

TEST REPORT

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Report Number: SZ3231226-78343E-RF-00A
FCC ID: 2BDOP-UPT-1448

Test Standard (s)

FCC PART 15.247

Sample Description

Product Type: Wireless keyboard
Model No.: UPT-1448
Multiple Model(s) No.: UPT-1446
Trade Mark: N/A
Date Received: 2024/01/17
Report Date: 2024/01/26

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

Prepared and Checked By:

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Michelle Zeng
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Approved By:

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Nancy Wang
RF Supervisor

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

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TABLE OF CONTENTS

DOCUMENT REVISION HISTORY	4
GENERAL INFORMATION.....	5
PRODUCT DESCRIPTION FOR EQUIPMENT UNDER TEST (EUT)	5
OBJECTIVE	5
TEST METHODOLOGY	5
MEASUREMENT UNCERTAINTY	6
TEST FACILITY	6
SYSTEM TEST CONFIGURATION	7
DESCRIPTION OF TEST CONFIGURATION	7
EUT EXERCISE SOFTWARE	7
SPECIAL ACCESSORIES	7
EQUIPMENT MODIFICATIONS	7
SUPPORT EQUIPMENT LIST AND DETAILS	8
EXTERNAL I/O CABLE.....	8
BLOCK DIAGRAM OF TEST SETUP	8
SUMMARY OF TEST RESULTS	9
TEST EQUIPMENT LIST	10
FCC§15.247 (I), §1.1307 (B) (I) &§2.1093 – RF EXPOSURE	11
APPLICABLE STANDARD	11
FCC §15.203 – ANTENNA REQUIREMENT.....	12
APPLICABLE STANDARD	12
ANTENNA CONNECTOR CONSTRUCTION	12
FCC §15.205, §15.209&§15.247(D) – RADIATED EMISSIONS	13
APPLICABLE STANDARD	13
EUT SETUP	13
EMI TEST RECEIVER & SPECTRUM ANALYZER SETUP	14
TEST PROCEDURE	14
FACTOR & OVER LIMIT/MARGIN CALCULATION	15
TEST DATA	15
FCC §15.247(A) (1)-CHANNEL SEPARATION TEST	29
APPLICABLE STANDARD	29
TEST PROCEDURE	29
TEST DATA	29
FCC §15.247(A) (1)–20DBEMISSION BANDWIDTH&99% OCCUPIED BANDWIDTH	31
APPLICABLE STANDARD	31
TEST PROCEDURE	31
TEST DATA	32
FCC §15.247(A) (1) (III)-QUANTITY OF HOPPING CHANNEL TEST.....	35
APPLICABLE STANDARD	35
TEST PROCEDURE	35
TEST DATA	35

FCC §15.247(A) (1) (III) - TIME OF OCCUPANCY (DWELL TIME).....	37
APPLICABLE STANDARD	37
TEST PROCEDURE	37
TEST DATA	37
FCC §15.247(B) (1) - PEAK OUTPUT POWER MEASUREMENT	39
APPLICABLE STANDARD	39
TEST PROCEDURE	39
TEST DATA	39
FCC §15.247(D) - BAND EDGES TESTING.....	41
APPLICABLE STANDARD	41
TEST PROCEDURE	41
TEST DATA	41

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	SZ3231226-78343E-RF-00A	Original Report	2024/01/26

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	Wireless keyboard
Tested Model	UPT-1448
Multiple Model(s)	UPT-1446 (Please refer to the DoS [#] provided by the applicant)
Frequency Range	2402-2480MHz
Maximum conducted peak output power	-8.31dBm
Modulation Technique	GFSK
Antenna Specification [#]	2.34dBi (provided by the applicant)
Voltage Range	1*1.5V AA Alkaline Battery
Sample serial number	2FSJ-1 for RF Conducted Test 2FSJ-2 for Radiated Emissions (Assigned by BACL, Shenzhen)
Sample/EUT Status	Good condition
Adapter Information	N/A

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

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

Test Facility

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

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

SYSTEM TEST CONFIGURATION

Description of Test Configuration

The system was configured for testing in an engineering mode.

Channel list

Channel No.	Frequency (MHz)	Channel No.	Frequency (MHz)
0	2402	40	2442
1	2403	41	2443
2	2404	42	2444
...
...
36	2438	75	2477
37	2439	76	2478
38	2440	77	2479
39	2441	78	2480

Channel 0, 38, 78 was tested.

EUT Exercise Software

“FCC_test_tool V2.3.2.exe”[#] 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

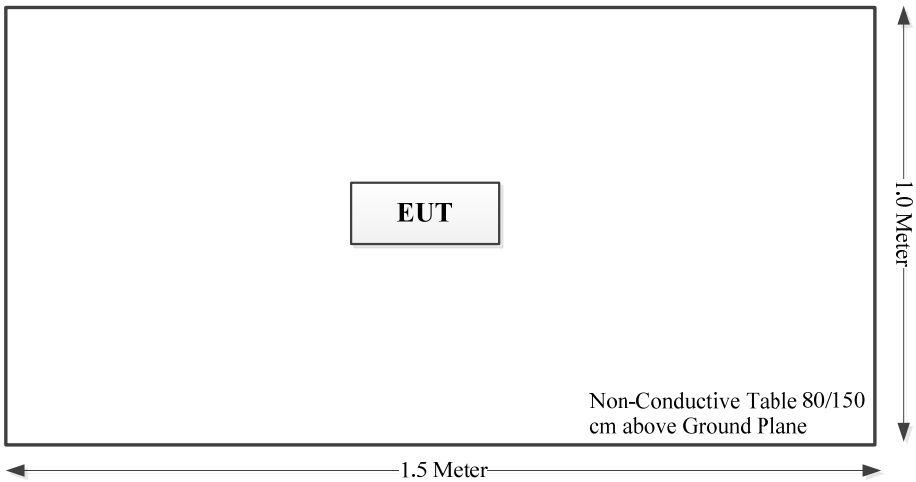
Manufacturer	Description	Model	Serial Number
/	/	/	/

External I/O Cable

Cable Description	Length (m)	From/Port	To
/	/	/	/

Block Diagram of Test Setup

Spurious emissions:



SUMMARY OF TEST RESULTS

FCC Rules	Description of Test	Result
§15.247 (i), §1.1307 (b) (1) & §2.1093	RF Exposure	Compliant
§15.203	Antenna Requirement	Compliant
§15.207(a)	AC Line Conducted Emissions	Not Applicable
§15.205, §15.209 & §15.247(d)	Radiated Emissions	Compliant
§15.247(a)(1)	20dB Emission Bandwidth & 99% Occupied Bandwidth	Compliant
§15.247(a)(1)	Channel Separation Test	Compliant
§15.247(a)(1)(iii)	Time of Occupancy (Dwell Time)	Compliant
§15.247(a)(1)(iii)	Quantity of hopping channel Test	Compliant
§15.247(b)(1)	Peak Output Power Measurement	Compliant
§15.247(d)	Band edges	Compliant

Not Applicable, the device was powered by battery when operating.

TEST EQUIPMENT LIST

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
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	2024/07/19
ETS	Passive Loop Antenna	6512	29604	2023/07/07	2024/07/06
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	2023/04/18	2024/04/17
COM-POWER	Pre-amplifier	PA-122	181919	2023/06/29	2024/06/28
Schwarzbeck	Horn Antenna	BBHA9120D(1201)	1143	2023/07/26	2024/07/25
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
SNSD	2.4G Band Reject filter	BSF2402-2480MN-0898-001	2.4G filter	2023/08/03	2024/08/02
Audix	EMI Test software	E3	191218(V9)	NCR	NCR
A.H.System	Pre-amplifier	PAM-1840VH	190	2023/08/03	2024/08/02
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
RF Conducted Test					
Rohde & Schwarz	SPECTRUM ANALYZER	FSU26	200982	2023/12/18	2024/12/17
MARCONI	10dB Attenuator	6534/3	2942	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§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:

$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$ for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where

1. $f(\text{GHz})$ 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
2.4G FHSS	2402-2480	-8.0	0.16	5	0.1	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.

