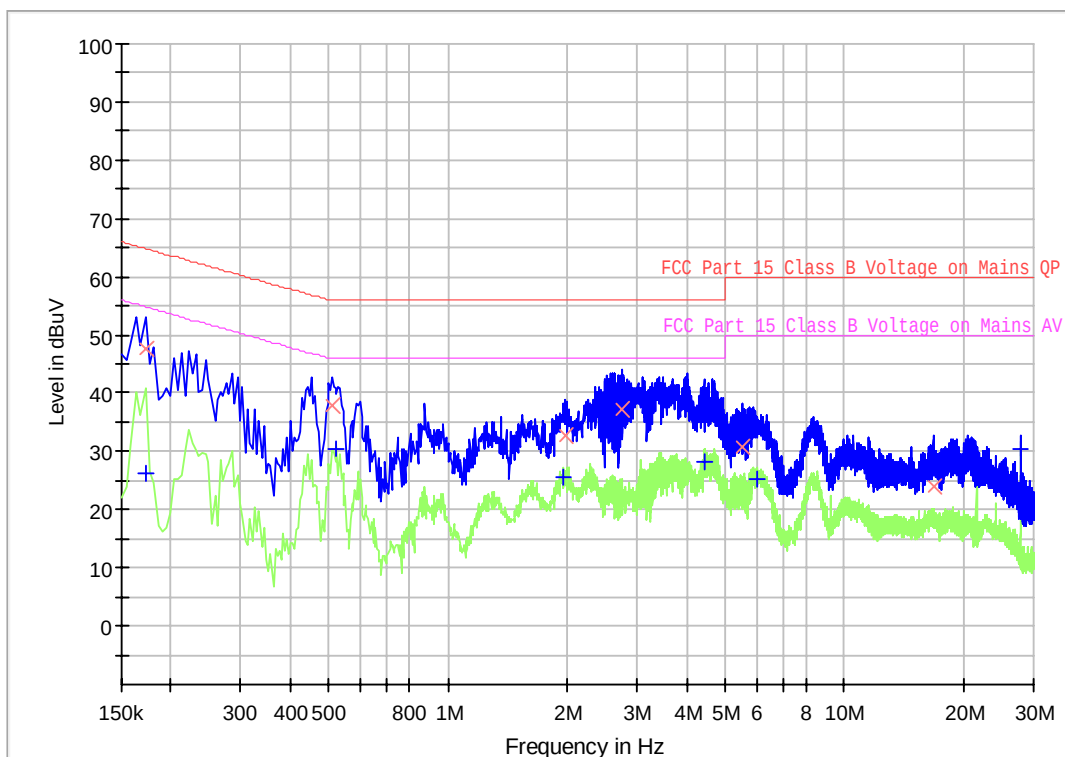
EUT Information

EUT Name: Wi-Fi and Bluetooth Module
 Model: TYAUX-F2
 Client: Hangzhou Tuya Information Co., Ltd
 Op Cond: Power on, TX_2437MHz at N20 mode, AC 120V/60Hz
 Operator: Chengjie Guo
 Standard: FCC Part 15.207(a)
 Comment: Phase N
 Sample No.: SHA-866932-2

Scan Setup: Voltage with 2-Line-LISN pre [EMI conducted]

Hardware Setup: Voltage with 2-Line-LISN
 Receiver: [ESR 3]
 Level Unit: dBuV

Subrange	Step Size	Detectors	IF BW	Meas. Time	Preamp
9 kHz - 150 kHz	100 Hz	PK+	200 Hz	0.02 s	0 dB
150 kHz - 30 MHz	4.5 kHz	PK+; AVG	9 kHz	0.01 s	0 dB





Final Result

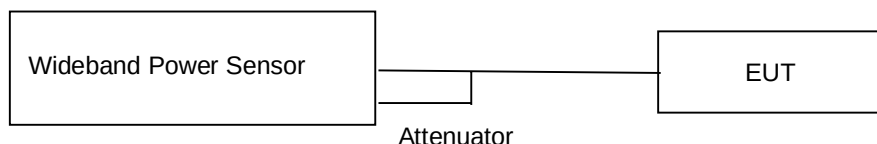
Frequency (MHz)	QuasiPeak (dBuV)	CAverage (dBuV)	Limit (dBuV)	Margin (dB)	Meas. Time (ms)	Bandwidth (kHz)	Line	Corr. (dB)
0.172500	---	26.17	54.84	28.67	1000.0	9.000	N	19.5
0.172500	47.44	---	64.84	17.40	1000.0	9.000	N	19.5
0.510000	37.77	---	56.00	18.23	1000.0	9.000	N	19.5
0.523500	---	30.43	46.00	15.57	1000.0	9.000	N	19.5
1.963500	---	25.54	46.00	20.46	1000.0	9.000	N	19.5
1.981500	32.84	---	56.00	23.16	1000.0	9.000	N	19.5
2.751000	37.33	---	56.00	18.67	1000.0	9.000	N	19.5
4.443000	---	28.32	46.00	17.68	1000.0	9.000	N	19.6
5.500500	30.81	---	60.00	29.19	1000.0	9.000	N	19.6
5.995500	---	25.39	50.00	24.61	1000.0	9.000	N	19.6
16.849500	23.91	---	60.00	36.09	1000.0	9.000	N	20.0
27.649500	---	30.47	50.00	19.53	1000.0	9.000	N	20.8

Note 1: Measure Level (dBuV/m) = Reading Level (dBuV) + Factor (dB)
 Factor (dB) = Cable Loss (dB) + LISN Factor (dB) + 10dB Attenuator

10.2 Conducted peak output power and e.i.r.p.

Test Method

- 1) The EUT is configured to transmit continuously, or to transmit with a constant duty cycle.
- 2) At all times when the EUT is transmitting, it shall be transmitting at its maximum power control level.
- 3) The integration period of the power meter exceeds the repetition period of the transmitted signal by at least a factor of five.
- 4) Measure the peak power of the transmitter. This measurement is a peak over both the ON and OFF periods of the transmitter.



Wideband Power Sensor conducted test setup

Limits

According to §15.247 (b) (3) & RSS-247 5.4(d) conducted peak output power limit as below:

	Frequency Range	Limit	Limit
	MHz	W	dBm
Conducted peak output power	2400-2483.5	≤1	≤30
e.i.r.p.	2400-2483.5	≤4	≤36

Test result as below

802.11B: Antenna gain=1.68dBi				
Frequency MHz	Conducted Peak Output Power(dBm) §15.247 (b) (3)	Result	e.i.r.p.(dBm) RSS-247 5.4(d)	Result
2412MHz	20.15	Pass	21.83	Pass
2437MHz	19.74	Pass	21.42	Pass
2462MHz	19.57	Pass	21.25	Pass

802.11G: Antenna gain=1.68dBi				
Frequency MHz	Conducted Peak Output Power(dBm) §15.247 (b) (3)	Result	e.i.r.p.(dBm) RSS-247 5.4(d)	Result
2412MHz	22.69	Pass	24.37	Pass
2437MHz	22.77	Pass	24.45	Pass
2462MHz	21.21	Pass	22.89	Pass

802.11N20: Antenna gain=1.68dBi				
Frequency MHz	Conducted Peak Output Power(dBm) §15.247 (b) (3)	Result	e.i.r.p.(dBm) RSS-247 5.4(d)	Result
2412MHz	21.31	Pass	22.99	Pass
2437MHz	22.64	Pass	24.32	Pass
2462MHz	20.47	Pass	22.15	Pass

10.36dB bandwidth and 99% Occupied Bandwidth

Test Method

1. Set RBW = shall be in the range of 1% to 5% of the OBW but not less than 100 kHz.
2. Set the VBW $\geq [3 \times \text{RBW}]$.
3. Detector = peak.
RBW=100KHz, VBW $\geq$ 3RBW, Sweep = auto, Detector function = peak, Trace = max hold
4. Trace mode = max-hold.
5. Sweep = No faster than coupled (auto) time.
6. Allow the trace to stabilize.
7. Measure the maximum width of the emission by placing two markers, one at the lowest frequency and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the “-6 dB down amplitude”. If a marker is below this “-6 dB down amplitude” value, then it shall be as close as possible to this value.

Test Method for 99 % Bandwidth

1. Connect EUT test port to spectrum analyzer.
Use the following spectrum analyzer settings:
RBW=1% to 5% of the actual occupied, VBW $\geq$ 3RBW, Sweep = auto, Detector function = peak, Trace = max hold
2. Use the occupied bandwidth measurement capability of test receiver.
3. Allow the trace to stabilize, record the occupied bandwidth value.

