

TEST REPORT

Applicant Name: Grandstream Networks, Inc.
Address: 126 Brookline Ave., 3rd Floor Boston, MA 02215, USA
Report Number: 2401T49306E-RFA
FCC ID: YZZGWN7661E
IC: 11964A-GWN7661E

Test Standard (s)

FCC PART 15.247; RSS-GEN ISSUE 5, FEBRUARY 2021 AMENDMENT 2;
RSS-247 ISSUE 3, AUGUST 2023

Sample Description

Product Type: In-Wall AX3000 Wi-Fi 6 Access Point
Model No.: GWN7661E
Multiple Model(s) No.: N/A
Trade Mark: GRANDSTREAM
Date Received: 2024/05/20
Issue Date: 2024/07/26

Test Result:	Pass▲
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▲ In the configuration tested, the EUT complied with the standards above.

Prepared and Checked By:

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Andy Yu
RF Engineer

Approved By:

Nancy Wang

Nancy Wang
RF Supervisor

Note: The information marked # is provided by the applicant, the laboratory is not responsible for its authenticity and this information can affect the validity of the result in the test report. Customer model name, addresses, names, trademarks etc. are included.

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	2401T49306E-RFA	Original Report	2024/07/26

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

HVIN	GWN7661E
FVIN	0.5.16.3
Product	In-Wall AX3000 Wi-Fi 6 Access Point
Tested Model	GWN7661E
Multiple Model(s)	N/A
Frequency Range	2412-2462MHz
Maximum Conducted Peak Output Power	29.01dBm
Modulation Technique	DSSS, OFDM, OFDMA
Antenna Specification [#]	ANT0: 2.86dBi, ANT1: 3.85dBi (It is provided by the applicant)
Voltage Range	DC 48V From POE
Sample serial number	2LK3-2 for Conducted and Radiated Emissions 2LK3-3 for RF Conducted Test (Assigned by BACL, Shenzhen)
Sample/EUT Status	Good condition
Adapter Information	N/A

Objective

This report is in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission's rules and RSS-GEN Issue 5, February 2021 Amendment 2 and RSS-247 Issue 3, August 2023 of the Innovation, Science and Economic Development Canada rules.

The tests were performed in order to determine Compliant with FCC Part 15, Subpart C, and section 15.203, 15.205, 15.207, 15.209 and 15.247 rules.

Test Methodology

All measurements contained in this report were conducted with ANSI C63.10-2013, American National Standard of Procedures for Compliant Testing of Unlicensed Wireless Devices and RSS-GEN Issue 5, February 2021 Amendment 2 and RSS-247 Issue 3, August 2023.

And KDB 558074 D01 15.247 Meas Guidance v05r02.

All emissions measurement was performed at Bay Area Compliance Laboratories Corp. (Shenzhen). The radiated testing was performed at an antenna-to-EUT distance of 3 meters.

Each test item follows test standards and with no deviation.

Measurement Uncertainty

Parameter		Uncertainty
Occupied Channel Bandwidth		±5%
RF Frequency		213.55 Hz(k=2, 95% level of confidence)
RF output power, conducted		0.72 dB(k=2, 95% level of confidence)
Unwanted Emission, conducted		1.75 dB(k=2, 95% level of confidence)
AC Power Lines Conducted Emissions	9 kHz~150 KHz	3.94dB(k=2, 95% level of confidence)
	150 kHz ~30MHz	3.84dB(k=2, 95% level of confidence)
Radiated Emissions	9kHz - 30MHz	3.30dB(k=2, 95% level of confidence)
	30MHz~200MHz (Horizontal)	4.48dB(k=2, 95% level of confidence)
	30MHz~200MHz (Vertical)	4.55dB(k=2, 95% level of confidence)
	200MHz~1000MHz (Horizontal)	4.85dB(k=2, 95% level of confidence)
	200MHz~1000MHz (Vertical)	5.05dB(k=2, 95% level of confidence)
	1GHz - 6GHz	5.35dB(k=2, 95% level of confidence)
	6GHz - 18GHz	5.44dB(k=2, 95% level of confidence)
	18GHz - 40GHz	5.16dB(k=2, 95% level of confidence)
Temperature		±1°C
Humidity		±1%
Supply voltages		±0.4%

Note: The extended uncertainty given in this report is obtained by combining the standard uncertainty times the coverage factor K with the 95% confidence interval. Otherwise required by the applicant or Product Regulations, Decision Rule in this report did not consider the uncertainty.

Test Facility

The Test site used by Bay Area Compliance Laboratories Corp. (Shenzhen) to collect test data is located on the 5F(B-West) , 6F, 7F, the 3rd Phase of Wan Li Industrial Building D, Shihua Rd, FuTian Free Trade Zone, Shenzhen, China.

The lab has been recognized as the FCC accredited lab under the KDB 974614 D01 and is listed in the FCC Public Access Link (PAL) database, FCC Registration No. : 715558, the FCC Designation No. : CN5045.

The lab has been recognized by Innovation, Science and Economic Development Canada to test to Canadian radio equipment requirements, the CAB identifier: CN0023.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

For 2.4GHz Wi-Fi mode, total 13channels are provided to testing:

Channel	Frequency (MHz)	Channel	Frequency (MHz)
1	2412	7	2442
2	2417	8	2447
3	2422	9	2452
4	2427	10	2457
5	2432	11	2462
6	2437	/	/

For 802.11b, 802.11g, 802.11n20 and 802.11 ax20, EUT was tested with Channel 1, 6 and 11.
For 802.11n40 and 802.11 ax40, EUT was tested with Channel 3, 6 and 9.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

“QATool_Dbg.exe”[#] exercise software was used and the power level is below. The software and power level was provided by the manufacturer.

The worst case was performed under:

Mode	Data rate	Antenna	Power Level [#]		
			Low Channel	Middle Channel	High Channel
802.11b	1Mbps	ANT0	15.5	15.0	17.5
		ANT1	12.0	11.5	12.0
802.11g	6Mbps	ANT0	16.0	19.0	16.5
		ANT1	17.5	18.5	16.0
802.11n-HT20	MCS0	ANT0&ANT1	18.0	18.0	17.0
802.11n-HT40	MCS0	ANT0&ANT1	17.0	17.5	16.0
802.11ax-HE20	MCS0	ANT0&ANT1	16.0	16.0	16.0
802.11ax-HE40	MCS0	ANT0&ANT1	16.0	16.0	15.5

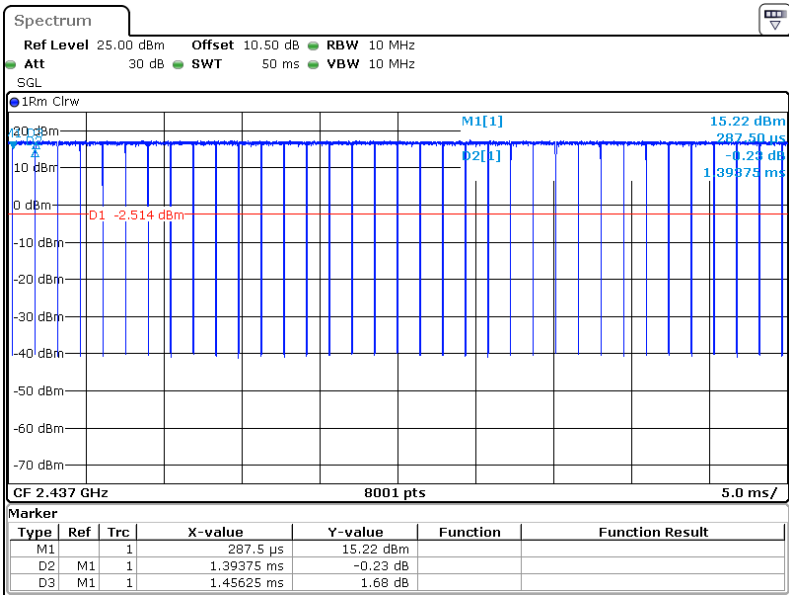
Note:

1. The worst-case data rates are determined to be as follows for each mode based upon investigation by measuring the average power, peak power and PSD across all data rates bandwidths, and modulations.
2. The device supports SISO in all modes, and MIMO 2T2R in 802.11n/ax modes, per pretest, 2T2R mode was the worst mode and reported for 802.11n/ax modes.
3. For 802.11n/ax modes, the device support beamforming and non-beamforming mode, all modes share the same power level setting under the same modulation. So the worst case (non-beamforming) was selected to test.
4. For 802.11 ax modes, the device not support partial RU mode.

Duty cycle

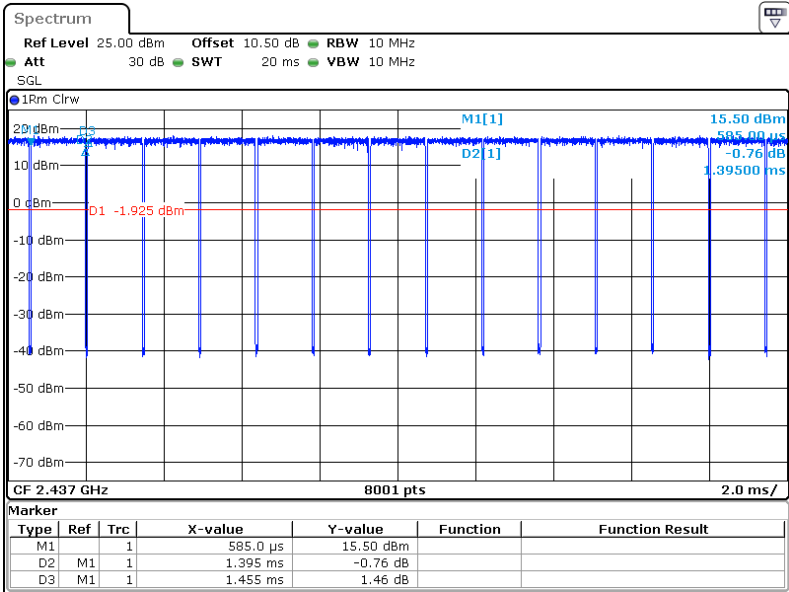
Test Modes	Ton (ms)	Ton+off (ms)	Duty Cycle (%)	1/T (Hz)	VBW Setting (Hz)
802.11b	1.39375	1.45625	95.71	717	1000
802.11g	1.395	1.455	95.88	717	1000
802.11n-HT20	1.30875	1.36625	95.79	764	1000
802.11n-HT40	0.64875	0.70625	91.86	1541	2000
802.11ax-HE20	1.02625	1.085	94.59	974	1000
802.11ax-HE40	0.5475	0.6075	90.12	1826	2000
Note: Test only was performed at ANT 0.					

802.11b



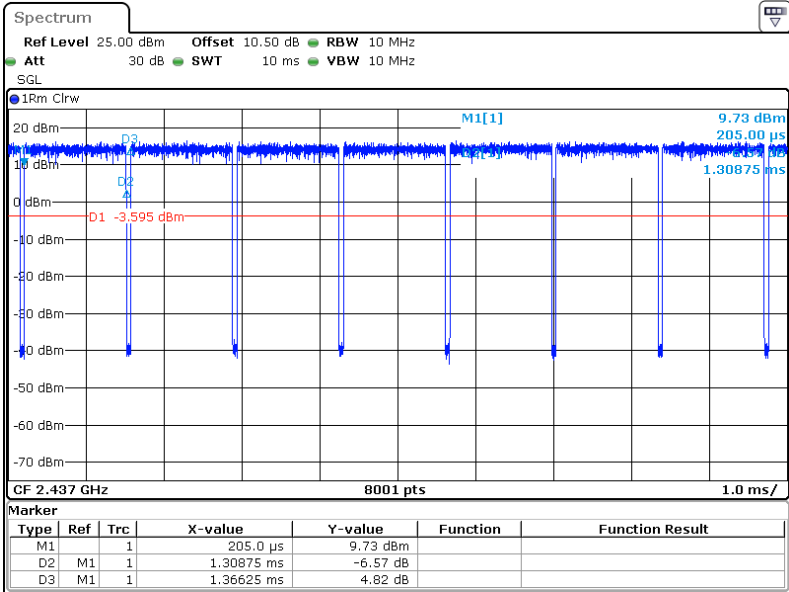
ProjectNo.:2401T49306E-RF Tester:Kungfumaster Liang
Date: 4.JUN.2024 22:49:30

802.11g



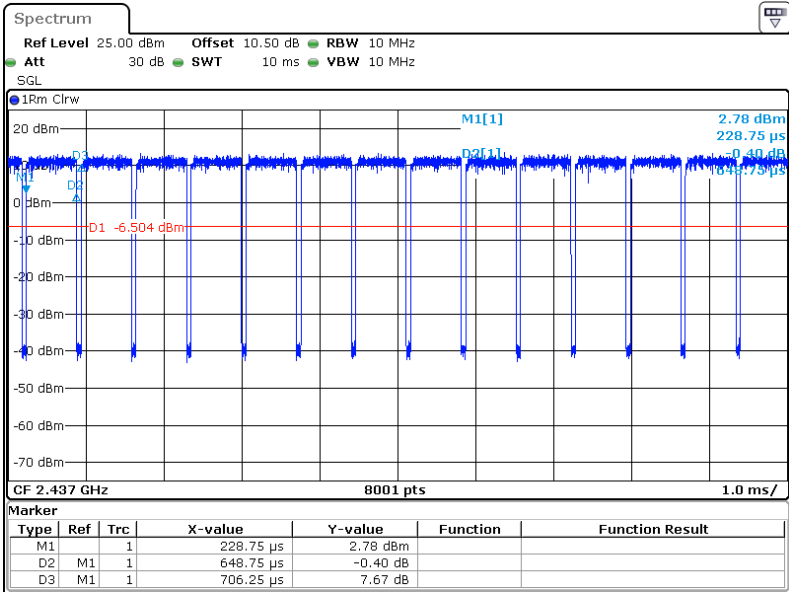
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Date: 4.JUN.2024 22:50:08

802.11n20



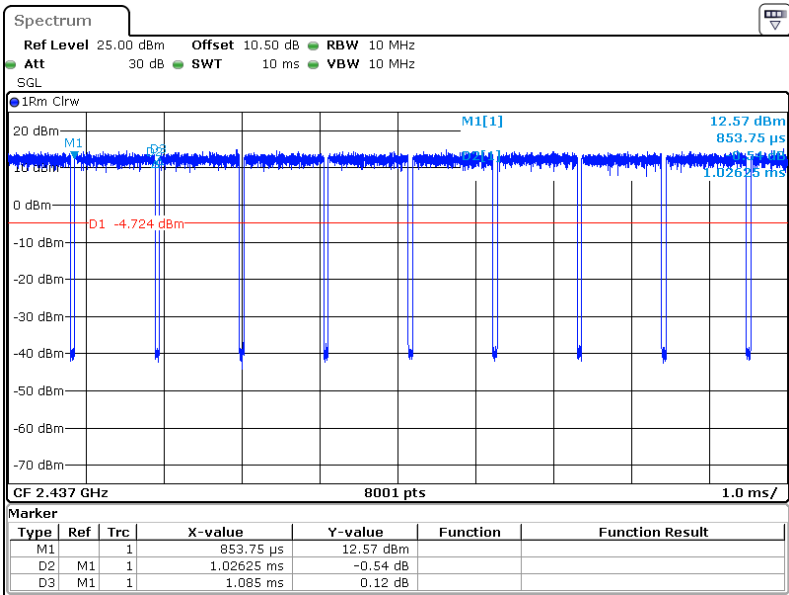
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Date: 5.JUN.2024 22:40:19

802.11n40



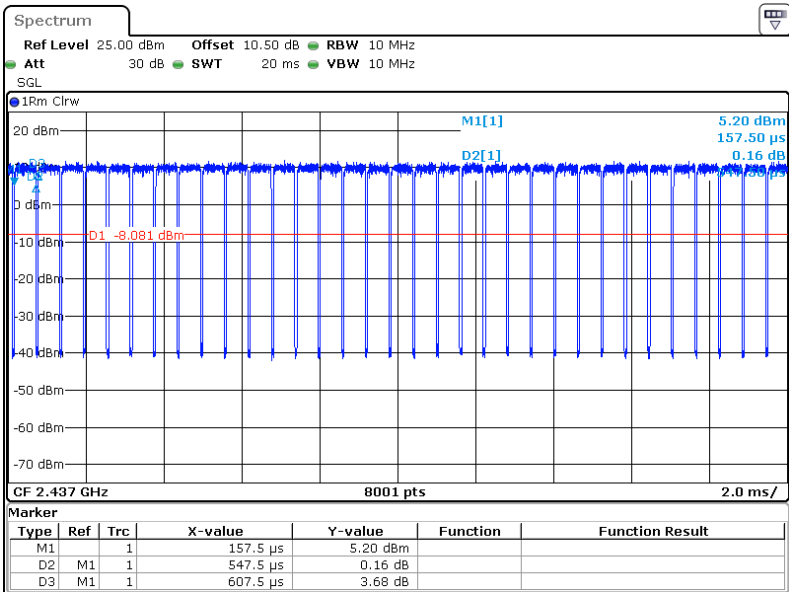
ProjectNo.:2401T49306E-RF Tester:Kungfumaster Liang
Date: 5.JUN.2024 00:25:28

802.11ax20



ProjectNo.:2401T49306E-RF Tester:Kungfumaster Liang
Date: 6.JUN.2024 01:15:03

802.11ax40



ProjectNo.:2401T49306E-RF Tester:Kungfumaster Liang
Date: 6.JUN.2024 01:29:14

Support Equipment List and Details

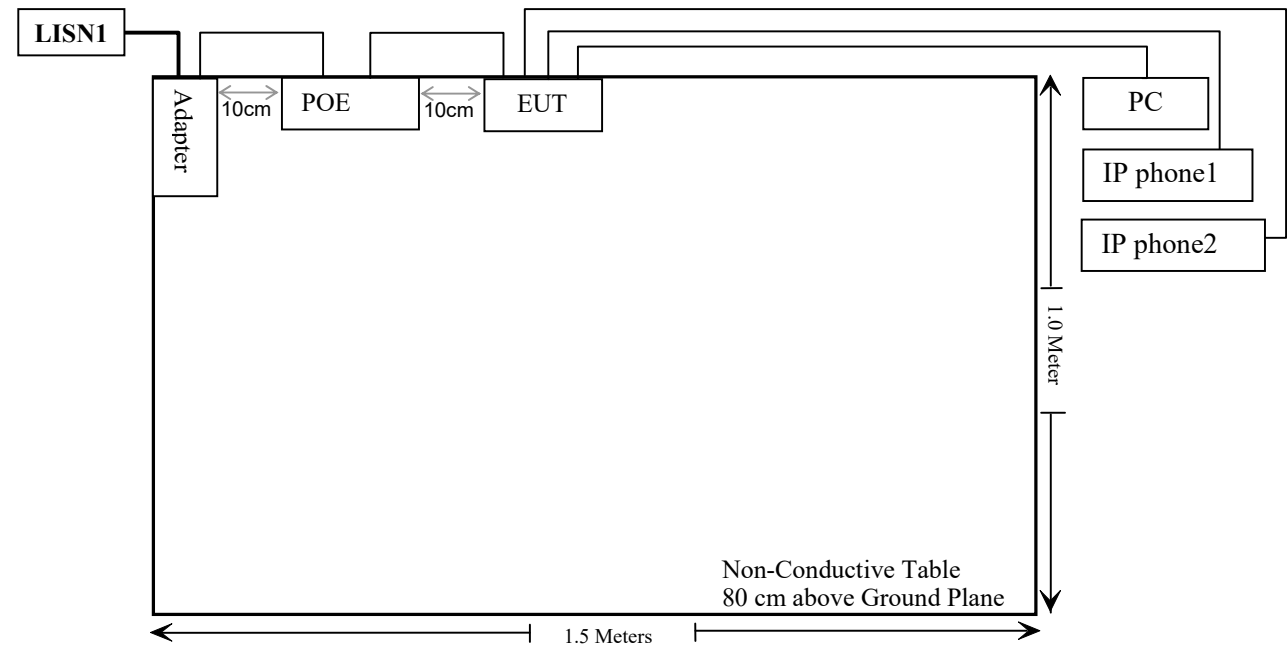
Manufacturer	Description	Model	Serial Number
DELL	PC	Latitude E7280	9RVYFH2
Grandstream	IP phone1	GXV3450	T11223323B898
Grandstream	IP phone2	GXP1625	271FVJSNB0BFDC21
TP-link	POE	ES210GP	Unknown
TP-link	Adapter	T535243-2-DT	Unknown

External I/O Cable

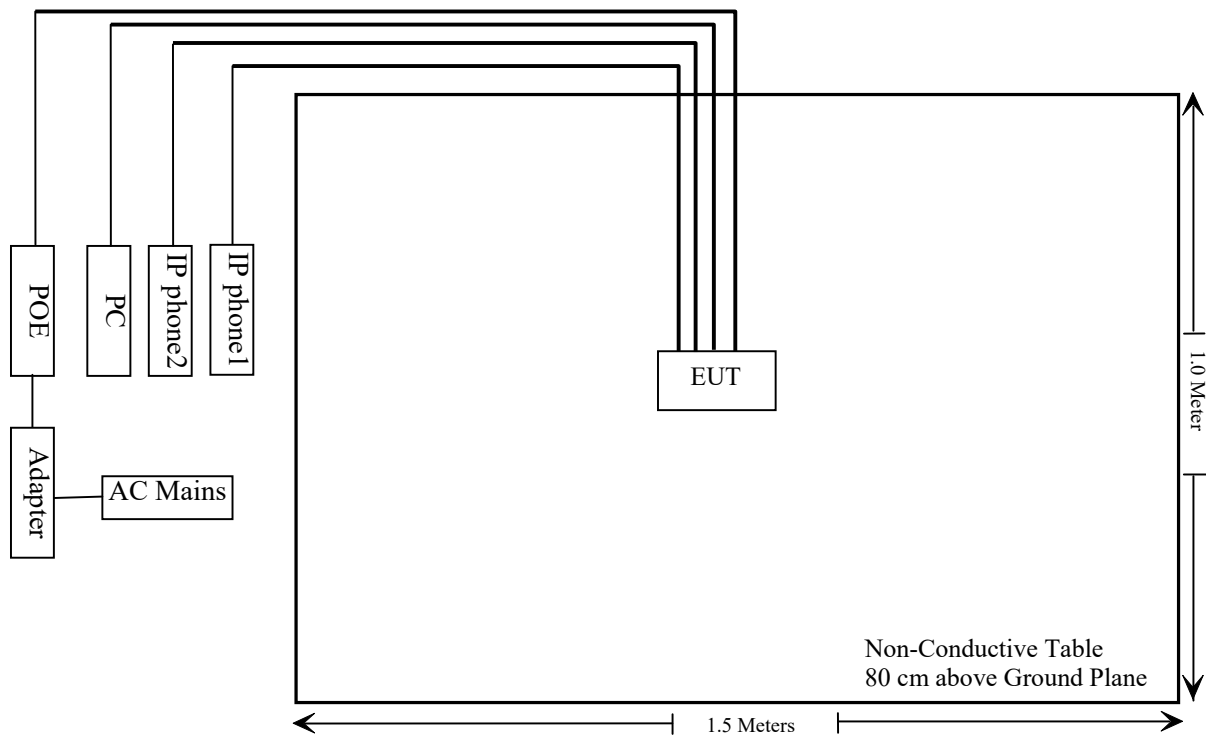
Cable Description	Length (m)	From Port	To
Un-shielded Detachable AC cable	1.4	LISN/ AC mains	Adapter
Un-shielded Un-Detachable DC cable	1.2	Adapter	POE
Un-shielded Detachable RJ45 cable	1.0	POE	EUT
Un-shielded Detachable RJ45 cable	8.0	EUT	PC
Un-shielded Detachable RJ45 cable	8.0	EUT	IP phone1
Un-shielded Detachable RJ45 cable	8.0	EUT	IP phone2

Block Diagram of Test Setup

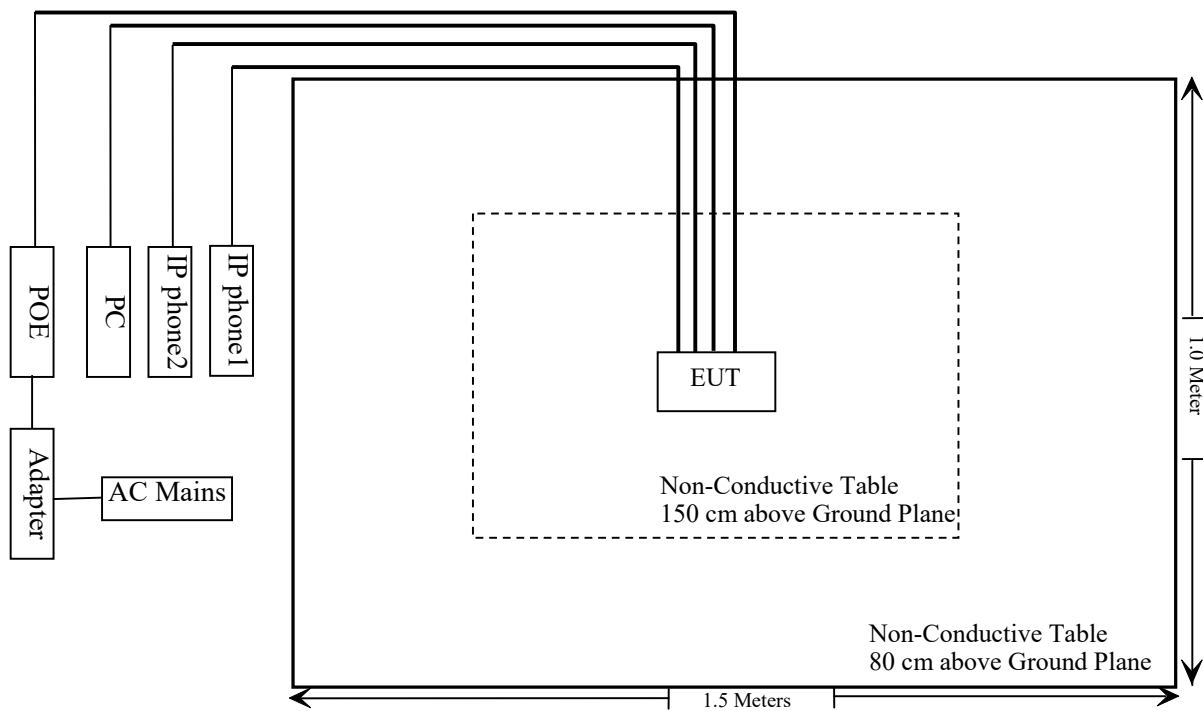
For conducted emission:



For radiated emission (Below 1GHz):



For radiated emission (Above 1GHz):



SUMMARY OF TEST RESULTS

FCC Rules	RSS Rules	Description of Test	Result
§15.247 (i), §1.1310 & §2.1091	RSS-102 §4	Maximum Permissible Exposure (MPE) & Exposure Limits	Compliant
§15.203	RSS-Gen §6.8	Antenna Requirement	Compliant
§15.207 (a)	RSS-Gen §8.8	AC Line Conducted Emissions	Compliant
§15.205, §15.209, §15.247(d)	RSS-GEN § 8.10 & RSS-247 § 5.5	Spurious Emissions	Compliant
§15.247 (a)(2)	RSS- Gen§6.7 RSS-247 § 5.2 (a)	99% Occupied Bandwidth & 6 dB Emission Bandwidth	Compliant
§15.247(b)(3)	RSS-247 § 5.4(d)	Maximum Conducted Output Power	Compliant
§15.247(d)	RSS-247 § 5.5	100 kHz Bandwidth of Frequency Band Edge	Compliant
§15.247(e)	RSS-247 § 5.2 (b)	Power Spectral Density	Compliant

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emissions Test					
Rohde & Schwarz	EMI Test Receiver	ESCI	101120	2024/01/16	2025/01/15
Rohde & Schwarz	LISN	ENV216	101613	2024/01/16	2025/01/15
Rohde & Schwarz	Transient Limiter	ESH3Z2	DE25985	2024/05/21	2025/05/20
Unknown	CE Cable	Unknown	UF A210B-1-0720-504504	2024/05/21	2025/05/20
Audix	EMI Test software	E3	191218(V9)	NCR	NCR
Radiated Emissions Test					
Rohde & Schwarz	EMI Test Receiver	ESR3	102455	2024/01/16	2025/01/15
Sonoma instrument	Pre-amplifier	310 N	186238	2024/05/21	2025/05/20
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2023/07/20	2026/07/19
Unknown	Cable	Chamber A Cable 1	N/A	2024/05/21	2025/05/20
Unknown	Cable	XH500C	J-10M-A	2024/05/21	2025/05/20
BACL	Active Loop Antenna	1313-1A	4031911	2024/05/14	2027/05/13
Unknown	Cable	2Y194	0735	2024/05/21	2025/05/20
Unknown	Cable	PNG214	1354	2024/05/21	2025/05/20
Audix	EMI Test software	E3	19821b(V9)	NCR	NCR
Rohde & Schwarz	Spectrum Analyzer	FSV40	101605	2024/03/27	2025/03/26
COM-POWER	Pre-amplifier	PA-122	181919	2023/06/29	2024/06/28
A.H.System	Horn Antenna	SAS-200/571	135	2021/07/14	2024/07/13
Unknown	RF Cable	KMSE	0735	2023/10/08	2024/10/07
Unknown	RF Cable	UFA147	219661	2023/10/08	2024/10/07
Unknown	RF Cable	XH750A-N	J-10M	2023/10/08	2024/10/07
JD	Multiplex Switch Test Control Set	DT7220FSU	DQ77926	NCR	NCR
Audix	EMI Test software	E3	191218(V9)	NCR	NCR
A.H.System	Pre-amplifier	PAM-1840VH	190	2023/08/02	2024/08/01
Electro-Mechanics Co	Horn Antenna	3116	9510-2270	2023/09/18	2026/09/17
UTIFLEX	RF Cable	NO. 13	232308-001	2023/08/03	2024/08/02

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted Test					
R&S	spectrum analyzer	FSV40	101942	2023/12/18	2024/12/17
MARCONI	10dB Attenuator	6534/3	2942	2023/07/04	2024/07/03
Unknown	RF Cable	65475	01670515	2023/07/04	2024/07/03
ANRITSU	Microwave peak power sensor	MA24418A	12622	2024/05/21	2025/05/20

* **Statement of Traceability:** Bay Area Compliance Laboratories Corp. (Shenzhen) attests that all calibrations have been performed in accordance to requirements that traceable to National Primary Standards and International System of Units (SI).

FCC §15.247 (i) & §1.1310 & §2.1091- MAXIMUM PERMISSIBLE EXPOSURE (MPE)

Applicable Standard

According to subpart 15.247(i) and subpart §1.1310, systems operating under the provisions of this section shall be operated in a manner that ensures that the public is not exposed to radio frequency energy level in excess of the Commission's guidelines.

Limits for Maximum Permissible Exposure (MPE) (§1.1310, §2.1091)

(B) Limits for General Population/Uncontrolled Exposure				
Frequency Range (MHz)	Electric Field Strength (V/m)	Magnetic Field Strength (A/m)	Power Density (mW/cm ²)	Averaging Time (minutes)
0.3–1.34	614	1.63	*(100)	30
1.34–30	824/f	2.19/f	*(180/f ²)	30
30–300	27.5	0.073	0.2	30
300–1500	/	/	f/1500	30
1500–100,000	/	/	1.0	30

f = frequency in MHz; * = Plane-wave equivalent power density;

According to §1.1310 and §2.1091 RF exposure is calculated.