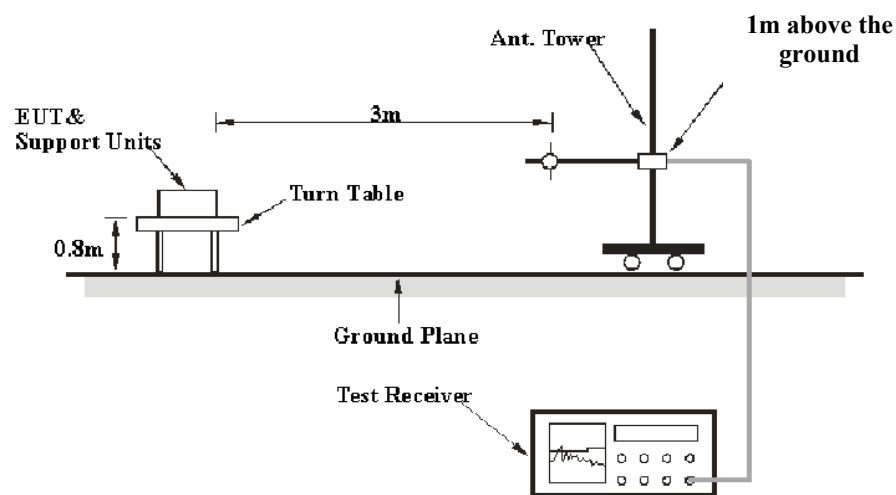
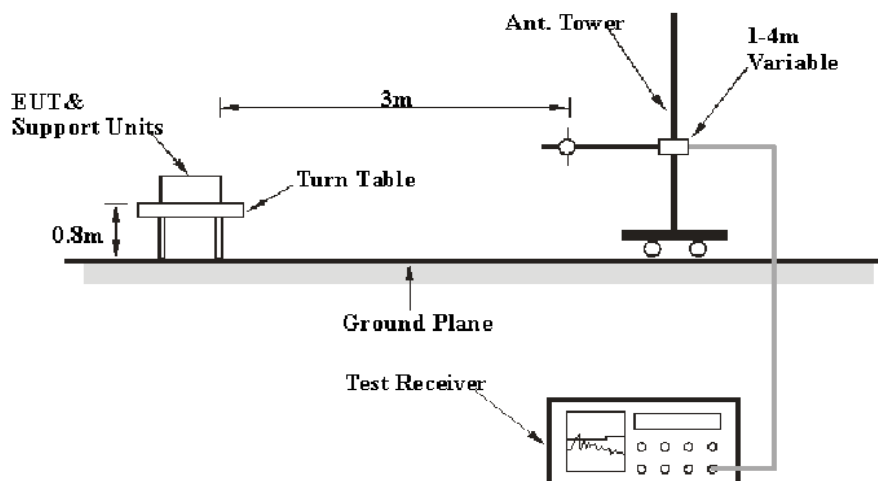
Antenna Connector Construction

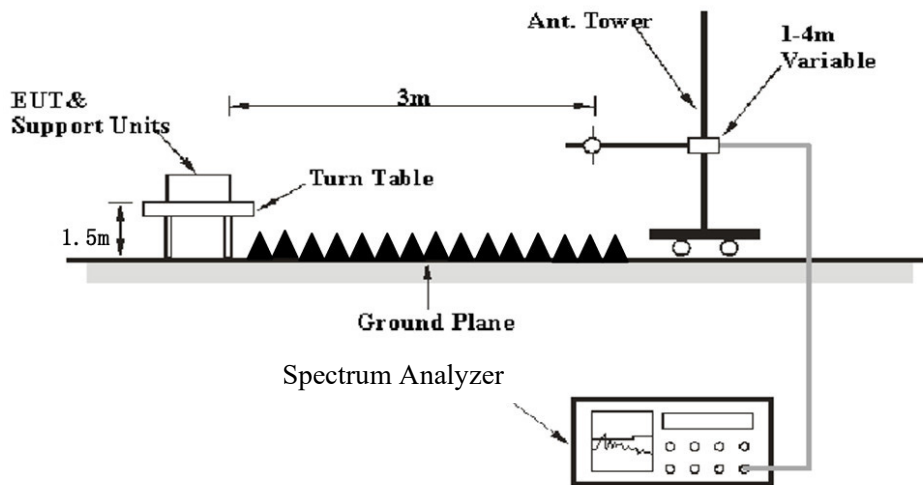
The EUT has one internal antenna arrangement which was permanently attached and the antenna gain[#] is 2.34dBi, fulfill the requirement of this section. Please refer to the EUT photos.

Result: Compliant

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 3meters, 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	1MHz	3 MHz	/	PK
	1MHz	10 Hz	/	AV

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.

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.

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

Factor & Over Limit/Margin Calculation

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

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

The “**Over Limit or 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 margin calculation is as follows:

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

Test Data

Environmental Conditions

Temperature:	22~25.1 °C
Relative Humidity:	50~55 %
ATM Pressure:	101 kPa

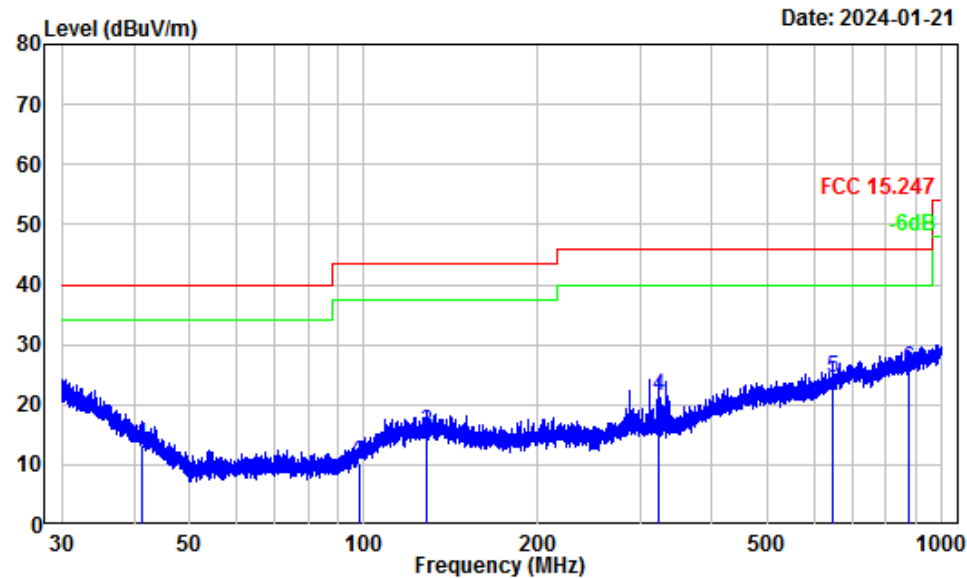
The testing was performed by Warren Huang on 2024-01-21 for below 1GHz and Tyler Wu from 2024-01-17 to 2024-01-25 for above 1GHz.

EUT operation mode: Transmitting

Note: For 9 kHz-30MHz, The amplitude of spurious emissions attenuated more than 20 dB below the limit was not be recorded.

30MHz-1GHz: Maximum output power mode, low channel

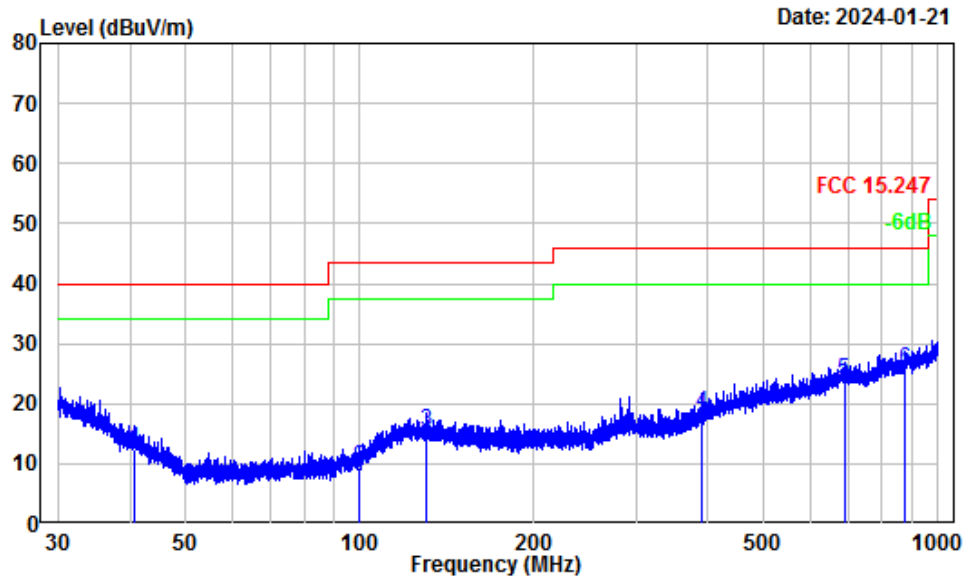
Horizontal



Site : chamber
Condition : 3m Horizontal
Project Number: SZ3231226-78343E-RF
Note : 2.4G
Tester : Warren Huang