Limit

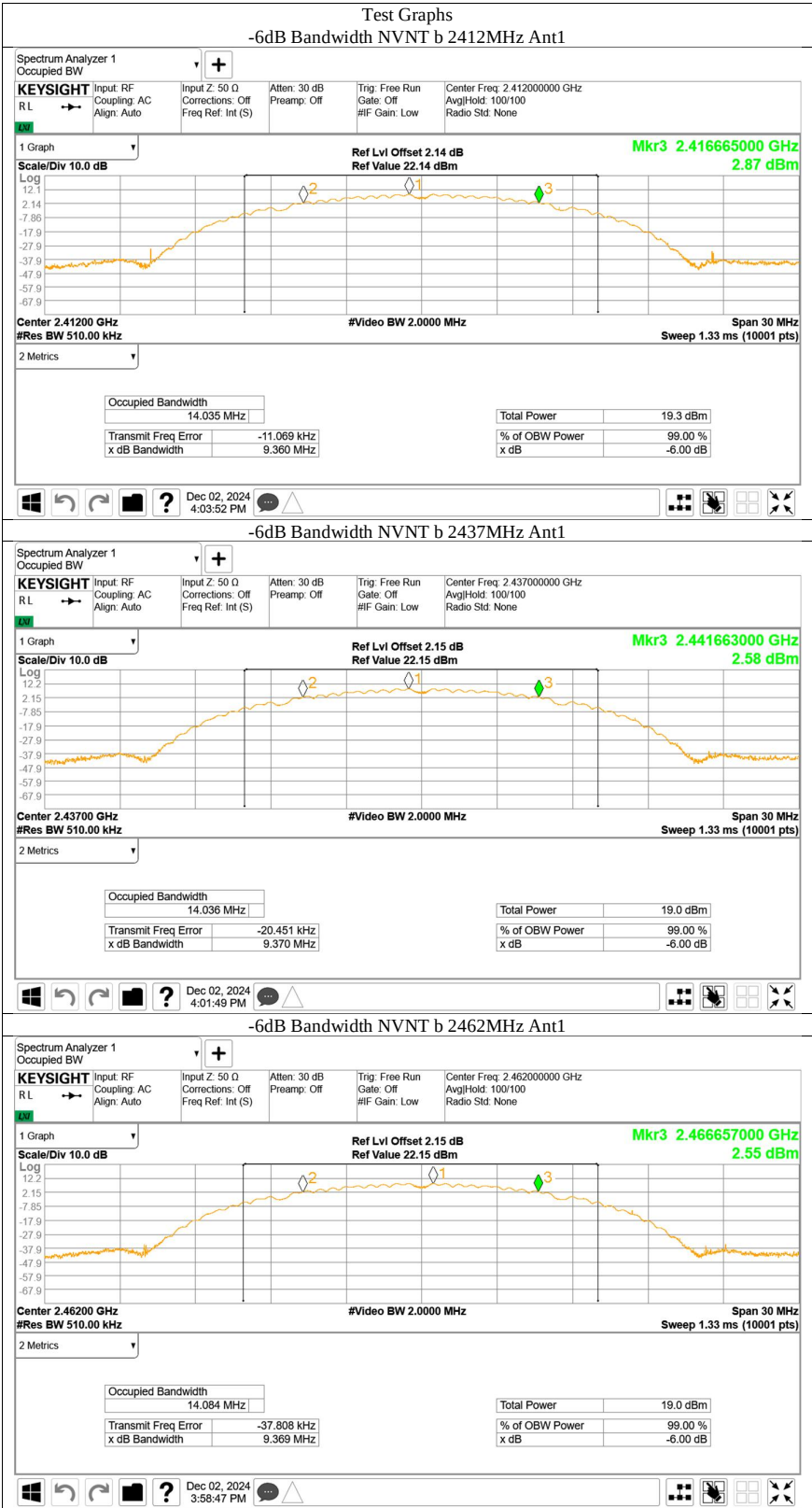
6dB bandwidth Limit [kHz]	99% bandwidth Limit [kHz]
≥ 500	--

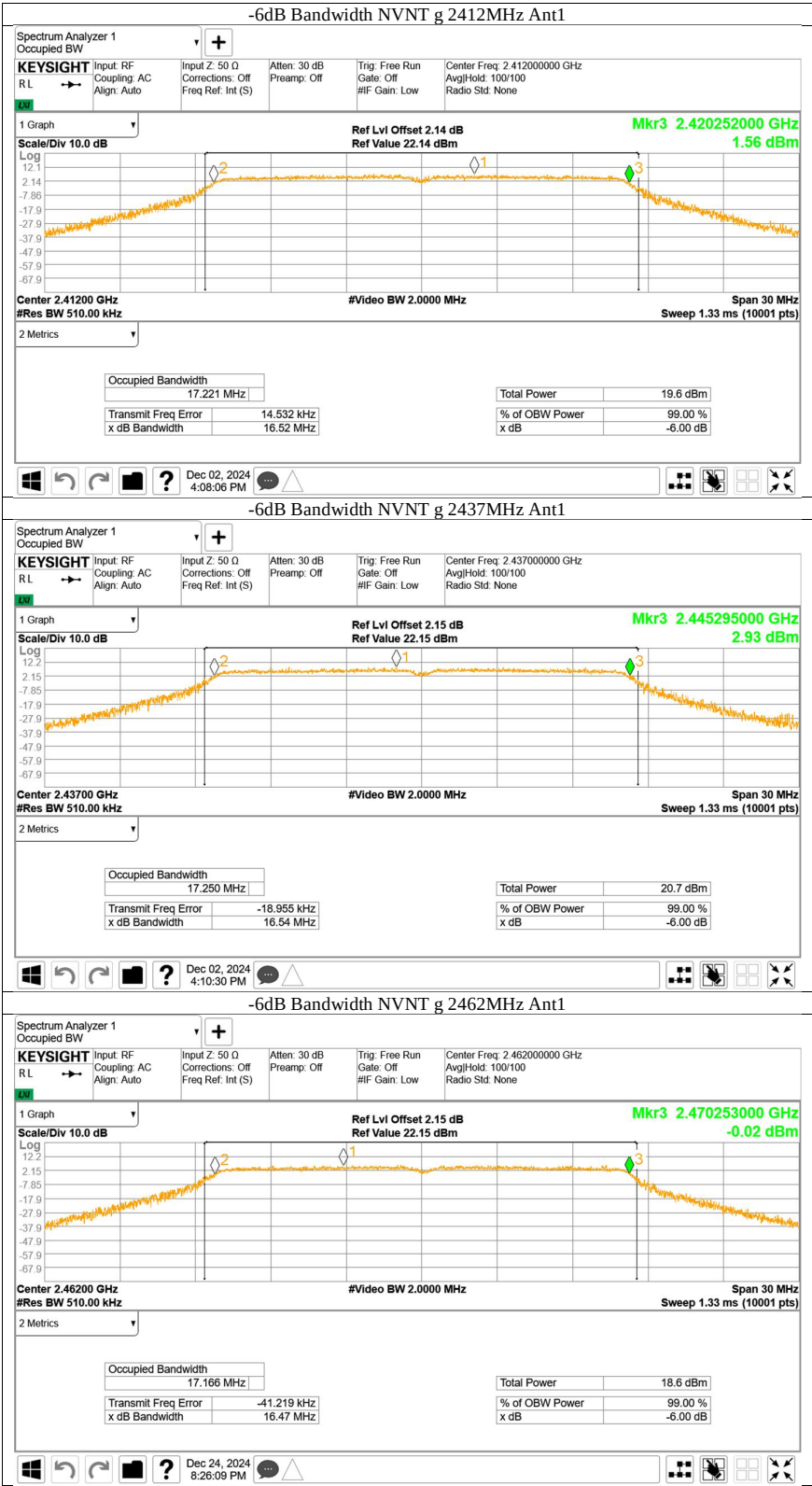
Test result

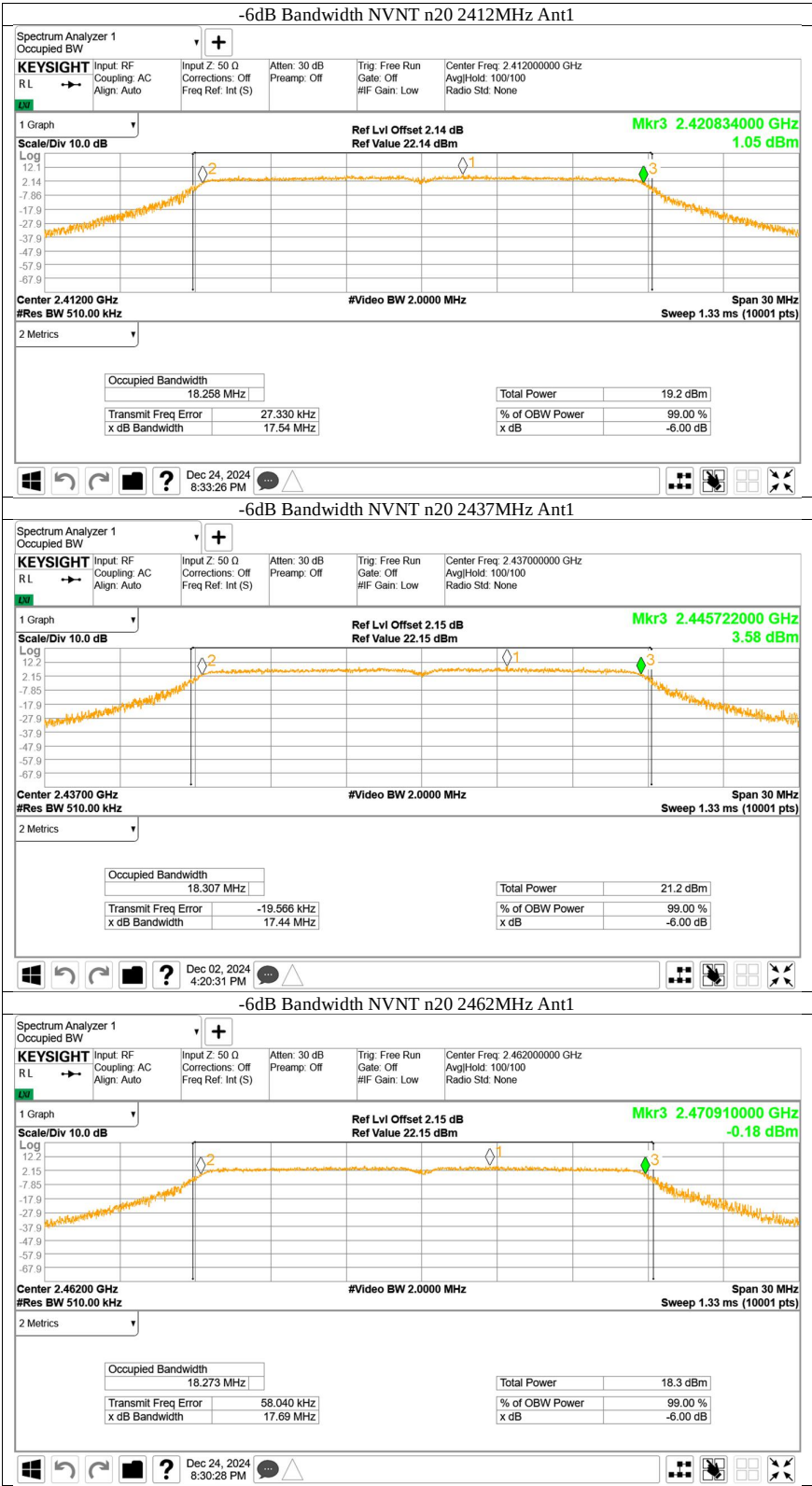
Test Mode	Frequency MHz	6dB bandwidth (MHz)		Result	99% occupied bandwidth MHz
		result	limit	verdict	
802.11b	2412	9.36	≥ 0.5	Pass	14.054
	2437	9.37	≥ 0.5	Pass	14.043
	2462	9.369	≥ 0.5	Pass	14.086
802.11g	2412	16.522	≥ 0.5	Pass	16.600
	2437	16.542	≥ 0.5	Pass	16.599
	2462	16.469	≥ 0.5	Pass	16.603
802.11n(HT20)	2412	17.543	≥ 0.5	Pass	17.753
	2437	17.44	≥ 0.5	Pass	17.775
	2462	17.687	≥ 0.5	Pass	17.755



