TEST REPORT

Applicant Name:	Loewe Technology GmbH
Address:	Industriestrasse 11, 96317 Kronach, Germany
Report Number:	2401S39342E-RF-00B
FCC ID:	2AZD4-64510D10

Test Standard (s)

FCC PART 15.247

Sample Description

Product Type:	We. BEAM
Model No.:	64510D10
Multiple Model(s) No.:	N/A
Trade Mark:	We. by Loewe.
Date Received:	2024/04/25
Issue Date:	2024/07/12

Test Result:	Pass▲

▲ In the configuration tested, the EUT complied with the standards above.

Prepared and Checked By:

Bruce Lin

RF Engineer

Approved By:

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.

This report may contain data that are not covered by the NVLAP accreditation and are marked with an asterisk "▼".

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DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	2401S39342E-RF-00B	Original Report	2024/07/12

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	We. BEAM
Tested Model	64510D10
Multiple Model(s)	N/A
Frequency Range	BLE: 2402-2480MHz Wi-Fi: 2412-2462MHz
Maximum Conducted Output Peak Power	BLE: 7.57dBm Wi-Fi: 21.68dBm(802.11b), 26.26dBm(802.11g), 28.11dBm(802.11n20) 26.90dBm(802.11n40)
Modulation Technique	BLE: GFSK Wi-Fi: DSSS, OFDM
Antenna Specification#	BLE: 2.11dBi Wi-Fi: ANT1: 2.34dBi, ANT2: 2dBi (provided by the applicant)
Voltage Range	DC 20.0V from adapter
Sample serial number	2KFJ-2 for Conducted and Radiated Emissions Test 2KFJ-1 for RF Conducted Test (Assigned by BACL, Shenzhen)
Sample/EUT Status	Good condition
Adapter Information	Model: P6514I Input: AC 100-240V, 50/60Hz, 1.5A Output: DC 5.0V/9.0V/12.0V/15.0V, 3.0A or 20.0V, 3.25A, 65.0W, Max

Objective

This test report is in accordance with Part 2-Subpart J, Part 15-Subparts A and C of the Federal Communication Commission's rules.

The tests were performed in order to determine compliance 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 Compliance Testing of Unlicensed Wireless Devices.

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 output power, conducted		0.72 dB(k=2, 95% level of confidence)
AC Power Lines Conducted Emissions	9kHz~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℃
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.

SYSTEM TEST CONFIGURATION

Description of Test Configuration

For 2.4GHz Wi-Fi mode, total 11 channels 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	/	/

802.11b, 802.11g and 802.11n-HT20 mode was tested with Channel 1, 6 and 11.
802.11n-HT40 mode was tested with Channel 3, 6 and 9.

Note:
According to the manufacturer,

For 802.11 b/g modes, the device only support SISO mode.

For 802.11 n modes, the device support SISO and MIMO mode, the SISO and MIMO modes share the same power level setting under the same modulation. So the worst mode MIMO was selected to test.

For BLE mode, 40 channels are provided to testing:

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

EUT was tested with Channel 0, 19 and 39.

Equipment Modifications

No modification was made to the EUT tested.

EUT Exercise Software

"QA Tool_Dbg"[#] exercise software was used and the power level as below. The software and power level was provided by the manufacturer.

The worst case was performed under:

Mode	Data rate	Power Level[#]		
		Low Channel	Middle Channel	High Channel
802.11b	1Mbps	20	20	20
802.11g	6Mbps	20	20	20
802.11n20	MCS0	20	20	20
802.11n40	MCS0	1D	1D	1D
BLE	1Mbps	Default	Default	Default
BLE	2Mbps	Default	Default	Default
Note: All the antenna ports have the same power level.				

Duty cycle

Test Modes	Ton (ms)	Ton+off (ms)	Duty Cycle (%)	1/T (Hz)	VBW Setting (Hz)
BLE 1Mbps	0.385	0.625	61.60	2597	3000
BLE 2Mbps	0.200	0.625	32.00	5000	5000
802.11b	8.378	8.453	99.11	/	10
802.11g	1.390	1.465	94.88	719	1000
802.11n-HT20	1.300	1.375	94.55	769	1000
802.11n-HT40	0.648	0.723	89.63	1543	2000
Note: 2.4G Wi-Fi Test only was performed at ANT1.					

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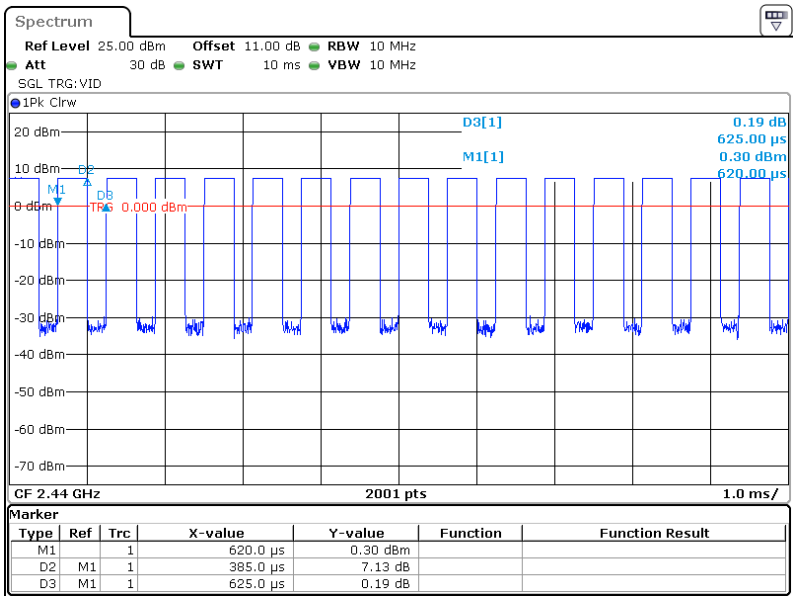
BLE 1M



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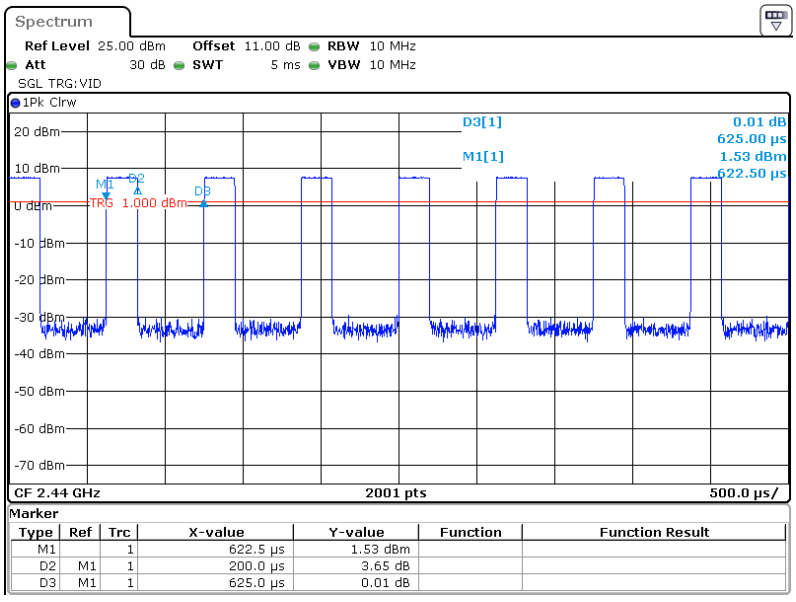
BLE 2M



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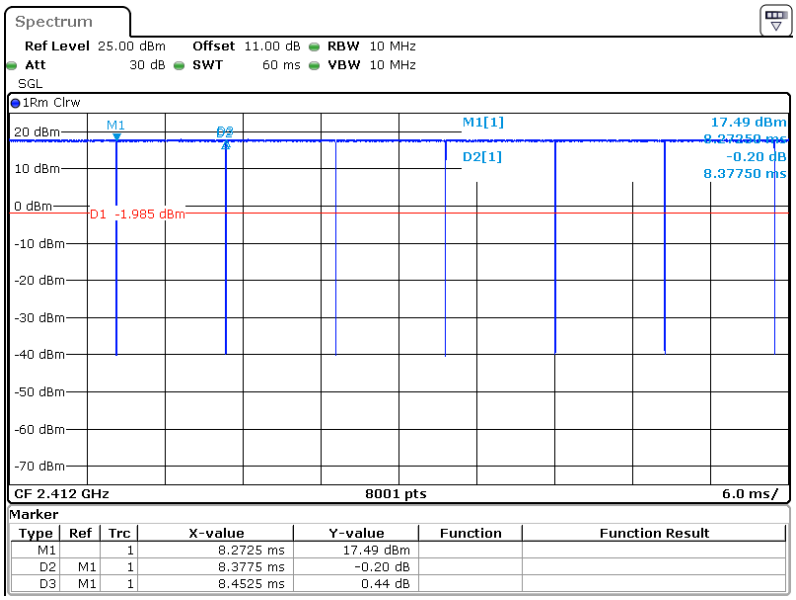
802.11b



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	8.2725 ms	17.49 dBm		
D2	M1	1	8.3775 ms	-0.20 dB		
D3	M1	1	8.4525 ms	0.44 dB		

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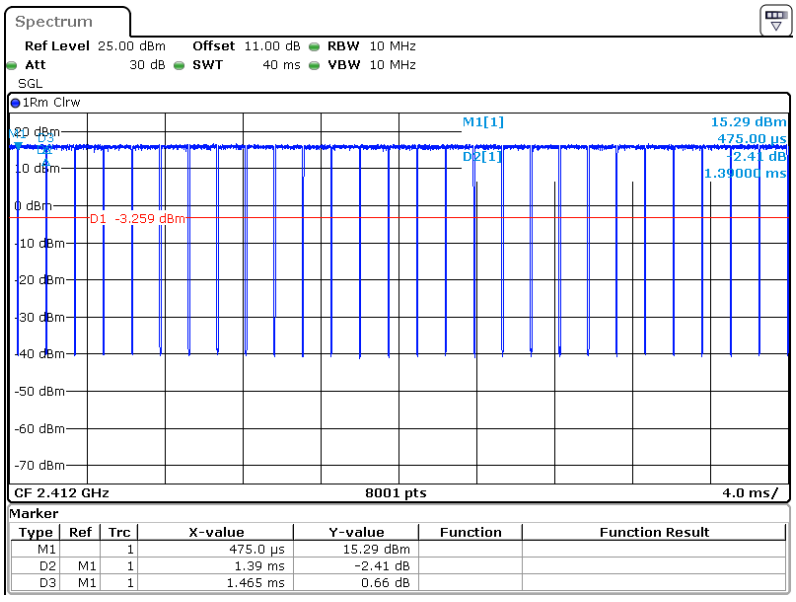
Date: 9.MAY.2024 13:16:23

802.11g



Marker

Type	Ref	Trc	X-value	Y-value	Function	Function Result
M1		1	475.0 µs	15.29 dBm		
D2	M1	1	1.39 ms	-2.41 dB		
D3	M1	1	1.465 ms	0.66 dB		

ProjectNo.:2401S39342E-RF Tester:Cheeb Huang

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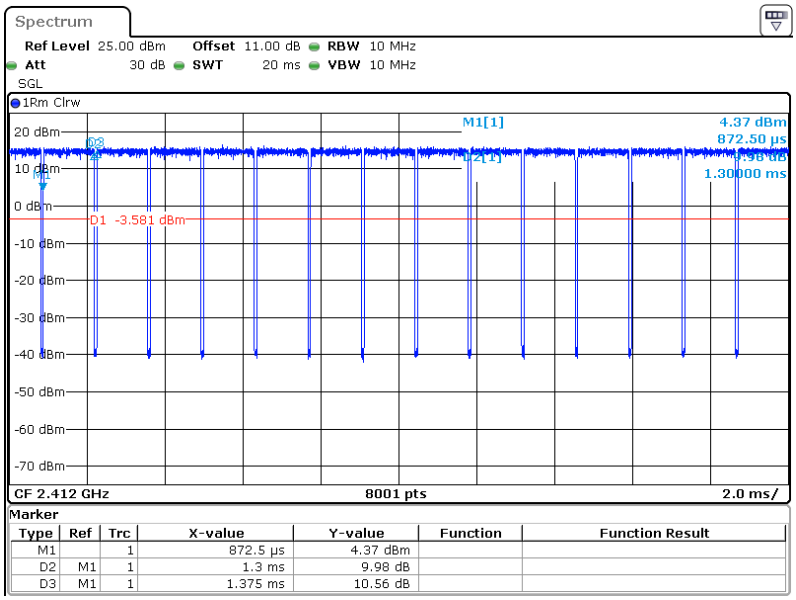
802.11n20



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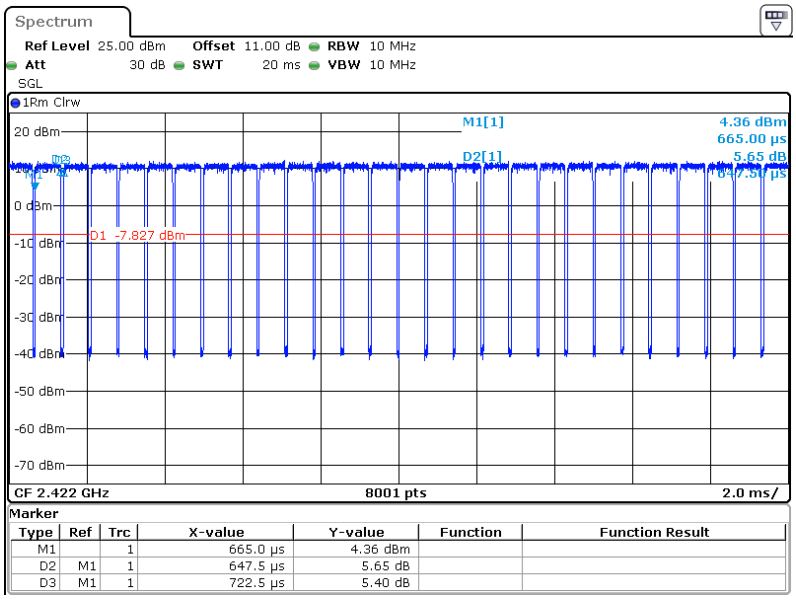
802.11n40



ProjectNo.:2401S39342E-RF Tester:Cheeb Huang

Date: 9.MAY.2024 13:57:19

Support Equipment List and Details

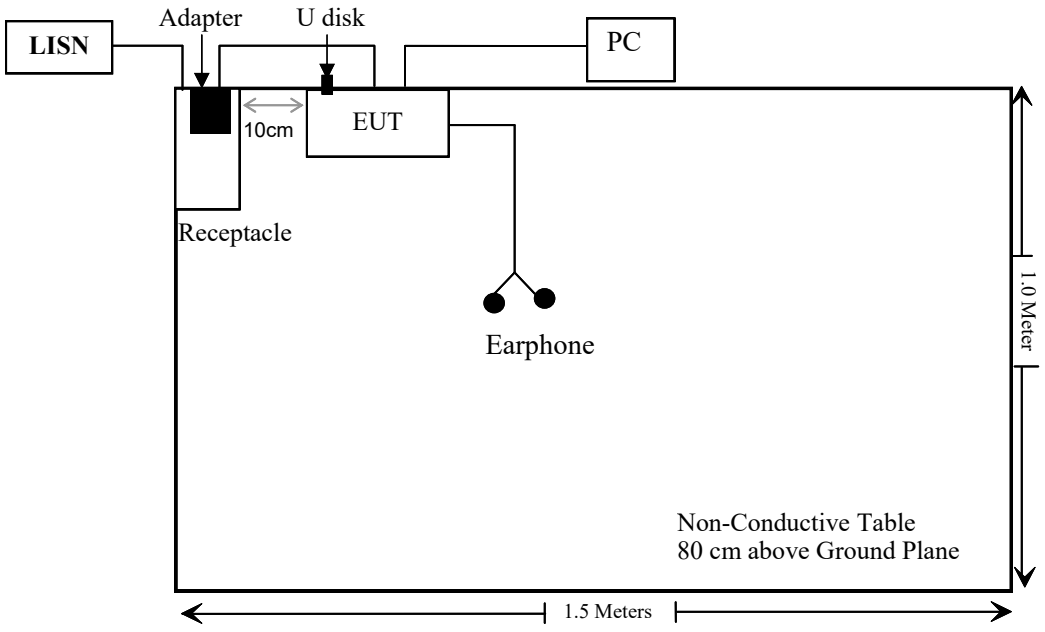
Manufacturer	Description	Model	Serial Number
Xiao mi	Earphone	Unknown	Unknown
Kingston	U disk	Unknown	Unknown
Lenovo	PC	TIANYI510Pro-18ICB	R3NO28B21001

External I/O Cable

Cable Description	Length (m)	From Port	To
Un-shielded Un-Detachable DC Cable	1.0	EUT	Adapter
Un-shielded Detachable HDMI cable	1.6	EUT	PC
Un-shielded Detachable Audio cable	1.2	EUT	Earphone

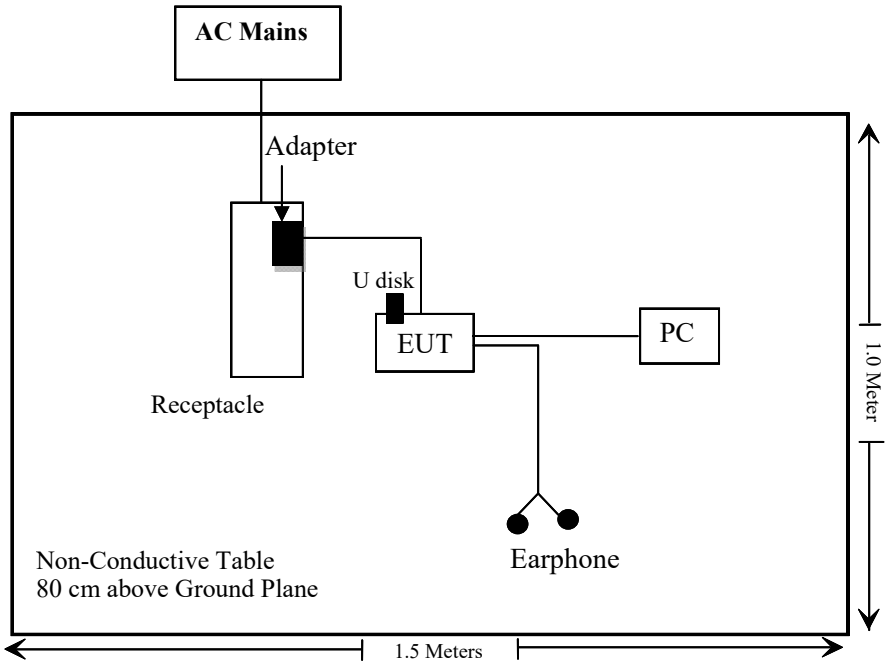
Block Diagram of Test Setup

For conducted emission

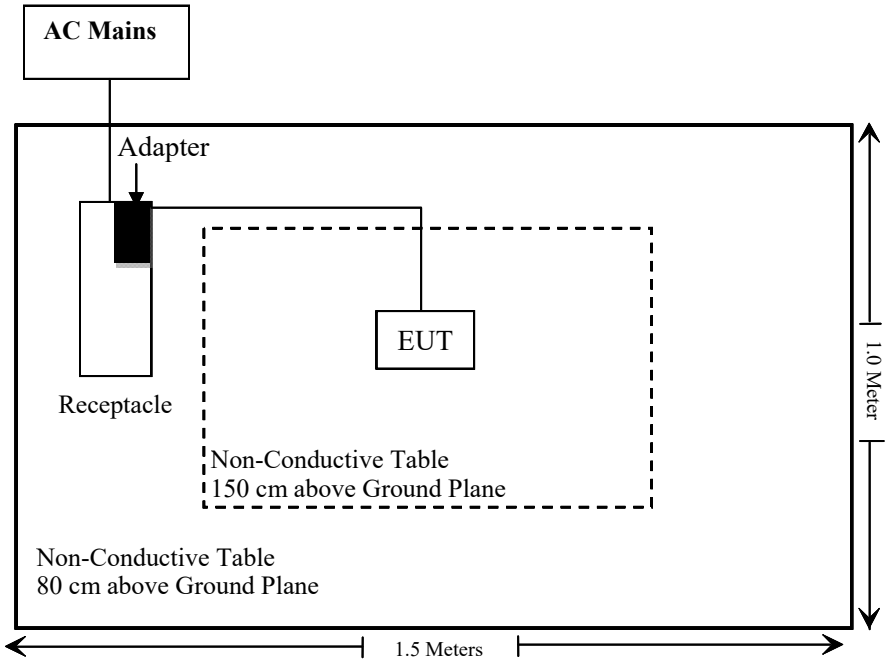


For Radiated Emissions:

Below 1GHz



Above 1GHz



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §1.1307 (b) & §2.1091	MPE-Based Exemption	Compliant
§15.203	Antenna Requirement	Compliant
§15.207 (a)	AC Line Conducted Emissions	Compliant
§15.205, §15.209, §15.247(d)	Spurious Emissions	Compliant
§15.247 (a)(2)	6 dB Emission Bandwidth	Compliant
§15.247(b)(3)	Maximum Conducted Output Power	Compliant
§15.247(d)	100 kHz Bandwidth of Frequency Band Edge	Compliant
§15.247(e)	Power Spectral Density	Compliant

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
Conducted Emission 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	2023/08/03	2024/08/02
Unknown	CE Cable	CE Cable	UF A210B-1-0720-504504	2023/08/03	2024/08/02
Audix	EMI Test software	E3	191218(V9)	NCR	NCR
Radiated Emission Test					
R&S	EMI Test Receiver	ESR3	102455	2024/01/16	2025/01/15
Sonoma instrument	Pre-amplifier	310 N	186238	2023/06/08	2024/06/07
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2023/07/20	2026/07/19
BACL	Active Loop Antenna	1313-1A	4031911	2024/03/21	2025/03/20
Unknown	Cable	Chamber Cable 1	F-03-EM236	2023/08/03	2024/08/02
Unknown	Cable	Chamber Cable 4	EC-007	2023/08/03	2024/08/02
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
Schwarzbeck	Horn Antenna	BBHA9120D(1201)	1143	2023/07/26	2026/07/25
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
SNSD	2.4G Band Reject filter	BSF2402-2480MN-0898-001	2.4G filter	2023/08/03	2024/08/02
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
Audix	EMI Test software	E3	191218(V9)	NCR	NCR
RF Conducted Test					
R&S	spectrum analyzer	FSV40	101942	2023/12/18	2024/12/17
ANRITSU	Microwave peak power sensor	MA24418A	12622	2023/08/08	2024/08/07
Unknown	10dB Attenuator	Unknown	F-03-EM122	2023/07/04	2024/07/03
Unknown	RF Cable	65475	01670515	2023/07/04	2024/07/03

*** 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 1.1307 (B) & §2.1091- MPE-BASED EXEMPTION

Applicable Standard

According to subpart 2.1091 systems operating under the provisions of this section shall be operated in a manner that ensures the public is not exposed to RF energy level in excess of the communication guidelines.

According to KDB 447498 D04 Interim General RF Exposure Guidance

MPE-Based Exemption:

General frequency and separation-distance dependent MPE-based effective radiated power (ERP) thresholds are in Table B.1 [Table 1 of § 1.1307(b)(1)(i)(C)] to support an exemptionfrom further evaluation from 300 kHz through 100 GHz.

Table 1 to § 1.1307(b)(3)(i)(C) - Single RF Sources Subject to Routine Environmental Evaluation

RF Source frequency (MHz)	Threshold ERP (watts)
0.3-1.34	1,920 R^2.
1.34-30	3,450 R^2/f^2.
30-300	3.83 R^2.
300-1,500	0.0128 R^2f.
1,500-100,000	19.2R^2.

R is the minimum separation distance in meters
f = frequency in MHz

For multiple RF sources: Multiple RF sources are exempt if:

in the case of fixed RF sources operating in the same time-averaging period, or of multiple mobile or portable RF sources within a device operating in the same time averaging period, if the sum of the fractional contributions to the applicable thresholds is less than or equal to 1 as indicated in the following equation:

$$\sum_{i=1}^{a} \frac{P_i}{P_{th,i}} + \sum_{j=1}^{b} \frac{ERP_j}{ERP_{th,j}} + \sum_{k=1}^{c} \frac{Evaluated_k}{Exposure\ Limit_k} \leq 1$$

Result

Mode	Frequency (MHz)	Tune up conducted power#	Antenna Gain#		ERP		Evaluation Distance (m)	ERP Limit (mW)
		(dBm)	(dBi)	(dBd)	(dBm)	(mW)		
BT	2402-2480	9.5	2.11	-0.04	9.46	8.83	0.2	768
BLE	2402-2480	8.0	2.11	-0.04	7.96	6.25	0.2	768
2.4G Wi-Fi	2412-2462	28.5	2.34	0.19	28.69	739.61	0.2	768
5.2G Wi-Fi	5180-5240	13.5	3.19	1.04	14.54	28.44	0.2	768
5.3G Wi-Fi	5260-5320	19.0	3.19	1.04	20.04	100.93	0.2	768
5.6G Wi-Fi	5500-5720	17.0	3.19	1.04	18.04	63.68	0.2	768
5.8G Wi-Fi	5745-5825	18.5	3.19	1.04	19.54	89.95	0.2	768

Note: 1. The tune up conducted power and antenna gain was declared by the applicant.
2. The BT and Wi-Fi can transmit at same time. The 2.4G and 5G Wi-Fi cannot transmit at same time.
3. 0dBd=2.15dBi

Simultaneous transmitting consideration (worst case):

The ratio=ERP_{BT}/limit+$ERP_{2.4G\ Wi\text{-}Fi}$/limit = 8.83/768+739.61/768 =0.975＜1.0,
so simultaneous exposure is compliant.