Freq Factor		Read Level	Level	Limit Line	Over Limit	Remark
MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	41.33 -11.24	24.42	13.18	40.00	-26.82	QP
2	98.31 -14.21	24.49	10.28	43.50	-33.22	QP
3	128.11 -10.30	25.80	15.50	43.50	-28.00	QP
4	323.04 -9.91	31.38	21.47	46.00	-24.53	QP
5	647.67 -2.54	26.99	24.45	46.00	-21.55	QP
6	876.01 0.62	25.37	25.99	46.00	-20.01	QP

Vertical



Site : chamber
Condition : 3m Vertical
Project Number: SZ3231226-78343E-RF
Note : 2.4G
Tester : Warren Huang

	Freq Factor		Read Level		Limit	Over	Remark
	MHz	dB/m	dBuV	dBuV/m	Line	Limit	
1	40.74	-12.31	24.73	12.42	40.00	-27.58	QP
2	99.53	-15.33	24.78	9.45	43.50	-34.05	QP
3	130.04	-10.78	26.11	15.33	43.50	-28.17	QP
4	389.53	-8.10	26.63	18.53	46.00	-27.47	QP
5	688.05	-2.14	26.13	23.99	46.00	-22.01	QP
6	875.25	0.25	25.35	25.60	46.00	-20.40	QP

Above 1GHz:

Frequency (MHz)	Receiver		Rx Antenna	Factor (dB/m)	Corrected Amplitude (dBμV/m)	Limit (dBμV/m)	Margin (dB)
	Reading (dBμV)	PK/Ave	Polar (H/V)				
Low Channel(2402MHz)							
4804.00	56.14	PK	H	2.42	58.56	74	-15.44
4804.00	50.42	AV	H	2.42	52.84	54	-1.16
4804.00	52.26	PK	V	2.42	54.68	74	-19.32
4804.00	43.85	AV	V	2.42	46.27	54	-7.73
Middle Channel(2440MHz)							
4880.00	56.02	PK	H	2.68	58.70	74	-15.30
4880.00	50.92	AV	H	2.68	53.60	54	-0.40
4880.00	50.83	PK	V	2.68	53.51	74	-20.49
4880.00	43.21	AV	V	2.68	45.89	54	-8.11
High Channel(2480MHz)							
4960.00	55.93	PK	H	2.68	58.61	74	-15.39
4960.00	50.52	AV	H	2.68	53.20	54	-0.80
4960.00	50.14	PK	V	2.68	52.82	74	-21.18
4960.00	41.09	AV	V	2.68	43.77	54	-10.23

Note:

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

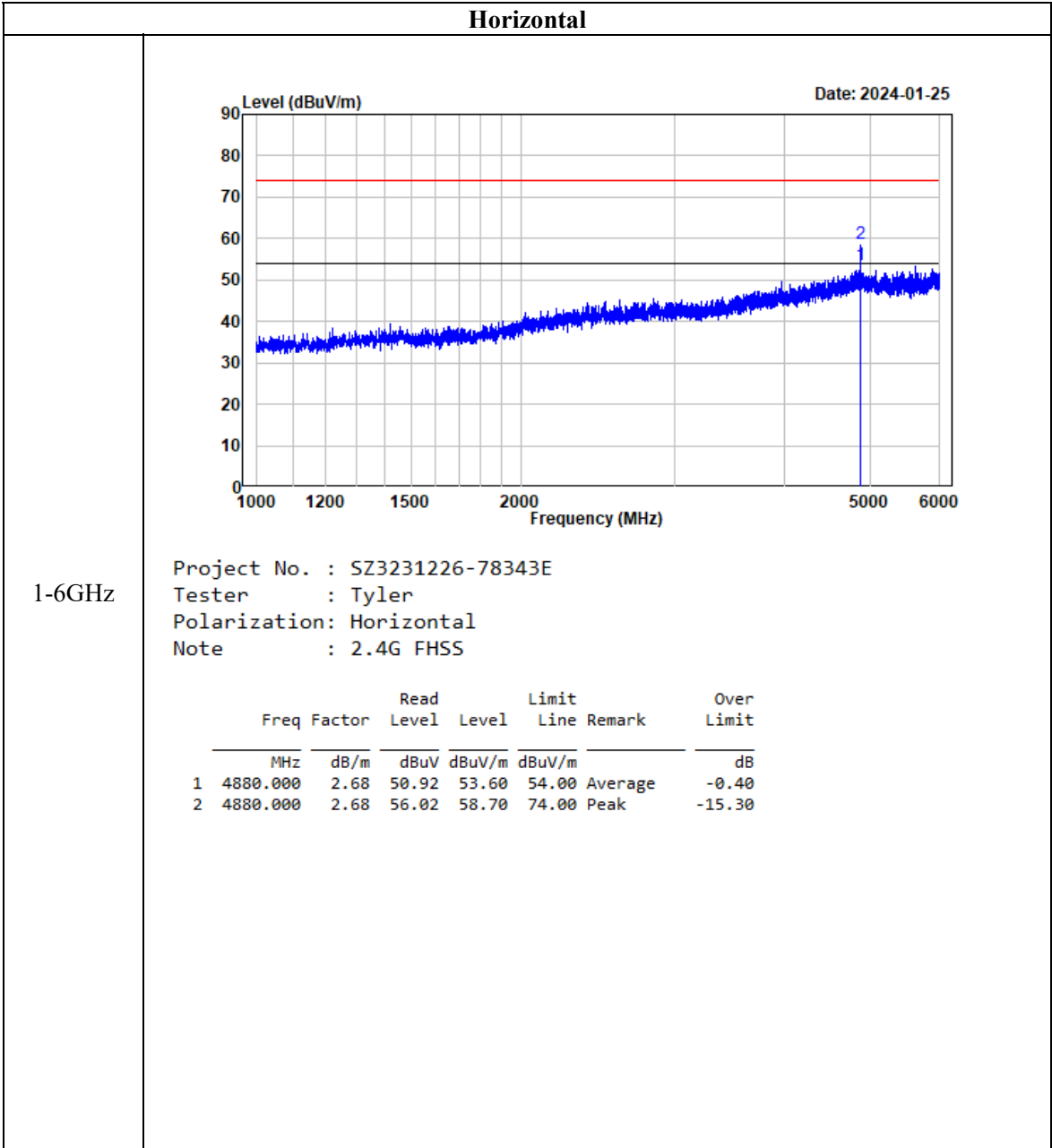
Corrected Amplitude = Corrected Factor + Reading

