

# TEST REPORT

Applicant Name: Bytech NY Inc.  
Address: 2585 West 13th Street, Brooklyn NY 11223.USA  
Report Number: 2401S71807E-RF-00  
FCC ID: 2AHN6-AUBE176

## Test Standard (s)

FCC PART 15.247

## Sample Description

Product Type: BE Meter Earbuds-Asst  
Model No.: BY-AU-BE-176-AC  
Multiple Model(s) No.: N/A  
Trade Mark: **BYTECH**  
Date Received: 2024/04/26  
Issue Date: 2024/05/14

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

## Prepared and Checked By:

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Jojo Guo  
RF Engineer

## Approved By:

*Nancy Wang*

Nancy Wang  
RF Supervisor

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

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## DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	2401S71807E-RF-00	Original Report	2024/05/14

## GENERAL INFORMATION

### Product Description for Equipment under Test (EUT)

Product	BE Meter Earbuds-Asst
Tested Model	BY-AU-BE-176-AC
Multiple Model(s)	N/A
UPC number	805112128969, 805112128976, 805112128983
SKU number	9150703
Lot number	BY051324
Frequency Range	Bluetooth: 2402~2480MHz
Transmit Peak Power	6.93dBm
Modulation Technique	Bluetooth: GFSK, $\pi/4$ -DQPSK, 8DPSK
Antenna Specification <sup>#</sup>	2.67dBi (provided by the applicant)
Voltage Range	DC 3.7V from battery
Sample serial number	2KJL-4 (Assigned by BAACL, Shenzhen)
Sample/EUT Status	Good condition
Adapter Information	N/A
Note: The left earbud and the right earbud are electrically identical. All tests were performed with left earbud.	

### 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 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°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	Frequency (MHz)	Channel	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

EUT was tested with Channel 0, 39 and 78.

### EUT Exercise Software

“bt-tool-v1.0.9”<sup>#</sup> exercise software was used and the power level is 5<sup>#</sup>. 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

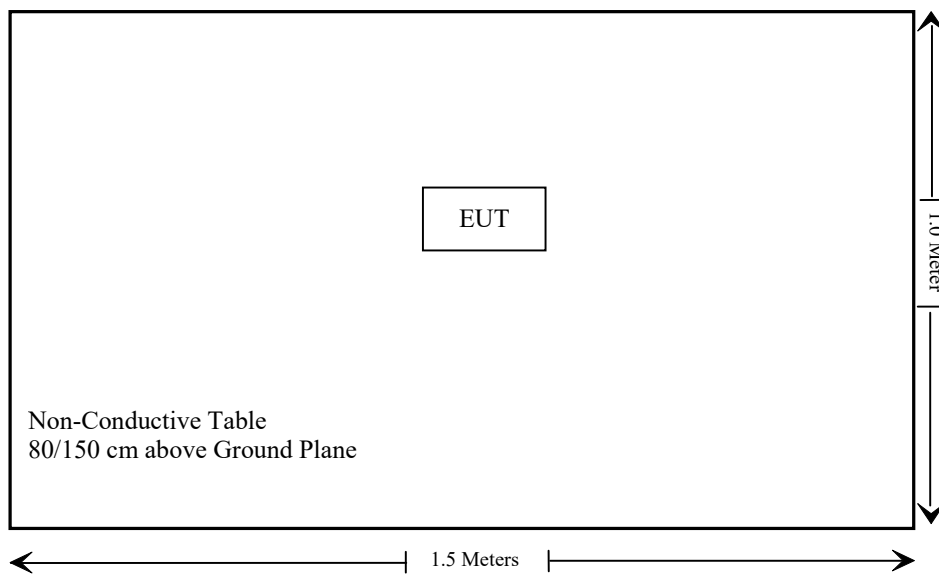
Manufacturer	Description	Model	Serial Number
/	/	/	/

**External I/O Cable**

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

**Block Diagram of Test Setup**

For Radiated Emissions:





**SUMMARY OF TEST RESULTS**

<b>Rules</b>	<b>Description of Test</b>	<b>Result</b>
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	Not Applicable
FCC §15.205, §15.209, §15.247(d)	Radiated Emissions	Compliant
FCC §15.247(a)(1)	20 dB Emission Bandwidth & 99% Occupied 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

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

**TEST EQUIPMENT LIST**

Manufacturer	Description	Model	Serial Number	Calibration Date	Calibration Due Date
<b>Radiated Emission Test</b>					
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
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	2023/08/02	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
<b>RF Conducted Test</b>					
Tonscend	RF control Unit	JS0806-2	19D8060154	2023/09/06	2024/09/05
Rohde & Schwarz	Signal and Spectrum Analyzer	FSV40	101473	2024/01/16	2025/01/15
MARCONI	10dB Attenuator	6534/3	2942	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§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:

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

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
BT	2402-2480	7.0	5.01	5	1.6	3.0	Yes

**Result: Compliant**

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## **FCC §15.203 - ANTENNA REQUIREMENT**

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### **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, the antenna gain<sup>#</sup> is 2.67dBi, fulfill the requirement of this section. Please refer to the EUT photos.

**Result: Compliant**

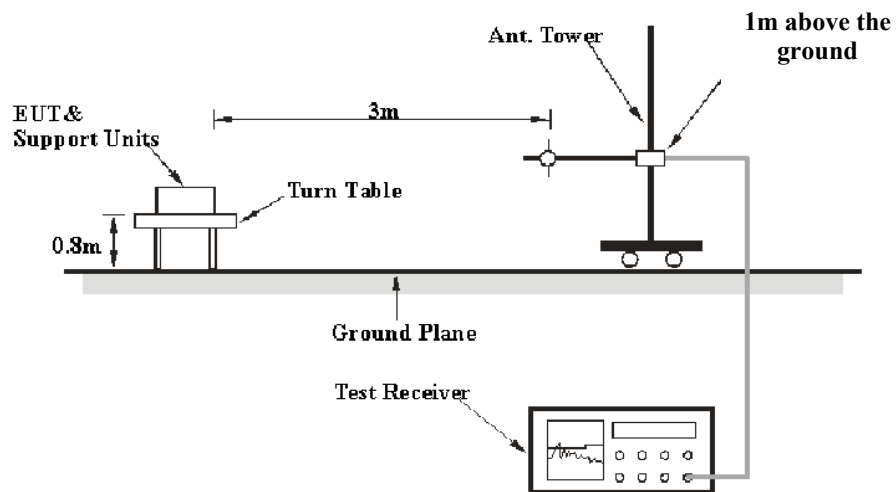
## FCC §15.205, §15.209 & §15.247(d) - RADIATED EMISSIONS

### Applicable Standard

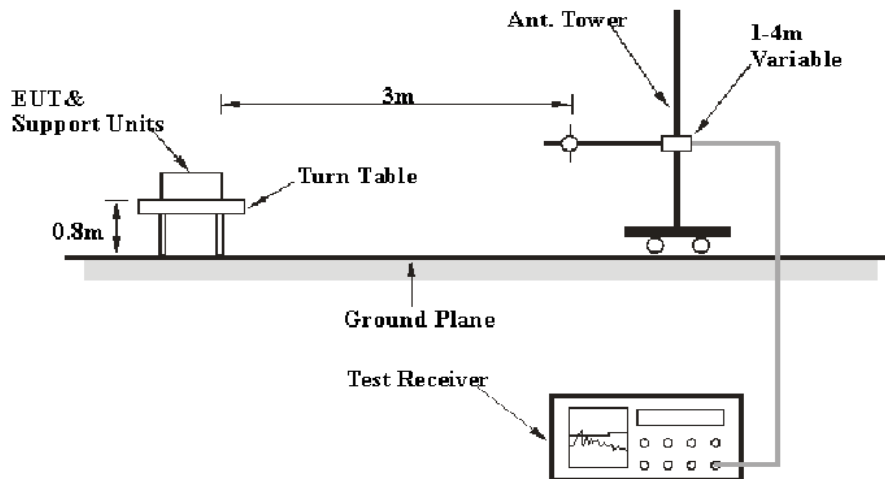
FCC §15.205; §15.209; §15.247(d)

### EUT Setup

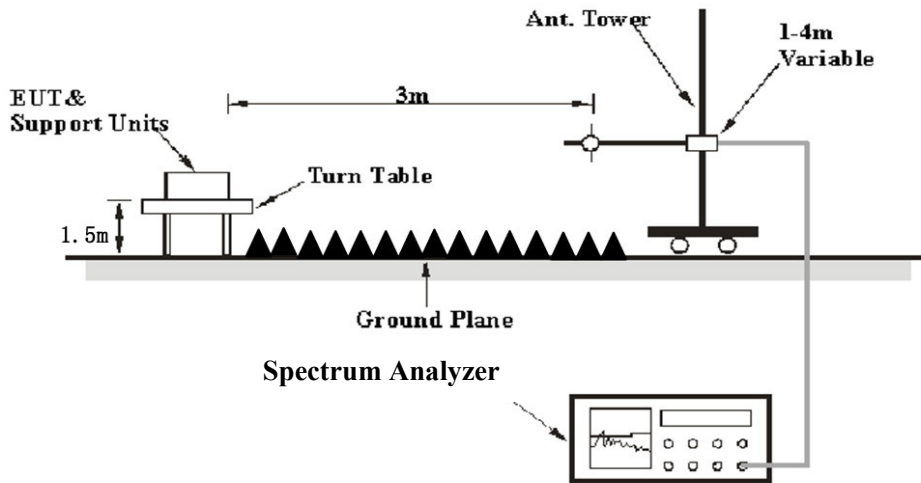
9 kHz-30MHz:



30MHz-1GHz:



**Above 1GHz:**



The radiated emission tests were performed in the 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= $N_1 * L_1 + N_2 * L_2 + \dots + N_{n-1} * L_{n-1} + N_n * L_n$ ,

Where  $N_1$  is number of type 1 pulses,  $L_1$  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 installing 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.

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

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

**Test Data**

**Environmental Conditions**

<b>Temperature:</b>	22~25.3 °C
<b>Relative Humidity:</b>	50~54 %
<b>ATM Pressure:</b>	101 kPa

*The testing was performed by Warren Huang on 2024-04-29 for below 1GHz and Tyler Wu on 2024-04-29 for above 1GHz.*

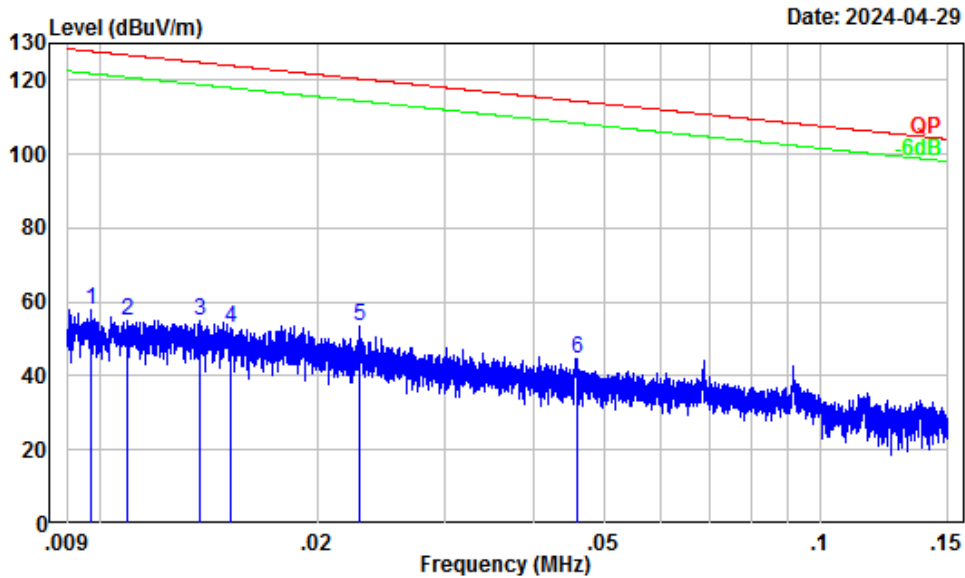
*Test mode: Transmitting*

*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, EDR Mode (8DPSK) Low channel)

Note: When the test result of peak was less than the limit of QP/Average more than 6dB, just peak value were recorded.

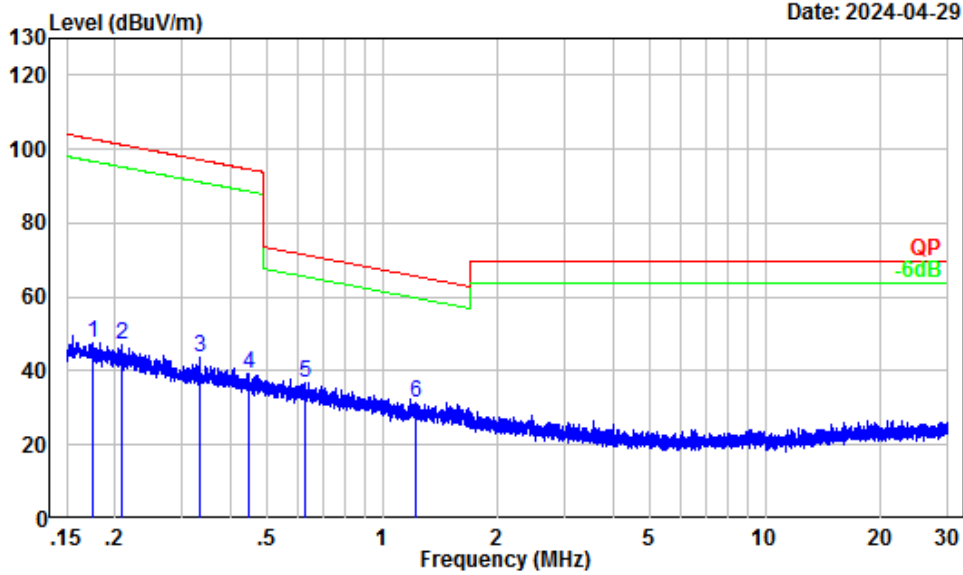
Parallel (worst case)



Site : Chamber A  
 Condition : 3m  
 Project Number: 2401S71807E-RF  
 Note : BT  
 Tester : Warren Huang

	Freq	Factor	Read Level	Limit Level	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB
1	0.01	37.89	20.08	57.97	127.83	-69.86 Peak
2	0.01	37.23	17.61	54.84	126.85	-72.01 Peak
3	0.01	35.75	19.23	54.98	124.81	-69.83 Peak
4	0.02	35.02	17.89	52.91	123.95	-71.04 Peak
5	0.02	31.07	22.46	53.53	120.39	-66.86 Peak
6	0.05	23.98	20.78	44.76	114.38	-69.62 Peak



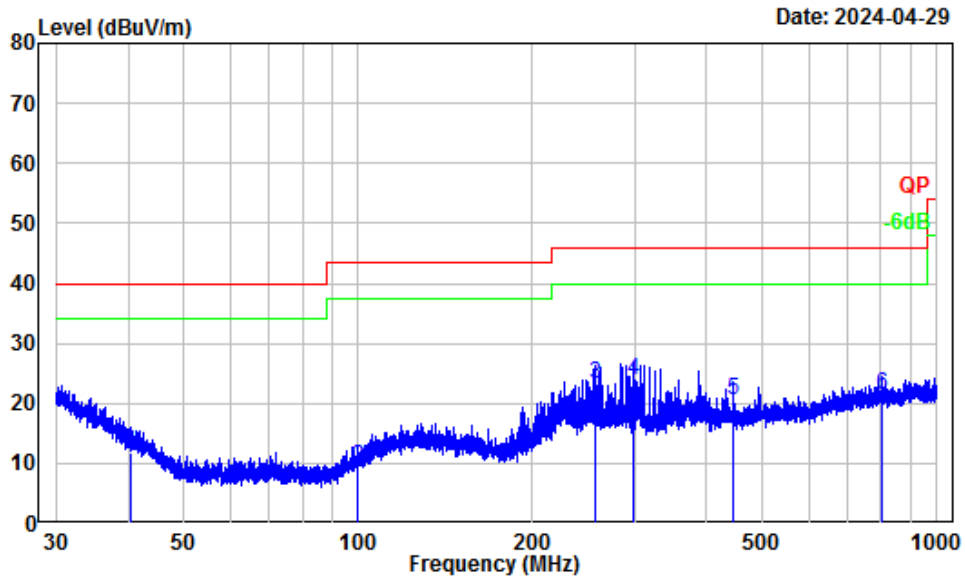


Site : Chamber A  
 Condition : 3m  
 Project Number: 2401S71807E-RF  
 Note : BT  
 Tester : Warren Huang

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	0.18	13.50	34.28	47.78	102.69	-54.91	Peak
2	0.21	11.97	35.05	47.02	101.21	-54.19	Peak
3	0.33	7.00	36.47	43.47	97.13	-53.66	Peak
4	0.45	4.57	34.63	39.20	94.57	-55.37	Peak
5	0.63	1.96	34.81	36.77	71.61	-34.84	Peak
6	1.23	-2.39	33.77	31.38	65.64	-34.26	Peak

**30MHz-1GHz:** (Maximum output power mode, EDR Mode (8DPSK) Low channel)

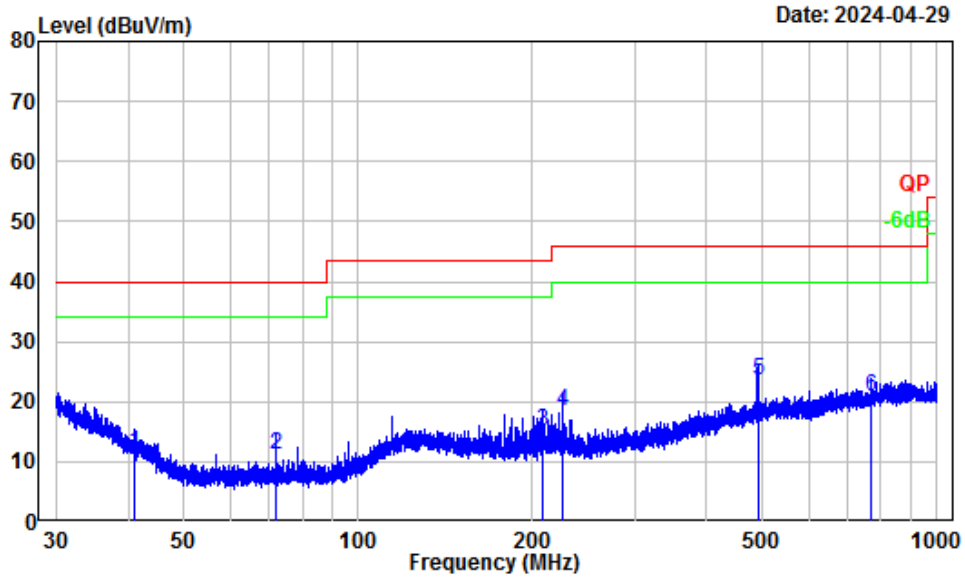
**Horizontal**



Site : Chamber A  
 Condition : 3m Horizontal  
 Project Number: 2401S71807E-RF  
 Note : BT  
 Tester : Warren Huang

	Freq Factor		Read Level		Limit	Over	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	40.40	-11.77	23.63	11.86	40.00	-28.14	QP
2	99.97	-15.47	24.84	9.37	43.50	-34.13	QP
3	257.54	-14.27	37.60	23.33	46.00	-22.67	QP
4	299.84	-12.79	36.67	23.88	46.00	-22.12	QP
5	444.85	-9.69	30.26	20.57	46.00	-25.43	QP
6	803.90	-5.26	26.61	21.35	46.00	-24.65	QP

**Vertical**



Site : Chamber A  
 Condition : 3m Vertical  
 Project Number: 2401S71807E-RF  
 Note : BT  
 Tester : Warren Huang

	Freq	Factor	Read Level	Level	Limit	Over	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	40.88	-13.52	24.90	11.38	40.00	-28.62	QP
2	71.99	-18.67	29.95	11.28	40.00	-28.72	QP
3	208.03	-14.71	29.94	15.23	43.50	-28.27	QP
4	225.80	-14.80	33.07	18.27	46.00	-27.73	QP
5	490.74	-8.77	32.31	23.54	46.00	-22.46	QP
6	770.43	-5.77	26.68	20.91	46.00	-25.09	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					
<b>8DPSK</b>							
Low Channel 2402MHz							
2345.95	55.34	PK	H	-3.03	52.31	74	-21.69
2370.26	55.65	PK	V	-2.93	52.72	74	-21.28
4804.00	57.05	PK	H	2.42	59.47	74	-14.53
4804.00	57.56	PK	V	2.42	59.98	74	-14.02
Middle Channel 2441MHz							
4882.00	57.26	PK	H	2.58	59.84	74	-14.16
4882.00	56.23	PK	V	2.58	58.81	74	-15.19
High Channel 2480MHz							
2483.55	62.09	PK	H	-3.17	58.92	74	-15.08
2488.94	54.50	PK	V	-3.18	51.32	74	-22.68
4960.00	56.56	PK	H	2.68	59.24	74	-14.76
4960.00	56.02	PK	V	2.68	58.70	74	-15.30

**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)	Corrected Amplitude (dBµV/m)	FCC Part 15.247		
					Limit (dBµV/m)	Margin (dB)	Comment
Low Channel 2402MHz							
2345.95	52.31	H	-24.73	27.58	54	-26.42	Bandedge
2370.26	52.72	V	-24.73	27.99	54	-26.01	Bandedge
4804.00	59.47	H	-24.73	34.74	54	-19.26	Harmonic
4804.00	59.98	V	-24.73	35.25	54	-18.75	Harmonic
Middle Channel 2441MHz							
4882.00	59.84	H	-24.73	35.11	54	-18.89	Harmonic
4882.00	58.81	V	-24.73	34.08	54	-19.92	Harmonic
High Channel 2480MHz							
2483.55	58.92	H	-24.73	34.19	54	-19.81	Bandedge
2488.94	51.32	V	-24.73	26.59	54	-27.41	Bandedge
4960.00	59.24	H	-24.73	34.51	54	-19.49	Harmonic
4960.00	58.70	V	-24.73	33.97	54	-20.03	Harmonic

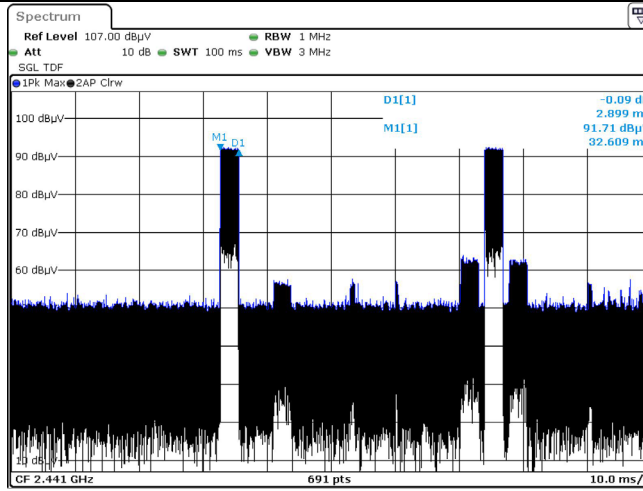
Note: Average level= Peak level+ Duty Cycle Corrected Factor

Worst case duty cycle:

$$\text{Duty cycle} = \text{Ton}/100\text{ms} = 2.899*2/100=0.05798$$

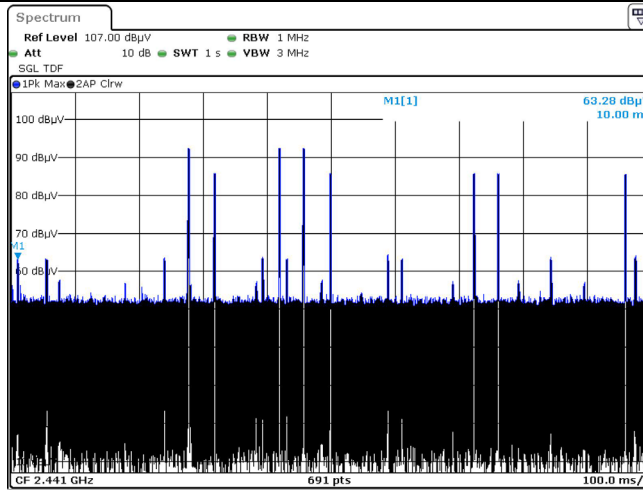
$$\text{Duty Cycle Corrected Factor} = 20\lg(\text{Duty cycle}) = 20\lg 0.05798 = -24.73$$

**Duty Cycle  
(100ms)**



ProjectNo.:2401S71807E-RF Tester:Tyler Wu  
Date: 29.APR.2024 19:36:47

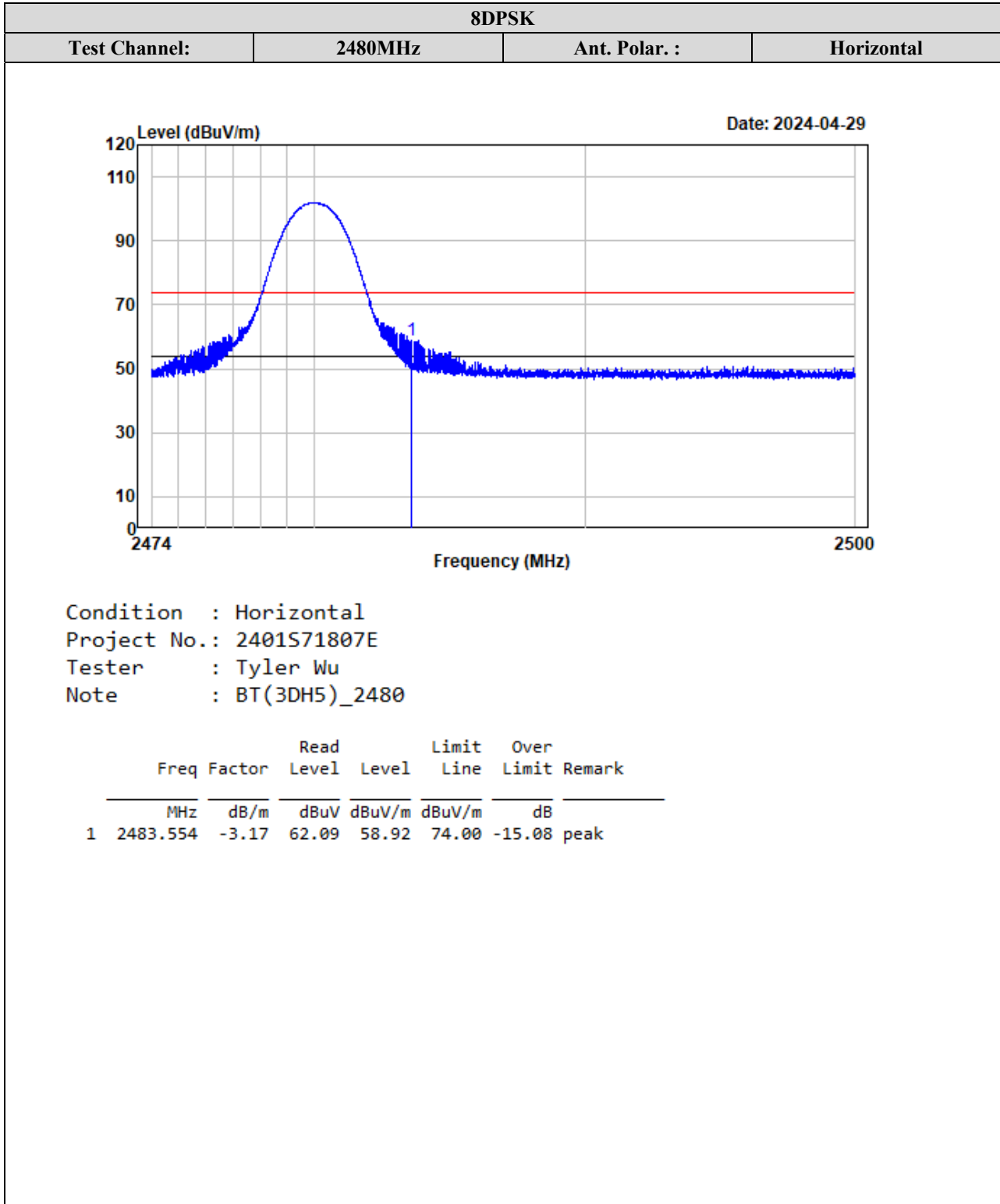
**Duty Cycle  
(1s)**



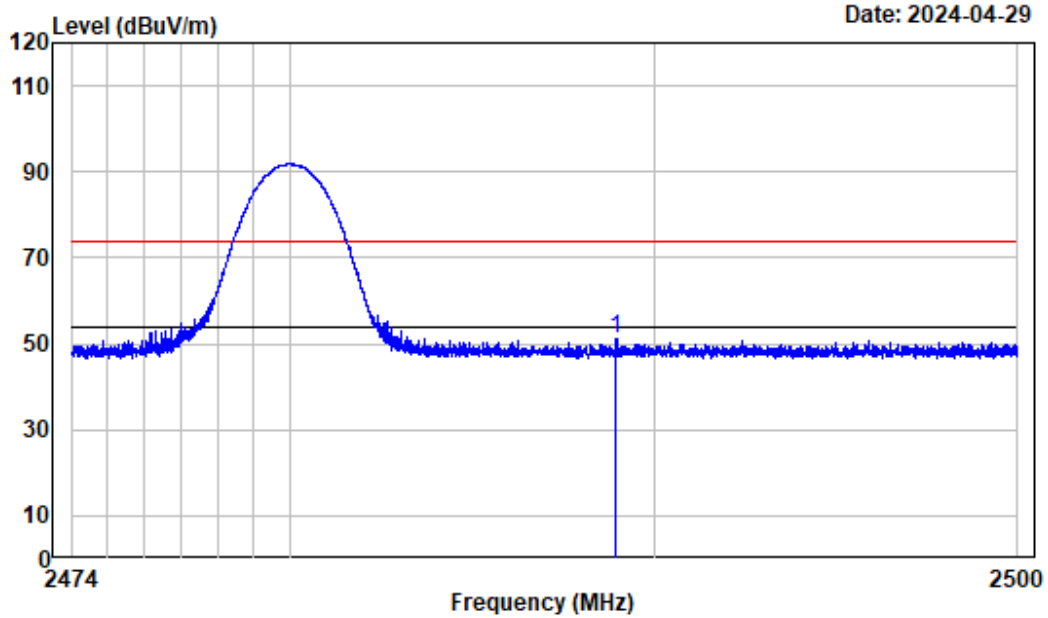
ProjectNo.:2401S71807E-RF Tester:Tyler Wu  
Date: 29.APR.2024 19:35:21

Test plots for example as below:

**Band Edge Measurements (Radiated):**



8DPSK			
Test Channel:	2480MHz	Ant. Polar. :	Vertical

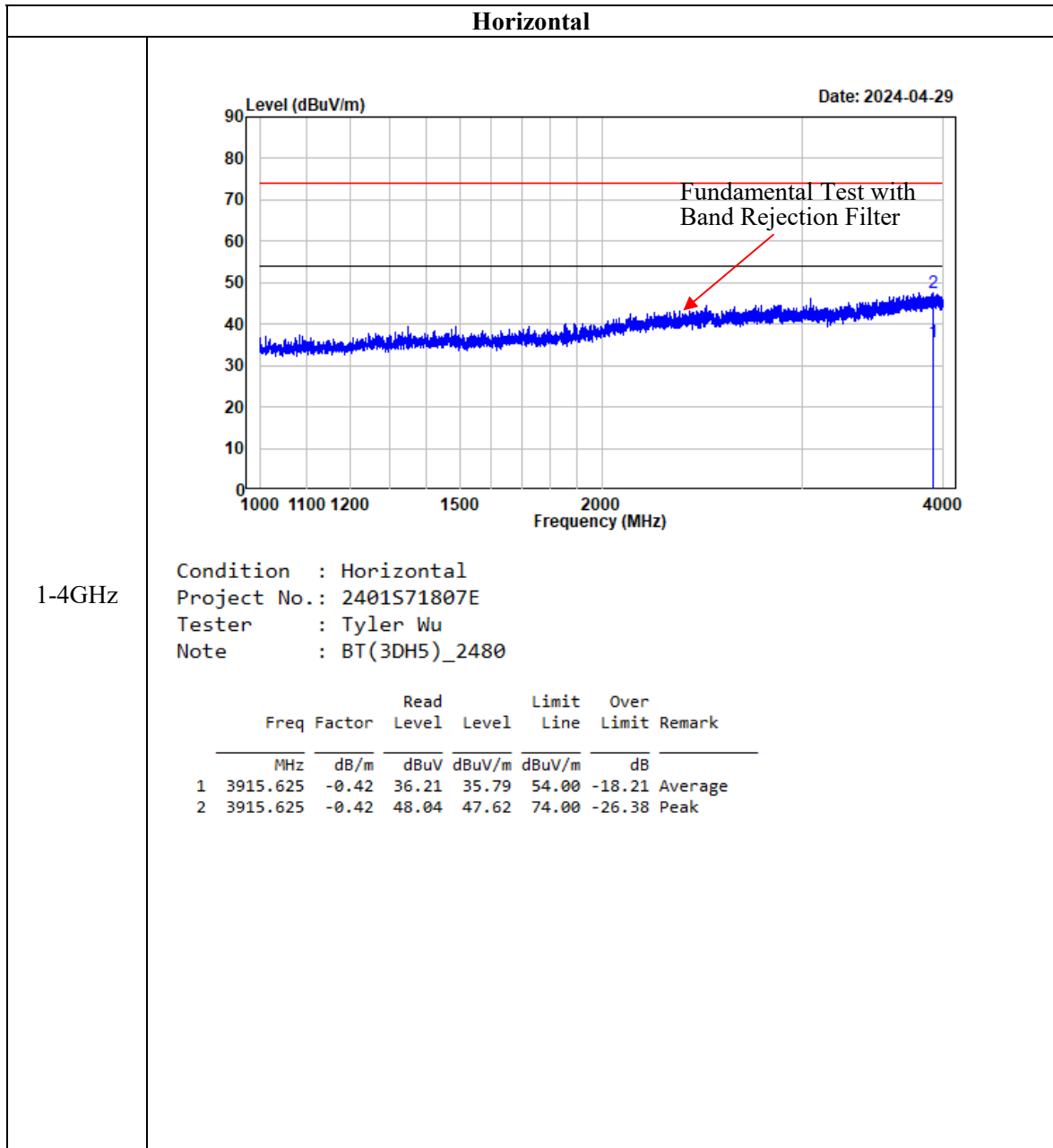


Condition : Vertical  
 Project No.: 2401S71807E  
 Tester : Tyler Wu  
 Note : BT(3DH5)\_2480

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	2488.942	-3.18	54.50	51.32	74.00	-22.68	peak

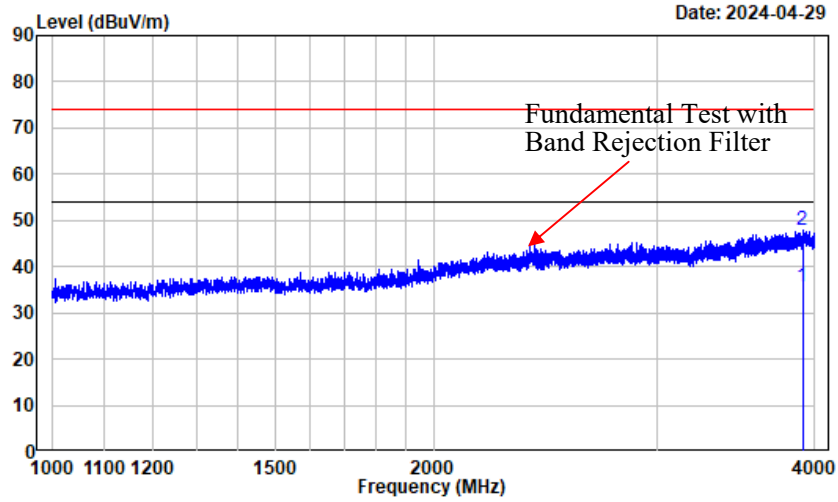


**Harmonic and Spurious Emissions Measurements:**



**Vertical**

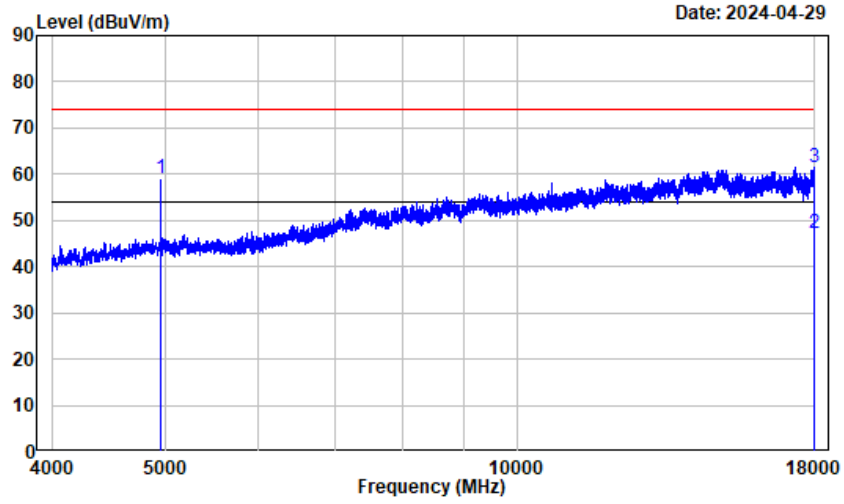
1-4GHz



Condition : Vertical  
 Project No.: 2401S71807E  
 Tester : Tyler Wu  
 Note : BT(3DH5)\_2480

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	3912.250	-0.45	36.17	35.72	54.00	-18.28	Average
2	3912.250	-0.45	48.37	47.92	74.00	-26.08	Peak

**Horizontal**



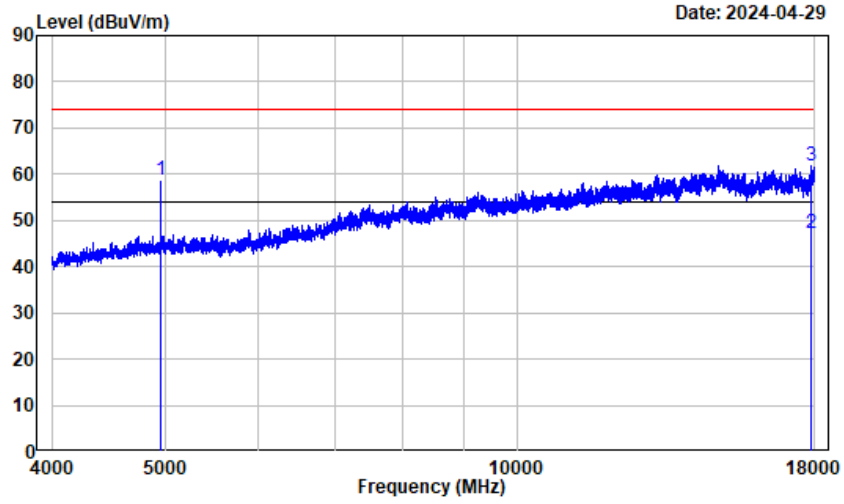
4-18GHz

Condition : Horizontal  
 Project No.: 2401S71807E  
 Tester : Tyler Wu  
 Note : BT(3DH5)\_2480

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	4960.000	2.68	56.56	59.24	74.00	-14.76	Peak
2	17986.000	24.52	22.83	47.35	54.00	-6.65	Average
3	17986.000	24.52	37.01	61.53	74.00	-12.47	Peak

**Vertical**

4-18GHz

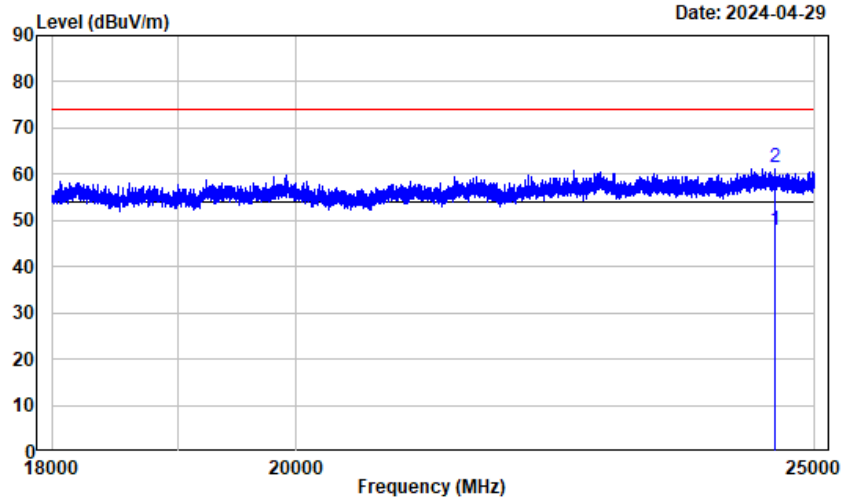


Condition : Vertical  
 Project No.: 2401S71807E  
 Tester : Tyler Wu  
 Note : BT(3DH5)\_2480

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	4960.000	2.68	56.02	58.70	74.00	-15.30	Peak
2	17891.500	23.77	23.52	47.29	54.00	-6.71	Average
3	17891.500	23.77	38.05	61.82	74.00	-12.18	Peak

**Horizontal**

18-25GHz

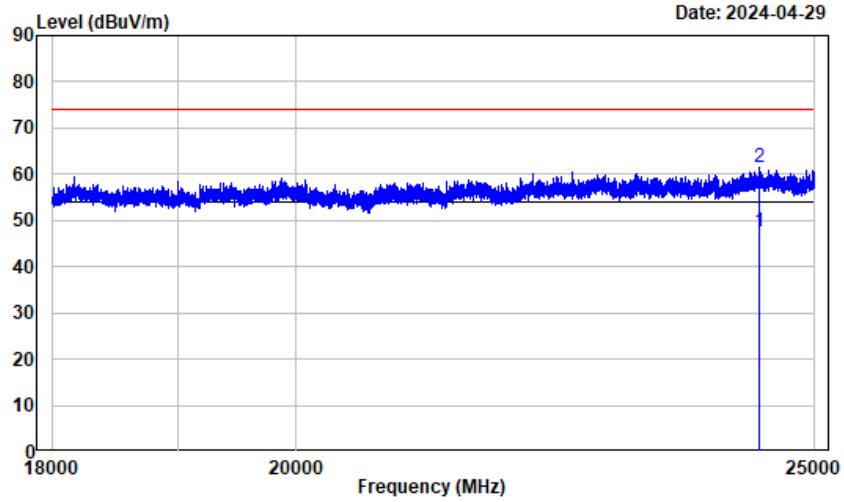


Condition : Horizontal  
 Project No.: 2401S71807E  
 Tester : Tyler Wu  
 Note : BT(3DH5)\_2480

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	24574.870	18.90	28.88	47.78	54.00	-6.22	Average
2	24574.870	18.90	42.47	61.37	74.00	-12.63	Peak

**Vertical**

18-25GHz



Condition : Vertical  
 Project No.: 2401S71807E  
 Tester : Tyler Wu  
 Note : BT(3DH5)\_2480

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	24408.630	18.79	28.89	47.68	54.00	-6.32	Average
2	24408.630	18.79	42.77	61.56	74.00	-12.44	Peak

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

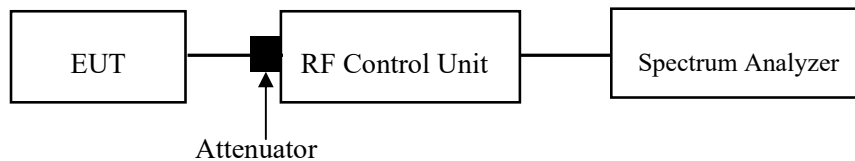
### Applicable Standard

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

<b>Temperature:</b>	25 °C
<b>Relative Humidity:</b>	55 %
<b>ATM Pressure:</b>	101 kPa

*The testing was performed by Navilite Cai on 2024-05-05.*

*EUT operation mode: Transmitting*

***Test Result: Compliant. Please refer to the Appendix.***

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

### Applicable Standard

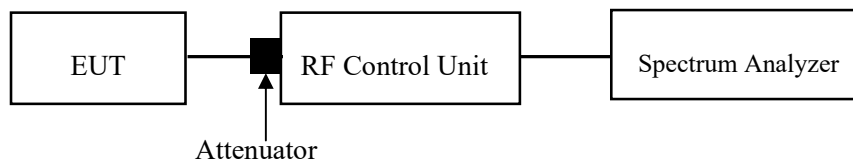
Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

### Test Procedure

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

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 nominal IF filter bandwidth (3 dB RBW) shall be in the range of 1% to 5% of the OBW/ 20dB bandwidth and video bandwidth (VBW) shall be approximately three times RBW, unless otherwise specified by the applicable requirement.





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

<b>Temperature:</b>	25 °C
<b>Relative Humidity:</b>	55 %
<b>ATM Pressure:</b>	101 kPa

*The testing was performed by Navilite Cai on 2024-05-05.*

*EUT operation mode: Transmitting*

***Test Result: Compliant. Please refer to the Appendix.***

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

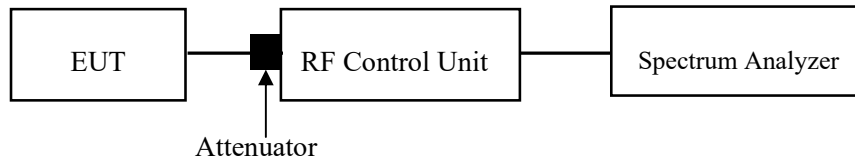
**Applicable Standard**

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**

<b>Temperature:</b>	25 °C
<b>Relative Humidity:</b>	55 %
<b>ATM Pressure:</b>	101 kPa

*The testing was performed by Navilite Cai on 2024-05-05.*

*EUT operation mode: Transmitting*

***Test Result: Compliant. Please refer to the Appendix.***

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

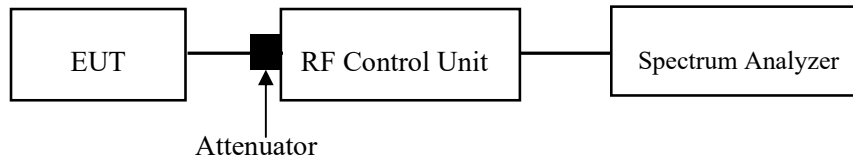
### **Applicable Standard**

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



Note 1: A period time= $0.4 \times 79 = 31.6(S)$ , Result=BurstWidth\*Totalhops

Note 2: Totalhops=Hopping Number in  $3.16s \times 10$

Note 3: Hopping Number in  $3.16s =$ Total of highest signals in  $3.16s$ (Second high signals were other channel)

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

<b>Temperature:</b>	25 °C
<b>Relative Humidity:</b>	55 %
<b>ATM Pressure:</b>	101 kPa

*The testing was performed by Navilite Cai on 2024-05-05.*

*EUT operation mode: Transmitting*

***Test Result: Compliant. Please refer to the Appendix.***

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

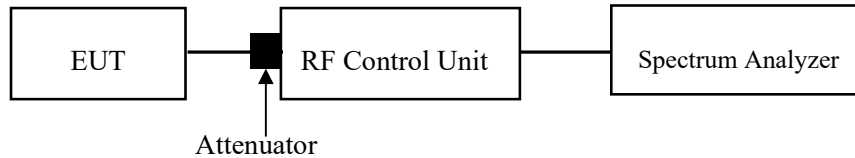
### Applicable Standard

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

<b>Temperature:</b>	25 °C
<b>Relative Humidity:</b>	55 %
<b>ATM Pressure:</b>	101 kPa

*The testing was performed by Navilite Cai on 2024-05-05.*

*EUT operation mode: Transmitting*

***Test Result: Compliant. Please refer to the Appendix.***

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

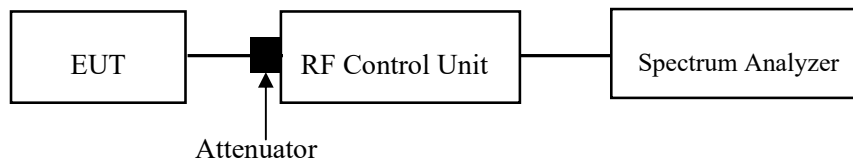
### Applicable Standard

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**

<b>Temperature:</b>	25 °C
<b>Relative Humidity:</b>	55 %
<b>ATM Pressure:</b>	101 kPa

*The testing was performed by Navilite Cai on 2024-05-05.*

*EUT operation mode: Transmitting*

***Test Result: Compliant. Please refer to the Appendix.***

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## **EUT PHOTOGRAPHS**

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Please refer to the attachment 2401S71807E-RF External photo and 2401S71807E-RF Internal photo.



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## **TEST SETUP PHOTOGRAPHS**

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Please refer to the attachment 2401S71807E-RF Test Setup photo.

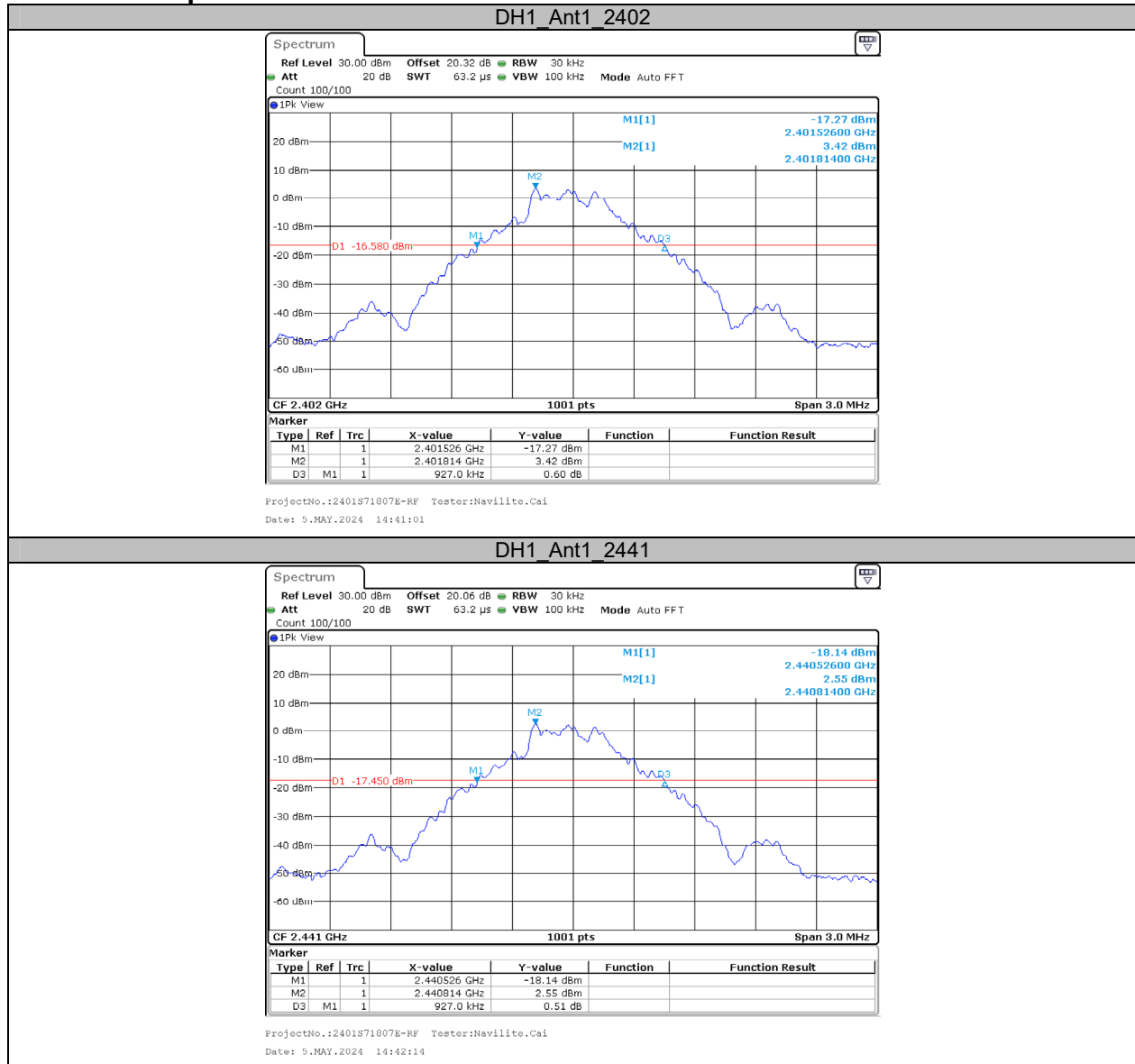
**APPENDIX**

**Appendix A: 20dB Emission Bandwidth**

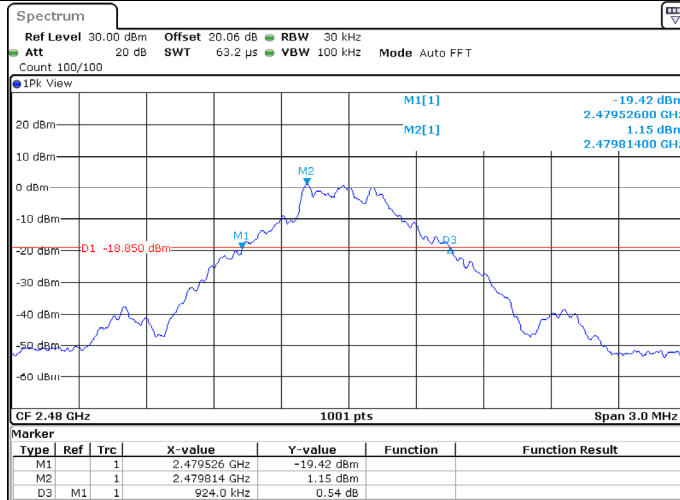
**Test Result**

Test Mode	Antenna	Frequency[MHz]	20db EBW[MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH1	Ant1	2402	0.927	2401.53	2402.45	---	---
		2441	0.927	2440.53	2441.45	---	---
		2480	0.924	2479.53	2480.45	---	---
2DH1	Ant1	2402	1.251	2401.35	2402.60	---	---
		2441	1.251	2440.35	2441.60	---	---
		2480	1.251	2479.35	2480.60	---	---
3DH1	Ant1	2402	1.212	2401.39	2402.60	---	---
		2441	1.215	2440.39	2441.60	---	---
		2480	1.212	2479.39	2480.60	---	---

### Test Graphs

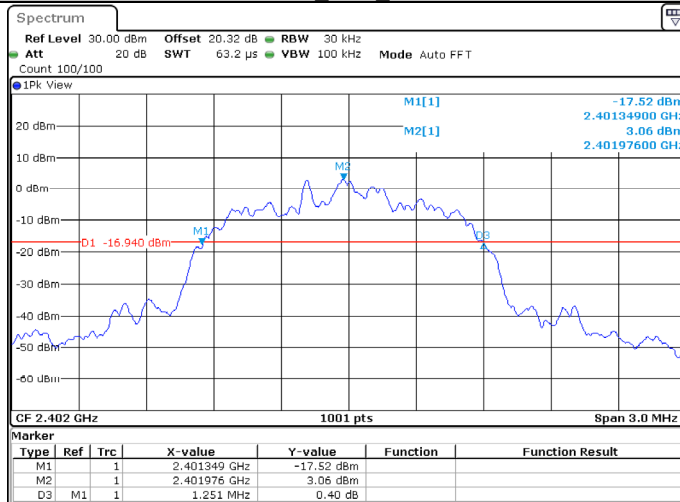


DH1 Ant1 2480



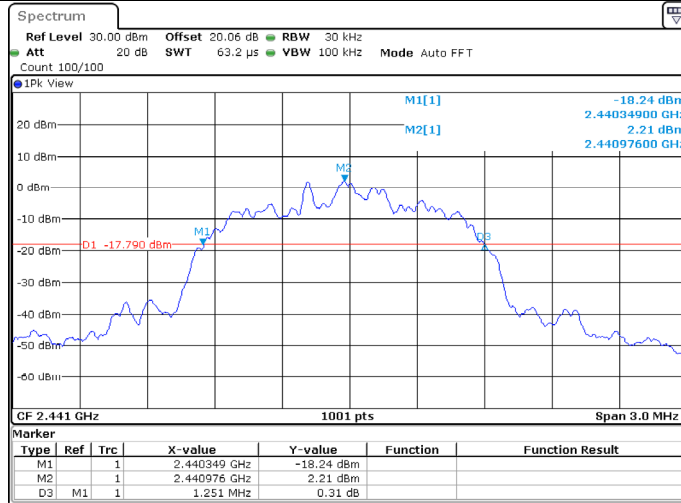
ProjectNo.: 2401S71807E-RF Tester: Navillite.Cai  
 Date: 5.MAY.2024 14:44:54

2DH1 Ant1 2402



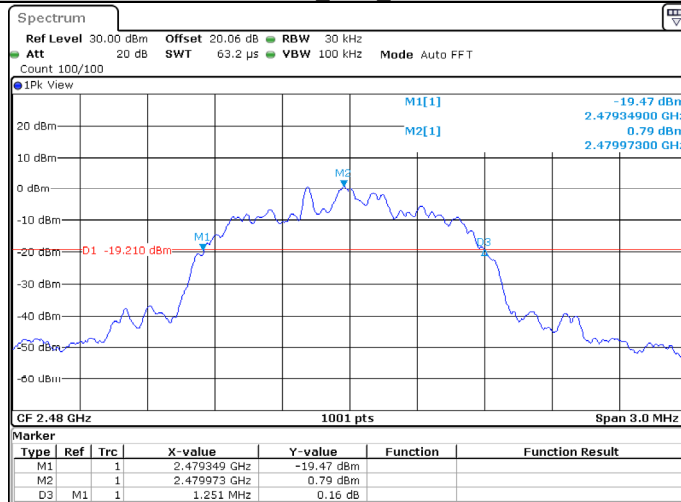
ProjectNo.: 2401S71807E-RF Tester: Navillite.Cai  
 Date: 5.MAY.2024 14:46:03

2DH1\_Ant1\_2441

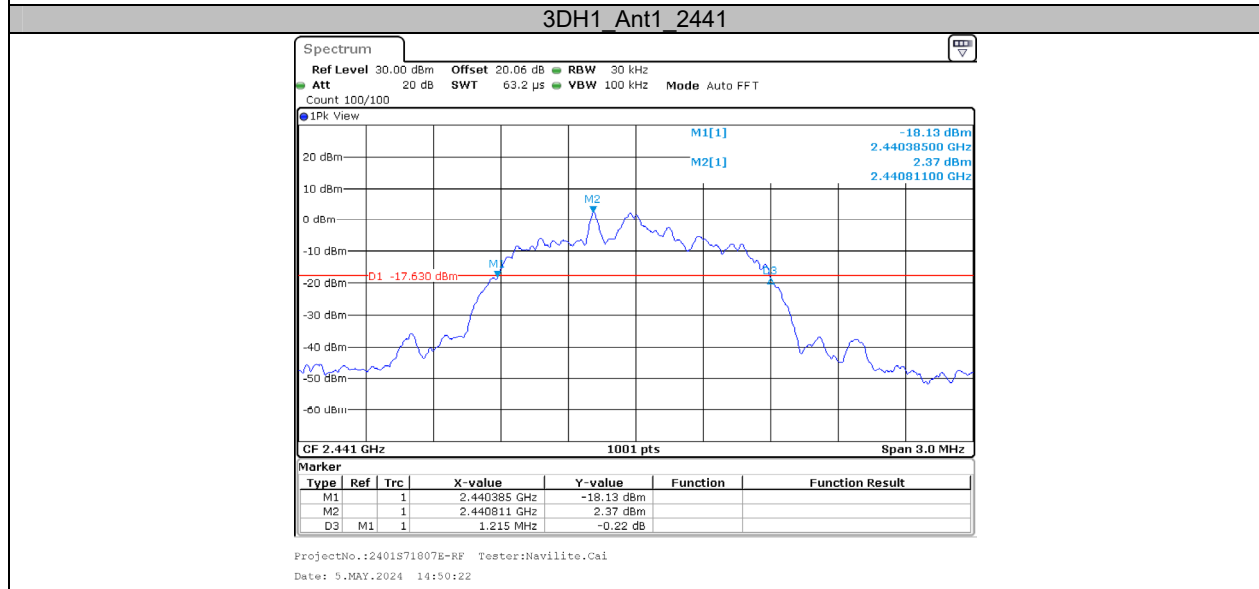
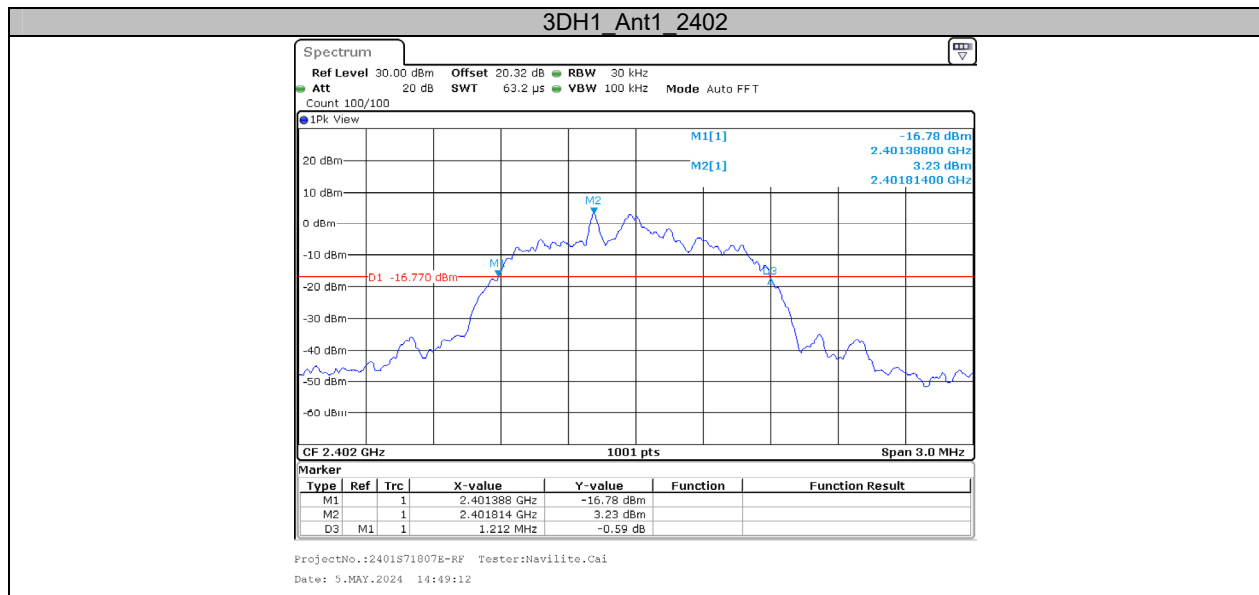


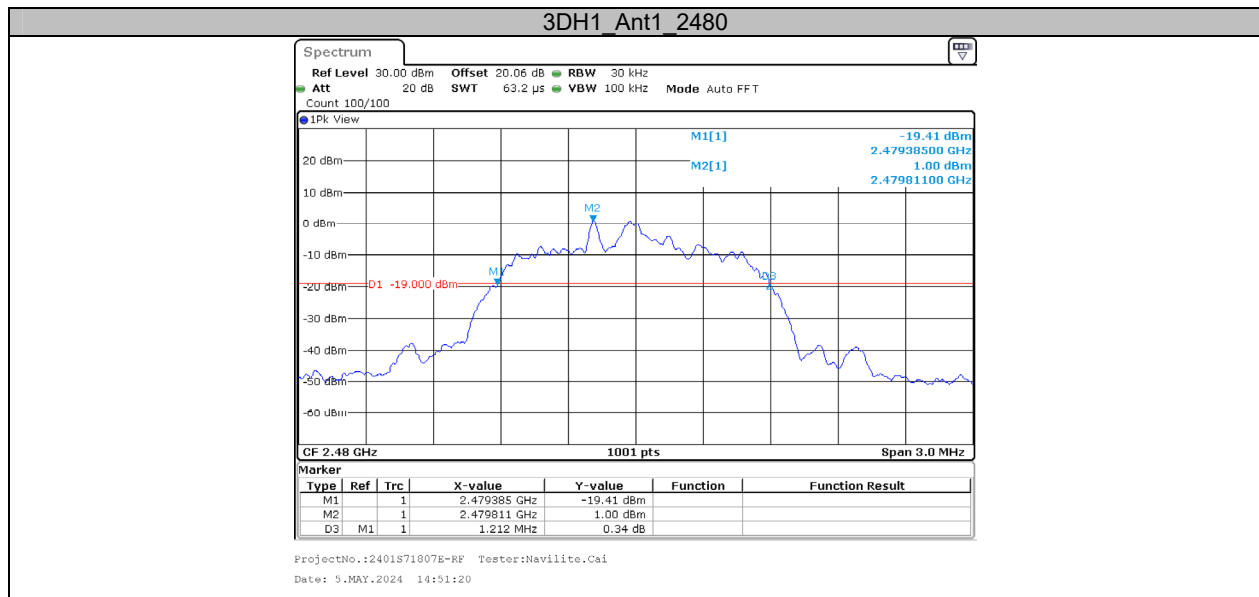
ProjectNo.:2401S71807E-RF Tester:Navillite.Cai  
 Date: 5.MAY.2024 14:47:02

2DH1\_Ant1\_2480



ProjectNo.:2401S71807E-RF Tester:Navillite.Cai  
 Date: 5.MAY.2024 14:48:02





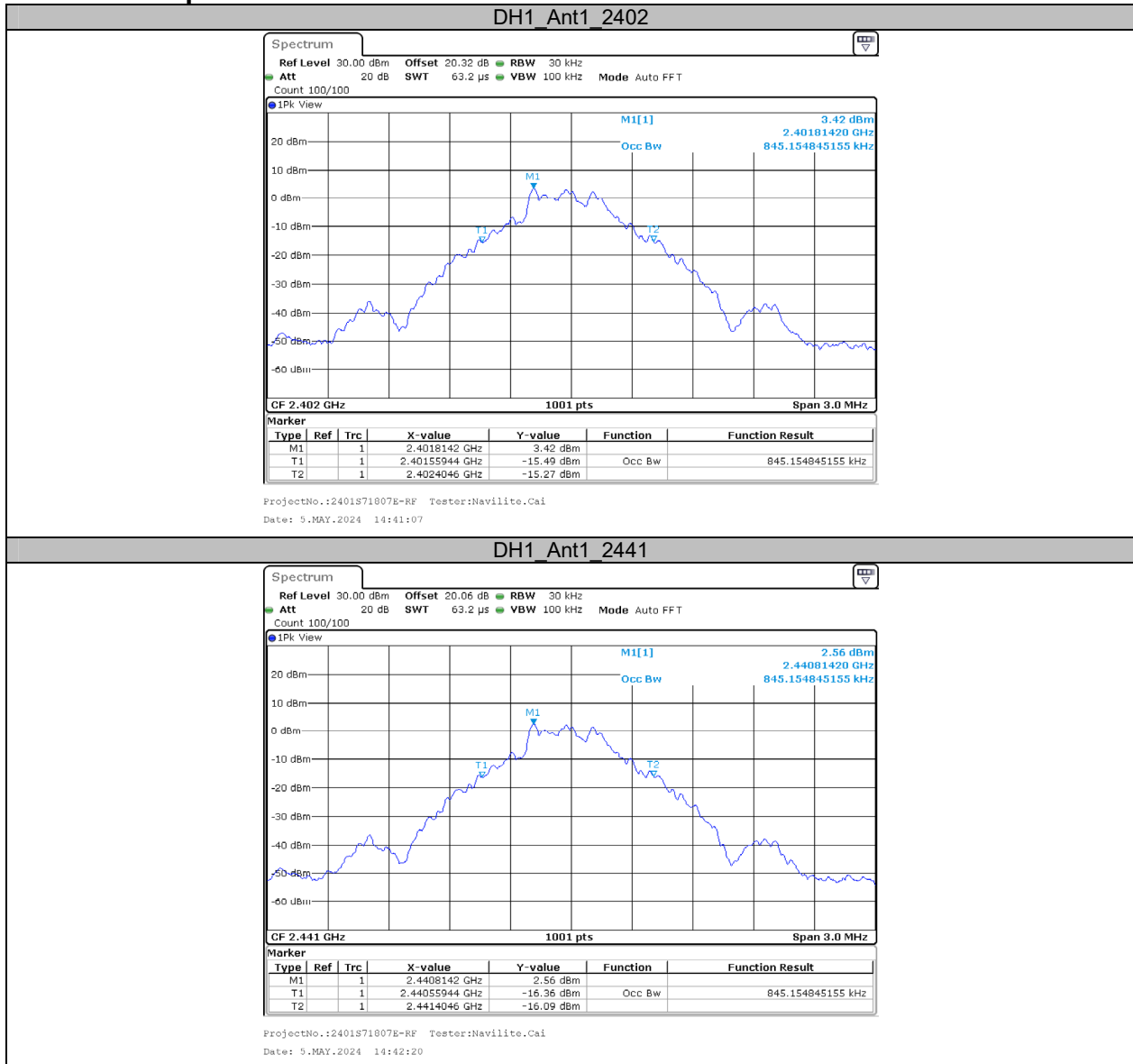
**Appendix B: Occupied Channel Bandwidth**

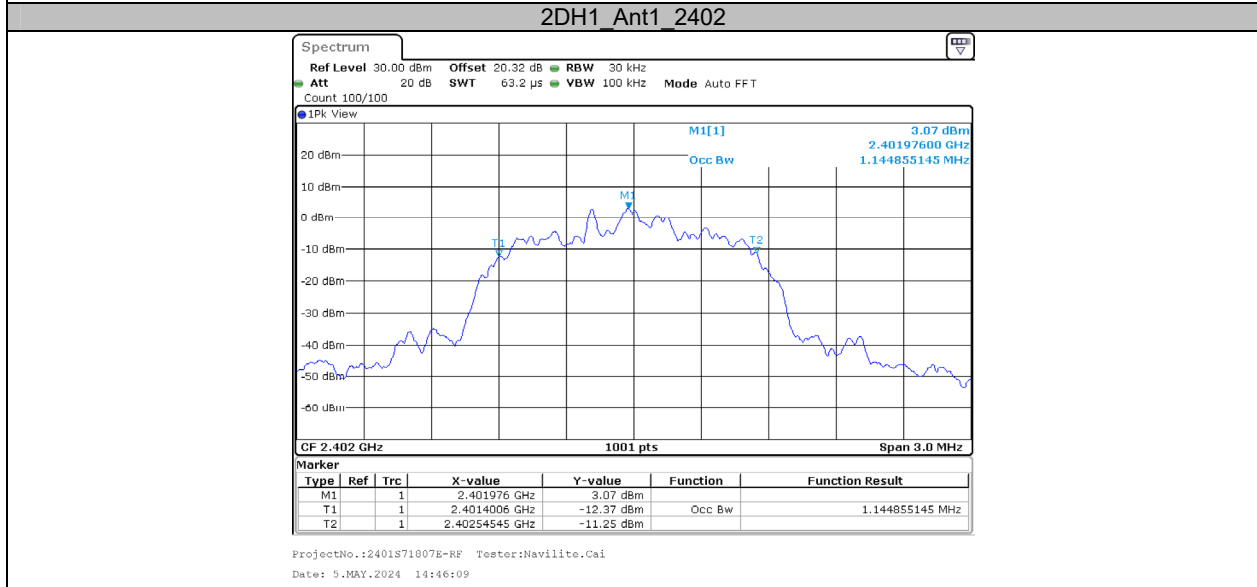
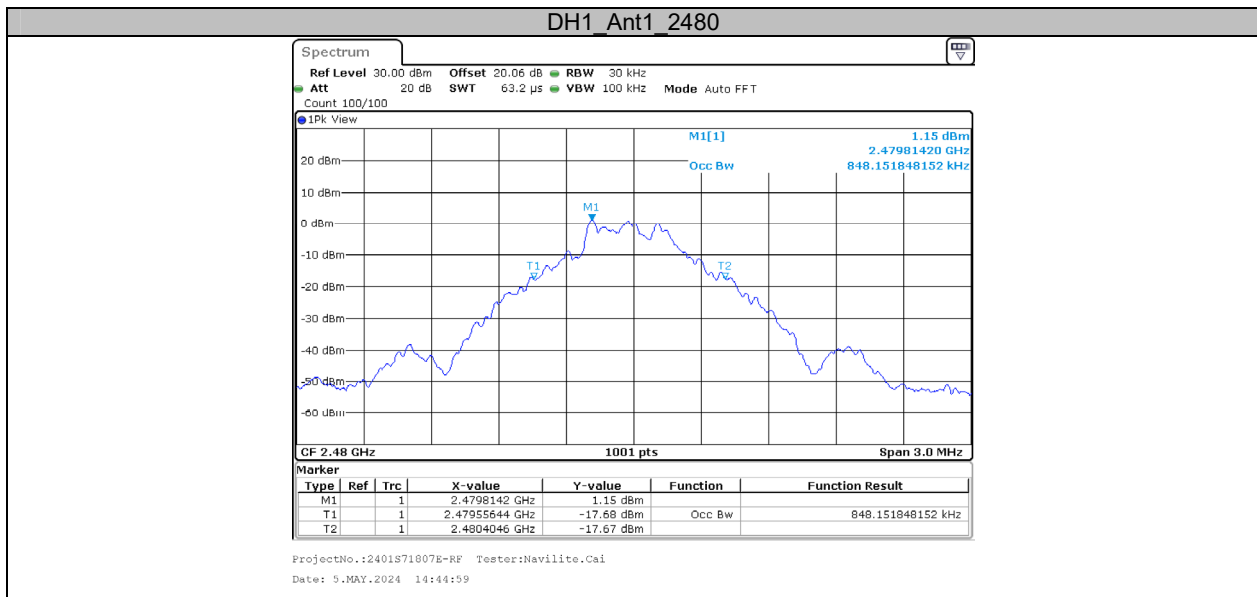
**Test Result**

Test Mode	Antenna	Frequency[MHz]	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH1	Ant1	2402	0.845	2401.5594	2402.4046	---	---
		2441	0.845	2440.5594	2441.4046	---	---
		2480	0.848	2479.5564	2480.4046	---	---
2DH1	Ant1	2402	1.145	2401.4006	2402.5455	---	---
		2441	1.145	2440.4006	2441.5455	---	---
		2480	1.145	2479.4006	2480.5455	---	---
3DH1	Ant1	2402	1.139	2401.4186	2402.5574	---	---
		2441	1.139	2440.4156	2441.5544	---	---
		2480	1.139	2479.4156	2480.5544	---	---

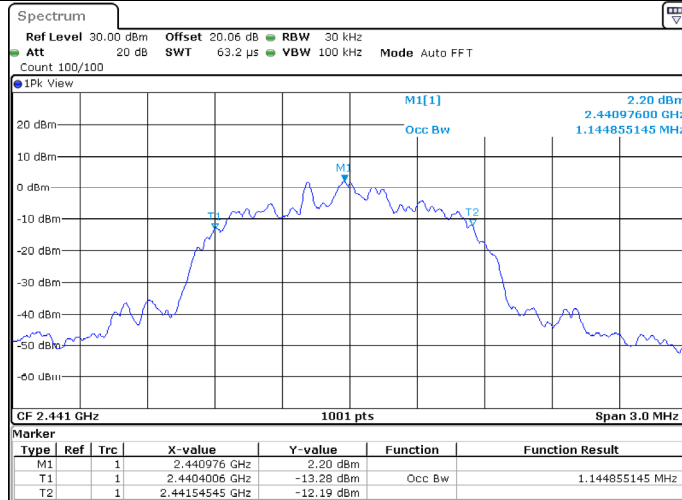


### Test Graphs



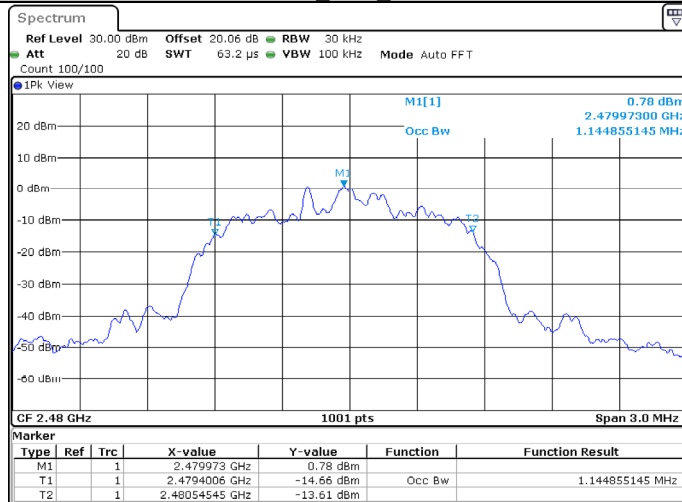


2DH1\_Ant1\_2441

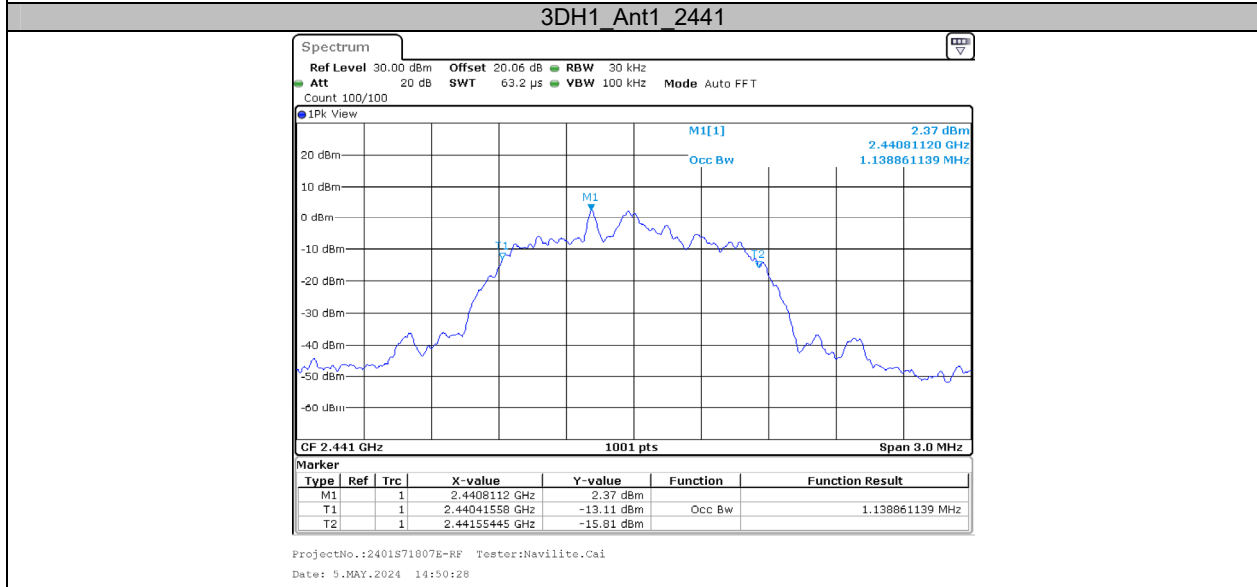
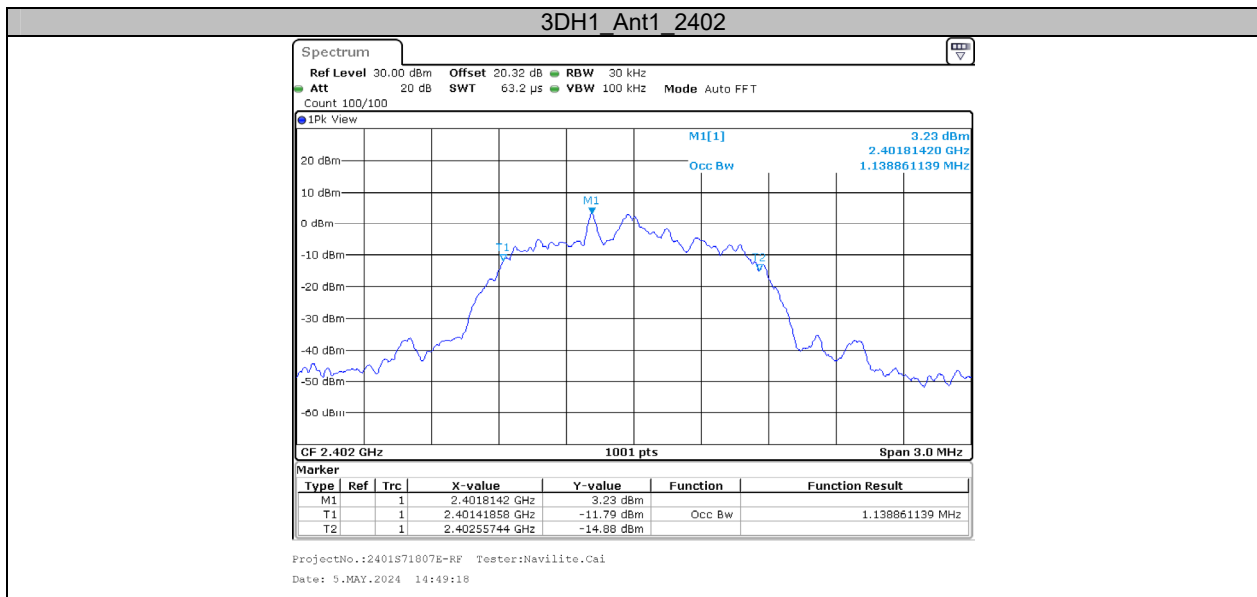


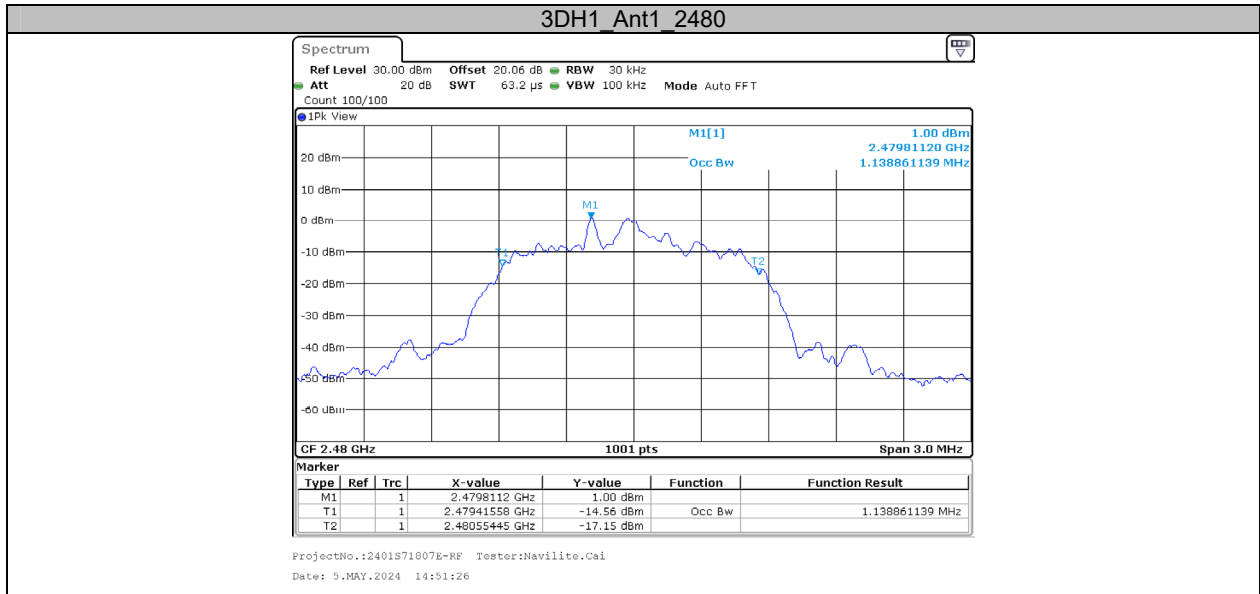
ProjectNo.:2401S71807E-RF Tester:Navilite.Cai  
 Date: 5.MAY.2024 14:47:08

2DH1\_Ant1\_2480



ProjectNo.:2401S71807E-RF Tester:Navilite.Cai  
 Date: 5.MAY.2024 14:48:08

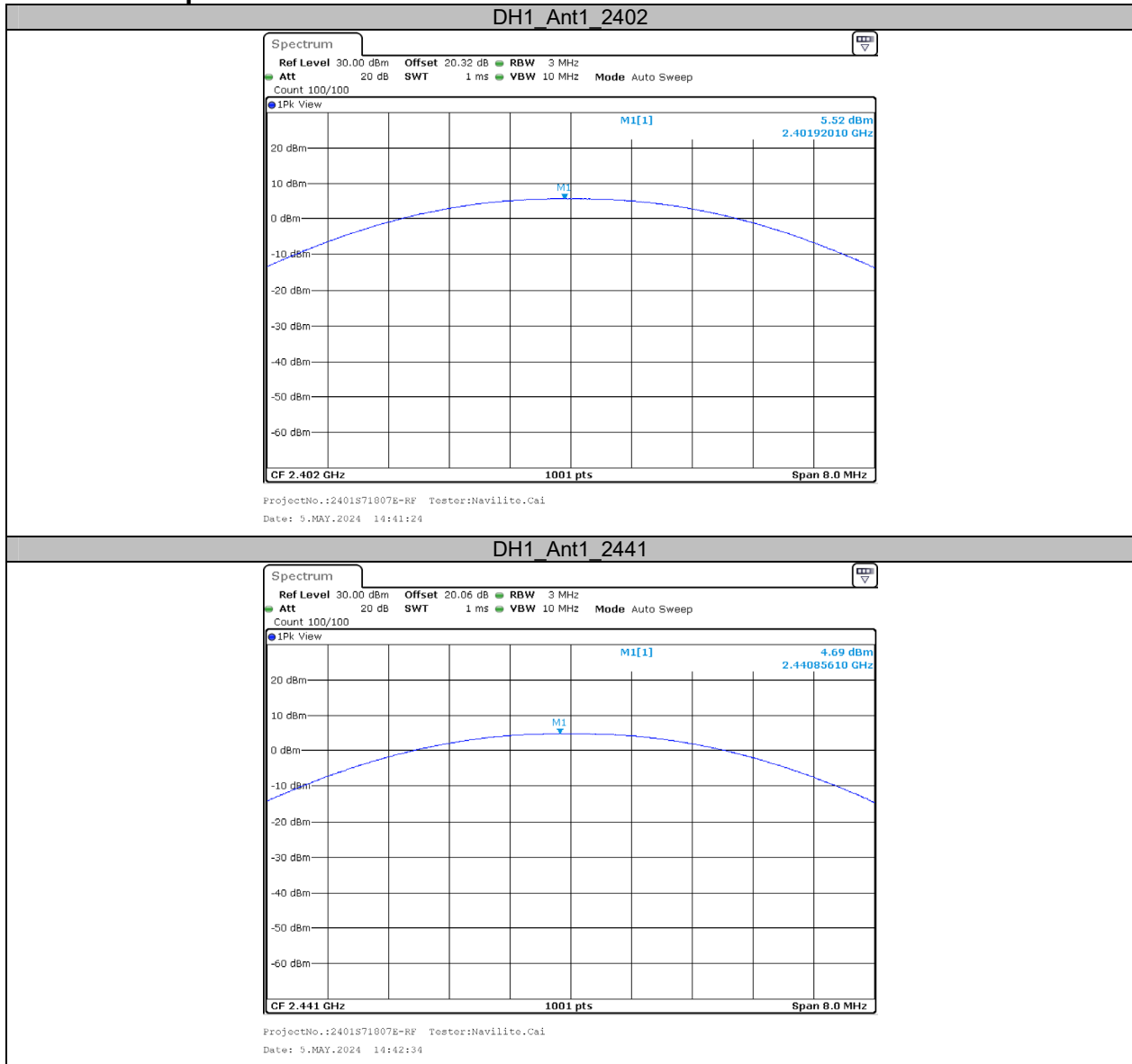


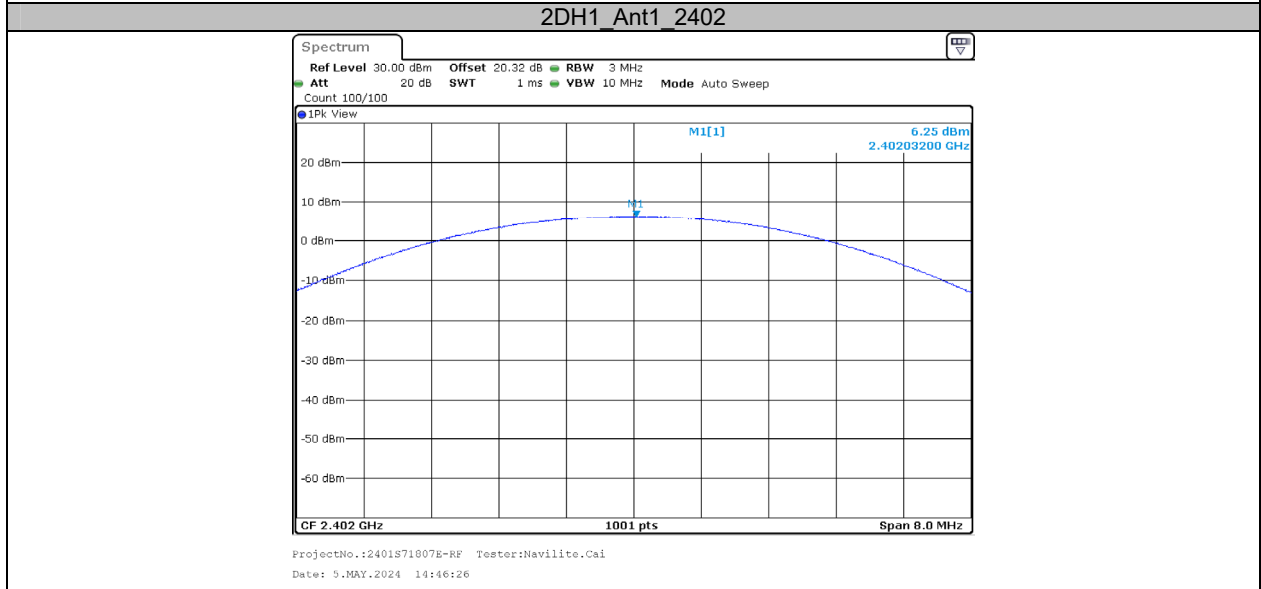
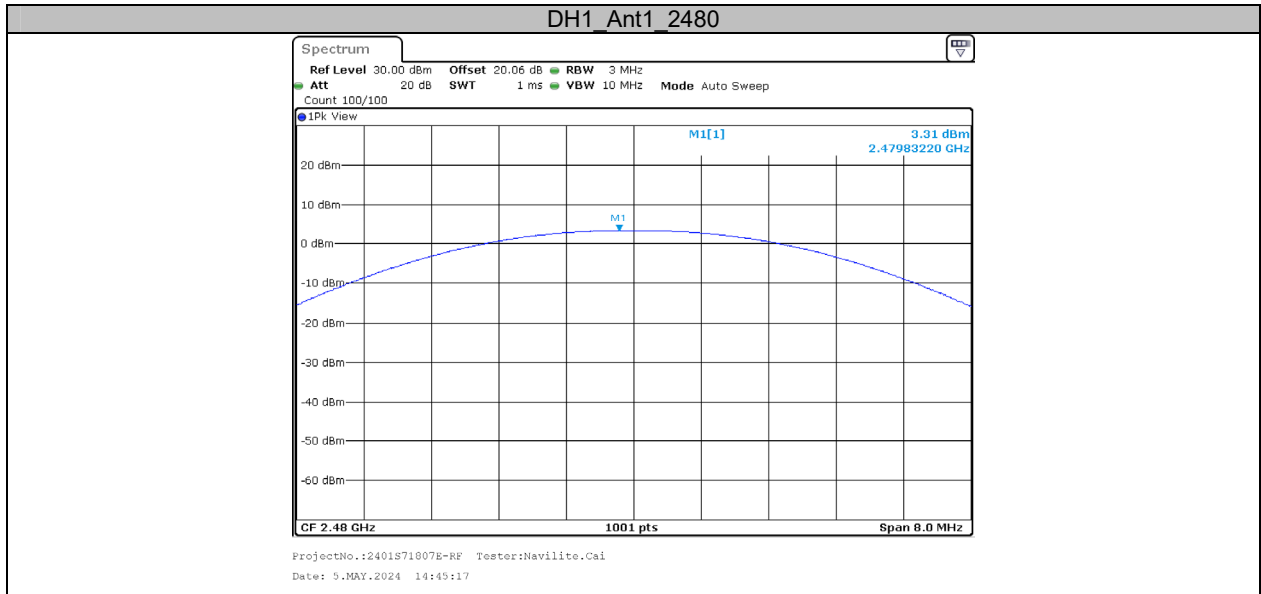


**Appendix C: Maximum Conducted Output Power****Test Result**

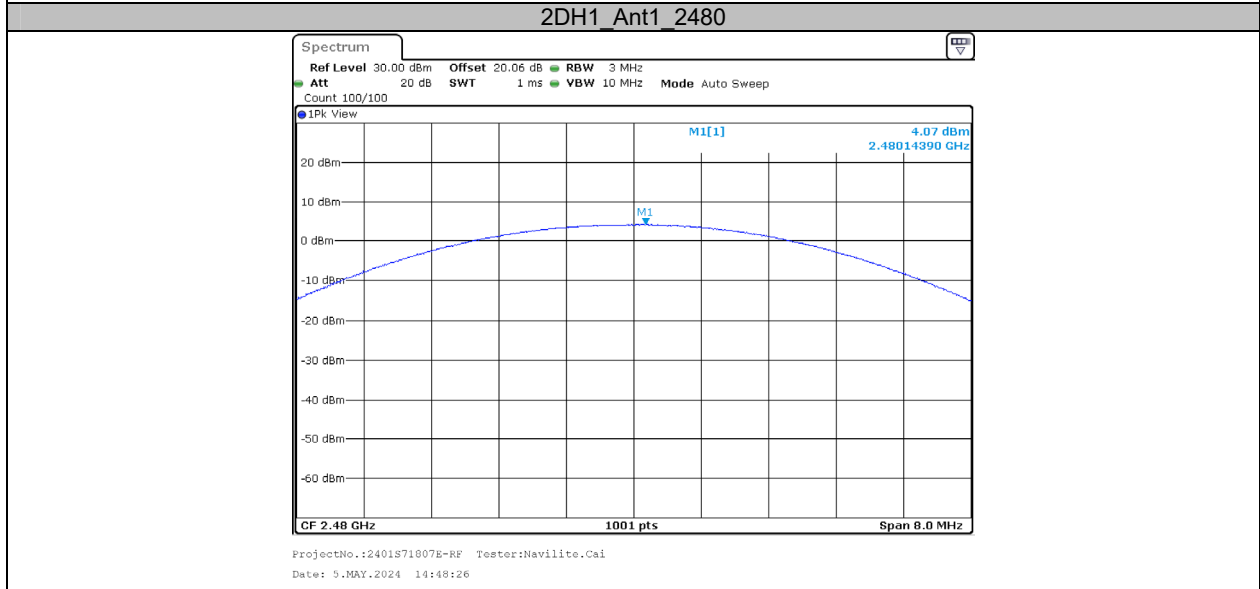
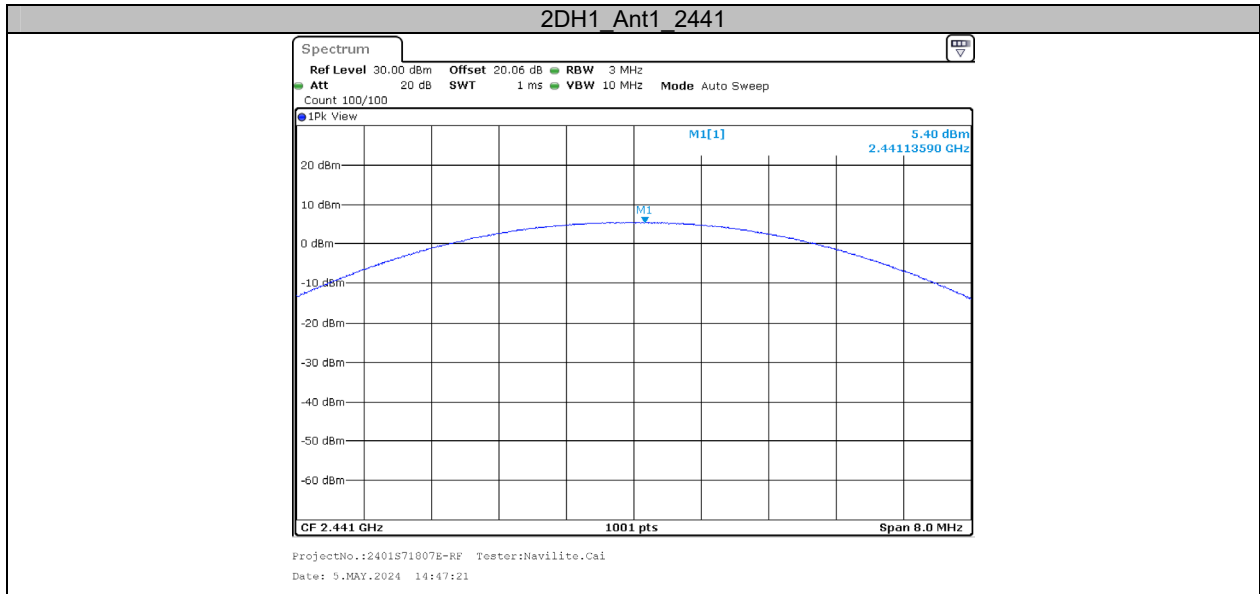
Test Mode	Antenna	Frequency[MHz]	Conducted Peak Power[dBm]	Conducted Limit[dBm]	Verdict
DH1	Ant1	2402	5.52	≤20.97	PASS
		2441	4.69	≤20.97	PASS
		2480	3.31	≤20.97	PASS
2DH1	Ant1	2402	6.25	≤20.97	PASS
		2441	5.40	≤20.97	PASS
		2480	4.07	≤20.97	PASS
3DH1	Ant1	2402	6.93	≤20.97	PASS
		2441	6.10	≤20.97	PASS
		2480	4.77	≤20.97	PASS

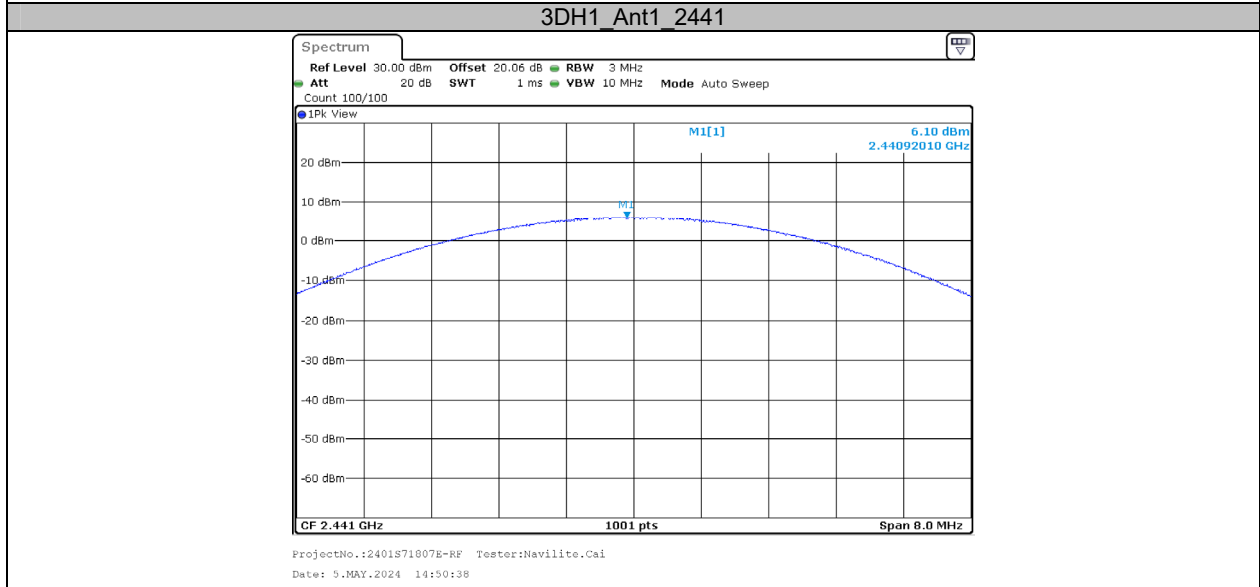
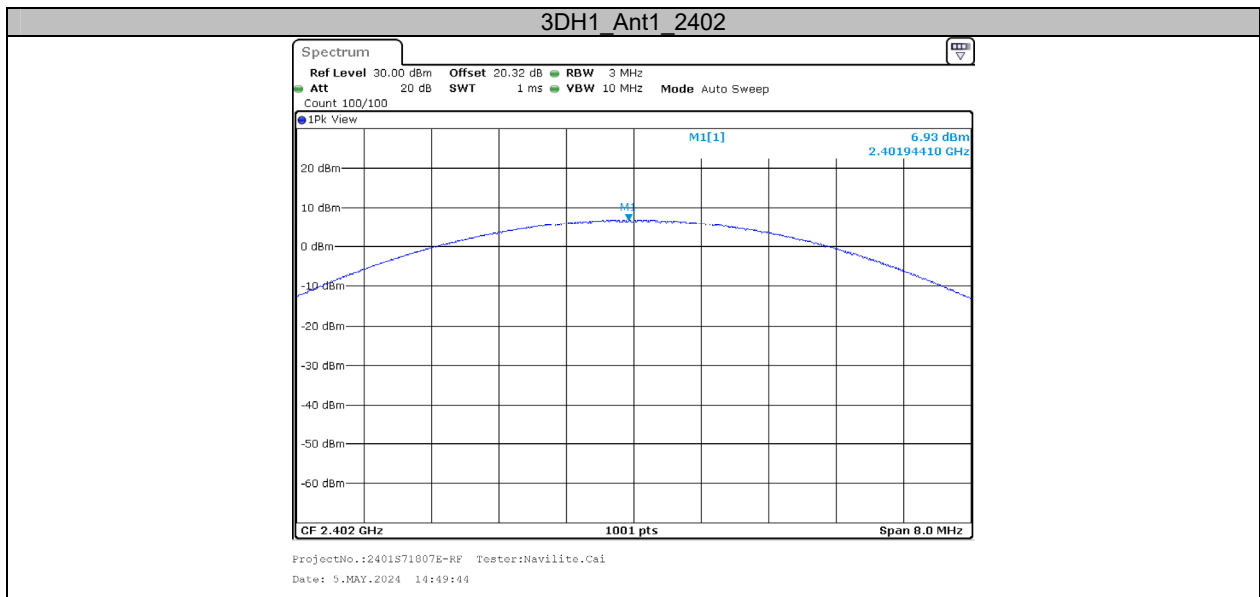
### Test Graphs

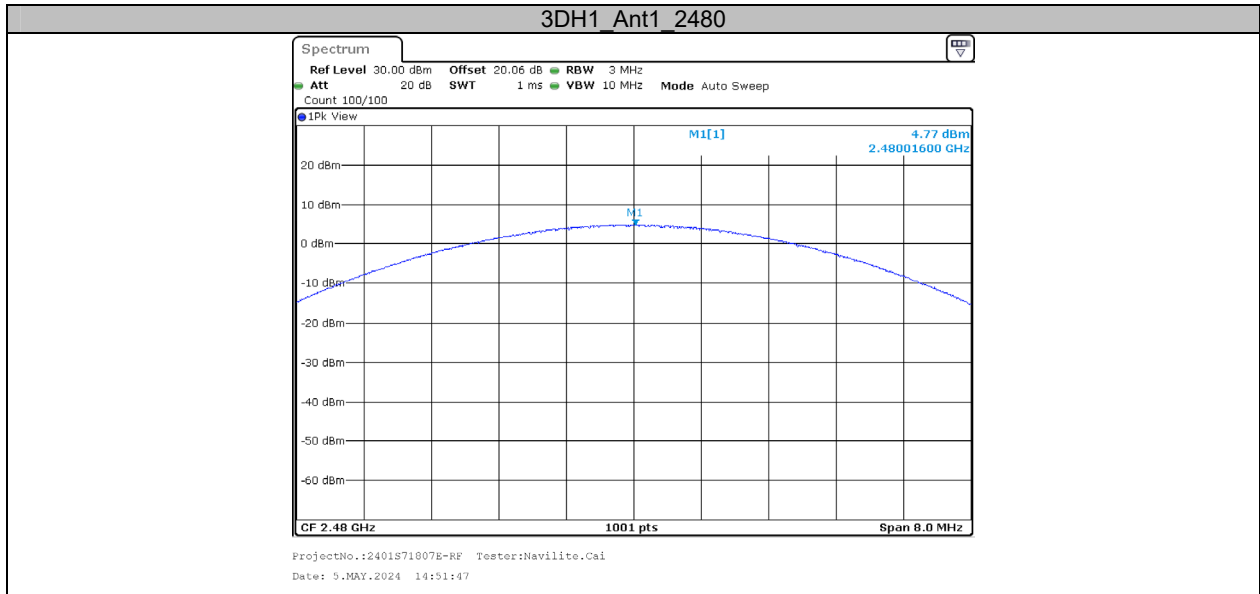












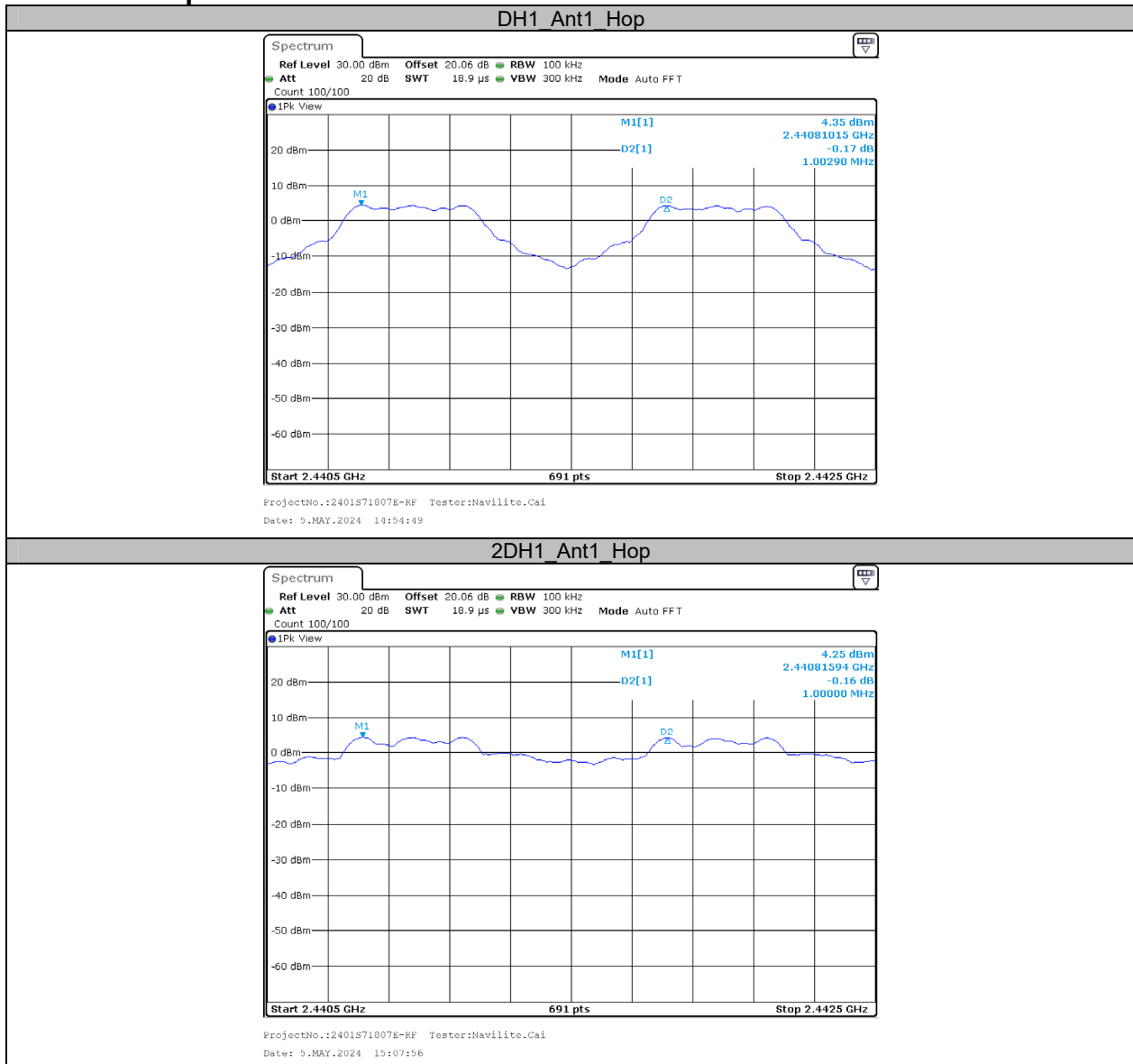
### Appendix D: Carrier Frequency Separation

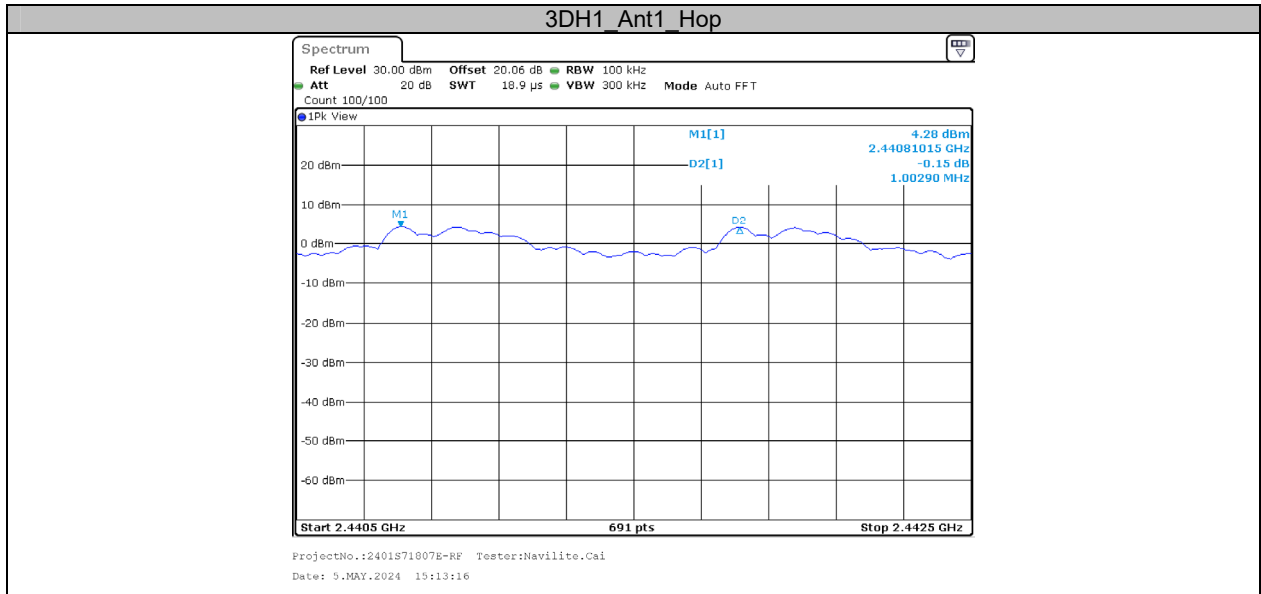
#### Test Result

Test Mode	Antenna	Frequency[MHz]	Result[MHz]	Limit[MHz]	Verdict
DH1	Ant1	Hop	1.003	≥0.618	PASS
2DH1	Ant1	Hop	1	≥0.834	PASS
3DH1	Ant1	Hop	1.003	≥0.810	PASS

Note: Limit= Two-thirds of the 20 dB bandwidth

#### Test Graphs



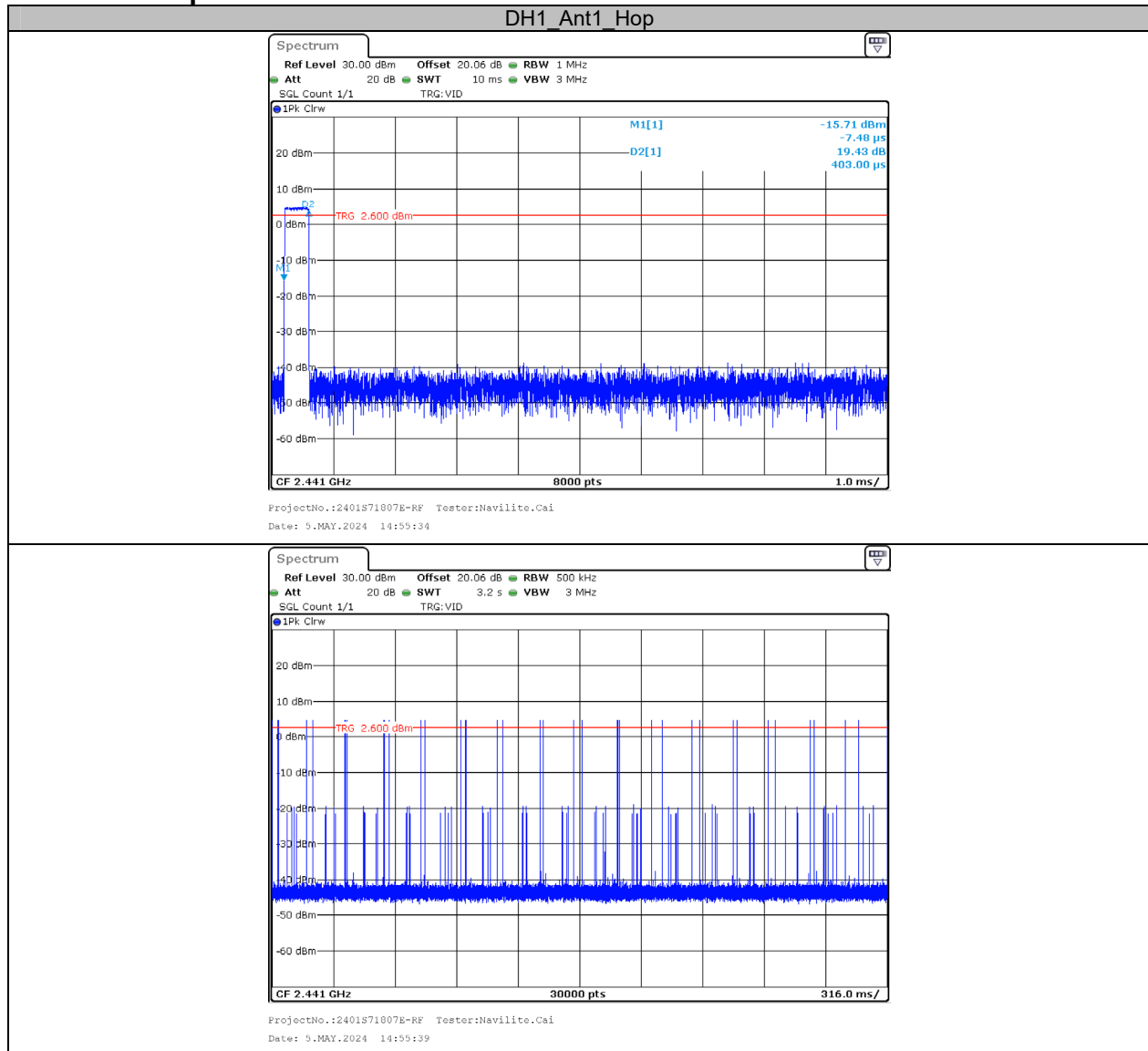


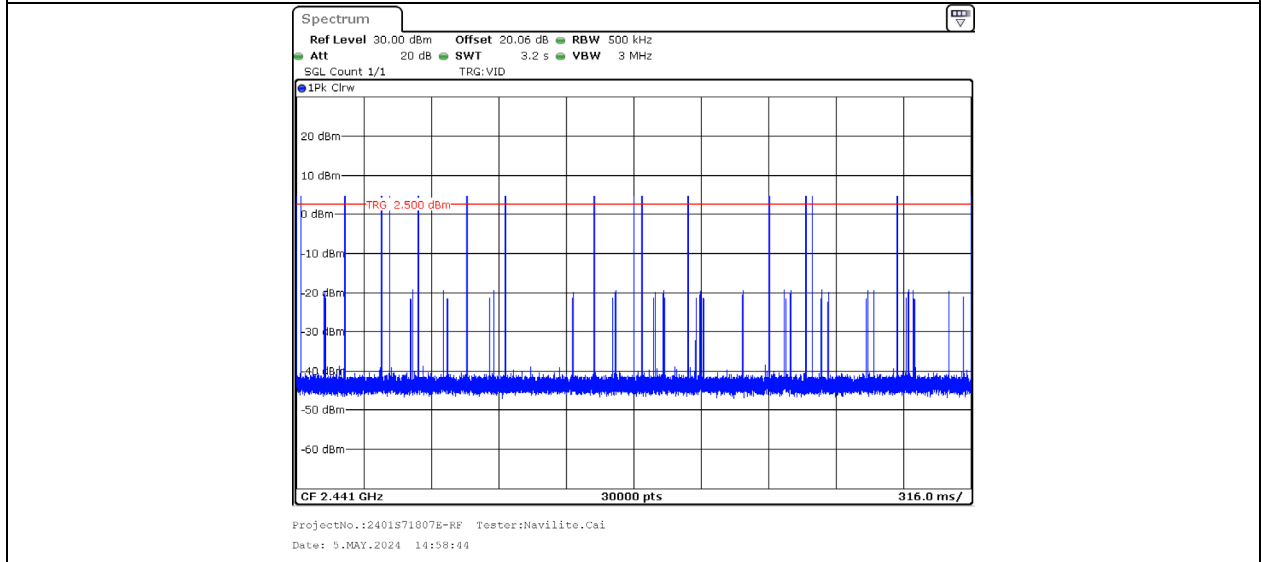
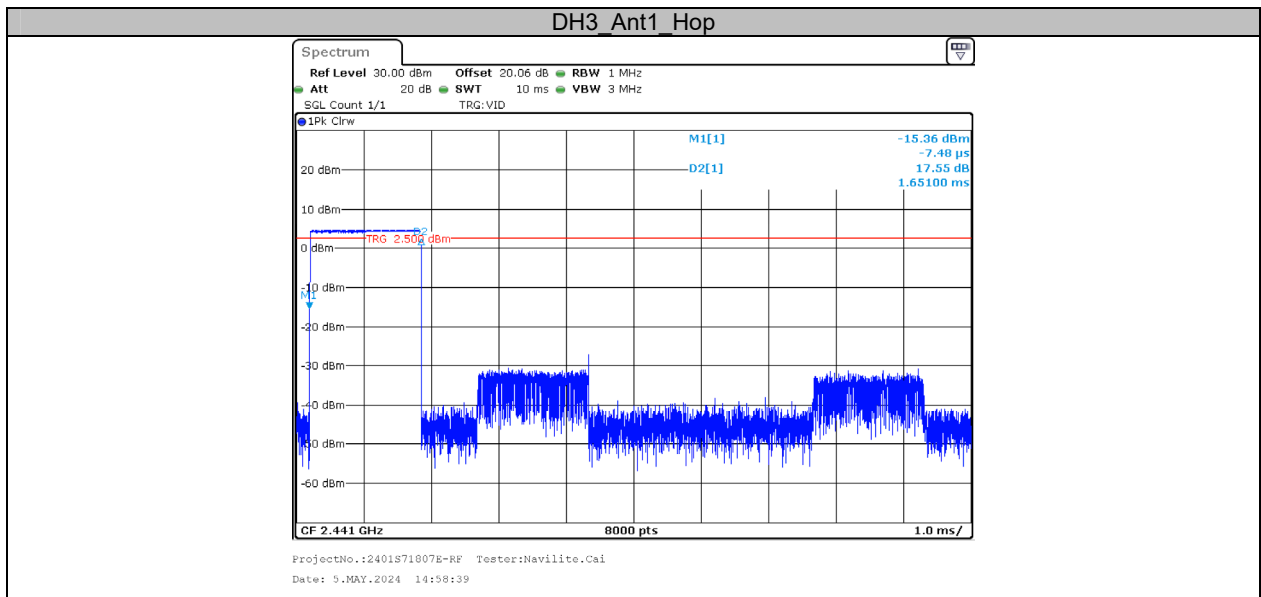
### Appendix E: Time of Occupancy

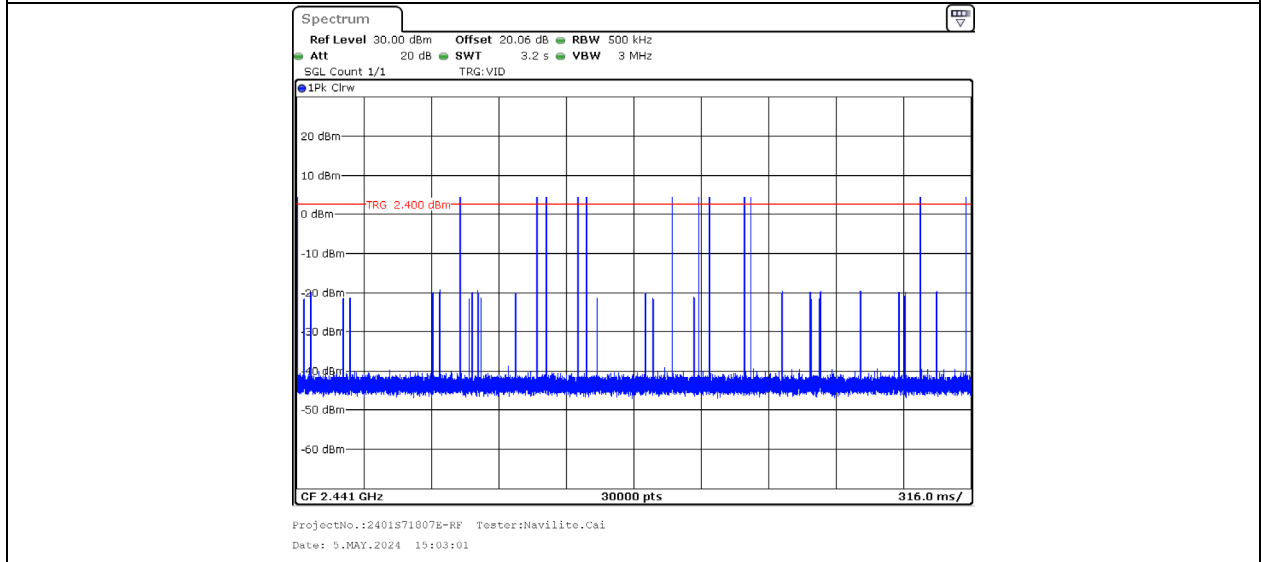
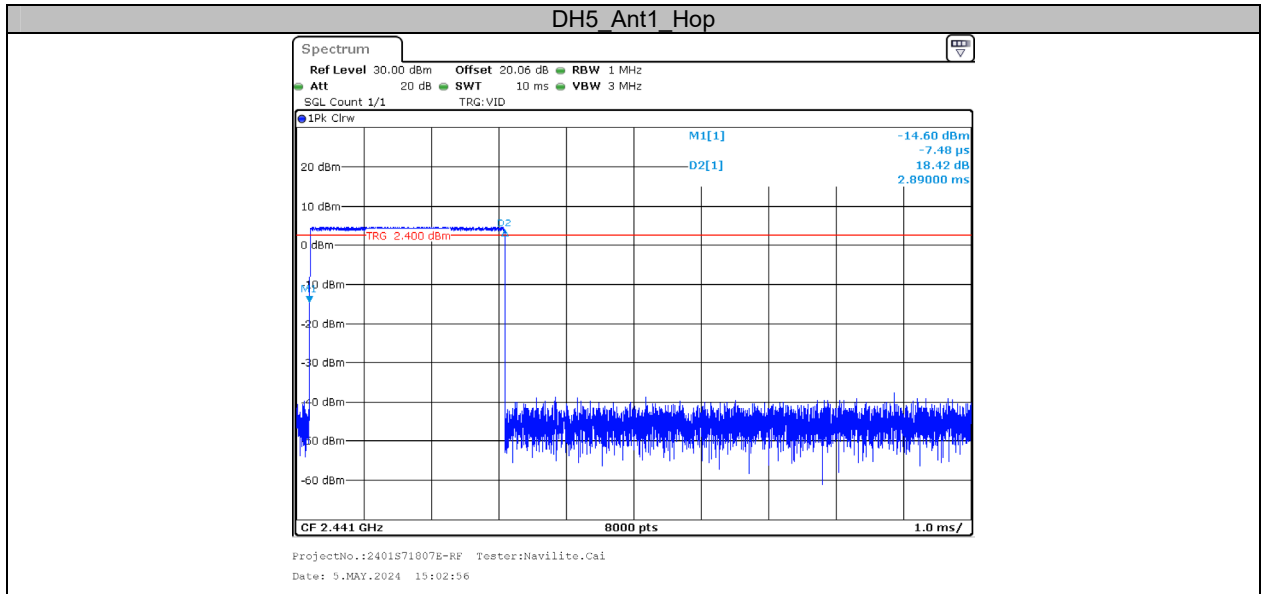
#### Test Result

Test Mode	Antenna	Frequency[MHz]	BurstWidth [ms]	TotalHops [Num]	Result[s]	Limit[s]	Verdict
DH1	Ant1	Hop	0.403	320	0.129	≤0.4	PASS
DH3	Ant1	Hop	1.651	160	0.264	≤0.4	PASS
DH5	Ant1	Hop	2.890	130	0.376	≤0.4	PASS
2DH1	Ant1	Hop	0.413	320	0.132	≤0.4	PASS
2DH3	Ant1	Hop	1.658	160	0.265	≤0.4	PASS
2DH5	Ant1	Hop	2.898	120	0.348	≤0.4	PASS
3DH1	Ant1	Hop	0.415	320	0.133	≤0.4	PASS
3DH3	Ant1	Hop	1.656	150	0.248	≤0.4	PASS
3DH5	Ant1	Hop	2.899	130	0.377	≤0.4	PASS

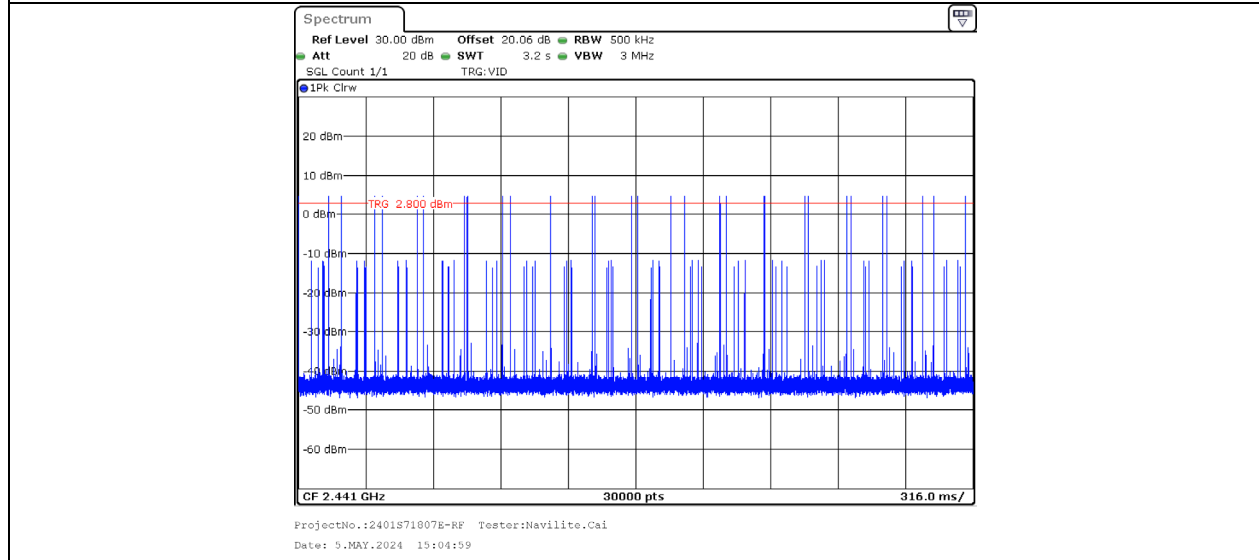
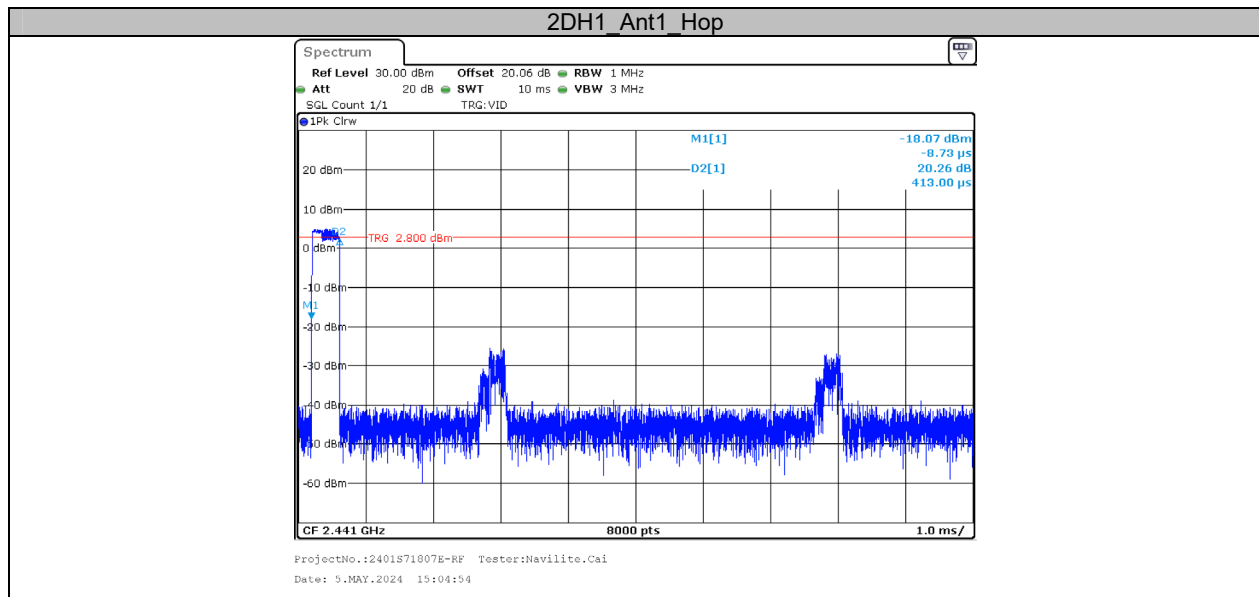
#### Test Graphs

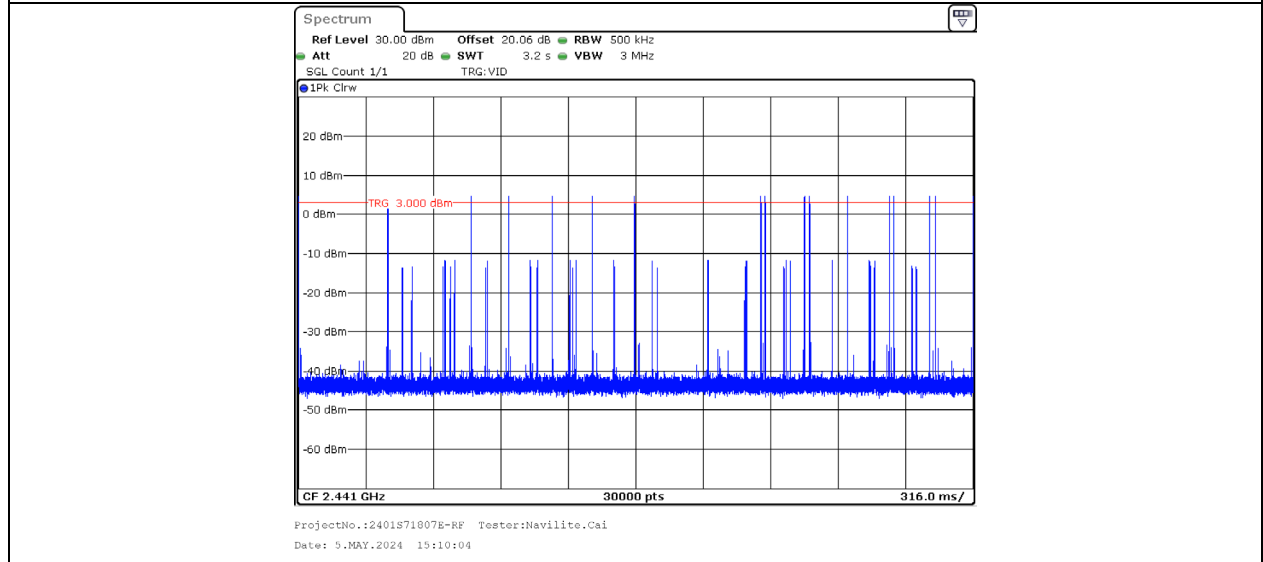
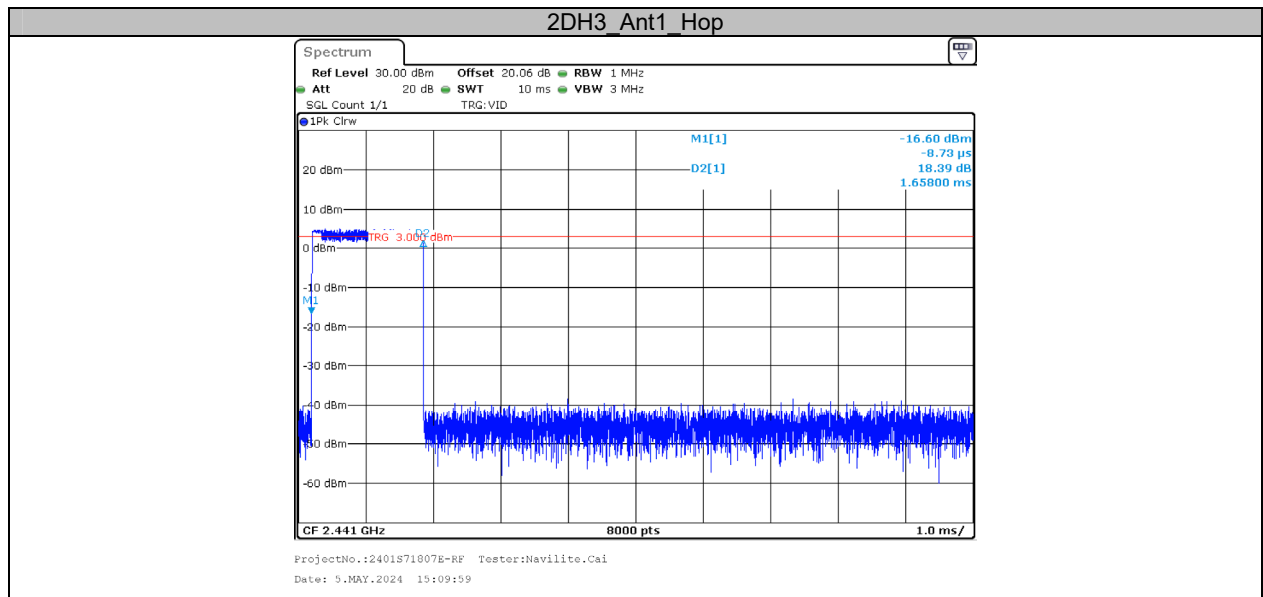


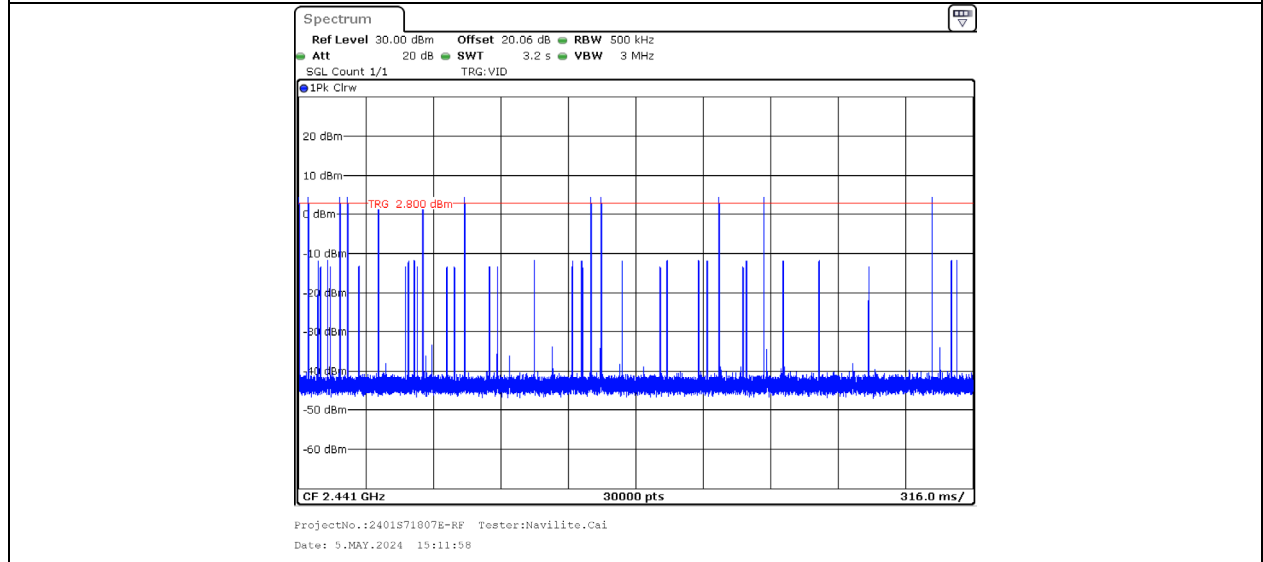
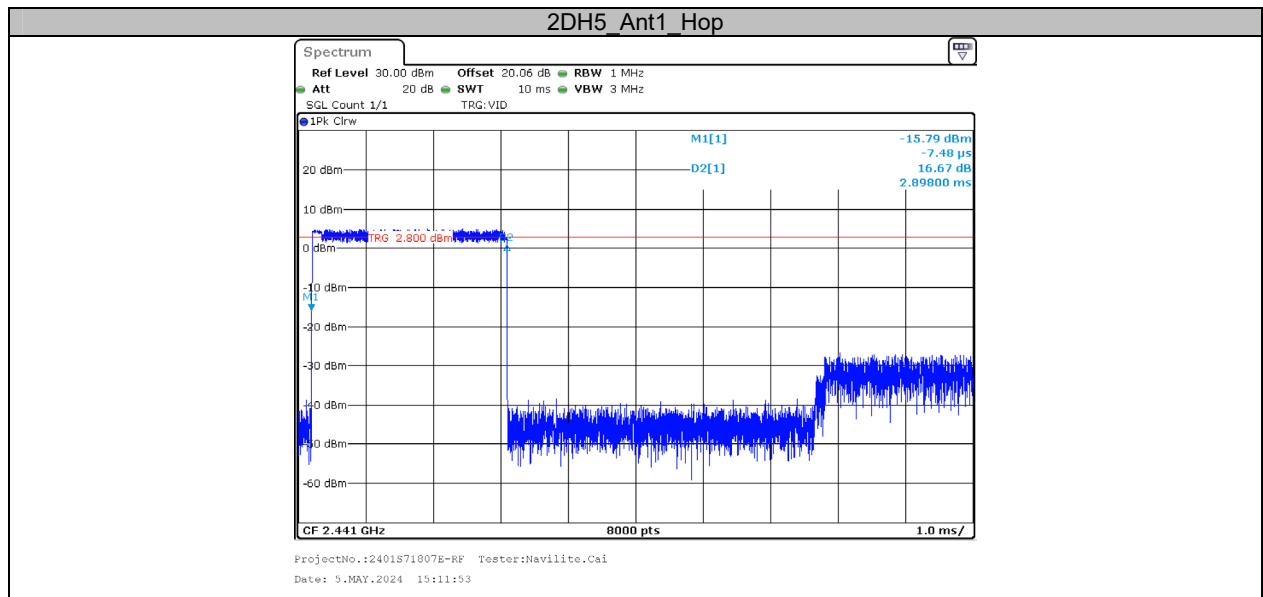


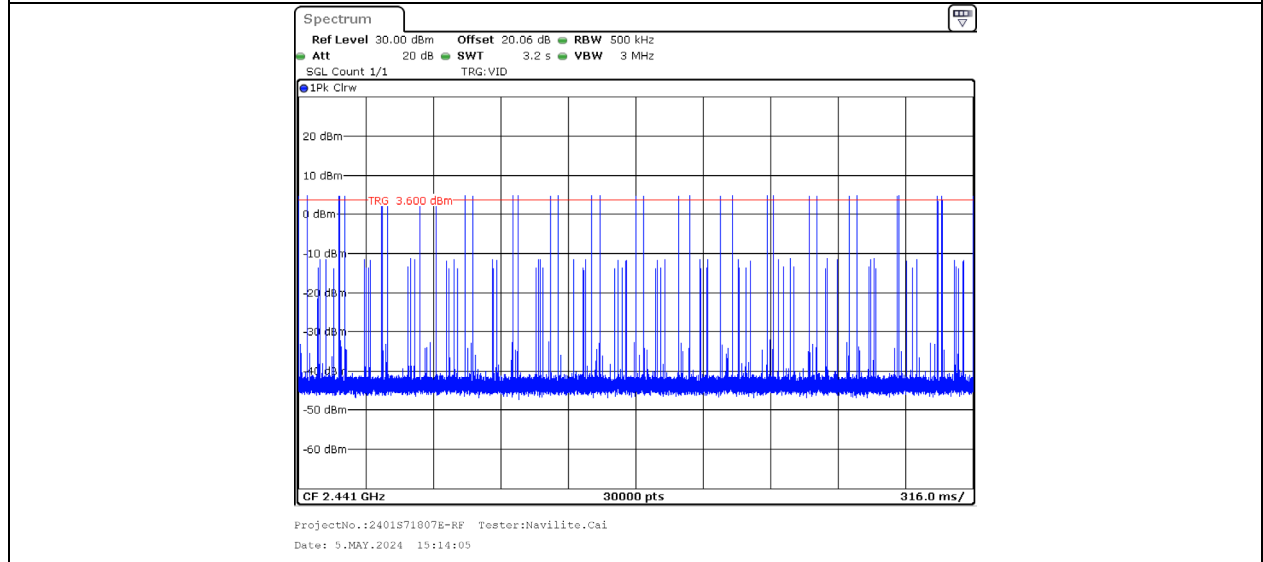
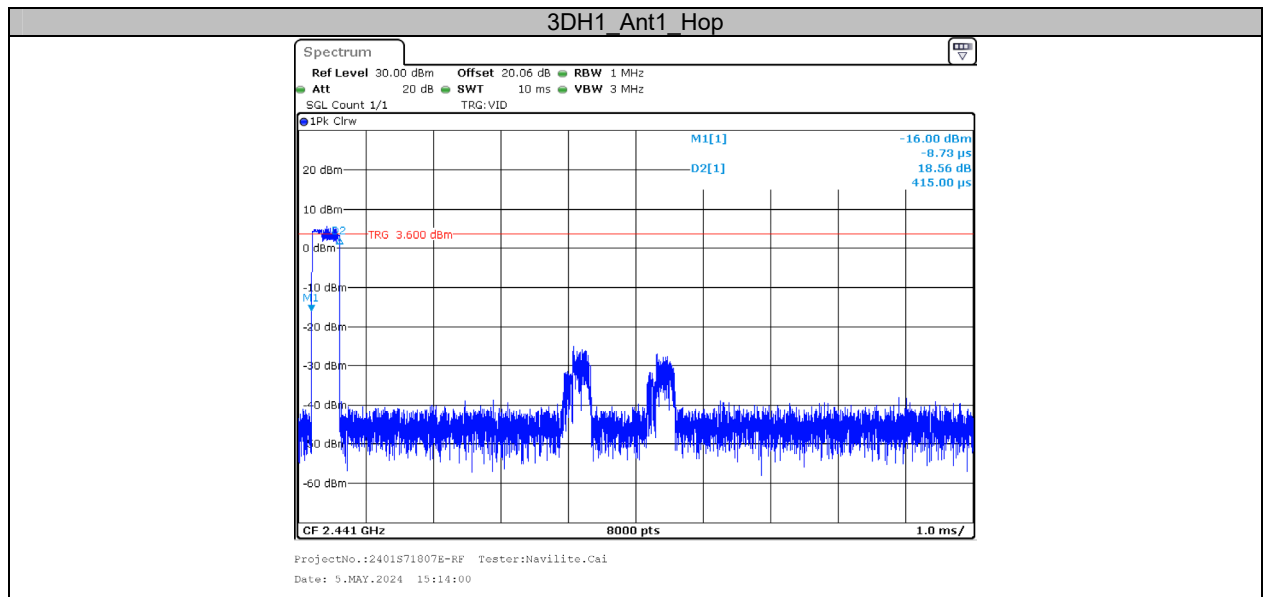


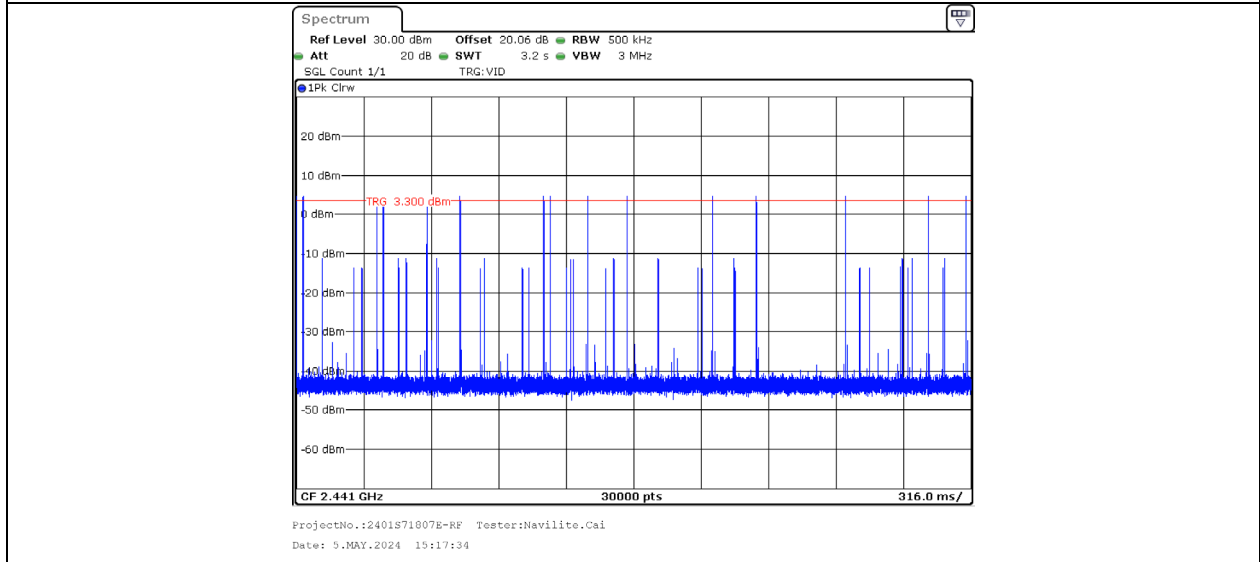
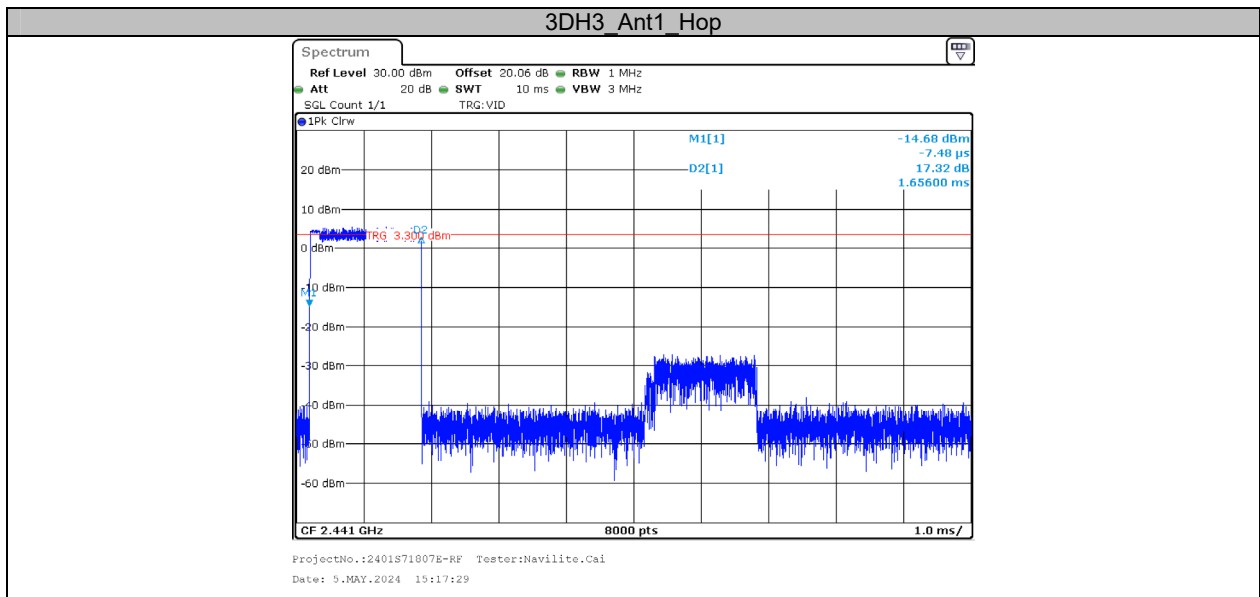


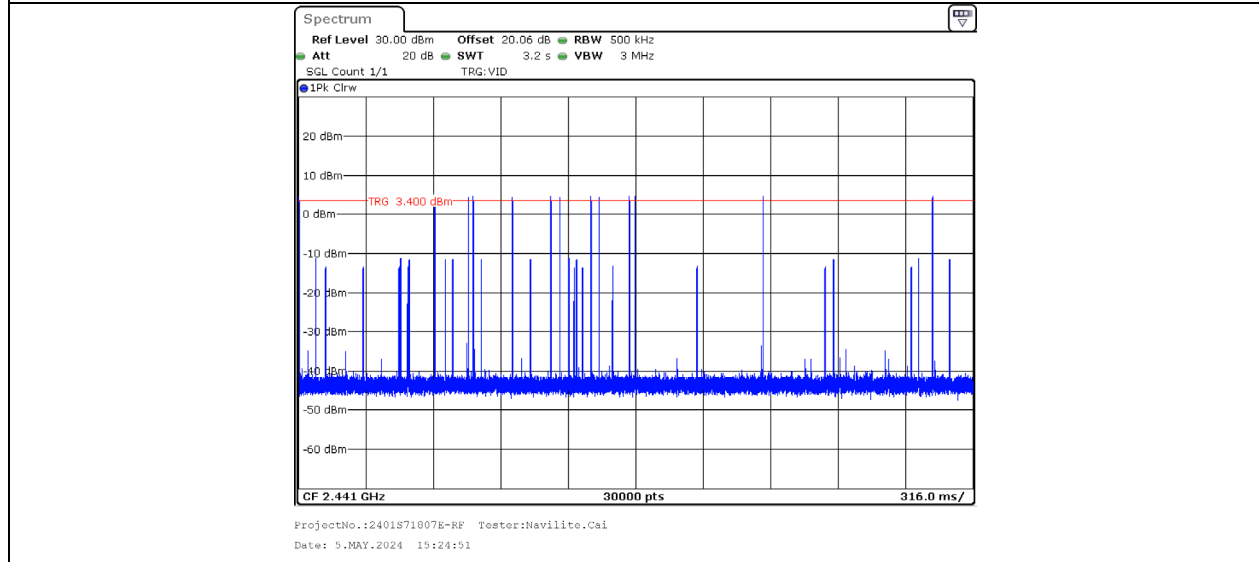
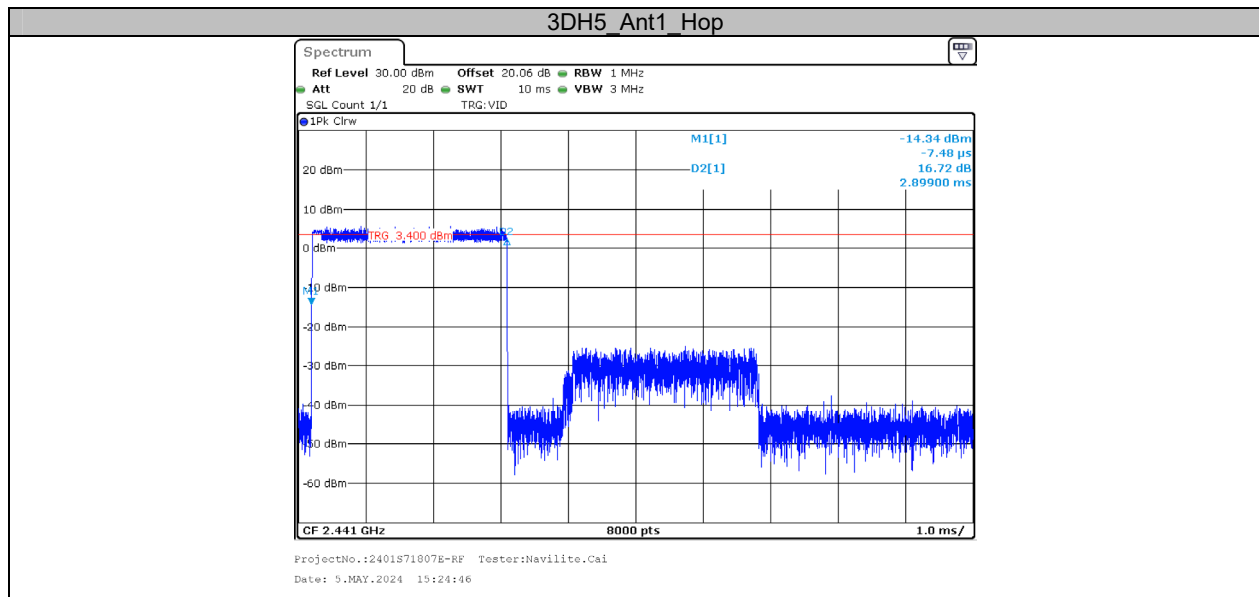










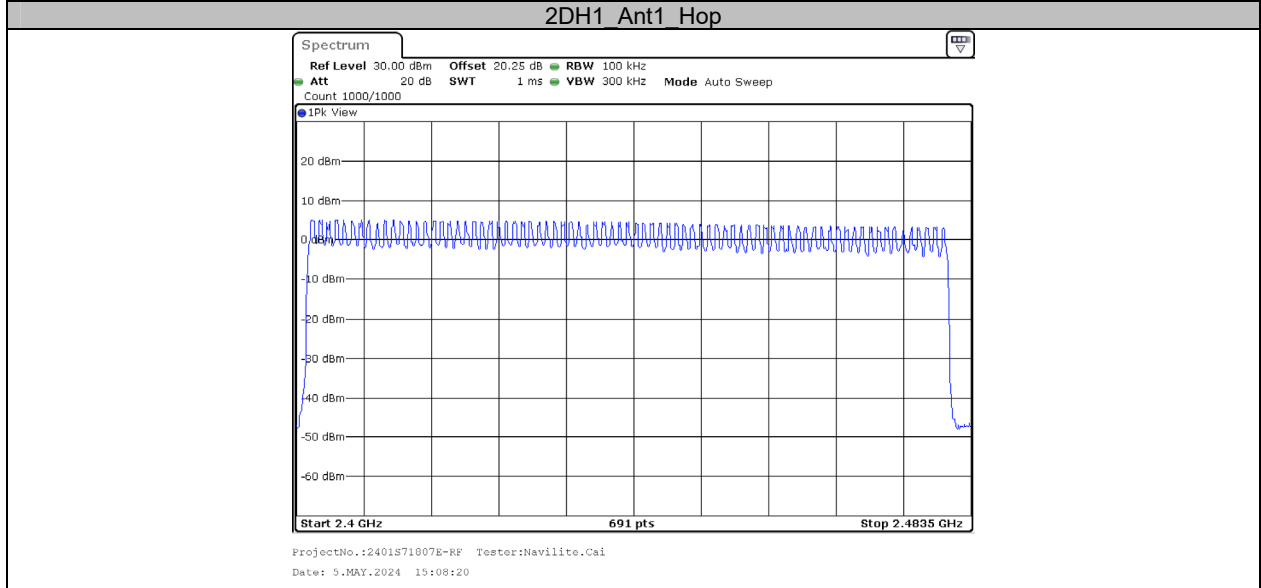
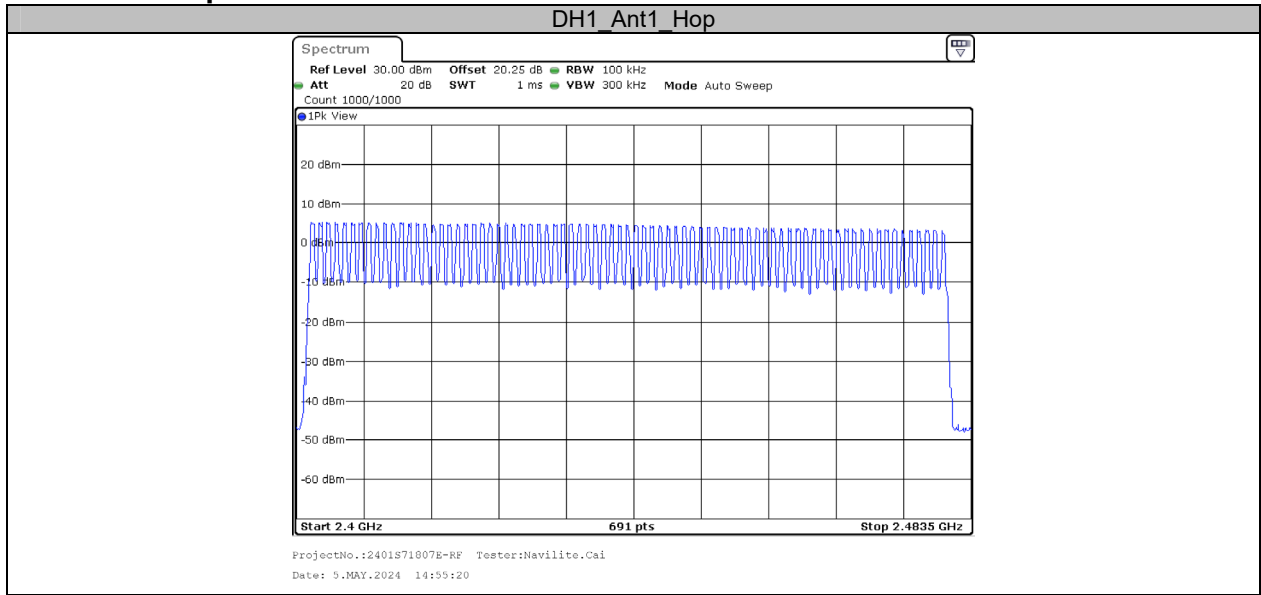