To maintain compliance with the FCC's RF exposure guidelines, place the equipment at least 20cm from nearby persons.

Result: Compliant.

FCC §15.203 - 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 compliance 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.

Antenna Connector Construction

The EUT has one internal antenna arrangement for BLE, and two internal antennas arrangement for Wi-Fi, which were permanently attached, the antenna gain# as below table, fulfill the requirement of this section. Please refer to the EUT photos.

Antenna	Antenna Type	Antenna Gain#	Impedance	Frequency Range
BLE ANT	FPC	2.11dBi	50Ω	2.4~2.5GHz
Wi-Fi ANT1	FPC	2.34dBi	50Ω	2.4~2.5GHz
Wi-Fi ANT2	FPC	2.00dBi	50Ω	2.4~2.5GHz

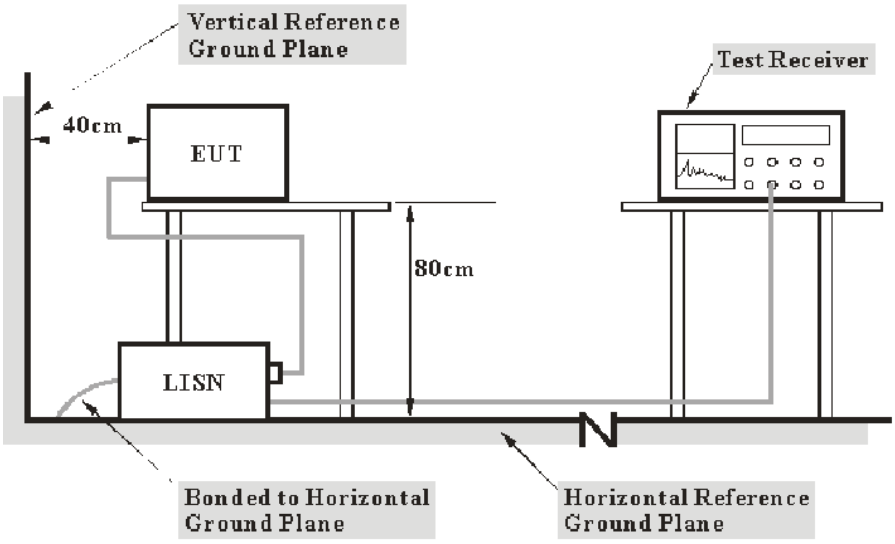
Result: Compliant

FCC §15.207 (a) - AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC§15.207

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 limits.

The spacing between the peripherals was 10 cm.

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

During the conducted emission test, the adapter was connected to the outlet of the LISN.

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:

Factor = LISN VDF + 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:

Over Limit = Level – Limit
Level = Read Level + Factor

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

Test Data

Environmental Conditions

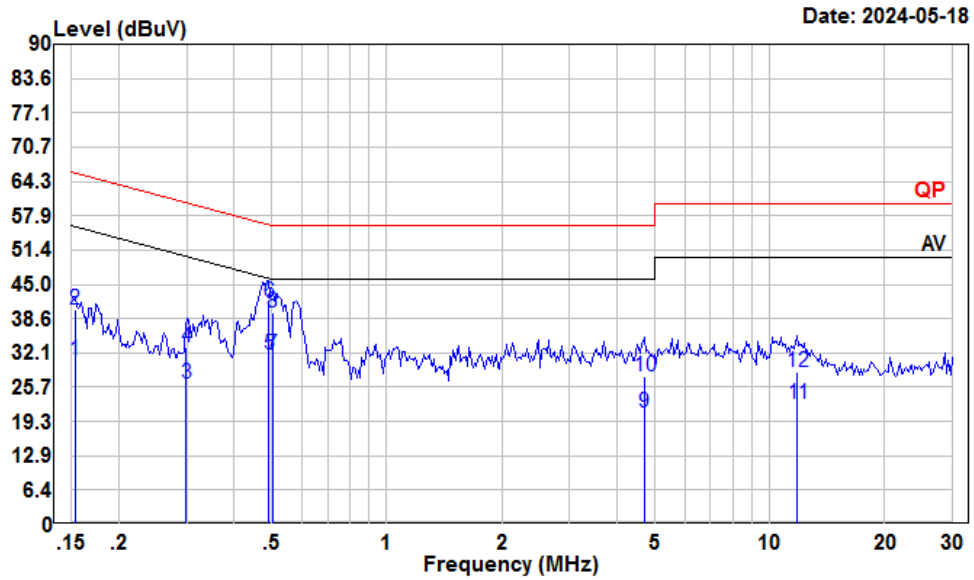
Temperature:	25 ℃
Relative Humidity:	62 %
ATM Pressure:	101 kPa

The testing was performed by Macy Shi on 2024-05-18.

EUT operation mode: Transmitting

BLE: *(Maximum output power mode, BLE 2M Middle Channel)*

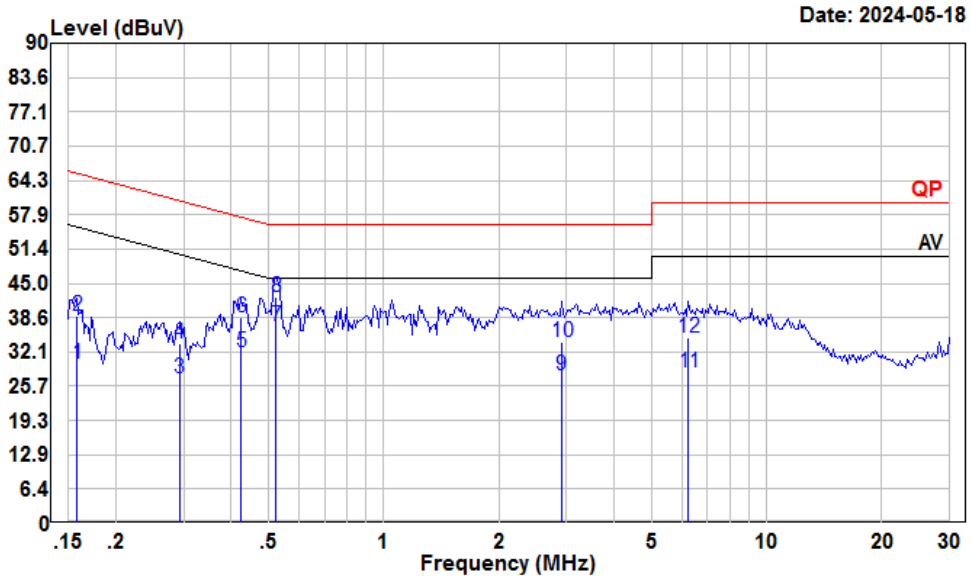
AC 120V/60 Hz, Line



Condition: Line
Project : 2401S39342E-RF
Tester : Macy shi
Note : BLE

	Freq	Read Level	LISN Level	Factor	Cable Loss	Limit Line	Over Limit	Remark
	MHz	dBuV	dBuV	dB	dB	dBuV	dB	
1	0.15	9.70	30.74	10.89	10.15	55.82	-25.08	Average
2	0.15	19.13	40.17	10.89	10.15	65.82	-25.65	QP
3	0.30	5.55	26.34	10.67	10.12	50.28	-23.94	Average
4	0.30	12.32	33.11	10.67	10.12	60.28	-27.17	QP
5	0.49	11.09	31.76	10.51	10.16	46.14	-14.38	Average
6	0.49	20.81	41.48	10.51	10.16	56.14	-14.66	QP
7	0.50	11.11	31.76	10.50	10.15	46.00	-14.24	Average
8	0.50	19.18	39.83	10.50	10.15	56.00	-16.17	QP
9	4.70	0.26	20.85	10.36	10.23	46.00	-25.15	Average
10	4.70	7.08	27.67	10.36	10.23	56.00	-28.33	QP
11	11.81	1.70	22.50	10.60	10.20	50.00	-27.50	Average
12	11.81	7.73	28.53	10.60	10.20	60.00	-31.47	QP

AC 120V/60 Hz, Neutral

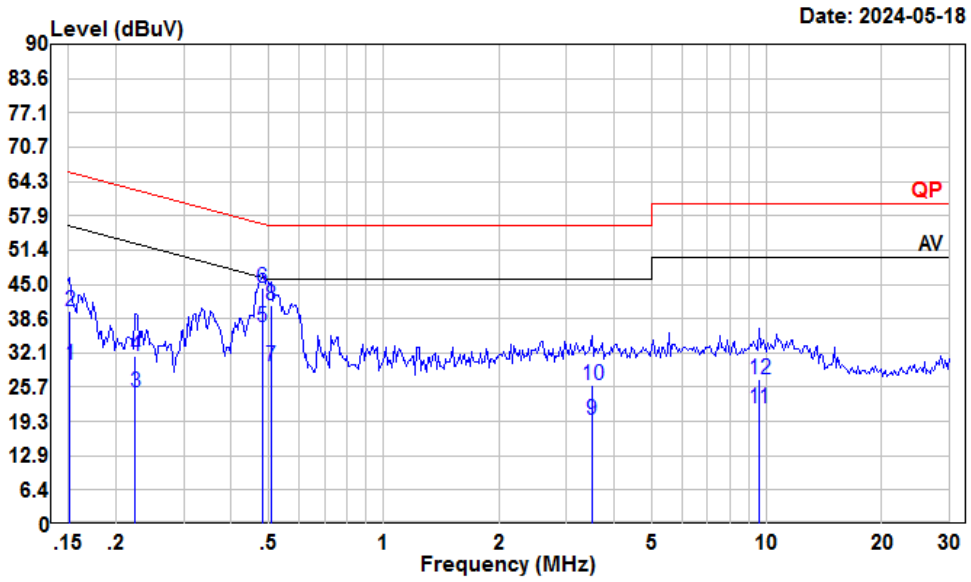


Condition: Neutral
Project : 2401S39342E-RF
Tester : Macy shi
Note : BLE

	Freq	Read Level	Level	LISN Factor	Cable Loss	Limit Line	Over Limit	Remark
	MHz	dBuV	dBuV	dB	dB	dBuV	dB	
1	0.16	9.14	29.85	10.56	10.15	55.56	-25.71	Average
2	0.16	18.13	38.84	10.56	10.15	65.56	-26.72	QP
3	0.29	6.55	27.20	10.52	10.13	50.46	-23.26	Average
4	0.29	13.03	33.68	10.52	10.13	60.46	-26.78	QP
5	0.42	11.16	32.01	10.65	10.20	47.37	-15.36	Average
6	0.42	17.84	38.69	10.65	10.20	57.37	-18.68	QP
7	0.52	16.17	37.04	10.70	10.17	46.00	-8.96	Average
8	0.52	21.54	42.41	10.70	10.17	56.00	-13.59	QP
9	2.92	7.02	27.68	10.40	10.26	46.00	-18.32	Average
10	2.92	13.29	33.95	10.40	10.26	56.00	-22.05	QP
11	6.25	7.44	28.30	10.64	10.22	50.00	-21.70	Average
12	6.25	14.07	34.93	10.64	10.22	60.00	-25.07	QP

2.4G Wi-Fi: *(Maximum output power mode, 802.11n20 Low Channel)*

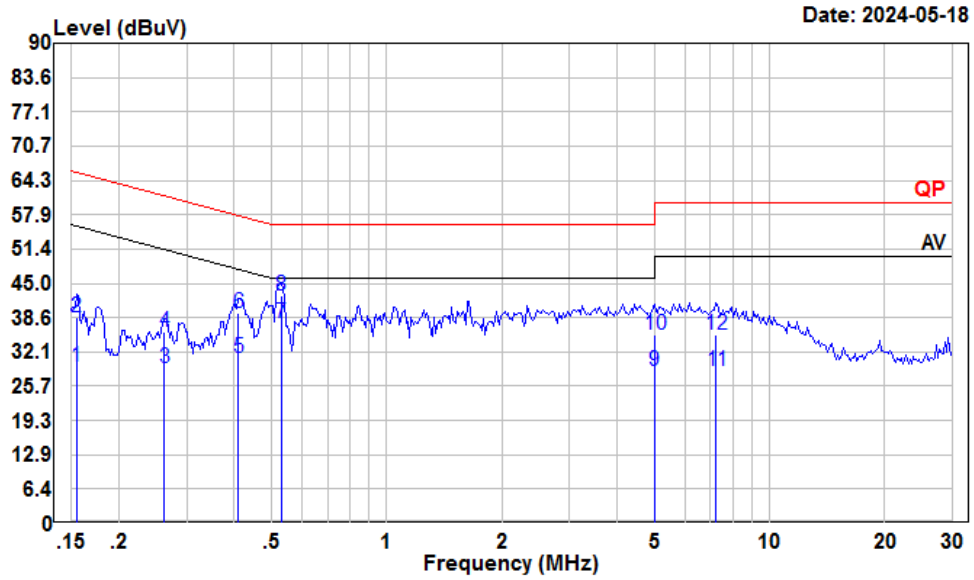
AC 120V/60 Hz, Line



Condition: Line
Project : 2401S39342E-RF
Tester : Macy shi
Note : 2.4G WIFI

	Freq	Read Level	LISN Level	Factor	Cable Loss	Limit Line	Over Limit	Remark
	MHz	dBuV	dBuV	dB	dB	dBuV	dB	
1	0.15	8.87	29.92	10.90	10.15	55.91	-25.99	Average
2	0.15	18.90	39.95	10.90	10.15	65.91	-25.96	QP
3	0.22	3.93	24.84	10.76	10.15	52.66	-27.82	Average
4	0.22	10.61	31.52	10.76	10.15	62.66	-31.14	QP
5	0.48	16.44	37.11	10.51	10.16	46.32	-9.21	Average
6	0.48	23.72	44.39	10.51	10.16	56.32	-11.93	QP
7	0.51	9.05	29.71	10.50	10.16	46.00	-16.29	Average
8	0.51	20.47	41.13	10.50	10.16	56.00	-14.87	QP
9	3.49	-0.98	19.65	10.36	10.27	46.00	-26.35	Average
10	3.49	5.47	26.10	10.36	10.27	56.00	-29.90	QP
11	9.55	0.83	21.67	10.59	10.25	50.00	-28.33	Average
12	9.55	6.37	27.21	10.59	10.25	60.00	-32.79	QP

AC 120V/60 Hz, Neutral



Condition: Neutral
Project : 2401S39342E-RF
Tester : Macy shi
Note : 2.4G WIFI

	Freq	Read Level	Level	LISN Factor	Cable Loss	Limit Line	Over Limit	Remark
	MHz	dBuV	dBuV	dB	dB	dBuV	dB	
1	0.15	8.74	29.47	10.58	10.15	55.74	-26.27	Average
2	0.15	17.83	38.56	10.58	10.15	65.74	-27.18	QP
3	0.26	8.44	29.12	10.49	10.19	51.34	-22.22	Average
4	0.26	15.11	35.79	10.49	10.19	61.34	-25.55	QP
5	0.41	10.10	30.95	10.64	10.21	47.64	-16.69	Average
6	0.41	18.61	39.46	10.64	10.21	57.64	-18.18	QP
7	0.53	16.78	37.65	10.70	10.17	46.00	-8.35	Average
8	0.53	21.74	42.61	10.70	10.17	56.00	-13.39	QP
9	5.01	7.75	28.49	10.52	10.22	50.00	-21.51	Average
10	5.01	14.63	35.37	10.52	10.22	60.00	-24.63	QP
11	7.25	7.65	28.58	10.71	10.22	50.00	-21.42	Average
12	7.25	14.39	35.32	10.71	10.22	60.00	-24.68	QP

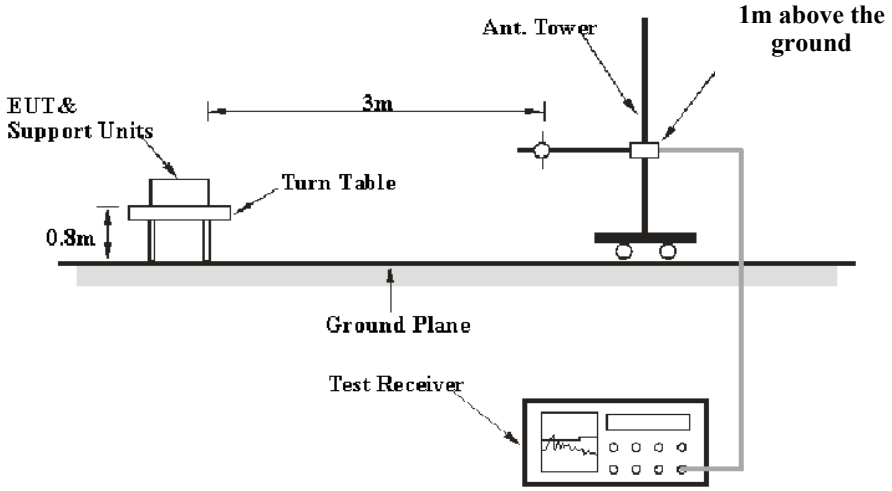
FCC §15.209, §15.205 & §15.247(d) - SPURIOUS EMISSIONS

Applicable Standard

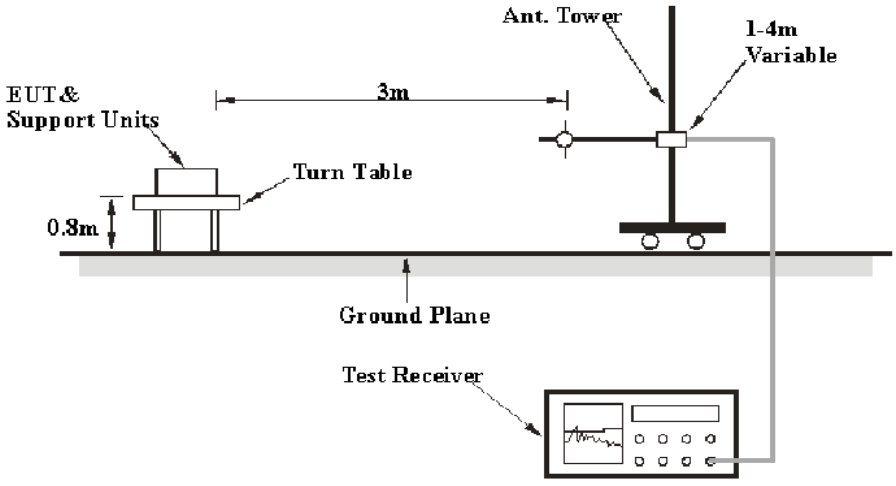
FCC §15.247 (d); §15.209; §15.205;

EUT Setup

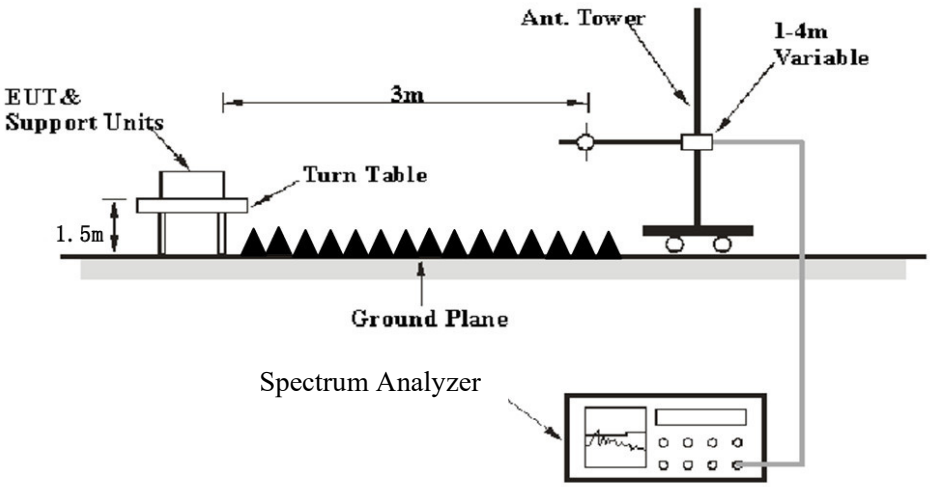
9 kHz-30MHz:



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. The specification used was the FCC 15.209, and FCC 15.247 limits.

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:

Factor = Antenna Factor + Cable Loss - 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:

Over Limit/Margin = Level/Corrected Amplitude – Limit
Level / Corrected Amplitude = Read Level + Factor

Test Data

Environmental Conditions

Temperature:	25~25.5 ℃
Relative Humidity:	50~54 %
ATM Pressure:	101 kPa

The testing was performed by Warren Huang on 2024-05-10 for below 1GHz and Zenos Qiao from 2024-05-08 to 2024-05-09 for above 1GHz.

EUT operation mode: Transmitting

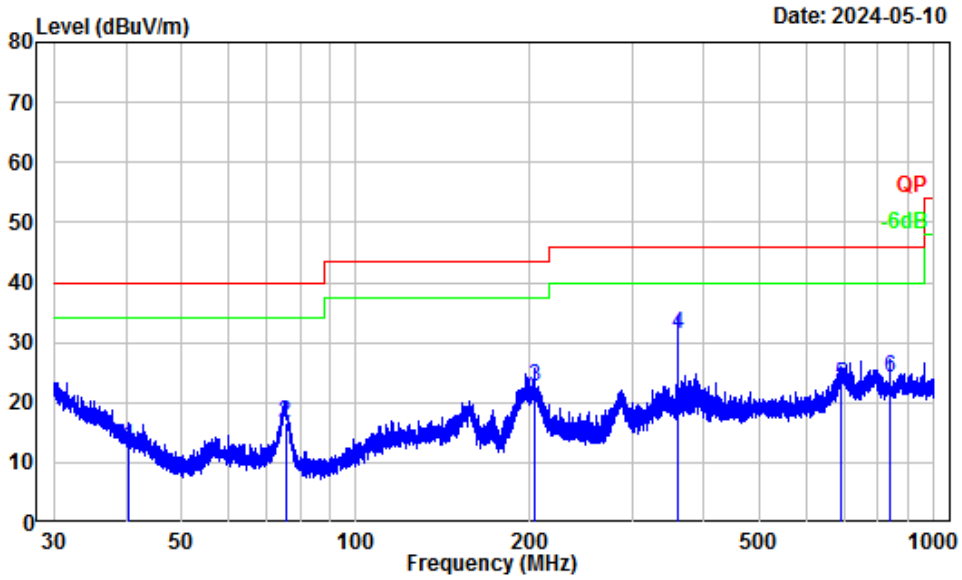
9 kHz-30MHz: *(Maximum output power mode, 802.11n20 Low Channel)*

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

30MHz-1GHz:

BLE *(Maximum output power mode, BLE 2M Middle Channel)*

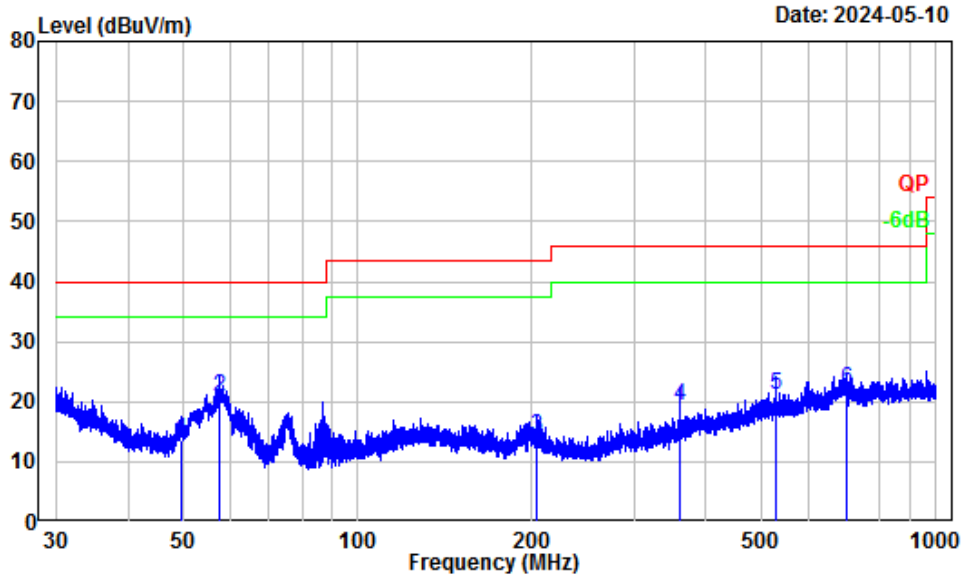
Horizontal



Site : Chamber A
Condition : 3m Horizontal
Project Number: 2401S39342E-RF
Note : BLE
Tester : Warren Huang

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	40.42	-11.78	24.40	12.62	40.00	-27.38	QP
2	75.51	-17.93	34.63	16.70	40.00	-23.30	QP
3	203.97	-13.55	36.11	22.56	43.50	-20.94	QP
4	359.97	-11.71	43.14	31.43	46.00	-14.57	QP
5	690.47	-6.28	29.33	23.05	46.00	-22.95	QP
6	840.29	-4.92	28.95	24.03	46.00	-21.97	QP