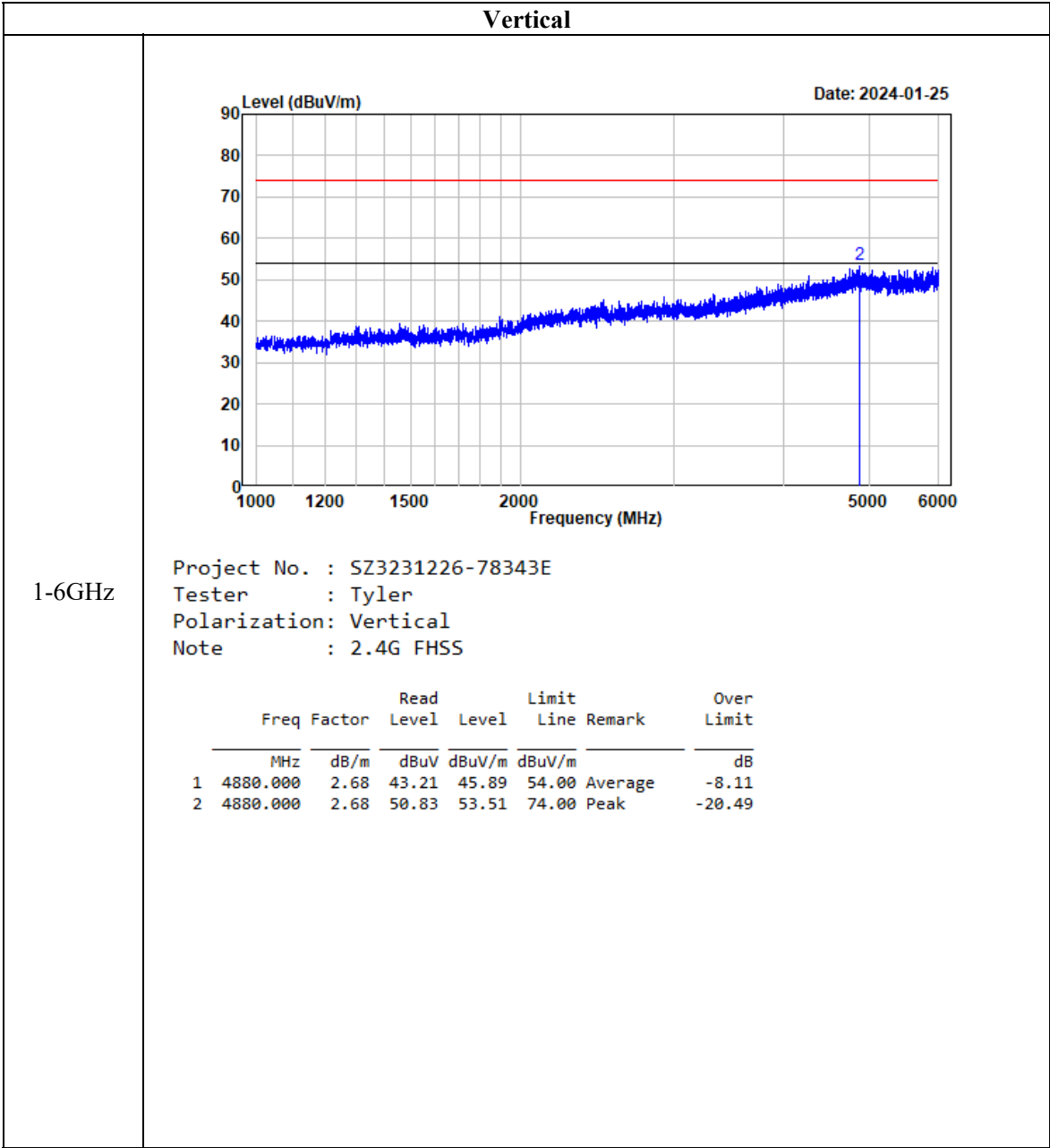
Margin = Corrected. Amplitude - Limit

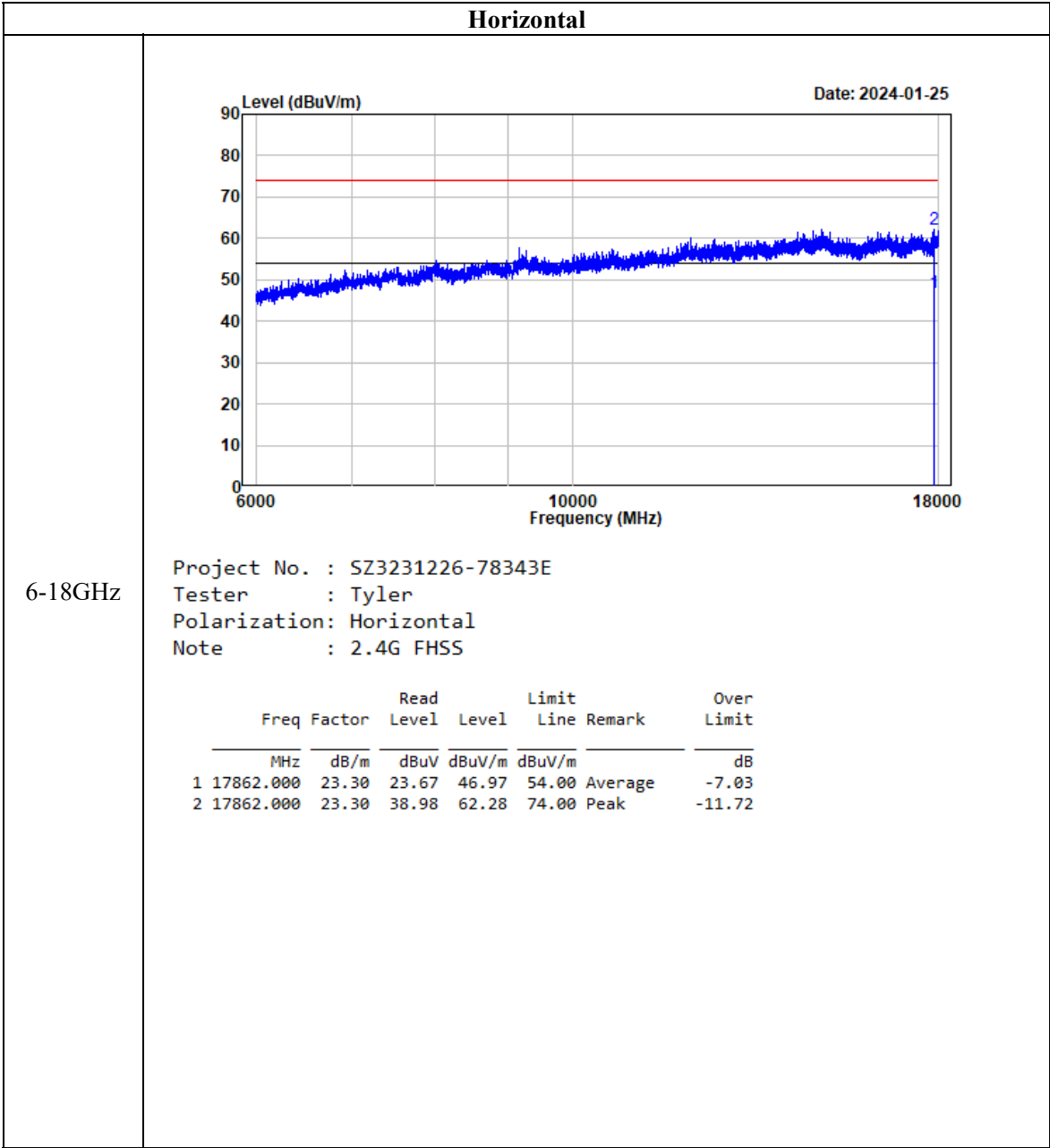
Other emissions which were more than 20dB below limit or on noise floor level was not recorded..

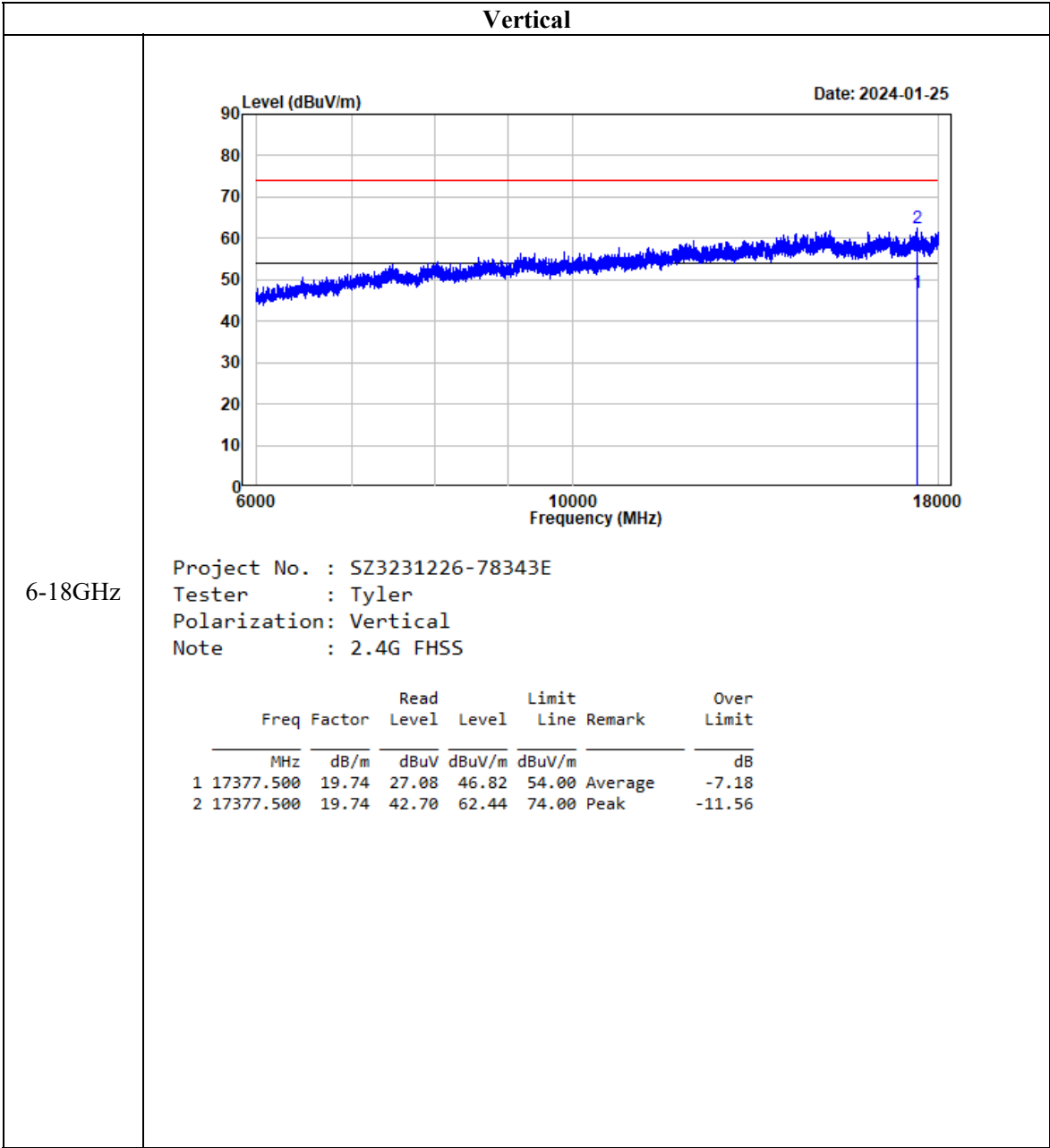
Listed with the worst harmonic margin test plot:

