TEST REPORT

Applicant Name:	Shenzhen Jiayz photo industrial ., Ltd
Address:	A16 Building, Intelligent Terminal Industrial Park of Silicon Valley Power, Guanlan,Longhua District, Shenzhen, China
Report Number:	2401W32386E-RF-00
FCC ID:	2ARN3-050811RX

Test Standard (s)

FCC PART 15.247

Sample Description

Product Type:	Wireless Microphone
Model No.:	BY-V-RXU
Multiple Model(s) No.:	BY-V-RXD, BY-V-RX, BY-V3-RXU, BY-V3-RXD, BY-V3-RX
Trade Mark:	BOYA
Date Received:	2024/08/19
Issue Date:	2024/10/29

Test Result:	Pass▲

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

Prepared and Checked By:

Wills Yu
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 "▼".

TABLE OF CONTENTS

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	2401W32386E-RF-00	Original Report	2024/10/29

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Wireless Microphone
Tested Model	BY-V-RXU
Multiple Model(s)	BY-V-RXD, BY-V-RX, BY-V3-RXU, BY-V3-RXD, BY-V3-RX
Frequency Range	2402-2480MHz
Transmit Peak Power	4.67dBm
Modulation Technique	GFSK
Antenna Specification[#]	-0.8dBi (provided by the applicant)
Voltage Range	DC 5V from USB-C Port
Sample serial number	2QAT-2 for Radiated Emissions Test 2QAU-1for RF Conducted Test (Assigned by BACL, Shenzhen)
Sample/EUT Status	Good condition
Adapter Information	N/A
Note: The Multiple models are electrically identical with the test model except for model name and sales channels. Please refer to the declaration letter[#] for more detail, which was provided by manufacturer.	

Objective

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

The tests were performed in order to determine compliance with FCC Part 15, Subpart C, 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.

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-150kHz	3.94dB(k=2, 95% level of confidence)
	150kHz-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

The system was configured for testing in an engineering mode.

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

EUT was tested with Channel 17, 37 and 39.

EUT Exercise Software

"BT_Tool v1.1.4"[#] exercise software was used and the power level is 5[#]. The software and power level was provided by the applicant.

Special Accessories

No special accessory.

Equipment Modifications

No modification was made to the EUT tested.

Support Equipment List and Details

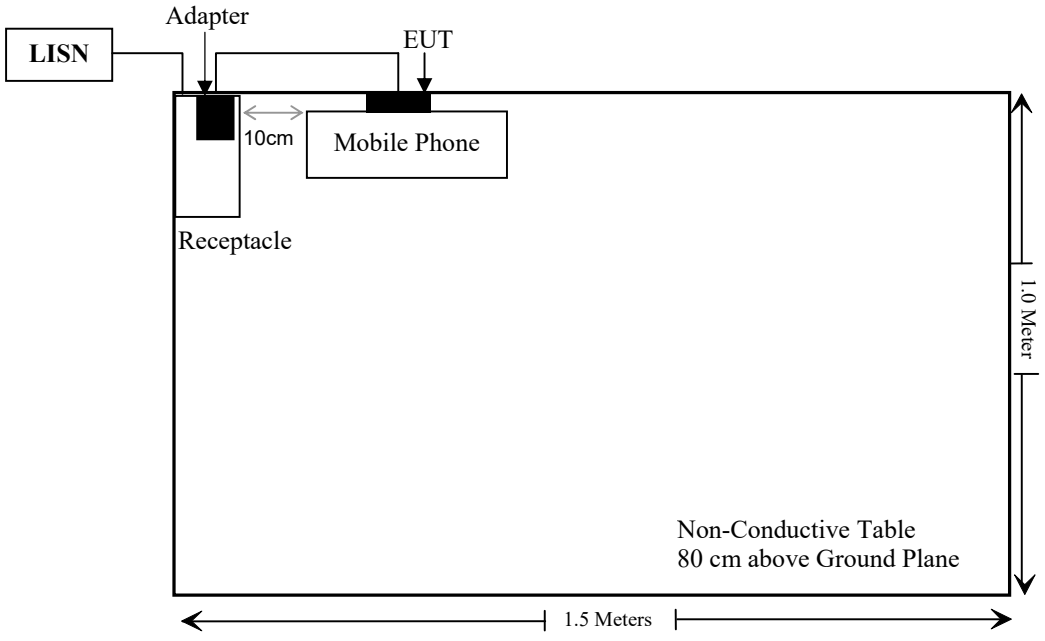
Manufacturer	Description	Model	Serial Number
Vivo	Mobile Phone	iQOO Neo5	341473253400B2Y
UMIDIGI	Adapter	HF-0502000U	Unknown

External I/O Cable

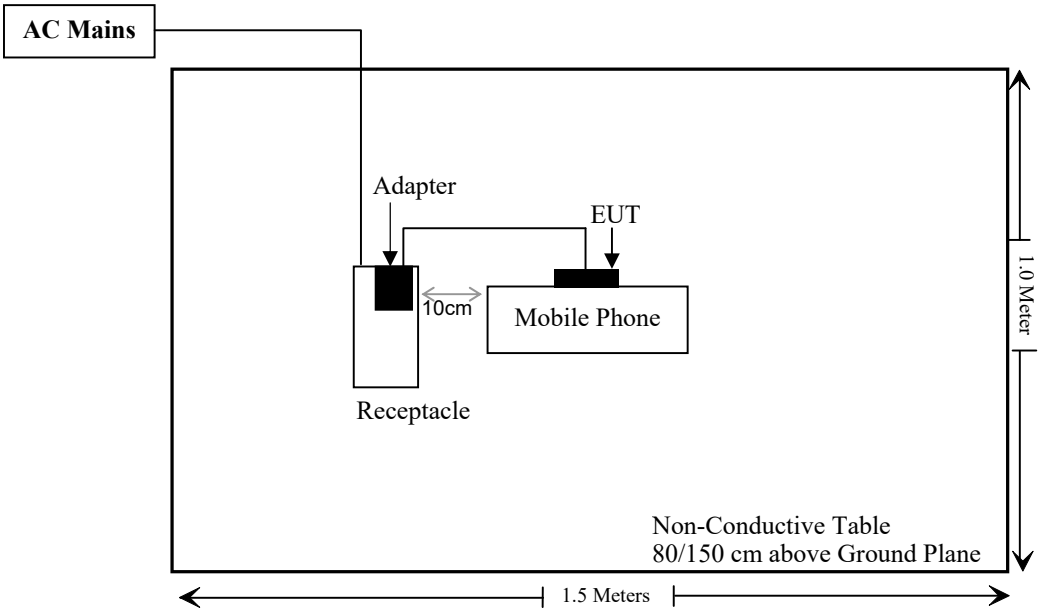
Cable Description	Length (m)	From Port	To
Un-shielded detachable USB Cable	1.0	EUT	Adapter

Block Diagram of Test Setup

For Conducted Emissions:



For Radiated Emissions:



SUMMARY OF TEST RESULTS

Rules	Description of Test	Result
FCC 15.247 (i), §1.1307 (b) (1) & §2.1093	RF Exposure	Compliant
FCC §15.203	Antenna Requirement	Compliant
FCC §15.207(a)	AC Line Conducted Emissions	Compliant
FCC §15.205, §15.209, §15.247(d)	Radiated Emissions	Compliant
FCC §15.247(a)(1)	20 dB Emission Bandwidth	Compliant
FCC §15.247(a)(1)	Channel Separation Test	Compliant
FCC §15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	Compliant
FCC §15.247(a)(1)(iii)	Quantity of hopping channel Test	Compliant
FCC §15.247(b)(1)	Peak Output Power Measurement	Compliant
FCC §15.247(d)	Band edges	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	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 Emission 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	2024/06/18	2025/06/17
Unknown	Cable	XH500C	J-10M-A	2024/06/18	2025/06/17
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	2024/06/18	2025/06/17
Schwarzbeck	Horn Antenna	BBHA9120D(1201)	1143	2023/07/26	2026/07/25
Unknown	RF Cable	KMSE	735	2024/06/18	2025/06/17
Unknown	RF Cable	UFA147	219661	2024/06/18	2025/06/17
JD	Multiplex Switch Test Control Set	DT7220FSU	DQ77926	2024/06/18	2025/06/17
Audix	EMI Test software	E3	191218(V9)	NCR	NCR
A.H.System	Pre-amplifier	PAM-1840VH	190	2024/06/18	2025/06/17
Electro-Mechanics Co	Horn Antenna	3116	9510-2270	2023/09/18	2026/09/17
UTIFLEX	RF Cable	NO. 13	232308-001	2024/06/18	2025/06/17

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
RF Conducted Test					
R&S	SPECTRUM ANALYZER	FSU26	200120	2024/01/08	2025/01/07
Unknown	10dB Attenuator	Unknown	F-03-EM190	2024/06/27	2025/06/26

*** 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), §1.1307 (b) (1) & §2.1093 - RF EXPOSURE

Applicable Standard

According to FCC §2.1093 and §1.1307(b) (1), systems operating under the provisions of this section shall be operated in a manner that ensure that the public is not exposed to radio frequency energy level in excess of the Commission's guideline.

According to KDB 447498 D01 General RF Exposure Guidance

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:
[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where
1. f(GHz) is the RF channel transmit frequency in GHz.
2. Power and distance are rounded to the nearest mW and mm before calculation.
3. The result is rounded to one decimal place for comparison.
4. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test Exclusion.

Measurement Result

For worst case:

Mode	Frequency (MHz)	Max tune-up conducted power# (dBm)	Max tune-up conducted power# (mW)	Distance (mm)	Calculated value	Threshold (1-g SAR)	SAR Test Exclusion
GFSK	2402-2480	5.5	3.55	5	1.1	3.0	**Yes**

Result: Compliant.

FCC §15.203 - ANTENNA REQUIREMENT

Applicable Standard

According to FCC § 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 use of a standard antenna jack or electrical connector is prohibited.

Further, this requirement does not apply to intentional radiators that must be professionally installed, such as perimeter protection systems and some field disturbance sensors, or to other intentional radiators which, in accordance with § 15.31(d), must be measured at the installation site. However, the installer shall be responsible for ensuring that the proper antenna is employed so that the limits in this part are not exceeded.

Antenna Connector Construction

The EUT has one internal antenna arrangement, which was permanently attached, the antenna gain[#] is -0.8dBi, fulfill the requirement of this section. Please refer to the EUT photos.