Vertical

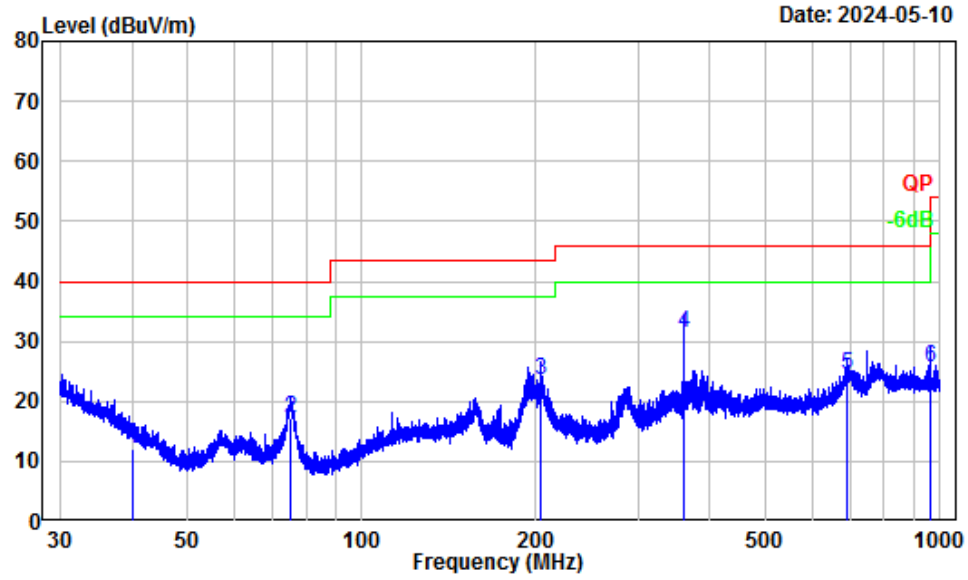


Site : Chamber A
Condition : 3m Vertical
Project Number: 2401S39342E-RF
Note : BLE
Tester : Warren Huang

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	49.55	-18.41	31.95	13.54	40.00	-26.46	QP
2	57.70	-18.81	39.56	20.75	40.00	-19.25	QP
3	203.97	-14.69	28.97	14.28	43.50	-29.22	QP
4	359.97	-11.99	31.40	19.41	46.00	-26.59	QP
5	528.01	-8.36	29.61	21.25	46.00	-24.75	QP
6	699.92	-6.58	28.59	22.01	46.00	-23.99	QP

2.4G Wi-Fi: *(Maximum output power mode, 802.11n20 Low Channel)*

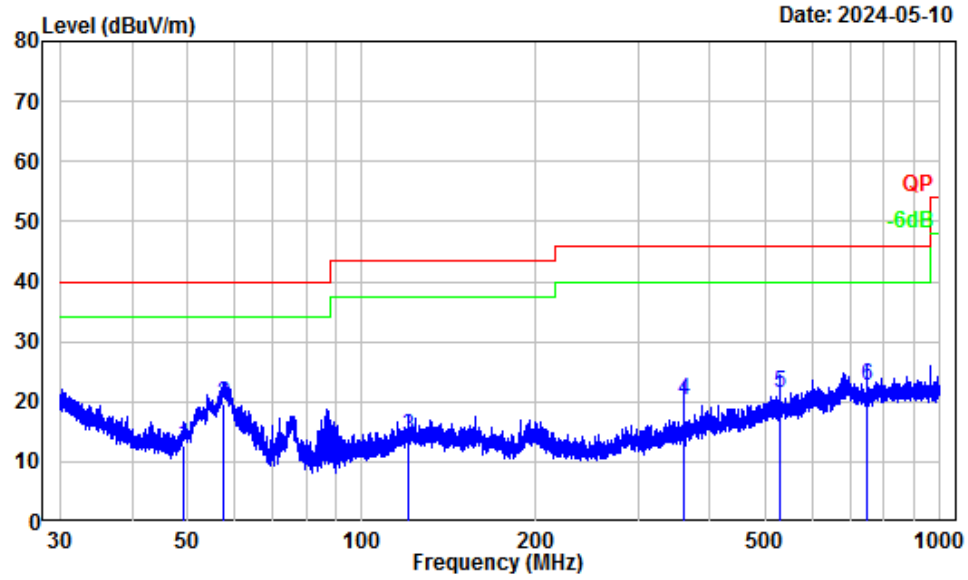
Horizontal



Site : Chamber A
Condition : 3m Horizontal
Project Number: 2401S39342E-RF
Note : 2.4G WIFI
Tester : Warren Huang

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	40.08	-11.57	23.76	12.19	40.00	-27.81	QP
2	75.28	-17.91	35.11	17.20	40.00	-22.80	QP
3	203.97	-13.55	37.00	23.45	43.50	-20.05	QP
4	359.97	-11.71	43.12	31.41	46.00	-14.59	QP
5	689.26	-6.29	30.63	24.34	46.00	-21.66	QP
6	959.64	-4.22	29.99	25.77	46.00	-20.23	QP

Vertical



Site : Chamber A
Condition : 3m Vertical
Project Number: 2401S39342E-RF
Note : 2.4G WIFI
Tester : Warren Huang

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	49.27	-18.25	30.85	12.60	40.00	-27.40	QP
2	57.67	-18.81	38.46	19.65	40.00	-20.35	QP
3	120.07	-12.77	27.09	14.32	43.50	-29.18	QP
4	359.97	-11.99	32.07	20.08	46.00	-25.92	QP
5	528.01	-8.36	29.81	21.45	46.00	-24.55	QP
6	745.85	-6.09	28.87	22.78	46.00	-23.22	QP

1-25 GHz:

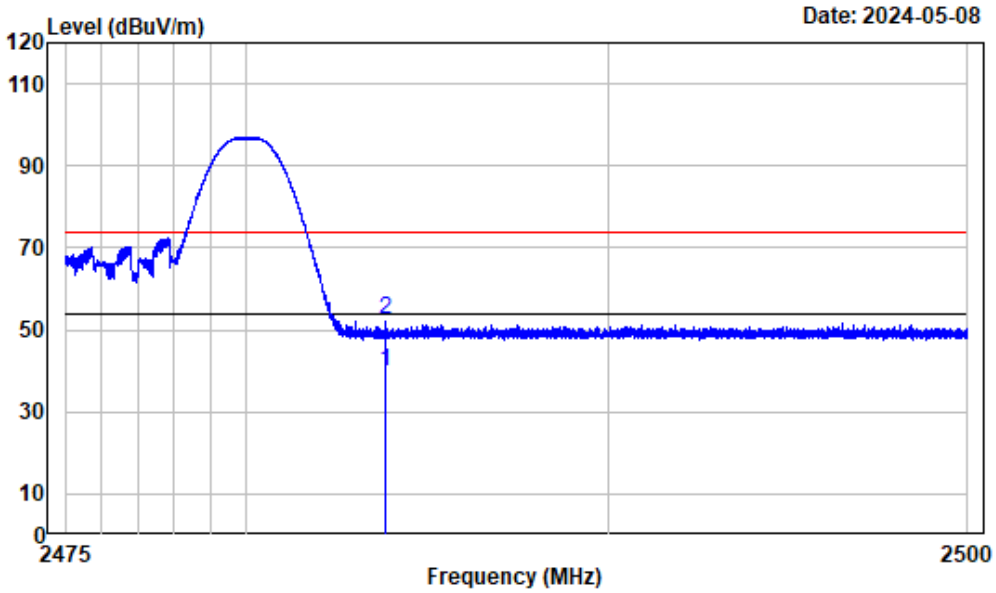
Frequency (MHz)	Receiver		Polar (H/V)	Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/AV					
BLE 1M							
Low Channel 2402MHz							
2389.94	55.17	PK	H	-2.93	52.24	74	-21.76
2389.94	41.98	AV	H	-2.93	39.05	54	-14.95
2389.59	55.53	PK	V	-2.93	52.60	74	-21.40
2389.59	42.25	AV	V	-2.93	39.32	54	-14.68
4804.00	47.09	PK	H	2.42	49.51	74	-24.49
4804.00	32.75	AV	H	2.42	35.17	54	-18.83
4804.00	47.36	PK	V	2.42	49.78	74	-24.22
4804.00	32.98	AV	V	2.42	35.40	54	-18.60
Middle Channel 2440MHz							
4880.00	47.24	PK	H	2.58	49.82	74	-24.18
4880.00	32.87	AV	H	2.58	35.45	54	-18.55
4880.00	47.45	PK	V	2.58	50.03	74	-23.97
4880.00	33.06	AV	V	2.58	35.64	54	-18.36
High Channel 2480MHz							
2483.83	55.78	PK	H	-3.17	52.61	74	-21.39
2483.83	42.89	AV	H	-3.17	39.72	54	-14.28
2483.61	55.43	PK	V	-3.17	52.26	74	-21.74
2483.61	42.64	AV	V	-3.17	39.47	54	-14.53
4960.00	46.58	PK	H	2.68	49.26	74	-24.74
4960.00	32.63	AV	H	2.68	35.31	54	-18.69
4960.00	46.84	PK	V	2.68	49.52	74	-24.48
4960.00	32.77	AV	V	2.68	35.45	54	-18.55

Frequency (MHz)	Receiver		Polar (H/V)	Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/AV					
BLE 2M							
Low Channel 2402MHz							
2389.13	55.26	PK	H	-2.93	52.33	74	-21.67
2389.13	42.52	AV	H	-2.93	39.59	54	-14.41
2389.48	55.63	PK	V	-2.93	52.70	74	-21.30
2389.48	42.78	AV	V	-2.93	39.85	54	-14.15
4804.00	47.42	PK	H	2.42	49.84	74	-24.16
4804.00	33.39	AV	H	2.42	35.81	54	-18.19
4804.00	47.58	PK	V	2.42	50.00	74	-24.00
4804.00	33.67	AV	V	2.42	36.09	54	-17.91
Middle Channel 2440MHz							
4880.00	47.64	PK	H	2.58	50.22	74	-23.78
4880.00	33.53	AV	H	2.58	36.11	54	-17.89
4880.00	47.81	PK	V	2.58	50.39	74	-23.61
4880.00	33.79	AV	V	2.58	36.37	54	-17.63
High Channel 2480MHz							
2483.59	56.01	PK	H	-3.17	52.84	74	-21.16
2483.59	44.54	AV	H	-3.17	41.37	54	-12.63
2483.75	55.69	PK	V	-3.17	52.52	74	-21.48
2483.75	44.25	AV	V	-3.17	41.08	54	-12.92
4960.00	47.02	PK	H	2.68	49.70	74	-24.30
4960.00	33.27	AV	H	2.68	35.95	54	-18.05
4960.00	47.19	PK	V	2.68	49.87	74	-24.13
4960.00	33.45	AV	V	2.68	36.13	54	-17.87

Note:
Corrected Factor = Antenna factor (RX) + Cable Loss – Amplifier Factor
Corrected Amplitude = Corrected 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):

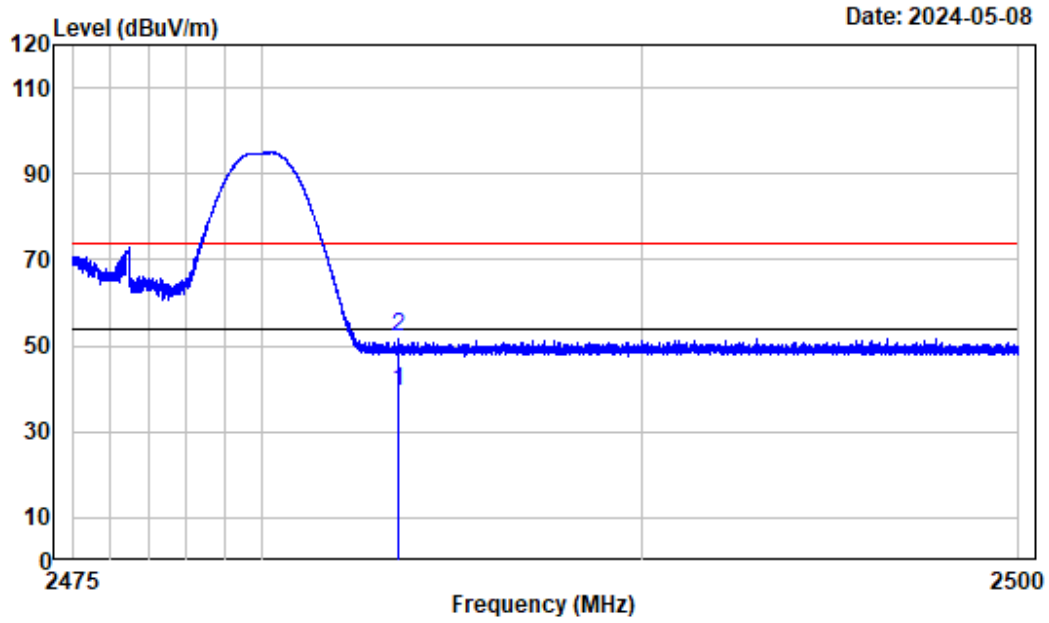
BLE 1M			
Test Channel:	**2480MHz**	**Ant. Polar. :**	**Horizontal**



Condition : Horizontal
Project No.: 2401S39342E-RF
Tester : Zenos Qiao
Note : BLE1M-2480

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	2483.831	-3.17	42.89	39.72	54.00	-14.28	Average
2	2483.831	-3.17	55.78	52.61	74.00	-21.39	Peak

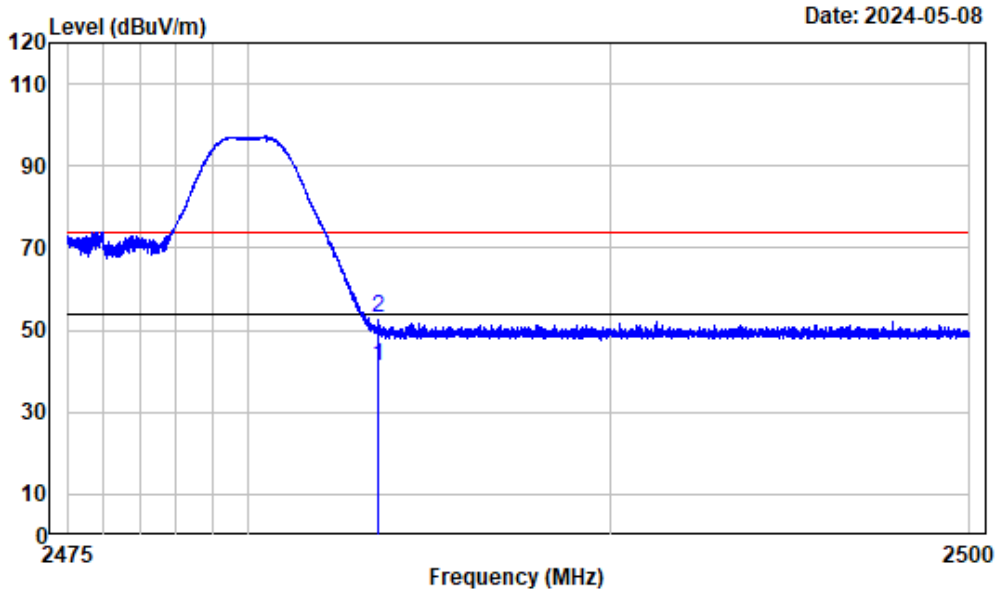
BLE 1M			
Test Channel:	**2480MHz**	**Ant. Polar. :**	**Vertical**



Condition : Vertical
Project No.: 2401S39342E-RF
Tester : Zenos Qiao
Note : BLE1M-2480

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	2483.609	-3.17	42.64	39.47	54.00	-14.53	Average
2	2483.609	-3.17	55.43	52.26	74.00	-21.74	Peak

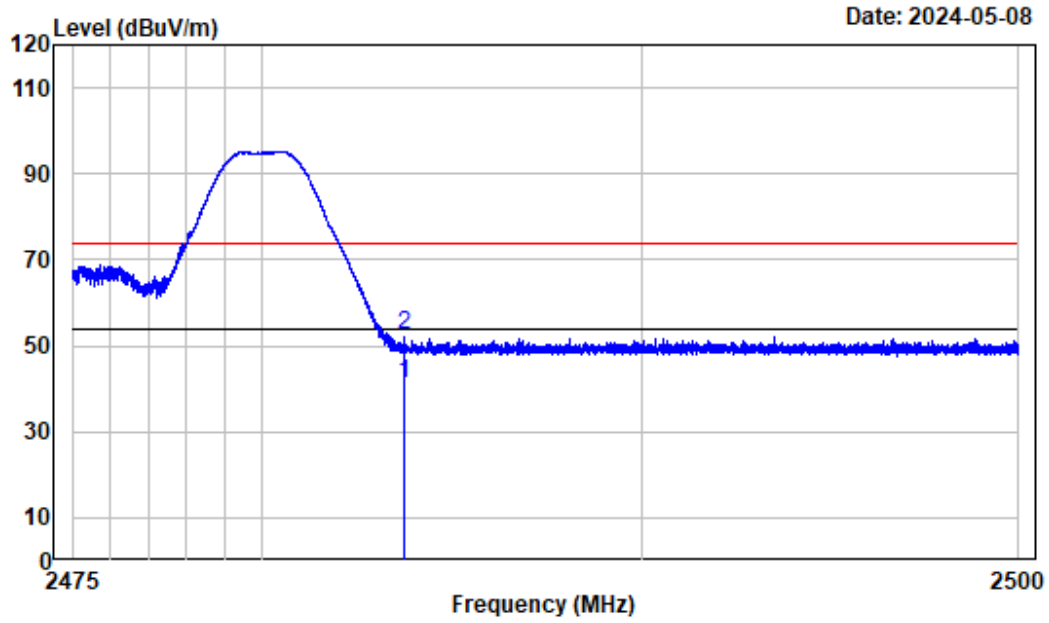
BLE 2M			
Test Channel:	**2480MHz**	**Ant. Polar. :**	**Horizontal**



Condition : Horizontal
Project No.: 2401S39342E-RF
Tester : Zenos Qiao
Note : BLE2M-2480

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	2483.594	-3.17	44.54	41.37	54.00	-12.63	Average
2	2483.594	-3.17	56.01	52.84	74.00	-21.16	Peak

BLE 2M			
Test Channel:	**2480MHz**	**Ant. Polar. :**	**Vertical**



Condition : Vertical
Project No.: 2401S39342E-RF
Tester : Zenos Qiao
Note : BLE2M-2480

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	2483.753	-3.17	44.25	41.08	54.00	-12.92	Average
2	2483.753	-3.17	55.69	52.52	74.00	-21.48	Peak

2.4G Wi-Fi

Frequency (MHz)	Receiver		Polar (H/V)	Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/AV					
ANT 1							
802.11b							
Low Channel 2412MHz							
2386.35	58.96	PK	H	-2.93	56.03	74	-17.97
2386.35	46.13	AV	H	-2.93	43.20	54	-10.80
2387.54	57.84	PK	V	-2.93	54.91	74	-19.09
2387.54	45.37	AV	V	-2.93	42.44	54	-11.56
4824.00	48.21	PK	H	2.45	50.66	74	-23.34
4824.00	33.09	AV	H	2.45	35.54	54	-18.46
4824.00	48.73	PK	V	2.45	51.18	74	-22.82
4824.00	33.64	AV	V	2.45	36.09	54	-17.91
Middle Channel 2437MHz							
4874.00	47.86	PK	H	2.56	50.42	74	-23.58
4874.00	32.42	AV	H	2.56	34.98	54	-19.02
4874.00	48.39	PK	V	2.56	50.95	74	-23.05
4874.00	33.05	AV	V	2.56	35.61	54	-18.39
High Channel 2462MHz							
2484.50	57.16	PK	H	-3.17	53.99	74	-20.01
2484.50	44.98	AV	H	-3.17	41.81	54	-12.19
2483.96	56.57	PK	V	-3.17	53.40	74	-20.60
2483.96	44.25	AV	V	-3.17	41.08	54	-12.92
4924.00	47.42	PK	H	2.63	50.05	74	-23.95
4924.00	31.75	AV	H	2.63	34.38	54	-19.62
4924.00	47.97	PK	V	2.63	50.60	74	-23.40
4924.00	32.48	AV	V	2.63	35.11	54	-18.89

Frequency (MHz)	Receiver		Polar (H/V)	Factor (dB/m)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
	Reading (dBµV)	PK/AV					
ANT 2							
802.11b							
Low Channel 2412MHz							
2388.69	56.78	PK	H	-2.93	53.85	74	-20.15
2388.69	44.89	AV	H	-2.93	41.96	54	-12.04
2386.70	57.67	PK	V	-2.93	54.74	74	-19.26
2386.70	45.52	AV	V	-2.93	42.59	54	-11.41
4824.00	49.87	PK	H	2.45	52.32	74	-21.68
4824.00	41.92	AV	H	2.45	44.37	54	-9.63
4824.00	51.14	PK	V	2.45	53.59	74	-20.41
4824.00	43.05	AV	V	2.45	45.50	54	-8.50
Middle Channel 2437MHz							
4874.00	50.56	PK	H	2.56	53.12	74	-20.88
4874.00	42.73	AV	H	2.56	45.29	54	-8.71
4874.00	51.92	PK	V	2.56	54.48	74	-19.52
4874.00	43.84	AV	V	2.56	46.40	54	-7.60
High Channel 2462MHz							
2487.25	58.37	PK	H	-3.17	55.20	74	-18.80
2487.25	46.86	AV	H	-3.17	43.69	54	-10.31
2488.43	59.55	PK	V	-3.17	56.38	74	-17.62
2488.43	47.69	AV	V	-3.17	44.52	54	-9.48
4924.00	51.29	PK	H	2.63	53.92	74	-20.08
4924.00	43.51	AV	H	2.63	46.14	54	-7.86
4924.00	52.45	PK	V	2.63	55.08	74	-18.92
4924.00	44.68	AV	V	2.63	47.31	54	-6.69

Frequency (MHz)	Receiver		Polar (H/V)	Factor (dB/m)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
	Reading (dBµV)	PK/AV					
ANT 1							
802.11g							
Low Channel 2412MHz							
2389.71	67.09	PK	H	-2.93	64.16	74	-9.84
2389.71	52.14	AV	H	-2.93	49.21	54	-4.79
2389.94	66.75	PK	V	-2.93	63.82	74	-10.18
2389.94	51.88	AV	V	-2.93	48.95	54	-5.05
4824.00	47.04	PK	H	2.45	49.49	74	-24.51
4824.00	32.18	AV	H	2.45	34.63	54	-19.37
4824.00	47.39	PK	V	2.45	49.84	74	-24.16
4824.00	32.45	AV	V	2.45	34.90	54	-19.10
Middle Channel 2437MHz							
4874.00	46.82	PK	H	2.56	49.38	74	-24.62
4874.00	32.03	AV	H	2.56	34.59	54	-19.41
4874.00	47.07	PK	V	2.56	49.63	74	-24.37
4874.00	32.25	AV	V	2.56	34.81	54	-19.19
High Channel 2462MHz							
2483.69	68.87	PK	H	-3.17	65.70	74	-8.30
2483.69	50.96	AV	H	-3.17	47.79	54	-6.21
2483.78	67.49	PK	V	-3.17	64.32	74	-9.68
2483.78	49.78	AV	V	-3.17	46.61	54	-7.39
4924.00	46.53	PK	H	2.63	49.16	74	-24.84
4924.00	31.81	AV	H	2.63	34.44	54	-19.56
4924.00	46.87	PK	V	2.63	49.50	74	-24.50
4924.00	32.06	AV	V	2.63	34.69	54	-19.31

Frequency (MHz)	Receiver		Polar (H/V)	Factor (dB/m)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
	Reading (dBµV)	PK/AV					
ANT 2							
802.11g							
Low Channel 2412MHz							
2389.32	66.24	PK	H	-2.93	63.31	74	-10.69
2389.32	51.58	AV	H	-2.93	48.65	54	-5.35
2389.59	67.42	PK	V	-2.93	64.49	74	-9.51
2389.59	52.75	AV	V	-2.93	49.82	54	-4.18
4824.00	47.77	PK	H	2.45	50.22	74	-23.78
4824.00	34.06	AV	H	2.45	36.51	54	-17.49
4824.00	48.95	PK	V	2.45	51.40	74	-22.60
4824.00	34.89	AV	V	2.45	37.34	54	-16.66
Middle Channel 2437MHz							
4874.00	48.08	PK	H	2.56	50.64	74	-23.36
4874.00	34.35	AV	H	2.56	36.91	54	-17.09
4874.00	49.24	PK	V	2.56	51.80	74	-22.20
4874.00	35.17	AV	V	2.56	37.73	54	-16.27
High Channel 2462MHz							
2483.78	70.48	PK	H	-3.17	67.31	74	-6.69
2483.78	52.32	AV	H	-3.17	49.15	54	-4.85
2484.37	71.73	PK	V	-3.17	68.56	74	-5.44
2484.37	53.25	AV	V	-3.17	50.08	54	-3.92
4924.00	48.39	PK	H	2.63	51.02	74	-22.98
4924.00	34.68	AV	H	2.63	37.31	54	-16.69
4924.00	49.53	PK	V	2.63	52.16	74	-21.84
4924.00	35.45	AV	V	2.63	38.08	54	-15.92