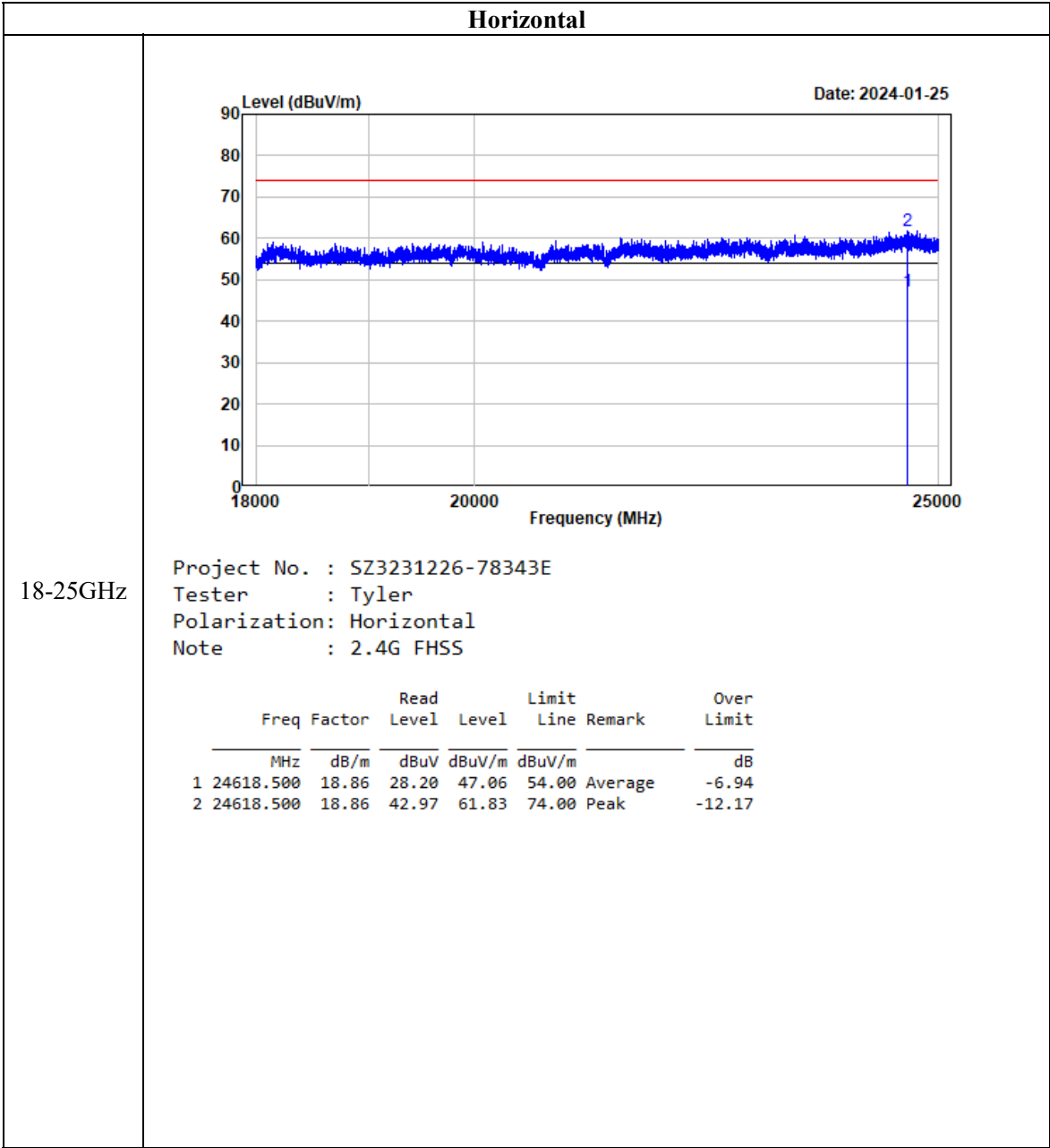
Pre-scan, Middle Channel (worst case)