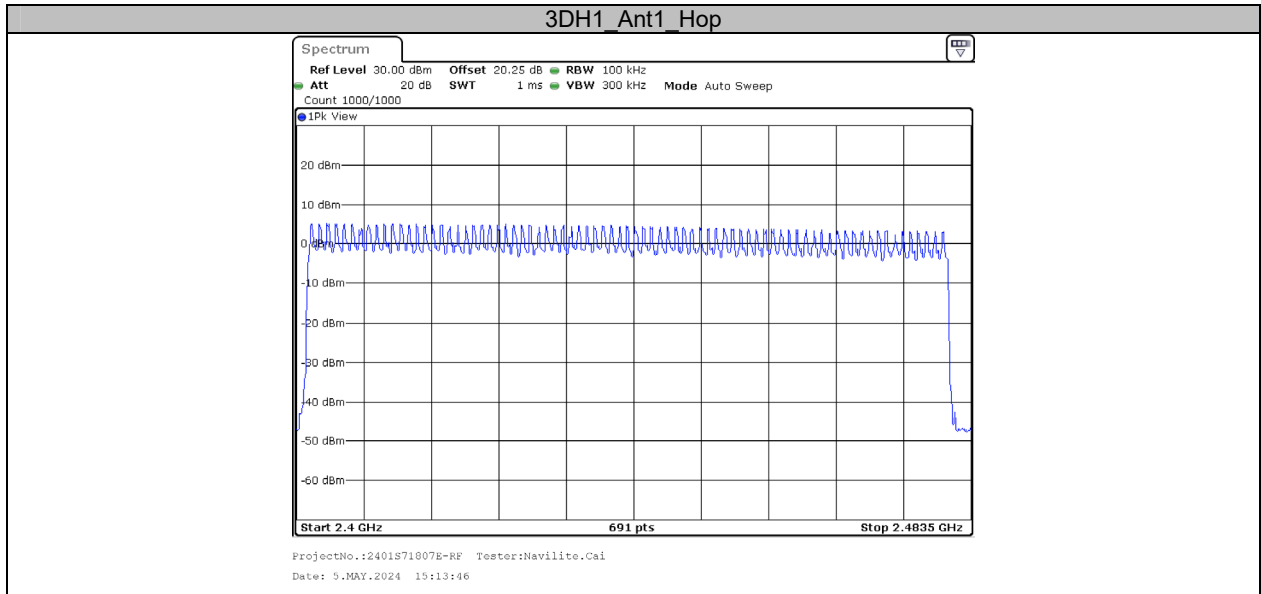
### Appendix F: Number of Hopping Channels

#### Test Result

Test Mode	Antenna	Frequency[MHz]	Result[Num]	Limit[Num]	Verdict
DH1	Ant1	Hop	79	≥15	PASS
2DH1	Ant1	Hop	79	≥15	PASS
3DH1	Ant1	Hop	79	≥15	PASS

#### Test Graphs

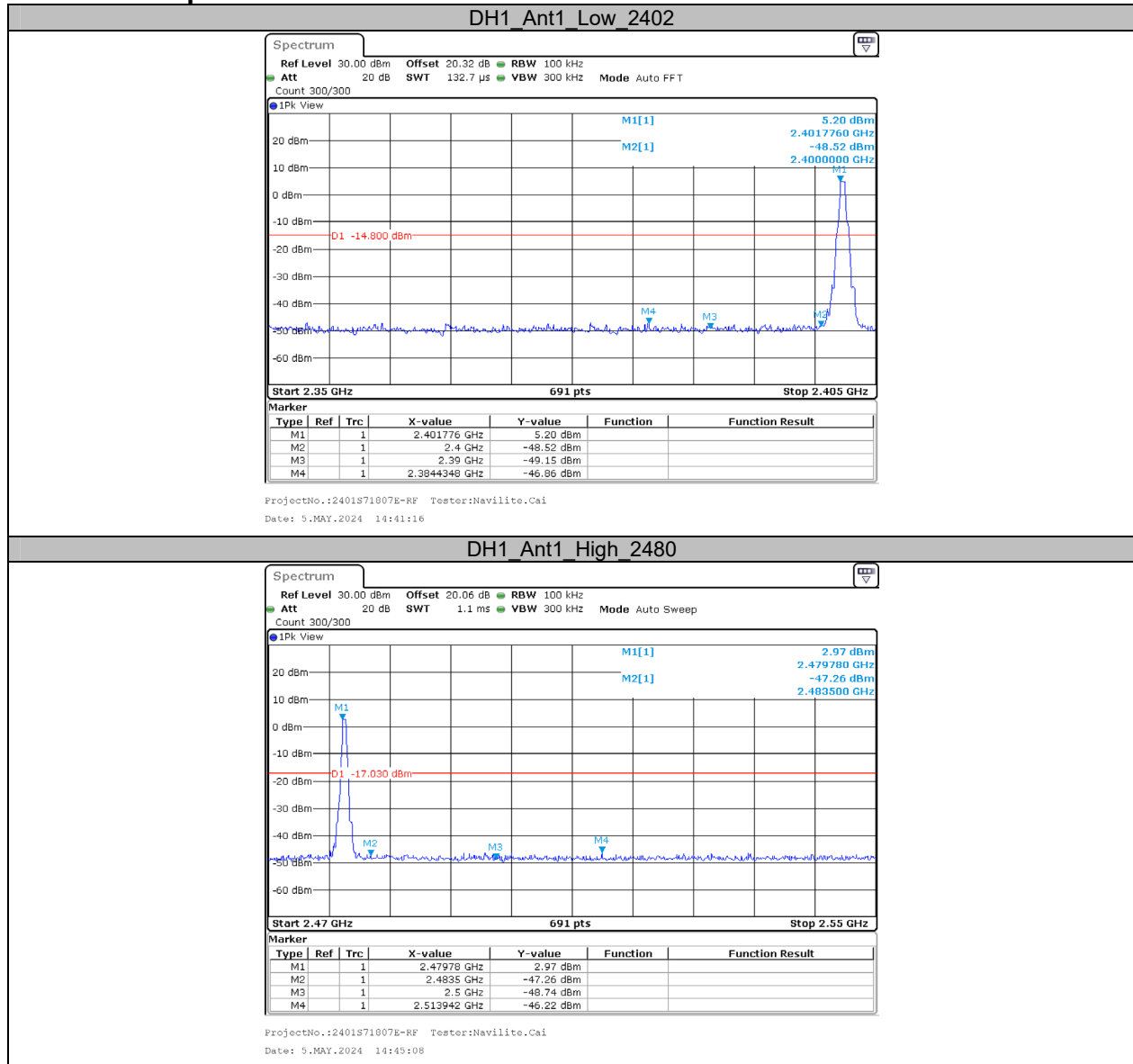




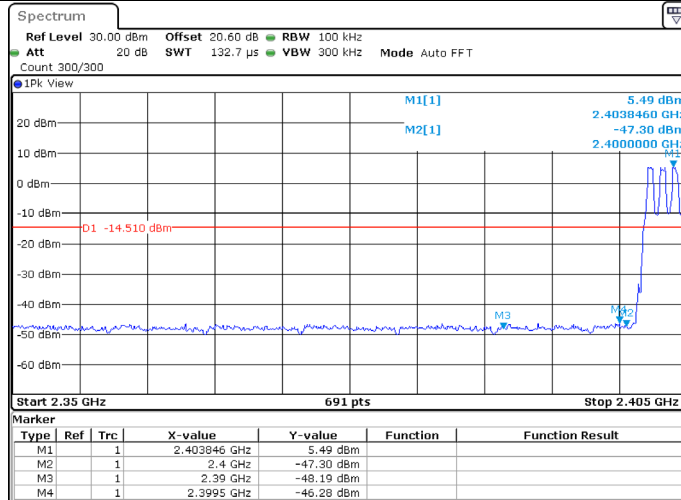


### Appendix G: Band Edge Measurements

#### Test Graphs

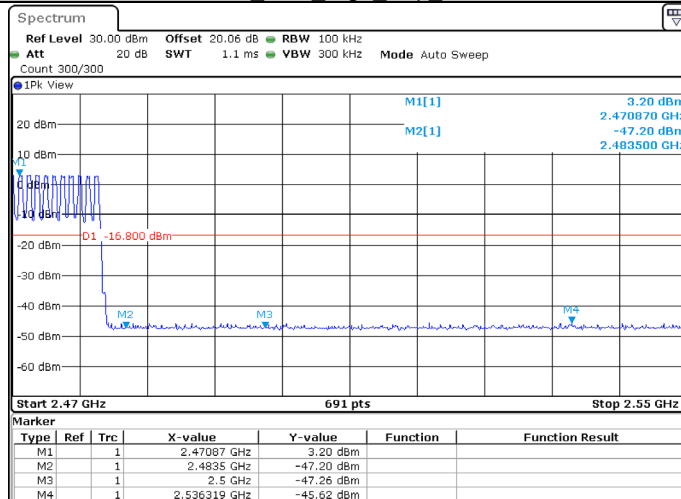


DH1 Ant1 Low Hop 2402



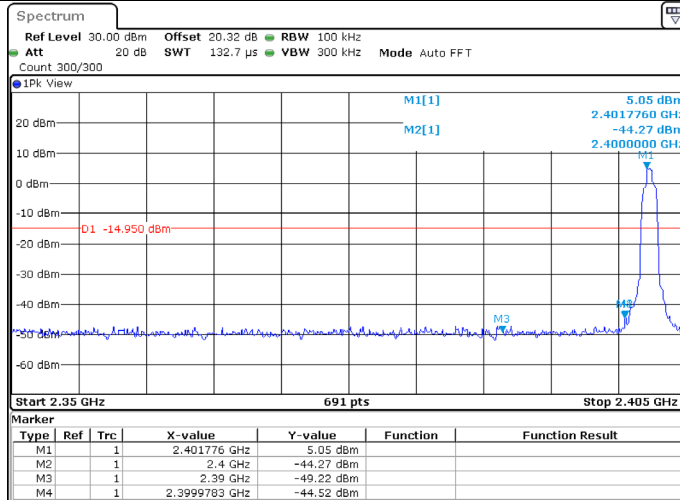
ProjectNo.:2401S71807E-RF Tester:Navilite.Cai  
 Date: 5.MAY.2024 14:54:09

DH1 Ant1 High Hop 2480



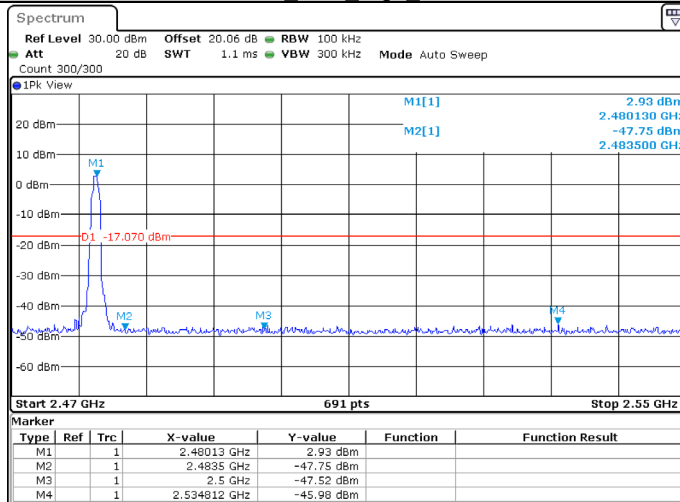
ProjectNo.:2401S71807E-RF Tester:Navilite.Cai  
 Date: 5.MAY.2024 14:57:30

2DH1\_Ant1\_Low\_2402



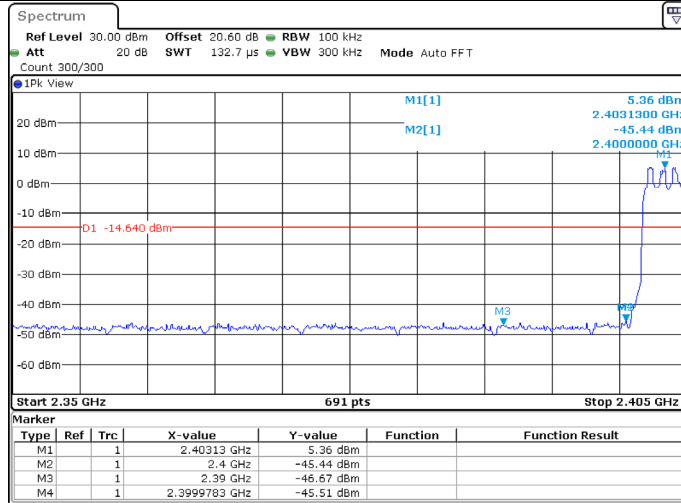
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 Date: 5.MAY.2024 14:46:18

2DH1\_Ant1\_High\_2480



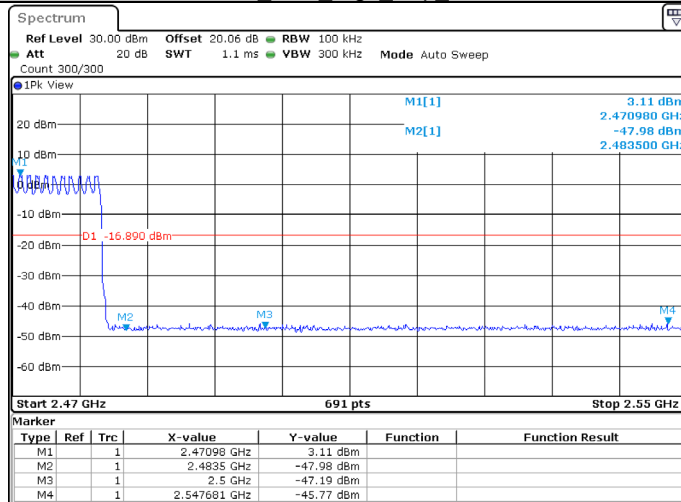
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2DH1\_Ant1\_Low\_Hop\_2402



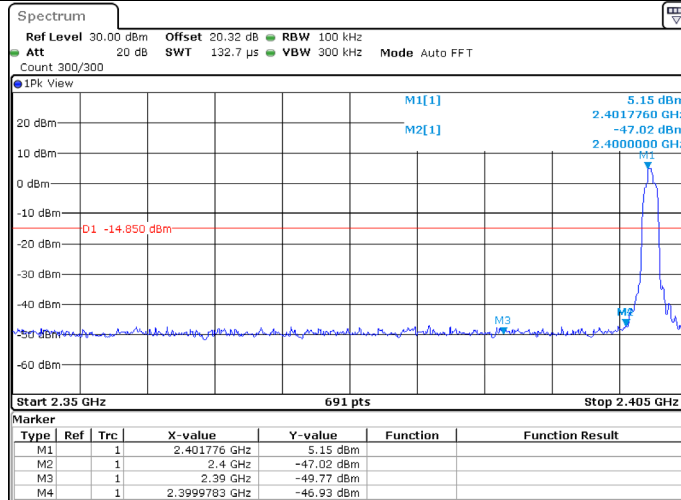
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 Date: 5.MAY.2024 15:07:10

2DH1\_Ant1\_High\_Hop\_2480



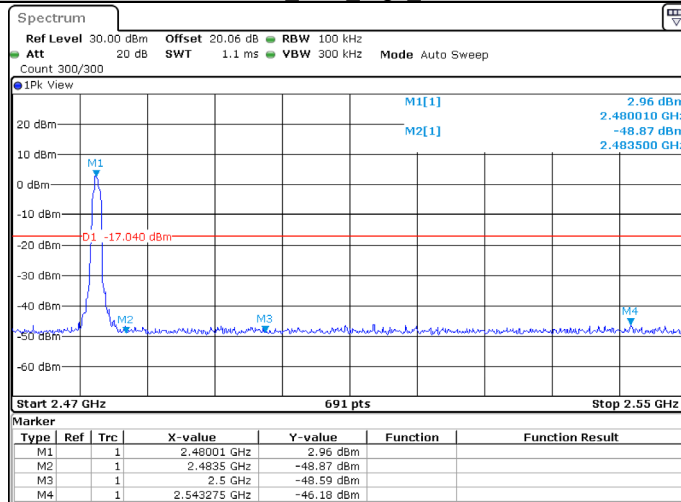
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 Date: 5.MAY.2024 15:09:16

3DH1\_Ant1\_Low\_2402

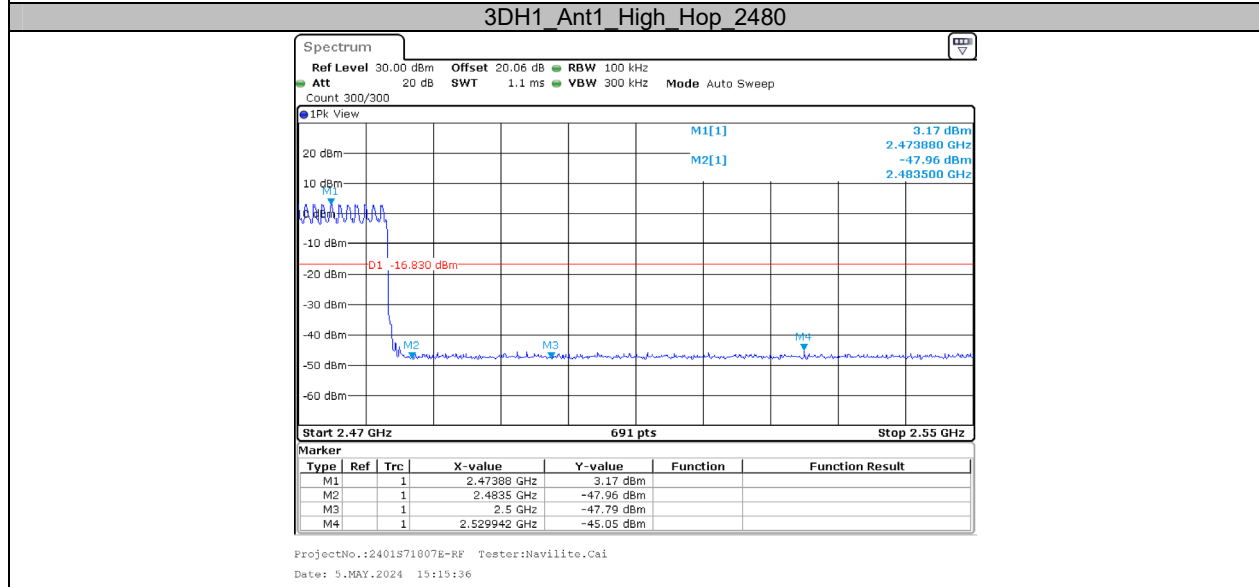
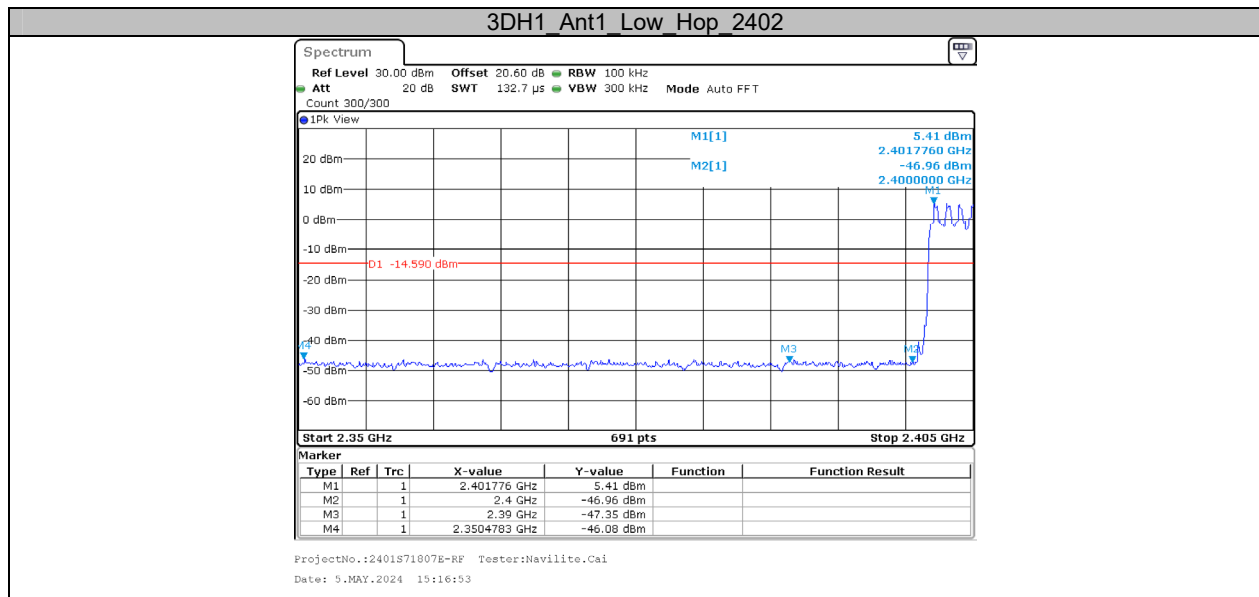


ProjectNo.:2401S71807E-RF Tester:Navilite.Cai  
 Date: 5.MAY.2024 14:49:27

3DH1\_Ant1\_High\_2480



ProjectNo.:2401S71807E-RF Tester:Navilite.Cai  
 Date: 5.MAY.2024 14:51:35



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