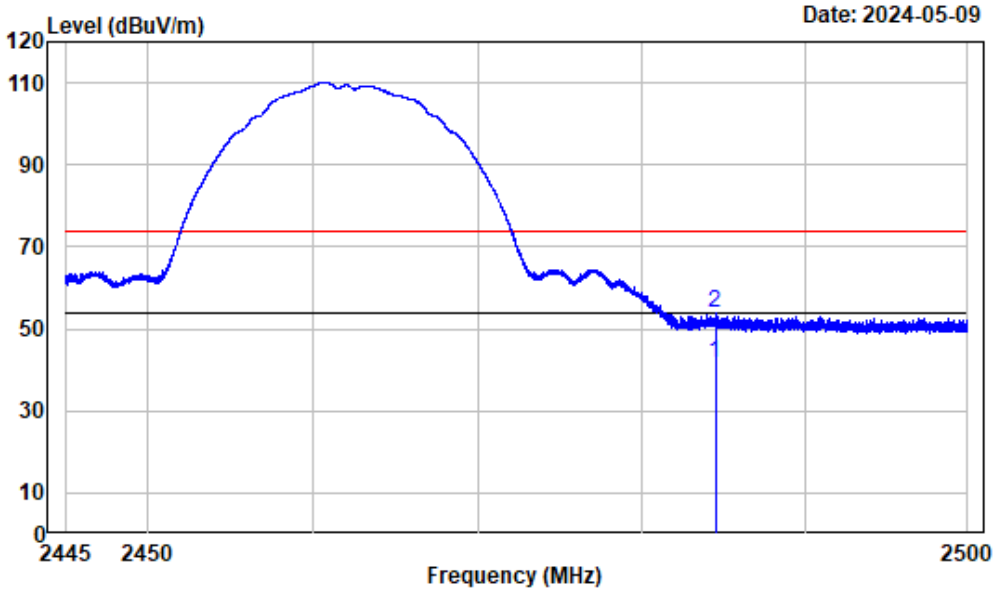
Frequency (MHz)	Receiver		Polar (H/V)	Factor (dB/m)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
	Reading (dBµV)	PK/AV					
802.11n20							
Low Channel 2412MHz							
2389.71	67.36	PK	H	-2.93	64.43	74	-9.57
2389.71	52.72	AV	H	-2.93	49.79	54	-4.21
2389.94	66.45	PK	V	-2.93	63.52	74	-10.48
2389.94	51.57	AV	V	-2.93	48.64	54	-5.36
4824.00	47.82	PK	H	2.45	50.27	74	-23.73
4824.00	33.69	AV	H	2.45	36.14	54	-17.86
4824.00	48.78	PK	V	2.45	51.23	74	-22.77
4824.00	34.57	AV	V	2.45	37.02	54	-16.98
Middle Channel 2437MHz							
4874.00	48.38	PK	H	2.56	50.94	74	-23.06
4874.00	34.54	AV	H	2.56	37.10	54	-16.90
4874.00	49.26	PK	V	2.56	51.82	74	-22.18
4874.00	35.45	AV	V	2.56	38.01	54	-15.99
High Channel 2462MHz							
2483.58	71.95	PK	H	-3.17	68.78	74	-5.22
2483.58	53.56	AV	H	-3.17	50.39	54	-3.61
2483.63	70.07	PK	V	-3.17	66.90	74	-7.10
2483.63	52.39	AV	V	-3.17	49.22	54	-4.78
4924.00	48.94	PK	H	2.63	51.57	74	-22.43
4924.00	35.57	AV	H	2.63	38.20	54	-15.80
4924.00	49.85	PK	V	2.63	52.48	74	-21.52
4924.00	36.62	AV	V	2.63	39.25	54	-14.75

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							
2389.59	67.78	PK	H	-2.93	64.85	74	-9.15
2389.59	53.25	AV	H	-2.93	50.32	54	-3.68
2389.83	66.53	PK	V	-2.93	63.60	74	-10.40
2389.83	51.96	AV	V	-2.93	49.03	54	-4.97
4844.00	47.37	PK	H	2.45	49.82	74	-24.18
4844.00	32.52	AV	H	2.45	34.97	54	-19.03
4844.00	47.68	PK	V	2.45	50.13	74	-23.87
4844.00	33.05	AV	V	2.45	35.50	54	-18.50
Middle Channel 2437MHz							
4874.00	47.25	PK	H	2.56	49.81	74	-24.19
4874.00	32.48	AV	H	2.56	35.04	54	-18.96
4874.00	47.56	PK	V	2.56	50.12	74	-23.88
4874.00	32.99	AV	V	2.56	35.55	54	-18.45
High Channel 2452MHz							
2483.89	68.28	PK	H	-3.17	65.11	74	-8.89
2483.89	53.77	AV	H	-3.17	50.60	54	-3.40
2484.16	67.09	PK	V	-3.17	63.92	74	-10.08
2484.16	52.45	AV	V	-3.17	49.28	54	-4.72
4904.00	47.19	PK	H	2.64	49.83	74	-24.17
4904.00	32.66	AV	H	2.64	35.30	54	-18.70
4904.00	47.75	PK	V	2.64	50.39	74	-23.61
4904.00	33.27	AV	V	2.64	35.91	54	-18.09

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):

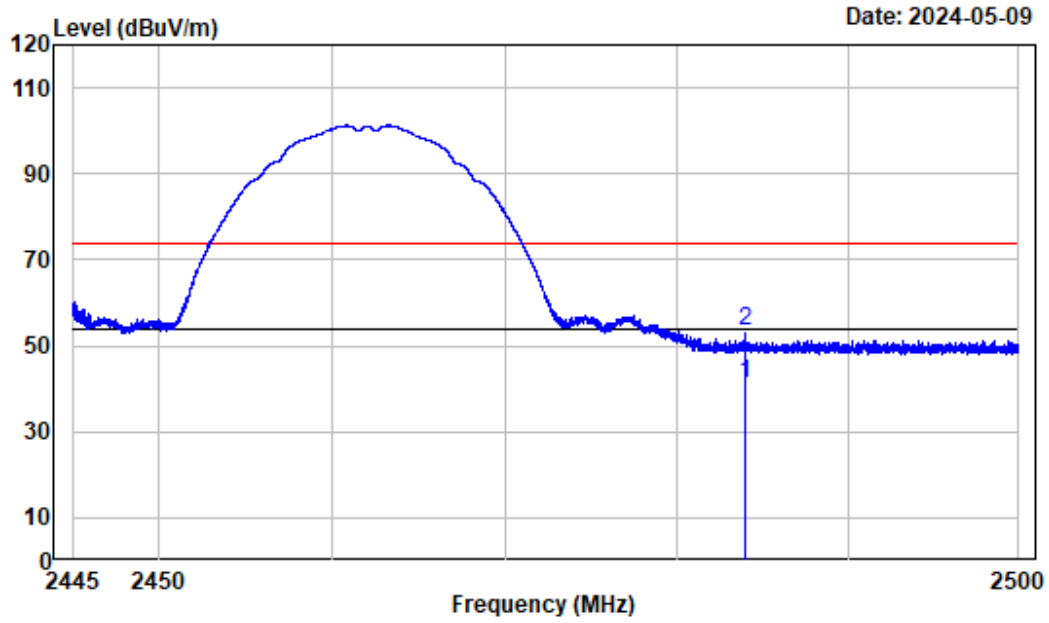
ANT1-802.11b			
Test Channel:	**2462MHz**	**Ant. Polar. :**	**Horizontal**



Condition : Horizontal
Project No.: 2401S39342E-RF
Tester : Zenos Qiao
Note :

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	2484.497	-3.17	44.98	41.81	54.00	-12.19	Average
2	2484.497	-3.17	57.16	53.99	74.00	-20.01	Peak

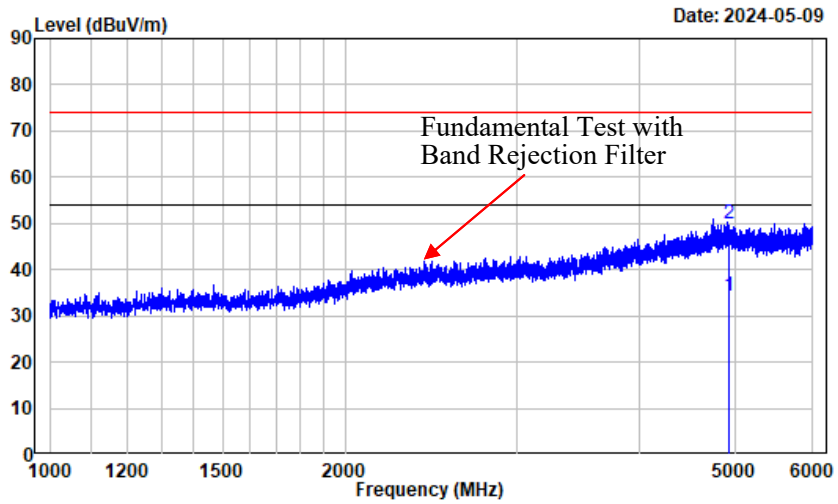
ANT1-802.11b			
Test Channel:	**2462MHz**	**Ant. Polar. :**	**Vertical**

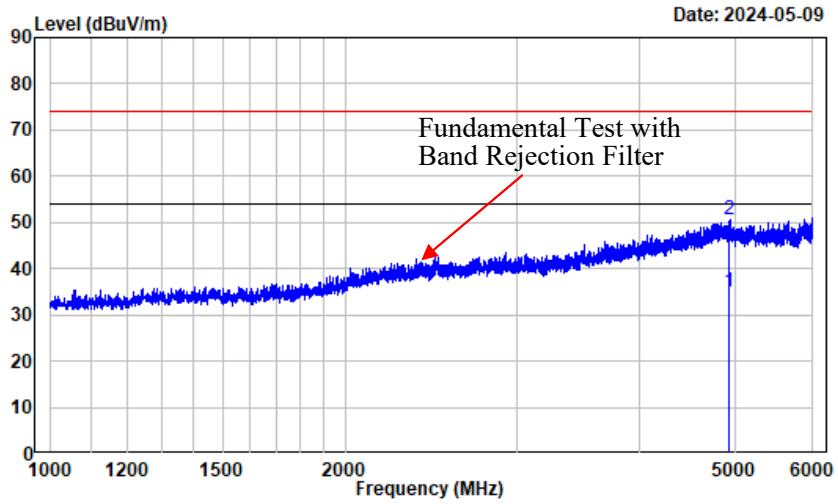


Condition : Vertical
Project No.: 2401S39342E-RF
Tester : Zenos Qiao
Note :

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	2483.961	-3.17	44.25	41.08	54.00	-12.92	Average
2	2483.961	-3.17	56.57	53.40	74.00	-20.60	Peak

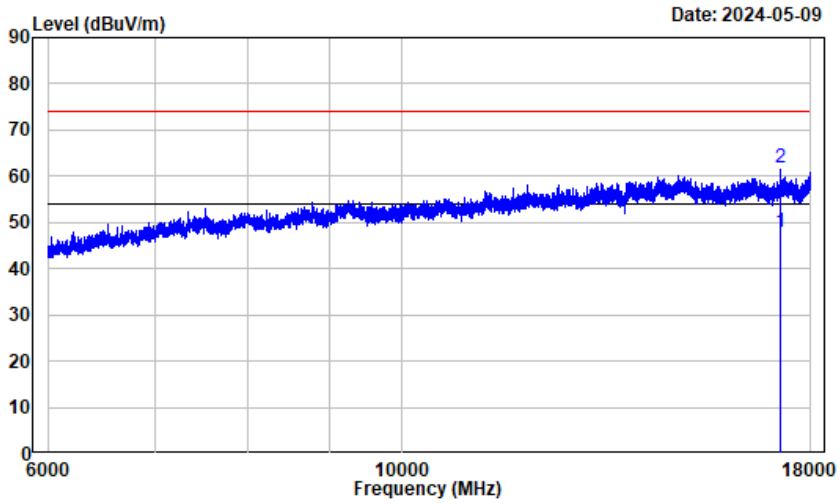
Harmonic and spurious emissions Measurements: ANT1, 802.11b 2462MHz

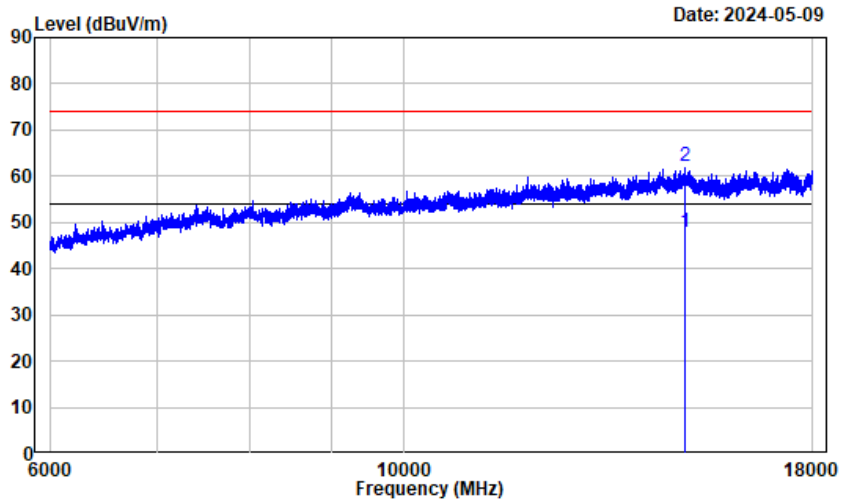
Horizontal	
1-6GHz	 Condition : Horizontal Project No.: 2401S39342E-RF Tester : Zenos Qiao Note : Freq / Factor / Read Level / Limit Level / Limit Line / Over Limit / Remark MHz / dB/m / dBuV / dBuV/m / dBuV/m / dB 1 4924.000 2.63 31.75 34.38 54.00 -19.62 Average 2 4924.000 2.63 47.42 50.05 74.00 -23.95 Peak

Vertical	
1-6GHz	

Condition : Vertical
Project No.: 2401S39342E-RF
Tester : Zenos Qiao
Note :

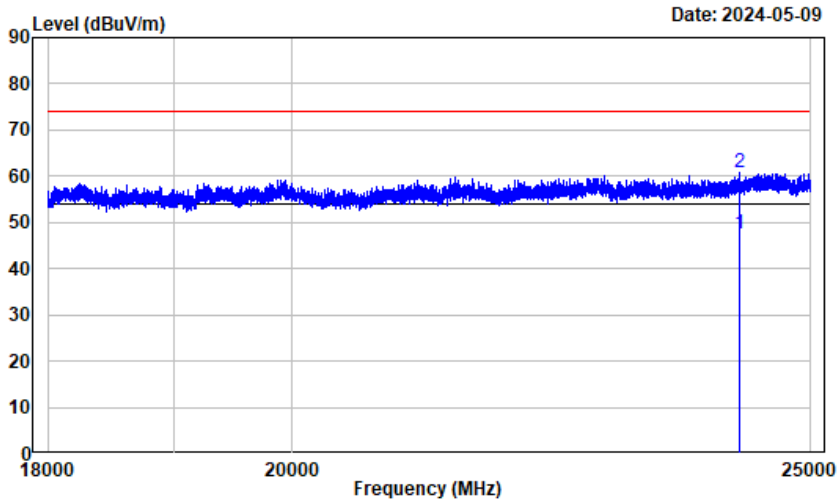
	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	4924.000	2.63	32.48	35.11	54.00	-18.89	Average
2	4924.000	2.63	47.97	50.60	74.00	-23.40	Peak

Horizontal	
6-18GHz	 Condition : Horizontal Project No.: 2401S39342E-RF Tester : Zenos Qiao Note : Freq / Factor / Read Level / Level / Limit Line / Over Limit / Remark MHz / dB/m / dBuV / dBuV/m / dBuV/m / dB 1 17223.000 18.80 28.92 47.72 54.00 -6.28 Average 2 17223.000 18.80 42.91 61.71 74.00 -12.29 Peak

Vertical	
6-18GHz	 Condition : Vertical Project No.: 2401S39342E-RF Tester : Zenos Qiao Note : Freq / Factor / Read Level / Level / Limit Line / Over Limit / Remark MHz / dB/m / dBuV / dBuV/m / dBuV/m / dB 1 14961.000 16.42 31.45 47.87 54.00 -6.13 Average 2 14961.000 16.42 45.67 62.09 74.00 -11.91 Peak

Horizontal

18-25GHz

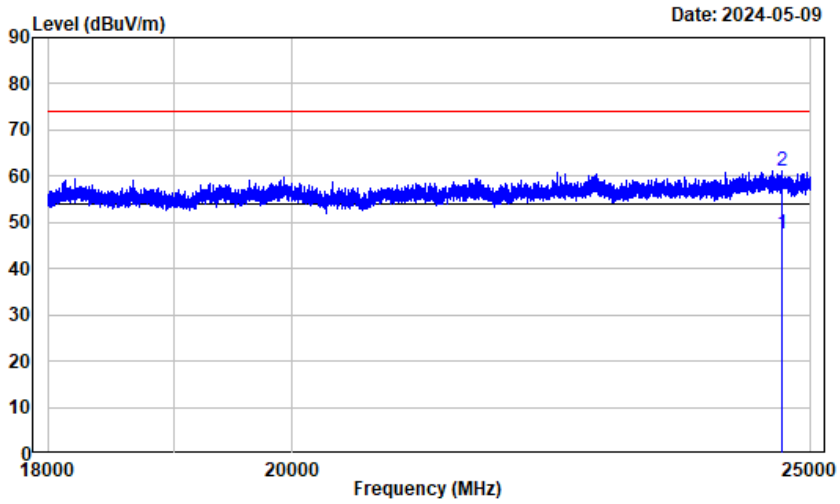


Condition : Horizontal
Project No.: 2401S39342E-RF
Tester : Zenos Qiao
Note :

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	24246.630	18.39	29.15	47.54	54.00	-6.46	Average
2	24246.630	18.39	42.50	60.89	74.00	-13.11	Peak

Vertical

18-25GHz



Condition : Vertical
Project No.: 2401S39342E-RF
Tester : Zenos Qiao
Note :

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	24685.000	18.77	28.91	47.68	54.00	-6.32	Average
2	24685.000	18.77	42.51	61.28	74.00	-12.72	Peak

FCC §15.247(a) (2) - 6 dB EMISSION BANDWIDTH

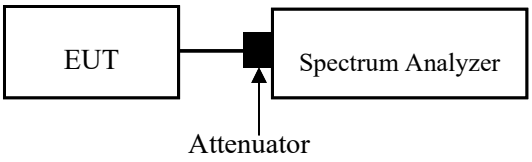
Applicable Standard

According to FCC §15.247(a) (2)
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.

Test Procedure

Test Method: ANSI C63.10-2013 Clause 11.8.1 & Clause 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.



Test Data

Environmental Conditions

Temperature:	25.3~25.7 ℃
Relative Humidity:	50~52 %
ATM Pressure:	101 kPa

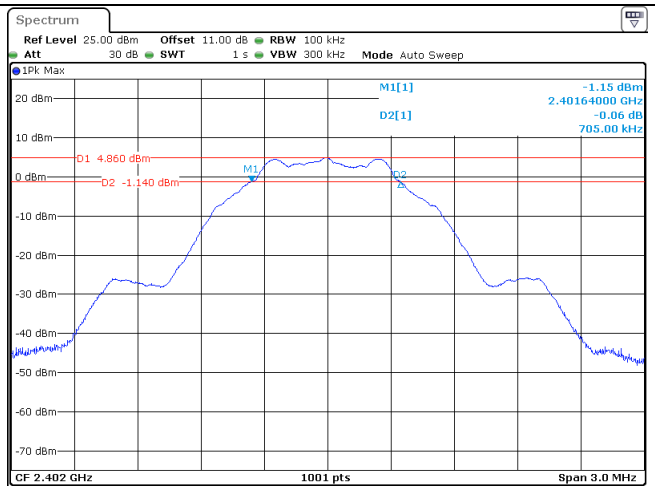
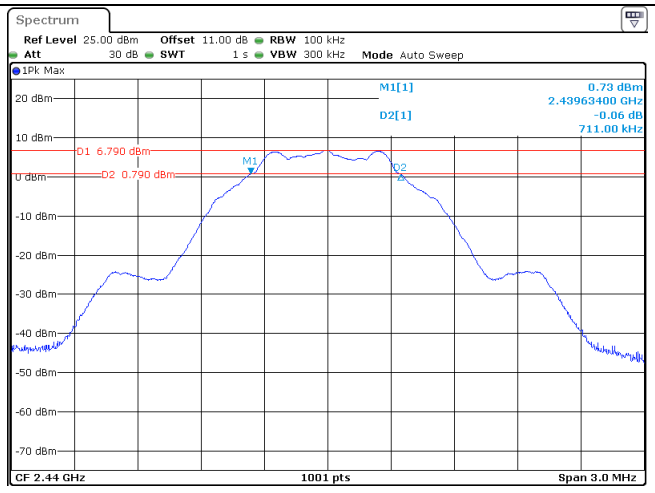
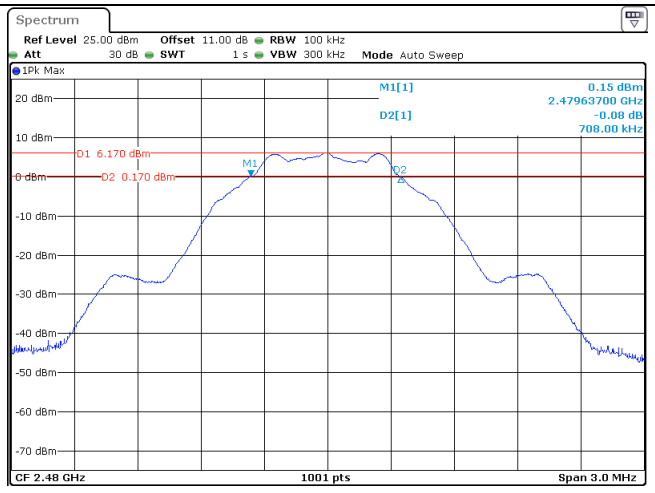
The testing was performed by Cheeb Huang on 2024-05-09.

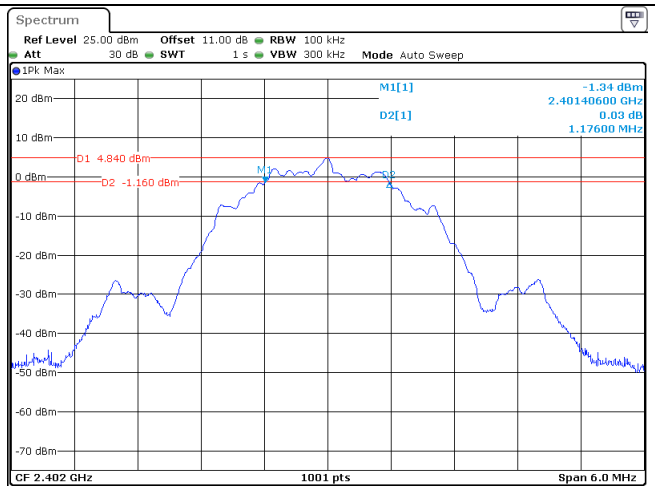
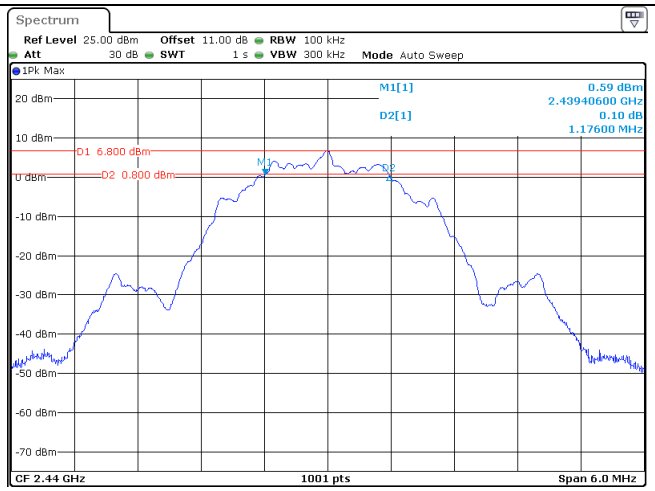
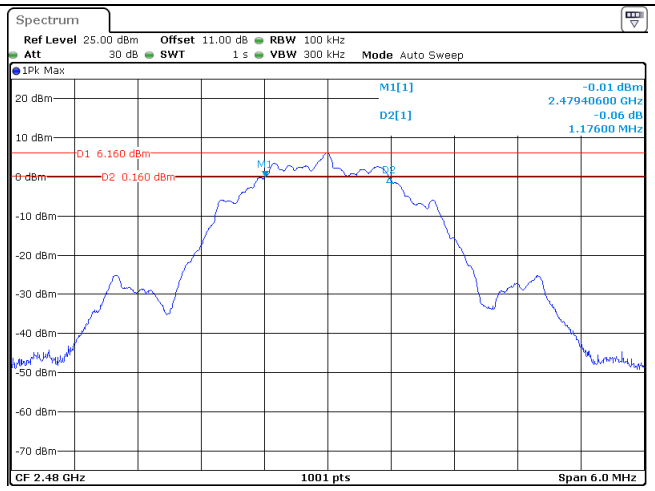
EUT operation mode: Transmitting

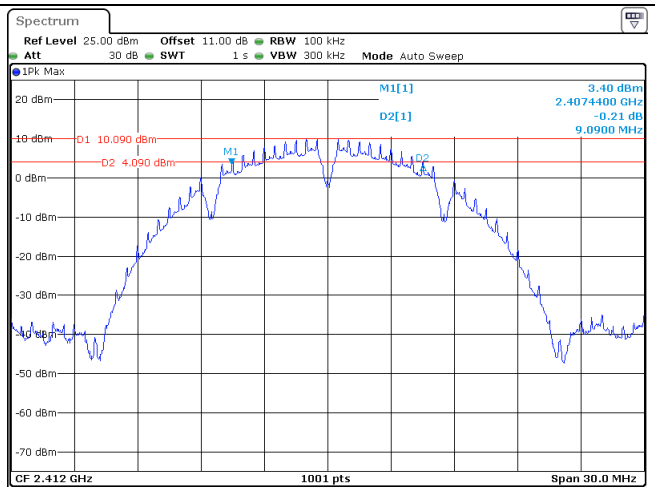
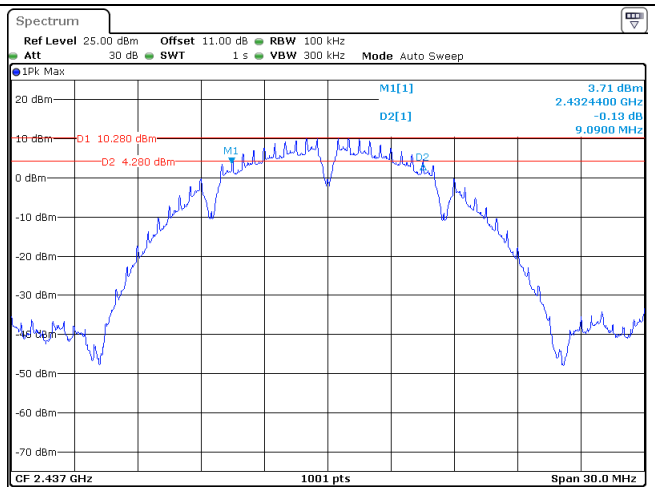
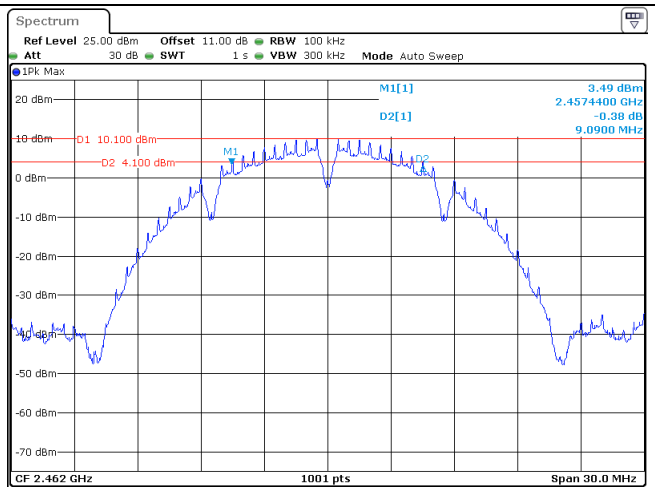
Test Result: Compliant.