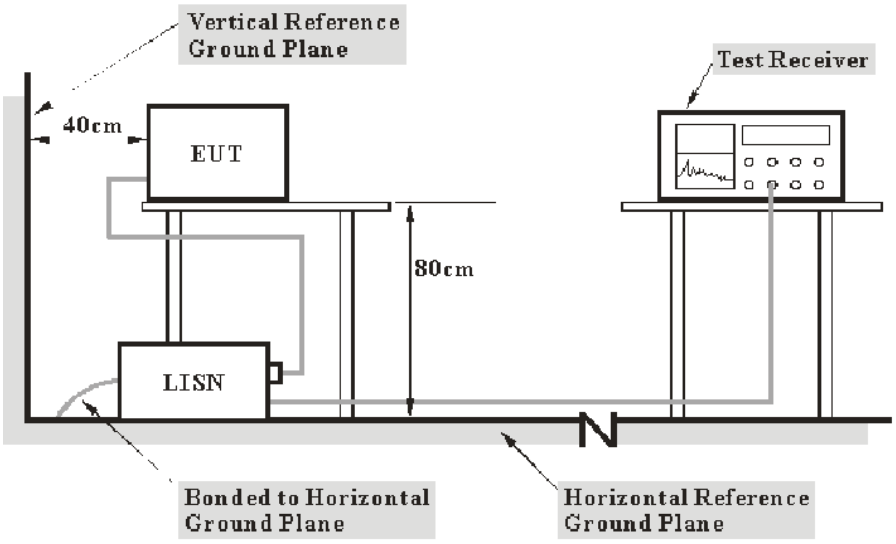
Result: Compliant

FCC §15.207 (a) - AC LINE CONDUCTED EMISSIONS

Applicable Standard

FCC §15.207(a)

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 measurement procedure of EUT setup is according with ANSI C63.10-2013. The related limit was specified in FCC Part 15.207.

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

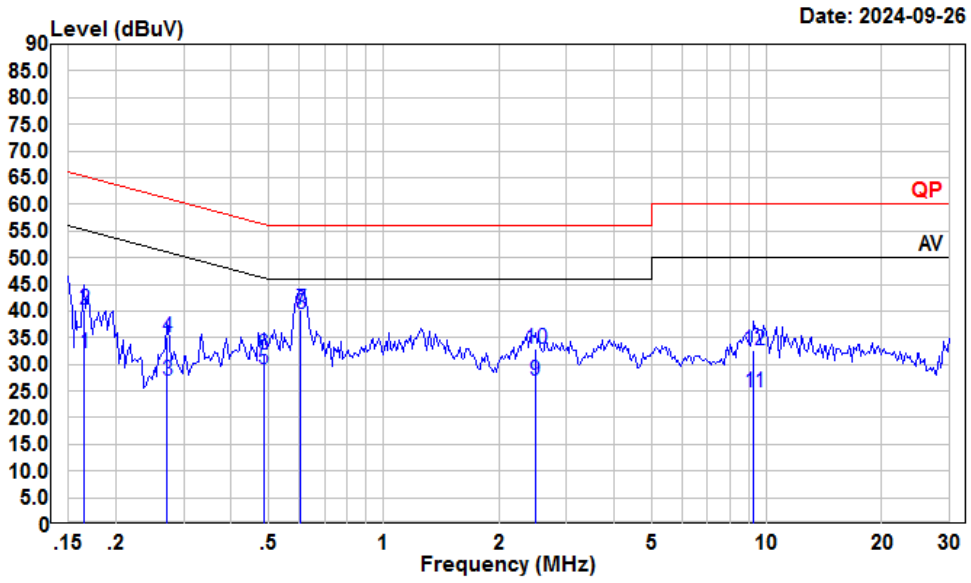
Environmental Conditions

Temperature:	26 ℃
Relative Humidity:	75 %
ATM Pressure:	101 kPa

The testing was performed by Macy Shi on 2024-09-26.

EUT operation mode: Transmitting (Maximum output power mode, High channel)

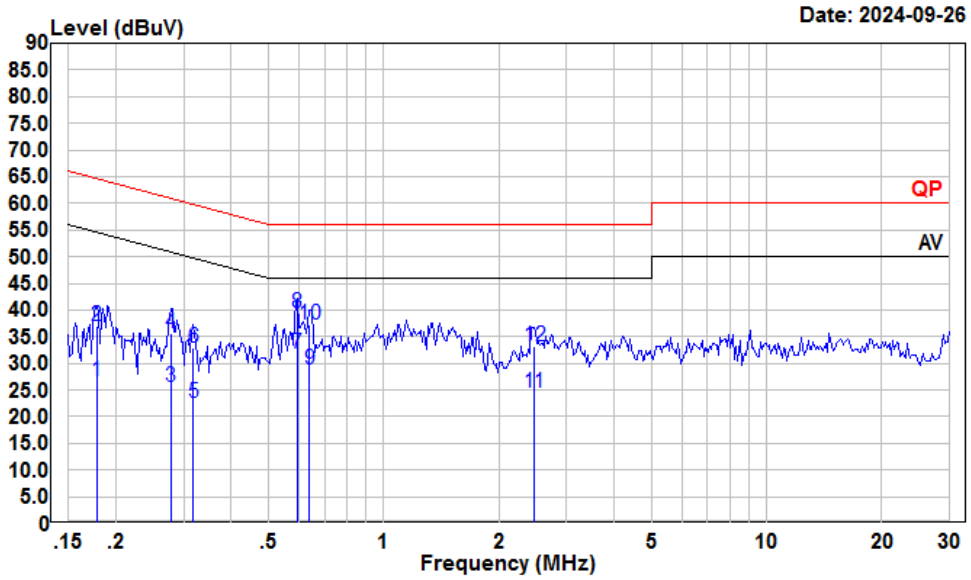
AC 120V/60 Hz, Line



Condition: Line
Project : 2401W32386E-RF
tester : Macy.shi
Note : Transmitting

	Freq	Read Level	LISN Level	Factor	Cable Loss	Limit Line	Over Limit	Remark
	MHz	dBuV	dBuV	dB	dB	dBuV	dB	
1	0.165	11.07	32.05	10.87	10.11	55.21	-23.16	Average
2	0.165	19.19	40.17	10.87	10.11	65.21	-25.04	QP
3	0.272	6.19	26.98	10.70	10.09	51.07	-24.09	Average
4	0.272	14.26	35.05	10.70	10.09	61.07	-26.02	QP
5	0.486	8.38	29.02	10.51	10.13	46.23	-17.21	Average
6	0.486	11.14	31.78	10.51	10.13	56.23	-24.45	QP
7	0.608	19.69	40.31	10.50	10.12	46.00	-5.69	Average
8	0.608	18.79	39.41	10.50	10.12	56.00	-16.59	QP
9	2.487	6.20	26.88	10.51	10.17	46.00	-19.12	Average
10	2.487	12.31	32.99	10.51	10.17	56.00	-23.01	QP
11	9.253	3.84	24.63	10.58	10.21	50.00	-25.37	Average
12	9.253	11.84	32.63	10.58	10.21	60.00	-27.37	QP

AC 120V/60 Hz, Neutral



Condition: Neutral
Project : 2401W32386E-RF
tester : Macy.shi
Note : Transmitting

	Freq	Read Level	LISN Level	Factor	Cable Loss	Limit Line	Over Limit	Remark
	MHz	dBuV	dBuV	dB	dB	dBuV	dB	
1	0.178	6.10	26.68	10.48	10.10	54.59	-27.91	Average
2	0.178	16.42	37.00	10.48	10.10	64.59	-27.59	QP
3	0.277	5.08	25.69	10.51	10.10	50.90	-25.21	Average
4	0.277	15.04	35.65	10.51	10.10	60.90	-25.25	QP
5	0.318	1.85	22.51	10.55	10.11	49.75	-27.24	Average
6	0.318	12.33	32.99	10.55	10.11	59.75	-26.76	QP
7	0.595	10.92	31.74	10.70	10.12	46.00	-14.26	Average
8	0.595	18.57	39.39	10.70	10.12	56.00	-16.61	QP
9	0.641	8.00	28.83	10.70	10.13	46.00	-17.17	Average
10	0.641	16.50	37.33	10.70	10.13	56.00	-18.67	QP
11	2.461	3.98	24.55	10.40	10.17	46.00	-21.45	Average
12	2.461	12.70	33.27	10.40	10.17	56.00	-22.73	QP

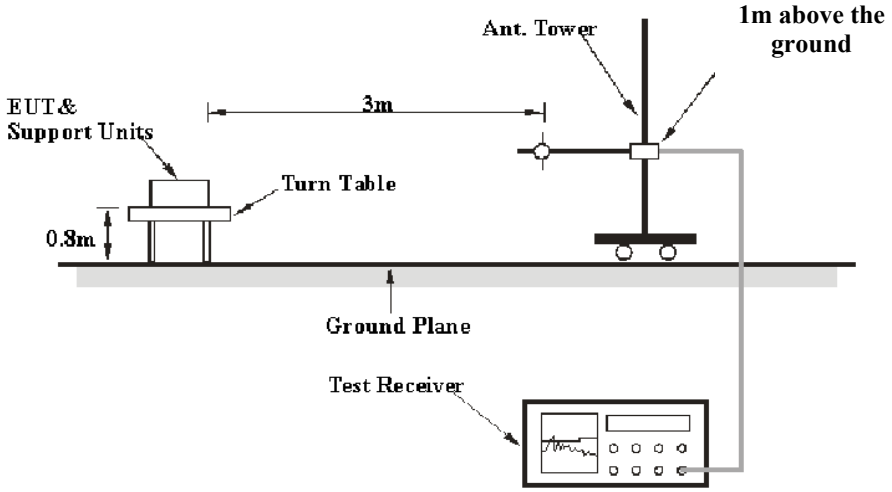
FCC §15.205, §15.209 & §15.247(d) - RADIATED EMISSIONS

Applicable Standard

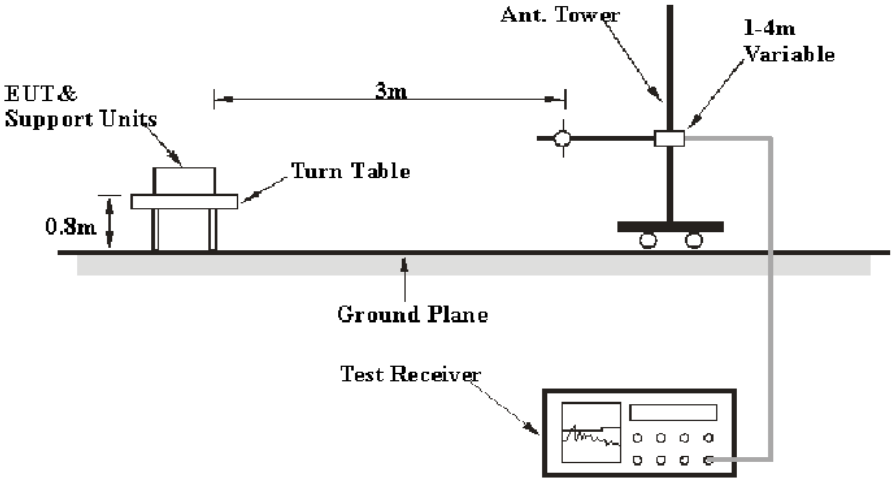
FCC §15.205; §15.209; §15.247(d)