6 dB Bandwidth

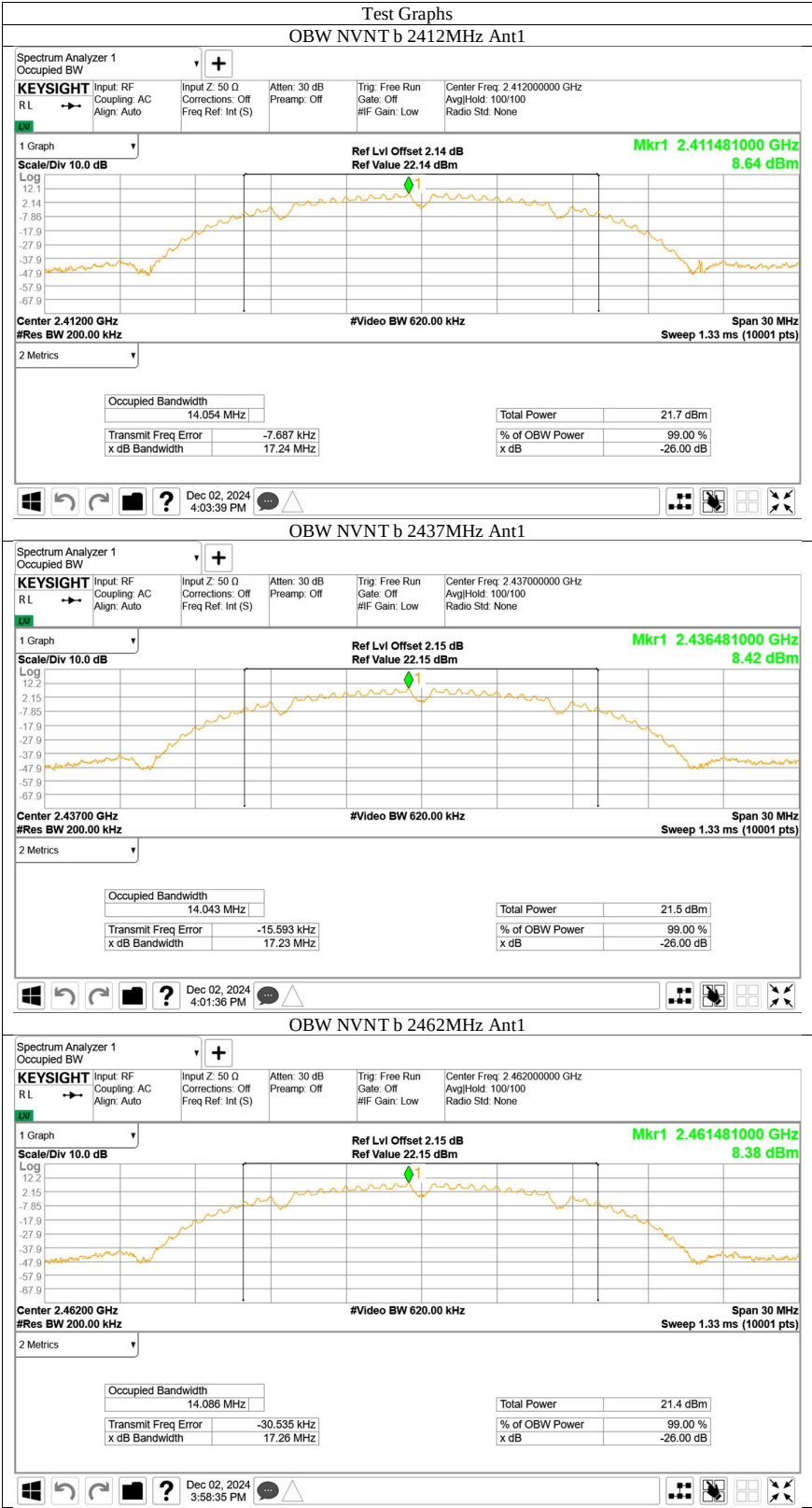


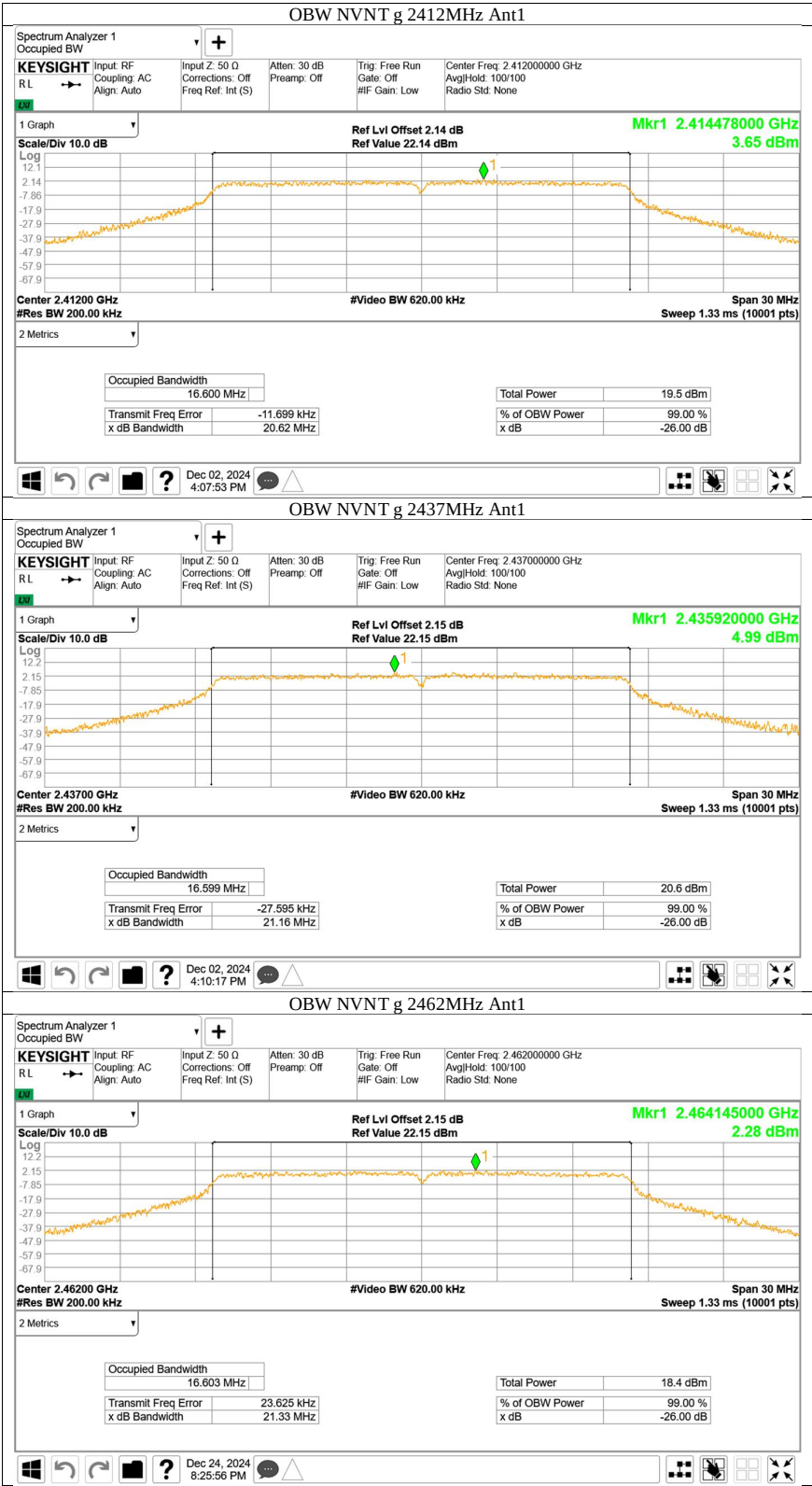


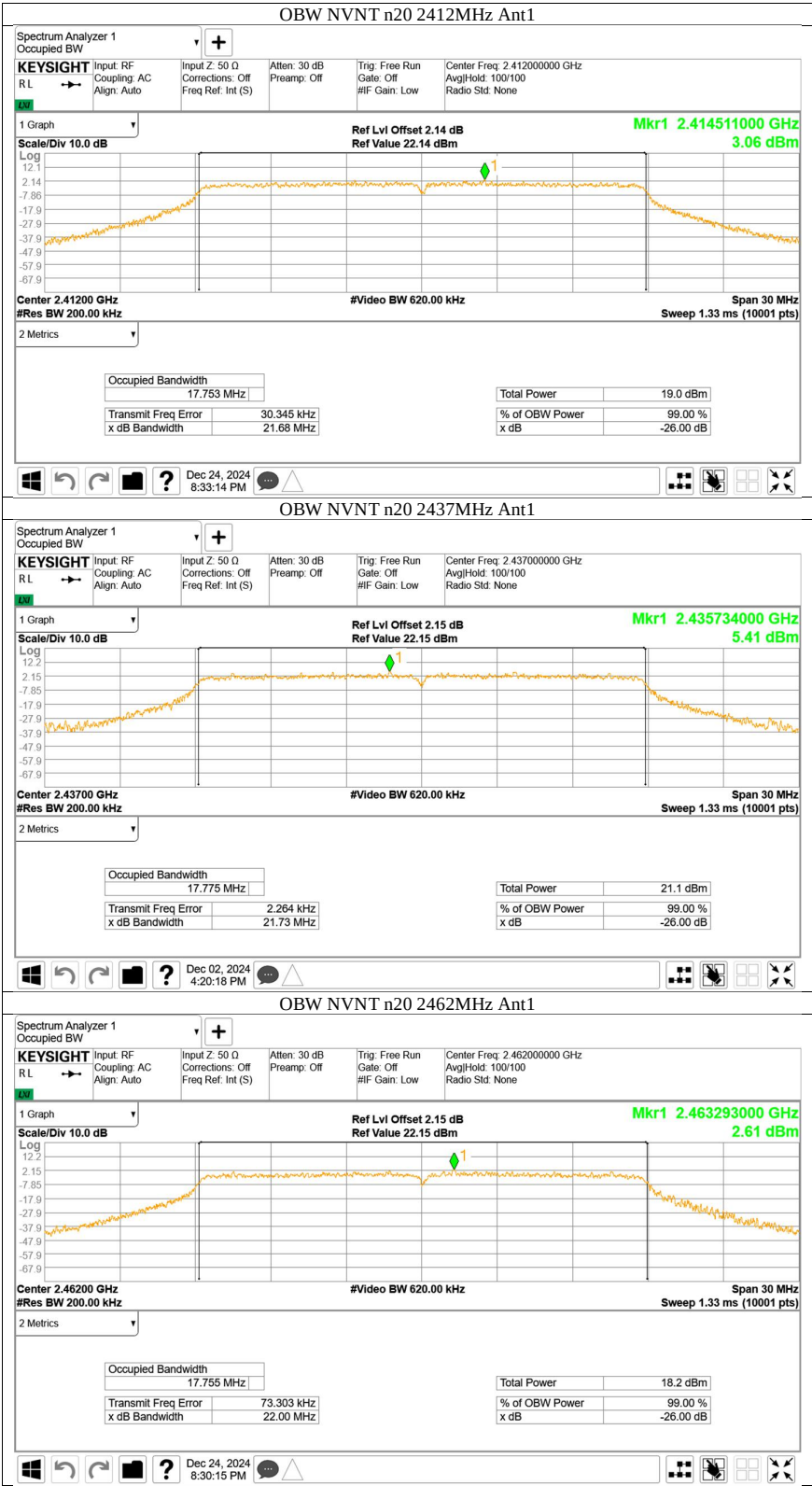




99% Occupied Bandwidth







10.4 Power spectral density

Test Method

This procedure shall be used if maximum peak conducted output power was used to demonstrate compliance:

1. The RF output of EUT was connected to the spectrum analyzer. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting, the instrument center frequency is set to the nominal EUT channel center frequency enable the EUT transmit continuously.
3. Use the following spectrum analyzer settings:
4. Set analyzer center frequency to DTS channel center frequency. RBW=3kHz, VBW $\geq$ 3RBW, Span=1.5 times DTS bandwidth, Detector=Peak, Sweep=auto, Trace= max hold.