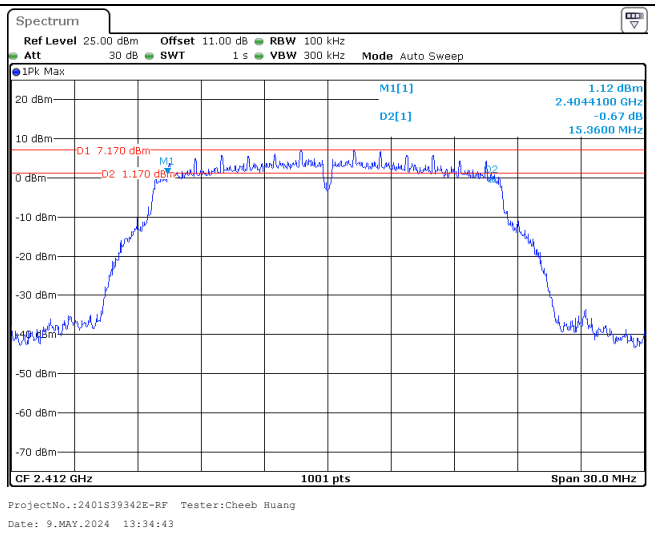
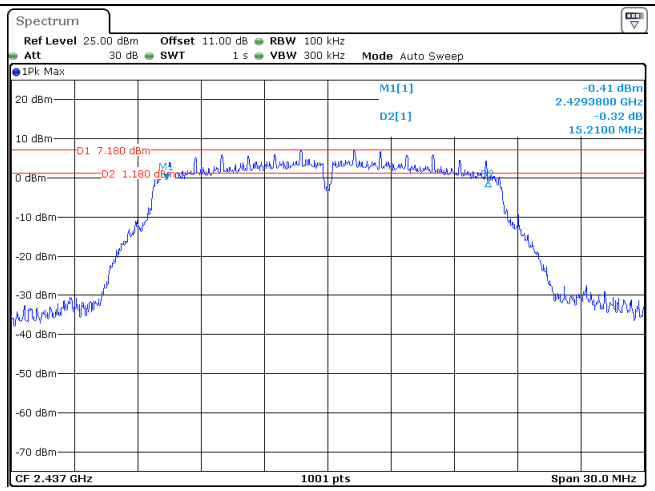
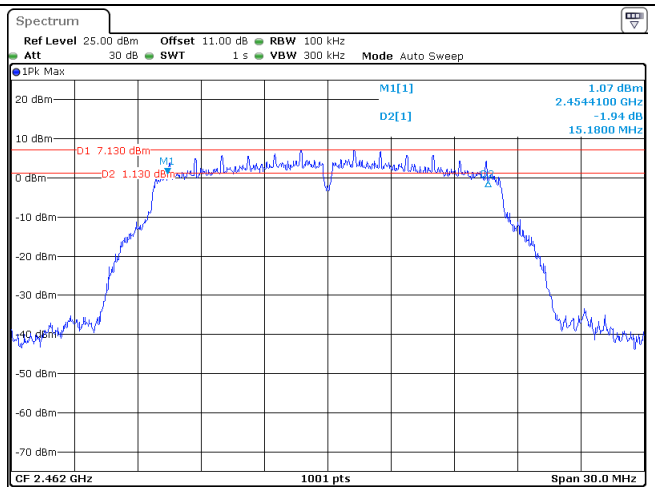
Test Modes	Test Frequency (MHz)	99% Occupied Bandwidth (MHz)	6 dB Bandwidth (MHz)	Limit (MHz)
BLE 1M	2402	1.037	0.705	≥0.5
	2440	1.037	0.711	≥0.5
	2480	1.037	0.708	≥0.5
BLE 2M	2402	2.068	1.176	≥0.5
	2440	2.068	1.176	≥0.5
	2480	2.068	1.176	≥0.5
802.11b	2412	13.506	9.090	≥0.5
	2437	13.506	9.090	≥0.5
	2462	13.506	9.090	≥0.5
802.11g	2412	16.823	15.360	≥0.5
	2437	16.823	15.210	≥0.5
	2462	16.823	15.180	≥0.5
802.11n20	2412	17.742	15.180	≥0.5
	2437	17.782	15.180	≥0.5
	2462	17.742	15.210	≥0.5
802.11n40	2422	36.124	35.280	≥0.5
	2437	36.204	35.220	≥0.5
	2452	36.204	35.280	≥0.5
Note: 2.4G Wi-Fi Test only was performed at ANT1.				

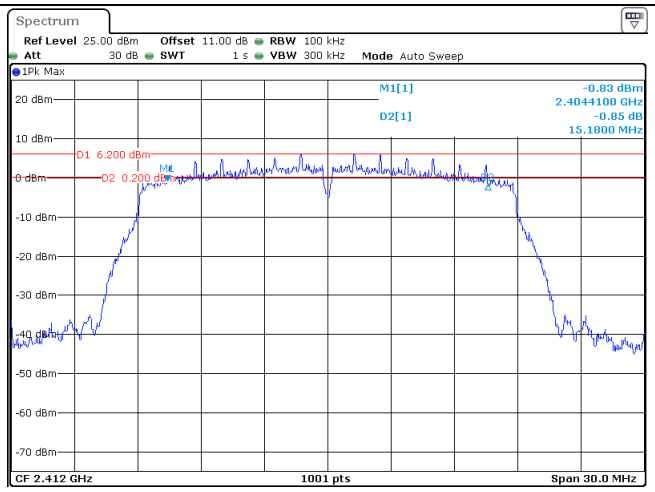
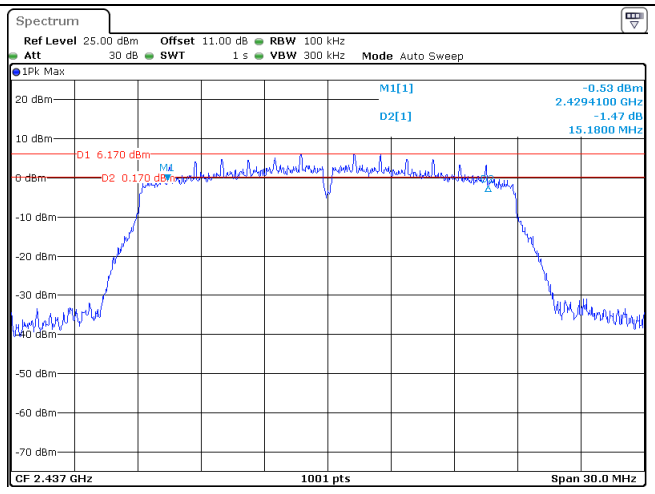
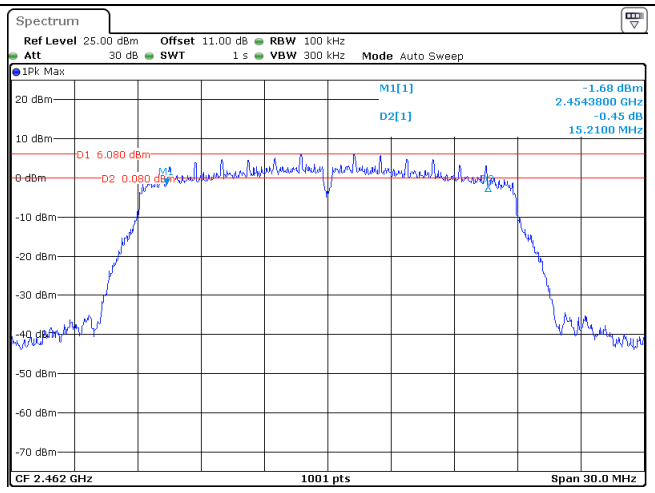
6 dB Bandwidth

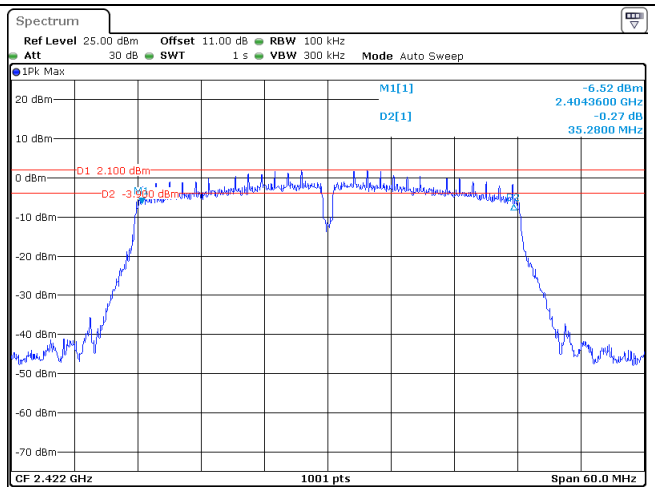
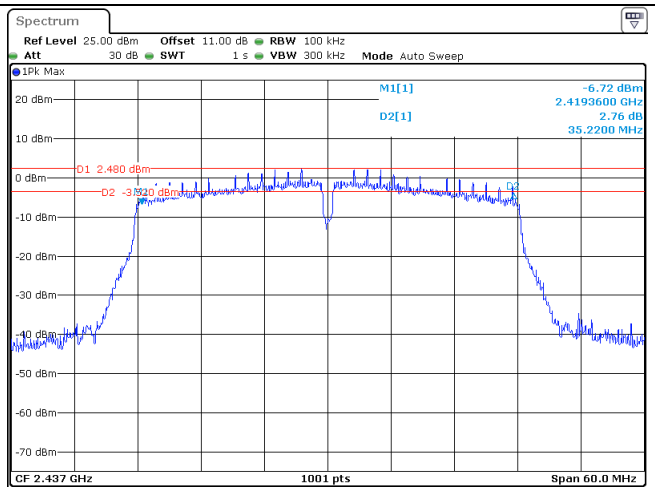
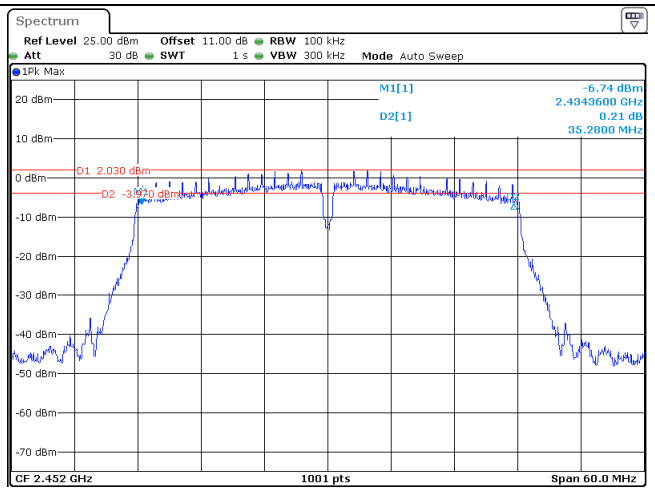
BLE 1M	
Low Channel	
Middle Channel	
High Channel	

BLE 2M	
Low Channel	
Middle Channel	
High Channel	

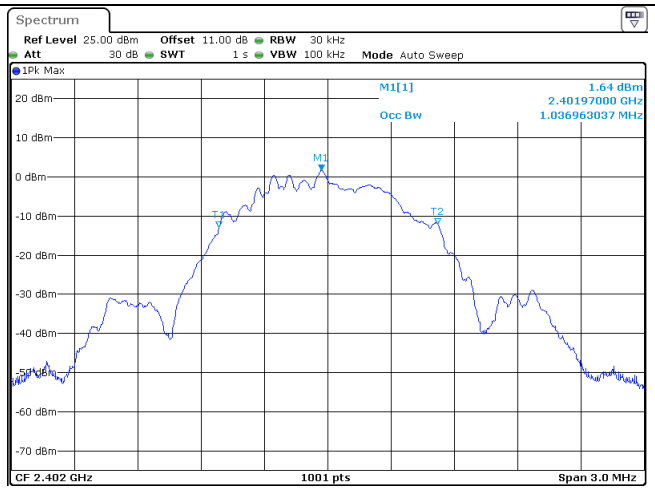
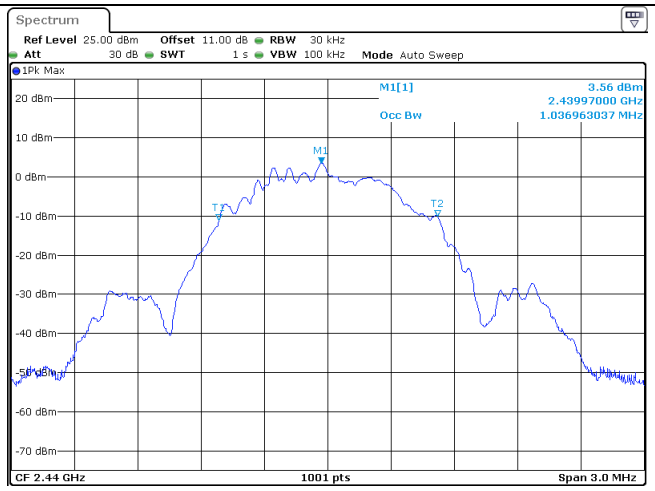
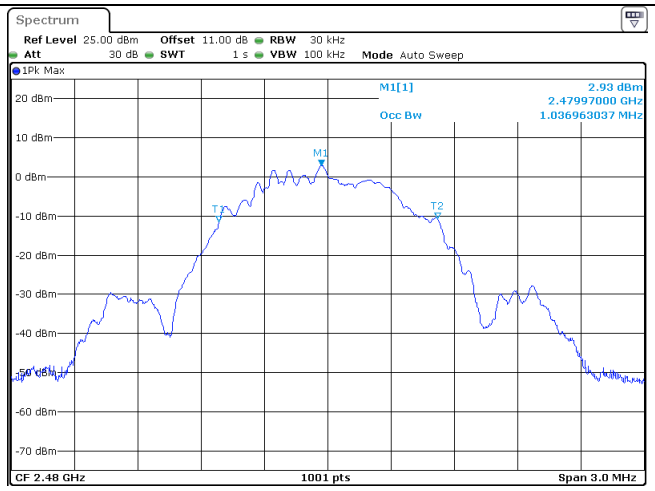
802.11b	
Low Channel	
Middle Channel	
High Channel	

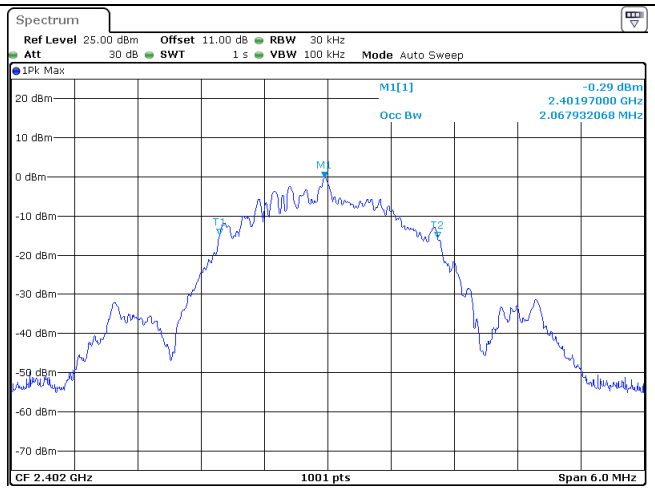
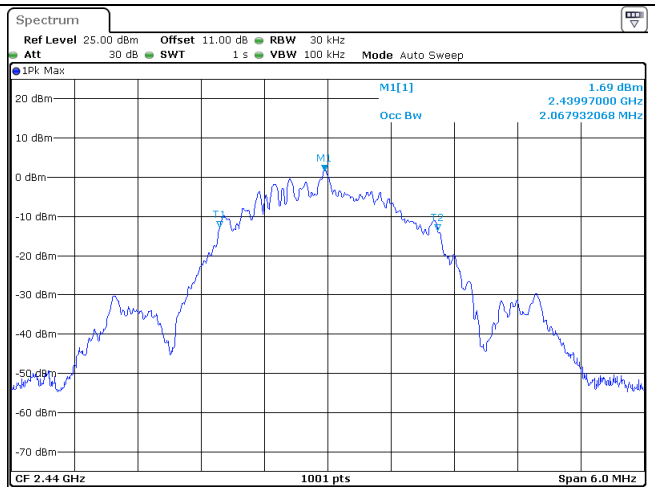
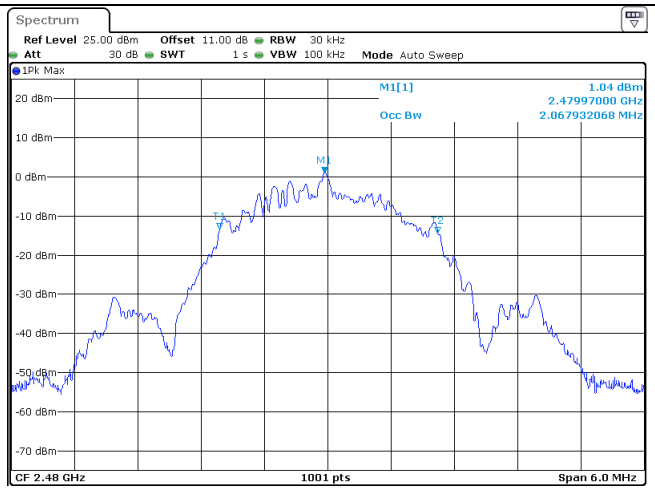
802.11g	
Low Channel	
Middle Channel	
High Channel	

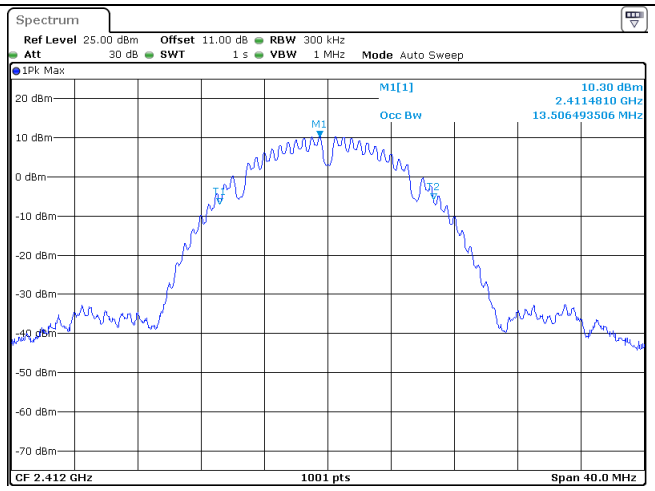
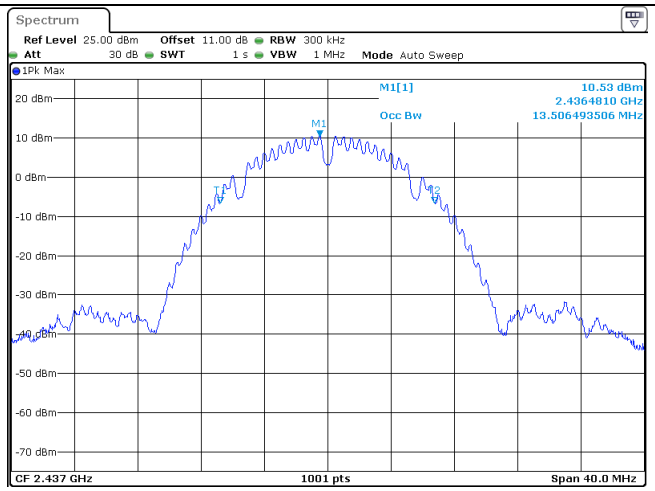
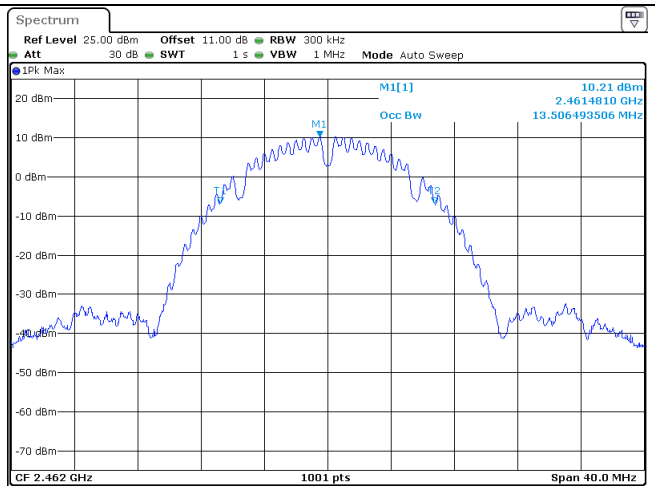
802.11n20	
Low Channel	
Middle Channel	
High Channel	

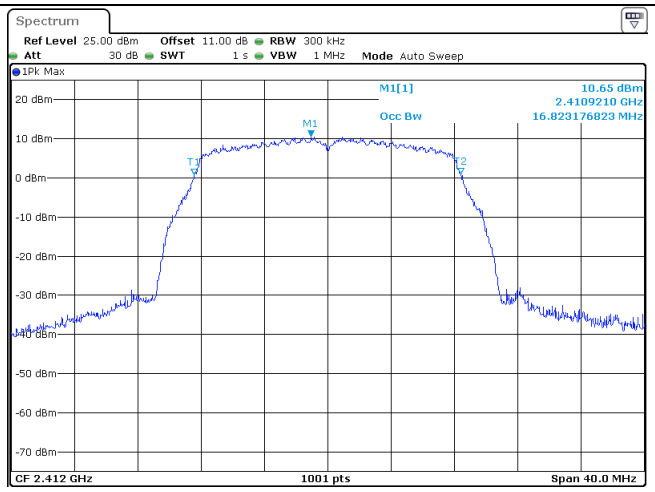
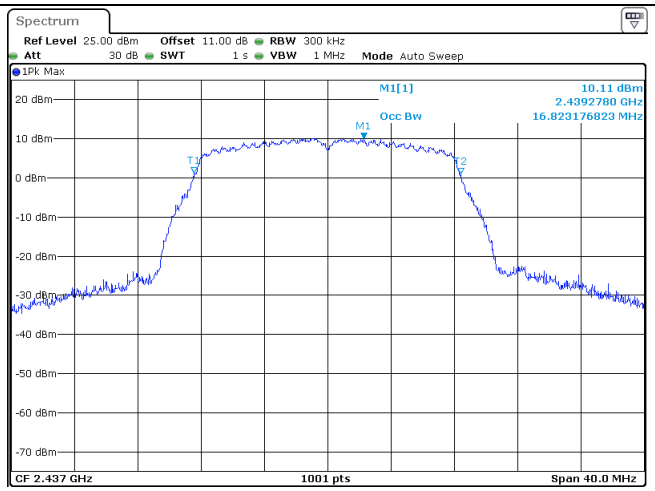
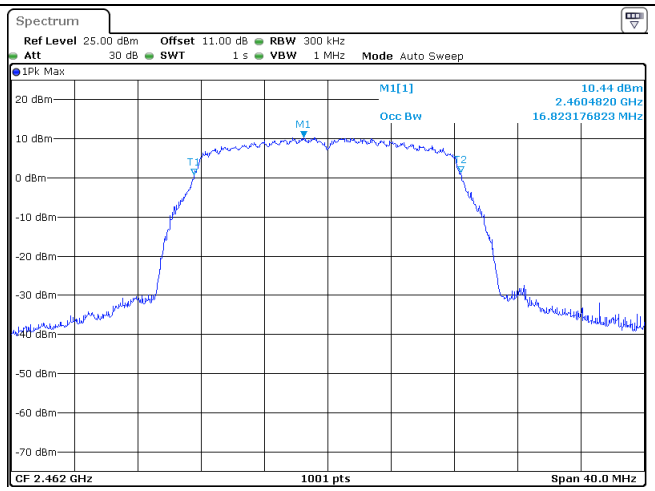
802.11n40	
Low Channel	
Middle Channel	
High Channel	