Result

Calculation formula:

Prediction of power density at the distance of the applicable MPE limit

$S = PG/4\pi R^2$ = power density (in appropriate units, e.g. mW/cm²);

P = power input to the antenna (in appropriate units, e.g., mW);

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain;

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm);

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

Calculated Data:

For worst case:

Mode	Frequency (MHz)	Antenna Gain [#]		Max Tune-up Power [#]		Evaluation Distance (cm)	Power Density (mW/cm ²)	MPE Limit (mW/cm ²)
		(dBi)	(numeric)	(dBm)	(mW)			
2.4G Wi-Fi	2412-2462	6.85	4.84	29.5	891.25	31	0.357	1.0
5.2G Wi-Fi	5180-5240	10.62	11.53	25.0	316.23	31	0.302	1.0
5.3G Wi-Fi	5260-5320	10.62	11.53	20.5	112.20	31	0.107	1.0
5.6G Wi-Fi	5500-5700	10.62	11.53	20.0	100.00	31	0.096	1.0
5.8G Wi-Fi	5745-5825	10.62	11.53	25.0	316.23	31	0.302	1.0
5.9G Wi-Fi	5850-5895	10.62	11.53	24.0	251.19	31	0.240	1.0

Note:

- 1) The tune up conducted power and antenna gain was declared by the applicant.
- 2) For the Wi-Fi mode, the antenna gain would be the directional gain.
- 3) The 2.4G Wi-Fi and 5G Wi-Fi can transmit simultaneously.

The ratio= $MPE_{2.4G\ Wi-Fi}/limit + MPE_{5G\ Wi-Fi}/limit = 0.357/1.0 + 0.302/1.0 = 0.659 < 1.0$, simultaneous exposure is not required.

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 31cm from nearby persons.

Result: Compliant

RSS-102 § 4 –EXPOSURE LIMITS

Applicable Standard

According to RSS-102 §4:

Table 4: RF Field Strength Limits for Devices Used by the General Public (Uncontrolled Environment)

Frequency Range (MHz)	Electric Field (V/m rms)	Magnetic Field (A/m rms)	Power Density (W/m ²)	Reference Period (minutes)
0.003-10 ²¹	83	90	-	Instantaneous [*]
0.1-10	-	0.73/ <i>f</i>	-	6 ^{**}
1.1-10	87/ <i>f</i> ^{0.5}	-	-	6 ^{**}
10-20	27.46	0.0728	-2	6
20-48	58.07/ <i>f</i> ^{0.25}	0.1540/ <i>f</i> ^{0.25}	8.944/ <i>f</i> ^{0.5}	6
48-300	22.06	0.05852	1.291	6
300-6000	3.142 <i>f</i> ^{0.3417}	0.008335 <i>f</i> ^{0.3417}	0.02619 <i>f</i> ^{0.6834}	6
6000-15000	61.4	0.163	10	6
15000-150000	61.4	0.163	10	616000/ <i>f</i> ^{1.2}
150000-300000	0.158 <i>f</i> ^{0.5}	4.21 x 10 ⁻⁴ <i>f</i> ^{0.5}	6.67 x 10 ⁻⁵ <i>f</i>	616000/ <i>f</i>

Note: *f* is frequency in MHz.

^{*} Based on nerve stimulation (NS).

^{**} Based on specific absorption rate (SAR).

Result

Calculated Formulary:

Predication of MPE limit at a given distance

$$S = \frac{PG}{4\pi R^2}$$

S = power density (in appropriate units, e.g. W/m²)

P = power input to the antenna (in appropriate units, e.g., W).

G = power gain of the antenna in the direction of interest relative to an isotropic radiator, the power gain factor, is normally numeric gain.

R = distance to the center of radiation of the antenna (appropriate units, e.g., cm)

For simultaneously transmit system, the calculated power density should comply with:

$$\sum_i \frac{S_i}{S_{Limit,i}} \leq 1$$

For worst case:

Mode	Frequency (MHz)	Antenna Gain [#]		Max Tune-up Power [#]		Evaluation Distance (cm)	Power Density (W/m ²)	MPE Limit (W/m ²)
		(dBi)	(numeric)	(dBm)	(mW)			
2.4G Wi-Fi	2412-2462	6.85	4.84	29.5	891.25	31	3.572	5.37
5.2G Wi-Fi	5180-5240	10.62	11.53	15.0	31.62	31	0.302	9.05
5.3G Wi-Fi	5260-5320	10.62	11.53	17.0	50.12	31	0.479	9.14
5.6G Wi-Fi	5500-5700	10.62	11.53	20.0	100.00	31	0.955	9.43
5.8G Wi-Fi	5745-5825	10.62	11.53	25.0	316.23	31	3.019	9.71
5.9G Wi-Fi	5850-5895	10.62	11.53	24.0	251.19	31	2.398	9.83

Note:

- 1) The tune up conducted power and antenna gain was declared by the applicant.
- 2) For the Wi-Fi mode, the antenna gain would be the directional gain.
- 3) The 2.4G Wi-Fi and 5G Wi-Fi can transmit simultaneously.

The ratio= $MPE_{2.4G\ Wi-Fi}/limit + MPE_{5.8G\ Wi-Fi}/limit = 3.572/5.37 + 3.019/9.71 = 0.976 < 1.0$, simultaneous exposure is not required.

Result: Compliant.

Note: To maintain compliance with the RF exposure guidelines, place the equipment at least 31cm from nearby persons.

§15.203 & RSS-GEN §6.8 ANTENNA REQUIREMENT

Applicable Standard

According to § 15.203, an intentional radiator shall be designed to ensure that no antenna other than that furnished by the responsible party shall be used with the device. The use of a permanently attached antenna or of an antenna that uses a unique coupling to the intentional radiator shall be considered sufficient to comply with the provisions of this section. The manufacturer may design the unit so that a broken antenna can be replaced by the user, but the user of a standard antenna jack or electrical connector is prohibited. The structure and application of the EUT were analyzed to determine Compliant with section §15.203 of the rules. §15.203 state that the subject device must meet the following criteria:

- a. Antenna must be permanently attached to the unit.
- b. Antenna must use a unique type of connector to attach to the EUT.
- c. Unit must be professionally installed, and installer shall be responsible for verifying that the correct antenna is employed with the unit.

And according to FCC 47 CFR section 15.247 (b), if the transmitting antennas of directional gain greater than 6dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

The applicant for equipment certification shall provide a list of all antenna types that may be used with the transmitter, where applicable (i.e. for transmitters with detachable antenna), indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna. The test report shall demonstrate the Compliant of the transmitter with the limit for maximum equivalent isotropically radiated power (e.i.r.p.) specified in the applicable RSS, when the transmitter is equipped with any antenna type, selected from this list.

For expediting the testing, measurements may be performed using only the antenna with highest gain of each combination of transmitter and antenna type, with the transmitter output power set at the maximum level. However, the transmitter shall comply with the applicable requirements under all operational conditions and when in combination with any type of antenna from the list provided in the test report (and in the notice to be included in the user manual, provided below).

When measurements at the antenna port are used to determine the RF output power, the effective gain of the device's antenna shall be stated, based on a measurement or on data from the antenna's manufacturer.

The test report shall state the RF power, output power setting and spurious emission measurements with each antenna type that is used with the transmitter being tested.

For licence-exempt equipment with detachable antennas, the user manual shall also contain the following notice in a conspicuous location:

This radio transmitter [enter the device's ISED certification number] has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Immediately following the above notice, the manufacturer shall provide a list of all antenna types which can be used with the transmitter, indicating the maximum permissible antenna gain (in dBi) and the required impedance for each antenna type.

Antenna Connector Construction

The EUT has two internal antennas arrangement which were permanently attached and the maximum antenna gain[#] is below table, fulfill the requirement of this section. Please refer to the EUT photos.

Antenna	Antenna Type	Antenna Gain [#]	Impedance	Frequency Range
ANT0	Dipole	2.86dBi	50Ω	2.4~2.5GHz
ANT1	Dipole	3.85dBi	50Ω	2.4~2.5GHz

Result: Compliant

§15.207 (a) & RSS-GEN §8.8 AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC § 15.207 (a) & RSS-GEN §8.8

Unless stated otherwise in the applicable RSS, for radio apparatus that are designed to be connected to the public utility AC power network, the radio frequency voltage that is conducted back onto the AC power line on any frequency or frequencies within the range 150 kHz to 30 MHz shall not exceed the limits in table 4, as measured using a 50 μ H / 50 Ω line impedance stabilization network. This requirement applies for the radio frequency voltage measured between each power line and the ground terminal of each AC power-line mains cable of the EUT.

For an EUT that connects to the AC power lines indirectly, through another device, the requirement for Compliant with the limits in table 4 shall apply at the terminals of the AC power-line mains cable of a representative support device, while it provides power to the EUT. The lower limit applies at the boundary between the frequency ranges. The device used to power the EUT shall be representative of typical applications.

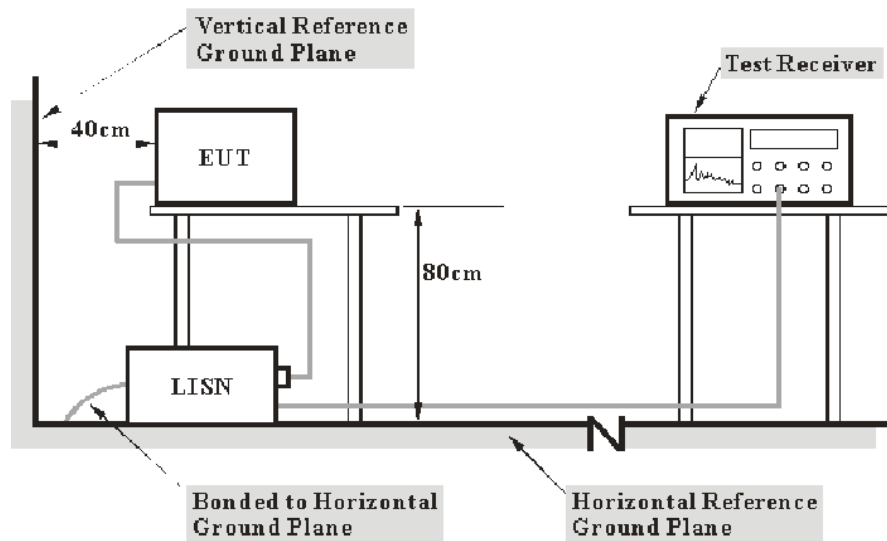
Table 4 - AC Power Lines Conducted Emission Limits		
Frequency range (MHz)	Conducted limit (dB μ V)	
	Quasi-Peak	Average
0.15 – 0.5	66 to 56 ¹	56 to 46 ¹
0.5 – 5	56	46
5 – 30	60	50

Note 1: The level decreases linearly with the logarithm of the frequency.

For an EUT with a permanent or detachable antenna operating between 150 kHz and 30 MHz, the AC power-line conducted emissions must be measured using the following configurations:

- Perform the AC power-line conducted emissions test with the antenna connected to determine Compliant with the limits of table 4 outside the transmitter's fundamental emission band.
- Retest with a dummy load instead of the antenna to determine Compliant with the limits of table 4 within the transmitter's fundamental emission band. For a detachable antenna, remove the antenna and connect a suitable dummy load to the antenna connector. For a permanent antenna, remove the antenna and terminate the RF output with a dummy load or network that simulates the antenna in the fundamental frequency band.

EUT Setup



Note: 1. Support units were connected to second LISN.
2. Both of LISNs (AMN) 80 cm from EUT and at the least 80 cm from other units and other metal planes support units.

The setup of EUT is according with per ANSI C63.10-2013 measurement procedure. The specification used was with the FCC Part 15.207 & RSS-247/RSS-Gen limits.

The spacing between the peripherals was 10 cm.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

EMI Test Receiver Setup

The EMI test receiver was set to investigate the spectrum from 150 kHz to 30 MHz.

During the conducted emission test, the EMI test receiver was set with the following configurations:

Frequency Range	IF B/W
150 kHz – 30 MHz	9 kHz

Test Procedure

Maximizing procedure was performed on the six (6) highest emissions of the EUT.

All final data was recorded in the Quasi-peak and average detection mode.

Factor & Over Limit Calculation

The factor is calculated by adding LISN VDF (Voltage Division Factor) and Cable Loss. The basic equation is as follows:

$$\text{Factor} = \text{LISN VDF} + \text{Cable Loss}$$

The “**Over limit**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, an Over limit of -7 dB means the emission is 7 dB below the limit. The equation for calculation is as follows:

$$\begin{aligned}\text{Over Limit} &= \text{Level} - \text{Limit} \\ \text{Level} &= \text{Read Level} + \text{Factor}\end{aligned}$$

Note: The term "cable loss" refers to the combination of a cable and a 10dB transient limiter (attenuator).

Test Data

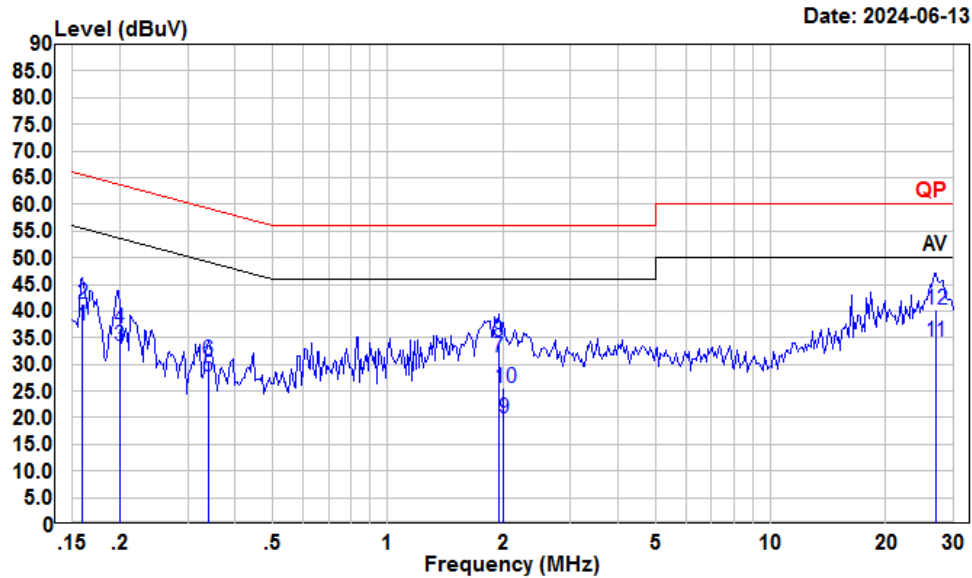
Environmental Conditions

Temperature:	25 °C
Relative Humidity:	65 %
ATM Pressure:	101 kPa

The testing was performed by Macy Shi on 2024-06-13.

EUT operation mode: Transmitting (Maximum output power mode, ANT1 802.11g mode, middle channel)

AC 120V/60 Hz, Line



Condition: Line

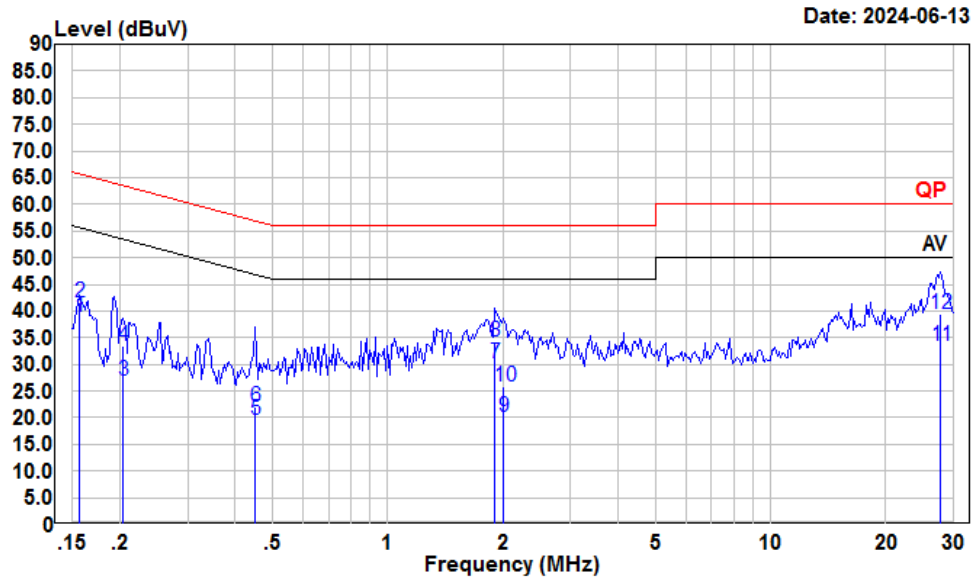
Project : 2401T49306E-RF

tester : Macy.shi

Note : 2.4G WIFI

	Freq	Read Level	LISN Level	LISN Factor	Cable Loss	Limit Line	Over Limit	Remark
	MHz	dBuV	dBuV	dB	dB	dBuV	dB	
1	0.16	16.87	37.39	10.40	10.12	55.47	-18.08	Average
2	0.16	20.84	41.36	10.40	10.12	65.47	-24.11	QP
3	0.20	12.96	33.45	10.40	10.09	53.62	-20.17	Average
4	0.20	16.32	36.81	10.40	10.09	63.62	-26.81	QP
5	0.34	7.37	27.77	10.28	10.12	49.22	-21.45	Average
6	0.34	10.37	30.77	10.28	10.12	59.22	-28.45	QP
7	1.95	10.87	31.37	10.31	10.19	46.00	-14.63	Average
8	1.95	13.64	34.14	10.31	10.19	56.00	-21.86	QP
9	2.01	-0.51	19.98	10.30	10.19	46.00	-26.02	Average
10	2.01	5.20	25.69	10.30	10.19	56.00	-30.31	QP
11	26.98	13.31	34.14	10.63	10.20	50.00	-15.86	Average
12	26.98	19.48	40.31	10.63	10.20	60.00	-19.69	QP

AC 120V/60 Hz, Neutral



Condition: Neutral
Project : 2401T49306E-RF
tester : Macy.shi
Note : 2.4G WIFI

	Freq	Read Level	LISN Level	LISN Factor	Cable Loss	Limit Line	Over Limit	Remark
	MHz	dBuV	dBuV	dB	dB	dBuV	dB	
1	0.16	18.41	38.79	10.26	10.12	55.65	-16.86	Average
2	0.16	21.13	41.51	10.26	10.12	65.65	-24.14	QP
3	0.20	6.20	26.89	10.60	10.09	53.45	-26.56	Average
4	0.20	12.64	33.33	10.60	10.09	63.45	-30.12	QP
5	0.45	-1.36	19.54	10.78	10.12	46.85	-27.31	Average
6	0.45	1.17	22.07	10.78	10.12	56.85	-34.78	QP
7	1.91	9.81	30.10	10.11	10.18	46.00	-15.90	Average
8	1.91	13.91	34.20	10.11	10.18	56.00	-21.80	QP
9	2.01	-0.04	20.25	10.10	10.19	46.00	-25.75	Average
10	2.01	5.65	25.94	10.10	10.19	56.00	-30.06	QP
11	27.86	12.86	33.35	10.28	10.21	50.00	-16.65	Average
12	27.86	19.04	39.53	10.28	10.21	60.00	-20.47	QP

§15.205, §15.209, §15.247(d) & RSS-GEN § 8.10 & RSS-247 § 5.5 SPURIOUS EMISSIONS

Applicable Standard

FCC §15.247 (d); §15.209; §15.205;

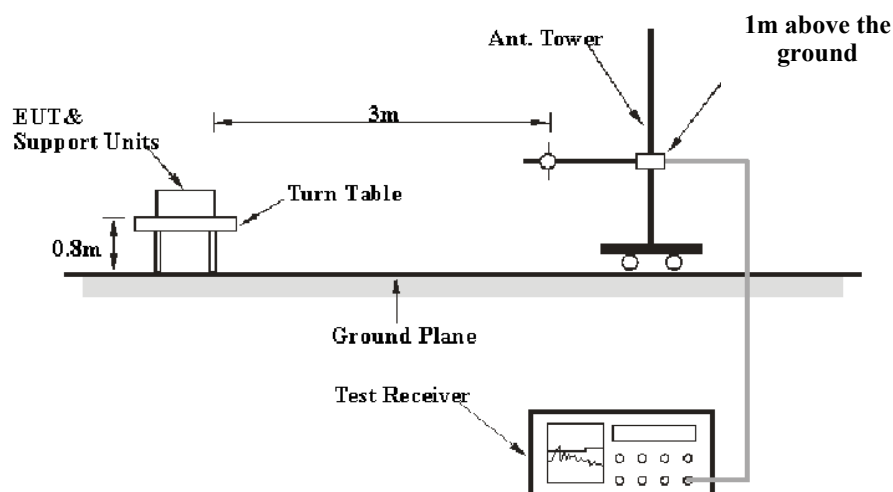
According to RSS-GEN § 8.10 & RSS-247 § 5.5

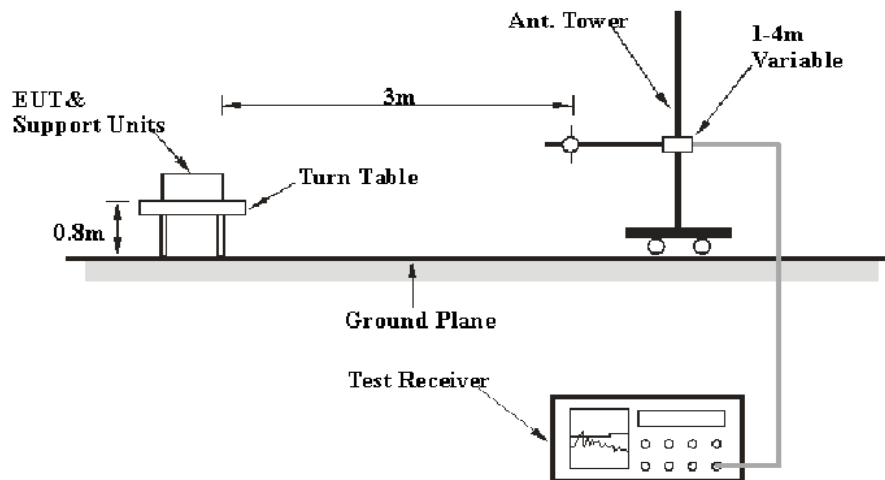
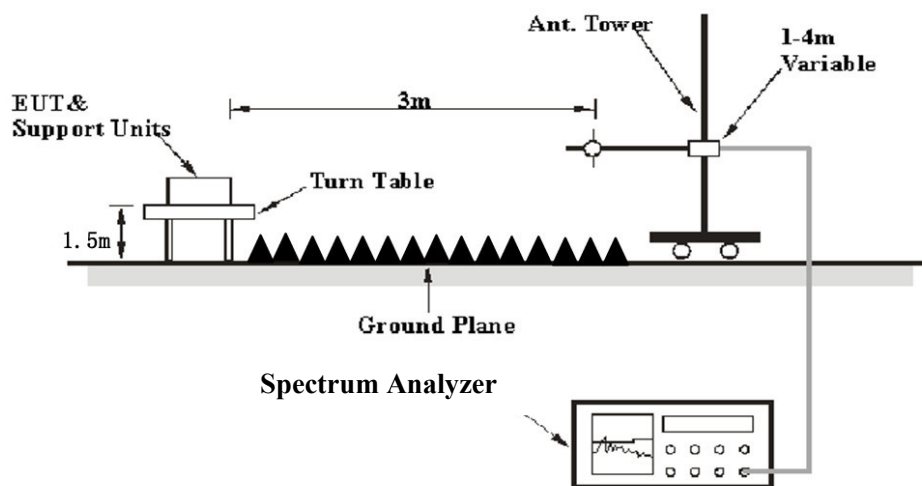
Restricted frequency bands, identified in table 7, are designated primarily for safety-of-life services (distress calling and certain aeronautical activities), certain satellite downlinks, radio astronomy and some government uses. Except where otherwise indicated, the following conditions related to the restricted frequency bands apply: (a) The transmit frequency, including fundamental components of modulation, of licence-exempt radio apparatus shall not fall within the restricted frequency bands listed in table 7 except for apparatus compliant with RSS-287, Emergency Position Indicating Radio Beacons (EPIRB), Emergency Locator Transmitters (ELT), Personal Locator Beacons (PLB), and Maritime Survivor Locator Devices (MSLD). (b) Unwanted emissions that fall into restricted frequency bands listed in table 7 shall comply with the limits specified in table 5 and table 6. (c) Unwanted emissions that do not fall within the restricted frequency bands listed in table 7 shall comply either with the limits specified in the applicable RSS or with those specified in table 5 and table 6.

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 Compliant with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of root-mean-square averaging over a time interval, as permitted under section 5.4(d), the attenuation required shall be 30 dB instead of 20 dB. Attenuation below the general field strength limits specified in RSS-Gen is not required.

EUT Setup

9 kHz-30MHz:



30MHz-1GHz:**Above 1GHz:**

The radiated emission tests were performed in the 3 meters test site, using the setup accordance with the ANSI C63.10-2013 & RSS-Gen. The specification used was the FCC 15.209, and FCC 15.247 & RSS-Gen limits.

The external I/O cables were draped along the test table and formed a bundle 30 to 40 cm long in the middle.

EMI Test Receiver & Spectrum Analyzer Setup

The system was investigated from 9 kHz to 25 GHz.

During the radiated emission test, the EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

9 kHz-1GHz:

Frequency Range	RBW	Video B/W	IF B/W	Measurement
9 kHz – 150 kHz	/	/	200 Hz	QP
	300 Hz	1 kHz	/	PK
150 kHz – 30 MHz	/	/	9 kHz	QP
	10 kHz	30 kHz	/	PK
30 MHz – 1000 MHz	/	/	120 kHz	QP
	100 kHz	300 kHz	/	PK

1-25GHz:

Measurement	Duty cycle	RBW	Video B/W
PK	Any	1MHz	3 MHz
AV	>98%	1MHz	10 Hz
	<98%	1MHz	≥1/Ton

Note: Ton is minimum transmission duration

If the maximized peak measured value complies with under the QP/Average limit more than 6dB, then it is unnecessary to perform an QP/Average measurement.

Test Procedure

Maximizing procedure was performed on the highest emissions to ensure that the EUT complied with all installation combinations.

All final data was recorded in Quasi-peak detection mode except for the frequency bands 9–90 kHz, 110–490 kHz and above 1000 MHz, average detection modes for frequency bands 9–90 kHz and 110–490 kHz, peak and average detection modes for frequencies above 1 GHz.

For 9 kHz-30MHz, the report shall list the six emissions with the smallest margin relative to the limit, for each of the three antenna orientations (parallel, perpendicular, and ground-parallel) unless the margin is greater than 20 dB.

All emissions under the average limit and under the noise floor have not recorded in the report.

Factor & Over Limit/Margin Calculation

The Factor is calculated by adding the Antenna Factor and Cable Loss, and subtracting the Amplifier Gain. The basic equation is as follows:

$$\text{Factor} = \text{Antenna Factor} + \text{Cable Loss} - \text{Amplifier Gain}$$

The “**Over Limit/Margin**” column of the following data tables indicates the degree of compliance with the applicable limit. For example, an Over Limit/margin of -7dB means the emission is 7dB below the limit. The equation for calculation is as follows:

$$\begin{aligned}\text{Over Limit/Margin} &= \text{Level/Corrected Amplitude} - \text{Limit} \\ \text{Level / Corrected Amplitude} &= \text{Read Level} + \text{Factor}\end{aligned}$$

Test Data

Environmental Conditions

Temperature:	22 ~25.5°C
Relative Humidity:	50~55 %
ATM Pressure:	101 kPa

The testing was performed by Anson Su on 2024-06-14 for below 1GHz and Zenos Qiao from 2024-05-30 to 2024-05-31 for above 1GHz.

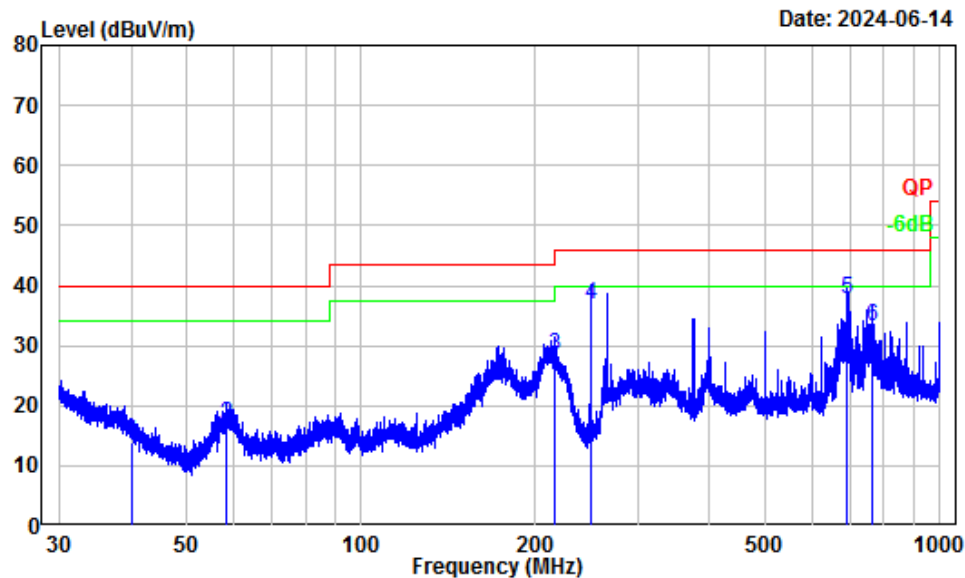
EUT operation mode: Transmitting

9 kHz-30MHz: *(Maximum output power mode, ANT1 802.11g mode, middle channel)*

The amplitude of spurious emissions attenuated more than 20 dB below the limit was not recorded.