EUT Setup

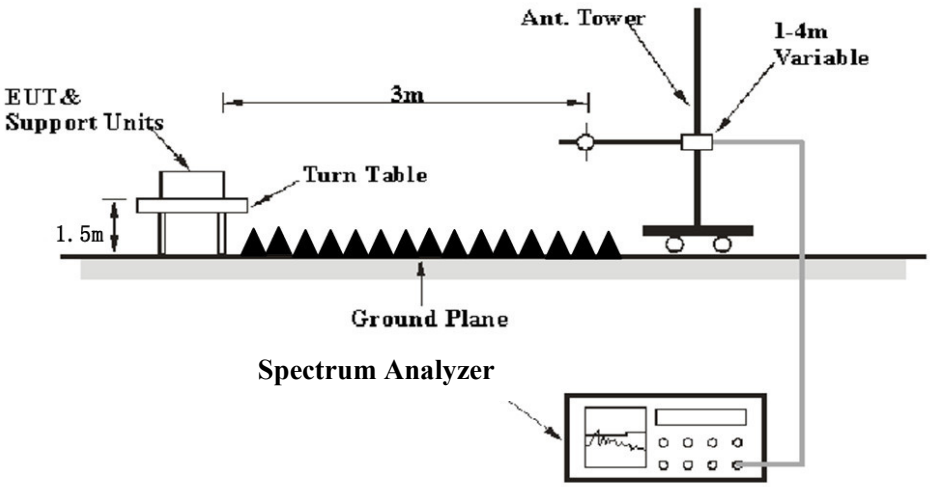
9 kHz-30MHz:



30MHz-1GHz:



Above 1GHz:



The radiated emission tests were performed in the 3 meters, 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 EMI test receiver & Spectrum Analyzer Setup were set with the following configurations:

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
Above 1 GHz	Harmonics & Band Edge			
	1MHz	3 MHz	/	PK
	Average Emission Level=Peak Emission Level+20*log(Duty cycle)			
	Other Emissions			
	1MHz	3 MHz	/	PK
	1MHz	10 Hz	/	Average

For Duty cycle measurement:

Use the duty cycle factor correction factor method per 15.35(c).
Duty cycle=On time/100milliseconds, On time=N1*L1+N2*L2+…Nn-1*Ln-1+Nn*Ln,
Where N1 is number of type 1 pulses, L1 is length of type 1 pulse, etc.

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:	23~25 ℃
Relative Humidity:	50~57 %
ATM Pressure:	101 kPa

The testing was performed by Jack Liu on 2024-09-25 for below 1GHz and Zenos Qiao from 2024-09-27 to 2024-10-16 for above 1GHz.

Test mode: Transmitting

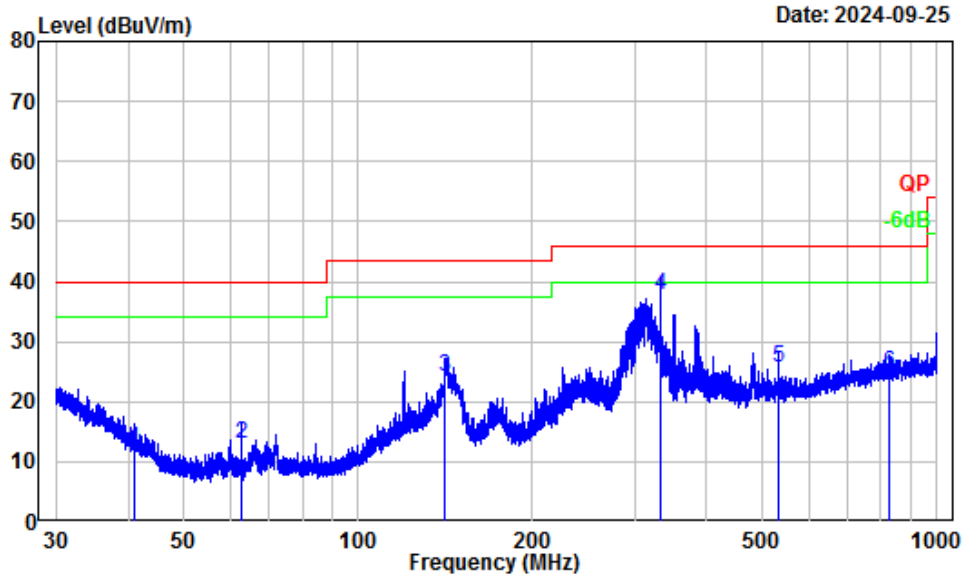
Note: After pre-scan in the X, Y and Z axes of orientation, the worst case z-axis of orientation were recorded.

9 kHz-30MHz: *(Maximum output power mode, High channel)*

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

30MHz-1GHz: *(Maximum output power mode, High channel)*

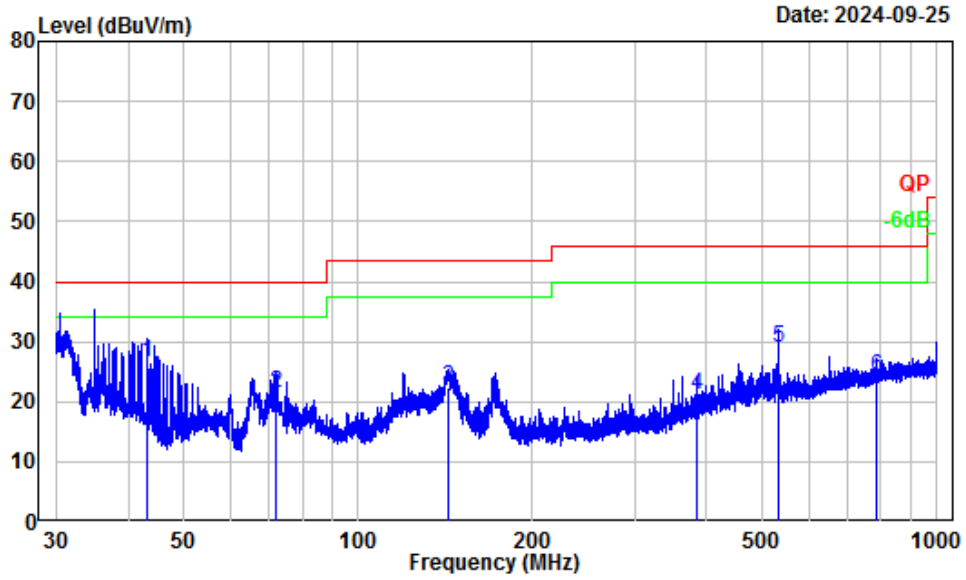
Horizontal



Site : Chamber A
Condition : 3m Horizontal
Project Number: 2401W32386E-RF
Test Mode : 2.4G HFSS
Tester : Carl Zhu

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	40.92	-13.02	25.23	12.21	40.00	-27.79	QP
2	62.71	-18.11	31.03	12.92	40.00	-27.08	QP
3	141.45	-11.94	36.03	24.09	43.50	-19.41	QP
4	333.10	-10.58	48.31	37.73	46.00	-8.27	QP
5	532.90	-5.75	31.34	25.59	46.00	-20.41	QP
6	826.77	-1.93	26.62	24.69	46.00	-21.31	QP

Vertical



Site : Chamber A
Condition : 3m Vertical
Project Number: 2401W32386E-RF
Test Mode : 2.4G HFSS
Tester : Carl Zhu

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	43.22	-14.71	41.17	26.46	40.00	-13.54	QP
2	71.96	-17.85	39.30	21.45	40.00	-18.55	QP
3	142.82	-12.06	34.37	22.31	43.50	-21.19	QP
4	384.27	-9.03	30.19	21.16	46.00	-24.84	QP
5	533.13	-5.75	34.85	29.10	46.00	-16.90	QP
6	784.75	-2.36	26.58	24.22	46.00	-21.78	QP

Above 1GHz:

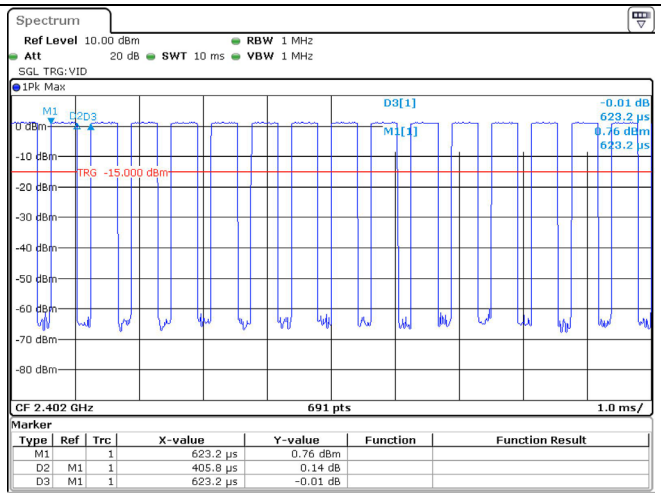
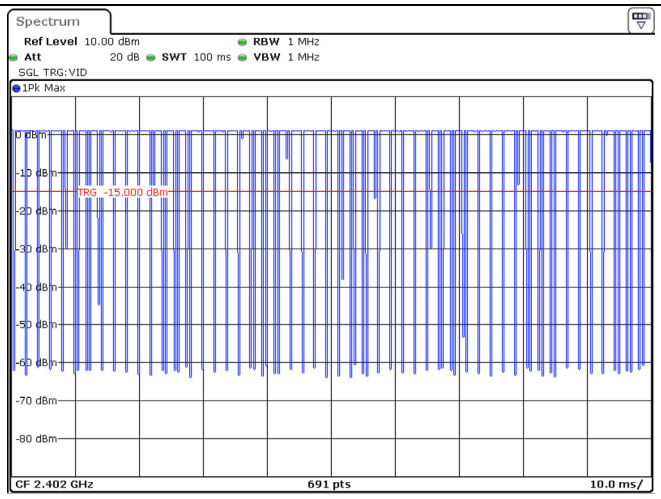
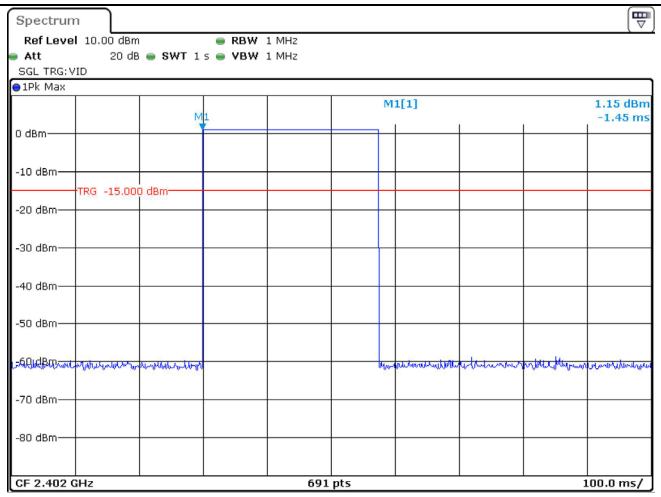
Frequency (MHz)	Receiver		Polar (H/V)	Factor (dB/m)	Corrected Amplitude (dBµV/m)	Limit (dBµV/m)	Margin (dB)
	Reading (dBµV)	PK/AV					
GFSK							
Low Channel 2402MHz							
2389.58	55.19	PK	H	-3.20	51.99	74	-22.01
2374.44	55.00	PK	V	-3.18	51.82	74	-22.18
4804.00	50.83	PK	H	2.42	53.25	74	-20.75
4804.00	50.41	PK	V	2.42	52.83	74	-21.17
Middle Channel 2440MHz							
4880.00	50.45	PK	H	2.58	53.03	74	-20.97
4880.00	49.94	PK	V	2.58	52.52	74	-21.48
High Channel 2480MHz							
2483.52	57.89	PK	H	-3.17	54.72	74	-19.28
2483.51	56.43	PK	V	-3.17	53.26	74	-20.74
4960.00	50.01	PK	H	2.68	52.69	74	-21.31
4960.00	49.68	PK	V	2.68	52.36	74	-21.64

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.