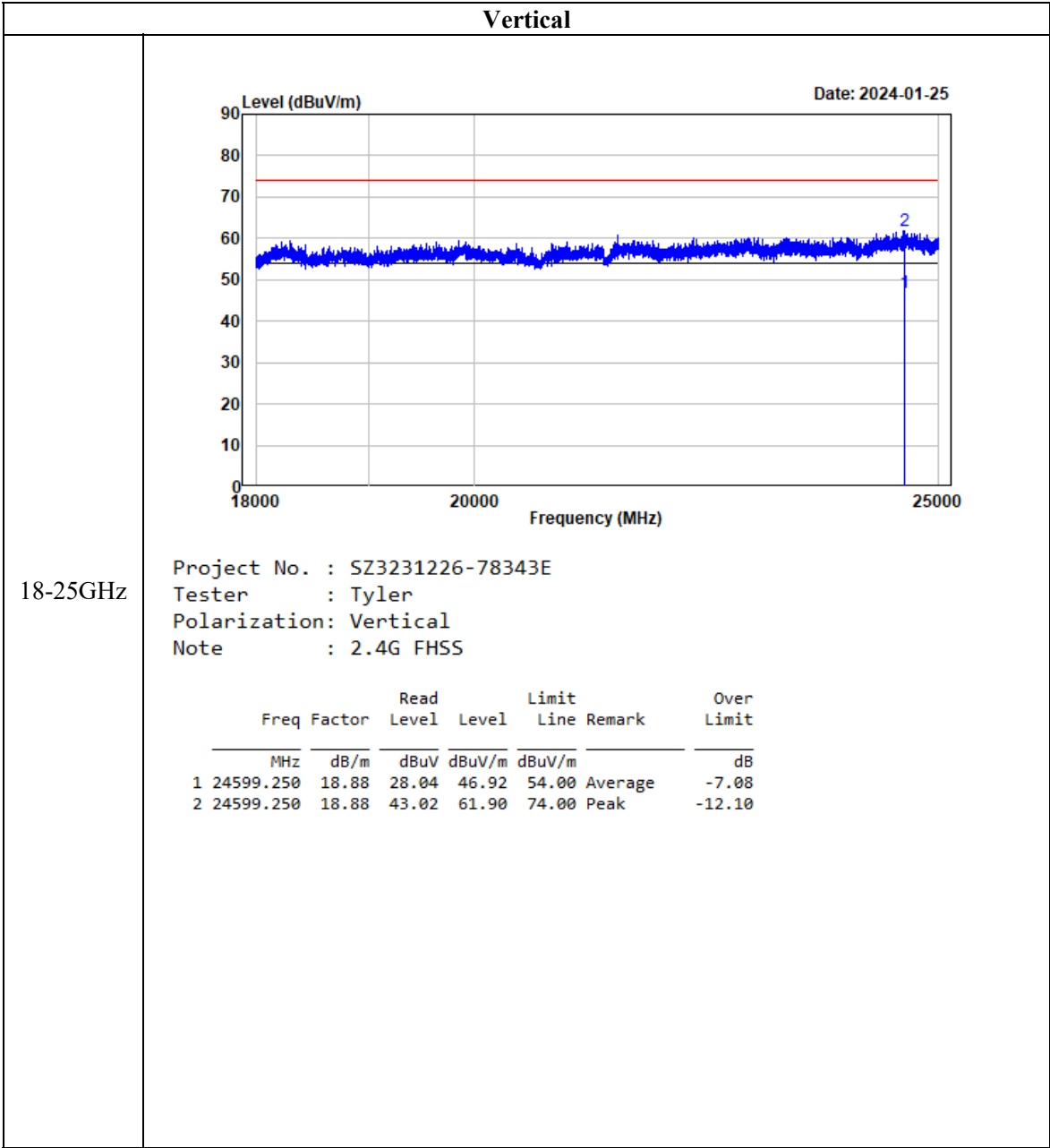




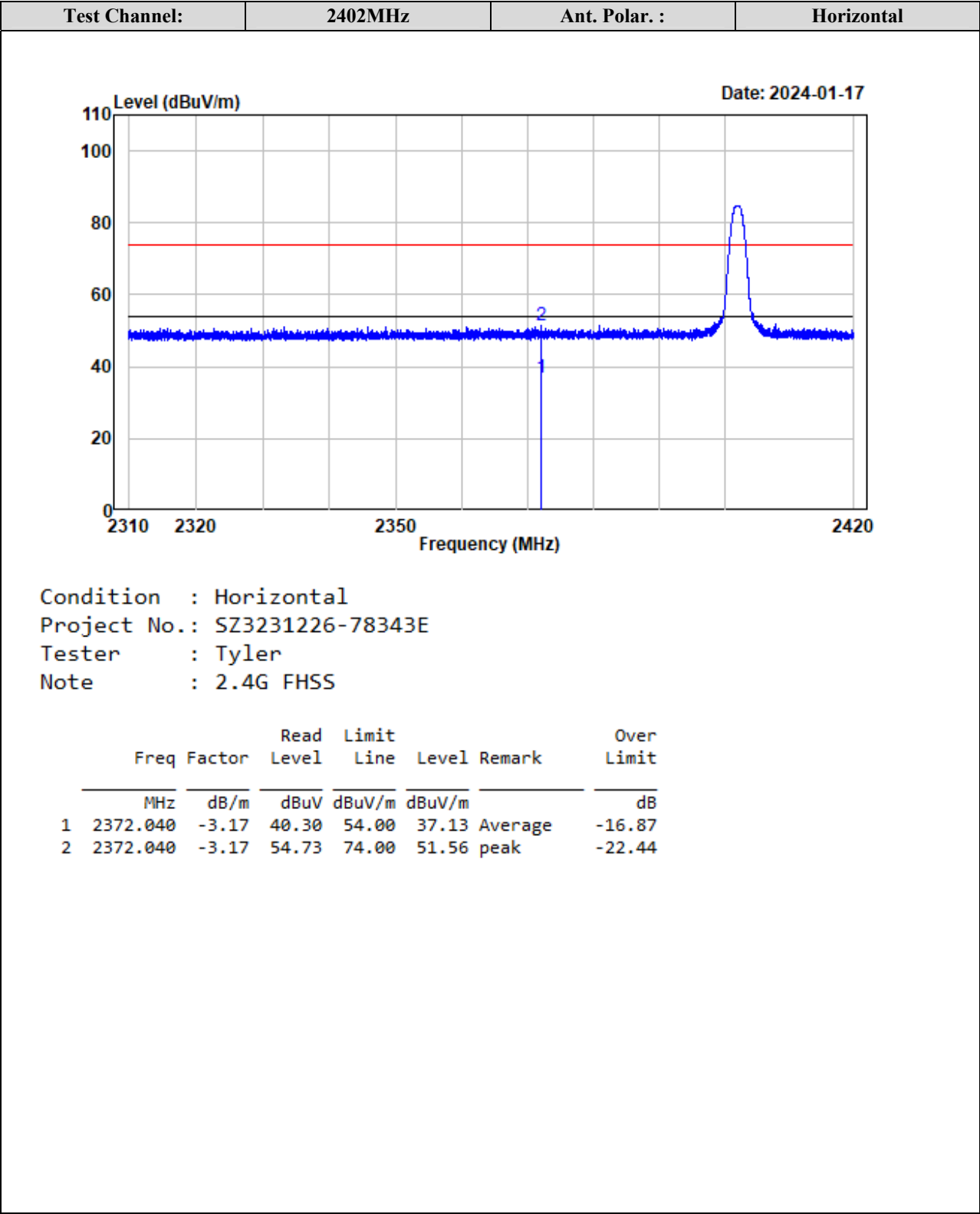








Test plots for Band Edge Measurements (Radiated):

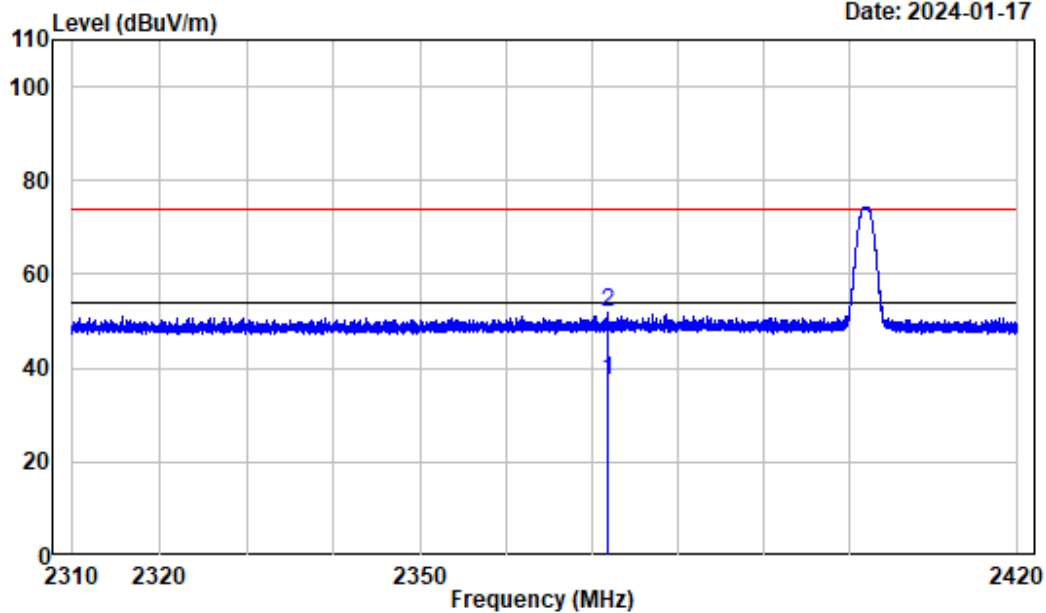


Test Channel:

2402MHz

Ant. Polar. :

Vertical



Condition : Vertical

Project No.: SZ3231226-78343E

Tester : Tyler

Note : 2.4G FHSS

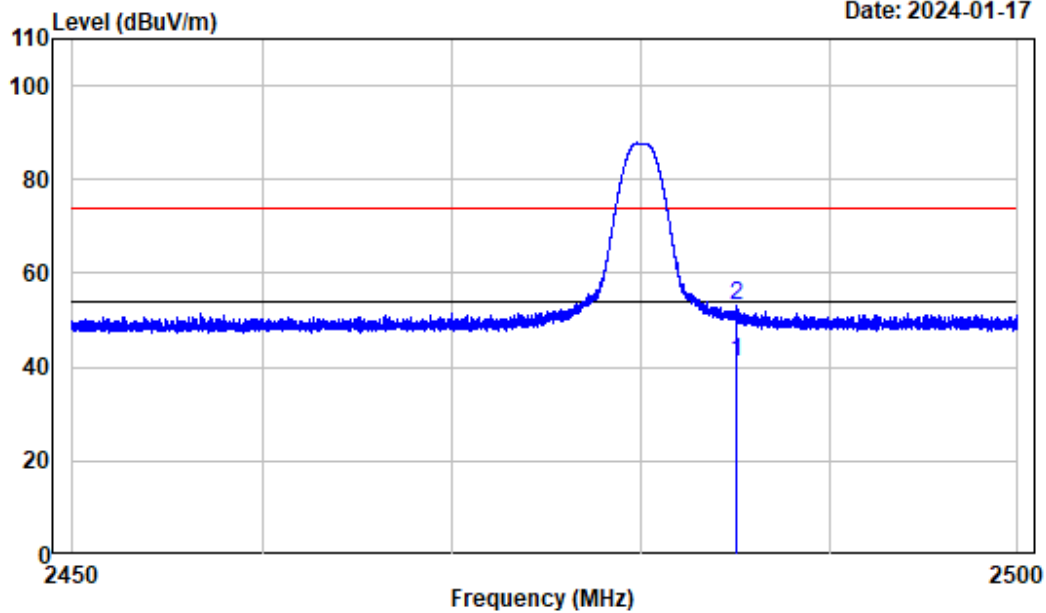
		Read		Limit			Over
Freq Factor		Level	Line	Level	Remark	Limit	
	MHz	dB/m	dBuV	dBuV/m	dBuV/m		dB
1	2371.655	-3.17	40.55	54.00	37.38	Average	-16.62
2	2371.655	-3.17	55.11	74.00	51.94	peak	-22.06