30 MHz~1 GHz: (Maximum output power mode, ANT1 802.11g mode, middle channel)

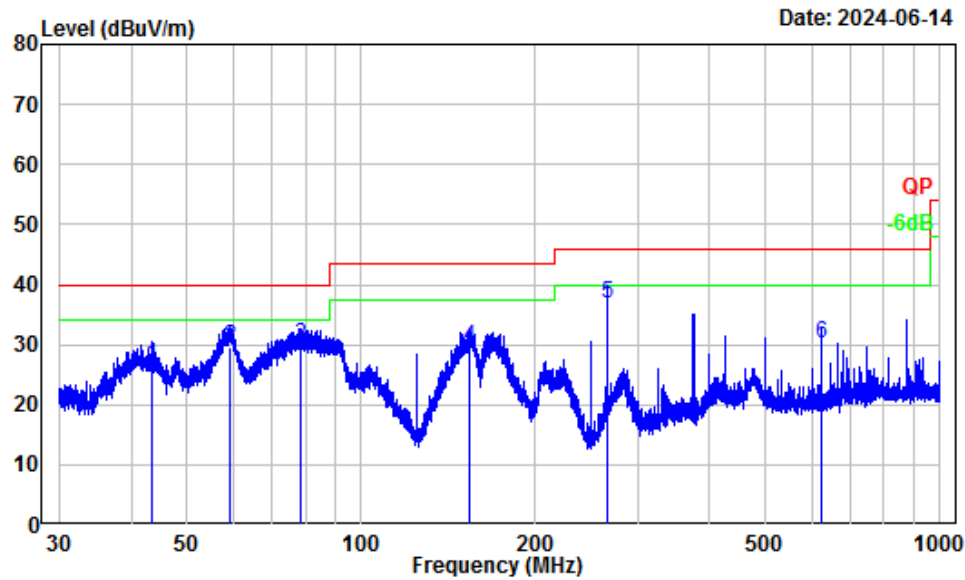
Horizontal



Site : Chamber A
Condition : 3m Horizontal
Project Number: 2401T49306E-RF
Test Mode : 2.4G WIFI
Tester : Anson Su

	Freq Factor		Read Level		Limit	Over	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	40.13	-11.60	25.45	13.85	40.00	-26.15	QP
2	58.23	-17.77	34.61	16.84	40.00	-23.16	QP
3	215.55	-13.81	42.04	28.23	43.50	-15.27	QP
4	249.97	-14.53	51.30	36.77	46.00	-9.23	QP
5	692.90	-6.24	44.00	37.76	46.00	-8.24	QP
6	765.05	-5.47	38.83	33.36	46.00	-12.64	QP

Vertical



Site : Chamber A
Condition : 3m Vertical
Project Number: 2401T49306E-RF
Test Mode : 2.4G WIFI
Tester : Anson Su

	Freq Factor		Read Level	Limit Level	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB
1	43.54	-15.02	41.47	26.45	40.00	-13.55 QP
2	59.41	-18.85	48.52	29.67	40.00	-10.33 QP
3	78.48	-18.70	48.59	29.89	40.00	-10.11 QP
4	153.94	-13.99	43.60	29.61	43.50	-13.89 QP
5	266.73	-14.34	51.07	36.73	46.00	-9.27 QP
6	625.08	-7.68	37.86	30.18	46.00	-15.82 QP

1 GHz-25 GHz:

Frequency (MHz)	Receiver		Polar (H/V)	Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/AV					
ANT0							
802.11b							
Low Channel 2412MHz							
2385.24	56.53	PK	H	-2.93	53.60	74	-20.40
2385.24	43.86	AV	H	-2.93	40.93	54	-13.07
2386.57	56.27	PK	V	-2.93	53.34	74	-20.66
2386.57	43.62	AV	V	-2.93	40.69	54	-13.31
4824.00	52.10	PK	H	2.45	54.55	74	-19.45
4824.00	49.19	AV	H	2.45	51.64	54	-2.36
4824.00	53.66	PK	V	2.45	56.11	74	-17.89
4824.00	50.44	AV	V	2.45	52.89	54	-1.11
Middle Channel 2437MHz							
4874.00	52.82	PK	H	2.56	55.38	74	-18.62
4874.00	49.54	AV	H	2.56	52.10	54	-1.90
4874.00	53.43	PK	V	2.56	55.99	74	-18.01
4874.00	50.25	AV	V	2.56	52.81	54	-1.19
High Channel 2462MHz							
2486.24	57.70	PK	H	-3.17	54.53	74	-19.47
2486.24	48.93	AV	H	-3.17	45.76	54	-8.24
2486.04	57.27	PK	V	-3.17	54.10	74	-19.90
2486.04	48.38	AV	V	-3.17	45.21	54	-8.79
4924.00	53.73	PK	H	2.63	56.36	74	-17.64
4924.00	49.32	AV	H	2.63	51.95	54	-2.05
4924.00	54.27	PK	V	2.63	56.90	74	-17.1
4924.00	50.24	AV	V	2.63	52.87	54	-1.13

Frequency (MHz)	Receiver		Polar (H/V)	Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/AV					
ANT1							
802.11b							
Low Channel 2412MHz							
2388.32	56.76	PK	H	-2.93	53.83	74	-20.17
2388.32	44.18	AV	H	-2.93	41.25	54	-12.75
2387.97	56.45	PK	V	-2.93	53.52	74	-20.48
2387.97	43.84	AV	V	-2.93	40.91	54	-13.09
4824.00	53.68	PK	H	2.45	56.13	74	-17.87
4824.00	49.74	AV	H	2.45	52.19	54	-1.81
4824.00	54.43	PK	V	2.45	56.88	74	-17.12
4824.00	50.35	AV	V	2.45	52.80	54	-1.20
Middle Channel 2437MHz							
4874.00	53.33	PK	H	2.56	55.89	74	-18.11
4874.00	49.69	AV	H	2.56	52.25	54	-1.75
4874.00	54.22	PK	V	2.56	56.78	74	-17.22
4874.00	50.38	AV	V	2.56	52.94	54	-1.06
High Channel 2462MHz							
2486.65	58.14	PK	H	-3.17	54.97	74	-19.03
2486.65	46.05	AV	H	-3.17	42.88	54	-11.12
2486.32	57.69	PK	V	-3.17	54.52	74	-19.48
2486.32	45.58	AV	V	-3.17	42.41	54	-11.59
4924.00	53.92	PK	H	2.63	56.55	74	-17.45
4924.00	49.93	AV	H	2.63	52.56	54	-1.44
4924.00	54.59	PK	V	2.63	57.22	74	-16.78
4924.00	50.31	AV	V	2.63	52.94	54	-1.06

Frequency (MHz)	Receiver		Polar (H/V)	Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/AV					
ANT0							
802.11g							
Low Channel 2412MHz							
2389.83	74.38	PK	H	-2.93	71.45	74	-2.55
2389.83	55.63	AV	H	-2.93	52.70	54	-1.30
2389.68	73.19	PK	V	-2.93	70.26	74	-3.74
2389.68	55.64	AV	V	-2.93	52.71	54	-1.29
4824.00	50.75	PK	H	2.45	53.20	74	-20.80
4824.00	37.08	AV	H	2.45	39.53	54	-14.47
4824.00	51.46	PK	V	2.45	53.91	74	-20.09
4824.00	37.79	AV	V	2.45	40.24	54	-13.76
Middle Channel 2437MHz							
4874.00	54.17	PK	H	2.56	56.73	74	-17.27
4874.00	40.72	AV	H	2.56	43.28	54	-10.72
4874.00	54.89	PK	V	2.56	57.45	74	-16.55
4874.00	41.34	AV	V	2.56	43.90	54	-10.10
High Channel 2462MHz							
2483.51	75.86	PK	H	-3.17	72.69	74	-1.31
2483.51	56.04	AV	H	-3.17	52.87	54	-1.13
2483.63	75.29	PK	V	-3.17	72.12	74	-1.88
2483.63	55.69	AV	V	-3.17	52.52	54	-1.48
4924.00	50.27	PK	H	2.63	52.90	74	-21.10
4924.00	36.52	AV	H	2.63	39.15	54	-14.85
4924.00	51.03	PK	V	2.63	53.66	74	-20.34
4924.00	37.16	AV	V	2.63	39.79	54	-14.21

Frequency (MHz)	Receiver		Polar (H/V)	Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/AV					
ANT1							
802.11g							
Low Channel 2412MHz							
2389.83	75.01	PK	H	-2.93	72.08	74	-1.92
2389.83	55.91	AV	H	-2.93	52.98	54	-1.02
2389.59	74.16	PK	V	-2.93	71.23	74	-2.77
2389.59	55.50	AV	V	-2.93	52.57	54	-1.43
4824.00	55.64	PK	H	2.45	58.09	74	-15.91
4824.00	43.12	AV	H	2.45	45.57	54	-8.43
4824.00	56.53	PK	V	2.45	58.98	74	-15.02
4824.00	43.88	AV	V	2.45	46.33	54	-7.67
Middle Channel 2437MHz							
4874.00	57.65	PK	H	2.56	60.21	74	-13.79
4874.00	44.32	AV	H	2.56	46.88	54	-7.12
4874.00	58.43	PK	V	2.56	60.99	74	-13.01
4874.00	45.16	AV	V	2.56	47.72	54	-6.28
High Channel 2462MHz							
2483.57	76.02	PK	H	-3.17	72.85	74	-1.15
2483.57	55.79	AV	H	-3.17	52.62	54	-1.38
2483.69	75.06	PK	V	-3.17	71.89	74	-2.11
2483.69	54.86	AV	V	-3.17	51.69	54	-2.31
4924.00	54.02	PK	H	2.63	56.65	74	-17.35
4924.00	40.98	AV	H	2.63	43.61	54	-10.39
4924.00	54.84	PK	V	2.63	57.47	74	-16.53
4924.00	41.75	AV	V	2.63	44.38	54	-9.62

Frequency (MHz)	Receiver		Polar (H/V)	Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/AV					
802.11n20							
Low Channel 2412MHz							
2389.83	75.78	PK	H	-2.93	72.85	74	-1.15
2389.83	55.81	AV	H	-2.93	52.88	54	-1.12
2389.75	74.85	PK	V	-2.93	71.92	74	-2.08
2389.75	54.95	AV	V	-2.93	52.02	54	-1.98
4824.00	53.97	PK	H	2.45	56.42	74	-17.58
4824.00	40.68	AV	H	2.45	43.13	54	-10.87
4824.00	54.81	PK	V	2.45	57.26	74	-16.74
4824.00	41.45	AV	V	2.45	43.90	54	-10.10
Middle Channel 2437MHz							
4874.00	55.32	PK	H	2.56	57.88	74	-16.12
4874.00	42.84	AV	H	2.56	45.40	54	-8.60
4874.00	56.25	PK	V	2.56	58.81	74	-15.19
4874.00	43.68	AV	V	2.56	46.24	54	-7.76
High Channel 2462MHz							
2483.65	76.05	PK	H	-3.17	72.88	74	-1.12
2483.65	56.12	AV	H	-3.17	52.95	54	-1.05
2483.57	75.29	PK	V	-3.17	72.12	74	-1.88
2483.57	55.63	AV	V	-3.17	52.46	54	-1.54
4924.00	52.47	PK	H	2.63	55.10	74	-18.90
4924.00	38.96	AV	H	2.63	41.59	54	-12.41
4924.00	53.23	PK	V	2.63	55.86	74	-18.14
4924.00	39.79	AV	V	2.63	42.42	54	-11.58

Frequency (MHz)	Receiver		Polar (H/V)	Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/AV					
802.11n40							
Low Channel 2422MHz							
2388.32	70.76	PK	H	-2.93	67.83	74	-6.17
2388.32	55.47	AV	H	-2.93	52.54	54	-1.46
2388.57	70.72	PK	V	-2.93	67.79	74	-6.21
2388.57	55.54	AV	V	-2.93	52.61	54	-1.39
4844.00	49.84	PK	H	2.45	52.29	74	-21.71
4844.00	37.78	AV	H	2.45	40.23	54	-13.77
4844.00	50.51	PK	V	2.45	52.96	74	-21.04
4844.00	38.42	AV	V	2.45	40.87	54	-13.13
Middle Channel 2437MHz							
4874.00	50.07	PK	H	2.56	52.63	74	-21.37
4874.00	38.15	AV	H	2.56	40.71	54	-13.29
4874.00	50.89	PK	V	2.56	53.45	74	-20.55
4874.00	38.96	AV	V	2.56	41.52	54	-12.48
High Channel 2452MHz							
2483.67	71.91	PK	H	-3.17	68.74	74	-5.26
2483.67	56.12	AV	H	-3.17	52.95	54	-1.05
2483.86	70.64	PK	V	-3.17	67.47	74	-6.53
2483.86	55.84	AV	V	-3.17	52.67	54	-1.33
4904.00	48.39	PK	H	2.64	51.03	74	-22.97
4904.00	36.01	AV	H	2.64	38.65	54	-15.35
4904.00	49.12	PK	V	2.64	51.76	74	-22.24
4904.00	36.83	AV	V	2.64	39.47	54	-14.53

Frequency (MHz)	Receiver		Polar (H/V)	Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/AV					
802.11ax20							
Low Channel 2412MHz							
2389.83	75.83	PK	H	-2.93	72.90	74	-1.10
2389.83	55.90	AV	H	-2.93	52.97	54	-1.03
2389.56	74.72	PK	V	-2.93	71.79	74	-2.21
2389.56	55.71	AV	V	-2.93	52.78	54	-1.22
4824.00	53.14	PK	H	2.45	55.59	74	-18.41
4824.00	39.89	AV	H	2.45	42.34	54	-11.66
4824.00	53.98	PK	V	2.45	56.43	74	-17.57
4824.00	40.75	AV	V	2.45	43.20	54	-10.80
Middle Channel 2437MHz							
4874.00	54.96	PK	H	2.56	57.52	74	-16.48
4874.00	42.32	AV	H	2.56	44.88	54	-9.12
4874.00	55.83	PK	V	2.56	58.39	74	-15.61
4874.00	43.18	AV	V	2.56	45.74	54	-8.26
High Channel 2462MHz							
2483.56	75.81	PK	H	-3.17	72.64	74	-1.36
2483.56	56.10	AV	H	-3.17	52.93	54	-1.07
2483.75	75.20	PK	V	-3.17	72.03	74	-1.97
2483.75	55.45	AV	V	-3.17	52.28	54	-1.72
4924.00	51.64	PK	H	2.63	54.27	74	-19.73
4924.00	39.16	AV	H	2.63	41.79	54	-12.21
4924.00	52.45	PK	V	2.63	55.08	74	-18.92
4924.00	39.93	AV	V	2.63	42.56	54	-11.44

Frequency (MHz)	Receiver		Polar (H/V)	Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/AV					
802.11ax40							
Low Channel 2422MHz							
2388.67	72.45	PK	H	-2.93	69.52	74	-4.48
2388.67	55.79	AV	H	-2.93	52.86	54	-1.14
2388.32	71.32	PK	V	-2.93	68.39	74	-5.61
2388.32	55.42	AV	V	-2.93	52.49	54	-1.51
4844.00	49.37	PK	H	2.45	51.82	74	-22.18
4844.00	37.54	AV	H	2.45	39.99	54	-14.01
4844.00	50.15	PK	V	2.45	52.60	74	-21.40
4844.00	38.28	AV	V	2.45	40.73	54	-13.27
Middle Channel 2437MHz							
4874.00	50.59	PK	H	2.56	53.15	74	-20.85
4874.00	37.85	AV	H	2.56	40.41	54	-13.59
4874.00	51.32	PK	V	2.56	53.88	74	-20.12
4874.00	38.68	AV	V	2.56	41.24	54	-12.76
High Channel 2452MHz							
2483.69	71.19	PK	H	-3.17	68.02	74	-5.98
2483.69	55.83	AV	H	-3.17	52.66	54	-1.34
2483.57	71.14	PK	V	-3.17	67.97	74	-6.03
2483.57	55.67	AV	V	-3.17	52.50	54	-1.50
4904.00	48.51	PK	H	2.64	51.15	74	-22.85
4904.00	35.93	AV	H	2.64	38.57	54	-15.43
4904.00	49.24	PK	V	2.64	51.88	74	-22.12
4904.00	36.65	AV	V	2.64	39.29	54	-14.71

Note:

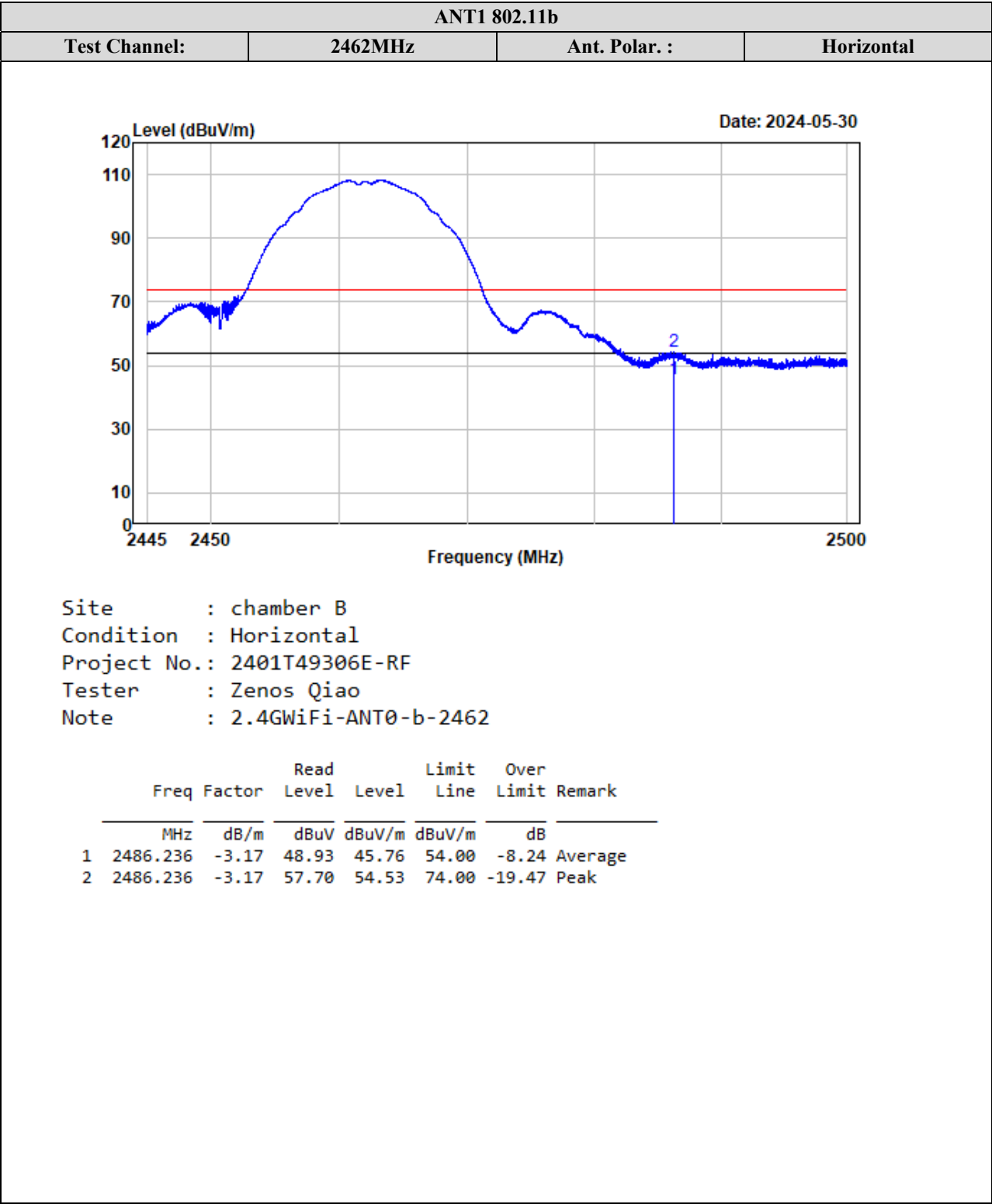
Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor

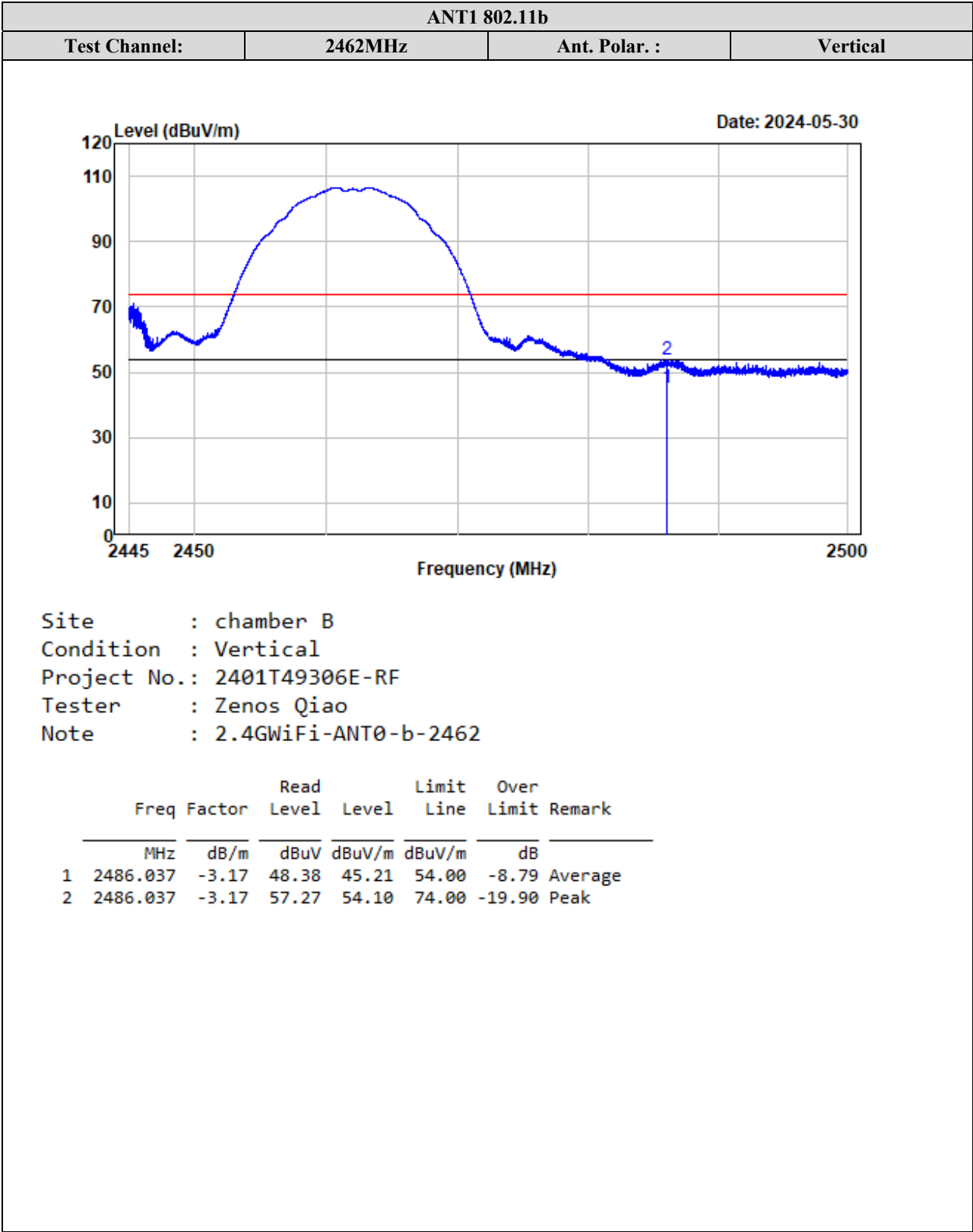
Corrected Amplitude = Factor + Reading

Margin = Corrected. Amplitude - Limit

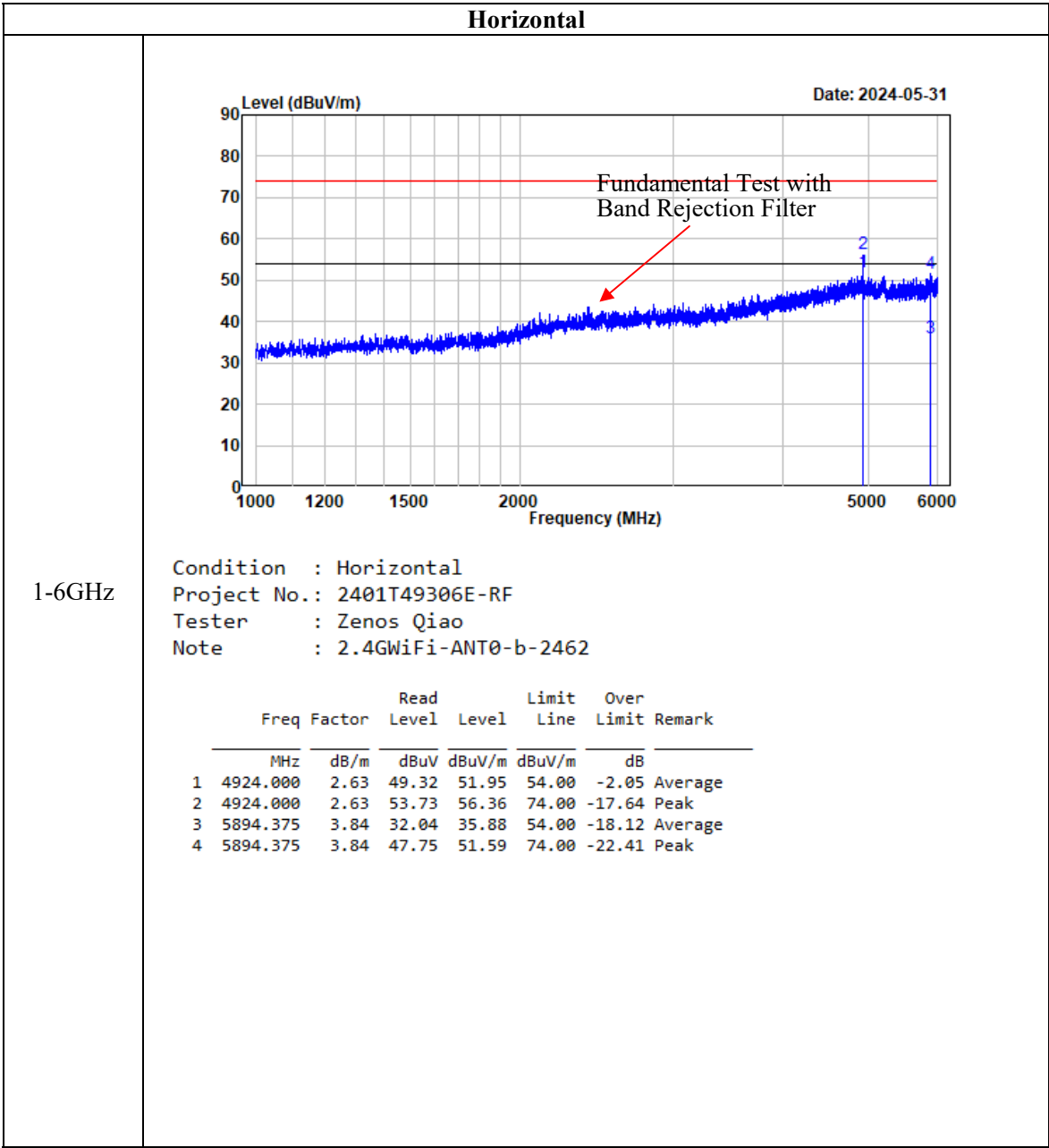
The other spurious emission which is in the noise floor level was not recorded.

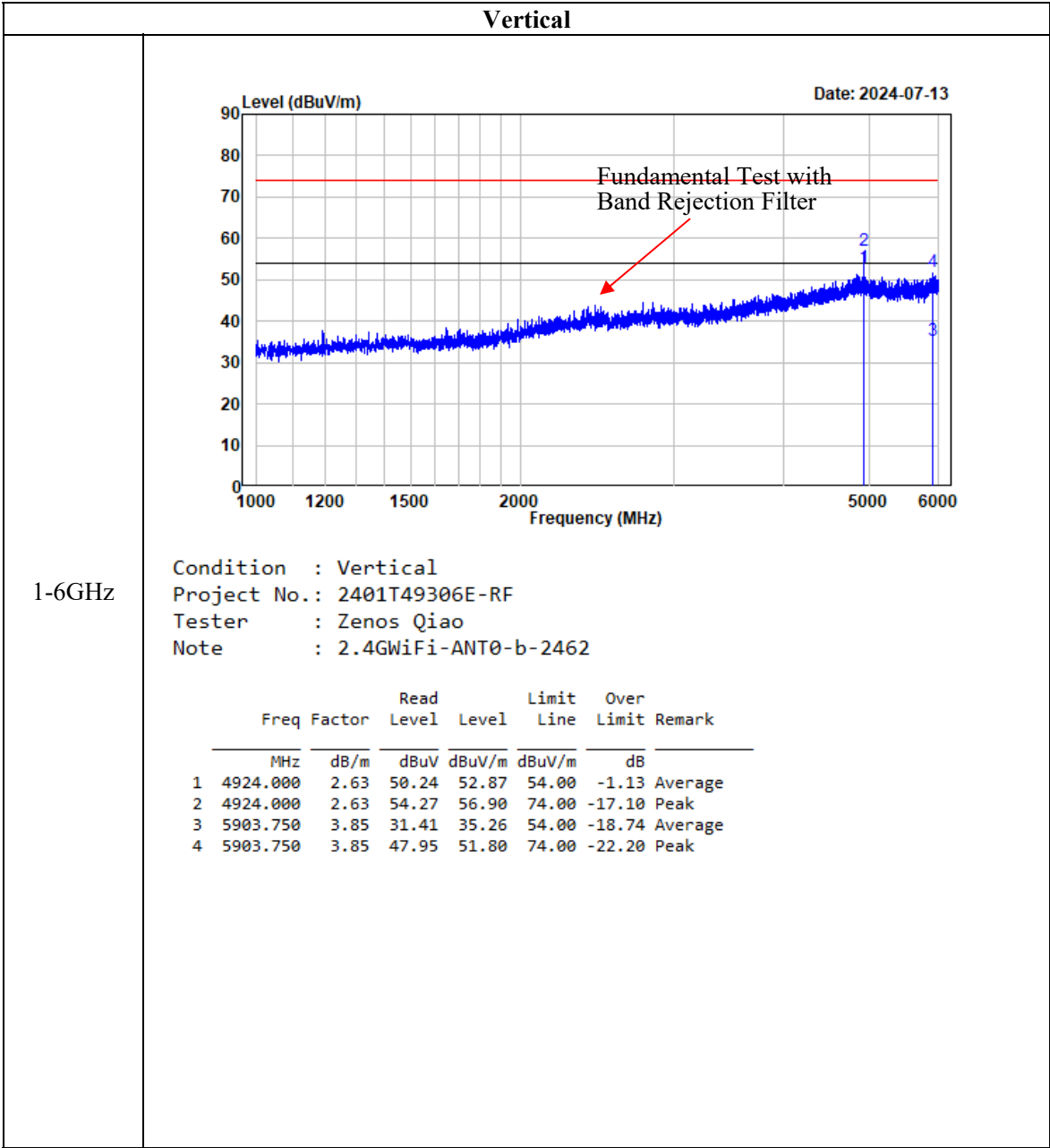
Test plots for Band Edge Measurements (Radiated):