Field Strength of Average							
Frequency (MHz)	**Peak Measurement @3m (dBµV/m)**	**Polar (H/V)**	**Duty Cycle Corrected Factor (dB)**	**Average Level (dBµV/m)**	**Limit (dBµV/m)**	**Margin (dB)**	**Comment**
Low Channel 2402MHz							
2389.58	51.99	H	-3.75	48.24	54	-5.76	Bandedge
2374.44	51.82	V	-3.75	48.07	54	-5.93	Bandedge
4804.00	53.25	H	-3.75	49.50	54	-4.50	Harmonic
4804.00	52.83	V	-3.75	49.08	54	-4.92	Harmonic
Middle Channel 2440MHz							
4880.00	53.03	H	-3.75	49.28	54	-4.72	Harmonic
4880.00	52.52	V	-3.75	48.77	54	-5.23	Harmonic
High Channel 2480MHz							
2483.52	54.72	H	-3.75	50.97	54	-3.03	Bandedge
2483.51	53.26	V	-3.75	49.51	54	-4.49	Bandedge
4960.00	52.69	H	-3.75	48.94	54	-5.06	Harmonic
4960.00	52.36	V	-3.75	48.61	54	-5.39	Harmonic

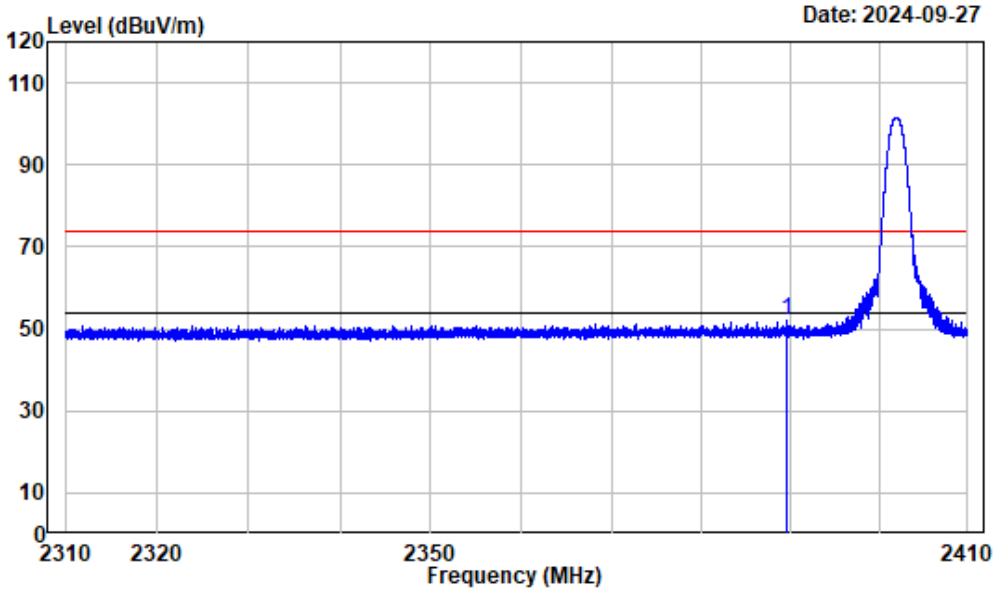
Note: Average level= Peak level+ Duty Cycle Corrected Factor

Worst case duty cycle:
Duty Cycle = Ton/100ms = 0.4058*16*10/100=0.64928
Duty Cycle Corrected Factor = 20lg (Duty Cycle) = 20lg0.64928= -3.75

Duty Cycle (10ms)	
Duty Cycle (100ms)	
Duty Cycle (1s)	

Test plots for Band Edge Measurements (Radiated):

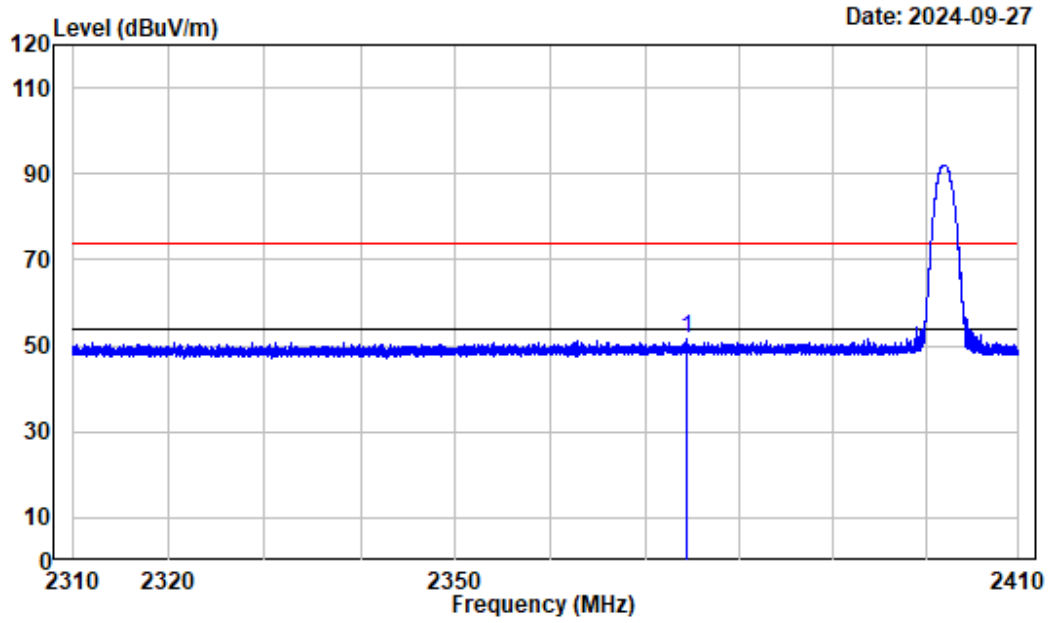
GFSK			
Test Channel:	**2402MHz**	**Ant. Polar. :**	**Horizontal**



Condition : Horizontal
Project No.: 2401W32386E-RF
Tester : Zenos Qiao
Note : 2.4G FHSS-2402

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	2389.575	-3.20	55.19	51.99	74.00	-22.01	Peak

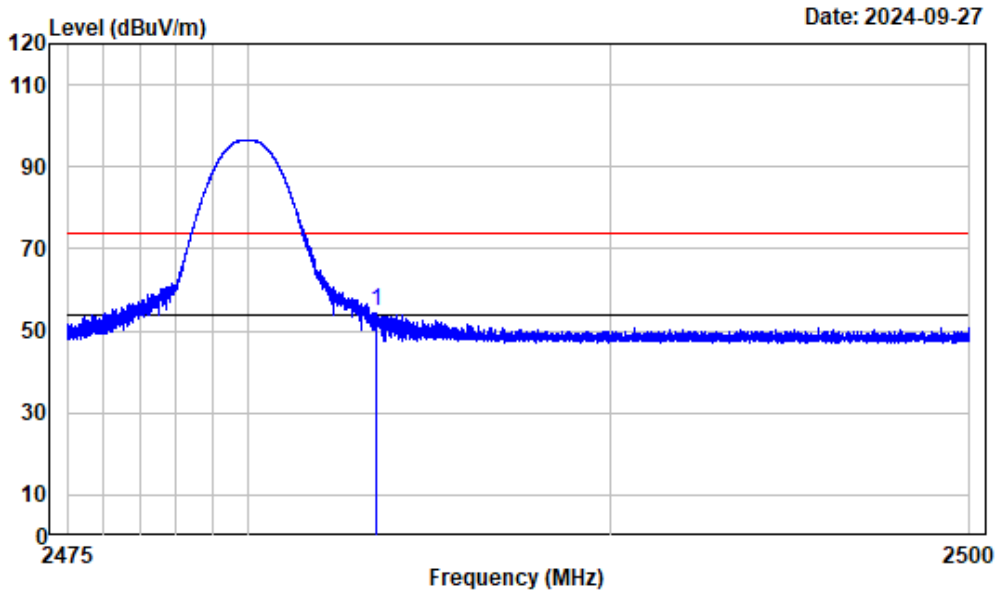
GFSK			
Test Channel:	**2402MHz**	**Ant. Polar. :**	**Vertical**



Condition : Vertical
Project No.: 2401W32386E-RF
Tester : Zenos Qiao
Note : 2.4G FHSS-2402

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	2374.438	-3.18	55.00	51.82	74.00	-22.18	Peak

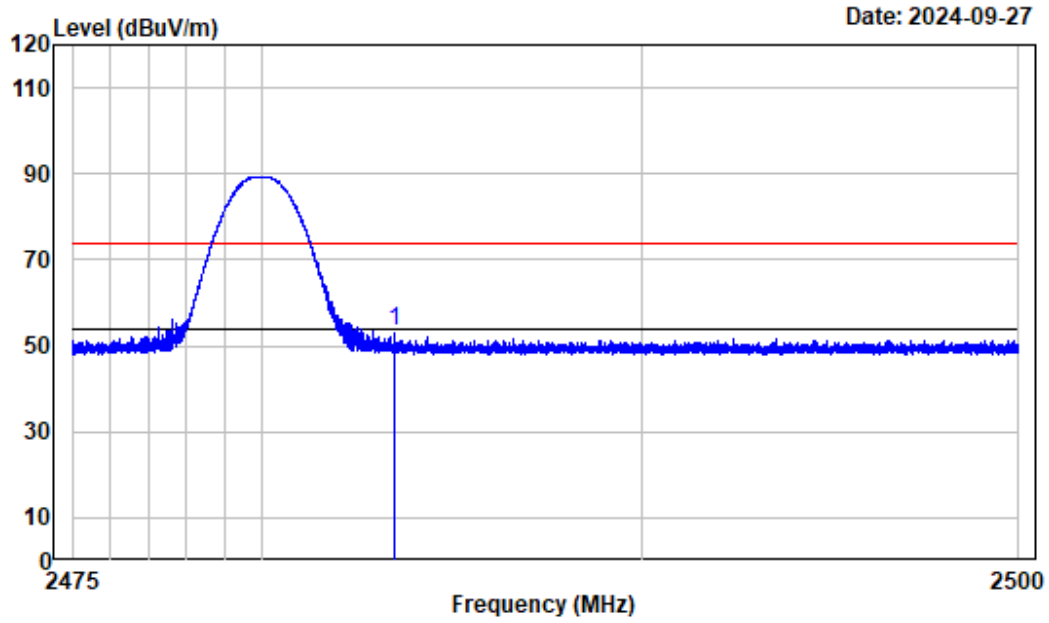
GFSK			
Test Channel:	**2480MHz**	**Ant. Polar. :**	**Horizontal**