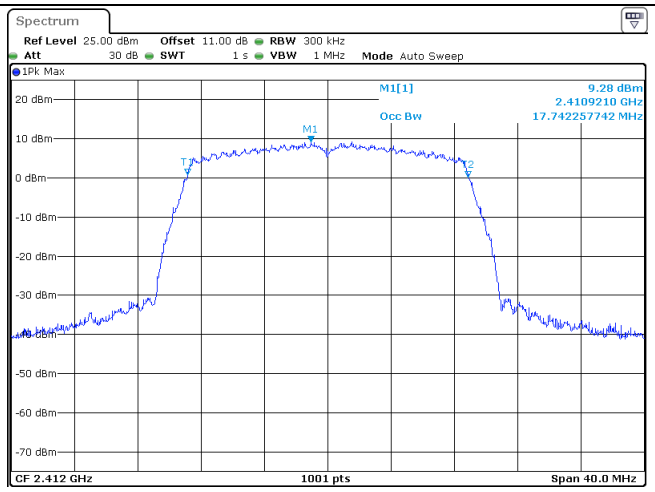
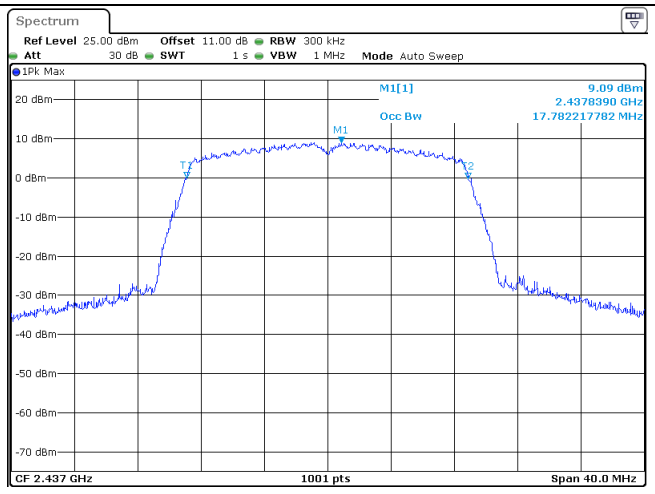
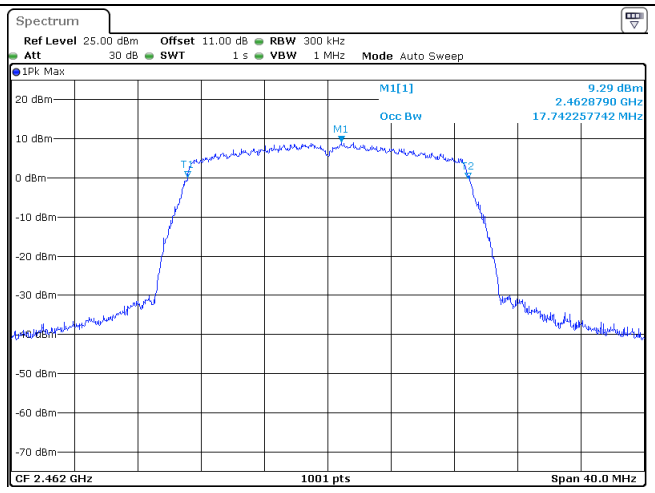
99% Occupied Bandwidth

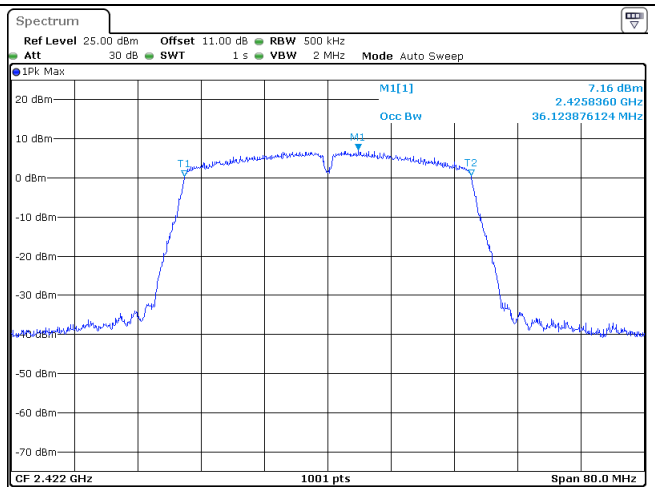
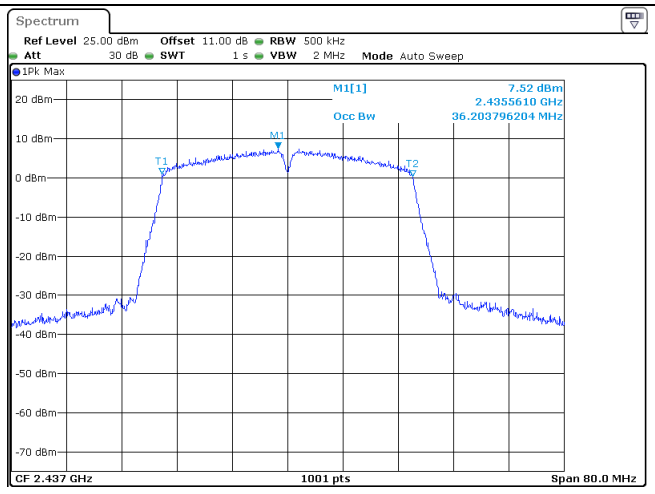
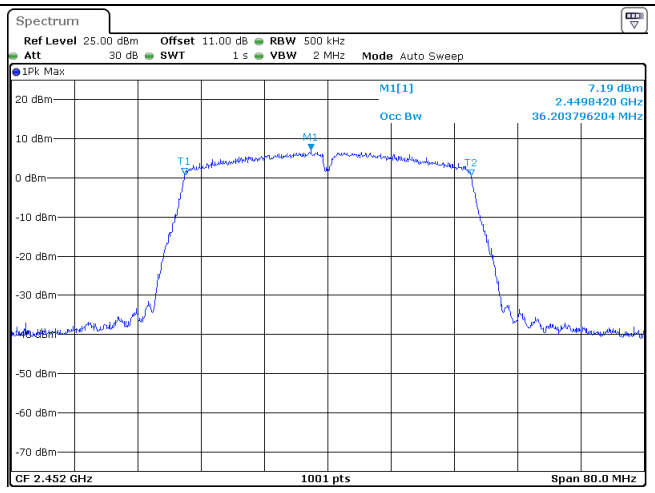
BLE 1M	
Low Channel	
Middle Channel	
High Channel	

BLE 2M	
Low Channel	
Middle Channel	
High Channel	

802.11b	
Low Channel	
Middle Channel	
High Channel	

802.11g	
Low Channel	
Middle Channel	
High Channel	

802.11n20	
Low Channel	
Middle Channel	
High Channel	

802.11n40	
Low Channel	
Middle Channel	
High Channel	

FCC §15.247(b) (3) - MAXIMUM CONDUCTED OUTPUT POWER

Applicable Standard

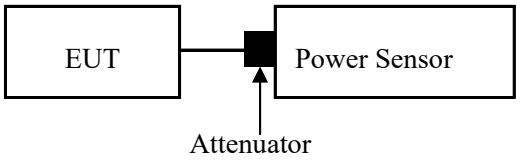
According to FCC §15.247(b) (3), for systems using digital modulation in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands: 1 Watt. As an alternative to a peak power measurement, compliance with the one Watt limit can be based on a measurement of the maximum conducted output power. Maximum Conducted 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.

Test Procedure

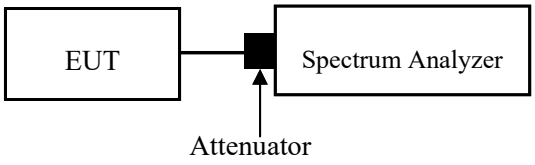
Test Method: ANSI C63.10-2013 Clause 11.9.1.1 for BLE & Clause 11.9.1.3 for Wi-Fi

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

For Wi-Fi mode:



For BLE mode:



Test Data

Environmental Conditions

Temperature:	25.3~25.7 ℃
Relative Humidity:	50~52 %
ATM Pressure:	101 kPa

The testing was performed by Cheeb Huang on 2024-05-09.

EUT operation mode: Transmitting

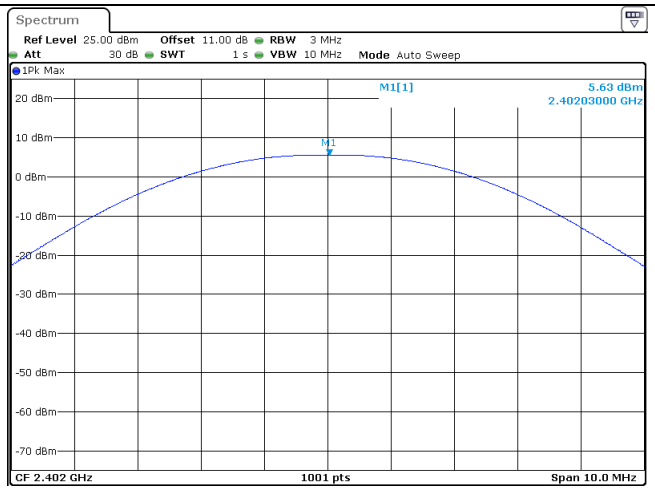
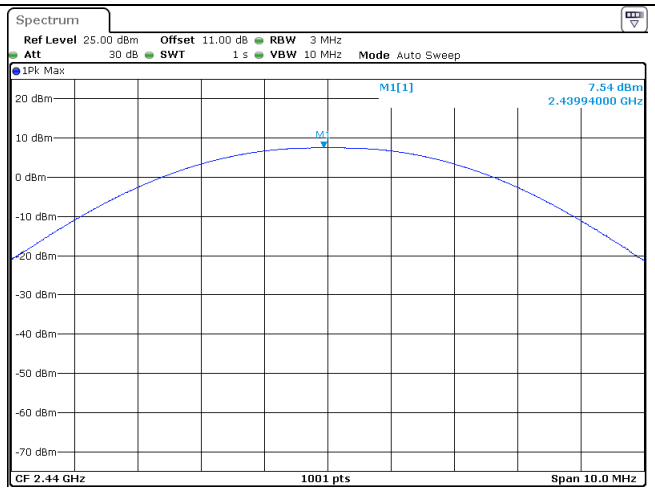
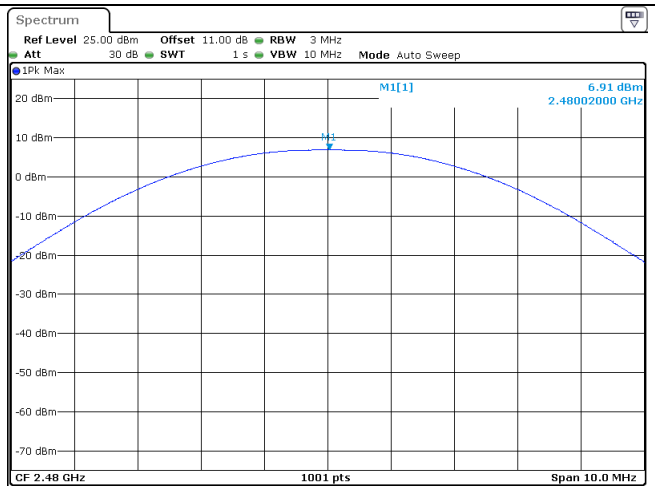
Test Result: Compliant.

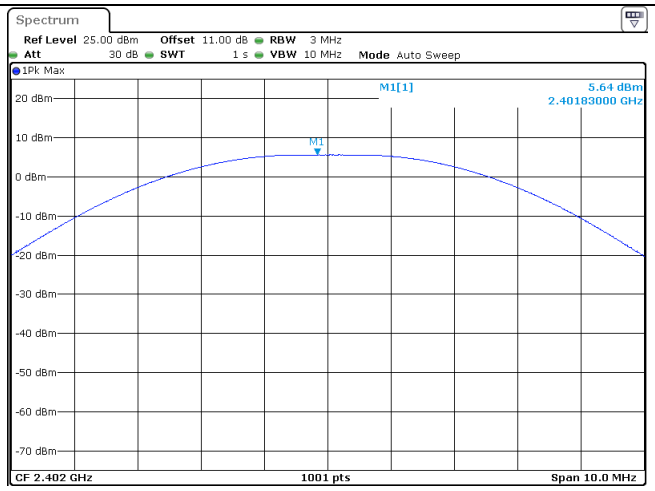
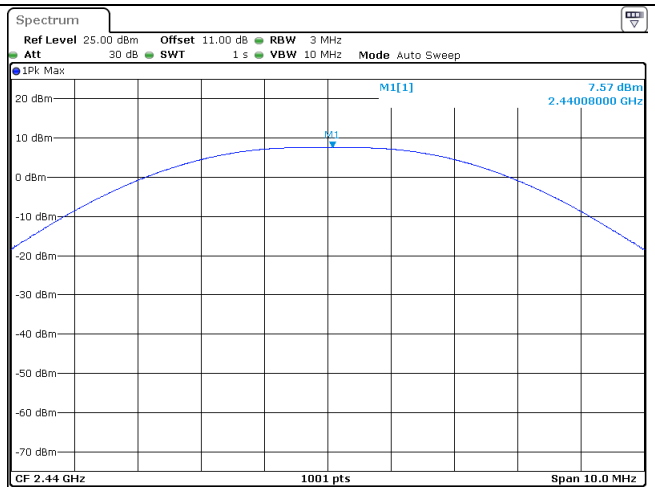
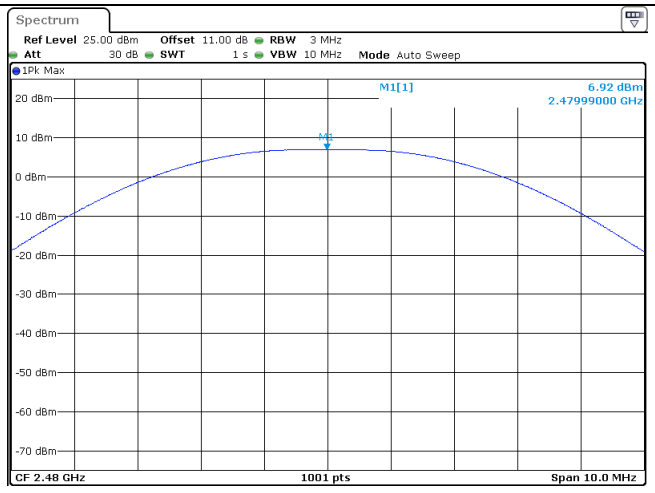
Test Modes	Test Frequency (MHz)	Peak Conducted Output Power (dBm)	Limits (dBm)
BLE 1M	2402	5.63	≤30
	2440	7.54	≤30
	2480	6.91	≤30
BLE 2M	2402	5.64	≤30
	2440	7.57	≤30
	2480	6.92	≤30

Test Modes	Test Frequency (MHz)	Maximum Conducted Peak Output Power (dBm)			Limit (dBm)
		ANT1	ANT2	Total	
802.11b	2412	21.44	21.12	/	≤30
	2437	21.68	21.47	/	≤30
	2462	21.38	21.15	/	≤30
802.11g	2412	26.18	26.15	/	≤30
	2437	26.26	26.06	/	≤30
	2462	26.17	25.96	/	≤30
802.11n20	2412	25.19	25.00	28.11	≤30
	2437	25.09	24.86	27.99	≤30
	2462	24.98	24.87	27.94	≤30
802.11n40	2422	23.88	23.67	26.79	≤30
	2437	23.94	23.84	26.90	≤30
	2452	23.84	23.72	26.79	≤30

Note: The device employed Cyclic Delay Diversity (CDD) for 802.11 MIMO transmitting, per KDB 662911 D01 Multiple Transmitter Output v02r01, for power measurements on IEEE 802.11 devices:
Array Gain = 0 dB (i.e., no array gain) for $N_{ANT} \leq 4$

Max Antenna Gain:	2.34	dBi	Directional gain:	2.34	dBi

BLE 1M	
Low Channel	
Middle Channel	
High Channel	

BLE 2M	
Low Channel	
Middle Channel	
High Channel	

FCC §15.247(d) - 100 kHz BANDWIDTH OF FREQUENCY BAND EDGE

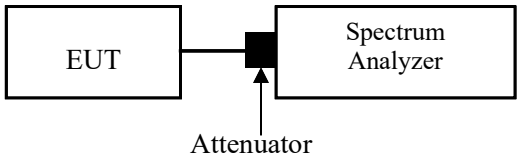
Applicable Standard

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 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 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 Clause 11.11

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 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.
3. 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.
4. 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.
5. Repeat above procedures until all measured frequencies were complete.



Test Data

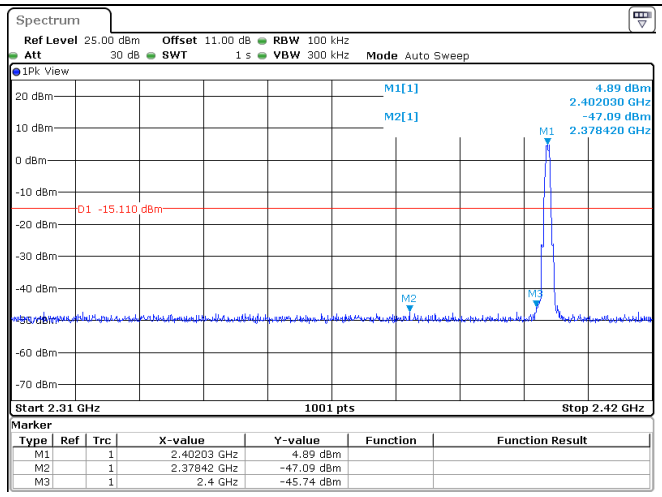
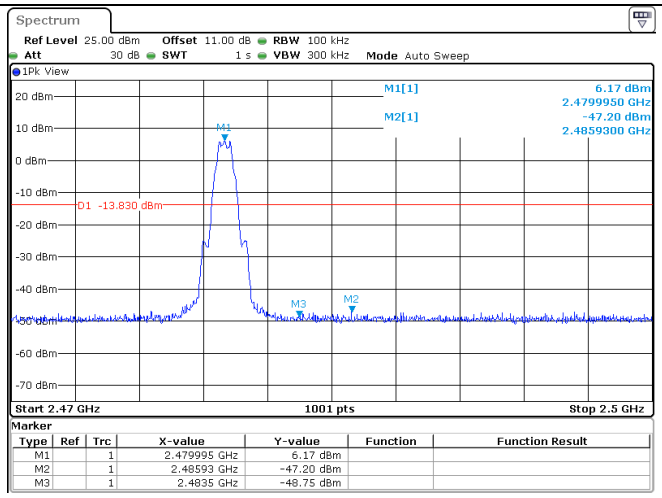
Environmental Conditions

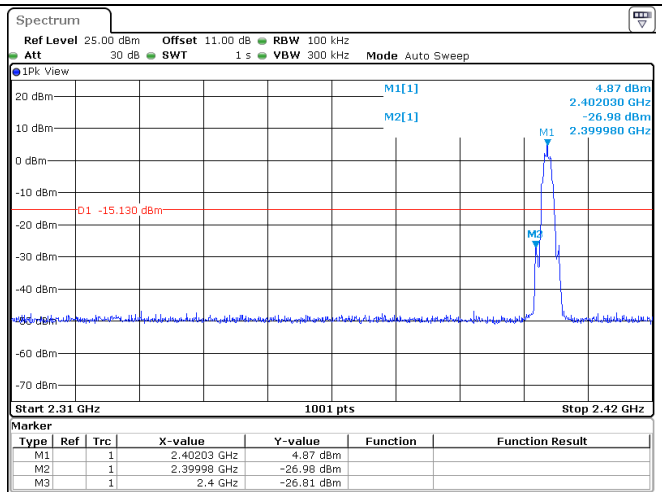
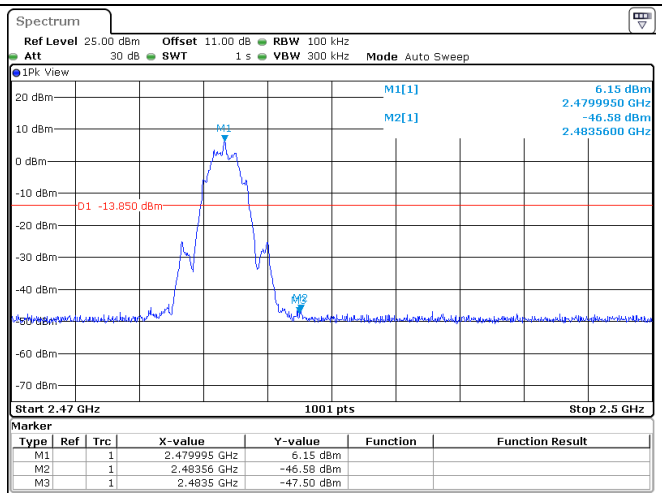
Temperature:	25.3~25.7 ℃
Relative Humidity:	50~52 %
ATM Pressure:	101 kPa

The testing was performed by Cheeb Huang on 2024-05-09.

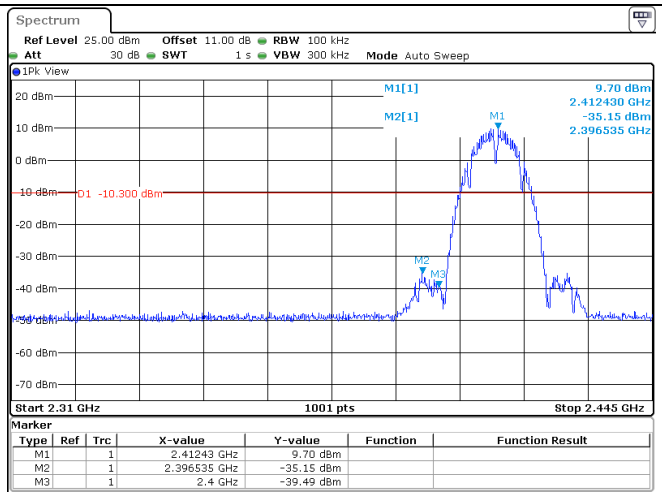
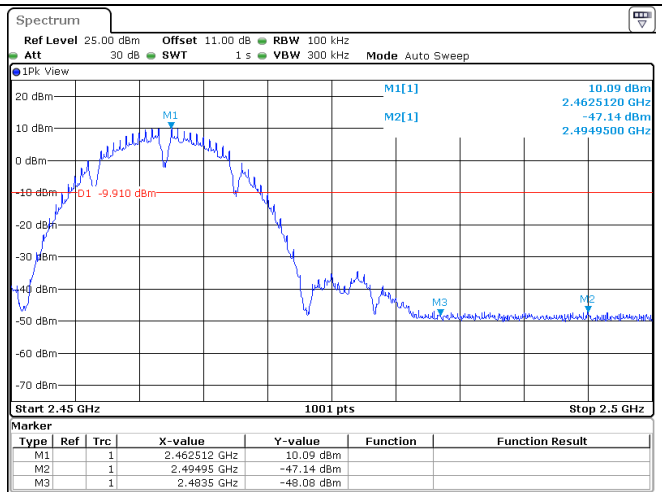
EUT operation mode: Transmitting

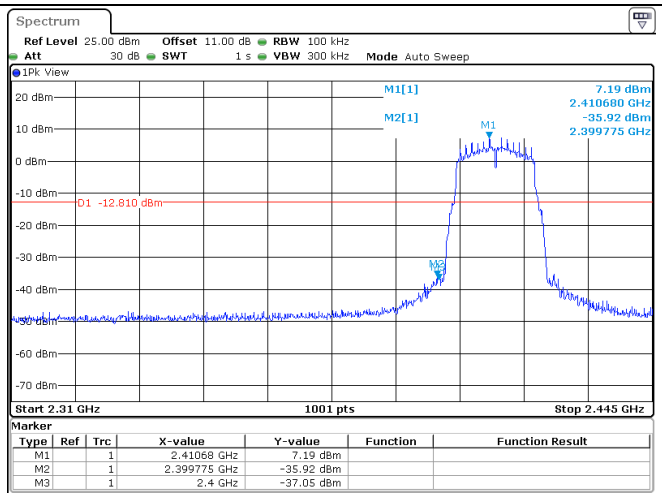
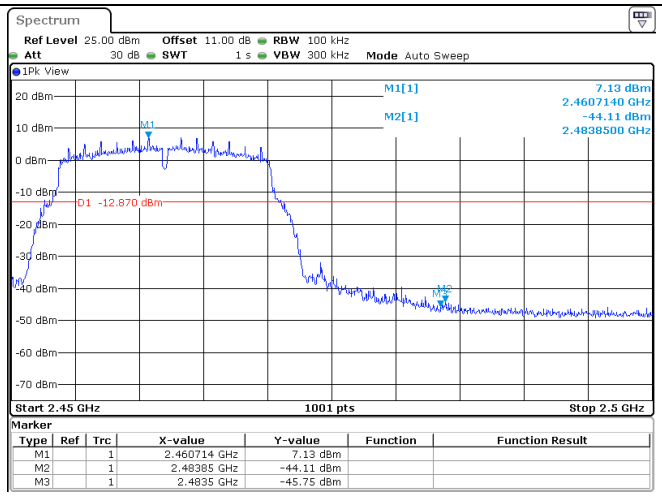
Test Result: Compliant.