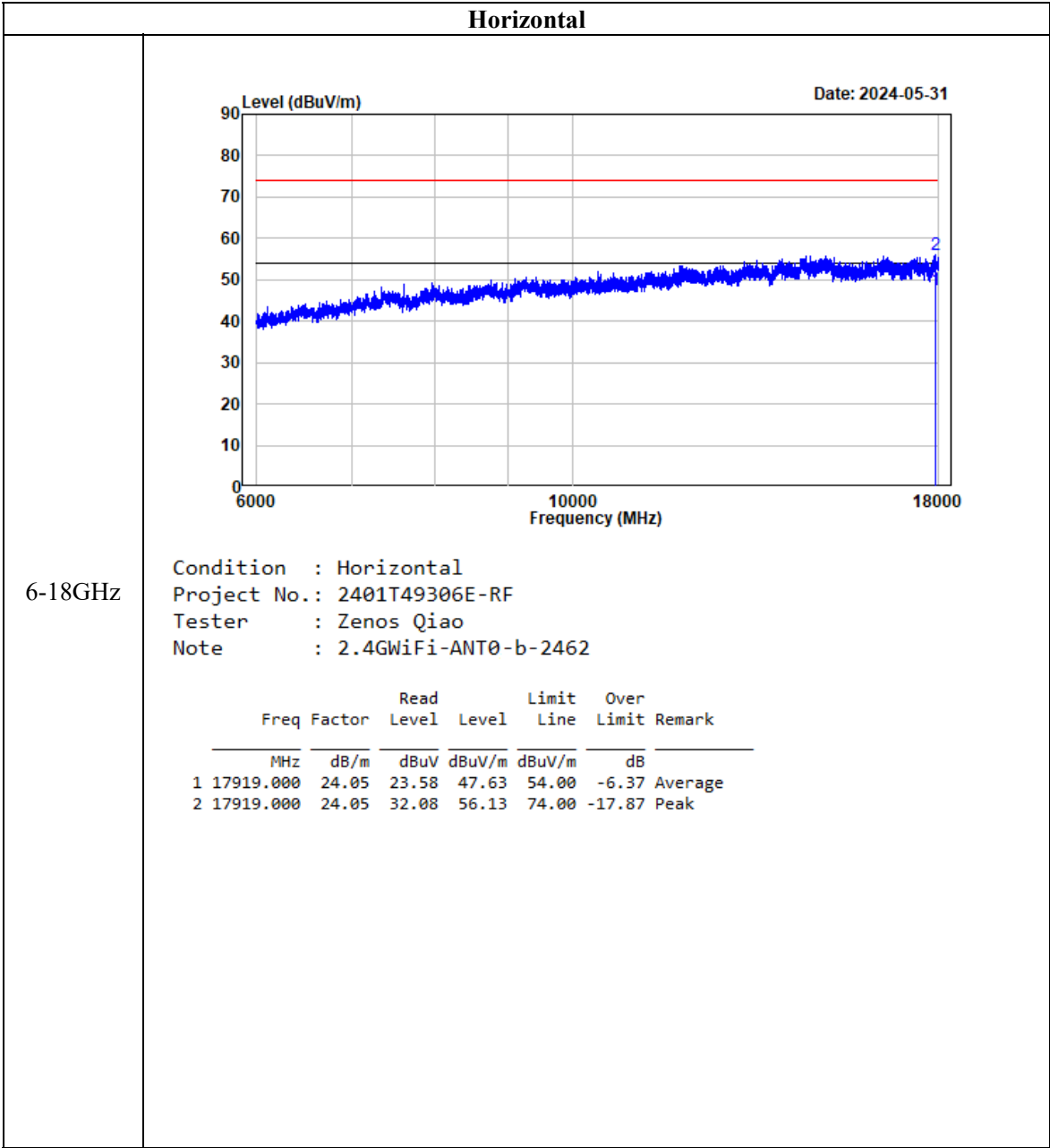


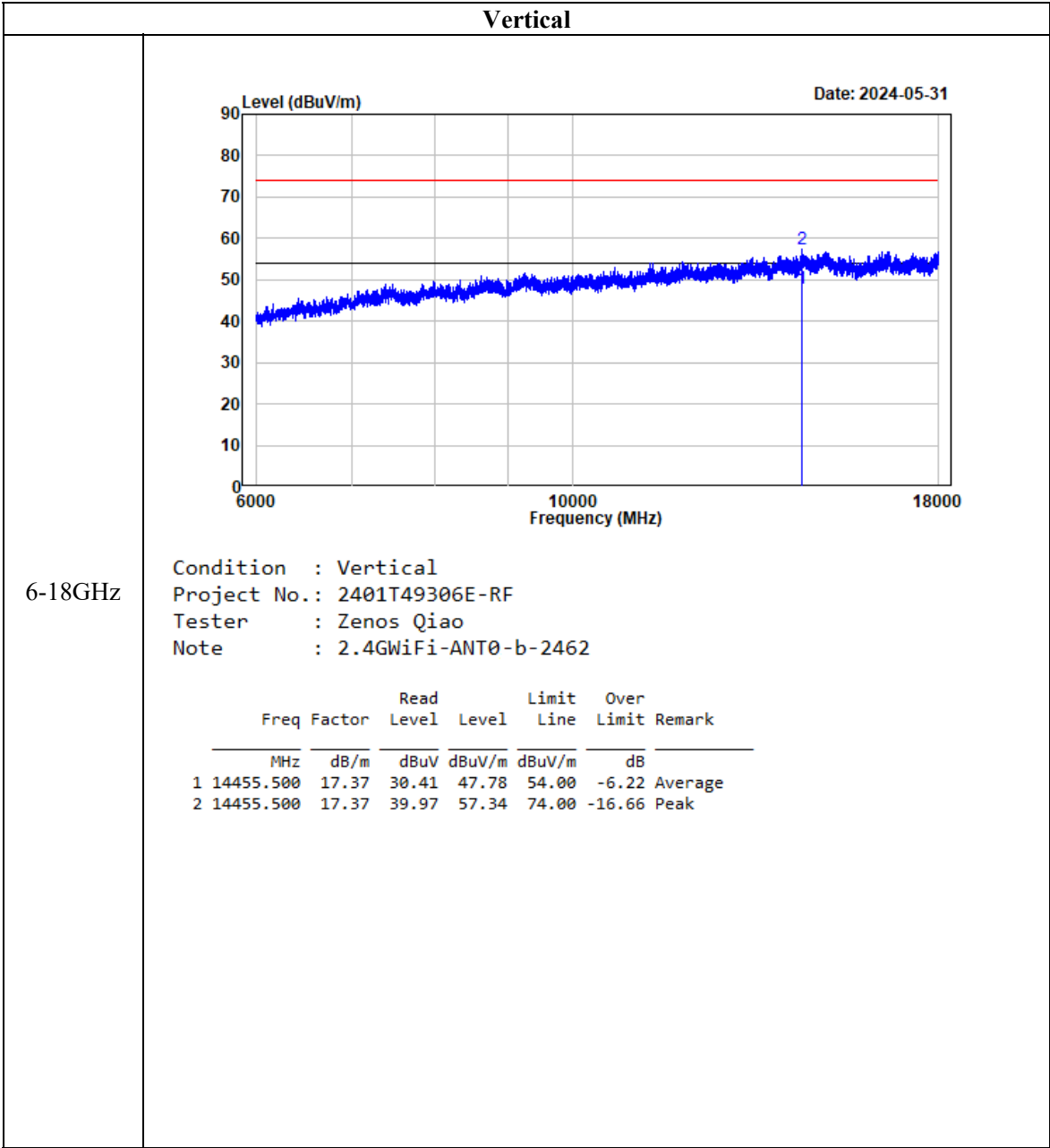


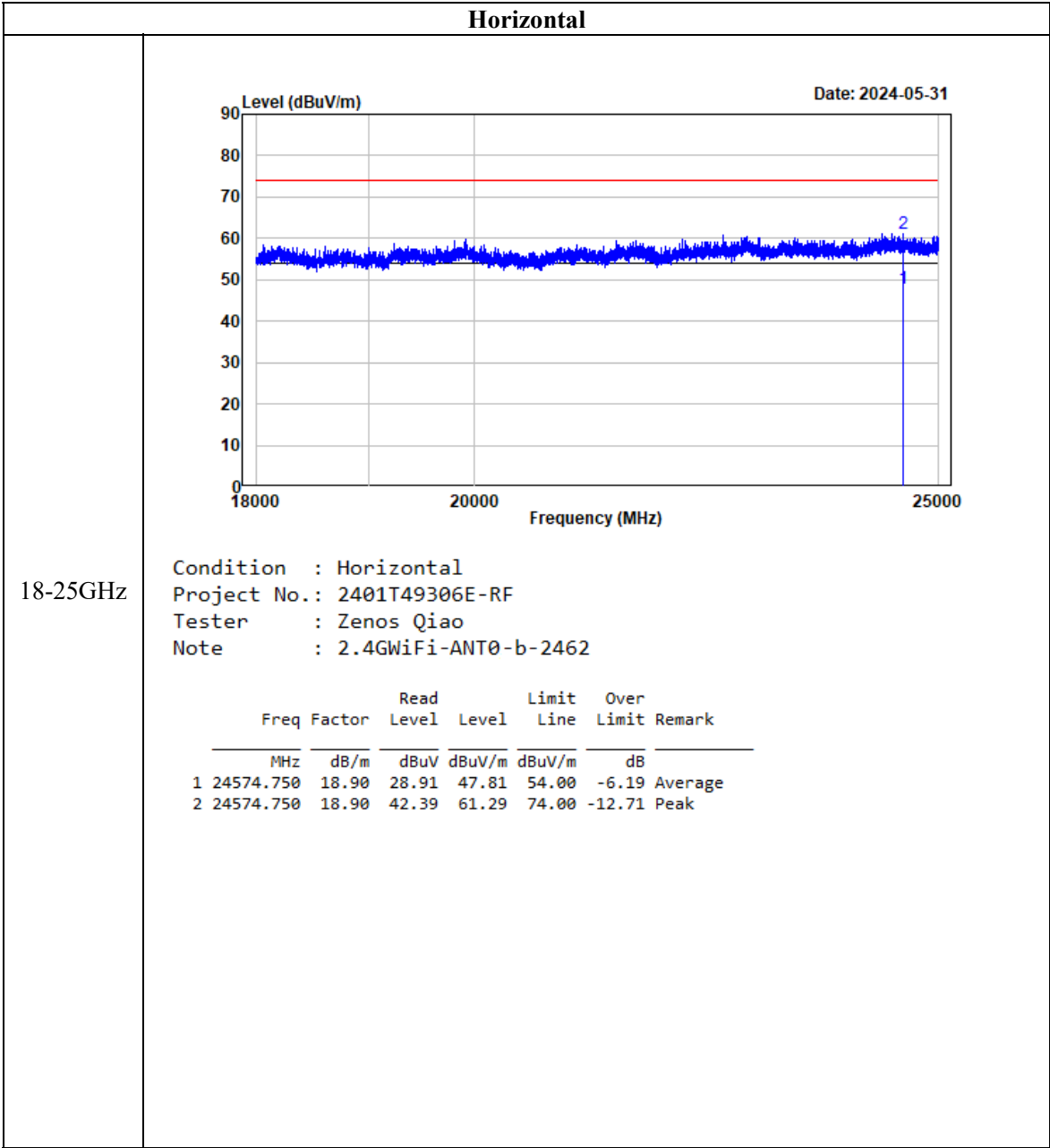
Test plots for Harmonic and Emissions Measurements:

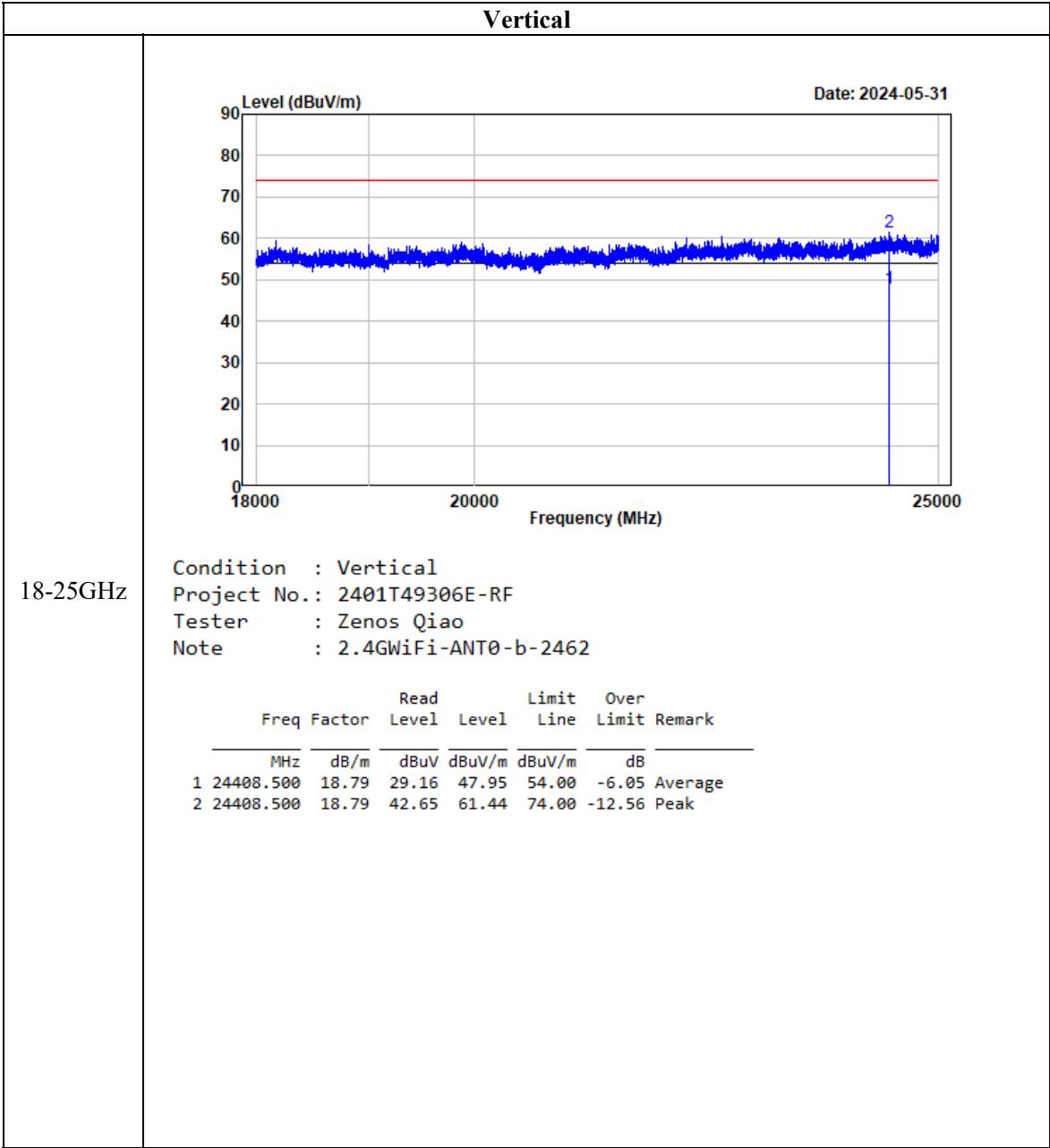












§15.247 (a)(2) & RSS-Gen§6.7 & RSS-247 § 5.2 (a) 99% OCCUPIED BANDWIDTH & 6 dB EMISSION BANDWIDTH

Applicable Standard

Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

The occupied bandwidth or the “99% emission bandwidth” is defined as the frequency range between two points, one above and the other below the carrier frequency, within which 99% of the total transmitted power of the fundamental transmitted emission is contained. The occupied bandwidth shall be reported for all equipment in addition to the specified bandwidth required in the applicable RSSs.

In some cases, the “6 dB bandwidth” is required, which is defined as the frequency range between two points, one at the lowest frequency below and one at the highest frequency above the carrier frequency, at which the maximum power level of the transmitted emission is attenuated 6 dB below the maximum in-band power level of the modulated signal, where the two points are on the outskirts of the in-band emission.

Test Procedure

Test Method: ANSI C63.10-2013 section 11.8&6.9.3

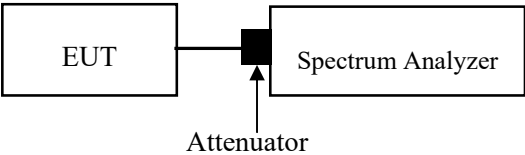
1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Position the EUT without connection to measurement instrument. Turn on the EUT and connect it to measurement instrument. Then set it to any one convenient frequency within its operating range. Set a reference level on the measuring instrument equal to the highest peak value.
3. Measure the frequency difference of two frequencies that were attenuated 6 dB from the reference level. Record the frequency difference as the emission bandwidth.
4. Repeat above procedures until all frequencies measured were complete.

The following conditions shall be observed for measuring the occupied bandwidth and 6 dB bandwidth:

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
- The detector of the spectrum analyzer shall be set to “Sample”. However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or “Max Hold”) may be necessary to determine the occupied / 6 dB bandwidth if the device is not transmitting continuously.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / 6 dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

Note: It may be necessary to repeat the measurement a few times until the RBW and VBW are in Compliant with the above requirement.

For the 99% emission bandwidth, the trace data points are recovered and directly summed in linear power level terms. The recovered amplitude data points, beginning at the lowest frequency, are placed in a running sum until 0.5% of the total is reached, and that frequency recorded. The process is repeated for the highest frequency data points (starting at the highest frequency, at the right side of the span, and going down in frequency). This frequency is then recorded. The difference between the two recorded frequencies is the occupied bandwidth (or the 99% emission bandwidth).



Test Data

Environmental Conditions

Temperature:	23.6~25.5 °C
Relative Humidity:	52~58 %
ATM Pressure:	101 kPa

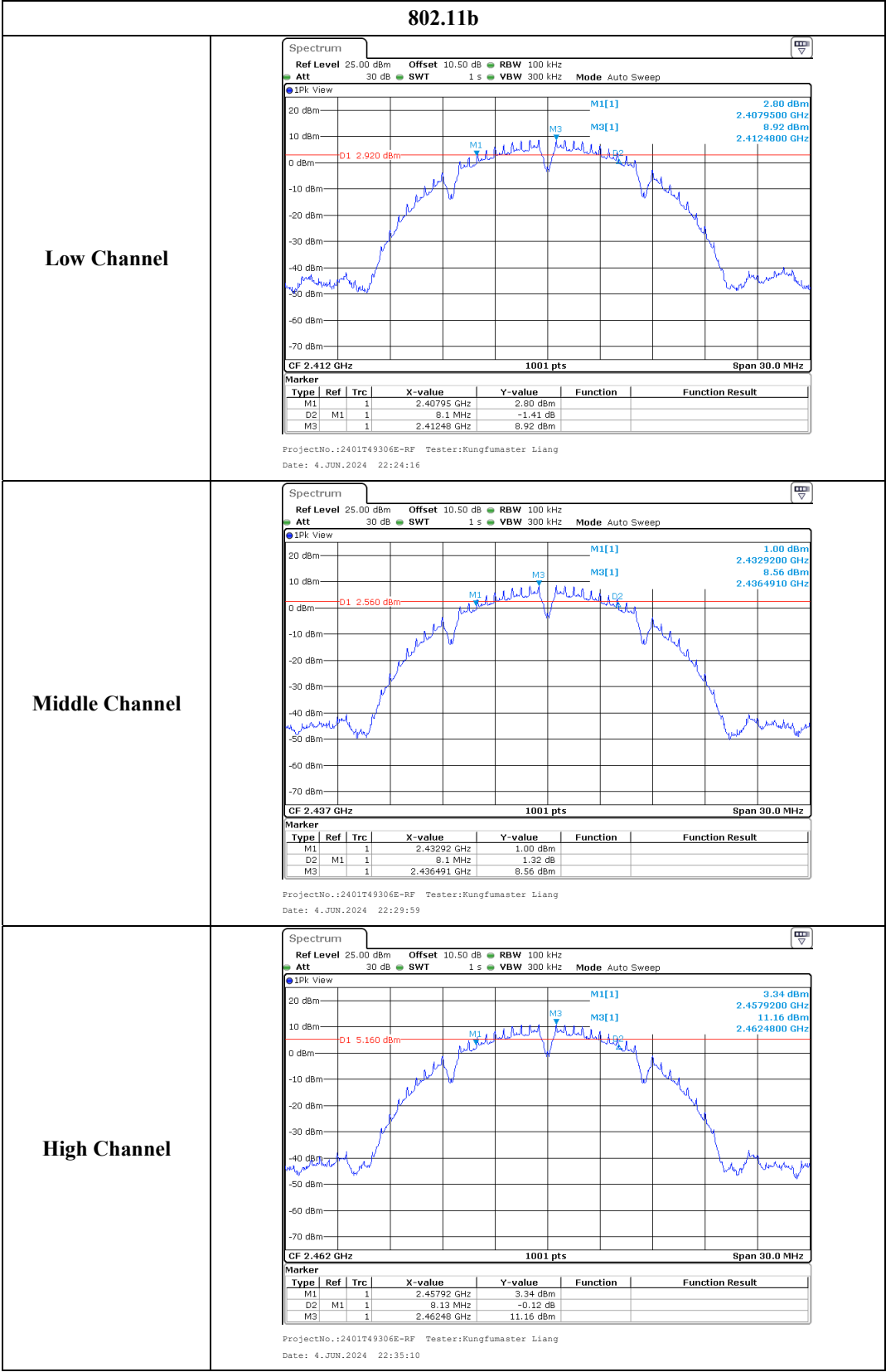
The testing was performed by KungfuMaster Liang from 2024-06-04 to 2024-06-06.

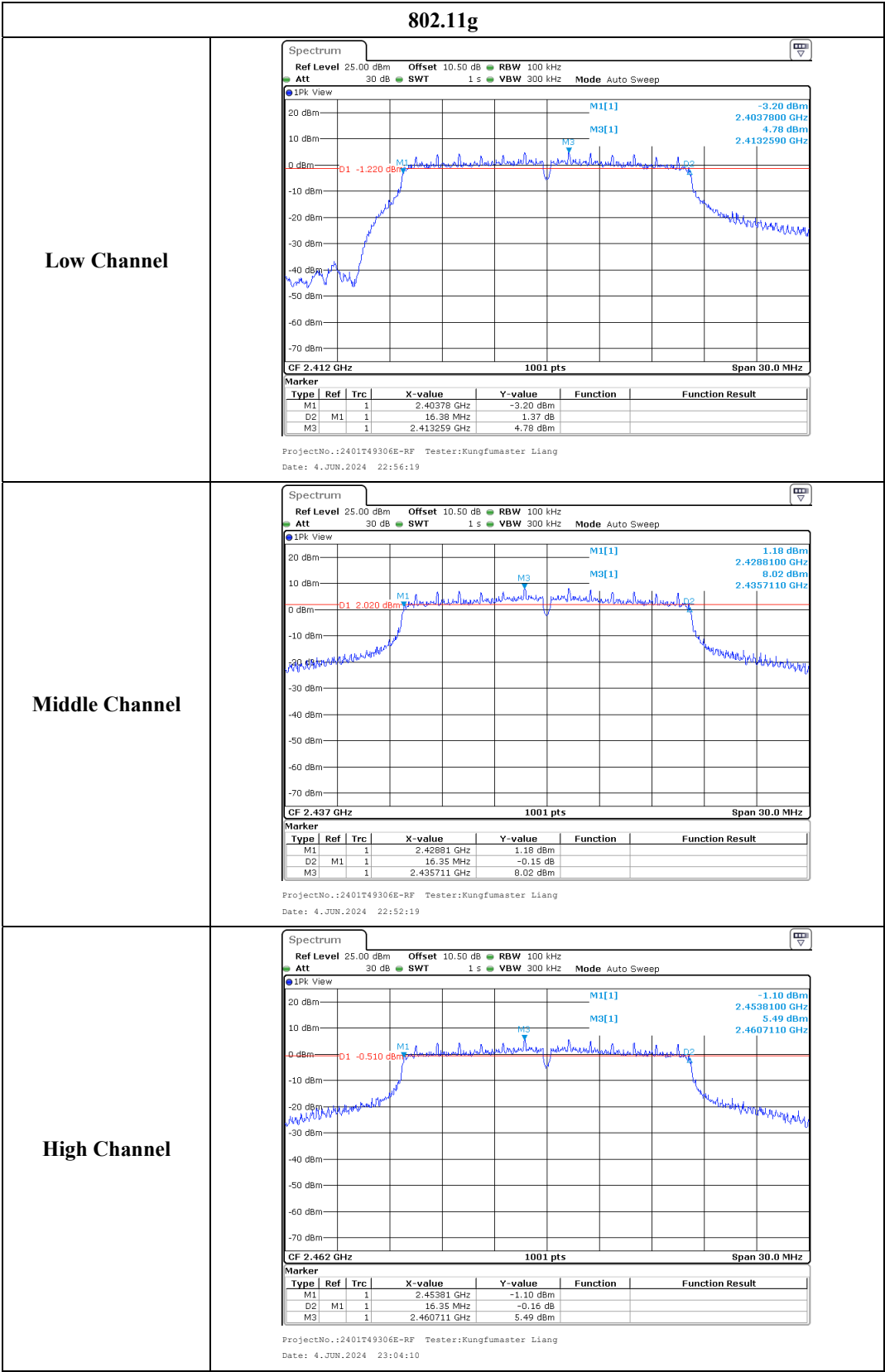
EUT operation mode: Transmitting

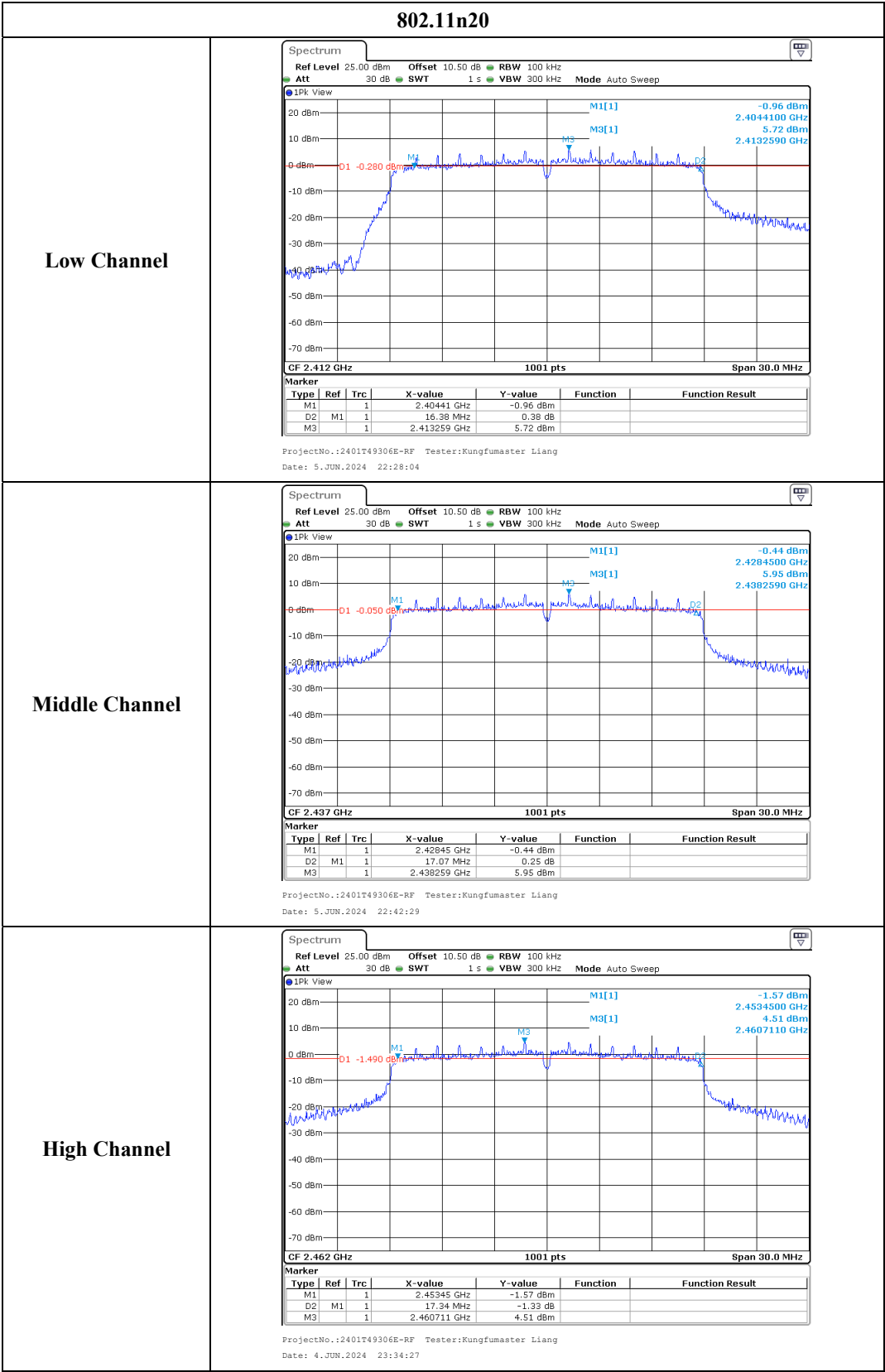
Test Result: Compliant.

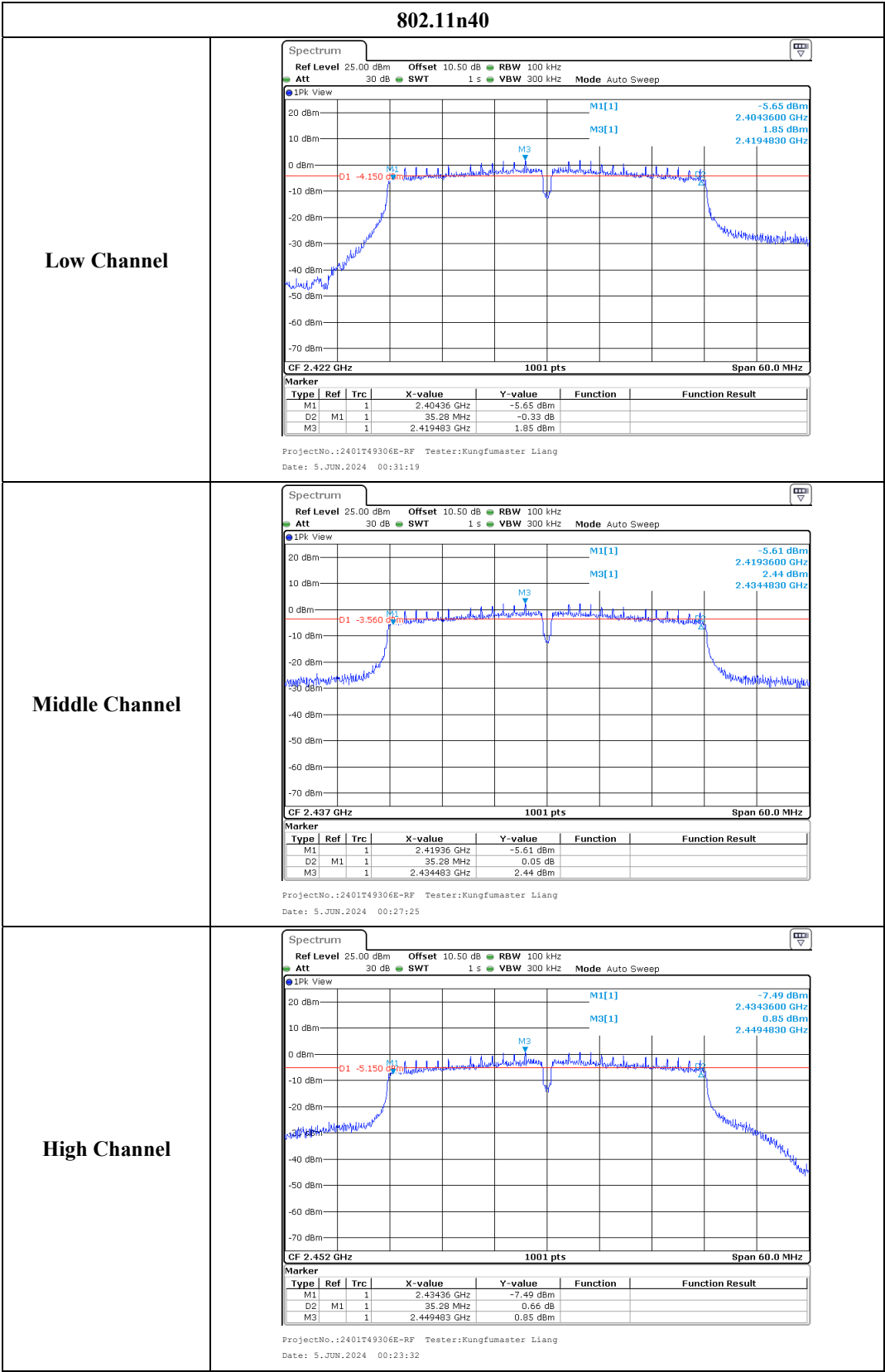
Test Modes	Test Frequency (MHz)	6 dB Bandwidth (MHz)	99% Occupied Bandwidth (MHz)	Limit (MHz)
802.11b	2412	8.10	12.707	0.5
	2437	8.10	12.747	0.5
	2462	8.13	12.707	0.5
802.11g	2412	16.38	17.303	0.5
	2437	16.35	17.463	0.5
	2462	16.35	17.263	0.5
802.11n-HT20	2412	16.38	18.262	0.5
	2437	17.07	18.462	0.5
	2462	17.34	18.342	0.5
802.11n-HT40	2422	35.28	36.683	0.5
	2437	35.28	36.763	0.5
	2452	35.28	36.683	0.5
802.11ax-HE20	2412	18.87	18.941	0.5
	2437	18.72	19.221	0.5
	2462	18.72	19.261	0.5
802.11ax-HE40	2422	37.38	37.642	0.5
	2437	36.60	37.802	0.5
	2452	37.50	37.722	0.5
Note: Test only was performed at ANT 0.				