Condition : Horizontal
Project No.: 2401W32386E-RF
Tester : Zenos Qiao
Note : 2.4G FHSS-2480

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	2483.522	-3.17	57.89	54.72	74.00	-19.28	Peak

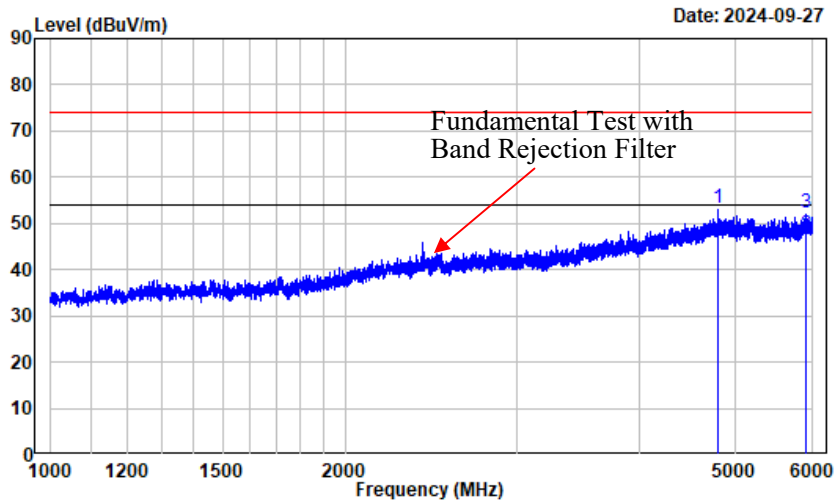
GFSK			
Test Channel:	**2480MHz**	**Ant. Polar. :**	**Vertical**



Condition : Vertical
Project No.: 2401W32386E-RF
Tester : Zenos Qiao
Note : 2.4G FHSS-2480

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	2483.506	-3.17	56.43	53.26	74.00	-20.74	Peak

Listed with the worst harmonic margin test plot:

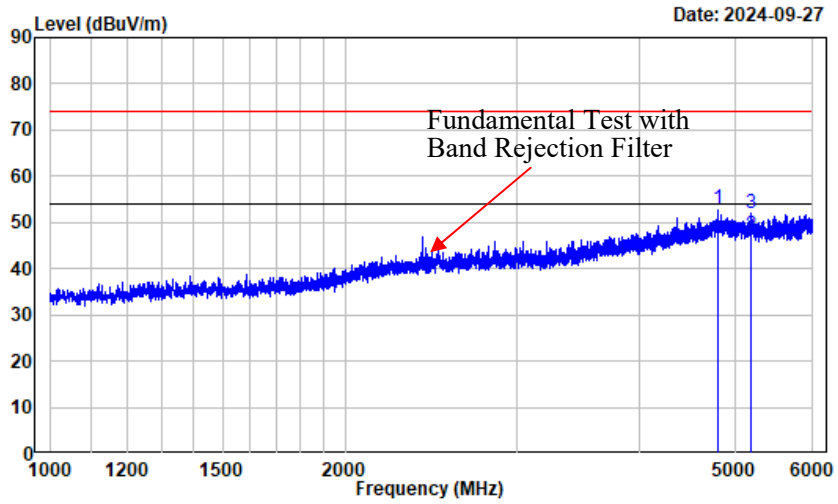
Horizontal	
1-6GHz	

Condition : Horizontal
Project No.: 2401W32386E-RF
Tester : Zenos Qiao
Note : 2.4G FHSS-2402

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	4804.000	2.42	50.83	53.25	74.00	-20.75	Peak
2	5906.875	3.84	43.62	47.46	54.00	-6.54	Average
3	5906.875	3.84	48.33	52.17	74.00	-21.83	Peak

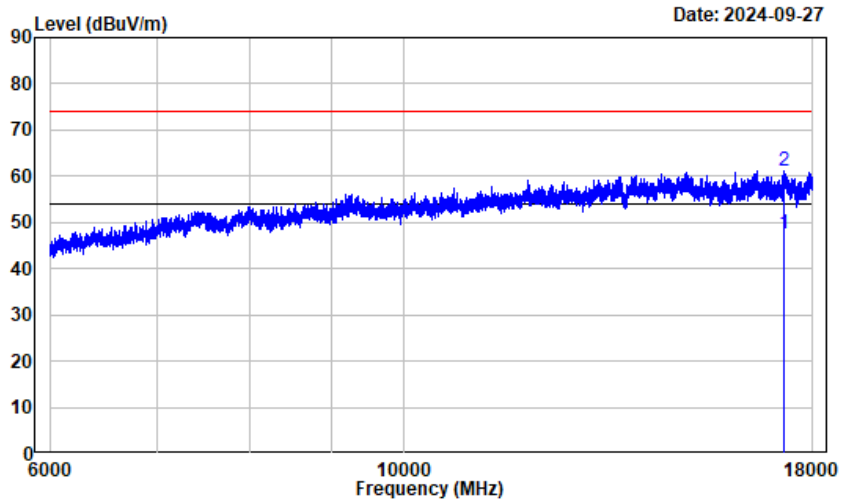
Vertical

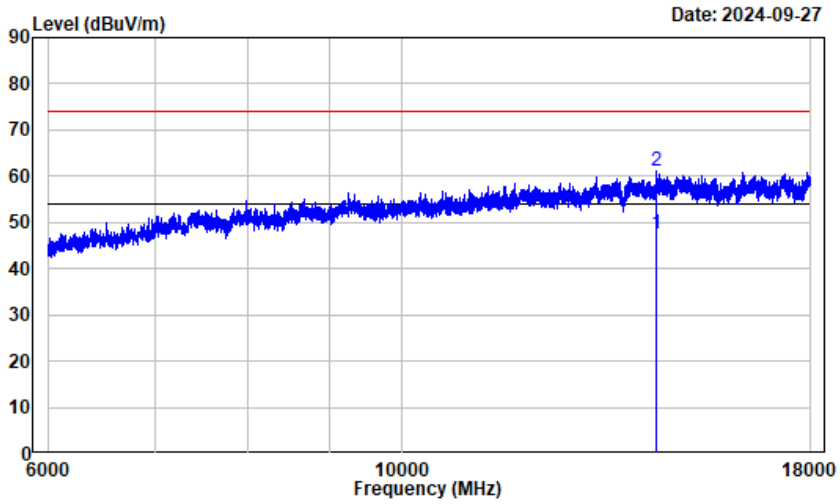
1-6GHz



Condition : Vertical
Project No.: 2401W32386E-RF
Tester : Zenos Qiao
Note : 2.4G FHSS-2402

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	4804.000	2.42	50.41	52.83	74.00	-21.17	Peak
2	5182.500	2.95	44.40	47.35	54.00	-6.65	Average
3	5182.500	2.95	49.09	52.04	74.00	-21.96	Peak

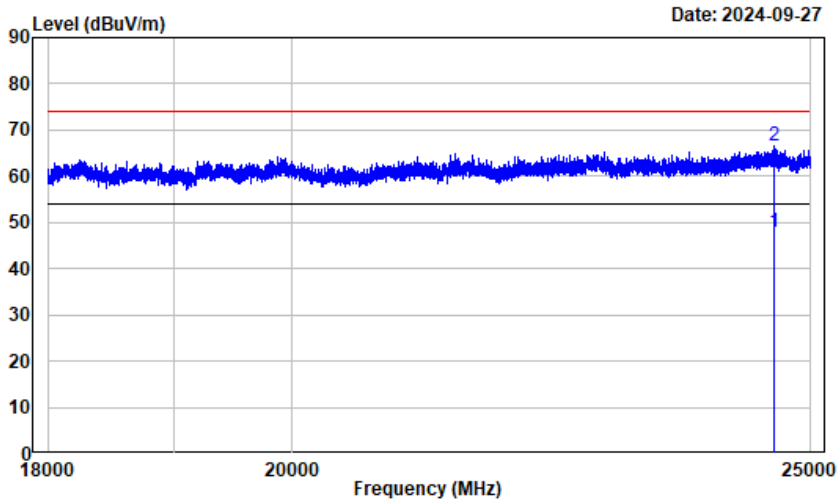
Horizontal	
6-18GHz	 Condition : Horizontal Project No.: 2401W32386E-RF Tester : Zenos Qiao Note : 2.4G FHSS-2402 Freq / Factor / Read Level / Level / Limit Line / Over Limit / Remark MHz / dB/m / dBuV / dBuV/m / dBuV/m / dB 1 17266.500 19.11 28.58 47.69 54.00 -6.31 Average 2 17266.500 19.11 42.10 61.21 74.00 -12.79 Peak

Vertical	
6-18GHz	 Condition : Vertical Project No.: 2401W32386E-RF Tester : Zenos Qiao Note : 2.4G FHSS-2402

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	14419.500	17.28	30.29	47.57	54.00	-6.43	Average
2	14419.500	17.28	43.73	61.01	74.00	-12.99	Peak

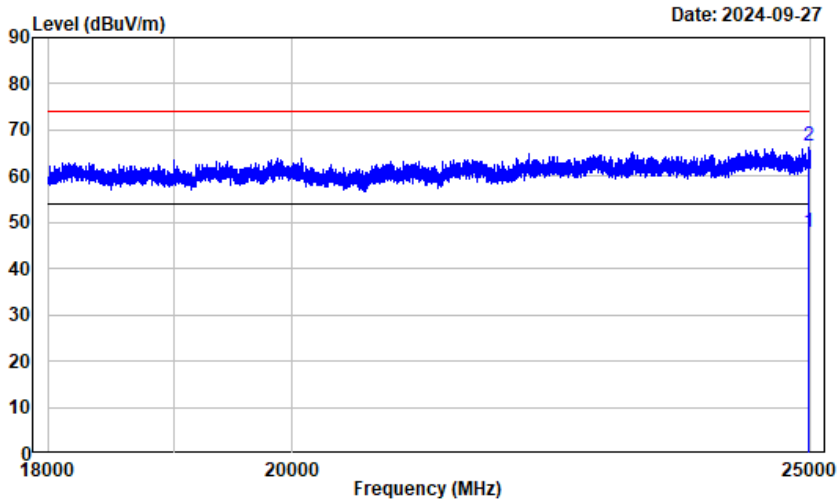
Horizontal

18-25GHz



Condition : Horizontal
Project No.: 2401W32386E-RF
Tester : Zenos Qiao
Note : 2.4G FHSS-2402