5. Allow trace to fully stabilize, use the peak marker function to determine the maximum amplitude level within the RBW.
6. Repeat above procedures until other frequencies measured were completed.

Limit

Limit [dBm/3kHz]

≤ 8

Test result

802.11 b

Frequency MHz	Power spectral density dBm/3kHz	Result
Low channel 2412MHz	-5.34	Pass
Middle channel 2437MHz	-5.82	Pass
High channel 2462MHz	-6.37	Pass

802.11 g

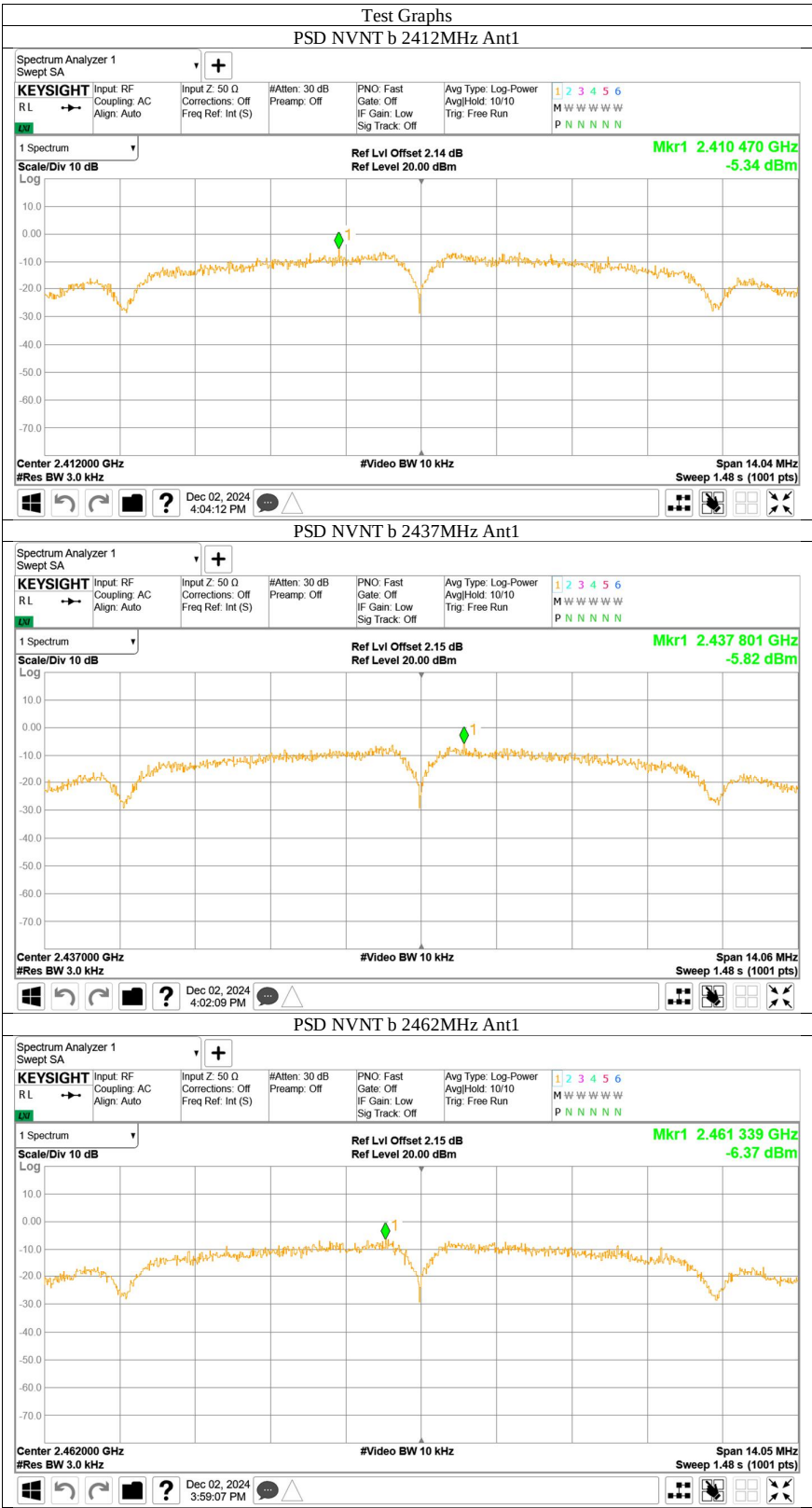
Frequency MHz	Power spectral density dBm/3kHz	Result
Low channel 2412MHz	-11.59	Pass
Middle channel 2437MHz	-10.12	Pass
High channel 2462MHz	-12.24	Pass

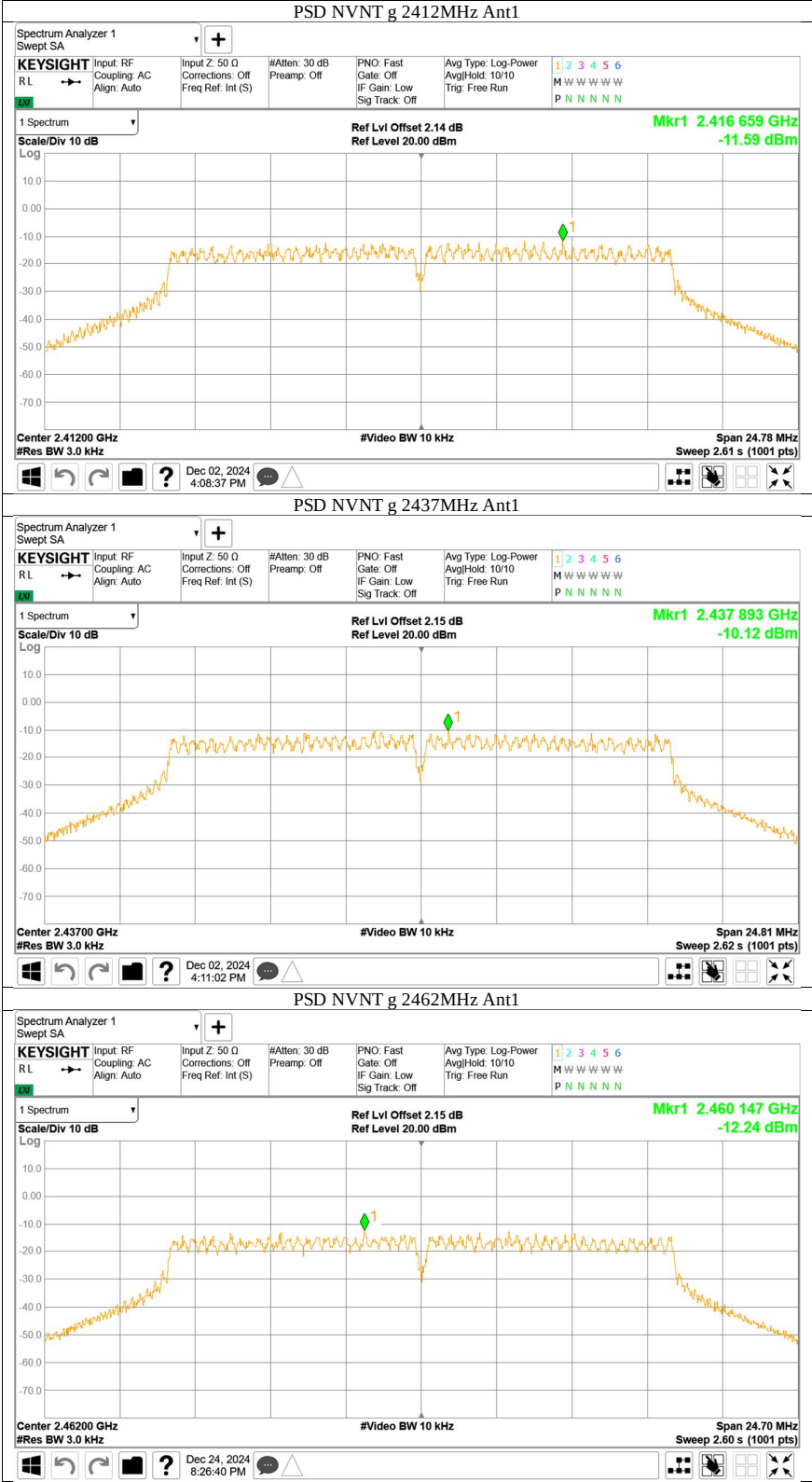
802.11 n (HT20)