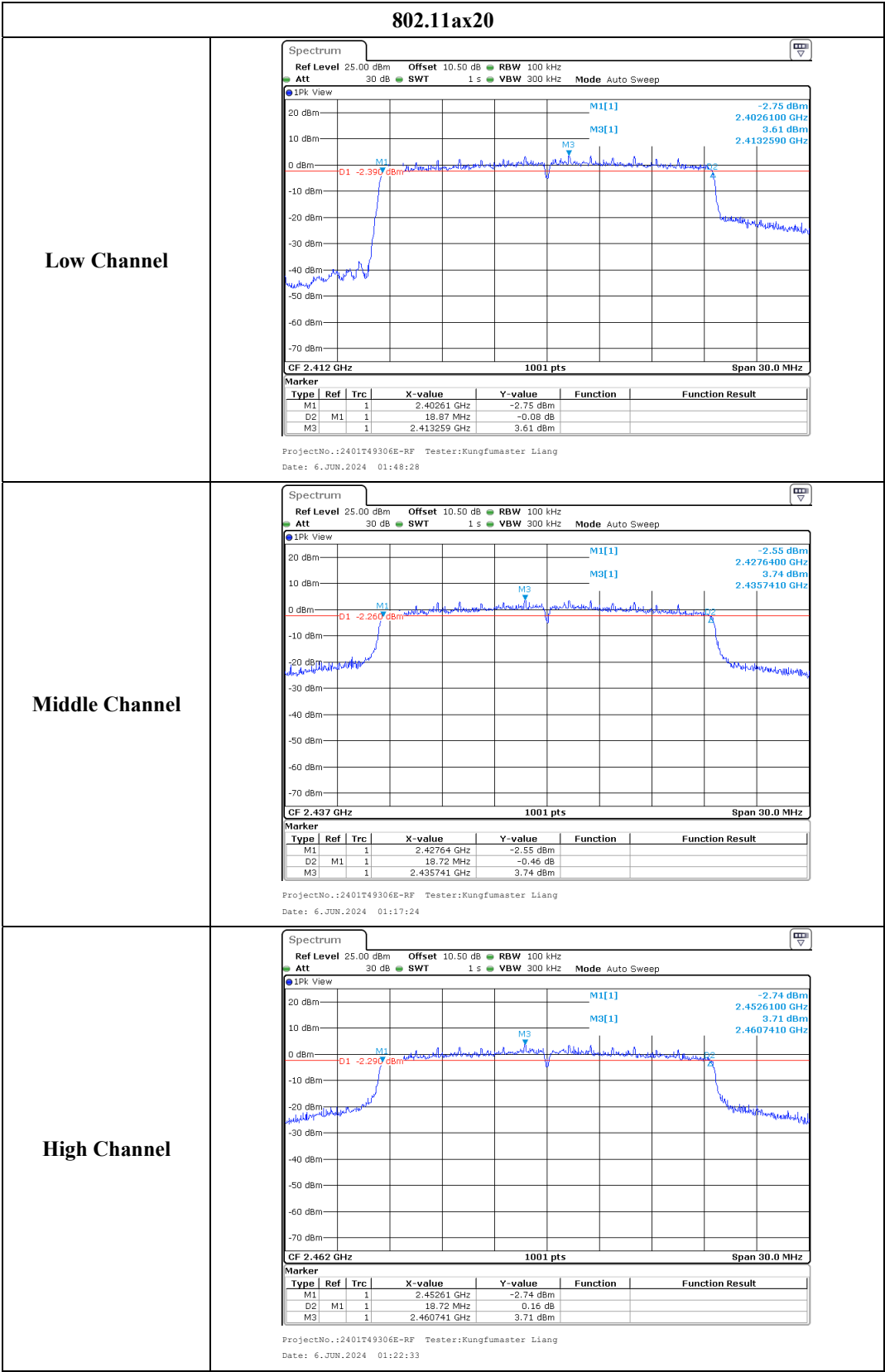
6 dB Bandwidth

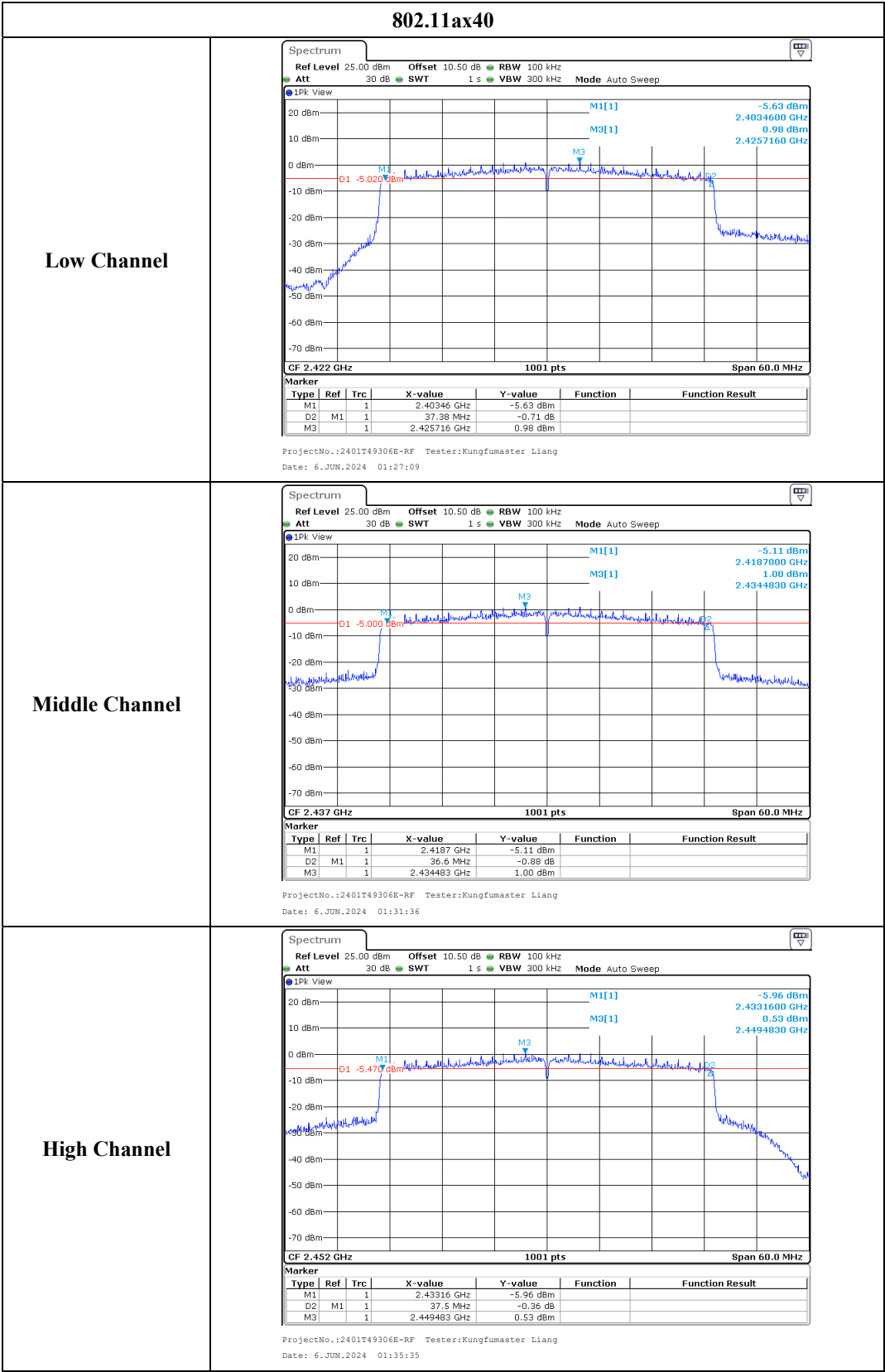




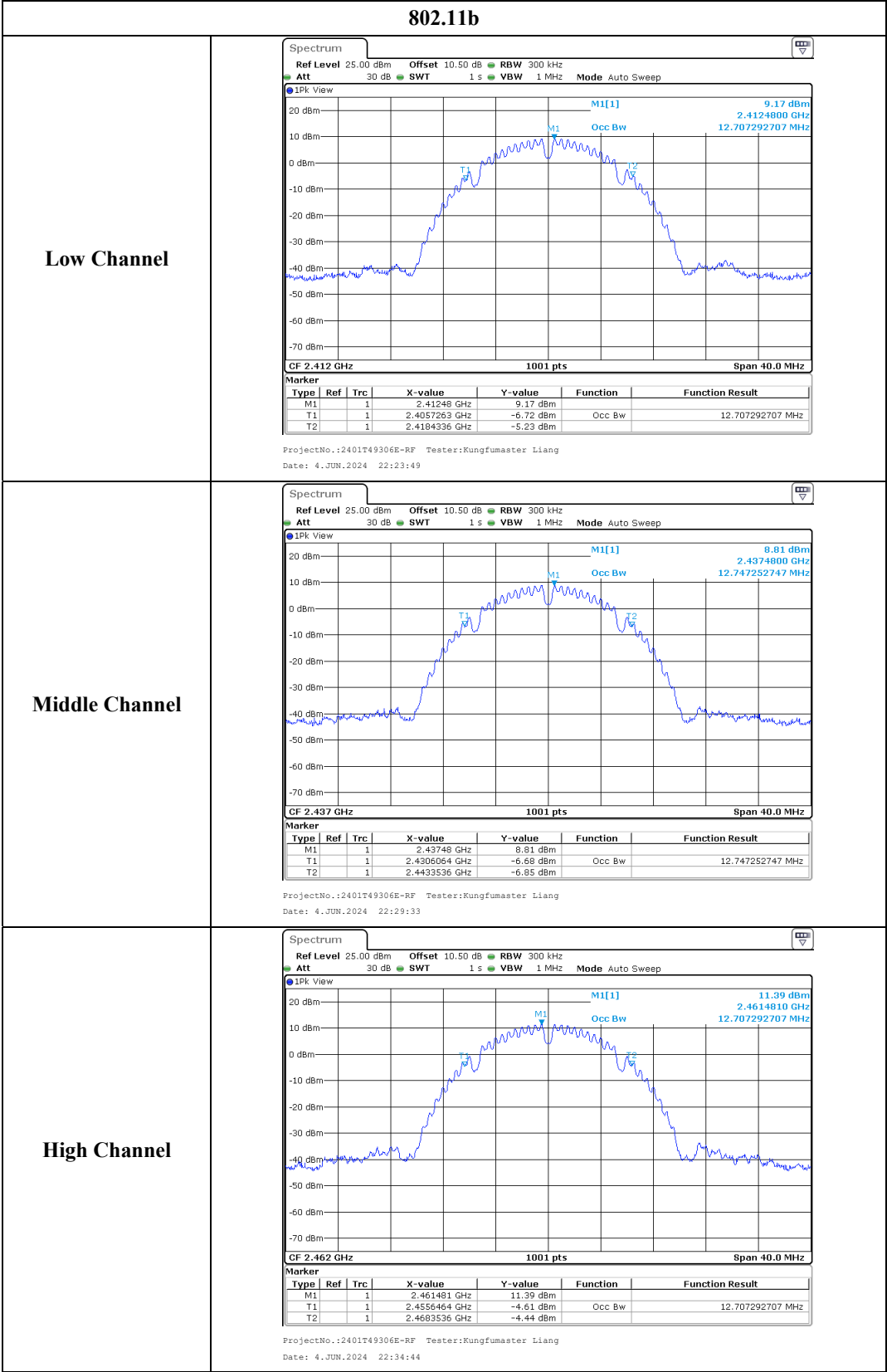


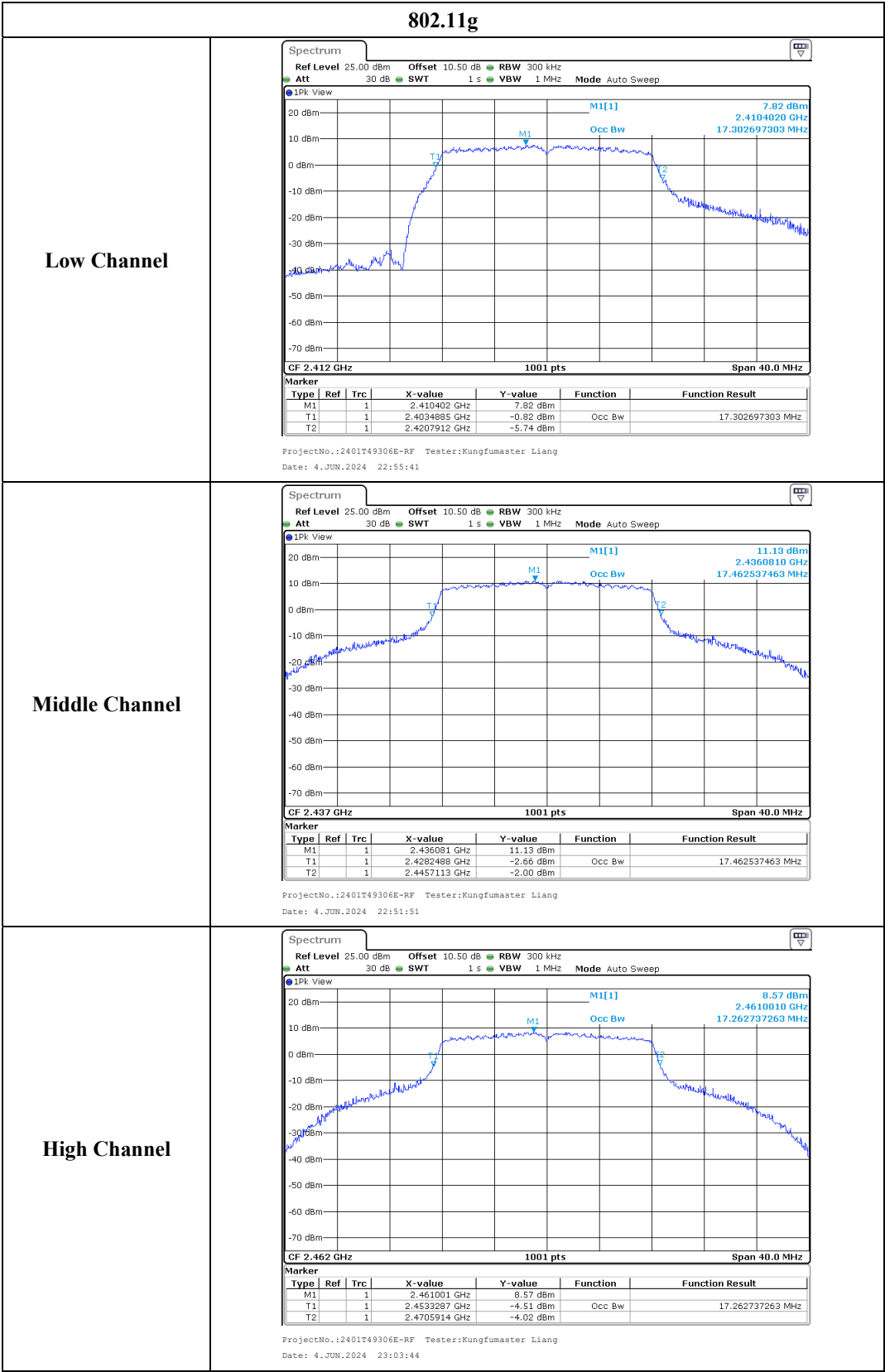


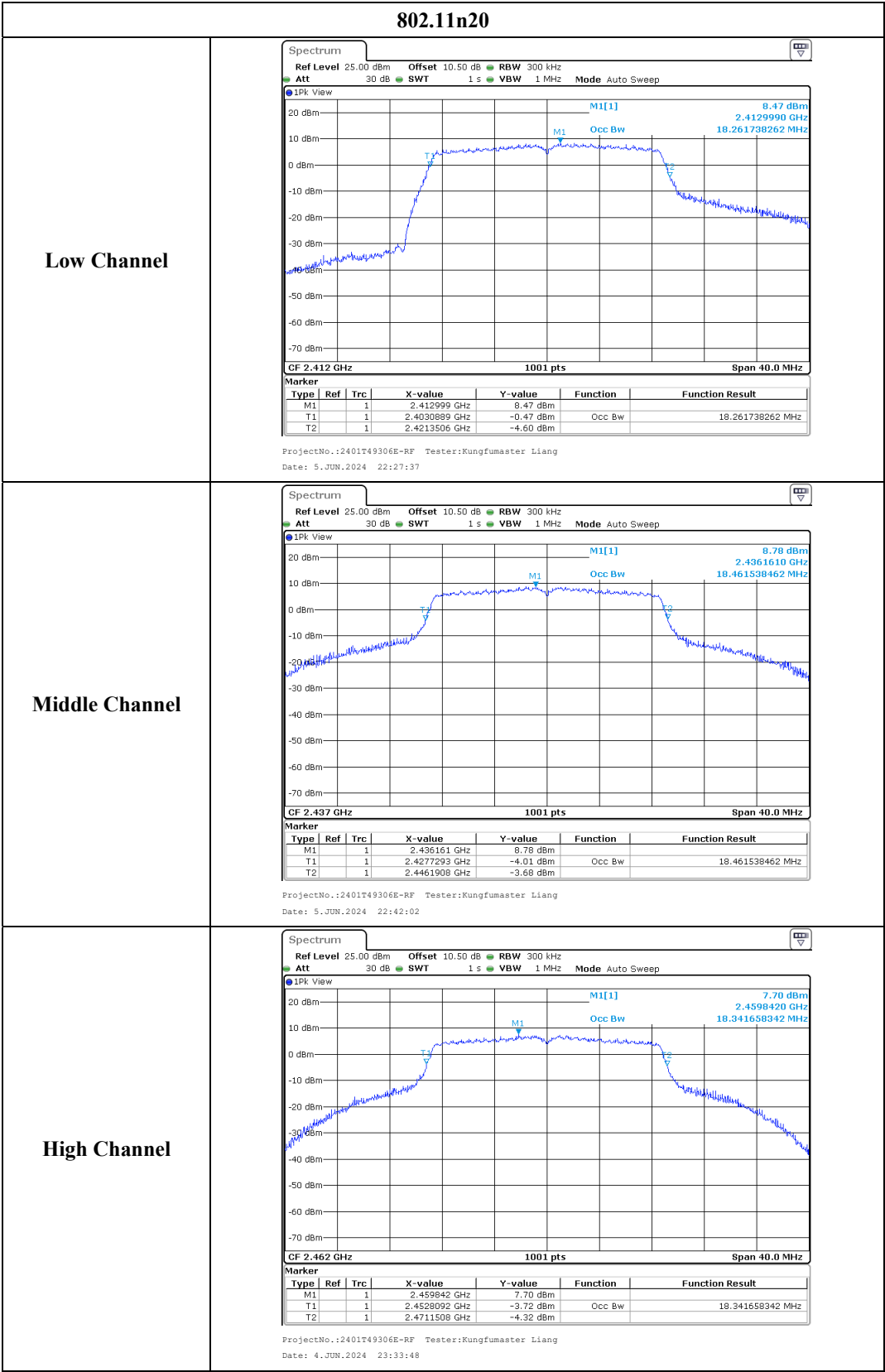


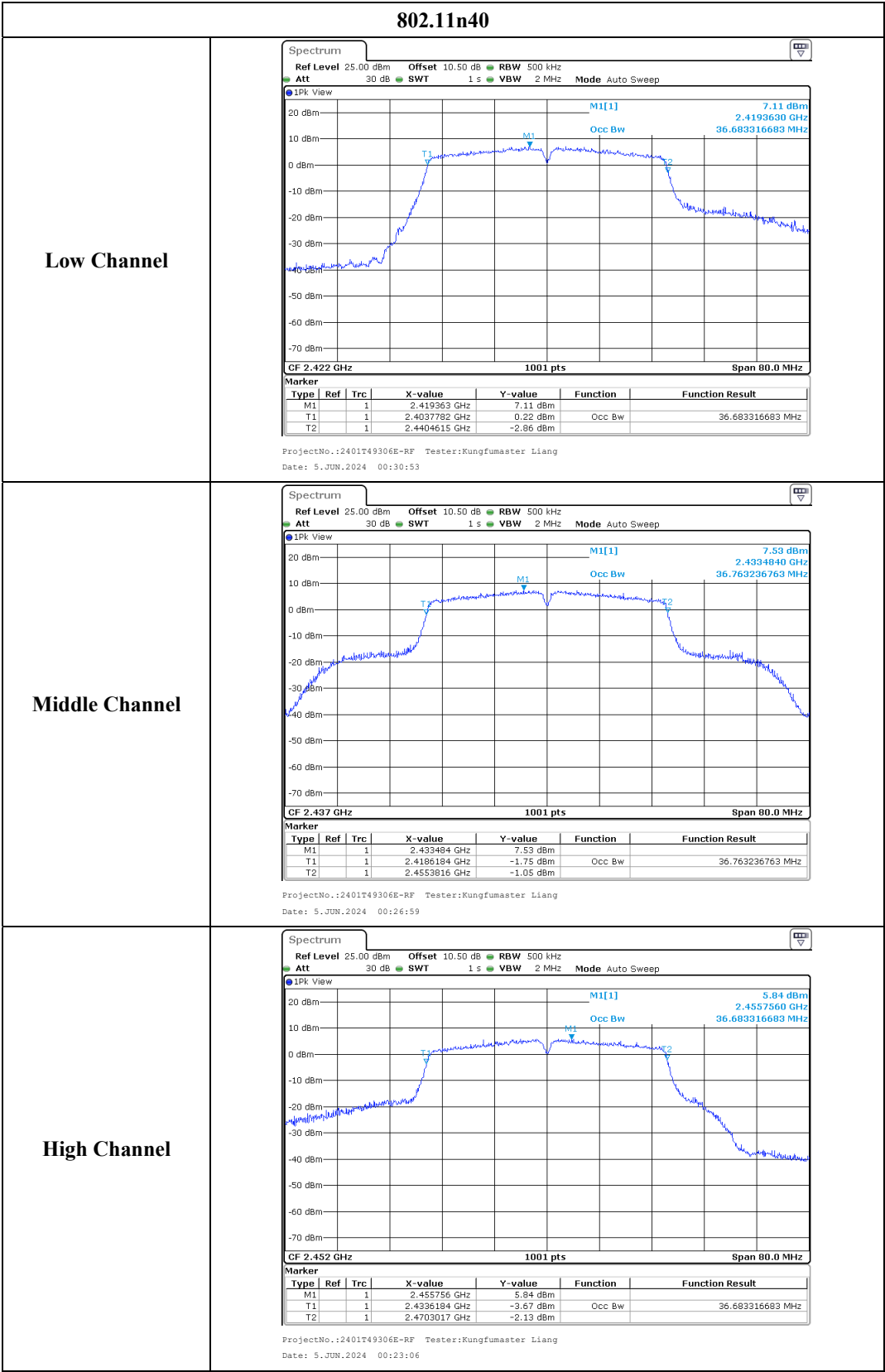


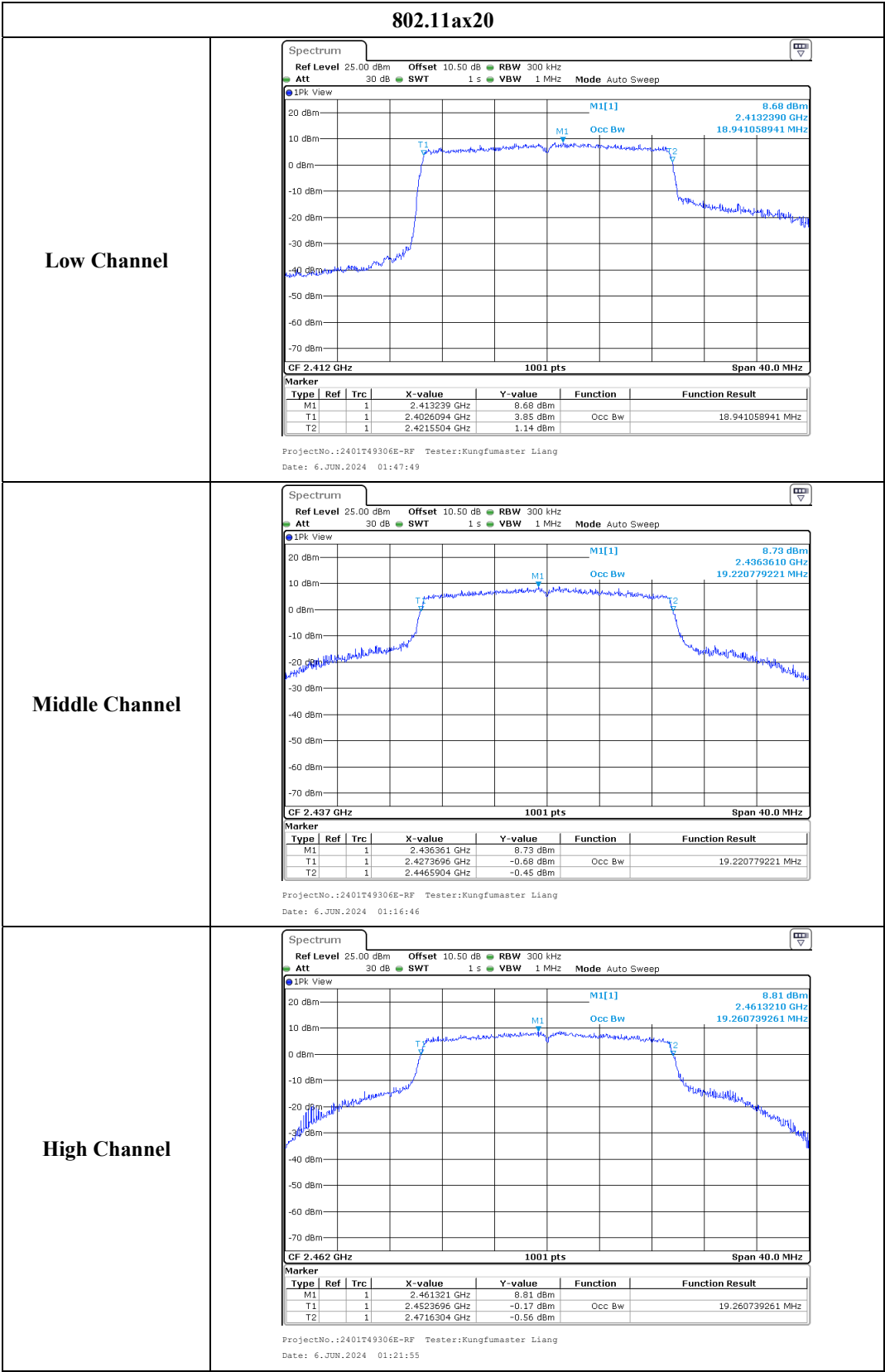
99% Occupied Bandwidth

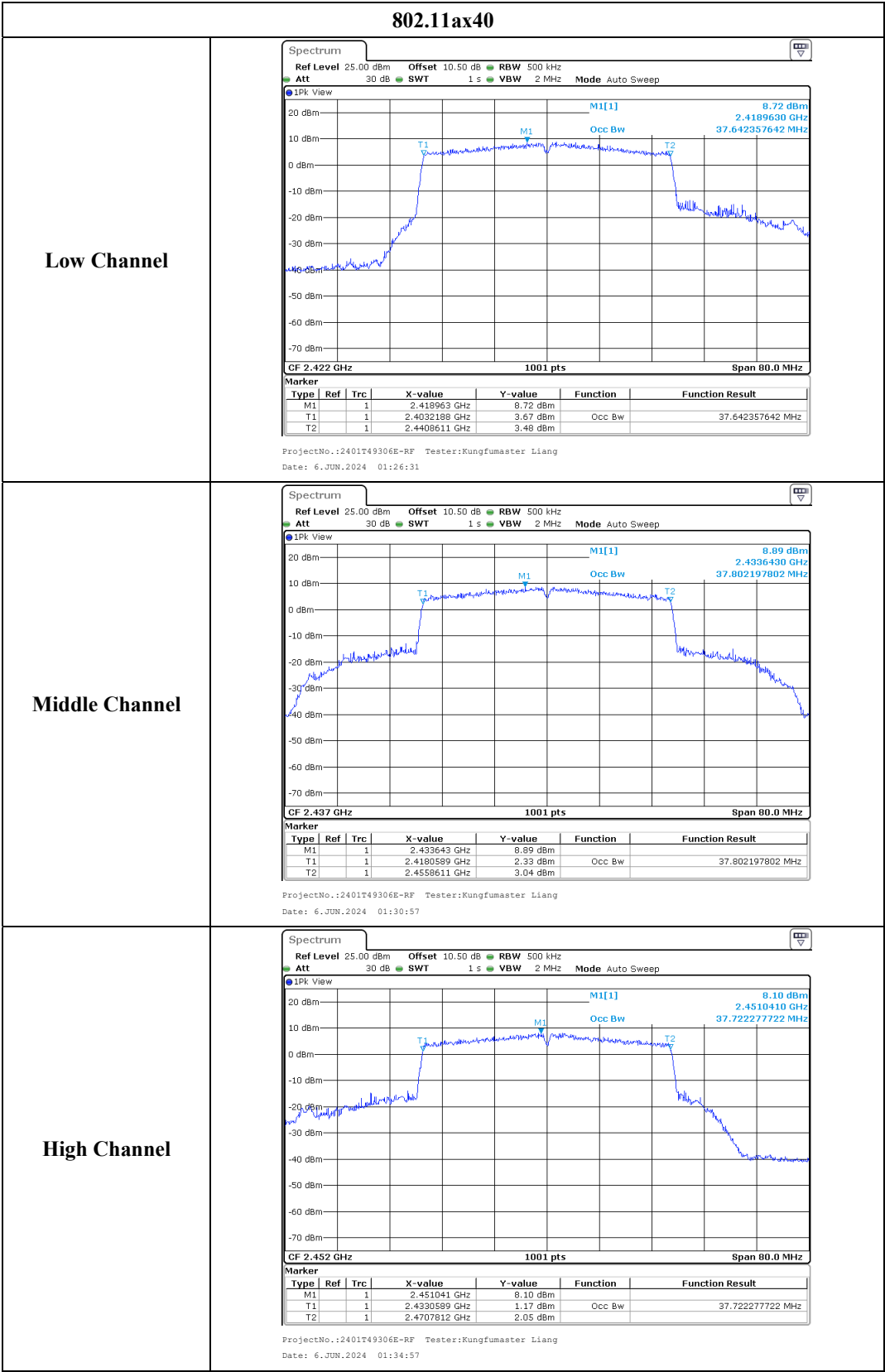












§15.247(b)(3) & RSS-247 § 5.4(d) MAXIMUM CONDUCTED OUTPUT POWER

Applicable Standard

According to FCC §15.247(b) (3), for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, Compliant with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted Output Power is defined as the total transmit power delivered to all antennas and antenna elements averaged across all symbols in the signaling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or is transmitting at a reduced power level. If multiple modes of operation are possible (e.g., alternative modulation methods), the maximum conducted output power is the highest total transmit power occurring in any mode.

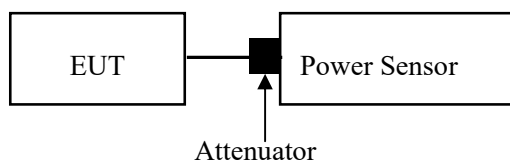
For DTSs employing digital modulation techniques operating in the bands 902-928 MHz and 2400-2483.5 MHz, the maximum peak conducted output power shall not exceed 1 W. The e.i.r.p. shall not exceed 4 W, except as provided in section 5.4(e).

As an alternative to a peak power measurement, Compliant can be based on a measurement of the maximum conducted output power. The maximum conducted output power is the total transmit power delivered to all antennas and antenna elements, averaged across all symbols in the signalling alphabet when the transmitter is operating at its maximum power control level. Power must be summed across all antennas and antenna elements. The average must not include any time intervals during which the transmitter is off or transmitting at a reduced power level. If multiple modes of operation are implemented, the maximum conducted output power is the highest total transmit power occurring in any mode.

Test Procedure

Test Method: ANSI C63.10-2013 section 11.9.1.3

- Place the EUT on a bench and set it in transmitting mode.
- Remove the antenna from the EUT and then connect a low loss RF cable from the antenna port to one test equipment.
- Add a correction factor to the display.



Test Data

Environmental Conditions

Temperature:	23.6~25.5 °C
Relative Humidity:	52~58 %
ATM Pressure:	101 kPa

The testing was performed by KungfuMaster Liang from 2024-06-04 to 2024-06-06.

EUT operation mode: Transmitting

Test Result: Compliant.

Test Modes	Test Frequency (MHz)	Maximum Conducted Peak Output Power (dBm)			Limit (dBm)
		ANT 0	ANT 1	Total	
802.11b	2412	19.96	17.85	/	30
	2437	19.63	17.46	/	30
	2462	22.17	17.87	/	30
802.11g	2412	23.99	27.67	/	30
	2437	27.10	29.01	/	30
	2462	24.64	26.25	/	30
802.11n20	2412	24.69	26.43	28.66	29.15
	2437	24.88	26.56	28.81	29.15
	2462	23.59	25.39	27.59	29.15
802.11n40	2422	23.70	25.40	27.64	29.15
	2437	24.29	25.93	28.20	29.15
	2452	22.75	24.39	26.66	29.15
802.11ax20	2412	24.82	26.10	28.52	29.15
	2437	24.91	26.12	28.57	29.15
	2462	24.90	26.11	28.56	29.15
802.11ax40	2422	24.86	26.14	28.56	29.15
	2437	25.03	26.14	28.63	29.15
	2452	24.56	25.67	28.16	29.15
Note: The device employed Beam-forming for 802.11 MIMO transmitting, per KDB 662911 D01 Multiple Transmitter Output v02r01, for power measurements on IEEE 802.11 devices: Array Gain = 10 log(N _{ANT} /N _{SS}) dB					
Antenna Gain:	3.85	dB _i	Directional gain:	6.85	dB _i
Maximum EIRP	35.66	dBm	EIRP Limit for RSS-247	36	dBm

§15.247(d) & RSS-247 § 5.5 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

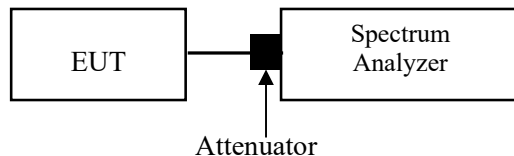
Applicable Standard

In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates Compliant 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 paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions 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) (see §15.205(c)).