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	24603.630	18.87	29.05	47.92	54.00	-6.08	Average
2	24603.630	18.87	47.76	66.63	74.00	-7.37	Peak

Vertical	
18-25GHz	 Condition : Vertical Project No.: 2401W32386E-RF Tester : Zenos Qiao Note : 2.4G FHSS-2402 Freq / Factor / Read Level / Level / Limit Line / Over Limit / Remark MHz / dB/m / dBuV / dBuV/m / dBuV/m / dB 1 24977.250 18.40 29.40 47.80 54.00 -6.20 Average 2 24977.250 18.40 48.09 66.49 74.00 -7.51 Peak

FCC §15.247(a) (1) - CHANNEL SEPARATION TEST

Applicable Standard

Frequency hopping systems shall have hoping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater provided the systems operate with an output power no greater than 125 mW. The system shall hop to channel frequencies that are selected at the system hopping rate from a pseudo randomly ordered list of hopping frequencies. Each frequency must be used equally on the average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their corresponding transmitters and shall shift frequencies in synchronization with the transmitted signals.

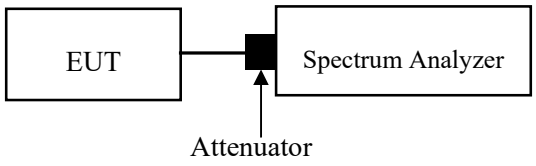
Test Procedure

Test Method: ANSI C63.10-2013 Clause 7.8.2

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

a) Span: Wide enough to capture the peaks of two adjacent channels.
b) RBW: Start with the RBW set to approximately 30% of the channel spacing; adjust as necessary to best identify the center of each individual channel.
c) Video (or average) bandwidth (VBW) ≥ RBW.
d) Sweep: Auto.
e) Detector function: Peak.
f) Trace: Max hold.
g) Allow the trace to stabilize.

Use the marker-delta function to determine the separation between the peaks of the adjacent channels. Compliance of an EUT with the appropriate regulatory limit shall be determined.



Test Data

Environmental Conditions

Temperature:	27 ℃
Relative Humidity:	49 %
ATM Pressure:	101 kPa

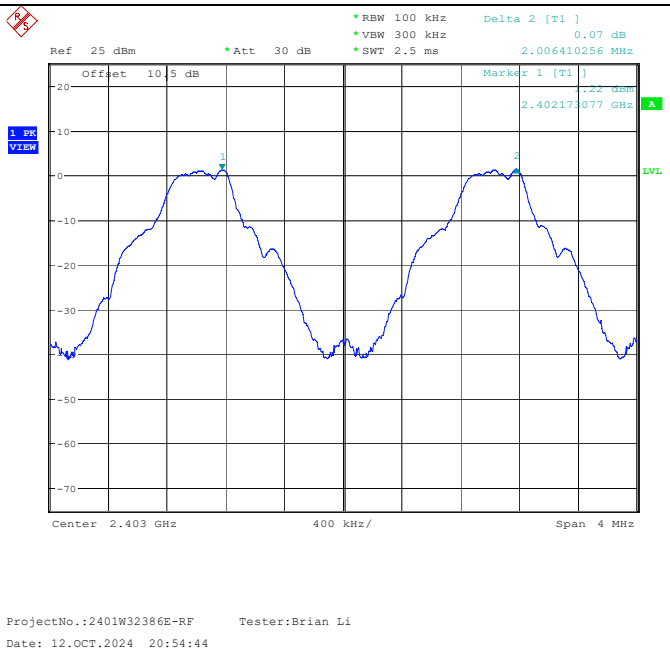
The testing was performed by Brian Li on 2024-10-12.

EUT operation mode: Transmitting

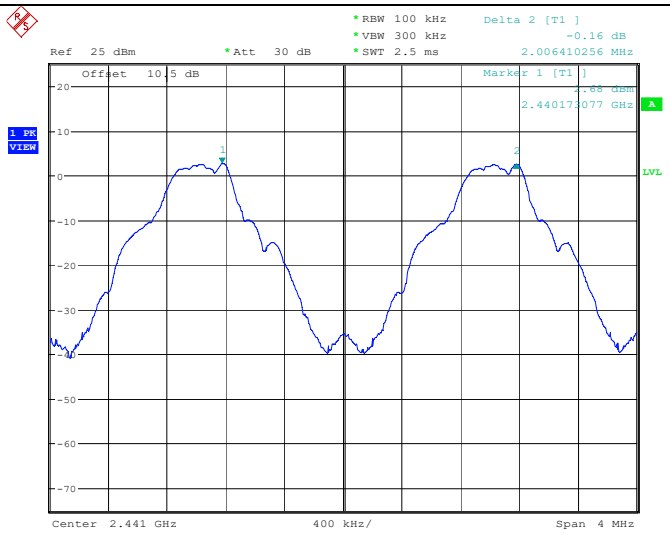
Test Result: Compliant.

Test Mode	Test Frequency (MHz)	Channel Separation (MHz)	Limits (MHz)
GFSK	2402	2.006	0.579
	2440	2.006	0.581
	2480	2.006	0.576
Limit= Two-thirds of the 20 dB bandwidth			

Lowest



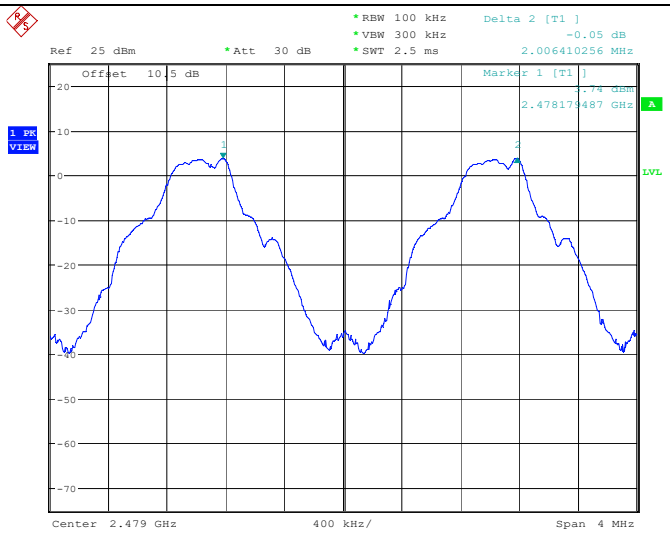
Middle



ProjectNo.:2401W32386E-RF Tester:Brian Li

Date: 12.OCT.2024 20:56:29

Highest



ProjectNo.:2401W32386E-RF Tester:Brian Li

Date: 12.OCT.2024 20:57:34

FCC §15.247(a) (1) - 20 dB EMISSION BANDWIDTH

Applicable Standard

Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

Test Procedure

Test Method: ANSI C63.10-2013 Clause 7.8.7 & Clause 6.9.2

a) The spectrum analyzer center frequency is set to the nominal EUT channel center frequency. The span range for the EMI receiver or spectrum analyzer shall be between two times and five times the OBW.

b) The nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW and video bandwidth (VBW) shall be approximately three times RBW, unless otherwise specified by the applicable requirement.

c) Set the reference level of the instrument as required, keeping the signal from exceeding the maximum input mixer level for linear operation. In general, the peak of the spectral envelope shall be more than [10 log (OBW/RBW)] below the reference level.

d) Steps a) through c) might require iteration to adjust within the specified tolerances.

e) The dynamic range of the instrument at the selected RBW shall be more than 10 dB below the target "−xx dB down" requirement; that is, if the requirement calls for measuring the −20 dB OBW, the instrument noise floor at the selected RBW shall be at least 30 dB below the reference value.

f) Set detection mode to peak and trace mode to max hold.

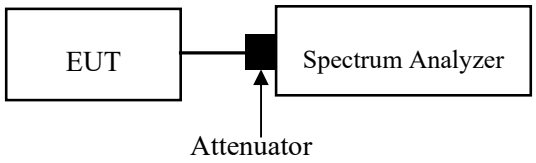
g) Determine the reference value: Set the EUT to transmit an un-modulated carrier or modulated signal, as applicable. Allow the trace to stabilize. Set the spectrum analyzer marker to the highest level of the displayed trace (this is the reference value).

h) Determine the "−xx dB down amplitude" using [(reference value) − xx]. Alternatively, this calculation may be made by using the marker-delta function of the instrument.

i) If the reference value is determined by an un-modulated carrier, then turn the EUT modulation on, and either clear the existing trace or start a new trace on the spectrum analyzer and allow the new trace to stabilize. Otherwise, the trace from step g) shall be used for step j).

j) Place two markers, one at the lowest frequency and the other at the highest frequency of the envelope of the spectral display, such that each marker is at or slightly below the "− xx dB down amplitude" determined in step h). If a marker is below this "−xx dB down amplitude" value, then it shall be as close as possible to this value. The occupied bandwidth is the frequency difference between the two markers. Alternatively, set a marker at the lowest frequency of the envelope of the spectral display, such that the marker is at or slightly below the "− xx dB down amplitude" determined in step h). Reset the marker-delta function and move the marker to the other side of the emission until the delta marker amplitude is at the same level as the reference marker amplitude. The marker-delta frequency reading at this point is the specified emission bandwidth.

k) The occupied bandwidth shall be reported by providing plot(s) of the measuring instrument display; the plot axes and the scale units per division shall be clearly labeled. Tabular data may be reported in addition to the plot(s).