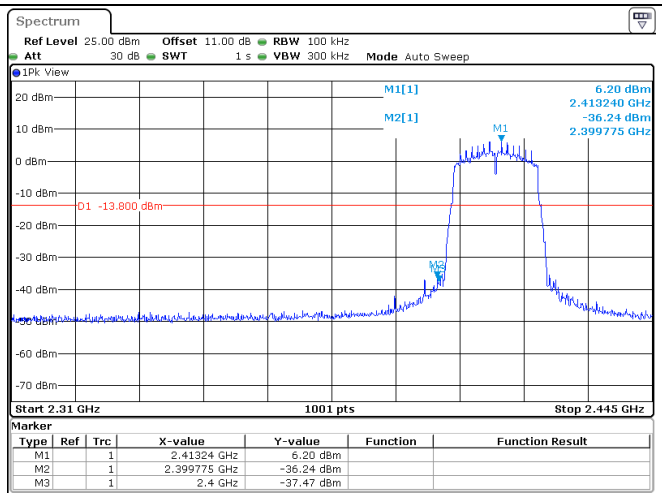
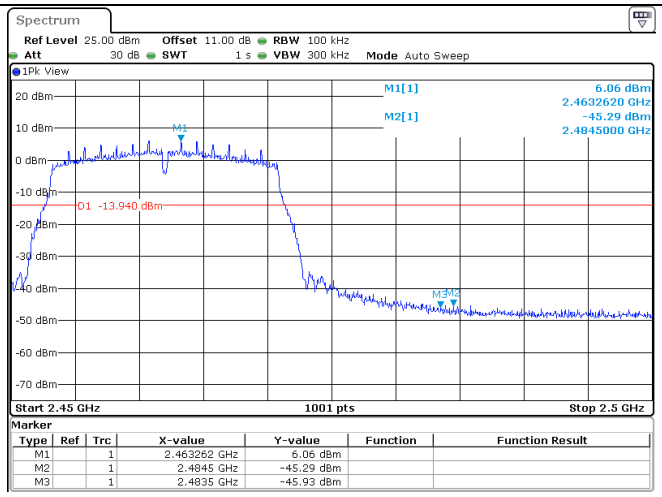
Band Edge, Single Channel	
BLE 1M, Left Side	
BLE 1M, Right Side	

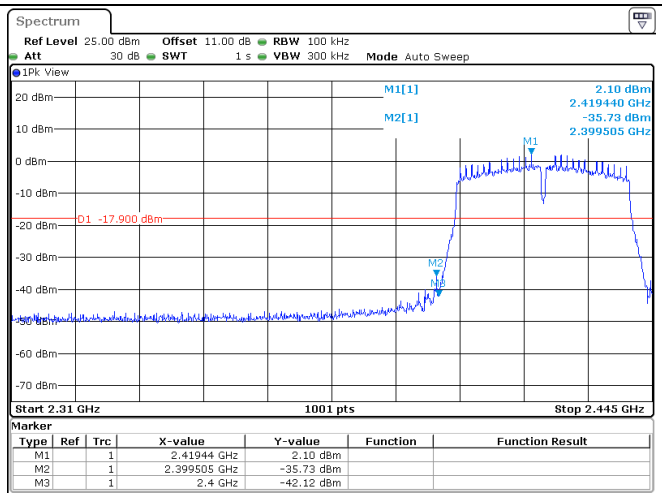
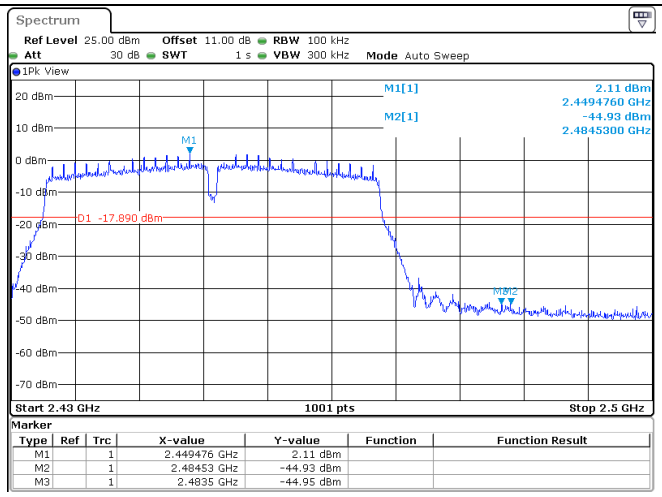
Band Edge, Single Channel	
BLE 2M, Left Side	
BLE 2M, Right Side	

ANT 1

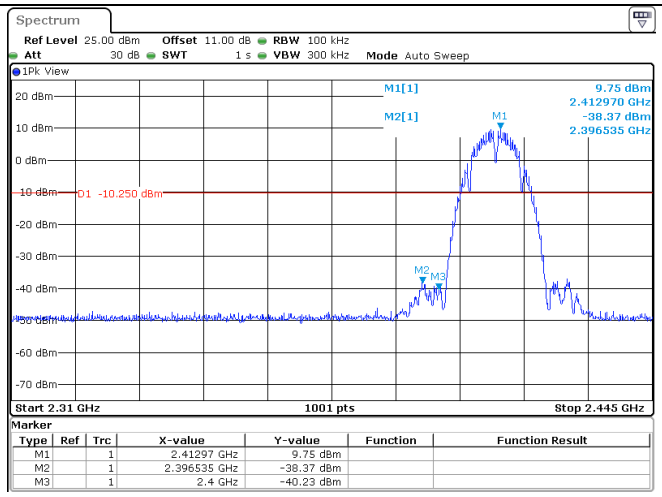
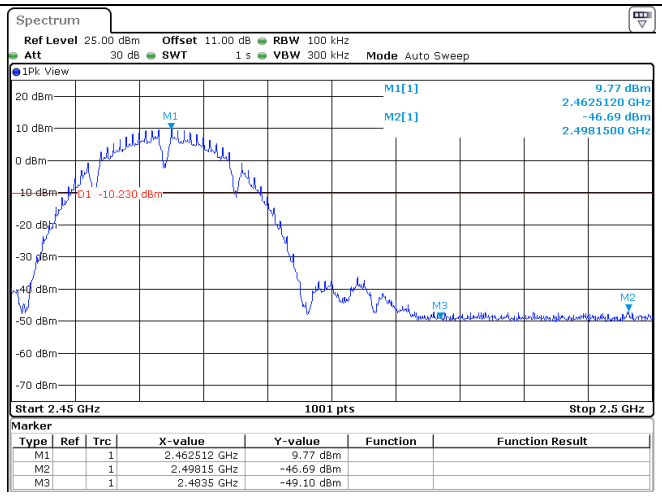
Band Edge	
802.11b, Left Side	
802.11b, Right Side	

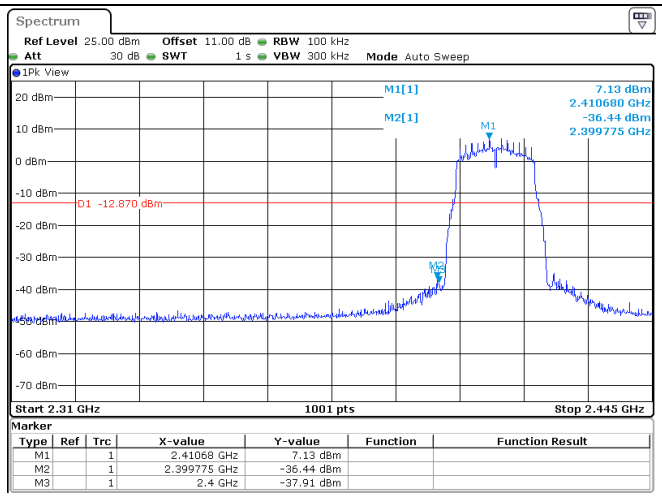
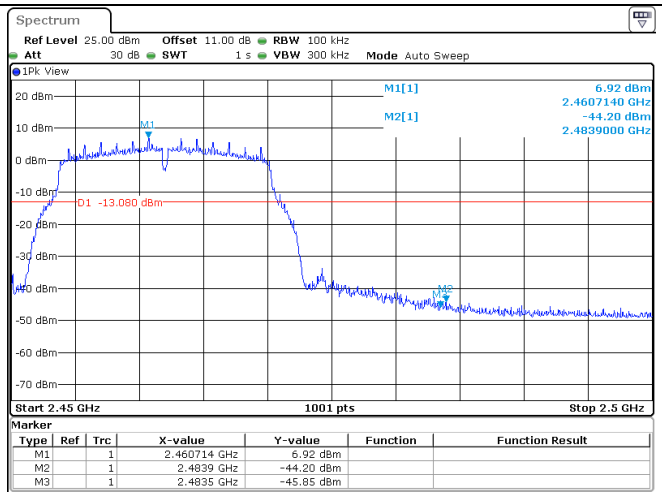
Band Edge	
802.11g, Left Side	
802.11g, Right Side	

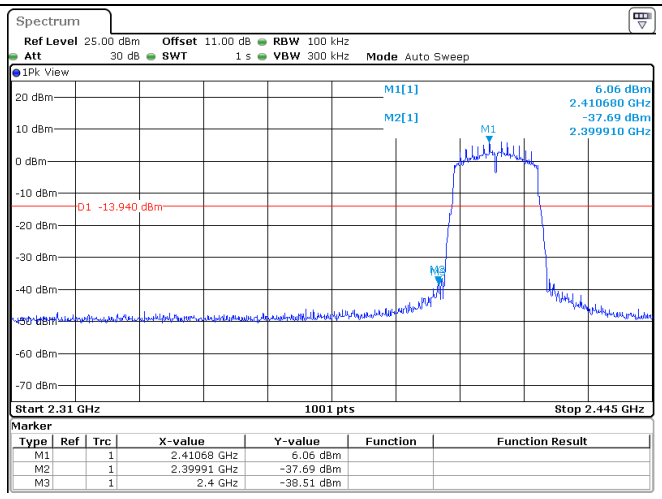
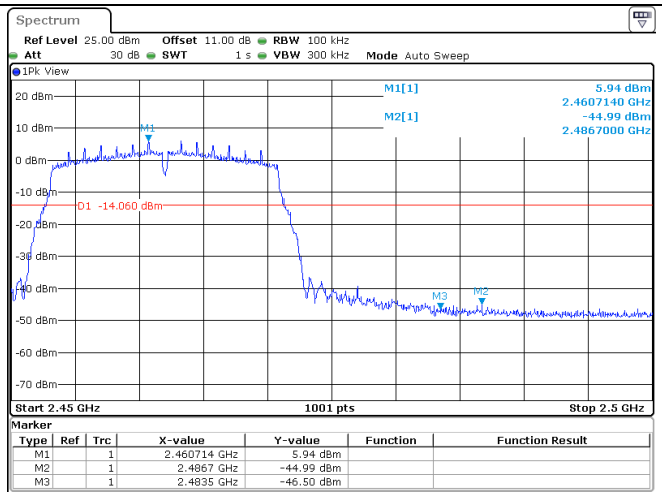
Band Edge	
802.11n20, Left Side	
802.11n20, Right Side	

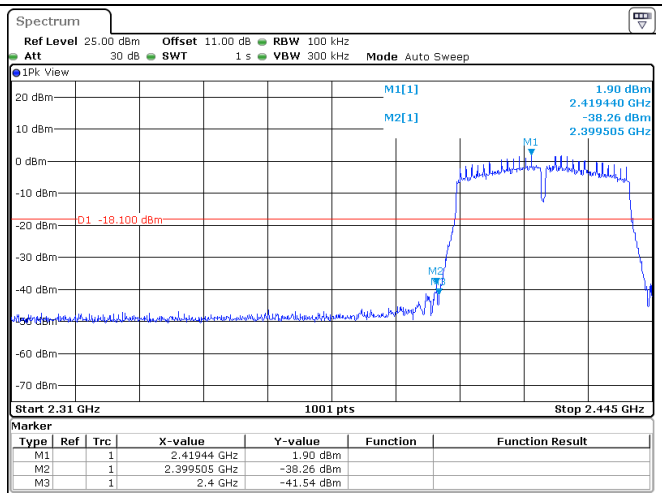
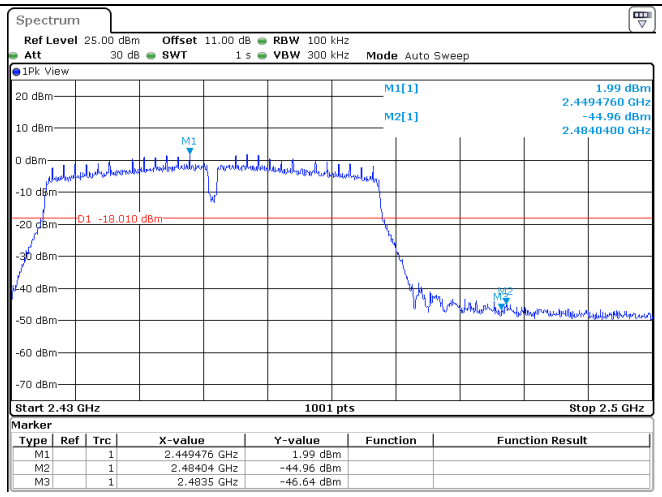
Band Edge	
802.11n40, Left Side	
802.11n40, Right Side	

ANT 2

Band Edge	
802.11b, Left Side	
802.11b, Right Side	

Band Edge	
802.11g, Left Side	
802.11g, Right Side	

Band Edge	
802.11n20, Left Side	
802.11n20, Right Side	

Band Edge	
802.11n40, Left Side	
802.11n40, Right Side	

FCC §15.247(e) - POWER SPECTRAL DENSITY

Applicable Standard

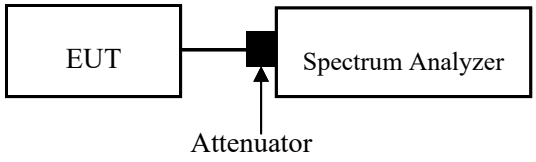
For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission. This power spectral density shall be determined in accordance with the provisions of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

Test Procedure

Test Method: ANSI C63.10-2013 Clause 11.10.2

Use this procedure when the maximum peak conducted output power in the fundamental emission is used to demonstrate compliance.

1. Set the RBW to: 3kHz≤ RBW≤100 kHz.
2. Set the VBW ≥ 3×RBW.
3. Set the span to 1.5 times the DTS bandwidth.
4. Detector = peak.
5. Sweep time = auto couple.
6. Trace mode = max hold.
7. Allow trace to fully stabilize.
8. Use the peak marker function to determine the maximum amplitude level within the RBW.
9. If measured value exceeds limit, reduce RBW (no less than 3 kHz) and repeat.



Test Data

Environmental Conditions

Temperature:	25.3~25.7 ℃
Relative Humidity:	50~52 %
ATM Pressure:	101 kPa

The testing was performed by Cheeb Huang on 2024-05-09.

EUT operation mode: Transmitting

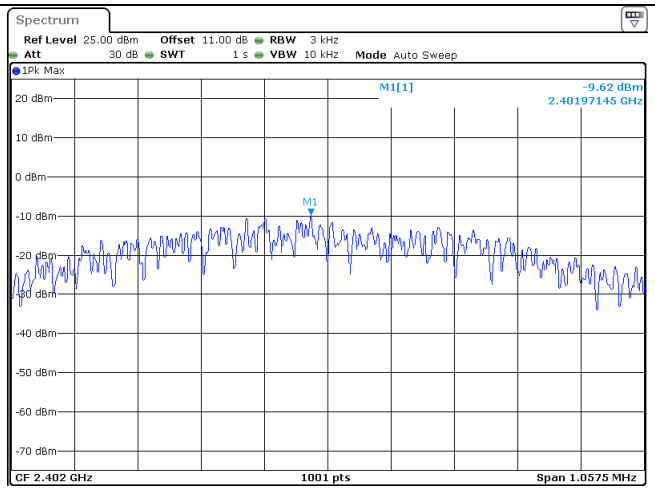
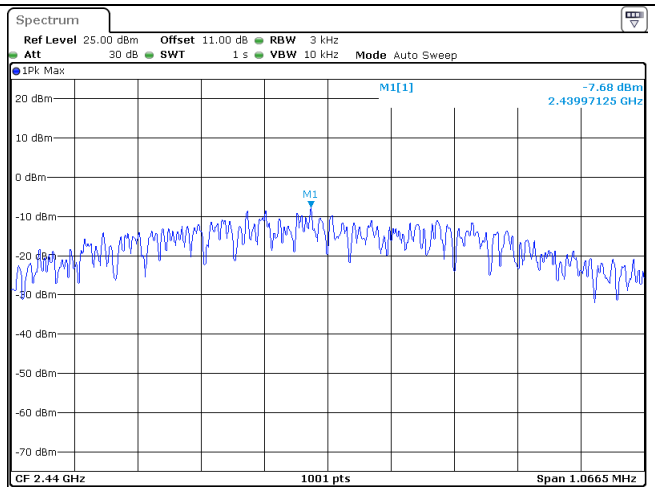
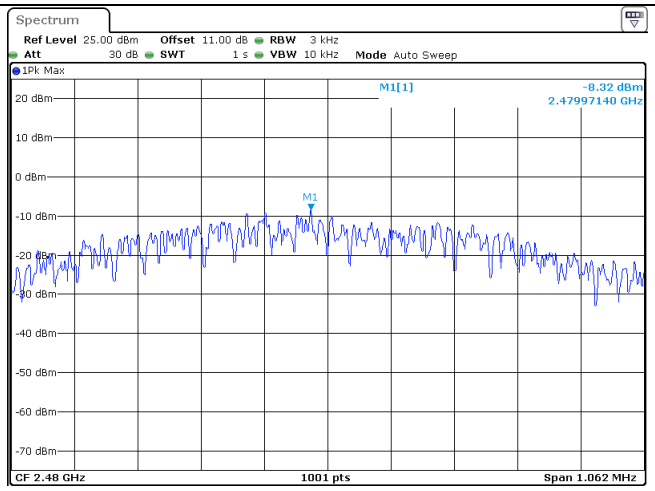
Test Result: Compliant.

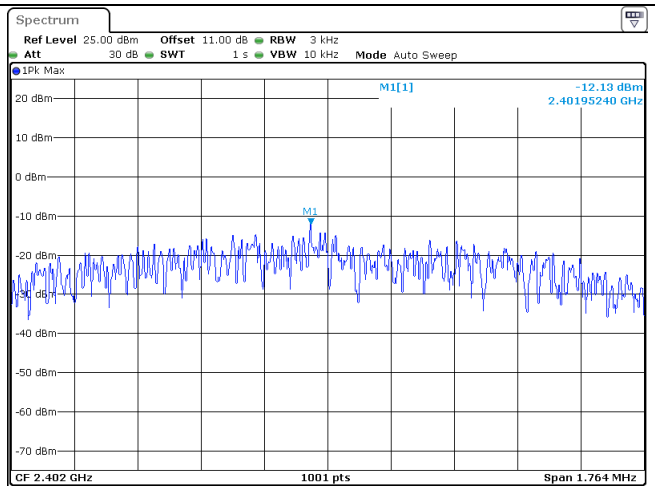
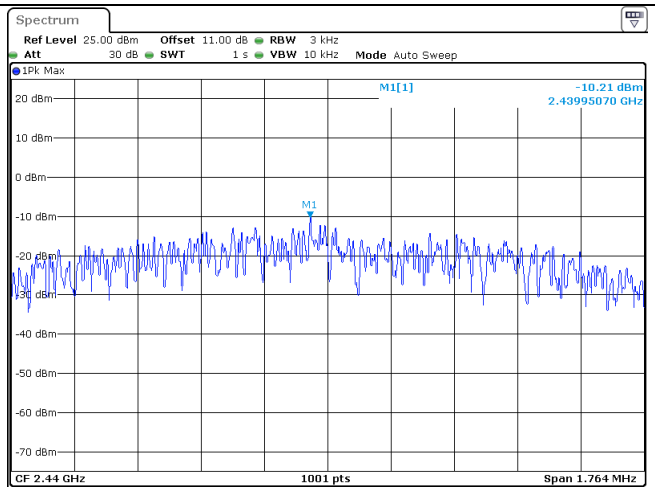
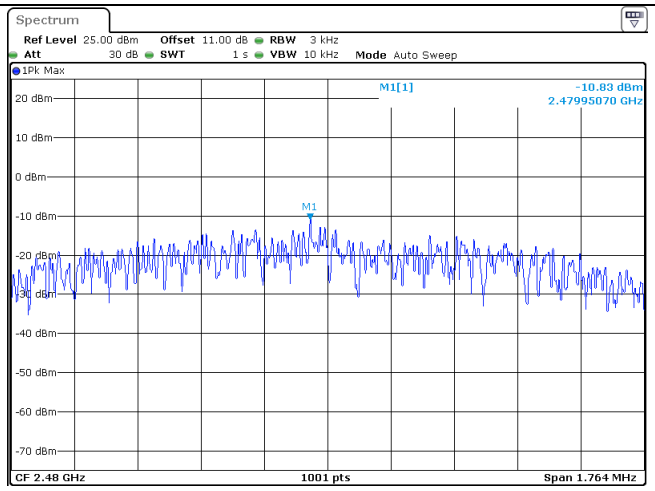
Test Modes	Test Frequency (MHz)	Power Spectral Density (dBm/3kHz)	Limit (dBm/3kHz)
BLE 1M	2402	-9.62	≤8.00
	2440	-7.68	≤8.00
	2480	-8.32	≤8.00
BLE 2M	2402	-12.13	≤8.00
	2440	-10.21	≤8.00
	2480	-10.83	≤8.00

Test Modes	Test Frequency (MHz)	Maximum Conducted Peak Output Power (dBm)			Limit (dBm)
		ANT1	ANT2	Total	
802.11b	2412	-3.21	-3.37	/	≤8.00
	2437	-2.69	-3.34	/	≤8.00
	2462	-2.99	-4.06	/	≤8.00
802.11g	2412	-5.73	-5.49	/	≤8.00
	2437	-4.93	-4.87	/	≤8.00
	2462	-5.35	-5.18	/	≤8.00
802.11n20	2412	-6.32	-5.58	-2.92	≤8.00
	2437	-6.13	-7.35	-3.69	≤8.00
	2462	-7.41	-7.00	-4.19	≤8.00
802.11n40	2422	-10.74	-11.04	-7.88	≤8.00
	2437	-10.59	-10.05	-7.30	≤8.00
	2452	-10.42	-12.05	-8.15	≤8.00