Test Channel:

2480MHz

Ant. Polar. :

Horizontal



Condition : Horizontal

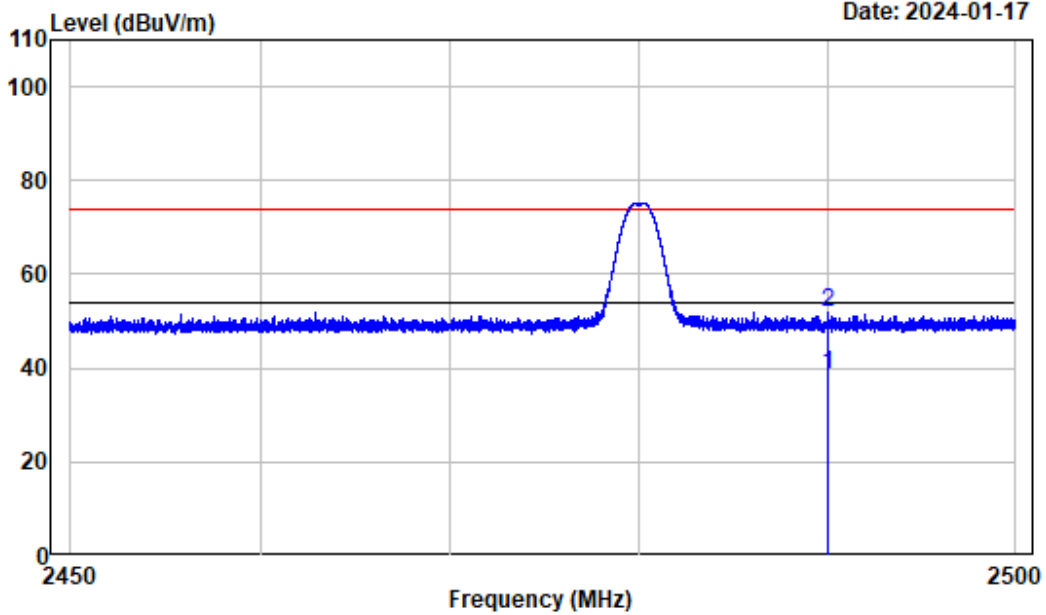
Project No.: SZ3231226-78343E

Tester : Tyler

Note : 2.4G FHSS

	Freq Factor		Read	Limit	Level	Remark	Over
	MHz	dB/m	Level	Line			Limit
	MHz	dB/m	dBuV	dBuV/m	dBuV/m		dB
1	2485.087	-3.17	44.25	54.00	41.08	Average	-12.92
2	2485.087	-3.17	56.19	74.00	53.02	peak	-20.98

Test Channel: 2480MHz Ant. Polar. : Vertical



Condition : Vertical
 Project No.: SZ3231226-78343E
 Tester : Tyler
 Note : 2.4G FHSS

			Read	Limit		Over
	Freq	Factor	Level	Line	Level Remark	Limit
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB
1	2489.975	-3.18	41.76	54.00	38.58 Average	-15.42
2	2489.975	-3.18	54.99	74.00	51.81 peak	-22.19

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

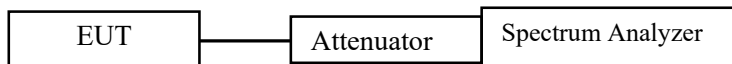
Applicable Standard

Frequency hopping systems shall have hopping 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

1. Set the EUT in transmitting mode, maxhold the channel.
2. Set the adjacent channel of the EUT and maxhold another trace.
3. Measure the channel separation.



Test Data

Environmental Conditions

Temperature:	27.4 °C
Relative Humidity:	38 %
ATM Pressure:	101 kPa

The testing was performed by Cheeb Huang on 2024-01-23.

EUT operation mode: Transmitting

Test Result: Compliant

Test Channel	Test Frequency (MHz)	Channel Separation (MHz)	Limits (MHz)
Lowest	2402	1.012	0.702
Middle	2440	0.996	0.706
Highest	2480	0.996	0.704

Please refer to the below plots:

FCC §15.247(a) (1)–20dBEMISSION BANDWIDTH&99% OCCUPIED 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

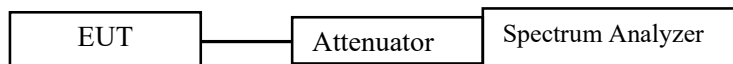
Test Method: ANSI C63.10-2013 Clause 7.8.7 & Clause 6.9.2

The following conditions shall be observed for measuring the occupied bandwidth and 20 dB bandwidth:

- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the spectrum analyzer shall be set large enough to capture all products of the modulation process, including the emission skirts, around the carrier frequency, but small enough to avoid having other emissions (e.g. on adjacent channels) within the span.
- The detector of the spectrum analyzer shall be set to “Sample”. However, a peak, or peak hold, may be used in place of the sampling detector since this usually produces a wider bandwidth than the actual bandwidth (worst-case measurement). Use of a peak hold (or “Max Hold”) may be necessary to determine the occupied / 20 dB bandwidth if the device is not transmitting continuously.
- The resolution bandwidth (RBW) shall be in the range of 1% to 5% of the actual occupied / 20 dB bandwidth and the video bandwidth (VBW) shall not be smaller than three times the RBW value. Video averaging is not permitted.

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

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



Test Data

Environmental Conditions

Temperature:	27.4 °C
Relative Humidity:	38 %
ATM Pressure:	101 kPa

The testing was performed by Cheeb Huang on 2024-01-23.

EUT operation mode: Transmitting

Test Result: Compliant

Mode	Channel	Frequency (MHz)	99% Emission Bandwidth (MHz)	20 dB Emission Bandwidth (MHz)
GFSK	Low	2402	0.966	1.053
	Middle	2440	0.969	1.059
	High	2480	0.975	1.056

Please refer to the below plots:

GFSK

Ref 25 dBm Att 30 dB SWT 1 s Delta 2 (T1) -0.13 dB 1.053000000 MHz

Offset 11 dB Marker 1 (T1) -25.130 dBm 2.40145000 GHz

D1 -12.22 dBm D2 -12.22 dBm

Center 2.402 GHz 300 kHz/ Span 3 MHz

Ref 25 dBm Att 30 dB BW 30 kHz VMH 100 kHz SMT 1 s Delta 2 [T1] ~0.12 dB 1.059000000 MHz

Offset 11 dB Marker 1 [T1] 33.44 dBm 2.43945000 GHz

D1 -19.44 dBm

D2 -33.44 dBm

9.99 VdB

Center 2.44 GHz 300 kHz/ Span 3 MHz

Ref 15 dBm Att 30 dB SWT 1 s Delta 2 [T1] 0.06 dB 1.056000000 MHz

Offet 11 dB Marker 1 [T1] 2.479454000 GHz

D1 -14.11 dBm D2 -34.31 dBm

Center 2.48 GHz 300 kHz/ Span 3 MHz

99 VIEW

ProjectNo.:SZ3231226-78343E-RF Tester:Cheeb Huang
Date: 23.JAN.2024 15:08:48

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

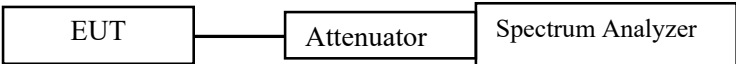
Applicable Standard

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

- 1. Check the calibration of the measuring instrument (SA) using either an internal calibrator or a known signal from an external generator.
- 2. Set the EUT in hopping mode from first channel to last.
- 3. By using the max-hold function record the quantity of the channel.