Test Procedure

Test Method: ANSI C63.10-2013 section 11.11

- Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
- Position the EUT without connection to measurement instrument. Turn on the EUT and connect its antenna terminal to measurement instrument via a low loss cable. Then set it to any one measured frequency within its operating range, and make sure the instrument is operated in its linear range.
- Set RBW to 100 kHz and VBW of spectrum analyzer to 300 kHz with a convenient frequency span including 100 kHz bandwidth from band edge.
- Measure the highest amplitude appearing on spectral display and set it as a reference level. Plot the graph with marking the highest point and edge frequency.
- Repeat above procedures until all measured frequencies were complete.



Test Data

Environmental Conditions

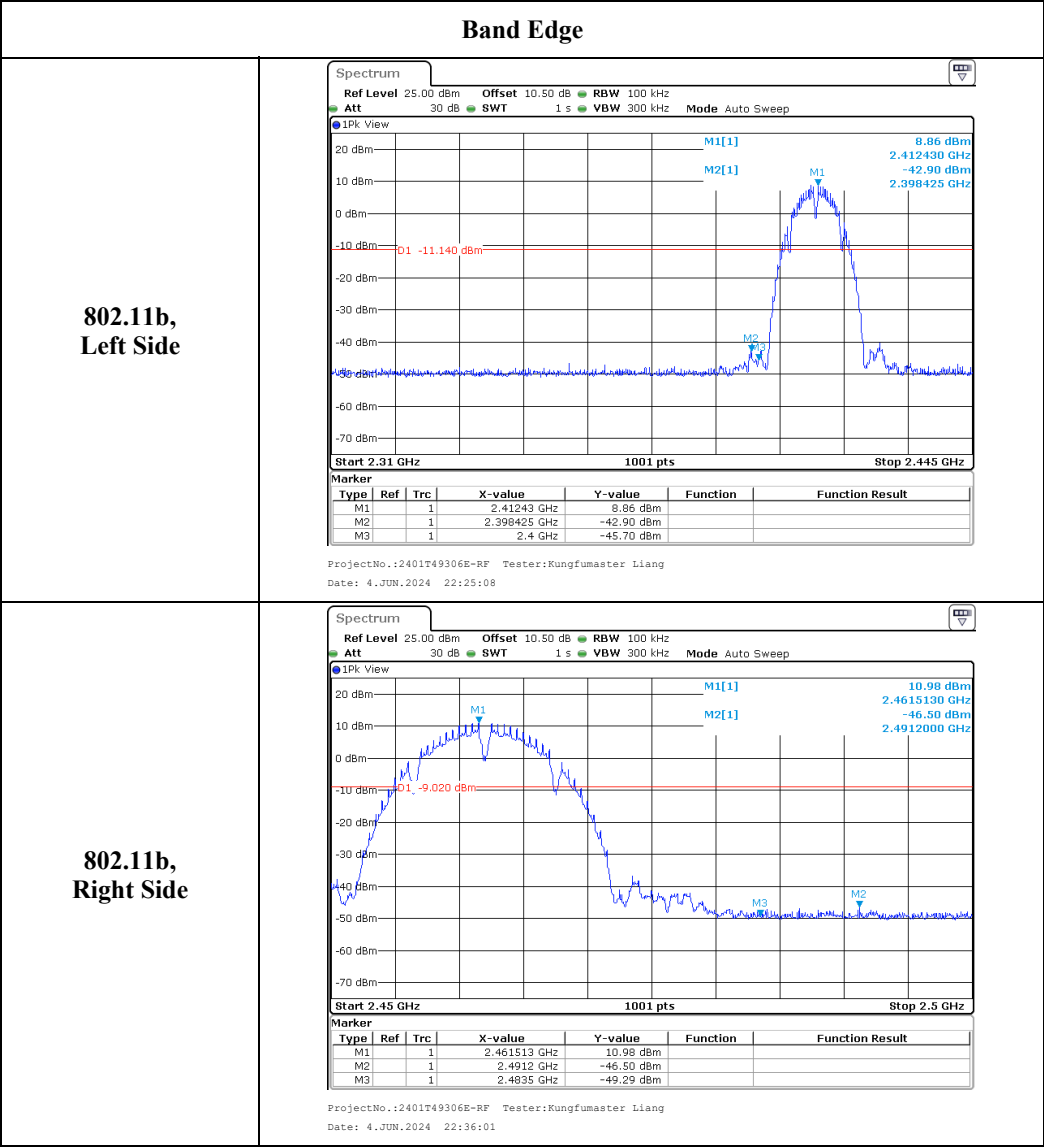
Temperature:	23.6~25.5 °C
Relative Humidity:	52~58 %
ATM Pressure:	101 kPa

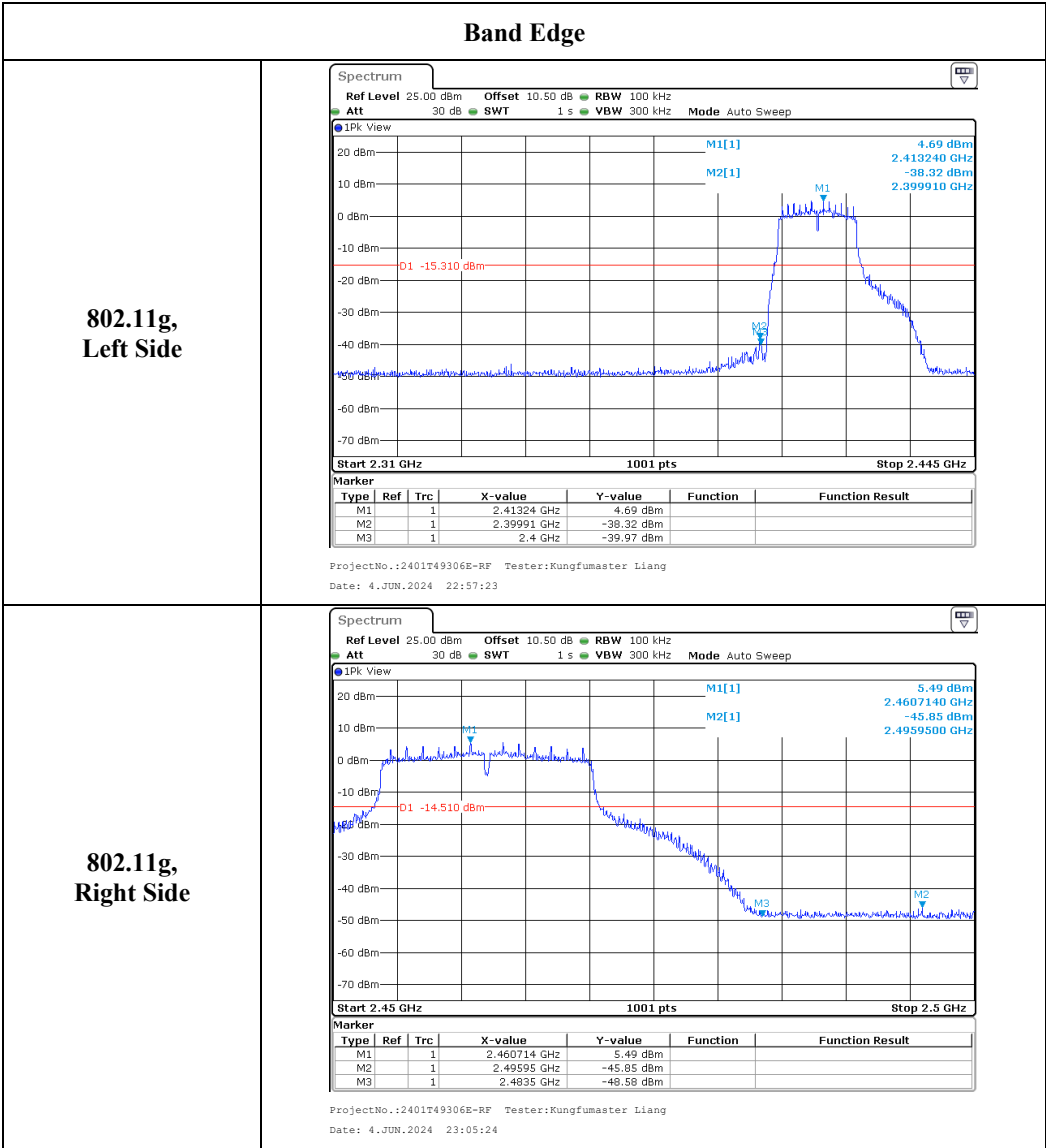
The testing was performed by KungfuMaster Liang from 2024-06-04 to 2024-06-06.

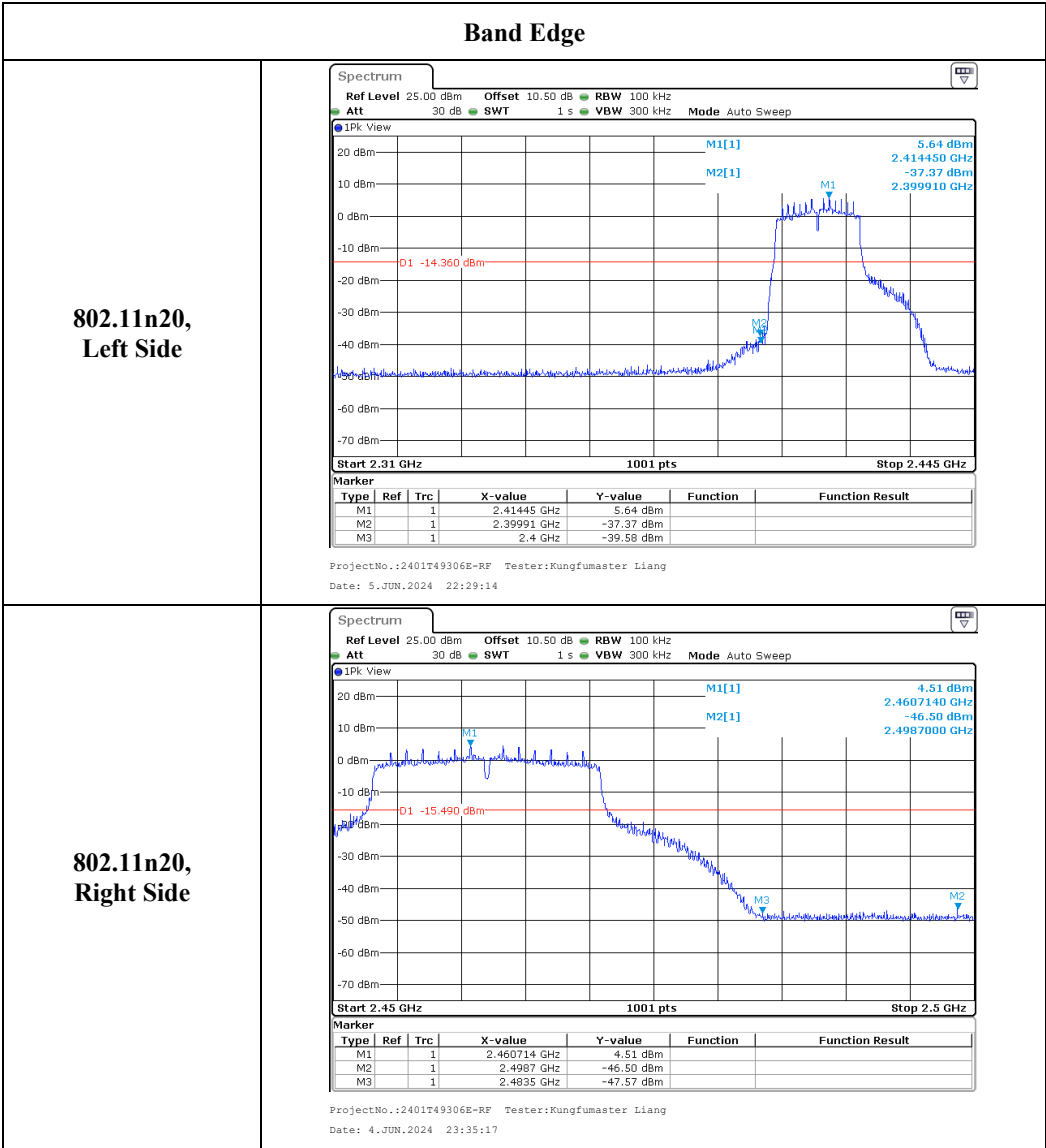
EUT operation mode: Transmitting

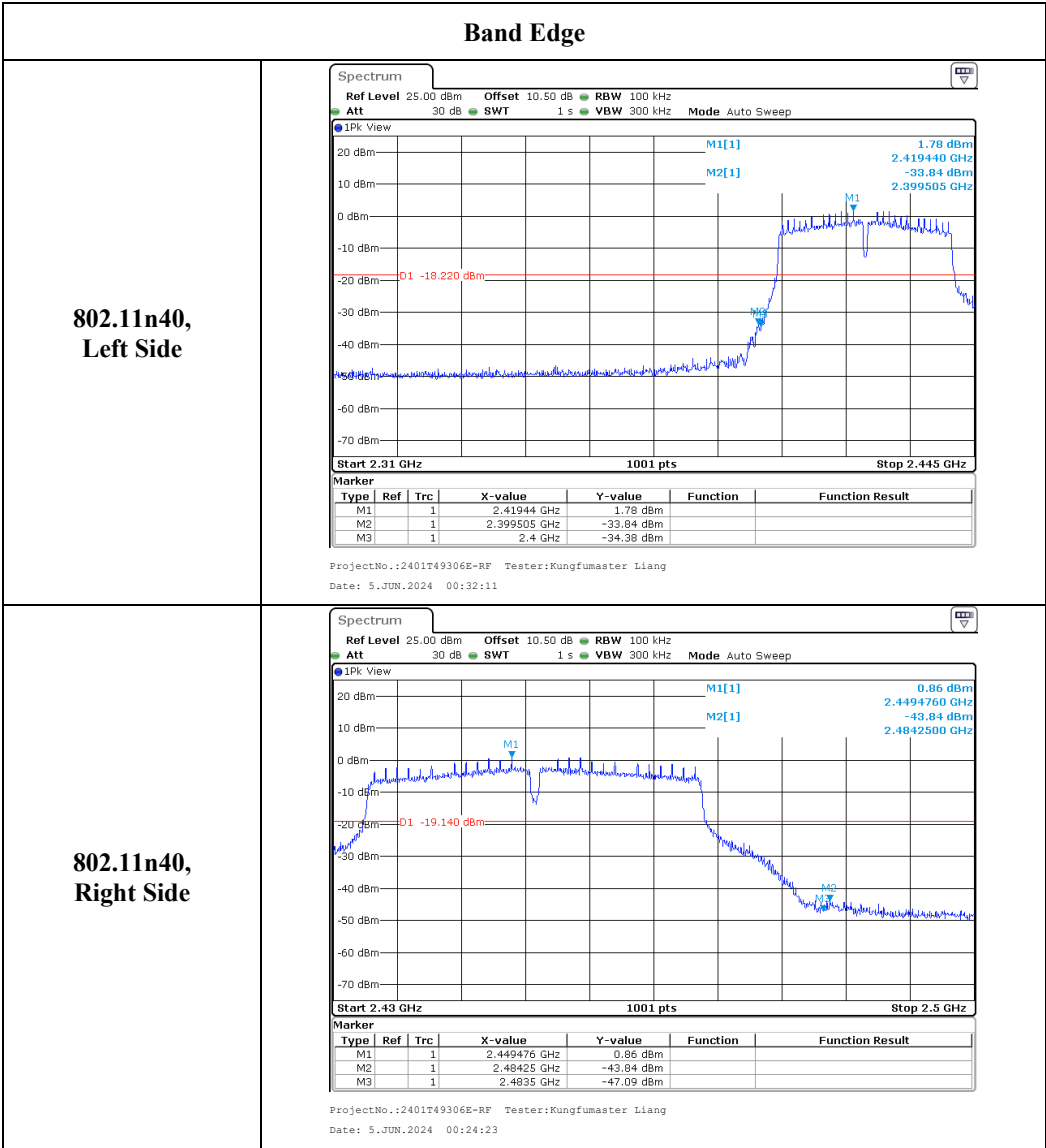
Test Result: Compliant.