Test Data

Environmental Conditions

Temperature:	27 ℃
Relative Humidity:	49 %
ATM Pressure:	101 kPa

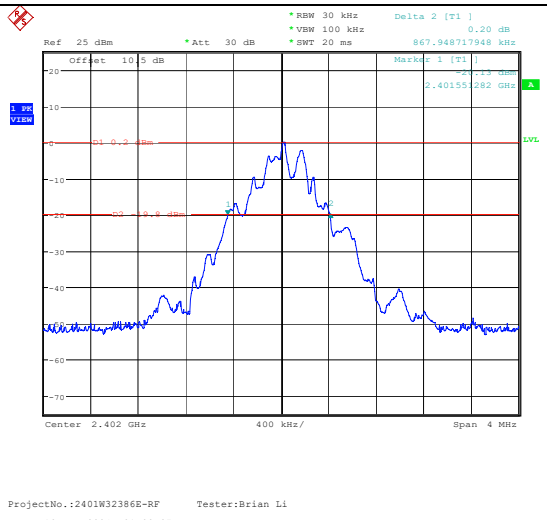
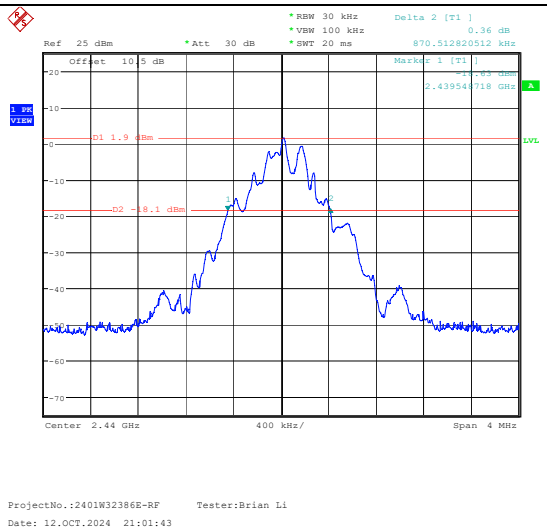
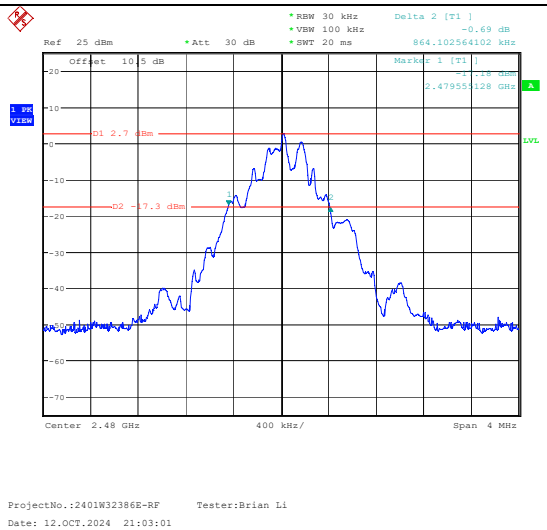
The testing was performed by Brian Li on 2024-10-12.

EUT operation mode: Transmitting

Test Result: Compliant.

Test Mode	Test Frequency (MHz)	20 dB Bandwidth (MHz)
GFSK	2402	0.868
	2440	0.871
	2480	0.864

20 dB Bandwidth

Low Channel	
Middle Channel	
High Channel	

FCC §15.247(a) (1) (iii) - QUANTITY OF HOPPING CHANNEL TEST

Applicable Standard

Frequency hopping systems in the 2400–2483.5 MHz band shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that
a minimum of 15 channels are used.

Test Procedure

Test Method: ANSI C63.10-2013 Clause 7.8.3

a) Span: The frequency band of operation. Depending on the number of channels the device supports, it may be necessary to divide the frequency range of operation across multiple spans, to allow the individual channels to be clearly seen.

b) RBW: To identify clearly the individual channels, set the RBW to less than 30% of the channel spacing or the 20 dB bandwidth, whichever is smaller.

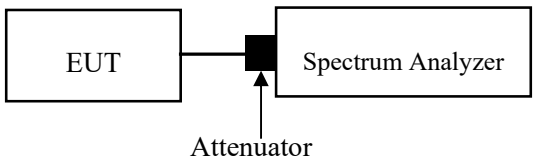
c) VBW ≥ RBW.

d) Sweep: Auto.

e) Detector function: Peak.

f) Trace: Max hold.

It might prove necessary to break the span up into sub ranges to show clearly all of the hopping frequencies. Compliance of an EUT with the appropriate regulatory limit shall be determined for the number of hopping channels.



Test Data

Environmental Conditions

Temperature:	27 ℃
Relative Humidity:	49 %
ATM Pressure:	101 kPa

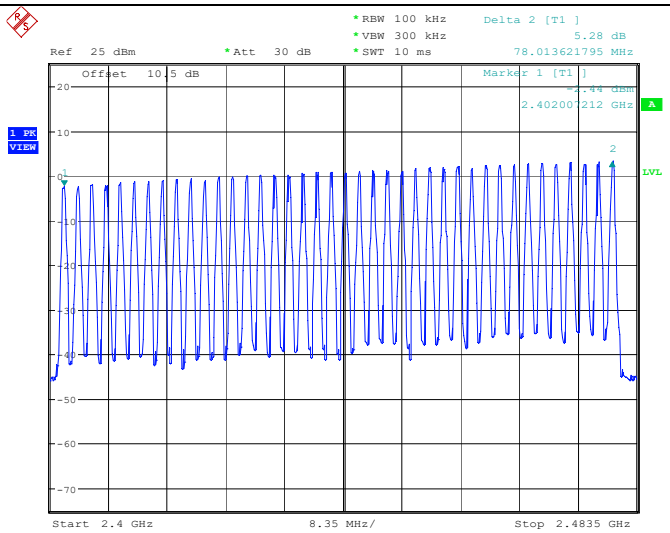
The testing was performed by Brian Li on 2024-10-12.

EUT operation mode: Transmitting

Test Result: Compliant.

Frequency Range (MHz)	Number of Hopping Channel	Limits
2400-2483.5	40	≥15

Hopping Channel



ProjectNo.:2401W32386E-RF Tester:Brian Li

Date: 12.OCT.2024 22:10:55

FCC §15.247(a) (1) (iii) - TIME OF OCCUPANCY (DWELL TIME)

Applicable Standard

Frequency hopping systems in the 2400-2483.5 MHz shall use at least 15 channels. The average time of occupancy on any channel shall not be greater than 0.4 seconds within a period of 0.4 seconds multiplied by the number of hopping channels employed. Frequency hopping systems may avoid or suppress transmissions on a particular hopping frequency provided that a minimum of 15 channels are used.

Test Procedure

Test Method: ANSI C63.10-2013 Clause 7.8.4

The EUT shall have its hopping function enabled. Use the following spectrum analyzer settings:

a) Span: Zero span, centered on a hopping channel.
b) RBW shall be ≤ channel spacing and where possible RBW should be set >> 1 / T, where T is the expected dwell time per channel.
c) Sweep: As necessary to capture the entire dwell time per hopping channel; where possible use a video trigger and trigger delay so that the transmitted signal starts a little to the right of the start of the plot. The trigger level might need slight adjustment to prevent triggering when the system hops on an adjacent channel; a second plot might be needed with a longer sweep time to show two successive hops on a channel.
d) Detector function: Peak.
e) Trace: Max hold.

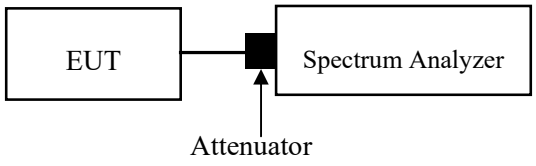
Use the marker-delta function to determine the transmit time per hop. If this value varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation in transmit time.

Repeat the measurement using a longer sweep time to determine the number of hops over the period specified in the requirements. The sweep time shall be equal to, or less than, the period specified in the requirements. Determine the number of hops over the sweep time and calculate the total number of hops in the period specified in the requirements, using the following equation:

(Number of hops in the period specified in the requirements) =(number of hops on spectrum analyzer) × (period specified in the requirements / analyzer sweep time)

The average time of occupancy is calculated from the transmit time per hop multiplied by the number of hops in the period specified in the requirements. If the number of hops in a specific time varies with different modes of operation (data rate, modulation format, number of hopping channels, etc.), then repeat this test for each variation.

The measured transmit time and time between hops shall be consistent with the values described in the operational description for the EUT.



Test Data

Environmental Conditions

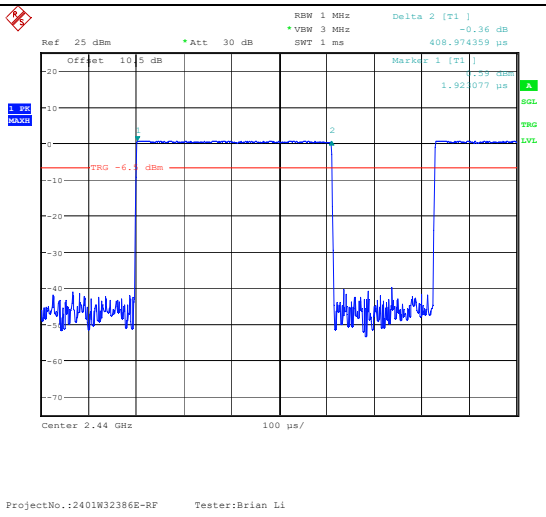
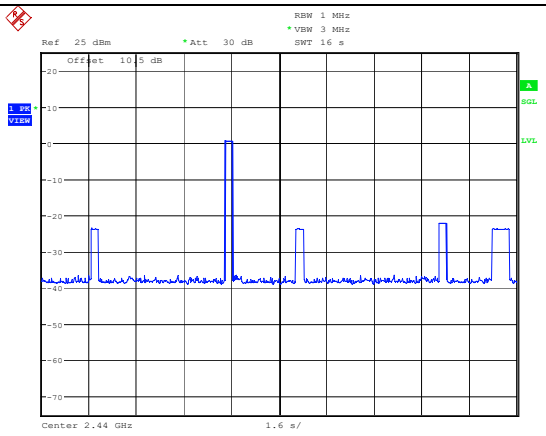
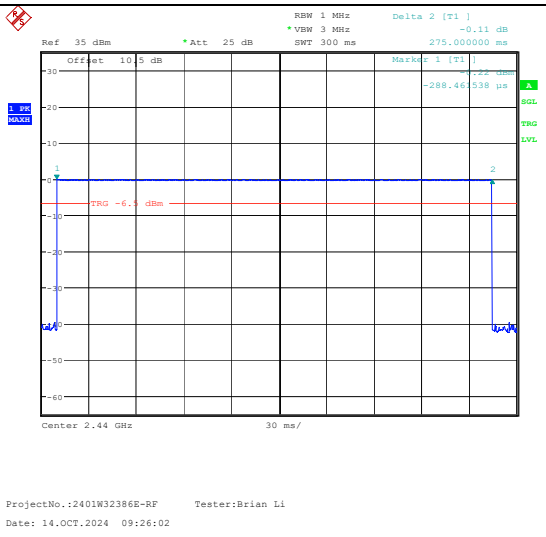
Temperature:	25~27 ℃
Relative Humidity:	46 ~49%
ATM Pressure:	101 kPa

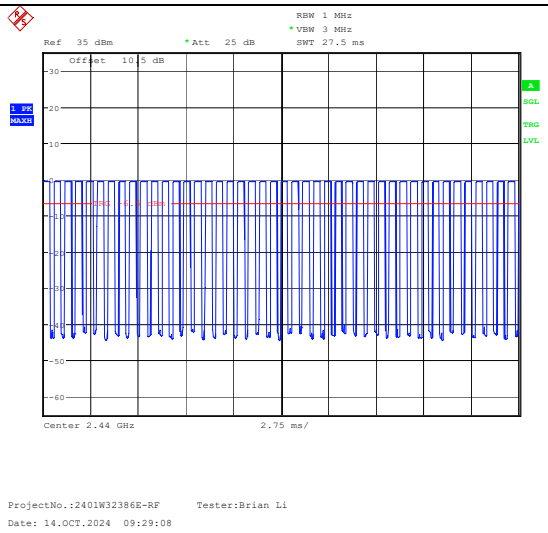
The testing was performed by Brian Li from 2024-10-12 to 2024-10-14.