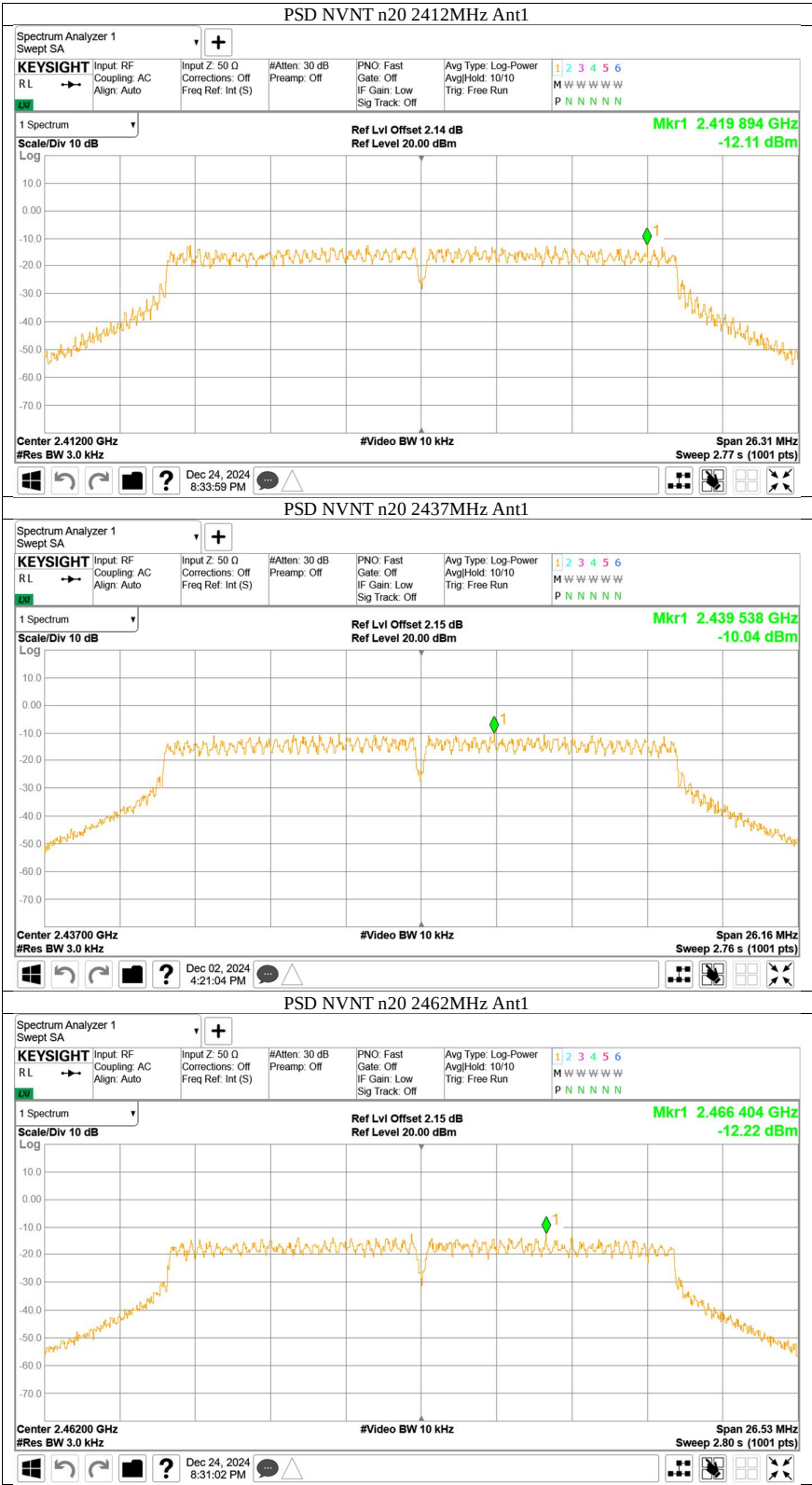
Frequency MHz	Power spectral density dBm/3kHz	Result
Low channel 2412MHz	-12.11	Pass
Middle channel 2437MHz	-10.04	Pass
High channel 2462MHz	-12.22	Pass



Power spectral density







10.5 Spurious RF conducted emissions

Test Method

1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting, the instrument center frequency is set to the nominal EUT channel center frequency enable the EUT transmit continuously.
3. Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the in-band emission and all spurious emissions (e.g., harmonics) from the lowest frequency generated in the EUT up through the 10th harmonic. Typically, several plots are required to cover this entire span.
RBW = 100 kHz, VBW ≥ 3RBW, Sweep = auto, Detector function = peak, Trace = max hold
4. Allow the trace to stabilize. Set the marker on the peak of any spurious emission recorded.
5. The level displayed must comply with the limit specified in this Section. Submit these plots.
6. Repeat above procedures until all frequencies measured were complete.

Limit

Frequency Range MHz	Limit (dBc)
30-25000	-20



Spurious RF conducted emissions

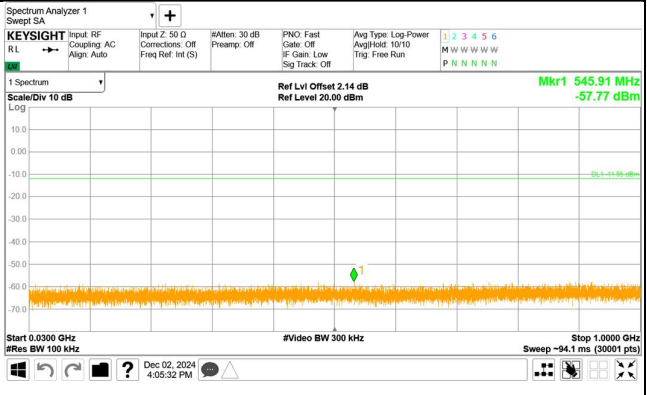
802.11 B

Out-of-Band Emissions

Channel 1 (2412MHz)

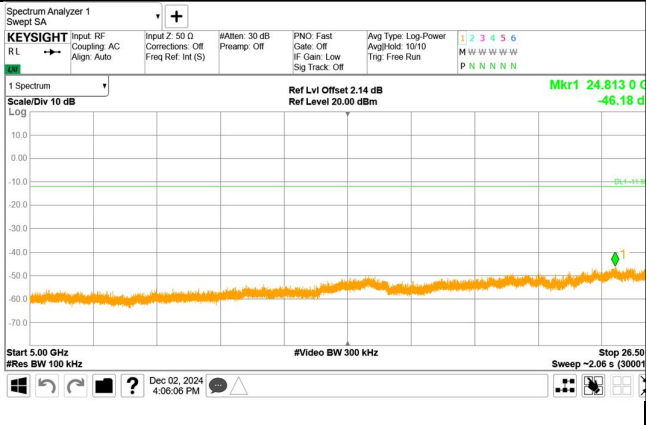
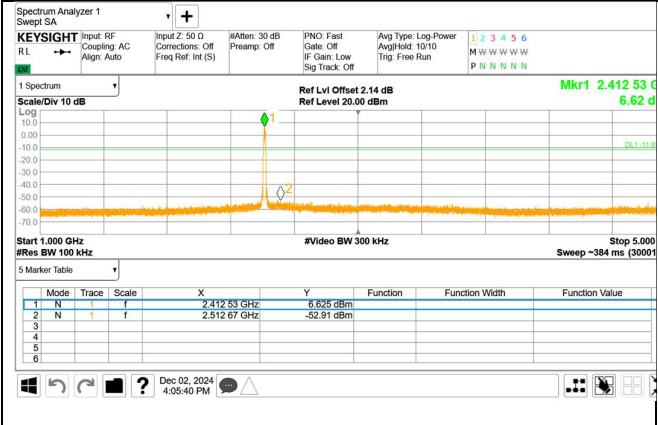
Reference point

