

TEST REPORT

Applicant Name: Bytech NY Inc.
Address: 2585 West 13th Street, Brooklyn NY 11223.USA
Report Number: 2401S71806E-RF-00
FCC ID: 2AHN6-AUBE175

Test Standard (s)

FCC PART 15.247

Sample Description

Product Type: BE Dual Driver Earbuds
Model No.: BY-AU-BE-175-AC
Multiple Model(s) No.: N/A
Trade Mark: **BYTECH**
Date Received: 2024/04/26
Issue Date: 2024/05/14

Test Result:	Pass▲
--------------	-------

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

Prepared and Checked By:

Jojo. Guo

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.

This report cannot be reproduced except in full, without prior written approval of the Company. Unless otherwise stated the results shown in this test report refer only to the sample(s) tested. This report is valid only with a valid digital signature. The digital signature may be available only under the Adobe software above version 7.0.

This report must not be used by the customer to claim product certification, approval, or endorsement by NVLAP or any agency of the U.S. Government.

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

Bay Area Compliance Laboratories Corp. (Shenzhen)

5F(B-West), 6F, 7F, the 3rd Phase of Wan Li Industrial Building D, Shihua Rd, FuTian Free Trade Zone, Shenzhen, China

Tel: +86-755-33320018 Fax: +86-755-33320008 www.baclcorp.com.cn

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	7
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) (1) & §2.1093 - RF EXPOSURE	11
APPLICABLE STANDARD	11
MEASUREMENT RESULT	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	15
FACTOR & OVER LIMIT/MARGIN CALCULATION	15
TEST DATA	15
FCC §15.247(A) (1) - CHANNEL SEPARATION TEST	31
APPLICABLE STANDARD	31
TEST PROCEDURE	31
TEST DATA	31
FCC §15.247(A) (1) - 20 DB EMISSION BANDWIDTH	32
APPLICABLE STANDARD	32
TEST PROCEDURE	32
TEST DATA	32
FCC §15.247(A) (1) (III) - QUANTITY OF HOPPING CHANNEL TEST	33
APPLICABLE STANDARD	33
TEST PROCEDURE	33
TEST DATA	33

FCC §15.247(A) (1) (III) - TIME OF OCCUPANCY (DWELL TIME).....	34
APPLICABLE STANDARD	34
TEST PROCEDURE	34
TEST DATA	34
FCC §15.247(B) (1) - PEAK OUTPUT POWER MEASUREMENT	35
APPLICABLE STANDARD	35
TEST PROCEDURE	35
TEST DATA	35
FCC §15.247(D) § 5.5 - BAND EDGES TESTING.....	36
APPLICABLE STANDARD	36
TEST PROCEDURE	36
TEST DATA	36
EUT PHOTOGRAPHS.....	37
TEST SETUP PHOTOGRAPHS	38
APPENDIX	39
APPENDIX A: 20dB EMISSION BANDWIDTH.....	39
APPENDIX B: OCCUPIED CHANNEL BANDWIDTH	45
APPENDIX C: MAXIMUM CONDUCTED OUTPUT POWER	51
APPENDIX D: CARRIER FREQUENCY SEPARATION	57
APPENDIX E: TIME OF OCCUPANCY	59
APPENDIX F: NUMBER OF HOPPING CHANNELS	69
APPENDIX G: BAND EDGE MEASUREMENTS	71

DOCUMENT REVISION HISTORY

Revision Number	Report Number	Description of Revision	Date of Revision
0	2401S71806E-RF-00	Original Report	2024/05/14

GENERAL INFORMATION

Product Description for Equipment under Test (EUT)

Product	BE Dual Driver Earbuds
Tested Model	BY-AU-BE-175-AC
Multiple Model(s)	N/A
UPC number	805112128938, 805112128945
SKU number	9150696
Lot number	BY062024
Frequency Range	Bluetooth: 2402~2480MHz
Transmit Peak Power	1.94dBm
Modulation Technique	Bluetooth: GFSK, $\pi/4$ -DQPSK, 8DPSK
Antenna Specification [#]	2.67dBi (provided by the applicant)
Voltage Range	DC 3.7V from battery
Sample serial number	2KJK-3(Assigned by BACL, 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”[#] 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

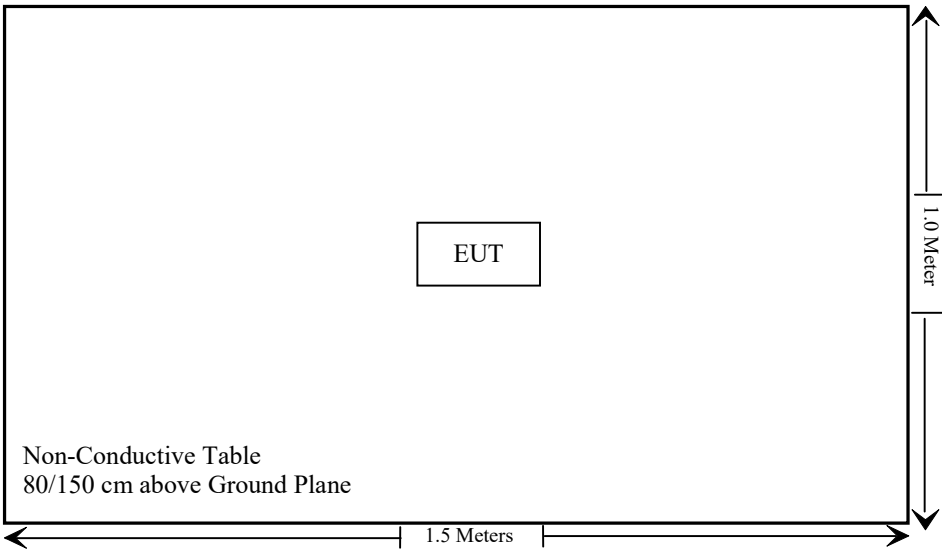
Manufacturer	Description	Model	Serial Number
/	/	/	/

External I/O Cable

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

Block Diagram of Test Setup

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	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
Radiated Emission Test					
R&S	EMI Test Receiver	ESR3	102455	2024/01/16	2025/01/15
Sonoma instrument	Pre-amplifier	310 N	186238	2023/06/08	2024/06/07
Sunol Sciences	Broadband Antenna	JB1	A040904-1	2023/07/20	2026/07/19
BACL	Active Loop Antenna	1313-1A	4031911	2024/03/21	2025/03/20
Unknown	Cable	Chamber Cable 1	F-03-EM236	2023/08/03	2024/08/02
Unknown	Cable	Chamber Cable 4	EC-007	2023/08/03	2024/08/02
Audix	EMI Test software	E3	19821b(V9)	NCR	NCR
Rohde & Schwarz	Spectrum Analyzer	FSV40	101605	2024/03/27	2025/03/26
COM-POWER	Pre-amplifier	PA-122	181919	2023/06/29	2024/06/28
Schwarzbeck	Horn Antenna	BBHA9120D(1201)	1143	2023/07/26	2026/07/25
Unknown	RF Cable	KMSE	0735	2023/10/08	2024/10/07
Unknown	RF Cable	UFA147	219661	2023/10/08	2024/10/07
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
RF Conducted Test					
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:

$[(\text{max. power of channel, including tune-up tolerance, mW})/(\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$ 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
BT	2402-2480	2.0	1.58	5	0.5	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.

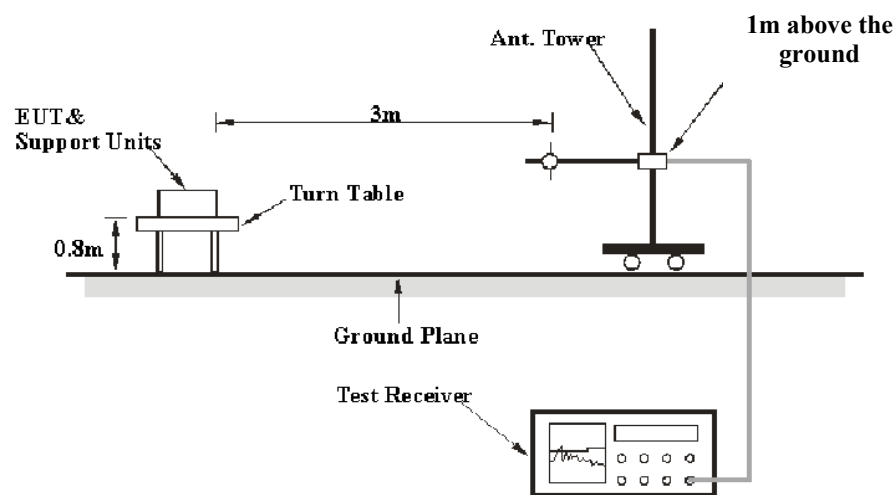
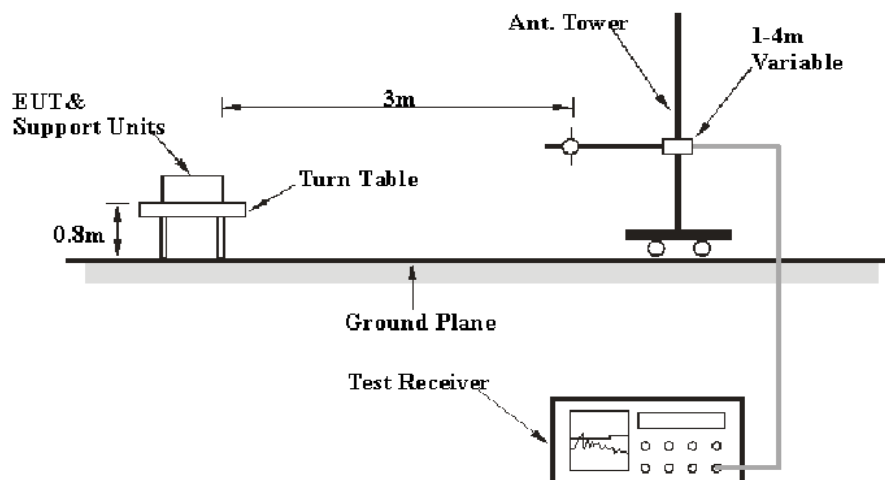
Antenna Connector Construction

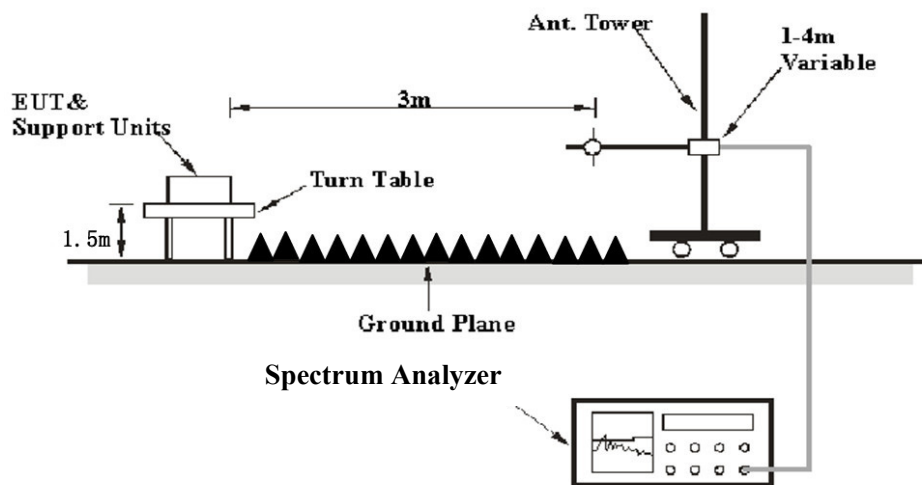
The EUT has one internal antenna arrangement, which was permanently attached, the antenna gain[#] is 2.67dBi, fulfill the requirement of this section. Please refer to the EUT photos.

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= $N_1 \cdot L_1 + N_2 \cdot L_2 + \dots + N_{n-1} \cdot L_{n-1} + N_n \cdot L_n$,

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 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.

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

Temperature:	22~25.3 °C
Relative Humidity:	50~54 %
ATM Pressure:	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.

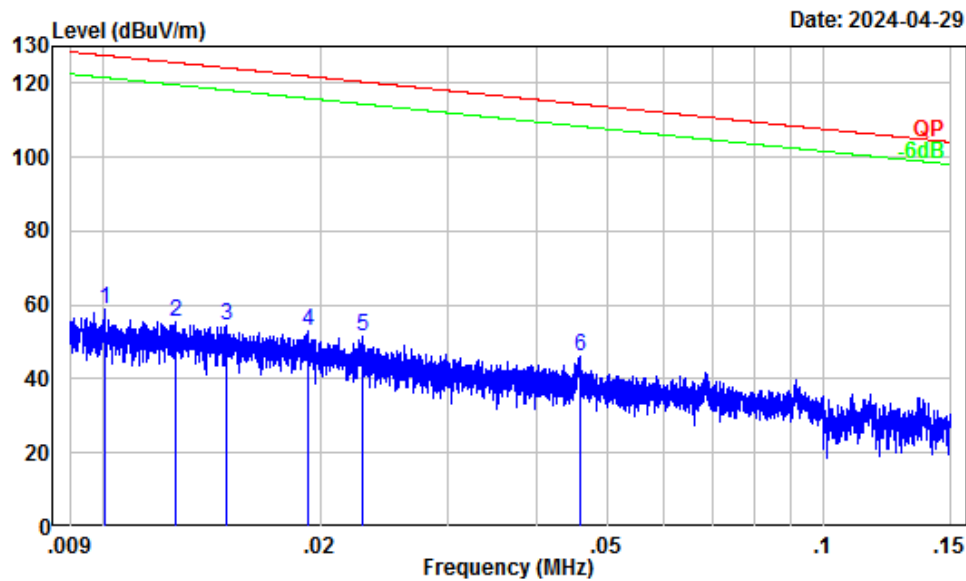
Test mode: Transmitting

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 ($\pi/4$ -DQPSK) Low channel)

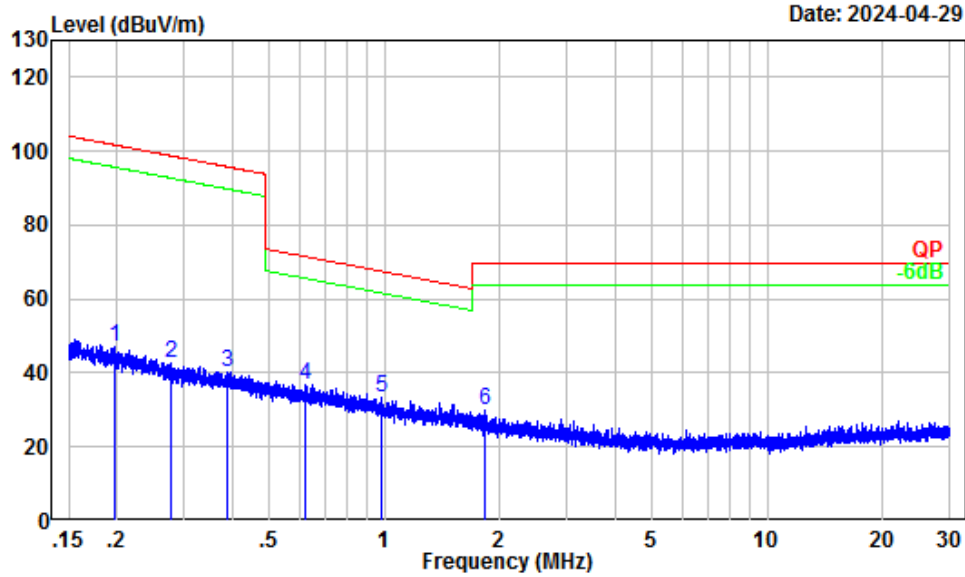
Note: When the test result of peak was less than the limit of QP/Average more than 6dB, just peak value were recorded.

Parallel (worst case)



Site : Chamber A
Condition : 3m
Project Number: 2401S71806E-RF
Note : BT
Tester : Warren Huang

	Freq	Factor	Read		Limit	Over	Remark
			Level	Level	Line	Limit	
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	0.01	37.65	21.23	58.88	127.53	-68.65	Peak
2	0.01	36.36	19.26	55.62	125.60	-69.98	Peak
3	0.01	35.22	19.17	54.39	124.18	-69.79	Peak
4	0.02	32.96	19.81	52.77	121.91	-69.14	Peak
5	0.02	31.10	20.20	51.30	120.41	-69.11	Peak
6	0.05	23.98	22.06	46.04	114.37	-68.33	Peak

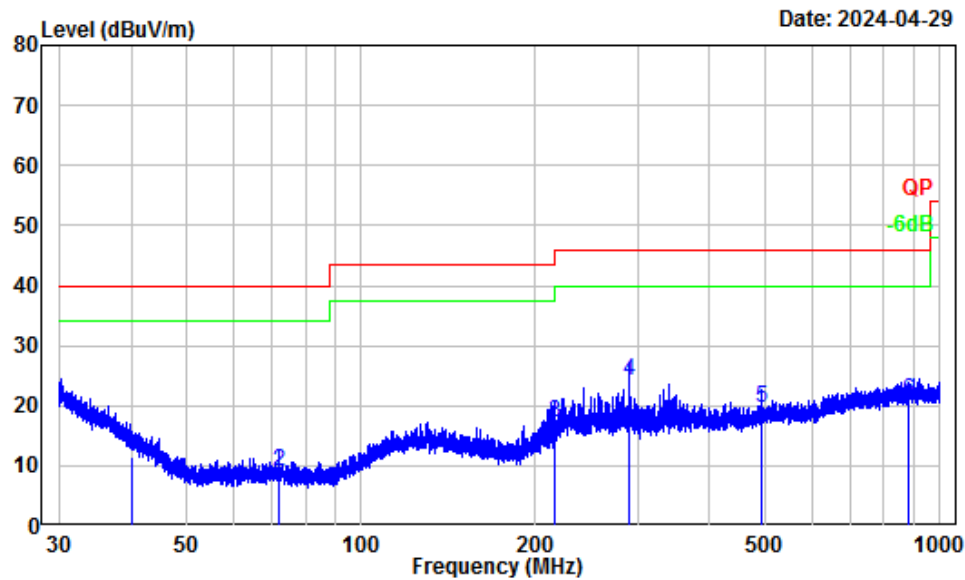


Site : Chamber A
 Condition : 3m
 Project Number: 2401S71806E-RF
 Note : BT
 Tester : Warren Huang

	Freq	Factor	Read Level	Level	Limit Line	Over Limit	Remark
	MHz	dB/m	dBuV	dBuV/m	dBuV/m	dB	
1	0.20	12.46	34.80	47.26	101.65	-54.39	Peak
2	0.28	8.81	33.79	42.60	98.77	-56.17	Peak
3	0.39	5.79	34.55	40.34	95.76	-55.42	Peak
4	0.62	2.03	34.69	36.72	71.70	-34.98	Peak
5	0.98	-1.44	35.00	33.56	67.65	-34.09	Peak
6	1.84	-4.51	34.33	29.82	69.54	-39.72	Peak

30MHz-1GHz: (Maximum output power mode, EDR Mode ($\pi/4$ -DQPSK) Low channel

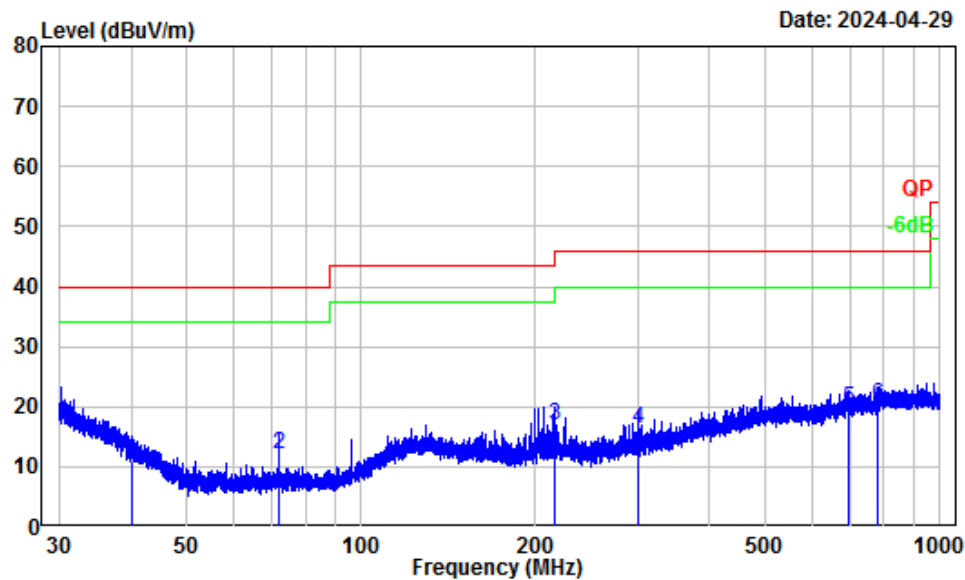
Horizontal



Site : Chamber A
Condition : 3m Horizontal
Project Number: 2401S71806E-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	40.10	-11.58	23.15	11.57	40.00	-28.43 QP
2	72.02	-17.69	26.71	9.02	40.00	-30.98 QP
3	216.02	-13.81	31.15	17.34	46.00	-28.66 QP
4	291.04	-13.09	37.24	24.15	46.00	-21.85 QP
5	490.96	-8.50	28.18	19.68	46.00	-26.32 QP
6	884.89	-4.55	25.46	20.91	46.00	-25.09 QP

Vertical



Site : Chamber A
Condition : 3m Vertical
Project Number: 2401S71806E-RF
Note : BT
Tester : Warren Huang

	Freq Factor		Read Level	Limit	Over	Remark
	MHz	dB/m	dBuV	Line	Limit	
1	40.10	-13.08	24.01	40.00	-29.07	QP
2	71.99	-18.67	30.83	40.00	-27.84	QP
3	216.12	-14.75	31.57	46.00	-29.18	QP
4	301.95	-13.15	29.53	46.00	-29.62	QP
5	696.25	-6.62	26.29	46.00	-26.33	QP
6	779.27	-5.67	25.94	46.00	-25.73	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					
Maximum output power mode, π/4-DQPSK							
Low Channel 2402MHz							
2383.34	55.27	PK	H	-2.93	52.34	74	-21.66
2383.57	55.61	PK	V	-2.93	52.68	74	-21.32
4804.00	67.61	PK	H	2.42	70.03	74	-3.97
4804.00	66.34	PK	V	2.42	68.76	74	-5.24
Middle Channel 2441MHz							
4882.00	68.01	PK	H	2.58	70.59	74	-3.41
4882.00	67.32	PK	V	2.58	69.90	74	-4.10
High Channel 2480MHz							
2483.68	59.66	PK	H	-3.17	56.49	74	-17.51
2483.88	55.49	PK	V	-3.17	52.32	74	-21.68
4960.00	67.94	PK	H	2.68	70.62	74	-3.38
4960.00	66.25	PK	V	2.68	68.93	74	-5.07

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.