Test Data

Environmental Conditions

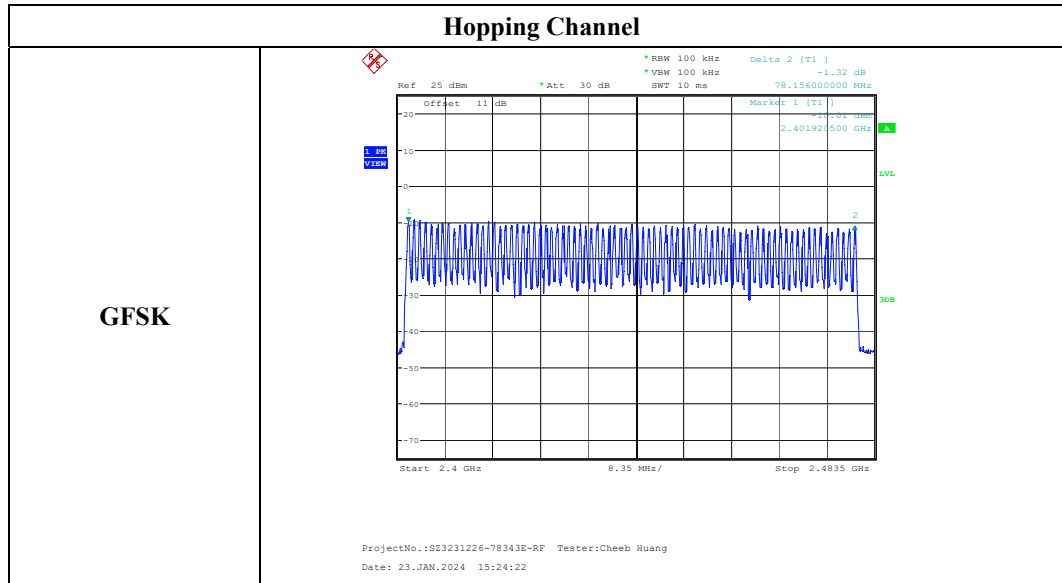
Temperature:	27.4 °C
Relative Humidity:	38 %
ATM Pressure:	101 kPa

The testing was performed by Cheeb Huang on 2024-01-23.

EUT operation mode: Transmitting

Test Result: Compliant

Mode	Frequency Range (MHz)	Number of Hopping Channel (CH)	Limit (CH)
GFSK	2400-2483.5	79	≥15



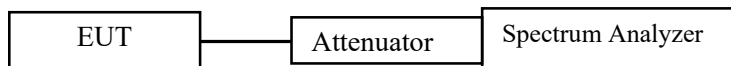
FCC §15.247(a) (1) (iii) - TIME OF OCCUPANCY (DWELL TIME)**Applicable Standard**

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

1. The EUT was worked in channel hopping.
2. Set the RBW to: 1MHz.
3. Set the VBW $\geq 3 \times$ RBW.
4. Set the span to 0Hz.
5. Detector = peak.
6. Sweep time = auto couple.
7. Trace mode = max hold.
8. Allow trace to fully stabilize.
9. Recorded the time of single pulses

**Test Data****Environmental Conditions**

Temperature:	27.4 °C
Relative Humidity:	38 %
ATM Pressure:	101 kPa

The testing was performed by Cheeb Huang on 2024-01-24.

EUT operation mode: Transmitting

Test Result: Compliant

Test Mode	Test Frequency (MHz)	Pulse width (ms)	Observation time (s)	Hopping Numbers in Observation time	Dwell Time (s)	Limit (s)
GFSK	2440	0.435	31.6	54	0.023	0.400

Note 1: Observation time= Hopping Channel Number \times 0.4

Note 2: Dwell Time = Pulse width *Hopping Numbers in Observation time

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

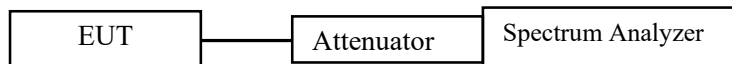
Applicable Standard

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

1. Place the EUT on a bench and set 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.



Test Data

Environmental Conditions

Temperature:	27.4 °C
Relative Humidity:	38 %
ATM Pressure:	101 kPa

The testing was performed by Cheeb Huang on 2024-01-23.

EUT operation mode: Transmitting

Test Result: Compliant

Mode	Channel	Frequency (MHz)	Peak Output Power (dBm)	Limit (dBm)
GFSK	Low	2402	-8.31	21
	Middle	2440	-9.48	21
	High	2480	-10.44	21

FCC §15.247(d) - BAND EDGES TESTING

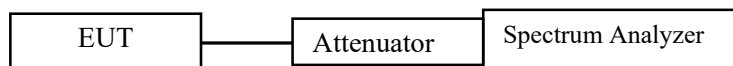
Applicable Standard

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 100kHz 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

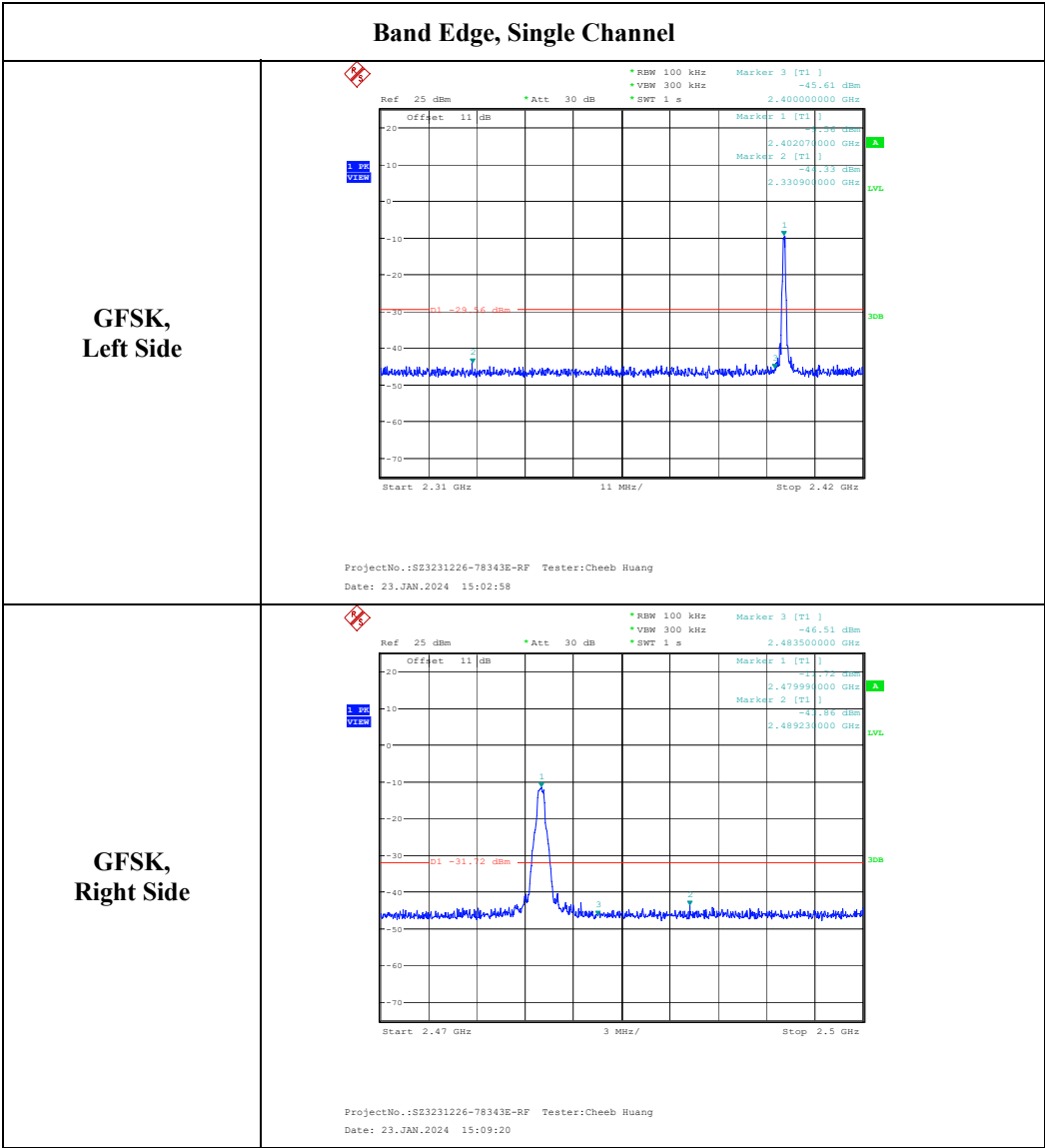
Temperature:	27.4 °C
Relative Humidity:	38 %
ATM Pressure:	101 kPa

The testing was performed by Cheeb Huang on 2024-01-23.

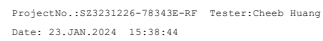
EUT operation mode: Transmitting

Test Result: Compliant

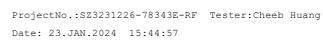
Conducted Band Edge Result:



**GFSK,
Left Side**



**GFSK,
Right Side**



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