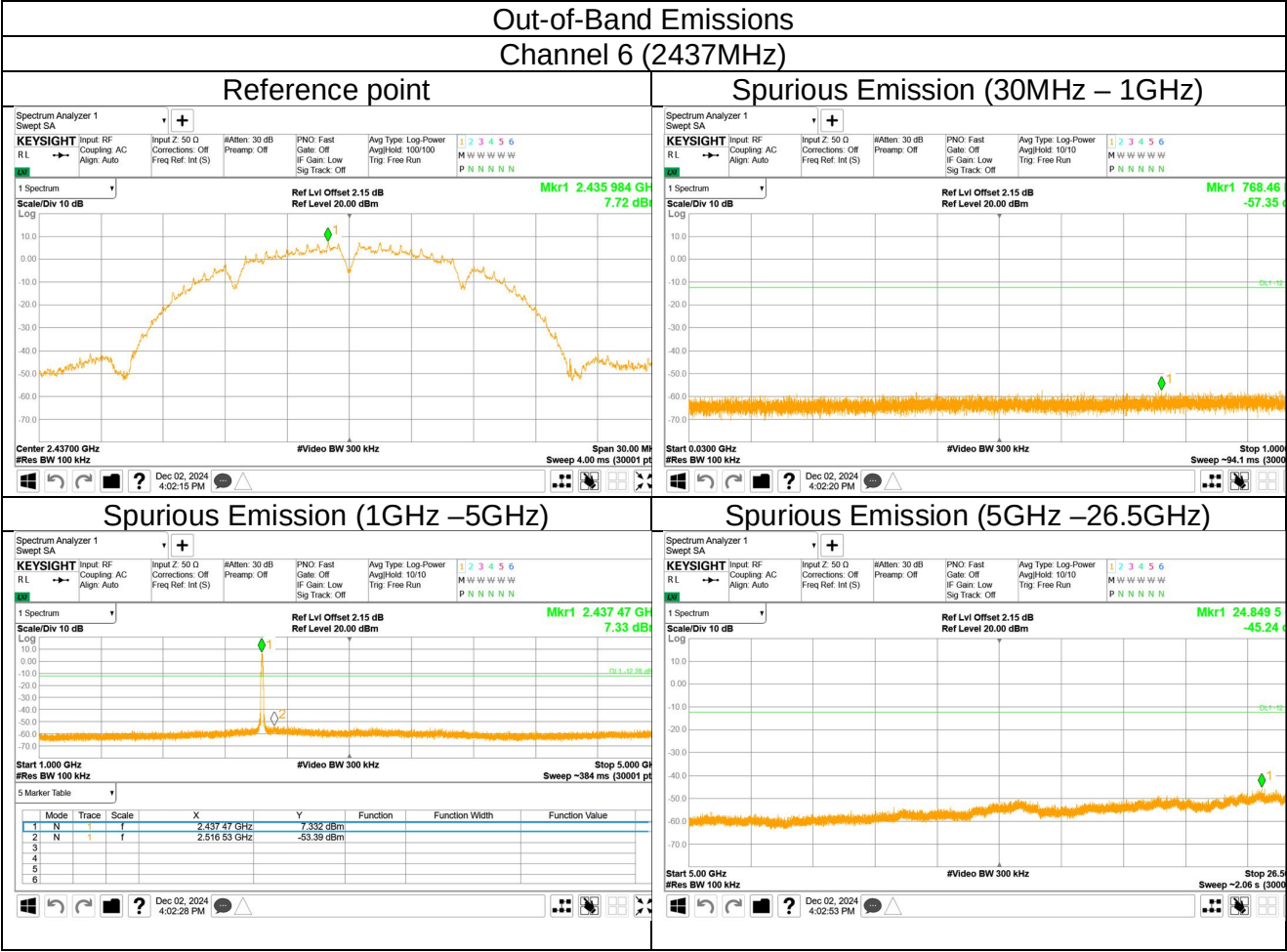
Spurious Emission (30MHz – 1GHz)

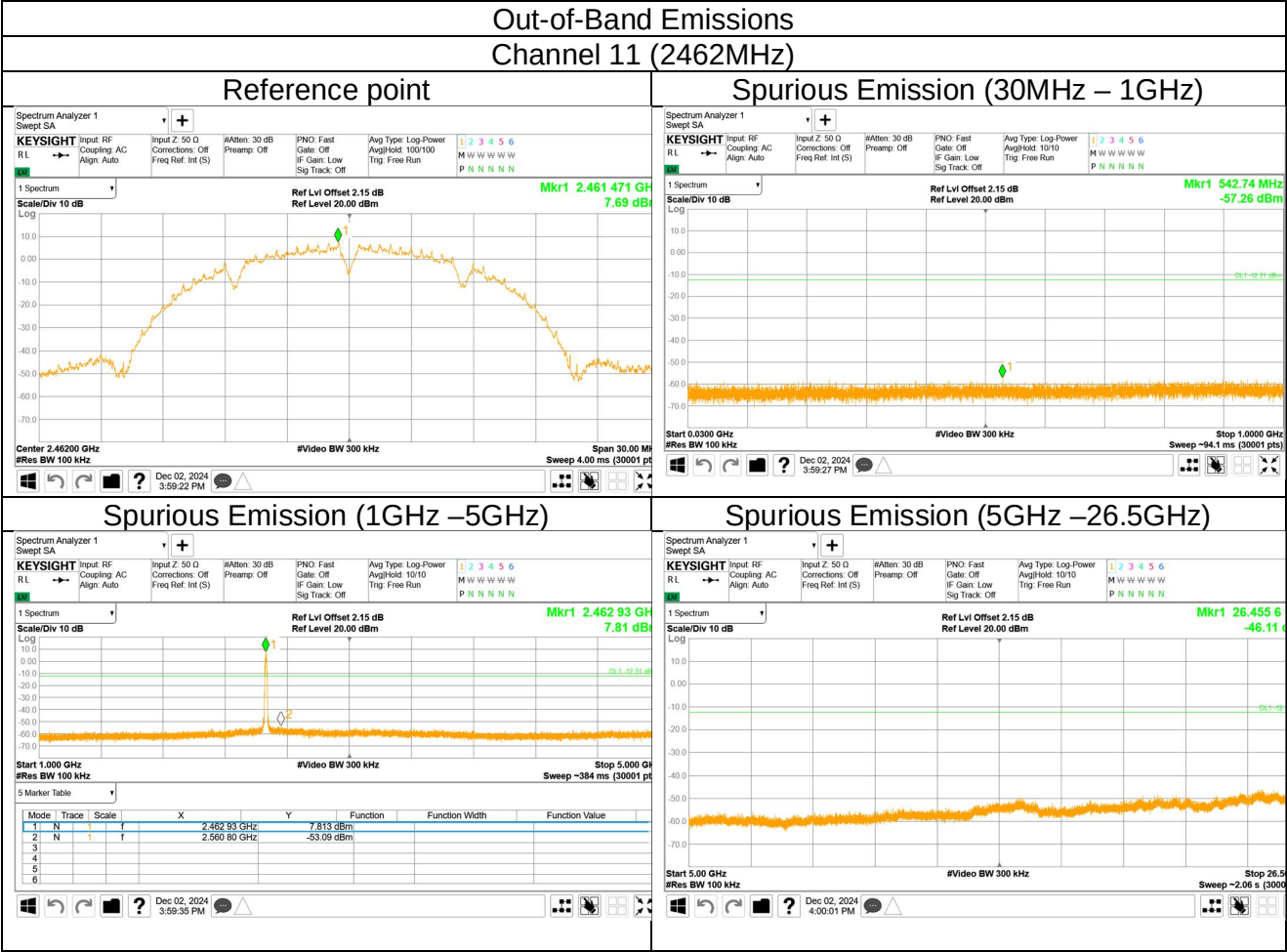


Spurious Emission (1GHz –5GHz)

Spurious Emission (5GHz –26.5GHz)









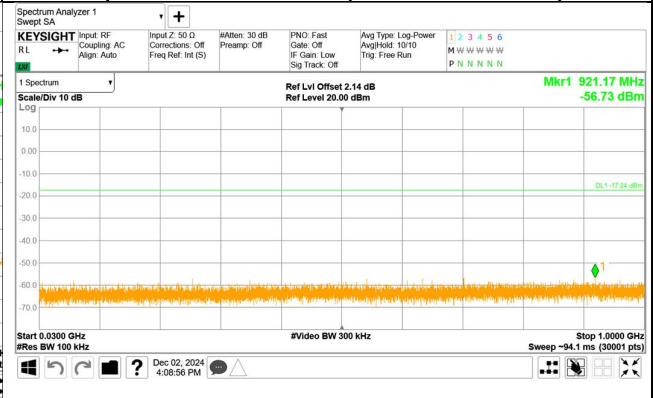
802.11 G

Out-of-Band Emissions
Channel 1 (2412MHz)

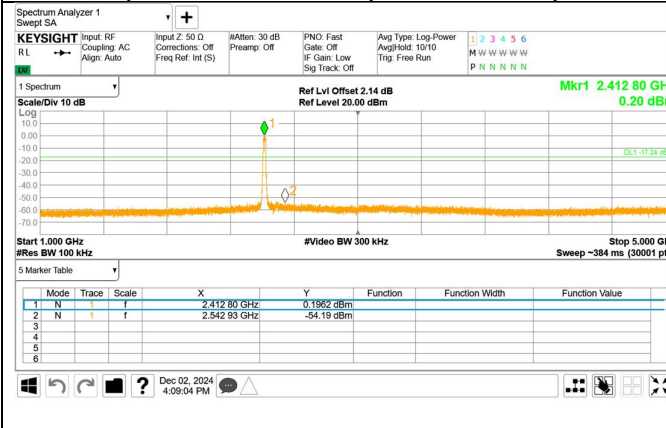
Reference point



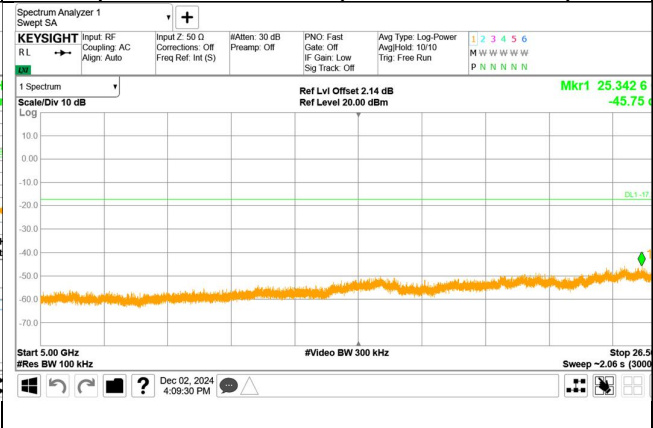
Spurious Emission (30MHz – 1GHz)