EUT operation mode: Transmitting

Test Result: Compliant.

Test Frequency (MHz)	Pulse Width (ms)	Observation time (s)	Hopping Numbers in Observation time	Dwell Time (s)	Limit (s)
Hop_2440	179.96	16	1	0.180	0.400
Note: Observation time= Hopping Channel Number× 0.4= 40× 0.4= 16 (s) Pulse Width = Pulse Time* Pulse Numbers =0.409ms*440= 179.96ms Pulse Numbers= Maximum Pulse Numbers in 27.5ms*10=44*10=440 Dwell Time = Pulse Width × Hopping Numbers in Observation time					

Pulse Time: 0.409ms	
Hopping Numbers in 16s	
Occupied Time of a Hop Channel: 275ms	

Maximum Pulse Numbers in 27.5ms: 44	

FCC §15.247(b) (1) - PEAK OUTPUT POWER MEASUREMENT

Applicable Standard

According to §15.247(b) (1), for frequency hopping systems operating in the 2400–2483.5 MHz band employing at least 75 non-overlapping hopping channels, and all frequency hopping systems in the 5725-5850 MHz band: 1 watt. And for all other frequency hopping systems in the 2400–2483.5 MHz band: 0.125 watts.

Test Procedure

Test Method: ANSI C63.10-2013 Clause 7.8.5

This is an RF-conducted test to evaluate maximum peak output power. Use a direct connection between the antenna port of the unlicensed wireless device and the spectrum analyzer, through suitable attenuation. The hopping shall be disabled for this test:

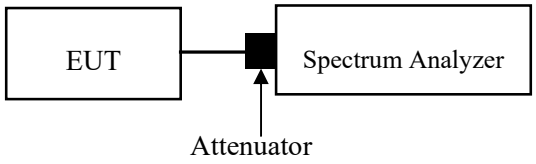
a) Use the following spectrum analyzer settings:

1) Span: Approximately five times the 20 dB bandwidth, centered on a hopping channel.
2) RBW > 20 dB bandwidth of the emission being measured.
3) VBW ≥ RBW.
4) Sweep: Auto.
5) Detector function: Peak.
6) Trace: Max hold.

b) Allow trace to stabilize.

c) Use the marker-to-peak function to set the marker to the peak of the emission.

d) The indicated level is the peak output power, after any corrections for external attenuators and cables.



Test Data

Environmental Conditions

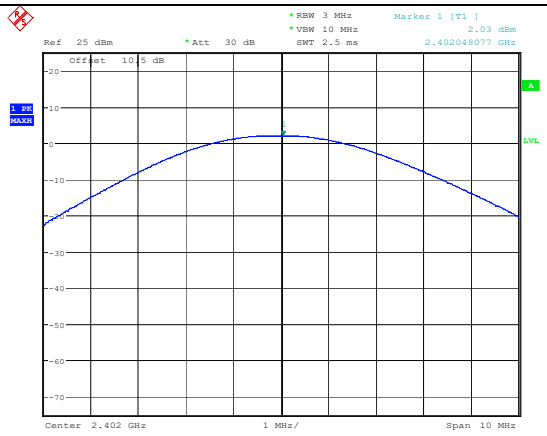
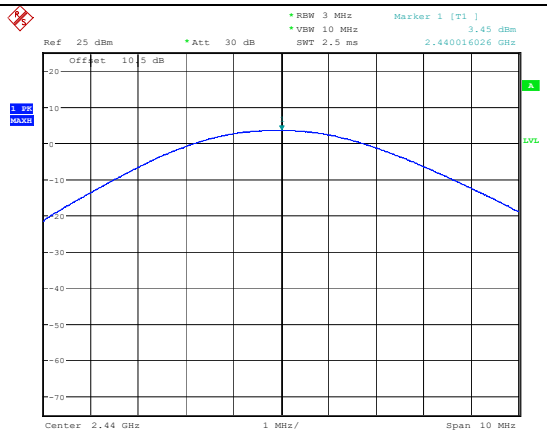
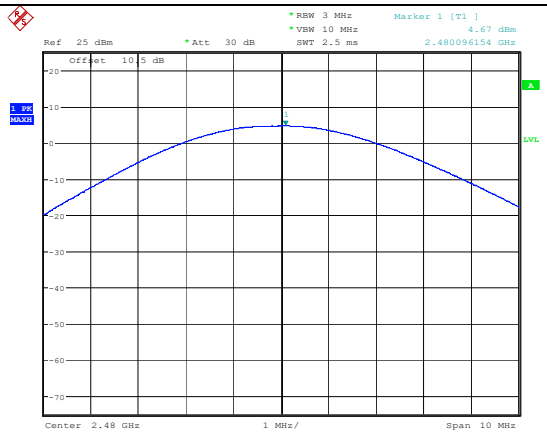
Temperature:	27 ℃
Relative Humidity:	49 %
ATM Pressure:	101 kPa

The testing was performed by Brian Li on 2024-10-12.

EUT operation mode: Transmitting

Test Result: Compliant.

Mode	Frequency (MHz)	Peak Output Power (dBm)	Limit (dBm)
GFSK	2402	2.03	21
	2440	3.45	21
	2480	4.67	21

Low Channel	
Middle Channel	
High Channel	

FCC §15.247(d) § 5.5 - BAND EDGES TESTING

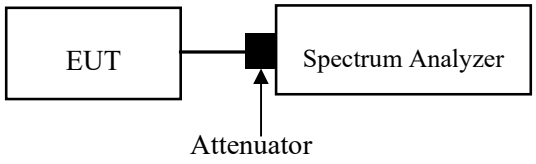
Applicable Standard

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 7.8.6 & Clause 6.10

1. Check the calibration of the measuring instrument using either an internal calibrator or a known signal from an external generator.
2. Remove the antenna from the EUT and then connect to a low loss RF cable from the antenna port to a EMI test receiver, then turn on the EUT and make it operate in transmitting mode. Then set it to Low Channel and High Channel within its operating range, and make sure the instrument is operated in its linear range.
3. Set RBW of spectrum analyzer to 100 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

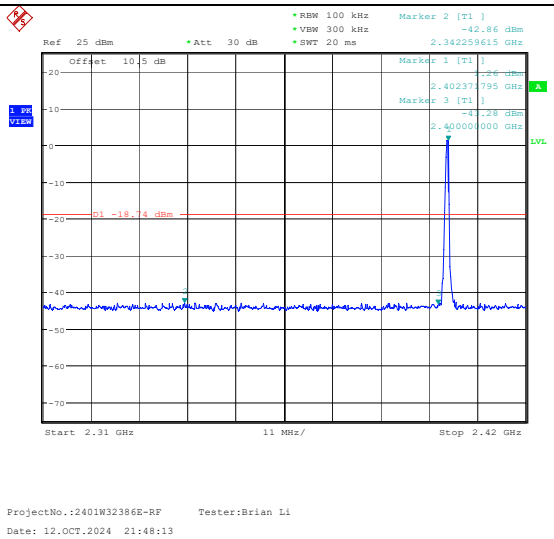
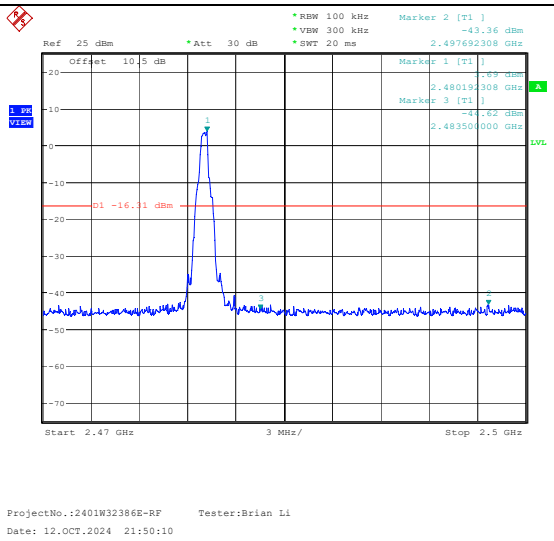
Environmental Conditions

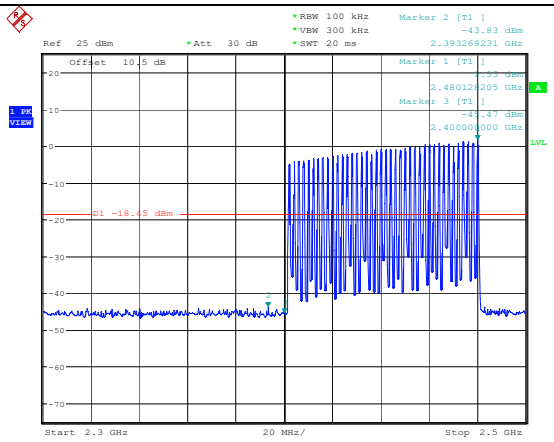
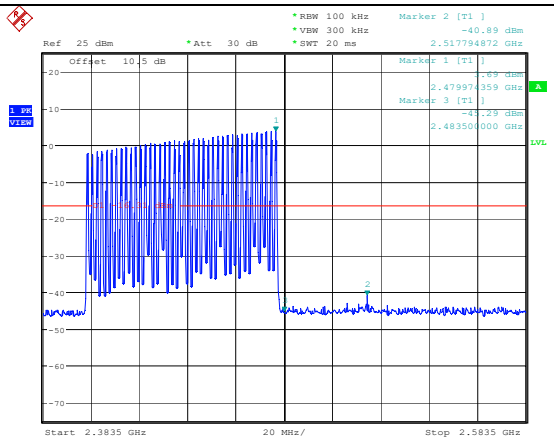
Temperature:	27 ℃
Relative Humidity:	49 %
ATM Pressure:	101 kPa

The testing was performed by Brian Li on 2024-10-12.

EUT operation mode: Transmitting

Test Result: Compliant.

Band Edge, Single Channel	
Left Side	
Right Side	

Band Edge, Hopping Channel	
Left Side	
Right Side	

EUT PHOTOGRAPHS

Please refer to the attachment 2401W32386E-RF External photo and 2401W32386E-RF Internal photo.

TEST SETUP PHOTOGRAPHS

Please refer to the attachment 2401W32386E-RFA Test Setup photo.

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