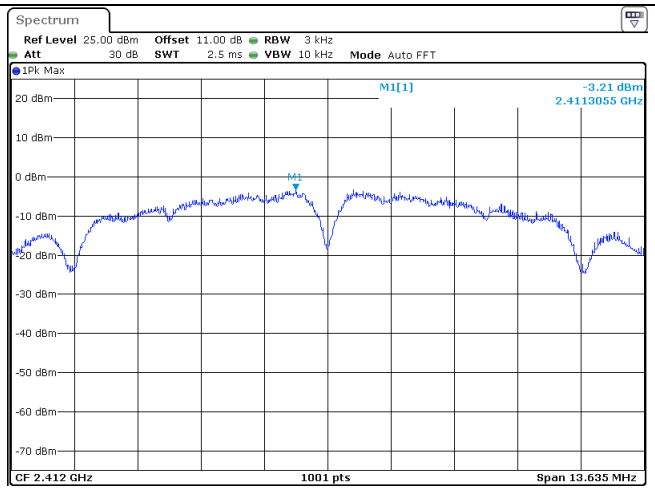
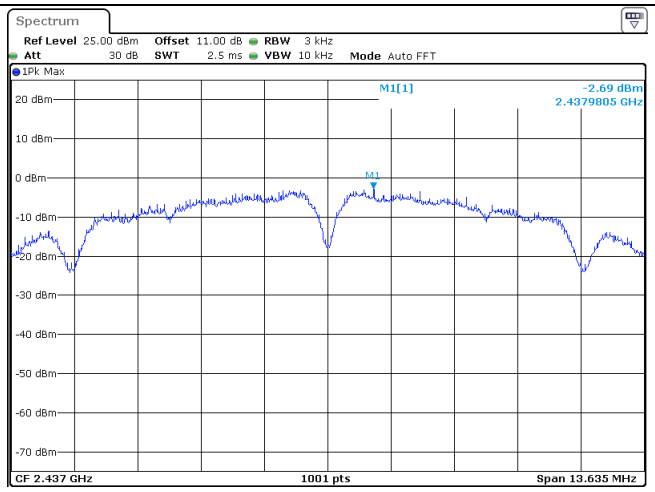
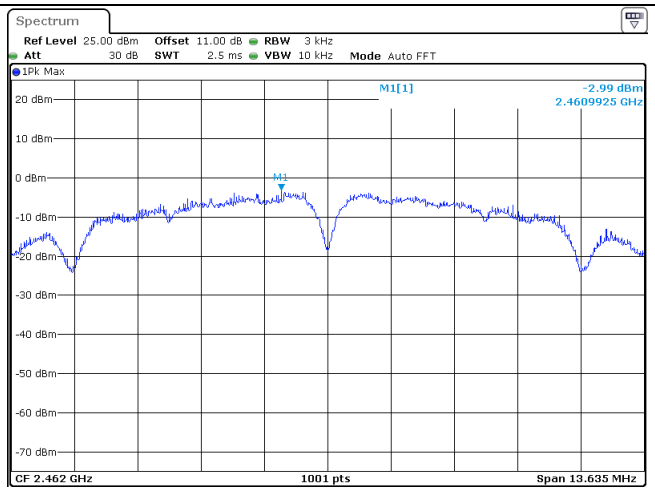
Note:
The device employed Cyclic Delay Diversity (CDD) for 802.11 MIMO transmitting, per KDB 662911 D01 Multiple Transmitter Output v02r01, for power spectral density (PSD) measurements on the devices:
Array Gain = 10 $\log(N_{ANT}/N_{SS})$ dB

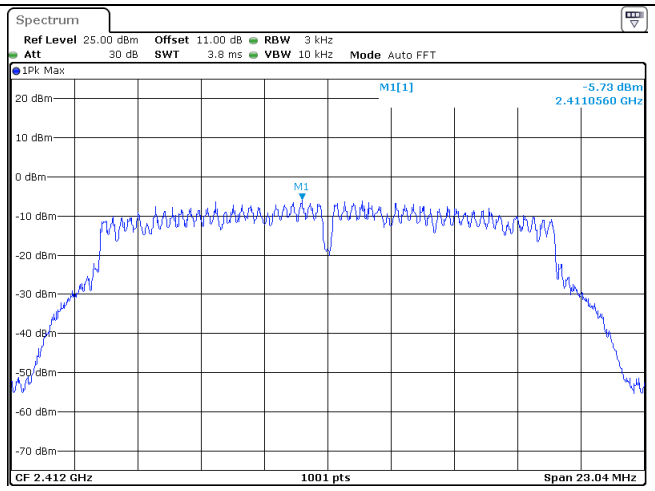
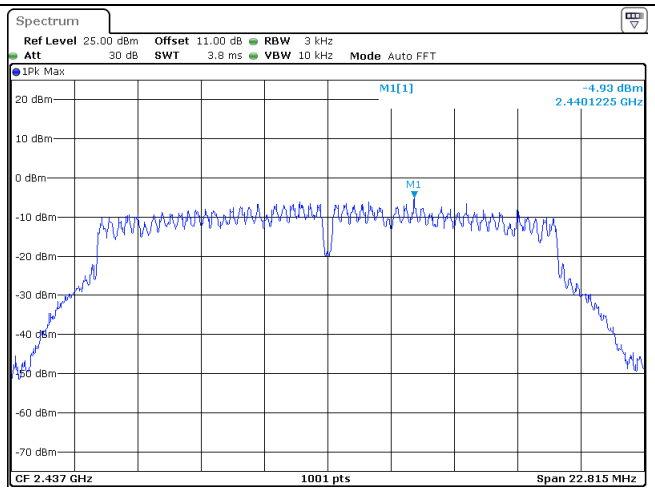
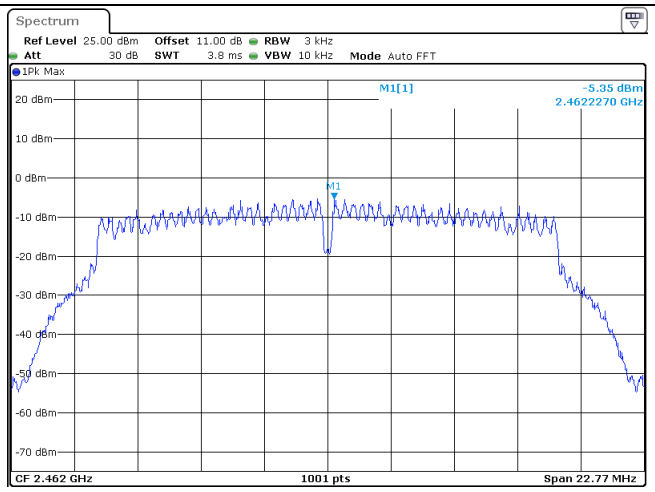
Max Antenna Gain:	2.34	dBi	Directional gain:	5.34	dBi

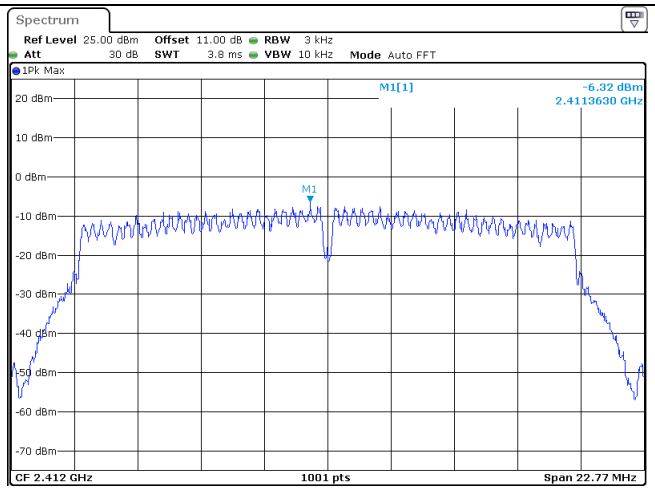
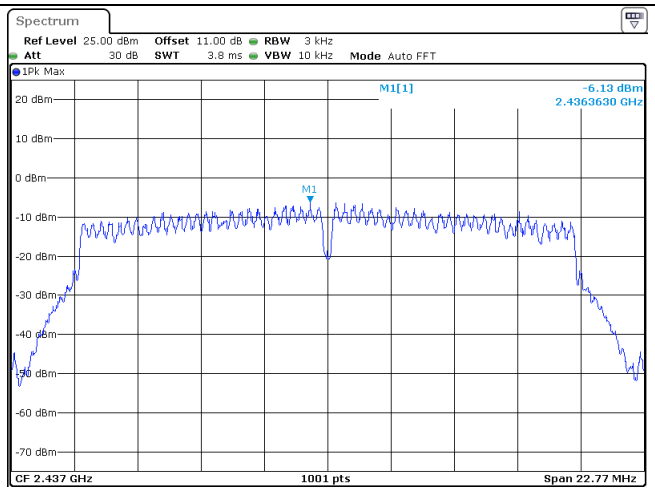
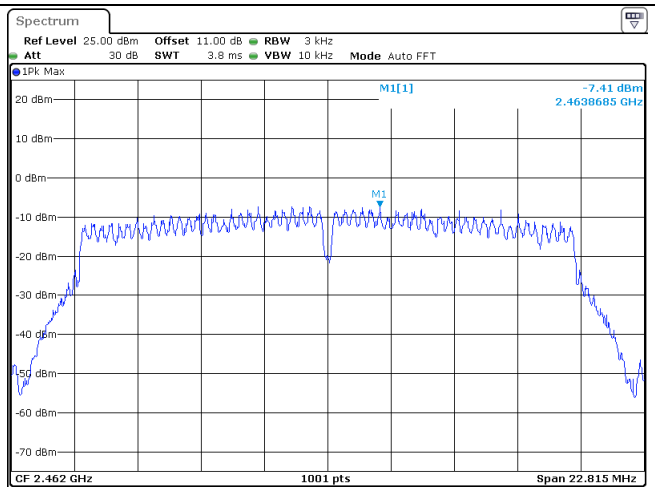
BLE 1M	
Low Channel	
Middle Channel	
High Channel	

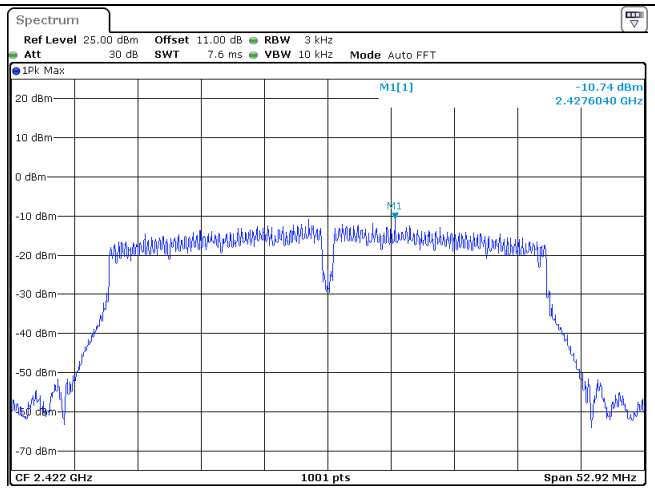
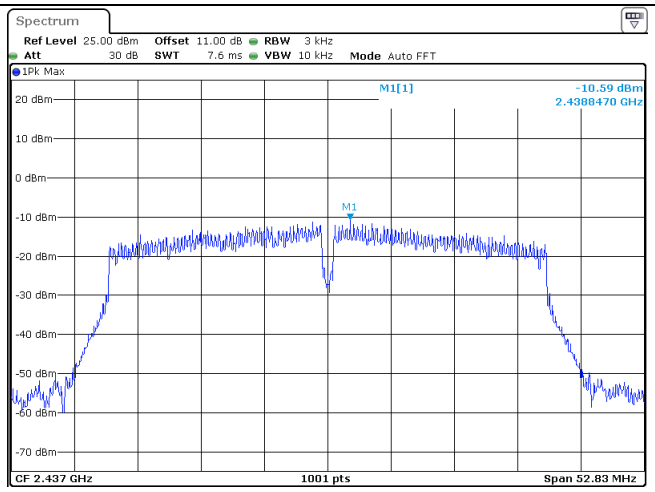
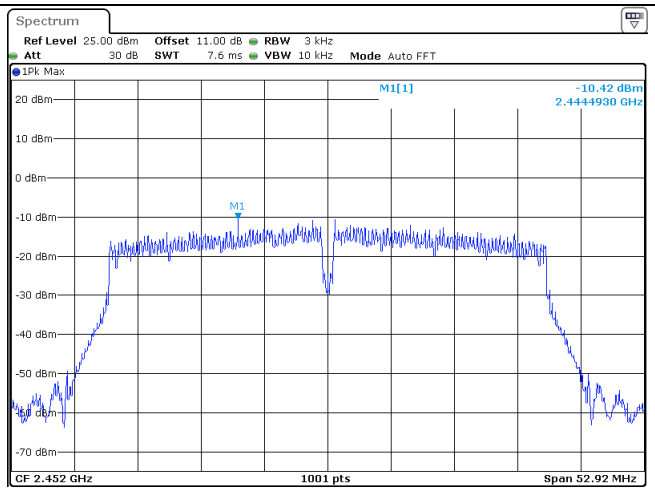
BLE 2M	
Low Channel	
Middle Channel	
High Channel	

ANT 1

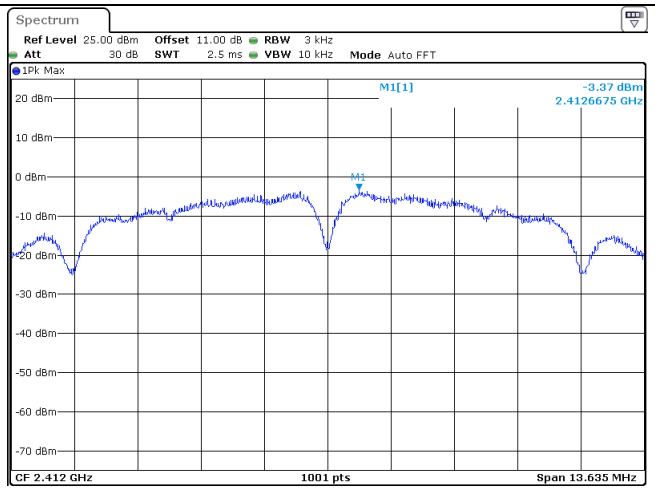
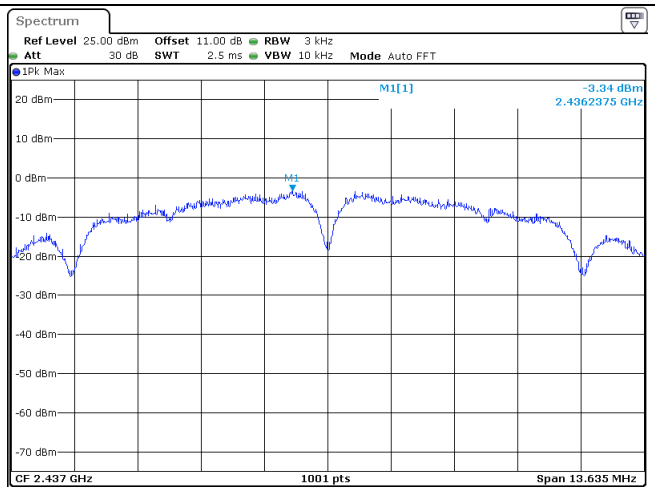
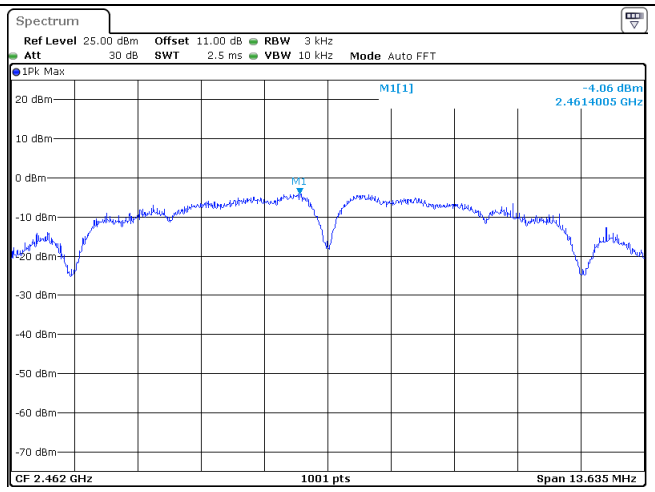
802.11b	
Low Channel	
Middle Channel	
High Channel	

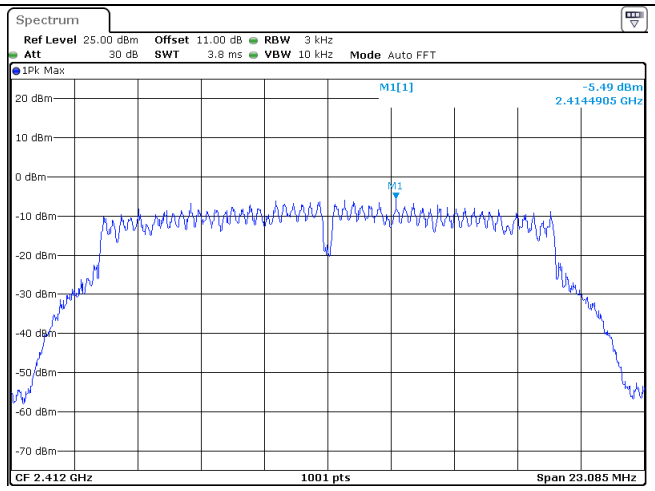
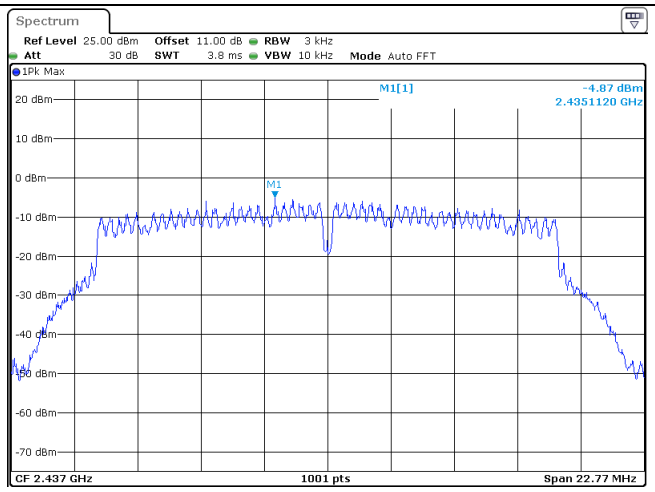
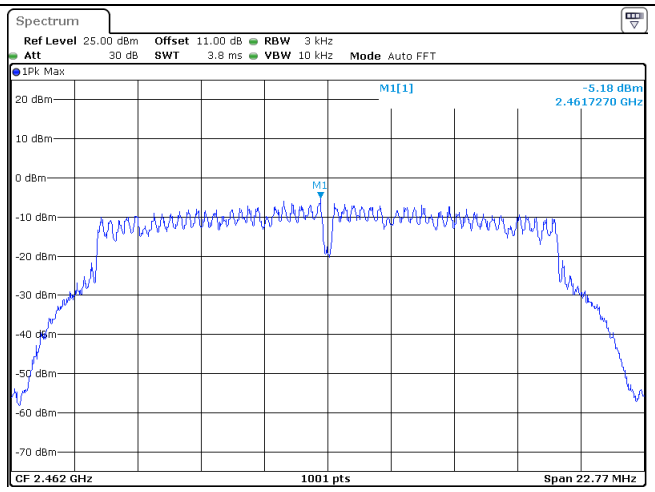
802.11g	
Low Channel	
Middle Channel	
High Channel	

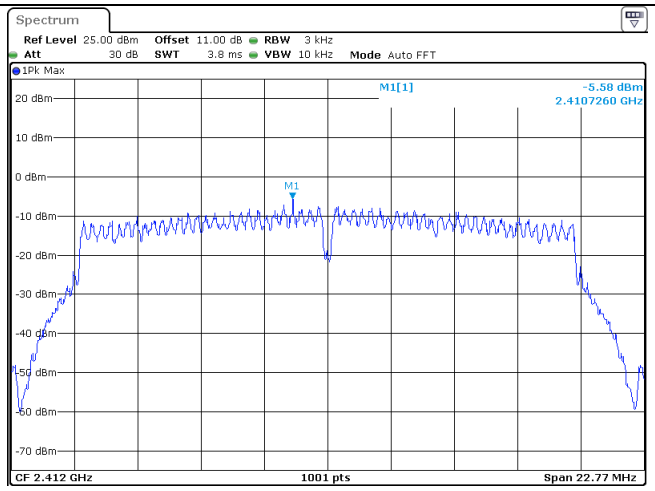
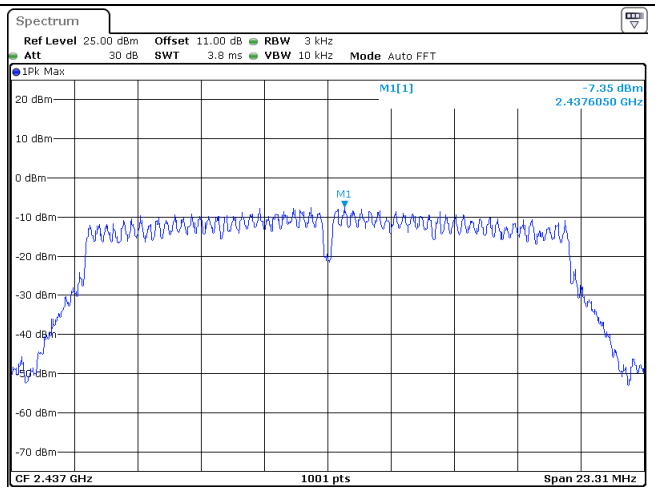
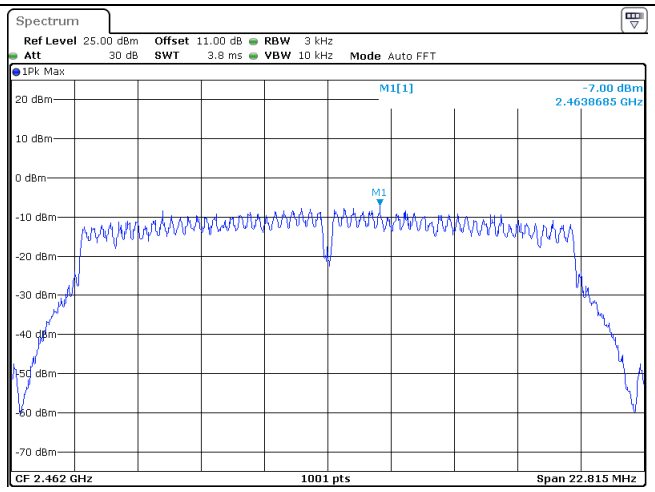
802.11n20	
Low Channel	
Middle Channel	
High Channel	

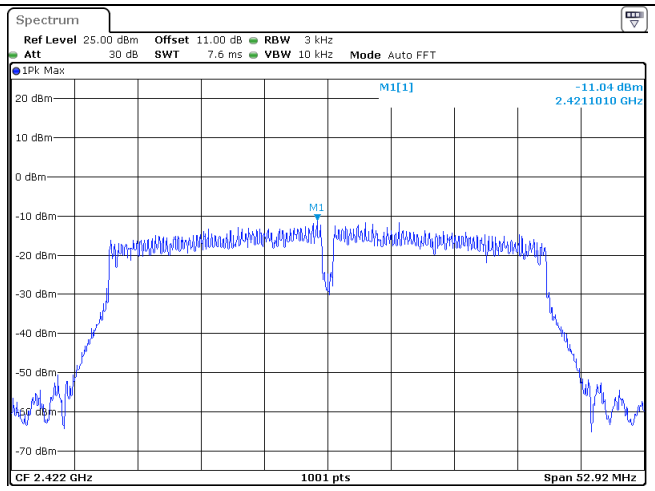
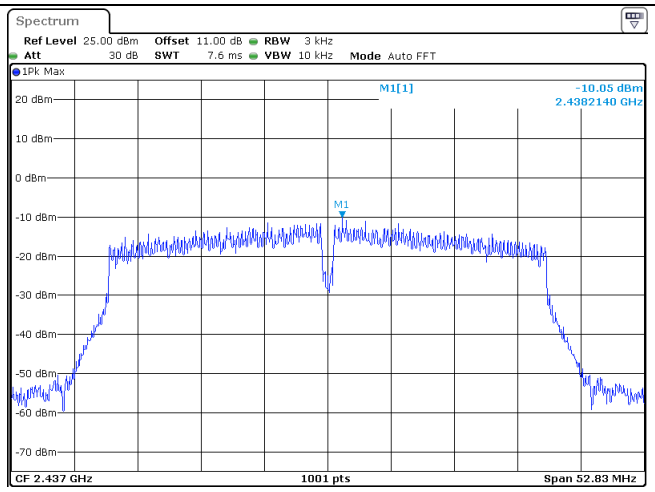
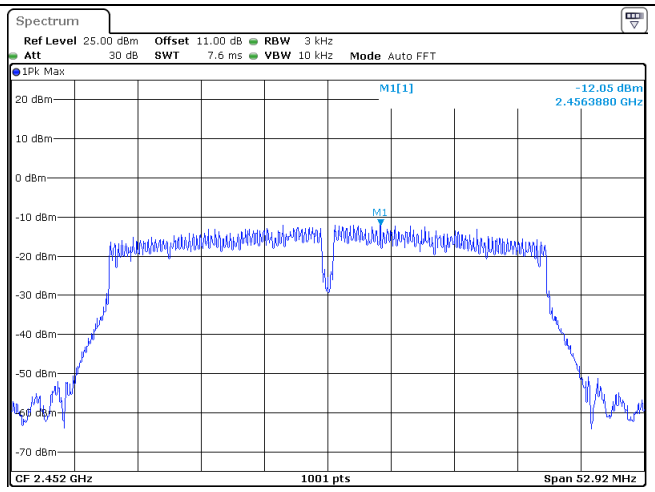
802.11n40	
Low Channel	
Middle Channel	
High Channel	

ANT 2

802.11b	
Low Channel	
Middle Channel	
High Channel	

802.11g	
Low Channel	
Middle Channel	
High Channel	

802.11n20	
Low Channel	
Middle Channel	
High Channel	

802.11n40	
Low Channel	
Middle Channel	
High Channel	

EUT PHOTOGRAPHS

Please refer to the attachment 2401S39342E-RF External photo and 2401S39342E-RF Internal photo.

TEST SETUP PHOTOGRAPHS

Please refer to the attachment 2401S39342E-RFA Test Setup photo.

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