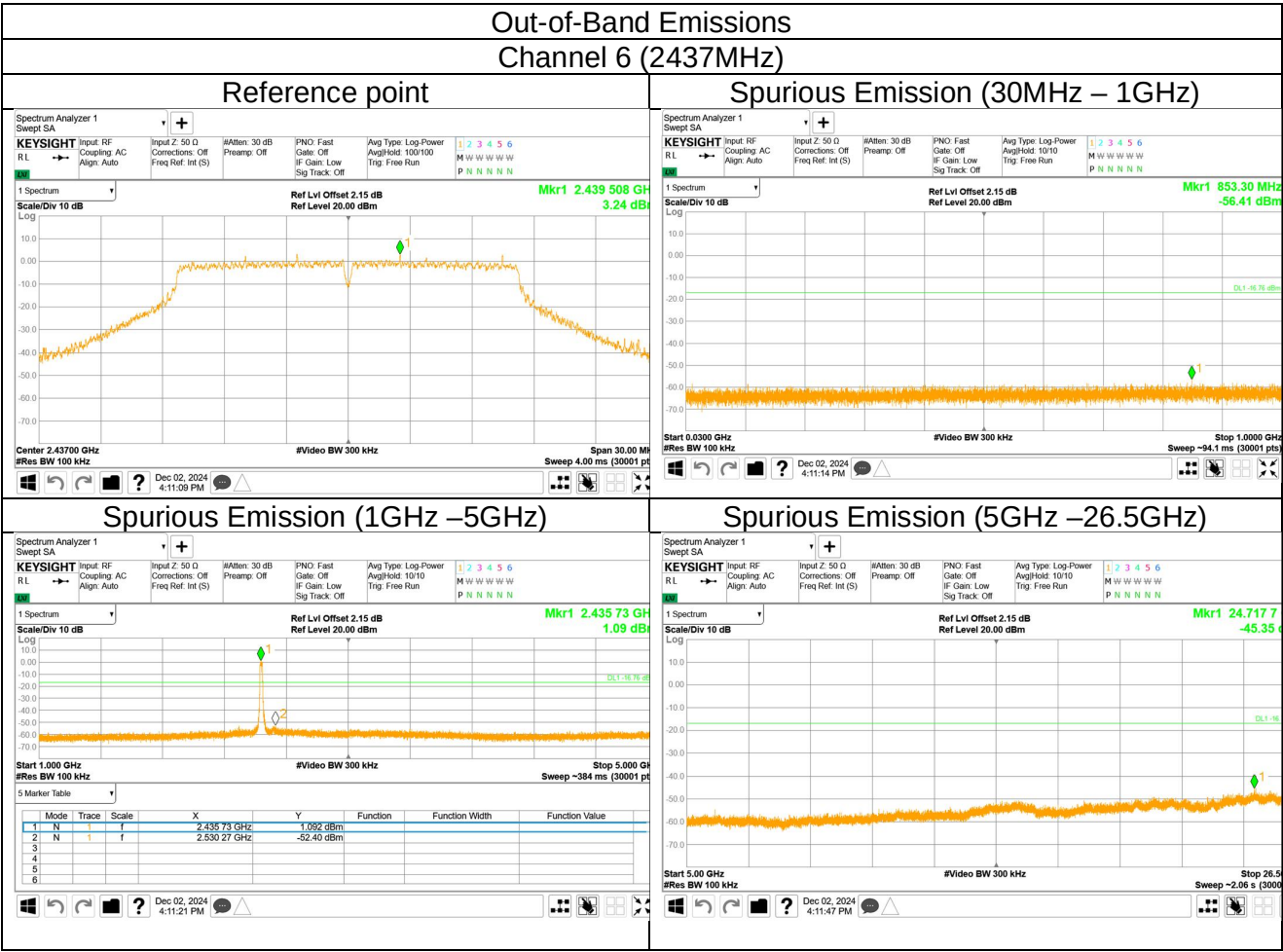


Spurious Emission (1GHz –5GHz)



Spurious Emission (5GHz –26.5GHz)





Spurious Emission (5GHz –26.5GHz)

Spectrum Analyzer 1

Sweep SA

KEYSIGHT

Input: RF

Coupling: AC

Align: Auto

Input Z: 50 Ω

Corrections: Off

Freq Ref: Int (S)

Attenu: 30 dB

Preamp: Off

PNO: Fast

Gate: Off

IF Gain: Low

Sig Track: Off

Avg Type: Log-Power

Avg/Hold: 10/10

Trig: Free Run

1 2 3 4 5 6

M W W W W W

P N N N N N

1 Spectrum

Scale/Div 10 dB

Log

Ref Lvl Offset 2.15 dB

Ref Level 20.00 dBm

Mkr1 24.717 7 GHz

-45.35 dBm

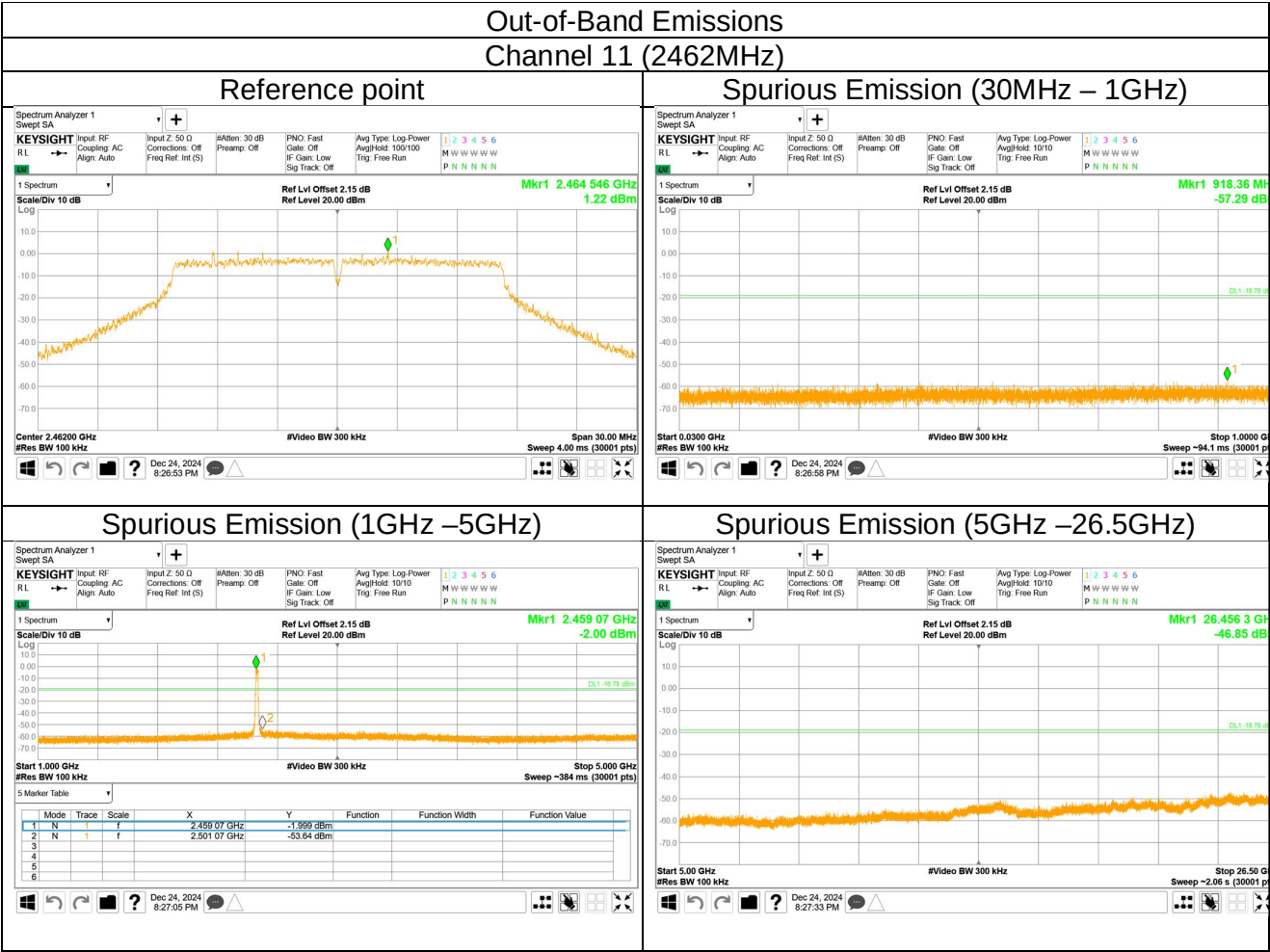
Start 5.00 GHz

#Res BW 100 kHz

Stop 26.5 GHz

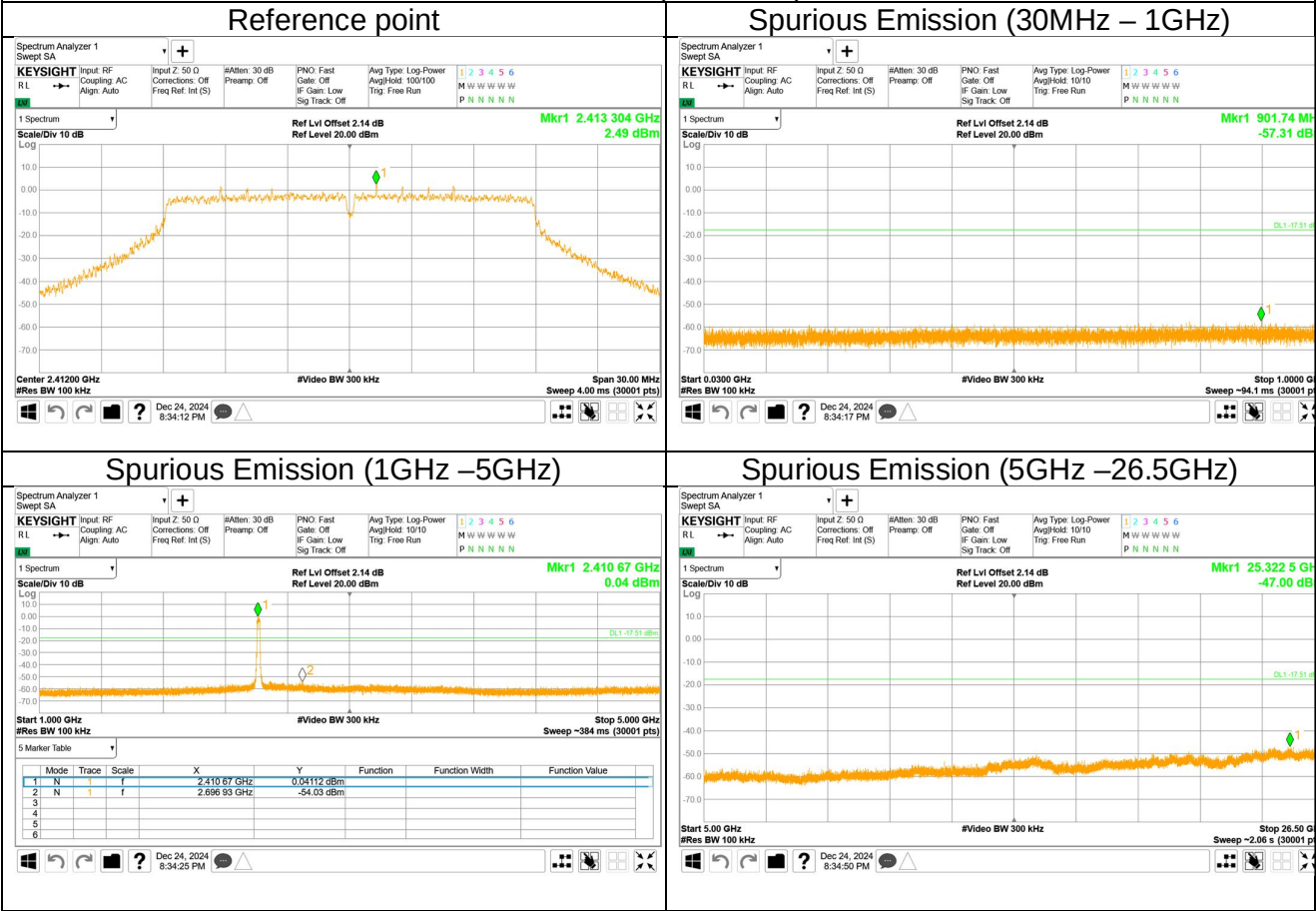
Sweep ~2.06 s (30001 pts)