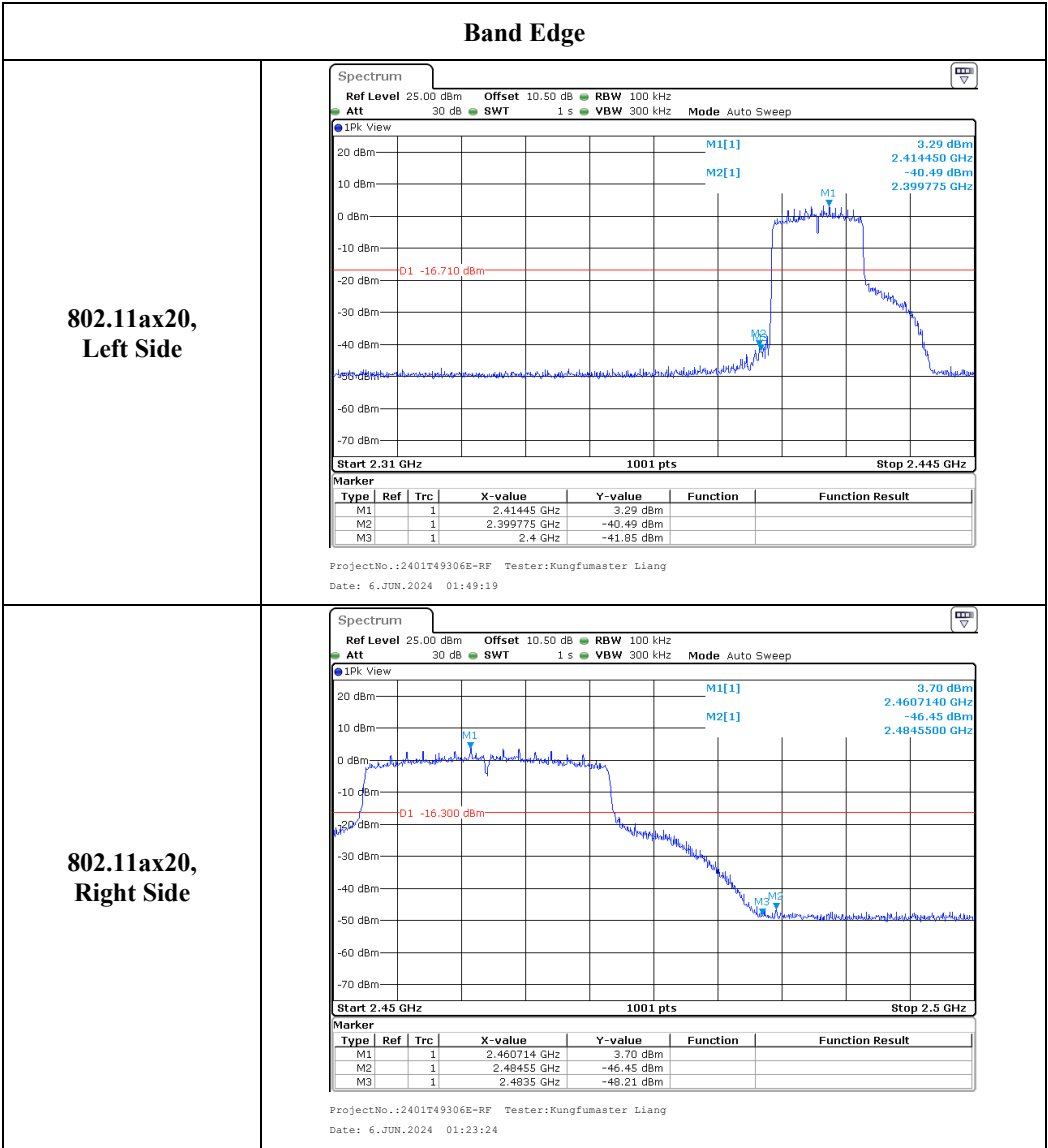
ANT0

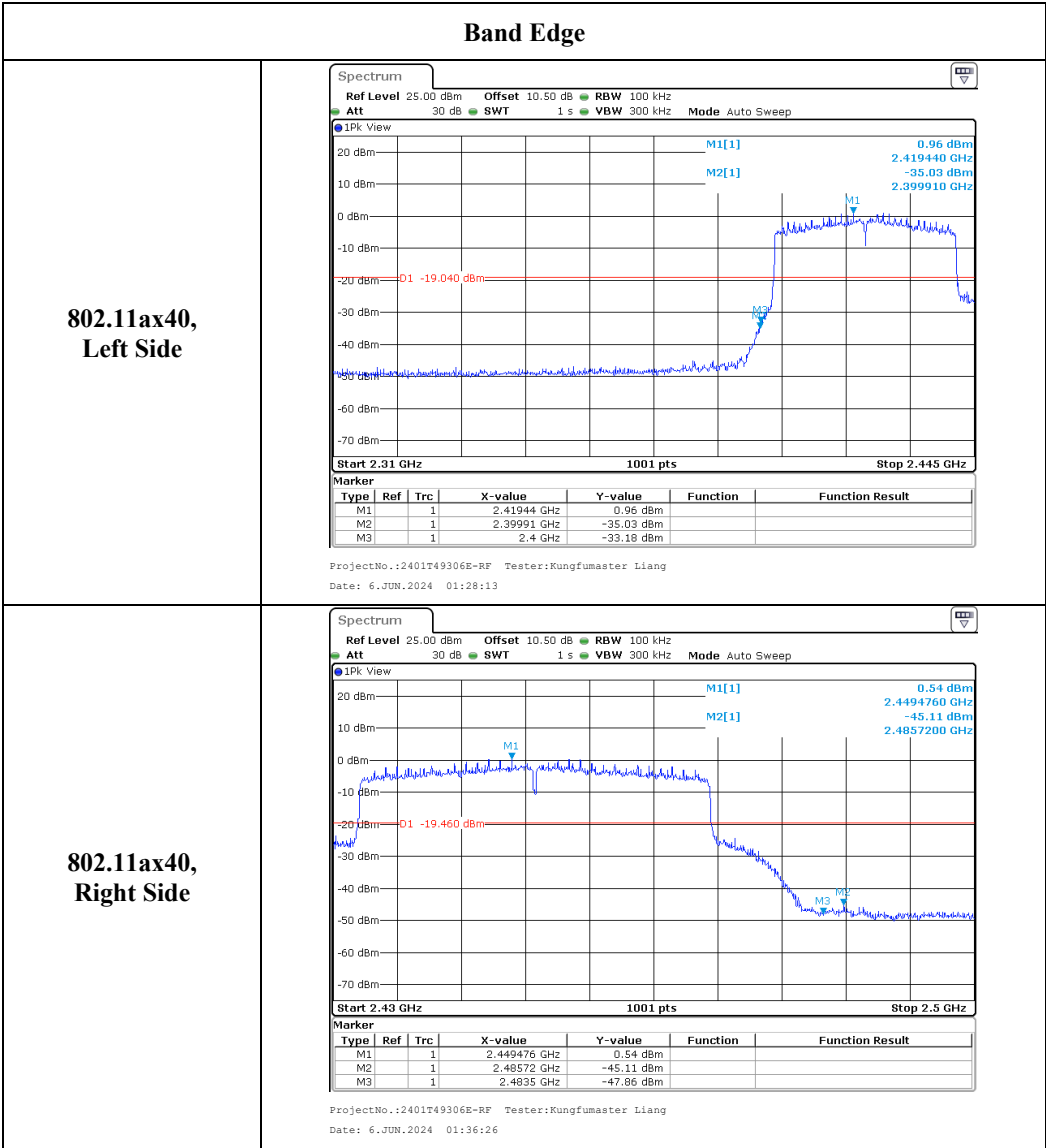




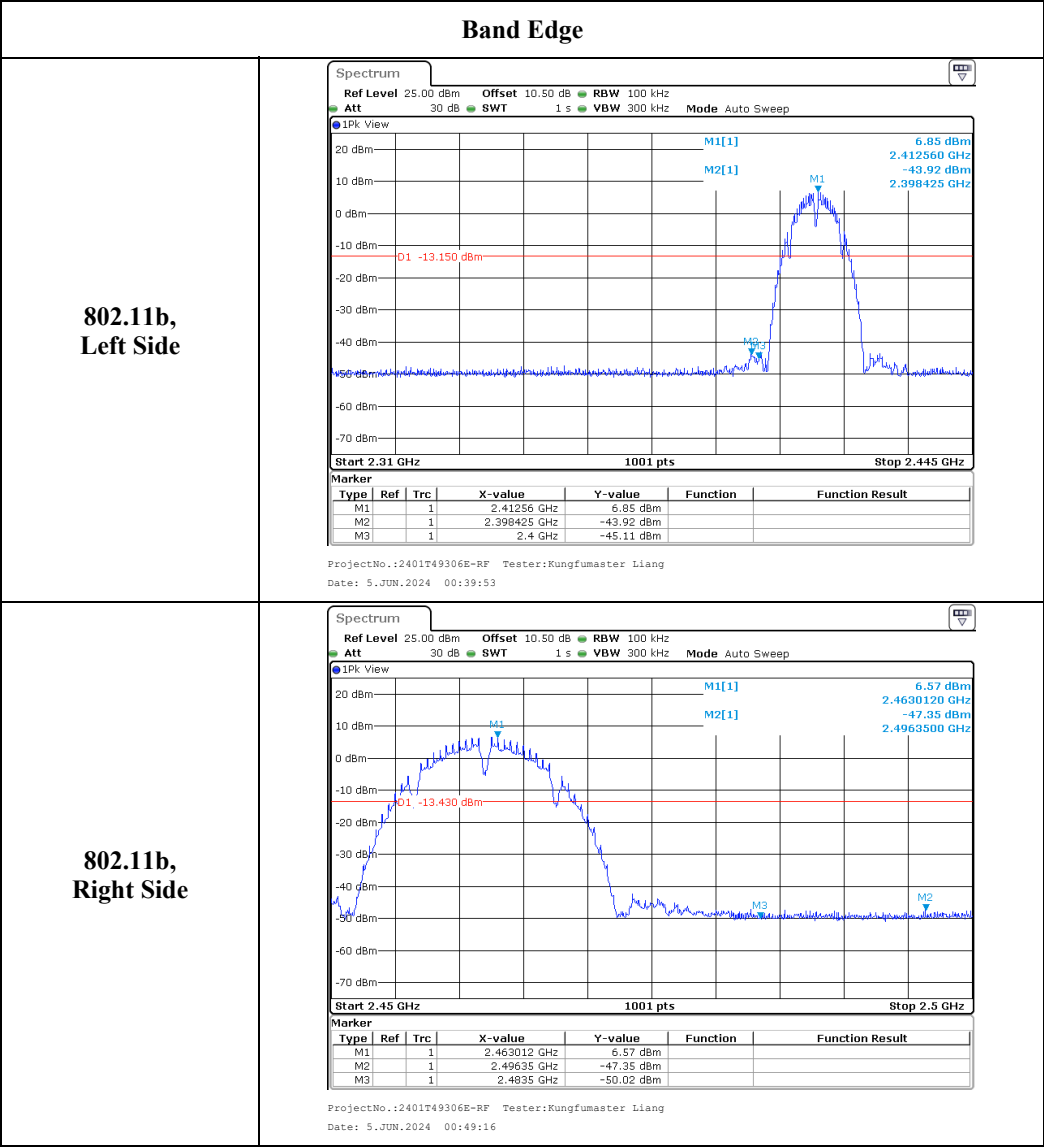


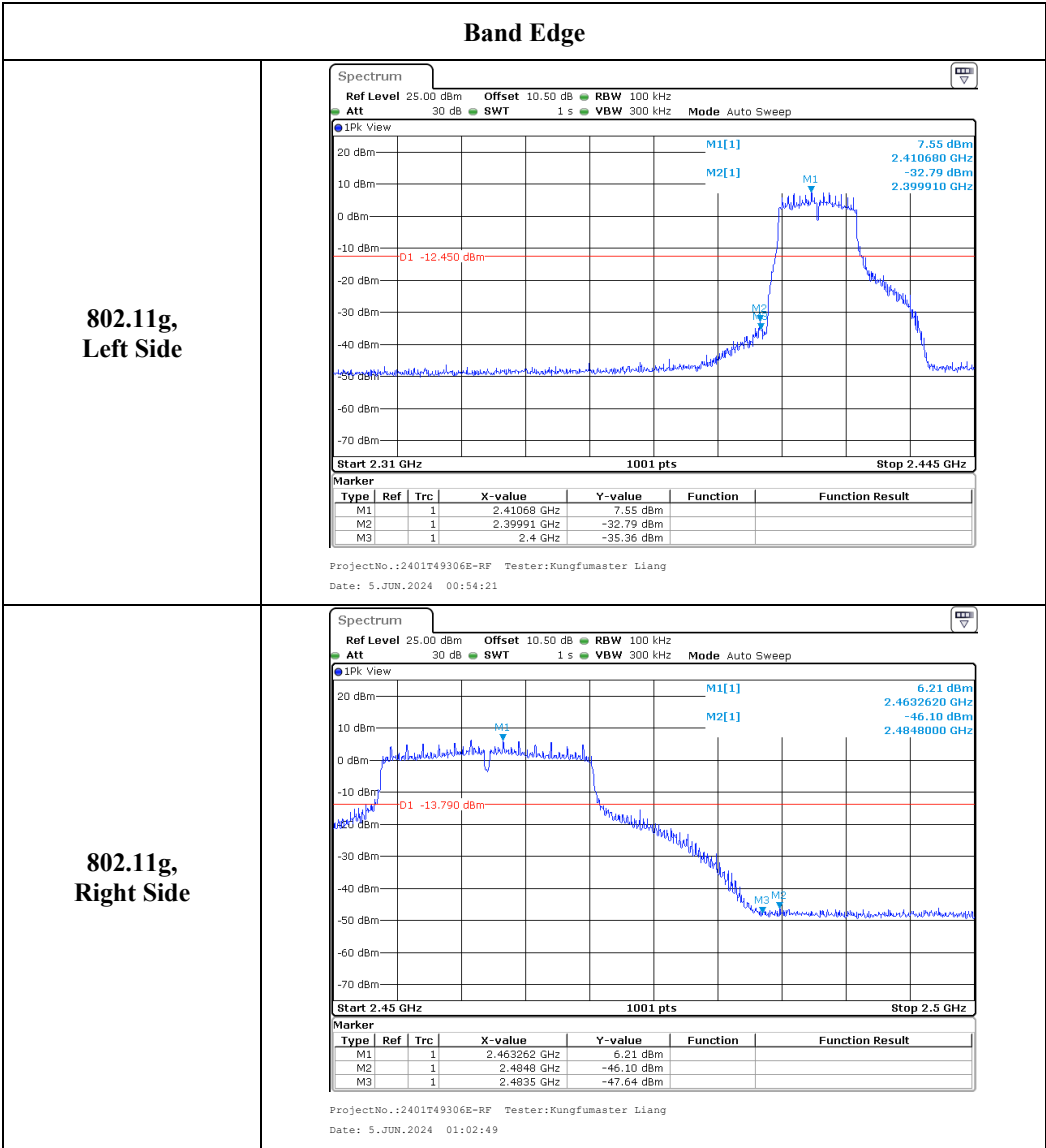


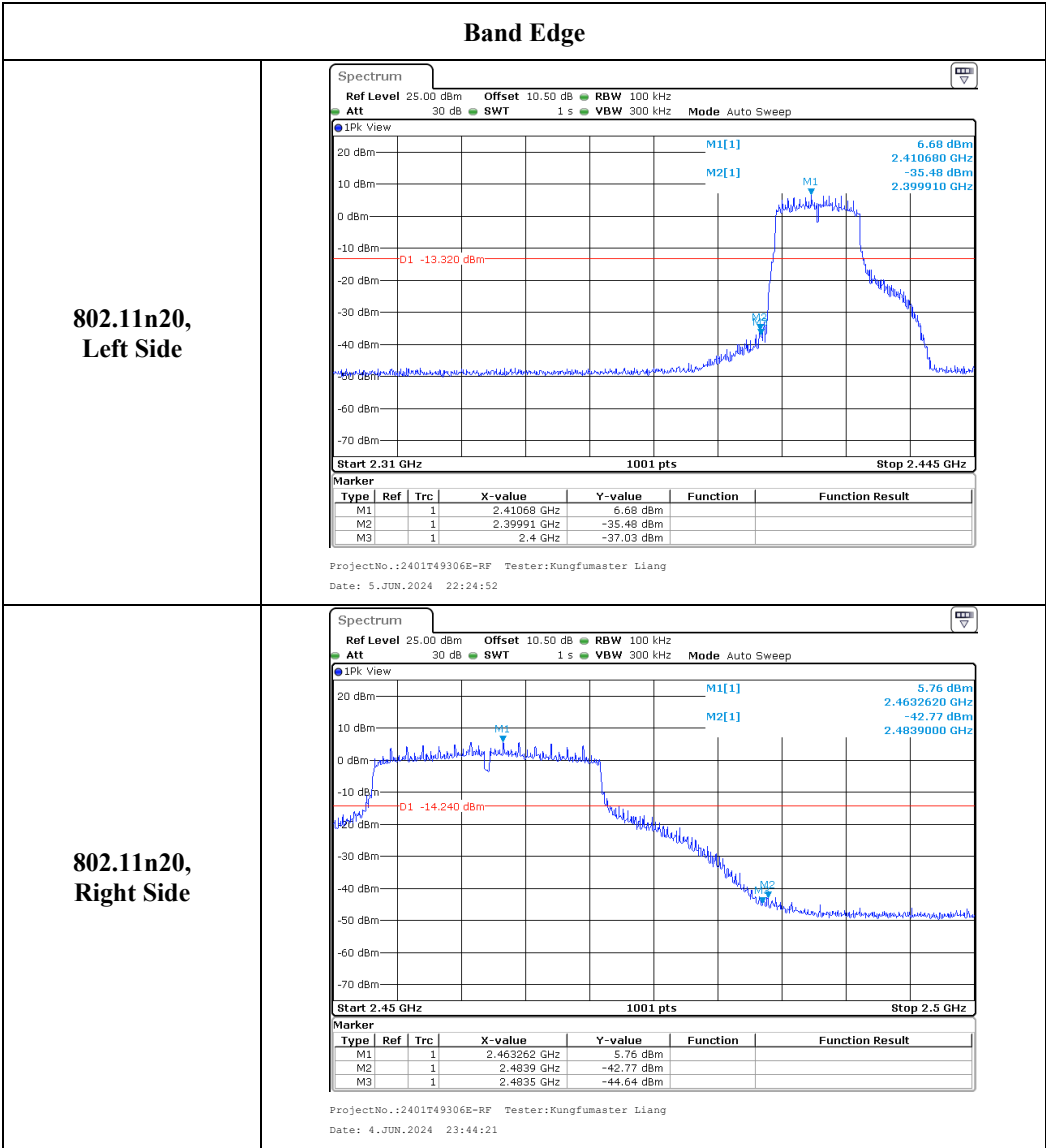


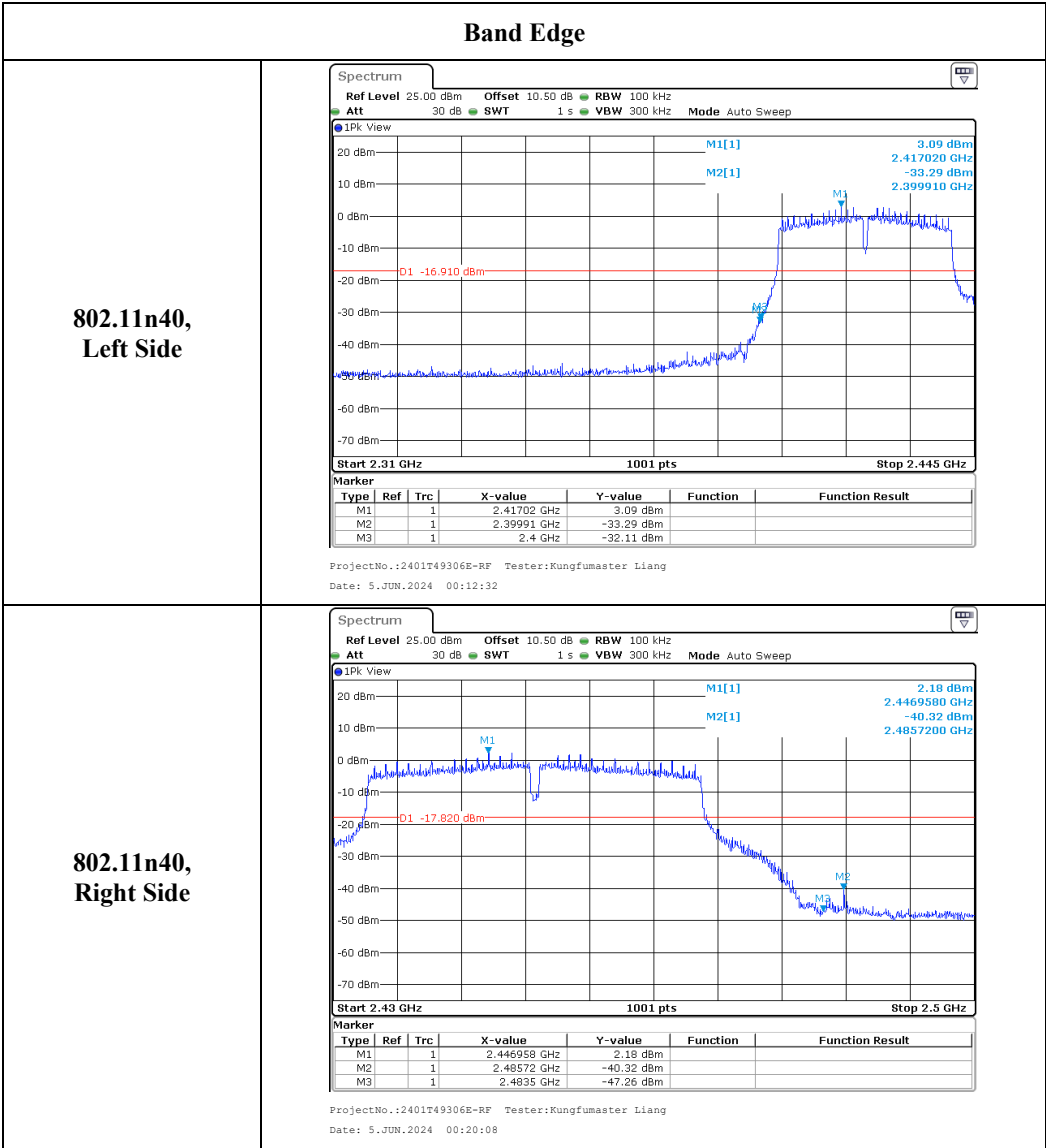


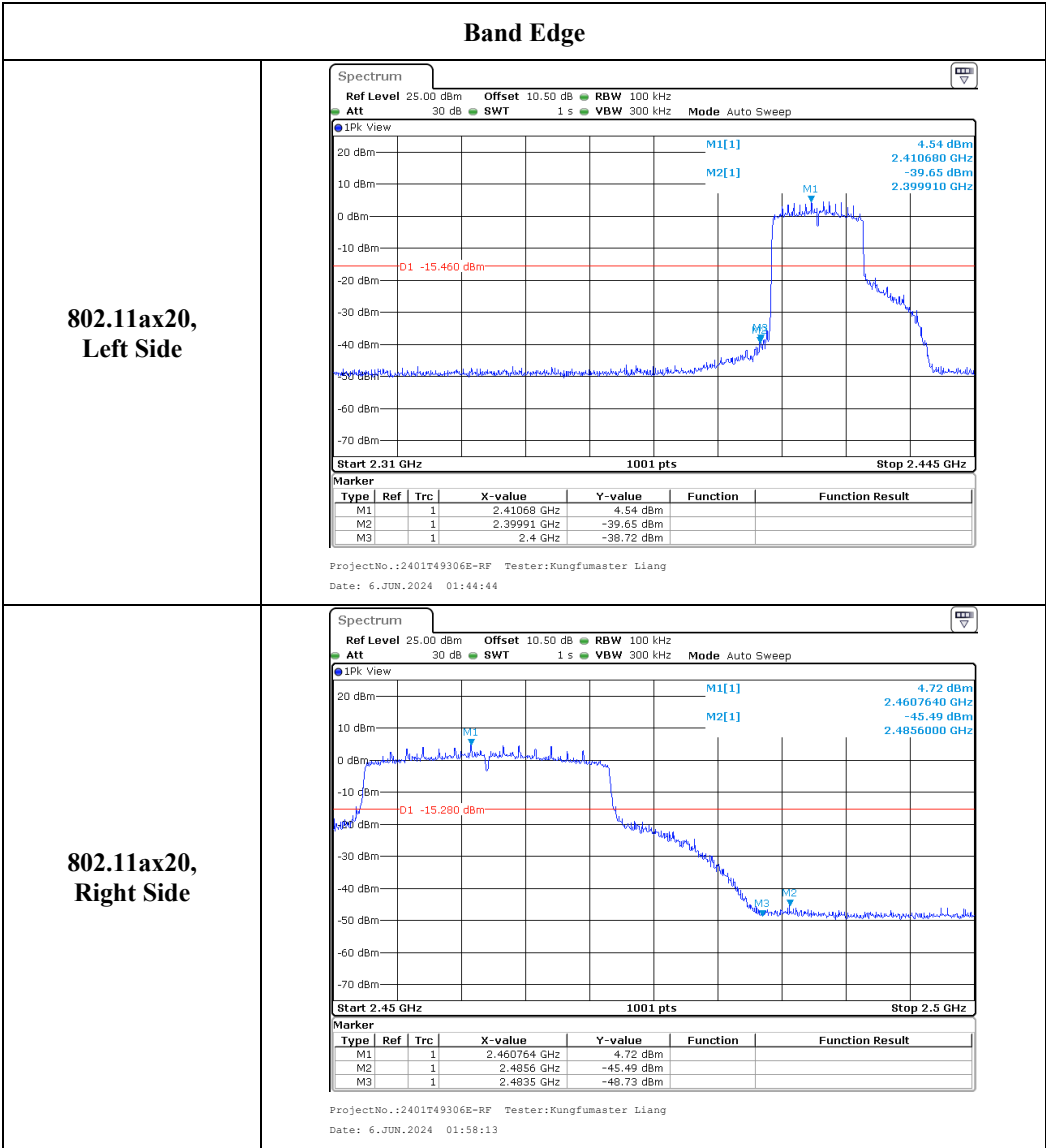
ANT1

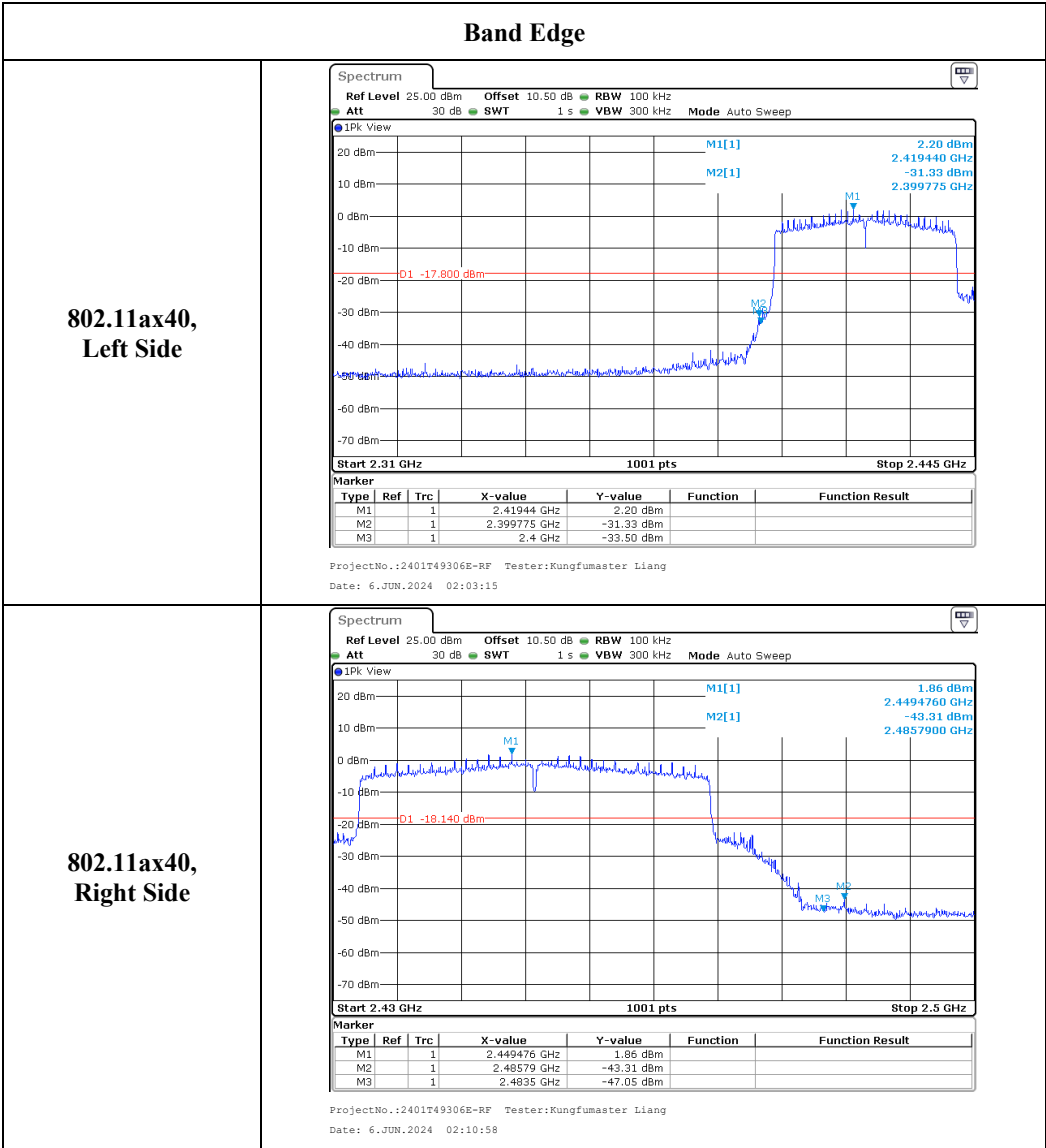












§15.247(e) & RSS-247 § 5.2 (b) POWER SPECTRAL DENSITY

Applicable Standard

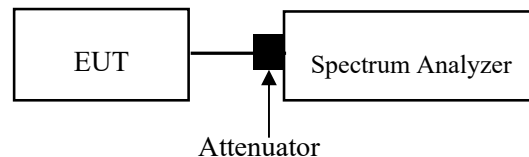
For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of paragraph (b) of this section. The same method of determining the conducted output power shall be used to determine the power spectral density.

The transmitter power spectral density conducted from the transmitter to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of section 5.4(d), (i.e. the power spectral density shall be determined using the same method as is used to determine the conducted output power).

Test Procedure

Test Method: ANSI C63.10-2013 section 11.10.2

- Set analyzer center frequency to DTS channel center frequency.
- Set the span to 1.5 times the DTS bandwidth.
- Set the RBW to $3 \text{ kHz} \leq \text{RBW} \leq 100 \text{ kHz}$.
- Set the VBW $\geq [3 \times \text{RBW}]$.
- Detector = peak.
- Sweep time = auto couple.
- Trace mode = max hold.
- Allow trace to fully stabilize.
- Use the peak marker function to determine the maximum amplitude level within the RBW.
- If measured value exceeds requirement, then reduce RBW (but no less than 3 kHz) and repeat.



Test Data

Environmental Conditions

Temperature:	23.6~25.5 °C
Relative Humidity:	52~58 %
ATM Pressure:	101 kPa

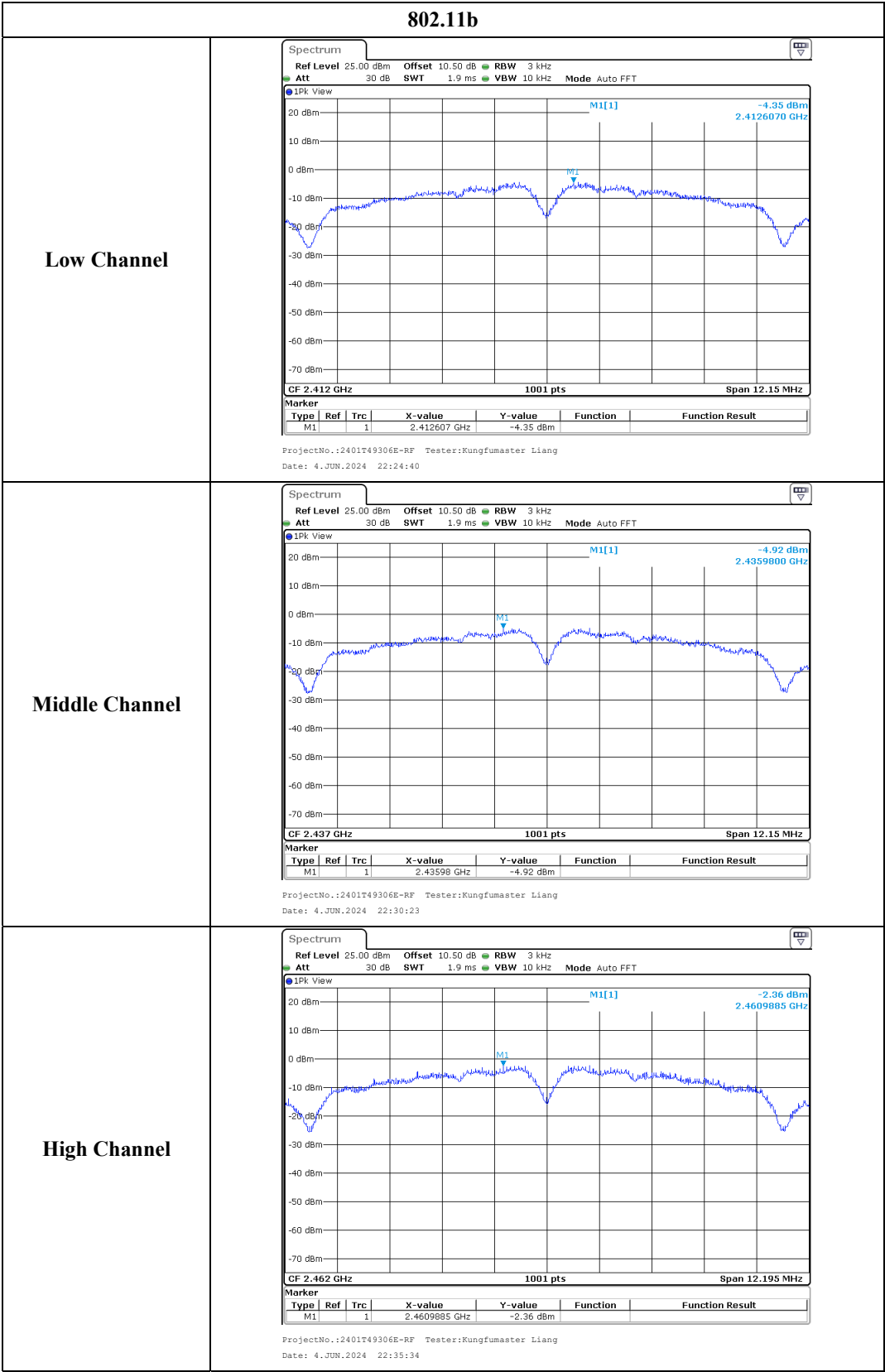
The testing was performed by KungfuMaster Liang from 2024-06-04 to 2024-06-06.

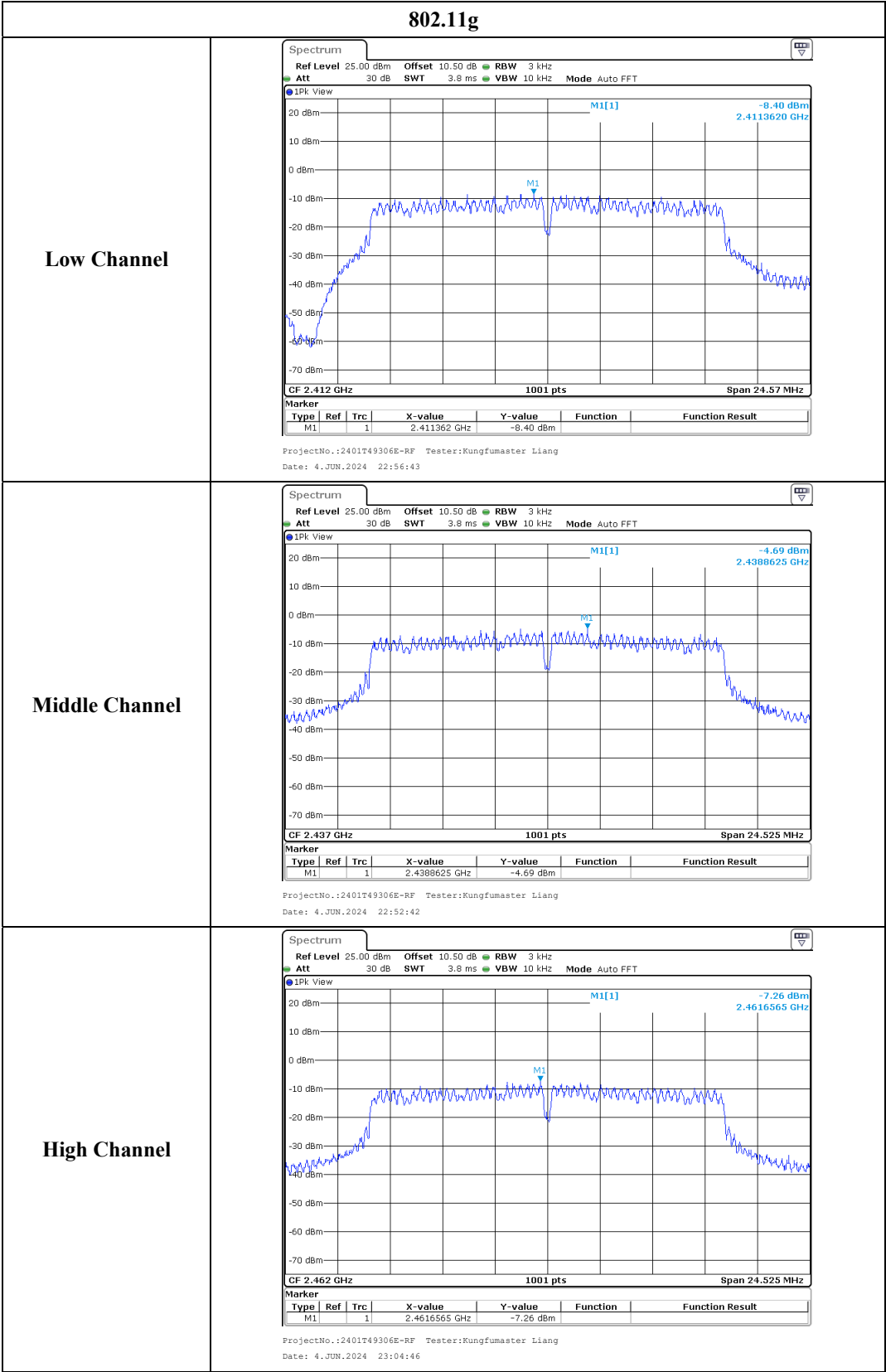
EUT operation mode: Transmitting

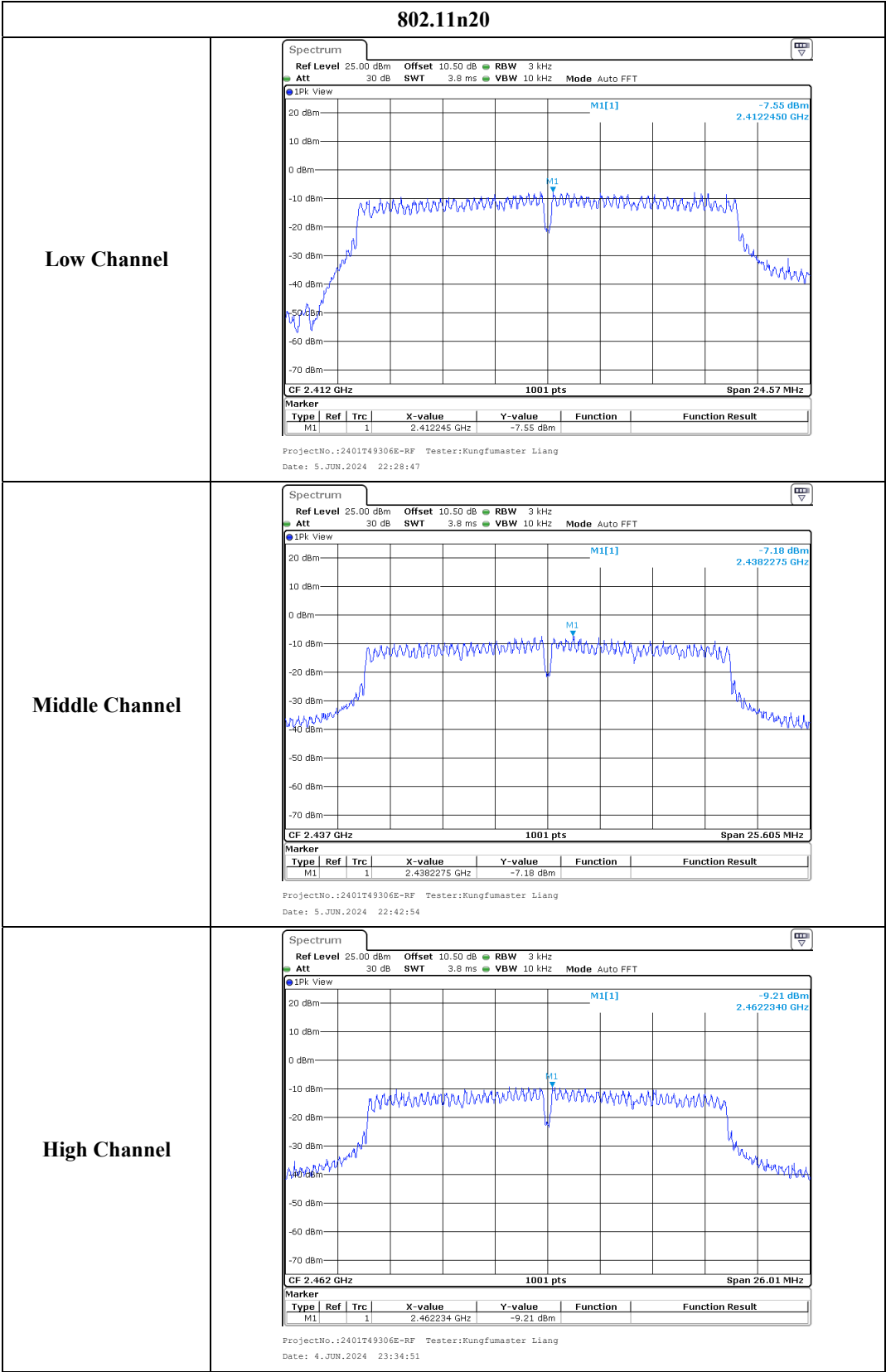
Test Result: Compliant.

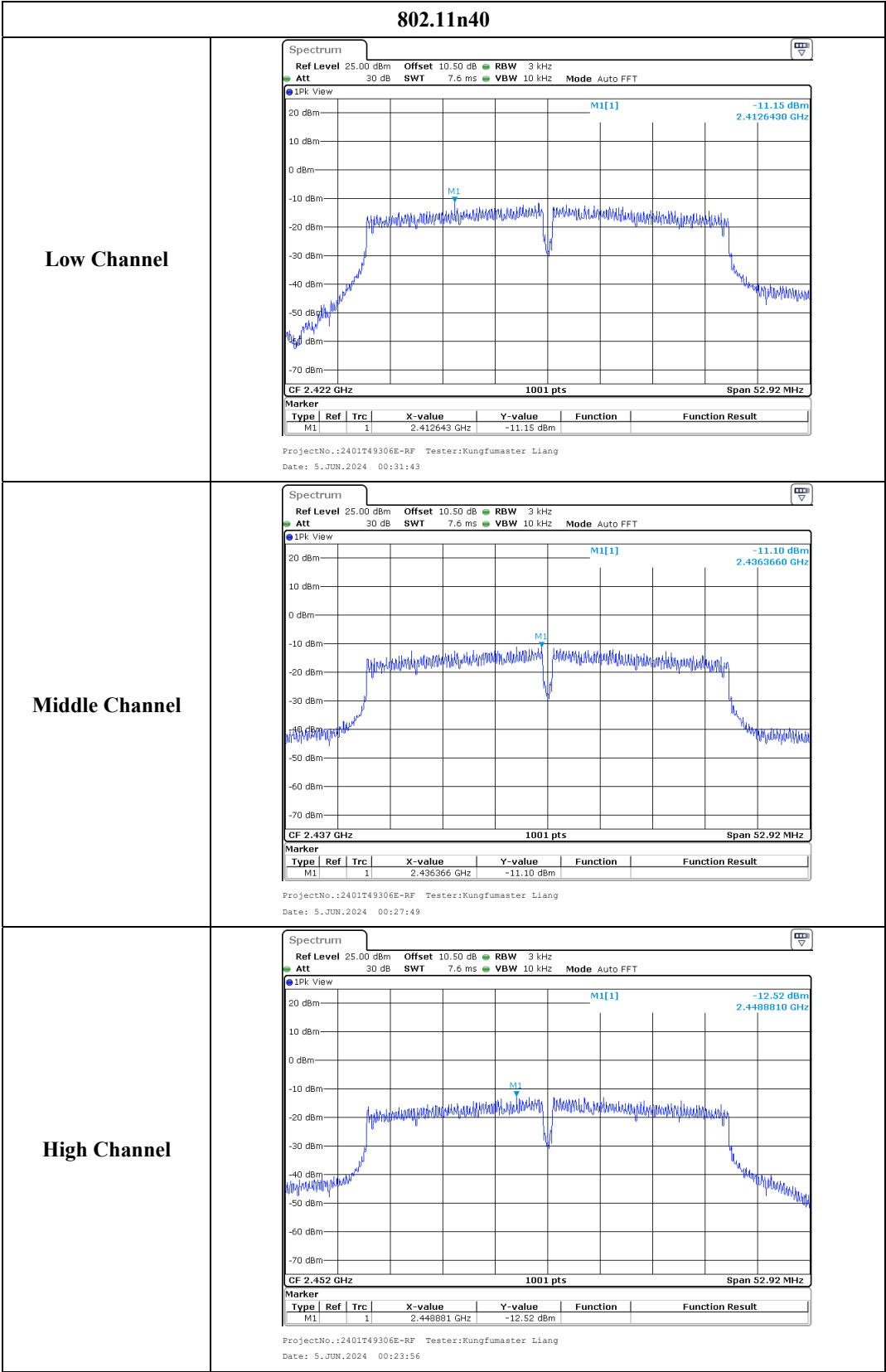
Test Modes	Test Frequency (MHz)	Maximum Power Spectral Density (dBm/3kHz)			Limit (dBm/3kHz)
		ANT 0	ANT 1	Total	
802.11b	2412	-4.35	-5.17	/	8.00
	2437	-4.92	-6.63	/	8.00
	2462	-2.36	-6.33	/	8.00
802.11g	2412	-8.40	-4.69	/	8.00
	2437	-4.69	-3.61	/	8.00
	2462	-7.26	-6.51	/	8.00
802.11n20	2412	-7.55	-5.10	-3.14	7.15
	2437	-7.18	-6.75	-3.95	7.15
	2462	-9.21	-7.12	-5.03	7.15
802.11n40	2422	-11.15	-10.22	-7.65	7.15
	2437	-11.10	-10.52	-7.79	7.15
	2452	-12.52	-11.22	-8.81	7.15
802.11ax20	2412	-11.18	-8.72	-6.77	7.15
	2437	-10.00	-8.78	-6.34	7.15
	2462	-10.44	-7.69	-5.84	7.15
802.11ax40	2422	-12.45	-11.05	-8.68	7.15
	2437	-12.20	-11.89	-9.03	7.15
	2452	-13.94	-11.86	-9.77	7.15
Note: The device employed Beam-forming for 802.11 MIMO transmitting, per KDB 662911 D01 Multiple Transmitter Output v02r01, for power spectral density measurements on IEEE 802.11 devices: Array Gain = $10 \log(N_{\text{ANT}}/N_{\text{SS}})$ dB					
Antenna Gain:	3.85	dBi	Directional gain:	6.85	dBi

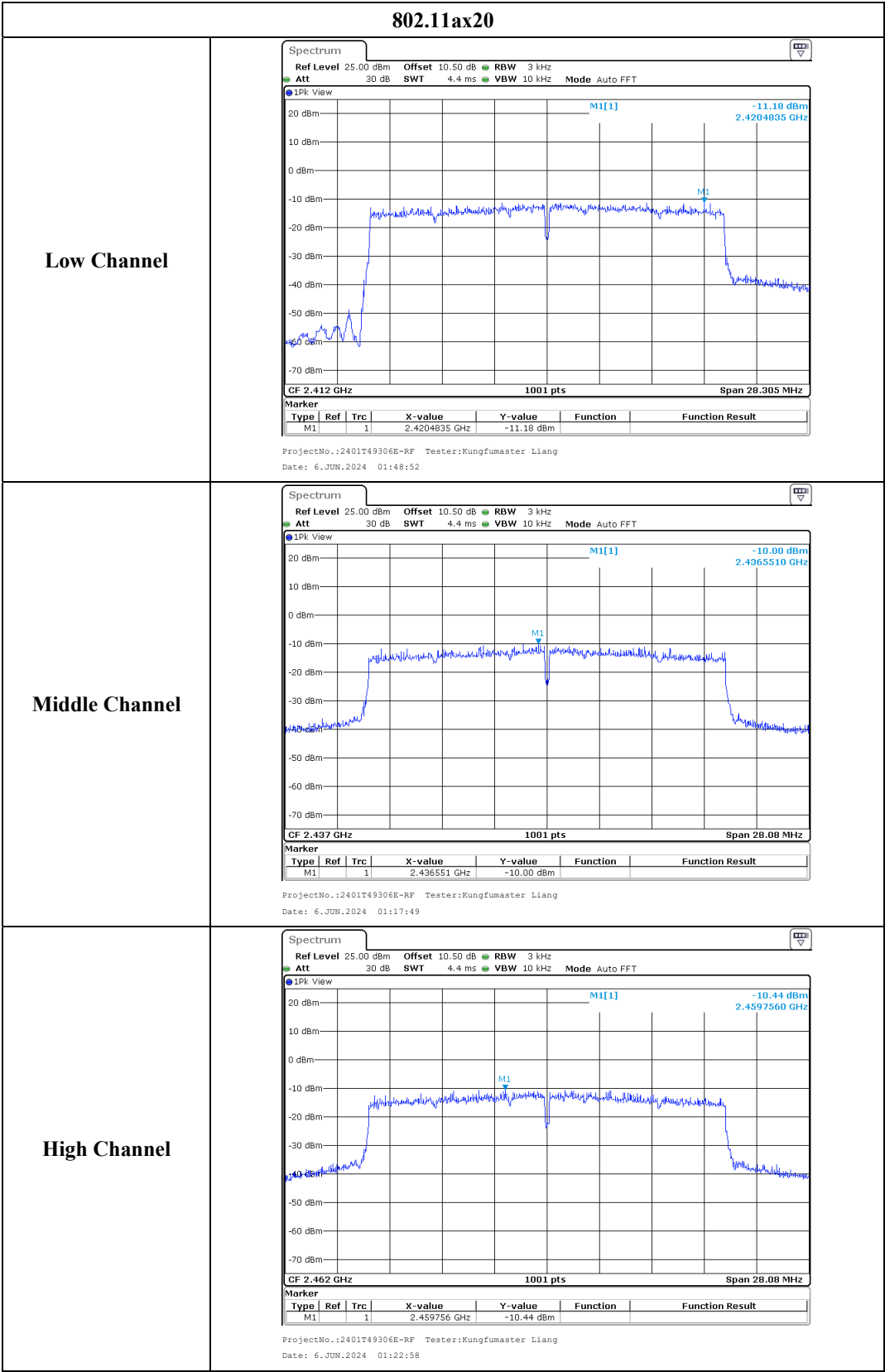
ANT 0

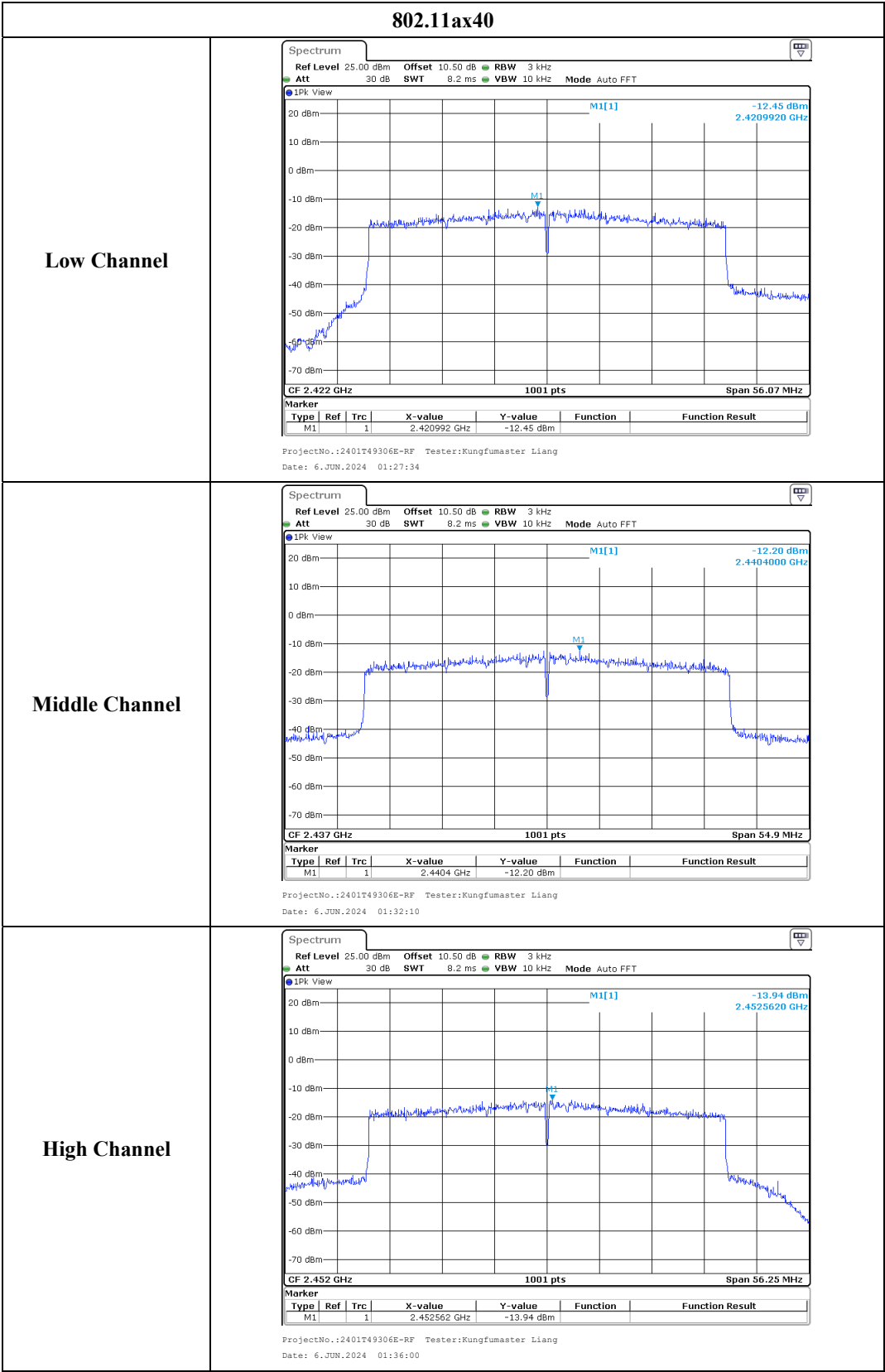




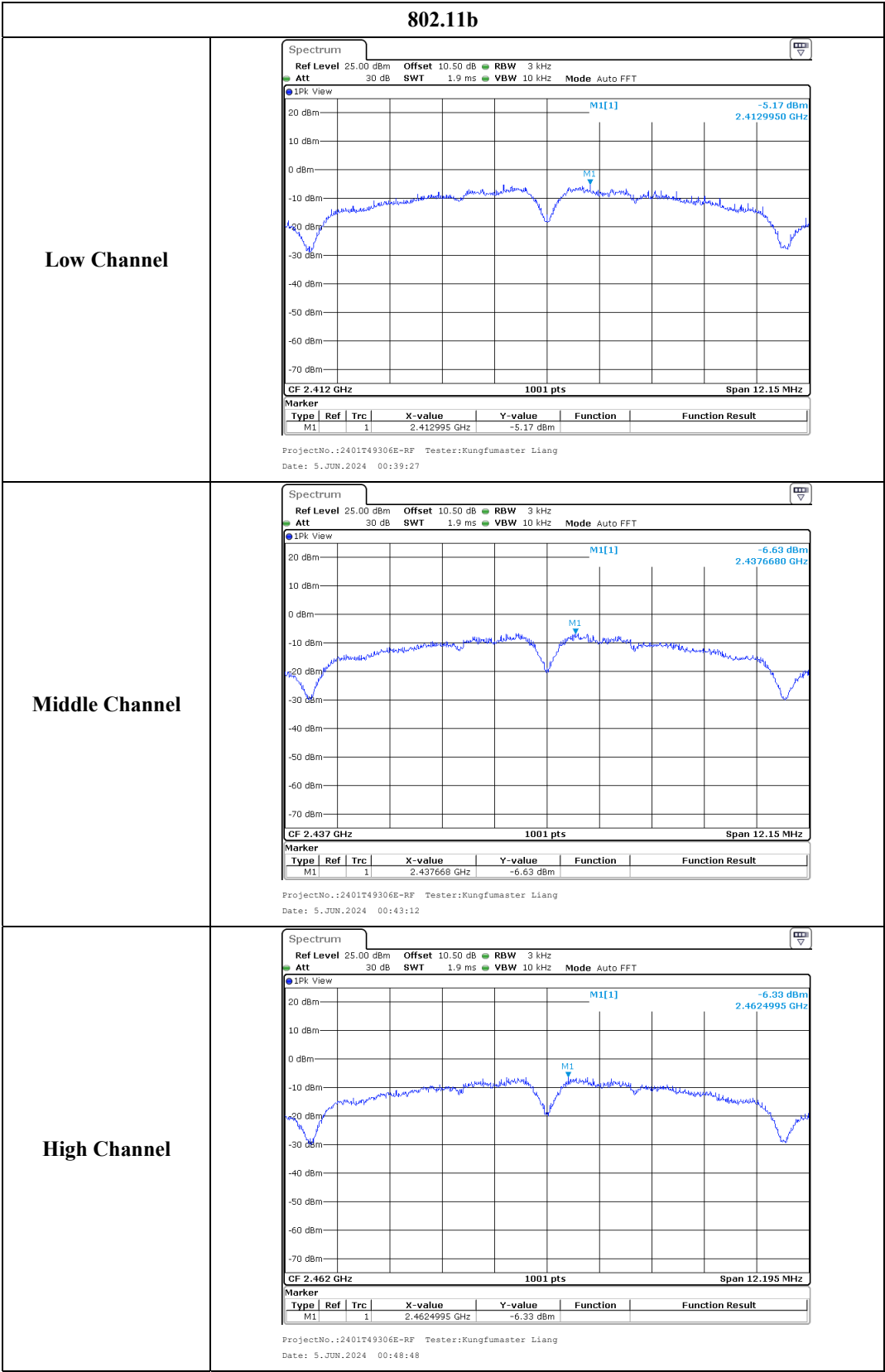


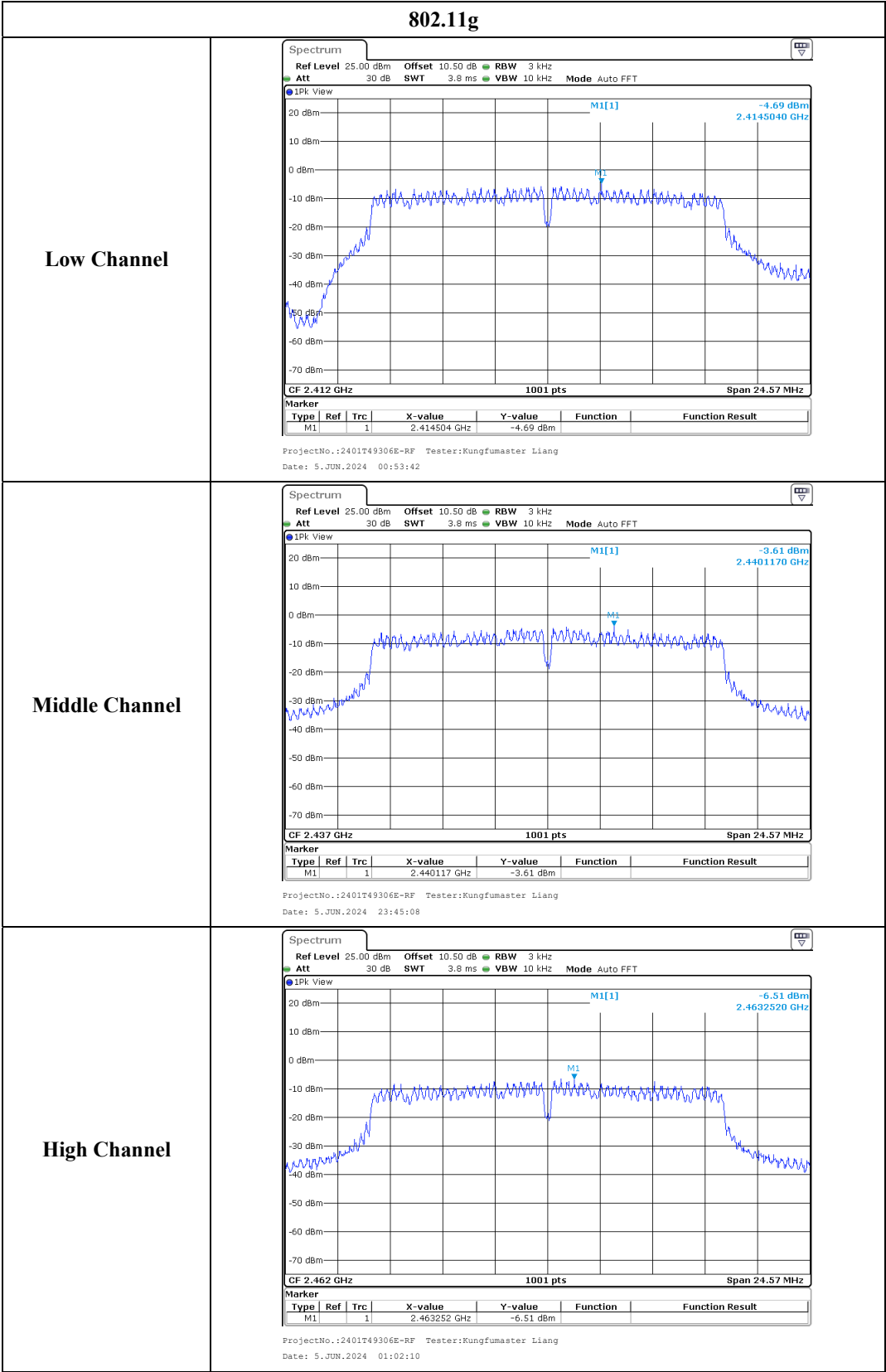


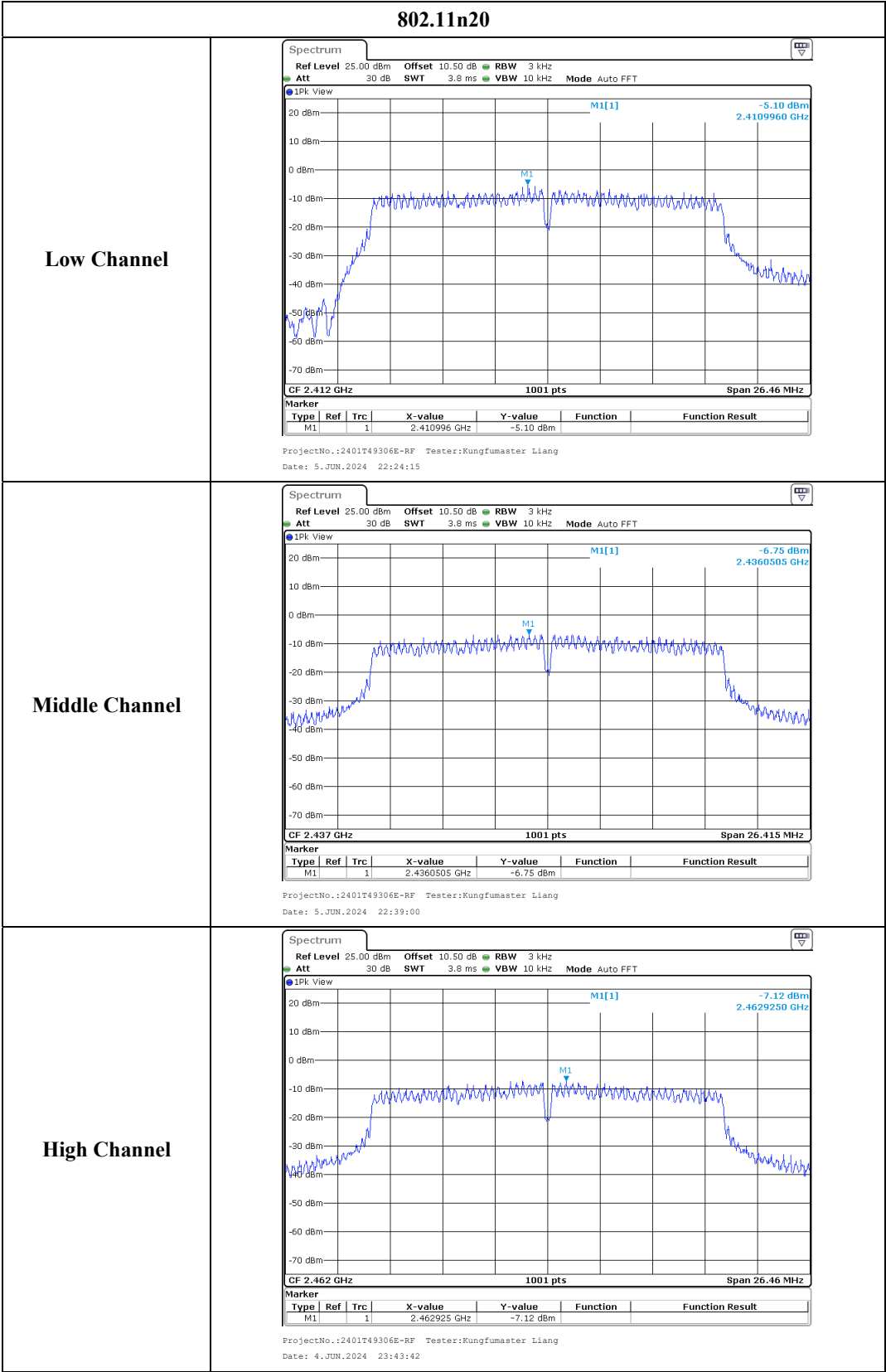


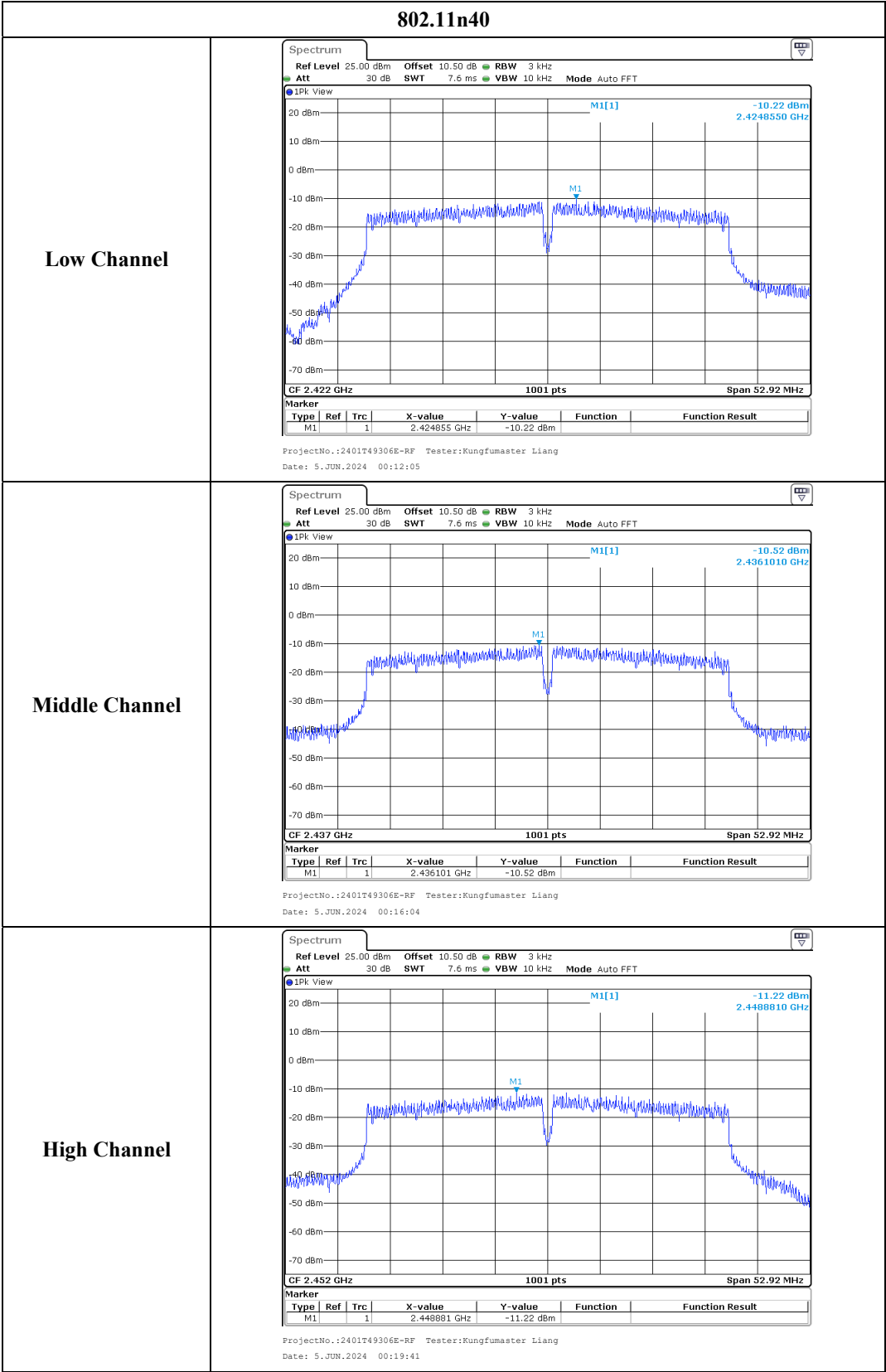


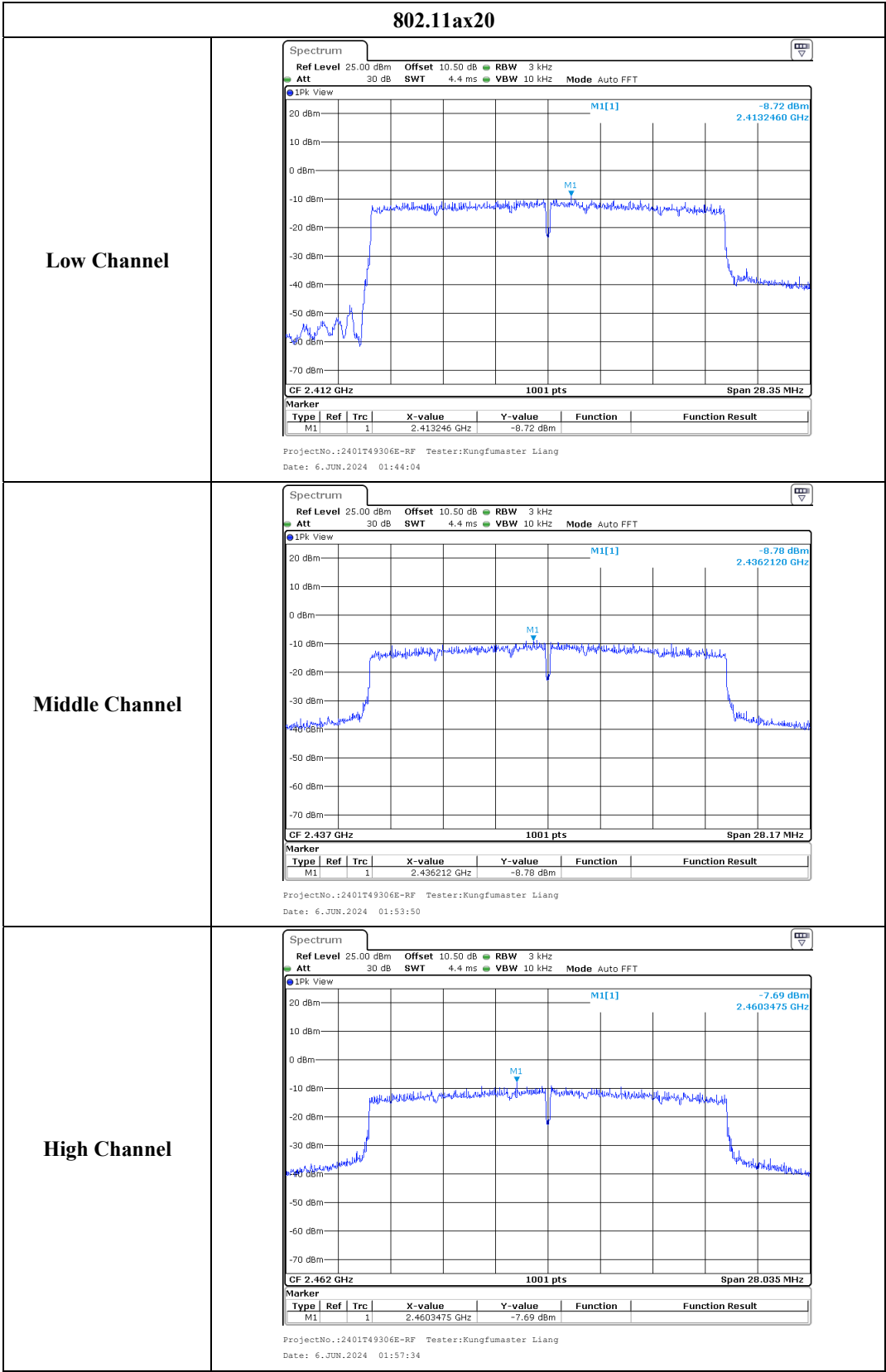
ANT 1

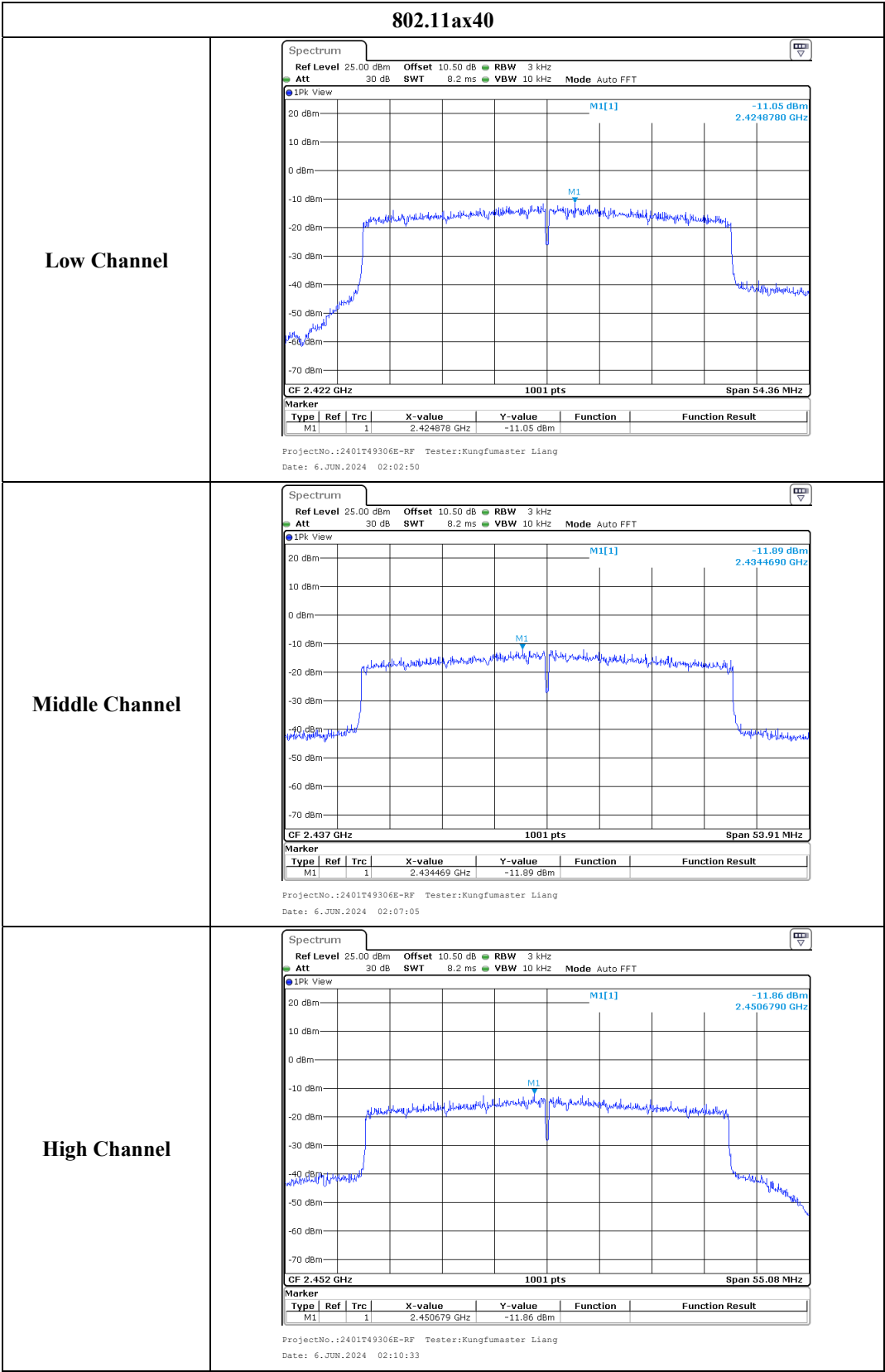












EUT PHOTOGRAPHS

Please refer to the attachment 2401T49306E-RF External photo and 2401T49306E-RF Internal photo.

TEST SETUP PHOTOGRAPHS

Please refer to the attachment 2401T49306E-RFA Test Setup photo.

******* END OF REPORT *******