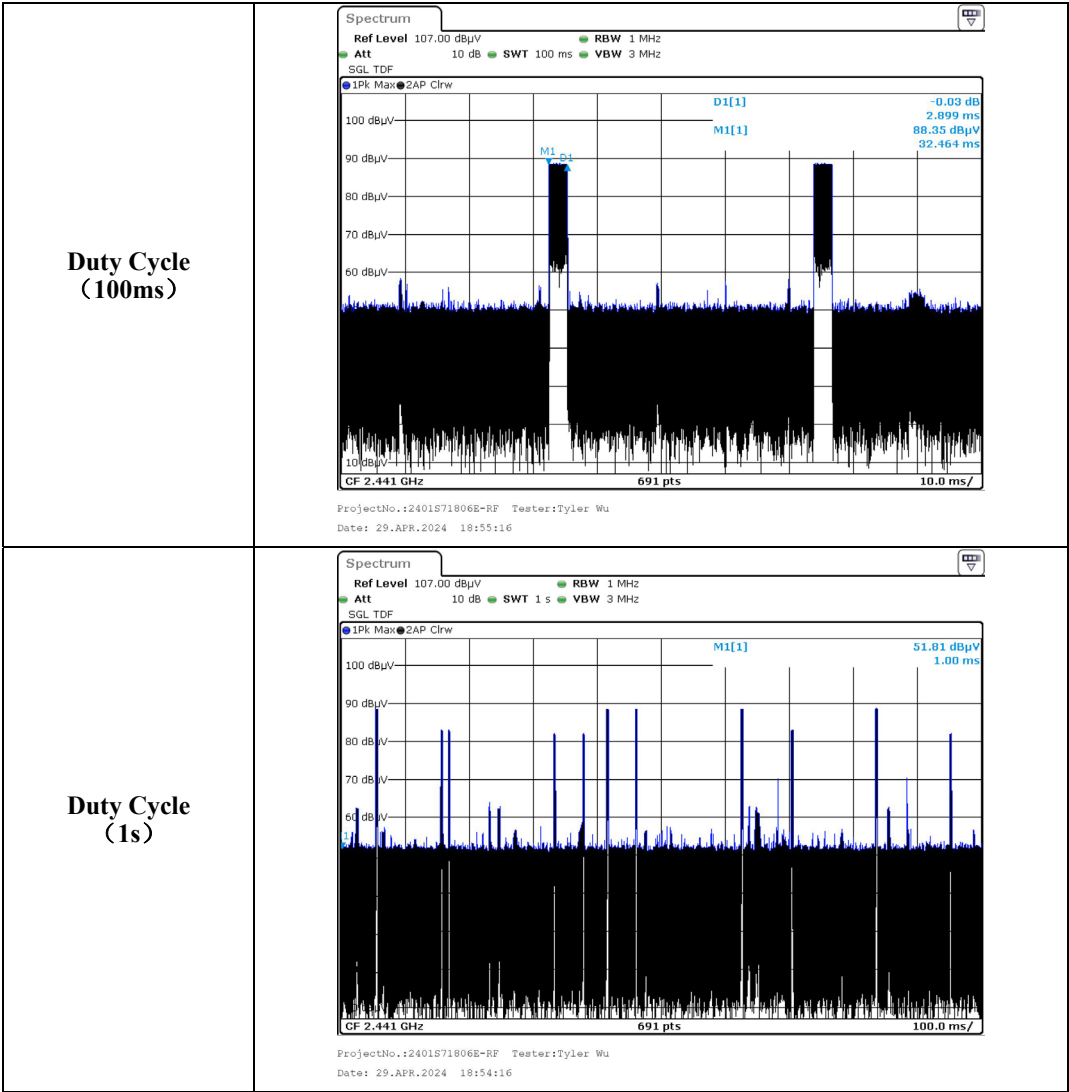
Field Strength of Average							
Frequency (MHz)	Peak Measurement @3m (dBμV/m)	Polar (H/V)	Duty Cycle Corrected Factor (dB)	Average Level (dBμV/m)	FCC Part 15.247		
					Limit (dBμV/m)	Margin (dB)	Comment
Low Channel 2402MHz							
2383.34	52.34	H	-24.73	27.61	54	-26.39	Bandedge
2383.57	52.68	V	-24.73	27.95	54	-26.05	Bandedge
4804.00	70.03	H	-24.73	45.3	54	-8.70	Harmonic
4804.00	68.76	V	-24.73	44.03	54	-9.97	Harmonic
Middle Channel 2441MHz							
4882.00	70.59	H	-24.73	45.86	54	-8.14	Harmonic
4882.00	69.90	V	-24.73	45.17	54	-8.83	Harmonic
High Channel 2480MHz							
2483.68	56.49	H	-24.73	31.76	54	-22.24	Bandedge
2483.88	52.32	V	-24.73	27.59	54	-26.41	Bandedge
4960.00	70.62	H	-24.73	45.89	54	-8.11	Harmonic
4960.00	68.93	V	-24.73	44.2	54	-9.80	Harmonic

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

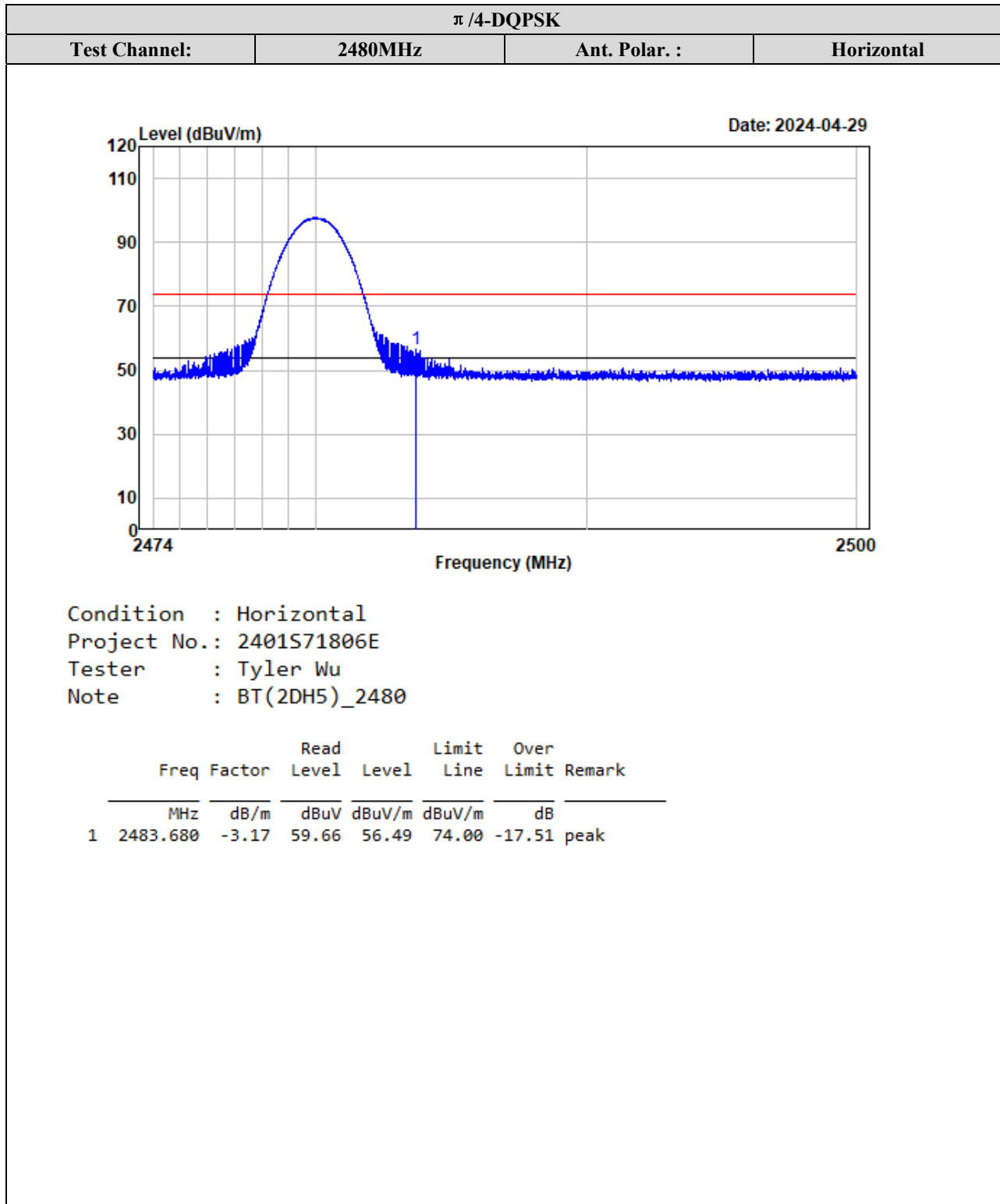
Worst case duty cycle:

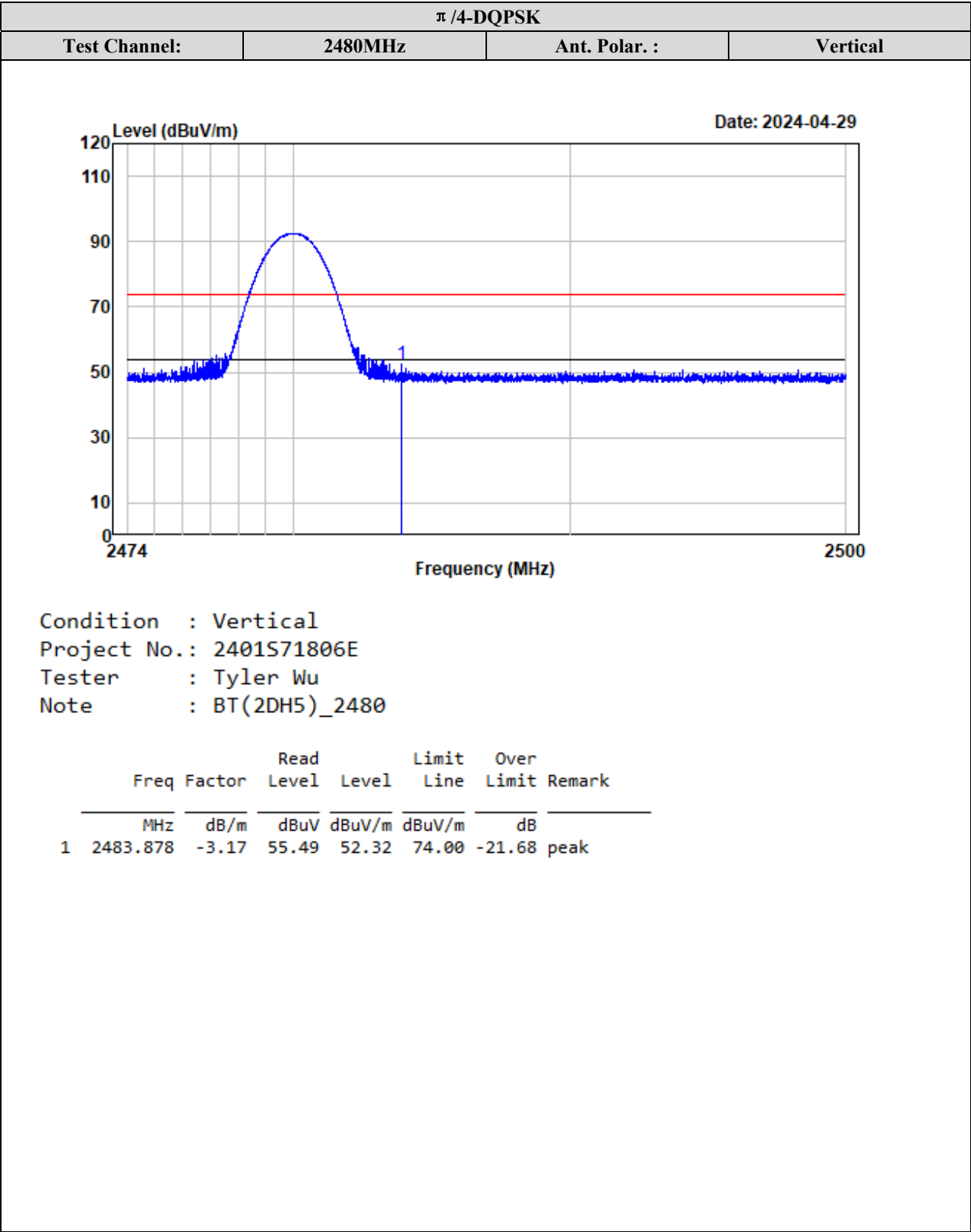
Duty cycle = Ton/100ms = 2.899*2/100=0.05798

Duty Cycle Corrected Factor = 20lg (Duty cycle) = 20lg0.05798 = -24.73

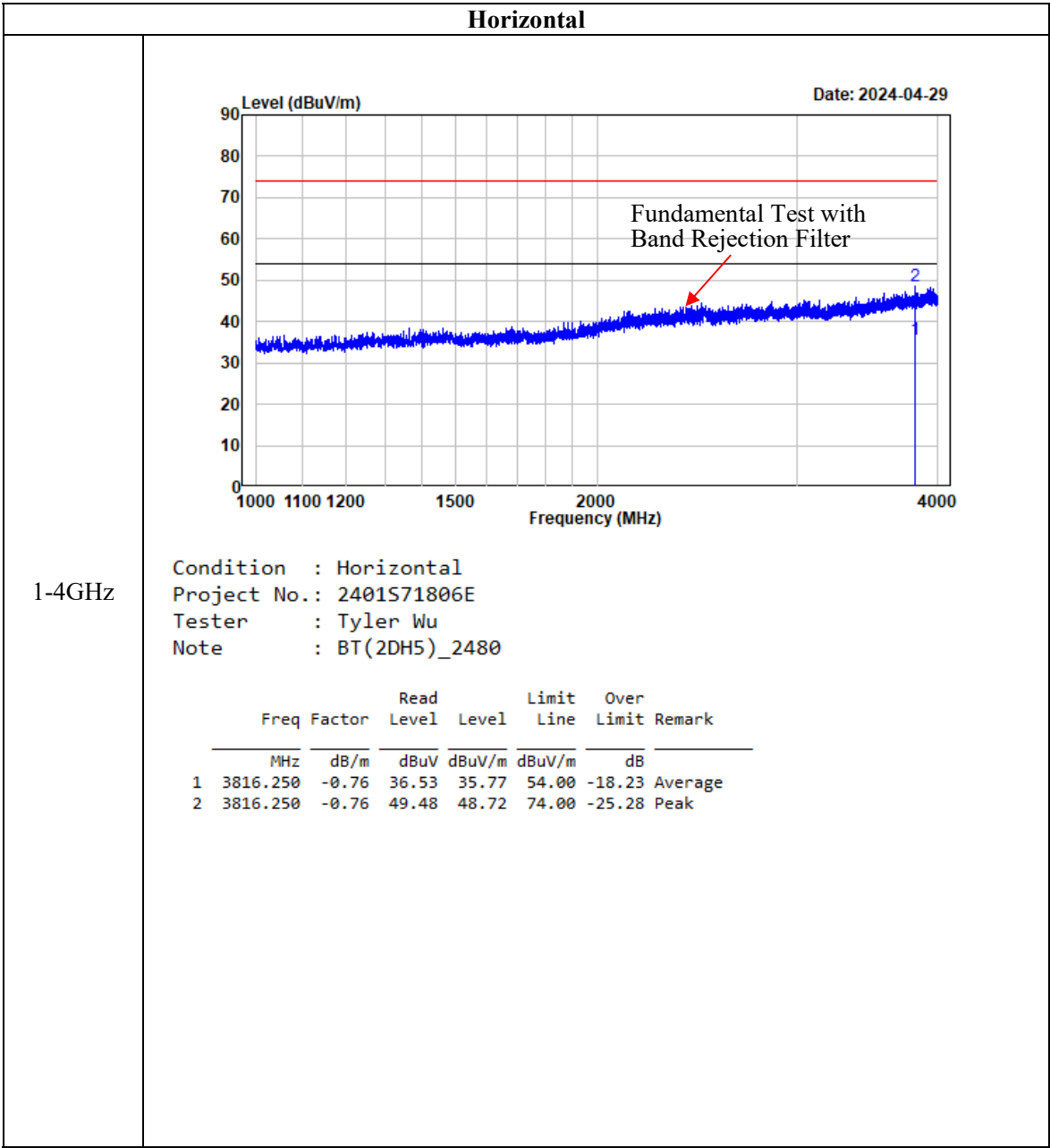


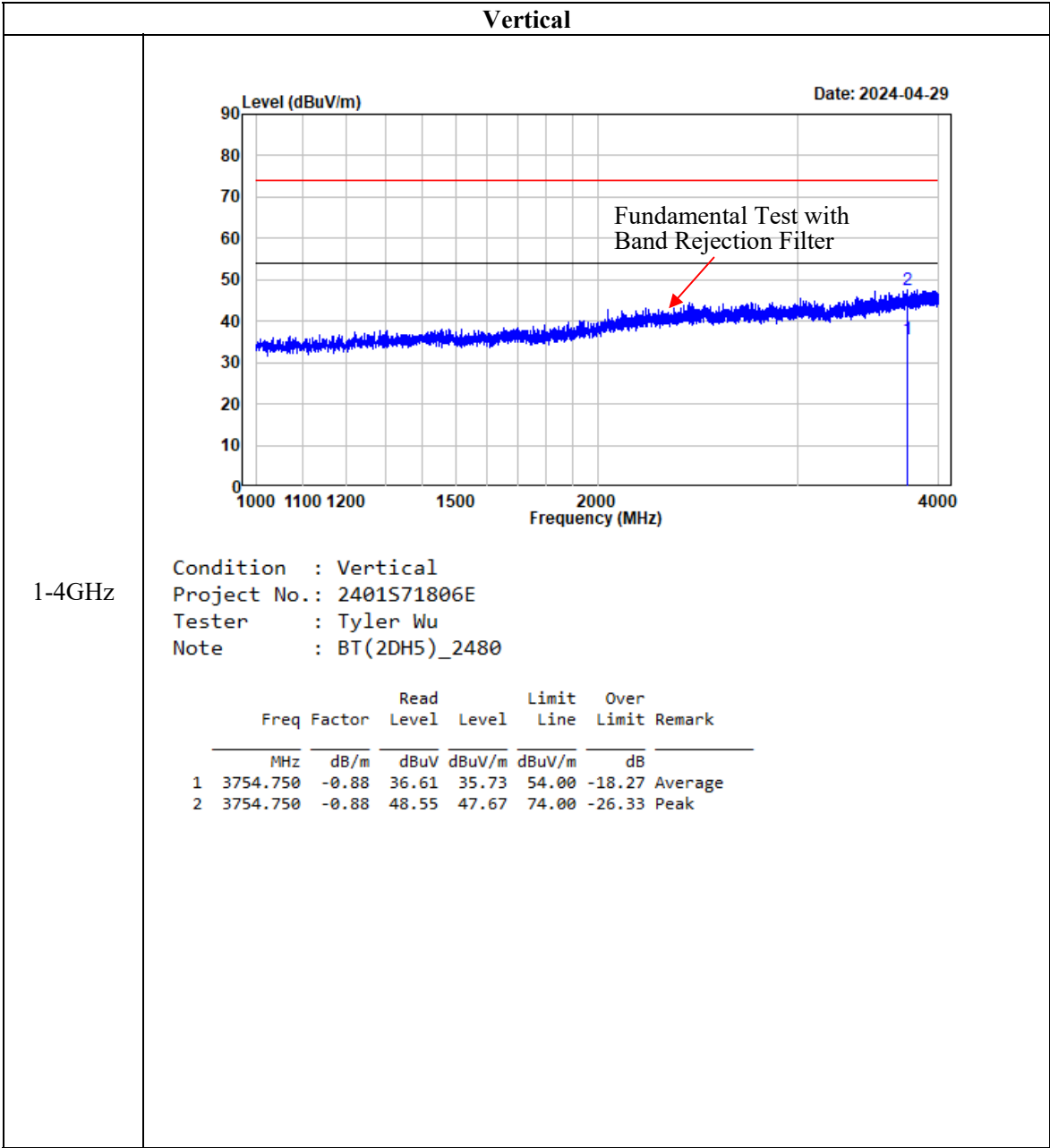
Band Edge Measurements (Radiated):

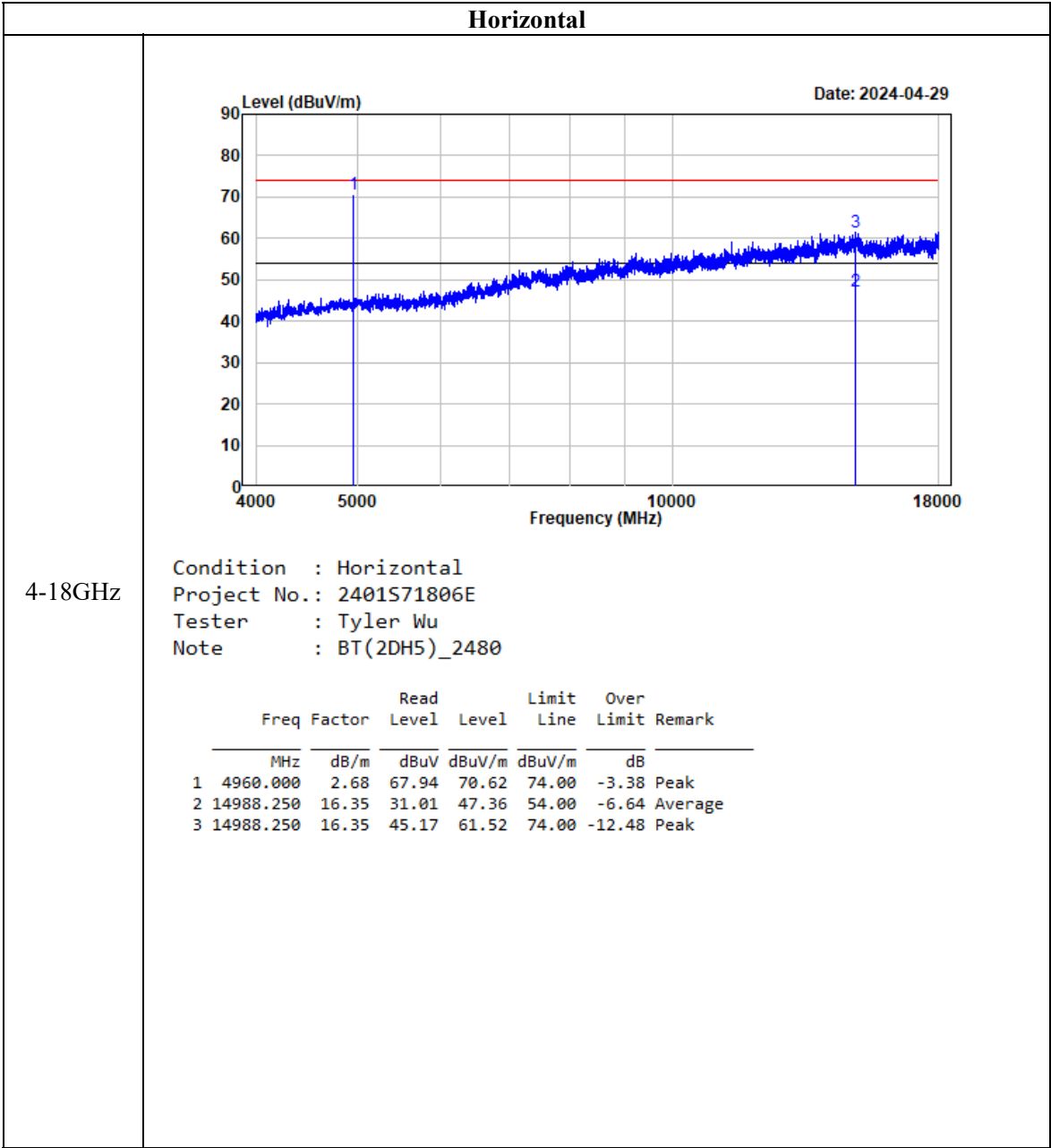


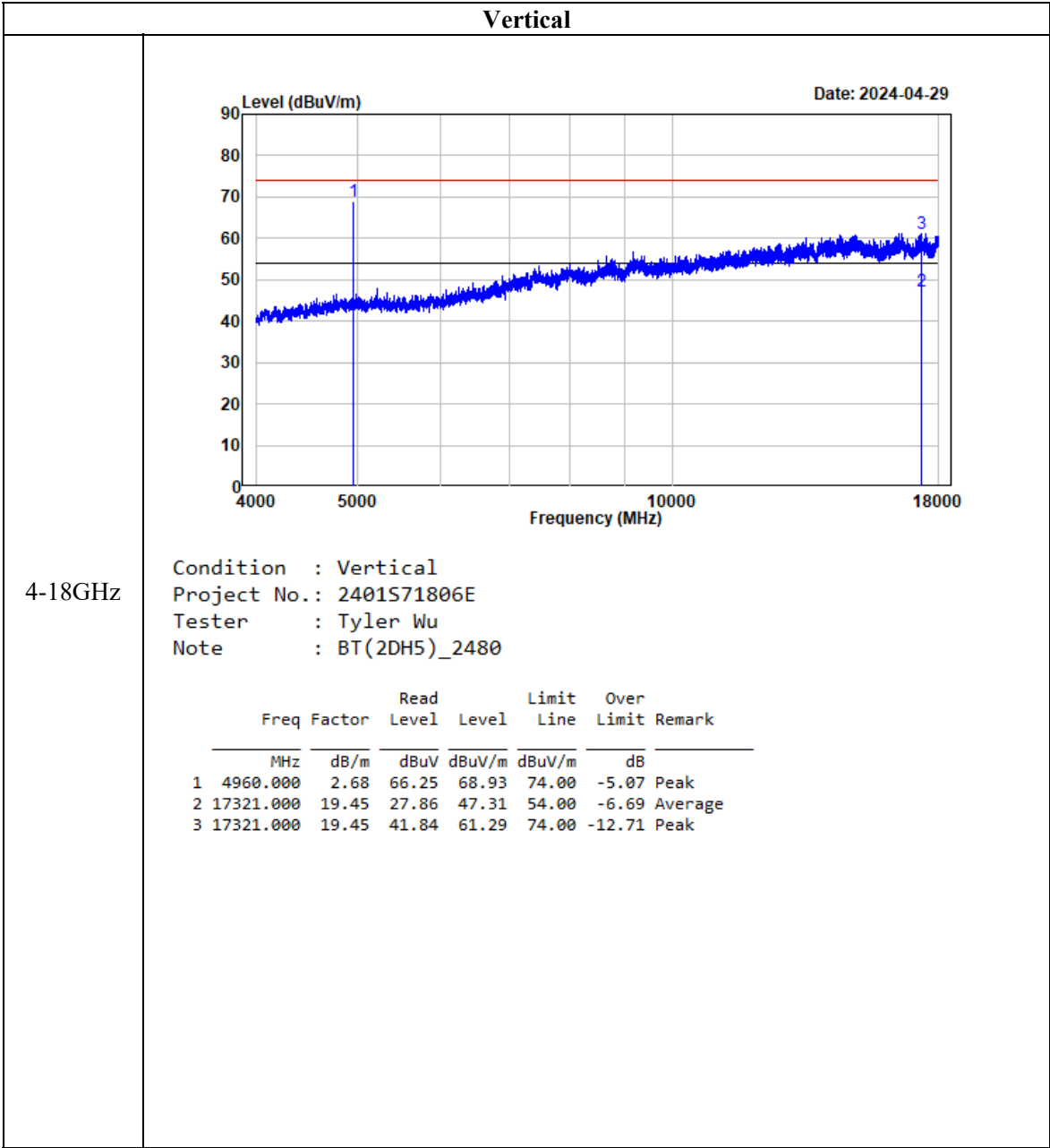


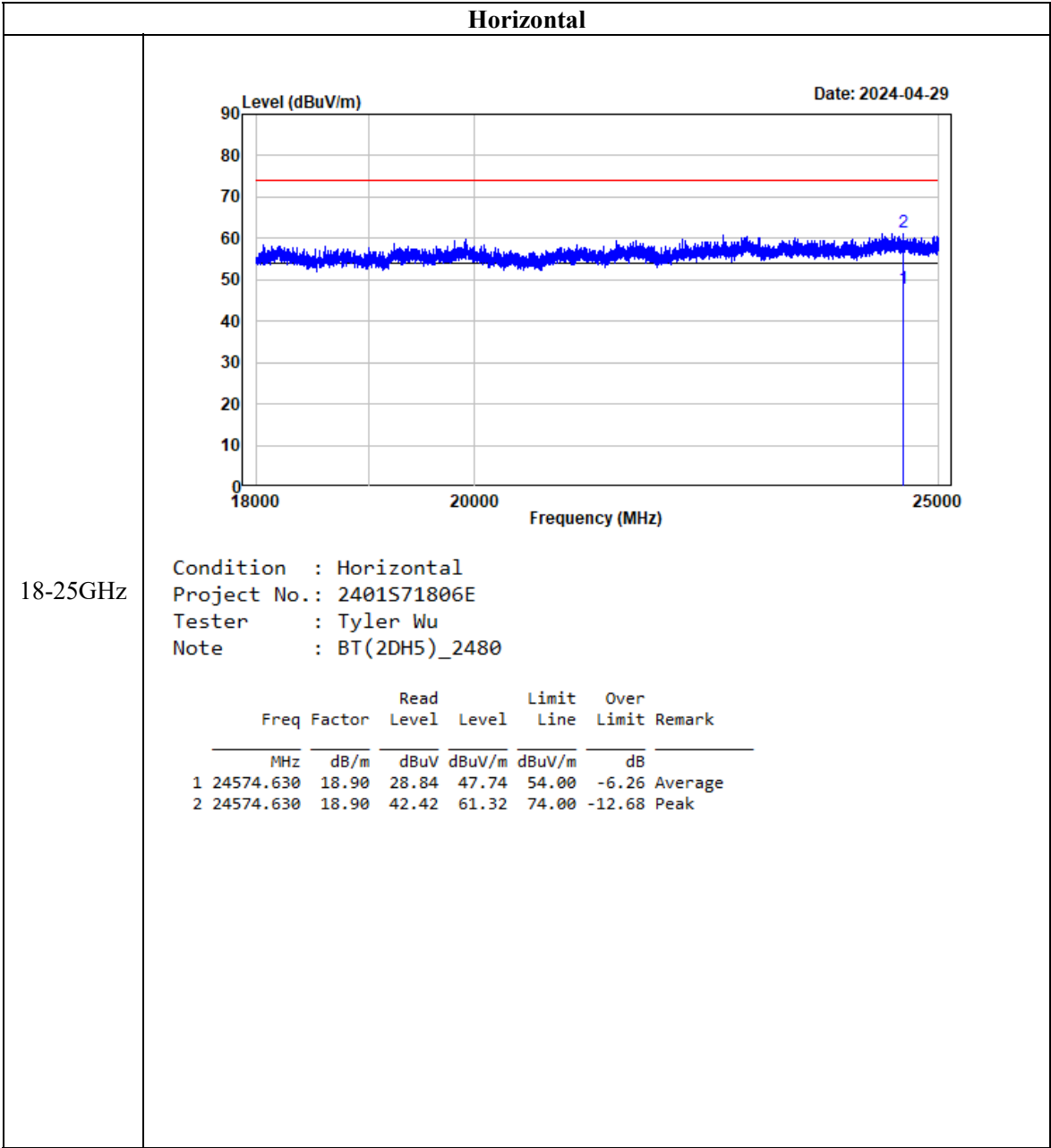
Harmonic Measurements:

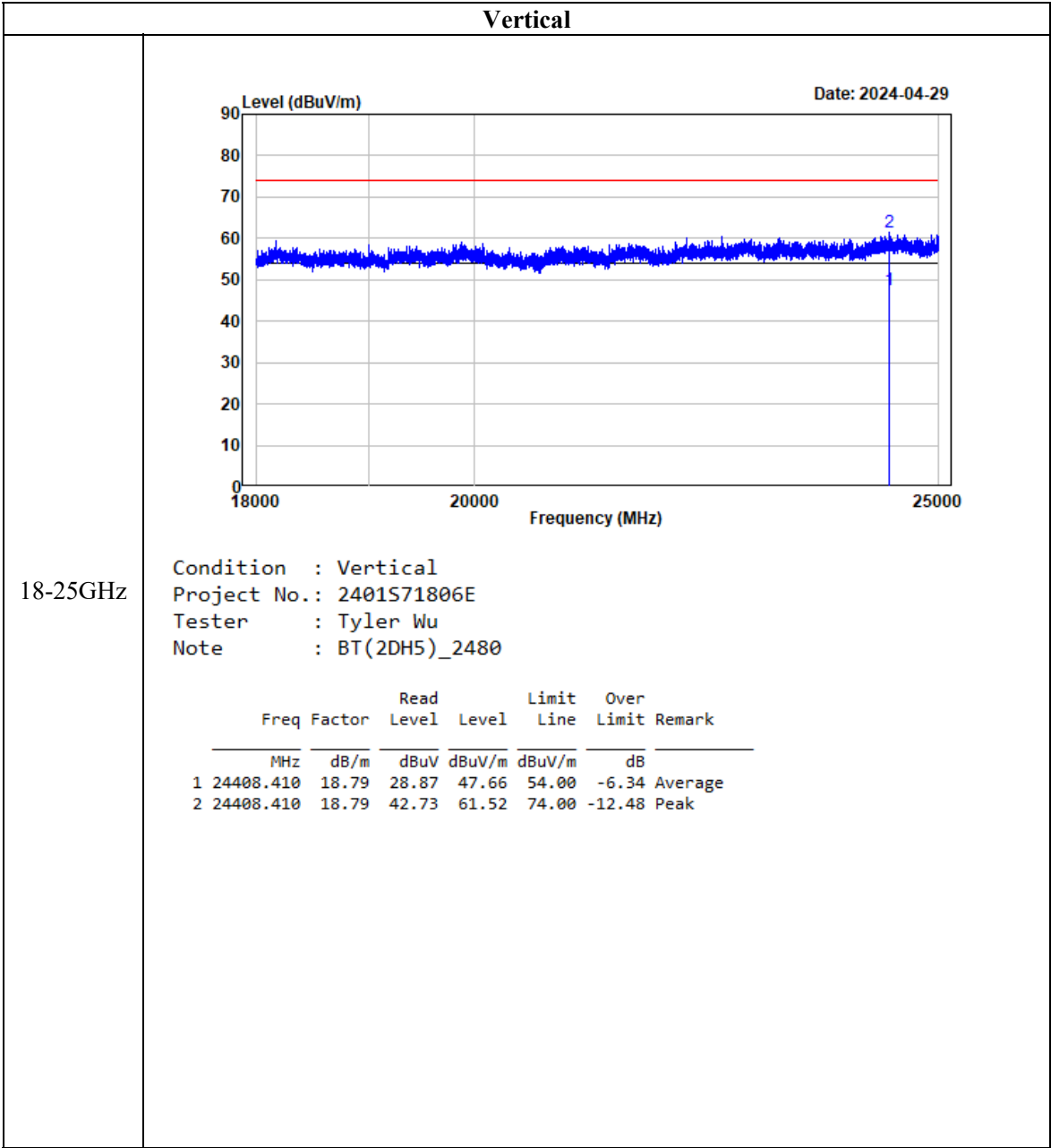












FCC §15.247(a) (1) - CHANNEL SEPARATION TEST

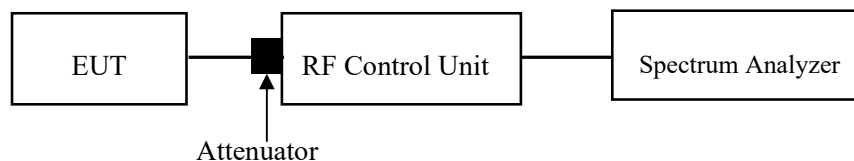
Applicable Standard

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:	25 °C
Relative Humidity:	55 %
ATM Pressure:	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

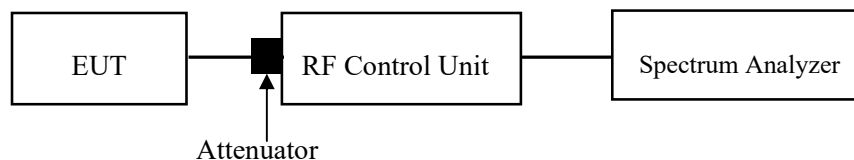
Alternatively, frequency hopping systems operating in the 2400–2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than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

Temperature:	25 °C
Relative Humidity:	55 %
ATM Pressure:	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

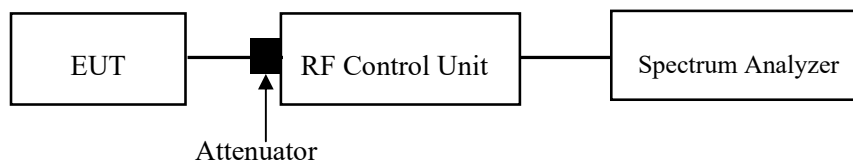
Applicable Standard

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

Temperature:	25 °C
Relative Humidity:	55 %
ATM Pressure:	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.

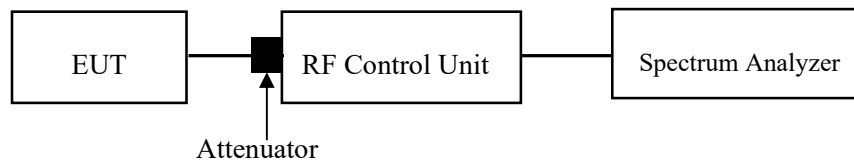
FCC §15.247(a) (1) (iii) - TIME OF OCCUPANCY (DWELL TIME)**Applicable Standard**

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**

Temperature:	25 °C
Relative Humidity:	55 %
ATM Pressure:	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

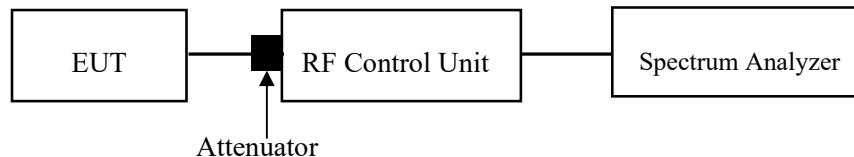
Applicable Standard

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

Temperature:	25 °C
Relative Humidity:	55 %
ATM Pressure:	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

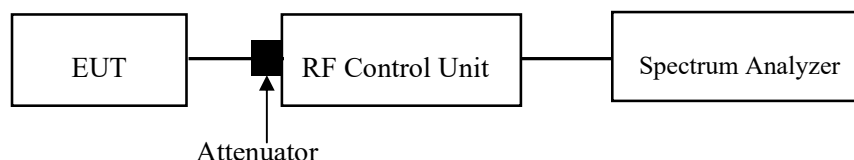
Applicable Standard

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

Temperature:	25 °C
Relative Humidity:	55 %
ATM Pressure:	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.

EUT PHOTOGRAPHS

Please refer to the attachment 2401S71806E-RF External photo and 2401S71806E-RF Internal photo.

TEST SETUP PHOTOGRAPHS

Please refer to the attachment 2401S71806E-RF Test Setup photo.

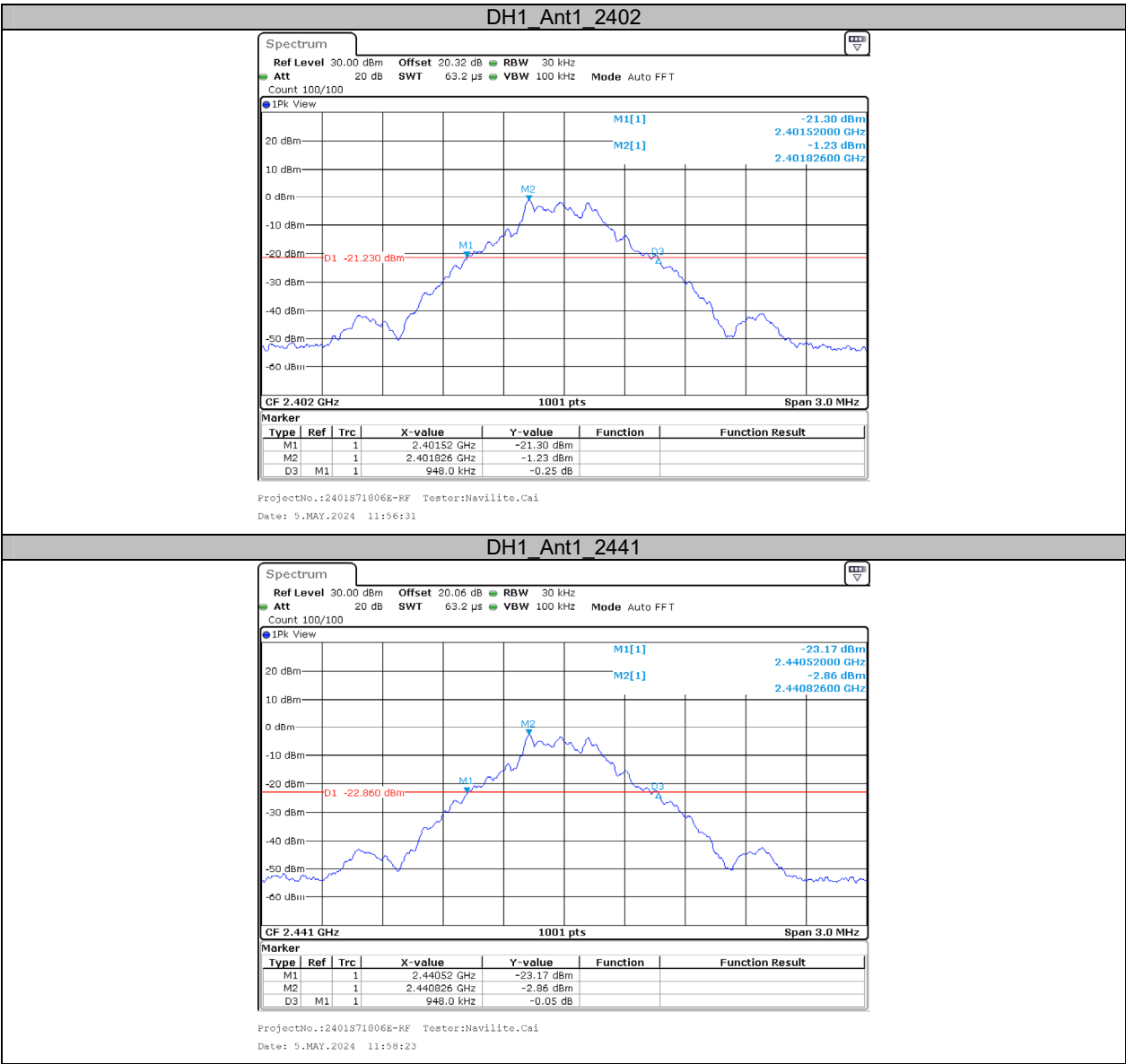
APPENDIX

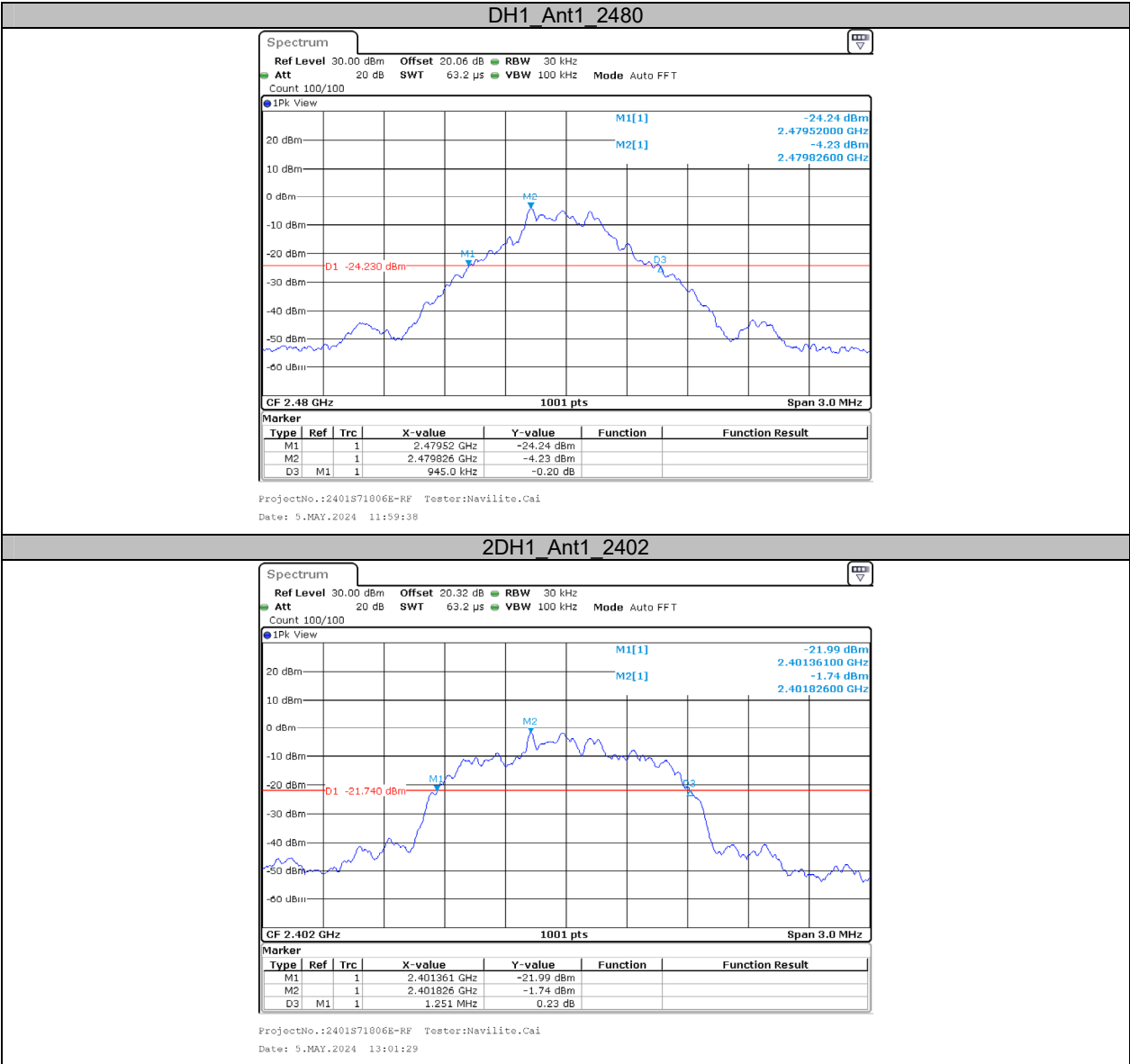
Appendix A: 20dB Emission Bandwidth

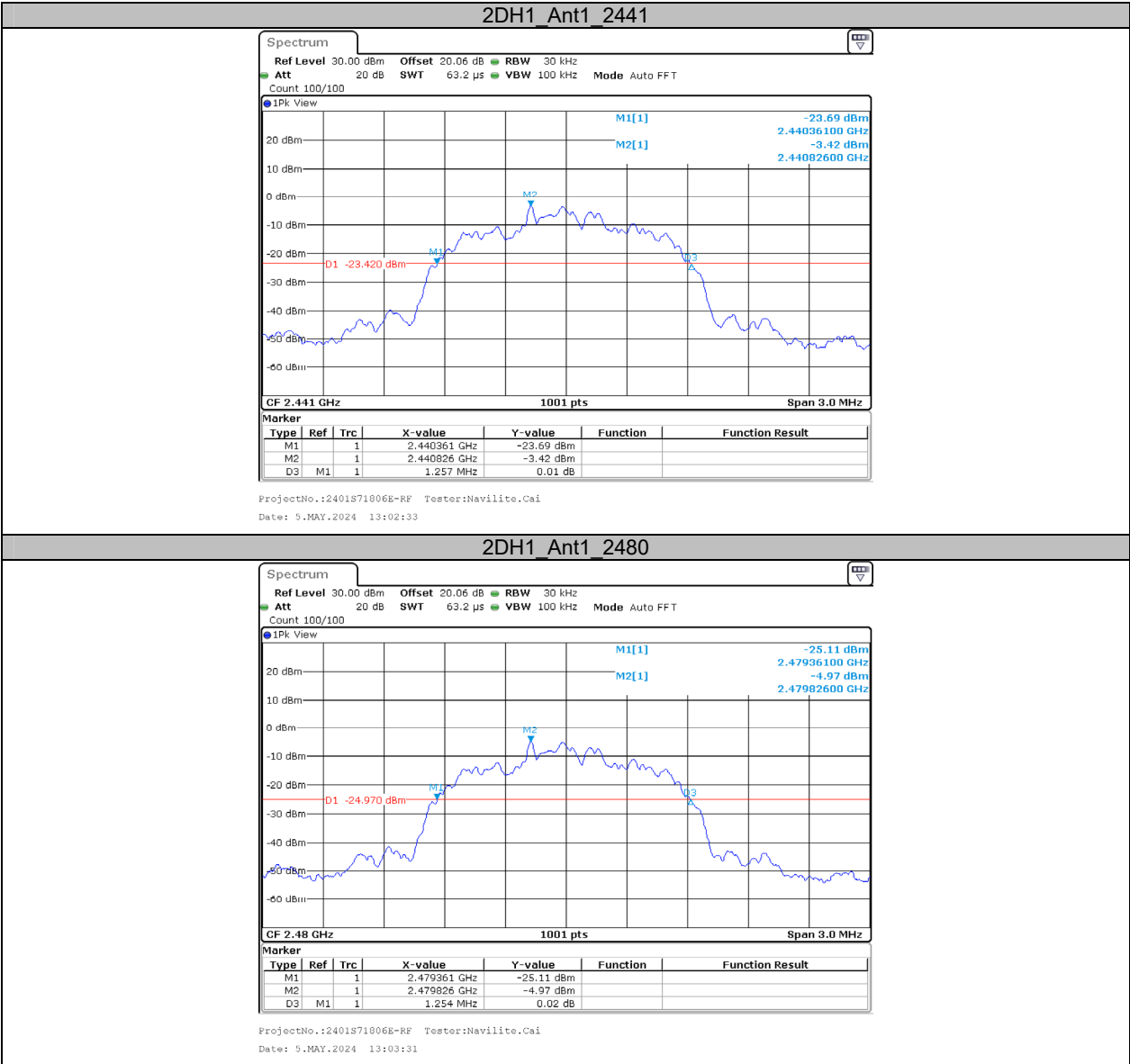
Test Result

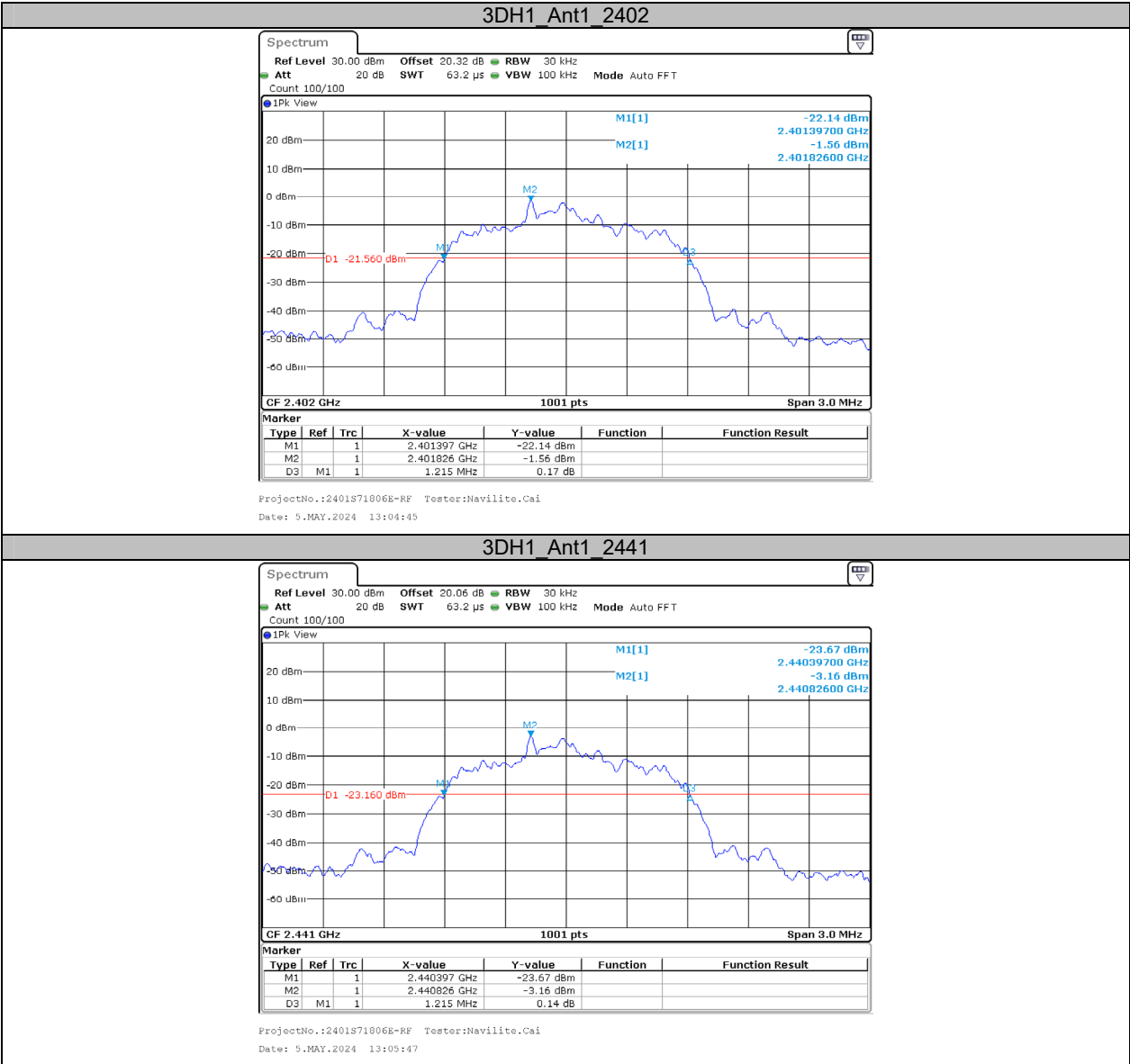
Test Mode	Antenna	Frequency[MHz]	20db EBW[MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH1	Ant1	2402	0.948	2401.52	2402.47	---	---
		2441	0.948	2440.52	2441.47	---	---
		2480	0.945	2479.52	2480.47	---	---
2DH1	Ant1	2402	1.251	2401.36	2402.61	---	---
		2441	1.257	2440.36	2441.62	---	---
		2480	1.254	2479.36	2480.62	---	---
3DH1	Ant1	2402	1.215	2401.40	2402.61	---	---
		2441	1.215	2440.40	2441.61	---	---
		2480	1.212	2479.40	2480.61	---	---

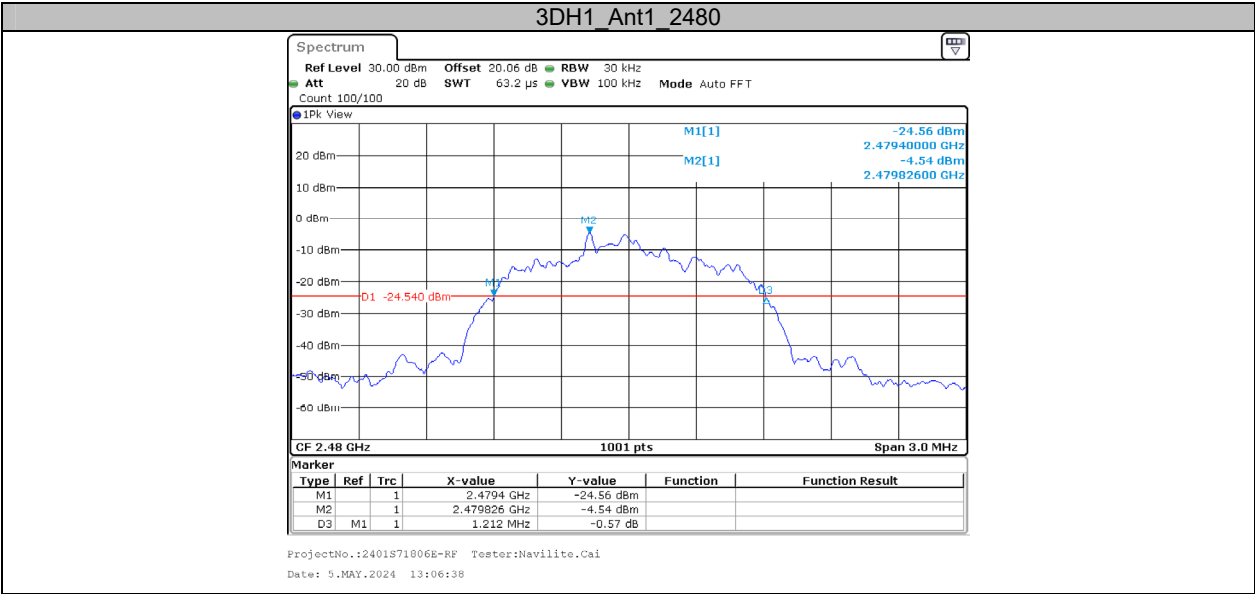
Test Graphs







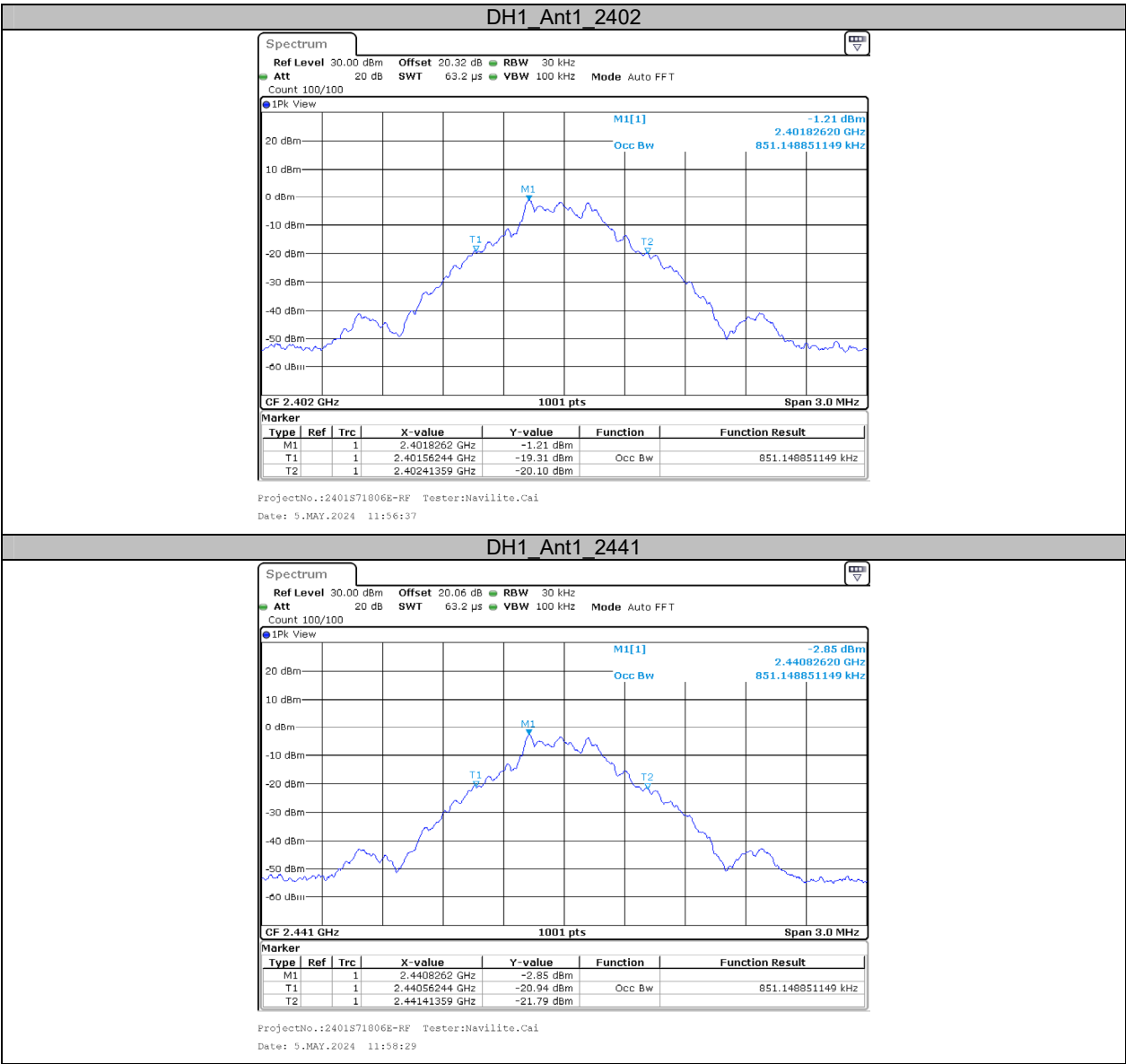


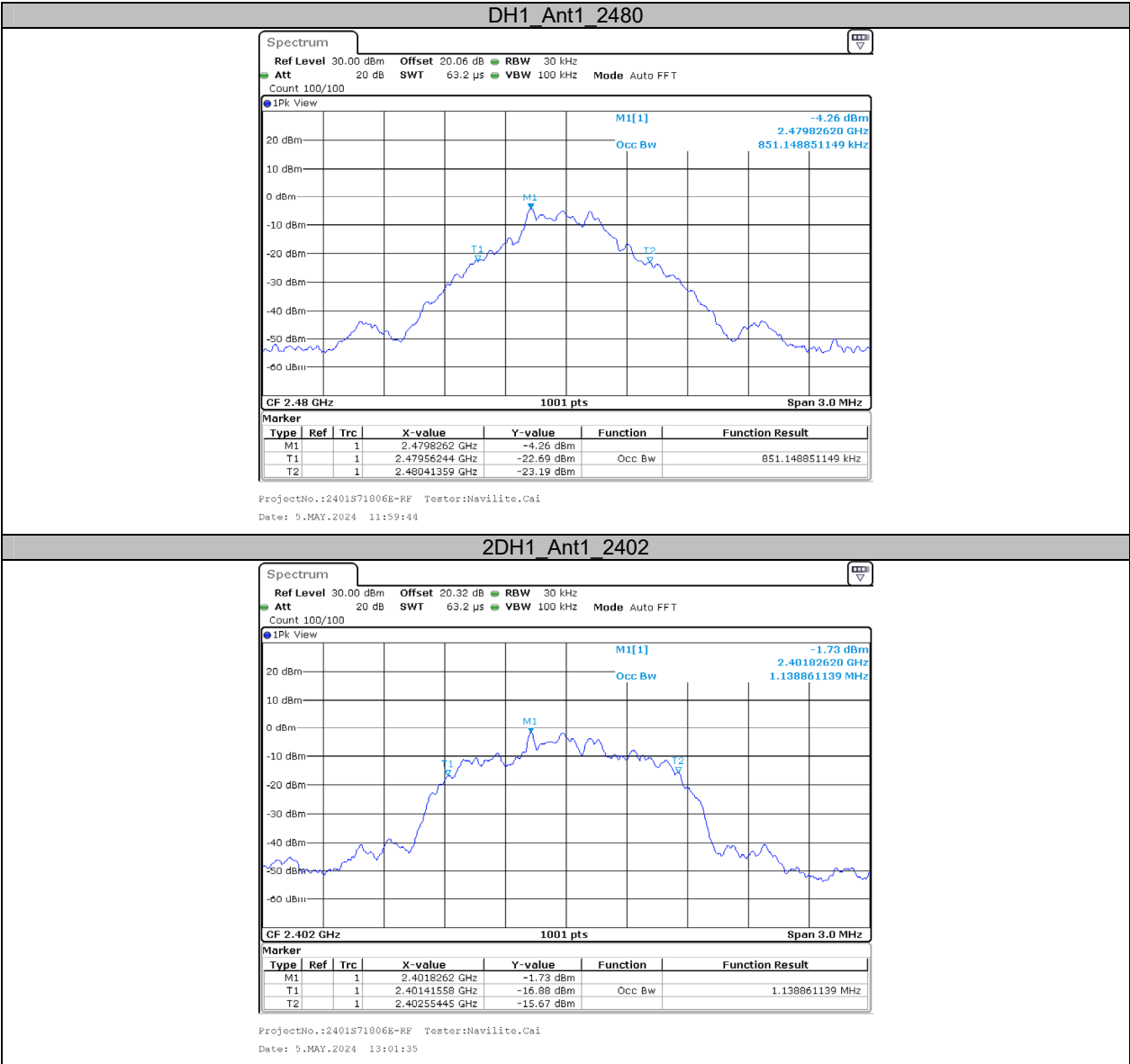


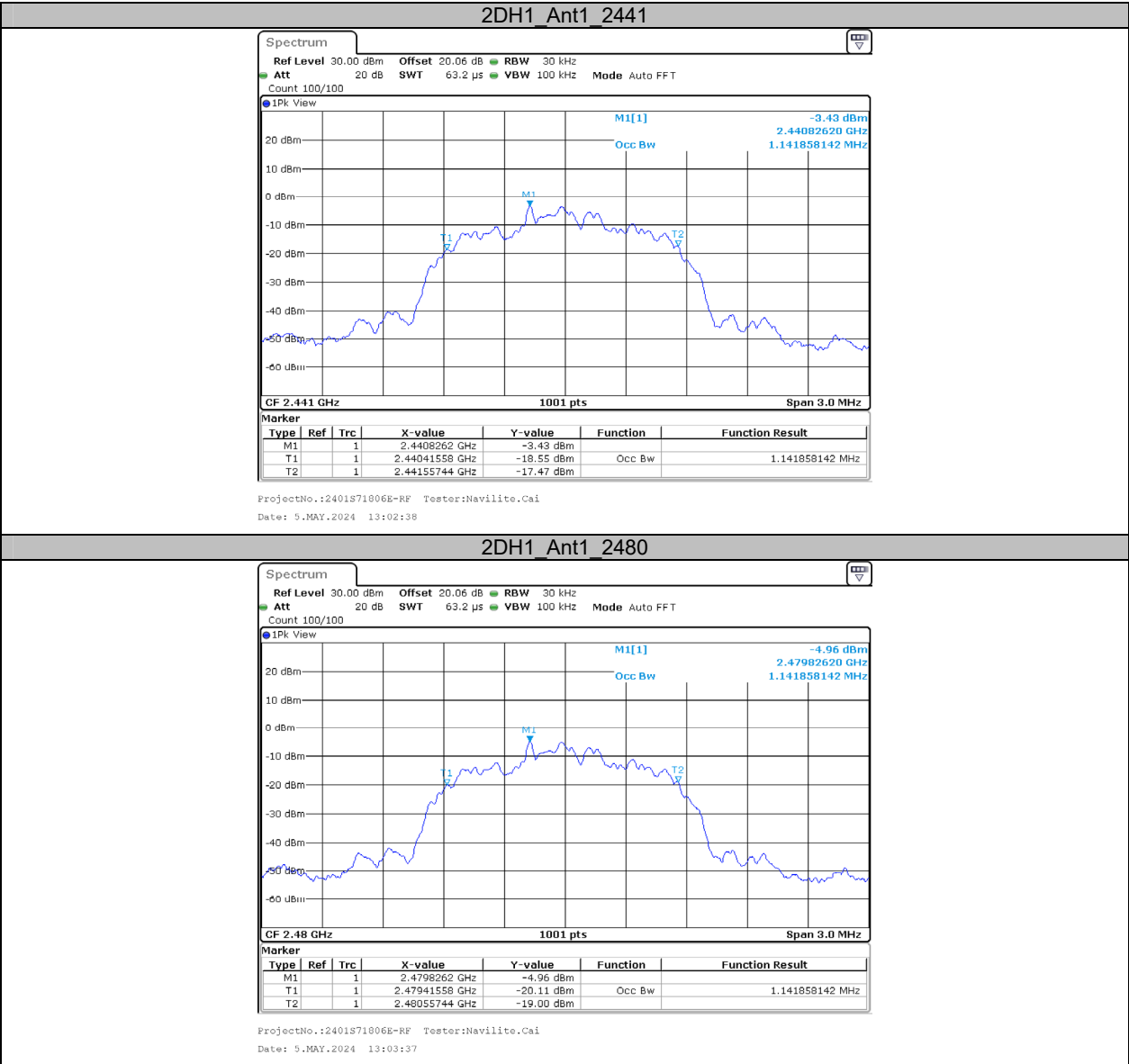
Appendix B: Occupied Channel Bandwidth**Test Result**

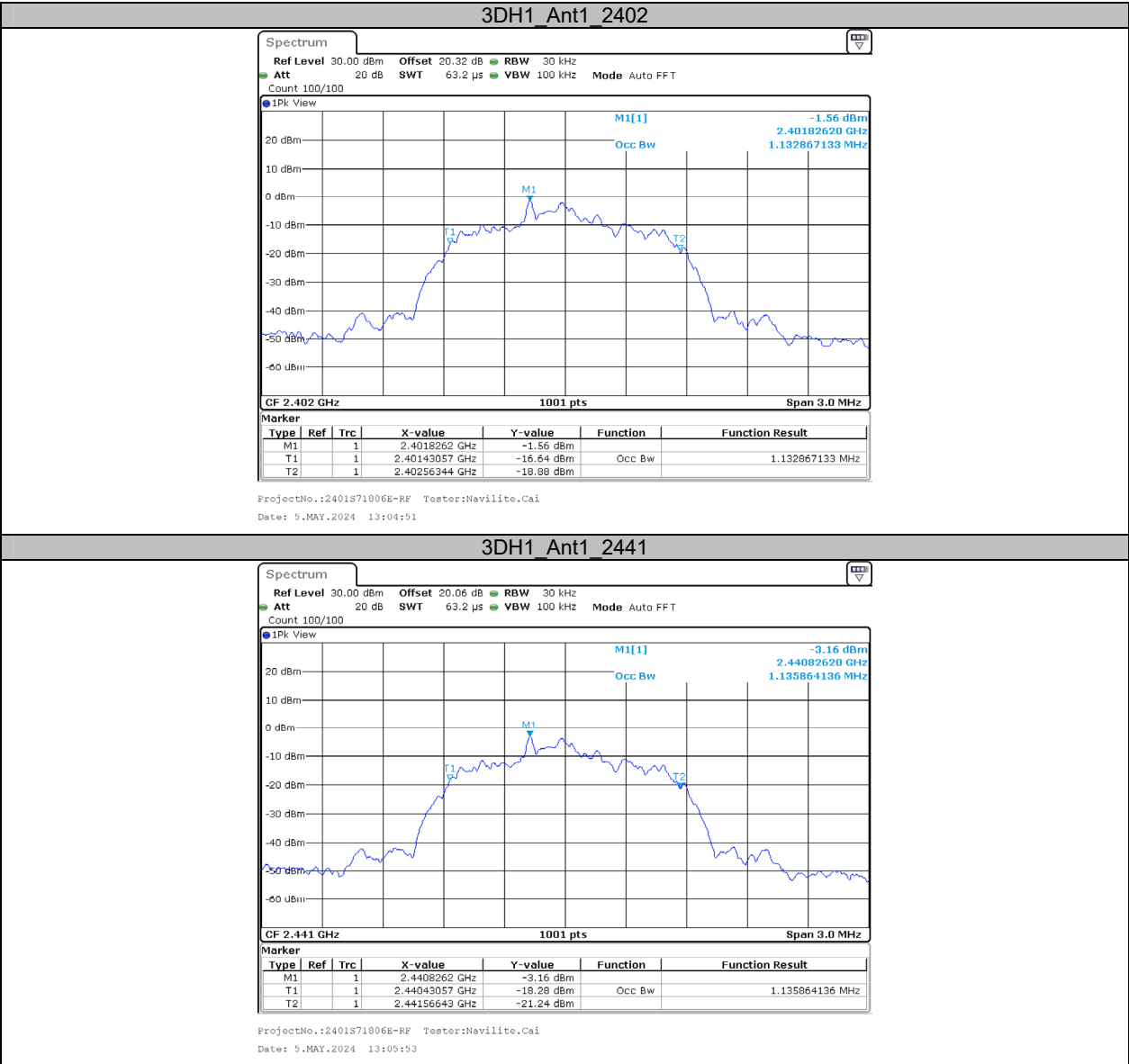
Test Mode	Antenna	Frequency[MHz]	OCB [MHz]	FL[MHz]	FH[MHz]	Limit[MHz]	Verdict
DH1	Ant1	2402	0.851	2401.5624	2402.4136	---	---
		2441	0.851	2440.5624	2441.4136	---	---
		2480	0.851	2479.5624	2480.4136	---	---
2DH1	Ant1	2402	1.139	2401.4156	2402.5544	---	---
		2441	1.142	2440.4156	2441.5574	---	---
		2480	1.142	2479.4156	2480.5574	---	---
3DH1	Ant1	2402	1.133	2401.4306	2402.5634	---	---
		2441	1.136	2440.4306	2441.5664	---	---
		2480	1.133	2479.4306	2480.5634	---	---

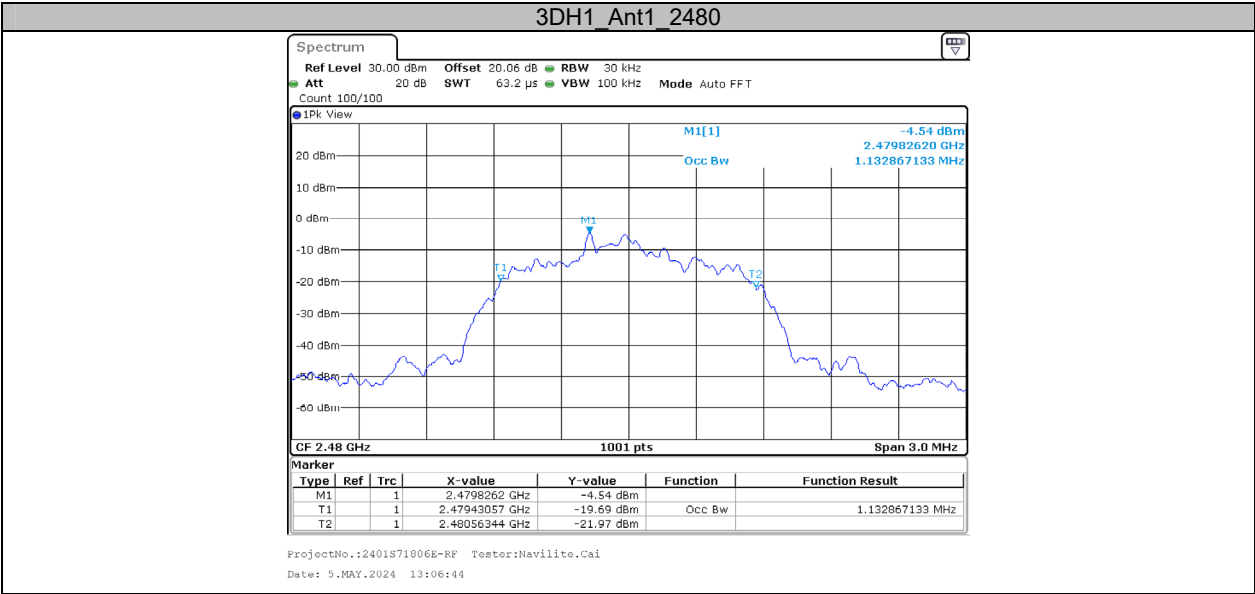
Test Graphs







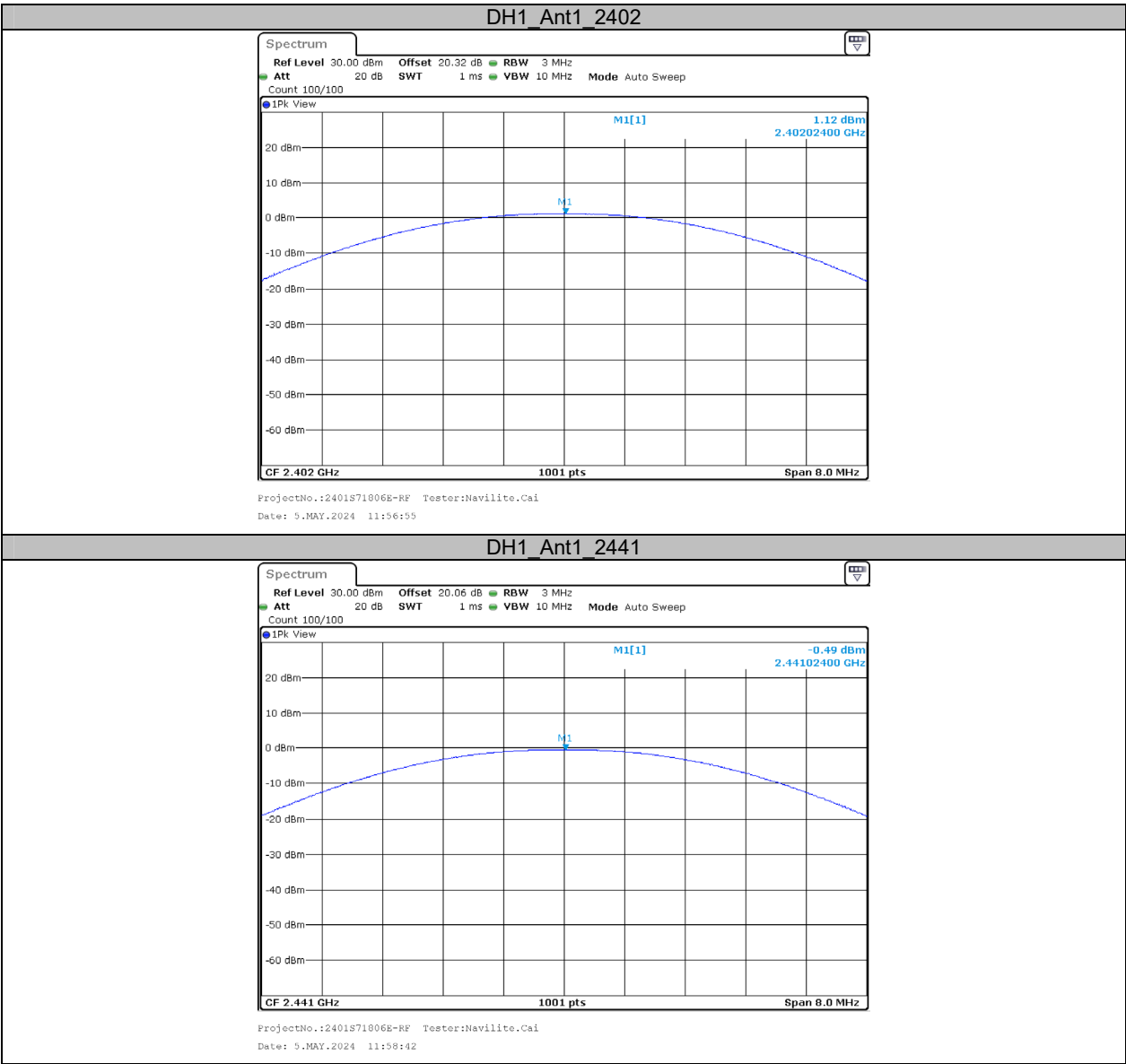


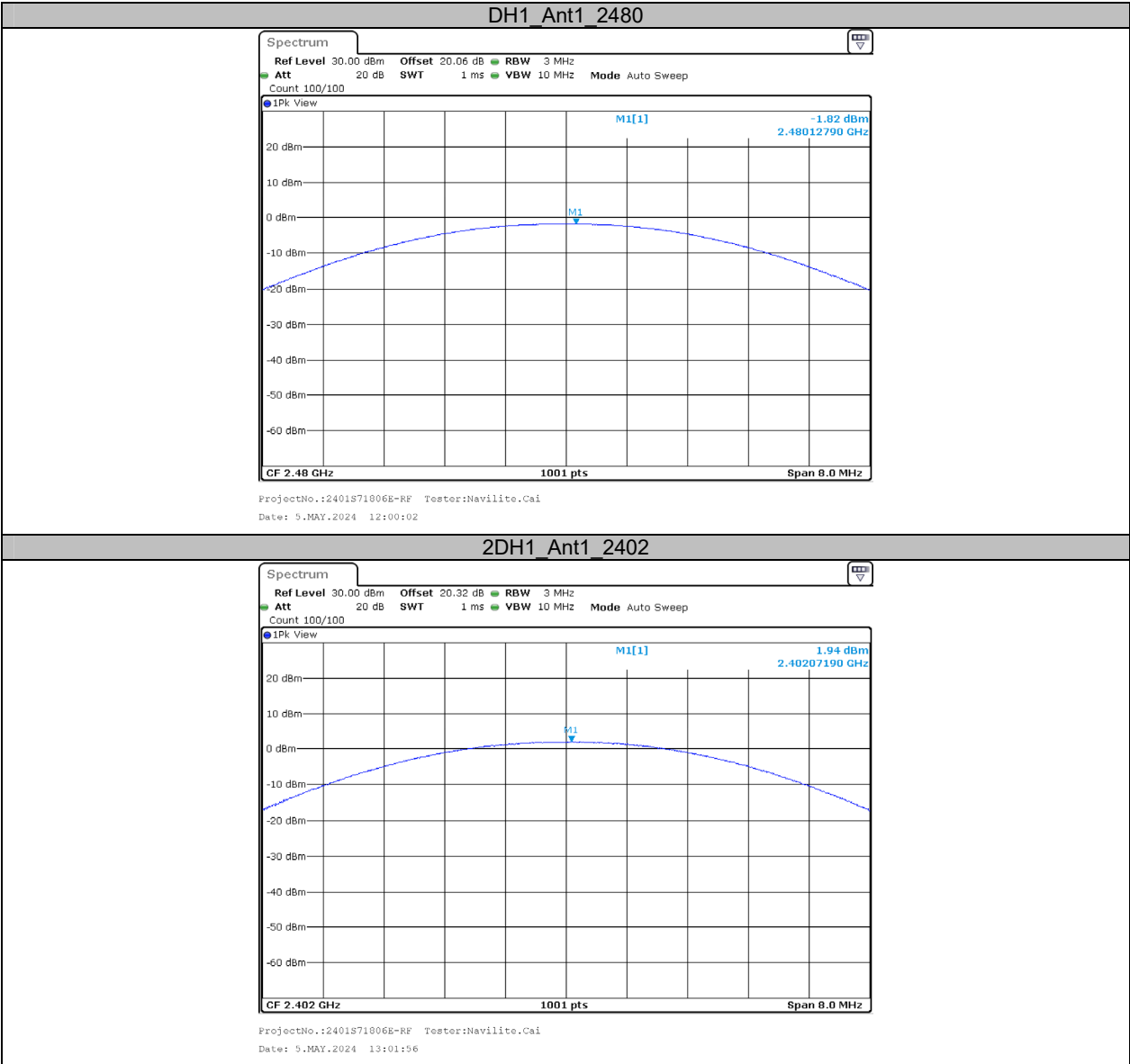


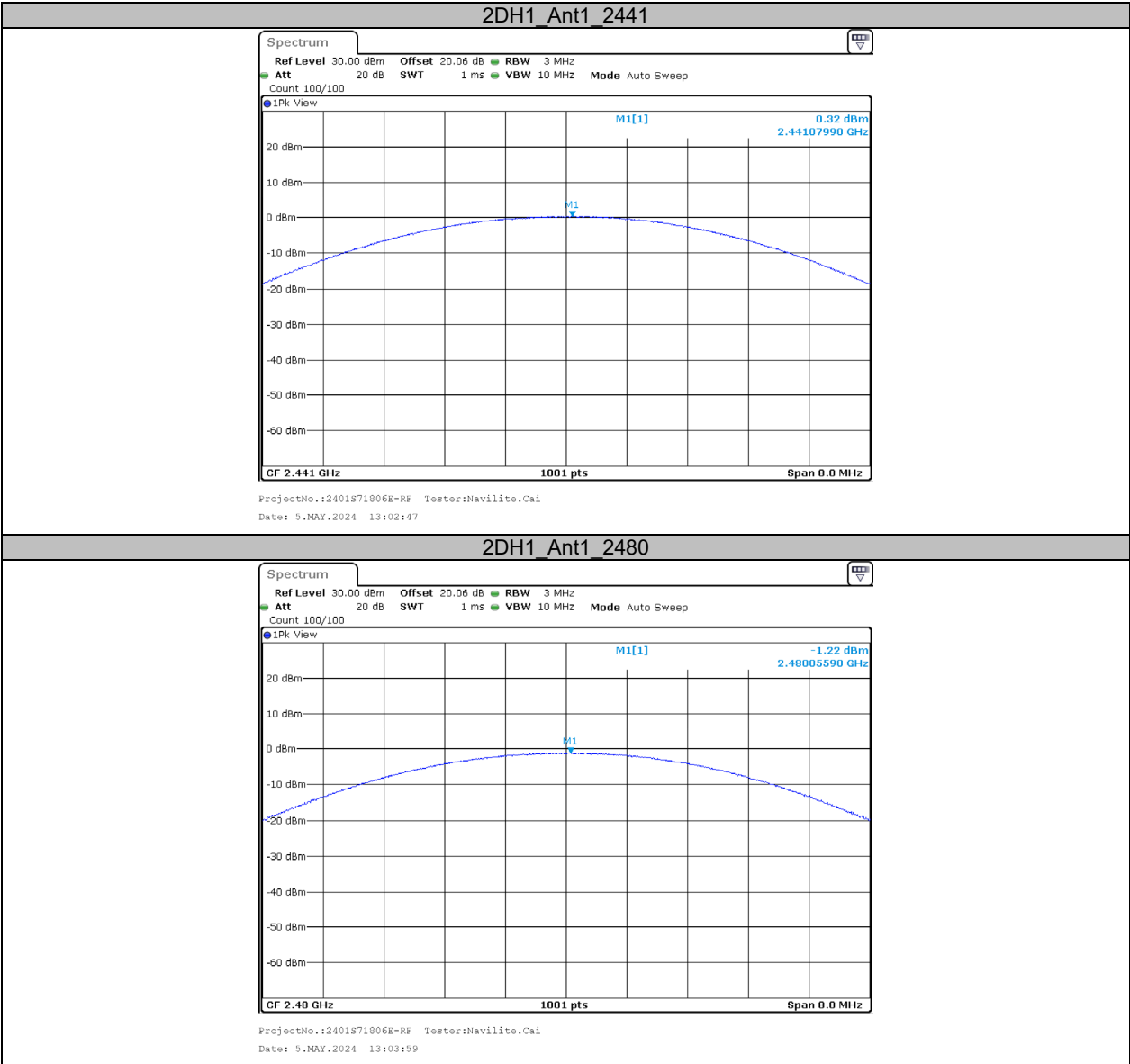
Appendix C: Maximum conducted output power**Test Result Peak**

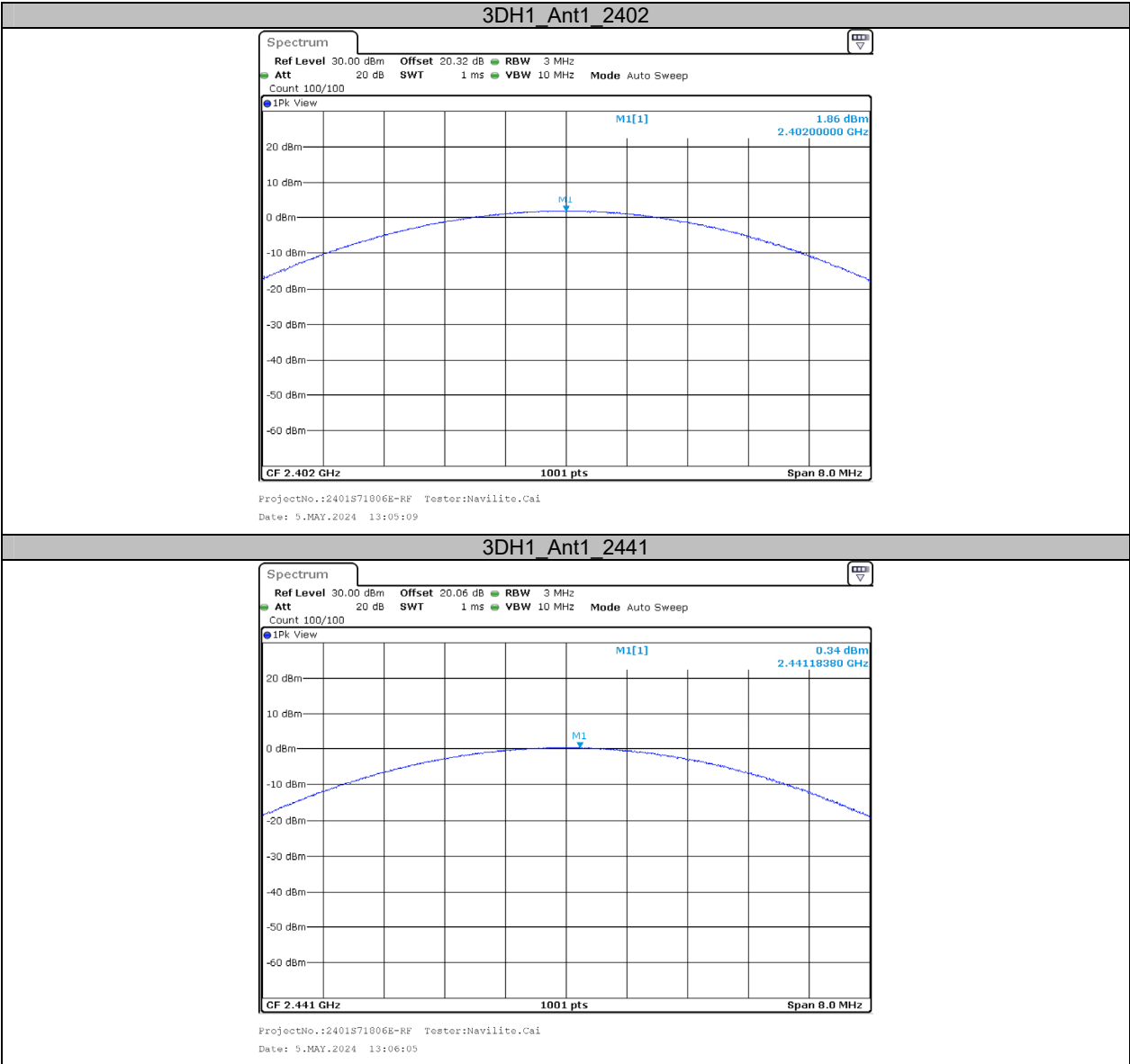
Test Mode	Antenna	Frequency[MHz]	Conducted Peak Power [dBm]	Conducted Limit [dBm]	Verdict
DH1	Ant1	2402	1.12	≤20.97	PASS
		2441	-0.49	≤20.97	PASS
		2480	-1.82	≤20.97	PASS
2DH1	Ant1	2402	1.94	≤20.97	PASS
		2441	0.32	≤20.97	PASS
		2480	-1.22	≤20.97	PASS
3DH1	Ant1	2402	1.86	≤20.97	PASS
		2441	0.34	≤20.97	PASS
		2480	-1.01	≤20.97	PASS

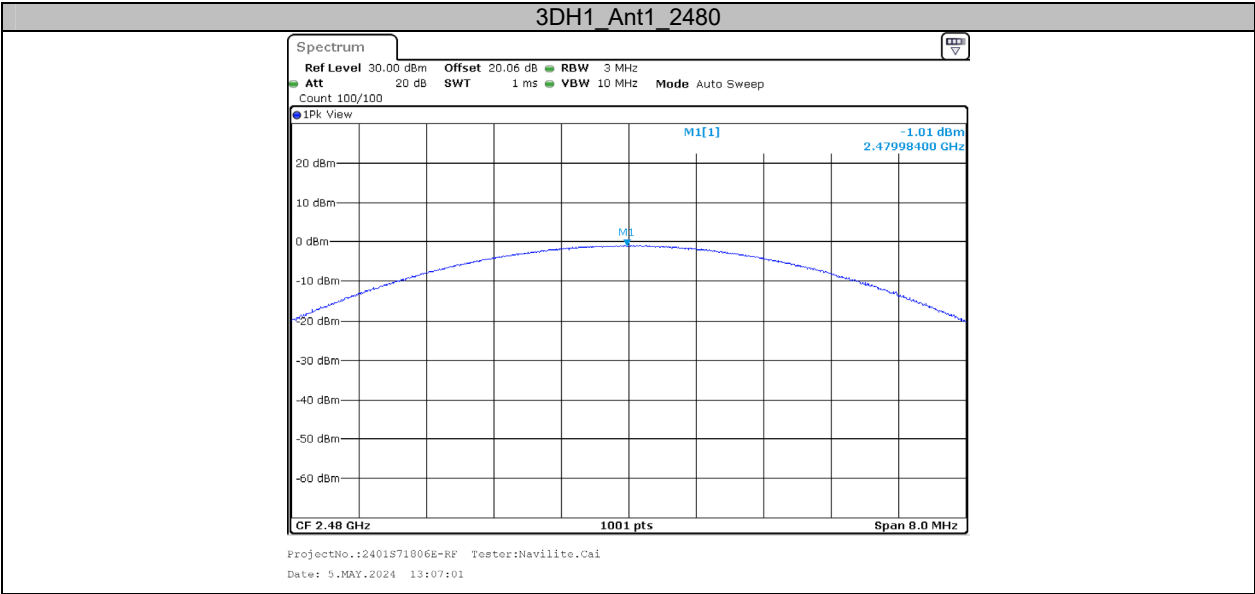
Test Graphs









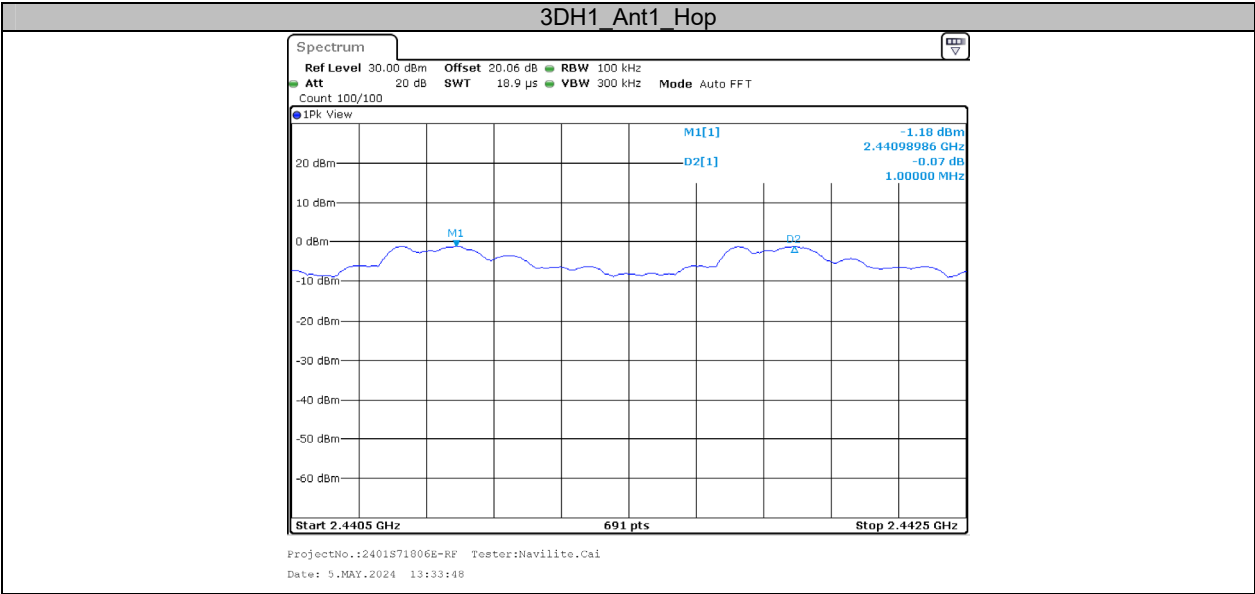


Appendix D: Carrier frequency separation**Test Result**

Test Mode	Antenna	Frequency[MHz]	Result[MHz]	Limit[MHz]	Verdict
DH1	Ant1	Hop	1.003	≥ 0.632	PASS
2DH1	Ant1	Hop	1	≥ 0.838	PASS
3DH1	Ant1	Hop	1	≥ 0.810	PASS

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

Test Graphs



Appendix E: Time of occupancy**Test Result**

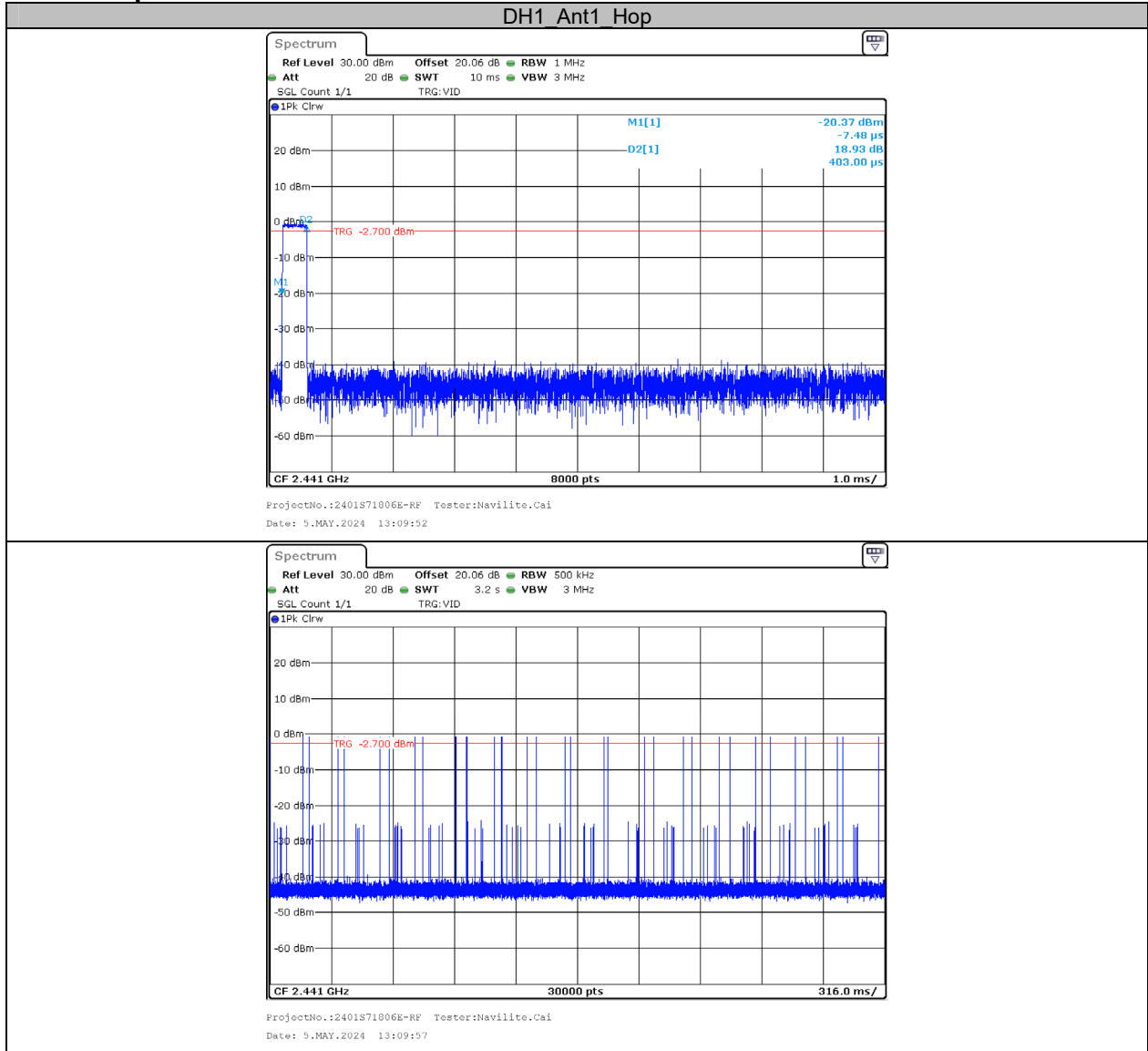
Test Mode	Antenna	Frequency[MHz]	Burst Width [ms]	Total Hops [Num]	Result[s]	Limit[s]	Verdict
DH1	Ant1	Hop	0.403	320	0.129	≤0.4	PASS
DH3	Ant1	Hop	1.651	160	0.264	≤0.4	PASS
DH5	Ant1	Hop	2.892	130	0.376	≤0.4	PASS
2DH1	Ant1	Hop	0.413	330	0.136	≤0.4	PASS
2DH3	Ant1	Hop	1.658	170	0.282	≤0.4	PASS
2DH5	Ant1	Hop	2.898	110	0.319	≤0.4	PASS
3DH1	Ant1	Hop	0.415	320	0.133	≤0.4	PASS
3DH3	Ant1	Hop	1.656	160	0.265	≤0.4	PASS
3DH5	Ant1	Hop	2.900	110	0.319	≤0.4	PASS

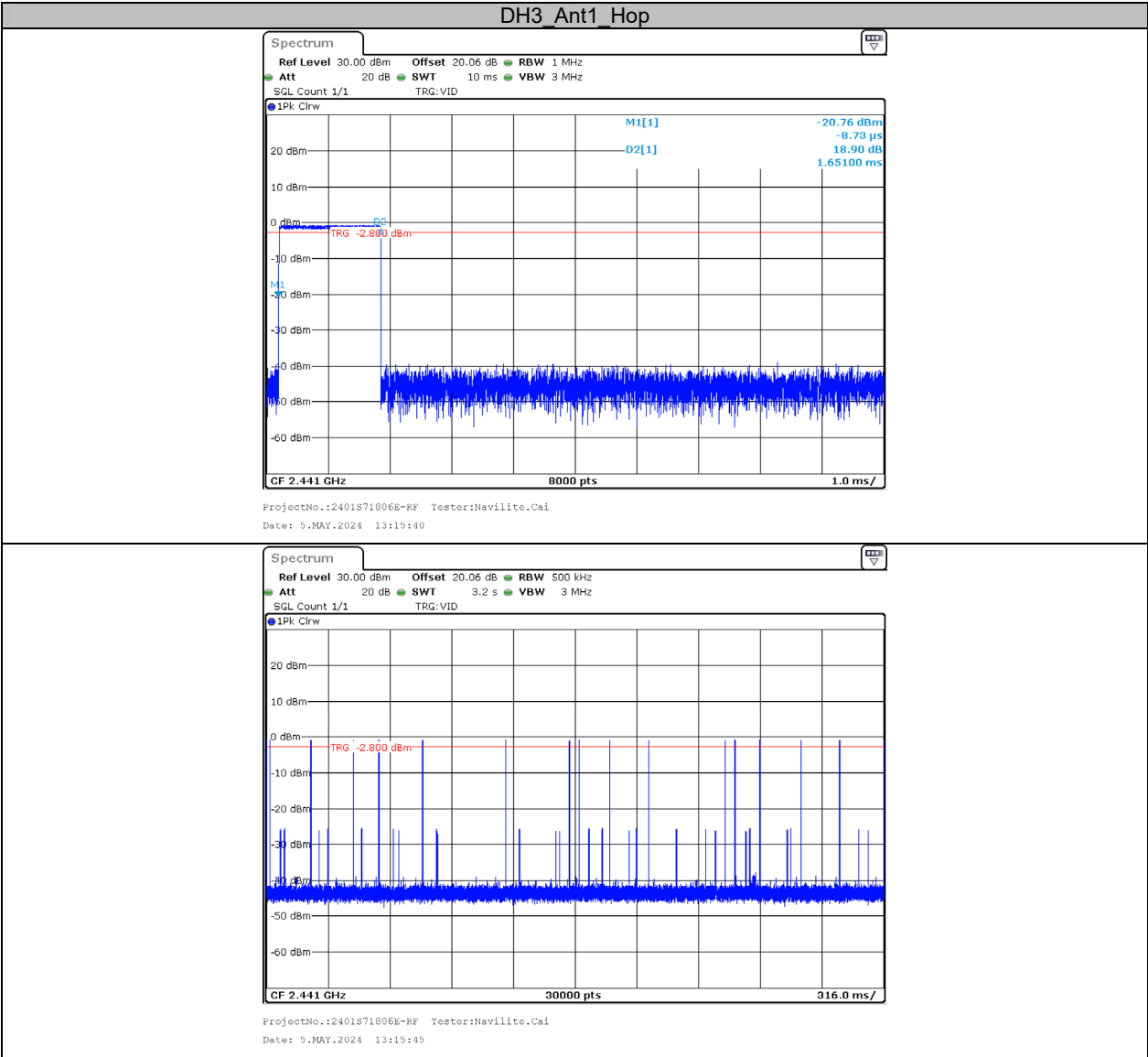
Note 1: A period time= $0.4 \times 79 = 31.6$ (S), Result=Burst Width*Total hops

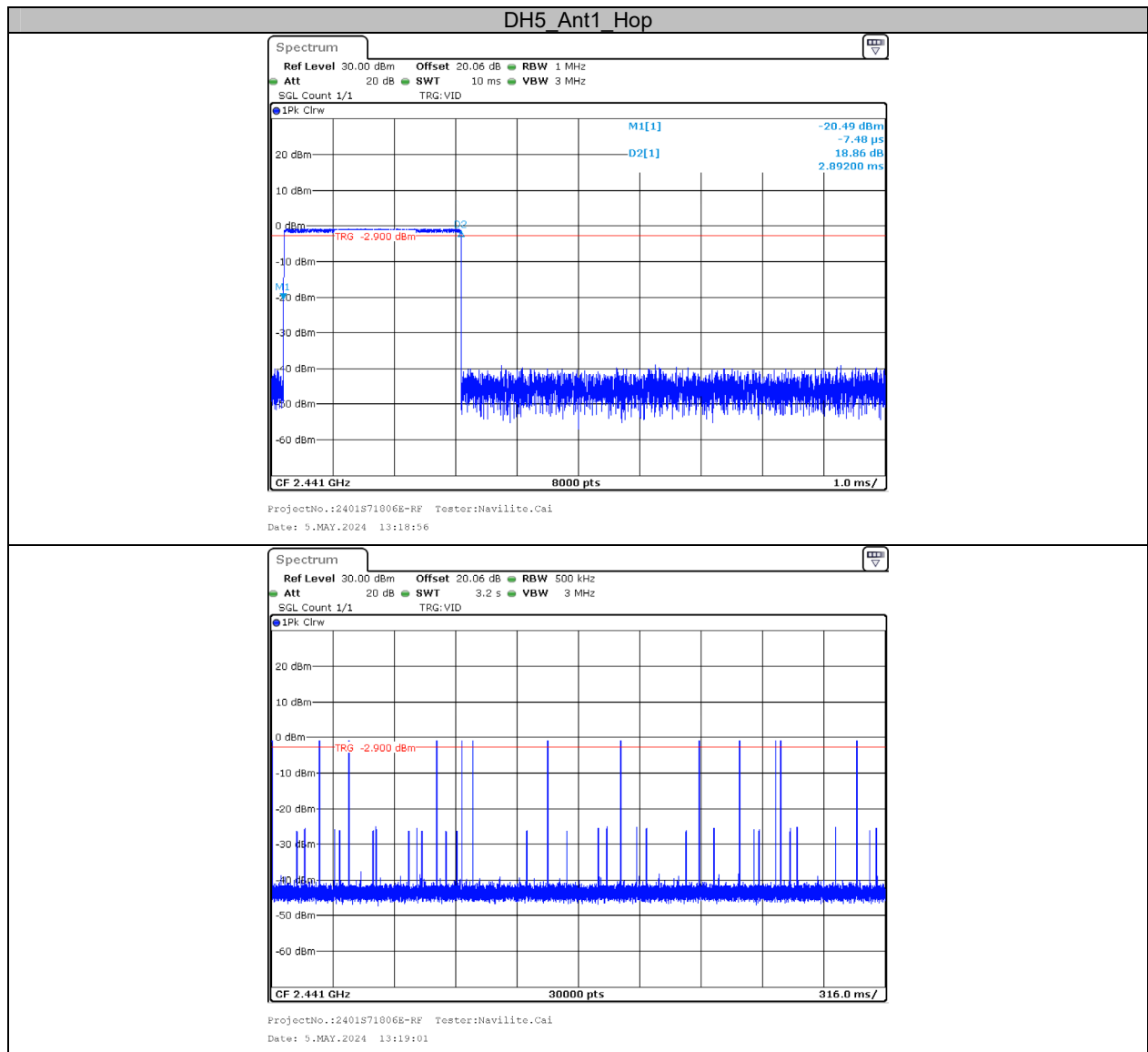
Note 2: Total hops=Hopping Number in $3.16s \times 10$

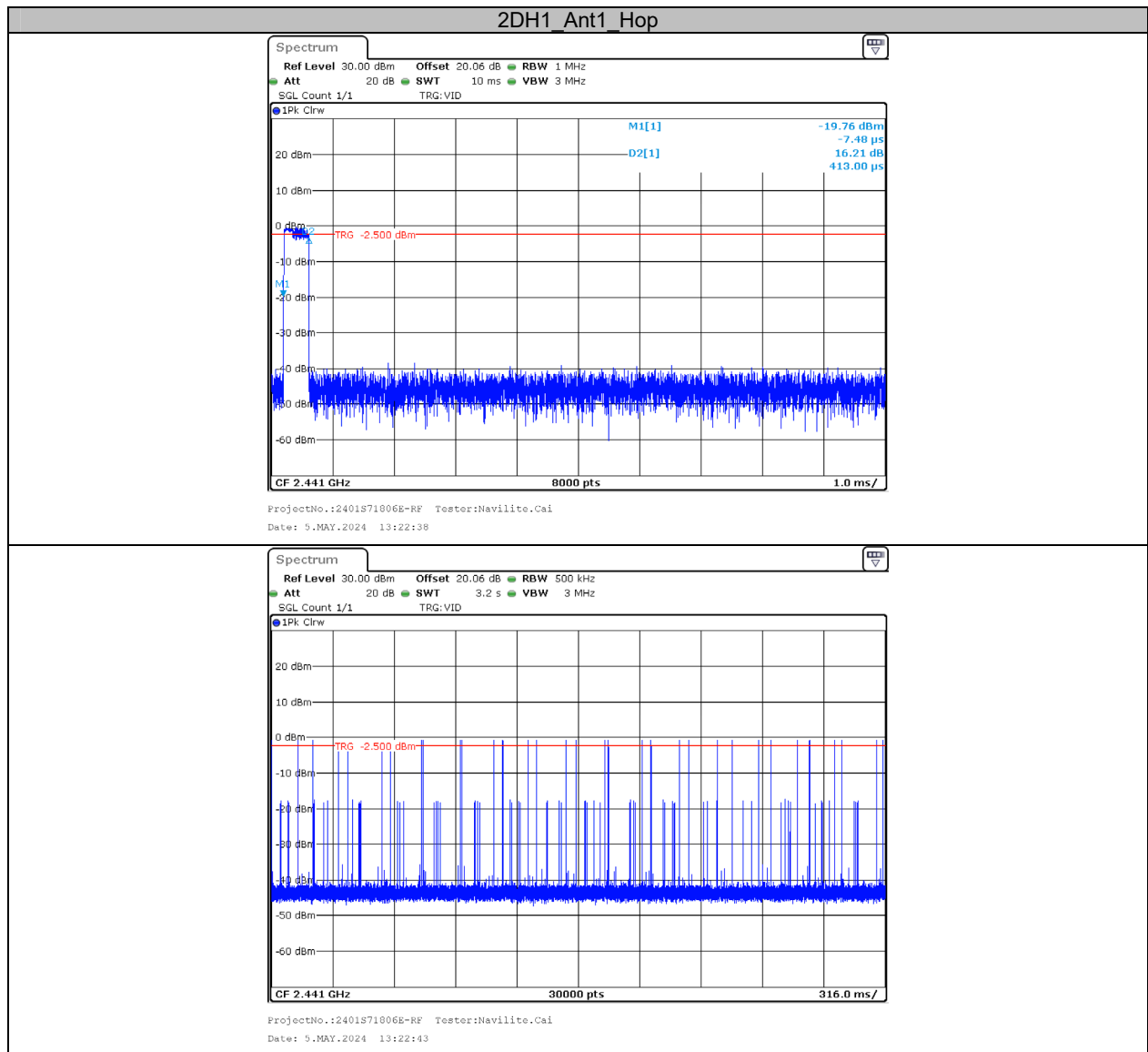
Note 3: Hopping Number in $3.16s$ =Total of highest signals in $3.16s$ (Second high signals were other channel)

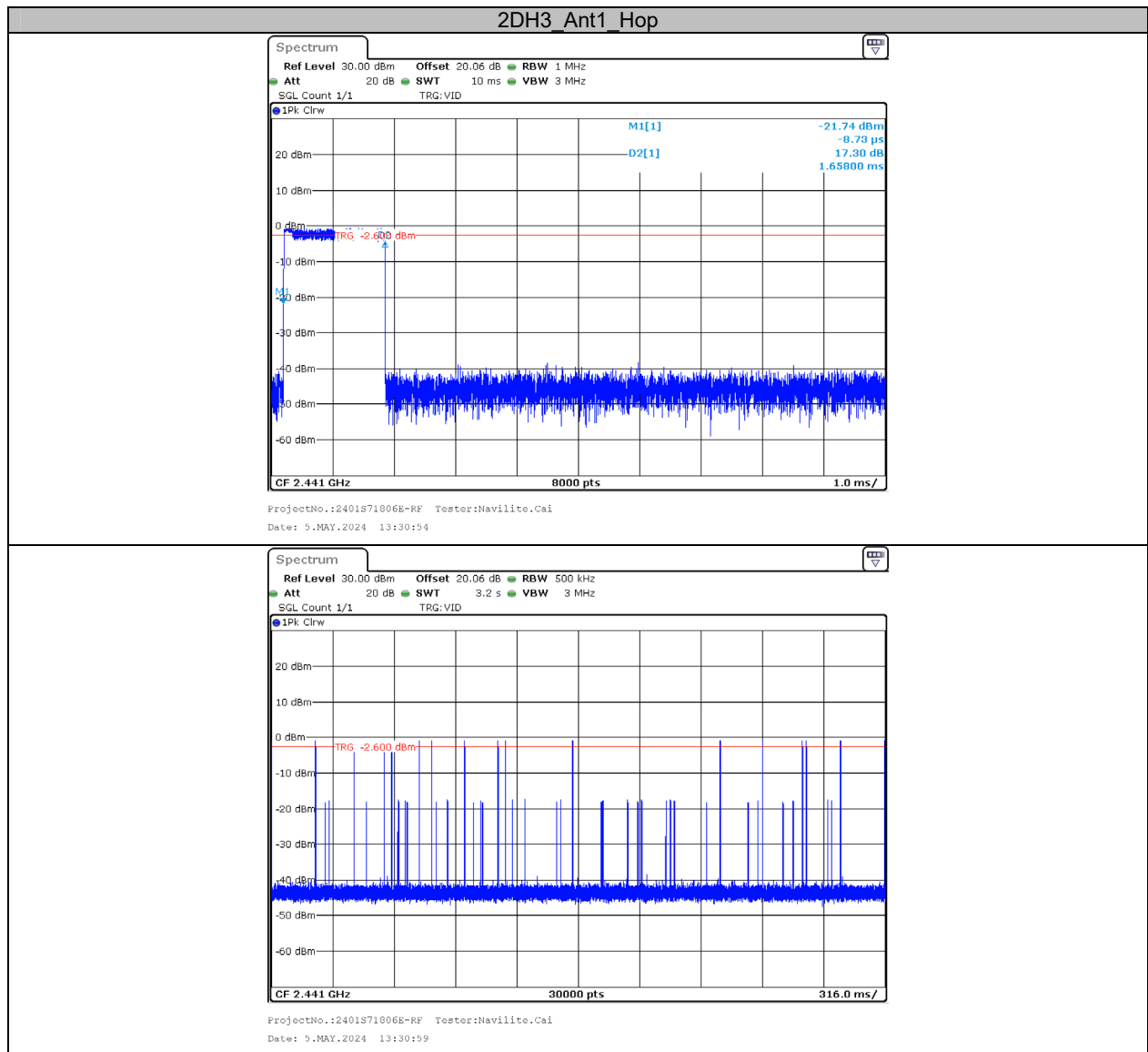
Test Graphs

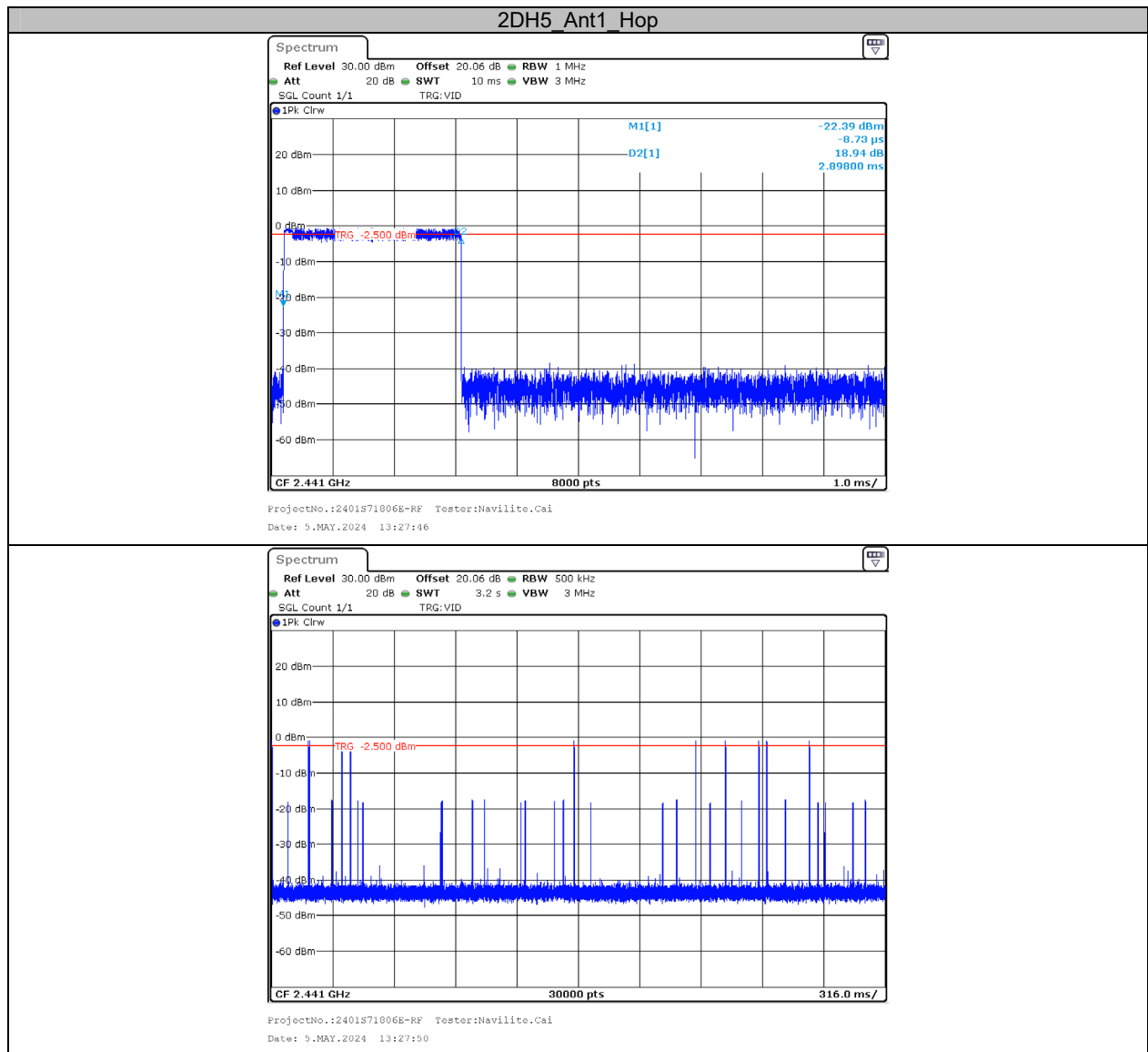


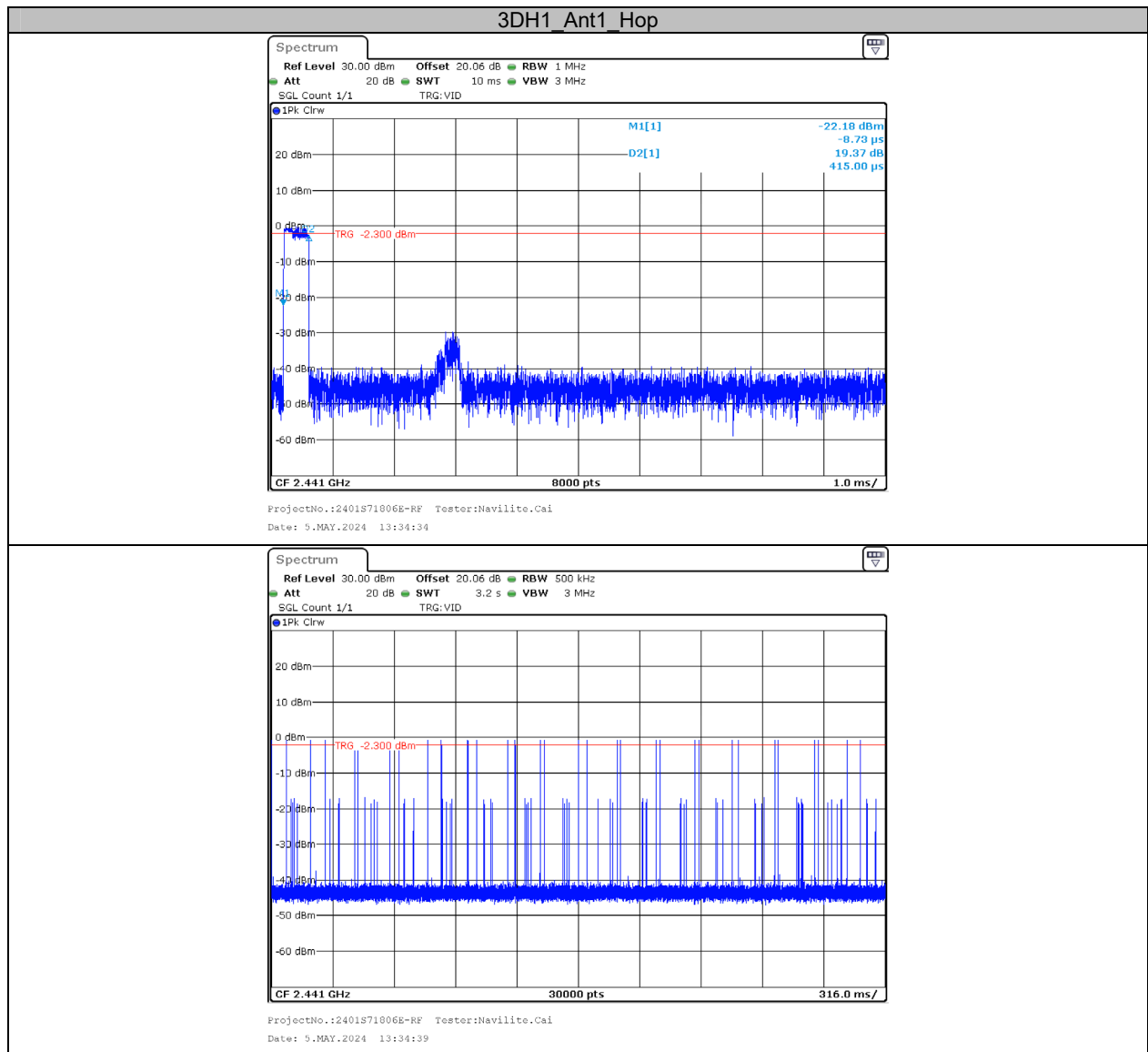


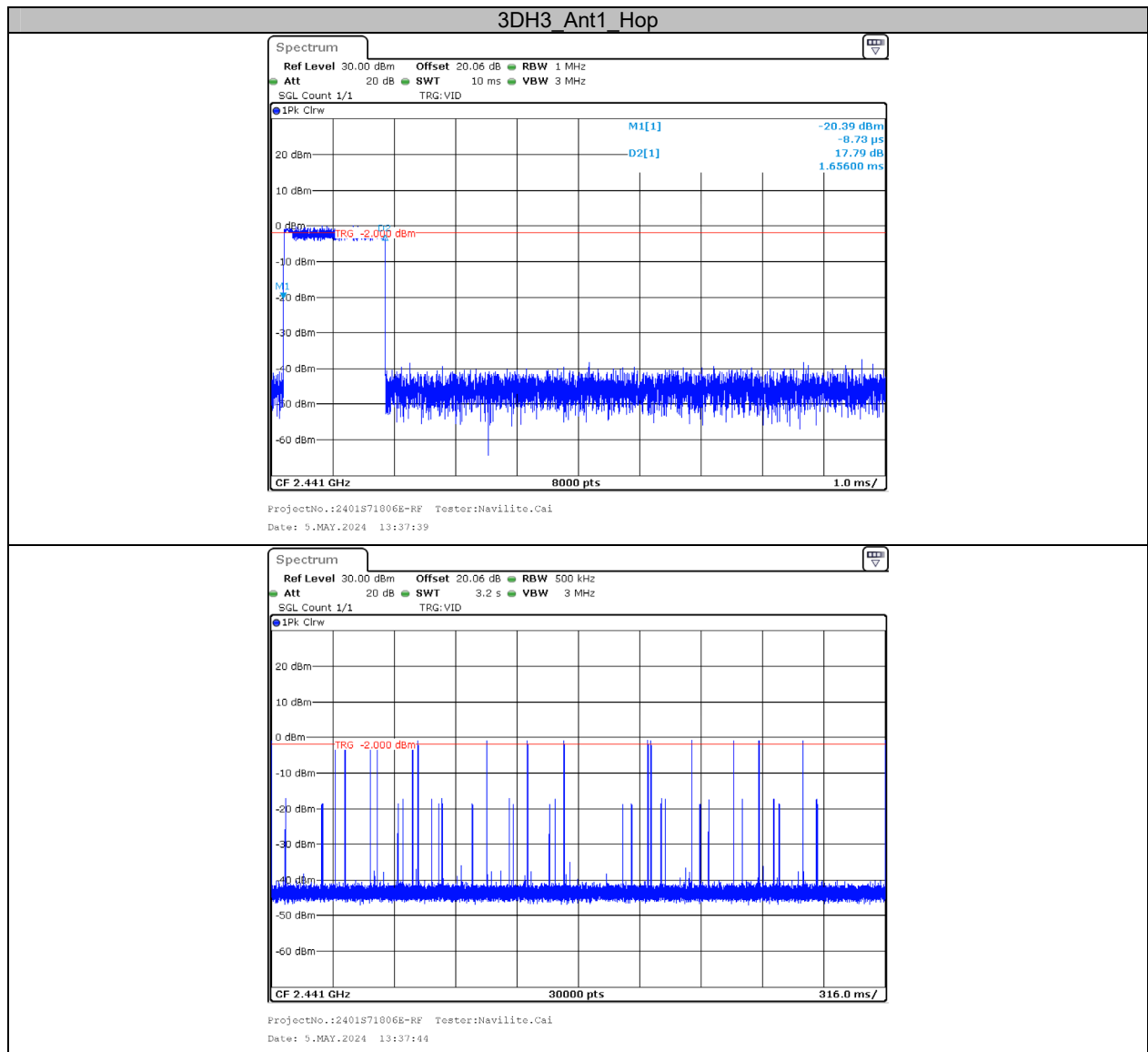


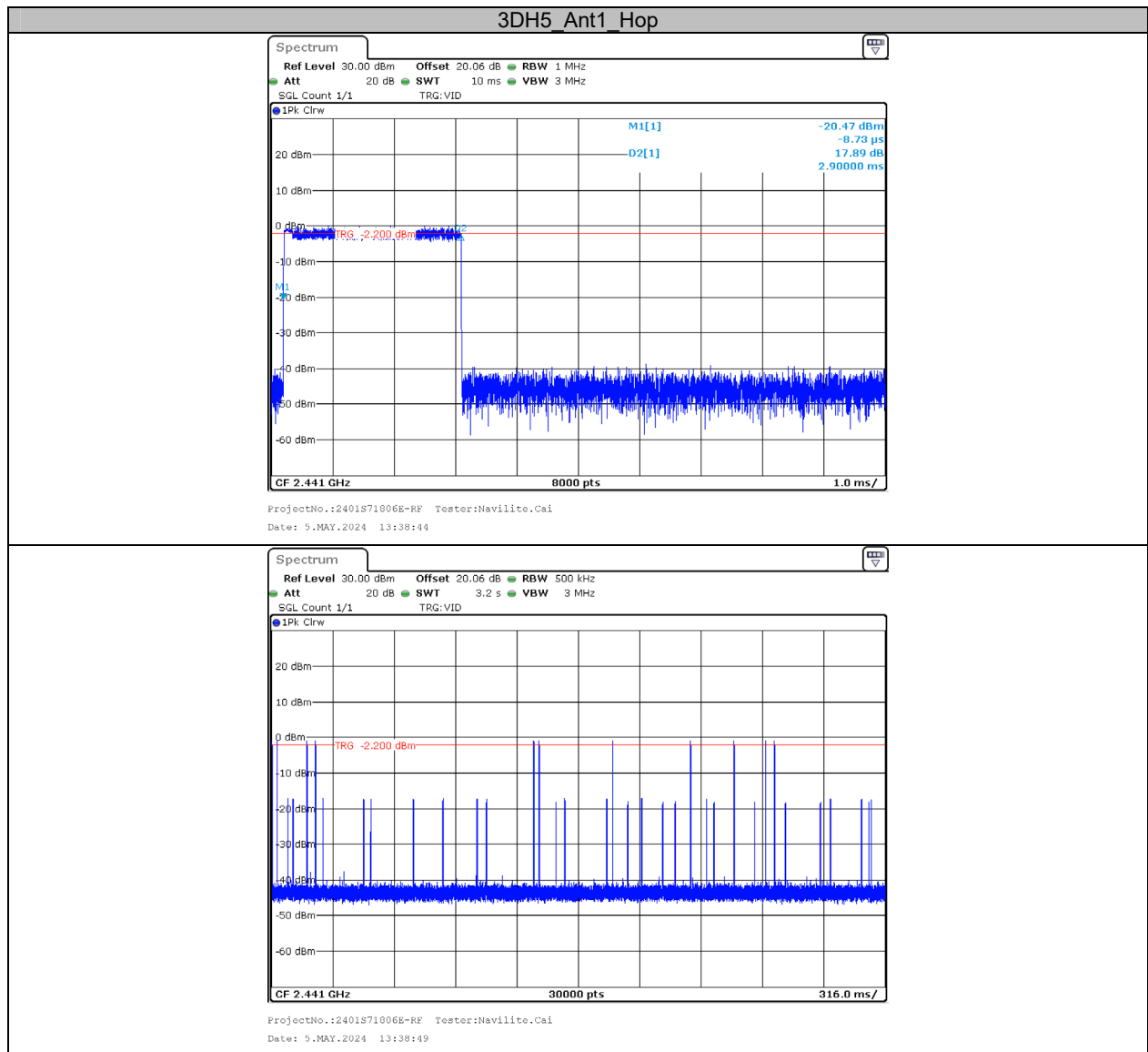










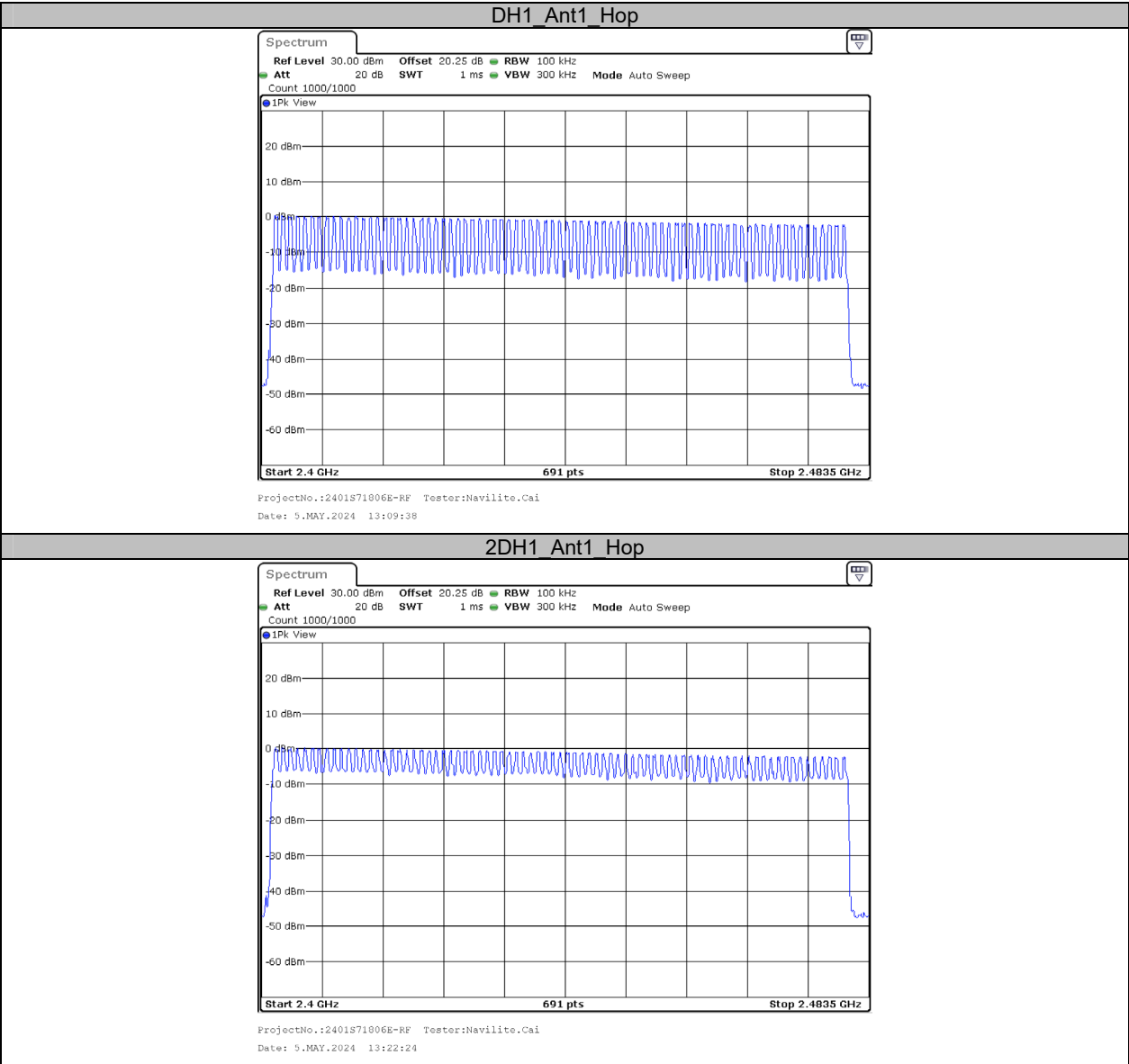


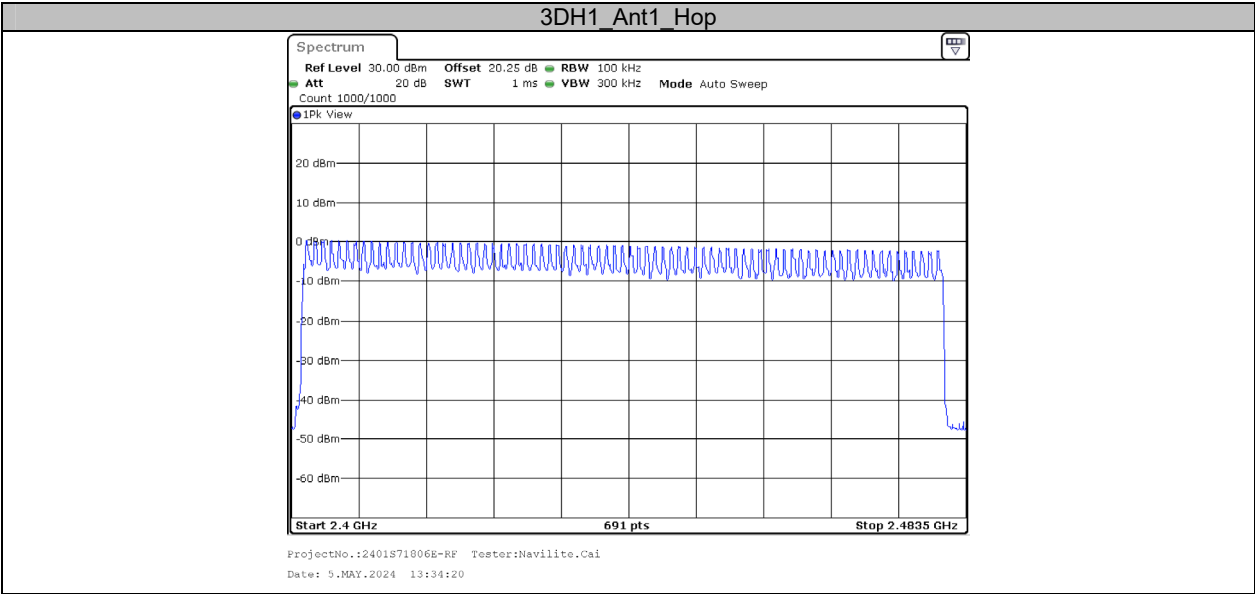
Appendix F: Number of hopping channels

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