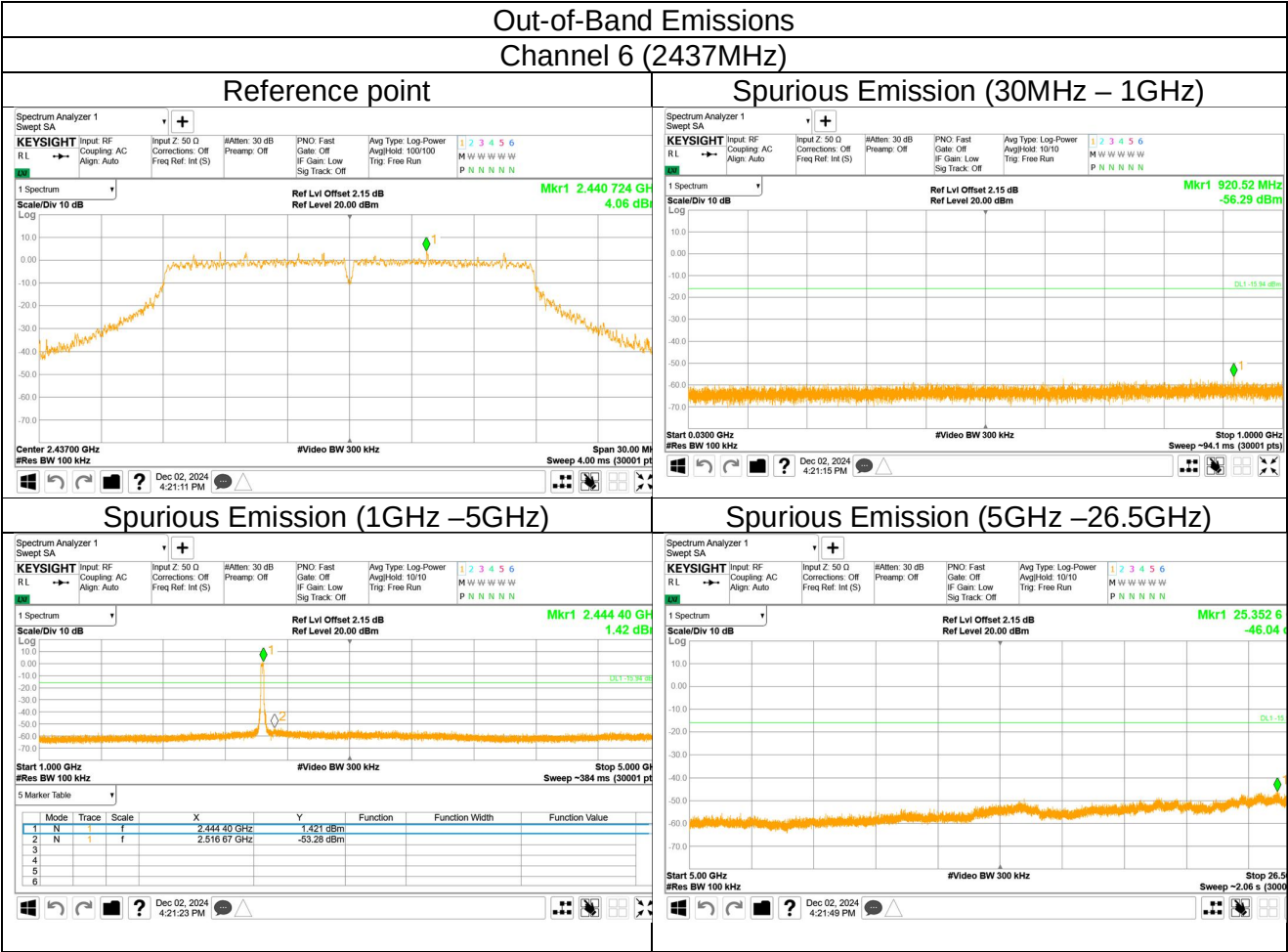
Dec 02, 2024 4:11:47 PM

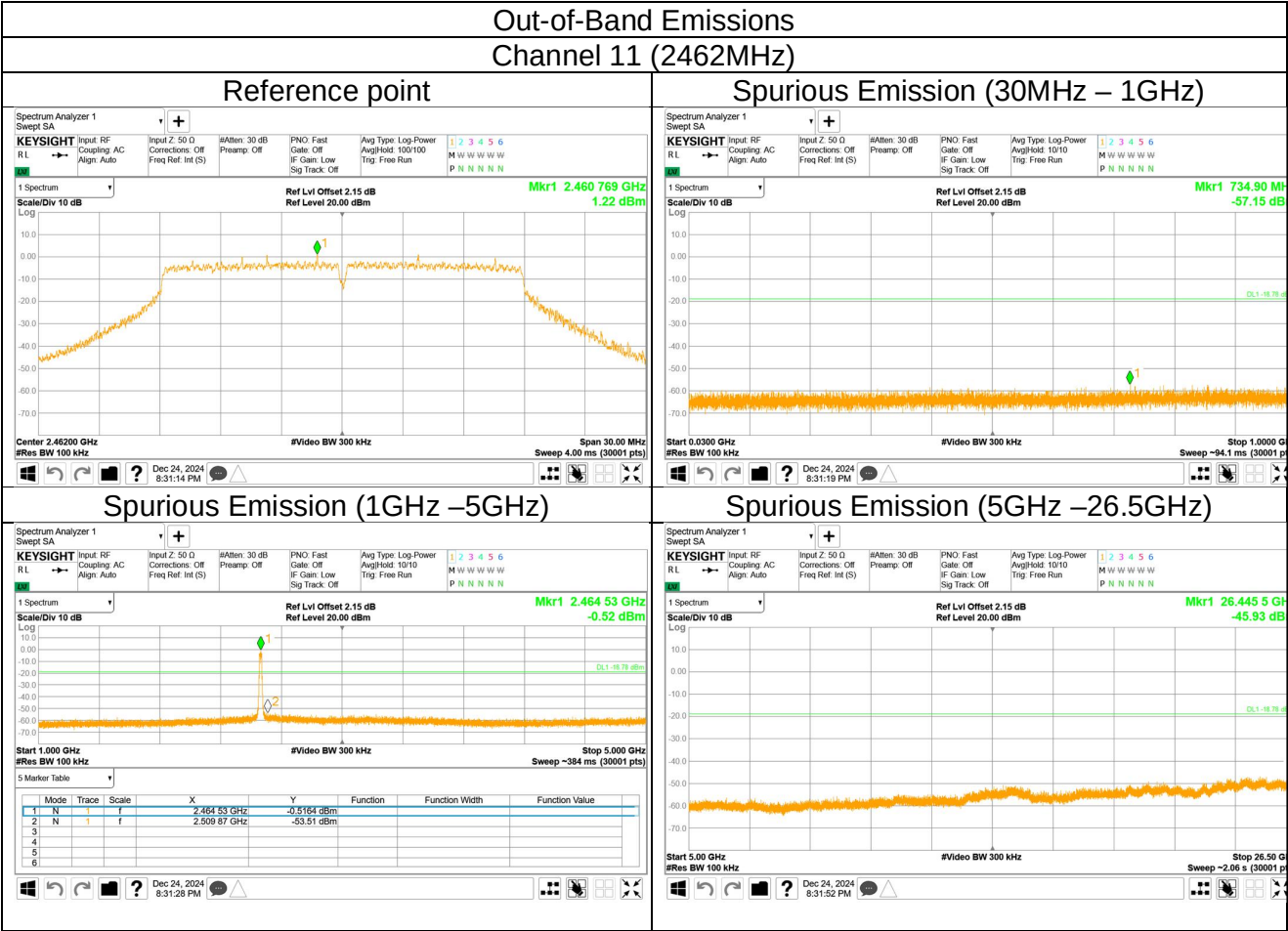




802.11 N HT20
Out-of-Band Emissions
Channel 1 (2412MHz)







10.6 Band edge

Test Method

1. The RF output of EUT was connected to the spectrum analyzer by RF cable. The path loss was compensated to the results for each measurement.
2. Set to the maximum power setting, the instrument center frequency is set to the nominal EUT channel center frequency enable the EUT transmit continuously.
3. Use the following spectrum analyzer settings:
Span = wide enough to capture the peak level of the in-band emission and all spurious
RBW = 100 kHz, VBW $\geq$ 3RBW, Sweep = auto, Detector function = peak, Trace = max hold
4. Allow the trace to stabilize, use the peak and delta measurement to record the result.
5. The level displayed must comply with the limit specified in this Section.
6. Repeat above procedures until all frequencies measured were complete and submit all the plots.

Limit

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated device is operating, the RF power that is produced shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided that the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under § 15.247(b)(3) and RSS-247 section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB.